DOCUMENT RESUME

ED 045 856 VT 012 431

TITLE	Microfiche Collection of Clearinghouse Documents Reported in Abstracts of Instructional Materials in Vocational and Technical Education (AIM), Fall 1970.
INSTITUTION	Ohio State Univ., Columbus. Center for Vocational and Technical Education.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C.
PUB DATE	70
NOTE	13,356p.
EDRS PRICE	EDRS Price MF-$47.75 HC Not Available from EDRS.
DESCRIPTORS	Agricultural Education, Business Education, Clearinghouses, Distributive Education, Health Occupations Education, Home Economics Education, Indexes (Locaters), Industrial Arts, *Instructional Materials, *Technical Education, Trade and Industrial Education, *Vocational Education

ABSTRACT

Documents announced with VT numbers only in the Fall 1970 issue (VT 012 408) of "Abstracts of Instructional Materials in Vocational and Technical Education" (AIM) are included in this microfiche set. The microfiche set is arranged in the following sequence: (1) a Vocational Technical (VT) number index to documents in the microfiche collection, (2) the author and subject index from AIM, and (3) the full text of documents listed in the VT number index. The texts are filmed continuously in VT number sequence. (CD)

CLEARINGHOUSE ACCESSION LOG SHEET

CLEARINGHOUSE: Vocational Technical PAGE 1 OF 9

DATE LOGGED: January 8, 1971 APPROVAL: [illegible]

ACCESSION NUMBER PREFIX	ACCESSION NUMBER NUMBER	LEVEL	AUTHOR (LAST NAME)	LOG/ DOC. CHECK	PAPER TAPE CHECK	EDIT LIST	SOURCE	AUTHOR	COMMENTS
VT	000 239	2							
VT	000 282	1	Burns						
VT	000 378	1	Rawls						
VT	000 379	1	Rawls						
VT	000 380	1	Green						
VT	000 381	1	Green						
VT	000 382	1							
VT	000 420	1	Peale						
VT	000 946	1							
VT	000 949	1							
VT	000 989	1							
VT	001 093	1							
VT	001 238	1	Clark						
VT	001 323	1	Levendowski						
VT	001 346	1							
VT	001 359	2							
VT	001 571	1							
VT	001 873	1							
VT	001 881	1							
QTY. 19									

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VT	001 998	1							
VT	002 053	1	Cornett						
VT	002 112	1							
VT	002 345	1							
VT	002 563	1	Durham						
VT	002 588	1							
VT	002 645	1							
VT	002 650	1							
VT	002 656	1							
VT	002 658	1							
VT	002 659	1							
VT	002 660	1							
VT	002 661	1							
VT	002 663	1							
VT	002 685	1							
VT	002 731	1	Collins						
VT	002 808	1							
VT	002 834	1							
VT	002 841	1	Wise						
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VT	002 846 ✓	2	Beam						
VT	003 553 ✓	2	Salmon						
VT	003 726 ✓	1							
VT	003 728 ✓	1							
VT	003 730 ✓	1							
VT	003 732 ✓	1							
VT	003 733 ✓	1							
VT	003 735 ✓	1							
VT	007 073 ✓	1							
VT	007 363 ✓	1	Warfield						
VT	008 419 ✓	1							
VT	008 420 ✓	1							
VT	008 421 ✓	1							
VT	008 422 ✓	1	Doyner						
VT	008 499 ✓	1	Ebbets						
VT	008 501 ✓	1	Prudhomme						
VT	008 503 ✓	2	Jones						
VT	008 634 ✓	1	Mercuric						
VT	008 757 ✓	1	Jefferson						
QTY. 19									

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ACCESSION NUMBER PREFIX	ACCESSION NUMBER NUMBER	LEVEL	AUTHOR (LAST NAME)	LOG/ DOC. CHECK	PAPER TAPE CHECK	EDIT LIST	SOURCE	AUTHOR	COMMENTS
VT	009 288	1	Brown						
VT	009 359	1							
VT	009 527	1							
VT	009 867	1							
VT	009 884	1							
VT	009 973	1	Phipps						
VT	009 974	1							
VT	009 975	1	Pulaski						
VT	009 976	1	Phipps						
VT	009 996	1	Phipps						
VT	010 012	1	Phipps						
VT	010 013	1	Phipps						
VT	010 014	1	Phipps						
VT	010 015	1	Phipps						
VT	010 024	1	Pulaski						
VT	010 025	1	Pulaski						
VT	010 026	1	Phipps						
VT	010 054	1							
VT	010-114	1							
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VT	010 201	1							
VT	010 215	1							
VT	010 216	1							
VT	010 217	1							
VT	010 219	1							
VT	010 223	2							
VT	010 235	1							
VT	010 245	1							
VT	010 251	1	Dalton						
VT	010 253	1							
VT	010 255	1	Dalton						
VT	010 259	1							
VT	010 333	1							
VT	010 350	1							
VT	010 360	1							
VT	010 362	1	Curtis						
VT	010 363	1	Oliver						
VT	010 372	1							
VT	010 406	2	Green						
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VT	010 409	2							
VT	010 411	2							
VT	010 412	2							
VT	010 413	1							
VT	010 421	1							
VT	010 422	1							
VT	010 423	1							
VT	010 425	1							
VT	010 439	1							
VT	010 457	2	Curry						
VT	010 461	1	Ruth						
VT	010 46[illegible]	2							
VT	010 470	2							
VT	010 47[illegible]	1	Madson						
VT	010 480	1	Malone						
VT	010 484	1	Siegfried						
VT	010 505	1							
VT	010 527	1							
VT	010 543	1							
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VT	010 544 ✓	1							
VT	010 545 ✓	1	Bent						
VT	010 546 ✓	1							
VT	010 570 ✓	1							
VT	010 571 ✓	2							
VT	010 572 ✓	2							
VT	010 582 ✓	1							
VT	010 583 ✓	1							
VT	010 590 ✓	1							
VT	010 601 ✓	1							
VT	010 611 ✓	1							
VT	010 615 ✓	1							
VT	010 616 ✓	2	Hodges						
VT	010 620 ✓	1	Henrod						
VT	010 621 ✓	1							
VT	010 627 ✓	1							
VT	010 629	1	Looker						
VT	010 638 ✓	1							
VT	010 682	1							
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VT	010 690	1							
VT	010 726	2	Courson						
VT	010 742	1	Dale						
VT	010 745	1	Tulloch						
VT	010 746	1	Tulloch						
VT	010 747	1							
VT	010 754	1							
VT	010 755	1							
VT	010 756	1							
VT	010 757	1							
VT	010 762	2	Herbst						
VT	010 771	1							
VT	010 773	1							
VT	010 774	1							
VT	010 775	1							
VT	010 776	1							
VT	010 904	1	Burkhardt						
VT	011 142	1							
VT	011 143	1							
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ACCESSION NUMBER PREFIX	ACCESSION NUMBER NUMBER	LEVEL	AUTHOR (LAST NAME)	LOG/ DOC. CHECK	PAPER TAPE CHECK	EDIT LIST	SOURCE	AUTHOR	COMMENTS
VT	011 145	1							
VT	011 151	1							
VT	011 152	1							
VT	011 169	1							
VT	011 179	1	Kudo						
VT	011 220	1							
VT	011 236	1							
VT	011 237	1							
VT	011 294	2							
VT	011 352	1							

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1900 Kenny Road
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Microfiche Collection of Clearinghouse Documents Reported in Abstracts of Instructional Materials in Vocational and Technical Education (AIM)

Compiled and Indexed by The ERIC Clearinghouse
on Vocational and Technical Education

FALL 1970

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The Ohio State University
1900 Kenny Road, Columbus, Ohio 43210

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INTRODUCTION

This collection of microfiche consists of the documents which are announced with VT number only in the Fall 1970 issue of Abstracts of Instructional Materials in Vocational and Technical Education (AIM). Microfiche availability is shown in the resume as MF AVAILABLE IN VT-ERIC SET. The documents are grouped in VT number sequence and filmed continuously as a microfiche set. These documents are not available on microfiche as individual items, but are obtainable only through purchase of this set, or from agencies who have this set and have the capability of reproducing microfiche. The microfiche set includes the following sections:

1. Vocational Technical (VT) Number Index to Microfiche Collection of Clearinghouse Documents Reported in AIM, Fall 1970.

2. Selected indexes from AIM, Fall 1970.

   a. Subject Index
   b. Personal and Institutional Author Index

   The documents identified in the indexes with an ERIC Document (ED) number are usually available as separate documents from the ERIC Document Reproduction Service (EDRS). Information about EDRS Service can be found in AIM or Research in Education (RIE).[1] Items not available through EDRS will include a source of availability. The page numbers shown in these indexes refer to the location of the abstracts in AIM, Fall 1970.

3. The full text of documents listed in the Vocational Technical (VT) Number Index to Microfiche Collection of Clearinghouse Documents Reported in AIM, Fall 1970.

[1] Research in Education is published 12 times a year. The first issue was no. 1, November 1966. Subscription: Domestic $21.00 a year; foreign $5.25 additional. Single copy: Domestic, $1.75. Send check or money order (no stamps) to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

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Vocational Technical (VT) Number

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VT 000 282	VT 003 728	VT 010 223
VT 000 378	VT 003 730	VT 010 235
VT 000 379	VT 003 732	VT 010 245
VT 000 380	VT 003 733	VT 010 251
VT 000 381	VT 003 735	VT 010 253
VT 000 382	VT 007 073	VT 010 255
VT 000 420	VT 007 363	VT 010 259
VT 000 946	VT 008 419	VT 010 333
VT 000 949	VT 008 420	VT 010 350
VT 000 989	VT 008 421	VT 010 360
VT 001 093	VT 008 422	VT 010 362
VT 001 238	VT 008 499	VT 010 363
VT 001 323	VT 008 501	VT 010 372
VT 001 346	VT 008 503	VT 010 406
VT 001 359	VT 008 634	VT 010 409
VT 001 571	VT 008 757	VT 010 411
VT 001 873	VT 009 288	VT 010 412
VT 001 881	VT 009 359	VT 010 418
VT 001 998	VT 009 527	VT 010 421
VT 002 053	VT 009 867	VT 010 422
VT 002 112	VT 009 884	VT 010 423
VT 002 345	VT 009 973	VT 010 425
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VT 002 658	VT 010 013	VT 010 478
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VT 002 661	VT 010 024	VT 010 505
VT 002 683	VT 010 025	VT 010 527
VT 002 685	VT 010 026	VT 010 543
VT 002 731	VT 010 054	VT 010 544
VT 002 808	VT 010 114	VT 010 545
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VT 010 690	
VT 010 726	
VT 010 742	
VT 010 745	
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VT 010 754	
VT 010 755	
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VT 010 755 16
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VT 010 756 16
Fundamentals of Service: Engines.
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VT 010 360 8
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VT 010 754 15
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VT 010 755 16
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Fundamentals of Service: Engines.
VT 010 757 16
Fundamentals of Service: Electrical Systems.
VT 010 904 17
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AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE
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VT 010 746 15
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AGRICULTURAL SUPPLIES
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A Specialized Course Outline for Advanced Vocational Agriculture Students in Agricultural Supply, Sales and Services.
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A Specialized Course Outline for Advanced Vocational Agriculture Students in Agricultural Supply, Sales and Services.
VT 000 381 3
Agriculture Supplies, Sales and Services (A Student Study Guide). Agribusiness Education Series.
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VT 010 425 11
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VT 011 510 ED 041 159 83
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ABSTRACT - This resource guide offers industrial arts teachers project ideas and guides for developing shop activities in the following major industrial areas: General Construction and Repair, Building Construction and Maintenance, Power Mechanics, and In-Plant Printing. The projects in each area include materials and equipment lists, visual aids, procedures, outcomes, references, and assignments. The guide also contains plans and suggestions for organizing a multi-area shop to provide the pupils with a diversified program of shop experiences. Twenty-nine operation sheets are appended. This guide is to be used in conjunction with "Industrial Arts" available as VT 001 359 (also in this issue). (GR)

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CAREER
GUIDANCE
SERIES

Industrial Arts Supplement

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- F O R E W O R D -

This resource guide offers the teachers of industrial arts in the Career Guidance Program project ideas and specific lesson guides for developing shop activities in four major industrial areas: General Construction and Repair, Building Construction and Maintenance, Power Mechanics, and In-Plant Printing. In developing basic concepts and skills in the four areas, a special effort has been made to correlate shop activities with all other subject areas.

This manual also contains plans and suggestions for organizing a multi-area shop to provide the pupils with a diversified program of shop experiences which will satisfy their individual interests and skills and help them crystalize plans for further training. It is expected that the teachers will contribute greatly to improving the industrial arts aspects of the Career Guidance Program.

Helene M. Lloyd
Acting Deputy Superintendent of Schools

June 1967

THE CAREER GUIDANCE PROGRAM

The Career Guidance Program grew out of a deep concern on the part of the Junior High School Division for the many pupils who were over-age, frustrated, retarded in most school subjects, and indifferent to education. The typical pupil in this group has a poor self-image, few or no aspirations either academic or vocational, and is biding his time until he can drop out of school.

During the school year 1957-1958, Dr. Joseph O. Loretan,* Deputy Superintendent of Instruction and Curriculum, and Dr. Morris Krugman,** Associate Superintendent of the Division of Child Welfare and five selected and interested principals worked on a plan and structure to create a program for these potential dropouts. In September 1958, six classes were organized in the 7th, 8th and 9th grades of five junior high schools. It was hoped that with specialized and intensive guidance and a curriculum centered around the world of work these pupils would remain in school and be infused with a desire to set higher educational goals for themselves.

In each of these schools a teacher was designated curriculum coordinator to work with the other teachers of these experimental classes to prepare special materials. Most of the schools used the core approach. A job area was chosen as the center of learning, e.g., Garment Trades, Food Handling, etc. All instruction in the various subject areas served to develop and to extend the learnings connected with the particular job area chosen. In September 1960, the Junior High School Division appointed a Job-Placement Supervisor to provide part-time employment for youngsters who wanted to earn money while in school.

Under the supervision of Max Rubinstein, Assistant Superintendent, Junior High School Division ***, this experiment was expanded to include a total of twenty-four junior high schools in September 1962 and thirty junior high schools in February 1963. The program now was organized in the 9th grade, since this was the terminal year of the junior high school and it was at this time that young people had to make a serious decision: Should they go on to high school or should they go to work? Therefore, a concentrated effort had to be made at this point to raise their educational and vocational aspirations if these pupils were to be motivated to seek higher learning. The program was introduced into the junior high schools that requested it. It comprised a unit of three classes, each with a maximum register of fifteen pupils. A full-time advisor was assigned in each school to meet with each class for group guidance twice a week and with every pupil individually at least once a week. An industrial arts teacher was also assigned full-time to instruct the pupils in pre-vocational and avocational skills.

* deceased
** retired
*** District Superintendent, District 29, Queens

In September 1965, the program was introduced into the 8th grade of 17 junior high schools that were reorganized with the 8th grade as the terminal grade. This brought the total number of schools in the program to fifty-two.

Three years of experimentation and a study of similar programs throughout the nation showed that a new teaching approach was essential in every subject area, if these youngsters were to be rehabilitated and redirected. Adaptations or "watered-down" versions of the traditional curriculum without a modified approach presented learning situations which were only too familiar and were filled with the failures and frustrations of the past. It was also evident that once these pupils had spent some time in a Career Guidance class they began indicating that they no longer wanted to go to work; they now wanted to prepare themselves for high school.

Thus, In February 1963, a team of specialists in each of the curriculum areas began to work on specially-designed teaching guides in guidance and job placement, language arts, speech, social studies, science, mathematics and industrial arts. To prepare these guides the curriculum specialists visited each of the schools that had been in the Career Guidance Program from two to five years and studied the teacher-prepared materials in use, observed and conferred with the pupils in the classes, and interviewed the teachers and supervisors to become oriented with the pupils' backgrounds, aspirations, cultures, interests, and needs. Workshop committees composed of teachers, advisors, and assistant principals were organized to work with each curriculum specialist. As the teaching material was developed it was tried out experimentally in selected schools and evaluated.

By September 1963, teaching guides in seven subject areas were made available in mimeograph form to all the schools in the program. The subject matter developed departed largely from the job-centered themes and concentrated on the skills and subject matter necessary for further study in high school; less on theory and more on the functional and manipulative aspects of each subject area so as to present the pupils with true-to-life problems and situations. Beginning September 1963, the area of Office Practice was included to equip the pupils with immediate saleable skills for obtaining part-time jobs and to motivate them toward further vocational work in high school.

Through a continuous program of evaluation by teachers, supervisors, and curriculum consultants, the teaching guides were revised and extended during the year 1965-66 under the general direction of Martha R. Finkler*, Acting Associate Superintendent, Junior High School Division.

In September 1966, the Career Guidance Series, consisting of teacher guides in Guidance and Job Placement, Language Arts, Speech, Mathematics, Social Studies 1 (You as a Citizen), Social Studies 2 (You and the Working World), Social Studies 3 (You and the World Today), Science-Grade 9, Industrial Arts, and Office Practice, were distributed to the teachers in the program .

* retired

Additional curriculum material has been prepared during the past year (1966-1967). The following experimental teacher resource guides will be distributed to the schools in the program in September 1967: Science-Grade 8; Industrial Arts Supplement; Office and Business Practices; Food, Hospital and Camp Services; and a Reading manual for teachers to be used with Reading-Book 1 and Reading-Book 2 by the pupils.

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Gida Cavicchia, Coordinator of the Career Guidance Program, served as project director.

Arlen J. De Vito, Supervisor of Industrial Arts, planned and organized the material in the manual and coordinated the work of the writing committee.

The material was prepared by industrial arts teachers in the Career Guidance Program with the cooperation of industrial arts supervisors.

The supervisors were: Robert Cynar, Eugene Haug, and Arthur Weener. Mr. Patrick J. Fitzmaurice, Principal of P.S. 25R, made many valuable suggestions and contributions.

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The consultants were: Arthur Dudley Chief of the Bureau of Industrial Arts, New York State Department of Education; and George Keane, Professor of Industrial Arts, College of the City of New York.

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Aaron N. Slotkin, Editor, Bureau of Curriculum Development provided production assistance.

INTRODUCTION

This teacher resource guide was prepared as a sequel to the Industrial Arts manual of the Career Guidance Series 1966-67 and is to be used in conjunction with it. It presents suggestions for organizing a Career Guidance industrial arts shop and for developing an instructional program in each of the four areas introduced in the previous manual:

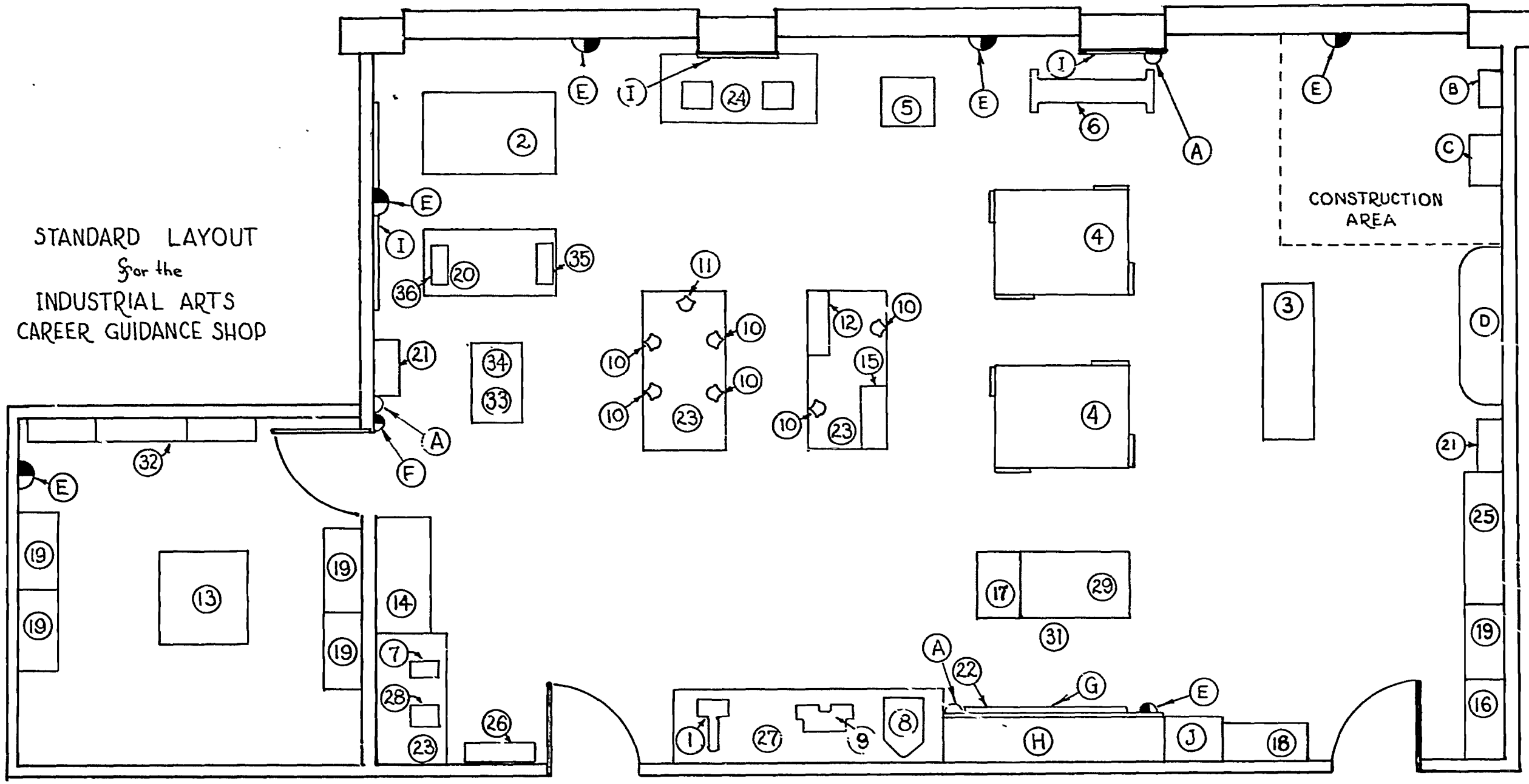
1. General Construction and Repair
2. Building Construction and Maintenance
3. Power Mechanics
4. In-Plant Printing

Organization of the Career Guidance Shop

The Career Guidance industrial arts shop should be organized as a multi-area shop to offer the pupils an opportunity to explore a wide range of learning experiences in various industrial areas, i.e., Building Construction and Maintenance, Power Mechanics, etc. This shop plan differs from the organizational pattern of the unit shop currently found in junior high schools. It is hoped that with an orientation to the many vocational opportunities available in the world of work the pupils will be encouraged to plan realistically for further technical training.

To hope the industrial arts teacher organize a multi-area shop, a standard shop layout was designed by the Industrial Arts Department in cooperation with the School Planning and Research Division and the Office of School Buildings. This year several selected junior high schools will be provided with the equipment shown in this layout. As funds become available, additional junior high schools will receive the proposed equipment. Until each school is outfitted with the essential equipment, the industrial arts teacher should plan to set up as many of the areas shown in the layout as he can with the equipment available in his school.

STANDARD LAYOUT
for the
INDUSTRIAL ARTS
CAREER GUIDANCE SHOP



Legend for Standard Shop Layout

1. Jig saw
2. Office offset duplicator
3. Glue bench
4. Woodworking bench - 2
5. Belt and disc sander
6. Wood lathe
7. Spot welder
8. Drill press
9. Tool grinder
10. Machinist's Vises - 6
11. Combination pipe vise
12. Box and pan brake
13. Circular saw
14. Ravena platemaker
15. Squaring shears
16. Hardware cabinet
17. File cabinet
18. Injection moulder
19. Storage cabinet - 5
20. Utility table
21. Paint cabinet - 2
22. Projection screen
23. Work bench - 3
24. Power mechanics unit
25. Tool storage cabinet
26. Magazine rack
27. Machine bench
28. Hermes engraver
29. Demonstration bench
30. Dust collector (not shown)
31. Teacher's stool
32. Lumber storage rack
33. Fluid duplicator
34. Spiral bookbinding unit
35. Electric collator
36. Vari-typer headliner
37. Electric portable drills - 4 (not shown)
38. Mobile stock cart (not shown)
39. Typewriter (not shown)
40. Portable belt sander (not shown)
41. Orbital sanders - 3 (not shown)
42. Overhead projector (not shown)
43. Aluminum ladder (not shown)
44. Picture frame vise (not shown)
45. Mitre box (not shown)
46. Stripprinter machine (not shown)

Construction Notes:

1. Emergency stop switches
2. Electrical service to construction area: One safety switch box 120 Volts A.C. 30 Amp. 2 pole Square D #D98251 or equal, one pull box 8" X 6" X 4" deep hinged
3. Plumbing service to construction area: Provide hot and cold water lines from sink, labled and mounted on service panel. Service lines to be 1/2" brass pipe with lock type teacher's shut off valves at sink and service valves at service panel in construction area with hose fitting threads at outlet.
4. Sink, white enamel, 6 feet long
5. Electrical convenience outlets, 110 V.A.C.
6. Twist lock wall receptacle, 20" high, 220 V.A.C. compatable with table saw
7. Chalkboard
8. Wardrobe
9. Cork display board
10. Teacher's locker

Teacher Planning:

The industrial arts teacher has but one year to cover the four areas of instruction recommended in this manual. In order to organize a diversified program, the teacher will have to plan for group instruction as well as for individual instruction. It is, therefore, suggested that the teacher's daily lesson plan include teacher-prepared Operation Sheets which can be distributed to pupils who are working independently. A series of Operation Sheets have been provided for the teacher in this manual and may serve as models for the preparation of additional Operation Sheets as they are needed.

Operation Sheets will be used to:

1. enable pupils to work independently
2. teach pupils how to follow written instructions
3. teach pupils to follow procedures
4. reinforce manual skills taught
5. help the pupils evaluate their work
6. encourage each pupil to maintain a shop workbook
7. reinforce reading skills
8. develop leadership
9. supplement instruction
10. help the teacher evaluate the pupil's progress

Organizing Pupil Activities:

It is suggested that the pupils begin the school year with the construction of a basic or an individual project. The selection and construction of these projects should be planned cooperatively by the teacher with the pupils. Work on a basic or individual project is a familiar shop experience and will help prepare the pupils for the introduction of instructions in each of the four industrial areas recommended in this manual.

When the pupils have progressed sufficiently on their individual projects, the teacher should launch another area of shop activity, such as the refinishing of a pupil's desk top. Each new project should be introduced with a shop talk and a demonstration of the activities involved. Two or three pupils can then be assigned to this new area while the remaining members of the class return to the completion of their individual projects.

Additional new areas of work should be introduced periodically throughout the school year depending on the interests and abilities of the pupils, the availability of necessary tools and equipment, and the ingenuity of the industrial arts teacher. As the work progresses in the various areas, the teacher should plan a program of rotation to provide all pupils with an opportunity to experience as many shop activities as possible.

Planning a Shop Demonstration:

An effective technique for teaching manipulative skills is to plan a demonstration lesson. When preparing to demonstrate a particular skill, the teacher must plan to have the necessary tools and materials near at hand. During the demonstration the pupils should be allowed to manipulate the tools and materials being used, ask questions, answer questions, and perform specific parts of the operation.

If the skill being taught involves the use of stationary equipment, it is important for all pupils to have a clear view of all operations. If power equipment is being used, the teacher

should plan a discussion of the safety measures involved prior to the demonstration. For example, if the teacher plans to demonstrate the operation of a grinder, a drill press, or a wood lathe, the pupils should be cautioned to wear goggles or shields to protect their eyes, to wear aprons to protect their clothing, etc.

Every shop demonstration should conclude with a summary of the points taught and with a review of the safety factors involved.

Pupil Participation in Shop Management:

Pupil participation in shop management is an important factor when planning a successful industrial arts program. To encourage pupil participation in shop management, the teacher should do the following:

1. Give a shop management assignment to every pupil.
2. Provide ample time for completion of assignment.
3. Provide instructional sheets that describe each assignment.
4. Assign pupils to positions which develop leadership:
   a. Shop superintendent
   b. Tool foreman
   c. Storage foreman
   d. Clean-up foreman
   e. Supply foreman
   f. Machine foreman
   g. Shop safety foreman
   h. Shop secretary
   i. Shop librarian
   j. Assistants (for the above assignments)

Further information regarding shop management may be obtained in Industrial Arts Shop Management, Curriculum Bulletin #9, 1964-65 Series, Board of Education of the City of New York.

Establishing Shop Routines:

Basic shop procedures and routines should be explained to the pupils very early in the school year. Pupils should become familiar with acceptable safety rules and regulations, especially those related to safe and efficient procedures in the shop. The teacher will find it helpful to do the following:

1. Assign a work station to each pupil.
2. Designate an area for storage of books and outer clothing.
3. Train pupils to prepare for shop work, e.g., wear apron, roll up sleeves, tuck in necktie.
4. Designate an area of the shop for demonstration activities.
5. Discuss procedures for safe and orderly movement about the shop.
6. Designate a signal to begin work and a signal to stop work.
7. Discuss procedures for clean-up of work areas and for storage of projects, tools, and supplies.
8. Instruct the pupils on the acceptable manner of leaving the shop at the end of the period.

Encouraging Pupil Achievement:

Every youngster should be encouraged to experience a feeling of success and accomplishment in his school work. This is especially important for pupils in the Career Guidance Program. The industrial arts teacher can encourage good work in many ways. It is suggested that the teacher:

1. Make a wall chart with the names of those pupils who are considered: Master Craftsman, Journeyman, Master Printer, Electrician, etc.
2. Encourage the pupils to plan and engage in special school, community, and shop projects.
3. Assign the more proficient pupils to serve as teacher assistants, aides to slower pupils, and supervisors of shop routines, etc.

Recording Pupil Progress:

To establish a continuity of instruction and to evaluate pupil progress, the teacher should maintain a record of the following information for each pupil:

1. shop activities engaged in by each pupil
2. basic skills learned
3. evaluation of performance
4. evaluation of work habits and attitudes

The Shop Safety Program:

Shop safety is the responsibility of the administration, the teacher, and the pupils. These responsibilities are outlined in The Administration of Safety in the New York City Schools, Curriculum Bulletin #13, 1958-59 Series, Board of Education of the City of New York, and in the School Shop Safety Manual, Curriculum Bulletin #13, 1964-65, Board of Education of the City of New York.

Instruction in safety should be given very early during the school year to orient the pupils to general safety rules and practices. However, the safe operation of machines and the prudent use of tools and materials is a necessary part of all instruction given in the industrial arts shop throughout the school year. Verbal and written instruction should accompany each new process and operation when it is presented to the pupils. The teacher should be satisfied that the information is understood and will be utilized by each pupil.

To instruct the pupils in shop safety practices, the teacher should explain carefully the safety rules listed below. Each pupil should then be requested to sign a safety pledge for the teacher to

keep on file. It is suggested that a copy of the safety rules and the pledge be maintained by each pupil in his shop notebook.

SAFETY RULES

1. Do not enter the shop unless the teacher is in the room.
2. Wear your shop apron and roll your sleeves up to the elbow when you are working.
3. Use only those tools and machines which have been demonstrated by the teacher.
4. Ask for permission from the teacher before you use tools and machines.
5. Walk, do not run, in the shop.
6. Handle sharp-edged tools and materials properly to avoid injury to yourself and to others.
7. Pick up all scraps of materials from the floor to avoid accidents.
8. Report immediately to the teacher any shop hazards or violations of the shop safety rules.
9. Report an accident immediately to the teacher.
10. Wash your hands before leaving the shop.

SAFETY PLEDGE

This is to certify that I have received both verbal and printed instructions in Shop Safety which I understand. I realize that failure to observe these instructions may lead to serious consequences. Therefore, to avoid any injury to myself or to others, I promise to observe these rules carefully and faithfully. Pupil's Signature_____
Official Class _____ Date _____
Teacher's Signature _____

Safety tests should be administered to the pupils periodically to evaluate their understanding of the safety rules and safety practices. A sample safety test is given below:

SAFETY TEST

Pupil's Name_____ Class_____ Date_____

Directions: Select the correct answer in each question and indicate your choice by placing the latter a, b, c, d in the space provided at the right.

1. When the fire gong sounds, you should
   a. run to the nearest exit
   b. continue to work until instructed to stop by the teacher

c. stop work and line up at the door
d. shut off shop machines and continue to work with hand tools

Ans._____

2. Power equipment may be used
   a. if you feel that you have the skill to operate it
   b. if you have been taught how to use it and have permission
   c. if a pupil who has permission supervises you
   d. if you have read the instruction book

Ans._____

3. Tools must be returned to the storage cabinets because
   a. they may get lost in scrap material
   b. the tool cabinet looks better if all tools are in place
   c. the tool monitor is not expected to return the tools
   d. they will get damaged on the bench

Ans._____

4. Accidents, cuts, scratches, burns, and bruises
   a. may be ignored if they are slight
   b. must be reported to the school office immediately
   c. must be reported to the teacher immediately
   d. should be taken care of at home

Ans._____

5. Power machinery may be operated without guards
   a. if the guard gets in your way
   b. when a mass production job requires speed
   c. at no time while you are working
   d. if an assistant helps you with your work

Ans._____

6. Eye protection must be used
   a. when working with equipment that creates chips, sparks, or dust
   b. at all times in the shop
   c. only by pupils who wear glasses
   d. in shops with poor lighting

Ans._____

7. A brush must be used to remove scraps from a work bench to
   a. avoid raising dust in the shop
   b. avoid injury to your hands
   c. create less work for the sweepers
   d. polish the bench top

Ans._____

8. When operating a power machine or a portable power tool
   a. wear work gloves to prevent injury to your hands
   b. remove your watch and your rings
   c. roll down your sleeves to keep your arms clean
   d. keep your fingers away from moving parts of the machine or tool

Ans._____

9. Oily rags must be
   a. disposed of in the incinerator
   b. stored in airtight plastic containers
   c. disposed of in covered metal containers
   d. wrapped in newspaper

Ans._____

Accident Report Forms:

If an accident occurs in the shop, the teacher must report it to the principal and fill out an accident report immediately.

Requisitioning of Shop Tools, Materials, and Supplies:

Each year a special allotment of funds is made to each industrial arts teacher for the purchase of small tools, materials, and supplies. Shop items may be requisitioned from the "G-1" List as per instructions given in the supply manual. Shop items not listed in the "G-1" List may also be order to provide for the many and varied activities planned in the Career Guidance Program. Non-list items are ordered on "R" requisitions. The following information must be provided on an "R" requisition:

1. description and price of item
2. vendor's item number
3. vendor's reference number
4. vendor's name and address

Teachers should reserve a small portion of the shop allotment to provide for "emergency" purchases of tools, materials, and supplies. The principal should be apprised of the amount reserved,

in writing, and a bill should be submitted to him for each "emergency" purchase.

Note: Items which can be ordered from the "G-1" List may not be purchased as "emergency" items at any time.

Tools:

Allen wrenches
Awl, brad
Awl, scratch

Bender, tube, spring type
Bending jig with base
Bits, auger, 4/16 to 16/16"
Bits, dowel, 4/16 to 16/16"
Bit, expansion #1
Bit, expansion #2
Bit, screw driver, 1/2"
Bit, screw driver, 3/8"
Bit, twist for wood, 8/32"
Bit, twist for wood, 6/32"
Brace, hand ratchet, 10"

Caliper, outside, 6"
Caliper, outside, 8"
Caliper, inside, 6"
Caliper, inside, 8"
Can, safety, one gallon
Carving, wood chisels
Chisels, wood, 1/8" to 1"
Clamps, C, 4"
Clamps, C, 6"
Clamp, drill press
Countersink, 3/8" and 1/2"
Copper, soldering, electric
Copper, soldering, gun type
Cutter, glass

Dividers, 6"
Dresser, grinding wheel
Drill, hand, 3/8" chuck
Drills, twist, 1/16" to 1/2"
Drills, masonry, 3/16" to 1/2"

Files, flat
Files, half round
Files, round
Files, triangle

Gauge, auger bit
Gauge, center
Gauge, drill
Gauge, marking, wood
Gauge, spark plug
Gauge, thickness
Goggles
Glazier's point drive, Red Devil, Model DP1
Gouges, firmer, 1/2"
Gouges, firmer, 3/4"

Hammer, ball peen, 8 oz.
Hammer, ball peen, 12 oz.
Hammer, ball peen, 16 oz.
Hammer, brad, 7 oz.
Hammer, nail, 13 oz.
Hammer, nail, 16 oz.
Handles, file, #2
Handles, file, #3
Handles, file, #4
Handscrews, adjustable
Hickey, pipe with handle
Hoe

Knife, Sloyd

Level, spirit, 24"

Mallet, rubber
Mallet, wood
Mallet, fibre

Nippers, Utica #60
Numbers, set, steel, punch, 3/16"

Oil can, pump type, 6 oz., flexible spout

Pail, water, 12 qts., galvanized iron
Plane, wood, 9"
Plane, wood, 11"
Plane, wood, 14"
Plane, block
Pincers, carpenter
Pipe cutter, 1 1/4", wheel type
Pipe cutter, 1 1/4", roller type
Pipe stock and dies, set, ratchet type, 3/8" to 1"
Pliers, electrician's
Pliers, roundnose
Pliers, slip joint, 6"
Pliers, slip joint, 8"

Pliers, tru-arc
Pliers, vise grip
Pliers, water pump
Punch, prick
Punch, center

Rasp, wood
Reamer, pipe, to fit wood brace chuck
Rule, circumference
Rule, steel, 12"
Rule, steel, 24"

Saw, back, 10"
Saw, coping
Saw, hack, adjustable frame
Saw, hand, cross cut, 24", 10 point
Saw, hand, rip, 26", 6 point
Saw, key hole
Scraper, cabinet, 2 1/2" X 5"
Screw driver, common, 2 1/2" to 10" blade
Screw driver, Phillips, 4", 6", 8"
Set, nail, 1/8"
Shovel, grading, common
Socket wrench set, complete w/sockets, 3/8" to 1"
Spoke shave, 6"
Square, try, 6"
Square, try, 12"
Square, steel, 24" X 16"
Square, bevel, 6"
Snips, combination, 2 1/2" blade
Snips, straight, 2 1/2" blade
Snips, curved, 2 1/2" blade
Snips, aviation
Stone, oil, 6" X 2" X 1", cased, combination
Surform, flat and half round

Tamp, masonry
Taps and dies set, screw plate
Tape, steel, measuring, 10 ft.
Toilet auger, 3 ft.
Toilet snake, 6 ft.
Torch, set, propane
Trowel, pointing, 3"
Trowel, pointing, 6"
Trowel, smoothing
Trowel, notched
Tube cutter set and flaring tool

Wrench, box end, set, 3/8" to 1"
Wrench, basin, 14"
Wrench, crescent, 8" and 10"
Wrench, open end, set, 3/8" to 1"
Wrench, pipe, 8" to 18"
Wrench, chain
Wrench, torque

Supplies and Materials:

Aprons, shop, bib, denim
Aluminum, sheets, 20 ga.

Brush, dust, counter
Brush, varnish, flat 1" and 1 1/2"
Brads, wire, lb. in box:

1/2"	-	#20
3/4"	-	#18
1"	-	#17
1 1/4"	-	#16
1 1/2"	-	#15
1 3/4"	-	#13
2"	-	#13

Cement, rubber, half pints
Corrugated fasteners #7
Copper, 16 oz., 12" X 12" square
Compound, pipe joint

Dowels - birchwood, pkg. (25) 1/4" to 1"

Electrical items:
bell, electric, 2 1/2" gong, #740
buzzer, electric, #725
box, octagon, 4" X 1 1/2" deep
box, sectional switch, 3" X 2" X 2 1/2"
box, square, 4" X 1 1/2"
covers for 4" square box
relay, enclosed, 12 v. - a.c./d.c.
pushbutton, 2 1/4" diameter
fuse base, fused neutral #220
clips, distributor, automotive
connectors, straight, steel, for armored cable
plates, Bakelite, single convenience outlet
plates, Bakelite, duplex convenience outlet
plates, Bakelite, tumbler switch
lampholder, porcelain, medium base
switches, snap, 2 circuit, electrolier
switches, snap, 3 circuit, electrolier
switches, tumbler, single, pole, flush
switches, tumbler, three way flush

Electrical items - continued

socket bodies, key #10, brass
socket bodies, pull, #15
cap, socket, 1/8", #HA - brass
wire, annunciator, #18, plastic covered, red and white
wire, armored cable, BX, two conductor, #14
wire, armored cable, BX, three conductor, #14
heater cord, type HPD
black lampcord
brown lampcord
ivory lampcord
magnet wire, #20, #22, #30
brass flange, nipple
emery cloth, #00
emery cloth, #0
electric meter panel

Enamel paint, 1/2 pint cans: assorted colors

Foil, copper, soft, #26 Band S ga., 12" wide
Fuse box and switch box, 4 plug base
Fixture, flourescent, ring type, complete
Fittings for 1/2" galvanized iron pipe:
- El 45 degrees
- El 90 degrees
- El street
- union
- coupling
- plug
- cap
- "T", 1/2" X 1/2" X 1/2"
- nipples, 1" to 6" by 1" increments

Fittings for 1/2" copper tubing:
- El 45 degrees
- El 90 degrees
- El street
- union
- coupling
- plug
- "T", 1/2" X 1/2" X 1/2"

Grinder, faucet seat
Goggles, plastic, one piece
Glue, liquid, white

Hardboard, untempered, 1/8" X 4' X 8'
Hardboard, untempered, 1/4" X 4' X 8'

In-Plant Printing Supplies:
- 8 1/2" X 11", sub 20H, mimeograph paper
- 8 1/2" X 14", sub 20H, mimeograph paper
- 8 1/2" X 11", spirit duplicator process paper, #1, white, sub. 20H
- spirit duplicator process, master sets, 8 1/2" X 11"
- correction pencils
- cleansing cream, 1 lb. jar
- duplicating fluid - 1 gal. cans
- paper, 10" X 12", 100 sheets to pkg.
- compound padding, white
- 8 1/2" X 11", 60 lb. white offset paper
- 8 1/2" X 14", 60 lb., white offset paper
- 17½" X 22½", 60 lb., white offset paper
- plates for the Ravena Platemaker OT3
  - slow 1 contact - speed negatives
  - liquid developer concentrate
  - plate fixer
  - Durolac fixer
  - supplies for offset suplicator:
    - medium run masters
    - short run masters
    - colored ink - all purpose black
    - cartridge inks - regal blue
    - cartridge inks - Christmas green
    - cartridge inks - brilliant red
    - etch (blue)
    - fountain concentrate
    - gum
    - preservation solution
    - reproducing pencil
    - reproducing pencil (hard lead)
    - ball point pen
    - refill cartridge (for ball point pen)
    - pencil eraser with brush
    - offset blanket green
    - blanket wash dispensing can
    - blanket wash
    - hand cleaner
    - cotton pad
    - clean-up mats, white, pinbar
    - glaze remover (for ink roller and blanket)
    - ink dispensing gun
    - ink roller conditioner

Lavatory, wall mount, complete with bracket, faucets, drain and trap
Lacquer thinner
Lacquer, transparent, brushing
Letters, display, blue 1 1/4" high
Letters, display, red 3" high
Lumber, assorted kinds and sizes

Marking pens, 8 felt tip cartridge, assorted colors

Nails, wire, FH - 3/8" - #19
Nails, wire, FH - 1 1/4" - #16
Nails, wire, FH - 2" - #12
Nails, wire, FH - 2 1/2" - #11
Nails, wire, FH - 3" - #10
Nails, needle point, FH - 3/4" - #17
Nails, wire, 4" common
Nails, sheetrock, blued 4D
Nails, roof, galvanized, 3/4"
Nails, steel cut, 6D
Nuts, wing iron, 8/32
Nuts, wing iron, 10/32
Nuts, wing iron 1/4" - 20

Oil, lubricating, SAE 10W - 30

Plastic supplies:
- polyethylene, low density, assorted colors
- polystyrene, general purpose, rigid, assorted colors
- polypropylene, tough and flexible, assorted colors
- Devon C castable epoxy aluminum
- PMS silicone mold release aerosol spray

Pins, cotter, steel 1/6" X 1"
Putty, glazier's, white, plastic
Plastic wood, natural
Plastic wood, solvent
Paint and varnish remover
Plywood, common, 1/4" X 4' X 8'
Paste, soldering
Pipe, galvanized iron, 1/2" inside diameter

Rags, printer's (25 lb. bale)

Rivets, copper, tinner's, 1 lb. sz.
Rivets, copper, tinner's, 2 lb. sz.

Screws, machine:
- FH 6-32-1/2" to 1 1/2"
- RH 6-32-1/2" to 1 1/2"
- FH 8-32-1/2" to 2"
- RH 8-32-1/2" to 2"
- FH 10-32-1/2" to 2"
- RH 10-32-1/2" to 2"
- FH 10-24-1/2" to 2"
- RH 10-24-1/2" to 2"
- FH 1/4" - 20 1/2" to 2 1/2"

Screws, wood, steel FH 3/4" to 3"
Screw eyes: assorted sizes
Screw, hooks, vert, shoulder #1
Sandpaper, fine

Sandpaper, medium
Sandpaper, coarse
Staples for electrical armored cable BX
Solder, soft 1/8" diameter wire
Solder, wire rosin core
Shellac solvent
Shellac substitute, clear
Steel, galvanized, 28 ga.

Triangles, 6", 45 degrees
Triangles, 8", 30-60-90 degrees
Tape, electrical, plastic
Turpentine
Tape, masking
Tin plate, bright coke, 90 lb. base
Transformer bell, 12-14 volts, 110 AC
Toilet tank, ceramic, complete with internal fittings
Tubing, copper 1/2" inside diameter
Tacks, upholsterer's - assorted sizes

Varnish, rubbing

Wax, paste
Washers, faucet seat, assorted sizes
Washers, iron, assorted sizes
Washers, black fibre 1" O.D.

General Construction and Repair

ERIC

Making an Upholstered Stool

Introduction:

The upholstered stool is presented as an individual project to give the pupil instruction in several occupational skills. The pupil will have an opportunity to assemble a furniture frame, apply a furniture finish to wood, and work with upholstery materials.

Materials, Tools, and Equipment:

Materials

pine, clear - 2 sides 14" X 3" X 1"
2 ends 12" X 3" X 1"
2 rails 19" X 5" X 1"
2 braces 14" X 4" X 1"
Note: Pine should be pre-cut.
dowels - 2 rods 1" d. X 15"
legs - 4 - molded plastic with brass foot
webbing - 18'
foam rubber (for padding)
covering - tapestry, leather or other suitable material
upholstery tacks
wood screws
wood glue
sandpaper
shellac
oil stain
varnish
wax
cotton waste
burlap
cotton bat

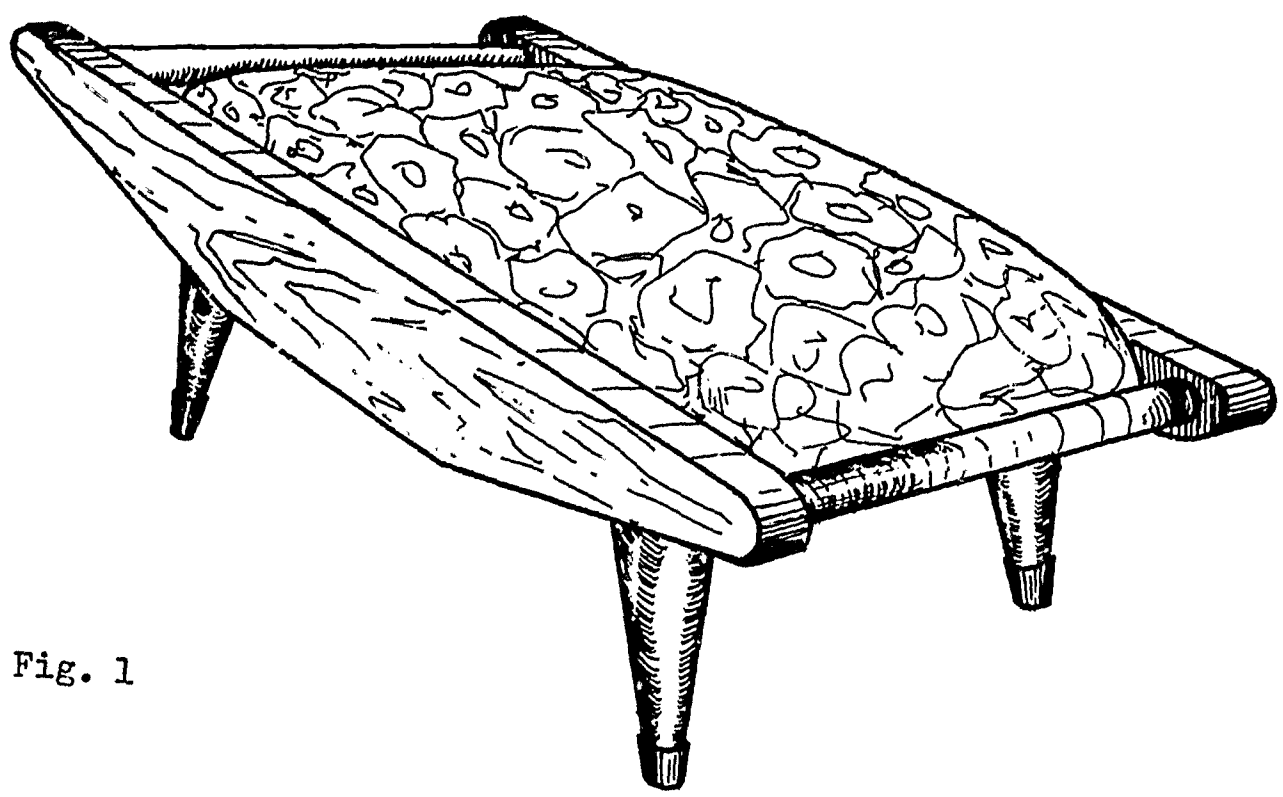


Fig. 1

Tools

plane	countersink	auger bit
files	back saw	Forstner bit
hand drill	try square	rule
screw driver	hammer	chisel
		brace

Equipment

circular saw
drill press

Visual Aids:

Wall charts (Figs. 1, 2, 3, 4, 5, 6, and 7)

Pictures of various designs of stools

Procedure:

1. Show models of upholstered stools to motivate interest.

2. Lay out gains on the sides for the frame. (Fig. 2)

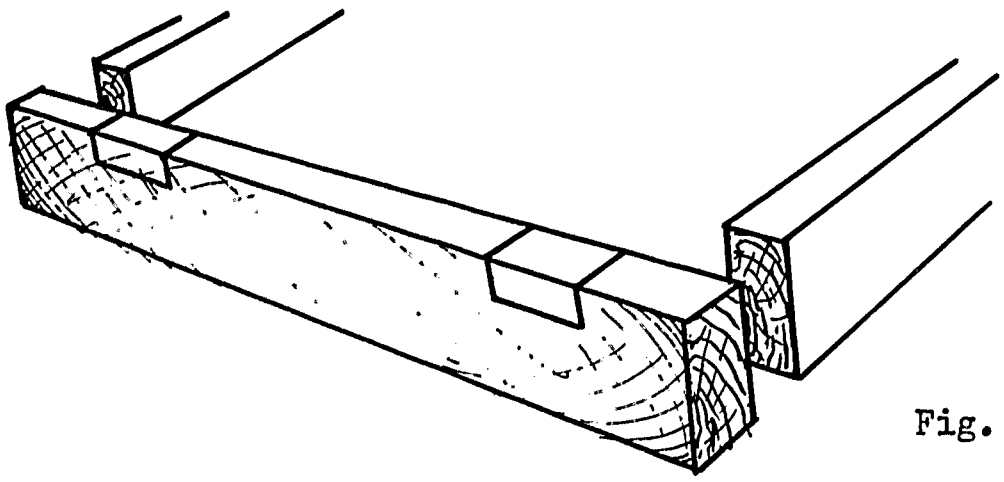


Fig. 2

3. Demonstrate how to cut gains for the braces. (Fig. 3)

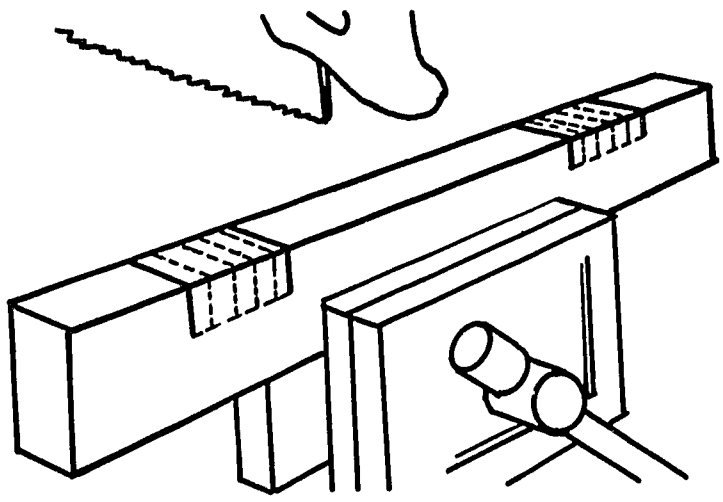


Fig. 3

4. Distribute Operation Sheet #11, Drilling Pilot Holes, and have pupils lay out and drill pilot holes in the sides of the frame.

5. Demonstrate how to assemble the two sides and the two ends to form the frame. (Fig. 4)

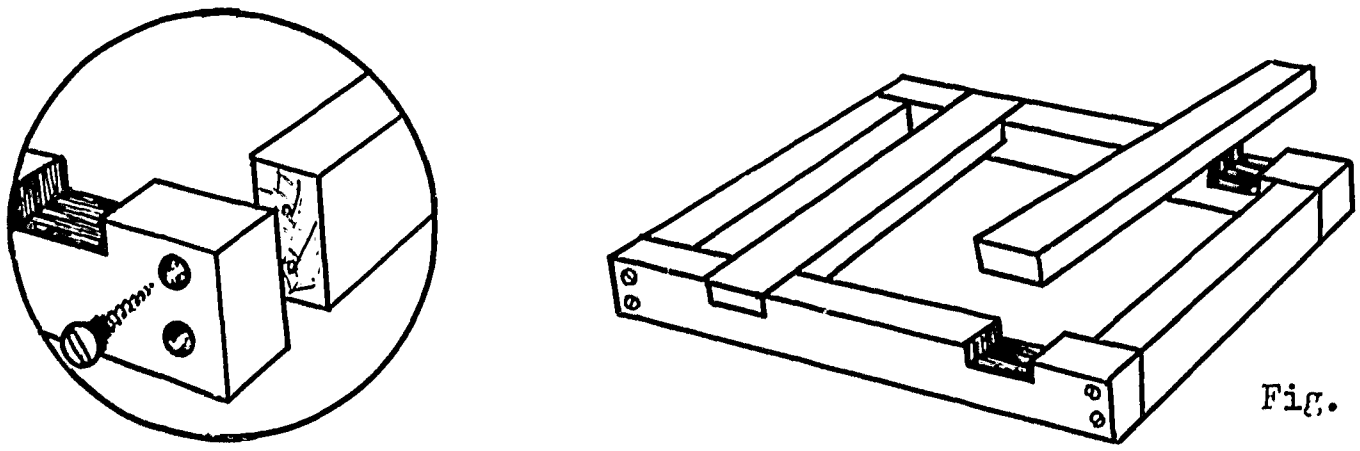


Fig. 4

6. Demonstrate how to attach the braces to the frame.

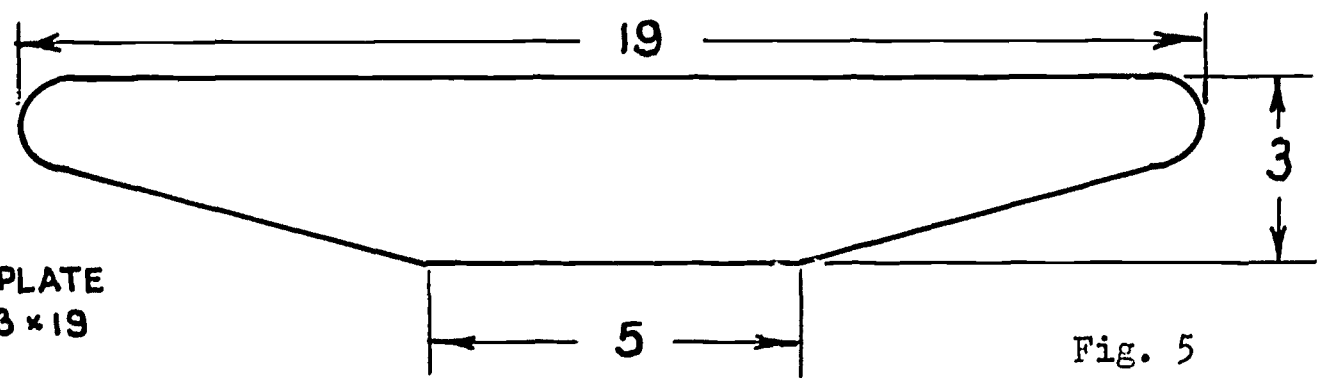
7. Demonstrate how to upholster:

   a. attach webbing to the frame

   b. add padding

   c. tack covering to the frame

8. Make a template for the rails of the stool. (Fig. 5)



SIDE RAIL TEMPLATE
MAKE 2EA.-1×3×19

Fig. 5

9. Shape the rails of the stool.

10. Drill holes in the rails for the dowel rods.

11. Distribute Operation Sheet #12, Smoothing Wood, and have pupils smooth the rails and rods.

12. Distribute Operation Sheets and have the pupils perform the operations given in each sheet:

    a. Operation Sheet #4, Applying a Wash Coat of Shellac

    b. Operation Sheet #5, Applying Varnish

c. Operation Sheet #6, Rubbing with Pumice and Oil

d. Operation Sheet #7, Rubbing with Rottenstone and Water

e. Operation Sheet #8, Applying Paste Wax

13. Demonstrate how to attach the rails and the rods to the frames.

14. Demonstrate how to attach metal plates for holding the legs.

Outcomes:

1. Manipulative skills

   a. to shape wood

   b. to assemble a frame

   c. to attach webbing and padding

   d. to install upholstery covering

   e. to finish wood

   f. to install plastic furniture legs

2. Safety practices

   a. to avoid holding tacks in the mouth

   b. to wear goggles when using the drill press

   c. to ventilate the shop when working with finishing materials

3. Academic learnings

   a. Language arts

      (1) vocabulary

assembling	webbing
template	padding
butt joint	covering
brace	upholstering
plastic	volatile

      (2) discussing stool design and construction

      (3) reading Operation Sheets

Assignment:

Have the pupils do the following:

1. List five different kinds of woods used to make furniture.

2. Make a drawing of a butt joint.

Follow-Up:

1. Plan a visit to a local furniture store to observe various styles of furniture.

2. Plan a visit to a furniture manufacturing plant.

3. Prepare a report on each of these visits.

References:

General Woodworking, Groneman, Chris H., McGraw-Hill Book Company, Inc., New York, N. Y. 1959.

General Shop Woodworking, Fryklund, Verne C., and LaBerge, Armand J. McKnight and McKnight, Bloomington, Ill. 1963.

Making a Box Planter

Introduction:

The box planter is made with an outer decorative wooden case, and an inner metal liner. To construct a box planter, the pupils will use hand and power tools.

This lesson consists of two parts: Part I will give instructions for the construction of the outer wooden case of the box planter, while Part II will give instructions for constructing the inner metal liner of the box planter.

Part I: Wooden Case

Materials, Tools, and Equipment:

Materials

pine - clear - 1 bottom 17" X 4" X 1/2"
1 back 17" X 7" X 1/2"
1 front 18" X 4½" X 1/2"
2 ends 6" X 4½" X 1/2"
Note: Pine should be pre-cut.

wood glue
brads 1", #17
plastic wood
sand paper (medium and fine)
varnish
oil stain
wax

Tools

surform (curved)
wood files
small putty knife
nail set
brad hammer
plane

Equipment

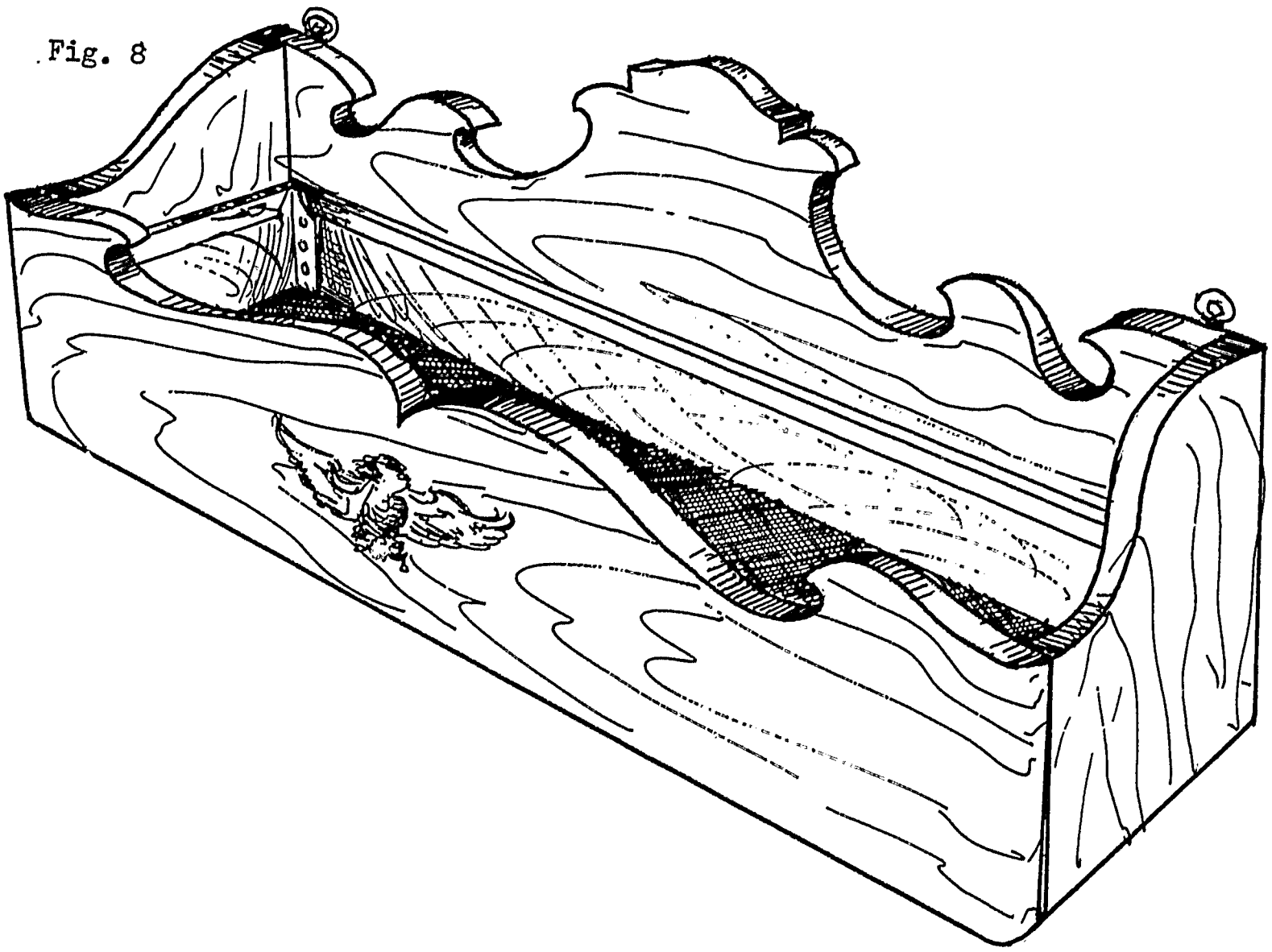
scroll saw
belt sander

Visual Aids:

Model of box planter

Wall chart (Fig. 8)

Fig. 8



Procedure:

1. Show model of a box planter to motivate pupils' interest.

2. Distribute the pre-cut wood stock and have the pupils label each piece.

3. Demonstrate each of the procedures listed below. Then have the pupils perform the operations.

   a. Make templates for the back, front, and ends of the box.

   b. Trace the templates on the wood stock.

   c. Cut the stock on the scroll box.

   d. Shape the stock with the surform and wood files.

   e. Assemble the parts (with glue and brads).

f. Use the nail set to sink the brads.

g. Fill the nail holes with plastic wood.

4. Demonstrate how to smooth wood with the belt sander.

5. Distribute Operation Sheet #10, Using the Belt Sander, and have the pupils follow the directions given.

6. Demonstrate the following:

   a. Apply oil stain and wipe dry.

   b. Apply two coats of varnish. (Operation Sheet #5)

   c. Apply a coat of wax and polish. (Operation Sheet #8)

Part II: Metal Liner

Materials, Tools, and Equipment:

Materials

tin plate - 1 piece 25" X 12"	asphaltum
steel wool, 00	solder
rivets	flux

Tools

mallet	sheet metal punch
soldering copper	rivet set
scriber	riveting hammer
tin snips	

Equipment

pan brake	sheet metal stake
bar folder	gas bench furnace
soldering bench	

Procedure:

Demonstrate the following steps and then have the pupils perform each operation:

1. Make a template of a metal liner.

2. Scribe the layout on the tin plate.

3. Cut the layout with tin snips.

4. Punch holes in the metal for rivets.

5. Form a folded edge on the bar folder.

6. Form the box on the pan brake.

7. Rivet the corners of the box.

8. Solder the corners of the box. (Operation Sheet #14)

9. Coat the metal box with asphaltum.

Outcomes:

1. Manipulative skills

   a. to transfer a design (template)

   b. to cut irregular shapes on a scroll saw

   c. to file curved surfaces

   d. to assemble a wooden box

   e. to finish wood with oil stain and varnish

   f. to use a belt sander

   g. to cut tin plate

   h. to form a metal box on a pan brake

   i. to solder a metal seam

   j. to rivet

2. Safety practices

   a. to handle sharp metal with care

   b. to avoid burns when soldering

   c. to operate a scroll saw with care

   d. to avoid injury when working with a belt sander

3. Academic learnings

a. Language arts

(1) vocabulary

tin plate	scribe
flux	surform file
asphaltum	pan brake
rivet	plastic wood
solder	stake

(2) reading Operation Sheets

b. Mathematics

(1) measuring to lay out a sheet metal box

(2) estimating when spacing rivets and brads

c. Science

(1) chemical action of soldering flux

(2) metal coatings and effect of oxidation

(3) melting point of different metals

Assignment:

Have the pupils answer the questions below:

1. Name two ways in which asphalt materials are used to protect metal.

2. Find out why varnish, and not shellac, is used to finish the wooden box.

3. Describe a suitable location for the box planter in your home.

References:

General Shop Woodworking, Fryklund, Verne C., and LaBerge, Armand J. McKnight and McKnight, Bloomington, Ill. 1963.

General Woodworking, Groneman, Chris H., McGraw-Hill Book Company, Inc., New York, N. Y. 1959.

Basic Sheet Metal Work, Wilkinson, H., The MacMillan Company, Toronto, Canada 1964.

Basic Sheet Metal Drafting, Almon, Joseph J., The Bruce Publishing Company, Milwaukee, Wisconsin 1963.

Refinishing a Pupil's Desk

Introduction:

Refinishing of school desks involves using operations and processes commonly found in the furniture-making industry. The pupils use varnish remover, machine tools, and finishing materials.

Materials, Tools, and Equipment:

Materials

varnish remover	shellac	pumice
newspaper	towels	lacquer thinner
rags	varnish	garnet paper (6-0)
steel wool	sandpaper	paraffin oil
soap	paste wax	rottenstone

Tools

sloyd knife
putty knife
woodscraper

Equipment

goggles	orbital sander
rubber apron	belt sander
rubber gloves	paint brushes
clean cans	

Visual Aids:

Samples of various furniture finishes

Samples of furniture "before" and "after" refinishing

Procedure:

1. Show the pupils samples of finished pieces of work to promote interest and to establish appropriate standards of workmanship.

2. Have pupils:

   a. prepare to remove varnish (Operation Sheet #1)

   b. remove varnish (Operation Sheet #2)

c. put refinishing materials away after using varnish remover (Operation Sheet #3)

d. sand the desk top with a belt sander (Operation Sheet #10)

e. sand the small areas with an orbital sander (Operation Sheet #9)

f. smooth and clean the corners of desk with sandpaper (Operation Sheet #12)

g. apply a wash coat of shellac (Operation Sheet #4)

h. apply varnish (Operation Sheet #5)

i. smooth the varnish finish with pumice and oil (Operation Sheet #6)

j. add luster to the varnish finish with rottenstone and water (Operation Sheet #7)

k. polish the desk with paste wax (Operation Sheet #8)

Outcomes:

1. Manipulative skills

   a. to use the belt sander

   b. to use the orbital sander

   c. to use varnish remover and a putty knife

   d. to use a paint brush

   e. to apply a finish rub

2. Safety practices

   a. to use goggles for eye protection

   b. to use rubber gloves for protecting hands from corrosive chemicals

   c. to use a rubber apron for protection of clothing

   d. to handle volatile liquids with care

3. Academic learnings

a. Language arts

(1) vocabulary

varnish	rottenstone
varnish remover	wax
lacquer thinner	belt sander
shellac	orbital sander
pumice	

(2) reading Operation Sheets

b. Mathematics

(1) estimating liquid measure

(2) estimating time required for chemical reactions (varnish remover)

Follow-Up:

Have pupils bring in marred furniture from home to refinish it in school.

References:

Finishing Materials and Methods, Soderberg, George A., McKnight and McKnight Publishing Company, Bloomington, Ill. 1952.

Paint and Varnish Technology, Von Fischer, William, Reinhold Publishing Company, New York, N. Y. 1948.

Making a Bed Serving Tray

Introduction:

Service to others is one of the most rewarding activities of a good citizen. Pupils in the Career Guidance Program can be encouraged to develop this positive attitude by making projects which satisfy a community need or help beautify the community.

A bed serving tray is a suitable project for the pupils to produce and contribute to local hospitals, nursing homes, or other community agencies. It may be produced as an individual project or as a mass production project.

Materials, Tools, and Equipment:

Materials

plywood -	top	(1)	24" X 15" X 1/4"
	legs	(2)	12" X 10" X 1/4"
pine, clear -	end rails	(2)	12" X 1" X 3/8"
	edge rail	(1)	24" X 1" X 3/8"
red oak -	latch	(1)	24" X 1" X 3/8"
	block	(1)	3½" X 1" X 3/8"
butt hinges		(4)	3/4", middle
wood screws		(16)	1/4", No. 0, F.H.
		(2)	3/4", No. 6, F.H.

shellac
enamel
glue
sandpaper
decals
brads

Tools

plane
files
hammer
ruler
try square
hand drill
brad awl
countersink
brace

Equipment

circular saw
scroll saw
mitre box
dado head
band saw

Visual Aids:

Pictures of bed serving trays

Procedure:

1. Show models of bed serving trays to motivate interest.
2. Distribute the plywood for the top of the tray and demonstrate how to lay out the curves on the front edge.
3. Demonstrate the following operations:
   a. Cut out the front edge on the scroll saw.
   b. Cut the rails on the mitre box.
   c. Attach the rails to the tray with glue and brads.
   d. Smooth the tray and the rails. (Operation Sheet #12)
   e. Cut the latch piece on the circular saw and cut the dadoes in each end.
   f. Cut the recess in the latch on the band saw.
   g. Smooth the latch.
   h. Cut the blocks on the circular saw.
   i. Attach the latch and block to the tray with wood screws.
4. Have the pupils perform the operations demonstrated on their trays.
5. Distribute plywood for the legs and review how to lay out and cut the legs.

6. Demonstrate the following operations: (Operation Sheet #12)

   a. Smooth the legs.

   b. Attach the butts to the legs.

   c. Attach the legs to the tray.

   d. Apply a coat of shallac. (Operation Sheet #4)

   e. Apply a coat of enamel.

   f. Apply decals.

7. Have the pupils complete their trays as demonstrated.

Outcomes:

1. Manipulative skills

   a. to operate a scroll saw

   b. to operate a band saw

   c. to install hinges

   d. to apply enamel finish

   e. to make mitre joints

2. Safety practices

   a. to use a scroll saw with safety

   b. to use a band saw with safety

   c. to use a mitre box with safety (clamp, stock)

3. Academic learnings

   a. Language arts

      (1) vocabulary

recess	decals
dado	plywood
countersink	enamel
butts	hinges
mitre	brad

      (2) writing letters to local hospitals, nursing homes, and other community agencies

b. Mathematics

(1) measuring (1/4", 3/8", 1 1/2", etc.)

(2) finding equal parts by dividing

(3) measuring angles (45°, 90°, etc.)

c. Social studies

(1) community service (volunteer work)

(2) mass production techniques

Assignment:

Have the pupils:

1. Write a report on the properties of oak wood.

2. Calculate the cost of the materials used to construct the bed serving tray.

References:

Woodworking Technology, Hammond, Donnelly, Harrod and Rayner, McKnight and McKnight Publishing Co., Bloomington, Ill. 1966.

Hand and Machine Woodwork, Miller, H. G., The Macmillan Company, Toronto, Canada 1962.

Building Construction and Maintenance

Constructing the Foundation Platform

Materials and Tools:

1. Materials

   lumber (2" X 6")
   5/8" plyscord 4' X 6'
   6 penny nails
   8 penny nails
   10 penny nails
   sawhorses

2. Tools

   claw hammer
   framing square
   try square
   crosscut saw
   6' rule

Visual Aids:

Samples of different types and sizes of plywood, e.g., fir, birch; 1/2", 3/4", etc.

Wall charts (Fig. 1, Fig. 2, Fig. 3, Fig. 4)

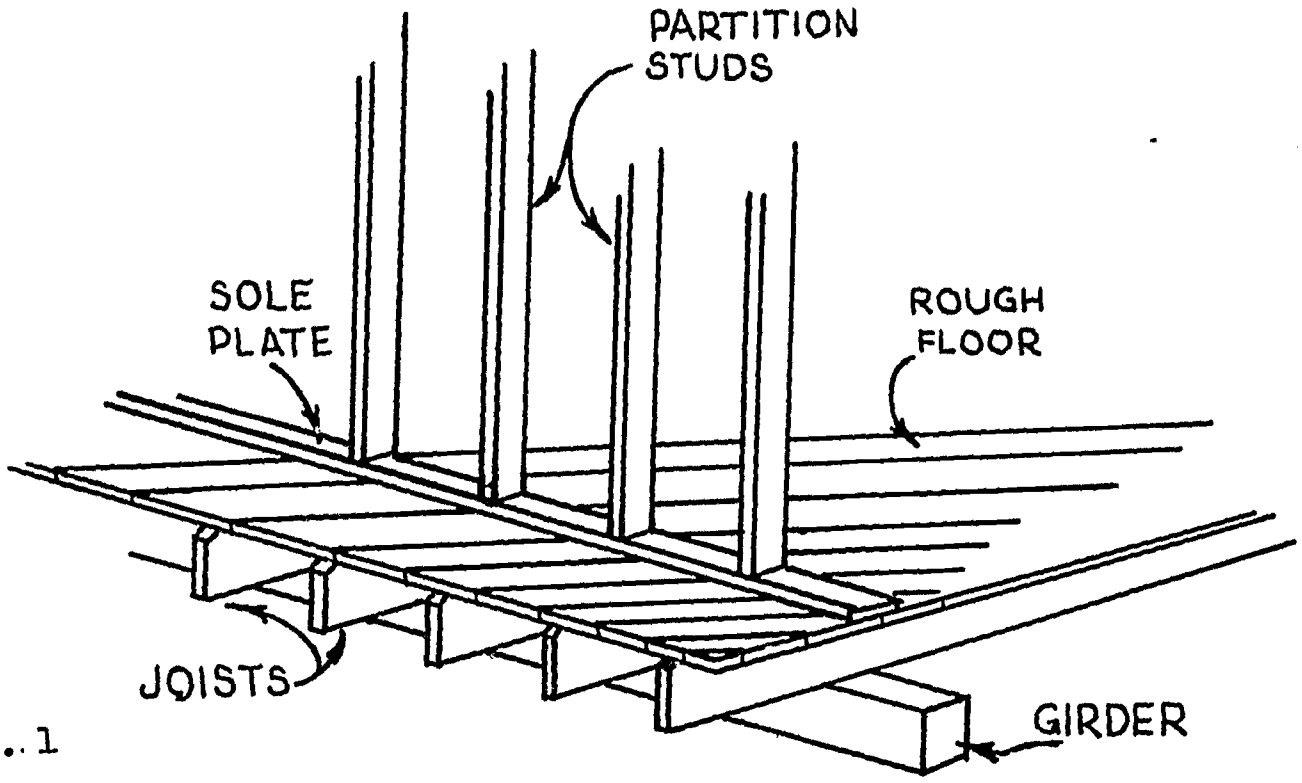


Fig. 1

Procedure:

1. Prepare to build a foundation platform.

   a. Lay out, prepare, and install the header and edge joists to form the box headers.

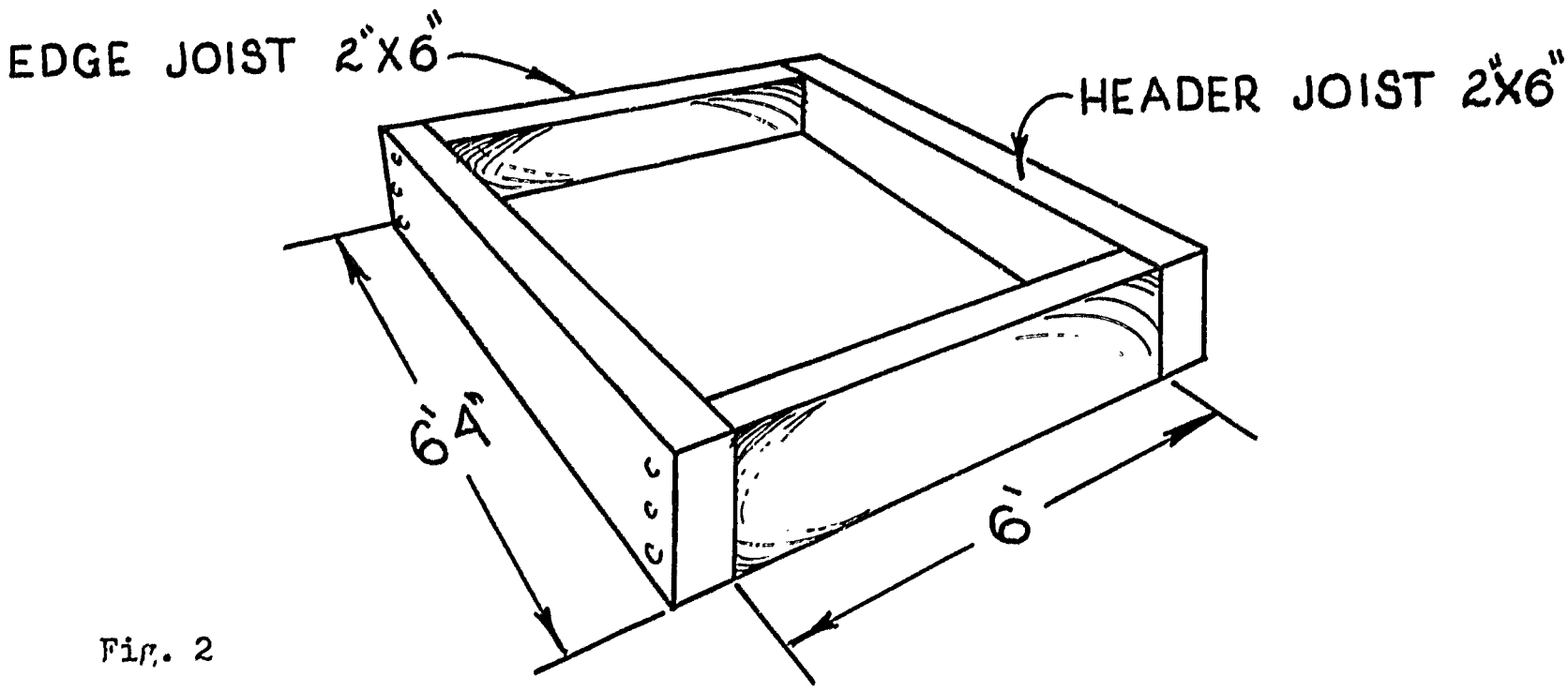


Fig. 2

   b. Lay out the length of the header joist with the rule and try square on a 2" X 6".

   c. Lay out the length of the edge joist. (It should be the length of the header joist, less the double thickness of 2" X 6" stock.)

   d. Cut the header and edge joists to length with a cross-cut saw.

   e. Nail the header joist to the edge joist. See Figure 1. (Use the claw hammer and ten penny nails.)

   f. Test the corners for squareness with the framing square.

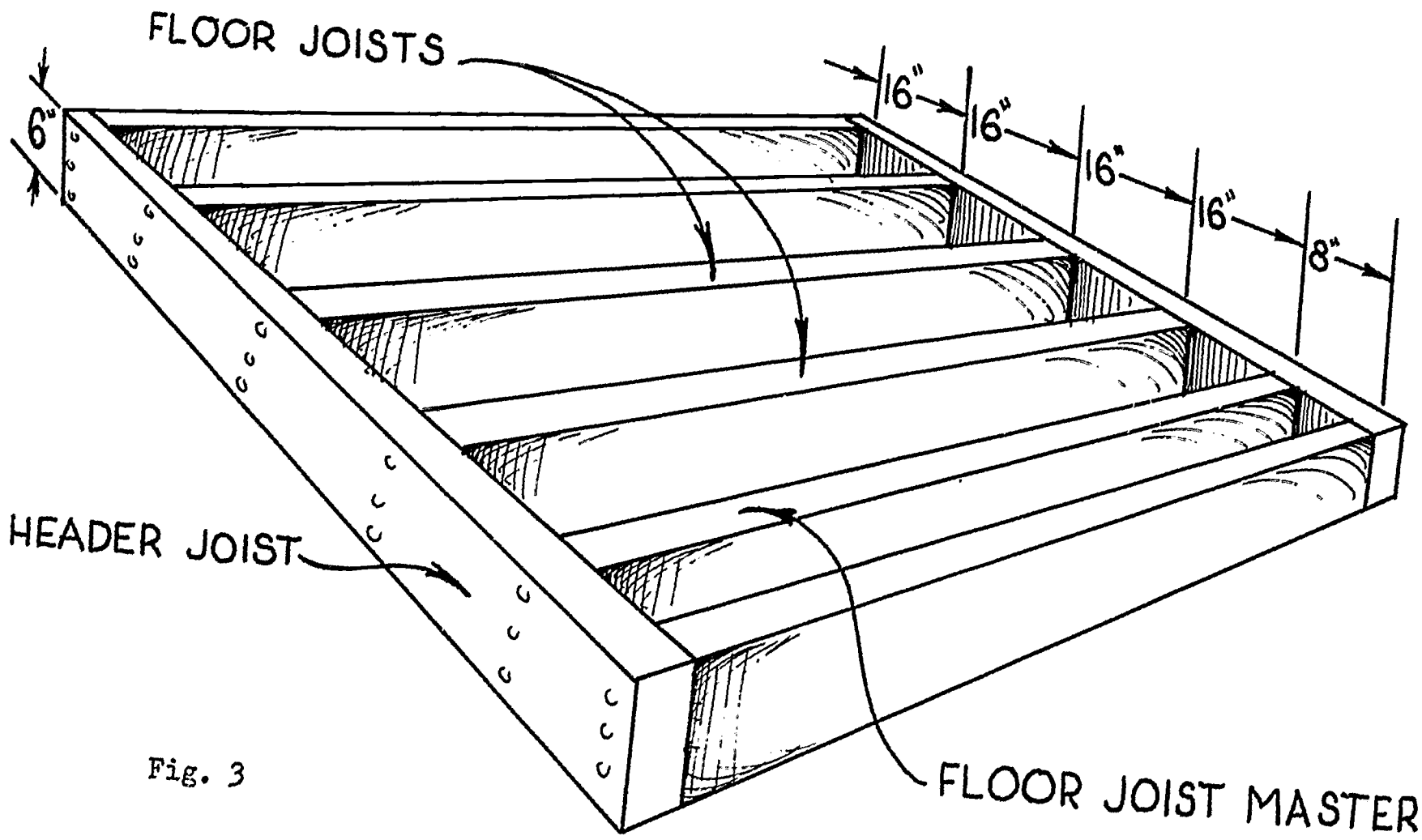


Fig. 3

2. Installing the floor joists.

   a. Lay out the length of the floor joist master.

   b. Cut the floor joist master to length with the crosscut saw.

   c. Determine the number of floor joists required and lay out the other floor joists with the master.

   d. Cut the required floor joists to length.

   e. Install the floor joists. (16" center to center)

   f. Test the floor joist for squareness to the header joist.

   g. Nail the header joist to the floor joists with ten penny nails.

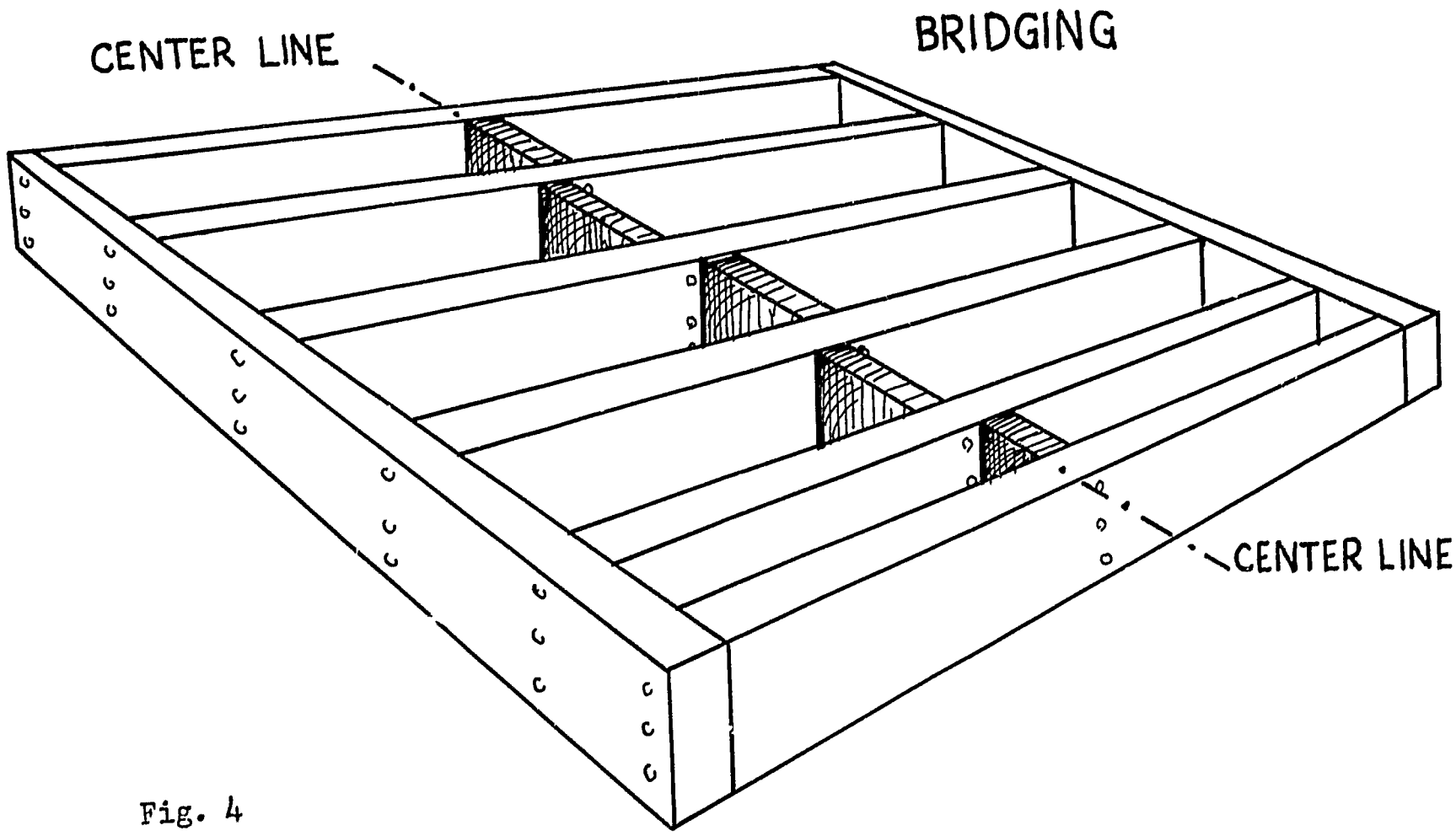


Fig. 4

3. Lay out, prepare and install the bridging.

   a. Lay out the lengths of the bridging stock.

   b. Cut the bridging pieces to length.

   c. Lay out a center line across the floor and edge joists. (Fig. 3)

   d. Install the first piece of bridging on one side of the center line to provide nailing surfaces for both ends of the bridging.

   e. Nail the bridging into place with ten penny nails.

   f. Install the next piece of bridging on the other side of the center line.

   g. Nail and stagger the subsequent pieces of bridging.

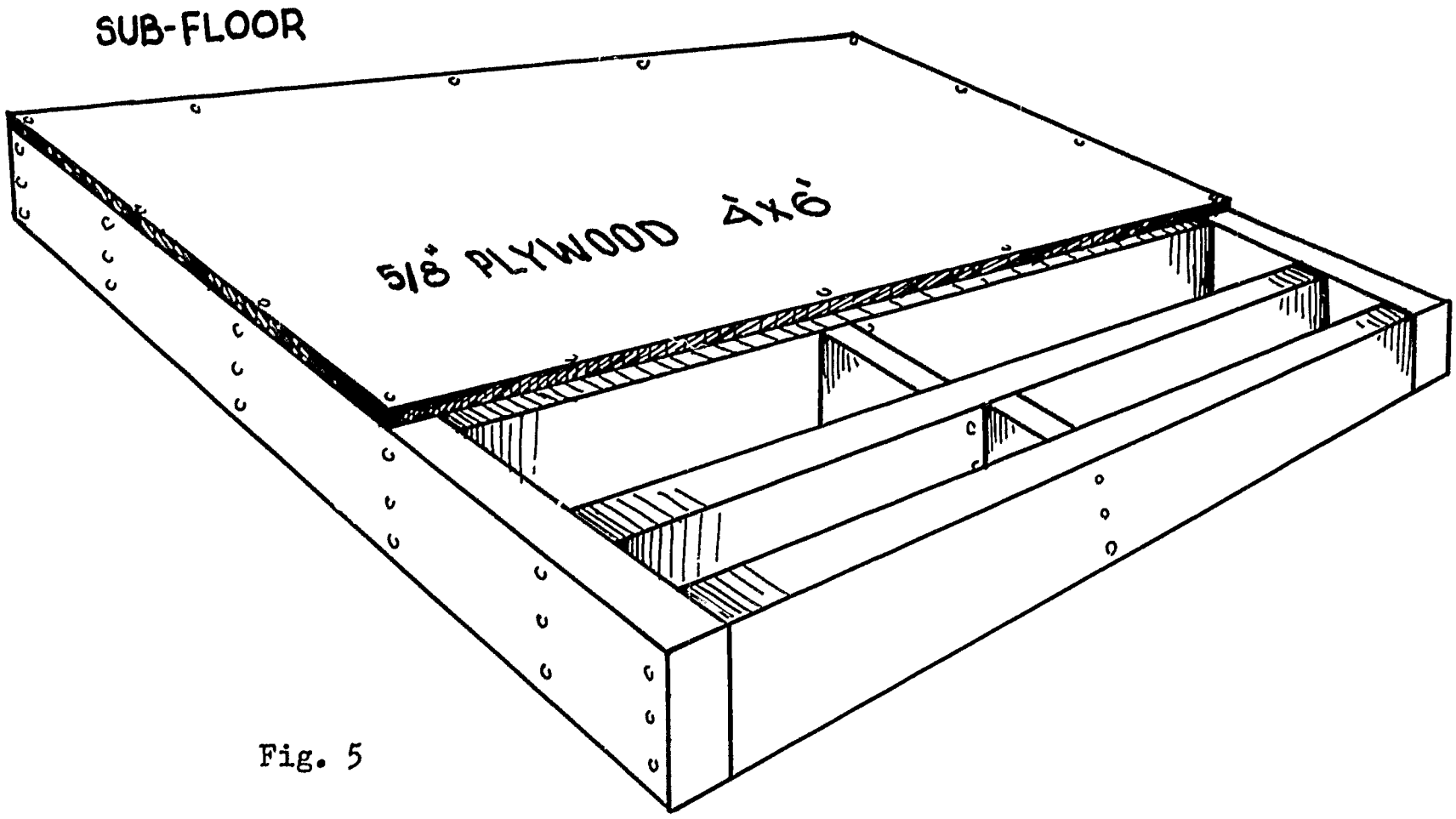


Fig. 5

4. Lay out, prepare, and install the sub-flooring.

   a. Select a 5/8" X 4' X 6' plywood panel.

   b. Place the plywood panel on the box frame. (Fig. 4)

   c. Install the plywood with six penny nails. (12" apart)

   d. Cut another plywood panel to complete covering the box frame (2 1/4" X 4')

   e. Nail this plywood panel into place.

Outcomes:

1. Manipulative skills

   a. to use the ruler and the square

   b. to use the crosscut saw

   c. to use the saw horses

   d. to use the claw hammer in straight nailing

   e. to test for squareness

2. Safety practices

   a. to carry lumber with care

   b. to prevent binding when cutting lumber on saw horses

c. to keep hands away from the saw teeth when sawing wood

d. to be sure that the hammer head is firmly attached to handle

e. to avoid striking fingers when using a hammer

3. Academic learnings

a. Mathematics

(1) linear measurement

(2) concepts of length, width, and thickness

(3) angle measurement

(4) penny weight

b. Language arts

(1) vocabulary

header
joists
square
cross cut
bridging

(2) reading blueprints, sketches, and drawings

c. Science

(1) lumber source, characteristics

(2) steel (sources and production)

References:

1. Wood Frame House Construction, Anderson, L. O. and Heyer, O. C., U. S. Dept.of Agriculture, Washington, D. C. 1955.

2. Audel's Carpenters' and Builders' Guide, Graham, F. D. and Emery, T. J., Theodore Audel and Co., New York 1963.

Workbook Assignment

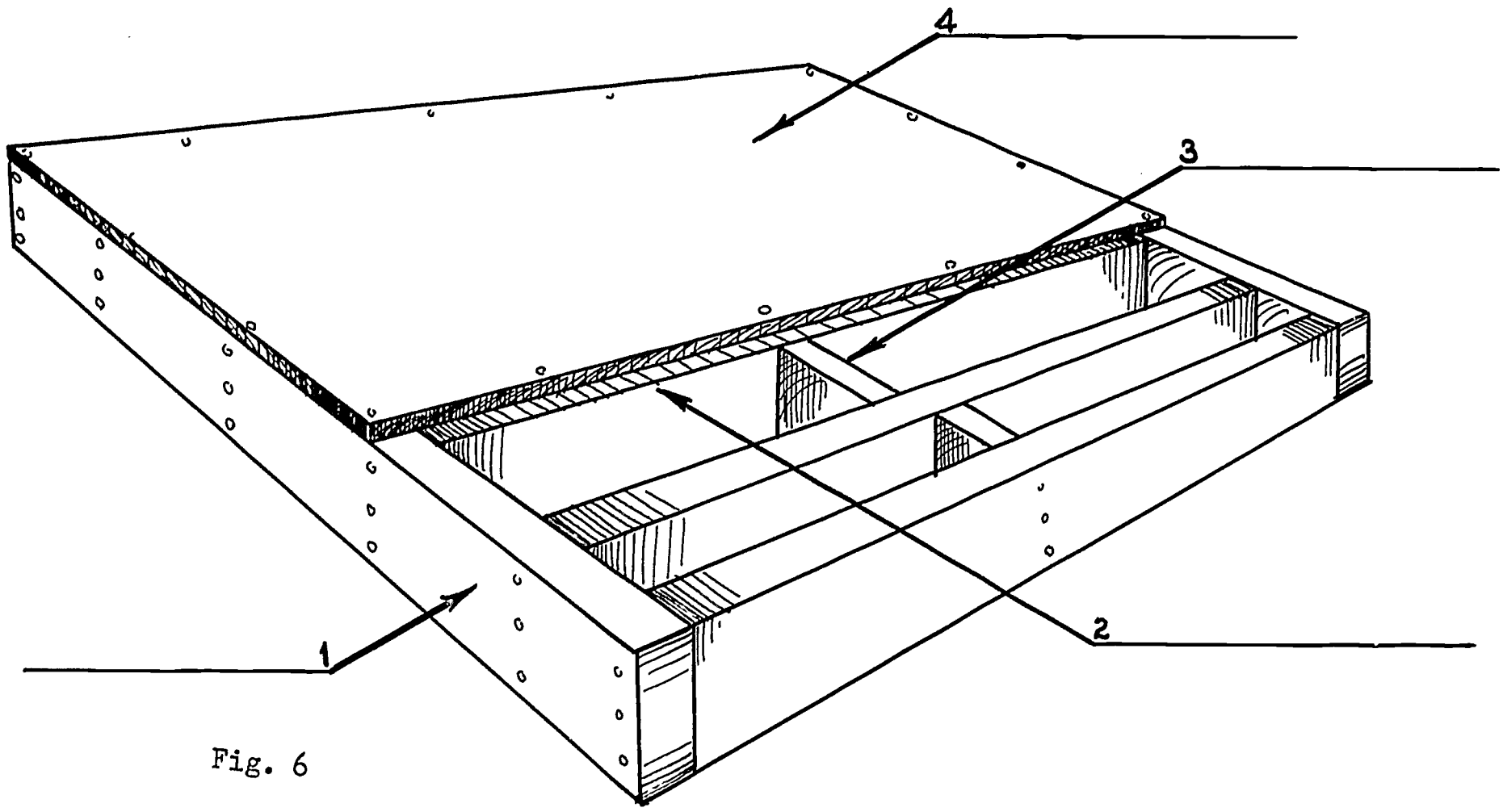


Fig. 6

1. Label parts of the foundation platform above.

   Header joist, sub-floor plywood, bridging, floor joist

2. Why are floor joists placed 16" center to center?

   _____

3. Measure the length of a 10 penny nail. _____"

   Measure the length of an 8 penny nail. _____"

4. Why is the bridging staggered?

   _____

Constructing Frame for a Wall Panel

Materials and Tools:

1. Materials

   lumber (2" X 4", 2" X 6", 1" X 3")
   common nails (10D)

2. Tools

   claw hammer
   crosscut saw
   6' rule
   try square
   framing square
   6' step ladder

Visual Aids:

Blue Print of wall construction (Fig. 7)

Chart illustrating lumber sizes (2" X 4", 2" X 6", 1" X 3")

Chart illustrating nail sizes (10D, 6 penny, 10 penny, etc.)

Procedure:

1. Cut 2" X 4" lumber to length desired. (Suggested lengths: 6', 7', or 8')

2. Cut stock for sole and top plate. (Suggested length 6')

3. Lay sole and plate side by side and mark off stud locations with framing square. (Fig. 7)

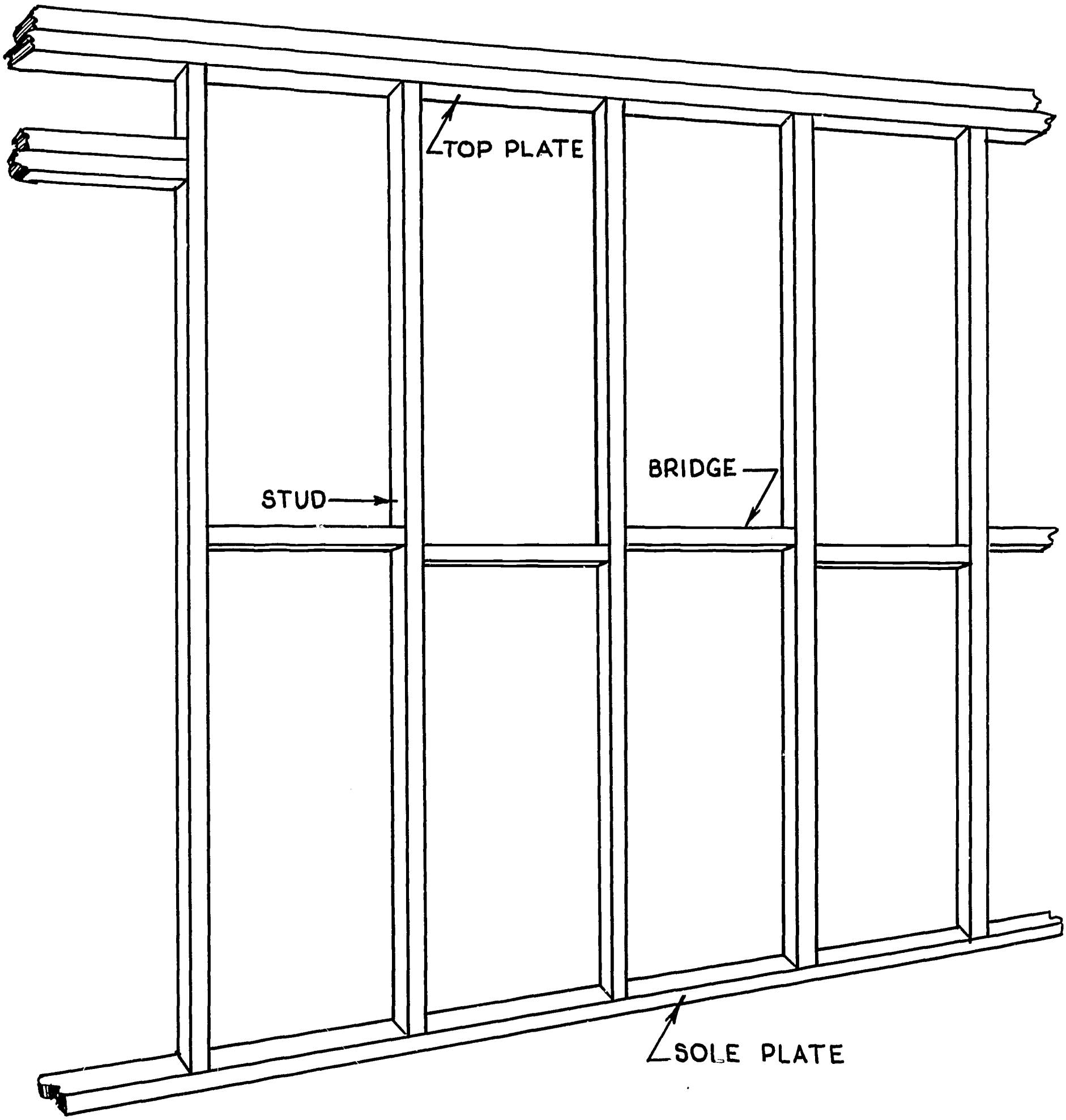


Fig. 7

4. Lay sole, plate, and studs in proper position for assembly.

5. Drive 10D nails through the plate and sole into studs. (Do not toe-nail.)

6. Check frame for squareness with a framing square.

7. Tack a brace diagonally across the studs to prevent shifting.

Outcomes:

1. Manipulative skills

   a. to use small hand tools

   b. to use framing square for layout of studs

   c. to use the ruler for measuring

2. Safety practices

   a. to keep hands away from the saw teeth when sawing

   b. to carry lumber with care

3. Academic learnings

   a. Mathematics

      (1) concept of length, width, and thickness

      (2) angle measurement

      (3) linear measurement

   b. Language arts

      (1) vocabulary

try square	framing
step ladder	sole
plate	stud
diagonally	

      (2) discussing reasons for using: diagonal brace, framing square, 10D nails, etc.

   c. Science:

      (1) fireproofing (siding, paints, etc.)

      (2) manufacture of plywood, fiberboard, etc.

Assignment:

Have pupils make a scale drawing in their workbooks of the frame for the wall panel they constructed in class.

Follow-Up:

Plan trip to a construction site to observe builders at work.

References:

1. Building Supply News, Industrial Publications, Inc., 4 South Wabash Ave., Chicago, Illinois.

2. Wood Frame House Construction, Anderson, L. O. and Heyer, O. C., U. S. Department of Agriculture, Washington, D. C., 1955.

Assembling Panels to Form a Building Unit

Materials, Tools, and Equipment:

1. Materials

   3/8" washers
   3/8" carriage bolts
   common nails (8D)

2. Tools

   6' rule
   3/8" auger bit
   brace
   smooth jaw wrench
   cross cut saw
   steel tape
   hammer
   spirit level
   square

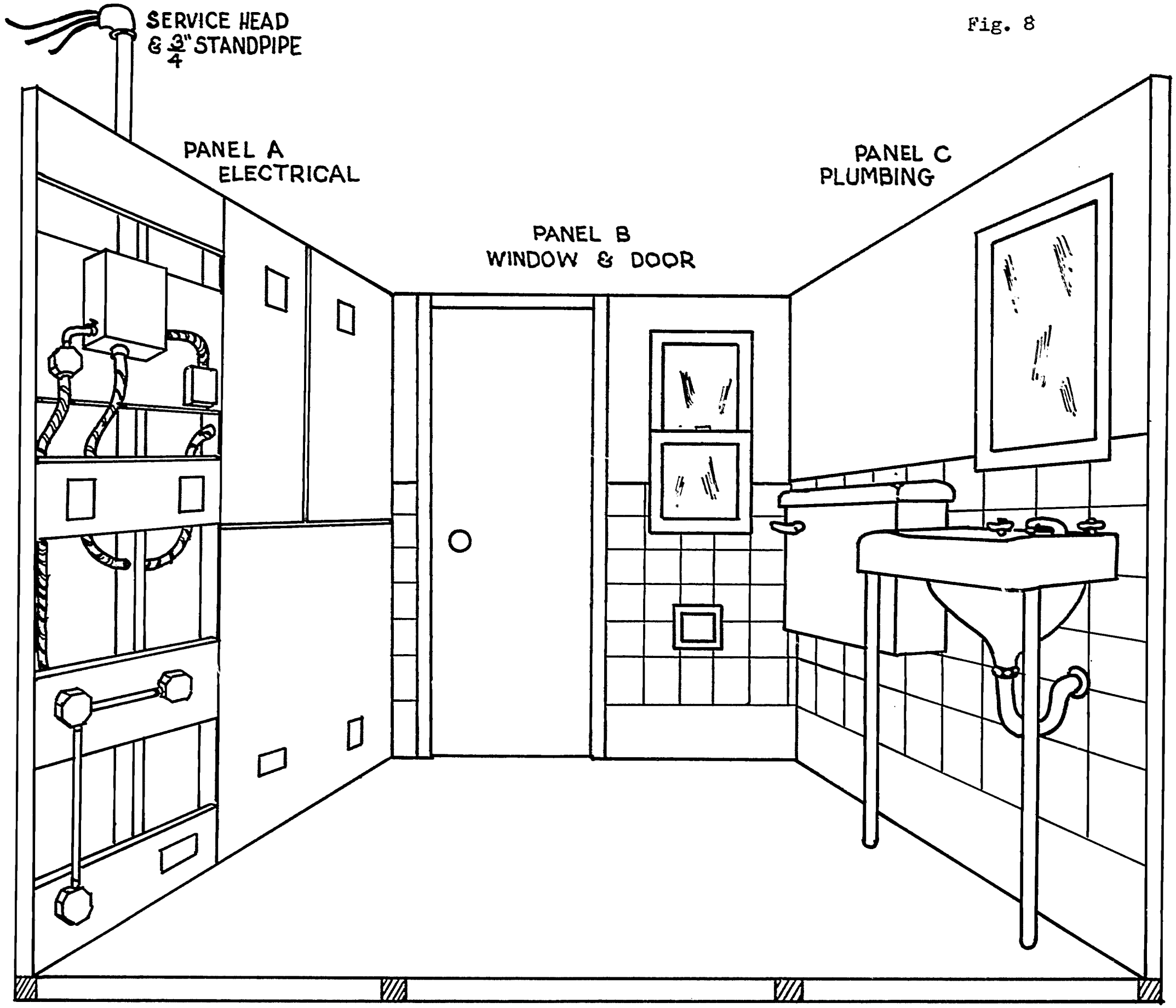
3. Equipment

   6' ladder

Visual Aids:

Wall chart (Fig. 8)

Fig. 8


SERVICE HEAD
& 3/4" STANDPIPE
PANEL A
ELECTRICAL
PANEL B
WINDOW & DOOR
PANEL C
PLUMBING

Procedure:

1. Prepare two more panels as the one prepared in previous lesson.

2. Assemble the three wall panels. (See Fig. 8)

3. Locate centers for drilling holes for carriage bolts.

4. Bolt panels together with 3/8" carriage bolts.

5. Lay out and install 2" X 6" ceiling joists to provide rigidity. (The ceiling joists also provide installation bases for electrical fixtures and ceiling tile.)

6. Use spirit level to align panels.

7. Use framing square to lay out ceiling joists.

Outcomes:

1. Manipulative skills

   (a) to use the spirit level for aligning panels

   (b) to use the framing square for laying out ceiling joists

   (c) to use the hammer to toe nail joists

   (d) to use temporary braces

   (e) to use the cross cut saw

   (f) to use the try square and framing square

2. Safety practices

   (a) to avoid injury when handling large wood panels

   (b) to avoid lifting heavy weights without help

   (c) to use temporary bracing when placing panels on the frame

3. Academic learnings

   (a) Mathematics

      (1) measuring to locate centers for bolts

      (2) measuring 16" centers for ceiling joists

b. Language arts

(1) vocabulary

rigidity
construction
alignment
claw hammer
nails

(2) discussion of safety practices related to lifting heavy weights

Assignment:

Have the pupils prepare an estimate of the cost of labor and materials involved in assembling the panels in the building unit.

Follow-Up:

Plan a trip to a local lumber yard to familiarize the pupils with building materials and their costs.

Reference:

American Builder, Simons Boardman Publishing Co., Emmett Street, Bristol, Connecticut.

Sheathing the Construction Panel

Materials and Tools:

1. Materials

   4' X 8' plywood panels
   6D common nails

2. Tools

   crosscut saw
   framing square
   folding ruler
   level
   hammer

Visual Aids:

Wall chart (Fig. 9)

Samples of various types of wall sheathing:

   #3, #4 common lumber
   various types of plywood
   fiberboard panel
   gypsum panel

Procedure:

1. Discuss with the class the four major types of wall sheathing: wood, plywood, fiberboard, gypsum board.

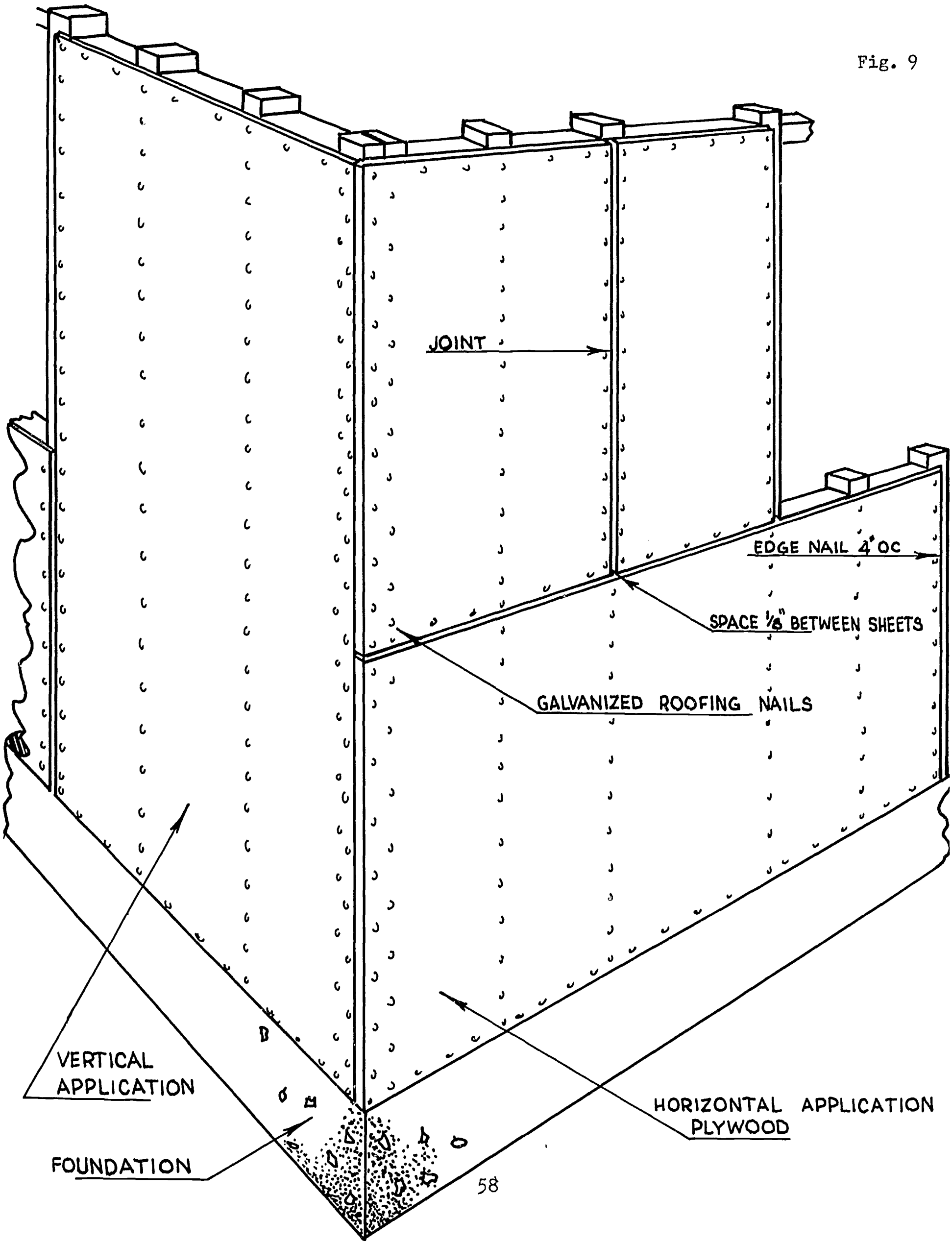
2. Select the type of wall covering the pupils wish to use. Note: In Fig. 9 plywood is used.

3. Lay out the panels to fit on the wall, around the window, and around the door.

4. Cut the panels to fit.

5. Have the pupils secure the panels to the wall framing to fit around the window and the door.

Fig. 9


JOINT
EDGE NAIL 4" OC
SPACE 1/8" BETWEEN SHEETS
GALVANIZED ROOFING NAILS
VERTICAL APPLICATION
HORIZONTAL APPLICATION PLYWOOD
FOUNDATION

Outcomes:

1. Manipulative skills
   a. to measure and lay out wall panels
   b. to cut wall panels
   c. to install wall panels
2. Safety practices
   a. to handle large wall panels with care
   b. to hold panels being nailed firmly in place
3. Academic learnings
   a. Mathematics
      (1) to use tools for measuring
      (2) to use squaring tools (right angle)
   b. Social studies
      (1) types of walls (fire prevention, sound proof)
      (2) choice of walls (locale, climate, needs, etc.)
      (3) importance of sound proof walls in city apartments (privacy)
   c. Science
      (1) manufacture of plywood, fiberboard, and gypsum board
      (2) fire-proofing (wall coverings, paint)

Follow-Up:

Have the pupils visit a local lumber yard to observe sheathing materials.

References:

1. Wood Frame House Construction, Anderson, L. I. and Heyer, O. C., U. S. Dept. of Agriculture, Washington, D. C. 1955.
2. Building Supply News, Industrial Publications, Inc., 4 South Wabash Ave., Chicago 3, Illinois.

Constructing the Electrical Panel

Materials and Tools:

1. Materials

   pine lumber (1" X 8" X 6')
   sheetrock (4' X 8' X 1/2")
   sheetrock nails

2. Tools

   claw hammer
   try square
   cross cut saw
   utility knife
   6' rule

Visual Aids:

Wall chart (Fig. 10)

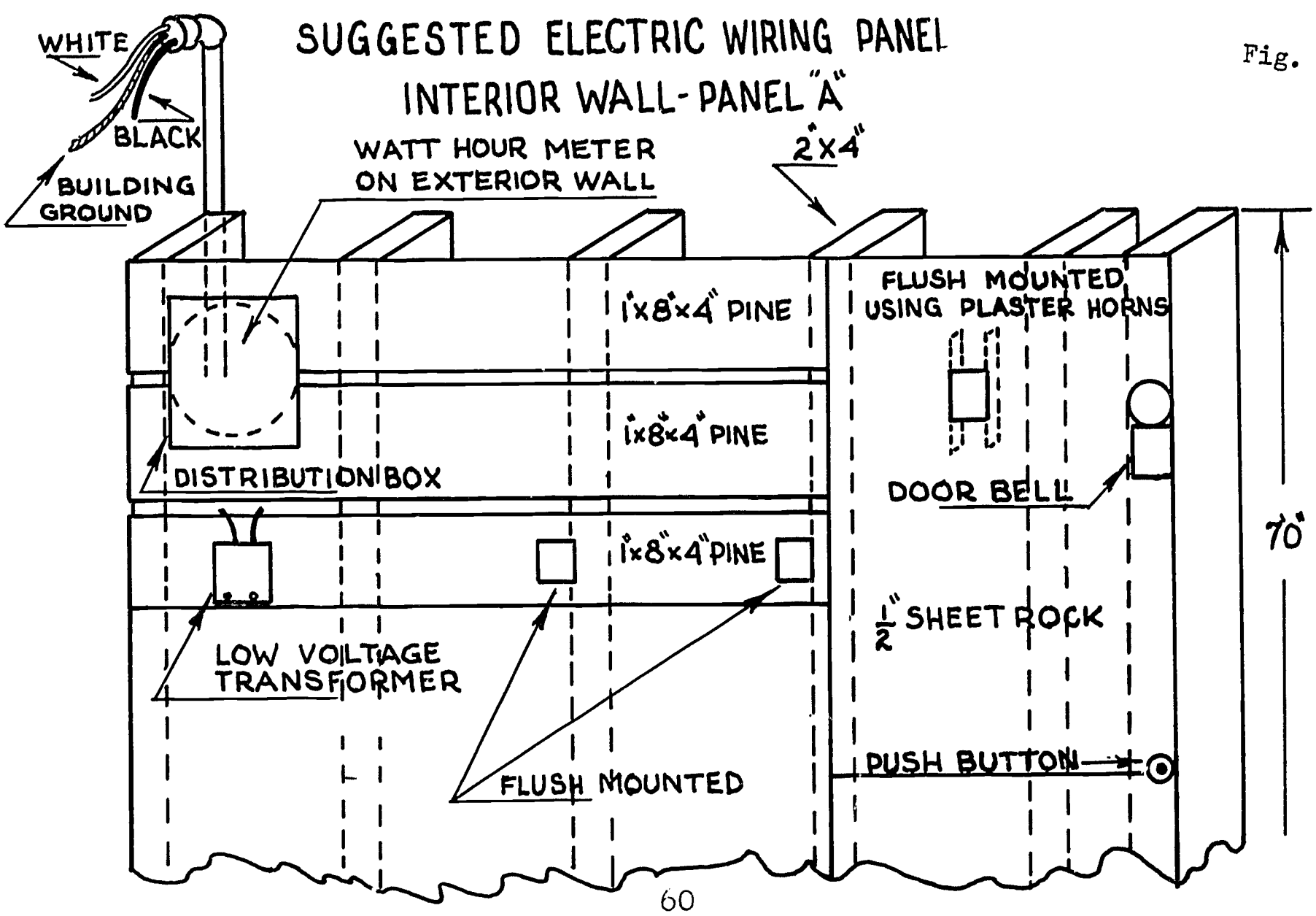


Fig. 10

Procedure:

1. Explain to the pupils that electrical boxes and fixtures are attached to various materials; that some are surface mounted and some are flush mounted.

2. Cut the 1" X 8" pine to 4' lengths. (4 pcs.)

3. Nail the 1" X 8" pine in position. (Fig. 10)

4. Cut the sheetrock to size. (2' X 7')

5. Nail sheetrock to studs. (Fig. 10)

   Note: This electrical panel may be used to provide the pupils with instruction on the installation of surface mounted switches, receptacles, transformers, and bells. (See Fig. 10)

Outcomes:

1. Manipulative skills
   a. to use the ruler
   b. to use hand tools
   c. to use the utility knife for cutting sheetrock
2. Safety practices
   a. to exercise care when using a utility knife
   b. to observe safety precautions when using hand tools
   c. to store tools in designated storage spaces
3. Academic learnings
   a. Language arts
      (1) vocabulary

          sheetrock
          utility
          variety
          electrical

      (2) making a bill of materials
   b. Mathematics
      (1) linear measurement
      (2) determining the cost of labor and materials

(3) keeping a time sheet

(4) drawing to scale

d. Science

(1) manufacture of sheetrock

(2) holding power of sheetrock nails

Assignment:

Have the pupils prepare a short report on "The Production of Sheetrock".

Installing an Electrical Service and Distribution System

Materials, Tools, and Equipment:

1. Materials

   1/2" thinwall conduit
   conduit straps
   #12 R. C. wire
   wood screw
   insulating tape
   solder

2. Tools

   folding ruler
   hack saw
   reamer
   brace and bit
   pliers
   screw driver
   gas torch

3. Equipment

   step ladder
   watt hour meter
   distribution box

Visual Aids:

Wall charts (Fig. 11, Fig. 12)

Watt hour meter

Distribution box

Procedure:

1. Ask the following questions:

   a. How is electricity conducted into our homes and distributed safely?

      (1) underground installation

      (2) overhead installation with wires on poles

   b. Why is electricity metered?

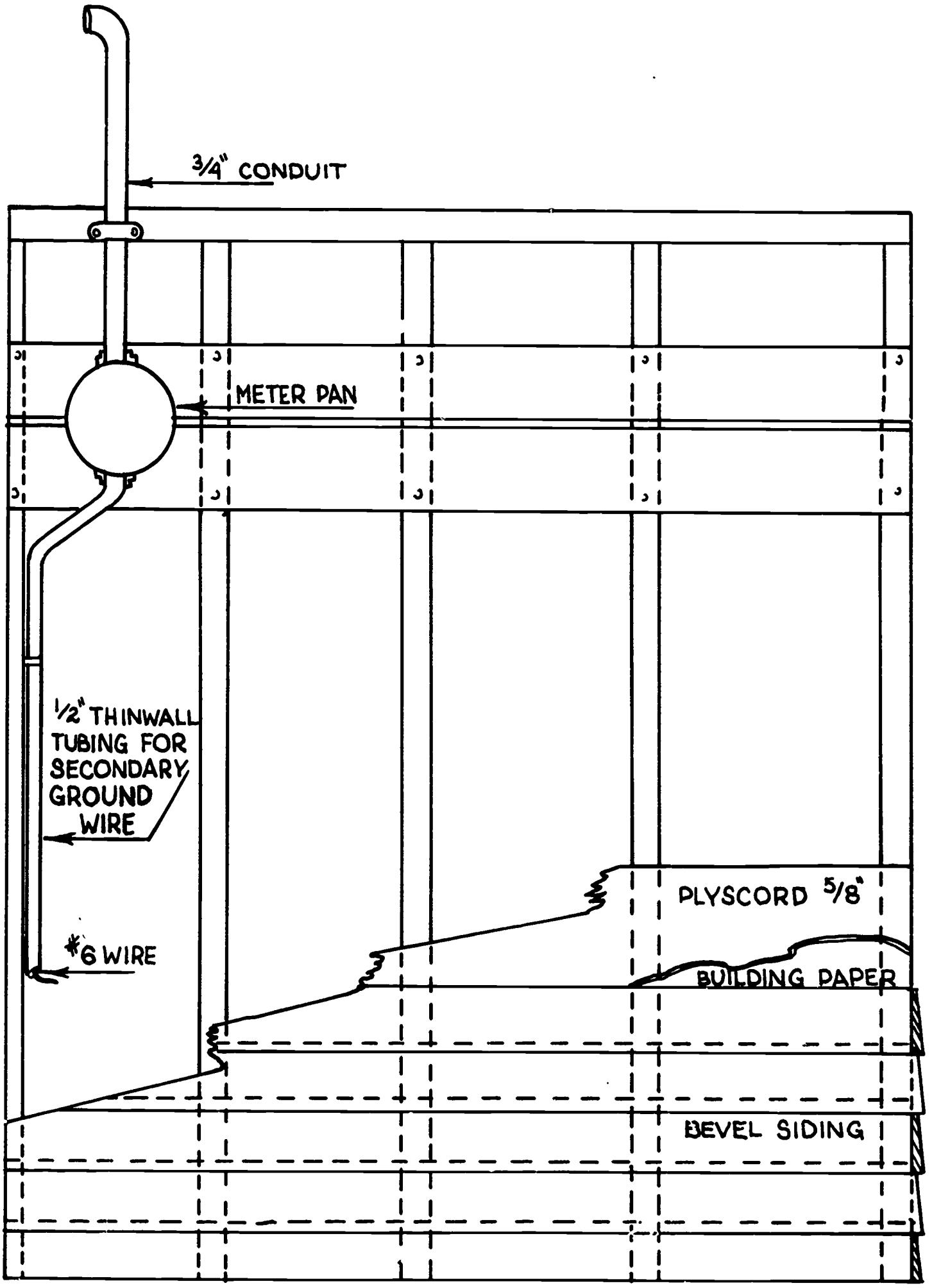

3/4" CONDUIT
METER PAN
1/2" THINWALL TUBING FOR SECONDARY GROUND WIRE
#6 WIRE
PLYSCORD 5/8"
BUILDING PAPER
BEVEL SIDING

Fig. 11

2. Are there laws regulating electric wiring?

3. Plan locations for meter and distribution box. (Figs. 11 and 12)

4. Install conduit from the source of supply to the meter and fasten with straps. (Fig. 11)

5. Mount the distribution box on inside wall. (Fig. 10)

6. Install a nipple, or conduit run, between the meter and the distribution box.

7. Connect wires. (Fig. 12)

8. Make circuit alive and test.

<u>Outcomes</u>:

1. Manipulative skills

   a. to measure

   b. to cut conduit to length

   c. to thread conduit

   d. to mount electrical equipment

   e. to install electrical fittings

   f. to read schematic diagrams

   g. to wire electrical equipment

   h. to use a stock and die

2. Safety practices

   a. to use the hack saw

   b. to use pipe wrenches

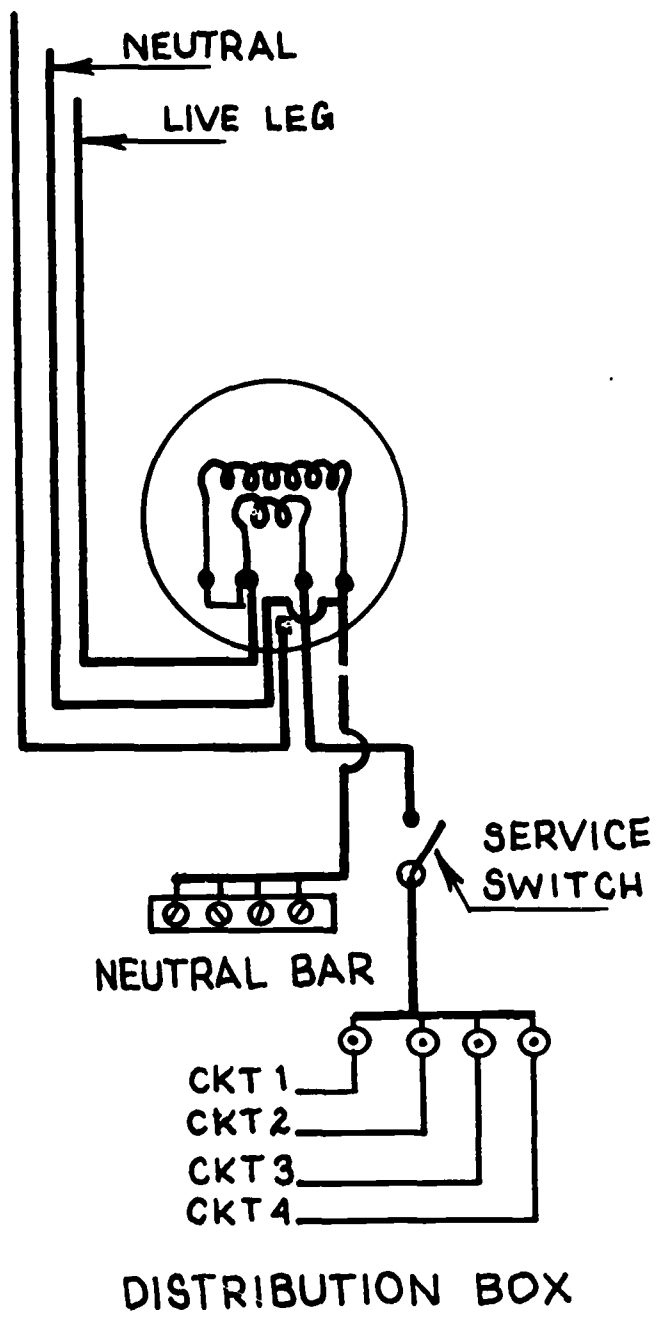


Fig. 12

c. to test a circuit

d. to use a gas torch

3. Academic learnings

a. Mathematics

(1) linear measurement

(2) calculations of electrical current ($I = \frac{W}{E}$)

(3) wire size calculations ($\frac{CM = K \times L \times I}{C}$)

(4) calculating cost of electrical installation

(5) calculating cost of electric power

b. Science

(1) generating and distributing electricity

(2) use of insulators and conductors of electricity

(3) Ohm's law

(4) electrical power

(5) protective devices (melting point of metals)

c. Language arts

(1) vocabulary

distributor	insulator	meter
conduit	conductor	watt hour
circuit	schematic	diagram

(2) reading a working drawing

(3) reading a schematic drawing

(4) locating electrical supplies and equipment in trade catalogs

(5) reading and learning Ordinance and Fire Underwriters' Code

e. Social studies

(1) the role of the utility company in the community

(a) generating electricity

(b) disposing of residue from oil and coal

(c) controlling air pollution

(d) developing atomic plant

(2) role of the Public Service Commission as a community agency

(a) rate fixing

(b) concern with labor and management problems

Assignment:

Have the pupils read the electric meter in their homes to calculate one month's bill.

References:

How to Read Electrical Blue Prints, Heine, Gilbert M., Dunlap, Carl H., Jones, C. S., American Technical Society, 848 East 58 Street, Chicago, Illinois.

Electrical Code, National Board of Fire Underwriters, John Street, New York, N. Y.

Practical Electrical Wiring, Richter, H. P., McGraw-Hill Book Company, 330 West 42 Street, New York, N. Y.

Installing a Door Bell or Chime

Materials, Tools, and Equipment:

1. Materials

   #18 annunciator wire
   staples (insulated)

2. Tools

   screw driver
   wire stripper
   hammer
   pliers
   cutting pliers
   flat wire gauge

3. Equipment

   transformer (6 volt for bells) (12-15 volt for chimes)

Visual Aids:

Chart (Fig. 13)

Transformers

Bells and buzzers

Procedure:

1. Locate a suitable position for a transformer and mount a 4" box. (This box is usually supplied with a transformer.)

2. Mount the bell (or chime) and the push button.

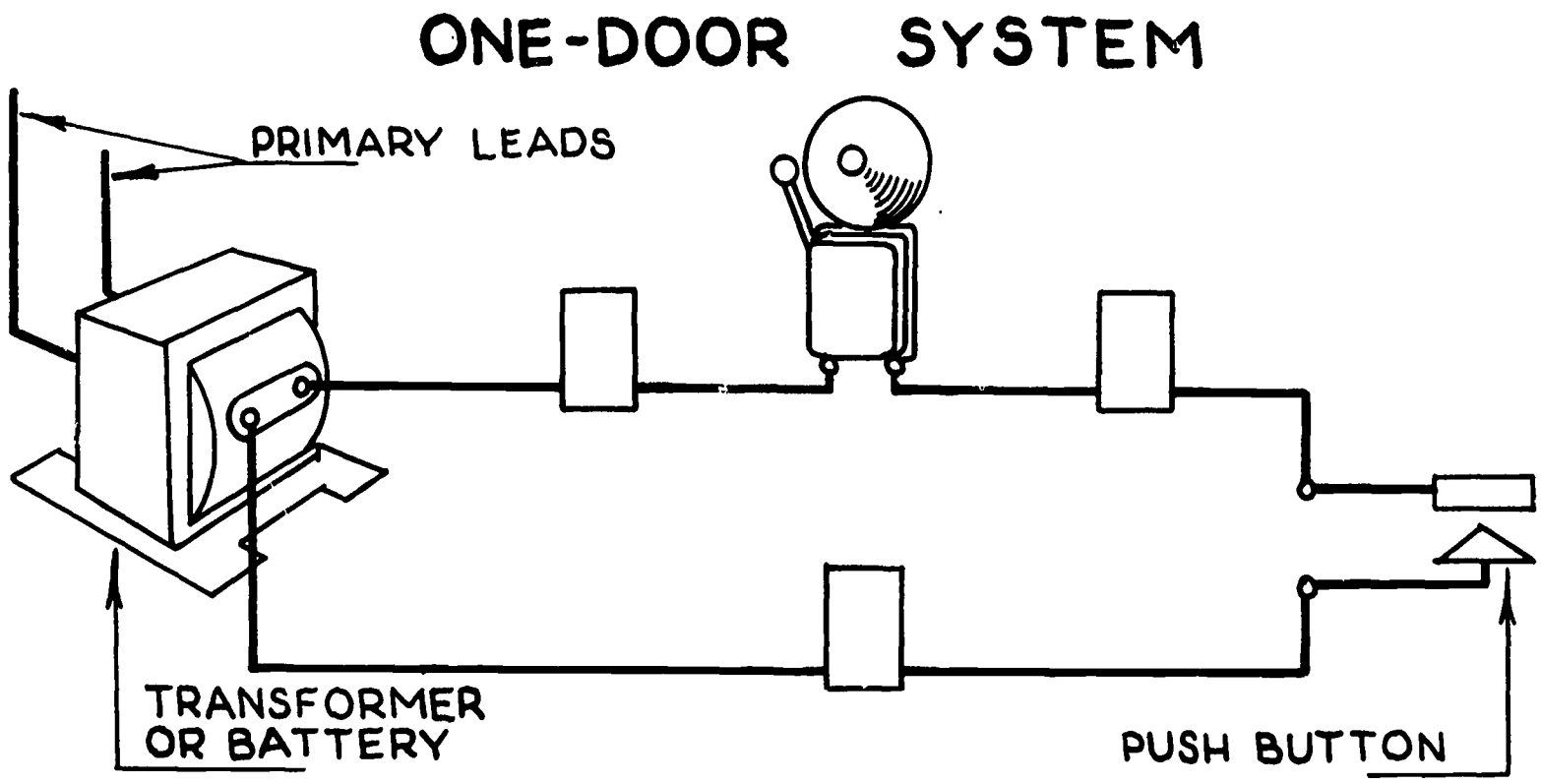


Fig. 13

3. Run the wire (#18) from low voltage side of the transformer to the bell and staple the wire in place.

4. Run the wire (#18) from the bell to the push button and staple the wire in place.

5. Run the wire (#18) from the push button to the low voltage side of the transformer.

6. Run the BX cable (#14) from the transformer box to the distributor box.

7. Connect the primary transformer wires to the BX cable.

8. Connect the BX leads at the distributor box to the ground and fuse the cut out terminal.

9. Check the wiring.

10. Insert the fuse.

11. List the system.

Outcomes:

1. Manipulative skills

   a. to strip wire

b. to secure wire to a terminal screw

c. to gauge wire

d. to attach the primary leads to the supply

2. Safety practices

a. to shut off the circuit when connections to it are being made

b. to handle the gas torch with care to avoid burns

3. Academic learnings

a. Language arts

(1) vocabulary

transformer	secure	chimes
primary	fuse	gauge
buzzer	strip	connections
		terminal

(2) reading labeled schematics

b. Mathematics

(1) measuring with a ruler

(2) application of Ohm's Law

(3) planning electrical installations economically

c. Science

(1) testing conductivity of various metals

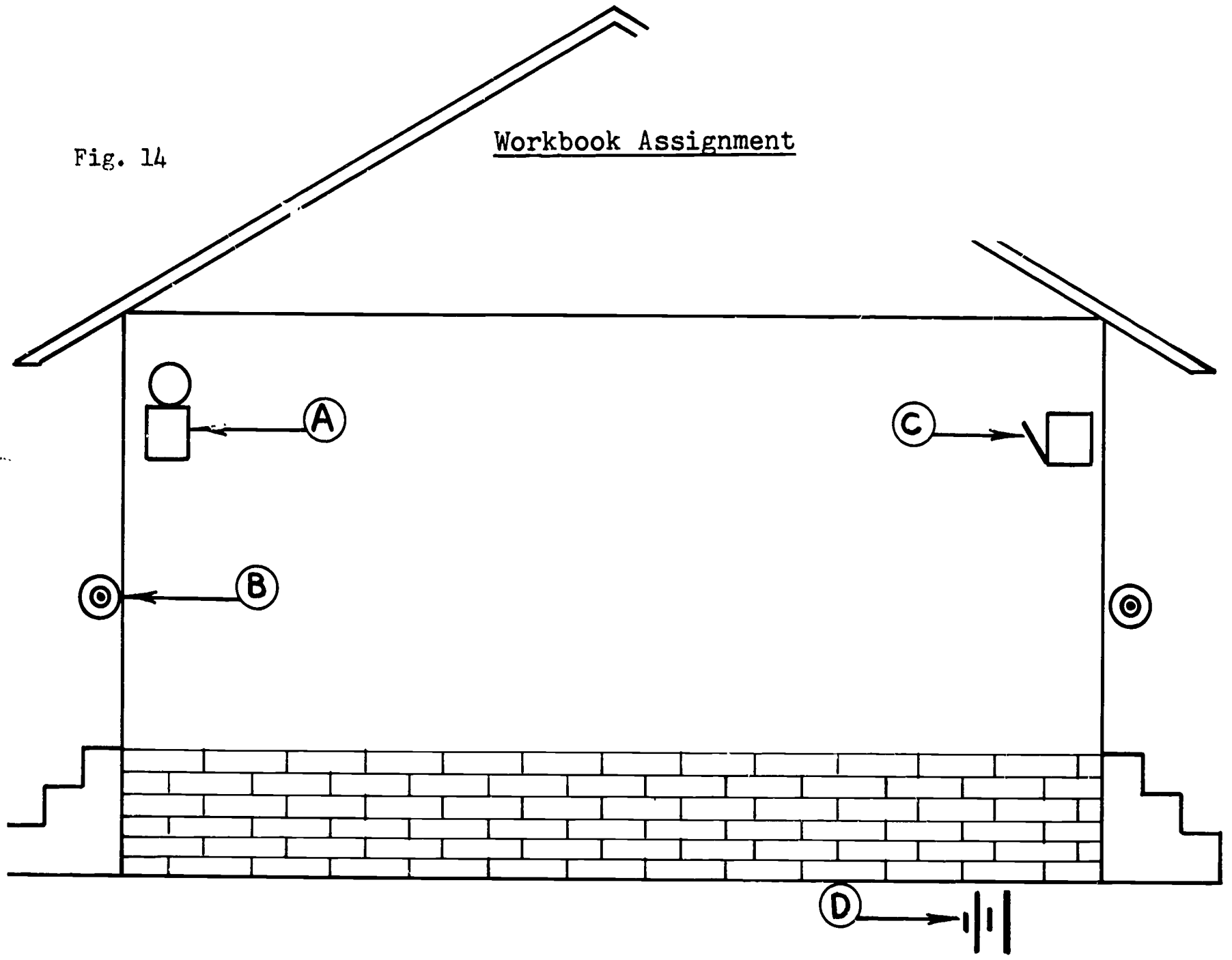
(2) operation of a transformer

Reference:

Practical Electrical Wiring, Richter, H. P., McGraw-Hill Book Company, 330 West 42 Street, New York, N. Y.

Fig. 14

Workbook Assignment



1. Label the following lettered parts in the diagram above:

   a_____, b_____, c_____,

   d_____.

2. Make a schematic diagram showing how to install a two door dignal system. Use a bell at one door and a buzzer at the other.

3. What is meant by the term "low potential"?

   _____

   _____

Installing a Ceiling Light Fixture Controlled by a Single Pole Switch

Materials, Tools, and Equipment:

1. Materials

   BX cable
   connectors
   gem box
   single pole switch
   light fixture
   screws
   wire nuts
   bushings

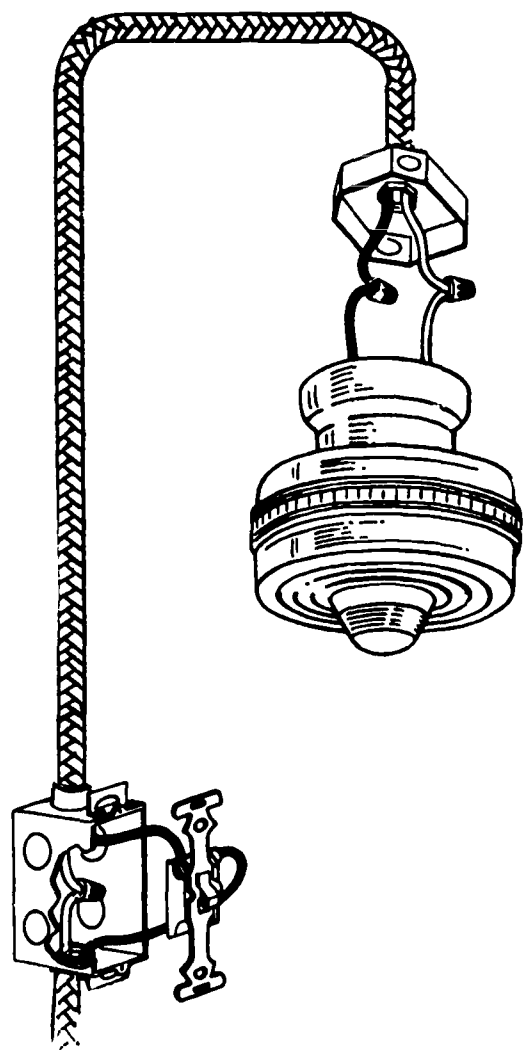
2. Tools

   brace and bit
   hammer
   hack saw
   screw driver
   pliers

3. Equipment

   6' step ladder

Fig. 15



Visual Aids:

Panel of switches, boxes and cables

Catalogs of electrical fixtures

Procedure:

1. Lay out the location of the switch box on the plaster or sheetrock wall and cut the opening. (Fig. 15)

2. Mount the 4" box on the ceiling. (Fig. 15)

3. Measure and cut the cable for the run from the distribution box to the switch. Allow for bends and 8" on each end for the connections.

4. Make diagonal cut on armored cable 8" from each end and remove the armor. (Fig. 16)

5. Insert a protective bushing (Fig. 17) and install the cable in the connector. (Fig. 18)

6. Fasten the connector to the box. (Fig. 19)

7. Repeat operations 3, 4, 5, 6 to run the cable from the switch box to the ceiling box.

8. Connect the neutral wires at the switch box using a wire nut. (Fig. 20)

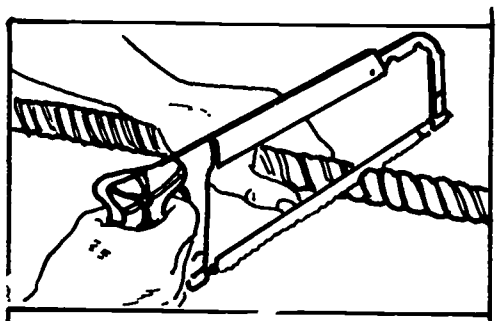
9. Connect and mount the switch. Install the switch plate.

10. Repeat operations 8 and 9 for installation of the fixture.

11. Connect the supply wires at the distributor box.

12. Inspect the job before making the circuit active.

Fig. 16



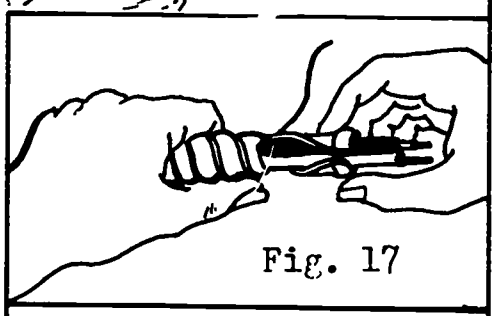


Fig. 17

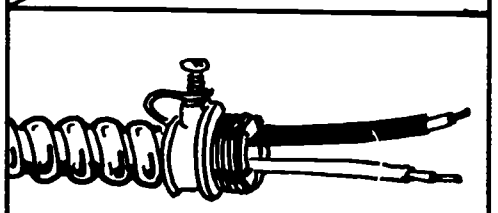


Fig. 18

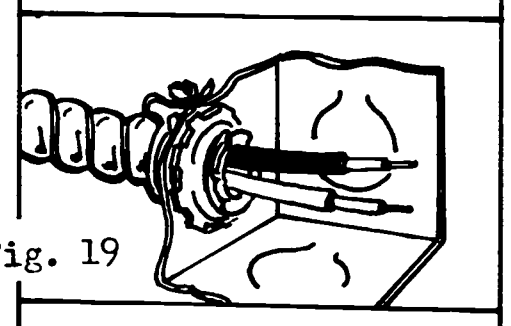


Fig. 19

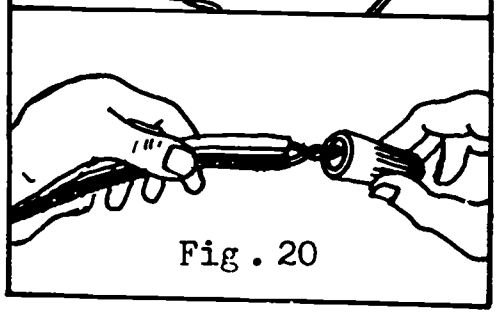


Fig. 20

Outcomes:

1. Manipulative skills

   a. to cut armored cable

   b. to splice wire

   c. to insert a fiber bushing

2. Safety practices

   a. follow the Electrical Code Rules when making an electrical installation

   b. to use a fiber bushing to prevent short circuits

3. Academic learnings

a. Language arts

(1) vocabulary

armored	fixture
inspect	active
neutral	bushing
insert	fiber

(2) reading a schematic diagram

(3) requisitioning of tools and materials on order blanks

(4) reading the electrical code for a specific installation

Assignment:

1. Have the pupils trace a current flow from the distribution box to the ceiling fixture and have them list all code regulations that apply to this installation.

2. Have the pupils give the steps they would take to install an outlet for an electric train set.

Reference:

Practical Electric Wiring, Richter, H. P., McGraw-Hill Book Company, 330 West 42 Street, New York, N. Y.

Controlling a Light from Two Locations

Materials and Tools:

1. Materials

   BX cable (2-wire, 3-wire)
   sectional switch boxes (Gem box)
   4" switch box
   two 3-way switches
   one lighting fixture
   wire nuts
   screws

2. Tools

   brace and bit
   hack saw
   screw driver
   pliers

Visual Aids:

Wall charts (Fig. 21, Fig. 22)

Procedure:

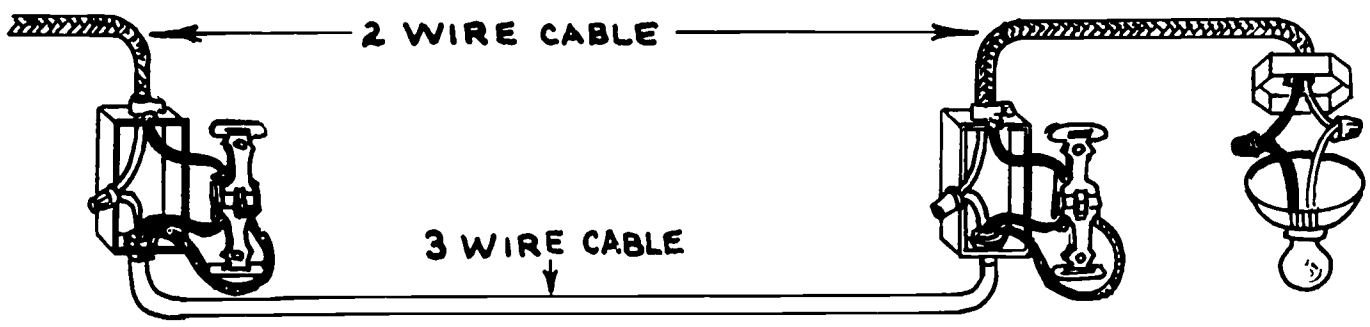
1. Position and install switch and fixture boxes on the electrical wall panel.

2. Run a 2-wire cable from the distribution box to the nearest switch box.

3. Run a 3-wire cable between the switch boxes.

4. Run a 2-wire cable from the fixture box to the second switch box.

Fig. 21



5. Fasten the switch boxes securely in place.

6. Fasten the cable securely to the boxes.

7. Insert the anti-short bushings.

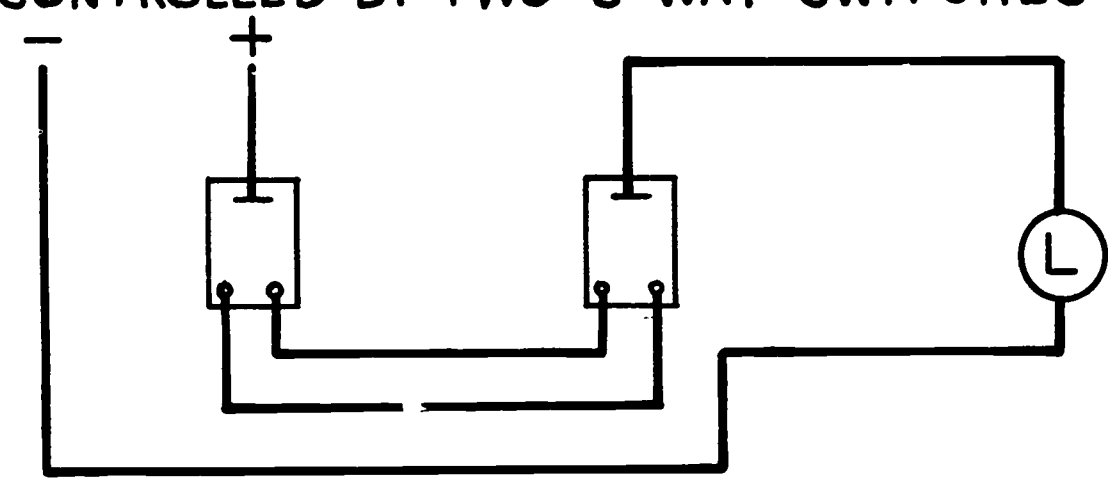
8. Connect the wires to the switches and fixture. (Fig. 21)

9. Connect the wires to the source of supply.

10. Install the switch plates.

Fig. 22

SCHEMATIC DIAGRAM OF ONE LIGHT CONTROLLED BY TWO 3-WAY SWITCHES



Outcomes:

1. Manipulative skills

   a. to cut and install cable

   b. to install switch boxes in sheetrock and/or on plaster walls

   c. to understand the operation of the 3-way switches

   d. to install electrical fixtures

2. Safety practices

   a. to avoid hammering on a screw driver

   b. to test for continuity and correct installation before turning on electric current

   c. to use a hack saw with care to avoid slipping

   d. to observe precautions in handling the jagged ends of BX cable

3. Academic learnings

a. Language arts

(1) vocabulary

continuity
cable
symbols
bushing

(2) reading blueprints

b. Mathematics

(1) linear measurement

(2) computing the cost of materials

(3) calculating electrical power ($W = E \times 1$)

c. Science

(1) use of conductors

(2) use of insulators

(3) electricity and how it is generated

d. Social studies

(1) composition of mica

(2) use of asbestos

(3) characteristics of copper

(4) production of copper

References:

Practical Electrical Wiring, Richter, H. P., McGraw-Hill Book Company, 330 West 42 Street, New York, N. Y.

National Electric Code, 85 John Street, New York, N. Y.

Workbook Assignment

Interview an electrical worker in the building industry and obtain the information below:

1. What is your name? _____
2. What is your employer's name? _____
3. Where are you working now? _____
4. What kind of work are you doing? _____
5. How many years of trade experience have you had? _____
6. What are your duties? _____
7. What tools do you use? _____
8. What are your hours of employment? _____
9. Do you belong to a union? _____
10. Are opportunities for employment in your trade good? _____
11. Are there opportunities for advancement? _____
12. What advice can you give to someone who is preparing to enter your field of work?

_____

_____

_____

_____

Constructing the Window and Door Panel

Materials and Tools:

1. Materials

   2 X 4's
   2 X 6's
   10D common nails
   8D common nails
   3/8" stock (for spacer between header)

2. Tools

   claw hammer
   6' rule
   try square
   framing square
   crosscut saw

Visual Aids:

Wall chart (Fig. 23)

Procedure:

1. Cut the header stock (2 X 6) to the required length. (Fig. 23) (1-5/8" plus 1-5/8" for jack studs and 1" plus 1" for door jambs, plus width of the door)

   Note: The location of the studs on the panel will be determined by the size of the window and the size of the door to be used. In Fig. 23 the door is 2'0 X 6'8", and the window is 2'0 X 3'0.

2. Cut the jack stud to the proper length. (Length of door plus 1/2" clearance plus 1" for header jamb)

3. Cut the common stud to the required length. (over-all length)

4. Insert the 3/8" lath between the 2" X 6" header stock and nail the pieces together. (This will maintain the width of a 2" X 4")

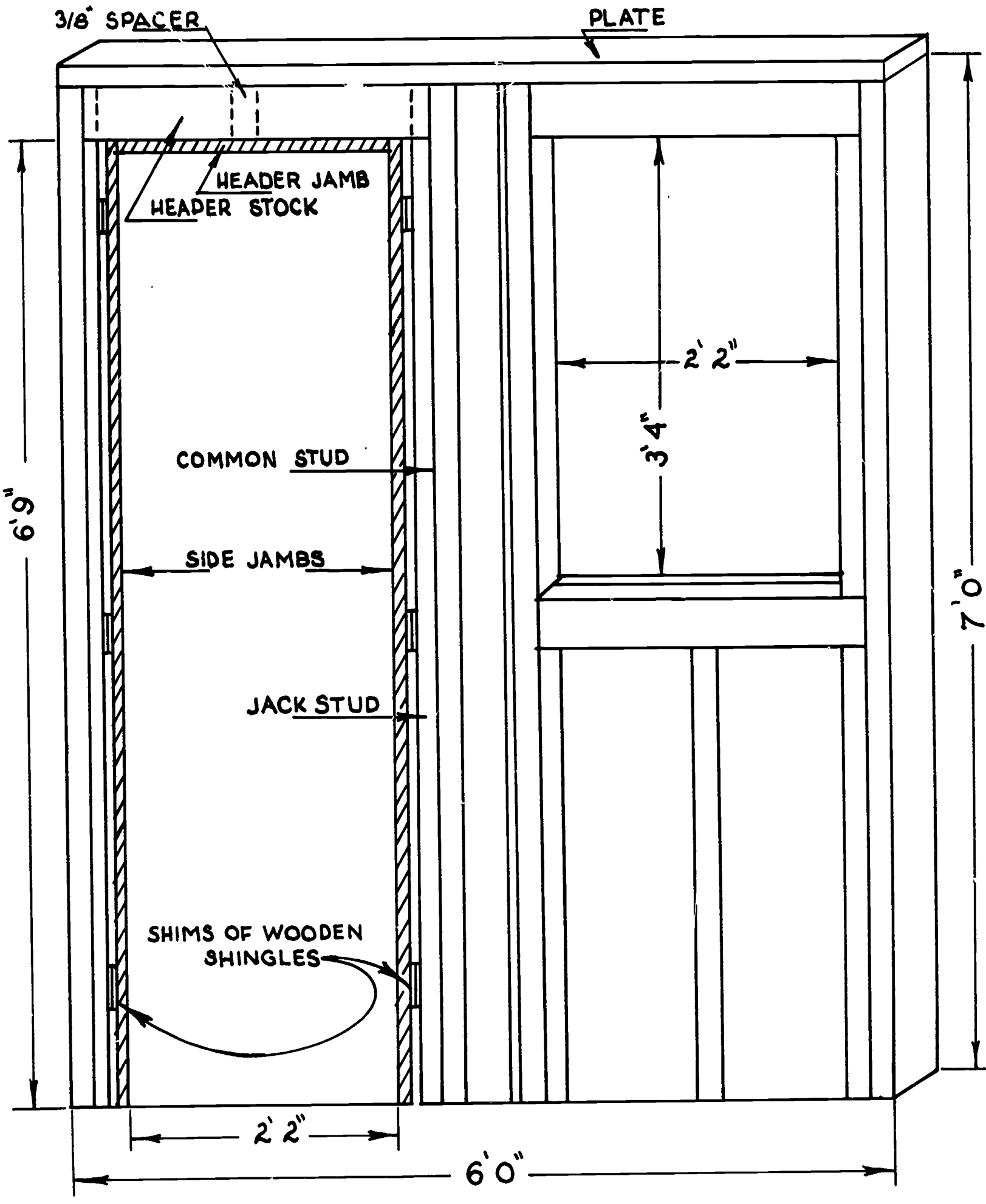
5. Nail the common studs to the plate. (Fig. 23)

6. Install the header between the common studs. (Fig. 23)

7. Install the jack studs under the header. (Fig. 23)

PANEL FOR SETTING WINDOWS & HANGING DOORS

Fig. 23



Outcomes:

1. Manipulative skills
   a. to use the ruler for measuring
   b. to use the crosscut saw
   c. to use the square
2. Safety practices

   To use hand tools and construction materials with care
3. Academic learnings
   a. Language arts
      (1) vocabulary

         header
         studs
         spacer
         jack stud

      (2) making a bill of materials

      (3) submitting estimates and awarding contracts

   b. Mathematics
      (1) linear measurement

      (2) board foot measurement

      (3) drawing to scale

      (4) making a working drawing

Follow-Up:

Have the pupils locate the building code regulations regarding the spacing and installation of studs with the use of books provided in the shop library.

References:

Practical Builder, Cahners Publishing Co., Inc., 5 South Wabash Ave., Chicago, Illinois.

American Builder, Simons-Boardman Publishing Corp., Emmett St., Bristol, Conn.

Framing, Sheathing and Insulation, Delmar Publishers, Inc., Albany, N. Y.

Installing a Door

Materials and Tools:

1. Materials

   a door (2'0 X 6'8")
   1 set of door jambs
   1 set of door stop molding
   1 lock set
   1 pair 3 1/2" loose pin butt hinges
   1 set of casing molding
   shims (2 pieces of wooden shingles)
   8D finishing nails
   "spacer stock" (a piece of 1 X 2 stock)

2. Tools

claw hammer	crosscut saw	screw driver
1" chisel	spirit level	3 1/2" butt gauge
miter box	hand drill	nail set

Visual Aids:

Wall chart (Fig. 23)

Charts showing various types of doors. (Local lumber companies and hardware supply houses will supply these.)

Procedure:

1. Assemble the side and header jambs. (Fig. 23)

2. Set the unit in the rough opening and tack into place using shims to insure that jamb is plumb. (Fig. 23)

3. Square the header jamb and the first side jamb. Shim the header jamb and tack the first side jamb and the header jamb in place.

4. Use a "spacer stock" (2'0 X 1/8") to provide uniform width of the jambs. Shim the second side jamb and tack it in place.

5. Check the jambs for plumb and squareness and nail in place.

6. Determine upper and lower hinge location. Shim behind the jamb at these locations to provide rigidity in the jamb when installing the hinges.

7. Cut the gains in the jamb to receive the 3 1/2" butt hinges.

8. Cut corresponding gains in the door.

9. Install the hinges in the jamb and door gains using the screws provided.

10. Place the door in position and insert the pins.

11. Install the lock set at a height 36" from the floor. Since there is a great variety of door locks, it is suggested that the detailed instructions packaged with the merchandise be followed carefully.

12. Install the stop molding. (Fig. 23) (Usually a shim or spacer the thickness of a match box cover is sufficient to provide clearance between the door and the stop.)

13. Install suitable trim molding.

<u>Outcomes</u>:

1. Manipulative skills

   a. to use shims

   b. to use a spirit level

   c. to use a "spacer stick"

   d. to install a lock set

2. Safety practices

   a. to carry sharp edged tools with care

   b. to get help when handling heavy and large objects

3. Academic learnings

   a. Language arts

      (1) vocabulary

         gain
         lock
         jambs
         hinge
         molding

      (2) reading instructions on a door lock directions sheet

b. Mathematics

(1) measuring to determine width and length of jambs

(2) measuring to determine locations of hinges and lock set

(3) computing cost of the job (labor and materials)

c. Science

(1) gravity and the spirit level

(2) stress (bearing points)

References:

Wood Frame House Construction, Anderson, L. O. and Heyer, O. C., U. S. Dept. of Agriculture, Washington, D. C. 1955.

Audel's Carpenters' and Builders' Guide, Graham, F. O. and Emery, L. J., Theodore Audel and Co., New York, N. Y. 1963.

Installing a Window

Materials and Tools:

1. Materials

   window unit (2'0 X 3'2")
   strips of building paper (to cover three sides of the window opening)
   8D common nails
   shims (wood shingles)

2. Tools

   claw hammer
   spirit level
   6' rule
   framing square

Visual Aids:

Wall charts (Fig. 24, Fig. 25, Fig. 26)

Procedure:

1. Cover the top and two sides of the rough opening for the window with building paper.

2. Staple the building paper in place.

3. Place the window unit into position.

4. Level the window unit at the sill with the spirit level and tack the unit in place. (Fig. 24)

5. Square the frame with the framing square, or use diagonal measurements. (Fig. 26)

6. Insert the shims between the stud and the frame and recheck the diagonal measurements. (Fig. 25)

7. Fasten the window unit securely into place by nailing through the shims and through the exterior trim.

Outcomes:

1. Manipulative skills

   a. to determine squareness (diagonal measurements)

   b. to use shims

Fig. 24

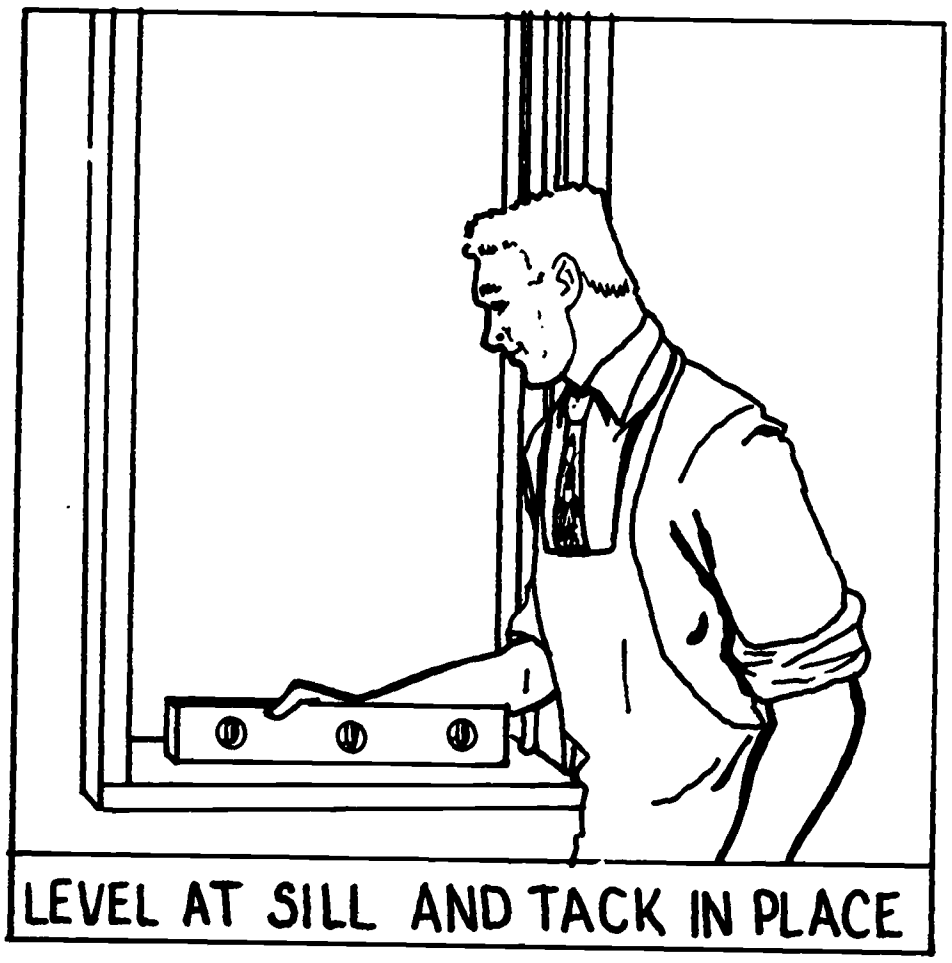
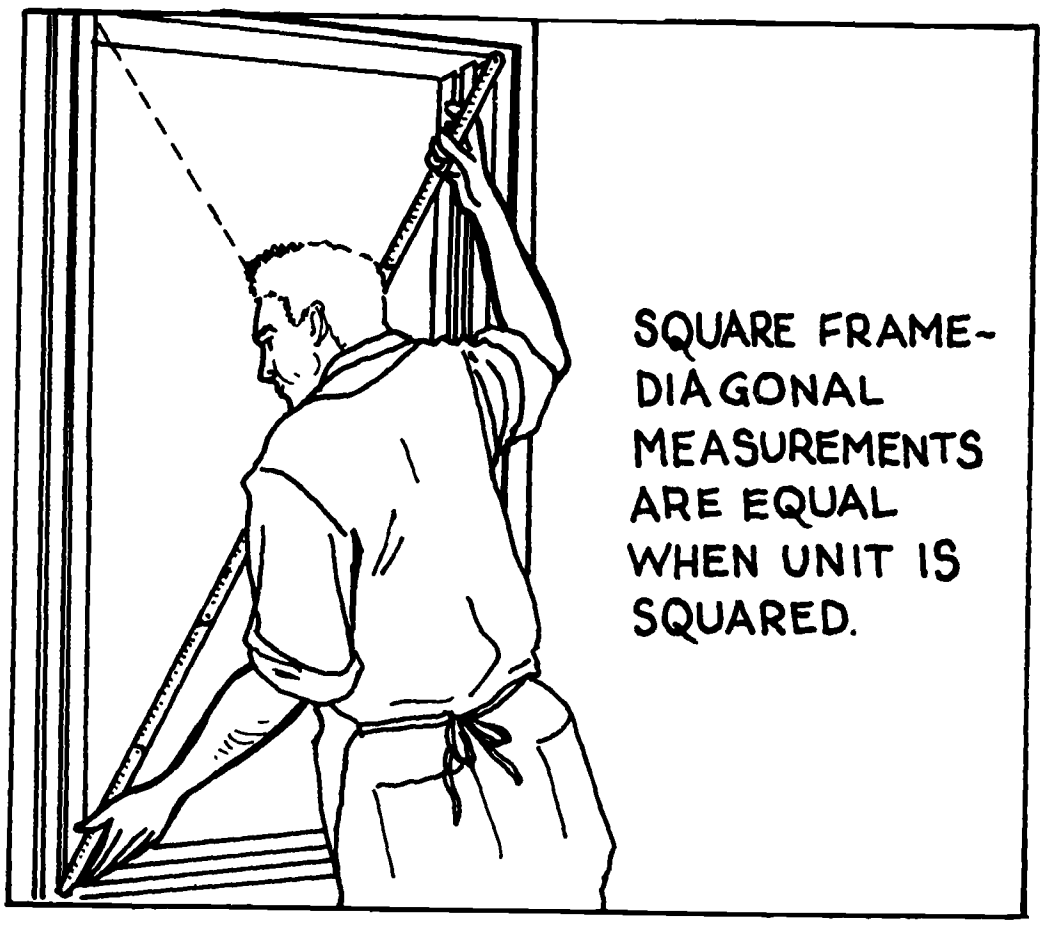


Fig. 25

Fig. 26



c. to use the spirit level

d. to use the staple gun

2. Safety practices

a. to use hand tools with care

b. to avoid breaking the glass when working with a window sash

3. Academic learnings

a. Language arts

(1) vocabulary

shims
diagonal
shingles

(2) following verbal instructions

(3) understanding written instructions on wall charts

(4) preparing a bill of materials

b. Mathematics

(1) linear measurement

(2) practice in estimating the cost of a job

(3) adjusting for squareness (diagonal measurements)

Follow-Up:

Have the pupils discuss why building paper has been placed between the exterior sheathing and the window trim.

References:

Light Frame House Construction, National Committee on Wood Utilization, U. S. Department of Health, Education and Welfare, Washington, D. C. 1956.

Agriculture Handbook #73, United States Dept. of Agriculture, Forest Service, Washington, D. C. 1955.

Interior and Exterior Trim, Delmar Publishers, Inc., Albany, N. Y.

ERIC

Constructing the Plumbing Panel

Materials and Tools:

1. Materials

   1" X 8" pine
   8D common nails
   1 1/4" #10 F.H. bright screws
   1/2" sheetrock

2. Tools

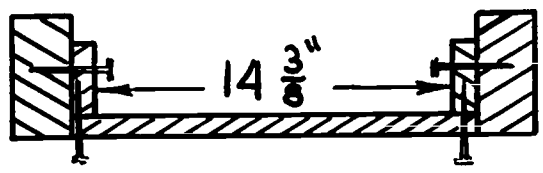
   ruler
   square
   hammer
   utility knife
   straight edge
   crosscut saw

Visual Aids:

Wall charts (Fig. 27, Fig. 28)

Procedure:

Fig. 27



1. Cut the 1" X 8" pine (the nailer) to fit snugly between the studs. (Fig. 27)

2. Install the nailer for the lavatory at approximately 32" on center above the finished floor. (Fig. 28)

3. Follow the above procedure for mounting the flush tank.

4. The nailer for the shower head is installed at approximately 6'6" from the floor.

5. Nailers for bathroom accessories, e.g. soap dish, glass holder, etc., are installed as desired.

6. If a medicine cabinet is to be installed, suitable framing should be provided.

SUGGESTED PLUMBING PANEL WALL C– *INTERIOR*

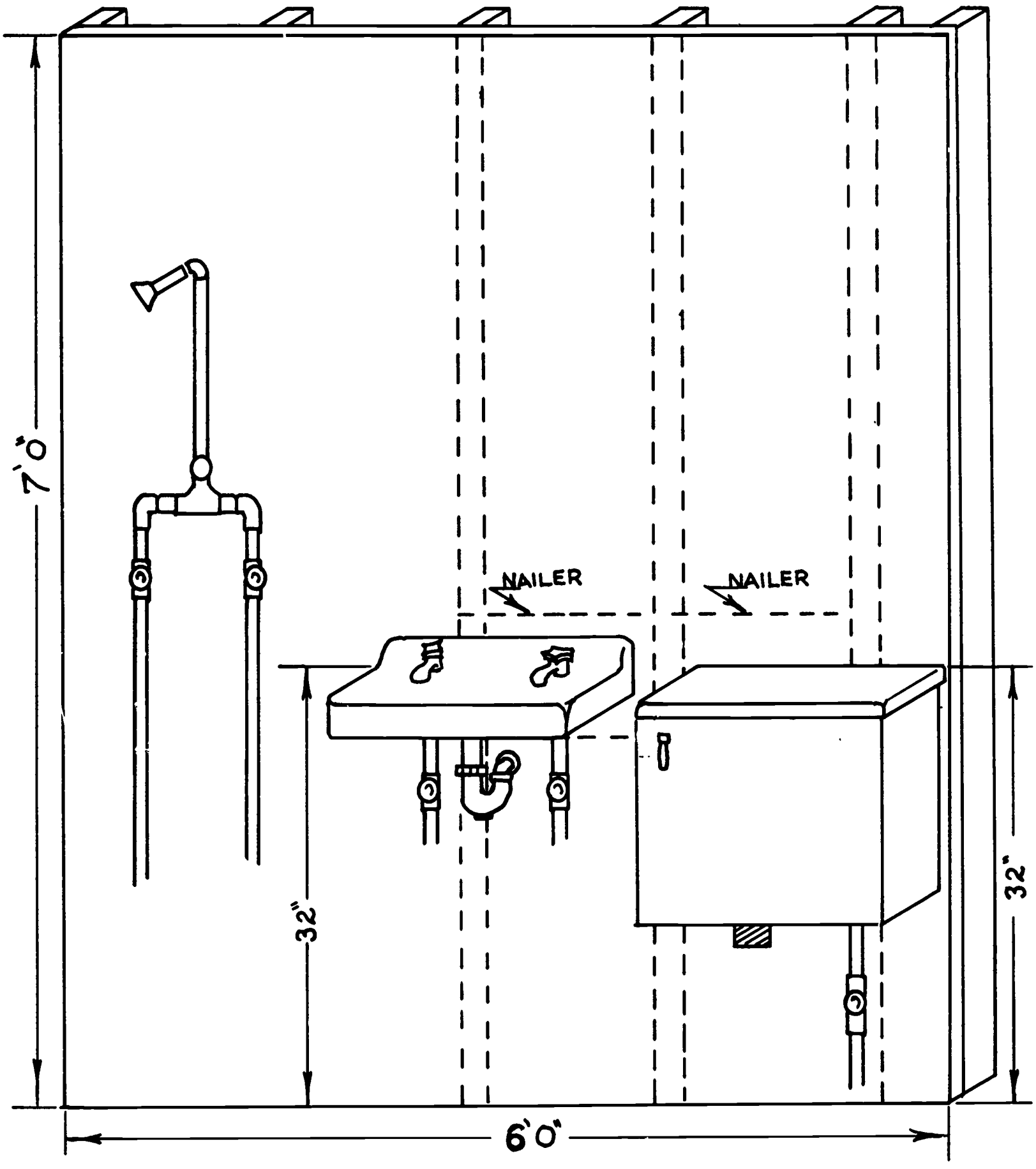


Fig. 28

7. Cover the plumbing panel with sheetrock.

8. Cut opening in sheetrock to allow for installation of the medicine cabinet.

Outcomes:

1. Manipulative skills

   a. to use the ruler for measuring

   b. to use the square

   c. to use the crosscut saw

   d. to use the spirit level

   e. to use a straight edge and a utility knife for cutting sheetrock

2. Safety practices

   a. to put tools in their proper places when not in use

   b. to observe safety precautions when using handtools

3. Academic learnings

   a. Language arts

      (1) vocabulary

         nailer
         snugly
         fixture
         on-center

      (2) making a bill of materials

   b. Mathematics

      (1) linear measurement

      (2) making a working drawing

      (3) drawing to scale

Follow-Up:

Discuss:

1. Why nailers are necessary.

2. Factors which determine the size and location of nailers.

Reference:

Audel's Carpenters' and Builders' Guide, Graham, F. D. and Emery, T. J., Theodore Audel and Co., Publishers, New York, N. Y. 1963.

Installing a Lavatory

Materials and Tools:

1. Materials

   lavatory
   water faucets
   mounting brackets
   1 1/2" F. H. #12 screws
   two 1/2" valves
   two 1/2" couplings
   two 6" nipples

2. Tools

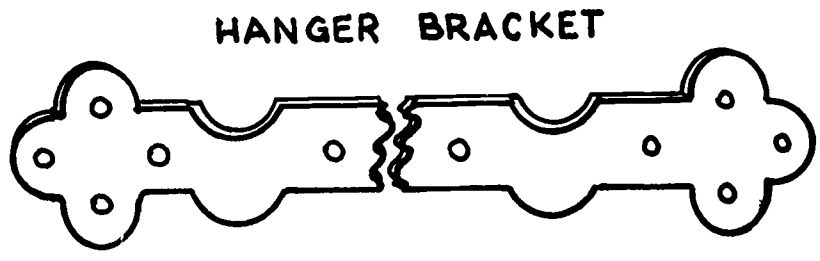
   screw driver
   claw hammer
   6' rule
   spirit level
   basin wrench
   smooth jaw wrench

Visual Aids:

Wall charts (Fig. 29, Fig. 30)

Plumbing charts from local supply houses showing various types of mounting brackets

Fig. 29



Procedure:

1. Install the sink hanger bracket 32" from the finished floor of the plumbing panel to accommodate the lugs on the rear of the sink with 1 1/2" #12 F. H. screws. (Fig. 29)

   Note: A "nailer" has been installed in the plumbing panel at a height 32" from the floor. (Fig. 27)

2. Use the spirit level to insure level installation.

3. Install the sink by sliding the sink lugs into the mounting bracket. (Fig. 30)

4. Connect the hot and cold water faucets to the sink using appropriate washers and lock nuts.

   Note: The hot water faucet is mounted to the left side.

5. Connect the two 6" nipples to the hot and cold water faucets. (Use the two couplings and the water valves.) (Fig. 30)

   Note: If the 6" nipples are plated, use a smooth jaw wrench to avoid damage to the finish.

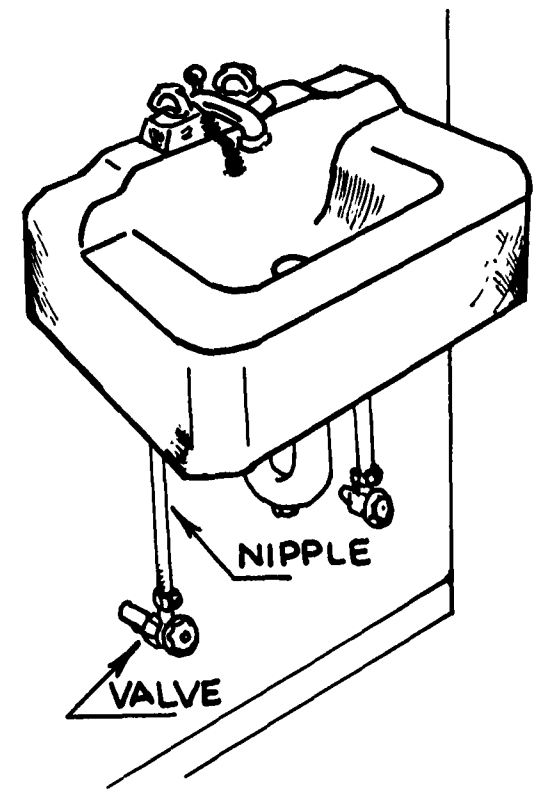


Fig. 30

Outcomes:

1. Manipulative skills

   a. to use the spirit level

   b. to use a pipe wrench

   c. to use a basin wrench

   d. to use a smooth jaw wrench

2. Safety practices

   a. to request aid when lifting lavatory

   b. to insure proper grip when using a wrench

3. Academic learnings

   a. Language arts

      (1) vocabulary

         wrench
         basin

(1) vocabulary - continued

lavatory
faucet
plated

(2) making a bill of materials

b. Mathematics

(1) finding costs of materials

(2) estimating time and materials

(3) submitting a bid

Follow-Up:

Have pupils bring in samples of toggle bolts, molly screws, lead shields, and fibre plugs.

Reference:

Audel's Carpenters' and Builders' Guide, Graham, F. D. and Emery, T. J., Theodore Audel and Co., Publishers, New York, N.Y. 1963.

Installing a Flush Tank and Water Lines

Materials and Tools:

1. Materials

   flush tank
   2" #12 R. H. wood screws
   two large, flat, steel washers
   1/2" pipe
   1/2" valve
   joint compound

2. Tools

   6' rule
   spirit level
   screw driver
   pipe wrench - 14"

Visual Aids:

Wall charts (Fig. 31, Fig. 32)

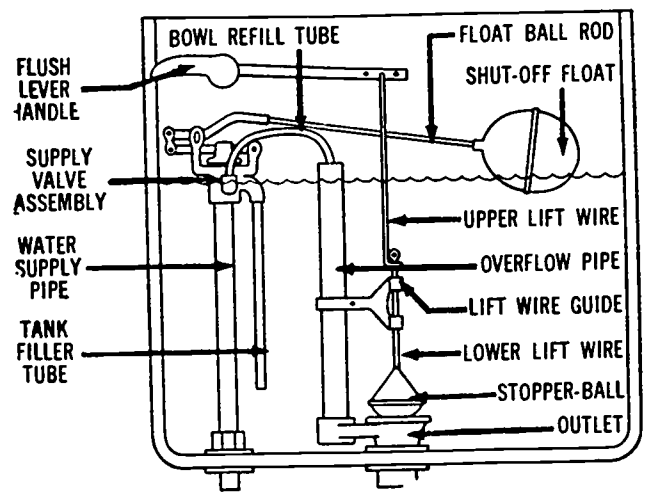


Fig. 31

Procedure:

1. Measure a distance 30" from the floor of the plumbing panel and mark with a pencil.

   Note: A "nailer" has been installed in the plumbing panel. (Fig. 28)

2. After determining where the toilet will be set, center the flush tank directly behind it with the top of the tank at the 30" height.

3. Use the spirit level to insure that the flush tank is level.

4. Fasten the tank securely to the nailer with the 2" screws and the large flat washers.

5. Cut and thread the necessary length of 1/2" pipe to supply water to the flush tank. Insert a 1/2" valve in the line to provide a convenient means of shutting off the water lines in the event that repairs to the tank become necessary. (Fig. 32)

6. Connect the 1/2" pipe to the nipple of the flush tank with a coupling. (Fig. 32)

Outcomes:

1. Manipulative skills

   a. to use a spirit level to install the tank

   b. to cut pipe

   c. to thread pipe

   d. to use pipe wrenches

   e. to use smooth jaw wrenches

   f. to cut tubing

   g. to use a reamer

2. Safety practices

   a. to avoid sharp edges of pipe threads and burrs

   b. to avoid burns from a gas torch

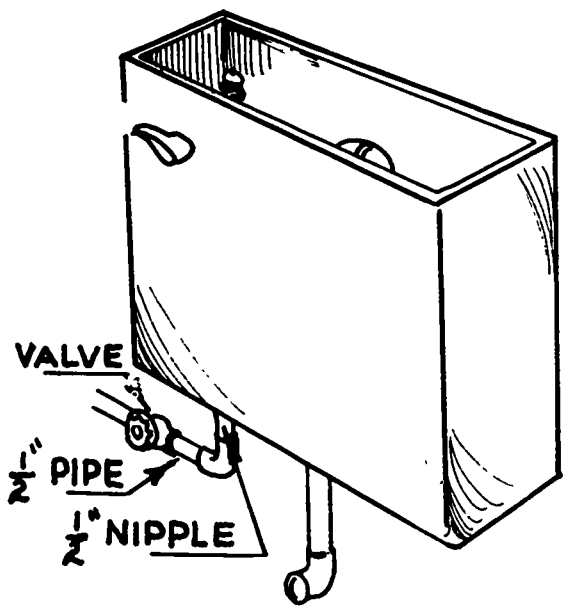


Fig. 32

c. to hold a pipe securely in the vise

d. to maintain the work area clear of unnecessary tools and materials

3. Academic learnings

a. Language arts

(1) vocabulary

contractor
competitive
flush tank
valve
repairs

(2) reading catalogues to find cost of materials used

b. Mathematics

(1) estimating cost of installation jobs

(2) centering an object

c. Science

(1) gravity

(2) balance (spirit level)

Follow-Up:

Discuss the reason for venting waste water pipes.

Reference:

Plumbing Repairs Made Simple, Popular Mechanics Press, Chicago, Illinois, 1954.

Power Mechanics

ERIC

How to Repair a Bicycle Fender

Materials, Tools, and Equipment:

Materials

body solder	emery cloth #00
steel wool	spray paint
paste wax	masking tape
8/32 nuts	8/32 X 1/2" machine screws
#8 flat washers	#8 lock washers
rags	

Tools

box end wrench set	4" screw driver
6" slip joint pliers	fibre mallet
half round file, smooth	half round file (2nd cut)
sand bag	putty knife
#10 twist drill	raising hammer
ball peen hammer	planishing hammer

Equipment

machinist's vise	stake plate
round head stake	1/4" cap. electric drill

Visual Aids:

Wall chart showing forming of metal on a sand bag

Sample of repaired bicycle fender

Procedure:

1. Demonstrate the following operations:

   a. Remove wheel from bicycle.

   b. Inspect bicycle fender to determine extent of damage.

   c. Remove fender from frame of bicycle by detaching fender mounting screw where it is threaded into the bicycle frame fork.

   d. Locate dents and punctures on fender.

   e. Hammer out dents with a raising hammer, a planishing hammer, a ball peen hammer and a fibre mallet (on a sand bag or a round head stake).

f. Remove dirt and paint from the damaged fender with emery cloth and steel wool to prepare for application of body solder.

g. Fill damaged areas with body solder.

h. File and sand excess body solder to form the final shape of the fender.

i. Use emery cloth #00 to smooth all minor irregularities.

j. Prepare surfaces of fender for spray painting. (Rub entire fender with fine steel wool.)

k. Use masking tape to divide two-color finishes.

l. Spray paint on repaired fender.
Note: Be sure to ventilate finishing area.

m. Replace repaired fender on bicycle with screws, nuts, flat washers, and lock washers.

n. Rotate bicycle wheel to check proper installation of fender.

o. Wax and polish entire bicycle.

2. Have the pupils perform each of the operations demonstrated.

Outcomes:

1. Manipulative skills

   a. to form sheet metal with hammer, mallet, or stake

   b. to repair holes in metal with body solder

   c. to file metal

   d. to smooth metal with emery cloth

   e. to spray paint

   f. to use masking tape when spray painting

2. Safety practices

   a. to handle sharp edges of sheet metal with care

   b. to store combustible materials in metal cabinet

   c. to provide adequate ventilation when spray painting

3. Academic learnings

a. Language arts

(1) vocabulary

fender	stake	dent
emery	solder	damage
planishing	hammering	puncture

(2) preparing a bill of materials for fender repair jobs

(3) writing a report on how to repair a fender

b. Science

(1) adhesion of metals by soldering

(2) molecular structure of metals and metal fatigue

(3) effect of oxidation on metals

c. Mathematics

(1) estimating costs of bicycle parts

(2) estimating costs of repair, materials and labor

d. Art

(1) selection and use of colors in painting

(2) development of shapes and forms in reforming damaged fenders

Assignment:

Have pupils bring in damaged bicycle fenders to repair in the school shop.

Follow-Up:

Plan a visit to a local body and fender automobile repair shop to observe similarities between automobile and bicycle fender repairs.

Reference:

It's Easy to Fix Your Bike, McFarlane, John, Follette Publishing Company, Chicago, 7, Ill. 1958.

How to Repair a Bicycle Tire Tube

Materials, Tools, and Equipment:

Materials

- rubber cement
- rubber patches
- scraper
- rags
- chalk
- dusting powder
- carbon tetrachloride

Tools

- bicycle wrenches
- scissors
- air gauge
- wood or metal roller
- screw drivers
- air pump
- pliers

Equipment

- tire test tank

Visual Aid:

Wall chart showing bicycle wheel assembly

Procedure:

1. Demonstrate the following operations:

   (a) Place bicycle upside down on newspaper to protect the bicycle seat and the chromium handle bars.

   (b) Rotate bicycle wheel to inspect tire.

   (c) Locate and remove the object that caused the puncture.

   (d) Mark the puncture area with white chalk.

   (e) Remove the wheel with appropriate wrenches.

   (f) Remove the valve stem. (Use wrench end of tire dust cap.)

   (g) Deflate tire completely.

   (h) Pry loose one bead of the tire. (Use two screw drivers as tire irons.) See Operation Sheet #25.

   (i) Remove tire tube and locate puncture.

j. Pry loose other tire bead and remove tire from the wheel.

k. Cut a tube patch with scissors to desired size. (See Operation Sheet #24)

l. Clean punctured area with carbon tetrachloride.

m. Scrape punctured area with scraping tool.

n. Apply a coat of rubber cement to scraped area and allow it to dry thoroughly.

o. Remove protective cloth backing from tire patch. (Do not touch the adhesive side of patch.)

p. Replace valve stem on inner tube and inflate the tube with a hand pump.

q. Submerge the repaired area of the tube in the tire testing tank to test for leaks. (Air bubbles indicate escaping air.)

r. Dry wet tube with a rag and sprinkle it with dusting powder.

s. Replace tire on wheel.

t. Clean inside of tire and insert tube. (Place inner tube valve into valve hole of wheel rim.)

u. Inflate tire. (Recommended pressure is marked on tire wall.)

v. Check air pressure in tire with air-gauge.

w. Replace wheel on bicycle frame fork.

2. Have the pupils perform each of the operations demonstrated.

Outcomes:

1. Manipulative skills

a. to repair a tube puncture

b. to check tire tubes for leaks

c. to remove and replace bicycle wheels

2. Safety practices

   a. to wear gloves when checking for nails and other sharp objects in a punctured tire

   b. to store rubber cement away from heat or open flame

   c. to keep hands away from spokes when rotating bicycle wheels

   d. to hold the bicycle firm when removing and replacing the wheels

3. Academic learnings

   a. Language arts

      (1) vocabulary

stem	bead	gauge
fork	insert	rotate
submerge	puncture	valve
rim	scrape	spokes

      (2) reading instructions on bicycle repair kits

      (3) reading bicycle maintenance manuals

   b. Social studies

      (1) primitive methods of transportation

      (2) use of bicycle for recreation

      (3) production of natural rubber in the Far East and South America

   c. Mathematics

      (1) determining circumference of a wheel

      (2) determining air pressure needed for a given volume

   d. Science

      (1) elasticity of rubber

      (2) manufacture of synthetic rubber

      (3) vulcanization of rubber

Assignment:

Have the pupils bring punctured tire tubes to the school shop for repair.

References:

Understanding America's Industries, Gerbracht, Carl and Robinson, Frank E., McKnight and McKnight Co., Bloomington, Ill. 1962.

Bicycle Safety Tests, Bicycle Institute of America, Inc., New York, N. Y. 1965.

In-Plant Printing

ERIC

Making a Layout for a Shop Workbook

Materials:

drawing board	T square	45/90 degree triangle
ruler	tracing tissue	lettering guide
masking tape	compass	pencil
eraser	triangle	

Visual Aid:

Wall chart (Fig. 1)

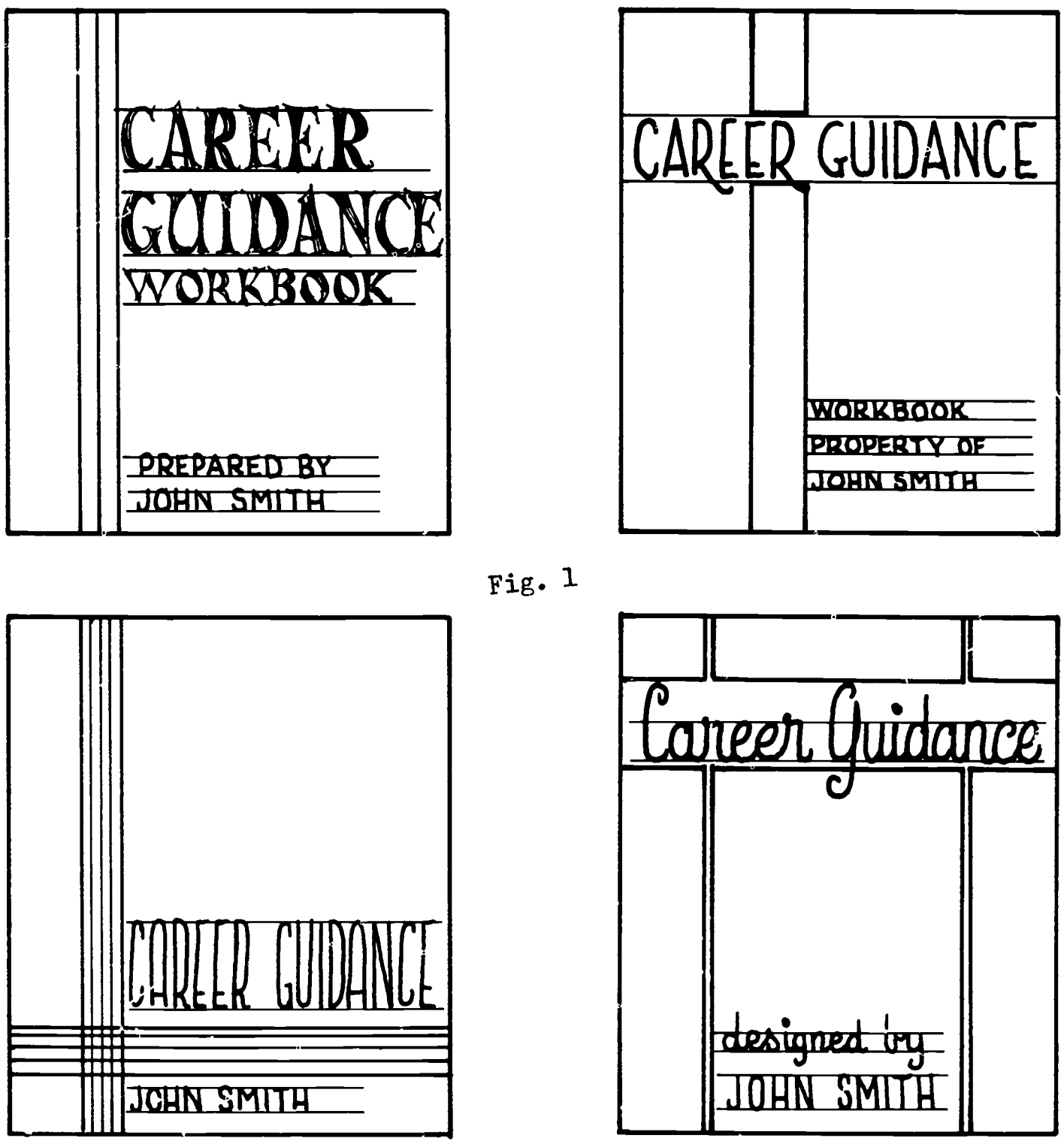


Fig. 1

Procedure:

1. Plan to print a shop workbook on the spirit duplicator with the pupils.

2. Elicit from the pupils the need for a blueprint, or layout, when working on a project.

3. Have the pupils make two or three thumb-nail sketches of a title page. (Fig. 1)

4. Have each pupil evaluate his sketches and select the title page he likes best.

5. Demonstrate the following:

   a. placing the drawing board on the work bench

   b. centering a piece of 11" X 12" tracing paper on the drawing board

   c. holding paper in position with masking tape

   d. using the T square and triangle to place paper in proper position

6. Have pupils place tracing paper on drawing board.

7. Have pupils measure an 8 1/2" X 11" rectangle on the paper.

8. Have the pupils rough out their layouts on the tracing paper.

9. Demonstrate use of the lettering guide.

10. Have pupils complete their layouts with the proper tools and equipment.

Outcomes:

1. Manipulative skills

   a. to use the drawing board, T square, and triangles

   b. to draw a thumb-nail sketch

   c. to develop a layout from a thumb-nail sketch

   d. to use layout tools, lettering guides, and shading plates

2. Safety practices

   a. to avoid paper cuts

   b. to use sharp or pointed tools properly

3. Academic learnings

   a. Language arts

      (1) vocabulary

drawing board	T square
verticle	sketch
horizontal	tracing
compass	proportion

   b. Mathematics

      (1) measuring with a ruler

      (2) determining paper proportions

      (3) recognizing the following paper proportions:

         (a) long oblong - ratio 1:2
         (b) printer's oblong - ratio 2:3
         (c) golden oblong - ratio 3:5
         (d) regular oblong - ratio 4.6
         (e) hypotenuse oblong - ratio 5:7

   c. Art

      (1) use of proportion, balance, and harmony

      (2) developing layout ideas (sketching and drawing)

<u>Follow-Up</u>:

1. Have the pupils bring in samples of title pages, advertisements, and circulars for the class to evaluate.

2. Have the pupils find the meaning of the following words in the books recommended as references in this lesson:

balance	rough sketch
detailed layout	harmony
display	type specifications
formal arrangements	

References:

Printing Layout and Design, Delmar Publishers, Inc., Albany, New York, 1955.

Printing Area, Related Information, The University of the State of New York, State Education Department, Albany, New York, pp. 1-23.

Graphic Arts, Kagy, Frederick D., Goodheart-Wilcox Co., Chicago, Ill., 1961, pp. 32-40.

Assignment Sheet

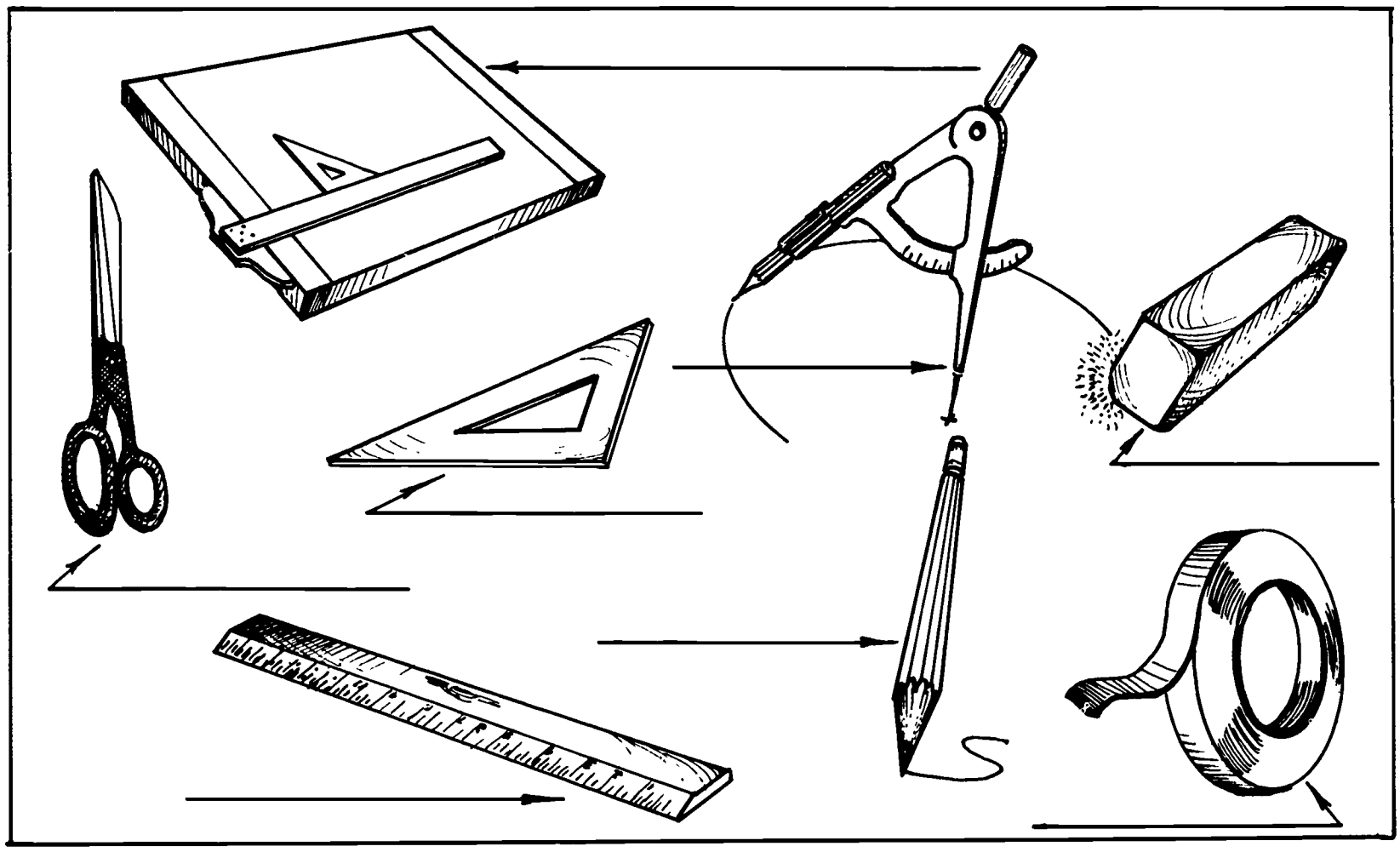


Fig. 2

1. Label the eight tools in the figure above.
2. Answer each of the following questions with a complete sentence:
   a. What is the purpose of a layout?

   _____

   _____

   b. How is a rough sketch used in making a layout?

   _____

   _____

Making a Spirit Master Unit

Materials and Equipment:

Materials

spirit master unit	letter guides
stylus	ruler
masking tape	shading tape

Equipment

mimeoscope

Suggested Visual Aid:

Filmstrip: Technique of Modern Fluid Duplicating, #911-1008, Part I, A. B. Dick Company, Chicago, Ill.

Procedure:

1. Inform the class that they will transfer the layout of their title page to the spirit master unit.

2. Demonstrate the preparation of a spirit master unit:

   a. Place the spirit master unit on a firm, smooth surface, such as a mimeoscope or a desk top.

   b. Fasten the unit to the drawing surface at upper corners with two pieces of masking tape.

   c. Make a spirit master unit. (Use methods (1) or (2) below.)

      (1) For better reproduction, redraw layout on master with a ball point pen, a stylus, or a 3H pencil.

      (2) Place the original layout over the master unit and fasten with masking tape. Then trace all the lines with a 3H pencil to transfer the original layout to the spirit master unit. (Be sure to use a firm, even pressure when drawing on the master unit.)

3. Demonstrate how to make corrections on the master unit.

4. Demonstrate use of the shading plates.

5. Have the pupils make their own spirit master unit for the title page of their workbooks.

Outcomes:

1. Manipulative skills

   a. to prepare a spirit master unit

   b. to make corrections on a spirit master

   c. to use shading plates

2. Safety practices

   a. to handle sharp instruments with care

   b. to wash hands thoroughly after handling carbon coated master units

3. Academic learnings

   vocabulary

   transfer
   mimeoscope
   spirit master
   carbon coating

Assignment:

Ask the pupils to write the answers to the questions:

1. What is the spirit master unit coated with?

2. What liquid do we use with the master unit?

3. How many copies can be printed with a spirit master unit?

References:

Mimeograph and Spirit Duplicator Selector, A. B. Dick Company, New York, N. Y., pp. 14,15.

Printing and Promotion Handbook, Meecher, Daniel and Larrick, Nancy, McGraw-Hill Book Company, Inc., New York, N. Y., 1960.

Operating a Spirit Duplicating Machine

Materials and Equipment:

Materials

master unit
duplicating fluid
duplicator paper
funnel

Equipment

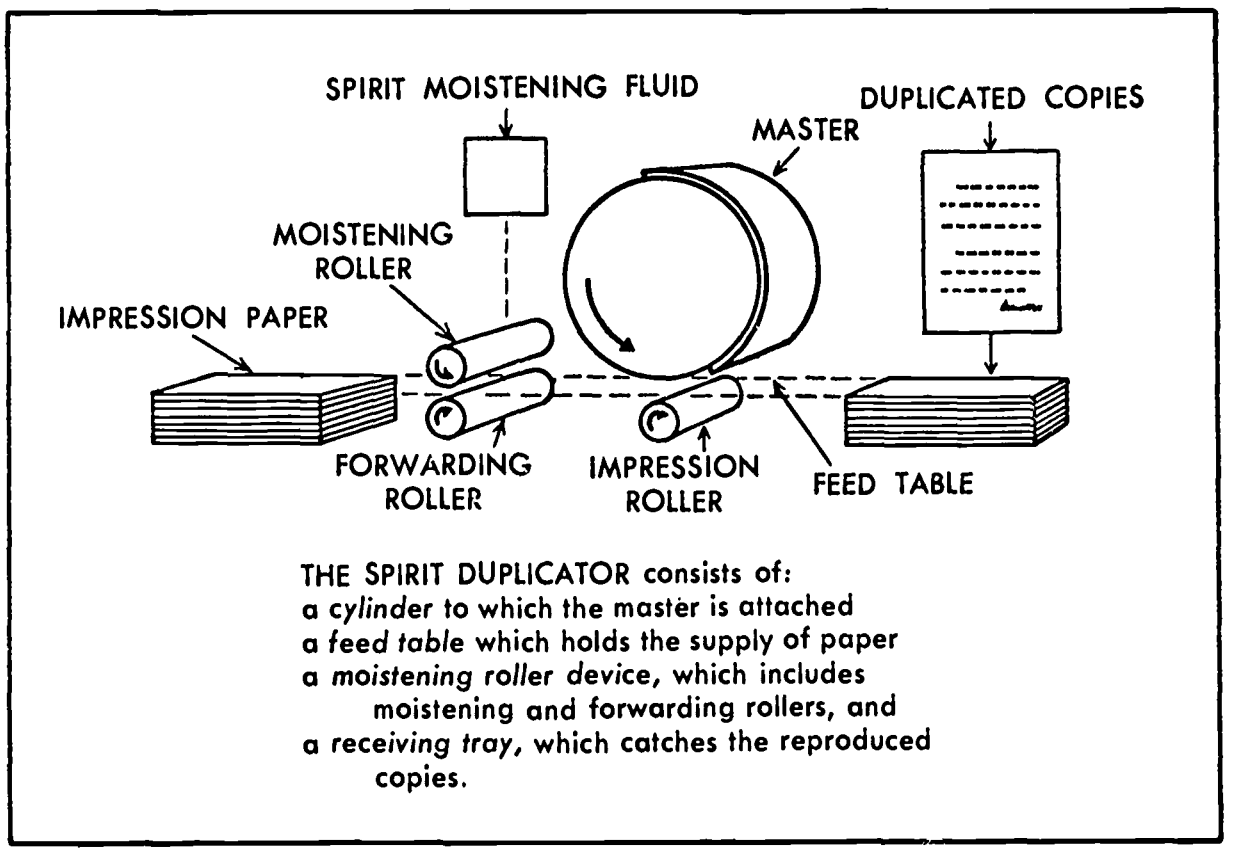
spirit duplicator

Visual Aids:

Wall chart (Fig. 3)

Filmstrip: The Fluid Duplicator, #911-1009, A. B. Dick Company, Chicago, Ill.

Fig. 3



Procedure:

1. Explain the spirit duplicating process to the pupils.
2. Demonstrate operation of the duplicator:
   a. Remove the spirit liquid tank.
   b. Fill the tank with fluid. (Use a funnel.)
   c. Insert the tank into the machine.
   d. Place the master unit under the clamp.
   e. Load the paper on the machine.
   f. Adjust the impression roller.
   g. Make a printed copy.
      (1) Adjust the cylinder if the impression on paper is not centered correctly.
      (2) Adjust the receiving tray, if necessary.

      Note: Emphasize the importance of releasing all tension rollers and of inverting the fluid tank after using the machine.
3. Have each pupil print his own title page with the spirit duplicator.

Outcomes:

1. Manipulative skills
   a. to operate a spirit duplicator
   b. to clean and check the duplicating machine
2. Safety practices
   a. to wash hands after work with the spirit master units
   b. to stop the machine when adjustments have to be made
   c. to avoid paper cuts

3. Academic learnings

a. Language arts

(1) vocabulary

spirit duplicator	duplicating fluid
impression	tension rollers
clamp	invert
cylinder	stacker

(2) reading operating instructions on the spirit duplicating machine

b. Science

(1) chemical action of duplicating fluid

(2) use of plastic container to hold duplicating fluid

(3) effect of duplicating liquid on carbon coating of master unit

(4) role of tension rollers

Reference:

Mimeograph and Spirit Duplicator Supplies Selector, A. B. Dick Company, New York, N. Y.

Assignment Sheet

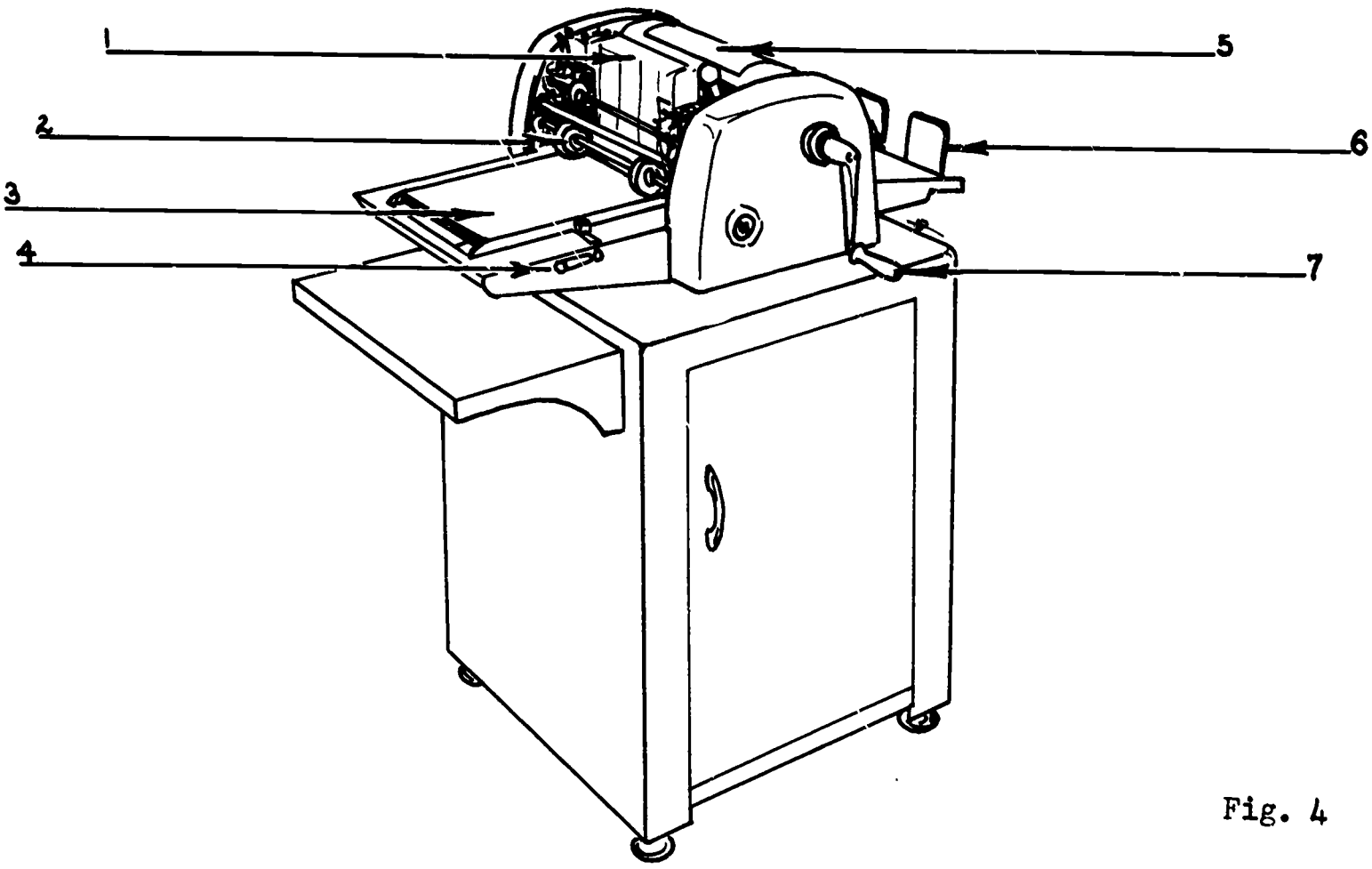


Fig. 4

1. Label each part of the spirit duplicating machine shown in Fig. 4 above.

2. Explain the function of each of the parts listed below:

   (a) liquid tank _____

   _____

   _____

   (b) cylinder _____

   _____

   _____

   (c) tension rollers _____

   _____

   _____

Collating a Shop Workbook

Materials:

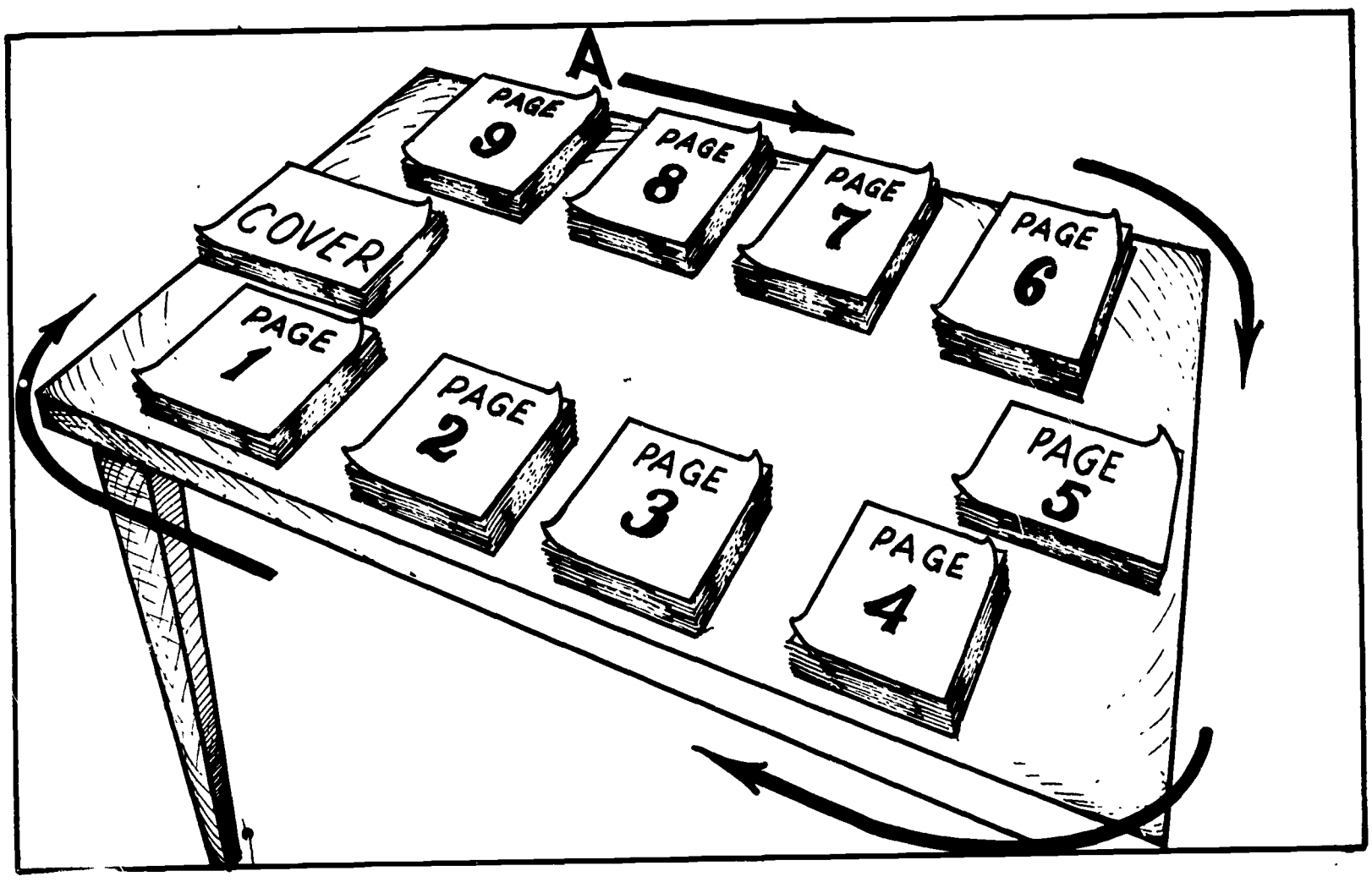
printed pages of the shop workbook (job sheets, safety rules, information sheets)
glycerine pad

Visual Aids:

Wall chart (Fig. 5)

Sample shop workbooks

Fig. 5



Procedure:

1. Explain to the pupils how collating machines are used in industry, e.g., Thomas Collator.

2. Show sample workbooks, and inform the pupils that they will collate their own shop workbooks manually.

3. Have the pupils arrange the printed pages for their booklets in numerical order. (Fig. 5)

4. Explain the use of a glycerine pad.

5. Then have three pupils at a time start collating their workbooks, beginning with the last page first. (Fig. 5)

   Note: Caution pupils to discard any pages with imperfections, e.g., smudges.

6. Demonstrate jogging and stacking of collated pages.

Outcomes:

1. Manipulative skills

   a. to organize printed pages for collation

   b. to jog and stack printed pages

   c. to work with clean hands to avoid smudges

2. Safety practices

   a. to avoid paper cuts

   b. to work in a team (avoid pushing and crowding)

3. Academic learnings

   vocabulary

   collate
   cover
   glycerine
   stack
   jog

Follow-Up:

Have the pupils organize a service squad to collate materials for school office.

Reference:

Comprehensive General Shop III, Miller, John, Bruce Publishing Co., Milwaukee, Wisconsin, p. 186.

Stapling the Shop Workbook

Materials and Equipment:

Materials

printed pages of the shop workbook
staples
ruler

Equipment

foot stapler
side stitch guide
saddle stitch attachment

Visual Aids:

Wall chart (Fig. 6)

Samples of saddle stitched and side stitched magazines and booklets

Procedure:

1. Explain the use of the foot stapler to the pupils.

2. Demonstrate the operation of a foot stapler:

   a. Place the staples into the machine.

      Note: Explain purpose of the clincher to the pupils.

   b. Adjust the side stitch attachment.

   c. Adjust the saddle stitch attachment.

   d. Place the guide marks on the foot stapler. The guide marks are generally placed as follows:

	Page Size	No. of Pages	Top	Center	Bottom
1.	5½ X 8½	8 - 25	2"		2"
2.	8½ X 11	10 - 25	2"		2"
3.	8½ X 11	25 - 50	2"	5½"	2"
4.	8½ X 14	10 - 25	2½"		2½"
5.	8½ X 14	15 - 50	2½"	7"	2½"

e. Show the pupils how to hold the booklet when side stitching.

f. Show the pupils how to open the booklet for saddle stitching.

3. Have each pupil stitch his workbook with the stitching he prefers.

Outcomes:

1. Manipulative skills

   a. to insert staples

   b. to adjust clinchers

   c. to change stitcning tables

   d. to set guides on stitching table

   e. to hold booklet for side stitching

   f. to hold booklet for saddle stitching

2. Safety practices

   a. to guard against injury from the stitching head

   b. to use the foot treadle with safety

3. Academic learnings

   a. Language arts

      vocabulary

foot stapler	stapling head	saddle stitch
side stitch	staples	guide
clinchers	thumbscrew	treadle

   b. Mathematics

      measuring with a ruler to determine position of staples

Reference:

Comprehensive General Shop III, Miller, John, Bruce Publishing Co., Milwaukee, Wisconsin, p. 187.

ASSIGNMENT SHEET

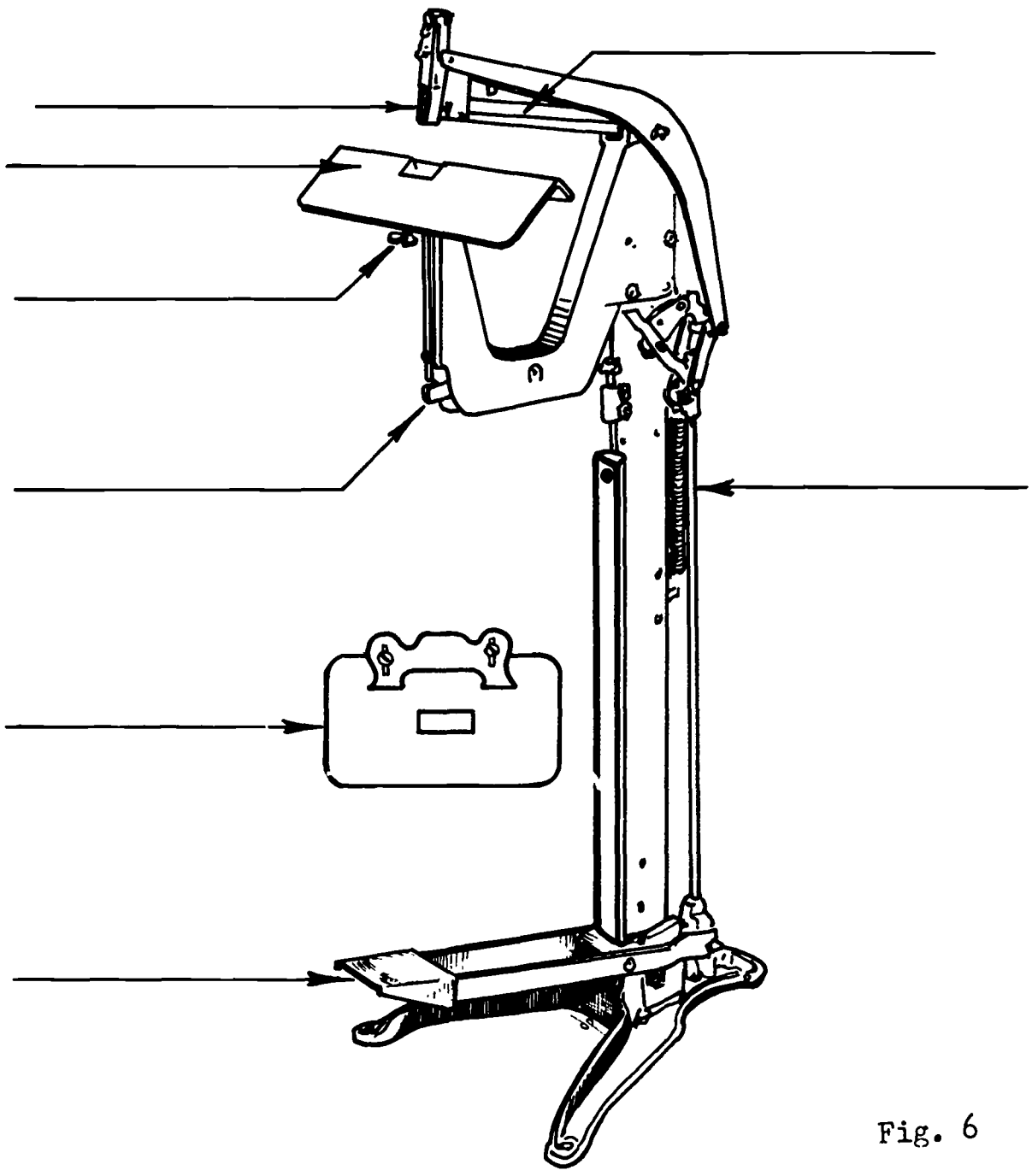


Fig. 6

Write the names of the machine parts on each of the numbered lines in Fig. 6. (Throat, side stitch table, foot treadle, clincher lever, table thumbscrew lock, stapler head, foot treadle connecting rod, saddle stitch table)

Using a Spiral Bookbinding Unit

Materials and Equipment:

Materials

cover stock
printed pages for the shop workbook
3/8" plastic binding spiral

Equipment

Combo (spiral binding unit)

Visual Aids:

Samples of spiral-bound booklets (various sizes of spiral bindings)

Procedure:

1. Hold up samples of spiral-bound booklets for pupils to examine.

   a. Elicit the special features:

      (1) binder may be removed to insert or remove paper

      (2) booklet opens with facility

   b. Elicit that the size of the plastic spiral binding depends upon the thickness of the booklet.

2. Demonstrate the operation of the Combo machine.

   a. Set the guides and punches.

   b. Punch the sheets of paper.

      Note: Punch no more than six sheets at a time and keep the pages in sequential order.

   c. Place the plastic spiral into position on the machine.

   d. Place the sheets (about six sheets at a time) on the open plastic spiral.

   e. Close the spiral binder and remove the bound booklet.

Outcomes:

1. Manipulative skills

   to operate the Combo spiral binding machine, and to make the following adjustments:

   (1) to set the guides on the Combo binding machine

   (2) to adjust the punches

   (3) to open and to close the spiral binder

   (4) to load the punched sheets on the plastic spiral

2. Academic learnings

   a. Language arts

      vocabulary

spiral	adjust
plastic	bind
binding	lever
punch	bound

   b. Mathematics

      determining capacity of plastic binding spiral

Reference:

Combo, Punching and Binding with One Compact Desk Top Machine, General Binding Corporation, Northbrook, Ill.

Preparing a Mimeograph Stencil

Materials and Equipment:

Materials

- styli
  - ball point stylus
  - loop stylus
- shading plates
- lettering guides
- T square
- stencil

Equipment

- mimeoscope

Visual Aids:

Samples of projects prepared with the use of a mimeoscope

Filmstrip: Technique of Mimeographing, Part I, #911-1004. The Stencil, A. B. Dick Co., Chicago, Ill.

Procedure:

1. Plan to print a shop workbook on the mimeograph machine.

   Note: You may use layout prepared in Unit 1. (Fig. 1)

2. Demonstrate how to transfer the layout to a mimeograph stencil.

   a. Fasten a mimeograph stencil on the mimeoscope.

   b. Insert the layout under the stencil.

3. Demonstrate how to use each of the following:

   a. T square (vertical and horizontal lines)

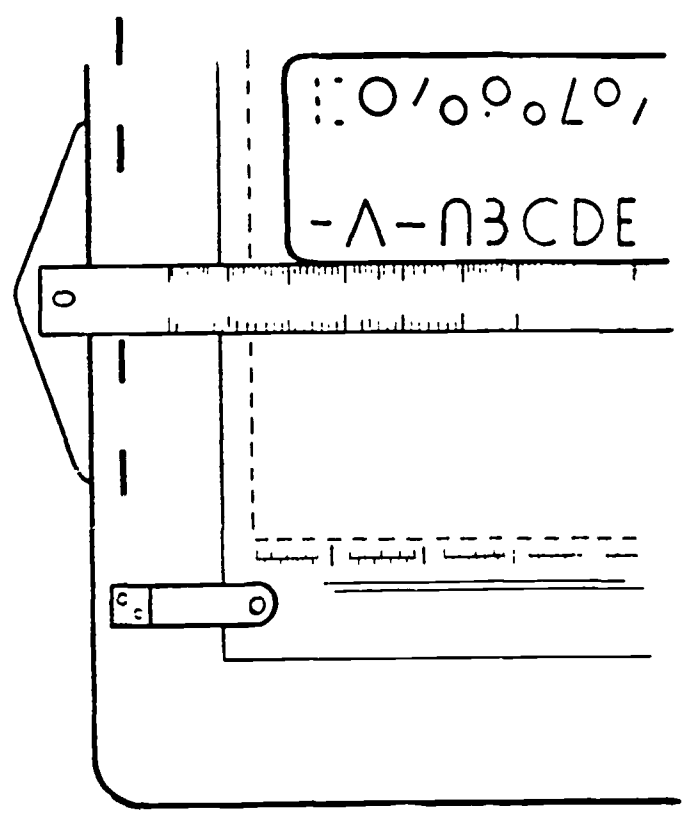


Fig. 7

b. lettering guides (Fig. 7)

Note: First letter must be 1/2" inside dotted boundary line.

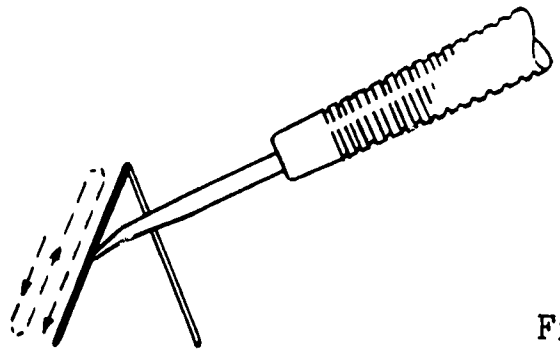


Fig. 8

c. loop and ball point styli (Fig. 8)

Note: Move the stylus back and forth lightly. Approach the junction of two lines from the opposite points. (Fig. 9)

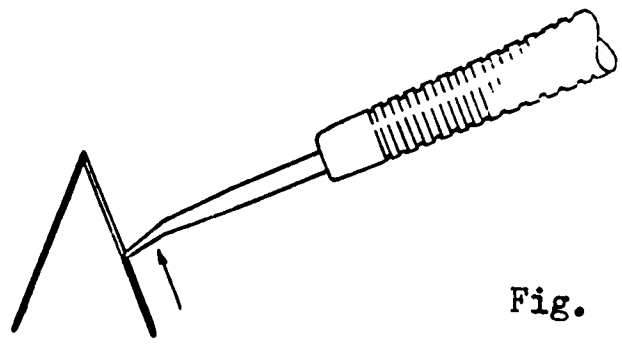


Fig. 9

d. shading plates

4. Have pupils practice using the tools as demonstrated.

Outcomes:

1. Manipulative skills

   a. to adjust and use a mimeoscope

   b. to use a stylus, T square, lettering guide, and shading plates

2. Safety practices

   a. to avoid pressure when working on a glass surface

   b. to handle sharp pointed tools with care

3. Academic learnings

   a. vocabulary

mimeoscope	lettering guides
styli	shading plates
clamps	stylus
horizontal	vertical

b. art and drafting

(1) drawing lines with a T square

(2) sketching

Reference:

Techniques of Mimeographing, A. B. Dick Co., New York, N. Y., 1966.

ASSIGNMENT SHEET

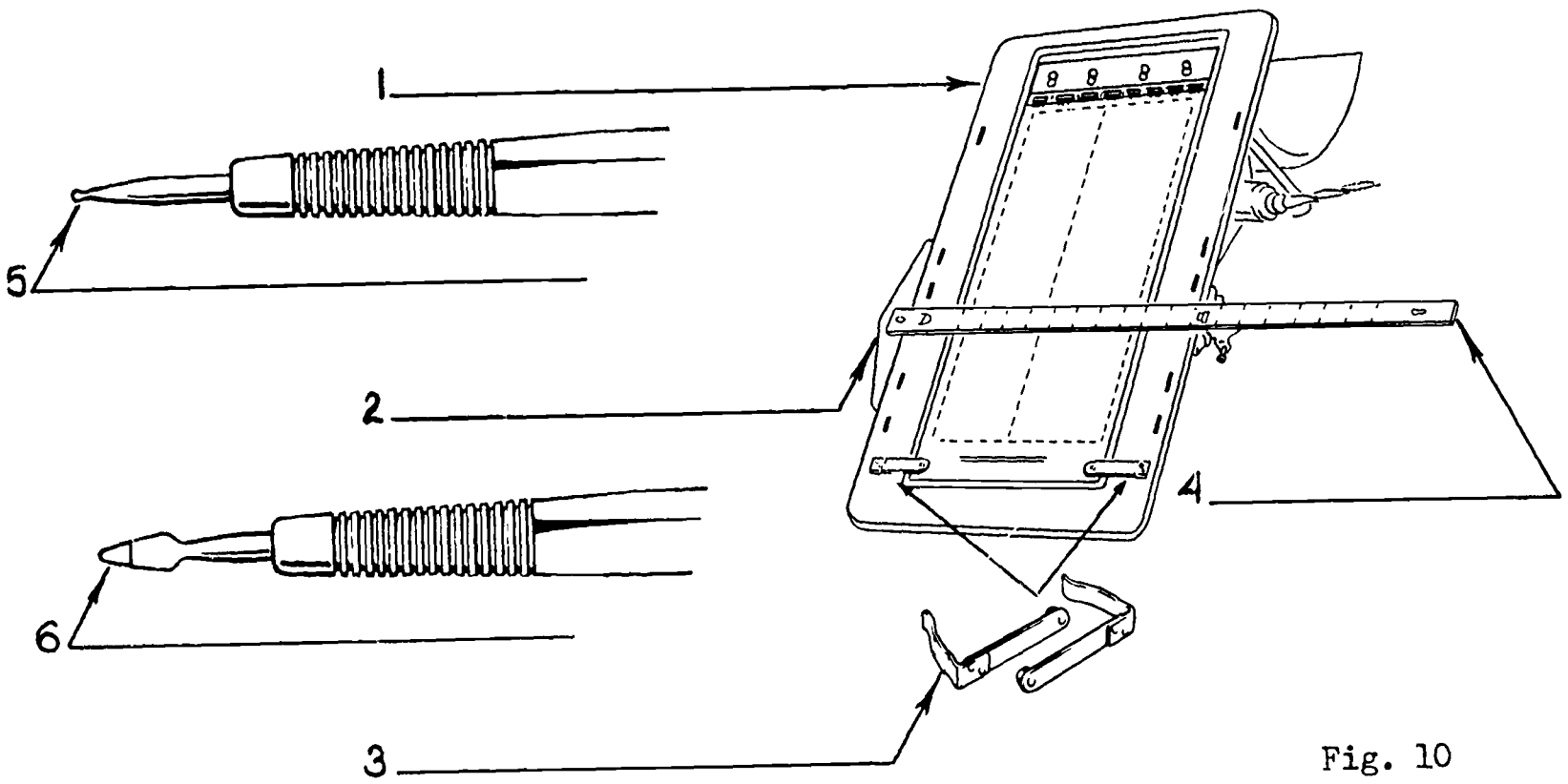


Fig. 10

Answer the following questions with complete senctences:

1. What is the purpose of a layout? _____

_____

_____

2. How do we use a T square when working with the mimeoscope?

_____

_____

3. How do we use a ball point stylus when making a stencil?

_____

_____

Estimating Simple Cuts of Paper Stock

Materials:

ream of 12" X 22" paper stock
yard stick
sloyd knife

Visual Aids:

Wall charts (Fig. 11, Fig. 12)

Samples of basic paper sizes:

17" X 22" - bond paper
20" X 26" - cover stock
20 1/2" X 24 3/4" index bristol
25" X 38" book paper

Procedure:

1. Plan to cut paper for the title page of the shop workbook:
   a. Determine size of title page, e.g., 8 1/2" X 11".
   b. Determine the number of sheets needed for the class.
2. Discuss:
   a. basic paper sizes
   b. meaning of a ream
   c. information on the labels of packaged paper stock (weight and size)
   d. use of large sheets of paper stock (12" X 22")
3. Demonstrate how to figure the number of sheets of 8 1/2" X 11" sheets that can be cut from one 17" X 22" sheet of paper stock. (Use a yardstick.)
   a. Method #1 - Vertical Cancellation

$$\frac{\overset{2}{\cancel{17}} \times \overset{2}{\cancel{22}}}{\underset{2}{\cancel{8}} \times \cancel{11}} = 4 \text{ sheets } (8\ 1/2" \times 11")$$

b. Method #2 - Diagonal Cancellation

$$\frac{\overset{2}{\cancel{17}} \times \overset{1}{\cancel{22}}}{\underset{\cancel{2}}{\cancel{8\tfrac{1}{2}}} \times \cancel{11}} = 2 \text{ sheets } (8\ 1/2'' \times 11'')$$

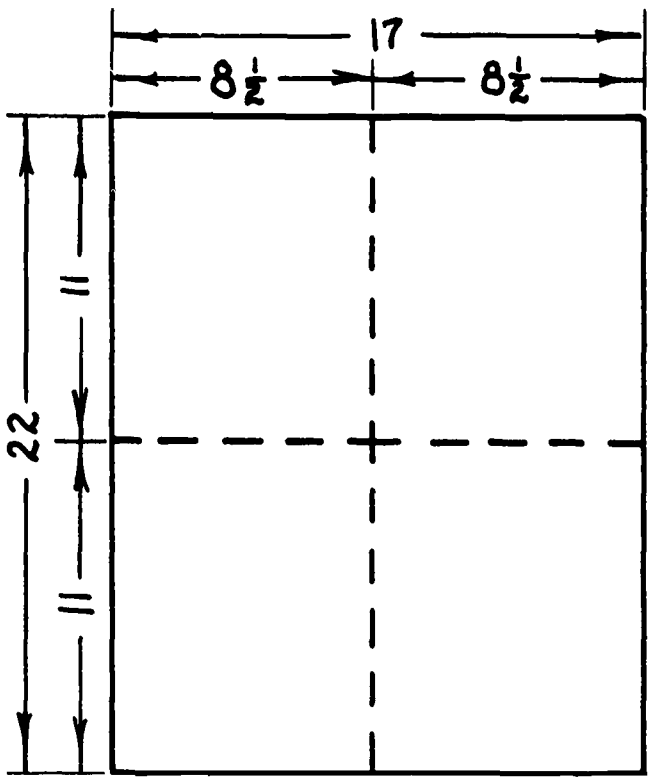


Fig. 11

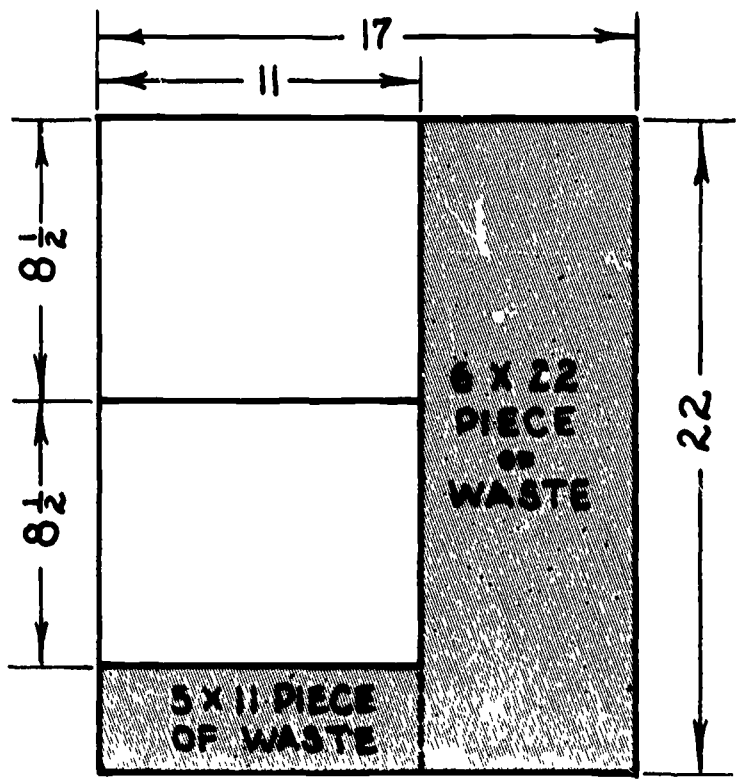


Fig. 12

4. Elicit from the pupils that if they use Method #1 there will be no waste of paper stock.

5. Have the pupils compute the number of 8 1/2" X 11" sheets they can cut from 17" X 22" paper stock.

Outcomes:

1. Manipulative skills

   a. to use a sloyd knife to open packages of paper stock

   b. to stack large sheets of paper stock

2. Safety practices

   a. to use a sloyd knife with care

   b. to avoid paper cuts

   c. to lift heavy packages of paper without causing strain

3. Academic learnings

a. Language arts

(1) vocabulary

divide	sloyd knife	stock
waste	weight	cancellation
sheet	quantity	diagonal
size	ream	vertical

(2) reading labels on packaged paper stock

b. Mathematics

(1) determining quantity of small sheets that can be cut from large sheets of paper stock (vertical and diagonal cancellations)

(2) to measure with a yardstick

Reference:

Comprehensive General Shop II, Miller, John, Bruce Publishing Co., Milwaukee, Wisconsin, p. 164.

ASSIGNMENT SHEET

Use the cancellation method of paper estimating to solve the following problems:

a. How many 9" X 12" sheets can be cut from a sheet of paper stock 25" X 38"?

b. Draw a diagram to prove your answer.

c. How many 6" X 9" sheets can be cut from a sheet of paper stock 25" X 38"?

d. Draw a diagram to prove your answer.

e. How many 3" X 5" cards can be cut from a sheet of paper stock 19" X 24"?

f. Draw a diagram to prove your answer.

ERIC

Operating a Paper Cutting Machine

Materials and Equipment:

Materials

paper stock
strip of chipboard
yardstick

Equipment

paper cutting machine

Visual Aids:

Wall chart of a paper cutter with the following parts labelled:

safety handle	right guide
cutting table	paper clamp
measuring tape	cutting lever
left guide	back guide

Procedure:

1. Prepare to cut 8 1/2" X 11" sheets from the 17" X 22" sheet of paper stock.

2. Demonstrate to the pupils how to set the paper cutter for the first cut.

   a. Set the measuring tape of the machine at 8 1/2".

   b. Jog the paper stock before placing it on the cutting table.

      (1) Limit the quantity of stock to be cut at one time.

      (2) Stress the importance of placing stock against the left guide to insure accuracy in cutting.

   c. Set the paper clamps. (Use chipboard strip to insure even cuts.)

   d. Lower the cutter lever to cut the paper stock. (Explain the safety grip.)

3. Have several pupils operate the paper cutting machine while the other pupils evaluate their performance.

4. Now set the measuring tape at 11" and make the second cut.

5. Have the pupils cut the paper stock they need for their shop workbooks.

Outcomes:

1. Manipulative skills

   a. to adjust measuring gauge

   b. to jog paper

   c. to use the clamp on the paper cutter

   d. to use the lever on the paper cutter

2. Safety practices

   a. to use the safety devices on the paper cutter

   b. to lift large packages of paper

   c. to keep hands away from the knife edge of the machine

3. Academic learnings

   vocabulary

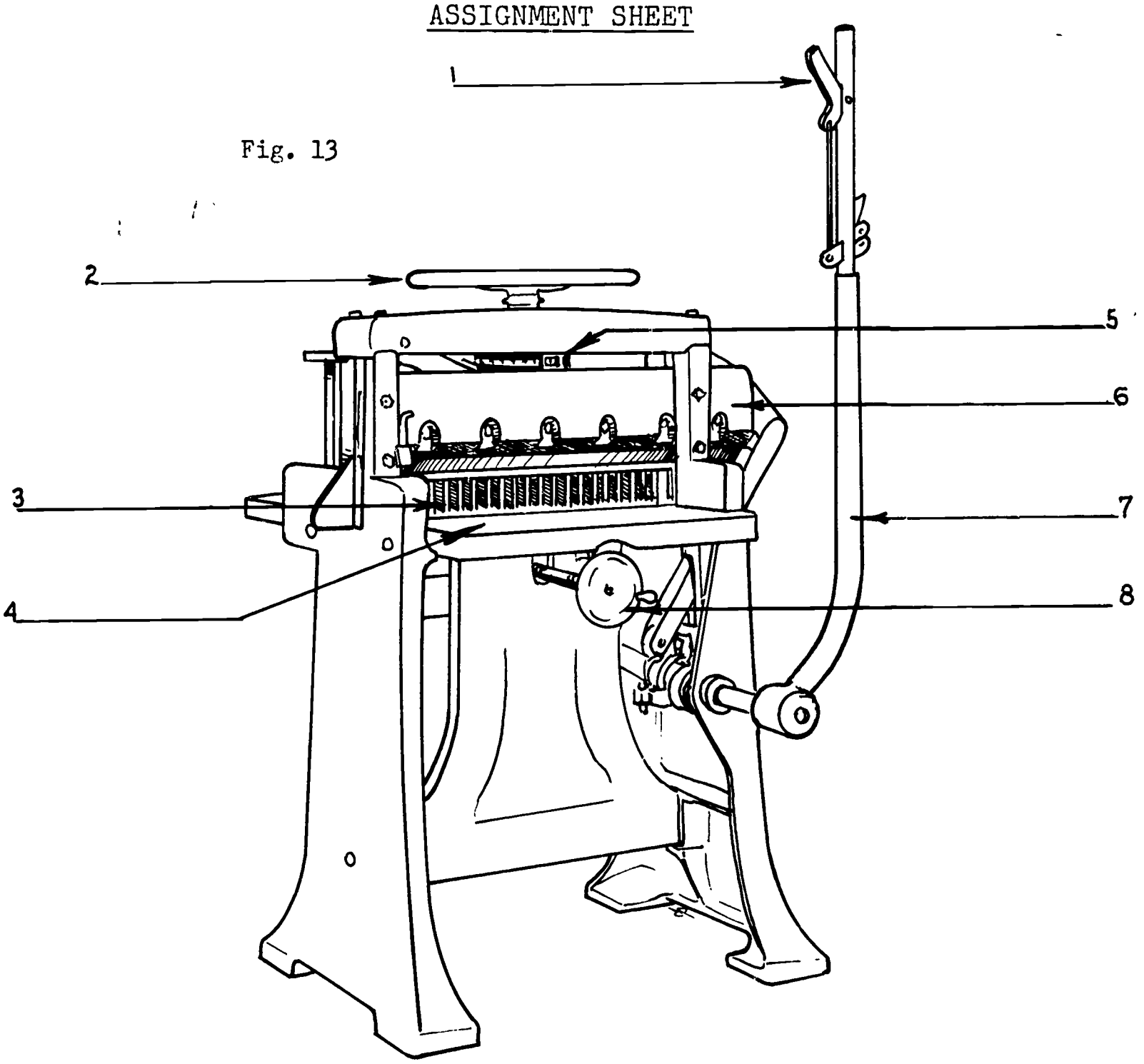
stock	jogging
yardstick	clamp
guide	measuring tape
chipboard	

Reference:

Comprehensive General Shop II, Miller, John, Bruce Publishing Co., Milwaukee, Wisconsin, p. 165.

ASSIGNMENT SHEET

Fig. 13



1. Write the parts of the paper cutter in the above figure.

_____

_____

2. Explain the purpose of the paper cutter. _____

_____

3. State one safety practice that must be observed when using the paper cutter. _____

_____

Operating a Mimeograph Machine

Materials and Equipment:

Materials

mimeograph paper
absorbent wrapper
prepared stencil
rags

Equipment

A. B. Dick mimeograph machine

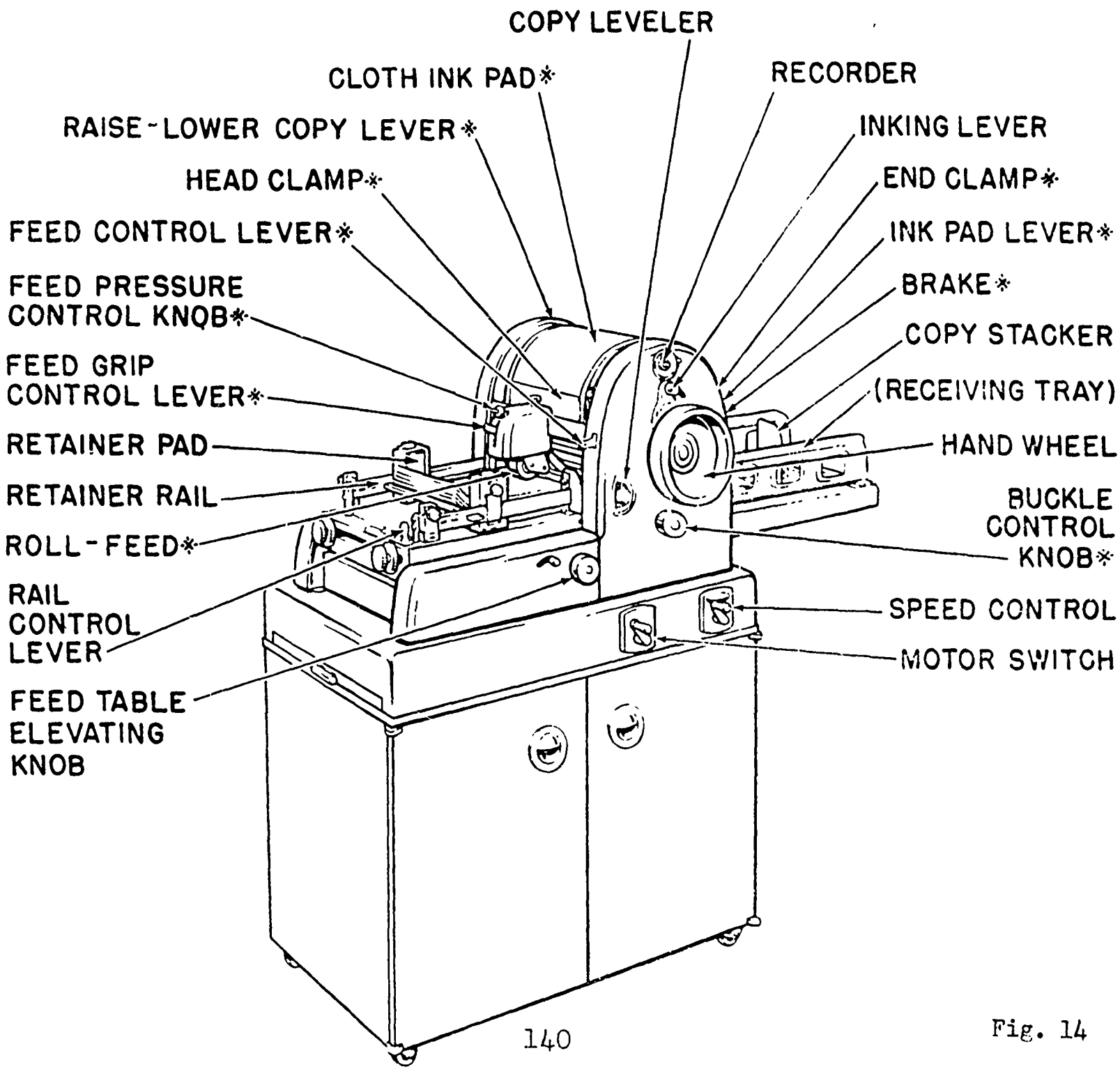


Fig. 14

Visual Aids:

Wall chart (Fig. 14)

Filmstrip: Technique of Modern Mimeographing, #911-1005a, A. B. Dick Co., Chicago, Ill.

Procedure:

1. Prepare to run off the stencil for the title page of the shop workbook.

2. Demonstrate the operation of an A. B. Dick mimeograph machine:

   a. Release the brake.

   b. Raise the clamp lever and remove the protective cover. (Fig. 15)

   c. Measure the closed cylinder ink supply.

   d. Open the head clamp. (Fig. 16)

   e. Attach the stencil (backing sheet face up). (Fig. 17)

   f. Hold the stencil taut and lay it down over the cylinder.

   g. Turn the cylinder and fasten the stencil with the end clamp.

   h. Set the feed table retainer and retainer pads. Then place the paper on the feed table. (Fig. 18)

   i. Make certain that the brake lever is in the horizontal "OFF" position before running the copy.

   j. Run a single test copy and check the position of the copy on the paper.

   k. Adjust the mimeographing on the paper.

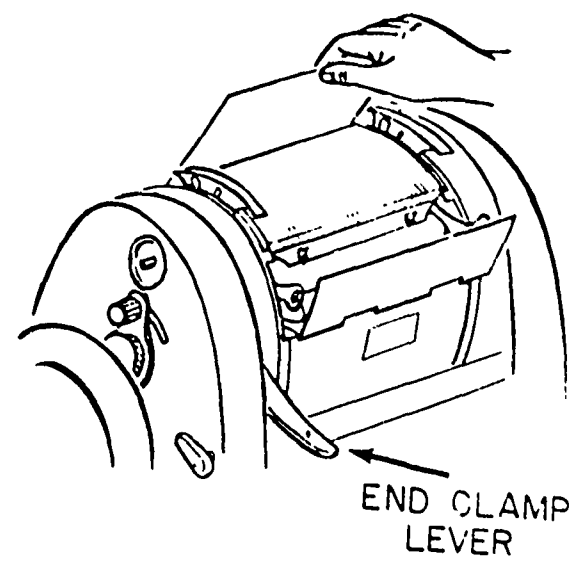


Fig. 15

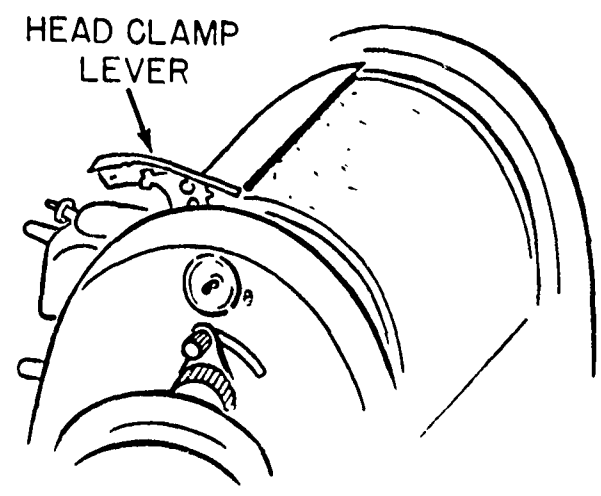


Fig. 16

3. Have several pupils perform the steps that were demonstrated, while the rest of the class observes.

4. Then organize the class into teams. (3 pupils on each team)

5. Have one team run off 50 copies of a sample stencil, while the rest of the class observes and then evaluates the performance.

6. Have each pupil on the team evaluate his own performance.

7. Now, have each of the other teams operate the machine until every team has had an opportunity to work at the machine.

8. Demonstrate the storage of used stencils in absorbent wrappers.

9. Have the pupils clean the working area when their work is complete.

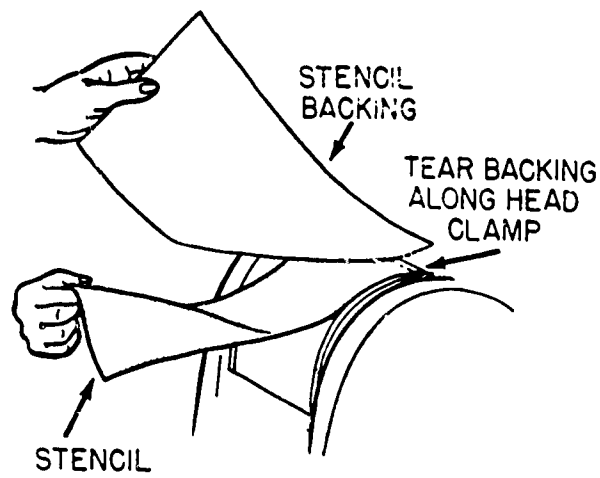


Fig. 17

Outcomes:

1. Manipulative skills

   a. to measure the ink in the cylinder

   b. to attach the stencil to the cylinder

   c. to adjust the paper feed table

   d. to run the mimeograph machine

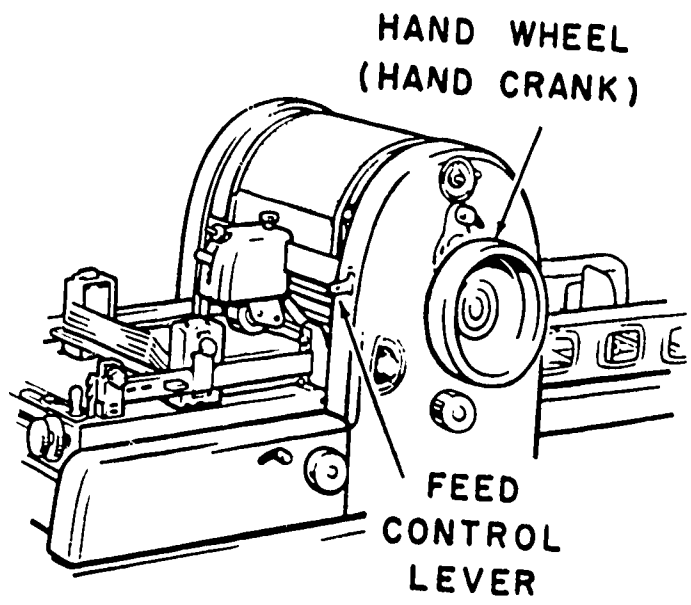


Fig. 18

2. Safety practices

   a. to check all parts of the mimeograph machine before starting it

   b. to keep hands off moving parts when the machine is in operation

   c. to avoid starting the machine at high speed

   d. to tend the machine constantly while it is in operation

   e. to clean the machine and the work area

3. Academic learnings

   vocabulary

mimeograph	impression	switch
absorbent	control	buckle
elevate	recorder	clamp
knob	brake	

References:

Techniques of Mimeographing, A. B. Dick Co., Chicago, Ill., 1964.

Fundamentals of Mimeographing, A. B. Dick Co., Chicago, Ill., 1965.

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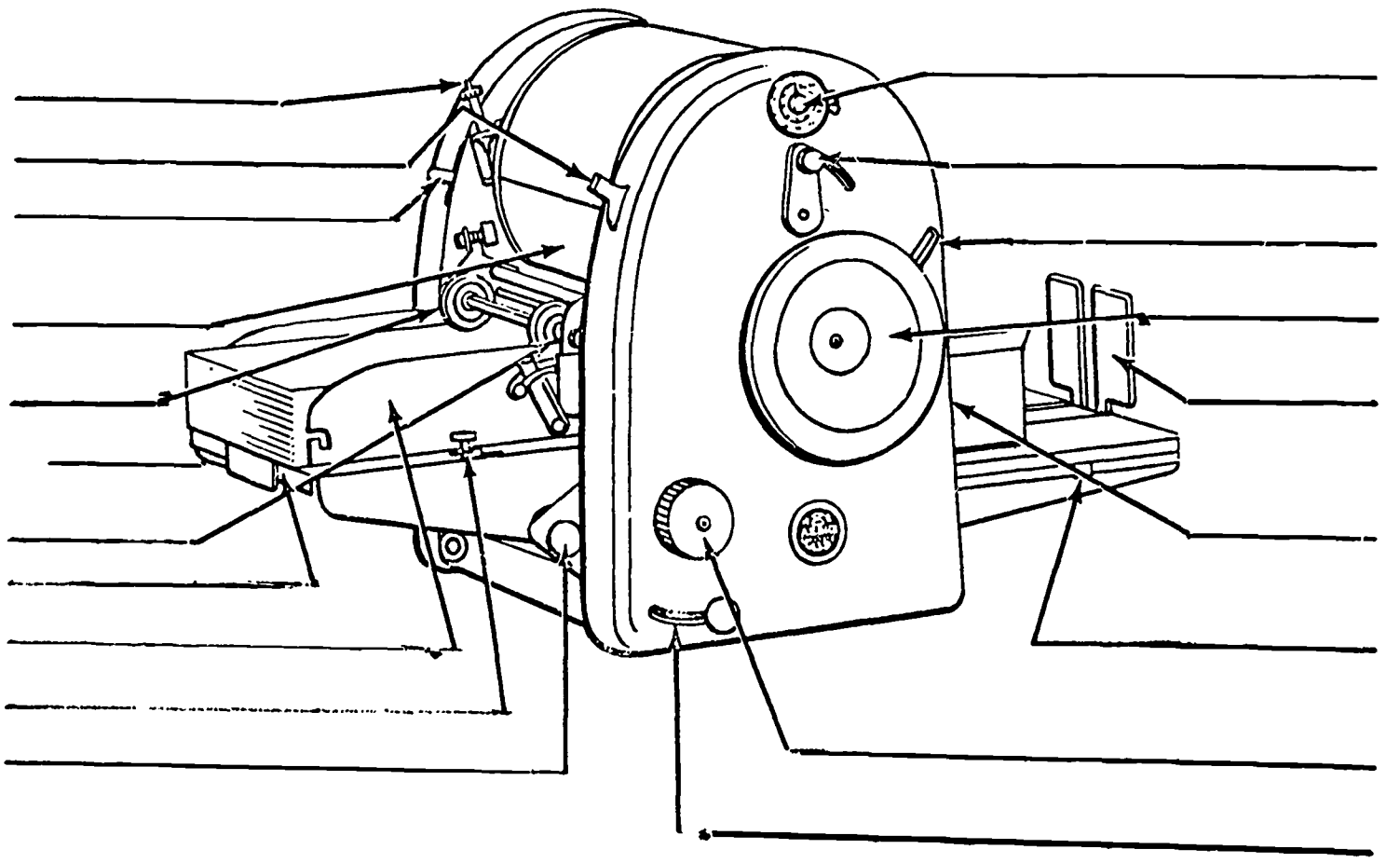


Fig. 19

1. Label the parts of the mimeograph machine on the lines provided in the figure above.

2. Complete the following sentences:

   a. The mimeograph machine is used to _____

   b. A stencil is made on a _____

   c. The standard size of paper used is _____

   d. _____ ink is used on a mimeograph machine.

   e. The purpose of the end clamp is to _____

Using a Stripprinter for Headlines

Introduction:

When preparing to print a school newspaper by photo-offset, headlines and captions can be produced on the Stripprinter machine. This is a photographic process similar to a contact print frame.

Materials and Equipment:

Materials

35 MM photographic paper
photographic developer
photographic fixer

Equipment

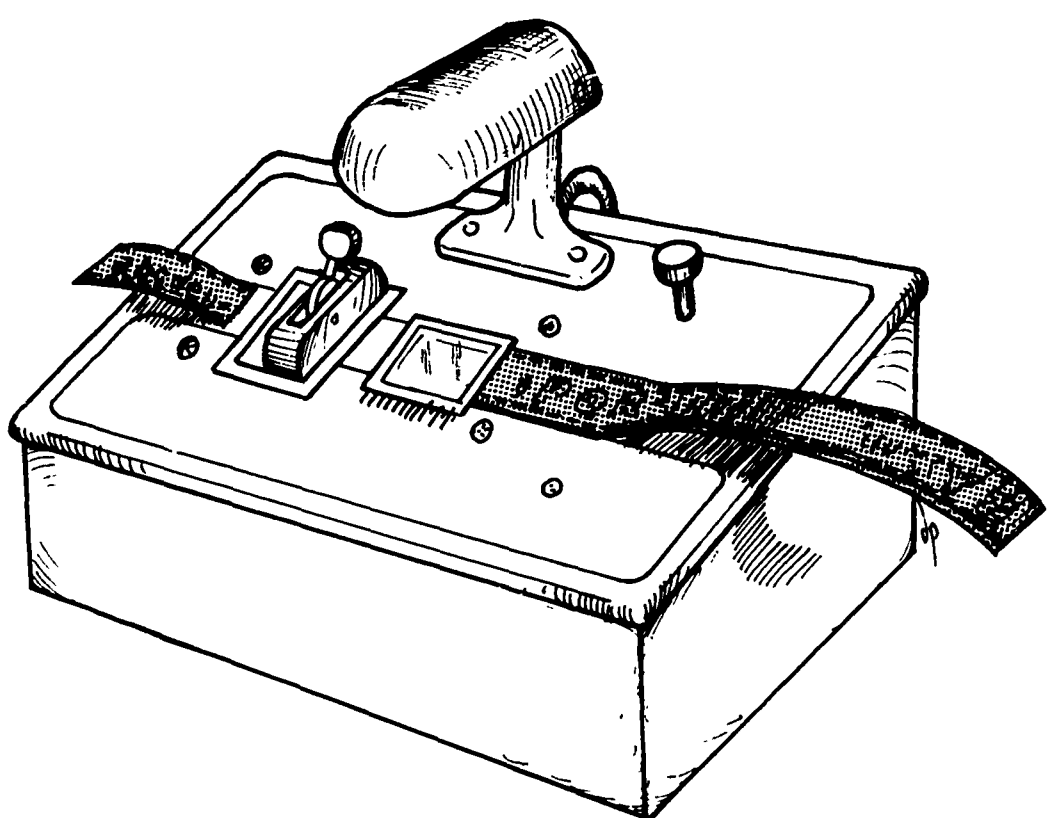
Stripprinter machine
3 amber developing jars
variety of type fonts

Visual Aids:

Wall charts (Fig. 20, Fig. 21)

Stripprinter type style charts

Fig. 20



Procedure:

1. Demonstrate the operation of the Stripprinter machine:

   a. Select style and size of type desired.

   b. Insert type font (roll of film) through slots and over 35 MM photographic paper.

   c. Move letter on film to desired position over photo paper. (Spacing is manual and visual.)

   d. Press red button to expose photo paper for predetermined time.

   e. Advance 35 MM paper to the left.

   f. Pull out font (left to right) to second letter, adjust space, and continue to compose needed lines.

   g. When lines are composed, remove the strip from the Stripprinter.

   h. Immerse photo paper strip into amber jar containing developer.

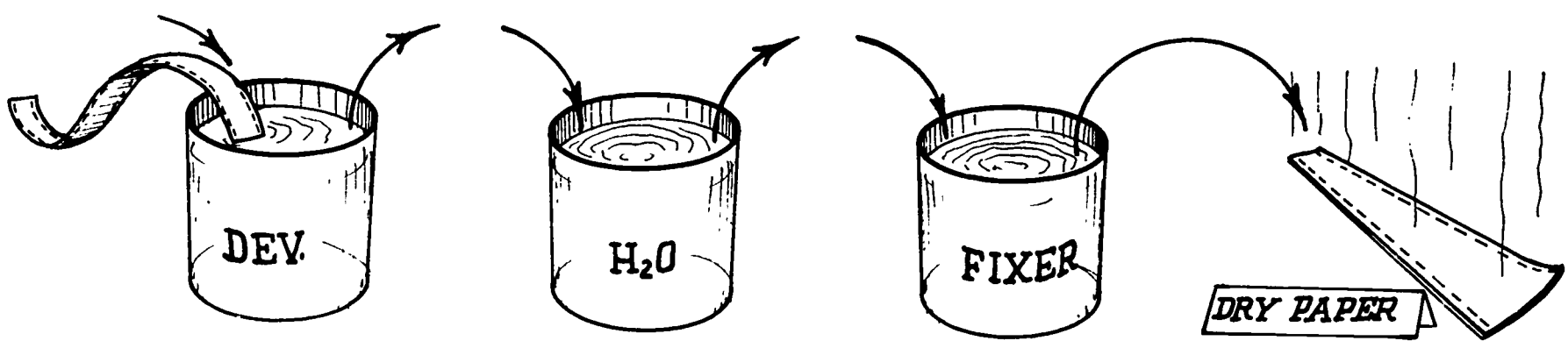


Fig. 21

i. Then rinse strip in the amber jar containing water. Now, immerse strip in amber jar containing fixer.

j. Wipe the strip. (It is now ready for paste-up.)

2. Have two pupils prepare strips while the other pupils observe and evaluate the procedure.

Outcomes:

1. Manipulative skills

   a. to use the Stripprinter

   b. to develop photographic paper

2. Safety practices

   a. to use electrical equipment with care

   b. to use chemicals with caution

   c. to wash hands carefully when the printing job is completed

3. Academic learnings

   a. Language arts

      (1) vocabulary

exposure button	developer	photographic paper
immerse	glossy	strip
select	amber	type font
		fixer

      (2) composing headlines and captions

   b. Mathematics

      (1) determining space needed for a given font size; calculating font size needed for a given space

      (2) determining exposure time necessary to complete photographic process

   c. Science

      (1) chemicals used in the manufacture of film and photographic paper

      (2) chemistry of the photographic process

d. Art

(1) copy design

(2) harmony of composition

Reference:

Stripprinter Manual, Stripprinter, Inc., Oklahoma City, Oklahoma.

Making a Newspaper Paste-Up

Materials and Equipment:

Materials

rubber cement
white tempera paint
black India ink

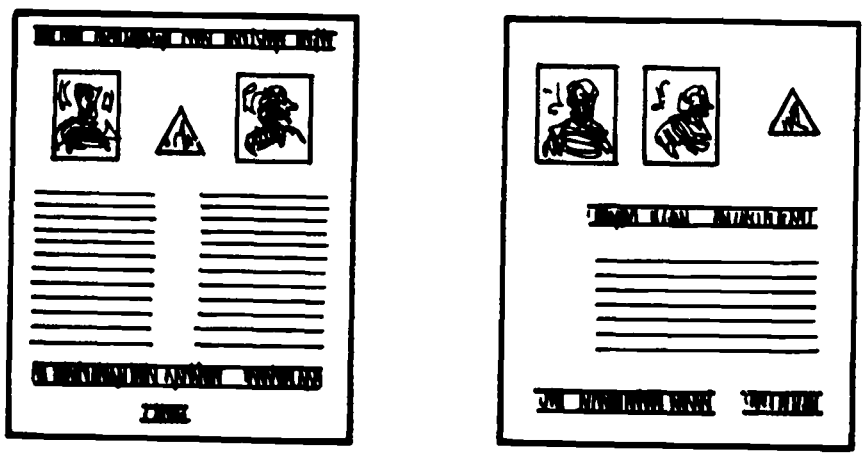
Equipment

drawing board	T square
45° triangle	scissors
razor blade	blue crayon pencil
ruler	small artist brush
small dust cloth	soft eraser

Visual Aids:

Wall charts (Fig. 22, Fig. 23, Fig. 24, Fig. 25)

Fig. 22



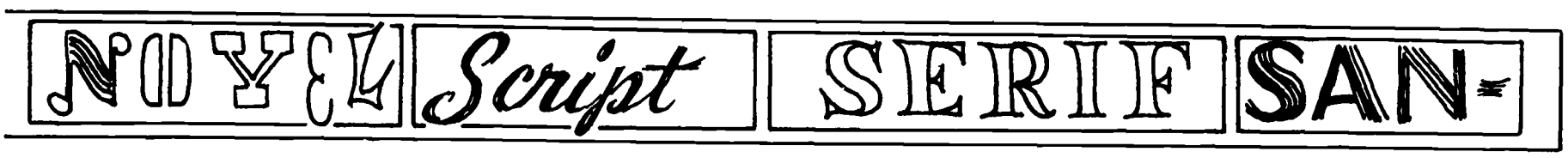


Fig. 23

Procedure:

1. Plan the layout of a page with the pupils.
   a. Determine size and location of illustrations.
   b. Use appropriate display lines (made with Stripprinter).
   c. Estimate the area needed for typewritten copy.

2. Fasten a blank sheet of paper (size of paper determined by size of school newspaper) to the drawing board using a T square and two pieces of masking tape. (Fig. 24)

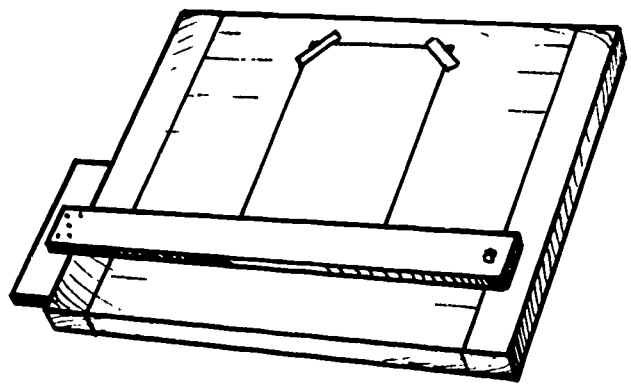


Fig. 24

3. Cut the copy and the illustrations as shown in Fig. 25.

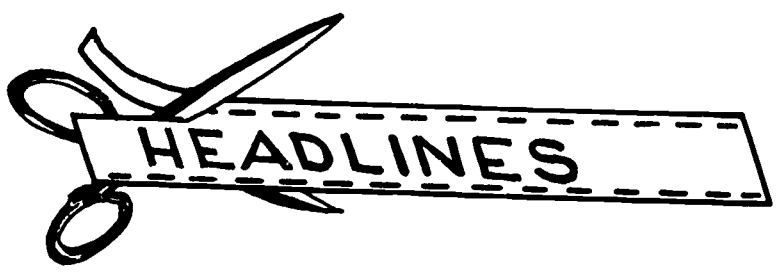
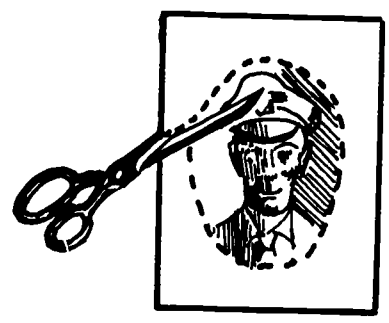
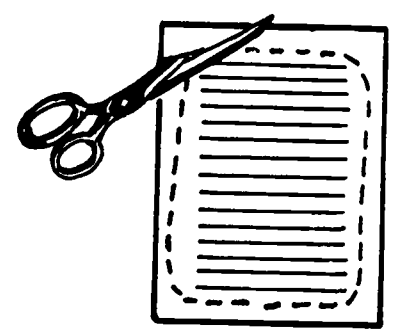


Fig. 25





4. Draw light blue guide lines to indicate the position of type illustrations. (Use drawing board and T square to assure squareness.)

5. Position the paste-up copy.

   a. Apply rubber cement to back of copy.

   b. Apply rubber cement to the desired area on the page.

   c. When both cemented surfaces are tacky, paste the copy into position.

   d. Check with T square for squareness.

   e. Remove excess cement with soft cloth.

   f. Erase the guide lines.

g. Remove all blemishes and shadows with white tempera paint.

h. Cover each finished page with a protective sheet of tissue.

6. Have the pupils prepare individual paste-ups.

Outcomes:

1. Manipulative skills

   a. to use a T square on a drawing board

   b. to use rubber cement

   c. to prepare proofs for paste-up

2. Safety practices

   a. to use scissors and razor blades safely

   b. to use and store inflammable materials

3. Academic learnings

   a. Language arts

      (1) vocabulary

align	paste-up
proportion	tacky
position	rubber cement
solvent	guide lines
margin	blemish

      (2) proofreading of copy

   b. Mathematics

      (1) measuring space allotments with a ruler

      (2) estimating cost of photo-copy (rate per word and cost of typewritten copy)

   c. Art

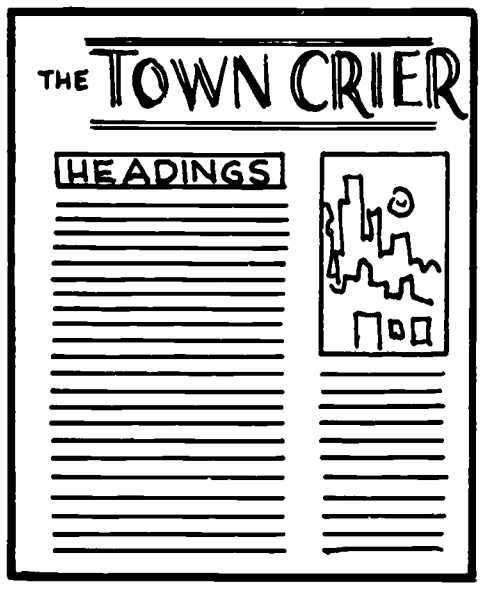
      (1) appreciation of good design

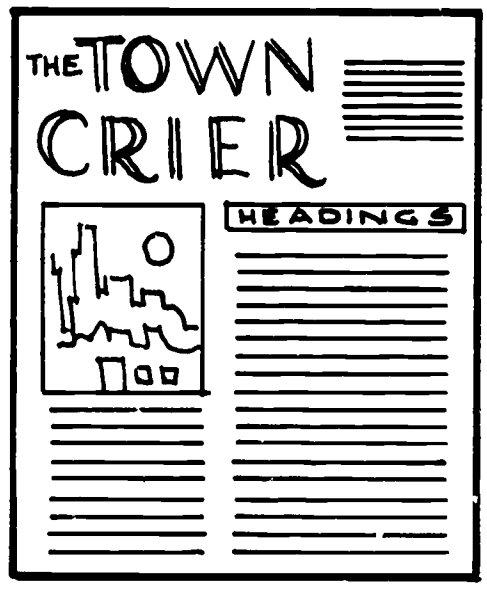
      (2) developing a sense of proportion and layout design

(3) developing an awareness of the skills needed in commercial art (drawing, hand lettering, photography, etc.)

Assignment:

Have the pupils design an original paste-up front page for a class newspaper.





Refere

Graphic Arts Tips, The Nu Arc Graphic Equipment Co., 410 West Grand Ave., Chicago, Ill.

Preparing an Offset Plate (Gevaert Process)

Materials and Equipment:

Materials

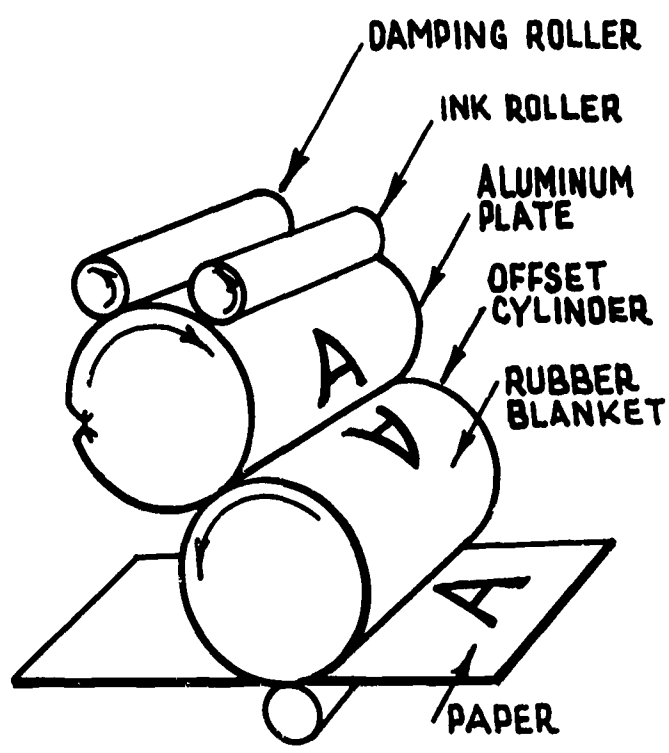
Gevacopy aluminum offset plates
Gevacopy negative slow offset paper
Gevacopy offset developer
Gevacopy offset fixer
Gevacopy offset duralak
Gevacopy offset corrector

Equipment

platemaker

Visual Aids:

Wall charts (Figs. 26 - 31) Fig. 26



Procedure:

1. Explain to the pupils that before they can print the newspaper they must make an offset plate of the copy to be printed.

2. Show the pupils a sample of a Gevacopy offset plate.

3. Demonstrate how to make an offset plate on the Gevacopy platemaking machine with the copy prepared for the newspaper.

   a. Center copy to be printed on the registration sheet.

   b. Place a Gevacopy negative sheet on top of the copy.

   c. Show the pupils how to lock the frame and make an exposure. (Fig. 27)

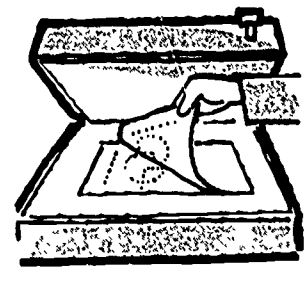


Fig. 27

   d. Pass the exposed negative paper with the Gevacopy aluminum offset plate through the developing unit (Fig. 28)

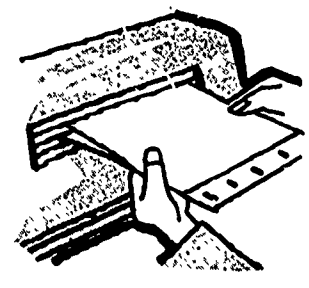


Fig. 28

   e. Allow the negative and aluminum plate to remain in contact for ten seconds. Then, separate the negative paper from the plate. (Fig. 29)

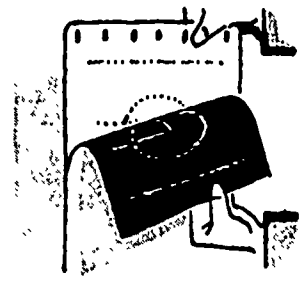


Fig. 29

   f. Rub down the plate with Gevacopy Fixer and Gevacopy Duralak. (Use a cotton pad.) (Fig. 30)

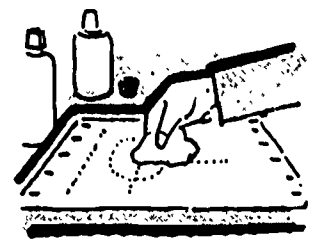


Fig. 30

   g. Mount the plate on the offset duplicator and prepare to make the press ready for printing. (Fig. 31)

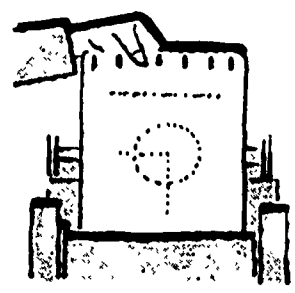


Fig. 31

4. Have two pupils prepare an offset plate of the copy for the school newspaper (one page) while the rest of the class observes.

5. Continue this procedure with additional pupils until the offset plates for the newspaper are completed.

Outcomes:

1. Manipulative skills

   a. to center copy on registration sheet

   b. to make Gevaert negative sheet

   c. to position negative sheet on aluminum plate

   d. to process negative and aluminum plate

   e. to develop and lacquer plate

   f. to mount the offset plate on the duplicator

   g. to make the press ready for printing

2. Safety practices

   a. to protect eyes and clothing (chemicals)

   b. to avoid cuts from sharp edges of plate

   c. to wash hands thoroughly after using chemicals

3. Academic learnings

   a. Language arts

      (1) vocabulary

repulsion	fixer
image	registration
lacquer	corrector
cylinder	transfer
developer	aluminum
offset	

      (2) reading labels on chemical bottles and other containers

b. Mathematics

(1) estimating time for correct exposure for developing plate

(2) estimating cost of the process (number of copies printed, cost of plate, chemicals, and ink)

c. Guidance

(1) vocational opportunities in the photo-offset industry and the skills required for these positions

commercial artist	copy writer
typist	printing estimator
Varitype operator	advertising designer

(2) job classifications in industry related to processes learned in school

d. Social studies

(1) effect of technological improvement on the printing industry

(2) automation and its effect on workers (leisure time, retraining, etc.)

e. Science

(1) principles of photography

(2) principles of lithography

Reference:

Guide for the Use of Gevacopy Material, The Gevaert Company of North America, Inc., Teterboro, New Jersey.

Operating an Offset Duplicator

Materials and Equipment:

Materials

ink
Gevaert plate for school newspaper
paper stock
blanket wash
fountain solution
soft rags or commercial "wipes"

Equipment

A. B. Dick Duplicator (Model #350)

Visual Aids:

Wall chart (Fig. 32)

Samples of work produced on an offset duplicator

Operating manual for Model #350 A. B. Dick Offset Duplicator

Procedures:

1. Explain the various parts of the Offset Press (Fig. 32).
2. Show pupils how to start and stop the press.
3. Show pupils how to place the rollers in position for operating.
4. To motivate the pupils, start the duplicator so that the pupils can observe how the "press rolls".
5. Demonstrate and explain the following procedures:
   a. inking the duplicator
   b. preparing the fountain solution
   c. setting the paper feed
   d. attaching the offset plate
   e. adjusting the ink and water settings

6. Have the pupils practice each of the procedures in #5 with the aid of teacher-prepared Operation Sheets.

7. Continue to demonstrate:

   a. Jog the paper stock.

   b. Load the paper stock on the machine.

   c. Start the machine and run off some of the copy for the school newspaper.

   d. Remove the printed sheets from the press.

   e. Jog the finished copies.

8. Have the pupils run off copy for the complete newspaper.

9. Demonstrate how to wash and clean the offset press when work on the newspaper is complete.

Outcomes:

1. Manipulative skills

   a. to start and stop the press

   b. to apply ink and dampen roller

   c. to place rollers into operating position

   d. to jog paper stock and load elevator table

   e. to remove paper from delivery stacker

2. Safety practices

   a. to dress properly when working on the press

   b. to exercise caution when operating press

   c. to wash hands after working with offset chemicals

   d. to store solvents and cleaning solutions in safe containers and cabinets

3. Academic learnings

a. Language arts

(1) vocabulary

aquamatic	counter
fountain	vacuum
image	solution
receptive	oscillating

(2) reading instructions for operating an offset duplicator

b. Mathematics

(1) determining cost of production

(2) determining rate of production, based upon capacity of press

c. Science

(1) properties of water and grease, and reaction to each other

(2) development of synthetic materials, such as butane

d. Social studies

(1) visual communication (Chinese block prints to modern offset methods of printing)

(2) effect of automation

e. Guidance

(1) vocational opportunities in the graphic arts industry in New York City

(2) requirements for union membership in the graphic arts industry

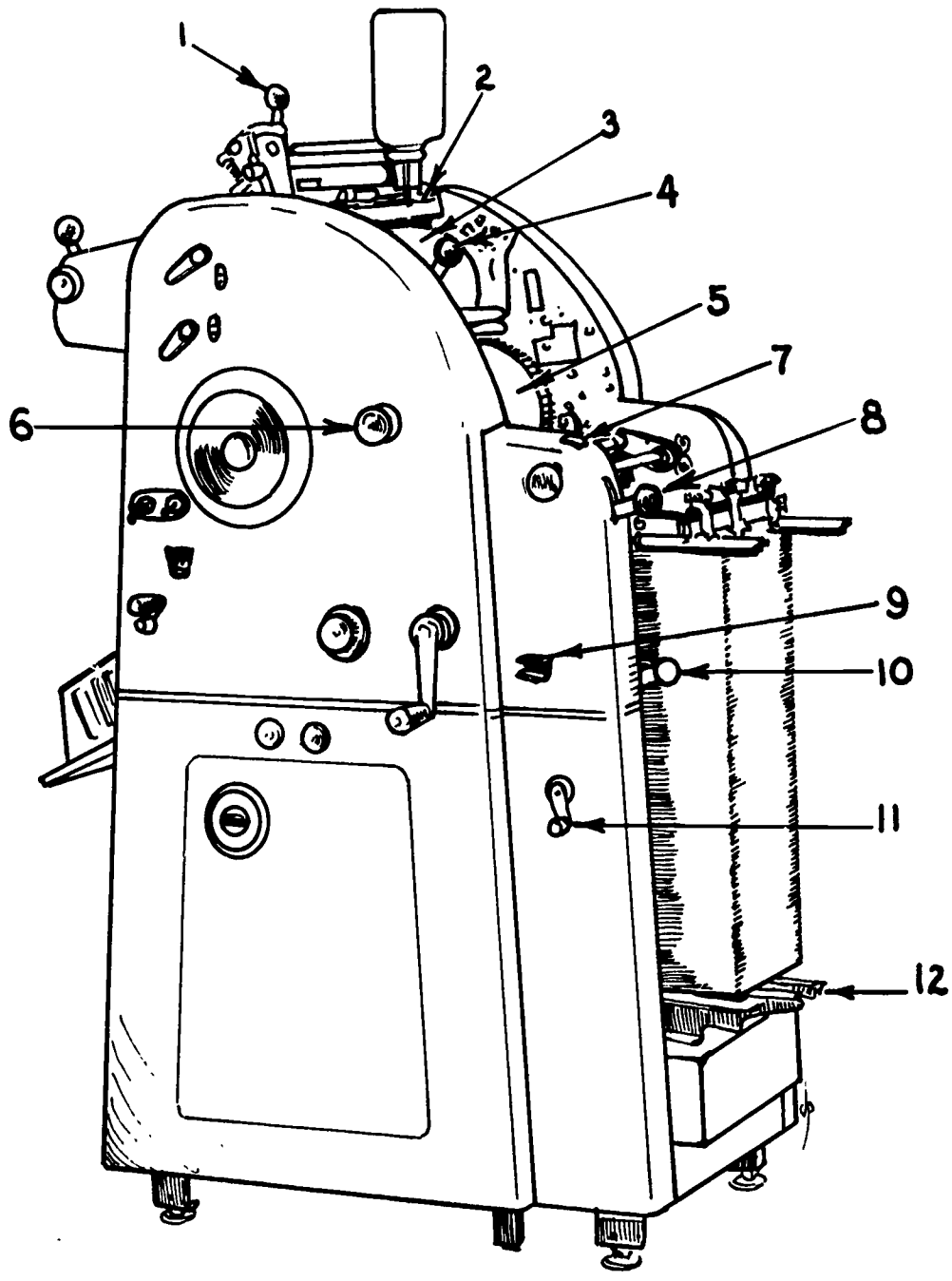
References:

Techniques of Offset, A. B. Dick Company, 5700 West Touhy Ave., Chicago, Ill.

Operating Instructions, Models 350 and 360, A. B. Dick Company, 5700 West Touhy Ave., Chicago, Ill.

Fig. 32

ASSIGNMENT SHEET



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

1. Label the numbered parts of the offset duplicator in Fig. 32.
2. The main purpose of the offset duplicator is _____

   _____
3. Three safety rules I must remember when running the press are:

   a. _____

   b. _____

   c. _____

OPERATION SHEETS

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Operation Sheet #1

Preparing to Use Varnish Remover

1. Lay newspapers on the bench top and on the floor in the work area.
2. Put on goggles to protect your eyes.
3. Put on a rubber apron to protect your clothing.
4. Put on a pair of rubber gloves to protect your hands.
5. Open the window to air the room because you will use varnish remover.
6. Pour a small amount of varnish remover into a clean can.
7. Get a clean paint brush. (1" for a small job, 2" for a large job)
8. Get a putty knife, lacquer thinner, and steel wool.

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #2

Working with Varnish Remover

1. Select one part of the object to be refinished.
2. Fill the brush with varnish remover and stroke over the part you selected.
3. Allow the varnish remover to soften the old finish (about two minutes).
4. When the old varnish looks soft and wrinkled, scrape it off with a putty knife.
5. Select a second part of the object to be refinished and repeat steps #2, 3, and 4.
6. Continue to remove the old varnish from the rest of the object until it is all removed.
7. Carefully pour the unused varnish remover back into the supply can and store the can in the metal paint cabinet.
8. Now, pour a small amount of lacquer thinner into another clean can.
9. Make a pad of steel wool.
10. Dip the steel wool into the lacquer thinner and scrub clean all of the surfaces of the object to be refinished.
11. The object is now ready for sandpapering.

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #3

Putting Things Away after Using Varnish Remover

1. Clean the brush with soap and water and store it in the paint cabinet.

2. Clean the putty knife with steel wool and varnish remover and store it in the tool cabinet.

3. Use turpentine to clean the can you used for varnish remover and store it in the paint cabinet.

4. Throw the newspaper and steel wool you used into the metal refuse container.

5. Store the gloves, apron, and goggles you used in the closet.

6. Wash your hands with soap and water and dry them well.

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #4

Applying a Wash Coat of Shellac (first coat)

Getting Ready:

1. Get the shellac jar and shellac brush from the storage cabinet.

2. Use a clean rag to remove all dust from the object to be shellacked.

3. Place the object to be shellacked on the finishing bench.

Applying Shellac:

1. Brush a thin, even coat of shellac on the whole object.

   a. Coat all areas at once.
   b. Brush each surface from the middle to the edge to avoid runs.

2. Allow the shellac ten minutes to dry.

Checking Your Work:	Circle One	
1. Are all parts of the object covered with shellac?	Yes	No
2. Are there any runs on the edges?	Yes	No
3. Is the shellac coat even?	Yes	No
4. Did you go over any area more than once?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #5

Applying Varnish

Getting Ready:

1. Sandpaper all surfaces of the object to be varnished with 6-0 garnet paper.
2. Remove all dust from the object.
3. Place the object on the finishing bench.
4. Take the can of varnish and a varnish brush from the storage cabinet.
5. Open the can of varnish. (Do not stir the varnish.)

Applying Varnish:

1. Dip 1/3 of the brush bristles into the varnish.
2. Brush the varnish on the object. (Stroke the brush from the raw surface to the varnished surface.)
3. Allow four hours for the object to dry in a dust-free area.

Checking Your Work:	Circle One	
1. Did you stir the varnish?	Yes	No
2. Are all areas of the piece covered with varnish?	Yes	No
3. Are there runs or drips on the edges?	Yes	No
4. Are there any air bubbles on the varnished surface?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #6

Smoothing a Varnish Finish with Pumice and Oil

Note: You should wait three days for the varnish coat on the object you are refinishing to dry, before you apply the pumice and oil finish.

Getting Ready:

1. Lay newspapers on the bench top.
2. Pour a small amount of pumice in a clean can.
3. Mix enough paraffin oil with the pumice to make a creamy solution.
4. Get several pieces of lint-free cloth.
5. Place the object to be finished on the newspaper.

Rubbing a Varnish Coat with Pumice and Oil:

1. Dip a piece of cloth in the pumice and oil mixture.
2. Rub the surfaces of the object with the pumice and oil mixture.
   a. Rub gently.
   b. Stroke with the grain of the wood.
3. Rub the pumice and oil mixture on the surfaces until the object is clean and dry.
4. Continue to rub the surfaces of the object until you get a desired finish.

Checking Your Work:	Circle One	
1. Did you stroke the surfaces with the grain of the wood?	Yes	No
2. Did you rub all areas well?	Yes	No
3. Did you remove all the pumice and oil from the piece?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #7

Adding Luster to a Varnish Finish

Getting Ready:

1. Lay newspaper on the bench top.
2. Pour a small amount of rottenstone in a clean can.
3. Mix enough water with the rottenstone to make a creamy solution.
4. Get several pieces of lint-free cloth.
5. Place the object to be finished on the bench top.

Rubbing a Varnish Finish with Rottenstone:

1. Dip a piece of cloth into the rottenstone and water mixture.
2. Rub the surfaces of the object with the rottenstone and water mixture.
   a. Rub gently.
   b. Stroke with the grain of the wood.
3. Rub the surfaces of the object till the luster appears.
4. Clean off all excess rottenstone solution with a clean cloth.

Checking Your Work:	Circle One	
1. Did you stroke with the grain of the wood?	Yes	No
2. Did you obtain a fine even luster?	Yes	No
3. Did you remove all the rottenstone and water?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #8

Polishing Furniture with Paste Wax

1. Get a small piece of clean cloth and a can of furniture wax.
2. Dip the cloth lightly into the can of paste wax.
3. Rub the paste wax over the surfaces of the object to be polished.
4. Wait a few minutes for the wax to dry.
5. Polish the surfaces of the object with a cloth until you get a desired finish.

Checking Your Work:	Circle One	
1. Did you apply too much wax?	Yes	No
2. Did you polish all of the surfaces of the object?	Yes	No
3. Did you get the finish you desired?	Yes	No

Date_____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #9

Using the Orbital Sander

Getting Ready:

1. Ask the teacher for permission to use the sander.
2. Place the object to be sanded near an electrical outlet.
3. Examine the sandpaper in the sander to see that it is satisfactory.
4. Inspect the electrical cord for cuts.

Sanding:

1. Be sure the switch of the sander is set on the OFF position.
2. Plug the electrical cord into the electrical outlet.
3. Place the sander on the surface to be sanded.
4. Grip the handles of the sander.
5. Turn the switch to the ON position.
6. Operate the sander by moving it slowly back and forth with the grain of the wood.

   Note: Avoid running the sander off the ends of the surfaces being sanded.

7. Turn the switch to the OFF position when the sanding is completed.
8. Inspect the surface for imperfections.
9. Repeat the sanding if there are imperfections.

Checking Your Work: Circle One

1. Did the machine dig into the surface at any time? Yes No
2. Did the sander run off the ends of the surfaces being sanded at any time? Yes No
3. Did you sand with the grain of the wood? Yes No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #10

Using the Belt Sander

Getting Ready:

1. Ask the teacher for permission to use the sander.
2. Place the object to be sanded near the electrical outlet.
3. Check the sandpaper in the sander to see that it is satisfactory.
3. Check the dust bag connection to see that it is secure.
4. Empty the dust bag if necessary.
5. Inspect the electrical cord for cuts.

Sanding:

1. Set the switch to the OFF position.
2. Plug the electrical cord into the electrical outlet.
3. Place the sander on the surface to be sanded.
4. Grip the handles of the sander.
5. Turn the switch to the ON position.
6. Operate the sander by moving it slowly back and forth with the grain of the wood.

   Note: Avoid running the sander off the ends of the surfaces being sanded.

7. Turn the switch to the OFF position.
8. Inspect the surface for imperfections.
9. Repeat the sanding if there are imperfections.

Checking Your Work:	Circle One	
1. Did the machine dig into the surface at any time?	Yes	No
2. Did the sander run off the ends of the surfaces being sanded at any time?	Yes	No
3. Did you sand with the grain of the wood?	Yes	No

Date_____

Pupil's Signature_____

Teacher's Remarks:

Operation Sheet #11

Drilling Pilot Holes

Getting Ready:

1. Lay out the location of the pilot holes with intersecting lines.
2. Get the wood screws needed.
3. Get the appropriate twist drill.
4. Put the twist drill in the hand drill.
5. Clamp the wood in a vise.

Drilling Pilot Holes:

1. Place the point of the drill on the center of the intersecting lines.
2. Firmly hold the handle of the drill down and turn the crank clockwise.

   Note: Hold the drill perpendicular to the wood when drilling the pilot holes.

Checking Your Work:	Circle One	
1. Did you drill the pilot hole straight?	Yes	No
2. Did you drill the holes in the center of the intersecting lines?	Yes	No

Date_____

Pupil's Signature_____

Teacher's Remarks:

Operation Sheet #12

Smoothing Wood

Things to Know:

1. Get coarse sandpaper to remove deep scratches and file marks on the surfaces being sanded.
2. Get medium sandpaper to remove medium scratches.
3. Use fine sandpaper to remove fine scratches.

Getting Ready:

1. Get a sandpaper block from the tool cabinet.
2. Wrap the sandpaper around the sandpaper block.

Smoothing the Wood:

1. Sand the wood surfaces with the grain of the wood.
2. Sand the edges and the ends of the wood.

Checking Your Work:	Circle One	
1. Have all the tool marks and scratches been removed?	Yes	No
2. Have all the pencil lines been removed?	Yes	No
3. Did you sand the surfaces with the grain of the wood?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #13

Countersinking Pilot Holes

Getting Ready:

1. Get a rose-pattern countersink and a bit brace from the tool cabinet and fasten the countersink in the brace.

2. Fasten the work to be drilled in a woodworking vise.

Boring Holes:

1. Place the point of the countersink in the pilot hole.

2. Hold the brace perpendicular to the wood being bored.

3. Turn the brace in a clockwise direction.

4. Continue to bore until the tapered recess is large enough for the head of the screw.

Checking Your Work:	Circle One	
1. Did the head of the screw fit into the hole?	Yes	No
2. Is there space over the screw head for plastic wood filler?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #14

Soldering Sheet Metal Seams

Getting Ready:

1. Clean the seams with steel wool.
2. Place the work to be soldered on the soldering bench.
3. Get the solder, flux, and soldering copper from the storage cabinet.
4. Put on a pair of asbestos gloves.
5. Turn on the gas furnace.
6. Tin the soldering copper.

Soldering:

1. Apply flux to the seam with a small brush.
2. Place the hot soldering copper at one end of the seam.
3. Touch the solder to the seam just ahead of the soldering copper.
4. When the solder melts, slowly draw the soldering copper along the seam and let the solder flow into the entire seam.
5. Let the solder harden before continuing with your work.

Putting Things Away:

1. Turn off the gas furnace.
2. Store the solder, flux, and soldering copper in the storage cabinet.
   Note: Be sure that the soldering copper is cooled before you store it.
3. Store the asbestos gloves.

Checking Your Work:	Circle One	
1. Is the seam soldered completely?	Yes	No
2. Is the solder smooth?	Yes	No
3. Is the gas furnace turned off?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #15

Preparing to Turn on the Wood Lathe

Getting Ready:

1. Select wood suitable for your project. (free of checks, splits, and knots)

2. Get a back saw, a center punch, a pair of dividers, and a ruler.

Laying Out the Wood:

1. Square the ends of the wood on the mitre box saw.

2. Find the center of each end of the wood by marking with diagonal lines.

3. Saw on the diagonal lines of one end of the wood with a back saw. (not more than 1/8" deep)

4. Center punch the other end of the wood where the diagonal lines intersect. (about 1/8" deep)

5. Check the centers for accuracy on both ends of the wood. (with dividers)

Checking Your Work:	Circle One	
1. Are the ends of the wood square?	Yes	No
2. Did you locate the centers accurately on the ends of the wood?	Yes	No
3. Is the wood free of checks, splits, and knots?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #16

Mounting Wood Stock on the Wood Lathe

Getting Ready:

1. Get a wooden mallet and the live center.
2. Drive the live center into the wood so that the spurs enter the saw kerfs already made by the back saw. (Use a wooden mallet to drive the live center into the wood.)

Mounting the Wood:

1. Put the live center with the wood firmly attached into the lathe head stock.
2. Extend the tail stock spindle 1" from the tail stock housing.
3. Slide the tail stock dead center into the center of the wood.
4. Lock the tail stock in this position.
5. Back out the dead center by turning the tail stock hand wheel.
6. Lubricate the dead center.
7. Adjust the dead center until it is firmly imbedded in the wood.
8. Rotate the wood (by hand) to check the adjustment. (Wood should rotate freely.)
9. Lock the tail stock spindle.

Checking Your Work:	Circle One	
1. Is the tail stock lubricated?	Yes	No
2. Are the centers imbedded firmly in the wood?	Yes	No
3. Does the wood rotate freely when turned by hand?	Yes	No
4. Did your teacher check the way you mounted the wood in the lathe?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #17

Adjusting the Tool Rest on the Wood Lathe

Getting Ready:

1. Get a tool rest which fits between the two centers of the wood you are planning to turn.

2. Put the tool rest into the tool rest holder of the lathe.

Making Adjustments:

1. Raise the tool rest so that it is 1/8" above the centers of the wood that is mounted in the lathe.

2. Lock the tool rest in position with the tool rest clamp.

3. Move the tool rest toward the mounted wood as close as possible.

4. Move the tool rest away from the wood so that it clears the wood when it is rotated by hand. (The tool rest should never be more than 3/8" away from the wood being turned.)

5. Lock the tool rest holder in position.

Checking Your Work:	Circle One	
1. Is the tool rest 1/8" above the centers of the wood mounted in the lathe?	Yes	No
2. Can you rotate the wood on the lathe (by hand) without touching the tool rest?	Yes	No
3. Is the distance between the wood and the tool rest approximately 1/8"?	Yes	No
4. Is the tool rest locked in position?	Yes	No
5. Did you ask the teacher to check the tool rest adjustments?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #18

Operating the Scroll Saw

Getting Ready:

1. Adjust the hold-down presser foot so that it rests on the wood you are planning to saw.
2. Lock the hold-down presser foot with the thumb screw.
3. Put on safety goggles.
4. Check the belt guard and the blade guard to see that they are secure.

Operating the Scroll Saw:

1. Start the scroll saw and move the wood slowly toward the saw blade. (Keep hands away from the blade.)
2. Press down firmly on the wood as you guide it so that the saw blade cuts on the lines marked.
3. When sawing angles, saw each side of the angle separately (from the outside in).
4. When you finish your sawing, brush the sawdust and wood scraps from the machine and sweep up the work area. (Do not blow sawdust.)

Checking Your Work:	Circle One	
1. Did you saw on the lines you marked on the wood?	Yes	No
2. Did the wood vibrate a great deal when you were sawing?	Yes	No
3. Did you use the correct method for sawing angles?	Yes	No
4. Did you observe all shop safety practices?	Yes	No
5. Did you brush the scroll saw after completing your work?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #19

Preparing to Drill Holes in Metal on a Drill Press

Getting Ready:

1. Get the correct size twist drill.
2. Put the twist drill into the drill press chuck.
3. Tighten the drill press chuck with the drill chuck key. (Remove the chuck key immediately after tightening the chuck.)
4. Adjust the drill press table.
5. Fasten the metal to be drilled with a drill vise, clamps, or fixtures.
6. Move the drill point toward the metal and align it with the center punched hole.
7. Put a drop of cutting oil on the center punched hole.

Checking Your Work:	Circle One	
1. Did you get the correct size twist drill?	Yes	No
2. Is the drill press table adjusted correctly?	Yes	No
3. Is the twist drill locked firmly in the drill press chuck?	Yes	No
4. Did you remove the drill press key after you tightened the drill press chuck?	Yes	No
5. Is the metal fastened and ready for drilling?	Yes	No
6. Did you ask your teacher to check your work?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #20

Drilling Holes in Metal on the Drill Press

Getting Ready:

1. Put on clean goggles.
2. Roll up your shirt sleeves.
3. Tuck in your tie.
4. Fasten the metal you are drilling to the drill press table.

Drilling Holes:

1. Start the machine and feed the drill slowly into the metal.
   a. Add cutting oil to prevent the drill from overheating.
   b. Use light pressure to avoid breaking the drill or tearing the metal.
2. Stop the machine after you have completed the drilling operation.
3. Remove the twist drill and all fastening devices from the drill press and return them to the tool storage cabinet.
4. Clean the drill press and the drill press area.
   a. Brush the metal shavings into a dust pan.
   b. Wipe the excess oil from the machine with a wiping rag.

Checking Your Work:	Circle One	
1. Did you drill accurately?	Yes	No
2. Did you let the twist drill overheat?	Yes	No
3. Did you break the twist drill?	Yes	No
4. Did you wear safety goggles?	Yes	No
5. Did you clean the drill press and the drill press area?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #21

Replacing a Toggle Switch

Getting Ready:

1. Get a screw driver with an insulated handle, a test lamp, and a new toggle switch.

2. Turn off the power to the toggle switch.

Removing the Old Toggle Switch:

1. Remove the switch plate.

2. Use a test lamp to see if the power is off.

3. Remove the screws that hold the switch in the switch box. Then pull the switch out to expose the terminal screws.

4. Loosen the terminal screws and detach the wires from the switch.

Installing the New Toggle Switch:

1. Attach the wires to the new switch.

   a. Bend the ends of the wires into loops to fit around the terminal screws.

   b. Attach the loops to the terminal screws (in the direction the screw turns when tightening).

2. Press the newly attached switch into the switch box.

3. Fasten the new switch to the switch box (with screws).

4. Put the switch plate back into place and fasten it with screws.

5. Turn on the power and test the new toggle switch.

Checking Your Work:	Circle One	
1. Did you test to see if the power was off before you removed the switch?	Yes	No
2. Did you attach the loops to the terminal screws correctly?	Yes	No
3. Did the new toggle switch work satisfactorily?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #22

Cutting Window Glass

Getting Ready:

1. Cover the work bench with newspapers to cushion the glass during the glass cutting operation.
2. Get a straightedge, a ruler, a can of kerosene, a glass cutter, a brush, a pair of goggles, and a pair of gloves.
3. Measure and mark the piece of glass to be cut.
4. Place the straightedge on the marks made on the glass.
5. Brush kerosene along the straightedge.
6. Dip the glass cutter wheel into the kerosene to lubricate it. (This prevents chipping and flaking of the glass.)

Cutting the Glass:

1. Hold the straightedge down firmly on the marks and score the break line. (Hold the glass cutter in a perpendicular position.)
2. Move the glass on the workbench so that the waste part extends over the edge of the work bench.
3. With the ball end of the glass cutter, tap the glass along the score line (on the reverse side).
4. Return the glass cutter and other tools to the tool storage area.
5. Put the used newspaper into the metal container.
6. Clean up the work bench and the work area.

Checking Your Work:

		Circle One	
1.	Did you cut the glass to the correct dimension?	Yes	No
2.	Did you remove all glass waste from the work bench?	Yes	No
3.	Did you clean the work bench and the work area?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #23

Putting Glass in a Window Sash

Getting Ready:

1. Get a putty knife, glazing compound, glazier's points, linseed oil, gloves and newspaper.
2. Brush a light coat of linseed oil on the rabbet of the window sash, where the window glass will be placed.
3. Put a thin layer of glazing compound on the rabbet.

Installing the Glass:

1. Bed the window glass in the layer of glazing compound.
2. Put the glazier's points flat against the glass and press them into the rabbet with a putty knife. (4" apart)
3. Apply more glazing compound to fill the space between the glass and the rabbet. (Use a putty knife and hold it at a 45° angle.)
4. Put away all the supplies.
5. Clean the putty knife before returning it to the tool cabinet.
6. Clean up the work area.

Checking Your Work: Circle One

1. Did you use linseed oil on the window sash? Yes No
2. Did you use glazier's points to hold the glass? Yes No
3. Did you apply the compound with a putty knife? Yes No
4. Did you clean up the work area? Yes No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #24

How to Repair a Bicycle Tire Tube

Getting Ready:

1. Get a valve wrench, an air pump, an inner tube scraper, a rubber patch, rubber cement, a tire test tank, yellow crayon, rags, a knife, and carbon tetrachloride.

2. Locate the puncture in the tube:

   a. Inflate the tube.
   b. Immerse the tube in the water-filled tire test tank.
   c. Locate the puncture and mark it with a yellow crayon.

3. Deflate the tube.

4. Remove valve stem. (Use wrench end of tire dust cap.)

5. Repairing the tube:

   a. Cut a patch to fit the puncture. (Cut off corners of patch.)
   b. Clean the punctured area with carbon tetrachloride.
   c. Scrape the punctured area with a scraping tool.
   d. Apply a coat of rubber cement to the scraped area.
   e. Peel the cloth backing from the patch and apply the adhesive side of the patch to the punctured area.
   f. Replace the valve stem.
   g. Inflate the tube.
   h. Submerge the repaired area of the tube into the tire testing tank.
   i. Return all tools and supplies to storage cabinets.

Checking Your Work:	Circle One	
1. Are all edges of the patch tightly sealed?	Yes	No
2. When you tested the repaired tube in the test tank, did you see any air bubbles?	Yes	No

Date_____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #25

Removing a Tire from a Bicycle Wheel

Getting Ready:

1. Get two screw drivers and a valve wrench from the tool cabinet.

2. Remove the valve stem from the inner tube valve with the valve wrench.

Removing the Tire:

1. Loosen the tire bead from the wheel rim.

2. Press one side of the tire bead into the wheel well.

3. Loosen the tire bead by inserting a screw driver between the wheel rim and the tire bead. (Avoid puncturing tire tube with the screw driver.)

4. Insert the second screw driver between the rim and the tire bead (about four inches from the first screw driver) and continue loosening the tire bead.

5. Remove the inner tube valve from the valve hole and pull the inner tube out of the tire.

6. Press the other side of the tire bead into the wheel well to remove the tire from the wheel.

7. Return the two screw drivers and the valve wrench to the tool cabinet.

Checking Your Work:	Circle One	
1. Did you puncture the inner tube with the screw driver?	Yes	No
2. Did you tear the tire bead?	Yes	No

Date _____

Pupil's Signature_____

Teacher's Remarks:

Operation Sheet #26

Mounting a Tire on a Bicycle Wheel

Getting Ready:

1. Get two screw drivers, a tire pressure gauge, and a tire pump from the tool cabinet.

2. Remove the valve stem from the inner tube with the valve wrench.

Putting the Tire on the Bicycle Wheel:

1. Insert one tire bead into the well of the bicycle rim.

2. Insert the screw driver between the tire bead and the wheel rim and fit the rest of the tire bead over the wheel rim.

3. Insert the valve stem into the valve hole of the wheel.

4. Insert the inner tube into the tire.

5. Insert the other tire bead into the well of the wheel rim.

6. Replace the valve stem on the inner tube valve.

7. Inflate the tire. (Check recommended pressure on the wall of the tire.)

8. If the tube appears pinched, deflate the tire.

9. Return the tools, the tire pump, and the tire pressure gauge to the tool cabinet.

Checking Your Work:	Circle One	
1. Are the tire beads placed correctly on the rim?	Yes	No
2. Does the tire tube appear pinched between the tire and the rim?	Yes	No
3. Did you check the recommended pressure on the wall of the tire before you inflated it?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #27

How to Replace a Worn Bicycle Pedal

Getting Ready:

1. Get an open-end automobile valve tappet wrench, a flat smooth file, rags, lubricating oil, penetrating oil, a bicycle stand, and a new bicycle pedal (left pedal marked "L", right pedal marked "R").

2. Turn the bicycle upside down on the bicycle stand.

3. Pour a few drops of penetrating oil on the threaded shaft of the pedal to be removed. (Allow several minutes for the oil to loosen the pedal.)

Replacing the Pedal:

1. Loosen the threaded shaft of the pedal with a 5/8" open end automobile valve tappet wrench (clockwise for right pedal, counter clockwise for left pedal).

2. Remove old pedal.

3. If the shaft is burred, smooth it with a flat file.

4. Check the new pedal. It should rotate freely on the ball-bearing axis.

5. Install the new pedal on the threaded shaft. Hold shaft firmly to prevent stripping the thread.

6. Tighten shaft with a 5/8" open end wrench.

7. Return tools and supplies to storage cabinets.

Checking Your Work:	Circle One	
1. Did you strip the threads on the shaft?	Yes	No
2. Did the pedal rotate freely?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #28

Aligning a Bicycle Wheel

Getting Ready:

1. Turn bicycle upside down and rest it on the floor.
2. Get two open end wrenches to fit the axle nuts of the wheel to be aligned.
3. Get a piece of chalk.

Aligning the Wheel:

1. Spin the wheel and make a chalk mark on the tire where it rubs against the frame.
2. Loosen the axle nuts of the wheel with the open end wrenches. (Do not remove the nuts.)
3. Center the wheel on the frame and tighten the axle nuts.
4. Rotate the wheel to see if it is properly aligned.
5. Repeat steps #1, #2, #3, and #4 if the wheel still rubs against the frame.

Checking Your Work:	Circle One	
1. Does the wheel rotate freely?	Yes	No
2. Are the axle nuts tight?	Yes	No
3. Did you store the tools in the tool cabinet?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

Operation Sheet #29

Installing Handle Bar Grips

Getting Ready:

1. Place the bicycle in the bicycle stand.
2. Remove the old handle bar grips. (Use a knife if it is necessary to cut the grips loose.)
3. Get a new pair of handle bar grips, a sheet of emery cloth, shellac, rubber cement or hardening type automotive gasket cement, and a wiping rag.

Installing the Handle Bar Grips:

1. Loosen all rust, dirt, or hardened cement from the grip ends of the handle bars by rubbing with emery cloth.
2. Remove all dust, rust, or dirt from the handle bars with a wiping rag.
3. Apply cement to the handle bar ends.
4. Install the new grips on each side of the handle bar while the cement is moist.
   a. Push the grips in as far as they will go.
   b. Be sure the finger grooves are on the under side.
5. Allow the cement to dry thoroughly.

Checking Your Work:	Circle One	
1. Have the grips been cemented with the finger grooves on the under side?	Yes	No
2. Have you wiped off any extra cement?	Yes	No

Date _____

Pupil's Signature _____

Teacher's Remarks:

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ABSTRACT - Prepared in a 6-week curriculum workshop to develop training programs for off-farm agricultural occupations, this curriculum guide is for use in planning and implementing 11th-and 12th-grade training programs in wildlife and recreation. The 520-hour course is divided into three general subject areas: applied agricultural mechanics, applied production agriculture, and applied business principles and procedures basic to wildlife and recreation. Some representative titles included in the 19 units under these three general headings are; (1) Small Engines and Equipment, (2) Maintenance and Operation of Tractors and Allied Equipment, (3) Tool Selection and Maintenance, (4) Irrigation Systems, (5) Insect, Disease, and Pest Control, (6) Game and Fish Management, (7) Care of Plants and Soils, (8) Ornamental Horticulture, (9) Wildlife and Recreation Communication, and (10) Human Relations. Each unit provides content, objective, competencies to be developed, student motivation, teaching outline and suggestions, student activities, references and teaching aids, and evaluation. (AW)

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A

TRAINING PROGRAM FOR VOCATIONAL AGRICULTURE

IN

WILDLIFE AND RECREATION

LOUISIANA STATE DEPARTMENT OF EDUCATION
Vocational Education Division

in cooperation with

LOUISIANA STATE UNIVERSITY
Agricultural Education Department
and the
General Extension Division
Baton Rouge

00282

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FOREWORD

Passage of the National Vocational Education Act in 1963, together with the need for fewer people on the farm as a result of advancing technology and automation, focuses attention upon the need for a school program that will provide appropriate training for boys who desire employment in off-farm agriculture.

Helping farm youth to find off-farm careers is now becoming widely accepted as a responsibility of vocational agriculture, even though preparation for farming will undoubtedly continue to be its major goal. Acceptance of this new concept is paving the way for widespread efforts towards program planning for the many students in vocational agriculture who need jobs but require something more than the traditional program to qualify.

For the boys who aren't going to farm, but wish to stay within the agricultural field where their farm background can be used as capital, the obvious answer is that they must seek jobs in the nonfarm sector of the economy. Increasing specialization has greatly expanded the number of jobs in nonfarm firms performing tasks that were formerly done on the farm. Surveys in Louisiana made by Louisiana State University show that a great majority of these businesses prefer employees with a background in agriculture.

The potential of these firms to attract farm boys with work opportunities is shown from a survey of the state's larger metropolitan areas. These cities were found to contain 1,067 agricultural firms having 30,300 employees. Among the employees were 9,087 workers with agricultural competencies, holding 1,582 different job titles--all involving knowledge and skill in agricultural subjects. Over a five-year span employee numbers will grow by 9,836, including 1,800 who must have agricultural training prior to job entry. These jobs beckon youth who will have to take the big step and move away from the farm.

From a structural standpoint, nonfarm agricultural firms follow an organizational pattern developed according to products handled, or services rendered to the farmer and the buying public. Similar concerns compete with each other. They handle about the same product or service and have employees with comparable training and experience. Even where differences exist in products handled or services performed, the workers involved still profit by the same training and experience.

Such a close similarity between firms engaged in handling the same product or service permits a grouping under descriptive family headings which tends to wrap up employees having commonalities in training and duties.

Familism, as a type of classification of nonfarm agricultural firms, simplifies the approach to building training programs, as it offers an opportunity to train for a family of occupations rather than for specific job titles which are far too numerous to identify in a training program.

The structure and function of the nonfarm "family of agricultural occupations" and the role they should play in developing training programs for use in high schools was covered in a six-week "curriculums laboratory" undertaken at L.S.U., beginning January 3, 1966, by the State Department of Education in cooperation with L.S.U.'s Department of Agricultural Education. Personnel from vocational agriculture, distributive education, and office occupations were selected to make up a task force, which was charged with the responsibility of developing training programs for off-farm agricultural jobs.

This team approach was used in structuring new programs designed for each family of agricultural occupations, including:

Farm Machinery Sales & Service	Farm Supplies & Equipment
Livestock & Poultry	Wildlife & Recreation
Crops, Forestry, & Soil Conservation	Ornamental Horticulture
Farm Service	Agricultural Service

Subject matter areas made a part of each program were: Agricultural Mechanics considered basic to the occupational family, Agricultural Production applicable to the occupational family, Business Principles and Procedures relating to the occupational family, Leadership Training, and Pre-employment Work Experience. Units of instruction, along with lessons were structured for each instructional area.

When used at the local level any of these programs will accompany or serve as an alternative to the program in production agriculture at the 11th and 12th grade levels---they will allow farm youth to use their agricultural background most effectively. Yet, to attain full potential each program will require a teacher-team approach, using the services of office and distributive occupations to strengthen the efforts of the agricultural instructor.

In developing a specialized program aimed at preparing youth for jobs in Wildlife and Recreation, the task force made a thorough examination of the educational needs of those going into this family of occupations, together with potential job opportunities.

The major metropolitan areas of the state were found to contain 29 different concerns that could be classified under Wildlife and Recreation. These agencies employed 1,536 workers, of which over 300 had knowledge and skill in agricultural subjects. Over the coming 5-year span an additional 300 workers will be employed. Workers with agricultural competencies served under 63 specific job titles. These figures do not take into account the concerns known to be operating outside the metropolitan areas surveyed.

The number of schools electing to use the program in Wildlife and Recreation will necessarily be limited to areas in the state where situations favorable to success now exist or can be developed with the addition of new resources

TITLE OF COURSE: Wildlife and Recreation

OBJECTIVE: To familiarize the students with and prepare them for job entry in the field of wildlife and recreation

TIME ALLOTMENT:

In School:

Class Instruction	215	hrs.
Shop or Laboratory Work	105	hrs.
Total	320	hrs.
Occupational or Job Experience	200 (minimum)	hrs.
Course Total	520	hrs.

GRADE LEVEL OF THE COURSE: Eleventh and twelfth grades

PERSONS TO BE SERVED: High school students at the junior and senior level, out of school youths, and adults interested in obtaining training leading to job entry in wildlife and recreation

SUPPORTING VOCATIONAL SERVICES: Distributive Education
Office Occupations

SUPPORTING ACADEMIC SUBJECTS: English, Mathematics, Science, Journalism

INTRODUCING THE COURSE:
1. Procedure to be determined by individual instructor
2. Suggested procedure for course introduction

INSTRUCTOR:
Today, with wages higher and hours shorter, people are looking for ways to spend their leisure time and extra money. More and more game preserves and recreational areas are being established by the government as well as individuals or private enterprise. This provides many job opportunities in the field of wildlife and recreation. Many farmers and ranchers are providing these facilities to add additional income. This provides a variety of opportunities for graduates who are interested in working outdoors and who like jobs associated with plant materials and wildlife.

Point out some of the requirements for job success, such as:

1. Willingness to work and learn
2. General appearance
3. Skills in business principles
4. Getting along with people
5. Good citizenship
6. Skills in wildlife management
7. Skills in plant and animal care
8. Ability to follow instructions
9. Skills in maintenance of recreational equipment
10. Safety consciousness

Explain in general terms the areas to be covered by the course

Point out some of the available jobs in wildlife and recreation

1. Game bird propagator
2. Game management employee
3. Golf course employee
4. Grounds maintenance employee
5. Riding stable employee
6. Animal trainers
7. Others

TEACHING UNITS MAKING UP THE COURSE:

A. Applied agriculture mechanics basic to wildlife and recreation
   1. Small engines and equipment
   2. Building, maintaining, and renovating of wildlife and recreation structures
   3. Establishing shops
   4. Maintenance and operation of tractors and equipment
   5. Tool selection and maintenance
   6. Irrigation systems

B. Applied production agriculture basic to wildlife and recreation
   1. Insect, disease, and pest control
   2. Game and fish management
   3. Care of animals used for recreational purposes
   4. Care of plants and soils
   5. Recreational projects for income
   6. Wildlife and recreation communication
   7. Ornamental horticulture

C. Applied business principles and procedures basic to wildlife and recreation
   1. Orientation and scope of wildlife and recreation
   2. Job procurement
   3. Organization and management of business
   4. Human relations
   5. Legal information
   6. Sales promotion

D. Leadership training
   1. FFA

AGRICULTURE III

OPTION B--WILDLIFE AND RECREATION, NON-FARM AGRICULTURE

Instructional Area	Hours	Instructional Unit	Hours
I. Applied Agriculture Mechanics Basic to Wildlife and Recreation	60	1. Small Engines and Equipment a. Selection and operation of small engines and equipment b. Maintenance and repair of small engines and equipment c. Storage of small engines and equipment	35
		2. Building, Maintaining, and Renovating of Wildlife and Recreation Structures a. Constructions b. Types and designs of structures c. Care and maintenance of structures	20
		3. Establishing Shops a. Arranging a shop b. Requisitioning supplies	5
II. Applied Production Agriculture Basic to Wildlife and Recreation	70	1. Insect, Disease, and Pest Control a. Agriculture chemicals--use, laws, and regulations b. Weed control c. Pest control of plants d. Pest control of animals associated with wildlife and recreation e. Controlling household pests f. Prevention and control of plant diseases	30
		2. Game and Fish Management a. Classification and characteristics of game species b. Specific management practices for important game species c. Multiple use of forest lands d. Fish pond management e. Wildlife income f. Wildlife predator control	20
		3. Care of Animals Used for Recreational Purposes a. Feeding animals(dogs, horses, etc.) b. Animal sanitation	20

		c. Grooming of animals d. Housing and equipment for animals e. Training of animals	
III. Applied Business Principles and Procedures Basic to Wildlife and Recreation	20	1. Orientation and scope of Wildlife and Recreation Businesses a. The American Enterprise System b. Wildlife and recreational opportunities in the community	5
		2. Job Procurement a. Applying for a job b. Human relations on the job	5
		3. Organization and management of business a. Types of businesses b. Principles of business management	5
		4. Human Relations a. Dealing with employer or supervisor b. Dealing with co-workers c. Dealing with the public	5
IV. Leadership Training	10	1. FFA a. Program of work b. Judging contests c. Parliamentary procedures d. Public speaking	10
V. Supervised Experiences Basic to Wildlife and Recreation	100		

AGRICULTURE IV

OPTION B--WILDLIFE AND RECREATION, NON-FARM AGRICULTURE

Instructional Area	Hours	Instructional Units	Hours
I. Applied Agriculture Mechanics Basic to Wildlife and Recreation	45	1. Maintenance and Operation of Tractors and Equipment	25
		a. Types of tractors and equipment	
		b. Operation and care of tractors and equipment	
		c. Maintenance of tractors and equipment	
		d. Storage of tractors and equipment	
		2. Tool Selection and Maintenance	10
		a. Selection and maintenance of hand and power tools	
		b. Fitting and shaping hand and power tools	
		3. Irrigation Systems	10
		Plan and install and service irrigation systems	
II. Applied Production Agriculture Basic to Wildlife and Recreation	80	1. Care of Plants and Soils	25
		a. Plant propagation	
		b. Soil preparation for planting shrubs, trees, grasses, flowers, etc.	
		c. Fertilization of plants used in golf greens, parks, etc.	
		d. Pruning, trimming, and care of existing plants	
		2. Recreational Projects for Income	10
		a. Recreational projects dealing with game and fish	
		b. Other projects for recreational income	
		3. Wildlife and Recreation Communications	10
		a. Communication media	
		b. Analyzing reports	
		4. Ornamental Horticulture	35
		a. Identification of ornamental horticultural plants	
		(1) Plant vocabulary and botanical names	
		(2) Identification of plants by physical appearance, growth, and plant keys	
		b. Establishing and caring for lawns and turf	

III.	Applied Business Principles and Procedures Basic to Wildlife and Recreation	25	1. Legal Information a. Employment certificates b. Labor laws c. Social security laws d. Income tax	10
			2. Job Procurement Review of third year	5
			3. Sales Promotion a. Advertising as a means of sales promotion b. Personal selling	10
IV.	Leadership Training	10	1. FFA a. Programs of work b. Judging contests c. Parliamentary procedure d. Public speaking	10
V.	Supervised Experiences Basic to Wildlife and Recreation	100		

UNIT 1

SMALL ENGINES AND EQUIPMENT

One of nineteen units of instruction in the occupational family

Wildlife and Recreation

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Agricultural Mechanics Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Small Engines and Equipment

UNIT OBJECTIVE: To develop the ability to select and maintain small engines and equipment necessary in the operation of a business in the field of wildlife and recreation

TIME ALLOTMENT:

In School:

Class Instruction	5	hrs.	
Shop or Laboratory Work	30	hrs.	
Total	35	hrs.	
Occupational or Job Experience		hrs.	(To be determined by
Unit Total		hrs.	individual teachers)

COMPETENCIES TO BE DEVELOPED:

1. Ability to select small engines and equipment
2. Ability to maintain and operate small engines and equipment
3. Ability needed to make adjustments and repairs on small engines and equipment
4. Ability to use the service manual of small engines and equipment

STUDENT MOTIVATION:

To create a desire needed for the development of competencies essential to job entry by:

1. Relating the growing importance of wildlife and recreation and the importance of power equipment
2. Pointing out the importance of the knowledge of small engines and equipment for job entry in wildlife and recreational businesses
3. Showing films relating to the use of power equipment in recreational areas

TEACHING THE UNIT:

I. Organization

A. Lessons to be Taught
   1. Selection and operation--gasoline engines and equipment
   2. Maintenance and repair of small gasoline engines and equipment
   3. Storage of small engines and equipment

B. Instructional Materials
   1. Service manuals of several types of engines
   2. Several small engines and equipment operated by small engines
   3. Outboard motors
   4. Charts, films, and filmstrips
   5. Necessary tools for engine repairs

C. Job Experience
   1. Local sporting goods stores
   2. Park and recreational area

3. Marina
4. Service and repair shops

II. Teaching the Lesson

Lesson 1: Selection and Operation of Small Engines and Equipment

A. Objectives
1. Acquaint students with the different types and makes of small engines and equipment that are in use
2. To develop the ability to make the proper selection of engines and equipment
3. To understand the importance of equipment to the business of wildlife and recreation
4. Develop safety techniques needed in use of small engines and equipment

B. Motivation
1. Films and slides secured from equipment companies
2. Select several types and makes of engines and point out the proper use of each type
3. Demonstrate the advantages of certain types of engines and equipment over others
4. Illustrate simple adjustments of small engines
5. Stress the importance of safety precautions that must be taken in the use of any and all equipment operated by these small engines
6. Emphasize the great possibilities of job entry

C. Subject Matter Content
Assignment: What students need to learn
1. Definition of the following: engine, motor, internal combustion, external combustion, compression, cycle, vertical, horizontal, micrometer, four cycle, two cycle, S.A.E., calipers, peen, detonation, R.P.M.
2. Types and makes of engines and equipment used in:
   a. Marina
   b. Country clubs
   c. Recreation parks
   d. City parks
   e. Riding clubs
3. Dealers that handle engines and equipment needed in local area
4. Nearest authorized repair -service shops for engines and equipment used in wildlife and recreational area
5. Principles of an internal combustion engine
6. Major components of a small engine
7. Major components of equipment operated by engine
8. Factors to consider in selecting an engine and equipment
9. Principal parts of equipment that are most likely to wear and break
10. Advantages of two cycle engines; four cycle engines

E. Teaching Aids and References
1. Charts of equipment and engines
2. Brochures of the different makes

3. Several types and makes of engines and equipment
4. Cutaway model of four-cycle and two-cycle engines
5. Major components of a disassembled engine
6. The ABC'S of Internal Combustion
7. All About Small Gas Engines
8. General Theories of Operation, Briggs and Stratton Corporation
9. Farm Mechanics Text and Handbook, Phipps, McColly, Scranton, Cook
10. Farm supply and equipment catalogs of various companies(Sears, Wards, etc.)
11. Brochures from equipment dealers

II. Teaching the Lesson

Lesson 2: Maintenance and Repair of Small Engines and Equipment

A. Objectives
1. To develop the ability of the student to recognize and identify all parts of small engines and equipment
2. Disassemble and reassemble engine and equipment
3. Make necessary repairs

B. Motivation
1. Have students bring a small engine and equipment from home
2. Select several of the most common types of engines and equipment used in wildlife and recreation and point out where simple trouble may develop
3. Demonstrate the importance of simple maintenance and adjustment in saving labor and costly repairs

C. Subject Matter Content
Assignment: What students need to learn
1. Nomenclature of small gasoline engine
a. Main engine components
(1) Crankcase and cylinder block
(2) Cylinder head
(3) Spark plug grounding switch
(4) Crankcase breather
(5) Bearing plate
(6) Valves, springs, and keepers
(7) Tappet cover plate
(8) Governor control lever
(9) Governor weight assembly and shaft
(10) Valve tappets
(11) Spark advance weight and spring
(12) Cam gear
(13) Engine base
(14) Cam shaft and plug
(15) Governor crank assembly
(16) Governor lever assembly
(17) Throttle link
(18) Governor control rod
(19) Main bearings

(20) Piston, rings and ring assembly
(21) Connecting rod and oil slinger
(22) Crankshaft
(23) Reduction gear assembly

b. Air, fuel, and exhaust system components
(1) Fuel tank, fuel tank outlet
(2) Exhaust outlet and muffler
(3) Carburetor upper body
(4) Throttle, throttle lever, choke, choke lever
(5) Butterfly
(6) Idle valve
(7) Needle valve
(8) Idle adjuster screw
(9) Float
(10) Air cleaner and parts
(11) Venture tube

c. Ignition system (flywheel magnets)
(1) Flywheel and magnet assembly
(2) Magneto mounting flange
(3) Breaker point assembly
(4) Lock washer
(5) Nut and washer
(6) Screw and lock washer
(7) Condenser
(8) Ignition coil
(9) Coil clamp
(10) High tension lead
(11) Breaker cam
(12) Washer
(13) Different types of ignition systems--battery, Delco-Remy distributors, Wisco, Evinrude, Johnson, etc.

2. How to disassemble and reassemble engines and equipment
3. Ability to use owner's manual and parts list of engines and equipment. Examples: Outboards, two-cycle air cooled engines, four-cycle air cooled engines, four-cycle water cooled engines, chain saws, lawn mowers, water pumps, light plants, roto-tillers, golf buggies, etc.
4. Trouble-shoot when engine fails to start
   a. Check gas
   b. Check ignition
   c. Check compression
   d. Check carburetor
5. Tune up engine
   a. Clean, repair, and adjust carburetor
   b. Change points and adjust timing
   c. Adjust valves
6. Repair main engine
   a. Use a micrometer
   b. Vacuum gauge
   c. Grind and seat and adjust valves
   d. Replace all running gear bearings
   e. Hone cylinder
   f. Adjust or repair lubricating system
   g. Replace gaskets
7. Repair of carburetors

a. Principles of carburetors
b. Types
c. Reasons for vapor locking and icing
d. Clean jets
e. Adjust float
f. Use of combustion analyzers

8. Ignition system
   a. Theories of operation
   b. Types of ignition systems
   c. Repair of each type
   d. Use of volt meter
   e. Types of spark plugs, check and set
9. Governors
   a. Purpose and principles of governors
   b. Types used
   c. Disassemble and make necessary repairs
10. Cooling system
    a. Purpose and types of cooling systems
    b. Maintain and make necessary repairs
11. Types, specifications, and use of lubricants
12. Air cleaners
    a. Types and purposes
    b. Clean and service
13. Adjust, maintain, and repair equipment used with small motors

D. Student Participation
   1. Each student disassemble and reassemble engine
   2. Set up simple problems and have students to trouble-shoot and start engine
   3. Have students perform the following jobs: clean and set plugs, check and adjust points, use ignition tester, volt meter, clean and replace air filter, adjust governor, grind valves, clean and adjust carburetor
   4. Use manufacturer's parts catalog and make out an order list for parts

E. Teaching Aids and References
   1. Necessary tools for repairing small engines and equipment
   2. Several types of engines and equipment
   3. Films, filmstrips, and slides
   4. Charts and brochures from dealers
   5. Catalogs and books with equipment that may be used in wildlife and recreational businesses
   6. General Theories of Operation. Repair instructions from Briggs and Stratton, Clinton, Lauson, Craftsman, etc.
   7. All About Small Gas Engines
   8. Farm Mechanics Text and Handbook
   9. Small Engine Manual

Lesson 3: Storage of Small Engines and Equipment

A. Objectives
   1. To develop a realization of the economic importance of properly storing engines and equipment when they are set up during off-

seasons
2. To develop the ability to store engines and equipment properly

B. Motivation
1. Show examples of engines and equipment that have been improperly stored and compare with engines and equipment that have been properly stored
2. Have students examine carburetors in which gas has been left several months
3. Give estimates of damages of rust and corrosion each year
4. Relate examples of time and cost in getting the engines and equipment repaired

C. Subject Matter Content
Assignment: What students need to learn
1. Methods of cleaning engines and equipment for storage
2. Cleaning fuel system of leaded gasoline
3. Drain oil and fill crankcase with preservative lubricating oil
4. Flush preservative oil through upper cylinders
5. Protect spark plugs
6. Coat valve, tappet, springs, and valve stems with preservative lubricating oil
7. Seal all openings such as breather pipe, air cleaner, intake opening, and exhaust pipe
8. Store battery
9. Steps in starting engines that have been improperly stored
10. Methods of cleaning fuel line, carburetor, and tank of gum
11. Methods of preventing erosion of equipment

D. Student Participation
1. Prepare engine and equipment for storage(outboard, mower, light plant, etc.)
2. Clean gum from fuel line
3. Start and run equipment that has been improperly stored

E. Teaching Aids and References
1. Service manuals of several types of engines
2. Several units of power equipment
3. Farm Mechanics Text and Handbook. Phipps, McColly, Scranton, and Cook. The Interstate Printers and Publishers, Inc. Danville, Illinois
4. Purvis, Jud. All About Small Gas Engines. Goodheart-Wilcox Company, 18050 Harwood Avenue, Homewood, Illinois, 1963. Price $3.38
5. Briggs and Stratton Repair Instruction II. Form MS4750-54, Milwaukee, Wisconsin. Briggs and Stratton Corporation, Free
6. General Theories of Operation. Form MS3553-31, Milwaukee, Wisconsin. Briggs and Stratton Corp. Free
7. Moses and Frost. Farm Power. New York. John Wiley and Sons, 1952
8. Gulf Farm Tractor Guide. Gulf Oil Corp. Gulf Building, Pittsburgh, Pennsylvania
9. Adjustment, Maintenance, and Repair of Small Gasoline Engines, Module No. 12, The Ohio State University, The Center for Research and Leadership Development in Vocational and Technical Education, 980 Kinnear Road, Columbus, Ohio

10. Jones, M.M., Shopwork on the Farm. New York. McGraw Hill Book Company, Inc. 1965

UNIT EVALUATION

1. Test on theories and types of small engines and equipment
2. Evaluate ability to identify parts
3. Check ability in disassembling, assembling, tunirg-up, and trouble-shooting engines
4. Check ability in use of parts catalog by having students complete an order for needed parts suggested by teacher
5. Evaluate safety steps taken in operation of engine and equipment

UNIT REFERENCES

Jones, M.M., Shopwork on the Farm. New York, Toronto, London. McGraw Hill Book Company

Moses and Frost. Farm Power. New York. John Wiley and Sons, 1952

Phipps, McColly, Scranton, and Cook. Farm Mechanics Text and Handbook. Sixth edition. Danville, Illinois. The Interstate Printers and Publishers Inc. 1961

Purvis, Jud. All About Small Gas Engines. 18050 Harwood Avenue, Homewood, Illinois. Goodheart-Wilcox Company, 1963. Price $3.38

Adjustment, Maintenance, and Repair of Small Gasoline Engines. Module No. 12 The Ohio State University, 980 Kinnear Road, Columbus, Ohio. 43212, August 1965

Briggs and Stratton Corporation, Milwaukee, Wisconsin. Briggs and Stratton Repair Instruction II Form MS4750-54. General Theories of Operation Form MS3553-31

Gulf Farm Tractor Guide. Gulf Oil Corp. Gulf Building, Pittsburgh, Pa.

UNIT 2

BUILDING, MAINTAINING, AND RENOVATING WILDLIFE AND RECREATIONAL STRUCTURES

One of nineteen units of instruction in the occupational family

Wildlife and Recreation

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Agriculture Mechanics Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Building, Maintaining, and Renovating, Wildlife and Recreational Structures

UNIT OBJECTIVE: To develop the ability of students to construct, maintain, and renovate wildlife and recreational structures

TIME ALLOTMENT:

In School:

Class Instruction	8	hrs.
Shop or Laboratory Work	12	hrs.
Total	20	hrs.
Occupational or Job Experience		hrs. (To be determined by individual teachers)
Unit Total		hrs.

COMPETENCIES TO BE DEVELOPED:

1. Developing a knowledge of the different building materials
2. To recognize the types of structures, draw designs for small and large structures
3. Be able to care for, and maintain wildlife and recreational structures

STUDENT MOTIVATION:

1. Select the different construction materials and place them on display
2. Find out how much students know about construction materials
3. Carry class to lumber shed and supply store
4. Have students make a list of the different construction materials
5. Show students a structure that has been well kept and one that has not

TEACHING THE UNIT:

I. Organization

A. Lessons to be Taught
   1. Construction materials
   2. Type and design of structures
   3. Care and maintenance

B. Instructional Materials
   1. Samples of building materials
   2. Models
   3. Pictures of buildings
   4. Blue prints
   5. Books

C. Job Experience
   1. School
   2. Lumber sheds
   3. Hardware stores

II. Teaching the Lesson

Lesson 1: Construction Materials

A. Objectives
   1. Provide the basic learning which will enable students to recognize or identify the different construction materials
   2. Provide those experiences that will fit students for job entry

B. Motivation
   1. Have students visit places of business that carry the different building materials
   2. Stimulate students in the importance of construction materials and how they are used

C. Subject Matter Content
   Assignment: What students need to learn
   1. Identify the different building materials
   2. The importance of good materials
   3. What type of materials would one use in a given location
   4. Have students prepare a list of materials used in constructing the following type of buildings, and compare the costs
      a. Brick
      b. Lumber
      c. Blocks
   5. Define or explain the following terms
      a. Center match
      b. Dropsiding
      c. Matched lumber
      d. Siding
      e. Studding
      f. Stop, window or door
      g. Roofing etc.
   6. Grades of materials used in the construction business
   7. Find cost of the different construction materials
   8. Figure a bill of material for a building

D. Student Participation
   1. Have students visit lumber and supply sheds
   2. Visit a place where construction is being carried on, and let students list the materials that are being used

E. Teaching Aids and References
   1. Charts
   2. Filmstrips
   3. Films
   4. Material catalogues
   5. Models
   6. Carpentry. Townsend, Gilbert, American Technical Society, Chicago, Illinois
   7. Carpentry. Griffity, Ira S. The Manual Arts Press, Peoria, Illinois
   8. Shop Work for Farm Boys. Thurmond, M.F., Interstate Printers and Publishers Inc., Danville, Illinois

9. Farm Mechanics Text and Handbook. Cook, Scranton, Phipps, and McColly. The Interstate Publishing Company, Danville, Illinois
10. A Primer of Blueprint Reading. Diamond Bruce Publishing Company, Milwaukee, Wisconsin
11. Mechanical Drawing for Beginners. The Manual Arts Press, Peoria, Illinois
12. Farmstead Planning. Republic Steel, Agricultural Extension Bureau, P.O. Box 7587, Birmingham 13, Alabama

II. Teaching the Lesson

Lesson 2: Type and Design of Structures

A. Objectives
1. Provide knowledge that will help students learn the different type and design of structures
2. Provide knowledge that will help students design small and large buildings, which will provide skills for job entry

B. Motivation
1. Have students discuss in class the types of structure constructed by the Wildlife and Fisheries Commission, and what designs were used
2. Carry students on tour and point out the different type and design of buildings
3. Show films of the different type and design of recreational buildings found in your area
4. Make drawings of the different type of recreational structures

C. Subject Matter Content
Assignment: What students need to learn
1. The advantages and disadvantages of different types and designs
2. How to design large and small structures
3. To know the different type of structures according to their use
4. How to follow blueprints for dimensions and specifications of structures
5. Cost of professional service
6. Types and desings used in community
7. Factors that influence selection
8. The economic value of selecting different types and designs
9. The effect of the different climatic conditions on the type of structures
10. The purpose for which the structure will be used
11. How to select equipment and materials needed for sketching and drawing
12. How to identify types of sketchings and drawings

D. Student Participation
1. Have students secure catalogues showing type and design of structures
2. Have students draw plans of type and design of wildlife and recreation structures
3. Construct a small building using plans and designs they have drawn

E. Teaching Aids and References
   1. Filmstrips and films
   2. Charts
   3. Blueprints
   4. Professional aid
   5. Reference books
   6. Repairing and Constructing Farm Buildings. Wooley, J.C., McGraw Hill Book Company Inc., New York
   7. Shop Work on the Farm. Jones, Mack M., McGraw Hill Book Company, New York
   8. Modern Farm Buildings. Wallace, Ashly; Dodge, Robert J.;Shedd, C.K. Prentice Hall Inc. Englewood Cliffs, New Jersey
   9. Farmstead Planning. Republic Steel, Agricultural Extension Bureau, P.O. Box 7587, Birmingham, Alabama

II. Teaching the Lesson

Lesson 3: Care and Maintenance

A. Objectives
   1. Provide knowledge which will enable students to perform the basic jobs in the care and maintenance of wildlife and recreation structures
   2. To familiarize the students with the economic value in the care and maintenance of wildlife and recreation structures
   3. Develop skills in the students that will lead to job entry

B. Motivation
   1. Show the class a wildlife and recreation structure that has not been properly maintained
   2. Have the class visit a wildlife and recreation structure that has been well kept
   3. Have members of the class tell the methods used in caring for and maintaining wildlife and recreation structures
   4. Give class primary reasons for the care and maintenance of wildlife and recreation structures

C. Subject Matter Content
   Assignment: What students need to learn
   1. Plan building maintenance and improvement program
   2. Estimate materials and construction cost for a building
   3. The preservatives used in different kinds of structures(paints, varnishes, etc.)
   4. Estimating amount of preservatives and cost
   5. Selecting materials for use in the care and maintenance of structures
   6. Determine the supplies and equipment needed for the job
      a. Wood
      b. Concrete
      c. Masonry
      d. Metal
      e. Roofing
      f. Nails and screws
      g. Paints and varnishes
      h. Plastics

i. Glues
j. Insulation
k. Other materials that will be suitable for the job

7. Give some advantages of using synthetic materials
8. Name the basic tools used in the care and maintenance of wildlife and recreation structures

D. Student Participation
1. Check buildings in the community that need repair
2. Show students structures that have not been well kept and have them make a check list on what could have been done
3. Give the reasons for good care and maintenance of wildlife and recreation structures
4. Estimate the cost of the individual that does not use good maintenance practices

E. Teaching Aids and References
1. Charts
2. Filmstrips
3. Slides
4. Films
5. Pictures
6. Reference books
7. Repairing and Constructing Farm Buildings. Wooley, J.C., McGraw Hill Book Company, New York
8. Shop Work on the Farm. Jones, Mack M., McGraw Hill Book Company Inc. New York
9. Modern Farm Buildings. Wallace, Ashly, Dodge, Robert J., Shedd, C.K., Prentice Hall, Inc. Englewood Cliffs, New Jersey

UNIT EVALUATION

1. Suggestions for evaluating educational outcome of unit
   a. Written test
   b. Oral test
   c. Performance test

UNIT REFERENCE

Cook, Scranton, and McColly. Farm Mechanics Text and Handbook. Interstate Printers and Publishers, Danville, Illinois

Griffity, Ira S., Carpentry. The Manual Arts Press, Peoria, Illinois

Jones, Mack, M., Shop Work on the Farm. McGraw Hill Book Company, New York

Thurmond, Gilbert. Carpentry. American Technical Society, Chicago, Illinois

Wallace, Ashly; Dodge, Robert J., Shedd, C.K., Modern Farm Buildings. Prentice Hall Inc., Englewood Cliffs, New Jersey

Wooley, J.C., Repairing and Constructing Farm Buildings. McGraw Hill Book Company, Inc., New York

A Primer of Blueprint Reading. Diamond Bruce Publishing Company, Milwaukee, Wisconsin

Farmstead Planning. Republic Steel, Agricultural Extension Bureau, P.O. Box 7587, Birmingham 13, Alabama

UNIT 3

ESTABLISHING A SHOP

One of nineteen units of instruction in the occupational family

Wildlife and Recreation

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Agriculture Mechanics Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Establishing a Shop

UNIT OBJECTIVE: To acquaint students with the advantages of establishing a shop

TIME ALLOTMENT:

In School:

Class Instruction	2	hrs.
Shop or Laboratory Work	3	hrs.
Total	5	hrs.
Occupational or Job Experience		hrs. (To be determined by individual teachers)
Unit Total		hrs.

COMPETENCIES TO BE DEVELOPED:

1. To develop in students the ability to arrange a shop for convenient and efficient operation
2. To develop in students the skills needed in requisition of equipment and supplies

STUDENT MOTIVATION:

1. Discuss with students the value of good shop arrangement
2. Let students make out sample requisition orders for equipment and supplies
3. Visit a shop that is will arranged
4. Take students into the school shop and give demonstration on good and poor arrangement

TEACHING THE UNIT:

I. Organization

A. Lessons to be Taught
   1. Arranging a shop
   2. Requisition of equipment and supplies

B. Instructional Materials
   1. Prints on shop arrangements
   2. Charts
   3. Blue prints
   4. Books (arrangements)
   5. Tool and equipment sheets or lists
   6. Catalogs

C. Job Experience
   1. School shop
   2. Home shop
   3. Hardware store

II. Teaching the Lesson

Lesson 1: Arranging a Shop

A. Objective

To teach the best possible way of arranging a shop

B. Motivation
   1. Discuss shop arrangement
   2. Let students tell how they have arranged their shops
   3. Let them observe a shop that is well arranged
   4. If possible, show a film on shop arrangement

C. Subject Matter Content
   Assignment: What students need to learn
   1. Discuss these terms in the planning and arranging of a shop
      (a) Location
      (b) Size
      (c) Height
      (d) Depth
      (e) Width
      (f) Construction materials
      (g) Doors
      (h) Windows
      (i) Floor
      (j) Water
      (k) Heat
      (l) Electric wiring
      (m) Entrance panel
      (n) Convenient outlets
      (o) Power outlets
      (p) Fireproofing
   2. Panel for tool-fitting and cold metalwork tools
      (a) List tools that should go on this panel
         (1) Die stock
         (2) Top wrenches
         (3) File
         (4) Hack saw
         (5) Others (name)
   3. Panel for machinery maintenance tools
      (a) Some tools will be named that should go on the panel, list the others
         (1) Anti-freeze tester
         (2) Battery Hydrometer
         (3) Spark plug wrenches
         (4) Glass cutter
         (5) Others
   4. Panel for masonry, sheet metal, plumbing, and hot-metal tools
      (a) A partial list, complete the list
         (1) Cement trowel
         (2) Painting trowel
         (3) Square blade shovel
         (4) Tin snips
         (5) Others (name)
   5. Panel for woodworking tools
      (a) Make a list of the tools that should go on the panel
   6. Arc-welding tools section
      (a) List the tools and equipment that should be kept in this section
   7. Do the same for gas welding tools

8. Locating or arranging power tools in the shop
9. The advantages of a shop

E. Teaching Aids and References
1. Diagrams showing shop arrangements
2. Charts
3. Film and filmstrips on shop arrangement
4. Government publications (State and Federal)
5. The Farm Shop. Wakeman, T.J. and McCoy, Lee Vernon. The Macmillan Company, New York, 1960
6. Farmstead Planning. Republic Steel, Agricultural Extension Service P.O. Box 7587, Birmingham 13, Alabama

II. Teaching the Lesson

Lesson 2: Requisition of Supplies and Equipment

A. Objectives
1. To teach students how to make out requisition forms for supplies and equipment
2. To develop necessary skills for job entry

B. Motivation
1. Show students carbon copies of requisition sheets that have been used by the school
2. Have students fill out sample requisition forms in class
3. Have students tell how they go about making a list for tools and equipment, they are ordering

C. Subject Matter Content
Assignment: What students need to learn
1. Requisition sheet and purchase order
2. Give the correct procedures in filling a requisition order and purchase order
3. The use of the tools and equipment
4. Information required in requisitioning of tools and equipment
5. The importance of brands, in the selection of tools and equipment
6. Reputation of the firms selling tools and equipment
7. Percentage discount given organization
8. Prices of tools and equipment from several companies
9. Discuss distance as a factor in securing tools
10. The importance of checking the shipping invoice with your original requisition sheet

D. Student Participation
1. Have students request tools and equipment by making out requisition forms for these items
2. Bring old requisition sheets and have students to check them

E. Teaching Aids and References
1. Forms
2. Catalogs-farm tool and equipment companies
3. Catalogs from tool and equipment companies
4. Farm Mechanics Text and Handbook. Phipps, Lloyd J., McColly, H.F.,

Scranton, L.L., and Cook, G.C. The Interstate Printers and Publishers Inc., Danville, Illinois, 1959

5. The Farm Shop. Wakeman, T.J., McCoy, Lee Vernon, The Macmillan Company, 1960

UNIT EVALUATION

1. Draw plans of shop arrangement
2. Written test
3. Performance test

UNIT REFERENCES

Phipps, Lloyd, McColly, H.F., Scranton, L.L., and Cook, G.C., Farm Mechanics Text and Handbook. The Interstate Printers and Publishers, Inc., Danville, Illinois

Wakeman, T.J., McCoy, Lee Vernon, The Farm Shop. The Macmillan Company, New York

Catalogs from tool and equipment companies

UNIT 4

MAINTENANCE AND OPERATION OF TRACTORS AND ALLIED EQUIPMENT

One of nineteen units of instruction in the occupational family

Wildlife and Recreation

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Agriculture Mechanics Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Maintenance and Operation of Tractors and Allied Equipment

UNIT OBJECTIVE:

To develop the ability to

1. Understand tractors and allied equipment
2. Select power equipment and
3. Effectively tune, maintain, and efficiently operate tractors and allied equipment

TIME ALLOTMENT:

In School:

Class Instruction	15	hrs.
Shop or Laboratory Work	10	hrs.
Total	25	hrs.
Occupational or Job Experience		hrs. (To be determined by
Unit Total		hrs. individual teachers)

COMPETENCIES TO BE DEVELOPED:

1. Ability to determine type, size, brand of tractor and equipment needed for wildlife and recreation jobs
2. Ability to properly operate tractors and equipment and to care for them
3. Ability to properly maintain tractors and allied equipment
4. Ability to determine proper storage

STUDENT MOTIVATION:

To create student interest and stimulate them in a study of farm power and allied equipment by the presentation of the following information:

1. The importance of farm tractors and equipment to the services needed in wildlife and recreation
2. The scope of business needing such machinery and equipment
3. Techniques used in selection and operation of farm power and equipment
4. Farm machinery for business or farm, is costly and requires a great deal of knowledge to operate

TEACHING THE UNIT:

I. Organization

A. Lesson to be Taught
   1. Types of tractors and equipment
   2. Operation and care of tractors and equipment
   3. Maintenance of tractors and equipment
   4. Storage of tractors and equipment

B. Instructional Materials
   1. Small models of tractors

2. Tractor and equipment company brochures, operators manual, and literature
3. Films, filmstrips, and slides pertaining to farm tractors and equipment
4. Small tractors of some type
5. Charts prepared by various agencies
6. Parts of tractors that give most trouble
7. Safety charts
8. Equipment that can be secured

C. Job Experience
1. On the farm
2. Agency--tractor or equipment
3. Shop--school or business

II. Teaching the Lesson

Lesson 1: Types of Tractors and Equipment

A. Objectives
1. Provide knowledge which will enable persons dealing with tractors and equipment to select tractors needed for specific jobs in wildlife and recreation businesses
2. Be able to identify parts of tractor and its allied equipment
3. Provide knowledge in selecting types of tractors

B. Motivation
1. Stimulate student's interest in learning the types, sizes, and brands of tractors needed in wildlife and recreation. Relate to them the number of tractors and equipment currently being used and why it is imperative that a knowledge of types and sizes are important in providing services in wildlife and recreational activities
2. Observe some jobs in the area requiring tractors of various sizes, and types (Ex. ASC work units, fertilizer distributing companies, rental services)
3. Selection made on basis of use of tractors and equipment

C. Subject Matter Content
Assignment: What students need to learn
1. The general types of tractors and allied equipment available for each tractor
2. How tractor engines are classified
3. Principles of internal combustion engine
4. Sizes of tractors relative to make and model
5. Factors to consider when selecting tractor and its allied equipment
6. Types of allied equipment needed in wildlife and recreational work

D. Student Participation
1. Secure brochures from tractor agencies for use in class and shop
2. Secure at least one operator's manual from agency or equipment dealer
3. Field trip to nearby tractor and equipment dealer to observe and study sizes, types, and kinds of tractors and equipment

4. Field trip, if possible, to a farm service department for demonstrations of tractors and equipment

E. Teaching Aids and References
1. Tractor of some type
2. Operator's manual
3. Model tractors and brochures
4. Internal combustion engine(knock-down)
5. Films, filmstrips
6. Moses and Frost. Farm Power
7. Wilson, L.W., Farm and Power Equipment Retailer's Handbook.
8. O'Brien, Michael, Demonstrations for Farm Mechanics
9. Gulf Farm Tractor Guide. Gulf Oil Corporation
10. Brown and Morrison, Farm Tractor Maintenance
11. Stone and Gulvin, Machines for Power Farming

Lesson 2: Operation and Care of Tractors and Equipment

A. Objectives
1. To develop in the individual student the ability to care for tractors and allied equipment properly
2. To develop the ability to operate tractors and machinery, and to attach allied equipment for operation
3. To develop the ability to properly adjust machinery and equipment for operation
4. Select proper fuels and lubricants for the machinery to be used

B. Motivation
1. The economy of properly caring for tractors and equipment
2. The ease of accomplishment in performing a job when tractors and allied equipment are properly adjusted
3. The value of knowing the proper adjustment of tractors and allied equipment for job security
4. Employers demand for more mechanical knowledge and ability
5. The value of competent operation skills

C. Subject Matter Content
Assignment: What students need to learn
1. Preventive maintenance
2. Operational maintenance
3. Factors to consider for tractor, its allied equipment and machinery (combines, etc.) operation
4. Safety precautions in operation of machinery
5. Operating parts of tractors, allied equipment and machinery
6. Correct handling of all operating parts of tractors, allied equipment and machinery
7. Procedure for ordering replacement parts
8. Operation of tractors, allied equipment and machinery
9. Operation of tractors and equipment in cold weather
10. Selection of proper fuels and lubricants

D. Student Participation
1. Operate tractors and equipment on farm or at school

2. Perform preventive maintenance on tractors in department, on farm, or in business
3. Prepare a preventive maintenance sheet outlining points to check on tractors, allied equipment and machinery
4. Prepare a list of safety precautions relative to the preventive maintenance and operation of machinery
5. Identify the various operating parts of tractors, allied equipment and machinery

E. Teaching Aids and References
1. Tractors and equipment
2. Shop with tools to perform preventive and operational maintenance
3. Resource personnel from an agricultural service that employs farm boys
4. Farm Power. Textbook
5. Samples of various fuels and lubricants
6. Moses and Frost. Farm Power
7. Brown and Morrison. Farm Tractor Maintenance
8. Wilson, L.W., Farm and Power Equipment Retailers Handbook
9. O'Brien, Michael. Demonstrations for Farm Mechanics
10. Johnson and Hollenburg. Servicing and Maintaining Tractors
11. Gulf Farm Tractor Guide. Gulf Oil Corporation
12. Operation, Care, and Repair of Farm Machinery. Deere and Company, Moline, Illinois

II. Teaching the Lesson

Lesson 3: Maintenance of Tractors and Equipment

A. Objectives
1. To familiarize students with proper maintenance of tractors and equipment needed for persons operating tractors and equipment
2. To familiarize students in locating troublesome spots in maintaining tractors and equipment
3. To understand the various systems of tractors and equipment

B. Motivation
1. Develop in the student an appreciation of the importance of well-maintained tractors and equipment
   a. Try to start tractor or other power equipment that fails to start because of poor maintenance
   b. Correct trouble spot and illustrate the importance of good maintenance in saving time and money on the part of the employer and businessman
   c. Have students participate in a discussion on personal experiences with malfunctioning equipment and machinery that they have had dealings with
   d. Illustrate what a "thingamajig" is and explain the importance of knowing how to call for a part

C. Subject Matter Content
Assignment: What students need to learn
1. General maintenance

2. Identification and nomenclature of the systems of tractors,(cooling, fuel, ignition, electrical, hydraulic, power transmission, and chassis)
3. Servicing each of the systems
4. Understand how to use operator's manual and service manuals when maintaining and repairing agricultural machinery
5. Machine specifications
6. Trouble-shooting and how to perform
7. To maintain and adjust tractor air, fuel, and exhaust systems
8. To adjust belts and pulleys on tractors and equipment
9. To maintain cooling systems
10. Adaptations of tractors and equipment for different jobs

D. Student Participation
1. Trace the various systems on the tractor and/or machinery
2. Secure an operators and service manual of several kinds of farm machinery
3. Perform the necessary maintenance on some type of tractor or equipment
4. Perform some type of trouble-shooting

E. Teaching Aids and References
1. Operator's and service manuals
2. Tractors and/or machinery
3. Tools and equipment needed for maintenance of farm machinery
4. Samples of various fuels and lubricants
5. Parts of tractors that constitute the different metals and construction
6. Films and filmstrips
7. Brown and Morrison, Farm Tractor Maintenance
8. Moses and Frost. Farm Power
9. Stone and Gulvin. Machines for Power Farming
10. Johnson and Hollenburg. Servicing and Maintaining Farm Tractors
11. Gulf Farm Tractor Guide, Gulf Oil Corporation
12. The Operation, Care, and Repair of Farm Machinery, Deere and Co.

Lesson 4: Storage of Tractors and Equipment

A. Objectives
1. Proper storage of tractors and machinery when not in use
2. Preparing the tractor and machinery for service after storage

B. Motivation
1. Point out to the students the economic value of storing tractors and equipment
2. Present pictures of tractors, equipment, etc., contrasting the well-kept equipment with the poorly kept
3. Visit farm or business where machinery is properly stored and/or a place where it is improperly stored
4. Used personnel from a local business firm or farm to give the importance and some of the techniques of storage

C. Subject Matter Content

Assignment: What students need to learn

1. Recommended procedures for proper storage
2. Recommended procedures and practices for servicing farm tractors and machinery after storage
3. Storage requirements for tractors and farm machinery

D. Student Participation

1. Prepare tractor and machinery for storage
2. Remove tractors and machinery from storage

E. Teaching Aids and References

1. Tractors and machinery
2. Tools for storage
3. Charts
4. Films, "Operation and Care of Machinery," and others
5. Filmstrips
6. Operators and service manual
7. Moses and Frost. Farm Power
8. Jones, M.M., Shopwork on the Farm
9. Hamilton and Bryant, Profitable Farm Management
10. Johnson and Hollenburg, Servicing and Maintaining Farm Tractors

UNIT EVALUATION

Suggestions for evaluating educational outcome of unit:

1. Examinations should be practical in nature. Exams may consist of identifying parts, likely troublespots, operating a tractor, etc.
2. Provide chart of progress. This could be prepared by teacher in order for students to check themselves as they perform the maintenance skills required
3. Spot-check students as they perform their operation and maintenance work
4. Make field trips to school farm or machinery dealer and by casual questioning determine if students understand the sizes, types, and construction of farm machinery
5. Student should prepare tractors and machinery for storage and instructor check as each task if performed
6. Ask oral questions at certain intervals during the unit work
7. Recommend students evaluate themselves with a standard set up by the teacher at the end of the unit

UNIT REFERENCES

Brown and Morrison. Farm Tractor Maintenance. Danville, Illinois, Interstate Printers and Publishers, 1958

Hamilton and Bryant. Profitable Farm Management. Englewood Cliffs, N.J. Prentice Hall Inc., 1956

Johnson and Hollenberg. Servicing and Maintaining Farm Tractors. New York

Jones, M.M., Shopwork on the Farm. New York. McGraw Hill Book Company Inc., 1955

Moses and Frost. Farm Power. New York. John Wiley and Sons Inc., 1952

O'Brien, Michael, Demonstrations for Farm Mechanics. Danville, Illinois. Interstate Printers and Publishers, 1957

Stone and Gulvin. Machines for Power Farming. New York. John Wiley and Sons Inc., 1957

Wilson, L.W., Farm and Power Equipment Retailers' Handbook. St. Louis, Mo. National Farm and Power Equipment Dealers Association, 1964

Gulf Farm Tractor Guide. Pittsburgh, Pa. Gulf Oil Corporation

The Operation, Care, and Repair of Farm Machinery. Moline, Illinois. Deere and Company, 1957

UNIT 5

TOOL SELECTION AND MAINTENANCE

One of nineteen units of instruction in the occupational family

Wildlife and Recreation

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Agriculture Mechanics Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Tool Selection and Maintenance

UNIT OBJECTIVE:

1. To develop in students an understanding of tool selection and maintenance
2. Students acquire ability to fit and shape hand tools
3. Students observe and practice safety in these operations

TIME ALLOTMENT:

In School:

Class Instruction	2	hrs.
Shop or Laboratory Work	8	hrs.
Total	10	hrs.
Occupational or Job Experience		hrs. (To be determined by individual teachers)
Unit Total		hrs.

COMPETENCIES TO BE DEVELOPED:

1. Understand factors involved in tool selection and maintenance
2. Know how to fit and shape hand tools
3. Practice safety in all of these activities

STUDENT MOTIVATION:

1. Discuss job opportunities in this area of wildlife and recreation
2. Local serviceman point out values of proper tool selection and maintenance
3. Students tell of experiences in fitting and shaping tools
4. Stress the fact that a good job may depend on proper tool fitting and shaping
5. Discuss importance of safety in these operations

TEACHING THE UNIT:

I. Organization

A. Lessons to be Taught
   1. Selection and maintenance of hand and power tools
   2. Fitting and shaping hand and power tools

B. Instructional Materials
   1. Films and filmstrips on tool selection, maintenance, fitting, and shaping
   2. Charts with instructions for fitting and shaping hand tools
   3. Necessary hand and power tools
   4. Equipment needed for fitting and shaping tools
   5. References

C. Job Experience
   1. On the farm
   2. In the classroom and shop

II. Teaching the Lesson

Lesson 1: Selection and Maintenance of Hand and Power Tools

A. Objective
To develop in students an understanding of selection and maintenance of hand and power tools

B. Motivation
1. Group discussion on selection of hand and power tools
2. Representative of tool and equipment company point out factors to consider in tool selection and stress importance of maintenance
3. Students discuss tool maintenance in relation to years of usefulness
4. Point out the economic values of proper selection and maintenance

C. Subject Matter Content
Assignment: What students need to learn
1. List common hand and power tools needed in wildlife and recreation occupations
2. Identify these tools giving variations in each type and specific uses of each
3. Factors to consider in selecting hand and power tools
4. List name brands of different tools, compare prices and values
5. Selecting size and type of tool in respect to job to be performed
6. Importance of tool care and maintenance
7. How can tool usefulness be prolonged
8. Precautions to consider in tool care and maintenance
9. Proper cleaning and storage of tools
10. List all safety practices to be followed in selection and maintenance of hand and power tools

D. Student Participation
1. List tools purchased at home and tell why you think they were properly or improperly selected
2. Practices followed at home to increase tool usefulness
3. Visit shop to observe selection and maintenance of tools. Discuss these observations after returning to classroom
4. Make a list of tool maintenance practices

E. Teaching Aids and References
1. Equipment and tool companies catalogs
2. Charts on care and maintenance of tools
3. Samples of properly maintained tools
4. Samples of tools that have not had proper maintenance
5. Pictures of various hand and power tools and information as to uses
6. Wakeman and McCoy. The Farm Shop. The Macmillan Company, New York
7. Phipps, McColly, Scranton, and Cook. Farm Mechanics Text and Handbook. The Interstate, Danville, Illinois
8. Jones, Shopwork on the Farm. McGraw Hill Book Company, New York
9. Sampson, Mowery, and Kugler. Farm Shop Skills in Mechanized Agriculture. American Technical Society, Chicago

Lesson 2: Fitting and Shaping Hand and Power Tools

A. Objectives
   1. To develop in students an understanding of the importance of properly fitted tools
   2. Students learn procedures for fitting tools
   3. Students be able to follow procedures and fit tools
   4. Observe and practice all safety in these operations

B. Motivation
   1. Students relate experiences in fitting and shaping tools
   2. Experienced tool fitter discuss tool fitting with students and demonstrate skills needed
   3. Examine properly and poorly fitted tools and compare their usefulness in job to be performed

C. Subject Matter Content
   Assignment: What students need to learn
   1. How good workmanship depends on properly fitted tools
   2. List the processes involved in fitting tools
   3. Fitting equipment needed and its uses
   4. Maintenance of fitting equipment
      a. Dressing and truing grinding wheels
      b. Carborundum
      c. Files
   5. List safety practices to follow when using fitting equipment
   6. Explain reasons for and methods of removing rust and dirt from tools
   7. Give the procedures for fitting the following tools and list safety involved in each operation: Knives (pruning, budding, draw, etc.), ax, hatchet, wood chisel, wood scraper, auger bit, twist drill, cold chisel, punch, screw driver, hand plane, snips, shears,(hand and power), shovel, hoe, turf edger, sod-lifter, post hole digger, trowel, dibble, mattock, mattock pick, pick, fork, rake, weeder, cultivator, weed cutter, bush hook, mower blade (power and hand), rotary cutter, blade, pruner (hand and power), tree trimmer(pole pruner, pole saw, etc.),saws (all types), etc.
   8. What are the values of replacing broken tool handles
   9. Supplies and equipment needed to fit new tool handles
   10. Give procedure for fitting new handles in tools
   11. Safety practices to observe when fitting handles in tools

D. Student Participation
   1. Bring in tools that need fitting
   2. Check tools in school shop and list all tools that need fitting
   3. Fit tools in school shop
   4. Put on tool fitting demonstrations

E. Teaching Aids and References
   1. Tool companies supply catalogs
   2. Price lists of the various tools
   3. Charts illustrating tool fitting
   4. Films and filmstrips on tool fitting
   5. Exhibits of properly and poorly fitted tools
   6. Phipps, McColly, Scranton, and Cook. Farm Mechanics Text and

Handbook. The Interstate Printers and Publishers, Danville, Ill.
7. Ross and Craig. Modern Farm Shop. (Book one). The Steck Company, Austin, Texas
8. Jones, Shopwork on the Farm. McGraw Hill Book Company, New York
9. Wakeman and McCoy. The Farm Shop. The Macmillan Company, New York
10. Sampson, Mowery, and Kugler. Farm Shop Skills in Mechanized Agriculture. American Technical Society. Chicago
11. Jones, Farm Shop Practice. McGraw Hill Book Company, New York
12. Roehl. Fitting Farm Tools. The Bruce Publishing Company, Milwaukee

UNIT EVALUATION

1. Oral and written tests
2. Grade demonstrations
3. Skills acquired

UNIT REFERENCES

Jones, M.M., Shopwork on the Farm. New York. McGraw Hill Book Company

Jones, M.M., Farm Shop Practices. New York. McGraw Hill Book Company

Phipps, McColly, Scranton, and Cook. Farm Mechanics Text and Handbook. Danville, Illinois. The Interstate Printers and Publishers

Roehl. Fitting Farm Tools. Milwaukee, Wis. The Bruce Publishing Co.

Ross and Craig. Modern Farm Shop. Austin, Texas. The Steck Co.

Sampson, Mowery, and Kugler. Farm Shop Skills in Mechanized Agriculture. Chicago. American Technical Society

Wakeman and McCoy. The Farm Shop. New York. The Macmillan Company

UNIT 6

IRRIGATION SYSTEMS

One of nineteen units of instruction in the occupatio ıal family

Wildlife and Recreation

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Agriculture Mechanics Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Irrigation Systems

UNIT OBJECTIVE: To develop the abilities and understanding necessary for job entry into occupations dealing with the planning, installing, and servicing irrigation systems

TIME ALLOTMENT:

In School:

Class Instruction	5	hrs.
Shop or Laboratory Work	5	hrs.
Total	10	hrs.
Occupational or Job Experience		hrs. (To be determined by individual teachers)
Unit Total		hrs.

COMPETENCIES TO BE DEVELOPED:

1. To plan an irrigation system
2. To install an irrigation system
3. To service and maintain an irrigation system

STUDENT MOTIVATION:

In introducing the unit explore the projects that an irrigation system could make more productive. Golf course, flower garden, shrubs, etc.

TEACHING THE UNIT

I. Organization

A. Planning an irrigation system
   1. Sources of water supply
      a. Streams
      b. Ponds
      c. Reservoirs
      d. Wells
   2. Methods of moving water from source
      a. Sprinkling
      b. Sub-irrigation--amount of water required, rate of flow, and speed applied must be considered in all methods above

B. Selecting and installing irrigation systems
   1. Methods of moving water from source
   2. Methods of preparing ground and installing equipment
   3. Methods of applying water to soil
   4. Preparation of soil and installing equipment
   5. Maintaining an irrigation system
      a. Protection of water source
      b. Maintaining ditches
         (1) Store or treat pumps and pipes
         (2) Proper treatment and storage of wood parts

C. Study and define irrigation terms, structures, and equipment

D. Student Participation
   1. Survey job opportunities in community dealing with irrigation
   2. Diagram an irrigation system that will operate in the community
   3. Figure the materials cost and cost of labor for installing the system
   4. Visit an irrigation system of each type if available

E. Teaching Aids and References
   1. Films
   2. Charts
   3. Pamphlets put out by Irrigation Supply Company
   4. Code, W.E. and A.J. Hammon. When to Use Sprinkler System. Colorado Agriculture and Mechanics College Bulletin. 405, A. 1950

UNIT EVALUATION
   1. Conventional testing
   2. Test ability to design and irrigation system

UNIT 7

INSECT, DISEASE, AND PEST CONTROL

One of nineteen units of instruction in the occupational family

Wildlife and Recreation

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Agriculture Production Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Insect, Disease, and Pest Control

UNIT OBJECTIVE:

To develop in the student a working knowledge of the insects and diseases that affect plants, animals, and household pests; the controls and laws regulating the use of chemicals

TIME ALLOTMENT:

In School:

Class Instruction 30 hrs.
Shop or Laboratory Work _____ hrs.
Total 30 hrs.
Occupational or Job Experience _____ hrs. (To be determined by individual teachers)
Unit Total _____ hrs.

COMPETENCIES TO BE DEVELOPED:

1. Agricultural chemicals used in wildlife and recreation, the proper use, and laws regulating the use
2. Controlling the most common weeds affecting the wildlife and recreation areas
3. Pest affecting the American families and businesses, prevention and control, and services rendered by a pest control company or insecticide dealer
4. Identify the common pests affecting horticulture and forestry plants and measures taken to control
5. Prevention and control of animal and household pest
6. Prevention and control of common plant diseases in wildlife and recreation business

STUDENT MOTIVATION:

To create in the student an interest in the study of insects, diseases, and pests and stimulate in them a desire to learn more in this area by:

1. Relating how much the American people rely on the control of insects, diseases, and pests for a better standard of living
2. Asking for group discussions on the various chemicals used in their homes, chemicals used on ornamental plants, fish ponds, and lakes
3. Relating the importance of controlling diseases, insects, and pests to safeguarding the health of people
4. Making a survey of the people in your community other than farmers performing work with agricultural chemicals, disease and insect eradication
5. Relating how an insufficient knowledge of chemicals and how to use them can cause hazards in the destruction of wildlife

TEACHING THE UNIT:

I. Organization

A. Lessons to be Taught

1. Agriculture chemicals: use, laws, and regulations
2. Weed control
3. Pest control of plants
4. Pest control of animals associated with wildlife and recreation
5. Controlling household pests
6. Prevention and control of plant diseases

B. Instructional Materials
1. A collection of the various agricultural chemicals with labels
2. A collection of pests most frequently encountered in home, farm or in wildlife areas
3. A chart prepared to list the safety rules to follow when using medications, pesticides or any other chemicals
4. A collection of insects affecting wildlife and a collection of insects affecting the forestry business
5. Commercial literature using agricultural chemicals
6. Commercial literature displaying insects, their prevention and control
7. A collection of diseases affecting ornamental plants
8. Films and filmstrips

C. Job Experience
1. Farm, school, or home
2. Wildlife or recreation businesses

II. Teaching the Lesson

Lesson 1: Agricultural Chemicals: Use, Laws, and Regulations

A. Objectives
1. Provide knowledge which will enable persons performing work connected with agricultural chemicals to know the agricultural chemicals
2. Provide knowledge and experience in the use of agricultural chemicals
3. Provide knowledge of the laws and regulations governing chemical use including Louisiana laws
4. Provide training in handling the various chemical compounds (safety precautions)
5. Be able to identify the various types of pests in your area and damage done by each

B. Motivation
1. Point out in a group discussion the wide use of agricultural chemicals in your area and attempt to develop with them a list as their experience permits
2. Using a collection of several agricultural chemicals with labels, illustrate the wide range of chemicals, ranging from the common house-fly spray to the more concentrated and restricted types
3. Point out that chemicals come in types and forms and the selection of a wrong chemical might lead to a very costly disaster to wildlife and fish , and animals used for experiment purposes
4. Persons can use chemicals effectively to reduce labor cost in the productions of farm crops. The easiest way is the best way--

provided you gain the same results

5. Illustrate to students the importance of keeping plants in parks and so forth in healthy condition
6. In the United States alone, it is estimated that two billion dollars are lost annually by diseases and three billion dollars are lost by insect damage to plants

C. Subject Matter Content

Assignment: What students need to learn

1. Terms: Herbicides, insecticides, bactericides, fungicides, rodenticides, nematocides, molluscides, and vermicides
2. Areas in which agriculture chemicals play an important role(six areas)
3. Types and the physical characteristics of the various types of chemicals called pesticides, and chemical compounds used in most areas
   a. Herbicides (three types)
   b. Insecticides (four types)
   c. Vermicides (two types)
   d. Rodenticides
   e. Bactericides (three types)
   f. Fungicides (five types)
   g. Nematocides
   h. Molluscicides
4. Types and characteristics of agricultural chemicals that are not treated as pesticides
   a. Desiccants and defoliants
   b. Hormones or growth regulants
5. Factors to consider when selecting a pesticide or agricultural chemical when the problem is severe enough to merit treatment and chemical control is the best treatment
6. Materials mixed with pesticides to make them more effective and/or easier to handle or use
7. Understanding of the difficulty involved in recommending correct practices to follow in the application of pesticides
   a. Form of physical properties of the pesticide
   b. Time to apply
   c. Method of applying
   d. The amount of pesticide to apply
8. Advising the safe handling and use of agricultural chemicals
   a. Statutes covering the interstate and intrastate marketing of pesticides
   b. Safety rules
   c. Safety precautions for storage of pesticides
   d. Handling or using pesticides
   e. Accident procedure
9. Ability to read labels on containers
   a. Requirements
   b. Regulations
10. Safe disposal of empty pesticide containers and surplus pesticides
11. Laws regulating the level of residue remaining on or in edible products

D. Student Participation

1. Have the students collect labels of common pesticides used in your community. It is recommended that full or empty pesticide containers not be collected due to toxic conditions of many of the materials
   a. Determine the type of each insecticide, fungicide, herbicide, etc.
   b. Determine the active ingredients of each pesticide
   c. Determine the specific use of each pesticide
2. Compare the costs of various chemicals designed to accomplish the same purpose. Prepare a table showing the cost per acre against the loss expected from the insects or diseases
3. Demonstrate the translocation of systemic herbicides by treating susceptible perennial plants in various ways, such as leaf sprays, soil treatment, etc.
4. Have an agricultural chemical representative discuss with the class the changes and opportunities available to young men in the industry
5. Have students collect samples of the various forms of pesticides, identify them and have discussion on how to handle them
6. Have students calculate the cost of various pesticides on a pint or pound comparison when purchased in various sized containers

E. Teaching Aids and References
1. Filmstrips, "Facts About Pesticides" and "Points About Pesticides." Available from the Manufacturing Chemists Association Inc., 1825 Connecticutt Avenue, N. W. Washington, D.C.
2. Labels of pesticides for review
3. Film, "Safe Use of Pesticides," color, 1963, 16mm, 21 minutes. USDA, Order from your state film library
4. Samples of the various forms of pesticides plus diluents, emulsifiers, and wetting agents
5. Color slides of the larger applicators used in your area
6. Farm Chemical Handbook. Farm chemical dictionery sect.
7. Weed Control: As A Science. pp. 21-23, 52-63
8. Agriculture in Our Lives
9. "The War That Never Ends," Louisiana Agriculture Extension Publication 1431
10. "Safe Disposal of Empty Pesticide Containers and Surplus Pesticides," USDA publication, August, 1964
11. Pesticide Handbook Entoma. pp. 19-21

Lesson 2: Weed Control

A. Objectives
1. Importance of weed control for the protection of man, his food, and fiber supplies, forests and recreational activities
2. To familiarize the student with the most troublesome weeds of the park, forest, and recreational areas
3. To familiarize the student with the chemicals and methods of applying chemicals for modern weed control
4. To familiarize the student with chemicals that wildlife and recreation businesses deal with and what these chemicals can do
5. To familiarize the student with conditions under which chemicals function at their best

B. Motivation

1. Point out that weeds were controlled primarily by hand until about 1945. Chemical weed control came into operation and made this work much easier. The increase in the use of chemicals has made it nearly compulsory that people dealing in such service have a knowledge of chemicals in weed control
2. By use of color slides contrast crops that have had chemical weed control and crops that have had primitive weed control. (Large acreage)
3. Herbicides are used for weed control on more than 70 million acres of agricultural land annually at a cost of more than $272 million
4. Visit farm where some type of chemical weed control is being used and ask the farmer questions concerning ease of operations, knowledge, etc.
5. Show some type of film on chemical weed control, herbicides, etc. Secure through extension department or through the audio-visual department of commercial firms

C. Subject Matter Content

Assignment: What students need to learn

1. Life span and reproduction of plants
   a. Annuals
   b. Biennials
   c. Perennials
2. Weeds most commonly found in the recreational areas
3. Types of chemicals grouped according to effect on plants
4. Types of herbicides and their primary functions
   a. Pre-transplant
   b. Pre-emergence
   c. Post-emergence
5. Chemicals and their characteristics used in weed control
   a. Form of 2-4-D
   b. 2-4-5-T
   c. 2-4-Des
   d. Substituted urea
   e. Simazin
   f. Dinitro
   g. Herbicidal oils
   h. Ammonium sulfamate
   i. TCA
   j. Sodium chlorate
   k. Potassium cyanat and sodium cyanat
   l. Amino triazole
6. Chemicals that are used and what plants they can control or eradicate; weeds common to parks, lawns, etc.
7. Spray equipment needed to use herbicides correctly
8. Calibration of sprayers and dusters
9. Cleaning sprayers and dusters

D. Student Participation

1. Students collect specimens of local weeds that are of economic importance to your area and state. Classify the weeds and give recommendations as to how to control

2. Student write to the agriculture colleges in the state and ask for latest bulletins on weed control
3. Visit a spray equipment dealer or a farm service operator and observe the various sprayers and dusters in operation
4. Visit retail or commercial chemical establishment selling or applying weed killers

E. Teaching Aids and References
1. Collection of the various chemicals used to control weeds
2. Labels obtained from all common herbicides
3. Filmstrips and films
4. Charts illustrating the cost of using herbicides in relation to the amount of income derived from it
5. Weed Control As A Science. pp. 21-23
6. Crop Production in the South. pp. 136-162
7. Southern Crops
8. Field Crops
9. Raising Vegetables
10. Literature from commercial firms

Lesson 3: Pest Control of Plants

A. Objectives
1. Importance of controlling pest of plants to help supply man's needs
2. The methods of control of pests dealt with in wildlife and recreation businesses

B. Motivation
1. Point out that pests cost the farmer and homemaker more than three billion dollars in damages to plants
2. Use a collection of the most common insects affecting plants in recreational areas
3. If possible, visit a situation where a large number of insects are attacking a crop, garden, or lawn. Point out that these pests could be controlled
4. If possible, visit a situation in which nematodes have practically destroyed a crop, garden, or lawn. Discuss the treatments that could possibly control such disasters

C. Subject Matter Content
Assignment: What students need to learn
1. Economic importance of plant pests and related jobs in this field.
2. Types of insects, their mouth parts and how they damage plants
3. Identification of common plant pests and their damage
   a. Crop and garden
   b. Forestry
   c. Household and surroundings
4. Life cycle of an insect, the importance of knowing a life cycle
5. Common habitats of insects
6. Methods of prevention and control of plant pests
   a. Those found in park, lawn, etc.
   b. Forestry

c. Household and surroundings
7. Chemicals used to prevent and control plant pests
8. Public law 518 (Miller Bill) and how it affects the dispensing of chemicals
9. Recommendations as to time of applications of pesticides to the various plants
10. Ability to read and understand approved insecticide labels and their recommendations
11. Restrictions in some of the job entries in this field

D. Student Participation
1. Students prepare a collection of identified insects and prepare life cycles
2. Students observe insects and their habitats (termites-home, crops-farm, lawn-chinch bug)
3. Visit farm business that serves persons effectively in controlling plant pests

E. Teaching Aids and References
1. Collection of various chemicals used as insecticides(using safety precautions) classify as to what each will control
2. Films, including "Rival World," Shell Oil Company
3. Filmstrips
4. Chart comparing the chemicals as to cost and effectiveness
5. Literature from the commercial companies
6. Brochures from USDA and extension department
7. Farm Chemical Handbook
8. Agriculture in Our Lives
9. Raising Vegetables.pp. 128-138
10. Field Crops
11. USDA Circular No. 632
12. USDA Bulletin No. 120
13. Yearbook on Insects. 1953, USDA
14. "Insect Control Guide, 1965," Agriculture Extension

Lesson 4: Pest Control of Animals Associated With Wildlife and Recreation

A. Objective
To develop in the student the ability to recognize the common pests affecting animals commonly found in recreational businesses and in wildlife and to be able to recommend methods and practices which can effectively control such pests

B. Motivation
1. Point out to students that pests cost the livestock and poultry industry approximately two-three billion dollars a year, in which is included animals used for recreational purposes
2. Survey job opportunities in this field
3. In a group discussion, ask students to name pests that hinder or destroy wildlife reproduction
4. By the use of films, filmstrips or color charts, show the effects of pests on animals and the cost to the person concerned
5. A wildlife or recreational resource person could explain the

importance of controlling pests in this field of work

C. Subject Matter Content
Assignment: What students need to learn
1. Economic importance of pest control for animals used in wildlife and recreation
2. Common parasites affecting animals in this area
   a. Internal
   b. External
3. Common parasites affecting fowls in wildlife and/or recreational areas and their damage
   a. Internal
   b. External
4. Prevention and control of pests of animals associated with wildlife and recreation
   a. Insecticides
   b. Vermicides
5. Effective methods of prevention and control of parasites in fowls used in recreation and wildlife
6. Reading and interpreting guides on insecticides and vermicides
7. Laws regulating the dispersal or application of insecticides and vermicides
8. Getting factual information on old and new chemicals
9. Administering the insecticides or vermifuges
10. Terms: Insecticides, vermicides, toxic, sex lures, ovipostion lures, pest attractants, residue

D. Student Participation
1. Collect specimens of pests that affect the various animals and fowl found in wildlife and recreation
2. Develop tables with students categorizing the damages, costs, and effects of different pests
3. Collect insecticides or vermifuges, align them in display and let students identify as to what the chemical can prevent or control
4. Visit an operation where insecticides are being used to observe the applications

E. Teaching Aids and References
1. Films, filmstrips
2. Color slides of the various pests
3. Collection of specimens affecting animals and fowls
4. Textbooks, charts, commercial literature
5. Collection of the various insecticides and vermifuges
6. Wildlife areas or recreational parks, etc.
7. Introductory Animal Science. Garrigus
8. USDA Agriculture Handbook, 120
9. Applied Entomology. Fernold, Shepard
10. "Insect Control Guide, 1965," Agriculture Extension
11. USDA Bulletin 167, 1948
12. Poultry Science and Practice. Winter, Funk
13. Practice of Wildlife Conservation. Wing, John Wiley and Sons, New York, 1951

14. Horses and Horsemanship. Ensminger

Lesson 5: Controlling Household Pests

A. Objective
To familiarize students with the common household pests, and develop the ability to identify, prevent, and control these pests

B. Motivation
1. If possible, visit a structure heavily damaged by pest such as the termite or powder-post beetle
2. Survey the community with the aid of students and find the number of people engaged in this type of work
3. Show filmstrips on how household pests damage the home and buildings
4. Illustrate how pests can harm the health of people

C. Subject Matter Content
Assignment: What students need to learn
1. Competencies needed by an individual to enter this type of service
2. Common pests that the American families as well as the businesses encounter
3. Classification of household pests and damage done by each class
   a. Insects
   b. Rodents
   c. Mollusks
4. Life cycles of the most common insects considered to be household pests
5. Rodent reproduction and their desired habitat
6. Gastropod reproduction and their desired habitat
7. The control of insects, rodents, and mollusks and the prevention where it applies
8. Types of applicators used by most pest control companies
9. Use and maintenance of the various applicators
10. Policies regulating the use of chemicals in this type of business
11. Insurance and bonding required by state for such businesses to operate
12. Environmental factors that would hinder prevention and control of pests
13. Quarantines
14. Ability to dilute solutions

D. Student Participation
1. Students collect specimens of pests, identify and give recommendations as to how to control
2. Outline procedure for preventing and controlling pests on students' farms or homes or a recreational area
3. Observe, if possible, a serviceman serving a building or surrounding
4. Compare costs of the different methods of control of household pests
5. Perform some type of pest control work, using dilutes and chemicals

E. Teaching Aids and References
1. Samples of the various chemicals that are used to eradicate or

control
2. Films
3. Filmstrips and color slides
4. Applicators
5. Charts or diagrams of the parts of insects, rodents, and mollusks
6. "Louisiana Structural Pest Control Law,Rules, and Regulations," Louisiana Department of Agriculture
7. "Structural Pest Control Commission," Louisiana Department of Agriculture
8. "The War That Never Ends," Cooperative Extension Service, Pub. 1431
9. Applied Entomology. Fernold, Shepard
10. "Yearbook on Insects," USDA
11. USDA publication 120
12. "Termites and Their Control in Louisiana," Publication 1162, Louisiana Agricultural Extension Service
13. " Control House Flies on the Farm," Publication 1247, Louisiana Extension Service
14. "Controlling Household Pest," USDA Bulletin, Home and Garden, 96

Lesson 6: Prevention and Control of Plant Diseases Associated With Wildlife and Recreation

A. Objective

To familiarize the students with the plant diseases associated with jobs in the field of wildlife and recreation and help the student to develop competencies in the prevention and control of plant disease that will facilitate job entry

B. Motivation

1. Students make surveys of job opportunities in the field of wildlife and recreation concerning this type of work
2. Point out that in the United States the average annual loss from plant diseases is estimated to be about three billion dollars
3. Point out that there are more than 170 bacteria which cause diseases in plants, 200 viruses and several hundred fungi that also cause plant disease, therefore creating a vast need for scientific knowledge
4. Show color slides or charts identifying certain diseases and illustrating damage of some of these diseases
5. Visit a farm, timber plot, or park where diseases have attacked and show the students how disasterous diseases can be

C. Subject Matter Content

Assignment: What students need to learn

1. The economic importance of plant diseases
2. The common plant diseases that persons would be associated with in performing services in wildlife and recreation
   a. Diseases associated with horticulture plants
   b. Forestry diseases
3. The symptoms of these plant diseases and cause of each as to
   a. Bacteria
   b. Virus

c. Fungi

4. Recommending the prevention of diseases of plants associated with wildlife and recreation
5. Recommending the control of plant diseases
   a. Methods
   b. Chemicals
6. Ability to treat plants for diseases
7. Physiological factors that help a disease
8. State and Federal laws regulating standards or controls on disease prevention and control
9. Preparing a diseased specimen for shipment
10. Use of state and federal laboratories in identifying and controlling diseases

D. Student Participation

1. Practice in observing symptoms of plant diseases
2. Students prepare diseased plants for shipment to laboratory, etc.
3. Visits to greenhouse, farm, forestry plot or business to spot plants with fungus, virus, or bacteria type diseases
4. Survey job opportunities in this field
5. Student collect diseased plant specimens and give recommendations for prevention and control
6. Students observe the various fungi and bacteria under microscopes or bioscopes
7. Test for viruses

E. Teaching Aids and References

1. Films, filmstrips
2. Color charts of methods of control
3. Specimens of diseased plants
4. Color slides
5. Use of opaque type projectors
6. Microscope or bioscope to observe bacteria and fungi
7. Plant tissue kit
8. USDA yearbook, Plant Diseases. 1953
9. Field Crops. Fergus, Hammonds, Rogers. 1958
10. Southern Crops. Chapman, Thomas, 1958
11. USDA Publications, 590; others
12. Southern Forestry. Elliott, Mobley, 1949
13. Profitable Southern Crops. Walton, Holt, 1959
14. Forestry in the South. Mobley, Hoskins. 1956
15. Developing Farm Woodlands. Preston. 1954
16. Crop Production in the South

UNIT EVALUATION

1. Any type of examination may be given but the test should be practical when it is possible
2. As students progress in their work, their achievements should be recorded on a work sheet
3. Oral questioning and answering sessions could be called at various times during the work unit
4. Students could do performance work on applying chemicals, etc.
5. Practical examinations on identification of disease, insects,

rodents, etc. Specimens may be erected on some type of table and students have time limit on identification

6. Practical examination on chemicals as to color, smell, and structure

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Bundy and Diggins. Livestock and Poultry Production. Englewood Cliffs, N.J. Prentice Hall, 1960

Chapman and Thomas. Southern Crops. Atlanta. Turner E. Smith and Company, 1958

Elliot and Mobby. Southern Forestry. Atlanta. Turner E. Smith and Company, 1949

Ensminger, M.E., Beef Cattle Science. Danville, Illinois. Interstate Printers and Publishers Inc., 1960

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Farm Chemical Handbook. Meister Publishing Company, Willoughby, Ohio

Fergus, Hammonds, Rogers. Field Crops. Chicago, J.B. Lippincott Company, 1958

Fernold and Shepard. Applied Entomology. New York. McGraw Hill Book Company, 1955

Frear, D.E.H. Pesticide Handbook-Entoma. State College, Penn: College Science Publishers

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Krebs, A.H. Agriculture in Our Lives. Danville, Illinois. Interstate Printers and Publishers Inc.

Mobley and Hoskins. Forestry in the South. Turner E. Smith, Atlanta, 1956

Peterson,Field. Dairy Farming. Chicago, J.B. Lippincott Company, 1958

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Wing, L.W. Practice of Wildlife Conservation. New York. John Wiley and Sons Inc., 1951

Winter and Funk. Poultry Science and Practice. Chicago. J.B. Lippincott Company, 1960

USDA Yearbook Plant Diseases, 1953, Washington, D.C., Superintendent of Documents

Walter and Holt. Profitable Southern Crops. Englewood Cliffs, N.J. Prentice-Hall Inc., 1959

Yearbook on Insects, USDA, 1953

"Control House Flies on the Farm," 1247, Louisiana Agricultural Extension Service

"Controlling Household Pest," USDA Bulletin, Home and Garden, 96

"Insect Control Guide." 1965, Agricultural Extension Service

"Louisiana Structural Pest Control Law, Rules, and Regulations." Louisiana Department of Agriculture

"Safe Disposal of Empty Pesticide Containers and Surplus Pesticides," USDA Publication, 1964

"Structural Pest Control Commission," Louisiana Department of Agriculture

"Termites and Their Control in Louisiana," 1162, Louisiana Agriculture Extension Service

USDA Bulletin No. 120

USDA Bulletin No. 167, 1948

USDA Circular No. 632

"The War That Never Ends," Louisiana Agricultural Extension Service

UNIT 8

GAME AND FISH MANAGEMENT

One of nineteen units of instruction in the occupational family

Wildlife and Recreation

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Production Agriculture Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Game and Fish Management

UNIT OBJECTIVE: To develop the abilities and understandings necessary for job entry into game and fish management

TIME ALLOTMENT:

In School:

Class Instruction	15	hrs.
Shop or Laboratory Work	5	hrs.
Total	20	hrs.
Occupational or Job Experience		hrs. (To be determined by individual teachers)
Unit Total		hrs.

COMPETENCIES TO BE DEVELOPED:

1. Classification and characteristics of game species
2. Specific management practices for important game species
3. Multiple use of forest lands
4. Fish pond management
5. Wildlife income
6. Wildlife predator control

STUDENT MOTIVATION:

1. In introducing the unit, study the organizational makeup of the State Wildlife and Fisheries Commission, the director, the enforcement force, and financing
2. From a state hunting license determine what game can be hunted in the state
3. List the game that is available locally
4. Survey the fishing businesses and the open fishing areas found in the local area
5. Study the local, state, and federal hunting and fishing laws and regulations

TEACHING THE UNIT:

I. Organization

A. Lessons to be Taught
   1. Classification and characteristics of game species
   2. Specific management practices for important game species
   3. Multiple use of forest lands
   4. Fish pond management
   5. Sources of wildlife income
   6. Control of wildlife predators

B. Instructional Materials
   1. Films, charts, and pamphlets from the State Wildlife and Fisheries Commission
   2. Government pamphlets
   3. Conservation Department pamphlets

4. State laws and regulations

C. Job Experience
1. Jobs connected with the Wildlife and Fisheries Commission
2. Jobs in the enforcement department
3. Jobs in the conservation department

II. Teaching the Lesson

Lesson 1: Classification and Characteristics of Game Species

A. Objective
To develop the ability to classify and an understanding of the characteristics of game species that is necessary for job entry into game and fish management

B. Motivation
1. Have students name and give some characteristics of some game species(animals, fowl, and fish) found in local area
2. Make estimates of the amount of money spent on hunting and fishing in the community

C. Subject Matter Content
Assignment: What students need to learn
1. Farm game
   a. Types of game found in community
   b. Feeding habits and breeding grounds
   c. Conservation practices and laws
2. Forest game
   a. Types found in local area
   b. Feeding habits and breeding grounds
   c. Conservation practices and laws
3. Migratory game
   a. Types found in community and state
   b. Feeding and breeding grounds
   c. Federal and state laws

D. Student Participation
1. List common local game and formulate plans that would help increase production
2. Try to determine the amount of money spent each year on hunting
3. Survey the businesses that directly or indirectly make money from hunting or hunting supplies

E. Teaching Aids and References
1. Charts, films, and pamphlets from the State Wildlife and Fisheries Commission
2. Government pamphlets
3. Conservation Department pamphlets
4. State laws and regulations

Lesson 2: Specific Management Practices for Important Game Species

A. Objective
To develop understanding necessary for job entry into businesses that deal with the management and protection of certain game species

B. Motivation
1. Survey the businesses in the community that are supported or partially supported by certain game species
2. Visit these businesses if possible and explore the employment opportunities

C. Subject Matter Content
Assignment: What students need to learn
1. Quail
   a. Feeding habits
   b. Reproduction
   c. Protection
      (1) Laws
      (2) Natural
2. Rabbit and squirrel
   a. Feeding habits
   b. Reproduction
   c. Protection
      (1) Laws
      (2) Natural
3. Wild turkey and deer
   a. Feeding habits
   b. Reproduction
   c. Protection
      (1) Laws
      (2) Natural
4. Geese, snipe, doves, and woodcock
   a. Local feeding grounds
   b. Breeding grounds
   c. State and Federal regulations

D. Student Participation
Survey the businesses that receive income either directly or indirectly from these game species

E. Teaching Aids and References
1. Charts, films, and pamphlets from the State Wildlife and Fisheries Commission
2. Government pamphlets
3. Conservation Department pamphlets
4. State laws and regulations

Lesson 3: Multiple Use of Forests

A. Objective
To develop understanding necessary for job entry into occupations that deal with forest and its use for wildlife game

B. Motivation

1. Survey forest land available in the community
2. Determine the abundance of game species and to what extent it is used for hunting and trapping

C. Subject Matter Content
Assignment: What students need to learn
1. Control burning for game
   a. When to burn
   b. How to burn
2. Selective cutting for deer browse
3. Plants for game feed
   a. Types and variety for local area
   b. When and how to plant

D. Student Participation
1. Outline plan whereby forest game could be increased in area
2. List things that have happened that have caused a decrease in forest game
3. List benefits derived from forest game

E. Teaching Aids and References
1. Charts, films, and pamphlets from the State Wildlife and Fisheries Commission
2. Government pamphlets
3. Conservation Department pamphlets
4. State laws and regulations

Lesson 4: Fish Pond Management

A. Objective
To develop the understanding necessary for job entry into occupations dealing with fish pond management

B. Motivation
1. Survey the farm and fish ponds in local area
2. Determine to what extent they are used for fishing

C. Subject Matter Content
Assignment: What students need to learn
1. Fertilization
   a. Type to use for best results
   b. When to fertilize
   c. How to fertilize
2. Weed control
   a. Importance
   b. Methods
3. Stocking
   a. Best time
   b. Size to stock
   c. Feeding
4. Fish harvest
5. Care of pond
   a. Proper overflow

b. Proper control of water shed into pond
c. Raising and lowering water level

D. Student Participation
1. Formulate plans whereby fishing for pleasure or profit could be increased in the community
2. Study the practicability of building more ponds in the community

E. Teaching Aids and References
1. Charts, films, and pamphlets from the State Wildlife and Fisheries Commission
2. Government pamphlets
3. Conservation Department pamphlets
4. State laws and regulations

Lesson 5: Wildlife Income

A. Objective
To understand the importance of wildlife to the local, state, and national economy

B. Motivation
Check the businesses that receive at least part of their income from wildlife or wildlife related activities

C. Subject Matter Content
Assignment: What students need to learn
1. Raising quail and other game for income
2. Raising minnows for income
3. Raising catfish for income
4. Raising miscellaneous fish bait for income
5. Trapping for income

D. Student Participation
1. List all income-bearing activities in the local area that are related to wildlife and fish
2. Check job opportunities available in these activities

E. Teaching Aids and References
1. Charts, films, and pamphlets from the State Wildlife and Fisheries Commission
2. Government pamphlets
3. Conservation Department pamphlets
4. State laws and regulations

Lesson 6: Wildlife Predator Control

A. Objectives
1. To identify wildlife predators
2. To understand the importance of predator control
3. To develop understanding necessary for job entry into the business of predator control

B. Motivation
   1. List the local wildlife predators
   2. What is being done to control these predators

C. Subject Matter Content
   Assignment: What students need to learn
   1. Trapping predators
   2. Fox control in rabies control
   3. Rodent control
   4. Miscellaneous pests
      a. Cats (wild and house cats)
      b. Stray dogs
      c. Hawks

D. Student Participation
   1. Estimate percentage of game that is destroyed by predators
   2. Study methods being used locally to control predators
   3. Give some ways of improving these methods

E. Teaching Aids and References
   1. Charts, films, and pamphlets from the State Wildlife and Fisheries Commission
   2. Government pamphlets
   3. Conservation Department pamphlets
   4. State laws and regulations

UNIT EVALUATION
   1. Conventional examinations

UNIT REFERENCES

Bulletins from Department of the Interior, Bureau of Outdoor Recreation, Washington, D.C., 20240

Bulletins from State Parks and Recreation Commission, Leroy A. Talley, Director of State Parks and Recreation, Old State Capitol Building, P.O. Drawer 1111, Baton Rouge, La.

Wing, Leonard. Practice of Wildlife Conservation. John Wiley and Sons, Inc., New York, 195[illegible]

UNIT 9

CARE OF ANIMALS USED FOR RECREATIONAL PURPOSES

One of nineteen units of instruction in the occupational family

Wildlife and Recreation

ERIC

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Production Agriculture Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Care of Animals Used for Recreational Purposes

UNIT OBJECTIVE:

To familiarize students with the animals used in recreational areas and to stimulate in students a desire to develop those competencies that are needed to take care of animals that are used in businesses or agencies catering to the public for recreation

TIME ALLOTMENT:

In School:

Class Instruction	15	hrs.
Shop or Laboratory Work	5	hrs.
Total	20	hrs.
Occupational or Job Experience		hrs. (To be determined by individual teachers)
Unit Total		hrs.

COMPETENCIES TO BE DEVELOPED:

1. Animals used in recreational activities
2. The necessary feeding requirements of animals used in the various recreational areas
3. The importance of animal sanitation and the statutes of sanitation that regulate the use of animals in recreational agencies or private businesses; also ability to provide for sanitation
4. The effects of good grooming of animals and how to perform this work
5. The proper housing of animals
6. The importance of training animals and procedures for training certain types of animals

STUDENT MOTIVATION:

1. Point out to students that more and more jobs are becoming available in the field of recreation and that animals, such as horses, dogs cattle, fowl, and even hogs in some cases, not to mention the animals in zoos, are being used to help further the activities being offered by the agency or business. Personnel taking care of these animals, most of which are farm animals, must be able to properly care for these animals
2. In class discussion ask students to give situations where animals are being used for recreational purposes
3. Use a chart (bar, graph, line, etc.) illustrating the rise in popularity of dogs and light horses. Point out that many of these animals are used in recreational activities
4. Point out in general class discussions the importance of keeping animals healthy and well groomed. The public doesn't like to look at sickly or rough coated animals. "Fat and glossy animals are always the best ones."

TEACHING THE UNIT:

I. Organization

A. Lessons to be Taught
   1. Feeding animals (dogs, horses, cattle, fowl, and others)
   2. Animal sanitation
   3. Grooming of animals
   4. Housing and equipment for animals
   5. Training of animals

B. Instructional Materials
   1. Films, filmstrips
   2. Equipment used in grooming
   3. Charts
   4. Color slides of well-groomed animals
   5. Models of animals
   6. News articles
   7. Magazines
   8. Samples of feeds

C. Job Experience
   1. Farm, school, or home
   2. Riding stables
   3. Other agencies

II. Teaching the Lesson

Lesson 1: Feeding Animals

A. Objective
   To familiarize the students with the various animals used in recreational agencies and the proper methods of providing nutrition for these animals

B. Motivation
   1. Point out to the students that animals, for production or pleasure, must have the proper nutrition in order to perform the work they are designated to do
   2. By the use of two large color charts or color slides, contrast an animal suffering from malnutrition and one that has been properly fed
   3. The use of some type of film along this line would be of great help
   4. Filmstrip "Minerals for Livestock," secured through Morton Salt Co.
   5. Illustrate that animals being fed a large quantity of feed do not necessarily get the right kinds and amounts

C. Subject Matter Content
   Assignment: What students need to learn
   1. Terms: Nutrient, nutritive, maintenance ration, productive ration, roughage, concentrate, fiber, feeding standards, T.D.N., digestion, balanced ration, stomach, digestive system, digestive tract, and others
   2. The six most important nutrients and feeds high in each of these
   3. The important minerals and their function
   4. The types of digestion systems of animals found in recreational businesses

5. Correlation between the digestive tract and the type of feed needed
6. Factors to consider in selecting feeds for the various animals used in recreational work
7. Importance of selecting good roughage for feed
8. Importance of adding vitamins, minerals, etc.,to feeds where animals do not have pasture
9. Feeding and nutritional requirements for:
   a. Horses (medium-heavy, light and ponies)
   b. Dogs and other small animals
   c. Fowl (quail, duck, geese, chickens, etc.)
   d. Cattle and other ruminants
   e. Burros
10. Changes brought about in food as a part of the digestive process
11. The use of feeding standards in relation to the feeding of animals used in recreational work
12. Finding the percentage of protein required in a mixed feed
13. Determining the type of feed from the feed tag
14. The procedures used to balance a ration
15. Determining the formula for a concentrate mixture
16. Importance of regular feeding

D. Student Participation
   1. Students calculate daily rations for different kinds of animals and fowl found in recreational business
   2. Work out formulas for concentrate mixture for the different classes of animals being used
   3. Students draw and label the digestive systems of animals that will be used in recreational businesses
   4. Students collect samples of feed they would probably be using and classify them as to roughage, grain, concentrate, etc.
   5. Visit nearby feed supply house to learn the techniques in ordering feeds you need

E. Teaching Aids and References
   1. Filmstrips. "Digestion,", "Digestion of Simple Stomachs," others
   2. Films, "The Rumen Story," Ralston Purina Company, etc.
   3. Charts of the classification of feeds, average composition of feeds, etc.
   4. Pictures or drawings showing the several types of digestive systems such as the horse, cow, fowl, dog, etc.
   5. Collection of feed samples
   6. Mimeographed (duplicated) copies of feeding standards
   7. Sample rations for light horses, dogs, cattle, fowl, etc.
   8. Livestock and Poultry Production. Bundy, C.E., Second edition, Englewood Cliffs, New Jersey. Prentice Hall Inc. 1961
   9. Feeds and Feeding. Morrison, F.B. Morrison Publishing Company, Ithaca, New York. 1956
   10. Animal and Poultry Nutrition. Ralston Purina Company, Checkerboard Square, St. Louis, Missouri
   11. Mineral Feeding Facts. Darling and Company. Union Stockyards, Chicago, 1965 edition
   12. Feed Additive Compendium. Minneapolis Feedstuffs, 2501 Wayzata Blvd.
   13. Introduction Animal Science. Garrigus, Third edition, J.B.

Lippincott Company. Chicago, New York, 1960
14. Horses and Horsemanship. Ensminger
15. Stockman's Handbook. Ensminger

Lesson 2: Animal Sanitation

A. Objective
To familiarize students with techniques and procedures for taking care of the animals health and provide knowledge which will enable students to develop good sanitation practices for animals used in recreational work

B. Motivation
1. Point out to students that horses, dogs, fowl, or other animals cannot perform the work they are to do if they are not healthy
2. Show color slides or picture charts of sickly animals and contrast them with pictures or slides of well groomed and healthy animals
3. Students participate in a discussion of experiences they have had with sick animals
4. Bring to the attention of the students that diseased animals can transmit diseases to humans
5. Point out to students that most animals used in recreational work are usually confined to small areas, usually in towns and cities, and sanitation becomes a major problem. Many of these businesses are usually regulated by the Health and Sanitation Department

C. Subject Matter Content
Assignment: What students need to learn
1. Terms: Healthy, disease-free, diseased infection, infectious, non-infectious, vaccines, serums, antibiotics, medicated feeds, immune, immunization
2. Vehicles of infection of animals
3. Sources available for vaccines, antibiotics, serums that individuals may safely use on animals without the aid of a veterinarian
4. Recognition of normal versus abnormal animals relative to body temperature and other common symptoms of sick animals
5. Recognition of parasites affecting animals used in recreational businesses through laboratories or observation
   a. External
   b. Internal
6. Treating recreational type animals for parasitic conditions
   a. Methods
   b. Medications available
7. Common ailments and symptoms of the animals in recreational businesses
   a. Horses: colic, foot rot, distemper, pollevil, heaves, string-haltered, wind broke, etc.
   b. Dogs: colic, food poison, fits, diarrhea, etc.
   c. Fowl: Diarrhea, cannibalism, etc.
   d. Cattle: Foot rot, bloat, stifled, etc.
   e. Sheep and goats: Foot rot, bloat, etc.
   f. Other animals

8. Common diseases and symptoms of animals in recreational businesses
   a. Horses
   b. Dogs
   c. Fowl
   d. Cattle
   e. Sheep and goats
   f. Others
9. Treatment, prevention, and control of common diseases and ailments of the various animals used in this type work
10. Types of disinfectants and their use for good sanitation practices
11. Good sanitation practices used in the prevention and control of diseases and parasites
12. Procedure for diagnosing diseases and ailments when the disease is not known
13. Securing additional help in diagnosing diseases (veterinarian)
14. The use of the different instruments and tools used in providing good sanitation
15. Laws and regulations that recreational agencies or businesses have to comply with in order to operate

D. Student Participation
   1. Students learn how to use the different instruments and tools used in sanitation practices
   2. Make some type of chart or folder of diseases and ailments showing causes, symptoms, control, and prevention methods
   3. Field trips or educational tours to nearby farms where they can observe diseases, give diagnosis, and recommend treatment and control
   4. Visit a diagnostic laboratory
   5. Students mix disinfectants and apply these mixtures to premises using various types of sprayers or dusters

E. Teaching Aids and References
   1. Films, filmstrips
   2. Collection of the different disinfectants
   3. Collection of tissue or parts of diseased animals for observation
   4. Chart of common diseases with symptoms, cause, control, and prevention
   5. Color slides
   6. Equipment, instruments, and tools used in giving medication to animals
   7. Commercial booklets
   8. Magazines and newsletters
   9. U.S.D.A. Bulletins
   10. Microscope and bioscope
   11. Livestock and Poultry Production. Bundy, C.E. Second edition, Prentice Hall Inc., Englewood Cliffs, New Jersey, 1961
   12. U.S.D.A. Yearbooks, 1942-1958
   13. Introductory to Animal Science. Garrigus. Third edition, J.B. Lippincott Company, Chicago, New York, 1960
   14. Horses and Horsemanship. Ensminger. Interstate Printers and Publishers, Danville, Illinois
   15. Stockman's Handbook. Ensminger. Interstate Printers and Publishers,

Danville, Illinois
16. Livestock Farming. Chapman, P.W., Dinsmore, W., Turner E. Smith Company, Atlanta, Georgia, 1956
17. Beef Cattle Science. Ensminger, M.E., Interstate Printers and Publishers. Danville, Illinois, 1960
18. Dog Owner's Veterinary Guide. Stamm, G.W., T.F.H. Publications
19. Raising Game Birds in Captivity. Greenburg, D.B., D.Van Nostrand
20. Raising Game Birds. Pence, Dr. P.M.

II. Teaching the Lesson

Lesson 3: Grooming of Animals

A. Objective
To acquaint the students with the importance of good grooming and to develop competencies in the procedures for grooming animals used in recreational agencies or businesses

B. Student Motivation
1. Impress the students with the over all importance of well-groomed animals
2. Point out to students that well-groomed animals usually are more valuable to most people because they "look good"
3. Using the models of several animals let students discuss how they would groom or train certain parts (mane, horns, etc.) of the animal and/or let them ask questions as to what they should do
4. If possible, visit a nearby riding stable, dog kennel, or another similiar type business where students may observe grooming practices
5. Color slides may be prepared by teacher contrasting the well-groomed animal versus the ungroomed animal in the same class

C. Subject Matter Content
Assignment: What students need to learn
1. The importance of grooming
2. The approved procedure of trimming, cleaning, and oiling feet
3. Importance of washing; when to wash
4. The methods of clipping different classes of animals found in this type of business
5. The purpose and types of curling for:
   a. Horses
   b. Cattle
   c. Dogs
6. Procedures for trimming and grooming horses mane and tail
7. The purpose of blanketing, which animals should be blanketed and when they should be blanketed
8. Proper method of cleaning and brushing dogs
9. Proper method of grooming cattle, sheep, and goats
10. Proper procedures for keeping fowls clean
11. The purpose of oiling animal coats, kinds of oils (mixtures) to use, when and how to use
12. Tools and equipment needed for grooming
13. The operation and maintenance of the proper equipment used in grooming livestock

14. Some safety precautions to observe when grooming animals

D. Student Participation
1. Students completely groom some type of animal (horse, dog, etc.)
2. Students learn to operate tools and equipment associated with grooming
3. Students prepare folders relating to equipment needed, mixtures of oils needed and procedures for grooming individual animals
4. Students trim the feet of horses, ponies, or burros
5. If possible, students visit a horse, dog, or any type of animal show and observe the different methods of grooming

E. Teaching Aids and References
1. Films, filmstrips
2. Pictures of well groomed animals
3. Charts
4. Commercial literature
5. Collection of the different mixtures of grooming oils
6. Equipment needed for grooming
7. Color slides
8. Livestock and Poultry Production. Bundy, Diggins. Prentice Hall Inc., Englewood Cliffs, New Jersey, 1961
9. Horses and Horsemanship. Ensminger. The Interstate Printers and Publishers, Danville, Illinois
10. Beef Cattle Science. Ensminger. Third edition. Interstate Printers and Publishers, Danville, Illinois, 1960
11. Poultry Science and Practice. Funk, E.M., Winter, A.R., J.B. Lippincott Company, Chicago-New York, 1960
12. How to Buy a Healthy Horse-And Keep Him That Way. Schield, Dan
13. The Quarter Horse Breeder. Lindeman
14. Commercial pamphlets and brochures from the various feeding companies
15. U.S.D.A. Bulletins
16. Bulletins obtained from Agricultural Extension Service
17. The Sheep Book. McKinney, John, John Wiley and Sons, Inc., New York
18. Raising Game Birds in Captivity. Greenberg, David B., D. Van Nostrand

II. Teaching the Lesson

Lesson 4: Housing and Equipment for Animals

A. Objective
To provide basic knowledge and understanding of the housing and equipment needed for the animals used in recreational businesses in Louisiana

B. Motivation
1. Careful planning of equipment and houses needed in order to use equipment more effectively because of high investment
2. Point out that animals need housing during the winter months
3. In group discussion ask students to relate their experiences in providing shelter for animals
4. By the use of filmstrips or color slides show the students examples

of good housing and equipment and illustrate that good housing also helps promote good sanitation

C. Subject Matter Content

Assignment: What students need to learn

1. Importance of housing animals used for recreation businesses
2. Importance of equipment in maintaining animals for work or pleasure
3. Types and floor requirements of houses for horses
4. Types of equipment needed for horses in recreational work
5. Types of houses needed for fowls (quail, ducks, geese, etc.) and floor space needed
6. Equipment essential for the production of quail, geese, ducks, and other fowl
7. Housing and equipment needed for cattle for different recreational purposes
8. Types of houses for dogs, essential equipment for kennels
9. Types of houses needed for sheep and goats, equipment that might be needed to carry on recreational work
10. Sanitation requirements for various buildings
11. Relationship of housing location to water, lights, etc.
12. Accessibility
13. Storage facilities needed for supplies for animals used in recreational agencies or businesses
14. Regulations or restrictions applicable to shelters in urban areas

D. Student Participation

1. Students visit and observe several different types of housing
2. Students visit a local equipment dealer for a demonstration of the newest types of equipment
3. Students prepare a notebook-type folder illustrating the various types of buildings and equipment that are used for animals in recreational businesses
4. Compare costs of different types of equipment and housing with selected animals of the recreational businesses
5. Students list the different materials that are used for the construction of buildings for housing animals

E. Teaching Aids and References

1. Films, filmstrips
2. Charts
3. Pictures illustrating various structures
4. Price sheets of building materials
5. Sanitation regulations of your area
6. Drawing boards
7. Various equipment
8. Magazines and other publications
9. Livestock Production. Bundy, Diggins. Prentice Hall Inc., Englewood Cliffs, New Jersey, 1961
10. Stockman's Handbook. Ensminger, Interstate Publishers and Printers Inc., Danville, Illinois
11. Horses and Horsemanship. Ensminger. Interstate Publishers and Printers Inc., Danville, Illinois
12. Farm Machinery and Equipment. Smith.

13. Profitable Farm Management. Hamilton and Bryant. Prentice Hall Inc. Englewood Cliffs, New Jersey, 1956
14. Commercial literature
15. U.S.D.A. Bulletins
16. Publications from Agriculture Extension Service

II. Teaching the Lesson

Lesson 5: Training Animals

A. Objectives
1. To familiarize the students with the great task of training animals for recreational purposes
2. To stimulate an interest in the students to develop competencies in procedures for training animals that would prepare them for job entry

B. Motivation
1. Point out that animals used in recreational businesses must be properly trained before they can be offered to the public because of the great liability that might be incurred
2. Point out to students that properly trained animals are much more valuable than untrained animals and there is a great demand for trained animals
3. Stress the importance of knowing what to do with animals at the right times, otherwise a potentially good animal may prove to be of little value
4. Point out that with the high standard of living that American people now have, they are willing to pay for the services of training animals

C. Subject Matter Content
Assignment: What students need to learn
1. Economic importance of properly trained animals
2. Selection of animals for recreational purposes
   a. Horses
   b. Dogs
   c. Other livestock
3. Procedures for gentling and posing animals
4. Procedures for training dogs for hunting purposes
5. Procedures for training horses for
   a. Pleasure riding
   b. Working stock
   c. Rodeo
   d. Racing
6. Procedures for training fowl
7. Teaching tricks to small animals
8. Common mistakes amateurs make in handling animals

D. Student Participation
1. Have students compile a folder on procedures used for training of animals used in recreational businesses
2. If possible, visit a riding stable, dog kennel, etc. where students will be able to observe animals being trained

3. Have each student train a small animal. Student should record the progress of the animal
4. Students compile a list of abilities a person must have in order to train animals

E. Teaching Aids and References
1. Films, filmstrips
2. Charts illustrating procedures for training
3. Animals that are trained
4. Commercial literature
5. Resource personnel
6. Color slides
7. Bulletins: U.S.D.A., Agriculture Extension Service
8. Horses and Horsemanship. Ensminger, M.E., Interstate Publishers and Printers, Danville, Illinois
9. Breaking and Training the Stock Horse, Williamson, C.O. Nasco
10. The Schooling of the Western Horse. Young, J.R. University of Oklahoma Press, Oklahoma
11. A Practical For Horse Owners. Widmer, Jack. Charles Scribner's Son's Publishing Company
12. Raising Game Birds. Pence, Dr. P.M. Ozark Quail Farm
13. How to Train Your Dog. Sohn, David. T.F.H. Publication
14. Expert Obedience Training for Dogs. Strickland, W.C., Macmillan Publishing Company, New York
15. Livestock and Poultry Production. Bundy, Diggins. Prentice Hall Inc. Englewood Cliffs, New Jersey, 1961

UNIT EVALUATION
1. Conventional examinations
2. Identification of animals
3. Oral questioning periods set up throughout the course
4. As students progress through the unit make a check as to how well the student developed the competencies
5. Individual evaluation of students

UNIT REFERENCES

Bundy and Diggins. Livestock and Poultry Production. Englewood Cliffs, New Jersey. Prentice Hall Inc., 1961

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"Animal and Poultry Nutrition," St. Louis, Missouri. Ralston Purina Company, Checkerboard Square

"Feed Additive Compendium," Minneapolis. Minneapolis Feedstuffs, 2501 Wayzata Boulevard

"Manual of Poultry Diseases," Charles City, Iowa. Dr. Salisbury Laboratories

"Mineral Feeding Facts," Chicago. Darling and Company, Union Stockyards, 1965

UNIT 10

CARE OF PLANTS AND SOILS

One of nineteen units of instruction in the occupational family

Wildlife and Recreation

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Agriculture Production Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Care of Plants and Soils

UNIT OBJECTIVE: To develop in students the ability to properly care for plants and soils

TIME ALLOTMENT:

In School:

Class Instruction	15	hrs.
Shop or Laboratory Work	10	hrs.
Total	25	hrs.
Occupational or Job Experience		hrs. (To be determined by individual teachers)
Unit Total		hrs.

COMPETENCIES TO BE DEVELOPED:

1. Provide a basic knowledge in the propagation of plants
2. Provide a basic knowledge in preparing soil for planting
3. Provide a basic knowledge of the fertilization requirements of plants used on golf greens, parks, etc.
4. Provide a basic knowledge of pruning, trimming, and caring for plants

STUDENT MOTIVATION:

1. Discuss job possibilities
2. Have individuals that have had experience in wildlife and recreational activities, talk to the class
3. Make field trips and have the students observe the different practices used in the care of plants and soils
4. Have students tell in class the methods they use in the care of plants and soil in their homes and surroundings

TEACHING THE UNIT:

I. Organization

A. Lessons to be Taught
   1. Plant propagation
   2. Soil preparation for planting
   3. Fertilization of plants used in golf greens, parks, etc.
   4. Pruning, trimming, and care of plants

B. Instructional Materials
   1. Plant cuttings
   2. Fertilizer samples
   3. Soil samples
   4. Charts listing the names of common plants used
   5. Pictures showing the layout of these public places, and plant arrangements
   6. Tools
   7. Books

8. Seeds
9. Rooting media

C. Job Experience
1. School
2. Public places in the community
3. Green houses
4. Home

II. Teaching the Lesson

Lesson 1: Propagation

A. Objective
To develop in students an understanding of the various methods by which plants are propagated and to develop the individual's ability to carry out propagating procedures

B. Motivation
1. Explain the objective content with the students, informing them of the expected performance and activities during the study of the unit
2. Display sexual and asexual reproduction in various phases of maturity from the initial stage to a growing plant

Sexual	Asexual
Corn	Bulbs (onions, tulip, etc.)
Radish	Cutting (taxus, juniperus)
Lima beans	Lead planting (air plant-bryophyllum)
	Stolons (certain grasses)
	Layering (rubber plant, philodendron honeysuckle)

C. Subject Matter Content
Assignment: What students need to learn
1. Structure of a seed
2. Production of seed
3. The activities of the various parts of the seed
4. Storage of seed
5. Germination of seed
6. Factors affecting germination
7. Reasons for failures in germination
8. Viability of seed
9. Reading and understanding labels on packages
10. Preparing seed for planting
11. Preparing the seedbed
12. Planting the seed
13. Seeding in flats
14. Using pot labels
15. Care of the seedlings
16. Controlling heat and light
17. Preparing the seedlings for transplanting

18. Propagating by cuttings
    a. Importance of cuttings
    b. Type of cuttings
    c. Factors which affect success in making and rooting cuttings
    d. Making cuttings of various types
    e. Rooting and cutting
    f. Placing cutting in rooting media
    g. Care of cuttings during rooting
    h. Preparing the cuttings for transplanting
19. Propagating by budding
    a. T-budding
    b. Patch budding
    c. Chip budding
20. Discuss the several methods of grafting and give the advantages and disadvantages of each
21. What is a scion
22. The care and maintenance of the graft after completion
23. Discuss safety measures

D. Student Participation
    1. Bring seeds and cuttings to the classroom, and identify them
    2. Propagate plants by using seeds, cuttings, budding, and grafting
    3. Bring the media for the different types of propagation

E. Teaching Aids and References
    1. Plants
    2. Scions
    3. Budding and grafting wax
    4. Drawings and charts
    5. Films and filmstrips on propagation
    6. Introductory Horticulture. Christopher, E.P.
    7. Plant Propagation: Principles and Practices. Hartman and Kester
    8. Plant Propagation. Mahlstede, John P.
    9. Plant Propagation Practices. Wells, James S.
    10. State and USDA Bulletins

II. Teaching the Lesson

Lesson 2: Soil Preparation

A. Objective
   To develop in students a knowledge and appreciation for the proper preparation of soil in the development of golf greens, parks, etc.

B. Motivation
    1. Discuss the practices used in the area
    2. To interest students in the lesson and its mastery, present the following:
        a. The value of good soil preparation
        b. Changes that have taken place in the preparation of soils

C. Subject Matter Content
   Assignment: What students need to learn

1. Methods of preparation for different soil types and plants
2. Define the following terms:
   a. Aeration
   b. Mulching
   c. Subsoiling
   d. Hard pan
   e. Humus
   f. Topsoil
3. Equipment and machinery used in soil preparation
4. Give the advantages of thorough soil preparation
5. Methods used in preparing different soils
6. Requirement of a good seed bed
7. Importance of good drainage
8. Give the relationship of soil preparation to plant growth

D. Student Participation
1. Visit equipment and machinery dealers and make a list of equipment used in soil preparation
2. Visit a golf course or park during the time the soil is being prepared for planting shrubs and flowers, and take notes on procedures being used
3. Prepare soil around the school for planting

E. Teaching Aids and References
1. Supplies and equipment used in soil preparation
2. Pamphlets on soil preparation
3. Films and filmstrips
4. Charts
5. Using and Managing Soils. Gustafson
6. Productive Soils. (revised.) Weir
7. Crop Management and Soil Conservation. Cox and Jackson
8. Southern Crops. Chapman and Thomas

II. Teaching the Lesson

Lesson 3: Fertilization of Plants

A. Objectives
1. To present to students basic knowledge of:
   a. The plant nutrient elements found in the soil and those that are missing
   b. Plant nutrient elements needed for growing the different plants, grasses, and shrubs on golf courses, parks, etc.
   c. Natural and commercial fertilizers
   d. Function of plant nutrient elements
   e. Different methods of applying fertilizers in the amounts needed for growing grasses, flowers, and shrubs
2. To develop skills in the purchasing and application of fertilizer which will prepare individuals for job entry

B. Motivation
1. Discuss the economical value of fertilization with the class
2. Have students tell the kinds and amounts of fertilizer they use on different grasses, shrubs, and flowers

3. Show labels of the different kinds of fertilizers
4. Have students observe plants that have been fertilized correctly and some that have not

C. Subject Matter Content

Assignment: What students need to learn

1. Give the history of fertilizers
2. The different commercial fertilizers that are available for flowers, grasses, shrubs
3. The importance of commercial fertilizers to the
   a. Citizen
   b. Economy of this nation
4. Types of fertilizers to use in different situations
5. The plant nutrient elements furnished by the different commercial fertilizers
6. Give the functions of the following elements as listed:

Grouping	Nutrients
Primary elements	Nitrogen Phosphorus Potassium
Secondary elements	Calcium Magnesium Sulphur
Fertilizer elements	Nitrogen Phosphorus Potassium
Lime elements	Calcium Magnesium
Trace elements or micronutrients	Iron Copper Zinc Boron Chlorine Manganese Molybdenum

7. Give deficiency symptoms of plants lacking the different elements
8. Correct methods of applying fertilizer to plants, shrubs, and grasses
9. Give the test methods for determining whether a soil is acid, basic, or neutral
10. What is meant by PH
11. There are better tests than red and blue litmus paper for determining whether a soil is acid, basic, or neutral; name and discuss them
12. Give the relationship of fertilization to the kind of plant to be fertilized

13. What are the results obtained by growing plants without enough fertilizer of the right kind
14. The use of natural fertilizers in the growing of grasses, shrubs, and flowers
15. Safety precautions

D. Student Participation
1. Collect samples of the different fertilizers
2. Fertilize the plants on the school ground
3. Fertilize their own grass, shrubs, and plants

E. Teaching Aids and References
1. Fertilizer samples
2. Fertilizer tags
3. Films and filmstrips
4. Charts
5. Fertilizer Handbook. National Plant Food Institute, 1700 K Street N.W. Washington, D.C. 20006
6. Ground Maintenance Handbook. Conover, H.S. New York. McGraw Hill Book Company, 1958
7. Soils. 1957 Yearbook

II. Teaching the Lesson

Lesson 4: Pruning, Trimming, and Caring for Plants

A. Objective
To provide basic knowledge in pruning, trimming, and caring for plants

B. Motivation
1. Discuss with the class the benefits derived from pruning, trimming, and general care of plants
2. Observe if possible a job where pruning, trimming, and general care of plants is being carried on

C. Subject Matter Content
Assignment: What students need to learn
1. What is pruning
2. Discuss the nine basic reasons for pruning as they are listed:
   a. Training plants into desired forms
   b. Rejuvenating old plants
   c. Increasing flowering and fruiting
   d. Increasing the amount of fruit
   e. Opening up
   f. Preventing future damage
   g. Keeping to desired size
   h. Removing injured and diseased parts
   i. Producing special forms
3. Know physical make-up of plants so that terms will not appear strange
   a. What stems are like
   b. How a stem grows thicker

c. What a twig is like
d. What happens when you cut
e. How to make the cut

4. How the following tools are used in pruning
   a. Hand pruners
   b. Long handled pruners
   c. Pole pruners
   d. Hand saws
   e. Power tools
   f. Others
5. Discuss methods of pruning different types of shrubs and trees
6. Discuss pruning for larger flowers
7. Give the advantages of pruning before setting
8. Trimming
   a. Name the kinds of trees and hedges that should be trimmed
   b. Give the advantages of trimming the above trees and hedges
   c. Give methods of trimming
9. Cultivation of plants
   a. Methods used in the cultivation of different plants
   b. Time to cultivate
   c. How often to cultivate
10. Watering
    a. Time to water
    b. The amount of water for different plants and grasses
11. Safety : Discuss safety measures that should be followed
12. Diseases and insects
    a. Recognizing the different diseases and insects
    b. Control methods used in combating these diseases and insects
    c. Application of control materials

D. Student Participation
   1. Bring plants to school; prune and trim them using the correct procedures
   2. Field trip to observe someone pruning and trimming trees, shrubs, hedges, etc.
   3. Perform the same job at the school

E. Teaching Aids and References
   1. Charts
   2. Tools
   3. Films and filmstrips
   4. Practical Horticulture. Shoemaker, James S. and Teskey, Benjamin, John Wiley and Sons, Inc. New York
   5. Pruning Made Easy. Steffek, Edwin F. Henry Holt and Company, New York
   6. Small Fruit Culture. Shoemaker, J.S. McGraw Hill Book Company, New York

UNIT EVALUATION

1. Skill and ability in seeding plots
   a. Proper media
   b. Filling the plot

c. Using row marker
d. Sowing seed

2. Preparing cuttings
   a. Length of cuttings
   b. Rooting hormones
   c. Spacing cuttings
3. Oral quizzes and examinations as opportunities present themselves to the teacher

UNIT REFERENCES

Chapman, Paul W. and Thomas Roy H., Southern Crops. Turner E. Smith Book Company, Atlanta, Georgia

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Mahlestede, John P. and Ernest S. Haber. Plant Propagation. John Wiley and Sons Inc., New York

Shoemaker, James S. and Teskey, Benjamin, Practical Horticulture. John Wiley and Sons Inc. New York

Steffek, Edwin F. Pruning Made Easy. Henry Holt and Company, New York

Wells, James S. Plant Propagation Practices. The Macmillan Company, New York

UNIT 11

RECREATIONAL PROJECTS FOR INCOME

One of nineteen units of instruction in the occupational family

Wildlife and Recreation

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Production Agriculture Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Recreational Projects for Income

UNIT OBJECTIVE: To develop the abilities and understanding necessary for job entry into occupations dealing with recreational projects for income

TIME ALLOTMENT:

In School:

Class Instruction	8	hrs.
Shop or Laboratory Work	2	hrs.
Total	10	hrs.
Occupational or Job Experience		hrs. (To be determined by individual teachers)
Unit Total		hrs.

COMPETENCIES TO BE DEVELOPED:

1. Recreational projects dealing with game and fish
2. Other projects for recreational income

STUDENT MOTIVATION:

1. Survey the number of recreational facilities or projects in the local area that deal with game and fish
2. Survey for other facilities that are maintained for recreational purposes
3. Estimate the total amount of money that is spent in the local area in one year

TEACHING THE UNIT:

I. Organization

A. Lessons to be Taught
   1. Recreational projects dealing with game and fish
   2. Other projects for recreational income

B. Instructional Materials
   1. Films, charts, pamphlets, magazines from wildlife and fisheries commission
   2. State and USDA bulletins on wildlife
   3. State and recreational bulletins and publications

C. Job Experience
   1. Golf course
   2. Marina
   3. City, State, and National Parks
   4. Hunting clubs

II. Teaching the Lesson

Lesson 1: Recreational Projects Dealing With Game and Fish

A. Objective
To develop abilities and understanding necessary for job entry into the operation, supervisor, and maintenance of recreational projects dealing with game and fish

B. Motivation
1. Survey projects in local area dealing with game and fish
2. Survey job opportunities found in these projects

C. Subject Matter Content
Assignment: What students need to learn
1. Fishing rights
   a. Privileges
   b. Local, state, and federal
2. Hunting rights
   a. Laws
   b. Limits
   c. Seasons
3. Shooting preserves
   a. Laws
   b. Limits
   c. Seasons
   d. Banding
   e. Reporting
4. Hunting clubs
   a. Privileges
   b. Local, state, and federal laws
5. Shooting and fishing safety

D. Student Participation
1. Have students visit local projects in community
2. Estimate amount of money spent locally on this type of recreation

E. Teaching Aids and References
1. Films, charts, pamphlets, magazines, from Wildlife and Fisheries Commission, New Orleans, Louisiana
2. State and USDA bulletins on wildlife
3. State and recreational bulletins and publications

Lesson 2: Other Projects for Recreational Income

A. Objective
To develop abilities and understanding necessary for job entry into the operation, supervision, and maintenance of other recreational projects

B. Motivation
1. Survey other recreational projects in community that operate for income
2. Survey job opportunities found in these projects

C. Subject Matter Content

Assignment: What students need to learn

1. Camping facilities
   a. Maintenance of facilities
   b. Health precautions
   c. Safety precautions
2. Lakeside cabins
   a. Maintenance
   b. Safety precautions
3. Horseback riding
   a. Care of horses
   b. Care of stables
   c. Developing riding trails
   d. Care of equipment
4. City, State, and National Parks
   a. Recreational areas and golf courses
      (1) Care and maintenance
      (2) Rules and supervision
   b. Swimming pools
      (1) Care and maintenance
      (2) Safety precautions
5. Marina
   a. Care and maintenance of boats
   b. Boat safety
   c. Knowledge of supplies furnished
6. Boat and ski clubs
   a. Care and maintenance of boats
   b. Boat and ski safety
   c. Knowledge of supplies furnished

D. Student Participation
   1. Survey all recreational projects operating for profit in local area
   2. Explore job possibilities of these projects
   3. Estimate the economical value of these to the local area

E. Teaching Aids and References
   1. Films, charts, pamphlets, and magazines from wildlife and fisheries commission
   2. State and USDA bulletins on wildlife
   3. State and recreational bulletins and publications

UNIT EVALUATION

1. Written and oral examination to test proficiencies

UNIT REFERENCES

Wing, Leonard W. Practice of Wildlife Conservation. New York, London, John Wiley and Sons Inc., 1951

Hoover, Norman K. Handbook of Agriculture Occupations. Danville, Illinois. The Interstate Printers and Publishers Inc. 1964

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Federal Assistance in Outdoor Recreation
List of Agencies Administering State Parks and Related Recreation Areas
State Outdoor Recreation Statistics, 1962

Bulletins-Louisiana Wildlife and Fisheries Commission 400 Royal Street, New Orleans, Louisiana, 70130

Bulletins-State Parks and Recreation Commission, Director of State Parks and Recreation, Old State Capitol Building, P.O. Drawer 1111, Baton Rouge

A Picture Story of the Soil and Water Conservation Program in Louisiana, U.S. Department of Agriculture Soil Conservation Service, Box 1630, Alexandria, Louisiana($3.00)

Pamphlets from Louisiana Wildlife and Fisheries Commission, Wildlife and Fisheries Building, 400 Royal Street, New Orleans, 16, Louisiana

Pamphlets from Department of the Interior, Bureau of Outdoor Recreation, Washington, D.C., 20240

UNIT 12

WILDLIFE AND RECREATION COMMUNICATION

One of nineteen units of instruction in the occupational family

Wildlife and Recreation

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Agriculture Production Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Wildlife and Recreation Communication

UNIT OBJECTIVE: To develop within the students the value and understanding of communications as applied to wildlife and recreation and to develop competencies in analyzing reports and getting information needed to help people understand these types of businesses

TIME ALLOTMENT:

In School:

Class Instruction	10	hrs.	
Shop or Laboratory Work	0	hrs.	
Total	10	hrs.	
Occupational or Job Experience		hrs.	(To be determined by
Unit Total		hrs.	individual teachers)

COMPETENCIES TO BE DEVELOPED:

1. Sources of communication media
2. Communication skills needed in wildlife and recreation
3. Abilities to analyze reports and get them across to people needing such information

STUDENT MOTIVATION:

To create student interest and stimulate them in a study of the communicable skills by giving the following information

1. People in today's modern world rely on people with the technical know-how to provide them with the information they need; therefore, much of the work in wildlife and recreation is presenting factual information to the public
2. The reasons for communicable skills in any phase of our American society
3. A person must be able to get his information across to interested persons or his work is in vain
4. The many job opportunities that exist in this field of wildlife and recreation
5. More and more people are interested in recreation of some type and more employment is available provided skills and technical knowledge are acquired by students

TEACHING THE UNIT:

I. Organization

A. Lessons to be Taught
   1. Communication media
   2. Analyzing reports

B. Instructional Materials
   1. Radio, television, newspapers, newsletters, magazines, etc.

2. Tape recorders
3. News articles
4. Analytical reports
5. Films
6. Filmstrips
7. Any other helpful literature

C. Job Experience
1. Radio-school or radio station
2. Newspaper-school or town newspaper
3. Magazines-(writing articles for some magazines)
4. Television

II. Teaching the Lesson

Lesson 1: Communication Media

A. Objectives
1. Provide knowledge which will enable students to learn communication media and to develop competencies of getting information across to people, which would help in securing jobs in the field of wildlife and recreation
2. Familiarize students with coordination and the use of all methods in getting information to interested persons

B. Motivation
1. Relate to students that thousands of men and women have jobs of getting sound, helpful information to the American farm businesses, farm people and others interested in wildlife and recreation
2. Point out that it should be remembered that vehicles of communication can carry misinformation just as they can carry sound information, therefore, persons performing this type of work need technical skills in presenting information
3. Show some type of film or filmstrip that deals with one or more types of communication skill
4. Have discussion on the many types of job opportunities available in your community or state that need agricultural experiences in order to hold these jobs
5. Students list the many types of communication people in wildlife and recreation perform

C. Subject Matter Content
Assignment: What students need to learn
1. Sources of communications
2. Communication media
   a. Newspapers
   b. Magazines
   c. News letters
   d. Radio and T.V.
   e. Advertising
   f. Bulletin boards
   g. Others

3. Factors to consider in reaching people concerned with wildlife and recreation businesses and other interested persons through newspapers, newsletters, and other papers.
4. Factors to consider in reaching people and businesses through radio and television
5. Factors to consider in reaching businesses and other interested persons through visual aids
   a. Good picture taking
   b. Simple exhibits
   c. Circular letters
6. Operation of visual aid equipment
7. Coordination and use of all methods in getting information to wildlife and recreational agencies, businesses, and interested persons
8. Limitations on entering jobs of this type

D. Student Participation
1. Write articles for local newspapers; take pictures if possible
2. Record wildlife and recreational type reports for local radio station
3. Make tape recordings of wildlife reports
4. If possible, put on special television programs concerning some type of wildlife or recreational work
5. Write some type of article for magazine or newsletter, sending the news in for evaluation. (A refined article could be used)
6. Students show films and filmstrips and operate tape recorder

E. Teaching Aids and References
1. Tape recorder
2. Good pictures and poor pictures
3. Formats of newspapers
4. Visual aid equipment (movie projector, opaque projector, filmstrip projector, etc.)
5. School radio shops
6. Newsprints, etc.
7. Various types of cameras
8. Magazines, newsletters, etc.
9. Hadley Read. Getting Information to Farm Families. University of Illinois, College of Agriculture, Urbana, Illinois, 1955
10. S.E. Fitzgerald. Communicating Ideas to the Public. Modern Industry Magazine, New York, 1950
11. Erik Barnouw. Mass Communication. Rinehart and Company Inc., New York, Toronto, 1956
12. Emery, Veser. Information, Decision, and Action. Melbourne University Press, London, New York, 1958
13. Wing. Practices of Wildlife Conservation. John Wiley and Sons Inc., New York, 1961
14. Commercial literature
15. Bulletins from extension service, Baton Rouge, Louisiana Numbers, 1074, 1090, 1100, 1178, and 1308

II. Teaching the Lesson

Lesson 2: Analyzing Reports

A. Objective
Students develop competencies in taking data and analyzing it in such a way that the average person working in wildlife and recreation businesses or interested people will be able to interpret the information, yet not leave the "meat" out of the news

B. Motivation
1. Place before the student a short, technical report, ask them to read it and then let them translate what they read. You may condense the report and let them read it, asking if there was a difference. In some cases a simplified form of report may have already been made, in which case give this report to them to analyze
2. Point out to students that persons making technical or statistical reports are not necessarily interested in the public's opinion, but it is left up to communicator to get information to the interested people in a way in which they can use it
3. Point out to students that most people are not interested in a lot of "flowering up" of material but are interested in only the factual information
4. Discuss merits of news programs, articles and newsletters

C. Subject Matter Content
Assignment: What students need to learn
1. Sources of analytical data
2. Factors to consider in selecting materials to get information
3. "Inverted Pyramid" approach
4. Breaking down analytical data
5. Public opinion polls in selection of news from technical reports
6. Advertising news media
7. Use of pictures in helping break down reports

D. Student Participation
1. Secure analytical data from some source and break it down into news story, radio program, etc.
2. Develop an advertising format for a hypothetical situation
3. Take pictures and write the information to form a report of some type

E. Teaching Aids and References
1. Reports from experiment stations
2. Reports from colleges, universities, etc.
3. Reports from State Departments concerning wildlife and recreation
4. Pictures to assemble news stories
5. Commercial literature from agricultural businesses
6. Advertising mats from newspapers
7. Formats made by teacher for securing public opinions
8. Hadley Read. Getting Information to Farm Families. University of Illinois, College of Agriculture, Urbana, Illinois, 1955
9. S.E. Fitzgerald. Communicating Ideas to the Public. Modern Industry Magazine, New York, 1950

10. Commercial magazines
11. Bulletins from USDA
12. Bulletins from Agriculture Extension Department
13. Others as can be secured

UNIT EVALUATION

(Suggestions)

1. Conventional examinations where applicable
2. Observation of students as they prepare the different types of news media
3. Performance jobs in which the teachers prepare charts of achievements and check these achievements as they progress
4. Discussion of topics. Teachers can spot questions to certain students

UNIT REFERENCES

Barnouw, Erik. Mass Communication. New York. Rinehart and Company Inc. 1956

Emery and Oeser. Information, Decision, and Action. London, New York, Melbourne University Press, 1958

Fitzgerald, S.E., Communicating Ideas to the Public. New York. Modern Industry Magazine, 1950

Read, Hadley. Getting Information to Farm Families. Urbana, Illinois. University of Illinois, College of Agriculture. 1955

Wing, L.W. Practices of Wildlife Conservation. New York. John Wiley and Sons Inc. 1961

Louisiana Agriculture Extension Service, Baton Rouge, Louisiana
"Justify Your Job With Good Reports." Publication 1308
"Recipe for Writing the Ag News Story." Publication 1100
"Snappy Styles for Your Bulletin." Publication 1090
"When you Write a Newspaper Column." Publication 1178

UNIT 13

ORNAMENTAL HORTICULTURE

One of nineteen units of instruction in the occupational family

Wildlife and Recreation

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Agriculture Production Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Ornamental Horticulture

UNIT OBJECTIVES:

1. Acquire the ability to identify common ornamental horticulture plants
2. Be able to establish and care for a lawn
3. Develop ornamental horticulture plant vocabulary

TIME ALLOTMENT:

In School:

Class Instruction	30	hrs.
Shop or Laboratory Work	5	hrs.
Total	35	hrs.
Occupational or Job Experience		hrs. (To be determined by individual teachers)
Unit Total		hrs.

COMPETENCIES TO BE DEVELOPED:

1. Identification of ornamental horticulture plants
   a. Vocabulary
   b. Plant structures and growth habits
   c. Plant keys
2. Establish and maintain a lawn

STUDENT MOTIVATION :

1. Students list ornamental horticulture plants they can identify and discuss means of identification
2. Point out to students the importance of plant identificationand vocabulary for job entry in areas of wildlife and recreation
3. Wildlife and recreation representative discuss with students employment possibilities in this field
4. Discussion of grasses used for home lawns
5. Students relate how home lawns were established and how they are being maintained

TEACHING THE UNIT:

I. Organization

A. Lessons to be Taught
   1. Identification of ornamental horticulture plants
      a. Plant vocabulary and botanical names
      b. Identification of plants by physical appearance, growth habits and plant keys
   2. Establishing and caring for lawns and turfs

B. Instructional Materials
   1. Nursery catalogs
   2. Plants in different stages of growth
   3. Plant specimens
   4. Charts giving botanical names and identification information

5. Charts and pictures showing types of root systems, leaves, bark, etc.
6. Sod samples of different grasses used for lawns
7. Films and filmstrips
8. References giving plant descriptions

C. Job Experience
1. School or commercial nursery
2. School or local greenhouse
3. Flower shops
4. Wildlife and recreation businesses where ornamental horticulture plants and lawns are included

II. Teaching the Lesson

Lesson 1: Identification of Ornamental Horticulture Plants
a. Plant vocabulary and botanical names
b. Identification of plants by physical appearance, growth habits, and plant keys

A. Objectives
1. Students develop plant vocabularies and be able to identify ornamental horticulture plants
2. Teach students the value of scientific names of plants
3. Students acquire vocabulary of scientific names and terms
4. Students learn the physical characteristics of plants
5. Learn to use plant structures in identifying plants
6. Learn to use plant keys in plant identification

B. Motivation
1. Discuss and illustrate the importance of botanical names
2. Wildlife and recreation representative discuss with students the importance of a usable vocabulary and ability to identify plants
3. Demonstrate and discuss the use of plant physical characteristics as a means of identifying
4. Discuss use of plant keys in identification

C. Subject Matter Content
Assignment: What students need to learn
1. Plant vocabulary and botanical names
a. Define: Annual, bedding plant, biennial, broad leaf evergreen, conifer, cool-season plant, deciduous, evergreen, foliage, fruit, hardy plant, herbaceous plant, narrow leaf evergreen, nursery plant, perennial, shrub, small fruit, tender plant, tree, tree fruit, vine, warm-season plant, weed and woody plant
b. Origin of two-name system of naming plants
c. Reasons why binomial system was adopted
d. Give example of binomial nomenclature and explain points that this example include:
(1) Common name
(2) Two names that make up scientific name
(3) Reasons for using Latin in writing scientific name
(4) Genus name

(5) Species name
(6) Where genus and species names are taken from
(7) The relationship of the genus and species groupings to the other groupings of the classification (example)
(8) How a plant is fitted into this plan of classification (by example)

e. Evidences of use of scientific names when concerned with ornamental horticulture plants

2. Identification of plants by physical appearances, growth habits and plant keys
   a. Define: Leaf terms: Alternate leaves, blade, broad leaf, compound leaf, entire leaf, forked venation, lobed leaf, leaf base, leaflet, margin, mid vein, net venation, opposite leaves, petiole, palmate, pinnate, parallel venation, stipule, simple leaf, sessile leaves, and whorled leaves. Stem terms: Aerial stem, bundle scar, bulb, corm, internode, lateral bud, leaf scar, lenticel, node, rhizome, runner, stolon, spine, terminal bud, tuber, and thorn. Flower terms: Anther, calyz, carolla, complete flower, composite flower, double flower, filament, incomplete flower, ovary, petal, pistil, pistillate flower, panicle, raceme, sepals, stamen, stigma, style, single flower, staminate flower, spike, and umbel. Root terms: Adventitious root, fibrous root, fleshy root, primary root, root hairs, secondary root, and tap root. General terms: Class, dicot, family, genus, kingdom, order, plant keys, phylum, specie, and variety
   b. What information is included in plant keys
   c. How to use plant keys for identifying plants (give examples)
   d. Discuss differences in physical structure of plants and list plants that can be identified under each classification
   e. How can these differences be used in plant identification(give examples)

D. Student Participation
   1. Students bring in plant specimens
      a. Determine common and botanical names
      b. Identify plants using physical differences and plant keys
   2. Students prepare plant keys for identifying plants
   3. Put into use plant vocabulary during class discussions and prepared talks
   4. Field trips to practice use of plant vocabulary and identification
   5. Students make plant collections giving common and scientific names of plants and labeling all parts of plants (as to: types, arrangements and structures of leaves, structures and types of stems, roots, and flowers)
   6. Draw and label plant parts

E. Teaching Aids and References
   1. Plant specimens
   2. Prepared plant posters and charts
   3. Films, filmstrips, and slides
   4. Nursery and plant catalogs
   5. Horticulture references giving plant characteristics, common and

scientific names
6. Plant keys for identifying plants
7. Plant name tags and stickers
8. Practical Horticulture. Shoemaker and Teskey. John Wiley and Sons, New York
9. Horticultural Science. Janick, W.H. Freeman Company San Francisco
10. The Standard Cyclopedia of Horticulture. Baley, L.H. Macmillan Company, New York
11. Floriculture Fundamentals and Practices, Laurie and Ries, McGraw Hill, New York
12. Modern Biology. Moon, Mann, and Otto. Henry Holt and Company, New York
13. Identifying Horticultural Plants. Module Number Two, The Center for Research and Leadership Development in Vocational and Technical Education, Ohio State University, 980 Kinnear Road, Columbus, Ohio, 43212

Lesson 2: Establishing and Caring For Lawns and Turf

A. Objectives
1. Students develop an understanding of procedures to follow in establishing a lawn
2. Be able to maintain lawns and turf

B. Motivation
1. Students relate experiences in establishing and caring for their home lawns
2. Discuss importance of lawn in appearance of home and surroundings
3. Show pictures of well kept and unsightly lawns and students discuss value of each
4. General discussion of lawn grasses

C. Subject Matter Content
Assignment: What students need to learn
1. List the values of a lawn
2. First step to consider in establishing a lawn
3. Soil preparation
   a. Testing
   b. Grading
   c. Leveling
   d. Drainage
   e. Fertilizing
   f. Final preparation of seedbed (for seeding, planting stolons, and sodding)
4. List equipment, tools, and materials needed for establishing and caring for a lawn
5. Factors to consider in determining method to be used to establish lawn grasses
6. Compare costs of the methods of establishing lawn grasses
7. Grass mixtures versus one species for lawns
8. Name and give characteristics of grasses recommended for lawns
9. Explain how to establish a lawn by seeding
10. Explain how to establish a lawn by using sod; stolons

11. Consider the following in caring for a lawn
    a. Watering
    b. Fertilizing including top dressing
    c. Mowing
    d. Rolling
    e. Aerifying
    f. Control of weeds
    g. Control of insects
    h. Control of diseases

D. Student Participation
    1. Make a map of home lawn and list improvements needed
    2. Outline procedure for establishing a new lawn
    3. Chart specimens of important lawn grasses giving scientific names, common names, and plant characteristics
    4. Check diseased grasses for disease identification and list control measures
    5. Practice mowing with reel and rotary mowers and examine results (Height of cut, condition of grasses, etc.)

E. Teaching Aids and References
    1. Samples of materials used for lawn drainage systems
    2. Samples of lawn grass seeds, specimens, and sod
    3. Equipment and tools needed for establishing and caring for a lawn
    4. Soil test recommendations
    5. Samples of turf showing disease and insect damages
    6. Turf Management. Musser. McGraw Hill Book Company, New York
    7. General Horticulture. Shoemaker, J.B. Lippincott Company, Philadelphia, Pa.
    8. Practical Horticulture. Shoemaker and Teskey. John Wiley and Sons, Inc. New York
    9. Establishing and Caring for Lawns and Turf. Module Number Nine. The Center for Research and Leadership Development in Vocational and Technical Education, The Ohio State University, 980 Kinnear Road, Columbus, Ohio, 43212

UNIT EVALUATION
    1. Oral and written examination
    2. Identification tests
    3. Vocabulary tests
    4. Ability to detect lawn troubles and suggest means for control

UNIT REFERENCES

Baley, L.H. The Standard Cyclopedia. New York. Macmillan Company

Janick, W.H. Horticultural Science. San Francisco, California. Freeman Company

Laurie and Ries, Floriculture Fundamentals and Practices. New York. McGraw Hill

Moon, Mann, and Otto. Modern Biology. New York. Henry Holt and Company

Musser. Turf Management. New York. McGraw Hill Book Company

Shoemaker and Teskey. Practical Horticulture. New York. John Wiley and Sons

The Center for Research and Leadership Development in Vocational and Technical Education, The Ohio State University, 980 Kinnear Road, Columbus, Ohio 43212
Establishing and Caring for Lawns and Turf. Module No.9

Identifying Horticulture Plants. Module No. 2

UNIT 14

ORIENTATION AND SCOPE OF WILDLIFE AND RECREATION OCCUPATIONS

One of nineteen units of instruction in the occupational family

Wildlife and Recreation

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Business Principles and Procedures Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Orientation and Scope of Wildlife and Recreation Occupations

UNIT OBJECTIVE:

To teach an understanding of and an appreciation for our American business system as it applies to wildlife and recreation

TIME ALLOTMENT:

In School:

Class Instruction	5	hrs.	
Shop or Laboratory Work	0	hrs.	
Total	5	hrs.	
Occupational or Job Experience		hrs.	(To be determined by
Unit Total		hrs.	individual teachers)

COMPETENCIES TO BE DEVELOPED:

1. An understanding of the American enterprise system
2. An understanding of wildlife and recreation occupations in the community

STUDENT MOTIVATION:

1. Explain the extent to which American enterprise is free to do as it wishes
2. Have student identify some of the wildlife and recreation businesses in the community

TEACHING THE UNIT:

I. Organization

A. Lessons to be Taught
1. The American enterprise system
2. Wildlife and recreation opportunities in the community

B. Instructional Materials
1. Films, chalkboard
2. Reference books

C. Job Experience
Field trips

II. Teaching the Lesson

Lesson 1: The American Enterprise System

A. Objective
To gain an understanding of the freedoms, controls, privileges, and responsibilities of the American businessman

B. Motivation

The economic freedoms of an individual consist of the rights to work and earn, to make a profit, to choose how he shall earn a living, to go into business, to spend his income as he chooses, to offer his labor or products at any price he chooses, to use private property to make more income, to select and buy what will best satisfy his needs, and to compete in prices and quality of product or service he offers to others

C. Subject Matter Content
Assignment: What students need to learn
1. Factors of production
   a. Labor
   b. Capital
   c. Management
2. Capitalism and free enterprise
3. Nature of American business
   a. Private property
   b. Limitations of property rights
   c. Special property rights
   d. Competition
   e. Profit incentives and risks
   f. Ownership of American business
   g. Limitations on individual initiative

D. Student Participation
1. From his own knowledge and opinions and from information gained from businessmen or from library reading make a list of the ways in which a business enterprise has freedom to do as it wishes
2. Make another list of the ways in which business is regulated and therefore does not have complete freedom
3. Compare our system with another economic system

E. Teaching Aids and References
1. Books
   a. Economics for our Times. McGraw Hill Book Company
   b. Introduction to Business Enterprise. John Wiley and Sons
   c. Consumer Economic Problems. South-Western Publishing Co.
   d. Business Principles and Management. South-Western Publishing Company
2. Pamphlets
   a. Business in Our Community, the Private Enterprise System. National Education Association, Washington, D.C.
   b. Capitalism and Other Economic Systems. Baldwin Lee. Study on Economic Education, Council for Advancement of Secondary Education, 1201 Sixteenth Street, N.W. Washington, D.C. Case Economic Literary Service Number Two
   c. The Free Enterprise System. National Association of Manufacturers, Second East 48th Street, New York 17, N.Y.
   d. You and American Competitive Private Enterprise. Industry and the American Economics Series, Number Two, Educational Department National Association of Manufacturers, Second East 48th Street, New York 17, New York

Lesson 2: Wildlife and Recreation Opportunities in the Community

A. Objective
To recognize the importance of wildlife and recreation businesses in every community and understand the employment opportunities provided by these businesses

B. Motivation
1. With so much leisure time more and more people are looking for ways to enjoy that leisure. Recreation areas are springing up everywhere
2. Survey number of businesses that get income from activities connected with wildlife and recreation

C. Subject Matter Content
Assignment: What students need to learn
1. Common types of wildlife and recreational businesses
2. Common wildlife and recreational occupations
   a. Game bird propagator
   b. Game management employee
   c. Golf course employee
   d. Grounds maintenance employee
   e. Others
3. Education and experience required

D. Student Participation
1. Make a list of wildlife and recreation businesses in the community
2. Visit a business connected with wildlife and recreation
3. Have each choose a wildlife and recreation connected business and name the job opportunities that business provides

E. Teaching Aids and References
1. Handbook of Agricultural Occupations
2. Your Off-the-Farm Business

UNIT EVALUATION
1. Suggestions for evaluating
   a. Conventional examinations to determine whether or not students understand the unit
   b. Use the reports naming the job opportunities that business provides to determine the understanding of job opportunities

UNIT REFERENCES

Glos, Baker. Introduction to Business. Cincinnati. South-Western Publishing Company, 1963

Hoover, Handbook of Agricultural Occupations. The Interstate Printers and Publishers, Inc. Danville, Illinois, 1963

Jobs in Agriculture. Job Family Series 11, Science Research Association, Inc. 259 East Erie, Chicago 11, Illinois, 1960

McNaughton, Wayne. Introduction to Business Enterprise. John Wiley and Sons. New York, 1960

Shilt, Bernard and Harmon, Wilson. Business Principles and Management. South-Western Publishing Company, Chicago, 1961

Smith,Augustus. Economics for Our Times. McGraw Hill Book Company, New York, 1957

Wilson, Harmon and Elvin Eyster. Consumer Economic Problems, Southwestern Publishing Company, Chicago, 1961

UNIT 15

JOB PROCUREMENT AND HUMAN RELATIONS

One of nineteen units of instruction in the occupational family

Wildlife and Recreation

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Business Principles and Procedures Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Job Procurement and Human Relations

UNIT OBJECTIVE: To teach how to apply for a job and the various hiring procedures used by employers and an understanding of the factors and personal qualities that contribute to occupational success

TIME ALLOTMENT:

In School:

Class Instruction	5	hrs.	
Shop or Laboratory Work	0	hrs.	
Total	5	hrs.	
Occupational or Job Experience		hrs.	(To be determined by
Unit Total		hrs.	individual teachers)

COMPETENCIES TO BE DEVELOPED:

1. How to apply for a job
2. Human relations for success on the job

TEACHING THE UNIT:

I. Organization

A. Lessons to be Taught
1. Applying for a job
2. Human relations on the job

B. Instructional Materials
Films, chalkboard, application blanks, posters, tape recorder

C. Job Experience
1. At school
2. On the job

II. Teaching the Lesson

Lesson 1: Applying For a Job

A. Objectives
1. To teach how to prepare a data sheet
2. To teach how to write a letter of application
3. To teach how to fill in application blanks
4. To teach the importance of the interview and how to prepare for it

B. Motivation
1. Ask them what they plan to be doing five years from now
2. Have each member of the class write on a 3"x5" card what his career goals are. Group the cards in broad occupational fields. Discuss each field.
3. Ask how each plans to go about getting work

C. Subject Matter Content

Assignment: What students need to learn

1. Personal data sheet
   a. Definition
   b. Content
      (1) Personal information
      (2) Education
      (3) Experience
      (4) General information
      (5) References
2. Letter of application
3. Application blanks
4. Personal interview
   a. Before the interview
      (1) If possible, get name of interviewer
      (2) Obtain permission to use the names of those you plan to give as references
      (3) Anticipate the questions you will be asked and prepare answers
      (4) Check your appearance
   b. During the interview
      (1) Be on time
      (2) Go alone
      (3) While waiting, behave in a businesslike manner
      (4) Introduce yourself and state the position for which you are applying
      (5) Remain standing until asked to be seated
      (6) Let interviewer do most of the talking
      (7) Try to appear well-poised, (no smoking or other habits)
      (8) If you have previous experience, do not criticize former employer
      (9) Ask questions to clear up anything you may want to know but do not ask about wages or hours until you have been offered the job
      (10) Thank interviewer when interview is over
   c. After the interview
      (1) Write thank-you letter
      (2) Restate your interest

D. Student Participation

1. Prepare a data sheet and a letter of application
2. Fill out an application blank
3. Divide into groups and have one in each group interview the others
4. Record the interviews and play back
5. Prepare an exhibit of application blanks collected from local firms

E. Teaching Aids and References

1. General Business, Unit 12
2. Clerical Office Practice, Unit 14, Part 2
3. General Business for Everyday Living. Unit 12
4. How to Get and Hold the Right Job. Bureau of Labor Statistics, Washington 25, D.C. A frank discussion of procedures to be used in job-hunting and in holding on to a job once it is obtained
5. Tape recorder

6. Application blanks

Lesson 2: Human Relations

A. Objective
To teach the importance of getting along with the employer, the employees, and the public in order to assure success on the job

B. Motivation
1. "How to Keep a Job" (Coronet, ten minute film)
2. Getting a job does not guarantee keeping it

C. Subject Matter Content
Assignment: What students need to learn
1. Employer-employee relations
2. Employee-employee relations
3. Employee-public relations

D. Student Participation
1. Give case study and let them solve it, keeping in mind the points that have been brought out
2. Have each interview two adult friends or relatives to find out what characteristics or actions of their co-workers please them most and which ones annoy them most. No names should be used
3. Have each interview two adult friends or relatives to find out what characteristics or actions of the public please them most and which ones annoy them most

E. Teaching Aids and References
1. General Business. Unit 12, Part 60
2. General Business for Everyday Living. Unit 12

UNIT EVALUATION
1. Conventional examinations
2. Evaluate the data sheet, application blank, and letter of application prepared by each
3. Evaluate a case problem on human relations dealing with employer-employee, employee-employee, employee-public, relations, or all three

UNIT REFERENCES

Agnew, Peter, and James R. Meehan, Clerical Office Practice. Third edition. South-Western Publishing Company, Chicago, 1961

Crabbe, Ernest, Herman Enterline, Joseph DeBrum, General Business. Eighth edition. South-Western Publishing Company, Chicago, 1961

Price, Ray, Vernon Musselman, Edwin Weeks, Jr. General Business for Everyday Living. Second edition. McGraw Hill Book Company. New York, 1960

UNIT 16

ORGANIZATION AND MANAGEMENT OF BUSINESS

One of nineteen units of instruction in the occupational family

Wildlife and Recreation

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Business Principles and Procedures Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Organization and Management of Business

UNIT OBJECTIVE: To develop an understanding of the organization and management of business needed by workers for entry into occupations in wildlife and recreation

TIME ALLOTMENT:

In School:

Class Instruction	5	hrs.
Shop or Laboratory Work		hrs.
Total	5	hrs.
Occupational or Job Experience		hrs. (To be determined by individual teachers)
Unit Total		hrs.

COMPETENCIES TO BE DEVELOPED:

1. Types of businesses
2. Principles of business management

TEACHING THE UNIT:

I. Organization

A. Lessons to be Taught
   1. Types of businesses
   2. Principles of business management

B. Instructional Materials
   1. Films
   2. Chalkboard

C. Job Experience
   Field trips

II. Teaching the Lesson

Lesson 1: Types of Businesses

A. Objective
   To teach a knowledge of the differences between the single proprietorship, partnership, corporation, and co-operative forms of business organization; of the advantages and disadvantages of each type, and of some of the factors that may determine the way in which a business is organized.

B. Motivation
   1. Show the film, "What is Business?" (Coronet, ten minutes) The film and ensuing discussion will serve to bring out how people's economic needs and wants are satisfied by means of business activities
   2. Have students tell the ways in which they have come in contact with business during the past week

3. Discuss "What Business Means to Me."

C. Subject Matter Content
Assignment: What students need to learn
1. Single proprietorships
   a. Definition
   b. Characteristics
   c. Advantages
   d. Disadvantages
2. Partnerships
   a. Definition
   b. Characteristics
   c. Advantages
   d. Disadvantages
3. Corporations
   a. Definition
   b. Characteristics
   c. Advantages
   d. Disadvantages
4. Co-operatives
   a. Definition
   b. Characteristics
   c. Advantages
   d. Disadvantages
   e. Types

D. Student Participation
1. Make a trip to a wildlife and recreation business
2. Make four lists of businesses of the community, listing them according to sole proprietorships, partnerships, corporations, and co-operatives
3. Each write a paragraph stating what type of business he would prefer being associated with and why
4. Discuss advantages and disadvantages of sole proprietorship, partnership, corporation, and co-operative from the standpoint of a person who wishes to invest money

E. Teaching Aids and References
1. Films
   a. "What is a Corporation?" Coronet, ten minutes
   b. "What is a Co-op?" Co-op League, twenty minutes
2. Books
   a. Consumer Economic Problems. Wilson-Eyster. South-Western Publishing Company
   b. General Business for Everyday Living. Price, Musselman, Weeks. McGraw Hill Book Company, Inc.
   c. General Business. Crabbe, Enterline, DeBrum. South-Western Publishing Company
   d. Your Off-The-Farm Business. Cooperative League of the USA, Chicago, Illinois

II. Teaching the Lesson

Lesson 2: Principles of Business Management

A. Objective
To teach an appreciation of the importance of internal organization of a business, large or small, and to understand how some businesses are organized

B. Motivation
Be sure a student understands that no one man can run the average business. He needs help but each person must know to whom he is responsible and who is responsible to him

C. Subject Matter Content
Assignment: What students need to learn
1. Characteristics of a good business organization
2. Functions of organizational charts
3. How small businesses are organized
4. Types of organizational structures
   a. Line organization
   b. Staff organization
   c. Line-and-staff organization
   d. Committee organization
   e. Departmental organization
5. Business terms
   a. Delegation of authority
   b. Organization chart
   c. Line organization
   d. Staff organization
   e. Line-and-staff organization
   f. Committee organization

D. Student Participation
1. Name some local firms using each of the different organizations
2. Obtain an organizational chart of a local business. Write an explanation of what the chart means, indicating the lines of responsibility and control and any staff positions that may be found in the chart

E. Teaching Aids and References
1. Films
   a. "Operation '46" Ten minutes, General Mills, Inc. Film library, 400 Second Avenue, South, Minneapolis, Minn.
   b. "Share the Production Plan," 20 minutes, Venard Organization, Educational Films, 702 South Adams Street, Peoria 2, Illinois
2. Books: Business Principles and Management. Shilt and Wilson, South-Western Publishing Company

UNIT EVALUATION: Suggestions for evaluating educational outcome of unit
1. Conventional examination
2. Give case problem and let each explain or solve it using points brought out in the unit
3. If there was a field trip during the unit, ask questions of each about the trip
4. Let them prepare a report organizing a business and giving its line of authority

UNIT REFERENCES

Crabbe, Enterline, DeBrum. General Business. Eighth edition. Chicago, South-Western Publishing Company, 1961

Price, Musselman, Weeks. General Business for Everyday Living. Second edition. New York. McGraw Hill Book Company, 1960

Shilt, Wilson. Business Principles and Management. Fourth edition. Chicago, South-Western Publishing Company, 1961

Tonne, Simon, McGill. Business Principles, Organization, and Management. New York. McGraw Hill Book Company, 1956

Wilson, Eyster. Consumer Economic Problems. Sixth edition. Chicago, South-Western Publishing Company, 1961

UNIT 17

HUMAN RELATIONS

One of nineteen units of instruction in the occupational family

Wildlife and Recreation

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Business Principles and Procedures Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Human Relations

UNIT OBJECTIVES:

1. To develop an awareness to the importance of getting along with people
2. To develop an understanding of the benefits of satisfactory human relations to the organization, the public, and the individual employee

TIME ALLOTMENT:

In School:

Class Instruction	5	hrs.	
Shop or Laboratory Work		hrs.	
Total	5	hrs.	
Occupational or Job Experience		hrs.	(To be determined by individual teachers)
Unit Total		hrs.	

COMPETENCIES TO BE DEVELOPED:

1. A knowledge of how to deal with the people for whom and with whom the student works
2. A realization of the importance of human relations to job success

STUDENT MOTIVATION:

1. Selling oneself is of prime importance in job success. Discuss this statement
2. Have local businessman speak on the importance of human relations in business
3. Human relations is no more than being a good neighbor, good citizen, and a good employee or employer

TEACHING THE UNIT:

I. Organization

A. Lessons to be Taught
   1. Dealing with employer or supervisor
   2. Dealing with co-workers
   3. Dealing with the public

B. Instructional Materials
   1. Chalkboard
   2. Films
   3. Posters
   4. Bulletin boards

C. Job Experience
   1. School
   2. On the job
   3. At home

II. Teaching the Lesson

Lesson 1: Dealing With Employer or Supervisor

A. Objectives
   1. To stress the importance of a good practice of human relations with the employer or supervisor
   2. To emphasize how the employee can help to make his relations with the employer or supervisor satisfactory

B. Motivation
   1. What should a "boss" expect from his employees
   2. What should an employee expect from his "boss"

C. Subject Matter Content
   Assignment: What students need to learn
   1. What employer expects from employee
      a. Loyalty
      b. Respect for authority
      c. Willingness to learn
      d. Cooperation
      e. Honesty
      f. Responsibility
      g. Leadership
   2. Supervisor's responsibilities to employees
      a. Treat employee as individual
      b. Give deserved recognition
      c. Help and instruct without belittling
   3. Employee must be aware of supervisor's duties to management, which are:
      a. Carry out rules and regulations
      b. See that system is followed
      c. See that people under him are productive and efficient
   4. Benefits to employees from the practice of good human relations toward the employer or supervisor
      a. Greater job satisfaction
      b. Greater job happiness
   5. How employees can benefit from constructive criticism
      a. Listen attentively
      b. Realize that the manner in which the job is being done is being criticized--not an individual
      c. Don't alibi--take the deserved part of the blame
      d. Ask for suggestions on how to improve work
      e. Do the job correctly--if in doubt, ask

D. Student Participation
   1. Have students draw chart showing line of authority from owner down to employees in a public recreational area in the community
   2. Have students make a list of ways to improve relations with employers or supervisors

E. Teaching Aids and References
   1. Film, "More Than Telling," local Bell Telephone Company
   2. <u>A Suggested Course of Study in Human Relations</u>

II. Teaching the Lesson

Lesson 1: Dealing With Employer or Supervisor

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   1. To stress the importance of a good practice of human relations with the employer or supervisor
   2. To emphasize how the employee can help to make his relations with the employer or supervisor satisfactory

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      a. Loyalty
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      d. Cooperation
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      f. Responsibility
      g. Leadership
   2. Supervisor's responsibilities to employees
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   3. Employee must be aware of supervisor's duties to management, which are:
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      a. Listen attentively
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      d. Ask for suggestions on how to improve work
      e. Do the job correctly--if in doubt, ask

D. Student Participation
   1. Have students draw chart showing line of authority from owner down to employees in a public recreational area in the community
   2. Have students make a list of ways to improve relations with employers or supervisors

E. Teaching Aids and References
   1. Film, "More Than Telling," local Bell Telephone Company
   2. <u>A Suggested Course of Study in Human Relations</u>

II. Teaching the Lesson

Lesson 2: Dealing With Co-Workers

A. Objective
To emphasize the importance of developing good human relations with co-workers

B. Motivation
1. Relate an experience to students that you had on your first day of employment
2. Encourage any students who are working to discuss an extra "kindness" shown them by co-workers on their first day at work

C. Subject Matter Content
Assignment: What students need to learn
1. Developing good human relations with co-workers
   a. Plan work together
   b. Be considerate
   c. Maintain friendly interest
   d. Show cooperative attitude
2. Relations of new employees to old employees
   a. Be friendly
   b. Be considerate
3. Do's in creating human relations with co-workers
   a. Treat co-workers as individuals
      (1) Notice co-workers
      (2) Call co-workers by name
      (3) Keep all promises
   b. Give desired recognition
      (1) Recognize effort as well as achievement
      (2) Do not blame
   c. Put co-workers on same level
      (1) Give others opportunity to express their opinion
      (2) Give constructive criticism
         (a) In private
         (b) Be objective and impersonal
         (c) Allow co-workers to correct own mistakes

D. Student Participation
1. Have students prepare a list of do's and a list of dont's in creating good human relations with co-workers
2. Have students prepare a bulletin board depicting a good human relations situation and a bad one
3. Give a case problem and have them tell what they would do in that situation, keeping in mind the points brought out in this lesson

E. Teaching Aids and References
1. Chalkboard
2. Bulletin board
3. A Suggested Course of Study in Human Relations
4. How to Supervise Employees
5. Film, "First Impression"

II. Teaching the Lesson

Lesson 3: Dealing With the Public

A. Objectives
   1. To create an awareness of the customer as an individual with moods, likes, and dislikes
   2. To gain an understanding of what people expect from those who serve them
   3. To create an awareness of the responsibility that lies with the employee for relations in order to build business

B. Motivation
   1. Have you ever accused a friend of "getting up on the wrong side of the bed?" Did everything you do displease him? Discuss this in relation to customers who sometimes have a "bad day"
   2. Have you ever had a situation where an employee snapped back at you, the customer? Do you care to have that employee serve you?
   3. Can you feel "welcome" in a place of business?

C. Subject Matter Content
   Assignment: What students need to learn
   1. What customers expect of employees
      a. Interest in customer's needs and wants
      b. Realization of customer's viewpoint
      c. Information about service
      d. Neat appearance
         (1) Cleanliness
         (2) Grooming
      e. Pleasing personality
         (1) Congeniality
         (2) Pleasant voice
         (3) Sense of humor
         (4) Patience
         (5) Self-control
      f. Honesty
      g. Tact
      h. Reliability
      i. Courtesy
      j. Dependability
      k. Cooperativeness
   2. Traits an employee must recognize as important in his job
      a. A liking for people
      b. Tact
      c. Patience
      d. Assurance
      e. Knowledge of service
      f. Professional attitude
   3. How human relations affect business
      a. Advantages of good relationship with public
      b. Disadvantages of poor relationship

D. Student Participation
   1. Have students write a report telling how poor human relations

between employee and the public can affect business

2. Have students solve case problem using the points stressed in this lesson. Example: Mrs. Jones, a regular customer, entered the riding stable one day and asked for a horse to ride. The only person around was Adam Smith, a young man hired to look after the feeding of the horses. Though he was capable of the saddling, his reply to Mrs. Jones was, "that's not my job." What position would you have taken if you were Adam? Do you think Adam's attitude will affect the business? How?

E. Teaching Aids and References
   1. A Suggested Course of Study in Human Relations
   2. Films
   3. Bulletin board

UNIT EVALUATION

1. Conventional examinations
2. Case problems involving employer-employee, employee-employee, and employer-public relations can be used to evaluate the unit. One case can involve all three aspects or three cases can be used. Evaluate the problems according to points brought out in the lesson.

UNIT REFERENCES

A Suggested Course of Study in Human Relations. Distributive Education Section, State Department of Education

How to Supervise Employees. Extension Department, University of Texas,

Human Relations in Agricultural Occupations. Module 3. The Center for Research and Leadership Development in Vocational and Technical Education, The Ohio State University, 980 Kinnear Road, Columbus, Ohio 43212. 1965

Russon, Allien R. Business Behavior. Chicago, South-Western Publishing Co.

UNIT 18

LEGAL INFORMATION

One of nineteen units of instruction in the occupational family

Wildlife and Recreation

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Business Principles and Procedures Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Legal Information

UNIT OBJECTIVE: To develop an understanding of the laws regulating wildlife and recreation businesses and the employees in these businesses

TIME ALLOTMENT:

In School:

Class Instruction	10	hrs.	
Shop or Laboratory Work		hrs.	
Total	10	hrs.	
Occupational or Job Experience		hrs.	(To be determined by individual teachers)
Unit Total		hrs.	

COMPETENCIES TO BE DEVELOPED:

1. Obtaining papers necessary for job entry
2. Labor laws
3. Federal Social Security Acts
4. Income taxes

STUDENT MOTIVATION:

1. Explain to the students that though we have a free enterprise system there are still some regulations by which businesses must abide
2. Ask for some discussion on what social security taxes cover

TEACHING THE UNIT:

I. Organization

A. Lessons to be Taught
   1. Employment certificates
   2. Labor laws
   3. Social Security Law
   4. Income taxes

B. Instructional Materials
   1. Forms
   2. Chalkboard
   3. Pamphlets
   4. Books

C. Job Experience
   1. School
   2. On the job

II. Teaching the Lesson

Lesson 1: Employment Certificates

A. Objective

To teach the students what must be done before a minor can be employed

B. Motivation
   1. Ask how many have employment certificates or are familiar with them
   2. If you plan to work after school, will you need a work permit

C. Subject Matter Content
   Assignment: What students need to learn
   1. Commissioner of labor furnishes forms
   2. Employers must keep records
   3. Persons authorized to issue
   4. Requirements for issuance
      a. Intention to employ
      b. Proof of age
   5. Signing of certificate by minor
   6. File copy with commissioner of labor
   7. Revocation

D. Student Participation
   Have students fill out forms used in connection with the issuance of employment certificates

E. Teaching Aids and References
   1. Forms
   2. Handbook for Young Workers
   3. Labor Laws Relating to Women and Children

II. Teaching the Lesson

Lesson 2: Labor Laws

A. Objectives
   1. To teach our present social philosophy relative to working conditions, hours, wages, and protection of children
   2. To teach the provisions of the Child-Labor Laws

B. Motivation
   1. Why have laws regulating children on the labor force
   2. What do we mean by "time and a half?"

C. Subject Matter Content
   Assignment: What students need to learn
   1. How is employment regulated
   2. What are Child-Labor Laws
   3. What is the right to bargain collectively
   4. What are unfair labor practices
      a. Unfair labor practices by employers
      b. Unfair labor practices by unions
   5. What is the law as to wages and hours
   6. What do other labor laws provide

D. Student Participation
   1. Have committee report on child-labor laws in your state
   2. Make a list of businesses that can hire minors

3. Make a list of businesses that cannot hire minors

E. Teaching Aids and References
1. Handbook for Young Workers
2. Labor Laws Relating to Women and Children
3. Applied Business Law

II. Teaching the Lesson

Lesson 3: Social Security Tax Law

A. Objectives
1. To teach the kinds of social insurance
2. To teach the benefits under each kind of social insurance and who is eligible
3. To teach the importance of the Social Security number
4. To teach how to apply for the Social Security number
5. To teach the importance of filing an application for benefits
6. To teach how the Social Security Laws are financed

B. Motivation
1. Ask how many have a social security card
2. Obtain from the Social Security office in your district pamphlets which explain the operation of the Social Security Laws and benefits
3. What would you do if you were dismissed because you were no longer needed in your position

C. Subject Matter Content
Assignment: What students need to learn
1. What is social insurance
   a. Unemployment insurance
   b. Old-age insurance (retirement income)
   c. Survivors insurance
   d. Disability insurance
2. Who are entitled to unemployment benefits
   a. Worker must be covered by state law
   b. Worker must be working for employer that employs four or more on at least one day of each of twenty weeks during the calendar year
   c. Worker must have received minimum pay or worked minimum time
3. What unemployment benefits are provided
4. How are unemployment benefits obtained
   a. File claim
   b. Register at public employment office for a job
   c. Be able and available for work on a suitable job
   d. Be totally unemployed for a specified period of time
5. When are unemployment benefits forfeited
   a. Quits without good cause
   b. Refuses to apply for, or to accept, suitable work
   c. Loses job through strike or labor dispute in which he is involved
   d. Intentionally misrepresents the facts
   e. Is discharged for misconduct connected with his work
   f. Is discharged for theft if guilty

g. Misrepresents claims for benefits
h. Is attending school full time

6. Who are entitled to OASDI coverage
7. How does one qualify for benefits
8. How is OASDI financed
9. How are OASDI benefits determined
10. How are OASDI benefits reduced if you work
11. When are disability benefits available

D. Student Participation
1. Have students prepare a report on the way to file an application for unemployment compensation
2. Using a chart for monthly benefit payments of 1960, give problems and let students determine how much would be collected. Example: Jules, fully insured and retired under OASDI with average monthly earnings of $100 died. What would be the single lump sum death benefit to assist in paying the funeral expenses
3. Have students apply for social security number if they do not already have one

E. Teaching Aids and References
1. Applied Business Law
2. Suggestions for Orienting Vocational Agriculture Students to Employment Opportunities in Farm Based Businesses and Agencies
3. Forms
4. Brochures

II. Teaching the Lesson

Lesson 4: Income Tax

A. Objectives
1. To teach an understanding of the procedure used to report income to the government
2. To teach the forms used by employee and employers in reporting tax withheld

B. Motivation
1. What is an income tax refund
2. Who pays income tax
3. What does April 15 mean to most people

C. Subject Matter Content
Assignment: What students need to learn
1. Employee's withholding exemption certificate
a. Purpose
b. Common name--W-4
c. Who fills it out
d. Who keeps it on record
e. When and how often it is filled out
f. What are exemptions
2. Withholding tax statement
a. Purpose
b. Common name--W-2

c. Who fills it out
d. Who receives it
e. Number of copies
f. What to do with each copy
g. When are W-2 forms sent out

3. Income tax returns
   a. Who files
   b. Where to file
   c. When to file
4. Income tax return forms
   a. 1040A--short form
      (1) Follow directions carefully
      (2) Retain a copy for personal use
   b. 1040--itemized deductions--long form
      (1) Follow directions carefully
      (2) Retain copy
   c. Where to obtain forms and instructions for preparing them
5. Employer's forms
   a. Employer's quarterly federal tax return
      (1) Purpose
      (2) Common name--941
      (3) Who completes it
      (4) How often is it completed
      (5) What does it contain
   b. Reconciliation of income tax withheld from wages
      (1) Purpose
      (2) Common name--W-3
      (3) When completed
      (4) Who completes it

D. Student Participation
   1. Have students fill out W-4 forms
   2. Have students fill out 1040A forms
   3. Have students fill out 1040 forms
   4. Have students discuss need for each form
   5. Have students discuss time when each form is due

E. Teaching Aids and References
   1. Teaching Taxes Kit 1 and 2--Income Tax Kit for Teaching Income Tax (Includes large forms for display and forms for students. Available from Internal Revenue Service in New Orleans)
   2. Bookkeeping and Accounting Simplified. Freeman, Herbert, Hanna, Marshall, Kahn, Gilbert, McGraw Hill Inc., New York

UNIT EVALUATION

1. Conventional examinations
2. Evaluate the different forms filled out by students
3. Check understanding of legal information by casual questions

UNIT REFERENCES

Freeman, Herbert; Hanna, Marshall; and Kahn, Gilbert. Bookkeeping and Accounting Simplified. New York, McGraw Hill Inc.

McKee, Fisk and James C. Snapp. Applied Business Law. Eighth edition. South-Western Publishing Company, Chicago, 1960

Handbook for Young Workers. Bulletin 271, U.S. Department of Labor, Bureau of Labor Standards (Write Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402)

Labor Laws Relating to Women and Children. Commissioner of Labor, Baton Rouge, Louisiana

Tax Guide for Small Businesses. Superintendent of Documents. U.S. Government Printing Office, Washington, D.C. 20402, or from District Director of Internal Revenue

Your Federal Income Tax. District Director. Internal Revenue Service, New Orleans, Louisiana

UNIT 19

SALES PROMOTION

One of nineteen units of instruction in the occupational family

Wildlife and Recreation

OCCUPATIONAL FAMILY: Wildlife and Recreation

INSTRUCTIONAL AREA: Applied Business Principles and Procedures Basic to Wildlife and Recreation

INSTRUCTIONAL UNIT: Sales Promotion

UNIT OBJECTIVE: To develop an understanding of the importance of advertising and selling for job opportunities in wildlife and recreation

TIME ALLOTMENT:

In School:

Class Instruction	10	hrs.
Shop or Laboratory Work		hrs.
Total	10	hrs.
Occupational or Job Experience		hrs. (To be determined by individual teachers)
Unit Total		hrs.

COMPETENCIES TO BE DEVELOPED:

1. To develop an understanding of advertising
2. To develop an understanding of the objectives of advertising
3. To develop an understanding of personal selling

STUDENT MOTIVATION:

1. "It Pays to Advertise"
2. Discuss some of the television commercials
3. Have a bulletin board made up of advertisements for different recreational areas
4. Discuss whether or not advertising alone can bring about desire for a product or service

TEACHING THE UNIT:

I. Organization

A. Lessons to be Taught
1. Advertising as a means of sales promotion
2. Personal selling

B. Instructional Materials
1. Films
2. Pamphlets
3. Books
4. Tape recorder

C. Job Experience
1. School
2. On the job

II. Teaching the Lesson

Lesson 1: Advertising as a Means of Promoting Sales

A. Objectives
1. To teach an understanding of advertising and its value

2. To teach the kinds of advertising
3. To teach the essentials of advertising

B. Motivation
1. Ask the students to describe their favorite television commercials
2. Ask how many have had the desire to buy something just to see if it does what it is advertised to do
3. Have a discussion about the different kinds of advertising media the students know

C. Subject Matter Content
Assignment: What students need to learn
1. Advertising as a form of sales promotion
   a. Advertising versus personal selling
   b. Advantages of advertising
   c. Disadvantages of advertising
2. Objectives of advertising
   a. Stimulate demand
   b. Attract attention and create interest
   c. To sell the service
   d. To keep former customers satisfied
3. Kinds of advertising
   a. Institutional
   b. Promotional
      (1) Pioneer
      (2) Reminder
      (3) Notice of sale
4. Essentials of effective advertising
   a. Advertise right services
   b. Advertise at the right time
   c. Advertise in the right media
      (1) Periodicals
      (2) Direct advertising
      (3) Outdoor advertising
      (4) Transportation advertising
      (5) Broadcasting
      (6) Occasional publications
   d. Use the right advertising technique
      (1) Attention
      (2) Interest
      (3) Desire
      (4) Action
5. Ethics of advertising

D. Student Participation
1. Have each student prepare a newspaper advertisement for a recreational area
2. Have each student prepare a billboard advertisement for a riding stable
3. Have each student make a list of advertisements for the different wildlife and recreational areas in the community

E. Teaching Aids and References
1. Newspapers

2. Magazines
3. Brochures
4. Pamphlets
5. Rowse. Fundamentals of Advertising

II. Teaching the Lesson

Lesson 2: Personal Selling

A. Objectives
1. To teach the importance of health, personal appearance, and lack of unpleasant mannerisms upon the success of the salesman
2. To teach the important mental and moral qualities that make up a good salesman's personality
3. To teach the importance of keeping the customer happy
4. To teach the fact that everyone is a salesman

B. Motivation
1. Would you trust a place of business if the employees grumbled and complained about the service
2. Have you ever been to a recreational area and have everyone ignore you? Did you want to go back?
3. Have a discussion on the statement, "Everyone is a salesman."

C. Subject Matter Content
Assignment: What students need to learn
1. Physical characteristics of a salesman
   a. Health
   b. Posture
   c. Cleanliness and good grooming
   d. Clothes
   e. Voice
   f. Mannerisms (lack of)
2. Mental characteristics
   a. Honesty
   b. Responsibility and adaptibility
   c. Loyalty
   d. Enthusiasm
   e. Courtesy
   f. Tact
   g. Others

D. Student Participation
1. Give each a chart and let him rate himself as to: Health, posture, grooming, clothing, voice, and absence of mannerisms
2. Have each record a short sales talk prepared by teacher or student. On the play back have him listen and rate his voice on enuciation, speed, volume, emphasis, tone, etc. Give him a chart to use to rate himself
3. Give a case problem where a customer was not satisfied and let students write a report stating what caused the dissatisfaction and how it could be corrected

E. Teaching Aids and References

1. Tape recorders
2. Charts
3. Ernest. Salesmanship Fundamentals
4. Wingate. Fundamentals of Selling

UNIT EVALUATION

1. Conventional examinations
2. Evaluations of reports or case problems
3. Evaluations of advertisements, if prepared

UNIT REFERENCES

Ernest, John W., and DaVall, George M. Salesmanship Fundamentals. Third edition. McGraw Hill Book Company, New York, 1965

Rowse, Edward, and Nolan, Carroll. Fundamentals of Advertising. Sixth edition. South-Western Publishing Company, Chicago, 1957

Wingate, John, and Nolan, Carroll. Fundamentals of Selling. Eighth edition. South-Western Publishing Company, Chicago, 1964

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ABSTRACT - Prepared by a subject matter specialist, this course outline is designed to prepare advanced vocational agriculture students for employment in a forestry occupation. Teaching units, providing content, laboratory experiences, and references, are given for: (1) Orientation to Forest Occupations, (2) Supervised Practice Program, (3) Forestry in Alabama, (4) Forest Trees, (5) Protecting the Forest, (6) Measurements in Forestry, (7) Cuttings, (8) Reforestation, (9) Marketing Forest Products, (10) Multiple Use of Forests, (11) Agricultural Mechanics, and (12) Leadership. A list of suggested references is included. (AW)

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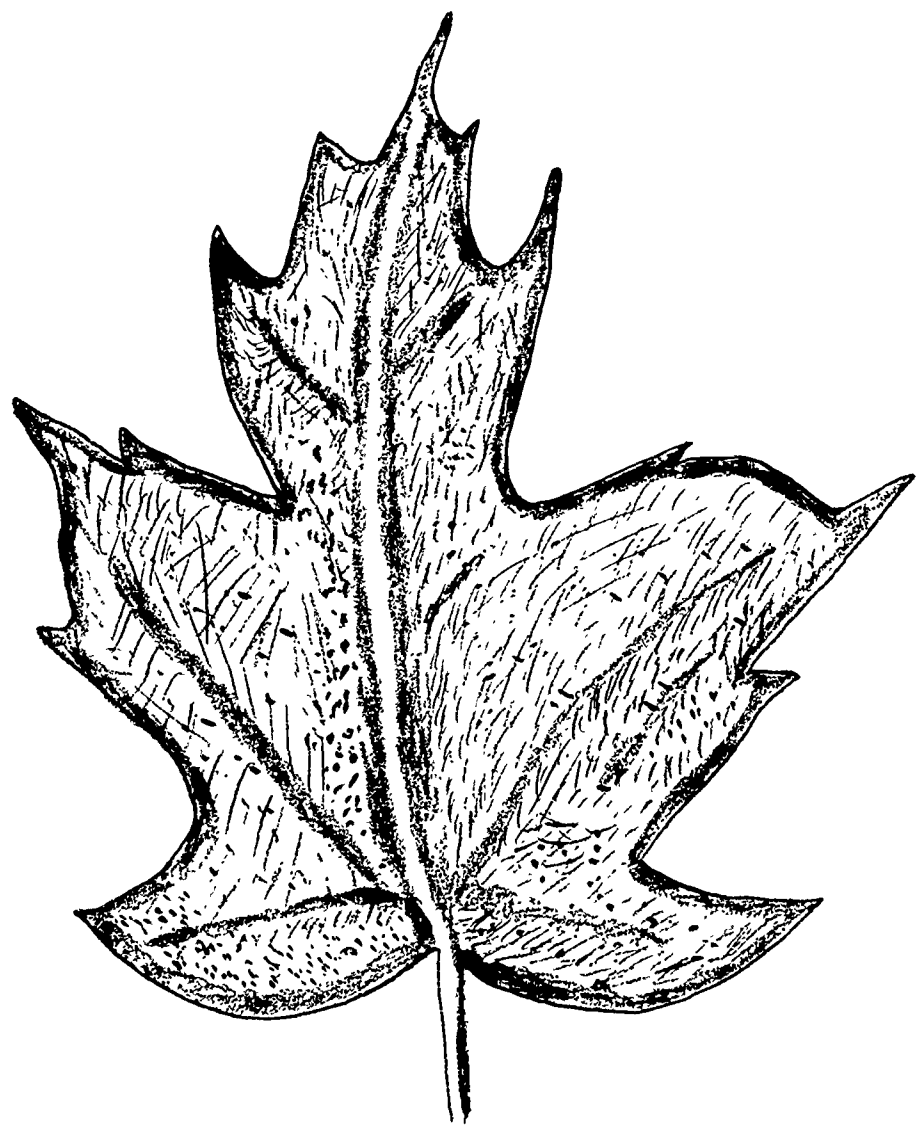
A SPECIALIZED COURSE OUTLINE FOR ADVANCED VOCATIONAL AGRICULTURE STUDENTS IN FOREST PRODUCTS PRODUCTION SALES AND SERVICES



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State of Alabama
Department of Education
A. R. Meadows - Superintendent
Vocational Division
Agricultural Education Service
Montgomery, Alabama

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Ala. 1966

FOREST PRODUCTS PRODUCTION, SALES AND SERVICES

(A Specialized Course Outline For Advanced Vo-Ag Students)

Prepared by Byron F. Rawls, Subject Matter Specialist,
Vocational Agriculture

Objectives of the Course

1. To assist interested students in developing an understanding of career opportunities in forestry.

2. To assist these students in developing skills and abilities in forestry through planned and supervised work experience programs.

3. To assist students in developing the personality traits essential to securing and maintaining employment in a forestry occupation.

4. To assist students in learning the basic functions of the forest industry in Alabama.

5. To assist students in learning the basic use of tools and mechanical equipment.

6. To assist students in applying basic agricultural knowledge to the forest industry.

7. To assist the student in developing leadership abilities through FFA.

TEACHING UNITS	TIME	REFERENCES
I. Orientation To Forest Occupations		1, 2, 7
A. Type of Work 1. Technical sales and service 2. Association, technical writing, publicity, editorial 3. Teaching 4. Machinery operation 5. Consulting (industrial forester) 6. Research and development 7. Timber and wood procurement 8. Protection specialist 9. Administration 10. Nursery (production) 11. Forest pathology 12. Range management 13. Engineering (logging, road construction) 14. Forest recreation 15. Forest entomology 16. Forest wildlife management 17. Watershed management 18. Processing 19. Forest management (specialist) 20. Scaling and grading		NOTE: Numbers in this column refer to the number of a reference on the attached list.

TEACHING UNITS	TIME	REFERENCES
21. Forestry aid		
22. Foresters (self-employed)		
a. Tree preservation		
b. Cost studies of forest operations		
c. Forest management		
d. Forest protection		
e. Surveying and mapping		
f. Timber valuation and appraisal		
g. Timber volume and quality estimates (cruising)		
h. Reforestation		
B. Training Needed		
1. On the job		
2. High school		
3. Post high school		
a. Short course		
b. Trade school		
c. Junior college		
d. Agricultural college		
C. Employment and Advancement		
1. Employment requirements		
a. Health		
b. Character		
c. Education		
2. Salary		
a. Beginning		
b. Maximum		
c. Rate of salary advancement		
3. Requirements for advancement		
a. Basic knowledge		
b. Application of self		
c. In-service training		
d. Opportunity		
D. Organizations Employing Forestry Trained Persons		
1. U.S. Forest Service		
2. State forestry and conservation departments		
3. Tree farms and nurseries		
4. Industry		
a. Lumber		
b. Furniture		
c. Pulp and paper		
5. Public and private institutions (schools and colleges)		
6. City and community agencies		
E. Laboratory Experiences		
1. Class visit local forest or park. Make oral and written reports of visit.		
2. Class visit local wood using industries. Make oral and written reports of visit.		

TEACHING UNITS	TIME	REFERENCES
3. Invite a professional forester to visit the class and answer questions.		
4. Assign each class member an occupation. Ask him to make a thorough study of it and report to the class.		
II. Supervised Practice Program		1, 2, 3, 4
A. Forestry Practices at Home and School		
1. Planning practices		
2. Producing trees		
3. Determining the economics of growing trees		
4. Marketing trees		
B. Forestry Practices on the job and at school		
1. Surveying and mapping		
2. Estimating stands		
3. Record keeping		
4. Selecting and procuring wood		
5. Operation of stationary and mobile machinery		
6. Forest protection		
7. Selection and use of equipment		
C. Laboratory Experiences		
1. Visit local wood using industries with members and plan their placement for experiences.		
2. Have class members report to the class their experiences.		
3. Plan and conduct a school forestry program.		
III. Forestry in Alabama		1, 3
A. Land		
1. Ownership		
a. How		
b. Who		
2. Use		
a. Forest land		
b. Crop land		
c. Pasture		
d. Other (farmsteads, roads, power lines, urban, etc.)		
B. Forests		
1. Types		
2. Trends		
a. Volume of growing stock		
b. Overall forest situation		
(1) Production up or down		
(2) Outlook		
C. Laboratory Experiences		
1. Discuss the ownership of land in the county.		

TEACHING UNITS	TIME	REFERENCES
2. Discuss the types of forests in the community.		
3. Ask a forester to visit the class and answer questions.		
4. Visit types of forests with the class.		
IV. Forest Trees		1, 2, 3, 4
A. How Trees Grow		
1. Parts of a tree		
2. Functions of tree parts		
3. Factors affecting rate of growth		
B. Reproduction of Trees		
1. Fruit and seed		
a. Types of seeds		
b. Formation of seeds		
c. Dispersal of seed		
C. Identification of Forest Trees in Alabama		
1. Leaf characteristics (Check in Sept.)		
a. Forms		
b. Tips		
c. Bases		
d. Arrangement		
e. Composition		
f. Margins		
2. Twig characteristics (Check in Jan.)		
3. Types of fruit (Check in Sept.)		
4. Families and genera		
a. Pinaceae - pine family		
b. Judlandaceae - willow family		
c Betulaceae - birch family		
d. Fagaceae - beech family		
e. Ulmaceae - elm family		
f Others		
5. Individual trees		
a Pine		
b. Hemlock		
c. Walnut		
d. Juniper		
e. Hickory		
f. Birch		
g. Beech		
h. Oak		
i. Yellow Poplar		
j. Black gum		
k. Others		
D. Laboratory Experiences		
1. Have class identify all trees on the school grounds.		
2. Visit a local forest and identify the trees.		
3. Have each student mount, label and display leaves, fruit and seeds of local trees.		

TEACHING UNITS	TIME	REFERENCES
4. Examine growth rings on a freshly cut stump. Let class determine the age of the tree.		
5. Select a tree that has made rapid growth. Ask class to determine why. Do the same for a slow growing tree. (fertilizer, shade, etc.)		
V. Protecting the Forest		1, 2, 4, 5
A. Protecting From Fire		
1. Effect of fire		
a. Tree growth		
b. Reproductive power of the tree		
c. Scenic and recreational value		
d. Wildlife		
2. Causes of forest fires		
a. Man-caused fires		
(1) Campers		
(2) Smokers		
(3) Debris burning		
(4) Harvesting operations		
(5) Railroads		
(6) Incendiary		
(7) Miscellaneous		
b. Natural		
(1) Lightening		
3. Classification of forest fires		
a. Ground		
b. Surface		
c. Crown		
4. Spread of fires		
a. Fuel		
b. Topography		
c. Air flow		
d. Humidity		
5. Presuppression of fires		
a. Maintaining facilities and equipment		
b. Detection of the fire		
c. Communications		
d. Fire lanes		
e. Transportation		
f. Organization		
(1) Tools		
(2) Equipment		
(3) Supplies		
(4) Personnel		
6. Suppression of fires		
a. Characteristics of spread		
b. Methods of fighting		
(1) Direct attack		
(a) Swatting		
(b) Watering		
(c) Dirt		

TEACHING UNITS	TIME	REFERENCES
(2) Indirect attack		
(a) Firebreaks		
(b) Backfires		
7. Mopping-up and patrol		
a. Preliminary mopping-up		
b. Final mopping-up		
c. Inspection of area		
B. Protecting from Insects		
1. Destructive forest insects		
a. Bark beetles		
b. Wood-borers		
c. Leaf-eaters		
d. Gall-makers		
e. Seed-feeders		
f. Tip feeders		
2. Control of destructive insects		
a. Natural		
b. Artificial		
c. Indirect control or special practices		
C. Protecting From Disease		
1. Diseases of forest trees		
a. Mistletoe		
b. Gall		
c. Rots		
d. Sap stains		
e. Needle blight		
f. Fusiform		
g. Littleleaf		
2. Control of forest tree diseases		
a. Controlled burning		
b. Controlled		
c. Pruning		
d. Thinning		
e. Removal of infected trees		
D. Protecting From Livestock		
1. Livestock damage		
a. Soil compaction		
b. Damage to seedlings		
c. Site deterioration		
2. Control of livestock damage		
a. Prevention of grazing		
E. Controlling Undesirable Species		
1. Determining undesirables		
a. In established stands		
b. On land to be reforested		
2. Necessity for control		
a. In pine stands		
b. In hardwood stands		
c. In combination stands		

TEACHING UNITS	TIME	REFERENCES
3. Methods of control a. Chemical b. Girdling c. Frill d. Basal spray e. Tree injector f. Heavy mechanical and chemical combination g. Pellets		
F. Laboratory Experiences 1. Take a field trip to a fire damaged forest. 2. Ask students to observe and record damage to trees in the stand. These reports should be given in class. 3. Check fire protection plans in your area. 4. Have a forester visit the class to discuss forest protection. 5. Examine local forests for disease and insect damage. 6. Have class members collect specimens of insect and disease damage for discussion in class. 7. Practice undesirable control with class.		
VI. Measurements In Forestry		1, 2, 4, 5
A. Land measurement 1. Instruments 2. Units of measurement 3. Elevation 4. Slope 5. Sample survey 6. Area		
B. Tree Measurement 1. Diameter 2. Height 3. Volume		
C. Log Measurement 1. Doyle log rule 2. International log rule 3. Scribner log rule 4. Application of log rules		
D. Growth Measurement 1. Diameter 2. Height 3. Board feet 4. Cubic volume		
E. Cruising and Estimating Timber 1. Ocular or "lump" method 2. Average tree method 3. Total method 4. Percentage method		

TEACHING UNITS	TIME	REFERENCES
F. Computing Field Data 1. Organization of records 2. Tabulate information 3. Reading tables 4. Totaling separate strips		
G. Laboratory Experiences 1. Let each student determine the length of his pace. Check the accuracy on measured distances. 2. Make a boundry survey of a local plot of land. Determine the acreage of the area. 3. Let class make a diameter tape and cruising stick. 4. Measure trees and estimate the volume using tables. 5. Let class use an increment borer and determine growth percentage. 6. Let class cruise a local stand of timber.		
VII. Cuttings		1, 2, 4, 5
A. Harvest Cuttings 1. Clear-cutting 2. Seed-tree cutting 3. Selection cutting 4. Shelterwood cutting		
B. Stand Improvement Cutting 1. Cleaning 2. Thinning 3. Liberation 4. Salvage 5. Sanitation		
C. Laboratory Experiences 1. Class inspect an unmanaged stand and figure basal area. 2. Classify trees in above stand into saw logs, poles, crossties, pulpwood, and trees to be left standing. 3. Prepare a work plan for the area. 4. Class assist in marking and cutting trees.		
VIII. Reforestation		1, 2, 4, 5
A. Natural 1. Selection of seed trees 2. Care of seed trees		
B. Artificial 1. Seeding 2. Seedlings a. Obtaining and caring for seedlings b. Planting seedlings c. Soil preparation		

TEACHING UNITS	TIME	REFERENCES
d. Time to plant		
e. Species to plant		
f. Spacing and site recommendations		
g. Fertilizing seedlings		
C. Laboratory Experiences		
1. Class collect seed from local trees		
2. Germinate pine seed in classroom		
3. Visit nearest state tree nursery		
4. Class members construct a dibble		
5. Class inspect a tree planting machine and observe its operation		
6. Have all class members set out trees in school forestry plot		
IX. Marketing Forest Products		1, 2, 4
A. Time To Market		
1. Demand for products		
a. Current		
b. Prospective		
2. Condition of the stand		
a. Thinning needed		
b. Salvage needed		
c. Sanitation needed		
d. Liberation needed		
B. Methods of Marketing		
1. Lump or bulk sale		
2. Unit sale		
C. Marketable Products		
1. Poles and piling		
2. Sawlogs		
3. Pulpwood		
4. Posts		
5. Hewn crossties		
6. Manufactured products		
D. Laboratory Experiences		
1. Obtain prices and specifications from a local buyer of forest products.		
2. Class prepare sales contracts for lump and unit sales methods.		
3. Class visit local industry and report to class on use of forest products.		
X. Multiple Use of Forests		1, 8
A. Timber Production		
B. Wildlife Production		

TEACHING UNITS	TIME	REFERENCES
1. Wildlife protection		
a. Cover		
b. Reproduction environment		
c. Food		
2. Species		
a. Rabbit		
b. Squirrel		
c. Quail		
d. Deer		
e. Turkey		
f. Others		
C. Recreation		
1. Hiking		
2. Hunting		
3. Fishing		
4. Camping		
5. Picnicking		
6. Canoeing		
D. Laboratory Experiences		
1. Have professional forester discuss multiple use with class.		
2. Class members exchange experiences.		
3. Take week-end trip to observe and practice multiple use of the forest.		
XI. Agricultural Mechanics		11,12, 13
A. Engines		
1. Operating principles		
a. Gasoline		
b. Diesel		
c. L. P. engines		
2. Care, service and maintenance		
3. Overhaul		
4. Troubleshooting multiple cylinder engines and machinery		
B. Equipment		
1. Operating principles		
a. Chain saw		
b. Farm Tractor		
c. Truck		
d. Front-end loader		
e. Wood-loading equipment		
f. Peelers		
g. Dozier		
h. Fire-fighting equipment		
i. Tree planter		
j. Other		
2. Maintenance		

TEACHING UNITS	TIME	REFERENCES
a. Manufacturer's recommendations		
b. Troubleshooting		
c. Field repairs		
C. Welding		
1. Cast iron, alloys and sheetmetal		
2. Brazing		
3. Fusion (without rod)		
4. Cutting		
5. Safety practices (review)		
D. Electrification		
1. Planning electrical systems		
2. Selecting materials		
3. Installing electrical systems		
4. Selecting motors		
5. Troubleshooting		
E. Painting		
1. Wood preservatives		
2. Rust resistant paints		
3. Applying paints and preservatives		
4. Safety		
F. Engineering		
1. Using surveying instruments		
2. Squaring, laying out and leveling foundations		
3. Determining elevations		
4. Using a compass		
5. Map reading		
G. Laboratory Experiences		
1. Class disassemble, repair and reassemble small gasoline engines.		
2. Class practice trouble-shooting on a multiple cylinder engine		
3. Class visit a woodyard, sawmill and other industry and examine heavy equipment used in handling wood. Practice operation if possible.		
4. Class practice welding alloys, cast iron and sheetmetal using both electric and oxyacetylene welders.		
5. Class visit house which is being wired and examine the electrical system.		
6. Class practice using a spray painter.		
7. Class use surveying instruments to:		
a. Determine elevations		
b. Square and lay out foundations		
8. Class use compass to follow land line and locate corners.		
XII. Leadership		14
A. FFA		

TEACHING UNITS	TIME	REFERENCES
1. Public speaking		
2. Parliamentary procedure		
3. Citizenship		
4. Contests and awards		
B. Succeeding on the Job		
1. Obtaining a job		
2. Developing a winning personality		
3. Relations with fellow workers		
4. Relations with superiors		
5. In-service training and application of self to the job		
C. Laboratory Experiences		
1. Class plan contest and awards entries		
2. All class members enter public speaking contest		
3. Practice parliamentary procedure in the class		
4. Have employers discuss relations with the class		
5. Class practice role-playing in applying for a job and relations with others on the job		

SUGGESTED REFERENCES

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2. Manual of Southern Forestry, Weaver and Anderson, The Interstate, Danville, Ill.

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ABSTRACT - Prepared by a subject matter specialist, this study guide is for use by students not enrolled in specialized courses of instruction in forestry. Contents include study questions, learning activities, and suggested references for the following topics: (1) Forestry in Alabama, (2) Forest Trees, (3) Protecting the Forest, (4) Measurements in Forestry, (5) Cutting, (6) Reforestation, (7) Marketing Forest Products, and (8) Multiple Use of Forests. (AW)

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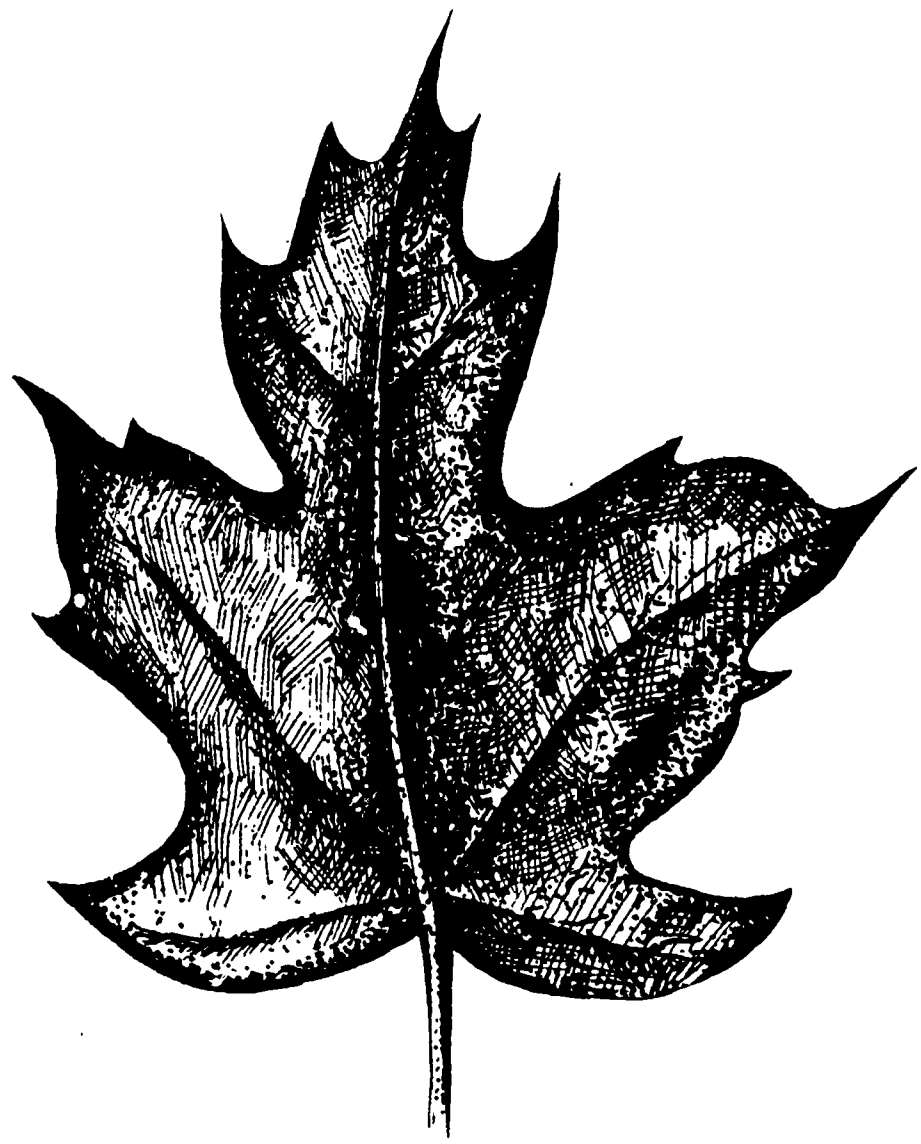
FORESTRY PRODUCTION SALES AND SERVICES

(A Student Study Guide)



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FOREWORD

This study guide has been prepared to assist the interested student who wishes to study forestry. It is intended primarily as a guide for the individual who may not be in a special course of instruction in this field. However, it is designed so that it can be used as a supervised study guide by the teacher and students in a special course in forestry. It may also be helpful to the teacher in his over-all program of instruction in vocational agriculture.

March, 1966
Prepared by B. F. Rawls,
Subject Matter Specialist

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State Department of Education
Montgomery, Alabama

ERIC

FORESTRY IN ALABAMA

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. What is meant by the expression "Alabama is a timber growing state"?
2. What factors make Alabama so favorable to growing trees?
3. What is the total land acreage in Alabama?
4. What per cent of the land in Alabama is in forests?
5. How is farm land used in Alabama?
6. Who owns the forest land in Alabama?
7. Approximately how many industries in Alabama depend on forests for their raw material?
8. Name several industries in Alabama that depend on the forests for raw material.
9. How does the present Alabama forest compare to the virgin forests in contribution to the state?
10. What percent of the industrial employees in Alabama are in the forest industries?
11. What are the types of forests in Alabama?
12. What are the trends in the types of forests in Alabama?
13. What percent of the Alabama forests is in pine or pine and hardwood?
14. What is meant by "growing stock"?
15. What is the trend in growing stock?
16. What is the trend in the over-all forest situation in Alabama?

SUGGESTED LEARNING ACTIVITIES

1. Visit a "all pine" forest.
2. Visit a "pine and hardwood" forest.
3. Visit a "hardwood" forest.
4. Survey the community for all of the wood using industries.
5. Visit several of these industries.
6. Discuss forest trends with the other class members.

SUGGESTED REFERENCES

1. Developing Farm Woodlands In Alabama, Alabama Dept. of Conservation, Division of Forestry, Montgomery, Alabama, and Alabama Dept. of Education, Division of Vocational Education, Montgomery, Alabama.

2. Manual of Southern Forestry, Weaver and Anderson, The Interstate, Danville, Illinois.

3. 100 Forest Trees of Alabama, State of Alabama, Department of Conservation, Division of Forestry, Montgomery, Alabama.

FOREST TREES

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. Name the three main parts of a tree.
2. Sketch a cross-section of a tree showing the three main parts.
3. What is the function of each of the three parts?
4. What is an "annual ring"?
5. What can you determine by studying the annual rings of a tree?
6. By what method do trees reproduce?
7. Which method of reproduction in trees is most common?
8. What is the difference between a fruit and a seed?
9. How does reproduction in pine differ from that in oaks?
10. What is the test for determining if a pine cone is mature?
11. What is meant by the term "hardwood"?
12. How does water travel from the ground to the crown of a tree?
13. What is the process of manufacturing sugar in a plant called?
14. What part do leaves play in the growth of a tree?
15. What part does the outer bark play in tree growth?
16. How are growth rings formed?
17. How can you tell the age of a tree without cutting it down?

SUGGESTED LEARNING ACTIVITIES

1. Make a collection of tree seeds found in the community.
2. Practice identifying tree seeds with other members of the class.
3. Study growth rings from either tree cross sections or stumps.
4. Determine the age of trees by their annual rings.

SUGGESTED REFERENCES

1. Developing Farm Woodlands In Alabama, Alabama Department of Conservation, Division of Forestry, Montgomery, Alabama and Alabama Department of Education, Division of Vocational Education, Montgomery, Alabama.

2. Manual of Southern Forestry, Weaver and Anderson, The Interstate, Danville, Illinois.

3. 100 Forest Trees of Alabama, State of Alabama, Department of Conservation, Division of Forestry, Montgomery, Alabama.

PROTECTING THE FOREST

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. What are some of the direct losses resulting from forest fires?
2. Name several indirect losses resulting from forest fires.
3. What are the 9 headings under which fire causes are classified?
4. List the 5 main causes of forest fires in the south.
5. Which of the main fire causes occur most frequently.
6. What factors affect the spread of forest fires?
7. What factors determine how severe a forest fire is?
8. What fire protection and fire suppression services are available to woodland owners in Alabama?
9. To whom would you report a forest fire which you could not suppress?
10. Outline the differences between direct and indirect methods of fighting a fire.
11. What main points should be kept in mind when locating a firebreak?
12. How can you help prevent forest fires?
13. What are forest lookout towers and what are their purposes?
14. Explain how a fire is located using the lookout tower.
15. What are some things that you may do to prevent forest fires?
16. Name several of the common fire-fighting tools.
17. What part does the radio play in combating forest fires?
18. Explain how a firebreak is constructed.
19. What are the principal destructive forest insects in Alabama?
20. Describe the damage caused by bark beetles in the south.
21. How may active "brood" trees be identified?
22. What chemicals have been found to be most effective for bark beetles? How is it applied?
23. Explain the damage caused by the southern pine beetle.

24. How can this damage be identified?

25. What is the Ips Engraver Beetle and explain the damage caused by it.

26. How severe is black turpentine beetle damage in Alabama?

27. How may black turpentine beetle be identified?

28. Name several other destructive insects commonly found in Alabama forests?

29. Outline a control program for each of the insects mentioned in the above questions.

30. When are hardwood trees undesirable in Alabama forests?

31. Outline several control measures used on hardwoods.

32. What are the principal damaging effects caused by livestock in forests?

33. What percent of the forest fires in Alabama are caused by man?

34. How are these man caused fires generally started?

35. What is an incendiary fire?

36. What is meant by "mopping up"? Explain the procedure used.

37. Outline a disease control program for your community.

SUGGESTED LEARNING ACTIVITIES

1. Visit a local forest and examine the firebreaks that have been constructed.

2. Examine insect damages in a local forest.

3. Bring samples of insect damage to class and discuss it with other class members.

4. Suggest the organization of a local fire-fighting unit to assist in the control of forest fires.

5. If your school does not now operate a forestry demonstration plot, suggest to your instructor that one would be very helpful in teaching forestry.

SUGGESTED REFERENCES

1. Developing Farm Woodlands In Alabama, Alabama Department of Conservation, Division of Forestry, Montgomery, Alabama, and Alabama Department of Education, Division of Vocational Education, Montgomery, Alabama.

2. Manual of Southern Forestry, Weaver and Anderson, The Interstate, Danville, Illinois.

MEASUREMENTS IN FORESTRY

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. What information will a good survey provide?

2. How many linear feet make one chain?

3. Why is the chain a handy unit for measuring land?

4. How many square feet are contained in one acre of land?

5. How many pine trees should be left on one acre.

6. Name 3 accurate methods of determining the length of a line.

7. What is the bearing of a line running 123.5° from north?

8. What is the name given to the variation between true north and a magnetic north?

9. How may true bearings be read directly from a compass?

10. What essential information should survey notes contain?

11. What 3 methods may be used to determine the diameters of standing trees?

12. What is meant by DBH?

13. How is the volume of lumber measured as it comes out of the mill?

14. How does a volume table differ from a log rule?

15. Which log rule is most accurate for small diameter logs?

16. What is meant by merchantable height?

17. How does a talley sheet for standing timber differ from a talley sheet for sawlogs?

18. What do the following terms mean?
    A. Board feet
    B. Piece
    C. Cord
    D. Unit
    E. Cubic foot
    F. Linear foot

19. What is meant by cruising timber?

20. Explain the details that should be included in a timber sale agreement.

21. Give several sources of professional assistance that is available to the land owners who are interested in marketing his timber.

22. Why is it important to have a lawyer prepare a sales agreement when timber is sold?

SUGGESTED LEARNING ACTIVITIES

1. Prepare a list of forest product markets in your community.

2. Determine the length of your pace by pacing several established distances.

3. Make a survey of the boundary of the school campus or a local forest area using a compass and tape.

4. Determine the number of acres in the areas described in activity number 3.

5. Make a cruising stick and tape in the shop.

6. Measure several trees in the immediate area of the school and estimate the volume of each tree using volume tables.

7. Use an increment borer to determine the growth percentage of a tree.

8. Assist the other class members in making a cruise of a local stand of timber.

SUGGESTED REFERENCES

1. Developing Farm Woodlands In Alabama, Alabama Dept. of Conservation, Division of Forestry, Montgomery, Alabama, and Alabama Dept. of Education, Division of Vocational Education, Montgomery, Alabama.

2. Manual of Southern Forestry, Weaver and Anderson, The Interstate Danville, Illinois.

3. Forestry in the South, Mobley and Hoskins, Turner E. Smith and Co., Atlanta, Georgia.

CUTTINGS

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. Explain the situations under which cutting timber is normally done.
2. What is meant by the term harvest cutting?
3. What is meant by the term intermediate cutting?
4. Does clear cutting fall under the catagory of harvest cutting or intermediate cutting?
5. Under what situations is clear cutting recommended?
6. What is a seed tree?
7. How many seed trees should be left per acre?
8. What is a selection cutting?
9. What is a salvage cutting?
10. What is a sanitation cutting?
11. What is meant by "thinning"?
12. What precaution should be taken in making cuttings?
13. Under what situations should pruning be practiced?
14. What part should the market play in determining the type of cutting to be made?

SUGGESTED LEARNING ACTIVITIES

1. Visit with other members of the class a current cutting.
2. While visiting the cutting operation, determine the type of cutting that is being made.
3. Visit a wood lot with the other members of the class and determine the type of cutting needed. Mark the trees that should be removed.
4. Examine in the shop or local business establishment tools and equipment used in cutting operations.

SUGGESTED REFERENCES

1. Developing Farm Woodlands In Alabama, Ala. Dept. of Conservation, Div. of Forestry, Montgomery, Ala., and Ala. Dept. of Ed., Division of Vocational Education, Montgomery, Alabama.
2. Manual of Southern Forestry, Weaver and Anderson, The Interstate, Danville, Ill.
3. Forestry In the South, Mobley and Hoskins, Turner E. Smith and Co., Atlanta, Ga.

REFORESTATION

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. What is meant by natural reforestation?
2. What is meant by artificial reforestation?
3. How is natural reforestation accomplished?
4. Discuss the situations under which natural reforestation can be accomplished.
5. Discuss the selection and care of seed trees.
6. What is direct seeding?
7. Discuss the process of using wild seedlings.
8. What is the most important tree for lumber in the south?
9. How are pine seedlings grown in a nursery?
10. Discuss the procedure for selecting cones and extracting seed to be used in the nursery.
11. Where can seedlings be obtained in Alabama?
12. What are the advantages of reforestation by planting seedlings obtained in a nursery?
13. Sketch the steps needed to successfully plant a pine seedling using a dibble.
14. What are the advantages in planting seedlings with a tree planter?
15. Discuss the care of seedlings upon arrival at the planting site.
16. What species of pines are best suited for the different areas of Alabama?
17. What is the normal length of time needed to grow a sawlog from a pine seedling?
18. What age seedlings are recommended for planting?
19. What season of the year is planting normally done?
20. What preparation of the site is needed before planting?
21. What spacing is used on a new seedling stand?
22. What are the disadvantages of using a mechanical tree planter?

23. Discuss the care needed by the pine plantation after planting.

24. How often should the stand be inspected?

25. How are young pine seedlings fertilized?

SUGGESTED LEARNING ACTIVITIES

1. Select a seed tree near the school and along with other members of the class collect seed from this tree.

2. After collecting pine seed prepare and plant these seeds in a small plot.

3. Determine the germination percentage of the seed which have been planted.

4. Visit the nearest private, state, or federal nursery and observe the methods used. Prepare and present oral reports on the visit.

5. Visit and observe the operation of planting trees mechanically.

6. Prepare a dibble in the shop.

7. Order seedlings from the state nursery and plant either on your own farm or on the farm of another class member.

SUGGESTED REFERENCES

1. Developing Farm Woodlands In Alabama, Alabama Department of Conservation, Division of Forestry, Montgomery, Alabama, and Alabama Department of Education, Division of Vocational Education, Montgomery, Alabama.

2. Manual of Southern Forestry, Weaver and Anderson, The Interstate, Danville, Illinois.

3. Forestry in the South, Mobley and Hoskins, Turner E. Smith and Co. Atlanta, Ga.

MARKETING FOREST PRODUCTS

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. How does demand for forest products affect the market?

2. Should the owner of forest products consider the prospective market before selling his timber?

3. How does the condition of the stand affect the marketing of forest products?

4. What is a salvage cutting?

5. How would a salvage cutting affect the price obtained on the market?

6. What are the chief factors that affect the price of timber?

7. Name 4 common methods of marketing timber.

8. Aside from commercial forest products what necessary items are provided by the forest?

9. If it is necessary to sell when the price is low, which trees should be cut first?

10. List the steps that should be taken in selling timber.

11. At what diameters do trees cut for poles bring greater prices than trees cut for sawlogs?

12. Why is it necessary to prepare a sales contract when selling timber?

13. What is meant by a "lump" sale?

14. What is meant by "unit" sale?

15. What forest products are sold by the piece, by the cord, by the board foot, and by the linear foot?

16. What are the length of crossties for standard gauge railroad?

17. What are the minimum widths and thicknesses of crossties?

18. Explain what is meant by marketing by lumber talley.

19. What are the principle uses of cordwood?

20. What is the prospective market for cordwood?

21. In your judgement does Alabama have a bright future in the selling of forest products? Why?

22. Give some of the uses for 10 of the forest trees found in your community.

SUGGESTED LEARNING ACTIVITIES

1. Investigate the local prices of the forest products being marketed in your community.

2. Obtain the specifications from a local buyer for pulpwood, sawlogs, crossties, and poles.

3. Prepare a sales contract for sales by the lump and unit methods.

4. Visit one or more local forest product industry in your community and prepare an oral or written report on what you observed.

SUGGESTED REFERENCES

1. Developing Farm Woodlands In Alabama, Alabama Department of Conservation, Division of Forestry, Montgomery, Alabama, and Alabama Department of Education, Division of Vocational Education, Montgomery, Alabama.

2. Manual of Southern Forestry, Weaver and Anderson, The Interstate, Danville, Ill.

3. Forestry In The South, Mobley and Hoskins, Turner E. Smith and Co. Atlanta, Ga.

MULTIPLE USE OF FORESTS

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. What is meant by the term "multiple use of the forests"?

2. About how long has this idea been popular with the owners of woodlands?

3. What adverse effects would strict uses of the woods have on the production of wood products?

4. For what can the woods be used other than for the production of wood products?

5. How does the forest serve the cause of wildlife conservation?

6. Do the results of multiple use of the forest show that it is advantageous?

7. How does the care and production of the forest as a water shed affect the production of fish in the streams?

8. What are the advantages of having clear streams?

9. Should industry-using the forest encourage the use of their woodlands for recreational purposes?

10. Do you know of any industry that encourage the uses of their forests for recreational purposes?

11. What steps should a camper take to assist in the protection of the woodlands?

12. What affect does fire have on the recreational uses of the forest?

13. Do you know of any industry that is providing facilities for the public to use for the enjoyment of their woodlands?

14. Does public use of the woodland improve the attitude of the public toward caring for the woodlands?

SUGGESTED LEARNING ACTIVITIES

1. Prepare a set of rules on the use of the forest that would need to be observed by those using the forest for recreational purposes.

2. Visit a local wood using industry and discuss with them multiple use of their forest lands.

3. Discuss with the class ways and means of increasing the population of wildlife in the woods in your community.

SUGGESTED REFERENCES

1. Multiple Use of Forests, A progress Report, International Paper Co., Mobile, Alabama.

VT 000 380
Green, H.W.

A Specialized Course Outline for Advanced Vocational Agriculture Students in Agricultural Supply, Sales and Services.

Alabama State Dept. of Education, Montgomery. Agricultural Education Service
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DESCRIPTORS - *CURRICULUM GUIDES; *VOCATIONAL AGRICULTURE; *AGRICULTURAL SUPPLIES; *AGRICULTURAL SUPPLY OCCUPATIONS; *SALES OCCUPATIONS; SERVICE OCCUPATIONS; SECONDARY GRADES

ABSTRACT - Prepared by a district supervisor of vocational agriculture, this curriculum guide is for use in conducting a specialized course in agricultural supplies, sales and services for advanced vocational agriculture students. Objectives of the course are to train students for future employment in the field, to aid students in developing the personality traits and abilities needed in agricultural sales and services, and to assist students in developing a sense of responsibility through leadership activities in The Future Farmers of America (FFA). Some of the topics covered, in outline form, are: (1) career opportunities, (2) leadership training (FFA), (3) operation and maintenance of small power tools and equipment, (4) shop skills needed for sales and service personnel, (5) home and farm electrification, (6) agricultural salesmanship, (7) agricultural business procedures, (8) livestock feeds, fertilizers, and crop, lawn, and garden seeds sales and service, and (9) agricultural chemicals sales and services. Lists of instructional materials and supplies are also provided. (AW)

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A SPECIALIZED COURSE OUTLINE

FOR

ADVANCED VOCATIONAL AGRICULTURE STUDENTS

IN

AGRICULTURAL SUPPLY

SALES AND SERVICES

State of Alabama
Department of Education
A. R. Meadows - Superintendent
Vocational Division
Agricultural Education Service
Montgomery, Alabama

VT 00380

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Ala. 1966

AGRICULTURAL SUPPLY SALES AND SERVICE OCCUPATIONS

(A Specialized Vo-Ag Course Outline for Advanced Students)

Prepared By H. W. Green, District Supervisor
of Vocational Agriculture

Appreciation is expressed to the Center for Research and Leadership Development in Vocational and Technical Education, Columbus, Ohio, for furnishing much of the information used in developing this course outline.

Course Objectives

1. To train for future employment in the area of marketing and merchandising, agricultural supplies, equipment and services.
2. To assist students in developing the personality traits and abilities needed for success in the marketing and distribution of agricultural products and supplies.
3. To assist students in developing a sense of responsibility through leadership activities in the FFA.

Note: Students should receive basic information on the following subjects before entering this course: Livestock feeding, Soils, Crop production, Insect, disease, and pest control, Weed control, Agricultural mechanics, especially welding, machinery maintenance, electricity and safety, Insurance and taxes, Conservation

TEACHING	EST. DAYS	REFERENCES
I. Career Opportunities in Agricultural Sales and Services		
a. Changes in agriculture 1. Local businesses that handle agricultural supplies 2. Functions of these businesses 3. What their employees do 4. Demand for workers in local agricultural businesses 5. Qualifications for employment in these local businesses		Yellow pages of telephone book Handbook of Agricultural Occupations, Hoover, Interstate, Danville, Ill.
b. Training, experience, and competencies needed for employment in following agricultural businesses: 1. Agricultural machinery 2. Agricultural supplies and equipment 3. Livestock and poultry 4. Crops, forestry and soil conservation		Agriculture In Our Lives, Krebs, Interstate, Danville, Ill.

UNIT	EST. DAYS	REFERENCES
5. Ornamental Horticulture 6. Recreation and wildlife 7. Agricultural services		
c. Classify local businesses in one of 7 above categories listing training needs and employment opportunities in each		
d. Classify occupations in above businesses into major fields of activity listed below: 1. Managerial 2. Professional 3. Technical 4. Clerical 5. Sales 6. Service		
e. Products handled by agricultural supply businesses: 1. Livestock, small animal, and pet feeds 2. Field, garden, and lawn seeds 3. Fertilizers 4. Agricultural chemicals - herbicides, pesticides, fungicides, insecticides 5. Petroleum and petroleum products 6. Small equipment - hardware, lawn mowers, garden tools, lawn tools and equipment for gardens, lawns and the home. Visit local businesses and determine what agricultural supplies and services are handled.		
f. Laboratory experiences 1. Identify and list the agricultural businesses in the community 2. Field trips to business and industry to learn working conditions, employment opportunity and other important considerations found in agricultural sales and service occupations		
II. <u>Leadership (FFA)</u>		
a. Public speaking		
b. Developing good personal work habits (neatness, dress, etc.)		<u>Leadership Training and Parliamentary Procedure for FFA</u>, Gay and Jackson, Prentice Hall, Englewood Cliffs, N. J.
c. Assuming responsibility - FFA Committee Assignments, etc.		
d. Introductions		
e. Cooperative activities		
f. Participation in contests and awards		<u>Agriculture In Our Lives</u>, Krebs, Interstate, Danville, Ill.

UNIT	EST. DAYS	REFERENCES
III. Operating, repairing and maintaining small power and other tools and equipment connected with agricultural sales and service centers		Farm Mechanics text and Handbook, Phipps and others, Interstate, Danville, Ill.
a. Types of equipment		
b. Criteria for selection of equipment		
c. Use of equipment		
d. Maintenance and repair of equipment (small gasoline engine unit suggested)		All About Small Gasoline Engines, Purvis Goodheart-Wilcox Co., Chicago, Ill.
e. Safety practices		
f. Conditioning and maintenance of hand tools		
g. Laboratory experiences 1. Visit equipment dealers and compare different makes 2. Arrange for equipment dealers to demonstrate their equipment 3. Repair used equipment 4. Experience in repair, adjusting on overhauling household appliances, garden tractors, etc. 5. School shop experience in a variety of areas		
IV. Shop skills needed for sales and service center employees (The more complicated jobs are not listed but would be referred to as mechanics)		
a. Replacing electrical cords, replacing fuses, tubes, etc.		
b. Cutting and replacing broken glass		
c. Assembling merchandise received "knocked down"		Small Gasoline Engines Manual - Briggs and Stratton
d. Checking rental tools in and out		
e. Sharpening rental or customer tools		
f. Testing and replacing plugs, points, and condensors		The Farm Shop, Wakeman - Macmillan Co., New York
g. Testing for compression and grinding valves, if necessary, on small gasoline engines		
h. Testing electric motors for shorts		Farm Mechanics Text and Handbook, Phipps and others, Interstate, Danville, Ill.
i. Disassembling and cleaning electric motors		
j. Completely overhaul small gasoline engine		
k. Sharpen and adjust or replace teeth on chain saws		

UNIT	EST. DAYS	REFERENCES
l. Use a paint sprayer and keep track of small parts in the service center		
m. Order, unpack and keep track of small parts in the service center		
n. Laboratory experiences should be provided in the school shop and in work experience programs		
V. Calculating building material needs		Modern Farm Buildings, Ashby and Others, Prentice Hall, Englewood Cliffs, N. J.
a. Parts of a structure		
b. Determining lumber needs and cost		
c. Determining concrete needs and cost		Other Shop Books previously listed
d. Determining masonry needs and cost		
e. Determining roofing needs and cost		
f. Determining milk work needs and cost		
g. Determining paint needs and cost		
h. Determining hardware needs and cost		
i. Determining needs and costs of remodeling		
j. Laboratory experiences 1. Get local prices and calculate the cost of constructing a small building		
VI. Farm and home electrification		Farm Mechanics Text and Handbook, Phipps and Others, Interstate, Danville, Ill.
a. Materials and supplies		
b. Wire sizes and uses		
c. Selecting, adjusting and repairing labor saving equipment		Other shop books previously listed
d. Selecting and installing light fixtures		
e. Selecting and installing heating and cooling		Electricity on the Farm, Alabama Power Company, Birmingham, Ala.
f. Selecting switches and wall plugs		
g. Laboratory experiences 1. Demonstrate electrical controls, relays and switches 2. Layout and wire for single pole switch, light and convenience outlet		

UNIT	EST. DAYS	REFERENCES
3. Wire a small building		
VII. Relations between persons engaged in agricultural sales and services		Sales Horizons, Haas and Perry, Englewood Cliffs, N. J.
a. Understanding people 1. Individual differences 2. Student self evaluation 3. Choosing an occupation 4. Training and skills needed in different levels of production and management 5. Desirable personality traits of employees 6. Relationship between education and occupational levels		Handbook of Agricultural Occupations, Hoover, Interstate, Danville, Ill.
b. Laboratory experiences 1. Have students evaluate themselves and identify occupations which offer them prospective employment 2. Invite five employees who are rated successful by their employers to talk to the class on "What business firms want from their employees and what are the most important personal characteristics of a business employee?" 3. Arrange practice interviews for students with prospective employers. Ask for a report on the interview from cooperating employer		An Introduction to Agricultural Business and Industry, Weyant and Others, Interstate, Danville, Ill.
VIII. Agricultural Salesmanship		Sales Horizons, Haas and Perry, Prentice Hall, Englewood Cliffs, N. J.
a. Opportunities		
b. Becoming a salesman		
c. Developing the right sales personality		Handbook of Agricultural Occupations, Hoover, Interstate, Danville, Ill.
d. Types of customers		
e. Making the approach to the sale		
f. Fundamentals of presenting a product		An Introduction to Agricultural Business and Industry, Weyant and Others, Interstate, Danville, Ill.
g. Types of markets		
h. Functions of the different type markets		
i. Training and experience needed to operate each type		
j. Displaying the products		
k. Advertising		
l. Keeping inventories up-to-date		

UNIT	EST. DAYS	REFERENCES
m. Laboratory experiences 1. Arrange for class to observe a successful agricultural salesman in action meeting a customer 2. Visit an agricultural supply center and observe how products are displayed 3. Have students give demonstrations on proper sales techniques		
IX. Organization and functions of agricultural businesses		
a. Importance of business to a community 1. Supplies material needed in agriculture 2. Supplies services needed 3. Supplies information about agricultural products and techniques 4. Provides jobs 5. Supports schools, etc. through payment of taxes		Farm Business Management, Chastain, Yeager and McGraw, Auburn, Ala. Chapter VII
b. Functions of an agricultural supply business 1. Provides supplies and service 2. Involves form, time, place and price problems		
c. Purposes of agricultural business 1. Processing 2. Packaging 3. Transportation 4. Storing 5. Grading 6. Financing 7. Selling		
d. Types of agricultural supply businesses 1. Individual proprietorship 2. Partnership 3. General-business-type corporation 4. Cooperative-type corporation 5. Characteristics of above types 6. Advantages and disadvantages of each of above types 7. How each type is set up 8. Taxes paid by each		
e. Laboratory experiences 1. Have a panel of local agricultural supply businessmen appear before the class to explain the functions of their businesses		
X. Agricultural Business Procedures		
a. Importance of complete and accurate records 1. Sales ticket 2. Profit and loss statement 3. Balance sheet showing annual financial condition		

UNIT	EST. DAYS	REFERENCES
b. Analysis of day's business 1. Amount of cash taken in 2. Amount of merchandise sold 3. Amount of sales tax collected		
c. Importance and use of credit 1. Customer use of credit 2. Business firms use of credit 3. Long range credit 4. Credit policies 5. Time payment purchases 6. Collection policies		
d. Determination of selling price 1. Overhead costs 2. Fixed costs - insurance, taxes, etc. 3. Merchandising cost 4. Reasonable profit 5. Conditions affecting overhead costs a. Overstocking b. Price drops c. Interest d. Insurance e. Taxes f. Transportation g. Wages and salary 6. Business forms a. Purchase order b. Receiving records c. Bills of lading d. Invoices for payment		Farm Business Management, Yeager and Others, Auburn, Ala., Chapter VI An Introduction to Agricultural Business and Industry, Weyant and Others, Interstate, Danville, Ill. The Farm Management Handbook, Hall and Others, Interstate, Danville, Ill.
e. Inventory		
f. Receiving and storing merchandise		Secure business forms locally
g. Stock control policies		
h. Laboratory exercises - laboratory exercises 1. Secure supply of sales tickets and have students practice filling them out 2. Field trip to local businesses to observe business procedures		
XI. Feeds, Sales and Service		
a. Basic economics of livestock feeding 1. Major objective in feeding 2. Feed costs 3. Rate of gain and feeding efficiency 4. Losses from improper feeding		Livestock and Poultry Production, Bundy and Diggins, Prentice-Hall, Englewood Cliffs, N. J.

UNIT	EST. DAYS	REFERENCES
b. Understanding animal nutrition 1. Nutrients required by livestock 2. How livestock use basic nutrients 3. Nutritional requirements by classes of farm animals 4. Importance of feed additives a. Antibiotics b. Hormones c. Tranquilizers d. Others		Approved Practices in Feed and Feeding, Cassard, Interstate, Danville, Ill. Better Feeding of Livestock, U.S.D.A. Farmers Bulletin No. 2052, Washington, D. C.
c. Understanding the different livestock feeds and their value 1. Common terms a. Roughage b. Concentrate c. Others 2. Carbohydrates and sources 3. Protein and sources 4. Fats and sources 5. General rules in feeding minerals 6. Sources and values of minerals 7. Nutritive ratio		
d. Understanding the regulations in the formulating, labeling and using of feeds 1. Federal regulations 2. Regulations on medicated feeds 3. What feed labels must include 4. Feed laws required by states 5. Laboratory exercises a. Have students gain experience in reading and understanding feed labels		
e. Formulating grain rations 1. Factors to consider in formulating feeds 2. Steps in formulating ration 3. Practice balancing rations		
f. Methods of preparing feeds 1. Reasons for preparing feeds 2. Preparation processes a. Grinding b. Crushing c. Mixing d. Pelleting e. Crumbling f. Cooking g. Soaking h. Fermenting, sprouting 3. Methods of feed preparation for different classes of livestock 4. Terms a feed store employee should know		

UNIT	EST. DAYS	REFERENCES
g. Methods and trends in feed merchandising 1. Steps in merchandising 2. Information needed by salesman 3. New trends in feed merchandising a. Pick-up and delivery service b. Bulk handling c. Increased farm grinding and mixing 4. Services rendered and merchandising methods		
h. Laboratory exercises 1. Students given experience in: a. Delivering feed b. Making farm calls with salesman c. Answering customer questions and making sales d. Arranging displays e. Livestock feeding by developing a livestock enterprise 2. Collect feed and feed additives 3. Calculate nutritive requirements of various classes of livestock		
XII. <u>Crop, Lawn and Garden Seeds Sales and Service</u>		<u>Handbook of Agricultural Occupations</u>, Hoover, Interstate, Danville, Ill.
a. Some available jobs 1. Country store clerk 2. Farm hardware and equipment employee 3. Feed mill employee 4. Farm cooperative service store employee 5. Farm equipment and supply salesman 6. Grain elevator (feed mill) employee 7. (Truck driver - salesman) 8. Garden center employee 9. Landscape gardener 10. Golf course and lawn worker		<u>Seeds, U.S.D.A. Yearbook</u>. 1961 Washington, D.C.
b. List local businesses serving in area of seeds, plants and service		<u>An Introduction to Agricultural Business and Industry</u>, Weyant and Others, Interstate, Danville, Ill.
c. Job description of jobs in above businesses		
d. Study of plants and seeds offered for sale and how used by customers -- see landscaping information		
e. Reproduction and source of seeds and plants		
f. Factors in plant material production 1. Pure line selection 2. Hybridization 3. Mutations 4. Improved seed production		<u>Crop Production in the South</u>, Klingman, John Wiley & Sons, New York, N. Y.
g. To become familiar with variety names and characteristics		

UNIT	EST. DAYS	REFERENCES
h. To be able to interpret information on tags, labels and containers		
i. Laws regarding labeling of seed packages		
j. Services performed by supply stores 1. Seed treatment 2. Chemical weed control 3. Lawn service 4. Landscaping 5. Insect and disease control		
k. Laboratory experiences 1. Campus field trips 2. Work experience with local business 3. Production experience in nurseries, greenhouses or on the farm		
XIII. <u>Fertilizers, Sales and Service</u>		
a. To develop knowledge and abilities a salesman needs to: 1. Interpret a soil test report 2. Determining basic fertilizer needs of soils 3. Make accurate fertilizer recommendations 4. Understand the basic principles of fertilizer manufacture and plant operations		<u>Crop Production In The South</u>, Klingman, John Wiley & Sons, New York, N. Y. <u>Soils, An Introduction To Soils And Plant Growth</u>, Donahue, Prentice-Hall, Englewood Cliffs, N. J. <u>Our Land and Its Care</u>, fourth edition, National Plant Food Institute, Washington, D. C. <u>The Fertilizer Handbook</u>, National Plant Food Institute, Washington, D. C. <u>Using Commercial Fertilizers</u>, McVickar, Prentice-Hall, Englewood Cliffs, N. J.
b. Economic value of fertilization in crop production		
c. Relation of plant growth to availability of plant food		
d. Primary and secondary plant nutrients		
e. Trace elements needed		
f. Environmental factors affecting crop yield 1. Water 2. Light 3. Temperature 4. Soil conditions 5. Insects and diseases 6. Weeds		
g. How fertilization is affected by basic physical, chemical, and biological properties of soils		
h. Characteristics of commonly used fertilizer materials 1. Materials available for three major plant foods; nitrogen, phosphorus and potassium a. Characteristics of the major nitrogen materials		

UNIT	EST. DAYS	REFERENCES
b. Liquid nitrogen fertilizers		
c. Natural nitrogen materials		
d. Characteristics of the major phosphorus materials		
e. Characteristics of potash materials		
2. Forms fertilizer is sold in:		
a. Liquids		
b. Dry		
c. Gaseous		
3. Fertilizer formulas		
a. The meaning of numbers on the bag		
b. Ratios and grades		
c. State laws regarding grades		
4. Determining fertility needs		
a. Soil sampling		
b. Field test plots		
c. Interpreting soil test results		
5. Making fertilizer recommendations		
6. Methods of applying fertilizer		
a. Rate		
b. Time		
c. Placement		
7. Principles of fertilizer manufacture		
a. Use of ammonia		
b. Types of fertilizer plants		
c. Selecting proper ingredients		
8. Fertilizer application equipment		
a. Varieties of application equipment		
b. Fertilizer applicators		
c. Row distributors and drills		
d. Machines with fertilizer attachments		
e. Advising customer of the type of applicator to buy		
f. Care of applicators		
9. Merchandising fertilizer		
a. Importance of customer relations		
b. Areas for effective sales		
1. New technology		
2. Effective advertising		
3. Strengthen sales ability		
4. Enthusiasm for the product being sold		
g. Laboratory exercises		
1. Repair and operation of fertilizer applicators		
2. Panel to discuss trends		
3. Practice taking soil sample and interpreting results		
4. Determine how much crop production must increase by the year 2000 to feed our population		

UNIT	EST. DAYS	REFERENCES
XIV. Agricultural Chemicals - Sales and Service		
a. General background needed for sales and service in agricultural chemicals		Crop Production In The South, Klingman, John Wiley and Sons New York, N. Y.
b. Importance of agricultural chemicals in modern agriculture		
c. Crops needing use of agricultural chemicals		Alabama Experiment Station and Extension Service Publications, Auburn, Ala.
d. Pests in the area and damage done		
e. Insects and diseases and their control		
f. Responsibility involved in recommending correct pesticides		
g. Types of pesticides and application 1. Herbicides (weeds) a. Contact materials b. Growth regulators c. Soil sterilants 2. Insecticides a. Stomach poisons b. Contact poisons c. Repellents d. Attractants		
h. Chemical insecticides and use		
i. Types of fungicides		
j. Rodenticides		
k. Nemotocides		
l. Mixing pesticides		
m. Recommending pesticides 1. Solid forms 2. Liquid forms 3. Gas		
n. Time of application		
o. Methods of application		
p. Safety with pesticides		
q. Laboratory exercises 1. Review pesticide labels 2. Practice in recommending and selling pesticides		

UNIT	EST. DAYS	REFERENCES
3. Collect specimens of weeds, insects and diseases that are of economic importance 4. Develop a table listing damage, costs and control for different pests 5. Field trip to a firm that sells agricultural chemicals		
XV. Miscellaneous Agricultural Supplies and Small Equipment - Sales and Service		Handbook of Agricultural Occupations, Hoover, Interstate, Danville, Ill.
a. Understanding of retail sales and service work associated with miscellaneous supplies and small equipment sold in agricultural businesses		
b. Becoming familiar with the wide range of supply and small equipment which may be carried by the agricultural supply business		An Introduction to Agricultural Business and Industry, Weyant and Others, Interstate, Danville, Ill.
c. Determining what lines to carry 1. Opportunity to make a greater profit 2. Customers demand it 3. It will meet competition		
d. Common lines of products 1. Veterinary supplies and equipment 2. Large animal supplies and equipment 3. Poultry supplies 4. Agricultural hardware 5. Basic hardware 6. Small equipment such as garden equipment 7. Tires, batteries, oils, and accessories 8. Lumber 9. Builders supply materials 10. Pet supplies and equipment 11. Outdoor living equipment 12. Athletic and sports equipment 13. Other miscellaneous items		Farm Mechanics Text and Handbook, Phipps and Others, Interstate, Danville, Ill.
e. Characteristics of miscellaneous small equipment and supplies 1. Dehorners a. Electric b. Paste c. Blade or shears 2. Castrating equipment a. Elastrators b. Burdizzo emasculatomes c. Knife 3. Animal health products 4. Veterinary supplies a. Plastic syringes b. Balling guns c. Hypodermic syringes		

UNIT	EST. DAYS	REFERENCES
5. Large animal supplies a. Horn weights b. Bridles, horseshoes, mastitis test kits 6. Field and poultry fencing a. Size b. Kinds, gauge, posts, gates, electric fence controllers 7. Agricultural hardware a. Pruning shears b. Forks, garden tools, etc. 8. Roofing a. Metal b. Asphalt 9. Garden tractors a. Walking b. Riding c. Attachments 10. Lawn mowers a. Reel type b. Rotary 11. Rototillers a. Walking b. Riding 12. Brush cutters a. Saw blade b. Bush hog 13. Chain saws a. Electric b. Gasoline		
f. Shop skills needed for repair of small gasoline engines, electrical equipment and other items servicemen repair		
g. Laboratory exercises 1. Field trip on large general farm or agricultural supply center 2. Employment of some students in a farm supply store 3. Experience in repair, adjusting or overhauling household appliances, garden tractors, etc. 4. School shop experiences in a variety of areas		

References: Principal references are found by each job. References used in developing the unit were taken largely from the recommended book list.

Sources of Other Suggested Instructional Materials and References for the Outline

Instructional Materials

Posters

1. How Soil pH Affects Availability of Plant Nutrients, poster, National Plant Food Institute, 1700 K Street, Washington, D. C. 20006. Price $.17.

2. Lime Means More Money for You, poster, National Plant Food Institute, 1700 K Street, Washington, D. C., 20006. Price $.10.

Filmstrips, Slides and Films

1. "Dynamic Careers Through Agriculture," 16 mm film, 28 minutes. Farm Film Foundation, 1425 H Street, Northwest, Washington, D. C., 20005.

2. "Feeding Farm Animals," film, 19 minutes, black and white. Washington, D. C.: Motion Picture Service, Office of Information, USDA.

3. "First the Seed," 16 mm film, 27 minutes, color and sound, Associated Seed Growers, Inc. Modern Talking Picture Service, 3.E. 54th St., New York.

4. "Getting Along With Others," 16 mm film, 29 minutes. Business Education Films, 5113 16th Avenue, Brooklyn, New York.

5. National Plant Food Institute, 1700 K Street, Washington, D. C. 20006, has the following films and slide sets available: "Nutrient Deficiency Symptoms in Plants," 35 mm, 2" x 2" colored slides, price $.25 each.

   "How to Take a Soil Sample," 10 - 35 mm, 2" x 2" colored slides, price $2.50.

   "Making the Most of a Miracle," 27 minutes, color, free, return postage.

   "The Big Test," 15 minutes, color, free, return postage.

   "What's in the Bag," 17 minutes, color, free, return postage.

   "Weather or Not," 22 minutes, color, free, return postage.

   "The Land's Legacy and Promise," 27 minutes, color, free, return postage.

6. "Personal Qualities for Job Success," Oklahoma State University Film Library, 16 mm. Stillwater, Oklahoma.

7. "Points about Pesticides" and "Facts about Pesticides." Colored filmstrips with 33 1/3 recordings. Order from Manufacturing Chemists' Association, Inc., 1825 Connecticut Avenue, N. W., Washington, D. C.

8. "The Rumen Story," film, 24 minutes, color. Ralston Purina Company. Checkerboard Square, St. Louis, Missouri.

9. "A Step Ahead--on Careers in Agriculture," 16 mm color film, 14 minutes. Your local New Holland Machinery dealer.

10. "A Tree is Born", 29 minutes, color or black and white, Motion Picture Service, Office of Information, USDA. Washington, D. C.

Instructional Supplies

1. Representative tags or labels from:

   a. feed sacks

   b. seed sacks

   c. fertilizer bags

   d. chemical containers

2. Different samples of:

   a. Feed--dairy, poultry, rabbit, horse, pet, cattle

   b. Seeds--field crop, vegetable, and ornamental plants

   c. Fertilizer

   d. Insecticides

   e. Herbicides

   f. Fungicides

3. Empty quart oil cans showing different A. P. I. service classifications

4. Oil samples of different viscosities

5. Farm and garden supply catalogs such as:

   a. Nasco's Farm Catalog

   b. Montgomery Ward's Farm Catalog

VT 000 381
Green, H.W.
Agriculture Supplies, Sales and Services (A Student Study Guide). Agribusiness Education Series.

Alabama State Dept. of Education, Montgomery. Agricultural Education Service
MF AVAILABLE IN VT-ERIC SET.
PUB DATE - Mar66 21p.

DESCRIPTORS - *STUDY GUIDES; *VOCATIONAL AGRICULTURE; *AGRICULTURAL SUPPLY OCCUPATIONS; *SALES OCCUPATIONS; *SERVICE OCCUPATIONS; AGRICULTURAL SUPPLIES; EQUIPMENT; MARKETING; MERCHANDISING

ABSTRACT - This guide is intended primarily for use by vocational agriculture students interested in employment in the area of marketing and merchandising, agricultural supplies, equipment and services, but not enrolled in a special course of instruction in this field. Contents include questions to be answered, suggested learning experiences, and suggested references on the following: (1) Career Opportunities in Agricultural Supplies, Sales, and Services, (2) Relations between Persons Engaged in Agricultural Sales and Services, (3) Agricultural Salesmanship, (4) Organization and Functions of Agricultural Businesses, (5) Agricultural Business Procedure, (6) Feeds-Sales and Service, (7) Crop, Lawn and Garden Seeds - Sales and Service, (8) Agricultural Chemicals, and (9) Miscellaneous Agricultural Supplies and Small Equipment. The guide is also suitable for use as a supervised study guide by teachers and students is a special course in agricultural supply, sales, and service. (AW)

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AGRIBUSINESS
EDUCATION
SERIES

AGRICULTURE SUPPLIES SALES AND SERVICES

(A Student Study Guide)

STATE DEPARTMENT OF EDUCATION
VOCATIONAL EDUCATION DIVISION
AGRICULTURAL EDUCATION SERVICE
MONTGOMERY, ALABAMA

VT 003381

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FOREWORD

This study guide has been prepared to assist the interested student who wishes to prepare for future employment in the area of marketing and merchandising, agricultural supplies, equipment and services. It is intended primarily as a guide for the individual who may not be in a special course of instruction in this field. However, it is designed so that it can be used as a supervised study guide by the teacher and students in a special course in agricultural supply, sales, and service. It may also be helpful to the teacher in his over-all program of instruction in vocational agriculture.

March, 1966
Prepared by H. W. Green
District Supervisor

T. L. Faulkner, State Supervisor
Vocational Agricultural Education
State Department of Education
Montgomery, Alabama

ERIC

CAREER OPPORTUNITIES IN AGRICULTURAL SUPPLIES, SALES AND SERVICES

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. Why is the study of agriculture important to everyone?
2. What is meant by the statement, "farming is a business"?
3. Define (a) farming, (b) agriculture.
4. What are the recent changes in farming regarding capital required, mechanization, skills, knowledge needed for success, etc.?
5. What businesses in this area handle local supplies?
6. What services for customers do these businesses perform?
7. What qualifications are needed to work in local agricultural businesses?
8. Is there a demand for trained workers in these businesses?
9. List some things you should be capable of doing if employed in the following agribusiness firms:
   a. Agricultural machinery
   b. Agricultural supplies and equipment
   c. Livestock and poultry
   d. Ornamental horticulture
10. What do you look for in an occupation?
11. What is meant by the term agribusiness?
12. What are some of the occupations in agribusiness?
13. What effect will increased population have on the future growth of agriculture and opportunities for careers in agriculture?
14. What basic education and training will be needed by future employees in modern agriculture?
15. What are the major products handled by agricultural supply businesses?

SUGGESTED LEARNING ACTIVITIES

1. Determine the off-farm agricultural businesses which serve the community. Yellow pages of the telephone book will serve as a good reference.
2. Classify the above businesses according to whether they deal in sales or service or both.
3. Study census information which indicates number employed in various agribusiness firms. Assuming of five percent annual turnover of employees how many occupational openings would there be in a year?

SUGGESTED REFERENCES

1. Handbook of Agricultural Occupations, Hoover, Interstate, Danville, Ill.

2. Agriculture In Our Lives, Krebs, Interstate, Danville, Ill.

3. An Introduction to Agricultural Business and Industry, Weyant, Hoover and McClay, Interstate

4. Your Future In Agriculture, Hutchison, Richard Rosen Press, 29 East 21st Street, New York, New York 10010

RELATIONS BETWEEN PERSONS ENGAGED IN AGRICULTURAL SALES AND SERVICES

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. Name 10 qualities of a desirable personality.

2. What physical characteristics are desirable for employees?

3. Why is honesty most often rated as one of the most desirable traits desired in an employee?

4. List the personality traits you admire most in others.

5. Name at least ten (10) factors that must be considered before selecting an occupation.

6. Name the job possibilities and the usual amount of education and/or experience needed in each of the areas of activity listed below.
   a. Professional
   b. Technical
   c. Managerial
   d. Clerical
   e. Production
   f. Sales
   g. Service

SUGGESTED LEARNING ACTIVITIES

1. Evaluate yourself on the desirable personality traits listed above.

2. Interview an employer in a local business firm on "What business firms want from their employees and what are the most important personal characteristics of a business employee?"

SUGGESTED REFERENCES

1. Sales Horizons, Haas and Perry, Prentice Hall, Inc., Englewood Cliffs, N.J.

2. An Introduction to Agricultural Business and Industry, Weyant and Others, Interstate, Danville, Ill.

3. Handbook of Agricultural Occupations, Hoover, Interstate, Danville, Ill.

AGRICULTURAL SALESMANSHIP

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. Name the three main divisions or ingredients that make up salesmanship.
2. Explain two ways of learning to sell.
3. What is a good sales attitude?
4. What are the right learning methods?
5. How do you become a "Scientific Salesman"?
6. What is the first thing a salesman has to sell?
7. Name ten qualities of the personality that a successful salesman must have.
8. Which quality smoothes out the differences of opinion before an argument starts?
9. Which quality does a smile indicate?
10. Which quality is indicated when the salesman puts "everything he has" into the sale?
11. Which quality causes good first impressions.
12. A feeling of ease is created in the customer by which quality?
13. Why is the quality of memory so important to the salesman and his potential customers?
14. Explain the importance of the quality of application.
15. Name other personal qualities that are important for a successful salesman.
16. What do we mean by a buying interest?
17. Explain what is meant by the interest of economy.
18. Explain what is meant by the interest of performance.
19. Which one of these 8 interests would you say is the most important?
20. What are the two types of customers?
21. What do we mean by the term "approcah to the sale"?
22. What are several characteristics of a good approach?
23. How do you, the salesman, attract favorable attention?

24. What is the importance of appearance in getting the attention of the customer?

25. Where does your enthusiasm play a part in the sales approach?

26. Why must the salesman plan a dynamic and enthusiastic sales approach?

27. What is one of the most important fundamentals of successful selling?

28. What is "product knowledge"?

29. How is learning a product a continuous process?

30. What are two basic methods of getting information about the prospect?

31. What answers do salesmen need about prospects?

32. What is meant by "feature-by-feature" selling?

33. Is there any set time for closing a sale?

34. What are some good indications that a customer is ready to buy?

35. List some good do's and don'ts to follow in closing a sale.

36. Why is being sincere so important in gaining the confidence of the customers?

37. What happens when a customer is high-pressured?

38. What is meant by over-selling?

39. What is meant by being persistent?

40. What percentage of the salesmen get 75 to 80% of all the sales?

41. Rather than sell "price" to a customer what should you sell?

42. Advertising is broken down into three main areas, name them.

43. What is meant by outside advertising?

44. Describe news media in outside advertising.

45. What type of advertising is done through radio?

46. What is point-of-purchase advertising?

47. What does point-of-purchase advertising consist of?

48. How are window displays used in advertising sales items?

49. Name several things that need to be considered when setting up the arrangement of the window display.

50. What is meant by a central theme?

51. Why would you not display plow bottoms, insecticides, anti-freeze, and cultivator sweeps on the same table?

52. How frequently should a display be changed?

53. What is meant by a special promotion?

54. How are special promotions organized?

SUGGESTED LEARNING ACTIVITIES

1. Visit an agricultural supply center and observe how products are displayed.

2. Arrange to visit with a successful salesman and observe sales techniques.

3. Participate in FFA sales of nursery shrubs, fruit trees, etc.

SUGGESTED REFERENCES:

1. Sales Horizons, Haas and Perry, Prentice-Hall, Englewood Cliffs, N. J.

2. Popular Sales Techniques, Series, International Harvester Company, Chicago, Illinois

3. Ornamental Horticulture For Vocational Agriculture In Alabama, a reference unit, 1966

4. Handbook of Agricultural Occupations, Hoover, The Interstate, Danville, Ill.

5. Marketing Agricultural Supplies, Equipment, Services, a reference unit, 1965. Thach Hall, Auburn, Ala.

ORGANIZATION AND FUNCTIONS OF AGRICULTURAL BUSINESSES

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. What are the functions (or services rendered) performed by an agricultural business? Name at least 10.

2. What are the advantages and disadvantages of the four basic types of business ownership listed below:
   a. The individual proprietorship
   b. The partnership
   c. The general-business-type corporation
   d. The cooperative-type corporation

3. What is meant by the term "business"?

4. List seven functions of marketing.

5. What are the tax advantages of a cooperative, if any?

6. What is the main function or purpose of an agricultural supply business?

7. Why is storage of seasonal supplies a problem to business?

8. Discuss the following types of credit needed by a business and give sources of each:
   a. Long-term credit
   b. Short-term credit

9. What main purposes are the above terms of credit used for by a business?

10. What are some of the common risks that are involved in operating a business?

SUGGESTED LEARNING ACTIVITIES

1. Become familiar with the management and ownership structure of one type of agribusiness in the community.

2. Study an agricultural business and observe methods used.

3. List the functions performed by a local, well-known business.

SUGGESTED REFERENCES

1. Farm Business Management, Chastain and Others, Chapter VII

2. An Introduction to Agricultural Business and Industry, Weyant and Others, Interstate

3. Sales Horizons, Haas and Perry, Prentice-Hall, Englewood Cliffs, N. J.

4. Handbook of Agricultural Occupations, Hoover, The Interstate, Danville, Ill.

AGRICULTURAL BUSINESS PROCEDURE

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. Why are complete and accurate records important to a business?
2. What records are used to determine profit and loss?
3. How are sales slips used in determining amount of goods sold?
4. What records are used in analyzing a day's business?
5. How is selling price determined?
6. What is meant by overhead costs? Fixed costs?
7. What conditions affect overhead costs?
8. What business forms are used in most local businesses?
9. Why is an inventory important?
10. What procedure is followed in receiving and storing merchandise?
11. Discuss the importance and use of credit by:
    a. Customers
    b. Business firms
12. Compare records kept in supervised practice record book with those kept by most businesses.
13. What interest rate does a customer usually pay for
    a. Short time credit
    b. Long time credit?

SUGGESTED LEARNING ACTIVITIES

1. Secure sales tickets and practice filling them out.
2. Interview manager of a local business and discuss business procedure used.

SUGGESTED REFERENCES

1. Farm Business Management, Yeager and Others, Auburn, Ala.
2. An Introduction to Agricultural Business and Industry, Weyant and Others, Interstate, Danville, Ill.
3. The Farm Management Handbook, Hall and Others, Interstate, Danville, Ill.
4. Managing for Greater Returns, Phillips, Agri-Research, Inc., Manhattan, Kansas
5. Guides for Profit Planning, Small Business Administration, Superintendent of Documents, U.S. Government Printing Office, Washington, D. C.

FEEDS - SALES AND SERVICE

STUDENT STUDY GUIDE

(Use separate sheets of paper for answering questions.)

1. Why is good feeding of livestock important?
2. What percent of the total cost of production is feed?
3. What is the relation between rate of gain and profit?
4. How do animals use feed?
5. How do animals use the following nutrients (1) carbohydrates, (2) fats, (3) proteins, (4) minerals, (5) vitamins
6. What are the nutritional requirements of various classes of farm animals?
7. What is the meaning of the following terms: (1) ration, (2) supplement, (3) anti-biotics, (4) protein, (5) carbohydrates, (6) fats, (7) fiber, (8) roughage, (9) silage, (10) minerals, (11) digestive nutrients
8. What is meant by feed analysis? Why is it important that a livestock farmer understand the analysis of his feeds?
9. Describe the differences in digestive systems of various farm animals. How does this affect the kind and amount of feed needed?
10. What is a protein supplement and when should it be used?
11. Balance a ration for (1) hogs, (2) beef cattle, (3) dairy cattle
12. Describe recommended methods of feeding (1) dairy cattle, (2) chickens, (3) hogs, (4) beef cattle
13. Why is buying feed in bulk becoming more popular?
14. What are the methods of preparing and mixing feeds?

SUGGESTED LEARNING ACTIVITIES

1. Calculate the nutritive requirement of various classes of farm animals.
2. Collect feed tags and learn to interpret the feed analysis shown.
3. Gain experience by:
   (1) delivering feed, (2) making farm calls with salesmen, (3) collect feed and feed additives
4. Visit a feed store and observe feeds most commonly sold.

SUGGESTED REFERENCES

1. Livestock and Poultry Production, (Second edition) Bundy and Diggins, Prentice-Hall, Inc., Englewood Cliffs, N. J.

2. Approved Practices In Feed and Feeding, Cassard, Interstate, Danville, Ill.

3. Better Feeding of Livestock, U.S.D.A. Farmers Bulletin No. 2052, Washington, D. C.

4. Agriculture In Our Lives, Krebs, The Interstate, Danville, Ill.

CROP, LAWN AND GARDEN SEEDS, SALES AND SERVICE

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. Why will an employee in an agricultural supply business need a knowledge of several agricultural products?

2. What are the usual steps in advancing to a managerial position in such businesses.

3. Give the description and nature of work, educational qualifications and how to enter and advance in the following occupations:

	*Page
Country store clerk	118
Farm Hardware and Equipment Store Employee	120
Feed Mill Employee	121
Farm Cooperative Service Store Employee	123
Farm Equipment and Supply Salesman	126
Grain elevator (feed mill) employee	127
(Truck Driver - Salesman)	127
Garden Center Employee	198
Landscape Gardener	206
Golf Course and Lawn Worker	199

4. Make a copy of the following table, fill in the spaces left blank and put it in your notebook.

*Refers to page number in current issue of Handbook of Agricultural Occupations, Hoover, The Interstate, Danville, Ill.

OCCUPATIONAL INFORMATION ON AGRICULTURAL SALES AND SERVICE OCCUPATIONS

Job	Regular Income?	Regular Hours?	Offers Opportunity For Advancement?	Travel Required	Fringe Benefits	Desirable Educational Requirements
Country Store Clerk						
Feed Mill Employee						
Farm Cooperative Service Store Employee						
Farm Equipment and Supply Salesman						
Grain Elevator (Feed Mill) Employee						
(Truck Driver - Salesman)						
Garden Center Employee						
Landscape Gardener						
Golf Course and Lawn Worker						

Rate yourself on the following qualifactions needed in certain agricultural firms: This should serve as a guide in selecting occupation and in your future study.

Area of Information	Competent	Fair Knowledge	Need to do additional Study
Knowledge of products offered for sale and usage which can be made of these products by the purchaser			
Understanding of the types and usage of various plant materials			
Familiar with factors in plant material production that benefits customers			
Familiar with variety names and characteristics			
Able to interpret information on tags or labels on containers			
Familiar with services offered by a firm which require use of special equipment			
Can compare the strong and weak points of the products offered by the employee's company and its competitors			
The ability to find product information quickly from catalogs and other sources			
Understanding of the basic economics of home beautification, crop, and garden production in terms of costs and expectations			
Ability to help customers solve their problems through advice given related to plant production			

SUGGESTED LEARNING ACTIVITIES

1. Work in a retail outlet or local business in either sales or service capacities. This may be part time during the school year or full time during the summer.

2. Work in the merchandising of products of the school farm, greenhouse, or individual home projects.

3. Work in the production or marketing phases of farming or commercial gardening.

4. When actual experience is not possible, use observations, study of local business and class reports.

SUGGESTED REFERENCES

1. Handbook of Agricultural Occupations, Hoover, the Interstate, Danville, Ill.

2. An Introduction to Agricultural Business and Industry, Weyant and Others, Interstate, Danville, Ill.

3. Crop Production In The South, Klingman, John Wiley & Sons, New York, N.Y.

4. Seeds, U.S.D.A. Yearbook, 1961. Washington, D. C.

AGRICULTURAL CHEMICALS

STUDENT STUDY GUIDE

(Use separate sheets of paper for answering questions.)

1. Why is the use of chemicals important in modern agriculture?

2. What major pests are found in the area and damage done?

3. List the major crops grown in the area and give some of the common insects attacking them. Give at least one recommended control for each insect listed.

4. List the most common diseases damaging plants grown in the area with a recommended control for each.

5. What is the most commonly used herbicide for control of weeds in: (a) corn, (b) cotton, (c) other major crops in your area?

6. Where can manufacturers recommendation be found for each product sold?

7. Why is it important to practice all safety precautions in the use of chemicals?

8. Give examples of "stomach poison" types of insecticides and what they are used for.

9. Give examples of "contact poison" insecticides and what they are used for.

10. What are the recommended chemicals for control of nematodes?

11. Weeds are classed annuals, biennials, and perennials. Define these terms.

12. Insects are classified according to mouth parts into chewing and sucking insects which type of insecticide would be used for each?

13. Health hazard insects are flies, mosquitos, fleas and roaches. Give a recommended control for each.

14. Diseases of plants can be classified as bacteria, viruses and fungi. Give an example of each and recommended control measures.

15. What is a recommended control for rodents?

16. Develop a time table of pest control for major pests in the area.

17. What general methods of pest control may be used?

SUGGESTED LEARNING ACTIVITIES

1. Collect specimens of plants which show damage from plant diseases. Try to identify each disease and determine control measures.

2. In newspapers and farm magazines read articles describing the damage to crops from diseases and insects.

3. Start a collection of insects commonly found in your community.

4. Plan a control program for some insect which is damaging a field crop, garden crop or some other plants on your land. If possible carry out this control program.

5. Visit a local dealer of farm chemicals and find out which chemicals are most commonly bought and what they are used for.

SUGGESTED REFERENCES

1. Agriculture In Our Lives, Krebs, The Interstate, Danville, Ill.

2. Crop Production In The South, Klingman, John Wiley and Sons, New York, N.Y.

3. Handbook of Alabama Agriculture, 1965 Edition, Alabama Extension Service, Auburn, Alabama

4. Weed Control: As A Science, Klingman, John Wiley and Sons, New York, N.Y.

5. Fruit Growing, Schneider and Scarborough, Prentice-Hall, Inc., Englewood Cliffs, N. J.

6. Publications available from various chemical companies.

Miscellaneous Agricultural Supplies and Small Equipment

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. Since more than 50 percent of the business transactions of a farm supply business deal in fertilizer and feed student should study these two subjects in detail if they are not taught to the entire group.

2. Visit a local supply store and find out what major items are sold besides feed, seed, and fertilizer.

3. What determines when a new product is added to a store?

4. What are the most common veterinary supplies and equipment sold?

5. Study agricultural supply catalogues and learn the descriptions of the better quality products.

6. Analyze manufacturers' catalogs and learn to distinguish between the high quality and inferior products.

7. Use the following table to evaluate your qualifications and need for additional training to become fully qualified.

	HIGHLY COMPETENT	COMPETENT	NEED FURTHER TRAINING	NOT PART OF MY DUTIES
1. To what degree do I know the different kinds of miscellaneous supplies?				
2. To what degree do I possess the "product knowledge" to intelligently answer inquiries pertaining to miscellaneous supplies?				
3. Can I properly handle situations beyond my product knowledge by referral to superiors or the service department?				
4. Do I know the store policy with respect to service and can handle properly a complaint because of poor service?				
5. Can I properly fill out a service order including entries for parts and labor?				
6. To what degree am I competent to perform service activities as follows:				
a. Replacing electrical cords, replacing fuses, tubes, etc.				

	HIGHLY COMPETENT	COMPETENT	NEED FURTHER TRAINING	NOT PART OF MY DUTIES
b. Cutting and replacing broken glass				
c. Assembling merchandise received "knocked down"				
d. Checking rental tools in and out				
e. Sharpening rental or customer tools				
f. Testing and replacing plugs, points, and condensors on small gasoline engines				
g. Testing for compression and grinding valves, if necessary, on small gasoline engines				
h. Testing electric motors for shorts				
i. Disassembling and cleaning electrical motors				
j. Completely overhaul small gasoline engine				
k. Sharpen and adjust or replace teeth on chain saws				
l. Use a paint sprayer and keep track of small parts in the service center				
m. Order, unpack, and keep track of small parts in the service center				
n. Keep tools in order to do the usual housekeeping in the shop properly				
o. Others				

SUGGESTED INSTRUCTIONAL MATERIALS AND REFERENCES

Instructional materials

1. Catalogs, house, and trade magazines available through major manufacturers of the different products.

2. Service work order forms, may be secured from local business firms or mimeographed for students use.

3. Telephone kit and tape recorder for role playing.

SUGGESTED REFERENCES

1. Hoover, Norman K. Handbook of Agricultural Occupations: The Interstate Printers and Publishers, Inc., Danville, Illinois, 1963.

2. Logan, William and Moon, Helen M. Facts About Merchandise. Englewood Cliffs, New Jersey: Prentice Hall, 1962.

3. Robinson, O. P.; Blackler, W. L.: Logan, W. B. Store Salesmanship. Englewood Cliffs, New Jersey: Prentice-Hall, 1965.

4. An Introduction to Agricultural Business and Industry, Weyant and Others, The Interstate, Danville, Ill.

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ABSTRACT - Designed primarily for use by agriculture students interested in ornamental horticulture but not enrolled in a specialized course in this field, this study guide covers the following subjects: (1) occupational opportunities in ornamental horticulture, (2) identification of ornamental horticulture plants, (3) plant propagation, (4) uses of soil and other plant-growing media, (5) production of floral crops, (6) production of nursery plants, (7) control of plant insects and diseases and other plant disorders, (8) construction, maintenence and use of plant-growing structures, (9) merchandising, (10) landscape design and planning, and (11) establishment and care of lawns and turf. Units contain questions to be answered, suggested learning activities, and references. (AW)

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Ornamental Horticulture For Vocational Agriculture In Alabama

(A Student Study Guide)

STATE DEPARTMENT OF EDUCATION
A. R. Meadows
State Superintendent of Education

DIVISION OF VOCATIONAL EDUCATION
AGRICULTURAL EDUCATION SERVICE
MONTGOMERY, ALABAMA

VT 00382

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FOREWORD

This study guide has been prepared to assist the interested student who wishes to study ornamental horticulture. It is intended primarily as a guide for the individual who may not be in a special course of instruction in this field. However, it is designed so that it can be used as a supervised study guide by the teacher and students in a special course in ornamental horticulture. It may also be helpful to the teacher in his over-all program of instruction in vocational agriculture.

February, 1966

T. L. Faulkner, State Supervisor
Vocational Agricultural Education
State Department of Education
Montgomery, Alabama

ERIC

EXPLORING OCCUPATIONAL OPPORTUNITIES IN ORNAMENTAL HORTICULTURE

STUDENT STUDY GUIDE

(Use separate sheets of paper for answering questions.)

1. Define what is meant by ornamental horticulture.

2. Name several divisions that offer employment opportunities in the field of ornamental horticulture.

3. Name the job possibilities in each of the areas of activity listed below.

   a. Professional
   b. Technical
   c. Managerial
   d. Clerical
   e. Production
   f. Sales
   g. Service

4. Name at least ten (10) factors that must be considered before selecting an occupation.

5. Describe the opportunities for advancement in the field of ornamental horticulture.

6. Why is it so important to consider whether or not you are personally suited for a career in ornamental horticulture?

7. Name several personal questions that will help you to determine if you are personally suited for a career in ornamental horticulture.

8. Name several good general indications that could serve as a guide in selecting a career.

9. Give information that would be helpful in deciding if you would like to be employed in each of the following jobs.

   a. Greenhouse worker
   b. Nursery worker
   c. Garden Center Employee
   d. Golf Course Employee
   e. Assistant Groundskeeper
   f. Parks employee

10. Make a copy of the following table, fill in the spaces left blank and put it in your notebook.

OCCUPATIONAL INFORMATION ON SOME ORNAMENTAL HORTICULTURAL JOBS

Job	Regular Income?	Regular Hours?	Outdoor or Indoor Work?	Offers Opportunity for variety?	A great deal of travel required?	Stability of Residence?	Fringe Benefits?	Work with Others?	Desirable Educational Requirements
Greenhouse Worker									
Nursery Worker									
Garden Center Employee									
Golf Course Employee									
Assistant Grounds-keeper									
Parks Employee									

SUGGESTED LEARNING ACTIVITIES

1. List all ornamental horticulture occupations in your community.

2. Write up a job description of each occupation found.

3. Visit local horticulture businesses found in the community.

4. Practice job application interviews with other students.

5. Discuss job possibilities with at least one horticultural business manager in the community.

SUGGESTED REFERENCES

X 1. Ornamental Horticulture For Alabama Vocational Agriculture, a reference unit, 1966.

2. Introductory Horticulture, Christopher, E. P., McGraw-Hill, New York, 1958.

3. Plant Propagation: Principles and Practices, Hartman and Kester, Prentice-Hall, 1959.

X 4. Horticulture Science, Janick, Jules, W. F. Freeman Company, San Francisco, 1963.

X 5. Handbook of Agricultural Occupations, Hoover, Norman K., Interstate Publishers and Printers, Inc., Danville, Ill., 1964.

X 6. Exploring Occupational Opportunities in Ornamental Horticulture, a teaching unit, Center for Vocational and Technical Education, The Ohio State University Columbus, Ohio, May, 1965.

IDENTIFYING ORNAMENTAL HORTICULTURAL PLANTS

Student Study Guide

(Use separate sheets of paper for answering questions)

1. Give two good reasons why scientific names of plants are composed of Greek and Latin terms.

2. Why is it necessary to use scientific names in plant identifications?

3. Why is it so necessary for a person preparing for employment in ornamental horticulture to be able to accurately identify plants?

4. List several ways that leaves, stems, flowers, and fruits can be used in plant identification.

5. Define the following terms:

Annual	deciduous plant
biennial	ground cover
perennial	vine
herbaceous plant	tree
woody plant	shrub
cool-season plant	edible plant
hardy plant	simple leaf
tender plant	compound leaf
foliage plant	leaflet
nursery plant	small fruit
bedding plant	poisonous plant
evergreen	warm-season plant
conifer	

6. Draw a simple and a compound leaf.

7. Collect 50 stem and leaf specimens of ornamental plants within the community and identify each.

8. After collecting your 50 specimens, start learning to identify one additional plant each school day for the rest of the year. This activity will enable you to learn all the plants that are used in your area. List these plants with their characteristics in your student notebook.

9. There are good reasons for ornamental horticulture employees' knowing how to identify plants. Name them.

SUGGESTED LEARNING ACTIVITIES

1. Participate in a spelling match on ornamental horticulture terms.

2. Review before the class plant characteristics of the specimens in your collection.

3. Diagram the different leaves on a chalk board and discuss the characteristics with the class.

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1. Ornamental Horticulture For Alabama Vocational Agriculture, A reference unit, 1966.

2. Horticultural Science, Janick, Jules, W. H. Freeman Company, San Francisco, California, 1963.

3. Modern Biology, Moon, Thurman, Paul Mann, and James Otto, Henry Holt and Company, 1956.

4. Identifying Horticultural Plants, a teaching unit, Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio, 1965.

5. Plants Native to Alabama For Landscape Use, a listing, McElwee, E. W., Auburn University, Auburn, Alabama.

6. List of Ornamental Plants with Key and Characteristics, Fisher, Homer S., and Orr, Henry P., Department of Horticulture, Auburn University, Auburn, Alabama.

PLANT PROPAGATION

STUDENT STUDY GUIDE

(Use separate sheets of paper for answering questions.)

1. What is meant by plant propagation?
2. What are the two methods of plant propagation?
3. How is a seed formed?
4. Discuss the use of seed in the propagation of plants.
5. How are seed classified?
6. Discuss several basic principles that should be remembered in getting good germination of seed.
7. What is meant by asexual reproduction of plants?
8. What means of propagation are included in the asexual method?
9. What type of wood do soft wood cuttings come from?
10. Describe the procedure for getting a soft wood cutting.
11. What procedure should be followed after getting a soft wood cutting?
12. Describe the management of soft wood cuttings after the rooting process.
13. Make soft wood cuttings and root them at school or at home.
14. What is layering?
15. Name and describe six types of layering.
16. How should the soil be prepared around the parent plant before layering?
17. Make drawings of the different methods of layering.
18. What is meant by "root cuttings"?
19. How is the technique of root cutting used to propagate plants?
20. What is grafting?
21. What is meant by scion, stock, cambium, callus?
22. Why is grafting used for propagation purposes?
23. Name the factors necessary for a successful graft.

24. What are the important factors in selecting scion wood?

25. What season of the year is best for grafting?

26. Name several different types of grafts.

27. Describe the procedure for making a cleft graft.

28. Draw a diagram of a cleft graft.

29. How are hardwood cuttings used in the propagation of plants?

30. Describe the details involved in making a hardwood cutting.

31. Name several plants that can be propagated by hardwood cuttings.

32. Describe the leaf bud cutting and how it is used.

33. Discuss the use of leaf cuttings in propagation of plants.

34. How are bulbs propagated?

35. What is meant by a "root inducing substance"?

36. How are these substances used?

37. Discuss propagation by "division".

38. Discuss how "budding" is used in the propagation of ornamental plants.

39. Describe the procedure for potting plants.

40. How is compost prepared for use in potting plants?

41. Discuss the use of tin cans by the nurserymen.

42. Discuss the details involved in fertilizing young ornamental plants.

SUGGESTED LEARNING ACTIVITIES

1. Demonstrate seed treatment.

2. Demonstrate seed propagation with seed brought from home.

3. Practice propagation of plants by budding, grafting, cutting and layering.

4. Draw plans for home propagation structures.

SUGGESTED REFERENCES

1. Ornamental Horticulture For Alabama Vocational Agriculture, a reference unit, 1966.

2. Plant Propagation: Principles and Practices, Hartman and Kester, Prentice-Hall, 1959.

3. Propagating Horticultural Plants, a teaching unit, Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio, 1966.

4. The Ball Red Book, 11th edition, staff, George J. Ball, Inc., West Chicago, Illinois.

USING SOIL AND OTHER PLANT GROWING MEDIA

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. Define soil.
2. What is a soil profile?
3. Describe the soil layers giving their texture, origin, depth, etc.
4. How is soil formed?
5. What part does organic matter play in soil formation?
6. How does organic matter affect the condition of the soil?
7. How does the amount of organic matter in soil determine the name of the soil?
8. What determines the color of soil?
9. Is "color" a good indicator of the richness of the soil?
10. How are soil particles named?
11. Can soil be identified by touch? If so, how?
12. Why is moisture or soil water so important to plant growth?
13. Discuss what happens to rain when it falls to the earth's surface.
14. What effect does organic matter have on the water-holding capacity of soil?
15. What is capillary water?
16. Describe the movement of capillary water in the field.
17. How do soil type and sunlight affect plant watering practices?
18. Why should the ornamental horticulturist be concerned with soil and moisture?
19. What is a soil mixture?
20. Why is it necessary for the ornamental horticulturist to use soil mixtures?
21. Name some typical soil mixtures used for plants under different conditions.
22. List the characteristics of a good soil mixture.
23. What equipment is needed to properly mix soil?

24. Describe the procedure used in mixing soil.

25. What is the function of a mulch?

26. What effects do mulches have if they become mixed with the soil?

27. Describe inorganic or processed mulches.

28. Describe organic mulch material.

29. Name several materials used as mulches. Classify them as inorganic or organic properties.

30. Why is it necessary to add fertilizer nutrients to the soil when growing horticultural plants?

31. Name fertilizer nutrients needed in large amounts by plants and give their source. Do the same for nutrients needed in small amounts.

32. List the effects of the following nutrients on plants. Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Sulfur, Boron, Iron, Copper, and Zinc.

33. What basic conditions must be met if plant nutrients are to be available to the plant?

34. What can the horticulturist do to avoid harming the seed and foliage of plants while using fertilizer?

35. Discuss the different forms of fertilizer and their uses in the greenhouse or field.

36. Discuss soil organisms and their place in the soil.

37. How can harmful soil organisms be controlled?

38. List three ways of controlling harmful soil organisms.

39. How is soil prepared for steaming?

40. Discuss the use of steam.

41. Discuss fumigation of soils to kill harmful soil organisms.

42. After visiting your local pesticide dealer, discuss several of the recommended soil fumigants.

43. What are the precautions to be observed while using soil fumigants?

44. Compare steam and chemical soil sterilization.

45. List several plant growing media that can be used either alone or in mixtures with soil. Discuss each of these media, giving the advantages, limitations and specific uses of each.

46. Why is it necessary to add nitrogen fertilizer when using undecayed material in mixtures or as a mulch.

SUGGESTED LEARNING ACTIVITIES

1. Make a collection conditioning materials.

2. Set up a plant experiment with each of the soil materials.

3. Make a collection of the different mulching materials.

4. Prepare a soil mixture.

5. Assist in determining the needs of and fertilizing the school lawn and shrubs.

6. Demonstrate the use of various soil fumigation materials.

SUGGESTED REFERENCES

1. Ornamental Horticulture For Alabama Vocational Agriculture, a reference unit, 1966.

2. Handbook of Alabama Agriculture, 7th edition, Cooperative Extension Service, Auburn University, Auburn, Alabama.

3. Plant Propagation: Principles and Practices, Hartman and Kester, Prentice - Hall, Inc., Englewood Cliffs, N. J.

FLORAL CROP PRODUCTION

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. How did the floral crop industry gets its beginning?
2. Name at least 7 divisions or specialized groups within the floral crop industry.
3. What are several of the skills needed by the producer and handler of floral crops?
4. How did greenhouses enter into the picture in floral crop production?
5. Were greenhouses a great advantage in floral crop production?
6. What are the 5 factors that effect plant growth the most?
7. At what time of the day is greenhouse temperature measured.
8. How are plants classified in accordance with cool or warm greenhouses?
9. Name several warm greenhouse crops.
10. Name several cool greenhouse crops.
11. How can temperature in the greenhouse best be controlled?
12. How can ventilation of the greenhouse best be accomplished?
13. Describe evaporative cooling.
14. Even with automatic controls why is it necessary that the operator always be alert and know what his temperature requirements are?
15. What are the two forms of water in the greenhouse?
16. What is the primary aim in watering properly in the greenhouse?
17. Why is it necessary to prevent splashing water onto the leaves during the watering process?
18. What are the two broad general methods of applying water in the greenhouse?
19. Describe subsurface watering.
20. How does the type of soil effect the frequency of watering?
21. What is the importance of light to plant growth in the greenhouse?
22. Name several ways of controlling the amount of light in the greenhouse?

23. What is the function of soil in the greenhouse?

24. What is the best type of soil for the greenhouse?

25. What is the best method to determine the fertilizer needs of plants in the greenhouse?

26. What is meant by pH?

27. If a soil has a pH of 7, is it acid or alkaline?

28. Name a way of correcting the soil pH if it is too acid.

29. What is meant by house plants?

30. Name several common house plants and give the cultural practices required for each.

31. What is meant by pot plant production?

32. What is the best soil for pot plant production?

33. How are pot plants fertilizer?

34. How are plants growing in pots watered?

35. Name several types of pots that can be used for pot plants.

36. Why is the size of the pot so important to the growth of the plant?

37. How is the soil prepared for potting plants?

38. Name several pot plants sold by florist in Alabama and give the cultural practices of each.

39. What is meant by cut flower production?

40. Why is it necessary for the producer of cut flowers to produce only one type of plants?

41. Name specific plants grown for cut flowers and discuss their cultural practices.

42. What is meant by pinching floral plants?

43. Develop a suitable rotation plant that can be used by the greenhouse operator who produces floral crops.

44. What is meant by a terrarium?

45. Develop a terrarium to be used in your classroom at school.

46. Develop a terrarium to be used at home.

47. What is the importance of carbon dioxide?

48. How can additional carbon dioxide in the atmosphere of the greenhouse improve plant growth?

SUGGESTED LEARNING ACTIVITIES

1. Set up a crop rotation plan for producing flowers in your community.

2. Demonstrate transplanting flowering plants.

3. Identify the common cut-flowers in the community.

4. Demonstrate potting flowering plants.

5. Demonstrate production of cut-flowers, pot plants, and bedding plants.

SUGGESTED REFERENCES

1. The Ball Red Book, 11th Edition, staff, George J. Ball, Inc., West Chicago, Illinois.

2. Propagating Horticultural Plants, a teaching unit, Center for Vocational and Technical Education, The Ohio State University, Columbus, Ohio, 1966.

3. Plant Propagation, Hahlstede and Haber, John Wiley and Sons, Inc., New York, N. Y.

4. Plants and Gardens, series, staff and others, Brooklyn Botanic Garden, Brooklyn 25 N. Y.

5. Home and Garden, series, U.S.D.A., U.S. Government Printing Office, Washington, D. C.

6. Commercial Flower Forcing, Laurie, Kiplinger and Nelson, McGraw - Hill Book Company, Inc., New York, N. Y.

7. Ornamental Horticulture For Alabama Vocational Agriculture, a reference unit, 1966.

NURSERY PLANT PRODUCTION

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. What is the importance of the production of nursery plants to the horticulturist?
2. How does this phase of plant production differ from that of floral crop production?
3. What types of plants are normally produced in the nursery?
4. How are nursery crops normally propagated?
5. How is the ground to be used for setting nursery crops prepared?
6. What method is used for planting young seedlings in the nursery?
7. What is meant by liner stock?
8. How are plants processed that are received at the nursery from commercial producers?
9. What is meant by heeling in?
10. What is meant by a heeling pit?
11. How is the process of heeling in accomplished?
12. Describe the process of preparing the hole for setting a new plant.
13. What is the importance of water to the new plant in the nursery?
14. How often should young plants be watered in the nursery?
15. How much of the new nursery plant should be pruned at the time of setting?
16. Describe this pruning process.
17. How are mulches used in the nursery?
18. What determines the type of mulch to be used.
19. Name several mulches available in your area.
20. What precautionary measures should you observe in using mulch material?
21. How can a nitrogen deficiency brought on by the use of a mulch be corrected?
22. How are weeds controlled in the nursery plot?

23. Discuss the use of chemical weed control in the nursery plot.

24. What method should be used to determine the fertilizer need of the young nursery plants?

25. Give the general recommendation for applying fertilizer in the nursery.

26. Describe the process of digging and preparing nursery plants for shipment or sale.

27. Describe the method used in setting out nursery plants in the landscape.

28. Why is it necessary to allow 6" clearance on all sides of the roots of the new landscape plant?

29. Why is it necessary to brace young trees with stakes?

30. What is the advantage of producing nursery plants in containers?

31. What types of containers can be used for this production?

32. Discuss the factors involved in selecting a location for a container grown nursery.

33. What are the factors involved in planting the layout of the container nursery?

34. Discuss several materials now being used in the nursery for container plants.

35. Discuss the preparation of soil mixtures for container grown plants.

36. What makes the control of temperature so important in the container nursery?

37. How are container grown plants watered?

38. Discuss light requirements for container grown plants.

39. How are container grown plants best fertilized?

40. What is the danger of minor element deficiency in producing container grown plants?

41. Discuss the possibility of a combination field and container grown nursery.

SUGGESTED LEARNING ACTIVITIES

1. Dig and ball field grown plants.

2. Grow several plants in containers.

3. Demonstrate chemical weed control with ornamental plants.

4. Demonstrate transplanting shrubs.

SUGGESTED REFERENCES

1. Fertilizer and Lime For Ornamentals, Circular P-26, Cooperative Extension Service, Auburn University, Auburn, Ala.

2. The U.C. System, Baker, Kenneth F., California Agricultural Experiment Station, University of California, Berkeley, California.

3. Handbook of Alabama Agriculture, 7th edition, Cooperative Extension Service, Auburn University, Auburn, Ala.

4. Production of Woody Ornamentals In Containers, a paper, Faruta, Horticulture Department, Auburn University, Auburn, Ala.

5. Be Your Own Nurseryman, Scharff, M. Barrows and Company, New York, N. Y.

6. Ornamental Horticulture For Alabama Vocational Agriculture, a reference unit, 1966.

CONTROLLING PLANT INSECTS, PLANT DISEASES, AND OTHER PLANT DISORDERS

STUDENT STUDY GUIDE

(Use separate sheets of paper for answering questions.)

1. Name several causes of trouble in the production of ornamental plants.

2. What tool can be used as a very effective aid in determining the cause of trouble in the greenhouse?

3. Name 6 different groups under which the common trouble exist.

4. What is a main misconception among growers concerning the application of fertilizer to ornamental plants?

5. Is fertilizer ever injurious to plants?

6. What damage is caused to plants by the use of natural gas?

7. How can this damage be prevented?

8. How is natural gas damage detected?

9. How is ethylene gas damage detected?

10. How is sulfur dioxide gas damage detected?

11. Describe mercury damage in the greenhouse.

12. What must one know about the use of 2, 4-D in the greenhouse?

13. Describe generally the life cycle of insects.

14. Give the following information on each of the insecticides listed below: preparation, application, insects killed

aramite - 2	endrin	OMPA	VC-13
chlordane	lindane	parathion	
DDT	malathion	systox	
dieldrin	methyle bromide	tedion	
dithio	nemagon	TEPP	

15. Describing a chewing insect and the damage that he does to plants.

16. Describe each of the following insects and give the control used.

ants	Fuller's Rose weevil	roaches	white grubs
blister beetles	grasshoppers	rose midge	wireworms
black vine weevil	leaf-cutting bees	rose stem sawfly	
corn borer	leaf minors	slugs & snails	
corn-ear worm	leaf rollers	sow bugs & pill bugs	
cutworm	millipedes	springtail	
earthworm	orchid weevil	strawberry root worm	
		symphlids	
		termites	

17. Describe a piercing-sucking insect.

18. Describe each of the following piercing -sucking insects and give the control measures used.

aphids & plant lice	greenhouse orthezia	scale insects
broad mite	greenhouse white fly	spittle bug
bulb mites	leaf hopper	tarnished plant bug
chrysanthemum gall midge	mealy bugs	
cyclamen mite	red spider mite	

19. What is a rasping-sucking insect?

20. Describe each of the rasping-sucking insects and give the control measure used.

thrips	Foliar, or leaf nematode
meadow, or root-lesion, nematode	bees
dragger nematode	

21. What does one do to effectively control mice, rats and sparrows in the greenhouse?

22. What are the principal causes of plant diseases?

23. Describe a bacterial disease.

24. Describe a fungus disease.

25. Describe a virus disease.

26. What is the general relationship between the environment of the plant and the control of diseases on that plant?

27. Give the preparation, application, and use of the following fungicides:

arasan	dithane	parzate
bichloride of mercury	fermate	semesan
bordeaux mixture	manate	spergon
captan	ceresan	sulfer
cuprinol	omazene	terraclor
cuprocide	pano-drench	

28. Describe each of the following fungus diseases and give the control measure used.

damping-off	mildews	stem and root rots
leaf or flower blight	rusts	canker
stem blight	wilts	
leaf or flower spot	stunt	

29. Describe and give the control measure for each of the following bacterial diseases.

Wilts	fasciation	leaf spots
stem and root rots	galls	

30. Describe and give the control measure for each of the following virus diseases.

mosaic	yellows	crinkle
streak	stunts	

31. What are the things to look for in getting a power sprayer for use in the greenhouse?

32. Give the points that should be considered in mixing spray materials for use in the greenhouse.

33. Why is it so important that sprayers are cleaned thoroughly after each use?

34. What is the best method to use in cleaning the sprayer?

35. What are the advantages of using a high-pressure sprayer?

SUGGESTED LEARNING ACTIVITIES

1. Study the common insects and sketch label several.

2. Prepare a pest control calendar for lawn and nursery.

3. Assist in conducting an ornamental pest control project in the community.

4. Practice safety precautions in mixing chemicals.

5. Demonstrate proper use and care of small sprayers and dusters.

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5. Plant Disease Handbook For Alabama, Circular P-40, Cooperative Extension Service, Auburn University, Auburn, Ala.

6. Handbook of Alabama Agriculture, 7th edition, Cooperative Extension Service, Auburn University, Auburn, Alabama.

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CONSTRUCTING, MAINTAINING, AND USING PLANT GROWING STRUCTURES

STUDENT STUDY GUIDE

(Use separate sheets of paper for answering questions.)

1. What is the main purpose for using plant growing structures in the production of ornamental plants?

2. What is a plant growing structure?

3. Name several plant growing structures.

4. What is a coldframe?

5. Why is it called a coldframe?

6. What season of the year is the coldframe used?

7. What can the coldframe be used for in the early spring, late spring, summer, fall, and winter?

8. Describe the ideal location for a coldframe.

9. What materials are used in the construction of coldframes?

10. What types of wood are best suited for the construction of coldframes?

11. Is there any damage involved in the treatment of wood for coldframe use?

12. Give the general specifications for building a coldframe.

13. How can the following be provided for in the coldframe?

    a. ventilation
    b. sunlight
    c. shade
    d. water
    e. severe cold

14. What is a hotbed?

15. What is most generally used for heating hotbeds?

16. Why is manure no longer used?

17. What is a hotcap?

18. How are hotcaps used in the production of plants?

19. What is a lathhouse?

20. What is the purpose of a lathhouse?

21. What is a clothhouse and how is it used?

22. What is meant by a sash greenhouse?

23. How is a sash greenhouse similar to a regular greenhouse?

24. How are greenhouses most generally heated?

25. Describe how steam heat is used in the greenhouse.

26. Describe how forced air is used for heating the greenhouse.

27. Describe the use of hot water for heating the greenhouse.

28. What are the advantages and disadvantages for each of the systems of heating used?

29. How are greenhouses generally cooled?

30. How are greenhouses ventilated?

31. List the equipment needed in the operation of a greenhouse.

32. What is a bench?

33. How are benches constructed?

34. What are the advantages and disadvantages of using benches in the greenhouse?

35. How is the height of a bench determined?

36. How is the arrangement and width of a bench determined?

37. What are the different types of greenhouse structures?

38. What material other than glass are used on greenhouses?

39. How are lathhouses most generally constructed?

40. What is used in the construction of a clothhouse?

41. How is a sash greenhouse constructed?

42. Why is it necessary to understand glazing in constructing greenhouses?

43. What materials are used in glazing greenhouses?

44. What is a bar cap?

45. Describe the procedure for cutting glass and other material in the maintenance of the greenhouse.

SUGGESTED LEARNING ACTIVITIES

1. Draw plans for greenhouse, hotbed, and coldframe.

2. Demonstrate the use of the coldframe and hotbed.

3. Make a list of equipment needed in a greenhouse.

4. Assist in constructing a hotbed and coldframe for school use.

SUGGESTED REFERENCES

1. Commercial Flower Forcing, Laurie, Kiplinger, Nelson, McGraw-Hill Book Company, Inc., New York, N. Y.

2. Greenhouse Construction and Heating, USDA.

3. Hotbeds and Coldframes, USDA.

4. Be Your Own Nurseryman, Scharff, Barrows and Co., New York, N. Y.

5. Ornamental Horticulture For Alabama Vocational Agriculture, a reference unit, 1966.

MERCHANDISING HORTICULTURAL PLANTS AND SUPPLIES

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. Name the three main divisions or ingredients that make up salesmanship.
2. Explain two ways of learning to sell.
3. What is a good sales attitude?
4. What are the right learning methods?
5. How do you become a "Scientific Salesman"?
6. What is the first thing a salesman has to sell?
7. Name ten qualities of the personality that a successful salesman must have.
8. Which quality smoothes out the differences of opinion before an argument starts?
9. Which quality does a smile indicate?
10. Which quality is indicated when the salesman puts "everything he has" into the sale?
11. Which quality causes good first impressions.
12. A feeling of ease is created in the customer by which quality?
13. Why is the quality of memory so important to the salesman and his potential customers?
14. Explain the importance of the quality of application.
15. Name other personal qualities that are important for a successful salesman.
16. What do we mean by a buying interest?
17. Explain what is meant by the interest of economy.
18. Explain what is meant by the interest of performance.
19. Which one of these 8 interests would you say is the most important?
20. What are the two types of customers?
21. What do we mean by the term "approach to the sale"?
22. What are several characteristics of a good approach?

23. How do you, the salesman, attract favorable attention?

24. What is the importance of appearance in getting the attention of the customer?

25. Where does your enthusiasm play a part in the sales approach?

26. Why must the salesman plan a dynamic and enthusiastic sales approach?

27. What is one of the most important fundamentals of successful selling?

28. What is "product knowledge"?

29. How is learning a product a continuous process?

30. What are two basic methods of getting information about the prospect?

31. What answers do salesmen need about prospects?

32. What is meant by "feature-by-feature" selling?

33. Is there any set time for closing a sale?

34. What are some good indications that a customer is ready to buy?

35. List some good "do's and don'ts to follow in closing a sale.

36. Why is being sincere so important in gaining the confidence of the customers?

37. What happens when a customer is high-pressured?

38. What is meant by over-selling?

39. What is meant by being persistent?

40. What percentage of the salesmen get 75 to 80% of all the sales?

41. Rather than sell "price" to a customer what should you sell?

42. Advertising is broken down into three main areas, name them.

43. What is meant by outside advertising?

44. Describe news media in outside advertising.

45. What type of advertising is done through radio?

46. What is point-of-puchase advertising?

47. What does point-of-purchase advertising consist of?

48. How are window displays used in advertising sales items?

49. Name several things that need to be considered when setting up the arrangement of the window display.

50. What is meant by a central theme?

51. Why should you not display plow bottoms, insecticides, anti-freeze, and cultivator sweeps on the same table?

52. How frequently should a display be changed?

53. What is meant by a special promotion?

54. How are special promotions organized?

55. How do the principles of selling apply to selling ornamental plants?

56. How are plants displayed for sale?

57. How are plants labeled?

58. How are pictures used in the sale of plants?

59. What is the normal mark-up on plants?

SUGGESTED LEARNING ACTIVITIES

1. Practice approaching a customer and making a sale.

2. Visit a home owner and make an agreement to maintain his lawn and shrubs.

3. Observe the operation of a nursery and garden supply center.

4. Practice displays of garden supply items.

5. Practice filling out sales slips.

6. Write for plant and supply cataloges.

7. Order plants and supplies to be used in the shcool nursery and greenhouse.

SUGGESTED REFERENCES

1. Sales Horizons, Haas and Perry, Prentice-Hall, Englewood Cliffs, N. J.

2. Popular Sales Techniques, Series, International Harvester Co., Chicago, Ill.

3. Beginning In The Nursery Business, Pinney, John J., The American Nurseryman, 343 South Dearborn St., Chicago 4, Illinois.

4. Ornamental Horticulture For Vocational Agriculture In Alabama, a reference unit, 1966.

DEVELOPING THE LANDSCAPE DESIGN OR PLAN

STUDENT STUDY GUIDE

(Use separate sheets of paper to answer questions.)

1. What is the very first thing that must be done before landscaping a building?
2. Why do small properties need more detailed study before landscaping?
3. When should planning begin for a new development?
4. What is a survey?
5. What things are included in the survey?
6. Why is it important to include the land form or topography in the survey?
7. Why is it necessary to include family desires in the survey?
8. What is a preliminary plan?
9. What is included on the preliminary plan?
10. Which is generally most satisfactory for small properties, formal or informal design? Why?
11. What three major areas are used in landscaping?
12. At what time during the planning process is the location of these areas determined?
13. Discuss the purpose and use of the three major areas.
14. How important is the service area in the home grounds?
15. Discuss the location of the garage.
16. When is the best time to plant shrubs?
17. List 9 steps used in planting shrubs.
18. What is a foundation planting?
19. Why does a house need plants?
20. How may tall, box-like houses or structures be scaled down and made to look smaller?
21. How may landscaping make a narrow house look wider?
22. Discuss the relationship of texture in the building and plants.
23. What type of plants are generally used in foundation plantings?

24. Why are group plantings generally prefered over straight line plantings?

25. Discuss how pruning plants achieve the following:

    a. reduce size of plant
    b. increase size of flower
    c. change the density of the plant
    d. train plants

26. Name other reasons for pruning shrubs.

27. What are the general recommendations for fertilizing shrubs and trees?

28. How can the exact fertilizer needs be determined?

29. How is an outside living area developed and used?

30. List 50 landscaping terms and define each.

31. What is meant by "grading"?

32. Discuss a situation where grading"?

33. When is the best time to grade a lot?

34. List several reasons for grading.

35. Discuss the construction of retaining walls.

36. What materials are used as retaining wall material?

37. Discuss 5 landscape situations and list the plants used in each situation.

38. How are annual flowering plants used in the landscape plan?

39. Discuss several situations where "annuals" would be used.

40. List 10 fruits and nuts and show how each may be used in a landscape.

41. Make sketches of several driveway designs.

42. Sketch a "turn about" showing the dimensions required.

43. What matérials are best for driveways?

44. What materials are best for walks?

45. Sketch several walk situations.

SUGGESTED LEARNING ACTIVITIES

1. Prepare a landscape plan of your home.

2. Prepare a simple scale drawing.

3. Prepare a scale plan of an existing landscape project.

4. Practice reading blueprints and plans.

5. Plan and construct an ornamental garden structure.

SUGGESTED REFERENCES

1. Landscaping Alabama Homes, Circular 614, Extension Service, Auburn University, Auburn, Alabama.

2. Landscaping Georgia Homes, Bulletin 583, Extension Service, University of Georgia, Athens, Ga.

3. Care and Pruning of Ornamental Shrubs, Leaflet 12, Extension Service, Auburn University, Auburn, Ala.

4. Ornamental Horticulture For Vocational Agriculture In Alabama, a reference unit, 1966.

ESTABLISHING AND CARING FOR LAWNS AND TURFS

STUDENT STUDY GUIDE

(Use a separate sheet of paper to answer questions.)

1. How important is the lawn to the total landscape?
2. What care should be exercised in saving top soil for a new lawn?
3. How should drainage problems be handled on a new lawn?
4. What is the recommended slope for a lawn?
5. How should the smoothing process be handled while preparing a new lawn?
6. When should the first application of fertilizer be applied to a new lawn?
7. List the steps in preparing a site for a new lawn?
8. What factors should be considered in selecting a lawn grass?
9. Name several grasses that can be used for winter lawns.
10. Which grass will provide the quickest cover?
11. Which grasses grow best in shade?
12. Which grasses grow well in open sun?
13. Which grasses require the least maintenance?
14. Under what conditions should a mixture of grasses be used?
15. When is the best time to plant a lawn?
16. What are the methods of establishing a lawn?
17. Should soil have any chemical treatment before planting?
18. What methods should be used in sodding grass?
19. How is the amount of grass needed for sodding determined?
20. What procedure is best for sowing lawns?
21. How deep should lawn seed be covered?
22. How is the amount of lawn grass seed determined?
23. Should mulch be used on a newly seeded area?
24. Why should soil be firmed by rolling after seeding?

25. When should the soil for lawns be tested?

26. How should a soil sample be taken?

27. Why is it important to follow soil testing recommendations?

28. What fertilizer treatment is needed on new lawns?

29. What is the recommended fertilizer schedule for established lawns?

30. What precautions should be observed while fertilizing lawns to prevent burning?

31. What are the fertilizer recommendations for centipede grass?

32. What type mower is best for large lawns?

33. Should clippings be removed after lawn is mowed?

34. What are the recommendations for watering lawns?

35. How often should a lawn be mowed?

36. What procedure should be followed in reworking an old lawn?

37. Give the control recommendations for chinch bugs.

38. Name 5 additional insects that damage lawns and give the control for each.

39. Give the control for "brown patch" of lawns.

40. How are broadleaf weeds controlled in a lawn?

41. When should weed control chemicals be applied to a lawn?

42. Name 4 weeds that damage lawns and give the control of each.

SUGGESTED LEARNING ACTIVITIES

1. Take of the soil in your lawn and have it tested.

2. Fertilize your lawn according to the soil test recommendations.

3. Make a collection of the grasses used in lawns and turfs in your community.

4. Assist in preparing the soil and seeding plots of various grasses.

5. Patch and reseed an existing lawn.

6. Advise one home builder in the selection of proper grasses and shrubs for his home.

SUGGESTED REFERENCES

1. Approved Practices In Beautifying The Home Grounds, Hoover, The Interstate, Danville, Ill.

2. Lawn Insects, How To Control Them, Home and Garden Bulletin No. 53, USDA.

3. The Planting and Maintenance of Lawns, Circular No. 85, Agricultural Experiment Station, Auburn University, Auburn, Alabama.

4. The zoysia Grasses, Circular P-24, Extension Service, Auburn University, Auburn, Ala.

5. St. Augustine Grass, Circular P-23, Extension Service, Auburn University, Auburn, Ala.

6. Centipede Grasses, Circular P-22, Extension Service, Auburn University, Auburn, Ala.

7. Ornamental Horticulture For Alabama Vocational Agriculture, a reference unit, 1966.

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ABSTRACT - The teacher of the mentally retarded student has the special challenge of presenting a functionally oriented program to prepare the students for an adult community. This guide, designed for special education teachers, is suggested for use at the 10th and 11th grade levels as part of a comprehensive course in functional home-living. The six major areas of consumer economics covered are: (1) money and banks, (2) using money wisely, (3) buying wisely, (4) effective use of credit, (5) investing in a home, and (6) protection through insurance. Within each major area the material is organized by instructional units, suggested educational activities, audiovisual aids, and suggested materials for teacher references. A selected bibliography is appended. (CH)

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TEACHING CONSUMER EDUCATION

To Special Students on the Secondary Level

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Orange County

TEACHING CONSUMER EDUCATION

TO SPECIAL STUDENTS

on

THE SECONDARY LEVEL

by

Burma Rose Peale, Teacher of Trainable Retardates; Former Teacher of Educable Mentally Retarded

Daniel J. Fischer, Teacher in Consumer Education for the Educable Mentally Retarded

Linn Hutchinson, Orange County Consultant in Education for the Educable Mentally Retarded

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Any publication must be based on the background and experience of its author or authors. Affecting these experiences is a wide array of people who have made their contributions. Lost in the recesses of neural integration called learning is this background. Our thanks go to the many people who have helped us along the way but now must remain unnamed.

Appreciation is expressed to the authors of source materials from which ideas and suggestions were gleaned. The main sources are listed in "The Suggested Materials for Teacher Reference," and in the Bibliography.

The authors

FOREWORD

It is the function of special education to provide for each educable mentally retarded student who is less favored academically the best possible education for him. He, too, is an integral part of our society. His competencies are an educational concern.

Specialists in special education are consistent in advocating for the educable mentally retarded a curriculum which is close to the everyday living needs of these students. The chief orientation is vocational, but along with this is the necessity for training in personal and social adjustment, healthful living, and effective consumership. This guide should be helpful to secondary teachers in developing course content with respect to this latter need.

F. A. Grunenfelder
County Superintendent of Schools

Willard H. Saucerman
Assistant Superintendent
Educational Services Division

A NOTE REGARDING THE GUIDE'S DEVELOPMENT

Perhaps the development of this guide needs some explanation as the production has been in a developmental stage for the past few years.

While the mandatory program in California for teaching educable mentally retarded students at the secondary level was yet in its early childhood, the Garden Grove Union High School District had introduced specific course work in consumer education for these special students. A course of study was developed and adopted as an integral part of the curriculum.[1] Daniel J. Fischer, at that time teacher of the course in consumer education, assembled a quite comprehensive teachers' guide.[2]

Fischer's provisional guide came to the attention of Dr. Linn Hutchinson in the office of the Orange County Superintendent of Schools. Both Hutchinson and Fischer saw a need in enriching the information and making it more widely available to other special education personnel. Hutchinson then proceeded for some time to gather pertinent materials from various sources. In the interim Fischer left the County. However, prior to his departure, Fischer gave Hutchinson permission to use the outline in any way he saw fit.

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[1]Garden Grove Union High School District. District Coordinated Course Outlines for 1960-61.

[2]Daniel J. Fischer, "Consumer Education for Secondary Educable Mentally Retarded," (unpublished paper, 1960-61).

In the fall of 1962, Mrs. Burma Rose Peale approached Hutchinson for suggestions on a research project for a graduate thesis in her master's program. As a result of this and subsequent meetings and after consultation with her thesis committee, Mrs. Peale went ahead with a survey of the literature to see what in general is being done nationally with respect to consumer education for E.M.R. secondary students. In addition, she made a direct and fairly definitive study of Orange County to determine what is being done locally in this area of work. Peale's survey revealed that in most special education programs little was formally done specific to consumer education on either the national or local level.

The authors' premise was that consumer education when geared to the retardate's level of operation is extremely necessary curriculum content for these students. As a result of Peale's survey the need to develop a curriculum guide seemed more evident. Starting with the original outline of Fischer and utilizing the materials gathered by Hutchinson, Peale added her own spice, refined and added to the mixture and came out with a suggested guide.[3] Further minor editorial changes have been added. We trust that the publication will have the utility and practicability as was originally intended.

---

[3]Burma Rose Peale. "Suggestions for Teaching Consumer Education to the Educable Retarded Students on the Secondary Level," Consumer Education School Program for the Educable Mentally Retarded Students on the Secondary Level, (unpublished Master's thesis, Chapman College, Orange, California, May 1963). Chapter V.

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SECTION I

INTRODUCTION

When the educable mentally retarded student reaches high school, a program should be offered that will help him prepare for the problems of practical living which he now faces as well as those which he will face later in life. Secondary schools with responsibility for educating academic retardates are continuing to develop programs better designed to meet the problems of real living. Directors of special programs realize the importance of consumer education as an essential ingredient in the school lives of these young people.

This very important aspect of the curriculum should perhaps be emphasized in the tenth and eleventh grades as a part of a more comprehensive category of functional home-living. The twelfth grade is appropriately the level at which the school concentrates its effort on applied vocational education---knowledges, principles, attitudes. Through the school's off-campus work experience program each student, when eligible, is carefully placed in an appropriate off-campus job.

The following suggested guide is intended to be a flexible one that would be adjusted to each individual school situation. The adage, "nothing succeeds like success" can have even greater meaning for the special education teacher. Many times the mentally retarded student leaves school before the twelfth grade, having had little success in school achievement. Success, being a strong

motivating influence, tends to build confidence, something these students generally seem to lack. The more success they have, the more encouraged they are to stay in school. The teacher has a definite challenge, for he realizes the content of his course must relate to the immediate interests of his students and the learning experiences should be made as concrete as possible. With this in mind, the teacher has the task of presenting a functionally oriented program to prepare the students for an adult community.

It is hoped that by actually experiencing many life situations the students will discover and solve the reading, mathematics, spelling and writing problems of community living by putting to use these basic tool skills developed during previous years.

Role playing may be used frequently to bring to reality many types of life situations. Frequent use of bulletin boards serve to stimulate interest and aid in making an otherwise theoretical discussion meaningful and purposeful. Realistic experiences are imperative for the handicapped student.

It is suggested that a notebook be compiled with the purpose of becoming a source of useful information for later reference by the student. Each class member should be encouraged to have a durable notebook with an attractive cover, one he would be proud to keep and use at a later time. The student should be guided to organize the notebook in an easy-to-find orderly manner that would be of value to him for future reference after leaving school.

PURPOSE OF THE GUIDE

The guide has purposely been made quite detailed. The hope of the authors is that the materials presented will serve teachers by reminding them of usable content, activities and sources. The general purposes of this consumer education guide for educable mentally retarded students on the secondary level are:

1. To develop an understanding of importance of money and banks in our everyday living, and how banking services can be used most efficiently.
2. To develop an awareness of importance of efficient money management through careful budgeting and wise buying.
3. To develop an understanding of how credit may affect our standards of living.
4. To develop a knowledge of how protections are provided by insurance.

PROCEDURE

Consumer education in the educable mentally retarded class will become meaningful and purposeful to the student when the teaching methods are adapted to the needs of the class. The following are some suggestions that might be used:

1. Constant motivation will keep boredom to a minimum.
2. Praise can be an effective stimulus to learning.

3. Class goals should be kept simple enough for each student to understand.

4. All experiences should be related to the student's needs.

5. Students and teacher should work together in planning for learning experiences.

6. Role playing affords many opportunities for learning.

7. Make certain that individual or group activities within the classroom are simple enough to be successfully completed.

8. Encourage individual projects outside of school.

9. Invite outside speakers to class frequently.

10. Take field trips to banks, stores, markets, etc., to gain first hand experiences.

11. Provide many life-related experiences, e.g. - practicing filling out forms, blanks, checks, etc.

12. Compile notebook containing useful information and samples of blanks, forms, checks, etc., one needs to use for everyday practical living.

13. Keep a dictionary of words important to banking, insurance, etc., in notebook.

14. Encourage the notebook to be arranged in an orderly fashion that can be used as a source of information after leaving school.

15. Make frequent use of audio-visual aids for supplementary instructional materials.

16. Make use of bulletin boards with interesting and meaningful materials.

17. Provide reading materials so selected that they will be both meaningful and acceptable to the students.

ORGANIZATION

The guide is organized under six major headings dealing specifically with consumer economics, namely:

1. Learning About Money and Banks
2. Learning How to Use Money Wisely
3. Learning to Buy Wisely
4. Learning How to Make Effective Use of Credit
5. Learning About Investing in a Home
6. Learning About Protection Through Insurance

In order to make the guide as usable for the teacher as we could, the authors have presented materials in the following sequence for each major category and in many cases sub-categories: First, suggested course; second, suggested educational activities; third, audio-visual aids (in some cases); and last, suggested resource references.

TEACHING CONSUMER EDUCATION

TO SPECIAL STUDENTS

on

THE SECONDARY LEVEL

ERIC

SECTION II

LEARNING ABOUT MONEY AND BANKS

A. BANKS

Develop a knowledge of how banks can serve individuals.

Develop skills needed if banking services are to be used effectively.

1. What a bank is.

   a. A bank is a business firm whose principal function is to take in and pay out money.

2. What banks do.

   a. Accept and safeguard the money people leave with them.

   b. Provide a means of making payments by check.

   c. Make loans to people.

3. Vocabulary pertinent to banking.

   a. Deposit--money left with a bank for safekeeping.

   b. Depositor--a person who keeps money in a bank.

   c. Account--a careful record of the amount that belongs to each depositor. The bank keeps this record.

   d. Checking account--a bank account against which checks may be written.

   e. Check--a written order on a bank to pay out money for a depositor.

B. CHECKING ACCOUNT

Develop knowledge and skills necessary to use a checking account correctly.

1. Types of checking accounts available.

   a. Regular single--one person using checking account.

b. Regular joint--two or more persons using same checking account.

c. Special Ten Plan single account--charge of $1.50 for ten checks to be written by one person.

d. Special Ten Plan joint--ten checks for $1.50 to be written by two or more persons.

2. Advantages of having a checking account.

a. There is little need to carry cash.

(1) Cash can be lost.

(2) Cash can be stolen.

(3) Cash is too easily spent.

(4) Cash is difficult to keep track of.

b. Provides a safe place for money that is not needed immediately.

c. Checks can be sent safely by mail.

(1) Bills paid by mail save time and footsteps.

d. One way to have a permanent record of expenditures.

(1) Check received and paid by bank will be returned to depositor.

(2) Enables one to have best possible receipt.

(3) Helps to keep track of how much money has been spent.

(4) Helps to make budget work.

(5) Enables one to keep definite and proper records for yearly income tax.

3. Disadvantages of having a checking account.

a. Easy way to spend money that one doesn't have.

b. Easy to get one's self in trouble by improper or careless use.

c. No interest paid on money in checking account.

d. Depositor is charged a fee depending on how much balance regularly kept in account.

4. How to open a checking account.

a. Go to person in charge of "NEW ACCOUNTS"

b. Find bank that is close to home or work.

c. Ask a friend known to bank to introduce you for identification.

d. Sign name on a signature card.

(1) This signature card is kept by bank.

(2) Always sign check same way you sign signature card.

(a) This protects you as a depositor.

e. Make initial deposit.

5. How to make a deposit.

a. Fill in a printed form called a deposit slip.

(1) Lines for: your name, the date, amount of deposit, total amount of deposits.

b. Give deposit and deposit slip to bank clerk.

c. Bank will give you a special receipt on which the amount of money deposited is recorded by machine.

(1) Keep the special receipts.

d. Bank provides a book of printed check forms called a check book.

(1) Check stubs provide spaces for recording deposits and important information about each check written.

(2) Check book may have ruled form instead of stubs on which to record deposits and checks written.

6. How to write a check.

   a. Write clearly and neatly.

   b. Fill in correct date.

   c. Fill out blank space that says "Pay to the order of" with the name of the person or firm who is to receive check.

   d. Fill out with numbers the amount of the check next to the sign "$"

      (1) Write close to "$" so another number cannot be added.

   e. Fill out blank in front of word "Dollars" with the written numbers amount of the check.

      (1) Dollar amount is written in words.

      (2) Cents are written as a fraction of a dollar.

   f. Sign the check in own handwriting.

   g. Never sign a check that has not been filled out.

   h. Carefully study check for mistakes that may have been made.

   i. If a mistake is made, tear it out and start again.

   j. Understand the penalties for overloading.

7. Checks you receive.

   a. Endorsement--checks of other people.

      (1) Signing name on back of a check is endorsing the check.

      (2) Signature on back of check is an endorsement.

      (3) Person who signs his name is the endorser.

      (4) After a check is endorsed or signed on the back, the check may be:

         (a) Cashed.

         (b) Deposited in bank.

         (c) Transferred to another person or business.

b. Bank statement

(1) Prepared by bank at end of each month.

(2) A record of checks written by you.

(a) Balance at beginning of month.

(b) Deposits made during the month.

(c) Deductions for each check that was paid during the month.

(d) Service charge, if any, made for previous month's service; a fee to be paid for handling checking account.

C. SAVINGS ACCOUNT

Develop a knowledge of why people save, the importance of systematic savings, and of how wisely invested savings work for their owners.

Develop an understanding of the place and purpose of savings accounts in everyone's investment program.

1. Types of savings accounts available.

a. Individual

b. Joint

c. Christmas Club Single

d. Christmas Club Joint

e. Payroll deduction

2. Advantages of a savings account.

a. Provides money for unexpected events.

(1) Emergencies

(2) Illnesses

(3) Sudden bills

b. Provides money for specific future wants.

(1) Trips

(2) Vacation

(3) Education

(4) Home purchases

(5) Car purchases

c. Banks regard people with savings accounts as good risks for:

(1) Home loans

(2) Furniture loans

(3) Automobile loans

(4) Business loans

(5) Medical loans

d. Savings passbook a fine character reference.

(1) Recommendation for establishing credit with other firms.

e. Gives a feeling of security.

3. <u>How to open a savings account</u>.

a. Take a friend with you to help you establish your identity.

b. Sign a signature card.

(1) This card will have an account number.

c. A Passbook that has same number as signature card will be given to depositor.

(1) This book has space for recording deposits, withdrawals and interest or dividend payments.

d. Make a deposit.

(1) Fill out deposit slip used only for savings accounts.

(2) Name, account number and amount of deposit must be written on deposit slip.

(3) Present deposit slip, passbook and deposit to clerk.

4. How to make a withdrawal from a savings account.

a. Present savings passbook.

b. Sign a special withdrawal form.

c. Signed withdrawal slip serves as a receipt.

5. Necessary documents for a savings account.

a. Signature card.

b. Reverse side of signature card.

c. Deposit slip.

d. Savings passbook.

e. Withdrawal slip.

D. OTHER BANK SERVICES

Develop an awareness that banks offer different kinds of services.

1. Services provided by banks.

a. Safe-deposit boxes.

(1) Special steel box that may be rented at bank.

(2) May be rented for safekeeping of valuables.

(a) Birth certificates
(b) Contracts
(c) Social Security cards
(d) Insurance Policies
(e) Marriage certificates

b. Banks give advice.

(1) Banks can tell you if a house is worth the price, if it is for sale.

(2) Banks can give you good advice as to the amount of money you can safely afford to borrow.

c. Items you can purchase at a bank.

(1) Money order--a money substitute that can be bought at banks.

(a) This is a safe way to send money through the mail.

(b) Easier to cash than checks.

(c) Can be used to pay bills when you do not have a checking account.

(2) Traveler's checks.

(a) A special check sold by the bank to provide travelers protection for their money.

(b) A safe way to carry money when traveling.

(c) Can be replaced if lost or stolen.

(d) Traveler's checks are accepted anywhere.

d. Banks lend money.

(1) Personal loans.

(a) Made to individuals.

(b) You may borrow money to pay off debts, pay for medical expenses, or buy furniture.

(2) Real Estate Loans.

(a) Money borrowed for the purpose of buying or improving property, such as land or a house.

(3) Commercial loans.

(a) Loans made to business people.

(4) Agricultural loans.

(a) Made to farmers.

(b) Loans of this type are usually for a short term.

SUGGESTED EDUCATIONAL ACTIVITIES

Building your vocabulary.

Discuss the meaning of the following important words in banking. Write the meaning of each word as a class project. A copy should be given to each member of the class to put in his notebook.

Account	Single account
Checking Account	Joint account
Checkbook	Special checking account
Deposit	Service charge
Deposit slip	Payee
Passbook	Signature card
Bank statement	Post dated
Endorsement	Bank statement
Endorser	Cancelled check
Endorsing	

Arrange for a class visit to a local bank to see a bank at work.

Invite a person from a bank to attend your class and explain the services of a bank.

Make a bulletin board display of bank forms such as deposit slips, deposit receipts, signature cards, blank checks, bank statement.

Practice signing a signature card as if you were opening a checking account.

Practice preparing deposit slips.

Each member of class obtain a check book from your bank.

Bring printed check forms to class and compare the forms used by different banks.

Practice writing a check, filling in the stub first.

Practice writing checks to one another in class.

Pretend you have a check payable to you. On the back side of the check form, endorse the check properly.

Practice endorsing a check for deposit only.

Discuss the following important questions about checking accounts:

1. If I make a mistake in writing a check, should I correct it?

2. Can checks be written only on the forms furnished by the bank?

3. Is it a good idea to use a counter check?

4. What happens if I overdraw my account?

5. What must I do if this happens?

6. Should I accept a check dated for sometime in the future?

If possible, have every member in class actually open a savings account. Even if your allowance is a small amount, plan to save to add to your savings account.

AUDIO-VISUAL AIDS

Film--Fred Meets a Bank F320
Study prints of banking.

SUGGESTED MATERIALS FOR TEACHER REFERENCES

Banking Knowledge for Young Americans. Dr. Garney L. Darrin, Grade Teacher, January, 1963. Vol. LXXX No. 5.

Bank Terminology. National Cash Register Co., Dayton (9), Ohio.

Hints for People Who Hate Money. First National City Bank of New York, New York.

Know Your Money. Superintendent of Documents, Government Printing Office, Washington (25), D.C.

Price, Ray G., Vernon A. Musselman and Edwin E. Weeks, Jr.: General Business for Everyday Living. Gregg Publishing Division, Mc-Graw Hill Book Company, Inc., Second Ed., 1960.

Tips on Making Change. Pamphlet, National Cash Register Co., Main and K Streets, Dayton, Ohio.

Pamphlets and brochures on money and banks may be obtained from any local bank.

SECTION III

LEARNING HOW TO USE MONEY WISELY

A. BUDGETS

Develop the knowledge, skills and attitudes necessary for the individual or family to budget their income satisfactorily.

Understand the factors which contribute to good money management of one's income.

Understand the nature of the financial problems which may arise within the family and the wisest way to handle these problems.

1. What is a budget?

    a. A plan for spending money.

2. Why people budget.

    a. Helps one live within his income.

    b. Provides for first things first.

    c. Helps build a reserve fund of money.

    d. Forces one to look ahead.

    e. Helps one to make wise choices.

3. Budget goals.

    a. To plan and save for the future.

    b. To meet regular and irregular expenses.

    c. To have money for pleasure.

    d. To have money for investments.

    e. To have a definite plan for retirement.

Develop a knowledge of concepts related to resources of income.

1. Main sources of income.

   a. Wages of father and/or mother from full-time employment.

   b. Supplementary incomes earned by husband on secondary job.

   c. Supplementary incomes earned from part-time employment of the wife or children.

   d. Other sources of income.

      (1) Pensions.

      (2) Unemployment compensation.

      (3) Insurance benefits.

      (4) Interest.

Develop a knowledge of average expenditures to be considered

1. Types of expenditures

   a. Savings.

      (1) U. S. Savings Bonds.

      (2) Life Insurance premiums.

      (3) Savings Banks.

      (4) Social Security and pension.

      (5) Other savings or investments.

   b. Taxes.

      (1) Income--Federal.

      (2) Income--State.

      (3) Personal property.

   c. Food.

      (1) Groceries, milk, meat.

      (2) Family meals out.

      (3) Daily lunches out.

(4) Beverages.

(5) Between meal indulgences.

(6) Business or social entertainment.

d. Clothing.

(1) New clothes for each member.

(2) Up-keep, cleaners, laundry, shoe repair, etc.

e. Shelter.

(1) Rent or mortgage payments.

(2) Taxes--property, water, schools, etc.

(3) Utilities.

(4) Equipment, supplies, maintenance of yard, etc.

(5) Up-keep of house--painting.

(6) Insurance of property.

f. Health and Personal Appearance.

(1) Medical and dental costs.

(2) Drug store purchases.

(3) Barber, beauty parlor, cosmetics.

(4) Health and accident hospitalization.

g. Transportation.

(1) Automobile.

(a) Purchase payments.

(b) Gas and oil.

(c) Maintenance and repairs.

(d) Insurance.

h. Recreation.

(1) Vacation fund.

(2) Periodicals, newspapers.

(3) Amusements, movies, sports, etc.

(4) Hobbies

(5) Club dues

i. Advancement

(1) Education

(2) Travel

j. Miscellaneous

(1) Luxuries, non-essentials.

(2) Tobacco

(3) Maintenance of pets, livestock.

(4) Christmas and birthday gifts.

(5) Allowance for children.

(6) Contributions, church, etc.

(7) Gifts to charity.

(8) Union dues

SUGGESTED EDUCATIONAL ACTIVITIES

Building your vocabulary

Budget
Need
Want
Thrift
Estimate
Fixed expenses
Flexible expenses

Class discuss steps, in detail, necessary for setting up a budget:

1. First step is find out how you are spending your money now.

2. Keep track of your income and expenses for one week.

3. Record all the money you receive--

   The amount
   Where you got it
      Allowance
      Money earned from working
      Gifts
      Other money from family

4. Write down each day how you spend your money.

   Write down each item and how much it costs.

5. Write down how much money you saved.

6. Keep this record in your notebook, using three headings:

   Money received
   Money spent
   Money saved

7. At end of week, add up each column.

8. This is the foundation for keeping a budget.

Class set up a hypothetical case of a person earning a specific amount of money each week.

Class works out together how much the man should budget for food, rent, and other expenses.

Teacher arrange a bulletin board of different types of budget books, and have discussion on the differences of each one and their functions.

Every member in class acquire a budget book and bring to class. These may be obtained from the U. S. Agriculture Extension Department, book store, or a variety store, such as Woolworths, etc.

Teacher and each student work together on a budget, the teacher helping the student to use his own budget book properly.

SUGGESTED MATERIALS FOR TEACHER REFERENCES

Crabbe, et. al, General Business, (Seventh edition), South-Western Publishing Company, Cincinnati, 1956.

A Discussion of Family Money. (How Budgets Work and What They Do), Institute of Life Insurance, 488 Madison Ave., New York (22), New York.

The Family Money Manager. Institute of Life Insurance, 488 Madison Ave., New York (22), New York.

Facts You Should Know About Budgeting. Association of Better Business Bureaus, 723 Chrysler Building, New York, New York.

Managing Your Money. Administrative Committee of the Consumer Education Study, Consumer Education Series, Unit #7, National Education Association, Washington, D.C., 1958.

Money Management At Your House (reprint) Changing Times, The Kiplinger Magazine, 1729 H. St., N.W. Washington, D.C.

Money Management for Young Moderns and Money Management--Your Budget. Consumer Education Department, Household Finance Corporation, 913 N. Michigan Ave., Chicago (11), Illinois.

Money Management--Your Budget. Household Finance Company, 919 N. Michigan Ave., Chicago (11), Ill.

B. SHOPPING TECHNIQUES

Develop the knowledge and skills necessary to understand how good shopping habits contribute to wise money management.

1. Efficient shopping begins at home.

    a. Make a list of things needed at the store.

        (1) A shopping list is a time-saver.

        (2) Eliminates impulsive buying.

    b. Decide on <u>what</u> quality to buy.

        (1) Think of purpose article is to serve.

    c. Decide on <u>what</u> quantity to buy.

        (1) Storage space available in your home.

            (a) Cupboards

            (b) Closet

            (c) Refrigerator

            (d) Freezer

    d. Decide <u>where</u> to buy.

        (1) Think of store that will meet your buying needs and habits.

        (2) Consider variety of merchandise available.

        (3) Decide whether sales clerks serve you or you serve yourself.

    e. Decide <u>when</u> to buy.

        (1) Time your buying to avoid rush hours, if possible.

        (2) Selecting the right time to buy can save you money.

            (a) Seasonal goods, such as fresh fruits, are cheapest when supply is at its peak.

            (b) Clothing prices are lowest at end of season.

f. Shopping at sales.

(1) If planning to attend a sale, go at the beginning.

(a) Selection will be greater.

(2) Considerable savings are made at legitimate sales.

(a) Clearance sales--at end of season.

(b) White-goods sales in January.

(c) Shoe sales in July.

(d) Furniture sales in August.

g. Do not be fooled by clever packaging (See "Value of Labels," Sub-section D following).

(1) Use of thick glass.

(2) Indented bottoms of containers.

(3) Irregular shape of package or bottle.

(4) Flashy color of container.

(5) Size of container.

C. MAKING USE OF ADVERTISEMENTS

Develop an ability to read and analyze modern advertising techniques.

1. Informative advertisements.

a. Tell you what you want to know about a product.

(1) Where it can be purchased.

(2) What the price of the article is.

2. Be alert to "catchy wording in advertisements.

a. "Plus trade in"

b. "As is"

c. "Seconds, irregulars"

d. "Factory rejects"

e. "Close-outs"

f. "Quitting business sales"

g. "Discount houses"

h. "All sales final"

i. "Price for one--get second one for $.01"

j. "Cannot discuss manufacturer's name on sales"

3. Telephone can be of help when you shop.

a. Use telephone to find out which stores carry the things you plan to buy.

(1) This can save needless trips to stores that do not sell your desired item.

b. Yellow page section in telephone book can help locate needed merchandise.

D. VALUE OF LABELS

Develop understanding of labels and their purposes.

1. <u>What a label is</u>.

a. A message about the product to which it is attached.

2. <u>Labels are in different forms</u>.

a. Tag

b. Carton

c. Written

3. <u>Importance of labels</u>.

a. Tells vital facts.

4. Information a good label tells.

   a. What can or package contains.

   b. Weight and volume of content.

   c. What it is made of.

   d. How it is made.

   e. What the product will do.

   f. How it should be cared for.

   g. How it should be used.

   h. Who made it.

   i. Price--sometimes.

Develop an awareness of cautions and facts about labels.

1. Facts that should be known about labels and packages.

   a. Information you want may not be on label.

   b. All information on label must be accurate.

   c. Known brand names are usually reliable.

   d. Labels are designed to sell products.

      (1) Do not be fooled by

         (a) Color

         (b) Picture

         (c) Design

   e. Size of container must not be deceiving.

      (1) Product must fill package.

SUGGESTED EDUCATIONAL ACTIVITIES

Class take trip to large department store to learn of various departments within one store.

Invite a speaker from Better Business Bureau or Chamber of Commerce to talk on laws, inspections, and licensing of door to door salesmen.

Make a bulletin board display of pictures of articles such as a camera, transistor radio, record album, watch, sweater, etc. Show the cost of each article on a piece of cardboard placed near it. Have each member of the class select the article he would most like to have and calculate how long it would take him to save the money with which to buy it from his normal income or allowance.

Have each student interview his mother or close adult relative or friend, asking them for their favorite shopping rules. Report list to class. Make a list of rules in class.

Bring to class and display containers which are misleading through clever packaging.

SUGGESTED MATERIALS FOR TEACHER REFERENCE ON GENERAL SHOPPING TECHNIQUES

Crabbe, et al, General Business. (Seventh edition), South-Western Publishing Company, Cincinnati, 1956.

Gregg, General Business for Everyday Living, McGraw-Hill Book Company, Incorporated, New York, 2nd. Ed., 1960.

Effective Shopping, Consumer Education Series, Unit No. 11, National Education Association, Washington, D.C., 1947.

Facts You Should Know About Advertising. Better Business Bureau, 742 So. Hill Street, Los Angeles, California.

Learning to Use Advertising. Wilhelms, Fred T., Consumer Education Series, Unit No. 2, National Educational Association, Washington, D.C., 1945.

Review of Good Buying Principles. Brand Names Foundation, Inc., 437 5th Ave., New York (16), New York.

SECTION IV

LEARNING HOW TO BUY WISELY

A. BUYING FOOD

Develop knowledge and skills needed to gain competence through efficient buying practices.

1. Types of markets where food may be purchased.

    a. Supermarkets

        (1) Advantages

            (a) Volume basis--lower prices.

            (b) Carry a wide variety of brands to select from.

            (c) Other household products are sold.

            (d) Many needs can be purchased in one location.

        (2) Disadvantages

            (a) Less personal contact with buyer.

    b. Independent markets.

        (1) Advantages

            (a) Uncrowded, usually.

            (b) Delivery service.

            (c) Charge accounts.

            (d) Usually located in neighborhood.

        (2) Disadvantages

            (a) Prices usually higher.

            (b) Number of brands limited by lack of space.

            (c) Not as many household products other than food sold.

c. Individual Food Markets.

Meat Market

Bakery Shops

Dairy Stores

(1) Advantages.

(a) Feature special products.

(b) Products fresh and bigger variety.

(c) Sometimes lower prices than in general food market, if one buys in quantity, as in dairy store.

(2) Disadvantages.

(a) Sometimes higher prices due to smaller quantity of merchandise carried.

(b) Only limited items available at each type of store.

Develop a knowledge of essential needs in buying food.

1. Essential things to know in buying food.

a. How to plan a meal.

(1) Consider cost of food.

(2) Consider balanced diet.

(a) Have a knowledge of basic foods necessary for good health:

(1) Fruits

(2) Vegetables

(3) Milk and cheese

(4) Eggs

(5) Meat

(6) Fish

(7) Bread and cereal

(3) How to make a grocery list of needed items.

(4) How to estimate money needed to pay for groceries.

b. Kinds of payment for groceries.

(1) Cash

(2) Check

(3) Charge--only if really needed.

c. How to have check accepted in store.

(1) Itentification.

(2) Credit references.

B. VALUE OF FOOD LABELS

Develop knowledge and skills necessary to understand the following concepts in the labeling of foods.

1. Canned or packaged foods.

a. What the can or package contains.

(1) Must be truthful.

(2) The common or usual name of the food must be on the label.

b. Weight and volume of food must be stated.

(1) If food is liquid, measure must be in terms of liquid measure.

(2) If food is solid, it must be labeled in terms of weight.

c. Must give name and place of business of packer, manufacturer, or distributor.

d. What foods were used to make the product.

e. Quality or grade of food must be on label.

f. Directions how to use (sometimes).

g. Cautions (sometimes).

2. Dairy Products.

a. Milk

(1) Label gives liquid measurement of fresh milk.

(a) One half pint

(b) One pint

(c) One quart

(d) One half gallon

(2) Type of processing given.

(a) Raw milk

(b) Pasteurized

(c) Homogenized

(d) Skimmed

(e) Evaporated--canned

b. Eggs

(1) Label will give size.

(a) U. S. Extra Large

(b) U. S. Large

(c) U. S. Medium

(d) U. S. Small

(2) Label will give quality.

(a) U. S. grade AA

(b) U. S. grade A

(c) U. S. grade B--seldom sold in stores

c. Butter

(1) Quality grading must be listed.

(a) U. S. grade AA

(b) U. S. grade A

(c) U. S. grade B

d. Cheese

(1) Type of cheese listed.

(2) Quality of grading.

3. Meat labels.

a. Weight and prices stamped on packaged meat.

b. Government inspection has a purple grade stamp indicating grade name.

c. Knowledge of quality is implied by cut of meat listed on the label.

(1) U. S. Prime

(2) U. S. Choice

(3) U. S. Good

(4) U. S. Standard

(5) U. S. Commercial

4. Bakery Products

a. Label will name type of product.

(1) Types of bread

(2) Types of rolls

b. Label will give ingredients of products.

c. Label will give weight.

C. IMPORTANCE OF FOOD GRADING

Develop an understanding of different grades of canned food.

1. Standards for grading canned goods.

   a. Quality of contents must be same as quality stated on label.

2. Different grades of contents.

   a. Fancy

      (1) Top quality.

      (2) Usually costs more unless on sale.

   b. Standard

      (1) This quality of product on all grocery shelves.

      (2) Will be found under many private name brands.

      (3) Medium price.

         (a) Not highest price

         (b) Not lowest price

      (4) Considered good buy for the money.

      (5) Often placed on store sales.

   c. Sub-standard

      (1) Low grade quality

      (2) Broken pieces--sometimes

      (3) Lowest price can

D. BUYING FRESH FRUITS AND VEGETABLES

Develop a knowledge and skills necessary for efficient buying of fruits and vegetables.

Develop an understanding that high prices do not necessarily indicate desirable quality.

Develop a realization that low prices are not always indicative of par quality.

1. Helpful suggestions in buying.

   a. Make your own selection of perishable produce.

      (1) Personal inspection tends to give greatest satisfaction and economy.

      (2) Trial and experience aid immensely.

   b. Do not buy just because price is low.

      (1) So-called "bargain" may be undesirable.

   c. Consider fruit and vegetables that are in season.

      (1) Example--strawberries in summertime.

      (2) Newspapers, radio and television inform of products in great supply.

   d. Do not buy more than needed.

      (1) Unwise to purchase more than can be properly refrigerated and used without spoiling.

   e. Select produce that does not show signs of decay.

      (1) "Off-quality" stock may be bought at reduced price.

      (2) Purchase not wise if not intended for immediate use.

   f. Largest is not always the best.

      (1) Not necessarily best quality.

      (2) Not always economical to buy.

E. BUYING MEATS

Develop knowledge and skills necessary for efficient buying of meats.

1. Kinds of meat.

   a. Beef

   b. Pork

   c. Lamb

   d. Poultry

2. Cuts of meat available.

   a. Roasts

      (1) Rump roast

      (2) Boneless roast

      (3) Round roast

      (4) Chuck rib roast

   b. Steaks

      (1) Chuck steak

      (2) Flank steak

      (3) Round Steak

      (4) Swiss steak

      (5) T Bone steak

      (6) Top Sirloin

      (7) New York

   c. Stews

      (1) Short ribs

      (2) Beef stew

      (3) Plate stew

      (4) Heel of round stew

3. Buying Bone

   a. Must be considered in cost of meat.

   b. Boneless

      (1) Less flavor.

      (2) Get more for your money.

   c. Excess bone

      (1) Look carefully to make sure you are not buying mostly bone and fat.

      (2) Bone can be used for stews and soups.

4. Buying fat

   a. Better cuts of meat are liberally marbled with fat.

   b. Fat keeps meat moist, tender, and preserves flavor content.

5. Government grading

   a. Best guide for selecting meat.

   b. Tells quality of meat.

   c. Types of grading

      (1) U. S. Prime

         (a) Excellent quality and flavor

         (b) Tender and juicy

         (c) Good distribution of fat through the lean meat

      (2) U. S. Choice

         (a) Very acceptable quality

         (b) Combines moderate amount of fat with desirable eating quality

      (3) U. S. Good

         (a) Tender beef with a high ratio of lean meat to fat.

(4) U. S. Standard

(a) It has a very thin covering of fat and a high proportion of lean meat.

6. In making purchases, take advantage of advertised meat "specials" in the newspapers.

SUGGESTED EDUCATIONAL ACTIVITIES

Class visit a super market and an independent market.

Discuss the difference in the two stores.

1. Are they the same size?
2. Do they have the same number of cash registers?
3. Do they have the same number of people working in each store?
4. Do they both sell the same amount of merchandise?

Class makes out a shopping list. Go to a large market and make a list of the prices.

Take the same list to another type of market and list the prices in that store.

Compare the price list of the two stores.
Is one store cheaper than the other store?

Students bring in newspaper advertisements for "week-end specials".

Add up the costs of the groceries needed for the week.

Discuss the seven basic foods essential for balanced meals.

Plan several meals and make out the grocery lists to purchase the needed food items.

By checking the week-end newspaper specials, decide how much each meal will cost.

Prepare a bulletin board of the seven basic foods one should have to maintain balanced meals.

Bring to class different labels from can, bottle, and discuss what each label says, what is in can and size of can.

Make a bulletin board of different kinds of labels, placing a card with size of contents under each.

Each student assemble a collection of labels, each depicting a different size content.

Place the labels in notebook and mark size of content of each one for future reference.

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Money Management--Your Food Dollar. Household Finance Corporation, Consumer Education Department, 919 North Michigan Ave., Chicago (11), Ill.

Shoppers Guide to U. S. Grades of Food. Home and Garden Bulletin No. 58, U.S. Department of Agriculture, Superintendent of Documents, U.S. Government Printing Office, Washington (25), D.C., 1962.

Tips on Selecting Fruits and Vegetables. Marketing Bulletin No. 13, U.S. Department of Agriculture, 1961.

Using Canned Foods. National Canners Association, 1133 Twentieth St., N.W., Washington, D.C.

What Consumers Should Know About Food Standards. Food and Drug Administration Publication No. 8. Department of Health, Education and Welfare, Washington (25), D.C., 1961.

F. CLOTHING

Develop a knowledge and understanding of important factors in buying clothing.

1. Things to consider in buying clothes.

   a. Needs of the family.

      (1) Work clothes

      (2) Dress clothes

   b. Occupations of family members.

      (1) What kind of clothes is necessary for work.

         (a) Painter or office worker

   c. Present wardrobe.

      (1) Will new purchase go with what you already have.

   d. Clothing allowance.

      (1) Decide on a price limit before you go shopping.

   e. Shop at stores with reputation for:

      (1) Merchandise of good quality.

      (2) Fairness to customers.

   f. Study current styles and colors.

      (1) Keep your own needs in mind.

2. Value of knowing sizes.

   a. Important to know how various articles of clothes are sized.

   b. Important to know size to get proper fit.

3. Value of knowing material clothing is made of.

   a. Different types.

      (1) Cotton

(2) Silk

(3) Rayon

(4) Wool

(5) Synthetics

b. Kind of material is important factor in price of clothing.

4. Value of knowing care of material.

a. Can it be washed?

(1) Wash and wear materials.

(2) Machine washable.

(3) Hand washable.

b. Does it require dry cleaning?

SUGGESTED EDUCATIONAL ACTIVITIES

Building your vocabulary

Fabric	Pre-shrunk
Cotton	Virgin wool
Silk	Sanforized
Rayon	Sunfast
Wool	Guaranteed
Synthetics	Trade name
Accessories	

Arrange a bulletin board with different types of fabrics to study kind, quality and price.

Secure as many clothing labels as possible. Discuss good and poor labels, reliability of labels, and terms used on labels such as:

Pre-shrunk
Virgin wool
Sanforized

Guaranteed
Sunfast
Trade-name

SUGGESTED MATERIALS FOR TEACHER REFERENCE

Your Clothing Dollar. Pamphlet. Household Finance Corporation, Consumer Education Dept., 919 North Michigan Ave., Chicago (11), Ill.

Buying Women's Coats and Suits. Home & Garden Bulletin No. 31, Agriculture Research Service, U.S. Dept. of Agriculture, 1961.

G. BUYING FURNITURE AND MAJOR APPLIANCES

Develop knowledge and skills necessary for efficient buying of furniture.

1. Things to consider in buying furniture.

   a. How much money can you spend on furniture.

   b. Will you buy on installment plan or pay cash.

   c. What kind of furniture will you buy.

      (1) Maple

      (2) Modern

      (3) Traditional

2. Where to buy furniture.

   a. New furniture stores

   b. Used furniture stores

   c. Discount houses

   d. Want ads in newspapers

3. Things to look for in quality of furniture.

a. Construction

(1) Nailed

(2) Nailed and glued

(3) Jointed

(a) With glue

(b) With screws

b. Finish of wood

(1) Real hardwood

(a) Maple

(b) Walnut

(c) Mahogany

(d) Wood finished with walnut, maple, or mahogany stain.

(e) Synthetic finish

(1)[1] Plastic

(2)[1] Formica

c. Upholstery

(1) Type of fabric

(a) Cotton

(b) Acetate

(c) Wool

(d) Nylon

(e) Dacron

d. Things to remember in buying furniture

(1) Used furniture in good condition is sometimes a better buy than cheap new furniture.

(a) Used furniture is sometimes sold by individuals.

(b) Watch "used furniture" column in want ad section of newspaper.

(2) Be aware of come-on furniture ads in newspapers.

(3) Quality furniture stores do not use misleading ads.

4. Major appliances.

a. Need for appliance.

b. Reputation of "brand" name.

c. Reputation of store selling appliance.

(1) Do they "back-up" their merchandise.

(2) Do they recognize a warranty.

(3) Discount houses

(a) May not carry quality merchandise.

(b) Prices may or may not be lower.

d. Advantages of buying new appliances.

(1) Well known brands carry guarantee.

e. Disadvantages of buying new appliances.

(1) Cost will be higher.

f. Advantages of buying used appliances.

(1) Cost will be lower.

g. Disadvantages of buying used appliances.

(1) Condition of appliance may be unknown.

(2) Often there is no guarantee from store if appliance breaks down.

(3) Sometimes proves costly in the end.

SUGGESTED EDUCATIONAL ACTIVITIES

Building your vocabulary

Maple	Provincial
Walnut	Modern
Mohagany	Traditional
Formica	Upholstery
Quality	Brand name

Students bring in new furniture ads from newspapers for class discussion.

Bring used furniture want-ads to school. Discuss where they are found in paper.

Discuss what information is given in want-ad:

Item to be sold	Description of item
Price of item	Telephone or address given

Teacher bring "come-on" furniture ads to school. Discuss with class how ads can be misleading.

Look for newspaper ads of furniture from cheap stores and quality furniture stores. Compare ads. Compare prices.

SUGGESTED MATERIAL FOR TEACHER REFERENCE

Your Home Furnishing Dollar. Household Finance Corporation, Consumer Education Department, 919 N. Michigan Ave., Chicago (11), Illinois.

Washing Machines, Selection and Use. Home and Garden Bulletin No. 32, U. S. Department of Agriculture, 1961.

H. BUYING FROM A CATALOGUE

Develop knowledge and skills necessary to buy efficiently from a catalogue.

1. Advantages of catalogue buying.

   a. Time saver

   b. Convenience if one does not live near a store.

c. Prices are usually less.

2. Disadvantages

a. Can not be certain of quality of merchandise.

(1) Can be returned, however.

b. Can not see merchandise until it is delivered.

c. Clothes may not be proper fit.

3. Stores selling by catalogue.

a. Sears, Roebuck and Company

b. Montgomery Ward Company

c. Spiegels

4. Ordering from a catalogue.

a. Fill in proper information on order blank usually found at back of catalogue.

(1) Your name

(2) Your address

(3) Item wanted

(4) Catalogue number

(5) Size or kind

(6) Color, 1st and 2nd choice

(7) Quantity of merchandise wanted

(8) Price

SUGGESTED EDUCATIONAL ACTIVITIES

Building your vocabulary

Catalogue	Quality
Catalogue number	Quantity

Item	Size
Mail order	1st choice
Order blank	2nd choice
Price	

1. Bring catalogues from different stores to class. Discuss how items are grouped together in catalogue.

2. Select one item in catalogue to be ordered. Read for information as to catalogue number, sizes, choice of color and price.

3. Each student practice writing out an order blank with the correct information filled in.

4. Class discuss filled in order blanks to see if all important information has been included.

I. BUYING A CAR

Develop the knowledge and skills necessary to efficiently buy a car.

1. Where to purchase a car.

   a. From a new car dealer.

   b. From a used car dealer.

   c. From a private party.

2. Information about car agencies.

   a. New car agencies

      (1) New cars are backed by reputation.

      (2) New cars are backed by a factory warranty.

      (3) One has choice of model and color.

      (4) New car agencies sell used cars.

         (a) Used cars taken in on trade-ins on purchase of new car.

         (b) These used cars are usually safer.

(1) They are not junk bought by agency just for resale.

(2) Usually sell old trade-in cars to regular used car lots.

(5) New car agencies have efficient service facilities for both new and used cars.

(a) Factories require service facilities for new cars in agencies where they are sold.

(6) New car agency is usually considered a reliable place to buy a used car.

b. Used car dealers

(1) Usually there are no facilities for servicing cars.

(2) Sometimes difficult to get adjustments made on inferior car sales.

(3) Sometimes sell left-over or rejected cars from the trade-ins of new car dealers.

(4) Cars on a used car lot will sell for less because of less overhead.

c. Private party

(1) Car usually cheaper in price.

(a) No overhead.

(2) Financing sometimes more difficult.

3. Auto Blue Book

a. What it tells.

(1) Average prices of new and used cars.

(2) Finance chart with average interest rates on car loans.

4. Things to look for in buying a used car.

a. Condition of tires.

b. Condition of body.

c. Areas repainted.

d. Speedometer reading.

(1) Cannot be depended on.

e. Get advice of a mechanic.

SUGGESTED EDUCATIONAL ACTIVITIES

Building your vocabulary

Auto agency	New car dealer
Auto blue book	Used car dealer
Factory warranty	Financing
Guarantee	Liability insurance
Service facilities	

Bring in newspaper advertisements of used cars.

Have class discussion concerning ad to see if it tells:

Condition of car.
Does it list features of car, such as color, "extras", etc.
Does it give information about financing or trade-ins.

Invite Insurance Agent to class to discuss important facts on car insurance.

Class should apply vicariously for an automobile loan, understand payment requirements, and make payments by check until loan is repaid.

AUDIO-VISUAL AIDS

Film--"Your Ticket to Safety	F102
Filmstrip--"Controlling The Car"	FS668

SECTION V

LEARNING HOW TO MAKE EFFECTIVE USE OF CREDIT

A. BUYING ON CREDIT

Develop an awareness of the importance of credit.

Develop an awareness of the value of a good credit rating.

Develop an understanding of the different types of consumer credit and their purposes.

Develop a realization of the fact that the disadvantages of credit stem not so much from its use as from its abuse.

Develop the knowledge and skills necessary to use credit wisely in personal and family money management.

1. <u>What credit is</u>.

   a. Credit is a means by which something of value is obtained now with the promise to pay for it at some future time.

2. <u>Types of sales credit</u>.

   a. Open charge accounts

   b. Installment plan

   c. Revolving plan

<u>Open Charge Accounts</u>

A form of credit whereby customers are expected to pay for their purchases in full within 10 or 15 days after receiving the bill.

Develop ability to understand advantages and disadvantages of buying on credit.

1. <u>Advantages of charge accounts</u>.

   a. Charge accounts enable you to have goods when you need them.

   b. Charge accounts are a convenience.

c. Charge account customers receive good services.

d. Charge accounts help establish your credit rating.

(1) Establish a good credit rating by paying bills promptly.

2. Disadvantages of charge accounts.

a. Buying on credit can be more expensive.

b. Buying on credit may encourage extravagance.

(1) Charge accounts tend to increase impulsive spending.

c. A charge account may tie you down.

Develop ability to successfully make application for credit at a store.

1. How to open a charge account.

a. Fill out a credit application form.

(1) Applicant's income

(2) Size of family

(3) Amount of any money you owe on

(4) Name of applicant's bank

(a) Savings Account

(b) Checking Account

(5) Own your own home

(6) How long applicant has lived at present address

(7) How long on present job

Develop ability to use open charge account wisely.

1. Using an open charge account.

a. "Credit Card" or "Charge Plate" will be sent to you.

(1) Place your signature (name) in proper place.

b. Sales ticket--a form on which the sales clerk records the sale.

(1) One copy is given to you.

(2) Keeping sales tickets for a period of time is wise:

(a) They help you to keep track of the amount you have been charged.

(b) They will be needed if merchandise purchased has to be returned.

(c) They may serve as evidence in case of an error in your account.

c. A bill is mailed once a month for purchases.

d. Monthly charge statements should be checked carefully.

e. Paying your account

(1) If you pay a bill by check, your cancelled check serves as a receipt.

(2) If you pay by cash, store will use rubber stamp on bill.

(3) Keep receipted bill in safe place.

B. BUYING ON INSTALLMENT

Develop ability to buy on installment wisely.

1. <u>What installment credit is</u>.

a. Form of sales credit that permits buyer to pay for goods by making regular payments over an extended period of time.

2. <u>Disadvantages</u>

a. It costs more.

b. You must pay extra for the privilege of extending payments over a period of time.

c. A down payment is required on installment buying.

d. Buyer must sign a written agreement.

(1) How much is to be paid.

(2) When and how payments are to be made.

(3) What happens if payments are missed.

3. Purchases made on installment plan.

a. Items usually not purchased on a 30, 60, or 90 day charge account basis.

(1) Automobiles
(2) Major household appliances
(3) Furniture

4. Differences of charge accounts and installment credit.

Charge Account Buyer	Installment Credit Buyer
a. Usually does not pay extra for service he receives.	a. Must pay extra for privileges.
b. Usually not required to pay anything at time of sale.	b. Must make down payment when he buys merchandise.
c. Usually not required to sign a formal contract at time of purchase.	c. Must sign a written agreement that lists the terms of the sale.
d. When purchase is made, ownership passes immediately to buyer.	d. Ownership does not pass to the buyer until the goods are paid for.

5. Things an installment credit contract should show.

a. Cash price of article purchased.

b. Any credit service charge.

c. Any insurance fees.

d. Miscellaneous charges, if any, like sales taxes, excise tax, etc.

e. Total purchase price.

f. Amount of the down payment.

g. Special allowances, if any.

h. Trade-in or other credits.

i. Amount of unpaid balance.

j. Amount of each payment and when it is to be made.

6. Things to consider before signing an installment contract.

a. Does the cost of article justify buying it on installment?

b. Can you make the payments?

c. Do you understand all the terms of the contract?

SUGGESTED EDUCATIONAL ACTIVITIES

Building your vocabulary

Credit
Open charge account
Credit rating
Sales ticket
Credit ticket
Credit bureau

Invite a speaker from a local credit department to explain credit buying. Ask him to explain steps necessary in making a time payment purchase.

After careful preparation, students are assigned to go to a large store and obtain blanks necessary for credit buying.

Discuss different types of forms brought to class.

Each member of class fill out a form properly, with the teachers help.

Place filled out application blank into notebook for future reference.

Prepare a bulletin board showing dangers and advantages of buying on credit.

SUGGESTED MATERIALS FOR TEACHER REFERENCE

Gregg. General Business for Everyday Living. McGraw-Hill Book Company, Incorporated, New York, 1958.

Bahr, Gladys, Using Consumer Credit. Consumer Education Series, Unit No. 9, National Education Association, Washington, D.C., 1947.

Mors, Wallace P., Consumer Credit-Facts for You. Educational Pamphlet, No. 1, Bureau of Business Research, Western Reserve University, 1955.

Swanson, Naomi, Your Shopping Dollar. Money Management Institute of Household Finance Corporation, Chicago, Illinois, 1958.

Using Our Credit Intelligently. National Foundation of Consumer Credit, 925 15th St., N.W., Washington, D.C.

C. BORROWING MONEY

Develop an understanding of the obligations involved when borrowing money.

Develop the ability to make wise choices when borrowing money.

1. Borrowing money is a form of credit.

   a. Cash loan, borrowing, credit.

      (1) When money is obtained with a promise that it will be repaid at some future time.

2. How to obtain a loan.

   a. You will always be asked to sign a promissory note, commonly known as note.

      (1) This is a written promise you will repay the amount of money lent to you.

3. Types of loans

   a. Character loan

      (1) Small loan given to person (with reputation for honesty and dependability) on his signature alone.

b. Installment loan

(1) Repaid by means of equal weekly or monthly payments.

c. Single-payment loan

(1) Repaid in lump sum usually 30, 60, or 90 days after it is made.

4. Where you can borrow money.

a. Borrowing from a bank.

(1) Convenient to have all financial transactions in one place.

(2) If you are known at bank, it may mean you can get better service than elsewhere.

b. Borrowing from a Small-Loan Company.

(1) Interest rates are generally higher than those charged by banks.

(2) Most loans are of the installment type.

c. Borrowing from a Credit Union.

(1) Cost of loan is less than cost of a small-loan company.

(2) Loan sometimes cost less than a bank loan.

(3) Credit union provides loans to members only.

(a) Members of a credit union are people with a common interest.

5. How to get a loan.

a. Investigate different loan sources for the best service.

b. Locate the correct department or person to discuss loan.

c. Have the necessary information with you at time of applying for a loan.

(1) Purpose of loan
(2) Name of employer, job, income
(3) Collateral
(4) Method of repayment
(5) Credit rating

d. Information you want to know.

(1) Length of loan
(2) Interest rate you will pay
(3) Small loans are costly sometimes
(4) Total amount to be repaid
(5) Mortgage refinancing

e. Your legal obligations and responsibilities.

(1) Penalties for failure to meet payment
(2) Contract contents
(3) Procedure to follow in case of inability to meet payments.

6. Rules to follow in borrowing money.

a. Is it necessary for me to borrow this money?

b. Am I certain I can repay the loan?

c. Am I borrowing only the amount of money I really need?

d. Am I getting the loan at the lowest cost?

e. Do I clearly understand the contract before I sign any papers?

SUGGESTED EDUCATIONAL ACTIVITIES

Building your vocabulary

Credit union
Small loans
Principal
Single-payment loan
Installment loan
Short-term credit

Work some problems which show the extra cost (percentage wise) when purchasing an article, e.g., T.V. set, on time payments.

Invite a speaker from credit department of a local store to explain various credit payment plans and the total procedure involved in making a time payment purchase.

Invite a speaker from a local credit bureau to explain how credit ratings are established.

Invite a banker or credit manager to discuss "Use and Abuse of Credit".

Role-play shopping for a loan at a bank.

Role-play shopping for a loan at a credit union.

Role-play shopping for a loan at a small-loan company.

Have a class discussion of the charges and conditions of each loan.

Make a bulletin board display of various credit buying forms, such as bank note, installment sales contract, loan agreement from a small-loan company, credit application form, charge-a-plate, credit cards of all kinds.

Class should become familiar with the data required for completing these forms.

AUDIO-VISUAL AIDS

Film--Banks and Credit	F 731
Film--Credit and Loans	F 2747
Film--Installment Buying	F 732
Film--Wise Use of Credit	F 2749

SUGGESTED MATERIALS FOR TEACHER REFERENCES

Consumer Credit--Facts for You. Educational Pamphlet No. 1, Bureau of Business Research, Western Reserve University, 1955.

Using Our Credit Intelligently. National Foundation for Consumer Credit, 125 15th St., N.W., Washington (5), D.C.

Small Loan Laws--Consumer Credit Facts for You. Household Finance Corporation, Consumer Education Department, 919 N. Michigan Ave., Chicago (11), Ill.

What Are Credit Unions and How Can We Use Them. Credit Union National Association, 1617 Sherman Ave., Madison (1), Wisconsin.

SECTION VI

LEARNING ABOUT INVESTING IN A HOME

A. BUYING A HOME

Develop the knowledge, skill and attitudes necessary for the student to understand:

The purchase of a home represents a form of savings.

When purchase is completed, the buyer has something of permanent value.

It continues to provide the owner with shelter.

Home ownership provides a kind of security that does not go with renting.

1. Reasons for home ownership.

   a. When paid for, the buyer has something to show for his money.

   b. The owner has security in that he cannot be forced to move.

   c. The owner can make any changes in the home and yard that please him.

   d. Home ownership improves a person's credit rating.

2. Reasons for renting.

   a. A person is not tied down to one neighborhood.

   b. Landlord usually assumes all responsibility for maintenance and repairs.

   c. Landlord takes all investment risks.

B. THINGS TO CONSIDER IN PURCHASING A HOME

1. Costs of home ownership.

   a. Monthly payments (with interest)

   b. Taxes

   c. Up-keep

   d. Insurance

   e. Improvements

      (1) Landscaping

      (2) Fences

      (3) Carpeting

      (4) Furniture

2. Loan payments.

   a. Ninety per cent of people who buy homes today pay for them on an installment basis.

      (1) Pay a down payment on part of purchase price.

      (2) Borrow the balance.

      (3) Loan is repaid in monthly installments over a period of years.

3. Taxes

   a. Property taxes

      (1) Factors that determine the amount of tax to be paid.

         (a) Location of a house.

         (b) Value of a house.

         (c) Size of the lot on which house stands.

4. Home insurance.

   a. Cost of insurance depends on

(1) Materials used in the house.

(2) The distance of the property from other buildings.

(3) Efficiency of the local fire department.

5. Up-keep

a. Keeping a home in good repair protects its value.

b. Maintenance costs will vary with age of house and type of construction.

(1) Different types of construction.

(a) Wood

(b) Stucco

(c) Block

(2) Types of windows are important in cost of up-keep.

(a) Wooden

(b) Aluminum

(c) Steel

(3) Types of roofs.

(a) Wooden shingles

(b) Asphalt

(c) Rock

6. Location of home.

a. Is the home near your job?

b. Is it near a school?

c. Is it near a shopping center?

d. Are the homes around it similar in price?

e. Is the neighborhood well kept or is it already rundown?

f. Are the streets, sewers, street lights, and curbs in?

g. Is there a heavy traffic nearby?

h. Is it near factories or dumps where there might be unpleasant smells?

7. <u>What to look for inside the house and out</u>.

a. Does the house seem well built?

b. Does it have adequate floor space for your family needs?

c. Is the heating system good?

d. Does it have enough bedrooms and toilet facilities for your present or future needs?

8. <u>Observe rules for wise buying</u>.

a. Have a steady job before buying a home.

b. Be certain of where you want to live for a long time.

c. Study all extra costs of a home, besides payments, before you buy.

d. Get the help of experts.

(1) Real Estate Agent

(2) Real Estate Appraiser who is trained to judge the value of property.

(3) Lawyer

(a) You will have to sign many papers.

(b) Make sure you understand all of the terms.

(c) Do not hesitate to ask for help and information.

e. Be sure you have title insurance.

(1) This protects your ownership.

(2) A lawyer can be helpful to make certain you are obtaining clear title.

SUGGESTED EDUCATIONAL ACTIVITIES

Building your vocabulary

- Appraiser
- Real estate agent
- Mortgage
- Closing costs
- Maintenance
- Depreciation
- Title

Invite a real estate man to talk to class about problems involved in buying a home.

Have speaker discuss the costs, legal involvements, and obligations in purchasing a home.

Ask questions about problems involved when renting a home.

Make a bulletin board display of different types of homes; include big and little homes, low, medium and high priced homes.

Make a list of procedures to follow when buying a home on the blackboard and have a class discussion of the list.

Give each student a copy of this list to be placed in his notebook.

SUGGESTED MATERIALS FOR TEACHER REFERENCE

Your Home-Buying Ability. Federal Housing Administration, F.H.A. No. 428, Washington (25), D.C.

Your Shelter Dollar. Household Finance Corp., Consumer Education Dept., 919 N. Michigan Ave., Chicago (11), Ill.

SECTION VII

LEARNING ABOUT PROTECTION THROUGH INSURANCE

A. INSURANCE

Develop an awareness of the important role insurance plays in our lives.

Develop the knowledge, skill and attitudes necessary for the student to:

Understand the need for the major types of insurance and the purposes they serve.

Evaluate the extent of protection needed.

Obtain competent assistance when purchasing necessary insurance protection.

1. What is insurance?

   a. Insurance--a promise of protection against loss.

   b. Insured or policy-holder--a person who buys insurance protection.

   c. Policy--a written agreement or contract in which an insurance company guarantees or promises to protect a policy-holder against certain losses or misfortunes.

   d. Premium--a sum of money paid by the policy-holder for protection. This is paid monthly, quarterly (three times a year), semi-annually (twice a year), or yearly (once a year).

   e. Insurance agent--one who sells insurance.

2. There are many different kinds of insurance to give protection in many ways.

B. AUTOMOBILE INSURANCE

Develop the knowledge, skills and attitudes necessary for the student to recognize the importance of and understand principles of automobile insurance.

1. Public liability or bodily injury insurance.

   a. Provides financial protection in the event your car injures another person.

   b. California State Law requires every car owner to carry this kind of insurance.

2. Property Damage

   a. Insurance that pays for damages caused by the insured's car to any type of property.

   b. The property may be another automobile, a house, a store, or anything else except a person.

3. Collision Insurance

   a. Insurance that pays for damage to the insured's automobile for collision or upset regardless of responsibility.

4. Deductible Clause

   a. A clause in the Collision Insurance that makes the insured person responsible for paying part of the loss or damage himself.

   b. Collision insurance is available in $50 and $100 deductions.

   c. The car owner who is willing to assume responsibility for small losses in case of minor repairs pays much less for collision insurance than the person who has full coverage.

5. Comprehensive Insurance

   a. Gives you protection against damages to your car that are not covered by collision insurance.

   b. Includes fire and theft as well as damages caused by storms, falling objects, such as tree branches, and glass breakage.

6. Medical Payments

   a. The insurance company pays medical expenses, or funeral expenses if the passenger is killed.

7. Procedures to follow after an automobile accident.

   (It is difficult to remain calm when an accident occurs, but there are important things to do).

   a. Report the accident to Police.

   b. Get name, address and telephone number of driver of other car.

   c. Write license number of other car.

   d. Get name and address of any person who witnessed accident.

   e. For your own protection, do not admit responsibility.

   f. Get policy number of other driver and his insurance company.

   g. Report accident to your insurance company immediately.

8. Factors which contribute to the cost of Automobile Insurance.

   a. Teenage drivers

   b. State regulations

   c. Driver education

   d. Areas where you live

   e. Use of your car

   f. Value of your car

   g. Costs of Finance Company Insurance added to purchase price.

9. Factors to be considered in selecting a desirable insurance agency.

   a. Business history of company and agents.

      (1) Is the company well known?

b. Ethics practiced by company and agents.

c. Experiences of people who have needed and received the various services rendered by insurance companies.

(1) Have they been helpful in time of need?

(2) Did they pay immediately?

d. Choose an agent you can talk with easily.

e. A good agent can help choose the policy that is best for your purposes.

SUGGESTED EDUCATIONAL ACTIVITIES

Building your vocabulary

Public liability insurance
Property damage insurance
Collision coverage
Comprehensive coverage
Deductible clause
Medical payment coverage

Students bring Motor Vehicle Code book to class.

Have class discussion on safety rules for driving.

Make a list of safe and sensible driving rules.

Invite insurance agent to class to explain important facts one should know about automobile insurance.

Discuss how safety and automobile insurance are related.

List the five kinds of automobile insurance and the risks involved in each type.

SUGGESTED MATERIALS FOR TEACHER REFERENCE

Crabbe, et al, General Business, (Seventh edition), South-Western Publishing Company, Cincinnati, 1956.

Price, Ray G. and Musselman, Vernon, General Business, McGraw-Hill Book Company, Incorporated, New York, 1958.

Sample policies and pamphlets from leading automobile insurance companies.

C. HOME INSURANCE

Develop the knowledge, skills and attitudes necessary for the student to understand the needs of the basic types of home insurance.

1. Fire Insurance

   a. Protection against losses caused by fire itself, and damage caused by the smoke that accompanies the fire.

   b. Covers losses caused by water or by chemicals used to put out the fire.

   c. Covers losses caused by destruction of buildings to prevent the spread of fire.

2. Extended Coverage

   a. For an added premium, fire insurance will also provide protection against losses by windstorms, hailstorms, falling aircraft, vehicles, explosion or vandalism.

3. Personal Liability Insurance

   a. Protection against having to pay damages in case others are injured while on his property.

4. Theft Insurance

   a. Another way of protecting personal property against loss.

   b. This type of insurance is quite high compared to costs of other insurance.

5. Homeowners Policy

   a. It is now possible to buy one insurance policy that combines several different kinds of protection. It includes:

      (1) Extended coverage insurance on home and contents.

      (2) Theft insurance.

      (3) Personal liability coverage.

b. If one wants protection against all of the possible losses, it is cheaper to buy one policy rather than several separate ones.

SUGGESTED EDUCATIONAL ACTIVITIES

Building your vocabulary

Compensation
Fire insurance
Extended coverage
Personal liability
Personal property
Theft insurance
Homeowner policy

Each member of class collect pamphlets and brochures from insurance companies selling policies on home insurance.

Make a bulletin board display of advertisements of different types of insurance policies found in pamphlets, newspapers, and magazines.

Discuss advantages and disadvantages of different home insurance policies.

Invite an insurance agent to class to explain home insurance and discuss what the minimum coverage should be.

Each member of class secure and complete a household furniture inventory of their home. Make estimate of the replacement value to be covered by insurance.

SUGGESTED MATERIAL FOR TEACHER REFERENCE

F.H.A. Home Mortgage Insurance (Fact Sheet), Office of Public Information, F.H.A. Bulletin No. 208, 1961.

The Voluntary Home Mortgage Credit Program, What It Is--How It Works. National Committee, Washington (25), D.C., 1960.

Risks We Face. National Board of Fire Underwriters, 85 John St., New York, New York.

D. LIFE INSURANCE

Develop the knowledge, skills and attitudes necessary for the student to realize the importance of planning for the future through life insurance.

1. Basic functions

   a. Provides protection for a wage earner's dependents in case he should die.

   b. Provides a means of accumulating savings for the policyholder's use.

2. Types of life insurance available

   Term Insurance

   Straight Life Insurance called Ordinary Life

   Limited Payment Life

   Endowment Insurance

   a. Term Insurance

      (1) Provides protection for only a definite period of time.

      (2) Least expensive form of life insurance.

   b. Straight Life Insurance

      (1) Provides protection for a lifetime as long as premiums are paid.

      (2) Premium payments never change.

   c. Limited Payment Life

      (1) Provides permanent protection same as straight life except premiums are paid only a certain number of years.

      (2) Payments of premiums are higher since fewer payments are made.

   d. Endowment Insurance

      (1) Pays the policyholder himself the value of the policy if he is still living at end of protection period.

(2) Policyholder pays into this policy 10, 20, or 30 years from the date the policy is issued.

(3) This policy costs more per year than other policies do.

3. Determining needs for life insurance.

a. Single

b. Married

c. Size of family

d. Family support

e. Child education

4. Understanding factors which contribute to cost of life insurance.

a. Age

b. Type of policy

c. Amount of policy

5. Why buy term insurance?

a. A person may have only a temporary need for extra protection.

b. It provides the most protection for least amount of money while it is in effect.

6. Why buy straight life insurance?

a. Straight life insurance is the type most people purchase.

b. Provides lifetime protection for the least cost.

c. A forced savings.

d. Premiums remain the same as long as the policy is carried.

7. Why buy payment life insurance?

a. People whose earnings are high for brief periods, like professional ball players, find limited payment life policies a wise buy.

8. Why buy endowment insurance?

   a. Provides protection for a policyholder's dependents should the policyholder die.

   b. Provides savings as the face value will be paid to the policyholder when the policy matures.

9. Some policies have special features.

   a. Double Indemnity

      (1) Twice the value of the policy is paid if the insured dies as a result of an accident.

   b. Disability Income Clause

      (1) The insurance company pays the policyholder's premiums plus a monthly income in case he is disabled.

SUGGESTED EDUCATIONAL ACTIVITIES

Building your vocabulary

Beneficiary	Limited payment life insurance
Cash-surrender value	Renewable
Convertible	Straight-life insurance (ordinary life insurance)
Endowment insurance	Term insurance
Grace period	Double Indemnity

Invite a speaker from a major life insurance company to explain and discuss the basic types of life insurance.

Ask the speaker to explain the steps necessary to purchase life insurance. Be sure he includes coverage needed, cost determination and health examination in his discussion.

Class members obtain a sample life policy and discuss thoroughly in class.

Teacher and class construct hypothetical insurance coverage for different family needs:

1. Single employed individual.
2. Married home owner with children.

SUGGESTED MATERIALS FOR TEACHER REFERENCE

"Life Insurance Knowledge For Young Americans" Garney L. Darrin, Grade Teacher, March, 1963. Vol. LXXX No. 7.

A Teachers Guide To Sharing The Risk. Educational Division, Institute of Life Insurance, 488 Madison Ave., New York (22), New York.

What a Young Man Should Know About Life Insurance. Educational Division, Institute of Life Insurance, 488 Madison Ave., New York (22), New York.

Student Kit Life Insurance Policy Contracts, Massachussetts Mutual Life Insurance Company, Springfield, Mass.

What's In Your Life Insurance Policy? Institute of Life Insurance, 488 Madison Ave., New York (22), New York.

E. HEALTH AND ACCIDENT INSURANCE

Develop the knowledge, skills and attitudes necessary for the student to recognize the needs of the various kinds of health and accident insurance.

1. Types of insurance available.

   a. Accident Insurance

      (1) Covers losses resulting from injuries only.

   b. Loss of Income Insurance

      (1) Provides protection against loss of wages or salary because of disability.

   c. General Medical Expense Insurance

      (1) Covers doctor bills for illnesses not requiring surgery.

   d. Hospital Expense Insurance

      (1) Pays all or part of the costs of hospitalization.

   e. Major Medical Expense Insurance

(1) Provides payment of expenses resulting from a very serious or prolonged illness.

f. Surgical Medical Expense Insurance

(1) Pays all or part of the doctor's bill for an operation.

g. Workmen's Compensation Insurance

(1) Certain employers are required by law to carry protection for employees who may be injured on the job.

2. Determination of needs for Health and Accident Insurance

a. Protection against large medical bills.

b. Feeling of personal and family security.

3. Factors which contribute to the cost.

a. Total costs of medical bills submitted to the company.

b. Number of persons in family covered by the policy.

c. Extent of benefits covered by policy.

d. Employer participation in costs.

SUGGESTED EDUCATIONAL ACTIVITIES

Building your vocabulary

Accident insurance
General Medical expense insurance
Hospital expense insurance
Loss of income insurance
Major medical expense insurance
Surgical expense insurance
Workmen's compensation insurance

Discuss how the following ways can prevent losses and reduce insurance rates.

1. Regulation of trash burning.

2. Restriction on sale of fireworks.

3. Approval of new building construction.
4. Zoning regulations.
5. Sponsorships of safety campaigns.
6. Efficient fire and police protection.
7. Traffic regulation and control.
8. Inspections of fire hydrants.
9. Flood-control projects.
10. Construction of better roads.
11. Mandatory inspection for fire hazards.
12. Improved highway maintenance.
13. Required maintenance of vacant lots.
14. Accurate and improved weather forecasting.
15. Improved public-health service.
16. Improved health information.
17. Industrial safety regulations.

Obtain brochures from Blue Cross, or other group insurance plans and discuss the types of coverage in each one.

Teacher lead discussion of workmen's compensation laws and benefits.

SUGGESTED MATERIALS FOR TEACHER REFERENCE

Price, Ray G. & Musselman, Vernon, General Business For Everyday Living, Gregg Publishing Division, McGraw-Hill Book Company, Incorporated, New York, 1958.

State Workmen's Compensation Laws. U. S. Department of State Labor, Superintendent of Documents, Washington, D. C.

F. OLD-AGE AND UNEMPLOYMENT PROTECTION

Develop the knowledge, skills and attitudes necessary to develop an understanding of the need for financial security in old age or during periods of unemployment, and an understanding of the different ways this security may be obtained.

1. Social Security Program

   a. Two types of protection.

      (1) Old-age, survivors, and disability insurance.

      (2) Unemployment insurance.

   b. Old-age, survivors and disability insurance.

      (1) Provides retirement income for a worker if he lives.

      (2) Insurance protection for his family if he dies.

   c. Who pays for old-age, survivors and disability insurance?

      (1) Financed by a tax deducted from worker's pay by his employer.

      (2) Employer also must contribute an equal sum.

      (3) Self-employed persons pay at time they file income tax returns.

   d. Social Security Number

      (1) Obtained when one is old enough to work.

      (2) Apply at nearest Social Security Office.

      (3) Card will have account number.

      (4) Number remains the same during entire life time.

      (5) Social Security has two parts:

         (a) One is carried with person at all times.

         (b) Other part should be kept in safe place.

(6) If card is lost, duplicate card will be given at nearest security office.

(a) Duplicate card will have same number.

2. Unemployment Insurance

a. Provides an income to workers who, through no fault of their own, have lost their jobs.

3. Pension

a. Money paid to a retired worker.

SUGGESTED EDUCATIONAL ACTIVITIES

Building your vocabulary

Old-age, survivors and disability insurance
Pension
Unemployment insurance
Living benefits

Obtain a bulletin describing social security benefits from your local Social Security Office.

Each student go to Social Security Office and ask for forms required for applying for social security card.

Students practice filling out forms.

Each class member should complete requirements for receiving a social security card.

SUGGESTED MATERIALS FOR TEACHER REFERENCE

Social Security Kit. U. S. Department of Health, Education and Welfare, Washington (25), D.C.

Good News For Household Workers. U. S. Department of Health, Education and Welfare, (Social Security Administration O A S I-24). Washington (5), D.C., 1961.

SECTION VIII

EVALUATION

The following suggestions are some of the ways a teacher may evaluate each student's progress:

1. Individuals participating in discussions and activities related to actual consumer experience.
2. Evaluation of vocabulary comprehension.
   a. Observing to what degree a student functionally uses pertinent vocabulary.
   b. Appropriate use of words in his written work.
3. Initiative and incentive on a student's part in collecting outside learning aids and other materials used in the course (checks, labels, application forms, etc.).
4. Evidence of acceptance and application of the concepts being taught (positive attitude, cooperation, active participation, etc.).

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SELECTED BIBLIOGRAPHY

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Dinger, Jack C. "Former Educable Retarded Pupils", Exceptional Children, 27:253-260, March, 1961.

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Education Code. Vol. I. Sacramento: State of California Documents Section, Printing Division. Sections 1 to 17104, Division 6, Chapter 9, Section 6902, pp. 348, 349, 350.

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Featherstone, William H. Teaching the Slow Learner. New York: Teachers College, Columbia University, 1951. pp. 35-44.

Garden Grove Union High School District. District Coordinated Course Outlines for 1961-62. pp. 403-408.

Goldstein, Herbert, and Dorothy Seigle. The Illinois Plan for Special Education of Exceptional Children: A Curriculum Guide for Teachers of the Educable Mentally Handicapped. Circular Series B-3, No. 12. Springfield, Illinois: State Department of Public Instruction, 1958.

Ingram, Christine P. Education of the Slow-Learning Child. New York: The Ronald Press Company, 1960. pp. 3-74.

Kirk, Samuel A. Educating Exceptional Children. Boston: Houghton Mifflin Company, 1962. pp. 105-132.

_____, and G. Orville Johnson. Educating the Retarded Child. Cambridge, Massachusetts: Houghton Mifflin Company, 1951. pp. 434.

Los Angeles County Superintendent of Schools, 808 North Spring Street, Los Angeles, California. Educating the Mentally Handicapped: A Search for Potentialities. Supplement Special Education No. 3. Los Angeles: County Board of Education, 1960.

MacMillan, Hazel. "Retarded in Educational Programs for Exceptional Children". Pittsburg, Pennsylvania: Tri-State Area School Study Council 1956-1957 School Year.

Martens, Elsie, H. Curriculum Adjustments for the Mentally Retarded: A Guide for Elementary and Secondary Schools. Bulletin 1950, No. 2, Office of Education, Department of Health, Welfare, and Education. Washington, D.C.: U.S. Government Printing Office, 1957. pp. 1-100.

Orange County Superintendent of Schools. Administrator's Handbook for the Establishment and Operation of Classes for Educable Mentally Retarded Children of Orange County. Prepared by Division of Guidance and Special Services: Santa Ana, California: Office of the County Superintendent of Schools, Bulletin Series S., No. 117, November, 1960.

Preparation of Mentally Retarded Youth for Gainful Employment. U.S. Department of Health, Education, and Welfare, Office of Education, Office of Vocational Rehabilitation, and Project on Technical Planning, American Association on Mental Deficiency. Office of Education Bulletin 1959, No. 28, and Rehabilitation Service Series No. 507. pp. 2-82.

Shawn, Bernard. Foundations of Citizenship Book Two. Chapter III, "Spending and Saving Your Income", Chapter IV, "Savings and Insurance". Phoenix, New York: Frank E. Richards, 1962.

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Suggested Activities for Mentally Retarded Children. Bulletin of the California State Department of Education, Vol. XXI: No. 2, January, 1952. Sacramento: California State Department of Education. pp. 1-7.

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Addenda

A REQUEST

The authors realize that real evaluation of this publication can be made only by those who put it to actual use. Each teacher using this guide (particularly those of Orange County) is urged to please make notations on the blank backsides of the sheets of his copy -- criticisms, corrections, additions, deletions. At the time of reprinting, these suggestions will be incorporated into the revised edition.

Your help to improve continually the usability of these materials will indeed be appreciated.

The Authors

VT 000 946

Agriculture II: A Curriculum Unit Outline for Vocational Agriculture.

South Carolina State Dept. of Education, Columbia. Vocational Agriculture
Clemson Univ., S.C. Dept. of Agricultural Education
MF AVAILABLE IN VT-ERIC SET.
PUB DATE - 65 82p.

DESCRIPTORS - *CURRICULUM GUIDES; *VOCATIONAL AGRICULTURE; *GRADE 10; PLANT SCIENCE; SOIL SCIENCE; AGRICULTURAL PRODUCTION; CONSERVATION EDUCATION; SUPERVISED FARM PRACTICE; AGRICULTURAL ENGINEERING; LEADERSHIP TRAINING

ABSTRACT - For use in teaching second-year vocational agriculture, this curriculum guide outlines the subject matter content, giving suggested time allotment, suggested resource materials, and detailed lists of references. The subject matter, often posed in the form of problems, includes units on: (1) Importance of Agriculture, (2) Crop Production, (3) Plant Science and Soils, (4) Farm Home and Family, (5) Farm Mechanics, (6) Supervised Programs of Agricultural Practice, (7) Leadership Training, (8) Conservation of Natural Resources, and (9) Animal Production. (AW)

VT 000 946

ERIC

AGRICULTURE II

A CURRICULUM UNIT OUTLINE

FOR

VOCATIONAL AGRICULTURE

Vocational Agriculture
Division of Vocational Education
State Department of Education

and

Department of Agricultural Education
Clemson University

1965

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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VT000 946

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CODE USED TO HELP TEACHERS DETERMINE POSSIBLE NEED FOR THE RESOURCE MATERIALS LISTED IN THE BIBLIOGRAPHIC LIST FOLLOWING EACH UNIT

Between the identification code number and the title you will find a letter. This letter is a coded attempt to indicate probable usage of this publication in your department. The code is as follows:

(T) This is probably limited to use as a teacher reference. One copy per department is probably the maximum you would possibly want.

(ST) This is a publication that may be a teacher reference and may be used by students on a limited basis. Perhaps one copy for every four or five students in your largest class would be sufficient.

(S) This publication is one that probably would serve well as a student reference for classroom work. Perhaps, if this reference were selected, there should be one copy available for each member of your largest class.

(D) This is a publication that should already be available in your department since it has been distributed in recent years. In most instances these publications are out of print.

This does not mean that you must order one copy of each (S) rated bulletin for each member of your largest class. Some bulletins duplicate each other. However, if you decide you can use such a bulletin the code is used only as a guide for determining the number of copies you might need. Neither does this mean that you can not use (T) or (ST) bulletins for class reference. If, after ordering one, you believe you can use this bulletin to advantage with your class, that is your option. This code is a guide. It is hoped that it will help you to order materials in a more practical manner.

IMPORTANCE OF AGRICULTURE

Suggested Minimum Time Allotment is 2 Periods	Suggested Resource Material
I. Review Up to Date Materials on the Opportunities in: A. Production agriculture B. Agricultural employment C. Agricultural occupations	Review resource materials list in Agriculture I Curriculum Outline, "Importance of Agriculture" unit. Also: 1. 2. pp. 81-116, 673-688 3. pp. 153-182 4. pp. 3-74, 424-610 Clemson 1 Clemson 2 USDA 1 USDA 2 USDA 3 USDA 4 USDA 5 USDA 6 USDA 7 USDA 8 USDL 1 USDL 2 USDL 3 USDL 4 USDL 5 USDL 6 C 1 C 2
II. Review Up to Date Information Concerning Needs of an Education for the Agriculture of Tomorrow in Terms of: A. Types of education needed for various types of agricultural work. B. The importance of early planning so that one is prepared to enter the appropriate area of educational training upon completion of high school.	
III. Individual Counseling With Students, School Administration, Guidance Personnel.	
IV. Acquaint Students With all Possible Ways of Financing an Education.	

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2. Krebs, Alfred H., Agriculture In Our Lives, The Interstate Printers and Publishers, Incorporated, Danville, Illinois. 1964.

3. Byram, Harold M., Guidance In Agricultural Education, The Interstate Printers and Publishers, Incorporated, Danville, Illinois. 1959.

4. Chapman, Paul W., Occupational Guidance, Turner E. Smith & Company, Atlanta, Georgia. 1950

II. Clemson University Agricultural Publications, Clemson, South Carolina

Clemson 1 (S) Careers In Agriculture and Biological Sciences, Order from Director of Resident Instruction, College of Agriculture, Clemson University, Clemson, South Carolina.

Clemson 2 (D) Occupational Survey of Former Agricultural Students, The Clemson Agricultural College, Clemson, South Carolina. 1958. (Additional copies are no longer available).

III. Publications of the United States Department of Agriculture, Division of Information, Washington, D. C. 20250

USDA 1 (T) Economic Factors Influencing Educational Attainments and Aspirations of Farm Youth, Agricultural Economic Report No. 51. April 1964.

USDA 2 (S) An Appraisal of Agricultural Research, Agriculture Information Bulletin No. 221. February 1960.

USDA 3 (ST) An Engineering Career For You In Soil Conservation Service, Soil Conservation Service, United States Department of Agriculture, Miscellaneous Publication No. 715. May 1960.

USDA 4 (ST) A Job With the Forest Service, Forest Service, Miscellaneous Publication No. 843. July 1963.

USDA 5 (ST) A Soil Science Career for You in SCS, Soil Conservation Service, United States Department of Agriculture, Miscellaneous Publication No. 716. March 1960.

USDA 6 (S) Choose a Challenging and Rewarding Career in the United States Department of Agriculture, Miscellaneous Publication No. 833. January 1961.

USDA 7 (ST) Questions and Answers on Agricultural Research, Agricultural Research Service, Agriculture Information Bulletin No. 224. June 1963.

USDA 8 (ST) The Forest Service Engineer - Your Gateway to the Future, Forest Service, Miscellaneous Publication No. 841, November 1963.

IV. Publications of the United States Department of Labor, Bureau of Labor Statistics, 1371 Peachtree Street, N.E., Atlanta 9, Georgia

USDL 1 (S) Semiskilled and Unskilled Workers, Occupational Outlook Brief.

USDL 2 (T) From School to Work, Highlights from a Study on . . . . The Early Employment Experience of Youth in Seven Communities 1952-1957. March 1960.

USDL 3 (S) Looking Ahead to Earning a Living . . . . How Occupational Trends Affect Career Planning, Reprinted from the 1961 Edition of the Occupational Outlook Handbook, Bulletin No. 1300-A. 15¢ charge per copy.

USDL 4 (S) Family Breadwinners: Their Special Training Needs, Manpower Administration, Office of Manpower, Automation and Training, Bulletin No. 5. January 1964.

USDL 5 (T) Training for Jobs in Redevelopment Areas, Office of Manpower, Automation and Training. June 1962.

USDL 6 (T) Amendments to the Manpower Development and Training Act: More Effective Training Program for Young Workers, Office of Manpower, Automation and Training, Reprint No. 4. May 1964.

V. Commercial and Other Publications

C 1 (T) A Suggested Training Program -- The Forestry Aide, OE-87011, United States Office of Health, Education and Welfare, Office of Education, Washington, D. C. 25¢ charge.

C 2 (ST) Careers In Conservation, Soil Conservation Society of America, 838 Fifth Avenue, Des Moines 14, Iowa.

CROP PRODUCTION

I. Small Grains

Suggested Minimum Time Allotment is 8 Periods	Suggested Resource Material
A. What is the importance of small grains in South Carolina?	1.
	2. pp. 109-178
	3. pp. 387-436
	4. pp. 284-315
1. What is the importance of oats? Wheat? Barley? Rye?	5. pp. 211-273, 374-376
	6. pp. 262-328, 339-345
	7. pp. 152-174
	8. pp. 145-149, 214-231, 252 280-313, 347-349, 358 420
a. Acreage	Clemson 1
	Clemson 2
b. Yield	Clemson 3 pp. 31-33
	Clemson 4
c. Production	Clemson 5
	Clemson 6
d. Value	Clemson 7
	Clemson 8
2. What are the various uses of small grains?	Clemson 9
	Clemson 10 pp. 44-47, 73-80
3. What are the advantages of growing small grains?	Clemson 11 pp. 47-61
	Clemson 12
4. Under what conditions is it economical for a farmer to grow small grains?	Clemson 13
	Clemson 14
	Clemson 15
	Clemson 16
B. What are the principles of selecting a variety?	Clemson 17
	Clemson 18
	Clemson 19
1. How does one determine what variety of small grains to grow?	Clemson 20
	Clemson 21
	USDA 1
	USDA 2
a. What are the leading varieties of oats?	USDA 3
	USDA 4
	USDA 5
b. What are the leading varieties of wheat?	C 1
	C 2
	C 3
c. What are the leading varieties of barley?	C 4
	AV 1
	AV 2
d. What are the leading varieties of rye?	AV 3

2. How are the characteristics of each variety determined? AV 4 AV 5

   a. What are the characteristics of wheat varieties as to:

      (1) Disease resistance?

      (2) Milling quality?

      (3) Maturity?

      (4) Weight of straw?

      (5) Straw strength?

      (6) Test weight?

3. What are the characteristics of each variety of rye?

4. What are the characteristics of each variety of oats?

5. What are the characteristics of each variety of barley?

C. Fertilizing and liming small grains

1. What are the plant food requirements of:

   a. Oats?

   b. Wheat?

   c. Barley?

   d. Rye?

2. What are the things to consider in fertilizing and liming small grains?

3. What fertilization program should be followed at planting time for:

   a. Oats?

   b. Wheat?

   c. Barley?

   d. Rye?

4. What is the importance of top dressing small grains?

   a. What are the economic values of top-dressing?

   b. How much nitrogen, as top-dressing, should be used on:

      (1) Oats?

      (2) Wheat?

      (3) Barley?

      (4) Rye?

   c. When should small grains be top-dressed?

      (1) Oats?

      (2) Wheat?

      (3) Barley?

      (4) Rye?

5. What effect does lime have on small grains?

D. Seeding small grains

1. What are the considerations one must take in selecting land for production of:

   a. Oats?

   b. Wheat?

   c. Barley?

   d. Rye?

2. When is the best time to sow:

   a. Oats?

   b. Wheat?

   c. Barley?

d. Rye?

3. How much seed should be used per acre when seeding:

a. Oats?

b. Wheat?

c. Barley?

d. Rye?

E. Controlling disease, insects and weeds

1. What are the disease problems involved in the production of small grains?

a. What are the common diseases of small grain?

b. How is each disease identified?

c. What means do we have for controlling these diseases?

d. Why is seed treatment an important step in disease control?

2. What small grain production problems arise as the result of insects?

a. What are the common insects of small grain?

b. How can insect infestations be controlled?

3. How can the most common weeds in small grains be controlled?

F. How may small grains be used for grazing?

1. Which crop or combination of crops should be grown for grazing?

2. What is the value of small grains for grazing?

3. How long may oats be grazed if a crop of grain is desired?

4. How important is top-dressing for grazing crops?

5. What is the potential of seeding small grains with legumes when this crop is used for grazing purposes?

G. How may small grains be used for winter hay?

H. Harvesting, storing and marketing

1. When should small grains be harvested?

a. How is maturity determined?

b. How does weather conditions enter into harvesting operations?

c. What machinery and equipment should we use for harvesting small grains?

d. What is the cost of harvesting small grains?

2. What services are available to farmers for cleaning, grading and testing small grains?

3. How can small grains be stored and protected?

a. When is it economical to store small grains?

b. Why is a clean storage space essential?

c. How can we protect small grains from moisture damage?

d. How does fumigation prevent insect damage?

e. What is the importance of prevention of rat damage?

4. What are some of the problems of marketing small grains?

   a. When is the best time to market small grains?

   b. Can a farmer borrow money on small grains in storage?

   c. Where must grain be stored to be eligible for a loan?

   d. What facilities are necessary for farm storage?

   e. How much can a farmer borrow on properly stored grain?

   f. What are the costs in securing a loan?

I. How is certified seed produced?

1. What factors should one consider before engaging in certified seed production?

2. What procedures must be followed in producing certified seed?

I. Reference Publications

1. (D) Small Grains . . . . An Enterprise in Supervised Farming Programs of Students of Vocational Agriculture, State Department of Education, Columbia, South Carolina. Vol. VII - Number 1. 1954.

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5. Fergus, E. N., Hammonds, Carsie, and Rogers, T. H., Field Crops Including Southern Crops, J. P. Lippincott Company, New York, New York. 1958.

6. Walton, E. V. and Holt, O. M., Profitable Southern Crops, Prentice-Hall, Incorporated, Englewood Cliffs, New Jersey. 1959.

7. Wilson, Harold K. and Richer, Chester A., Producing Farm Crops, The Interstate Printers and Publishers, Incorporated, Danville, Illinois. 1960.

8. Dungan, George H. and Ross, W. A., Growing Field Crops, McGraw-Hill Book Company, Incorporated, Dallas, Texas.

II. Clemson University Agricultural Publications, Clemson, South Carolina

Clemson 1 (S) Stored Grain Insects and the Clean Grain Program, Extension Miscellaneous Leaflet. 1961.

Clemson 2 (S) Insect Control of Stored Grains, Extension Circular 435. June 1960.

Clemson 3 (D) Agronomy Handbook for South Carolina, Extension Bulletin 407. 1961.

Clemson 4 (S) Performance of Small Grain Varieties in South Carolina, Agronomy and Soils Research Series No. 50. September 1964.

Clemson 5 (S) Fall Planting Guide, Extension Service Information Card No. 91. 1963.

Clemson 6 (S) 1964 Recommended Varieties for South Carolina, Extension Circular 477. September 1963.

Clemson 7 (D) Stored Grain Insects and Their Control, Southern Cooperative Series, Bulletin No. 75. 1962.

Clemson 8 (T) Cash Receipts from Farm Marketing, AE 247. October 1963.

Clemson 9 (T) Crop Statistics, AE 220. June 1962.

Clemson 10 (T) Production Requirements and Estimated Returns from Selected Crop and Livestock Enterprises in the Piedmont Area, AE 202. October 1960.

Clemson 11 (T) Estimated Production Requirements and Returns from Selected Crop and Livestock Enterprises in the Upper Coastal Plain Area, AE 243. July 1963.

Clemson 12 (S) Control Loose Smut of Barley, Extension Circular 461. May 1960.

Clemson 13 (S) Disease and Insect Pests of Small Grains in South Carolina, Extension Circular 458. April 1959.

Clemson 14 (S) Steps in Control of Small Grain Diseases and Insects, Extension Circular 432. May 1961.

Clemson 15 (S) Wheat Kernal Damage, Extension Service.

Clemson 16 (S) Oat Kernal Damage, Extension Service.

Clemson 17 (S) Small Grains for Grain, Grazing, Hay, Silage, and Winter Cover, Extension Circular 480. August 1961.

Clemson 18 (T) South Carolina Wheat Statistics, AE 170. 1959.

Clemson 19 (T) South Carolina Oats Statistics, AE 178. 1959.

Clemson 20 (T) A Study of Small Grain Planted by South Carolina Farmers, SC 1. 1958.

Clemson 21 (S) Weeds, A South Carolina Handbook, Extension Bulletin 113. 1960.

III. Publications of the United States Department of Agriculture, Division of Information, Washington, D. C. 20250

USDA 1 (S) Store Grain Safely on the Farm, Farmers Bulletin No. 2071. 1960.

USDA 2 (ST) Inclined-Column Grain Drier, Leaflet No. 314. 1951.

USDA 3 (T) A Small Country Elevator for Merchandising Grain . . . . Designs and Recommendations, Marketing Research Report No. 387. 1960.

USDA 4 (S) Chinch Bugs - How to Control Them, Leaflet No. 364. 1958.

USDA 5 (S) Control of Common White Grubs in Cereal and Forage Crops, Farmers Bulletin No. 1798. July 1961.

IV. Commercial and Other Publications

C 1 (T) How to Dry and Store Grain and Seed on Georgia Farms, Bulletin N.S. 33, Georgia Agricultural Experiment Stations, University of Georgia, College of Agriculture, Athens, Georgia. February 1958.

C 2 (T) South Carolina Handbook of Seed Certification Standards, South Carolina Crop Improvement Association, Clemson, South Carolina. 1960.

C 3 (S) Handbook of the Insect World, Hercules Powder Company, Agricultural Chemicals Division, Naval Stores Department, Wilmington, Delaware.

C 4 (S) Diazinon Insecticides Handbook, Geigy Agricultural Chemicals, Division of Geigy Chemical Corporation, Saw Mill River Road, Ardsley, New York. 1964.

V. Loan Free Audio Visual Materials - School Pays Postage

A. Movies

AV 1 Blue Chip Farming, A. O. Smith Corporation, Audio-Visual Section, Department 0162, P. O. Box 584. Milwaukee 1, Wisconsin.

AV 2 Life from the Land, Cargill, Incorporated, Mr. Sid Burkett, Training Director, Cargill Building, Minneapolis, Minnesota 55402.

AV 3 Romance of the Reaper, Farm Film Foundation, 1425 H Street, Northwest, Washington, D. C. 20005.

AV 4 Marketplace, USA, Sterling-Movies USA, Incorporated, 43 West 61st Street, New York, New York 10023.

B. Filmstrips and Slides

AV 5 Grain Grading, Minneapolis Grain Exchange, Mr. A. W. Donahoo, Educational Director, 150 Grain Exchange Building, Minneapolis, Minnesota.

IV. Commercial and Other Publications

C 1 (T) How to Dry and Store Grain and Seed on Georgia Farms, Bulletin N.S. 33, Georgia Agricultural Experiment Stations, University of Georgia, College of Agriculture, Athens, Georgia. February 1958.

C 2 (T) South Carolina Handbook of Seed Certification Standards, South Carolina Crop Improvement Association, Clemson, South Carolina. 1960.

C 3 (S) Handbook of the Insect World, Hercules Powder Company, Agricultural Chemicals Division, Naval Stores Department, Wilmington, Delaware.

C 4 (S) Diazinon Insecticides Handbook, Geigy Agricultural Chemicals, Division of Geigy Chemical Corporation, Saw Mill River Road, Ardsley, New York. 1964.

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AV 2 Life from the Land, Cargill, Incorporated, Mr. Sid Burkett, Training Director, Cargill Building, Minneapolis, Minnesota 55402.

AV 3 Romance of the Reaper, Farm Film Foundation, 1425 H Street, Northwest, Washington, D. C. 20005.

AV 4 Marketplace, USA, Sterling-Movies USA, Incorporated, 43 West 61st Street, New York, New York 10023.

B. Filmstrips and Slides

AV 5 Grain Grading, Minneapolis Grain Exchange, Mr. A. W. Donahoo, Educational Director, 150 Grain Exchange Building, Minneapolis, Minnesota.

II. Tobacco Production

Suggested Minimum Time Allotment is 20 Periods	Suggested Resource Material
A. Tobacco as a farming enterprise	1. Entire Publication
1. History and economic importance of tobacco	2. pp. 122-192
	3. pp. 390-446
	4. pp. 256-283
	Clemson 1 pp. 28-32
2. Availability of allotment	Clemson 2
	Clemson 3
a. Home farm	Clemson 4
	Clemson 5
b. In community	Clemson 6
	Clemson 7
3. Labor and equipment required	Clemson 8
	Clemson 9
4. Cost of production	Clemson 10
	Clemson 11
5. Expected income	Clemson 12
	Clemson 13
6. Making tobacco compatible with other farm enterprises	Clemson 14
	Clemson 15
	Clemson 16
B. Selecting tobacco variety	USDA 1
	USDA 2
1. Disease resistance	C 1 pp. 42-44
	C 2
2. Yield, quality	C 3
	C 4
3. Adaptability for mechanization	C 5
	C 6
4. Growth characteristics	
5. Source of seed	
C. Practices in producing tobacco plants	
1. Selecting soil for plant bed	
2. Selecting site for plant bed	
3. Preparation of plant bed	
4. Treating soil	
5. Fertilizing	
6. Rate and method of seeding	
7. Selecting bed cover	
8. Controlling plant bed insects and diseases	

D. Selecting and preparing tobacco soil

   1. Acidity of soil

   2. Soil drainage

   3. Soil type

   4. Past history of disease

   5. Preparing the soil for transplanting

E. Nematode and soil insect control

F. Fertilization

G. Irrigation

H. Spacing tobacco

I. Transplanting

J. Cultivation

K. Identifying and controlling insects

L. Identifying and controlling diseases

M. Topping and suckering

N. Harvesting

O. Curing

P. Sorting

Q. Grading

R. Marketing

I. Reference Publications

1. Flue-Cured Tobacco, State Department of Education, Columbia, South Carolina. Vol. XII. November 1956.

2. Fergus, E. N., Hammonds, Carsie and Rogers, T. H., Field Crops Including Southern Crops, J. B. Lippincott Company, Chicago, Illinois. 1958.

3. Walton, E. V. and Holt, O. M., Profitable Southern Crops, Prentice-Hall, Incorporated, Englewood Cliffs, New Jersey. 1959.

4. Klingman, Glen C., Crop Production in the South, John Wiley and Sons, Incorporated, New York, New York. 1957.

II. Clemson University Agricultural Publications, Clemson, South Carolina

Clemson 1 (D) Insect and Plant Disease Handbook, South Carolina, Extension Bulletin 114.

Clemson 2 (S) Recommended Varieties for South Carolina, Extension Circular 477. September 1963.

Clemson 3 (S) Tobacco Insects and Diseases, South Carolina, Extension Bulletin 109. April 1964.

Clemson 4 (S) Growing Flue-Cured Tobacco in South Carolina, Extension Circular 287. January 1958.

Clemson 5 (S) Controlling Wireworms in Tobacco Lands, Extension Circular 486. December 1962.

Clemson 6 (S) Tobacco Plant Production in South Carolina, Extension Circular 291. November 1961.

Clemson 7 (S) Tobacco Irrigation in South Carolina, Extension Circular 438. November 1961.

Clemson 8 (S) Tobacco Insect Control Chart - South Carolina, Extension Information Card No. 82. December 1963.

Clemson 9 (T) Some Effects of Topping Heights and Suckering Flue-Cured Tobacco, Experiment Station Bulletin 510. March 1964.

Clemson 10 (S) Preparing Loose Leaf Tobacco For Market, Extension Circular 485. 1962.

Clemson 11 (T) Marketing Flue-Cured Tobacco Tied and Untied, AE 206. March 1961.

Clemson 12 (T) Tobacco Marketing Practices of Farmers in the Coastal Plain Area of South Carolina, AE 194. April 1960.

Clemson 13 (T) Tobacco Statistics, AE 172. May 1959.

Clemson 14 (T) Tobacco Production Practices in the Coastal Plain Area of South Carolina, Experiment Station Bulletin 405. 1953.

Clemson 15 (T) Effects of Tobacco Mosaic on Flue-Cured Tobacco, Resistant and Susceptible Varieties, Experiment Station Bulletin 513.

Clemson 16 (T) Effects of Subsoiling and Soil Fumigation on Flue-Cured Tobacco, Experiment Station Bulletin 514. June 1964.

III. Publications of the United States Department of Agriculture, Division of Information, Washington, D. C. 20250

USDA 1 (S) Principles of Tobacco Irrigation, Agriculture Information Bulletin No. 228. August 1960.

USDA 2 (S) Irrigating Tobacco, Farmers Bulletin No. 2156. 1961.

IV. Commercial and Other Publications

C 1 Handbook of the Insect World, Hercules Powder Company, Agricultural Chemicals Division, Naval Stores Department, Wilmington, Delaware.

C 2 (S) Flue-Cured Tobacco - Diseases, Nutrient Deficiencies and Excesses, Injuries - Pests of Cured Tobacco, The American Tobacco Company, 150 East 42nd Street, New York 17, New York.

C 3 Flue-Cured Tobacco Barn Construction, Extension Circular No. 316, The North Carolina Agricultural Extension Service, State College Station, Raleigh, North Carolina. 1953.

C 4 Flue-Cured Tobacco Varieties in North Carolina, Extension Circular No. 302, North Carolina State College of Agriculture and Engineering, State College Station, Raleigh, North Carolina. 1956.

C 5 Tobacco Insects of North Carolina and Their Natural Enemies, Experiment Station Bulletin 394, North Carolina State College of Agriculture and Engineering, State College Station, Raleigh, North Carolina. 1959.

C 6 Tobacco Plant Production Guide, Extension Circular 363, North Carolina State College of Agriculture and Engineering, State College Station, Raleigh, North Carolina. 1956.

III. Corn Production

Suggested Minimum Time Allotment is 10 Periods	Suggested Resource Material
A. What is the importance of growing corn?	1. pp. 16-97
	2. pp. 7-66
	3. pp. 168-209
	4. pp. 175-202
1. What is the importance of corn in the United States?	5. pp. 134-142, 185-231, 239-248, 269-275, 306-310, 345-347, 358-421
	6. pp. 227-255
a. How many acres were harvested in 1950?	7. pp. 33-108
	8. pp. 215-269
b. How many acres were harvested this past year?	9. pp. 62-67
	Clemson 1
c. What was the yield of corn per acre in 1950?	Clemson 2 pp. 32-35
	Clemson 3 pp. 33-40
	Clemson 4
d. What was the yield of corn per ace this past year?	Clemson 5
	Clemson 6
	Clemson 7
	Clemson 8
2. What is the importance of corn in South Carolina?	Clemson 9
	Clemson 10
	Clemson 11
a. How many acres were harvested in 1950?	Clemson 12
	Clemson 13
	Clemson 14
b. How many acres are harvested at the present time?	Clemson 15
	Clemson 16
	Clemson 17
	Clemson 18
c. What was the yield per acre in 1950?	Clemson 19
	USDA 1
	USDA 2
d. What is the yield per acre now?	USDA 3
	USDA 4
	USDA 5
e. What was the acreage harvested by type of farming area according to recent figures available?	USDA 6
	USDA 7
	USDA 8
	USDA 9
	USDA 10
3. What is the importance of corn in our county?	USDA 11
	C 1
	C 2
a. How many acres were harvested in 1950?	C 3
	C 4
	C 5
b. How many acres were harvested this past year?	C 6
	C 7

c. What was the yield per acre in 1950? — AV 1, AV 2, AV 3

d. What was the yield per acre this past year? — AV 4, AV 5, AV 6

4. What are the required needs of corn for food and feed? — AV 7, AV 8, AV 9

a. What are the trends for use of corn for food? — AV 10, AV 11, AV 12

b. How much corn is used in feeding livestock and poultry? — AV 13, AV 14, AV 15, AV 16

B. How much equipment and labor is needed to produce corn?

1. Tractor

2. Mule

C. What are the costs and returns of growing corn as determined by various sizes of operations?

D. How important are good yields?

E. How does one select soil for corn?

1. What soil is best suited for corn?

2. What fields on the farm are best suited for corn?

3. How does the soil test assist one in selecting the proper field for corn?

F. How should the seedbed be prepared?

1. Is fall plowing recommended?

2. How deep should land be plowed?

3. Does it pay to subsoil corn land?

G. How does one select the proper variety?

1. Should we consider an open pollinated variety?

2. What should we consider in selecting the variety of hybrid to plant?

   a. What hybrid is adapted to our location?

   b. What hybrids show most resistance to the diseases common in our area?

   c. How is hybrid seed produced?

H. How is corn fertilized?

1. What factors should be considered in fertilizing corn?

   a. How does soil type, soil fertility level, and soil capability help determine the proper fertilization program?

   b. What effect does previous crops and crop yields have on the fertilization program?

   c. How does the number of corn plants per acre affect the fertilization program?

   d. What effect does the expected yield have upon determination of the fertilization program?

2. What is required to make a 100 bushel corn crop?

   a. What pH level is desirable?

   b. How much nitrogen should be used for corn?

   c. How much phosphorus is needed for corn?

   d. How much potash does corn need?

e. What minor elements are needed?

f. What are signs of hunger deficiency displayed by insufficient:

(1) Nitrogen?

(2) Phosphoric acid?

(3) Potash?

(4) Trace minerals

g. How should fertilizer be applied to corn?

(1) What kinds and amounts should one use?

(2) What methods of application can one use?

(3) What is the economy of using fertilizer?

(4) How does the plow-sole method compare with the regular method of applying fertilizer?

h. When should corn be side-dressed?

i. What is the best source of nitrogen for corn?

j. What is the effect of spacing on corn production?

(1) Spacing between rows

(2) Spacing in the row

(3) Plants per acre

I. What are the principles of weed control in corn?

1. What is a weed?

2. What is the purpose of cultivation?

a. What are the recommended methods of cultivation?

b. How does one adjust equipment to accomplish proper cultivation?

c. What is the proper time to cultivate?

d. Can one successfully produce a crop without cultivation?

3. How should weeds in corn be controlled by the use of chemicals?

a. What are two ways of applying chemical herbicides?

b. What weeds will be controlled?

c. What chemicals can be used to control weeds in corn?

(1) What is the proper rate of application for each chemical?

(2) What are the best ways to apply these chemicals?

(3) What are the results in yields per bushels?

(4) What is the cost of applying a chemical broadcast as compared to the band method?

(5) When do you apply these chemicals?

(6) What effect does sunlight, temperature, and moisture have on these chemicals?

(7) How effective are herbicides for controlling weeds?

(8) How does one calibrate a sprayer?

(9) What equipment is used in applying these chemicals?

(10) What are the possibilities of including a weed spray with a nitrogen solution when you layby corn?

(11) What safety precautions must one take in using these sprays?

4. What is the importance of witchweed control in corn?

a. What is witchweed?

b. What areas in South Carolina are infested?

c. What is the appearance of witchweed?

d. How does it damage the plant?

e. How can it be controlled?

(1) What chemicals can be used?

(2) What are trap crops and how are they used?

(3) What are catch crops and how are they used?

(4) How is soil sterilization used for witchweed control?

f. When was the Federal and State quarantine program established?

g. Who administers the witchweed eradication program?

h. What is the purpose of the witchweed eradication program?

i. What methods should be used on field crops for the control of witchweed?

J. Corn insects and pests

1. How important is corn insect control to the South Carolina farmer?

a. What damage do corn insects inflict?

b. What are the general control methods?

2. What are the common corn insects in South Carolina?

a. What insects work on the corn seed before it sprouts?

b. What insects work on corn roots?

c. What insects work on the corn stalk and leaves?

d. What insects work on the entire corn plant?

e. What insects work on stored corn?

3. What control measures are recommended for corn insects?

K. What are the control measures for our common corn diseases?

1. What are the common corn diseases?

2. How do these diseases affect the plant?

3. How do we prevent or control these corn diseases?

L. What are some of the other corn pests?

M. How is corn harvested?

1. How does moisture content determine the proper time for the harvest of corn?

2. How does one determine yield of corn?

3. What are the common methods of harvesting?

4. How does one reduce harvesting losses to a minimum?

N. How should one store corn?

1. If one uses natural drying techniques what type of facilities are needed?

2. What are the possibilities of the use of artificial drying procedures for efficient corn storage?

3. Do market prices warrant the investment in adequate storage facilities for proper corn storage?

4. How can one finance storage facilities?

O. How is corn marketed?

1. Where are the corn markets in our area?

2. Should a farmer market corn directly from the field or should he store it?

3. What are the advantages and disadvantages of ASCS loans on corn?

I. Reference Publications

1. Fergus, E. N., Hammonds, Carsie, and Rogers, T. H., Field Crops Including Southern Crops, T. B. Lippincott Company, New York, New York. 1958.

2. (D) Corn, An Enterprise in Supervised Farming Programs of Students of Vocational Agriculture, State Department of Education, Columbia, South Carolina. 1955.

3. Walton, E. V. and Holt, O. M., Profitable Southern Crops, Prentice-Hall, Incorporated, Englewood Cliffs, New Jersey. 1959.

4. Wilson, Harold K. and Richer, Chester A., Producing Farm Crops, The Interstate Printers and Publishers, Incorporated, Danville, Illinois. 1960.

5. Dungan, George H. and Ross, W. A., Growing Field Crops, McGraw-Hill Book Company, Dallas, Texas. 1957.

6. Klingman, Glenn C., Crop Production in the South, John Wiley and Sons, Incorporated, New York, New York. 1957.

7. Delorit, Richard J. and Ahlgren, Henry L., Crop Production, Prentice-Hall, Incorporated, Englewood Cliffs, New Jersey. 1959.

8. Chapman, Paul W. and Thomas, Roy H., Southern Crops, Turner E. Smith and Company, Atlanta, Georgia.

9. (D) South Carolina Agricultural Credit Manual, Prepared by Wachovia Bank and Trust Company, Reproduced by State Department of Education, Columbia, South Carolina. 1958.

II. Clemson University Agricultural Publications, Clemson, South Carolina

Clemson 1 (T) Crop Statistics, County Estimates 1962 and 1963, AE 259. June 1964.

Clemson 2 (T) Production Requirements and Estimated Returns from Selected Crop and Livestock Enterprises in the Piedmont Area, AE 202. October 1960.

Clemson 3 (T) Estimated Production Requirements and Returns from Selected Crop and Livestock Enterprises in the Upper Coastal Plain Area, AE 243. July 1963.

Clemson 4 (D) Corn Statistics, AE 168. April 1959.

Clemson 5 (S) Performance of Corn Hybrids in South Carolina, Agronomy and Soils Research Series No. 34. December 1962.

Clemson 6 (S) Sprinkler Irrigation of Field Corn, Experiment Station Bulletin No. 421. May 1955.

Clemson 7 (S) Corn Kernal Damage, Extension Service.

Clemson 8 (T) Weather and Corn Production in South Carolina, Agronomy and Soils Research Series 24. June 1960.

Clemson 9 (S) Use of Insecticides with Fertilizer to Control Corn Billbugs, Extension Service Information Card No. 100. November 1961.

Clemson 10 (S) Maize Billbug Control in South Carolina, Experiment Station Bulletin 452. October 1957.

Clemson 11 (S) Weeds, A South Carolina Handbook, Extension Service Bulletin 113. June 1960.

Clemson 12 (S) Spring Planting Schedule, Extension Service Information Card No. 107. February 1964.

Clemson 13 (S) Witchweed, Extension Service Circular 445. April 1958.

Clemson 14 (D) Insect and Plant Disease Handbook, South Carolina, Extension Service Bulletin 114. December 1952.

Clemson 15 (D) Stored Grain Insects and Their Control, Southern Cooperative Series Bulletin No. 75. January 1962.

Clemson 16 (D) Agronomy Handbook for South Carolina, Extension Service Circular 407. June 1961.

Clemson 17 (S) Recommended Varieties for South Carolina, Extension Circular 477. September 1963.

Clemson 18 (S) Insect Control of Stored Grains, Extension Circular 435. June 1960.

Clemson 19 (S) Corn Weed Control for South Carolina, Extension Circular 492. 1964.

III. Publications of the United States Department of Agriculture, Division of Information, Washington, D. C. 20250

USDA 1 (S) Chinch Bugs - How to Control Them, Leaflet 364. 1962.

USDA 2 (S) Japanese Beetle, Picture Sheet No. 4. April 1963.

USDA 3 (S) European Corn Borer, Picture Sheet No. 14. April 1948.

USDA 4 (S) Detect and Report Your Insect Enemies, PA-414. 1960.

USDA 5 (S) Watch Out for Witchweed, PA-331. April 1957.

USDA 6 (T) A Small County Elevator for Merchandising Grain, Market Research Report No. 387. 1960.

USDA 7 (S) You Can Store Grain Safely on the Farm, Farmers Bulletin 2071. 1960.

USDA 8 (S) Mechanical Drying of Corn on the Farm, Circular No. 839. 1950.

USDA 9 (S) Inclined-Column Grain Drier, Leaflet No. 314. 1951.

USDA 10 (S) Bacterial Wilt and Stewarts Leaf Blight of Corn, Farmers Bulletin No. 2092. 1960.

USDA 11 (S) Irrigating Corn in Humid Regions, Farmers Bulletin No. 2143. 1959.

IV. Commercial and Other Publications

C 1 Cost Comparison Harvesting Corn Mechanically, North Carolina Agricultural Extension Circular No. 432, North Carolina Agricultural Extension Service, State College Station, Raleigh, North Carolina. September 1961.

C 2 (D) How to Make a Corn Yield Check, Department of Agricultural Education, Clemson University. Extra copies are available.

C 3 (S) 1964 Geigy Corn Manual, GAC 700-43, Geigy Agricultural Chemicals, Division of Geigy Chemical Corporation, P. O. Box 430, Yonkers, New York, Attention: Mrs. Agnes E. Humphrey.

C 4 (S) Handbook of the Insect World, Agricultural Chemicals Division, Naval Stores Department, Hercules Powder Company, Wilmington, Delaware.

C 5 (T) South Carolina Handbook of Seed Certification Standards, South Carolina Crop Improvement Association, Clemson, South Carolina. 1960.

C 6 (T) How to Dry and Store Grain and Seed on Georgia Farms, Bulletin D.S. 33, Georgia Agricultural Experiment Stations, Athens, Georgia. 1956.

C 7 (S) Diazinon Handbook, GAC 100-131, Geigy Agricultural Chemicals, Division of Geigy Chemical Corporation, P. O. Box 430, Yonkers, New York.

V. Loan Free Audio-Visual Materials

A. Movies

AV 1 Acres of Science, Modern Talking Picture Service, 714 Spring Street, Northwest, Atlanta, Georgia, or 501 North College Street, Charlotte 6, North Carolina.

AV 2 Breeding Better Corn, Farm Film Foundation, 1425 H Street, Northwest, Washington, D. C. 20005.

AV 3 Breeding Corn for Todays Farming, Farm Film Foundation, 1425 H Street, Northwest, Washington, D. C. 20005.

AV 4 Cash in on Corn, National Plant Food Institute, Film Department, 1700 K Street, Northwest, Washington 6, D. C.

AV 5 Great Story of Corn, Farm Film Foundation, 1425 H Street, Northwest, Washington, D. C. 20005.

AV 6 Hybrid Corn -- America's Greatest Crop, The Venard Organization, 113 North Madison Avenue, Peoria, Illinois.

AV 7 Hybrid Corn, Allis-Chalmers Manufacturing Company, Tractor Photographic Group, Tractor Group, Milwaukee 1, Wisconsin 53201.

AV 8 A New Day in Corn, (How weeds rob the corn of the fertility it needs) Sterling - Movies USA, Incorporated, 46 West 61st Street, New York, New York 10023.

AV 9 This Business of Growing Corn, United States Steel Corporation, Birmingham Film Distribution Center, Fairfield, Alabama.

AV 10 304 Bushel Challenge, The Venard Organization, 113 North Madison Avenue, Peoria, Illinois.

B. Filmstrips and Slides

AV 11 Corn Borer, DeKalb Agricultural Association, Incorporated, Educational Division, DeKalb, Illinois 60115.

AV 12 Corn Colors and Color Mixtures, (a simple study in genetics) DeKalb Agricultural Association, Incorporated, Educational Division, DeKalb, Illinois 60115.

AV 13 Five Tested Steps to Maximum Profit Corn, Spencer Chemical Company, Visual Aids Library, Dwight Building, Kansas City, Missouri 64105.

AV 14 Hidden Values in Hybrid Corn, DeKalb Agricultural Association, Incorporated, Educational Division, DeKalb, Illinois 60115.

AV 15 Hunger Signs in Corn, DeKalb Agricultural Association, Incorporated, Educational Division, DeKalb, Illinois 60115.

AV 16 Story of A Kernal of DeKalb Corn, DeKalb Agricultural Association, Incorporated, Educational Division, DeKalb, Illinois 60115.

PLANT SCIENCE AND SOIL

Suggested Minimum Time Allotment is 21 Periods	Suggested Resource Material
I. Classifying Land	
A. How are soils classified?	1. pp. 42-74 2. pp. 1-41
B. What are the factors to consider in classifying a soil?	3. pp. 81-93, 106-115, (147-400 as needed) 4. pp. 59-102 5. pp. 90-123, 325-348
C. What are the land capability classes?	6. pp. 323-346 7. pp. 633-634
D. What soil conservation practices should be used for each class of land?	8. pp. 17-38 9. pp. 193-201 10. pp. 123-128 11. pp. 53-62, 362-366 12. pp. 1-20
E. How do you determine land use as based on land capability?	See your Soil Conservation Service for county and local materials. Clemson 1 Clemson 2 Clemson 3 Clemson 4 Clemson 5 Clemson 6 pp. 5-23 USDA 1 USDA 2 C 1 C 2 pp. 12-21, 50-56 C 3
II. Soil Testing	
A. Why is soil testing needed?	1. pp. 233-274 3. pp. 94-105
B. When should soil testing be done?	4. pp. 39-43 5. pp. 116-117, 228-230 6. pp. 159-176
C. How should a soil sample be taken?	10. p. 129 11. pp. 333-338, 489
D. Where should soil samples be taken for analysis?	See your County Extension Agent for local soil testing information. Clemson 1
E. What use should be made of soil-test results?	Clemson 6 pp. 26-27 C 4 pp. 71, 95 C 5 p. 67

I. Reference Publications

1. Welch, Charles D. and McCart, Gerald D., An Introduction to Soil Science in the Southeast, The University of North Carolina Press, Chapel Hill, North Carolina. 1963.

2. (D) Soil Judging and Land Treatment for Students of Vocational Agriculture, State Department of Education, Columbia, South Carolina. Vol. XIII. 1959.

3. Stallings, J. H., Soil Use and Improvement, Prentice-Hall, Incorporated, Englewood Cliffs, New Jersey. 1957.

4. Donahue, Roy L., Our Soils and Their Management, The Interstate Printers and Publishers, Incorporated, Danville, Illinois. 1961.

5. Vanderford, H. B., Managing Southern Soils, John Wiley and Sons, Incorporated, New York. 1957.

6. Knuti, Leo L., Korpi, Milton and Hide, J. C., Profitable Soil Management, Prentice-Hall, Incorporated, Englewood Cliffs, New Jersey. 1962.

7. Doane Agricultural Digest, Doane Agricultural Service, Incorporated, 5144 Delmar Boulevard, St. Louis 8, Missouri.

8. Soil, The Yearbook of Agriculture 1957, United States Department of Agriculture, Washington, D. C. 20250.

9. After a Hundred Years, The Yearbook of Agriculture 1962, United States Department of Agriculture, Washington, D. C. 20250.

10. Power to Produce, The Yearbook of Agriculture 1960, United States Department of Agriculture, Washington, D. C. 20250.

11. Land, The Yearbook of Agriculture 1958, United States Department of Agriculture, Washington, D. C. 20250.

12. Foster, Albert B., Approved Practices in Soil Conservation, The Interstate Printers and Publishers, Incorporated, Danville, Illinois. 1964.

II. Clemson University Agricultural Publications, Clemson, South Carolina

Clemson 1 (S) Soil Survey Report How It Concerns You, Extension Miscellaneous Leaflet. January 1961.

Clemson 2 (T) Land Resource Areas in South Carolina, (Map), Experiment Station Circular 112. June 1957.

Clemson 3 (D) Soils of South Carolina, Keys for Their Identification, Agronomy and Soils Research Series 23. February 1960.

Clemson 4 (D) Soil Judging and Land Treatment, Extension Circular 390. February 1961.

Clemson 5 (T) The pH Values of South Carolina Soils, Agronomy Department Mimeographed Series No. 1. June 1957.

Clemson 6 (D) Agronomy Handbook for South Carolina, Extension Bulletin No. 104. June 1957.

III. Publications of the United States Department of Agriculture, Division of Information, Washington, D. C. 20250

USDA 1 (S) The Measure of Our Land, PA 128.

USDA 2 (S) Know Your Soil, Agricultural Information Bulletin No. 267. February 1963.

IV. Commercial and Other Publications

C 1 (T) Our Land and Its Care, American Plant Food Council, Incorporated, 910 Seventeenth Street, N.W., Washington 6, D. C. 2nd Edition, 3rd Printing. 1961.

C 2 (T) South Carolina Soil and Water Conservation Needs Inventory, South Carolina Conservation Needs Committee, Soil Conservation Service, 901 Sumter Street, Columbia, South Carolina. September 1961.

C 3 (S) Know Your Land, Soil Conservation Service, 901 Sumter Street, Columbia, South Carolina. June 1961.

C 4 (D) The 1963 Ford Almanac, Ford Motor Company, Ford Division and Ford Tractor and Implement Operations, Ford Motor Company, Dearborn, Michigan.

C 5 (D) The 1964 Ford Almanac, Ford Motor Company, Ford Division and Ford Tractor and Implement Operations, Ford Motor Company, Dearborn, Michigan.

FARM HOME AND FAMILY

Suggested Minimum Time Allotment is 19 Periods	Suggested Resource Material
I. Home Beautification	1.
	2.
A. What is the first and perhaps the most important step in landscape planning?	3. pp. 135-167, 197-251, 268-271, 276-295, 430-463
1. What are the steps in the mapping of a building and grounds?	Clemson 1
	Clemson 2
	Clemson 3
	Clemson 4
	Clemson 5
a. How would you go about making a sketch with the aid of a photograph?	Clemson 6
	Clemson 7
	Clemson 8
	USDA 1
b. What are the desired effects?	USDA 2
	USDA 3
	USDA 4
2. What are three simple rules which should be followed if a desired effect is to be achieved in your landscaping efforts?	USDA 5
3. What are the eight points to consider in selecting plants for certain locations?	
4. What are the common shrubs and trees used for home beautification in this area?	
a. Describe the height, color, and other identifying features.	
b. What are the soil, fertilizer, and lime requirements?	
B. What are the three purposes for selecting shrubs for foundation planting?	
1. What shrubs can be used for various types of foundation planting?	
a. What are some things to avoid in choosing shrubs?	

b. What is meant by mass planting?

c. What is meant by border planting?

d. What is meant by boundary planting?

2. How does one determine the kind and number of plants needed for a building?

3. What are the basic sources from which plants are secured?

C. How are plants propagated?

1. What are the methods of propagating plants used for landscaping?

2. How is a rooting bed made?

3. What are the two basic types of cuttings?

4. What is the value of commercial rooting compound in making cuttings?

5. How are broad-leaf evergreens rooted?

6. What plants are easily propagated from seed?

D. Why is planting or transplanting shrubbery a skill?

1. What directions should be followed for planting or transplanting?

2. What are the methods of pruning at transplanting?

E. Why is it important to maintain shrubs that are established?

F. Why is it necessary to prune shrubs and trees?

1. What shrubs need to be pruned?

2. What is the best time to prune shrubs and trees?

G. Why is control of insects important?

1. What are the common insects? What is the control of each?

2. What are the common diseases? What is the control of each?

H. Why is the lawn considered as part of the home beautification program?

1. How does one select a lawn grass or mixture?

2. What grading and soil preparation is needed?

3. How much lime and fertilizer is needed?

4. How does one maintain a good lawn?

I. What considerations should one give to electric hotbeds in a total home beautification program?

1. What are the electrical problems involved?

2. How does one use and operate such a hotbed?

3. How do fumigants fit in the program?

J. What opportunities exist for the owner of a home greenhouse?

II. The Home Orchard

A. Needs for a home orchard

1. How much fruit is needed by the family?

a. How much will be needed as fresh fruit?

b. How much will be needed for preservation?

3. pp. 3-134, 311-360
4. pp. 7-30, 39-217, 328-339
5. pp. 1-230
6.
7.
8.
Clemson 9
Clemson 10
Clemson 11
Clemson 12
Clemson 13
Clemson 14

2. What is the availability of fruit outside of that which is to be grown at home?

3. What are the prospects of marketing surplus fruits that may be produced by the home orchard?

B. Plant and fruit development

1. How do plants grow?

2. How do plants develop flowers?

3. How does pollination and fruit set take place?

C. Determining varieties

1. What varieties are adapted to this area?

2. What is the spread of ripening dates?

3. What are the considerations one should give to resistance to disease and insect damage when selecting a variety?

4. How can equipment required enter into varietal selection?

5. What is the quality of the fruit produced?

6. What is the intended use of the fruit?

7. What is the size of the mature trees or vines?

8. What are the pollination considerations?

D. Planting and setting

1. What is the best choice of site?

a. Is it easily accessible to the home?

Clemson 15
Clemson 16
Clemson 17
Clemson 18
Clemson 19
Clemson 20
Clemson 21
Clemson 22
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USDA 12
USDA 13
USDA 14
USDA 15
USDA 16

b. Is there good air and water drainage?

c. Is the soil type suitable and is it fertile?

d. Is the soil free to a satisfactory degree from insects and diseases that would be harmful to the fruit crops being considered?

2. What land preparation is needed?

3. What is the most desirable spacing?

4. Where should plants, vines, and trees be procured?

5. How should the plants, trees or vines be set out?

E. Training and pruning

1. What are the purposes of pruning?

a. How does pruning aid in insect and disease control?

b. How is the shape or form of the tree or vine developed?

c. How does pruning aid in fruit quality?

d. Why is pruning an aid to cultivation?

2. When should pruning be done?

3. How should pruning be done?

4. What equipment is needed for pruning?

F. Insect and disease control for the home orchard.

1. What are the fruits being grown? to be grown?

2. What are the insect pests and diseases of these fruits?

3. What equipment is needed and what equipment is available?

4. What insecticides and fungicides need to be used?

5. What is the application schedule to be followed?

6. What are the safety precautions to be observed in the use of farm chemicals?

7. How will orchard sanitation aid in insect and disease control?

G. Fertilization and management

1. What are the fertilizer needs for specific fruit crops?

   a. What analysis and rate shall be used?

   b. When shall applications be made?

   c. What are the fertilizer needs of the cover crops being used?

2. What are the management problems of producing fruit?

   a. What are the cultivation needs of fruit?

   b. How does orchard sanitation aid in fruit production?

   c. How may fruit crops be improved by thinning?

3. What is the importance of understanding quality in fruit?

I. Reference Publications

1. (D) Improving the Farm Home and Community Through Instruction in Landscaping, State Department of Education, Columbia, South Carolina. Vol. IV. December 1951.

2. Hoover, Norman K., Approved Practices in Beautifying the Home Grounds, The Interstate Printers and Publishers, Incorporated, Danville, Illinois. 2nd Edition, 1959.

3. Edmund, J. B., Senn, T. L. and Andrews, F. S., Fundamentals of Horticulture, McGraw Hill Book Company, New York, New York. 3rd Edition, 1964.

4. Talbert, Thomas Jesse, Growing Fruit and Vegetable Crops, Lea & Febiger, Philadelphia, Pennsylvania. 1953.

5. Stuckey, H. P., Southern Horticulture, Turner E. Smith and Company, Atlanta, Georgia. 1951.

6. Scheer, Arnold H. and Juergenson, Elwood M., Approved Practices in Fruit Production, The Interstate Printers and Publishers, Incorporated, Danville, Illinois. 1964.

7. Chandler, William Henry, Deciduous Orchards, Lea & Febiger, Philadelphia, Pennsylvania. 1957.

8. Schneider, G. W. and Scarborough, C. C., Fruit Growing, Prentice-Hall, Incorporated, Englewood Cliffs, New Jersey. 1960.

II. Clemson University Agricultural Publications, Clemson, South Carolina

Clemson 1 (D) Margaret Martin, Propagation of Plants, Mimeograph.

Clemson 2 (T) Heating Plastic Greenhouses, Experiment Station Bulletin 666. May 1963.

Clemson 3 (S) Familiar Trees of South Carolina, Extension Bulletin 117. 1964.

Clemson 4 (D) Beautifying the Home Garden, Extension Bulletin 119. September 1961.

Clemson 5 (D) Care of Ornamental Plants, Extension Circular 430. May 1961.

Clemson 6 (S) Lawn Grasses of South Carolina, Extension Circular 495. July 1964.

Clemson 7 (S) Lawn Insects, How to Control Them, Supplement 1 (Lawn Grass Circular). July 1964.

Clemson 8 (S) Controlling Turf Grass Diseases, Supplement 2 (Lawn Grass Circular). July 1964.

Clemson 9 (S) Control of Apple Insects and Diseases, Information Card 110. January 1964.

Clemson 10 (T) Market Prospects and Production Potential for Apples in Oconee County, South Carolina, AE 183. November 1959.

Clemson 11 (T) The Long Creek Apple Marketing Authority, AE 164. February 1959.

Clemson 12 (T) Costs and Returns From Apple Production, AE 193. March 1960.

Clemson 13 (T) Senn, T. L., Figs in South Carolina, Mimeograph.

Clemson 14 (S) Spray Program for Bunch Grapes, Information Card No. 99. January 1964.

Clemson 15 (T) Grape Statistics, AE 196. August 1960.

Clemson 16 (S) The ABC's of Grape Production, Mimeograph.

Clemson 17 (S) Peach Pest Control, Extension Circular 360. January 1964.

Clemson 18 (D) Tips for Peach Packs, Miscellaneous Information Circular. June 1954.

Clemson 19 (S) Summer Spray Schedule for Peaches, Information Card 72. February 1963.

Clemson 20 (S) Labor Efficiency and Damage Control in Harvesting Peaches, Experiment Station Bulletin 475. January 1960.

Clemson 21 (ST) Consumer Acceptance of Packaged South Carolina Peaches in Selected Supermarkets, Experiment Station Circular 132. January 1962.

Clemson 22 (ST) Effects on Decay of Adding Various Reagents to the Water for Hydrocooling Peaches, Experiment Station Circular 124. July 1959.

Clemson 23 (T) A Mechanical Pitter for Freestone Peaches, Experiment Station Circular 119. May 1958.

Clemson 24 (ST) Peach Orchard Soil Fumigation, Botany Department, Mimeo Series No. 4. January 1958.

Clemson 25 (T) South Carolina Peach Statistics, AE 169. May 1959.

Clemson 26 (T) South Carolina Peach Tree Survey, AE 257. April 1964.

Clemson 27 (T) The Potential for Reducing Costs in Packing South Carolina Peaches, AE 201. October 1960.

Clemson 28 (T) Opinions of Selected South Carolina Consumers Toward Fresh Peaches, AE 211. June 1961.

Clemson 29 (T) Climate and Peach Production in South Carolina, Agronomy and Soils Research Series No. 18. October 1959.

Clemson 30 (T) Effectiveness of Fiber Pads in Reducing Damage to Basket Packed Peaches, AE 192. February 1960.

Clemson 31 (T) Some Unresolved Questions Affecting Grower Decisions in Marketing Fresh Peaches, AE 205. February 1961.

Clemson 32 (T) Worker Activity in Facing and Tubbing South Carolina Peaches, AE 180. September 1959.

Clemson 33 (ST) Weed Control in Fruit Crops, Extension Horticulture Mimeo No. 1F. April 1962.

Clemson 34 (D) Pecan Spray Schedule for South Carolina, Pecan Notes. April 1962.

Clemson 35 (S) Pecan Pest Control, Extension Circular 484. September 1962.

Clemson 36 (S) Growing Pecans in South Carolina, Extension Circular 482. February 1962.

III. Publications of the United States Department of Agriculture, Division of Information, Washington, D. C. 20250

USDA 1 (S) Better Lawns, Home and Garden Bulletin No. 51. 1962.

USDA 2 (S) Selecting Fertilizers for Lawns and Gardens, Home and Garden Bulletin No. 89. May 1963.

USDA 3 (S) How Much Fertilizer Shall I Use; A Gardeners Guide for Converting Tons or Pounds Per Acre Into Pints, Cups, Tablespoons or Teaspoons Per Row or Plant, Leaflet No. 307. April 1951.

USDA 4 (S) Electric Heating of Hotbeds, Leaflet No. 445. February 1959.

USDA 5 (S) Control of Insect Pests of Greenhouse Vegetables, Agriculture Handbook No. 142. January 1959.

USDA 7 (S) Control of Apple Tree Borers, Leaflet No. 274. January 1961.

USDA 8 (S) Blight of Pears, Apples and Quinces, Leaflet No. 187. August 1963.

USDA 9 (S) Establishing and Managing Your Apple Orchards, Farmers Bulletin No. 1897. September 1962.

USDA 10 (S) Fig Growing in the South, Agriculture Handbook No. 196. June 1961.

USDA 11 (S) Growing American Bunch Grapes, Farmers Bulletin No. 2133. April 1963.

USDA 12 (S) Muscadine Grapes, A Fruit for the South, Farmers Bulletin No. 2157. February 1961.

USDA 13 (S) Why Fruit Trees Fail to Bear, Leaflet No. 172. 1958.

USDA 14 (S) Preparing Peaches for Market, Marketing Bulletin No. 9. 1960.

USDA 15 (S) The Home Fruit Garden in the Southeastern and Central Southern States, Leaflet 219. October 1958.

USDA 16 (S) Strawberry Culture in South Atlantic and Gulf Coast Regions, Farmers Bulletin No. 1026. January 1963.

USDA 17 (T) Strawberry Varieties in the United States, Farmers Bulletin No. 1043. November 1958.

USDA 18 (S) Growing Blackberries, Farmers Bulletin No. 2160. April 1961.

USDA 19 (S) Strawberry Diseases, Farmers Bulletin No. 2140. January 1963.

USDA 20 (S) Dwarf Fruit Trees, Selection and Care, Leaflet No. 407. June 1961.

USDA 21 (S) Blueberry Growing, Farmers Bulletin No. 1951. July 1962.

USDA 22 (S) Growing Raspberries, Farmers Bulletin No. 2165. April 1961.

FARM MECHANICS

Suggested Minimum Time Allotment is 21 Periods	Suggested Reference Material
I. Tractor Maintenance	
A. What are the principles and fundamentals of a:	4. pp. 13-15 8. pp. 393-400 10. pp. 1-19 11. 12. pp. 223-276 14. pp. 1-26 15. Chapter 4 AV 9 AV 10 AV 13
1. 2-cycle gasoline motor?	
2. 4-cycle gasoline motor?	
3. A diesel motor?	
B. How are small motors maintained?	12. pp. 9-276 C 10
C. How are tractors and large power units maintained?	1. pp. 1-130 3. pp. 2-19 4. pp. 2-12, 16-82 8. pp. 401-444 10. pp. 20-217 11. 13. 14. pp. 61-242, 247-252 15. Chapters 5-16, 18-35 20. AV 11 AV 12 AV 14 AV 15 AV 16 AV 17 C 4 C 5 C 6 C 7 C 8 C 9 C 11 C 12 C 13 C 14 C 15 C 16 C 17 C 18 C 19 C 20
1. What is tractor maintenance?	
2. What are the principles of, and procedures of, maintenance to follow after 50 hours of operation?	
3. What are the principles of, and procedures of, maintenance after 100 hours of operation?	
4. What are the principles of, and procedures of, maintenance after 250 hours of operation?	
5. What are the principles of, and procedures of, maintenance after 500 hours of operation?	
6. What are the principles of, and procedures of, maintenance after one year of operation?	

	C 22 C 23 C 24
D. What should one know about trouble shooting in tractor engines?	3. pp. 2-19 10. pp. 267-270 14. pp. 243-246 15. Chapter 17
E. What are the principles of selecting and storing tractor fuels and lubricants?	2. pp. 1-46 14. pp. 27-60
1. What are the fundamentals of selecting tractor fuels?	
2. How should fuels be stored?	
3. What are the fundamentals of selecting tractor lubricants?	
4. How should lubricants be stored?	

II. Farm Welding

A. Arc welding	5. pp. 129-164 6. pp. 223-252 7. pp. 478-523 8. pp. 241-278 9. pp. 384-401 16. pp. 1-336 17. pp. 2-451 18. pp. 3-301 19. C 2 C 21 AV 1 AV 2 AV 3 AV 4 AV 7
1. What are the principles of selecting and caring for arc welding equipment?	
2. How are electrodes selected?	
3. What are the safety measures one should observe in arc welding?	
4. How does one control distortion?	
5. How does one identify the metals commonly welded?	
6. What are the welding terms we should be familiar with?	
7. How do we strike an arc and run a flat bead?	
8. How do we weave with a welding bead?	
9. What are the principles used in making a butt weld; a fillet weld?	

10. What are the procedures used in welding in vertical, horizontal, and overhead positions?

11. How is cast iron welded with an arc welder?

12. How do we weld steels having poor weldability?

13. How is metal cut with an arc welder?

14. How can metals be hard-surfaced with an arc welder?

15. What are the principles and procedures of operation when using a carbon arc torch?

16. What are the principles of shaping, conditioning, tempering, and soldering tools with arc welding equipment?

B. Oxyacetylene welding and cutting

1. What are the kinds of oxyacetylene welding?

2. How is equipment for oxyacetylene welding selected and used?

3. What is fusion welding?

4. What is braze welding?

5. How is hardsurfacing accomplished with the oxyacetylene torch?

6. What are the fundamentals of cutting with the oxyacetylene flame?

5. pp. 165-192
6. pp. 205-223
7. pp. 524-553
8. pp. 279-312
9. pp. 402-417
C 1
AV 5
AV 6
AV 8

I. Reference Publications

1. Tractor Maintenance, Principles and Procedures, Southern Association for Agricultural Engineering and Vocational Agriculture, Athens, Georgia. 1962.

2. Selecting and Storing Tractor Fuels and Lubricants, Southern Association for Agricultural Engineering and Vocational Agriculture, Athens, Georgia. 1964.

3. Farm Tractor Tune-up and Service Guide, Southern Association for Agricultural Engineering and Vocational Agriculture, Athens, Georgia. 1962.

4. The Operation, Care, and Repair of Farm Machinery, Deere and Company, Moline, Illinois. 1957.

5. Wakeman, T. J. and McCoy, Vernon Lee, The Farm Shop, The Macmillan Company, New York, New York. 1960.

6. Sampson, Harry O., Mowery, Albert S. and Kugler, Harold L., Farm Shop Skills in Mechanized Agriculture, American Technical Society, Chicago, Illinois.

7. Jones, Mack M., Shopwork on the Farm, McGraw-Hill Book Company, Incorporated, New York, New York. 1955.

8. Phipps, Lloyd J., McColly, H. F., Scranton, L. L. and Cook, G. C., Farm Mechanics Text and Handbook, The Interstate Printers and Publishers, Incorporated, Danville, Illinois. 1959.

9. Roehl, Louis M. and Longhouse, A. D., Farmers Shop Book, The Bruce Publishing Company, Milwaukee, Wisconsin. 1953.

10. Promersberger, William J. and Bishop, Frank E., Modern Farm Power, Prentice-Hall, Incorporated, Englewood Cliffs, New Jersey. 1962.

11. Kates, Edgar J., Diesel and High Compression Gas Engines Fundamentals, American Technical Society, Chicago, Illinois. 1954.

12. Purvis, Jud, All About Small Gas Engines, The Goodheart-Wilcox Company, Incorporated, 18250 Harwood Avenue, Homewood, Illinois. 1963.

13. Frazee, Irving and Eshelman, Philip V., Tractors and Crawlers, American Technical Society, Chicago, Illinois. 1957.

14. Brown, Arlen D. and Morrison, Ivan Gregg, Farm Tractor Maintenance, The Interstate Printers and Publishers, Incorporated, Danville, Illinois. 1962.

15. Toboldt, William K. and Purvis, Jud, Motor Service's Automotive Encyclopedia, The Goodheart-Wilcox Company, Incorporated, 18250 Harwood Avenue, Homewood, Illinois. 1962.

16. Kugler, Harold L., Arc Welding Lessons for School and Farm Shop, The James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio. 1950.

17. Morford, V. J., Farm Arc Welding, The James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio. 1954.

18. Jefferson, T. B. and Woods, Gorham, Metals and How to Weld Them, The James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio. 1954.

19. Hollenberg, A. H., How to Teach Arc Welding in Farm Mechanics, The James F. Lincoln Arc Welding Foundation, Cleveland 17, Ohio. 25¢.

20. (D) Worksheets in Farm Mechanics for Students in Vocational Agriculture, State Department of Education, Columbia, South Carolina. Vol. 1. 1959-60.

II. Commercial Publications

C 1 Hand Welding and Cutting Outfits, Installation, Operation and Maintenance, Instructions and Parts 840, Air Reduction, 150 East 42nd Street, New York 17, New York. 1963.

C 2 (S) Students' Guide for the Lincoln Short Course in Arc Welding, The Lincoln Electric Company, Cleveland 17, Ohio. 1962. 15¢.

C 3 (T) Teacher's Guide for the Lincoln Short Course in Farm Arc Welding, The Lincoln Electric Company, Cleveland 17, Ohio. 50¢.

C 4 (T) Pure Tractor Handbook, Lubricant Recommendations and Capacities, Mr. K. P. Dutton, Eastern Marketing Division, 1524 East Morehead Street, Box 2607, Charlotte 1, North Carolina.

C 5 (T) Motor Oil and Gear Lubricants for Trucks and Tractors, Phillips Petroleum Company, Mr. H. C. McCown, P. O. Box 10405, Cameron Village Station, Raleigh, North Carolina.

C 6 (T) The Engine Cooling System (Chart) Form AFP-1678, Mr. N. R. Cooper, Technical Supervisor, Sales Technical Service, Union Carbide Consumer Products Company, 270 Park Avenue, New York 17, New York.

C 7 (S) The Engine Cooling System, Mr. N. R. Cooper, Technical Supervisor, Sales Technical Service, Union Carbide Consumer Products Company, 270 Park Avenue, New York 17, New York.

C 8 (T) Too Hot, Ethyl Corporation, New York 17, New York.

C 9 (T) Service Manual for the Doctor of Motors, Perfect Circle Corporation, School Assistance Department, 552 South Washington, Hagerstown, Indiana. 50¢.

C 10 (S) Doctor of Motors Prescription for Better Small Engine Overhauls, Perfect Circle Corporation, School Assistance Department, 552 South Washington, Hagerstown, Indiana.

C 11 (S) Doctor of Motors Prescription for Better Gasoline Engine Overhauls, Perfect Circle Corporation, School Assistance Department, 552 South Washington, Hagerstown, Indiana. Free.

C 12 (S) Piston Rings, Pistons and Cylinders, Perfect Circle Corporation, School Assistance Department, 552 South Washington, Hagerstown, Indiana. Free.

C 13 (D) Champion Spark Plug Company Teachers Kit, Champion Spark Plug Company, P. O. Box 910, Toledo 1, Ohio.

C 14 (T) Lubricating Greases, G-227A, American Oil Company, P. O. Box 6110-A, Chicago 80, Illinois.

C 15 (T) Hydraulic Power Transmission, HP-221A, American Oil Company, P. O. Box 6110-A, Chicago 80, Illinois.

C 16 (T) Mechanical Power Transmission, MP-231A, American Oil Company, P. O. Box 6110-A, Chicago 80, Illinois.

C 17 (T) Bearings and Their Lubrication, B-226A, American Oil Company, P. O. Box 6110-A, Chicago 80, Illinois.

C 18 (T) Things to Know About Engine Wear, Technical Bulletin No. 61-8A, American Oil Company, P. O. Box 6110-A, Chicago 80, Illinois.

C 19 (T) Facts About LP-Gas as a Motor Fuel, Technical Letter No. X-1010-A, American Oil Company, P. O. Box 6110-A, Chicago 80, Illinois.

C 20 (T) Things to Know About Motor Oil, Technical Bulletin No. 61-14A, American Oil Company, P. O. Box 6110-A, Chicago 80, Illinois.

C 21 (T) How to Build a Trailer-Loading Chute (an excellent welding project) Department of Agricultural Education, University of Missouri, 122 Waters Hall, Columbia, Missouri.

C 22 (S) A Power Primer, General Motors, Public Relations Staff, Detroit 2, Michigan.

C 23 (T) Power Goes to Work, General Motors, Public Relations Staff, Detroit 2, Michigan.

C 24 (S) What You Should Know About Farm Tires, Mr. K. R. Cox, The B. F. Goodrich Company, 500 South Main Street, Akron, Ohio 44318 - explain in letter that these bulletins are to be used for vocational agricultural classes.

III. Audio Visual Materials that are Rental Free Except for Return Postage

AV 1 Welding Comes to the Farm, (Movie) The Lincoln Electric Company, Box 3115, Cleveland 17, Ohio.

AV 2 The Prevention and Control of Distortion in Arc Welding, (Movie) The Lincoln Electric Company, Box 3115, Cleveland 17, Ohio.

AV 3 The Magic Wand of Industry - Arc Welding, (Movie) The Lincoln Electric Company, Box 3115, Cleveland 17, Ohio.

AV 4 Futures in Welding, (Movie) Arcos Corporation, Attention James A. Brickett, Sales Manager, 1500 South 50th Street, Philadelphia, Pennsylvania 19143.

AV 5 Industrial Gases and Shielded Arc Welding, (Movie) Air Reduction Sales Company, P. O. Box 2, Union, New Jersey.

AV 6 Oxyacetylene Flame -- Master of Metals, Bureau of Mines, United States Department of Interior, Graphic Services, 4800 Forbes Avenue, Pittsburg 13, Pennsylvania.

AV 7 Always on the Job, (Filmstrip on arc welding safety -- for loan only) Air Reduction Sales Company, P. O. Box 2, Union, New Jersey.

AV 8 Guy Behind Your Back, (Filmstrip on oxyacetylene safety -- for loan only) Air Reduction Sales Company, P. O. Box 2, Union, New Jersey.

AV 9 ABC of Internal Combustion, (Movie) General Motors Corporation, Public Relations Staff, Film Library, General Motors Building, Detroit, Michigan 48202.

AV 10 ABC of Diesel Engine, (Movie) General Motors Corporation, Public Relations Staff, Film Library, General Motors Building, Detroit, Michigan 48303.

AV 11 Case of the Slippery Oil, (Movie) Perfect Circle Corporation, School Assistance Department, Hagerstown, Indiana 47346.

AV 12 Spark in Time on the Firing Line, (Movie) Champion Spark Plug Company, Film Department, 900 Upton Avenue, Toledo 1, Ohio.

AV 13 What Makes It Go, (Movie) Modern Talking Picture Service, 714 Spring Street, Northwest, Atlanta, Georgia - or - 501 North College Street, Charlotte 6, North Carolina.

AV 14 Engine Cooling System - Basic Maintenance, (Filmstrip -- for loan only) Union Carbide Corporation, Consumer Products Division, Sales Technical Services, Automotive Products, 270 Park Avenue, New York, New York 10017.

AV 15 Better Ignition, (Filmstrip -- for loan only) Delco-Remy Division, General Motors Corporation, Technical Literature Section, Anderson, Indiana.

AV 16 Installing Piston Rings in Farm Tractors, (Filmstrip -- for loan only) Perfect Circle Corporation, School Assistance Department, Hagerstown, Indiana 47346.

AV 17 That High Power Top Inch, (Filmstrip -- for loan only) Perfect Circle Corporation, School Assistance Department, Hagerstown, Indiana 47346.

SUPERVISED PROGRAMS OF AGRICULTURAL PRACTICE

Suggested Minimum Time Allotment is 17 Periods	Suggested Resource Material
I. Summarization of Previous Years Records for Supervised Program of Agricultural Practices	See Agriculture I for Resource Materials.

II. Use of Summarized Records to:

A. Develop concepts with the individual of:

1. Weaknesses in his program.
2. Strengths in his program.
3. Possible areas for reduction of activity.
4. Possible areas for enlargement of present enterprises or activities.
5. Possible areas for new enterprises or activities.
6. Possible areas for introduction of new techniques or approaches.

B. Develop concepts of sound agricultural practice with the entire class or department.

C. Develop a basis for public relations programs in school and community.

III. Development of Goals in Supervised Programs of Agricultural Practices for the Coming Year

IV. Development of Plans for Supervised Programs of Agricultural Activities for the Coming Year

LEADERSHIP TRAINING - FFA - NFA

Suggested Minimum Time Allotment is 11 Periods	Suggested Resource Material
I. Reorganizing the Local Chapter for the Present Years Program	4. pp. 29-55, 67-72 5. pp. 50-72, 105-138, 231-252, 443-465 6. pp. 3-34 7. pp. 369-389
A. Training of new officers	
B. Development of committees and training committee members	
C. Developing the local program of work	
D. Developing a program of finances for the chapter	
II. Planning and Conducting Meetings	
A. Time and place of meetings	4. pp. 56-60, 97-100 5. pp. 253-284 7. pp. 363-368
B. Publicity and recording of chapter accomplishments	
III. Awards and Contests	1. 2. 3.
A. Building towards a "Superior Chapter Award."	
B. Building towards the development of individuals through:	
1. Foundation awards	
2. Advancement by the degree program	
IV. Educational Fairs, Contests, and Exhibits	7. pp. 390-404, 422-441

I. Reference Publications

1. Superior Chapter Award Forms, Available from the State Executive FFA Secretary.

2. National FFA Foundation Awards for You, The Future Farmers of America Foundation, Incorporated, Agricultural Education Branch, Division of Vocational and Technical Education, Bureau of Educational Assistance Programs, United States Office of Education, Washington 25, D. C.

3. American Farmer Degree and South Carolina Farmer Degree, Forms available from the State Executive FFA Secretary.

4. Official Manual, Future Farmers of America and NFA Guide, Future Farmers Supply Service, P. O. Box 1180, Alexandria, Virginia.

5. Bender, R. E., Clark, R. M. and Taylor, R. E., The FFA and You, The Interstate Printers and Publishers, Incorporated, Danville, Illinois. 1962.

6. Gray, Jarrell D. and Jackson, J. R., Leadership Training and Parliamentary Procedure for FFA, Prentice-Hall, Incorporated, Englewood Cliffs, New Jersey. 1958.

7. Phipps, Lloyd J. and Cook, Glen Charles, Handbook on Teaching Vocational Agriculture, The Interstate Printers and Publishers, Incorporated, Danville, Illinois. 1956.

CONSERVATION OF NATURAL RESOURCES

Suggested Minimum Time Allotment is 18 Periods	Suggested Resource Material
I. Soil and Water Conservation	1. pp. 245-308
A. Effects of soil erosion	2. pp. 124-150
1. What is erosion?	3. pp. 248-316
2. What are the erosion forces?	4. pp. 29-56, 149-325
a. Wind	5. pp. 21-207, 259-278
(1) How does the wind cause erosion?	USDA 1
(2) Where is wind erosion most likely to occur?	USDA 2
(3) What kinds of soils are most likely to be effected by wind erosion?	USDA 3
(4) How can wind erosion be recognized?	USDA 4
b. Water	USDA 5
(1) What are the kinds of water erosion?	USDA 6
(2) How does water cause erosion?	USDA 7
(3) Why is erosion more damaging to some soils than others?	USDA 8
(4) What effect does slope have on the amount of erosion?	USDA 9
c. What are the detrimental effects of erosion:	USDA 10
(1) To the soil?	USDA 11
(2) To crop yields?	AV 4
	AV 5
	AV 6
	AV 7
	AV 8
	AV 9
	AV 10
	AV 11
	AV 12
	AV 13
	AV 14

B. Methods of erosion control

1. How can wind erosion be controlled by:

a. Crop rotation?

b. Wind breaks?

c. Mulch cultivation?

d. Method and time of tillage?

2. How can water erosion be controlled by:

a. Terracing and meadow outlets?

b. Contour tillage?

c. Crop rotation?

d. Mulch tillage?

C. Planning a conservation program for the farm

1. What is a conservation farm plan?

2. What are the advantages of a soil conservation plan?

3. How does one map a farm?

4. How is land classified on a farm?

II. Farm Forestry

A. Improving a forest by cutting

1. How does cutting improve a forest?

2. What should determine the cutting system to use?

3. When should trees be cut?

a. How are trees selected?

5. pp. 207-236
6. pp. 32-232, 266-294
7. pp. 66-92
8. pp. 224-268, 283-346
9. pp. 76-334
Clemson 1
Clemson 2
Clemson 3
Clemson 4
Clemson 5
Clemson 6

b. How should trees be marked?

c. How is selective cutting done?

4. Why should trees be thinned?

5. How does pruning improve a forest?

6. How should trees be harvested?

7. How can we improve our cutting practices?

B. Controlling insects, diseases, and undesirable hardwoods

1. What are the major forest insects in South Carolina and why are they important?

2. How can these forest insects be combated in woodlands?

3. What are some diseases of our forest in South Carolina?

4. How can we combat forest diseases?

5. Why control undesirable hardwoods in our timberland?

a. What methods can be used?

b. What materials can be used?

C. Marketing farm timber

1. What are the market outlets for:

a. Veneer logs?

b. Sawlogs?

c. Pulpwood?

d. Pilings?

e. Fence posts?

USDA 12
USDA 13
USDA 14
USDA 15
C 1
C 2
AV 1
AV 2
AV 3

2. How are farmers selling their timber?

3. How should farm timber be sold?

4. Why are sale contracts important?

5. How should the value of farm timber be determined?

6. What factors should be considered to determine the cutting system to be used for:

   a. Sawlog trees?

   b. Pulpwood trees?

   c. Pilings?

   d. Veneer logs?

   e. Fence posts?

7. What is the essential equipment needed to work the farm forest?

8. What are the common units of measure used for measuring:

   a. Sawlogs?

   b. Pulpwood?

   c. Veneer logs?

   d. Pilings?

   e. Railroad ties and timbers?

   f. Fence posts?

9. How are pulp and fuel wood measured?

10. How is sawed lumber measured?

11. How are sawlogs measured?

12. How is board-feet in standing trees measured?

13. How is volume measured in standing trees for a given size plot?

14. How is quality of timber determined in a farm forest?

15. How should the farm forest be thinned?

16. What system should be used in marking trees to be cut in the farm forest?

17. What are some measuring and estimating instruments that can be made in the agricultural class and shop?

    a. Log scale stick

    b. Diameter tape

    c. Hypsometer (scale stick)

    d. Tree scale board

    e. Volume tables

    f. Tally sheets

18. What are the important factors to be considered in harvesting farm timber for maximum returns?

I. Reference Publications

1. Knuti, Leo and Korpi, Milton, Profitable Soil Management, Prentice-Hall, Incorporated, Englewood Cliffs, New Jersey. 1962.

2. Vanderford, H. B., Managing Southern Soils, John Wiley & Sons, Incorporated, New York, New York. 1957.

3. Donahue, Roy L., Our Soils and Their Management, The Interstate Printers and Publishers, Danville, Illinois. 1961.

4. Stallings, J. H., Soil Use and Improvement, Prentice-Hall, Incorporated, Englewood Cliffs, New Jersey. 1957.

5. Foster, Albert B., Approved Practices in Soil Conservation, The Interstate Printers and Publishers, Danville, Illinois. 1964.

6. Weaver, Howard E. and Anderson, David A., Manual of Southern Forestry, The Interstate Printers and Publishers, Incorporated, Danville, Illinois. 1954.

7. (D) Farm Forestry Practices for Students of Vocational Agriculture, State Department of Education, Columbia, South Carolina. 1960.

8. Mobley, M. D. and Haskins, Robert N., Forestry in the South, Turner E. Smith and Company, Atlanta, Georgia. 1956.

9. Preston, John Frederick, Developing Farm Woodlands, McGraw Hill Book Company, Incorporated, New York, New York. 1954.

II. Clemson University Agricultural Publications, Clemson, South Carolina

Clemson 1 (T) Volume Tables for Small Diameter Loblolly, Shortleaf, and Virginia Pine in Upper South Carolina Piedmont, Forest Research Series No. 7. September 1962.

Clemson 2 (S) Thinning Pines for Pulpwood, Extension Service Circular 332. November 1960.

Clemson 3 (T) Tension Wood and Its Relation to Splitting in Hickory, Experiment Station Bulletin 480. March 1960.

Clemson 4 (S) Insects Attacking Pines -- South Carolina, Extension Service Information Card 98. 1959.

Clemson 5 (S) Getting Open Land Ready for Planting Pines, Extension Service Information Card No. 93. 1958.

Clemson 6 (D) Forest Tree Planting Guide, Extension Service Information Card 88. April 1957.

III. Publications of the United States Department of Agriculture, Division of Information, Washington, D. C. 20250

USDA 1 (T) Agricultural Conservation Program, South Carolina, ACP-1965 SC. 1964.

USDA 2 (S) Grass Waterways in Soil Conservation, Leaflet No. 477. 1960.

USDA 3 (S) Farming Terraced Land, Leaflet No. 335. 1958.

USDA 4 (S) Soil-Conserving Tillage Systems for Corn, Farmers Bulletin No. 2118. August 1958.

USDA 5 (S) The Measure of Our Land, PA-128. 1951.

USDA 6 (S) The Soil That Went to Town, A1B95. 1962.

USDA 7 (S) Emergency Tillage for Wind-Erosion Control, PA362. July 1958.

USDA 8 (S) Your Soil . . . . Crumbly or Cloddy? Leaflet No. 328. 1962.

USDA 9 (S) Facts About Wind Erosion and Dust Storms on the Great Plains, Leaflet No. 394. 1961.

USDA 10 (S) How to Control Soil Blowing, Farmers Bulletin No. 2169. 1961.

USDA 11 (S) Windbreaks in Conservation Farming, Miscellaneous Publication No. 759. August 1959.

USDA 12 (S) Managing the Family Forest, Farmers Bulletin No. 2187. May 1962.

USDA 13 (S) Six Ways to Conserve and Improve Your Farm Woodlands, PA461. 1961.

USDA 14 (S) Logging Farm Wood Crops, Farmers Bulletin No. 2090. 1962.

USDA 15 (S) Chemical Control of Brush and Trees, Farmers Bulletin No. 2158. 1961.

IV. Commercial and Other Publications

C 1 (S) Forestry Practice Payments Under A.C.P., See ASCS Office or South Carolina State Commission of Forestry, Columbia, South Carolina.

C 2 (S) Facts About the Nations Lumber Industry, National Lumber Manufacturers Association, 1319 Eighteenth Street, N.W., Washington 6, D. C.

V. Loan Free Audio Visual Materials

A. Movies

AV 1 A Firm Foundation, Union Bag Camp Paper Corporation, Training Center, Mr. Asa B. Johnson, Jr., Training Director, Franklin, Virginia.

AV 2 The Lasting Gift, Southern Pine Association, Mr. John M. Collier, Advertising Manager, P. O. Box 52468, New Orleans 50, Louisiana.

AV 3 When A Fellow Needs a Forester, Film Service Laboratories, Incorporated, Jefferson Road, Athens, Georgia.

AV 4 Arteries of Life, Soil Conservation Service, Columbia, South Carolina.

AV 5 Building Back, Soil Conservation Service, Columbia, South Carolina.

AV 6 The Dust is Dying, Soil Conservation Service, Columbia, South Carolina.

AV 7 The Earth is the Lords, The Venard Organization, 113 North Madison Avenue, Peoria, Illinois.

AV 8 From the Ground Up, Soil Conservation Service, Columbia, South Carolina.

AV 9 Land and Life, Tennessee Valley Authority, Information Office, Knoxville, Tennessee.

AV 10 Raindrops and Soil Erosion, Soil Conservation Service, Columbia, South Carolina.

AV 11 Save That Soil, Soil Conservation Service, Columbia, South Carolina.

AV 12 Your Soil -- Your Future, Soil Conservation Service, Columbia, South Carolina.

B. Filmstrips

AV 13 Story of TVA, Tennessee Valley Authority, Information Office, Knoxville, Tennessee.

AV 14 Save Our Soil, The New Zealand Embassy, 19 Observatory Circle, Northwest, Washington 8, D. C.

ANIMAL PRODUCTION

Suggested Minimum Time Allotment is 36 Periods	Suggested Reference Material
I. Dairy Cattle	1. 2. pp. 287-298 3. pp. 21-38 5. pp. 17-40 6. pp. 1-44 7. pp. 57-69 USDA 1 pp. 14-23 USDA 2 USDA 6 USDA 7 Clemson 1 Clemson 2 pp. 119-123
A. What are the possibilities of:	
1. Dairy as a livestock enterprise?	
2. Dairy in our community?	
3. Profit from dairy cattle?	
4. A strong price structure for dairy products in the future?	
5. Getting started in dairying?	
6. Raising dairy calves?	
B. How does one select foundation stock?	Clemson 7 p. 5 Clemson 8 C 1 USDA 3 2. pp. 299-321 3. pp. 39-82 4. pp. 78-124 5. pp. 41-64, 321-357 6. pp. 45-111 7. pp. 70-100 10. pp. 85-110
1. Review of breeds and characteristics	
a. What are the characteristics of the different breeds of dairy cattle?	
b. What is the weight of a mature Guernsey, Jersey, Holstein, Brown Swiss, and Ayrshire and give the percent of butter fat of each?	
c. Picture identification.	
2. Selecting dairy cows and heifers	
a. What are the factors that make up "dairy character?"	
b. How important is the mammary system in selecting dairy cattle?	
c. How are production and progeny records used in selecting dairy cattle?	

C. Understanding general principles of feeding

1. How is feed utilized by dairy cattle for:

   a. Body maintenance?

   b. Growth?

   c. Reproduction of fetus development?

   d. Milk production?

2. What are the requirements of dairy cattle in terms of the various feed nutrients?

   a. Protein

   b. Carbohydrates

   c. Fats

   d. Minerals

   e. Salt

   f. Phosphorus

   g. Calcium

   h. Trace minerals

   i. Vitamins

   j. Water

3. Kind of feeds, composition and characteristics

   a. What are the classes and kinds of feed a dairyman may feed dairy animals?

   b. What is the composition of dairy feeds?

   c. How are dairy rations computed by:

      (1) Feeding standards?

      (2) Square method?

2. pp. 1-43
3. pp. 83-145
5. pp. 127-241
6. pp. 112-132
7. pp. 40-56, 101-110
8. pp. 1-293
9. pp. 1-105, 107, 209-240
11. pp. 627-656
Clemson 3
Clemson 4
Clemson 5
Clemson 6
Clemson 7 pp. 6-10
USDA 4
USDA 5
C 2

(3) Complex mixture method?

II. Beef Cattle

A. Determining the possibilities

1. Trends in production, consumption, markets, prices.

a. What is the trend in number of beef cattle on the farms in South Carolina?

b. How many beef cattle were there on the farms of our county on January 1, 1963?

c. What is the trend in production in our county?

d. It is estimated that in the United States by 1975 we shall need 55% more beef and veal. What does this mean as far as the future is concerned for beef production in the United States?

e. In producing any commodity one should consider the availability of markets. Are there markets within reasonable distance of our community where farmers can sell their cattle and calves? Name three beef cattle markets within 100 miles of our area.

f. What has been the average price paid South Carolina farmers for beef cattle during the past 10 years?

g. If a beef calf weighs 500 lbs. at weaning, what will he sell for at this average price?

h. How does the potential income from beef production in South Carolina compare with that of other beef producing areas?

2. Beef cattle as a farming enterprise

a. What do the economists and livestock

1.
2. pp. 181-186
7. pp. 171-183
12. pp. 11-52
13. pp. 15-49
14. pp. 1-19
15. pp. 22-53
Clemson 1
USDA 1 pp. 34-37, 84-89
USDA 2
USDA 6
USDA 8
C 3

specialists think will be the future of beef production in South Carolina and this area?

b. What are the advantages of beef production as an enterprise?

c. Are there any idle acres of land on the farms of our area? Would the individual landowners and the community as a whole benefit if these idle acres could be made to produce income?

d. What system of beef cattle production best fits a specific farm, a purebred herd, commercial herd or feeder cattle?

B. Selecting breeding and fattening stock

2. pp. 187-213
4. pp. 7-31
7. pp. 184-207
8. pp. 1-50, 592-596, 607
10. pp. 2-12, 25-36
12. pp. 53-114
13. pp. 50-108, 219-252
14. pp. 20-48, 51-87
15. pp. 84-130

1. How can you identify the different breeds of beef cattle?

2. Which breeds are popular locally?

3. What type characteristics does one look for in selecting breeding stock?

4. What does one look for in terms of production records in selecting breeding stock?

5. What considerations should one give to local availability in selecting breeding stock?

6. How does one select feeder cattle?

a. What are the classes and grades?

b. How does one determine the class and grade he should select?

C. Developing a beef cattle enterprise

12. pp. 115-121
14. pp. 49-51
15. pp. 54-83
Clemson 2 pp. 103-112
Clemson 9 pp. 108-121
Clemson 18
Clemson 19

1. What does it take to develop a cow-calf beef program?

a. What does one need in terms of capital investment for such a program?

b. What is the extent of the receipts one might expect from such a project?

c. What expenses does one have to allow for?

d. What is the potential profit in such a venture?

e. How much labor would be required throughout the year?

2. What is the potential of a beef-yearling enterprise?

a. What capital investment is needed?

b. What income can one anticipate?

c. What are the expenses of such an enterprise?

d. What returns can one expect?

3. What possibilities are there for beef fattening programs in South Carolina?

a. What investment is required?

b. What income can one anticipate?

c. What expenses must one plan for?

d. What profits can one anticipate?

4. What facilities are needed for beef production?

5. How can one finance a beef cattle enterprise?

D. Feeding beef cattle

1. What are the nutritional requirements of beef cattle?

2. What feeding procedures should one follow with:

a. Calves?

2. pp. 1-36, 214-272
7. pp. 208-223
8. pp. 51-293
9. pp. 1-98, 106, 157-186, 281-352
11. pp. 692-766
12. pp. 28-417
13. pp. 139-219, 355-386
14. pp. 88-207
15. pp. 161-234

b. Brood cows?	Clemson 10 Clemson 11
c. Fattening animals?	Clemson 12 Clemson 13
3. What is the value of temporary and permanent grazing for:	Clemson 14 Clemson 15 Clemson 16
a. Breeding herd?	Clemson 17 C 2
b. Calves?	C 4 C 5
c. Stockers?	7. pp. 224-230 8. pp. 617-635
E. How does one feed, train and groom an animal for showing?	10. pp. 18-24 12. pp. 748-791 13. pp. 327-354 14. pp. 304-328 15. pp. 235-263
F. What should one know in regards to prevention and control of:	8. pp. 432-590 12. pp. 537-654 13. pp. 387-428
1. Screw worms?	14. pp. 231-257 15. pp. 264-298
2. External parasites?	Clemson 20 USDA 11
3. Insecticide for beef producers?	USDA 12 USDA 13 USDA 14
4. Shipping fever?	USDA 15 USDA 16
5. Horn flies?	USDA 17 USDA 18
6. Blackleg?	USDA 19 USDA 22
7. Demodectic mange?	
8. Anaplasmosis?	
9. Cattle warts?	
10. Hyperkeratosis?	
11. Cattle lice?	
12. Liver flukes?	
13. Cattle grubs or heel flies?	
14. Brucellosis?	
G. Managing beef herds	2. pp. 214-272, 664-674 7. pp. 231-244
1. The breeding herd	8. pp. 1-37, 294-431, 658-663, 683-731

a. What breeding principles must one be familiar with?

(1) How can herds be improved by using "standard of performance" records and testing procedures?

(2) How do present consumer trends in beef consumption affect the breeding program of a beef producer?

(3) How does reproduction occur?

(4) What laws of inheritance must a cattle breeder understand?

b. What special care should be given the cow during gestation? Immediately after calving? Prior to breeding?

c. How should the newborn calf be cared for?

d. What are the advantages and methods one can use for dehorning beef animals?

e. When and how should beef males be castrated?

f. What are the merits of the various marking systems for beef animals?

g. How should beef heifers be selected and raised for herd replacements?

h. How should the herd sire be cared for?

2. The stocker and fattening herd

a. How do we determine profits on this type of herd?

b. How do we fit the cattle feeding program to local farm conditions?

3. What housing and equipment is needed for beef production?

12. pp. 122-279, 918-536
13. pp. 278-326, 444-462
14. pp. 208-230, 290-303
15. pp. 131-160, 299-357
16
USDA 9
USDA 20
USDA 21
C 8
C 9
C 14

H. Marketing beef cattle

1. How does the law of "supply and demand" control the beef market?

   a. How does feed cost and available feed affect the market?

   b. How do prices and market trends affect "supply?"

   c. What factors affect "demand?"

2. What are the basic concepts one must understand in marketing feeder cattle?

   a. What are the methods of marketing?

      (1) Direct buying and selling.

      (2) Selling through a dealer.

      (3) Auction sales.

      (4) Terminal markets

      (5) Cooperatives

   b. What are the grades of feeder cattle?

   c. How does one determine the best time of marketing feeder cattle?

3. What are the basic principles of marketing slaughter cattle?

   a. What must a beef feeder know about grades of slaughter cattle to market such cattle efficiently?

   b. In marketing slaughter cattle what are the advantages and disadvantages of:

      (1) Selling to the packer or packer buyer?

      (2) Selling on grade and yield?

2. pp. 273-286
8. pp. 636-656
12. pp. 655-747
13. pp. 253-277, 429-443
14. pp. 258-289
15. pp. 358-393
Clemson 21
Clemson 22
USDA 10

(3) Selling through a commission firm?

(4) Selling to private buyers?

c. How can cooperatives assist farmers in marketing beef?

d. How does one determine when to sell slaughter cattle?

4. How can losses due to damaged carcasses be reduced or prevented?

5. How does beef travel from the producer to the consumer?

I. Reference Publications

1. (D) Program Planning With Agricultural Facts, Agricultural Education Department, Clemson College. 1960.

2. Bundy, Clarence E. and Diggins, Ronald V., Livestock and Poultry Production, Prentice-Hall, Incorporated, Englewood Cliffs, New Jersey. 2nd Edition, 1961.

3. A Reference Unit on Dairy Production, State Board for Vocational Education and Mississippi State University, Jackson, Mississippi.

4. Youtz, H. G. and Carlson, A. C., Judging Livestock, Dairy Cattle, Poultry, and Crops, Prentice-Hall, Incorporated, Englewood Cliffs, New Jersey. 1962.

5. Reaves, Paul M. and Pegram, C. W., Southern Dairy Farming, The Interstate Printers and Publishers, Incorporated, Danville, Illinois. 1956.

6. Diggins, Ronald V. and Bundy, Clarence E., Dairy Production, Prentice-Hall, Incorporated, Englewood Cliffs, New Jersey. 1961.

7. Chapman, Paul W. and Dinsmore, Wayne, Livestock Farming, Turner E. Smith and Company, Atlanta, Georgia. 1953.

8. Ensminger, M. E., The Stockman's Handbook, The Interstate Printers and Publishers, Incorporated, Danville, Illinois. 1962.

9. Cassard, Daniel W. and Juergenson, Elwood M., Approved Practices in Feeds and Feeding, The Interstate Printers and Publishers, Danville, Illinois. 1963.

10. Selecting, Fitting and Showing Livestock, State Department of Education, Columbia, South Carolina. Vol. VI. August 1959.

11. Morrison, Frank B., Feeds and Feeding, The Morrison Publishing Company, Clinton, Iowa. 1959.

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13. Williams, D. W., Beef Cattle Production in the South, The Interstate Printers and Publishers, Incorporated, Danville, Illinois. 1955.

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15. A Reference Unit on Beef Cattle Production, State Board for Vocational Education and Mississippi State University, Jackson, Mississippi. 1961.

16. Beef Cattle Plans for South Carolina, Publication Distributed by F. H. Hedden, Extension Agricultural Engineer, Clemson University.

II. Clemson University Agricultural Publications, Clemson, South Carolina

Clemson 1 (T) South Carolina Livestock and Poultry Statistics, AE 260. June 1964.

Clemson 2 (T) Production Requirements and Estimated Returns From Selected Crop and Livestock Enterprises in the Piedmont Area, AE 202. October 1960.

Clemson 3 (S) Dairy Concentrate Grain Mixtures, Extension Circular 427. March 1959.

Clemson 4 (D) Comparison of Coastal Bermuda, Common Bermuda, and Oat Hays With Alfalfa Hay for Milking Cows, Experiment Station Bulletin 490. July 1961.

Clemson 5 (S) Blackstrap Molasses for Milking Cows, Experiment Station Bulletin 487. January 1961.

Clemson 6 (S) Silage Production and Use on Selected Dairy Farms, Experiment Station Bulletin 470. April 1959.

Clemson 7 (S) The Family Dairy Cow, Extension Circular 157. October 1956.

Clemson 8 (S) Judging Dairy Cattle, Extension Bulletin 78. July 1958.

Clemson 9 (T) Estimated Production Requirements and Returns from Selected Crop and Livestock Enterprises in the Upper Coastal Plain Area, AE 243. July 1963.

Clemson 10 (S) Beef Production From Summer Grasses in the Coastal Plain, Experiment Station Bulletin 509. January 1964.

Clemson 11 (S) Recommended Pastures for Beef Cattle, Livestock Leaflet 4. August 1962.

Clemson 12 (S) Winter Forage for Fattening Steers, Extension Circular 471. May 1960.

Clemson 13 (D) Common and Coastal Bermuda Pastures for Yearling Steers, Experiment Station Bulletin 472. July 1959.

Clemson 14 (S) Urea-Molasses as a Partial Replacement of Protein in Wintering Rations for Yearling Steers Fed Coastal Bermuda Grass Hay, Experiment Station Circular 135. October 1962.

Clemson 15 (S) Comparison of Blackstrap Molasses and Ground Snapped Corn in Wintering Rations for Beef Cattle, Experiment Station Bulletin 477. March 1960.

Clemson 16 (T) A Comparison of Drylot and Winter Grazing Systems for Fattening Feeder Cattle, Animal Husbandry Research Series 12. August 1962.

Clemson 17 (S) Urea-Molasses in Wintering Rations for Yearling Steers, Experiment Station Circular 138. October 1963.

Clemson 18 (S) Economic Analysis of Annual Adjustments in Developing a Beef Cattle-Grain Farm in the Piedmont Area of South Carolina, Experiment Station Bulletin 459. July 1958.

Clemson 19 (S) The Business Side of Producing Beef Calves in the Piedmont Area of South Carolina. Experiment Station Bulletin 426. July 1955.

Clemson 20 (S) Control Program for External Parasites on Beef Cattle, Information Card No. 78B. November 1963.

Clemson 21 (S) Consumer Preference for Beef Produced on Grass and Grain or in Drylot, Experiment Station Bulletin 499. August 1962.

Clemson 22 (T) Consumer Preference for Beef, AE 199. September 1960.

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USDA 1 (T) Farm Costs and Returns, Commercial Farms by Type, Size, and Location, Agriculture Information Bulletin No. 230. June 1964.

USDA 2 (T) Resource Requirements on Farms for Specified Operator Incomes, Agricultural Economics Report No. 5. February 1962.

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USDA 5 (S) Feeding Dairy Cattle, Farmers Bulletin No. 2153. 1961.

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USDA 10 (S) Beef Marketing Margins and Costs, Miscellaneous Publication No. 710. February 1956.

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USDA 12 (S) Demodectic Mange in Cattle, Leaflet No. 438. 1958.

USDA 13 (S) Liver Flukes in Cattle, Leaflet No. 493. 1961.

USDA 14 (S) Horn Flies on Cattle, Leaflet No. 388. 1963.

USDA 15 (S) Anaplasmosis in Cattle, Leaflet No. 437. 1960.

USDA 16 (S) Hyperkeratosis of Cattle, Leaflet No. 447. 1959.

USDA 17 (S) What You Should Know About Market Cattle Testing for Brucellosis, PA 434. January 1963.

USDA 18 (S) Anthrax, Farmers Bulletin No. 1736. 1960.

USDA 19 (S) Anthrax in Livestock, Program Aid No. 431. 1961.

USDA 20 (S) Automatic Livestock Waterers, Leaflet No. 395. August 1962.

USDA 21 (S) Cattle Walkways, an aid to Coastal Marsh Range Conservation, Leaflet No. 459. November 1959.

USDA 22 (S) Mr. Livestock Producer -- It pays to Use Chemicals Safely, Leaflet No. 472. 1960.

IV. Commercial and Other Publications

C 1 (S) Hoards Dairyman Annual Cow Judging Contest Pictures, Hoards Dairyman, Fort Atkinson, Wisconsin. (Free in quantities sufficient for the largest class.)

C 2 (S) Dairy-Beef Feeding Guide, New Holland Machine Company, New Holland, Pennsylvania.

C 3 (T) South Carolina Crop Reporting Service Publications, Obtain current materials by placing your name on their mailing list. Their address is United States Court House, Columbia, South Carolina.

C 4 (S) Feeding High-Concentrate Rations, National Cottonseed Products Association, Incorporated, Research and Educational Division, 1104 Praetorian Building, Dallas 1, Texas.

C 5 (S) Feeding Practices, Bulletin No. 32. National Cottonseed Products Association, Incorporated, Research and Educational Division, 1104 Praetorian Building, Dallas 1, Texas. 1955.

C 6 (S) Interval Feeding of Cottonseed Cake, National Cottonseed Products Association, Incorporated, Research and Educational Division, 1104 Praetorian Building, Dallas 1, Texas. 1963.

C 7 (S) Fattening Beef Cattle, Bulletin No. 36, National Cottonseed Products Association, Incorporated, Research and Educational Division, 1104 Praetorian Building, Dallas 1, Texas. 1962.

C 8 (S) Pave Your Barnyard With Concrete, Portland Cement Association, 161 Peachtree Street, Atlanta, Georgia. 1955.

C 9 (S) Slotted Floors for Efficient Livestock Production, Portland Cement Association, 161 Peachtree Street, Atlanta, Georgia. 1964.

C 10 (S) Bunker Type Feeding Silo, Plan No. PF-103, Southern Pine Association, P. O. Box 52468, New Orleans, Louisiana.

C 11 (S) Hay and Rest Barn, Plan No. FF-104, Southern Pine Association, P. O. Box 52468, New Orleans, Louisiana.

C 12 (S) Multi-Purpose Building-Clear Span, Plan No. PF-105, Southern Pine Association, P. O. Box 52468, New Orleans, Louisiana.

C 13 (T) Southern Pine Smaller Farm Structures, Southern Pine Association, P. O. Box 52468, New Orleans, Louisiana.

C 14 (T) Equipment for the Hereford Producer, The American Hereford Association, Hereford Drive, Kansas City, Missouri.

List of publications not included in List of Clemson's Agricultural Publications for Farm and Home.

PLANT SCIENCE AND SOIL UNIT

Agronomy Mimeograph Series

_____ (T) The pH Values of South Carolina Soils. Series No. 1. June 1957.

Experiment Station Circular

_____ (T) Land Resource Areas in South Carolina, (Map). No. 112. June 1957.

CROP PRODUCTION UNIT

Agricultural Economics

_____ (T) South Carolina Wheat Statistics. AE 170. 1959.

_____ (T) Tobacco Statistics. AE 172. May 1959.

_____ (T) South Carolina Oats Statistics. AE 178. 1959.

_____ (T) Tobacco Marketing Practices of Farmers in the Coastal Plain Area of South Carolina. AE 194. April 1960.

_____ (T) Production Requirements and Estimated Returns from Selected Crop and Livestock Enterprises in the Piedmont Area. AE 202. October 1960.

_____ (T) Marketing Flue-Cured Tobacco Tied and Untied. AE 206. March 1961.

_____ (T) Crop Statistics. AE 220. June 1962.

_____ (T) Estimated Production Requirements and Returns from Selected Crop and Livestock Enterprises in the Upper Coastal Plain Area. AE 243. July 1963.

_____ (T) Cash Receipts from Farm Marketing. AE 247. October 1963.

_____ (T) Crop Statistics, County Estimates 1962 and 1963. AE 259. June 1964.

Agronomy and Soils Research Series

_____ (S) Performance of Small Grain Varieties in South Carolina. No. 50. September 1964.

_____ (S) Performance of Corn Hybrids in South Carolina. No. 34. December 1962.

_____ (T) Weather and Corn Production in South Carolina. No. 24. June 1960.

Experiment Station Bulletin

_____ (S) Maize Billbug Control in South Carolina. No. 452. October 1957.

Extension Circulars

_____ (S) 1964 Recommended Varieties for South Carolina. No. 477. September 1963.

_____ (S) Preparing Loose Leaf Tobacco For Market. No. 485. 1962.

_____ (S) Controlling Wireworms in Tobacco Lands. No. 486. December 1962.

Extension Miscellaneous Leaflet

_____ (S) Stored Grain Insects and the Clean Grain Program. 1961.

Seed Certification Department

_____ (T) A Study of Small Grain Planted by South Carolina Farmers. SC 1. 1958.

CONSERVATION OF NATURAL RESOURCES UNIT

Forestry Research Series

_____ (T) Volume Tables for Small Diameter Loblolly, Shortleaf, and Virginia Pine in Upper South Carolina Piedmont. No. 7. September 1962.

FARM HOME AND FAMILY UNIT

Agricultural Economics

_____ (T) The Long Creek Apple Marketing Authority. AE 164. February 1959.

_____ (T) South Carolina Peach Statistics. AE 169. May 1959.

_____ (T) Worker Activity in Facing and Tubbing South Carolina Peaches. AE 180. September 1959.

_____ (T) Market Prospects and Production Potential for Apples in Oconee County, South Carolina. AE 183. November 1959.

_____ (T) Effectiveness of Fiber Pads in Reducing Damage to Basket Packed Peaches. AE 192. February 1960.

_____ (T) Costs and Returns From Apple Production. AE 193. March 1960.

_____ (T) Grape Statistics. AE 196. August 1960.

_____ (T) The Potential for Reducing Costs in Packing South Carolina Peaches. AE 201. October 1960.

_____ (T) Some Unresolved Questions Affecting Grower Decisions in Marketing Fresh Peaches. AE 205. February 1961.

_____ (T) Opinions of Selected South Carolina Consumers Toward Fresh Peaches. AE 211. June 1961.

_____ (T) South Carolina Peach Tree Survey. AE 257. April 1964.

Agronomy and Soils Research Series

_____ (T) Climate and Peach Production in South Carolina. No. 18. October 1959.

Botany Mimeograph Series

_____ (ST) Peach Orchard Soil Fumigation. No. 4. January 1958.

Experiment Station Bulletin

_____ (T) Heating Plastic Greenhouses. No. 666. May 1963.

Extension Bulletin

_____ (S) Familiar Trees of South Carolina. No. 117. 1964.

Extension Circulars

_____ (S) Pecan Pest Control. No. 484. September 1962.

_____ (S) Lawn Grasses of South Carolina. No. 495. July 1964.

_____ (S) Lawn Insects, How to Control Them, Supplement 1 (Lawn Grass Circular). July 1964.

_____ (S) Controlling Turf Grass Diseases, Supplement 2, (Lawn Grass Circular). July 1964.

Horticulture Mimeograph Series

_____ (T) Figs in South Carolina, by T. L. Senn.

_____ (S) The ABC's of Grape Production.

_____ (ST) Weed Control in Fruit Crops, Mimeo No. 1F. April 1962.

ANIMAL PRODUCTION UNIT

Agricultural Economics

_____ (T) Consumer Preference For Beef. AE 199. September 1960.

_____ (T) Production Requirements and Estimated Returns from Selected Crop and Livestock Enterprises in the Piedmont Area. AE 202. October 1960.

_____ (T) Estimated Production Requirements and Returns from Selected Crop and Livestock Enterprises in the Upper Coastal Plain Area. AE 243. July 1963.

_____ (T) South Carolina Livestock and Poultry Statistics. AE 260. June 1964.

Animal Husbandry Research Series

_____ (T) A comparison of Drylot and Winter Grazing Systems for Fattening Feeder Cattle. No. 12. August 1962.

Experiment Station Bulletins

_____ (S) The Business Side of Producing Beef Calves in the Piedmont Area of South Carolina. No. 426. July 1955.

_____ (S) Silage Production and Use on Selected Dairy Farms. No. 470. April 1959.

VT 000 949

Agricultural Production and Management; A Third Year Curriculum for Vocational Agriculture.

South Carolina State Dept. of Education, Columbia. Vocational Agriculture
Clemson Univ., S.C. Dept. of Agricultural Education
MF AVAILABLE IN VT-ERIC SET.
PUB DATE - 66 71p.

DESCRIPTORS - *CURRICULUM GUIDES; *VOCATIONAL AGRICULTURE; *AGRICULTURAL PRODUCTION; *CONSERVATION EDUCATION; *FARM MANAGEMENT; AGRICULTURAL ENGINEERING; SUPERVISED FARM PRACTICE; LEADERSHIP TRAINING; GRADE 11

ABSTRACT - For use in teaching third-year vocational agriculture classes, this curriculum guide provides content and problems to be solved, suggested time allotment, and references for the following eight units: (1) Importance of Agriculture, (2) Animal Production, specifically diary, (3) Crop Production, including cotton, pastures, and soybeans, (4) Conservation of Natural Resources, including soil and water, and wildlife and fish, (5) Farm Management, covering modern day farming, starting in farming, and farm financing, (6) Farm Mechanics, including farm machinery and electricity and motors, (7) Leadership Training, and (8) Supervised Programs of Agricultural Practice. A list of additional reference publications and brief instructions for determining the need for resource materials are also given. (AW)

VT 000 949

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AGRICULTURAL PRODUCTION AND MANAGEMENT . . . .

A Third Year Cirriculum for Vocational Agriculture

Vocational Agriculture

Division of Vocational Education

State Department of Education

and

Department of Agricultural Education

Clemson University

1966

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CODE USED TO HELP TEACHERS DETERMINE POSSIBLE NEED FOR THE RESOURCE MATERIALS LISTED IN THE BIBLIOGRAPHIC LIST FOLLOWING EACH UNIT

Between the identification code number and the title you will find a letter. This letter is a coded attempt to indicate probable usage of this publication in your department. The code is as follows:

(T) This is probably limited to use as a teacher reference. One copy per department is probably the maximum you would possibly want.

(ST) This is a publication that may be a teacher reference and may be used by students on a limited basis. Perhaps one copy for every four of five students in your largest class would be sufficient.

(S) This publication is one that probably would serve well as a student reference for classroom work. Perhaps, if this reference were selected, there should be one copy available for each member of your largest class.

(D) This is a publication that should already be available in your department since it has been distributed in recent years. In most instances these publications are out of print.

This does not mean that you must order one copy of each (S) rated bulletin for each member of your largest class. Some bulletins duplicate each other. However, if you decide you can use such a bulletin the code is used only as a guide for determining the number of copies you might need. Neither does this mean that you can not use (T) or (ST) bulletins for class reference. If, after ordering one, you believe you can use this bulletin to advantage with your class, that is your option. This code is a guide. It is hoped that it will help you to order materials in a more practical manner.

IMPORTANCE OF AGRICULTURE

Suggested Minimum Time Allotment is 2 Periods

I. Review Up-to-Date Outlook Data on Agriculture

II. Develop with Students an Awareness of How Production Farmers Must Keep Up to Date with Production Practices, Techniques and Planning

A. Observation of successful farmers.

B. Continual educational improvement through:

1. Formal education

a. College

b. Technical

c. Young and adult farmer classes

2. Informal education

a. Radio and television

b. Farm field days, etc.

c. Current farm papers

d. Dealers in agricultural products

e. Current publications, research and other programs of the USDA

f. Current publications, research and other programs of Clemson University Extension Service

g. Farm management organizations

h. Local demonstration plots and activities.

C. Farmer conducted research.

III. Encourage Qualified Students Toward Agricultural Education By Developing Work Experiences for Teacher Assistants

SUGGESTED REFERENCE MATERIALS

A. Periodic Outlook Publications of Clemson University Agricultural Publications

1. South Carolina Cash Receipts from Farm Marketings (annual), AE Publication.

2. Agricultural Outlook for South Carolina (annual), Miscellaneous Circular.

B. Periodic Publications of the South Carolina Crop Reporting Service, Office of Agricultural Statistics, U. S. Court House, Columbia, South Carolina

1. Weekly Chick Hatchery Report

2. Livestock, Poultry, and Crop Report

3. Commercial Livestock Slaughter and Red Meat Production

4. Turkey Poultry Report

5. Monthly Agricultural Report

C. Publications of the United States Department of Agriculture, Division of Information, Washington, D. C., 20250

1. Agricultural Outlook Digest (monthly), Economic Research Service.

2. The Agricultural Outlook for ____(annual), Economic Research Series.

3. Agricultural Conservation Program, South Carolina (annual), Agricultural Stabilization and Conservation Service.

4. Handbook of Agricultural Charts (annual), Economic Research.

5. Fact Book of U. S. Agriculture (annual), Office of Information.

6. Agricultural Situation (monthly), Statistical Reporting Service.

7. The Balance Sheet of Agriculture (annual), Economic Research Service.

8. The Agricultural Finance Outlook (annual), Economic Research Service.

9. Crop Production (monthly), Statistical Reporting Service.

10. Milk Production (monthly), Statistical Reporting Service.

11. Commercial Livestock Slaughter and Meat Production (monthly), Statistical Reporting Service.

12. Pig Crop Report (quarterly), Statistical Reporting Service.

13. Shipments of Stocker and Feeder Cattle & Sheep (monthly), Statistical Reporting Service.

D. Commercial and Other References

1. Agricultural Policy Review (quarterly), Agricultural Policy Institute, North Carolina State College, Raleigh, North Carolina.

2. Doane Agricultural Digest, and Doane's Agricultural Report, $14.95 yearly; Doane Farm Management Guide, $5.95, Doane Agricultural Service, Inc., 5144 Delmar, St. Louis 8, Missouri.

3. Other current farm magazines.

E. Library Filing System

In your filing system look for additional information under:

200 - Agriculture - General
235 - Importance of Agriculture
250 - Publications
260 - Research
745 - Outlook
770 - Statistics

ANIMAL PRODUCTION

Suggested Minimum Time Allotment is 16 Periods

I. Dairy

A. Caring for calves and heifers.

1. Feeds for different stages of growth.

2. Breeding management.

3. Registration and records.

B. Caring for dairy cows.

1. How should you care for a dairy cow during the gestation period?

2. How should the dairy cow be fed and housed during calving?

3. What care should be given the cow and calf during lactation?

a. How should the newborn calf be fed?

b. What sanitary precautions should be taken with newborn calves?

c. How should the lactating cow be cared for?

C. How does one fit and show dairy animals?

D. How does one prevent and control diseases and parasites of dairy cattle?

1. What dairy herd management practices are involved in a successful disease and parasite control program?

2. Disease causes and symptoms.

a. Why is the good dairyman concerned about such symptoms as:

(1) Loss of appetite?

(2) Cessatation of chewing cud?

(3) Abnormal craving of appetite?

(4) Roughened or dull hair coat?

(5) Loss of flesh?

(6) Rise in body temperature?

(7) Abnormal droppings?

(8) Skin irritations?

b. What are the causes, symptoms and control of such common dairy cattle diseases as:

(1) Bangs?

(2) Blackleg?

(3) Shipping fever?

(4) Malignant Edena?

(5) Foot rot?

(6) Leptospirosis?

(7) Pink eye?

(8) Mastitis?

(9) Milk fever?

(10) Bloat?

(11) Calf scours?

(12) Calf pneumonia?

3. Controlling parasites

a. How does one prevent and control infestations of such internal parasites as:

(1) Common stomach worm?

(2) Lung worm?

b. How does one control external parasites such as:

(1) Horn flies?

(2) Grubs?

(3) Stable flies?

(4) House flies?

(5) Cattle lice?

(6) Cattle ticks?

E. Managing a dairy herd.

1. What is the value of proven sires?

2. What are the advantages of artificial insemination?

3. What are the basic principles of each of the various types of breeding programs one can follow?

4. What are the principles of feeding for high production?

5. What type of testing and record keeping should a dairyman follow for greatest herd improvement?

6. What type of a disposition is essential for one to be a successful dairyman?

7. How can correct milking procedures affect dairy efficiency?

F. Providing housing and equipment.

1. What health regulations must one meet as a milk producer that affects the planning of dairy housing and equipment?

2. What type of planning assistance can one obtain from:

a. Outstanding dairy farmers?

b. Agricultural extension leaders?

c. The agricultural experiment stations?

d. Your milk market?

e. Building material suppliers?

3. What are the basic advantages and disadvantages of:

a. Stanchion type barns?

b. Loose housing?

c. Free stalls?

4. What are the space requirements for feed area, bedded area, exercise area in:

a. Stanchion type barns?

b. Loose housing?

c. Free stall housing?

6. What lighting and ventilating principles must one be aware of?

7. What must one provide in terms of:

a. Maternity facilities?

b. Calf raising facilities and equipment?

c. Replacement stock raising facilities?

d. Bull housing and handling?

e. Milking and milk storage facilities?

f. Loading and unloading facilities?

g. Feed storage and preparation?

h. Hospital and isolation facilities?

i. The best exposure?

j. Drainage of building site?

k. Location in relation to the rest of the farming operation?

8. How does one plan for mechanization of:

a. Feed handling?

b. Manure disposal?

c. Clean up operations?

d. Insect and parasite control?

e. Milk handling?

9. How does one apply economic principles to providing the most efficient, utilitarian facilities?

G. Marketing milk.

1. What are the market grades of milk?

2. What are the basic principles of retailing and wholesaling milk?

3. In producing quality milk what considerations must one give to:

   a. Cow health?

   b. Local milk code?

4. What are Federal Marketing orders?

5. What state and local controls exist on the marketing of milk in South Carolina?

SUGGESTED REFERENCE MATERIALS

A. Reference Books

1. Bundy, Clarence E., and Ronald V. Diggins, Livestock and Poultry Production, 2nd Edition, Prentice-Hall, Inc., Englewood Cliffs, New Jersey. 1961.

2. A Reference Unit on Dairy Production, State Board for Vocational Education and Mississippi State University, Jackson, Mississippi.

3. Reaves, Paul M., and C. W. Pegram, Southern Dairy Farming, The Interstate Printers and Publishers, Danville, Illinois. 1956.

4. Diggins, Ronald V., and Clarence E. Bundy, Dairy Production, Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

5. Chapman, Paul W., and Wayne Dinsmore, Livestock Farming, Turner E. Smith and Company, Atlanta, Georgia. 1953.

6. Selecting, Fitting and Showing Livestock, State Department of Education, Columbia, South Carolina, Vol. VI. August 1959.

7. Morrison, Frank B., Feeds and Feeding, The Morrison Publishing Company, Clinton, Iowa.

8. Herd Health Guide, Hoard's Dairyman, Fort Atkinson, Wisconsin. 1959.

B. Clemson University Agricultural Publications, Clemson, South Carolina

1. (S) Breeding Efficiency Standards for Dairy Cows and Heifers, Extension Circular 449. October 1958.

2. (T) Obtaining Milk Weights With a Milk Metering Device, Experiment Station Bulletin 494. July 1961.

3. (ST) The Organization and Operation of Grade A Dairy Farms in South Carolina, Experiment Station Bulletin 471. June 1959.

4. (S) Mastitis Control Through Herd Management, Extension Circular 475. November 1960.

5. (S) Prevention and Control of Brucellosis, Extension Circular 361. June 1957.

6. (S) Dairy Housing Systems, Extension Agricultural Engineering Handbook No. 3.

7. (S) The Family Dairy Cow, Extension Circular 157. October 1956.

8. (S) Dairy Calves-Care and Management, Extension Bulletin 120.

9. (S) Insecticide Use Chart for Milk Producers, Information Card 103. May 1964.

10. (S) Control Program for Dairy Cattle External Parasites, Information Card 78-A.

11. (T) Grade "A" Milk Production in South Carolina, Experiment Station Bulletin 456. April 1958.

12. (T) Financing Development of Small Grade A Dairy Farms - Piedmont Area, South Carolina, Experiment Station Bulletin 482. April 1960.

13. (T) Supply and Distribution of Milk by Distributors and Producer-Distributors in South Carolina, Experiment Station Bulletin 504. December 1962.

14. (T) A Review of Milk-Pricing Plans, Experiment Station Bulletin 438. June 1956.

15. (T) Prices and Price Relationships for Milk in South Carolina, Experiment Station Bulletin 462. July 1958.

16. (T) Milk Movement Patterns in the Southeast, Southern Cooperative Series Bulletin 84. April 1962.

17. (T) Consumption and Demand for Ice Cream in the Urban South, Southern Cooperative Series Bulletin No. 76. January 1961.

18. (T) Methods Used by Distributors to Increase Milk Sales in South Carolina, Experiment Station Bulletin 481.

19. (T) Consumption and Demand -- Fluid Milk and Fluid Milk Substitutes in the Urban South, Southern Cooperative Series Bulletin No. 53. October 1957.

20. (T) Use of Milk by the Urban and Rural Families in South Carolina, Experiment Station Bulletin 437. May 1956.

21. (T) Use of Milk by Rural Families in South Carolina 1953, Experiment Station Bulletin 431. November 1955.

22. (T) An Analysis of Milk Vendor Operations in South Carolina, Experiment Station Circular 100. November 1955.

23. (T) Selling Milk by Automatic Vending Machine, Experiment Station Bulletin 435. June 1956.

24. (T) Prospective Demand for Milk and Milk Products in the South, Southern Cooperative Series Bulletin 68. October 1959.

25. (T) Household Buying Practices for Dairy Products in Charleston and Columbia, South Carolina, Experiment Station Circular 113. October 1957.

26. (S) Milk and Its Products, Extension Service Bulletin 100. September 1961.

27. (S) Meet Your Licensed Bulk Milk Collector, Information Leaflet No. 2. March 1961.

28. (S) Bulk Milk Haulers Guide, Extension Service Circular 478. July 1962.

29. (S) Feeding Dairy Cows in South Carolina, Dairy Science Extension Leaflet 1. August 1964.

30. Single Copies of Plans Available From F. H. Hedden, Extension Agricultural Engineer, Clemson University, College of Agriculture, Clemson, South Carolina

    1. (D) Beef Cattle Plans for South Carolina.

    2. (T) Individual Stalls for Dairy Cattle.

    3. (T) Breeding Rack for Cattle, Ex. 5853.

    4. (T) Variable Width Chute for Cattle, Ex. 5850.

    5. (T) Milking Plant - U Type, Ex. 5736.

    6. (T) Homemade Milking Stall - Side Entering Type, Ex. 5846.

C. Publications of the United States Department of Agriculture, Division of Information, Washington, D. C. 20250

1. (S) Farm Silos, Miscellaneous Publication No. 810.

2. (S) High-Roughage Rations for Dairy Heifers, Production Research Report No. 15. December 1957.

3. (S) Mr. Livestock Producer -- It Pays to Use Chemicals Safely, Leaflet 472. 1960.

4. (S) Feeding Dairy Cattle, Farmers' Bulletin No. 2153. 1961.

5. (S) Improving Your Dairy Herd Through the National Cooperative Dairy Herd Improvement Program, Farmers' Bulletin No. 2132. January 1959.

6. (S) Udder Diseases of Dairy Cows, Farmers' Bulletin No. 1442.

7. (T) Breeding Experiments With Holstein-Friesion Cattle, Technical Bulletin No. 1220.

8. (T) Dairy Economics Handbook, Agriculture Handbook No. 138.

9. (S) Automatic Livestock Waterers, Leaflet No. 395. August 1962.

10. (S) Cattle Walkways - An Aid to Coastal Marsh Range Conservation, Leaflet No. 459. November 1959.

11. (S) Anthrax in Livestock, Program Aid No. 431, April 1961.

12. (S) Anthrax, Farmers' Bulletin No. 1736. March 1960.

13. (S) What You Should Know About Market Cattle Testing for Brucellosis, PA 434. January 1963.

14. (S) Hyperketosis in Cattle, Leaflet No. 447. January 1959.

15. (S) Anaplasmosis, Leaflet No. 437. September 1958.

16. (S) Horn Flies on Cattle -- How to Control Them, Leaflet No. 388. July 1963.

17. (S) Liver Flukes in Cattle, Leaflet No. 493. June 1961.

18. (S) Demodectic Mange in Cattle, Leaflet No. 438. August 1958.

19. (S) Cattle Grubs or Heel Flies with Suggestions for Their Control, Farmers' Bulletin 1596. August 1957.

D. Commercial and Other Publications

1. (T) Labor and Capital Requirements in Herringbone and Other Elevated-Stall Milking Parlors, Virginia Agricultural Experiment Station Bulletin 539, Virginia Polytechnic Institute. July 1962.

2. (S) Electricity in Dairying, Tennessee Valley Authority Electrical Demonstration Branch, Chattanooga, Tennessee.

3. (T) Harvestore Dairy Feedlot Plans, A. O. Smith, Harvestore Products, Inc., 550 West Algonquin Road, Arlington Heights, Illinois, $1.50, Bulletin MH-134. 1963.

4. (T) Dairy Farm Buildings, Southern Pine Association, P. O. Box 52468, New Orleans, Louisiana.

5. (T) Smaller Farm Structures, Southern Pine Association, P. O. Box 52468, New Orleans, Louisiana.

6. (S) Multi-Purpose Building - Clear Span, Plan No. PF-105, Southern Pine Association, P. O. Box 52468, New Orleans, Louisiana.

7. (S) Hay and Rest Barn, Plan No. PF-104, Southern Pine Association, P. O. Box 52468, New Orleans, Louisiana.

8. (S) Bunker Type Self-Feeding Silo, Plan No. PF-103, Southern Pine Association, P. O. Box 52468, New Orleans, Louisiana.

9. (T) Slatted Floors and Free Stalls for Cattle, Research Progress Report 71, Purdue University, Agricultural Experiment Station, Lafayette, Indiana. July 1963.

10. (S) Pave Your Barnyard with Concrete, Portland Cement Association, Harvey J. Field, Jr., District Engineer, 161 Peachtree Street, Atlanta, Georgia 30303.

11. (S) Slotted Floors for Efficient Livestock Production, Portland Cement Association, Harvey J. Field, Jr., District Engineer, 161 Peachtree Street, Atlanta, Georgia 30303.

12. (S) Selecting, Feeding and Showing Dairy Cattle, Albers Milling Company, 1016 Central Avenue, Kansas City 5, Missouri.

13. (T) Teaching Manual on Dairy Cattle Sterility, 50¢, Hoard's Dairyman, Fort Atkinson, Wisconsin.

E. Loan Free Movies

1. Movies available from Clemson University Extension Agent.

a. More Profit Per Acre, 19 Min., Color, 1953.

b. The Rumen Story, 25 Min., Color, 1952.

c. Exposed - Brucellosis in Problem Herds, 15 Min., Color, 1962.

d. Back the Attack on Brucellosis, Color, 27 Min., 1959.

e. The Triple Threat of Brucellosis, Color, 27 Min., 1950.

f. Brucellosis Ring Test, 6 Min., 1957, Color.

g. Weigh A Day, Black and white, 5 Min., 1958.

2. Feeding Cattle and Man, Sound, Color, 12 Min., Maine Department of Agriculture, Mr. Hildreth G. Hawes, Publicity Director, State Office Building, Augusta, Maine 04330.

3. Golden Heritage, Color, Sound, 17 Min., The American Guernsey Cattle Club, Promotion Division, 79 Main Street, Peterborough, New Hampshire 03458.

4. Loose Housing for Dairy Cattle, Color, Sound, 22 Min., United States Steel Corporation, Birmingham Film Distribution Center, Box 599, Fairfield, Alabama 35064.

5. New Horizons Along the Milky Way, Color, Sound, 26 Min., Union Pacific Railroad, Department of Livestock and Agriculture, 1416 Dodge Street, Omaha, Nebraska 68102.

6. New Ideas In Livestock Farming, Color, Sound, 26 Min., The Venard Organization, 113 North Madison Avenue, Peoria, Ill. 61602.

7. Raising Dairy Calves, Color, Sound, 10 Min., Union Pacific Railroad, Dept. of Livestock and Agriculture, 1416 Dodge Street, Omaha, Nebraska 68102.

F. Loan Free Filmstrips and Slides

1. Control and Prevention of Mastitis, 1961, DeLaval Separator Company, Mr. John H. Bronson, Director, Marketing Service, Poughkeepsie, New York.

2. Garget, 1965, Babson Bros. Dairy Research Service, Film Department, 2843 West 19th Street, Chicago, Illinois 60623.

3. The Inside Story of Dairy Profits (Importance of nutrition during the gestation period), Ralston Purina Company, Mr. R. C. Morton, Manager, Educational Department, Public Relations, St. Louis, Missouri 63199.

G. Library Filing System

In your filing system look for additional information under:

215 - Chemicals - General
260/70 - Research - Livestock
300 - Animal Science - General
310 - Breed Identification
315 - Breeding Livestock
320 - Feeds and Feeding
325 - Health
330 - Improving Livestock
335 - Insects and Parasites
340 - Management - General
360 - Dairy
805/40 - Buildings and Structures - Livestock

CROP PRODUCTION

Suggested Minimum Time Allotment is 14-16 Periods

I. Cotton

A. Possibilities of growing cotton

1. Where is cotton grown in the United States?

2. What are the cotton production areas of South Carolina?

3. What are the labor requirements for cotton?

4. What are the expected returns from an acre of cotton?

5. What equipment is needed for cotton production?

6. What are the restrictions on growing cotton?

B. What are the basic principles of selecting and preparing cotton land?

1. What are the general soil requirements for cotton?

2. What types of soils are adapted to cotton in our locality?

3. How does one determine whether or not a particular farm is suited for cotton production?

4. What is the proper method of preparing the soil for cotton production?

C. What is the basis for selecting cotton varieties and seed?

1. How does one select a variety?

a. What are the yields of different varieties of cotton in terms of:

(1) Seed cotton?

(2) Lint cotton?

b. What varieties are most resistant to diseases?

c. Of what importance is staple length?

d. What picking qualities should cotton have?

e. What storm resistance should cotton have?

2. What are the characteristics of a good seed?

   a. What is the importance of seed treatment?

   b. What are the methods of seed treatment?

   c. How is germination determined?

   d. What are reliable sources of seed?

D. What is the place of fertilization in cotton production?

   1. What are the plant nutrient requirements?

   2. How much nitrogen is needed for cotton production?

   3. What are the sources of nitrogen?

   4. How much phosphorus does cotton require?

   5. How much potash is required?

   6. What are the sources of potash?

   7. What analysis of fertilizer should be used on cotton?

   8. How does soil acidity effect cotton production?

E. What are the principles of planting cotton?

   1. What is the proper time to plant cotton?

   2. What is the rate of planting per acre?

   3. How should cotton be spaced?

      a. What is the effect of row width per acre?

      b. What are the main methods of spacing cotton? What are the advantages and disadvantages of each?

F. How are weeds controlled in cotton?

   1. What are the labor requirements of weed control?

   2. What procedures should be used in chemical weed control?

   3. What equipment is used in cultivating cotton?

   4. At what depth and distance from the plant should cotton be cultivated?

5. How often should cotton be cultivated?

6. What are the basic principles of flame cultivation?

G. How are cotton diseases controlled?

1. What are the most common diseases of cotton?

a. How is each identified?

b. How is each controlled?

c. What is the economic importance of each?

2. What does the date of planting have to do with disease control?

3. How does the age of seed affect seedling disease?

4. How is disease damage prevented?

H. How are cotton insects controlled?

1. What insects of cotton need to be controlled?

a. How is each identified?

b. What is the economic importance of each?

c. What is the recommended control of each?

2. What are the principles of using chemicals to control cotton insects?

3. Does it pay to dust or spray?

4. What are some of the mechanical means of insect control?

I. Defoliating and Harvesting

1. Is defoliation profitable?

2. What effect does defoliation have on grade of cotton?

3. When should one defoliate?

4. What effect does the time of harvest have on quality of fiber?

5. What are the costs of harvesting:

a. By hand?

b. With machines?

J. Classing and marketing cotton

1. How is cotton graded?

2. What is the importance of staple length?

3. What is character?

4. How does character affect the spinning value of cotton?

5. How does one go about having cotton classified?

6. When should farmers sell their cotton?

7. How can a farmer determine what is a fair price for his cotton?

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20. (S) Cotton Irrigation in South Carolina, Extension Information Leaflet. May 1957.

21. (S) Mr. Cotton Grower---Defoliate for Better Quality and More Profit, Extension Service Cotton Leaflet 3. July 1965.

22. (D) Cotton Defoliation in South Carolina, Experiment Station Circular 114. October 1957.

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C. Publications of the United States Department of Agriculture, Division of Information, Washington, D. C. 20250

1. (S) Facts About Cotton, Leaflet No. 167. 1963.

2. (S) The Cotton Aphid: How to Control It, Leaflet No. 467. March 1960.

3. (S) Cotton Leafworm, Bureau of Entomology and Plant Quarantine, Picture Sheet No. 19. April 1949.

4. (S) Cotton Flea Hopper, Bureau of Entomology and Plant Quarantine, Picture Sheet No. 18. April 1949.

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9. (S) The Boll Weevil: How to Control It, Farmers' Bulletin No. 2147. October 1962.

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11. (T) Extent and Cost of Using Chemicals in Cotton Production, Selected Areas, 1961, ERS-155. March 1964.

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13. (T) Farmers' Weekly Cotton Market Report, United States Department of Agriculture, Agricultural Marketing Service, Cotton Division, P. O. Box 13956, Station K, Atlanta, Georgia.

14. (T) Weekly Cotton Quality Report, United States Department of Agriculture, Agricultural Marketing Service, Cotton Division, P. O. Box 13956, Station K, Atlanta, Georgia.

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14. (T) Skip-Row Planting Increases Cotton Yields, Georgia Experiment Station, Athens, Georgia, Mimeograph Series N.S. 172. April 1963.

E. Loan Free Movies

1. Movies available from your Clemson University Extension Agent:

   a. Cotton - Fiber with Future, Color, 15 Min., 1959.

   b. Cotton - Nature's Wonder Fiber, Color, 25 Min., 1958.

   c. Cotton Meets the Challenge, Color, 25 Min., 1957.

   d. Man with a Problem, Color, 30 Min., 1962 (Harvesting and ginning problems).

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2. The Enemy Underground, Color, Sound, 12 Min., 1958 (Johnson grass control in cotton), The Dow Chemical Company, Audio Visual Center, Film Library, Abbott Road Building, Midland, Michigan, 48640.

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5. Mechanical Cotton Pickers, Color, Sound, 11 Min., 1964, Farm Film Foundation, 1425 H Street, N. W., Washington, D. C., 20005.

F. Library Filing System

In your filing system look for further information under:

215 - Chemicals - General
260/10 - Research - Crops
425 - Plant Pests
440 - Weeds
465 - Soils - Fertilization
500 - Field Crops - General
515 - Cotton
740 - Marketing
745 - Outlook
750/20 - Input-Output Data
835/10 - Cultivators
835/80 - Sprayers
840/80 - Machinery - Pickers
845/20 - Cotton Planters

Suggested Minimum Time Allotment is 15-20 Periods

II. Pastures

A. What is a pasture?

1. A permanent pasture?

2. A temporary pasture?

3. A supplemental pasture?

B. What is the value of pastures as a crop?

1. What effect does quality pasture have on feed costs?

2. What effect does pasture have on producing milk?

3. How important are pastures in beef production?

4. What is the value of temporary grazing for dairy cows?

5. Why is it important to include legumes in the production of pastures?

C. Identification, selection, and combinations of pastures.

1. What are the most common permanent type pasture grasses for:

a. beef?

b. dairy?

c. swine?

2. What are the most common temporary pasture grasses for:

a. beef?

b. dairy?

c. swine?

3. What are the most common supplemental grazing crops for:

a. beef?

b. dairy?

c. swine?

4. What combination of grasses and legumes should be used in South Carolina to provide year-round grazing?

5. What type of land should be used for pasture?

6. How does one determine the amount of pasture needed as:

   a. permanent pasture?

   b. temporary pasture?

   c. supplementary pasture?

D. What are the steps to follow in establishing a pasture?

1. How should land be prepared for pasture establishment?

2. What are the procedures for making soil tests?

3. What plans should be made toward fertilizing and land treatment?

4. What are the best methods of seeding grasses and legumes for:

   a. permanent pastures?

      (1) year-round

      (2) winter

      (3) summer

   b. temporary pastures?

      (1) fall and winter

      (2) spring

      (3) summer

   c. supplementary pastures?

      (1) cool weather

      (2) warm weather

E. Managing a pasture --- fertilization, liming, grazing, clipping, and weed control.

1. What is pasture management?

2. What is rotational grazing? What are the advantages of rotational grazing?

3. What is over-grazing? What are the effects of this practice?

4. What is under-grazing? What are the effects of this practice?

5. What use can be made of surplus pasture?

6. When and how are summer pastures top seeded?

7. What are the advantages and purposes of cross fencing?

8. When and how should established pastures be fertilized and limed?

9. How are weeds controlled in pastures?

10. What are the advantages of clipping?

11. What are the advantages of spraying?

12. What chemicals are used for spraying?

13. What precautions should one take when spraying?

14. How are pasture insects and diseases controlled?

15. How are water, shade, and rest areas provided in pastures?

16. What are the means and advantages of irrigation for pastures?

17. What is bloat? What are the causes and remedies?

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6. (S) 1965 Fall Planting Guide, Information Card No. 91. September 1965.

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14. (S) How to Maintain White Clover in Fescue-Clover Pastures, Forage Memo No. 2.

15. (S) Orchard Grass, Forage Memo No. 1.

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2. (S) Winter Annual Legumes for the South, Farmers Bulletin No. 2146. February 1960.

3. (S) Annual Lespedezas - Culture and Use, Farmers' Bulletin 2113. January 1961.

4. (S) Lupines - Culture and Use, Farmers' Bulletin 2114. March 1958.

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6. (T) How Soil pH Affects Availability of Plant Nutrients, (chart) National Plant Food Institute, 1700 K Street, N. W., Washington, D. C. 1958.

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8. (S) Maximum Economic Yields: Cost Cutters! American Potash Institute, 1102 16th Street, N. W., Washington 36, D. C. Reprint E-122, October 1964.

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E. Loan Free Audio-Visual Materials

A. Movies

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2. Better Seeds for Better Grasslands, 31 Minutes, Sound, 1955. Motion Picture Service, Office of Information, United States Department of Agriculture, Washington 25, D. C. (Also available from your agricultural extension agent.)

3. The Dynamic New Age of Hay, 9 Minutes, Color, Sound. New Holland Machine Company, New Holland, Pennsylvania.

4. Growing Alfalfa Successfully, 25 Minutes, Sound, Color, American Potash Institute, Visual Education Service, 1102 16th Street, Washington 6, D. C.

F. Library Filing System

In your library filing system look for additional information under:

260/10 - Research - Crops
300 - Animal Science - General
320 - Feeds and Feeding
355/30 - Beef Feeding
360/30 - Dairy - Feeding
365/40 - Horses, Mules & Ponies - Feeding
375/30 - Sheep - Feeding
380/30 - Swine - Feeding
410 - Plant Classification
425 - Plant Pests
440 - Weeds
465 - Soils - Fertilization
520 - Hay, Forage

Suggested Minimum Time Allotment is 7 Periods

III. Soybean Production

A. History

1. Where did they come from?

2. How old are soybeans?

B. Is it profitable to produce soybeans?

C. How is the selection of a variety determined by such factors as:

1. Yield per acre?

2. Height in growth?

3. Resistance to disease?

4. Resistance to lodging?

5. Oil content?

6. Date of maturing?

7. Non-shatter?

D. What are the basic principles of soil and soil preparation needed for soybean production?

1. What type of land is best suited for soybeans?

2. How does pH of soil and fertility of soil enter into soybean production?

3. How is land prepared for soybeans?

E. Seed and seed treatment:

1. What is the value of seed of recommended varieties?

2. How and with what materials is seed treated?

3. How is seed inoculated?

F. Planting:

1. When should soybeans be planted?

2. What is the correct rate to plant per acre?

3. What are the accepted procedures for planting soybeans?

4. How should soybeans be spaced?

5. What is the proper planting depth?

6. What procedures are followed in selecting and applying pre-emergence sprays?

G. How should soybeans be fertilized?

1. What rate and kind of fertilizer should be used?

2. What is the most effective spacing and placement of fertilizer?

3. What are the methods of applying fertilizer?

H. How are weeds controlled in soybeans?

1. What methods of cultivation are effective?

2. What are the chemical weed control practices one can use effectively?

I. How are insects controlled?

1. What are the common insects and how is each controlled?

2. What equipment is required?

3. What is the cost of insecticide?

J. Soybean diseases:

1. What are the common soybean disease control problems a producer faces?

K. How are soybeans harvested?

1. When should soybeans be harvested?

2. What are some factors one must consider in providing efficient storage?

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A. Reference Books

1. Klingman, Glenn C., Crop Production in the South, John Wiley & Sons, Inc., New York, New York. 1957.

2. Fergus, E. N., Carsie Hammonds, and T. H. Rogers, Field Crops Including Southern Crops, J. B. Lippincott Company, New York, New York. 1958.

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3. (S) Soybeans, Extension Circular 370, June 1959.

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10. (S) 1966 Recommended Varieties for South Carolina, Extension Circular 477, 1965.

11. (S) 1966 Spring Planting Schedule, Information Card No. 107, January 1966.

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14. (S) Fertilizer Recommendations for South Carolina, Extension Circular 476, October 1965.

15. (S) Weeds, A South Carolina Handbook, Extension Bulletin 113, June 1960.

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1. (T) U. S. Soybean Processing Capacity Continues to Expand, ERS-211, November 1964.

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2. (S) Thimet 10-G. Systemic Insecticide for Beans, American Cyanamid Company, Agricultural Division, P. O. Box 400, Princeton, New Jersey, 1964.

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5. (T) How to Dry and Store Grain and Seed on Georgia Farms, Bulletin N. S. 33, Georgia Agricultural Experiment Stations, University of Georgia College of Agriculture, Athens, Georgia, 1958.

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9. (S) Methods of Applying Fertilizer, National Plant Food Institute, 1700 K Street, N. W., Washington, D. C.

10. (S) 1965 Diazinon Handbook - Insecticides, Division of Geigy Chemical Corp., Saw Mill River Road, Ardsley, New York.

11. (S) Handbook of the Insect World, Agricultural Chemicals Division, Naval Stores Department, Hercules Powder Company, Wilmington, Delaware.

12. (S) Malathion Growers Handbook for Insect Control, American Cyanamid Company, P. O. Box 400, Princeton, New Jersey.

E. Loan Free Movies

1. The Green Bud, (Soybean production for food in Japan), Sound 34 Min., Color, American Soybean Association, Hudson, Iowa, 50643.

2. Grow Soybeans Not Weeds, 15 Min., Sound, American Soybean Association, Hudson, Iowa, 50643.

3. Soybeans--The Feature Story, Sound, 12 Min., Color, American Soybean Association, Hudson, Iowa, 50643.

4. The Soybean Story, 25 Min., Sound, American Soybean Association, Hudson Iowa, 50643.

5. Tomorrow's Foodpower, 27 Min., Sound, Color, Farm Film Foundation, 1425 H Street, N. W., Washington, D. C., 20005.

F. Library Filing System

In your teaching file check for further information for this subject under:

215 - Chemicals - General
260/10 - Research - Crops
425 - Plant Pests
440 - Plant Weeds
465 - Fertilization
500 - Field Crops - General
565 - Soybeans

CONSERVATION OF NATURAL RESOURCES

Suggested Minimum Time Allotment is 12 Periods

I. Soil and Water Conservation

A. Using and treating land according to its capabilities.

1. How was the land used before a conservation plan was made?

2. What are the general recommended treatments for the different sub-classes of land?

B. Controlling surplus water.

1. What are the water laws that are commonly used?

2. What methods do we have available for the control of surplus water?

a. Tile

(1) What is tile drainage?

(2) What are the advantages of tile? disadvantages?

(3) What is the cost of tile drainage?

(4) What kind of assistance is available in planning and laying tile drainage systems?

b. How can open ditches aid in drainage?

c. What are the possibilities of using terracing and meadow-strips for drainage?

d. What place do water sheds have in the control of surplus water?

C. Conservation practices in supervised farming.

1. What conservation practices can be used on my home farm?

a. Crop rotation

b. Use of cover crops

c. Strip cropping

d. Drainage

e. Terracing

2. How can the soil and conservation practices on a farm become a part of a student's supervised farming program?

a. Productive enterprises?

b. Improvement projects?

c. Supplementary farm jobs?

II. Wildlife and Fish

A. Caring for game and wildlife on the farm.

1. Why has much of our natural wildlife disappeared?

2. What types of land should be set aside for recreational and reforestation use?

3. Hunting and fishing opportunities are affected by the way farmers and ranchers manage their land. How can farmers and ranchers increase wildlife opportunities?

4. What part do game laws play in wildlife preservation?

B. Establishing and maintaining farm and fish ponds.

1. Why establish farm ponds?

2. What are factors to consider before beginning pond construction?

3. What fish combination should be stocked?

4. What are the principles of pond fertilization?

5. Controlling water weeds:

a. Why does one control water weeds?

b. How does one control water weeds?

6. Fishing the pond

a. Why fish a pond?

b. How heavy can one fish a pond?

REFERENCE MATERIALS

A. Reference Books

1. Knuti, Leo and Milton Korpi, Profitable Soil Management, Prentice-Hall, Inc., Englewood Cliffs, New Jersey. 1962.

2. Vanderford, H. B., Managing Southern Soils, John Wiley & Sons, Inc., New York, New York. 1957.

3. Donahue, Roy L., Our Soils and Their Management, The Interstate Printers and Publishers, Danville, Illinois. 1961.

4. Stallings, J. H., Soil Use and Improvement, Prentice-Hall, Inc., Englewood Cliffs, New Jersey. 1957.

5. Foster, Albert B., Approved Practices in Soil Conservation, The Interstate Printers and Publishers, Danville, Illinois. 1964.

6. (D) Teaching Soil and Water Conservation, State Department of Education, Columbia, South Carolina, Vol. XI. May 1956.

7. (D) Soil Judging and Land Treatment for Students of Vocational Agriculture, State Department of Education, Columbia, South Carolina, Vol. XIII. December 1957.

B. Clemson University Agricultural Publications, Clemson, South Carolina

1. (S) Soil Judging and Land Treatment, Extension Circular 390. February 1961.

2. (S) Raising Bobwhite Quail, Extension Service Circular 396. May 1961.

3. (S) Raising Pheasants in Confinement, Extension Service Circular 397. May 1961.

C. Publications of the United States Department of Agriculture, Division of Information, Washington, D. C. 20250

1. (S) Water Rights and Soil and Water Conservation, PA 306. January 1957.

2. (S) Conservation Irrigation in Humid Areas, Agricultural Handbook No. 107. January 1957.

3. (T) Major Uses of Land and Water in the United States, Agricultural Economic Report No. 13. 1959.

4. (T) Basic Statistics of the National Inventory of Soil and Water Conservation Needs, Statistical Bulletin 317. August 1962.

5. (S) Watershed Work on the Farm, PA 523. September 1962.

6. (S) The Sportsman's Stake in Agricultural Conservation, PA 603. November 1963.

7. (S) ACP and You, PA 611. 1964.

8. (S) Autumn Olive for Wildlife and Other Conservation Uses, Leaflet No. 458. 1959.

9. (S) More Wildlife Through Soil and Water Conservation, Agriculture Information Bulletin No. 175. May 1963.

10. (S) Making Land Produce Useful Wildlife, Farmers' Bulletin No. 2035. August 1961.

11. (S) Trout in Farm and Ranch Ponds, Farmers' Bulletin No. 2154. 1960.

12. (S) The Multiflora Rose for Fences and Wildlife, Leaflet No. 374. 1960.

13. (S) Lespedezas for Quail and Good Land Use, Leaflet No. 373. 1960.

14. (S) Soil Conservation Tips for the Sportsman, PA 400. 1959.

15. (S) Managing Farm Fields, Wetlands, and Waters for Wild Ducks in the South, Farmers' Bulletin No. 2144. 1959.

D. Loan Free Movies

1. Aqua Folly, Boyd Film Company, 1569 Selby Avenue, St. Paul, Minnesota, 55104.

2. Clear Water on the Colorado, Bureau of Reclamation, Chief Engineer, Building 53, Denver Federal Center, Denver, Colorado, 80225.

3. Great River, Bureau of Reclamation, Chief Engineer, Building 53, Denver Federal Center, Denver, Colorado, 80225.

4. Friendly Waters, Motion Picture Service, Office of Information, United States Department of Agriculture, Washington, D. C.,20250.

5. From the Ridge to the River, Motion Picture Service, Office of Information, United States Department of Agriculture, Washington, D. C., 20250.

6. Water for Farm and City, Motion Picture Service, Office of Information, United States Department of Agriculture, Washington, D. C., 20250.

7. Weather or Not, National Plant Food Institute, Film Department, 1700 K Street, N. W., Washington, D. C., 20006.

E. Loan Free Filmstrips

1. Miracles of Water, Bureau of Reclamation, Chief Engineer, Building 53, Denver Federal Center, Denver, Colorado, 80225.

FARM MANAGEMENT

Our Suggested Farm Mechanics Course Consists of Nine Major Topics. They Are:

I. Present Day Farming

II. Getting Started in Farming

III. Farm Financing

IV. Marketing Farm Products

V. Analyzing the Farm Business

VI. Reorganization of the Farm

VII. Increasing the Size of the Business

VIII. Importance of High Rates of Production

IX. Use of Power and Machinery

Topics I, II, and III are outlined in the 3rd year curriculum. Topics IV, V, VI, VII, VIII, and IX are outlined in the 4th year curriculum.

IF YOU HAVE A TWO OR THREE YEAR PROGRAM, DON'T REDUCE THE FARM MANAGEMENT OFFERINGS. TRY:

Alternate A: Teach Units I, II, and III the 2nd year, and the other topics the 3rd year.

Alternate B: Teach all topics the 3rd year.

Alternate C: If you have only a 2-year program, teach all topics the 2nd year.

Suggested Minimum Time Allotment is 18 Periods.

I. Present Day Farming

A. What is the management challenge?

B. Why is agriculture an industry?

1. What has been the economic progress of agriculture?

2. What resources are used in agriculture?

3. What is the basis for classifying farms into such types as:

a. Field crop farms?

b. Livestock farms?

c. Tree farms?

d. Fruit and vegetable crop farms?

e. Special enterprises such as:

(1) Recreation?

(2) Fish bait farming?

4. How is the type of farming influenced by such factors as:

a. Soil and topography?

b. Climate?

c. Markets?

d. Transportation?

e. Individual differences and preferences?

5. Of what importance is the business organization of a farm?

II. Getting Started in Farming

A. What resources are needed to become established in farming in terms of:

1. Land?

2. Labor?

3. Capital?

a. What are the requirements for operating capital?

b. What are the capital requirements for permanent and long term investment?

B. What are the methods of becoming established in farming?

C. What are the advantages and disadvantages of:

1. Farm employment?

2. Farm partnership?

3. Renting a farm?

4. Buying a farm?

D. What should one know about the various forms of leases and farm agreements?

E. What factors should be considered in selecting and appraising a farm?

III. Farm Financing

A. What is the importance of credit in today's agriculture?

B. What are the sources of farm credit? (short, intermediate, and long-term)

C. What is the procedure in establishing credit and obtaining a farm loan?

1. When does one seek credit?

2. How does one determine the best interest rates?

3. How does one select a credit source?

4. How does one establish and keep a good credit rating?

D. In addition to capital investments and operating costs, what must tomorrow's farmer know about:

1. Insurance?

2. Social security?

3. Taxation?

SUGGESTED REFERENCE MATERIALS

A. Reference Books

1. Chastain, E. D., Joseph H. Yeager, and E. L. McGraw, Farm Business Management, Auburn Printing Company, Auburn, Alabama.

2. Dorries, W. L., and J. Roland Hamilton, Economics for Modern Agriculture, Exposition Press, 386 Park Ave. S., New York 16, New York. 1965.

3. Hall, I. F., and W. P. Mortenson, The Farm Management Handbook, The Interstate Printers and Publishers, Inc., Danville, Illinois. 1963.

4. Hamilton, James E., and W. R. Bryant, Profitable Farm Management, Prentice-Hall, Inc., Englewood Cliffs, New Jersey. 1963.

B. Clemson University Agricultural Publications, Clemson, South Carolina

1. (S) South Carolina - Cash Receipts From Farm Marketings, AE 280, September 1965.

2. (S) 1966 Agricultural Outlook for South Carolina, Misc. Circular, December 1965.

3. (S) Fifty Years of South Carolina Agricultural Progress, Annual Report, Clemson University Extension Service, 1964.

4. (S) South Carolina Agriculture Is Big Business, AE 278, July 1965.

5. (D) Teaching the Importance of Agriculture in South Carolina, Agricultural Education Department, December 1959.

6. (T) The Agriculture of (your) County, AE Publications on individual counties in South Carolina.

7. (D) Resources Required for Specified Levels of Income on Cotton Farms, Upper Coastal Plain, South Carolina, AE 242, July 1963.

8. (D) Production Requirements and Estimated Returns From Selected Crop and Livestock Enterprises in the Piedmont Area, AE 202, October 1960.

9. (D) Estimated Production Requirements and Returns From Selected Crop and Livestock Enterprises in the Upper Coastal Plain Area, AE 243, July 1963.

10. (S) Financing a Farm Business, Southern Farm Management Extension Publication No. 8, May 1958.

11. (S) The Family Plans Its Financial Security Program, Circular No. 201, May 1957.

12. (T) Cooperative Farm Credit, Experiment Station Bulletin 505, 1963.

13. (D) Legal Aspects of Farm Tenancy and Share Cropping in South Carolina, Experiment Station Bulletin 449, June 1957.

14. (T) Inheritance - Your Farm and Family, Southern Farm Management Extension Publication No. 5, 1953.

C. Publications of the United States Department of Agriculture, Division of Information, Washington, D. C. 20250

1. (S) The Balance Sheet of Agriculture 1965, Agricultural Information Bulletin No. 290, 1965.

2. (T) Handbook of Agricultural Charts 1965, Agriculture Handbook No. 275, 1965.

3. (T) Fact Book of U. S. Agriculture, January 1965.

4. (S) The Adequate Family Farm -- Mainstay of the Farm Economy, ERS-247, September 1965.

5. (T) Changes in Farm Production and Efficiency, Statistical Bulletin No. 233, July 1965.

6. (S) Resource Requirements on Farms for Specified Operator Incomes, Agricultural Economics Report No. 5, November 1964.

7. (T) Farm Costs and Returns, Agricultural Information Bulletin No. 230, August 1965.

8. (T) Farm Real Estate Market Developments, CD-66, Issued 3 times a year by Economic Research Service.

9. (S) Managing Your Money - A Family Plan, March 1964.

10. (T) Agricultural Finance Review, Annual Publication of Economic Research Service, Farm Production Economics Division.

11. (S) What Young Farm Families Should Know About Credit, Farmers' Bulletin No. 2135, June 1959.

12. (S) When You Use Credit for the Family, January 1965, Division of Home Economics.

13. (S) Your Farm Renting Problem, Farmers' Bulletin No. 2161, June 1961.

14. (S) Your Farm Rent Determination Problem, Farmers' Bulletin 2162, June 1961.

15. (S) Insurance Facts for Farmers, Farmers' Bulletin 2137, June 1963.

16. (S) Understanding Life Insurance for the Family, Division of Home Economics, December 1964.

17. (S) 1964 Revenue Act Provisions of Significance to Farmers, ERS-165.

18. (S) Your Farm Lease Checklist, Farmers' Bulletin 2163, 1961.

19. (S) Your Farm Lease Contract, Farmers' Bulletin No. 2164, 1961.

20. (S) Your Cash Farm Lease, Miscellaneous Publication No. 836, 1961.

21. (S) Your Livestock Share Farm Lease, Miscellaneous Publication No. 837, 1961.

22. (S) Your Crop-Share Lease, Miscellaneous Publication No. 838, 1961.

23. (S) Father-Son Agreements for Operating Farms, Farmers' Bulletin No. 2179, 1961.

D. Commercial and Other Publications

1. (D) U. S. Census of Agriculture, 1959, South Carolina, U. S. Department of Commerce, Bureau of the Census.

2. (T) Getting Started and Established in Farming with and Without Family Help, Circular 822, University of Illinois, College of Agriculture, Extension Service in Agriculture and Home Economics, Urbana, Illinois, 1960.

3. (T) An Analysis of Capital Use on Owner Operated Farms in the Lower Piedmont Area of Georgia, Bulletin N.S. 74, Georgia Agricultural Experiment Stations, University of Georgia, College of Agriculture, Athens, Georgia, March 1960.

4. (D) South Carolina Agricultural Credit Manual, Wachovia Bank and Trust Company, 1958.

5. (T) Your Guide to Teaching Money Management, Money Management Institute, Household Finance Institute, Prudential Plaza, Chicago 1, Illinois.

6. (S) Essentials of Social Security in the United States, U. S. Department of Health, Education, and Welfare, Social Security Administration, Washington, D. C.

7. (S) Farmers Tax Guide, U. S. Treasury Department, Internal Revenue Service, Washington, D. C., Publication No. 225.

8. (T) Family Farm-Operating Agreements, North Central Regional Research Publication 143, Circular Bulletin 243, Agricultural Experiment Station, Michigan State University, East Lansing, Michigan.

9. (S) Incorporating the Farm Business, Extension Folder No. 174, N. C. Agricultural Extension Service, North Carolina State College, State College Station, Raleigh, North Carolina 1960.

10. (T) The Farm Corporation, Pamphlet 273, June 1960, Cooperative Extension Service, Iowa State University of Science and Technology, Ames, Iowa.

11. (T) Father-Son and Other Farm Partnerships, B809, University of Missouri Agriculture Experiment Station, 1963.

E. Library Filing System

In your library filing system check:

200 - Agriculture - General
235 - Importance of Agriculture
260/20 - Research - Economics
700 - Agricultural Economics - General
720 - Farm Management - General
730 - Finance
745 - Outlook
750 - Production Economics
770 - Statistics
780 - Tenure

F. Loan Free Movies

1. Credit Where Credit is Due, Color, 28 Min., 1963, Available through your county agricultural Extension Service agent.

2. The Big Gamble (the value of insurance), Sound, Black & White, 15 Min., 1953, Motion Picture Service, Office of Information, U. S. Department of Agriculture, Washington, D. C., 20250.

3. American Farmer (the story of mechanization and science in modern farming), Sound, Color, 28 Min., Ford Film Library, 16 E. 52nd Street, New York, New York, 10022.

4. Businessman-Farmer, Color, Sound 14 Min., 1963, Farm Film Foundation, 1425 H Street, N. W., Washington, D. C., 20005.

5. Farming's Fabulous Future, Color, Sound, 17 Min., 1965, New Holland Machine Company, Motion Picture-Photography Section, New Holland, Pennsylvania, 17557.

6. Farm Management, Color, Sound, 15 Min., 1961, Sterling-Movies U. S. A., Incorporated, 43 West 61st Street, New York, New York, 10023.

7. Part-Time Farmer, Color, Sound, 17 Min., 1956, Farm Film Foundation, 1425 H Street, N. W., Washington, D. C., 20005.

8. Production Credit Does the Job, Color, Sound, 20 Min., 1953, Farm Credit Banks, Columbia, South Carolina, 29202.

9. Things Keep Changing, Sound, 40 Min., 1957, Sinclair Refining Company, Farm Sales Department, P. O. Box 1710, Atlanta, Georgia, 30301.

10. The World of Farm Mechanomics, Color, Sound, 12 Min., New Holland Machine Company, Motion Picture-Photography Section, New Holland, Pennsylvania, 17557.

FARM MECHANICS

Suggested Minimum Time Allotment is 20 Periods

I. Farm Machinery

A. What are the basic principles one should understand about grain drills in relation to:

1. Field operation?

2. Proper adjustment?

3. Maintenance?

4. Repair and trouble shooting?

5. Selection on a new or used basis?

B. What are the basic principles one should understand about row crop planters in relation to:

1. Field operation?

2. Proper adjustment?

3. Maintenance?

4. Repair and trouble shooting?

5. Selection on a new or used basis?

C. What are the basic principles one should understand about mowers in relation to:

1. Field operation?

2. Proper adjustment?

3. Maintenance?

4. Repair and trouble shooting?

5. Selection on a new or used basis?

D. What are the basic principles one should understand about hay harvesters in relation to:

1. Field operation?

2. Proper adjustment?

3. Maintenance?

4. Repair and trouble shooting?

5. Selection on a new or used basis?

E. What are the basic principles one should understand about corn pickers in relation to:

1. Field operation?

2. Proper adjustment?

3. Maintenance?

4. Repair and trouble shooting?

5. Selection on a new or used basis?

F. What are the basic principles one should understand about tillage equipment in relation to:

1. Field operation?

2. Proper adjustment?

3. Maintenance?

4. Repair and trouble shooting?

5. Selection on a new or used basis?

G. What are the basic principles one should understand about combines in relation to:

1. Field operation?

2. Proper adjustment?

3. Maintenance?

4. Repair and trouble shooting?

5. Selection on a new or used basis?

H. What are the basic principles one should understand about dusters in relation to:

1. Field operation?

2. Proper adjustment?

3. Maintenance?

4. Repair and trouble shooting?

5. Selection on a new or used basis?

I. What are the basic principles one should understand about sprayers in relation to:

1. Field operation?

2. Proper adjustment?

3. Maintenance?

4. Repair and trouble shooting?

5. Selection on a new or used basis?

J. What are the basic principles one should understand about other farm machines in relation to:

1. Field operation?

2. Proper adjustment?

3. Maintenance?

4. Repair and trouble shooting?

5. Selection on a new or used basis?

REFERENCE MATERIALS

A. Reference Books

1. Jones, Mack M., Shopwork on the Farm, McGraw-Hill Book Company, Inc., New York, New York. 1955.

2. Sampson, Harry O., Albert S. Mowery and Harold L. Kugler, Farm Shop Skills in Mechanized Agriculture, American Technical Society, Chicago, Illinois. 1959.

3. Roehl, Louis M. and A. D. Longhouse, Farmers' Shop Book, The Bruce Publishing Company, Milwaukee, Wisconsin. 1963.

4. O'Brien, Michael, Demonstrations for Farm Mechanics, The Interstate Printers and Publishers, Inc., Danville, Illinois. 1957.

5. The Operation, Care and Repair of Farm Machinery, Deere & Company, Moline, Illinois.

6. Phipps, Lloyd J., H. F. McColly and L. L. Scranton, Farm Mechanics Text and Handbook, The Interstate Printers and Publishers, Inc., Danville, Illinois, 6th Edition, 1959; 5th Printing, 1963.

7. Selecting and Maintaining Farm Mowers, Southern Association of Agricultural Engineers and Vocational Agriculture, Coordinator's Office, Barrow Hall, Athens, Georgia. 1966.

B. Publications of the United States Department of Agriculture, Division of Information, Washington, D. C. 20250

1. (S) Flame Cultivation Equipment and Technique, Production Research Report No. 86, February 1965.

2. (S) Hose Pump for Applying Nitrogen Fertilizers, Farmers' Bulletin No. 2128, January 1959.

C. Commercial and Other

1. (T) Operators' manuals for specific machines studied.

2. (S) Bearings and Their Lubrication, Engineering Bulletin B-226A, American Oil Company, Sales Training Department, File MER-T-5, 910 South Michigan Avenue, Chicago 80, Illinois, June 1962.

3. (S) Hydraulic Power Transmission, Engineering Bulletin HP-221A, American Oil Company, Sales Training Department, File MER-T-5, 910 South Michigan Avenue, Chicago 80, Illinois, February 1961.

4. (S) Equipping Calibrating Sprayers for Geigy Wettable Powder Herbicides, Geigy Agricultural Chemicals, Division of Geigy Chemical Corporation, Saw Mill River Road, Ardsley, New York.

5. (T) Herbicide Sprayer Guide (chart), Geigy Agricultural Chemicals, Division of Geigy Chemical Corporation, Saw Mill River Road, Ardsley, New York.

D. Loan Free Movies

1. Corn Planter, Sound, Color, 10 Min., 1961, Farm Film Foundation, 1425 H Street, N. W., Washington, D. C., 20005.

2. Hitching and Adjusting Tractor Drawn Moldboard Plows, Sound, Color, 15 Min., John Deere Film Library, 2524 Kirk Avenue, Baltimore, Maryland.

3. Balanced Head Mower, Color, Sound, 10 Min., 1964, Farm Film Foundation, 1425 H Street, N. W., Washington, D. C., 20005.

4. Mechanical Cotton Pickers, Color, Sound, 11 Min., Farm Film Foundation 1425 H Street, N. W., Washington, D. C., 20005.

5. Romance of the Reaper, Sound, 27 Min., Farm Film Foundation, 1425 H Street, N. W., Washington, D. C., 20005.

6. Forage Harvesters, Color, Sound, 13 Min., Farm Film Foundation, 1425 H Street, N. W., Washington, D. C., 20005.

7. Story of Twine, Sound, Color, 26 Min., Farm Film Foundation, 1425 H Street, N. W., Washington, D. C., 20005.

8. There's a Profit in On-the-Farm Feedmaking, Color, Sound, 15 Min., Gehl Bros. Manufacturing Company, Advertising Department, 143 Water Street, West Bend, Wisconsin, 53095.

9. Movies available from your Clemson University Extension Agent:

   a. Reconditioning a Grain Drill, 28 Min., 1946.

   b. Early Does It, 23 Min., 1949.

   c. Low Gallonage Spraying, Color, 15 Min., 1957.

   d. Farming with Fire, Color, 11 Min., 1963 (flame cultivation).

   e. The Clean Cut (mower reconditioning), 11 Min., 1945.

   f. More Grain in the Tank (combine adjustment), 10 Min., 1945.

   g. Electric Mix Mills, 11 Min., 1960.

F. Library Filing System

In your library filing system look for additional information under:

260/40 - Research - Engineering
270 - Safety
510/20 and 510/30 - Corn - Growing, Harvesting & Storing
515/20 and 515/30 - Cotton - Growing, Harvesting & Storing
520/20 and 520/30 - Hay, Forage - Growing, Harvesting & Storing
540/20 and 540/30 - Peanuts - Growing, Harvesting & Storing
550/20 and 550/30 - Potatoes - Irish - Growing, Harvesting & Storing
555/20 and 555/30 - Small Grains - Growing, Harvesting & Storing
560/20 and 560/30 - Sorghum - Growing, Harvesting & Storing
565/20 and 565/30 - Soybeans - Growing, Harvesting, & Storing
570/20 and 570/30 - Sweet Potatoes - Growing, Harvesting & Storing
580/20 and 580/30 - Tobacco - Growing, Harvesting & Storing
750/20 - Input-Output Data

750/60 - Mechanization Economics
800 - Agricultural Engineering - General
830 - Machinery - General
835 - Machinery - Field
840 - Machinery - Harvesting
845 - Machinery - Planting
855 - Materials Handling, Processing

Suggested Minimum Time Allotment is 20 Periods

II. Farm Electricity and Motors

A. What role does electricity play in agriculture?

B. What are some of the basic principles of electricity?

1. What is electricity?

2. What is a circuit?

3. What are conductors and insulators?

4. What is resistance?

C. What terms are used to describe electricity?

1. What is meant by "volts"?

2. What is meant by "ampheres"?

3. What is meant by "watts"?

4. What is meant by "AC" and "DC"?

5. What is meant by "single phase" and "3 phase"?

D. How does one maintain the farm wiring and lighting system?

1. What are the fundamentals of repairing various kinds of service cords?

2. What are the procedures of maintaining or replacing:

a. Fuses and circuit breakers?

b. Single-pole switches?

c. Three-way switches?

d. Four-way switches?

e. Convenience outlets?

f. Wiring between buildings that have excess sag?

g. Wires that have broken between buildings?

h. Light fixtures?

E. What are the principles and procedures of planning the farm home wiring system?

1. Why is planning of a farm electrical system important?

2. How are connected or installed loads determined?

3. What are the types of metering? What are the uses of each?

4. How does one select service entrance equipment for individual buildings?

5. What is grounding? Why is it important?

6. What are the principles involved in selecting feeders for individual buildings?

7. What considerations should be taken in locating and selecting equipment for a service entrance center?

8. How are the number of circuits determined?

9. How does one prepare a sketch of a farm wiring system?

F. How does one estimate costs of electrical services?

1. How does one determine wattage?

2. What is electrical consumption of farm and home electrical equipment?

3. How does one calculate operating costs of farm and home electrical equipment?

G. How does one select and maintain farm motors?

1. What size and type of motor should be provided for various uses?

2. What features and accessories should be provided?

3. What electric controls should be provided?

4. How does one select the type and size of drive?

5. How are motors maintained?

REFERENCE MATERIALS

A. Reference Books

1. Wakeman, T. J., and Vernon Lee McCoy, The Farm Shop, The Macmillan Company, New York, New York. 1960.

2. Sampson, Harry O., Albert S. Mowery and Harold L. Kugler, Farm Shop Skills in Mechanized Agriculture, American Technical Society, Chicago, Illinois. 1959.

3. Jones, Mack M., Shopwork on the Farm, McGraw-Hill Book Company, Inc., New York, New York. 1955.

4. Roehl, Louis M., and A. D. Longhouse, Farmer's Shop Book, The Bruce Publishing Company, Milwaukee, Wisconsin, 10th Edition, 1953; 22nd Edition. 1963.

5. O'Brien, Michael, Demonstrations for Farm Mechanics, The Interstate Printers and Publishers, Inc., Danville, Illinois. 1957.

6. Promersberger, William J., and Frank E. Bishop, Modern Farm Power, Prentice-Hall, Inc., Englewood Cliffs, New Jersey. 1962.

7. Hamilton, J. Roland, Using Electricity on the Farm, Prentice-Hall, Inc., Englewood Cliffs, New Jersey. 1952.

8. Mix, Floyd, and E. C. Pritchard, All About House Wiring, The Goodheart-Willcox Company, Inc., Homewood, Illinois. 1962.

9. Schaenzer, J. P., Rural Electrification, The Bruce Publishing Company, Milwaukee, Wisconsin. 1955.

10. Jones, E. W., and J. L. Johnston, Adequate Wiring for Home and Farm, The Bruce Publishing Company, Milwaukee, Wisconsin. 1963.

11. Kitts, Harry W., and Marvin Nabben, Farm Electricity, a demonstration manual for students of vocational agriculture, Delmar Publishers, Inc., Albany 5, New York. 1960.

12. Richter, H. P., Wiring Simplified, Park Publishing, Inc., P. O. Box 5527 (Lake Street Station), Minneapolis 8, Minnesota (65¢). 1962.

13. Simplified Electric Wiring Handbook, Sears Roebuck and Company (29¢). 1962.

14. Phipps, Lloyd J., H. F. McColly and L. L. Scranton, Farm Mechanics Text and Handbook, The Interstate Printers and Publishers, Inc., Danville, Illinois, 6th Edition, 1959; 5th Printing, 1963.

15. Electrical Terms, Their Meaning and Use, Southern Association for Agricultural Engineering and Vocational Agriculture, Barrow Hall, Athens, Georgia. 1958.

16. Maintaining the Home Lighting and Wiring System, Southern Association for Agricultural Engineering and Vocational Agriculture, Barrow Hall, Athens, Georgia. 1965.

17. Selecting Farm Electric Motors, Controls, and Drives, Southern Association for Agricultural Engineering and Vocational Agriculture, Barrow Hall, Athens, Georgia.

B. Clemson University Agricultural Publications, Clemson, South Carolina

1. (T) 4-H Electric Project, Unit One, October 1965.

2. (T) 4-H Electric Project, Unit Two, September 1961.

3. (T) 4-H Electric Project, Unit Three.

C. Publications of the United States Department of Agriculture, Division of Information, Washington, D. C., 20250

1. (S) Standby Electric Power Equipment for the Farm, Leaflet No. 480, 1960.

D. Commercial and Other Publications

1. (T) Experimenting with Electricity, Rural Sales Section, Alabama Power Company, Alabama, 1964.

2. (T) Electricity in Dairying, Tennessee Valley Authority, Electrical Demonstration Branch, Chattanooga, Tennessee.

3. (T) Electrical Farm Equipment You Can Build, Westinghouse Electric Corporation, 306 Fourth Avenue, P. O. Box 1017, Pittsburg 30, Pennsylvania.

4. (T) Electrical Ideas for Better Farming, Westinghouse Electric Corporation, 306 Fourth Avenue, P. O. Box 1017, Pittsburg 30, Pennsylvania.

5. (T) Planning Modern Farm Wiring, Farm Electrification Bureau, National Electrical Manufacturers Association, 155 East 44th Street, New York 17, New York, 1959 ($13 per 100 copies).

6. (T) Specifications for Farmstead Wiring, Farm Electrification Bureau, National Electrical Manufacturers Association, 155 East 44th Street, New York 17, New York, 1959 ($10 per 100 copies).

7. (T) Farmstead Wiring Handbook, Industry Committee on Interior Wiring Design, Room 2650, 420 Lexington Avenue, New York 17, New York, 1955 (50¢).

8. (T) Farm Electrification Lesson Plans for Vocational Agricultural Teachers, Edison Electric Institute, 420 Lexington Avenue, New York 17, New York.

E. Loan Free Movies

1. Movies available from your Clemson University County Extension Agent:

   a. Power and the Land (the start of REA), B/W, 38 Min., 1940.

   b. Three-Wire Service Entrance, B/W, 23 Min., 1944.

   c. Roughing-In Nonmetallic Sheathed Cable, B/W, 24 Min., 1944.

   d. Dawn of Better Living, Color, 16 Min., 1947 (emphasizes the need of proper wiring and home planning).

2. Atomic Venture, Color, Sound, 24 Min., U. S. Atomic Energy Commission, Savannah River Operations Office, Office of Public Information, P. O. Box A, Aiken, South Carolina, 29802, 1961.

3. Birth of an Era, Color, Sound, 27 Min., U. S. Army Engineer District, 200 East Julian Street, P. O. Box 889, Savannah, Georgia, 31402, 1954 (the Clark Hill story).

F. Loan Free Filmstrips

1. Shocking Conditions (hazards of electrical shock), Zurich-American Insurance Companies, Film Department, 111 West Jackson Boulevard, Chicago, Illinois, 60604, 1950.

2. Story of TVA, Tennessee Valley Authority, Information Office, Knoxville, Tennessee, 37902, 1963.

G. Library Filing System

In your filing system look for additional information under:

260/40 - Research - Engineering
270 - Safety
750/20 - Input-Output Data
750/60 - Mechanization economics
800/50 - Miscellaneous Plans
820 - Electrification

LEADERSHIP TRAINING

I. Developing in Supervised Practice, Character, and Leadership to Attain the South Carolina State Farmer Degree

   A. Requirements.

   B. Ways to attain this goal.

   C. The value of reaching for this goal.

   D. The South Carolina Star Farmers.

II. The Role of Leadership in Improving Our Agriculture Community

   A. Organizations devoted to promoting agriculture

      1. Purpose of such organizations

      2. Membership of such organizations

      3. Leadership roles of members.

   B. Developing community awareness of agriculture

      1. Analyzing a community and its problems

      2. Solving community problems

      3. Promoting and publicizing agriculture.

   C. The role of the individual in a community leadership program.

   D. Ways by which youth can become involved in the leadership role.

SUGGESTED REFERENCES

A. Reference Books

1. Kreitlow, Burton W., E. W. Aiton and Andrew P. Torrence, Leadership for Action in Rural Communities, The Interstate Printers and Publishers, Inc., Danville, Illinois, 1960.

B. Other References

1. Dunbar, John O., and William J. Block, Your Part in Agricultural Policy Development, Agricultural Policy Institute, North Carolina State, Raleigh, North Carolina, 1964.

2. So You Are on a Committee, U. S. Department of Agriculture, Office of Personnel, Miscellaneous Publication, Washington, D. C., 20250.

SUPERVISED PROGRAMS OF AGRICULTURAL PRACTICE

Suggested Minimum Time Allotment is 17 Periods

I. Summarization of Previous Years Records for Supervised Program of Agricultural Practices

II. Use of Summarized Records to:

A. Develop concepts with the individual of:

1. Weaknesses in his program.

2. Strengths in his program.

3. Possible areas for reduction of activity.

4. Possible areas for enlargement of present enterprises or activities.

5. Possible areas for new enterprises or activities.

6. Possible areas for introduction of new techniques or approaches.

B. Develop concepts of sound agricultural practice with the entire class or department.

C. Develop a basis for public relations programs in school and community.

III. Development of Goals in Supervised Programs of Agricultural Practices for the Coming Year

IV. Development of Plans for Supervised Programs of Agricultural Activities for the Coming Year

List of publications not included in List of Clemson's Agricultural Publications for Farm and Home. You may remove this and use it as an order blank.

ANIMAL PRODUCTION UNIT

Extension Agricultural Engineering

_____ (S) Dairy Housing Systems, Handbook No. 3.

Information Card

_____ (S) Insecticide Use Chart for Milk Producers, No. 103. May 1964.

Southern Cooperative Series

_____ (T) Milk Movement Patterns in the Southeast, Bulletin 84. April 1962.

_____ (T) Consumption and Demand for Ice Cream in the Urban South, Bulletin 76. January 1961.

_____ (T) Consumption and Demand -- Fluid Milk and Fluid Milk Substitutes in the Urban South, Bulletin 53. October 1957.

_____ (T) Prospective Demand for Milk and Milk Products in the South, Bulletin 68. October 1959.

Experiment Station Bulletins

_____ (T) Use of Milk by the Urban and Rural Families in South Carolina, Bulletin 437. May 1956.

_____ (T) Use of Milk by Rural Families in South Carolina 1953, Bulletin 431. November 1955.

CROP PRODUCTION UNIT - COTTON

Agricultural Economics

_____ (S) South Carolina Crop and Miscellaneous Statistics. July 1965.

_____ (D) South Carolina Cash Receipts From Farm Marketings, No. 280. September 1965.

_____ (D) Resources Required for Specified Levels of Income on Cotton Farms, Upper Coastal Plain, South Carolina, No. 242. July 1963.

Extension Service Circulars

_____ (S) 1966 Recommended Varieties for South Carolina, No. 477. September 1965.

_____ (D) Cotton Production, Weed, Insect and Disease Control in South Carolina, No. 440. March 1962.

Extension Service Bulletin

_____ (S) Weeds, Bulletin 113. June 1960.

Extension Agricultural Engineering Leaflets

_____ (D) Cotton Weed Control for Mechanized Production, No. 88. April 1962.

_____ (S) Flame for Grass Control, No. 92. February 1963.

Extension Leaflets

_____ (S) Mr. Cotton Grower--Count to 8 and Watch the Date for Insecticide Application, Leaflet 3. February 1964.

_____ (S) Cotton Diseases, Leaflet 2. 1965.

_____ (S) Mr. Cotton Grower--Defoliate for Better Quality and More Profit, Leaflet 3. July 1965.

_____ (S) Mr. Cotton Grower--Proper Harvesting, Handling and Ginning Will Increase Your 1962 Cotton Profits, Leaflet 7. August 1962.

Cotton Leaflet

_____ (D) Plan for Quality Cotton in 1965, Leaflet 1. March 1965.

Experiment Station Circular

_____ (D) Cotton Defoliation in South Carolina, Circular 114. October 1957.

CROP PRODUCTION UNIT - PASTURES

Extension Service Bulletins

_____ (S) Weeds, A South Carolina Handbook, Bulletin 113. June 1960.

_____ (D) Agronomy Handbook for South Carolina, Bulletin 104.

Extension Circular

_____ (S) 1965 Recommended Varieties for South Carolina, Circular 477. September 1965.

County Agent's File and Reference Copy

_____ (S) Chemical Weed Control and Equipment to Use. January 1961.

Southern Farm Management Extension Publication

_____ (S) The Economics of Fertilizer Use in the South, No. 10. January 1962.

Forage Memos

_____ (S) How to Maintain White Clover in Fescue-Clover Pastures, No. 2.

_____ (S) Orchard Grass, No. 1

CROP PRODUCTION UNIT - SOYBEANS

Agricultural Economics Series

_____ (D) South Carolina Soybean Statistics, AE 212. August 1961.

_____ (T) South Carolina Crop and Miscellaneous Statistics, AE 277. July 1965.

_____ (S) South Carolina - Cash Receipts From Farm Marketings, AE 280. September 1965.

Agronomy Series

_____ (S) Performance of Soybean Varieties in South Carolina, No. 46. April 1964.

Extension Service Circulars

_____ (S) 1966 Recommended Varieties for South Carolina, No. 477. 1965.

_____ (S) S. C.'s Intensified Soil Fertility Program Results Show Progress, Circular 499. July 1937.

Extension Bulletin

_____ (S) Weeds, A South Carolina Handbook, Bulletin 113. June 1960.

County Agent's File and Reference Copy

_____ (S) Chemical Weed Control and Equipment to Use. January 1961.

CONSERVATION OF NATURAL RESOURCES

Extension Circular

_____ (S) Soil Judging and Land Treatment, Circular 390. February 1961.

FARM MANAGEMENT

Agricultural Economics

_____ (S) South Carolina - Cash Receipts From Farm Marketings, No. 280. September 1965.

_____ (S) Fifty Years of South Carolina Agricultural Progress, Annual Report of Extension Service. 1964.

_____ (S) South Carolina Agriculture Is Big Business, AE 278. July 1965.

_____ (T) The Agriculture of (your) County, AE Publications on individual counties in South Carolina.

_____ (D) Resources Required for Specified Levels of Income on Cotton Farms, Upper Coastal Plain, South Carolina, No. 242. July 1963.

_____ (D) Production Requirements and Estimated Returns From Selected Crop and Livestock Enterprises in the Piedmont Area, No. 202. October 1960.

_____ (D) Estimated Production Requirements and Returns From Selected Crop and Livestock Enterprises in the Upper Coastal Plain Area, No. 243. July 1963.

_____ (S) The Family Plans Its Financial Security Program, Circular No. 201. May 1957.

_____ (D) Legal Aspects of Farm Tenancy and Share Cropping in South Carolina, Experiment Station Bulletin 449. June 1957.

Agricultural Education Department

_____ (D) Teaching the Importance of Agriculture in South Carolina. December 1959.

Southern Farm Management Extension Publications

_____ (S) Financing a Farm Business, No. 8. May 1958.

_____ (T) Inheritance - Your Farm and Family, No. 5. 1953.

FARM MECHANICS UNIT

4-H Publications

_____ (T) 4-H Electric Project, Unit One. October 1965.

_____ (T) 4-H Electric Project, Unit Two. September 1961.

_____ (T) 4-H Electric Project, Unit Three.

VT 000 989
Agricultural Instruction, Units I-VIII.

Los Angeles City Schools, Calif. Vocational and Practical Arts Section
MF AVAILABLE IN VT-ERIC SET.
PUB DATE - 63 85p.

DESCRIPTORS - *STUDY GUIDES; *VOCATIONAL AGRICULTURE; INSTRUCTIONAL MATERIALS; *AGRICULTURAL PRODUCTION; *SOIL SCIENCE; *ANIMAL SCIENCE; HORTICULTURE; NURSERIES (HORTICULTURE); EQUIPMENT; ENTOMOLOGY; PLANT SCIENCE

ABSTRACT - For use in vocational agriculture classes, this manual consists of eight instructional units, including: (1) Tools, Equipment, and Safety, (2) Soils and Soil Preparation, (3) Vegetable Crops and Unsweet Fruits, (4) Planting the Garden, (5) Flowers, (6) Nursery Practice, (7) Insects, and (8) Animal Husbandry. Units provide information sheets and operation sheets containing purpose, activities and procedures, problems, and questions for each of the topics covered under the general unit headings. The guide is illustrated with numerous line drawings and diagrams. (AW)

VT 000 989

Agricultural Instruction Units I-VIII

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LOS ANGELES CITY SCHOOLS
Division of Instructional Services
Curriculum Branch
Vocational and Practical Arts Section
1963

AGRICULTURE INSTRUCTIONAL UNIT I

TOOLS, EQUIPMENT, AND SAFETY

Soil Preparation, Spading Tools 2
Cultivating Tools, Weeding and Mulching Tools 3
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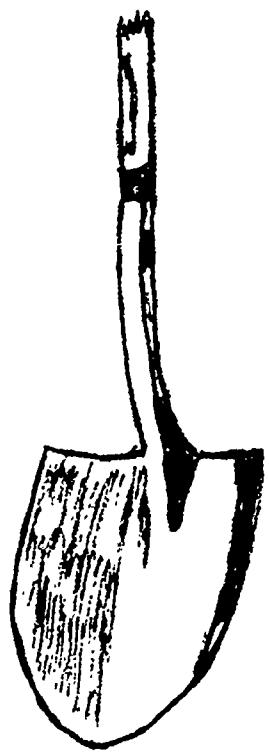
LOS ANGELES CITY SCHOOLS
Division of Instructional Services
Curriculum Branch
Vocational and Practical Arts Section
1963

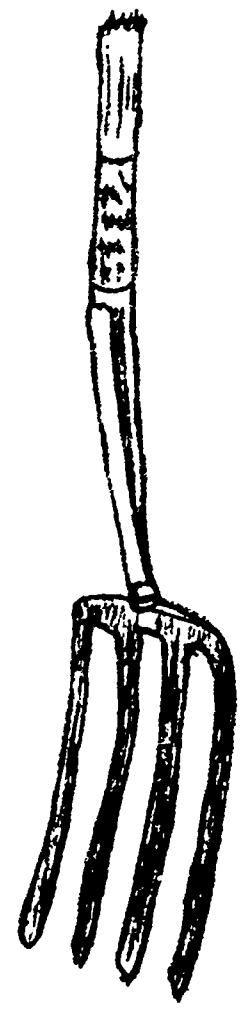
Information Sheet

IDENTIFICATION AND USE OF TOOLS (1)

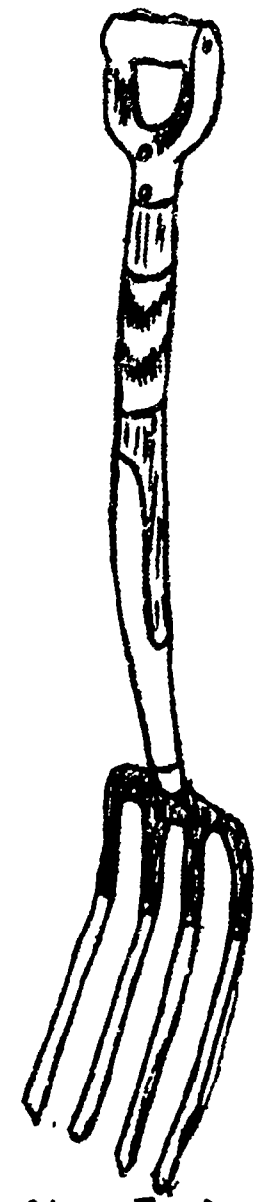
SOIL PREPARATION (Spading Tools)



Round Point Shovel
Long Handle

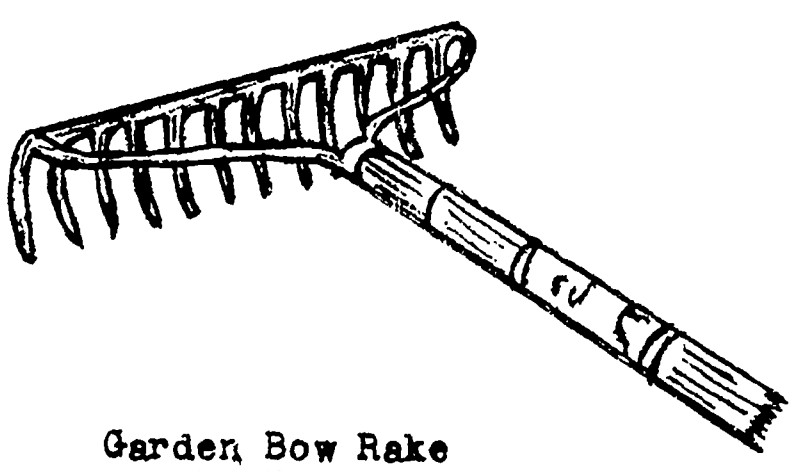


Spading Fork
Long Handle

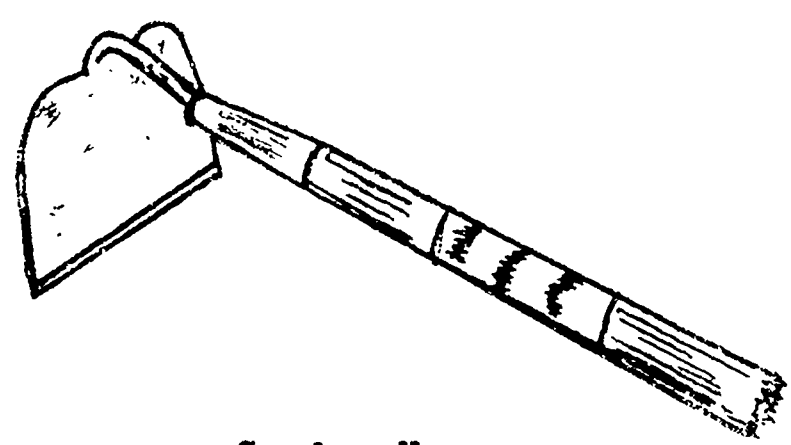


Spading Fork
D Handle

LEVELING TOOLS



Garden Bow Rake
12 Tooth

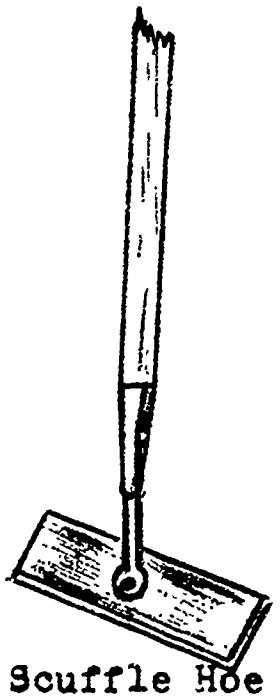


Garden Hoe
6" Blade

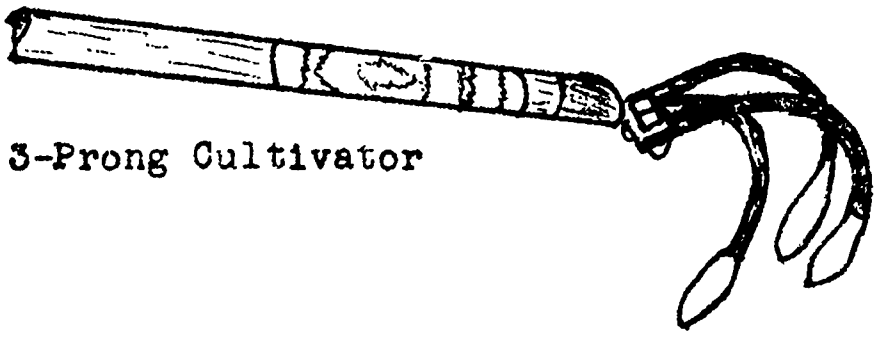
Information Sheet

IDENTIFICATION AND USE OF TOOLS (2)

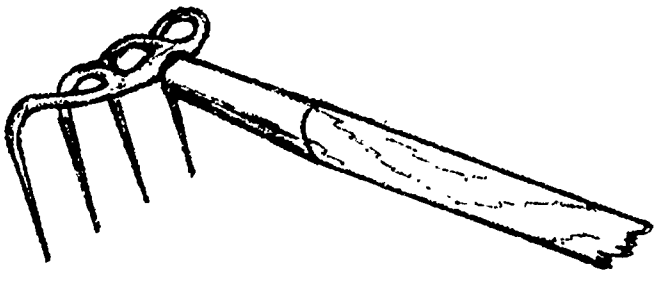
CULTIVATING TOOLS



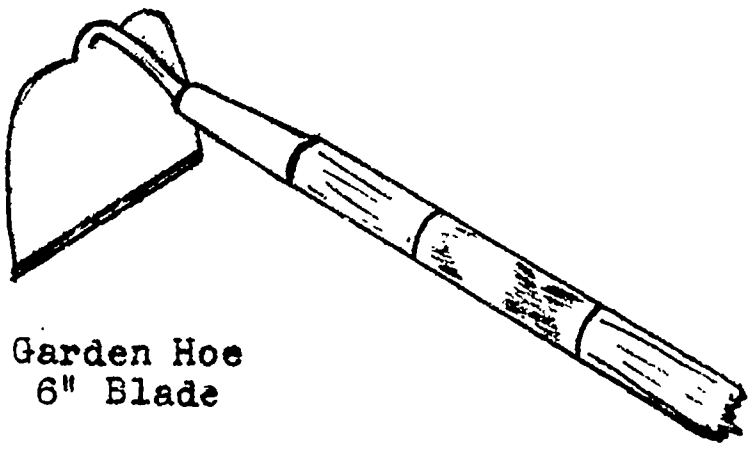
Scuffle Hoe



3-Prong Cultivator

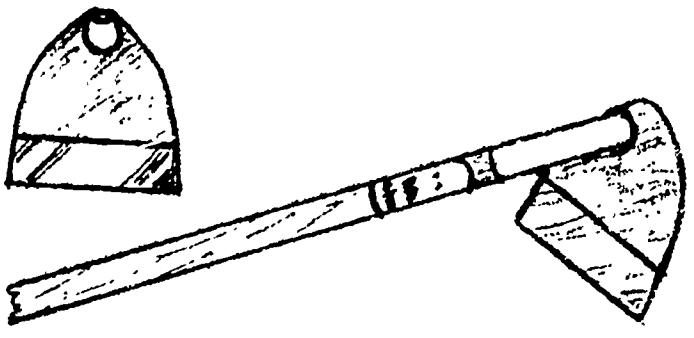


4-Tine California Cultivator

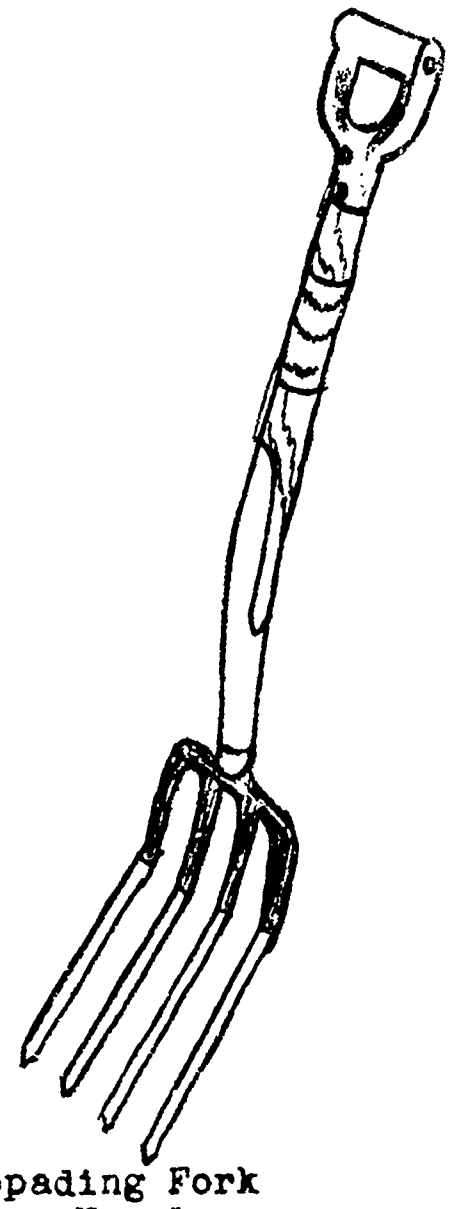


Garden Hoe
6" Blade

WEEDING AND MULCHING TOOLS



Plantation Hoe

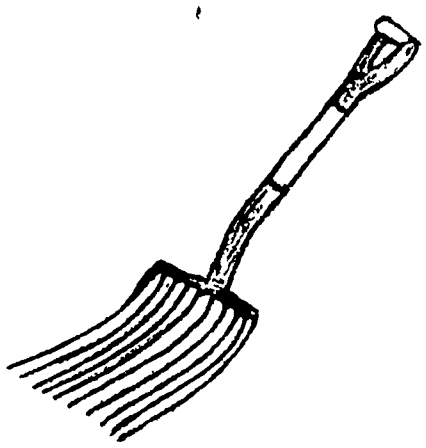


Spading Fork
D Handle

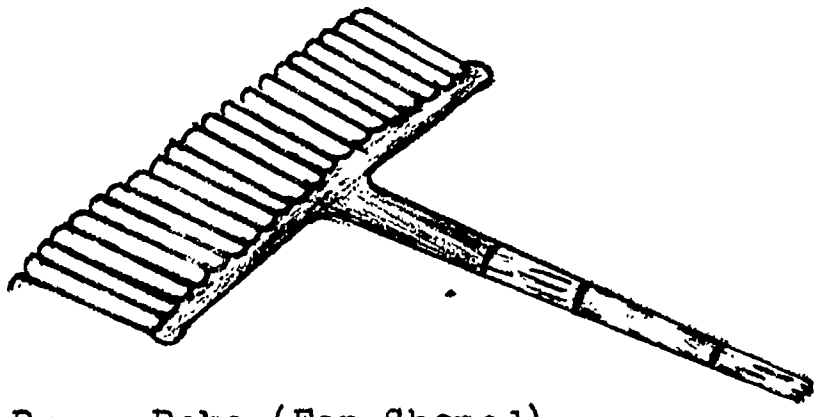
Information Sheet

IDENTIFICATION AND USE OF TOOLS (3)

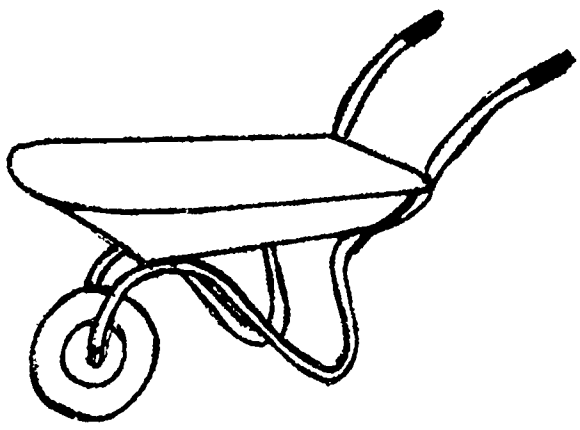
GARDENING MAINTENANCE TOOLS



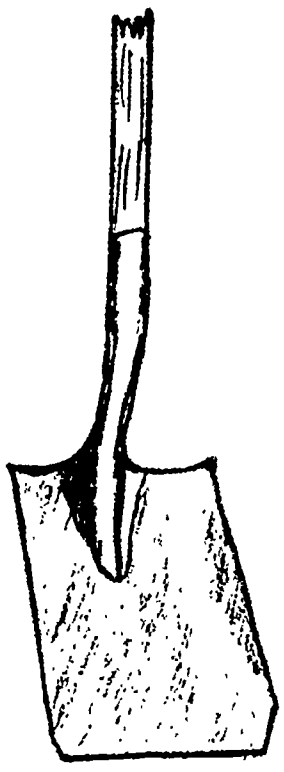
10-Tine Rubbish Fork
To pick up leaves, etc., without picking up soil.



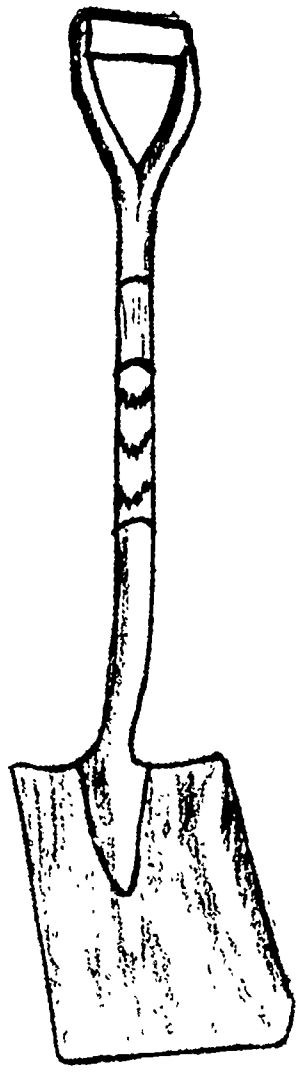
Broom Rake (Fan Shaped)
To rake leaves, grass, and clean paths.



Wheelbarrow



Square Point Shovel
Long Handle
To spread manure, compost, mix soils.



Square Point Shovel
D Handle
To pick up rocks and debris, mix soils, move soils.

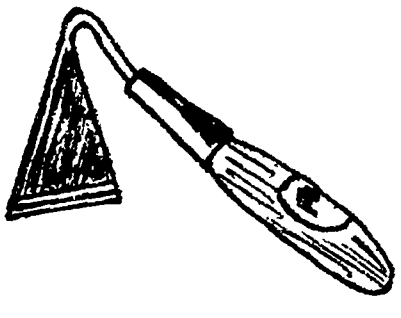
Information Sheet

IDENTIFICATION AND USE OF TOOLS (4)

GARDEN HAND TOOLS (Light)

Garden Trowel

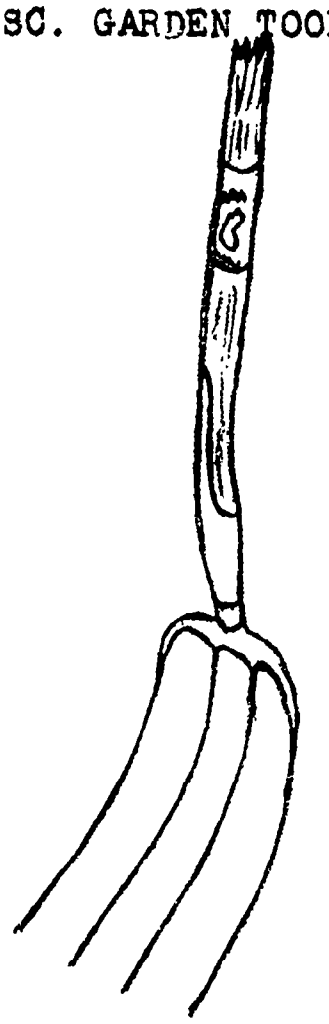
Scratcher
For cultivating.



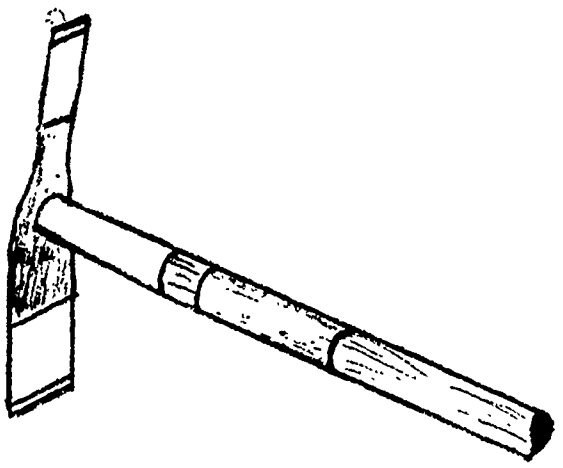
Onion Hoe
For cultivating, weeding.

Transplanting Trowel

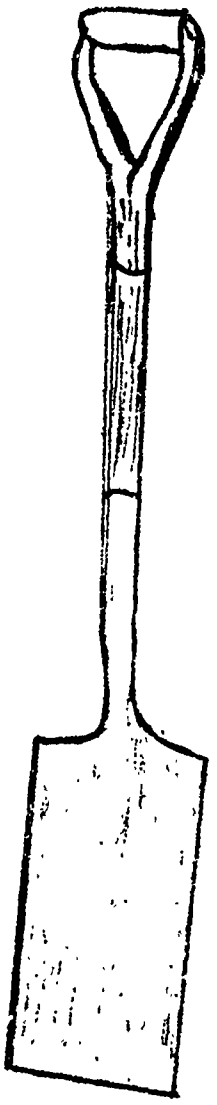
MISC. GARDEN TOOLS (Heavy Duty)



4-Tine Manure Fork
Move brush or other
coarse materials.



Mattock - dig or grub out
plants

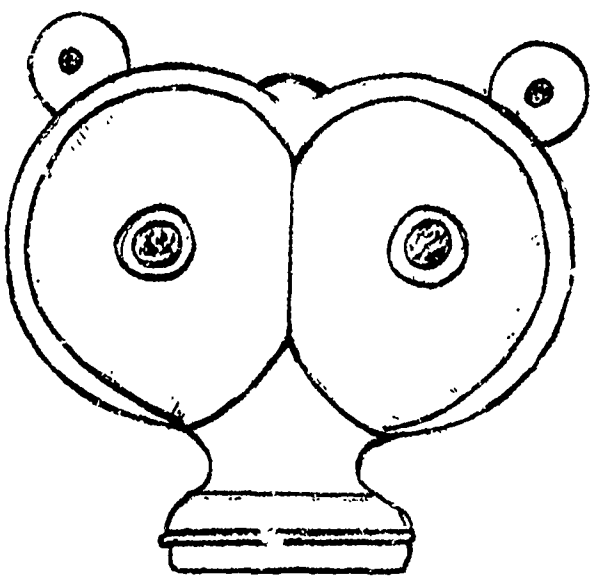


Spade, D Handle
Balling out or root
pruning. Dig holes for
large plants.

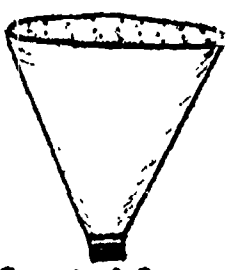
Information Sheet

IDENTIFICATION AND USE OF TOOLS (5)

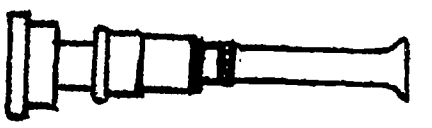
HAND WATERING TOOLS



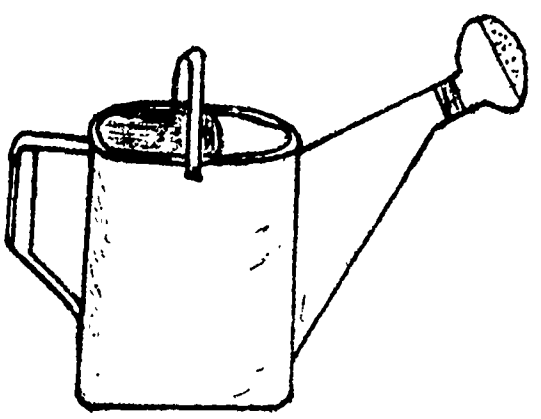
Twin Sprinkler



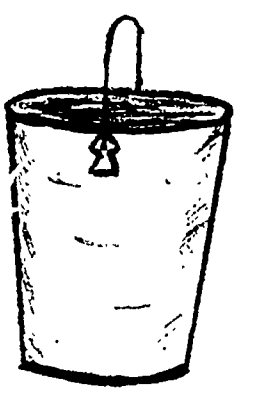
Fan Sprinkler



Boston Nozzle



Sprinkling Can



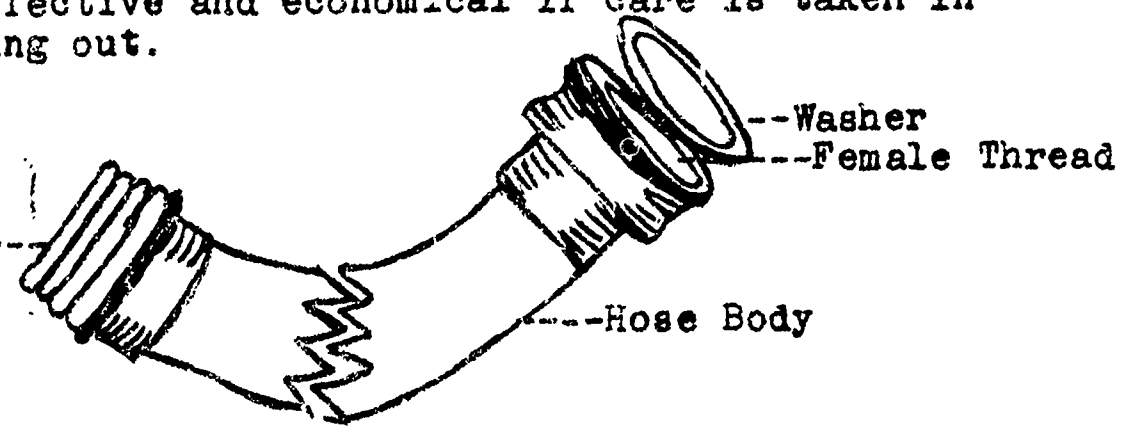
Bucket

Operation Sheet

CONNECTING THE GARDEN HOSE

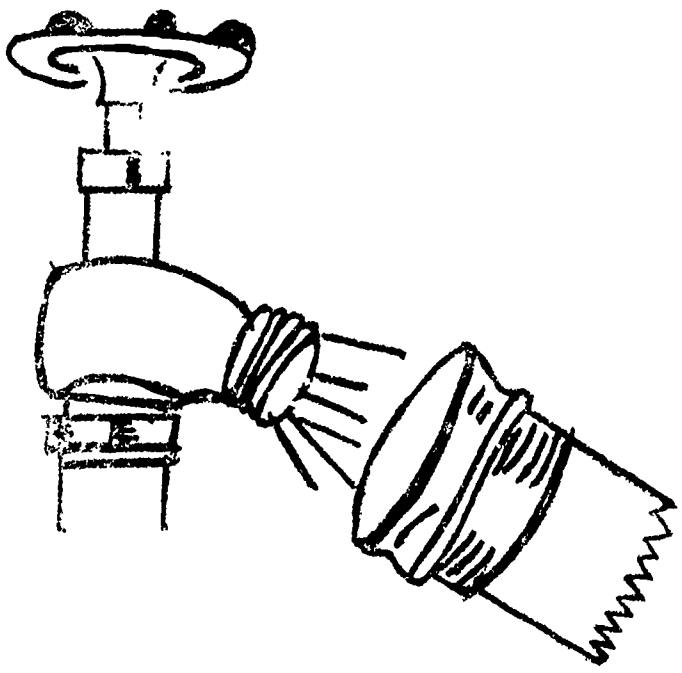
The garden hose is a very necessary tool in gardening. Its function can be much more effective and economical if care is taken in connecting and laying out.

HOSE PARTS:

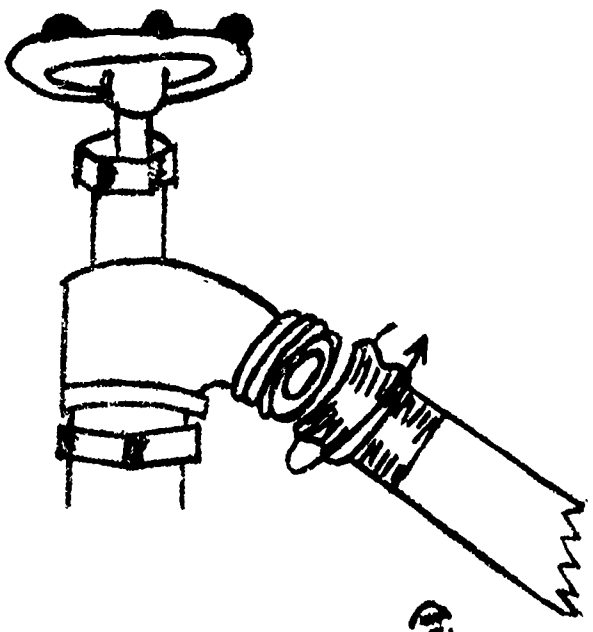


ACTIVITY:

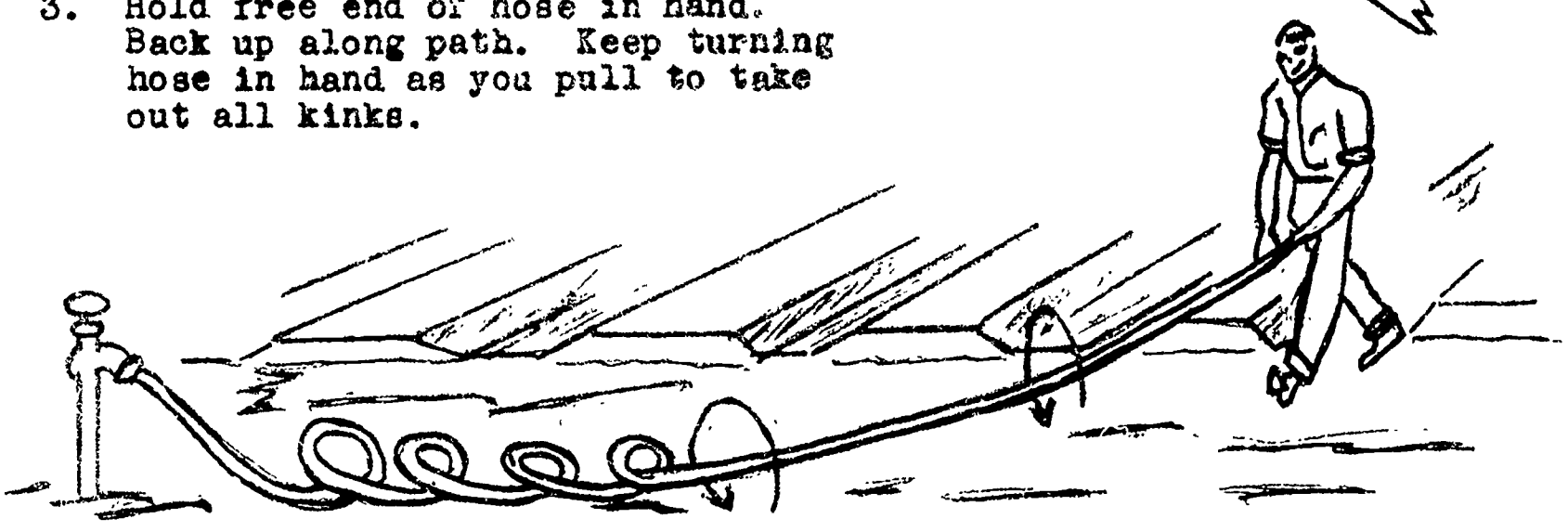
1. Wash soil and rock particles from female thread.



2. Hold female thread parallel with faucet thread. Turn clockwise. Be sure connection is tight.



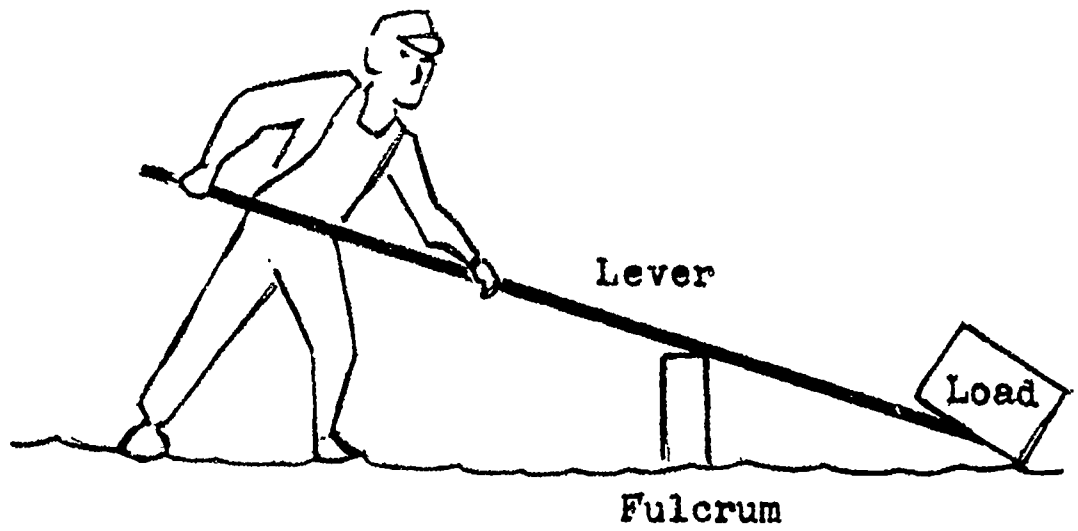
3. Hold free end of hose in hand. Back up along path. Keep turning hose in hand as you pull to take out all kinks.



Operation Sheet

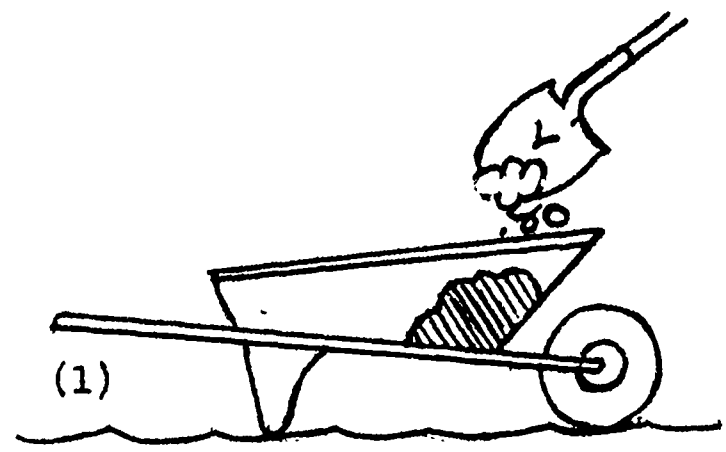
LOADING A WHEELBARROW

PURPOSE: A wheelbarrow is designed to utilize the basic law of the fulcrum.

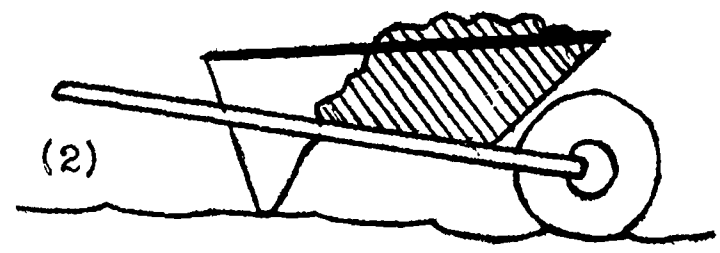


ACTIVITY:

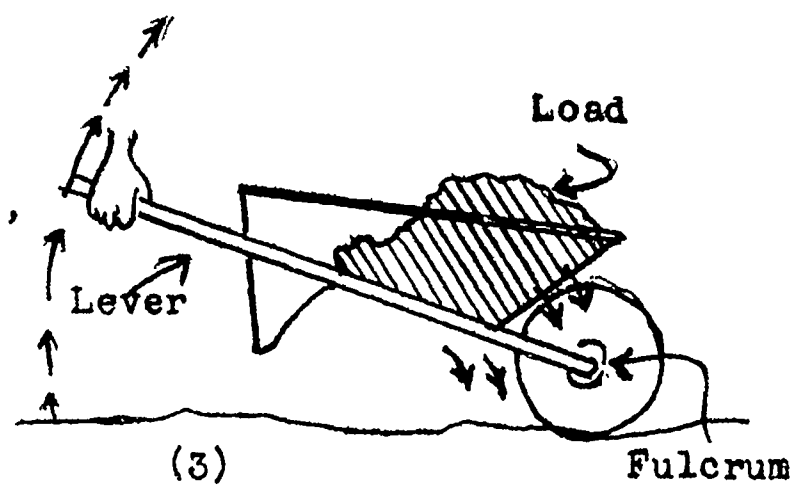
1. Shovel sand, soil, or debris, or lift material into wheelbarrow, placing load over the wheel.



2. Keep area of pan, near the handles, clear and unfilled.



3. Load properly placed puts strain of lifting on wheel, not on back muscles, thus avoiding strain.



Operation Sheet

BEGINNING TOOL INVENTORY

NUMBER	TOOL NAME	UNIT PRICE	TOTAL COST
	Hoe	$ 1.19	$
	Rake, garden	1.34	
	Cultivator	1.04	
	Shovel, round point	1.88	
	Shovel, square point	1.95	
	Hoe, potato	1.58	
	Spade	1.75	
	Fork, spading	1.71	
	Rake, broom	.85	
	Wheelbarrow	14.75	

It is recommended that this sheet be used as a form, and that students use their own notebook paper when doing this lesson.

Operation Sheet

ADVANCED TOOL INVENTORY

Tools cost money. Some are lower in cost than others. You are to find the number of each kind of tool on hand and the total cost of each. Also the grand total cost of all the tools in the tool room.

Your lesson plan is divided into four columns. Why is the column titled "Number" blank? Why is the column titled "Total" blank? How can you find the numbers of each tool? How can you arrive at the "Grand Total"? Why are the decimal points placed in the "Total" column?

Number	Tool Name	Unit Price	Total
_____	Hoe	$ 1.19	$.
_____	Rake, garden, bow	1.34	.
_____	Cultivator, 3 prong	1.05	.
_____	Shovel, round point, L.H.	1.88	.
_____	Shovel, square point, L.H.	1.76	.
_____	Cultivator, 4 curved tines	1.47	.
_____	Spade, Long handle	1.93	.
_____	Spade, D handle, plain back	1.77	.
_____	Hose, garden, 3/4" (25' L.)	4.07	.
_____	Rake, fan shaped, steel	.99	.
_____	Trowel, garden, blade 3 x 6	.15	.
_____	Sieve, soil, 1/8" mesh	1.24	.
_____	Sieve, soil, 1/4" mesh	1.24	.
_____	Hammer, claw, 16 oz.	1.47	.
_____	Wheelbarrows, rubber tires	21.50	.
_____	Shears, pruning, 27" over-all	3.36	.
_____	Shears, pruning, 8"	2.66	.
_____	Fork, spading, D handle, 4 tines	1.94	.
_____	Flat, seed, 18 x 18, 3½" deep	.52	.
		Grand Total . . . . . $	_____

Operation Sheet

SAFETY TEST FOR JUNIOR HIGH SCHOOL GARDENING

You must pass this safety test before you will be allowed to use garden tools, materials and facilities. The purpose of this test is to determine your understanding of the necessary safety precautions to be observed in the garden.

DIRECTIONS: The following statements are to be made complete by writing the correct word or words on the line to the right. The first statement will serve as an example.

1. Paths and walk areas should always be kept clear of trash and ____tools____
2. After spraying or dusting plants, you must always _____
3. When using a wheelbarrow, it is dangerous to go faster than a _____
4. When not in use, pruning shears should be kept _____
5. If you are a skilled and careful worker, you should not raise a shovel, rake, hoe or similar tool higher than your _____
6. All injuries, no matter how slight, must be reported at once to the _____
7. When handling wood, you must be careful of sharp edges and _____
8. Garden tools should be carried by your side, with sharp edges away from your body, and pointed _____
9. All sharply pointed tools must be placed with points or tines down on the _____
10. Sharp hand tools should never be carried in your _____
11. Throwing objects is dangerous as it may cause _____
12. You should never take a drink from a _____
13. You should avoid breathing garden sprays and dusting powders because they contain harmful _____
14. The improper handling of wire and cans may cause your hands to be _____
15. It is dangerous for you to use a mallet or hatchet with a loose handle because the head may _____

ANSWERS:

poisons	splinters	pocket	down	hose
injury	teacher	closed	knee	cut
ground	fly off	wash	walk	tools

AGRICULTURE INSTRUCTIONAL UNIT II

SOILS AND SOIL PREPARATION

Types and Composition of Soils 13
Types and Composition of Soils 14
Types and Composition of Soils 15
Soil Tests - Acidity, Alkalinity, Sediment 16
Soil Tests - Hand Test for Friability 17
How to Evaluate Cattle Manures 18
The Why of Compost 19
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    How to Find Area of Irregular Plot 21
Basining 22
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LOS ANGELES CITY SCHOOLS
Division of Instructional Services
Curriculum Branch
Vocational and Practical Arts Section
1963

Information Sheet

TYPES AND COMPOSITION OF SOILS (1)

WHAT IS SOIL:

Soil is the thin layer or crust of the earth's surface in which plants grow. This soil, usually 8" to 12" deep, is called top soil. The soil below this surface layer is called sub-soil. Sub-soils usually have little or no organic matter or food materials for growing plants.

Man uses the soil to grow plants for food, fibre for clothing, plastics, vegetable oils, and medicines. Other cultivated plants, such as trees and shrubs, furnish man with rubber, medicine, lumber, fibre, industrial oils, food, shade, and beauty. Without soil and its ability to grow things neither man, animals, or plants could survive.

HOW SOILS ARE FORMED:

Soils were made long before man existed on earth. They have been formed from rocks by the grinding erosive action of winds, rains, rivers, snow, glaciers, heat, cold, and root action. This process is still going on, even though in some areas soil is being lost faster than it is being made. Floods wash soil into the ocean and winds blow it away. It is man's responsibility to conserve and protect the soil.

STUDY QUESTIONS:

1. The surface of the earth that produces plant life is called _____.
2. The thickness of productive soil is 4" to 6", 6" to 8", 8" to 12", 12" to 24"?
3. Name five products from soil used by man.
4. Name two ways in which soil may be lost.
5. The non-productive soil found below the surface is called _____.
6. List several ways in which man can prevent the loss of soil.

VOCABULARY:

conserve	fibre	organic matter	surface
crust	grinding	process	survive
erosive	layer	sub soil	top soil

REFERENCES:

Skilling: Nature Study Agriculture, Chapter III
Sunset: Western Garden Book, p. 26
Worthen: Farm Soils, pp.24-26

Information Sheet

TYPES AND COMPOSITION OF SOILS (2)

WHAT IS IN SOIL:

Good agriculture soil is made up of:

1. Small rock particles (loam type)
2. Soil air
3. Soil water
4. Decaying organic matter
5. Living (and dead) organisms

AIR AND WATER

In dry soils, the spaces between the soil particles is occupied by air. The air contains oxygen which is necessary for plants and soil bacteria to live. When the soil is saturated with water from rains or irrigation, the air is driven out. As the water evaporates and the soil dries out, the pore space is again occupied by air. Too much water in fine soils, such as silt or clay, compacts the soil and reduces the pore spaces.

Good soil must have the right proportion of air and water.

ORGANIC MATTER

Decaying plant and animal life in the soil forms organic matter known as humus. Soils containing humus are usually darker in color and quite fertile. Those without humus are usually light in color and poor in fertility.

ORGANISMS

Soils contain many kinds of bacteria which help to speed up decomposition of animal and vegetable matter. This decomposed vegetable matter (humus) breaks down into chemical elements, such as nitrogen, phosphorous, potassium. These chemical elements are then taken into plants through their root systems.

Continuous cropping of soils will eventually use up these important elements. When this happens, soils lose their fertility.

Fertility of the soil can be renewed by adding compost, animal manures, green crops, refuse from harvested crops, or commercial fertilizers.

STUDY QUESTIONS:

1. Name the five major things found in good soils.
2. What happens to soil when too much water is added?
3. Decayed vegetable matter in soil is called _____.
4. How can you tell by looking at soil whether or not it contains humus?
5. Organisms in soils which aid decomposition are known as _____.
6. Plants take food materials from the soil through their _____.

VOCABULARY:

bacteria	fertility	nitrogen	phosphorous
element	humus	organism	saturated

Information Sheet

TYPES AND COMPOSITION OF SOILS (3)

KINDS OF SOIL

Since soils are made from rocks which are ground into particles of various sizes, they are usually divided into classes according to the size of particles.

These classes are:

- gravel or stone soils
- coarse sand soils
- fine sand soils
- silt soils
- clay soils

The common classification for soils is:

Clay soil has a large proportion of very fine particles. It is usually sticky and difficult to till.

Sandy soil is high in sand content (larger rock particles). It usually dries rapidly and is easy to till.

Loam soil contains about equal amounts of clay, silt, and sand. It holds moisture well, yet drains easily and is easy to till. Loams are divided as follows: silt loam, clay loam, sandy loam; and gravel loam. These soils are considered the best for gardening and agricultural purposes.

STUDY QUESTIONS:

1. One method of classifying soils is according to the size of the soil _____.

2. Soils which contain a very high per cent of fine particles are known as _____soils.

3. The best type of gardening soils are called _____soils.

4. Soils containing large amounts of rock particles and which dry rapidly are called _____soils.

5. Clay soils usually are difficult to till because they become _____ with too much water.

6. Loam soils are divided into _____classes.

VOCABULARY:

classes	common	loam	proportion	soil
classification	considered	moisture	sand	till
clay	ground	particle	silt	various

Operation Sheet

SOIL TESTS (1)

PURPOSE: To learn about the nature of soils by means of simple soil tests.

MATERIALS NEEDED: Three or four 250 c.c. graduated cylinders, blue litmus paper, distilled or rain water, soil samples, dilute hydrochloric acid.

TEST I - ACIDITY (Litmus Method)

1. Take three soil samples; one on the surface, one 12" deep, and one 2' deep.
2. Moisten each sample slightly with distilled water and mold each sample into a ball.
3. Carefully break open each ball in the center and insert ½ of the blue litmus paper. Press ball together tightly. Wait ten minutes.
4. Open ball and remove litmus paper. If the end of the paper in the ball turns pink or red, it indicates the soil is acid.
5. Record results for each sample.

TEST II - ALKALINITY

1. Take three small samples (about the size of a golf ball) of your moistened soils. Place each sample in a dish or can lid.
2. Pour a teaspoon of dilute hydrochloric acid over each soil sample.
3. Observe closely. If the soil is alkaline, the acid should bubble. If acid, there should be no reaction.
4. Record the results of your tests.

TEST III - SEDIMENT

1. Fill your gallon cans with soil samples; one sample of top soil from your garden plot, one sample from 2' deep, one sample from well decomposed compost, and one sample of pure sand.
2. Place two handsful of each sample in a graduated cylinder, add water to within two inches of the top of the cylinder and shake until soil and water are thoroughly mixed. Let stand until water is clear.
3. Observe and record your test results. Keep a record of how long it takes for the water in each sample to become clear. Each mark on the graduated cylinder is one cubic centimeter (1 cc). Count the number of cubic centimeters of each different layer of soil you see and record.

Operation Sheet

SOIL TESTS (2)

TEST IV - HAND TEST FOR FRIABILITY

1. Soil that has been watered thoroughly should be allowed to dry sufficiently before spading. To test the soil condition, dig up a shovel full of soil. Take a handful of soil from the center and squeeze tightly in your hand.

2. If the soil forms a solid ball (Fig. 1) and sticks together, it is too wet. If it crumbles easily (Fig. 2), it is ready to spade.

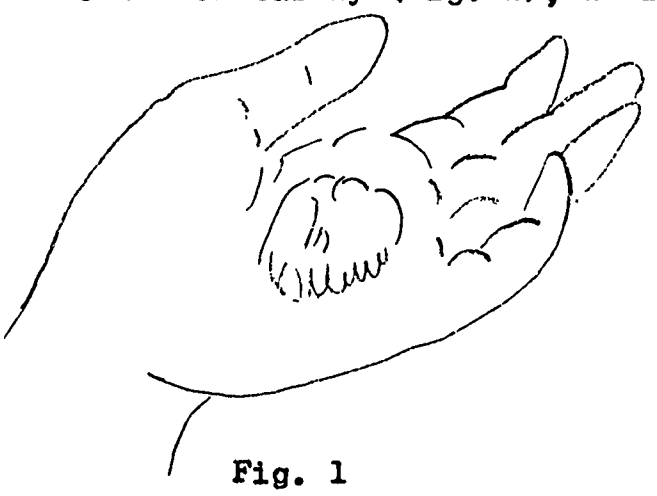


Fig. 1

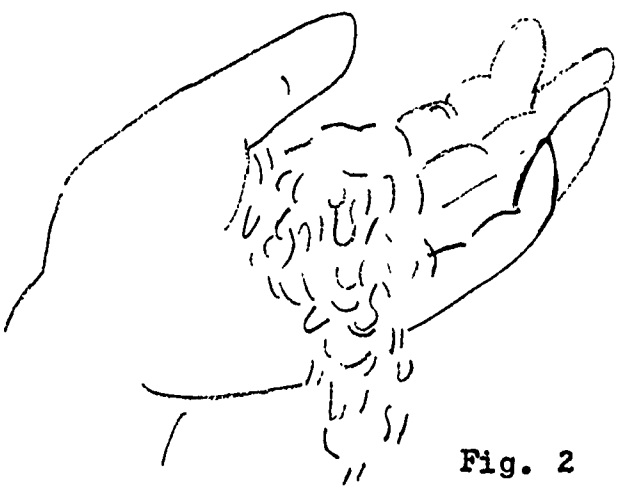


Fig. 2

STUDY QUESTIONS:

Test I - Acidity

1. Which of the three samples appears to be more acid? Can you explain the reasons why?
2. Explain the reason why the sample from two feet reacted differently from the surface sample.

Test II - Alkalinity

3. Which of the soil samples appears to be alkaline? Explain why.

Test III - Sediment

4. In which sample did it take the longest time for the water to become clear? Why?
5. What is the material that floats on top of the water?
6. Which sample had the most coarse material?
7. Which sample had the most silt?

VOCABULARY:

acid	cubic	hydrochloric
acidity	cylinder	litmus
alkaline	dilute	observe
alkalinity	distilled	sample
centimeter	graduated	sediment

Information Sheet

HOW TO EVALUATE CATTLE MANURES

STEER MANURE

1. Usually from feed lots.
2. Stock fed cottonseed meal.
3. Yard floors of concrete.
4. Cured, weed-free.
5. Cleaned, ground, and sacked without contact with soil.
6. $2\frac{1}{4}$ cubic feet average weight.
7. Average price $.75 per sack.
8. Average coverage 150 square feet.

- - - - - - -

THINK:

1. What is the purpose of purchasing manure?
2. Would introduced weed seed add to labor hours?
3. Is weed seed digestible by cattle?
4. Which would be the most pure, manure gathered from cement or dirt yards? Why?
5. Test what you buy by placing a handful of manure in a pint jar of water and allow to settle.

DAIRY MANURE

1. Usually from dairy yards.
2. Cattle which are fed a variety of foods, including weeds mixed in the green grasses and alfalfa hay.
3. Droppings on dirt floors.
4. Usually treated for weed seeds.
5. Mixed with soil when collected for grinding and sacking.
6. $2\frac{1}{4}$ cubic feet average weight.
7. Average coverage 150 square feet.
8. Price usually 4 to 5 sacks for $1.00

Information Sheet

THE WHY OF COMPOST

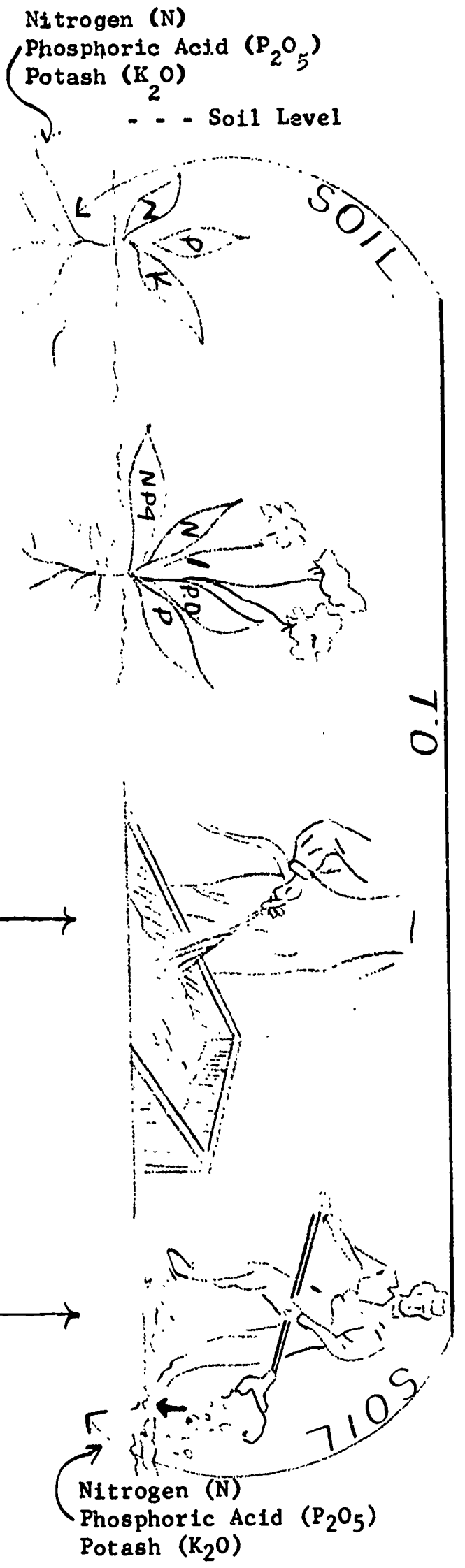
1. Soils contain many of the chemical elements required by plants which are called plant nutrients.

2. Seeds planted in soils germinate, the roots carry the nutrients from the soil to the stems, and, thus, to the leaves for manufacture into food for plant growth.

3. After the plant matures, the crop is harvested. Then, the remaining plant parts, containing the stored nutrients, are placed in the compost pile.

4. In the compost pile, the decaying plant material is broken down into HUMUS by frequent turning and watering to aid fermentation and decomposition.

5. In one or two years the decomposed, rich and mellow COMPOST is put back into the soil, thus, returning the plant nutrients originally taken out by the plant in its growth. Compost also improves the mechanical condition of the soil.



Operation Sheet

GARDEN PROBLEMS

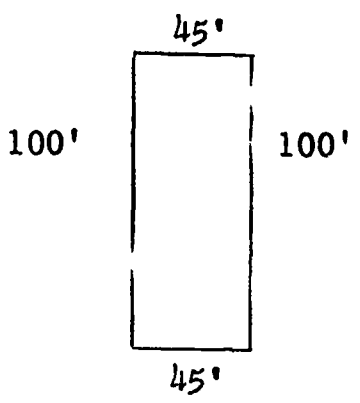
How to Find the Area of a Rectangular Plot

PROBLEM: The class decided to put a four-foot wire fence around a neighborhood lot which is 45 feet wide by 100 feet long. If wire costs $13\frac{1}{2}$¢ per foot, how much will it cost to buy the fence wire for all four sides of the lot?

TO FIND: (A) The perimeter
(B) The cost of wire

REMEMBER: The perimeter of a plane figure, or the distance around it, is equal to the sum of the lengths of its sides.

SOLUTION: (A)



(B)

$13\frac{1}{2}$¢ = \$.135

```
      290
  x  $.135
    1 450
    8 70
   29 0
  $39.150
```

Cost of fence \$39.15

- -

WORK THESE PROBLEMS:

1. The dimensions of the garden bungalow are 24 feet by 36 feet. What is its perimeter?

2. Mr. Hart dug a hole for a fish pond 4 feet wide and 10 feet long. What is its perimeter? If the concrete costs $27\frac{1}{2}$¢ per foot, how much will it cost to build the sides of the pool?

3. What is the perimeter of a triangular garden with two sides each 27 feet 6 inches long and the third side 14 feet long? What will be the cost of edging the triangular garden with 2" x 6" redwood edging at 13¢ a foot:

4. Measure the sides of your garden. What will it cost to fence the four sides with 8-foot link fencing at \$3.85 per foot?

5. Measure the plots in your garden. What will it cost to edge all the plots with 2" x 6" redwood at 13¢ a foot? What is the cost for one plot?

Operation Sheet

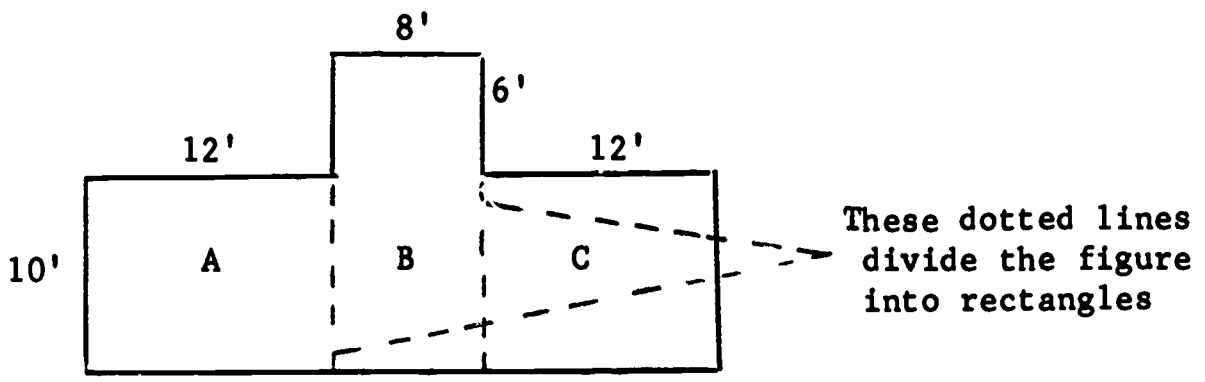
GARDEN PROBLEMS

How to Find the Area of an Irregular Plot

HELP: We sometimes need to find the area of a figure that has an irregular shape. Such a figure is really made of two or more figures that are combined. Drawing lines that divide the figure into rectangles, or triangles, helps us to find the total area of the figure.

PROBLEM: The garden class decided to plant a lawn in front of their new bungalow. The area they wished to plant had an irregular shape. Before they could estimate the amount of lawn seed and steer manure needed they had to determine the number of square feet in the area.

REMEMBER: The area of a rectangle equals the product of its length and width.

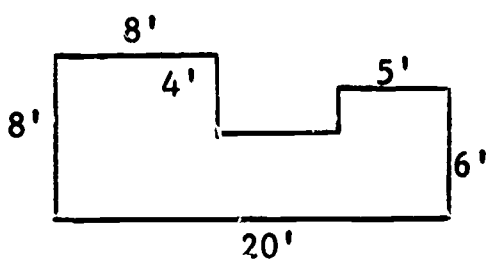


SOLUTION:

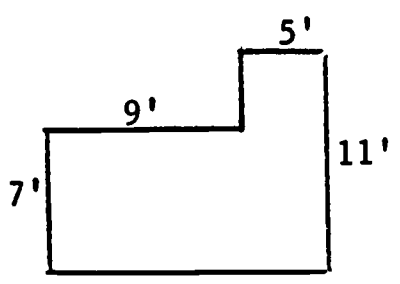
(A)	(B)	(C)		
12	16	12	(A)	120 sq. ft.
x 10	x 8	x 10	(B)	128 sq. ft.
120	128	120	(C)	120 sq. ft.
				368 sq. ft. total to be planted to lawn.

- -

ACITIVITY: Now, you work these problems - find the area of the following combined plane figures.

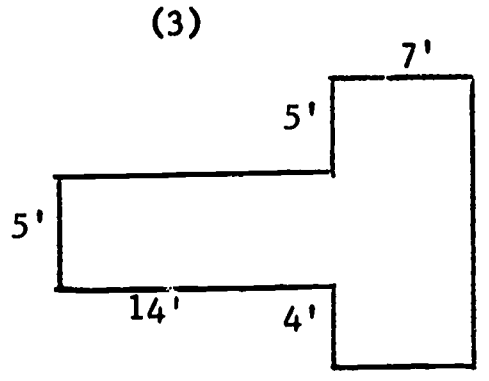


(1)



(2)

(3)



Operation Sheet

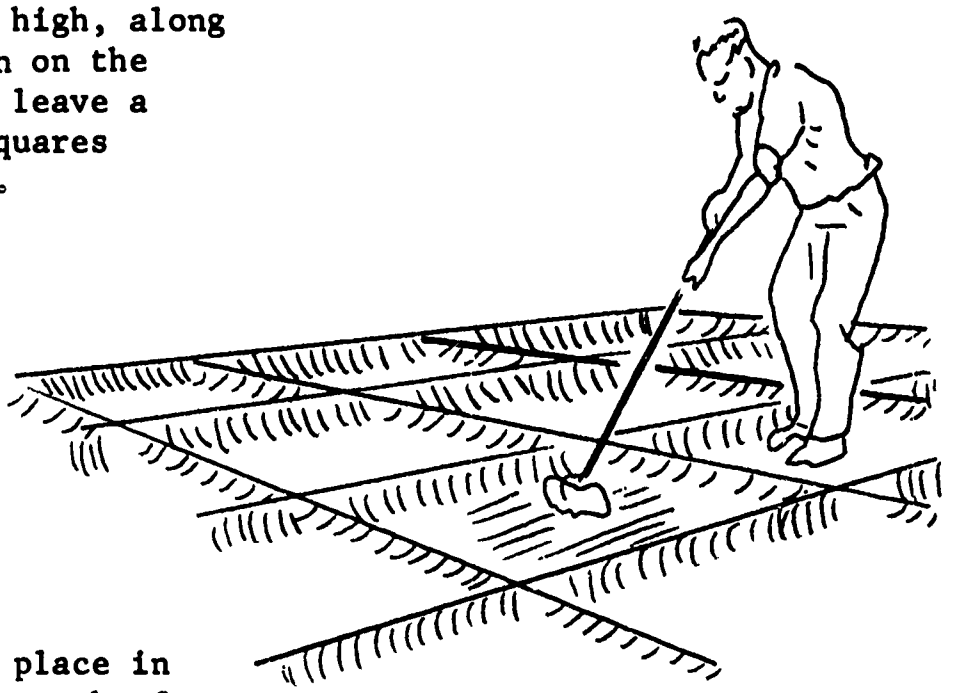
BASINING

PURPOSE: It is necessary to build the moisture content in a plot to permit spading, raking, seeding, and germination before further irrigation is needed. Basining gets more water in the soil, more economically, and with better penetration than other methods.

ACTIVITY: 1. With a hoe draw lines, a hoe-length apart, across the garden plot. Do the same in the opposite direction. This leaves a series of lined squares drawn on the ground.

(1)

2. With a hoe, draw or scrape the surface of the soil into ridges, about three inches high, along all the lines drawn on the ground. This will leave a series of ridged squares ready for flooding.



(2)

3. Connect a hose and place in a basin farthest from the faucet. Use a can or gunny-sacking to prevent washing of soil. Fill the basin, and when it is full move hose to the next basin. Continue the procedure until all basins are flooded. DO NOT break down ridges for water to run from one basin to another. Keep all ridges intact.

Operation Sheet

SPADING

PURPOSE: The soil is spaded to improve its condition, to turn the topsoil which is rich in humus underneath, and to place the subsoil on the surface. As the plants grow, the roots may feed deeply in the rich humus and not be forced to seek food near the surface area where there is danger of the soil being dried out by the sun.

ACTIVITY:

SIMPLE SPADING

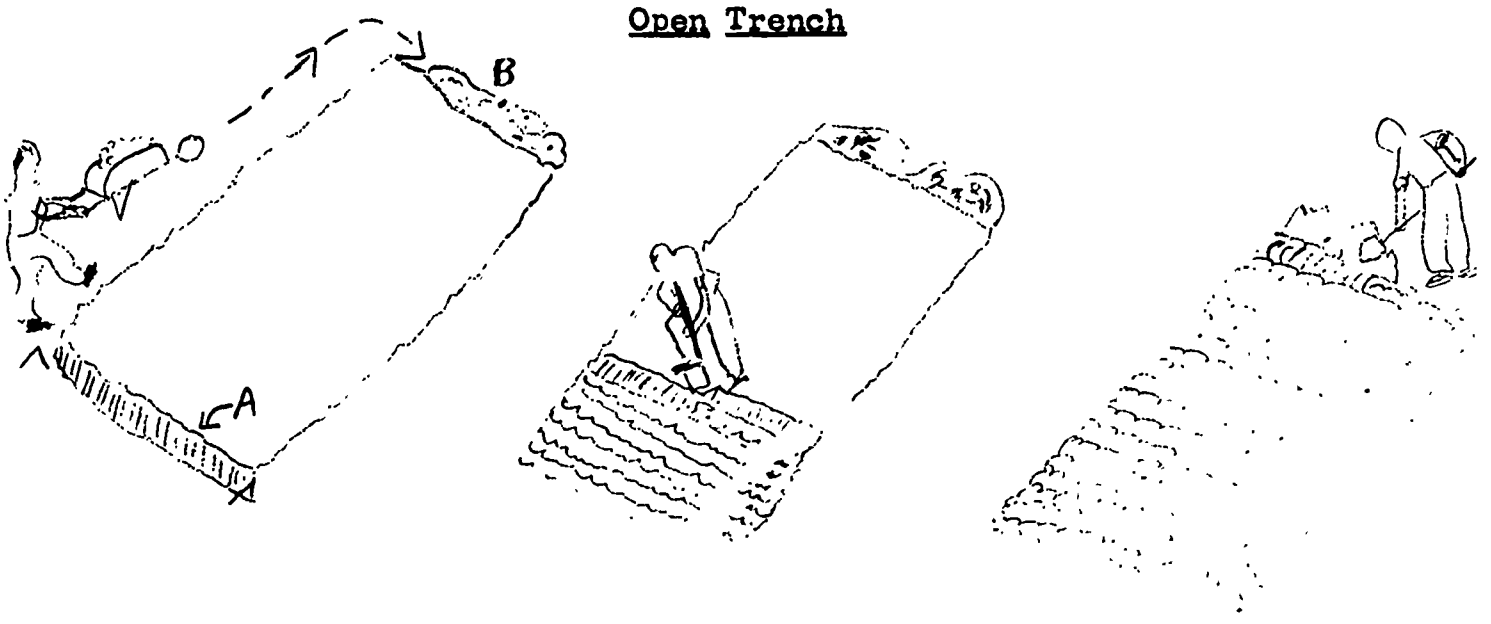
1. Drive shovel or fork full length into the ground.
2. Lift the cut and turn completely over.
3. Break the lumps with a stroke of the shovel.
4. Spade from left to right.
5. Each new bite should be from 3" to 5" in width.

Simple Spading

OPEN TRENCH

1. Make a trench about 6" wide and 10" deep along one side of the plot (A).
2. Carry removed soil to opposite side of the plot and place in row on path (B).
3. Place tool in soil 6" back from trench and drive full length into the soil.
4. Throw each spade full of soil forward into the prepared trench.
5. After each strip is completed, a new trench has been formed.
6. When the end is reached, the last trench is filled in with the soil that was taken from the first trench.

Open Trench



Operation Sheet

RAKING

PURPOSE: Raking and leveling of the plot is an important skill to master because small seed cannot grow in soil that is not even in texture. Good raking builds even soil texture and assures good germination.

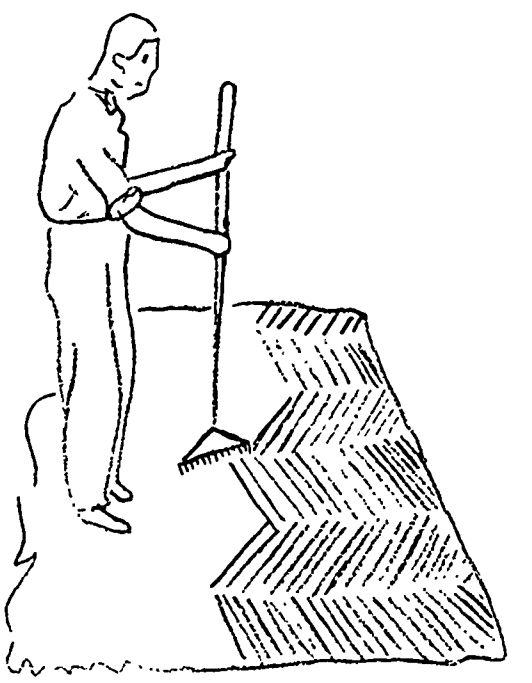
ACTIVITY:

1. Grasp rake handle near the middle, with hands well apart. Stand straight, holding rake close to body, keep the tines of the rake parallel to the soil surface. Move the rake in short sweeping motions along the path edge. Sweep soil from edge to plot center. Sweep soil from edge to plot center. Rake soil level about 1" below path level. This will be a guide for the leveling of the entire area.

2. Rake with short four-inch strokes. First from right to left, then from left to right. Keep moving your feet as you stroke with the rake. Do not rake straight back nor bend over and push and pull rake. Rake as mother sweeps with a broom. Place all uncovered debris on path. Move soil with short strokes, lifting and sweeping the area. Continue raking, in oblique strokes back and forth, sweeping high spots to low. Keep rake handle straight up and down and tines parallel to soil.

3. A finished raking job leaves the soil level so that water will flow evenly over the entire surface, and the texture of the soil fine enough for seeding.

4. When the area is completely raked, clean the rake and rack it in the tool room. Sweep the edge of the plot and clean all paths with a broom rake.



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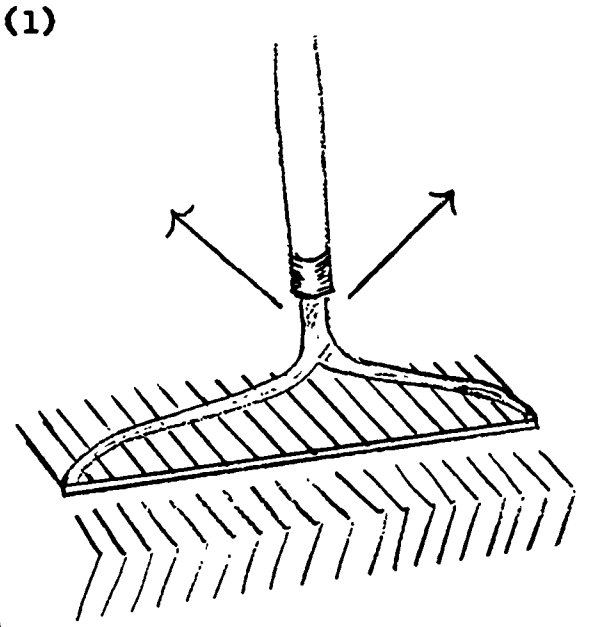

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Operation Sheet

PLOT LAYOUT

PROBLEM: To find the number of rows of vegetables or flowers which may be planted in a plot.

TO KNOW:

1. The method of planting recommended for a crop
   a. Double row ridge
   b. Single row
   c. Hill
2. How to find measurements for width of row in seed catalog.
   a. Planting chart
   b. Cultural direction
3. Directions of row in plot must always run in the direction which will permit the most sunlight to reach all plants. Which direction should the rows run?

EXAMPLE: Plot One is 19 feet on the south side and 22 feet on the east side. The plan is to plant carrots. How many rows will be planted if carrots are planted on double rows 28 inches apart? What will be the measurement for the first stake?

A. South side (sun)

```
 19
x 12
 38
 19
228= number of inches
```

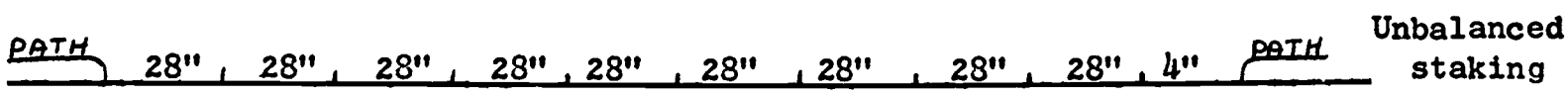
B.

```
      8 (No. rows to be planted)
28 )228 (Total inches in plot)
    224
      4 = Remainder. (Measure-
          ment of last space.)
```

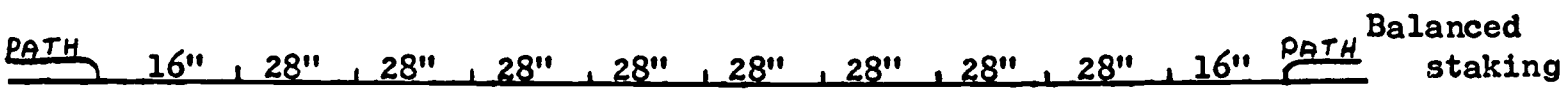
C. 28" width of row
4" remainder
32" Total width of spaces

D.

```
      16"   = Measurement of
2 )32          first stake
```



Unbalanced staking



Balanced staking

ACTIVITY:

1. Measure the (sunshine) side of the plot to obtain the number of feet. Change this measurement to inches (number of feet x 12 equals number of inches.)

2. Divide total number of inches of the plot side by the width of row recommended for the crop to be planted.

```
                Number of rows
Row width )Total inches in plot

Remainder   = distance of last space
```

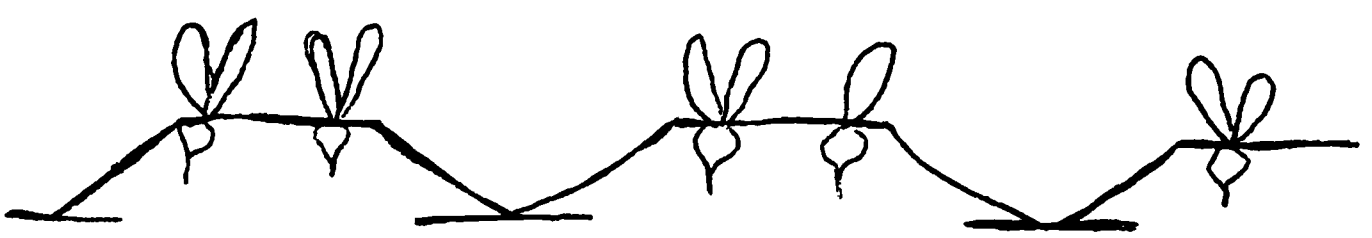
3. In order to have enough space at both ends to hill, irrigate, and cultivate, it is necessary to balance both spaces. Do this by adding the number of inches in the row width to the remainder and divide by two. The quotient will then be the distance of measurement for the first stake from the path. Stake all remaining rows the recommended distance for the crop. The last space will be the same distance as the first space.

Information Sheet

COMMON PLANTING METHODS

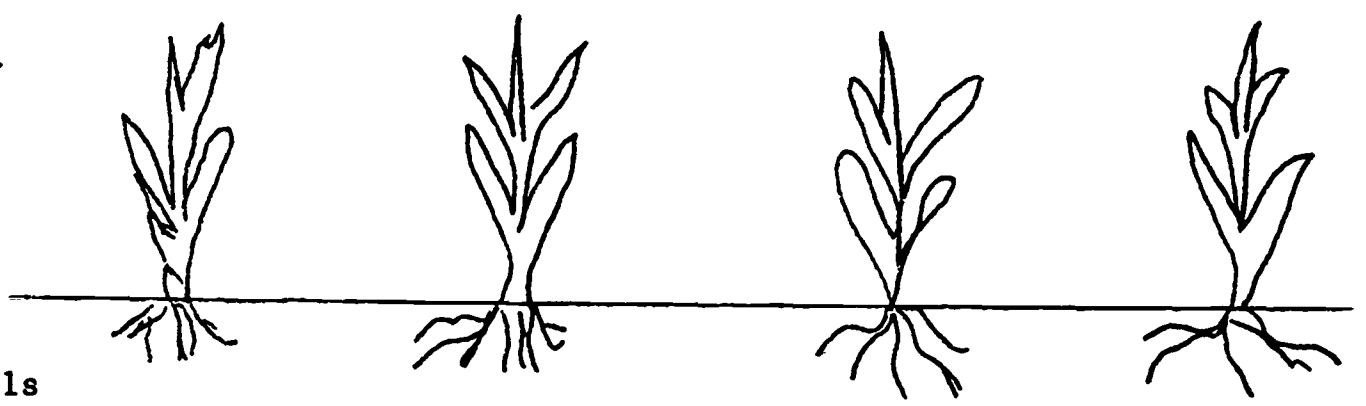
A. The Standard Double Ridge

1. Measurements:
   a. 28" center to center
   b. 12" surface of ridge
   c. 16" furrow
2. Reasons for use:
   a. Eliminates costly irrigation preparation
   b. Prevents over-watering of small plants
   c. Reduces spacing to a minimum
3. Crops:
   a. carrots, beets, turnips, and radish (roots)
   b. lettuce, endive, and spinach (leaves)
   c. kohl rabi, and onion (stems)
   d. flowers



B. The Single Row

1. Measurement - mature growth of plant determines width of row.
2. Reasons for use:
   a. Permits normal growth of plant
   b. Eliminates crowding
   c. Permits normal absorption of sunlight
3. Crops:
   a. cabbage, cauliflower (cole crops)
   b. beans, corn, and peas (seed)
   c. cucumber, tomato, peppers and squash (fruit)
   d. flowers



C. Hills

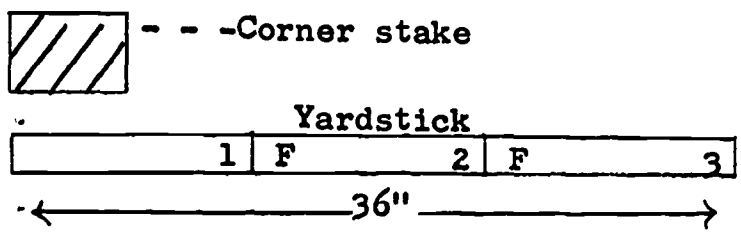
1. Measurement - Mature growth of plant determines distance planted.
2. Reasons for use - Increases chances of pollination
3. Crops - corn, squash, melons, and cucumbers

Operation Sheet

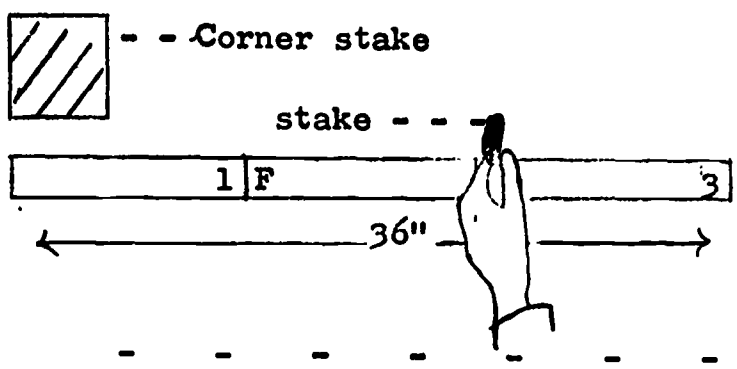
DRIVING GARDEN STAKES

Stakes are used in layout of many gardening activities to mark widths of rows. The appearance of the garden is greatly enhanced if the stakes are uniform in length and in the materials used.

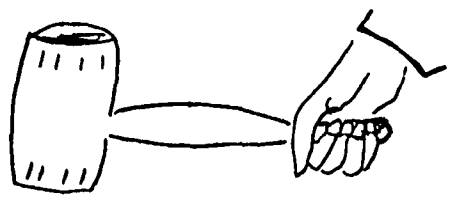
Use the following steps:



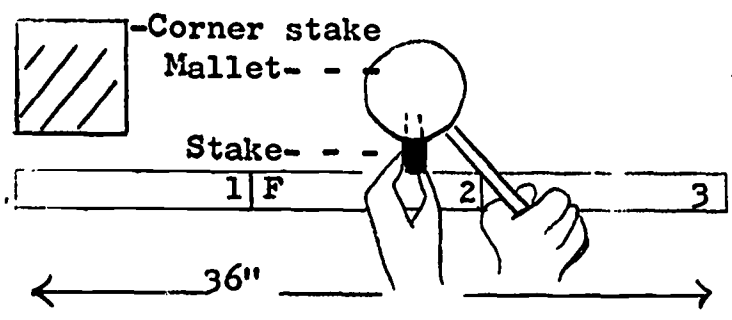
1. Lay yardstick along edge of plot with end flush with outside edge of corner stake. Keep it there.



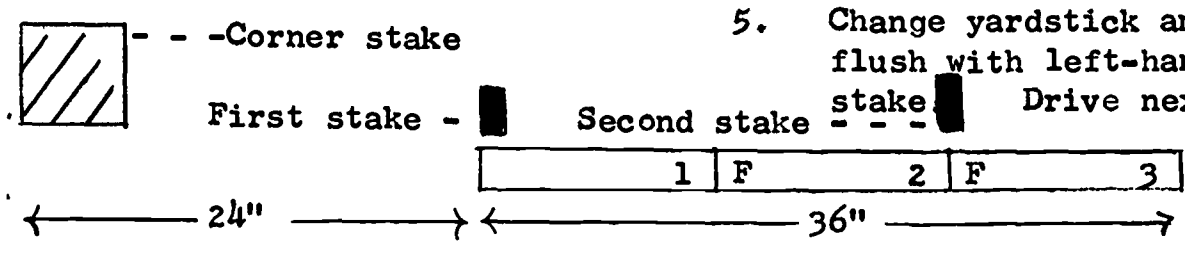
2. Hold stake in left hand at proper row measurement. (Thin edge toward path.) Do not move yardstick.



3. Hold mallet firm, near the end of handle.



4. Drive the stake, placing the face of the mallet on the stake end. Give the stake a light tap to start. Keep eyes on stake.



5. Change yardstick and place flush with left-hand side of first stake. Drive next stake as before.

Did you read these instructions carefully? These hints will help you lay out your garden in neat rows.

REMEMBER: Keep the yardstick down along the edge until the stake is firmly placed.

Operation Sheet

CONSTRUCTING THE DOUBLE RIDGE

PURPOSE: The standard double ridge used in the production of low growing vegetables was developed for irrigation farming. It is popular because it eliminates costly irrigation preparation and maintenance; prevents over-watering of small plants; and because it reduces spacing to a minimum.

ACTIVITY:

1. Stretch garden line from stake to stake to mark peak or center of ridge.

2. Mark a line, with hoe handle, on ground halfway between rows of garden line.

3. Begin in center of row, and, with a hoe, pull soil from drawn line to a peak under the garden line. Move over one hoe width after each stroke. Complete one side of row. Move feet with each stroke.

4. Step over string and pull soil from opposite side to peak under string. This gives the hilled soil an inverted appearance.

5. With a rake held in a vertical position (with tines parallel to soil surface) sweep or push soil with a lifting, forward motion, thus widening ridge surface to the width of the rake (12 inches). Move feet with each sweeping four-inch stroke of the rake. Continue operation until all of the ridge surface is of even width and flush with surface of the path.

6. Firm shoulders of the ridge by pressing sides with the blade of the hoe or tines of the rake.

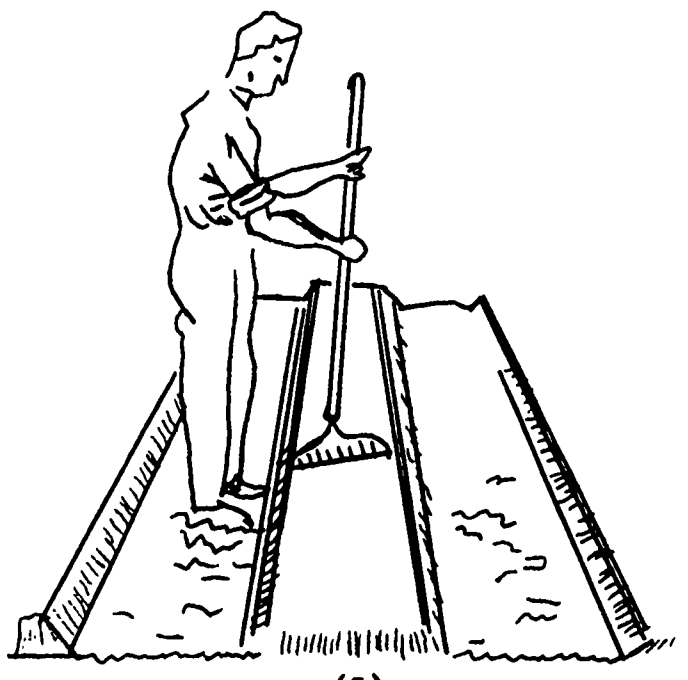
(3 & 4)

CLEAN-UP:

1. Wind garden line. Use figure-eight method.

2. Cultivate out footprints in furrows with potato hook.

3. Sweep edges and broom rake paths.



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AGRICULTURE INSTRUCTIONAL UNIT III

VEGETABLE CROPS AND UNSWEET FRUITS

The Orderly Arrangement of Plants 30
Plant Parts We Eat 31
The Root 32
The Stem 33
The Leaf 34
The Flower 35
The Seed 36
The Fruit 37
Classification of Vegetable Varieties 38
How To Lay Out A Rotation Planting Plan 39

LOS ANGELES CITY SCHOOLS
Division of Instructional Services
Curriculum Branch
Vocational and Practical Arts Section
1963

Operation Sheet

THE ORDERLY ARRANGEMENT OF PLANTS

Linnaeus (1707-1760) evolved the idea of classifying all living matter into two great kingdoms with its many subheads. These two kingdoms were the animal and plant groups.

Our study will be simple. It will help us to understand that plants have differences in growth habits. This study will classify some of the common vegetables into one of three groups:

Annuals (A): Plants which complete their life-cycle in one growing season or period. The seed germinates, the plant flowers, fruits (produces seed), and dies within one year.

Biennials (B): Plants that flower, fruit, and die the second year after planting from seed. Note: Annuals and biennials are propagated by seed only.

Perennials (P): Plants that live for many years - flowering and producing fruit each successive year or season. They do not die after seeding. They may be propagated (grown) from seed, cuttings, by dividing clumps, layering, or by budding and grafting. Roses and carnations are perennials.

COMMON VEGETABLES AND FLOWERS:

cucumbers -	A	sweet pea -	A	squash -	A	peppers -	A
asparagus -	P	beets -	B	carrot -	B	delphinium -	P
foxglove -	B	tomatoes -	A	beans -	A	lima beans -	A
turnip -	A	rhubarb -	P	corn -	A	sweet potato -	P
spinach -	A	cabbage -	B	hollyhock -	B	artichoke -	P
onion -	B	aster -	A	lettuce -	A	chinese cabbage -	A
chard -	B	pansy -	A	kohl rabi -	A	chrysanthemum -	P
parsley -	B	parsnip -	B	radish -	A		

ACTIVITY:

1. Place your ruler on the second line of your foolscap paper. Draw a line 7½" long starting at ½" and stopping at 8". Be sure the ruler is flush with the left-hand edge of your paper.

2. Now, do the same thing 8" below your first drawn line. This gives you two lines running across your paper and parallel to each other. Join them together with a light line.

3. Next, place your ruler so that it is even with the left-hand edge of your paper and very lightly make dots at the following measurements (make dots on top line and bottom line of oblong):
   A. Two and three-quarter inches.
   B. Five and one-half inches.

4. Now, draw a line connecting the dots. This will give you a three-column chart.

5. Letter the columns (from left to right) Annual, Biennial, and Perennial.

6. Refer to paragraph "Common Vegetables and Flowers." Cucumber is the first vegetable, why is it followed by an "A"? Write it in the "Annual" column.

7. Arrange the vegetables in alphabetical order and in the correct column according to their classification.

8. Arrange the flowers in alphabetical order and in the correct column according to their classification.

Operation Sheet

PLANTS PARTS WE EAT

All common plants, as vegetables, have roots, stems, leaves, flowers, seeds, and fruits. Sometimes these plant parts are quite small and unnoticeable - for example, the fruits are so small that only the skilled botanist could identify them. We are not aware of the plant in its entirety as we see only the part which is edible in the vegetable market and not the whole plant growing in the field.

Man has found through experience that certain plants store food in different areas of plant's structure, as the root in carrots and beets, the full seeds of corn, and the thick stems of the white potato and the onion. Vegetables are grown, therefore, for the plant part which is known to be edible.

In this lesson we are to classify the vegetables listed below as to the plant part which is edible by man.

cucumbers	beets	squash	peppers
asparagus	tomatoes	carrot	lima beans
turnip	rhubarb	beans	sweet potato
spinach	cabbage	corn	artichoke
onion	parsnip	lettuce	chinese cabbage
parsley	chard	radish	kohl rabi

ACTIVITY:

1. Place your ruler on the second line of your paper and even with the left-hand edge of paper and draw a line 7½" long, starting at 1/2" and stopping at 8". Do the same on the second line from the bottom. Join these two lines together.
2. Next, place your ruler even with the left-hand edge of your paper and along the top line of your oblong, then along the bottom line, place dots at the following measurements:
   A. One and three-quarter inches.
   B. Three inches.
   C. Five and one-half inches.
   D. Six and three-quarter inches.
3. Connect these dots so when finished you will have an oblong consisting of six columns.
4. Title the columns, left to right, Root, Stem, Leaf, Flower, Seed, and Fruit.
5. Arrange the vegetables in the list in alphabetical order on a separate sheet of paper. "Artichoke" would head the list. This will be your work page.
6. From the list of vegetables on your work page, write each vegetable in the correct column as to the part of it which is edible. For examble, Beet would be placed in the Root column, Peppers in the Fruit column, as peppers contain seed and, as such, are fruits.
7. Your dictionary will help you complete your chart.
   A. Look up the vegetable named.
   B. Read the definition. Sometimes more than one definition for the same word is given. Choose the one that is most applicable to your gardening lesson.

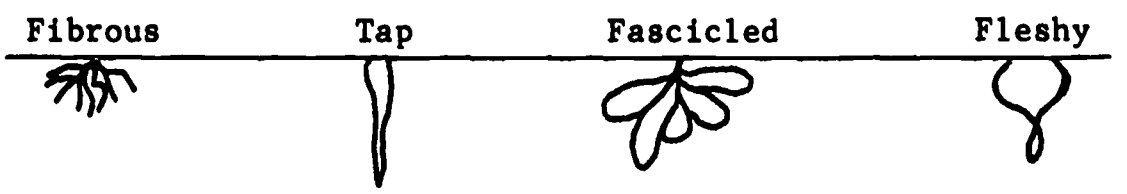
Operation Sheet

THE ROOT

Roots form an important part of a plant's structure but because they are below the surface of the soil, we generally have little knowledge of their worth or their function.

Generally roots are classified into four types:

1. Fibrous
2. Tap
3. Fascicled
4. Fleshy



Simple parts of the root system are:

1. Primary root: the long main root, the first root formed.
2. Secondary roots: branch off of the primary roots.
3. Tertiary roots: branch off from the secondary roots.

STUDY GUIDE QUESTIONS:

1. Roots cannot _____ their own food because they do not have _____.
2. Name three ways in which roots serve plants.
3. Compare the growth habits of the tap-root system with that of the fibrous-root system.
4. Why do most weeds have fibrous roots? Think.
5. Do all roots grow in the soil? Explain
6. Give two ways in which roots are useful to man.
7. What do we mean when we say a plant's root system is extensive?

ACTIVITY:

1. Dig up a small clover or dandelion plant, and an oat or grass plant. Save as much of the root system as possible. Wash carefully and draw what you see.
2. Carefully dig a green onion from the garden. Wash gently and lay each individual root end to end. How many feet are there in all?

READ: TODAY'S AGRICULTURE, Chapter Five, "Plant Roots and How They Differ".

VOCABULARY:

aerial	fascicled	lateral	fibrous	nodule
fleshy	adventitious	tertiary	primary	tap

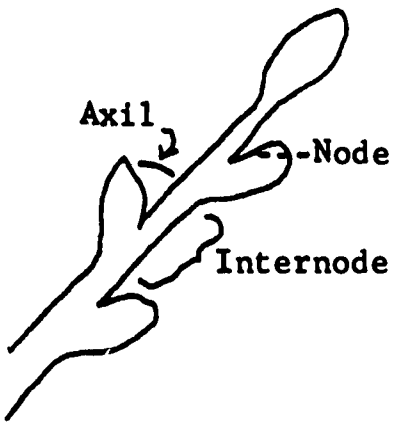
Information Sheet

THE STEM

A stem is the part of a plant that holds the leaves, branches, flowers, and fruits. The stem of plants can be as high as the giant redwoods, or it can be as small and frail as a stem of grass.

PARTS OF THE STEM

1. Node: area from which a leaf or leaves arise.
2. Internode: area on the stem between the nodes.
3. Axil: the angle between the upper side of the leaf and stem.



STUDY GUIDE QUESTIONS:

1. Name five functions of plant stems.
2. Two important vegetable stems are the _____ and the _____ _____.
3. In what way does the stem of corn differ from that of the oak tree?
4. Make a list of the types of stems and name one plant example of each.
5. Why does the farmer stake and string his planting of pole beans?
6. _____ develop from buds located between the _____ and the stem.
7. In outside/inside growing stems as corn and grasses, growth takes place at the _____ _____ of each internode, while in outside/inside growing stems, as trees, all growth takes place in the _____.
8. Make a list of the uses which man makes of the stems of plants.

DIRECTIONS IN WHICH STEMS GROW

1. Erect: straight.
2. Prostrate: lying flat, usually on the ground.
3. Creeping: flat on the ground and rooting at the nodes.
4. Climbing: ascending or clinging to other objects; some plants climb by means of twining, some by tendrils, some by twisting of the petiole, and others by rootlets.

READ: TODAY'S AGRICULTURE, Chapter Six, "Stems of Plants".

VOCABULARY:

stem	axil	fleshy	alternate	opposite	growth
node	pith	twining	internode	cambium	tendrils

Information Sheet

THE LEAF

The factory of the plant is the leaf. In it are manufactured starch, protein and oil. The framework of the leaf is largely a collection of veins which gives stiffness to the leaf, and distribute the plant food carrying moisture. Tiny openings in the skin of the leaf, mainly on the underside, are its breathing pores. They are about one-tenth the thickness of this paper. It has been estimated that there are about 13,000,000 of these breathing pores in a sunflower leaf.

PARTS OF THE LEAF

1. Blade: the expanded portion of the leaf.
2. Petiole: the stem part of the leaf. It may or may not be present.
3. Stipule: small structure born at the base of the petiole.

LEAF FUNCTION

1. Respiration
2. Food manufacture (photosynthesis)
3. Digestion
   A. Sunlight
   B. Chlorophyll
   C. Water brought up through the xylem veins.

STUDY GUIDE QUESTIONS:

1. Name three functions of leaves.

2. Bring in a leaf from the garden. Draw the leaf and label its parts.

3. Make a list of leaf types and name two plant examples of each.

4. Collect one specimen of each leaf type. Press and dry mount on a single sheet of paper and label.

5. Why is the arrangement of leaves on a stem important?

6. Buds may produce _____, _____, or both _____ and _____.

7. How many more gallons of water are given off per day by potatoes than corn?

8. Why is it good gardening practice to immediately irrigate newly transplanted plants?

READ: TODAY'S AGRICULTURE, Chapter VII, "Leaves of Plants".

VOCABULARY: Remember to learn to use a word and to spell correctly.

respiration	photosynthesis	compound	stipule	carbon dioxide
alternate	radical	whorled	opposite	parallel
oxygen	chlorophyll	cambium	vein	petiole

Information Sheet

THE FLOWER

A flower is the part of a plant that produces seed. Cauliflower, broccoli, and artichoke are examples of immature flowers that we eat. Some flowers, such as roses, are large and fragrant; others are small and minute. Because of his knowledge of plants man can develop large blooms. No plants produce flowers for man to enjoy their beauty and fragrance, because the true purpose of the flower is to produce seed to perpetuate the species.

PARTS OF THE FLOWER

1. Calyx: the outer whorl of parts in a normal flower.
2. Corolla: the whorl of parts next to the calyx. The parts of which are referred as petals when free.
3. Stamens: the third whorl composed of two parts, the ANTHERS, within which pollen is made, and the FILAMENT, which supports the anthers.
4. Pistil: the innermost whorl of the usual flower. The pistil is composed of the OVARY, STYLE, and STIGMA.

STUDY GUIDE QUESTIONS (Write, on your answer paper, the letter of the word or words to complete each statement.):

1. The two flower parts directly concerned with producing seed are: (a) calyx and stamen (b) pistil and stamen (c) pistil and corolla (d) stamen and anther

2. Seeds are developed in the (a) stigma (b) sepal (c) calyx (d) ovary

3. Insects visit flowers to (a) collect nectar or pollen (b) pollenize the ovary (c) rest their wings (d) smell the fragrance

4. The calyx is nearly always (a) red (b) white (c) green (d) yellow

COMPLETE THE FOLLOWING:

1. Flower buds develop between the _____and_____or in the_____ of_____.

2. A composite flower is made up of _____.

3. Garden peas, beans, soybeans, and clover are known as _____.

4. The egg cells are located in the _____.

5. Pollen is distributed by _____, _____, _____, and _____.

READ: TODAY'S AGRICULTURE, Chapter VII, "Flowers and How they Serve the Plant".

VOCABULARY:

calyx	corolla	stamen	pistil	ovary	whorl
sepal	petal	anthers	pollen	ovules	

Information Sheet

THE SEED

The production of seed is the most important function of a plant. The seed matures within the fruit and is in reality a minute embryo, containing immature (baby) roots, stems, leaf or leaves, with its food supply and coverings.

Much of man's basic food is supplied by the cereals (rice, wheat, corn and rye) and the staples (beans, lentils, nuts, coffee, and cocoa). The food ration of our domestic animals which supply us with meat, milk, and eggs, is also derived from seeds.

PARTS OF THE SEED

1. Testa: hard outside covering.
2. Hilum: scar on the seed coat showing the point of attachment to the parent plant.
3. Microphyle: a minute opening in the testa.
4. Cotyledon: seed leaf containing food which is used when the seed sprouts.
5. Hypocotyl: stem portion.
6. Plumule: the primary bud.

COMPLETE THE FOLLOWING STATEMENTS:

1. A seed is a mature / an immature plant with its food / water supply and covering.
2. The seed contains _____ to supply the young plant until it can develop _____ and send its _____ into the air.
3. Seeds are distributed by _____, _____, _____, _____, and by the _____ itself.

STUDY GUIDE QUESTIONS:

1. Why is it necessary to plant seeds in shallow seed furrows?
2. Do all seeds produced develop into new plants? Explain.
3. What is the purpose of the dormant stage in the seed?
4. When is germination complete?
5. In what way does germination of the seed differ from dormancy?
6. Why is it best to plant fresh seed?

READ: TODAY'S AGRICULTURE, Chapter IX, "Seeds and Their Functions."

VOCABULARY:

cereal	function	embryo	immature	domestic
testa	cotyledon	plumule	hilum	hypocotyl
scar	dormant	produce	basic	germination

Information Sheet

THE FRUIT

A fruit, botanically, is the matured ovary, with its seeds and any parts of the flower which may be closely associated with it. The fruit contains the seed or seeds. Fruits are classified into three types:

1. Dry dehiscent fruits split open at maturity in a definite way permitting the seeds to escape. Peas and beans are examples of one type of dehiscent fruits which we commonly eat as vegetables.

2. Dry indehiscent fruits do not open on maturity. We eat this type of fruit as seeds or grains, such as barley, wheat, oats, rice, and nuts.

3. Fleshy fruits are those with a fleshy pericarp (ovary wall) inside of which seeds are borne. Examples of this type which we eat as vegetables are tomatoes, squash, mellons, pumpkins, peppers, and eggplant. Examples of those we eat as true fruits are peaches, plums, apricots, apples, cherries, and berries.

STUDY QUESTIONS:

1. A fruit is a matured _____ with _____.

2. Wheat is an example of a _____ dry fruit.

3. In the following list, underline those that are fleshy fruits:

tomato	beans	watermellon	eggplant
peas	cucumber	cantaloupe	pepper

4. Write a definition of a pericarp.

VOCABULARY:

associated	dry	indehiscent
borne	fleshy	maturity
botanically	fruit	pericarp
dehiscent	grains	seed

Operation Sheet

CLASSIFICATION OF VEGETABLE VARIETIES

Use of Seed Catalog

When an area of ground is planted to one kind of vegetable, as beans or carrots, the vegetable planted is called a CROP. As there are different types of soils (sandy to clay), and as climatic conditions vary in different areas of planting, man has found it necessary to develop variations of types in a single crop to best meet the soil or weather conditions in the various areas. These variations in a crop are called VARIETIES.

In this lesson, you are to write on the blank lines the name of the crop to which the variety named in the left-hand column belongs. It will help you to read the list of varieties first. Then, open your seed catalog and read the varieites listed under each crop. When you find a variety in your list, look at the crop named and write it on the correct line. The first one will serve as an example.

Variety	Crop
Mary Washington	Asparagus
Danish Ballhead	_____
Fordhook Pole	_____
Early Wonder	_____
Imp. Green Tint White Bush Scallop	_____
Improved Pearson	_____
Kentucky Wonder Rust Resistant W. Seeded	_____
Danvers' Half Long	_____
Golden Cross Bantam	_____
Imperator	_____
Staysgreen	_____
Utah Sweet Spanish	_____
Early Scarlet Globe	_____
California Wonder	_____
New York Special	_____
Italian Green Sprouting	_____
Wong Bok	_____

Information Sheet

HOW TO LAY OUT A ROTATION PLANTING PLAN

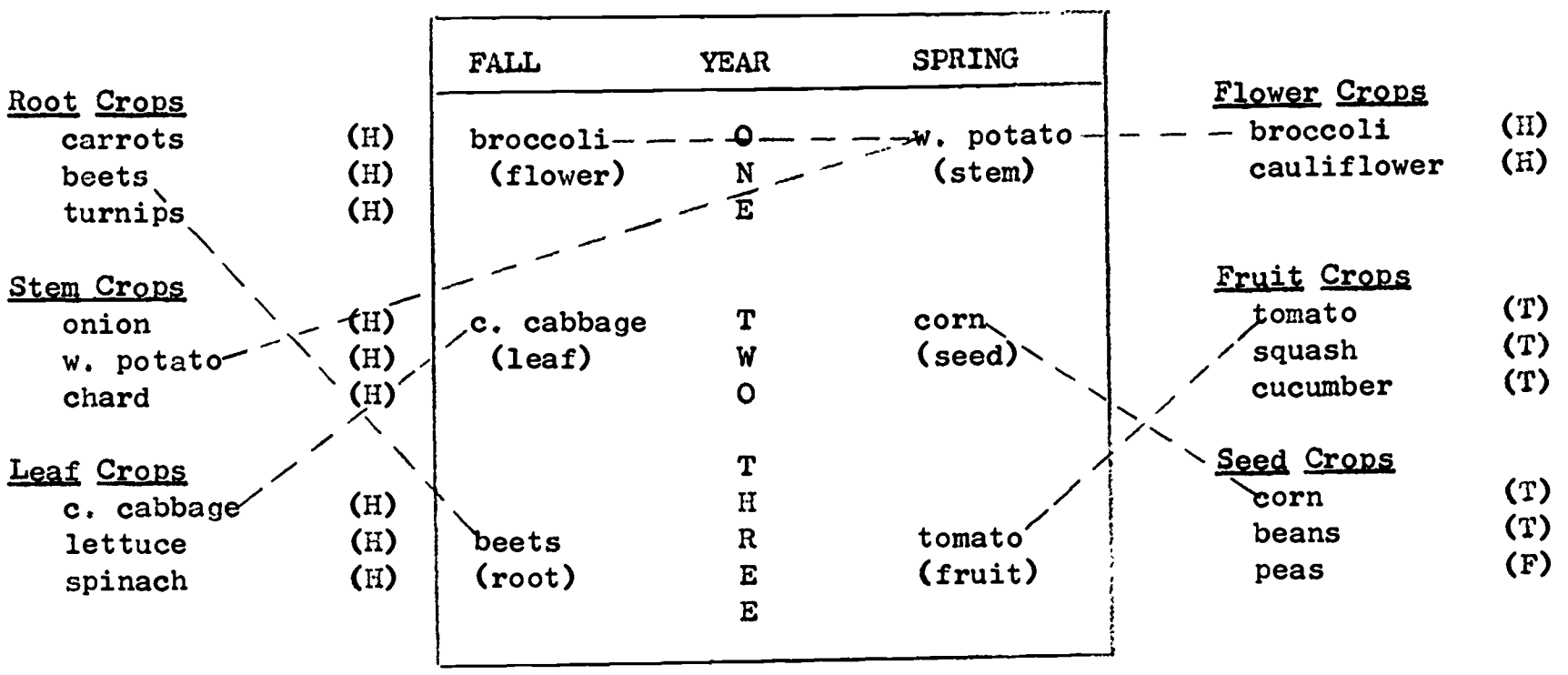
Good crops are sometimes grown for a number of years, and then become poor even when they have been well cultivated and given all the moisture they have required. If they are free from insect and fungus pests, the fault must lie in some condition of the soil.

One of the most common causes of poor crops is the growing of the same crop on the land year after year. The roots then take out the same nutrients from the soil in the same places every year.

Different crops affect soils in different ways and take different elements out of the soil, therefore, no one crop should be planted in the same place in the garden year after year. The root crops, for example, draw heavily upon the potash and phosphorus in the soil. They should be followed by a crop such as beans, or a leaf crop which uses those elements in lesser proportions.

If we were to plant radishes year after year, the soil in our school garden would soon become exhausted. Therefore, it is necessary to rotate the plantings according to the parts of the vegetables we eat.

Below is a suggested plan rotating the various vegetable types over a three-year period. In a sense, this follows the accepted method of varying crops planted in any one given area.



HARDY (H) vegetables are those that may be planted all year.
TENDER (T) vegetables cannot stand cold weather and are planted from March 15 to August 15.
PEAS prefer cool weather.

Any combination may be used for a period of three years without repeating any one crop more than once during the period.

AGRICULTURE INSTRUCTIONAL UNIT IV

PLANTING THE GARDEN

How to Sow and Cover Seed 41
How to Sow and Cover Seed .....
Mulching 43
How and When to Irrigate 44
How and When to Irrigate .....

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Operation Sheet

HOW TO SOW AND COVER SEED (1)

PURPOSE: To learn how to sow seed, cover, and water.

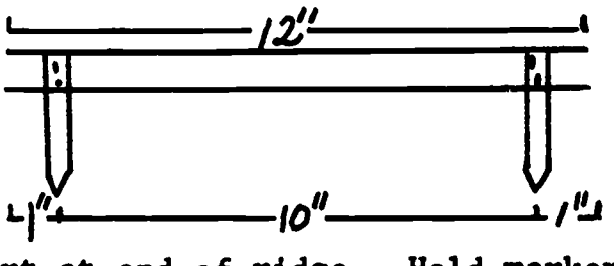
ACTIVITY:

SEED BED

The seed bed should be smooth, level, moist, and free from lumps.

PLANTING ON THE RIDGE

Your prepared ridge is 12" wide on top. You are now ready to make the seed furrow using a double row marker, a stick, or a trowel. If you do not have a double row marker, use a string for a guide in making your seed furrows.



Straddle ridge. Start at end of ridge. Hold marker so each end remains even with the edge of your ridge. As you move backwards, make short sharp strokes about ½" deep with marker. Keep furrows even with edge of ridge.

SOWING SEED

Small seed, such as carrot and lettuce, should be planted in shallow seed furrows not more than ¼" deep. Larger seeds, such as beans, sweet peas, lima beans, and corn, are planted in deeper furrows.

Each seed is an immature plant and will mature into one full-sized flower or vegetable. In planting lettuce seed, think how large the mature lettuce plant will be. Should you be careful in how thin the seed is sown?

THREE SUGGESTED METHODS OF SOWING SEED

1. Mix one part seed with ten parts sand. Stir until thoroughly mixed. Spread the mixture lightly in furrow. This sows seeds thinly.
2. Hold a few seeds in one hand. With the thumb and index finger of other hand, sow seeds one at a time in seed furrow.
3. Seal a standard envelope. Cut in half with scissors. Make a crease in center of envelope. Place one teaspoon of seed in envelope. Hold envelope in horizontal position above seed furrow, tap envelope with forefinger to jar seeds out of the envelope a few at a time. Walk as you sow for better seed distribution.

NOTE: Keep hands with seed close to furrows to keep seeds from blowing or scattering.

Operation Sheet

HOW TO SOW AND COVER SEED (2)

COVERING SEED

With a hoe, or back of a rake, cover seed with soil. Work from center toward outside of ridge. Cover seed furrow flush with surface of planting area. Firm soil with back of rake.

It is often advisable to cover the seed furrow with a mulch of screened manure, peat moss, sawdust, or sand. This prevents excess loss of moisture and cracking of soil.

WATERING

In order for seed to germinate, they must be moist. Build moisture content after seeding by overhead sprinkling of the planted area, or by filling the irrigation furrow with water. Fill furrow to edge of ridge. Keep moist until seeds germinate.

SOWING THE SINGLE ROW

Mark rows with planting line. With a hoe, make a V-shaped furrow as deep as seed size requires. Drop seed in furrow. Cover seed with soil from only one side of furrow. Cultivate area between rows to eliminate footmarks and to mulch moisture content. Water with overhead sprinkler if moisture content is low.

STUDY QUESTIONS:

1. Seeds should be planted in a _____ furrow.
2. When planting a ridge, the seed furrows should be at least _____ inches from each edge of the ridge.
3. Small seed should not be planted over _____ inch deep.
4. Name four conditions of a seed bed before planting.
5. What should you use to make a straight seed furrow if there is no double row marker available?
6. Name three methods of sowing seed.
7. The seed furrow should be covered _____ with the surface.
8. After covering seed, the soil should be firmed with _____ of _____.
9. Cracking of soil may be prevented by covering with a _____.

Operation Sheet

MULCHING

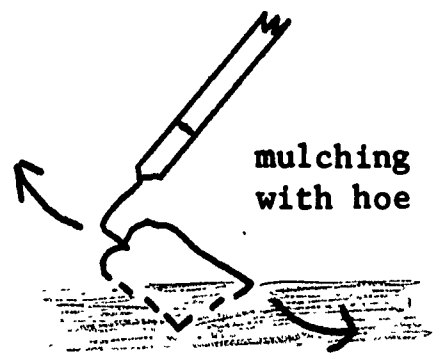
DEFINITION: Mulch is a blanket-like layer of dust, clods, straw, sawdust, leaves, manure, or paper spread over the soil surface to save moisture.

PURPOSE: Moisture escapes from the subsoil to the surface through many tiny tubes between the soil particles. To stop the loss of moisture, it is necessary to break this tube structure by cultivating or spreading a mulch material on the surface. Mulched plants are healthy because a mulch retains soil moisture necessary for bacteria activity.

ACTIVITY:

HOEING

Hold hoe almost parallel to soil surface. Mulch by working hoe into the top 1" of soil with a forward and backward action. Do not lift hoe. Use short 4" strokes.

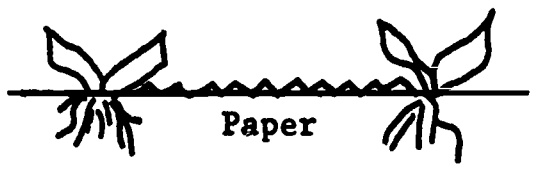


MULCHING

Water soil, cultivate when ready, then spread materials.

1. Strawy manure and peat moss on light, sandy soils to increase water-holding capacity.
2. Sawdust, leaves, and manure on heavy, clay soils as they decompost slowly and lighten the soil texture.

NOTE: Heavy mulching lengthens the interval between watering and also smothers young weed growth.



STUDY QUESTIONS: (On the line after each item, write the number of the phrase that best completes each statement.)

1. Strawy manures _____.
   (1) improves clay soil. (2) increases water-holding capacity of sandy soils. (3) is similar to sawdust in texture.

2. Young weed growth is best controlled by _____.
   (1) light mulching. (2) heavy watering. (3) heavy mulching.

3. Mulching during the rainy seasons prevents _____.
   (1) soil packing. (2) loss of moisture. (3) weed growth.

4. Plants which thrive on acid soil prefer _____ as a mulch.
   (1) sawdust. (2) strawy manures. (3) leaf mold.

REFERENCE:

Sunset's: Flower Garden Book, p. 45

Information Sheet

HOW AND WHEN TO IRRIGATE (1)

The watering of plants at the right time and in the correct amount is the biggest problem of the gardener. It should not be too difficult if you learn a few simple facts and practice what you learn.

FACTORS EFFECTING WATERING:

1. Type of soil - sandy soil takes more water than clay soil.

2. Climate - hot desert climate requires much more water than cool climate.

3. Type of plant - deep rooted plants require more water than shallow roots.

4. Loss of water -

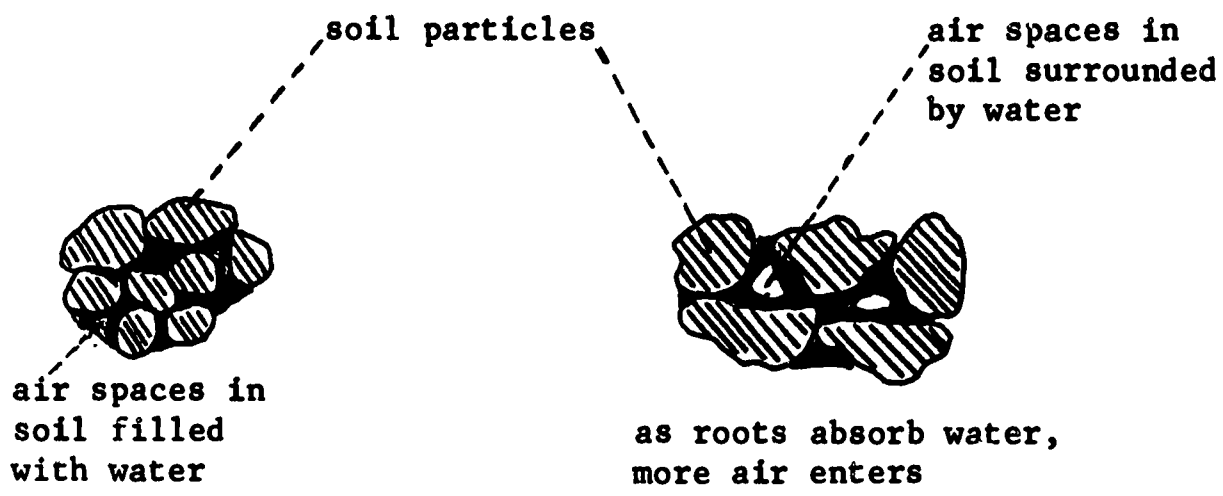
   a. Transpiration from the leaves is affected by type of leaf, amount of sun and wind, etc.
   b. Evaporation from the soil surface is affected by type of soil, cultivation practices.
   c. Percolation is the water that goes down through the soil beyond the reach of the roots.
   d. Run-off is the water lost where there is too much slope or the soil is too heavy for the water to penetrate as fast as it is put on.

WATER HOLDING CAPACITY OF SOILS:

1. Water penetrates sandy soils easily, and surplus water percolates through. Therefore, water sandy soils deeply and more frequently.

2. Heavy soils hold more water and require less frequent irrigation.

3. Over-Watering, or "free water", is as harmful to plants as too little water. Air spaces are filled with water, and without oxygen the plants will drown.



REMEMBER: Healthy growing roots need plenty of oxygen as well as a good supply of water in the soil.

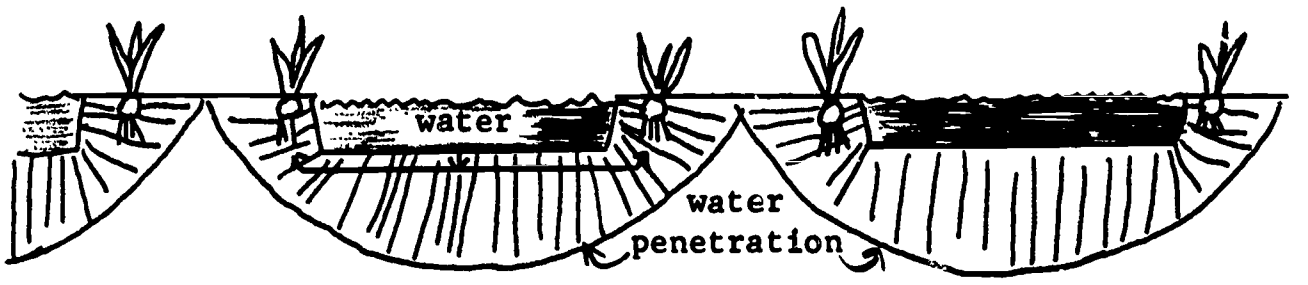
Information Sheet

HOW AND WHEN TO IRRIGATE (2)

METHODS OF IRRIGATING:

FURROW: The furrows should be wide and shallow for greatest penetration of water. Sufficient water must be applied to penetrate completely through the ridge.

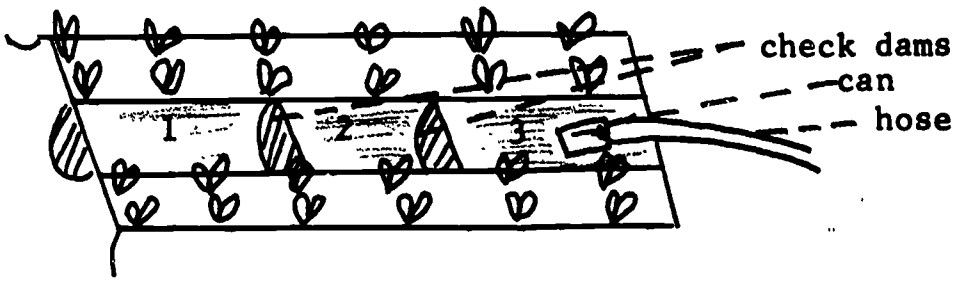
Place hose in a can at the end of the furrow, allowing water to run slowly. The can will prevent washing of soil. Burlap sack may be used in place of can.



To be effective, water must go deep and sidewise through the ridge.

If the water runs too fast in furrow, due to a steep slope, use check dams across the furrow.

Place check dams. Fill basin 1, then fill basin 2, etc.



SPRINKLER: There are many kinds of sprinklers; Skinner, Rainbird, twin, fan with spike, etc. Whichever kind is used, you should check the soil occasionally to determine the depth of the water penetration.

STUDY QUESTIONS:

1. Water will penetrate _____ soil the fastest.

2. Name four ways in which water may be lost.

3. When soil is saturated with water, _____ is shut out.

4. What precautions must you take when irrigating ridge plantings?

5. Run-off water from sloping ground may be prevented by the use of _____ _____.

6. What should always be done to be sure enough water has been applied to the soil?

VOCABULARY:

air space	effective	hose	run-off
basin	evaporation	irrigation	shallow
capacity	"free water"	penetration	sprinkler
clay	furrow	percolation	transpiration

AGRICULTURE INSTRUCTIONAL UNIT V

FLOWERS

Classification and Use of Flowers 47
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Information Sheet

CLASSIFICATION AND USE OF FLOWERS

The purpose of this information is to help you understand how flowers are classified. Knowing this, you should be able to select a variety of flowers that will give your garden color all year.

CLASSIFICATION: (Flowers, like vegetables, are classified into three groups.)

Annuals: Plants that grow, flower, and produce seed within one year, and then die. Annuals are grown from seed only.

Biennials: Plants that require two years, or parts of two years, to mature. Biennials are grown from seed only.

Perennials: Plants that normally live more than two years, each year producing flowers. Perennials may be propagated from seeds, cuttings, divisions, layering, budding, or grafting.

USE:

Annuals may be grown in beds of borders which can be changed each year.
Examples:

Winter or early spring bloom (sow in late summer or fall)

african daisy	cineraria	snapdragon
bachelor button	larkspur	stock
calendula	marigold	sweet pea

Late spring or early summer bloom (sow in early spring)

african daisy	petunia	snapdragons
asters	primula malacoides	stock
cosmos	salvia	sweet alyssum

Summer or fall bloom (sow in late spring)

bachelor button	gaillardia	salvia
cockscomb	lobelia	sweet alyssum
coreopsis	pinks	zinnia

Biennials are not as common as annuals and perennials. Many biennials are grown as perennials and therefore should be placed in the garden or borders where they will not be disturbed. Sow in spring.
Examples:

cape forget-me-not	canterbury bell	hollyhock
chinese forget-me-not	foxglove	sweet william

Perennials have many uses. You can select varieties for shade or sun, for narrow or wide spaces.
Examples:

campanula	coreopsis	chrysanthemum
canna	ferns	penstemon
columbine	fuchsia	phlox

Operation Sheet

PARTS OF THE FLOWER

PURPOSE:

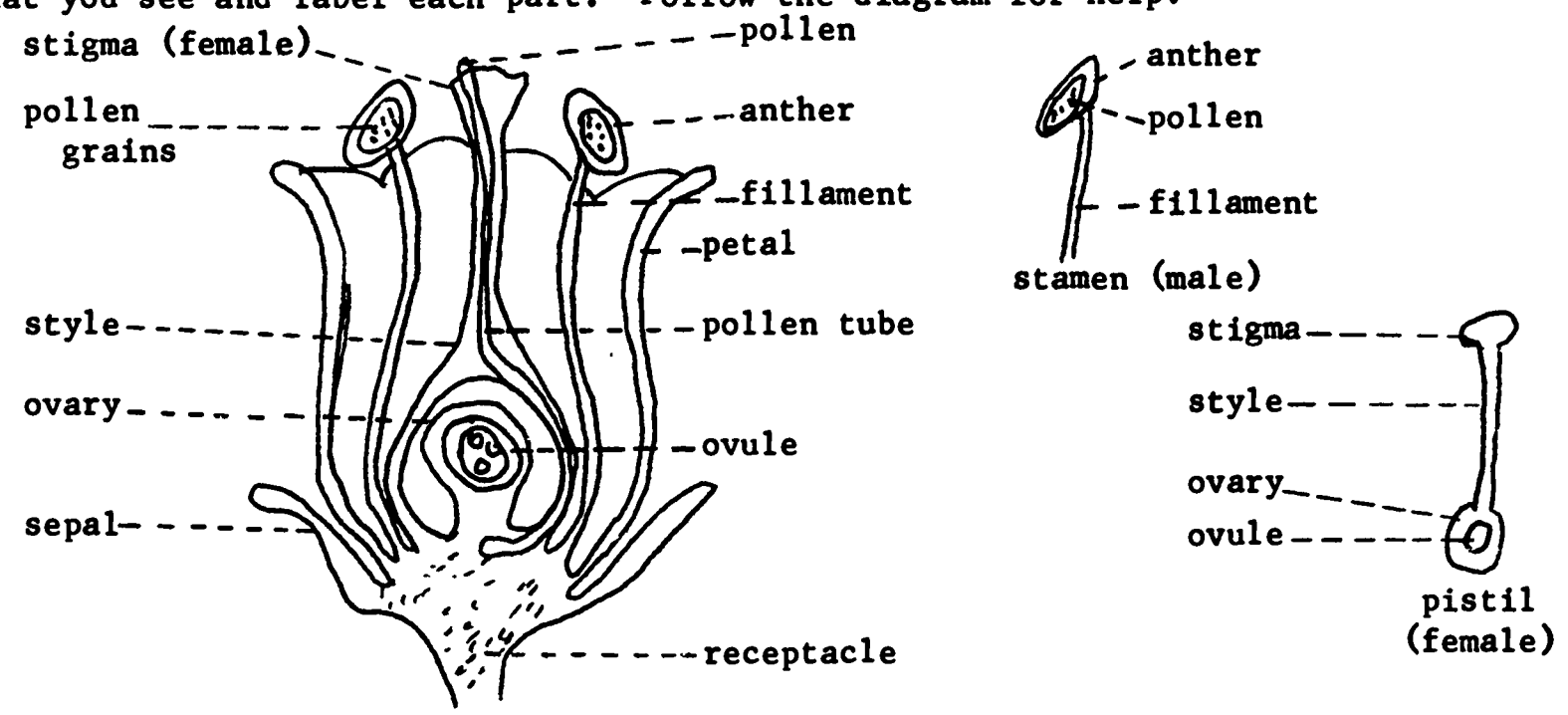
To learn the parts of the flower and the function of each part.

MATERIALS:

Any common garden flower, preferably a large type such as a calla lily; scissors; tweezers; and scalpel.

ACTIVITY:

Cut flower through the center lengthwise, as shown in diagram. Make a drawing of what you see and label each part. Follow the diagram for help.



STUDY GUIDE QUESTIONS:

1. How many stamens did you find in your flower?
2. How many pistils did you find?
3. Can you explain the difference in numbers of stamens and pistils?
4. What does the ovule develop into when fertilized? Give five examples.
5. What becomes of the petals after fertilization?
6. Why do flowers have color and odor?

VOCABULARY:

anther	function	pistil	style
diagram	pollen	sepal	ovary
fillament	petal	stigma	ovule

REFERENCE:

Sunset: Western Garden Book, p. 12

Information Sheet

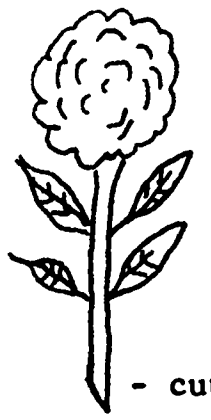
HOW TO CUT AND PRESERVE FLOWERS

WHEN TO CUT:

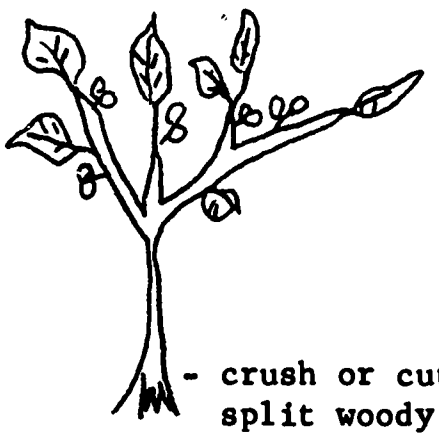
Flowers should be cut in the early morning or late evening, it is best not to cut flowers during the sunny part of the day. Have a container of cool water and plunge the flowers into the water as soon as they are cut. This will prevent them from wilting. It is best to store them in water in a cool, shady place for several hours before arranging them.

HOW TO CUT:

Always cut stems on an angle, and cut the stems as long as possible. This allows the stem to absorb more water. Hard or woody stems should be split an inch or two above the base so that they will absorb more water. Select flowers in bud or partly open if you want them to last several days.



- cut at angle



- crush or cut and split woody stems

PRESERVATION:

There are many products on the market that are supposed to make flowers last longer. The best process is to cut flowers correctly and at the proper time, plunge in cool water and keep in a cool place.

Some kinds require special treatment. You can recognize these by the milk they produce when cut. Poinsettias, euphorbias, and oriental poppies are examples. These plants should be plunged into boiling water or singed over a flame and then immediately placed in ice water.

Two commercial products, know as Bloomlife and Floralife, will increase the keeping qualities of cut flowers.

STUDY QUESTIONS:

1. When is the best time to cut flowers?
2. What precautions should be taken immediately after cutting fresh flowers?
3. Why cut flower stems at an angle?
4. How should woody stems be treated?
5. Name two commercial flower preservatives?
6. How should poinsettias be treated after cutting? Why?

VOCABULARY:

absorb	precaution	treatment
angle	preservative	wilting
plunge	process	woody

Information Sheet

FLOWER ARRANGEMENT

Have you ever heard your mother say, "I wish I had a nice floral centerpiece for the table."? Have you noticed how much more pleasant your home is when there are flowers in the house? If you would like to be able to design your own flower arrangements, study these few simple rules and you will be surprised at what you can do.

Flower arranging is an art. Everyone has their own likes and dislikes. Just remember that what pleases you in an arrangement is most important. There are many types of arrangements. Start with a simple arrangement, and then as you learn how, progress to the more complicated types.

The first rule to remember is that the purpose of a flower arrangement is to bring cheerfulness and happiness.

Materials needed include a container (it can be a vase, bowl, pottery, or glass dish), some type of flower holder, flowers, and a few leaves.

To start, there are four basic principles you must remember. They are Design, Scale, Balance, and Harmony. Other principles will follow in another lesson.

Design refers to form or shape. It means you have a definite plan. An architect designs a house before it is built. He decides how big it is to be, where every room is to be located, and how big they are to be. You must use the same idea in designing your arrangement.

Scale refers to the size of the various parts of your arrangement, and their relationship to each other. If you saw one of your classmates coming to school wearing his dad's suit, or a great big man riding on a little pony, you would think it funny. Without thinking, you laugh because you recognize the differences in size. That is Scale.

Balance in an arrangement gives the impression of stability. If you have more flowers on one side than the other, it may look as though it would tip over. There are two kinds of balance in flower arranging: Symmetrical, both sides the same; and asymmetrical, the two sides are unlike but one balances the other.

Harmony means everything is pleasing and in tune; the flowers, container, and other materials used. If one member of a quartet strikes a "sour note", that is lack of harmony.

You will find many excellent books on flower arranging in your school or community library. Get a good book and study the pictures. They are very helpful.

Watch for pictures of arrangements in your Home Magazine section of your Sunday paper. Cut out and make a scrap book.

Operation Sheet

MAKE A SIMPLE FLOWER ARRANGEMENT

PURPOSE:

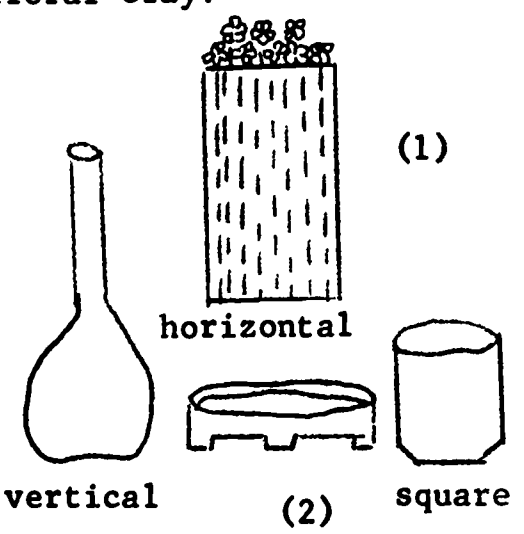
To make a flower arrangement using the four basic principles of Design, Scale, Balance, and Harmony.

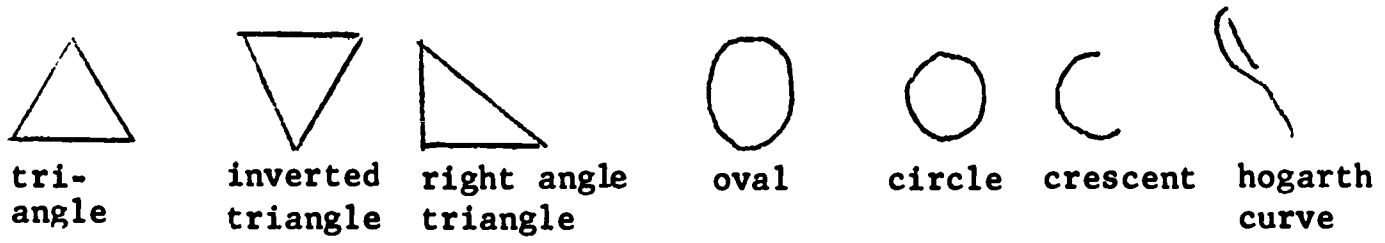
MATERIALS:

Flowers of one variety, leaves, container, flower holders, floral clay.

ACTIVITY:

1. Select fresh flowers. Cut flowers in the evening and plunge in cool water over night. Water should cover the stems.
2. Select appropriate container. Type of container depends upon (a) the kind and size of flowers, and (b) where the arrangement is to be used: piano, coffee table, end table, dining table, etc.
3. Decide on the shape of the arrangement.





4. Select accessories: Flower holders, pin frogs, chicken wire, or pottery type; leaves of appropriate size; floral clay.
5. Start your arrangement. Learn by doing.
   a. Start with flower or leaves that form the main line or axis of the arrangement
   b. Gradually fill in other flowers.
   c. Have a center of interest.
   d. Use 1, or 3, or 5 flowers in your first arrangement.
   e. Use your own originality.
   f. Is your arrangement pleasing to you?

STUDY QUESTIONS:

1. Name four basic principles of flower design?
2. Make a drawing to describe or illustrate your understanding of each of the four basic principles.
3. What materials must a beginner have to make a simple flower arrangement?
4. What type of container should be used on a coffee table?

VOCABULARY:

accessories	balance	container	harmony	scale
arrangement	choose	crescent	horizontal	triangle
axis	circle	design	oval	vertical

Operation Sheet

ADVANCED FLOWER ARRANGEMENT

PURPOSE:

To make a flower arrangement using five principles in addition to the four you applied in your first arrangement.

PRINCIPLES:

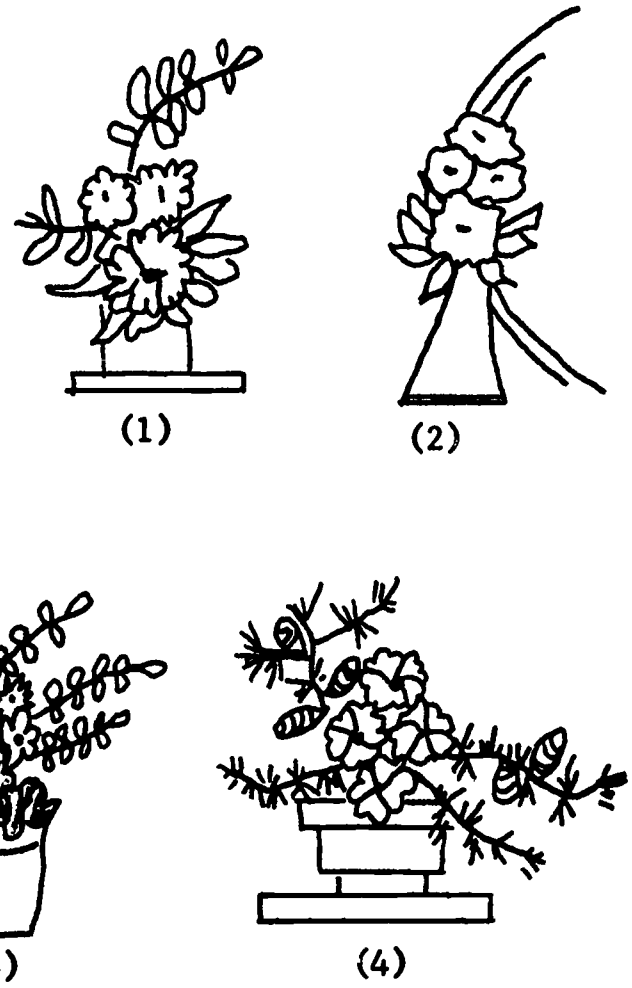
1. Focus is the center of interest. Usually, a larger flower or flowers placed just above the center of the arrangement.

2. Rhythm gives the feeling of motion. Lines which carry the eye through the center of focus. These lines should be established before filling in the arrangement.

3. Accent may be accomplished by sharp contrasts in color, size, or form. (Add one or two darker flowers at the base of your arrangement.)

4. Repetition is obtained by using several cones, flowers, or other materials in the arrangement. This also adds accent.

5. Unity is accomplished if all parts of your arrangement harmonize into one composition. It includes scale, harmony, texture, form, and color.



ACTIVITY:

Start your arrangement by establishing the line or design first. Fill in gradually, remembering to include the principles outlined for you.

STUDY QUESTIONS:

1. Would you use cut flowers in a dried arrangement? Why?
2. What is meant by accent?
3. What do you think is the most difficult part in making an arrangement?
4. How do you get focus in an arrangement?
5. Should all of the container show in an arrangement?

VOCABULARY:

accent	focus	repetition
additional	harmonize	rhythm
composition	principle	unity

Operation Sheet

MAKE A CORSAGE (1)

PURPOSE:

To learn to design and make a 1, or 3, or 5 flower corsage.

MATERIALS:

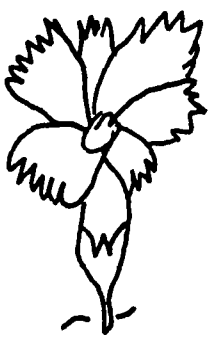
Flower in season, florist wire #26, florist tape, ribbon, leaves, scissors, and wire cutters.

ACTIVITY:

Make your corsage using the steps outlined in the following diagrams. The bow should be placed between the second and third flower. Ends of the wires may be coiled on a pencil or left extended.

Wiring (Piercing method)

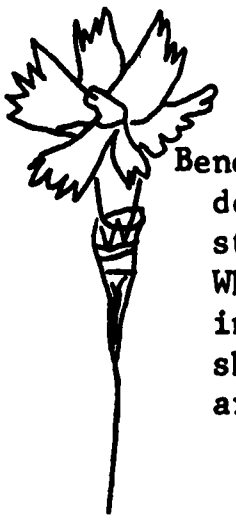
(1)



Cut stem 1" below calyx.

(2)

Insert wire through center of calyx about 4"



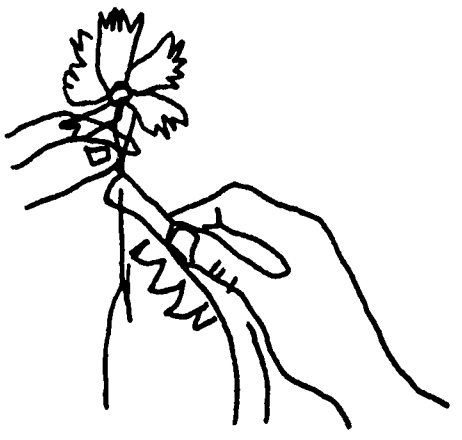
(3)

Bend long end of wire down and wrap around stem 2 or 3 times. While holding flower in left hand, wrap short wire gently around calyx.

(4)

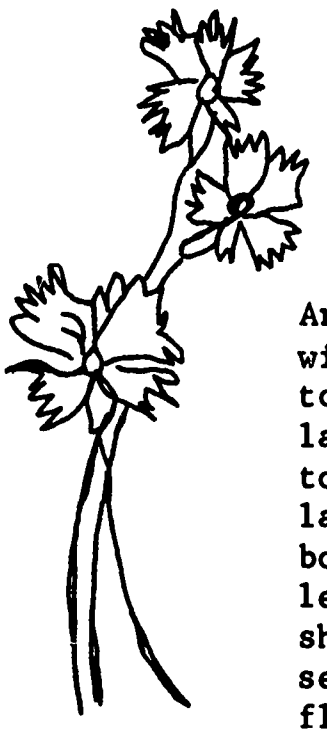
Wrap floral tape around calyx as close to petals as possible.

(5)



Hold calyx in left hand and turn while pulling down on floral tape with right hand. Tear off tape at end of wire.

(6)



Arrange flowers with smallest at top, second largest below and to the right, with largest flower at bottom and to the left. Ribbon should go between second and third flowers.

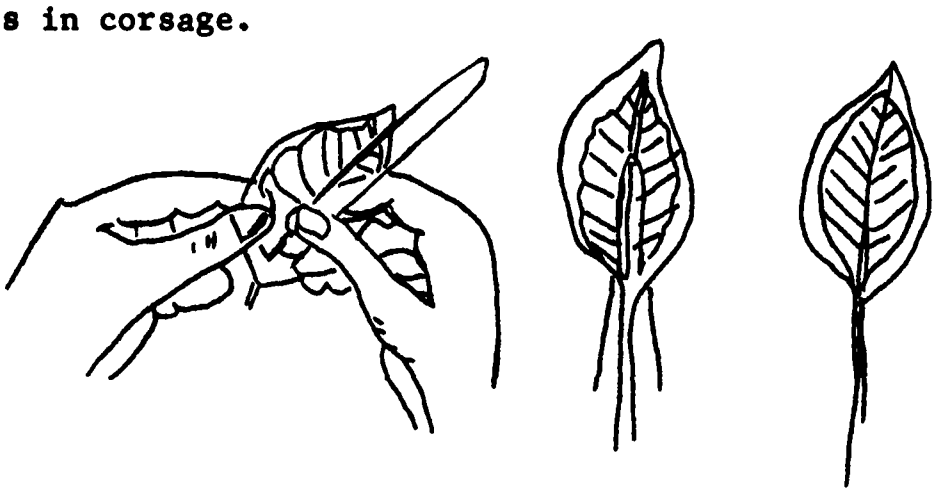
Operation Sheet

MAKE A CORSAGE (2)

ACTIVITY:

Wiring Leaves (Hairpin Method)

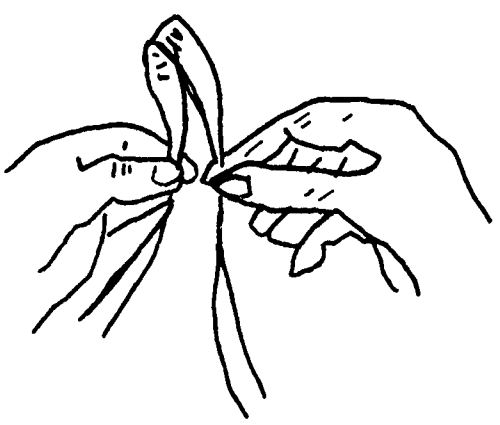
1. Hold leaf in left hand with the shiny side of leaf facing you.
2. Insert ends of wire loop (bent to look like a hairpin) just above the petiole. Pull wire down and twist several turns around the petiole.
3. Make as many leaves as you will need for your corsage. Tape the stems with floral tape as you did your flowers.
4. Place leaves in corsage.



Tying Corsage Bow

1. Place ribbon in left hand between thumb and forefinger.
2. Start two inches from end of ribbon. Make two loops, one opposite the other.
3. Gather and twist each loop. Hold bow tightly in left hand.
4. Make each succeeding loop slightly smaller than preceding loop.
5. Adjust loops (see Fig. 4) by pulling with little finger of right hand.
6. Tie and add to corsage.

(1)



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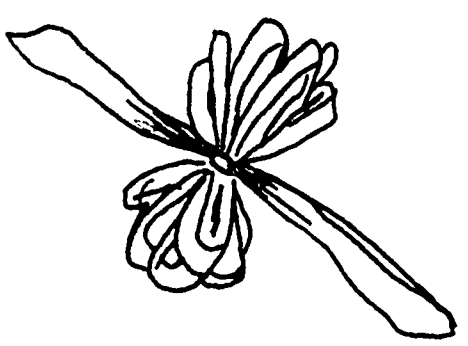

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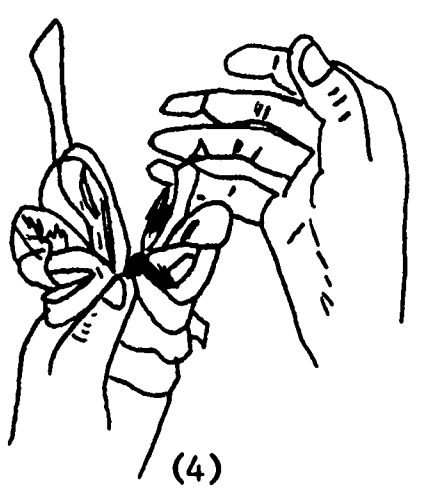
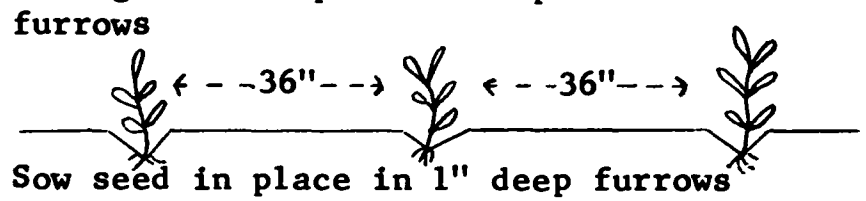


(4)

FLOWER CHART

FALL

PLANTING TO OPEN GROUND

Flower Kind	Height	Color	Season of Bloom	Distance Apart - Rows	Time To Bloom From Seed	Cultural Directions - Remarks
Antirrhinum "Snapdragon" Transplant	10" - 40"	White Yellow Pinks Red	March - May	36"	6 - 8 months	Seed to flats in July - spot when 1" high. Transplant 24" apart in furrows 
Calendula Seed	12" - 18"	Lemon Orange	Dec. - June	30"	4 months	Sow seed in place in 1" deep furrows and cover with sand - when 4" high thin to 18" spacing - keep cutting for continuous bloom. Hardy for handling by children
Larkspur Seed	24" - 48"	White Pink Lavender Purple	May - August	30"	4 - 6 months	Sow seed - broadcast in 6" wide furroughs-set 30" apart - cover with sand. Broadcasting gives support against wind. Eliminates staking
Scabiosa Seed	12" - 24"	Various	Continuous	30"	7 - 10 months	Sow seed to single furrow - early as possible. Thin to 12" when 6" tall
Stocks Seed "Mathiola"	18" - 36"	White Purple Blue-Pink Ruby	Feb. - June	28" Ridge Centers	7 - 8 months	Dislike transplanting - drill seeds to single row on ridge. Thin columnar types to 6"
Sweet Pea Spencer - Fall-Sept. Cuthbertson - Spring-March -- Seed		Various	Feb - June	48" if planted in plots-not against wall or fence	6 - 8 months	Drill seeds in row 4" deep. Gradually fill in as plant grows. Dust every two weeks-sulphur. Water - respond to blood meal. Build trellis before planting

FLOWER CHART

SPRING

PLANTING TO OPEN GROUND

Flower Kind	Height	Color	Season of Bloom	Distance Apart - Rows	Time To Bloom From Seed	Cultural Directions - Remarks
Aster Transplant Seed	12" - 24"	Purple White Pink	July - Sept.	30"	3 - 4 months	Sow seed in hot bed in February or March - spot to flat or 2" pot. Transplant to "V" furrow in April, sow seed to single furrows mid-April -- thin to 24"
Centaurea	18" - 36"	Blue Pink White	March June	30"	4 - 6 months	Sow seed in place in January. Thin to 18". Spray for aphis - prefers cool weather
Celosia Dwarf forms	18" - 36"	Red Orange Pink	May - August	30"	4 - 6 months	Sow seed in single rows. Late spring - thin - easily transplanted - needs water. Long lasting flowers - likes heavy soils
Marigold Winter Border (French) Tall (African)	12" - 36"	Yellow Orange Brownish	May - Dec.	30"	3 - 4 months	Sow seed in single-row furrows - cover with sand - thin to 12" - plants grown in flats set 2" deeper in open ground - hardy for handling by children
Zinnia	8" - 36"	All Colors Except Blue	Late May August	30"	1½ - 3 months	Seed sown in single row in early April - water by furrows - subject to mildew. Add lime to acid soils. Respond to seedling in flats. Good for teaching transplanting

AGRICULTURE INSTRUCTIONAL UNIT VI

NURSERY PRACTICE

How to Plant A Seed Flat 56
How to Write A Label 57
Transplanting Seedlings to Pots 58
How to Transplant to Pots 59
Removing Plant From A Pot for Transplanting 60
Plunging Potted Material in Bench 61
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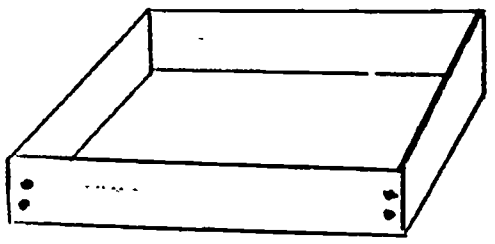
1963

Operation Sheet

HOW TO PLANT A SEED FLAT

Flats are used in propagating plants from seed that are too small or minute; too tender to cold; or too expensive to be planted in the open ground. You are to sow a seed flat following the techniques shown in the following diagrams.

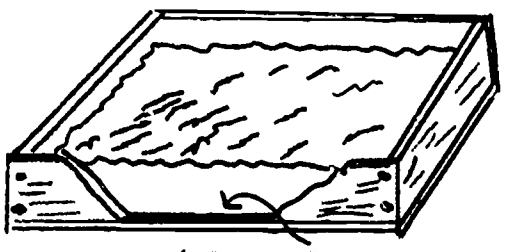
ACTIVITY:



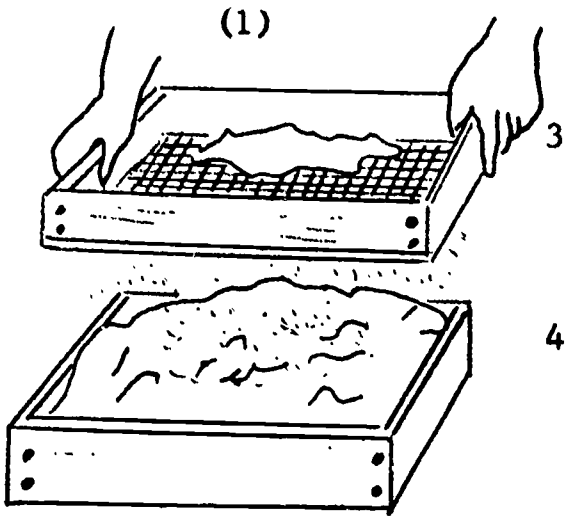
(1)

1. Place a thin sheet of paper in bottom of flat.

2. Fill flat three-fourths full with unscreened potting soil.



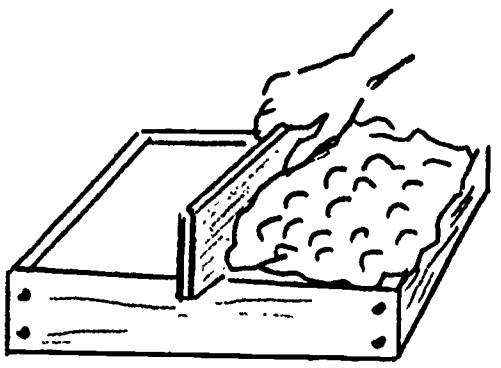
(2) Paper



(3)

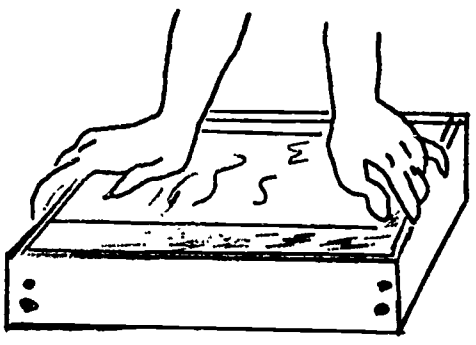
3. Sift soil through screen to fill remaining area of flat.

4. Place scraper on top edges across flat. Level soil even with top edges of flat.



(4)

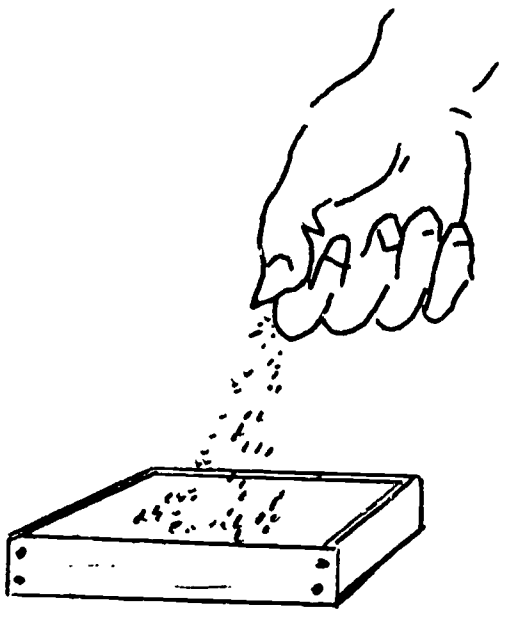
5. Place float on soil and firm. Press down on center of float.



(5)

6. Broadcast seed thickly over soil surface.

7. Hold screen above flat. Cover seed by sifting sand or peat moss evenly over surface. Label and water with sprinkling can.



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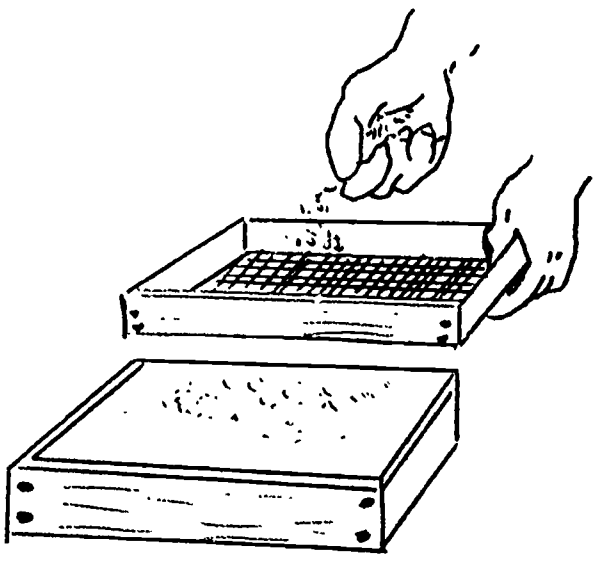


(7)

Operation Sheet

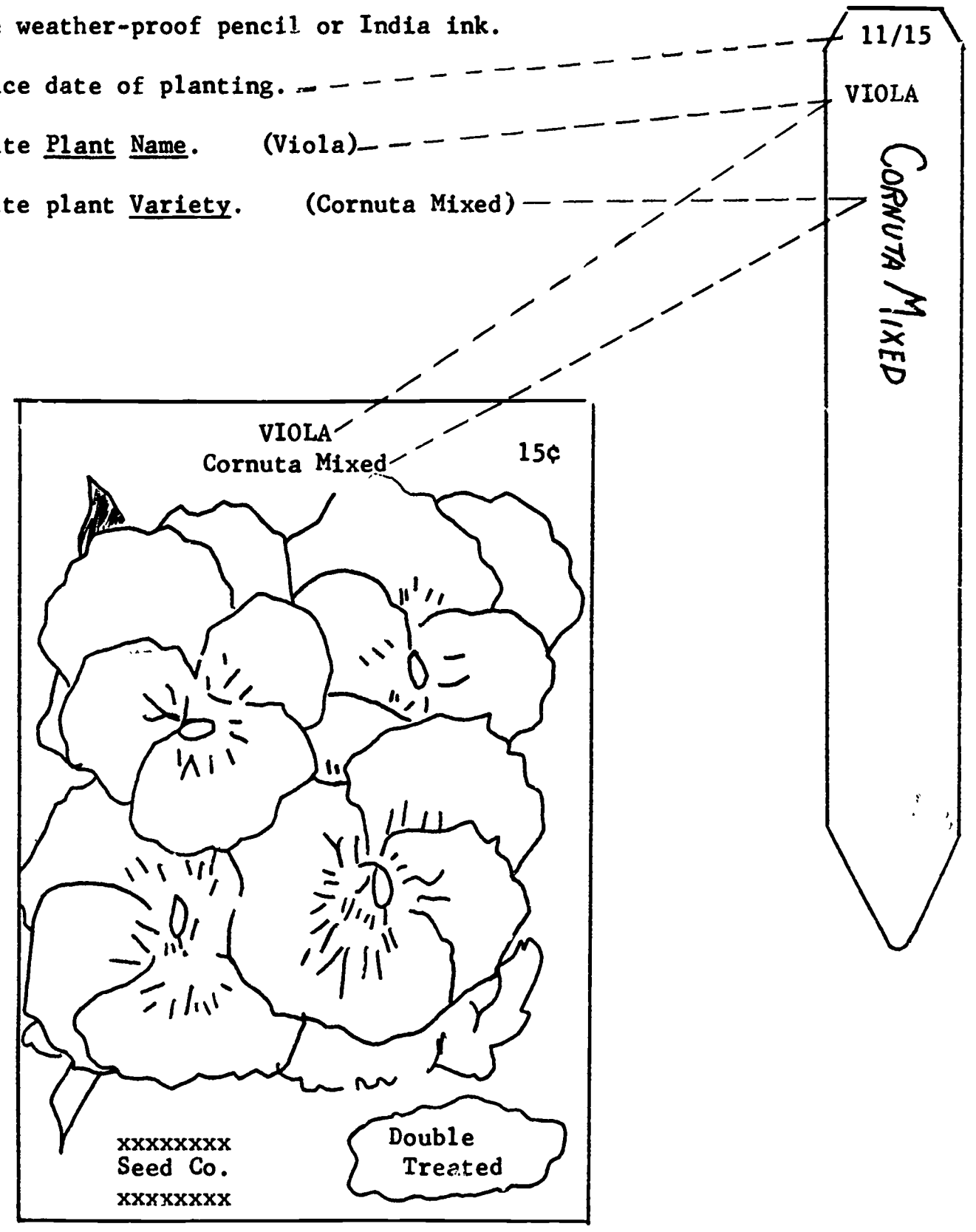
HOW TO WRITE A LABEL

The label is essential in all gardening and nursery practices to identify planted rows or flats of seed.

ACTIVITY:

Prepare labels for your seed flats as follows:

1. Use weather-proof pencil or India ink.
2. Place date of planting.
3. Write Plant Name. (Viola)
4. Write plant Variety. (Cornuta Mixed)



Information Sheet

TRANSPLANTING SEEDLINGS TO POTS

PURPOSE:

1. To stimulate further root growth.
2. To provide additional plant food.
3. To improve plant's appearance.

TYPES OF PLANTS POTTED:

1. Rooted seedlings

   A. Annuals
   B. Biennials
   C. Perennials
   D. Shrubs
   E. Trees

2. Rooted cuttings

   A. Perennials
   B. Shrubs
   C. Trees

3. Potted plants whose roots have exhausted potted soil area.

SOIL MIXTURE FOR COMMON PLANTINGS:

1. One part loam
2. One part sand
3. One part peat moss or leaf mold

ACTIVITY:

Technique

1. Place pots in row on right side.
2. Place peat moss and plant material on left.
3. Place peat moss in bottom ½" (or pottery if preferred).
4. Hold plant in pot with left hand.
5. With right hand, fill pot to rim with soil.
6. Firm soil twice with ends of thumbs. Press down with thumbs along side of pot.
7. Level soil by jarring the pot once.
8. Plunge pots in lath house bench, and water.

Clean-up

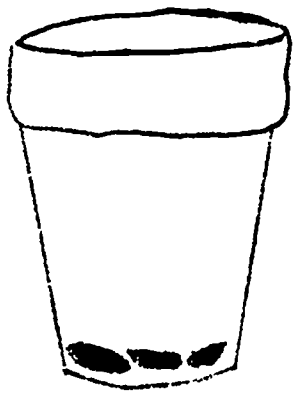
1. Clean potting table and hill soil.
2. Clean floor.
3. Return flats or pots to original place.
4. Wash all empty pots and dry for storage.

Label

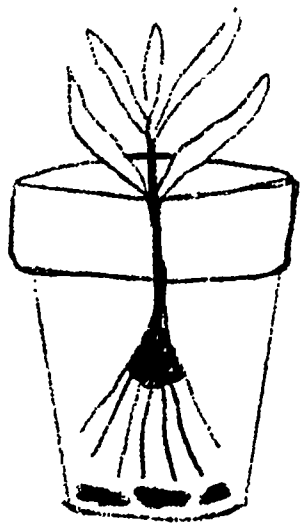
1. Label individual pots as to variety if flowering plants such as fuchsia.
2. Label group potting if plant is easily identified.

Operation Sheet

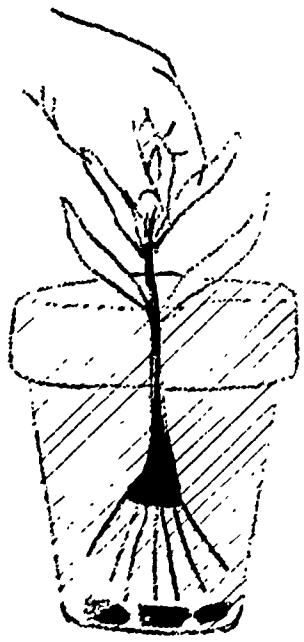
HOW TO TRANSPLANT TO POTS



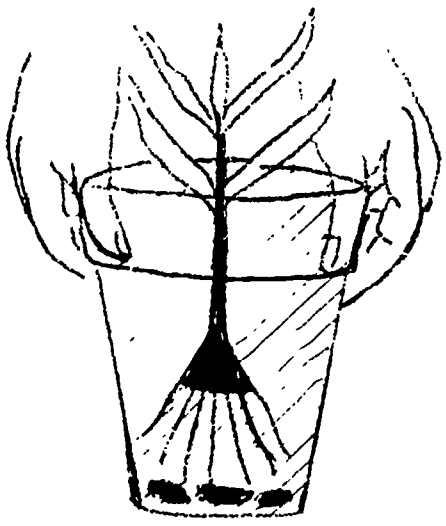
STEP 1. Place pinch of peat moss or broken pottery in bottom of pot to hold soil.



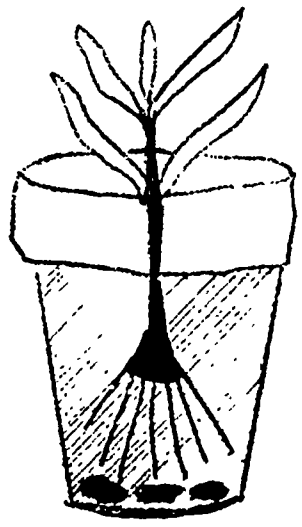
STEP 2. Hold plant in center of pot with roots resting on peat moss.



STEP 3. Hold plant firm with left hand. With right hand, fill pot to rim with soil.



STEP 4. Firm soil around plant by pressing thumbs down along sides of pot.



STEP 5 Jar bottom of pot on table to even soil surface. Soil level should be even with bottom edge of pot lip

Operation Sheet

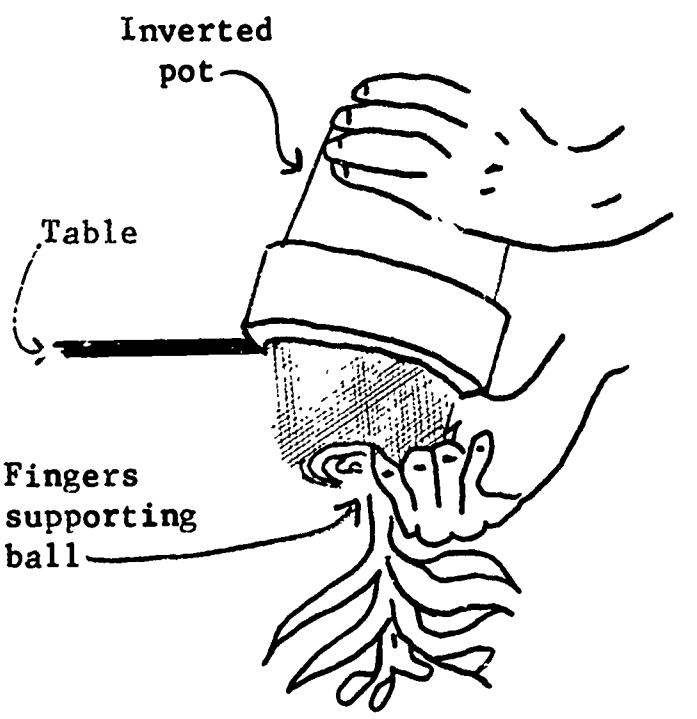
REMOVING PLANT FROM A POT FOR TRANSPLANTING

Plants are removed from a pot for transplanting to the open ground or to a larger container to:

1. Permit normal growth.
2. Prevent dwarfing.
3. Prevent their being root bound.

TO REMOVE PLANT:

1. Place hand on soil surface to support ball. Spread fingers around the plant stem.
2. Invert pot over table edge, garden stake, or trowel handle.
3. Tap the top edge of pot rim gently on the hard surface.
4. Remove pot with left hand.
5. Place removed plant ball upright in free hand.
6. Transplant to prepared hole in open ground or to larger container.
7. For transplanting to pots or soil, follow instructions on Information Sheet titled, "Transplanting Seedlings to Pots."



Operation Sheet

PLUNGING POTTED MATERIAL IN BENCH

PURPOSE:

Potted materials should be placed in plant shelters immediately after potting to:

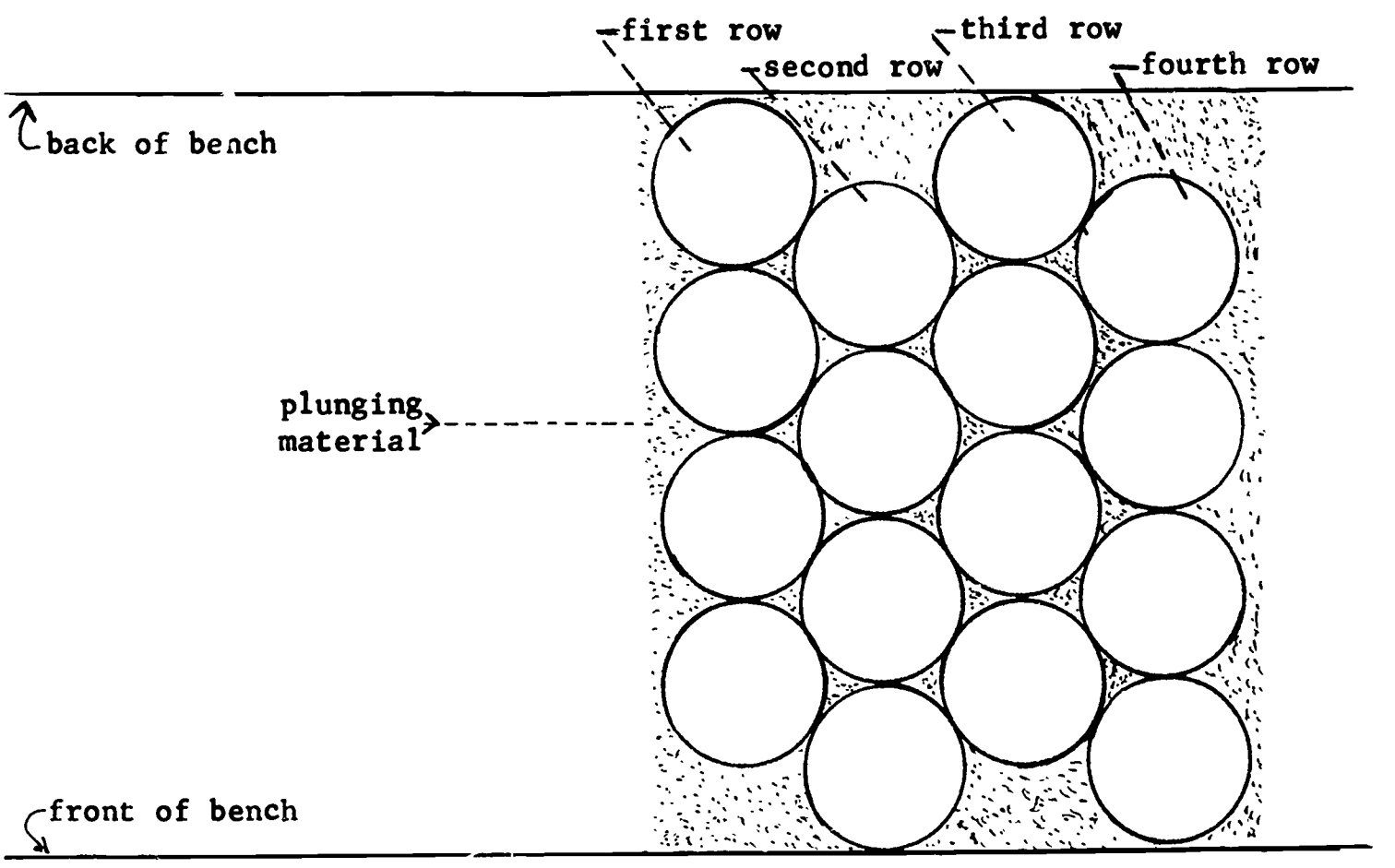
A. Clear potting shed for further activities.
B. Prevent potting material from drying out.
C. Give potted material adequate light.

ACTIVITY:

1. Scatter several inches of sawdust, shavings, peat moss, or preferably course sand in bench or shelter area.
2. All material to be plunged should be of the same size. Do not mix sizes of pots.
3. Starting at one side of the selected area, arrange one straight row, keeping tops of pots level from front to back.
4. Arrange rows by sliding pot on bench floor so bottom of pot touches the wood. This firms the pots and prevents them from tipping over, also prevents unevenness of rows.
5. Additional rows are formed by pushing in a pot with a sliding motion between two pots of the preceding row. The sliding motion fills the small spaces between the pots with the plunging material.

RESULT:

1. More plant material may be stored in a given area than in other ways.
2. Plunged material presents a more orderly appearance.
3. Plants are more easily watered.



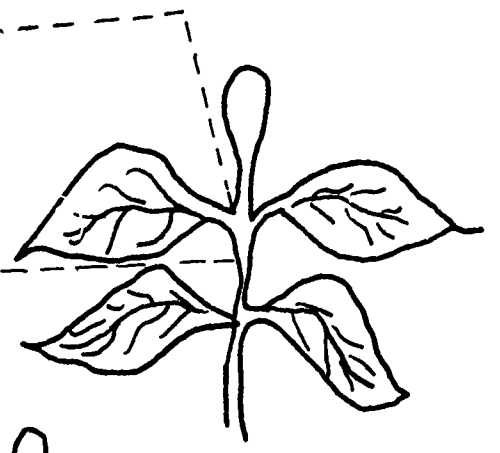
Operation Sheet

SOFTWOOD CUTTINGS

Softwood cuttings are made from wood taken from new growth or softwood at the tip of branches. New growth may be forced by cutting back old wood. If plant material is ripe, it will break clean when snapped. Test your cutting material before making cuttings.

STEM STRUCTURE:

Node where food is stored and leaf bud join.
Internode is the space between the nodes.

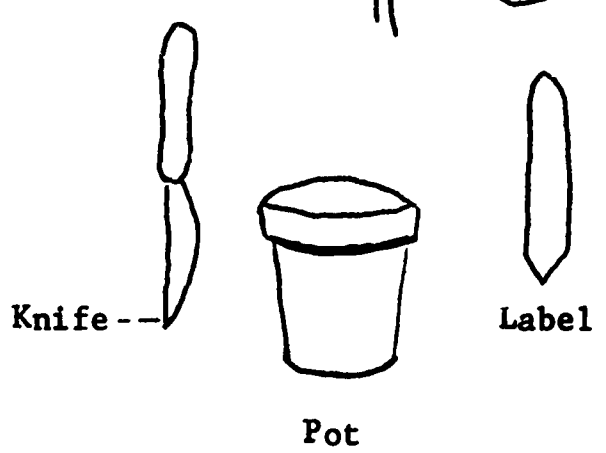


MEDIUM:

Sand (river washed and sharp), peat moss, and vermiculite.

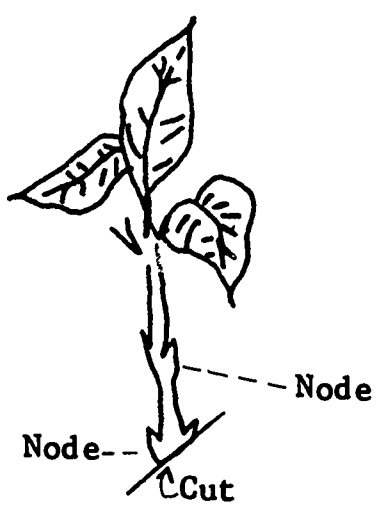
MATERIALS:

Knife, 4" pot or cutting box, peat moss, medium, and label.



ACTIVITY:

1. Cut 15 tips from maternal plant.
2. Place peat moss in bottom of pot.
3. Fill pot with medium, one-half inch from top.
4. Cut tips three inches long just below node.
5. Remove all leaves except top three. Leave all petioles.
6. Dust bottom of cutting with rootone.
7. Make deep hole in center of sand in pot.
8. Insert cutting three-fourths deep in medium (sand mixture).
9. Continue operation. Work from center of pot to outside.
10. Place completed pot in coldframe or hotbed.
11. Label as to variety.
12. Water.



AGRICULTURE INSTRUCTIONAL UNIT VII

INSECTS

Types of Insects and Their Control 64
Life History of the Butterfly 65
Study of A Typical Insect 66
Study of A Typical Insect .....

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1963

Information Sheet

TYPES OF INSECTS AND THEIR CONTROL

The problem of every gardener is what to do about the pests. There are so many different kinds that most people have difficulty in controlling them. There are also many different kinds of sprays which adds to the confusion.

TWO MAJOR TYPES OF INSECTS:

Chewing insects have mouth parts called mandibles with which they chew leaves, stems, bark, flowers, or roots. Some insects have chewing mouth parts in the larvae (caterpillar) and adult stages, others in the larvae stage only. Their method of breathing is through the pores or spiracles on each side of the abdomen. Grasshoppers, termites, caterpillars, beetles, weevils, and grubs are a few examples of this type of insect.

Sucking insects have a long tube through which they suck the juices out of the plant. They also breathe through pores (spiracles) on each side of their bodies. Some of the most harmful insects are in this group.

METHODS OF CONTROL:

Chewing insects are usually controlled by using some type of spray or dust which is poisonous for them to eat. These materials are called "stomach poisons". The most common ones in use are Lead-Arsenate, Nicotine-Sulfate (Black Leaf 40), Paris Green, Rotenone and Pyrethrum. Rotenone and Pyrethrum, in addition to acting as stomach poisons, paralyze the nerves of the insect whenever the body comes in contact with them.

Sucking insects are often very hard to kill. Stomach poisons are of little value since they suck the juices out of the inside of the plant. Therefore, they are killed by "contact sprays or dusts". These materials close the pores of the insect and they suffocate to death or they are paralyzed by the spray. Rotenone, Pyrethrum, oil sprays, D.D.T., Malathion, and Chlordane are a few of the materials used as contact sprays.

PRECAUTIONS - Read the instructions on the label and follow them carefully. All sprays are dangerous if used carelessly, and many of the newer and more powerful sprays are toxic to humans if inhaled or get on the skin. Always wash your hands in soap and hot water after using or handling these materials. Be safe, not sorry.

STUDY QUESTIONS:

1. For practical purpose, what are the two types of insects?
2. Describe the important features of each of these two types.
3. Give five examples of each type.
4. What two classes of insecticides are used for control?
5. Name three examples of insecticides for each type.
6. List the precautions to follow when using insecticides.

VOCABULARY:

abdomen	contact	mandible	precaution
adult	insect	pores	suffocate
chewing	insecticide	poison	spray

Information Sheet

LIFE HISTORY OF THE BUTTERFLY
(Metamorphosis)

The life history of the butterfly is divided into four stages:

1. Egg - The small eggs are usually rounded or barrel-shaped with either a smooth or a cross-lined network on the surface. The colors may be yellow, brown, red, blue, or green. Some butterflies lay their eggs in a mass, while others lay their eggs singly. Each butterfly lays her eggs upon a special plant family.

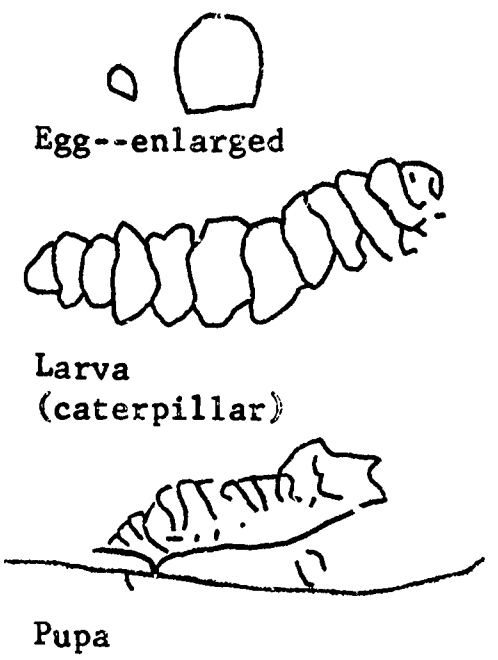
2. Larva - Larva are hatched from the egg, eat the broken egg shell, then eat the plant leaf. The outer skin is shed several times as growth takes place. All growth takes place at this stage.

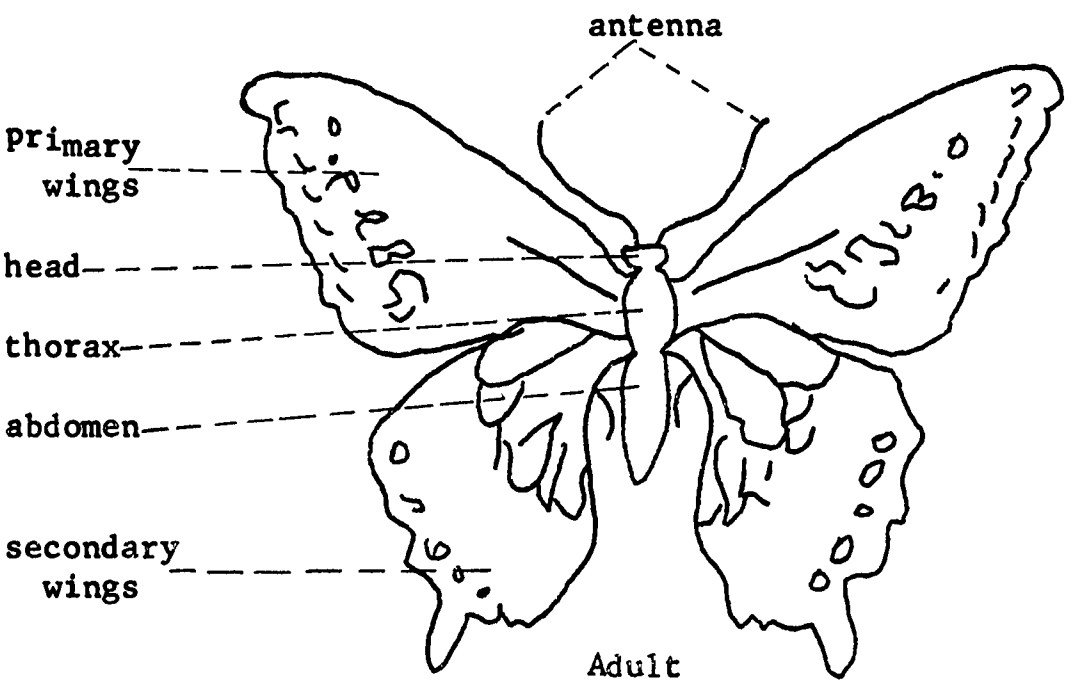
3. Pupa - The caterpillars when full grown becomes a chrysalis. The hard chitinous covering is spun from the silk glands which open within the mouth. The larva skin is shed and the chrysalis is formed. In this stage the body parts are made over into a grown butterfly with wings, legs, and feelers (antenna) folded against the breast as it lies within the pupa skin.

4. Adult - After some weeks of summer, or the next spring, the butterfly breaks through the pupa skin. At first, the wings are soft and flabby. Then, body fluid flows in, the wings spread, flap slowly and become firm and hard. When the wings are sufficiently hard and dry, the adult soars away to sip the nectar of flowers with its long tubular tongue and to seek its mate.

STUDY QUESTIONS:

1. Have you ever seen a baby butterfly? Explain.
2. At what stage of growth is the butterfly most injurious to man?
3. Do butterflies have cocoons?





Operation Sheet

STUDY OF A TYPICAL INSECT (1)

PURPOSE:

To learn the body structure of a typical insect and how it functions.

MATERIALS:

Grasshoppers, magnifying lens, killing jar, tweezers.

ACTIVITY:

Collect from your home or school garden five different insects including a grasshopper. Place insects in killing jar prepared by teacher. Remove from jar when dead and study them with the magnifying glass. Use the following drawings of a grasshopper as a guide.

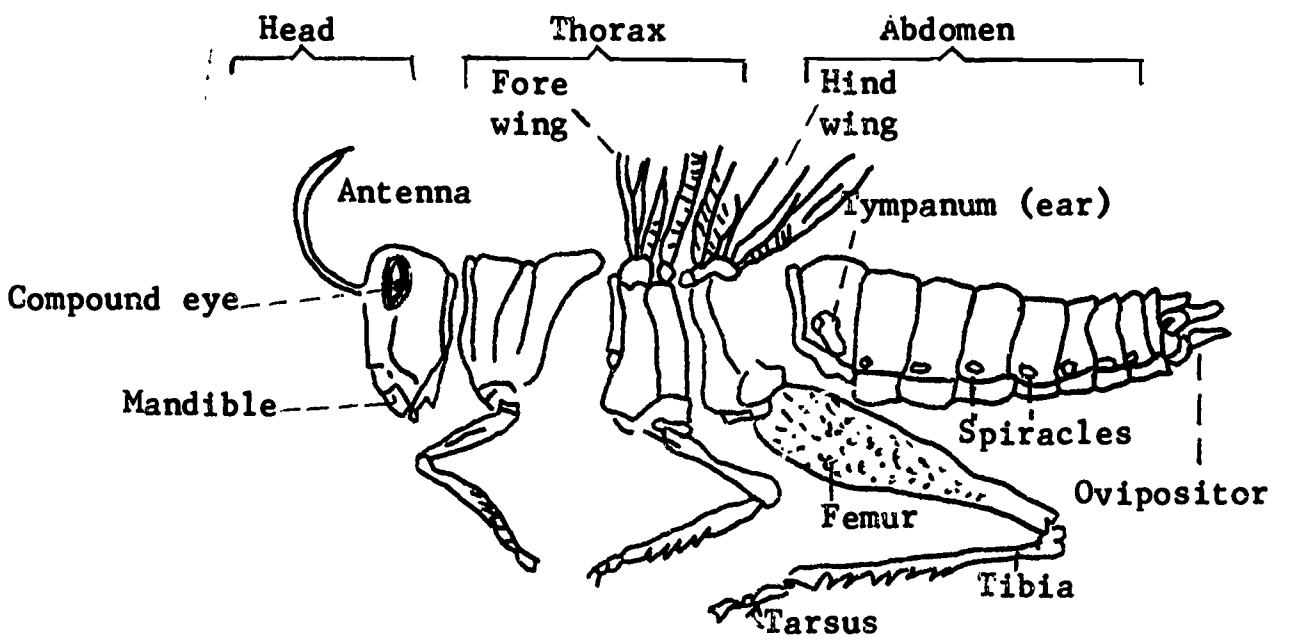
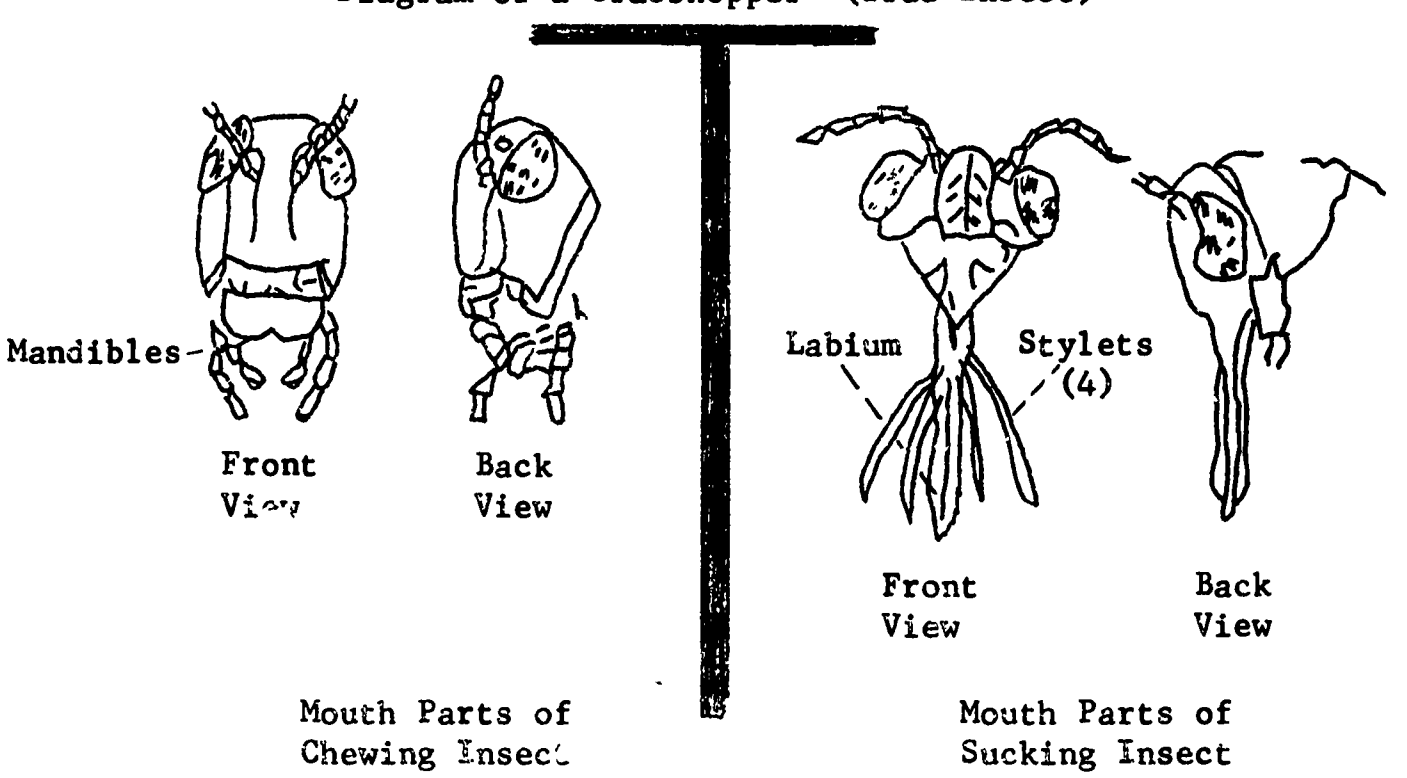


Diagram of a Grasshopper (True Insect)



Operation Sheet

STUDY OF A TYPICAL INSECT (2)

STUDY QUESTIONS:

1. Classify each of your insects under the following headings: "Sucking Insects", and "Chewing Insects".

2. Make a sketch of how each insect looks to you and label their body parts.

3. Make a list of those insects that have a complete life cycle. Make another list of those insects that have an incomplete life cycle. Refer to your Information Sheet titled, "Life History of the Butterfly."

4. Use reference books and recommend an insecticide for each insect.

5. Find several different kinds of insects at home or in your school garden. Bring them to class for identification. Add them to your list of insects (see number 3) with methods of control for each.

6. Can you explain why many insects are so hard to catch? What makes them so sensitive?

VOCABULARY:

cycle	metamorphosis	tarsus
femur	sensitive	thorax
head	spiracles	tibia
labium	stylet	tympanum

AGRICULTURE INSTRUCTIONAL UNIT VIII

ANIMAL HUSBANDRY

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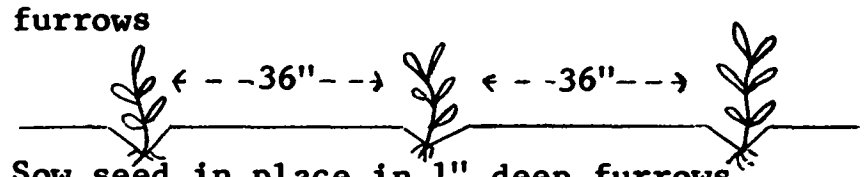
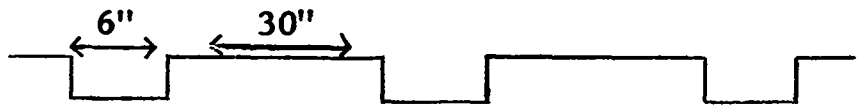
LOS ANGELES CITY SCHOOLS
Division of Instructional Services
Curriculum Branch
Vocational and Practical Arts Section
1963

FLOWER CHART

FALL

PLANTING TO OPEN GROUND

Flower Kind	Height	Color	Season of Bloom	Distance Apart - Rows	Time To Bloom From Seed	Cultural Directions - Remarks
Antirrhinum "Snapdragon" Transplant	10" - 40"	White Yellow Pinks Red	March - May	36"	6 - 8 months	Seed to flats in July - spot when 1" high. Transplant 24" apart in furrows 
Calendula Seed	12" - 18"	Lemon Orange	Dec. - June	30"	4 months	Sow seed in place in 1" deep furrows and cover with sand - when 4" high thin to 18" spacing - keep cutting for continuous bloom. Hardy for handling by children
Larkspur Seed	24" - 48"	White Pink Lavender Purple	May - August	30"	4 - 6 months	Sow seed - broadcast in 6" wide furroughs-set 30" apart - cover with sand. Broadcasting gives support against wind. Eliminates staking 
Scabiosa Seed	12" - 24"	Various	Continuous	30"	7 - 10 months	Sow seed to single furrow - early as possible. Thin to 12" when 6" tall
Stocks Seed "Mathiola"	18" - 36"	White Purple Blue-Pink Ruby	Feb. - June	28" Ridge Centers	7 - 8 months	Dislike transplanting - drill seeds to single row on ridge. Thin columnar types to 6"
Sweet Pea Spencer - Fall-Sept. Cuthbertson - Spring-March -- Seed		Various	Feb - June	48" if planted in plots-not against wall or fence	6 - 8 months	Drill seeds in row 4" deep. Gradually fill in as plant grows. Dust every two weeks-sulphur. Water - respond to blood meal. Build trellis before planting

Information Sheet

POULTRY (1)

During very early times the people of India and Asia caught and tamed the many wild jungle fowl (Gallus bankiva) which were abundant there. Because of their small size, willingness to live near man, rapidity of multiplication, and the ease with which they can be raised and cared for in captivity, early man was able to select the types of fowl he preferred and raise them in large numbers.

Poultry is a collective term that refers to all birds that have been domesticated by man and useful to him. The term "poultry" includes chickens, turkeys, ducks, geese, swans, guineas, pigeons, pheasants, peafowl, and ostriches. The term "fowl" is used to refer to chickens, the most common of the domestic birds. Domestic birds, except waterfowl and ostriches, usually have four toes and the ability to scratch for their food; thus, they are classified by naturalists as Rasores or scratchers.

We chew food until it is soft and fine, then swallow it. The chicken, however, swallows it whole, and after being softened by the juices of the stomach, it passes into a little mill, or gizzard. The gizzard contains gravel which the chicken has swallowed and this helps grind the food.

A chicken cannot swallow water as we do because it has no muscles in the throat. Thus, it first has to fill its beak with water, then hold up its head so the water will flow down the throat.

The class to which chickens belong is determined by their place of origin and development. The chickens developed in Asia belong to the Asiatic class and are used primarily for meat; those developed in the Mediterranean region belong to the Mediterranean class and are used mainly for egg production; and those developed in America belong to the American class and are used for both meat and egg production

GENERAL CHARACTERISTICS:

Class	Mediterranean	American	Asiatic
Native home	Mediterranean	United States	Asia
Maturity	Early	Medium	Late
Use	Eggs	Eggs and meat	Meat
Egg production	High	Good	Poor
Color of eggs	White	Brown	Brown
Meat production	Poor	Good table meat	Excellent meat
Most popular	White Leghorns	Barred Rocks	Light Brahmas

Operation Sheet

POULTRY (2)

STUDY GUIDE QUESTIONS:

1. Write a brief paragraph on the origin of the chicken.
2. Classify three types of chickens according to their usefulness to man.
3. What is meant by the term "standard bred"?
4. List ten breeds of chickens and identify each by color, body shape, and usefulness.
5. What are the characteristics of the "American class"?
6. Give three points to consider when choosing a place to build the poultry house.
7. How many eggs are recommended for a setting when a hen is used for incubation?
8. What is the incubation period for chicken eggs?
9. What is "candling" and why is it important?
10. Why is it necessary to turn the eggs when artificially incubated?
11. Make an egg tester and test a dozen store eggs for blood rings or test a setting of eggs about the seventh day.
12. Set six eggs under a hen, one of the eggs being infertile. Each day open and examine one of the fertile eggs to see what progress has been made by the embryo. On the sixth day, examine the infertile egg.
13. List six common poultry diseases and give the treatment or remedy for each.
14. Draw a full page sketch of a chicken and label: beak, comb, wattles, ear, ear lobe, points, hackle, breast, spur, shank, wing bow, tail, and vent.
15. Make a chart for selection of good producing hens.
16. Make a simple poultry device, such as a dry mash feeder (waste prevention), a box for shell and grit, or a drinking fountain.
17. Send a letter, asking for Farmer's Bulletins Numbers 1506 and 806, to the Bureau of Publications, U. S. Department of Agriculture, Washington, D. C.

Operation Sheet

POULTRY (3)

COMPLETE THESE:

1. The yearly value of poultry is more than the value of _____.
2. The hen puts her head _____ when she is sleeping.
3. The first fowl were domesticated in _____ and _____.

STUDY GUIDE QUESTIONS:

1. Explain the chicken's habit of raising the head to swallow.
2. Animals that eat all kinds of food are called _____.
3. Why are White Leghorns better layers than Brown Leghorns?
4. What importance is given to leg color in breeds producing eggs?
5. Explain the method and reason for the practice of Hoganizing.
6. Give three rules to follow in care of newly hatched chicks.
7. What need of the baby chick does the brooder supply?
8. How should eggs be marketed?
9. Look in the market page of the daily paper and find the selling weight for broilers, fryers, roasters, and capons.

VOCABULARY: Learn the spelling and meaning. Use your dictionary.

broiler	combs	mash
brooder	fowl	poultry
candling	fryer	pullet
capon	grit	succulent feed
chicken	incubation	ventilation

REFERENCES:

Grim: Introduction to Agriculture, XXXIII

Skilling: Nature Study Agriculture, XVIII

Information Sheet

THE HORSE (1)

The first little horse with many toes, lived when the earth was a damp, warm place and when animals needed toes to spread out to prevent them from miring in the mud. But as the ages went on, the earth grew colder and drier, the many toes changed into a long leg ending in a single hoof.

The length of the horse's leg was designed by nature to meet the need for flight from fierce and swift enemies. The length of the neck and head are necessary in order that an animal with such length of the leg, as the horse, may be able to graze. The head of the horse tells much of its disposition; a perfect head should not be too large, it should be broad between the eyes and high between the ears, while below the eyes it should be narrow. The ears should point upward and forward; sensitive, quick-moving ears indicate a high-strung, sensitive animal, while the ears laid back is always a sign that the horse is angry.

The name "Thoroughbred" is applied properly only to the breed of running race horses produced originally in England. Three Arabian stallions are credited with laying the foundation for this breed, their names being Byerly Turk, The Darley Arabian, and the Godolphin Barb. They produced the three famous racing families Herod, Eclipse, and Matchem, respectively. The Thoroughbred is the best as a race horse.

There are five chief purposes for which horses are raised: speed, trotters and runners, sport or fashion, family riding and driving, farm purposes, and draft purposes.

There are many contrasts between draft horses and those that are kept for speed. The following table shows some of the contrasts:

	Trotter or Roadster	Draft Horse
General appearance:	High, lithe, active	Low, massive, plump
Head and Neck:	Long, graceful, thin, light	Short, thick, broad
Nostrils:	Large	Large
Eyes:	Full, bright, intelligent	Full, bright, intelligent
Shoulders:	Long, sloping	More upright
Front feet:	Near together	More apart
Body:	Deep up and down	Round, with well-arched ribs
Flank:	High	Not so high; should not be "wasp-waisted"
Legs:	Rather long	Not so long; not over half height
Hoofs:	Smooth, polished, no creases not too flat	Same, except flatter and larger
Fetlock joint:	Not too short, nor too erect	May be shorter and more erect

The term "hand" used in description of the height of a horse is the width of a hand or approximately 4 inches.

Operation Sheet

THE HORSE (2)

COMPLETE THESE:

1. The first horse had _____ toes while the horse of today has one _____ which is called a _____.

2. A good horseman can tell if a horse if gentle by judging the shape of the _____ and the position of the _____.

3. The Thoroughbred was originally produced in _____.

STUDY GUIDE QUESTIONS:

1. What is the average weight for light breeds and for heavy breeds?

2. Explain the leg action in trotting, in pacing.

3. Is it easier to tell the age of a four year old horse or a nine year old horse? Explain.

4. Give the scientific theory of the development of the horse.

5. What was man's reasons for developing the draft horse?

6. Give characteristic differences between heavy and light breeds.

7. List the four leading breeds of draft horses and give the country in which each was developed.

8. How high in feet would a horse "17 hands high" be?

9. Which breed of draft horse is not liked in America? Give the reason or reasons for this dislike.

10. Give three types of light horses and list the purposes or uses for which each is best suited.

11. Name several good practices in cleaning a horse.

12. Why must horses, particularly the working horse, be fed regularly?

13. The "heaves" is caused by feed which is not free of _____.

14. Can a horse feel pain?

VOCABULARY:

colt	filly	golding	muzzle	stallion
conformation	foal	mane	nostril	thoroughbred
draft	forelegs	mare	pacer	trotter

REFERENCES:

Grim: Introduction to Agriculture, XXXI
Skilling: Nature Study Agriculture, XVII

Information Sheet

CATTLE (1)

When man emerged from the savage state, his first step toward civilization was domesticating wild animals and training them for his own use. From the first, cattle have been used in three capacities: First, for carrying burdens and as draught animals; second, as meat; and third, as a source of milk.

Cattle eat grass and herbage, and their teeth are specifically arranged for this. There are eight front teeth on the lower jaw, and a horny pad opposite them on the upper jaw. In back of these on each jaw is a bare place and six grinding teeth on each side. As the cow feeds, she moves her head up and down to break off the leaves of the plants.

The cow, bison, camel, buffalo, yak, deer, elk, antelope, sheep, and goat all chew their cud. These cud chewers graze in the morning and the evening, swallowing the food as it is torn from the plants and storing it in their ruminating stomachs. The food is churned by the second stomach and lower part of the gullet and formed into a "cud". The cud is regurgitated when the animals are at rest. After being chewed and mixed with saliva a cud, or bolus, containing, in the case of cattle, about three or four ounces of food, is ready for digestion by the remaining two stomachs.

The cow can turn her ears in any direction, and her sense of hearing is keen as is her sense of smell. With the moist sensitive skin of her nose, she is quick to sense danger and also, thus, tests her food.

Civilized man has bred cattle for two main purposes, producing beef and milk.

The beef animal is like a brick seen sidewise. It should be big and full across the loins and back; the shoulders and hips covered with flesh; the legs, short and stout; and the face, short. The beef cattle are chiefly Aberdeen-Angus, Galloway, Shorthorn, and Hereford.

The milk cow is oval and triangular in appearance, rather than square; the back line sags in front of the hips, which are prominent and bony; there is little flesh on the shoulders; the body is wedge-shaped from the shoulders to the hips; and the stomach line slants downward from the shoulders to the udder. The dairy breeds are Jersey, Guernsey, Aryshire, Brown Swiss and Holstein-Frisian.

All the best breeds of cattle have been evolved in the British Isles and in Europe, north of Italy and west of Russia. All of our domesticated cattle were developed from wild cattle of Europe and Asia. The cattle of our West are of European ancestry. America had no wild cattle except the Bison.

Milk contains much more nutriment than is commonly supposed. One-hundred pounds of good milk contains about 87 pounds of water, 4 pounds of fat, 5 pounds of milk sugar, 3.3 pounds of casein and albumen, and 0.7 pounds of mineral matter.

Operation Sheet

CATTLE (2)

STUDY GUIDE QUESTIONS:

1. What is the main reason for man's interest in cattle?
2. In what two divisions are farm cattle classified?
3. Describe the appearance of beef cattle.
4. Name four common breeds of beef cattle. Give the origin of the breed and general coloring.
5. Describe, in general, the body-outline differences between dairy and beef type cattle.
6. What are points to consider in choosing a good dairy animal?
7. How does a Jersey differ from a Guernsey?
8. Why is the Holstein-Frisian a popular dairy animal?
9. Which dairy breed produces the richest milk (butter-fat)?
10. A "baby beef" is a _____.
11. In raising cattle, what are some good rules to observe in their care?
12. Give the requirements for certified milk.
13. What is pasteurization? Why is it beneficial?
14. In what ways does the cooling of milk protect our health?
15. How may dairies control danger of disease germs being in the milk?

BREEDING CHART:

Best Age to Breed	Heat Period	Time to Breed After Delivery	Gestation Period
15 to 24 months	18 to 21 days	8 to 12 weeks	283 days

VOCABULARY:

breeds	dairy	Holstein	Shorthorn
bull	Guernsey	Jersey	steer
calf	heifer	pasteurization	tuberculosis
cattle	Hereford	separator	udder

REFERENCES:

Grim: Introduction to Agriculture, XXIX
Skilling: Nature Study Agriculture, XVI

Information Sheet

SHEEP (1)

Many kinds of wild sheep are found in temperate countries all around the world, but it is not certain from which of these the domestic breeds of today were developed. From ancient times, sheep have been prized for their fleece or wool, and for their flesh. As with other animals, man has developed different breeds to serve two different needs. The finest wool is obtained from the Merino. The two best meat breeds are the Shropshires and the Southdowns.

Sheep raising has been carried on in the northeastern part of the United States since the days when that area was first settled. Since then the industry has spread to all areas of the United States.

In the States of Pennsylvania, Maryland, Virginia, West Virginia, Kentucky, and Tennessee, there are large areas of land well suited for the raising of sheep. Sheep raisers in these states are more successful because they are in the center of the mutton consuming area and therefore have lower transportation costs.

Sheep do best in high and dry areas, and do not do well on land that is wet and swampy. It is natural for sheep to seek a variety of food plants over wide areas of land. Because of this habit sheep will do well on lands that have little plant life, or on lands that furnish a wide choice of grasses or other plants. Sheep do better on grasses that are short and fine than they do on coarse or high feed.

It is not profitable to feed sheep on grain when good grazing is to be had for them. Under most conditions, flocks can be kept in good condition and lambs can be raised to the marketing stage without the feeding of grain. The feeding program that is most profitable is one that provides frequent changes of pasture and grazing crops, and winter feeding of good leguminous hay with some succulent feed.

The period of gestation in sheep is 145 days. Ewes should be mated to drop their first lambs when about 24 months old. The heat periods in which ewes will breed last from 1 to 3 days and at intervals from 14 to 19 days. A good healthy ram should serve from 40 to 60 ewes if he is allowed to run loose with the flock. With many of the medium-sized mutton breeds, 115 to 150 lambs per 100 ewes may be expected. Lambs, usually 4 to 5 months of age, bring the highest price when weighing between 65 and 80 pounds.

Docking or removing the tail from lambs is best done at the age of 7 to 14 days. When correctly done, it adds much to the looks and cleanliness of the lamb and raises the selling price at the market. Any sharp clean tool may be used. The cut should be made about one inch from the body as measured on the underside of the tail.

Shearing is usually done in late spring or early summer, after lambing. It should be done on a warm day to prevent chilling of the ewes. Power shearing machines are now used on large flocks. The wool returns vary from 7 to 11 pounds per ewe.

Operation Sheet

SHEEP (2)

COMPLETE THESE:

1. The origin of sheep was in the mountains of _____, _____ and _____.

2. _____ introduced sheep to the North American continent.

3. The merino supplies the finest _____.

STUDY GUIDE QUESTIONS:

1. Why have different types of sheep been developed?

2. Why is it necessary to dock lambs?

3. Why is it more profitable to raise sheep in the Northeastern States?

4. Why is sheep raising one of the outstanding industries of Australia?

5. Why have different types of sheep been developed?

6. "Spring lambs" are _____.

7. Compare Southdowns, Dorsets, and Shropshires.

8. Name two of the general practices in feeding sheep.

9. Give three reasons why sheep raising should be encouraged in the United States.

10. What are "hot-house" lambs, and why are they "force" fed?

11. In what countries of Europe is sheep raising a most profitable farming industry?

12. Describe the main types of sheep and give their use to man.

13. What is peculiar about the diseases of sheep?

VOCABULARY:

breeds	enclosure	grazing	pasture
chill	ewe	lamb	profitable
contagious	fleece	legumes	quarantined
diarrhea	forage	mutton	ram
docking	gestation	parasites	sheep

REFERENCES:

Grim: Introduction to Agriculture, pp 358-365
Skilling: Nature Study Agriculture, pp 279-280

Information Sheet

SWINE (1)

Of all animals, the pig is naturally the neatest, keeping its bed clean often in the most discouraging and ill-kept pens The belief that the pig is synonymous with filth is the result of the influence of man upon this animal. The pig has few bristles and hairs which give it little protection from flies and other insects. It has learned to wallow in the mud to protect itself from these pests.

The nose of the pig is a fleshy disc with nostrils in it and is also a most sensitive organ of feeling; it can select grain from chaff, and yet it is so strong that it can root up the hardest ground in search of food. The sense of smell in the pig is very keen. Many have been trained as a pointer in hunting birds, and in many instances has shown a keener sense of smell and keener intelligence for this capacity than do dogs.

The pig has a full set of teeth: six incisors, two canines, and seven grinding teeth on each jaw. The upper canines, or tushes, curve upward instead of downward; the lower canines are sharpened by grinding against the upper. The upper tushes are only highly developed in the male; and in the case of the wild boar are used as weapons. With them, the wild boar slashes out and upward inflicting terrible wounds, often disabling horses and killing men.

Almost anything, animal or vegetable, is eaten by the hog, and many a rattlesnake has lost its life to the hunger of the hog. To sustain the pig through the hardship of winter, nature provided it with the ability to take on fat; and this characteristic is what makes swine useful for our own food. To do best, pigs need plenty of fresh green food; feeding troughs should be kept clean and above all they should have plenty of pure water; and arrangements should be made for cooling mud baths as the pig does not perspire freely.

The pig is well fitted for locomotion on either wet or dry soil. The two large hoofed toes enable it to walk well on dry land The hind toes, smaller and higher up, help to support it on marshy land.

In the United States, there are two distinct classes of swine represented by breeds of the lard-type and breeds of the bacon-type. The principal lard-type breeds are the Duroc-Jersey, Poland China, Chester White, Berkshire, Hampshire, and Spotted Poland China. The most popular bacon-type breeds are the Tamworth and Yorkshire. Farmers throughout the United States breed more of the lard-type hogs than the bacon type

Practical hog raisers know that the most profitable hog is the one which can be grown to the desired market weight in the shortest possible time and by using the least amount of feed per pound of gain. The best market weight is generally from 175 to 225 pounds.

There are strong differences between present day suburban development and development prior to World War II. These differences are generally based on age, density and homogeneity of population.

Older suburbs have developed over many years. Capital improvements such as schools, sewers, and public transit have been paid for years ago. Due to long periods of development there is much greater visual variety in the older city. The new suburbs, mass produced in units as large as 1000 at a time, are still pretty raw. Eventually, they also will assume the patina of age; at least we hope that they will.

Density is the second difference. Density can be defined as the number of people living on a unit of land measure, say, an acre or a square mile. Density has a very strong effect on spaciousness, privacy, parking and outdoor recreation. It also exerts an opposite effect on the variety of services, the ease of transportation, and the cost of utilities.

The third difference is the variety of population. New housing developments have been built a neighborhood at a time, resulting in similar size, layout, and price of homes. Families of similar age and income move into them at the same time. Of course, this is just the type of environment that many people choose. Again, in time, this situation is bound to change, especially with the mobility of today's population.

The growth of the suburbs can be traced to the need for housing suppressed by the depression and the war, and the resultant marriage postponement. Added to this was savings during the war, coupled with easy mortgage money available after the war. The result was the mass produced suburbs that overwhelmed the local municipalities between 1945 and 1960, before they had a chance to gird themselves for the onslaught. This has left us with the pattern that we have today. A very densely populated core, surrounded by an urbanized belt of 1000 square miles. This urbanized belt is unlike the core in density patterns, but very much like the core in the complexity of its problems.

density can support--shops, services, theatres and better transportation to the city.

The situation envisaged by the Regional Plan Association, of a sprawling urbanization, spreading from the beaches of Montauk to the mountains of Middletown, represents a range of possibilities, if not probabilities. But, it does not yet form a plan to be considered by its constituent counties. Our accomodation to the pressure of this megalopolitan monster is therefore somewhat vague.

It would seem that if the 315 square miles of New York City can support 8 million people, then certainly 14 million remaining people can live on 6,600 square miles. Yet, the distribution of this population of 14 million is of critical importance if this metropolitan area is to survive as a proper environment. Of course, ther is some doubt that a circumscribed area of 22 counties, supporting 22 million people, can ever be called a proper environment, no matter how fine the plan.

How much of this projected development will assumed by Rockland County is difficult to predict. At present, our land, some 2-1/2% of the total Region, houses about 1% of its population. The limiting factor we can apply is the zoning ordinances which hold the population possible to the previously mentioned 360,000, or approximately 1-3/4% of the projected Region's population by 1985. Of course, the viability of zoning ordinances is questionable. For example, most of the County is engaged in the County increasing its density.

But we cannot forget that lurking figure of a population of 30 million for our state in 35 years. If we are to take a responsible approach to our growth, then we must secure our long range values against temptations to maximize immediate revenue returns. These values include proper development standards, preservation of our remaining natural endowment, and last, but not least, the provision of housing that allows a variety of choice and occupancy.

By these three values--proper development standards, preservation of open space, and variet of housing--we may overcome the challenge of the population explosion, and while still absorbing a share of the coming people, pass on our natural heritage, undamaged, to the succeeding generation.

5. Acquire the satisfaction of efficient and quality production on the job.

6. Acquire appreciation for the dignity of work.

7. Prepare for advanced education in this field.

The above general aims will aid students to become gainfully employed where job opportunities now exist. The needs will increase as the county approaches the forecast in the article entitled "Rockland in Megalopolis" and demand for these services increase. Typical occupations for which pupils are trained for are:

Local, town, city, or state park employee - approximately 30% of county in park areas

School grounds employee - approximately 70 school areas

Garden center employee or operator

Landscape gardener or maintenance employee or operator of own business

Nursery employee or operator of own nursery

Ground maintenance employee for industrial buildings or operator supplying service

Golf Course grounds employee

Cemetery grounds keeper

Greenhouse employee or worker

Stock man in parts department

Equipment operator employee or owner

Plus many other jobs directly or indirectly connected with Ornamental Horticulture or further education.

dealers, lawn maintenance o

sales outlets, golf courses a

ment in the nature of landsca

II. ORNAMENTAL HORTICULTURE 3 and
called: LANDSCAPING-NURSERY

For high school students in t
est after high school may be
continuation of their educati
tion through detailed technic
dents to obtain employment in
excellent opportunities for s
scaping, nursery and mechanic

It also offers excellent back
education in the many fields
ticulture, landscaping and me

GREENHOUSE 22 x 64 1408 sq. ft.

Aluminum rib frame plastic greenhouse connected to workroom on one end and with aluminum frame and door on other end used to propagate nursery plants	$ 1,500.00
Equipped with:	
Automatic gas heat	400.00
120 ft. of soil heating cables-electric-automatic	150.00
120 ft. of automatic fog mist system, time cloc operated	250.00
Transit benches: (2) 4' x 28' -$300 (2) 3' x 32' - 250	550.00
Yearly value of Greenhouse supplies - pearlite, chemicals, peat moss, jiffy pots, cuttings, etc.	500.00
GREENHOUSE TOTAL	$ 3,350.00

TOTAL VALUE OF EQUIPMENT, SUPPLIES, etc.
Total value of equipment, supplies and other resources of Landscaping Department, excepting cost of land and buildings, and army surplus material.

TOTAL $ 33,085.00

SERVICE ACCOUNTS
In addition to above, we have two service accounts with revolving funds as follows:
$300. - Repair shop
300. - Plants

COOPERATIVE PROGRAMS WITHIN THE CENTER

COURSE OF STUDY EXPLANATION

The following course of study applies to both courses. The subject matter for each being comparable as to content and time spent, but the approach to the various jobs are entirely different.

For the Applied Landscaping and Mechanics the approach is practical, with very

COURSE OF STUDY EXPLANATION, con't.

Each student must have at least 540 hours of actual instruction per year during regular school hours, and any time lost due to absence from school for any reason must be made up.

WORK EXPERIENCE REQUIREMENT

COURSE OF STUDY EXPLANATION
(continued)

Seniors who have completed the work exper
will also receive three credits in their
senior year is admitted to the program by
the course in his junior year, he w
work - otherwise there is no partial cred

Operation Sheet

ANIMAL HUSBANDRY NOMENCLATURE

Below you will find a list of 17 animal terms referring to different classes of domesticated animals. From the list of animals at the bottom of the page, choose the correct name and write the word after the matching definition on the blank line at the right of the page.

DEFINITION:	(Write word here)
1. young horse	_____
2. altered male hog	_____
3. female sheep	_____
4. altered male horse	_____
5. a young hog	_____
6. a young of the horse family	_____
7. adult female of swine	_____
8. a cow that hasn't had a calf	_____
9. a female of the horse	_____
10. the male of swine	_____
11. a male horse	_____
12. an unbred female hog	_____
13. a young sheep	_____
14. a female colt	_____
15. a male sheep	_____
16. altered male of cattle	_____
17. male of cattle	_____

WORD LIST

filly	steer	foal	barrow	boar	gelding
heifer	ram	sow	bull	ewe	mare
lamb	shoat	colt	gilt	stallion	

Information Sheet

ANIMAL FEEDING (1)

In order to know the fundamentals of livestock feeding, it is necessary to know the nature of the animal, it's digestive process, and the foods suited to each type of animal.

TWO BASIC TYPES OF ANIMALS (based upon digestive systems)

Ruminants, such as cattle, sheep, and goats, have four stomachs and are commonly known as "cud" chewers. The cud is a small mass of food about the size of a golf ball that is returned to the mouth from the first stomach for chewing. It is then swallowed and passes through the other stomachs for digestion. Another common characteristic of these animals is the absence of front teeth in the upper jaw. They bite off grass or hay by pressing the lower front teeth against the hard upper gum.

Non-ruminants are of three types:

1. These animals have single stomachs and usually eat more concentrates, such as grains and grain products. Swine and rabbits are in this group.
2. Horses, although they have a single stomach, have a large intestine to aid in the digestion of coarse foods.
3. All fowl including chickens, turkeys, ducks, etc., have a gizzard instead of teeth which grinds their food. Tests have shown that a chicken gizzard can grind a nail in two and can exert a pressure equal to 500 pounds per square inch.

WHAT ANIMALS EAT (types of feeds)

Roughages are coarse feeds, such as hay, grass, straw, cornstalks, and silage. These feeds make up the largest part of the diet of ruminants and horses. Swine do well when allowed to run in good pasture.

Concentrates are those feeds made up of grains and grain products, such as hominy, wheat, barley, corn, cottonseed meal, linseed meal, etc.

Minerals, such as calcium, phosphorous, and salt, are very important to the health and growth of animals, as they are to man. If animals are healthy, they produce better foods for man, such as milk, meat, eggs, etc.

Vitamins, such as Vitamins A, B, B_1, C, and D, are as important in the development of strong healthy animals as they are to man.

Water is vital to animals for growth and health. The amount of clean, fresh water needed will depend upon the size of the animal, kind of feed eaten, and the weather.

VT 001 093
Course of Study for Ornamental Horticulture Courses.

Rockland County Center of Technology and Education, West Nyack, N.Y. Ornamental Horticulture Dept.
MF AVAILABLE IN VT-ERIC SET.
PUB DATE - 1Apr66 34p.
DESCRIPTORS - *PROGRAM GUIDES; CURRICULUM GUIDES; VOCATIONAL AGRICULTURE; *ORNAMENTAL HORTICULTURE; *LANDSCAPING; *NURSERIES (HORTICULTURE); GRADE 11; GRADE 12; *ORNAMENTAL HORTICULTURE OCCUPATION

ABSTRACT - This program guide covers a 2-year high school course in landscaping and nursery management and mechanics, intended to prepare students for entry into horticultural occupations or for continued education in the field. The material is designed primarily for grades 11 and 12 and is divided into two courses of study, covering the same subject material but set up on ability levels with varying degrees of technical information and practical work. Contents provide: (1) general and specific aims of the program, (2) information on the advisory board, (3) policies regarding sale of plants and work projects, (4) suggested facilities, including costs, (5) service accounts, (6) cooperative work programs, and (7) explanation of the course of study, including work experience requirements, credits, time requirement, and a breakdown of the study units. Study units are: (1) Orientation, (2) Plants, (3) Plant Pest and Controls, (4) Soils, (5) Nursery Management, (6) Landscape Planning, (7) Landscaping, (8) Landscaping Maintenance, (9) Christmas Decorations, (10) Business Management Relations, (11) Mechanics, and (12) Student Practice. (AW)

VT 001 093

ED0 45856

BOARD OF COOPERATIVE EDUCATIONAL SERVICES

OF ROCKLAND COUNTY

COURSE OF STUDY

for

ORNAMENTAL HORTICULTURAL COURSES

ROCKLAND COUNTY CENTER OF TECHNOLOGY AND EDUCATION

61 Parrott Road
West Nyack, N. Y. 10994

ERNEST J. STEDGE
ORNAMENTAL HORTICULTURAL DEPARTMENT HEAD

VT 01093

U.S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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COURSE OF STUDY FOR:

ORNAMENTAL HORTICULTURE 1 and 2

called APPLIED LANDSCAPING AND MECHANICS

and

ORNAMENTAL HORTICULTURE 3 and 4

called LANDSCAPING-NURSERY MANAGEMENT AND MECHANICS

Offered to the students of Rockland County

through the

ORNAMENTAL HORTICULTURE DEPARTMENT

ROCKLAND COUNTY CENTER OF TECHNOLOGY AND EDUCATION
61 Parrott Road
West Nyack, N. Y. 10994

APPROVED: NEW YORK STATE DEPARTMENT OF EDUCATION
BUREAU OF SECONDARY CURRICULUM DEVELOPMENT
and
BUREAU OF AGRICULTURAL EDUCATION
April 1, 1966

FORWARD

The staff charged with the task of preparing this course of study on Ornamental Horticultural courses recognized that Ornamental Horticulture has a definite part to play in today's educational goals. The Ornamental Horticulture program at the Rockland County Center of Technology & Education is a team approach on the part of all school personnel, industry, and parents, who are aware that competency and success at a job depend upon diligent training and the willingness of a student to put forth that special effort necessary to succeed.

One of the important objectives of the staff is to keep abreast of the challenge to send students forth confidently into this age of automation with character qualities and salesable skills which will enable them to find rewarding and satisfying employment.

A second, and equally important, aim is to formulate an overall picture of what is required in implementing such curriculums. General and specific aims, cost factors with regards to facilities, equipment, cooperative programs, were but a few areas documented to complete the planning picture.

Since the first approval by the Bureau of Agricultural Education, the New York State Department of Education,* many changes in the facilities and organization presentation have occurred that have made revision of the course of study desirable. The staff has adhered to the objectives of the original course of study. The outline of the curriculum has been maintained with the revisions directed at:

1. Design of new facilities
2. Revision of curriculum to meet the State Education Department's new Master Plan for Area Programs
3. Inclusion of new equipment added to new units of study
4. Deletion of section dealing with obsolete areas of instruction

Ernest Stedge, Department Head
Ornamental Horticulture
January 15, 1966

*January 15, 1962

HISTORY OF BOCES

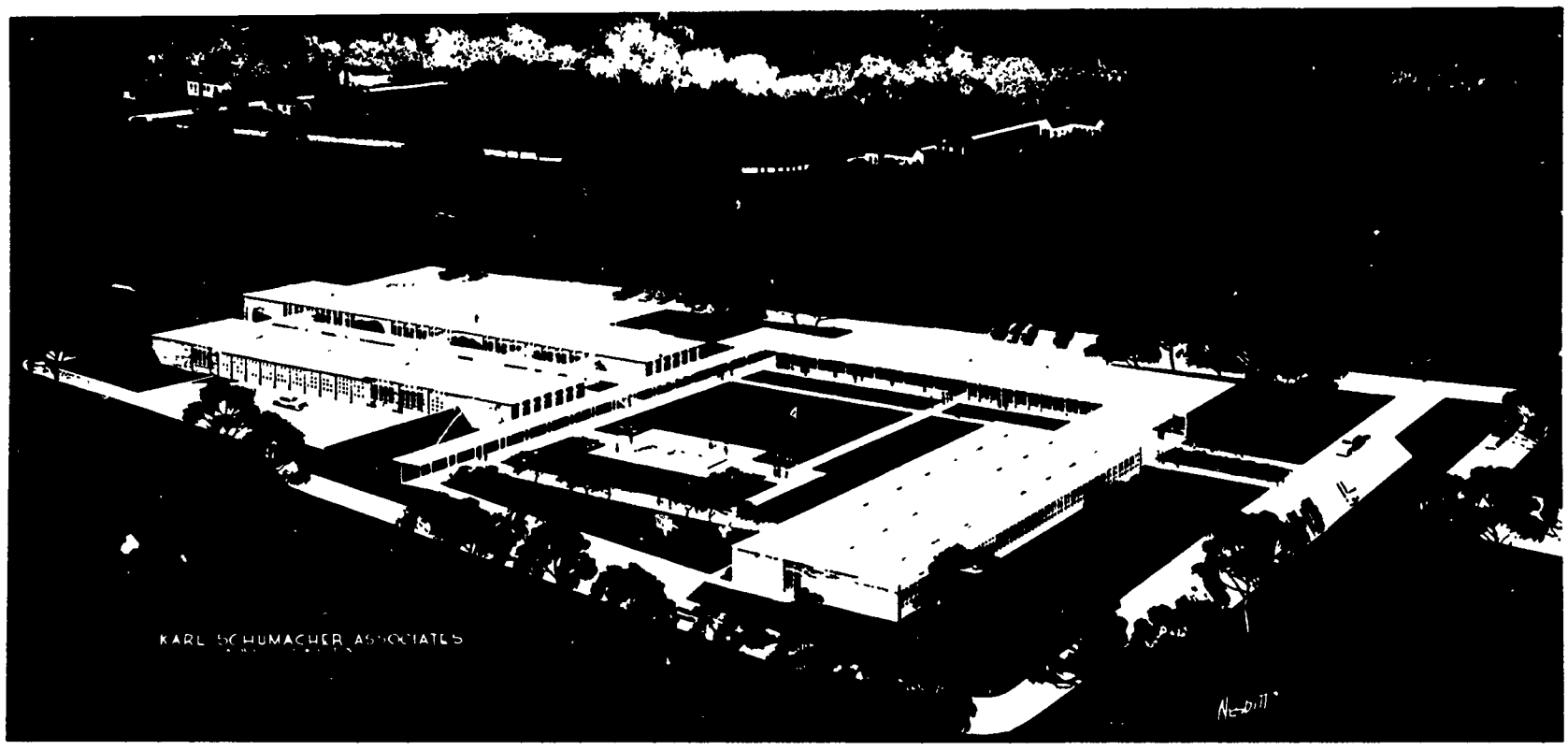
The name "Board of Cooperative Educational Services" goes back only to July 1, 1961, but the history behind its formation extends back to 1930. At that time the need for establishing a supplementary educational facility resulted in the creation of the Vocational Education & Extension Board; the first of its kind in New York State.

In 1946 Rockland County school districts, in cooperation with VEEB, established a decentralized vocational education program. Vocational courses were established in various locations throughout the county with a transportation system which made it possible to transport students to their various courses.

As a result of this far-reaching action, Rockland County offered its youth trade and technical education which increased their productive power and prepared them for work designed to give direction to their lives.

It has become evident in reports from industry, business and labor areas that many trade and technical students have since become leaders in their respective fields.

In 1963 the building program to centralize the facilities was initiated.



Pictured above is the architect's drawing of the completed Center of Technology & Education building complex. Located on 21 acres of land at 61 Parrott Road, West Nyack, New York, the center houses 20 occupational and technical courses in Agriculture, Health, Trades, Business and Technical Education. Here, in the most modern facilities, the youth of Rockland County are offered educational opportunities second to none.

Note-Ornamental Horticulture courses have been taught contininously since 1934 first at the Nyack Public School, then VEEB and now BOCES.

ACKNOWLEDGMENT

Acknowledgment is hereby given to the many who have helped in the preparation of this curriculum course of study, especially to: the members of the Landscaping Advisory Board, herein listed; Dr. John F. Hopf, Jr., Executive Officer; Mr. Orvis Hazard, Director of Programs; Mr. A. Thomas Castelli, Director of Occupational Education; the Bureau of Agricultural Education, New York State Department of Education; Aaron Fried, Director of Rockland County Planning Board; members of the secretarial and business staff who assisted in the documentation, typing, and proofreading of the material; the Drafting class instructor and students who designed the cover; and to the Business Machines class instructor and students who printed and assembled same.

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ROCKLAND IN MEGALOPOLIS

Aaron D. Fried, Director
Rockland County Planning Board

About one year ago, the New York State Office for Regional Development put out a book called "Change, Challenge, Response". The introduction contained some interesting statistics.

In the year of 6000 B.C. man had occupied this planet for some 500,000 years. The population of the world at that time was estimated at 5 million people. That which took half a million years, now is duplicated in 30 days. By the year 2000, some 35 years from now, 5 million people will be added to the world's population every 11 days. The population of our State, at present about 17,000,000, should rise to about 30 million.

The population explosion is no longer a major news item. Except for a sporadic television documentary, or occasional article, it no longer occupies the center stage of puplic interest. But it still exists and its effects are being felt not only world wide, but even down to our own County.

The greatest concentration of people in the United States is the New York Metropolitan Area, the center of the eastern saeboard's Megalopolis. The population of this urban complex is 16 million people, more than the combined population of Sweden, Norway and Denmark. Within the New York State section of this Tri-State region, consisting of the City of New York, and the Counties of Westchester, Nassau, Suffolk and Rockland, are 2/3 of the State's total population.

This population of 16 million is about equally divided between New York City, containing 8 million people on 315 square miles, and the rest of the region's 17 counties, containing 8 million people on 6,600 square miles. The next 20 years, according to the Regional Plan Association, will bring an additional 6 million people to our region--raising its population to 22 million. To house this population may require an additional 1,800,000 homes.

The first thought that comes to mind, is where will these people live? If present trends continue, the Core region, that is New York City and the near New Jersey counties, will not take any part of the coming population. Barring a major change in taste or policy, this area will probably decline by about 450,000 people by 1985. Figures released by the Regional Plan Association shows that in 1963 building permits in this area plummeted downward by 29%.

The already developed suburbs of the inner ring of counties, including Nassau, Bergen and southern Westchester, will take very few of these people. Again, quoting the same source, building permits here have also declined, by about 1%. Current apartment construction in these inner suburbs does not seem to be attracting younger families with children. They are built in areas with aging population and declining household sizes. Therefore a relatively stable population is forecast for 1985 for this inner ring.

The 6 million, plus a good part of the 450,000 projected to leave the core areas, will be looking for housing in the relatively undeveloped portions of the region, such as Rockland, Northern Westchester, Orange and Suffolk in New York; Sussex, Warren, Hunterdon, Mercer and Monmouth Counties in New Jersey.

The current density of this area is about 2,300 persons per committed square mile, that is per square mile of developed land including parks; as compared to densities of 31,000 per square mile for the Core area, and 6,500 persons per square mile for the developed suburbs of the Inner Ring of countries, previously described. This intermediate ring of countries, including Rockland, has shown the greatest growth rate in the 1963 study cited before. Building permits between 1960 and 1963 are up about 15%. The fastest growing in the region, is Rockland, where building permits were up 25% in that period.

This metropolitan region will grow for two basic reasons:
First. Our area is sufficiently advanced technologically to attract economic activity that will push the 1960 employment figure of 6.7 million to almost 9 million jobs in the next 20 years.
Second. The major part of the population increase will be our own children. In fact, out-migration from the Region may equal in-migration in about 10 years, and still do no violence to the growth figure of 6 million persons.

The age distribution of these people may show some sharp changes. While the total population will rise by about 37%, the number of school-age children will increase by 55%, and the college-age population will increaseby 94%; possibly indicating the need for new levels of public education. The lack of depression babies has caused a decline in the 30 to 34 year age group. This is the age when a family is established enough to purchase a home. This temporary decline is an important reason for the slowdown in single-family home construction today. As the large baby boom of the post war period reaches this age group, roughly about 1975, development pressures will rise to new heights.

Where does Rockland fit into this regional picture that we have described? Let us backtrack for a moment, and present some of out past population history and future estimates, in some dry, but nevertheless significant statistics.

In 1950, a short 15 years ago, the population of Rockland County stood at 90,000. The yaer 1950 found us a self-contained community, with relatively few commuters, living on the outer edge of the metropolitan area. There was little concern about schools and sewers, drainage, roads, or industry. Planning, zoning, subdivision regulations, county health departments, town engineers were topics of little importance.

By 1960, this population had increased 52% to 138,000. This growth over the 10 years, was of course not steady. The building of the Tappan Zee Bridge in 1956, and the opening of the Palisades Interstate Parkway in 1958, catapulted us into the metropolitan region, and we were on our way to the hectic pattern of growth we are experiencing today.

In the three years between 1960 and 1963, the population rose another 18% to 162,000 and the end is not in sight. Based on present zoning, the population of our county will be in the neighborhood of 360,000 persons by 1980. This represents an additional increase of over 120%. Thus over the next 15 years, we should add about 198,000 people or approximately 57,000 families to the County.

This population projection is based on present zoned capacity of buildable land within the County, and it should be understood that it does not represent ultimate growth. Forces operating to increase this figure are zoning changes, conversions, and multi-family constructions

The rate of growth, presently about 6 to 7% yearly, will increase year by year, until about 1969. After that it will decrease until about 1980, when it should sustain itself at that level.

Residential development moved out to Rockland County in the late 1950's, with most of the new residents commuting to jobs in New York City. It didn't take long before they found that the local road system needed some patching and that the schools had to be enlarged. Before long, a controlled access highway was reguired to speed them to the city; and new high schools were needed. Industry and commerce from the central city came in, looking for better surroundings for their expanded business. For a dubious financial advantage, the new communities opened their doors to these employment centers and thereby sowed the seed of unbanization. The industrial development increased the demand for residental development and thus, for further school expansion. The community then looked for additional non-residential revenue producers, and soon, the cycle began again. Pretty soon the septic systems started to break down, and we found the need for sanitary sewer facilities. The simple problem of a new development became a very complex problem indeed.

People who fled from the city because of high rents, poor schools and to be in the "country" have found that these goals have eluded them. The desire to escape burdensome taxes has led these people to embrace industry as a fiscal salvation, unaware of Industry's attendant urban needs. At the same time, their urbane sophistication has led then to favor services that only high density can support--shops, services, theatres and better transportation to the city.

The situation envisaged by the Regional Plan Association, of a sprawling urbanization, spreading from the beaches of Montauk to the mountains of Middletown, represents a range of possibilities, if not probabilities. But, it does not yet form a plan to be considered by its constituent counties. Our accomodation to the pressure of this megalopolitan monster is therefore somewhat vague.

It would seem that if the 315 square miles of New York City can support 8 million people, then certainly 14 million remaining people can live on 6,600 square miles. Yet, the distribution of this population of 14 million is of critical importance if this metropolitan area is to survive as a proper environment. Of course, ther is some doubt that a circumscribed area of 22 counties, supporting 22 million people, can ever be called a proper environment, no matter how fine the plan.

How much of this projected development will assumed by Rockland County is difficult to predict. At present, our land, some 2-1/2% of the total Region, houses about 1% of its population. The limiting factor we can apply is the zoning ordinances which hold the population possible to the previously mentioned 360,000, or approximately 1-3/4% of the projected Region's population by 1985. Of course, the viability of zoning ordinances is questionable. For example, most of the County is engaged in the County increasing its density.

But we cannot forget that lurking figure of a population of 30 million for our State in 35 years. If we are to take a responsible approach to our growth, then we must secure our long range values against temptations to maximize immediate revenue returns. These values include proper development standards, preservation of our remaining natural endowment, and last, but not least, the provision of housing that allows a variety of choice and occupancy.

By these three values--proper development standards, preservation of open space, and variet of housing--we may overcome the challenge of the population explosion, and while still absorbing a share of the coming people, pass on our natural heritage, undamaged, to the succeeding generation.

GENERAL AIMS

The general objective of the Ornamental Horticulture Department is to provide as much basic information from the course content as possible coupled with providing training situations equal to commercial and practical institutions in the field in order to enable the students an opportunity to:

1. Become acquainted with the industry, its opportunities, advantages and disadvantages.

2. Experience real and actual practices.

3. Acquire skills that are demanded in the trade and marketable by the student.

4. Acquire good working habits such as: safety practices, cooperation with fellow workers, responsibility, the care of equipment and tools and the ability to follow and carry out instructions.

5. Acquire the satisfaction of efficient and quality production on the job.

6. Acquire appreciation for the dignity of work.

7. Prepare for advanced education in this field.

The above general aims will aid students to become gainfully employed where job opportunities now exist. The needs will increase as the county approaches the forecast in the article entitled "Rockland in Megalopolis" and demand for these services increase. Typical occupations for which pupils are trained for are:

Local, town, city, or state park employee - approximately 30% of county in park areas

School grounds employee - approximately 70 school areas

Garden center employee or operator

Landscape gardener or maintenance employee or operator of own business

Nursery employee or operator of own nursery

Ground maintenance employee for industrial buildings or operator supplying service

Golf Course grounds employee

Cemetery grounds keeper

Greenhouse employee or worker

Botanical garden workers

Highway or utility company employee for maintenance of highway property and trees - and rights of way

Tree pruners

Arborist employee or self employed

Spray operator employee or self employed

Lawn mower repair shop employee or operator

Garden and agricultural equipment repairman or salesman employee or owner of business

Stock man in parts department

Equipment operator employee or owner

Plus many other jobs directly or indirectly connected with Ornamental Horticulture or further education.

ERIC

SPECIFIC GOALS

I. ORNAMENTAL HORTICULTURE 1 and 2
called: APPLIED LANDSCAPING AND MECHANICS

For students in the 9th and 10th grades and other students interested primarily in employment after leaving school. It offers training in the subject areas of an applied nature and would enable students to obtain employment with landscapers, nurserymen, tree workers, small engine repair shops, equipment dealers, lawn maintenance operators, garden centers and other sales outlets, golf courses and public parks and other employment in the nature of landscaping maintenance.

II. ORNAMENTAL HORTICULTURE 3 and 4
called: LANDSCAPING-NURSERY MANAGEMENT AND MECHANICS

For high school students in the 11th and 12th grades whose interest after high school may be employment, self-employment or a continuation of their education. It offers training and instruction through detailed technical units of study and enables students to obtain employment in any of the areas listed above, plus excellent opportunities for self-employment in fields of landscaping, nursery and mechanics maintenance and sales.

It also offers excellent background and preparation for further education in the many fields of agriculture and ornamental horticulture, landscaping and mechanics.

LANDSCAPING DEPARTMENT ADVISORY BOARD*

Term of Office

1966-1971 - Robert Pugh, Chairman
Landscaping contractor
231 McNamara Road, Spring Valley, New York

Landscaping Contractor and Nurseryman - 20 years.
Graduate Rutgers University - Landscaping
Landscaping Engineer - Rutgers University - 9 years.
Member:
- Ramapo Town Planning Board
- Rockland County Nurserymen's Assoc., Past President
- Tri-County Nurserymen's Association of Rockland - Orange - Ulster Counties.
- New York State Nurserymen's Assoc., [redacted]
- Rotary Club - Past President
- Conservation Association
- Rockland County Extension Service - Board of Directors

1965-1970 - Victor Musso - Nurseryman and Landscaper
Pine Knoll Nursery (owner)
45 N. Airmont Road, Suffern, New York

Nurseryman and Landscaper - 15 years
Member:
- Rockland County Nurserymen's Assoc. - Past President
- Tri-County Nurserymen's Association of Rockland - Orange - Ulster Counties - President
- New York Nurserymen's Association, President
- American Association of Nurserymen
- Rockland County Extension Service

1964-1969 - Ira Wicks, Jr. - Arborist and Landscaper
203 Spook Rock Road
Suffern, New York

Partner with father:
- Ira F. Wicks and Son
- Tree and Shrub Specialists

Arborist - 15 years
Attended - Paul Smith and Stockbridge Agricultural Colleges
Graduate - University of Massachusetts - Arborist
Member:
- Rockland County Nurserymen's Association
- New York State Arborist Assoc. -Board of Directors
- National Arborist Association
- National Shade Tree Conference
- New Jersey Shade Tree Commission
- Rotary
- Rockland County Extension Service - Board of Directors

Term of Office		
1963-1968	-	Herman Brandt - Nurseryman and Lanscaper Horticulturist, Queens Botanical Garden Flushing, N.Y. Nurseryman and Landscaper - Operator of own nursery and Landscaping Service for 35 years Plant Propagator and Breeder Rockland County Nurserymen's Association Rockland County Extension Service
1962-1967	-	Kenneth Dilts - Nurseryman and Landscaper Summit Park Nursery (owner) 13 West New Hempstead Road, Spring Valley, New York Nurseryman and Landscaper - 23 years Member: Rockland County Nurserymen's Assoc. - President Rockland County Extension Services - Board of Directors Rockland County Nursery Commodity Committee - Chairman
Ex-Officio Members	-	Dr. John Hopf - Executive Officer of the Board of Cooperative Services Orvis Hazard - Director of Programs for the Board of Cooperative Services Thomas Castelli - Director of Occupational Education at the Center of Technology and Education Paul Lutz - Rockland County Agricultural Extension Agent
Secretary	-	Ernest J. Stedge - Landscaping Instructor (Appointed by Advisory Board)
Arboretum Advisor	-	Martin Flayter, Director Queens Botanical Garden 43-50 Main Street, Flushing, N.Y.

*Appointed by official action of the Board of Cooperative Educational Services in October 1962, from a list submitted by the instructor, and each member was informed of his appointment by letter from Dr. Hopf, Superintendent of Schools, and Executive Officer of the Cooperative Board. All members were reappointed for a second term.

*POLICIES IN REGARD TO SALE OF NURSERY PLANT MATERIALS AND LIVE WORK PROJECTS:

1. Nursery plant materials can be auctioned or sold into the wholesale trade, but cannot be offered for sale to the general public.
2. Landscaping and grounds maintenance projects cannot be done for private individuals or industry but only for non-profit institutions, and only if the projects can be of educational benefit to the class.
3. Live work on engines, tractors and other agricultural equipment can be done for individuals in the department's shop. Work will be selected and limited to that which will provide the desired experience and practice for the program, and no promise to finish such work for a specified time will be given. The work must fit within the scope and objectives of the program.
4. Maintenance and repair of equipment, nursery work and landscaping projects owned by Board of Cooperative Educational Services has priority.

*Recommended by Landscaping Advisory Board, and Approved by BOCES Board Action

FACILITIES

Each department's facility at the Rockland County Center of Technology and Education is complete and independent from each other with modern, well lighted, heated and ventilated areas. The facilities within each department are connected and arranged in such a way as to provide the specific needs of the department in addition to their efficient use.

The Ornamental Horticulture Department facilities*, which are available for instrucation at the Center, are described as follows with replacement value of same, excepting the cost of the buildings, in order that the information should be of value to anyone planning facilities for like courses.

CLASSROOM 20 X 30 600 sq. ft.

Equipped with 16 lineal feet blackboard, 20 lineal feet of bulletin or tack board, 40 lineal feet back shelf, and telephone. The classroom opens into shop area and into the library.

Teacher's desk and chair	$ 100.00
4 - 8' X 2-1/2' utility tables with laboratory tops	500.00
18 - student chairs	145.00
2 - 4-drawer legal files with locks	175.00
1 - Storage cabinet, 3' X 6', doors and lock	50.00
1 - Botanical chart	20.00
Open bulletin (6' X 8' X 1-1/2') file containing publications from: N.Y. State College of Agriculture; N.Y. State College of Forestry; Other State Colleges of Agriculture; U.S. Department of Agriculture; Commercial Companies	250.00
16 mm sound motion picture projector	450.00
35 mm slide projector	100.00
Overhead projector	225.00
Soil sampling and testing equipment	300.00
Microscope	150.00
Slides, transparancies & other Visual Aids	350.00
Textbooks	850.00
CLASSROOM TOTAL	$ 3,665.00

*The Department maintains facilities for a class load of 18 students per session per instructor, as well as toilet and shower facilities with lockers for each student enrolled in the department's courses. (At present one instructor is employed, but with present layout and equipment, the department could expand to a three-teacher station situation with corresponding student load.)

LIBRARY 10' X 14' 140 sq. ft.

Connected to classroom and equipped with 150 lineal feet of book shelf space	$ 275.00
Reading table and 2 chairs	50.00
Periodicals - at least 10 paid subscriptions to trade and horticulture magazines	75.00
Reference books	2000.00
LIBRARY TOTAL	$ 2400.00

MAIN SHOP 30' X 40' 1200 sq. ft.

Located between and connected to classroom and greenhouse workroom, and opening into garage and tractor shop by overhead door. Also connects to locker and shower room area. Shop is fully equipped to completely overhaul and maintain any lanscaping or gardening equipment, such as tractors, small gas engines, sprayers, lawn mower, etc.

Equipped with 60 lineal feet of bench area 28" wide with tool board and wire mold on wall above benches and shelf under benches	$ 800.00
2-island benches, 5' X 5', equipped with vises and lockers underneath	500.00
2-island benches, 7' X 28", equipped with heavy duty shop vises	200.00
14 lineal feet of bench for power tools along wall	120.00
3-recoil extension lines over island benches	45.00
1-shop desk-portable	55.00

The list of equipment and tools includes the following:

Hand tools: Socket wrench sets, end wrenches, box wrenches, screwdrivers, deep well sockets, pliers, hammers wheel and gear pullers, punches, torque wrenches, soft face hammers, taps and dies, etc.	1500.00
Special hand Tools: for small gas engines and tractors include ring extractors, valve spring compressors, cylinder hones, reamers, carburetor tools, fly wheel pullers, etc.	500.00
Test and Measuring Equipment: timing light, compression gauge, spark plug testers and cleaners, ignition coil and iondensor tester, generator and voltage regulator testor, tachometer, micrometer, calipers, telescopic gauges, etc.	500.00
Power Tools: Drill press 1/2" chuck, power buffers, bench grinders, rotary blade grinders, blade balancer, chain saw blade grinders, 1/2" air impact wrench, arbor press, portable electric drills, 1/2" and 1/4", valve facer and seat grinder, soldering equipment, etc.	2000.00

Shop Manuals

Up to date repair manuals for all tractor and chain saws, small gas engines, and outboard motors. $ 150.00

Shop Visual Aids and Charts

Complete sets of Charts 50.00

MAIN SHOP TOTAL $6,420.00

SHOP STORAGE for parts and special tools and test equipment not kept on the tool board in the Main Shop. 10' X 10', 100 sq. feet, with 300 sq. ft. of shelf area and 80 sq. feet of drawer area for parts and supplies.

Shelving and drawers	450.00
Supplies, such as nuts, bolts, washers, some small parts, oil, hydraulic fluid, emery paper, rags, etc.	150.00
SHOP STORAGE TOTAL	$ 600.00

TRACTOR GARAGE AND SHOP 30' X 40' 1200 sq. ft.

Connected to main shop by overhead door and open outside by 14' overhead door.

1 - High pressure air line connection for air hose	$ 15.00
1 - Parts cleaning table with cleaning fluid pump	250.00
1 - Steam cleaner	400.00
1 - OxyAcetylene welding equipment	300.00
1 - Arc welding equipment	250.00
1 - Welding table and curtains	75.00
2 - Chain hoist and trolleys 1/2 T and 1 T	185.00
1 - 10 T hydraulic jack	200.00
1 - Pressure grease outfit	200.00
TOTAL SHOP EQUIPMENT IN TRACTOR SHOP	$ 1,875.00

LANDSCAPING EQUIPMENT

The tractors, sprayer and rototiller are stored in the tractor garage. The other landscaping equipment, except the trucks which are stored outside, are stored in the 30' X 20' (600 sq. ft.) mezzanine in 1/2 of tractor shop. The landscaping equipment includes the following:

1 - Tractor - heavy duty industrial, 40 H.P., power steering, 3 point hitch and 66" landscaping front end loader.	$ 4,500.00
1 - Tractor Rake 8' complete with scairfier, grader blade and wheels	700.00

1 - Tractor-medium farm	$ 2,000.00
1 - Trailor 2-wheeled tractor	100.00
1 - Rototiller-"Arions" 28" cut, 16-1/2 H.P.	1,200.00
1 - Garden tractor	300.00
1 - Sprayer - 150 gal. Sprayer 400/p.s.i. on rubber	1,000.00
2 - Lawn spreaders - one 3 ft. drill type-one broadcast type	75.00
2 - Commercial reel type lawn mowers	900.00
3 - Commercial rotary type lawn mowers	360.00
1 - Chain saw	175.00
1 - Reciprocating power saw	195.00
3 - Wheelbarrows	105.00
1 - Dump truck - 4yd. water level	Army surplus
1 - 2-1/2 T rack body truck	" "
1 - 1/2 T pick-up truck	" "
Use of 2 T fork lift	" "
Complete stock of hand tools for garden, nursery and landscaping work which includes rakes, hoes, stone forks, tree spades, long and short handled shovels, pick axes, axes, lawn rakes, planting lines, hose, pruning shears, pruning saws, light weight rakes, trowels, etc.	1,200.00
Snow Blower	300.00
LANDSCAPING EQUIPMENT TOTAL	$ 13,100.00

GREENHOUSE WORKROOM 18' X 22' 396 sq. ft.

Located between and connected to main shop and greenhouse. Location for:

Automatic controls for mist system	$ 75.00
Automatic controls and location of 42" exhaust fan	350.00
2 - Concrete work benches, 9' X 3' for potting, etc. with 2 - 3' X 3' storage bins under each bench for mixes	50.00
1 - Storage cabinet with doors and lock for knives, propagation, chemicals, labels, hand tools used in greenhouse, etc.	50.00
Automatic unit to supply liquid fertilizer to water lines	150.00
GREENHOUSE WORKROOM TOTAL	$ 675.00

TOTAL VALUE OF EQUIPMENT, SUPPLIES, etc.

Total value of equipment, supplies and other resources of Landscaping Department, excepting cost of land and buildings, and army surplus material.

TOTAL $ 33,085.00

SERVICE ACCOUNTS

In addition to above, we have two service accounts with revolving funds as follows:

$300. - Repair shop
300. - Plants

COOPERATIVE PROGRAMS WITHIN THE CENTER

A cooperative program within the center is very useful and a real benefit to the total program as explained in the following two areas:

1. Exchange teaching in which the welding department, with its excellent facilities for 18 students, teaches the Landscaping students welding while the welding students may be in a Drafting class and the Drafting students are in the Landscaping class.

2. Assistance in providing materials and other help from the specific specialities of the various Departments, for example, plans from Drafting Department, printing and mimeo from Business Machines Department, standardization of test equipment by Instrumentation Department, repair and making of machine parts by Machine Shop, etc.

TRANSPORTATION FOR FIELD TRIPS

Vehicles and drivers available for planned field trips

COOPERATIVE PROGRAMS WITH OTHER AGENCIES

Lawn demonstration plot in cooperation with the Rockland County Extension Service, and the Rockland County Garden Equipment and Garden Supply Dealers Association.

Ground cover plots in cooperation with Rockland County Extension Service and the Rockland County Nurserymen's Association.

Nursery weed control plots and other demonstration plots in cooperation with the Rockland County Extension Service, and the Ornamentals Research Laboratory located at Farmingdale under Dr. Arthur Bing, Cornell.

STUDENT REQUIREMENTS

Students must purchase 2 uniforms (shirt and pants) and loose leaf notebook.

COURSE OF STUDY EXPLANATION

The following course of study applies to both courses. The subject matter for each being comparable as to content and time spent, but the approach to the various jobs are entirely different.

For the Applied Landscaping and Mechanics the approach is practical, with very little technical material, whereas for the Landscaping-Nursery Management and Mechanics the approach is more technical in order to train those students interested in more advanced positions or further education in the field.

The course of study is based on a two year sequence with each year independent of each other.

The periods listed are based on 60 minutes per period, but the actual instruction per day is not divided into three 60-minute periods. Students will recieve approximately one hour of related work and two hours of actual practical work per day. There are times in the early fall and late spring when the entire three hours will be spent in actual job experience in the greenhouse, nursery and grounds.

In general, the course of study is divided with 1/3 for Landscaping, 1/3 for Nursery Management and 1/3 for Mechanics.

STATEMENT OF TIME

60 minute periods, 3 periods per day for 180 days =540 periods or hours of instruction per year, or 1,080 periods or hours for two years, plus approved supervised work experience outside of regular school time.

COURSE OF STUDY EXPLANATION, con't.

Each student must have at least 500 hours of actual instruction per year during regular school hours, and any time lost due to absence from school for any reason must be made up.

WORK EXPERIENCE REQUIREMENT

Each student, except graduating seniors, must have full-time approved employment or be self-employed in the fields of Landscaping-Nursery or allied work for 400 hours; or he must attend planned work experience program at our school nursery for a total of 22 days, 8 hours per day. Students will be transported to and from programs. The only excuses allowed are as follows:

> For each 3 days of approved part-time employment, student's attendance will be reduced one day in program at nursery. Students who have nursery projects will have time reduced according to size of area and number of plants in nursery (approximately one day per 1,000 square feet). However, each program is treated individually.

Program and schedule is set up for each student in June. Each student employed or self-employed will be visited at least once a week to go over records and other necessary instructions.

STATEMENT OF CREDIT

Each student receives 3 units of credit per year on satisfactory completion of classroom instruction and supervised work experience.

All final grades, except graduating seniors, will be given in September after students have completed this work experience requirement.

COURSE OF STUDY EXPLANATION
(continued)

Seniors who have completed the work experience requirement in their junior year will also receive three credits in their senior year. If a student in his senior year is admitted to the program by special permission without taking the course in his junior year, he will receive only 2 credits for the year's work - otherwise there is no partial credit. All requirements must be met or no credit will be given.

STUDENT-INDUSTRY COOPERATIVE PROGRAM

Students who are seniors in high school and have satisfactorily completed their previous year in the program with one year's work experience requirement may be released from the program four days per week, starting April 1st of their senior year, to start employment in the field. This will provide those who take part an opportunity to obtain on-the-job training in a job they can continue after graduation, and also provides them training during the season of the year when much of the work in this field is done.

Only students recommended by the instructor will be able to participate in the program, and only after a conference and certain agreements are signed by the parties concerned (student, parents, employer, and Landscaping Department as agency for BOCES) will the actual program begin.

Records must be furnished regularly by the students and employer in regard to work, attendance, etc.

COURSE OF STUDY	Season of Instruction	Periods of Instruction (Each period=1 hour) 1st year	2nd year
A. ORIENTATION			
1. Introduction to industry	F	1	
2. Status of industry	F	2	
3. Job opportunities in landscaping, nursery and related areas.	W	3	3
B. PLANTS			
1. Plant structure and terminology	F	6	3
2. Use of identification keys	F	3	
3. Identification of woody plant materials, their growth habits and ornamental value	F-W-S	45	25
4. Identification of herbaceous plants, their growth habits and ornamental value	F-S	15	
5. Physiological processes and environmental factors influencing plant growth	W	6	
6. Propagation of plant materials			
(a) Cuttings	F	15	
(b) Grafting and budding	S		15
(c) Layering	S	2	
(d) Division	F	2	
(e) Seeds	W-S	6	
7. Plant breeding	W		3
C. PLANT PEST AND CONTROLS			
1. Safety in the use and handling of chemicals	W	2	2
2. Nature of insects and method of control	F-W	4	
3. Nature of diseases and method of control	F-W	4	
4. Nature of weeds and methods of control	W-S	4	
D. SOIL			
1. Nature of soils	W	3	
2. Organic matter - its value and use	W	3	

COURSE OF STUDY	Season of Instruction	Periods of Instruction 1st year	2nd year
D. SOIL (Con't.)			
3. Soil judging and value	S		6
4. Soil sampling and testing - procedure and practice	F-W-S	12	8
5. Fertilizers and their use	W	3	3
6. pH - understanding, testing and adjustment	F-W	12	8
7. Soil mixtures - propagation, potting, etc.	W	3	3
8. Soil sterilization for pest control	S		6
9. Water in relation to soils and its management	W		4
E. NURSERY MANAGEMENT			
1. Nursery layout	S		3
2. Preparation and management of nursery soils	F-S		6
3. Securing and handling plant materials for planting	W		3
4. Lining out stock	S		15
5. Transplanting	S		3
6. Pruning and training plants in nursery	S		6
7. Greenhouse use and practice as it pertains to nursery management	F-W-S	15	
8. Use of cold frames and other types of plant starting units	F		9
9. Balling and burlaping plants	S-F		15
10. Bare root digging	S		9
11. Cultivation and chemical weed control in the nursery	S		9
12. Control of insects and diseases in the nursery	S		9
13. Care and handling of plant ready for sale	F-S	9	

COURSE OF STUDY	Season of Instruction	Periods of Instruction 1st year	2nd year
E. NURSERY MANAGEMENT (Con't.)			
14. Management of lath house for holding plants for sales	F-S		9
F. LANDSCAPE PLANNING			
1. Aesthetic and economic importance of landscaping and home grounds improvement	W	2	
2. Site selection and value in landscaping	W	1	
3. Requirements of a landscaping plan	W	2	
4. Principles and layout of the three landscaping areas	W	4	
5. Selection and use of trees in the landscape	W	4	
6. Using lawns in the landscape	W	1	
7. Using foundation plantings in the landscape	W	4	
8. Using border planting in the landscape	W	4	
9. Location and use of drives, walks, and other architectural features in the landscape	W	2	
10. Location and use of gardens and other plantings (vegetables, small fruits, rock gardens, hobby gardens, specimen plants, etc.)	W	2	
11. Nursery classification and selection of plant materials	W	25	
12. Use and making of landscape sketches	W	6	
13. Use of symbols and reading of blue prints and plans	W	3	
14. Making landscape plan or model	W	15	

COURSE OF STUDY	Season of Instruction	Periods of Instruction 1st year	2nd year
G. LANDSCAPE CONSTRUCTION & PLANTING			
1. Layout procedures for landscaping features and determination of grades with use of leveling instruments and transit	F		15
2. Grading of landscaping areas	F		6
3. Drainage of landscaping areas	F		6
4. Lawn construction	F		15
5. Selection and seeding of lawn seeds	F		6
6. Planting of bare root plants	S	3	
7. Planting of balled plants	S	3	
8. Planting of bulbs.	F	1	
9. Planting of herbaceous plants	S-F	2	
10. Layout and planting of garden areas	S	9	
11. Layout and construction of dry walls, walks, and other landscape features	F-W		12
H. LANDSCAPE MAINTENANCE			
1. Lawn maintenance	S-F	15	
2. Pruning and training of plant materials	S	3	12
3. Fertilization of plants	S	6	
4. Cultivation and mulching of plants	S	6	
5. Edging of plant beds and gardens	S-F	3	
6. Control of insects and diseases	S	6	
7. Winter protection of plants	F	3	
8. Garden cleanup	S	3	

COURSE OF STUDY	Season of Instruction	Periods of Instruction 1st year	2nd Year
H. LANDSCAPE MAINTENANCE (Con't.)			
9. Tree repair and bracing	W-S		6
10. Tree removal	W		5
I. CHRISTMAS DECORATIONS (off-season work)			
1. Opportunities for part-time employment or sales	W	1	
2. Selection and securing materials	W	1	1
3. Making Christmas wreaths, sprays, arrangements and corsages	W	12	5
J. BUSINESS MANAGEMENT RELATIONS			
1. Contracts and agreements	W		4
2. Job estimate and pricing	W		12
3. Local, state and federal trade and licensing regulations	W	2	
4. Labor regulations, state and federal	W		3
5. Insurance and social security	W	3	3
6. Income tax	W		4
7. Securing credit and financing	W		3
8. Record keeping	W	3	6
9. Employee and employer contacts and relationships	W		5
10. Purchasing procedures	W		3
11. Retail and wholesale sales	W		6
12. Trade papers	W		2
13. Organizations	W		2
14. Garden center operations	S		9
K. MECHANICS			
1. Shop layout, safety and procedure	F	6	3

COURSE OF STUDY	Season of Instruction	Periods of Instruction 1st year	2nd year
K. MECHANICS (Con't.)			
2. Principles of internal combustion engines-tractor and small gasoline engine	W	9	
3. Operation, safety, maintenance and repair of small engines	W-S	52	
4. Operation, safety, maintenance and repair of tractors	F-W-S		54
5. Selection, care, maintenance, and safe use of garden and nursery hand tools	F-W	9	
6. Selection, care, maintenance, and safe use of lawn mowers	W-S	6	
7. Selection, care, maintenance and safe use of sprayers and dusters	S-F		12
8. Selection, care, maintenance and safe use of landscaping and nursery power equipment	F-W-S	10	20
9. Layout and construction of concrete walks and walls	S-F	15	
10. Greenhouse and greenhouse equipment construction and maintenance	F		15
11. Heating, plumbing and electrical maintenance	W		12
12. Cold frame and starting structure construction	S		12
13. Lath house construction and maintenance	S		12
14. Safe and proper use of arc welder	W	18	
15. Safe and proper use of oxy-acetylene welder	W	15	
L. STUDENT PRACTICE			
Student will carry out chores and or projects of his own choice in the greenhouse, nursery or shop under supervision of instructor	F-W-S	30	30

COURSE OF STUDY SUMMARY

	1st year	2nd year
A. Orientation	6	3
B. Plants	100	46
C. Plant Pest and Controls	14	2
D. Soils	36	40
E. Nursery Management	24	96
F. Landscape Planning	75	--
G. Landscaping	18	60
H. Landscaping Maintenance	45	23
I. Christmas Decorations	14	6
J. Business Management Relations	8	62
K. Mechanics	140	140
L. Student Practice	30	30
Period or hours of Instruction	540	540

VT 001 238
Clark, Raymond M., And Others
Source Units for the Dairy Enterprise. Agricultural Education Source Units, Number 1.

Michigan State Univ., East Lansing. Bureau of Educational Research
MF AVAILABLE IN VT-ERIC SET.
PUB DATE - Jul64 95p.

DESCRIPTORS - *RESOURCE MATERIALS; *RESOURCE UNITS; *VOCATIONAL AGRICULTURE; *DAIRYMEN; *AGRICULTURAL PRODUCTION; SECONDARY GRADES; TEACHING GUIDES; TEACHING TECHNIQUES

ABSTRACT - Designed by an instructional materials specialist and technical experts, these source units provide high school vocational agriculture instructors with suggestions for teaching courses in dairy production. Major objectives, understandings, concepts, and abilities to be developed are provided for each unit as well as basic principles, factors for consideration, suggested learning exercises and activities, questions, and problems to be solved. The unit topics are: (1) Feeding Dairy Cattle, (2) Disease Control, (3) Understanding the Ruminant, (4) Dairy Herd Improvement, (5) Raising Dairy Calves, (6) Housing, and (7) Milking Equipment and Systems. The units provide a number of suggestions for using additional resource materials. A bibliography of books, bulletins, and films is included. (AW)

VT 001 238

ED0 45856

Agricultural Education Source Units, Number 1
July 1964

Source Units for the Dairy Enterprise

Raymond M. Clark and
William Householder, Agricultural Education
College of Education, Michigan State University
Donald Murray, Clinton Meadows, and
Donald Hillman, Cooperative Extension, Dairy
College of Agriculture, Michigan State University

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Bureau of Educational Research Services
College of Education
Michigan State University
East Lansing, Michigan

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Agricultural Education Source Units
Number 1: The Dairy Enterprise

SOURCE UNITS FOR THE DAIRY ENTERPRISE

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William Householder, Agricultural Education

College of Education, Michigan State University

Donald Murray, Clinton Meadows, and

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College of Agriculture, Michigan State University

Bureau of Educational Research Services
College of Education
Michigan State University
East Lansing, Michigan

July, 1964

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USING THE SOURCE UNITS

Teachers of Vocational Argiculture in Michigan have used large numbers of source units, prepared cooperatively by staff members in agricultural education and appropriate technical specialists in agriculture. While the sections on "questions and problems of students" and "activities of students" still provide desirable suggestions for teachers, the illustrations are often out-of-date. For example, acceptable production levels for dairy cows is much higher than was the case in 1956 when the first dairy source units were prepared.

Committees of teachers have participated in revision of these units. They have recommended that the principles on which the units are based be stated and that more specific suggestions as to subject matter and student activities be incorporated. Teachers have also suggested that the activities included in these units be sufficiently broad to provide students with experiences and study in the off-farm agricultural occupations related to the work being studied. For example, when students are studying the unit on "Feeding Dairy Cattle", opportunity now is provided for them to study the occupational opportunities and the requirements of the feed industry as it applies to the dairy enterprise. Teachers who use these units must recognize that they are designed to provide ideas for teaching. Files of lesson plans adapted to individual situations; lists of books and bulletins and other materials will be needed to supplement these units. Comments and suggestions of teachers will be welcomed.

Raymond M. Clark

FEEDING DAIRY CATTLE

SOURCE UNIT

A subject matter source unit can, at best, state basic known truths and rely upon teachers to relate them to changing times. For example, this unit recognizes the truth that increased TDN in the ration through heavier feeding of grains, especially corn and cob meal, should increase milk production. This practice is valid today partly because of a favorable price ratio between forages and grains. In years to come this price ratio may not be as favorable and even though the truth remains, that increased TDN usually increases production, it may not be feasible to practice it. Teachers are continually having to make these kinds of subject matter evaluations.

The focus of this source unit is on its stated principles and five corollaries. The principle is a scientific fact which is basic to the major objective. The corollaries are also truths which are attributed to the basic principle. It is highly desirable that all students of agriculture become aware of the scientific fact that a cow is a unique converter of low value feeds, unsuitable for human consumption, into highly valued human foods. The corollaries relate to this principle in such a way that each contributes to the awareness of the students. Through our experience we know "canned lesson plans" do not meet the needs of each and every vocational agriculture department. This unit is intended as a source of teaching ideas. It will help you build the kinds of lessons your particular students need. Under the sections, "factors which the producer needs to consider", there are included ideas and suggested procedures for visual aids and for all types of paper and pencil exercises in which you may want some or all of your students to participate.

Teachers will find it expedient to file with this source unit, mimeographs, leaflets, magazine articles and other references which are suitable. At the same time, teachers should throw away obsolete reference material.

Major Objective: To develop an understanding of the fundamental concepts of dairy cow nutrition.

Teaching the concepts of dairy cow nutrition requires the student to develop:

I. Understandings

1. Understanding the composition of feedstuffs.

2. Understanding the significance of nutritional requirements and feed standards for: growth, maintenance, production, reproduction.

3. Understanding the processes and feed programming and practical ration balancing.

4. Understanding methods of evaluation of feedstuffs.

   a. TDN and digestible protein
   b. Factors affecting forage quality

5. Understanding economic considerations and limitations in feed programming.

II. Abilities

1. Ability to classify feedstuffs, e.g., forage, concentrate, protein, and mineral.

2. Ability to plan a feeding program for a dairy herd.

3. Ability to balance rations.

4. Ability to plan the management aspects of a feeding program.

These skills and mental abilities are important in the application of the following principle:

III. Principles and Corollaries included in this unit

BASIC PRINCIPLE:

Dairying is a means of converting low value crops such as forages into high value products that can be marketed for human consumption.

Corollaries

1. Low value farm-produced forages and grains must be balanced with adequate amounts of protein if we are to make maximum use of these home grown feeds for milk production.

2. There is a relationship between milk production, and roughage and concentrate consumed by the cow. When the milk producer establishes this relationship for each cow in the herd he will have achieved the optimum in feeding.

3. Liberal feeding of concentrates before freshening and early in the lactation sets the pace for milk production to follow.

4. Cattle can utilize large amounts of corn silage when it is properly supplemented. This is fortunate for milk producers because on good corn growing land, corn silage will yield more TDN per acre than will other forages.

5. Forages supply most of the minerals required by the cow; however, the producer should guard against deficiencies in calcium, phosophorus, cobalt, iodine and common salt.

****

COROLLARY 1: Low value farm-produced forages and grains must be balanced with adequate amounts of protein if we are to make maximum use of these home grown feeds for milk production.

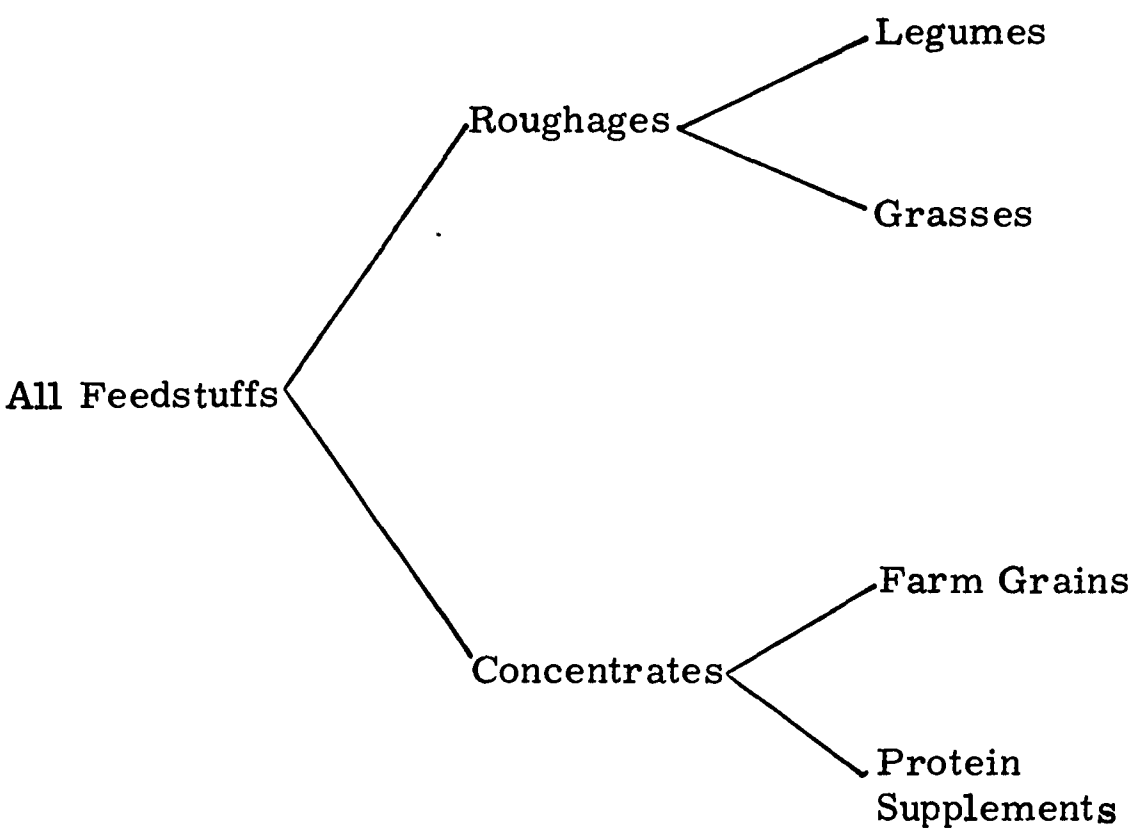
a. This means that farm grown feeds must either be fed in proper proportions, or

b. Additional protein supplements must be purchased to balance the home grown feeds. This method is generally most practical.

c. For these reasons, a knowledge of the classification and composition of feeds is vital for dairymen and for service people associated with the production of milk.

PRIMARY ASSUMPTION:

A first Classification of Feedstuffs is as Follows:



(This may be used as a transparency for the overhead projector)

SECONDARY ASSUMPTION:

Each feedstuff has its particular chemical composition.

Each individual sample of a feed will closely approximate the average known consumption.

FACTORS WHICH PRODUCERS NEED TO CONSIDER:

1. Familiarity with such terms as concentrates, roughages, carbohydrates, protein, total digestible nutrients (TDN), nitrogen-free extract (NFE), fats, minerals, and vitamins, is essential in understanding either of the above assumptions. More effective dairy nutrition is possible with a better understanding of the chemical composition of feeds:

    a. Crude fiber: A fraction of the feed that is left after repeatedly washing the sample with dilute acid and dilute base. It represents the least digestible fraction of a feedstuff. It usually contains ligium, cellulose, hemicellulose, and other carbohydrates.

    b. Nitrogen-free extract: Generally considered the carbohydrate fraction of a feedstuff. It includes sugars, starches, pectins, and other slightly soluble carbohydrates.

    c. Protein: In feed analysis, refers to the nitrogen content of the feed multiplied by 6.25 (N x 6.25= Crude Protein). Not all crude protein is true protein. Amino acids, amides, nitrates, urea and other non-protein nitrogen compounds are included in the crude protein fraction.

    d. Minerals: Natural elements contained in feeds and required for specific body functions in animals. Calcium (Ca), Phosphorus (P), Cobalt (Co), Iodine (I), Sodium (Na), and Chlorine (Cl), are normally the only elements that must be added.

    e. Vitamins: Feed ingredients required in small quantities by the animal. These enable the animal to make more efficient use of other feed ingredients. The fat soluble vitamins are the only ones to be concerned within the diet of

FACT SHEETS*, pages 461, and 347, list those feeds common to Michigan. The completed table can be left in the students' notebook for use in balancing rations, selection of Foodstuff, studying the economics of feeds and for test review. For more effective teaching, display samples of feeds, especially the more uncommon commercial feeds. It is embarrassing for a student to know about a feed and not to be able to identify it. Also use Morrison, Feeds and Feeding as a reference.

DAIRY FEED FAIR: (The shortest fair on record, 2 class periods) The objective of this activity is to have students bring to school and exhibit all sorts and kinds of dairy feed samples and specimens. Give boys a week's time to collect and prepare their feed samples. Suggest that farm boys exhibit feeds produced or consumed on their farms and that non-farm boys ask for samples of feed ingredients from the local feed elevators. However, let's not restrict boys in what they can or cannot bring.

In arranging for the fair, use your farm shop and designate areas for exhibiting samples of roughages. Grasses and corn silage are normally low in protein. Legume roughages are higher in protein. Receive and enter exhibits, arrange samples and specimens in the exhibit area and make the necessary posters and signs for proper identification and explanation. No judging is involved.

Students not in charge of the above areas can be assigned to put up special exhibits using feed samples to represent ideas as the "cow ration", "ration for feeds", "the more protein in the feed the higher the cost", "feeds rich in minerals (or vitamins)". There are a lot of ideas. Have one or two boys in charge of each exhibit. The things to stress during the fair are: (1) kind, classification and composition of feeds in such a way that students can get a perspective of the various feeds, (2) the relation to the feed needs of cows as converters of feed into high value products, and (3) the relative economics of feeds (have students determine the cost per 100 pounds of TDN, protein, etc. for several feeds).

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*Fact sheets are prepared by specialists in the Cooperative Extension Service. They are sent to all departments of vocational agriculture in Michigan as they become available.

Use a bit of your dairy class time for a week prior to the fair to organize and to orient your students. Many signs can be made during this week and hung in the exhibits. The second hour may be used to view and have individual students talk about their exhibits. The "feed fair" requires little effort and at the same time teaches a valuable lesson.

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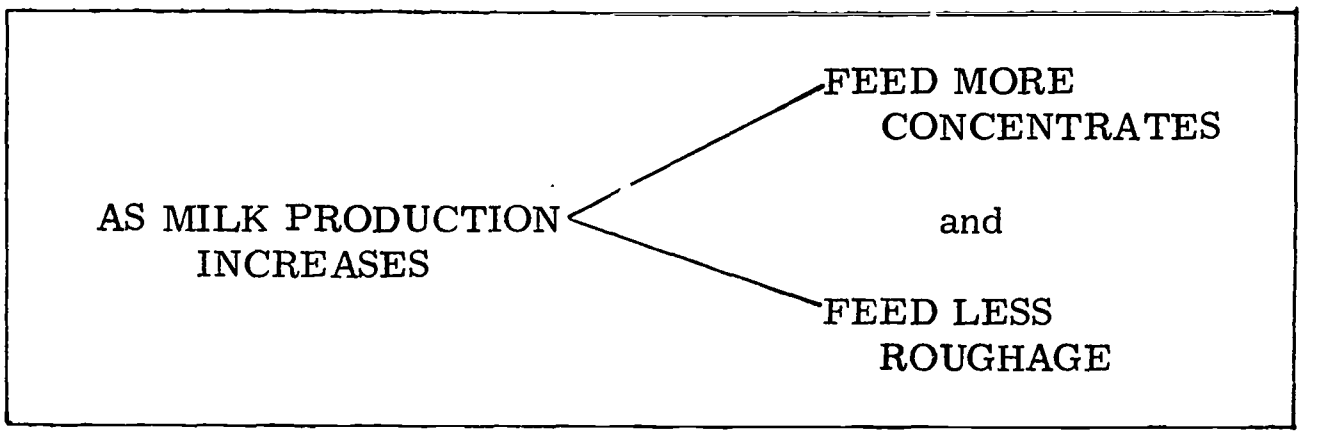
COROLLARY 2: There is a relationship between milk production, roughage and concentrate. When the milk producer establishes this relationship for each cow in the herd he has achieved the optimum in feeding.



FACTORS WHICH PRODUCERS NEED TO CONSIDER:

1. The strength of this relationship depends largely on the quality of roughages. As the quality of roughage decreases we need to increase the quality of concentrates, and increase the proportion of protein supplement.

2. TDN and digestible protein must be kept in a satisfactory balance as suggested by nutrient requirements for producing cows.

3. As milk per cow per day increases or decreases the relationship between amounts of roughages and concentrates changes. The dairyman must make the

necessary feed adjustments for each cow or group of cows according to their production, and feed them separately.

4. This relationship may also be influenced by the relative cost of roughage and grains.

LEARNING EXERCISE

From your herd of cows select ten at random, and bring the individual cow records to school, especially needed are (1) the most recent daily milk production records per cow (2) the amount of roughage and concentrate fed daily to each of the cows and (3) taped body weight of each cow. With these data compute:

a. Recommended amount of concentrate and roughage in pounds that the cow should be fed based on production and body weight. Use "A Progressive Feeding Program for Milk Production", M.S.U. Extension Bulletin, E-123.

b. How does this compare with what they are actually fed? Are you underfeeding?

c. On the basis of the data in part (a) above, what are the total feed needs (roughages and concentrates) in pounds for the month for the ten cows?

d. Can you make these conclusions: The cow's daily milk production is the direct result of the kind and amount of feed fed to each of the cows within the limits of the inherited ability of each cow. If we fed more (i.e., followed recommended rate) it would increase production and it would pay. Can you prove this to be true?

Students who do not have dairy herds to work with may participate in this activity by collecting the following data from the boys who have been working in this activity.

a. Average daily production of each set of ten cows.

b. Pounds of concentrate and roughage which should be fed to the average cow.

c. With these data verify this statement, "Assume that two dairy farmers are each feeding their cows to their milk production capacity and that one of the herds has a high production average and the other a low production average; the farm having the higher production average will need to produce more grain and less roughage per cow than the farm with the lower average".

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COROLLARY 3: Liberal feeding of concentrates before freshening and early in the lactation sets the pace for milk production to follow.

FEEDING LEADS PRODUCTION ON THE WAY UP AND FOLLOWS PRODUCTION ON THE WAY DOWN

FACTORS WHICH PRODUCERS NEED TO CONSIDER:

Prepartum feeding, as recommended, helps to adjust the cow's rumen, the cow's eating habits, and her appetite before calving occurs. This results in getting the cow on a higher level of feeding early in lactation. The practice of "steaming-up" a cow (or heifer) for the ensuing lactation helps the animal to reach her peak of production earlier in lactation and at a higher level.

1. Individual cow differences are sometimes neglected.

   a. Size of cow affects total feed intake and capacity and the feed requirements to maintain her.

   b. The appetite and desire to eat varies with individual cows.

   c. Differences in potential milk production rates affect total annual production.

2. Quality of forage is a major consideration, we need to increase grain consumption if quality of forage is average to poor.

3. The prime objective is to get the cow to an early production peak. The relative value of milk to feed, therefore, is irrelevant during the period of three weeks before calving to 30 days after.

ACTIVITIES WHICH PROVIDE EXPERIENCE WITH THE ABOVE FACTORS

The boss tells you that he wants to demonstrate to himself the theory that in order to make his cows produce nearer their maximum, feed should lead production on the way up and follow production on the way down. He has a heifer and two cows to freshen within the next three weeks. The first-calf heifer weighs 1000 pounds, one of the cows weighs 1200 pounds and the other weighs 1400 pounds. For simplicity, assume the three will calve the same day. Let the heifer be called A and the two cows B and C respectively. The boss asks you for a suggested plan.

a. Plan a feeding program for each animal (refer to Michigan State University Bulletin E-423).

b. Consider that cow B (weight 1200 pounds) turns out to be a non-responder to increased feed.

Following the same technique, take the next two or three heifers or cows in your own herd which are due to calve and set up an experimental plan to determine if they would respond to this kind of feeding. An experiment of this kind may be included in your farming program.

If any student in the class has had actual experience with heavier prepartum feeding he could prepare a short report for the class, using before and after milk records, if possible, to prove the value of heavier feeding before calving in terms of milk production in the next lactation period.

COROLLARY 4: Cattle can utilize large amounts of corn silage when it is properly supplemented. This is fortunate for the milk producers because on good corn growing land, corn silage will yield more TDN per acre than will other forages.

CONCERN:	Increasing the livestock carrying capacity of the farm
ONE SOLUTION:	Production and utilization of more corn silage

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. The comparative yields of forage-producing crops with respect to TDN varies among crops. For example, consider an acre of standing corn. How will the various methods of harvesting affect total yield of TDN? Will harvesting corn as shelled corn, corn and cob meal or corn silage produce the greatest amount of TDN per acre. How will oats or barley compare with corn in terms of TDN produced per acre?

2. Nutrient equivalents when using silage in place of hay are to be considered. The activity to be described shortly will demonstrate what happens when silage replaces another roughage.

3. Supplementing corn silage with protein supplements requires greater purchase of off-the-farm feeds than is required when alfalfa is used.

4. How well is the farm adapted to producing corn?

5. Consider that silage making is completely mechanized and that it is a means of distributing late summer and fall work loads.

6. Compare the cost of making and using silage with other types of forages.

VERIFYING FACTOR NO. 1. (Above)

Verify this statement "Corn silage will yield more TDN per acre than will any other type of forage crop." Use local average yields in tons or pounds per acre and your Morrison, "Feeds and Feeding Tables", for the data you will need.

VERIFYING FACTOR NO. 2

A DHIA tester, on one visit to a farm, noticed that a producer was feeding 20 pounds of alfalfa hay and 40 pounds of corn silage to a cow whose average daily production was 80 pounds of milk. On the next visit he noticed that the herd owner had decreased the hay to 10 pounds and increased the corn silage to 80 pounds. What did this do to the intake of TDN, protein, calcium, and phosphorus? Assume that the concentrate fed was providing 40% of the TDN both before and after the hay was decreased and silage increased. What would you, the DHIA tester, recommend that the producer do to replace the loss of phosphorus, calcium, and protein. Were calcium or phosphorus deficient in either ration?

SUMMARIZE THROUGH A SYMPOSIUM

Select two groups of students called Group A & B. Group A may make a management study of dairy farms using alfalfa hay as the chief roughage, B group may make a management study of a dairy farm using corn silage as the chief roughage. The students should develop a list of criteria to study, considering the following factors: labor requirements, and months of peak labor; mechanization; methods of feeding hay and silage; storage equipment needed; and costs. Have the two groups jointly discuss their findings with the whole class in terms of the criteria developed. What general conclusions can be made?

GRAPHIC VISUALIZATION OF IDEAS IN THIS COROLLARY

Not all vo-ag students or teachers can draw, but this need not keep them from teaching boys how graphically to visualize an idea. The significant part of making a poster, cartoon or diagram is that the student needs to understand the idea before he can consider graphic presentation of it. Are there ideas in the above factors which can be visualized in a poster? Example: For every 5 pounds of alfalfa which is replaced by 15 pounds of corn silage there is a loss of about .005 pounds of calcium; 5 pounds of alfalfa equals .07 pounds calcium, 15 pounds of silage equals .015 pounds calcium. Represent these two equations graphically on the top part of your poster, using pictures or words to represent the objects. On the lower half is the final equation, calcium in alfalfa minus calcium in silage equals the difference which must be made up by calcium in something else. Will 1 per cent dicalcium phosphate or steamed bone meal in the grain ration meet calcium requirements when corn silage is fed heavily and grain is fed according to feeding standards?

Note: If adequate phosphate is supplied, it is impossible to have a calcium deficient ration.

USING CHARTS AND GRAPHS TO VISUALIZE FACTOR FIVE

Make a calendar chart showing the labor distribution for making alfalfa hay and making corn silage. Starting your calendar in May and ending in October will require six divisions on the chart, one division for each month. Then divide each month into fourths for each week, and indicate the week of the month in which various job operations in haying and producing corn and harvesting it for silage are likely to take place. Wide, colored tape will save time and add attractiveness.

A READING RESEARCH PROBLEM

Some boys like the kind of activity in which they have a problem or question to answer but for which there is no ready source of reference. Boys planning on college should become familiar with this type of reading research activity. Try this on one or two

boys. If a dairyman substantially reduces alfalfa hay and increases corn silage the cows intake of minerals will be affected. If he used dicalcium phosphate to increase the level of phosphorus in the ration what will happen to the level of calcium?

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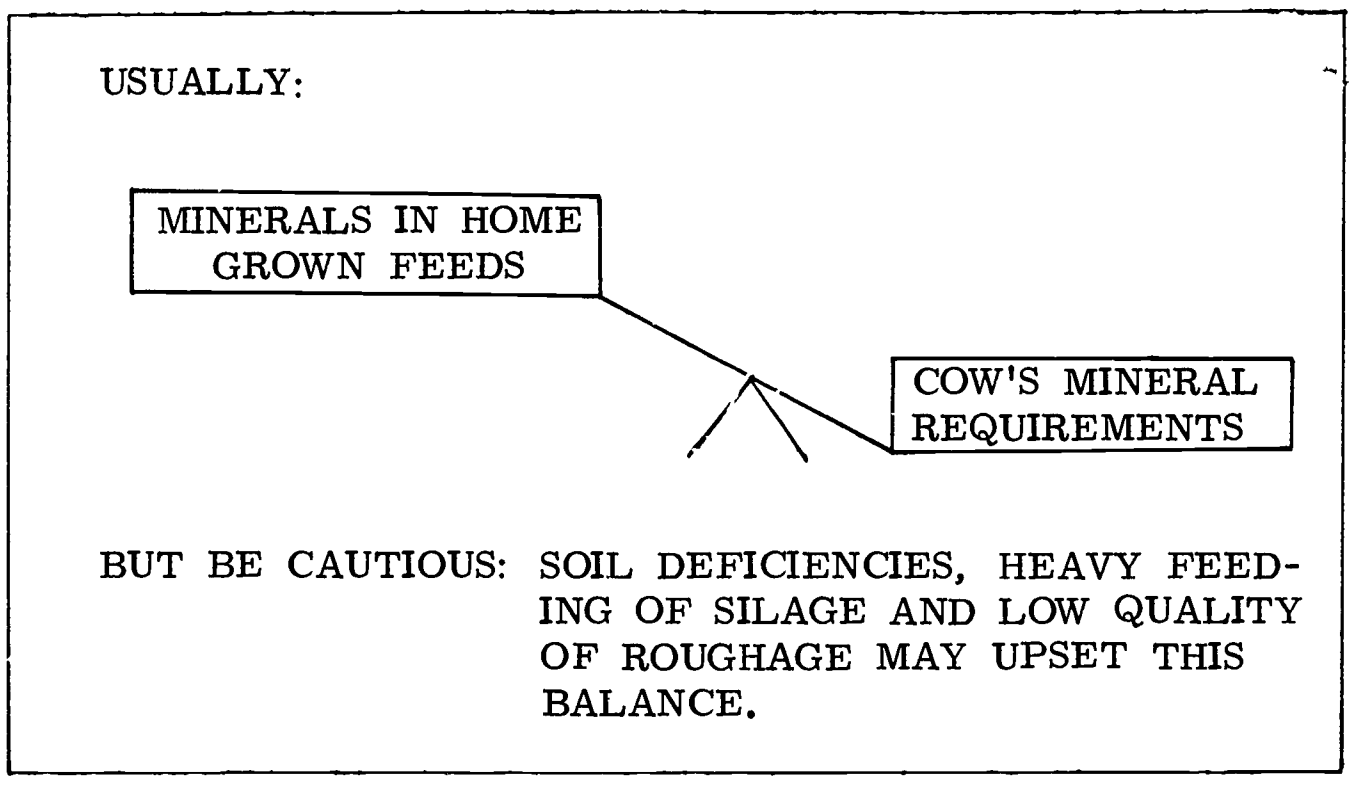
COROLLARY 5: Forages supply most of the minerals required by the cow; however, the producer should guard against deficiencies in calcium, phosphorus, cobalt, iodine and common salt.



(This might be used as a transparency)

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. What the cow requires in the way of minerals and the more important feeds and supplements which provide the various minerals in quantity.

2. Known soil deficiencies, especially cobalt and iodine.

3. Function of minerals, especially calcium, phosphorus, cobalt, and iodine. Fact Sheet No. 467 is a valuable

reference and Morrison's, "Feeds and Feeding" may be used. Also see Fact Sheets No. 348, 349, 449 and 452.

4. Understanding what is a mineral supplement and recognizing the conditions which lead up to the need for using mineral supplement.

LOGIC AND REASONING

Start the process of reasoning with your boys with this assumption: Most of the mineral elements needed by Michigan (or use your own area) dairy cattle are supplied by home grown feeds. And then use a second assumption: Dairymen sometimes pay high prices for mineral supplements without realizing that the first assumption is true. Now develop a set of conditions which when considered, will indicate whether or not mineral supplements should be used and to what extent.

EXAMPLE: Fact Sheet 467 states: "When one-sixth or more of the grain ration is made up of the oil meals or wheat bran, no other source of phosphorus is normally needed." This is a condition.

INTEREST REPORT

A student(s) interested in soils as a career or who shows a talent in this area should visit the soil conservation office or extension office for information concerning trace mineral deficiencies in the area. This could be a short class report.

SUPPLEMENTAL INFORMATION

In order for students to work out the suggested activity A, above; the following information based on Michigan State University's recommendation for feeding during prepartum, parturition, and postpartum is reproduced for your convenience. *

FEEDING PERIOD	FEEDING PROGRAM
Prepartum (3 weeks before Freshening Date)	Start feeding 7-8 pounds of concentrate per head daily and increase at the rate of two pounds per day until feeding 1 - 1 1/2 pounds of concentrates per 100 pounds of body weight per head daily. (Some farmers will feed up to the appetite of the cow. Common practice is to feed 18-20 pounds per day.)
Parturition (calving day and 3 to 4 days post-partum)	Offer the same amount as fed prepartum. Appetite will determine the intake within limits of the amount offered.
Postpartum (30-60 days)	Offer additional concentrate as soon as the cow will eat it. Increase about 2 pounds per day until either milk production or the cow's appetite reaches its peak, whichever occurs first. Responders: Continue at this rate until the cow declines normally in milk production then adjust grain

*"Progressive Feeding for Milk Production", Cooperative Extension Service, Michigan State University, East Lansing, Bulletin E-423.

FEEDING PERIOD	FEEDING PROGRAM
	feeding to about 1:2 1/2 - 3 (one pound grain to 2 1/2 - 3 pounds of roughage). Non-Responders: Cows that do not respond to liberal feeding within 30 to 45 days after calving should be reduced to about 1:2.5 to 1:3.5. Adjust to a reasonable and economic level. Later in the lactation the grain-milk ratio can be wider. Depends on forage and condition of the cow.

AUDIO-VISUAL AIDS

STRIP FILM: Winter Feeding of Dairy Cows: 63 frames, black and white, Audio-Visual Center, Michigan State University. This strip film is a valuable aid, and it may be shown to students in its entirety to give an overview of feeding dairy cows. Then use only selected frames at later times when you want to emphasize selected areas of the unit on feeding. For example, frames 7-20 are excellent aids in teaching "What are feed nutrients."

SAMPLES: Have you taken time to make your collection of "Farm Grains and Their By-Products?" This is most interesting and tells a real story besides serving as an aid in learning to identify feeds. You will need several two ounce sample jars and an equal number of four ounce milk sample jars (see your vo-ag supply catalog) and you will need your friendly feed dealer. The two ounce jars should have numbered caps and the four ounce plain aluminum caps. Next, make a list of farm grains and the by-product animal feeds produced from each grain. For example,

corn, dent No. 2 -- Corn gluten feed, corn gluten meal, distillers dried corn grain, hominy feed (5% fat). You will also want corn and cob meal. If you include wheat, soft winter - the by-products are wheat bran, bran and screenings, middlings, and wheat germ oil meal. In addition there are several important protein supplements unrelated to farm grains. Plan to add them to another section of your feed collection.

The next step is to send your complete list and a four ounce and two ounce sample bottle for each feed sample on your list to your local grain elevator. Of course, you will have to make prior arrangements. Within two or three weeks the elevator will have handled most of these feeds in their normal mixing operations and if your sample jars are handy it is no problem to fill them, and probably at no charge. Use your four ounce jars for display, for your classroom teaching, for room exhibits and for FFA exhibits. It is simpler and more efficient to have the identifying names on the cap, since one usually looks down on the sample jars. If you are not too sure of the identification yourself, use an identifying number or mark (paint) on the bottom of the jar.

Use the two ounce jars for identification and test purposes only. Fill these jars about 3/4 full. A few shakes of the jar gives the appearance of a fresh sample. Since these caps are numbered, a random switching of caps prevents memorizing feeds by number.

Don't forget to give the elevator due credit for providing help. A short newspaper acknowledgement or a courtesy notice on the display is sufficient.

SOME KEY RESOURCE PEOPLE AND HOW THEY CAN HELP YOU

1. An experienced dairy manager is an excellent choice as an outside resource person to work with you on the day of the symposium discussed earlier. He could discuss the topic with the students and keep the nature of discussion concentrated on real farm situations.

2. Your DHIA fieldman would be helpful in providing data to resolve and understand corollaries two and three.

3. There is one really serious problem confronting dairymen which needs the attention of all of us. This is the ability to determine if the quality of forages is high, medium, low, or poor. This is one of the problems to which day students, young and adult farmers alike need exposure. Why not enlist the time of a qualified technician or extension specialist to help you? Plan the program for your vo-ag classes during the day and for your out-of-school classes at night. Perhaps your FFA could sponsor a "Good Neighbor Night" or "Father and Neighbor Night", the latter being a program in which the FFA member brings his father, a neighbor, or both for an evening class to hear a specialist discuss hay quality. In arranging for an extension specialist, work through your county extension agent to avoid duplication of effort within the area.

DAIRY SOURCE UNIT

DISEASE CONTROL

Major Objective: To develop an understanding of the fundamental concepts necessary for preventing disease and maintaining a disease free herd.

Teaching the concepts of disease control requires that students develop:

I. Understandings

1. Understanding the nature of diseases.

2. Understanding the objectives, values, and operation of state and federal disease control programs.

3. Understanding the principles of establishing successful disease prevention programs for the farm herd.

4. Understanding how approved management practices correlate with the prevention of diseases.

5. Understanding the nature, cause, and control of diseases prevalent in Michigan.

6. Understanding the role of the local veterinarian in disease control programs.

II. Abilities

1. Ability to arrange for and to prepare the farm herd for testing for tuberculosis and Bangs.

2. Ability to keep pertinent health records on the dairy animals in the herd.

3. Ability to plan a vaccination program which can be adapted to a dairy herd, starting with calfhood vaccination for Bangs.

4. Ability to plan a community cooperative disease control campaign.

5. Abilities contained in a list of management practices necessary for controlling diseases.

III. Basic Principles and Corollaries

BASIC PRINCIPLE:

Disease control in a dairy herd is based on proper sanitation, avoidance of injury, recommended immunization practices, and control of sale and shipment of infected animals.

We consider disease as being of two different types:

a. That caused by bacteria or other organisms
b. That caused by nutritional deficiencies

Corollaries

1. Basic sanitation practices set the stage for an on-the-farm disease control program.

2. Closely allied to sanitation practices are those management practices which specifically deal with the avoidance of bodily injury that increases the susceptibility to infectious bacteria.

3. Mastitis, more than any other disease, is related to cow comfort. Comfort reduces stress and strain on the animal's system and on sanitation and management practices dealing with avoidance of injury.

4. Immunization by vaccination is essential to disease control but it is not a substitute for sanitation and avoidance of injury or for testing programs for detection of diseases.

5. The proper management and vaccination program on the farm is not always sufficient to control disease; cow testing through a state or federal disease eradication or control program provides additional values for the herd owner.

6. Dairy farm managers do not assume that external disease control programs or that other dairymen are completely effective in controlling diseases; therefore, the purchase and introduction of animals into the herd constitutes a hazard.

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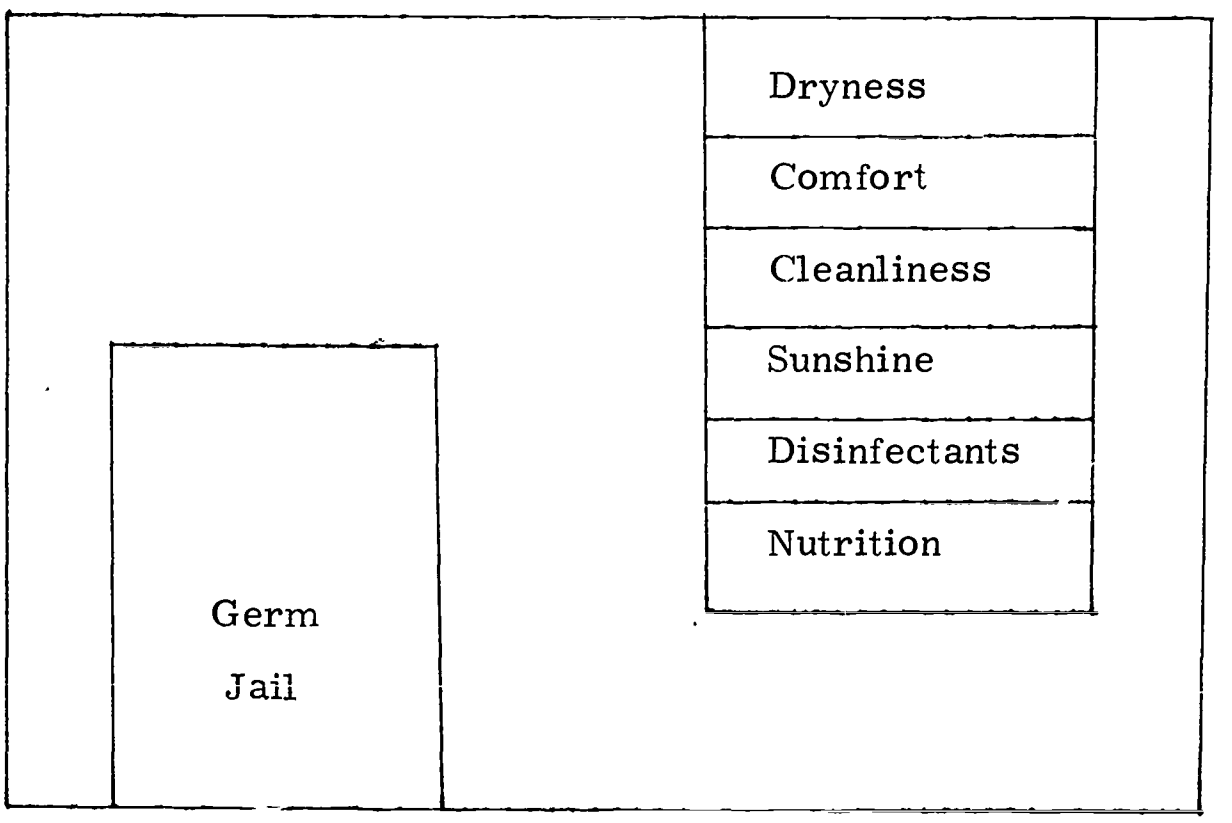
COROLLARY 1: Basic sanitation practices set the stage for an on-the-farm disease control program.



BREAK ANY BAR AND YOU CAUSE A JAILBREAK
(This may be used as a transparency)

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. Before students can be motivated for this unit or become willing to make applications to their actual situation (especially young farmers and adults) they must have a fair knowledge of:

   a. The nature of disease

   b. The optimum conditions which disease organisms require for life

   c. The relation of nutrition to disease

2. Basic sanitation practices are best considered as a group or a team and in relation to each other.

   a. Disease organisms are literally "carried" from cow to cow or place to place by the physical equipment we use, including our shoes. Obviously, the same broom used to sweep the gutters should not be used to sweep the feed alleys.

   b. Moisture and temperature affect the reproduction of disease organisms. This is why producers need to be concerned with dryness as affected by clean bedding, dry ceilings and walls, sunshine, and wet holes, stagnant water and manure piles in which some organisms live.

   c. Use of disinfectants, like hot lye solution, kill or deter bacterial growth.

   d. Isolation of sick animals involves various practices, such as use of separate feeding equipment, disinfecting boots and shoes, burning infected bedding and placing infected milk in a hole dug in the ground or in a septic tank where it cannot carry infection to other animals.

3. Determining the diseases that are prevalent in the area and to which the herd is susceptible is important. Farm people working with dairy cattle should be able to recognize a sick animal and to identify the more prevalent diseases by their symptoms.

APPRAISING CONTENT

Teachers will usually want students to learn about individual diseases prevalent in the area. However, it may be wise to spend a minimum of time on this part of the unit and a maximum of time available on the prevention and nature of disease.

Reading Research or Individual Reports:

Boys having exceptional ability and those who have keener insights into the biological and physical sciences should be encouraged to delve into the content of this unit a little deeper. This may be accomplished by developing reading research projects as follows:

a. The nature of disease: disease factors, transmission of disease and how the body fights disease.

b. The optimum conditions for bacterial growth and the spreading of a disease.

c. Relation of nutrition to disease.

These reports should come early in the unit. They need not be confined to diseases of dairy cattle but rather to disease itself regardless of what it attacks.

Visualization of facts:

What does the following statement mean to you? "Animal diseases are carried from farm to farm on people's boots and shoes." How do you mentally perceive this common statement found in many books and bulletins? How do you think students perceive it? Of course, the statement means that the disease

organism itself is being transported from farm to farm. The student, however, must be capable of visualizing facts and ideas, otherwise much of what he perceives will be unreal or fantasy.

Many 9th or 10th grade boys will picture a disease as a cartoon character riding or clinging on a boot as a man walks from one farm to another. In principle, such a fantasy is meaningful, at least an idea is conceived. However, more accurate visualizations can be taught.

Facts can be visualized through conscious practice. This corollary provides the opportunity for practice.

Instruct each of your students graphically to visualize or represent one of the following ideas or facts.

1. Contaminated feed and water spreads disease.

2. Many things can carry disease organisms. (What and How)

3. Poor ventilation aids the spread of disease.

4. Disinfectants help keep down disease.

5. Barn windows need to be kept clean.

6. Straw bedding serves a major function in disease control.

7. Improper feeding causes nutritional disease.

Students may visualize their mental images in a number of ways; cartooning (a disease organism drawn as a monster riding on a boot). Symbols and diagrams or words may be used for these visualizations.

If the teacher desires, he may ask students verbally to explain their mental picture of one of the above practices.

COROLLARY 2: Closely allied to sanitation practices are those management practices specifically dealing with the avoidance of bodily injury which increases the susceptibility to infectious bacteria.

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. According to the nature of disease, open wounds or irritated tissue increase the possibility of exposure to infectious bacteria.

2. One source of potential injury are objects to which animals are exposed. Many such objects are so commonplace that dairymen need to be constantly alert to the problem.

3. The milking machine, improperly operated, will cause teat and udder injury.

DEVELOPING CONCEPTS

Humans are extremely conscious of their own safety and well being. The essence of farm and home safety programs is the elimination of injury-inflicting objects and training ourselves in new habits which will minimize exposure to injury. Is there any reason why these same notions cannot be transferred to the safety of farm animals? For some students this will require a changed attitude and a realization that animals have feelings and that they distinguish between comfort and discomfort. This, plus the fact that animals in poor physical condition, or those that are permanently injured become economic liabilities, represent sufficient reasons for promoting safety of farm animals.

Nearly 60% of the cow deaths per year in Michigan are due to accidents or to swallowing hardware-like objects. Ten per cent of the cows sold have been victims of an accident. Accidents can be prevented.

In developing this concept discuss with your students this theme, "If we were to organize and promote a farm and barn safety campaign for farm animals, what would we recommend that

A Mastitis Survey: With a Field Trip for Collection of Data

Much modern research depends upon the technique of surveying or observing actual situations. The object of this survey is to determine the likelihood or probability of mastitis in dairy herds taken at random from the community.

This mastitis survey may be used as the method for teaching about mastitis and may be substituted for your usual teaching procedures. The following outline will guide you in this activity.

1. Assign reading references on mastitis.

2. Develop in class a survey form which will serve as a checklist to use on your field trip to determine the likelihood that a dairy herd is susceptible to mastitis. You may save time by providing students with a basic outline and having them expand it to a survey form. The survey should include: past history of mastitis, questions of the herd manager or owner concerning milking procedures, conditions of equipment and physical facilities, and sanitation practices (Corollary 1, factor 3).

3. Divide your class into three or four groups and select (at random if possible) as many dairy herds. Seek the support of each herd owner, explain the project to him and enlist his cooperation.

4. Arrange for each group to gather the data on the herds during out-of-school hours.

5. Analyze data in the classroom as soon as possible. There are several ways. Have each group report separately or have groups report on a comparative point-by-point basis.

6. Each group may then decide on the likelihood that the herd they surveyed will be troubled by mastitis.

NOTE: Michigan State University Extension Bulletin 344, "Mastitis Control" is exceptionally helpful in preparing the survey form.

Mastitis Demonstration

On pages 14 and 18 of the College of Education Bulletin, "Demonstrations in Dairy" are two demonstrations, either one of which may be conducted on a farm during a field trip. These demonstrate that the incidence of mastitis is in part due to improper operation of the milking machine.

The Demonstration Model of the milker system as described on pages 20 and 21 of the bulletin, "Demonstrations in Dairy", is a piece of equipment with multipurpose uses including:

1. Classroom instruction for all-day, young-farmer and adult-farmer classes in teaching the operation and maintenance of the system, cleaning and sanitizing the units, and how improper adjustments irritate the cow's udder.

2. It is a valuable piece of equipment for use in teaching students the art of making demonstrations, training FFA demonstration teams, and providing practice.

3. The construction of the model provides many skills in pipe fitting, identification of pipe and pipe fittings as well as of parts of the system. Let the construction be a shop project for some advanced students. You might even want to have the boys disassemble it at the year's end so a new group the next year might reassemble the model. If so, discard the pieces of straight pipe formerly used and provide a length of new pipe from which these pieces can be cut and threaded. One of your major responsibilities is to provide opportunities for skill practices.

4. Your FFA may justify the expenditure for some or all of the necessary parts for the model by using it in FFA exhibits at your local or state fair. The model can be operated during fair hours to demonstrate proper operating procedures.

COROLLARY 4: Immunization by vaccination is essential to disease control but it is not a substitute for practices of sanitation and avoidance of injury or for testing programs for detection of disease.

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. The better dairy manager thinks in terms of a vaccination program rather than vaccinating against individual diseases.

2. Immunization by vaccination starts with calfhood.

3. Some diseases require a second vaccination or a booster shot.

4. Vaccination is a relatively simple task. It is required, however, that a veterinarian be called to perform this service. See "Brucellosis Vaccination Requirements for Michigan", published by Michigan State University Cooperative Extension Service for information on legal requirements related to vaccination.

Planning a vaccination program:

A baby receives his first vaccination when he is but a few months old. As the child grows he is vaccinated against other diseases and as a result the body builds an immunity against a whole complex of disease organisms.

We should not hesitate to teach that the same principles of immunity apply to animals. There are certain diseases which we should vaccinate against during calfhood. All the diseases which can be controlled by vaccination require that the animal be of a certain age before it is vaccinated.

The Vaccination Guide and Time Schedule, a form of which may be found at the end of this unit, may help your students to develop a program for vaccinating dairy cattle in your region of Michigan.

The best sources of information in helping develop this with students are:

1. Your local veterinarian. He can help you prepare a list of diseases to include on the above chart and can give recommendations for a vaccination program.

2. Government and college animal disease bulletins.

A COMMUNITY SURVEY:

Using the guide for vaccination form, give your students an opportunity to learn how to make a community survey and to discover how dairymen regard herd health.

After the students have developed the guide for vaccination, they may:

1. Develop a one or two page questionnaire, deriving questions from the guide.

   For example:

   a. Which of the following diseases do you vaccinate against? (If desirable include all farm animals and their known diseases.)
   b. How often do you test for tuberculosis and Bangs?

It is not difficult to frame a few questions which will collect the kind of data desired by the class.

2. Each student may be made responsible for getting the data from one or more farmers.

3. Try to use and to teach as good a survey technique as possible.

4. Let the class tabulate, analyze and discuss the data and make generalizations concerning the population sampled.

IMPROVEMENT PROJECT:

Students who develop a "vaccination guide and time schedule" for the animals in their home dairy herds and are responsible for its implementation should be given credit in their supervised farming programs. The project may include making a schedule poster (on cardboard) to hang in the barn and made in such a way that when a calf is born it can be added to the schedule, so that the dates (by months of age) when it should be vaccinated will be included. Schedules should also include when herd should be tested for tuberculosis and Bangs.

SYMPOSIUM:

Using local resources invite your local veterinarian, county agent or an official from the State Department of Agriculture to explain how eradication programs operate, their benefits and the role of the dairyman in these programs.

Your boys should prepare one or two questions which they will ask during a question and answer period. Do not forget to review the question yourself ahead of time.

Acquainting Students with Officialdom:

This unit presents several opportunities to make students aware of many health requirements or laws regarding the movement of livestock to and from the farm. While many of these may appear to be a nuisance, there are sound reasons and merits for them and they were promoted and made effective in the interest of disease control -- both human and animal.

The following are very appropriate to introduce to students during the course of this unit:

1. Health requirements for livestock exhibited in Michigan, see Fact Sheet, page 511.

2. Michigan laws governing sale of cattle, Fact Sheet, page 512.

3. Disinfectants approved for official disinfection, Fact Sheet page 513.

4. Requirements in producing Grade A milk. Grade A Milk Act Number 216 P. A., 1956, Michigan Department of Agriculture, Dairy Division.

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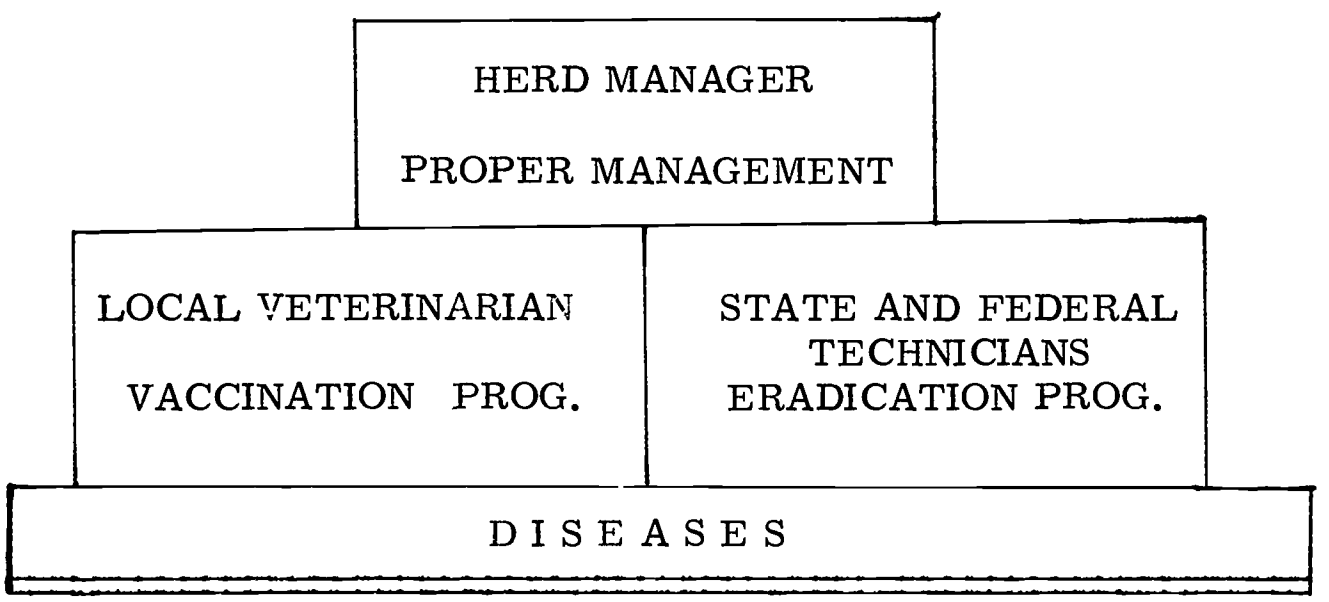
COROLLARY 5: The proper management and vaccination programs on the farm are not always sufficient to control diseases; cow testing through a state or federal disease eradication or control program provides additional values for the herd owner.

THE DISEASE CONTROL TEAM



FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. Diseases such as Brucellosis and tuberculosis may go undetected for a long period during which time they may spread to healthy animals.

2. The main advantage of an eradication program is that it provides the herd owner the opportunity to test his cows. Testing will expose any animal which reacts positively to the test.

3. Tuberculosis and Brucellosis testing may involve dairymen in a situation in which moral decisions become important factors to consider. For example, a high producing cow, worth two or three times her market value, is found to have tuberculosis and must be slaughtered, or thirty per cent of an entire herd is found to be infected with Brucellosis. Discuss the possible reactions in which the herd owner must take a loss.

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COROLLARY 6: Dairy managers do not assume that external disease control programs or that other dairymen are completely effective in controlling diseases; therefore, the purchase and introduction of animals into the herd constitutes a hazard.

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. Since most disease organisms require a period of time for incubation a farmer might purchase an apparently healthy animal only to have it show symptoms of the disease after having introduced it to the herd.

2. Different diseases require different incubation periods. Some animals may be carriers of tuberculosis, Bangs and mastitis without showing any symptoms of the disease.

3. The only sure way of introducing a new animal into the herd is to first place it in quarantine for at least 30 days. This practice requires adequate farm facilities.

Farm Planning:

This corollary provides the teacher with an excellent opportunity to evaluate the comprehension of the student regarding (a) the nature of disease, (b) conditions for optimum growth of disease organisms, and (c) disease control practices. Assign your students the task of planning a system and the facilities for quarantining new or sick animals. Give them a simple farm layout on

the chalkboard including location of the barn, loafing shed, pasture, road entrance and farm truck lanes. The student should locate the quarantine barn or shed with due consideration as to how disease organisms are carried, getting animals to the shed, foot traffic and the physical facilities and equipment needed. The plan will need to include a self contained unit, independent from other livestock facilities, with the minimum danger of the disease being carried by people attending the animal in the quarantine unit.

SUMMARY ACTIVITIES

One way of summarizing a unit of study is to involve your students in some activity or learning experience in which they must consider or evaluate new knowledge. In the end, a teacher must ask himself two questions:

1. Are the students sufficiently aware of the knowledge related to this unit?

2. Have students been in learning experiences to the extent of their being willing to do something with what they have learned, i. e. changed attitudes or practices?

Developing a Herd Health Record Form

Developing a health record requires that the herd manager be aware of the requirements and practices of maintaining good cow health and of the knowledge of when and how certain practices must be done. The activity involves developing a form which keeps a record of the health of each individual animal in the herd. It may be placed on one large sheet as a herd record or on notebook size paper, allowing one sheet for each animal. The latter is preferable. The record sheet should note date of birth, sire and dam (perhaps also their production records), diseases for which animals must be vaccinated and a vaccination schedule (corollary 4), dates of tuberculosis and Bangs testing and results (corollary 5), space for noting dates animal is sick and description of the symptoms, injuries and cause of any injury (corollary 2), records of quarantines, space for outbreaks or symptoms of mastitis and possible causes, dates milking machines were checked (corollary 3) and other such pertinent information.

Organization of this activity will depend on your teaching schedule and how you want to evaluate the results. You may want to use it as an examination, as a small group activity, or as an out-of-class problem.

Supervised Farming Programs

One of the most practical ways of applying new knowledge in vo-ag is to encourage the boy to incorporate it into his supervised farming program through supplementary and improvement projects or practices. Not all boys have such opportunities. We must, however, not neglect the ones that do. Some students may not appear to have opportunities until one starts to really look around. A neighbor's herd, an uncle's farm, or that of a good friend may present an opportunity for a non-farm student to plan a vaccination program, survey and remove from the premises causes for injury, planning and testing a herd for tuberculosis or Bangs, or making a test for mastitis. These are acceptable supplementary or improvement projects for students in their farming programs.

Demonstrations Which Accent This Unit

1. Use of strip cup or other tests to detect the presence of mastitis.

2. Washing the udder of the cow and sanitizing the teat cups of the milker.

3. Care and management of sick animals.

4. Graphic demonstration of diseases prevalent in the region.

5. Demonstration of the sanitation practices mentioned in this unit.

6. Demonstrations involving the conditions for optimum bacterial growth may be carried out. The help of the science teacher for equipment may be needed.

A SUGGESTED VOCABULARY LIST

Abortion

Acute

Antibiotics

Antiseptic

Body resistance

Chronic

Clean animal

Contamination

Disinfectant

Eradication

Eradication program

Fetus

Hormone

Infectious

Inflammation

Injurious

Isolation pen

Parasite

Periodic testing

Prevention and control

quarantine

Reactor (positive)

Reactor (negative)

Sanitizing solution

Serum

Stress and discomfort

Streptoccocci

Staphylococci

Symptoms

Toxic

Vaccination

Vaccine

Undulant fever

UNDERSTANDING THE RUMINANT

Introduction:

The ruminant has often been called the most interesting example of symbiosis known to man. The large microbial population in the rumen, which uses the food consumed by the cow, die and are assimilated by the animal as amino acids. The cow, sheep, and goat, our domestic ruminants, are thus able to utilize large amounts of vegetative matter unsuitable for human consumption and to convert it into high value protein foods on which human nutrition depends.

We often take the process of ruminant digestion for granted. However, as with many other agricultural processes involving basic principles, the more we know about it the more knowledge we have to work with in helping people to make operational decisions. Solutions to many questions rely upon one's understanding the rumen. How much urea can I feed to cows? Are these animals vitamin deficient? How can I appraise the need for micro feeds? How can I appraise the validity of this feed manufacturer's advertisement?

This source unit gives suggestions for an approach to understanding the rumen process.

Corollaries

1. In the ruminant most of the fermentation occurs in the rumen, ahead of the true stomach and small intestine, whereas in the horse and rabbit, fermentation occurs in the caecum and colon near the end of the digestive tract. The rumen arrangement allows (1) products of fermentation to be more completely absorbed and (2) for more efficient digestion of fibrous feeds.

2. Energy comes primarily from carbohydrates (starch, cellulose, sugar) and fats.

3. Nitrogen in the protein that a cow uses to form body protein and milk comes from two general sources (1) true protein of plants or animals and (2) non-protein nitrogen such as amino acids, enzymes, nitrates, and urea which are also contained in the feed. Both sources are degraded to ammonia nitrogen in the rumen. Rumen bacteria use this nitrogen to form the protein of their own bodies. These bacteria are digested in the true stomach and small intestine and are absorbed as amino acids. It is known that all of the ten amino acids that are essential to normal nutrition of animals are produced in the rumen.

4. All of the known B-complex vitamins and vitamin K are synthesized in the rumen. Vitamin A, D and E must be supplied in the feed.

   The rumen microorganisms also synthesize (manufacture) all of the known essential amino acids from ingested protein and elemental nitrogen. All of the B-complex vitamins are also synthesized in the rumen as well as vitamin K. Vitamin C is formed in the animal tissues. Thus vitamin A, D, and E are the only ones that must be provided in the diet. <u>These complex processes greatly simplify the feeding of ruminants and allow them to utilize roughages and other fibrous materials that otherwise have very little value to man.</u>

COROLLARY 1: In the ruminant most of the fermentation occurs in the rumen, ahead of the true stomach and small intestine, whereas in the horse and rabbit fermentation occurs in the caecum and colon near the end of the digestive tract. The rumen arrangement allows (1) products of fermentation to be more completely absorbed and (2) for more efficient digestion of fibrous feeds.

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

Compare the digestive tract of (1) a ruminant (2) a pig, and (3) a rabbit. Note the relative size of the various parts of the intestinal tract.

VISUAL AIDS WHICH TEACH COMPARISONS:

The comparative method of teaching is often ignored and yet it can be the most valuable when used at the right time. Usually we understand one thing better when it is placed in relation with something similar. A comparative study of digestive systems of a ruminant and a non-ruminant provides an opportunity for using this method of teaching.

Charts are a useful visual aid. You can secure the internal anatomy charts of the cow and pig from supply houses. If you have an overhead projector you can secure the same charts as transparencies with three to four overlays. It is not difficult to make your own transparencies if your school has the equipment.

Opaque projectors can do the same with pictures or drawings from a book, bulletin or magazine. Simply find the right ones to fit your needs. An opaque projector has the advantage of projecting diagrams of a cow's and a pig's digestive system side by side at the same time.

Specimen: At the end of this unit are directions for obtaining, preserving, and mounting a calf's stomach.

COROLLARY 2: Energy comes primarily from carbohydrates and fats.

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. Roughages contain carbohydrates in the "crude fiber" fraction, i.e., cellulose. What are the products of cellulose digestion in the rumen? Cellulose is converted to glucose which in turn is fermented into volatile fatty acids. Acetic, propionic and butyric account for about 95 per cent of the total acids fermented.

2. Sugars and starches are part of the "nitrogen-free extract" fraction which is the largest component of grains. Glucose and fatty acids are the primary products that are formed from sugar and starches and finally used by the cow for energy.

3. About one half of the cow's energy comes from fatty acids fermented in the rumen. Where does the remainder of energy come from? Answer: Some of the sugar and starches that pass into the true stomach (abomasum) are degraded to glucose and absorbed as such, just as in the simple stomach animal.

LEARNING VOCABULARIES

The student is continually faced with the problem of having to learn specialized vocabularies in order to understand and to assimilate knowledge new to him. Unfortunately many students have fallen victim to the habit of skipping over new words. Therefore, new agricultural concepts and principles are not completely learned. This unit on rumen digestion presents this very situation.

Writing functional definitions of the technical vocabulary of this unit is the first step in learning the new vocabulary. After developing a word list, have each student find working definitions for four or five of the words. The work of the students is then compiled in a meaningful vocabulary. Don't be afraid to include such important words as: volatile, fatty acids, glucose, butyric acid and synthesis as well as the old standbys as, cellulose, starch, protein, energy, and nitrogen-free extract.

USE OF AN ELECTRIC QUESTIONER MACHINE

Learning a new vocabulary requires practice as do other skills. The use of new words in speech is the best practice but a technical vocabulary has restricted conversational use. The ELECTRIC QUESTIONER is useful for providing practice. Let your definitions be the questions and the words the answers. Change the circuits often to prevent location memory. If you do not have an electric questioner write the Agricultural Education Service, College of Education, Michigan State University for plans and have one of your students make it as a shop project.

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COROLLARY 3: Nitrogen in the protein that a cow uses to form body protein and milk comes from two general sources (1) true protein of plants or animals and (2) non-protein nitrogen such as amino acids, enzymes, nitrates, and urea which are also contained in the feed. Both sources are degraded to ammonia nitrogen in the rumen. Rumen bacteria use this nitrogen to form the protein of their own bodies. These bacteria are digested in the true stomach and small intestine and are absorbed as amino acids. It is known that all of the ten amino acids that are essential to normal nutrition of animals are produced in the rumen.

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. We need to make certain conclusions regarding the value of the various feeds as sources of protein in the ruminant ration. A major conclusion is that for all practical purposes one source of protein is as good as another. Some commercial nitrogen compounds, such as urea, provide concentrated sources of nitrogen from which the animals can make protein.

2. Urea is used in many commercial cattle feeds to furnish part of the nitrogen for bacteria to use in making body protein.

3. Excess urea not efficiently used can upset normal functions. It also causes the feed to be unpalatable and cattle will not eat enough grain.

DEVELOPING REALISTIC CONCEPTS

Confusion and disillusion often stand in the way of change and of sound practical ideas. If people do not perceive and clearly understand a new idea or a new way of doing something in terms of its capabilities and limitations they may resist change and continue with their familiar ways.

This concept of change is mentioned here in conjuction with the use of urea, a commercial feed, which can be used advantageously and yet has some severe limitations. As you discuss urea "262" with the vo-ag boys and out-of-school farmers, try to develop a realistic concept of its use, i. e., in changing to or considering changing to the use of a new technique, such as feeding urea which is appealing and saves money and time, the student should understand that such a new idea can have many limitations.

Try this approach as you discuss the use of urea in your classes. First, establish complete awareness of the advantages in using urea, then, weigh the advantages agains limitations.

Some limitations are as follows:

1. Not more than 1/3 of the total crude protein in the total ration (hay, grain, silage) should come from urea.

2. Not more than three per cent of the grain ration should be urea. Since urea is unpalatable it may be necessary to use smaller amounts, or add molasses to get cattle to eat sufficient amounts in the milking parlor where time is limited.

3. Not more than one per cent of the total dry matter should be urea.

4. One per cent urea (20 pounds per ton) in the grain ration is the upper limit to use unless molasses is added to avoid palatability problems. Low palatibility is more likely to be evident in milking parlors where eating time is limited. Two per cent urea can be used when mixed with two per cent dry molasses without depressing consumption.

5. Urea does not contain energy and must be fed with a starch feed such as cereal grains to be considered equivalent to the oil meals in feed value.

   Example:

Ingredients	Pounds	Protein	Protein Equivalent	Cost
		%	lbs.	
Shelled Corn	1720	8.5	146	--
Urea 262	280	262.0	734	--
Total Supplement	2000	44%	880 lbs.	--

The above example merely illustrates how urea can be compared with other supplements for economic considerations.

Feeding Grade Urea contains 42 per cent nitrogen whereas, most proteins contain about 16 per cent nitrogen. Since crude protein is based on the nitrogen content of average protein, the protein-equivalent value of urea is 2.62 times that of an equal weight of actual protein -- 42% N ÷ 16 = 2.62.

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COROLLARY 4: All of the known B-complex vitamins and vitamin K are synthesized in the rumen. Vitamins A, D, and E must be supplied in the feed.

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. Vitamin A as such is not found in plants. The source is carotene, a yellow colored pigment of plants, which is converted to vitamin A in the intestinal wall of the animal.

2. Feeds normally contain sufficient amounts of carotene to supply all the needs of ruminants. Most of the carotene comes from roughages.

3. Vitamin E is normally found in adequate supply in forage and grains. White muscle disease in calves and stiff-lamb disease in sheep are caused by lack of vitamin E.

4. Vitamin K is synthesized in the rumen and large intestine, therefore, it need not normally be added to the ration.

5. Vitamin B-12 may be deficient if cobalt is lacking in the ration. B-12 is essential in the process of maturing newly formed red blood cells.

Thinking, Talking, Studying, and Learning about Vitamins

A white mold growing on sweet clover that has been put in the mow too damp produces a compound that destroys the Vitamin K supply of cattle fed this feed. Cattle deficient in Vitamin K bleed to death internally. Wisconsin workers discovered that the harmful compound was dicumarol.

What product used on the farm, with which you are familiar, contains dicumarol? Answer: Warfarin

If a feed company advertised that a certain feed supplied all the cow's need for vitamin B-12, how would you appraise the advertising?

Under what conditions might Vitamin A become deficient in dairy cattle rations? Discuss low quality hay; limited hay-high grain feeding; corn silage that has been frozen destroying carotene. Recent research shows some evidence that nitrates in feeds interfere with conversion of carotene to Vitamin A in the intestine, and may destroy carotene during storage in a silo. Information concerning the practical importance of these findings is incomplete.

Why would young calves have different dietary vitamin requirements than when they become older? When does a calf become a functional ruminant?

METHOD OF PRESERVING AND MOUNTING A CALF'S STOMACH

Remove stomach from carcass	Remove the stomach by severing the esophagus 6 inches above the stomach and 6 inches below the duodenum. Care should be taken not to puncture or tear the tissue as the stomach is to be inflated.
Remove contents and clean thoroughly	Remove contents completely by repeatedly filling with water and draining off the contents. (It is easier to fill and drain through the esophagus than through the duodenum.)
	Lumps of ingested hay or other roughage can be removed with a sort of milking action by shutting off the rumen below the esophageal opening forcing out the lumps to where they can be removed with the fingers.
	Lumps of coagulated milk should be broken up by pressure through the abomasum wall. Then, they will flow out with the wash water.
Preserve with 10% formalin solution	Fill the stomach with formalin and immerse it in formalin for three or four days.
Empty and rinse thoroughly	Remove the formalin and rinse several times with water. Finally rinse with alcohol to help dry the tissues.
Attach tire valve in esophagus and plug duodenum	A tire valve should next be fastened securely in the esophagus and a stopper placed in the duodenal opening.

METHOD OF PRESERVING AND MOUNTING A CALF'S STOMACH
(Continued)

Inflate the stomach with a tire pump	Inflate to distend the stomach. Be careful not to over-inflate and break the tissue, thus letting out the air. Allow to dry several days and then apply several coats of shellac. Each coat of shellac should be allowed to dry thoroughly before the next one is applied. Inflate daily or oftener to keep the stomach distended during drying and shellacing. Leave valve in position so stomach can be reinflated from time to time, if necessary. (C. L. Blackman, Extension Dairyman, Ohio State University, Columbus 10, Ohio.)

DAIRY HERD IMPROVEMENT

Introduction:

Efficiency with the dairy herd is largely dependent on high milk production per cow and per man. Factors associated with high production include feeding, disease control, housing, management and breeding. Testing to determine the high producers and using the best available sires represent two of the important aspects of production efficiency.

This unit will deal primarily with principles and practices of breeding for the purpose of maintaining or improving the level of production of the herd. The importance of production records is recognized in this unit, but commonly accepted programs for obtaining these records are left for another unit.

DAIRY HERD IMPROVEMENT

Following is a statement of the principle and its five corollaries around which this source unit has been developed.

BASIC PRINCIPLE:

Every normal dairy cow has the ability to produce milk. The amount which she is capable of producing is limited by her milk inheritance which is transmitted to her by both her sire and dam. Therefore, a first consideration in improvement deals with the inheritance of the ability to produce milk.

Corollaries

1. A milk producer's major objective, other than maximum milk production, is to produce female offspring which will produce more pounds of milk and/or butter fat than did the dam.

2. Production records are the acceptable and approved manner by which a producer can determine the potential production capability of a producing cow and if the production capability of the sire is known (proven sire), the probable capability of the progeny can be estimated.

3. The cows of a dairy herd can be ranked and compared at any given point in their lactation by extending the incomplete records of each individual to the mature equivalent values.

4. It is difficult and expensive for a dairyman to own his own bull(s) and achieve the results which usually occur through an artificial breeding service.

MATHEMATICAL GYMNASTICS:

Problem 1:

Sometimes we can explain a concept through a mathematical problem better than through verbal expression. Often this type of problem solving resorts to mathematical gymnastics, i.e., playing with numbers, but it does get a point across.

We often have a tendency to measure a dairy herd in terms of number of cows rather than pounds of milk per cow, average herd production, and net labor income per cow. The following problem is one through which you can teach the concept that cow profit is directly proportional to cow production.

Assume that two dairymen had set their objectives to take in $25,000 gross income after feed expenses during a period of one year.

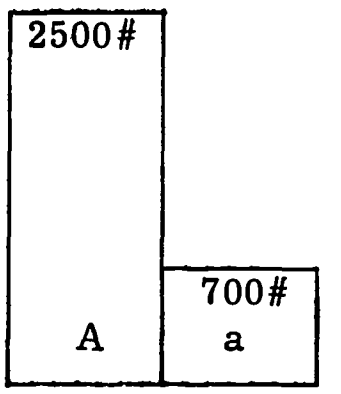
Given:	Herd A	Herd B
Average cow production	8,000	13,000
Value of milk per cwt.	4.00	4.00
Pounds of milk required to pay for feed	5,000	7,000
Pounds of milk after feed	3,000	6,000
30.00 cwt. X 4.00 and	$120.00	$240.00
60.00 X 4.00		
Number cows required to return $25,000 above feed	208	104

A Problem in Heredity:

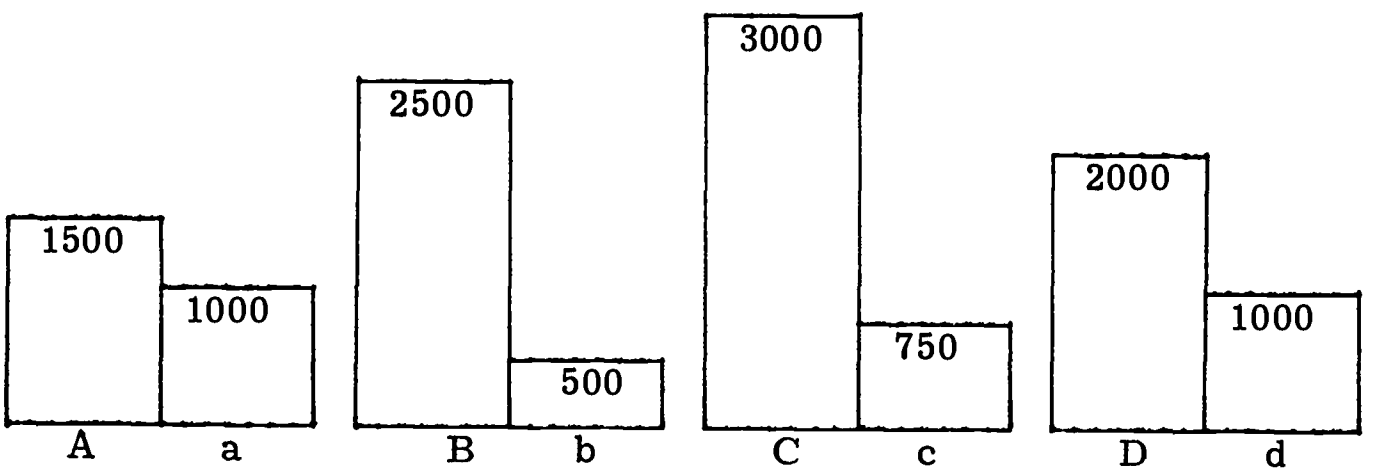
There is nothing quite as discouraging as having boys growing up with the idea that we "breed a cow to get a calf because then she starts giving milk". Of course, this is true but it is not the whole story. We do not breed a cow with any bull just to get a calf. We want the calf, but more important we want this calf to have a high production capability and it is this concept which we must teach.

Geneticists are still not certain how many pairs of chromosomes carry the hereditary material which transmits milk production capability. We are sure that it is carried on in at least four pairs; we will, therefore, use four pairs in the following illustration.

Each pair of chromosomes carries a milk production capability factor: for example, the animal will transmit one chromosome of this pair to the progeny through the egg cell (or if the bull, the sperm cell) and therefore, either the 2500 lb. or 700 lb. production factor will be transmitted to the progeny. We can see the importance of both chromosomes having high and nearly equal capabilities.

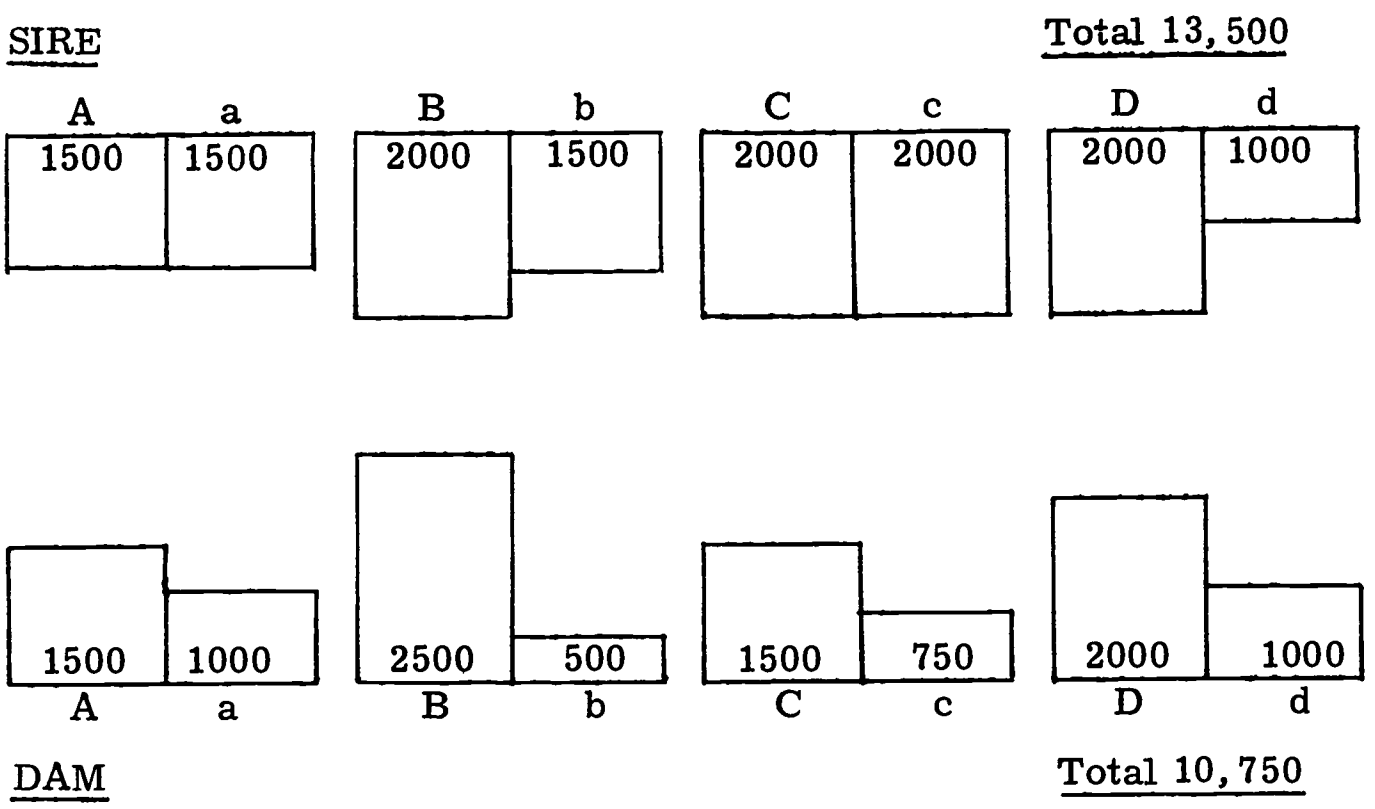


Let us assume four pairs of chromosomes of a cow: Aa, Bb, Cc, Dd, and assign each a production factor. Of course, geneticists cannot actually do this but we can for illustration.

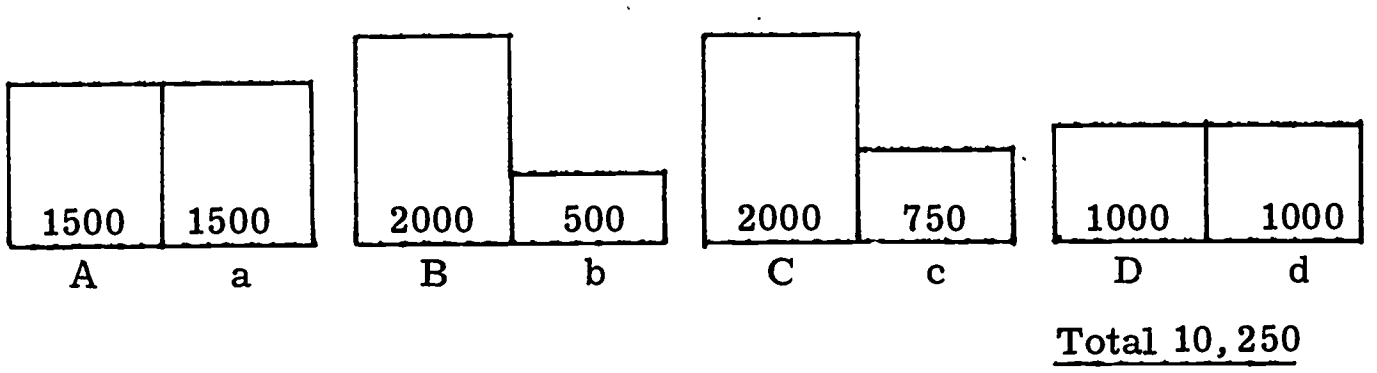


If we add the eight production factors together we can get a sum total of 12,250 which represents the milk production capability of this individual. Furthermore we know that at the time of reduction division of cells, there is random selection which results

in a combination of four chromosomes (one of each of the pairs). The egg and the sperm each will carry one combination and thereby transmit a production capability which when added together equals the total production capability of the progeny.



The profile of the progeny is represented as follows:



In this progeny profile the chromosome at the left in each pair represents the inheritance from the sire and the one on the right the inheritance from the dam.

Questions which motivate students:

1. Through chance inheritance, can the daughter have lower milk production capabilities than the dam? How?

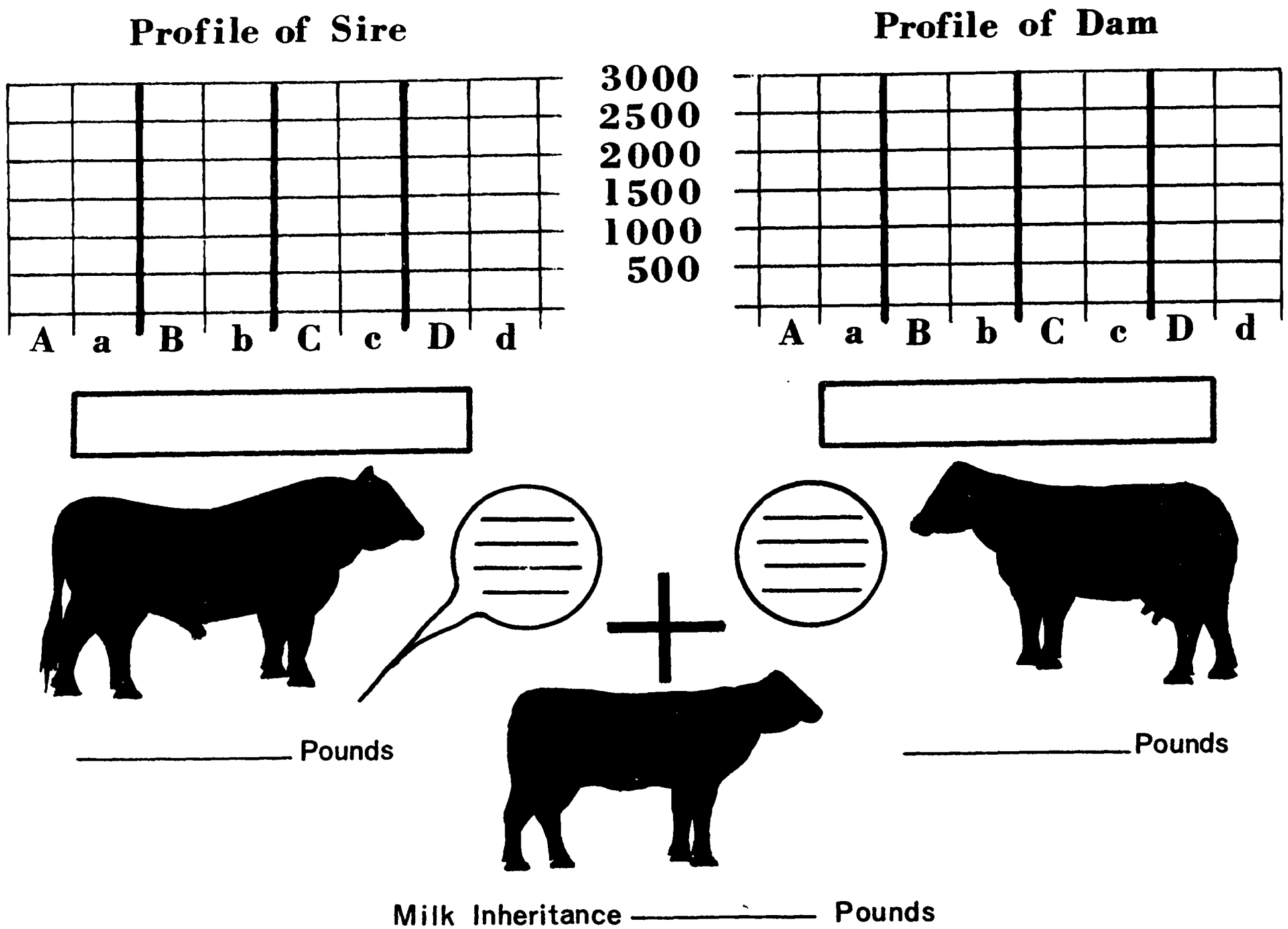
2. What if the inheritance had been Dam = ABCd x Sire = aBcD. Compare profiles of this cross and the one preceding.

3. When both chromosomes of a pair carry a low production factor, do chances for low production capability increase more than when only one of a pair has a low production factor? Chromosome pairs consisting of high production factors are desired in dairy breeding and hence the values of desirably proven sires.

A VISUAL AID:

Following this explanation is a graphic design which you can use to illustrate the concepts of milk inheritance and why it is essential to use proven sires.

You may duplicate this form in a number of ways. If you have an overhead projector you may make a transparency. The design may be reproduced on the chalkboard, or it may be dittoed and given to students.


Profile of Sire
Profile of Dam
3000
2500
2000
1500
1000
500
A a B b C c D d
A a B b C c D d
Pounds
Pounds
Milk Inheritance
Pounds

Following is the step by step procedure in using this aid.

1. Write the 16 possible combinations of the four chromosome pairs Aa Bb Cc Dd on slips of paper or tags or cardboard and place them in a hat.

ABCD	AbCD	aBCD	abCD
ABcd	AbCd	aBcD	abCd
ABcD	AbcD	aBcd	abcD
ABCd	Abcd	aBCd	abcd

2. Have students assign a milk production factor to each of the eight chromosomes. Try to keep the total milk production capability, that is the total of the eight chromosomes, a reasonable figure for each animal. Example: A = 1500, a = 750, B = 1000, b = 2000, and so on through Cc and Dd. This is done for both the sire and the dam.

3. Indicate the production factors on each of the chromosomes on the Profile of Sire and Profile of Dam charts at the top of the design. This is done by using the scale between the profiles and charting in the production factor for each chromosome above its letter designation.

4. Draw a tag from the hat and record the letter combination in the block above the silhouette of the bull, replace the tag, mix them up and draw one for the cow and record this one in the block above the cow. This accurately demonstrates the chances of various chromosome combinations. In the real situation the different combinations of all chromosomes is very great.

5. Add the production factors of the four chromosomes corresponding to the tag drawn for the bull and write this on the line below the outline of the sperm. Repeat the same for the cow and write her total on the line under the egg. The four lines in each of the sperm and

the egg is to remind students that at least four of the total chromosomes of the animal contained genes which carried the inheritable material determining milk production.

6. The two totals added together represent the milk inheritance of the progeny.

If you should decide to draw this design on a blackboard and if your blackboard is washable you may use permanent chalk to draw the design. Permanent chalk will not erase with an eraser but it is easily washed off; therefore, you can use regular chalk to work several problems without erasing the design.

To make permanent chalk, make up a one-half pint solution of sugar and water in a pint jar with a lid (add sugar to water until no more will dissolve) place three or four sticks of chalk into the solution; the chalk will commence bubbling and when this bubbling ceases, pour off all of the liquid solution leaving the chalk sealed in the jar. To use, take a piece out of the jar, use as any piece of chalk and when you are finished put it back in the jar and replace the jar lid. Permanent chalk will keep a long time in a sealed jar.

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COROLLARY 2: Production records are the acceptable and approved manner by which a producer can determine the potential production capability of a producing cow and if the production capability of the sire is known (proven sire) the probable capability of the progeny can be determined.

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. The rationale for cow testing is that record keeping is the only means of measuring the cow's basic function. Testing is both quantitative and qualitative. Therefore, it is both a measure and an evaluation of her production abilities.

2. Records have essentially two major aspects: (a) they tell the actual output of the cow in pounds of milk or pounds of butterfat, and (b) they tell the farmer if this output is profitable and to what degree.

3. By converting 305 day milk records to mature equivalent records any cow of any age can be compared with any other cow.

4. The herd net income is not an accurate indicator of how well each cow in the herd is producing. Net income may be high and still have some cows losing money.

Understanding Mature Equivalents:

Mature equivalents provide a reasonable comparison of a cow's actual production with her probable production at maturity. Maturity is considered to be seven years.

The computation is made by multiplying the actual production of the first 305 days following calving by a conversion factor which can be found in a table, Age-Conversion Factors for 305 Day Production Records.

Record interpretation is much simpler and more meaningful when students have an adequate understanding of mature equivalents and know how to compute them. Take time to teach the method of computing them.

Here is a good use for the overhead projector. On a clean piece of 7 X 10 acetate copy place the M. E. table with a grease pencil, which can then be projected. On another piece of acetate write a sample problem; this can then be projected too. On another piece of acetate write a sample problem, such as a Holstein cow whose age is 3 years, 6 months, produced 11,519 pounds during the first 305 days of lactation. What is her mature equivalent?

The more information a farmer has concerning production, the better decisions he will be able to make. Therefore, it is logical that in teaching this concept the teacher must:

1. Create a sensitivity in students that there is a need for production records.

2. Teach the ability to keep records.

3. Provide practice in record keeping and in making analyses and interpretations.

What does an Annual Summary reveal?

Summaries, reports, financial statements and other forms of data regarding dairy herd records present a wealth of concise information, some graphically illustrated, which requires a minimum amount of time to read and study. When we consider that the major portion of United States agricultural statistics and information is contained in such form we have the obligation to teach students how to read and interpret them. This unit offers this kind of opportunity.

Secure a quantity of the most recent Michigan Dairy Herd Improvement Association Annual Summary. Following are suggestions for learning how to make a study of such literature, using this Annual Summary as a source.

1. Determine if students know how to read tables and charts.

2. Make a list of the kinds of information and data which the summary provides.

3. Note that a table or chart is a device which presents a quantity of data in an easy-to-read form.

4. Some information is inferred, for example, a reader may have mentally to add two columns to arrive at a total. In this case the information is secondary in terms of the intention of the author.

5. It is often possible to convert the numerical data to percentages, especially when the expression of data as a percentage is more meaningful.

Short Projects Involving Students with the Annual Summary

1. Refer to the table of county production averages. Make a bar graph, including your county and the surrounding counties, of the average milk production of cows on DHIA.

2. The pie chart is a useful device to show comparisons. Again refer to the page with the County Production Averages table and the DHIA column. Let a circle represent all the counties reporting and divide the circle to show (1) the number of counties whose average production per cow is over 12,000 pounds (2) those between 11,000 and 12,000 (3) those between 10,000 and 11,000 and (4) those under 10,000. To determine how many degrees of the circle to give each production group, count the number of counties reporting and divide this number into the 360 degrees of the circle to determine the number of degrees a single county will represent. Next, count those counties in which the average production per cow was 12,000 and multiply this number by the number of degrees for a single county. This answer represents the number of degrees to measure off on the circle for this production group. Repeat the same procedure for the other groups. A second pie chart could be made for owner sampler average cow production by a different group of students. Then the two pie charts could be compared.

Visualization of Ideas

In directing students toward the understanding of some aspect of an enterprise, such as dairy herd management, we need to break down the total complex of the management problem into simplified items which students can understand. Among these will be:

1. Milk production per cow

2. Number of dry days per cow

3. Calving interval

4. Age of cows at calving

5. Feeding levels

6. Season of calving

7. Culling for cow removal

One of the goals of a dairyman is a high herd average and the achievement of his goal will be largely dependent on how well the seven management factors are understood and the approved practices are followed.

Your students should visualize these factors in terms of how they affect the herd average. Their visualization depends on the kinds of activities in which they engage. You may want to: (1) arrange a symposium (a forum type discussion with groups of boys prepared to discuss one of the factors and to relate it to the whole), (2) make a poster to illustrate each factor (asking each boy to illustrate one of the seven), (3) as a class, to arrange all seven factors in a meaningful exhibit (working in small groups first to explore design ideas), (4) prepare a flip chart or transparencies for an overhead projector (a series of transparencies rather than a series of flip-over sheets), or (5) help students plan for individual projects or reports relating to supervised farming programs.

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COROLLARY 3: The cows of a dairy herd can be ranked and compared at any given point in their lactation by extending the incomplete records of each individual to the mature equivalent values.

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. Genetic improvement of the dairy herd partially depends on the dairyman's ability to cull out poor producing cows.

2. The logical way to upgrade the herd is to weed out those cows which are the lowest producers. This system requires a method of ranking the cows within the herd.

Let us consider the logic of ranking a cow with all other cows after she has been producing 100 to 120 days. If all records, complete or incomplete, can be projected to 305 days mature equivalent we do not need to wait until the cow begins to fall off in production or to complete her lactation in order to determine her rank in the herd. When low productivity is determined early in lactation, the cow can be sold to better advantage than when her lactation period is nearing its end. A low producer may return a profit over feed costs for the first months of lactation and begin losing during the last five to six months of lactation. If the cow loses money during the first months of lactation the owner will have less loss if he sells her at market value. The process of ranking, using the above data, is as follows:

1. Extend the present incomplete record (less than 305 days) to a calculated 305 day record.

2. Determine the mature equivalent of each cow.

3. Find the average mature equivalent of the entire herd (total of mature equivalent values divided by the number of cows) and place cows in numerical rank by their mature equivalent values.

The Michigan State University Dairy Slide Rule makes these calculations simply and rapidly. Considering that the slide rule is very inexpensive, no attempt will be made to explain how to make long-hand arithmetical calculations. Every department should have one or more for use in the department.*

Supervised Farming Program Activity

Non-farm boys have an opportunity to work with dairy farmer friends or relatives to rank the cows in the dairy herd. A student would gain deep insight into herd improvement if a project were set up to rank periodically a herd (every 2 - 4 months) and on the basis of each ranking make hypothetical decisions and then check these decisions against completed records.

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*Available @ $1.00 from Clinton Meadows, Cooperative Extension Department, Dairy, Michigan State University, East Lansing, Michigan.

COROLLARY 4: It is difficult and expensive for a dairyman to own his own bull(s) to achieve the results which usually occur through an artificial breeding service.

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. There is still a need to convince some milk producers that artificial breeding is superior to owning one's own bull.

2. Feed costs, labor requirements, stall room and need for managerial decisions usually required in keeping a bull can be transferred to two or more extra cows when a dairyman changes to artificial breeding.

3. Bull costs increase as a farmer attempts to own and use proven sires of the quality found in artificial breeding organizations.

4. Artificial breeding associations are available to every Michigan dairyman.

If we admit that resistance is a factor in change then we can understand that our job in agricultural education is to facilitate learning in such a way that resistance will be diminished as rapidly as possible. We will teach our students:

1. To use artificial breeding of dairy cattle as a means of studying what has been involved in order to encourage dairymen to change from using their own bulls to artificial breeding.

2. To correlate events and history of artificial breeding in dairying and the application of genetic principles with artificial breeding on commercial hog farms, a practice not now widely used but which is receiving considerable attention.

A Procedure for Analysis

I. How was the dairyman made aware of artificial breeding?

1. A knowledge of how artificial insemination worked.

2. Planned demonstrations and experiments.

3. Encouraged by promise that artificial breeding. was cheaper than keeping a bull.

4. Knowledge of what is a proven sire.

II. How was the dairyman made interested in artificial breeding?

1. Presented with pertinent facts.

a. Availability of artificial breeding service to provide semen and inseminators.
b. Various extension and agricultural education methods of diseminating information.
c. Results obtained by neighbors.

2. Self-appraisal of own dairy business.

a. What are my measures of efficiency and are they up to standard?
b. Can I afford to use an unproven sire?
c. Am I properly prepared to house and handle a top quality sire?
d. Can I afford the investment of a proven sire?
e. What is the cost of artificial breeding?

III. How did the dairyman decide to try artificial breeding?

1. Attended educational meetings or talked to experts.

2. Obtained more information on what practices he himself was obligated to follow in order to be successful -- clearly an agriculture teacher's function.

3. Decide, on a trial basis, to breed artificially one or a few cows.

IV. How did the dairyman come fully to accept artificial breeding as a continuous practice?

1. Evaluated his experience with his first attempts or trials.

2. Learned the practices that were obligatory on his part.

3. Developed favorable attitudes toward the concept of artificial insemination, toward his artificial breeding association, and toward the inseminator.

The above outline is not entirely complete but it is complete enough so that a teacher can readily determine that he is an important person in bringing about change.

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COROLLARY 5: Successful artificial breeding requires cooperation between the dairyman and the inseminator. The herd manager has a definite responsibility and unless he does his job well, the rate of conception on first insemination will be low.

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. One fundamental concept of dairy cattle breeding is the necessity of using the best bull available. For most dairymen this will be the use of a bull in an artificial breeding stud.

2. Artificial Breeding Associations throughout the United States have developed a highly efficient artificial breeding service for their members or clients. Most of the services are using a high percentage of proven sires.

3. Methods of handling, storing and transporting the semen have been so highly developed that there is little chance of using impotent semen.

4. Inseminators who work for artificial breeding services are trained in the skills required for successful breeding of cows.

5. Dairymen as a whole need to be better informed and more skillful in fulfilling their obligations to an artificial breeding program.

6. If the farmer has one or one hundred cows, he needs breeding records. Events such as heat periods, breeding dates and calving dates cannot safely be committed to memory. Records must be kept in writing.

Developing a System of Breeding Records

Records do not need to be complicated but they do need to be complete and accurate.

The following activity builds on the concept that a system of records must have utility. The experiences involved include the construction of a system of records based on the principle that when we know what information we need, we can devise a method of collecting it, and once collected, the records will be useful.

Breeding records consist of four main items.

1. Dates of heat periods

2. Dates when cows are bred

3. Dates of calving

4. Medical history on each cow including dates

The next logical step is to determine why the above information is needed.

For example:

1. Exact dates of heat periods tell (a) the length of heat cycle, (b) duration of heat periods, (c) first period after calving, (d) number of periods between calving and first breeding, (e) number of periods between first breeding and conception, (f) patterns of regularity.

2 Dates when cow is bred provides (a) accurate date of conception, (b) a base to calculate the time when the owner must be alert to determine if the cow has conceived and (c) the date from which calving can be calculated.

3. Date of calving is necessary to determine the beginning of the next breeding period.

4. Medical history provides much useful information.

With this amount of background, your students are now ready to tackle the construction of a system of records. The student actually has a wide choice of basic considerations, i.e.:

1. System may be constructed on a large sheet of poster paper as a total herd record.

2. Use individual cow records on 8 1/2 x 11 sheets of notebook paper.

3. Use a card file system using 4 x 6 or 5 x 7 cards.

The activity permits creativity and the teacher must stimulate creativity by being as helpful as possible without being directive. The following criteria will help him supervise and evaluate the activity.

1. Is the system of records which the student is constructing providing space for the four basic items of information?

2. Is his system too complex and can it be simplified?

3. Is data on desired information made readily available by his system or is too much interpolation needed?

4. Is the system arranged in logical parts?

5. Do all records (i. e. dates) as recorded, consistently go either horizontally or vertically (one direction only, both directions cause confusion)?

6. If the system is a herd record, are individual cows easily traced throughout the record sheet?

7. If single cow pages are used, is the information sequential and like a case history?

8. If a card system is used are specific cards easily found, with no more than one or two cards required per cow?

9. In all systems, does key information stand out or is it easily found?

The success of first-service conceptions is dependent upon the farmer's knowledge of the order of events which occur during the heat cycle and his observation of the relationships between events in order to select the right time to have the cow inseminated.

The visual aid, "Timing Guide", for the average cow is reproduced for you at the end of this unit. This chart, used as a direct visual or as a transparency for projection, is suitable for teaching students and dairymen how to determine the time to call the inseminator and to teach the order of events of the heat cycle.

WHEN TO BREED
Timing Guide

HOURS		
0		BEFORE HEAT: 6 - 10 Hours Smells other cows Tries to ride other cows Vulva moist, red, swollen
6	TOO EARLY	STANDING HEAT: 18 Hours Stands to be ridden Bawls frequently Nervous and excitable Rides other cows Off feed and milk Vulva moist and red Clear mucus discharge
9	FAIR	
18	BEST	AFTER HEAT: 10 Hours Will not stand Clear mucus discharge
28	Egg released	
	TOO LATE	LIFE OF EGG: 6 - 10 Hours

DAIRY SOURCE UNIT

RAISING DAIRY CALVES

Introduction:

The success of approved breeding practices is largely dependent on the ability of the dairyman to raise heifer calves that are healthy, fully grown and capable of making excellent records of production in the herd.

This unit is based on one overall principle, the same as the earlier units in this series. However, no corollaries have been included since it was felt this would result in overlapping of subject matter with other units.

BASIC PRINCIPLE:

Profitable dairy herds depend upon heifer replacements which have been sired by high quality bulls and are from high producing cows. However, good breeding has little value if proper feeding and management is not practiced.

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. Calf management starts during the gestation period.

2. Strong, vigorous calves are associated with quality heifer replacements.

3. Colostrum milk for the first three to five days is important in giving the calf a good start.

4. Feeding during the first four to six weeks is most critical. Supplementary to feeding are management practices which facilitate vigorous, healthy growth in calves.

Approved Practices for Raising Calves:

A dairyman's overall objective in raising replacement heifers is that they will be vigorous at birth, remain healthy, grow normally and be well-developed at the time they reach breeding maturity. Through calf nutrition and management research there is a general understanding and wide-spread acceptance of approved practices which dairymen should use in meeting this objective.

Many of these practices are departures from former or more traditional ways of raising calves. For example, a recommended labor efficiency practice is to take calves away from their mother permanently, after the first 12 to 18 hours. Traditionally, the calf is allowed to nurse until milk is ready for market use.

This classroom activity is divided into two parts:

1. Searching through the literature to find approved practices which are recommended.

2. Rate each practice according to the factors listed below.

Activity 1: Distribute copies of some or all of the following bulletins and books.

a. Calf Management Practices in Michigan, M. S. U. Agriculture Experiment Station, Article 40-11, August, 1957.

b. Raising Dairy Calves & Heifers, Farmers Bulletin No. 2176, U. S. D. A.

c. (New M. S. U. Bulletin coming out in 1964 on dairy calves)

d. Diggins and Bundy, Dairy Production, Prentice-Hall, 1961.

e. Other material of your choice. Do not overlook Dairy Notes, which are furnished by the Dairy Department at Michigan State University and mailed with your Service Letter.

From these publications the students should search for dairy calf practices on which two or more sources are in agreement. Lists prepared by individuals or small groups may then be combined into a single list. They should be written on the chalkboard, large sheets of paper, or on acetate for overhead projection.

Activity 2: Provide each student with a dittoed rating sheet and ask him to give each practice a 1 to 5 rating (5 being high) for each of the statements listed.

(Numbers correspond with the practices on the list developed by the class.)

Factors for Rating Each Approved Practice (1 is low or some, 5 is high or much)	1	2	3	4	5	6	7	8	9
1. Degree to which the practice is suited for a 35 cow herd or larger.									
2. Degree to which the practice is suited for herds less than 35 cows.									
3. Degree to which practice requires the learning of new technical information.									
4. Degree to which practice requires a change in routine tasks.									
5. Degree to which practice will likely involve physical facility changes.									
6. Degree to which you believe this practice is now being used on dairy farms.									

HOUSING

BASIC PRINCIPLE 1:

The features or elements of a housing system, to a large extent, (1) determine how adequately safe, sanitary, healthful conditions can be maintained and (2) greatly contribute to overall labor efficiency.

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. Some of these features are manure removal, drainage, prevention of ice and snow accumulation, fly and rodent control, elimination of injury-inviting obstacles and protection from the natural elements.

2. Primary considerations are new innovations, both large and small, which when added to or combined with a system increases general productivity.

Student Reports, Using a Special Theme (For example: Recent Innovations in Housing Livestock)

Agricultural innovations provide a type of student motivation which teachers sometimes forget to use. They serve to remind students that agriculture is as dynamic and as ever-changing as are other sciences. Student reports should not necessarily try to predict the future but rather should describe what has been recently introduced and is being successfully used by a few farmers.

Do not encourage those kinds of reports which are copied from a magazine, book or sales propoganda, but rather those that use this same literature as source material. The following outline will be helpful.

1. A brief description (a paragraph) of the idea or the innovation.

2. How it especially contributes to herd health, safety and sanitation.

3. How it increases labor efficiency.

4. Is this "something new" in our community, county, or state? To what extent?

5. How difficult would it be for a farmer to change to this new idea; what does it involve (construction, reconstruction, simple installation, heavy or light capital investment, contractual services)?

6. Include cut-out pictures which are rubber cemented to the report.

7. Use sketches, drawings and diagrams.

8. Explain this innovation and how it should be introduced in our community.

9. Explain how difficult or how easy it would be to adapt this innovation to our farm (or any farm).

10. Describe what its introduction would mean in terms of dollars and cents and what the other awards and incentives of using this innovation would be.

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BASIC PRINCIPLE 2:

Housing is part of a management system for dairy cattle, or for any other type of livestock, which provides the livestock owner efficient means and methods of performing the work required by animals. These include feeding, watering, milking, animal comfort and sanitation.

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. There are different systems of housing and usually the first consideration is the selection of one of the several systems. For example, there is stanchion housing, loose housing and loose housing with individual stall systems.

2. Pros and cons of each system need to be emphasized. Suitable criteria are as follows:

   a. Point of view of purebred breeder in displaying his animals.

   b. Automation is probably best suited for loose housing but yet practical in stanchion housing.

   c. Milking parlor eliminates some hard work and stooping.

   d. One man can handle a few more cows in loose housing.

   e. Costs are about equal if loose housing is complete.

   f. Production of Grade A milk is easier to maintain in stanchions.

   g. Bedding costs vary with the system.

3. In planning to build or remodel, referral to publications suggesting minimum standards for the design and operation of the housing system is necessary to determine requirements for a herd of a given size.

4. Plans and standards for design and operation of systems usually incorporate labor and management factors. The producer needs only to adapt them to his own situation.

5. Loose housing systems, equipped with individually bedded stalls, keep cows cleaner, require less bedding, and appear to give animals a greater degree of security.

Comparative Approach to Understanding Livestock Housing

Obviously, housing for the dairy herd will be considerably different from housing the swine, sheep or beef herds and yet the elements of housing of each are similar. For example, all housing systems require that there be a feeding area and that this area have minimum standards and requirements for given herd sizes. All animals need to drink and to rest and provision for these must be incorporated into the system.

Activity 1: The first task of the comparative approach to understanding livestock housing is to list those elements or areas common to all livestock herds. The class as a whole may develop this reference list, making sure that an element or area needed in dairy housing such a feeding area, is also required in swine, beef and sheep housing. An area for sheep shearing and wool storage has no place on a general list.

Activity 2: The last sentence above suggests the next step which is to list those elements or areas of housing unique to each kind of livestock and to specific production purposes. Pig brooding facilities are important in swine production, rotation pens are necessary in swine feeding and milkrooms are a part of dairy housing. However, maternity stalls, farrowing pens, and lambing quarters, while different in design, have a common purpose (parturition) and should be treated as a common area. This phase of the comparative study lends itself to small interest group study and action. Boys who are interested in dairy or whose farming programs are strongly dairy may work on dairy housing and list those areas and elements of a housing system pertinent to dairying.

Activity 3: This task includes determining the relationship between the areas and/or the elements of each of the housing systems included in the comparative study. This may be done without reference to size of herd, scale or measurements. The important thing is that students learn the concept that efficiency of time, ease of labor, health and sanitation, effect of natural elements, and

meeting public health requirements all depend upon the interrelationship and the planning of the areas.

Provide the groups of students with sheets of newsprint paper, or with wrapping paper and instruct them to sketch various system plans without regard to measurement but with regard to proportion. Individual students should be encouraged to consider their own situation as much as possible.

Activity 4: Plan a system to scale for a specific herd.

A second approach to the comparative study of livestock housing, using the field trip method:

The communities of most vo-ag departments have farms representing types of housing systems which would serve as models for study. This approach requires a field trip. If this comparative study is to be made at one time and on farms, an entire half day should be arranged for the field trip, otherwise several trips of shorter time may be made, each to a single farm.

In order to keep the study student-centered it will be important to have the student interest groups (i. e., dairy housing, sheep housing, etc.) plan the trip and conduct the study on the farm. This would require prior study in class and a prior visit to the farm by at least one of the members of the interest group. One needs only to stretch his imagination in order to determine several alternative ways of conducting this type of study.

A Realistic Approach to the Problem of Improving Housing Facilities:

Housing is usually subject to upgrading in order to insure that the system will provide the maximum labor efficiency. Remodeling is expensive and represents a capital investment. Therefore most dairymen (or other types of livestock producers) are not always able to make the several necessary improvements at one time. Periodic improvements or remodeling requires planning concerning how to construct or add something new to an existing system which is in some part out-of-date.

As an example of this consider remodeling (or improving) an existing loose housing system with the addition of free stalls. What considerations would be involved? Some of these would be:

1. What area of the system would remodeling affect?

2. Does existing floor plan permit installation of stalls without wasting area?

3. What would the new floor plan look like?

4. Would reconstruction alter any of the existing and desirable characteristics of the present system; such as drainage, system of manure removal, access to feeding and storage or plans for future reconstruction?

5. To what extent would remodeling interfere with daily routine work? Would the work have to be done during any particular part of the year?

6. After planning and careful consideration is it evident that the improvement will be as advantageous as initially conceived?

It is obvious that a class activity of this nature has many directions and many stopping points; the first of which would be at the concept level, stated in the first paragraph. The teacher has choices ranging from real farm situations which normally occur in the community to hypothetical units such as working from drawings and loose housing floor plans. Regardless of choice, the important thing is to teach that changes in livestock housing are more frequently incorporated through a process of reconstruction than by building completely new facilities.

BASIC PRINCIPLE 3:

Minimum standards and requirements for the milkhouse and milkroom are subjects covered in Grade A milk codes. The American milk consumer expects that every milk producer will comply fully with these regulations thus preserving, in part, high health standards which our country enjoys.

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. In Michigan the Dairy Division of the Michigan Department of Agriculture can provide you with a copy of Grade A milk standards; "Dairy Farm Standards and Interpretations."

2. Usually other published standards for the design and operation of bulk milk handling do not run counter to the Grade A Milk Code and can be used as effective guides in the classroom.

3. The vo-ag class has the obligation to learn the interpretations of the Grade A Milk Law from the viewpoint of a consumer as well as a producer.

Use of Outside Resources such as Michigan Department of Agriculture and Public Health Representatives:

Students of vocational agriculture are often surprised to learn that Departments of Public Health and the inspection divisions of the Michigan Department of Agriculture are vitally interested in agriculture, especially in the producing and handling of foods for human consumption. In many instances they are made responsible for the enforcement of various codes and ordinances concerning on-farm production of foods. A representative from either would have two important presentations to make to your class. First, he would describe how dairy inspectors and the Public Health Service operate in relation to agriculture and why their services are important to

the public as a whole. Second, he would tell how each provides occupational opportunities for students who have a knowledge of agriculture, farm life, and the ways of farm people.

Becoming Familiar with Present Day Milk Codes

It is the nature of American society to demand continually high health standards and, furthermore, to create institutions to make sure these health standards are upheld. Students of agriculture must become aware of the increasing controls and regulations over the production of human foods. It is important that they understand why these requirements are essential to human health and how to interpret the various regulations, as well as their mandatory nature.

Secure sufficient copies of the Michigan Department of Agriculture, Grade A Milk Standards, and select one or more sections for study by the class. For example, the Code lists a series of recommendations relative to locating the farm bulk tank in the milkroom, which when followed will provide satisfactory compliance with the present milk code. It is possible from this work description to make sketches of how to install a farm tank.

Supervised Farming Program

The Michigan Department of Agriculture includes a copy of the inspection form for dairy farms in their Grade A Milk publication. It may be a part of a boy's farming program to use this inspection form and to inspect his own dairy farm or a student may choose to make unofficial inspections of some other dairy farm. In either case, a part of the project should be the making of recommendations for corrective measure. The teacher may arrange for an interested student to go with a Michigan Department of Agriculture inspector on an actual farm visit for an inspection. This would provide the student with a valuable learning experience.

DAIRY SOURCE UNIT

MILKING EQUIPMENT AND SYSTEM

BASIC PRINCIPLE:

The effect of good breeding, feeding, and management can be lost simply by an improperly adjusted milking machine and/or improper practices. The improvement of either can result in more milk production, higher profits, increased labor efficiency and a lower incidence of disease.

FACTORS WHICH THE PRODUCER NEEDS TO CONSIDER:

1. The condition of the milker system is affected largely by the interest of the dairyman and his technical knowledge of it.

2. Field services provided by the manufacturer may not include the necessary follow-up inspections after the period of the guarantee has elapsed. They may not have or use testing instruments to properly check out the system.

3. Inadequacy of vacuum reserve and the condition of the vacuum pump, vacuum lines and cocks may result in fluctuations in vacuum level, variations in pulsator rates and slower milking.

4. A vacuum or pulsator recording instrument which charts the action on graph paper is a recommended means of testing the efficiency of a milking system.

DEMONSTRATIONS IN DAIRY

The first eight recommendations in the College of Education Bulletin, Michigan State University, Demonstrations in Dairy are concerned with the milking machine and milking practices.

Special attention is called to the demonstration model of the milker system which you can build in your own farm shop.

Providing a Pulsator Tester as a Community Service

A pulsator recording instrument may provide an important service to members of the class with supervised farming programs in dairy, and to young farmers and adult farmers. Local conditions would determine how the tester may be owned, paid for, and used. Because manufacturers' specifications vary greatly, a teacher should hesitate to make a diagnosis of mal-operating systems. It would be better to recommend that the dairyman call the manufacturers' serviceman to recheck the system.

Providing Ag-Related Occupational Experience

School districts in which dairying is a major enterprise are frequently visited by milking machine company sales and service representatives. Among their many interests, several of these representatives are interested in boys and are willing to help them. Vo-ag teachers have an excellent opportunity to help those students interested in ag-related occupations by arranging to have a boy travel with a serviceman to a dairy farm to observe and work along with him as he does his job. The student might even work on a farm during the installation of a milker system. A few such experiences as these over a course of four years may put a student in a favorable position for being employed by a milking machine company. It is an opportunity which a teacher and his students should not overlook.

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Test Construction in Distributive Education.

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DESCRIPTORS - *GUIDES; *GUIDELINES; *DISTRIBUTIVE EDUCATION; *TEST CONSTRUCTION; *TESTING; TESTS

ABSTRACT - Prepared by a researcher and teacher educator, this guide for test construction lists points to observe in making tests, sample directions for each type of test, and sample questions for: (1) matching tests, (2) listing or enumeration tests, (3) cluster true-false tests, (4) completion tests, (5) case problem tests, (6) true-false tests, (7) multiple choice tests, and (8) written tests. Guidelines for administering tests and a bibliography also are included. (AW)

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CALIFORNIA STATE DEPARTMENT OF EDUCATION

BUREAU OF BUSINESS EDUCATION

TEST CONSTRUCTION IN DISTRIBUTIVE EDUCATION

Prepared by
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TEST CONSTRUCTION IN BUSINESS EDUCATION

The concepts of "evaluation" and of "measurement" are not synonymous. Enterline points out that evaluation is a broader concept than measurement. Measurement refers to techniques and devices used to obtain data as a basis for evaluation.

Evaluation is the process of applying value judgment to reliable data obtained by devious means. The value judgments are determined by an objective analysis of the data in terms of clearly defined outcomes. The basic purpose of evaluation in education, whatever the specific forms or tools may be, is to determine the nature and extent of changed behavior in students. (1:4)

The concepts of evaluation and of measurement are further explained by Ross: "As used in education, evaluation is a far more inclusive concept than measurement. Two aspects of evaluation may be distinguished: (1) data relating to some important aspect of the school, such as its organization, program, or results; and (2) a set of values or standards against with these data are interpreted and appraised. . . Measurement implies the use of some tool or instrument, such as a test of scale, and provides a quantitative description of observed phenomena. This is always desirable, but it should never exclude relevant data of a subjective and qualitative character, or the consideration of outcomes not immediately observable . . ." (2:488)

The test is a means to secure data about the student. It may consist of ten or twelve questions hastily drawn up by a teacher with each question calling for discussion. This kind of test is preferably called an essay examination. When the questions are carefully framed, the essay examination has important values in the instructional process. Much research has shown, however, that it is extremely difficult to score or grade these examinations reliably.

One of the most common types of objective tests used by teachers have been the true-false test which consist of a series of statements, some of which are true and some false.

Another common type of objective test is the completion test, in which the student is required to complete a series of sentences or statements by filling in a blank with a missing word or phrase.

By far the most generally favored type at present is what is known as the multiple-choice test. In this type, each question is followed by several suggested answers, and the student is required to choose what he thinks is the right answer for each question.

Characteristics of a Good Test

1. A good test must be reliable. It should measure accurately the student's mastery of the subject matter.

2. A good test must be valid. A test is valid if it measures what it is supposed to measure. The content of the test must be in agreement with the objectives of the course and the subject matter included in the course.

3. A good test should be comprehensive. It should measure the individual's ability on all phases of the subject matter presented but not overcrowded with unnecessary details. The main points should be considered. Items that have not been presented to the class should not be included. Trick questions should be avoided.

4. A good test must be easy for the students to take. The directions should be clear and complete so that students know exactly what they are expected to do. Sample questions should be provided and these should precede each section. The test should be duplicated if possible.

5. A good test must be easy to score.

POINTS TO OBSERVE IN MAKING MATCHING TESTS

The matching type of test includes two or more lists or columns of related words, phrases, or symbols. The individual is required to match each item in one list with an item in the other list to which it is most closely related.

You can use test items of this sort for matching tests:

1. Terms or words with their definitions.

2. Short questions with their answers.

3. Technical parts or units with their proper names.

4. Parts to the unit with which they belong.

5. Causes with effects.

6. Symbols with their proper names.

7. Descriptive phrases with words they describe.

8. Principles or rules to the situations to which they apply.

Matching questions find their greatest value in requiring class members to recognize relationships and to make associations. A large number of responses can be obtained from these items due to the small space required. Moreover, they can be completed quickly by the individual and scored quickly by the instructor. The possibility of guessing the correct response is so slight that it tends to make this type of test item highly reliable. Like the other test items, matching questions do not provide a good measure of complete understanding when used alone. They make their biggest contribution as a measurement when they are used with other types of test items.

Directions to the student for handling these items may be illustrated as follows:

Directions: The phrases and items in Column I and Column II refer to the packing of goods for shipment through parcel post or express. Identify each item in Column II with its appropriate phrase in Column I and write the number of that group in the blank space provided. Items in Column I may be used more than once. The first item is answered as an example.

Column I	Column II
1. Should be wrapped into a solid package with outer wrapper of two or three thicknesses.	5 Cameras
2. Should be packed in strong box; outer wrapping of strong paper.	_____ Women's wear
3. Wrapped with reinforcements along sharp edges. Outer covering preferably a strong box.	_____ Silverware
4. Should be reinforced throughout their full length with strips of wood or heavy cardboard. Tightly wrapped in strong paper and tied.	_____ Fishing rods
5. Should be carefully cushioned with corrugated cardboard or packed in excelsior.	_____ Chinaware
	_____ Yardage
	_____ Handbags
	_____ Dried fruit
	_____ Hammers
	_____ Pictures

(over)

The main points to observe when constructing matching test items are:

1. To reduce the operation of chance, it is important to have at least 10 items. However, if long lists are used, considerable time is wasted in sorting. The ideal number is approximately 12.

2. Include only closely related material in matching items so that several plausible responses are provided for each item.

3. When an individual is permitted to use an item more than once in matching, the directions should clearly state this fact.

4. Include a few extra items from which responses may be chosen when you can. This tends to reduce the possibility of guessing or answering by a process of elimination.

5. When constructing matching items, set up all the matching items on one page.

6. Make the directions specific. Leave no room for doubt.

POINTS TO OBSERVE IN MAKING LISTING OR ENUMERATION TESTS

The listing or enumeration type of test requires the individual to supply a list of terms, rules, factors, etc., that have been emphasized in the course. The factors to be listed do not necessarily have to be put down in any particular order unless they form the steps in an operation or process. This type of test allows a greater degree of freedom of expression than do the others. Listing can minimize the possibility of guessing and yet can be made highly objective, reliable, and valid.

The directions to class members taking this section of the test usually precede each test question. An example of this type of test is as follows:

Directions: Follow carefully the directions given in each question.

1. List five chief points to observe in marking packages for parcel post or express shipments.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

The chief points to observe when constructing these test questions are:

1. Design the question so that it will call for specific information or procedures.

2. Each thing to be listed should involve only a few words.

3. A single question should rarely call for more than six to eight things to be listed.

4. Do not call for a listing involving only a part of a greater number of factors, for example, a listing of five out of a possible fifteen answers.

POINTS TO OBSERVE IN CONSTRUCTING CLUSTER TRUE-FALSE TESTS

The cluster true-false item consists of one incomplete statement followed by several phrases, any one of which will complete the sentence. The group is required to indicate by a "T" or an "F" those phrases that make the statement true or false. The directions are shown usually in the following manner:

Directions: The incomplete numbered statements below are followed by several phrases, each of which will complete the statement. Place a "T" in the space provided at the left of each phrase that makes the item true and place an "F" in the space at the left that makes the item false. The first item is answered as an example.

1. When marking packages for parcel post or express shipment

__F__ previous marks on the package or container should not be obliterated.

_____ perishable articles should be marked "Fragile."

_____ the name of the shipper should be designated.

_____ a fountain pen would be preferable to a dark pencil.

_____ a package of undeveloped film should be marked "Fragile."

_____ the shipper's name should go in the upper left-hand corner of the package.

In constructing the cluster true-false section of your test, the main points to be observed are:

1. List at least five phrases, words, or clauses after each incomplete sentence. Of course, many more may be listed, and the more you list, the better this section of your test will be--provided each one is good.

2. Make certain that each phrase, word, or clause will make a complete sentence.

3. Choose points that deal with the application of things learned as far as possible.

4. Make all responses plausible.

POINTS TO OBSERVE IN MAKING COMPLETION TESTS

The completion type test question requires the student to recall and supply one or more key words which, when inserted in the appropriate blanks, make the sentence complete, meaningful, and true. Although completion questions are difficult to construct and often hard to make entirely objective, they are extremely reliable and have the advantage of measuring the individual's ability to recall rather than to recognize specific facts and points demanding accurate information. Guessing and chance factors operate here very slightly.

Here, as with other types of test items, it is very important to provide clear and complete directions. For example:

Directions: An incomplete statement is given below. The blank space or spaces in the statement indicate the omission of a word or phrase which is needed to make the sentence complete and true. Complete the statement by writing the correct word or phrase in the blank space provided. The first item is answered as an example.

Example: The upper left-hand corner of the package is used to designate the name of the __shipper_____.

1. Packages containing delicate or breakable articles should be marked _____.

2. Packages containing food items that may easily decompose should be marked

_____.

The chief points to observe in constructing completion test items are:

1. Omit only key words.

2. Construct each statement in such a manner that it will remain incomplete until the correct response is inserted.

3. Omit no more than three words or short phrases in a single sentence. A one-word blank in a sentence is preferable.

4. Be sure there is only one correct response for each blank.

5. Do not copy statements directly from a textbook.

6. Do not omit verbs or the first two or three words in a sentence. Place the blank near the end or, at least, past the center of the sentence.

7. Make all the blanks of the same length and provide enough space to accommodate the longest word or phrase.

POINTS TO OBSERVE IN MAKING CASE PROBLEM TESTS

The case problem is often used as a teaching aid to stimulate interest, discussion, and participation by the students. When used as a test, each item is made as short and simple as possible, for the longer the answer to the problem, the less objective the scoring becomes.

The case problem consists of setting up a situation to which the class member responds by analyzing the case and then coming to a decision concerning how the situation is to be handled. When used as a test, the problem must be limited in scope and worded to permit a short, concise answer. Directions for taking the test are indicated as follows:

Directions: Each of the problems illustrated below should be carefully analyzed. You will be required to write in the space provided just how you would handle the particular situation. Limit your answer to one paragraph.

Example: The shipping clerk of the A-A Chemical Supply Company was asked to send a dozen pipettes to an eastern manufacturing plant. The pipettes were made of a delicate type of glass, about 24 inches long, and hollow. The edges were sharp and unbeveled, and the center part blown out so that it was larger than the ends. This was the first time that these articles had ever been shipped by this company, and the shipping clerk had to figure out how to ship these items safely.

Problem:

Solution:

The main points to observe in constructing and scoring case problems are:

1. Make them short.

2. Provide for short answers.

3. Provide clear and concise directions.

4. Make it clear to the class members on what basis they are to be scored.

5. Place emphasis in scoring on solution, rather than on organization, clearness of expression, etc.

6. A student should not be penalized for misspelled words, poor sentence structure, etc.

7. The papers should be scored by the same person who made out the questions, and the correct answers expected should be written out before scoring.

POINTS TO OBSERVE IN MAKING TRUE-FALSE TESTS

This kind of test question consists of a simple statement that may either be true or false, and the student is required to indicate which is the case. Good true-false tests are not easy to construct because it is difficult to formulate statements which are strictly true or false without being too obvious. However, the true-false test can be used to sample effectively a wide range of subject material, it is adaptable, and it can be easily and objectively scored. It may include statements that are factual, depending upon memory for a correct answer, or those that require reasoning; and it can be designed to include the application of things learned.

One criticism of true-false questions is that they tend to encourage guessing. However, many teachers discourage guessing by the "penalty method"; i.e., giving one point for each correct answer, a zero for an unanswered question, and deducting one point for each wrong answer. If this is done, it should always be made clear to the student--either in the written directions or orally.

Directions for answering true-false test questions should precede the items in the test. For example:

Directions: Some of the following statements are true and some are false. If you consider the statement more nearly true than false, place a "T" in the space provided. If you consider the statement more nearly false than true, place an "F" in the space provided. The first statement is answered as an example.

Example: __F__ Fragile items should be shipped in paper-wrapped packages.

_____1. Fabrics should be wrapped in two or three thicknesses of paper.

_____2. Sharp-pointed or sharp-edged instruments should be packed in excelsior.

When constructing a true-false test, plan on using a generous number of questions in order to get a representative sample of the subject to be covered and to minimize the effects of guessing. Usually about 50 true-false items are included in a 100-item test. Points to observe in making up a true-false test are:

1. Make approximately half the items true and half false.
2. The statements should be written in simple, direct language.
3. Do not make one part of a statement true and another part false.
4. Avoid using unnecessary technical terms and trivial details.
5. Avoid double negatives or long and involved sentences.
6. Make application of things learned the point of as many items as possible.

(over)

7. Avoid using such words as "all," "none," "never," "always," or "only," as experience has shown that true-false questions containing such words are generally false. Test-wise members can guess the answers to such statements.

8. Plan on either distributing true-false items throughout the test or placing them all in one section, depending upon the type of subject matter covered and the type of test item you are using.

POINTS TO OBSERVE IN CONSTRUCTING MULTIPLE-CHOICE TESTS

This type of test item consists of an incomplete sentence followed by several phrases, words, or clauses from which the group must select the one that will best complete the sentence. The simplest type of multiple-choice item requires that the group identify the one correct response listed among several that are wrong. It is probably the most applicable to life situations, for we are generally confronted with a variety of choices rather than just two.

Multiple-choice items can be designed to measure the group's ability to form judgments and apply the things that have been learned. They can also be used to measure the amount of material that an individual can recognize. Multiple-choice items can be used to measure practically all types of achievement, from the fundamentals to refined points of judgment and technical know-how.

There are difficulties in preparing multiple-choice tests, the main one being that it is sometimes impossible to invent equally plausible wrong responses for an item. There is also the danger that the test-maker may include more than one response that can be marked correctly. The guessing factor is reduced in this type of test over true-false, by increasing the number of possible responses.

Directions to the class for answering this type of test item can usually follow the example presented below:

Directions: Each incomplete statement given below is followed by several phrases. From these phrases choose the one which, when added to the incomplete statement, best completes that statement. Place the letter of the phrase that you select in the blank space provided at the right. The first item is answered as an example.

Example: The name of the shipper should be placed ___d___

a. in the upper right-hand corner of the package.
b. in the center of the package.
c. in the lower left-hand corner of the package.
d. in the upper left-hand corner of the package.

1. When shipping a set of curtain rods, you should _____

a. reinforce them with strips of wood.
b. pack them in excelsior.
c. wrap them in corrugated paper.
d. tape them together with scotch tape and wrap tightly in plain paper.

2. When shipping a delicate optical instrument, you should _____

a. wrap tightly in paper.
b. cushion with corrugated cardboard.
c. reinforce with strips of wood.
d. ship it unwrapped with a special label attached.

(over)

The main points to observe in constructing multiple-choice items are:

1. Include four responses in each item, all of which are plausible, but only one of which is possible. Less than four choices increases the possibility of guessing the correct response. More than four increases the difficulty of writing plausible items.

2. Avoid responses that are obviously wrong or correct. Response "d" in #2 shown above might be classed as such. All responses should be worded in such a manner that the individual must know the subject matter in order to select the correct one.

3. Avoid (a) Clues to the correct response such as words or phrases taken directly from the text in the exact manner as they were worded; (b) Shifts in grammatical construction for the correct response; (c) Making correct responses longer or shorter than the other responses.

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RULES FOR CONSTRUCTING GOOD WRITTEN TESTS

1. Ask questions which are of the most importance. Under no circumstances include "trick" questions or unusually difficult ones.

2. Select items from material actually taught, preferably from the teaching outline.

3. Plan for a variety of items, if possible. Use true-false, multiple-choice, completion, matching, etc., all in one test, when possible.

4. Phrase items clearly, so that they cannot possibly be misunderstood.

5. Construct questions that require application of what has been learned.

6. Arrange items in order of difficulty, with easier items first, so that the student doesn't spend all his time on the difficult ones, failing to answer many he knows.

7. Include a few easy items as well as a few difficult ones so that no individual will make a perfect score or a failure.

8. Provide clear and complete directions. Use sample test questions as illustrations.

9. Check your test with someone who is familiar with the subject matter. Get reactions from your class members and throw out any "too easy," "too hard," or "unfair" items before using the test again.

10. Arrange to have the test duplicated, if possible.

11. Remember that a test is no better than the questions of which it is constructed.

Guides for Administering Tests

Also important in the testing are the procedures for the administration of the tests. The following guidelines should assist the teachers in the proper techniques in administering classroom examinations:

1. Put students at ease.

2. Be prepared to administer the examination. Have all necessary test materials ready for distribution. Make a list of the materials as a reminder.

3. Provide the best possible testing conditions. Keep the test room free from disturbances or distractions. No student should be allowed to interrupt another student nor create any disturbance. All questions should be directed to the teacher. Ample work area should be provided for each student taking the test.

4. Give a careful explanation of the purpose of the test. Provide directions and explain them carefully to the group. Go over the various parts of the test with the students before they begin. If the test is to be given with no time limit, the group should be told to take all the time they need.

   If conducting a timed test, students should be informed of how much time is left periodically. Record the exact time that students complete the test.

5. Provide for a review and scoring of test items. Set aside sufficient time at the end of the class meeting or the following meeting to review answers to all test questions.

6. If the students find actual errors in the test, admit the errors and revise those test items.

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Agricultural Chemicals. A Guide for Providing Instruction for 11th or 12th Grade Vocational Education in Agriculture.

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ABSTRACT - This curriculum guide is for teacher use in planning and conducting a 36-week course in agricultural chemicals for grades 11 and 12. Topical outlines covering subunits and problem areas, principles to be taught and/or competencies to be developed, suggested resources, suggested teaching-learning activities, and teacher notes are provided for the following major units of study: (1) Introduction, Orientation, and Guidance, (2) Plant Foods, (3) Pesticides, (4) Agricultural Chemical Controls, and (5) Education and Career Opportunities. Recommended facilities and equipment, suggestions for supervised practice programs, and suggested references including texts, supplementary materials, and audiovisual aids are appended. Courses in agricultural science and mathematics and general biology are recommended prerequisites. (AW)

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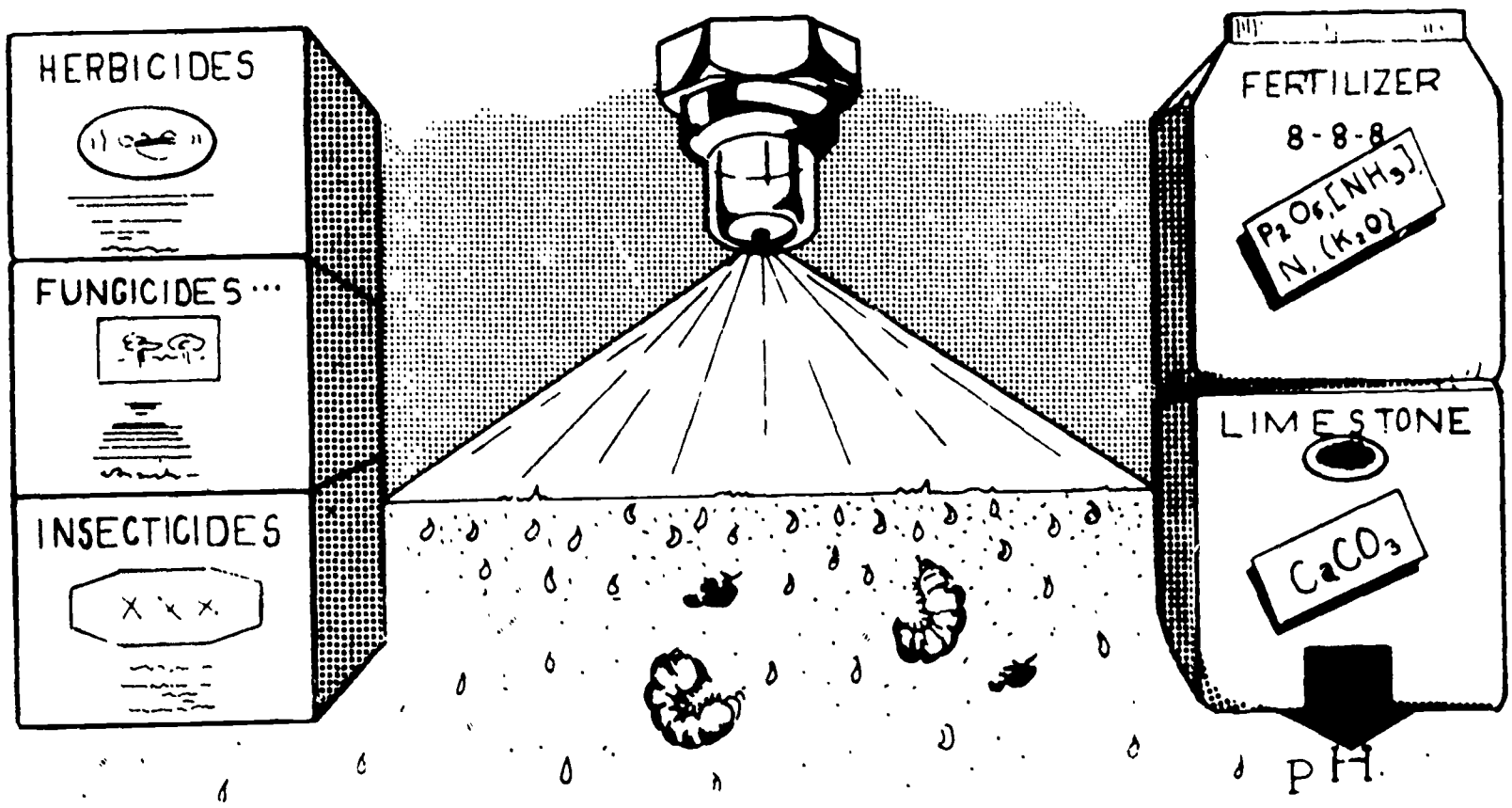
A GUIDE FOR PROVIDING INSTRUCTION

IN

AGRICULTURAL CHEMICALS

Course No. 705.8



VOCATIONAL EDUCATION
in
AGRICULTURE

Division of Vocational Education
Agricultural Education Section
Department of Public Instruction
Raleigh, North Carolina

June 1964

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AGRICULTURAL CHEMICALS

A Guide for Providing Instruction for 11th or 12th Grade Vocational Education in Agriculture

June 1964

Developed by:

Curriculum Laboratory
Department of Community Colleges
Raleigh

Division of Vocational Education
Department of Public Instruction
Raleigh

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Preface

Agricultural Chemicals are playing a tremendous role in providing the standard of living we have today. Authorities tell us that 90 per cent of the food man grows would be destroyed by insects and diseases unless we exert continual vigilance. Starvation and epidemic disease are immediate dangers in all areas of the world where chemical products such as pesticides and fertilizers are not widely used.

The contents of this guide provide for planning an elective course in agricultural chemicals, preferably in the eleventh or twelfth grades. It is recommended that Agricultural Science and Mechanics, and General Biology be prerequisites to the course.

This guide is designed for a period of 36 weeks. However, the course could be adapted to a different period of time as may best fit the needs in the local area.

Due to the constant technological changes in this study area and the quantity of good reference material available from commercial companies, there are many sources of reference materials. It is suggested that the North Carolina Pesticide Manual and Using Commercial Fertilizers, as listed in the Appendix, would serve as desirable basic texts.

Objectives

Agricultural Chemicals

To enable students

1. To develop an understanding and appreciation of the scope and importance of agricultural chemicals as related to the social and economic welfare.

2. To develop mental and performance skills which are essential to the effective, efficient, and safe use of certain agricultural chemicals.

3. To learn about occupational requirements and opportunities in the broad field of agricultural chemicals.

4. To learn about opportunities for continuing education in agricultural chemicals.

5. To appreciate the necessity of controls and regulations relative to the sale and distribution of certain agricultural chemicals.

6. To understand that man through the use of agricultural chemicals can actually improve upon the "balance of nature" for the benefit of mankind.

COURSE OF STUDY IN AGRICULTURAL CHEMICALS

	1st 6-week Period	2nd 6-week Period	3rd 6-week Period	4th 6-week Period	5th 6-week Period	6th 6-week Period
1st week	Introduction Orientation Guidance	Phosphorus Plant Foods	Dry Mixed Fertilizers	Insecticides	Fungicides	Agricultural Chemical Controls
2nd week	Introduction Orientation Guidance	Phosphorus Plant Foods	Dry Mixed Fertilizers	Insecticides	Herbicides	Safety with Agricultural Chemicals
3rd week	Plant Foods Introduction	Potash Plant Foods	Liquid Fertilizers	Insecticides	Herbicides	Safety with Agricultural Chemicals
4th week	Nitrogen Plant Foods	Potash Plant Foods	Economics of Fertilizers	Insecticides	Rodenticides and Nematocides	Educational and Career Opportunities
5th week	Nitrogen Plant Foods	Secondary Plant Foods	Economics of Fertilizers	Insecticides	Pesticide Equipment	Educational and Career Opportunities
6th week	Nitrogen Plant Foods	Secondary Plant Foods	Review and Evaluation	Fungicides	Pesticide Equipment	Review and Evaluation

Unit - INTRODUCTION, ORIENTATION, AND GUIDANCE

Educational objectives for this unit:

To enable students -

- To develop an understanding and appreciation of the scope and importance of agricultural chemicals as related to the social and economic welfare.

- To become acquainted with the career opportunities in the broad field of agriculture chemicals and gain some insight as to what preparation would be required to enter such an occupation.

INTRODUCTION, ORIENTATION, AND GUIDANCE

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed	Suggested Resources	Some Suggested Teaching-Learning Activities	Teacher Notes
I. Agricultural chemicals contribute greatly to our present standard of living as fertilizer components in plant nutrition and as insect and disease control products for crop and livestock production.	11, 14, 17	Class may discuss the book, Silent Spring by Rachel Carson, as basis for introduction to this course.	
II. The fertilizer industry is one of the largest units of the heavy chemical industry. A. The quantity of fertilizer used increases each year. B. Many different materials are used in the manufacture of fertilizers.	1, 13		
III. Chemicals used as pesticides may be in one of three large groups: A. Insecticides B. Fungicides C. Herbicides	2, 11		
IV. There are many opportunities for employment in the field of agriculture chemicals.	10, 13	Students should build or add to the "careers" cabinet in the area of agricultural chemicals.	

INTRODUCTION, ORIENTATION, AND GUIDANCE

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	
			Teacher Notes
A. Sales B. Manufacture C. Custom applications D. Exterminating E. Education F. Inspection			

Unit - PLANT FOODS

Educational objectives for this unit:

To enable students -

- To develop an understanding and appreciation of the economic necessity of efficient use of commercial fertilizers.

- To understand the need of certain controls and regulations relative to the manufacture, sale, and distribution of commercial plant foods.

- To develop mental and performance skills essential to the purchase and application of plant foods.

PLANT FOODS

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	Teacher Notes
I. Nitrogen, phosphorus, and potassium are often referred to as the primary plant foods. A. Nitrogen fertilizers 1. Inorganic materials a. Sulfate of ammonia b. Nitrate of soda c. Ammonium nitrate d. Ammonium phosphate e. Anhydrous ammonia f. Liquid ammonia g. Calcium nitrate h. Nitric phosphates 2. Natural organic nitrogen materials 3. Synthetic organic nitrogen materials 4. What nitrogen does for plants B. Phosphate fertilizers 1. Sources of phosphate fertilizers a. Superphosphate b. Ammonium phosphates c. Nitric phosphates d. Liquid phosphoric acid	1, 12, 16, 17	Each student should be asked to collect and send off a soil sample. Some students living on a farm may wish to send samples from several different fields. The returned analysis forms will make excellent sources of study materials for understanding the primary and secondary plant foods. Students should be able to draw and color the symptoms indicated in leaves when any of the three primary plant foods are deficient.	

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	Teacher Notes
e. Rock phosphate f. Colloidal phosphate g. Basic slag h. Bone products			
2. Soil phosphorus			
3. What phosphatic fertilizer materials do for plants.			
C. Potash fertilizers	1		
1. Sources of potash salts			
a. Muriate of potash b. Sulfate of potash c. Manure salts and kainit d. Nitrate of potash e. Potassium-magnesium sulfate f. Tobacco by-products g. Potassium phosphate h. Nitrate of soda and potash			
2. What potash fertilizer materials do for plants.			
II. Secondary and trace element plant foods have important functions in the total growth processes.	1, 12, 16		

PLANT FOODS

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	
			Teacher Notes
A. Sulfur B. Calcium C. Magnesium D. Manganese E. Boron F. Copper G. Zinc H. Iron I. Molybdenum J. Chloride			
III. Dry-mixed fertilizers are plant food materials which are combined to obtain certain ratios of plant nutrients. A. Understanding fertilizer analysis and ratio. B. Granulation converts dry mixture into granules of uniform size and composition. C. Dry fertilizers may be chemically blended. D. The purchasing of mixed fertilizers has almost completely replaced the mixing of fertilizers on the farm.	1	Students may be asked to determine the actual number of pounds of each plant food in a 100 pound bag of 5-10-5, and find out what makes up the remaining 80 pounds. A class trip to a near-by fertilizer manufacturer would enable students to consider career opportunities as well as present a good teaching environment.	

PLANT FOODS

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	Teacher Notes
IV. Liquid mixed fertilizers have attracted increased attention and use in recent years. A. There are two methods of manufacturing liquid fertilizers. 1. Batch process 2. Neutralization process B. Storage and distribution present new problems with liquid fertilizers. C. Many factors should be considered in evaluating agronomic properties of liquid fertilizers. 1. More uniform application. 2. Solubility desirable for starter solutions. 3. Homogeneous mixture. 4. Water soluble materials may be more efficient on high-lime soils. 5. More adaptable to foliage spray application. 6. Advantageous in dry seasons.	1	An experiment of various concentration on potted plants could be effective in teaching some techniques and precautions with liquid fertilizers.	

PLANT FOODS

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	Teacher Notes
7. Possibility of foliage burning on growing plants. 8. Limited plant food content. 9. Relatively low in secondary and trace element foods. 10. Difficult to place in relation to seeds. 11. Soil fixation of plant nutrients may be high because of solubility.			
V. Principles in the use of fertilizers A. The economic justification is the first problem of the user. 1. Response differs with kind of crop. 2. Other factors such as moisture will determine final returns. B. Many soil factors affect fertilizer response. 1. Chemical composition. 2. Physical condition of the soil. 3. Organic matter content. 4. Soil reaction.	1	Students may develop a chart showing the returns in corn production when various amounts of nitrogen fertilizers are used. Some students may be able to conduct some small scale experiments on the results of using various quantities of commercial fertilizers on their home farms.	

PLANT FOODS

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	Teacher Notes
C. The method of application can be just as important as the correct amount and analysis. 1. Fertilizer placement varies with different field crops. a. Alfalfa b. Forage crops c. Corn d. Cotton e. Field beans f. Pastures g. Peanuts h. Small grains i. Soybeans j. Tobacco 2. Vegetable crops often require large amounts and different application methods. 3. Fruits and nuts require special knowledge and techniques for efficient application. 4. Liquid fertilizers may be applied in a variety of ways. a. In irrigation water b. Machine applications c. Starter solutions d. Directly to plants	1, 15		

PLANT FOODS

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	Teacher Notes
5. Fertilizer-pesticide mixtures are gaining in popularity despite problems in preparing and regulating them.		A fertilizer sales representative may be invited to visit the class and discuss new methods and practices with agricultural chemicals.	

Unit - PESTICIDES

Educational objectives for this unit:

To enable students -

- To develop an understanding and appreciation of the importance of pesticides as related to the social and economic welfare.

- To develop mental and performance skills which are essential to the safe and efficient use of pesticides.

- To become acquainted with occupational opportunities in the field of pesticides.

PESTICIDES

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	Teacher Notes
I. Insecticides include those agricultural chemicals used to protect growing and stored crops from insect damage, and to protect people and livestock from disease carrying insects.	2, 8, 17, 18		
A. Understanding something about the physiology of insects and the types of damages they cause is important in the proper use of insecticides.		Students may be asked to make an insect collection and identify as far as possible.	
B. It is important to know how to send off insect specimens for identification when they can not be identified locally.		Each student should collect at least one insect specimen and prepare for shipment to be identified.	
C. Insecticides may be classified generally as to how they work.		Students could be asked to bring to class as many different empty insecticide bottles, boxes, cartons, etc. as they can find to set up a class display of these materials. The labels of these containers would be studied when teaching the safe use of all agricultural chemicals.	
1. Stomach poisons			
a. Lead arsenate b. Calcium arsenate c. Sodium fluoride d. Other fluorides (cryolite) e. Phenothiazine			
2. Contact poisons			
a. Lime-sulfur			

PESTICIDES

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	Teacher Notes
b. Sulfur dust c. Oils d. Nicotine e. Rotenone f. Pyrethum g. Sabadilla h. Chlorinated hydrocarbons (1) DDT (2) BHC (3) Lindane (4) Methoxychlor (5) DDD or TDE (6) Chlordane (7) Toxaphene (8) Hepatachlor (9) Dieldrin (10) Aldrin i. Organic phosphates (1) "HEPT" (2) "TEPP" (3) Parathion j. Dimtro compounds 3. Fumigants a. Methyl bromide			

PESTICIDES

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	Teacher Notes
b. Carbon disulphide c. Carbon tetrachloride d. Chloropicrin e. Ethylene dichloride f. Paradichlorobenzene g. Naphthalene h. Formaldehyde i. Aerosols 4. Repellents such as "whitewash" are sometimes effective pesticides.			
II. Fungicides are used to protect stored products against fungi, and to control bacterial and fungicidal infestation of plants. A. Parasitic plant diseases have very important consequences upon human affairs. B. There are several general types of fungicides being used. 1. Seed protectants 2. Fruit protectants 3. Foliage and blossom protectants 4. Eradicants 5. Antibiotics 6. Soil fumigants 7. General purpose spray and dust formulations	2, 6, 7		

PESTICIDES

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	Teacher Notes
C. The properties of fungicides are determined by their source.			
1. Copper fungicides			
a. Bordeaux mixture			
b. Basic copper sulphates			
c. Copper chlorides			
d. Copper carbonates			
e. Copper dusts			
2. Sulfur fungicides			
a. Liquid lime-sulfur			
b. Dry lime-sulfur			
c. Sulfur dusts			
3. Mercury fungicides			
a. Inorganic mercurials Mercuric chloride			
b. Organic mercurials Cersans and related compounds			
4. Organic fungicides			
a. Thiram			
b. Ferbam			
c. Ziram			
d. Nabam			

PESTICIDES

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	Teacher Notes
e. Zineb f. Maneb g. Chloranil h. Captan i. Glyodin j. Dichlone k. Dodine l. Folpet 5. Other materials used for plant disease control are a. Fumigants b. Antibiotics - actidione, terramycin, streptomycin			
III. Herbicides are those chemicals used to control unwanted vegetation, either selectively or generally. A. Many factors influence the effectiveness of the herbicide 1. The soil 2. Surface agents a. Detergents b. Wetting agents c. Emulsifiers	3, 4, 18	It is most likely that small demonstrations can be conducted on or nearby the school grounds to teach the effective and safe use of several different herbicides.	

PESTICIDES

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	Teacher Notes
d. Spreaders e. Stickers 3. Formulations 4. Application equipment			
B. Chemical weed control should be compared economically with other methods.			
C. Identification of weeds, by both the plant and seed, would be most beneficial to a user of herbicides. Specimens may be sent off for identification.		Many departments have excellent collections of seeds and plants which have been used in the crops contest.	
D. A knowledge of herbicides currently being marketed is desirable. Some common names: 1. 2, 4-D 2. 2, 4, 5-T 3. Silnex 4. TCA 5. Dalaphon 6. Amitrole 7. Atrazine 8. Simazine 9. MH 10. DNBP 11. PCP 12. Dinron		Teachers may wish to prepare seed and plant specimens during the summer months for teaching weed identification later in the school year.	

PESTICIDES

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	Teacher Notes
13. Norea 14. Ammate 15. DCPA 16. PMA 17. Trifluralin			
IV. Rodenticides are used to control rats, mice and other rodent pests. A. Poisons are usually most effective, with large numbers to be controlled. B. Local and State laws should be known before killing game animals	2	Classes may wish to participate in one of several commercially sponsored rodent control programs. Wildlife protectors and game wardens are often anxious to appear before classes to discuss rodent-game problems.	
V. Nematodes were ignored for a long time because they could not be classified as either an insect or a fungus. A. Nematodes are found in all parts of the world under many types of conditions. B. Soil fumigants represent a new branch of agricultural chemicals and are proving very effective weapons against nematodes.	2, 11		

PESTICIDES

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	Teacher Notes
VI. Proper equipment which is correctly used is a very essential part of an effective pesticide use program. A. Acreage, crops, and types of labor will help determine type of equipment needed. B. Separate equipment may be required for certain chemicals such as herbicides. C. Equipment must be carefully calibrated and adjusted. D. Ease of attachment may be very important in being able to make timely applications. E. Large, high clearance, self-propelled equipment is very desirable on large acreages but may not be justified on smaller farms with small fields. F. Spray pressures in excess of 30 psi should be avoided in weed control work.	2, 3, 4	There are many different demonstrations in the use and adjustments of equipment which can be taught in the Vo-Ag shop. Students should get actual experience in different methods of sprayer calibration.	

Unit - AGRICULTURAL CHEMICAL CONTROLS

Educational objectives for this unit:

To enable students -

- To develop mental and performance skills which are efficient to the safe and effective use of certain agricultural chemicals.

- To understand the need for legal controls on the manufacture and distribution of certain agricultural chemicals

AGRICULTURAL CHEMICAL CONTROLS

Subunits and Problem Areas (Principals to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	Teacher Notes
I. Legal controls protect both the manufacturer and user of agricultural chemicals. A. Federal laws 1. Federal Insecticide, Fungicide, and Rodenticide Act. 2. Public Law 86-319. 3. Miller Pesticide Residue Amendment to Federal Food, Drug, and Cosmetic Act. 4. Food Additives Amendment to Federal Food, Drug, and Cosmetic Act. B. State laws 1. N. C. Insecticide, Fungicide, and Rodenticide Act. 2. N. C. Fertilizer Law. 3. N. C. Aerial Crop Dusting Law.		Students could obtain copies of both Federal and State laws to use as resource material in writing a paper on "Controls of Agricultural Chemicals."	
II. Safety in the use of pesticides requires detailed consideration in many areas such as:	2, 4, 18	Students could be asked to bring in newspaper clippings of accidents resulting from misuse of pesticides and	

AGRICULTURAL CHEMICAL CONTROLS

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	Teacher Notes
		these displayed on a class tack board.	
A. Follow direction exactly.			
B. Learn toxicity			
1. LD 50 values			
2. Label precautions			
C. Protective equipment and clothing.			
D. Protecting crops and livestock.		Each student should be tested as to his knowledge of what to do in case of various types of accidental poisoning.	
E. Storage precautions.			
F. What to do in case of accidental poisoning.			
G. Poison control centers in North Carolina.			

Unit - EDUCATION AND CAREER OPPORTUNITIES

Educational objectives for this unit:

To enable students -

- To learn about the occupational requirements and opportunities in the broad field of agricultural chemicals.

- To learn about possibilities of continuing education in agricultural chemicals.

EDUCATION AND CAREER OPPORTUNITIES

Subunits and Problem Areas (Principles to be taught and/or competencies to be developed)	Suggested Resources	Some Suggested Teaching-Learning Activities	Teacher Notes
I. Careers in the field of agricultural chemicals will be found in many areas. A. Sales B. Development and Promotion C. Research D. Pest control advisor E. Extension service F. USDA Agriculturist G. Education H. Inspection I. Custom applications J. Manufacturing	10	Students may make a list of all agricultural chemical related jobs in the local area. The list should be divided into groups of jobs which require college level training and those which do not. Field trips may be made to get a firsh-hand view of such types of work as exterminator companies, research, manufacturing, custom applications, and others in the local area.	

APPENDIX

Suggested References

Text:

1. McVickar, Malcolm H., Using Commercial Fertilizers, The Interstate, Danville, Illinois, 1961.

2. The North Carolina Pesticide Manual, North Carolina State College, Division of College Extension, Raleigh, N. C. (Latest Edition).

Supplementary References:

1. Klingman, Glenn C., Weed Control: As A Science, John Wiley & Sons, Inc., New York, 1961.

2. Hough, W. S., and Mason, A. F. M., Spraying, Dusting, and Fumigation of Plants, The Macmillan Co., New York, 1951.

3. Brown, A. W. A., Insect Control by Chemicals, John Wiley & Sons, New York, 1961.

4. Sharnelle, E. G., The Nature and Use of Modern Fungicides, 426 S. Sixth Street, Minneapolis 15, Minn., Burgess Publishing Co., 1961.

5. Plant Diseases, The Yearbook of Agriculture, USDA, Superintendent of Documents, Washington, D. C., 1953.

6. Insects, The Yearbook of Agriculture, USDA, Superintendent of Documents, Washington, D. C., 1952.

7. The North Carolina Pesticide Manual contains a very comprehensive list of reference bulletins and pamphlets on insects and disease control.

8. "Career Opportunities in Agricultural Chemicals." Write 1145, 19th Street, N. W., Washington 6, D. C., National Agricultural Chemicals Association.

9. Agricultural Chemicals, 64 p. What they are/how they are used. Free single copy. Write Manufacturing Chemists Association, 1825 Connecticut Avenue, N. W., Washington 9, D. C.

10. Dictionary of Plant Foods. Compliments of Nitrogen Division, Allied Chemical Corporation, 37841 Euclid Avenue, Willoughby, Ohio.

11. The Role of Agricultural Chemicals in Feeding an Exploding Population. Robert White-Stevens, Agricultural Division, American Cyanamid Co., Princeton, New Jersey.

Audiovisual Aids:

1. The Unseen Harvester. DuPont, 16 mm. sound film.

2. Fertilizer Placement Slides With Script. American Potash Institute. 1102 16th Street, N.W., Washington, D. C.

3. Soil Testing - An Aid to Every Farmer. 13 min. 16 mm. sound film. Visual Aids Film Library. 3 Ricks Hall, N. C. State College, Raleigh, North Carolina.

4. Infinite Harvest, 28 min., Agricultural Chemicals Movie. Spencer Chemical Co., Visual Aids Library, Dwight Building, Kansas City 5, Missouri.

5. See list in Educational Aids on Soil Fertility, by North Carolina Soil Fertility Committee.

Facilities and Equipment

It is assumed that this course in Agricultural Chemicals will be taught in a vocational agriculture department which has adequate classroom, shop, and visual aids equipment. A listing of the facilities and basic shop tools which will have been used in the course in Agriculture Science and Mechanics would be quite repetitious. Therefore, the listing below represents only those tools and equipment which would be needed in the teaching of a course in Agricultural Chemicals, and which may not already be a part of the department inventory.

Item	Number	Description	Approx. Cost Each	Total Cost
Duster	1	Rotary, Hand crank, 8 lb. capacity, complete with tubes and attachment.	32.00	32.00
Power Sprayer	1	15 gal. tank capacity, 2-2½ H.P. gasoline engine, carty type, includes spray gun and hose.	200.00	200.00
Respirator	2	Respirator, filter chemical, extra filter, cartrizer, and goggles, Willson Agri-Tax, or equivalent.	13.50	27.00
Sprayer	2	Compressed air, 3½ gal. galvanized tank, brass nozzle.	10.00	10.00
Fumigation Equipment	1	Methyl Bromide Applicator	3.00	3.00
	1	Plastic cover, 5 x 20 yds.	6.50	6.50
Soil Test Kit	1	Complete for testing N, P, K, and acidity.	30.00	30.00
Tissue Test Kit	1	Complete for testing N, P, K deficiencies.	4.00	4.00

SUGGESTIONS FOR SUPERVISED PRACTICE PROGRAMS

This section of the course guide is devoted to a modern concept of supervised practice as it applies to replanned courses in vocational agriculture. The factors of modern agriculture, home environments of youth, and research in vocational guidance necessitate a change in course offerings in vocational agriculture. Supervised practice programs also must be changed to meet the needs of students enrolling in replanned courses.

A quality supervised practice program is a sound educational endeavor. Its primary purpose is to broaden the quality and quantity of opportunities for effective learning in agriculture. A modern concept may be defined in the following paragraphs:

> "Supervised practice consists of those learning experiences, related to instruction, which require development beyond the normal school hours and class facilities. Supervised practice utilizes the realistic work opportunities made available at the home, the farm, the school, and community businesses for developing desired and needed student competencies in agriculture.
>
> The term 'supervised' refers to the guidance and counsel provided by teacher, parents, and employers of the student for the primary purpose of insuring meaningful, effective on-the-job experience."[1]

Supervised practice programs should be a joint effort of the school, parents, and the student. In addition, they should be planned and conducted to relate closely to the course in which the student is enrolled. It is desirable that learning activities should be planned for and obtained in each of the major learning areas included in the course. They should assist the student in reaching the desired objectives of the course.

On the following page is a form with which the teacher can plan in advance with students, parents and agricultural businesses or professions the supervised practice programs for individual students. This form implies the need for planning in advance the supervised practice program, including the major activities, proposed amount of time and approximate dates. Planning should be done as early in the course as possible, however, additional planning and modifications may be necessary during the year. Complete follow-up records may be kept in the student's supervised practice record book.

In using this form, a copy each should be provided for the student and the school. Where part or all of the practice is obtained in a non-farm establishment a copy should be provided also for the employer. For some students with larger programs two or more sheets may be needed.

For further suggestions on supervised practice, teachers are urged to review the publication, Improving Supervised Practice in Vocational Agriculture, State Department of Public Instruction, Publication No. 361, 1963. Each teacher was issued a copy of this bulletin during the summer of 1963.

---

[1] State Department of Public Instruction, Improving Supervised Practice in Vocational Agriculture, 1963.

SUPERVISED PRACTICE PLANS
Vocational Education in Agriculture

19__19__

Name of Student _____ Age_____ Address_____

Course Title _____, _____ High School

Supervised Practice Learning Activities	Place Where Activity is to be Performed (School Land Laboratory, Non-Farm Agricultural Business, a Farm, Etc.)	Approximate Date of Activity to be Performed	Proposed Length of Activity No. Hours

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ABSTRACT - This resource guide is for teachers of industrial arts in the Career Guidance Program to use in providing pupils with industrial activities and related academic experiences at the junior high school level. It was developed by a group of supervisors and teachers as an experimental study to create a program for potential dropout students and revised during three years of trial and evaluation. The guide presents suggested methods, materials, and instructional aids in four areas: (1) General Construction and Repair, (2) Building Construction and Maintenance, (3) Power Mechanics, and (4) Office Duplicating Machines. Each area contains a list of processes and skills to be taught, related academic learnings to be developed, materials, tools, and equipment to be used, and suggested resource lessons. A related supplement is available as VT 000 239 (also in this issue). (GR)

VT 001 359

Career Guidance Series

RESOURCE MATERIAL FOR TEACHERS

Industrial Arts

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CAREER GUIDANCE SERIES

Industrial Arts

BOARD OF EDUCATION • CITY OF NEW YORK

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- F O R E W O R D -

This resource guide for teachers of industrial arts in the Career Guidance Program is designed to provide the pupils with industrial activities and related academic experiences. Thus, they will be given an apportunity to acquire a realistic understanding of the environment and the world of work.

The material presented offers experience in four areas: General Construction and Repair, Building Construction and Maintenance, Power Mechanics and Office Duplicating Machines. Each area divides instruction in basic tool operations and training in industrial skills which are aimed to prepare the pupils for further technical schooling.

It is hoped that this experimental material will be further developed and extended to include additional areas of work.

JOSEPH O. LORETAN
Deputy Superintendent of Schools

July, 1966

THE CAREER GUIDANCE PROGRAM

The Career Guidance Program grew out of a deep concern on the part of the Junior High School Division for the many pupils who were over-age, frustrated, retarded in most school subjects, and indifferent to education. The typical pupil in this group has a poor self-image, few or no aspirations either academic or vocational, and is biding his time until he can drop out of school.

During the school year 1957-1958, Dr. Joseph O. Loretan, Deputy Superintendent of Instruction and Curriculum Division*, and Dr. Morris Krugman, Associate Superintendent of the Division of Child Welfare **, and five selected and interested principals worked on a plan and structure to create a program for these potential dropouts. In September 1958, six classes were organized in the 7th, 8th and 9th grades of five junior high schools. It was hoped that with specialized and intensive guidance and a curriculum centered around the world of work these pupils would remain in school and be infused with a desire to set higher educational goals for themselves.

In each of these schools a teacher was designated curriculum coordinator to work with the other teachers of these experimental classes to prepare special materials. Most of the schools used the core approach. A job area was chosen as the center of learning, e.g., Garment Trades, Food Handling, etc. All instruction in the various subject areas served to develop and to extend the learnings connected with the particular job area chosen. In September 1960, the Junior High School Division appointed a Job-Placement Supervisor to provide part-time employment for youngsters who wanted to earn money while in school.

This experiment was expanded to include a total of twenty-four junior high schools in September 1962 and thirty junior high schools in February 1963. The program now was organized in the 9th grade, since this was the terminal year of the junior high school and it was at this time that young people had to make a serious decision: Should they go on to high school or should they go to work? Therefore, a concentrated effort had to be made at this point to raise their educational and vocational aspirations if these pupils were to be motivated to seek higher learning. The program was introduced into the junior high schools that requested it. It comprised a unit of three classes, each with a maximum register of fifteen pupils. A full-time advisor was assigned in each school to meet with each class for group guidance twice a week and with every pupil individually at least once a week. An industrial arts teacher was also assigned full-time to instruct the pupils in pre-vocational and avocational skills.

* formerly Associate Supt. J.H.S. Div.
** now retired

Three years of experimentation and a study of similar programs throughout the nation showed that a new teaching approach was essential in every subject area, if these youngsters were to be rehabilitated and redirected. Adaptations or "watered-down" versions of the traditional curriculum without a modified approach presented learning situations which were only too familiar and were filled with the failures and frustrations of the past. It was also evident that once these pupils had spent some time in a Career Guidance class they began indicating that they no longer wanted to go to work; they now wanted to prepare themselves for high school.

Thus, in February 1963, a team of specialists in each of the curriculum areas began to work on specially-designed teaching guides in guidance and job placement, language arts, speech, social studies, science, mathematics and industrial arts. To prepare these guides the curriculum specialists visited each of the schools that had been in the Career Guidance Program from two to five years and studied the teacher-prepared materials in use, observed and conferred with the pupils in the classes, and interviewed the teachers and supervisors to become oriented with the pupils' backgrounds, aspirations, cultures, interests, and needs. Workshop committees composed of teachers, advisors, and assistant principals were organized to work with each curriculum specialist. As the teaching material was developed it was tried out experimentally in selected schools and evaluated.

By September 1963, teaching guides in seven subject areas were made available in mimeograph form to all the schools in the program. The subject matter developed departed largely from the job-centered themes and concentrated on the skills and subject matter necessary for further study in high school; less on theory and more on the functional and manipulative aspects of each subject area so as to present the pupils with true-to-life problems and situations. Beginning September 1963, the area of Office Practice was included to equip the pupils with immediate saleable skills for obtaining part-time jobs and to motivate them toward further vocational work in high school.

Through a continuous program of evaluation by teachers, supervisors, and curriculum consultants, the teaching guides were revised and extended and the present series evolved: Guidance and Job Placement, Language Arts, Mathematics, Social Studies I, Social Studies II, Social Studies III, Speech, Science, Industrial Arts, and Office Practice.

In September 1965, with the reorganization of the schools in New York City, the 8th grade became the terminal grade in some junior high schools. Thus, the Career Guidance Program was placed in the 8th grade of seventeen of these schools. At present there is a total of fifty-two schools in the Career Guidance Program.

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Gida Cavicchia, Coordinator of the Career Guidance Program, served as project director with the cooperation of Willia Peace, Coordinator of Pupil Personnel of the Career Guidance Program.

The material was revised during three years of try-out and evaluation by Arlen De Vito and the supervisory staff of the Industrial Arts Department. Others who contributed materials were Frank Costa, J-118, M., and Donald Pitkoff, J-68, K.

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The consultants were: Herbert Siegel, Director of the Industrial Arts Department; Jacob Steinberg, Chairman of Industrial Arts, Bushwick High School; and George Keane, Professor of Industrial Arts, College of the City of New York.

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- INTRODUCTION -

This resource guide presents suggested methods, materials, and instructional aids to the industrial arts teachers in the Career Guidance Program. The material is grouped under four areas of instruction.

1. General Construction and Repairing
2. Building Construction and Maintenance
3. Power Mechanics
4. Office Duplicating Machines

Each area contains a list of processes and skills to be taught; related academic learnings to be developed; materials, tools, and equipment to be used; and suggested resource lessons. The four areas are designed to provide the teachers with novel teaching approaches.

It is hoped that this guide will inspire the teachers to develop their own lessons and methods of implementation so that it will be possible to further expand and refine this material.

- A R E A # 1 -

GENERAL CONSTRUCTION AND REPAIR

This area of work is presented first because it cuts across many of the objectives of the industrial arts program for Career Guidance pupils: the development of basic skills in the use of tools, materials and supplies, the acquisition of consumer knowledge and the experiencing of maintenance, repair, and constructional activities commonly performed in the community by skilled craftsmen and mechanics. In addition, it contributes to the growth of the pupil by providing opportunities for the development of confidence, self-reliance, pride of workmanship, and appreciation for the material value of repaired furniture used in the home and school surroundings.

This area includes three units of instruction and suggested resource lessons for each unit to assist the teachers. Additional lessons should be developed by the teachers as they progress with the implementation of their program.

Unit I. Individual Projects

Resource Lesson

Making a Corner Shelf

Unit II. Mass Production Techniques

Resource Lesson

Making A Scrolled Flower Pot Stand

Unit III. Home, School, and Community Service Projects

Resource Lessons

1. How to Install Floor Tile
2. How to Repair and Refinish School Furniture
3. Making Toys

UNIT I.

INDIVIDUAL PROJECTS

It is suggested that pupils begin their shop activities in the Career Guidance industrial arts program with individual projects. This is a familiar shop experience for the pupils and will readily provide encouragement and motivation for getting started in the instructional program suggested in this teachers' guide. However, though individual projects are an important part of the pupils' activities, the teacher must bear in mind that the major portion of the pupils' work should be spent on occupational experiences related to areas of industry.

To aid the pupils in making their selection of individual projects, the industrial arts teacher should provide models of finished projects, working drawings, and shop library books and periodicals to suggest projects. Success with an individual project may encourage a pupil to achieve just as successfully in other areas of school life.

Operations and Processes to Be Taught

1. Pupils will design and lay out individual projects

    a. Select design

    b. Draw full size patterns, or templates

    c. Make working drawing of project

    d. Make bill of materials

2. Teacher will demonstrate the following operational procedures:

    a. Use of layout tools

ruler	try square
steel square	compass
dividers	sloyd knife
scriber	marking gage

    b. Use of cutting tools and machines

hand saw (for wood)	squaring shears
hack saw (for metal)	bench planes
power scroll saw	chisels
miter box	gouges
tinners snips	circular saw
sabre saw	cold chisel

c. Use of smoothing tools and machines

woodworking files and rasps
metalworking files
scrapers
orbital, belt, and disc sanders

d. Use of boring tools

hand drill	twist drill
bit brace	auger bit
drill press	router
counter sink	

e. Use of equipment for forming

bending jig	plastic ejector
box and pan brake	bar folder

f. Use of fasteners

glue	nuts and bolts
nails	corrugated fasteners
screws	brads
rivets	spot welding
solder	

g. Use of abrasives

flint paper	garnet paper
emery cloth	grinder, power

h. Finishing

wood staining	shellacing
varnishing	lacquering
painting	brush finishing
spray finishing	buffing
polishing	waxing

Materials, Tools, and Equipment

1. Materials for woodworking

Pine, various sizes
Philippine mahogany, various sizes
Masonite, untempered
Masonite, tempered
Plywood, sheets
Sandpaper, rough, medium and fine
Steel wool, grade 00
Emery cloth, medium and fine
Wood adhesives

Flat head and finishing nails, assorted sizes
Flat head and round head wood screws, steel and brass, assorted sizes
Wiping rags
Wood dowels
Shellac and shellac solvent
Varnish
Turpentine
Lacquer and lacquer thinner
Wax
Enamels, assorted colors

2. Materials for metalworking

Bright tin
Galvanized iron
Band iron
Sheet copper
Copper foil
Sheet aluminum
Machine screws and nuts, assorted sizes
Sheet metal screws, assorted sizes
Tinners rivets, iron and copper, 1-lb.
Rivets, round head, brass and aluminum
Solder, rosin core
Wire, copper, assorted sizes

3. Materials for plastics

Vinylite sheets
Lucite sheets
Plastics adhesives

4. Tools

The hand tools needed for work with individual projects are provided as standard items in the Career Guidance industrial arts shop.

5. Equipment for woodwork

Jig saw
Drill press
Belt and disc sander
Power tool grinder
Belt sander, portable
Orbital sander, portable

6. Equipment for metalwork

Electric drill, hand
Bar folder
Box and pan brake
Squaring shears
Bending jig
Spot welder
Sheet and art metal stakes

7. Equipment for plastics

Hermes engraving machine
Injection moulding machine
Vacuum forming machine

Academic Learnings

1. Language Arts

   a. Written and oral reports on the planning of an individual project

   b. Vocabulary (related to individual projects)

2. Mathematics

   a. Computing cost of materials

   b. Figuring area of flat surfaces

   c. Linear measurement

   d. Measuring thickness, width, and length

3. Social Studies

   a. Influence of forests and forest products on civilization

   b. Transportation of lumber to our city

   c. Specialization in industry

   d. History of the development of iron and steel

   e. Technological changes in modern industry

4. Science

   a. Growth and structure of trees

   b. Why wood floats

   c. Seasoning of lumber

   d. The smelting of iron ore

   e. Oxygen and its effect on metal

   f. Friction and the necessity of lubrication

5. Guidance

   a. Occupational opportunities in the woodworking industries

b. Qualifications of a woodworker

c. Demand for skilled workers

d. High school courses offered in the woodworking trades

e. Relationship between employer and employee

Personal Development

1. Selecting, designing, and constructing individual projects

2. Wording independently (research and planning)

3. Assuming responsibilities when working with others (sharing tools and materials and maintaining equipment)

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UNIT I.

Making a Corner Shelf

(Suggested Resource Lesson)

The corner shelf may be constructed as a basic project or as an individual project. The construction of a basic project provides opportunities for class instruction in basic operational procedures and shop management routines.

In addition, when pupils work on the same type of project, they learn from each other, they progress at their own speed, and they have an opportunity to create original designs.

Materials, Tools, and Equipment:

1. Materials

   wood glue
   shellac and shellac solvent
   rotten stone
   linseed oil
   sandpaper (medium and fine)
   wiping rags
   cabinet wax

2. Woodworking Tools

3. Equipment

   jig saw
   orbital sander
   woodworking vise

Visual Aids:

1. Model of a corner shelf

2. Full sized profile patterns of corner shelf (sides and shelves)

3. Blackboard profile drawing of a corner shelf showing how curves are developed and transferred (enlarged squares method)

4. Magazines, e.g., House Beautiful, Homes and Gardens, etc.

5. Charts illustrating the steps to be taken to construct a corner shelf

Motivation:

1. Introduce the lesson by discussing ways of decorating the home.

2. Show the model of the corner shelf and ask the pupils, "How can we build such a shelf?"

Procedure:

1. Demonstrate and explain the following steps:

   a. Join two identical pieces of mahogany with small brads.

   b. Plane one edge smooth and square.

   c. Draw profile pattern of corner shelf sides.

   d. Transfer profile pattern to wood. (See Fig. # 1.)

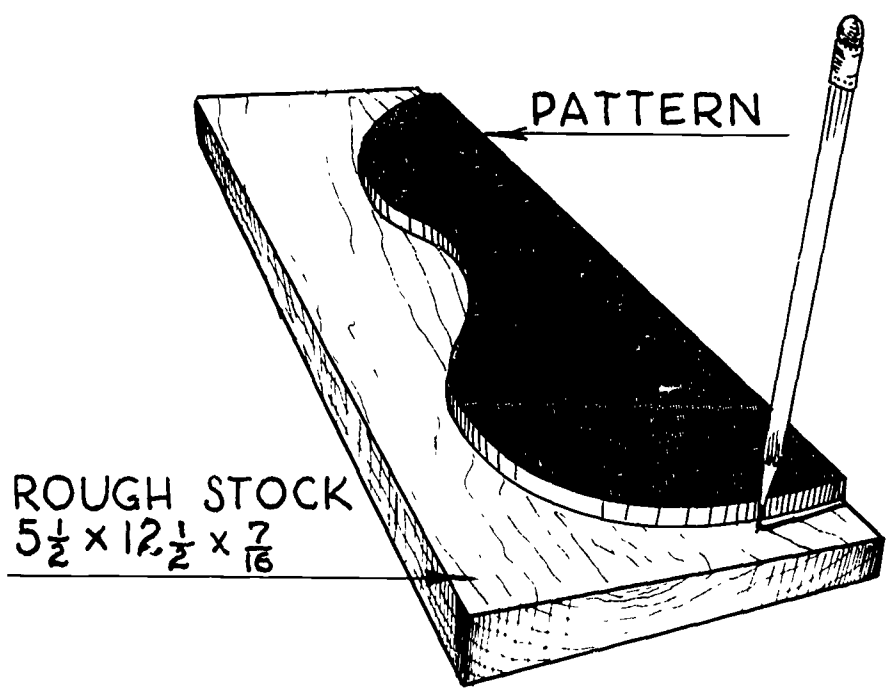

Fig. 1

e. Cut the two sides out with the power scroll saw.

f. Smooth curved edges with a wood file.

g. Plane off 7/16" from edge of one of the sides.

h. Sand all surfaces of both sides with an orbital sander.

i. Attach the two sanded pieces with brads and glue.

(1) Clamp smaller piece in vise.

(2) Apply glue to edge of smaller piece.

(3) Attach larger piece with $1\frac{1}{4}$" brads.

(4) Recess brads with a nail set. (See Fig. # 2.)

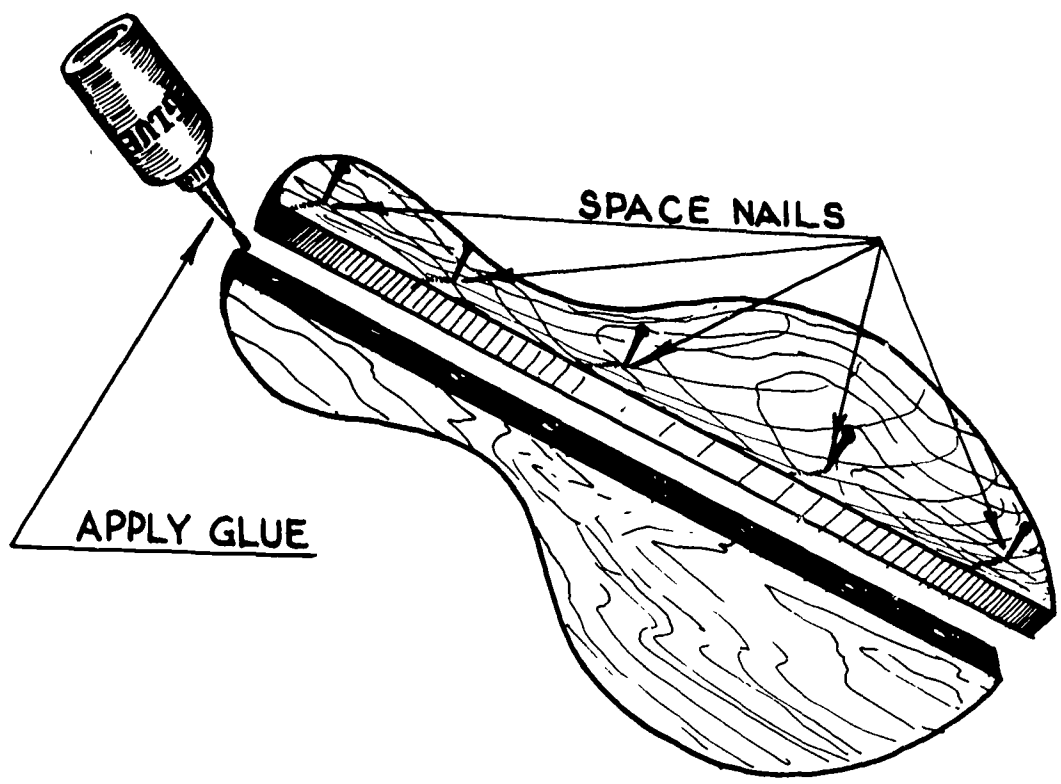

Fig. 2

j. Make patterns for upper and lower shelves.

k. Square one end and one edge of each piece of wood (upper and lower shelves).

l. Trace patterns of both shelves on stock.

m. Cut out patterns of shelves with a coping saw. (See Fig. # 3.)

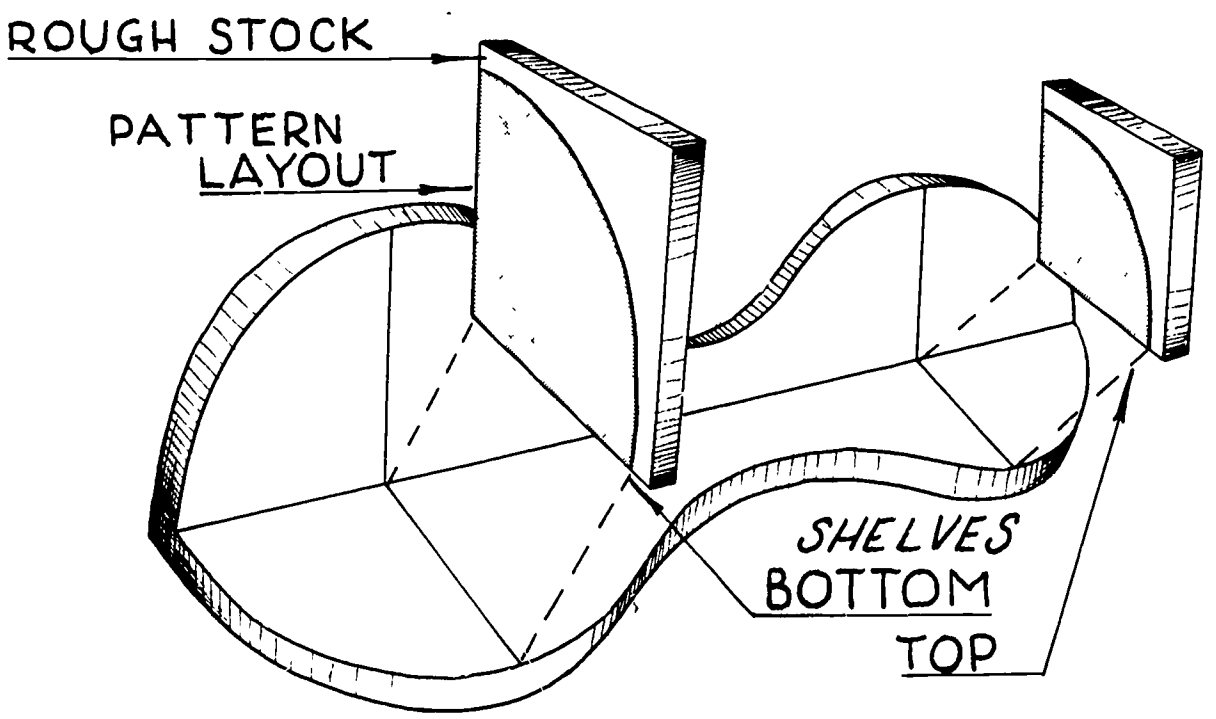

Fig. 3

n. File and smooth shelves.

o. Attach shelves to the sides.

(1) Mark spaces for attaching shelves. Extend marks to the back of corner shelf.

(2) Place shelves in vise and fasten sides with $1\frac{1}{4}$' brads and glue.

(3) Recess brads with a nail set.

(4) Drill $\frac{3}{4}$' mounting hole at top of corner shelf.

p. Sand project thoroughly and apply prime coat of shellac.

q. Rub final coat of shellac with rotten stone and oil, and coat finished surface with cabinet wax.

2. Have the pupils make individual shelves as demonstrated.

Outcomes:

1. Manipulative skills learned:

   a. Designing and laying out a pattern

   b. Cutting irregular shapes

   c. Smoothing wood surfaces

   d. Assembling wood parts with brads and glue

   e. Finishing wood with shellac, rotten stone, and oil

   f. Polishing a wood surface with wax

   g. Drilling a hole in wood

2. Safety practices learned:

   a. Safety rules must be observed when working with a coping or jig saw.

   b. Precautions should be taken when combustible finishing liquids are used.

3. Academic learnings:

   a. Mathematics:

      (1) Measuring with a ruler

      (2) Describing a circle quadrant with a pencil compass

      (3) Enlarging a design on graph paper

   b. Language Arts:

      Vocabulary

mahogany	file	attach
nail	measure	trace
clamp	smooth	assemble
shape	drill	polish

c. Science:

(1) Evaporation as applied to the use of shellac

(2) Combustion and fire prevention

(3) Oxidation as applied to wood finishes and the preservation of wood

d. Social Studies:

(1) Growing, processing, and shipping Philippine mahogany

(2) Study of accepted practices in home decoration

Assignment:

1. Have the pupils make a drawing of a section of their living room where a corner shelf could be placed.

2. Have the pupils make a list of various articles in their homes that could be placed on their corner shelves.

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UNIT II.

Mass Production Techniques

(Suggested Resource Lesson)

In this unit the pupils will be given an opportunity to construct articles through an assembly line technique. Each pupil will perform short and simplified operations and will complete one part of each project. The pattern of work includes orderly sequences and repetition of manipulative operations. It involves the use of sequential layout of work stations, routine benchwork, simple assembling, specialization of tool skills, use of jigs and fixtures, and emphasis on factory-production work skills.

Operations, Processes and Procedures

1. Selection of committees
    - a. Planning
    - b. Production
    - c. Business management
2. Group planning
3. Developing of working drawing
4. Drawing up a bill of materials
5. Constructing a pilot model
6. Planning jigs, fixtures, and templates
7. Organizing a production flow chart
8. Setting up work stations
    - a. Assignment of workers
    - b. Training of workers
9. Preparing enough stock
10. Stocking up each work station
11. Making test runs
    - a. Checking of production flow
    - b. Changing of worker assignments, if necessary

12. Starting production

    a. Inspection of sub-assemblies

    b. Provision of storage for projects to dry after finishing

13. Making final inspection of finished project

14. Packaging products

15. Delivering products

16. Cleaning up all work areas and store equipment

17. Planning critiques and evaluations

Suggested Projects and Activities

1. Wood projects

    bulletin boards
    picture frames
    flower boxes
    bird houses
    book cases
    stationery boxes
    toys
    tool kit boxes

2. Metal projects

    file card boxes
    tool boxes
    candlesticks
    plant holders
    enameled pins
    trivets
    dust pans
    spice racks

3. Graphic Arts projects

    memo pads
    calendars
    books
    greeting cards
    school forms
    rubber stamps

4. Electrical projects

    tube and continuity tester
    6 volt or 12 volt trouble lamp
    extension cords
    transistor radio

5. Ceramics projects

plates
ash trays
flower pots
hot plates
jewelry

6. Plastic projects

candy dishes
trays
salad spoons and forks
jewelry
souvenirs
wheels for toys
letters for signs

Related Occupational Learnings

1. Engineering Skills:

a. Designing

b. Organizing facilities

c. Selecting materials

d. Estimating quantities

2. Production Skills:

a. Manufacturing operations

b. Planning work schedules

c. Allotting sub-contracts

d. Controlling quality of production

3. Business Skills:

a. Financing

b. Estimating market value of product

c. Determining costs

d. Recording sales

4. Occupational Guidance:

a. Making a job analysis

b. Preparing for work training

c. Applying for employment

d. Learning about employer-employee relations

e. Planning for further training

5. Mass Production in Modern Industry:

a. Standardizing of parts

b. Training of workers and worker adaptability

c. Mass-produced products versus custom-made products

Academic Learnings

1. Language Arts

a. Reading manuals, booklets, textbooks, magazines, job sheets, blue prints, charts, sketches, and working drawings, etc.

b. Discussion of plans for production

2. Mathematics

a. Using instruments of measurement

b. Using mathematical knowledge and computational skills in solving problems (computing board feet measurement, linear measurement, quantity, cost and profit)

c. Using standard measures (length, width, depth)

3. Social Studies

a. Interdependence of all people

b. Labor Unions

c. Mass production and the Industrial Revolution

d. Automation and employment opportunities

4. Science

a. Motion and force

b. Electricity as it affects industry

c. Structure of materials

Personal Development

1. Development of desirable standards of workmanship
2. Performing repetitive work with interest
3. Improving manipulative skill through practice
4. Adapting various job assignments
5. Cooperation when working in a team
6. Give directions (shop foreman)

Audio-Visual Aids

1. The Metal Worker, Modern Talking Picture Service, 3 East 54th St., New York, N.Y.
2. Production Pioneering, Ford Motor Co., 3000 Shaefer Road, Dearborn, Michigan.
3. Machine Tools and Motion, General Motors, Film Section, 1775 Broadway, New York, N.Y.
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Scrolled Flower Pot Stand

Fig. 4

Making a Scrolled Flower Pot Stand

(Suggested Resource Lesson)

Materials, Tools, and Equipment:

1. Materials:

band iron, 1/2" x 1/16"
iron rivets, F.H. 1/8" x 1/4"
steel wool, medium grade
emery cloth, grade 00
enamels, brushing and spraying containers

2. Tools:

scriber	vise grip locking pliers
ball peen hammer	C clamp, 10"
rivet set #4	screwdriver, 4"
file, Flat 10"	twist drill, 1/8", high speed
center punch	try square
hand metal punch	hack square
bending jig	drill press jig

3. Equipment:

machinist's vise	slip forming roll
drill press	spot welder

Visual Aids:

1. Model of scrolled flower pot stand

2. Chalkboard drawing illustrating enlarged views of all parts of the project

3. Mass Production flow chart (Fig. # 5.)

4. Sketch of assembled project

5. Safety charts (drill press, hack saw, spot welder, safety goggles)

MASS PRODUCTION

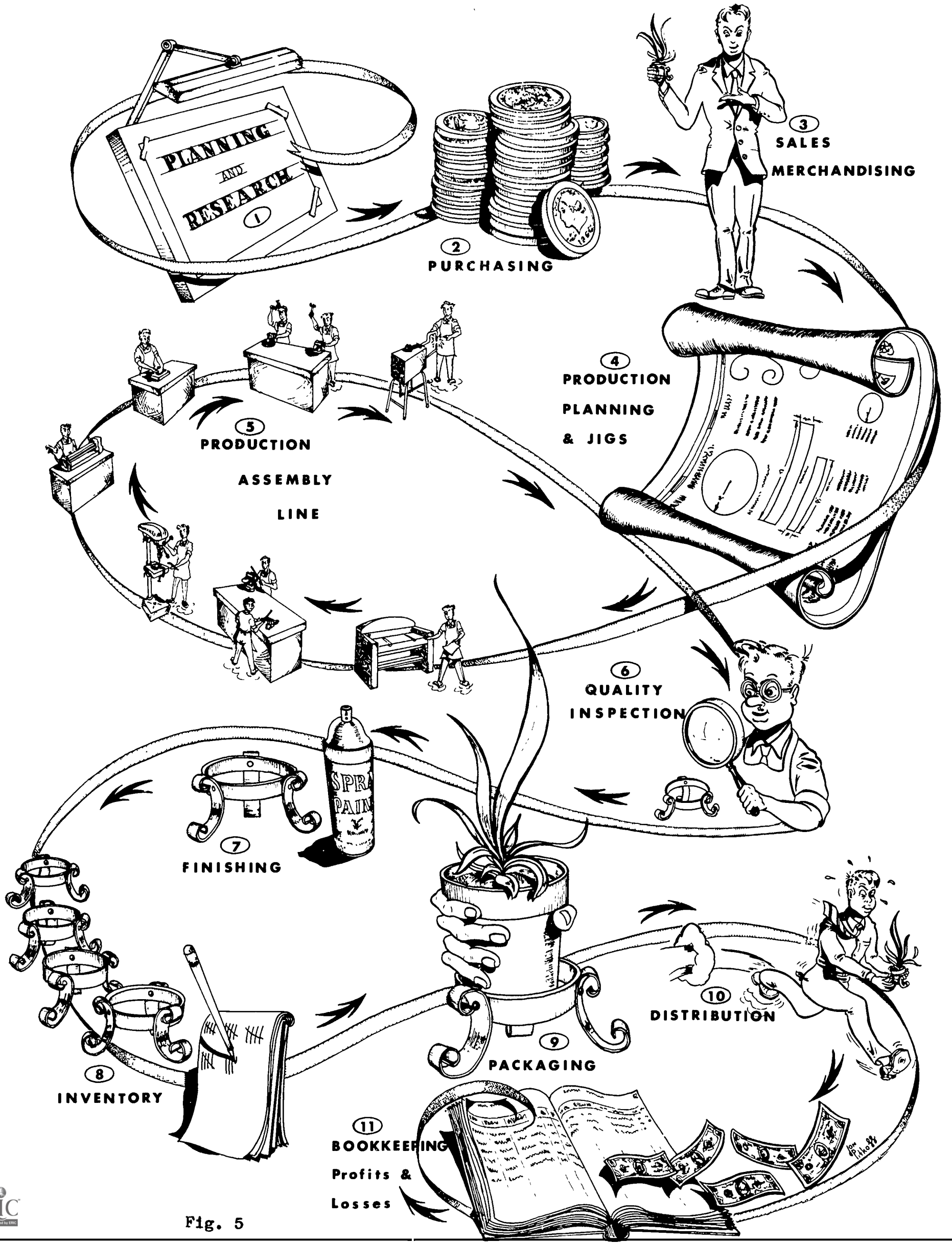
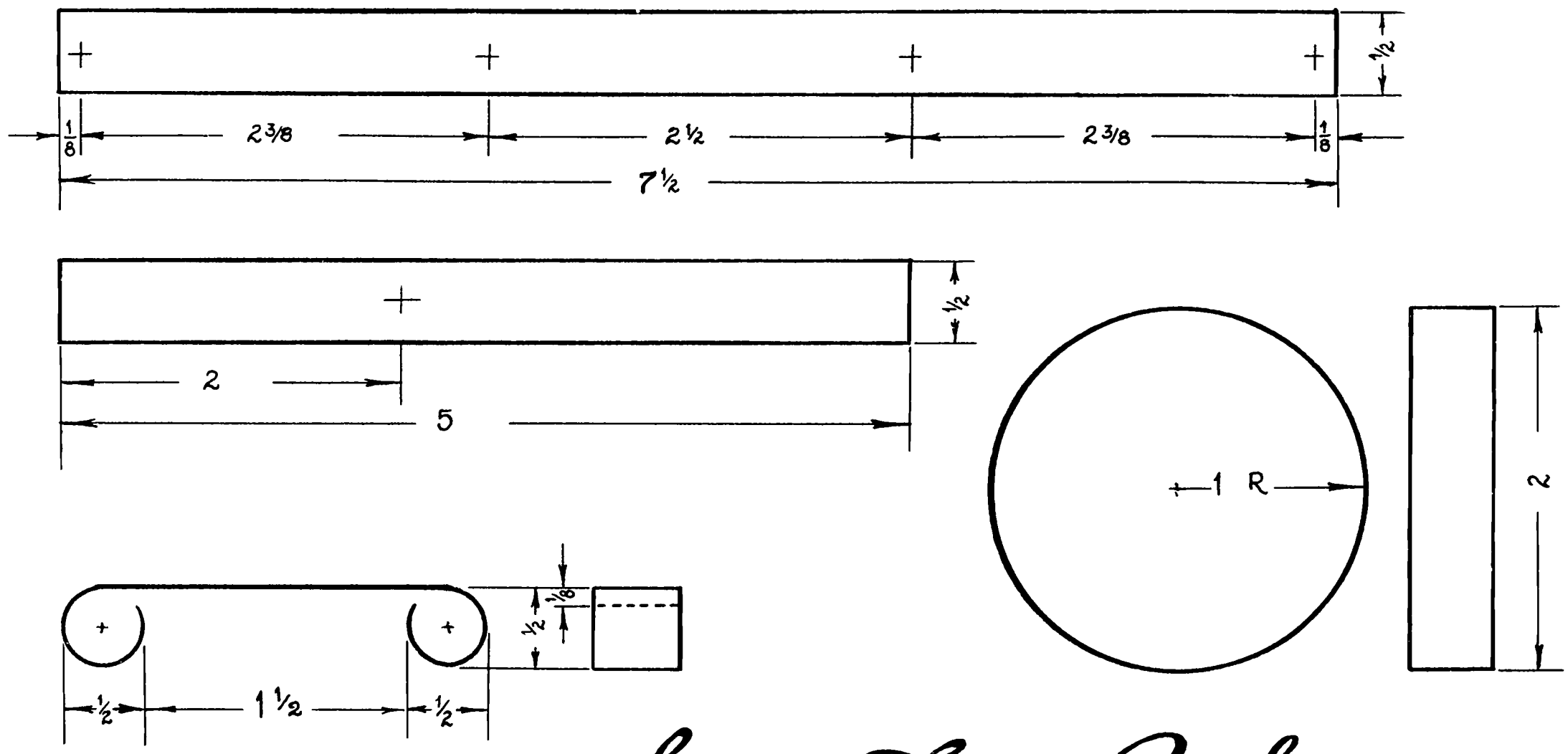
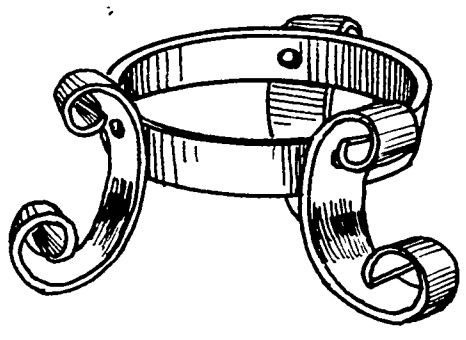


Fig. 5



Scrolled Flower Pot Stand



LIST OF MATERIALS			
1 EA.	RING	1/2" x 7 1/2"	1/16" BAND IRON
3 EA.	LEGS	1/2" x 5"	1/16" BAND IRON
3 EA.	FASTENER	1/8" D x 1/4" L	F. H. RIVET

Pitko

Fig. 6

Motivation:

1. Announce to the class that the principal of the school has asked that scrolled flower pot stands be made to beautify every classroom.

2. Ask the pupils, "How can we produce all the stands needed?"

3. Elicit the answer that they will have to be made by mass production.

Procedure:

1. Organize the class into committees and assign work stations.

2. Have the pupils do the following:

   a. Make a list of materials needed. (See Fig. # 6.)

   b. Lay out the stock to be cut with a try square and scribes.

   c. Clamp metal stock in vise and cut on scribed lines with hack saw.

   d. Count, stack, and label cut parts and move them to next work station on the production line.

   e. Round sharp ends with a metal working file. (See Fig. #7.)

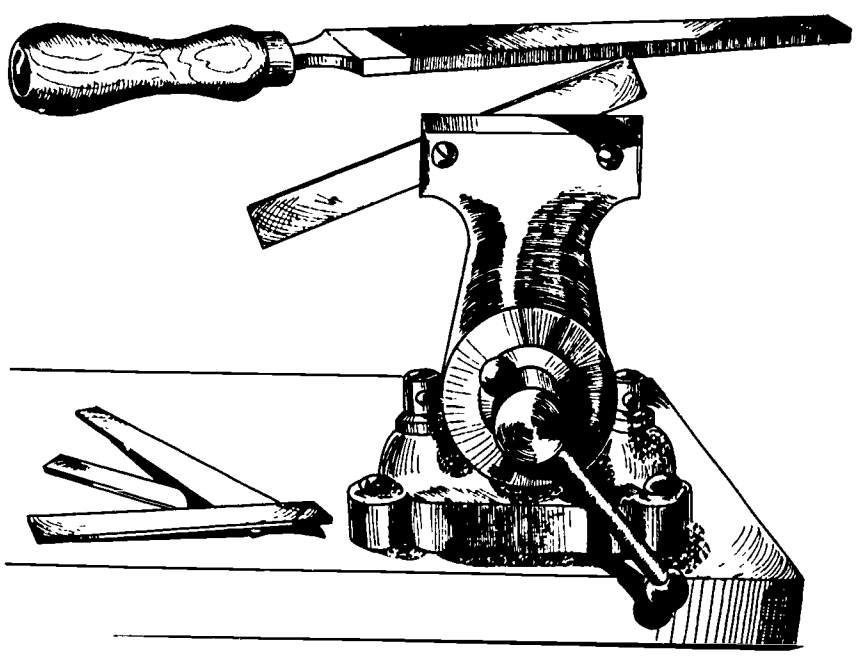


Fig. 7

f. Smooth each piece of cut stock with #0 emery cloth and #00 steel wool.

g. Mark points to be drilled with a center punch and a ball peen hammer.
(See Fig. # 8.)

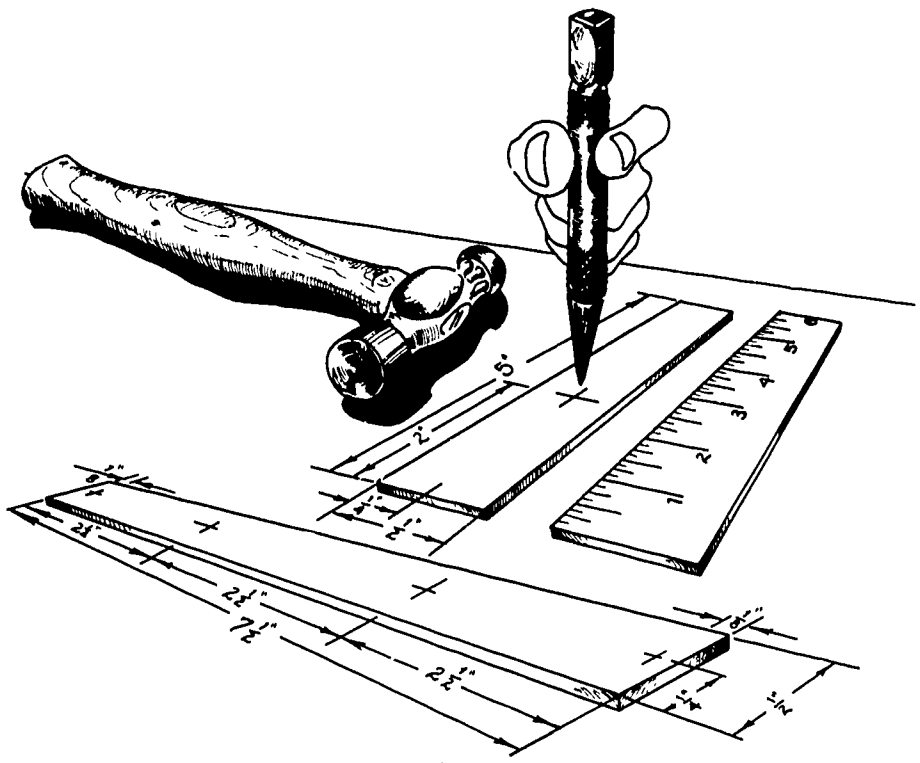


Fig. 8

h. Drill holes with a 1/8" drill on drill press.

(1) Learn use of drill press jig. (See Fig. # 9.)

(2) Use goggles for safety.

(3) Review safety rules related to the use of drill press.

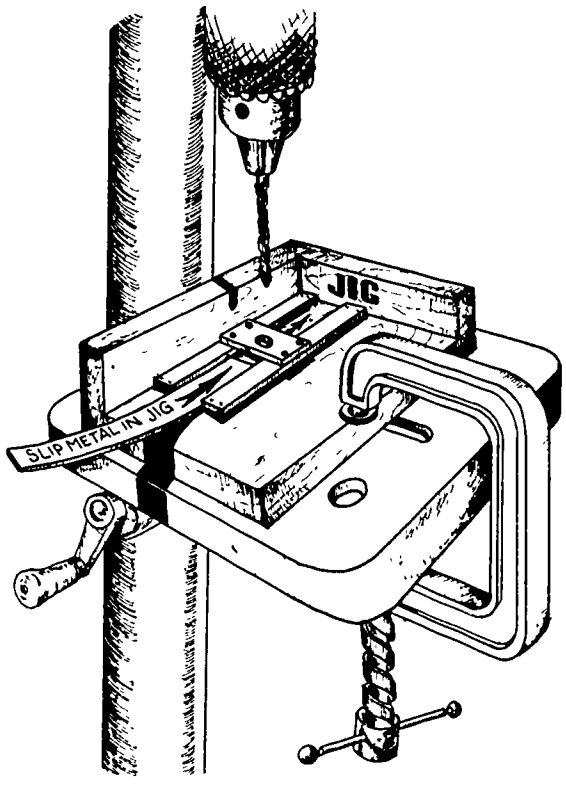


Fig. 9

i. Shape the 5" leg pieces on the bending jig.

(1) Form the scroll by matching each leg with the master pattern outline.

(2) Check to see that all pieces are identical in shape. (See Fig. # 10.)

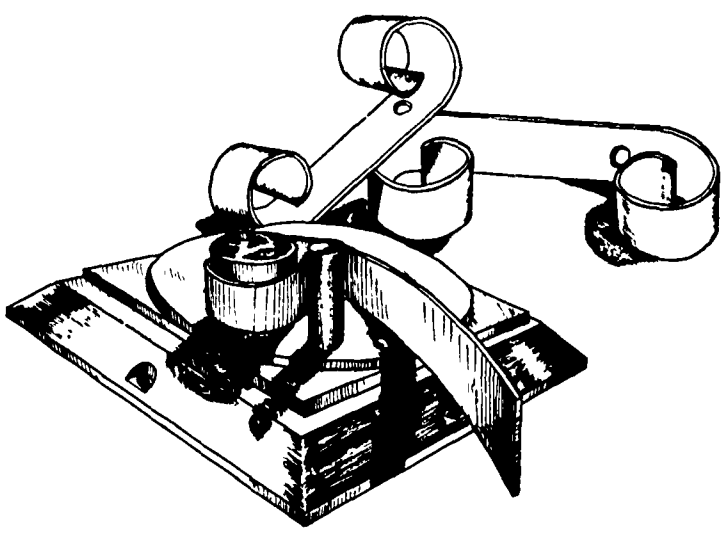


Fig. 10

j. Form ring-shaped parts on the slip roll forming machine. (Make all rings identical, 2" in diameter) (See Fig. # 11.)

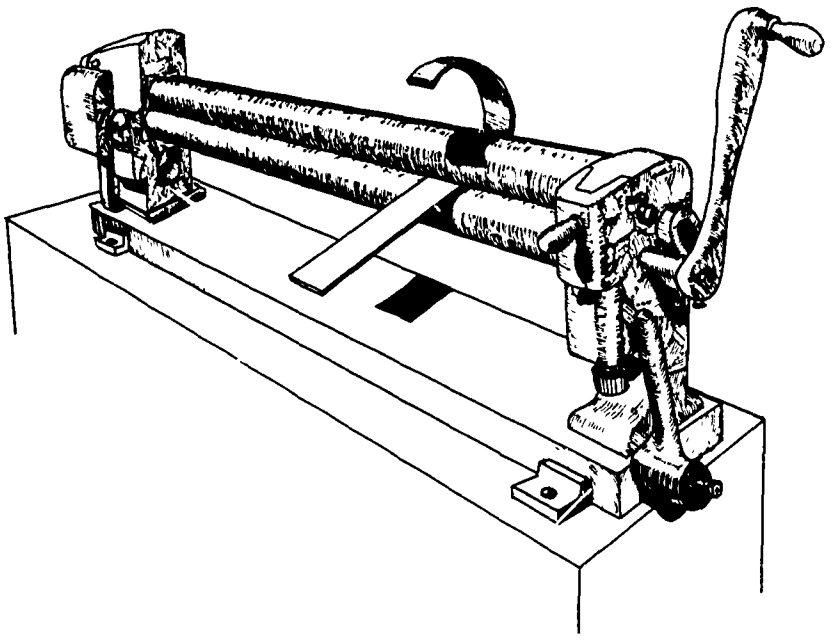


Fig. 11

Fig. 12

k. Join ends of flower pot rings with an electric spot welder. (See Fig. # 12.)

l. Clamp rings with vise grip pliers.

m. Observe following safety practices when using the spot welder:

(1) Wear tinted goggles to protect eyes.
(2) Wear asbestos gloves to avoid burns.
(3) Clean copper electrodes.
(4) Avoid overheating.

n. Assembly flower pot legs to ring with 1/8" R.H. iron rivets. (See Fig. # 13.) (Clamp rivet set in machinist's vise for firm support while spreading rivets.)

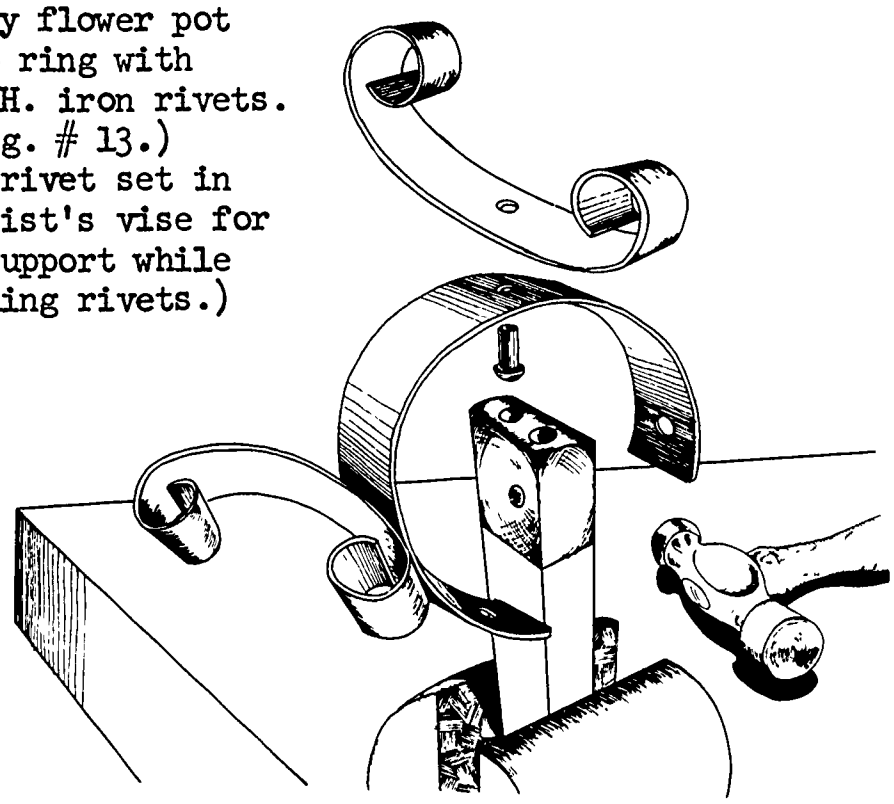


Fig. 13

o. Clean assembled stand with emery cloth, steel wool, and wiping cloth. Make preparations for painting.

p. Apply paint with brush or use spray paint containers as illustrated in Fig. 14.

NOTE: Use spray booth and keep paint area adequately ventilated when painting.

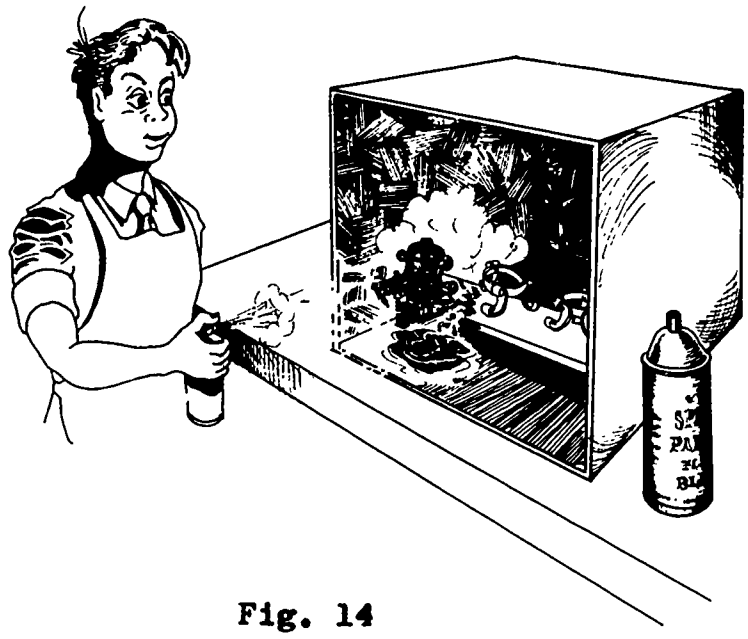


Fig. 14

Outcomes:

1. Manipulative skills learned:

   a. Measuring with a ruler

   b. Marking with a scriber

   c. Cutting with a hack saw

   d. Filing metal

   e. Using a center punch and hammer

   f. Drilling holes in metal with the drill press

   g. Using a drill press jig

   h. Shaping metal with a bending jig

i. Shaping metal with a slip forming roll

j. Joining metal with a spot welder

k. Assembling metal parts with rivets

l. Smoothing metal with emery cloth

m. Cleaning and polishing metal with steel wool

n. Brushing and spraying paint on metal

2. Safety practices learned:

The following tools and machines should be used with care:

a. spot welder (wear goggles)

b. drill press (wear goggles)

c. center punch (avoid pinched fingers)

d. metal file (avoid getting dust in eyes)

Academic learnings:

1. Mathematics:

a. Drawing a figure to scale

b. Computing bills for materials

c. Working with circles (radius, diameter)

d. Use of drill bits (fractional sizes)

e. Cost of tools and equipment

f. Records of working time and labor costs

2. Language Arts:

Vocabulary

assembly	production
merchandising	bottleneck
pilot	competition
profit	corporation
distribution	rivets
fixtures	scroll
templates	labor

3. Science:

a. Electric resistance and heat (spot welder)

b. Selecting plants for plant stand

c. Principle of the lever as applied to forming metal on the bending jib

d. Principle of the inclined plane as applied to the screw in the machinist's vise and drill press clamp

4. Social Studies:

a. The economics of mass production and the American standard of living

b. Biographies of leaders in the development of mass production techniques:

(1) Horace Mann (textiles)

(2) Eli Whitney (firearms)

(3) Henry Ford (automobiles)

c. Occupational opportunities in mass production in local industries

d. Industrial specialization and the interdependence of industries in mass production.

Assignment:

Distribute the notebook assignment sheet.

NOTEBOOK ASSIGNMENT SHEET

Mass Production

1. Draw a sketch of an object in your home that was produced by mass production techniques.

2. Make a list of the tools, machines, processes, and work stations that were used in making the object you sketched.

References:

1. Board of Education City of New York, General Metal Shop, Teacher's Work Manual, Curriculum Bulletin, 1956 Series, No. 14.

2. Haws, Robert W. and Schaefer, Carl J., Manufacturing in the School Shop, American Technical Society, Chicago, Ill. 1960.

3. Kronquist, Emil F., Art Metal Work, McGraw-Hill Book Co., New York, N.Y. 1958.

4. Sexton, Irwin, Industrial Techniques in the School Shop, Bruce Publishing Co., Milwaukee, Wisconsin. 1957.

5. Soderberg, George A., Finishing Materials and Methods, McKnight and McKnight Publishing Co., Bloomington, Ill. 1952.

UNIT III.

HOME, SCHOOL AND COMMUNITY SERVICE PROJECTS

The aim of this unit is to offer the pupils an opportunity to learn skills with shop tools, materials and processes through a variety of repair and construction activities in the home, the school, and the community. These activities will help build positive attitudes through pride in workmanship, confidence with handling tools, satisfaction with accomplishment, and good citizenship by service to others.

Operations and Processes

1. Floor tile installation
    - a. Prepare the floor surface for tiling
        - (1) Sand and scrape
        - (2) Sweep floor clean
        - (3) Measure floor surface and lay out in quadrants
    - b. Apply tile cement
    - c. Cut and install tile
    - d. Operate tile roller
2. Furniture refinishing
    - a. Remove original finish
    - b. Sand and clean all parts
    - c. Glue loose parts
    - e. Apply new finish:
        - (1) Shellac
        - (2) Varnish
        - (3) Paint
    - f. Rub down with pumice and rottenstone
    - g. Polish with waxing compound
3. Toy making
    - a. Trace pattern on wood stock
    - b. Cut wood with coping saw

c. Cut wood with power scroll saw

d. Shape and smooth wood

e. Assemble parts

f. Paint and decorate

Suggested Projects

1. Home service projects

   a. Repair, reinforce, and refinish the following items brought by the pupils from their homes:

chairs	stools
bookcases	roller skates
baby play pen	bicycles
baby carriage	radios

   b. Make picture frames

   c. Replace elements in home appliances:

      electric toaster
      hot plate
      heater

   d. Replace venetian blind tapes, cords, and mechanism

   e. Replace cord on electric toaster, lamps, and fans

2. School service projects

pupils' desks	bulletin boards
teachers' desks	file boxes
chairs	flower boxes
bookcases	display shelves

3. Community service projects

   a. Construct simple equipment, furniture, and toys for hospitals, homes for the aged, and other community agencies:

pull toys	serving tray
knock hockey games	doll houses
ping pong paddles	doll furniture
lapboards	checker boards
wheels (plastic)	checkers (plastic)
book carts	book wagons
cribbage boards	large wooden toys
foot rests	foot stools

Materials, Tools and Equipment

1. Materials

a. Home Service Activities

Floor tiles, cork, 12"x12"

Floor tiles, rubber, 12"12"

Floor tiles, solid vinyl, 12"x12"

Graph paper, $8\frac{1}{2}$"x11"

Builders chalk line

Builders chalk

Hardboard, $\frac{1}{4}$"x36"x36"

Venetian blind cord

Shade rollers and hardware

Appliance heater elements

Lamp cord

Asbestos heater cord

Lamp sockets

b. School Service Activities

Sandpaper, rough, medium, fine

Steel wool, medium, fine

Shellac and shellac thinner

Varnish

Lacquer and lacquer thinner

Stains

Wood filler

Plastic wood

Turpentine

Paint remover

Wood adhesives

Wiping rags

Wood screws and nails, ass rted sizes

Wood dowels, assorted sizes

Paste wax

Community Service Activities

Enamel paints (assorted colors)

Flat washers, #8

Toy wheels, 1-5/8" diameter

2. Tools

The hand tools required for this unit are available in the standard equipment of a career guidance shop.

3. Equipment

Jig saw

Belt sander with vacuum dust collector

Orbital sander

Bar clamps, woodworkers

Floor tile roller

Drill Press, pedestal or bench type

Belt and disc sander

Academic Learnings

1. Mathematics

a. Estimating costs of materials

b. Computing labor costs related to home repairs

c. Economy of repairing items

2. Science

a. Maintaining electrical appliances used in the home

b. Chemicals used in wood finishing products

c. Use of non-toxic paints on toys and baby play-pens

Personal Development

1. Improved attitudes through participation in home repairs and improvements

2. Appreciation for value of school furniture and other public property

3. Training in good citizenship through contributing service to the community

Audio-Visual Aids

Films related to Simple Repair and Refinishing
Bureau of Audio-Visual Instruction, Loan Collection.

1. Cabinet Making, Unit 11 - (9 min. color, Colonial Williamsburg Films, 1956, E-J)

   Woodworking tools and methods of the period are shown and the work of a craftsman displayed.

2. Painting and Decorating, - (11 min. Mahnke, 1946, J-V)

   Painting and the use of the tools of the trade, including the spray gun. Points out disadvantages, such as chemical fumes, lead poisoning, working at great heights.

3. Working Safely in the Shop - (10 min., Coronet, 1953, J-A-V)

   Review of safety features in the shop, e.g., separate work area around machines, safety guard, proper storage of material, use of proper clothing, keeping shop clean. Reviews instruction in proper use of machines, use of goggles for grinding, proper use of jigsaw, drill press, sanders, storing hand tools neatly.

4. The Mechanic, - (14 min., United World, 1946, J-A-V)

   Shows the importance of the mechanic's role in the making of steel, drawing blueprints, interpreting blueprints, building engines. This leads to the phase where management and labor share the responsibility of improving relationships and better working conditions and surroundings.

5. Mechanical Aptitudes, (11 min. Coronet, 1951, A.V.T.P.)

   Sound guidance practices are demonstrated as a high school counselor and student work together in choosing courses based on the boy's interests, abilities, and future plans. Ways to test mechanical interests and abilities and to increase mechanical abilities are shown.

6. Furniture Craftsmen, - (11 min. E. B. Films, 1940, A-V)

The role of the designer and skilled craftsmen in making custom-built furniture; pattern making, laying out, hand sawing, power planing, etc.

7. Wood Finishing: Industrial Arts, - (20 min. McGraw-Hill)

Steps used in finishing wood: stains, paints, lacquers, varnishes and rub-on finishes.

8. Woodworking, - (11 min. E. B. Films, 1953, J-A-V)

Describes the importance of woodworking and its values as a hobby. Illustrates the usage of basic woodworking tools, Shows the step-by-step construction of a project.

Bibliography

1. Bruce, Leroy, F., Sheet Metal Shop Practice, American Technical Society, Chicago, Ill. 1951 Edition.

2. DeWick, Ernest S. and Cooper, John H., Plastic Craft, Macmillan Company, New York, N.Y. 1946 Edition, pp. 67-69.

3. Gregor, A., Constructive Woodwork for Schools, The Manual Arts Press, Peoria, Ill. 1945 Edition, 171 pp.

4. Lockrey, A. J., Plastics in the School and Home Workshop, Governor Publishing Co., New York, N.Y. 1937 Edition.

5. McDonnell, Leo P., Portable Power Tools, Delmar Publishers Inc., Albany, 5, New York. 1962 Edition, 214 pp.

6. Pelton, B. W., Furniture Making and Cabinet Work, D. Van Nostrand Co., Princeton, New Jersey. 1961 Edition, 536 pp.

How to Install Floor Tile

(Suggested Resource Lesson 1)

FLOOR TILE INSTALLATION

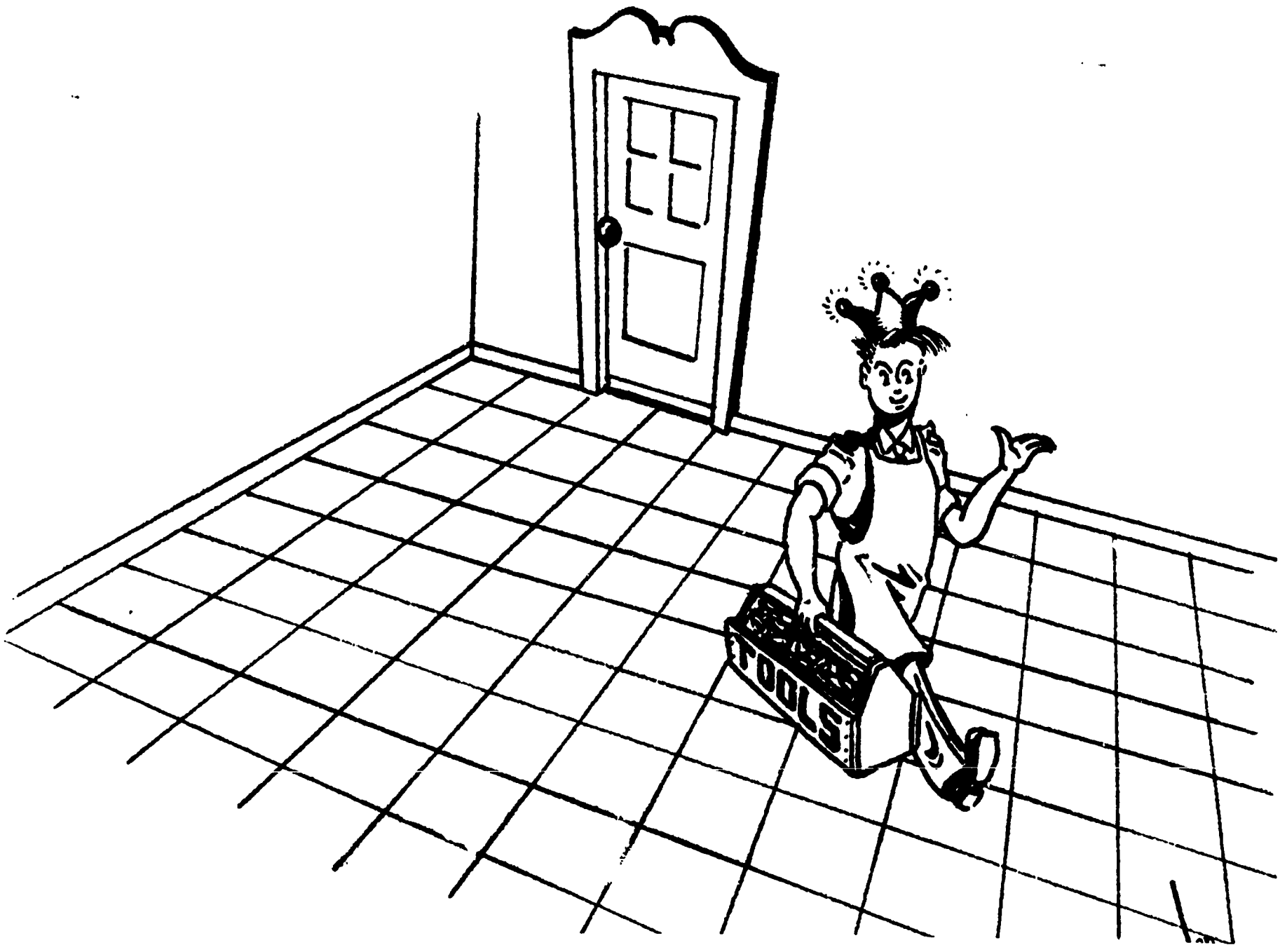


Fig. 15

Materials and Tools:

1. Materials

   floor tile
   rubber tile cement
   builders chalk and line
   graph paper
   rough sandpaper
   hardboard

2. Tools

   tile cutting board
   folding rule
   framing square
   notched trowel
   linoleum knife

Visual Aids:

1. Film Strip: Modern Craftsmanship, Tile Installation, Armstrong Cork Co., 60 West 49th Street, New York, N.Y.

2. Chalkboard drawing of a floor surface layout

3. Photographs demonstrating installation of floor tiles

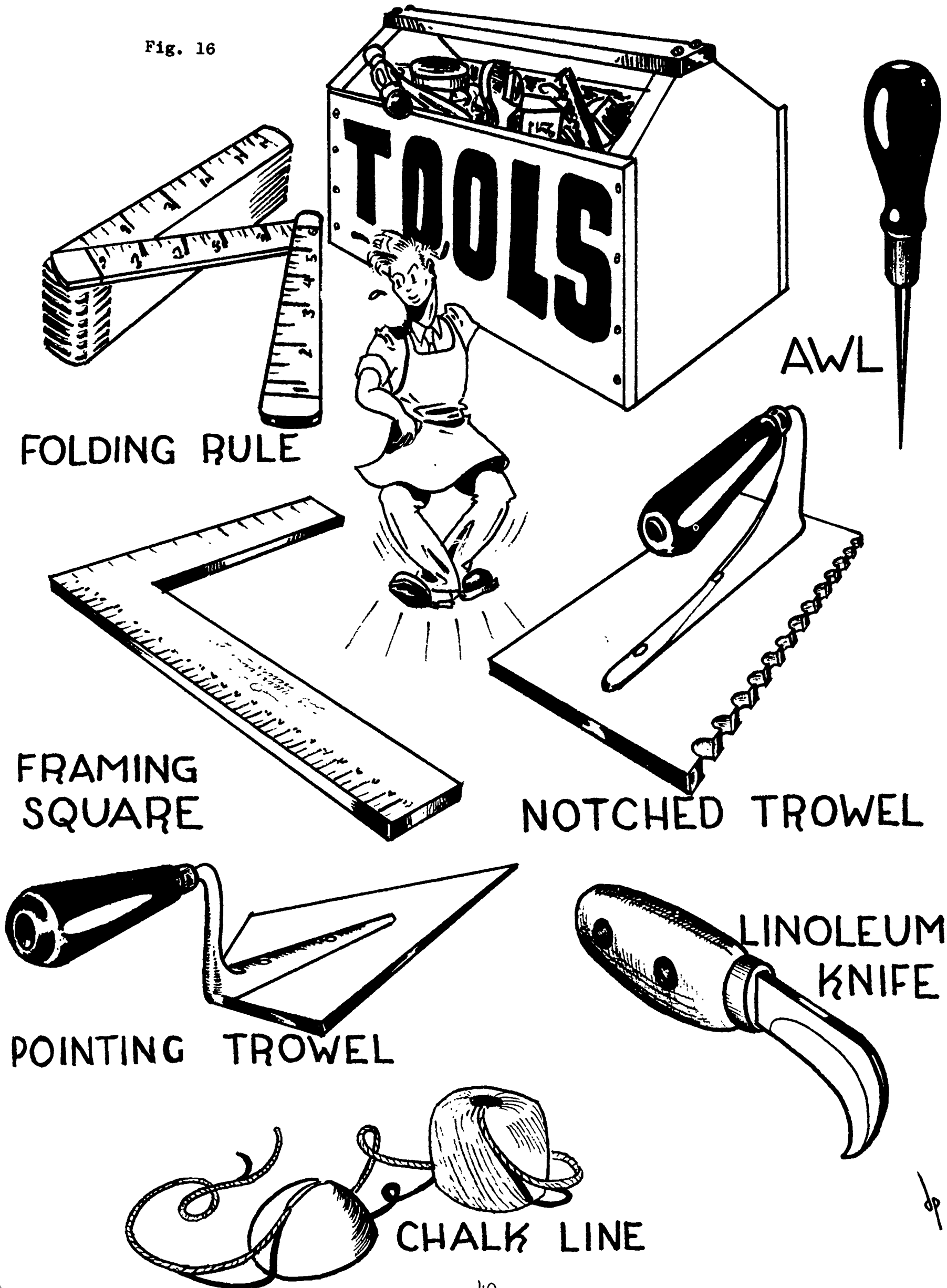
Motivation:

1. Ask the pupils to name items in their homes that could be repaired.

2. Elicit from some of the pupils that the flooring may be in poor condition.

3. Ask the pupils, "If we wanted to install floor tiling, what steps would we take?"

Fig. 16


TOOLS
FOLDING RULE
AWL
FRAMING SQUARE
NOTCHED TROWEL
POINTING TROWEL
LINOLEUM KNIFE
CHALK LINE

Procedure:

1. Review the steps to be taken to install a tile floor with the class:

   a. Nail down any loose floor boards.

   b. Remove all bumps and uneven surfaces to make floor surface level.

   c. Level cement floors with latex concrete patch. (Use a pointing trowel.) (See Fig. # 17.)

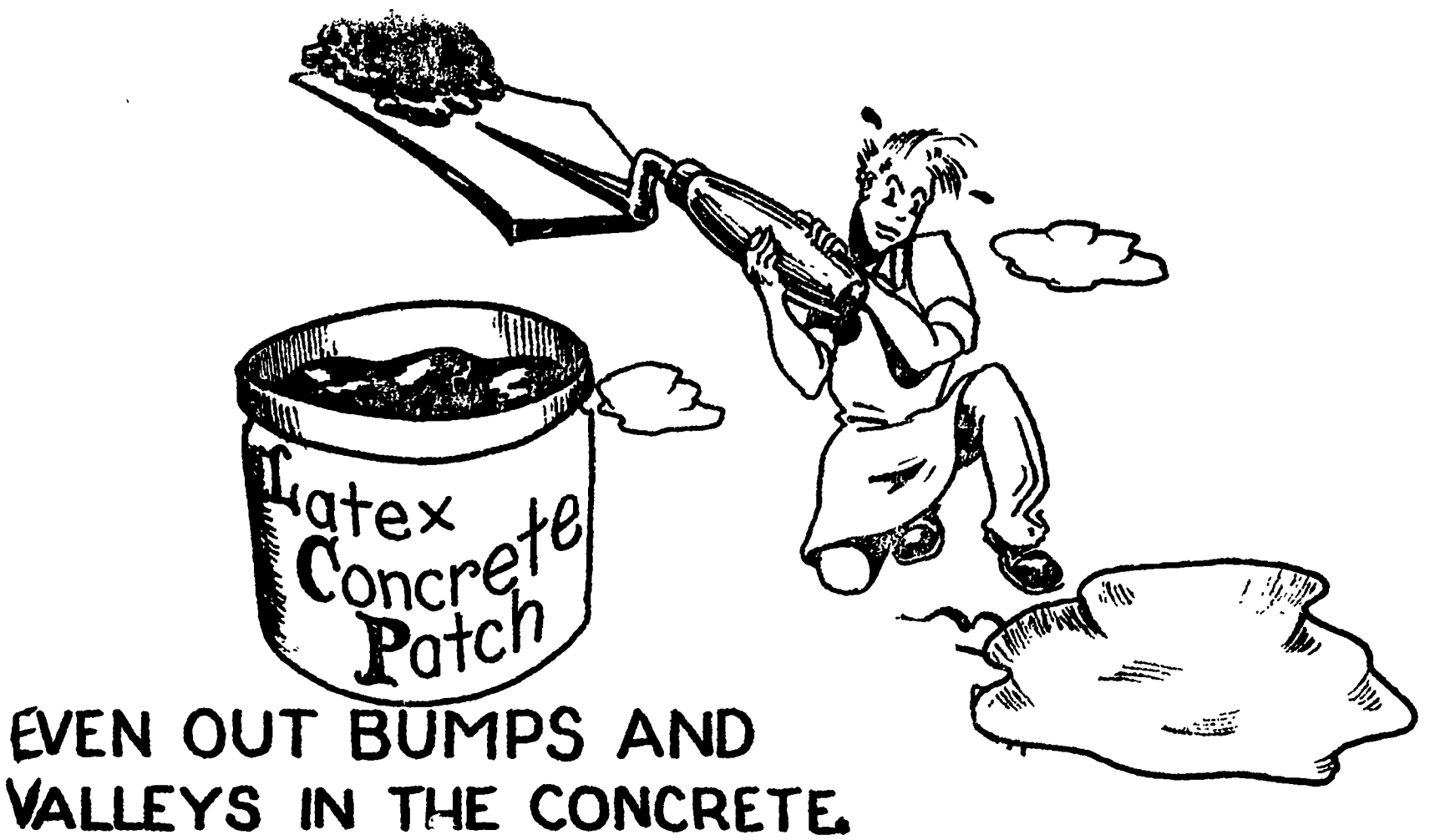


Fig. 17

d. Sweep the floor to remove all dust and dirt.
(See Fig. # 18.)

Fig. 18

e. Estimate the area of the surface to be tiled in square feet.

f. Determine the number of 9"x9" tiles needed. (Use graph paper as shown in Fig. # 19.)

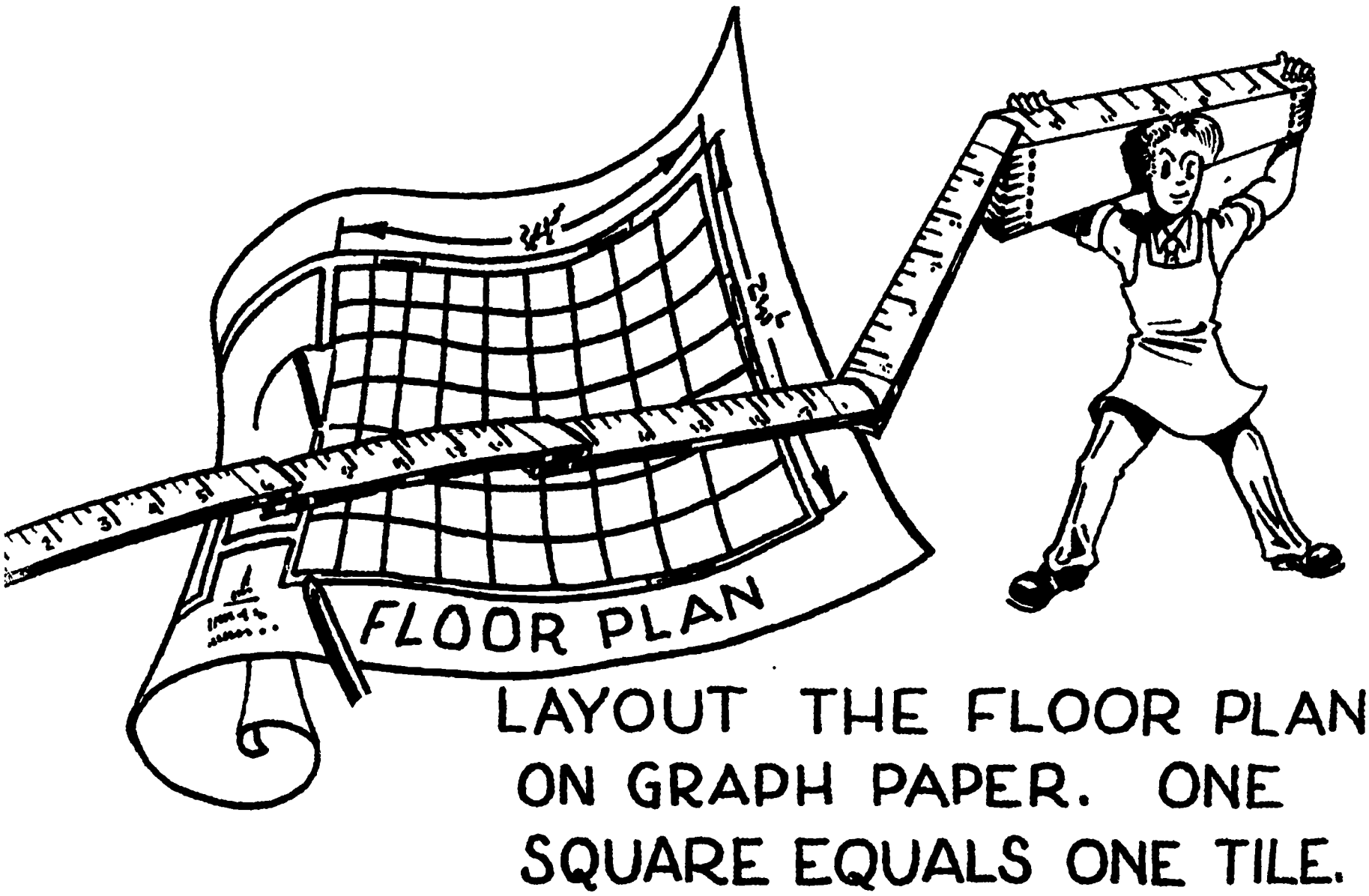


Fig. 19

g. Demonstrate how to divide a room into quarters with an extension rule and a framing square. (See Fig. # 20.)

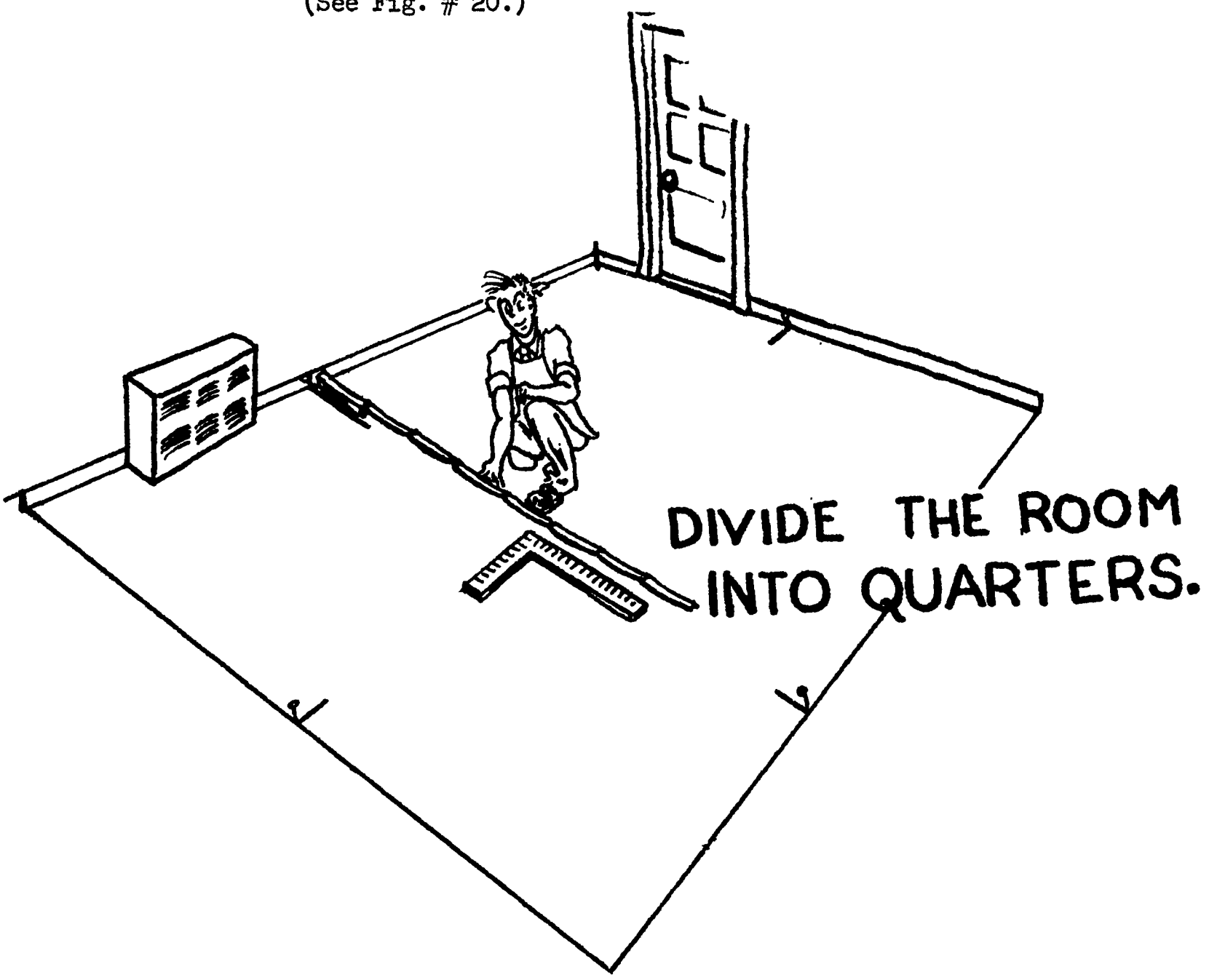


Fig. 20

h. Snap a chalk line across the floor to provide a guide line for laying the tile. (See Fig. # 21.)

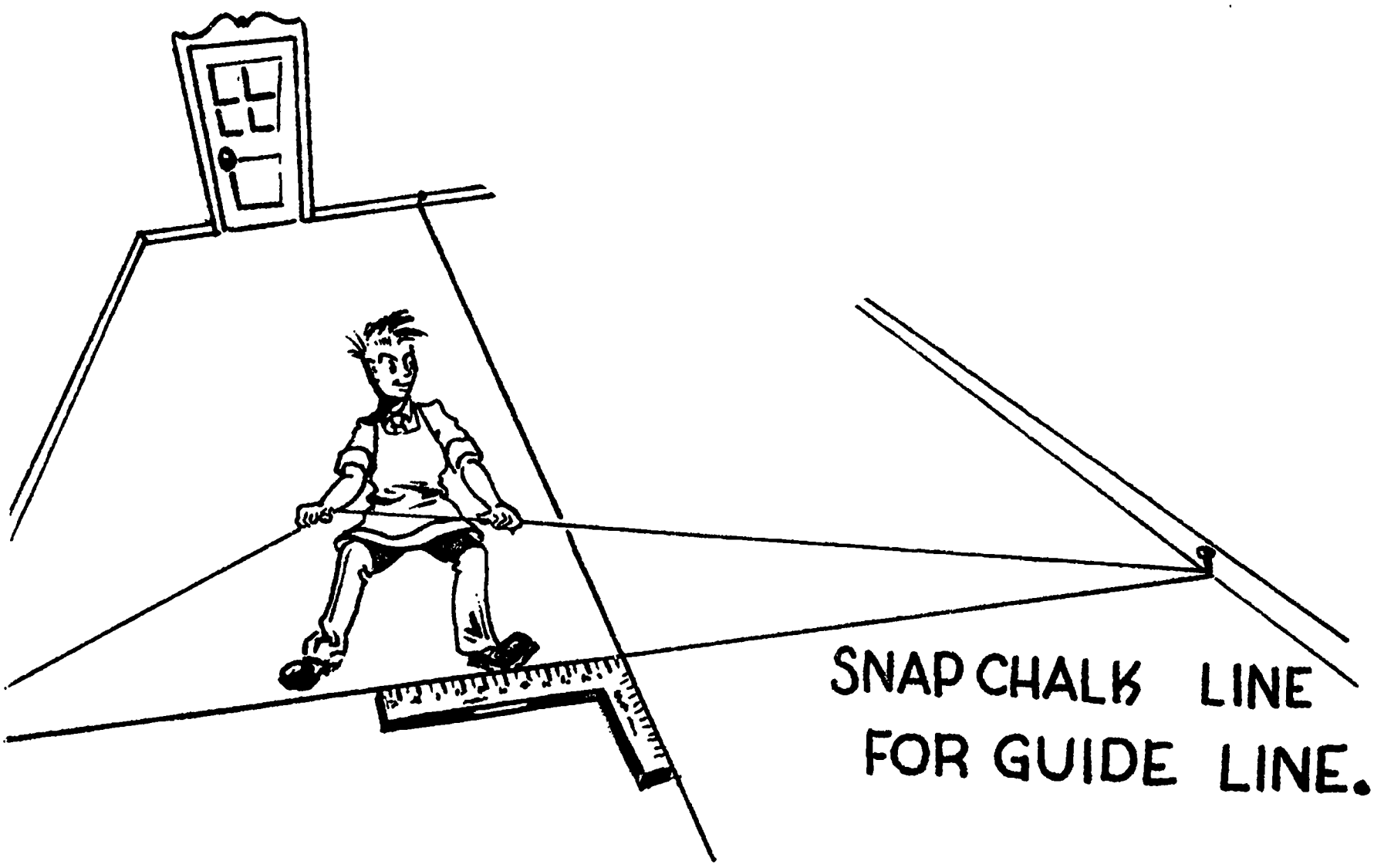


Fig. 21

i. Maintain the room temperature at 70 degrees while laying the tile and twenty-four hours after completing the job. (See Fig. # 22.)

j. Spread tile cement on the floor with a brush and smooth it out with a notched trowel. (Cement one quarter of the surface at a time.) (See Figs. # 23 and # 24.)

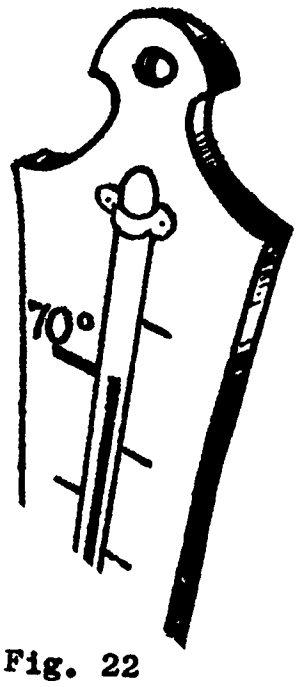


Fig. 22

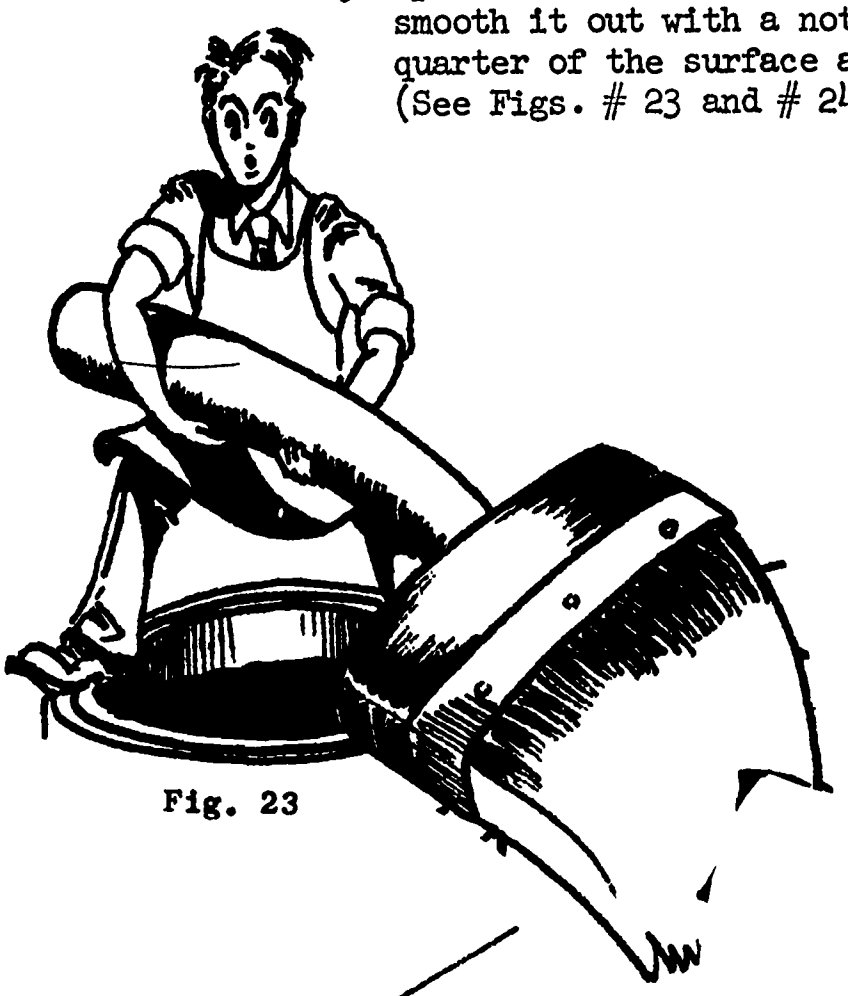


Fig. 23

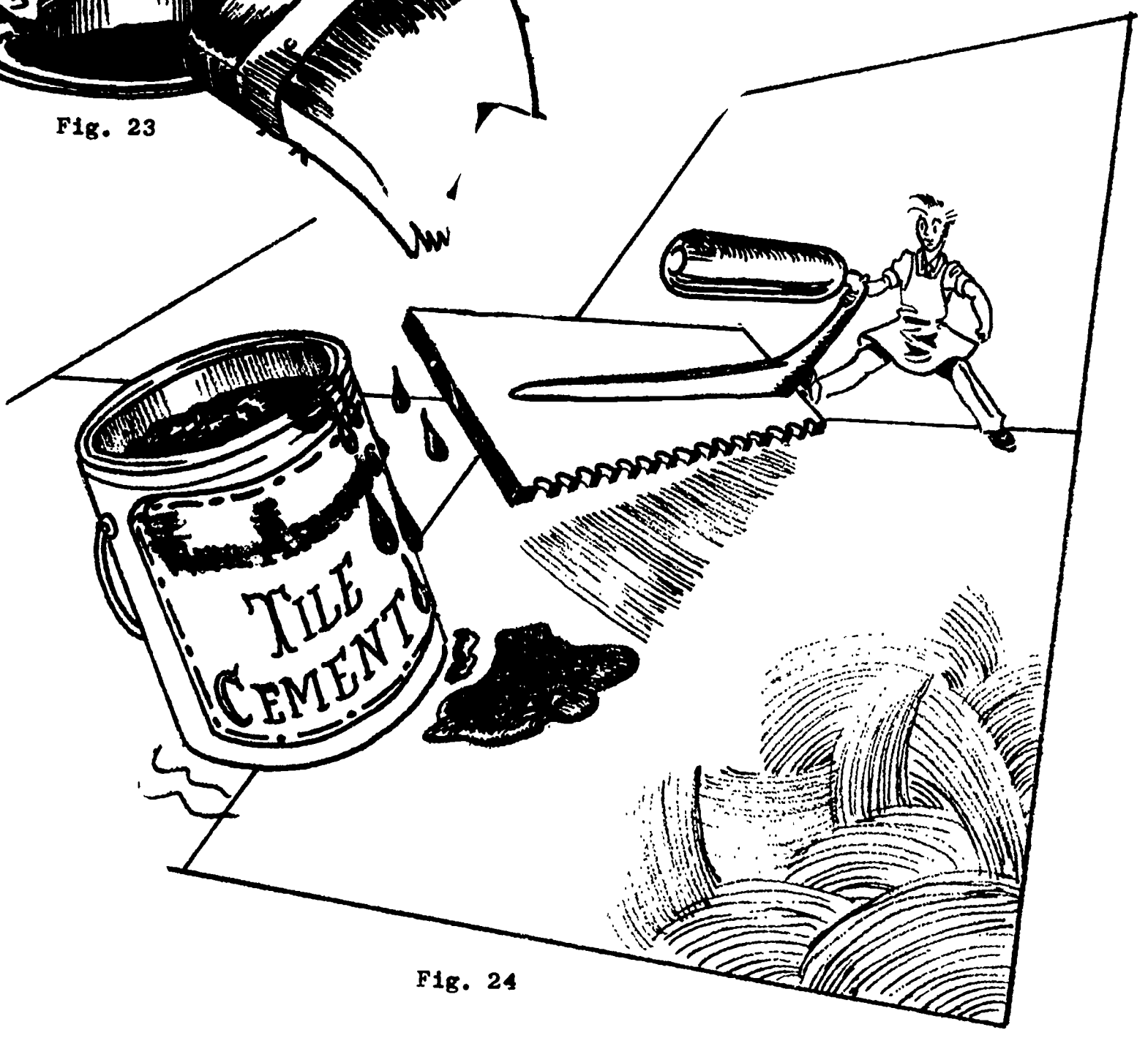


Fig. 24

k. Check to see that the adhesive is tacky dry before beginning to lay the tile. (See Fig. #25.)

TOUCH THE TILE CEMENT TO TEST IF IT IS DRY.

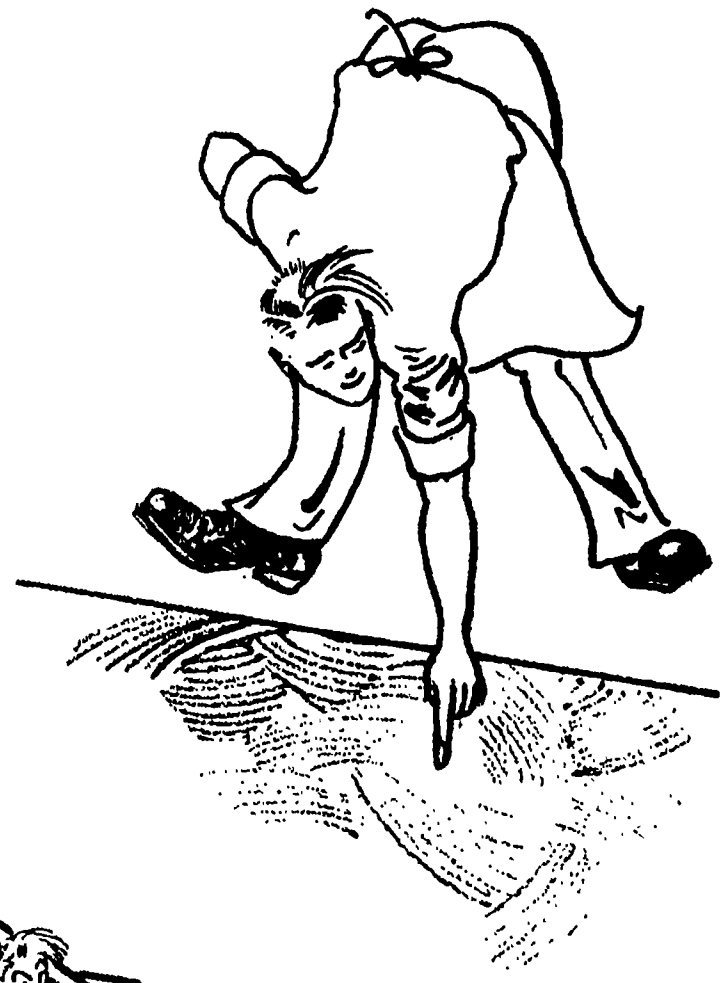
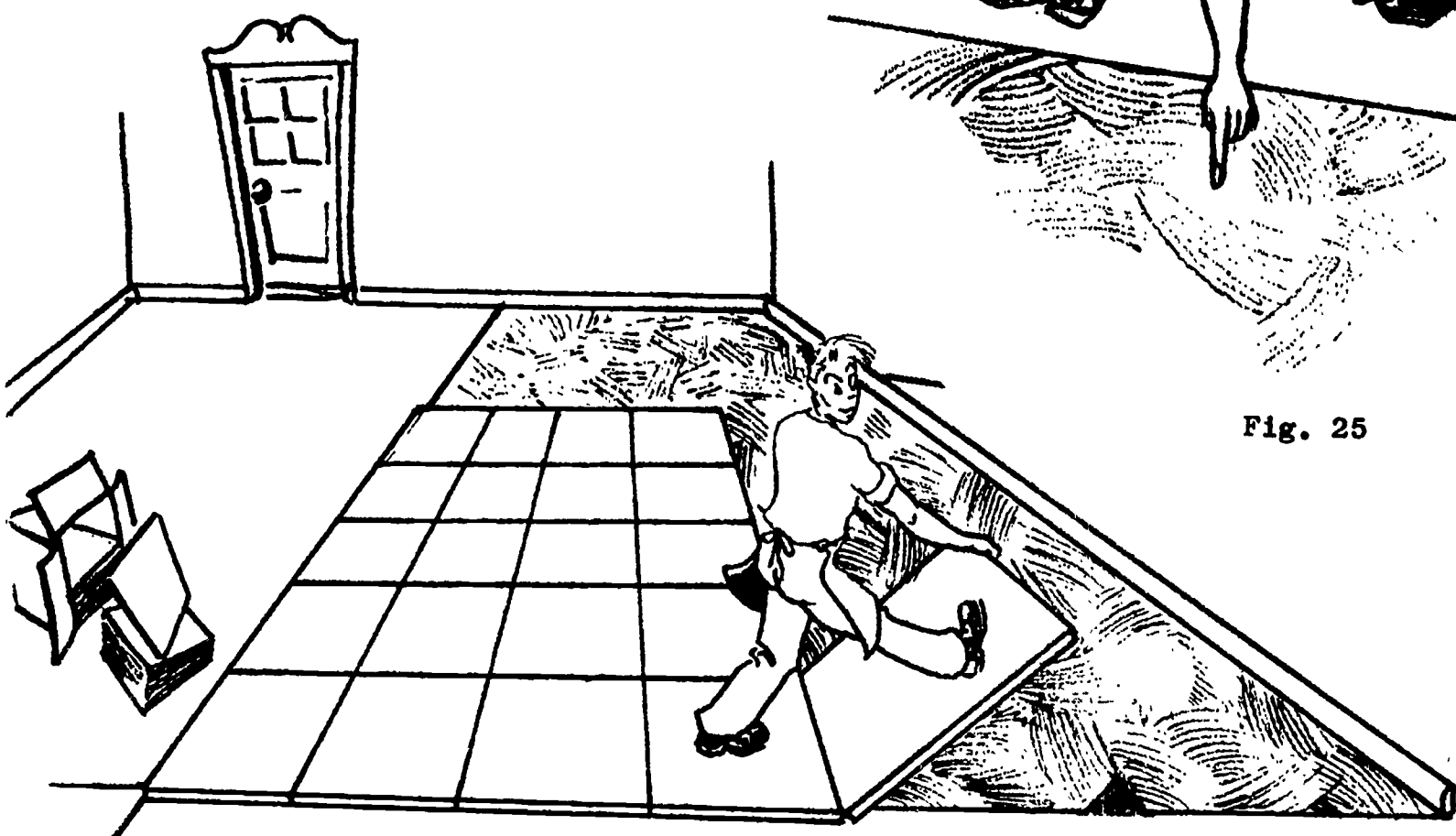


Fig. 25

l. Set tiles. (See fig. # 26.)



SET TILES NEATLY IN LINE. DO NOT SLIDE TILES IN PLACE.

Fig. 26

m. Lay tiles on border lines. Work tiles with an awl and cut with a linoleum knife or tinners snips. (See Figs. # 27 and # 28.)

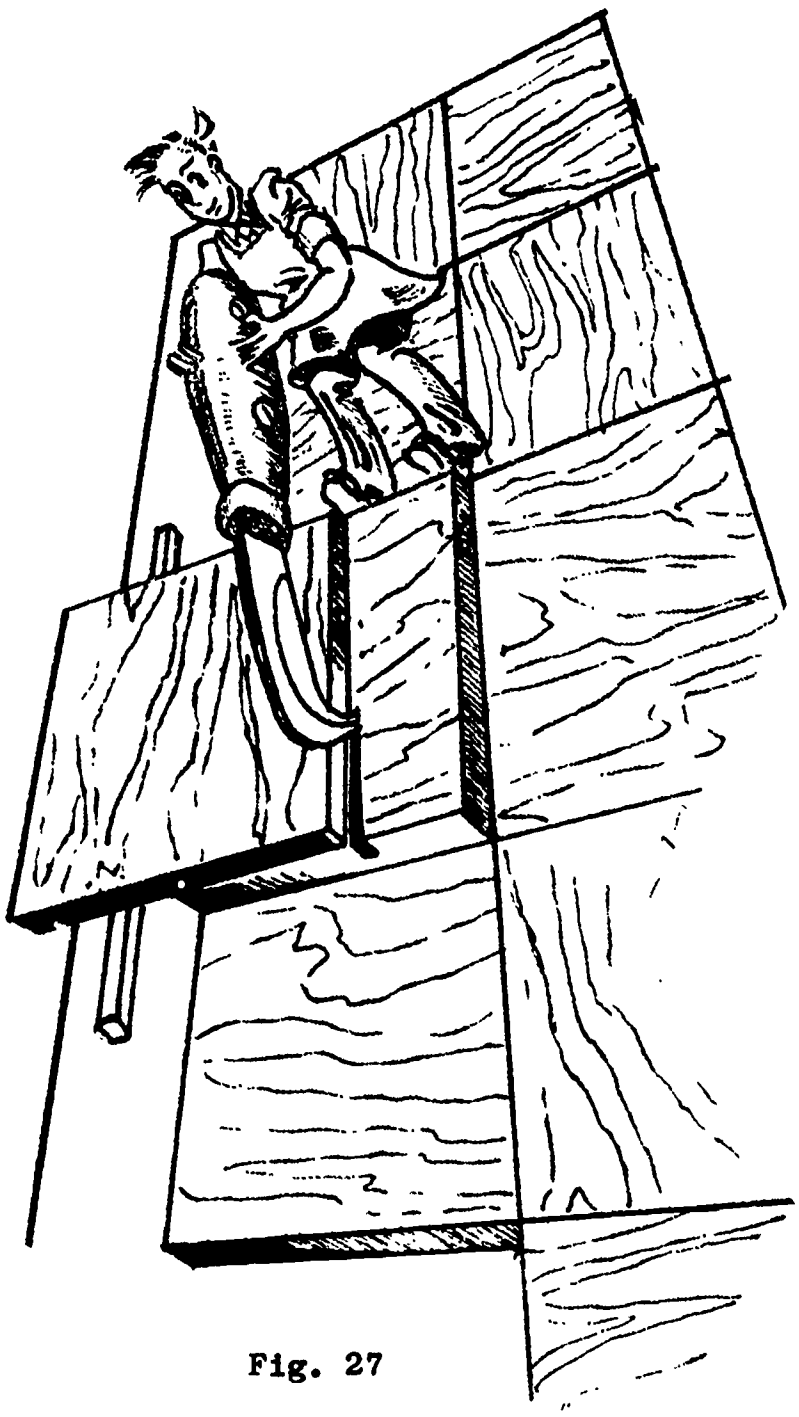


Fig. 27

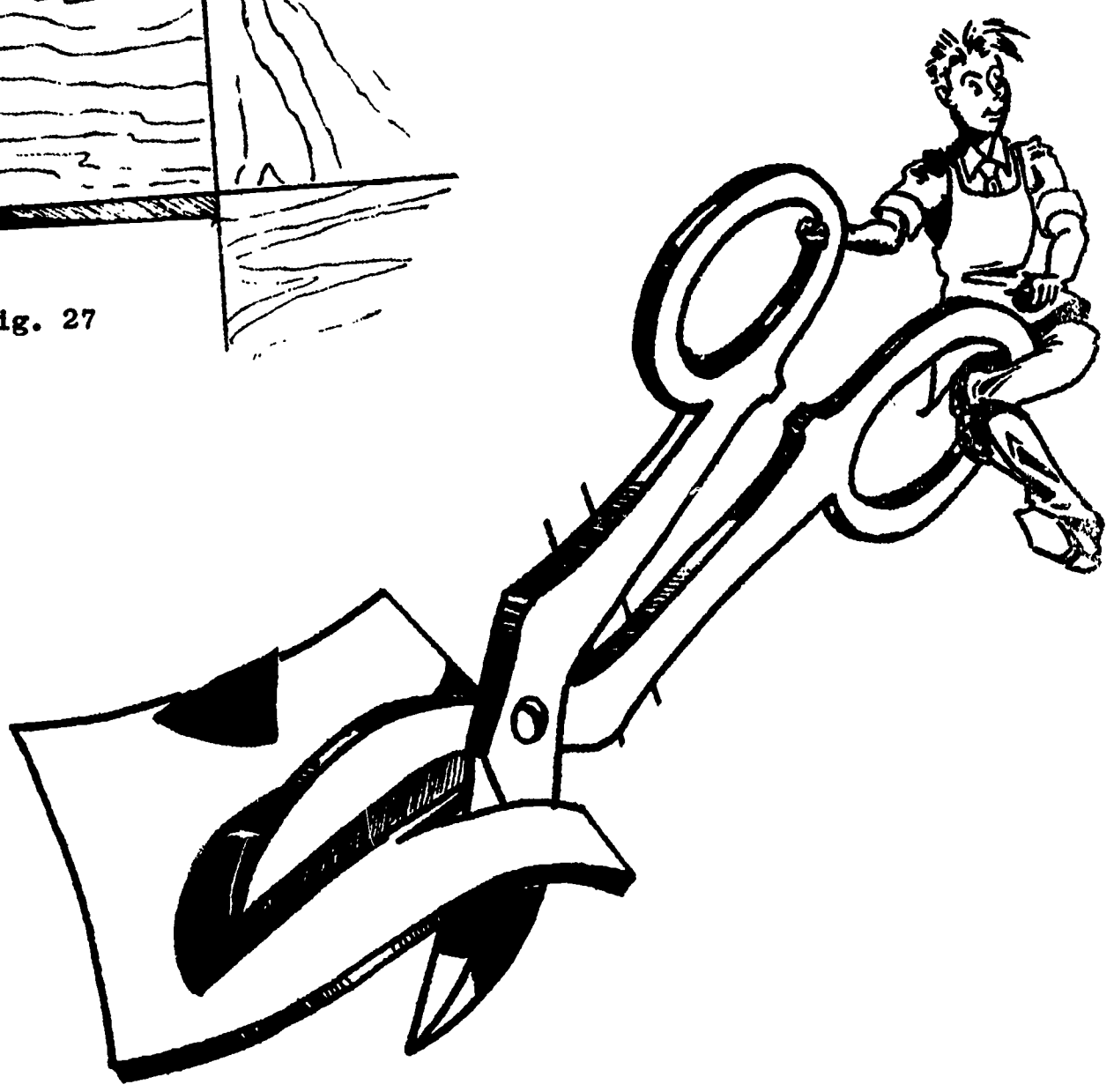


Fig. 28

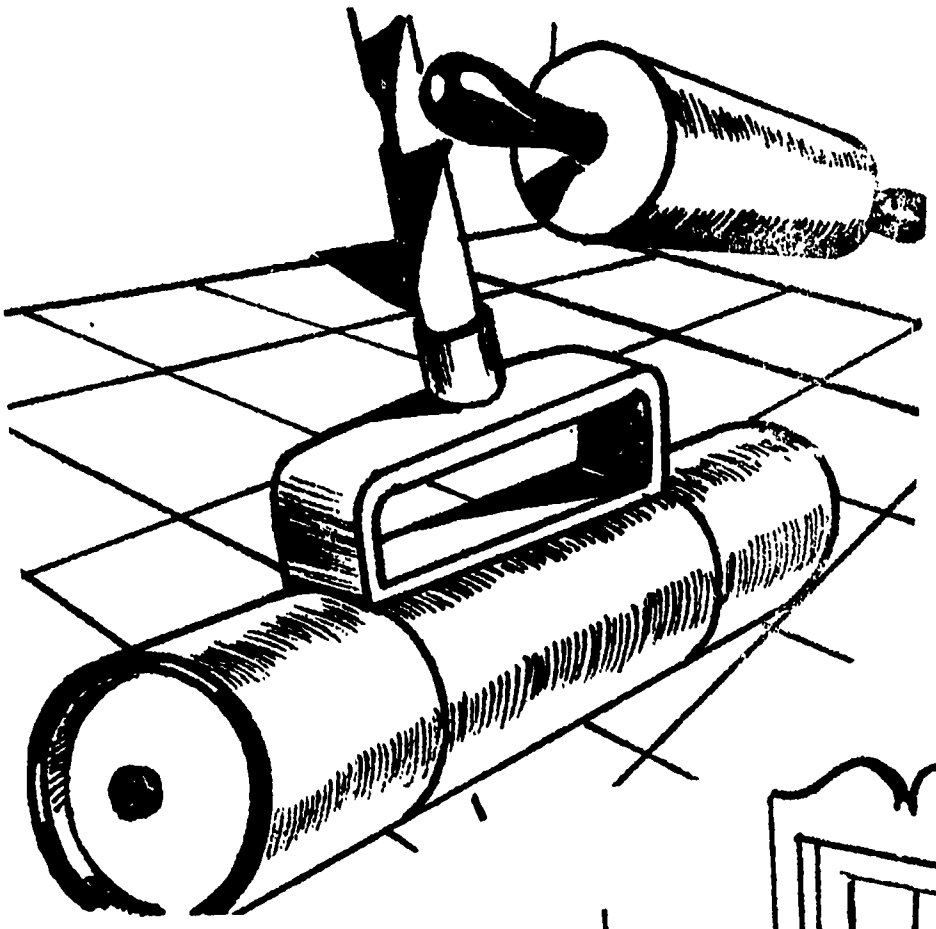


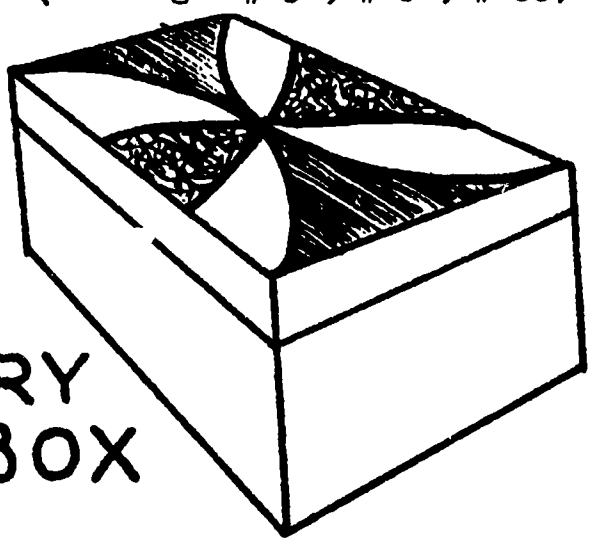
Fig. 29

n. Press tiles to the floor surface with a hand rolling pin or a special floor roller. (See Fig. # 29.)

o. Clean up work area when job is completed. (See Fig. # 30.)

Fig. 30

2. Have the pupils plan one of the individual projects listed below so that they can install tile as demonstrated. (See Figs. # 31, # 32, # 33, and # 34.)



JEWELRY BOX

Fig. 31

BOOKENDS

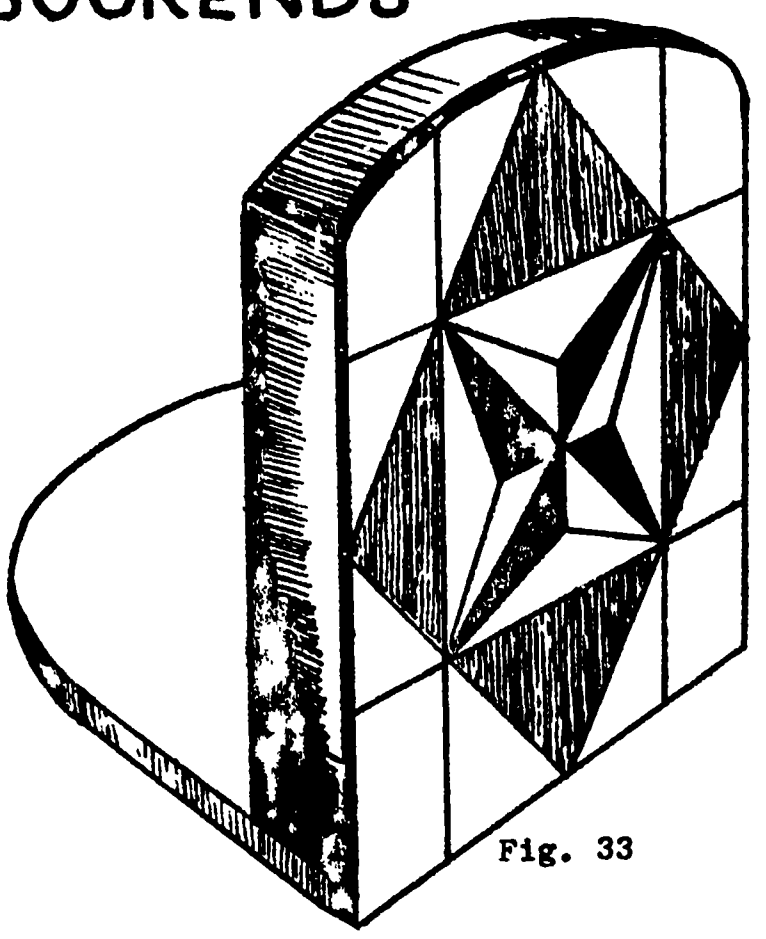
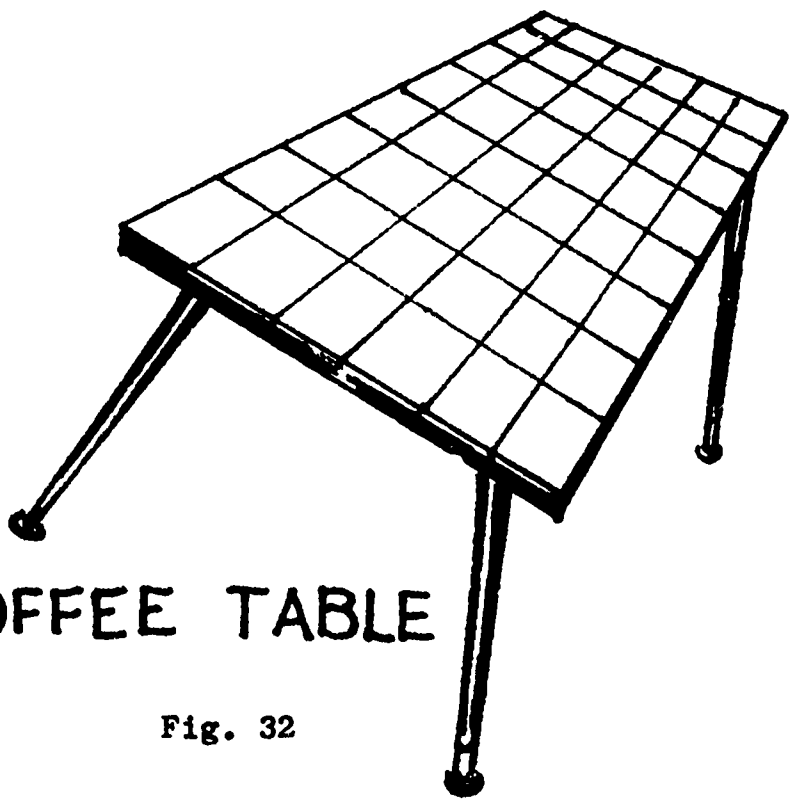
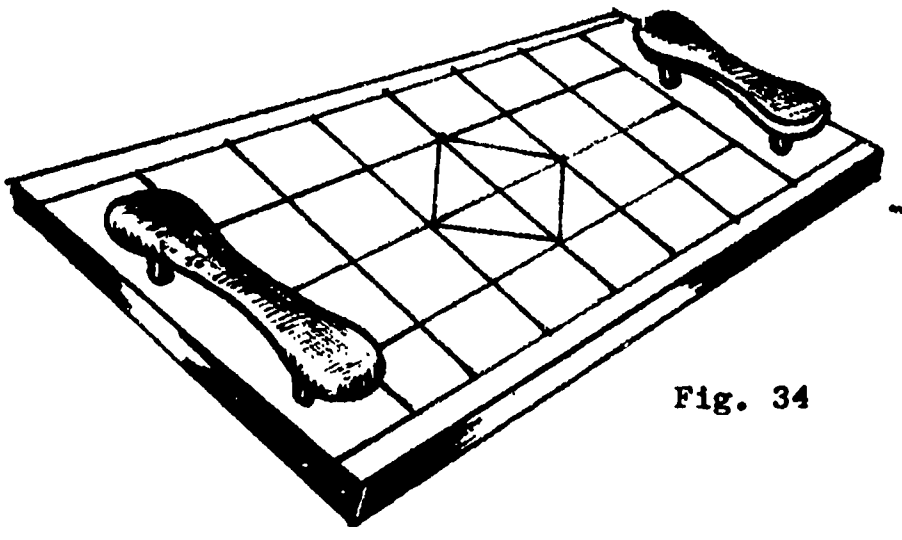


Fig. 33



COFFEE TABLE

Fig. 32



TRAY

Fig. 34

Outcomes:

1. Manipulative skills learned:

   a. Measuring the area of a floor surface to be tiled in square feet

   b. Smoothing a rough wood floor

   c. Smoothing a rough cement floor

   d. Applying tile adhesive

   e. Testing tile adhesive for installation of tile

   f. Setting tile

   g. Cutting and shaping tiles to fit small spaces

   h. Applying pressure to tile with a roller

2. Safety practices learned:

   a. When tiling a floor the working area should be well ventilated, and the room should be maintained at the proper temperature.

   b. Floor cements and thinners should be stored in metal cabinets.

   c. When cutting tile, care should be taken to avoid injury.

   d. When lifting boxes of tiles, care should be taken to avoid body strain.

3. Academic Learnings:

   a. Mathematics:

      (1) Measuring areas to be tiled

      (2) Dividing room are in quadrants

      (3) Using graph paper to make layout for repairs

   b. Language Arts:

      (1) Vocabulary

asphalt	install
asbestos	quarter
vinyl	score
latex	area
adhesive	perimeter
tacky	trowel

ventilate	floor
repairs	sweep
dust	knife

(2) Writing bills for materials

(3) Writing about individual repair projects

c. Science:

(1) The composition of floor tile

(2) Chemical composition of floor tile adhesives

(3) Solvent action of floor tile cement thinners

(4) Principle of evaporation related to the drying of floor tile cement

d. Social Studies:

(1) Manufacture of floor tiles

(2) Transportation and distribution of tiles

e. Guidance:

(1) Job opportunities in local floor tiling shops

(2) Good citizenship

References:

1. Installation Manual, Armstrong Cork Co., Lancaster, Penn., and 60 W. 49th St., New York, N.Y.

2. Mechanics Manual, Kentile Floors, Inc., 52 Second Avenue, Brooklyn, 15, New York.

How to Repair and Refinish School Furniture

(Suggested Resource Lesson 2)

Materials, Tools, and Equipment:

1. Materials

   Paint remover
   Steel wool, grade 00
   Shellac and shellac thinner
   Varnish
   Lacquer and lacquer thinner
   Wood stains
   Wood fillers
   Sandpaper, coarse, medium, fine
   Wiping rags
   Plastic wood
   Turpentine
   Finishing nails, assorted sizes
   Adhesives, vinyl resin, Weldwood
   Wood screws, flat head, round head, assorted sizes
   Wood dowels, assorted sizes

2. Tools

   This activity will employ the use of the standard inventory of hand tools available in the Career Guidance shop.

3. Equipment

   Portable orbital sander
   Electric belt sander with vacuum dust collector
   Portable electric drill, $\frac{1}{4}$" chuck capacity

Visual Aids:

Wall chart showing the steps in wood finishing

Demonstration board showing the various types of wood finishes

Commercial charts on wood finishing materials

Motivation:

1. Discuss with the class various ways in which they could contribute their services to the school.

2. Elicit that one way is to repair some of the classroom desks that have been marked up.

Procedure:

1. Obtain a desk in the school that needs repair and demonstrate the steps to be taken to refinish it:

   a. Brush on paint and varnish remover.

   b. Allow remover to remain until the coating is soft and wrinkled.

   c. Remove old finish with a putty knife.

   d. Scrub the surface with #00 steel wool and lacquer thinner.

   e. Sand surfaces with sanding machine.

   f. Apply a wash coat of shellac and allow to dry. (Apply shellac or varnish in a dust free area.)

   g. Sand surfaces with 6-0 Garnet paper.

   h. Apply another coat of shellac or varnish and repeat same procedure of drying, sanding, etc.

   i. After the third coat, rub finish with pumice and oil and wipe clean.

   j. Rub finish with rottenstone and oil and wipe clean.

   k. Rub to a high shine with paste or liquid wax.

2. Have each pupil refinish his own desk top following the steps demonstrated.

Outcomes:

1. Manipulative skills learned:

   a. Removing old furniture finish with paint remover, putty knife, and wood scraper

   b. Using steel wool and sandpaper

   c. Operating an orbital and belt sander

   d. Applying wood filler to surface grain of furniture

   e. Applying shellac or varnish in successive coats

   f. Smoothing a finish with pumice stone, rottenstone, and linseed oil

   g. Polishing furniture finish with wax

2. Safety practices learned:

   a. When refinishing furniture the work area should be well ventilated.

   b. Combustible liquids should be stored in a metal cabinet.

   c. Care should be taken to protect hands, eyes, and clothing when using wood-finishing liquids.

3. Academic Learnings:

   a. Mathematics:

      (1) Liquid measure

      (2) Area measurement

      (3) Linear measurement

      (4) Problems related to the cost of wood-finishing materials

   b. Language Arts:

      (1) Vocabulary

ventilate	paint
evaporation	remover
inflammable	thinner
knife	wax
putty	rags
cabinet	safety
container	hazard
shellac	surface
varnish	furniture

      (2) Reporting on project activities

   c. Science:

      (1) Evaporation as applied to finishing liquids

      (2) Use of abrasive materials (sandpaper, pumice, and rottenstone)

      (3) Oxidation, and the preservation of polished furniture surfaces

   d. Social Studies:

      (1) Furniture manufacturing centers in the U.S.

      (2) Packing, shipping, and delivering furniture

(3) Employment opportunities in furniture manufacturing industry

Assignment:

1. Have the pupils choose a piece of furniture which they will refinish in their own homes.

2. Have them prepare a report on their progress:

   a. Name of object being refinished

   b. Description of surface before refinishing

   c. Procedure used

   d. Difficulties encountered

   e. Reaction of the family to the project

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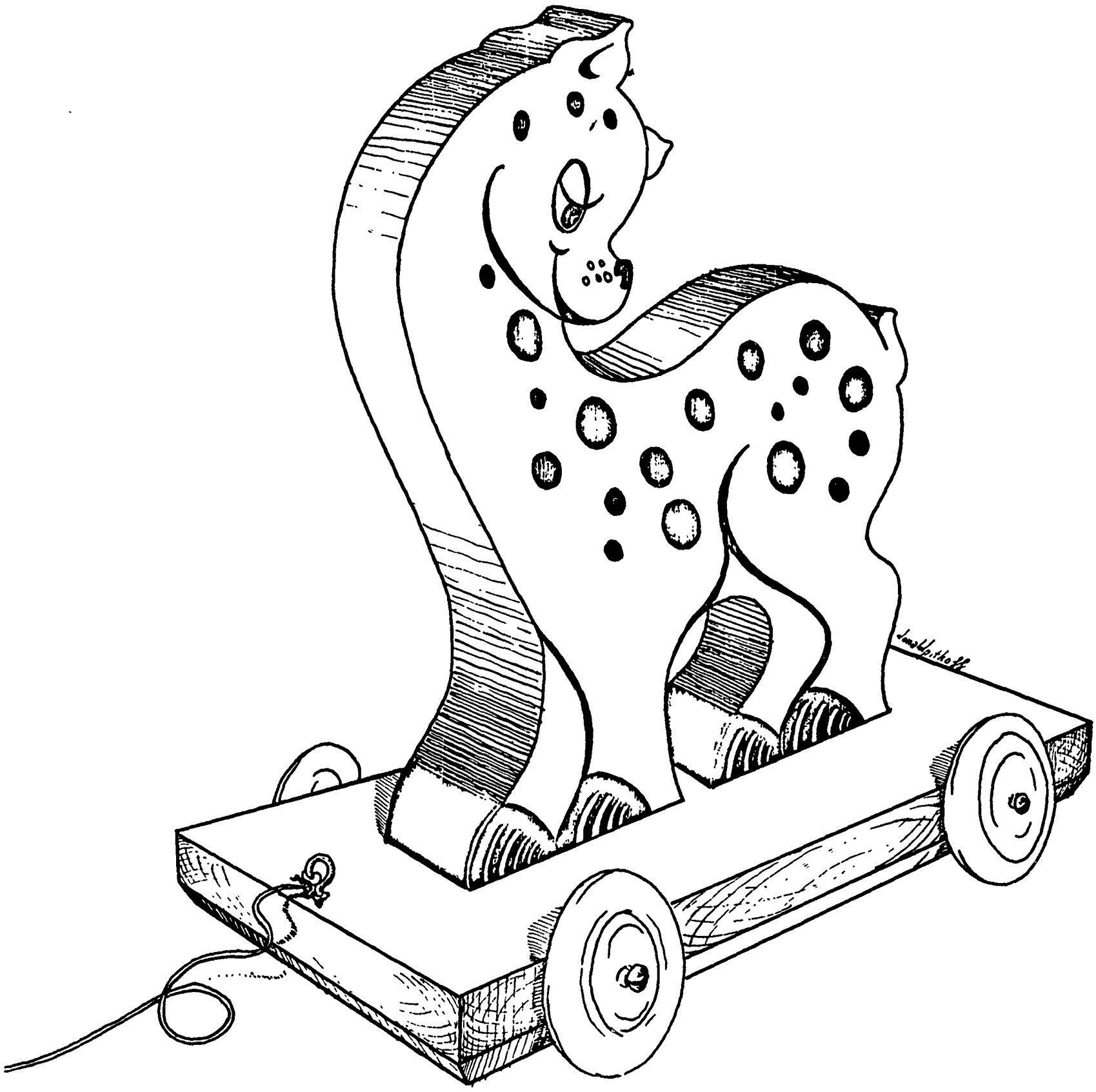

Fig. 42

Making a Toy

(Suggested Resource Lesson 3)

NOTE: This project can be made as an individual project or as a mass produced project. If it is to be mass produced, refer to Area 1, Unit II, "Mass Production Techniques."

Materials, Tools, and Equipment:

1. Materials:

   lumber, pine, 1# stock
   wood screws, F.H. $1\frac{1}{2}$" #8
   wood screws, R.H. $1\frac{1}{4}$" #8
   flat washers #8
   shellac
   enamel paints, non-toxic
   wheels, 1-5/8" diameter
   screw eyes, 1/4"

2. Tools:

   All woodworking tools needed for this project are available in the Career Guidance industrial arts shop.

3. Equipment:

   a. Table circular saw

   b. Mitre box saw

   c. Orbital sander

   d. Power scroll saw

   e. Drill press

   f. Belt and disc sander

Visual Aids:

1. Models of the toy animals

2. Full size template of animal shape

3. Film: Magic of Lumber, 16 MM, Sound, Color, 22 min., West Coast Lumberman's Association, Portland, 5, Oregon.

Motivation:

1. Discuss with the pupils the need for playthings for children who are hospitalized.

2. Ask the pupils if they would like to make toys as gifts for the children who are in a local hospital.

3. Show models of sample toys and ask the pupils to decide which toy they will make.

Procedure:

1. Demonstrate and explain the following steps:

   a. Cut lumber to size for all parts of the project. (See Fig. # 43.)

   b. Make a template of the animal shape.

   c. Use the template to trace animal shape on wood. (See Fig. # 44.)

   d. Cut animal shape on the power scroll saw. (See Figs. # 45 and # 46.)

      (1) Lower safety guard to the width of the wood.

      (2) Keep hands away from all moving parts. (thumbscrew, upper and lower chucks, and belt pulley)

      (3) Wear safety goggles.

   e. Use the drum sander, and the belt and disc sander. (See Fig. # 47.)

   f. Cut bases for toys on the mitre box saw. (See Fig. # 48.)

   g. Lay out and plane 1/4" chamfer on the base. (See Fig. # 49.)

   h. Sand all edges and surfaces of the base. (See Fig. # 50.)

   i. Lay out all measurements as shown in Fig. # 51.

   j. Drill holes. (See Fig. # 52.)

      (1) Use portable drill to make holes in animal shape.

      (2) Use drill press to make holes in base.

   k. Apply prime coat. (shellac or paint) (See Fig. # 53.)

   l. Rub down prime coat when it is dry and apply finishing coat. (Use non-toxic paints.)

m. Apply decorations and markings. (Use non-toxic paints) (See Fig. # 54.)

n. Assemble all parts. (See Fig. # 55.)

(1) Fasten base to animal shape with $1\frac{1}{2}$" F.H. screws.

(2) Fasten wheels to the base with $1\frac{1}{4}$" R.H. screws.

(3) Attach a screw eye to the base for the pull string.

2. Have the pupils design their own animal shapes. (See Figs. #56, #57, #58, #59, and #60.)

3. Have the pupils construct their own toys, either individually, or with a group. (mass production)

Outcomes:

1. Manipulative skills learned:

a. Using a template

b. Using the power scroll saw

c. Using sanding machines (drum sander on a drill press, orbital sander, and belt and disc sander)

d. Laying out and planing a chamfer

e. Using the portable drill and the drill press

f. Attaching wood parts with screws

g. Applying finish and decorative markings

2. Safety practices learned:

a. Care should be taken when operating a mitre box, a scroll saw, a drill press, a belt sander, an orbital sander, and a portable drill.

b. Goggles should be worn for protection when using machines and tools, such as, drill press, scroll saw, etc.

c. Inflammable materials should be stored in metal cabinets.

d. Non-toxic paints should be used when finishing and decorating children's toys.

3. Academic learnings:

a. Language Arts:

Vocabulary

mitre	brush	guard
chamfer	shellac	drill
lumber	pine	surfaces
pilot-hole	paint	non-toxic
enamels	wheel	washer
screw	nails	hammer
screwdriver	sander	portable

b. Mathematics:

(1) Measuring with a ruler

(2) Selecting appropriate drill size to make pilot holes

(3) Laying out stock economically

(4) Accuracy in fastening wheels to the base of a toy

c. Science:

(1) Use of the wheel and axle

(2) Principle of the inclined plane as applied to the use of wood screw fasteners

d. Guidance:

(1) Volunteer organizations and their services to the community

(2) Employment opportunities in hospitals, homes for the aged, recreation centers, and other social service agencies

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3. Keane, George R., Teaching Industry through Production, American Industrial Arts Association, Washington, D. C. 1959 Edition.

4. McDonnell, Leo P., Hand Woodworking Tools, Delmar Publishers, Inc., Albany, 5, New York. 1962 Edition. 294 pp.

5. The American Red Cross in Greater New York, 1 Red Cross Place, Brooklyn, N.Y. 11201, Request List, Junior High and High Schools. A list of projects for industrial arts shops with instructions.

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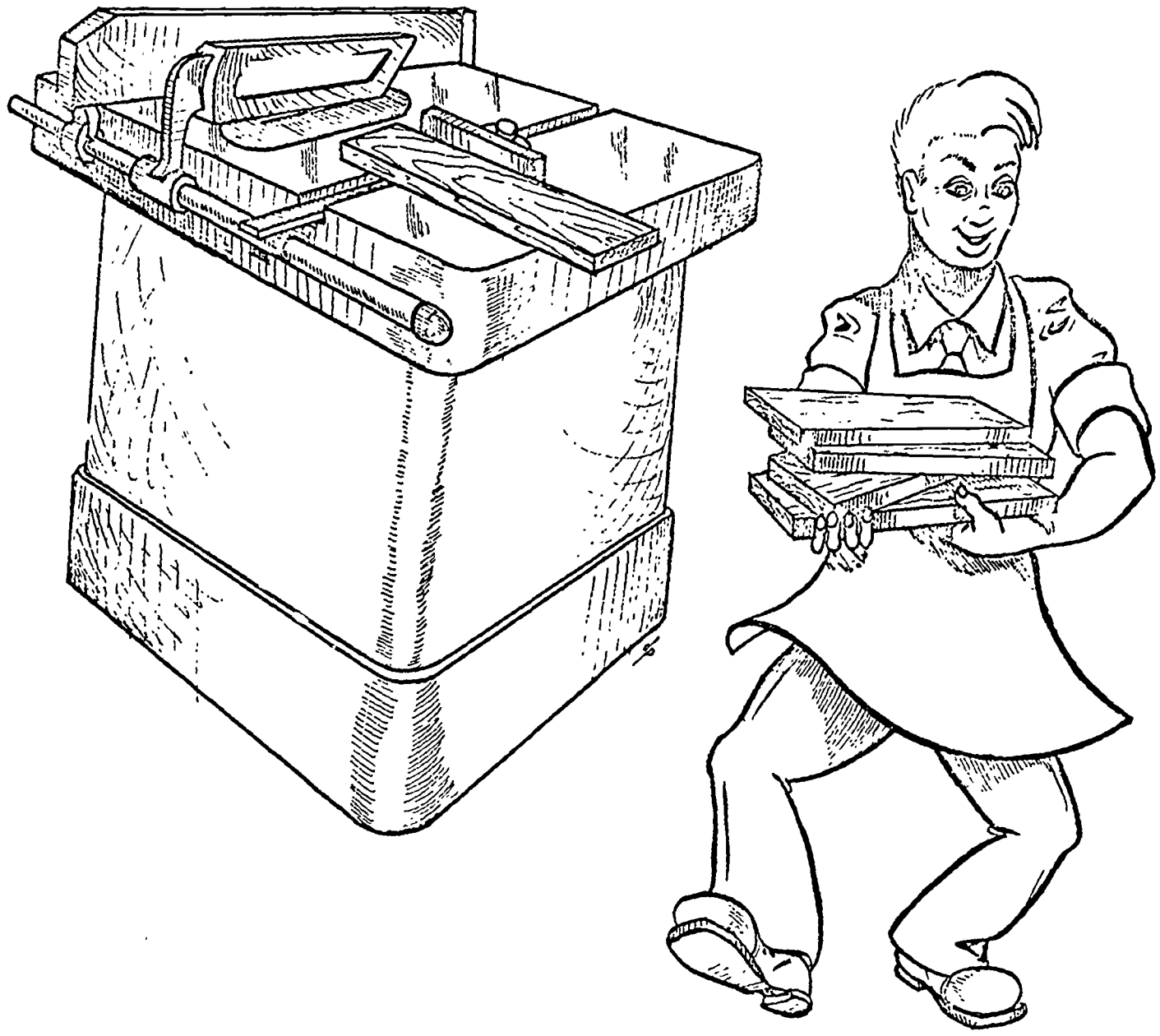


Fig. 43

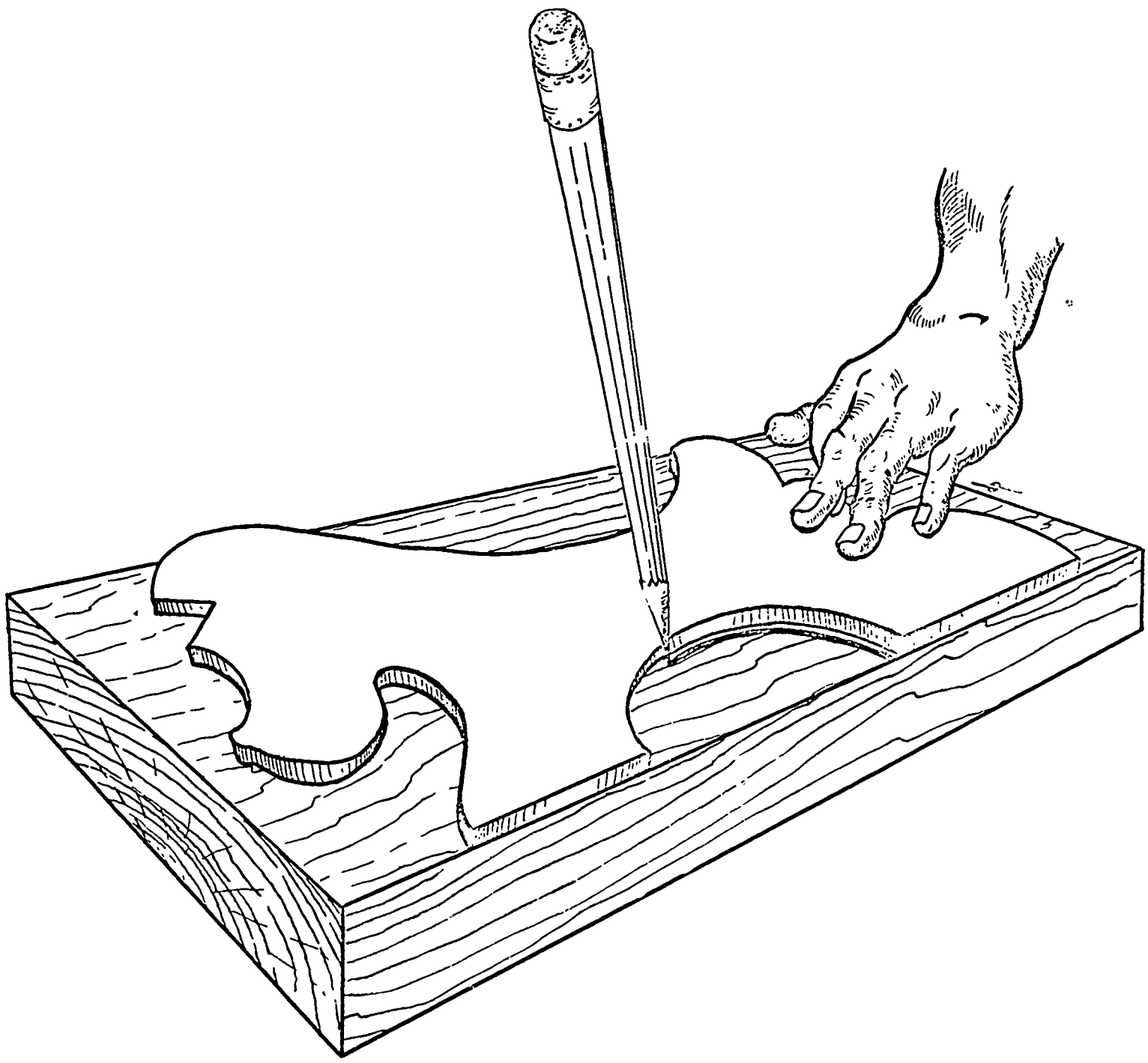


Fig. 44

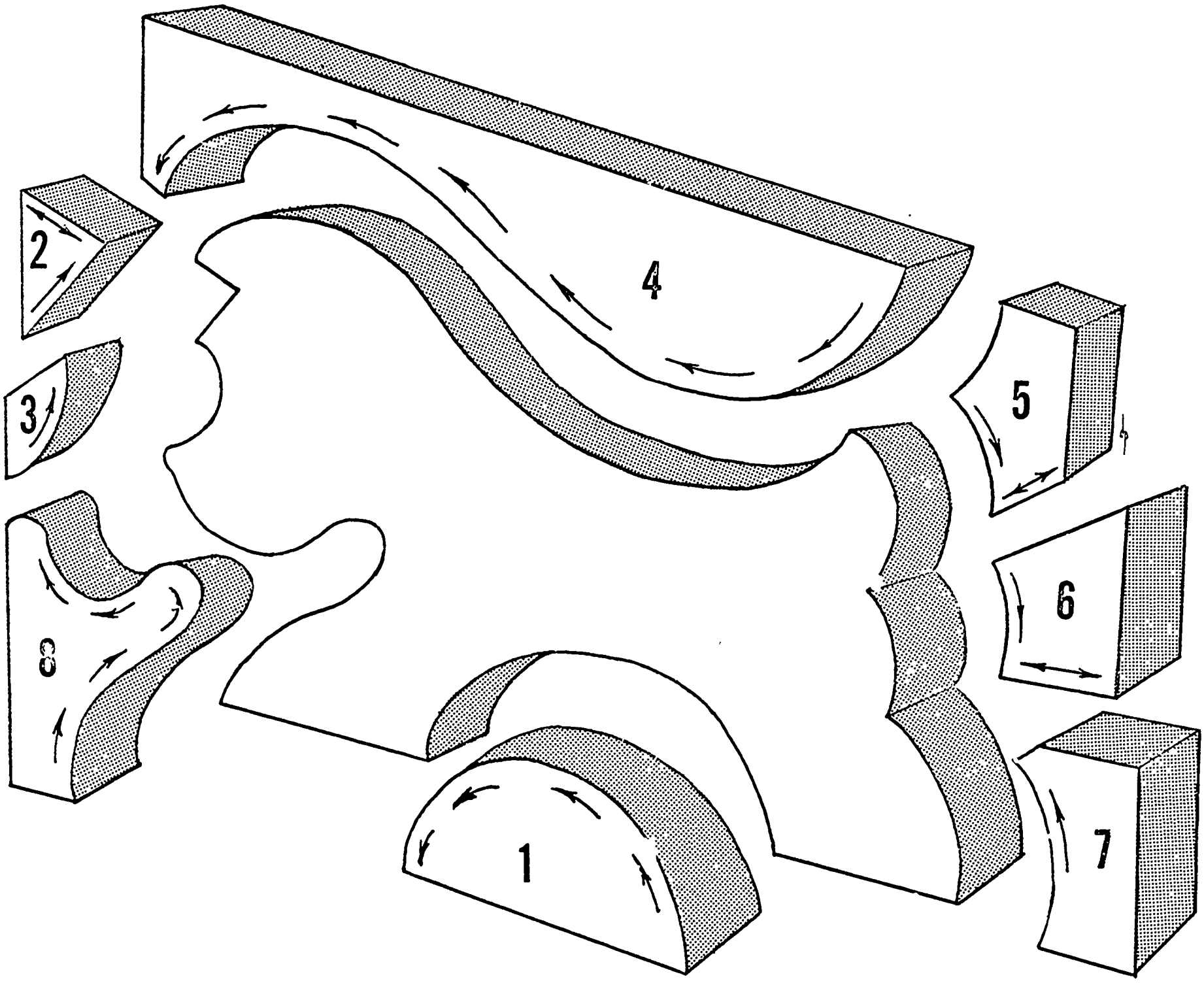


Fig. 45

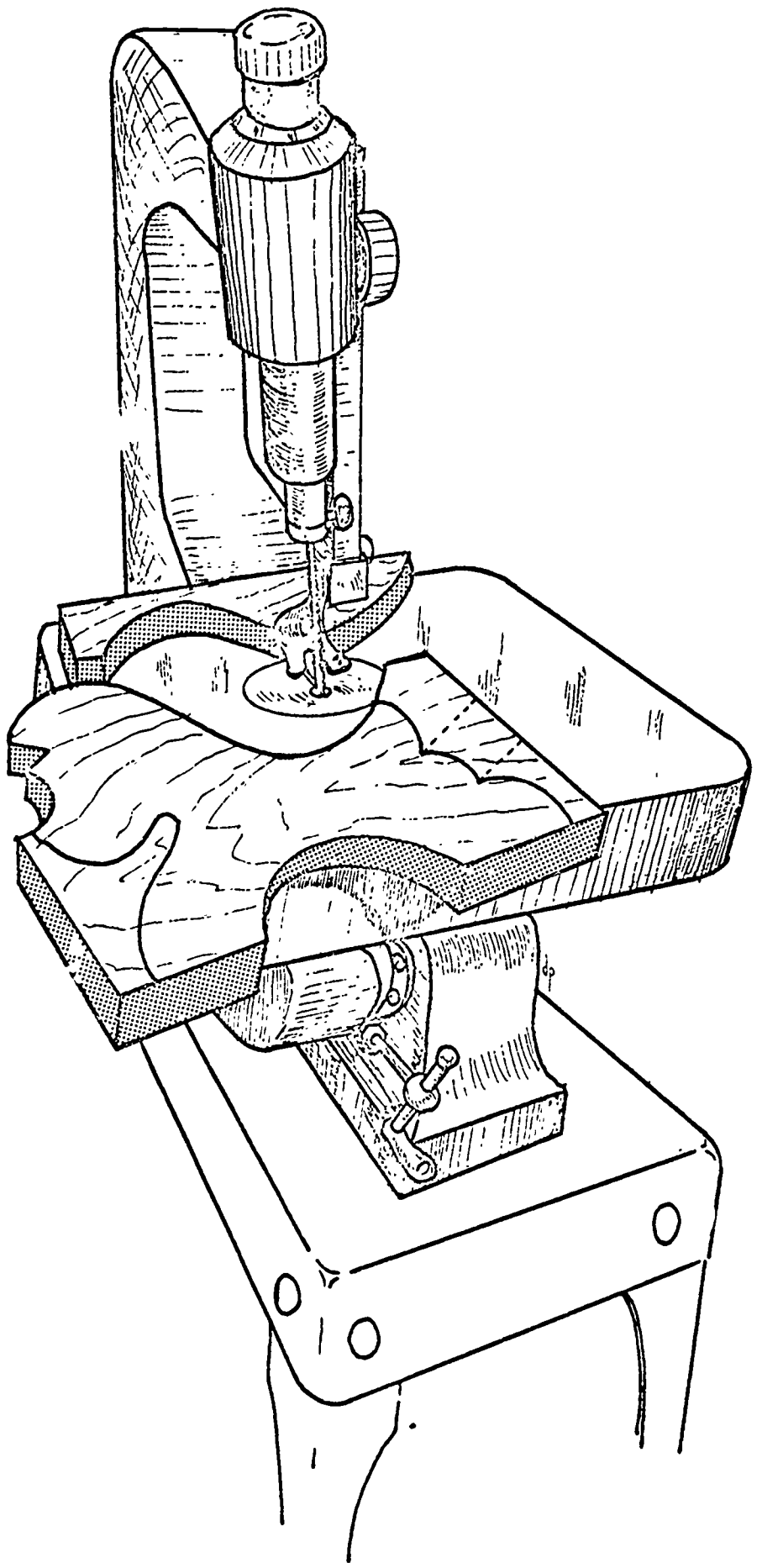


Fig. 46

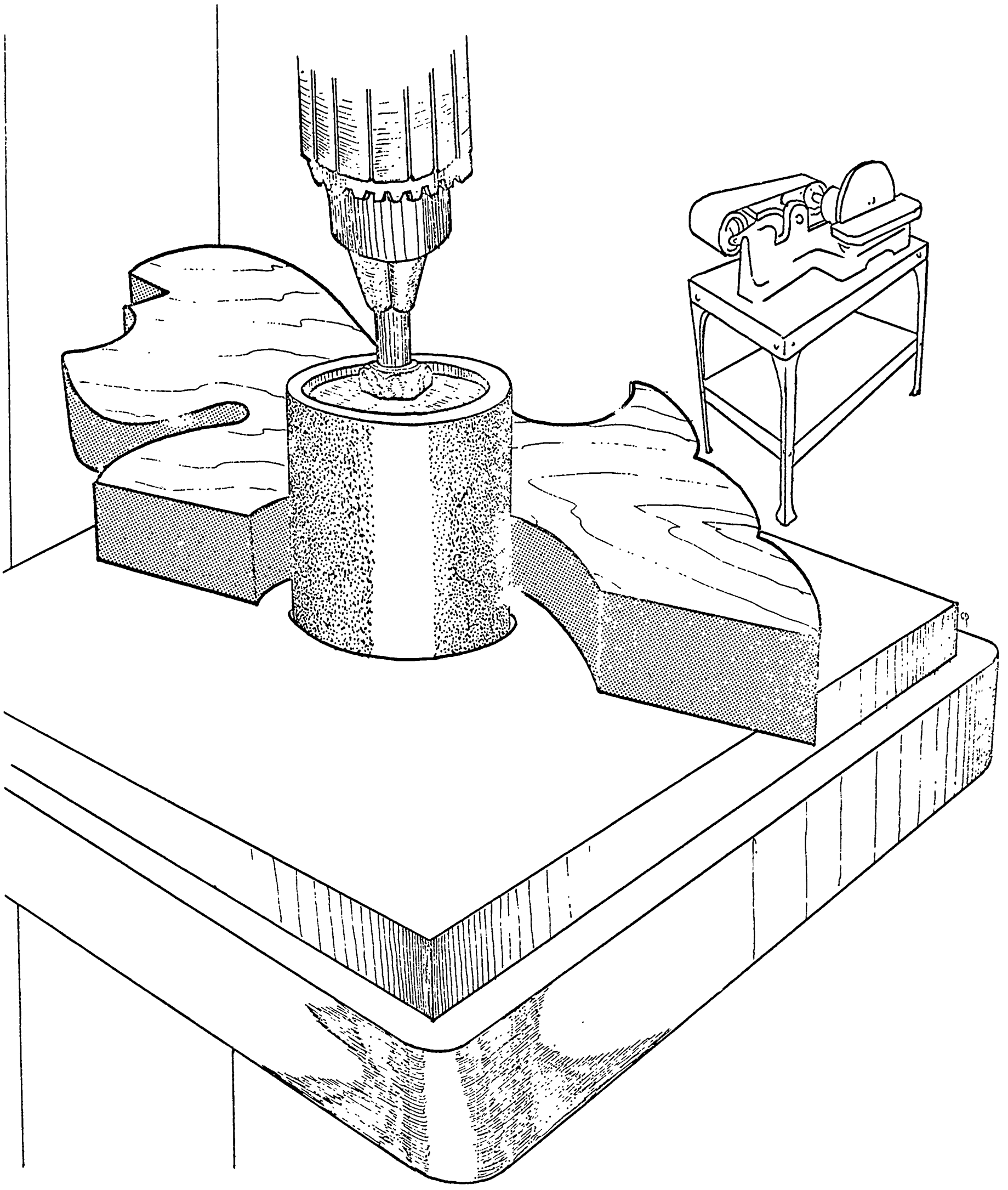


Fig. 47

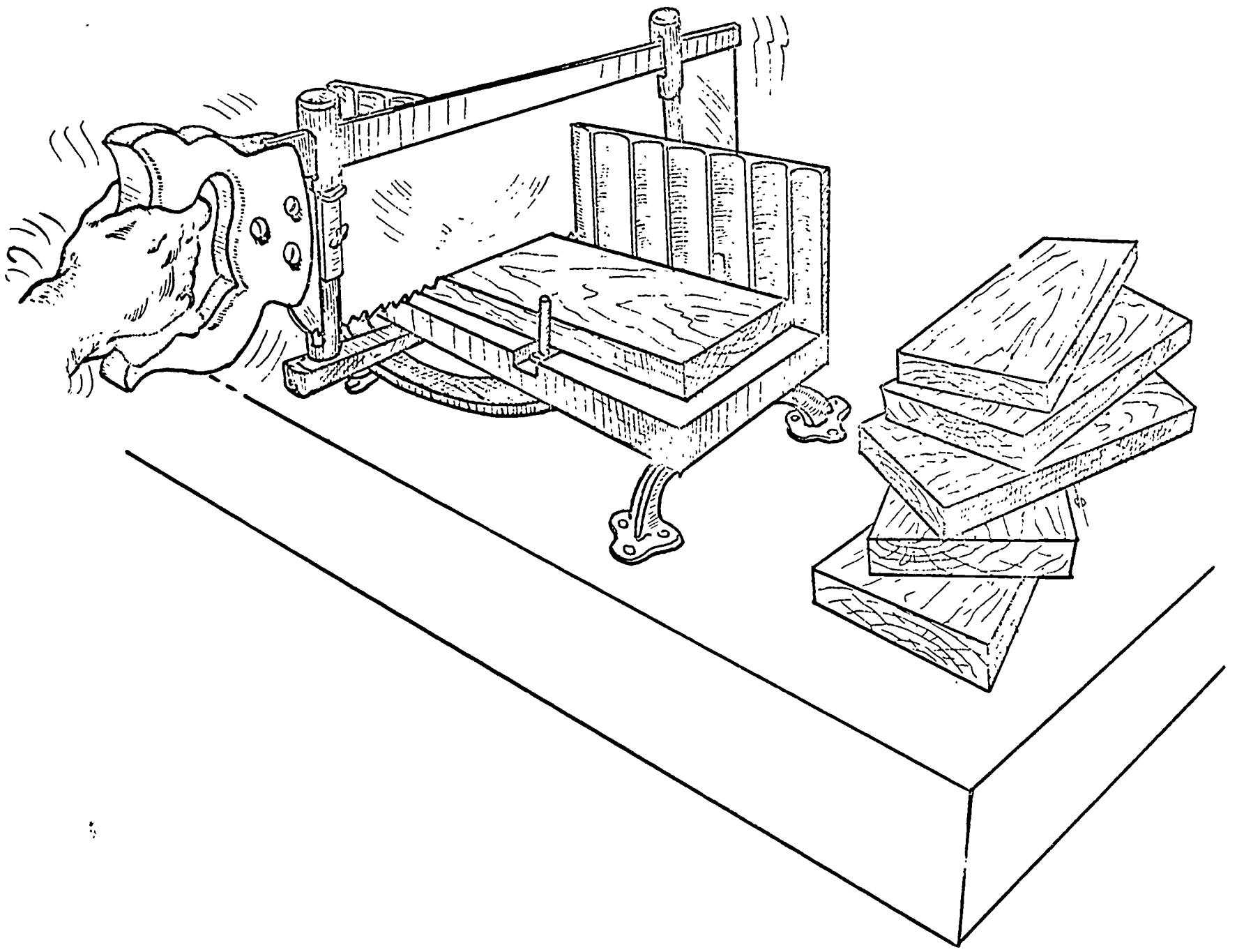


Fig. 48

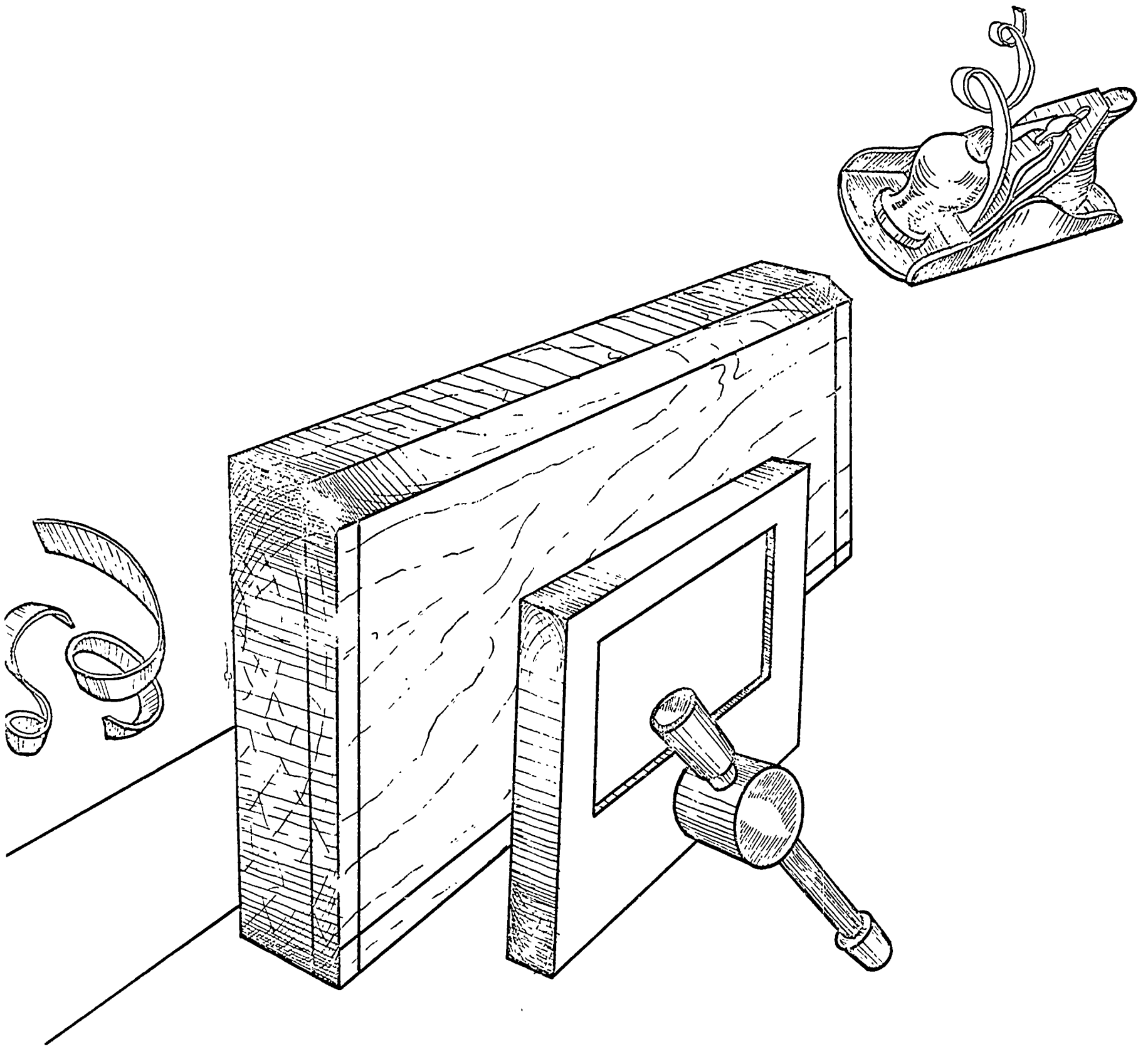


Fig. 49

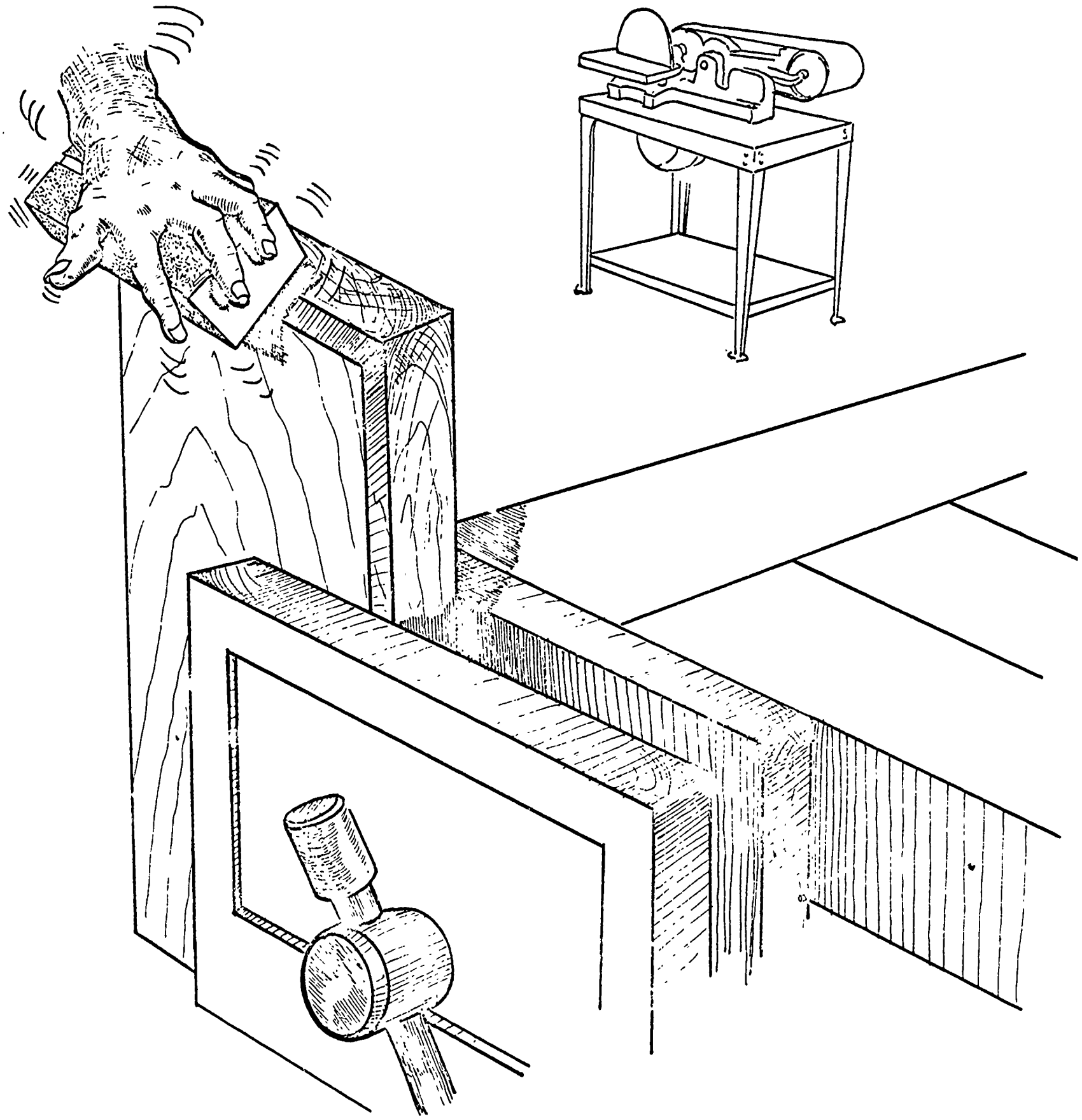


Fig. 50

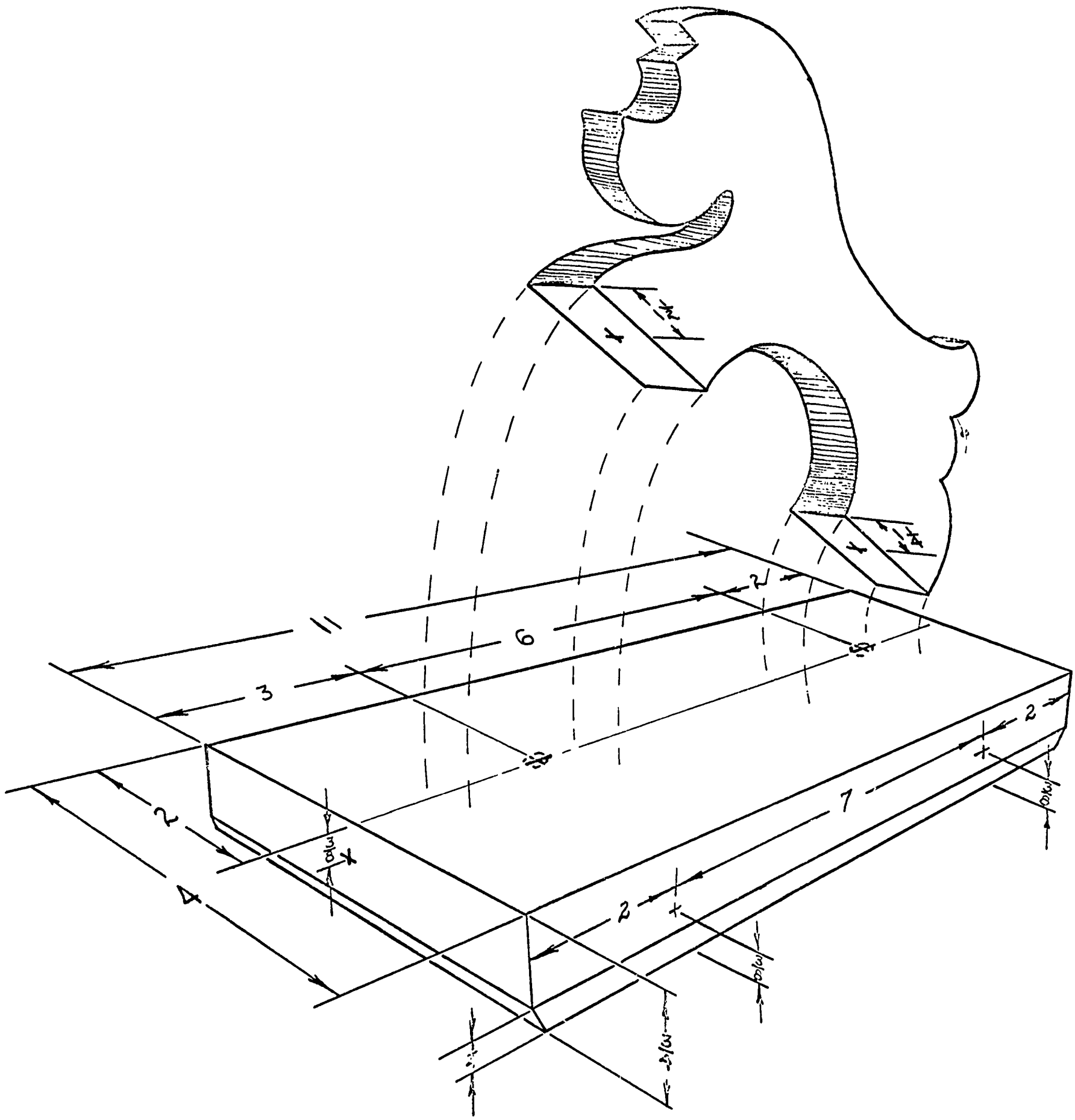


Fig. 51

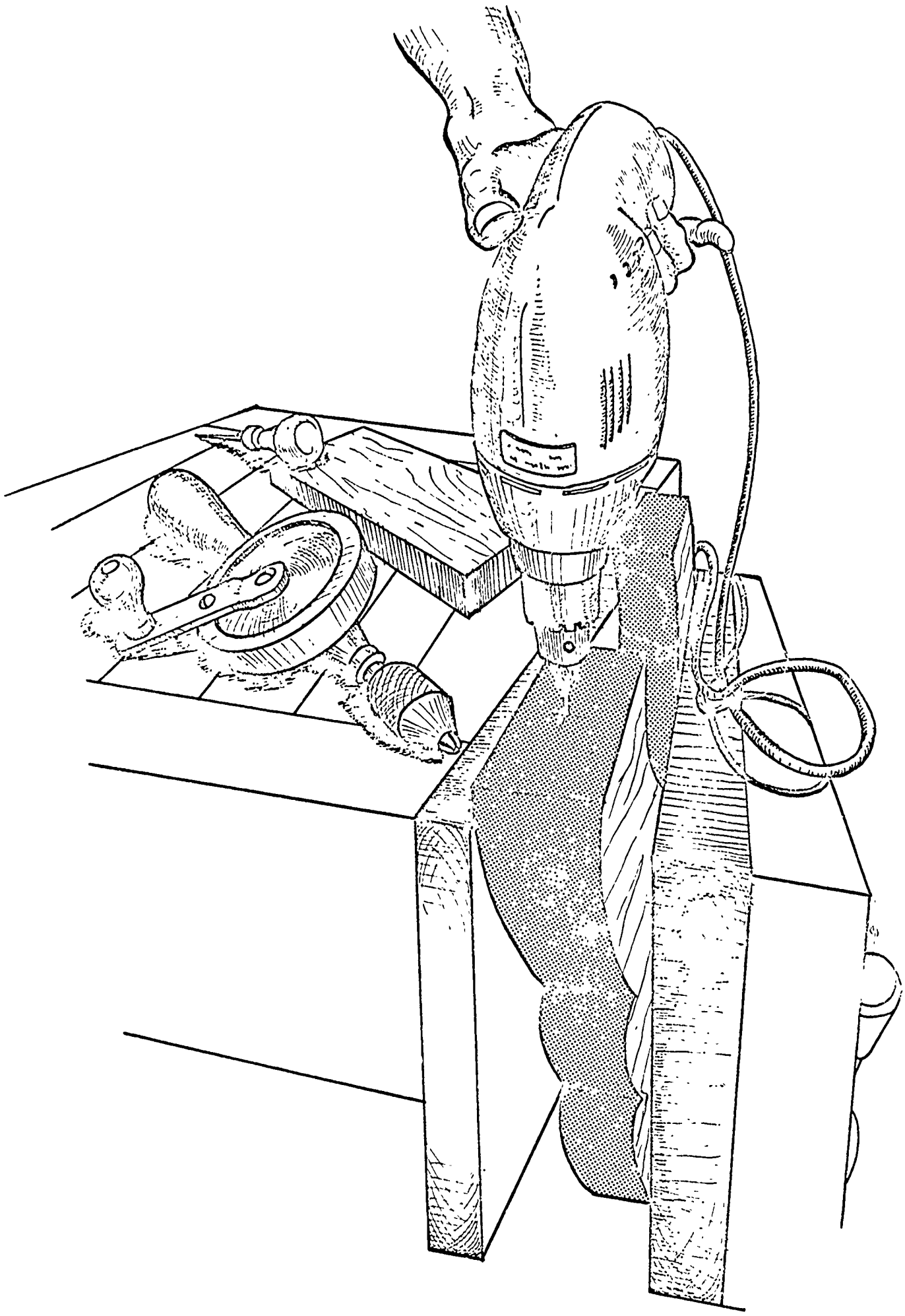


Fig. 52

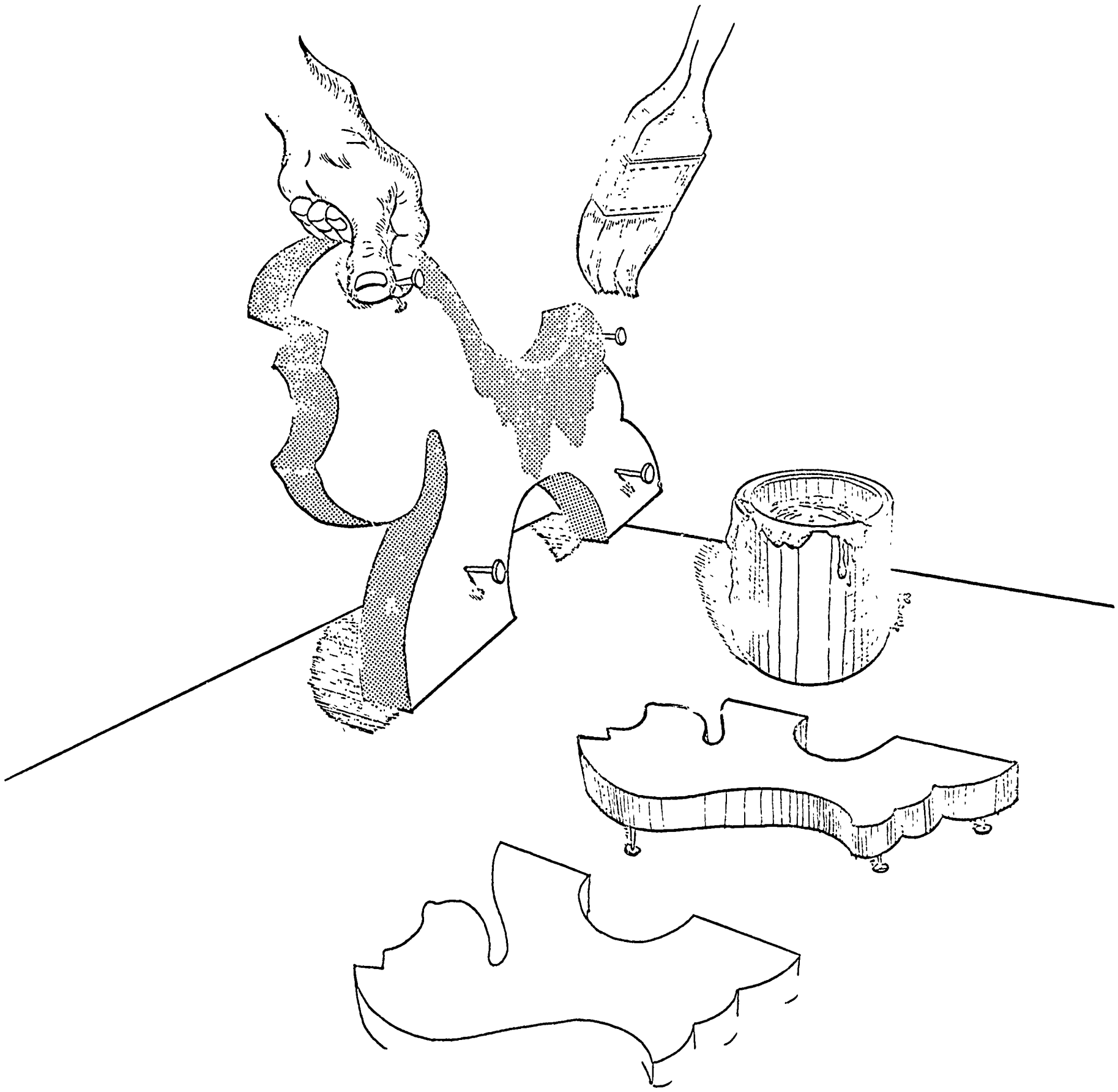


Fig. 53

Fig. 54

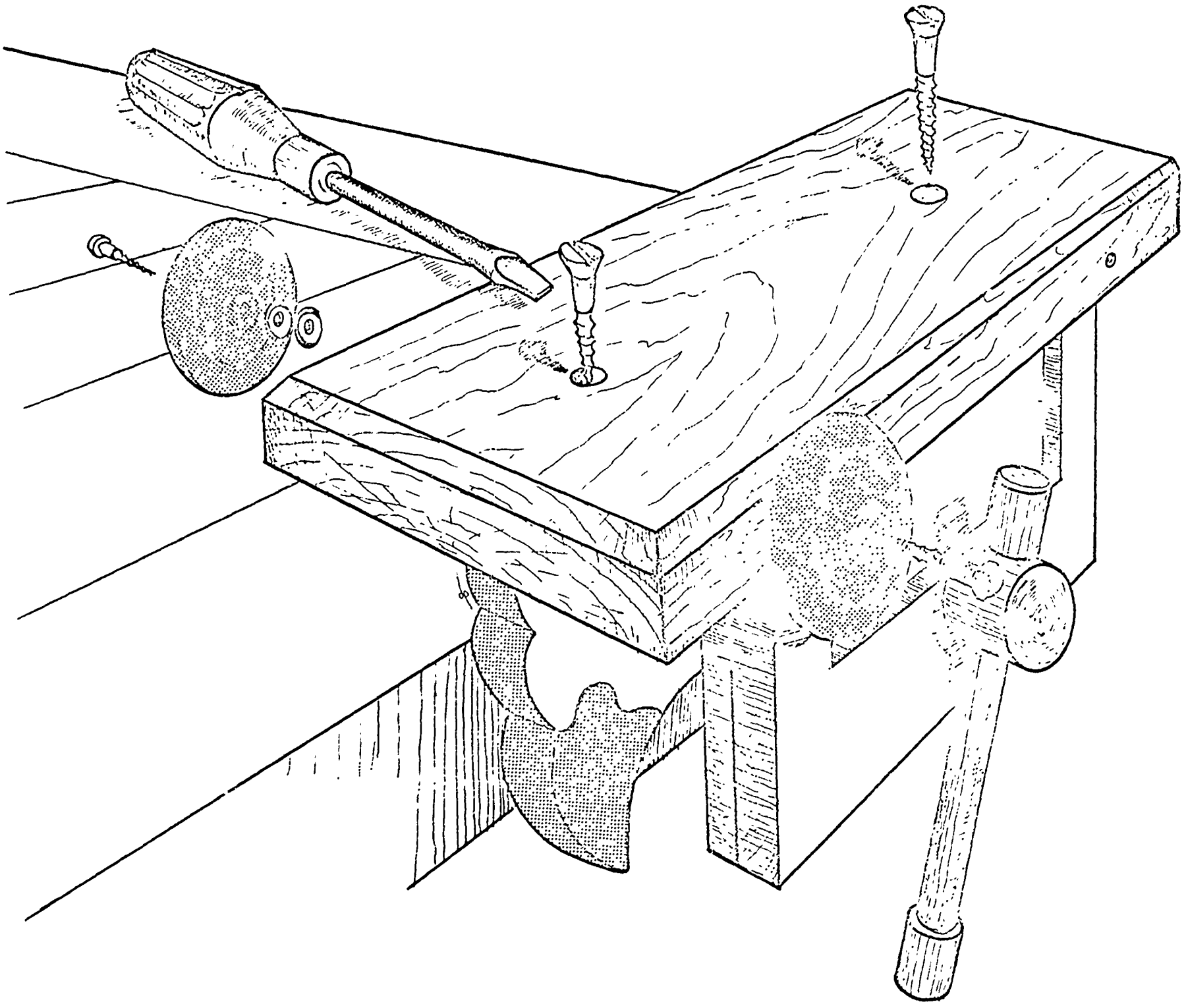


Fig. 55

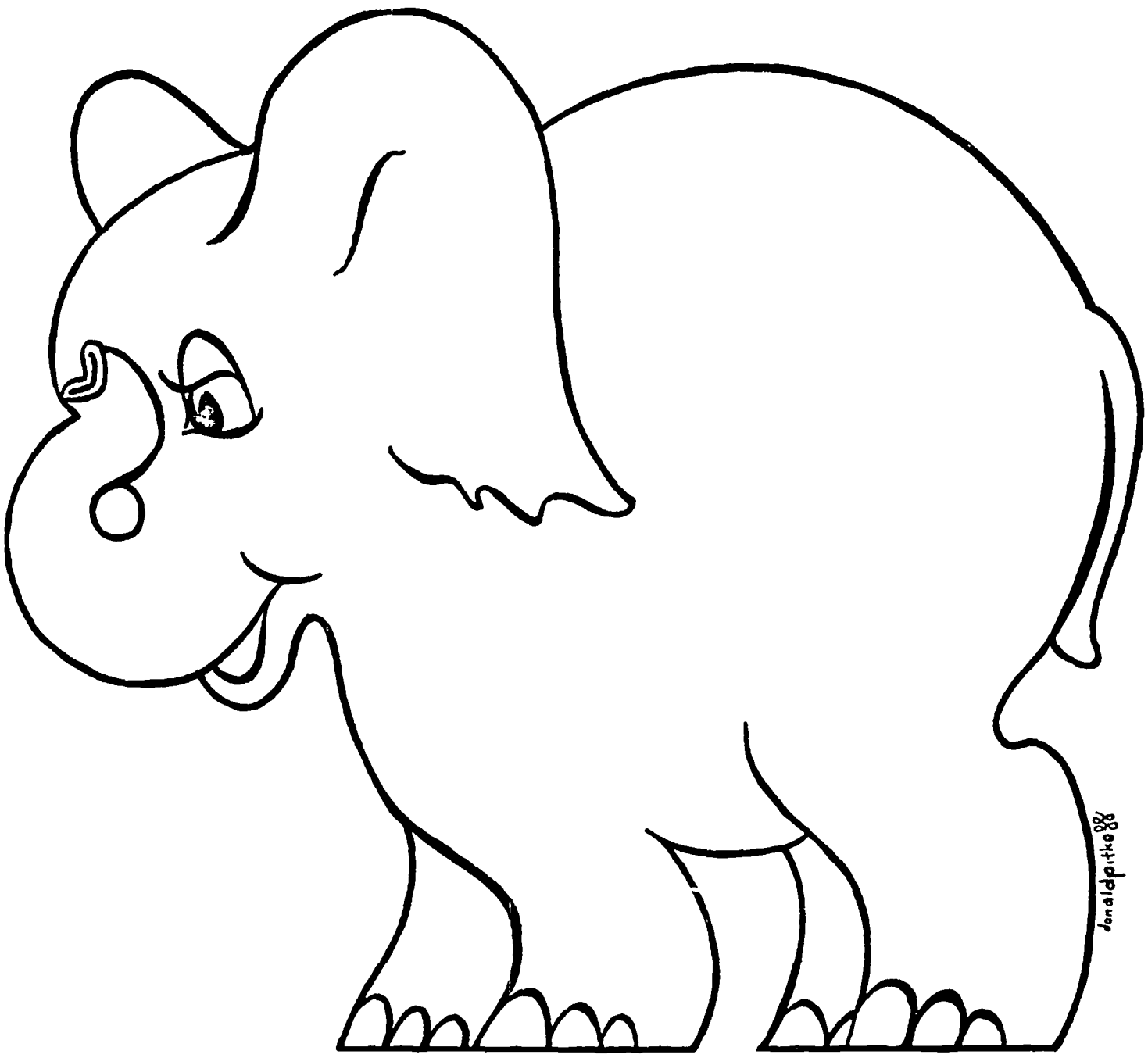
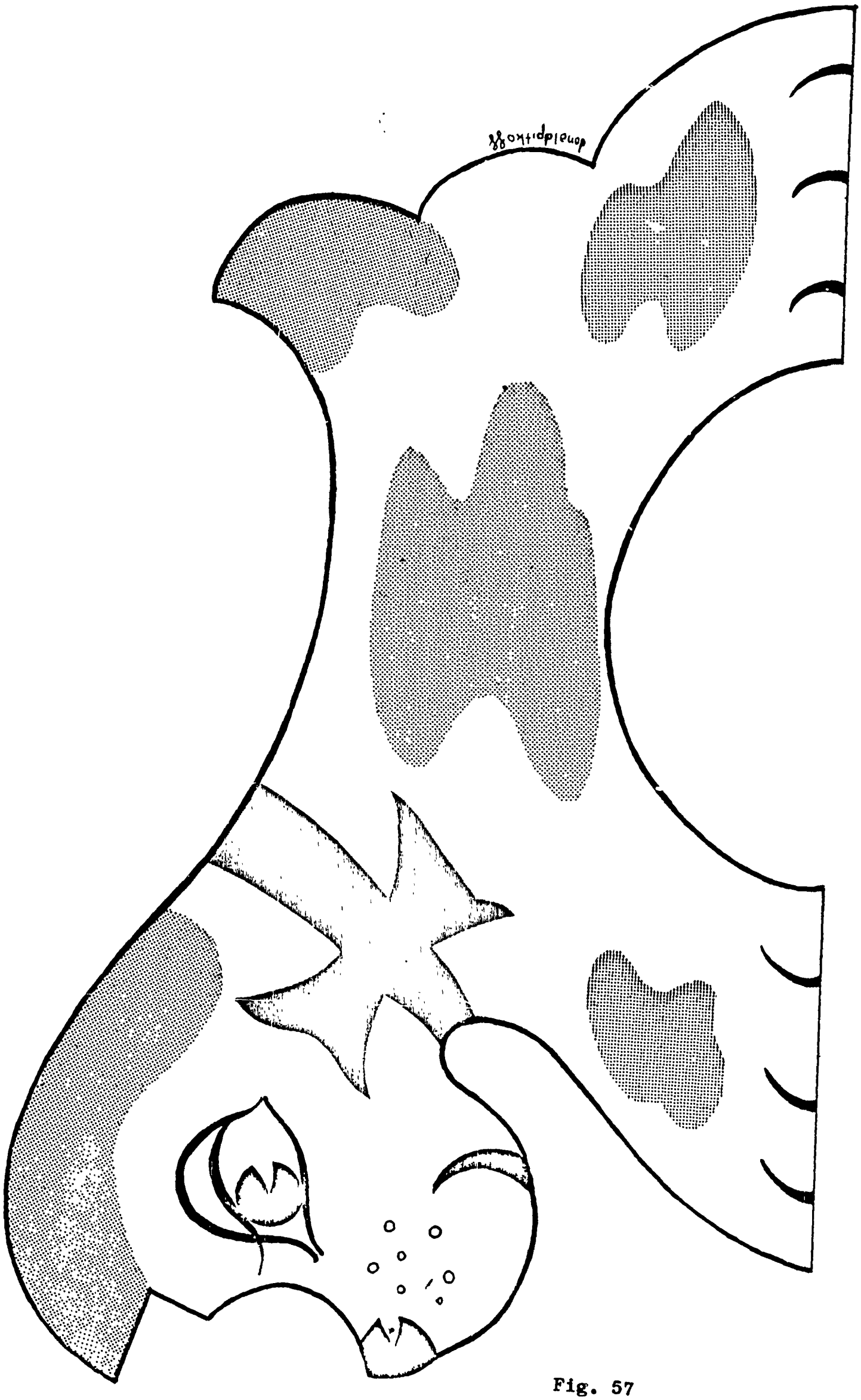


Fig. 56



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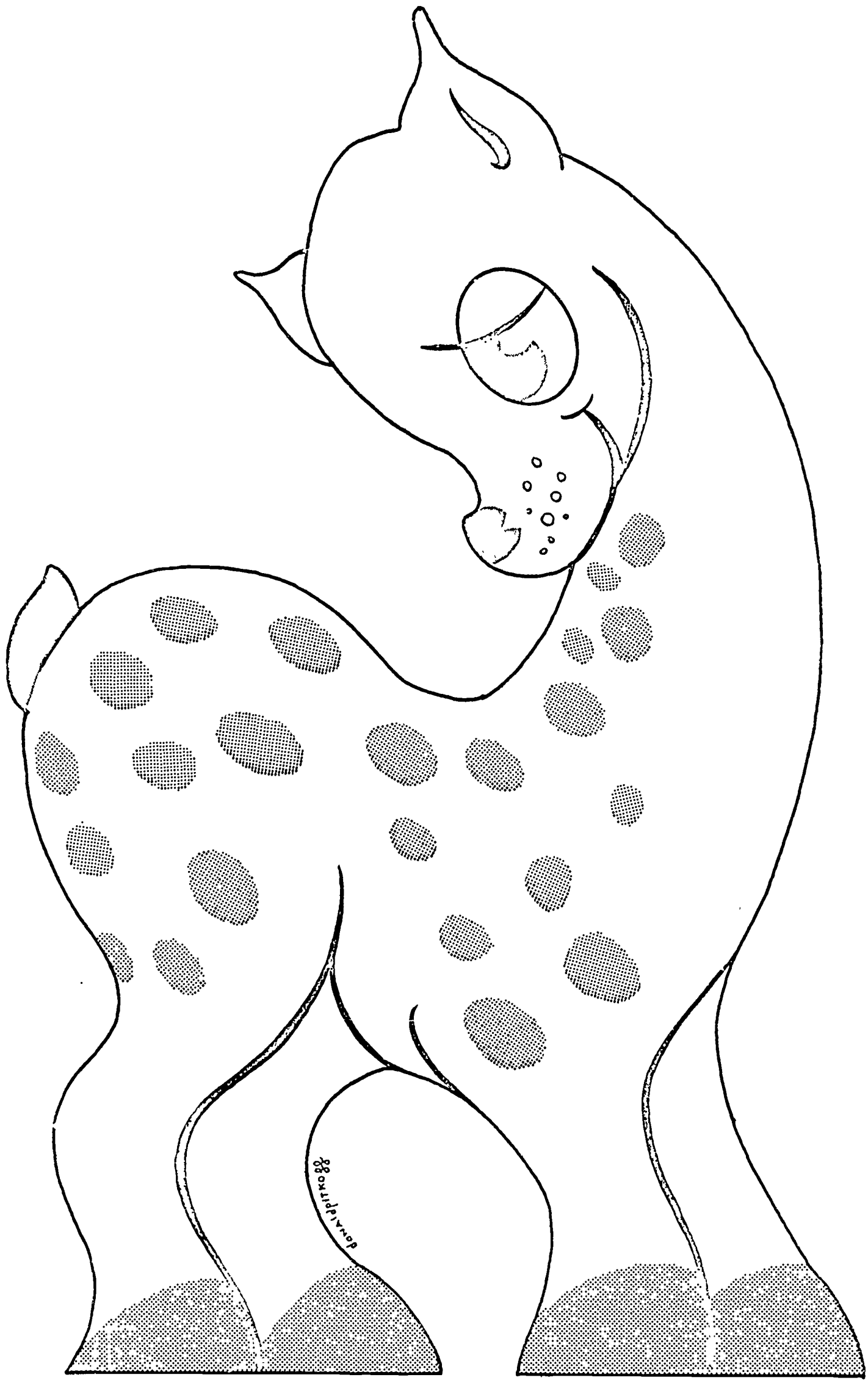

Fig. 56

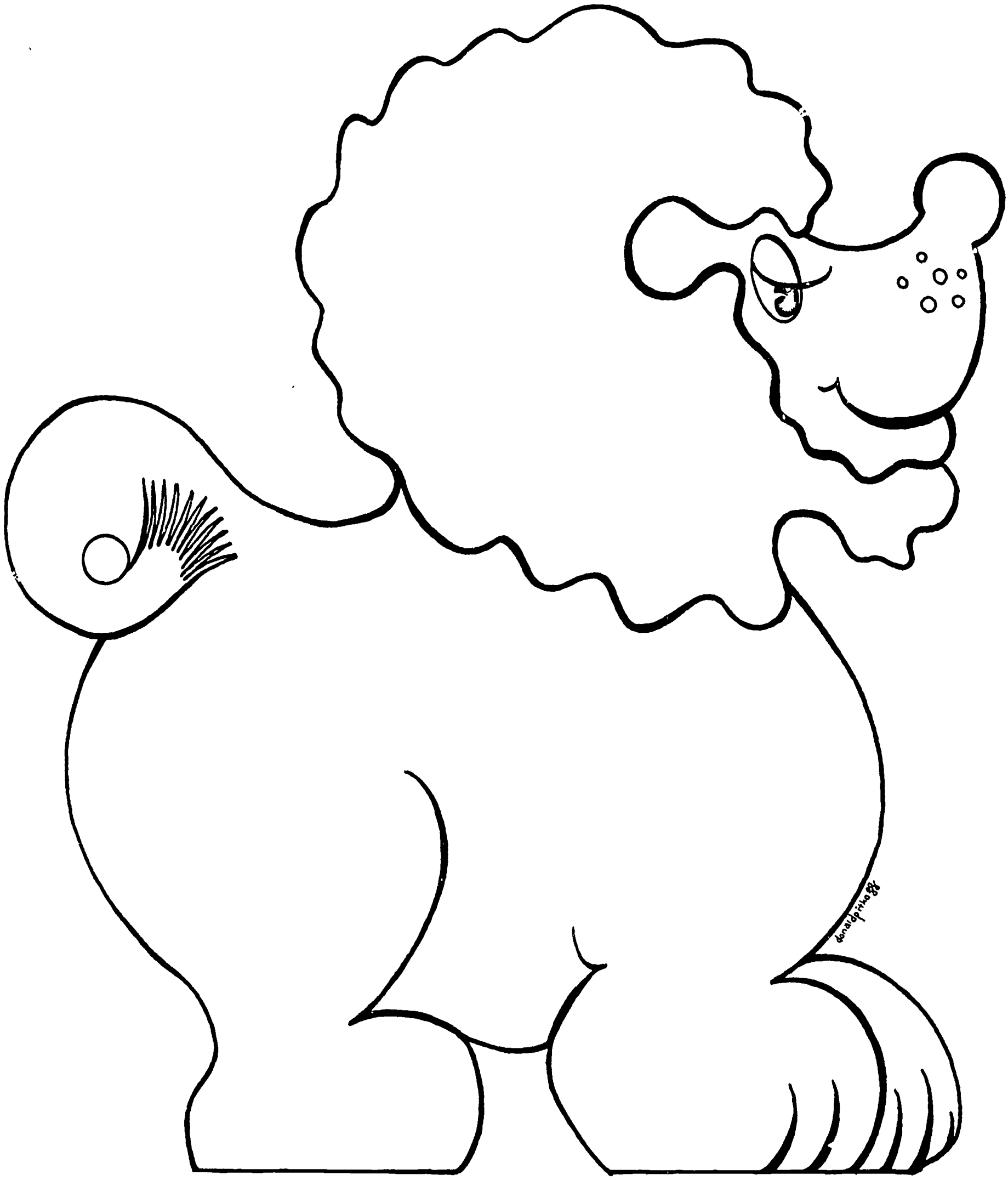

Fig. 59

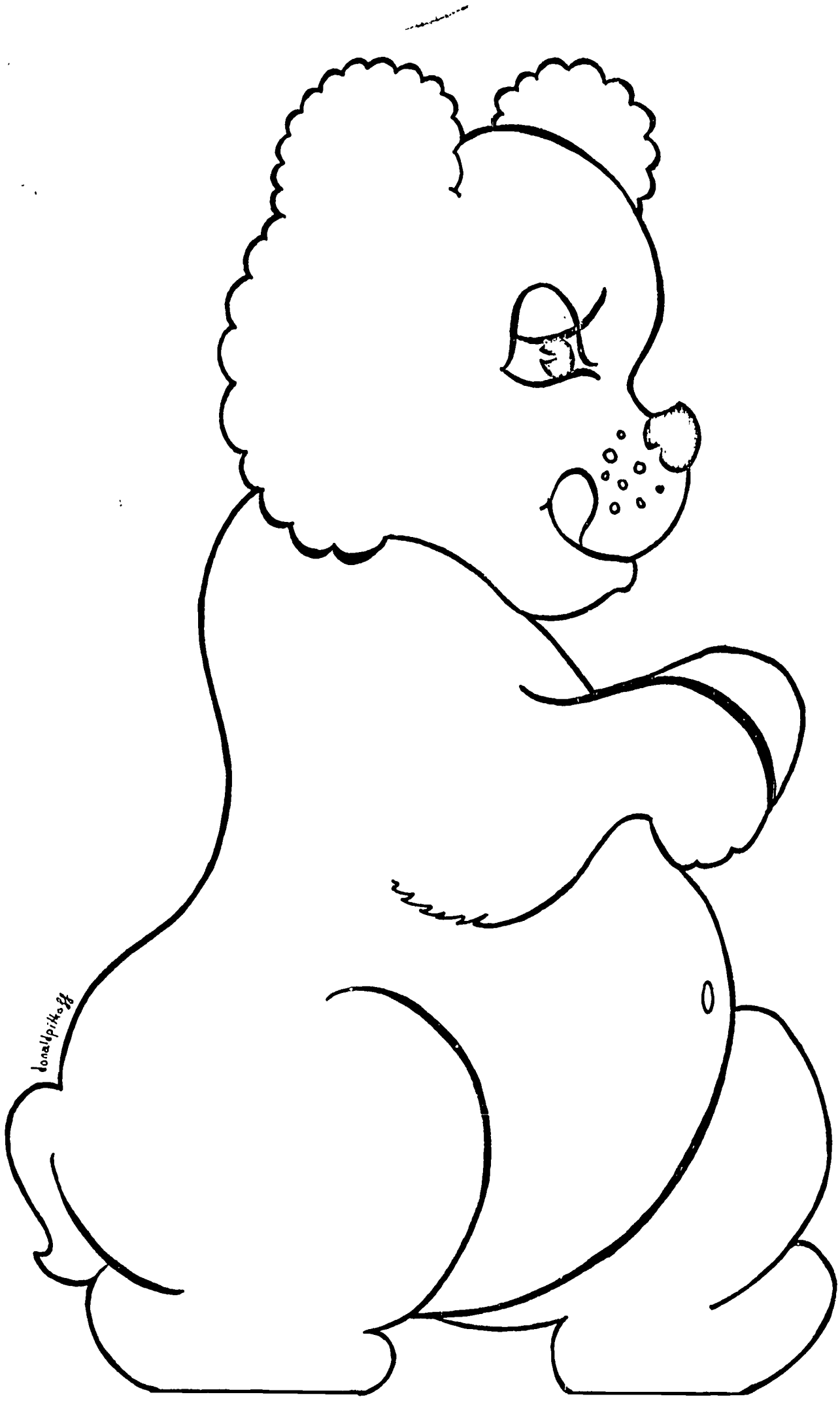

Fig. 60

- A R E A # 2 -

BUILDING CONSTRUCTION AND MAINTENANCE

This area of instruction is planned to interest the Career Guidance pupils in the building industry which provides employment for so many people in the city. The industrial arts experiences suggested in this area will offer basic instruction in building construction and maintenance, and will also offer occupational information and academic learnings related to the building industry.

Three units of instruction and suggested resource lessons for each unit have been developed to aid the teachers.

Unit I. Building Construction

Resource Lessons

1. Laying out the Dimensions for a Two-Room Apartment
2. Constructing the Foundation Platform
3. Framing a Wall
4. Sheathing a Wall

Unit II. Building Maintenance

Resource Lessons

1. Cutting a Pipe to Length
2. Threading Pipe
3. Installing a Waste Pipe and Trap
4. Using a Smooth Jaw Adjustable Wrench

Unit III. Urban Gardening

Resource Lesson

Making a Pebble Tray

UNIT I.

BUILDING CONSTRUCTION

To implement this unit, it is suggested that the teacher plan to construct a modified two-room apartment in the school shop, using the sub-contracting method. Organize committees of pupils to represent the various phases of the building construction industry, i.e., foundation builders, electricians, plumbers, carpenters, etc. The sub-contracting method, parallels the building procedures used in the building industry and also offers every pupil an opportunity to engage in activities best suited to his capabilities and interests.

Operations and Processes to Be Taught

1. Building a foundation

    a. Lay out of outer dimensions

    b. Lay out, prepare, and install the sill, box headers, floor joists, bridging, and subflooring

2. Building a Wall Frame

    a. Lay out, prepare, and install the sole plate, studs, top plater, window and door framing

    b. Construct wall braces and the framing for plumbing

3. Sheathing a Wall

    Prepare and install the exterior sheathing

4. Window and Door Installation

    a. Install the window

    b. Install the exterior door framing

5. Siding Installation

    a. Install several courses of brick veneer

    b. Install wood siding and wood shingle

6. Electrical Installation

    Lay out and install electrical equipment on a separate fused circuit for each room

    a. Kilowatt hour meter

    b. Two outlets in each room

    c. A ceiling fixture in each room

d. A wall switch in each room

7. Interior Wall and Ceiling Installation

a. Install interior wall and ceiling finish, such as, plaster board, sheet rock, plaster, etc.

b. Complete the trim of interior walls, window, and door frames (after the finish floors have been completed)

8. Floor Covering

Install appropriate finished floor materials

a. Vynil Tile

b. Ceramic Tile

c. Carpeting

9. Plumbing

a. Install a sink

b. Install a flush tank

10. Painting and Wall Papering

a. Paint several walls and ceilings

b. Paper several walls

c. Panel several walls

Materials, Tools, and Equipment

1. Materials and Supplies:

lumber (2"x4"s, 2"x10"s, 1"x3"s, etc.)
nails of assorted types and sizes (base and ceil-
windows and doors, including trim (ing moldings
sheathing
BX cable, switches, receptacles, boxes, Kilowatt hour Meter,
fuse box, ceiling fixtures, etc.
sink, flush tank, pipes, fittings, etc.
floor finishes (tile, wood, carpet)
interior paint, wallpaper, etc.

2. Basic Hand Tools:

rulers (steel, flexible, zig-zag)
squares (try, framing)
saws (crosscut, rip, keyhole, coping, hack)

hammers (assorted claw hammers)
hatchet
nail sets
brace and bits (short, long expansive)
drills (hand,electric)
twist drills of varied sizes
chisels (assorted sizes and types)
clamps ("C", cabinet, bar)
screwdrivers (straight, phillips, etc.)
pliers (electricians, combination, round nosed)
wrenches (adjustable, open end, box, pipe)
level and plumb bob

3. Specialized Tools and Equipment

The need for specialized tools and equipment depends upon the materials used. For example, asphalt floor tile installation requires small toothed trowels; wall papering requires a paste brush, smoothing brush, rollers, etc.; painting requires rollers, brushes, etc.; brick laying requires pointed trowels, mortar trough; etc.

Academic Learnings

1. Mathematics

a. Application of the Pythagorean Theorem

b. Application of tables, scales, etc.

c. Conversion of linear units (inches to feet, feet to inches)

d. Angle measurements

e. Calculating costs, orders, etc.

f. Units of measure (board foot, cubic foot, gallons, quarts, pints)

g. Surface area computations

h. Keeping time sheet, calculating wages, deductions, etc.

i. Writing checks, keeping books and records

j. Concepts of size, shape, relationships, etc.

2. Science

a. Chemical reactions in concrete, plaster, clay

b. Effects of moisture on various materials, insulations, etc.

c. Stress, strain, strength of materials

d. Electricity (source, type, voltage, amperage, use, grounding, parallel and series circuits and combinations)

e. Glass (production, properties, uses)

f. Soft woods and hard woods

g. Ventilation (its necessity and implementation)

h. Properties of lumber, metal, asphalt, rubber, paint, etc.

i. Fire (prevention and control)

3. Language Arts

a. Notetaking

b. Following oral and written directions

c. Preparing progress reports

d. Giving directions, reporting, discussing

e. Reading instructions on the use of materials, equipment, etc.

f. Reading labels on containers

g. Writing an order for materials, supplies, etc.

4. Social Studies

a. Living with others in a city apartment

b. Respect for the rights and privileges of others

c. Labor unions

d. Local, State and Federal laws related to work

e. Wages, housing, civil rights, taxes

5. Guidance

a. Occupational studies of the various trades

b. Applying for a job

c. Getting along with others on the job

d. Further educational opportunities

Personal Developments

1. Working and getting along with others

2. Developing a sense of pride and responsibility

3. Respect for authority (Building laws)

4. Developing dependability

Audio-Visual Materials

1. Educational Film Guide, Filmstrip Guide, H. W. Wilson Company, 950 University Avenue, New York, N.Y.

2. Caterpillar Tractor Company, Advertising Dept., Peoria, Illinois

3. Cornell Tractor Company, 1501 Broadway, New York, N.Y.

4. Veneer Association, 600 South Michigan Avenue, Chicago 5, Illinois

5. Western Pine Association, Yeon Building, Portland, Oregon

6. Aids to Educators, Educational Relations Staff, General Motors Corp., Warren, Michigan

7. Educational Materials, National Association of Manufacturers, 2 East 48th Street, New York, N.Y.

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2. National Committee on Wood Utilization, Light Frame House Construction, U.S. Department of Health, Education and Welfare, Washington, D. C., 1956

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9. Simmons-Boardman Publishing Corp., American Builder, Emmett Street, Bristol, Connecticut

Laying Out the Dimensions for a Two-Room Apartment

(Suggested Resource Lesson 1)

Material and Tools:

folding ruler
snap chalk line and chalk
framing square

Visual Aids:

floor plans

Motivation:

1. Introduce the idea of constructing a two-room apartment in the shop by discussing the educational values and the satisfaction to be gained from participation in such a project.

2. Ask the question, "How shall we start the construction"?

Procedure:

1. Plan and start the construction of the two-room unit with the pupils.

   a. Lay out the outer dimensions for the unit.

   b. Measure in 3' from the wall of the shop and make chalk marks on the floor 10' 8" apart.

   c. Use the snap chalk line for a straight line layout.

   d. Use the framing square at each end of the line to lay out right angles.

      (1) Locate the center of the 10' 8" line and indicate the partition wall.

      (2) Lay out a right angle with the framing square.

   e. Lay out 4' outer wall lines and partition wall line with the snap chalk line method.

   f. Make the fourth side layout by connecting the outer wall lines with a snapped chalk line.

   g. Determine the squareness of the layout by means of diagonal equality or Pythagorean Theorem.

      (1) Measure diagonals for equality.

      (2) Measure along one side a distance in 3' units and, along the adjacent side, the same number of 4' units.

(The hypotenuse should measure an equal number of 5' units if the layout is square.)

2. Have the pupils proceed to lay out the floor plan of the two-rooms and check for squareness.

Outcomes:

1. Manipulative skills learned:

   a. Use of the folding ruler

   b. Use of the snap chalk line

   c. Use of the framing square

2. Safety practices learned:

   All tools and materials, such as, the snap chalk line, the folding ruler and the framing square, should be used with care.

3. Academic Learnings:

   a. Mathematics

      (1) Linear measurement

      (2) A quadrilateral is a rectangle if the diagonals are equal

      (3) A quadrilateral is a rectangle if the diagonal forms a right triangle with the two adjacent sides

      (4) A triangle is a right triangle if the ratio of the adjacent sides and hypotenuse is 3:4:5

   b. Mechanical Drafting

      (1) Reading a working drawing

      (2) Making a scaled drawing

   c. Language Arts

      (1) Following verbal instructions

      (2) Understanding written directions

      (3) Vocabulary

chalk	partition	measure
square	angle	connect

d. Social Studies

(1) Working with other people

(2) Understanding and appreciating labor and management problems

Assignment:

Ask the pupils to collect pictures of various types of floor plans for houses and apartments and to keep them in their notebooks for reference and study.

Reference:

Anderson, L. O. and Heyer, O. C., Wood Frame House Construction, Agriculture Handbook #73, U.S. Department of Agriculture, Washington, D.C. 1955

Constructing the Foundation Platform

(Suggested Resource Lesson 2)

Materials and Tools:

2"x10" timber	claw hammer
framing square	8 penny nails
crosscut saw	16 penny nails
folding ruler	24 penny nails
	1"x3" lumber

Visual Aids:

floor plans
working drawings
charts showing detailed sketches of each step of the construction of the foundation

Motivation:

1. After the outer dimensions have been drawn, describe the principles of sturdy construction and the proper sequence of construction techniques.

2. Ask the class the following questions:

   a. "Why should heavy timber be used for the sill and box headers?"

   b. "Why should the joists be placed 16" center to center?"

   c. "What are the advantages of diagonal sub-flooring?"

Procedure:

1. Plan to lay out, prepare, and install the sill with the help of the pupils.

   a. Select 2"x10" timber for the sill.

   b. Lay out two 10' 8" pieces. (Use the folding ruler and framing square.)

   c. Cut pieces for the sill to length with the crosscut saw.

   d. Lay out the two end pieces to fit.

   e. Cut the end pieces to length with the crosscut saw.

   f. Place the sill pieces on the floor so that the outer edges are in line with the outer chalk lines.

   g. Toenail the butt joints with 8 penny nails.

   h. Test for squareness.

2. Lay out, prepare, and install the header and edge joists to form the box headers.

   a. Allow 3/4" of sill for sheathing.

   b. Lay out the header and edge joists.

   c. Cut to length.

   d. Install the header joists according to the plan.

   e. Toenail the headers to the sill and to each other with 16 penny nails.

   f. Test for squareness.

3. Lay out, prepare, and install the floor joists.

   a. Lay out the floor joist master.

   b. Determine the number of floor joists required and, using the master floor joist, lay out the other floor joists.

   c. Cut the floor joists to length.

   e. Install the floor joists. (16" center to center)

   f. Test for squareness.

   g. End nail the floor joists to the header joists with 24 penny nails.

4. Lay out, prepare, and install cross bridging.

   a. Lay out the cross bridging on the 1"x3" stock.

   b. Cut pieces for cross bridging to length.

   c. Mitre the ends of the cross bridging pieces at the proper angle to fit diagonally between the joists at the midspan.

   d. Nail the cross bridging in place at each junction with two 8 penny nails.

5. Lay out, prepare, and install the sub-flooring.

   a. Select the type of sub-flooring technique to be used.

   b. Layout as per selection of type.

   c. Cut the sub-flooring to lengths required.

   d. Install sub-flooring with appropriate nails.

6. Have the pupils review all the steps taken.

Outcomes:

1. Manipulative skills learned:

   a. Use of the folding ruler and framing square

   b. Use of the crosscut saw

   c. Use of saw horses

   d. Use of the claw hammer in straight nailing and toenailing

   e. Testing for squareness

   f. Cutting stock on an angle

2. Safety practices learned:

   a. Lumber should be carried with care.

   b. When lumber is cut on saw horses, the end being cut off should be beyond the second saw horse to prevent the board from binding or falling.

   c. When sawing lumber the free hand should be away from the saw teeth to avoid injury.

   d. When using a hammer, it is important to ascertain that the head is firmly attached to the handle.

   e. Care should be taken when hammering nails to avoid striking fingers.

3. Academic learnings:

   a. Mathematics:

      (1) Linear measurement

      (2) Concepts of length, width, and thickness

      (3) Angle measurement

      (4) Penny weight measurement of nails

   b. Language Arts:

      (1) Vocabulary:

sill	crosscut
toenail	sheathing
header	joists
bridging	midspan

c. Science:

(1) The Tree - Its growth and structure

(2) Steel - Its sources and production

d. Health Education:

(1) First aid for cuts, abrasions, and bruises

(2) Proper method of lifting and carrying heavy objects to avoid body strain

Assignment:

1. Ask the pupils to draw a cross section of a tree trunk and label its parts and their functions.

2. Have the pupils make a list of the different kinds of nails and to identify them according to size and penny weight.

References:

1. Anderson, L. O. and Heyer, O. C., Wood Frame House Construction, U.S. Department of Agriculture, Washington, D. C. 1955.

2. Graham, F. D. and Emery, T. J., Audels Carpenters and Builders Guide, Theodore Audel and Co., New York, 1963.

Framing a Wall

(Suggested Resource Lesson 3)

Materials and Tools:

2"x4" lumber
assorted penny weight nails
claw hammer
folding ruler
6' step ladder
framing square
try square
level
1"x3" stock

Visual Aids:

small scaled model of frame construction
chart showing window and door framing
floor plans and working drawings of the two-room unit

Motivation:

Introduce the lesson by saying, "Now that we have the foundation for our two-room unit, how shall we proceed to install the wall framing?"

Procedure:

1. Plan to build the wall frame with the pupils:

   a. Lay out, prepare, and install the sole plate on the subflooring.

   b. Construct and install the corner posts.

   c. Lay out, prepare, and install the first top plate.

   d. Determine and layout locations for the studs (16" center to center), window, and door frames.

      (1) Plan to install a window in one of the two rooms.

      (2) Plan to install a door in one of the two rooms.

   e. Lay out, prepare, and install the 2"x4" studs (16" center to center).

   f. Lay out, prepare, and install window and door frame, lintels, double studs, and double window sill.

   g. Lay out, prepare, and install the second top plates.

   h. Lay out, prepare, and install corner braces.

2. Have the pupils review and evaluate their work.

Outcomes:

1. Manipulative Skills learned:

   a. Constructing corner posts

   b. Toenailing studs

   c. Making dadoes for corner braces

   d. Using the folding ruler, crosscut saw, and claw hammer

   e. Using the level

2. Safety Practices learned:

   a. A step ladder must be carried with care.

   b. When using a step ladder, one pupil must hold the ladder for the pupil who is using it.

3. Academic Learnings:

   a. Mathematics:

      (1) The concept of "center to center" measurement

      (2) Fractions and the arithmetic functions of addition and subtraction

      (3) Estimating length of wood with Standard lumber lengths

   b. Language Arts:

      (1) Vocabulary

sole plate	braces
studs	dado
lintel	

      (2) Giving verbal instructions

   c. Science:

      (1) Stress, strain, bearing points, and leverage, etc.

      (2) Gravity and the level and plumb bob

Assignment:

Have the pupils interview a worker in the building construction trade and prepare a report with the help of the following outline:

Occupational Outline

Pupil's Name _____ Class _____

Industrial Arts Teacher _____ Date _____

Title of Occupation _____

Name of Person Interviewed _____

Trade engaged in _____

Educational Background _____

Trade Experience _____

Questions to be asked:

1. What are your duties?
2. What tools do you use?
3. What are your hours of employment, rate of pay, and seasons of employability?
4. Do you belong to a union?
5. Are opportunities for employment in your trade good?
6. Are there opportunities for advancement?
7. What advice can you give to someone who is preparing to enter your field of work?

References:

1. National Committee on Wood Utilization, Light Frame House Construction, U.S. Department of Health, Education and Welfare, Washington, D. C. 1956.

2. Anderson, L. O. and Heyer, O. C., Wood Frame House Construction, U.S. Department of Agriculture, Washington, D.C. 1955.

Sheathing a Wall

(Suggested Resource Lesson 4)

Materials:

4'x8' plywood panels
hammer
assorted nails
level
crosscut saw
framing square
folding ruler

Visual Aids:

Samples of various types of wall sheathing:

#3, #4 common
various types of plywood
fiberboard panel
gypsum panel

Motivation:

Introduce the lesson by saying, "Now that we have the wall frame completed, how shall we cover it and decorate it?"

Procedure:

1. Discuss with the class the four major types of wall sheathing: wood, plywood, fiberboard, gypsum board.

2. Select the type of wall covering the pupils wish to use.

3. Lay out the panels to fit on the wall, around the window and around the door.

4. Cut the panels to fit.

5. Have the pupils secure the panels to the wall framing.

6. Have the pupils install the panels to fit around the window and the door.

7. Have the pupils review and evaluate their work.

Outcomes:

1. Manipulative skills learned:

   a. Measuring and laying out wall panels

   b. Cutting wall panels

   c. Installing wall panels

2. Safety practices learned:

   a. Large wall panels should be handled with care to avoid injury.

   b. When hammering nails through panels, each should be held firmly.

3. Academic Learnings:

   a. Mathematics

      (1) Using tools for measuring

      (2) Using squaring tools

      (3) The properties of the right angle

   b. Social Studies

      (1) Types of walls (fire prevention, sound proof) depend upon culture, locale, climate, needs, etc.

      (2) The importance of privacy for family living, provided by walls in our city apartments

   c. Science

      (1) The manufacture of plywood, fiberboard and gypsum board

      (2) Fire-proofing (wall coverings, paint)

Assignment:

Ask the pupils to visit a neighborhood lumber yard to obtain samples of sheathing materials.

References:

1. Anderson, L. O. and Heyer, O.C., Wood Frame House Construction, U.S. Dept. of Agriculture, Washington, D.C. 1955.

2. Building Supply News, Industrial Publications, Inc., 4 South Wabash Avenue, Chicago 3, Illinois

UNIT II.

BUILDING MAINTENANCE

The aim of this unit is to offer the pupils opportunities to learn the many skills related to building maintenance, e.g., painting and finishing, electrical work, plumbing, carpentry, and maintenance of floors and ceilings, etc.

Only the area on "Plumbing Repairs and Maintenance" has been presented in detail and can be used by the teachers as a model and a guide to develop other areas of instruction.

Operations and Processes to Be Taught

1. Lay out and measure stock for pipe and replacement
2. Cut pipe to length with a pipe cutter
3. Use a tapered reamer to deburr a piece of pipe
4. Use a stock and die to thread pipe
5. Secure pipe in a pipe vise
6. Assemble pipe and fitting units
7. Use pipe wrenches, lamp wick, and pipe compound
8. Mount a wash basin
    a. Change washers
    b. Surface valve seats
    c. Replace valve seats
    d. Repack valves
    e. Remove and replace faucet handles
9. Hook up hot and cold water lines
10. Secure pipes with metal straps
11. Hook up and/or clean waste pipes and trap
12. Use smooth jawed adjustable wrenches
13. Hook up vent line
14. Mount shower valve assembly, adjust, and clean the shower head

15. Mount a flush tank assembly and hook up pipes

    a. Replace a tank ball

    b. Adjust for seating

    c. Adjust tank water level

    d. Adjust tank grip lever assembly

16. Install a faucet for garden hose

17. Install hose adapters on hose ends

18. Make up hose sections with required fittings

19. Provide for disposal of waste water

    a. Repair waste pipes

    b. Clean drains

20. Install pump to remove waste water, etc.

Materials, Tools, and Equipment

1. Materials and Supplies:

   pipe (black iron, waste, copper tubing, rubber and plastic hose)

   fittings (45°,90°, unions, couplings, caps, valves, trap)

   fixtures (wash basin,flush tank assembly, shower and bath spigot assembly)

   miscellaneous materials (pipe joint compound, cutting oil, pipe straps, lamp wick, packing, faucet washers, valve seats, hose fittings, hose clamps)

2. Tools and Equipment:

   pipe cutter
   stock and die (ratchet)
   tapered reamer (brace)
   monkey wrench
   flat adjustable open end wrench
   vise grip pliers
   channel lock pliers
   screw driver
   seat surfacing tool
   seat tightening wrench

plunger
pipe wrench
pipe vise
basin wrench
drill, hand and electric
ball peen hammer
hack saw
files, assorted
compass saw
seat tap
snake and pipe auger

Related Occupational Learnings

1. Water system

    Faucet noises

    Water hammer in pipes

    Servicing air chambers

    Pipe supports

    Water closet noises

    Leaky faucets

    Pipe leaks

    Dripping from condensation

    Protection from frost

    Thawing frozen water pipes

    Clogged pipes

2. Valves and faucets

3. Drainage

    Clogged sink drains

    Water closet stoppage

    Backflow from sewer

    Frozen drainage lines

Academic Learnings

1. Science

    a. Water as an elementary need

    b. Sources of water supply

    c. Pumping fundamentals

        (1) Suction

        (2) Friction loss

        (3) Horsepower

        (4) Centrifugal force, gravity

        (5) Velocity and pressure relationships

        (6) The venture tube

    d. Water and air pressure and their effects

    e. The water cycle

    f. Characteristics of water

    g. Gas as a source of heat

    h. Radiation effects of metals, their color, etc.

    i. Bernoulli's Principle

    j. Heat conduction

    l. Rate of heating liquids

    m. Vitreous china, its production and use

    n. Characteristics of metals, their mining, production and uses.

2. Mathematics

    a. Friction loss formula

    b. Conversion factors

    c. Concepts of cubic measure, weight per cubic foot

    d. Calculations concerning horsepower

    e. Concepts of shallow and deep

    f. Concepts of horizontal and vertical

g. Reading a water meter

h. Concepts of measurement, linear, liquid, weight, angles, triangles, circles

3. Social Studies

a. The needs of a community for adequate supply and disposal of water

b. The history of water systems and their effect on man's development

c. The development of piped water supply in the United States

d. Water shortage

e. Labor and management problems

f. Local, State, and Federal laws related to plumbing, labor, mangement, wages, and fair employment practices, etc.

g. Contributions of various cultures

h. Mass production

4. Health and Hygiene

a. Safety practices involved in the use of tools, machines, materials, etc.

b. Health and hygienic standards related to water

c. Disease as affected by water and water supply systems

5. Language Arts

a. Notetaking

b. Following oral and written directions

c. Keeping time records, job sheets, etc.

d. Preparing reports

e. Reading instructions, labels, delivery sheets, specifications, etc.

f. Using a table of contents, index, etc.

g. Writing an order, letters, etc.

h. Filling out forms, applications, etc.

i. Using the telephone (speech, manners, procedure)

6. Guidance

   a. Occupational information

   b. Applying for a job

   c. Getting along with others

   d. Educational opportunities in high school

   e. Local, State and Federal employment agencies

Personal Development

1. Working and getting along with others
2. Developing a sense of pride and responsibility
3. Improving one's self-image
4. Importance of personal cleanliness
5. Respect for law and authority
6. Relationships with the members of the family, school and community

Audio-Visual Aids

1. Educators Guide to Free Films, Educators Progress Service, Randolph, Wisconsin
2. Educational Service Bureau, American Gas Association, 420 Lexington Avenue, New York, N.Y.
3. Curriculum Bulletin 1962-63 Series 7, Bureau of Adio-Visual Instruction Board of Education, 131 Livingston Street, Brooklyn, New York, 11201
4. Sloan Valve Company, 4300 W. Lake Street, Chicago 24, Illinois
5. American Water Works Association, 2 Park Avenue, New York, N.Y.
6. Trade Education Committee of Plumbing Industry Board of Plumbers Local Union #1, 2400 Linden Blvd., Brooklyn, N.Y.

Bibliography

1. Anderson, L. O. and Heyer, O, C., Wood Frame House Construction, U. S. Department of Agriculture, Washington, D.C., 1955.
2. Popular Mechanics Press, Plumbing Repairs Made Simple, Popular Mechanics Press Co., Chicago, Illinois, 1954.

3. Graham, F. D. and Emery T. J., Audels Carpenters and Builders Guides, Thedore Audel and Co., Publishers, New York, 1963.

4. Home and Farm Water Supply Manual, F. E. Meyers and Bros., Co., Ashland, Ohio.

5. Science Principles Series, Educational Service Bureau, American Gas Association, 420 Lexington Ave., New York, N.Y.

6. The Story of Water Supply, American Water Works Assocation, 2 Park Avenue, New York, N.Y.

7. The Subject of Flush Valves, Sloan Valve Co., 4300 W. Lake Street, Chicago, Illinois.

8. Keating, Bernard M., Related Instruction and Information Sheets, Trade Education Committee, Plumbers Local Union #1, Brooklyn, New York.

Cutting a Pipe to Length

(Suggested Resource Lesson 1)

Materials:

samples of scrap pipes of various sizes
tubing
tubing cutter
small and large pipe cutters

Visual Aids:

drawing of a pipe cutter with parts labelled

Motivation:

1. Tell the class that a section of the pipe in the plumbing system of the two-room apartment they have built in the shop is leaking and must be replaced.

2. Ask the class, "How are we going to cut a piece of pipe to the proper length to replace the damaged section?"

3. Discuss the various tools used to cut pipes; e.g., hack saw, torch, etc.

Procedure:

1. Demonstrate the proper method of securing pipe in pipe vise.

2. Mark the desired length with chalk or crayon.

3. Demonstrate how the pipe cutter is held when cutting a pipe length. (cutting wheel should face up for easy alignment)

4. Engage cutter with pipe by tightening "T" handle.

5. Tighten the handle of the pipecutter approximately $\frac{1}{4}$ turn as each complete revolution is made around the pipe.

6. Continue the above operation until the pipe is cut.
   Note: The pipecutter should be well lubricated.

7. Point out to the class that a burr is formed on the inner edge of the pipe when it is cut.

8. Remove the burr with a pipe reamer.

9. Have several pupils cut sections of pipe to replace the pipe section which is damaged.

10. Have the pupils remove the burr from the pipe with the pipe reamer.

11. Have the pupils evaluate their work.

12. Have the pupils make a drawing of a pipe cutter in their notebooks and label all the parts.

Outcomes:

1. Manipulative skills:

   a. Securing a pipe in a pipe vise

   b. Marking distances (with chalk or crayon)

   c. Using pipe cutter

   d. Removing burr with a pipe reamer

2. Safety practices learned:

   a. Cuts from burrs and sharp edges of pipes should be avoided.

   b. When cutting a pipe the free section of the pipe should be held securely to avoid injury to the feet.

   c. A pipe must be secured well in the vise when using the cutting tool.

3. Academic learnings:

   Vocabulary

alternate	burr
alignment	reamer
pipe cutter	lubricate
measurement	

Reference:

Plumbing Repairs Made Simple, Popular Mechanics Press Co., Chicago, Illinois, 1954.

Threading a Pipe

(Suggested Resource Lesson 2)

Materials:

ratchet stock
dies to $1\frac{1}{4}$" to include $\frac{1}{2}$", 3/4", 1", $1\frac{1}{4}$"
short lengths of $\frac{1}{2}$", 3/4", 1", $1\frac{1}{4}$" pipe
pipe
lubricating oil
burlap or similar material for catching metal chips and oil

Visual Aids:

1. A drawing of the ratchet stock and die
2. A drawing of the Armstrong stock and die (no ratchet)
3. Mimeographed sheet for each pupil showing a picture of the stock and die with numbered parts

Motivation:

1. Ask the pupils, "How do you think we can replace the damaged pipe in the two-room apartment with the piece we cut?"

2. Elicit from the class that this may be done in various ways: welding, brazing, soldering, and with threaded fittings.

Procedure:

1. Refer to the stock and die and explain that this tool is used to make threaded fittings.

2. Explain how the stock and die is used:

   a. Insert the dies into the stock.

   b. Align the dies with the standard thread mark.

   c. Lock into position with the locking stud.

3. Demonstrate how the dies may be adjusted to make thread deep or shallow by turning the adjusting screw on each half of the die.

4. To insure a straight cut, show how a guide, corresponding in size to the die used, is inserted into the rear of the stock.

5. Lubricate the die cutter with lubricating oil to protect the dies and to obtain a smooth cut.

6. Allow approximately 2 threads to protrude through the outside of the die to insure enough threading.

7. Reverse the locking pen and back off the stock and die from the threaded pipe.

8. Have the pupils use the stock and die to thread the pipe for the project.

Assignment:

Distribute the mimeographed sheets with the picture of the stock and die and ask the pupils to label all the numbered parts and to describe the function of each part.

Outcomes:

1. Manipulative skills learned:

   a. Inserting and aligning dies in the stock

   b. Locking dies in position

   c. Adjusting dies for depth of cut

   d. Inserting a guide into the rear of the stock

   e. Lubricating the dies

2. Safety practices learned:

   a. When cutting a pipe it should be secured well in the pipe vise.

   b. A piece of burlap should be placed on the floor to catch chips and excess oil during a pipe-threading operation.

   c. Care should be taken to avoid cuts from sharp edges of pipe threads.

3. Academic learnings:

   a. Vocabulary

ratchet	standard	locking pin
brazing	guide	function
welding	protrude	adjust

   b. Science

      Law of Leverage

   c. Mathematics

      Concepts of diameter, helix

Reference:

Plumbing Repairs Made Simple, Popular Mechanics Press Company Co., Chicago, Ill., 1954.

Installing a Waste Pipe and Trap

(Suggested Resource Lesson 3)

Materials:

one $1\frac{1}{4}$" waste pipe complete with gland nut and washer
one $1\frac{1}{4}$" trap with gland nut and rubber washer
mimeographed job sheets with pictures of the above materials
smooth jaw adjustable wrench

Visual Aids:

1. Chalk board sketch of a sink showing a waste pipe and trap
2. Mock up of a sink
3. Waste pipe (sample)
4. Trap (sample)

Motivation:

1. Refer to the picture of the sink, point to the trap attached to the waste pipe, and ask the pupils why every sink has a trap.

2. Elicit the following:

   a. The trap seals off sewer gases.

   b. It traps waste and prevents clogging of waste pipe.

Procedure:

1. Discuss with the pupils and demonstrate the steps to be taken to install a waste pipe and trap:

   a. Connect waste pipe to the basin strainer assembly. (Explain the action of the gland nut and rubber washer.)

   b. Connect the trap to the waste pipe and tighten the gland nut with a smooth jaw wrench.

   c. Point out how the trap seals off the gases in the soil line from entering the sink when it is completely filled with water.

2. Have the pupils connect the waste pipe and the trap to the sink.

3. Have the pupils remove the waste pipe and trap and connect them again with a lamp wick.

4. Review and evaluate the pupils' work.

Outcomes:

1. Manipulative skills learned:

   a. Using a smooth jaw adjustable wrench

   b. Tightening gland nut to prevent leaks

   c. Using lamp wick

2. Safety practices learned:

   A wrench should be adjusted properly when using it to tighten nuts.

3. Academic learnings:

   a. Vocabulary

      gland washer
      smooth jaw wrench
      lamp wick

   b. Mathematics

      Measuring pipe lengths

Reference:

Graham, F. D. and Emery, T. J., Audels Carpenters and Builders Guides, Theodore Audel and Co., Publishers, New York, N.Y. 1963.

Using a Smooth Jaw Adjustable Wrench

(Suggested Resource Lesson 4)

Materials:

straight wrenches and crescent wrenches (various sizes)
pipe wrench
plated nut and fittings

Visual Aids:

1. A mock up of a sink
2. A shower head assembly
3. An old fitting showing pipe wrench chew marks

Motivation:

1. Describe the use of a smooth jaw adjustable wrench when installing a water faucet.

2. Ask the pupils: "Why should this type of wrench be used for this operation?"

Procedure:

1. Demonstrate and explain the following operations:

   a. Show how to adjust the jaws of the wrench snugly against the faces of the nut to be tightened. (A loosely fitted wrench will slip and round off the corners of the nut.)

   b. Demonstrate the use of a crescent wrench for getting into inaccessible places.

   c. Explain that a smooth jaw wrench may also be used as an outside caliper to measure the diameter of a pipe.

2. Have the pupils practice using the crescent wrench and the smooth jaw wrench.

3. Have the pupils determine the diameter of pipes of various widths.

4. Elicit from the pupils when each of the following wrenches should be used:

   a. smooth jaw wrench

   b. crescent wrench

   c. pipe wrench

Outcomes:

1. Manipulative skills learned:

   a. Using a smooth jaw wrench

   b. Using a crescent wrench

   c. Using a pipe wrench

2. Safety practices learned:

   a. Secure a wrench well when tightening bolts to avoid slipping.

   b. Care should be taken to avoid cuts from sharp edges of pipes, fittings, etc.

3. Academic learnings:

   a. Vocabulary

crescent	straight
calipers	smooth jaw

   b. Mathematics

      Concepts of diameter

      Measuring

Reference:

Plumbing Repairs Made Simple, Popular Mechanics Press Co., Chicago, Illinois, 1954.

UNIT III

URBAN GARDENING

The objectives of this unit are to encourage the pupils:

1. to develop an interest in the beautification of the home, the school, and the community.

2. to engage in worthwhile leisure time activities.

3. to acquire the many vocational and avocational knowledges and skills inherent in this are.

Operations and Processes

1. Planning and constructing flower boxes, flower pots, and other plant receptacles and containers

2. Planning and constructing artificial light-producing equipment

3. Planning and creating plant arrangements

4. Preparing soil for planting

5. Potting plants

6. Propagating of plants via seeds and cuttings

7. Maintaining a garden

8. Planning, preparing, creating, and maintaining lawns in outdoor gardens

Suggested Projects

1. Design and construct an indoor hot house

2. Construct pebble trays

3. Construct flower boxes, pots, or other containers

4. Prepare jungle, temperate zone, and desert soil mixtures

5. Plant appropriately selected plants in proper soil

6. Maintain the indoor gardens

7. Germinate plants from seeds

8. Propagate plants via root cuttings, leaf cuttings, division, air layerings, runners and offsets

9. Plan and create an outdoor garden

10. Plant shrubs and trees

11. Plan, create, and maintain a lawn

12. Make a portable potting bench

13. Plan and construct garden wagons, trellises, portable cold frames, shelves for pots, bird baths, outdoor garden pools, rock gardens, bird houses and lawn ornaments, concrete retaining walls, compost pits, etc.

Materials, Supplies, Tools, Equipment and Machines

topsoil	peat moss
humus	sphagnum moss
coarse sharp sand or gravel screenings	

garden trowel	Hormodin Powder #1, #2
mason's pointing trowel	bell jars
watering can, small	mason jars
hand continuous sprayer	table fork and spoon
thermometer, small	ant traps
sieves, $\frac{1}{2}$", and $\frac{1}{4}$" mesh	Bordeaux Mixture, powder
clay pots	Black Leaf
glass saucers	Dimite
pot stands	DX Parethrum-rotenone
self-irrigating window box	Chlordane Dust, 6%
bamboo stakes, 18"	wooden stick labels, 4"
hand duster-1 quart size	Twistems, or pipe cleaners
pruning shears, small	pail, 12 quart size
garden hose, sprinklers and sprayers	

shovels, large and small	rakes, metal and bamboo
lawn mower	edger
pruning shears, large	lawn roller
lawn sweeper	

Related Occupational Learnings

1. Hot house gardening

2. Outdoor gardening and maintenance

3. Tool and equipment sharpening and maintenance

4. Landscaping

5. Gardeners' supplies

6. Farming

7. Conservation

Academic Learnings

1. Mathematics:

   a. Concepts of linear, liquid, weight, volume, measurements

   b. Percentage, degrees, decimals, fractions

   c. Application of tables, scales, etc.

   d. Conversion of measurement units

   e. Calculating and estimating

   f. Maintaining records of cost, wages, deductions, etc.

   g. Concepts of size and shape relationships

2. Science:

   a. Length of day variations

   b. Light intensity

   c. Exposure, for maximum light

   d. The fluorescent bulb

   e. Spotlights, light intensity, heat, etc.

   f. Humidity

   g. Temperature (by zones, indoor requirements)

   h. Soil (ingredients, composition)

   i. Water (its makeup, control of acidity and alkalidity)

   j. The water cycle

   k. Water sources, systems, etc.

   l. Fertilizers (organic and inorganic)

   m. Plant life pests and diseases, nature and control

n. The sun and the earth

o. Air (its components and importance to plant life)

p. Climate

q. The plant and its life cycle

r. Propagation (seminal and vegatitive)

s. Types and varieties of plants, shrubs, trees, etc.

t. Chemicals and soiless planting

3. Social Studies

a. Plants and man's needs

b. Beautification of the home, school and community

c. Contributions of various cultures

d. Man's development from gatherer to farmer

e. Local, State and Federal laws, codes, regulations

f. The farmer and his work

g. Man's interdependence upon man

h. Food shortages and famine

i. Socio-economic and political implications

4. Language Arts

a. Notetaking

b. Following oral and written directions

c. Keeping records

d. Oral communication

e. Reading instructions, labels, delivery sheets

f. Use of the telephone

5. Guidance

a. Occupational studies

b. Applying for a job

c. Getting along with others

d. Further educational opportunities

e. Local, State and Federal agencies

f. The small businessman

6. Health and Hygiene

a. Safety in the use of hand tools, equipment, machines

b. Health hazards related to insecticides, pests, disease, poisonous plants, and shrubs

c. First Aid

Personal Development

1. Working with others

2. Developing a sense of pride and responsibility

3. Respect for authority, law, government

Audio-Visual Aids

1. Curriculum Bulletin, 1962-63 Series 7, Bureau of Audio-Visual Instruction, Board of Education, N.Y.C.

2. Educational Film Guide, H. W. Wilson Co., 950 University Avenue, New York, N.Y.

Bibliography

1. Ballard, Ernest Drinker, Garden for Your House, Harper and Bros., Pub., New York, 1958.

2. Melady, John Jayes, Better House Plants for Your Home, Grosset and Dunlap, Pub., New York, 1953.

3. Free, Montague, All About House Plants, American Garden Guild, New York, 1946.

4. Hersey, Jean, Garden in Your Window, Prentice-Hall, Inc., New York, 1958.

5. Zim, Herbert S., Plants, A Guide to Plant Hobbies, Harcourt, Brace and Co., New York, 1947.

6. Asch, John, The Story of Plants, G. P. Putnam's Sons, New York, N.Y. 1948.

7. Selson, Millicent E., Play with Plants, William Morrow and Company, New York, N.Y. 1949.

Making a Pebble Tray

(Suggested Resource Lesson 1)

Materials, Tools, and Machines:

tin plate	scriber
galvanized iron	square
solder	snips
flux	soldering copper
emery cloth	mallet
steel wool	bending brake
paint	

Visual Aids:

model of a finished pebble tray
chart showing plant structure

Motivation:

1. Suggest to the pupils that they make pebble trays to beautify the classrooms in the school.

2. Ask the pupils,

   a. "Why do plants require water and water drainage?"

   b. "How can a pebble tray serve this purpose?"

   c. "How can we make a pebble tray?"

Procedure:

1. Demonstrate and explain the following operations:

   a. Make a sheet metal layout for the tray.

   b. Transfer the layout to a piece of sheet metal.

   c. Cut the tray to shape with tinners snips.

   d. Smooth all sharp edges with a file.

   e. Bend metal on the box and pan brake.

   f. Solder the ends.

   g. Test for leaks.

   h. Paint the tray with a brush or spray.

2. Have each pupil make a tray using the procedure demonstrated and explainted in the lesson.

Outcomes:

1. Manipulative Skills:

    a. Making a sheet metal layout

    b. Using tinners snips

    c. Using bar folder

    d. Using box and pan brake

    e. Soldering

    f. Testing for leaks

    g. Washing and draining pebbles

    h. Pouring pebbles into tray

    i. Judging quantity of water

2. Safety practices learned:

    Care should be taken when soldering sheet metal.

3. Academic learnings:

    a. Mathematics

        (1) Linear measurement

        (2) Concepts of length, width and depth

        (3) Concepts of volume of pebbles and water

    b. Science

        (1) Water requirements of plants

        (2) How plants grow

        (3) Plant structure

        (4) Sources of water

        (5) Irrigation

    c. Language Arts

        (1) Following oral and written directions

        (2) Notetaking

        (3) Reading instructions, labels, etc.

d. Social Studies

(1) Effect of water shortages on agriculture and economy

(2) Effect of climate, geography, water sources, etc. on agriculture

Assignment:

1. Ask the pupils to draw a sketch of a plant, to label the parts and to show the path water takes through the plant.

2. Have the pupils collect pictures of flower boxes, pots, and other containers of various designs.

References:

1. Selson, Millicent E., Play with Plants, William Morrow and Co., New York, N.Y. 1949.

2. Ballard, Ernest Drinker, Garden in Your House, Harper and Bros., Pub., New York, N.Y. 1958.

3. Board of Education, City of New York, General Metal Shop, Teacher's Work Manual, Curriculum Bulletin #14, 1955 Series.

- A R E A # 3 -

POWER MECHANICS

Power Mechanics is presented in the Career Guidance industrial arts program because of the appeal that automobiles and other power mechanisms have for teenagers.

Further, the use of the gasoline engine has been a major factor in the development of transportation, which, in turn, is an integral part of the planning and building of the complex industrial and residential areas in our city. The use of the instructional materials provided in this area will introduce pupils to the modern uses of the gasoline engine and will trace briefly the historical development of the engine as a source of power. The materials also include basic information about tools, machines and equipment, and the occupational skills of the mechanics and other people who work with gasoline engines.

Three units of instruction and suggested resource lessons for each unit have been developed to aid the teachers. Additional lessons should be developed by the teachers as they progress with the implementation of this area.

Unit I. The Operation, Maintenance, and Repair of Bicycles

Resource Lessons

1. Making Pre-Ride Mechanical Inspection Check of a Bicycle

2. How to Adjust Bicycle Saddle and Handlebars

3. How to Remove and Replace Bicycle Front Wheel

Unit II. The Single-Cylinder Gasoline Engine

Resource Lessons

1. Pre-Start Inspection of a Single-Cylinder Gasoline Engine

2. How to Start and Run a Single-Cylinder Engine

Unit III. Operating Small Model Cars

Resource Lesson

Planning and Constructing a Panorama for Model Car Raceway Area

UNIT I.

THE OPERATION, MAINTENANCE, AND REPAIR OF BICYCLES

This unit is designed to serve as an introduction to the broad area of Power Mechanics. It will provide shop experiences to illustrate the use of mechanics' hand tools and equipment, to emphasize the importance of bicycle inspection for mechanical defects, and to teach how to keep a bicycle in good operating condition. It will also teach the rules of the road applicable to bicycle riders, automobile drivers, and the pedestrian.

Operations and Processes to Be Taught

1. Removal, Replacement, and Adjustment of Bicycle Parts

    a. Seat

    b. Front wheel, bearings, axle

    c. Rear wheel assembly

        (1) brake assembly
        (2) axle, bearings

2. Removal and Replacement of Front and Rear Tires

3. Repair of Inner Tubes

4. Emergency Repairs on Tubeless Tires

5. Removal and Replacement of Tire Valves

6. Checking of Air Pressure with Pressure Gage

7. Removal, Replacement and Adjustment of Tension and Lubrication of Drive Chain

8. Mounting and Adjusting of Chaim Guard

9. Removal, Replacement, and Adjusting Handlebars

10. Lubrication of Handlebars

11. Installing and adjusting Bicycle Seat

12. Removal, Replacement, and Adjustment of Tension on Wheel Spokes

13. Installing and Focusing Headlight

Suggested Projects and Activities

1. Replacement of Worn Front Wheel Bearings
2. Repairing, Installing, and Adjusting Broken Drive Chain
3. Removing and Replacing Bent or Broken Wheel Spokes
4. Repairing Tube and Tubeless Tires
5. Replacing Worn Pedals
6. Installing and Adjusting Kick Stand
7. Repairing and Refinishing Bent Wheel Fenders
8. Installing Handle Bar Grips
9. Installing Bicycle Basket
10. Aligning and Adjusting External Wheel Brakes

Materials, Tools and Equipment

1. Materials:

tire repair kit	rubber cement
machine oil	lubricating oil
liquid graphite	waterless hand cleaner
spray paints	brush-on paints
wiping rags	sandpaper
emery cloth	steel wool
valve caps	metal filler putty
solder	flux
electric tape	masking tape
machine screws and nuts	

2. Tools:

wire brush	tinners' snips, 2"
oil can, pump type	monkey wrench, 4"
pipe wrench, 6"	ball peen hammer, 6-oz.
nail hammer, 8-oz.	screwdrivers, 4",6",8",10"
screwdrivers, Phillips	pliers, slip joint, 6"
water pump pliers	pliers, vise grip
bolt cutter	hack saw
hand drill	valve insides wrench
tire test tank	tire pressure gage, 75-lb. Cap.

electric drill, $\frac{1}{4}$", Jacobs type chuck
extension cord, 8', rubber covered, 3-wire grounded
bicycle spanner wrenches

set, box-end wrenches, 12 pt., 3/8" to 1"
set, open-end wrenches, 3/8" to 1"

set, socket wrenches complete with sockets, 3/8" to 1"
3/8" square drive, complete with speed wrench, ratchet, hinge bar, universal joint, short and long extension bar

3. Equipment:

machinist vises, $3\frac{1}{2}$"
workbench, cabinet base, 3' x 6'
bicycle stand, two place
bench grinder

Academic Learnings

1. Mathematics

a. Estimating tire sizes

b. Computing wheel diameter and circumference

c. Using the odometer in measuring distances traveled

d. Using the speedometer to measure rate of speed

e. Computing speed and braking distances

f. Estimating sales tax and discount in purchasing bicycle, tools, and spare parts

g. Estimating depreciation value

2. Social Studies

a. The factory method used in assembly of bicycle

b. Source of materials used in manufacture of bicycle (rubber, steel, plastic, copper and leather)

c. The bicycle, a vehicle of transportation, and its use in foreign countries

d. Occupational opportunities in areas of industry related to the production and maintenance of bicycles

e. Mass production of bicycles in factories

f. Consumer information about bicycle

3. Science

a. Learning of words and concepts related to the field of science:

speed	tire pressures
balance	centrifugal force
friction and braking	centripital force
use of the wheel	law of motion
chain drive	

b. Lubricating oils (grades and uses)

c. Safety features in the construction of bicycles

4. Language Arts

a. Reading of road maps

b. Reading of travel stories

c. Writing safety slogans, such as:

"Better Safe than Sorry"

"Safety Pays and Costs Nothing"

"Wait a Minute - Save Your Life"

"Stop - Look - Listen"

"Signal Now - Live After"

d. Writing and learning "Rules of the Road" for cyclists

e. Writing and presenting dramatizations related to road safety

f. Vocabulary:

wait	traffic light	fender
stop	sprocket	street
wrench	brake	signal
bicycle	headlight	chain drive
wheel	reflector	pressure
	pedal	

5. Guidance

a. Shop talks to pupils by:

(1) Local bicycle repair man

(2) Bicycle manufacturer

(3) Neighborhood super-market delivery man

(4) Traffic safety representative from local police precinct

b. Suggested field trips

(1) Bicycle repair shop

(2) Bicycle sales department of a store or shop

(3) Cyclists' paths located in numerous parts of the city

Personal Development

1. Developing attitudes and habits of safety

2. Learning consideration for others when cycling

3. Gaining self-confidence through participation in work assignments that provide opportunities for developing self-direction, individual responsibility, and perseverance

4. Widening educational horizons and occupational ambitions through experiences with basic tool skills related to mechanics and other artisans in the field of transportation

5. Developing pride of ownership through the maintenance and repair of pupils' own bicycles

Audio-Visual Materials

1. Wall charts:

   a. Be Sure Your Bike Is Ready to Go

   b. Bike Hand Signals

   c. Bike Riders Safety Rules

   d. Bike Safety Aids

   NOTE: These charts may be obtained from:

   Bicycle Institute of America, Inc.
   122 East 42nd Street, New York, N.Y. 10017

2. Suggested Aids: (to be made in the shop)

   a. Display bicycle parts (pedal, sprocket)

   b. Mount saddle on stand to demonstrate adjustment

   c. Mount front wheel and axle on demonstration stand to teach bearing adjustment and wheel alignment

d. Display demonstration panel showing disassembled coaster brake

e. Display demonstration panel showing bicycle lighting system

f. Display process board showing the procedure and steps to be taken when patching a tire

Bibliography

1. Bicycle Institute of America, Inc., 122 East 42nd Street, New York, N.Y. 10017

   Bikeways, Booklet, 7 pages

   Bike Quiz Guide, Booklet, 5 pages

   Bicycle Safety Tests, Booklet, 18 pages

   Get Back on a Bike, Booklet, 4 pages

   The A.B.C. of Better Bike Riding, Booklet, 4 pages

2. McFarlane, John W., It's Easy to Fix Your Bike, Follet Pub. Co., 1010 W. Washington Boulevard, Chicago 7, Ill., 1958 Edition, 36 pp.

3. Spring - Summer Catalog, Bicycle Parts List, Montgomery Ward Co., Albany, 1, New York

4. What is Hosteling, American Youth Hostels, Inc., 14 W. 8th St., New York, N.Y. 10011

Making a Pre-Ride Mechanical Inspection of a Bicycle

(Suggested Resource Lesson 1)

Materials:

Fully equipped bicycle

Visual Aids:

1. Charts obtained from the Bicycle Institute of America, Inc.:

   a. Be Sure Your Bike Is Ready to Go

   b. Bike Safety Aids

2. Defective demonstration bicycle

Motivation:

1. Discuss with the class the large number of automobiles that break down on the streets and highways every day. Many of these breakdowns are caused by the lack of precautionary maintenance, lack of gas, blowouts, over-heating, etc.

2. Ask the question, "How can you keep your bicycle in good repair?"

Procedure:

1. Review and demonstrate the steps to be taken when checking a bicycle:

   a. Inspect tires.

      (1) Make test for proper inflation of tires. (Squeeze tire with fingers for firmness.)

      (2) Check for cuts or sharp objects imbedded in tread.

      (3) Check for missing dust caps on tire valves.

   b. Inspect saddle or seat.

      (1) Press saddle to see that it is firmly mounted.

      (2) Adjust saddle for proper riding position.

   c. Inspect handlebars.

      (1) Press to test for firmness of mounting.

      (2) Test handgrips for proper adjustment.

d. Inspect brakes.

(1) Squeeze hand brake control to test rim brake.

(2) Press foot pedal in reverse to test Bendix type brake.

e. Test chain for proper tension.

f. Test fenders for firmness of mounting and clearance from turning wheels.

g. Inspect wheels.

(1) Check to see that wheels rotate freely.

(2) Tighten wheel nuts and oil bearings.

(3) Check for bent, loose, and missing spokes.

h. Test pedals to see that they rotate freely, are firmly mounted, are securely assembled, and are well lubricated.

i. Inspect accessories.

(1) Check light, horn, and reflector.

(2) Check mounting of basket, luggage rack, and kick stand.

2. Have several pupils make a pre-ride test of the bicycle with the aid of the check list compiled.

3. Ask the pupils to list the faults and defects found in the pre-ride inspection and to note on a work-order what repairs and adjustments should be made.

Outcomes:

1. Manipulative skills learned:

a. Testing for correct tire pressure

b. Spinning wheel to test for alignment

c. Checking tightness of all parts

d. Operating coaster brake

2. Safety practices learned:

a. A precautionary maintenance check of a bicycle is necessary for safety.

b. Lubrication is necessary for keeping a bicycle in good running condition.

c. The saddle must be tightly mounted if the bicycle is to be safe.

3. Academic Learnings:

a. Language Arts

(1) Vocabulary

wheel	tire	test
reverse	squeeze	valve
dust	operate	seat
horn	rotate	fender
bicycle	saddle	rack
pedal	brake	pressure
reflector	vehicle	weight

(2) Writing safety slogans ("Better Safe Than Sorry")

(3) Reading safety rules, repair instructions, and catalogue descriptions

b. Science

Understanding principles related to:

(1) compression pressures

(2) friction and braking

(3) centrifugal force

(4) chain drive

c. Social Studies

(1) Use of bicycles in other lands

(2) Use of bicycles for delivery purposes

(3) Quality control in factory production

(4) Employment opportunities in the bicycle industry

Assignment:

Distribute teacher-prepared notebook assignment sheet.

Reference:

Bicycle Safety Tests, (brochure) Bicycle Institute of America, 122 East 42nd Street, New York, N.Y. 10017

Suggested Notebook Assignment

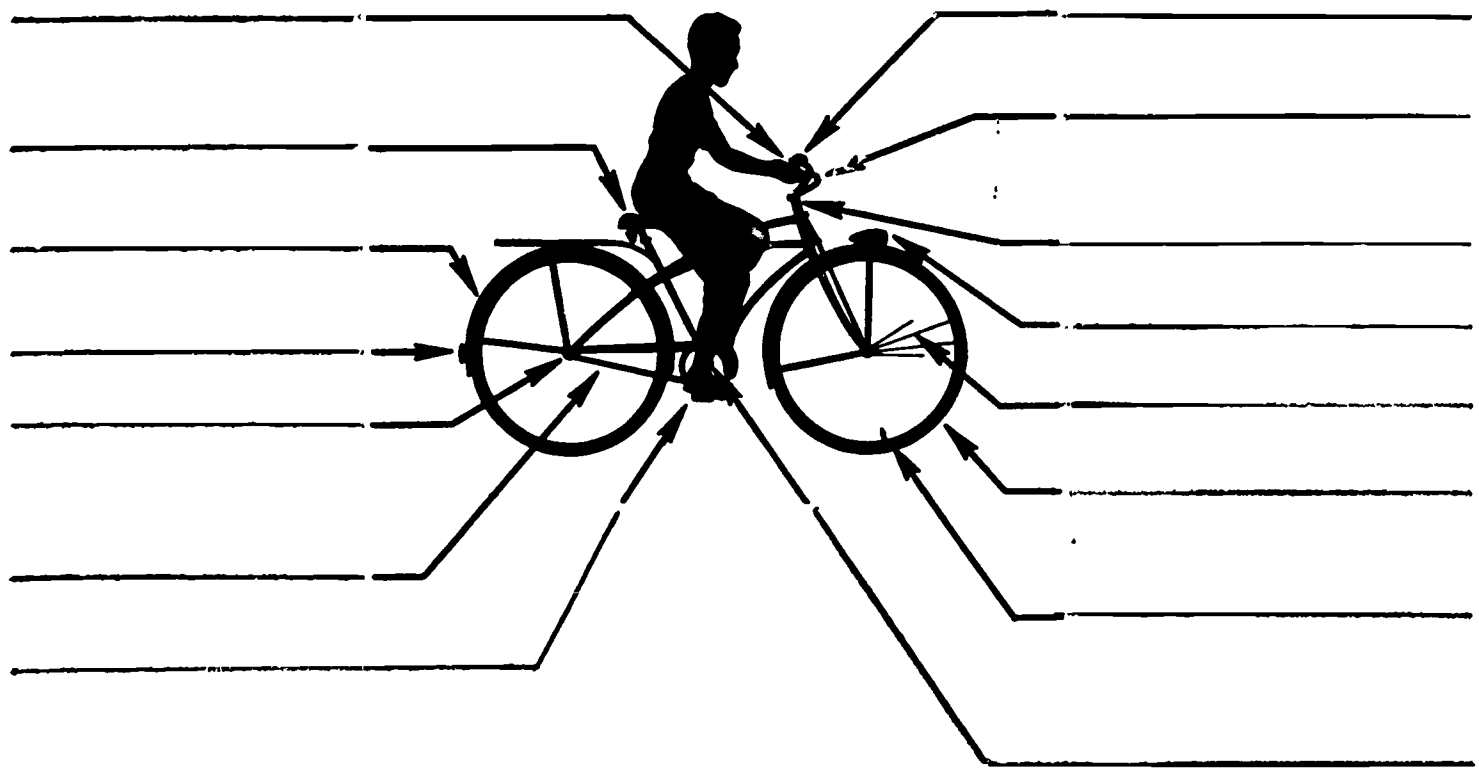

Fig. 1

Pre-Ride Inspection of Bicycle

1. Prepare pre-ride inspection list and keep it in your notebook.

2. Label all parts of the bicycle to be inspected in spaces provided on the picture.

3. Make pre-ride inspection of your own bicycle and submit a completed check-list.

4. Read Bicycle Safety Tests and write a brief report on what interested you most. (Booklet is available in the shop library.)

How to Adjust Bicycle Saddle and Handlebars

(Suggested Resource Lesson 2)

Materials:

set of box wrenches
soft faced hammer or mallet
penetrating oil
wiping rags
#0 emery cloth

Visual Aids:

demonstration bicycle

Motivation:

1. Explain to the class how the adjusting lever regulates the forward and backward motion of the driver's seat in an automobile.

2. Ask the question, "Why should you take time to make proper adjustments on your bicycle saddle?"

Procedure:

1. Review with the class the steps to be taken for adjusting the saddle on a bicycle:

   a. Adjust saddle height

      (1) Loosen seat post nut on bicycle frame just below saddle with a box wrench.

      (2) Straddle rear wheel and lower or raise saddle by twisting saddle from side to side. (Apply a few drops of penetrating oil to help loosen saddle shaft.)

      (3) Tighten nut slightly and test for proper height. (The rider's heel should rest on pedal with leg straignt while rider is seated on saddle.)

      (4) Tighten nut securely with box wrench. (Emphasize the importance of proper wrench size used. Wrong wrench will damage nuts and bolts.)

   b. Adjusting saddle tilt

      (1) Loosen nut on saddle clamp with a box wrench.

      (2) Tilt front of saddle up if rider tends to slide forward.

      (3) Tilt front of saddle down if rider tends to pull on handlebars.

(4) Tighten saddle nut with box wrench.

(5) Inspect saddle for broken springs or frame.

c. Adjusting the handlebar height

(1) Loosen handlebar post bolt with box wrench. (Do not remove bolt.)

(2) Tap bolt down with mallet to loosen tapered plug.

(3) Straddle front wheel and raise or lower handlebar.

(4) Tighten post bolt securely with box wrench. (Make sure handlebar is aligned with front wheel.)

d. Adjust the tilt of the handlebar

(1) Loosen clamp bolt with box wrench.

(2) Tilt handlebar to desired position and tighten clamp bolt securely.

2. Have individual pupils sit on the bike to test the position of the handle.

The position is correct if:

a. The ball of the pupil's foot is on the pedal

b. His knee is slightly bent

c. His body is leaning forward slightly

3. Organize the class in teams (three pupils in each group). Ask each team to check and to adjust the saddle on the bike as they have been taught.

4. Ask the class to evaluate each performance.

Outcomes:

1. Manipulative skills learned:

a. Use of various wrenches

b. Making adjustments on saddle and handlebars

2. Academic learnings:

Language Arts:

Vocabulary

saddle	align	secure
adjust	straddle	penetrating
tapered	tilt	tighten

Assignment:

Ask the pupils to make a drawing of a bicycle saddle. (See fig. 2)

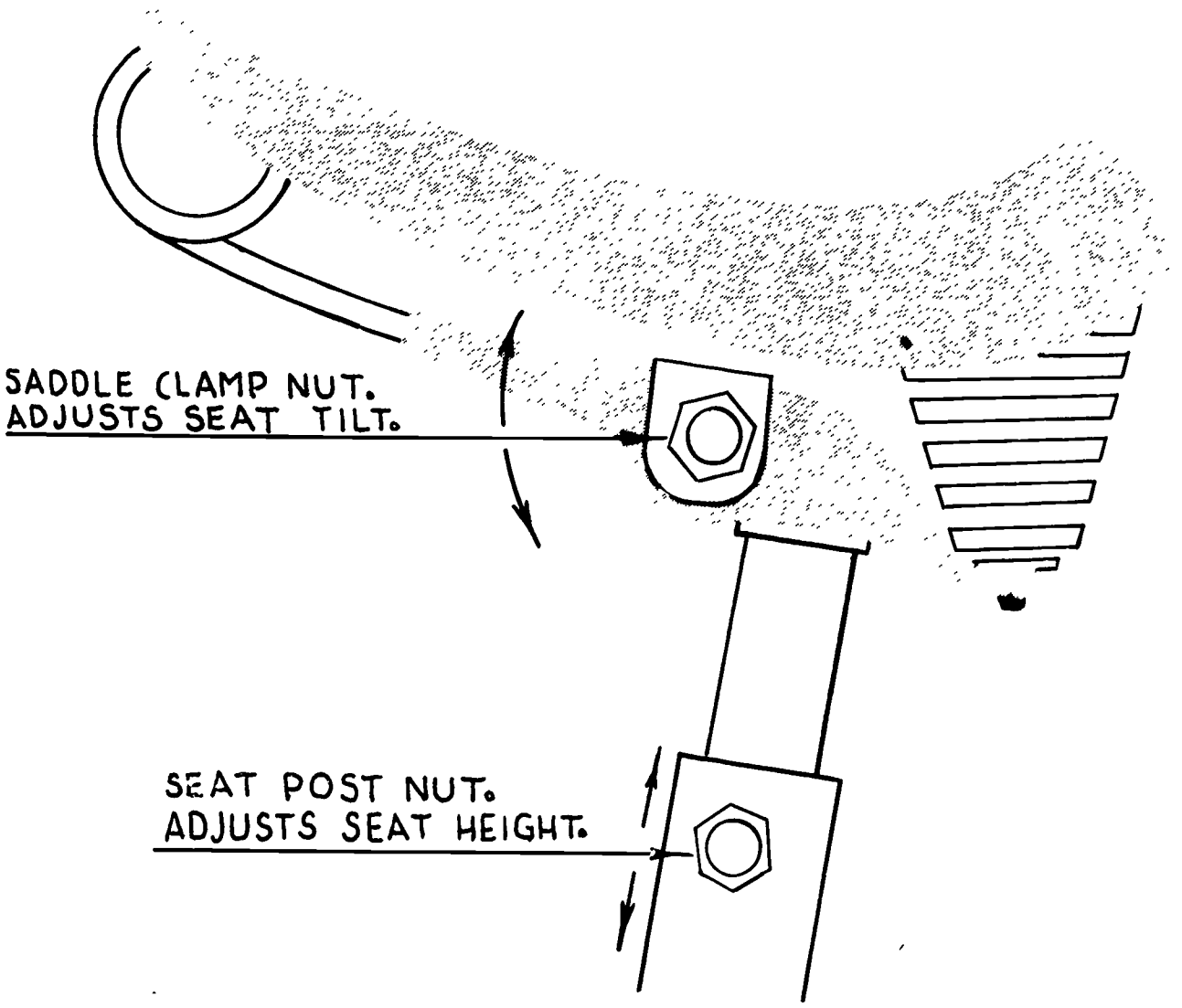

Fig. 2

Reference:

McFarlane, John, It's Easy to Fix Your Bike, Follette Publishing Co., Chicago, 7, Ill. 1958

How to Remove and Replace Bicycle Front Wheel

(Suggested Resource Lesson 3)

Tools:

bicycle wrench
cleaning brush
parts container
combination box-open and wrench set
cleaning basin

Materials:

cleaning solvent
grease
wiping rags
wheel bearing

Visual Aids:

large chart of front axle parts, axle nuts, lock nuts, cones, ball bearings

Motivation:

1. Discuss some of the reasons for removing the front wheel of a bicycle. (flat tire, loose axle nut, tire rubbing against fork)

2. Ask the question, "Have you ever experienced any of these difficulties?"

Procedure:

1. Review and demonstrate the removal of the front tire of a bicycle:

   a. Turn bicycle upside down.

   b. Remove both axle nuts with box wrench. (Do not use pliers on a threaded surface.)

   c. Remove fender supports and remove wheel from fork.

   d. Remove lock nuts and bearing cones from axle with open-end wrench.

   e. Remove bearings and axle from wheel hub. Place all parts in cleaning basin containing solvent, and allow to soak.

   f. Wash and scrub bearings and axle with brush. Then dry all parts including wheel hub. (Exercise caution when using cleaning solvents. Provide adequate ventilation.)

   g. Inspect all bearing surfaces for wear, damage, nicks or burrs. (cones, races and axle threads)

h. Pack wheel bearings with wheel bearing grease, and assemble bearings, axle, and cones to wheel hub.

i. Adjust bearing cones finger tight.

j. Replace wheel in the fork.

(1) Hold the bearing cone with bicycle wrench.

(2) Tighten axle nut with box wrench.

(3) The cone must not turn when the axle nut is being tightened.

k. Test for proper bearing adjustment by rotating the wheel.

(1) Wheel should turn freely and not wobble on the axle.

(2) Wheel must not rub against the fork.

2. Have individual pupils remove and replace the front wheel of the bicycle according to the instructions you have given.

3. Ask the class to evaluate each performance.

Outcomes:

1. Manipulative skills learned:

a. Use of various types of wrenches (box, open-end, bicycle)

b. Cleaning and lubricating of bearings and threads

c. Making sensitive adjustments on bearings

2. Safety practices learned:

a. The use of inflammable and toxic cleaning agents should be used with great care.

b. Solvents and lubricants should be stored properly.

c. Care should be taken to dispose of used rags to prevent combustion.

3. Academic learnings:

a. Science

Learning how ball bearings reduce friction

b. Language Arts:

Vocabulary

bearings	tension
cones	friction
lubrication	

c. Mathematics

(1) The dimension of tire size when purchasing a new tire and tube

(2) Measuring the diameter of a wheel

Assignment:

Ask the pupils to draw parts of a bicycle and to label each part. (See Fig. 3)

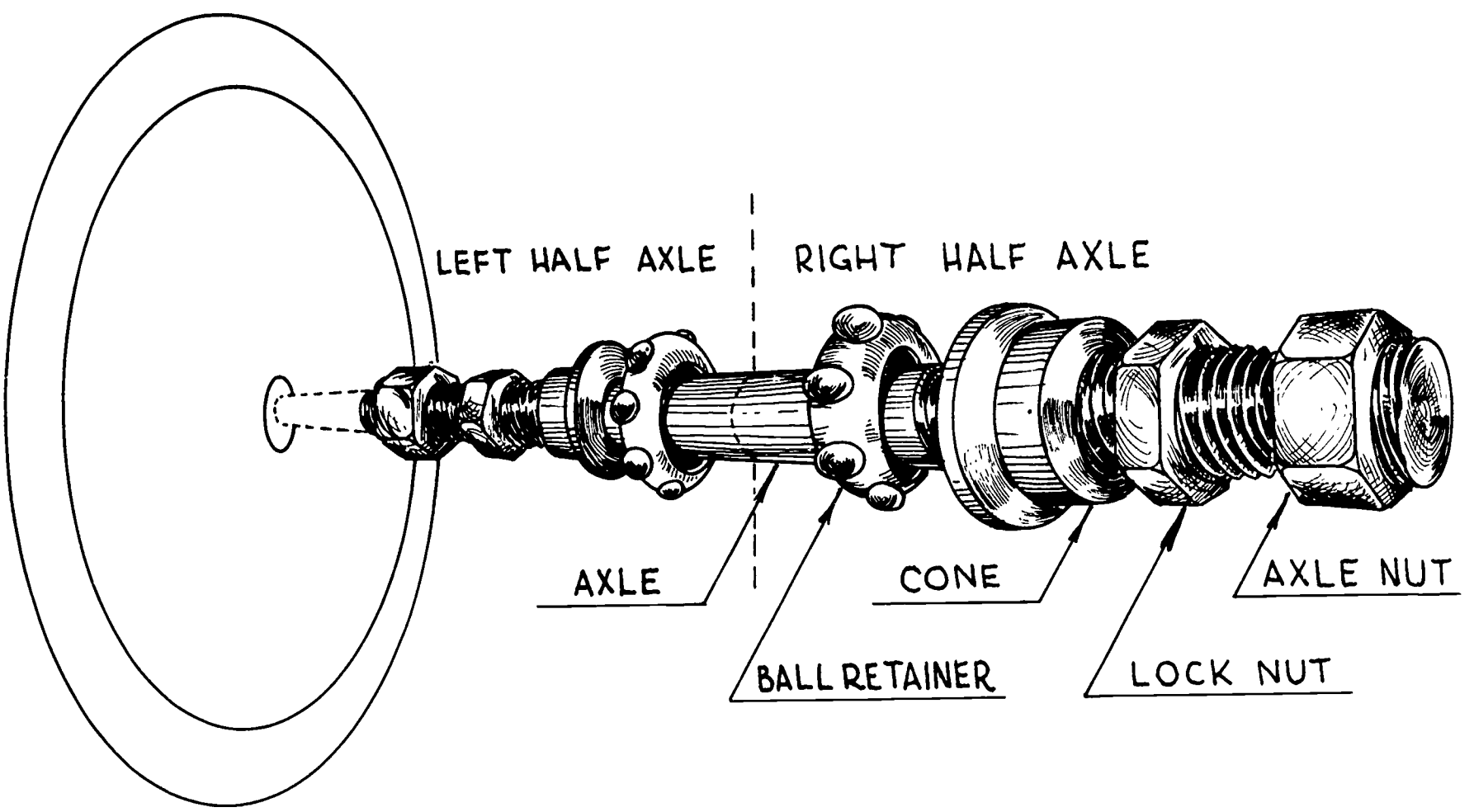

Fig. 3

References:

Geist, Roland C., Bicycling As a Hobby, Harper Bros. Pub. Co., 49 E. 33rd Street, New York, N.Y. pp 32-34

McFarlane, John, It's Easy to Fix Your Bike, Follette Publishing Co., 1010 W. Washington Boulevard, Chicago, Ill. 1958

Pine and Levine, Friction All Around Us, McGraw Hill Publishing Co., 330 West 42nd Street, New York, N.Y. 1960

UNIT II.

THE SINGLE CYLINDER TWO STROKE CYCLE AND FOUR STROKE CYCLE GASOLINE ENGINE

This unit is designed to familiarize the pupils with single cylinder two stroke cycle and four stroke cycle gasoline engine. Knowledge of the operation, care, and maintenance of this engine will help the pupils acquire skill with mechanics' tools, and an understanding of the practical applications of the gasoline engine as a primary source of power.

The basic learnings acquired in this unit will be utilized in the development of other instructional areas dealing with the care and use of power machines used on the farm, in the city, in the suburbs, and in the factory.

Operations and Processes to Be Taught

1. Preparation for starting the engine

    a. Position motor on a firm base.

    b. Attach engine exhaust manifold to flexible ventilation tube.

    c. Check fuel level.

    d. Check crankcase oil level.

    e. Inspect and lubricate carburetor linkage.

    f. Inspect and secure all ignition wires.

2. Starting the engine

    a. Read and study instructions in manufacturers' manuals.

    b. Check all safety precautions before starting engine.

3. Operating the engine

    a. Allow engine to reach operating temperature.

    b. Run engine through low, medium, and high speeds.

    c. Check engine's crankshaft speed with Tachometer.

4. Application of engine power

    a. Attach engine to automobile generator with V-belt to operate generator.

b. Attach Ammeter and Voltmeter to generator to observe generator output at various engine speeds.

c. Attach engine to water pump drive pulley with V belt and operate the engine.

d. Demonstrate use of the water pump to remove water from a pail.

Suggested Projects and Activities

1. Clean and lubricate the engine.

2. Refuel the engine.

   a. Measure and mix proportionate amounts of gasoline and oil.

   b. Add fuel to the gasoline tank.

3. Use Tachometer to measure engine speed.

4. Start and operate the engine

5. Use engine as a power source:

   a. to drive an automotive generator

   b. to drive a water pump

6. Diagnose and correct troubles in the electrical, mechanical, and induction systems of the engine.

Materials, Tools, and Equipment

1. Materials:

   wiping rags
   gasoline
   oil: SAE #10, #20, #30

2. Tools:

14 M.M. Spark plug socket	wire brush
spark plug gap gage	gasoline can, 1-gal.
thickness gage	funnel
pliers, vise grip	machinist's hammer, 8-oz.
monkey wrench	lead hammer
pipe wrench, 6"	wheel puller, 6"
pliers, slip joint, 6"	oil can, pump type

   set, socket wrenches 3/8" to 1", rachet drive, speed wrench, hinge bar, extension bars
   set, box-end wrenches, 3/8" to 1"
   set, open-end wrenches, 3/8" to 1"

screwdrivers, common, 4" - 6" - 8" - Phillips, 6"
set, Allen wrenches
files: flat, 8" - round, 8" - triangle, 6"

3. Equipment:

single cylinder two stroke cycle engine
single cylinder four stroke cycle engine
automotive generator with V belt pulley attachable to engine drive
flexible exhaust hose
dry powder fire extinguishers, 5 lbs.
asbestos blanket
water pump with V belt drive
engine Tachometer, 3/8" drive

Academic Learnings

1. Language Arts

   a. Reading instruction sheets and job sheets

   b. Locating items in Auto Parts Catalogues

   c. Writing up job-completion reports and repair progress sheets

   d. Taking notes during shop demonstrations

   e. Discussions on shop safety practices, repair operations, and use of special equipment

   f. Vocabulary

crank	heat	carbon monoxide
motor	gasoline	engine
petroleum	exhaust	speed
carburetor	ignition	revolution
explosion	mechanic	horsepower

2. Mathematics

   a. Use of fractions in selecting wrench sizes

   b. Measuring liquids (pint, quart, gallon)

   c. Use of ratios when measuring pressure with pounds

   d. Measuring diameter as applied to pulley sizes

3. Science

   a. Meaning and application of horsepower in power units

   b. Metals used in the manufacture of gasoline engines

c. Lubricating oils, their grades and uses

d. Types and grades of gasolines and additives

e. Types and uses of automotive wrenches

f. Engine air cooling

g. Electrical induction as applied to ignition

h. Rapid expansion of gases; compression pressures

i. Heat and ignition; conduction of heat

j. Detonation in gasoline engines

k. Evaporation

l. Carbon Monoxide poisoning

4. Social Studies

a. Iron mining regions in the United States

b. Steel, automotive, and petroleum producing regions in the United States

c. The use of motors and engines in the home, in the factory, on the farm, in the city, and in the suburbs.

5. Guidance

a. Talks to pupils by:

(1) Local vendor of small engines and outboard motors

(2) Repair mechanic from local garage

(3) Factory representative of small engine manufacturer

(4) Operator of lawn and gardening equipment

b. Suggested field trips:

(1) Service stations where engines are serviced

(2) Shopping centers where engines are sold

(3) Local airports where heating and power units driven by single cylinder engines are used

Personal Development

1. Developing the ability to work independently and with others
2. Learning the moral responsibility of the mechanic in his work
3. Learning work safety habits as practiced in industry
4. Understanding the academic and mechanical skills necessary in modern industry
5. Cultivating an appreciation for the proper care and use of tools and materials

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Rafferty, Max, Industrial Arts Automotive Mechanics, State of California, Department of Education, 721 Capitol Mall, Sacramento, Calif.

Stephenson, George E., Power Mechanics, Delmar Publishers, Albany, 5, New York. 1963.

Glenn, Harold T., Auto-mechanics Workbook, Charles A. Bennett Co., Peoria, Ill., 1962.

McGriffin, Mervin J., Automotive Mechanics, Principles and Operations, MacMillan Co., Canada, Ltd. 1962.

Audio Visual Aids

Films available at BAVI, Board of Education of City of New York, 131 Livingston St., Brooklyn, N.Y. 10001

1. Car Maintenance and Care, 11 min. color Coronet, 1951, J-A-V. By applying the simple, non-mechanical techniques of preventive car maintenance, Bill Richards lengthens the life of his automobile, reduces repair costs and insures greater safety.

2. Fundamental Skills, 11 min. Coronet, 1954, J-A.V. Before Tom takes his driver's license examination, his father checks him on the fundamental skills of car handling. His father demonstrates the skillful porcedures of getting the car ready, starting the motor, driving forward, stopping, backing, turning, signaling and parking.

Pre-Start Inspection of a Single Cylinder Gasoline Engine

(Suggested Resource Lesson 1)

Materials:

wiping rags	oil can
funnel	gasoline (1 quart)
paint brush, 1"	starting rope
liquid measure	lubricating oil

Visual Aids:

Wall chart showing labeled parts of a single cylinder engine

Shop model of a complete gasoline engine

Pictures of different types of engines

Chart showing detailed views of: carburetor, crankcase, ignition system

Teacher-prepared pre-start inspection check list

Motivation:

1. Show the pupils a picture of an auxiliary power unit that used a single cylinder engine to provide power for lighting through a generator.

2. Ask the question, "How can we be sure that the auxiliary power engine will operate when it is needed in an emergency?"

Procedure:

1. With the help of the pre-start inspection check list, demonstrate the following: (See Fig. 4)

   a. Place the engine on a firm base, supported to withstand vibration of engine, when it is running.

   b. Attach the engine exhaust to flexible ventilation tube. (Keep the shop adequately ventilated.)

   c. Remove dirt or grease accumulated on the engine.

   d. Check the oil mixture level. (Fuel and oil should be mixed as prescribed by engine manufacturer. Use a funnel when adding fuel and oil to the gas tank.)

   e. Inspect carburetor mounting for firmness and inspect all linkages for secure attachment.

   f. Remove carburetor air filter, clean with gasoline, and scrub brush. Replace filter securely.

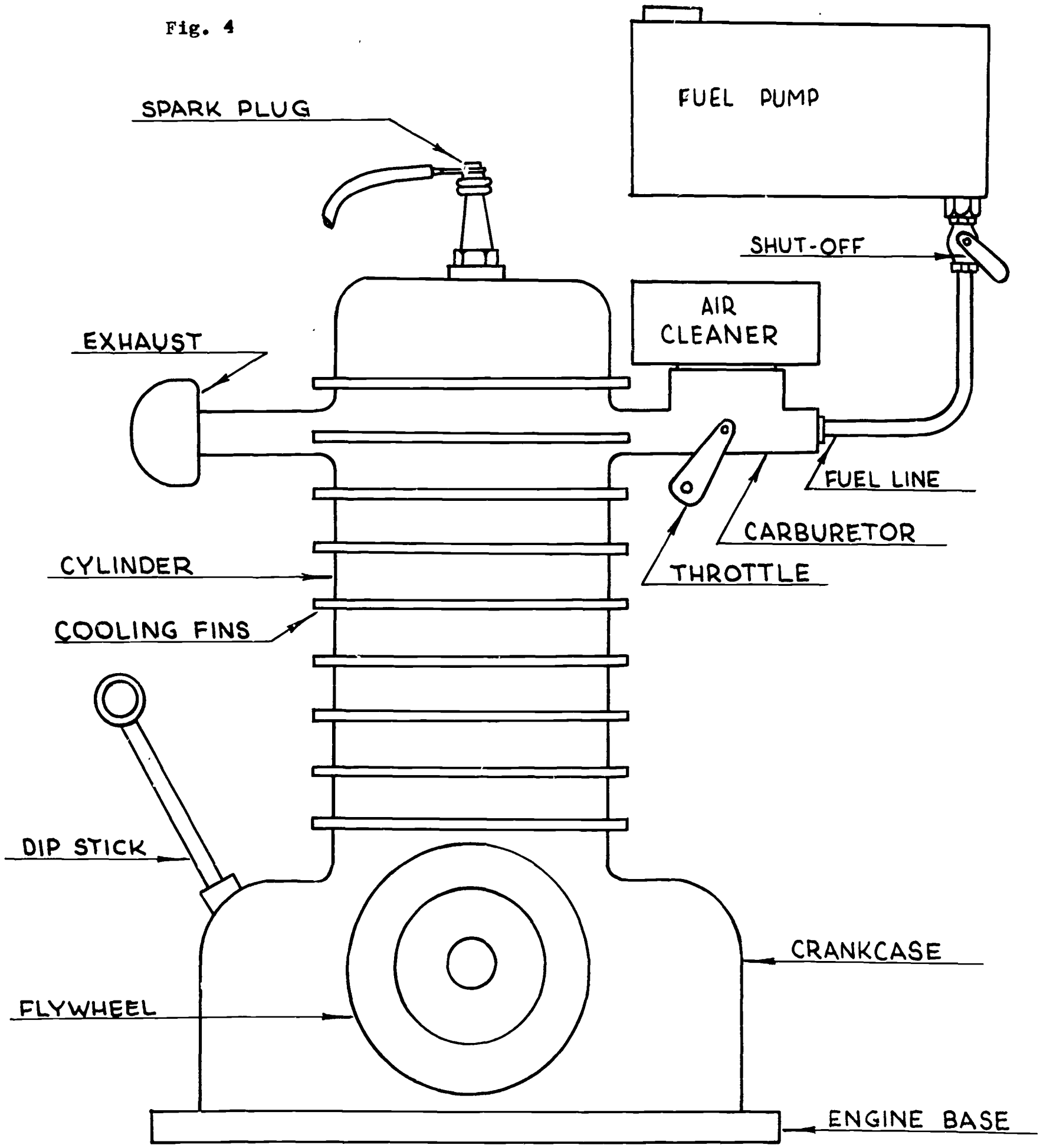
g. Check spark plug wire for breakage and loose insulation.

h. Test spark plug terminal for tight wire connection.

i. Check spark plug to see that it is threaded tightly to engine.

j. With a starting rope, or a starter spring, turn the engine crankshaft several revolutions to see if the shaft is free.

Fig. 4



2. Distribute copies of the pre-start check list to the pupils.

3. Organize the class in teams. (three pupils on each team)

4. Ask each team to make an inspection of the engine with the aid of the check list.

5. Collect all check lists for evaluation.

Outcomes:

1. Manipulative skills learned:

   a. Attaching flexible tube to engine manifold

   b. Cleaning an engine

   c. Checking oil level of engine crankcase

   d. Checking fuel level of the gas tank supply

   e. Mixing oil and gasoline in proper proprtion for two-stroke cycle engine

   f. Using funnel and measuring container

   g. Checking and lubricating carburetor linkages

   h. Cleaning carburetor air filter

   i. Using engine starting rope and starter spring

   j. Testing engine crankshaft for free movement

2. Safety practices learned:

   a. An engine must be mounted firmly for safe operation.

   b. To prevent possible engine fire, an engine must be cleaned well.

   c. Combustible liquids must be stored in a metal storage cabinet.

3. Academic learnings:

   a. Language Arts

      (1) Vocabulary

quart	ignition	crankshaft	engine
lubricate	carburetor	flexible	rope
gasoline	funnel	tank	cylinder
spring wire	linkage	rags	grease
stroke	liquid measure		

(2) Reading safety rules related to operation of engines

b. Social Studies

(1) The story of transportation

(2) The invention of the gasoline engine

(3) Occupational opportunities in the automobile industry

(4) The story of the petroleum industry from the oil fields to the neighborhood service center

c. Mathematics

(1) Liquid measure

(2) Purchasing gasoline and computing sales taxes

d. Science

(1) Fractional distillation of petroleum

(2) Combustion

(3) Evaporation

(4) Heat and lubrication

(5) Danger in carbon monoxide fumes

(6) Heat energy

References:

Groneman, Christopher H., Feirer, John L., General Shop, Third Ed., McGraw Hill Book Co., New York, N.Y., 1963.

Houmphrey, Geoffrey, Engines and How They Work, Franklin Watts, Inc., 575 Lexington Ave., New York, N.Y., 1962.

How to Start and Run a Single Cylinder Engine

(Suggested Resource Lesson 2)

Equipment:

Complete single cylinder 2-stroke cycle engine

Complete single cylinder 4-stroke cycle engine

Materials:

wiping rags
lubricating oil
gasoline

Visual Aids:

Single cylinder engine mounted firmly on stand and properly vented to take care of exhaust gases

Wall chart showing a single cylinder engine with parts labeled

Check list for starting an engine written on chalkboard

Motivation:

1. Elicit from the pupils that the internal combustion engine is used to run airplanes, ships, trucks, outboards, motor scooters, midget cars, model planes, lawn mowers, and other power machines.

2. Ask the class the question, "How do you start the engine of the lawn mower?"

Procedure:

1. Demonstrate the starting of the 2-stroke cycle engine as follows:

   a. Clean the air vent on gas tank filler cap so that atmospheric pressure enters the fuel tank.

   b. Open the fuel shut-off valve of the tank or carburetor.

   c. Set the magneto level to "Start" position. (slightly past center)

   d. Adjust the carburetor high speed needle for starting.

   e. Coil the starter rope, clockwise, around the starter pulley and pull to spin the fly wheel.

   f. When motor starts, advance speed control lever to "Fast" position.

g. Adjust needle valve until motor runs smoothly. If carburetor is flooded (gas dripping from carburetor) and engine will not start, shut off needle valve, move magneto lever back to "Start" position and spin motor until it sputters. Reset controls and try starting engine again.

h. Run engine to attain operating temperature. With the speed controls set in "Fast" position, adjust the high speed needle to position that provides smoothest operation. (A slightly richer mixture insures better lubrication and cooler running.)

i. Move speed control lever to "Slow" position and adjust the low speed needle so that the engine runs smoothly in lowest speed.

j. After adjusting the low speed needle, speed up the engine and readjust the high speed needle.

2. Organize the pupils in teams of three and have each team start the engine, following the procedure demonstrated.

3. Ask the class to evaluate each demonstration.

4. Have the pupils draw a sketch of the engine in their notebooks and indicate the location of: the air vent, the fuel shut-off valve, the fuel tank pump, the magneto level, the high speed level, the low speed lever, the priming pump, and the starter pulley.

Outcomes:

1. Manipulative skills learned:

   a. Adjusting the carburetor needle valve

   b. Coiling the starter rope around the pully to spin the fly wheel

2. Safety practices learned:

   a. Combustibles (gasoline, oil) should be handled with care.

   b. There should be enough ventilation to avoid carbon monoxide poisoning when running an engine.

3. Academic learnings:

   a. <u>Language Arts</u>

      Vocabulary

fuel	valve	carburetor
clockwise	lubrication	priming

b. Mathematics

(1) Determining engine horse power

(2) Use of Tachometer to measure R.P.M. (revolutions per minute)

c. Science

(1) Principle of the combustion engine

(2) Use of the pulley for power drive

(3) Use of lubrication for prevention of engine heat expansion.

d. Social Studies

(1) Travel in America 100 years ago

(2) Effect of the gasoline engine on city living

Reference:

Atteberry, Pat H., Power Mechanics, The Goodheart-Willcox Co., Inc., 1322 S. Wabash, Chicago 5, Ill. 1961.

UNIT III.

OPERATING SMALL MODEL CARS

The small model car is an interesting and compact mechanism for Career Guidance pupils to learn about in their industrial arts shop program. Working with a small, toy-like, attractive model car will provide opportunities for pupils to simulate adult automobile activities, i.e., selection, purchase, operation, maintenance, and repair of automobiles, as well as learning to drive, and learning the rules of the road.

These experiences will motivate learnings related to the occupations, and to the advanced courses of instruction in the automobile industry that are offered in high schools.

Suggestions for Organizing a Model Car Work Area

1. Select an appropriate area of the shop for a track raceway and include:

    a. Model homes and apartment houses

    b. Industrial centers and freight facilities

    c. Inter-connecting highways

    d. Other models to dramatize the industrial, cultural, and residential environment of a city

2. Design a multiple track raceway.

3. Provide work stations for group construction activities.

Operations and Processes to Be Taught

1. Building a model car

    a. Draw plans for construction.

    b. Cut metal with jeweler's saw.

    c. Cut heavy metal with hack saw.

    d. File metal shapes.

    e. Drill holes in metal.

    f. Use tube cutter.

    g. Fit metal wheels and bearings.

    h. Solder wire and tubing.

i. Assemble parts with nuts and bolts.

j. Shape and form plastic parts.

k. Assemble chassis.

l. Assemble electric motor.

m. Wind motor armature.

n. Paint and decorate body.

o. Apply decal decorations.

p. Use tape (electrical, masking).

q. Lubricate with graphite.

r. Assemble complete car.

2. Construction of panorama and raceway

a. Construct platform to hold tracks and panorama.

b. Plan, measure, and lay out miniature community areas.

c. Install tracks.

d. Wire 6-volt circuit.

e. Install 6-volt rectifier.

f. Install and operate Control Rheostat.

g. Install and operate car test dynamometer.

h. Attach and solder copper track tapes and electric wires.

i. Use Power Sabre saw.

j. Use Power Orbital sander.

k. Apply paint finish.

Suggested Projects and Activities

1. Building, designing, and fabricating parts for panorama setting of miniature city to include:

a. Apartment houses

b. Housing developments

c. Skyscrapers

d. Churches

e. Office buildings

f. Highways and streets

g. Traffic light systems

h. Navigation beacons and lights

i. Freight and railway terminals

j. Water front shipping centers

k. Parks and sports areas

l. Public buildings and monuments

2. Assembling of model car kits

3. Developing individual designs of model cars

4. Testing and operating model cars

Materials, Tools and Equipment

Most of the materials, tools, and equipment needed for the construction of the model car raceway area are standard items available in a career guidance industrial arts shop.

Academic Learnings

1. Language Arts

a. Vocabulary

motor	miniature	wrench
track	wheel	engine
city planning	speed limit	axle
solder	occupations	community
highways	chassis	street signs
traffic signal	road maintenance	tow truck
dynamometer	rheostat	orbital
rectifier	layout	armature

b. Reading directions for constructing model cars

c. Reading model car magazines

2. Social Studies

a. Transportation

(1) automobiles, trucks, and subways

(2) railroads, airplanes, ships and small crafts

(3) mail delivery, merchandise delivery

b. Recreational facilities

(1) parks

(2) sport areas

(3) theatres

c. Public services

(1) water filtration plants and reservoirs

(2) power plants

(3) water supply

(4) safety (police and fireman)

(5) medical centers

d. Education facilities

(1) schools and colleges

(2) libraries

e. Citizenship training

(1) observing rules for pedestrian safety

(2) observing traffic regulations

(3) courts and correctional institutions

(4) community planning

3. Mathematics

a. Measuring raceway area to scale

b. Solving problems of rate, time, and distance in the operation of model cars

4. Science

a. Electro-magnetism

b. Measuring and controlling electricity

5. Guidance

a. Occupational opportunities in the automobile industry

(1) Automobile mechanic

(2) Service station attendant

(3) Tow truck operator

(4) Garaging, selling, and renting automobiles

(5) Servicing used cars for resale

b. Occupations related to Community Services

(1) Policeman

(2) Fireman

(3) Public Works worker (road maintenance)

(4) Public utilities employee

(5) Building inspector

(6) Apartment house superintendent

(7) Teacher and social worker

Personal Development

1. Citizenship responsibilities:

   a. Understanding the necessity for many community services

   b. Respecting the rights and responsibilities of all persons in the community

2. Public Safety:

   a. Observing traffic regulations and driving courtesies

   b. Cooperating with civil government administrators and their department employees (policemen, firemen, inspectors and supervisors)

3. Economic responsibilities:

   a. Understanding the need for citizens' support in providing community services through taxes

   b. Providing training facilities and job opportunities for employees in the community and neighborhood industries

Audio - Visual Materials

1. Photographs of aerial views of community areas

2. Pictures of:

highways, roads, and streets	private homes
railroads	hospitals
ships, piers, waterfront areas	public buildings and monuments
shopping centers	industrial complexes
apartment houses	power stations
housing developments	model auto raceways
skyscrapers	parks and sport areas

3. Model Car Dynamometer for demonstrating operation of model cars (Dynamometer, Kit, Southern Engineering Products, Canton, Mass.)

4. Display of model car parts, labeled and mounted.

5. Road Maps

6. Subway Maps

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Bernstein, Allen L., Wells, David W., Trouble Shooting Mathematics Skills,Holt Rinehart and Winston, Inc., New York, N.Y. 1963. 359 pp.

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Turner,Rufus P., Basic Electricity, Holt, Rhinehart and Winston, New York, N.Y. Second Edition, 1963. 412 pp.

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Planning and Constructing a Panorama for Model Car Raceway Area

(Suggested Resource Lesson)

Materials:

lumber (soft)	plastic sponges
chicken wire mesh	poster colors
plaster of paris	sandpaper
powdered asbestos	emery cloth
plywood	finishing nails, 1"
polyethelene glue	shellac
sawdust	modeling clay
sketching paper	spray paints

Tools and Equipment:

tinners' snips	paint brush, 2"
artists' brushes, ass't.	putty knife
ruler	mixing bowl
sloyd knife	pliers
screwdriver	hammer

Visual Aids:

Aerial views of the city

Pictures of:

Buildings, streets, and industrial areas
Parks and recreation areas
Homes, schools, and shopping centers
Water front facilities, shipping, and railroad terminals

Motivation:

1. Show the pupils the aerial views of the city and discuss how cities are planned.

2. Elicit from the pupils the need for constructing a panoramic model of the city as a setting for the model car raceway.

Procedure:

1. Plan a model of the city with the pupils.

   a. Measure, and lay out the community areas to be included in the model:

      (1) Water front

(2) Railroad and bus terminals

(3) Industrial and commercial areas

(4) Residential areas

(a) Housing developments

(b) Private homes

(5) Streets, highways, and bridges

2. Have the pupils lay out the various areas on scaled drawing paper as follows:

a. Transfer detail plans of landscape and building structure in appropriate spaces, on the raceway platform.

b. Label and identify all areas to be constructed.

c. Sketch and plan details of models for the various areas.

3. Have the pupils do the following:

a. Make shapes to resemble buildings and land masses with wood and chicken wire mesh as illustrated in Step #1, Step #2, and Step #3 (Fig. #5).

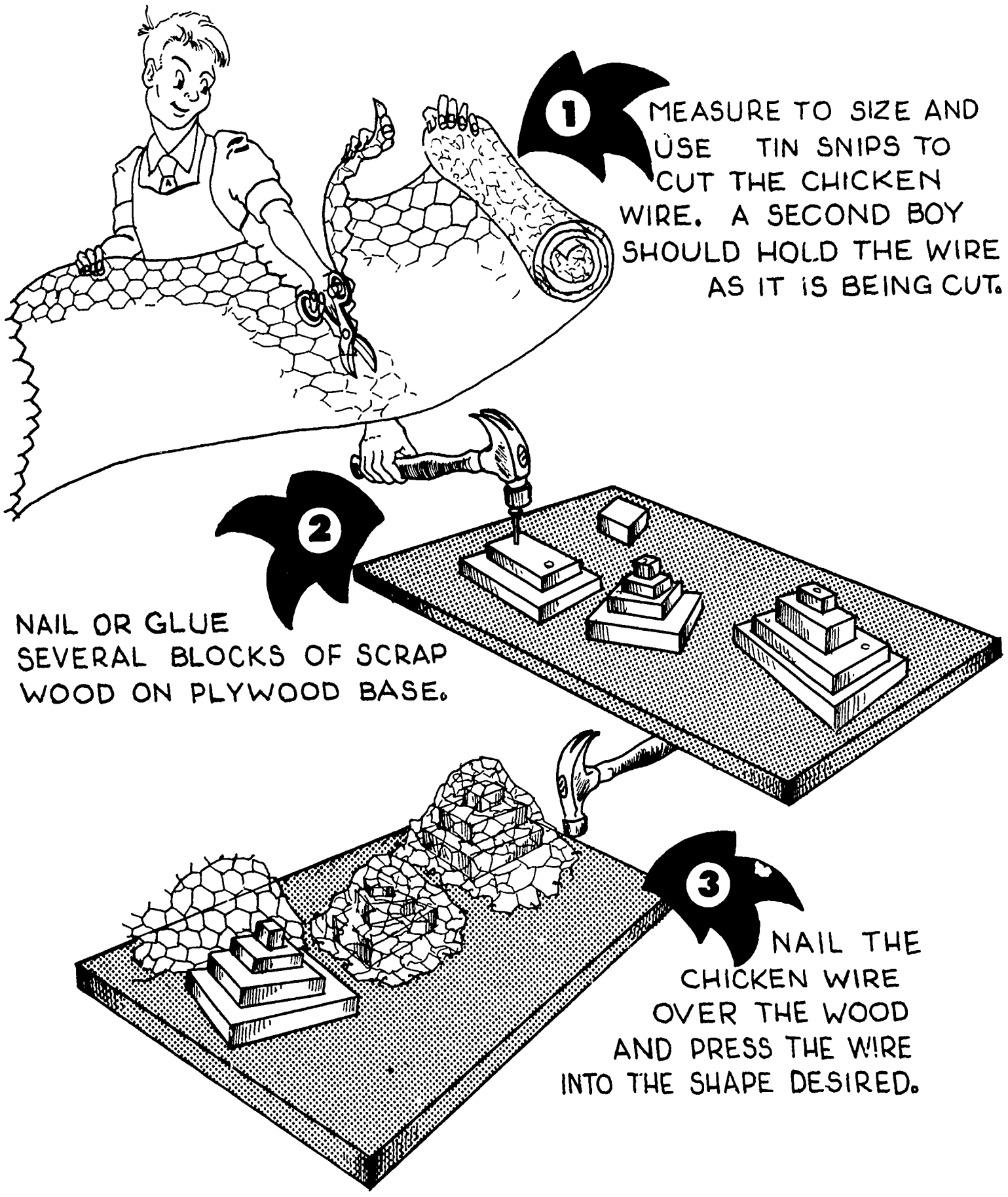


Fig. 5

b. Cover the basic shapes and forms with plaster of paris mixture as shown in Step #4, Step #5, and Step #6 (Fig. #6).

c. Shape the structured models, as the plaster hardens, with a putty knife and modeling tools.

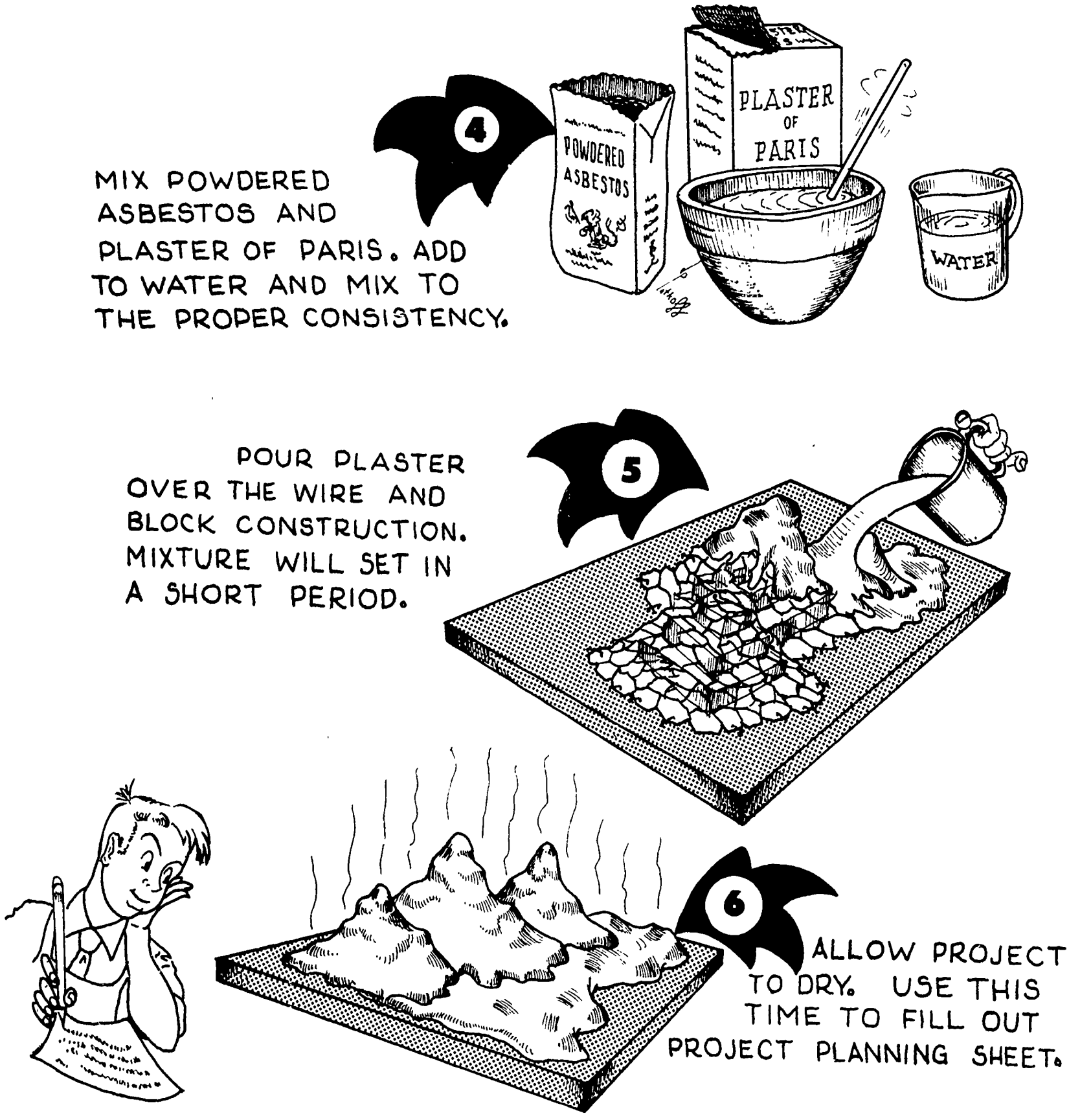
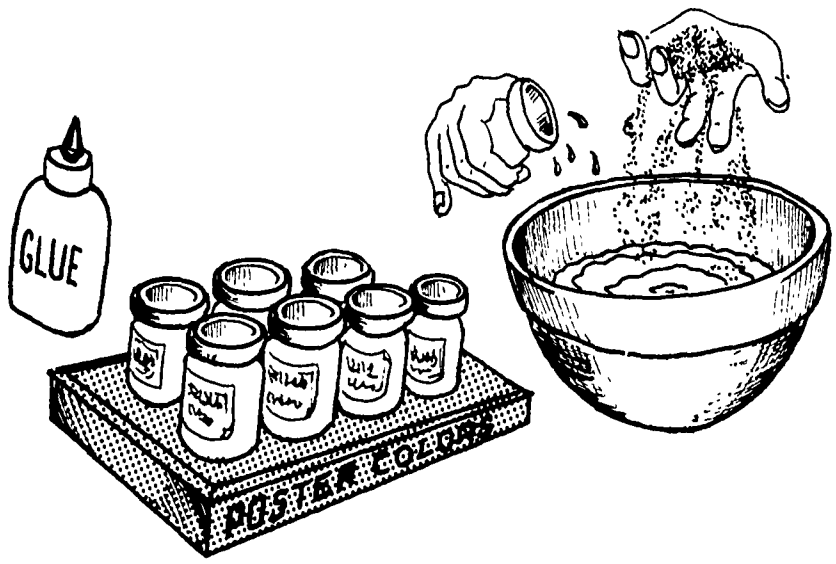


Fig. 6

d. Spread glue on the platform and sprinkle colored sawdust over it to make field surfaces, as shown in Step #7, (Fig. #7).

e. Make trees by shaping plastic sponge or fine steel wool. Then, glue these to the platform, as shown in Step #8, (Fig. #7).

f. Make road surfaces with sandpaper or emery cloth, as shown in step #9 (Fig. #7).

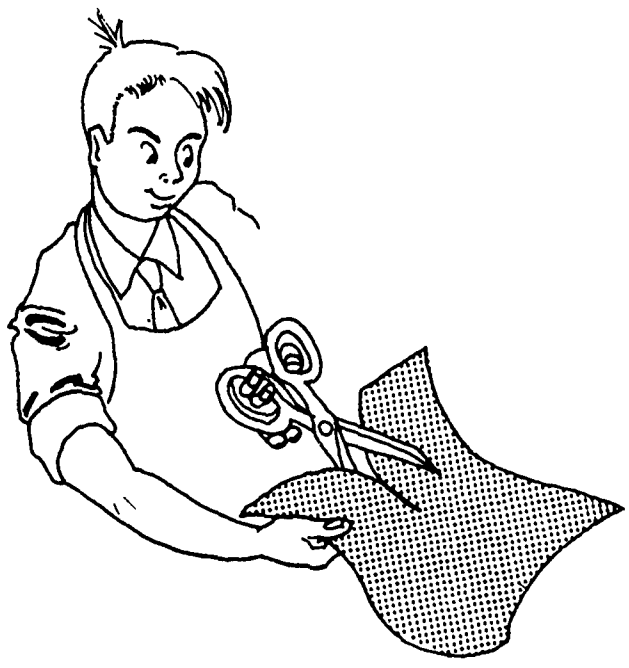


Step 7

Color sawdust in poster paints. Use green for grass and brown for earth. Allow to dry. Sprinkle generously over glue surface.

Step 8

Carefully tear fine steel wool or sponges into tree or bush shapes. Glue to diorama.



Step 9

Cut sandpaper or emery cloth to represent roads. Glue to diorama.

Fig. 7

g. Shellac all dry and hard surfaces.

h. Paint and decorate.

i. Cover the raceway area when not in use to protect it from dust and damage when not being utilized.

Outcomes:

1. Manipulative skills learned:

a. Drawing area plans to scale

b. Making detailed sketches of models

c. Transferring area drawings to platform surface

d. Cutting wood for models to specification

e. Attaching wood pieces with nails and glue

f. Cutting and forming chicken wire mesh

g. Mixing, pouring, and modeling plaster of paris

h. Applying shellac and paints

2. Safety practices learned:

a. Cuts from sharp wire ends should be avoided.

b. There should be proper ventilation when shellac and paints are used.

c. Care should be taken to prevent tools from rolling off the platform.

d. After using plaster, hands should be washed thoroughly.

3. Academic learnings:

a. Language Arts

city planning	landscaping	grading
drainage	highway	bridges
tunnel	subways	shipping
tinners' snips	adhesives	asbestos
expansion	contraction	asphaltum
plaster	mesh	traction
specifications	scale drawing	sketches
measurement	miniature	aerial view

b. Social Studies

(1) Problems related to city planning

(2) Traveling in the city by car, bus, and subway

(3) Observing rules for pedestrian safety

(4) Commuting to work in the city

(5) Parking and keeping the streets cleaned

(6) Directing and controlling traffic

(7) Using tunnels and bridges in the city

(8) Traveling by air and using city airports

(9) Visiting points of interest in the city

c. Mathematics

(1) Estimating and computing speeds in miles per hour

(2) Estimating and measuring distance in feet and inches

(3) Measuring distances on scaled maps

(4) Using liquid measure

(5) Measuring area spaces on platform to scale

d. Science

(1) Using copper as a conductor of electrical power

(2) Controlling electrical current with Control Rheostat

(3) Electro-Magnetism

(4) Grading, draining, and landscaping (highway and road building)

(5) Controlling car-skidding with the use of selected road building materials

(6) Improving design and manufacture of automobile tires for greater traction and road safety

(7) Expansion and contraction of road surfaces (use of asphaltum to control buckling)

e. Art and Mechanical Drafting

(1) Drawing areas and spaces on sketching paper for transferral to the platform surface of the raceway

(2) Sketching of buildings, roadways, and landscapes for transfer to appropriate spaces on the raceway platform

(3) Making working drawings of various models designed for panoramic setting of miniature city

(4) Selection of attractive patterns to decorate the raceway project

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- A R E A #4 -

OPERATING OFFICE DUPLICATING MACHINES

In the past few years many large business organizations have installed "in-plant" reproduction departments in their firms to produce such items as price lists, business forms and other office forms which would otherwise have to be sent to a letterpress printer for duplication. An example of such a department is the Mail Room at the Board of Education of the City of New York.

In 1965 there were a total of 131,000 such departments, an increase of ten percent over the previous year*. The employees in these shops operate 460,000 liquid duplicators, 465,000 stencil duplicators and 130,200 offset duplicators*. Frequently, simple bookbinding operations, e.g., collating, folding and wire stapling, are also a part of their work. The operation of this equipment may be on a skilled or semi-skilled level and pertinent to the Career Guidance Program.

Thus, this instructional area, "Operating Office Duplicating Machines," will offer the Career Guidance pupils instruction in a cluster of skills, which may lead to part-time employment in an in-plant shop or may provide motivation for additional training in the graphic arts industry.

To provide the pupils with experiences in this area, a small in-plant printing department may be set up in the Career Guidance shop, equipped with as many office duplicating machines as possible. The pupils can duplicate a great deal of the material requested by teachers and supervisors. This will not only offer the pupils an opportunity to develop manipulative skills and good work habits that are useful and important, but also provide a feeling of satisfaction and achievement because they are performing a service for the school.

Instruction may be organized to provide opportunities for individual projects as well as for mass production projects. The distinguishing factors between the individual and the mass-produced project is the quantity of work to be produced and the method of preparation for printing to be used. Thus, if a pupil designs a project and makes the master units (the mimeograph stencil, or the offset plates), it is considered an individual project. On the other hand, if the project is reproduced in quantity and involves the cooperation of other pupils in the preparation and printing, it becomes a mass production item.

* Reproduction Methods for Business and Industry, Annual Statistical Report, 1966, New York, N.Y.

The teacher should take advantage of the educational opportunities offered in developing a mass production project. Duplicating operations and processes performed in a shop situation, organized and patterned to simulate a small printing business, will familiarize the pupils with the basic production methods used in the graphic arts industry. By operating the simplified duplicating equipment used in our school offices, the pupils will become aware of the skills needed by a printer to prepare, run off copy, and to produce professional work.

To organize an in-plant printing unit in the Career Guidance shop the teacher should ask the principal's permission to move a mimeograph machine, a spirit duplicating machine and any other office duplicating machines available into the shop. He should also provide for the use of a paper cutter, a foot stapler, and other machines which are standard equipment in the graphic arts shop of the industrial arts department of most schools.

Suggestions for Teaching of Various Duplicating Operations and Related Activities

1. Liquid Duplicating Process

   a. Spirit duplicating machines

      (1) hand operated
      (2) electrically

   b. Principles of the liquid process

   c. Preparation of master units

      (1) typewritten
      (2) hand drawn

   d. Wetting devices

   e. Clamping and positioning master units

   f. Vari-colored printing

2. Stencil Duplicating Process

   a. Mimeograph machines

      (1) hand operated
      (2) electrically operated

b. Principles of mimeographing

c. Preparation of mimeographing stencils

(1) typewritten
(2) mimeoscoped
(3) electrically prepared

d. Placing stencil on mimeograph machine

e. Adjusting feed and delivery of paper

f. Method of placing an electrically-prepared stencil on the mimeograph machine

3. Offset Press

a. The offset process

b. Machines used

c. Preparation of press for printing

(1) inking
(2) dampening
(3) preparing the cylinder
(4) feeding
(5) delivery

d. Positioning of plate

e. Setting of paper magazine

f. Setting of guides

g. Handling of paper

h. Operating of press

(1) starting and stopping machine
(2) making adjustments
(3) supervising production

4. Stripprinter for Headlines

a. Principles of stripprinting

b. Operation of machine

c. Processes involved:

(1) use of film strips
(2) developing of film
(3) making paste-ups
(4) making stenofax stencils
(5) making offset plates

5. Paste-ups

   a. Use of paste-ups

   b. Processes involved:

      (1) use of tools and materials
      (2) use of simple paste-ups
      (3) use of rub-on type
      (4) use of paste on type
      (5) stripping in of type proofs

6. Electrically Reproduced Mimeograph Stencils

   a. Underlying principles

   b. Adjustment of light meter

   c. Use of burning-in stylus

7. Plate-making Machine for Offset Plates (Ravena)

   a. Placing original copy on sensitized plate

   b. Light exposure

   c. Placing paper negative on plate

   d. Developing of plate

8. The Paper Cutter

   a. Safety work practices

   b. Use of gauges and hand lever

9. The Stapler

   a. Hand operated, foot powered, electrically operated

   b. Side stitching

   c. Saddle stitching

10. Padding

   a. Jogging paper

   b. Using padding compound

   c. Using glue and bookbinder's crash

   d. Inserting chipboard

   e. Slitting pads

11. Collating

a. Collating machines

b. Quality control

c. Use of glycerine

Suggested Projects and Activities

1. Individual Projects

a. Calling cards

b. Birthday cards

c. Holiday cards

d. Memorandum pads

e. Shopping lists

f. Laundry lists

2. Mass Production Projects

a. Newspapers

b. Booklets

c. Office forms

d. Job sheets, information sheets (for shop)

Academic Learnings

1. Language Arts

   a. Proof reading

   b. Reading, writing and speaking technical language

      (1) Reading job sheets, information sheets and reference material

      (2) Preparing oral and written reports related to projects

2. Mathematics

   a. Estimating cost of paper, supplies, etc.

   b. Cutting stock to dimensions

   c. Learning the printer's point system

   d. Using different sizes of stock (weight, width, and length)

3. Science

   a. Composition of the metal used to make type

   b. Chemistry of ink for printing

   c. Chemistry involved in the process of printing by offset

   d. Photography in the offset process

   e. Mechanical principles (friction, pressure, speed)

4. Social Studies

   a. Source of raw materials (paper, ink, chemicals)

   b. Famous printers (Johann Gutenberg, Benjamin Franklin, etc.)

   c. History of printing

   d. Cultural contributions made by the graphic arts industry

5. Art

   a. Making layouts (proportion, balance, harmony)

   b. Designing copy

   c. Using drawing tools

6. Guidance

   a. Economic importance of the printing industry

   b. Career opportunities in the graphic arts industry

      (1) Bookbinding Industry (folding, collating, stapling, booklet trimming, and wire stitching)

      (2) Printing Press Work (feeding, make-ready, and color press work)

      (3) Hand Composition (pulling proof, type setting, and lockup)

   c. Opportunities for training in high school

   d. Apprenticeships offered by the graphic arts industry

Personal Development

1. Developing a sense of responsibility when initiating and completing an individual project

2. Learning to work with others as a team when working on a mass production project

3. Developing leadership qualities by directing, supervising, and performing shop assignments

4. Developing a sense of willingness by contributing to the production of projects for the school, local hospitals, the American Red Cross, and other community agencies

Duplicating a School Newspaper

(A suggested resource unit)

This unit is offered as a guide for developing techniques of teaching and selection of materials when planning lessons in other areas.

The pupils are given an opportunity of learning how to duplicate materials prepared for a school newspaper. This activity can be carried on as a mass production project. Committees of pupils are organized for every phase of the work: editing, production, circulation, advertising, etc.

Every teacher in the Career Guidance Program takes part in this project. The language arts teacher designates the editor-in-chief, assistant editor, reporters, sports editor, art editor and columnists. The mathematics teacher works with the pupils who manage the business aspect of publishing the newspaper: establishing advertising rates, production costs, and costs of supplies necessary. The typing teacher helps with the preparation of the stencils and the industrial arts teacher is responsible for the mimeographing (or offset printing), collating, stitching and distribution of the newspaper.

In order to insure some degree of success, it is suggested that this project be developed on a small scale.

Operating a Mimeograph Machine

Materials:

Mimeograph machine

Ink measuring rod

Impression paper

Absorbent file wrapper

Cylinder protective cover

Prepared stencil

Rags

Suggested Visual Aids:

Enlarged drawing of a Mimeograph Machine with parts labeled

Filmstrip: Technique of Modern Mimeographing, #911-1005a, A.B. Dick Co., Chicago, Ill.

Motivation:

1. Inform the class that they have been selected by the principal of the school to print 1000 copies of the school newspaper.

2. Ask the pupils if they have ever used a mimeograph machine. (Fig. 1)

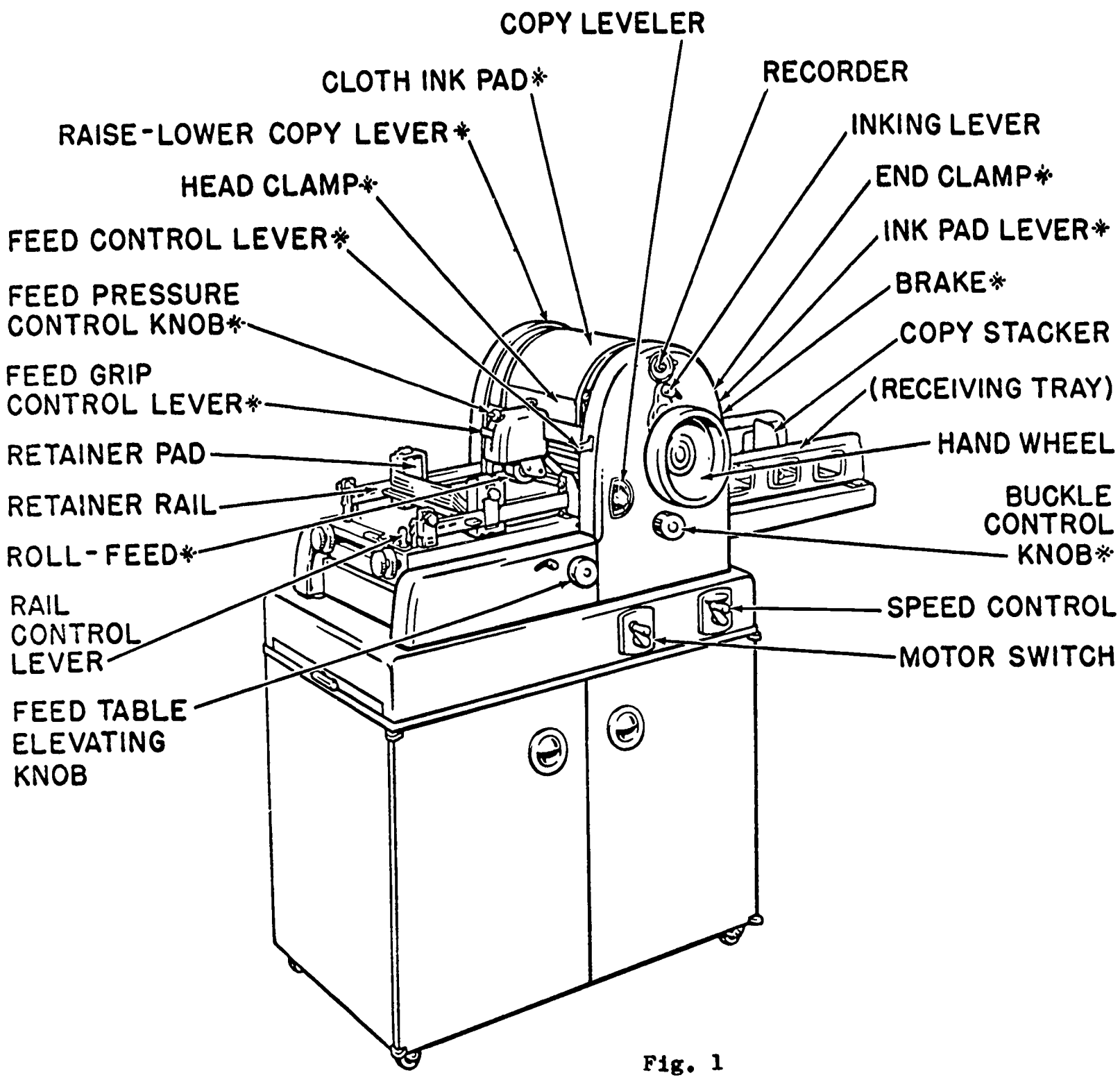


Fig. 1

Procedure:

1. Demonstrate the running of the mimeograph machine with the following instructions:

   a. Release the brake on the mimeograph machine.

   b. Raise the clamp lever and remove the protective cover. (Fig. 2)

   c. Measure the closed cylinder ink supply.

   d. Turn the cylinder and open the head clamp. (Fig. 3)

   e. Attach the stencil, keeping the backing sheet up. (Fig. 4)

   f. Hold the stencil taut and lay it down over the cylinder.

   g. Turn the cylinder sufficiently to open the end clamp.

   h. Set the feed table retainer and retainer pads. Then place the paper on the feed table. (Fig. 5)

   i. Make certain that the brake lever is in the horizontal "OFF" position before running the copy.

   j. Run a single test copy. Check the position of the copy on the paper.

   k. Adjust the mimeographing on the paper.

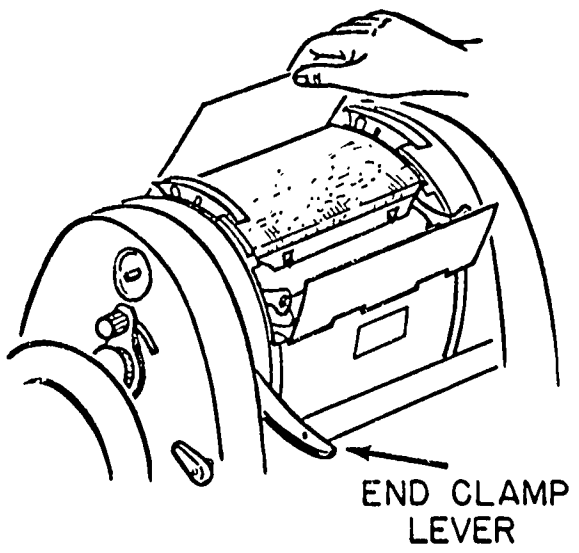


Fig. 2

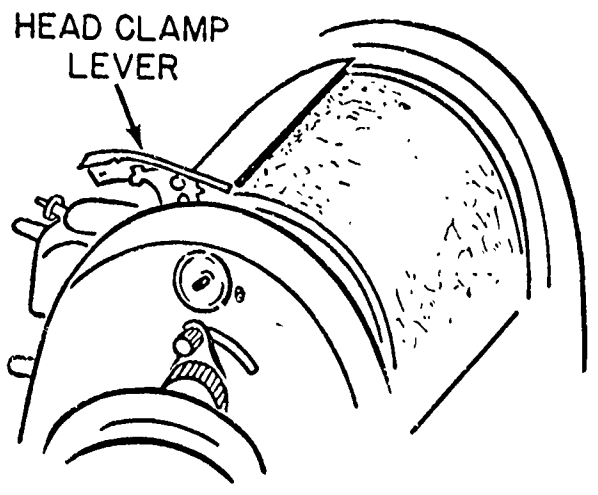


Fig. 3

2. Ask several pupils to perform the steps that were demonstrated, while the rest of the class observes carefully.

3. Then, organize the class in teams of three pupils each.

4. Have one team run off 100 copies of a sample stencil, while the rest of the class observes.

5. Ask each pupil on the team to evaluate his own performance.

6. Now, have each of the other teams operate the machine.

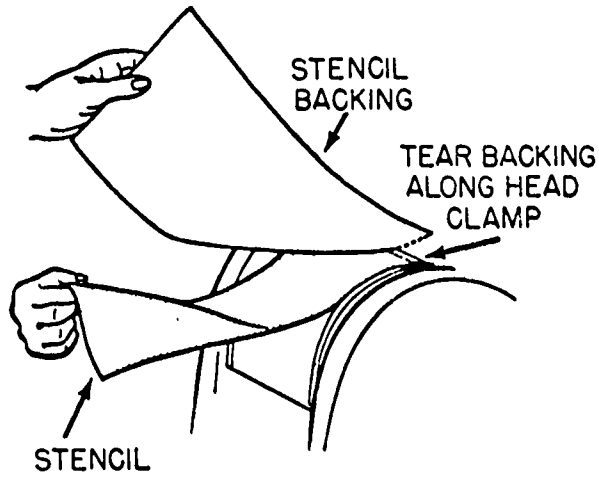


Fig. 4

Assignment:

Distribute teacher-prepared notebook assignment sheet to each pupil.

Outcomes:

1. Manipulative skills learned

The pupil learns how to:

a. Measure the ink in the cylinder

b. Attach the stencil to the cylinder

c. Adjust the paper feed table

d. Operate the mimeograph machine

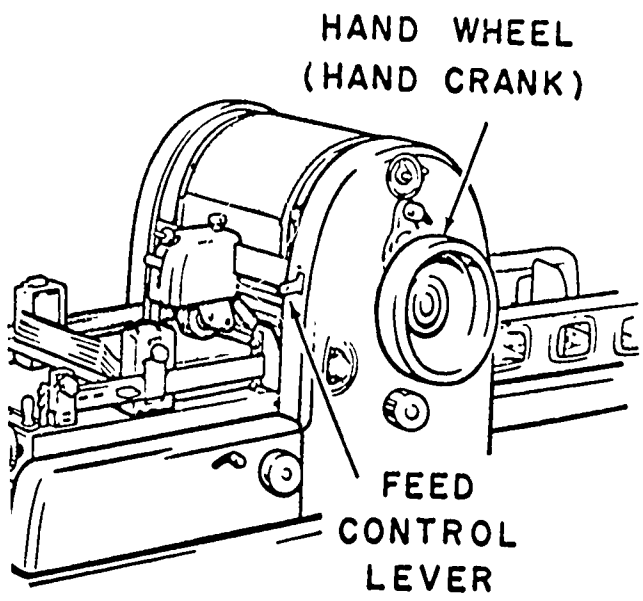


Fig. 5

2. Safety practices learned:

   a. All parts of the mimeograph machine must be checked before operation.

   b. When the machine is in operation, hands should be kept off moving parts.

   c. The machine should not be started at high speed.

   d. The machine should be tended constantly while it is in operation.

   e. When the job is completed care should be taken to clean up the machine and the work area.

3. Academic learnings

   Vocabulary:

mimeograph	measuring	duplicator
absorbent	impression	recorder
copy	lever	brake
elevating	control	switch
motion	retainer	buckle
knob	ink	clamp

References:

1. Techniques of Mimeographing, A. B. Dick Co.,Chicago,Ill.,1964

2. Fundamentals of Mimeographing, A.B. Dick Co.,Chicago,Ill.,1965

Suggested topics for additional lessons:

1. Making a layout for a mimeograph stencil

2. Making a mimeograph stencil

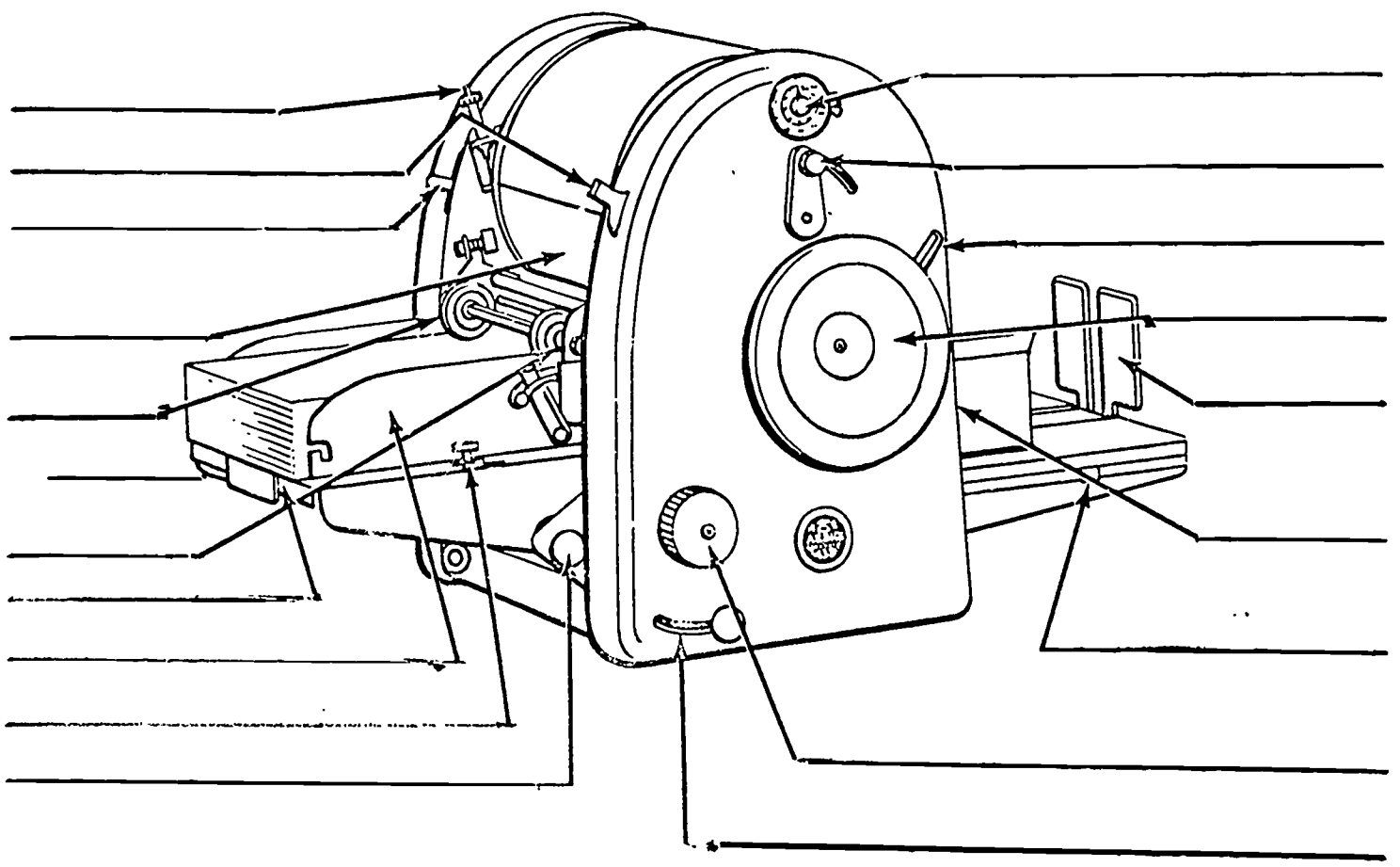
3. Paper cutting, (operating the paper cutting machine)

4. Collating

5. Operating a foot power stapler

6. Padding

Suggested Notebook Assignment



Mimeograph Machine

1. Label the parts of the machine on the lines provided.
2. Complete the following sentences:
   a. The mimeograph machine is used to _____.
   b. A stencil is made on a _____.
   c. The standard size of paper used is _____.
   d. _____ ink is used on a mimeograph machine.
   e. The purpose of the end clamp is to _____.

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4. Polk, Ralph W., The Practice of Printing, Charles A. Bennett Co., Peoria, Ill., 1960.

5. Mimeograph Techniques, A. B. Dick Co., Chicago, Ill., 1964.

6. How to Run a School Newspaper, A. B. Dick Co., Chicaog, Ill., 1965.

Audio-Visual Materials

1. The Stencil, A. B. Dick Co., Chicago, Ill.

2. The Mimeograph, A. B. Dick Co., Chicago, Ill.

3. Offset in Schools, Addressograph-Multigraph Corp., Cleveland, Ohio.

4. Modern Office Duplicating, Addressograph-Multigraph Corp., Cleveland, Ohio.

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Vocational Agriculture Course of Study Guide.

Utah State Dept. of Public Instruction, Salt Lake City
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ABSTRACT - Prepared by a committee of vocational agriculture teachers and state staff, this curriculum guide is for teacher use in planning and implementing high school vocational agriculture programs in Utah. Emphasizing both the scientific approach in teaching vocational agriculture and the practical approach of student and teacher activities in the field, the guide touches briefly on most major and many secondary farm enterprises of the State. Brief introductory material covers the history of vocational agriculture, the philosophy and objectives of the program, methods of teaching, and an explanation of the contents, followed by suggested topical outlines for Vocational Agriculture I, II, III, and IV, and Agricultural Mechanics I, II, and III, listing areas of instruction, level of course, and total days alloted per area. The major portion of the manual consists of detailed units of instruction for each course, providing content, hours, suggested student activities, teacher activities and demonstrations, and recommended references, films, filmstrips, and other resources. Sources from whom resource and reference materials may be obtained are also listed. (AW)

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VOCATIONAL AGRICULTURE

COURSE OF STUDY GUIDE

UTAH STATE DEPARTMENT OF PUBLIC INSTRUCTION
Walter D. Talbot, Deputy Superintendent
Mark Nichols, State Director Vocational Education
Elvin Downs, State Supervisor Agricultural Education
Salt Lake City, Utah
1963

VT 01571

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FOREWORD

This State Course of Study was prepared by a committee composed of vocational agriculture teachers, a high school principal, a district superintendent of schools, and the State Supervisory Staff in Vocational Agriculture. This committee was appointed by the State Course of Study Committee, and drew from its experiences, as well as from other sources in the field of vocational agriculture in compiling this revised Course of Study Guide which is to serve as a pattern for the schools of the state.

The point of view taken in making this revision was to follow much the same plan developed in the original guide. Several new sections have been added to provide for new emphasis now being given in agricultural education by a majority of teachers throughout the state.

This Course of Study Guide touches briefly on most of the important farm enterprises and many of those of secondary importance in our state. Adequate coverage has not been given some of the specialty crops common to certain areas of the state. Dairying may not be given complete consideration for students in the dairy centers of Utah. Each teacher will need to adapt his program to fit his local needs. However, this program should serve as a valuable guide in course planning.

The jobs have been outlined in such a way as to present a practical approach to the problem. Teacher and student activities and demonstrations have been suggested that will take the class into the field where good vocational training takes place. An effort has been made to list references that are current and useable. Teachers should add to the list of books, bulletins, films, other aids, and such materials from the local library that will keep the Course of Study up-to-date.

It is important that the instruction in agricultural science be integrated with the farm mechanics instruction so that these two areas of vocational agriculture do not become two separate courses. For example, the study of crop harvest in the fall of the year should lead to the study of actual operation, care, repair and maintenance of harvesting equipment in the farm shop.

This Course of Study Guide should serve as a valuable aid in giving emphasis to the scientific approach in teaching vocational agriculture. This guide also suggests greater depth and breadth in our teaching as a means of meeting the agricultural challenge of the 60's.

Walter D. Talbot
Deputy Superintendent in
charge of Administration

INTRODUCTION

Farming is basic to the welfare of all citizens of Utah. While only a small percentage of the land in the state is tilled, eighty-five per cent or more of its area is used for grazing purposes. The preservation of watersheds on the high plateaus, the conservation of our soil, and the intelligent use of our natural resources is the concern of every Utah citizen. An effective educational program in farming, therefore, is perhaps the greatest economic resource in agriculture.

With these thoughts in mind, a program of vocational agriculture at high school levels is organized as a part of the public school system of the State. The primary purpose of instruction and supervision in vocational agriculture is, to train for proficiency in farming. Instruction in vocational agriculture, should, therefore, make a direct contribution to those who till the soil and manage the range. Such instruction will also make a direct educational contribution to those who enter other agricultural occupations; such as, agricultural business, agricultural services, or one of the many jobs in professional agriculture.

At the present time forty-six high schools in Utah conduct programs in vocational agriculture. The future growth of the program in Utah will include an extension of the program to a few additional schools and an expansion of the service in existing schools. It is anticipated that this extended instruction service will reach the young farmers and adult farmers of the state. This proposed extension of vocational agriculture in every farm area is in keeping with modern educational trends. The local high school building becomes the "Community Institute" for use of all the people, the high school pupils, the out-of-school youth and adults.

The Vocational Agriculture Program

1. History of Vocational Agriculture

Agriculture was taught in Utah rural high schools as early as 1905. It may be safely stated that as fast as rural high schools were established in Utah, agriculture was one of the course offerings. At first, it was taught largely as a science, with little application to practice. As early as 1910, there was a shift from academic agriculture to a more practical form of instruction with practical application on the farms of the students. In a few districts of the state, the home project work was an established practice by 1913, and agricultural teachers were employed on a twelve months' basis to visit the farms of students registered in agricultural courses.

Vocational agriculture under the terms of the Smith-Hughes Act was introduced into fifteen high schools in 1918. A total of 706 high school boys completed home projects in terms of the new Smith-Hughes program during that year. From this time on, the number of high schools conducting vocational agricultural programs increased. At present, forty-six of the eighty-two senior high schools in the state offer programs of vocational agriculture with instruction on a twelve-month basis. The all-day enrollments in vocational agriculture now total approximately 3,200 students.

History of Vocational Agriculture Continued:

The first evening schools for adults in agricultural education were held in 1924 when 219 adults were registered in eight courses in as many high schools. The first part-time post-high school agricultural courses were taught in 1928 when three courses were conducted with a total enrollment of fifty-eight young farmers. Since this time, adult farmer programs and young farmer programs have gradually increased in number and enrollments. During the fiscal year ending June 30, 1963, there were 29 young farmer classes conducted with 363 enrolled and 32 adult farmer classes with an enrollment of 406.

2. Philosophy of Vocational Agriculture

The Smith-Hughes Act provides that vocational agriculture "shall be that which is under public supervision and control; that the controlling purpose of such education shall be to fit for useful employment, that such education shall be less than college grade and be destined to meet the needs of persons fourteen years of age or more who have entered upon or who are preparing to enter upon the work of the farm or farm home." The philosophy behind this federal act is that the farm becomes the extended arm of the school. In effect this means that all vocational agriculture programs give major emphasis to participating experience and the doing aspects of education. Thus, each enrollee conducts a farming program under the supervision of the teacher on the home farm and attempts to put into practice "here and now" improved methods of farming which have come to his attention through the instructional program. Such improvements are in the category of farm improvements, improved practices, skills, and abilities. When these improved practices are put into operation, the economic as well as the social well-being of the whole farm family is improved.

Since the passage of the Smith-Hughes Act, many jobs once performed on the farm have moved off the farm as an agricultural business or service. The fact that agriculture is broad and includes many job opportunities other than farming is becoming an important consideration in agricultural education planning. It suggests that the curriculum in vocational agriculture should be planned so as to contribute to a person's vocational development, regardless of the agricultural career he enters.

3. Objectives of the Program

A. The vocational agriculture program has five primary objectives as follows

(1) To offer guidance to the new enrollees in high school which will help them to decide whether or not they are interested in following agriculture as a life's profession.

(2) To offer broad agricultural training to high school students who are interested in employment in an agricultural business, service or profession.

(3) To aid high school students (Future Farmers) who have chosen agriculture as a life's profession to acquire skills, abilities, understandings and to make a beginning in the farming business.

Objectives of the Program Continued:

(4) To offer an adequate educational program to post-high school young farmers, which will aid them in becoming successfully established in the farming business.

(5) To aid already established farmers with an educational program which will help them to make satisfactory progress as farmers.

4. Methods of Teaching Vocational Agriculture

Methods of teaching vocational agriculture are, to a major degree, tools to make teaching more effective. Although education in the area of vocational agriculture is designed to bring about desirable behaviors and improved practices, skills, or abilities, much more is at stake. Certainly the pupil is more important than the subject matter, so the teacher's first concern must be for the individual. The individual must not become a robot filled with mechanical skills, nor a parrot that repeats facts or formulas in agriculture. Instead, the individual should develop into a well adjusted citizen who has acquired skills, abilities, knowledge, and proper perspectives, and the ability to think and solve problems.

Just as skilled mechanics have tools to ply their trades, so should teachers of vo-ag have tools (methods) to motivate and inspire their pupils. Then, too, like the skilled mechanic, the teacher must select the right tool for the particular job. Some tools will be used more than others. Teachers may have to construct special tools for special units. Sometimes a combination of tools work to the best advantage, but the welfare of the individual must always be kept uppermost in mind.

As a general premise, teachers can keep in mind four important phases of the teaching process and can carefully select the tools to fit. By some educators, the four phases are referred to as the four steps in the basic method of teaching vocational agriculture. The four basic steps (not to be confused with Herbart's procedure) are listed as:

a. Analyze the present situation
b. Decide upon the immediate and long range goals
c. Develop a plan of procedure to attain the goals
d. Evaluate the progress - periodically until completed

The above steps can be used in class, group, or individual instruction as a basis for thinking through a teachable unit, for solving a problem, or analyzing a job. When planning a Course of Study, be sure that problem areas are stated as such, and that jobs or other units are listed in terms of something that is to be accomplished. Individuals should be challenged by teaching that elicits thinking. Sound thinking will bring greater depth and should bring out the "why" as well as the "how" in the completion of units. "Put depth into teaching."

In view of the recognized value of problem solving, teachers are encouraged to be alert for problems that by their timeliness and complexity challenge the pupils. The degree of complexity should fit the maturity and experience of the class members. It should be definitely understood that one or more good questions doesn't constitute a problem. Unless it is a life situation that causes concern, suspense, curiosity, doubt, or some degree of apprehension, and requires the use of facts and sound thinking to bring about a solution, the chances are that it is not a problem so far as vocational agriculture is concerned. Questions such as: "How many Holstein Cows are there in Utah?" and, "Why is the McClean County System of swine sanitation a good program?" are not problems. The second question may stimulate thinking, but what is there to solve? (See Hammonds, Teaching Agriculture Pages 96-140, McGraw-Hill Company, or Phipps and Cook's, Handbook on Methods of Teaching Vocational Agriculture, Interstate Printers, for further assistance on problems.)

There are numerous variations in the problem method. Four common variations listed by Rhoad * are:

a. Problem-solving with the possibilities - factors tables.
b. Problem-solving leading to a process or procedure.
c. Problem-solving through comparing the present situation with accepted standards.
d. Problem-solving through evaluating facts in a YES or NO decision.

Dr. Rhoad further warns that the "Problem method must never become a mechanical procedure." Students' needs, desires, situations, and interests must be considered.

When suitable problems cannot be found, a suitable farm job makes a good teaching unit. Jobs are readily broken down into managerial or operative types due to their very nature. Jobs are more readily analyzed if stated in terms of the actual situations -- something to be done. "Planning a Rotation for 160 acre irrigated farm in northern Cache Valley," would indicate the statement of a managerial job while "Preparing the farrowing pen," would indicate an operative type of job. Managerial decisions may have to be made in many of the operative jobs.

Every teacher of vocational agriculture should carefully consider each unit that he plans to teach and should ask himself the following questions. Why am I teaching this unit in preference to another one? Are my objectives realistic and worthwhile? Is it practical or beneficial? What benefits should class members derive from it? Can I justify taking their time and mine? Will their lives and their thinking be enriched, or will their abilities or understanding be increased or improved. If the questions are not satisfactorily answered, perhaps the unit should be replaced by a more suitable one.

---

* "Problem Method of Teaching," Operators Manual, Dr. C. E. Rhoad, University of Nebraska, College of Agriculture.

Methods of Teaching Vocational Agriculture Continued:

If the answers to the above questions are favorable, then prepare to teach this unit. While making plans to teach it, keep in mind the value of a written plan and the four-step method of teaching adapted from the great Johann F. Herbart. His five-step procedure was reduced to four and changed to aid teachers of vocational classes. The four helpful steps are:

a. Prepare the learner -- Find out what he knows; show him the need; challenge him to think; put him at ease; get him ready and in position.

b. Present the lesson -- Tell, show, illustrate, explain, ask questions; get others to ask questions; follow logical sequences; vary the method; use demonstrations, field trips, audio-visual aids, panels, symposiums, buzz sessions, etc.

c. Apply the instruction, question, examine the responses; have pupils analyze the problems; have them demonstrate that they have learned; make application to specific situation where feasible; have pupils perform under supervision.

d. Follow up -- See if that which has been learned is being done on the farm or in other areas. Assist with problems; point the way to higher achievements.

Agricultural teachers should accept one of the maxims frequently used in teaching circles where vocations are concerned. "If the learner hasn't learned, the teacher hasn't taught." They may have some exceptions to this, but you should think them over before citing any.

Teachers of vocational agriculture in the surging 60's have many of the greatest opportunities that have been given to educators. It is up to them to decide whether or not, according to challenges recently presented in a convention, if they will "hold the class," "give the lesson," or "inspire the pupils." The pupils are of paramount importance; teach them to seek facts, analyze situations, and encourage them to THINK.

5. Explanation of Contents

This Course of Study Guide outlines in some detail four years of agricultural science and three years of agricultural mechanics. This guide is designed to challenge the thinking of the student enrolled for four complete years and to assist the busy teacher in organizing course content for a complete vocational agriculture program.

In departments where the agricultural science and agricultural mechanics are integrated into a given period, the teacher must select those instructional areas from both fields as to best fit the needs of students enrolled. In departments offering less than four complete years of vocational agriculture, teachers must select the important areas of instruction and develop his course of study in terms of time available.

Explanation of Contents Continued:

There has been some departure from the theory that the course of study follow seasonal sequence. Some consideration was given in developing the course guide in agricultural science, but only in a few instances was consideration given in the agricultural mechanics section. Our first concern has been to organize large units of study, providing adequate depth and breadth as to develop well the competencies needed in the particular instructional area.

While preparing the Course of Study Guide in Agricultural Mechanics, the committee previously set it up on a monthly basis. After doing this, some problems were encountered relative to the use of the equipment found in most shops. It is to be understood that if there are 20 students enrolled in agricultural mechanics and only enough equipment for 8 boys, in arc welding for instance, that it will be necessary to give demonstrations and other essential instruction in several areas so that when the boys work in the shop they may be assigned to areas to utilize the equipment (8 arc welding, 4 gas welding and cutting, 4 sheet metal work, and 4 tool sharpening, would be an example). These boys would be set up in a rotation pattern so that within 20 days, all would receive opportunity to work in the 4 selected areas.

The Course of Study Guide in Agricultural Mechanics has been arranged on a quarterly basis and it is understood that teachers will arrange their instructional program to fit shop facilities, equipment, and tools available.

The work on individual projects will vary according to the needs of the enrollees and their various abilities. Much of the follow up work on demonstrations may be given through assignments on individual projects.

SUMMARY OF FOUR-YEAR

SUGGESTED COURSE OF STUDY OUTLINE

AGRICULTURAL SCIENCE

UNIT OR AREA	Agriculture I	II	III	IV	Total
Orientation into Department	4	--	--	2	6
Supervised Farming	29	23	21	16	89
Orientation, Leadership Development, & FFA	24	19	17	12	72
Ag. New Developments	--	--	8	--	8
Opportunities in Ag. and Ag. Business	5	7	--	4	16
Fairs and Shows (also under FFA)	--	7	--	--	7
Beef Production and Management	12	10	5	10	37
Dairy	19	12	15	10	56
Livestock, Judging, Fitting	--	--	5	--	5
Livestock, Keeping Healthy, Disease Control	--	--	--	22	22
Poultry	1-	5	6	--	21
Sheep	11	4	7	--	22
Swine	17	3	5	3	28
Ag. Agencies or organizations, farm or other	--	--	3	16	19
Farmstead Beautification - Landscaping	5	5	--	15	25
Farm Law	--	--	28	--	28
Farm Management (Marketing, Accounts, Credit, Labor use, etc.)	--	--	--	33	33
Cereal Crops	--	--	12	--	12
Crop Production	3	13	--	--	16
Forage Crops	5	--	12	--	17
Fruit Production	--	--	--	10	10
Row Crops	--	15	--	--	15
Range and Conservation	--	8	--	5	13
Soils and Fertilizers	5	19	21	--	45
Vegetable Crops	10	--	--	--	10
Rural Life Problems	--	--	--	3	3
Weeds, Identification and Control	--	13	--	2	15
Optional (New developments, current trends, reports, etc.	21	17	15	17	70
TOTAL DAYS	180	180	180	180	720

A SUGGESTED FOUR-YEAR CURRICULUM IN
VOCATIONAL AGRICULTURE

Department _____ Year _____

# Days	Vo. Ag. I	# Days	Vo. Ag. II
Sept. (20)	____ Leadership Development - Orientation (4)		____ Supervised Farming (10)
	____ Supervised Farming (11)		____ Leadership Development (orientation with dept., FFA Awards, Program of Work) (5)
	____ Ag. Opportunities (3)		____ Opportunities in and Importance of Agriculture (3)
			____ Optional (2)
Oct. (22)	____ Supervised Farming (3)		____ Supervised Farming (1)
	____ Leadership Development (10)		____ Weeds and Their Control (10)
	____ Dairy (selecting, determining opportunities) (5)		____ Dairy Prod. & Management (10)
	____ Crop Production (3)		____ Optional (1)
	____ Optional (1)		____
Nov. (18)	____ Supervised Farming (2)		____ Supervised Farming (1)
	____ Dairy (14)		____ Beef Prod. & Management (7)
	____ Optional (2)		____ Sheep Production (4)
	____		____ Swine Prod. & Management (3)
			____ Optional (3)
Dec. (16)	____ Supervised Farming (2)		____ Supervised Farming (4)
	____ Beef Production & Management (12)		____ Crop Production (Propagation, Food Manufacturing, vegetive) (10)
	____ Optional (2)		____ Optional (2)
	____		
	____		

* No. in ( ) indicated time suggested by Course of Study Co., but should be changed to meet local needs.

**Blank space on the left is provided for penciling in the actual time that you need for your program.

# Days	Vo. Ag. I		# Days	Vo. Ag. II	
Jan. (22)	____ Supervised Farming	(3)		____ Supervised Farming	(1)
	____ Poultry Production	(10)		____ Crop Production (Nutrients Absorption, Deficiencies)	(8)
	____ Leadership Development	(7)		____ Leadership Development (FFA Pub. Spk, Parliamentary Procedure)	(10)
	____ Optional	(2)		____ Optional	(3)
	____				
Feb. (20)	____ Supervised Farming	(1)		____ Supervised Farming	(1)
	____ Leadership Development	(7)		____ Poultry Production (Feeding, Showing, and Grading)	(5)
	____ Swine Production	(10)		____ Range Conservation & Management	(8)
	____ Optional	(2)		____ Ag. Vocations	(4)
	____			____ Optional	(2)
	____				
Mar. (21)	____ Supervised Farming	(2)		____ Supervised Farming	(1)
	____ Swine Production Cont.	(7)		____ Soils & Fertilizers (tilling, managing, maintaining favorable relationships, draining, maintaining fertility)	(19)
	____ Sheep	(11)		____ Optional	(1)
	____ Optional	(1)		____	
	____				
	____				
April (22)	____ Supervised Farming	(2)		____ Supervised Farming	(1)
	____ Farmstead Beautification	(5)		____ Dairy Production & Mgmt.	(2)
	____ Soils and Fertilizers	(5)		____ Beef Production & Mgmt.	(3)
	____ Forage Crops	(5)		____ Row Crops (Sugar Beets, Potatoes, other row crops, tomatoes, canning corn, onions, carrots, beans, peas, etc.)	
	____ Vegetable Crops	(3)		____ Optional	(1)
	____ Optional	(2)			
	____				

* ** See previous footnote.

	# Days	Vo. Ag. I		# Days	Vo. Ag. II	
May (19)	____	Supervised Farming	(3)	____	Supervised Farming	(3)
	____	Vegetable Crops (Cont.)	(7)	____	Leadership Development (FFA Contests)	(4)
	____	Ag. Vocations (Opportunities in Agriculture)	(2)	____	Preparing Exhibits for Shows (Beef, Sheep, Swine)	(7)
	____	Optional	(7)	____	Weeds and Their Control	(3)
	____			____	Optional	(2)
	____					

# Days	Vo. Ag. III		# Days	Vo. Ag. IV	
Sept. (20)	_____ Supervised Farming	(3)	_____	Organizations & Orientations	(2)
	_____ Leadership Development (FFA Fair and Show Exhibits, program of work, parliamentary practice.)	(10)	_____	Supervised Farming (Planning budgets, taking inventories, analyzing records)	(3)
	_____ Beef Production and Management (Breeding, Managing Equipment.)	(5)	_____	Range Conservation & Management (Exploring range and forest possibilities, cooperate in developing a conservation program, multiple range use possibilities.)	(5)
	_____ Optional	(2)	_____	Rural Life Problems (RAD, Community activities, individuals responsibilities, developing recreational facilities.	(3)
			_____	Ag. Occupations	(4)
			_____	Optional	(3)
Oct. (22)	_____ Supervised Farming	(2)	_____	Keeping Livestock Healthy	(20)
	_____ Leadership Development (FFA Citizenship Awards)	(5)	_____	Optional	(2)
	_____ Dairy Production & Mgmt. (keeping healthy, housing, culling.)	(13)	_____		
	_____ Optional	(2)	_____		
			_____		
Nov. (18)	_____ Supervised Farming	(2)	_____	Supervised Farming (Determining production goals, posting records, revising records of successful programs.)	(2)
	_____ Leadership Development	(2)	_____	Keeping livestock healthy (Selecting & using sprays and Chemicals)	(2)
	_____ Learning About New Developments in Agriculture (Research new varieties, new positions.)	(8)	_____	Beef Production (Selecting and purchasing.)	(2)
	_____ Swine Production (Producing breeding, housing, controlling disease.)	(5)	_____	Dairy Production and Management (Improving by breeding, marketing products, selecting, fitting showing, judging)	(10)
	_____ Optional	(1)	_____	Optional	(2)

* ** See previous footnote

Days	Vo. Ag. III		# Days	Vo. Ag. IV	
Dec. (16)	_____ Poultry Production, (Maintaining, culling, controlling diseases)	(6)	_____	Supervised Farming Programs	(2)
	_____ Farm Law (SS. Benefits, income, and property taxes)	(5)	_____	Leadership Development (Chapter program, public speaking, parliamentary procedure.)	(12)
	_____ Ag. Organizations (Grange Bureaus, etc.)	(3)	_____	Optional	(2)
	_____ Optional	(2)	_____		
			_____		

* ** See Previous Footnotes

#Days	Vo. Ag. III	# Days	Vo. Ag. IV
Jan. (22)	_____ Supervised Farming Programs (12)	_____ Supervised Farming (3)	
	_____ Sheep Production (Managing, breeding, controlling diseases) (7)	_____ Farm Management (Planning, renting, buying, and financing a farm; land use capabilities, labor costs, etc.) (17)	
	_____ Optional	_____ Optional (2)	
	_____		
Feb. (20)	_____ Forage Crops (12)	_____ Supervised Farming (2)	
	_____ Farm Law (Determining Water rights.) (3)	_____ Farm Management (Four Methods of doing business, economics of free enterprise system, etc.) (16)	
	_____ Soils & Fertilizer (Leveling for irrigation.) (2)	_____ Optional (2)	
	_____ Optional (3)	_____	
Mar. (21)	_____ Soils & Fertilizers (Irrigation draining, measuring water, selecting soil, planning rotation, conserving fertility) (19)	_____ Supervised Farming (2)	
		_____ Swine Production (3)	
		_____ Fruit Production (10)	
	_____ Optional (2)	_____ Farmstead Beautification (5)	
		_____ Optional (1)	
April (22)	_____ Supervised Farming (2)	_____ Supervised Farming (1)	
	_____ Cereal Crops (Raising, Cultural practices, varieties, planting, controlling.) (10)	_____ Farmstead Beautification (10)	
		_____ Beef Production (Equipment needed, selecting breeding, purchasing, etc.) (8)	
	_____ Farm Law (Determining farmers responsibilities, Liabilities, highway, animals, water, etc.) (10)	_____ Optional (3)	
May (19)	_____ Farm Law (10)	_____ Supervised Farming (1)	
	_____ Dairy Production & Management (2)	_____ Weeds and Their Control (2)	
	_____ Livestock Selecting, Fitting showing (5)	_____ Ag. Agencies (U.S.D.A., State, county, and other public.) (16)	
	_____ Cereal Crops (Judging & Grading) (2)	_____ Optional	

* ** See Previous Footnotes

Vocational Agriculture I

September - 20 Days

ORIENTATION AND FFA Getting Acquainted with Departmental Policies and Standards Getting Acquainted with the FFA Organization	4 Days
SUPERVISED FARMING Determining Opportunities of Supervised Farming Selecting Farming Programs Writing an Agreement Planning a budget Planning Farm Improvement Projects Planning Improved Practices Reviewing Records of Successful Supervised Farming Programs Posting Entries Preparing Exhibits for Fairs and Shows	11 Days
AGRICULTURE OPPORTUNITIES	3 Days
OPTIONAL	2 Days

Suggested Student Activities

Prepare exhibits of grain, root crops, and fruits for school or fair.
Spend one full period or half-day, if possible, visiting business establishments related to farming. Example - flour mill, stockyard, poultry dressing plant, nursery, cannery, feed plant, sugar factory, farm machinery dealers, etc.
Plan sample budgets for various production projects.
Enter sample receipts and expenses on sheet provided for various enterprises.
Prepare a list of possible farm improvements and improved practices for home farm.
Have state FFA officer visit chapter and discuss the FFA program.
Review state and national FFA program of work.
Review local program of work and those of nearby chapters if available.

Suggested Teacher Activities and/or Demonstrations

Demonstrate proper method of exhibiting farm crops common to area.
Arrange for good farmer to discuss farming opportunities.
Arrange for class to visit business related to agriculture.
Provide Utah Record Books that have been submitted for the State Farmer Degree.
Arrange to show FFA film.
Arrange for an American Farmer or State Farmer to talk to prospective members.

Recommended References for These Jobs

Books:*

Exploring Agriculture; Evans & Donahue; Prentice-Hall, 1963.
Handbook of Agricultural Occupations· Hoover, 1963 Interstates.
Your Opportunities in Vocational Agriculture; Phipps, Interstate, 1957

*Addresses of publishers found in Appendix

Farming Programs in Vocational Agriculture; Deyoe; Interstate, 1953.
Starting to Farm; Beard, Interstate, 1958.
Handbook for Conducting FFA Meetings; Russell, Interstate.
Programs for Future Farmer Chapter Meetings; Tenney, Interstate.
A More Effective FFA; Wall, Interstate, 1956.
The FFA and You; Bender, Clark and Taylor, Interstate, 1962.

Bulletins:

1959 Agriculture Census, Vol. I. Counties and State Economic Areas, Part 31 U. S. Department of Agriculture.
County Records.
A Job Guide for Utah Jobseekers; Utah Department of Employment Security; available from State School Office.
"Careers Ahead;" Utah State University; Logan, Utah.
"Choosing Your Career", Humphreys, Science Research Associates.
"Should You Go To College", Warner; Science Research Associates.
Utah Vocational Agriculture Record Book; Interstate.
Mimeographed sheets provided students for posting sample records.
Official Manual Future Farmers of America; Future Farmer Supply Service, P. O. Box 1180, Alexandria, Virginia.
Career Service Opportunities, Agricultural Handbook No. 45 U.S.D.A.
There's A New Challenge in Agriculture; U.S.U., Logan, Utah
Ext. Circular 288 - Handbook for Utah Fair and Show Officials, U.S.U., Logan, Utah.

Films:

A Way of Life; Farm Film Foundation; 1731 Eye Street N. W. Washington 6, D. C.
Permanent Agriculture; Farm Film Foundation
Farmer of Tomorrow; State Office.
25th FFA Anniversary; State Office.
Here and There With the FFA, Vernard, 113 N. E. Madison Ave., Peoria, Illinois.
Star Farmer of America; Vernard, 113 N. E. Madison Ave., Peoria, Illinois.
The American Farmer; Ford Motor Company, 4303 Telegraph Ave., Oakland 9, Calif.

Film Strips:

Occupations Related to Farming; State Office

Record: 33 1/3 RPM - 20 min.

The Strangest Secret; Earl Nightingale

October - 22 Days

SUPERVISED FARMING Check Inventories Posting Entries	3 Days
LEADERSHIP DEVELOPMENT Becoming acquainted with FFA Activities and Awards History, Aims, Purposes, Degrees, Organizations, Values, Requirements, Creed, and Program of Work	10 Days
CROP PRODUCTION The Importance of Plants Learning About New Crops and New Developments	3 Days
DAIRY Determining Opportunities in Dairying Selecting Dairy Cattle Determining Profitable Cows	5 Days
OPTIONAL	1 Day

Suggested Student Activities

Visit storage facilities for common crops of area.
Trace and label parts of dairy cow.
Analyze dairy profits.
Visit grade A and grade C dairy farms.

Suggested Teacher Activities and/or Demonstrations

Arrange for field trips.
Arrange for DHIA representative to discuss the dairy business with class.
Have successful dairyman visit the class and discuss possibilities.
Demonstrate WADAM method of keeping dairy record of production.
Give oral reasons on class of dairy cows.

Recommended References for These Jobs

Books:*

The FFA and You; Bender, Clark, Taylor; 1962 - Interstate.
Livestock and Poultry; Bundy and Diggins; 1961.
Handbook For Dairymen; Coletti; Iowa State - 1963.
Dairy Production; Diggins and Bundy; 1961.
Successful Dairying; Knodt; McGraw Hill, 1954.
Dairy Cattle; Yapp and Nevens; Wiley, 1955.
Exploring Agriculture; Evans and Donahue; Prentice-Hall, 1957.
Approved Practices in Dairying; Juergenson and Mortensen; Interstate.
Western Dairying; Lascelles; Interstate.

*Addresses of publishers found in Appendix

Crops in Peace and War; Yearbook of Agriculture; 1950-51, U.S.D.A.
Crop Production; Delorit and Ahlgren; Prentice-Hall, 1959.
Judging Livestock, Dairy Cattle, Poultry, and Crops, Youtz and Carlson; Prentice-Hall, 1962.

See other FFA books that are listed for September Ag. I.

Bulletins:

F 1443 Dairy Cattle Breeds; U.S.D.A. Supt. of Documents.
F 1470 Care and Management of Dairy Cows, U.S.D.A.
F 1626 Feeding Dairy Cows, U.S.D.A.
F 1998 Selecting Dairy Cattle on the Basis of Type and Production Records, U.S.D.A.
282 Fly Control on Dairy Cattle and in Dairy Barns, U.S.D.A.
Profitable Dairying, Union Pacific Railroad.
Cattle Husbandry - Lederle Laboratories.
Official FFA Manual

Films (Motion Picture)

New Horizons Along the Milky Way; Union Pacific Railroad.
Producing Quality Milk; Association Films, Chicago, Illinois.
The New Story of Milk; Comars, 922 Bannock Street, Denver 4, Colorado.
The Science of Milk Production; Ralston Purina Company, Checkerboard Square, St. Louis 2, Missouri.
Modern Dairy Production; Ralston Purina Company, Checkerboard Sq., St. Louis 2, Mo.

Films (strips)

Dairy Cattle Breeds; U.S.D.A.
Selecting the Individual; U.S.D.A.
Slides (How to Look At a Cow) Nasco.

Magazines:

Western Dairy Journal
Hoards Dairyman
Journal of Dairy Science, Dr. George Stoddard, U.S.U.

November - 18 Days

SUPERVISED FARMING Determining Production Goals Posting Entries	2 Days
DAIRY Producing High Quality Milk Fitting, Showing, and Judging Dairy Animals Marketing Dairy Products	14 Days
OPTIONAL	2 Days

Suggested Student Activities

Judge class of dairy animals
Test milk for butterfat
Fit and Show Dairy Animals

Suggested Teacher Activities and/or Demonstrations

Demonstrate testing for butterfat.
Demonstrate fitting of dairy animal.
Demonstrate showing dairy animal.
Judge and give oral reasons on one or more classes of dairy animals.

Recommended References for These Jobs

Books:

Judging Livestock, Dairy Cattle, Poultry, and Crops, Youtz and Carlson, 1962.
Livestock Judging Handbook; Nordby and Beeson; Interstate, 1960.
Dairy Farming; Petersen and Field; Lippencott, 1953.
Dairy Production; Diggins and Bundy; Prentice-Hall, 1955.
Successful Dairying; Knodt; McGraw-Hill, 1954.
Livestock and Poultry Production, Bundy and Diggins, Prentice-Hall, 1961.

Bulletins:

F 1422 Udder Diseases of Dairy Cows, U.S.D.A. Supt. of Documents.
F 1610 Dairy Farming For Beginners; U.S.D.A.
F 1769 Dairy Cattle Judging; U.S.D.A.
F 2017 Clean Milk Production; U.S.D.A.

Motion Pictures:

Producing Quality Milk; Association Films, Chicago, Illinois.
The New Story of Milk; Comars, 922 Bannock Street, Denver, Colorado.

Film Strips:

Fitting and Showing Dairy Cattle; U.S.D.A.

December - 16 Days

SUPERVISED FARMING Determining Production Goals Posting Entries	2 Days
BEEF PRODUCTION AND MANAGEMENT Determining Opportunities in Beef Production Selecting and Judging Fitting and Showing Purchasing Breeders, Feeders, Etc.	12 Days
OPTIONAL	2 Days

Suggested Student Activities

Visit good beef production unit.
Prepare table of beef breeds showing: place of origin, color markings, special characteristics, and importance in community.
Fit and show steer or heifer.
Judge classes of fat and breeding cattle.
Identify parts of steer.

Suggested Teacher Activities and/or Demonstrations

Arrange for beef field trips.
Arrange for judging classes for beef.
Demonstrate showing cattle.
Demonstrate fitting of cattle.
Give oral reaons on classes of cattle.
Assign students to fit and show cattle for department livestock show.
Give prize for best fitted steer.

Recommended References for These Jobs

Books:

Livestock and Poultry Production; Bundy and Diggins; Prentice-Hall, 1961.
Stockman's Handbook; Ensminger; Interstate, 1962.
Beef Cattle; Snapp; Wiley, 1960.
Raising Livestock; Deyoe, Ross, and Peters; McGraw-Hill, 1954.
Selecting, Fitting, and Showing Beef Cattle; Nordby and Lattig; Interstate.
Animal Science; Ensminger; Interstate, 1960.
Livestock Judging Handbook; Nordby, et al; Interstate, 1960.
Approved Practices in Beef Cattle; Juergenson, Interstate, 1958.
The Meet We Eat; Ziegler, Intersate, 1962.
Range Beef Production; Hultz; Wiley.
Judging Livestock, Dairy Cattle, Poultry and Crops, Youtz and Carlson, Prentice-Hall, 1962.

Bulletins:

Farmer's Bulletin #1135: The Beef Calf--Its Growth and Development, U.S.D.A.
Farmer's Bulletin #1549: Feeding Cattle For Beef, U.S.D.A.
Farmer's Bulletin #1592: Beef Production On The Farm, U.S.D.A.

Films:

Cattle Country; Union Pacific Railroad, State Department, Salt Lake City.
Grass and Cattle; Forestry Service.
Feeding Farm Animals, U.S.D.A.
Tex - The Story of a Champion Calf; The Texas Co., P. O. Box 1278, Butte, Mont.
Santa Gertrudis Breed; Farm Film Foundation, 1425 H Street N. W. Washington 5, D.C.
Hereford Heritage; Farm Film Foundation, Washington 5, D.C.
More Beef at Less Cost, Farm Film Foundation.
Hereford Story, Farm Film Foundation.
Modern Beef Cattle, American Angus Association, 3201 Frederick Blvd., St. Joseph, Mo.
Mr. Black, Builder of Better Beef; American Angus Association.
On American Angus Trails, American Angus Association.

Film Strips:

Winning the Beef Show Made Easy; Educational Film Strips, 1409 19th Street, Huntsville, Texas.

January - 22 Days

SUPERVISED FARMING	3 Days
POULTRY PRODUCTION	10 Days
Ordering Baby Chicks, Broilers, or Pullets	
Brooding and Feeding Chicks	
Housing Broilers and Layers	
Feeding for Production	
Raising Turkeys	
LEADERSHIP DEVELOPMENT	7 Days
Developing Public Speaking Abilities	
Developing Skills in Parliamentary Procedure	
OPTIONAL	2 Days

Suggested Student Activities

Visit up-to-date poultry farm.
Analyze poultry income records.
Prepare table showing--breed, color markings, special characteristics.
Plan brooding equipment for 1000 chicks.
Cull poultry flock.
Judge poultry classes.
Review winning FFA speeches of past years.
Outline special reports.
Give 5-6 minute talks using brief notes - no reading.
Record speech with tape recorder. Play back to note weaknesses.
Record parliamentary demonstrations on tape. Play back to note weaknesses.

Suggested Teacher Activities and/or Demonstrations

Arrange for poultryman to tell of his experience in poultry production.
Arrange for field trip to poultry farm.
Exhibit several breeds of chickens to class members.
Demonstrate culling of chickens.
Demonstrate selection of layers.
Give oral reasons on classes of poultry being judged.
Read FFA speeches of past years.
Outline a speech on chalkboard.
Arrange for speakers to appear before various groups.

Recommended References for These Jobs

Books:

Successful Poultry Management; Morley A. Jull; McGraw-Hill, 1951.
Poultry Management; Heuser, Hall, Bruckner, J. B. Lippincott, 1952.
Approved Practices in Poultry Production; Biddle and Juergenson, Interstate, 1963.

Books Cont.:

Your Future In Poultry Farming; Goodman and Tudor; Prentice-Hall, 1960.
Poultry Science & Practice; Winter & Funk; Lippincott, 1960.
Selecting, Fitting, and Showing Poultry; Nordby and Lattig; Interstate.
Feeds and Feeding; Morrison, Morrison Publishing Company, 1961.
Turkey Management; Marsden; Interstate, 1955.
Winning Future Farmer Speeches; Purkey, Interstate.
FFA and You; Bender, Clark & Taylor; Interstate, 1962.
Robert's Rules of Order; Roberts; McGraw-Hill, 1943.
Practical Parliamentary Procedure; Henderson; Interstate.
Public Speaking for Future Farmers; Judson, Interstate.

Bulletins:

Culling the Laying Flock; U.S.U. Extension Service.
Poultry Production in Utah; U.S.U. Extension Service.
Breeds of Poultry; U.S.D.A.
Farm Poultry Raising; Farmers Bulletin No. 1524, U.S.D.A.
Starting and Growing Future Layers; Purina Co., St. Louis, Missouri.
Brooding Chicks; U.S.U. Extension Service.
Raising Pullets in Confinement; Clark and Draper, U.S.U. Leaflet.
Broiler Feeding; Utah Poultry and Farmers Cooperation.
Standard Breeds and Varieties of Chickens; Farmer's Bulletin.
Selecting for Egg Production; Ext. Bulletin 186, U.S.U.
Official FFA Manual.
Helps in Mastering Parliamentary Procedure; Stewart, Ohio State University, Columbus, Ohio.

Films:

Culling Chickens; Union Pacific Railroad, 1416 Dodge St., Omaha, Nebraska.
Design For More Eggs; Union Pacific Railroad; 1416 Dodge St., Omaha, Nebraska.

Filmstrips:

Parliamentary Procedure Made Easy (3)
Educational Filmstrips
1409 19th St.
Huntsville, Texas

[illegible]y - [illegible] Days

SUPERVISED FARMING Posting Entries	1 Day
LEADERSHIP DEVELOPMENT AND FFA Developing Skills in Parliamentary Procedure Preparing for Contests Evaluate the Chapter Program of Activities	7 Days
SWINE PRODUCTION Determining Opportunities in Swine Raising Selecting and Judging Swine Selecting Breeds, Types, Conformation Housing	10 Days
OPTIONAL	2 Days

Suggested Student Activities

Deliver speeches to school assembly, service clubs, church, etc.
Each student serve as chairman of parliamentary team.
Demonstrate parliamentry procedure to school, church, and community groups.
Student committees review program of work and make recommendations for changes or additions for the coming year.
Plan summer activity program for chapter.
Visit good hog production unit.
Prepare a table for hogs showing: place of origin, color markings, special characteristics, and importance in community.

Suggested Teacher Activities and/or Demonstrations

Demonstrate proper use of gavel.
Arrange for competition between classes in parliamentary procedure.
Organize FFA Committees for work on Program of Work.
Assist FFA officers in preparing a report of years chapter accomplishments. to present to Board of Education.
Arrange for swine field trip.
Give oral reasons on classes of swine.

Recommended References for These Jobs

Books:

Programs for Future Farmer Chapter Meetings; Tenney, Interstate.
Robert's Rules of Order; Roberts - McGraw-Hill, 1943.
Pan-L-View Slide Rule on Parliamentary Procedure; 708 Church St., Evanston, Ill.
Principles and Types of Speech; Monroe, Scott and Foresman.
Swine Management; Anderson; Lippincott, 1957.
Swine Science; Ensminger; Interstate, 1961.

Books Cont:

Approved Practices in Swine Production; Cook & Juergenson; Interstate, 1959.
Leadership Training and Parliamentary Procedure for FFA; Gray and Jackson, Prentice-Hall, 1958.
A Handbook for Conducting FFA Meetings, Russell, Interstate.

Bulletins:

Official FFA Manual
FL 1263 Breeds of Swine; U.S.D.A., Supt. of Documents.
F 1437 Swine Production; U.S.D.A.

Films: (Motion Picture)

Hog Sense; Union Pacific Railroad (motion picture) State Office.
Pork on the Farm; U.S.D.A.
Judging Barrow; Popular Science, New York 10, New York.
Saving Little Pigs, State Office.
Buckshot Goes to the Fair, Texaco Co.

Filmstrips:

Winning the Hog Show Made Easy, Educational Film Strips, 1409 19th St., Huntsville, Texas.

March - 21 Days

SUPERVISED FARMING — 2 Days
- Posting Entries

SWINE PRODUCTION — 7 Days
- Care for Sow and Litter
- Controlling Diseases and Parasites
- Fitting and Showing

SHEEP PRODUCTION — 11 Days
- Determining Opportunties in Sheep Raising
- Selecting Breeding Lams, ewes, rams -- include breeds, classes and types.
- Care of ewe and lamb at lambing.
- Fitting and Showing.

OPTIONAL — 1 Day

Suggested Student Activities

Fit and show swine.
Judge classes of fat and breeding hogs.
Prepare table showing breeds of sheep, color markings, special characteristics.
Visit a good farm flock of sheep.
Dock and castrate lambs.
Plan equipment and buildings.
Identify parts of lamb.
Fit and show lamb.
Judge classes of fat lambs and breeding sheep.

Suggested Teacher Activities and/or Demonstrations

Arrange for judging classes of swine.
Demonstrate fitting of swine.
Assign students swine to fit and show for department livestock show.
Give prize for best fitted hog.
Arrange for sheepman to discuss the farm flock business.
Arrange to judge classes of wool and mutton sheep and give oral reasons.
Castrate and dock lambs.

Recommended References for These Jobs

Books:

Swine Production; Bundy and Diggins, Prentice-Hall, 1956.
Swine Science; Ensminger; Interstate, 1961.
Approved Practices in Swine Production; Cook and Juergenson, Interstate, 1959.
Selecting, Fitting, and Showing, Nordby & Lattig, Interstate.
Swine Management; Anderson; J. B. Lippincott, 1957.

Books Cont:

Profitable Sheep; Collins and Johnson, MacMillan, 1956.
Sheep; Horlacher and Hammonds, Interstate.
Approved Practices in Sheep Production; Juergenson; Interstate, 1963.
The Sheep Book; McKinney; Wiley, 1959.
Sheep Production; Diggins & Bundy; Prentice-Hall, 1958.

Bulletins:

Sheep Production in Utah; U.S.U.
Farmers Bulletin #1263, -- Breeds of Swine, U.S.D.A.
Farmers Bulletin #1437, -- Swine Production, U.S.D.A.

Films:

Breeds of Sheep, Texaco Company, Butte, Montana, Box 1278.
Western Sheep; Union Pacific Railroad, State Office.
Culling Sheep; Union Pacific Railroad, State Office.

April - 22 Days

SUPERVISED FARMING Posting Entries	2 Days
FARMSTEAD BEAUTIFICATION Drawing the Plan Locating and Arranging Farm Buildings Determining Areas and Plants Locating Fences, Walks, etc.	5 Days
SOILS AND FERTILIZERS Importance of Soils Examining Soils to Determine Properties Maintaining Organic Matters Conservation of Soils and Fertility	5 Days
FORAGE CROPS Raising Legumes and Grasses for Forage Needs Establishing and Maintaining Pastures Seeding Forage Crops	5 Days
VEGETABLE CROPS Planning the Garden Planting and Caring for the Garden	3 Days
OPTIONAL	2 Days

Suggested Student Activities

Classify soils with respect to special properties.
Identify soil samples.
Determine value of farm manure.
Plan a suitable home vegetable garden. Select varieties and amounts.
Plant a garden.

Suggested Teacher Activities and/or Demonstrations

Take a field trip and classify soils.
Provide samples of soil of various types.
Provide several catalogs showing varieties of garden crops avilable.
Have boys start plants in hot beds or flats.

Recommended References for These Jobs

Books:

Farm Soils; Worthen & Aldrick; Wiley, 1956.
U.S.D.A. Yearbook; Soils, 1957.
Soils - An Introduction To Soils & Plant Growth; Donahue; Prentice-Hall, 1958.

Books Cont.:

Our Soils and Their Management; Donahue, Interstate, 1961.
Crop Production, Delorit and Ahlgren; Prentice-Hall, 1959.
Approved Practices in Vegetable Production; Interstate.
Vegetable Growing; Knott; Lea and Feibiger, 1958.
Profitable Soil Management, Knuti, Korpi, and Hide, Prentice-Hall, 1962.
Soil Use and Improvement; Stallings, Prentice-Hall, 1957.
Elements of Soil Conservation; Bennett, McGraw-Hill, 1955.
Irrigated Soils; Thorne & Peterson; McGraw-Hill, 1954.

Bulletins:

Our Land and Its Care; The American Plant Food Council, Inc., 910 17th St., N. W. Washington 6, D. C.
Utah Land Judging Handbook; Erickson and Christensen, U.S.U. Extension Service.
Testing Soils, University of Illinois; Unit No. 1, Better Farming Science.
Conquest of the Land Through 7000 Years; Ag. Inf. Bulletin #99 S.C.S., U.S.D.A.
Basic Fundamentals of Soil Fertility; Tolman; U & I Sugar Co.
Animal Manures on the Farm; Unit No. 6, Better Farming Methods, U. of Ill.
Maintaining Organic Matter in Soil; Unit No. 5, Better Farming Methods, Univ. of Ill.
U.S.U. Extension Circular 249, Growing Vegetables.
Profits in Gardening, U.S.U. Extension Service.

Films:

Understanding our Earth (color); BYU Audio-Visual Aids Dept.
Determining Fertilizer Needs from Soil Tests; Vocational Ag. Service, U. of Ill.
Making the Most of a Miracle; Western Phosphates, P. O. Box 893, Salt Lake City 10, Utah.
The Big Test; Western Phosphates, P. O. Box 893, Salt Lake City 10, Utah.
What's in the Bag; Western Phosphates, Inc.

May - 19 Days

SUPERVISED FARMING Posting Entries	3 Days
VEGETABLE CROPS Controlling Diseases, Insects, and Pests Importance of commercial vegetable crops Cultural practices and harvesting	9 Days
AGRICULTURE VOCATIONS Learning about the opportunities in farming and other agricultural occupations	2 Days
OPTIONAL	5 Days

Suggested Student Activities

Visit storage facilities for common crops of area.
Outline pest and insect control measures for garden plants.
Visit commercial vegetable growers.

Books:

Vegetable Growing; Shoemaker; Wiley (Latest Edition)
Vegetable Crops; Thompson; McGraw-Hill (Latest Edition)
Vegetable Production and Marketing; Work; Wiley
Western Vegetable Production; MacGillvray, U. of Calif., Davis Calif.
Crops in Peace and War; Yearbook of Agriculture 1950-51; U.S.D.A.
Your Opportunities in Vocational Agriculture, Phipps, Interstate, 1957.
Handbook of Agricultural Occupations; Hoover, Interstate, 1963.

Bulletins:

Fruit Guide, Union Pacific Railroad.
Vegetable Guide, Union Pacific Railroad.
Preparing Fruits and Vegetables for Exhibition, Ext. Service, M.S. 663.
Extension circular 288 - Handbook for Utah Fair and Show Officials; U.S.U.
There's a New Challenge in Agriculture; U.S.U.
Careers Ahead; U.S.U., Logan, Utah.
Choosing Your Career; Humphreys; Science Research Associates, 56 West Grant Ave., Chicago, Illinois.

Suggested Course of Study
Vocational Agriculture II

September - 20 Days

LEADERSHIP DEVELOPMENT AND FFA — 5 Days

- Getting acquainted with departmental policies and standards
- Getting acquainted with the FFA organization
- Getting acquainted with FFA activities and awards
- Checking the chapter program of work

SUPERVISED FARMING — 10 Days

- Selecting farming programs
- Writing an agreement
- Summarizing the farming program and analyzing results
- Planning a budget
- Taking inventories
- Planning farm improvement projects
- Planning better farm practices
- Reviewing records of successful supervised farming programs
- Posting entries in the record book
- Determining production goals
- Determining opportunities for supervised farming or other programs
- Financing

OPPORTUNITIES IN AND IMPORTANCE OF AGRICULTURE — 3 Days

OPTIONAL — 2 Days

Suggested Student Activities

Visit the homes of members with successful supervised farming programs.
Write sample agreements for various types of farming programs.
Plan sample budgets for various production projects.
Prepare a list of possible farm improvements and improved practices for the home farm.
Enter sample receipts and expenses on sheets provided for various enterprises.
Review state and national FFA program of work.
Review local program of work and those of nearby chapters if available.

Suggested Teacher Activities and/or Demonstrations

Provide Utah record books that have been submitted for the State Farmer Degree
Arrange to show FFA film.
Invite State Officer to speak to chapter meeting.

Recommended References for These Jobs

Books:

Handbook of Agricultural Occupations; Hoover; Interstate - 1963.
Your Opportunities in Vocational Agriculture; Phipps; Interstate - 1957.
Farming Programs in Vocational Agriculture; Deyoe; Interstate - 1953.
Starting to Farm; Beard; Interstate - 1958.
Handbook for Conducting FFA Meetings; Russell; Interstate.
Practical Activities for Future Farmers; Tenney; Interstate
Programs for Future Farmer Chapter Meetings; Tenney; Interstate.
A More Effective FFA; Wall; Interstate - 1956.
The FFA and You; Bender, Clark & Taylor; Interstate - 1962.

Bulletins:

Utah Vocational Agriculture Record Book; Interstate Printers.
Mimeographed sheets provided students for posting sample records.
Official Manual Future Farmers of America; Future Farmer Supply Service.
FFA at 25; Future Farmer Supply Service.
Future Farmers of America Org., What It Is, What It Does; Future Farmer Supply.
Vocational Agriculture and the FFA; Future Farmer Supply Service.

Films:

Farmer of Tomorrow; State Office.
25th FFA Anniversary; State Office.
The Star Farmers of American; Venard.
Here and There with the FFA; the Venard Organization, 113 NE Madison Avenue, Peoria, Illinois.

Filmstrips or Slides with Script:

A Pictorial Look at Utah's FFA Program, State Office.
80 frame filmstrip in color, "The Story of Vocational Agriculture", State Office.

October - 22 Days

SUPERVISED FARMING — 1 Day

Bring record book up to date

WEEDS AND THEIR CONTROL — 10 Days

Identifying and classifying weeds that are found locally

- Common annual weeds.
- Perennial weeds.
- Biennial weeds.
- Noxious weeds.
- Poisonous weeds.

Determining losses from weeds

- In crop yield.
- In irrigation water.
- In lower grade products.
- In adverse effect upon livestock.

Eradicating weeds

- Rotating crops.
- Spraying.
- Cultivating.
- Determining cost.
- Effectiveness of control measures.

DAIRY PRODUCTION AND MANAGEMENT — 10 Days

Feeding dairy cows

- Determining nutrients needed.
- Selecting feeds - roughages, concentrates, other.
- Using pasture.
- Feeding on a production basis
- Balancing rations
- Computing costs

OPTIONAL — 1 Day

Suggested Student Activities

Identify the common weeds of the area.
Collect and mount samples of all noxious weeds.
Compare cost of various methods of weed control.
Balance a ration for dairy cattle.
Compute the costs of various rations used for dairy cows.

Suggested Teacher Activities and/or Demonstrations

Prepare mounts of plant and sample of seed for all weeds common to the area.
Arrange for field trip to observe and identify growing weeds in the area.
Secure samples of common chemicals used in weed control.
Demonstrate proper technique in spraying weeds.
Balance a ration for a dairy cow.
Mimeograph forms on which students can balance rations.
Collect samples of feeds and feed supplements available locally.

Recommended References for These Jobs

Books:

Principles of Field Crop Production; Martin and Leonard, MacMillan - 1949.
Field Crops in Colorado; Leonard and Whitney; Burgess.
Principles of Weed Control; Ahlgren, Wiley.
Weeds; Muenscher; MacMillan.
Weeds of California; Robbins, Bellue, and Ball; California State Department of Agriculture, Printing Division (Documents Section) 11th and O Streets, Sacramento, California - 1953.
Identification and Judging Crops, Weeds, Diseases; Wilson and Larson; Midway Book Company.
Judging Crop Quality; Dungan and Bolin; Interstate.
Crop Management and Soil Conservation; Cox and Jackson - 1948.
Feeds and Feeding; Morrison; The Morrison Publishing Company; abridged - 1961.
Approved Practices in Feeds and Feeding; Cassard; Interstate.
Dairy Cattle; Selection Feeding and Management; Yapp and Nevens; Wiley - 1955.
Dairy Production: Bundy and Diggins; Prentice-Hall - 1961.
Approved Practices in Dairying; Juergenson and Mortenson; Interstate.
Dairy Science; Peterson; Minnesota University Press.
Dairy Farming; Peterson and Field, Lippincott - 1953.
Elements of Dairying; Olson; MacMillan.
Successful Dairying; Knodt; McGraw-Hill - 1954.
Principles of Feeding Farm Animals; Bull and Carroll; Interstate.

Bulletins:

Weeds of Utah; Holmgren; Special Report #12, U.S.U. Extension Service - 1958.
Weeds, Methods for their Control and Eradication; U.S.U. Cir. 127, Ag. Exp. Station.
Weeds of Colorado; Colorado Bulletin No. 466, C.S.U., Fort Collins, Colo.
Controlling Weeds; University of Illinois, Unit No. 40.
Noxious Weeds of Utah Farmlands, U.S.U. Circular 123, Agriculture Exp. Station.
Weed Control with 2,4-D; Fact Sheet No. 10, U.S.U. Extension Service.

Bulletins Continued:

The Halogeton Problem in Utah; Ext. Service, U.S.U.
Profitable Dairying; Union Pacific Railroad.
Dairy Production on Utah Farms; U.S.U.
Raising Dairy Calves; U.S.U. Circular No. 236.
Feeding Dairy Cows; U.S.D.A. F.B. No. 1626.
Feeding, Care, and Management of Dairy Stock; U.S.D.A. F.B. 1723.
Winter Feeding of Dairy Cattle; Illinois University, Unit No. 29.
Animal Poultry Nutrition; Ralston Purina Company, St. Louis 2, Mo.

Films:

The Last of Grass; Monsanto Chemical Co., Organic Chemicals Division, St. Louis 1, Missouri.
Roots and All; Modern Film Service, c/o Audio Visual Center, 922 Bannock St., Denver 4, Colorado.
New Horizons Along the Milky Way, Union Pacific Railroad.
Raising Dairy Calves, Union Pacific Railroad.
The Rumen Story; Purina Company.
The Science of Milk Production, Purina Company.

Slides with Script:

Irrigated Dairy Pastures and Pasture Management; State Office and Local Depts.

November - 18 Days

SUPERVISED FARMING — 1 Day
- Bring record books up to date

BEEF PRODUCTION AND MANAGEMENT — 7 Days
- Feeding Beef Cattle
  - Determining Nutrient requirements
  - Selecting and preparing feeds
  - Balancing rations
  - Computing costs

SHEEP PRODUCTION — 4 Days
- Feeding the breeding flock
  - Determining, Selecting, and preparing feeds
  - Nutrients needed
  - Balancing rations
- Commercial lamb feeding

SWINE PRODUCTION AND MANAGEMENT — 3 Days
- Feeding pigs, sows, and gilts
- Nutrients needed by the various classes of swine
- Determining, selecting, and preparing feeds
- Balancing rations
- Using home grown feeds where feasible
- Calculating cost of ration
- Self or hand feeding

OPTIONAL — 3 Days

Suggested Student Activities

Visit a good beef feeding unit.
Visit a successful sheep feeding operation.
Visit an efficient swine unit.
Visit a feed mill.
Balance a ration for the various classes of beef, sheep, and swine.
Calculate the cost of the above rations.
Collect samples of feeds and feed supplements available locally, and be able to recognize them.
Set up goals in the feeding operation. Such as rate of gain and cost per pound of gain, etc.

Suggested Teacher Activities and/or Demonstrations

Arrange for beef, sheep, and swine field trips.
Balance rations for beef, sheep, and swine.
Compute the cost of rations.
Establish a feed price bulletin to show the cost of all feeds available locally.
Review up to date cost data on livestock feeding operations in Utah.
Assist students in setting up goals in their feeding operations.

Recommended References for These Jobs

Books:

Feeds and Feeding; Morrison; The Morrison Publishing Company; Abridged-1961.
Approved Practices in Beef Cattle Production; Juergenson, Interstate.
Beef Production; Diggins and Bundy, Prentice-Hall - 1958.
Livestock and Poultry Production; Bundy and Diggins; Prentice-Hall - 1961.
Stockman's Handbook; Ensminger; Interstate Printers - 1962.
Beef Cattle; Snapp, John Wiley and Sons - 1960.
Animal Science; Ensminger; Interstate Printers - 1960.
Raising Livestock; Deyoe, Ross, Peters, McGraw Hill - 1954.
The Livestock Book; Thompson and McKinney; Vulcan Press.
Approved Practices in Swine Production; Cook & Juergenson; Interstate - 1959.
Approved Practices in Sheep Production; Juergenson; Interstate - 1963
Sheep Science; Kammlade, Lippincott - 1955.
Sheep Husbandry; Ensminger; Interstate.
Sheep; Horlacher and Hammonds; Interstate.
Swine Management; Anderson; Lippincott - 1957.
Swine Production; Bundy and Diggins; Prentice-Hall - 1956.
Sheep Production; Diggins & Bundy; Prentice-Hall - 1958.

Bulletins:

The Beef Calf - It's growth and development; U.S.D.A. F.B. 1135
Feeding Cattle for Beef; U.S.D.A. F.B. 1549.
Beef Production on the Farm; U.S.D.A. F.B. 1592.
Better Feeding of Livestock; U.S.D.A. F.B. 2052.
Range Sheep Production; U.S.D.A. F.B. 1710.
Sheep Raising on the Farm; U.S.D.A. F.B. 2058.
Swine Production; U.S.D.A. F.B. 1437.
Animal and Poultry Nutrition; Ralson Purina Company; St. Louis 2, Mo.

Films:

Grass and Cattle; Forest Service.
Feeding Farm Animals; U.S.D.A.
Design for Better Beef; Cromars, 922 Bannock St., Denver 4, Colo.
Sheep that Count; Cromars.
Blades of Green; Union Pacific Railroad.
Modern Pork Production; Purina Company.
The Rumen Story; Purina Company.

December - 16 Days

SUPERVISED FARMING — 4 Days

- Bring record books up to date.
- Close records of supervised farming programs for the previous year.

CROP PRODUCTION — 5 Days

- Propagating plants
  - Seeds
    - Structure of a flower
    - Process of Fertilization
    - Plant Breeding
    - Types of seeds
    - Conditions for germination
    - Testing seeds for germination
  - Vegetative
    - Budding
    - Grafting
    - Tip Layering
    - Rhizomes
    - Tubers
    - Bulbs
    - Corms
- Manufacturing and storage of food by plants
  - Conditions necessary for photosynthesis
  - Photosynthetic formula
  - Transpiration
  - Respiration
  - Osmosis
  - Translocation

LANDSCAPING AND HOME GROUNDS IMPROVEMENT — 5 Days

- Ornamental shrubbery
- Perennial flowering plants
- Annual flowering plants
- Lawn establishment and care
- Fertility and insect control

OPTIONAL — 2 Days

Suggested Student Activities

Test seeds for germination
Make colored drawing of male and female flower parts
Determine plant nutrients needed for various crops
Draw landscape plan for home

Suggested Teacher Activities and/or Demonstrations

Demonstrate test for germination.
Collect and show specimens indicating nutrient deficiencies .
Present demonstrations showing photosynthesis, and osmosis.
Show slides on landscaping.

Recommended References for These Jobs

Books:

Approved Practices in Beautifying the Home Grounds; Hoover; Interstate - 1959.
Landscape Planting; Better Homes and Garden; Meredith Press.
The Magic of Landscaping; Theodore Andre and Company; New York
Encyclopedia of Organic Gardening; Padole Books, Inc. Emmans; Pennsylvania.
Modern Landscaping; (available from nurseries)
Trees; A guide to familiar American trees; Golden Press; Rockefeller Center, New York 20, N.Y.
Landscaping for Modern Living; Sunset; Lane, 1959.
Plant Propagation Principles and Practices; Hartman, Oxford Press, 1959.

Bulletins:

Hardy Plant Materials for Utah Conditions - Ernest F. Reimschiissel, B.Y.U.
Home Lawns for Utah - Leaflet 86, USU, Logan, Utah.
Better Lawns, U.S.D.A. Bulletin No. 1.
Lawn Insects, USU, Bul. #53.
Lawn Diseases, How to Control Them, Bul. #61, U.S.D.A.

Films:

Flowers at Work, B.Y.U. Film Library.
From Flower to Fruit; B.Y.U. Library.
How Seeds Germinate; B.Y.U. Film Library.
Plant Growth; B.Y.U. Film Library.

Magazines:

Flower and Garden Magazine - Western Extension, Mid-American Publishing Corporation 543, Westport Pond, Kansas City 11, Missouri.
Organic Gardening and Farming, Padole Books, Inc. Emmans, Pennsylvania
Better Homes and Gardens, Meredith Press, DesMoines, Iowa.

January - 22 Days

SUPERVISED FARMING — 1 Day

Bring record books up to date

CROP PRODUCTION — 8 Days

Identifying the nutrients needed by plants
- Nutrients needed by plants
- How nutrients are absorbed
- Symptoms of nutrients deficiencies

Exploring new developments with plant research science

Using chemicals and other regulators for thinning, growth, storage, color, etc.

LEADERSHIP DEVELOPMENT — 10 Days

Developing public speaking abilities

Developing skills in parliamentary procedure

OPTIONAL — 3 Days

Suggested Student Activities

Students list nutrients required by plants and information as to source, importance, purpose, etc.

Each student make a short report on new developments in crop production.

Each student give a five minute talk in class using notes, but not reading.

Each student serve as a member of a parliamentary procedure team in a class contest.

Suggested Teacher Activities and/or Demonstrations

Prepare demonstration showing effect of nutrient deficiencies upon plants.

Arrange for class and chapter parliamentary procedure and public speaking contests.

Arrange for chapter parliamentary procedure team to present demonstrations before outside groups.

Recommended References for These Jobs

Books:

Crop Production; Delorit and Ahlgren; Prentice-Hall - 1959.

Our Soils and Their Management; Donahue; Interstate - 1961.

Forage Crops; Ahlgren; McGran-Hill - 1949.

Principles of Field Crop Production; Martin and Leonard; Macmillan - 1949.

Hunger Signs in Crops; American Society of Agronomy; Washington, D.C.

Yearbook of Agriculture 1951; (Crops in Peace and War) U.S.D.A. Washington, D.C.

Books Continued:

Soils and Introduction to Soils and Plant Growth; Donahue; Prentice-Hall - 1958.
The Nature and Properties of Soils; Buckman and Brady; MacMillan - 1960.
Crop Management and Soil Conservation; Cox and Jackson; John Wiley and Sons - 1948.
Irrigated Soils; Thorne and Peterson; McGraw-Hill - 1954.
Roberts Rules of Order; Roberts - 1943.
When You Preside; Sutherland; Interstate - 1962.
Winning Future Farmer Speeches; Purkey; Interstate.
Handbook on Speech for Future Farmers; Purkey; Interstate - 1959.
Now You're Talking; Karr; Interstate.
Public Speaking for Future Farmers; Judson; Interstate.

AGRICULTURAL VOCATIONS 4 Days

Learning about the occupations related to farming
What are the occupations related to farming?
Which of the jobs require a college degree?
Which of the jobs require advanced training?
Which of the jobs require a high school education or less?
For the jobs listed above discuss:
Pay schedule
Opportunities for advancement
Special abilities and aptitudes
Social acceptance
Personal enjoyment
Sick leave and hospitalization benefits
Retirement
Vocations

OPTIONAL 2 Days

Suggested Student Activities

Judge classes of poultry.
Visit a successful broiler operation.
Determine why out-of-state producers can ship broilers to Utah for less than we can produce them here.
Figure problems in feed conversation for broilers.
Candle eggs.
Visit a poultry processing plant to judge dressed broilers.
Select breeding stock from available flocks of poultry.
Take field trip over near-by range to observe conservation measures in operation and needed.
Identify range seeds and grasses.
Prepare a list of 30 or more occupations related to farming
Requiring college training
Advanced training
No advanced training
Take field trip to observe several occupations related to farming, such as a flour mill, stockyard, poultry processing plant, nursery, cannery, feed plant, sugar factory, farm machinery dealers, dairy, bank, insurance firms, etc.

Suggested Teacher Activities and/or Demonstration

Conduct a field trip to a broiler farm.
Arrange for a successful poultryman to discuss the broiler business in class.
Arrange for demonstration on candling.
Visit poultry processing plant to observe broilers being processed.
Demonstrate techniques of fitting, showing, and judging live and dressed broilers.
Arrange for field trip over the range with the Forest Service.

Suggested Teacher Activities Continued:

Have a specialist spend a day with the students on the subject of range management.
Arrange field trip to observe occupations related to agriculture.
Have local Employment Security representative discuss job opportunities in the state.
Arrange for special speakers from colleges and universities to meet with students regarding job opportunities in fields related to agriculture.

Recommended References for These Jobs

Books:

Successful Poultry Management; Morley A. Jull; McGraw-Hill - 1951.
Poultry Management; Heuser, Hall, Brucker; J.B. Lippincott Company - 1952.
Approved Practices in Poultry Production; Biddle and Juergenson; Inter-State - 1963.
Selecting, Fitting, and Showing Poultry; Nordby and Lattig; Interestate.
Farm Poultry Production; Card and Henderson, Interstate.
American Standard of Perfection; American Poultry Association - 1962.
Poultry Production; Bundy and Diggins; Prentice-Hall - 1963.
The Poultry Profit Guide; Weeks; Vulcan Press- 1952.
Practical Poultry Management; Rice and Botsford; Wiley - 1952.
Poultry Science and Practice; Winter and Funk, Lippincott - 1960.
Grasses; 1948 Yearbook of Agriculture, U.S.D.A.
The Range and Pasture Book; Donahue, Evans, Jones; Prentice-Hall - 1956.
Range Management; Stoddard and Smith; Wiley.
Forages; Hughes, Heath and Metcalfe; Iowa State College Press, Ames, Iowa.
Soil Conservation; Bennett; McGraw-Hill - 1955.
Range Plan and Handbock; Forest Service, U.S.D.A.
Range Management; Sampson; Wiley.
Approved Practices in Soil Conservation; Foster, Interstate.
Career Service Opportunities in the U.S. Department of Agriculture; Agriculture Handbook No. 45, U.S.D.A.
Careers Ahead; Land Grant Colleges and Universities in cooperation with the National Project in Agricultural Communications; U.S.U. - 1955.
Counseling Vocational Agriculture Pupils for Higher Education; California; State Department of Education - 1956.
Profitable Soil Management; Knuti, Korpi, and Hide - Prentice-Hall - 1962.

Bulletins:

U.S.D.A. Standards on dressed and live poultry; U.S.D.A.
U.S. Standards for Quality of Individual Shell Eggs; U.S.D.A.
Marketing Farm Poultry; Farmer's Bulletin 2030, U.S.D.A.
Marketing Eggs; Farmer's Bulletin 1378; U.S.D.A.
Standard Breeds and Varieties of Chickens; Farmer's Bulletin 1506; U.S.D.A.
Poultry Feeding the Milk White Way; Intermountain Farmers Association.
The Use of Salt in Range Management; Dept. Cir. 379, U.S.D.A.

Bulletins Continued:

Increasing Forage Yields and Sheep Production on Intermountain Western Ranges; Cir. 925, U.S.D.A. - 1953.
Deer Management and Range Livestock Production; Cir. 121, U.S.U.
Gains made by Cattle on Summer Range in Northern Utah; Bul. 317, U.S.U.
Range Lands of Utah County and Their Utilization; Bulletin 317, U.S.U.
Range Resources of Rich County, Utah; Bulletin 291, U.S.U.
Composition of Summer Range Plants in Utah; Bulletin 315, U.S.U.
Reseeding Range Lands of the Intermountain Region; F.B. 1823, U.S.D.A.
Recommendations for Range Reseeding in Utah; Bulletin 212, U.S.U
Range Livestock Nutrition and It's Importance in the Intermountain Region, U.S.U.
Controlling Sagebrush on Range Lands; Farmer's Bulletin 2072, U.S.D.A.
The Nutritive Value of Winter Range Plants in the Great Basin; Agric. Exp. Station, Bulletin 372, U.S.U.
Seeding Rangelands in Utah, Nevada, Southern Idaho, and Western Wyoming; Forest Service, U.S.D.A.
Sagebrush Eradication and Broadcast Seeding; Agric. Exp. Station, Bulletin 404, U.S.U.
Seeding Utah's Ranges, An Economic Guide; Ag. Exp. Station, Bulletin 423, U.S.U.
Growing Crested Wheatgrass in the Western States; Leaflet No. 469, U.S.D.A.
A Job Guide for Utah Jobseekers; Utah Department of Employment Security, available from State School Office.
Careers Ahead; U.S.U.
Choosing Your Career; Humphreys, Science Research Associates, 57 West Grand Avenue, Chicago, Illinois.
Should You Go To College; Warner, Science Research Associates.
Job Descriptions for Occupations Related to Agriculture; Vocational Division, Utah State Department of Public Instruction.
Teaching Vocational Agriculture as a Career; Bulletin of the Michigan State College, East Lansing, Michigan.
Occupational Outlook Handbook; United States Department of Labor, Bulletin No. 1215.
The Guidance Role of the Vocational Ag. Teacher, University of Wisconsin Mimeo - 1961.

Films:

Acres of Chix; DeKalb Agricultural Association, 310 North 5th Street, DeMoines, Iowa.
High Level Profits for Broilers; American Cyanamid Co., Pearl River, N.Y.
Rebuilding with Grass; U.S.D.A. Film Service, U.S.U.
Richer Range Rewards; U.S.D.A. Film Service, U.S.U.

Note: Many films on the subject of conservation are available free of charge from the local Forest Ranger, Soil Conservation Service, and Bureau of Land Management.

March - 21 Days

SUPERVISED FARMING — 1 Day

- Bring Record Books up to date

SOILS AND FERTILIZERS — 19 Days

- Tilling and Managing soils
  - Classifying soils as to origin and type
    - How are soils formed?
      - Rock weathering
        - Physical forces
        - Chemical forces
        - Rate of breakdown of rocks
      - Residual soils
      - Organic soils
      - Colluvial soils
      - Alluvial soils
      - Marine soil materials
      - Wind blown materials
      - Glacial materials
    - Types of soils
      - How does the S.C.S. classify soils?
      - What are the great soil groups?
      - What soil classes are represented on your county soil map?
      - How are soils classified as to size of particles?
      - What land practices are recommended for each type and class of soil?
  - Maintaining favorable soil, water, and plant relationships
    - Classifying soil water
      - Gravitational
      - Capillary
      - Hygroscopic
    - Drainage and crop production
    - Reducing water losses in soils
    - Determining the relationships of soil water to plants
    - Applying water to soils
      - Length of run
      - Amount to apply
  - Maintaining soil fertility
    - Determining soil fertility through soil tests
    - The place of organic matter in the soil
    - The nitrogen cycle
    - Conserving and using farm manures
      - Value
      - Proper handling and application
      - Growing and using green manure crops
      - Selecting and using commercial fertilizers
        - Terms and formulas
        - Kinds of fertilizers
        - Methods of application
        - Rates of application

Computing cost per pound of available nutrient
Use of a suitable tillage program
Benefits of tillage
Plowing soils
Preparing seed beds
Tilling and seeding
Cultivating crops
Selecting tillage implements
Dryland tillage
Tillage of heavy and light soils
Minimum tillage

Land Judging
Follow outline provided by the local S.C.S. Office
Give attention to soil types, classification, and capabilities.
Soil conservation and erosion.
Soil textures and identification
Land capability and permeability
Determining the slope of land

OPTIONAL 1 Day

Suggested Student Activities

Classify soils with respect to special properties.
Identify soil samples, in laboratory and field.
Visit local implement dealers.
Observe drainage and land leveling projects
Collect fertilizer tags on visit to local fertilizer dealer, compute comparative costs and composition.
Determine the kinds and amounts of plantfood removed from an acre for various crops common to area.

Suggested Teacher Activities and/or Demonstrations

Collect samples of various types of soil to use in class.
Demonstrate how to identify soil types.
Arrange field trips to observe tillage, machinery, fertilizer, dealer, examples of erosion, etc.
Prepare Score cards for land judging.
Review land judging bulletin.
Compute cost of various fertilizers.
Collect empty fertilizer bags to show various brands and composition.

Recommended References for These Jobs

Books:

Crop Production; Delorit and Ahlgren; Prentice-Hall - 1959
Our Soils and Their Management; Donahue; Interstate - 1961
Forage Crops; Ahlgren; McGraw Hill - 1949.
Principles of Field Crop Production; Martin and Leonard; MacMillan- 1949.

Books Continued:

Hunger Signs in Crops; American Society of Agronomy; Washington D.C.
Yearbook of Agriculture 1951; (Crops in Peace and War) U.S.D.A. Washington, D.C.
Crop Management and Soil Conservation; Cox and Jackson; Wiley - 1948.
Irrigated Soils; Thorne and Peterson; McGraw-Hill - 1954.
Soil Use and Improvement; Stallings; Prentice-Hall - 1957
Fertilizers and Crop Production; Van Slyke, Crange and Judd.
Dry Farming Around the World; Peterson, U.S.U., Logan, Utah.
The Nature and Properties of Soil; Buckman; MacMillan - 1960.
Profitable Soil Management; Knuti, Korpi, Hide, Prentice-Hall - 1962.

Bulletins:

How Much Fertilizer Should I Use?; Farmers Bulletin Leaflet No. 307, U.S.D.A.
Selecting and Using Fertilizers; Cir. 132; Ag. Exp. Station, U.S.U.
Fertilizer Guide for Utah; Cir. 142; Ag. Exp. Station, U.S.U.
Soil Tests Can Help You; Leaflet 3, Ext. Ser. U.S.U.
Utah Land Judging Handbook; Christensen and Erickson, U.S.U. Extension Service.
Classifying Land for Conservation Farming; Farmers Bulletin 1853, U.S.D.A.
Methods of Applying Fertilizer; National Plant Food Institute.
Our Land and Its Care; Utah-Idaho Sugar Company. SLC, Utah.
Conquest of the Land Through 7000 Years, Ag. Information Bulletin #99, SCS, USDA.
Testing Soils; University of Illinois, Unit No. I; Better Farming Methods Series.

Films:

Understanding our Earth (color) B.Y.U. Audio Visual Aids Department.
Determining Fertilizer Needs from Soil Tests; Vocational Agriculture Service, University of Illinois.
Thirsty Acres; Union Pacific Railroad; available from State Office.
Save the Soil; U.S.U. Film Service.
The Heritage We Guard; U.S.U. Film Service.
Muddy Waters; U.S.U. Film Service.
Our Soil Resources; U.S.U. Film Service.
Soil Conservation With Regular Farm Equipment; U.S.U. Film Service.
Adventure of a Junior Raindrop; U.S.U. Film Service.
Whats in the Bag - Western Phosphate, Inc. Box 893, Salt Lake City 10, Utah

April - 22 Days

SUPERVISED FARMING — 1 Day

Bring Record Books up to date

DAIRY PRODUCTION AND MANAGEMENT — 2 Days

Fitting, showing and judging dairy animals

BEEF PRODUCTION AND MANAGEMENT — 3 Days

Selecting and judging beef animals

ROW CROPS — 15 Days

- Sugar beet raising
  - Importance in the area
  - Determining the advisability of a sugar beet project
  - Cultural Practices
    - Plowing the land
    - Preparing the seed bed
    - Planting the seed
    - Cultivating
    - Thinning
    - Irrigation
    - Harvesting
  - Diseases and their control
  - Pests and their control
  - Preparing sugar beet exhibits
- Potato raising
  - Importance in the area
  - Determine the advisability of a potato project
  - Varieties
  - Cultural practices
    - Plowing the land
    - Preparing the seed bed
    - Securing the seed
    - Cutting and treating seed potatoes
    - Planting and spacing
    - Cultivation
    - Irrigation
    - Harvesting
    - Storing and grading
  - Diseases and their control
  - Pests and their control
  - Preparing potato exhibits
- Other Row Crops including Tomatoes, Beans, Canning Corn, Onions, Peas, Carrots, Etc.
  - Importance in the area
  - Determine the advisability of the crop
  - Varieties

Plowing the land
Preparing the seed bed
Securing plants
Transplanting
Protecting from frost
Cultivating
Irrigating
Harvesting
Grading
Diseases and their control
Pests and their control
Weed control

OPTIONAL 1 Day

Suggested Student Activities

Review the parts of a beef steer and a dairy cow.
Judge a class of dairy animals and a class of beef animals.
Clip beef and dairy animals in preparation for show.
Polish the hoofs and horns of beef and dairy animals in preparation for show.
Wash animals in preparation for show.
Practice showing beef and dairy animals correctly.
Visit a show and observe the correct procedure to follow in fitting and showing.
Take part in all judging contests possible.
Visit successful farmers raising the crops studied in this unit.
Learn to identify the various varieties of crops studied in this unit.
Obtain as much actual experience in raising the crops studied in this unit as possible.

Suggested Teacher Activities and/or Demonstrations

Give demonstrations on the fitting and showing of dairy and beef animals.
Give demonstration on points to look for when judging beef and dairy animals.
Give oral reasons on classes of dairy and beef animals.
Arrange field trips to observe successful operations in producing the above crops.
Demonstrate as many cultural practices as possible in the production of the crops studied in this unit.

Recommended References for These Jobs

Books:

Livestock and Poultry Production; Bundy and Diggins; Prentice-Hall - 1961.
Dairy Production; Bundy and Diggins, Prentice-Hall - 1961.
Selecting, Fitting, and Showing Dairy Cattle; Nordby and Lattig, Interstate.
Selecting, Fitting, and Showing Beef Cattle; Nordby and Lattig, Interstate.

Books Continued:

Dairy Cattle Judging and Selection; Yapp, Wiley - 1959.
Livestock Judging Handbook; Nordby, Beeson, and Fourt, Interstate - 1960.
Dairy Cattle; Selection, Feeding, and Management; Yapp and Nevens; Wiley - 1955.
Crop Production; Delorit and Ahlgren; Prentice-Hall - 1959.
Crop Management and Soil Conservation; Cox and Jackson; Wiley - 1948
Vegetable Production and Marketing; Work; Wiley - 1945.
Raising Vegetables; Ware & McCollum; Interstate.
Judging Livestock, Dairy Cattle, Poultry, and Crops; Youtz and Carlson, Prentice-Hall.
Handbook for Vegetable Growers; Knodt, Van Nostrand - 1960.
Vegetable Crops; Thompson; McGraw-Hill (Latest Edition).

Bulletins:

Sugar Beet Culture in the Intermountain Area; Farmers Bulletin No. 1903.
Sugar Beet Yield and Quality; U.S.U., Extension Bulletin 362.
Control of Sugar Beet Nematode; Farmers Bulletin No. 2054, U.S.D.A.
Harvesting and shipping Potatoes; Union Pacific Railroad, Omaha, Nebraska.
Potato Growing in the Western States; Farmers Bulletin No. 2034, U.S.D.A.
Control of Potato Insects; Farmers Bulletin No. 2040, U.S.D.A.
Corn Earworn Control It; U.S.U. Extension Leaflet 17.
Curly Top in Tomatoes; U.S.U. Exp. Station Bulletin 424.
Home Storage of Vegetable and Fruits; U.S.D.A. Farmers Bulletin No. 1939.
Vegetable Insects, How to Control Them in Canning, Market and Home Garden Crops, U.S.U. Ext. Ser. Cir. No. 248.
Preparation and Management of Hotbeds; A.L. Wilson; U.S.U. Exp. Station Leaflet #30.
Sprays and Dusts for Vegetables, Univ. of Illinois Unit No. 72.
Insects and Diseases of Vegetables in the Home Garden; Home and Garden Bulletin No. 46, U.S.D.A.
Growing Vegetables, Recommend Varieties for Utah; U.S.U. Ext. Service Cir. #249.
Vegetable Guide; Union Pacific Railroad.

Films:

Potatoes Unlimited; Union Pacific Railroad.
Fresh from the West; Union Pacific Railroad.

Film Strips:

Fitting and Showing Dairy Cattle; U.S.D.A.
Selecting Dairy Cattle; NASCO.
Slides; How to Look at a Cow; NASCO.
Fitting and Showing Dairy Cattle; Blatchford Calf Meal Company, Waukegan, Illinois.
Fitting and Showing Beef Cattle; Blatchford Calf Meal Company, Waukegan, Illinois.
Winning the Dairy Show Made Easy; Educational Filmstrips, Huntsville, Texas.
Winning the Beef Show Made Easy; Education Filmstrips, Huntsville, Texas.

May - 19 Days

SUPERVISED FARMING Bring record Books up to date Make plans for the summer program	3 Days
LEADERSHIP DEVELOPMENT Preparing for FFA Contests Livestock Judging Dairy Judging Dairy Products Crops Judging Poultry Judging Meats Judging Farm Mechanics	4 Days
PREPARING EXHIBITS FOR LIVESTOCK SHOWS, BEEF, SHEEP, SWINE	7 Days
WEEDS AND THEIR CONTROL Identifying and classifying weeds	3 Days
OPTIONAL	2 Days

Suggested Student Activities

Select and prepare exhibits for livestock shows.
Student should try out for the contest in which he is interested.
Student to demonstrate the correct procedure in fitting and showing beef, sheep, and swine.
Student to make a collection and learn to identify the common weeds found in the area in the spring.
Close records on feeder projects that may be completed.

Suggested Teacher Activities and/or Demonstrations

Demonstrate fitting of sheep, swine, and cattle.
Demonstrate showing sheep, swine, and cattle.
Assign students sheep, swine, and cattle to fit and show for department livestock show.
Give prize for the best fitted lamb, hog, and steer.
Arrange for livestock for fitting and showing demonstrations.
Arrange for field trip to collect weeds for identification.
Collect samples of weeds for department collection.
Prepare materials for students to use in training for FFA Contests.
Assist students in preparing for the contest in which they are interested.

Film Strips:

Winning the Beef Show Made Easy; Educational Filmstrips, 1409 19th Street, Huntsville, Texas.
Fitting and Showing Beef, NASCO.
Fitting and Showing Beef Cattle; Blatchford Calf Meal Co., Waukegan, Illinois.
Fitting and Showing Sheep; Blatchford Calf Meal Company, Waukegan, Illinois.
Fitting and Showing Hogs; Blatchford Calf Meal Company.
Winning the Hog Show Made Easy; Educational Filmstrips, Huntsville, Texas.

SUGGESTED COURSE OF STUDY
VOCATIONAL AGRICULTURE III

September - 20 Days

SUPERVISED FARMING PROGRAM Enlarging scope of farming programs Posting entries in the record book Farm Improvement Practices Improvement Projects	3 Days
LEADERSHIP DEVELOPMENT AND FFA Getting Acquainted with Departmental Policies and Standards Getting Acquainted with the FFA Organization Preparing Exhibits for Fairs and Shows Planning the Chapter Program of Work Developing Skills in Parliamentary Procedure	10 Days
BEEF PRODUCTION AND MANAGEMENT Breeding Beef Cattle Managing the Beef Herd Determining Building and Equipment Needs	5 Days
OPTIONAL	2 Days

Suggested Student Activities

Divide into teams and review parliamentary procedure.
Present demonstrations to school, church, and civic groups.
Use parliamentary procedure in committee meeting.
Visit commercial herd to observe facilities and practices in beef management.

Suggested Teacher Activities and/or Demonstrations

Give each boy a chance to be chairman.
Arrange for boys to give demonstrations in other classes.
Arrange for group demonstrations in civic organizations.
Arrange for field trip to cattle ranch.

Recommended References for These Jobs

Books:

Robert's Rules of Order; Roberts; McGraw-Hill, 1943.
A Handbook for Conducting FFA Meetings; Russell; Interstate.
Practical Parliamentary Procedure; Cruzan; McKnight & McKnight.
Leadership Training and Parliamentary Procedure; Gray; Prentice-Hall, 1958.
Parliamentary Procedure At A Glance; Stewart; Ohio State Press.
When You Preside; Sutherland, Interstate, 1962.
Approved Practices in Beef Cattle Production; Juergenson; Interstate, 1958.
Beef Cattle; Snapp; Wiley, 1960
The FFA and You; Bender, Clark, Taylor; Interstate, 1962.

Books cont.:

Stockmen's Handbook; Ensminger, Interstate, 1962.
Beef Cattle Husbandry; Ensminger, Interstate.
The Livestock Book; Thompson & McKinney, Vulcan Press.
Livestock and Poultry Production, Bundy and Diggins, 1961.

Bulletins:

A Guide to Parliamentary Practices; Henderson, Interstate.
FFA Manual
F 1584 Feed Lot and Ranch Equipment, U.S.D.A.
F 1592 Beef Production on the Farm, U.S.D.A.
F 1916 Beef Cattle For Breeding Purposes, U.S.D.A.
Helps In Mastering Parliamentary Procedure; Stewart; Co-op Printshop, New Concord, Ohio.

Films:

Film strip - Parliamentary Procedure No. 2, No. 3.
Cattle Country - Union Pacific Railroad, State Office.

October - 22 Days

SUPERVISED FARMING	2 Days
LEADERSHIP DEVELOPMENT Developing Desirable Citizenship Becoming Acquainted With FFA Activities and Awards Developing Public Speaking Abilities	5 Days
DAIRY PRODUCTION AND MANAGEMENT Feeding Dairy Cows Keeping Dairy Cows Healthy Managing the Dairy Herd Housing Dairy Cattle Keeping Records and Culling the Herd	13 Days
OPTIONAL	2 Days

Suggested Student Activities

Prepare and present speech in Chapter contest.
Give speeches before school, church, and civic groups.
Learn to read dairy pedigree records and evaluate them.

Special Teacher Activities and/or Demonstrations

Arrange for students to give speeches in other classes.
Make appointments for speeches to be given in civic organizations.
Provide pedigrees for class observation.
Arrange field trip to outstanding dairy farm.

Recommended References for These Jobs

Books:

Handbook In Speech For Future Farmers; Purkey; Interstate, 1959.
Winning Future Farmer Speeches; Purkey; Interstate.
FFA Manual
Principles and Types of Speech; Monroe, Scott-Foresmen Co.
Dairy Farming; Peterson & Field; Lippincott, 1953.
Approved Practices in Dairying; Juergenson, Interstate Printers.
Successful Dairying; Knodt; McGraw-Hill, 1954.
Dairy Cattle; Judging& Selection; Yapp & Nevens; Wiley, 1959.
Modern Dairy Cattle; Davis; Prentice-Hall, 1962.
Public Speaking for Future Farmers; Judson, Interstate.

Bulletins:

Proceedings of National FFA Convention
"Care and Management of Dairy Cows"; Farmers Bulletin #1470; U.S.D.A.
"Feeding Dairy Cows"; Farmers Bulletin, No. 1626, U.S.D.A.
"Feeding Care, and Management of Young Dairy Stock"; Farmers Bulletin #1723, U.S.D.A.
Method and Benefits of Clipping Dairy Cattle; Bulletin No. 100, Sunbeam Corp.
Producing Quality Milk; Unit 74, Univ. of Ill., College of Ag., Urbana, Ill.
Winter Feeding of Dairy Cattle, Unit 29, Univ. Of Ill., College of Ag., Urbana, Ill.

Films:

Triple Threat of Brucellosis, BYU Film Service.

November - 18 Days

SUPERVISED FARMING	2 Days
LEADERSHIP DEVELOPMENT Preparing for FFA Awards and Recognition	2 Days
LEARNING ABOUT NEW DEVELOPMENTS IN AGRICULTURE Research New Varieties New Practices Trends	8 Days
SWINE PRODUCTION Managing the Herd Breeding Swine Housing Swine	5 Days
OPTIONAL	1 Day

Suggested Student Activities

Get acquainted with foundation awards, scholarships, and other recognitions.
Study calendar of events for dates of awards, etc.
Subscribe to one or two good agricultural magazines.
Castrate young hogs.
Report findings on new developments.
Visit commercial hog farm.
Make a drawing of a desirable hog house.

Suggested Teacher Activities and/or Demonstrations

Keep students informed well in advance of awards and scholarships available.
Briefly review "Utah Future Farmer Awards and Contests Handbook" with students.
Have a field trip to study swine raising program.

Books:

Handbook of Ag. Occupations; Hoover; Interstate, 1963.
Livestock & Poultry Production; Bundy & Diggins; Interstate, 1962.
Swine Production; Carroll, Krider, & Andrews; McGraw-Hill, 1962.

Bulletins or Magazines:

Agricultural Research; U.S.D.A., Supt. of Doc., Gov. Printing Office, Washington 25, D.C. $1.00 per year (12 issues)
Utah Farm & Home Science; U.S.U. Ag. Experiment Station (Quarterly)
Scientific Journals in Agronomy, Dairying, Animal Science, Horticulture, etc.

September - [illegible] Days

POULTRY PRODUCTION — 6 Days
- Managing the Laying Flock
- Culling Laying Hens
- Controlling diseases and parasites
- Marketing Poultry and Poultry Products.

FARM LAW — 5 Days
- Social Security Benefits to Farmers
- Figuring Income Taxes
- Figuring Property Taxes

AGRICULTURAL ORGANIZATIONS — 3 Days
- Farm Bureau
- Farmers' Union
- Grange
- Young Farmer

OPTIONAL — 2 Days

Suggested Student Activities

Visit poultry farms.
Compute costs of various rations used for laying flocks.
Develop a table showing: Name of disease, Symptons, Causes, Prevention, Control Measures.
Compile a list of good management practices for the laying flock.
Interview officers of agricultural organizations to learn the objectives and methods of procedure.

Suggested Teachers Activities and/or Demonstration

Have successful poultryman take students through his plant and explain management practices.
On a field trip to a poultry farm demonstrate how to cull the flock.
Invite officers of various farm organizations to visit class and explain their programs.

Recommended References for These Jobs

Books:

Livestock and Poultry Production; Bundy and Diggins; Prentice-Hall, 1961.
Feeds and Feeding; Morrison, Morrison Publishing Co., 1960 (abridged)
Successful Poultry Management; Jull; McGraw-Hill, 1951.
The Poultry Profit Guide; Weeks; Vulcan Press, 1952.
Practical Poultry Management; Rice and Botsford; Wiley, 1952.
Poultry Management; Heuser, Hall, and Bruckner; Lippincott, 1952.

Books Cont.:

Poultry Science and Practice; Winter and Funk; Lippincott, 1960.
(Farm Law) Selected Lessons for Agricultural Science; Andrews, Interstate.
Utah Farm and Ranch Law; Fuller; Salt Lake City, Utah
Outline for Course in Farm Law and Social Security for Farmers; Utah State Department of Public Instruction.
Law on the Farm; Hannah; MacMillan, 1952.
Everyday Farm Laws; Adams and Bedford; Interstate, 1955.

Bulletins:

Publication 225, Farmers Tax Guide.

January - 2 Days

SUPERVISED FARMING PROGRAM — 12 Days

- Completing record books.
- Analyzing the farm business.
- Determining production goals.
- Planning the budget.
- Taking inventories.
- Planning improvement projects.
- Planning improved practices.

SHEEP PRODUCTION — 7 Days

- Managing the Farm Flock.
- Breeding sheep.
- Controlling diseases and parasites.
- Managing the range herd.

OPTIONAL — 3 Days

Suggested Student Activities

Visit a good farm-flock and observe methods, practices, and equipment.
Make arrangements to spend a day or two on the range during the summer months and assist with the care and operation of the unit.
Use approved methods and practices, castrate and dock several lambs.
Attend sessions of Wool Growers Association.

Suggested Teacher Activities and/or Demonstrations

Arrange field trip to sheep farm or ranch.
Have range operator discuss range problems and practices with class.
Give oral reasons on a class of breeding ewes.
Prepare forms for project analysis.
Prepare forms for inventories and budgets.

Recommended References for These Jobs

Books:

Sheep Science; Kammlade & Kammlade; Lippincott, 1955.
Sheep Husbandry; Ensminger, Interstate, 1955.
Sheep; Horlacher and Hammonds; Interstate.
Selecting, Fitting, and Showing Sheep; Nordby and Lattig; Interstate.
Approved Practices in Sheep Production; Juergenson; Interstate, 1963.
Range Sheep and Wool; Hultz and Hill; Wiley.
The Livestock Book; Thompson and McKinney; Vulcan Press.
Livestock and Poultry Production; Bundy and Diggins; Prentice-Hall, 1961
Stockman's Handbooks; Ensminger; Interstate, 1962.

Bulletins:

"Range Sheep Production"; Farmers Bulletin #1710, U.S.D.A.
"Sheep Raising on the Farm"; Farmers Bulletin #2058, U.S.D.A.
"Sheep Judging"; Farmers Bulletin #1191, U.S.D.A.

Films:

Western Sheep, Union Pacific Railroad, State Office.
Culling Sheep, Union Pacific Railroad, State Office.

February - 20 Days

FORAGE CROPS Establishing and Maintaining Alfalfa. Prevention and control of diseases and insects of forage crops. Harvesting and storing alfalfa. Growing silage and soil crops. Harvesting and storage of silage.	12 Days
FARM LAW Determining water rights	3 Days
SOILS Leveling Land for Irrigation	2 Days
OPTIONAL	3 Days

Suggested Student Activities

Select production goals for various production enterprises.
Learn to identify varieties of alfalfa.
Test seed for germination.
Determine plant nutrient requirements for various soils (test).
Visit farm and observe methods of storing alfalfa and silage.
Assist in setting grade stakes for land leveling.

Suggested Teacher Activities and/or Demonstrations

Demonstrate test for germination.
Show specimens indicating nutrient deficiencies.
Arrange field trips to two or more farms.

Recommended References for These Jobs

Books:

Crop Production; Delorit and Algren; Prentice-Hall, 1959.
Crop Management and Soil Conservation, Cox and Jackson; Wiley, 1949.
Principles of Field Crop Production; Martin and Leonard, MacMillan, 1949.
Plant Diseases; The Yearbook of Agriculture, 1953, U.S.D.A.
Forage Crops; Ahlgren; McGraw-Hill, 1949.
Hunger Signs in Crops; American Society of Agronomy; Washington, D.C.
Utah Farm Law; Fuller; Salt Lake City, Utah.

Bulletins:

"Alfalfa Insect Control"; Knowlton and Haws, Extension Service, U.S.U.
"Fertilizer Requirements of Alfalfa Hay in Utah"; Nielson, Thorne, Baird; Bulletin 374, Experiment Station, U.S.U.
"Alfalfa Varieties in the United States"; Farmers' Bulletin #1731; U.S.D.A.
"High-Grade Alfalfa Hay"; Farmers' Bulletin 1539, U.S.D.A.
"Growing Alfalfa"; Farmers' Bulletin #1722; U.S.D.A.
"Land Leveling and Irrigation"; Leaflet #371, U.S.U.

Bulletins:

Outline for Course in Irrigation Practices for Farmers; Vo-Ag. Division, State Dept. of Public Instruction, Salt Lake City, Utah
"Land Leveling and Irrigation"; Leaflet #371, U.S.U.
"Land Judging in Utah"; Christensen and Erickson, U.S.U. Extension Service.
"Soil Tests Can Help You"; U.S.U. Leaflet #3.
"Classifying Land for Conservation Farming"; Farmers Bulletin 1853, U.S.D.A.
"Our Land and Its Care"; Utah-Idaho Sugar Co., Salt Lake City, Utah
"Methods of Applying Fertilizer"; National Plant Food Institute.
"Conquest of the Land Through 7000 Years"; Agriculture Information Bulletin #99, S.C.S., U.S.D.A.
"Testing Soils"; Univ. of Ill. Unit No. 1; Better Farming Methods Series.
Border Irrigation"; Leaflet #297, U.S.D.A.
"Corrugation Irrigation"; Fact Sheet #343, U.S.D.A.
"Measuring Irrigation Water"; Fact Sheet #31, Extension Service, U.S.U.
"Should You Buy a Sprinkler System"; Ext. Cir. #215, U.S.U.
Irrigation Guide; Union Pacific Railroad.
Water Supply, Water Use and Its Conservation, Clyde, U.S.U.
Easier Irrigation With Canvas and Plastic Dams, Fact Sheet #16, U.S.U.
Fall and Winter Irrigation, Barker and Israelsen, Fact Sheet, #22, U.S.U.
Stubble Mulch Farming; Farmers' Bulletin 1997, U.S.D.A.
Farm Drainage; Farmers' Bulletin 2046; U.S.D.A.

Films:

Thirsty Acres; U.P.R.R., available from State Office.
Save the Soil; U.S.U. Film Service.
A Heritage We Guard; U.S.U. Film Service.
Muddy Waters; U.S.U. Film Service.
Our Soil Resources; U.S.U. Film Service.
Soil Conservation with Regular Farm Equipment; U.S.U. Film Service.
Adventures of a Junior Raindrop; U.S.U.
Understanding Our Earth; Soils; B.Y.U.
Irrigation Farming; Soil Conservation Service, 222 So. West Temple, SLC, Utah.

April - 12 Days

SUPERVISED FARMING 2 Days

CEREAL CROPS 10 Days

Raising small grains.
Cultural practices.
Selecting varieties.
Controlling weeds in grain.
Controlling diseases.
Harvesting and storing.
Identifying and controlling pests and insects in field storage.

FARM LAW 10 Days

Determining obligations and responsibilities of farmers on highways.
Distributing and operating property.
Determining kinds and benefits of state agricultural agencies laws.
Determing farmers liability and responsibilities - animals, trespassing, water, fences, buildings, weeds, etc.
Determining insurance needs.

Suggested Student Activities

Select production goals for their production enterprises.
Visit supervised farming programs where cereal crops are being produced.
Determine plant nutrient needs for cereal crops.
Calculate costs of fertilizing cereal crops.
Students to make short reports on new developments in cereal crop production.

Suggested Teacher Activities and/or Demonstration

Demonstrate test for germination.
Arrange field trips for observation of different varieties.
Judge classes of commerical grains.

Recommended References for These Jobs

Books:

"Utah Farm and Ranch Law"; Fuller; Salt Lake City, Utah.
Outline for Course in Farm Law and Social Security for Farmers; Utah State Dept. of Public Instruction, SLC, Utah.
Law on the Farm; Hannah; Macmillan, 1952.
Everyday Farm Law; Adams and Bedford; Interstate, 1955.
Crop Production; Delorit and Ahlgren; Prentice-Hall, 1959.
Principles of Field Crop Production; Martin and Leonard; MacMillan, 1949.
Plant Diseases - 1953 Yearbook of Agriculture; U.S.D.A.
U.S.D.A. Yearbooks of Agriculture, 1950-51-52-53.
Law For The Veterinarian & Livestock Owner; Hannah & Storm; Interstate.

May - 19 Days

FARM LAW — 10 Days
- Determining legal rights and responsibilities of farmers
- Entering into contracts - forms, essentials
- Using negotiable instruments
- Interpreting deeds, abstracts, titles, etc.
- Making financial transactions
- Doing business in a legal manner

DAIRY PRODUCTION AND MANAGEMENT — 2 Days
- Fitting, showing, and judging dairy animals

LIVESTOCK - SELECTING, FITTING, AND SHOWING — 5 Days
- Selecting and judging beef cattle
- Fitting and showing beef cattle
- Fitting and showing swine
- Fitting and showing sheep

CEREAL CROPS — 2 Days
- Judging and Grading

Suggested Student Activities

(See activities and references for month of April for Farm Law)

Study various classes of livestock at home and other places and judge them as to sound judging standards.
Study bulletins (USDA and USU) and pamphlets made available through agricultural agencies and commercial houses.
Study and observe grading of beef, hogs, and sheep at markets.
Try out for FFA judging teams.

Suggested Teacher Activities and/or Demonstrations

Arrange for field trips for purpose of giving students opportunities to judge various classes of livestock and dairy.
Demonstrate the giving of oral reasons on all classes.
Provide bulletins and pamphlets for student study
Prepare bulletin board displays showing the ideal types and score cards.
Encourage students to try out for FFA judging teams.
Show film strips and slides on judging.

Recommended References for These Jobs

Books:

Livestock Judging Handbook; Nordby and Beeson; Interstate, 1960.
Selecting, Fitting and Showing Beef Cattle, Sheep, Swine (3 separate books); Nordby and Lattig; Interstate.
(There are sections on selection in practically all livestock texts)

Bulletins:

"The Judging Manual of the Holstein Freisian Association of America"; Brattleboro, Vt.
"Jersey Judging Made Easy"; The American Jersey Cattle Club, 1521 East Broad St., Columbus 5, Ohio.
"Illustrated Lessons in Milking Shorthorn Judging"; American Milking Shorthorn Society, 313 So. Glenstone, Springfield 4, Missouri.
"Start Young - Learn to Judge"; American Shorthorn Association, Omaha 7, Neb.

Other references on judging and fitting and showing as listed under vo. ag. I and II this outline.

SUGGESTED COURSE OF STUDY
VOCATIONAL AGRICULTURE IV
(Agricultural Science)

September - 20 Days

ORIENTATION	2 Days
SUPERVISED FARMING PROGRAMS Planning a budget Taking inventories Analyzing records	3 Days
RANGE CONSERVATION AND MANAGEMENT Exploring Forest and Range Possibilities Cooperating in Developing a Conservation Program for the Range. Multiple Range Use Possiblities.	5 Days
RURAL LIFE PROBLEMS Cooperating in area re-development program Cooperate in development of rural social activities Determining the individual's responsibility in a community Possibilities of developing recreational areas	3 Days
AGRICULTURAL OCCUPATIONS	4 Days
OPTIONAL FFA Meeting Special School Activities State Fair	3 Days

Suggested Student Activities

Grade grain.
Make display of crops popular in the area.
Student demonstrate fitting an animal.
Prepare grain sheaves.
Take field trip to near-by range.
Identify range seeds and grasses.

Suggested Teacher Activities and/or Demonstrations

Demonstrate preparation of fair exhibits.
Arrange field trip with Forest Service.
Have specialist spend day with students on re-development or other problems.
Arrange to spend one day at State Fair.

Recommended References for These Jobs

Books:

Range and Pasture Book; Donahue; Evans, Jones; Prentice-Hall, 1956.
Range Management; Stoddard and Smith; Wiley, 1955.
Forages; Hughes, Heath and Metcalfe; Iowa State College, 1962.
Soil Conservation; Bennett, McGraw-Hill, 1955.
Range Plan and Handbook; Forest Service, U.S.D.A.
Range Management; Sampson, Wiley, 1952.
Exploring Agriculture; Evans and Donahue, Prentice-Hall, 1957.
Judging Crop Quality; Dungan and Bolin, Interstate, 1950.
Handbook of Agricultural Occupations; Hoover; Interstate, 1963.
Exploring Agriculture; Evans & Donahue; Prentice-Hall, 1963.

Bulletins:

State Fair Premium Book
Fairs and Shows Handbook, U.S.U.
Utah's Vocational Agriculture Record Book.
The Use of Salt in Range Management; Dept. Cir. 379, U.S.D.A.
Increasing Forage Yields and Sheep Production on Intermountain Western Ranges; Cir. 925, U.S.D.A., 1953.
Deer Management and Range Livestock Production, Cir. 212, U.S.U.
Gains Made by Cattle on Summer Range in Northern Utah, Bulletin 314, U.S.U.
Range Lands of Utah County and Their Utilization, Bulletin 305, U.S.U.
Range Resources of Rich County, Utah, Bulletin 291, U.S.U.
Composition of Summer Range Plants in Utah, Bulletin 305, U.S.U.
Reseeding Range Lands of the Intermountain Region, FB 1823, U.S.D.A.
Recommendations for Range Reseeding in Utah, Bulletin 212, U.S.U.
Range Livestock Nutrition and Its Importance in the Intermountain Region, U.S.U.
Phillips 66 Bulletin, Series Forage Plants; 1-4.

Films:

Rebuilding with Grass, U.S.D.A. Film Service, U.S.U., Logan.
Richer Range Rewards, U.S.D.A. Film Service, U.S.U., Logan.
The American Farmer; Ford Motor Co., 4303 Telegraph Ave., Oakland 9, California.

October 22 Days

KEEPING LIVESTOCK HEALTHY — 20 Days

Determining the nature and causes of disease.
Detecting Common Farm Diseases.
Using Drugs, Biologicols, Insectecides, and Pesticides.
Treating Wounds and Absceses of Livestock.
Stopping Hemorrhage.
Controlling non-infectious diseases.
Controlling infectious diseases.
Studying plants and substances that poison livestock.
Controlling fungus diseases of livestock and plants.
Controlling livestock parasites.

OPTIONAL — 2 Days

Special School Activities
FFA Meeting

Suggested Student Activities

Examine livestock organs infected with parasites.
Learn to use suture materials.
Examine microbes under microscope.

Suggested Teacher Activities and/or Demonstrations

Demonstrate how to identify various common diseases of livestock.
Arrange field trips to see unhealthy animals.
Demonstrate simple veterinary operations.
Demonstrate various types of sutures.

Recommended References for These Jobs

Books:

Veterinary Guide for Farmers; Stamm; Vulcan Service.
U.S.D.A. Yearbook, 1956.
Stockman's Handbook; Ensminger; Interstate, 1962.

Bulletins:

Triple Threat of Brucellosis, Colo. State Univ., Fort Collins.
Brucellosis Ring Test, Colo. State Univ., Fort Collins. (visual aids section)
Reducing Livestock Losses; Fact Sheet #1; U.S.U.

Films:

An Ounce of Prevention, Sears Roebuck Foundation
Film Strips with Record, Phizer Co.

November - 18 Days

SUPERVISED FARMING Determining Production Goals Posting Entries Reviewing Records of Successful Supervised Farming Program	2 Days
KEEPING LIVESTOCK HEALTHY Selecting and using effective sprays and chemicals.	2 Days
BEEF PRODUCTION Selecting and Purchasing	2 Days
ANIMAL BREEDING	7 Days
DAIRY PRODUCTION AND MANAGEMENT Selecting, trimming, clipping, culling, and sanitation	3 Days
OPTIONAL FFA Meeting Golden Spike National Livestock Exposition Special School Activities	2 Days

Suggested Student Activities

Review recent experimental data on feeding.
Field trip to reputable feeding set up.
Student reports on silage, pastures, hormones.
Field trip in relation to sanitation.

Special Teacher Activities and/or Demonstrations

Arrange for class to observe artificial insemination and have technician explain the program.
Bring veterinarian into class for illustrative sanitation lecture.
Arrange for class to attend livestock show at Ogden.

Recommended References for These Jobs

Books:

Feeds and Feeding; Morrison; Morrison Pub. Co. abridged, 1961.
Veterinary Guide for Farmers; Stamm; Vulcan Service.
Raising Livestock; Deyce, et al; McGraw-Hill.
Principles of Veterinary Science; Hadley; Saunders.
Livestock and Poultry Production; Bundy and Diggins; Prentice-Hall, 1961.

Bulletins:

Triple Threat of Brucellosis, Colorado State University.
Brucellosis Ring Test, Colorado State University, Visual Aids Section.
The Problem of Difficult Breeding in Dairy Cattle; Main Extension Bulletin No. 335.
Artificial Breeding of Dairy Cattle in Utah; U.S.U. Ext. Bulletin 204.
Steps to Success; American Shorthorn Breeders Association, Chicago, Illinois.
Plan and Profit with Herefords, American Hereford Association, K.C., Mo.
Feed Lot Fattening of Cattle in Utah; Bulletin 380, U.S.U.
Reducing Livestock Losses; Fact Sheet No. 1, U.S.U.

December - 16 Days

SUPERVISED FARMING PROGRAMS — 2 Days
- Posting entries in record book
- Planning improvement projects and improved practice projects

LEADERSHIP DEVELOPMENT — 12 Days
- Review the departmental policies standards
- Review the chapter program of work
- Develop public speaking abilities
- Develop skills in parliamentary procedure

OPTIONAL — 2 Days
- FFA Meeting
- Special Activities
- Christmas Program
- Utah State Jr. Turkey Show

Suggested Student Activities

Prepare and present speech in chapter contest.
Give speeches before school, church, and civic groups.
Divide into teams work parliamentary contest.
Present demonstrations to school, church, and civic groups.

Suggested Teacher Activities and/or Demonstrations

Arrange for boys to give speeches in public.
Give each boy chance to be chairman.
Arrange for group demonstrations.
Arrange for boys to give speeches and demonstrations to other classes.

Recommended References for These Jobs

Books:

Winning Future Farmer Speeches; Purkey; Interstate.
Public Speaking for Future Farmers; Judson; Interstate.
Robert's Rules of Order; Roberts; McGraw, 1943.
FFA Manual.
A Handbook for Conducting FFA Meetings; Russell, Interstate.
Helps in Mastering Parliamentary Procedure; Steward, Co-op Printshop.
Practical Parliamentary Procedure; Cruzan; McKnight & McKnight.
Principles and Types of Speech; Monroe; Scott-Foresman.
Leadership Training and Parliamentary Procedure; Grey; Prentice-Hall, 1958.
FFA & You; Bender, Clark, and Taylor; Interstate, 1962.
Selected Lessons for Agriculture Science; Andrews & Juergenson; Interstate.

Bulletins:

A Guide to Parliamentary Practices; Henderson, Interstate.

Films:

Film Strips, Parliamentary Procedure, No. 1; No. 2; No. 3; Parliamentary Procedure Made Easy; Educational Filmstrips, 1409 19th St., Huntsville, Texas.

January - 22 Days

SUPERVISED FARMING PROGRAMS — 3 Days
- Posting Entries in Record Book
- Planning Farm Improvements and Practices
- Closing the Record Book

FARM MANAGEMENT — 17 Days
- Planning a start in farming
- Planning the farm business
- Choosing or selecting a farm
- Renting or buying a farm
- Financing agricultural operations and using credit.
- Determining efficient use of land according to its capabilities
- Figuring man labor hours for crops and livestock
- Figuring machine labor hours
- Increasing labor efficiency
- Analyzing economic trends and prices in marketing agricultural products
- Appraising Property
- Analyzing and adjusting farm business to meet changes

OPTIONAL — 2 Days
- FFA Meetings
- Special School Activities
- Miscellaneous Meeting and Practices

Suggested Student Activities

Sketch a farm lay-out.
Plan a rotation system.
Plan a livestock system.
Plan a budget for machinery needs and repairs.
Bring marketing contracts to class.
Figure interest on farm operation for one year.
Prepare a budget for a simple enterprise.
Chart price curves for several farm commodities.
Learn to interpret quotations from newspapers.
Study storm forecasts.

Suggested Teacher Activities and/or Demonstrations

Present and demonstrate use of "Utah Farm Record Book" to class.
Show samples of good farm records.
Arrange for banker to discuss farm finance.
Have implement dealer discuss purchasing and maintaining machinery.

February - 20 Days

SUPERVISED FARMING 2 Days

FARM MANAGEMENT 12 Days

Doing business under a free enterprise system

a. Understanding the economics of a free enterprise business system.
b. Four methods of doing business in America.
c. Individual ownership, partnership, corporation, and cooperative.
d. Agreements

Marketing

FFA ACTIVITIES 4 Days

OPTIONAL 2 Days

Young Farmer State Convention
FFA Meeting
Special School Activities

Suggested Student Activities

Have student make display of products processed by farm cooperative in community.
Students visit local cooperatives.
Students visit business firms in community.
Meet with service clubs.
Set up display programs (radio, T.V.) etc.

Suggested Teacher Activities and/or Demonstrations

Arrange for field trips to various business houses.
Have farm coop leaders give flannel board story of farm cooperative in operation.
Organize chapter cooperative if there is a need.

Recommended References for These Jobs

Profitable Farm Marketing; Snowden and Donahue; Prentice-Hall - 1960.
Profitable Farm Management; Hamilton and Bryant; Prentice-Hall - 1963.
American Cooperation; American Institute of Cooperation Yearbook, Washington, D.C.
Marketing of Farm Products; Norton and Scranton, Interstate.
Approved Practices in Farm Management.
(Refer to list under January)

Bulletins:

How We Organize to do Business; A.I.C., Washington, D.C.
Cooperative Purchasing of Farm Supplies; Bulletin #1, Farm Credit Adm., U.S.D.A. Washington, D.C.
Agricultural Cooperation in the U.S.; Bulletin #54 Farm Credit Adm., U.S.D.A. Washington, D.C.
Organizing a Farmers Coop; Cir. #108, Farm Credit Adm., U.S.D.A., Washington, D.C.
Farmers Cooperatives in our Community; Cir. #E32, Farm Credit Adm., U.S.D.A., Washington, D.C.
You and Your Coop Series; Farm Credit Adm., U.S.D.A., Washington, D.C.
Bul. #1, 9, 21, 23, 26, 28 33, 35, 50, 54.
Cir. #108, 122, 125, E32, E24, E21, E20.

Films:

Partners; Utah Poultry and Farmers Coop; Intermountain Farmers; Salt Lake City, Utah.

Area - 21 Days

SUPERVISED FARMING PROGRAMS — 2 Days
- Reviewing records
- Posting entries in record books

SWINE PRODUCTION — 3 Days
- Selecting, judging, fitting and showing
- Marketing

FRUIT PRODUCTION — 10 Days
- Raising Small Fruits
- Cultural Practices
- Controlling Pests and Diseases
- Harvesting
- Raising Tree Fruits
- Planning, Pruning, Thinning
- Harvesting, grading, storing and exhibiting (Fall if possible)
- Controlling pests and insects

FARMSTEAD BEAUTIFICATION — 5 Days
- Drawing the farmstead plan
- Determining the use areas
- Determining plant materials

OPTIONAL — 1 Day
- State FFA Convention
- Special School Activities
- FFA Elections

Suggested Student Activities

Draw a farmstead to scale observing good design of fences, walks, drives, and buildings.
Show plant materials to be used about farmstead - trees, shrubs, and flowers.
Identify common trees, shrubs, and flowers.
Take a field trip to a local orchard.
Brush and spray paint.

Suggested Teacher Activities and/or Demonstrations

Provide catalogs and brochures showing plant materials.
Identify common trees and shrubs for students.
Demonstrate proper planting of trees and shrubs - root and top pruning.
Arrange for field trips to well landscaped farmsteads and homes.
Demonstrate proper brush and spray painting.
Demonstrate use of spray materials.
Provide charts, samples of insects and diseases.
Conduct a pruning demonstration

Recommended References for These Jobs

Books:

Beautifying Your Home Grounds; Rhodes; Doubleday.
Modern Fruit Science; Childers; Hort. Publications.
Pruning Trees and Shrubs; Felt; Orange - Judd.
Trees and Shrubs for Landscape Effect; Coffin, National Farm Book.
Small Fruit Culture; Shoemaker; McGraw-Hill - 1955.
Farm Work Simplification; Hardin; Wiley.
Shopwork on the Farm; Jones; McGraw-Hill.
Growing Fruit; Scarborough and Sneider
The Pruning Manual; Christopher; MacMillan - 1961.
Painting Farm Buildings and Equipment; Ross and Critchfield, Don Critchfield, 2217 Street, Lincoln, Nebraska.
Farm Mechanics Text and Handbook; Phipps, etal; Interstate - 1959.
Approved Practices in Beautifying the Home Grounds; Hoover, Interstate - 1963.
New Designs for Small Properties; Bottomlay; MacMillan.

Bulletins:

Planning a Small Farm Home; California Ext. Cir. #168; University of California, Davis, California.
Planning the Farmstead; Farmers Bulletin #1132, U.S.D.A.
Farm Layout and Farmstead; Ext. Service Bul. #685; Oregon State College, Corvallis.
Farmstead Planning-Building Arrangement; Ext. Service Bul. #337; State College of Washington, Pullman, Washington.
Course in Farmstead Beautification; State Office.
1961-62 Catalog, Wayside Gardens, Mentor, Ohio.
(Local Seed Catalogs) Price $1.50.
Fruit Guide - Union Pacific Railroad.

April - 22 Days

SUPERVISED FARMING PROGRAM Posting records in record book	1 Day
FARMSTEAD BEAUTIFICATION Locating and Arranging Farm Buildings Locating Fences, Walks, Fixtures, Etc. Selecting Plants. Caring for and maintaining a lawn Painting Buildings and Masonry Cleaning up farmsteads - barns, fences, ditches, dead trees, etc.	10 Days
BEEF PRODUCTION Determining building and equipment needs Selecting and judging Breeding beef cattle	5 Days
LIVESTOCK - FITTING AND SHOWING	3 Days
OPTIONAL FFA Meeting Special School Activities	3 Days

Suggested Student Activities

Field trips to judge different classes of stock.
Conduct a "fix-it" clean-up campaign.

Suggested Teacher Activities and/or Demonstrations

Arrange for judging classes.
Give reasons on placings.
Arrange field trips to observe lawns.

Recommended References for These Jobs

Books:

Approved Practices in Beautifying the House Grounds; Hoover; Inter-State - 1959.
Livestock Judging; Norby-Beeson; Interstate - 1960.
Stockman's Handbook; Ensminger; Interstate - 1962.
Judging Livestock, Dairy Cattle, Poultry and Crops; Youts & Carlson; Prentice-Hall - 1962.

Other Books and Bulletins:

(Refer to references cited for March.)

May - 19 Days

SUPERVISED FARMING PROGRAM Posting Records	1 Day
WEEDS AND THEIR CONTROL Setting up a weed control program for the farm Using services of the County Weed Control Program	2 Days
AGRICULTURAL AGENCIES Extension service Production Credit Association Soil Conservation Service Federal Land Bank Bureau Land Management Forest Service Fish and Game Commission Wild Life Service Agriculture Stabilization Committee FHA - Other	16 Days
OPTIONAL FFA Meeting Stock Shows Special School Activities	

Suggested Student Activities

Get record books complete and up to date.
Seniors submit completed record book.
Arrange for judging classes.
Arrange for farm-community leader to discuss the role of young farmers.
Review Agriculture agencies program of work.

Suggested Teacher Activities and/or Demonstrations

Collect all senior record books.
Provide animals for fitting and showing demonstrations.
Arrange for judging classes.
Arrange for farm-community leader to discuss the role of young farmers in our rural communities.

Recommended References for These Jobs

Books:

Selecting, Fitting, and Showing Swine, Sheep and Cattle; Nordby and Lattig; Interstate.
Farmers in a Changing World, 1962 Agricultural Yearbook; U.S.D.A.
How To Get Along With Others; Neugarten; Science Research Associates, 57 West West Grand Avenue, Chicago, Illinois.
Exploring Agriculture; Evans and Donahue; Prentice-Hall - 1957.

Bulletins:

Rural Planning, The Social Aspects; FB 1325 U.S.D.A.
Building a Prosperous Agriculture, A Program for Better Rural Living; Farm Bureau.
Full Prosperity for Agriculture, Conference on Economic Progress; Washington.
Development of Agriculture's Human Resources; Benson, U.S.D.A.
Family Farm-Operating Agreements; North Central Regional Publication 17, Michigan State Col., Special Bulletin 368.
Farm Bureau Discussion Sheets and other materials.

Films:

A Way of Life; Farm Film Foundation, 1731 Eye Street, N.W., Washington 6, D.C.
Farm in a Day; Farm Film Foundation, 1731 Eye Street, N.W., Washington 6, D.C.

COURSE OF STUDY GUIDE FOR AGRICULTURAL MECHANICS I - UTAH

SUMMARY OF TIME ASSIGNMENTS BY AREAS

Areas	Number of Hrs. and Time of Year			
	Fall	Winter	Spring	Total
Orientation	5	0	0	5
FFA Records and Supervised Programs	6	3	3	12
School and FFA Activities	5	3	3	11
Farm Shop Work	46	20	20	82
Farm Power and Machinery	2	0	13	15
Farm Buildings and Conveniences	0	15	5	20
Soil and Water Management	0	0	0	0
Farm Electrification	0	15	0	15
Individual Projects	0	4	16	20
TOTAL DAYS	60	60	60	180

VOCATIONAL AGRICULTURE

COURSE OF STUDY GUIDE

PART II

AGRICULTURAL MECHANICS

ERIC

COURSE OF STUDY GUIDE FOR AGRICULTURAL MECHANICS I

Fall Quarter (60 hours)

Hours	Area of Instruction	Teacher-Student Activities
5	ORIENTATION	Demonstrate shop safe practices
	Shop management and organization	
	Shop rules and regulations	Students learn shop safety rules
	Shop dress	Students obtain coveralls and other essentials
	Shop supplies	
6	FFA RECORDS AND SUPERVISED PROGRAMS	Give examples of proper record keeping
		Students keep FFA Record Book including ag. mech. entries
		Students plan improvement projects and improved practices
		Students plan supervised programs
5	SCHOOL AND FFA ACTIVITIES	
	State Fair and livestock shows	Assist students in making entries in fairs and shows
	Field trips and tours	Encourage students to exhibit in fairs and shows
	School activities	
	FFA meetings	
	Harvest Ball	
42	FARM SHOP WORK	
	Tools	Demonstrate selection and identification of tools
	Selecting and identifying hand tools	Demonstrate use of common hand tools
	Conditioning and sharpening	Demonstrate how to sharpen and recondition common hand tools.
	Using and maintaining common farm tools	Identify hand tools
		Select tools for different jobs
		Sharpen and condition, cold chisel, screw driver auger bits, etc.
		Replace handles in hammer, axe, fork, etc.
	Power tool operation, safety and maintenance	Demonstrate safe operation of power tools
		Stress safety and maintenance requirements
		Students operate power tools under teacher supervision
	Arc Welding	
	Welding equipment	Demonstrate how to select equipment and material
	Safety practices	Demonstrate how to set up and operate welders
	Operation of Welders	Demonstrate safety practices and how to strike an arc and run flat beads
	Striking the arc	
	Preparing materials & layout	Demonstrate cutting and piercing
		Students pass tests on arc welder safety
	Running a flat bead, lap, butt, and other welds	
	Welding characteristics of metals	
	Using the carbon arc	

	Gas welding and cutting	Demonstrate cutting and welding with gas
	Safety practices	
	Operating welders - welding & cutting	
	Brazing	Set up and light the torches
	Layout	Practice cutting steel
		Pass safety tests on gas welding
2	FARM POWER AND MACHINERY	
	Storage of farm equipment and winterizing	Give instruction on winterizing farm machinery
		Arrange field trip on storage of farm equipment
		Student winterize farm equipment

Spring Quarter (60 hours)

Hours	Area of Instruction	Teacher-Student Activities
3	FFA AND SUPERVISED PROGRAMS	
3	SCHOOL AND FFA ACTIVITIES State Convention FFA meeting Others	
20	FARM SHOP WORK	
	Sheet Metal	Demonstrate use of tools in riveting, bending, seaming, and soldering
	Identification and use of sheet metal tools	Demonstrate how to lay out a project
	Laying out sheet metal projects	Demonstrate soldering with carbon arc
	Bending and seaming	Solder
	Soldering	Make a sheet metal project such as a dust pan, funnel
	Tool Fitting	
	Fitting shovel, axe, hammer or other handles	Bring tools from home and fit handles
	Rope Work	Make different splices, eye, end, and tie common knots
	Make splices, halter, and tie common knots	
5	FARM BUILDINGS AND CONVENIENCES	
	Painting and beautification	Select paints for assigned jobs
	Select materials and paints	
	Prepare for painting	Field trip to observe buildings in need of painting
	Brush and spray painting	Prepare various surfaces for painting
		Demonstrate painting with brush, roller, and spray gun
		Students prepare surfaces for painting
		Students apply paint with brush and gun
13	FARM POWER AND MACHINERY	
	Safety practice in using operating tractors	Demonstrate operation and safety
	Servicing and maintaining	Demonstrate servicing air cleaner, cooling system, battery, tires, and electrical systems
	Storing fuels and lubricants	
	Observing new developments	Demonstrate how to lubricate
		Arrange for field trip on fuel handling and new developments
16	INDIVIDUAL PROJECTS Each boy working on individual project	

COURSE OF STUDY GUIDE FOR AGRICULTURAL MECHANICS II - UTAH

SUMMARY OF TIME ASSIGNMENTS BY AREAS

	Number of hrs. and Time of Year			
	Fall	Winter	Spring	Total
Orientation	4	0	0	4
FFA and Supervised Programs	3	3	3	9
School and FFA Activities	3	3	3	9
Farm Shop Work	20	0	0	20
Farm Power and Machinery	12	45	0	57
Farm Buildings and Conveniences	15	0	5	20
Soil and Water Management	0	0	21	21
Farm Electrification	0	0	10	10
Individual Projects	3	9	18	30
TOTAL DAYS	60	60	60	180

COURSE OF STUDY GUIDE FOR AGRICULTURAL MECHANICS II

Fall Quarter (60 hours)

Hours	Area of Instruction	Teacher-Student Activities
4	ORIENTATION	
	Shop management and organization	Explain methods and procedures
	Shop rules and regulations	Show film on safety
	Shop safety	Review rules and regulations
	Shop dress	Students place copy of rules, etc., in notebooks
	Shop supplies	Students obtain coveralls and other essentials
3	FFA AND SUPERVISED PROGRAMS	
3	SCHOOL AND FFA ACTIVITIES	
	FFA meetings	
	special school activities	
	Fairs and shows	
20	FARM SHOP WORK	
	Identification and review of shop tools	Review conditioning of tools
		Review operation of power tools
	Tool conditioning, sharpening, and use of hand and power tools	Identify tools
		Sharpen and condition tools - fit handles
	Review safety and operation of power tools	
	Arc Welding	Demonstrate vertical, pipe, and horizontal welding and hard facing (also flat)
	Review flat welding	
	Pipe welding	Complete horizontal, vertical, and pipe welds.
	Horizontal welding	
	Vertical welding	Hard face a small unit or project
	Hard facing	
	Gas Welding	Review setting up and operating gas welders
	Setting up equipment	Demonstrate brazing and hard facing
	Bronze brazing (or other)	
	Hard facing	Students braze and hard face small projects or other units
15	FARM BUILDINGS AND CONVENIENCES	
	Figuring bills of materials (Lumber, concrete, paint, etc.,)	Review figuring bills of materials
		Take field trip to building needing repairs
		Take field trips on farm layout, work simplification
	Selecting and using fastening devices (bolts, nails, screws, lagscrews, expansions, glue, etc.)	Figure bills of materials and make plans for actual buildings
	Planning farm layout and work simplification	Use fastening devices
		Repair a building on boy's farm
	Repairing farm buildings	Draw a farmstead layout

Hours	Area of Instruction	Teacher-Student Activities
12	FARM POWER AND MACHINERY Small engines-servicing and maintenance Check use of engines on sprayers, tillers, mowers, elevators, etc.	Demonstrate tune-up and servicing of small engines Student clean and service a small engine Check engines for worn parts Bring operators' manuals
3	INDIVIDUAL PROJECTS	

WINTER QUARTER (60 hours)

Hours	Area of Instruction	Teacher-Student Activities
3	FFA AND SUPERVISED PROGRAMS	
3	SCHOOL AND FFA ACTIVITIES	
45	FARM POWER AND MACHINERY Tractor servicing and maintaining Cooling systems Electrical systems Fuel systems Air Cleaners Lubricants Painting Timing a tractor Review winterizing and storage of tractor and equipment	Give servicing demonstration on each major system for tractor maintenance Demonstrate timing an engine Demonstrate safe and correct tractor operation Bring operator's manual for tractors Clean and flush cooling systems Service generators, wiring, spark plugs, batteries Clean and service carburetor, air cleaner, sediment bowl, fuel lines Lubricate and make minor repairs Select lubricants
	Tractor operation Safety practices Contests	Inspect and change oil Inspect and make minor repairs Have students make and use service charts Winterize cooling system, fuel, and lubrication system Time an engine Drive tractors under supervision
	Tractor - new developments Harvesting machinery and/or equipment. Teacher give instruction on all power machinery common to his area and offer help in: Selecting harvesting machinery & equipment Lubrication of all machines Care of chain and belt drives	Determine if investment in machinery is too much or too little Demonstrate how to check bearings, sprockets, and chains Lubricate various machines Adjust moving parts (when stopped) Check belts and pulleys (when stopped) Bring operator's manual Clean and store equipment Replace defective parts Make list of parts needed in own machine Paint machines

Hours	Area of Instruction	Teacher-Student Activities
	Care and operation of power take off Make various adjustments for safe and smooth operation Care and adjustment of cutter bar assembly Reconditioning and storage	Compare cost of owning versus hiring machines Replace worn bearings Stress need for early adjustment and replacement of worn parts Register knife align cutter bar Replace sections and guards Have student determine cost per hour of common harvesting machines
	Land preparation and seeding equipment and machinery Seeding and land preparation equipment (drills, cultivators, plows, discs, harrows, levelers). Each machine should be carefully considered as to: a. Selection b. Operation, adjustment, calibrating c. Reconditioning d. Storage e. Servicing (parts dealer, etc.)	Refer to list above for demonstrations and activities as they apply Students bring operator's manuals
9	INDIVIDUAL PROJECTS	

SPRING QUARTER (60 hours)

Hours	Area of Instruction	Teacher-Student Activities
3	FFA AND SUPERVISED PROGRAMS	
3	SCHOOL AND FFA ACTIVITIES Special school activities FFA meetings	
5	FARM BUILDINGS AND CONVENIENCES Fences Selection of tools Determine costs Construction procedures Types of fences	Conduct a field trip to determine construction procedures and types of fences Set up model electric fence Identify and use tools for fencing Design fence - showing bracing, gates, etc.
10	FARM ELECTRIFICATION Selection and care of electric motors Farmstead wiring Circuits, distribution, costs, fences Servicing and adjusting electric motors	Demonstrate cleaning and servicing electric motors Show types of motors and their use Demonstrate with electric power boards materials for farm wiring, size of wire, circuits, safety, and economy

Hours	Area of Instruction	Teacher-Student Activities
	FARM ELECTRICIATION (Continued)	
	Wiring for a farmstead, wiring a building Measuring starting loads of motors Testing capacities of fuses and overloads of devices Checking safety of house and farm wiring systems	Clean, service and adjust electric motors Rewire demonstration boards
21	SOIL AND WATER MANAGEMENT	
	Setting grade stakes for cut and fill Laying out irrigation system Constructing head gate forms Using a level, laying out contour lines, and planning ditch layouts Determining the acreage in boy's farm Values of storage ponds Installing sprinkler systems Farm drainage a. Determining drainage needs b. Types of drains c. Cost of drainage d. Laying out drainage systems	Test concrete materials Demonstrate use of rod, level and chain Lay out a ditch with given grade Plan an irrigation system for a farm Arrange field trip to ditch lining project Arrange field trip to area needing drainage Demonstrate estimating cost of drainage project Field trip to ditch being made for lining and when lining is being laid Figure cost of lining ditch Study area needing drainage Figure cost of sprinkling system
17	INDIVIDUAL PROJECTS	

COURSE OF STUDY GUIDE FOR AGRICULTURE MECHANICS III - Utah

FALL QUARTER (60 hours)

Hours	Area of Instruction	Teacher-Student Activities
3	ORIENTATION Shop management and organization Shop rules and regulations Shop safety Shop dress	Explain methods and procedures to be followed in the shop Show a film on shop safety Assign student jobs or responsibilities Review rules and regulations and place in notebook. Students obtain coveralls and other essentials.
3	FFA AND SUPERVISED PROGRAMS	

Course of Study Guide for Agriculture Mechanics III - Utah

Summary of Time Assignments by Areas

Areas	Number of Hrs. and Time of Year			
	Fall	Winter	Spring	Total
Orientation	3	0	0	3
FFA and Supervised Farming	3	3	3	9
School and FFA Activities	3	3	3	9
Farm Shop Work	20	5	0	25
Farm Power Machinery	0	16	17	33
Farm Buildings and Conveniences	31	0	10	41
Soil and Water Management	0	0	0	0
Farm Electricity	0	0	5	5
Individual Projects	0	33	22	55
TOTALS	60	60	60	180

Hours	Area of Instruction	Teacher-Student Activities
3	SCHOOL AND FFA ACTIVITIES FFA meetings Special school activities State Fair Harvest Ball	Similar to previous years
20	FARM SHOP WORK Review power tools Operation Safety practices Maintenance	Demonstrate proper use of power equipment Emphasize safety of power equipment
	Review Bills of Materials Lumber Metal products, concrete & block	Repair power tools Review computing bill of materials
		Demonstrate welding advances Demonstrate new equipment and new developments
	Welding Review of past units Hard facing, silver soldering Stainless & Inert-gas welding	Make up a trial bill of materials Hard face one item (i.e. plowshare, etc) Braze a joint (ie. tubing joints)
	Review gas welding and cutting General review of cutting Brazing	
31	FARM BUILDINGS AND CONVENIENCES Home Farm Shop Planning the shop building Selecting site (May include garage or machine shop) Arranging tools, supplies and equipment storage Selecting tools, equipment and supplies	Give students acceptable floor plans. Review State Foundation FFA Mechanics Award Use a model farmstead to show locations Discuss the work students can do in planning buildings and equipping the farm shop. Arrange field trips to see shops under construction and/or in use.
	Repair of buildings Walls Floors, roofs, ceilings Windows, doors, hardware Electrical repairs and installations Plumbing and concrete repairs or installations	Teachers demonstrate repair procedures. Students sketch out a farm shop with or without including garage, or machine shed, etc. Figure bill of materials for shop Make a list of essential shop equipment Students lay out a building on school grounds Students construct a corner concrete form Build a small building in the shop
	Layout of farmstead Layout Work simplification	Students plan a layout to improve his own farmstead Students make needed repairs on farmstead

Hours	Area of Instruction	Teacher-Student Activities
	FARM BUILDINGS & CONVENIENCES (continued)	
	Layout of a farm building Laying out the grade, footings, etc. Layout of structural members (framing) Types of doors, windows, hardware Plumbing, electrical Roofs, types and construction	Identify and select building materials Demonstrate use of materials Arrange field trip to observe work simplification and orderly farmstead layout.

WINTER QUARTER (60 hours)

Hours	Area of Instruction	Teacher-Student Activities
3	FFA AND SUPERVISED PROGRAMS	
3	SCHOOL AND FFA ACTIVITIES Meetings Special school activities Field trips	
5	FARM SHOP WORK Metal Lathe Turning Operating and maintaining the lathe Making accurate measurements Using common shop tools, ie. calipers, rule, etc. Plain turning	Demonstrate simple operations of metal lathe Explain and demonstrate maintenance Demonstrate use of tools used in making accurate measurements Demonstrate plain turning, ie. armature, shaft, etc. Advanced students turn down a shaft for a bearing and/or pulley
16	FARM POWER AND MACHINERY Review winterizing and storing farm equipment Figure tractor operating costs Review servicing and maintenance of tractors Cooling system Electrical system Fuel system Lubrication Cleaning Painting and replacing decals	Demonstrate operations for servicing Have students bring tractors Have two students work on each tractor Have groups complete each serving operation before going to next unit

Hours	Area of Instruction	Teacher-Student Activities
	Harvesting machinery Use Maintenance Cleaning Adjustment Lubrication Power take off drive Power units	Students by assignment inspect machines and list broken or worn parts and order in time for work season.
33	INDIVIDUAL PROJECTS	

SPRING QUARTER (60 hours)

Hours	Area of Instruction	Teacher-Student Activities
3	FFA AND SUPERVISED PROGRAMS	
3	SCHOOL AND FFA ACTIVITIES Meetings Special school activities	
17	FARM POWER AND MACHINERY	
	Farm trucks and trailers Operation License procedures Maintenance	Demonstrate safety procedures of farm equipment on way Demonstrate operation and maintenance procedures Stress licensing
	Small engines and garden or other equipment Garden tractor Trouble shooting Maintaining Cleaning Other items of equipment Shovel, rake, hoe	Have students make and use a service chart Demonstrate how to locate trouble, adjust, and maintain units Students clean, adjust, and repair units in agriculture shop Paint units that need it
	Miscellaneous farm equipment and machinery Sprayer Harrows Disc	Demonstrate cleaning and operating sprayers
5	FARM ELECTRIFICATION	
	Review Farmstead wiring Selection and care Wiring for yards, buildings, patios, and other areas Testing circuits, loads, etc.	Have field trip to wire farm buildings Students evaluate wiring systems

Hours	Area of Instruction	Teacher-Student Activities
10	FARM BUILDINGS AND CONVENIENCES	
	Farm Plumbing	
	Making repairs and servicing fixtures	Demonstrate selecting and using fittings, washers, etc.
	Selecting pipe and fittings	Demonstrate cutting, reaming, and threading.
	Measuring, cutting, reaming	Demonstrate installation of drains
	Installing lines	Students replace washers, fittings, etc.
	Installing drains to sewer or septic tank	
	Farm Conveniences	
	Build non-freeze waterers	Stress safety factors (electricity)
	Install waterers	
	Install fixtures as needed	Field trip to observe
22	INDIVIDUAL PROJECTS	

THREE YEAR SUMMARY OF AG. MECHANICS
1963

Areas	(Number of Days) Ag. Mech. I 1st	2nd	3rd	Total	Ag. Mech. II 1st	2nd	3rd	Total	Ag. Mech. III 1st	2nd	3rd	Total	3 Yr. Total
Orientation	5	--	--	5	4	--	--	4	3	--	--	3	12
FFA Records & Supervised Programs	5	3	3	12	3	3	3	9	3	3	3	9	30
School and FFA Activities	5	3	3	11	3	3	3	9	3	3	3	9	29
Farm Shop Work	42	20	20	82	20	--	--	20	20	5	--	25	127
Farm Power & Machinery	2	--	13	15	12	45	--	57	--	16	17	33	105
Farm Buildings & Conveniences	--	15	5	20	15	--	5	20	31	--	10	41	81
Soil & Water Management	--	--	--	--	--	--	21	21	--	--	--	--	21
Farm Electrification	--	15	--	15	--	--	10	10	--	--	5	5	30
Individual Projects	--	4	16	20	3	9	18	30	--	33	22	55	105
TOTAL DAYS	60	60	60	180	60	60	60	180	60	60	60	180	540

References for Ag. Mechanics

A. FARM SHOPWORK

Books:

Bennett Co.	Basic Bench Metal Practices
Coggins, Armstrong and Giles	A Manual on Sharpening - North Carolina State College, 1943
Ross and Cramlet	Woodwork Visualized, Bruce Publishing Co., 1954
Crewdson	Spray Painting, Fredrick J. Drake Co.
Feirer	General Metals, McGraw Hill, 1959
Giachina, Feirer	Basic Bench Metal Practice and Precision Measuring, Manual Arts Press, 1943
Hollenberg	How To Teach Arc Welding, Lincoln Foundation, 1952
Jones	Shopwork on the Farm - McGraw Hill, 1955
Kugler	Arc Welding Lessons For School and Farm Shop, Lincoln Foundation, 1957
Lincoln	Metals and How to Weld Them - Lincoln Foundation
Lincoln	Welding Helps for Farmers - Lincoln Foundation
Lincoln	Learning to Weld - Lincoln Foundation
Lincoln	Manual of Instruction for Arc Welding - Lincoln Foundation
Linde	Oxy-Acetylene Handbook O Linde Company, 1961
Linde	Welding and Cutting Manual - Linde Air Products (current)
Ludwig	Metalwork Technology and Practice - McKnight & McKnight, 1962
Mix and Cirou	Practical Carpentry - Goodheart and Wilcox Co., 1953
Morford	Farm Arc Welding - Lincoln Foundation, 1954
O'Brien	Demonstrations for Farm Mechanics - Interstate, 1957
O'Brien	Shopwork Teaching Tricks, Interstate, 1953
Parker	Farm Welding, McGraw Hill, 1958
Phipps, etal	Farm Mechanics Text and Handbook, Interstate, 1959
Roehl	Fitting Farm Tools - Bruce Publishing Co.

Books:

Ruley	Projects in General Metal Work - McKnight and McKnight
Sampson, et al	Farm Shop Skills in Mechanized Agriculture, American Technical Society
Stoody Company	Farm Hard Facing Handbook
Stieri	Sheet Metal Principles and Procedures, Prentice-Hall, 1953
Stieri	Basic Welding Principles, Prentice-Hall, 1953
Townsend	Woodwork, American Technical Society
Townsend	Carpentry, American Technical Society, 1950
Wakeman & McCoy	The Farm Shop, MacMillan, 1960
Young	Rural Arithmetic, Bruce Publishing Company

Bulletins:

Rope Knowledge for Riggers, Columbian Rope Co., Auburn, New York

Columbia Knot Chart, Columbian Rope Co., Auburn, New York

How to Use Hand Tools, Crescent Tool Co., Jamestown, New York

ABC's of Hand Tools, General Motors Corporation, Detroit, Michigan

How to Get Better Welds - Vest Pocket Guide, Hobart Brothers Co., Troy, Ohio

Manual of Instruction for Arc Welding, James F. Lincoln Foundation, Cleveland, Ohio

Useful Knots and How to Tie Them, Plymouth Cordage Co., Plymouth, Mass.

How to Put Rope to Work on The Farm, Plymouth Cordage Co., Plymouth, Mass.

Expert Soldering, Stanley Tool Co., New Britain, Conn.

The Stanley Tool Guide, Stanley Tool Co., New Britain, Conn.

Tool Catalog (for identification and use)

Hardware and Tool Identification Kit, Interstate Printers, Danville, Illinois

Soldering, Koester

Films:

New Welding Procedures - Eutechtic Welding Corporation (20 min.)

Use and Care of Hand Tools (Series of 6) Photo Tools, L.A. Cal. (58 min.)

Grinding Cutter Bits - South Bend Lathe Co., (20 min.) South Bend 22, Indiana

Plane Turning - South Bend Lathe Co. (20 min.)

The Lathe - South Bend Lathe Co. (20 min.)

Do-It-Yourself Aluminum, Reynolds Metal Co.

Leather in Your Life, Leather Industries (27 min.)

The Oxy-Acetylene Flame,Bureau of Mines (19 min.)

Story of Copper, Oldest Metal, (23 min.)

Heat and Its Control (b/w), (20 min.)

Story of Gasoline (23 min.)

Its Easy to Bend, O'Neil-Irwin Manufacturing Co.

Prevention and Control of Distortion, Association Films Industry

The Spray's the Thing (Spray Paint)

Welding Advances in Aluminum

This Is Steel #411, Modern Talking Picture Service

Welding With Aluminum #225

ABC of Hand Tools - General Motors Corporation

How To Run A Band Saw, DoAll Co.

Chucks and Their Uses, Skinner Chuck Co.

Uses & Abuses of Twist Drills, Cleveland Twist Drill, (26 min.)

The Art of Reaming (27 min.)

Grinding Wheel Safety, Norton Co. (20 min.)

Age of Precision, Cincinnati Milling Co., (16 min.)

Cool Chips (13 min.)

The Tools and Rules of Precision Measuring, L.S. Starrett Co.

Files & How to Use Them, Simonds Saw & Steel Co., (30 min.)

Films Cont.:

The Band Saw

Wickwire Rope, Thos. Barber Products, (30 min.)

Steelworker

The American Engineer, Jam Handy Products, (30 min.)

Milling Practices (35 m.m. Slide Tng. F.) Kenney and Trecker (180 min.)

Sharpening Hand Tools (FS McGraw 39f), McGraw Hill, New York

Sharpening & Using Auger Bits and Twist Drills (FS McGraw 39f), McGraw Hill

Sawing, Planing, and Smoothing Wood, (FS McGraw 39f), McGraw Hill

Fundamentals of Bench Work, Series by Jam Handy Organization, 2821 East Grant Blvd., Detroit 11, Michigan

Electric Arc Welds - FS, McGraw Hill

Welding Comes to the Farm, James Lincoln Foundation, (24 min.)

Learning Farm Welding With the Arc Welder, James Lincoln Foundation

Oxy-Acetylene Welding Series, Jam Handy Organization

Electric Welding Series

A Stitch in Time, C. L. Benard, Peoria, Illinois

Soldering, Shopwork Series, McGraw-Hill

Steel Wire in Agriculture, Venard Organization, Peoria, Illinois

The Story of Cordage, (Rope Materials), Plymouth Cordage Co., Plymouth, Mass.

The Rope Farm Story, Venard Organization, Peoria, Ill.

Let's Make Concrete, U.S.U. Film Library

B. FARM POWER AND MACHINERY

Briggs & Stratton	Small Motors Manual (Current)
Brown & Morrison	Farm Tractor Maintenance, Interstate, 1958
Lammey	Power Tools and How to Use Them - Popular Mechanics, 1950
I and T	Tractor Service Manuals, Technical Publications (Current includes complete service, (54.50)

I and T	Small Engines Service Manual (current - $4.95)
Johnson, et al	Servicing and Maintaining Farm Tractors, McGraw Hill
Mix and Moore	Farm Mechanics Power Tool Manual, Goodheart-Wilcox Co., 1952
Purvis	All About Small Engines, Goodheart-Wilcox Co.
Promersberger and Bishop	Modern Farm Power, Prentice-Hall, 1963
Smith	Farm Machinery and Equipment, McGraw Hill, 1955
Stone & Gulvin	Machines for Power Farming, Wiley and Sons, 1957
SAAEVA	Tractor Maintenance Principles and Procedures, Southern Association for Agricultural Engineering and Vocational Agriculture, 1963
SAAEVA	Farm Tractor Tune Up and Service Guide, 1963
SAAEVA	Selecting and Storing Tractor Fuels and Lubricants, 1963
SAAEVA	Tractor Fuels and Lubricants, 1961
SAAEVA	Tractor Operation and Daily Care, 1959
SAAEVA	Planning a Machinery Storage Layout, 1956
SAAEVA	Planning the Machinery Storage and Shop Structure, 1957

Bulletins:

Electric Drills, Use and Care, Handbook, Black and Decker Mfg. Co., Townson, Md.

Use & Care of Twist Drills, Cleveland Twist Drill Co., 1242 East 94th St., Cleveland, Ohio

Disston Saw Tool & File Manual, Disston & Sons, Philadelphia 35, Pa.

Take Care of Your Cooling System, E.I. DuPont DeNemours & Co., Wilmington 98, Delaware

Care & Maintenance of Farm Tractors Manual, FFA Supply Service, Alexandria, Va.

The Care, Operation and Adjustment of "Specific Machine," FFA Supply Service, Johnson & Hollenberg, Alexandria, Virginia

Selecting the Right Tap, Greenfield Tap and Die Corporation, Greenfield, Mass.

Gulf Farm Tractor Guide, Gulf Oil Corp., Pittsburgh 30, Pa.

How To Select, Use & Care for Bits, Irwin Auger Bit Co., Wilmington, Ohio

Care of Drills & Reamers, Latrobe, 411 West Ontario St., Chicago, Ill.

Files For The Farm, Nicholson File Co., Providence 1, R. I.

How To Run A Drill Press, So. Bend Lathe Co., So. Bend 22, Indiana

Utah 4-H Manual, Utah Refining Co., Salt Lake City, Utah

Engineering Bulletin #FT-53 Farm Tractors, Utah Oil Refining Co., Salt Lake City

First Aid For Plier, Utica Drop Forge & Tool Corp., Utica 4, N. Y.

Tractors Operators Manual

Films:

Service Procedure for Ball Bearings, General Motors Corp., (20 min.)

Farm Tractor Safety, Standard Talking Films, (30 min.)

Down Time, Caterpillar Tractor (23 min.)

Story of the Storage Battery (b/w), 32 min.)

Hold Your Horses (Tractor Cooling), (32 min.)

Basic Principles of Lubrications, General Motors Corporation

The ABC of Internal Combustion Engines

Farm Tractor Safety, American Petroleum Inst., Utah Oil Co., SLC, Utah

Farm Petroleum Safety, Utah Oil Co.

Farm Tractor Care, Utah Oil Co.

Gasolines Amazing Molecules, Standard Oil of Calif., SLC, Utah

Safe As You Think, General Motors Corporation

C. FARM BUILDINGS AND CONVENIENCES

Books:

Ashby, et al — Modern Farm Buildings, Prentice-Hall, 1959

Dalzell & Townsend — Concrete Block Construction For House & Farm, American Technical Society, 1955

Durbahn — Fundamentals of Carpentry - Vols. I and II, (Publisher #5, Elvin Downs - You have the publisher page that has the names) 1960

Books Cont.:

Foss	Construction & Maintenance For Farm & Home, Wiley & Sons, 1960
Howell, Coggin and Giles	Building & Equiping the Farm Shop, Interstate, 1956
Ross	Painting Farm Buildings & Equipment, Lead Industries, New York 1944, (4th Printing 1947)
Wooley	Farm Buildings, McGraw Hill, 1946
SAAEVA	Planning A Farm Shop Layout, 1956

Bulletins:

Building Farm Fences, Coordinators Office, Ag. Eng. Dept., Univ. of Georgia, Athens, Ga.

Building With Concrete Masonry, Portland Cement Association, 33 West Grand Ave. Chicago 10, Ill.

Concrete Making, Portland Cement Association

Drawings on Buildings With Concrete (33 Drawings, Refer to Item D 1674) Portland Cement Association

Farm Fences, U.S.D.A. Bulletin #1832

Concrete Handbook of Permanent Farm Construction, Portland Cement Association

Numerous other leaflets and folders relative to concrete construction for dairying, farm plumbing, etc. Local dealers often have these available.

Films:

Building Concrete Masonry, (19 min.), Portland Cement Association

Concrete on the Farm, Portland Cement Association, (21 min.)

Let's Make Concrete (How To Make), Portland Cement Association, (32 min.)

Making, Forming & Curing Cement, Portland Cement Association

Let's Build A Fence, #32, Farm Film Foundation

Fencing Electrically, Prime Manufacturing Co., (20 min.)

Farm Use For Plywood, Douglas Fir Plywood, (30 min.)

Let's Build a Fence, Venard Organization, Peoria, Ill.

Modern Fence Building, Venard Organization, Peoria, Ill.

D. SOIL & WATER MANAGEMENT

D. SOIL & WATER MANAGEMENT

Books:

Bennett	Elements of Soil Conservation, McGraw Hill, 1955
Israelson	Irrigation Principles & Practices, Wiley & Sons, 1962
Knuti, Korpi, & Hyde	Profitable Soil Management, Prentice-Hall, 1962
McColly & Martin	Surveying & Land Management, McGraw Hill, 1955
Schwab, et al	Elementary Soil & Water Engineering, Wiley & Sons, 1957
Schwab, et al	Manual of Soil & Water Conservation (publisher #2)

Bulletin:

Concrete Soil Saving Structures, Portland Cement Association

Films:

Linings, Concrete Ditches (Canal), Portland Cement Association

Land Leveling For Irrigation, Farmhand Company

Realock Fence

Thirsty Acres, Union Pacific Railroad, Available State Office

E. RURAL ELECTRIFICATION

Books:

Brown	Farm Electrification, McGraw Hill, 1956
Cornetet	Principles of Electricity, McKnight & McKnight, 1952
Dragoo	General Shop Electricity, McKnight & McKnight, 1952
Hamilton	Using Electricity on the Farm, Prentice Hall, 1959
Gerrish	Electricity, Goodheart-Wilcox Co., 1961
Jones	Fundamentals of Applied Electricity, Bruce Publ. Co., 1956
Knight	Electric Fences, Branding Irons, & De-Horners
Matson	#30 Instruction Units in Basic Electricity, McKnight & McKnight 1961

Norak	Practical Residential Wiring, D. Van Nostrand Co., 1948
Peterson	Fundamentals of Electricity, Bruce Publ. Co.
Richter	Wiring Simplified, Interstate, 1959
Rosenberg	Electric Motor Repair, Rinehart Co., 1951
SAAEVA	Selecting Farm Electric Motors, Controls & Drives, 1953
SAAEVA	Maintaining the Farm Wiring & Lighting Systems, 1952
SAAEVA	Electrical Terms, Their Meaning & Use, 1963
Wright	Electricity in the Home & on the Farm, Wiley & Sons, 1950, (third printing, 1955)

Bulletins:

Planning the Farm Home Wiring Systems, University of Georgia, Agriculture Dept.

Maintaining the Farm Wiring & Lighting System, Univ. of Georgia, Dept. of Eng.

Farmstead Wiring Handbook, Industry Wiring Co., Room 2650, 420 Lexington Ave., New York 17, N. Y.

Electric Fencing Construction & Operation of Electric Fence Systems, Prine Mfg. Co., Milwaukee, Wisconsin

Electric Wiring for Home & Farm, Sears-Roebuck Co.

Lighting the Farm, Albert Smith, E.E. Leaflet #8, U.S.U. Extension Service, Logan

Adequate Wiring on the Farm, Albert Smith, Leaflet #3, USU Extension Services, Logan, Utah

Adequate Farmstead Wiring - Electric Lights for the Farm Leaflets #39, #6, #7, Respectively)

Films:

Using Electricity Safely, Shopwork Series, McGraw-Hill.

F. PROJECTS & IDEAS

Cook	380 Things to Make, Interstate, 1941
Cook	500 More Things to Make, Interstate, 1944
Cook	600 More Things to Make, Interstate, 1953
	Ideas For Farm Mechanics Project Activities, Interstate
Lincoln	Farm Equipment Welding Plans, James Lincoln Foundation, 1959

OTHER PUBLISHERS AND ADDITIONAL BOOK

Bruce Publishing Company, Milwaukee, Wisconsin

Frederick J. Drake Co., Wilmette, Illinois

Popular Mechanics, Hawthorne Publishing Co., 70 at 5th Ave.,
New York 11, New York

Order sent to:
Inglewood Cliffs, New Jersey

Book:

SELECTED LESSONS FOR TEACHING AGRICULTURAL SCIENCE, Dale W. Andrews &
Elwood M. Juergenson, Interstate Printers, 1961

THREE YEAR SUMMARY OF AG. MECHANICS
1963

Areas	(Number of Days) Ag. Mech. I 1st	2nd	3rd	Total	Ag. Mech. II 1st	2nd	3rd	Total	Ag. Mech. III 1st	2nd	3rd	Total	3 Yr. Total
Orientation	5	--	--	5	4	--	--	4	3	--	--	3	12
FFA Records & Supervised Programs	5	3	3	12	3	3	3	9	3	3	3	9	30
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Farm Buildings & Conveniences	--	15	5	20	15	--	5	20	31	--	10	41	81
Soil & Water Management	--	--	--	--	--	--	21	21	--	--	--	--	21
Farm Electrification	--	15	--	15	--	--	10	10	--	--	5	5	30
Individual Projects	--	4	16	20	3	9	18	30	--	33	22	55	105
TOTAL DAYS	60	60	60	180	60	60	60	180	60	60	60	180	540

A LIST OF SOME OF THE PUBLISHING OR OTHER COMPANIES
WHOSE BOOKS, BULLETINS, OR LEAFLETS ARE USED IN VOCATIONAL AGRICULTURE
(Agricultural Science & Agricultural Mechanics)

Number	Name	Address
1	American Inst. of Coop.	1616 H St., N.W. Wash. 6, D.C.
2	American Poultry Assn., Inc.	Davenport, Iowa
3	American Society of Agronomy	677 So. Segoe Rd., Madison 11, Wis.
4	American Technical Society	848 E. 58 St., Chicago, Ill.
5	American Vocational Association	1010 Vermont Ave., N.W. Washington 5, D.C.
6	American Veterinary Publications	Evanston, Illinois
7	William C. Brown Company	1355 Locust, Dubuque, Iowa
8	Burgess Publishing Co.	426 S. 6 St., Minneapolis, Minn.
9	Calif. State Dept. of Education	State Capitol Bldg., Sacramento, Calif.
10	Co-op Printshop	New Concord, Ohio
11	Deere and Company	Moline, Illinois
12	Drake, Frederick J. & Co.	Wilmette, Illinois
13	Doubleday Company	575 Madison Ave., N. Y. 22, N. Y.
14	Farmer's Digest	Ft. Atkinson, Wisconsin
15	FFA Foundation Inc.	U.S. Office of Education Washington 25, D.C.
16	FFA Chapter Supply Service	Box 1180, Alexandria, Virginia
17	Golden Press	Rockefeller Center, N. Y. 20, N.Y.
18	Goodheart - Wilcox	1322 So. Wabash, Chicago, Illinois
19	Hobart Brothers Co.	Box EW 268, Troy, Ohio
20	Horticultural Publications	Rutgers University, New Brunswick, N. J.
21	Implement & Tractor Tech. Publishers	1014 Wyandotte St. Kansas City 5, Missouri
22	Interstate Printers & Publishers	19-27 No. Jackson, Danville, Ill.

23	Iowa State University Press	Press Building, Ames, Iowa
24	James F. Lincoln	Cleveland 17, Ohio
25	Lane Publishing Co.	Menlo Park, Calif.
26	Lea and Febiger	600 Washington Square, Philadelphia 6, Pa.
27	Lead Industries Association	420 Lexington Ave., N.Y.17, N.Y.
28	Linde Air Production Company	30 East 42nd St., N.Y. 17, N.Y.
29	Lippincott, J.B.	East Washington Square, Philadelphia 5, Penn.
30	MacMillan Publishing Co.	60 Fifth Ave., N.Y. 11, N.Y.
31	McGraw-Hill	330 West, 42 St., N.Y. 36, N.Y.
32	McKnight & McKnight Publishing Co.	Rt. 66 Towanda, Bloomington, Ill.
33	Meredith Press	Des Moines 3, Iowa
34	Midway Book Company	2173 Dudley Ave., St. Paul, Minn.
35	Minnesota University Press	St. Paul, Minnesota
36	Montgomery Ward	Denver, Portland, or San Francisco
37	Morrison Publishing Co.	515 Woodlands Dr., Clinton, Iowa
38	National Farm Book Company	Viroqua, Wisconsin
39	Ohio State College Press	Columbus, Ohio
40	Orange-Judd Publishing Co.	153 East 26th St., N. Y. 10, N.Y.
41	Oxford University Press	1600 Pollitt Dr., FairLawn, N.J.
42	Prentice-Hall Publishing Company	Englewood Cliffs, New Jersey
43	Research Association	57 West Grand Ave., Chicago, Ill.
44	Rinehard, Holt, and Winston	283 Madison Ave., New York 17, N.Y.
45	Saunders Publishing Co.	
46	Scott-Foresman Co.	
47	Sears Roebuck Co.	Los Angeles 54, Calif. or local store

48	SAEVA (Southern Association Ag. Engineers and Vocational Ag.)	Barrow Hall, U. of Georgia Athens, Georgia
49	Stoody Co.	Whittier, California
50	Theodore Andre & Co.	New York
51	Utah State University (USU)	Logan, Utah
52	University of Illinois	College of Ag., Urbana, Illinois
53	U.S.D.A. (U.S. Dept. of Agriculture)	Washington 25, D.C.
54	Van Nostrand	120 Alexander St., Princeton, N.J.
55	Vulcan Press (Vulcan Service Co.)	534 St., Oakland 12, California
56	John Wiley and Sons	440 4th Ave., N. Y. 16, N. Y.
57	Bruce Publishing Company	Milwaukee, Wisconsin
58	Popular Mechanics,	Hawthorne Publishing Company 70 at 5th Avenue, New York 11 New York Order sent to: Inglewood Cliffs, New Jersey

VT 001 873
Education for Business, Program Guide and Courses of Study.

North Carolina State Dept. of Public Instruction, Raleigh
MF AVAILABLE IN VT-ERIC SET.
Publication No. 368
PUB DATE - Dec63 155p.

DESCRIPTORS - *BUSINESS EDUCATION; *PROGRAM GUIDES; PROGRAM PLANNING; EDUCATIONAL FACILITIES; EDUCATIONAL EQUIPMENT; BUSINESS EDUCATION TEACHERS; COURSE DESCRIPTIONS; SECONDARY GRADES; GUIDANCE SERVICES

ABSTRACT - Intended as an aid for administrators and teachers in developing business programs, the major portion of the guide contains the scope and sequence of course offerings, suggesting the objectives, prerequisites, procedures and content for these courses of study: (1) Basic Business-Economic Education Courses, (2) Bookkeeping I, (3) Typewriting I, (4) Advanced Basic Business-Economic Information, and (5) Specialized Business Education Courses. Other sections deal with: (1) the scope and importance of education for business, (2) modification of business programs for different kinds of high schools, (3) guidance services, (4) recommendations for facilities and equipment, and (5) a continuing plan of improvement for business teachers. A sample form for evaluating students is appended. (SB)

VT 001 873

ED0 45856

Program Guide and Courses of Study

NORTH CAROLINA PUBLIC SCHOOLS

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY

VT 01873

EDUCATION FOR BUSINESS

STATE DEPARTMENT OF PUBLIC INSTRUCTION
RALEIGH
PUBLICATION NO. 368

A program of instruction, to serve the purposes for which it was created, must constantly be re-evaluated. For this reason, the State Department of Public Instruction requests suggestions for the improvement of this publication.

ED0 45856

Foreword

Education for business in North Carolina's secondary schools is big business. Approximately 130,000 students are enrolled in more than 5,000 daily business classes being taught by more than 1,200 teachers.

Education for business is a broad field of study. It is composed of a sequence of learning experiences which provides the student with a basic knowledge of business-economic education upon which he can develop the specialized skills and attitudes needed in a changing world of business. All students, college bound or noncollege bound, can fulfill many of their interests, needs, and career goals through education for business.

It is the purpose of this publication to make suggestions as to *the what* and *the how* of education for business at the secondary level and to serve as a guide to administrators, boards of education, and business teachers in developing business programs of outstanding quality. Supervisors, guidance personnel, student business teachers, and many others should, through this bulletin, be able to gain a perspective of education for business and how it is an interrelated part of the total secondary school curriculum. It should offer also many implications for personnel of teacher-education institutions.

Grateful appreciation is expressed to Miss Joyce Bateman, State Supervisor of Education for Business, for her keen analysis of the importance of developing competence in this area of learning and for her leadership in initiating and guiding the preparation of this publication.

Chas. L. Carroll

DECEMBER 1963 *State Superintendent of Public Instruction*

Preface

The impact of a rapidly changing and challenging economy has alerted educators and business personnel to the importance of planning balanced secondary business programs. Balance in this publication refers to[1]:

- adequate amounts and kinds of general education
- appropriate background work in basic business-economic education
- a concentration of study in some one specialized business area, in most cases leading to employment and advancement in business

The term "program" is being used to refer to the complete scope and sequence of course offerings and related learnings in the area of education for business. It should not be confused with "curriculum" which is being used to refer specifically to the total scope and sequence of carefully planned courses and related learning experiences in all programs of studies in secondary schools.

Since education for business is built upon a base of general education fixed by State law and tradition, this publication will be concerned with the properly balanced business programs involving the areas of basic business-economic and specialized business education.

This publication has been written following a study of the principles of business education that have stood the test of time; after exploring the latest developments in educational philosophy and practice, the orientation of education for business on a national scale to the present cross currents of thought, and the impact of automation on education for business.

The principle of flexibility in the balanced business program and that of planning student programs on an individual basis are the underlying theses for this publication.

Portions of Publication No. 267, *Curriculum Guide and Courses of Study in Business Education for North Carolina,* that were found to be adequate were copied freely without specific reference. Portions that were considered outmoded were deleted or rewritten and other parts condensed. Much reorganization of topics resulted.

NILE F. HUNT
Director, Division of Instructional Services

[1] Adapted from H. G. Enterline's unpublished Conference on Business Education, "The Place of Basic Business Education in The Business Curriculum," July 5, 1961, p. 1.

Acknowledgements

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Education for Business

EDUCATION FOR BUSINESS

Education for business is a vital, interrelated part of the whole process of education. It embraces three very closely related, yet distinct, areas. Each includes adequate and appropriate amounts and kinds of learning experiences for developing certain desired knowledges, understandings, attitudes, appreciations, and skills.

The three areas are:

GENERAL EDUCATION—which is fixed by State law and tradition. It is made available to all youth and designed to develop common knowledges, understandings, attitudes, appreciations, and skills needed by all persons in order to function satisfactorily and effectively as intelligent members of a changing society.

BASIC BUSINESS-ECONOMIC EDUCATION—which is built upon and contributes to general education. It is broad in scope and concerned with the development of knowledges, understandings, attitudes, appreciations, and skills which will enable the individual:

A. To understand the structure and function of business

B. To participate intelligently in political, social, and business community life
   - evaluate local, national, and international problems
   - support local, state, and federal governments and organizations designed to conserve human and natural resources

C. To become a wise buyer, user, and producer of business goods and services
   - use sources of production information effectively
   - comprehend buying motives and their effects upon choice making
   - discriminate in the choices of goods, credit, investments, and services

D. To consider his own physical and mental capacities; interests; career goals; needs; occupational opportunities; requirements for and rewards of occupational opportunities; and the advantages, disadvantages, and limitations of various types of occupations
   - utilize guidance services and employment helps
   - comprehend business needs to render a service, make a profit, and have a fair return on the training time, equipment, and salary that has been invested in him
   - evaluate occupational opportunities by considering his interests, aptitudes, growth, service opportunities, security, and earning capacity now and in the future
   - adapt to new occupational patterns and requirements

E. To manage his personal business affairs as an intelligent citizen
   - use skills for his own satisfaction and welfare
   - manage his personal finances wisely for his own security and happiness
   - accept his family and community responsibilities
   - appreciate hard work and exercise honesty and dependability

F. To utilize effectively his personality and character traits, work habits, and attitudes

In all secondary schools, the course offerings in this area should be elective for all youth regardless of career goals, long-range aspirations, economic or social status, and levels of ability.

SPECIALIZED BUSINESS EDUCATION—which is built upon general and basic business-economic education. It is concerned with the development of knowledges, understandings, attitudes, appreciations, and skill competencies needed for initial business employment and advancement in business careers.

Specialized business education provides learning experiences which will enable the individual:

A. To perform the duties and functions comprising the specific job for which he is preparing himself
B. To acquire desirable personal traits
C. To understand and practice good human relations
D. To acquire occupational intelligence and the ability to adapt to occupational change
E. To exercise wise choice and use of goods and services
F. To comprehend business procedures, practices, and their relationships
G. To comprehend the structure and function of business
H. To appreciate and help maintain a cultural environment
I. To prepare for further study

Course offerings and related learning experiences in this area should be open to students[2] who are

- highly capable but not college bound and are preparing for vocational service in office, sales, and service occupations
  ultimate ownership, management, and operation of individually owned and operated business enterprises
- college bound and want to supplement academic education with practical education or need an earning capacity while in school

[2] Adapted from circular "Current Directions in Business Education in High Schools," by Elvin S. Eyster, Chairman, Department of Business Education, Indiana University, Bloomington, Indiana.

IMPORTANCE OF EDUCATION FOR BUSINESS

Every major statement of the purpose of education in America has included principles which reflect the importance of basic business-economic and specialized business education. A direct implication of the importance of learning experiences in these areas of education for business is found in the traditionally accepted obligation of the school to teach:[3]

- Command of fundamental processes
- Health
- Worthy home membership
- Vocational competence
- Effective citizenship
- Worthy use of leisure
- Ethical character

The four Principles of Secondary Education, as defined by the Educational Policies Commission, include the following:[4]

- Objectives of self-realization
- Objectives of human relationship
- Objectives of economic efficiency
- Objectives of civic responsibilities

While education for business contributes to each objective, it makes its greatest contribution to the objective of economic efficiency. The principle of economic efficiency has been defined by the Educational Policies Commission[5] to include:

WORK—The educated producer knows the satisfaction of good workmanship.

OCCUPATIONAL INFORMATION—The educated producer understands the requirements and opportunities for various jobs.

OCCUPATIONAL CHOICE—The educated producer has selected his occupation.

OCCUPATIONAL EFFICIENCY—The educated producer succeeds in his chosen vocation.

OCCUPATIONAL ADJUSTMENT—The educated producer maintains and improves his efficiency.

OCCUPATIONAL APPRECIATION—The educated producer appreciates the social value of his work.

PERSONAL ECONOMICS—The educated consumer plans the economics of his own life.

CONSUMER JUDGMENT—The educated consumer develops standards for guiding his expenditures.

EFFICIENCY IN BUYING—The educated consumer is an informed and skillful buyer.

[3] The Educational Policies Commission, National Education Association of the United States and the American Association of School Administrators, *The Central Purpose of American Education*, January 1962, p. 5.

[4] *Ibid.*, p. 2.

[5] The Educational Policies Commission, National Education Association of the United States and the American Association of School Administrators, *The Purpose of Education in American Democracy*, 1940, p. 90.

CONSUMER PROTECTION—The educated consumer takes appropriate measures to safeguard his interests.

Education for business is important! All youth need to possess general, basic business-economic, and some specialized knowledges, understandings, attitudes, appreciations, and skills which will match the changing world of work.

A CHANGING WORLD OF WORK

Schools throughout the nation must help millions of youth to find their place in a changing world of work. Their preparation for work, for adjusting to change, and for problem solving through critical thinking cannot be left to chance. Constructive planning and implementation of the planning are imperative. Appropriate guidance, learning experiences, and quality instruction must be given because the demands of the times are great and the number of individuals engaging daily in business activities as purchasers, consumers, and producers of goods and services are many.

Multitudes of opportunities will be available for job seekers in the future. The ability of young people to embrace these opportunities, however, will depend to an important extent upon their educational background. The job-world of the future obviously calls for people who have a marketable skill,[6] a skill built upon a balanced educational background.

Although North Carolina is the leading manufacturing blue-collar employer in the South and tenth in the nation, white-collar or desk jobs are growing faster than any other kind of employment. Between 1950 and 1960 the number of jobs using professional, technical, and clerical skills grew about five times as fast as the State average for all jobs.[7]

Will our youth be prepared to meet changing job opportunities and demands? How can the challenge be met?

MEETING THE CHALLENGE

To meet the challenge of the changing, demanding world of work, educational systems should consider:

- Planning and implementing continuous evaluation for the development and improvement of business programs which will fit into the total school curriculum and meet the student and community needs
- Providing an atmosphere for creative thinking and experimentation
- Broadening and strengthening the scope and depth of basic business-economic learning
- Providing adequate specialized business learning experiences to meet the student and community needs
- Having each high school student include in his program of studies at

[6] United States Department of Labor, Bureau of Labor Statistics, OCCUPATIONAL OUTLOOK HANDBOOK, "Implications of the Outlook for Education and Training," 1961, p. 27.

[7] Federal Reserve Bank of Richmond, Virginia, NORTH CAROLINA: AN ECONOMIC PROFILE, April 1963, p. 12.

least one year of learning experiences in basic business and economic fundamentals as a part of his general education.

It is recommended that certain courses in business and economic fundamentals be considered as meeting part of the social studies sequence required for graduation from high school regardless of the department in which they are offered.[8] Such courses include Economics, the one-semester Advanced Basic Business-Economic Information courses, or the one-year Advanced Basic Business-Economic Information course integrating various subject areas.

- Providing opportunities for business teachers, other members of the teaching staff, administrators, supervisors, and guidance personnel to have a knowledge of the fundamental processes and economic understandings taught in elementary, junior high, senior high, and post-high schools

  Vertical articulation is essential to provide the proper sequential course content at any level of instruction.

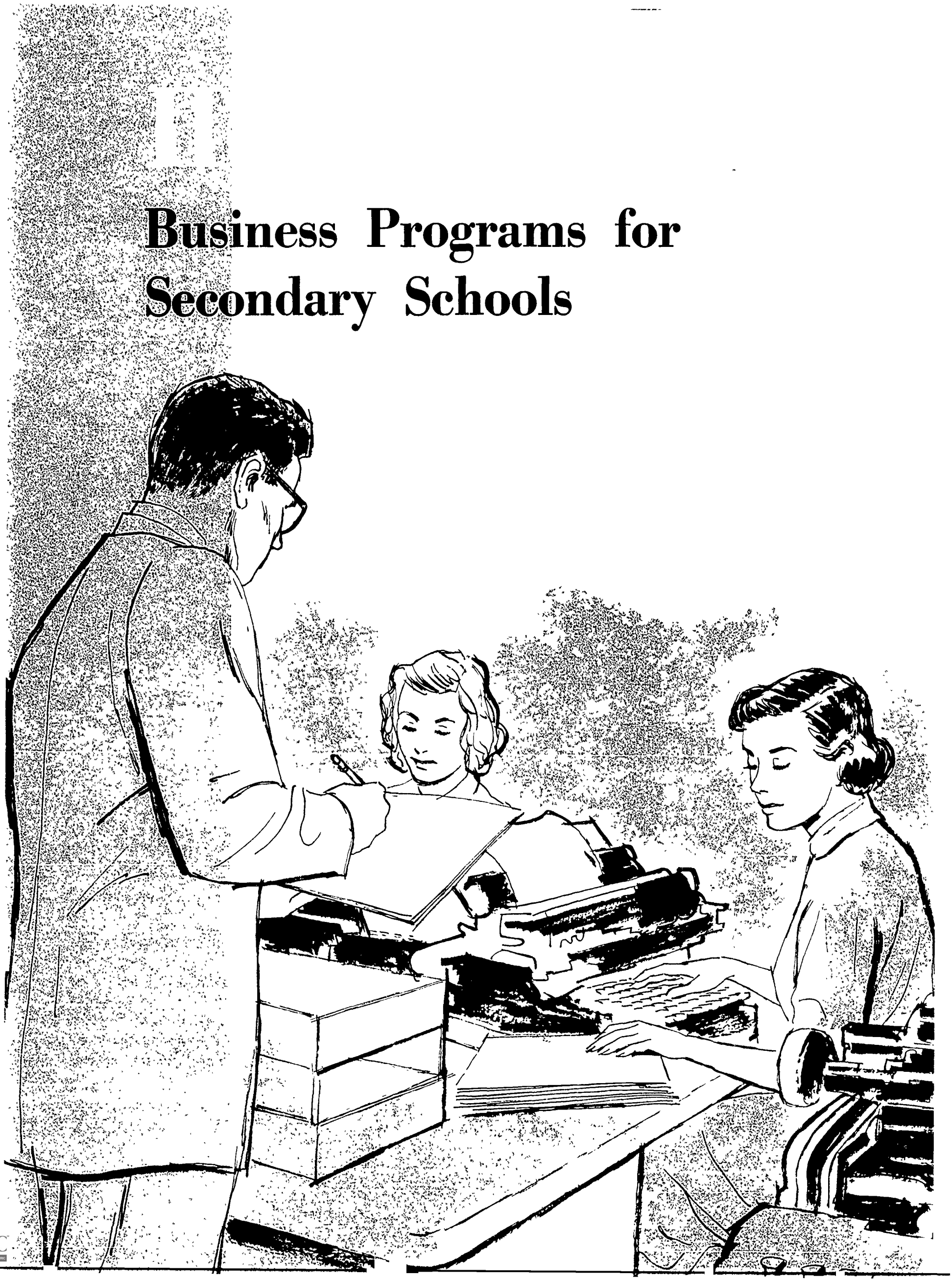
- Providing opportunities for the school's staff to gain an understanding of the school's philosophy and the purpose of each departmental area of the school

  With this basic horizontal articulation, courses within the business program and courses across other program lines may be correlated. No department should work in isolation, but in cooperation with other areas of the school because learnings in one area become functional to another. The business department should discuss and initiate correlation of subject matter across departmental lines.

- Providing qualified teaching personnel and adequate equipment and facilities to implement an effective business program
- Providing adequate, current student and teacher materials which will meet the ability and maturity levels of all students
- Providing adequate guidance services to help each student plan and complete a meaningful program of studies which best fits his needs, interests, aspirations, and purposes

[8] "This We Believe About Business Education in the High School," *Business Education Forum* (National Business Education Association, 17:4, January 1963).

Business Programs for Secondary Schools



BUSINESS PROGRAMS FOR SECONDARY SCHOOLS

Every program planner must work within definite limitations, and rightly so; otherwise, each educator would tend to favor his specialty and sacrifice balance. Balance is highly important to accomplishing a well-rounded and as complete an education as possible within the time available for the program of study, whether it be a business program or a program in some other area.[9]

In planning business programs, consideration must be given to the following:

A. The philosophy and objectives of the school system

B. The philosophy of education for business in the total secondary school educational environment

- attitudes of school administrators, boards of education, teachers, supervisors, guidance personnel, parents, students, and the business community toward basic business-economic and specialized education

C. Defensible and attainable education-for-business objectives against which all educational activities can be evaluated by studying

- nature of the student population
  - ability and maturity levels
  - interests
  - economic background
  - educational and career goals
  - attitudes toward the study of business
  - number of dropouts, their ability level, past and present activities
- nature of the school community
  - location
  - size
  - organizational pattern
  - economic and educational status of its citizens
  - aspirations of parents and other members of the school community
  - occupational opportunities
  - post-high school, college, and university educational opportunities

The depth and breadth of any secondary business education program should be especially designed to meet the needs of the students in that school and the community of which it is a part. The learning experiences in a small high school with one business teacher must necessarily be more narrow in depth and breadth than those in a larger school. Nevertheless, the program should be planned with balance and should be organized and directed toward the school population and community needs.

Whatever business program may be adopted, it is recommended that each student's program of studies be individualized. Neither

[9] Enterline, *op. cit.*, "The Place of Basic Business Education in the Business Curriculum," p. 1.

the school nor the student has the time or energy to engage in all learning activities which will fully meet every need, interest, purpose, and career goal. Choices among possible courses, learning activities, and related experiences are inevitable.

An ideal business program will provide for individual differences and seek maximum learning experiences for each student. Such a program can be achieved only if there is adequate planning, cooperation, and guidance on the part of administrators, business teachers, and the entire school staff. Coordinated efforts are needed to see that each student pursues a program of studies which will enable him to reach a meaningful goal once his program is planned and undertaken.

In order to assist administrators and teachers in planning and implementing effective business programs, suggested program patterns are outlined in this bulletin for the small high school, medium-size high school, comprehensive high school, junior high school, high school summer school, and adult education programs. The scope of course offerings, course content, procedures, and classroom management are suggestive only.

Each school system should plan the type of balanced business program which is most feasible for the present and projected nature of its school population, its community, its available and qualified staff, and its facilities.

It is recommended that all students pursuing a business program take

Basic Business-Economic Information
Bookkeeping I
Typewriting I
Advanced Basic Business-Economic Information

Courses taken beyond this minimum requirement should be chosen on the basis of student needs, interests, purposes, and career goals.

Suggested basic business-economic and specialized business education courses which might be offered in any school are given in Part IV. Each course outline gives the course description, objectives, prerequisites, suggested procedures, suggested content, and suggestions for classroom management.

College-bound students who need earning capacity while in college or who want to supplement academic education with practical education will find many helpful courses in both the basic business-economic and specialized areas of education for business.

The college-bound student might also consider taking Notehand, a one-semester twelfth-grade course, designed for the purpose of learning to take notes, not for developing a specialized skill. This course is outlined on pages 196 and 197.

THE SMALL HIGH SCHOOL

In the small high school in which there is only one business teacher, the business program should be designed

- to provide a core of learning experiences in basic business-economic education which will provide the background essential to useful citizenship as well as wise use of goods and services
- to give the widest possible selection of specialized business education courses in order to meet student and community needs

Although the depth and breadth of course offerings and related learning experiences in this type school must necessarily be fewer than in larger schools, the basic business-economic and specialized business course offerings should still be balanced and fulfill as nearly as possible community needs and the needs of students who

- have post-high school, college, or university educational goals
- are college or university bound and want to supplement academic education with practical education, or need an earning capacity while in school
- are average or above in ability and upon graduation are seeking business employment in office, sales, and service occupations; or are preparing for the ownership or operation of an individually owned business

The following suggested two-way program is perhaps the minimum which should be offered in a secondary business program. Whether a shorthand concentration should be offered in any secondary business program will depend upon the school's student population, the students' desire for stenographic jobs immediately upon graduation, and the number of jobs available for high school graduates in stenographic or general office positions. Careful guidance should be given each student in planning his program of studies in order to meet as nearly as possible all his needs and interests, as well as his educational and career goals. The business program should be planned, implemented, evaluated, and re-evaluated to be sure that it is meeting the needs of students and those of the community; not only for today's world of work, but also for tomorrow and its anticipated needs.

SUGGESTED TWO-WAY PROGRAM FOR THE SMALL SCHOOL

NINTH GRADE

Subject	Units
Basic Business-Economics Information[1]	1
Required and Elective Courses	2½
Health and Physical Education	½
English I	1
TOTAL	5

TENTH GRADE

Subject	Units
Basic Business-Economic Information or an elective in business (Business Mathematics)[2]	1
Typewriting I[3]	1
Required and Elective Courses	1½
Health and Physical Education	½
English II	1
TOTAL	5

[1] Basic Business-Economic Information is recommended for the ninth grade if possible. Otherwise, the student should take an elective from some other area and take Basic Business-Economic Information at the tenth-grade level.

[2] If Basic Business-Economic Information has been taken in the ninth grade, an elective course should be taken in its place at the tenth-grade level (perhaps Business Mathematics).

[3] Typewriting I is recommended at the tenth-grade level for students who are planning to take Shorthand I in the eleventh grade. Other students should take it at the grade level most appropriate for their educational goals. Typewriting I should be open to all students as an elective at either the tenth-, eleventh-, or twelfth-grade level. The number of students enrolled in the course should not exceed the number of available typewriters and work stations. A maximum class enrollment of not more than thirty-two students is recommended.

ELEVENTH GRADE

SHORTHAND CONCENTRATION

Subject	Units
Shorthand I	1
Bookkeeping I[4]	1
Required and Elective Courses	1½
Health and Physical Education	½
English III	1
TOTAL	5

BUSINESS FOUNDATION CONCENTRATION

Subject	Units
Bookkeeping I or Business Mathematics[5]	1
Advanced Basic Business-Economic Information[6]	1
Required and Elective Courses	1½
Health and Physical Education	½
English III	1
TOTAL	5

[4] Bookkeeping I is recommended for the eleventh-grade level if possible. Otherwise, the student should take an elective from some other area and take Bookkeeping I in the twelfth grade.

[5] By teaching six periods daily and by offering Bookkeeping I and Business Mathematics in alternate years, one business teacher can handle the breadth of this suggested two-way concentration. Another way the program can be handled is for the school to decide on a policy of offering a combination of the two programs which will most nearly meet the needs of the students and community.

[6] Advanced Basic Business-Economic Information may be offered according to one of three plans: (1) as one- or two-semester courses such as business economics, business law, consumer economics, principles of retailing, principles of selling, business organization, or economic geography; (2) as a selected units course in which teacher and students decide upon what units will be most worthwhile, then use two, three, or four separate textbooks as basic reference sources; (3) as a problems course (unstructured) in which students and teachers determine significant problems to be studied and then use whatever sources of information are needed to solve the major problems to be studied and then use whatever sources of information are needed to solve the major problems undertaken for study. (Adapted from Enterline, H. G., *op. cit.*, p. 2.)

TWELFTH GRADE

SHORTHAND CONCENTRATION

Subject	Units
Office Practice[7]	1
Required and Elective Courses	2½
Health and Physical Education	½
English IV	1
TOTAL	5

[7] Since Typewriting II and Shorthand II are not offered, Office Practice should be designed to develop these advanced skills.

BUSINESS FOUNDATIONS CONCENTRATION

Subject	Units
Bookkeeping I or Advanced Basic Business-Economic Information	1
Required and Elective Courses	2½
Health and Physical Education	½
English IV	1
TOTAL	5

THE MEDIUM-SIZE HIGH SCHOOL

The typical medium-size high school in North Carolina will be found in many rural areas. Business teachers in such a school will probably number two or more.

Each medium-size school should adopt a business program which will

- provide a core of learning experiences in basic business-economic education which will provide the background essential to useful citizenship as well as wise use of goods and services
- give the widest possible selection of specialized business education courses in order to meet student and community needs
- provide, if feasible, a cooperative work experience program

In planning the program, particular attention should be given to survey findings; population, educational, and job opportunity trends; economic potentials and legislative enactments.

The practicability of offering cooperative work experience programs should be seriously considered. This will depend primarily upon the size, type, and distance of the school from the nearest urban center and the use of such programs by urban schools. Office Occupations and Distributive Education Cooperative Work Programs are outlined on page 23.

The recommended scope of a business program for the consolidated high school is as follows:

Basic Business-Economic Courses	Year	Units
Basic Business-Economic Information	9 or 10	1
Business Mathematics	10 or 11	1
Bookkeeping I	11 or 12	1
Typewriting I	10, 11 or 12	1
Advanced Basic Business-Economic Information	11 or 12	1

Specialized Business Education Courses	Year	Units
Shorthand I	11	1
Shorthand II	12	1
Office Practice (½ unit—fall)	12	½
Business Machines (½ unit—spring)	12	½
Cooperative Work Program		
Office Occupations I	11	2
Office Occupations II	12	2
or		
Office Occupations I only	12	3
Distributive Education I	11	2
Distributive Education II	12	2
or		
Distributive Education I only	12	3

THE COMPREHENSIVE HIGH SCHOOL

Differentiated Business Programs

Because of the

- greater variety of course offerings and related learning experiences that are feasible in the comprehensive high school
- greater specialization of job opportunities available in the localities where these schools will be

more specialized business programs can be planned to meet the school's educational objectives and the student and community needs. The school should offer, from the suggested differentiated programs outlined, those which are most applicable to its school population and community characteristics. It is not expected that any one school will offer all of the programs. Probably no school will offer more than two or three.

In each program offered, it is recommended that adjustments be made in the student's program to meet his abilities, needs, interests, and purposes.

The recommended differentiated business programs are:

- Business Foundation Program
- Stenographic Program
- Manager-Owner Program
- General Office Program
- Marketing Program
- Cooperative Work Program
  - Distributive Education
  - Office Occupations

BUSINESS FOUNDATION PROGRAM

Design The business foundation program is designed primarily for college or noncollege bound students who desire a general background in business and economics.

Emphasis Emphasis in the learning activities is directed toward the general principles, concepts, practices, and procedures essential to our business and economic system.

Purpose The purpose of the program is to develop

- an understanding of business organization
- a business-economic vocabulary
- an understanding of and appreciation for business occupations
- economic efficiency
- an understanding of and appreciation for our economic system
- an aptitude for understanding human nature and the interrelationship of people in all walks of life
- a broad educational background as a basis for further study

Scope and Sequence

Course Title	Year	Unit
Basic Business-Economic Information	9 or 10	1
Bookkeeping I	11 or 12	1
Typewriting I	10, 11 or 12	1
Advanced Business-Economic Information	11 or 12	1
	TOTAL	4

Adoptations

1. Basic Business-Economic Information may be taken in the tenth grade; Typewriting I, in the eleventh or twelfth grade; Bookkeeping I, in the twelfth; and Advanced Basic Business-Economic Information, in the twelfth grade.
2. Advanced Basic Business-Economics may be offered according to one of three plans as explained in Part IV, pages 36 and 37.
3. The student may prefer the one-semester Economics course in place of or in addition to one of the Advanced Basic Business-Economic Information courses.
4. Provisions should be made for the student's ability and maturity level through methods of instruction, selection of instructional materials, and grouping.
5. Each student should be given guidance in choosing the courses which will most nearly meet his abilities, needs, interests, and purposes.
6. The feasibility of the scope of these course offerings will depend upon the school's organization and upon available qualified personnel.

STENOGRAPHIC PROGRAM

Design

The stenographic program is a specialized program planned to meet the needs of those students who

- are highly capable, but not college bound, and expect to become stenographers after graduation from high school
- are college bound and want to major in the field of business or who want to supplement academic education with a marketable skill

Emphasis

Emphasis in the learning activities is directed toward basic understandings of the business world and toward developing marketable skills.

Purpose

The purpose of the program is to develop

- skills satisfactory for initial employment in taking dictation and transcribing notes; filing; composing and typewriting with or without instruction; using voice writing, duplicating and reproducing machines; rendering communicative services, and accepting administrative responsibilities
- further proficiency in English fundamentals—spelling, punctuation, grammar, and oral and written communication
- an understanding of office procedures and an aptitude for adjusting to new procedures or changes in old procedures
- a business-economic vocabulary
- an understanding of business organization
- economic efficiency
- an understanding of an appreciation for our economic system
- an understanding of the role of automation in business activities
- a working knowledge of how stenographic work affects office data processing procedures
- an understanding of job potentials, their advantages and disadvantages, in the stenographic field

Explanation

1. Students who do not show evidence of developing employable personality traits and sufficient skills to become stenographers should be directed into another program.
2. It is recommended that one year of typewriting precede Shorthand I in order to permit early introduction to transcription work.
3. Students who enter this program should have average or above ability in reading, comprehension, and communicating through written and oral media; an aptitude for foreign languages; and an interest and desire to master the program of studies.
4. Only one year of typewriting is offered in this program. Skill building in typewriting skills and production work is continued in Shorthand II and Office Practice.
5. If at all possible, Office Practice should be scheduled the period after Shorthand II in order to give a double period of intensive coordinated learning experiences.

6. Shorthand I and Office Practice should be scheduled the same period in order that students who do not succeed in shorthand may be permitted to transfer to Office Practice.

Scope and Sequence

Course Title	Year	Unit
Basic Business-Economic Information	9 or 10	1
Typewriting I	10	1
Bookkeeping I	11 or 12	1
Shorthand I	11	1
Shorthand II	12	1
Business Communications	12	½
Business Machines (spring)	12	½
Office Practice (fall)	12	½
Advanced Basic Business— Economics (If plan 1 is used, Business Law and Business Organization or Business Economics should perhaps be given consideration first.)	11 or 12	1
	TOTAL	7½
Consideration should be given to the possibility of taking Cooperative Office Occupations I	12	3

Adaptations

1. Basic Business-Economic Information can be taken in the tenth grade; Bookkeeping I, in the twelfth grade.
2. Advanced Basic Business-Economics may be offered according to one of three plans as explained in Part IV, pages 36 and 37.
3. The student may prefer the one-semester Economics course in place of or in addition to one of the Advanced Basic Business-Economic Information courses.
4. Provisions should be made for the student's ability and maturity level through methods of instruction, selection of instructional materials, and grouping.
5. If time is a restricting factor for the student in taking Advanced Basic Business-Economic Information courses under plan 1, it may be more feasible for him to take only one of the Advanced Basic Business-Economic Information courses during the spring or fall semester and take Business Communications the remaining semester.
6. Schools which have been offering two years of typewriting and wish to retain it may substitute Typewriting II for Office Practice, but it is not recommended that both be offered. If Typewriting II is offered, it may be open to both stenographic and non-stenographic students at the twelfth grade level, but they should be sectioned.

7. Once the typewriting skill development is begun in the tenth grade, it should be continued in grades 11 and 12. This can be done through Shorthand II and Office Practice.
8. Each student should be given guidance in choosing the courses which will most nearly meet his abilities, needs, interests, and purposes.
9. In order to develop the skills in machine operation just prior to the time they are to be used on the job, it is recommended that Office Practice be offered in the fall semester and Business Machines in the spring.
10. The feasibility of the scope of these course offerings will depend upon the school's organization and upon available, qualified personnel.

ERIC

MANAGER-OWNER PROGRAM

Design

The manager-owner program is designed for

- college or noncollege bound students who desire a general background in business and economics
- students whose interests are centered in the possibility of
  - owning or directing a small business
  - taking a place in a small business already established
  - working in a large business in a non-technical or pre-managerial capacity

Emphasis

Emphasis in the learning activities is directed toward the general principles, policies, practices, and problems of business organization.

Purpose

The purpose of the program is to develop

- an understanding of business organization
- an understanding of the services a business can render
- an understanding of a business's coordinated activities
- insights into how to inspire people to work toward objectives
- an ability to exercise a positive influence to make things happen
- a belief in change if conditions warrant a change
- a sensitivity to a wide range of pressures and restrictions
- an understanding of the impact of world affairs on local business
- an understanding of the repercussions of political affairs
- an understanding of government actions, regulations on businesses, and taxes
- an insight into some of the things which society expects of a manager
- a business-economic vocabulary
- economic efficiency
- an understanding of and appreciation for our economic system
- a knowledge of bookkeeping, business law, and management principles and their application to everyday life
- further proficiency in written and oral communication, computational and reading fundamentals
- an aptitude for understanding human nature and the interrelationship of people in all walks of life

Explanation

1. Business Mathematics is recommended as an elective course to develop skills in the fundamental processes to be applied in bookkeeping. If possible, the study of Business Mathematics should precede Bookkeeping I.
2. The cooperative office occupations program requires two periods of related instruction and carries two units of credit. The minimum three hours' daily supervised work experience carries one unit credit.

Scope and Sequence

Course Title	Year	Unit
Basic Business-Economic Information	9 or 10	1
Typewriting I	10, 11 or 12	1
Bookkeeping I	11	1
Bookkeeping II	12	1
Business Machines (spring)	12	½
Advanced Basic Business—Economic Information (If plan 1 is used Business Law, Business Organization, and/or Business Economics should be given consideration first)	12	1
	TOTAL	5½
Consideration should be given to the possibility of taking		
Cooperative Office Occupations I	11	2
Cooperative Office Occupations II or	12	2
Cooperative Office Occupations I	12	3

Adaptations

1. Practice and problem materials can be selected to conform to current business procedures
2. Basic Business-Economic Information may be taken in the tenth grade; Typewriting I, in the eleventh; Advanced Basic Business-Economic Information, in the twelfth.
3. Advanced Basic Business-Economics may be offered according to one of three plans as explained in Part IV, pages 36 and 37.
4. The student may prefer the one-semester Economics course in place of or in addition to one of the Advanced Basic Business-Economic Information courses
5. Provisions should be made for the student's ability and maturity level through methods of instruction, selection of instructional materials, and grouping
6. Bookkeeping II provides development in advanced understandings and skills not attainable in Bookkeeping I
7. Each student should be given guidance in choosing the courses which will most nearly meet his abilities, needs, interests, and purposes
8. The feasibility of the scope of this program will depend upon the school's organization, available and qualified personnel, the school's student population, and the school's community

GENERAL OFFICE PROGRAM

Design

The general office program is a specialized, vocational program designed to prepare students

- to perform with a degree of efficiency general office and service work
- to be qualified for employment in jobs which do not call for shorthand skills and possibly bookkeeping principles

Emphasis

Emphasis in the learning activities is directed toward developing those knowledges, skills, and attitudes necessary to perform general office work efficiently.

Purpose

The purpose of the program is

- to familiarize students with business organizations, systems, and procedures
- to familiarize students with business machines and devices
- to develop a reasonable amount of skill in the operation of the most used business machines
- to acquaint students with papers and forms used in businesses
- to develop a business vocabulary
- to develop economic efficiency
- to develop an understanding of and appreciation for our economic system
- to develop a working knowledge of how general office work affects data processing procedures
- to develop an understanding of the role of automation in the business world and, more specifically, in an office
- to develop an understanding of office job opportunities, their advantages and disadvantages in the world of work
- to develop an aptitude to understand human nature and the interrelationship of general office workers to other types of office and business workers

Explanation

1. Business Mathematics is a desirable elective.
2. Recordkeeping may be taken instead of Bookkeeping I.
3. The cooperative program requires two periods of related instruction and carries two units of credit. The minimum three hours daily of supervised work experience carries one unit of credit.

Scope and Sequence

Course Title	Year	Unit
Basic Business-Economic Information	9 or 10	1
Typewriting I	10 or 11	1
Business Mathematics	10 or 11	1
Bookkeeping I or Recordkeeping	11	1
Office Practice (fall)	12	½
Business Machines (spring)	12	½
Advanced Basic Business-Economic Informotion	12	1
	TOTAL	6

Course Title	Year	Unit
Consideration should be given to taking		
Cooperative Office Occupations I	11	2
Cooperative Office Occupations II	12	2
or		
Cooperative Office Occupations I	12	3

Adaptations

1. A survey should be made of the business offices served by the school to determine if the high school graduate is meeting the needs of the office, if job opportunities are available, and if there is an opportunity for growth on the job.
2. Practice materials can be selected to conform to current business procedures.
3. Basic Business-Economic Information may be offered at the tenth-grade level; Typewriting I, at the eleventh-grade level; Advanced Basic Business-Economic Information, at the twelfth-grade level.
4. Advanced Basic Business-Economic Information may be offered according to one of three plans as explained in Part IV, pages 36 and 37.
5. Provisions should be made for the student's ability and maturity level through methods of instruction, selection of instructional materials, and grouping.
6. Recordkeeping provides development in the fundamentals of recordkeeping and its importance to business transactions. This course may be taken instead of Bookkeeping I.
7. Each student should be given guidance in choosing the courses which will most nearly meet his abilities, needs, interests, and purposes.
8. In order to develop the skills in machine operation just prior to the time they are to be used on the job, it is recommended that Office Practice be offered in the fall semester and Business Machines in the spring.
9. The feasibility of the scope of these course offerings will depend upon the school's organization and upon available, qualified personnel.

MARKETING PROGAM

Design

The marketing program is designed for

- college or noncollege bound students who desire a general background in business and economics
- college bound students who desire to study the field of marketing
- students whose interests are centered in the possibility of
  - owning or directing a small store
  - taking a sales job in a small business already established
  - working in a large business in a nontechnical or premarketing management capacity

Emphasis

Emphasis in the learning activities is directed toward business organization and the principles, policies, practices, and problems of marketing.

Purpose

The purpose of the program is to develop

- an understanding of business organization
- a business-economic vocabulary
- an insight into some of the fundamental marketing concepts and functions
- an insight into the importance of product planning, sales forecasting, sales promotions, pricing, marketing channels and institutions

Explanation

The noncollege bound student should consider the possibility of taking the Distributive Education Program. Detailed information on the organization of this program and course content can be secured from the State Supervisor of Distributive Education, State Department of Public Instruction, Raleigh.

Scope and Sequence

Course Title	Year	Unit
Basic Business-Economic Information	9 or 10	1
Typewriting I	10, 11 or 12	1
Bookkeeping I	11 or 12	1
Advanced Basic Business—Economic Information (It is recommended that two units of work be taken and that first consideration be given to Business Law, Business Organization, Principles of Retailing, Principles of Selling.)	11 or 12	2
Advertising	11 or 12	½
	TOTAL	5½
Consideration should be given to taking		
Distributive Education I	11	2
Distributive Education II	12	2
or		
Distributive Education I	12	3

Adaptations

Adaptations for this program are the same as those for the Manager-Owner Program listed on pages 18 and 19.

COOPERATIVE WORK PROGRAM

Design

The most common types of Cooperative Work Programs are

- Distributive Education Program
- Cooperative Office Occupations
- Industrial Cooperative Training

Of these three programs, Distributive Education and Cooperative Office Occupations have great potentialities in the school's over-all business program.

These two programs are generally found in the comprehensive high schools; smaller schools, however, can successfully carry out such programs, since it is possible to design them to fit local situations.

These cooperative work programs permit a student to complete his required courses for graduation while at the same time he may receive on-the-job training in a business firm. The student trainee receives both pay and school credit while training on-the-job in the community business firm.

A coordinator is needed for each of the programs within a school. Either one of the programs, or both, may be set up in a school.

Emphasis

The emphasis in the learning and related activities is upon the development of individual abilities, attitudes, and skills needed for the ultimate achievement of career goals.

Purpose

The purpose of the Cooperative Office Occupations Program is

- to provide students with an opportunity to have realism brought to their education which is hard to achieve by any other method of motivation
- to develop the abilities, attitudes, and skills needed for office and service employment
- to develop economic efficiency
- to develop an understanding of and appreciation for our economic system
- to develop an understanding of automation, business procedures, systems, practices, and techniques
- to serve as a medium for correlating the school with the business community
- to afford a direct basis for excellent public relations

Explanation

1. Work experience solely for the sake of work should not be condoned. A definite correlation between school work and on-the-job experience is imperative.
2. The work experience program should be a supervised learning activity. In a well-organized program, all learning experiences are blended to produce greater understandings and skill competencies.

The work experience of the student should vitalize the study experiences of the classroom.

3. The students being prepared in the cooperative work program perform a variety of distributive and office duties. This is as it should be, since they will confront a variety of experiences upon their entrance into the business world on a full-time basis.
4. A school which plans to implement a Distributive Education Program should consult the Supervisor of Distributive Education, State Department of Public Instruction, Raleigh, for details as to course of study.
5. A Cooperative Office Occupations Program can be integrated into the Secretarial, Manager-Owner, or General Office Program as offered in this guide.
6. The Cooperative Office Occupations Program should be planned so that all the students taking advantage of the work experience have at least one class of related instruction in which only they participate.

Standards

The following standards for coordinators, business firms, and schools should be maintained in a Cooperative Work Program:

STUDENTS

- should be at least 16 years of age
- should be able to secure health permits
- should be neat in appearance
- should have a desire to work
- should possess acceptable general personality traits
- should have developed skills of marketable standards

COORDINATORS

- should have a degree in business education
- should have had successful experience in teaching business subjects
- should have actual successful job experience in his particular area of distributive or office work for at least one year or its equivalent
- should have a pleasing appearance and be poised in talking to individuals and community groups; should be able to handle publicity releases to news media and to make effective contacts by telephone and correspondence

BUSINESS FIRMS

- should have sufficient, meaningful work for a minimum of 15 hours weekly employment
- should provide varied training experience so that the trainee will have a knowledge of general procedure as well as a mastery of specific skills upon completion of a year's work experience
- should provide adequate facilities for efficient work

- should require trainee's experience to meet its standards of production
- should compensate the trainee for his work at the rate paid other workers at a comparable stage of their training
- should provide the coordinator with an outline of the trainee's tasks
- should be willing for the coordinator to visit the firm and observe the trainee at work
- should be willing to furnish necessary reports on the trainee's work and personal adjustments to promote remedial instruction. Reports should include the following:
  - attendance records
  - criticism of work done
  - general attitude in regard to such things as judgment, initiative, cooperation, personality, appearance, and personal hygiene
- should have an experienced person to guide, instruct, help, and direct the trainee in the performance of his duties
- should be willing to serve on an advisory committee when requested
- should be willing for its representatives to visit the school in an effort to get a better understanding of the problems involved in learning skills and in applying the skills to job situations

SCHOOLS

- should plan for the coordinator's work to extend over a ten months' period
- should cooperate with the coordinator in setting up an advisory committee

  The advisory committee is essential to a cooperative program. It is usually composed of two employers, two supervisory level employees, the coordinator, and the school principal. Its chief functions are to help in the selection of training firms, to advise about training policies, to assist in promotional work, and to evaluate the work program.
- should provide a laboratory classroom equippe for office training
- should provide a centrally located conference room for privacy in interviewing students and for conferences with businessmen

  This room should be equipped with suitable office furniture and supplies to give it a pleasant appearance.
- should provide a telephone for the coordinator
- should provide for travel expenses in supervising the coordinator's area
- should assist the coordinator in giving information to the public concerning the program

THE JUNIOR HIGH SCHOOL

Because of the increasing popularity of a 6-3-3 plan for education, it is important that the business teacher be aware of the possibilities and limitations of a business program on the junior high school level.

Education for business has a contribution to make to the objectives of the junior high school by

- providing exploratory and guidance experiences
- laying the foundation for more advanced study
- developing further the fundamental processes of reading, communicating through written and oral media, and computing

The business courses most appropriate for the junior high school are

- Basic Business-Economic Information (ninth grade)
- Typewriting I (ninth grade)
- NO SPECIALIZED BUSINESS COURSES SHOULD BE OFFERED

If Typewriting I is taught, it is imperative that

- a qualified business teacher trained in the teaching of typewriting teach the course
- correct typewriting techniques be emphasized at all times and used by the students
- articulation be maintained with the senior high school typewriting learning experiences
- appropriate instructional materials be used
- a summary of the student's junior high typewriting experience, including the teacher's recommendation for high school typewriting work, be given
- the courses be conducted in standard semester units of work
- sustained emphasis on basic skill building be given

HIGH SCHOOL SUMMER PROGRAMS

The high school summer program, if conducted, must be authorized by the county or city board of education. The superintendent or the principal of the school must assume responsibility for organizing the summer program and for reporting its operation to the State Department of Public Instruction.

The business teacher should work with the school administrators in deciding which business courses should be offered. The scope of the summer school business program will depend upon

- student interests and needs
- available facilities, equipment, and qualified teachers

It is suggested that consideration be given to offering the following courses as electives open to all students

- Typewriting I—10, 11, and 12th graders
- Business Communications—11 and 12th graders
- Business Mathematics—10 and 11th graders
- Business Machines—12th graders only
- Advanced Basic Business-Economic Information—11 and 12th graders

A minimum of 150 hours of instruction should be given for one unit of credit and 75 hours for one-half unit of credit.

Teacher certification and assignment requirements should be the same as for the regular school year. High standards of excellence in all areas of instruction should be maintained.

Complete and accurate scholastic records should be kept.

ADULT EDUCATION PROGRAMS

Adult education is one of the greatest untapped fields of educational opportunity in North Carolina. As stated in the Department of Public Instruction's leaflet, *Guidelines for Establishing Adult General Education Programs,* county and city boards of education are encouraged to promote adult education programs in their respective units for the purposes of:

- Permitting culturally deprived individuals to continue their general education by engaging in programs of study normally offered at the elementary and secondary levels
- Providing for the development of satisfying avocational interests of individuals in the community
- Providing pre-vocational and vocational training for individuals desiring to acquire competencies
- Providing instruction for worthwhile community endeavors

It is suggested that consideration be given to offering in this program any of the basic business-economic or specialized business courses outlined in this guide. The program should be designed to meet the adults' needs and follow a sequential pattern. If the courses are to carry credit, the standards of achievement should conform to those recommended in this guide. Clock hours necessary for the completion of each credit course should be determined by the student's rate of progress.

BUSINESS PROGRAM EVALUATION

Regardless of the depth and breadth of a school's business program, planned evaluation and re-evaluation must take place in order to refine and improve instruction. The evaluation should be well planned and administered with the cooperation of all business teachers and administrators.

It is suggested that the evaluation determine to what extent the business department

- has a philosophy and a set of objectives in keeping with the school's overall philosophy and objectives
- contributes to general education
- offers adequate amounts and kinds of basic business-economic and specialized business instruction
- has pertinent data on school population and community needs
- enriches its program with community business materials and resources

- has staff members who believe in providing learning opportunities for all levels of students
- plans and implements a program which fulfills student and community needs
- meets the needs of college bound and noncollege bound students
- has an opportunity to cooperate with administrators in planning and achieving business instructional goals
- selects and uses effective instructional materials
- has a planned procedure for evaluating and selecting teaching materials
- provides purposeful learning activities
- develops vocational competency
- provides occupational information
- has access to adequate information for job guidance
- cooperates with the school's guidance service
- uses consultation services available for special problems in the guidance of students
- has access to and makes use of student cumulative records
- keeps records on all business students
- helps the student to evaluate his progress
- participates in the job placement of students
- makes use of student follow-up studies
- executes a public relations program
- maintains an amiable relationship with the school community
- encourages active participation in extra-class activities which supplement the instructional program
- provides for cooperative work programs if feasible
- evaluates frequently the cooperative work programs
- provides adequate kinds, amounts, and quality of equipment and facilities
- has a definite policy and plan for the purchase and replacement of equipment
- has a definite repair service or upkeep policy
- has qualified personnel
- utilizes the available library facilities
- participates in professional organizations
- accepts change as a challenge
- orients students entering the business program

Guidance Services

GUIDANCE SERVICES

Guidance in the Secondary Schools

The function of guidance in all secondary school programs of studies is to assist each individual to understand himself better and to use this understanding in the choices and adjustments he must make now and in the future. To fulfill this function, the secondary school organizes its guidance program around a series of services.

These services are:

STUDENT APPRAISAL—There should be a continuous recording of data on each student in the school. Techniques of obtaining data might include the use of anecdotal reports, rating scales, self-appraisal instruments, autobiographies, socio-metric devices, and standardized tests. Most schools have found that organizing these data in the form of the cumulative record is helpful.

INFORMATION SERVICES—This should include occupational and educational information files, books, pamphlets, directories, and related materials which assist the student in learning more about educational opportunities and the world of work.

COUNSELING—Counseling is the major means through which guidance is accomplished. It is a personal relationship carried on through interviews by which the student is enabled to see himself as a unique person with special abilities and limitations, and to relate this knowledge of himself to the changing world in which he lives.

PLACEMENT—This service includes preparation for and placement in the next step of the student's career. It includes curriculum placement, post-high school educational or training placement, and job placement.

FOLLOW-UP—This is a study of graduates and dropouts. The information gained from the follow-up study should reveal the adequacy of the school program in meeting the educational and vocational needs of students.

CONTRIBUTIONS OF BUSINESS TEACHERS TO THE TOTAL GUIDANCE PROGRAM

Guidance is not the sole responsibility of any single staff member. An effective guidance service should be organized and directed by an individual with special guidance knowledges, understandings, and skills; and by one who enlists the cooperation of all staff members.

Business teachers, by nature of their professional background and experience, have a unique contribution to make to an effective guidance program. Business teachers should take the initiative to hold several meetings with the guidance personnel each year, at which time all business teachers should be present to discuss cooperative efforts between the guidance service and the business department. Following are specific ways in which the business teacher may contribute to the guidance program:

STUDENT APPRAISAL—The closeness of the business teacher to the students provides a unique opportunity for the teacher to assist in student appraisal. Some specific ways in which he can contribute are:

- to make the counselor aware of the knowledges, skills, and abilities needed by students to do satisfactory work in business
- To discover the strengths and weaknesses of students enrolled in his classes and to make such information available through the guidance service
- To contribute to an accurate and complete file of students' personal qualifications, skill competencies, grades, and other anecdotal information as would enhance the guidance service (See attached form in Appendix, page 145)
- To describe work experience of students for cumulative records
- To encourage the administration of appropriate tests for the purpose of guiding students more effectively

OCCUPATIONAL AND EDUCATIONAL INFORMATION—Ways in which the business teacher can best contribute to the maintenance and improvement of occupational and educational information are:

- To contribute to an occupational and informational file for use in the business department
- To introduce students to occupational and educational information through the use of career studies
- To conduct well-planned field trips to industrial plants and business offices
- To invite qualified speakers to classes and to announce appropriate radio and television programs
- To know about scholarships for business students and make such information available
- To cooperate with the librarian and counselor in the selection and use of resource materials
- To assist in organizing and conducting community surveys
- To use every opportunity to interpret the offerings of the business department to other departments and organizations
- To serve as a resource person to provide counselors, teachers, and students with information about the scope and sequence of the business program

COUNSELING—While counseling is the major aspect of the guidance service, the business teacher does have a responsibility for contributing to this function. Some of the responsibilities are:

- To give as much individual counseling as possible, recognizing his limitations as a counselor, and to make referrals when necessary
- To assist students in selecting specific courses for which they are qualified and from which they will derive the most benefit
- To help students relate specific skills attained in various courses to job requirements
- To assist students in the development of desirable personal traits and habits
- To help students understand the changes in the business environment
- To help students realize that earning a living is a challenge and that adjustments are a life-long process
- To help each student recognize his worth as an individual and to develop confidence in himself

PLACEMENT—The business teacher has a responsibility to work with the guidance counselor in placing students in courses and on jobs in or out of school. Ways in which he may contribute are:

- To assist in placing students in courses in which they have an interest and will most likely succeed
- To contribute to a file of information on colleges and schools in which students may continue their education
- To aid students in developing techniques of applying for a job and to acquaint them with personal characteristics and adjustments necessary for keeping a job
- To establish, or work with, a school placement bureau
- To cooperate with local employment agencies
- To use results of community surveys to determine vocational opportunities for placing students
- To work with the guidance counselor in placing students in cooperative work programs and in summer positions

FOLLOW-UP—The business department should cooperate with the guidance department in making follow-up studies of business students to determine the students' adjustment and progress in chosen pursuits and to determine the appropriateness of their choices. The information gained from such a study should be useful in evaluating the adequacy of the business education program. Ways in which the business department may contribute to the follow-up are:

- To assist in compiling, tabulating, editing, and duplicating results of follow-up studies of business graduates and dropouts
- To use follow-up survey data as instructional materials to stress the importance of skill competencies and personal traits
- To contribute to a file of former students
- To continue to render service to former students in securing jobs or in planning for further education
- To cooperate with adult education and vocational and technical programs in an effort to improve the educational level of the community

SUGGESTIONS FOR COUNSELORS ABOUT GUIDANCE IN BUSINESS EDUCATION

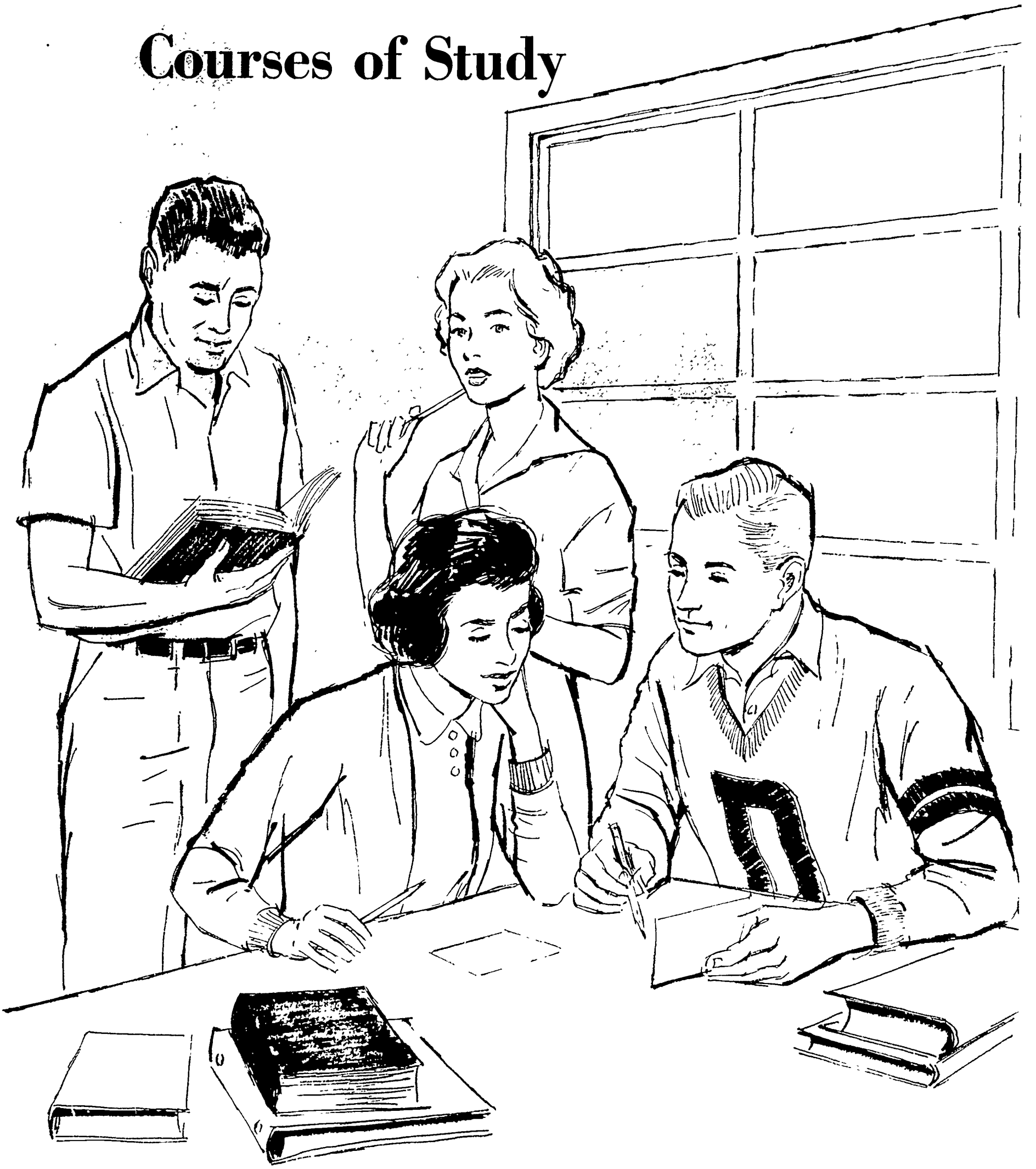
Counselors should become familiar with the objectives of the business program, the various courses offered, and the abilities and skills required in each course. Here are some suggestions of business courses:

- Basic business-economic education provides information needed by all for personal living.
- First-year typewriting should be an elective for all students.
- First-year bookkeeping should be available to all students.
- In second-year bookkeeping, the students should have a strong vocational interest and be average or above in ability. Probable success in bookkeeping may be determined by the student's ability to comprehend reading materials, by his interest in working with numbers and his ability to add and subtract rapidly, and by his consistency in legible handwriting, neatness, and methodical work habits.
- Since shorthand and transcription courses are vocational, students should be selected on the basis of their academic records and interests. Marks received on grammar and vocabulary are probably indicative of shorthand success.
- Notehand, which is a one-semester course, should be taken for the purpose of learning to take notes, not for developing a vocational skill.
- All basic business-economic information courses should be open as electives to all students.

SUGGESTIONS FOR ADMINISTRATORS ABOUT GUIDANCE IN BUSINESS PROGRAMS

- The administrator should give business teachers an opportunity to work with him in planning the business schedule.
- Skill subjects should be taught by teachers qualified to teach these subjects.
- The basic business-economic information courses and Typewriting I should be open to all interested students.
- A good background in English, spelling, and vocabulary is required for stenographic occupations. When enrolling students in the shorthand course, the administrator should keep this in mind. Information on the cumulative record may be of assistance in determining who should be enrolled.
- Shorthand I and Office Practice should be scheduled the same period in order that students who do not succeed in shorthand may be permitted to transfer to Office Practice.
- A student should not be permitted to enroll in shorthand unless he has had or is taking typewriting.
- Since typewritten transcripts of shorthand notes are required in an office, the shorthand class should have access to typewriters.
- Teachers of first-year shorthand and first-year bookkeeping should be consulted before placing students in advanced shorthand and bookkeeping courses.
- All business education fees should be eliminated.
- Duplicating, recordkeeping, and typewriting in connection with the operation of the school may be learning activities for the students. Such work should not be required as a school service beyond the learning stage.

Courses of Study



BASIC BUSINESS-ECONOMIC EDUCATION COURSES

Basic business-economic education courses should be elective for all youth, regardless of educational and vocational goals, long-range aspirations, economic or social status, and levels of ability. It is recommended that learning activities in this area of education for business be offered at the ninth- and tenth-grade levels as background and then again at the eleventh- and twelfth-grade levels with much greater depth and breadth to develop those knowledges, understandings, attitudes, appreciations, and skills needed for today's world of work and for tomorrow's anticipated needs.

The variable factors—student population, community characteristics and needs, total school curriculum, facilities and equipment, and qualified faculty—must be considered when planning any course of study. The course should be well-planned, maintain high standards of achievement, and be re-evaluated frequently as changes occur and as adjustments are needed.

It is suggested that Advanced Basic Business-Economic Information be offered according to one of three plans, depending upon what is best for the existing variables. The three plans are:

1. As a one- or two-semester course, such as:

   Business Economics
   Business Law
   Business Organization
   Consumer Economics
   Economic Geography
   Principles of Retailing
   Principles of Selling

2. As a selected-units course in which the teacher and students decide which units will be most worthwhile, then use two, three, or four separate textbooks as basic reference sources. In this plan the units suggested in the courses listed under 1 should be correlated to fit the needs of the students, school, and community.

3. As a problems course (unstructured) in which students and teachers determine significant problems to be studied and then use whatever sources of information are needed to solve the major problems undertaken for study. The problems should vary to cover many business and economic concepts, principles, and practices.

Course description, objectives, prerequisites, suggested procedures, and content are outlined for the following basic business-economic courses:

Course Title	Grade Level
Basic Business-Economic Information	9 or 10
Business Mathematics	10 or 11
Bookkeeping I	11
Typewriting I	10, 11 or 12
Advanced Basic Business-Economic Information	11 or 12
Business Economics	
Business Law	
Business Organization	
Consumer Economics	
Economic Geogrophy	
Principles of Retailing	
Principles of Selling	

BASIC BUSINESS ECONOMIC INFORMATION

Basic Business-Economic Information is a two-semester foundation course in the planned sequence of business and economic learning experiences. Its content is generally regarded as essential in a program of general education, for it includes many basic knowledges which contribute to effective management of business experiences. It is intended to develop broad understandings of and sound attitudes toward the social and economic environment of businesses. The course will contribute to the development of many knowledges, understandings, attitudes, appreciations, and skills that help to make young men and women more intelligent buyers, users, and producers of business goods and services.

Basic Business-Economic Information should provide orientation and guidance values to students who have educational goals for further study in business, economics, and distributive education.
The course is designed to meet the needs of ninth- and tenth-grade students in high schools. If the school is organized on the 6-3-3 plan, this course should be offered the last year of the junior high school program.

At junior high or senior high school level, the course may be

- a required course for all students regardless oi educational goals
- an elective course for all students who desire a basic course in business or who expect to continue studies in a secondary business program
- a required foundation course for all students planning to pursue a business program

OBJECTIVES

- To develop knowledges of business which every person must have if he is to be a wise buyer, user, and producer of business goods and services
- To establish concepts of business that will contribute to the solution of personal business problems and the understanding of world economic relations
- To furnish a background for becoming an intelligent participant in community and national affairs
- To develop an understanding and use of business terminology as it applies to business activities
- To develop further understandings of the role of money and money substitutes in budgeting, savings, and investing
- To develop knowledges, abilities, attitudes, appreciations, and understandings about
  - our business and economic world
  - communications
  - merchandising
  - traveling
  - transportation and shipping services
  - banking services
  - sharing economic risks
  - keeping personal records
  - successful economic citizenship

- To develop understandings of business occupations, their advantages, disadvantages, and limitations
- To build a foundation for further study in business, economics, and distributive education

COURSE PREREQUISITES

The prerequisites for Basic Business-Economic Information should be one, all three, or a combination of the following:

- An interest in understanding American business and its place in our social and economic world
- An interest in knowing how to conduct business-economic responsibilities
- An interest in studying more advanced business courses

SUGGESTED PROCEDURES

- Utilize prior learnings and understandings of the students. At the beginning of the course and each unit, pretest (preview) students to measure the extent of previously acquired knowledges and to reveal deficiencies. (Published standardized or non-standardized tests may be used, or oral or written tests may be constructed for this purpose.

  "Whatever form the preview may take, it should be designed to bring out four things:

  1) What students already know about the subject matter of the unit
  2) What students don't know about the unit
  3) Areas of misinformation . . .
  4) Area of controversy—problems about which there are differing points of view

  "Some attention needs to be given to item one above to assure that students have truly mastered the information. For example, if students through experience or other courses have learned how to write checks, there is little point in dwelling on this exercise at great length; yet enough needs to be done to assure that students have truly mastered this skill." [10]

- Develop challenging activities that will enable fast and slow learners in heterogeneous Basic Business-Economic Information classes to understand their responsibilities as buyers, users, and producers of goods and services.
- Encourage students to bring to class news clippings, charts, business forms, pictures, and brochures pertaining to business and economics. These may be displayed on the bulletin board and, if desired, later placed in a class scrapbook. Every contribution should receive definite recognition for the satisfaction of the student.
- Provide classroom atmosphere and concomitant learnings which will make the students feel free to contribute orally as well as otherwise when they discover observations or experiences relating to Basic Business-Economic Information, even though the particular topic does not pertain to the current assignment.

[10] Enterline, *op. cit.*, "The Preview," p. 1.

- Take advantage of the learning possibilities through carefully planned field trips to business organizations whose business officials are willing to receive the class and contribute to the planned visitation. Students should be permitted to share in the planning phases of such trips. The planning discussions should include procedures to be followed and particular things to be observed.
- Take advantage of every opportunity to provide students with learning experiences on actual business forms. For example, the discussion on banking should involve the use of checks, deposit slips; the discussion of transportation can be vitalized through the use of telegraph blanks, telephone directories, railroad and air travel timetables.
- Have available within the classroom standard reference books used in business—directories, postal manuals, telephone directories, and supplementary materials for enrichment purposes and for meeting the various ability and maturity levels of the students. The teacher must go beyond the textbook to teach effectively the suggested course content.
- Stress the professional prerequisites for working in marketing, banking, traveling, insurance, and other types of business activities in order to help students gain insights into the nature of occupations, their scope, limitations, advantages, and disadvantages.

SUGGESTED COURSE CONTENT

OUR BUSINESS AND ECONOMIC WORLD

Your role as a buyer, user, and producer of goods and services
Business and its role in our economy
    Production
    Distribution
    Service
Current economic trends and their effect upon business activities
Business agencies
    Types
    Interdependence
    Role in satisfying human wants
Business and labor
Business transactions and law
Business and government

COMMUNICATION

Communication media—written and oral communicative channels and systems
Business communicative problems and decision making
Importance of correct, effective communication
Skill competencies needed for communications

MARKETING

Dependence of business upon an adequate knowledge of markets
    Investigation of markets
    Planning the market effort
    Production scheduling
    Inventory controls
    Pricing and price policies
    Billing
    Advertising

Business forms and papers used in marketing activities
Integration and coordination of marketing activities
Marketing personnel
Appraisal of salesmen's performance
Control of marketing operations

TRAVELING

Traveling facilities
- Types
- Uses
- Advantages
- Disadvantages
- Limitations
- Effects upon business production, distribution, and services
- Traveling services
- Characteristics of and skills needed by traveling service personnel

TRANSPORTATION AND SHIPPING

Role of transportation and shipping activities in our economy
Transportation and shipping services in our economy
Necessary and unnecessary government control over transportation and shipping activities

MONEY

Role of money
Money substitutes in budgeting, savings, and investing

BANKING SERVICES

The function of banks in our economy
Bank regulations
Banks and related institutions
- Types
- Services rendered
- Types of personnel employed

SHARING ECONOMIC RISKS

Economic risk—financial loss
How to avert economic loss through insurance
Insurance principles
Types of insurance
Insurance policy provisions
Characteristics and skills of insurance personnel

KEEPING RECORDS

Records
- Types of record systems
- Uses of record information
- Advantages and disadvantages of record systems
- Essentials of efficient recordkeeping
- Filing of records

Role of recordkeeping

Recordkeeping and automation
- Centralized
- Decentralized

SUCCESSFUL ECONOMIC CITIZENSHIP

Business citizenship responsibilities
Occupational information
- Sources
- Uses

Occupational choices, efficiency, adjustment, appreciation
Business occupations
- Type
- Scope
- Limitations
- Advantages
- Disadvantages

SUGGESTED CLASSROOM MANAGEMENT

- Keep in mind the objectives of the course; it is not a training class to prepare students for jobs.
- Use considerable care in preparing lesson plans. Avoid treating unit topics in a manner beyond the comprehension of the students.
- Vary the classwork; the course should not become monotonous.
- Avoid technical terms in making explanations, but be sure the students develop a rather extensive business vocabulary.
- Do not make use of the workbook as a substitute for planned assignments.
- Do not attempt to teach a complicated system of filing. A few simple rules for indexing will be sufficient.

BUSINESS MATHEMATICS

Business Mathematics is a one- or two-semester elective course which provides learning opportunities for students to apply the principles of mathematics to the solution of business problems. The course is designed to meet the needs of tenth- and eleventh-graders.

OBJECTIVES

- To develop habits of accuracy, speed, neatness, and systematic procedures in business mathematics
- To give direction in reading, understanding, and interpreting mathematical exercises
- To develop the habit of judging the reasonableness of mathematical computations
- To develop the ability to make business computations rapidly and accurately
- To develop the ability to perform ordinary computations mentally
- To give practice in applying the knowledge of mathematics to personal business problems
- To develop proficiency in the practicable short-cut methods of calculations
- To develop mastery of aliquot parts, common and decimal fractions
- To develop an understanding of and skills in the methods of determining rate of return on investments
- To develop an understanding and knowledge of percentages, interest, and discounts
- To develop an understanding of the calculation of weights and measures
- To develop an understanding of and skill in constructing simple charts, graphs, and tables
- To develop ability in using mathematical formulas

COURSE PREREQUISITES

- An interest in learning the application of basic mathematical principles to everyday business problems
- Sophomore or junior class rank

SUGGESTED PROCEDURES

- Measure the student's previously acquired learning by means of pretests in the various areas of subject matter.
- Make substitutions in subject matter that seem advisable in light of students' interests and experiences.
- Give remedial instruction when it is needed.
- Emphasize the fact that computations in business are either right or wrong.
- Give complete instructions in understandable terms.
- Explain thoroughly the new terms in each day's assignment
- Allow sufficient time at the end of the class period for students to start on homework assignments with definite directions on how to proceed.
- Make use of rapid oral drills in fundamental processes.
- Encourage the habit of checking results for reasonableness of the obtained solution. In some class periods, have pupils write down approxi-

mate answers before they begin the exercises and compare them later with the computed results.

- Give opportunity for repetitive practice on short-cut calculation methods.
- Require neatness of written work and clear expression in oral analysis.
- Develop skills in determining the differences between cost of cash buying and time buying and in comparing this figure with the cost of borrowing the purchase money at commercial rates.
- Develop abilities to compute cost of insurance in terms of cost of "per dollar" protection.
- Use materials that are meaningful and applicable to business situations.

SUGGESTED COURSE CONTENT

It is recommended that the time schedule for the suggested subject matter be determined by the results of measuring the students' established abilities and knowledges.

USE OF MATHEMATICS IN BUSINESS REPORTS AND RECORDS

Organization of data
Reporting results mathematically

REVIEW OF FUNDAMENTAL PROCESSES

Addition
Subtraction
Multiplication
Division
Shortcuts

FRACTIONS AND PERCENTAGES

Common fractions
Decimal fractions and aliquot parts
Interpretation of the meaning of percentages, methods of computation, and skills in analyzing problems

GRAPHS, CHARTS, AND TABLES

Kinds and functions of graphs
Functions of charts and tables
Construction of graphs, charts, and tables

COMPUTATIONS IN PERSONAL BUSINESS PROBLEMS

Individual or family budgets
Verifying bills
Returns on investments

THRIFT AND SAVINGS

Installment buying
Interest
Savings
Buying and selling stock

COMPUTATIONS IN BUSINESS PROBLEMS

Extension and verification of prices and merchandise
Commercial discounts
Payroll and deductions
Social security, income, and other taxes
Insurance
Depreciation
Transportation and communication costs
Mathematics of ownership
Mathematics common to all businesses
Mathematics of retail businesses

BANK INTEREST

Simple interest and the bankers' 60-day 6% method
Interpretation of compound interest tables

WEIGHTS AND MEASURES

Linear, liquid, volume, and surface
Weight

SUGGESTED CLASSROOM MANAGEMENT

- Schedule, if possible, the business mathematics class so students may have access to adding and calculating machines.
- Utilize audiovisual aids.
- Provide supplementary student and teacher materials which will meet the ability and maturity needs of the students.

BOOKKEEPING I

Bookkeeping I is a basic course, contributing to the student's general education through the bookkeeping knowledges he acquires and the application he is able to make to his everyday life. The course places emphasis upon the application of bookkeeping principles to business problems and decisions. It affords excellent opportunities to integrate economic learnings and to contribute to general education. Bookkeeping I should be open to all students as an elective course. It should be a required course for all students pursuing a business program. If the business program is to include a course in Bookkeeping II, Bookkeeping I should be taken at the eleventh-grade level and Bookkeeping II at the twelfth-grade level. If only Bookkeeping I is offered in the program, it should be taken at the eleventh- or twelfth-grade level.

OBJECTIVES

- To teach the bookkeeping cycle in such a way that students see the entire process and the relation of each step
- To enable students to classify accounts and record transactions
- To familiarize students with the special journals and their functions
- To develop the essential traits of accuracy, neatness, orderliness, thoroughness, and responsibility
- To develop an understanding of bookkeeping terms
- To develop an understanding of business forms, business procedures, and equipment used in our business-economic world of work
- To extend the student's knowledge of the most used negotiable instruments
- To develop occupational intelligence needed by all office and store workers
- To stimulate interest in accounting as an occupation
- To understand the variety of ways transactions can be recorded other than by means of journals

COURSE PREREQUISITES

- An interest in acquiring a foundation in bookkeeping principles in order to seek an initial business job upon graduation, and/or to develop management know-how in planning income and expenditures wisely, and/or to study further in the field of bookkeeping and accounting
- Basic Business-Economic Information
  Business Mathematics
  (These courses are recommended as prerequisites; but if a student has not had these two courses or only one of these courses, it should not preclude him from taking Bookkeeping I.)
- A mastery of the fundamentals of arithmetic
- Junior or senior class rank

SUGGESTED PROCEDURES

- Begin instruction with simple illustrations expressed in language within the student's comprehension.
- Explain each new principle carefully through chalkboard illustrations and class discussion before requiring the student to work exercises containing the bookkeeping principles.

- Devote a portion of almost every class period to explaining and illustrating the techniques and procedures to the class as a whole. After class discussion, attention may be given to problems and difficulties of the individuals.
- Utilize supplementary books, pamphlets, monographs, handbooks, magazines, journals, ledgers, and business instruments to enrich the textbook materials.
- Explore different procedures for teaching practice sets.
- Utilize audiovisual materials, available community resources, and outside resources such as materials from government agencies, national professional organizations, and publishing companies.
- Help the student develop initiative, self-reliance, and other desirable personal traits through example and suggestion.
- Plan all classroom activities and learning experiences for the needs of future stenographers, general office and store workers, and future manager-owners.
- Be sensitive to teaching important economic ideas with each unit of work.

SUGGESTED COURSE CONTENT

The time schedule for covering the suggested topics for this one-year course should be planned according to the student's knowledges, abilities, and needs. It is recommended that consideration be given to the schedule plan outlined in the State-adopted textbook teacher's manual.

During the *FIRST SEMESTER*, the elementary principles and procedures embodied in the bookkeeping cycle should be covered and thoroughly understood by every student. The suggested topics to be covered are:

DEFINITION OF BOOKKEEPING AND ACCOUNTING
THE IMPORTANT ROLE BOOKKEEPING HAS PLAYED IN THE DEVELOPMENT OF OUR ECONOMY AND THE NEED TO KEEP ACCURATE RECORDS

For the individual
For the social organization
For the small business

BASIS FOR RECORDS

Things owned—assets
Amounts owed—liabilities
Net worth—proprietorship
Relationship of the fundamental elements

OPENING THE RECORDS

Understanding debits and credits
Recording the beginning balance sheet
Presentation of the general journal

POSTING THE OPENING ENTRY

Explanation of ledger accounts
Posting procedure

BUSINESS TRANSACTIONS

- Analyzing transactions
- Recording changes required by transactions

RECORDING TRANSACTIONS THROUGH JOURNALIZING

- Definition of journalizing and presentation of the cash journal
  - Transactions affecting assets
    - Assets and liabilities
    - Assets and proprietorship
  - Transactions affecting liabilities
    - Liabilities and proprietorship
  - Transactions affecting proprietorship
  - Recording transactions through other media
    - Invoice file
    - Punch card
    - Magnetic ink characters

SORTING AND SUMMARIZING TRANSACTIONS THROUGH POSTING

- Explanation of chart of accounts
- Posting procedure
- Posting totals of special columns

PROOF AND POSTING

- Footing and balancing ledger accounts
- Proving cash
- Proving the equality of debits and credits through a trial balance
- Locating and correcting errors in the trial balance
- A project is recommended at this point covering the use of the journal, ledger, and trial balance.

INTERPRETING THE RECORDS

- Explanation of the accounting period
- Preparation of the working trial balance
- Use of the profit and loss statement for ascertaining net profit or loss and use of the balance sheet for determining net proprietorship
- Development of the idea that profits determine the nature and direction of production

CLOSING THE LEDGER

- Closing income and expense accounts into the profit and loss summary account
- Posting the closing entries to the ledger
- Totaling and ruling the income and expense accounts
- Balancing and ruling the cash and capital accounts
- Preparing post-closing trial balance
- Use of a complete cycle project is recommended at this point

ACCOUNTING DEVICES AND PROCEDURES FOR RECORDS OF A SMALL BUSINESS

- Recording the purchase of merchandise on account
- Use of the purchases journal

Use of subsidiary ledger for creditors' accounts
Ruling and posting the purchases journal
Posting procedures in automated bookkeeping
Abstracting the accounts payable ledger

CASH PAYMENTS

Use of columnar cash payments journal
Writing of checks and bank charges
Reconciliation of the bank statement
Ruling and posting the cash payments journal

VARIATIONS OF THE CASH JOURNAL

Uses of the general journal for miscellaneous entries

RECORDING THE SELLING OF MERCHANDISE ON ACCOUNT

Use of the sales journal
Use of subsidiary ledgers for customers' accounts
Posting and ruling the sales journal
Abstracting the accounts receivable ledger
Use of sales slips
Automative posting of the sales transactions
Need for error controls at the point of sales
The importance of magnetic ink character references and the write-it-once principle

CASH RECEIPTS

Use of columnar cash receipts journal
Banking procedures and services
Automated banking
Ruling and posting the cash receipts journal

ADJUSTING AND CLOSING ENTRIES

Source of data for the adjusting entries
Closing entries for the income, cost, and expense accounts
Balancing the cash, accounts receivable controlling account, and the accounts payable controlling account
A complete cycle project is recommended at this point to cover columnal journals and subsidiary ledgers

During the *SECOND SEMESTER*, the advanced principles and procedures encountered in the bookkeeping cycle should be taught. The suggested topics to be covered are:

ADAPTATION OF SPECIAL JOURNALS

Cash receipts journal and sales discount
Cash payments journal and purchases discount
Combined cash journal
Sales returns and allowances
Purchases returns and allowances

EFFECT OF AUTOMATION ON SPECIAL JOURNALS

A cycle project is recommended at this point to cover the combination journal

PAYROLL RECORD AND DEDUCTIONS

Payroll records—automation
Social Security tax
Income tax
State and federal unemployment tax
Other payroll deductions

POSTING AND RULING SPECIAL JOURNALS
DEPRECIATION OF FIXED ASSETS

Reasons for depreciation
Methods of calculating depreciation
Methods of recording depreciation at the end of the fiscal period

BAD DEBTS AND ACCOUNTS RECEIVABLE

Reasons for bad debts
Methods of recording bad debts

THE CASH REGISTER AND ITS USE

Recording transactions
Auditing
Proving cash

A project is recommended at this point dealing with the records of a retail business that uses a cash register and a combination journal

SALES AND PURCHASES TRANSACTIONS

Sales taxes
Various methods of recording transactions

NOTES AND TRADE ACCEPTANCES

Notes and trade acceptances given or received in settlement of accounts
Procedure for collecting notes through banks
Use of notes receivable and notes payable registers

INTEREST AND BANK DISCOUNT

Recording the receipt and payment of both principle and interest

ACCRUED EXPENSE AND ACCRUED INCOME
PARTNERSHIPS

Opening entries for investment of cash and other assets
Recording payment of partners' salaries
Distributing profits or losses among the partners
Inventory valuation methods
Internal control of bookkeeping and accounting systems
Voucher system

TYPEWRITING I

Typewriting I is designed to develop the student's ability to operate and use the typewriter correctly and efficiently. The fundamentals of learning typewriting skills are the same whether the goal is for personal and/or vocational use.

The course may be set up as

- a required course for all students
- an elective course for all students, or
- a required course for all students planning to pursue a business program

Typewriting I should be taught at the tenth-grade level and above. Students who plan to pursue a stenographic program should take typewriting in the tenth grade in order that the typewriting skills can be developed and ready for application in Shorthand I transcription. Other students should take the course at the tenth, eleventh, or twelfth grade level, depending upon what is best for their program schedule. Once the typewriting skill development is begun, there should be a follow-through to develop the skills further and to make direct application of the skills to business situations.

This course of study is based upon the assumption that typewriting instruction is limited to one period a day for one year. The scope of this course incorporates many of the objectives, learnings, and activities frequently found in a second-year typewriting course.

OBJECTIVES

First Semester

- To acquire the fundamental techniques of the keyboard; machine parts; stroking; reading copy; and correct, controlled typewriting habits by intelligent daily practice on the typewriter
- To develop proficiency in the care and cleaning of the machine; changing the ribbons; and reporting necessary machine repairs
- To develop the ability to recognize and correct typewriting errors
- To improve competencies in punctuation, syllabication, and spelling
- To develop knowledges of the correct forms of spacing
- To develop the knowledges and skills necessary for typewriting simple business letters which are correct according to the current trends of style and format
- To develop work habits that will produce on the first attempt usable (mailable) copies of all types of typewritten materials
- To develop a responsible attitude toward starting work promptly, working steadily, holding to high standards of performance, following directions, and making a self-evaluation
- To develop the ability to apply concomitant learnings essential to typewriting

Second Semester

- To produce work of acceptable quantity and quality that meets the requirements for an initial job employment in business

- To develop the ability to conduct efficiently all auxiliary typewriting activities—erasing, cutting stencils, selecting and using wisely suitable typewriting supplies, and making multiple copies of typewritten materials
- To develop the ability to compose at the typewriter
- To develop the ability to apply the rules of form to more complex situations than those encountered during the first semester
- To develop the ability to plan and type simple tabulations; letters in various styles—block, semiblock, fullblocked, indented, NOMA Simplified; and interoffice memorandums
- To develop the ability to make neat erasures on both original and carbon copies
- To develop the knowledges and skills to do manuscript typewriting without the need to check references, manuals, or books

COURSE PREREQUISITES

- An interest in developing ability to use the typewriter for personal and/or vocational use
- Sophomore class rank

  (If a student has had junior high typewriting, he should be tested to determine the degree of his typewriting skill and to see if he should be placed in first or second semester of Typewriting I.)

SUGGESTED PROCEDURES

- Carefully plan an orientation program. It should cover such things as
  - when and where to obtain typewriting paper and other supplies that may be needed
  - how typewriting instruction will be given
  - how to clean and adjust the typewriter, assemble supplies, and begin practice
  - how to report machine breakdowns and needed repairs
  - what to do with the typewriter cover
  - how and when typewriting exercises and problems are to be submitted to the teacher
  - how the typewriting work station is to be left at the end of each class period
- Let each part of every class period be well planned and directed toward a definite goal. This goal must be known by the teacher and student. The classroom instruction should be varied to prevent monotony.
- Avoid giving the students too many things to learn at one time.
- Provide a pleasant classroom atmosphere which is free from an undue amount of tension.
- Make an effort to recognize individual talents and abilities; then give consideration to motivating and developing these talents and abilities.
- Give practice work which is effective. Evaluate length of practice periods, amount of practice work, and the suitability of practice materials to meet the ability and maturity levels of the students.
- Motivate the students in some way every day.
- Look for weaknesses and strengths in analyzing typewriting techniques.
- Stress correct techniques and show the students how to correct faulty techniques.

SUGGESTED COURSE CONTENT

Major emphasis during the first six-weeks should be on developing stroking technique.

KEYBOARD AND TECHNIQUES

- Learning the keyboard and developing good techniques of key stroking and machine manipulation
  - Keyboard introduction
  - Stroking techniques
  - Parts of the typewriter (each part to be presented as it is needed)
  - Care of the typewriter
- Mastering the basic rules applicable to typewritten form
  - Figures and symbols
  - Arranged copy
  - Unarranged copy
- Strengthening basic techniques
  - Stroking techniques and rate
  - Controlled stroking
  - Continuity in stroking
  - Word-level typewriting
  - Erasing and aligning material
  - Crowding and spreading letters
  - Techniques of reinserting paper
  - Centering material vertically and horizontally
  - Composition at the typewriter

TYPEWRITING APPLICATION

- Learning the application of typewriting techniques and skills
  - Centering techniques
  - Basic rules, procedures, and styles for typewriting postal cards, index cards, and personal letters
  - Proofreading
  - Use of carbon paper
  - Composition of personal and business letters at the typewriter
  - Production typewriting of cards, envelopes, and letters with speed requirements to match job standards
  - Folding and inserting letters in envelopes

TABULATION

- Computational know-how for tabulation work
- Columnar headings and subheadings
- Tabulation formats
- Production tabulation
  - Arranged material
  - Unarranged material
- Judgment placement of typewritten materials

MANUSCRIPTS AND REPORTS

- Manuscript format
- Title page
- Footnotes

Bibliographies
Manuscript typewriting from longhand copies
Proofreading
Themes
Minutes of clubs, organizations
Stencil typewriting

COMPLETING OFFICE FORMS

Form letters
- Styles
- Uses

Telegrams
Complete prepared forms
- Application forms
- Statements
- Notes
- Payrolls
- Invoices
- Bills of lading
- Leases and other simple contracts
- Income tax forms

INTEGRATING TYPEWRITING KNOWLEDGE AND HABITS

Units are introduced in which sustained skills are emphasized and in which the students can follow through business transactions from their inception to their completion

TENTATIVE STANDARDS FOR TYPEWRITING I

First Semester

FIRST SIX-WEEKS

Lessons 1 to 25

Key stroking techniques, margins and centering, mechanics of typewriting, care of typewriter, reporting necessary repairs, and manipulation of shift keys, carriage return level, space bar, tabulator mechanism, margin release, and backspace key

Grading

Technique—50 per cent of grade
- Stroking, relaxation, quiet control, mental attitude, control of operative parts, eyes held on copy

Speed and accuracy—50 per cent of grade
- One- and three-minute writings, practice material

Basis of marking—GWAM (Gross words a minute)

One-minute Writings		Three-minute Writings	
35 up	A	28 up	A
30 to 34	B	23 to 27	B
20 to 29	C	14 to 22	C
15 to 19	D	10 to 13	D

It is suggested that the student have five passing writings with three of the five writings within one grade range.

Maximum errors a minute—4

SECOND SIX-WEEKS

Lessons 26 to 50

Speed emphasis, control emphasis, centering, and introduction to the business letter. Erasing to be introduced for letter writing. Introduce the use of carbon paper. Stress related learnings in each lesson.

Grading

Class exercises—50 per cent of grade
- Letter tests from the textbook and personal files
- Centering tests
- Grade letter tests on usable copies with carbons and envelopes

Speed and accuracy—50 per cent of grade
- Three-minute writings

Basis of marking—GWAM (Gross words a minute)

Three-minute Writings

40 up	A
35 to 39	B
25 to 34	C
20 to 24	D

It is suggested that the student have five passing writings with three of the five writings within one grade range.

Maximum errors a minute—3

THIRD SIX-WEEKS

Lessons 51 to 75

Personal typewriting, control typewriting, proofreading of copy and correction of errors in production work, care of typewriter, changing the ribbon, cleaning the typewriter, further development of placement of paragraphs and letters, technique improvement.

Grading

Selected exercises
Timed production } —50 per cent of grade
- Letter tests
- Tabulation tests

Speed and accuracy—50 per cent of grade
- Five-minute writings

Basis of marking—GWAM (Gross words a minute)

Five-minute Writings		No. of Errors	Grade
45 up	A	0 to 1	A
40 to 44	B	2	B
30 to 39	C	3 to 4	C
25 to 20	D	5	D

It is suggested that the student have five passing writings with three of the five writings within one grade range.

Maximum errors a minute 2 to 1 (Use the higher tolerance for the first two weeks and the lower tolerance for the remaining weeks of the marking period.)

SEMESTER EXAMINATION based on knowledge of placement, technique, accuracy in copy, proofreading of copy, use of proper punctuation, simple business letters, and speed and accuracy on five-minute tests

Second Semester

FIRST SIX-WEEKS

Lessons 76 to 100

Composition at the typewriter, word-division guides, centering recalls, manuscript and report forms, capitalization guides, rough draft, footnotes, bibliographies, title pages, development of judgment placement of materials, sustained production skill.

Grading

Selected exercises } —50 per cent of grade
Timed production }
Speed and accuracy—50 per cent of grade
Five-minute writings
Basis for marking timed production work—GPRAM (Gross production rate a minute)

Fifteen-minute Letter Production

29 up	A
25 to 28	B
20 to 24	C
16 to 19	D

Usable copies

Basis for marking straight copy—GWAM (Gross words a minute)

Five-minute Writings		No. of Errors	Grade
50 up	A	0 to 3	A
43 to 49	B	3 to 4	B
33 to 42	C	5 to 7	C
26 to 32	D	8 to 10	D

Maximum errors a minute—2

SECOND SIX-WEEKS

Lessons 101 to 125

Efficient use of machine parts, finger-facility drills, backspace-from-center tabulation, sustained tabulating production problems, number guides, personal and office typewriting problems, further technique development in proofreading and correcting errors, special business letter variations, statistical copy production skills, classifying information.

Grading

Selected exercises } —75 per cent of grade
Production work }
Speed and accuracy—25 per cent of grade
Basis for marking production work—GPRAM (Gross production rate a minute)

Letters with tables and enumerations

Twenty-five Minute Writings

28 up	A
24 to 27	B
19 to 23	C
15 to 18	D

Addressing envelopes

Three-minute Writings—GWAM

24 up	A
20 to 23	B
15 to 19	C
12 to 14	D

Script copy

Three-minute Writings—GWAM

47 up	A
40 to 46	B
30 to 39	C
23 to 29	D

Statistical copy

Five-minute Writings—GWAM

38 up	A
34 to 37	B
25 to 33	C
19 to 24	D

Basis for marking straight copy—GWAM (Gross words a minute)

Five-minute Writings		No. of Errors	Grade
52 up	A	0 to 2	A
43 to 51	B	3	B
35 to 44	C	4 to 5	C
28 to 34	D	6 to 8	D

Maximum errors a minute—1

THIRD SIX-WEEKS

Lessons 126 to 150

Punctuation guides, sustained production skill, employment test, rough-draft copy.

Grading

Class exercises } —75 per cent of grade
Timed production }
Speed and accuracy—25 per cent of grade
Basis for marking production—GPRAM (Gross production rate a minute)

Envelope addressing

Three-minute Writings—No. addressed

8 up	A
7	B
6	C
5	D

Letter copy

Five-minute Writings—GWAM

39 up	A
33 to 38	B
26 to 32	C
20 to 25	D

Statistical copy

Five-minute Writings—GWAM

40 up	A
36 to 39	B
28 to 35	C
21 to 27	D

Tabulation copy

Five-minute Writings—GWAM

25 up	A
22 to 24	B
15 to 21	C
9 to 14	D

Rough draft

Five-minute Writings—GWAM

37 up	A
32 to 36	B
25 to 31	C
20 to 24	D

Basis for marking straight copy—GWAM (Gross words a minute)

Five-minute Writings		No. of Errors	Grade
55 up	A	0 to 2	A
48 to 54	B	3	B
38 to 47	C	4	C
31 to 37	D	5	D

Maximum errors a minute—1

ADVANCED BASIC BUSINESS-ECONOMIC INFORMATION

BUSINESS ECONOMICS

Business Economics is a one-semester eleventh- or twelfth-grade basic business-economic course designed to instill knowledges, understandings, appreciations, and attitudes essential for the demands of today's business-economic system.

The course seeks to

- provide stimulating learning opportunities and experiences, while presenting the basic principles for economic analysis and logical reasoning

OBJECTIVES

- To gain an understanding of and appreciation for our economic system
- To gain an understanding of the interrelationship of households and business firms in our economy
- To gain an understanding of the relationship of cost of living, business receipts, cost of production, and consumers' income
- To gain an understanding of the operation of the price system in guiding and directing resources toward more efficient use
- To develop a business-economic vocabulary
- To gain greater understanding of and perspective in the elements, organization, and function of our economic system basic to our way of life; and to appreciate the basic concepts of the free enterprise system in relation to economic principles and motivation

COURSE PREREQUISITES

- An interest in learning about our economic system and the important function of business firms in the economic world
- Junior or senior class rank

SUGGESTED PROCEDURES

- Utilize library and community facilities; broaden the scope of the materials beyond limited textbook presentation.
- Pretest students to determine what they already know, do not know, misunderstand, and should know through informal discussions, buzz sessions, or the question-answer technique.
- Invite local economists and businessmen to talk to the class on specific aspects of business economics at appropriate times.
- Let the class period become a clearing house for ideas, findings, and results of independent studies.
- Utilize current pamphlets, publicity materials, audiovisual materials on local firms, and local, state, and national economic organizations. Evaluate materials to determine if they are written without bias, whether written for the student or the teacher, and if they meet the maturity and ability levels of the students.

SUGGESTED COURSE CONTENT

PERSPECTIVE OF ECONOMICS

- The meaning and importance of economics
  - Elements of economic activity
    - Human wants
    - Resources
    - Techniques of production
- Organization of an economic system
  - Households
    - Individual units
    - Family
    - (Consumers of the product output)
  - Business firms
- Markets for consumer goods and services
  - Cost of living
  - Business receipts
- Resource markets
  - Consumer income
  - Cost of production
- Functions of an economic system
  - What is to be produced
  - How production is to be organized
  - How the products are to be distributed
  - How goods are to be rationed over periods during which their supplies are fixed
  - How the productive capacity of the economy is to be maintained and expanded

INTERACTION OF HOUSEHOLDS AS CONSUMERS AND BUSINESS FIRMS AS SELLERS IN THE MARKET

- Flow of goods and services
- Prices of goods and services
- How prices are determined
- Government control of prices

PERSPECTIVE OF THE BUSINESS FIRM

- Organizing and managing business
  - Small-scale business
  - Large-scale business
    - Proprietorship
    - Partnership
    - Corporation

PRODUCTION OF GOODS AND SERVICES

- Planning, organizing, directing and controlling activities and procedures
- Demand, supply, market price
- Role of price system in guiding and directing resources toward more efficient use
- Fundamental principles of production
- Cost of production
- Importance of recordkeeping

BUSINESS LAW

Business Law is a one-semester advanced basic business-economic information course designed to make a major contribution to economic education, and to provide a new approach to developing economic citizenship and personal responsibility. It deals with basic fundamentals of business law and should enable a student to understand his legal rights and obligations in everyday business transactions. It should create within the student a desire for good laws and good legal machinery. It should develop a realization that law, courts, and governmental services exist for protection of society. This course should be open to *all students* as an elective at the eleventh- or twelfth-grade level.

OBJECTIVES

- To give an understanding of the development of laws regulating modern business
- To give an acquaintanceship of the system of courts, their functions, their jurisdiction, their inadequacies, and their strengths
- To develop an understanding of the essentials of contractual relationships
- To instill a knowledge of rules governing negotiable business papers
- To teach the purpose, form, and use of legal documents which do not necessarily require the services of a lawyer
- To teach the factors to consider before signing legal documents
- To show the legal responsibilities in guaranteeing the debts of others
- To aid in acquiring a knowledge of North Carolina's laws affecting business
- To give an acquaintanceship of the laws relating to different types of business organizations
- To teach the principles of right conduct in business affairs which extend beyond legal duty
- To develop a knowledge and understanding of property rights and laws relating to the sale and acquisition of property
- To develop an understanding of the important legal rights and obligations involved in insurance contracts
- To develop a knowledge of the laws relating to employer and employee, bailor and bailee, producer and consumer, principal and agent
- To develop an interest in local incidents where civil rights are involved
- To build a legal vocabulary
- To develop an interest in acquiring a knowledge of state and federal legislation necessary for intelligent citizenship

COURSE PREREQUISITES

- An interest in acquiring a knowledge of the basic fundamentals of business law which will instill an understanding of legal rights and obligations in everyday business transactions
- Junior or senior class rank

SUGGESTED PROCEDURES

- Adapt subject matter to student interest.
- Invite business persons to speak to the class on definite phases of business law on occasions when their interpretations and comments will be of value to the students.

- Plan class visits to court sessions. Be sure to select a day on which a relevant case may be heard.
- Vitalize case problems by substituting names of members of the class in place of anonymous persons.
- Give the student an opportunity to place himself in various situations requiring the application of business law principles.
- Use case problems to illustrate the principles of law being studied.
- Give a preview of the assignment for the next day at an appropriate point in the class period.
- Make a chart of North Carolina courts showing interrelationships and the duties of the presiding officers.
- Have members of the class draw up simple contracts and other negotiable instruments. If these are not available, use duplicated forms.
- Have the students draw up simple articles of co-partnership or application for corporation charter for business organizations.
- Show the advantages and disadvantages of conditional sales contract blanks and chattel mortgages by bringing samples for class illustration.
- Invite an insurance representative to discuss different motor vehicle insurance policies.
- Have the students prepare lists of common and private carriers serving the local community and the services they render.
- Have the students prepare a chart comparing on one side the services the employer renders to his employees, with the other side showing the services the employee may give in return. Compile the results of individual charts into a class chart.
- Discuss rental of real property from both the tenant's and the owner's viewpoints.
- Present guaranty and suretyship in such a way that the students understand the privileges and responsibilities of each party connected with a negotiable paper.
- Relate the study of torts to the subject matter outline. For example, show that negligence on the part of the driver of an automobile for a partnership can be the basis of a tort action against each member of the partnership.
- Instill the idea that the business law knowledges acquired in this course are not sufficient to dispense with the services of a lawyer when needed.
- Approach the subject matter from both the businessman's and the consumer's viewpoints.
- Use discretion in discussing local cases.
- Attempt mock trials only after adequate preparation.

SUGGESTED COURSE CONTENT

LAW AND ITS ADMINISTRATION

Courts and their functions
Enforcement of rights
Strengths and weaknesses of our legal system

CONTRACTUAL RELATION

Nature and essential elements of contracts
Competent parties

Agreement—offer and acceptance
Defective agreements—genuineness of consent
Legal bargain
Consideration
Forms of agreements
Relation of third parties to contracts
Discharge of contractual duties
Remedies for breach of contract
Marriage

BUYER AND SELLER

Legal elements
Statute of frauds
Title of ownership
Values and limitations of a warranty
Rights and values of buyers and sellers
Conditional sales contract
Advantages and disadvantages of buying on credit
Laws pertaining to credit
Effects of the expansion and contraction of consumer credit upon business prosperity
Effects of the federal government fiscal policies, with particular reference to credit control, upon the level of income and employment

NEGOTIABLE INSTRUMENTS

Kinds of negotiable instruments
- Promissory notes
- Drafts
- Checks

Need and value of negotiable instruments

BUSINESS ORGANIZATION

Sole proprietorship
Partnerships
- Nature of the relation
- Rights and duties of partners to each other
- Relation of partners to third parties

Corporations
- Nature of corporations
- Powers and limitations of a corporation
- Rights and liabilities of members

Advantages and disadvantages of business organizations
Role of public ownership and cooperatives in our economy

EMPLOYER AND EMPLOYEE RELATIONS

Contracts of employment
Modern labor legislation
Benefits available to the working class

SALES OF PERSONAL PROPERTY

General nature
Statute of frauds
Acquiring title
Passing title
Warranties
Remedies of the seller
Remedies of the buyer
Conditional sales and chattel mortgages

INSURANCE

Nature of insurance
Concepts of risk
Types of insurance
- Property insurance
- Motor vehicle insurance
- Life insurance
- Social insurance

BAILMENTS

Nature and elements of bailment
Bailment for the benefit of one party
Bailment for the benefit of both parties
Hotels as bailees
Carriers of goods
Common carriers of passengers

REAL PROPERTY

Nature and interests in real property
Methods of acquiring title
Buying and selling real property
Mortgages and miscellaneous liens
Landlord and tenant

GUARANTY AND SURETYSHIP

Nature and essentials
Defenses and remedies

TORTS AND BUSINESS CRIMES

Public and private wrongs
Special types of torts
Unfair trade practices
Consumer protection

Remaining time should be devoted to employer-employee relations, insurance, bailment, real property, and guaranty and suretyship.

BUSINESS ORGANIZATION

Business Organization is a one-semester eleventh- or twelfth-grade level advanced basic business information course which should be open to all students as an elective. This course should be designed to contribute to the student's understanding of how businesses are organized and directed. The course should also give the student an appreciation of the interdependence of business, instill knowledges about the economic problems that businesses have in common, contribute to the concept of the relation of business to society, and develop an awareness of the need and importance of planning, organizing, directing, and controlling business activities.

OBJECTIVES

- To instill knowledges about the legal, financial, and directional organization of businesses
- To show the importance and functions of business records and budgets
- To extend knowledges of money and credit and the safe-guarding of business investments
- To develop knowledges about the broader aspects of buying and selling
- To develop understandings about unfair business practices, socially undesirable capital structures, and organizational abuses
- To advance understandings of the necessity and importance of taxation in the economic society
- To provide business information that is directly related to the individual's choice of vocation and initial employment and advancement
- To direct attention to business aspects that should be considered in starting an individual business

COURSE PREREQUISITES

- An interest in understanding how businesses are organized and directed
- Junior or senior class rank

SUGGESTED PROCEDURES

- Utilize library and community facilities. Learning materials cannot be limited to textbooks. The objectives of the course are difficult to achieve by the traditional assignment and question-answer recitation. A combination of the library plan of instruction and the laboratory plan is worthy of consideration.
- Vary classroom activities according to the students' interests, capacities, and experiences.
- Approach the teaching of business organization in terms of local businesses and industries; later compare businesses in other communities and other states in order to enrich the course.
- Give direction to the student's study and class discussion through the following questions:

  How many businesses are there in the community?
  Which ones are partnerships and which are corporations?
  What businesses are represented in single proprietorship?
  What types of business have become obsolete, and what new businesses have come into the community?
  What advertising and sales methods are employed by local concerns?

What is the capital structure of the local businesses?
In what types of business are there known employment opportunities?
What positions are available, and what are the requirements of the positions?

- Plan trips to local business plants. Be sure each trip is carefully planned in advance and the active cooperation of the firms is assured. Information desired, questions to be asked, and problems to be solved should be worked out by the teacher and class before starting on the trip. The trip should be followed by class oral and/or written reports.
- Invite local business managers to talk to the class on specified aspects of business organization.
- Utilize current pamphlets, publicity materials, audiovisual materials of local firms and national enterprises.
- Let the classroom period become a clearing house for ideas, findings, results of investigations.
- Use the problem method to motivate the course and at the same time extend activities for superior students. For example, let a student choose a particular business in which he is now interested or which he may hope to enter. From reference materials, trips, and conferences, have him compile a written report covering suggested phases, as:
  - Desirable location for the business
  - Rent or construction costs
  - Financing the business
  - Legal requirements, taxes, and local restrictions
  - The departments of the business, kind of personnel, and salary
  - Source of raw material or merchandise
  - Competition, locally or nonlocally
  - Channels of distribution, sales policies

SUGGESTED COURSE CONTENT

HOW BUSINESS IS OWNED AND OPERATED

- Introduction
  - How Americans earn a living
  - How communities specialize
- Classifications of business
  - Industrial
    - Extractive
    - Manufacturing
  - Commercial
    - Financing
    - Marketing
    - Transportation
- Types of business enterprise
  - Proprietorship
  - Partnership
  - Corporation
- Business records
  - Classification of business records
    - Historical
    - Statistical
    - Financial

How business transactions are recorded
How records show a profit or loss
How records help the businessman make wise decisions
Other uses of records in business
Common devices and safeguards in recordkeeping
The business budget
What it is
How it is prepared
Uses of business budgets

THE FINANCIAL BACKGROUND OF BUSINESS

Money
Kinds of money used in the United States
Who issues money in the United States
Characteristics of good money
Why we need money
Changes in the monetary system
Inflation and deflation
Credit and credit instruments
How to use credit
Credit and the business
Credit instruments
Ways to improve the credit system
Banks and banking
How the banks came into existence
Commercial banks
National banks
State banks
Trust companies
Mutual savings banks
Federal reserve banks
Various savings and credit organizations
How banks are protected

FINANCING A BUSINESS ENTERPRISE FOR SAFEGUARDING THE ENTERPRISE

How business is financed
Investment capital
Working capital
Long-term financing
Stocks
Bonds
Mortgages
Other
Short-term financing
The Securities Exchange Commission
Business insurance
Kinds of insurance companies
Stock companies
Mutual companies
Reciprocal exchanges
The terminology of insurance
The insurance needs of business
Insurance contracts and adjustment of losses

BUYING AND SELLING GOODS AND SERVICES

- Marketing
  - What is marketing
  - Channels of distribution
  - Marketing agricultural products
  - Marketing manufactured products
  - Marketing professional services
  - Marketing public-utility services
  - The retail store
- Trading with other countries
  - Why countries trade with one another
  - The Common Market
  - Imported items in common use
  - How transported goods move between countries
  - Financing foreign trade
  - Tariffs and quotas in foreign trade
- Advertising
  - The importance of advertising
  - Growth and development of advertising
  - Use of advertising in business
  - Methods used to check the effectiveness of advertising

RELATION OF BUSINESS TO SOCIETY

- The business cycle
  - What is a business cycle
  - Production and employment
  - Unemployment
  - Prices
  - Finance
  - Income
  - Psychological factors
  - What can be done about the business cycle
- How governments are financed
- Why taxes are needed
- Income taxation
- Sources of government revenues
- Kinds of business taxes
  - Property taxes
  - Income taxes
  - Excise customs levies
  - Social security taxes
  - Sales taxes
  - Special corporation taxes
- Law and business
  - Origin and growth of law
  - Business law in the conduct of businesses
  - Business law in everyday life
- Factors that influence the control of business
  - Influences which business cannot control
  - Voluntary groups which help to control business
  - Governmental controls of business
  - Future controls of business
- The obligation of business to society

What business has accepted
What it can do

FROM STUDENT TO BUSINESSMAN

- The first job
  - Selecting the line of business
  - Getting information about jobs in the chosen business
    - Advantages
    - Disadvantages
    - Requirements
    - Qualifications
  - Applying for the job
  - Job salaries
- Holding a job
  - Starting right
  - Self-analysis
  - Self-improvement on the job
  - Learning about the business
- Looking ahead
  - Budgeting
  - Forms of savings
  - Home ownership
  - Buying for investment
  - Expenditures for advancement
- Going into business
  - Kinds of businesses for small-scale operation
  - Preparing for business ownership

CONSUMER ECONOMICS

Consumer Economics is designed for all students regardless of educational or vocational aspirations. The primary objective of this eleventh- or twelfth-grade level course in the basic business-economic area is to provide general education values. The learning activities seek to enable the individual to advance his standard of living by wise planning and buying and to contribute to consumer citizenship by making him conscious of his social and economic responsibility.

OBJECTIVES

- To create a desire to improve consumer habits
- To develop a sense of values as a basis for intelligent planning
- To develop understandings of and skills in evaluating goods and services in terms of value
- To instill understandings of sources, use, and value of consumer information
- To develop ability to discriminate between advertising information which is helpful and that which is misleading
- To develop the habit of reading labels, evaluating brands, and distinguishing between genuine and worthless guarantees
- To develop an understanding of the importance of saving as a means of providing security
- To develop knowledges of and appreciations toward investment concepts, procedures, and policies
- To instill understandings of insurance needs and the rights and responsibilities under various types of policies
- To emphasize the importance of computing borrowing cost and installment buying
- To gain a knowledge of financial institutions from which funds may be obtained and in which funds can be invested
- To gain an understanding of the government's role in protecting and advancing consumer welfare
- To instill an understanding of the consumer's responsibilities in conserving national wealth
- To develop a vocabulary essential for understanding in handling consumer economic problems
- To develop an understanding relationship of business principles and procedures to wise management of income and savings to satisfy human wants

COURSE PREREQUISITES

- An interest in becoming aware of the social and economic responsibilities which a consumer has and in gaining know-how to handle efficiently these responsibilities
- Junior or senior class rank

SUGGESTED PROCEDURES

- Determine the students' understandings and misunderstandings about each subject matter unit in order to give the right perspective to each study unit.
- Maintain articulation with the Social Studies and Home Economics Departments to avoid duplication of subject matter and to utilize contributions which can be made by the teachers in these areas.

- Utilize many current instructional materials other than textbooks which meet the maturity and ability levels of the students (consumer publications, daily newspapers and magazines, publications of business and governmental organizations). Before using such materials, analyze carefully the content to determine the bias, if any, of the writers.
- Avoid making the course technical—a "cans and labels" course.
- Apply the discussion method.
- Take advantage of the many films and other aids available for consumer economics from educational agencies and business firms.
- Encourage students to get consumer information by visiting or writing educational agencies and business firms in order to extend their experience in ways of securing information.
- Purposefully plan, conduct, and evaluate field trips.
- Solicit the cooperation of civic clubs, labor unions, university clubs, merchants' associations, and others in sharing with the class their research on consumer economics.
- Utilize each subject matter unit by having the students listen for misleading advertising on the radio, television, and other mass media of communication, and report findings to the class.
- Encourage students with specialized interests to investigate more fully their interest in independent studies and to report their findings to the class.

SUGGESTED COURSE CONTENT

CONSUMER EDUCATION

Importance of consumer education
Living better economically
    Factors involved in better economic living
        Role of the consumer
        Role of the business
Basic consumer problems of today and topics of interest contrasted with those of the past
General business principles
Advantages and disadvantages of services for consumers

SALES PROMOTION AND ITS EFFECT ON THE CONSUMER

The importance of buying rather than "being sold"
Sales promotion
    Media
    Importance to business
    How regulated and controlled
    Cost
    Guide for analyzing

STANDARDS FOR EVALUATING CONSUMER GOODS

Government standards
Private consumer agencies standards
Brands and trade-marks
Packaging
Labels and informative labeling
Implied warranties; expressed warranties
Service and service policies

USE OF CREDIT IN BUYING CONSUMER GOODS AND SERVICES

- Understanding and using credit
- Installment plans
  - Advantages
  - Disadvantages

BUDGETING, SAVINGS, AND INVESTMENTS—A MANAGEMENT PLAN

- Importance of managing finances through budgeting, saving, and investing
- Planning a budget and a savings plan
- Estimating income and expenditures
- Importance of keeping financial records
- Criteria for selecting investments
  - Government bonds
  - Insurance annuities
  - Retirement opportunities other than Social Security and the state retirement provisions
  - Stocks and bonds
  - Real estate

PROTECTION THROUGH INSURANCE

- Need for insurance protection
- Kind of insurance
  - Life
  - Property
  - Fire
  - Automobile
  - Health and accident
  - Investment
- Provisions for premiums, cancellations, surrender, dividends, loans, and conversions
- Selecting an insurance company and utilizing its services

TAXES, TARIFFS, AND PUBLIC FINANCE

- Essential understandings
- Structure of the functions of federal, state, county, and city taxes
- Effects of tariffs on the economy
- Costs of local, state, federal government services and protection
- Responsibility of consumer to support local, state, federal government

PURCHASING FOOD, DRUGS, COSMETICS

- Legal protection
- Methods of evaluation and use
- Packaging
- Grades
- Informative labels
- Implied, expressed warranties
- Service policies
- Application of principles of wise buying to the purchase of foods, drugs, cosmetics

PURCHASING CLOTHING

- Standards of judgment
  - Quality
  - Service
- Budget planning
- Brands, labels, warranties
- Application of principles of wise buying to the purchase of clothing

PURCHASING HOUSING

- Standards in relation to income, position, and needs
- Choices between renting and home ownership
- Advantages, disadvantages of home ownership
- Problems involved in home ownership
  - Financial
  - Legal
- Responsibilities of the home owner
- Application of principles of wise buying to the purchase of a home
- Judging quality in selection of types, size, and floor plan
- Methods of purchase
  - Cash
  - Credit
  - Installment

PURCHASING AN AUTOMOBILE

- Standards in relation to income, position, and needs
- Judging quality in selecting types, styles, and sizes
- Methods of purchase
  - Credit
  - Cash
  - Installment
- Application of principles of wise buying

PURCHASING PROFESSIONAL SERVICES

- Planning for the purchase of professional services
  - Medical
  - Legal
- Agencies which protect the consumer of professional services
- Sources of professional services for consumers who cannot afford to buy them

CONSUMER SERVICES

- Consumer cooperative movements
- Government publications
- Consumer research groups

ECONOMIC GEOGRAPHY

Economic Geography is a study of how people in various parts of the world make a living by producing goods and services. It deals chiefly with the great commodities of the world—their place or origin, the various stages of their movement and manufacture, the finished product, and the market place. Economic Geography should be an elective one-semester course open to all students at the eleventh- or twelfth-grade level.

OBJECTIVES

- To develop an appreciation of the relationships which exist between the physical environment and the cultural levels of people
- To create an understanding and appreciation of habits and customs which are outgrowths of geographic factors
- To develop an understanding of the problems of conservation of both human and natural resources and their influence on technological development
- To create an understanding of the various methods by which products are extracted from the earth and made available to industry
- To develop a knowledge in the ways in which surface products of the earth are produced and made available to manufacturers and consumers
- To develop an appreciation of local and regional geographic influences upon the life of the people
- To develop further skill in reading maps, charts, and other graphic presentations of geographic data
- To create an interest in reading current literature on economic geography for the purpose of understanding events of significance around the world
- To understand activities involved in producing and handling each major commodity within the producing regions
- To understand activities involved in the consumption of the commodity in the consuming region
- To understand activities in connection with transporting the commodity from producing areas to consuming areas

COURSE PREREQUISITES

- An interest in studying how man, in various parts of the world, makes his livelihood and how this economic behavior is affected by geography
- Junior or senior class rank

SUGGESTED PROCEDURES

- Emphasize the efficient use and relationships of factors such as men, methods, machines, materials, and money which influence the production and distribution of goods and services.
- Emphasize cause-and-effect relations, contrast-and-comparison relationships in the economic progress of mankind in various parts of the world.
- Employ the use of oral reports, individual and committee studies, graphic illustrations, posters, charts, educational films, bulletin boards, and excursions in order that learning may be achieved through interest and participation.
- Help the student to see the scope of the subject matter and to relate the parts of the subject as the study progresses.

SUGGESTED COURSE CONTENT

EARTH AND MAN

- The earth's physical, regional, economic, and political features
  - Hot lands
  - Temperate lands
  - Cold lands
    - Characteristics
    - Relationships
    - Effects on man's activities to satisfy his needs and wants
    - Advantages and limitations

PRODUCTION OF GOODS AND SERVICES

- Dependency upon natural resources and conditions
  - Climate
  - Land surface
  - Soil
  - Vegetation
- Chief types of goods and services
  - How the goods or services will be used
  - Extent to which they affect the lives of people within a certain region throughout the world
  - Where natural conditions exist in proper combination for successful production
  - Processes necessary for carrying out production and preparation for the market
  - The use of the product or service, locally or in distant regions
  - Manufacturing processes involved
  - Where and how the product or service is marketed
  - Extent of present use and probable growth or decline of the product or service
- Influence of men, methods, materials, machines, money, natural resources, population characteristics and trends, and industrial patterns on the world's economy

MARKETING AND CONSUMPTION OF GOODS AND SERVICES

- Marketing activity
- Marketing media
  - Types
  - Utilization
  - Advantages and disadvantages

PRINCIPLES OF RETAILING

Principles of Retailing is a one-semester elective course designed for those students who are interested in sales work or in pursuing studies beyond high school in the field of marketing. This course may be taught at the eleventh- or twelfth-grade level. Principles of Retailing places emphasis on the over-all importance of retailing—on selling and buying practices, inventory control, pricing, advertising, and other facets of retailing.

OBJECTIVES

- To develop an understanding of the role of retailing in our economy
- To develop basic understandings of how to plan a store, to buy and sell merchandise
- To develop a degree of proficiency in the functions of recordkeeping and the planning of effective retail operations
- To gain an understanding of government regulation of distribution
- To gain an insight into the field of retailing—the job opportunities, their advantages, disadvantages, and limitations
- To gain insight into the qualifications needed for success in the field of retailing
- To build a retailing vocabulary
- To gain an understanding of automation's impact on retailing activities

COURSE PREREQUISITES

- An interest in sales occupations, upon graduation, in further study in the field of marketing
- Junior or senior class rank

SUGGESTED PROCEDURES

- Utilize community resources and current retail publications.
- Plan panel discussions for identifying retailer problems and making decisions concerning solutions of the problems.
- Use audiovisual materials to enrich the learning experiences.
- Encourage students to do independent reading and surveys.
- Emphasize the importance of good character and personality traits in retail employment.

SUGGESTED COURSE CONTENT

RETAILING

Importance of size of the retailing field
- Types and volume of retail outlets in the local community, in North Carolina, in the United States
- Types and volumes of everyday needs fulfilled by retailers
- Number and type of people employed in retail occupations
- Total North Carolina retail sales compared with other states

SMALL-SCALE RETAILING VERSUS LARGE-SCALE RETAILING

Importance and function of small-scale retailing
- General store
- Single line and neighborhood store

- Specialty shop
- Variety store
- Roadside market
- Consumer cooperative
- Side-line store

Importance and function of large-scale retailing

- Department store
- Mail-order house
- Supermarket
- Discount house
- Chain store

OWNERSHIP AND CONTROL OF RETAIL ESTABLISHMENTS

- Proprietorship
- Partnership
- Corporation
  - Advantages
  - Disadvantages

RETAILING ACTIVITIES

- Important facets of
  - Buying
  - Selling
  - Operating
  - Controlling
- Challenges
  - Balanced activities
  - Expense control
  - Profit and service
  - Innovation trends
  - Customer tastes
  - Customer buying habits
  - Competition

ESTABLISHING A RETAIL OUTLET

- Planning
  - Factors to consider
    - Type
    - Location
    - Building
    - Competition
    - Equipment needed
    - Organizational plan
    - Financing
    - Insurance protection
    - Policies needed
- Forecasting
  - Market potentials
  - Personnel needs
- Organizing procedures, policies, practices

OPERATING A RETAIL OUTLET

Directing and motivating activities
Regulation, local, state, federal
Recordkeeping
Budgeting
Forecasting

RETAILING JOBS

Knowing the retail-job market
How to secure a retail job
How to keep the retail job

PRINCIPLES OF SELLING

Principles of Selling is designed as a background, non-vocational eleventh- or twelfth-grade level course. It seeks to develop a wholesome point of view toward problems and relationships common to consumer and retailer, an understanding of basic principles and techniques involved in buying and selling, and to give insights into the problems of the marketing field and some preparations for the occupation of selling.

OBJECTIVES

- To develop ability to identify problems and relationships common to consumers and retailers and a wholesome attitude toward these problems
- To develop an understanding of basic principles and techniques involved in buying and selling
- To gain an understanding of professional buying and selling procedures
- To give insight into the problems of the field of marketing
- To provide background information essential to preparation for the occupation of selling
- To provide opportunities to apply principles of selling to business and personal activities
- To encourage the development of personal traits which contribute to successful selling

COURSE PREREQUISITES

- An interest in understanding the problems and relationships of consumers and sellers and an interest in selling as a vocation
- Junior or senior class rank

SUGGESTED PROCEDURES

- Utilize community resources. Arrange with local stores for their sales personnel to give demonstrations during the regular school class period and/or in the store. Have local merchants give talks on store system, procedures for pricing and promoting the sale of merchandise.
- Secure copies of trade publications and journals from store managers
- Plan panel discussions for identifying consumer and retailer problems and making decisions concerning solutions of the problems.
- Use audiovisual materials and other effective supplementary materials (pamphlets, newspapers, retail magazines) to enrich learning experiences.
- Encourage students to report observations in local and metropolitan stores.
- Emphasize the importance of good character and personality traits; provide information and reasons why employees lose their jobs.

SUGGESTED COURSE CONTENT

SELLING

- Types of selling
  - Procedures and middlemen
  - Retailers
    - Independent
    - Chain stores a. d voluntary chains of independent retailers
      - Supermarkets
      - Planned shopping centers
      - Discount houses
      - Mail-order companies
      - House-to-house selling
      - Vending machine operations
    - Manufacturer-owned
    - Farmer-owned
    - Government-operated
    - Consumers' cooperative
  - Wholesaler
  - Agent middlemen
  - Assemblers
  - Service establishments
- Selling as an aid to the consumer
  - Marketing functions
  - Stimulating the consumer to use his income more effectively
  - Fitting the goods to consumer needs
- How goods reach the consumer
  - Producer to consumer
  - Producer to retailer
  - Producer to wholesaler, to retailer, to consumer

BASIC KNOWLEDGE IN SELLING

- Consumer buying motives
  - Desire for physical well-being and comfort
  - Desire for recognition
  - Desire for monetary gains
  - Desire for knowledge
- How to analyze consumer demands
- How to fulfill consumer demands
- Consumer goods
  - Sources
  - Obtaining knowledge. of the product
  - Use, performance, care, and services of the product

PERSONAL QUALIFICATIONS NEEDED FOR SELLING OCCUPATIONS

- Physical qualities
  - Health
  - Cleanliness
  - Voice
- Personality traits
  - Trustfulness, loyalty
  - Showmanship
  - Interest and enthusiasm
  - Courtesy and tact

- Other qualities
  - Proficiency in oral and written English
  - Professional attitude
  - Proficiency in basic mathematical skills
    - Pricing goods
    - Discount
    - Sales tax

SALES TRANSACTIONS

- Opening the sale
- Determining the customer's wants
- Presenting the goods
- Answering questions and overcoming objections
- Closing the sale
- Suggestive selling

ON-THE-JOB INFORMATION

- Store rules, policies, procedures
- In-store location
- Sales terms
- Recording the sale

MAINTAINING GOOD CUSTOMER RELATIONS

- Customer expectations
  - Friendliness
  - Personal interest to needs
  - Courteous
- Salesperson's duty
  - To know the goods
  - To give information about merchandise willingly

SPECIALIZED BUSINESS EDUCATION COURSES

The specialized business education courses outlined in this section are suggestive only. The variable factors—student population, community characteristics and needs, total school curriculum, facilities and equipment, and qualified faculty must be considered when planning any course of study. The course should be well planned, maintain high standards of achievement, and be re-evaluated frequently as changes occur and adjustments are needed.

Specialized business education courses should not be taken indiscriminately by the student without consideration of his interests, needs, educational and vocational goals, long-range aspirations, and fitness to succeed.

Course description, objectives, prerequisites, suggested procedures, and content are outlined for the following specialized business education courses:

Course Title	Grade Level
Shorthand I	11
Shorthand II	12
Bookkeeping II	12
Recordkeeping	10 or 11
Business Communications	11 or 12
Office Practice	12
Business Machines	12
Cooperative Office Occupations I and II	11 and/or 12
Advertising	12
*Notehand	

* Notehand, outlined in this section, is a non-specialized course which should be taught by a teacher of specialized business courses.

SHORTHAND I

Shorthand I is a beginning shorthand course designed to develop fundamental knowledges and skills needed for stenographic and secretarial positions open to high school graduates. This specialized eleventh-grade level course should enable students to

- master shorthand theory
- develop fluency in reading shorthand plate material rapidly and accurately
- develop fluency in writing practiced and new-matter dictation
- develop ability to transcribe meaningful typewritten copy
- develop a shorthand vocabulary

OBJECTIVES

First Semester

- To build a basic foundation in shorthand theory
- To develop ability to read printed shorthand plates accurately and rapidly
- To develop ability to recognize sounds, to record in shorthand the sounds heard, and to read the shorthand notes rapidly and accurately
- To develop ability to take dictation of practiced shorthand material at no less than 60 words a minute for a minimum period of three minutes and to transcribe the shorthand notes meaningfully at the typewriter
- To lay the foundation for transcription work by integrating shorthand skill with the development of correct grammatical usage, punctuation, sentence structure, spelling, capitalization, diction, syllabication, and typewriting as related to shorthand transcription work
- To begin developing ability to transcribe meaningfully typewritten copy; emphasizing good machine transcription techniques and accurate copy
- To develop continuity in writing shorthand and in word-carrying ability

Second Semester

- To develop further the mastery of shorthand theory
- To develop skill in taking office-style dictation
- To develop a broader shorthand vocabulary and general vocabulary through dictation material of various levels of difficulty and on various subject matter
- To develop skill in taking previewed new-matter dictation at no less than 80 words a minute for three-minute periods and to transcribe the dictation
- To attain a minimum transcription production rate of three average-length letters (101-200 words) for a period of at least 30 minutes

COURSE PREREQUISITES

- A good background in English, spelling, vocabulary, and an aptitude for a foreign language
- Typewriting I
- Junior class rank

- An interest in learning shorthand in order to fulfill vocational goals
- An interest in learning shorthand in order to develop a skill which can be used in stenographic jobs while in college to help defray college expenses

SUGGESTED PROCEDURES

- Cover the first book of the Gregg Shorthand series during the first semester and the second book during the second semester.
- Check each student's longhand reading rate during the first week of class in order to determine whether his audible shorthand reading rate approaches his audible longhand reading rate.
- Beginning with Lesson 3, stress concerted reading.
- Preview new reading material with the students.
- Set a rapid class pace and use the entire class period advantageously.
- Once individual reading begins, encourage each student to read the shorthand plate at a speed approaching his audible longhand reading rate.
- Through chalkboard drills, stress the importance of developing the habit of spelling out the sound of each word before pronouncing it (except brief forms and phrases).
- Use frequently, but not beyond the point of learning, the chalkboard for drills and demonstration writing.
- Often have students spot-write (write one character over the top of the other in their shorthand notebooks while spelling aloud vocabulary board drills) in order to accustom the hand to follow the movements of writing the outline at a fast pace.
- Give frequently intense brief form drills and quizzes.
- Cover one lesson a day; present the lesson to the class before it is assigned as homework.
- Discuss with the class the best procedure for preparing homework.
- Introduce dictation after the class has developed reading fluency at 50 words a minute.
- Encourage students to dictate to each other outside of class and to do homework writing through self-dictation rather than word-for-word copying.
- Utilize dictation records and tapes for building speed in and outside of class.
- Keep accurate records on each student's shorthand ability and progress.
- Hold interviews with students in order to determine interests, problems, abilities, educational and vocational aspirations.
- Emphasize phrasing by drills and dictating in phrases.
- Use supplementary materials in order to hold the students' interests and to build a broad vocabulary and skill in taking dictation at various levels of difficulty.
- Give every student an opportunity to participate in each day's recitation.
- Introduce new shorthand principles by using words and illustrations that are within the students' comprehension.
- Change class activities frequently to avoid monotony.
- Emphasize fluency in writing.
- Promote speed in writing shorthand by stressing the importance of get-

ting something down for everything that is dictated rather than drawing perfect outlines.

- Give the student an opportunity to develop refinement of his outlines by lowering the dictation rate at an appropriate time in the speed building drills.
- Use a variety of speed drills and techniques to develop speed and fluency in writing.
- Integrate related learnings when feasible.
- Carry out a pre-transcription training program throughout the course.
- Establish a systematic system for marking shorthand and non-shorthand errors in the shorthand transcript. (Shorthand errors—deviations from actual dictation; non-shorthand errors—include all other errors such as spelling, punctuation, incorrect letter placement and form, non-acceptable erasures.)
- Provide a relaxed learning atmosphere when students show signs of tension.
- Encourage students to use common sense in their shorthand work if they do not have detailed instructions.
- Speak clearly and loudly enough; establish and maintain good rapport with students.

SUGGESTED COURSE CONTENT

Because of the nature of shorthand, the content of the course should follow the plan of procedures in the first semester State-adopted shorthand textbook.

First Semester

FIRST THIRD OF THE LESSONS IN THE FIRST BOOK OF THE GREGG SHORTHAND SERIES

Explanation of what shorthand is
Relationship of shorthand skill and English knowledge
Explanation of the textbook organization and the proper use of the student transcript
Explanation of brief forms, phrases, and special forms
Presentation of the new theory in each day's lesson
Chalkboard presentation of theory
Individual and concerted reading of word lists, phrases, sentences, and short letters
Introduction of writing through dictation (Dictation should start at 50 words a minute.)
Attention given to points of English—spelling, punctuation, sentence structure

SECOND THIRD OF THE LESSONS IN THE FIRST BOOK

Instruction directed toward increasing shorthand vocabulary
Improvement of ability to take dictation at 50 or more words a minute
Instruction in transcription techniques
Concerted and individual reading of chalkboard drills, textbook word lists, and plates
Supervised drills in writing material from dictation
Introduction of longhand transcription from dictation notes, stressing points of grammar

LAST THIRD OF THE LESSONS IN THE FIRST BOOK

Emphasis directed toward increasing and improving skill in dictation of practice material and transcribing it in an acceptable form at the typewriter
Complete the shorthand theory
Automatize the use of brief forms, phrases, and special forms with intelligent repetitive practice
Introduce new-matter dictation
Stress proper writing techniques
Combine speed development and its teaching of analogical word beginnings and endings

Second Semester

The second semester teaching procedure and textbook material should follow the general pattern set up in the first semester. The second book of the shorthand series should be used during this semester. The technique introduced in the first semester should be developed to a higher degree of efficiency. The theory covered in the first semester should be mastered, and the standards set up for the first-semester work should be raised as the students progress in the textbook materials and as they are given opportunity for additional practice. Adaptation of suitable supplementary dictation matter is important in the second semester. There should be further opportunity to integrate shorthand skill, typewriting skill, and English knowledge in order to lay a strong foundation for second-year shorthand work.

Throughout the second semester the teaching procedures and subject matter should be designed for:

REVIEW OF SHORTHAND THEORY

Words covering all principles, with stress on developing ability to write longer and more difficult words, should be presented systematically. Analogical word beginnings and endings should be frequently reviewed.
Provision should be made in each day's reading and writing home assignment for automatic review.
Brief forms, special forms, and phrases should be reviewed frequently.

INCREASE SHORTHAND VOCABULARY

Reading and writing related matter on a variety of subjects should be a part of daily home assignment work.
Dictation of business material should contain a wide range of vocabulary.
The dictionary should be used to look up new words encountered in daily assignment.

INCREASE SPEED AND ACCURACY IN TAKING PRACTICE MATTER DICTATION FOR LONGER PERIODS OF TIME

Such dictation should consist of materials containing many brief forms, simple words, and phrases, since its main purpose is increase of speed.

Repeated dictation of the same material at increasingly higher rates of speed should be given until a dictation speed is reached that is beyond the students' present shorthand writing rates.

The length of the dictation should be gradually increased to establish endurance and to develop word-carrying ability for longer periods of time.

INCREASE SPEED AND ACCURACY IN TAKING NEW-MATTER DICTATION FOR LONGER PERIODS OF TIME

Previews of the more difficult outlines should be given.

Repeated dictation on a pyramid basis should be employed for speed building.

Dictation should be given for sustained periods of time through increased length of dictation, progressing from simple material to more difficult material.

TRANSCRIBING AT THE TYPEWRITER

At least two periods a week should be devoted to transcription at the typewriter.

Transcription at the typewriter should be closely supervised both collectively and individually.

Early transcription lessons should consist of transcription of shorthand plates with emphasis on reading thought groups first and then typewriting them. Proper punctuation marks and spelling of difficult words should be discussed before typewriting the material.

The ability to detect errors and make acceptable corrections should be developed by emphasizing the proofreading of transcripts and correct techniques in erasing and inserting letters.

These early periods of transcription are mainly for the purpose of laying a sound foundation for transcription skill in second-year shorthand. Therefore, it is important to review letter forms, make carbon copies, improve typewriting techniques, and in general have every transcript prepared in a manner acceptable to business. The development of techniques essential to skill in transcription should be the major objective.

TENTATIVE STANDARDS FOR SHORTHAND I

First Semester

FIRST SIX-WEEKS

FIRST THIRD OF THE LESSONS IN THE FIRST BOOK

Grading

Daily tests—50 per cent of grade—Daily tests should be given at the discretion of the teacher.

Recognition tests of shorthand outlines should be evaluated on the basis of the percentage of outlines correctly recognized and preferably rated only as high, average, or low.

Longhand transcripts of related matter from shorthand plates in former assignments should be evaluated on the basis of either the number of actual words correctly transcribed or the number of sentences transcribed accurately. Here also a rating of high, average, or low should be sufficient.

Oral reading tests of related matter in former assignments should

be evaluated on the fluency in reading as high, average, or low. As students progress from lessons 1 through 24, the standards for these tests should gradually be raised.

In-class activities—50 per cent of the grade

Concerted reading

Individual reading

Participation in drills, spot writing, and other learning activities

SECOND SIX-WEEKS

SECOND THIRD OF THE LESSONS IN THE FIRST BOOK

Grading

Daily tests—75 per cent of grade—Daily tests similar to those suggested for the first six-weeks grading period should be given. Standards for each test should be raised as the students learn more shorthand. Tests can be scored on the basis of the amount transcribed and the degree of accuracy. It is still advisable to rate students as high, average, or low.

New-matter dictation and transcription at the typewriter should be included in the testing program. These tests can be graded on the basis of number of words transcribed and degree of accuracy. As the students have more practice in taking new-matter dictation, the rate and duration should be raised accordingly.

The transcript only should be checked for grading purposes.

Suggested marking scale for practice dictation:

Grade	*Rate of Dictation*	*Length of Dictation*	*Error Allowance*
A	70	3 min.	3 per cent based on shorthand errors only (A shorthand error is any deviation from that which was dictated—words added by the student will not be counted as errors.)
B	60	3 min.	
C	50	3 min.	
D	less than 50	3 min.	

Suggested marking scale for new-matter dictation:

A	70	1 ½ min.	3 per cent based on shorthand errors only.
B	60	1 ½ min.	
C	50	1 ½ min.	
D	less than 50	1 ½ min.	

In-class activities—25 per cent of grade

THIRD SIX-WEEKS

LAST THIRD OF THE LESSONS IN THE FIRST BOOK

Grading

Daily tests and in-class activities—50 per cent of the grade

Transcription—50 per cent of the grade

Verbatim transcription tests on previewed new matter

The transcript only should be checked for grading purposes

Suggested marking scale for practiced dictation:

Grade	*Rate of Dictation*	*Length of Dictation*	*Error Allowance*
A	80	3 min.	3 per cent based on shorthand errors only
B	70	3 min.	
C	60	3 min.	
D	less than 60	3 min.	

Suggested marking scale for new-matter dictation:

A	70	3 min.	3 per cent based on shorthand errors only
B	60	3 min.	
C	50	3 min.	
D	less than 50	3 min.	

Second Semester

The emphasis in testing should shift to the transcription of new-matter dictation. Daily tests suggested in the first-semester grading periods should be used occasionally with standards raised in accordance with the students' progress.

The students should be tested for automatization of brief forms, special forms, and analogical word beginnings and endings.

FIRST SIX-WEEKS

FIRST THIRD OF THE LESSONS IN THE SECOND BOOK

Grading

Tests—50 per cent of grade
Transcription—50 per cent of grade
The transcript only should be graded

Suggested marking scale for practice dictation:

Grade	*Rate of Dictation*	*Length of Dictation*	*Error Allowance*
A	90	3 min.	3 per cent based on shorthand errors only
B	80	3 min.	
C	70	3 min.	
D	60	3 min.	

Suggested marking scale for new-matter dictation:

A	80	3 min.	3 per cent based on shorthand errors only
B	70	3 min.	
C	60	3 min.	
D	50	3 min.	

SECOND SIX-WEEKS

SECOND THIRD OF THE LESSONS IN THE SECOND BOOK

Grading

Tests—50 per cent of grade
Transcription—50 per cent of grade
The transcript only should be graded

Suggested scale for practiced dictation:

Grade	*Rate of Dictation*	*Length of Dictation*	*Error Allowance*
A	100	3 min.	3 per cent based on shorthand errors only
B	90	3 min.	
C	80	3 min.	
D	70	3 min.	

Suggested marking scale for new-matter dictation:

A	90	3 min.	3 per cent based on shorthand errors only
B	80	3 min.	
C	70	3 min.	
D	60	3 min.	

THIRD SIX-WEEKS

LAST THIRD OF THE LESSONS IN THE SECOND BOOK

Grading

Tests—50 per cent of grade
Transcription—50 per cent of grade
The transcript only should be graded

Suggested scale for new-matter dictation:

Grade	*Rate of Dictation*	*Length of Dictation*	*Error Allowance*
A	100	3 min.	3 per cent based on shorthand errors only
B	90	3 min.	
C	80	3 min.	
D	70	3 min.	

Three-minute transcription tests based on usable form should be introduced during this grading period.

Suggested scale for mailable transcript:

Grade	*Rate of Dictation*	*Length of Dictation*	*Av. Length of Letters*	*Trans. Time*	*Trans. Rate*
A	100	3 min.	100-200 words	30	20
B	90	3 min.	100-200	30	15
C	80	3 min.	100-200	30	10
D	70	3 min.	100-200	30	less than 10

It is suggested that the student have three transcripts within a grade range before being assigned that grade.

SHORTHAND II

Shorthand II is a highly specialized terminal course designed to develop further the skills in shorthand, typewriting, and English and their application in the production of transcripts according to mailable standards.

OBJECTIVES

First Semester

- To continue the review of shorthand theory
- To develop skill in the use of the dictionary and other reference material
- To develop further the ability to take and transcribe dictation for sustained periods of time
- To develop further a broader shorthand vocabulary and automatization of frequently used words and phrases
- To develop skill in taking previewed new-matter dictation at no less than 100 words a minute for three-minute periods and to transcribe the dictation into mailable copy

Second Semester

- To continue transcription training
- To develop further skill in performing all operations involved in producing a mailable transcript, such as making carbon copies, addressing envelopes, proofreading, and making unnoticeable corrections when needed
- To develop ability to take new-matter dictation at no less than 110 words a minute for three minutes and to transcribe mailable copies for 30 minutes at a transcription rate of no less than 20 words a minute
- To develop ability to take extemporaneous dictation which simulates that given in a business office

COURSE PREREQUISITES

- An interest in using shorthand and transcription skills vocationally
- Shorthand I
- Typewriting I
- Senior class rank

SUGGESTED COURSE CONTENT

The course content and the teaching procedures employed in Shorthand II should be specifically selected and directed to accomplish two distinct and separate functions:

- To perfect techniques in taking more difficult dictation at an increasingly higher rate of speed for increasingly longer periods of time
- To develop transcription skill comparable to business standards (These may be stated in terms of teacher-imposed goals or job competency.)

Throughout the course, materials used and procedures employed must operate simultaneously toward achieving these two goals.

DICTATION

- Reviewing shorthand theory
  - Daily home assignment practice
  - *Today's Secretary* theory tests
  - Wide variety of new-matter dictation
  - Brief forms and phrases
  - Special forms and analogical word beginnings and endings
- Increasing shorthand vocabulary
  - New outlines in daily home assignments
  - New-matter dictation
  - Word lists
- Increasing rate of dictation
- Increasing difficulty of dictation
- Increasing length of dictation
- Timed dictation
- Untimed and irregular dictation

TRANSCRIBING

- Transcription of shorthand notes
- Class checked transcripts
- Proofreading
- Use of the dictionary and other reference materials
- Business reports

SUGGESTED PROCEDURES

- Dictate all related material in logical thought phrases, gradually increasing the length of the phrases to develop a sustained word carrying ability.
- Have a majority of the dictation material in letter form.
- Constantly increase the amount and frequency of transcription.
- Give a considerable amount of untimed and irregular dictation.
- Adapt procedures toward making the classroom work comparable to office situations, gradually developing in the student the ability to work without specific directions and supervision.
- Encourage developing work habits of neatness and orderliness.
- Emphasize organizing materials for quick, effective use, particularly the notebook, pen, stationary, carbon paper, eraser, and eraser shield.
- Make dictionaries and other reference materials available during transcription and encourage students to use them in solving their own problems.
- Emphasize proofreading every transcript and making needed corrections.
- Alternate verbatim with mailable-copy transcribing.
- Conduct transcription work according to office procedure and require quality and quantity standards comparable to actual business standards.
- Try to instill a sense of satisfaction in work well done.
- Schedule Shorthand II in a typewriting room, so each student will have access to a typewriter for transcription work.
- New-matter dictation should be carefully selected for wide and varied vocabulary content.
- Give varying rates of dictation daily.

TENTATIVE STANDARDS FOR SHORTHAND II

First Semester

FIRST SIX-WEEKS

FIRST THIRD OF THE LESSONS IN THE THIRD BOOK OF THE GREGG SHORTHAND SERIES.

Grading

Tests—25 per cent of grade (Tests should be given at the discretion of the teacher.)
Transcription—75 per cent of grade (The transcript only should be checked for grading purposes.)
Suggested marking scale for previewed new-matter dictation would be the same as the scale recommended for the third six-weeks grading period of second semester Shorthand I as given on page **91**.

SECOND SIX-WEEKS

SECOND THIRD OF THE LESSONS IN THE THIRD BOOK.

Grading

Tests—25 per cent of grade (Tests should be given at the discretion of the teacher.)
Transcription—75 per cent of grade

Suggested marking scale for new-matter dictation:

Grade	*Rate of Dictation*	*Length of Dictation*	*Av. Length of Letters*	*Trans. Time*	*Trans. Rate*
A	110	3 min.	100-200 words	30	25
B	100	3 min.	100-200	30	20
C	90	3 min.	100-200	30	15
D	80	3 min.	100-200	30	10

THIRD SIX-WEEKS

LAST THIRD OF THE LESSONS IN THE THIRD BOOK

Grading

Tests—25 per cent of grade (Tests should be given at the discretion of the teacher.)
Transcription—75 per cent of grade

Suggested marking scale for new-matter dictation:

Grade	*Rate of Dictation*	*Length of Dictation*	*Av. Length of Letters*	*Trans. Time*	*Trans. Rate*
A	120	1 ½ min.	100-200 words	30	25
B	110	1 ½ min.	100-200	30	20
C	100	1 ½ min.	100-200	30	15
D	90	1 ½ min.	100-200	30	10

Second Semester

FIRST SIX-WEEKS

FIRST THIRD OF THE LESSONS IN THE FOURTH BOOK.

Grading

Tests—25 per cent of grade (Tests should be given at the discretion of the teacher.)
Transcription—75 per cent of grade

Suggested marking scale for new-matter dictation would be the same as the scale recommended for the third six-weeks of the first semester, except the dictation period is to be increased from 1½ to 3 minutes.

SECOND SIX-WEEKS

SECOND THIRD OF THE LESSONS IN THE FOURTH BOOK.

Grading

Tests—25 per cent of grade (Tests should be given at the discretion of the teacher.)
Transcription—75 per cent of grade

Suggested marking scale for new-matter dictation:

Grade	*Rate of Dictation*	*Length of Dictation*	*Av. Length of Letters*	*Trans. Time*	*Trans. Rate*
A	over 120	1 ½ min.	100-200 words	30	30
B	120	1 ½ min.	100-200	30	25
C	110	1 ½ min.	100-200	30	20
D	100	1 ½ min.	100-200	30	15

THIRD SIX-WEEKS

LAST THIRD OF THE LESSONS IN THE FOURTH BOOK.

Grading

Tests—25 per cent of grade (Tests should be given at the discretion of the teacher.)
Transcription—75 per cent of grade

Suggested marking scale for new-matter dictation:

Grade	*Rate of Dictation*	*Length of Dictation*	*Av. Length of Letters*	*Trans. Time*	*Trans. Rate*
A	over 120	3 min.	100-200 words	30	30
B	120	3 min.	100-200	30	25
C	110	3 min.	100-200	30	20
D	100	3 min.	100-200	30	15

It is suggested that a student have at least three dictation takes within a grading range before being assigned that grade.

BOOKKEEPING II

Bookkeeping II is the advanced second-year course in bookkeeping. It should be offered only in those high schools in which student enrollment justifies its inclusion in the business program. Bookkeeping II is designed for those students who want further knowledge of the subject for positions as bookkeepers, for those who desire to engage in accounting as a profession, and for those who desire a bookkeeping foundation in preparation for manager-owner positions.

OBJECTIVES

- To give knowledge and facility in the use of business papers, forms, and reports involved in bookkeeping records
- To develop a satisfactory skill in analyzing and interpreting bookkeeping information in the solution of business problems
- To develop the student's responsibility in recording partnership and corporation business transactions
- To develop further essential bookkeeping traits of accuracy, neatness, orderliness, thoroughness, and responsibility
- To give students information about the field of accounting and to acquaint them with the qualifications and additional training necessary for advancement in the occupation
- To develop facility in producing formal statements and supporting schedules
- To contribute to the student's understanding of the buying and selling of merchandise on consignment and installment, and the effect of these types of transactions on the business
- To develop the student's understanding of the importance of departmental records in a business and the procedure of setting up these records
- To acquaint the student with taxation records and the correct preparation of various records and reports required by the state and federal governments

COURSE PREREQUISITES

- Successful completion of Bookkeeping I and the recommendation of the first-year bookkeeping teacher to continue studies in bookkeeping
- Senior class rank

SUGGESTED PROCEDURES

- Make the course plans flexible to meet the needs of the students.
- Keep in mind constantly that a thorough understanding of bookkeeping principles and practices is much more important than the completion of a certain number of pages of the textbook or a certain number of practice sets.
- Explain thoroughly by chalkboard illustrations and class discussions every new principle before exercises of the work are assigned for application of the principle.
- Plan class work so that the specific goals will be reached even though the students are working on different projects.
- Regard exercises, problems, and practice sets as learning activities and not as a testing program.

REVIEW OF BOOKKEEPING PRINCIPLES AND PROCEDURES

Columnar special journals
Controlling accounts
Preventing, finding, and correcting errors
Payroll records and deductions

ADJUSTMENT OF ACCOUNTS

Accruals and deferred items
Depreciation and depletion
Uncollectible accounts and notes

PARTNERSHIPS

Characteristics
Kinds
Advantages and disadvantages
Formation
Distribution of profits and losses
Operating interest for investment of these profits or other assets
Financial statements of a partnership
Use of a partnership practice set with or without papers, preferably covering one fiscal period, is recommended at this point.

CORPORATIONS

Proprietorship in a corporation
- Characteristics and management
- Classes of stock
- Balance sheet
- Comparison of corporations and partnerships
- Advantages and disadvantages
- Corporation recording and reporting

DEPARTMENTAL RECORDS

Expansion of columnar journals and financial statements

C.O.D. SALES AND PURCHASES

INSTALLMENT SALES

Characteristics
Installment contracts
Records and installment sales
Installment sales on financial statements

VOUCHER SYSTEM

Application of a corporation set for one fiscal period with business papers

PAYROLL RECORDS AND AUTOMATION

Individual earnings
Withholding and financial income taxes
Net amount to be paid each employee
Change lists specifying proper change

INTRODUCTION TO JOB ORDER, PROCESS, AND STANDARD COST

THE UNDERSTANDING OF MANUFACTURING COST ACCOUNTING

MANUFACTURING REPORTS

FINANCIAL STATEMENT ANALYSIS

BUDGETING AND INTERNAL REPORTING

SOURCES AND APPLICATION OF FUNDS

SUGGESTED CLASSROOM MANAGEMENT

- Give the classroom an appearance comparable to that of a modern office.
- Utilize business machines in teaching Bookkeeping II.
- Measure frequently students' attainment of skill and understanding in
  - analyzing and recording transactions
  - posting columnar journals
  - blueprinting the net profit
  - preparing financial statements
  - closing the ledger and recording the reversing entries
  - using columnar special journals
  - using controlling accounts
  - preventing, finding, and correcting errors
  - adjusting accounts
  - transacting records for installment selling
  - using departmental recordkeeping
  - using the voucher system and coding
  - preparing payroll records
  - keeping records of business transactions by the use of automative processes

RECORDKEEPING

Recordkeeping is a one- or two-semester course designed for students who want to learn how to keep simple records for personal use or who want to develop recordkeeping know-how for general office jobs upon high school graduation, but do not want to study double entry bookkeeping leading to accounting. It should be open to students at the tenth- or eleventh-grade level.

OBJECTIVES

- To develop an awareness of the importance of personal and business records
- To develop knowledges of and skills in handling accurately business forms used in general office jobs
- To develop a business vocabulary
- To gain insight into why records are kept and what they can do
- To develop further legibility in penmanship
- To develop arithmetical skills
- To emphasize the importance of personality and character traits, orderly work habits, and the completion of assigned work tasks
- To develop an understanding of automation and its impact on recordkeeping procedures.

COURSE PREREQUISITES

- An interest in learning how to keep records for personal use and for general office activities
- Sophomore or junior class rank

SUGGESTED PROCEDURES

- Adapt subject matter studied to student interest and ability.
- Invite business persons to speak to the class on phases of recordkeeping incorporated in their business.
- Preview materials to be covered in coming lessons to enable students to complement the lesson with pertinent personal and recordkeeping experiences.
- Lay a good foundation for a broad area of business activities and use of business forms.
- Vary class procedures to prevent monotony.
- Encourage initiative in organization and methods of procedure where feasible, since types of records will vary.
- Utilize appropriate available materials of private and commercial agencies or firms.
- Use practice sets and simulated materials to motivate the work.

SUGGESTED COURSE CONTENT

IMPORTANCE OF RECORDKEEPING

Recordkeeping for small businesses
- Barber shop
- Beauty shop
- Dairy
- Delivery service

- Dry cleaners
- Garages
- Laundries
- Motels
- Repair shops
- Restaurants
- Service stations
- Used-car lots
- Others

Responsibilities of the recordkeeper

Profit and loss statements
- Receipts and payments for small businesses
- Cash receipts journal
- Cash payments journal
- Checkbook
- Bank reconciliation statements

PAYROLL RECORDS FOR EMPLOYEES

Record of hours worked
- Time cards
- Time clock
- Out and in procedures
- Calculating the hours worked each day

Wage records
- Wage plan
- Wage per hour
- Fixed rate
- Piecework basis

Payroll book

Overtime records

Tax tables and their use
- Social Security deductions
- Withholding tax records

PURCHASING PROCEDURES AND STOCK CONTROL FOR SMALL BUSINESSES

Obtaining and keeping detailed information on
- Supply
- Consumption
- Quality
- Price

Handling records of products purchased and consumed
- Sources
- Specifications (detailed description)
- Quantity consumed
- Quantity purchased in the past
- Time required for delivery
- Satisfaction obtained from previous purchases
- Prices
- Price trends

The why of keeping these records

- Control of merchandise stock
  - Information needed and its importance
  - Best selling items
  - Rate of stock turnover
  - When goods should be reordered
  - What quantities of repeat orders should be placed
- Use of stock record cards
- Placing the order
  - Purchasing procedures
  - Purchasing forms
  - Purchase orders
  - Purchase invoices
  - Purchase register
- Handling incoming goods
  - Receiving shipment at a specific point
  - Examining each shipment
  - Making claims for damages or losts
  - Unpacking and checking
- Record of goods expected
- Price quotation cards
- Purchase returns and allowances
  - Adjustment letters
  - Debit memorandum (charge-back invoice)
  - Credit memorandum
- Marking the price on goods
- Taking an inventory
  - Cost method
  - Retail method
  - Perpetual inventory
- Careers in purchasing

RETAIL SALES RECORDS

- Sales slips
- Tax records
  - Sales
  - Luxury
- Record of charge sales
- Record of cash received
- Sales returns
- Statement of account
- Obtaining and keeping detailed information on
  - Advertising
  - Media
  - Cost
- Flow of sales data in a retail sales office

SALES RECORDS FOR A WHOLESALE BUSINESS

- Sales order
  - Terms of sale
  - Method of shipment
  - Recording description of merchandise
- Sales invoices
- Customer's account record
- Sales return

Credit memorandum
Use of a ledger
Recording sales in a sales register
Posting reference
Posting the amount
Collections from customers
Cash receipt book
Collection letters
Sales register and cash receipts book
Method of posting
Sales returns and allowances
Statement of account

RECORD OF PAYMENTS MADE FROM PETTY CASH FUNDS

Petty cash voucher
Classifying business expenses
Petty cash record
Recording petty cash vouchers in a petty cash book
Balancing the petty cash fund
Replenishing the petty cash fund

CONTROL THROUGH BUDGET RECORDS

Importance of a budget
How a budget should be prepared
Evaluation of the budget and how to make revisions

CASHIER RECORDS

Preparing receipts
Cashier's collections record
Proof of cash
Making money deposits
Deposit slip
Tally sheet

MOTION AND TIME STUDY

Importance of improving business activities through an economy of time and simplification of work procedures
Impact of automation on time and work simplifications
Methods of doing motion and time study, work-flow study

BUSINESS COMMUNICATIONS

Business Communications should be designed to develop the student's ability to speak and write correct and forceful English and to apply this ability to social and business situations. It may be a one- or two-semester course offered at the twelfth-grade level. The emphasis is on correct and effective skills and techniques needed to solve communicative problems.

OBJECTIVES

- To review the fundamentals of grammar, stressing the importance of correct spelling, punctuation, diction, word usage, and sentence structure
- To develop the student's ability to express himself correctly and forcefully in the writing of personal and business correspondence
- To improve the student's oral expression in personal and business situations
- To acquaint the student with the different types and forms of social and business correspondence used by individuals and businesses
- To encourage the student to develop an effective and extensive reading and writing vocabulary

COURSE PREREQUISITES

- An interest in developing knowledges, understandings, appreciations, attitudes, and skills necessary for effective communication
- Typewriting I
- Senior class rank

SUGGESTED PROCEDURES

- Relate business communications to the various activities of the school in order to provide an animated learning situation that is within the student's immediate observation and experience.
- Maintain high standards of neatness, completeness, consideration, clearness, conciseness, concreteness, correctness, and courtesy in all in-class and out-of-class assignments and activities
- Provide for individual abilities and maturity levels through the selection of materials, assignments, grouping techniques, and methodology.
- Plan a time schedule for each unit which will take into consideration the knowledge and the ability of the students.
- Give close individual direction and supervision in the development of the ability to write and speak well.
- Consider stimulating the student's interest and initiative through the writing approach rather than through the grammar approach.
- Stress vocabulary building throughout the course rather than in a concentrated block of work.

SUGGESTED COURSE CONTENT

THE BUSINESS LETTER AND RELATED BUSINESS WRITING

External structure
- Letterhead
- Placement
- Physical appearance
- Seven structural parts

- The message
  - Adapting the message to the situation
  - Developing the "you attitude"
  - Building a logical presentation
    - Determining core thought of letter
    - Determining topic sentence of the paragraph
    - Expanding core thoughts in logical sequence through
      - Proper words
      - Proper punctuation
      - Proper arrangement of words, sentences, and paragraphs
    - Placing special emphasis on the first and last paragraphs of the letter
  - Structure styles of letters
    - Block or full block
    - Modified block
    - Semiblock
    - Indented
    - Inverted paragraph
    - Simplified
    - Official
    - Personal
  - Forms of punctuation in the structural parts
    - Open
    - Mixed
    - Closed
  - The two-page letter
    - "Continuation" letterhead
    - Typing the second page heading
  - Types of letters
    - (As each type of letter is presented, all facts related to that particular type of letter should be taught, and practice should be given in applying this knowledge to the actual writing of such letters.)
    - Simple types of business and social letters
      - Letters of inquiry and reply
      - Announcements, business invitations, orders, remittances, and acknowledgements
      - Asking, granting, or declining favors
      - Appreciation, congratulations, and praise
      - Friendly letter
    - Individual sales letters
    - Form letters and mailing-list accuracy
    - Adjustment letters
    - Credit and collection letters
    - Application letters—applied principles of sales letters
    - Characteristics of good letters
      - Completeness
      - Courtesy
      - Consideration
      - Clearness
      - Conciseness
      - Concreteness
      - Correctness
    - Miscellaneous
      - The envelope

The second sheet
Carbon copies
The postscript
Related business writings
Business reports
Outlines
Minutes
Data sheet
Interoffice correspondence and instructions to employees
Telegrams, cablegrams, and letters of confirmation
Office manuals
Reports of business conferences, conventions, and meetings

REVIEW OF GRAMMAR

Grammar should be reviewed through practice in writing letters throughout the course:
Parts of speech as they relate to business writing
Nouns in business
Common
Trade names
Other proper nouns
Verbs in business and their vital force
The usefulness of pronouns
Adjectives, the picturemakers
Adverbs: when, where, how, why, and to what extent
Prepositions and conjunctions, the business couplers
Effective sentences and punctuation
Selection and placement of words
Unity, coherence, and emphasis
Punctuation marks and their use in developing emphasis and clarity
Business style
Writing of numerals
Writing of proper names and titles
Use and writing of abbreviations
Mechanical means of emphasis
Points of grammar arising in the student's writing of letters and in specimens from actual business correspondence

ORAL EXPRESSION

Improvement in oral expression should be emphasized daily through the student's class participation and his conversation. In addition, emphasis on the following is suggested as means of improvement:
Telephoning
Interviewing
Receiving guests in the office
Introducing speakers
Making announcements to the class
Making motions
Giving and responding to toasts
Making oral evaluations
Presiding in class

VOCABULARY BUILDING

Vocabulary building should be stressed from the first day as an integrated part of letter writing and oral expression.

Students should have direction in the use of the dictionary for word meanings, spelling, hyphenation, and syllabication.

Each student should be required to have and to use a dictionary throughout the course. Special exercises in vocabulary building may be assigned to give consideration to:

- Expressions common to all businesses
- Technical terms applicable to the different phases of business
- Synonyms, antonyms, homonyms
- Reference books
  - Signs and symbols used in each book
  - Simple marks of proofreading

SUGGESTED CLASSROOM MANAGEMENT

- Schedule the business communications class so students can have access to typewriters for the preparation of assignments and for class activities which require immediate composition of letters.
- Collect various styles of letterheads, envelopes, sample business letters in correct form, and a compilation of student-composed correspondence for class analysis and criticism.
- Utilize visual aids.
- Provide dictionaries for each student.
- Make available many types of supplementary student and teacher materials.

OFFICE PRACTICE

Office Practice is a one- or two-semester terminal course designed to provide job-stimulating learning experiences and should be taught by a teacher of the business skills who has had office work experience. Whether the course is designed as a one- or two-semester course will depend upon the needs of the school community and the student population. If it is to be a one-year course, the units outlined should be expanded and more emphasis placed on production typewriting. As a one- or two-semester course, it should seek to

- refine the knowledges and skills acquired in Basic Business-Economics, Typewriting I, Bookkeeping I, and Shorthand I
- attain proficiency in the application of new knowledges, understandings, attitudes, appreciations, and skills to perform various office jobs, and particularly to develop skills in the production of office-style typewriting
- develop ability to coordinate satisfactorily all specialized and basic business-economic education and to apply it successfully in an office situation

It is suggested that Office Practice, for those students pursuing a business program and needing the specialized office practice instruction, be scheduled in the fall semester of the senior year and followed by a business machines course in the spring.

Since the course should meet the needs of all students who expect to work in an office whether as a stenographer, bookkeeper, recordkeeper, or general office worker, all students enrolled may not have had shorthand. If the number of students pursuing the stenographic program is sufficient, a separate class should be organized and designed to fulfill their needs specifically. This course should be called Secretarial Practice. In such case the school could have an Office Practice course to meet general office workers' needs as well as a Secretarial Practice course to meet the needs of stenographers.

OBJECTIVES

- To maintain and improve skills
- To provide learning activities which demand application of the acquired specialized skills and knowledges and which will further develop them
- To instill understandings of business, office practice procedures, policies, and systems
- To develop a responsible attitude for assuming tasks and carrying them to completion without close supervision
- To develop know-how for office work simplification
- To instill an understanding of office standards of performance and production
- To make the working adjustment easier while increasing job proficiency
- To develop ability to judge completed work and to make necessary corrections and adjustments if necessary to make the work usable
- To develop ability to make intelligent use of reference materials
- To develop further a business vocabulary

- To develop further an understanding of and appreciation for our economic system
- To develop further an understanding of and appreciation for automation impact on handling office activities
- To instill a right concept toward work and what the employer expects for a fair return on his investment in his worker
- To inculcate standards of office dress and personal hygiene
- To develop acceptable office manners, desirable personality traits, and a desirable code of ethics
- To develop the ability to think constructively, to question and analyze practices, and to give appropriate and timely suggestions for improvements
- To develop an attitude of cooperation and fairness toward co-workers and a realization of how a job fits into the total office and business situation

COURSE PREREQUISITES

- An interest in office employment after high school graduation
- Typewriting I
- Shorthand I and enrolled in Shorthand II
- Bookkeeping I
- Senior class rank

These courses are highly recommended as prerequisites; but if a student has not had Shorthand I and is not enrolled in Shorthand II, it should not preclude his taking Office Practice. The class is designed to meet the needs of all students who expect to work in an office.

SUGGESTED PROCEDURES

- Seek to determine what the demands of the school's community employment market are before purchasing expensive equipment. A community survey might be used to get this information.
- Study all possible organizational plans which may be best for the office practice course; for example, the rotary plan, battery plan, integrated office plan, the cooperative plan, or some combination of these plans.
- Choose the organizational plan which most nearly fulfills your school population and community needs.
- Equip and arrange the classroom as nearly like an office as possible. The classwork should be done in an atmosphere and in a manner that stimulates actual office conditions.
- Label properly particular tables, shelves, and other suitable receptacles for the receipt of specified types of completed work and let the students be responsible for placing usable work in these places.
- Stress the care and economy of supplies and equipment.
- Require all work submitted to conform to usable standards and to be completed on a production schedule that requires definite accomplishments within a given time period.
- Organize the course so there will be ample opportunity for establishing supervisory and leadership learning situations.
- Exemplify desirable personality traits by example; that is, your attitude toward work and your techniques of dealing with people and directing student activities.

- Encourage students to assume, whenever such opportunity presents itself, tasks not specifically assigned to them but which they are aware must be performed.
- Take advantage of every opportunity to give guidance, since this type of course lends itself to a close student-teacher relationship and to an opportunity to recognize individual abilities and personality traits.
- Make assignments so the student can carry a task through to its completion rather than merely performing one step of the task. Provisions should be made for the student to do the task without close supervision.
- Allow time for make-up work in scheduling the class work. It is advisable to set aside specific class time within each grading period for this purpose.
- Preplanning learning activities is very important to the success of this class, although the majority of the time is devoted to individual and group laboratory work. It is necessary to have daily home assignments and class discussions. The assignment work and the discussions should be closely related to students' laboratory work.
- Supply related supplementary materials, practices, and procedures through individual assignments, discussions, field trips, and talks or demonstrations by businessmen.
- Keep well informed about local office practices, procedures, standards, and employment opportunities.
- Avoid letting the class become a workshop for the school. If the organization and schedule for the class is such that outside work can be accepted, it should be done only to the extent that it is a learning process and at a time when it will not disrupt the class organization.
- Demand, through appropriate projects, use of previously acquired knowledge. It will be necessary in covering certain units to prepare original projects.
- Coordinate the activities with the typewriting teacher, so that assignments of letters and other business papers can be done in duplicate with one copy for the typewriting teacher and one for the office practice teacher. Such papers can be used in office practice class for:
  - Indexing, coding, and filing projects
  - Proofreading drills
  - Practice in verifying facts and figures
  - Basis of original composition; for example, letters calling for replies may be used in typewriting projects, drills in folding and inserting letters and enclosures properly
- Work should be done in duplicate whenever practicable. Let the students retain one copy and hand in the other copy for recording purposes. Require students to keep a systematic record of work completed; the copies kept in their possession should be arranged in some orderly manner for practice and further reference.
- Initial instruction and supervision should be given for those projects done on the rotary or battery plan. However, succeeding groups should be instructed and supervised by capable students who have completed that particular job. This method is excellent for teaching leadership as well as that of following instructions.
- Organize and prepare systematic and appropriate sheets for recording students' work in order to save time.

- Give a variety of learning experiences which will perfect certain office techniques and develop an understanding of a wide range of other activities.
- Require, if possible, that each student complete a minimum of ten hours and preferably more of actual office work experience. Where feasible, work experience should be done in the community's business offices. If local conditions make this impossible, considerable benefits can be gained through work in various school offices. The office should be approved by the teacher. The students should be observed on the job and their ability evaluated by both the teacher and the employer.
- Plan the office practice class so that it is flexible and meets sudden changes without affecting the efficiency of the learning activities.

SUGGESTED COURSE CONTENT

For the purpose of emphasis and classification, the course content is divided into units; it is not necessary, however, to take up the units as they appear. The sequence of units should take into consideration the particular class, the school schedule, and the available facilities. Several of the units, such as dictation and transcription, should be taught at regularly scheduled times throughout the course, but the knowledges acquired in other units, such as reference books, should be applied in related projects throughout the course. Standardized or original projects should be employed to give students opportunity to apply the skills or knowledges in every unit. In some instances, the units follow the textbook material; but in other cases, original and supplementary materials will have to be supplied in order to cover the unit satisfactorily. Those skills which are developed to a marketable point should be determined by the needs of the students, the community, the facilities of the school, and the teaching staff.

ORIENTATION

Purpose—The purpose of this orientation is to introduce the classroom management, organization, equipment, supplies, machines, and in general the routine to be followed throughout the course. It is not actually a teaching unit but rather an information unit designed to give an overview of the entire course.

Time—The time spent on this unit will depend upon the amount and quality of preplanning by the teacher. The unit should be presented during the first two or three class periods.

Procedure—The teacher, assuming the role of an office manager, may present this unit in a manner comparable to that of inducting employees into an office. The unit should be presented through lecture, demonstration, and discussion. The success of the course will depend, to a large extent, on the students' understanding and appreciation of the material in the unit. Distribute, at this time, if used, supplementary materials.

Content—

- Class organization
  - Home assignments consisting of both study and application should be given daily from the textbook or supplementary materials.
  - Class discussions should be held on home assignment work.
  - Class demonstration and lecture should be employed whenever needed to assist the students.
  - Laboratory periods should be regularly scheduled for student application of skills and knowledges.
    - Laboratory work should include (1) projects undertaken by the entire class, (2) projects undertaken by assigned groups, and (3) projects undertaken by individual students.
  - Guests who can contribute interesting and worthwhile materials should be invited to participate occasionally.
  - Field trips, planned and supervised, should be fitted into the course when feasible.
- Class management
  - Students should be given an understanding of their responsibilities and the function of the teacher as follows:
    - When working on a class unit
      - Cooperation
      - Alertness
      - Initiative
      - Respect for opinions of others
    - When working in assigned groups
      - Cooperation
      - Assuming individual responsibility
      - Leadership development
      - Ability to follow instructions
      - Promptness
      - Accuracy
      - Initiative
      - Working without close supervision
      - Consideration for others in the group
    - When working individually
      - Receptive attitude
      - Initiative
      - Fairness
      - Promptness
- Equipment
  - Explanation of tables, storage cabinets, and respositories for completed work.
  - A tour of the office laboratory should be made to point out machines, trade names, and to explain their purpose.
    - Care of equipment should be emphasized.
    - Assignment of sitting space and storage space should be made.
- Supplies
  - Furnished by school
    - Quality and quantity of supplies will depend on individual school.
    - Care and economy should be stressed.
    - Allocations of supplies to individuals should be made.

Furnished by student

Quality and quantity of supplies will depend on particular situation.

If possible, all supplies needed for the course should be itemized by the teacher and the students given a specific time in which to secure them.

A list of the required supplies should be duplicated and given to each student. This list can be used as a running inventory record throughout the semester.

Each student is responsible for furnishing his own supplies.

REQUIREMENTS OF THE OFFICE WORKER

Purpose—The purpose of this unit is to present the numerous and varied duties and traits required in office work and to arouse a desire to acquire the necessary skill and information to become a successful office worker.

Time—This unit should follow immediately after Unit I and should be covered in one or two class periods, depending on the amount of detail considered necessary.

Procedure—Inform the students of the duties and traits required in the various office tasks.

Content—

- The office worker's role in the office
  - Handling office information
    - Incoming mail
    - Outgoing mail
    - Taking dictation
    - Transcription
    - Typewriting
    - Composing letters
    - Filing
    - Telephoning
    - Sending telegrams
    - Proofreading and revising
  - Finances and bookkeeping
  - Clerical duties
  - Services for employer
  - Care of the office
  - Using reference materials
  - Using business machines
- Meeting and dealing with office clientele
  - Personal qualities
  - Interest in work
  - Accuracy
  - Dependability
  - Intelligence
  - Responsibleness
  - Courtesy
  - Initiative
  - Judgment
  - Tact
  - Personal pleasantness
  - Personal appearance
  - Efficiency
  - Reticence
  - Adaptability
  - Neatness
  - Memory

Conduct toward
- Company
- Superior officers
- Co-workers
- Subordinates
- Clientele
- Public

TYPEWRITING

Purpose—The purpose of this unit is to improve the students' techniques in the performance of office typewriting tasks. The learning activities should be different from and go beyond those in Typewriting I. Emphasis should be on production typewriting, using numbers, and increasing accuracy in all types of typewritten work.

Time—Time spent on this unit should be determined by the needs of the students and their typewriting abilities. Since Typewriting II is being integrated into Office Practice, sufficient time should be allowed in this unit to develop the skills of production typewriting. After introducing thi unit early in the course, plan whenever feasible typewriting activitie throughout the course.

Procedure—Sufficient typewriters should be available, preferably all oı at least 25 per cent of them should be electric. All-class typewriting projects should be given occasionally; however, the major part of the typewriting work should be completed through assigned groups.

Content—

- Typewriting techniques should be reviewed and improved through continuous application.
- Production typewriting techniques should be developed.
- Typewriting projects should include quality production of
  - Cards
  - Various letter styles
  - Envelopes
  - Multiple copies
  - Tabulated material
  - Outlines
  - Manuscripts, footnotes, bibliographies
  - Rough drafts
  - Bills, statements, other types of office forms
  - Business reports
  - Fill-in letters, paragraphs
  - Statistical and graphic material
  - Composition at the typewriter
  - Legal papers

USE OF REFERENCE BOOKS

Purpose—The purpose of this unit is to acquaint students with various types of resource materials, enable them to find information efficiently, and instill an appreciation of research tools.

Time—The earlier this unit is presented the more opportunity there will be to get practice in using resource materials.

Procedures—Assignments and projects should include suitable materials. Direct students to reference books in the school library. Some study should be given each reference. Concomitant learnings should be incorporated.

Content—

- Reference books on English
  - Dictionary—special dictionaries
  - Style books and secretarial handbooks
  - English grammar
  - Synonyms and antonyms
  - Books on quotations
  - Roget's Thesarus
- Reference books on business firms and people
  - Trade and business directories
  - Professional directories
  - City, state, and Congressional directories
  - Lists of prominent persons
  - Credit information
- Books of facts
  - World Almanac
  - Information Please Almanac
  - Atlas and Gazetteer
  - Book of Knowledge
  - Encyclopedias
  - Catalogues
- Guides
  - Postal
  - Travel
  - Hotel—motel
- Etiquette and ethics
  - Business
  - General
- Public library rererences
  - Government publications
  - News items
  - Catalogues
  - Guides to periodical literature
  - Indexes

MAIL

Purpose—The purpose of this unit is to acquaint students with the techniques involved in handling incoming and outgoing mail and to give them practice in performing as many routine mailing tasks as possible.

Time—This unit could fit into the schedule at almost any time. It should be closely correlated with typewriting work, since letters and other business papers produced in the typewriting unit can be used for projects in this unit.

Procedures—Textbooks and supplementary assignments should be made on related information. The projects should consist of mailing routines. Local post office employees might contribute worthwhile information.

Content—

- Incoming mail
  - Opening and sorting

- Dating and timing
- Routing
- Special memos
- Disposal of letters

Outgoing mail
- Signing
- Checking enclosures
- Folding and inserting
  - Small envelopes
  - Large envelopes
  - Window envelopes
- Sealing
- Affixing stamps
- Disposal of carbon copies
- Mail classifications
- Mailing rates
- Mail weights
- Zone codes

Additional postal services
- Special handling
- Special delivery
- Registered mail
- Insured mail
- Parcel post
- C.O.D. service
- Mail orders
- Tracing mail
- Airmail
- Foreign mail
- Mailing lists
- Addressing machines
- Addressing services
- Messenger service

TELEGRAMS, CABLEGRAMS, AND RADIOGRAMS

Purpose—The purpose of this unit is to give the student information regarding the use of telegrams, cablegrams, and radiograms in business and to acquaint him with terms and forms used.

Time—This unit can be given at any time.

Procedure—Home assignments and class discussions of textbook and supplementary information should be timely. Sample forms should be secured and displayed as bulletin board material; and, if available in sufficient quantity, used by the students for their projects.

Content—

Classification of messages, rates applicable, basic number of words, special uses
- Straight telegram
- Day letter
- Night letter
- Greetings
- Code
- Cablegram
- Radiogram

Special telegraph services for business, relative costs, and how obtained
- Serial messages
- Automatic telegraph-transmitter recorder
- Time wire service
- Teleprinter
- Telautograph

Miscellaneous services, costs, and how obtained
- Transmitting money
- Messenger and errand service
- Clock services
- Telephone answering
- Delivery report
- Repeat back service
- Report delivery
- Cash, charge, collect service

Terminology
- Filing telegrams
- Transmitting telegrams
- Code
- Cipher
- Reversed cable code
- Verifying
- Time zones

How to construct a telegram
Carbons and confirmations
Word count
Methods of placing a telegram, cablegram, or radiogram
Code messages
Cable code addresses

MARKETING

Purpose—The purpose of this unit is to give information about different methods of handling routine marketing and to develop ability to apply knowledges and skills in making decisions relating to marketing problems.

Time—This unit could fit into the course at practically any point. Amount of time spent on this unit will depend upon the needs of the students and to some extent upon local conditions.

Procedure—Projects should be used extensively and should be a combination of home assignment work and class laboratory work.

Content—

Buying procedures
- Business forms used
- Impact of automation

Sales of goods
- Methods of selling goods
- Business forms used
- Impact of automation
- Sales letters
- Shipping terms
- Shipping forms
- Pricing goods

Transportation of goods
- Methods
- Business forms used in each method
- Restrictions as to size, weight, distance, time, and other factors under each method
- Rates and services of the various methods
- Preparation of goods for different methods
- Terminology peculiar to each

Storing
- Business forms used
- Impact of automation

Financing
- Business forms used
- Impact of automation

Recordkeeping
- Business forms used
- Impact of automation

Risk management
- Business forms used
- Impact of automation

TELEPHONE

Purpose—The purpose of this unit is to acquaint students with telephone services and good telephone procedures.

Time—This unit can be scheduled at any time.

Procedure—Home assignments and class discussion should consist of related material from the textbook, telephone directories, and available pamphlets distributed by the telephone companies.
Specimens of telephone instruments should be obtained from the local telephone office for use in teaching this unit. Telephone desk aids, such as telephone memo forms, indexes of frequently called numbers, long-distance timers, and other simple devices might be brought to the class by students. Telephone representatives may add significantly at appropriate times.

Content—
- Types of telephones
- Types of calls and relative costs and services
- Telephone techniques and manners
  - Voice
  - Enunciation
  - Courtesy
  - Conciseness
- Uses of the phone
- Incoming calls
- Outgoing calls
- Other services

MEETING CALLERS

Purpose—The purpose of this unit is to give students information that will enable them to meet and deal with office callers.

Time—This unit should come near the end of the series.

Procedure—Home assignments and class discussions on textbook and supplementary material should be pertinent to the situations.

Content—

- Classes of callers
- Recognizing and directing callers
- Building company good will through every contact

JOB GETTING

Purpose—The purpose of this unit is to give students information and to develop techniques that will enable them to locate prospective jobs, to construct letters of application, and to have effective personal interviews.

Time—This unit should be last in the series.

Procedure—Make home assignments and discussions of textbook and supplementary material correspond to the study.

Students should rate themselves by means of personality rating charts. Personnel officers of local business concerns might be invited to talk to the class and conduct a typical interview. Projects should consist of preparation of application letters and data sheets. Criticisms and suggestions for improvement should be given to each student.

Content—

- Inventory of qualifications
  - Abilities
  - Traits
  - Work experience
  - Specialized training
- Sources of information regarding jobs
  - School placement service
  - Friends
  - Employment agencies
  - Business personnel officers
  - State and federal employment services
  - Classified advertisements
  - Others
- Letters of application and data sheets
  - Preliminary considerations
    - Specific job desired
    - Probable job requirements
    - Requirements of the job as compared with qualifications of the applicant
- Securing permission from references to use their names
- Planning the letter
  - Introduction
  - Sequence of points
  - References
  - Requests for interview
  - Closing
- Typewriting the letter
  - Kind of stationary
  - Condition of type and ribbon
  - Mechanical form
  - Neatness
  - Proofreading

- Preparation of data sheet
  - Personal information
    - Name
    - Address
    - Telephone number
    - Age
    - Nationality
    - Schooling
    - Experience
    - Special qualifications
    - References
- Follow-up
  - Second letter
  - Telephone
  - Personal call under certain conditions
  - Recommendations from additional references
- Interview
  - Mental plan
    - Review requirements of job
    - Review qualifications
    - Determine selling points
- Mental rehearsing of planned interview
  - Appearance
  - Locating the employing office
  - Waiting in the outer offices
  - Entrance into the conference room
  - Introductory remarks
  - Presentation of qualifications
  - Asking clarifying questions
  - Omitting or postponing mention of salary
  - Request for future contact
  - Closing the conference
  - Exit
- Follow-up thank-you contacts
  - To interviewing officers
  - To references
  - To sources of notification about the position

ERIC

BUSINESS MACHINES

Business Machines is designed to prepare students "to operate those types of business machines which they will most often be required to use on the job. The common business machines used by clerical workers in a variety of different job titles have been identified in many studies throughout the country to include the following major categories: (1) adding and calculating machines, (2) duplicating machines, (3) filing and mailing devices, (4) transcribing machines.

". . . To warrant expenditure of public funds for such machines and equipment, and to merit the inclusion of such training in the program, certain criteria must be met. Different school systems use different criteria, but among the most common ones are the following:

1. The equipment must exist in fairly large numbers in business offices of the community or be used by relatively large numbers of workers.
2. The equipment should require skill in its operation.
3. The time required to attain a marketable skill must not be excessive.
4. The equipment must be reasonable in cost of purchase or rental.

"The justification for teaching one or more of the machines in the categories cited, or other specialized business machines, to a high degree of vocational competency will depend upon a survey of job opportunities in a given community and the application of the criteria listed above." [11]

[11] Doris H. Crank and Floyd L. Crank (Editors), NEW PERSPECTIVES IN EDUCATION FOR BUSINESS: NATIONAL BUSINESS EDUCATION YEARBOOK (Washington, D. C.: National Business Education Association, A Department of The National Education Association, 1963), p. 62-63.

OBJECTIVES

- To develop know-how in operating business machines most often used on the job
- To develop an understanding of the function of business machines and how they simplify office work
- To develop an appreciation for accuracy of machine work
- To build a business machines vocabulary

COURSE PREREQUISITES

- An interest in learning to operate business machines in order to apply the skill to an office job and/or to pursue further studies in a post-high school, college, or university
- Senior class rank

SUGGESTED PROCEDURES

- Schedule Business Machines for the spring semester.
- Additional procedures include those listed under Office Practice, pages 108-109.

ORIENTATION

Purpose—The purpose of this course is to introduce students to the classroom management, organization, equipment, supplies, business machines, and in general the routine to be followed. This is an informative unit designed to give an overview of the entire semester's work.

Time—Time spent on this unit will depend upon the amount and quality of preplanning of the course organization.

Procedure—Present the course overview through lecture, demonstration, and discussion. Distribute instructional sheets, job sheets, and essential supplementary materials the students will need.

Content—

- Class organization
  - Class demonstrations and lectures will be employed whenever feasible.
  - Machine projects will be well planned and scheduled for each student's maturity and ability level.
- Class management
  - Give each student an understanding of his responsibilities when working on a machine project.
    - Cooperation
    - Alertness
    - Initiative
    - Respect for opinions of others
    - Ability to follow instructions
    - Promptness
    - Accuracy
    - Working without close supervision
- Equipment
  - Place on the work station, a step-by-step procedure for operating the machine.
  - Emphasize the care of the machine.
- Supplies
  - Establish a procedure for distributing and returning supplies to their storage place.

ADDING AND CALCULATING MACHINES

Purpose—The purpose of this unit is to acquaint the student with computing machines which are used most in business offices and to develop a degree of proficiency in their operation through basic skill practice.

Time—Time spent on the adding and calculating machines will depend upon the degree of proficiency that is considered desirable and the aptitude of the student to progress in developing skills in operating these machines.

Procedures—

- Consider using block assignment work.
- Demonstrate through a problem approach and a preview of business papers and procedures the machine operations.
- Have carefully selected problems for each new machine technique assignment.
- Provide an opportunity for the student to test his knowledge and understanding of each technique.

Provide learning opportunities for the student to improve his skill through a variety of problems involving the use of repetitive drills for mastery of techniques.

Provide opportunities for the student to apply the learned technique to typical business situations.

Provide for individual differences by assigning supplementary problem work which is approximate for the student's maturity and ability level.

Content—

- Adding machines
  - Mechanism
  - Care
  - Use
  - Types—listing, non-listing, ten-key, full-key, electric, hand-driven
  - Activities
    - Subtraction
    - Multiplication short cuts
    - Addition of decimals and fractions
    - Calculating discounts
    - Completing business forms
    - Solving business problems
    - Handling business papers
- Calculating machines
  - Mechanism
  - Care
  - Use
  - Types—Rotary (hand-operated, semi-automatic, fully automatic)
    - Key-driven (hand-operated, electrically operated)
  - Activities
    - Adding of whole numbers
    - Multiplication of whole numbers
    - Subtraction of whole numbers
    - Division of whole numbers
    - Addition and multiplication of decimals
    - Subtraction and division of decimals
    - Percentage
    - Cash discount
    - Trade discounts in series
    - Constants in addition and subtraction
    - Constants in multiplication: double and accumulative in multiplication
    - Constants in division—use of reciprocals
    - Compared addition—use of complements
    - Special short-cut techniques
    - Auditing invoices
    - Interest
    - Credit balances
- Duplicating Machines
  - Mimeograph (stencil duplicator)
    - General information
    - Equipment needed
    - Number of copies that can be produced
    - Type paper
      - Full-size

- Irregular-size
- Weights
- Stencils
  - Grades
  - Sizes
  - How to type a stencil
  - How to correct errors
  - How to proofread the stencil
- Mimeoscope
  - Tools needed
  - Tracing
  - Drawing
  - Handwriting
  - Proofreading
  - Lettering
- Running the job on the mimeograph
  - Inking the machine
  - Attaching stencil to the drum
  - Operating and counting device
  - Operating the hand-feeding device
  - Adjusting the placement
  - Blocking out undersirable material on the stencil
  - Operating the slip sheet device
  - Removing the stencil
- Miscellaneous points
  - Changing the stencil
  - Filing the stencil
- Duplicator (fluid duplicator)
  - Preparing the master copy
  - Supplies used
  - Making corrections
  - How to copy
  - Fastening master copy to the machine
  - Feeding the machine

Other duplicating machines

Other duplicating machines, if they are available for student use, are to be studied in the same manner as the stencil and fluid duplicating machines; if not available, such machines are to be studied through reading current literature and taking field trips to business offices.

FILING DEVICES

Purpose—The purpose of this unit is to develop knowledge and skills in filing business papers rapidly and accurately according to a standard system and to find such papers quickly.

Time—Time spent on this unit will depend upon whether or not a practice set is used and whether or not it is advisable to give projects in all the systems or the most frequently used systems.

Procedure—Use a filing practice set for this unit if possible. When the rotary plan is used, only a minimum number of filing boxes need be purchased, but a complete set of papers must be available for every student in the class. It is suggested that class enrollment be limited to 24 students.

Content—

- Methods of filing
  - Alphabetic
  - Geographic
  - Subject
  - Numerical
- Complete filing equipment needed for each method
  - Inspecting
  - Reading correspondence
  - Coding
  - Cross reference
  - Preparing follow-ups
  - Indexing and sorting
  - Indexing and filing

MAILING DEVICES

Purpose—The purpose of this unit is to acquaint the students with the techniques involved in handling incoming and outgoing mail and to gain a degree of proficiency in performing as many routine mailing tasks as possible.

Time—Time spent on this unit will depend on the course organizational plan and whether this unit is to be correlated with the unit on transcribing machines.

Procedure—Opportunities for the student to perform many mailing activities should be provided.

Content—

- Incoming mail
  - Opening and sorting
  - Dating and timing
  - Routing
  - Special memos
  - Disposal of the letter
- Outgoing mail
  - Signing
  - Checking enclosures
  - Folding and inserting
    - Small envelopes
    - Large envelopes
    - Window envelopes
  - Sealing
  - Affixing stamps
  - Disposal of carbon copies
- Classification of mail
  - Rates
  - Weight
- Additional postal services
  - Special handling
  - Special delivery
  - Registered mail
  - Insured mail
  - Parcel post
  - C.O.D.

Mail orders
Tracing mail
Airmail
Foreign mail

TRANSCRIBING MACHINES

Purpose—The purpose of this unit is to develop ability to meet business standards of quality and quantity of production of transcription work on transcribing machines.

Time—Time spent on this unit perhaps should be longer than some of the others, since transcribing is one of the major duties in an office.

Procedure—Procedure should include a discussion and directed practice in the use of the various reference books helpful with transcription work.

Content—

- Transcribing Machines
  - Mechanism
  - Care
  - Use
  - Correct techniques in operating
  - Letters
    - Various lengths
    - Various degrees of difficulty
    - Covering a wide sampling of businesses
    - Inserts and vertification of certain facts and figures
    - Proofreading
    - Corrections
    - Enclosures
    - Disposing of original and carbon copies
  - Other business writings
    - Office and interoffice memorandums
    - Instructions and announcements to employees
    - Minutes of meetings
    - Conference reports
    - Fill-ins for letters
    - Filling in forms
    - Material to be tabulated
    - News media

OTHER MACHINES

Purpose—The purpose of this unit is to gain an acquaintance with and a degree of proficiency in manipulating any of the following machines that are in the business laboratory:

- Electric typewriter
- Vari-typewriter
- Bookkeeping machine

Time—Time spent on this unit will depend upon how many and what kind of machines are available.

Procedure—Procedure should include discussion of trade names, care of the machine, and demonstration of their use.

COOPERATIVE OFFICE OCCUPATIONS I AND II

Cooperative Office Occupations I and II are organized around the needs of the students, events taking place in the local business establishments, and office trends. The vocational interests of the students and the variety of working agreements with business establishments will determine subject-matter emphasis.

In a cooperative program covering two school years, one regular class period a day (carrying one credit) should be devoted to vocational instruction. The minimum three hours daily of supervised work experience carries one unit credit. In a cooperative program covering one school year, two regular class periods are devoted to vocational and/or related instruction and two units of credit are given. The minimum three hours daily of supervised work experience carries one unit credit.

OBJECTIVES

- To develop knowledges and skills essential for business employment and advancement
- To develop understandings of techniques as well as their applications for improving job performance
- To instill a willingness to accept responsibility for self-improvement
- To develop good habits of observation and good judgment skills
- To stimulate critical analysis of current jobs and career possibilities
- To stimulate creative thinking
- To develop a deeper understanding of human beings and their interrelationships

COURSE PREREQUISITES

- Stenographic, Manager-Owner, Marketing, or General Office Program background
- Junior class rank for Cooperative Office Occupations I
- Senior class rank for Cooperative Office Occupations II
- Senior class rank if only Cooperative Office Occupations I is to be taken

SUGGESTED PROCEDURES

- Utilize advisory committees.
- Plan extraclass activities which will supplement and complement the in-class and on-the-job learning experiences.
- Be cognizant of co-workers' impact on the learner's behavior.
- Integrate classroom activities and on-the-job experiences to build theory to occupational experiences.
- Keep the school's guidance services office personnel informed on the cooperative office occupations objectives and standards of employment on the part of the student, the school, and the business firm employing the trainee.
- Plan a logical sequence of good learning experiences jointly with the trainee's sponsor and the student.
- Place emphasis upon career development.
- Establish good rapport with the student.
- Help make the student more responsible for decision making.

- Seek to recognize individual differences and welcome personal conferences.
- Keep in mind at all times that individual instruction is one of the most important parts of the program.
- Stress the vital role of the training sponsor in the development of the trainee.
- Hold group meetings with the training sponsors to help them better understand what and how to teach the trainee.
- Utilize talents and experiences of teaching colleagues to vitalize the subject matter units.
- Use discussion, buzz session, and problem-solving techniques.
- Provide opportunities for the students to learn from each others' experiences.
- Keep the occupational performance and learning goals in balance.
- Keep up-to-date, accurate records on the trainee's program.

How units are developed will depend upon the achievement levels and experiences of the students. The subject matter should be made meaningful for each student.

ORIENTATION

Class organization
Class management
Training plan

BUSINESS MANAGEMENT AND PERSONNEL PROBLEMS

Selecting. training, promoting employees
Compensation and benefits
Workmen's protection
Employer and employee relationships
Psychology of human relationships

ECONOMIC FACTORS AFFECTING OFFICE OCCUPATIONS

Local
State
National

GOVERNMENT AND BUSINESS

Government regulations
Effects of government regulations

BUSINESS MANAGEMENT AND EMPLOYEE MOTIVATION

Creative thinking
Management and employee rapport

BUSINESS MANAGEMENT AND AUTOMATION

Automotive trends
Impact of automation
Management's responsibility

SUCCESS FACTORS IN BUSINESS

Recognizing change
Methods of meeting change

SUCCESS FACTORS FOR BUSINESS EMPLOYEES

Personal traits
Competencies

CAREERS IN BUSINESS

Opportunities
Advantages and disadvantages
Selling yourself

ADVERTISING

ADVERTISING is a one-semester elective course designed to instill knowledge of advertising as a medium for influencing the sale of goods and services. It seeks to develop an understanding of its prominent role in daily activities.

OBJECTIVES

- To gain an understanding of the role of advertising in our economy
- To develop an understanding of the basic principles, methods, and practices of advertising
- To develop understanding of the basis for the selection of advertising media
- To develop insight into the importance of testing advertising effectiveness
- To develop an advertising vocabulary

COURSE PREREQUISITES

- An interest in advertising media and techniques and in further study in the field of marketing
- Junior or senior class rank

SUGGESTED COURSE CONTENT

PREREQUISITES IN ADVERTISING

- Importance of advertising as a business activity
  - Types of advertising
    - Institutional and merchandise
    - Manufacturers, wholesalers, retailers, and cooperative
    - Consumer, trade, professional, and industrial
- Economic and social aspects of advertising
  - Contributions and services
    - Cause and effect of large-scale production
    - Effect on the standard of living
    - Encourage innovations
    - Educational effect, direct and indirect
    - Lessens to a greater degree the necessity for buying ability
  - Criticism of advertising
    - Costly
    - Emphasis on minor differences
    - Purely competitive
    - Misleading and false
    - Inefficiency
  - Control of advertising
    - Federal Trade Commission
    - Other federal agencies
    - Control by business community
      - Advantages
      - Disadvantages
  - Basic advertising principles and practices
    - Market research, forecast
    - Identify potential buyer
      - Types
      - Location
      - Number

Decision making
- Selection of media
- Flexibility in use
- Opportunity to cooperate with dealer
- Extent and duration of use
- Mechanical and quality characteristics
- Prestige afforded by use

Testing advertising effectiveness
- Consumer opinion test
- Recognition or readership test
- Identification test
- Inquiry test
- Sales test

JOB OPPORTUNITIES IN ADVERTISING

Types
Competencies needed
Sources of job information
Advantages, disadvantages, limitations

SUGGESTED PROCEDURES

- Utilize community resources, current advertisements, and advertising publications.
- Plan panel discussions and buzz sessions for identifying advertising problems and making decisions concerning their solution.
- Use audiovisual materials to enrich the learning activities.
- Analyze the local community's advertising media and their cost.
- Encourage students to analyze and critically judge advertisements.

NOTEHAND

Notehand is a one-semester twelfth-grade course designed to help students learn how to make selective and well-organized notes. This course is recommended for students who[12]

- plan to pursue further study in post-high schools, colleges, or universities
- are noncollege bound and who will have frequent opportunities to make notes from reading and listening and to prepare reports, speeches, articles, and research papers

OBJECTIVES

- To develop ability to make useful notes quickly
- To develop an understanding of practical notemaking techniques and an ability to apply these techniques
- To develop a broad vocabulary
- To develop better reading habits and to stimulate an appreciation for good literature.

COURSE PREREQUISITES

- An interest in learning techniques of notemaking—what to put down and how to put it down
  (This course is not designed for developing specialized skills necessary for stenographic and secretarial work.)
- Senior class rank

SUGGESTED PROCEDURES

- Give well-planned lectures and discussions on timely, interesting topics so that the students may have an opportunity to apply the notemaking principles.
- Utilize tape recorder, opaque projectors, notemaking materials of various types and levels of difficulty, motion pictures, and filmstrips.
- Utilize lecture materials from the following areas: history, biology, geography, government, economics, basic business-economic information, psychology, sociology, professional magazines, booklets, and pamphlets.
- Provide necessary reference books, such as a dictionary and an English grammar handbook.
- Apply the reading approach.

SUGGESTED COURSE CONTENT

FUNDAMENTALS OF NOTEMAKING

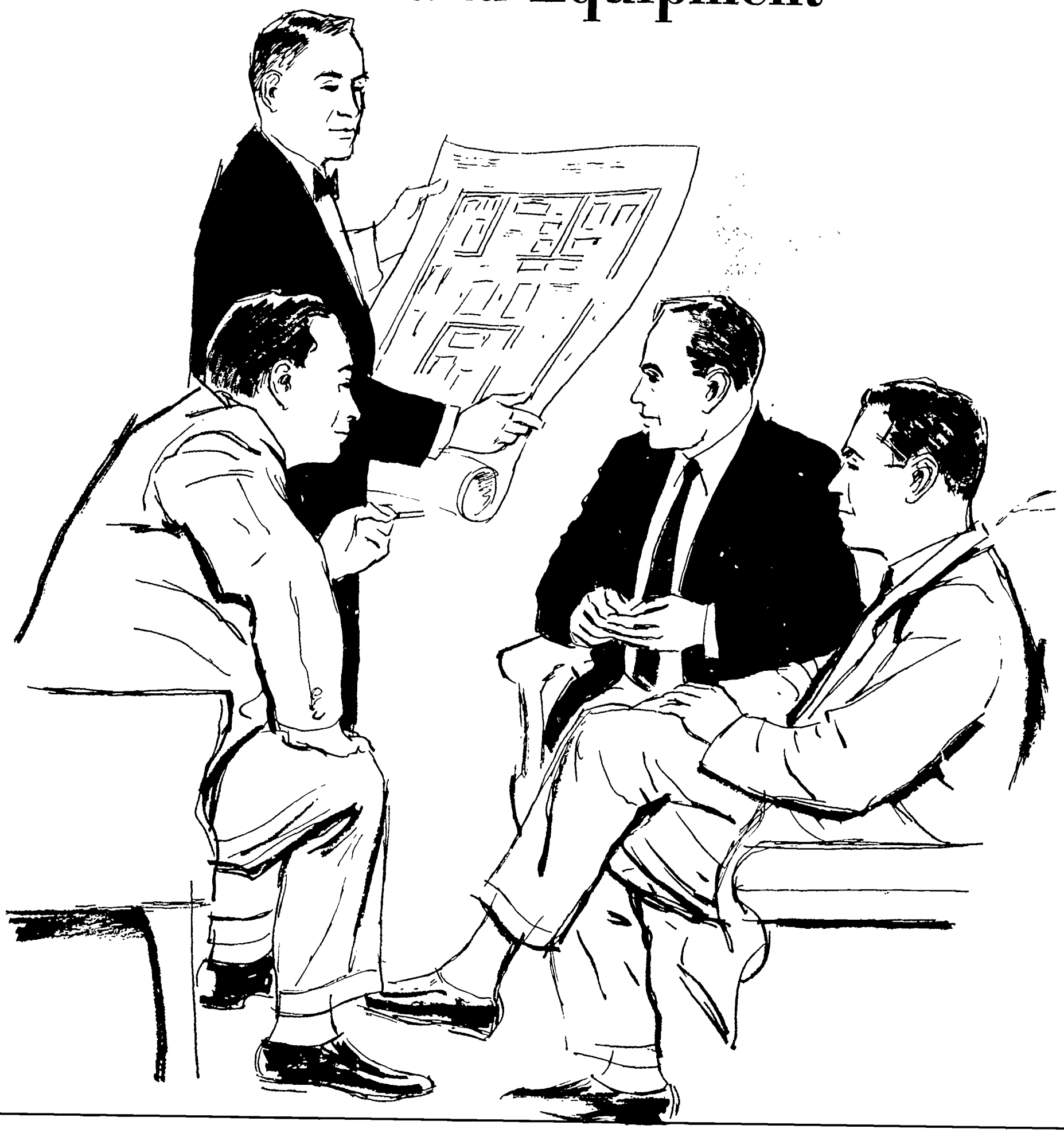
Notehand principles
Application of principles
Development of notemaking skill
- Listening
- Reading
- Finding central ideas
- Summarizing
- Outlining

EXTENDED APPLICATION OF NOTEMAKING

In original writing
For research papers
For examinations
At discussions, meetings, and conferences

[12] Louis A. Leslie, Charles E. Zoubeck, and James Deese, *Teacher's Guide for Gregg Notehand* (New York: Gregg Publishing Company, McGraw-Hill Book Company, 1960), p. 1.

Yardstick For Planning Facilities and Equipment



GENERAL RECOMMENDATIONS

There are some general recommendations regarding environment which apply to all education-for-business rooms.

ENVIRONMENTAL FACTORS

- Heating and ventilating
  Well heated, properly ventilated, cooled, if necessary; especially if used for summer work
- Acoustics
  Acoustical treatment and other special provisions for sound control in rooms because of noise produced by equipment and machines
  Furniture and equipment furnished with resilient footing for desk legs and with pads under each business machine
- Illumination
  High quality illumination, well balanced, with minimum glare and with limited shadows
  Quality of lighting to exceed normal requirements because of special visual needs such as rapid reading, close attention to detail, and the use of the rooms for evening classes
  Provision for control of artificial and natural illumination by the use of blinds, shades, draperies, dimmers, and special switches to permit convenient use of visual aids
- Decor
  Attractive through tasteful use of color, materials, furniture, and well-planned arrangement of materials and furniture

SPECIAL FEATURES

Some special provisions in the electrical wiring are recommended:

- Master switch
  A master control switch in all rooms housing electrical typewriters and other electrical machines to permit control of all circuits supplying the machines
- Special wiring
  An underfloor duct system to provide outlets in any area of the typewriting and office practice rooms in order to avoid the use of long and hazardous cords
  Outlets on all walls for use of electric machines and audio-visual equipment

Some basic equipment is needed in all rooms used for education for business:

- Chalkboard and tackboard
  Chalkboard 16 to 24 lineal feet with small tackboard at one end
  Tackboard 16 to 24 lineal feet
- Shelving
  Thirty lineal feet of appropriate adjustable shelving for reference books and periodicals
- Work and storage space
  For students, counter 20 feet long, 2 feet deep, 3 feet high,

with storage space of shelves with doors under counter
For teacher, a desk, and wardrobe with lock (combination filing and storage space included)

- Aisles
  Thirty-inch back clearance in all rooms (Black clearance is the distance from rear edge of the work table to front edge of the table behind.)
  Thirty-six-inch aisle width in typewriting and office practice rooms; 30-inch aisle width in other business rooms

FACILITIES

LOCATION OF FACILITIES—There are no strong relationships which must be maintained between the business department's facilities and those of other departments in the school. There are several factors which should be considered, however:

- The entire educational program should be considered in locating the business department within the school plant.
- Since some of the equipment such as typewriters and other business machines may produce some noise, as effort must be made to avoid acoustical problems which may result in conflict with other activities.
- Rooms for business instruction should be located near each other.

SPACE NEEDS—The number of business rooms needed depends upon school enrollment, enrollment in business courses, and trends and needs of the local community which affect education for business.

FACTORS TO BE CONSIDERED in determining the number of rooms:

- Number of students enrolled in business courses
- Number of class sections daily in the school's schedule
- Size of each class
- Total number of classes each week
- Anticipated percentage of utilization of each room, since scheduling problems may not permit full use of every room every hour

TYPEWRITING ROOM—All rooms used for instruction in typewriting should incorporate the general recommendations on page 134 in addition to those that follow:

- Location
  Adjacent to and connected by doors with the office practice room
- Capacity
  Large enough to house 32 individual work stations (A work station is defined as one desk with typewriter and one chair.)
  Desk: 20 inches by 40 inches, varying in height from 27 inches to 30 inches
  Chair: secretarial chair with adjustable back and height
  Typewriter: various makes
- Features
  A lavatory, or work sink in counter, with dispenser for soap and towels

ADVANCED TYPEWRITING ROOM—All rooms for advanced typewriting instruction should incorporate the general recommendations and the same facilities needed for the typewriting room plus those that follow:

- Special equipment
  All electric typewriters, if possible; otherwise 25 per cent of the machines should be electric
  At least one long-carriage typewriter
- Features
  A lavatory, or work sink in counter, with dispenser for soap and towels

GENERAL PURPOSE TYPEWRITING ROOM—In a secondary school with one business education teacher, it may be necessary to use the typewriting room for shorthand transcription and for office practice. If this is the situation the room should also have:

- Additional equipment
  Rotary calculator
  Key-driven calculator
  10-key adding machine
  Full-keyboard adding machine
  Dictation-transcription equipment
  Duplicating equipment
  Illuminated drawing board
- Features
  A lavatory, or work sink in counter, with dispensers for soap and towels

BOOKKEEPING ROOM—A room used for bookkeeping instruction should incorporate the general recommendations on page 134 in addition to those that follow:

- Location
  Adjacent to and connected by a door with the office practice room
- Capacity
  Large enough to house 32 individual work stations (A work station is defined as one desk and one chair.)
  Desk: 20 inches by 40 inches with storage space
  Chair: secretarial chair with adjustable back and height
- Space equipped for
  Teacher's desk
  File cabinet
  One adding machine and/or one calculator for each five students

SHORTHAND ROOM—The room used for shorthand instruction should incorporate the general recommendations on page 134 in addition to the following:

- Location
  Adjacent to and connected by a door with the typewriting room
- Capacity
  Large enough to house 32 single student work stations (A work station is defined as one desk and one chair.)
  Desk: 20 inches by 40 inches, varying height 27 to 30 inches
  Chair: secretarial chair with adjustable back and height
- Space equipped with
  Teacher's desk
  File cabinet
  Lectern or dictation stand
  Tape recorder and tapes
  Record player and records
  Dictionary for each station
  Unabridged dictionary
  Shorthand dictionary
  Stenographer's Reference Manual
  Stop watch
  Interval timer

OFFICE PRACTICE ROOM—The room used for office practice should also incorporate the general recommendations on page 134 plus:

- Location
  Between or adjacent to and connected by doors with both the typewriting and bookkeeping rooms
- Capacity
  Large enough to house 24 single work stations plus three work tables (A work station is defined as one desk or table and one chair.)
  Desk: 40 inches by 40 inches, varying in height 27 to 30 inches
  Chair: secretarial chair with adjustable back and height
  Work table: 24 inches by 72 inches, 30 inches high
- Features
  A lavatory, or work sink in counter, with dispensers for soap and towels
- Space equipped with
  Teacher desk
  File cabinet
  Demonstration stand
  Paper cutter
  City and telephone directories
  Machines 10 typewriters—manual and electric
  4 transcribing machines
  2 long-carriage typewriters
  1 bookkeeping machine
  2 full-keyboard adding-listing machines
  2 10-key adding-listing machines
  2 key-driven calculators
  2 rotary calculators
  1 stencil duplicator
  1 fluid duplicator
  1 illuminated drawing board

WORK ROOM—This room should be used for duplicating equipment, small group instruction, and supply storage

- Location
  Adjacent to and connected by doors with both the typewriting and office practice rooms
- Capacity
  Large enough to house six to eight students for specific projects
- Space equipped with
  Mimeograph machine
  Fluid duplicator
  Mimeoscope
  Work table
- Features
  Separated from adjoining rooms with partially glazed partitions for ease of supervision
  A lavatory, or work sink in counter, with dispensers for soap and towels

BASIC BUSINESS-ECONOMIC ROOM—A general classroom located near other business rooms may be used for instruction of courses such as

Basic Business-Economic Information
Advanced Basic Business-Economic Information
Business Mathematics

DISTRIBUTIVE EDUCATION AND COOPERATIVE OFFICE EDUCATION ROOMS—Distributive Education and Cooperative Office Occupations are two phases of education for high school students which entail cooperative arrangements or work experience with business firms. All rooms used for cooperative work programs instruction should incorporate the general recommendations on page 134 in addition to those that follow:

- Location
  Adjacent to or convenient to other rooms used for business instruction
  If possible, reasonably convenient to parking areas
- Capacity
  Large enough to accommodate a maximum of twenty-five students
- Features
  Special display window and exhibit cases in distributive education room

OFFICE SPACE—Adequate office space is needed to serve all business teachers and coordinators of the cooperative work programs.
The office is the setting for interviews and conferences with students, parents, teachers and other personnel.

- With space for
  Desk and swivel chair
  Additional chairs
  Bookcase for teachers and coordinators
  Filing cabinets
  Storage space for materials
- Equipped with
  Necessary furniture
  Clock
  Telephone

The Business Teacher

THE BUSINESS TEACHER

The foundation for professional growth and development is laid in the undergraduate preparation of the business teacher, but he should have a continuing plan for improvement. His endeavors should aim at correcting deficiencies, increasing his knowledge and skill, and keeping professionally informed.

READING—The professional reading of the business teacher should include the literature of business, of education for business, and of education in general. It is imperative that he be informed about business and economic trends as well as changes taking place in his specific subject areas. For the objectives of self-realization and civic responsibility, his reading should include a broad sampling of economic, social, scientific, and literary works.

GRADUATE STUDY—Graduate level work should enrich the academic and professional background of the teacher; it should broaden his educational perspective, deepen his philosophy, and strengthen his ties to the profession of teaching. Continued certification should be contingent upon professional improvement through graduate study, business experience, and travel. A Master's degree or a higher degree with a major in business education should be considered essential preparation for the career teacher.

WORK EXPERIENCE—The business teacher who has had business experience brings confidence to his teaching which is reflected in the atmosphere of the classroom and which provides incentive for students. Through work experience, the teacher acquires criteria for setting up course standards in terms of job requirements. Business experience must be kept current, as business requirements and procedures change quickly.

AUTOMATION—Because of the part automation is playing and will increasingly play in the total office procedure, the business teacher should become conversant with these changes through reading current literature, through taking part in a survey of the high school's business-employment community, through visiting business offices that have electronic data processing installations, and through making a study of changed office procedures brought about by automation. He must possess vocabulary and knowledge in this field sufficient to give an understanding of what automation means to the future office worker.

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS—Active participation in associations and organizations related to one's work is recognized as one of the most effective means of keeping up to date, obtaining advancement, and achieving professional growth. The business teacher should be a member of his local, state, regional, and national associations, and attend their conferences at every opportunity.

For instance, a business teacher in North Carolina should belong to the North Carolina Education Association and should be active in promoting a functioning department of business education within the Association. Certainly, he should join the National Business Education Association, a department of the National Education Association, because of its service through the **Business Education Forum, The National Business Education Quarterly, The National Business Education Yearbook,** and because of its organized effort to promote business education nationally.

PUBLIC RELATIONS—"The business teacher is primarily responsible for keeping the public informed about the work of the department, the types of preparation being offered, and the manner in which the business department serves the community . . . (he) should actively participate insofar as possible in the business and professional organizations and activities of the community . . . Suitable publicity should be given the work of the business department, as well as the achievement of its business students and graduates." [13]

PROFESSIONAL LIBRARY—The business teacher should maintain his own professional library of books and periodicals in education for business, philosophy, psychology, curriculum planning, tests and measurements, methodology, grouping, criteria for program evaluation, and for selection of instructional materials.

PROFESSIONAL WRITING—The business teacher should share his experiences and research findings with fellow teachers and administrators through group meetings and articles in professional publications.

[13] "This We Believe about Business Education in the High School," *Business Education Forum, op. cit.*

Appendix

Report on Business Education Students

GUILFORD COUNTY SCHOOLS, GREENSBORO, NORTH CAROLINA

I. GENERAL INFORMATION

Name _____ Home Phone No. _____ Sex ___ ___
Last First Middle M F

Home Address _____ School _____
Box Route Street City State

Birth Date _____ Graduation Date _____
Month Day Year Month Day Year

Course pursued in high school (check one):

academic (college preparatory) _____
business education _____
general _____

Has student planned to attend college? Yes _____ No _____ If "yes," what year? _____

II. COMPOSITE GRADES

	Grade	*Other business education courses:*	*Grade*
English (including spelling & punctuation)	_____	_____	_____
Mathematics	_____	_____	_____
Typing	_____	_____	_____
Shorthand	_____	_____	_____
Clerical Practice	_____	_____	_____

Check 1 or 2 years shorthand: ___ ___ (1 2) Check 1 or 2 years typing: ___ ___ (1 2)

III. TEST SCORES

Interest Inventory (Kuder): clerical _____ computational _____

Typewriting: straight copy, cwpm _____ no. of minutes _____ %ile rank _____

Shorthand: recording speed _____ transcription speed _____ %ile rank _____

IV. ATTENDANCE

	Junior Year	Senior Year	Reason(s)
Days Absent	_____	_____	_____
Times Tardy	_____	_____	_____

V. PERSONAL CHARACTERISTICS

	Excellent	Good	Fair	Poor	Unknown
Attitude	_____	_____	_____	_____	_____
Industriousness	_____	_____	_____	_____	_____
Dependability	_____	_____	_____	_____	_____
Citizenship	_____	_____	_____	_____	_____
Initiative	_____	_____	_____	_____	_____
Ability to get along with teachers	_____	_____	_____	_____	_____

Ability to get along with students	_____	_____	_____	_____	_____
Ability to think and exercise judgment	_____	_____	_____	_____	_____

VI. KINDS OF MACHINES STUDENT IS TRAINED TO USE AND LEVEL OF TRAINING

(Please check one or more, if appropriate.)

	Acquaintanceship	Practical Use	Proficient
Duplicating	_____	_____	_____
Transcription	_____	_____	_____
10-key adding, listing	_____	_____	_____
Full key adding, listing	_____	_____	_____
Rotary calculator	_____	_____	_____
Key driven calculator	_____	_____	_____
Others: _____	_____	_____	_____

_____

VII. RECOMMENDATION FOR SPECIFIC TYPE JOB (Please check one or more, if appropriate.)

	Superior	Good	Fair	Poor
Secretarial	_____	_____	_____	_____
General Office	_____	_____	_____	_____
Filing	_____	_____	_____	_____
Computational	_____	_____	_____	_____
Office Machines	_____	_____	_____	_____
Bookkeeping	_____	_____	_____	_____
Record Keeping	_____	_____	_____	_____
Other _____	_____	_____	_____	_____

VIII. PERSONAL APPEARANCE (Check one)

Above Average _____

Average _____

Below Average _____

IX. COMMENTS

This form was completed by _____ (Name of Teacher) _____ (Name of Teacher)

Summer Address: _____ _____

Telephone: _____ _____

Date: _____ _____

EXPLANATION OF DATA ON SECTIONS II, III, AND V OF THE "REPORT ON BUSINESS EDUCATION STUDENTS"

II. COMPOSITE GRADES

A. The grades for the various subjects in this section are teacher-awarded on the basis of (1) achievement tests (2) quality of recitation work or class projects (3) quality of completed out-of-class assignments (4) readiness to participate in class activities and group work (5) promptness in completing assignments and projects (6) persistent effort in working up to capacity (7) ability in carrying on work and study honestly and independently (8) progress in communicating facts and ideas.

B. The composite grades recorded represent an average of the eleventh grade and three-fourths of the twelfth grade.

C. The grading system for Guilford County is as follows: A 95-100, Superior; B 88-94, Above Average; C 77-87, Average; D 70-76, Below Average; F Below 70, Failing, E Conditional.

III. TEST SCORES

A. The clerical and computational score for the Kuder Interest Inventory simply represents an interest in the field rather than ability or performance. The percentile rank recorded indicates the number of high school students in the national population which were surpassed by the individual student.

B. The percentile ranks recorded for typewriting and shorthand indicate the rank of the individual student in comparison with other business students in Guilford County. For example, if a student has a percentile rank of 80 on "straight copy" in typewriting, it would indicate that he scored higher on the test than 79% of those taking the test, whereas he was surpassed by 20%. (Fifty percentile is average for Guilford County.)

V. PERSONAL CHARACTERISTICS

A. The checks indicated represent the concensus of the business education teacher(s).

VT 001 881
Damian (Brother), Ed.
Bookkeeping I, Syllabus.

Brothers of the Sacred Heart, New Orleans Province, Daphne, Ala. Business Education Committee
MF AVAILABLE IN VT-ERIC SET.
PUB DATE - 64 34p.

DESCRIPTORS - *BUSINESS EDUCATION; *TEACHING GUIDES; *CURRICULUM GUIDES; *BOOKKEEPING; GRADE 11; GRADE 12

ABSTRACT - Curriculum materials to aid teachers in planning a first-year bookkeeping course were developed by a business education curriculum committee and are intended for students in grades 11 or 12 who have had general business, business math, and business law. Time allotment, teaching suggestions, and aims and objectives are provided for these units: (1) The Bookkeeping Cycle in Its Simplest Form, (2) The Bookkeeping Cycle with Special Journals and Subsidiary Ledgers, (3) Practice Set with Business Papers, (4) Problems in Recording Bookkeeping Transactions and Practice Set, and (5) Adapting Bookkeeping Methods to the Business. Also included are reference lists, equipment and facilities requirements, and enrichment materials for advanced students. (SB)

VT 001 881

ED0 45856

A.C.J. A.C.M.

BOOKKEEPING I

SYLLABUS

Edited by

Brother Damian, S.C.

Business Education Committee
BROTHERS OF THE SACRED HEART
New Orleans Province

1964

U S. DEPARTMENT OF HEALTH. EDUCATION & WELFARE
OFFICE OF EDUCATION
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VT 01881

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PREFACE

Work on the initial outline of this syllabus was begun at the Brothers of the Sacred Heart 1960-1961 Teachers' Institute at St. Stanislaus, Bay St. Louis, Mississippi. A rough-draft was proposed by Brother Damian, S.C. The Business Education Committee then considered the proposed syllabus and presented one to be used on an experimental basis for the years 1962 to 1964.

To aid in developing the final syllabus, it was suggested that the following procedure by the teachers of bookkeeping in the Brothers of the Sacred Heart Schools be followed: (1) Comments about each section be written on the pages of the syllabus (adequate space was provided for this so that these valuable notes could be written in the tentative edition.) (2) Any successful results from experimentation with new materials and methods were reported in the tentative edition. (3) Whenever attending meetings of the Business Education Committee, particularly the Teachers' Institute, the teachers brought their syllabus with the notations to the meetings.

The present final edition of the Bookkeeping Syllabus is the result of the procedures outlined above.

I take this means to thank those who helped make this syllabus possible. As editor I am indebted to all the members of the Committee and the other bookkeeping teachers without whose help my task would have been difficult.

Credit is also given to: South-Western Publishing Co. "The Teacher's Manual" for 20th Century Bookkeeping and Accounting, First Year Course, by Carlson, Forkner and Boynton, 21st Edition. The section "Unit Development" was adapted from this publication for the present syllabus. Many of the teacher's aids and introductory treatment were also taken from this work.

State of New York, Department of Education, Committee on Bookkeeping. The syllabus published for the bookkeeping teachers of New York was the main guide in preparing the format of this syllabus.

In addition to the above, countless other sources were consulted. Credit is given in the body of the work whenever possible. The Committee on Bookkeeping of the Brothers of the Sacred Heart is grateful to the authors and publishers of these works as well as to the groups mentioned above.

Brother Damian, S.C.

BUSINESS EDUCATION COMMITTEE:

Chairman--Brother Lloyd, S.C.
Secretary--Brother Duane, S.C.
Members--Brothers Bernon, Remigius, Marion, Jerome, Celestine, and Damian, S.C.

INTRODUCTION

Need for Bookkeeping. Almost everyone in this complex civilization has a need for bookkeeping. The degree of this need varies with the individual and with the situation in which he finds himself. Government regulations on the state and federal levels make mandatory the keeping of certain records for large businesses, small businesses and individuals. This outline includes consideration of trading and nontrading businesses and professions.

Provision for Flexibility. This bookkeeping syllabus has been designed to provide flexibility to meet varied teaching conditions. Teachers should recognize that the syllabus prescribes only the minimum subject matter to be covered. Additional subject matter may be added to meet the interests, needs and abilities of the pupils.

Order of Presentation. The topics in this syllabus do not have to be followed in the order in which they appear in the outline as long as the aims and objectives are accomplished. However, if the general plan of the textbook used permit, topics should be covered in the order proposed.

Purpose of First Year Bookkeeping. The first year bookkeeping course is designed to be an overview of the field of bookkeeping. The course will be of value to non-business pupils who take it as an elective in that it will give them an understanding of the field of business and will have other personal values. It will be of additional value to all pupils who are pursuing business curriculums, not only because many office positions for beginners require some knowledge of bookkeeping, but also because all office workers should have the understanding of business which is gained through a knowledge of bookkeeping. For those pupils who develop a marked degree of interest and have ability in bookkeeping, the first year course will provide an excellent beginning for more advanced work in this subject in high school and college.

Bookkeeping Aspects Emphasized. Although the line which separates bookkeeping and accounting is difficult to define, this syllabus emphasizes the understanding of and facility in the bookkeeping aspects of the work. The accounting procedures are taught mainly for understanding in order that the pupil may see the ultimate results of his work as a bookkeeper.

GENERAL TEACHING SUGGESTIONS

Personality Traits and Work Habits. The teacher should make definite plans to teach desirable personality traits and good work habits throughout the course. The teaching of these characteristics should not be left to chance.

Understanding, Memorization and Skill. As an understanding of subject matter is much more important than mere memorization, memoriter learning of forms and other bookkeeping devices should be de-emphasized. Some topics are taught for understanding only, others for understanding and a limited degree of skill, whereas still others should be taught for understanding and a high degree of skill. In all cases understanding of the subject matter is more important than the mere ability to perform bookkeeping operations mechanically.

Community Resources. Approved bookkeeping procedures which are used in the school-community should be stressed throughout the course. All possible means should be used to enrich the subject matter; community resources should be used as much as possible; pupils should be encouraged to observe businesses in their local community; relevant experiences of the pupils should be drawn upon. Teachers are encouraged to make use of actual business forms as illustrations, to take their classes on field trips and to bring in outside speakers. Bookkeeping records of student organizations within the school may be used to good advantage.

Visual and Audio Aids. A program of "visual aids" and "audio aids" could include:

1. Textbook illustrations
2. Chaldboard
3. Bulletin board
4. Posters
5. Exhibits of work of students
6. Exhibits of accounting systems.
7. Bookkeeping wall charts
8. Booklets
9. Filmstrips
10. Glass slides
11. Motion pictures: silent & sound
12. Filed trips (tours)

1. Textbook Illustrations: Teachers should encourage students to analyze each illustration critically and thoroughly. Use of the chapter questions at the end of each chapter will help.

2. Chalkboard: Frequent use of the chalkboard in the bookkeeping classroom helps to emphasize an important point when used at the proper time. It is often desirable to have one student demonstrate a solution of a written exercise while all students at their seats are keeping up with the solution of the same problem at their desks. This gives the teacher free time to supervise and direct the work at the chalkboard and at the same time to observe the quality of each student's work at his desk. Chalk talks should not be monopolized by the teacher.

3. Bulletin Board: If the bulletin board is to be a most effective visual aid, the displays on it should be changed frequently and should be kept up to date with the assignments. Business forms not illustrated in the textbook that supplement the illustrations being studied may be placed on the bulletin board each week. The maintenance of the bulletin board should not

be the sole responsibility of the bookkeeping teacher; bulletin board responsibilities should be assigned to individual students or to committees of students.

4. Posters: Business forms and accounting forms may be mounted on heavy cardboard and be used year after year to supplement the illustrations in the textbook. Some of these posters may be a series of mounted snapshots or photos. Some of these posters may be prepared with colored crayons. All of them may be numbered, indexed, and filed to correlate with the chapters of the textbook. If the teacher will establish some model posters himself, the preparation and execution of additional posters may be assigned to individual students or to committees of students. From day to day these posters may be displayed on the chalk tray of the chalkboard. Or they may be plaed on an artist's tripod used every day for that special purpose.

5. Exhibits of Work of Students: One of the best visual aids is a changing exhibit of the best work from some of the best students. This may be an exhibit of the best work of this class or it may be an exhibit of some of the best work that has been kept for exhibit purposes from previous classes. Each year some students may strive to be included in this "hall of fame."

If a sample of the work of each student in the class is exhibited from time to time, this exhibit serves as an incentive for improvement as well as a visual aid. The work of students may be exhibited by using spring clips hung on wires strung on one wall of the classroom. An ideal arrangement is to have sufficient cork bulletin boards in the corridor near the bookkeeping classroom so that these exhibits of student work may be displayed frequently in the corridor.

6. Exhibits of Accounting Systems: The bookkeeping classroom should own some full-size journals and ledgers as a perpetual exhibit. A few ready-made accounting system books may be purchased from such national manufacturers as: Boorum & Pease Company, 84 Hudson Ave., Brooklyn 1, New York.
National Blank Book Co., Holyoke, Massachusetts
Wilson Jones Company, 3300 Franklin Blvd., Chicago 24, Ill.

There are other manufacturers of binders for journals and ledgers and other manufacturers of ready-made accounting systems, but the above list includes some of the largest concerns. The bookkeeping teacher should plan to obtain some of these bookkeeping systems for display purposes and for special discussions whenever they can be used effectively.

7. Bookkeeping Wall Charts: The wall chart on a roller spring has the advantage of being instantly available whenever it will serve best as a visual aid. It also has the advantage that it can be put away quickly just as soon as it has served its purpose. A set of wall charts may be purchased from the George F. Cram Co., Inc., 730 E. Washington St., Indianapolis 7, Ind. These wall charts measure 48 by 52 inches and are printed in three colors. A leaflet describing the contents of the charts may be obtained without obligation by writing to the George F. Cram Company. The wall charts that are available from the George F. Cram Company are as follows:

Chart No. 1 - Recording and Posting the Opening Entry
Chart No. 2 - Journalizing, Posting and Preparing a Trial Balance
Chart No. 3 - Work Sheet and Financial Statements

Chart No. 4 - Closing the Ledger for a Service Business
Chart No. 5 - Adjusting the Ledger
Chart No. 6 - The Bookkeeping Cycle

8. Booklets: Many corporations publish annual reports containing balance sheets, profit and loss statements, and visual aids interpreting these financial statements. Some of these annual reports contain a number of other visual aids. Often a bookkeeping teacher can get without charge enough copies of these annual reports to give each student in the class a copy. Often these printed annual reports may be obtained from local business houses. They help to demonstrate the value of bookkeeping.

9. Filmstrips: The Society for Visual Education, Inc., 1345 West Diversey Parkway, Chicago 14, Ill. publishes filmstrips tailored for individual textbooks. These filmstrips should be ordered directly from the Society for Visual Education, Inc. Write to them for a descriptive circular and prices.

10. Glass Slides: Some teachers make their own slides on glass and have students help them make additional slides. This adds local color and local interest to make the work of the classroom.

11. Motion Pictures: A number of motion pictures dealing with topics in bookkeeping are now available. Some of them are in color and some of them are in black and white only. Many of these motion picture films may be rented from the extension division of the state university in each state. Bookkeeping teachers should consult with the state university or other rental agencies as to what is available and the cost.

FILMS AVAILABLE FOR VIEWING BY THE BOOKKEEPING CLASS

ACCOUNTING, THE LANGUAGE OF BUSINESS 16mm Sound 20 min.
This film illustrates the significance of public accounting in modern business. It presents specific cases in which a CPA helps to solve practical problems for his clients, and points out the advantages of accounting as a career
Available from: Association Films, Inc., 1108 Jackson St., Dallas, Texas
Rent free; must pay return postage.

MATTER OF FORM, A 16mm Sound 22 min.
This film, in full color, gives a description of the place of business forms and of forms writing and handling equipment in all phases of business. It shows what forms do, the kinds of forms, how they are written, and how they are handled.
Available from: Moore Business Forms, Inc., Sales Promotion Department, 900 Buffalo Avenue, Niagara Falls, New York
Rent free; pay return postage

SAVING WITH SUIAP 16mm Sound 30 min.
This film, in full color, was produced to acquaint businessmen with Remington Rand's unique Simplified Unit Invoice Accounting Plan (SUIAP). The film explains the application of this system for simplifying the operation of accounts receivable, credit, and collection departments. It shows how one clerk can handle up to five thousand individual accounts.
Available from: Local office of Remington Rand.

[Credit: This list was compiled from EDUCATORS GUIDE TO FREE FILMS, Educators Progress Service, Randolph, Wisconsin.]

It is the opinion of the Committee of this syllabus that the subject matter does not easily provide time for the viewing of films. However, when the tedium of bookkeeping seems to make the class lag in spirit, one of these films will present the subject matter in a novel fashion and inject new interest in the class.

12. Field Trips: Tours of banks and business houses are very effective visual aids if they are carefully planned. What is to be seen in the tours should be carefully listed and discussed in advance. The tour of banks and business houses should be completely reviewed after the class returns to the classroom.

Field trips or tours usually require much school time. They often interfere with the classwork of other teachers, who should be consulted in advance by the bookkeeping teacher before the field trip is scheduled.

Method. The syllabus has been so prepared that any approved method of instruction may be used. Regardless of the method used pupils should learn not only subject matter but also how to work individually and with others.

From the beginning an attempt should be made to teach each topic in a form in which it can be used in actual practice.

In order that pupils understand that bookkeeping entries are made from business papers, it is important that these papers, business procedures and teacher-prepared or published practice sets be incorporated into the course.

Accurate arithmetic and legible penmanship are required. Remedial work in individual cases may be necessary.

Motivating Devices. Every opportunity should be taken to recognize the work of pupils who have shown improvement or who are especially competent. Publicity should be given the progress made by the pupils and if possible some formality should accompany the presentation of awards.

Individuation of Instruction. It is recognized that there will be marked differences in pupils, schools and communities. In order to provide for these differences, certain topics have been marked optional. These topics may be omitted, assigned to interested pupils or considered as regular work in certain classes. A variety of exercises and practice sets with business papers should be used in order to provide for the needs of various types of pupils.

Teachers should make definite plans to increase the amount of pupil participation in the class activities.

Consumer Information. Information for the consumer should be stressed wherever possible throughout the course. The alert teacher will find many topics where this type of instruction will be of great value.

SUGGESTED TEXTBOOKS

For teachers that use the T-account method:

Bookkeeping and Accounting (Simplified) published by Gregg Publishing Division, McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N.Y. It is written by Freeman, Hanna, and Kahn and it is the second edition that is recommended.

The following materials are available to be used with the Gregg Bookkeeping and Accounting book.

Teacher's Manual and Key
Workbook, Part I
Workbook, Part II
Objective Tests
*Practice Set I - Stone Radio and Television Service
*Practice Set II - George Heating Company
Teacher's Key for Practice Sets I and II
Correlated Filmstrips available
*with business papers

For teachers who prefer the journalizing method:

20th Century Bookkeeping and Accounting by Carlson, Forkner, Boynton - (21st edition) published by South-Western Publishing Company, Inc., 5101 Madison Road, Cincinnati 27, Ohio.

The following materials are available to be used with the South-Western 20th Century book.

Workbook (Chapters 1-36)
Teacher's Key
Teacher's Manual
Objective Tests
Practice Set I - Randall Wholesale Grocery with business papers
Practice Set II - Burton Retail Hardware Set with business papers.

SUGGESTED REFERENCE BOOKS FOR STUDENTS

For foreign students having great difficulty with the English language:
Contabilidad Practica para el Siglo XX, Curso Elemental (Capitulos 1-32), Traduccion de Antonio de la Luz y Marina Lledo, South-Western Publishing Company, 5101 Madison Road, Cincinnati 27, Ohio.

Etiquette In Business. Text Edition. 1948, by Carney, published by Gregg Publishing Division, McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N.Y.

SUGGESTED REFERENCE BOOKS FOR TEACHERS

Andrews, Margaret E., "Bookkeeping Curriculum Revised," The Balance Sheet, October, 1957, Vol. XXXIX, No. 2, p. 57, 5101 Madison Road, Cincinnati.

Boynton, Methods of Teaching Bookkeeping, 1955, No. X90, South-Western Publishing Co., 5101 Madison Road, Cincinnati 27, Ohio.

Brinkman and Dame, Guidance in Business Education, 1954, No. X82, South-Western Publishing Co., 5101 Madison Rd., Cincinnati 27, Ohio.

Leith, Howard, "Content of the Bookkeeping Course," The Balance Sheet, May, 1952, Vol. XXXIII, No. 9., p. 397, 5101 Madison Rd., Cincinnati 27, Ohio.

The Psychology and the Instructional Pattern of Teaching Bookkeeping, No.C569 South-Western Publishing Co., 5101 Madison Rd., Cincinnati 27, Ohio.

Rosettie, Louis R., "Bookkeeping in the State of New York," Journal of Business Education, November, 1953, Vol. XXIX, No. 2, p. 67, 512 Brooks Building, Wilkes-Barre, Pa.

Satlow, David I., Helpful Hints in Teaching Bookkeeping and Accounting, Monograph 96, 1956, South-Western Publishing Co., Cincinnati 27, Ohio.

Suggested Guide for Procedures in Teaching Bookkeeping, New York University, New YOrk, New York. 25¢

Turville, S.J., "Evaluating the Physical Needs of the Department of Business Education," The Balance Sheet, October, 1951, Vol. XXXIII, No. 2, p. 55, 5101 Madison Road, Cincinnati 27, Ohio.

EQUIPMENT, SUPPLIES AND FACILITIES

While it is not necessary to have an especially equipped room, it is advisable that the desks be of a size suitable for bookkeeping instruction (recommended top surface of not less than 30 inches by 22 inches.)

It is suggested that the following equipment be available: filing cabinet, ten-key adding-listing machine, full-key adding-listing machine, storage facilities, adequate bulletin boards and chalkboards.

Equipment which will make possible the use of various types of projected visual aids should be available. Schools should be alert also to new situations involving the use of audio-visual equipment.

Whenever possible, ruled bookkeeping paper and forms should be furnished the pupils. This will make the instruction more realistic and will save the time which otherwise might be used in ruling the forms. These ruled forms can be purchased from South-Western Publishing Co., 5101 Madison Road, Cincinnati 27, Ohio.

SUPPLEMENTARY MATERIALS

Governmental Information. Because of the scope of the subject, it is necessary that teachers keep up to date as to governmental regulations. Some sources of such information are:

Bureau of Internal Revenue, U.S. Treasury Department, New Orleans, La.

Division of Placement and Unemployment Insurance
State where school is located, Department of Labor, Capital City.

Local Post Office (Obtain address of the nearest field office of the Social Security Administration.)

State Department of Commerce, State of Louisiana, Capital Bldg., Baton Rouge

State Department of Taxation and Finance

Superintendent of Documents, Government Printing Office, Washington 25, D.C. (Ask to be placed on mailing list for selected government publications.)

National Business Entrance Tests. Individual bookkeeping tests from each series may be obtained for a nominal fee from the Joint Committee on Tests, National Office Management Association, 132 West Chelton Avenue, Philadelphia, 44, Pa.

These materials may be used for teaching purposes or for general testing. Because of their vocational emphasis they are particularly appropriate for use in second-year bookkeeping.

Bookkeeping Forms. Actual bookkeeping forms and related business papers should be obtained from local businesses and office supply houses and used as illustrative material.

Farm Bookkeeping (Bulletin 95 and 95-A)

Bookkeeping for Owners of Small Businesses (Bulletin 87).
While practice sets with business papers are suggested for use in bookkeeping instruction, two practice sets in the above areas without business papers are available from the Bureau of Business and Distributive Education (New York). These were written especially for adult groups but can be adapted to regular high school classes.

Social Security and You (Bulletin 103). This is another bulletin available from the Bureau of Business and Distributive Education (New York). It was prepared originally for adult groups. The information in it will prove helpful to a teacher not familiar with the details of this topic.

A list of references is also a part of the bulletin.

PROFESSIONAL PERIODICAL LITERATURE

Business Week, 330 West 42nd Street, New York 36, N.Y.

Consumer Bulletin, Consumers' Road, Washington, New Jersey.

FBE Bulletin, The Foundation for Business Education, Inc.
P.O. Box 7, Lenox Hill Station, New York 21, N.Y. (free)

The Balance Sheet, 5101 Madison Road, Cincinnati 27, Ohio. (free)

The Business Teacher, 330 West 42nd Street, New York 36, N.Y.

CBEA Bulletin, current address of the national publicity chairman of the Catholic Business Education Association.

The UBEA Forum*

The Journal of Business Education*

The Journal of Accountancy*

Additional reference book for bookkeeping teacher:

Accountant's Handbook, published by Ronald Press, New York City, is very useful as an encyclopedia collection of forms, illustrations, and business practices.

*At the writing of this syllabus the addresses of the publishers of these magazines was not available. However they can be obtained from South-Western Publishing Co., 5101 Madison Road, Cincinnati 27, Ohio.

AIMS AND OBJECTIVES

1. To develop an appreciation of the importance and value of bookkeeping to individuals, to business enterprises and to government.

2. To give an economic understanding of sound business procedure and management as revealed by the accounting records.

3. To give pupils a knowledge of bookkeeping and related business procedures that will function in the management of their personal business affairs, prepare them to become competent beginning workers and enable them to advance to higher positions. For some pupils this knowledge may lead to their ultimate success as managers or proprietors of business enterprises.

4. To give pupils an understanding of assets, liabilities, capital, income and expense that will enable them to analyze and interpret business situations.

5. To give pupils a knowledge of business papers, related office procedures and sound business practices, and an acquaintance with the business machines and equipment used in bookkeeping and related work.

6. To develop the technical skills required for competent performance by a bookkeeper at the beginner's level.

7. To develop the ability to interpret accounts and financial statements.

8. To acquaint pupils with the types of business organization and to develop their understanding of the basic bookkeeping records for each type.

9. To inculcate in pupils the habits, attitudes and ideals necessary for success on the job, and the realization that the success of individuals depends to a considerable extent on their ability to get along with their fellow workers; that the success of business enterprises depends largely on the cooperation of all connected with them and that society as a whole depends upon the ability of all its members to get along with and to cooperate with one another.

10. To give pupils the opportunity to explore their interest in and their fitness for advanced bookkeeping; and, by means of educational and vocational guidance, to foster in the more able pupils an abiding interest in the field of accounting which will continue beyond the high school.

FIRST YEAR BOOKKEEPING

The topics in the following syllabus need not be followed in the order in which they are given as long as the aims are accomplished. However, the syllabus committee gave careful consideration to the order of topics and it feels that only a very serious reason could justify deviating from the proposed sequence.

Exercises and practice sets with business papers and forms suitable to the needs, interests and abilities of the individual pupil should be included.

Time Requirement and Credit. First year bookkeeping should be taught for five periods a week. The minimum time for a period should be 50 minutes. Pupils who satisfactorily complete the course receive one credit.

Grade Placement. In general bookkeeping students should have credits in the following subjects before pursuing bookkeeping: General Business, Business Math, Business Law. This necessarily places the bookkeeping student in grade 12. However a pupil in grade 11 could pursue the first year bookkeeping course profitably.

TIME DISTRIBUTION

Part I :: FIRST SIX WEEKS :: THE BOOKKEEPING CYCLE IN ITS SIMPLEST FORM

1. Starting a bookkeeping system
2. Recording the opening entry in the journal
3. Posting the opening entry
4. Recording the changes in asset and liability accounts
5. Recording income and expenses
6. Posting
7. Proving the accuracy of posting
8. The six column work sheet
9. The profit and loss statement and the balance sheet
10. Closing the ledger

Part II :: SECOND SIX WEEKS :: THE BOOKKEEPING CYCLE WITH SPECIAL JOURNALS AND SUBSIDIARY LEDGERS

1. Recording the buying of merchandise on account
2. Recording cash payments
3. Recording the selling of merchandise on account
4. Recording cash receipts
5. The general journal
6. Bank deposits and reconciliation of bank statements
7. Work sheet with adjustments
8. Financial reports
9. Adjusting and closing entries

PART III :: THIRD SIX WEEKS :: PRACTICE SET WITH BUSINESS PAPERS

PART IV :: FOURTH SIX WEEKS :: PROBLEMS IN RECORDING BOOKKEEPING TRANSACTIONS

1. The combination journal and the petty cash fund
2. Problems relating to sales and purchases
3. Payroll records
4. Taxes and reports
5. Depreciation of fixed assets
6. Disposing of fixed assets

PART V :: FIFTH SIX WEEKS :: PROBLEMS IN RECORDING BOOKKEEPING TRANSACTIONS (continued) AND PRACTICE SET NUMBER 2.

1. Bad debts and accounts receivable
2. The use of the cash register
3. Practice Set #2

PART VI :: SIXTH SIX WEEKS :: ADAPTING BOOKKEEPING METHODS TO THE BUSINESS

1. Notes and interest
2. Accrued expenses
3. Partnerships
4. Bookkeeping and budgeting for the family and the individual
5. Columnar special journals

ENRICHMENT MATERIALS (These areas of bookkeeping are included for the more advanced or productive students.)

1. Bookkeeping and budgeting for school and social organizations
2. Bookkeeping for a professional man
3. Bookkeeping for a farmer.

UNIT DEVELOPMENT

I :: THE BOOKKEEPING CYCLE IN ITS SIMPLEST FORM

A. Starting a bookkeeping system

Purpose: This first section concentrates on understanding the meaning of three bookkeeping terms: assets, liabilities, and proprietorship through the use of short, simple, practical illustrations common to the experience of the high school student.

Points to emphasize:
1. The first step to install a new bookkeeping system is to find (a) what is owned, (b) what is owed, and (c) what is the net worth.
2. A complete detailed picture of what an enterprise owns, owes, and is worth is called a balance sheet.
3. The first business paper used in setting up a new set of books is the beginning balance sheet.
4. The ten steps used in preparing a balance sheet.
5. Any balance sheet can be summarized in a one-line statement:
   Assets = Liabilities + Proprietorship.

B. Recording the opening entry in the journal

Purpose: The main purpose of this unit is to give the student a first lesson in the meaning of debit and credit. The device used is an opening entry with several debits and several credits.

Points to emphasize:
1. Every entry in the journal has a debit and a credit part.
2. There may be more than one debit amount in the debit part of a journal entry and more than one credit amount in the credit part of the entry.
3. The total of the debit amounts in every entry in the journal should equal the total of the credit amounts in the entry.

4. Balance sheet asset items are always recorded as debits.
5. Balance sheet liability and proprietorship items are always recorded as credits.

C. Posting the opening entry

Purpose: It is the purpose of this section to teach the simple technique of posting.

Points to emphasize:
1. The relationship of the balance sheet to the journal and to the ledger.
2. The arrangement of the parts of the standard form of ledger ruling.
3. The eight steps used in posting each line of the journal.
4. The steps used in posting the remaining debits and the credits in the opening entry.
5. The use of the journal page column in the ledger account and the posted reference column in the journal.
6. The nature of account balances.

D. Recording the changes in asset and liability accounts

Purpose: It is the purpose of this section to explain in as simple a manner as possible what causes one or more items on the balance sheet to change each time a transaction is completed.

Points to emphasize:
1. Explain the nature of a business transaction.
2. All of the transactions in this section are cash transactions.
3. The immediate record of each transaction in this section is the carbon copy of a receipt issued or the check stub of a check issued.
4. The balances of two or more accounts in the ledger are changed each time a transaction is completed.
5. The changes produced by transactions must be recorded in the journal before they can be posted to the ledger.
6. Transactions are recorded in the journal in the exact order in which they are completed. The journal entries are made from the immediate record--carbon copy of a receipt or a check stub.
7. The amount of each cash receipt is recorded in the Cash Debit column of the journal. The amount of the credit for each cash received transaction is recorded in the General Credit amount column and the credit amount is identified in the Name of Account Column.
8. The amount of each cash payment is recorded in the Cash Credit amount column of the journal. The amount of the debit for each cash payment is recorded in the General Debit amount column and the debit amount is identified in the Name of Account column.
9. The complete record of each transaction in this section is written on a single line of the journal and the debit amount must always be equal to the credit amount on the same line.
10. The number of each receipt issued when cash is received is written in the No. column of the journal with a capital R before the number. This letter and number is the journal explanation.
11. The number of each check issued is written in the No. column of the journal with a capital C before the number. This letter and number is the journal explanation.

E. Recording Income and Expenses

Purpose: It is the purpose of this section to study the effect of income and expense transactions.

Points to emphasize:

1. In this section one learns how to record transactions that cause changes in proprietorship.
2. Income transactions increase proprietorship. If a cash received transaction does not increase proprietorship it is not an income.
3. Expense transactions decrease proprietorship. Many cash payment transactions do not decrease proprietorship and therefore are not expense transactions.
4. Limit all income transactions in this section to cash received for commissions income. Since these commissions income transactions are rather frequent, a special column with the heading Commissions Income Credit is provided in the journal.
5. The amount of cash received for commissions income is recorded in the Cash Debit amount column and in the Commissions Income Credit amount Column.
6. The expense transactions in this section are of great variety. No one type of expense occurs often enough during the month to warrant a special column for any of the several expense accounts.
7. Each expense account is debited by writing the name of the expense account in the Name of Account column and the amount of the expense in the General Debit amount column.
8. How to correct errors as they are found in the journal.

F. Posting

Purpose: It is the purpose of this section to teach how to post a complete journal that has special columns as well as two general columns.

Points to emphasize:

1. Steps in posting an entry in a five-column journal.
2. Steps in posting the total of a special column.
3. Why amounts in the general amount columns are posted to the accounts named in the Name of Account column.
4. Why amounts in the special amount columns are not posted individually.
5. Why only the total of special amount columns are posted.
6. Why the totals of the two general amount columns are not posted.
7. Why an account number is placed under each special column total immediately after it is posted.
8. Why a check mark is placed under the total of each of the two general columns.
9. Why accounts in the ledger are numbered according to a plan suited to a particular business.

G. Proving the accuracy of posting

Purpose: It is the purpose of this section to teach the nature of proof in bookkeeping, particularly as applied to (1) the proof of cash and (2) the proof of the equality of the debits and the credits in the ledger.

Points to emphasize:
1. The method of proving the cash on hand.
2. The method of footing each account in the ledger
3. How to prepare a trial balance step by step
4. What a trial balance proves and what it does not prove
5. How to locate errors indicated by a trial balance out of balance
6. How to correct errors in the ledger by drawing a single line through the incorrect item and writing the correct item above it.

H. The Six-Column Work Sheet

Purpose: It is the purpose of this section to teach how to analyze and interpret the trial balance through the use of six-column analysis paper called a six-column work sheet.

Points to emphasize:
1. The need for interpreting bookkeeping records periodically in order to determine the success of the business.
2. The use of analysis paper as a means of spreading on a single sheet of paper all information needed to determine net profit or net loss.
3. The seven steps used in preparing a work sheet.

I. The profit and loss statement and the balance sheet

Purpose: It is the purpose of this section to teach the method of preparing the two financial reports from the information sorted and summarized on the work sheet.

Points to emphasize:
1. The need for preparing a separate profit and loss statement and a separate balance sheet.
2. All of the information shown on the profit and loss statement is obtained from the two P. & L. Statement columns of the work sheet.
3. All of the information shown on the balance sheet is obtained from the two Balance Sheet columns of the work sheet.
4. Analyze the arrangement of the profit and loss statement.
5. Analyze the arrangement of the balance sheet in report form.

J. Closing the ledger

Purpose: It is the purpose of this section to teach the bookkeeping method of transferring the balances of the income and the expense accounts to the proprietorship section of the ledger.

Points to emphasize:
1. The need for bringing the proprietorship section of the ledger up to date.
2. The reason why incomes and expenses are not recorded directly in the proprietor's capital account or in the proprietor's drawing account.
3. The use of the profit and loss summary account as a means of summarizing the income and the expense accounts.
4. The method of closing the income and the expense accounts into the profit and loss summary account, using the work sheet as the guide.
5. The method of closing the profit and loss summary account into the proprietor's drawing account.

6. How income and expense accounts are closed and ruled.
7. How asset, liability and proprietorship accounts are balanced and ruled.
8. The use of the post-closing trial balance to prove the accuracy of the work at the end of the fiscal period.

II :: THE BOOKKEEPING CYCLE WITH SPECIAL JOURNALS AND SUBSIDIARY LEDGERS

A. Recording the buying of merchandise on account

Purpose: (1) To introduce a mercantile business in contrast to the service businesses used in Part I, Section 2 and 10; (2) to present the conditions under which several special journals are preferred to a single book of original entry; (3) to present the purchases journal as a special journal in which to record all purchases on account; (4) to present the alternative method of using a file of purchases invoices as a purchases journal; (5) to introduce the accounts payable ledger as a subsidiary ledger; and (6) to introduce balance-column ledger ruling for accounts with customers and creditors.

Points to emphasize:

1. Special journals are used instead of a single journal to allow two or more bookkeepers to record transactions at the same time.
2. In many businesses a purchases journal is used in recording all purchases of merchandise on account.
3. Only the total of the purchases journal is posted to the general ledger.
4. To maintain equality of debits and credits, the total of the purchases journal is posted to the debit side of the purchases account in the general ledger, and to the credit side of the accounts payable ledger.
5. The accounts payable account in the general ledger shows the total amount owed to all creditors on open account. A special or supplementary ledger, called the accounts payable ledger, is maintained to show the individual names of creditors and the amounts owed to each.
6. The accounts payable account in the general ledger shows the total that is owed, but the individual accounts in the accounts payable ledger show to whom this total is owed.

B. Recording cash payments

Purpose: (1) To present the cash payments journal as a special journal in which to record all cash payments; (2) to explain the use of special columns in books of original entry; and (3) to show relationships between postings to creditors' accounts in accounts payable ledger and postings to the controlling account in the general ledger.

Points to emphasize:

1. All cash payments, but only cash payments, are recorded in the cash payments journal.
2. In the cash payments journal a special column is maintained for accounts payable. (See note.)
3. An amount is recorded in the Cash Credit column for each cash payment transaction.
4. Each account that is credited in the Cash Credit column is also debited in either the General Debit column or the Accounts Payable Debit column.

5. The total of the General Debit column plus the total of the Accounts payable Debit column equals the total of the Cash Credit column.
6. It is excellent business policy to account for all cash payments by writing checks.
7. Correct procedures in writing checks.
8. How to prove the accounts payable account in the general ledger.
9. How to prepare the Schedule of Accounts Payable.
   (Note: Any account that appears frequently in transactions should be given a special column in this type of journal.)

C. Recording the Selling of merchandise on account

Purpose: (1) To present the sales journal as a special journal in which to record all sales of merchandise on account; (2) to introduce the accounts receivable ledger as a subsidiary ledger; and (3) to show the alternative method of using a file of sales invoices as the sales journal.

Points to emphasize:
1. In many businesses a sales journal is used in recording all sales of merchandise on account.
2. Only the total of the sales journal is posted to the general journal.
3. There is equality of debit and credit in the posting of the total of the sales journal, because this total is posted to the debit side of the accounts receivable account in the general ledger and to the credit side of the sales account in the general ledger.
4. The accounts receivable account in the general ledger shows the total amount to be collected from all charge customers and the amounts to be collected from each.
5. The accounts receivable account in the general ledger shows the total amount that is to be collected from all charge customers, but the individual accounts in the accounts receivable ledger show the amounts to be collected from each charge customer.

D. Recording cash receipts

Purpose: (1) To present the cash receipts journal as a special journal in which to record all cash receipts; (2) to explain the use of special columns in books of original entry; (3) to show how a beginning balance is recorded in the cash receipts journal; (4) to show the relationship between cash received from a customer on account and the customer's account in the accounts receivable ledger; (5) to present the methods of handling other cash receipts; (6) to explain the posting of the cash receipts journal; (7) to explain how cash is proved and what to do when cash is over or short; (8) to present the schedule of accounts receivable and its relation to the controlling account; and (9) to explain the use of statements sent to customers.

Points to emphasize:
1. All cash receipts, but only cash receipts, are recorded in the cash receipts journal.
2. An amount is recorded in the Cash Debit column for each cash receipts transaction.
3. In the four-column cash receipts journal, special columns are maintained for Accounts Receivable Credit and Sales Credit.

4. Each amount that is recorded in the Cash Debit column is credited in one of the credit columns--General, Sales, or Accounts Receivable.
5. The total of the Cash Debit column equals the total of the General Credit column plus the total of the Sales Credit column plus the total of the Accounts Receivable Credit column.
6. Cash should be proved each day.
7. Show the relationship between totals in the sales journal and the cash receipts journal to the accounts receivable account and to the customer's accounts.
8. How the schedule of accounts receivable provides proof of the accuracy of the work.

E. The general journal

Purpose: (1) To illustrate the need for a general journal for miscellaneous entries when special journals are used; (2) to review opening entries as presented in Part I, Section 2; (3) to present the types of entries that are recorded in the general journal; and (4) to review the general ledger and to show how the proof of equality of debits and credits in the general ledger is accomplished by taking a trial balance.

Points to emphasize:
1. The nature of the opening entry.
2. The nature of miscellaneous day-to-day entries that can be recorded only in the general journal.
3. Correcting entries.
4. Adjusting and closing entries.
5. Order of posting from special journals.

F. Bank deposits and reconciliation of bank statements

Purpose: (1) To stress the importance of protecting cash on hand; (2) how to open a bank account and make deposits; (3) how checks are endorsed; (4) how deposit tickets are prepared and the use of ABA numbers; (5) what records a bank keeps of depositors' accounts; (6) what a bank statement is and the importance of proving the accuracy of the bank statement; (7) steps in reconciling a bank statement; and (8) how service charges made by a bank are recorded.

Points to emphasize:
1. The importance of a checking account as a way to protect cash and to provide accurate records.
2. How to endorse a check properly.
3. How to prepare deposit tickets.
4. How bank records relate to the cash journals.
5. What a bank statement is.
6. How a bank statement is reconciled.
7. The importance of recording bank service charges in the cash payments journal.

G. Work Sheet with adjustments

Purpose: (1) To expand the six-column work sheet presented in Part I, Section 8 into an eight-column work sheet; (2) to develop an understanding of

the need for adjustments; (3) to show the adjustments for merchandise inventory through the Profit and Loss Summary account. (Note: The teacher is at liberty to teach the class to adjust merchandise inventory through Purchases or Profit and Loss Summary. However, the latter conforms to modern accounting procedures.) (4) to show the relationship between the merchandise inventory account and the profit and loss summary account; (5) to show the relationship between the supplies and prepaid insurance accounts and the supplies and insurance expense accounts; and (6) to show the steps in completing an eight-column work sheet.

Points to emphasize:

1. The work sheet is usually prepared in pencil because it is not a permanent record.
2. The need for adjusting the balances of some asset accounts such as Merchandise Inventory, Supplies, and Prepaid Insurance, in order to bring these accounts up to date.
3. That the profit and loss summary account is debited with the beginning inventory and credited with the ending inventory and that each of these amounts is extended to the P. & L. Statement columns of the work sheet.
4. The use of the Adjustments columns on a work sheet as an efficient way to plan the adjusting entries that are to be recorded in the journal and posted to the ledger.
5. The method of proving the entries and calculations on the work sheet.

H. Financial reports

Purpose: (1) To show the need for the profit and loss statement and the balance sheet as two separate reports and (2) to demonstrate the method of preparing the two reports from the data given on the work sheet.

Points to emphasize:

1. The work sheet gives in convenient form and on one single sheet all of the data that are needed in preparing the two financial reports.
2. The profit and loss statement is prepared from the P. & L. Statement columns of the work sheet. Point out that some businesses refer to the profit and loss statement as the income statement.
3. The profit and loss statement in this section contains three sections as follows: (a) income from sales section; (c) cost of merchandise sold section; and (c) operating expenses section.
4. The balance sheet is prepared from the Balance Sheet columns of the work sheet.

I. Adjusting and closing entries

Purpose: (1) To teach the need for recording adjusting entries in the general journal; (2) to demonstrate the use of the adjustments columns on the work sheet in recording adjusting entries in the general journal; (3) to teach the need for closing entries and the end of each fiscal period; (4) to demonstrate the use of the profit and loss statement columns of the work sheet as a basis for recording closing entries in the general journal; (5) to illustrate the balancing and ruling of accounts after adjusting and closing entries have been posted; and (6) to illustrate the proof of the ledger by taking a post-closing trial balance.

Points to emphasize:

1. In order to bring some of the general ledger accounts up to date so that they show the same information as is shown on the balance sheet, adjusting entries must be recorded in the general journal and posted to the general ledger.
2. All adjusting entries are prepared from the data in the adjustments columns on the work sheet.
3. Adjustments of ledger accounts are not made directly in the ledger. All adjustments of ledger accounts must be the result of postings from a book of original entry.
4. Closing entries are recorded in the general journal and are posted to thegeneral ledger so that the proprietorship section of the ledger will show the same information as is given on the balance sheet.
5. No balance may be transferred from one account to another directly in the ledger. All transfers of balances from one account to another must be authorized by a general journal entry.
6. All closing entries recorded in the general journal are prepared from the data given in the profit and loss statement columns on the work sheet.
7. All asset, liability, and proprietorship accounts that do not show clearly the balance of the account are balanced and ruled at the end of the fiscal period.
8. The post-closing trial balance proves that the ledger is in balance after the adjusting and the closing entries have been posted.

III :: PRACTICE SET WITH BUSINESS PAPERS

Purpose: (1) To give an entire review of the material covered in one problem; (2) to present a problem simulating a real business situation as much as possible in the classroom; and (3) the practice set is an ideal preparation for the semester examination.

Points to emphasize:

1. All work may be done in pencil. However, the teacher should instruct the class which sections are done in ink and which are done in pencil in the business world.
2. All transactions should be recorded immediately in the blank-books. The entries should not be made on loose paper and recopied.
3. The penmanship should be neat and legible.
4. The student should be encouraged to locate and correct his own errors.
5. All corrections of errors should follow the principles that have been studied in this course.
6. Instruct the students to prepare the work sheet in pencil since this is not a permanent record of the business.
7. If adding machines are available, have the students make free use of them in order to learn how to use such machines and to speed up the work of proving various columns of the work sheet.
8. Make certain the student completes the work sheet in the following order: (a) make the adjustments and prove the equality of the Adjustments columns; (b) extend the proper items to the Balance Sheet columns and find the difference between the Debit column and the Credit column; (c) extend the proper items to the P. & L. Statement columns and find the difference between the Debit column and the Credit column; (d) compare this difference with the

difference obtained in the Balance Sheet columns to make certain the work is correct; and (e) complete the work sheet by entering the net profit and ruling the work sheet.

9. Permit the students to refer to the text for the form of the profit and loss statement and the balance sheet.
10. Make certain the students prepare their adjusting entries from the information on the work sheet.
11. Make certain the students prepare their closing entries from the P. & L. Statement columns of the work sheet.
12. Be sure that, after the adjusting and closing entries are posted, the accounts are ruled in proper form.
13. Have the students compare the post-closing trial balance with the Balance Sheet columns of the work sheet. All items should agree with the exception of the drawing account.

IV :: PROBLEMS IN RECORDING BOOKKEEPING TRANSACTIONS

A. The combination journal and the petty cash fund

Purpose: (1) To combine the special journals and the general journal into one single book of original entry known as the combination journal; (2) to teach the use of the petty cash fund.

Points to emphasize:

1. The combination journal is a book of original entry that combines the purchases journal, the sales journal, the cash receipts journal, the cash payments journal, and the general journal in one single book of original entry by providing one or more amount columns for each of these journals.
2. The Purchases Debit column and the Accounts Payable Credit column in the combination journal, together with the Name of Account column, take the place of the purchases journal.
3. The Sales Credit column and the Accounts Receivable Debit column in the combination journal, together with the Name of Account column, take the place of the sales journal.
4. The Cash Debit column, the General Credit column, the Accounts Receivable column and the Sales Credit column take the place of the cash receipts journal.
5. The Cash Credit column, the General Debit column, the Accounts Payable Debit column and the Purchases Debit column take the place of the cash payments journal.
6. The General Debit and Credit columns, the Accounts Payable Debit column, and the Accounts Receivable Credit column take the place of the general journal.
7. All cash receipts should be deposited in the bank, all payments except petty cash items should be made by check.
8. To avoid writing checks for small amounts, a petty cash fund system should be maintained.
9. The petty cash fund payments should from time to time be summarized and replenished by check.

B. Problems relating to sales and purchases

Purpose: (1) To present a number of miscellaneous problems that supplement and expand upon the work of preceding sections such as (2) sales and purchases returns and allowances, (3) transportation charges, and (4) cash discount.

Points to emphasize:

1. When sales are returned by a charge customer or an allowance is given, Sales Returns and Allowances is debited and Accounts Receivable and the customer's account are credited.
2. When purchases are returned to a creditor or an allowance is received, Accounts Payable and the creditor's account are debited and Purchases Returns and Allowances is credited.
3. The credit memorandum is the business form from which the bookkeeper secures the necessary information for recording sales returns and allowances and for recording purchases returns and allowances.
4. The cost of freight, express, or parcel post on purchases is sometimes recorded in a special account with the title "Transportation on Purchases."
5. Cash discount is allowed in order to encourage the buyer to make payments before the end of the credit period.
6. A special column with the heading "Discount on Purchases Credit" is provided in the combination journal for the record of cash discount on purchases.
7. A special column with the heading "Discount on Sales Debit" is provided in the combination journal for the record of cash discount on sales.
8. On the profit and loss statement:
   a. Sales Returns and Allowances and Discount on Sales are subtracted from Sales in order to determine the Net Sales.
   b. Purchases Returns and Allowances and Discount on Purchases are subtracted from Purchases in order to determine the amount of Purchases.
   c. Transportation on Purchases is added to the Net Purchases in order to determine the Net Cost of Merchandise Purchases. (The teacher is free, however, to include the above discount accounts in the "Other Income, Other Expense" Section of the Profit and Loss Statement.)

Note: The column headings may vary according to the problems used as illustrations. This is not to indicate what problems are to be used in this section.

C. Payroll records

Purpose: (1) To present very briefly the principal provisions of the Social Security Act as they affect bookkeeping records; (2) to teach students some of the basic payroll work performed by bookkeepers or payroll clerks, and (3) to present some of the most common payroll time cards, forms, and records.

Points to emphasize:

1. The kinds of taxes and other deductions withheld from wages and paid by the employer.
2. Obtaining a social security card.
3. Payroll time cards.
4. Payroll register
5. Employee's earnings record.
6. Methods of paying the payroll.

D. Taxes and reports

Purpose: To teach the kind of records that must be kept for accurate payroll accounting and a form that is required by the government in connection with payrolls.

Points to emphasize: The principal topics in this section are:
1. Recording the paying of the payroll in the combination journal.
2. Recording the employer's liability for his share of FICA taxes.
3. Recording the liability for the employer's state unemployment taxes.
4. Recording the liability for the employer's federal unemployment taxes.
5. Paying the liability for all employees' taxes withheld.
6. Paying the liability for state unemployment taxes.
7. Paying the liability for federal unemployment taxes.
8. Reports to employees on Form W-2 of income taxes withheld.

E. Depreciation of Fixed Assets

Purpose: (1) To develop an understanding of depreciation and a simple method of calculating depreciation; (2) to introduce the account Allowance for Depreciation of Equipment as an example of valuation accounts; and (3) to show the relationship of fixed assets to current assets and of long-term (fixed) liabilities to current liabilities and in what order these accounts are reported on the balance sheet.

Points to emphasize:
1. Fixed assets are used by a business for several fiscal periods and often are not easily converted into cash.
2. Fixed assets decrease in value because of depreciation.
3. Depreciation is an expense which, if not recorded, causes the net profit to be OVERSTATED.
4. The amount of depreciation recorded for each fiscal period is an estimated amount. The actual depreciation is not known until the fixed asset is sold, discarded, or replaced.
5. The estimated amount of depreciation is recorded as an adjusting entry at the end of each fiscal period.
6. The estimated amount of depreciation is debited to Depreciation Expense and is credited to Allowance (Reserve) for Depreciation.
7. The estimated amount of depreciation on fixed assets is recorded as an operating expense of the business.
8. The allowance for depreciation account is a valuation account. It normally has a credit balance and is placed in the assets division of the ledger. It is a minus asset account.

F. Disposing of fixed assets

Purpose: It is the purpose of this section to illustrate and explain three methods of disposing of fixed assets.

Points to emphasize:
1. A fixed asset may be disposed of by being (a) discarded, (b) sold, or (c) traded as part of the purchase price of a new asset.

2. Because the value of a fixed asset at the time it is disposed of will probably not equal its book value, a business will frequently experience a loss or a gain at that time.
3. The book value of a fixed asset must be brought up to date at the time of its disposal for determining the loss or the gain.
4. The entry and the effect on accounts when an asset (a) with book value is discarded, and (b) with no book value is discarded.
5. The entry and the effect on accounts when an asset is sold (a) at a loss, (b) at a gain, and (c) at book value.
6. The entry and the effect of accounts when an asset is traded in.
7. How gain and loss on fixed assets is reported on the profit and loss statement.

V :: PROBLEMS IN RECORDING BOOKKEEPING TRANSACTIONS (continued) AND PRACTICE SET #2

A. Bad Debts and Accounts Receivable

Purpose: (1) To expand the work at the end of the fiscal period by including adjustments for bad debts; (2) to develop a better understanding of the nature of allowance accounts by including an allowance for bad debts; and (3) to present the two accounts that are needed in evaluating accounts receivable, Allowances for Bad Debts and Bad Debts Expense.

Points to emphasize:
1. Every business that sells on account acquires uncollectible accounts.
2. The balance of the accounts receivable account should be evaluated each time a balance sheet is prepared.
3. The estimated amount of uncollectible accounts receivable should be recorded in a separate account entitled "Allowance for Bad Debts."
4. The estimated amount of uncollectible accounts acquired each fiscal period should be charged to an expense account with the title "Bad Debts Expense."
5. The balance of the allowance for bad debts account is normally a credit balance that shows the amount to be subtracted from the debit balance of the accounts receivable account in order to determine the estimated real value of the accounts receivable.
6. The debit balance of the bad debts expense account is classified as an operating expense and is shown on the profit and loss statement.
7. The credit balance of the allowance for bad debts account is classified as a minus asset and is shown on the balance sheet.

B. The use of the cash register

Purpose: (1) To present the cash register records as an integral part of most retail store bookkeeping systems; (2) to explain the operation of the cash register; (3) to teach the proving of cash with the cash register records; (4) to explain the method of accounting for cash short and over; (5) to develop the petty cash fund; and (6) to review the multicolumn combination journal presented in the preceding sections and to use it in typical retail store transactions.

Points to emphasize:

1. The cash register is found in almost every retail business.
2. The cash register provides a convenient place for sorting coins and currency and keeping the money available for the daily transactions.
3. The cash register provides an immediate machine record of each cash transaction.
4. Many cash registers furnish the customer with a receipt of the transaction.
5. The cash register detailed audit strip and daily balance slip supply a very efficient method of proving cash.
7. The multicolumn combination journal is a very popular book of original entry in retail store bookkeeping systems.
8. Sales slips may be filed in a cabinet and the cabinet may displace the accounts receivable ledger.

C. Practice Set #2

Purpose: This practice set should be based upon the use of the cash register records as an integral part of the bookkeeping system. It applies the principle of the combination journal developed in Part IV, Sections 1-6 and Part V, Sections 1-2. It can also offer the opportunity to teach the use of sales slips and purchases invoices as subsidiary ledgers.

Points to emphasize:

--------Refer to Part III (third six weeks period)

VI :: ADAPTING BOOKKEEPING METHODS TO THE BUSINESS

A. Notes and interest

Purpose: (1) To present how notes are used in business and what notes are; (2) to show how interest tables are used to compute interest; (3) to review a simple method of calculating interest; (4) to develop the entries that are required in transactions involving notes receivable and interest income; (5) to develop the entries that are required in transactions involving notes payable and interest expense; (6) to show how interest income and interest expense are reported on the profit and loss statement; and (7) to develop the entries for the discounting of notes.

Points to emphasize:

1. The terminology of promissory notes, such as maker, payee, date, time, maturity date, principal, and interest rate.
2. The fundamental principles of calculating interest by use of a table and by arithmetic.
3. The general journal entry to record a note received from a customer.
4. The cash receipts journal entry to record the collection of a note and interest.
5. The general journal entry to record a dishonored note receivable.
6. The general journal entry to record a note issued to a creditor.
7. The cash payments journal entry to record the payment of a note and interest.

8. The general journal entry and the cash receipts journal entry to record the discounting of a note payable.
9. The method of listing interest income and interest expense on the profit and loss statement.

B. Accrued expenses

Purpose: (1) To explain the nature of accrued expenses; (2) to demonstrate the need for adjusting entries covering accruals; and (3) to demonstrate the need for reversing entries for accruals.

Points to emphasize:
1. In order to present an accurate balance sheet and an accurate profit and loss statement, accrued expenses must be included.
2. The amounts of the accrued expenses are added to the liabilities on the balance sheet and are added to the expenses on the profit and loss statement.
3. The adjusting entry for an accrued expense is a debit to an appropriate expense account and a credit to an appropriate liability account.
4. After the adjusting entries for accrued expenses have been recorded and the financial reports have been prepared, a reversing entry for each accrued expense should be recorded and posted.
5. The adjusting entry in the general journal for accrued salaries.
6. The adjusting entry in the general journal for accrued interest expense.
7. The method of showing adjustments for accrued expenses on the work sheet.
8. The method of showing accruals on the balance sheet.
9. The reversing entry in the general journal for accrued salaries.
10. The reversing entry in the general journal for accrued interest expense.

C. Partnerships

Purpose: To provide an introductory treatment of the partnership type of proprietorship and the bookkeeping problems peculiar to the partnership.

Points to emphasize:
1. The purpose served by a partnership.
2. The method of organization of a partnership.
3. The opening entries for cash investment and for the investment of cash and other assets.
4. The entries for recording the payment of the partner's salaries.
5. How the distribution of the partnership net profit is presented on the profit and loss statement.
6. How the details of each partner's proprietorship are set forth in the proprietorship section of the partnership balance sheet.
7. The adjusting and the closing entries for a partnership.

D. Bookkeeping and budgeting for the family and the individual

Purpose: To illustrate the applications of business bookkeeping and procedures to the financial records of a family.

Points to emphasize:
1. Need for a chart of income and expense accounts needed to record the income and the expenditures of a family.

2. The purpose and the method of preparation of the family budget.
3. The use of the combination journal for recording the transactions of a family.
4. Controlling expenditures.
5. The work at the end of the year.
6. The financial statements of a family.
7. The preparation of a budget for the coming year.
8. Income tax data.

E. Columnar Special Journals

Purpose: (1) To expand the number of special columns used in the cash receipts journal, the cash payments journal, and the general journal; (2) to present the double-page cashbook in multicolumn form; (3) to review the invoice file form of purchases and sales journals; and (4) to present the cash method of handling purchases on account.

Points to emphasize:
1. The use of many amount columns is not limited to the combination journal but may be adapted to special journals also.
2. The number of amount columns desirable in a special journal varies with the nature of the business.
3. If desired, the cash receipts journal and the cash payments journal may be combined in a double-page cashbook.
4. The purchases invoices may be filed and used as a purchases journal. This plan requires a summarizing entry in the general journal at the end of each month.
5. The sales invoices may be filed and used as a sales journal. This plan requires a summarizing entry in the general journal at the end of each month.
6. Purchases on account may be recorded only when the account is paid, at which time Purchases is debited and Cash is credited.

ENRICHMENT MATERIALS :: BOOKKEEPING SYSTEMS FOR SPECIAL PURPOSES

A Bookkeeping and budgeting for school and social organizations

Purpose: To illustrate the application of business bookkeeping principles and procedures to social organizations with which the student is familiar. Two different types of school organizations should be employed as an illustration: (1) a small club that does not handle much money, and (2) an athletic department that handles a considerable sum of money.

Points to emphasize:
1. The importance of careful budgeting of income and expenses by all social organizations.
2. The procedures for handling and auditing cash receipts and cash payments of a social organization.
3. The use of a simple two-column cashbook when the cash receipts and cash payments are few in number and easily analyzed.

4. The use of a multicolumn cash journal when the transactions are numerous and a considerable amount of money is handled.
5. Types of reports used by social organizations.

B. Bookkeeping for a professional man

Purpose: To illustrate the application of business bookkeeping principles and procedures to the bookkeeping for a professional man.

Points to emphasize:
1. The purpose and use of the daily appointment book.
2. The purpose and use of the patient's record and ledger account card.
3. The combination journal of a dentist.
4. The financial reports of a dentist.
5. The purpose and use of the collection docket and the case docket of an attorney.
6. The use of the combination journal of an attorney.
7. The financial reports of an attorney.

C. Bookkeeping for a farmer

Purpose: To illustrate the application of business bookkeeping principles and procedures to the bookkeeping for a farmer.

Points to emphasize:
1. The difference between the cash basis of bookkeeping and the accrual basis.
2. The bookkeeping of a farmer is usually kept on a cash basis.
3. The function of the special farm accounts such as: Livestock Raised Sales, Produce Sales, Livestock Purchased Cost, Livestock Purchased Sales, Merchandise Received for Produce, Miscellaneous Income.
4. The combination journal of a farmer.
5. The work sheet and the financial statements of a farmer.
6. The adjusting and the closing entries in farm bookkeeping.
7. The schedule of farm income and expenses in the income tax return of a farmer known as Form 1040F

Note: Although most textbooks discuss corporations and cooperatives, the committee felt that the subject should be reserved for the college level; therefore, it was not included in this syllabus.

AWARDS: Awards in bookkeeping are offered at reasonable prices by:
Gregg Publishing Division
McGraw-Hill Book Company, Inc.
330 West 42nd Street
New York 36, N.Y.

South-Western Publishing Company
5101 Madison Road,
Cincinnati 27, Ohio

The FBE Bulletin, P.O. Box 7, Lenox Hill Station, New York 21, N.Y., often lists free awards that commercial houses offer as advertisement or good will.

CONTESTS: Brother E. F. Ryall Bookkeeping Contest
74 West 124th Street
New York 27, N.Y.

CBEA Contest, contact Sister M. Edmunda, C.C.P., Secretary
Southern Unit, Catholic Business Education Association,
Our Lady of the Lake College, San Antonio, Texas.

The Balance Sheet, 5101 Madison Road, Cincinnati 27, Ohio, periodically publishes bookkeeping contests.

The Business Education Committee of the Southern Province favors participation in state rallies.

SOCIETIES: National Business Honor Society (sponsored by the CBEA),
400 East Second Street, Dayton 2, Ohio.
(School charter fee, $5 and $3 yearly charter dues.)

The state organization of the FBLA (Future Business Leaders of America.)

VT 001 998
Home Economics Humanities Media Guide, Project CUE, Culture, Understanding, Enrichment.

New York State Education Dept., Albany
MF AVAILABLE IN VT-ERIC SET.
Publications Distribution Unit, New York State Education Department, Education Building, Albany, New York 12224.
PUB DATE - 65 158p.

DESCRIPTORS - *HOMEMAKING EDUCATION; *RESOURCE GUIDES; RESOURCE MATERIALS; *AUDIOVISUAL AIDS; FILMS; FILMSTRIPS; LESSON PLANS

ABSTRACT - To integrate the arts into the home economics curriculum, the New York State Department of Education developed this resource guide containing a wide selection of classroom-tested materials related to areas in the state home economics curriculum guide. The 53 resources include films, filmstrips and records, slide sets, pictures, and books and booklets, many of which touch upon more than one home economics curriculum area. The materials are indexed according to these areas of emphasis: (1) Beauty in Appearance, (2) Creativity Through Food, (3) Esthetics of Family Housing and Dress, (4) Understanding of Peoples Around the World, and (5) Personal Appreciation of Beauty. A lesson plan, built around each of the 53 resource materials, contains: (1) home economics curriculum area, (2) purpose of the lesson plan, (3) synopsis of the information in the media, (4) preparation of the class for the media, (5) suggested followup and related creative activities, and (6) related materials. A list of producers is included. (SB)

VT 001 998

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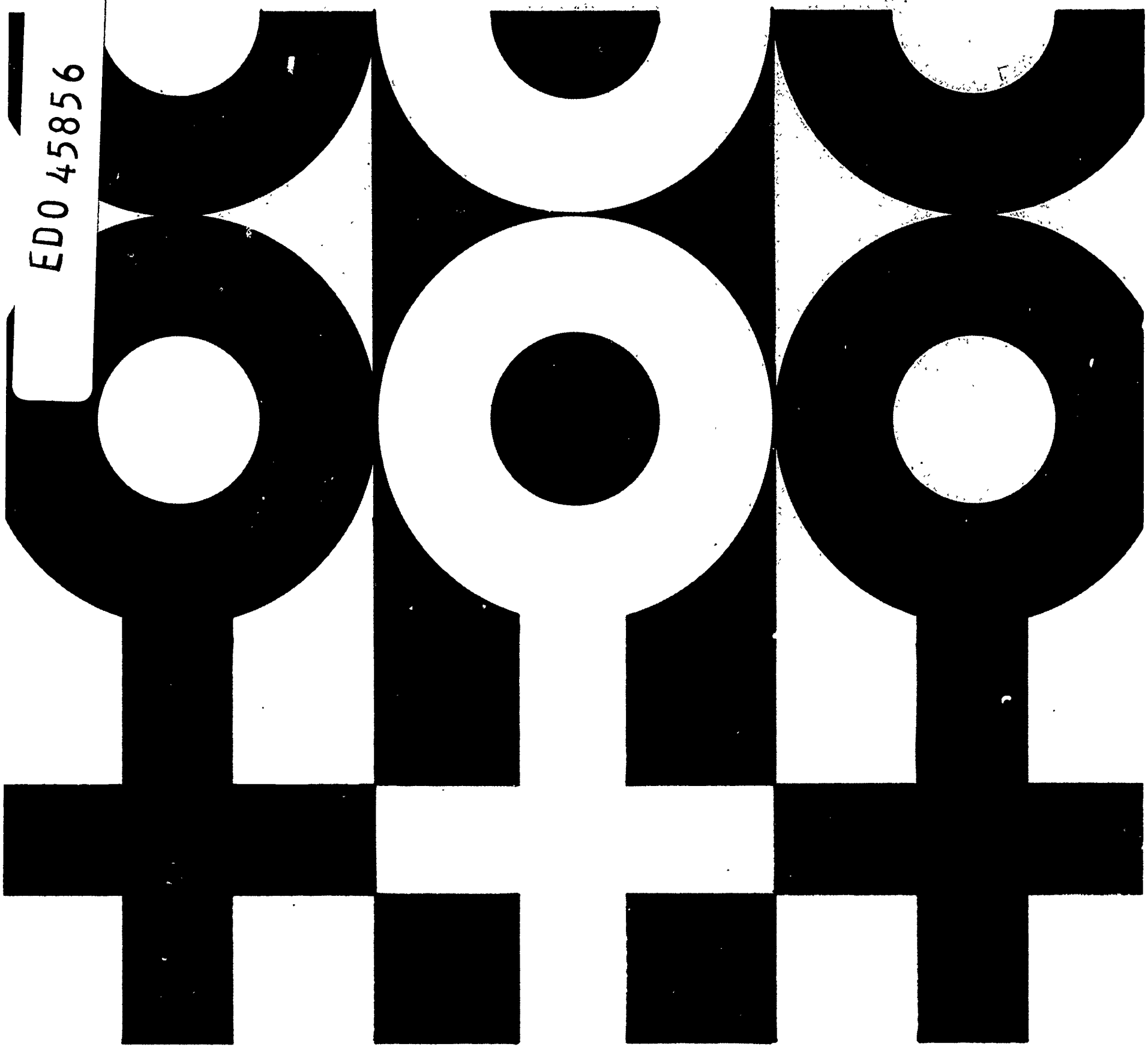
158p*



VT 01998

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CUE

ERIC

what is project CUE?

CUE opens doors.

IT'S a trip to Angkor Wat.
poetry, literature, drama.
Leonardo and Michelangelo.

IT'S temple dancers in Thailand.
Macchu Picchu and Brasilia.
weeping over Romeo and Juliet.

IT'S perception and understandings.
a visit with the ancient Greeks.
trips to museums, seminars, exhibits.

IT'S "High Life" music in West Africa.
a tour of France with Charles Boyer.
ballet, opera, string quartets, jazz.

IT'S rhythms of the South Pacific.
discovering that art is a way of life.
discovering texture, line, form, color.

IT'S packages of media--films, strips, slides, records, tapes, pictures which inform, instruct, delight, stir, inspire, amuse, teach, and stretch the mind.

IT'S guides which assist teachers to integrate the super-communication of the arts and humanities to illumine and enrich the ongoing curriculum in the 9th grade.

"TO SEE LIFE; TO SEE THE WORLD; TO EYEWITNESS GREAT EVENTS; TO WATCH THE FACES OF THE POOR AND THE GESTURES OF THE PROUD; TO SEE STRANGE THINGS--MACHINES, ARMIES, MULTITUDES, SHADOWS IN THE JUNGLE AND ON THE MOON; TO SEE MAN'S WORK--HIS PAINTINGS, TOWERS AND DISCOVERIES; TO SEE THINGS THOUSANDS OF MILES AWAY, THINGS HIDDEN BEHIND WALLS AND WITHIN ROOMS, THINGS DANGEROUS TO COME TO; THE WOMEN THAT MEN LOVE AND MANY CHILDREN; TO SEE AND TO TAKE PLEASURE IN SEEING; TO SEE AND BE AMAZED; TO SEE AND BE INSTRUCTED; THUS TO SEE, AND TO BE SHOWN, IS NOW THE WILL AND NEW EXPECTANCY OF HALF MANKIND." *LIFE

THE UNIVERSITY OF THE STATE OF NEW YORK
THE STATE EDUCATION DEPARTMENT
ALBANY 1965

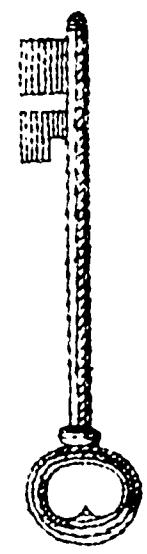
V381-N65-2000

ERIC

CULTURAL ENRICHMENT IDEAS IN THE AREA OF HOME ECONOMICS

Home economics teachers find many different ways of capitalizing on the range of culturally enriching moments in the life of the learner. Among the unlimited possibilities for integrating the arts and the humanities and expand the cultural horizons of learners in teaching of home economics are the

- use of foods in creative and varied ways in family meal planning through understanding the food habits of many cultures
- development of those values and the deeper appreciation of individual heritage and respect for the heritage of neighbors far and near through understanding of the influences of family traditions, national customs, religious beliefs throughout the world
- promotion of the concept of democracy as a basic value in society transferred to democratic family living
- development of taste in the use of paintings, art objects to express the personality of the individual or family in decorating the home
- use of color and design in table appointments to stimulate restful and relaxed meal time
- influence of ancient culture on modern day dress and the clothing habits of other cultures as created by needs and climate of living conditions



This volume provides a wide range of resources from which the teacher may select those appropriate to learning levels of particular group of students and to the home economics concepts being developed.

The research reported herein was supported by a grant from the United States Office of Education, Department of Health, Education, and Welfare.

FOREWORD

Two recent trends in education met in an exciting study, known as Project CUE, culture, understanding, enrichment. The first trend was the growing recognition on the part of educators and laymen, for doing a better job of teaching the arts, the humanities, in the public schools. The second trend recognized the potential impact of a well organized "system" of instruction to support the teacher in his day-to-day teaching.

The combination of these two ideas prompted the United States Office of Education to give the New York State Education Department a grant to integrate the arts into the curriculum through the technique of a carefully planned system of instruction, based upon media-materials, curriculum guides, and suggested methodology and techniques for implementing the program. The Division of Educational Communications and the Bureau of Secondary Curriculum were assigned the task of operating the project under the directorship of Dr. Robert Brown and Mrs. Grace N. Lacy.

Although the teaching of the humanities has been taking place in many schools in the country for many years, the study being made by the Education Department represented several different approaches. First, it was decided that the humanities were for all students and not just for a select few, who chose to elect a special humanities course at a particular grade level. Second, the humanities are part of all subject area content and should be recognized and appreciated in that context. Third, a carefully prepared program of media, materials and methodology could enable the teacher and student to teach and learn in a superior way. With these three points in mind, 13 experimental schools were selected to integrate the humanities program into the ninth grade curriculum.

In July, 1963, nine teacher consultants came to Albany to select the materials suitable to their subject areas. They then wrote lesson plans for use of the materials, under the direction of Mrs. Lacy. The lesson plans were edited by the Bureau of Secondary Curriculum and the assigned subject matter specialists, published, and sent to the 13 project schools. Packages of the chosen materials were assembled and sent to the schools by the Division of Educational Communications.

Mrs. Lacy visited all schools to orient the teachers to the program and explain the CUE system. Curriculum and audiovisual coordinators in each school acted as liason persons between the school and the CUE staff. Throughout the year the materials and guides were used and evaluated by the CUE teachers. As a result of one year's use, the materials and guides have been revised and upgraded in the light of the criticisms and suggestions of more than 250 teachers. Dr. Brown conducted testing in all schools before and after the cultural material had been used.

Special acknowledgement should be expressed to each individual who participated in Project CUE. Since this is impossible, due to the large

numbers that have contributed to the effort, the Department can only recognize in a general way, the help given by the United States Office of Education; the National Art Gallery; the teachers, coordinators and administrators in the thirteen project schools; the special writers and subject area supervisors; the staff of the Division of Educational Communications and the Bureau of Secondary Curriculum; and the manufacturers and producers of the media-materials used.

Lee E. Campion
Director, Division of
Educational Communications

Hugh M. Flick
Associate Commissioner for
Cultural Education and
Special Services

ADDENDUM

CUE has now been renewed for a third year by the United States Office of Education (1965-66). Interest in the project has become widespread throughout the State, and requests for the guides and information about the project come in from many parts of the country. A new "Do-It-Yourself Guide," which gives helpful information to those schools interested in implementing the CUE system, is now available. Use of this guide, CUE subject guides, and materials lists enable any school to benefit from CUE's pioneer research in arts and humanities integration through media and a "systems" approach.

Persons wishing further information about CUE should direct inquiries to:

Director of CUE
New York State
Education Department
Albany, New York

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CULTURAL ENRICHMENT PROJECT (CUE)
HOME ECONOMICS

ORGANIZATION OF MEDIA

Many of these materials touch upon more than one curriculum area. See guide below to determine which areas the materials stress.

1. Beauty in Appearance.
2. Creativity Through Food.
3. Esthetics of Family Housing and Dress.
4. Understanding of Peoples Around the World.
5. Personal Appreciation of Beauty.

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Over the centuries, the humanities have sustained mankind at the deepest level of being. In the formative years of our own country, it was a group of statesmen who fused their own experience with that of the past to create the enduring Constitution of the Republic.

During our early history, we were largely occupied in mastering the physical environment. Soon after, advancing technology put its claim on our energies. The result has often been that our social, moral and esthetic development lagged behind our material advance. We are proud of our artists and scholars and our technology, which has made their work highly available, but this is not enough. Now more than ever, with the rapid growth of knowledge and its transformation of society's material base, the humanities must command men of talent, intellect and spirit.

The state of the humanities today creates a crisis for national leadership. Many of the problems which confront the people of the United States involve the humanities. Among them are the following:

- All men require ideals and vision. Americans need today, as never before, understanding of such enduring values as justice, freedom, virtue, beauty and truth. Only thus do we join ourselves to the heritage of our nation and human kind.

- Wisdom - without the exercise of wisdom, free institutions and personal liberty are imperilled. The humanities impart insight and wisdom.

- When Americans accept their cultural responsibilities, the arts will help us understand cultures other than our own. Few people can understand a nation which spends billions on defense and will do little or nothing to maintain the creative and imaginative capabilities of its own people.

- World leadership cannot exist solely on the force of wealth and technology. Only excellence of goals and conduct entitle one nation to ask others to follow its lead.

- Greater life expectancy and automation make leisure a source of personal and community concern. The arts and humanities provide a stabilizing influence and fill the abyss of leisure profitably and enjoyably.

- The arts and humanities hold values for all human beings regardless of their abilities, interests or means of livelihood. These studies hold such value for all men precisely because they are focused upon universal qualities rather than on specific and measurable ends. They play a uniquely effective role in determining a man's behavior and values. These studies therefore should not be reserved for scholars alone but should be for all students whether they leave school after grades 9, 12, or after college or a doctoral degree. While the schools are not the only agency to accomplish this task, there is no other in America that bears so heavy a responsibility.

USING CUE MATERIALS EFFECTIVELY

The following points are stressed to give insight into the CUE system and the utilization of CUE materials. CUE schools are supplied with packages of media described in the CUE guides. Other school or libraries may also acquire the CUE materials from the listed producers in the back of this guide.

- CUE guides contain a wide selection of classroom tested materials related to the New York State Curriculum so that the teacher may select those which best suit the needs of his group.

- The Synopsis which is a description of each piece of material is provided for the teachers convenience in selecting material to preview.

- Synopsis and "Suggestions for Class Preparation" provide for class orientation and motivation.

- "Look and Listen For" items point out important areas in the material. Alerting students to these items results in increased retension of important factors.

- "Follow-Up Activities" contain numerous suggestions to stimulate the teachers own creativity.

- The Related Materials listings saves teacher time in locating other sources. Librarians may wish to acquire CUE related materials for teacher and student convenience.

- A stimulating learning atmosphere is made possible through permanent and traveling exhibits of art reproductions and realia as well as performances provided by CUE. These activities serve as a unifying thread around which many student experiences may be grouped. Such beneficial unification of learning experiences may be further enhanced by:

    - occasional use of team teaching
    - use of art and music teachers as resource persons

- A TV program "Cultures and Continents" provides for mountain top experiences ordinarily not obtainable in the classroom. This program gives insight into non-western cultures through their arts. Large group viewing of these programs enables some teachers to have free time for mutual planning.

- Kinescopes (filmed versions) of these shows are available for those schools not serviced by TV.

- Cutural organizations channel many of their services to schools through CUE.

- Business and Industry provide materials for schools through CUE. Such services are related to the curriculum in a meaningful way.

- CUE provides materials to develop abstract concepts and generalizations. Some of these materials may be seen, felt, smelled, heard, manipulated, or organized, assembled or taken apart during learning. These experiences are those which are retained and recalled and become a permanent part of the students knowledge.

- There is no substitute for teacher guidance and insight in selecting planning, organizing and using instructional materials. CUE provides the teacher with a wide choice of classroom tested, teacher certified materials which save teacher time in locating and evaluating materials and free that time for the important personal aspects of teaching.

- CUE materials are keys which open doors to new vistas of learning interest, broaden horizons and increase perception but it is still the teacher who remains THE MASTER KEY in proper selection, use and development of insights.

The Argument for Inter-disciplinary Relationships

Too commonly, the teacher teaches his subject, or a unit within it, without reference to its relationship to other components of the curriculum. Students often study one subject after another, with no idea of what his growing fund of knowledge might contribute to an integrated way of life.

The special job of education is to widen one's view of life, to deepen insight into relationships and to counter the provincialism of customary existence; in short, to engender an integrated outlook.

The arts and humanities may be used as a unifying thread in the curriculum. This unitary view of the curriculum is important because:

- Comprehensive outlook is necessary for intelligent decisions.
- A person is an organized totality - not a collection of separate parts.
- An atomized program of studies engenders disintegration in the life of a society.
- The value of the subject is enhanced by an understanding of its relationship to other subjects.
- Knowledge does not exist in isolation; integrated subject matter is more meaningful.

TIME TO INCLUDE THE ARTS?

Many teachers are firmly convinced of the worth of including the arts in the curriculum but profess they do not have the time to do so. The following are a few suggestions for making time available.

- Use the arts as a vehicle for subject skills
  The study of all subjects needs a vehicle. The arts can be such a vehicle - one can learn all the technique and skills of reading and communication while learning about the arts. Art and science are inextricably related; both are looking for sense, order, and beauty in the universe. True understandings of the people of the world cannot be grasped out of the context of their arts. Industrial arts are an outgrowth of fine arts. Homemaking involves knowledge and use of arts. The compelling reason for use of the arts as a vehicle is that students today are in dire need of acquiring a much higher level of cultural competence than was formerly thought adequate.

- Use of large group instruction
  Several groups may view T-V, a film or hear a lecture given by one person, thus freeing teachers for mutual planning or conference.

- Independent Study
  Students may use filmstrips, programed learning or do independent research on their own in study hall or learning center or library.

- After school seminars
  On arts and humanities for interested groups may be given.

- Use of time ordinarily not used for study-Before school, lunch hours, home room activity periods may be used for listening to good music or other activities.

- Out of School time
  Evenings, weekends may occasionally be used for museum or concert visits, architectural tours.

- Assembly programs may be cultural in nature. Thus large groups can be reached.

- Use of a stimulating environment
  Students learn at least as much outside of class as in. Educational displays provided by CUE, effective bulletin board displays create an atmosphere for learning and teach students in incidental moments.

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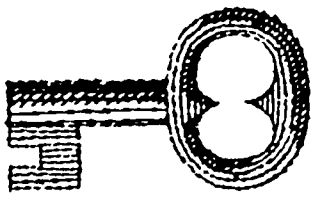
CULTURAL ITEM: "ADVENTURES IN COLOR" (Film)
10 min., Pittsburgh Plate Glass.



CURRICULUM AREA: Home Economics - Family Meals
Clothing Selection
Interior Design

PURPOSE:

This film is an excellent aid in alerting students to the wonder and joy of color.

NOTE: (to the teacher) The multiplicity of the visual images we receive tends to make us jaded and lacking in real perception. Color is not the province of the painter alone but a resource of everyone.)

SYNOPSIS:

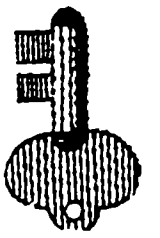
This is a gay, whimsical, animated film in beautiful design and color which tells in verse, and illustrates how color affects our moods, our vocabulary, our enjoyment of food and our surroundings. Color dynamics can reduce accidents, improve housekeeping, and promote productivity as well as express personality, create a mood, lend loveliness and pleasure to our lives. This film may be used to stimulate imagination and vocabulary development which in turn increases color perception and awareness. Resultant vocabulary gains may be employed in creative or descriptive writing.

SUGGESTED PREPARATION OF THE CLASS:

To orient students to the material in the film explain: Just as size and weight affect us so, too, does color. We speak of a bright morning, a blue funk, a red letter day. The world we live in is multicolored. Color helps us enjoy dress, food and drink and the rooms we live in. This film will show you how you can use color to create a mood, express personality, to make rooms seem larger and add loveliness and pleasure to your life. (Note: Have on hand Roget's Thesaurus and dictionaries for later use.) Copies of the delightful poem "Color" may be duplicated for later reading and enjoyment. Explain to the class that color words lend stimulation and pleasure to writing.

PUPILS SHOULD LOOK AND LISTEN FOR:

. The use of color and color words.
. How color can be used to enhance surroundings.
. Use of color dynamics in hospitals, factories and schools.



PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To insure understanding of color dynamics, discuss with the class:

   . How color creates moods and affects our feelings.
   . Use of color as a safety and health factor.
   . Use of color illusions in making rooms or furniture seem smaller or larger.

SUGGESTED RELATED ACTIVITIES:

1. To increase color perception, assist enlargement of color vocabulary by learning about color symbolism and how it affects our language.

   . Explain to the class: For primitive man color was symbolic. Every virtue or vice of man had a special color symbol. In later periods, color became decorative rather than symbolic but we still have remnants of this color association in our speech. Black is associated with evil--therefore we speak of a "black-hearted villain" --white is the symbol for innocence and we speak of persons being "pure as the driven snow."
   . Compile with the class expressions which contain color symbolism. (See CUE insights on "Color and Color Symbolism.")

2. To sensitize students to the power of color words in writing, discuss with them the feelings that various colors give them.

3. Compile with the class lists of related color words such as: purple, amethyst, yellow, amber, golden, tawny, green, viridian, seafoam, grassy, verdant, emerald, red, crimson, rose, fiery, roseate, cerise.

SUGGESTED RELATED CREATIVE ACTIVITIES:

. Ask the class to choose any colored object they like such as an emerald, a leprechaun, the sun, the moon, a car or other and utilize the color words they have learned or simply write a poem about a single color. Refer to the book "Hailstones and Halibut Bones."

RELATED MATERIALS:

Films:

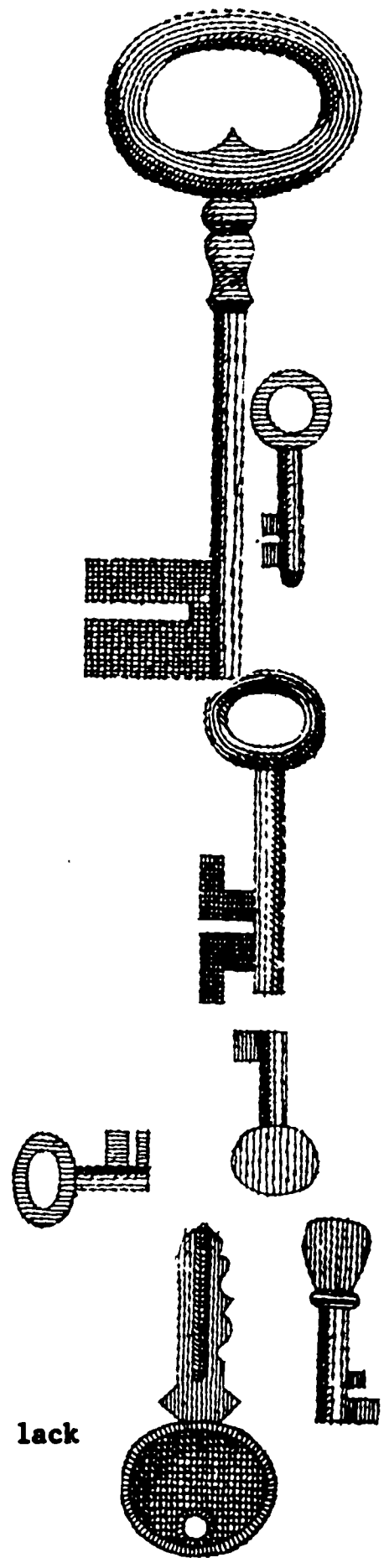
Discovering Color. (Film Associates) (CUE)
Hailstones and Halibut Bones. (National Film Board of Canada)

Filmstrips:

Take a Look at Color. (J.C. Penney Com., Inc.; McCall's Patterns; Coats & Clark's Threads)
Color and You. (J.C. Penney Co., Inc.; McCall's Patterns; Coats & Clarks Threads)

"COLORS"

Like acrobats on a high trapeze
Colors twist and bend their knees
Twist and turn and leap and blend
Into shapes and feelings without end.
Light is color and color is light
Prism, rainbow, day and night.
Every color unique alone
Has mood and meaning of own.
Yellow is the color of the sun,
The feeling of fun.
The yolk of an egg, a duck's bill
A canary bird, a daffodil.
Yes a topaz, a candle flame
Mimosa's yellow and I guess
Yellow's the color of happiness.
Red is a sunburn spot on your nose
And sometimes red is a red, red rose.
Red squiggles out when you cut your hand.
Red is a ball and a rubber band.
Red is a lipstick, red is a shout.
Red is a sign that says "Watch out"
Red is a show off, no doubt about it!
Can you imagine living without it?
Blue is the sky without a cloud.
Cool and distant, lonely and proud.
Blue is the quiet sea
And the eyes of some people
And many agree
As they grow older
That blue is the scarf
Spring wears on her shoulder.
Orange is a tiger lily,a carrot
A feather from a parrot, a flame
The wildest color you can name.
Orange is the fur of the fiery fox
Orange is the crayon in the box.
And in the fall when the leaves are turning
Orange is the smell of a bonfire burning.
Colors dance and colors sing.
Colors can do anything.
Colors can laugh and colors can cry
Turn off the lights and colors die.
But wait! Black is a color we can use.
Black is licorice and leather shoes.
Black is the print in the news
And think of what starlight and lamplight would lack
If they couldn't lean back against black.



CULTURAL ITEM: "THE AMERICAN LOOK" (Film)
29 min., Color, General Motors.

CURRICULUM AREA: Home Economics - Esthetics of Family Housing, Furnishings, and Equipment

PURPOSE:

To alert students to the work of stylists and how styling adds to the ease, grace and beauty of our lives.

SYNOPSIS:

Industrial stylists work in the form, line, texture and substances of the conveniences and necessities of life. The arts and crafts of American stylists add grace, ease and glamour to our lives. Homes now have new plans for living made attractive by new forms accented by new color selection. Today people are increasingly interested in the look of things.

Good styling is evidenced in packaging, machines, boats, cars; all kinds of equipment. Modern American architecture has a new boldness and functional beauty. This film shows the beauty of American styling in glowing color and explains how stylists work to achieve attractive new designs in furniture, equipment and automobiles.

SUGGESTED PREPARATION OF THE CLASS:

To acquaint students with the meaning of styling, secure the Ford book of Styling from CUE Industrial Arts Kit. As you show some of the book's illustrations to the class explain: Styling is the art of designing beauty into useful things. Although we think styling is a new endeavor, in reality it has been practiced since civilization began.

Discuss with students how product design has improved in beauty. Explain that this improvement is largely due to the work of industrial designers who believe that products can be beautiful as well as useful. The work of stylists gives us a new freedom-the freedom of individual choice.

PUPILS SHOULD LOOK AND LISTEN FOR:

- The way in which new forms and use of color make home and leisure more attractive and enjoyable.
- The bold colorful look of new products and architecture.
- The steps taken in the creation of a new product design.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To enhance appreciation of the role and work of the stylist and designer:

Explain to the student that the designer creates new designs; the stylist chooses fabrics, colors and materials and combines them for use in products. Refer to CUE insight sheet on "Styling."

2. To assist the student to understand the difference between fine and applied art explain: Although all art has a purpose, applied arts are those in which the function or use of the product is foremost in the artists mind.
   Art was used by primitive man as a magic to help him in the hunt or as a means of placating the gods or securing power over nature. Art which is used for these purposes or for pure pleasure is called Fine Arts.

   Man has an innate desire for beauty and he liked to embellish his tools and utensils with design to make them more attractive. However, in making these articles his main thought in mind was usefulness. The decorative or art element was then applied to the article. These are the applied arts (See CUE Insights "Function in Art"). Ask students to identify the fine and applied arts in the school, their homes.

3. View the CUE film "Seven Guideposts to Good Design." Follow lesson plan and refer to insight sheet on "Good Design and Styling."

SUGGESTED RELATED CREATIVE ACTIVITIES:

To develop critical judgment and creative thinking:

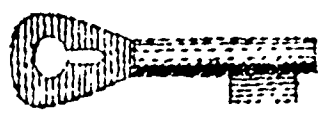
. Ask students to look about the home or school for products whose design could be improved in the light of their new learnings.

. To assist their creative thought ask: How could the product be improved? Could it be made larger? smaller? out of another material? Should something be added to or taken off of it? Could it be made more cheaply? Could it be made in two parts? Could two products be put together to make a better one? Could it be simplified? Are the color, texture, shape and line pleasing? Is it truly functional?

. Ask students to sketch their new designs and explain to the class what improvements they have made.

. Make the point clearly that it is this kind of thinking which helps American business and all stylists to provide better lives for us by giving us all fine products formerly available only to the wealthy few.

. As students work out their designs explain: All our acts of selections and arrangement are decisions on design. This decision involves our likes and dislikes, human needs and the application of the principles of design. Illustrate the following with sketches on the board or real objects:



- Proportion - try to achieve beautiful space relationships to make the article fit its use - (fit the hand or body). Try to create optical illusions that will give the impression of beautiful proportions when it is not possible or feasible to change the basic design. Organize the entire design to have good interesting space relations. Help students understand that unequal divisions of space are more interesting and less monotonous.
- Variety adds interest. The design must follow the function but can you add interest by expressing a new quality not in old designs?
- Balance - The design should have either formal (symmetrical) or informal (asymmetrical) balance. Explain to students how to achieve informal balance.
- Emphasis - Every design should have a center of interest or dominant area which may be emphasized by leading lines or unusual detail.
- Rhythm - Use lines and forms to lead the eye easily from one part of design to the other. Rhythm may be achieved by repetition of lines and shapes, gradation or progression and continuous lines of related movement.
- Unity - All of these elements must work together to give the design an overall oneness.

RELATED MATERIALS:

Film:

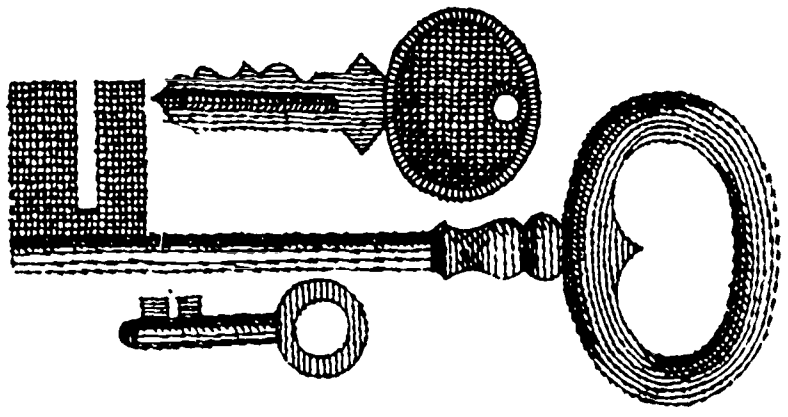
Seven Guideposts to Good Design. (CUE)

Booklet:

Ford Book of Styling. (CUE Industrial Arts Kit)
Alcoa Book of Styling. (CUE Industrial Arts Kit)

CUE Insights:

Design, Styling, Function in Art.



CULTURAL ITEM: "AMERICAN PAINTING IN HISTORY" (Filmstrip, record, book) 14 Frames, Color, National Gallery.

CURRICULUM AREA: Home Economics - Fashion Heritage- Socio-economic Influences on Dress

PURPOSES:

To reveal how costume is related to architecture and painting in that all the arts of a people express the ideals, hopes and way of life of their times.

To show how art and civilization are linked together.

(Note: Only 14 frames of the filmstrip are used and described here as an indication of what might be done with other paintings in CUE Kits or local museums.)

SYNOPSIS:

This beautiful filmstrip shows American life and people from colonial times to the present through paintings and architecture. By pointing out how the dress and architecture and other arts or a people reflect the spirit of their times, pupils are enabled to gain new insight into the meaning of these arts, and perceptions and understandings of costume and architecture will be enhanced.

SUGGESTED PREPARATION OF THE CLASS:

To aid pupils to gain the above insights explain: Ordinarily we do not think of houses and costumes as being related and yet if we look closely we can see that they both spring from the spirit, style and way of thinking of their time.

SUGGESTED PROCEDURE - SHOW:

Frame 3 - This is Pocahontas dressed in fashion of the English court where she visited with her husband, John Rolfe, in Queen Elizabeth's day. Her dress, with its wide starched lace collar, rich brocade and golden trimmings, is simple compared to Elizabeth's lavish costumes; yet it reflects the grandeur of the English court.

Frame 7 - When the English arrived in America on the ship Susan Constant:

Frame 8 - They built houses of wattle and daub (mud, straw and plaster). People in the colonies had to struggle hard just to survive. Grand clothes like those worn in the court in England were inappropriate here.

Frame 9 - They had to use native materials to make their own clothing. Here people are having a party while they break and beat flax to make thread for spinning. Much of the clothing was made of a fabric called linsey-woolsey, which was woven of both linen and wool threads. It was sturdy and warm. The clothes were

plain and simple, like the houses, reflecting the kind of life led by the people.

In the North, Pilgrims and Puritans removed all decorations and wore only subdued colors to express their disapproval of the excesses of the English court. Here religious thought is expressed in dress.

Frame 12 - This is a windmill built by the Dutch who settled in New Amsterdam and other places.

Frame 13 - This is Catalynje Post who lived in the New Netherlands, now New York State. Her family was prosperous enough to have her picture painted by a "limner" - a person who painted signs and clock faces. Her costume reveals that life was beginning to be easier for the Dutch traders in New York. The costume reflects the style of her native Holland and shows that the Dutch understood the making and mixing of dyes. She wears a quilted calico cap and sturdy leather high-heeled shoes. Her skirt is held out by numerous gay colored petticoats. A woman's wealth was judged in those days by the number of petticoats she could afford.

Frame 16 - This is the home of William Penn. This home shows an increasing ease of life and a fine eye for craftsmanship and design.

Frame 19 - This is the self portrait of Benjamin West, an early American artist. At this time, gentlemen began to copy the English style of wigs or powdered their hair. Puritans tried to stop this style but by 1716 the fashion was general. We can see that when life is no longer such a struggle, people have more time for fashion. Though much simpler than French styles, the Quaker garb was a great deal fancier than that of the Puritans.

Frame 20 - Of course the dress of Colonel Johnson, superintendent of Indian affairs, reflects his life on the frontier just as today's cowboys' garb reflects their life.

Frame 21 - Southern colonists were quite different in spirit from the Northern settlers and this difference of spirit shows quite plainly in architecture and costume. Far from disapproving of the English and French courts, they were so anxious to keep in style, that "fashion dolls," dressed in the latest gowns, millinery and coiffures, were sent to them from Paris. Local dressmakers copied the fashions. The great tobacco crops yielded funds for luxurious dress. Here we see Martha Washington, dressed in sumptuous satin, powdered wig and shawl, while the father of our country is dressed in the manner of the French court, in breeches, coat, cravat, wig, garters, buckles and silk hose.

Frame 22 - As they copied ideas of fashion from France, they also copied their architecture. Recent archeological discoveries had brought the ideas and arts of the Greeks and Romans to the attention of the French.

Frame 23 - French architects copied the classic styles of Roman and Greek temples in public buildings. The American colonists followed their lead and our public buildings and homes in the south reflect this classic tradition. This expression in architecture was more than a style; it was a symbol of the ideas of democracy taken from the Greeks. It was these ideas which were to bring on the revolutions both in America and France.

Frame 30 - In this Maryland home we see this neo-classic influence.

Frame 31 - And here is Eliza Ridgely, who lived in this house. Notice how different her simple dress and hair style appear, compared to previous fashions. This fashion change also reflects the spirit of the times. During the French Revolution, the people wished to repudiate anything reminiscent of the hated French king and court. Fashionable ladies shed their furbelows, hoops and powdered wigs and dressed in simple sheath gowns of linen called "mervielleuses," patterned after Greek and Roman classic dress. This style reflected their desire for democracy or a republic. The same ideas flourished in America and similar style changes occurred.

The above is merely a brief glimpse of the wonderful world of "arts and ideas." History and our own times are filled with many more.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

To assist students to see the spirit of the times reflected in various arts:

- Use the Time Magazine, November 8, 1963, CUE Tearsheet on Fashion to show how the baroque spirit is reflected in many arts.
- Compare contemporary, fashion, architecture and painting (e.g., a shift dress, bee hive hair-do, skyscraper and Mondrian painting).

SUGGESTED RELATED ACTIVITIES:

To further understandings, use World Book illustrations on clothing to acquaint students with costumes of other times and places.

Have students do research relating costume and architecture of a place or period which interests them.

Visit a museum of costume, or your local museum, to observe the history of your area as reflected in costume.

SUGGESTED RELATED CREATIVE ACTIVITIES:

To awaken creativity, have students design modern clothing based on inspiration from costumes of the past or other lands. Explain that professional costume designers use such inspiration.

RELATED MATERIALS:

Filmstrip:

Florentine Painting

Slides:

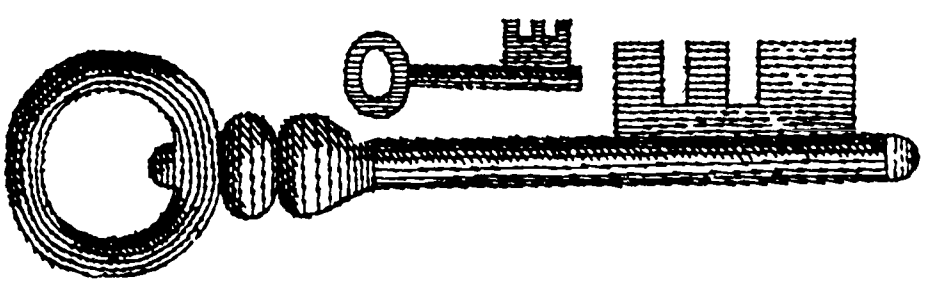
Survey of American Painting. (CUE)

Book:

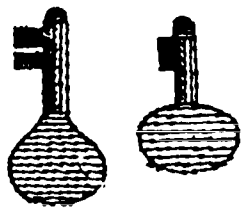
Costumes and Styles, Harold Hansen. (Dutton and Co., N.Y., 1957)

Booklets:

Historic Costume, Lester and Kerr.
Clothing - World Book, 1964.



CULTURAL ITEM: "THE ART OF GIFT WRAPPING" (Film)
15 min., Color, Hallmark Cards.



CURRICULUM AREA: Home Economics - Interpersonal Relationships
Expressing Creativity
in Giving

PURPOSES:

To alert students to the fact that art is a way of life that can add graciousness and charm even to the smallest acts.

SYNOPSIS:

It isn't what you give but how you give it. Thoughtful remembrance of important occasions makes life more gracious. Gift wrapping started in ancient China, with gifts carefully wrapped in rice paper. In Japan, gift wrapping is an art. Today's wide selection of beautiful papers, ribbons, stickers make it an art that can be acquired by all. This film demonstrates many beautiful and creative ways to wrap gifts for all occasions to give that added touch that means so much.

SUGGESTED PREPARATION OF THE CLASS:

. Ask students to bring in paper, ribbon, and an object for wrapping.

. Have on hand the booklet "The Art of Gift Wrapping," obtainable from stores selling Hallmark cards. No other preparation is necessary for this film, which is clear and fascinating.

PUPILS SHOULD LOOK AND LISTEN FOR:

. Techniques in securing a package and preparing an object for wrapping.
. The artist's uses of ribbon and color combinations.
. How to coordinate wrappings to accessories, occasion, season, or specific date.
. Use of wrapped packages as centerpieces.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. Practice making package with materials brought from home, using the technique suggested in the film and booklet.

2. Experiment with ribbon flowers for centerpiece, bulletin board, department display.

SUGGESTED RELATED CREATIVE ACTIVITIES:

1. Make tiny wrapped packages for mobile decorations for the holidays , depicting in the creative wrapping symbols that stand for the varied Christmas celebrations around the world.

2. Use ribbon decoration for cake decoration for birthdays and special occasions.

3. Study the customs of other countries in relation to giving and receiving gifts.

4. Make potato or sponge print wrapping paper.

5. Make a study of modern packaging. Secure the booklets on packaging from the CUE Industrial Arts Kit (see listing below). Assist students to learn that:

   . Packaging determines salability of a product.
   . Simplicity is the common denominator of all good designs.
   . New materials, especially plastics, make new, more efficient, pleasing and functional packaging possible.
   . Packages must have strong product identification as well as commercial appeal.

6. Study the prize winning packages in the Container Corporation booklet. Have students design a product package of tagboard or other materials.

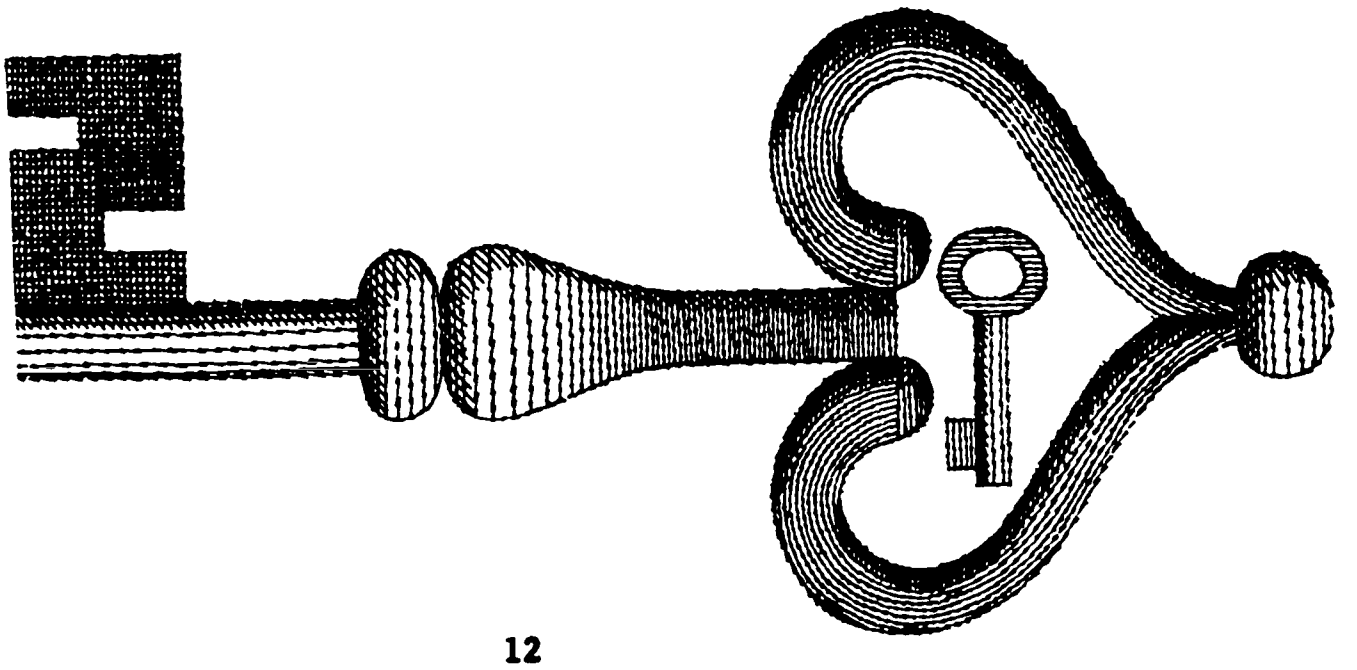
RELATED MATERIALS:

Booklets:

The Art of Gift Wrapping. (Hallmark Cards.)
Prize Package Designs. (Container Corporation of America.) (CUE)
Discussion in Design. (Shell Chemical Co.) (CUE)
23 Ideas for Tomorrow's Packages. (Shell Chemical Co.) (CUE)

CUE Insights:

Christmas Customs Around the World.



CULTURAL ITEM: "ASIA SERIES--IRAN" (Flat Pictures)
16 Flat Pictures, Color, International Communications Foundation.

CURRICULUM AREA: Home Economics - Understanding Peoples of Various Cultures
Intercultural Influences on Food, Home, Dress

PURPOSES:

To acquaint students with the flavor of life in Iran, its old Persian culture and beautiful monuments, as well as life today.

SYNOPSIS:

These beautiful colored flat pictures allow students to see that while nomadic patterns of life centuries old still persist in Iran, the impact of the modern world is felt because of the discovery of oil, which brings industry in its wake. Not the least of the charms of these pictures are the beautiful monuments and tombs and mosques reminiscent of days when Persia was an enormous and powerful empire.

SUGGESTED PREPARATION OF THE CLASS:

1. The teacher may explain that as the pictures from "Bounty of Foods" in Life Magazine were shown to the class, it had been emphasized that many fruits and vegetables originated in Persia (Iran). This series of pictures of Iran will deepen our understanding of the people of this country, their works of art, and their way of life.

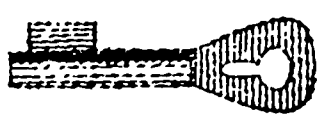
2. Bring a map or globe to the classroom and point out the location of Iran.

PUPILS SHOULD LOOK AND LISTEN FOR

. Nomadic ways of life, tents, rugs, hand spinning.
. Ways of earning a living - farming, metal working, herding, caviar industry, oil fields.
. Tomb of Avicenna -- esteemed philosopher and poet.
. Largest oil refinery in the world at Abadan.
. Garb of the Turkomen tribe, ways of eating.
. Persepolis built by Darius the Great.
. The mosque at Isfahan, with colorful kaski (tiles), minarets and domes.
. The priceless Naderi and Peacock Thrones.
. Foods eaten (fruits, rice, cheese, lamb, bread, tea).
. Manner of eating, pottery, china, housing.

PRESENT MEDIA.

(Play a recording of Persian music while students study pictures.)



SUGGESTED FOLLOW-UP ACTIVITIES:

1. To further understandings of Persian culture, help students to understand that:

   . Modern life is suddenly impinging on age-old cultural patterns.
   . While a few people in Iran are fabulously wealthy and some are educated, large groups of the peoples are poor and unlettered.
   . At one time, Persia was a great empire, and we can still see remnants of grandeur in the temples, tombs and mosques.
   . Persians were wonderful gardeners. They raised peaches and roses and melons in this arid land. They cherished their gardens and fountains as cool beauty spots in the desert. Persian rugs are really pictures of these gardens. These rugs are rare, beautiful, costly and treasured art works.
   . The Persians had many gifted poets. Poets and philosophers are honored in Persia as we honor our statesmen and heroes. One of these, Omar Khayyam, is well known among English speaking people for his Rubaiyat.

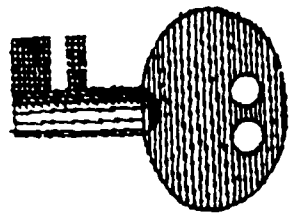
2. To encourage appreciation for the richness of the culture, ask students to describe the artistic skills they observed (architecture, metal work, tiles, rug weaving).

3. Summarize by asking:

   From these pictures, what can we gather about the people of Iran? Their religion? State of culture? Artistic skills? Ideals? Values? Their future?

SUGGESTED RELATIVE ACTIVITIES:

. Have the class prepare some typical foods of Iran such as "shish kebab" (meats such as lamb on a skewer).
. Have students trace the history of foods of Iran, such as the peach , melon, caviar.
. Find a picture of a samovar and explain its use.
. Have students locate lines in poetry or literature which describe food (e.g., "A loaf of bread a jug of wine and thou ..."). Use these along with photographs or drawings for a bulletin board.
. Have a student report on the story of the Peacock Throne.



RELATED MATERIALS:

Films:
   Ancient Mesopotamia. (Coronet Films)
   The Byzantine Empire. (Coronet Films)
   The Mohammedan World: Beginnings Art Growth. (Coronet Films)
Filmstrip:
   Iran. (Life)

CULTURAL ITEM: "AUTUMN COLOR" (Film)
7 min., Color, Thorne Films.

CURRICULUM AREA: Home Economics - Clothing Selection
Color in the Home

PURPOSE:

To awaken sensitivity to the beauty of color in our environment.

SYNOPSIS:

Color surrounds us. We cannot escape it, but whether we enjoy it or not depends on our ability to see. Some people enjoy only brilliant spectacular colors, like a bonfire or fireworks. Other people enjoy colors that are cool and lovely like an azure sea or the delicate white and green of young birch trees. Life is so much richer when we learn to see and enjoy fine color harmonies wherever we find them - in the woods, in the sky, on the street, in a dress or a rug. This beautiful film helps sensitize viewers to the beauty of color and texture in their surroundings.

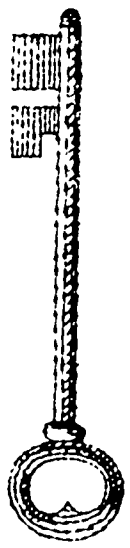
SUGGESTED PREPARATIONS OF THE CLASS:

1. Pupils should have a basic knowledge of color, the spectrum, the primaries and secondaries before seeing the film. (Note: This film should follow use of CUE film, "Discovering Color.")

2. Explain that the film will help them enjoy color more (see synopsis) by revealing how nature combines color. Of importance, too, are the tones of muted color seen in the film. Students should select examples of their favorite hue, value and intensity from the film. Alert students that there is no narration; they must learn with their eyes and feelings.

3. Arrange a display of a few fabrics or fashion photographs which show new fall patterns and colors. These will be used in discussion.

PUPILS SHOULD LOOK AND LISTEN FOR:



. The spectrum of colors found in nature.
. Warmth in colors.
. Variety in values and textures.
. Beauty and meaning in the colors that surround us.
. How colors affect our feelings.
. The relationship of colors to fabrics.
. Mood created by the piano accompaniment.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To help students analyze their feelings about color, ask:

. Which colors of the spectrum did you discover as you viewed the film?

. What is the effect of warm colors upon the individual?
. Why do red dresses appear more suitable in winter than in summer?
. Why are these colors called "advancing" colors?
. How do dimensions in color give variety?
. How do the seasons affect colors in fabrics?

2. Ask pupils to examine the fabrics on display and determine on the color wheel their hues, their values, their intensities. Emphasize in the discussion an individual's coloring in relation to color of fabrics.

SUGGESTED RELATIVE ACTIVITIES:

1. Playing with color and learning its properties helps students to be more observant and knowing about it. Display the color wheel on the flannel board using the primaries (red, yellow and blue) and the secondaries (green, orange and purple), and:

   . Either have all students paint, or use some as paint demonstrators, and show how to mix the secondary colors from the primaries.
   . Have students demonstrate how to mix the tertiaries from the secondaries and primaries; yellow, green - red orange - blue green - red violet - blue violet - yellow orange.
   . Have students choose any color they like, and continually add white to it to make paler and paler tints.
   . Have them choose a color and make darker and darker shades of it by adding black.
   . Have them practice greying colors by adding a bit of the color's complement.

2. Help them learn by experiment the following color facts:

   . Complementary colors are directly across from each other on the wheel.
   . When colors are brilliant, we say the intensity is high.
   . When the highest possible intensity occurs in colors, we call them <u>spectrum colors</u>.
   . <u>Hue</u> is that property of a color by which its part of the spectrum is distinguished - as red, blue, or yellow. To describe pale pink, you would say its hue is red but it has a light <u>value</u> and a weak <u>intensity</u>.
   . <u>Intensity</u> is that property of a color which gives it strength or brightness of hue. Encourage students to play with the colors for pleasing effects. No special artistic ability is needed. Explain that to get maximum pleasure from color, you must train your eye to detect small differences in hues, values, and intensities, which are important in achieving fine color harmonies. Wet some water color paper and drop colors on; allow them to mingle and flow freely. Tip the paper to encourage color flow. Observe and enjoy the results.

3. Place swatches of bright and cool colors on the flannel board. Assist students to understand why warm colors are called <u>advancing</u> colors and

cool colors are called receding. Explain these color illusions according to the wave length theory. Discuss how this affects choice of color for clothing and decor. (See CUE Insights on color.)

SUGGESTED RELATED CREATIVE ACTIVITIES:

1. Have students choose a print from Metropolitan Seminars or National Gallery paintings, or colored magazine photograph, and:

   . Make a collage of swatches of fall fabrics or paper painted in tones related to or suggested by the painting.
   . Dress a mannequin or design a costume in a color scheme suggested by the painting or photograph.

2. Use half-yard pieces of material as shoulderettes, so girls may judge their most becoming colors. Point out that use of white or pink near the face enables them to wear colors which might not be becoming close to their skin. Bring out the idea that large persons should not wear advancing colors except as small accents.

RELATED MATERIALS:

Films:

Discovering Color. (Film Association) (CUE)
Color and You. (Pittsburgh Plate Glass)

Filmstrip and record:

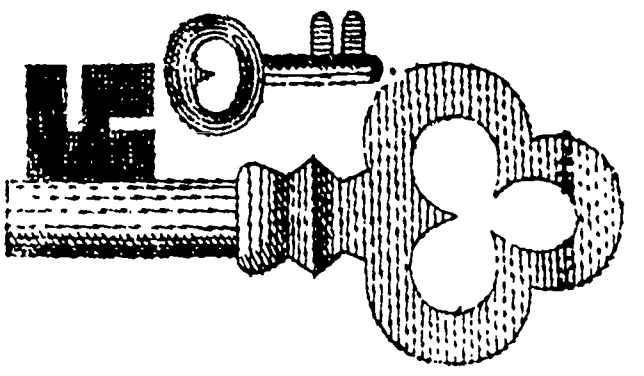
Using Color with Confidence

Book:

The Masterpieces of Modern Art. (The Modern Museum of Art, New York)

Pamphlet:

Artist Jr. - The Art Magazines for the Classroom
Vol. 4 No. 6 April 1963 (CUE Science Kit)
Vol. 4 No. 5 March 1963 (CUE Science Kit)
Vol. 4 No. 3 January 1963 (CUE Science Kit)
Decoration Unlimited. (film guide) (The Bell System) (CUE)



CULTURAL AREA: "BEAUTY IN THE MAKING" (Film)
20 min., Color, Avon.

CURRICULUM AREA: Home Economics - Personal Health and Grooming
Consumer Protection

PURPOSES:

To promote good grooming among teenage girls through proper cleansing and proper and restrained use of cosmetics.

SYNOPSIS:

This colorful film shows how lipstick, the most used cosmetic, is made, and tells what to look for in choosing one. More important, it shows teenagers what cosmetics to use and how to apply them properly.

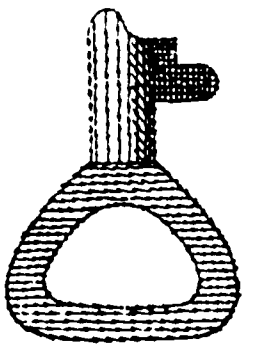
SUGGESTED PREPARATION OF THE CLASS:

The film needs little introduction. It should be used after students have seen the film "Good Looks" or a discussion of good grooming.

Secure lipstick samplers and other make-up from Avon or other source for use after seeing the film.

PUPILS SHOULD LOOK AND LISTEN FOR:

. How lipsticks are made.
. How new shades are chosen.
. The importance of thorough soap and water cleansing.
. How to treat blemishes.
. Proper use of foundation, powder, rouge and lipstick.
. When and how much make-up is appropriate.



PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To dramatize proper use of make-up, ask one girl to demonstrate for the class by using make-up in a theatrical way (too much of everything). The effect will be more impressive if she has an exaggerated teased "hair do." Make up another girl with a simple hair arrangement tastefully and properly. Ask the class to discuss the kind of impression each girl is likely to make on people.

2. Discuss when and how much make-up is appropriate. Stress the appropriateness of the fresh clean simple look, and the importance of scrubbing and diet in maintenance of unblemished skin.

3. Assist girls to learn whether they have oily, dry, combination or problem skin. Ask a local beautician to advise and demonstrate proper make-up.

SUGGESTED RELATED ACTIVITIES:

Some students may wish to do research and report on:

- The history of cosmetics; use paintings and photographs of statues to illustrate these reports.
- Pure food and drug laws, which protect the public from harmful cosmetics.
- Use of cosmetics and hairdressing as therapy for mental and convalescent patients.
- To provide consumer knowledge for intelligent buying, secure the aid of the chemistry department to analyze a very expensive lipstick and a budget-priced one.
- Point out to students that in general there is little difference in the materials used in comparable cosmetics. The tremendous differences in costs go for fancy containers, advertising, research, or are simply tacked on to make the consumer feel she is buying precious beauty ingredients.
- Discuss the psychological aspects of this situation. Alert students to home-made substitutes for these products such as:

  - Tooth cleanser made of baking soda and salt.
  - Hand cream made of glycerin and rose water.
  - Face cream - Lanolin is the only oil which penetrates the skin.
  - Deodorant made of cornstarch and aluminum chloride.
  - Scent - have students collect rose leaves and make a potpourri jar.

SUGGESTED RELATED CREATIVE ACTIVITIES:

1. Let girls use samplers to choose lipstick and other cosmetics suitable to their complexions, coloration and costume colors.

2. Display a girl's dressing table arrangement, showing all essentials of good grooming.

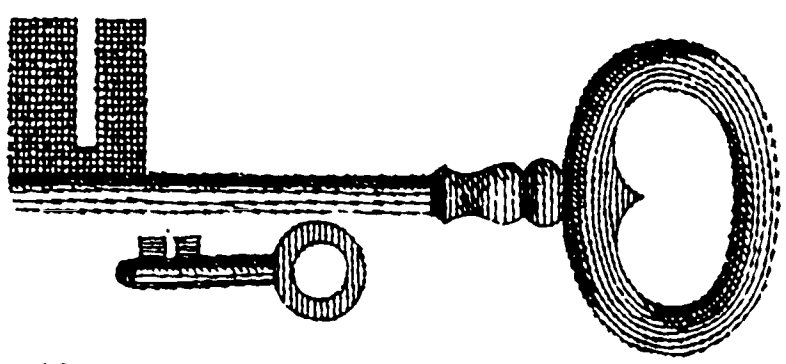
RELATED MATERIALS:

Film:

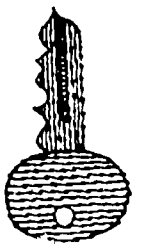
Joy of Fragrance. (Avon) (Film)

Booklet:

Through the Looking Glass. (A girl's guide to good grooming, Home Economics Department, The Proctor and Gamble Company.) (CUE)



CULTURAL ITEM: "BOUNTY OF FOOD" (Flat pictures)
from Life Magazine, November 23, 1962.



CURRICULUM AREA: Home Economics - Food for Health, Growth and Development
Esthetic Appreciation of Food
Esthetic Serving of Food

PURPOSES:

To acquaint students with the beauty, delight, and bounty of food and to sensitize them to color, flavor and texture in foods, and food as a subject in painting and photography; to awaken in them, the desire to arrange and serve food attractively.

SYNOPSIS:

This set of tear sheets contains famous paintings and photographs, which have attempted to capture the delight of food. These beautiful photographs will assist pupils to become more sensitive to color, texture and beauty in food, painting and photography.

SUGGESTED PREPARATION OF THE CLASS:

The teacher may explain that all senses are appealed to by food - taste, of course, and smell. Vision? Behold it. Sound? Who has not enjoyed a crisp crunchy apple. And touch? It is its texture most of all that delights; rough and smooth, soft and firm, all invite the hand.

If possible, have on hand, a variety of fruits and vegetables for touching and arranging.

SUGGESTED PROCEDURE:

Show the painting, "The Artist's Bill of Fare," by Arcimboldo. Explain that this jaunty gentleman made of fruits and vegetables is meant to represent summer.

Show the paintings, "Food for the Palate," by Jacobson and "Pleasures of Taste," by Bruegel the Elder. Explain that in the 17th century, the beauty and bounty of food had become a major art subject. Often these mouthwatering displays contained moralistic messages. Show the photographic compositions of food.

PUPILS SHOULD LOOK AND LISTEN FOR:

- The kinds of fruits and vegetables in the pictures, and their colors and textures.
- What the paintings tell us about life in the 17th century.
- Artistic arrangement of fruits and vegetables.
- The artistry of the photographer in helping us see the beauty of simple things.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To insure appreciations, ask students to:

   . Identify vegetables and fruits in the pictures.
   . Describe the differences in their textures.
   . Describe how these foods would appeal to their senses.
   . Tell of situations at home where such arrangements of fruits and vegetables might be used.
   . Find out the nutritional value of each of these foods.
   . Tell which vegetable or fruit has the greatest eye appeal to them.

2. Explain that many foods have interesting histories. Primitive peaches, called "tao," were grown 3000 years ago in ancient China. Growing of this fruit moved westward. As it migrated, it gained in flavor and beauty. When it reached Persia 25 centuries ago, it got the name, "peach." Persian traders and travellers brought peaches to ancient Greece as early as 332 B.C. Soon Romans served them at banquets. By 1300 A.D., peaches had charmed all of Europe. Early Spanish explorers planted peaches in Mexico and Florida. Other foods have equally interesting histories.

SUGGESTED RELATED ACTIVITIES:

1. Assign students to do research and reports on the history of certain fruits or vegetables.

2. Assist students to develop a vocabulary of words to describe texture.

SUGGESTED RELATED CREATIVE ACTIVITIES:

1. Ask students to utilize their new vocabulary of sense words to write paragraphs or poems about the bounty of food.

2. Plan with pupils the materials, fruits and vegetables needed to make table arrangements. On the following day when these are brought from home, have each one prepare a pleasing and artistic arrangement.

3. Ask for some volunteers in the class to arrange a bulletin board, which will consist of a world map and cutout pictures of fruits and vegetables. Colored yarns and pins may be used to show the geographical location and origin of each. Do some research to find quotations from poetry or prose referring to food and paintings.

4. Explore the National Gallery and Metropolitan Seminars for still life or other paintings containing food.

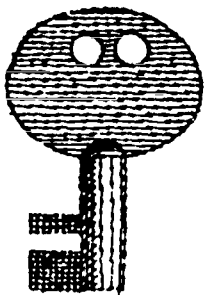
5. Some girls may wish to paint a still life scene of their food arrangements.

6. Some may also like to try photographing arrangements of foods.

7. Have the whole class participate in making collages of magazine cutouts of foods. Mount them on wash backgrounds for display.

CULTURAL ITEM: "CAVALCADE OF FIBERS" (Film)
16 min., Color, Dupont.

CURRICULUM AREA: Home Economics - Textiles in Home and Dress



PURPOSES:

To reveal the history of fibers and fabrics and the technological developments which enable us to have more useful and beautiful fabrics.

SYNOPSIS:

The story of fibers probably began when primitive men experimented with reeds and grasses to make mats for primitive clothes, fishnets and baskets. He also experimented with vines, feathers, animal hair and bark.

Man's first textile device was the spindle which enabled him to spin thread. The next steps were invention of the loom, domestication of wild animals and plant fibers, and use of dyes. Use of fibers was a potent civilizing and stabilizing force in society. It created skilled trades and advanced civilization. The Chinese discovered how to unwind cocoons of the silk worm and to create luxurious satins, brocades and damasks. In 1779, James Hargraves invented the spinning jenny, which led to the Industrial Revolution. In 1789, Cartwright invented the power loom, which led to mass production of textiles. Eli Whitney's cotton gin made cotton fibers cheap and available to all, but the world was still dependent on natural fibers.

The first artificial fiber, rayon, was made by a French chemist in 1884. Modern chemists now constantly make and improve new fibers for the new conditions, needs and demands of our lives.

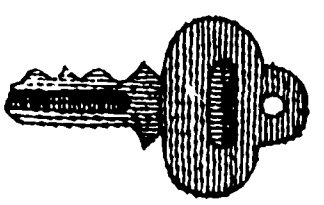
SUGGESTED PREPARATION OF THE CLASS:

This film is self-explanatory and needs little preparation except to have on hand materials from the CUE Home Economics Kit for use in follow-up activities.

PUPILS SHOULD LOOK AND LISTEN FOR:

- Man's early experiments with fibers.
- The four natural fibers we use.
- The inventions which revolutionized the making of textiles.
- The first man-made fiber; other man-made fibers.
- The ways in which modern chemistry improves living.
- The difference between fundamental and applied research.

PRESENT MEDIA.



SUGGESTED FOLLOW-UP ACTIVITIES:

1. To test for comprehension of film content, write these words on the board:

Primitive Man	James Hargraves	Eli Whitney
A Chinese Princess	Arkwright	Rayon
Lyon, France	Dr. Edmund Cartwright	Modern Chemists

   Ask students to explain how each played a part in the development of textiles.

2. To familiarize students with each of the fibers, secure samples of all types of fabrics, man-made fibers and silk cocoon from Textile and Fiber Kit in CUE Home Economics Kit (see related materials). Ask students to identify them.

SUGGESTED RELATED ACTIVITIES:

1. To enrich student background of knowledge, show CUE filmstrip on Textiles. Follow lesson plan.

2. If possible, secure samples or pictures of tapa cloth, Hawaiian feather capes, and felt. Explain that these were primitive non-woven fabrics. Ask students to do research on the processes involved in making these fabrics and where they were first made. Learn about batik cloth and how it is made.

3. Learn how to test natural fiber fabrics for wrinkling and fiber content. Use burning tests for silk content, wet finger for linen, crush in hand for wrinkling. See science teacher for chemical tests of synthetic fabrics. Test fabrics for shrinkage. Learn about Sanforizing, cold water soaps and waterproofing.

4. Select fabrics for various occasions of wear and household uses. Tell why one fabric or type of fiber is superior to another for a special use.

5. Use CUE Kit Textile and Fiber samples and booklets for further study. (See lesson on Man-Made Fibers.)

SUGGESTED RELATED CREATIVE ACTIVITIES:

For further appreciation of textiles:

1. Weave place mats, purses or other small articles. Use imagination by interweaving raffia, metallic fibers, straw, split bamboo or other materials with the other fibers. Secure a book containing illustrations of fabrics woven by Dorothy Leibes or other outstanding textile designer.

2. Choose a wardrobe for an around-the-world trip which takes you to many climates. Be sure to give fiber content and name fabrics, finishes and design.

The criteria for this wardrobe are:

- It must all fit in one large suitcase as you are traveling by air and are allowed only 40 pounds of luggage.
- Fabrics must be washable, drip-dry, wrinkle-resistant and relatively inexpensive.
- You must have outfits suitable for sightseeing, dining out, church, and dress-up, for both warm and cool climates.

3. Have each student bring in a l[illegible] from a clothing article for discussion of care of the fabrics of which the garment is made.

4. Have students assist in making a bulletin board or large scrap book containing sample swatches of all kinds of fabrics of natural and man-made fibers for identification. Have them cut out fashion designs appropriate for these fabrics. Have each student tell why the fabric is suited to her fashion selection.

RELATED MATERIALS:

Display Kits:

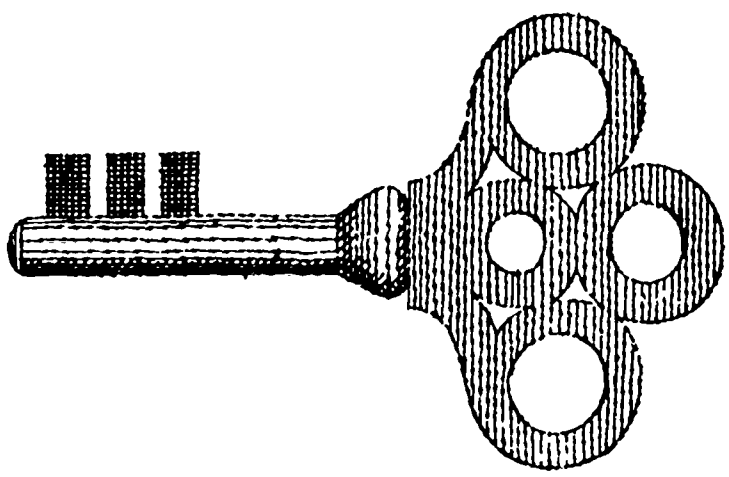
Fibers and Fabrics. (Celanese Fibers Company.) (CU[illegible])
The Story of Silk. (International Silk Association) (CUE)

Booklets:

Dacron for '64 in Fashion Fabrics. (Dupont) (CUE)
Identification-the Word is Identification. (Celanese Fibers) (CUE)
Man-Made Fibers, A Summary of Origins, Characteristics and Uses. (Man-Made Fiber Producers Assn. Inc.) (CUE)

Filmstrip:

Looking Your Best for Spring '64. (Consumer Education Division, Sears, Roebuck and Co.) (CUE)



CULTURAL ITEM: "CERAMIC ARTS OF JAPAN" (Film)
17 min., Color, Ideal Pictures.

CURRICULUM AREA: Home Economics - Craftsmanship in Home Furnishings
Intercultural Contributions to Family Live

PURPOSE:

To instill an appreciation for simple artifacts of the Japanese culture by revealing the careful craftsmanship involved.

SYNOPSIS:

Dishes are called "china" because back in the Stone Age the people of China learned to make pottery. When, in time, they learned to harden and glaze it by baking it at a high temperature, the art of ceramics began.

In the 13th century, the Japanese, influenced by China, began to make pottery. The craft continues to this day. Since the Japanese are highly artistic and skilled craftsmen, their ceramics are among the most beautiful in the world.

This film reveals the entire process of the shaping, glazing, decorating and firing of Japanese porcelain, and gives insight into the skill and artistry of its creators through beautiful color photography of processes and of handsome products.

SUGGESTED PREPARATION OF THE CLASS:

To provide background, explain the origin of the term "china." If possible, display a piece of Japanese or other porcelain; explain that although these ceramics were originally developed for utilitarian purposes, they are now a highly prized art form. Use CUE filmstrip, "Ceramic Arts," as an introduction.

PUPILS SHOULD LOOK AND LISTEN FOR:

- The use of the first ceramic utensils (the tea ceremony).
- The Japanese love of simplicity and formality in the tea ceremony.
- How porcelain material is prepared.
- The skill of the potter and the artists who decorate the ware.
- How glaze is prepared and applied.
- How the ware is fired in the kiln.
- Qualities which the craft reveals about the Japanese (their manual skill, high craftsmanship and artistic spirit).

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To further insight and appreciation, discuss:

   . The difference between china and porcelain (see "Woman's Day Dictionary of Pottery and Porcelain." Home Economics CUE Kit).
   . What Japanese porcelain reveals about its creators.

2. View other ceramics in "Woman's Day Dictionary of Ceramics" and Lenox Fine China Booklet.

3. Arrange for an exhibit of Japanese pottery. The exhibit may also include ceramicware from other countries, such as the United States, England and Denmark. Compare qualities of articles from different countries.

4. Ask the art teacher to demonstrate the potter's wheel, or visit a pottery shop, artist studio or the china department of a local department store.

SUGGESTED RELATED CREATIVE ACTIVITIES:

Since real appreciations come through doing, ask the art teacher to assist the girls to make and glaze small ceramic objects.

RELATED MATERIALS:

Film:

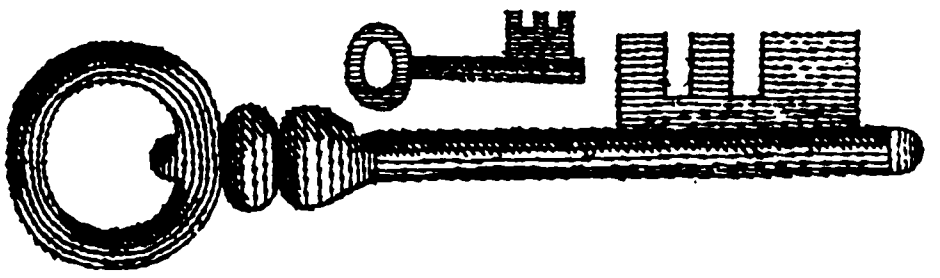
Peter the Potter. (National Film Board) (CUE)
Crafts of Japan. (Japanese Consulate) (CUE)

Filmstrip:

Ceramic Arts. (Encyclopedia Britannica Films) (CUE)

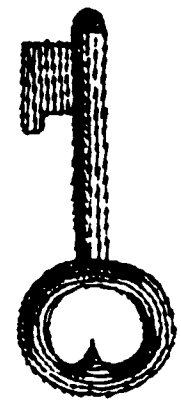
Booklet:

Book of Fine China. (Lenox, Inc., Trenton, New Jersey) (CUE)



CULTURAL ITEM: "COLOR FOR JOY" (Film)
15 min., Color, Rit Dyes.

CURRICULUM AREA: Home Economics - Personal Development
Design in Home and Dress



PURPOSE:

To stimulate interest in using color to brighten the character of the home and personality.

SYNOPSIS:

This film presents a method of redecorating by securing new trends of color usage in home and dress through the use of dyes. Dyeing techniques are demonstrated and the viewer is shown how to "work miracles" with color. Results are imaginatively portrayed. The lesson is that clever use of color in home or dress is a worthwhile artistic accomplishment that pays off in increased beauty and pleasure in surroundings.

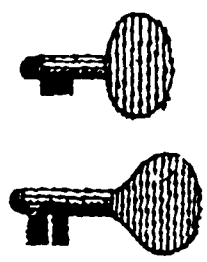
SUGGESTED PREPARATION OF THE CLASS:

To provide background knowledge, show the CUE film, "Discovering Color." Follow lesson plan. Pupils should be able to recognize various color harmonies,such as monochromatic, adjacent or analogous, triadic, complementary, split complementary and accented neutral.

Review design knowledge with class; include harmony, balance, emphasis, rhythym, proportion. Stress the principles of emphasis through repeating colors; rhythm, via the eye movements caused by the attraction of the eye to bright color; proportion, via the law of areas.

PUPILS SHOULD LOOK AND LISTEN FOR:

. Color combinations and harmonies.
. Before-and-after room decoration
. Thought processes dramatized by dance sequence in the film.
. Techniques of successful dyeing.



PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

. To check for learnings from the film: Discuss the possibilities for changes in bedroom color decor through use of dye.
. Discuss and evaluate the observance of principles of design in redecorating the room in the film. Point up the achievements of emphasis, rhythm and proportion through use of color.

- On flannel board or bulletin board, have students practice word association with color. For example: ask the girls to write on strips of paper with magic markers one word that would characterize a color as it is used in room decor: "relaxation,"- color response - "light green." The girls could take turns pinning up a word on the flannel board and having others pin up the appropriate color beside it, until a full board is displayed to stress the psychological use of color.
- Set up a panel of girls as a color clinic to make suggestions for the problems of the class in room decor or clothing selection. Each girl should present a problem to the board for solution. These should be discussed and evaluated.

SUGGESTED RELATED ACTIVITIES:

To aid girls to understand the various results obtained when dyeing fabrics of varying texture of finish:

- Ask each student to bring in a piece of fabric - terry cloth, smooth cotton, and nylon. Let each group of four students tint or dye several different kinds of fabrics, rough, smooth, dull and napped. Point out how the same color is affected by texture and finish.
- Discuss and experiment with special problems, such as dyeing woolens and synthetics: dyeing techniques for rich dark colors, color removers.
- View colors in different lights - east, west, north, south, neon, and incandescent - to observe color changes caused by various kinds of light.
- Use colored construction paper to show effect of advancing and receding colors, and how value and intensity of colors are modified by adjoining complementary colors or black or white.

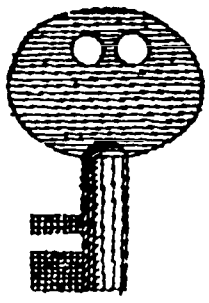
SUGGESTED RELATED CREATIVE ACTIVITIES:

1. Study famous paintings. Discuss the mood and feelings created by the artists' use of color.
2. Discuss the emotional effect on us of color in our environment.
3. Suggest each student pick a room in her home which she thinks can be improved with fresh new color. Have her make a floor plan suggesting new colors bearing the light exposure in mind. Evaluate the effectiveness of the new color schemes as contrasted to the old ones.
4. Have girls choose a painting or other art object, such as a plate or vase, and develop a room color scheme around it.

RELATED MATERIALS:

Films:
Discovering Color. (Film Association of California) (CUE)
Filmstrip:
Using Color with Confidence.
Plates:
Reproduction from the National Art Gallery, Washington, D.C. (CUE)

CULTURAL ITEM: "COLOR KEYING IN ART AND LIVING" (Film)
10 min., Color, Encyclopedia Britannica Films.



CURRICULUM AREA: Home Economics - Beauty in Dress
Home Decoration

PURPOSES:

To give insight into the nature of color and its artful use in costume and home decor.

SYNOPSIS:

This film reveals the scientific nature of color, and alerts the viewer as to how color illusions are formed. Awareness of these illusions and effects makes for wiser and more satisfying use of color in dress and home decoration.

SUGGESTED PREPARATION OF THE CLASS:

To alert class to the idea of color illusions, explain:

. Color is an exciting and vital part of our lives. It can make us feel happy or dreary and depressed, depending on how it is used. Knowing how to use it properly can help us and our homes to be more attractive.

. Use the flannel board and color discs to explain the primary and secondary colors. Indicate that the colors directly opposite on the color wheel are called complementary colors.

PUPILS SHOULD LOOK AND LISTEN FOR:

. The way a prism splits light into the spectrum.
. How a color can be made to appear grayer or more intense by surrounding it with its complement or with black.
. How the artist produces feelings in the viewer by his use of color.
. Ways to emphasize beauty of hair and eyes with color in dress and make-up.
. How to emphasize or de-emphasize furniture or room sizes with color.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. Have students demonstrate what they have learned by:

. Using pieces of colored paper or cloth on the flannel board to illustrate color illusions shown in the film.
. Analyzing make-up and color combinations in dress of members of the class.

2. Place on the flannel board colored cut-outs of separates in dress - blouses, sweaters, skirts. Ask pupils to combine these to illustrate pleasing color combinations.

3. Ask pupils to bring magazine illustrations to class to discover color harmonies in dress. Display these on bulletin board or opaque projector.

SUGGESTED RELATED ACTIVITIES:

1. Use color discs and flannel board to teach students that colors directly across on the color wheel are complementary. Those next to each other are analogous. Different shades and tints of the same color are called a monochromatic color scheme.

2. Ask students to select paper pieces, or to paint these three types of color schemes.

3. Ask students to study National Gallery paintings, or Metropolitan Seminar prints, for color schemes.

4. Show the film "Discovering Color" (CUE).

SUGGESTED RELATED CREATIVE ACTIVITIES:

To employ the knowledge gained, ask students to select colors appropriate for:

. A plump lady's dress.
. A dress for a too-thin girl.
. Accenting blue eyes and red hair, or other complexions.
. Minimizing a sofa too large for the room (consider both sofa and wall).
. Making a room look larger or smaller.
. Their room decor.

RELATED MATERIALS:

Films:

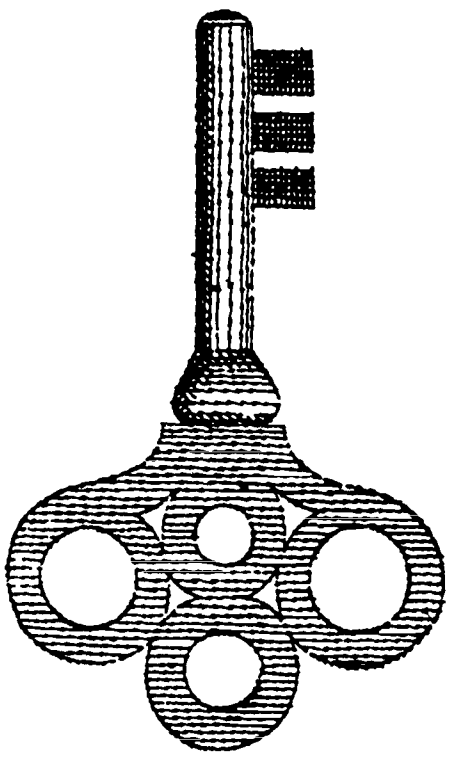
Discovering Color. (Film Associates) (CUE)
Color Magic. (Modern Talking Pictures)

Filmstrip and record:

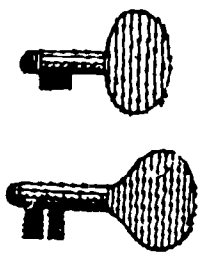
Using Color with Confidence. (CUE)

CUE Insights:

Color



CULTURAL ITEM: "CREATIVE ARTS OF JAPAN" (Film)
15 min., Color, CUE.



CURRICULUM AREA: Home Economics - Families in Various Cultures
Home Accessories

PURPOSES:

To present a pageant of Japanese art forms and to indicate their influence on contemporary arts and crafts

To provide a basis for appreciation of Japanese culture.

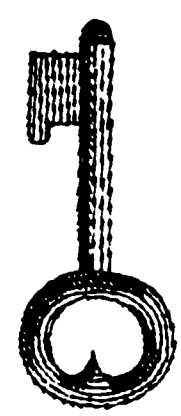
SYNOPSIS:

This film presents Japanese art forms dating from prehistoric times to the present, which indicate that artistic skill is an inherent quality of these people. Early grave figures show skill and ability to express emotion. Violence and powerful impact are characteristics of the 13th Century paintings, while those of later periods are both realistic and fantastic. Later forms show the subtle, serene art we characterize as oriental. The narration and art forms assist the viewer to understand how art and nature combined to influence Japanese culture and daily life. This role of art and nature is symbolized by a Japanese garden which is a small and carefully cared for miracle in nature.

SUGGESTED PREPARATION OF THE CLASS:

This film should be used after students have seen "Guided Tours of the World-Japan (CUE), and "Japanese Family," (CUE). Explain that the films emphasize many aspects of Japanese art, past and present, and that many objects seen are used in ceremonies of daily life, since art plays an important role in Japanese life.

PUPILS SHOULD LOOK AND LISTEN FOR:



- The color, form and emotional impact of the art forms.
- Music which emphasizes the emotional message.
- The fact that even functional forms are graceful and beautiful.
- The humble beauty of the objects used in the tea ceremony.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

To further appreciations:

1. Secure and display Japanese art objects. Compare Japanese art with that of other Asian countries.

2. Have students do research on Japanese arts not shown in the films: Kabuki, the puppet theatre, lacquer, cloisonne, wood carving, music.

SUGGESTED RELATED CREATIVE ACTIVITIES:

Discuss related arts of the Japanese not presented in the film: Bonsai, landscaping, ikebana, origami, and so on. Have students experiment with one of these arts as a projected activity for the semester or year.

RELATED MATERIALS:

Films:

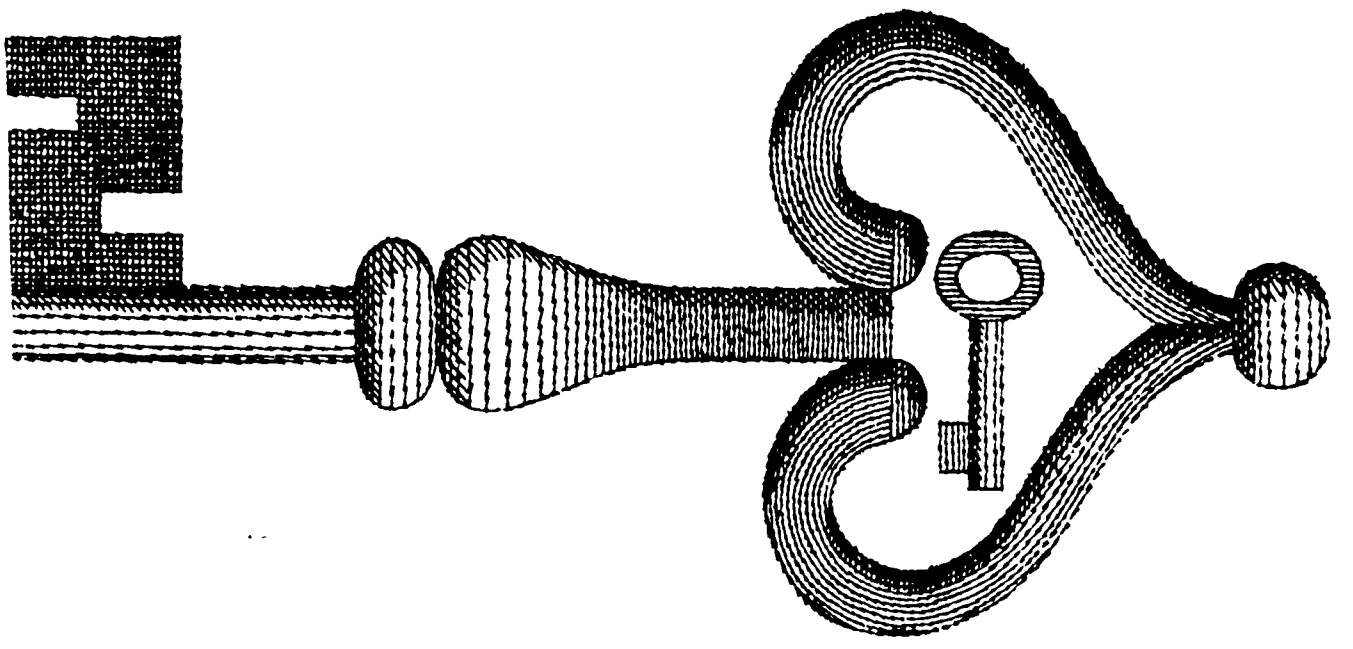
The Japanese Family. (CUE)
Ceramic Arts of Japan. (UE)
Japanese Gardens. (CUE)

Books:

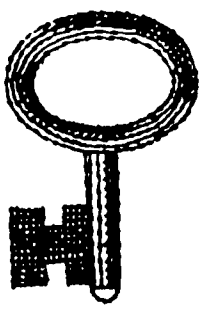
World Book Encyclopedia.
Japan Notebook. (CUE Social Studies Kit)
Masterpieces of Asian Art. (Asia House, 112 E. 64th St., New York, N.Y.)
Haniwa - (grave figures). (Asia House)

Pamphlets:

Recipes from the East. (Tuttle - Tokyo, Japan, 1955)



CULTURAL ITEM: "DESIGN FOR BEAUTY" (Film)
28½ min., Color, International Silver Company.



CURRICULUM AREA: Home Economics - Selecting Home Accessories
Table Setting

PURPOSES:

To alert students to the beauty and character inherent in silver.

To help them learn how fine silver pieces are created.

To inform them of industry's role in bringing fine quality and design to everyone.

SYNOPSIS:

In his search to bring beauty into his life man found the metal silver. It was used for adornment in ancient times and is still a treasured material. In creating designs for silver, the artist's hand and mind are essential in attaining quality and perfection. Today, this perfection can be repeated hundreds of times by the power of industry. This film reveals how man's creative talents are captured in silver.

SUGGESTED PREPARATION OF THE CLASS:

To interest students in design in silver:

1. Make a table or bulletin board display of samples or photographs of fine silver pieces.

2. Discuss the work of fine metal craftsmen, such as Paul Revere, Benvenuto Cellini and others. If possible, display photos of their work.*

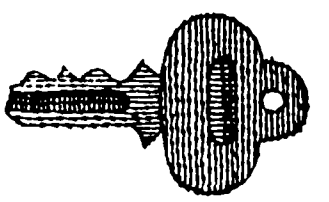
3. Explain that in times past only very wealthy people could afford such articles. Today, mass production of fine designs makes such beauty available to all.

PUPILS SHOULD LOOK AND LISTEN FOR:

. How silver has been valued and used through the ages.
. The origin of the name "sterling."
. The differences between flatware and holloware.
. How the artist creates a design for silver.
. How light and shade brings out the character of the material.
. How the artist's design is reproduced by industry.
. How the movements of dance forms are related to silver designs.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:



*Secure and display "The Chalice of the Abbott Suger" from the National Gallery CUE prints.

To educate students, as future consumers, to appreciate and demand fine design in products, discuss:

- Industry's role in bringing good design and quality to the masses. Everyone may have good design in products he uses, while formerly only the wealthy could enjoy many quality products.
- To enjoy good design, one must know what good design is. (See CUE Insights on Design.)
- All good design is functional, serves a purpose, fits the user, is esthetically pleasing.
- Beauty and functional design may be achieved in other metals, such as stainless steel for kitchenware for those unable to afford silver.
- The role of competition in attaining good designs.
- The artist's role in industry as a source of valuable ideas for production.
- The psychological and esthetic importance of beautiful table settings.
- How good design in surroundings contributes to pleasure and graciousness in life.
- How silver designs suggest movements of the dance. (Bring out that all arts have common elements of line, form, balance and composition.)

SUGGESTED RELATED ACTIVITIES:

To relate concepts of film and discussion to students' lives:

1. Visit a department store to view silverware and table settings.
2. Utilize CUE Kit materials to have girls select harmonizing glass, silver and china patterns.
3. Have students set tables for varying occasions, choosing proper silver, glass and linens. Use a painting as inspiration for color scheme and decorations.
4. To provide background for purchase, use and appreciation of silver, explain to the class: Silver should be used; not stored away and brought out for only festive occasions. Good silver becomes more beautiful by usage. Lacquering silver to prevent tarnish gives it a hard brilliance which is the negation of what good silver should look like. New polishes and dips take the work out of polishing.

   Although silver should be conveniently placed for constant use, it is never desirable to pile it up in an ostentatious display. Excessive luxury and ostentation do not suit the homes and times in which we live.

   When buying it is important to keep these distinctions in mind.
   Sterling is pure silver mixed with copper in a combination 925/1000 fine. (Pure silver is far too soft for ordinary use.) The surface of sterling is permanent.
   Silver plate denotes articles made from a base metal and covered with silver. The thickness of the plate, triple or quadruple, is determined by the firm so it is well to buy from a reputable source.

Sheffield is a fusing of silver and copper. Silver is hammered onto copper and fused.

5. To acquaint students with designs and motifs in old silver, use photos or examples to show the meaning of:

   Chasing - a design in low relief made by hammering the piece from the outside.
   Repousse - the design is made from the inside by hammering.
   Engraving - design is formed by incising on surface.
   Fluting - a grooved design in which flutes are depressed in the body.
   Gadrooning - a reeding raised above the surface of the piece.
   Piercing - cutting through the silver to form designs.
   Baroque and Rococo - silver pieces with curving contours and swirling applied designs.

6. To evoke interest in a possible future hobby, explain that "Silver marks" were a means of protecting the customer and making sure that he got what he paid for in sterling. These marks are a convenient means of dating the piece. Genuine sterling without marks sells for less. Have students do research on London marks, Sheffield marks and American marks.

7. Order silver display from Towle, Sears Roebuck or International Silver Company.

SUGGESTED RELATED CREATIVE ACTIVITIES:

Have students use paintings, dance, or other themes as inspiration for designs for silver or other metal pieces. These may be sketched and modeled in clay.

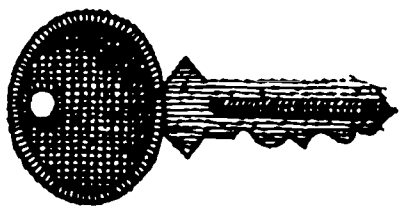
As students proceed, remind them design is always directed by the combination of tools and materials, methods of construction and purpose of the design. Function should determine form and form should express function. Although for years we have had table knives with long narrow blades, we could just as well have short broad blades which could both cut and spread. We are accustomed to a fork with long narrow tines. Consider a fork with short tines and a bowl-like base. How convenient for peas or hard ice cream! Help students realize, although we wish to be inspired by what is good from the past we do not need to slavishly copy old forms.

Observe Danish Designs Inc., Great Neck, N.Y. for Danish Silver.

RELATED MATERIALS:

Film:

Seven Guideposts to Good Design. (CUE)



CULTURE ITEM: "DISCOVERING COLOR" (Film)
16 min., Color, Film Associates of California.

CURRICULUM AREA: Home Economics - Color and Personality
Beauty in Home and Dress

PURPOSES:

To increase perceptual awareness of the wonderful world of color.

SYNOPSIS:

Color is not the province of the painter and designer alone; it is a resource for everyone. The constancy and multiplicity of the visual images we receive tend to make us jaded, and lacking in real perception; consequently all of us take color too much for granted, with the result that the general use of color is often tawdry and trite.

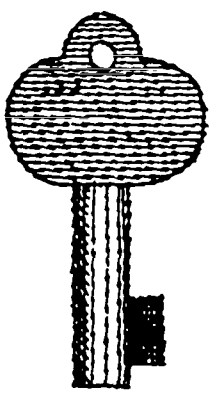
This film is a dazzling kaleidoscope of tints, hues and shades both warm and cool. It shows animals, fruits, rocks, the sea, butterflies, soap, bubbles and paints, all in exciting color, all revealing the complex wonder of the spectrum. It opens up a beautiful world of color, and points to many new directions of applied color knowledge.

SUGGESTED PREPARATION OF THE CLASS:

To help students realize the importance of understanding color, explain:

Color has been a vital force in the lives of men since earlist times. Color is everywhere we look. It plays a vital role in our emotional outlook on life, and is a definite factor in establishing moods of depression or gaiety. Proper use of color can create a better environment, more favorable to man's efficiency and comfort. To use color effectively, we must know something about it. Explain that the film will provide basic understandings about color.

PUPILS SHOULD LOOK AND LISTEN FOR:



. Colors of the spectrum.
. Qualities of color (hues, value, intensity).
. Hues which are warm or cool, and examples of each.
. How secondary and intermediate colors are made.
. Tints and shades in color.
. Illustrations of color in the surroundings.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To enable students to put the knowledge they have gained from the film

to work, have a flannel board available with color swatches scattered on it in unrelated fashion. Ask for a volunteer to arrange the swatches to form a color wheel and other color harmonies.

2. The film may be discussed with such questions as:

   . What are the primary colors? The secondary colors?
   . What is the meaning of the terms: "hue, value, intensity?"
   . Which colors are considered cool colors?
   . In what ways can the understanding of warm and cool colors be applied to our choices in clothing?
   . Which colors are considered warm colors?
   . How do warm and cool colors affect the size and figure?

3. Group students into pairs. Ask each pair to select one of the following and create a design, using colored paper:

Related hues	Contrasting hues
Related intensities	Contrasting values
Related values	Contrasting intensities

4. Ask two pupils to select and mount colors representing certain moods, as anger, dignity, calmness, or gaiety.

5. Have pupils prepare collages of colored paper or paint designs, representing a mood such as sadness, anger, or excitement.

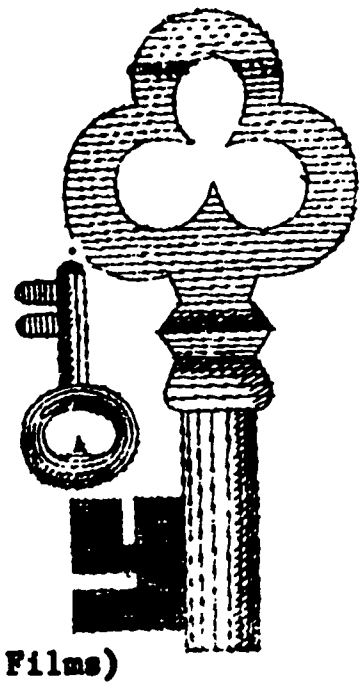
SUGGESTED RELATED ACTIVITIES:

1. To reveal the importance of proper use of color in the environment, use magazine photos to illustrate and explain:

   . Color plays an important part in the physical comfort of the individual. Used properly, it enables him to function at maximum efficiency.
   . Rooms on the north and east of a building have a tendency to feel cool.
   . Colors such as beige, ivory, cream or peach can give them a feeling of warmth.
   . Rooms on the south and west should be painted in tones of aqua, green, or blue, to offset brilliant sunlight and counteract the feeling of warmth.
   . Excessive contrasts in color and light are tiring to the eye since they cause continual dilation and contraction of the pupil. Harmonious muted colors, combined with proper lighting, can help avoid this kind of eyestrain. Glaring antiseptic white hospital rooms have been supplanted by soft greens. Properly selected color provides a better environment, speeding convalescence.

2. Ask students to draw designs for interiors of rooms, using what they have learned about color. They should state the exposure, and try for interesting rather than hackneyed color harmonies.

3. Have students do research on:



- Color as used in different climates.
- The symbolism of colors in history.
- What psychological tests reveal about color.
- How color affects our emotions.
- Scientific color research.
- The modern painter and color.
- The physics of color.

RELATED MATERIALS:

Films:

Color. (Encyclopedia Britannica Films)
Color, Light and Dark. (Encyclopedia Britannica Films)
Color for Joy. (Rit Dyes, Corn. Prod. Co.)

Slides:

Chemistry of Painting. (National Gallery) (CUE Science Kit)

Books:

New Horizons in Color, Faber Birren
The Story of Color, Faber Birren
Color Fundamentals, Maitland Graves

CUE Insights on Color

CULTURAL ITEM: "DISCOVERING TEXTURE" (Film)
16 min., Color, Film Associates of California.

CURRICULUM AREA: Home Economics - Beauty in Home and Dress
Child Development
Menu Planning

PURPOSES:

To assist students to become more aware of how our tactile sense helps us to see and gain impressions of the world around us.

To assist students to become more aware of textures in their environment and to help them enjoy texture in nature, manufactured articles, sculpture and paintings. (When tactile sense is developed to a high degree, visual perception is also strengthened.)

To enlarge students' vocabularies by helping them learn words descriptive of texture. (Word association strengthens concepts.)

SYNOPSIS:

This film is a visual delight. The eye of the camera brings smooth, shiny, rough, nubby and dozens of other textures to view, from the lacy tentacles of a sea anemone to the weathered gorge of the Grand Canyon. The parade of textures features animals, plants, the sea, clouds, and man-made pottery, sculpture, fabrics and painting. It points out the importance of light in allowing us to see texture, and helps widen perceptions to enjoy daily adventures with beauty.

SUGGESTED PREPARATION OF THE CLASS:

1. To provide tactile experience, assemble bits of cloth, paper, board, bark and other materials. Fasten these to a board to form a tactile library for students to experience. These same materials may make a bulletin board or table display. Students can help collect the materials or can bring in objects, garments or ceramics with interesting texture.

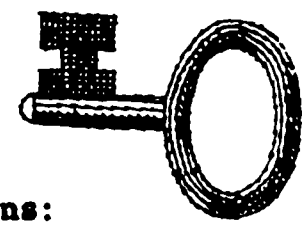
2. Explain to students that texture is the surface quality of an object. It may be smooth, furry, rough, slick, wiry or some other texture. When we feel soft velvet, rough bark, slippery soap or a grainy brick, we see these objects more clearly because our sense of touch helps us to perceive them. We can actually see texture because of light which is reflected from materials. Smooth objects, like those made of glass and silver, reflect light, and appear bright and shiny to us. Rough textures, like bark or nubby wool, absorb much light and break it up into a pattern of values of the color of the object. Velvets and fur reflect light in a different pattern.

PUPILS SHOULD LOOK AND LISTEN FOR:

. Descriptive adjectives applied to textures.

. Variations in textures in nature.
. Effects of light on objects that cause changes in the appearance of texture.
. Ways of creating variety in textures by using tools.
. Differences in textures in housing construction materials.

PRESENT MEDIA.



SUGGESTED FOLLOW-UP ACTIVITIES:

1. To check for comprehension, ask these or similar questions:

   . What are some common words used to describe textures?
   . How do living things show differences in texture?
   . What variations in texture can you identify in this room?
   . In what ways can methods of painting vary the textural quality of the finished product?
   . How can objects have more than one texture?
   . How do you determine which textures belong together and which do not?
   . Of what value to you is an understanding of textures?

2. To extend appreciations, have pupils handle: crisp crackly paper, silky fabric, wiry wool tweed, cellophane, other objects. Have them think about the quality of each material and visualize how it might be used.

3. As pupils examine the garments and objects on display and feel textures in the tactile library:

   . Call upon some members to give their reactions to textural variations.
   . Ask others to explain the role of light in seeing texture.

SUGGESTED RELATED CREATIVE ACTIVITIES:

To further sensitize students to texture:

1. Ask pupils to bring to class scraps of many materials or objects with a wide variety of textures - nubby, woolen, angora, velvet, satin, sandpaper, corrugated cardboard, net, gauze, steel wool. Have them make collage designs on cardboard or paper of these materials that:

   . Achieve an interesting design.
   . Follow good design principles.
   . Secure a pleasing variety of smooth and rough textures.

2. Secure scraps or discarded sample books of drapery and upholstery fabrics, or photos of them. Have students select pleasing combinations for room decor. Group textures that have a natural affinity.

3. Have students use scraps of garment fabric to suggest dress designs and combinations of materials in costume. Relate textures to each other and the use of the garment.

4. Stress suitability of fabric texture to use.

SUGGESTED RELATED ACTIVITIES:

- To extend ideas of texture appreciation, bring out that texture plays an important part in enjoyment of food, both visually and tactually. Think of crisp lettuce and celery, crunchy apples, chewy taffy and smooth ice cream. Visualize rough pumpkins and squash, frosted grapes, shiny red cherries, spiky pineapples. Have students make table arrangements of fruits and vegetables of varying textures. View textures in such paintings as Van Gogh's "Starry Night" and "Sunflowers."
- Conceal objects of art under a protective covering. Require students to feel these objects to strengthen both tactile and visual sense.

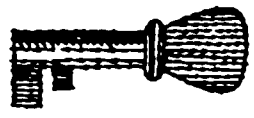
- To provide background for taste, explain what is meant by an honest expression in use of materials.

When many new synthetic materials came out customers reacted unfavorably to them unless they were imitations of older materials. Designers with imagination could see that the new materials had possibilities of beauty in themselves.

Painters used to paint floors and other surfaces to look like another wood or marble. Celluloid looked like ivory. Some plastics today look like wood or marble but the design is photographed from the real material.

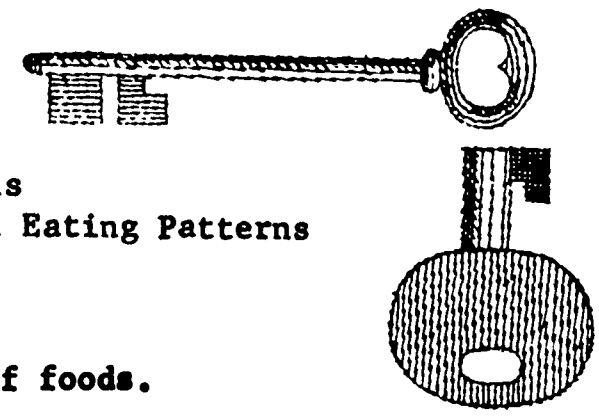
Early builders exposed beams of buildings and other structures of buildings because this was the quickest and easiest method of construction. Later people covered up all construction with board and plaster. Today there is a tendency to let the structure and building material textures such as concrete blocks form the design of the building. So, too, in fabrics and plastics; we are learning to enjoy them for their own qualities and not because they are imitations of other materials, Imitation fur coats are frankly fake; or we enjoy nylon and dacron for its packable washable qualities and do not pretend it is silk. Costume jewelry is worn for its intrinsic color and design and not because it imitates precious jewels.

RELATED MATERIALS:



Tearsheet:
Bounty of Food. (Life) (CUE Home Economics Kit)
Material:
Fabric Swatches. (Sears, Roebuck, Consumer Education Division) (CUE Home Economics Kit.)
Display:
Fabric Fiber Display Kits. (Celanese Corp.) (CUE Home Economics Kit)

CULTURAL ITEM: "THE ENCHANTED POT" (Film)
18 min., Color, Karo Syrup



CURRICULUM AREA: Home Economics - Creative Meals
Intercultural Eating Patterns

PURPOSES:

To promote the esthetic in the preparation of foods.

To stimulate interest in gourmet cookery.

SYNOPSIS:

An enchanting animated copper pot performs miracles of creative cookery to help a bewitched, bothered and bewildered bride learn that gourmet cuisine may be created by a novice. As he pours out his wisdom, each suggestion is mouth-wateringly illustrated with realistic color photography. Color, texture and flavor are combined with artistic arrangements to create dishes to tempt the most jaded palate.

SUGGESTED PREPARATION OF THE CLASS:

Very little preparation is necessary for this film; in fact, it would serve as a wonderful introduction to a food study. It arouses interest in spices, gourmet foods and a creative approach to meal planning, preparation and serving.

PUPILS SHOULD LOOK AND LISTEN FOR:

- The color, texture, flavor blends of foods used.
- The creative use of spices, sauces and garnishes.
- The various gourmet touches used in preparing and serving of foods and the countries of their origin.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To assist students to further regard food as an esthetic pleasure rather than as a mere source of energy, make a study of various spices. Give students the romance of spice by mentioning how it was given as a precious gift by the Wise Men to the Christ child. Since 950 B.C. or earlier the Arabs were masters of the spice trade. Then the demand for spices spread over Europe when the North learned of their preservative qualities. As the demand grew so did the value of spices, which came from Asia to Venice. The wealth from this trade sparked the Renaissance. Always the country who controlled the spice tradè remained rich and powerful. Whet interest by presenting these spicy facts:

   - Anise is one of the oldest flavorings and was known as a cure-all. It was used by Romans to prevent bad dreams and cure fits.
   - Sweet basil is planted by Hindus to insure happiness and worn in the hair by Italians to signify matrimonial intentions.

. Bay leaves (laurel) were once used by Greeks as a sign of victory.
. Cinnamon was one prized for love potions and perfume.
. Fennel was once regarded as an herb which could counteract disease.

2. Have each girl select a spice and report on its source and history, and demonstrate its use.

3. Prepare a comparison meal. Have students choose a menu. Prepare it in a plain way; then, using the same food and basic menu, prepare it using spices, sauces and a gourmet approach.

4. Discuss the effect of attractive preparation and service of food on feelings and health. Help students understand that dining can be gracious, relaxing and enjoyable, and conducive to conversation, health, pleasure and good family relationships.

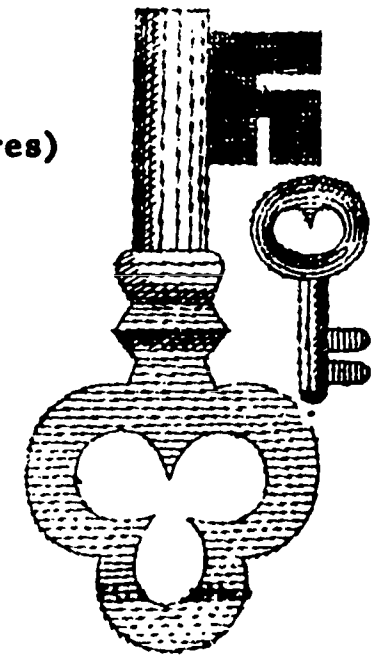
5. Discuss career opportunities in the fields of food research, testing, and display work for commercial photography and advertisements.

6. If possible, show pictures of menus from various gourmet restaurants, such as La Tour d'Argent and Maxim's in Paris; The Four Seasons in New York; Arnauds, Galatoire's and Brennan's, Vieux Carre in New Orleans; Sabatini's in Florence; Floating Restaurant near Hong Kong.

SUGGESTED RELATED CREATIVE ACTIVITIES:

Have students prepare a demonstration on creative cooking for 4-H girls, Farm and Home Administration or an adult education class.

RELATED MATERIALS:



Films:

Focus on Food - H. J. Heinz. (Modern Talking Pictures)
Kitchen Keyboard. (Modern Talking Pictures)

Filmstrip:

Song of the Salad. (H. J. Heinz) (CUE)

Books:

Sunset Cookbook.
How America Eats. (Paddleford)

<u>More about Spice</u>:

"Better a meal of herbs where love is, than a stalled ox and hatred" - The Bible.

In Elizabethan times, herbs were given significance and character. Rosemary stood for remembrance; fennel for flattery; rue represented both sorrow and repentance; therefore, became the herb of divine grace.

CULTURAL ITEM: "FOCUS ON FOOD" (Film)
26½ min., Color, (print No. 161) H. J. Heinz Co., New York.

CURRICULUM AREA: Home Economics - Eating Patterns of Various Cultures
Food Production and Distribution

PURPOSES:

To emphasize that food patterns are part of a country's culture.

To open doors to food patterns of other cultures, and to promote appreciation and understanding of them.

SYNOPSIS:

This film reveals exciting colorful glimpses of delectable foods as served by various peoples round the world. A gondolier, a Viennese chef, a barbecue cook in Australia, a fisherman in Pakistan - all give insights into the typical meals of their cultures. Behind each of these meals is a food industry which makes it possible. These industries are explored by the film.

SUGGESTED PREPARATION OF THE CLASS:

To assist students to good insight from the film,explain that the geography, customs, science, technology and economics of any country govern what and how its people eat. (Use CUE Life Tearsheets, "Beauty of the Autumn Harvest," to support the idea that the food of any country depends on these factors.)

PUPILS SHOULD LOOK AND LISTEN FOR:

. Ways of eating and serving food in various cultures.
. Concern for cleanliness in food handling in all cultures.
. How eating a country's food can help in an appreciation of its culture.
. The role of research in preparation and preservation of foods.
. Uses of spices - background information on such uses.

PRESENT MEDIA.

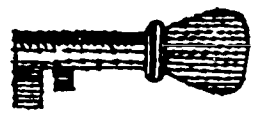
SUGGESTED FOLLOW-UP ACTIVITIES:

To further enhance understandings of food as a part of culture, discuss:

1. How natural resources affect the entire future of a country. (Compare foods available to a Japanese as compared to food available to a U.S. citizen.)
2. How food supply affects health, morale, ways of thinking.
3. How the kind of and amount of food available affects eating patterns.
4. How education affects handling and preparation of food.
5. How many religious rules about food are really health rules.

6. The role of spices in food preservation.
7. How food is served and eaten in various cultures, and use of decor in connection with it.

SUGGESTED RELATED ACTIVITIES:



Have students:

. Do research and reports on spices, their origins, and their uses in cooking for flavor and food preparation.
. Make charts utilizing information gained from these class reports.
. Study how Federal Food, Drug and Cosmetic Act restrictions protect us.

SUGGESTED RELATED CREATIVE ACTIVITIES:

An interesting and rewarding activity would be to have a culinary "around the world tour". Have the class draw a world map. As food specialities of each area are experienced place a miniature flag on the country. An outgrowth of this activity might be a year-end "do it yourself" World's Fair with foods, costumes, music of each country available. Social studies classes might cooperate. All recipes to be found in CUE Home Economics Kit.

. Start the tour with the tropical glamor of Hawaiian foods at a luau. Serve Polynesian beef, pink rice pilaf and island banana pie guaranteed to be "Ono Kau Kau" - very good food.
. Fly to Japan and have sukiyaki, melon, rice cookies or experience a formal Japanese tea and learn its ritual.
. Then off to Hong Kong to where subtle seasonings and tantalizingly sweet-sour sauces combine to make Chinese cuisine, a gourmet delight. Serve chicken with toasted almonds, sweet dumplings and tea.
. Then to Indonesia for nasi goreng, fried rice.
. To India for a curry and fruit.
. To Armenia for shish kebab.
. To Russia for beef Strogonoff and blintzes and tea.
. To Germany for Hasenpfeffer or Sauerbrauten or a Kaffee Klatch.
. To Italy for spaghetti, lasagna or chicken cacciatore and spumoni.
. To France for onion soup, croque Monsieur and cherries jubilee or crepes Suzette.
. To Spain for arroz con pollo and flan.
. To Louisiana for crab bisque, Pompano en Papilotte a la Antoine, pommes souffle and southern pecan pie.

At each stop alert students to terms used in gourmet cuisine of other countries such as:

hor d'ouevres	eau de vie	pommes souffle
caviar	sauerbraten	truffles
Chateaubriand	chutney	bisque
curry	bouillabaisse	Kirch

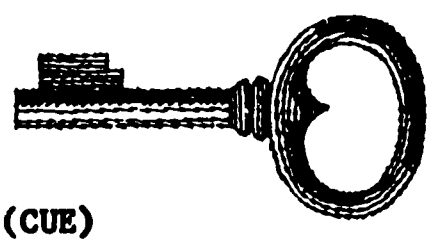
boeuf Bourguinon	scampi	Caesar salad
blintz	canapes	minestrone
capon	vichysoisse	zabaglione
champagne	chartreuse	vermouth
Chianti	Burgundy	Cherry Heering
vin blanc ou rouge	coq au vin	pate de foie gras
saute	cointreau	creme de menthe
cassis	cocoa	liqueur
parfait		

The purpose here is not that students will sample all these foods but simply to alert them of the wide range of food types as part of various cultures.

Describe Le Cordon Bleu Cooking School in Paris and the Julliard and Michelin guides to gourmet eating.

There are innumerable amuzing and interesting stories concerned with foods such as the origin of the sandwich and pommes souffle. There are also stories such as "La poulet des Trieze Chat" which give insight into the part food plays in a given culture. Explain that a formal Chinese dinner may take five hours to serve-that desert is often served in the middle and soup at the end. Ask resource persons for other food customs.

RELATED MATERIALS:



Films:

Secrets Out of the Bag. (Association Films Inc.) (CUE)

Pamphlet:

Your Kitchen Keyboard of Spices. (R.T. French Co.) (CUE)

Chart:

The Wonderful World of Seasonings. (R. T. French Co.) (CUE)

Books:

Israeli Cookery, Lilian Cornfield. (Avi Publishing Co.,Inc. Westport, Connecticut. 1962)
Dining Out in Any Language, Myra Waldo. (Bantam, $.50)
Art of Italian Cookery, Maria LaPinto. (Bantam, $.60)
Kyra's Secrets of Russian Cookery, Kyra Petrovskaya. (Prentice Hall, Inc., Englewood Cliffs, New Jersey. 1961)
How to Cook and Eat in Chinese, Buwei Yang Chao, (An Asia Press Book John Day Co., New York)
The Complete Scandinavian Cookbook, Alice B. Johnson. (Mac Millan Co., New York 1964)

CULTURAL ITEM: "FOUR FAMILIES" (Film)
2 reels, Part 1 - 30 min., Part 2 - 31 min., B & W
McGraw-Hill Films

CURRICULUM AREA: Home Economics - Similarities and Differences in Families
Children in Various Cultures

PURPOSES:

To demonstrate that although each culture places its stamp on its members according to its customs, traditions, and history, the basic factors influencing character formation are universal.

SYNOPSIS:

This film presents comparative sociological studies of four families in India, France, Japan, and Canada.

A typical day in the life of each family is shown. The lesson of the film is that regardless of climate or culture, the basic factors that influence a child's physical and emotional development are the family, religion, schooling, standard of living, and immediate environment. Comparisons are drawn between child-raising practices in the various cultures. The film also shows how each culture molds the habits and outlook of its young in these practices, which are outgrowths of its customs, traditions and history.

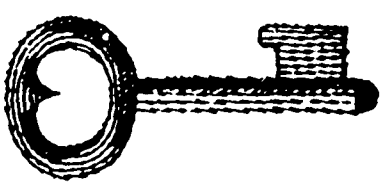
SUGGESTED PREPARATION OF THE CLASS:

Ideally, this film should come at the close of a unit on child care and development, since students would then have a good background of child-rearing practices in their own cultures for comparison.

Assuming students have this knowledge, ask them to list areas they feel are important influences on child development in this country. Discuss with them reasons for their selections. Keep the list on the board.

PUPILS SHOULD LOOK AND LISTEN FOR:

- Types of housing in the four countries -- India, France, Japan, and Canada.
- Meal patterns characteristic of each nationality.
- Facilities in the home.
- Demonstrations of affection for the young child which are common in all countries.
- Procedures in the baby's bath.
- Toys, playthings for children.
- Roles of women in the family.
- Characteristics of dress for children and adults.
- Evidences of religious beliefs.
- Evidences of discipline with children.
- Lullabies representative of each country.



PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. Divide the class into four groups with a recorder for each. Assign one country (India, France, Japan, or Canada) to each group. Allow ten minutes for a "buzz session" in which the groups discuss and record information from the film, or elsewhere, on the following topics:

   . Characteristic meal patterns of the country.
   . Equipment and facilities in the home.
   . Signs of affection for the baby and other children.
   . Forms of play for children.
   . Steps in bathing the baby.
   . Roles of women in the home.
   . Types of dress for adults and children.
   . Sizes of homes and construction materials used.
   . Family incomes typical of the average family.
   . Indications of religious beliefs.

2. Bring the entire class together, and discuss all areas listed above, comparing each country.

3. Encourage correspondence with a pen pal in at least one of the four countries described in the film.

4. To stimulate reflective thought and evaluation, have students draw a graph showing the degree of influence that income, standard of living, religion, school, customs, tradition, parental factors have on the child's development. Compare their results with the list on the board.

5. If there are students of a wide variety of nationality background, have them recall and discuss the factors of tradition, custom, religion, family habits that most influenced their lives. The rest of the class can help draw comparisions.

6. Discuss such points as the fact that Chinese - Americans have almost no juvenile delinquency, and that Japanese and many European children are usually very polite. Continue discussion and ask if this good behavior might be the result of loving but firm discipline. Point out that extreme permissiveness and lack of kind but firm guidance may make young children feel insecure rather than happy and free. Help students to see that all cultures have much of value to contribute, and that often we may learn important lessons from them.

SUGGESTED RELATED CREATIVE ACTIVITIES:

Assign small groups of students to do research and oral reports on homes of Japan, China, Indonesia, India, the Middle East, Africa, Russia, Latin America. These reports should include photographs, sketches and models of the homes, types of utensils and furniture used,

artistic aspects of the homes. In addition to pictures from books and magazines, students should be encouraged to use filmstrips and other visuals to support their report. National Geographic Magazines and Life Library are good sources.

RELATED MATERIALS:

Films:

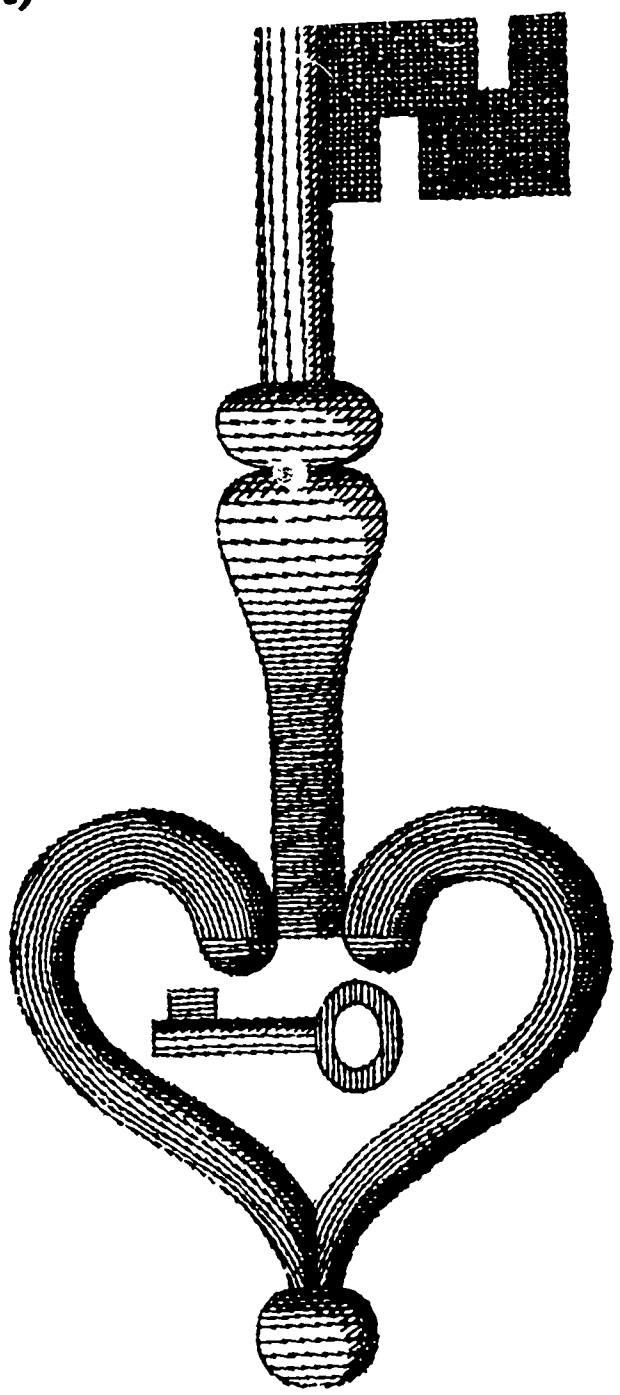
The Japanese Family. (McGraw-Hill Films) (CUE)
My Home is Africa. (Atlantis Films)
India. (Bailey Films)

Filmstrip:

Guided Tours of the World - Japan. (Columbia Records Club)

Book:

Japan Notebook. (CUE Social Studies Kit)



CULTURAL ITEM: "THE FOURTH SENSE" (Film)
12 min., Color, American Dairy Association.

CURRICULUM AREA: Home Economics - Cultural Heritage of Food
Creative Food Preparation

PURPOSES:

To acquaint students with the history of ice cream through artistic prints, paintings and lithographs.

SYNOPSIS:

The savage was concerned only with survival. He took his food where he found it. The Persians, however, added refinement to dining by bringing snow from the mountains for cool refreshments. The Greeks copied the idea, and the Romans improved it by using honey and fruit juices with it. Marco Polo brought the idea of milk ice from the Orient. This enjoyable film uses authentic museum prints, etchings and paintings, and an amusing musical background, to tell how ice cream developed from these early beginnings down through revolutionary times to the present. An added delight is to watch how the style of drawing changes with the times.

SUGGESTED PREPARATION OF THE CLASS:

Prepare a bulletin board of attractive gourmet dishes from Life Magazine or other sources.

Little preparation is needed except to explain that paintings and drawings reveal much of the spirit of their times. If we put enough of them together, we can reconstruct the past. This is what has been done to tell the history of one of our most delicious foods: ice cream.

PUPILS SHOULD LOOK AND LISTEN FOR:

- Early beginnings of iced foods.
- Relation of quality of food to difficulties of life.
- Famous people who ate and served ice cream.
- How inventions changed people's food serving and eating habits.
- Where ice cream was first served, and how.
- The origin of the name - "sundae."
- Drawings by Daumier, Charles Dana Gibson, and others.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To check for assimilation of concepts, ask what factors control the quality and refinement of the food eaten by any people. (Natural resources, difficulties of life, stage of development, imagination and ingenuity.) Bring out the fact that food is a part of a total culture. When times are hard, as in our early colonial period or the great depression, food is usually plain and eaten for survival. When a culture develops, however, the cooking, serving and eating of food becomes an art which can make life more pleasant and agreeable.

Point out that people who remain at the "hot dog and Coke" level are missing a great deal.

2. Refer to the bulletin board gourmet food display. Tell students that the French, from whom we have taken much of our culture, consider the cooking and serving of food a fine art. Much time, care, thought, artistry and ingenuity go into French cuisine. Chefs are highly paid, and housewives spend much effort on food preparation.

3. To help students understand the above thoughts:

   . Describe the serving of "pressed duck" at La Tour D'argent in Paris, or some equally famous dish at Maxim's.
   . Explain "LeGuide Michelin" system of rating French restaurants.
   . Explain "Le Cordon Bleu" cooking school in Paris.
   . Show the film, "Food for the Markets of Paris," which shows Les Halles - the produce market in Paris.

4. Explain that while our busy lives do not permit such time and care to be lavished on food preparation, packaged and frozen foods and other conveniences make an artistic and enjoyable cuisine possible, if we add the ingredients of imagination and know-how.

SUGGESTED RELATED ACTIVITIES:

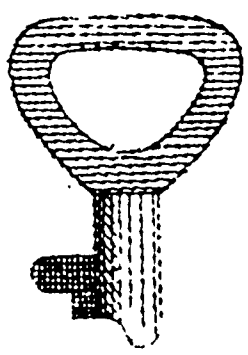
To widen student perceptions about foods, ask them to choose any food they are particularly interested in, and to do research on its history and report to the class.

SUGGESTED RELATED CREATIVE ACTIVITIES:

1. To stimulate imagination in the cooking and serving of food, ask students to choose any common food and cook and serve it in a new, interesting, and attractive way.

2. Ask students for constructive suggestions for improving school lunch food and atmosphere. Help them understand that their own behavior and attitudes are involved.

RELATED MATERIALS:



Films:

Food for the Paris Markets. (United World Films)
Focus on Food. (H. J. Heinz)

Filmstrips:

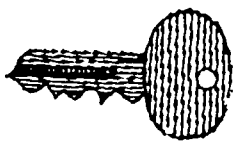
Ground Beef-Passport to Faraway Eating. (Pet Milk)
Song of the Salad. (H. J. Heinz and Co.)

CULTURAL ITEM: "FURNITURE IN FRANCE FROM MIDDLE AGES TO 1900" (Slide - set and booklet)

"CULTURAL HISTORY RESEARCH"

"WOMAN'S DAY DICTIONARY OF FURNITURE" (Pamphlet)
Alcoa Design Forecast 1 - Aluminum Company of America

CURRICULUM AREA: Home Economics - Heritage of Home Furnishings
Creative Home Interiors



PURPOSES:

To acquaint students with period furniture styles so they may appreciate them and better understand furniture of the present as well as to provide a basis for development of taste.

SYNOPSIS:

These slides are a fine introduction to the development of furniture design and provide a background for understanding it as an art form. They permit large group showings of beautiful period pieces. The accompanying notebook gives scholarly comment on the styles and provides a basis for understanding how the spirit of the times is reflected in all the arts.

The comments below merely suggest information given in the booklet.

The Woman's Day Dictionary, 16 pages of fine illustrations of the most important forms in every style, makes it possible to observe the outstanding characteristics of each style and to judge the derivation of modern furniture and the authenticity of reproductions.

SUGGESTED PREPARATION OF THE CLASS:

While it is possible to furnish a house without knowing the various period styles, it is easier and more fun to develop a familiarity with them in order to judge what to choose to give your home the character that will best suit your family. The more you know about the past, the better judge you will be of the present. Knowledge of period styles adds to understanding and enjoyment of furniture.

Period styles are the decorative expressions of specific times and places. Certain designs and motifs keep cropping up, adapted to the period of the moment. Decorative styles of any period grow naturally out of a definite way of life. Manners and customs control design. To understand designs of the past, you must get the feel of the society in which they were made. Remember each style was modern to the people of its time.

PUPILS SHOULD LOOK AND LISTEN FOR:

Show and explain:

Slide 1 - Ordinary Romans used to lie down at banquets, but here they are seated at a table.

Slide 2 - In the Dark Ages kings sat at thrones but ordinary people had stools often folding ones.

Slide 3 - In the 14th century furniture was chiefly for the monasteries and churches but here is the first piece of non church furniture-a chest. At that time beds were chests fitted with mattresses and tables were plain boards resting on matresses.

Slide 4 - As life grew more sophisticated the chest-bed was mounted on legs and had a canopy around it to keep out the drafts in cold stone castles.

Slide 5 - And here is the ancestor of our modern armchair, an adaptation of the throne. In Gothic times all arts were influenced by architecture. The back of the chair is carved to look like a stained glass window. Its canopy has another architectural design.

Slide 6 - This chest (15th century) shows progress in the cabinet makers art. It has two delicately carved fitted doors and splendid forged iron locks.

Slide 7 - During the Renaissance the rebirth of learning caused people to dislike their former crude furniture. Cabinet makers made new more refined designs like these "gossip or cackle" chairs.

Slide 8 - This double chest shows the classical detail of the Renaissance. Its decoration reflects an interest in the antiquity of Greece and Rome.

Slide 9 - This Henry IV armchair reflects the austerity of its period - a time of ruinous religious war.

Slide 10 - This Louis XIII armchair expresses the increasing sophistication of the day and shows a connection with the architecture. The large sloping back recalls the high sloping roofs of the period and the upholstery reflects the growth of the silk industry.

Slides 11,12,13 - These pieces reflect the growing desire for splendor and elegance to glorify the Sun King Louis XIV. After Louis' death the furniture became less massive and more comfortable although such furniture was only for the wealthy.

Slides 14,15,16 - 18th century furniture with its agreeable curved lines suggest the graceful bows and curtseys of the people. The rococo style reflects the spirit of gaiety and elegance of the French court of the day.

Slide 17 - The great trading companies brought back ideas from China like this chest.

Slides 18,19- Increasing interest in technology in the late 18th century inspired mechanical furniture like this desk with drawers which rise and fall.

Slide 20 - Louis XVI style was characterized by taste, elegance and perfect proportion. The straight classical lines reflect the architecture of the day.

Slides 21,22 - The French revolution ended the era of great furniture. Items became more austere and were decorated with patriotic emblems such as the laurel - also reminiscent of ancient Greece and democracy.

Slide 23 - Napoleon saw himself as another Roman emperor. Furniture now has straight lines of classic architecture and is decorated with metal pieces in classic motifs.

Slides 24,25 - As a reaction to Napoleon's wars, the spirit of Romanticism brought on the Gothic revival. Furniture and architecture copied medieval styles. People began searching for old Gothic pieces and this was the beginning of the antique trade.

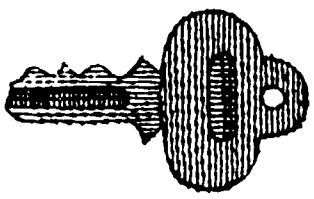
Slide 26 - Good taste revived the classic style, the Louis Phillipe style which was a simplified Empire style. At this time furniture began to be turned out industrially at low cost for mass production. Hand carving and bronze oramentation largely disappeared.

Slides 27,28 - The Second Empire copied many ideas from the past and put them together in a composite style attempting to be elegant - but often heavy and ugly.

Slides 29,30 - In trying to find a new style which expressed its time, 20th century designers turned out a "modern style." It was often ugly in itself but it opened up the way for a truly modern style which reflected contemporary architecture.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:



1. Use Woman's Day Dictionary of Furniture.

PREPARE THE CLASS BY EXPLAINING:

We have seen the development of furniture in France and how it was influenced by the spirit of the times. The furniture of other countries developed in similar ways. While much of the French furniture we saw was beautiful, it was in general not suitable for our homes today. Today we shall see some styles of other countries and learn the characteristics of the main ones so that you will be a better judge of what to choose in order to give your home a kind of character that will best suit you. A knowledge of these styles will add greatly to your appreciation and enjoyment of furniture. Project the pieces from the "Dictionary" explain each style or secure several booklets for students to observe.

PUPILS SHOULD LOOK AND LISTEN FOR:

. Characteristics of each period style.

MODERN FURNITURE:

Explain to the class: Modern designers have attempted to break away from simple reproduction to provide man with furniture that is both utilitarian and esthetically pleasing. Outstanding among the pioneers of the movement were Le Corbusier, Mies van der Rohe, Alto, Ponte and Breur.

Interior decoration was once considered separate from architecture. Today the architect thinks of furnishings and decorations as an integral part of the house. Availability of new materials and the desire to make housework easier have made furniture simpler and lighter. Metal, Masonite, laminated wood and plastics permit new, interesting, functional furniture designs.

Project Photos from Alcoa Design Forecast Book (CUE Industrial Arts Kit)

Eames Saarinen chair
Hardoy sling chair
Swedish, Danish and Italian modern pieces
Free-form furniture
Eames plywood chair

. Discuss the built-in features of storage walls which eliminate the necessity for much furniture.
. Show and discuss modern textiles. (See Alcoa folder in CUE Industrial Arts Kit)

To permit students to utilize their new found knowledge visit a museum or furniture store to see period furniture.

Secure and display some samples of various types of woods and finishes for identification.

Continue with a study of contemporary furniture (see New York Times Magazine 1963 - CUE Home Economics Kit).

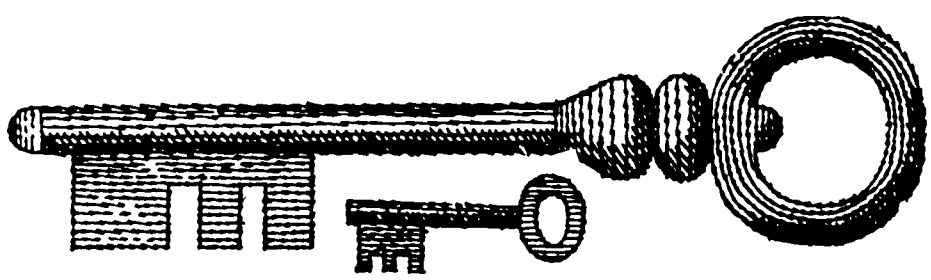
Encourage students to clip furniture from magazines and newspapers for decoration of a room elevation they have drawn.

Visit a museum to see period furniture and shops to see modern pieces.

RELATED MATERIALS:

Book:

Design Forecast 1. (CUE Industrial Arts Kit) (Alcoa)



CULTURAL ITEM: "GARDENS OF JAPAN" (Film)
15 min., Color, Japanese Consulate Films.

CURRICULUM AREA: Home Economics - Intercultural Understanding
Beauty in the Home

PURPOSES:

To reveal the beauty and symbolism of Japanese gardens, and through them to reveal part of the Japanese character.

SYNOPSIS:

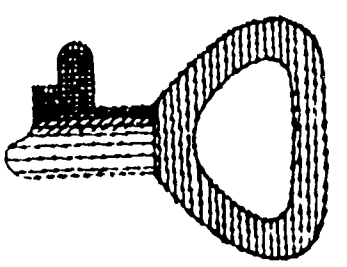
Japan is blessed with natural scenic beauty. Nature's gardens and man's gardens blend to make Japan beautiful, peaceful, serene. This film enables the viewer to visit outstanding Japanese gardens, where painstaking effort of the artist gardener brings everchanging scenes into view. Zen dry gardens, both classic and modern, are symbolic abstract versions of nature, used for contemplation by the monks. Views of the Silver Pavilion, Katsura Rikyu, Imperial Villa, a formal tea ceremony and garden ornaments as well as the role of the gardeners and the symbolism of the gardens are shown and explained.

SUGGESTED PREPARATION OF THE CLASS:

To enable students to grasp the importance of the garden in Japan, discuss the fact that Japan is a small country, and that every bit of land is precious and is carefully tended. Since prehistoric times, the Japanese have worshipped and loved nature. Orientals tend to be more contemplative then westerners. Their garden is considered part of the house and they like to view it and meditate on the poetry of nature. Great care and thought are lavished on these small miracles of nature.

PUPILS SHOULD LOOK AND LISTEN FOR:

. The scenic beauty of Japan and of the Silver Pavilion-one of the cradles of the tea ceremony and of the art of gardening.
. How nature is compressed in the Japanese garden.
. The constantly changing views presented to the stroller.
. The symbolism of the Zen Garden.
. The tea ceremony, garden ornaments.
. Katsura Imperial villa and pond.



PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To make sure students understand the symbolism of the garden, ask:

. How does the Japanese garden compress nature?
. What do the rocks and raked sand in a Zen garden stand for? (Explain that the gardens invite dreamy meditation on the mystery and poetry of the world, an agreeable state of mind to the contemplative oriental.)

2. For further understandings, ask:

   . What do Japanese gardens reveal about Japanese character? (Love of nature, careful workmanship, artistic ability.)
   . What does the tea ceremony reveal? (Ceremoniousness, the desire to make even small acts artistic and pleasurable.)

3. Discuss the garden as part of the home. (Shoji screens slide apart to reveal it. Western architecture is now attempting to make the transition from inside space to garden space gradual and natural.)

SUGGESTED RELATED ACTIVITIES:

1. Have a student report on Japanese bonsai - the art of dwarfing plants and trees.

2. Invite a Japanese resource person to discuss gardening or demonstrate the tea ceremony.

3. Learn about Japanese Haiku (poems,usually about nature).

4. View pictures in "Japan" (paperback in English CUE Kit).

5. View "Japanese Ceramics" and "Creative Arts of Japan," both CUE films.

SUGGESTED RELATED CREATIVE ACTIVITIES:

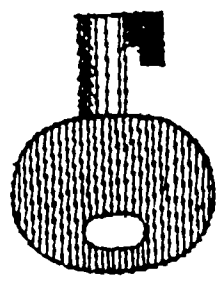
. To savor the ceremoniousness of Japanese culture, have students give a Japanese formal tea.

. Learn some Japanese phrases - (see back of Panorama Guided Tours Book). Write some Haiku to read at the tea (See "Haiku" English CUE Kit).

RELATED MATERIALS:

Films:

Ceramics of Japan. (Japanese Consulate) (CUE)
Creative Arts of Japan. (Japanese Consulate) (CUE)
Japanese Family. (Julian Bryan) (CUE)
Enchanting Japan. (Japanese Consulate)
Katsura Imperial Villa. (Japanese Consulate)



Filmstrip:

Playtime in Japan. (Teaching Aids Service, 31 Union Square West, New York 3, New York . 1954, Color)

Records:

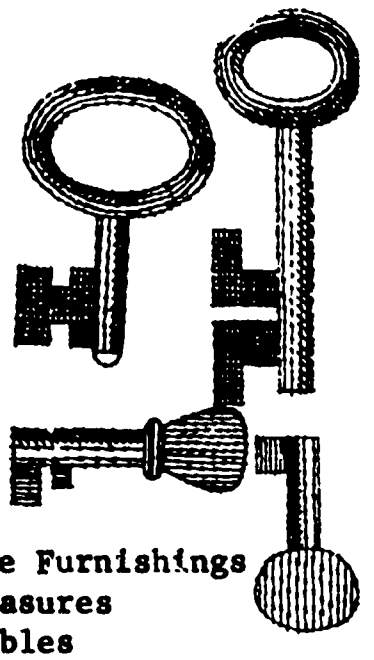
Folk Music of Japan (Ethnic Folkways FE 4429)
Traditional Folk Dances of Japan. (Ethnic Folkways FE 4356)

CULTURAL ITEMS: "GLASS AND YOU" (Film)
15 min., color, Corning

"ROMANCE OF GLASS" (Booklet)
Pittsburgh Plate Glass Company

"THIS IS GLASS" (Booklet)
Corning Glass

"POETRY AND CRYSTAL" (Book)
Steuben-Corning Glass



CURRICULUM AREA: Home Economics - **Selecting and Using Home Furnishings**
Appreciating Family Treasures
Arranging Attractive Tables

PURPOSES:

To acquaint students with the origin and history of glass and show its home and industrial uses.

To awaken sensitivity to the variety of beauty and charm found in glass.

SYNOPSIS:

During the formation of the earth, natural glass called obsidian was made by volcanic action. Prehistoric men chipped it into tools, vessels and mirrors. About 5000 B.C., man found out how to make glass, probably as an accident while firing pottery. The Egyptians used it for beads, and for glazing clay vessels. About 300 B.C., the blow pipe came into use. Romans used it to blow glass into molds to make intricate shapes and designs.

Only in the last few years have the enormous possibilities of glass come to light. It has dozens of industrial uses, as well as practical uses in the homes.

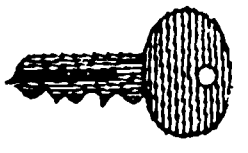
Steuben crystal is one of the clearest and finest of glasses. Both tableware and fine art pieces made of it enrich our lives.

SUGGESTED PREPARATIONS OF THE CLASS:

This film provides a good introduction to glass and glassware. Obtain booklets and book above for later use. If possible, display a piece of obsidian, ordinary glass, pressed glass, blown glass, cut glass and crystal Venetian glass. (If these are not available, use "Woman's Day Dictionaries of Glass," Home Economics CUE Kit.)

PUPILS SHOULD LOOK AND LISTEN FOR:

. The first natural glass - obsidian.
. Early production and use of glass in Egypt and Rome.
. Steuben crystal, clearest of glass.
. Industrial and scientific uses of glass.
. Glasses for home use.



PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. Encourage students to inspect various types of glass on display. Display photographs of Steuben glass in "Poetry in Crystal."

2. Explain as they inspect that glass has much charm that it captures brilliance and light in permanent form. Much fine glassmaking is still a hand art, although machine-made glass produces beauty at a price all can afford. Explain these terms:

   . Crystal is glass with usually 25 to 50 per cent lead content (Steuben crystal has 60 percent or more) It is always handmade, flawlessly clear, brilliant in color, and heavy. It is tough yet pliable and rings when you hit it sharply.

   . Cut glass is glass with its natural brilliance and reflective quality improved by cutting. The design is marked on the plain glass with a mixture of red lead and turpentine, and cut on an iron wheel. The glass is then polished on a wooden wheel or in an acid bath.

   . Engraving is cutting done on a smaller scale with a more intricate design. Cutting is purely geometric and stylized but engraving may take anything as its subject matter - portraits, scenes in nature or fantasy. Engraving tools are more complicated and more delicate than cutting tools. A fine emery and oil are used for polishing.

   . Intaglio is light cutting on a special wheel. It may be semi-bright or polished.

   . Etching is done with hydrofluoric acid. An object is coated with wax and a design cut in the wax. The object is then dipped in acid, which eats away exposed portions of the glass.

   . Printing is another resist process. The resist medium is printed on a copper plate and the design is taken off and transferred to the glass object. When the object is placed in an acid bath, a frosted effect is produced on the unprotected sections of the glass.

   . Sandblasting is done through a stencil to achieve a design.

   . Painting, enameling and gilding require further cooking in the kiln so the ingredients fuse with the glass.

3. Assign sections of the booklets to students for oral reports on:

   History of glass
   Egyptian and Roman glass
   Venetian glass
   Val St. Lambert Belgian - deeply cut crystal
   Orrefors-modern Swedish glass
   Venini-free-form colorful fantastic Venetian glass

Karhula - Finnish glass
Bacarat - French glass
Stained glass in cathedrals
Tiffany's art glass
Tableware made in ceramic glass

4. Use Woman's Day "Dictionary of Glass" to learn about early American glass.

SUGGESTED RELATED ACTIVITIES:

To capitalize on the newly found knowledge and interest:

- Take the class to a museum to see fine glass collections, or to a department store.
- View pictures of Venetian glass or mosaics from St. Mark's in Venice. Learn the mosaic process.

RELATED CREATIVE ACTIVITIES:

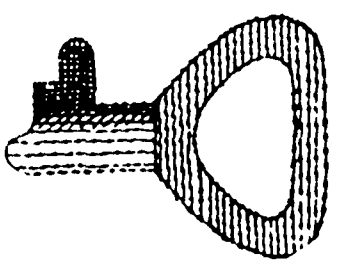
1. Obtain hydrofluoric acid in cream form from art supply house. Have students cover a piece of glass with wax or foil, and scrape or cut away design. Etch with acid. Use care to prevent acid burns.

2. Have students bring in colored glass bottles or dishes. Place between folds of corrugated cardboard, and crush with hammer. Draw a design on clear glass or other material. Cement broken bits of glass onto the design with Elmer's glue for a glass mosaic. The glass may be backed with silver or gold foil for a brilliant effect.

3. Draw a design on paper, such as a bowl of flowers. Place under a glass. Paint the outlines and background of the design on the glass with black enamel. When dry, back this with crushed aluminum, gold, or other colored foils that show through unpainted portions of glass for a brilliant effect. Frame with passe partout tape for a nice gift.

RELATED MATERIALS:

Film:
"Sealed in Glass" - Netherlands Consulate
Slides:
History of Glass (plus 30-minute lecture)
Origins of American Glass plus 45-minute lecture (42 slides - color)
both available - Corning Glass, Corning, N. Y.
Books:
Poetry and Crystal - Steuben Glass CUE
Booklets:
Romance of Glass - Pittsburgh Plate Glass
632 Fort Duquesne Blvd.
Pittsburgh 22, Pennsylvania
Filmstrip:
Glass and Mosaic EBF



CULTURAL ITEM: "GOOD LOOKS" (Film)
17 min., Color, Dial Laboratories.

CURRICULUM AREA: Home Economics - Personal Health
Personality and Grooming

PURPOSE:

To awaken sensitivity to and pride in an attractive personal appearance.

SYNOPSIS:

This film gives teenagers an objective look at how they appear to others when they are badly groomed, guilty of bad posture, or use exaggerated make-up and gestures.

Two young adults show how careful grooming provides a basis for poise and charm. Instruction is given in proper cleansing, subtle use of make-up, and hair care. The lesson given is that anyone can have good looks if he or she takes the trouble to groom and dress carefully.

SUGGESTED PREPARATION OF THE CLASS:

For students who suffer from lack of grooming knowledge or other related faults, this film provides a tactful means of providing them insight. It needs no introduction but, if possible, have equipment for face washing, and make-up samples, on hand for later use.

PRESENT MEDIA.

PUPILS SHOULD LOOK AND LISTEN FOR:

- How teenagers sometimes act and look.
- Techniques of good grooming.
- Factors to consider in hair styling.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. The teacher will be sensitive to the reactions of her group. In most cases, the film will drive the lesson home without further comment. The teacher may then take advantage of the new insights to suggest use of the make-up samples. She should:

   - Stress thorough scrubbing and cleansing.
   - Show students how to apply make-up properly.

2. Discuss hair style in relation to shape of face. Stress simple styles enhanced by the gleaming quality of fresh clean hair. Suggest each girl select from magazine illustrations a hair style that fits her personality and copy it.

3. Have students plan personal improvement charts for good grooming, listing their problems and their daily progress toward improvement.

4. Discuss care of problem skin. Encourage students to reduce acne by careful bathing, proper diet and rest.

SUGGESTED RELATED ACTIVITIES:

- Add skill and insight by securing a demonstration by a professional beautician.
- Arrange for a nurse to visit the class and discuss the importance of personal grooming for hospital patients.
- Encourage the buddy system, in which girls give each other various types of hairdo in experiments to find a becoming style.
- Have students role-play to show the importance of good grooming and pleasing manners in such situations as: employer and prospective employee; boy and girl on a date; meeting a friend's parent; a wife meeting her husband's boss; a girl traveling.
- Have the class discuss the importance of the first impressions they have experienced in their lifetimes.
- Research and discuss grooming practices in other lands, their similarities and differences, according to custom, religion and facilities available.
- Have students investigate various cosmetics. Compare advertising claims, price, true value, origin, and standards according to the Pure Food and Drug and Cosmetic Act.

RELATED MATERIALS:

Films:

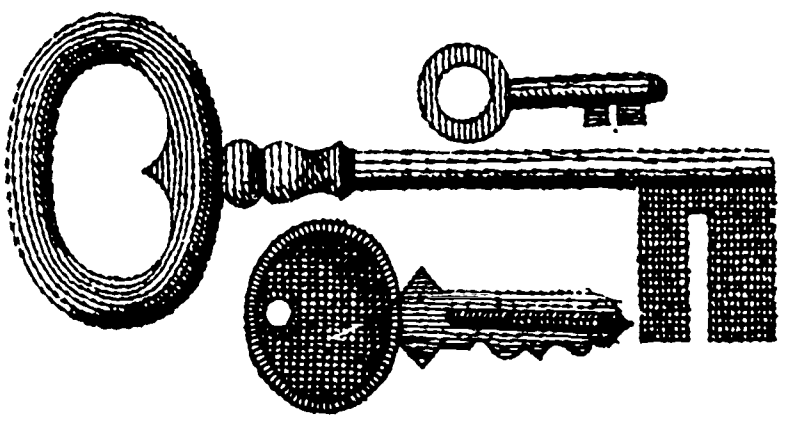
Beauty in the Making. (Avon) (CUE)
The Joy of Fragrance. (Avon) (CUE)

Pamphlets:

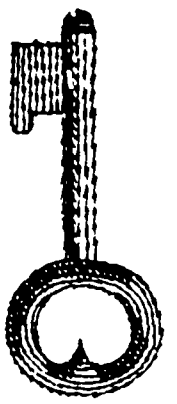
Through the Looking Glass. (Home Economics Department, The Proctor and Gamble Company)
Avon Beauty Book. (Avon Company)

Books:

How You Look and Dress, Carson. (McGraw Hill, New York, New York , 1959)



CULTURAL ITEM: "GROUND BEEF - PASSPORT TO FARAWAY EATING" (Filmstrip)
Pet Milk Co.



CURRICULUM AREA: Home Economics - Food Preparation
Cuisine of Various Cultures

PURPOSES:

To acquaint students with the cuisine of other cultures.

SYNOPSIS:

The All-American favorite-ground beef-rates high on the meat preference list of other countries as well. This filmstrip shows how to create appetizing and attractive main dishes with a foreign flair with a skillet of meat balls made from a basic recipe.

SUGGESTED PREPARATION OF THE CLASS:

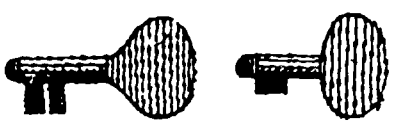
To orient student thinking toward food as part of culture, discuss:

. Popular and varied uses of ground beef as a basic food.
. A variety of ways to prepare ground beef (broiled, baked, grilled, sandwich, steak, meatballs, meat loaf).
. Use of spices and herbs in cooking, and the spices and herbs used most frequently by other countries.
. The value of learning cultural backgrounds through the common language of foods.

PUPILS SHOULD LOOK AND LISTEN FOR:

. Comparisons of the manner in which ground beef is prepared and served in Germany, Italy, France, Spain, Greece, Russia, Japan, China, and Sweden.
. Ingredients added to the meat in various countries.
. Spices, herbs, and special foods associated with certain countries.
. Kinds and types of table arrangements, dishes, decorations, covers, and silverware of different countries.
. Words and expressions related to foods we use which originated in other countries.

PRESENT MEDIA.



SUGGESTED FOLLOW-UP ACTIVITIES:

1. To enlarge on basic knowledge, discuss the following or similar questions:

   Which herbs and spices are typical of the different countries? Which are available in our groceries? Which are not? What accessories and decorative arrangements portray the cultural backgrounds of each country? (These might be listed on the board or written on paper with magic markers and placed on a flannel board for the class to see.)

. Individual research findings on foods of other countries, which interested students may report to the class. Have each girl tell about a special foreign dish, such as Swiss fondue, Spanish "arroz con pollo," Armenian shish kebab, Japanese sukiyaki, Hawaiian poi, Mexican tortillas, Greek lamb in grape leaves, and others. If possible, tell ingredients, manner of serving, and any other special customs involved.

2. Divide the class into groups to prepare a main dish, using a recipe characteristic of a particular country, as given in the "Teacher's Guide" or in foreign recipes in CUE Kit.

3. Have the class prepare a buffet meal typical of another culture. Ask pupils of varied nationalities within the class group to contribute added information on family foods, and to compile additional recipes. Pupils may add to the atmosphere of the occasion by dressing in native costume.

4. Ask a resource person in the community to demonstrate preparation of a typical main dish of her culture.

5. Encourage pupils to prepare these and other main dishes and report results to the entire class.

SUGGESTED RELATED ACTIVITIES:

Research on the history or romance of certain foods or spices, along with native customs which accompany its use, would make interesting reports.

Foods as represented in paintings and photographs would make an interesting study. (Consider Dutch and Flemish still-lifes, Van Gogh's "Potato Eaters," Cezanne's "Apples." See Bounty of Food" - Life Tearsheets CUE.)

RELATED MATERIALS:

Foreign Recipes - American Gas Association
U. N. Cookbook - United Nations

CULTURAL ITEM: "GUIDED TOURS OF THE WORLD-HAWAII" (Slides and record)
32 frames, Color, Panorama.

CURRICULUM AREA: Home Economics - Understanding Peoples of Various Cultures
Intercultural Influences on Food, Dress, Leisure

PURPOSES:

To acquaint students with the Hawaiian Islands, its landmarks, people and culture, past and present.

SYNOPSIS:

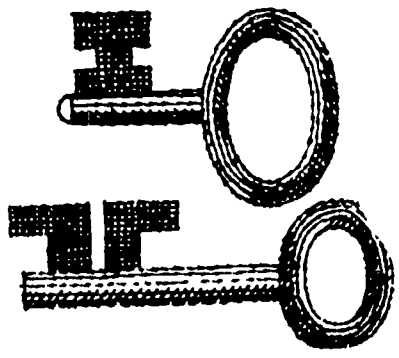
Arthur Godfrey takes viewers on a tour of the Islands, explains their colorful history, introduces us to the people, landmarks, sports, dances, beauty spots, sugar and pineapple plantations, celebrations and music.

SUGGESTED PREPARATION OF THE CLASS:

Little preparation is needed as these slides and records afford a fine introduction to Hawaii. Learning is always enhanced by proper atmosphere. A bulletin board with pictures of Hawaiian scenes and people, or a table display of related objects (muu muu, leis, grass skirt, tiki), will stimulate interest.

PUPILS SHOULD LOOK AND LISTEN FOR:

- History of Hawaii, landmarks, ceremonies and monuments.
- Polynesian and Japanese influences in parks, luaus, food celebrations and rituals, dancers, music, flowers and plants.
- Customs in dress; beauty of nature.



PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

To enhance understandings from the film, discuss:

- Polynesian settlement of Hawaii.
- The coming of the Americans and others.
- The melting pot culture and the rapidly vanishing old ways.
- Fruits, flowers and other tropical plants.
- How Hawaiian people conduct festivals and food celebrations.

SUGGESTED RELATED ACTIVITIES:

Do research on such items of Hawaii's culture as tapa cloth, tikis, dances and native Polynesian foods.

SUGGESTED RELATED CREATIVE ACTIVITIES:

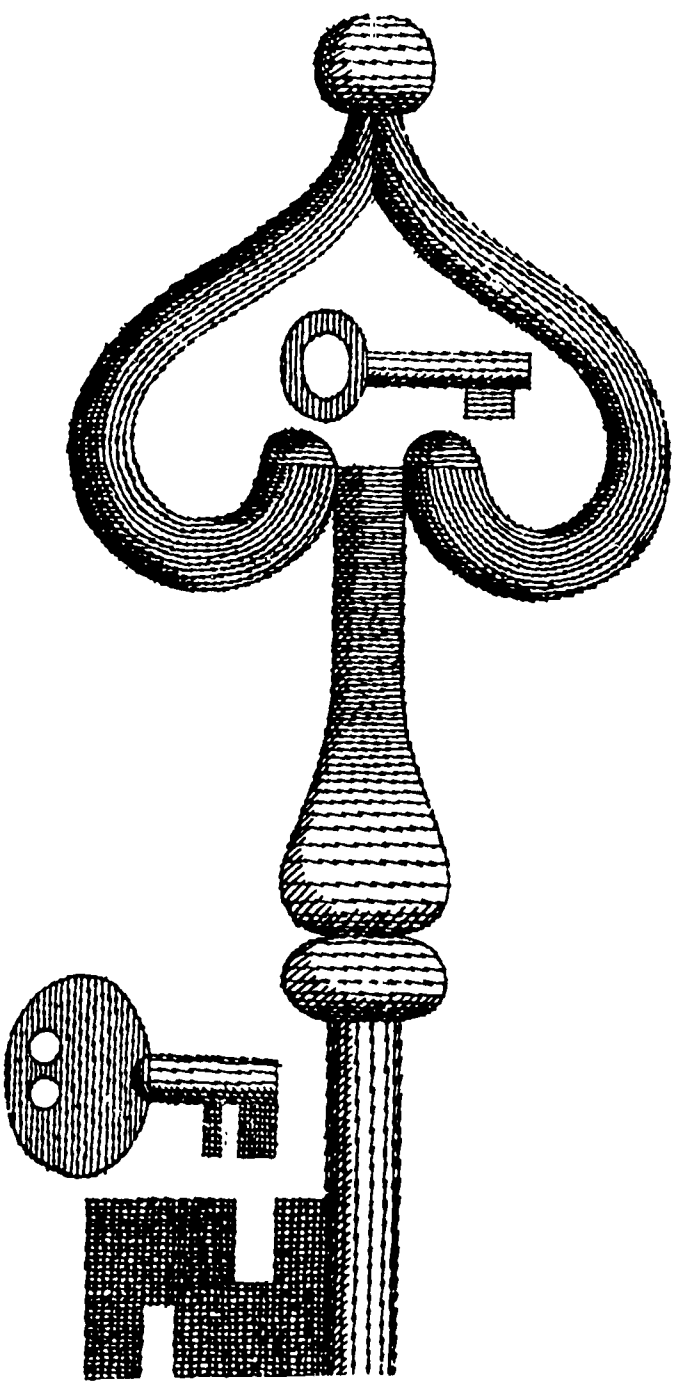
- Divide the class into groups to prepare main dishes using Polynesian recipes.

- Have other groups provide decor characteristic of Hawaii or other Polynesian islands.
- Learn some Hawaiian songs such as the "Huki Lau" to sing at a luau given by the class. Use appropriate background music.

RELATED MATERIALS:

Film:

Hawaii's History. (Film Associates)



CULTURAL ITEM: "GUIDED TOURS OF THE WORLD-JAPAN" (Filmstrip, Book and Record)
32 frames, Color, Panorama.

CURRICULUM AREA: Home Economics - Living Patterns of Various Cultures
Intercultural Influences in Home Decoration

PURPOSE:

To present the charm, beauty, culture and people of Japan, and to give insight into its way of life, past and present, through its arts, crafts, sports, industries, monuments and shrines.

SYNOPSIS:

Although Japan has taken on Western ways with amazing rapidity in the last century, she still retains much of the quaintness and strangeness of the Orient. This filmstrip, book and record present this fascinating combination of old and new.

In addition to the enchanting scenery, we see parks, pagodas, palaces, Buddhist shrines and rice fields of this oriental fairyland. The dancers, artists of all types, carvings, kites, flowers, puppets, ceramics, architecture and other arts remind us that there is underlying grace and beauty inherent in much of Japanese life. The ancient monuments, gardens and shrines give evidence of the richness and age of Japan's culture; the thriving shipyards and busy Ginza provide the sharp contrast of modern Western influence.

SUGGESTED PREPARATION OF THE CLASS:

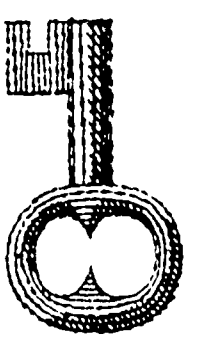
Little preparation is needed for this filmstrip except to explain that Japan was long cut off from the rest of the world by laws made by her emperor. As a result, she has maintained much that is old and strange to us. Today Japan is rapidly westernizing.

This material is an excellent introduction to Japan. To pique interest, ask students to give spontaneous reactions to the word Japan. List these on the board. Then ask: "What would you say are the outstanding characteristics of the Japanese?" Ask students to watch in the filmstrip for the answer.

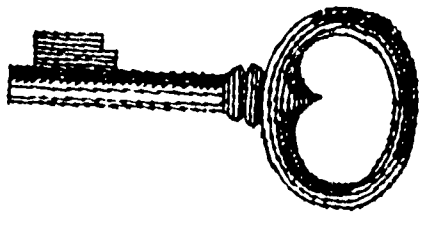
Locate Japan on the map or globe and point out Hakkaido, Honshu, Shikoko and Kyushu.

PUPILS SHOULD LOOK AND LISTEN FOR:

. The beautiful parks, shrines and palaces.
. The Asakusa, dancing girls, geisha girls, sumo wrestler.
. The Great Buddha of Kamakura.
. Ceremonial tea at Hakone.



. The "Three Monkeys" at Nikko.
. Puppeteers, Pachinko Den, theatre, other arts.
. Rice paddies, Miyajima torii, castles, shipyards.



PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. Ask students what the pictures and record have revealed about the Japanese character (industrious, love of beauty and nature, artistic, ingenious, polite, reserved, ceremonious). Ask them to list observations and resulting deductions about Japanese character. (See similar chart under "Guided Tours of the World-Thailand.")

2. Discuss the creative arts of Japan: puppets, lacquer, ceramics, carving,wood block, theatre, painting.

3. Discuss the Buddhas and "Three Monkeys." Explain that although many Japanese are Buddhist, they often practice the Shinto religion,a form of nature worship also. Many Japanese are Zen, a strict form of Buddhism involving asceticism and contemplation of nature. The tea ceremony is one of their rituals.

SUGGESTED RELATED ACTIVITIES:

1. Secure pictures of a Japanese house; explain the paper walls, shoji screens, tatami mats, tokenoma (small room shrine and place of beauty) scroll and silks.

2. Show and discuss three Japanese prints from Metropolitan Seminars of Art: Plates 53 and 54 in Portfolio 5, and Plate 119 in Portfolio 10.

3. Students may enjoy a real Japanese formal tea ceremony to gain insight into the simplicity and beautiful ritual of Japanese life. Green tea and whisks may be secured at import houses.

4. Display a Japanese hibachi and discuss Japanese foods.

SUGGESTED RELATED CREATIVE ACTIVITIES:

1. Display Japanese kabuki dolls or real Japanese kimono,tabi and obi. Have students dress a mannequin in Japanese style.

2. Have students cook sukiyaki or other Japanese food and serve it Japanese style, or visit a Japanese restaurant.

3. Secure long calendars with metal rods at ends. Use the backs to paint, in Japanese scroll style with water color or finger paint. Use as decor for Japanese tea.

RELATED MATERIALS:

Films:

Arts and Crafts of Japan. (Japanese Consulate) (CUE)

CULTURAL ITEM: "HAPPY ORIGAMI" (Book)
Japan Society, Japan Publication Trading Co. Ltd., Tokyo, Japan.

"ORIGAMI" (Booklet)
Harry C. Helfman, Platt Munk Publisher.

CURRICULUM AREA: Home Economics - Entertaining Convalescents
Creative Play for Children
Intercultural Understanding

PURPOSES:

To promote cultural understanding through appreciation of a fascinating oriental art.

SYNOPSIS:

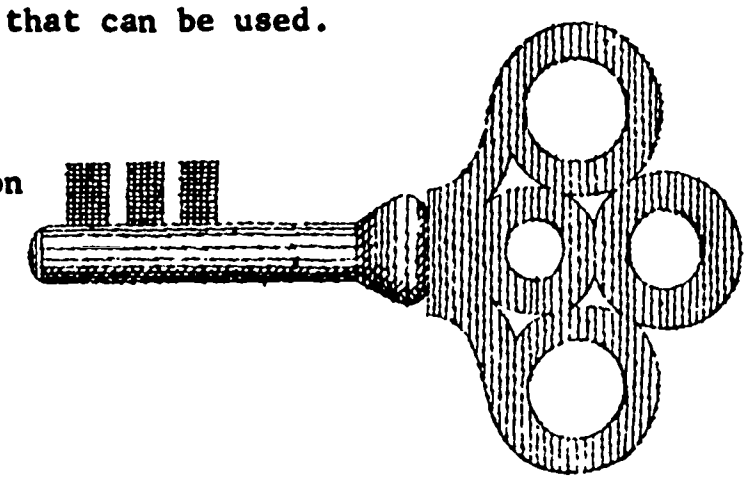
Origami, the art of creating three-dimensional objects from flat paper, is many centuries old. Paper, as we know it, was first developed in China two thousand years ago. The art of paper folding probably originated there, too. Through the centuries, the art has been handed down in the Far East from one generation to the next. In Japan, this art has reached its highest form. It is a suitable hobby for a wide range of age groups. These publications give a new and fascinating approach to art activities that lead to creative expression by convalescing persons or youth.

SUGGESTED PREPARATION OF THE CLASS:

Before the class session, the teacher should become familiar with Origami objects that can be constructed. She can select and make one very simple object, following directions in the book, and suspend it from the classroom ceiling, if possible. Inform students they will see a demonstration by the teacher of a creative paper-folding art which came to us from the Orient. Make one or two objects for the class and show the ready-made objects in the book.

PUPILS SHOULD LOOK AND LISTEN FOR:

. Kinds and characteristics of paper that can be used.
. Sizes of paper adaptable for use.
. Steps in creasing and folding.
. Possible variations in pattern.
. Limited time needed for construction
. Artistic appeal of the object.



PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. Divide the class into groups of four and distribute materials. Ask each pupil to make the same art object, according to steps observed in the demonstration. Each student will construct an object; combine all objects to form a mobile.

2. Explain the origin of the paper-folding art and its introduction into our country to the students.

3. Have students select other patterns to make from the books.

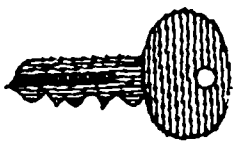
4. Ask pupils to describe ways how this creative art could be used to entertain and amuse convalescing patients.

5. Ask students to name other people who might enjoy this art, and other occasions when it might be interesting and effective in family life.

6. Plan with pupils the ensuing day's lesson in which they may select other patterns and put their own ideas into the creative art objects.

7. Make a mobile of several of the folded paper designs.

8. Some students may wish to create their own shapes.



SUGGESTED RELATED CREATIVE ACTIVITIES:

Other activities to amuse housebound patients:

. Japanese art of making designs by enclosing leaves, ferns, or other flat natural materials between sheets of translucent paper.

. Interesting stained glass effects obtained by shaving bits of crayon on waxed paper. Arrange colored string, yarn, bits of metallic or other paper designs. Cover with another sheet of waxed paper. Press with a hot iron. Brilliant color effects may be achieved. These may be used as place mats or taped to a window for a stained glass effect.

RELATED MATERIALS:

Books:

Alcoa's Book of Decorations. (Golden Press, New York 1959) (CUE)
Fun and Festival from Japan, Alice E. Gwinn, Esther L. Hibbard. (Friendship Press, New York. 1956)
(Takashimaya, 562 Fifth Ave. (at 46th St.) New York 36, New York. Origami paper and other Japanese articles may be purchased here.)

CULTURE ITEM: "HAWAII'S HISTORY" (Film)
20 min., Color, Film Associates of California.

CURRICULUM AREA: Home Economics - Living Patterns in Various Cultures
Intercultural Significance of Food

PURPOSE:

To reveal Hawaii's history as well as its past and present melting pot culture.

SYNOPSIS:

Hawaii, as we know it, began with its discovery by James Cook. This film shows its early history, including the coming of the whalers and missionaries, through prints, paintings and beautiful color photography. Days of Kamehameha and other rulers are shown, as well as the final granting of statehood, and life today. Insight is given into how Hawaii's melting pot culture came about, and how these people of many races and nationalities mix and mingle freely and amicably, and consider themselves Hawaiian rather than Japanese, Chinese, Negro, Polynesian or white. The arts, foods, housing, and ways of life, as well as character of the people, are vividly portrayed.

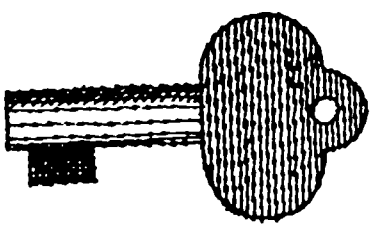
SUGGESTED PREPARATION OF THE CLASS:

1. Since this film moves rapidly and covers much information, it would be wise to use the "Guided Tours of the World-Hawaii", Panorama slides and record, as an introduction to Hawaii.

2. To arouse interest and alert students to cultural interdependence, place illustrations of Hawaiian foods, people on the bulletin board as well as displaying Hawaiian textiles, wood carvings and clothing.

3. Explain to pupils that the film will suggest new ideas in food for preparation in class and at home, and will give insight into interesting arts and crafts.

PUPILS SHOULD LOOK AND LISTEN FOR:



. Early grass houses and modern houses in cities.
. Foods characteristic of Hawaii.
. Artifacts used in construction of utensils.
. Textiles made from the bark of trees - tapa cloth.
. Wood carvings-their beauty and the skill involved in making them.
. Dances and their symbolism.
. Characteristics of the people.
. The following Hawaiian words -- luau, muu muu, poi, lei.
. Changes in ways of living from the days of native kingdoms to American communities.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

To further understandings received from the film, discuss:

- What is a "melting pot" culture?
- Why do you think people of all races mingle here amicably? Can this be a lesson for us?
- From your observations of the film, what are the characteristics of Hawaiian people?
- How would you describe the making of poi?
- What utensils were used for serving foods, and how were they made?
- What types of food are served at a luau?
- How are tapa cloth and feather capes made?
- What is the difference between the Hawaiian and Tahitian hulas? How and why are these dances related to Indian and Indonesian dances? (Use of hand, body and head movements to tell a story; Polynesians came from South Pacific.)
- In what ways have Hawaiian ideas influenced our culture? (Use of muu muus, leis, lanai, foods, songs.)

SUGGESTED RELATED ACTIVITIES:

1. Show the paintings of Paul Gauguin from the Metropolitan Seminars of Art. Although these are painting of Tahitians, they are Polynesian and much like the native Hawaiian. Also see Plate 48, Portfolio 4, "By the Sea," National Gallery reproduction in the school exhibit collection.

2. Learn the Huki Lau (fishing party) or other Hawaiian songs.

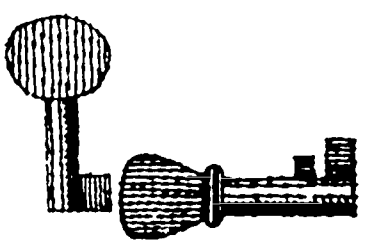
SUGGESTED RELATED CREATIVE ACTIVITIES:

To really savor Hawaiian culture; plan with pupils an opportunity to experiment with Hawaiian foods, customs, and social attitudes. Divide the class into two groups. Ask one group to make plans for the preparation and serving of Hawaiian foods suitable for a luau;the other group may plan appropriate table arrangements and room decorations for the room using the Hawaiian theme. Have the party on the second day after the film showing, to allow time for marketing and preparation. The class could wear muu muus, and crepe paper leis, and flowers and use Hawaiian music. (Explain: if this were a real luau the food would be served outdoors on the ground.) Evaluate the party in terms of food, table appointments, and decorative arrangements.

RELATED MATERIALS:

Filmstrip and record:

Guided Tours of the World-Hawaii. (CUE)



CULTURAL ITEM: "IKEBANA" (Film)
17 min., Color, Ministry of Japan.

CURRICULUM AREA: Home Economics - Arrangement of Home Accessories
Creative Table Settings
Housing in Various Lands

PURPOSES:

To demonstrate the art of flower arranging and show its importance in Japanese culture.

SYNOPSIS:

Japanese flower arrangement expresses universal life by being an idealized form of nature. The art of line design, rather than appreciation of form and color, is what differentiates ikebana from other floral arrangement. Equally as strong as emphasis on line or perfection is an insistence on the understanding of the natural growth of material and love of nature. Arrangements also suggest time and season. Every holiday has its prescribed arrangement. This film reveals this art and philosophy with breathtakingly beautiful ikebana in many styles. Excellent color photography shows how this art is as much a part of a Japanese girl's training as dancing lessons are in an American girl's education, and how its beauty is enjoyed in every Japanese home as part of daily life.

SUGGESTED PREPARATION OF THE CLASS:

Have on hand some real or plastic flowers, leaves and branches. Stuff them carelessly into a container. To ready students for the film one might say: "Everyone loves nature, but in our great country with its wealth of natural resources we tend to take nature's beauties for granted. We do not really look at and contemplate and study them as Oriental cultures do. Japan is a beautiful country, but poor in resources compared to population. Here people feel very close to nature: they love and study and conserve it in a way difficult for us to understand. They make even the simplest materials into works of art through care, study and love of all natural beauty." Explain that ikebana is studied in Japanese schools as a regular course.

PUPILS SHOULD LOOK AND LISTEN FOR:

. The basic triangle and its meaning (earth, heaven and man).
. The tokenoma (alcove beauty spot).
. How beauty and art are important in daily life in Japan.
. The importance of ikebana in Japanese decor.
. Older and more modern styles of ikebana.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To check for comprehension of concepts presented in the film, one might call attention to the container of flowers, and ask "Could anyone suggest how to improve it?" Lead the girls to realize that carefully thought out and planned flower arrangment gives more satisfaction and beauty.

2. Discuss the idea of line in space - how the design captures and holds space. Ask each girl to sketch some arrangements stressing line design, the basic triangle and relationship to container.

3. Explain the symbolism of materials used and types of arrangements, as well as the fact that ikebana grew out of Buddhist temple worship practices. (See Facts About Japan, pamphlet, Japanese Consulate, CUE Home Economics Kit.)

4. Explain that the tokenoma is a built-in alcove, the central feature of the main room of a Japanese home and the focal point of artistic expression. It probably developed from a family altar. It is adorned with scrolls, art objects and flower arrangements. Since it is the place of honor, the visitor is always seated in front of it.

SUGGESTED RELATED ACTIVITIES:

Secure CUE Kit ikebana book by Sofu Teshigahara. Show students the pictured arrangements. Sketch plans of arrangements on the board. Help students realize that nature is not art. The true beauty of ikebana is the beauty of nature heightened by art.

SUGGESTED RELATED CREATIVE ACTIVITIES:

Use the CUE ikebana book to teach basic arrangements , then let students prepare their own designs for the school entrance, cafeteria, auditorium or other appropriate area. As their designs are displayed, students may explain the art to assembly or reshow the film to the group as explanation.

RELATED MATERIALS:

Filmstrips:

The Story of Flowers. (Part 1 and 2) (CUE) (Colorado Flower Growers Assn.)

Book:

Stepping Stones to Japanese Floral Art, R. E. Carr. (Tokyo, 1956)

CULTURAL ITEM: "INVITATION TO DINING" (Flat Pictures in Brochure)
The Melamine Council

"METROPOLITAN SEMINARS IN ART" (Flat Pictures)
Plate 4 (Portfolio 1); Plate 83 (Portfolio 7); Plate 25 (Portfolio 3)

CURRICULUM AREA: Home Economics - Creative Table Setting
Variety in Meal Service

PURPOSES:

To awaken students to the realization that it is possible to create beauty in everyday life by creative table arrangements.

SYNOPSIS:

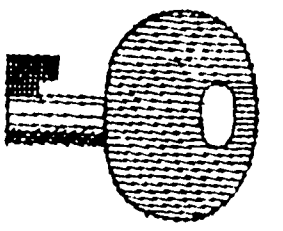
The brochure contains 12 beautiful full-page color illustrations of table decor, with unusual ideas for creativity in table arrangements. Varied menus are suggested such as a shore dinner, fireside supper, children's, teenage, engagement parties and others. Each has its own distinctive china, glass, silver, linen and conversation piece.

SUGGESTED PREPARATION OF THE CLASS:

Explain to the students that food is always more enjoyable when attractively served in pleasant surroundings. Show illustrations from the booklet on the opaque projector, and discuss with the class.

PUPILS SHOULD LOOK AND LISTEN FOR:

- Varieties of pattern in appointments.
- Color harmonies in table setting.
- Varieties of themes (Mexican, smorgasbord, Japanese).
- Types of menus suitable for different occasions.
- Kinds of accessories appropriate for various occasions.
- Types of centerpieces which add beauty to the meal.



PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. Use discussion method to evaluate the lesson. The following topics are suggested:

   - Types of menus which are nutritious and appealing.
   - Table appointments which are inexpensive, durable, and attractive.
   - Themes which are novel and appropriate for various occasions.
   - Color harmonies in mealtime settings.
   - Accessories which are well chosen and enhance table settings.

. Centerpieces which are simple, appropriate, and creative.
. Influences of other cultures on American eating habits.

2. Have students select and prepare a menu, using color harmony. The pupils may utilize swatches of color to decide on table decor, and recipes printed in the brochure.

3. Encourage pupils to seek beauty in table decor by emphasizing co-ordination of tableware and other accessories. Pupils may make original color schemes, or may use paintings as suggestions for pleasing color schemes. This may be done with the opaque projector to relate flat pictures in "Invitation to Dining" to the plates in the Metropolitan Seminars in Art by showing them in the following order:

   . Plate 4 (Portfolio 1) "In the Meadow" by Renoir; then show "Autumn Glory" in "Invitation to Dining" to illustrate how the table color scheme might have been inspired by this painting.
   . Plate 83 (Portfolio 7) "View of Toledo" by El Greco; then show how "Spring Violets" in the booklet is related in color scheme to this painting.
   . Plate 25 (Portfolio 3) "Starry Night" by Van Gogh; then show how it is related in color scheme to the "Flower Box" table in the booklet.

SUGGESTED RELATED CREATIVE ACTIVITIES:

Plan for a study of the history, use, and varieties of each type of table appointment for better understanding of its use.

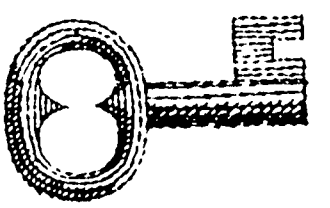
RELATED MATERIALS:

Pamphlets:

Romance of Glass. (Information Services Department, Pittsburgh Plate Glass Co.)
This is Glass. (Corning Glass Works)
The Reference Book of Fine China. (Lenox, Inc.) (CUE)
Starting with Sterling. A project book for students.
New Teaching Ideas on Buying, Using and Caring for Sterling Silver Flatware. (Sterling Silversmiths of America)

Magazine Articles:

"Dictionary of American Glass." (Woman's Day, August 1961)
"Dictionary of Pottery and Porcelain." (Woman's Day, August 1962)
"Dictionary of Sandwich Glass." (Woman's Day, August 1963)
"Melamine, the Modern Dinnerware," Olive C. Berry. (The Melamine Council)



CULTURAL ITEM: "JAPANESE FAMILY" (Film)
23 min., Color, McGraw-Hill Films.

CURRICULUM AREA: Home Economics - Understanding Peoples of Various Cultures
Intercultural Influences on Family Living

PURPOSE:

To give insight into and appreciation for Japanese arts and culture through living vicariously for a time with a Japanese family.

SYNOPSIS:

This charming film presents the essence of the culture of old Japan by letting us visit with a Japanese silk-weaving family in Kyoto. The simple yet harmonious rhythm of work, play, worship, family fun and festival reveal their way of life. Skilled fingers weave beautiful brocades, the evening meal and tea are prepared, homework is done; bed-time routine and family manners give the flavor of everyday life. A trip to the temple and a New Year's celebration and ceremony show the rest of the pattern.

SUGGESTED PREPARATION OF THE CLASS:

1. To stimulate class interest and curiosity about family life in another country, a bulletin board may be arranged with the theme, "Living Patterns of Other Cultures." This can display people of any country, including Japan, at work or play, and their homes, their architecture, their native dress. Illustrations may be clipped from magazines.

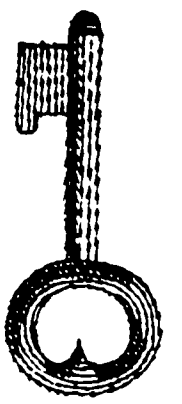
2. Ask pupils to identify the country which the pictures represent.

3. Explain to the class that they will see a film about a typical day in the life of a Japanese family.

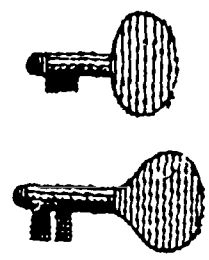
4. Explain that the new and the old cultures juxtapose in Japan. While life in Tokyo has many very modern aspects, other areas preserve many of the older ways. This is particularly true of Kyoto, the scene of this film which has been declared a national monument area because of its many fine temples and palaces.

PUPILS SHOULD LOOK AND LISTEN FOR:

. Evidences of unity in the family.
. Characteristics of dress in Japanese life.
. Types of recreation for young members and adults.
. The position of women in the home.
. Typical foods and beverages.
. How holidays are celebrated.
. Religious practices.



. The facilities in the home.
. Family occupations.
. Hospitality and courtesy in the family.
. Values in Japanese family life which set their standards.
. Appreciation of beauty in Japanese life.
. Oriental background music.



PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To assist students to crystallize thinking and reaction give each pupil a mimeographed sheet on which to record one example from the film for each of the following questions:

   . What kinds of recreation do the young people enjoy?
   . What acts of courtesy or hospitality are indicative of their manner of conduct?
   . What types of dress are characteristic for girls, boys and adults in Kyoto? In Tokyo? (Stress the fact that most younger people and many older ones in Tokyo wear western style clothing.)
   . What is the role of women in the home, compared with that of American women? (Point out that while most Japanese women have a very inferior role some of the young ones are becoming more emancipated as they get jobs and can support themselves.)
   . Can you describe any evidence of foods or beverages which are characteristic of Japanese families?
   . What equipment or facilities are available in the home to prepare the meals? (Display hibachi, rice bowls, chopsticks .)
   . How do the people celebrate their holidays?
   . How would you describe the puppet shows and the temples?
   . Did you observe any acts of worship which indicate their religious beliefs? (Discuss Buddhism, Shinto and Zen.)
   . What occupation is carried on in the home? (Point out that while Japan has factories and an atomic reactor much industry is still carried on in the home.)
   . Did you find any basic characteristics common to the cultures of all societies? Draw some parallels to our society. (Point out that all societies grow out of mans basic needs but differ according to environment, resources and history.)

2. Discuss the preceding questions, and reactions in the class, emphasizing comparison with American family life. (Point out the contrast between space and resources available to a Japanese as compared to an American.)

3. Assign readings on Japanese customs, mores, and cultural heritage to increase background information.

4. Have pupils bring in Japanese objects, clothing, or other articles for a room display.

5. Learn about a Japanese house.

SUGGESTED RELATED ACTIVITIES:

. Ask a Japanese resource person to discuss her home life and family patterns in Japan.
. Visit a Japanese restaurant for dinner.
. View Japanese clothing and fabrics, especially silks.

SUGGESTED RELATED CREATIVE ACTIVITIES:

1. Ask students to do research and write a paper on some aspect of Japanese family life, customs, festivals, food, clothing or arts.

2. Use Japanese word list in back of "Guided Tours of Japan" to learn some Japanese phrases.

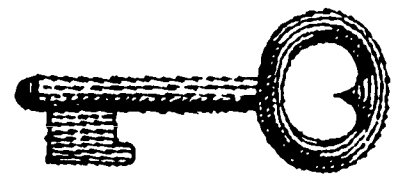
RELATED MATERIALS:

Films:

Four Families. (2 reels, Part 1, 30 min., Part 2, 31 min.) (McGraw-Hill Films)

Filmstrip:

Guided Tours of the World-Japan. (Panorama)



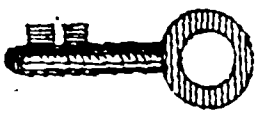
Books:

Japan, Werner Bischof. (Bantam Books, New York, 1961)
Fun and Festival from Japan, Alice . Gwinn, Esther L. Hibbard. (Friendship Press. New York, 1961)
An Introduction to Japan, Herschel Webb. (Columbia University Press, New York, 1960.)
Japan Notebook (CUE Social Studies Kit) (Life library)
Japan. (Life library)
Myths and Legends of All Nations, Herbert Spencer Robinson. Knox Wilson. (Bantam Books, New York) (CUE)

Booklets:

Useful Japanese Pronunciation and Basic Words, Hyman Kublin. (Japan Society, Inc., 112 East 64th Street, New York, New York)
Japan: A Resource Unit for High School Teachers. (Japan Society, Inc.)
An Introduction to Japanese Writing, A Special supplement to Language Arts News, Vol. VI, No. 2. (Allyn and Bacon, Inc.) (CUE)
Japan. (advertisement) (Standard Oil Company.) (CUE)

CULTURAL ITEM: "THE JOY OF FRAGRANCE" (Film)
20 min., Color, Avon Cosmetics.



CURRICULUM AREA: Home Economics - Personal Groming
Clothing Storage Accessories

PURPOSES:

To awaken the viewer to the charm and romance of perfume, and to give insights into its proper use.

SYNOPSIS:

Perfume is a grooming delight, and a joy to others if properly used. It can heighten personality and call to mind the misty romance of faraway places, suggest fragrant blossoms, or stimulate with fresh clean woodsy or spicy scents. This film gives a brief and beautiful glimpse of the blossoms and scenery of Grasse, France, where perfume is manufactured. It explains the various ingredients and how great scents are concocted. The difference between perfume, cologne, and bath oil and sachet are explained, and suggestions for proper use are given. Some advertising is present, but inoffensively so.

SUGGESTED PREPARATION OF THE CLASS:

1. Secure from some producer, or the class, various samples of perfume, cologne, bath oil and sachet for later use.

2. To pique curiosity, and thus motivate, write the words: musk, ambergris, sandalwood, bergamot, eucalyptus, on the board. Ask the class if these words mean anything to them. Perhaps they can guess that the words all have to do with perfume. Explain that ambergris is a substance coughed up by whales, and that it is extremely valuable as it is used as a fixative for scent in perfumes. Musk is oil from glands of the musk ox, also used for this purpose.

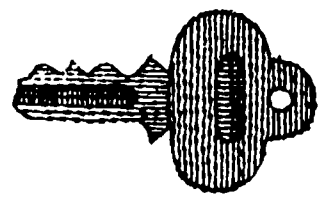
3. Give a brief insight into the history of cosmetics. Ancient Greeks used perfume. Cleopatra filled her navel with sweet smelling almond paste. Egyptians put vases of perfume by the dead for their use in the spirit world. Mohammed loved perfume. Louis 14th was France's sweetest smelling monarch. Catherine de Medici had her own special perfumer. Perfume has always been desired and was sought by early explorers. Perfumes were much used in the Middle Ages and later in France to hide unpleasant odors caused by infrequent bathing. In America it used to be thought bad taste to wear perfume in the daytime. French people think girls should be taught how to use perfume along with Latin and algebra for they feel even a homely woman can be attractive if she is fresh and fragrant.

4. Explain that although today we do not use them to mask odors, they are used to give ourselves and others heightened pleasure. If misused, however, they can be offensive. It is therefore important to learn to use them properly.

PUPILS SHOULD LOOK AND LISTEN FOR:

- The flower field of Grasse.
- The kinds of plants and other materials used for making perfume.
- The process of extracting flower and other oils.
- The way in which "the nose" concocts a scent.
- The "Basic Seven" scents and the type of personality they express.
- How to select and wear perfumes.
- The differences between perfume, cologne, bath oil and sachet.
- The uses for each of these and how they are best kept.

PRESENT MEDIA.



SUGGESTED FOLLOW-UP ACTIVITIES:

1. To test for comprehension of film content, ask:

   - What should we bear in mind when selecting and wearing fragrance? (Personal taste, personality, age, the place we are going, perhaps the time of year.) Is heavy perfume appropriate at school? For sports? For young girls?
   - What sort of fragrance is appropriate for a young girl?
   - Why is a heavy Oriental perfume inappropriate for young girls?
   - Why is cheap perfume a bad bargain? (Odors are not pleasing or lasting.)
   - How can fragrance increase our own and other's pleasure, both in the home and on the person?
   - Why is it important not to overpower others with our perfumes?

2. Let students use their newly acquired knowledge to judge the samples of scent which are on display.

SUGGESTED RELATED ACTIVITIES:

1. To further capture the romance of perfumes, study how they are made in Grasse or do research on American manufacture of perfume.

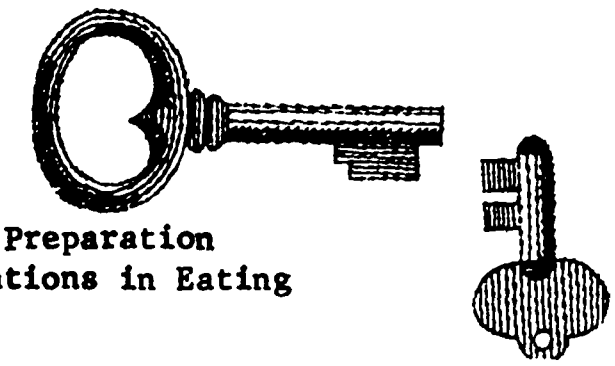
2. To develop and sensitize the sense of smell, have students learn through practice to recognize the scents of tuberose, violet, narcissus, hyacinth, honeysuckle, lavender, sage, orange, bergamot, geranium, lemon, rosewood, sandalwood, ginger and eucalyptus.

SUGGESTED RELATED CREATIVE ACTIVITIES:

1. To stimulate imagination and creative thought, ask students to write about images which come to mind when they smell various fragrances. Can scents influence thought? Ask them to list words descriptive of fragrances, aromas and odors. Use these words to write a story involving the sense of smell.

2. Ask them what home products might be improved by scent (e.g., scented paper for lining drawers, scented tissues, scented dress hangers). What products could be improved by having the scent removed or improved (e.g., some cleansing liquids and powders, insecticides)?

CULTURAL ITEM: "KITCHEN KEYBOARD" (Film)
20 min., Color, R. T. French



CURRICULUM AREA: Home Economics - **Creative Food Preparation**
Regional Variations in Eating Patterns

PURPOSES:

To awaken an interest in the history of spices and their use throughout the world, as well as an appreciation of foods cooked with spices.

SYNOPSIS:

Although once sought after by romantic adventurers, prized by kings, and afforded only by the wealthy, the zest and variety of spices are now available to all. Old paintings, artifacts and legends tell the story of spices round the world in this film. Roots, stems, leaves, buds, seeds are all sources of spices and herbs. Some need only cleaning but many are ground and made into condiments or powders; some are dried and made into flakes or left in natural form; some are combined to give variety and new flavor blends to foods.

Each spice by nature emphasizes certain qualities of food:for example, parsley enhances other herbs, tarragon is delicate, basil is warm and heavy, savory accents strong flavors.

There are three approaches to the use of spice as different as the cook's personality: experimental, traditional, and formal or classic. One may let her imagination guide her seasoning; one will adhere to past family-tested recipes; another will turn to the cookbook for aid in exact measurement.

Nationality, too, has an affect on the use of spice as illustrated by the country or area preparation of chicken. In France it would be roasted with tarragon; in Louisiana, cut up with gumbo and deep fat fried; in Texas, barbecued with hot sauce.

SUGGESTED PREPARATION OF THE CLASS:

To motivate students explain: Since many of you will be cooking thousands of meals in the future it is well to know that imaginative use of seasonings can do much to add variety and zest and zing to everyday foods.

Show the "Wonderful World of Seasoning Spice Chart" (Home Economics CUE Kit) and assist girls to learn the names of spices. Take full advantage of the romantic search for spices and their exotic aspects to stir interest.

Obtain examples of as many spices as possible; have the students study the names, shapes and forms of spices or herbs until they come familiar with the most common ones. Be sure they also associate smell with a spice.

This background will help students to identify many of the spices and herbs shown in the film.

STUDENTS SHOULD LOOK AND LISTEN FOR:

- The most common spices used.
- The country in which the various spices and herbs are grown.
- The paintings, artifacts, and maps used to tell the history of the spice voyages of long ago.
- The plant source of spice and herb (flower bud, flower part, stem, leaves, root, seed).
- The processes involved in refining spices for use (cleaned, ground, dried, and combined).
- Personality influences on the use of spices.
- The role of nationality and traditions in use of spices.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. Have the class artist draw a map of the world. Assign the girls to note the spices used in their menu that evening and report in class the ones used. Place colored pins, labeled to represent the spices and herbs, on the map to show the country of their origin. Using the encyclopedia or "The Kitchen Keyboard" pamphlet by R. T. French, trace the plant source of the spice and customs, traditions, and dishes used by that country in relation to spice. If desired, keep a continuing research map on spices for the entire semester, tracing the source of each new one and adding it to the map.

2. Make spice mosaics for framing as a kitchen accessory for department or home use.

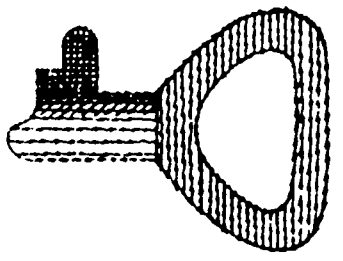
RELATED CREATIVE ACTIVITIES:

1. Plan a spice party. Show the girls how this could be adapted for entertainment or theme at home. Select 25 sample spices and herbs and place in numbered envelopes and seal. Include the most common and any of others that are often called for in cookbooks. Make a master list of the spices for each number. Have girls identify by feel and smell each envelope of spices and herbs. Encourage use of words to describe the aromas since this activity enhances perception.

2. Decorate a cake or other refreshments with spices as centerpiece for serving table of refreshments.

3. Make an old fashioned pomander ball of an orange and cloves--attach a ribbon for hanging. Explain to students how these are used to lend spicy fragrance to clothing.

CULTURAL ITEM: "LINE" (Film)
11 min., Color, McGraw-Hill.



"LINE IN YOUR WARDROBE" (Filmstrip)
J. C. Penney Company.

"METROPOLITAN SEMINARS OF ART" (Prints)
Prints 91, 95 (Portfolio 8); Prints 111, 112 (Portfolio 10)
Print 25 (Portfolio 3)

CURRICULUM AREA: Home Economics - Beauty and Dress
Selecting Clothing

PURPOSES:

To acquaint students with the psychological principles of line to provide a basis for appreciation of line quality.

To alert students to utilize this knowledge in costume.

SYNOPSIS:

This film gives fine insight into the meaning of lines by showing them both in nature and art. Animation illustrates how motion and other feelings are conveyed by lines and dots.

SUGGESTED PREPARATION OF THE CLASS:

To prepare the class to understand the psychology of line, draw on the board these lines: and ask what they mean. After they respond, reply: "We can see that even a few scribbled lines convey much meaning and effect. This film will give you further insight into how lines do this."

PUPILS SHOULD LOOK AND LISTEN FOR:

. Ways in which motion is implied by the attitude of a line.
. Ways in which motion is implied by line curvative.
. Use of line to determine boundaries in painting.
. Use of line to guide attention to the central figure of a painting.
. Movement portrayed by association.
. Use of dots to give the impression of line.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To check for understandings, ask:

. Why do diagonal lines tend to disturb us? (We expect motion to occur because the line is not at rest.)
. How does an artist portray movement by association? (Lines representing familiar things such as trees, waterfalls, and waves immediately imply motion to us.)

. What feeling of motion do we get from a horizontal line? (Since we normally read from left to right, a horizontal line gives an impression of movement toward the right, unless it is stopped by an opposing line.)
. How do curved lines give us the impression of motion? (Our familiarity with such things as water waves or billowing smoke tends to create a feeling of motion in the direction of the bulge in a curved line.)

2. Illustrate some simple techniques of line as composition, using the following prints from the Metropolitan Seminars in Art:

. Plate 91 (Portfolio 8) "The Resurrection" by Pierodella Francesca. Call attention to the triangular form made by lines which enclose the figures in this painting. This configuration is characteristic of many artists as it forms a simple stable shape which guides our eye around the composition and maintains its unity. To illustrate further this pyramidal form in painting, show Plates 64 and 65 (Portfolio 5).
. Plate 95 (Portfolio 8) "Sugar Cane" by Rivera. Point out how the figures on the extreme left and right are like pillars, and serve as the boundaries of the painting. The attitude of the lines which characterize the native workers in the background gives the feeling of motion to the left, but this motion is stopped by the figure on the left. In a similar manner, the attitude of the line around which the workers in the foreground were composed seems to imply movement to the right, but this movement to the right is stopped by the line of the stalwart figure there.
. Plate 111 (Portfolio 10) "Sloop, Bermuda" by Homer. Point out the use of line here to illustrate motion of water waves, and also to give the impression of billowing clouds in the sky.
. Plate 112 (Portfolio 10) "Boat off Deer Isle" by Marin. There is little subtlety here in the use of line. Note how the bold strokes of the water colors produce lines that enclose the boat in the center. There is some semblance of the triangular form in the brash use of the brush strokes which enclose the painting.
. Plate 25 (Portfolio 3) "The Starry Night" by Van Gogh. Here the artist uses line to portray motion, in an attempt to create feelings of emotion in the observer. This is characteristic of Van Gogh's style.

SUGGESTED RELATED ACTIVITIES:

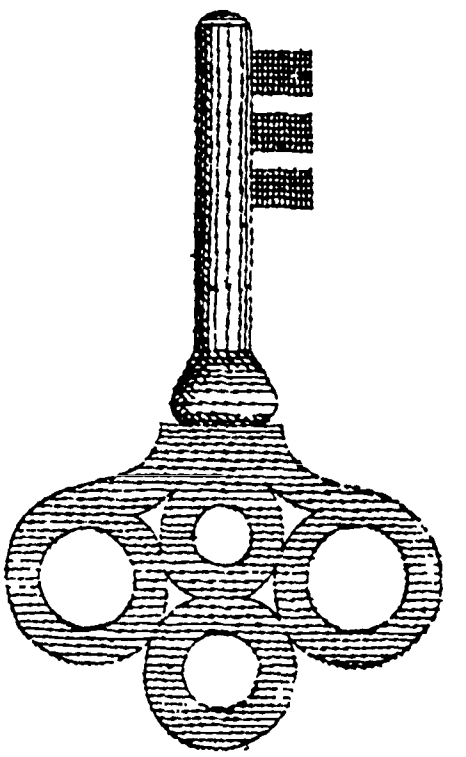
1. To assist girls to use line effectively in wardrobe and posture, use the filmstrip "Line in Your Wardrobe" and the J. C. Penney booklet (CUE Kit). Few of us have perfect proportions, but line is the key tool to use to achieve an illusion of perfect proportion. Even a perfect figure can be ruined by bad posture and wrong use of line in dress. Have the girls study their figure problems to see how they can be corrected by proper use of line in dress according to suggestions given in the filmstrip and in the CUE Guide.

2. Assist students to learn other properties of line: line divides space and connects shapes; lines of our garments and posture create emotions. Point out that:

   . Vertical lines give a feeling of formality and dignity. In clothing they create the impression of height and slenderness.
   . Horizontal lines create a mood of serenity and an illusion of width.
   . Diagonal lines give the feeling of active forceful movement. Clever use of diagonals in dress results in a slimming effect.
   . Curved lines are lovely but give a busy effect, if overdone.

RELATED CREATIVE ACTIVITIES:

Have students design garments suited to their figure type that utilize what they have learned about line.



Tips for Selecting Fashions for Figure Types

I. Analyze the Fashions of a New Season.

A. Study sources of fashion information.
1. Fashion magazines and newspapers.
2. Television.
3. People (fashion coordinators, sales people, buyers.)
4. Store windows and displays.

B. Find the colors of the season.
1. Evaluate the colors of the season with relation to you and your wardrobe.
2. Try the color on, to be sure your decisions are correct and don't go by what you have done in the past.
   a. Remember, there is a difference very often between your favorite color and your most becoming color.
   b. Consider your complexion, hair, eyes, and size.
   c. List the hues, values, and intensities of Fashion colors that enhance your natural coloring and blend with your wordrobe.
   d. Look for new color schemes for you. Avoid a color rut.

C. See yourself by checking the correct blank.
1. Neck: long..... short..... thin..... fat..... about right.....
2. Height: tall..... medium..... short
3. Weight: stout..... medium..... thin
4. Posture: erect..... stooped..... protruding stomach..... swayback..... protruding derriere..... prominent hips.....
5. Measurements: height..... bust..... hips..... waist..... thighs..... calf..... ankle..... weight.....

D. Personality traits that might affect your choice of clothes.
1. Quiet..... shy..... slow..... retiring..... vivacious..... aggressive..... poised..... fidgety..... quick.....

E. Describe the styles that you like best, and decide if they are really best for you.
1. To be well dressed you need a wardrobe in which all of the clothes and accessories coordinate for the occasions in your life. If your clothes are not suited to the time and place, their beauty is lost.

F. Study each part of the dresses of the new season, to see what changes have occurred and where the emphasis of the fashion lies.

1. Neckline	5. Belts	9. Buttons
2. Shoulders	6. Silhouette	10. Fullness
3. Sleeves	7. Details	11. Pockets
4. Waistline	8. Trimming	

G. Repeat for coats and suits.

H. Decide which of these fashion changes will be suited to your physique by emphasizing your good points and conceal figure defects.

I. Develop individuality in your adaptation of a season's fashions by wearing only what is most flattering in line, fabric and color, to your type.

J. Read about and examine the season's new fabrics.
1. Find the new fabrics that will be best for your figure and the line of clothes you wear best.
2. Consider whether the fabrics are suited to making into a garment for the occasions that you are planning.

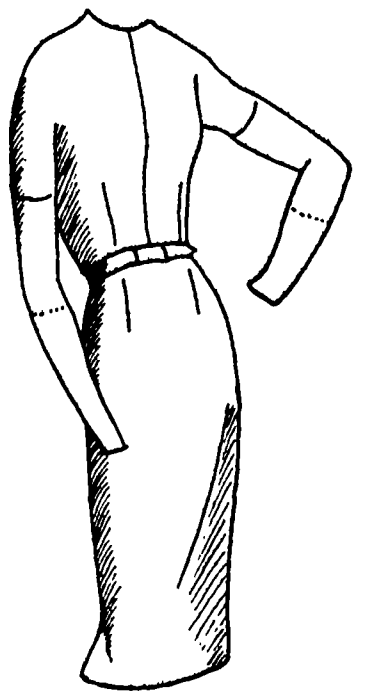
K. Observe trimmings of the new season suited to wool.
1. Use them in fashions for the season.
2. Use them to add individuality to the costume.

L. Study fashion for specific occasions and find the right one for the occasion for which you are planning this garment.

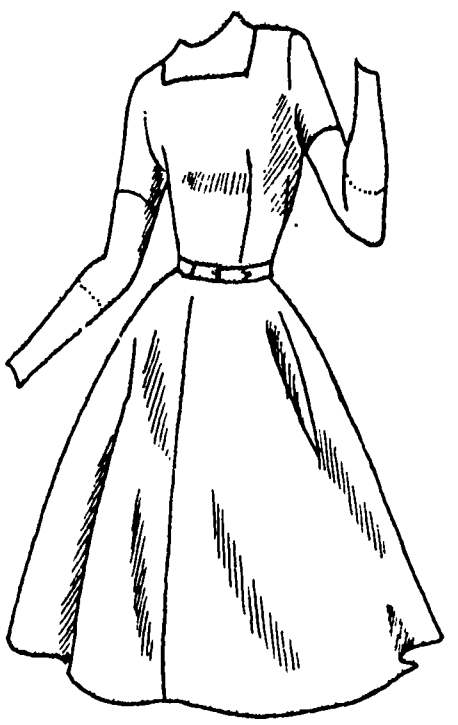
M. Plan to ensemble your wool garment the way garments are being worn this season.

N. Evaluate your selection.
1. Is your selection a fashion repeat for you?
2. It your dress new in color, line, fabric or trimming?
3. What does it do for your figure?
4. Does it suit your personality?
5. Does it have any of the qualities of your last fashion mistake?

II. Consider some basic rules to determine how to judge a fashion. Remember the road to good dressing is not royal. It is a task that demands patience and observation; judgment and careful consideration; energy and imagination. It's equally bad to be either dowdy or conspicuous.



Example of Structural Design



Example of Structural Design

A. Stay firmly yourself.
   1. Don't strive to be a type such as pretty, arty, ingenue, dramatic, spectacular, casual, or sporty.
   2. However, be feminine.

B. Explore new fashions. Follow and understand the sound, long-term trends of fashion as differentiated from the temporary nuances.
   1. Be cautious.
   2. Once decided, be brave.

C. Don't be too late to buy a new idea.
   1. When everyone has a fashion it is too late to adapt it. The time to adapt a fashion is just when it is coming into the horizon of fashion. Then you can wear it all during its development of popularity, through its popular phase and while it is being worn by everyone and even when it is beginning to wane.

D. Analyze a drastic change before you follow it. Many fashion errors are corrected in time and the final adaptation is quite acceptable. When the sheath dress was first exhibited, many people vowed that they would never accept it. It has stayed through many seasons. Never compromise with good taste.

E. Fashion can be outwitted.
   1. Lengths of skirts are a good example of this. Emphasize other fashion elements when a fashion is one that doesn't do most for you. Sometimes it is well to skip a complete cycle in fashion and wait for the next round.
   2. Know the fashions offered the consumer to be better able to evaluate them. Fashion is the style of the moment. Style is more valuable than fashion. Style designates the kind and shape of apparel that has stood the test of consumers and is constantly being revised in whole or part. A fashion may become a style if it has the qualities that endear it to women because of its universal becomingness and comfort. You proclaim a style of your own when you wear only what is flattering in line, fabric and color to your individual type. What you wear is going to influence your life and what others think about you.
      a. Ultra Fashions are the newest most startling and even sometimes eccentric. When such a fashion becomes modified, it is very often accepted and runs through all the other kinds of fashion until the market is saturated and every consumer has one. This is the point at which it is dangerous to invest in this fashion unless it has become so well accepted that it is a staple. Once upon a time the shirt waist dress was actually presented as an Ultra Fashion but has stayed on through season after season to become a classic. Women will not applaud the new it it is too extreme.
      b. Exclusive Fashions are those that are not common and are the highest in price. It is the point from which many of the fashions start that later are reproduced in less expensive materials and do become adapted by the ready made and custom made customers.
      c. Fads are short lived fashions that are often tricky manners of dress. Most fads are quickly accepted and also become obsolete quickly. Fads are concerned usually with parts of a costume or accessory apparel. The ruffle dress of the present day is a fad.
      d. Popular Fashion is that which is being worn and selected by most people at the time.
      e. Staple or classic fashions are really never out of style. They appear in one version or another season after season. The Chesterfield coat, the shirt waist dress could be examples of this.
      f. Conservative styles change very little from season to season and will not attract very much attention. The truly conservative might be given credit at times for being indifferent to fashion.

F. Complete one outfit before you start several. Remember you are judged by what you have on at the time. You cannot say to the observer to wait that you have something better at home. You are making the impression now. When you're on display be displayable.

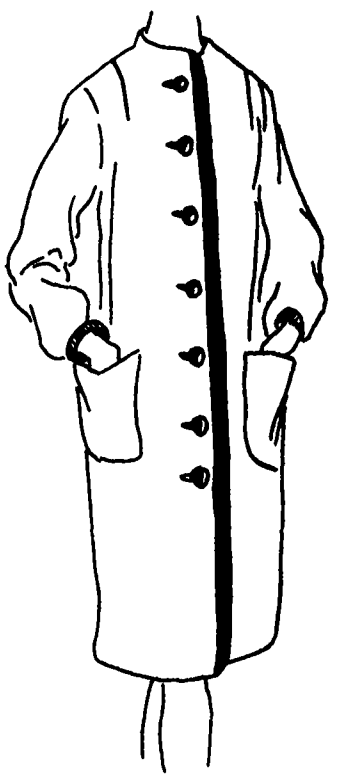
G. Choose the fashions that match your life. Know yourself. Buy fashions to suit your activities and not for the ones for which you wish you needed clothes. The perfectly turned out woman is harmonious to herself and her role. This is not an accident but the result of planning. Look right for where you are and what you are doing.

H. Evaluate your purchases.
   1. Record the original cost.
   2. Record the up-keep (this includes dry cleaning and making over).
   3. Keep record of how many times you wore the garment.
   4. Occasionally figure out how much it has cost you to wear the clothes by dividing the total cost by the number of times you have worn a garment. Look on clothes as fashion investments. This helps some people avoid repeating fashion mistakes.

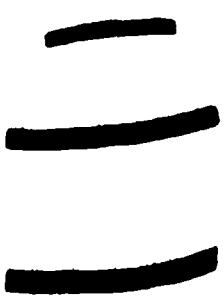
III. Select a pattern that is correct for your figure with these guides to help you.

A. Find structural lines that are becoming to you.
   1. Structural design (the size and shape of a garment) should be suited to its purpose and be beautiful in color.
   2. Good proportions should exist between all parts.
      a. If in making a garment the striped or plaid fabric was in poor proportion it would be very difficult to end up with a well-proportioned garment.

Vertical



Example of Vertical

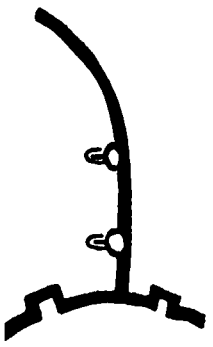


Horizontal

Example of Horizontal

b. The length of the blouse to the skirt; the length of a suit jacket or bolero; the width of a belt; the length of a sleeve; the width of a panel; and the width of a collar are all matters of proportion.

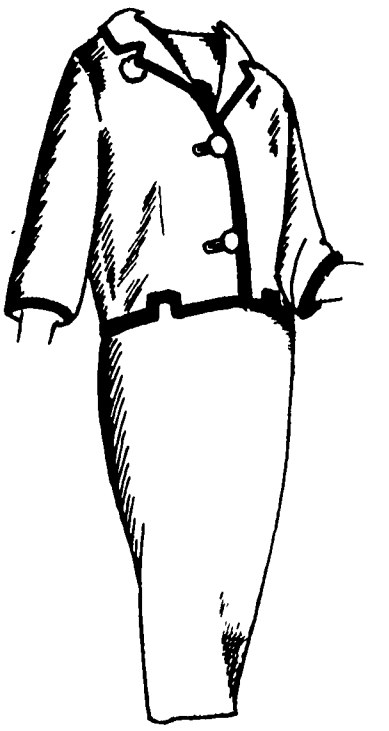
c. To be structurally well designed the material from which the garment is made must be suited to its purpose and to the processes which will follow in making it.



Oppositional

B. Enrich structural design with color, lines, fabric, thread or beads. This addition is decorative design.

1. Use decoration moderately.
   a. A wool print or wool plaid needs very little decoration because it is already patterned.
2. Use decorative design to strengthen structural design by placing decoration at structural points.
3. Allow enough plain background space to give an effect of simplicity and dignity to the design.
4. Select surface pattern that covers the surface quietly.
5. Select decoration that is harmonious with the material and the service it must give.

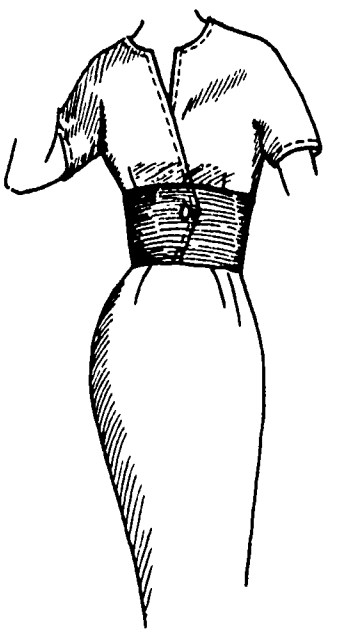


Example of Oppositional

C. Study the lines to see if they move in the direction best for your figure.

1. Use horizontal lines if you wish to look shorter. These lines run across the figure. Horizontal lines make the figure look wider and decrease apparent height.
2. Find horizontal lines in patterns: contrasting belts, wide belts, separates of contrasting color, contrasting sleeves in jumpers, bands of trimming running across the garment, sleeveless dresses, yokes, peplums, pockets on each side of the bodice or hipline, wide vertical stripes, horizontal stripes, broad panels, contrasting midriffs, wide bows, cummerbunds, over skirts, short sleeves, and side drapes.
3. Use vertical lines to increase height. Vertical lines add poise and dignity.
4. Find vertical lines in patterns: narrow panels, full length button closings, rows of buttons or braid, straight long narrow sleeves, narrow vertical stripes, long narrow collars, shawl collars, self-covered narrow belts or no belts, princess lines and vertical trimmings.
5. Select patterns with diagonal lines that approach vertical to slenderize your figure.
6. Avoid the harsh, severe effect of opposing straight lines joining each other at right angles. It is a line that should seldom be used by mature people. Oppositional lines give action in vertical and horizontal directions which has a broadening effect.
7. Select Transitional lines for modifying lines. They are graceful lines that lead from one line shape to another.
8. Remember that pattern and unusual detail will be accentuated in plain simple-textured fabric and will be lost in highly-textured patterned fabric. The latter should be made in simple designs with a minimum number of seams and details to give an uncluttered effect.

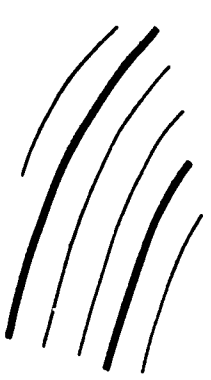
Transitional



Example of Transitional

D. Find fashions suited to your figure.

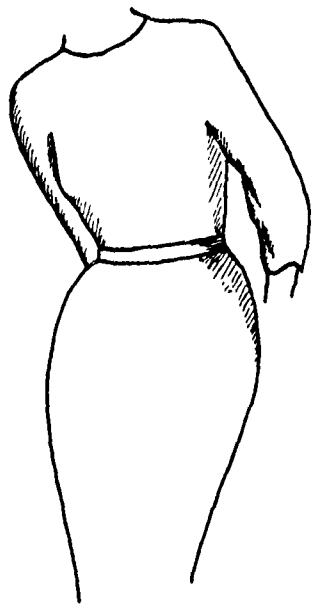
1. Tall heavy girls.
   a. Garments should fit easily so that they do not outline your figure.
   b. Use illusions to your advantage.
      1. Front panels leave the feeling you are no wider than the panel.
      2. Softly flared skirts direct the eye up—not around.
      3. De-emphasize your waistline with narrow self fabric belt or no belt.
   c. Your face is your center of interest. "V" neck lines are a wise selection.
      1. Ornamentation at shoulders will balance larger hips.
      2. Long sleeves create vertical interest.
   d. Use scale to harmonize with figure size.
      1. Big pockets, raglan sleeves.
   e. Use Culottes instead of slacks.
2. Tall Slender girls.
   a. Bold contrast in separates, cuts height.
   b. Big pockets, full skirts widen slim hips and thighs.
   c. Wide contrasting belts, cummerbunds, and contrasting midriffs are good ways to play up slender waist.
   d. Big details—small trimmings are wasted and look weak.
   e. Bloused tops fill out your thin torso.
   f. Horizontal detail at hiplines were designed for you.
   g. Stoles are dramatic and cut height at shoulders.
   h. Fullflared gathered skirts are excellent.
   i. Long tunics, over blouses, contrasting jackets shorten and soften figure.
   j. Double breasted dresses, jackets, coats.
   k. High fashions.
3. Average figure.
   a. Find suggestions under short, tall, and plump to camouflage any problems you may have.
   b. You may select things you really like that flatter you.
4. The short slim figure.
   a. Necklines—high, rounded.
   b. Skirts, full, gored, pleated (pleated skirts may have pressed or unpressed pleats). Sheath skirts pleated at waist for soft drape.
   c. Jackets—short, stand out, ending at the waist line.
   d. Sleeves—full (long or short) to hide thin upper arms.



Diagonal

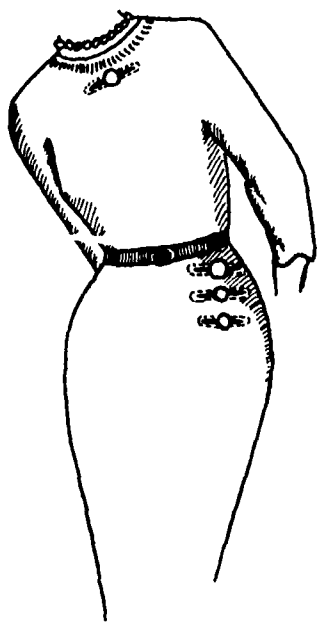
e. Scale—keep trim, buttons, ruffles, and accessories small.
f. Unbelted coats.
g. If this figure has an unusually large bust, her necklines should be cut low and use shoulder ornamentation to balance hips.

5. Short heavy figure.
   a. Use illusion to conceal figure faults.
      1. Use neck details to divert attention from body to face.
   b. Waist line defined subtly.
   c. Bodice should mold to the figure as surplus fabric adds unwanted bulk.
   d. Trimming must be neat.
   e. Continuous vertical line makes you appear taller, slimmer.
   f. Set in sleeves hide wide shoulders.
   g. Jackets should not reach the waist line.
   h. When this figure has a large bust, she must choose simple jackets without collars. She may also conceal this by eye catching detail on the skirt.
   i. If the average figure has large hips, ornamentation to balance her hips must be used above the waist.



Basic Design

IV. Develop a smart wool well-rounded wardrobe.
   A. Plan every garment you make or buy with your present wardrobe in mind.
   B. A smart wardrobe always has the answer to "what shall I wear?"
      1. It depends on coordinated appropriateness—not quantity.
   C. A smart wordrobe has the answer for these occasions:
      1. Daylight fashions have good-looking practicality—the main essential.
         a. Wool fabrics stand unrivaled for keeping you on schedule, because they have built-in wrinkle resistance.
      2. Late-day and after dark.
         a. Nothing spans the social hours as beautifully as wool in radiant colors.
      3. At ease clothes for relaxing at home, shopping at the market or a casual visit.
         a. Adaptable wool basic dresses or wool separates will establish a fashion reputation for you.



Example of Decorative

SUGGESTED EXERCISES FOLLOWING OR DURING DISCUSSION ON COLOR

I. Have a class debate on Fashion:
   Resolved that women are slaves to Fashion.
   Yes Suggested Arguments:
   1. Women adapt a style whether it suits their figure or personality.
   2. Everybody tries to be fashionable because fashion indicates prestige and wealth.
   3. The clothing industry promotes fashion changes to increase wealth.
   No Suggested Arguments:
   1. People accept a fashion only when it suits their taste.
   2. Clothing is being adapted to the way we live.
   3. Fashion is part of American Democracy.

II. Write a paper about your fashion mistakes.

III. Draw or cut out and mount as many illustrations as you can find of effects of line in dress. Be sure you write labels for each.

IV. Make a chart taking inventory of your wardrobe. Evaluate its contents. Are they flattering, necessary, becoming, and appropriate. Which need alteration or repair, which should be replaced. Write into your chart in another color ink those items you would like to buy. Do your accessories pull your wardrobe together?

	Dresses	Accessories	Coats	Alter or Repair
Daytime				
Late Day and after dark				
Casual—at ease				
Miscellaneous				

Example of Decorative

CULTURAL ITEM: "MAN-MADE FIBERS" (Booklets and Kit which consists of booklets, fabric samples, yarns, other materials (See Related Materials) J. C. Penney Company.

CURRICULUM AREA: Home Economics - Textile Selection and Care
Textiles in Home and Dress

PURPOSES:

To acquaint students with man-made fibers, their sources, methods of production, characteristics, care and uses and appreciations.

SYNOPSIS:

The use of textile fibers is older than recorded history. Over the centuries methods of making fibers into fabrics have been improved and refined. Spinning and weaving have evolved from fireside crafts into the great textile industry of our time. Until the past half century only the natural fibers were available, cotton linen jute torn from plant growths, wool and mohair from sheep and goats, and silk from the cocoon of the silkworm.

During the past 50 years man reached beyond natural fibers to create fiber-forming substances from wood and wood pulp and later by discovering how to make new fiber-forming chemicals from a wide variety of abundantly available raw materials. From simple elements found in coal, air, petroleum, salt and water, man can now produce fibers with almost any desired combination of properties for special purposes or for versatility in a wide range of applications. These booklets and accompanying sample kits provide an entire unit in the chemistry, manufacture, use and care of man-made fibers.

SUGGESTED PREPARATION OF THE CLASS:

Show the CUE Encyclopedia Britannica Films filmstrip "Textiles" to provide an early history. Show the Dupont film "Cavalcade of Fibers" to give students an overview of textile fiber development.

SUGGESTED PROCEDURE:

To provide more detailed background; explain to the class:

Man-made fibers, with some exceptions, notably rubber, glass and metallic filaments, are formed by forcing a syrupy substance through tiny holes. The filaments emerging from these holes are then hardened or solidified. The device through which the material is forced is called a spinneret. The process of extrusion and hardening is called spinning and is not to be confused with textile operation of the same nature.

The thick syrupy material forced through the spinneret may be:

1. A solution of a derivative of a fibrous material found in nature .
2. A solution or a melt of a fiber-forming substance which has been

produced by chemical process. These solids are dissolved in a solvent, melted by heat or converted chemically into soluable derivatives.

The extruded fibers are then hardened by:

- Wet Spinning - by immersing fibers in a chemical bath that regenerates the soluable compound into the insoluable substance that will constitute the fiber. This wet spinning is used to produce rayon (Show sample filaments from CUE Kit.)
- Dry Spinning - The derivative to be spun is dissolved in a solvent that can be evaporated. The fiber hardens by drying. This process is used to produce acetate.
- Melt Spinning - The melted fibre forming substance is hardened by cooling.
- Stretching and Orientation process - While fibers are hardening they are stretched. This reduces fiber diameter or size and causes its molecules to rearrange themselves in a more orderly pattern thus strengthening the fiber and giving it the ability to stretch (Show sample filament).

TYPES OF FIBERS

Explain: No fiber, natural or man made, is perfect for all uses. The very properties that make a fiber especially valuable in one type of application may reduce its value in another. The individual characteristics may be emphasized or minimized according to the way fiber is employed in the fabric, the nature of the finish applied or the design of the article in which the fibric is put to use. Various process make the filiaments into different type yarns.

Chemical Crimping

Under certain conditions the outer surface of the fiber can be hardened more rapidly than the inner core thus causing a thicker skin to form on one side than the other. These fibers produce more bulky open yarns because the filaments do not pack together.

Filament Yarns

After hardening in some processes filaments are washed and dried. Finishing oils may be added to aid textile processing. Monofiliments are used for hosiery or curtains. Two or more filaments may be twisted together to form yarns.

Tow

Large groups of continuous filaments without definite twist are referred to as tow.

Staple

Tow can be cut into any desired length. After such cutting it is called staple.

Spun Yarns

The short sections of fiber or staple may be spun or woven just like

cotton and wool. Staple of different lengths is provided for different systems of spinning. Some staple is used without spinning as padding in pillows and mattresses. Spun yarns are more bulky and fuzzy and are desirable for porous warm fabrics and textured surfaces.

Textured filament yarns
Texture and loft may be given to filament yarns either chemically or by heating which causes fibers to tangle and loop or producing fibers which shrink to different degrees combined in one yarn. When heated the high shrinking fibers shorten causing the others to coil and loop.

Lustre
Most man made fibers have a high lustre which may be reduced by adding white pigments to the fiber forming substance before spinning. Color may also be added. Spun dyed colored fibers are resistant to fading, salt water perspiration, soot, gas, washing and weathering. These are also called solution dyed.

Blends
Two or more fiber types may be combined in the yarn.

Mixtures
Yarns of one type are woven with yarns of another type. Thus a single chemical base may produce fibers of many different forms and properties, each of which is most suitable for its own use.

The Three Basic Man-Made Fiber Groups and Cellulosic

Use Man-Made Fiber Booklet - to explain sources of cellulosic fibers (cotton linters) and explain the various processes of producing Viscose, Cuprommonium and Saponified rayon, its characteristics, use and care.

Rayon - Characteristics - versatile and economical. It may be used in everything from hose to auto tires. Easy to care for.

Acetate and Triacetate

Use Man-Made Fiber Booklet and Celanese Kit Materials to explain the Acetate Process. Project the diagram of the acetate process as you explain. Also show samples in kit. Shredded wood pulp, acetate flake, spun dyed yarn, fabric samples. Discuss: the characteristics, appropriate uses and identification of Arnel, Dacron, and others.

Characteristics: lustrous supple resiliant wrinkle resistant, may be permanently pleated - high resistance to shrinking and stretching. Secure and display samples of the wide variety of fabrics made from acetate and triacetate.

Care: Although these fabrics require little care, they will dissolve in nail polish remover or melt with extreme hot iron temperatures.

Long Chain Polymer Fibers

Use the Man-Made Fiber book, yarn and fabric samples to dramatize polymers. Display a piece of coal or oil, a glass of water and empty bottle and a beautiful nylon garment. Say: These simple elements carbon, nitrogen, oxygen and hydrogen are combined by the wonders of modern chemistry into this beautiful garment. Use diagram in Dupont Fiber Facts booklet to explain how polymers are made. Explain the characteristics and uses of Nylon, Antron, Orlon, Dacron, Lycra and Teflon.

Characteristics: strength, extensibility, durability, water repellance; may be heat set or molded.

Use - Everything from tarpaulins to sheer hose.

Care - wash by hand, rinse thoroughly, drip dry or if ironed set at low heat.

Utilize samples and booklet to explain fabrics made of Modacrylic, acrylic, Spandix, Olefin and Saran, Nytril, vinyon, and vinal. (Show Dupont Hit Parade Booklet of Sample Fabrics). Explain fibers manufactured from monfibrous natural substances glass, metalic rubber and Azlon (produced from protiens of milk, peanuts or corn).

Use Modern Fibers and Fabrics Booklet (Penneys) and samples of fabric to learn fabric finish by showing samples.

Assist students to learn such terms as:

vat dying	embossing	flame resistant	gassing
mildew or moth resistant	napping	block printing	sizing
burn out (a method of applying design to a fabric)	screen print	shearing	sealers
	wrinkle resistant	Sanforized	flocking
	stain resistant	wetting agents	sueding
	water repellant		

Use the Fiber and Fabric Glossary in Modern Fibers and Fabric Booklet to teach students generic names of man-made fibers. Whenever possible illustrate with samples. Discuss use and care of man-made fiber fabrics. Merely to know what fibers a garment contains is not sufficient clue to its care. Some take to washing machine and dryer, others must be handwashed. Often the synthetics are combined with other fibers which again changes the rules.

The finishing process used on a fabric of a normally washable fiber may make washing risky. Linings and trimmings also change the care requirements.

Stress the fact that the consumer cannot always decide for herself in what way to cleanse a garment. For satisfaction she must get

instructions with the garment when bought and follow them.

Fibers fall into two classes. Hydrophilic (water loving). Cotton, wool, silk, linen, and rayon absorb moisture and dry slowly. Can be washed in hot water and ironed with a hot iron.

Hydrophobic (water hating) Nylon, polyester, acryllic fabrics are thermo plastic (will melt at high temperatures). These synthetics shed dirt easily since dirt does not penetrate the fibers. Luke warm water and mild soap removes soil from them. Sometimes they need no ironing, otherwise only a warm iron is needed. Handwashing is recommended for these. Avoid excessive amounts of bleach, rinse thoroughly or have dry cleaned.

Watch the tags on bought garments for washing instructions or make labels to put in homesewn ones.

SUGGESTED RELATED ACTIVITIES:

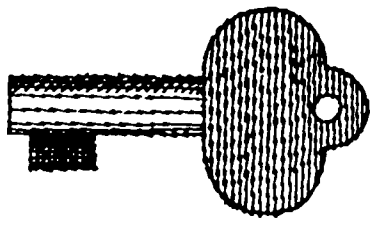
Secure samples of various man-made fiber fabrics to:

. test chemically
. learn how to launder and special sewing qualities of the fabrics
. Show the film Fashions of 1963-64. (Association Films)

SUGGESTED RELATED CREATIVE ACTIVITIES:

Have students make garments of synthetic fabrics. Have a fashion show which reveals the drama of textile development. Have each model explain how the fabric of her garment is made (use charts shown in booklet) and the characteristics of the fabric; its special uses and care.

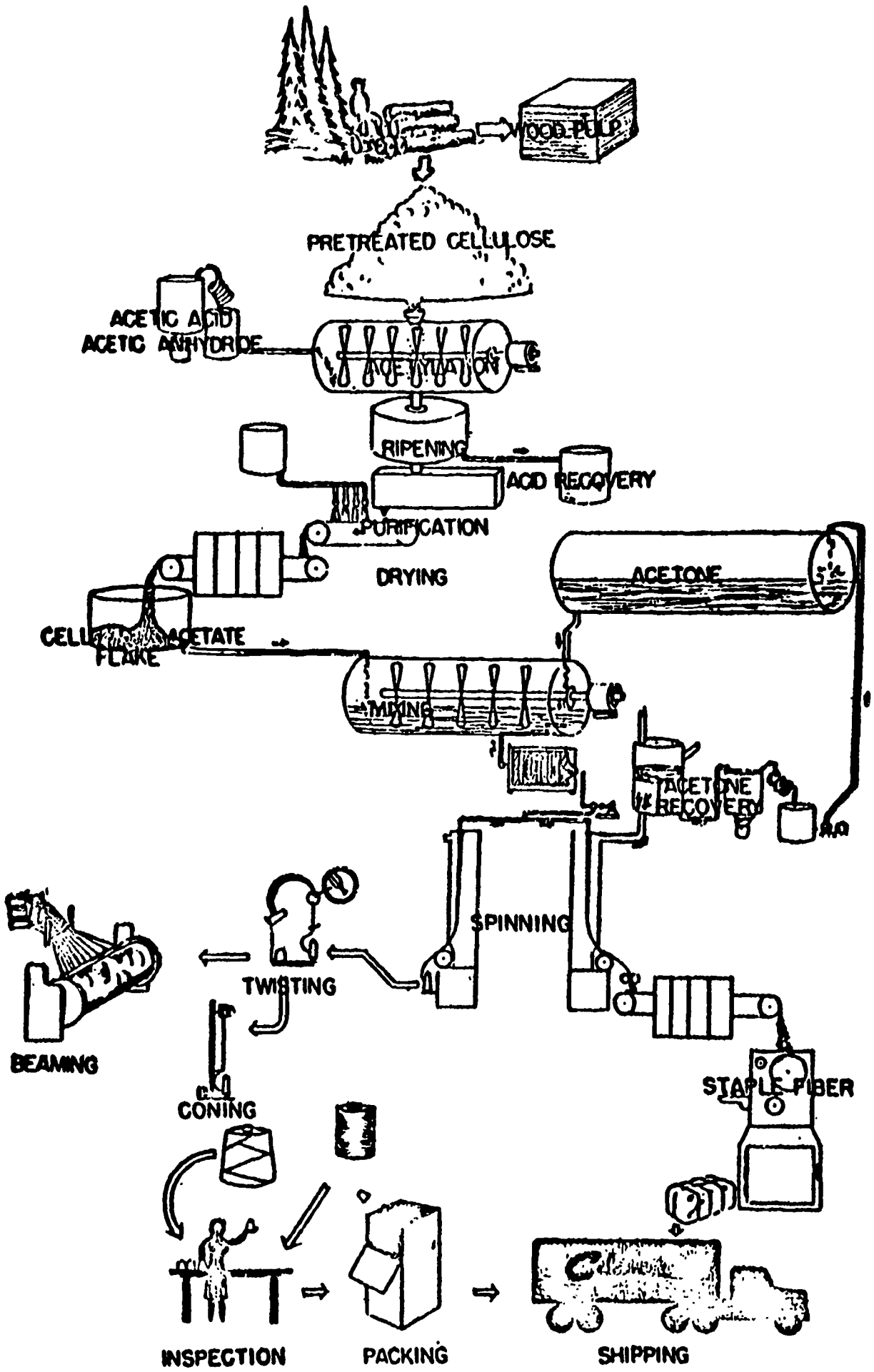
RELATED MATERIALS:



Films:
Fashions - 1963 - 64. (Association Films)
Calvalcade of Fibers. (Dupont)
Filmstrip:
Textiles. (Encyclopedia Britannica Films)
Booklets:
*Man Made Fibers. (Man Made Fiber, Producers Assocation, Inc.) (CUE)
*Modern Fibers and Fabrics. (J. C. Penny Co.)
*Creslan Primer. (American Cyanamid Co.)
*Celanese Identification Kit. (Celanese Fibers Co.) (CUE)
*Dupont Fiber Facts and Hit Parade. (El Dupont de Nemours and Co., Inc.)
Books:
AHEA Textile Handbook. (American Home Economics Assn., 1600 20th St. N.W. Washington, D.C.)
Fairchilds Dictionary of Textiles. (ed. S.S. Marks) (Fairchilds Publications Inc., 7 East 12th St., New York, New York.)

*Included in CUE MAN MADE FIBERS Kit along with fabric samples, flakes, chips staple and yarns.

ACETATE PROCESS



. The process of sericulture.
. The difference between tussah, spun silk, raw silk and Duppioni.

2. To further understandings of the use of silk in the wardrobe, discuss:

. For what garments silk is appropriate.
. The qualities of silk which make it preferable, such as wrinkle resistance, elegance and light weight.
. Its advantages for travel and use in the home.

3. Discuss the care of silk when wearing, dry cleaning, washing, ironing, and sewing.

4. Use the swatch chart to assist girls to identify silk terms, such as barathea, bengaline, brocade, crepe, damask, faille, jacquard, lame, marquisette, moire, organza, ottoman, peau de soie, pongee satin, shantung, sharkskin, surah, taffeta and tie silk.

SUGGESTED RELATED ACTIVITIES:

1. Do further research on silk and its use throughout history. Consult a costume museum.

2. Visit a department store or other which sells silk.

3. Observe paintings to see how silks and other fine fabrics are portrayed.

SUGGESTED RELATED CREATIVE ACTIVITIES:

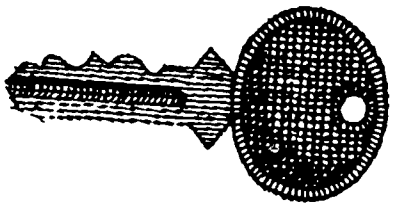
Make a small article of silk, such as a scarf, or beret, or rosette. One Simplicity Pattern #4178 may be used by the entire class; it takes only one-half yard of silk. Originality may be achieved through original interpretations of pattern, color and fabric choice.

RELATED MATERIALS:

Books:

American Fabrics Encyclopedia of Textiles, American Fabrics Magazine.
Handbook of Textile Fibers, J. Gordon Cook.
Textile Fabrics and Their Selection, Isabel B. Wengate.

Silk Teaching Guide - The International Silk Association, 185 Madison Ave., New York, N. Y.
This guide contains:
Teacher's Guide to Study of Silk.
Cocoon Box and Pamphlet - The Story of Silk.
Swatch Wall Chart - Eight Basic Fabrics.



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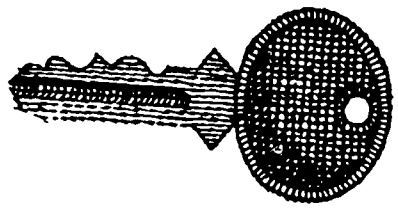
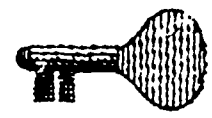
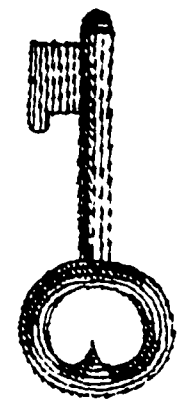


CULTURAL ITEM: "PENDLETON WOOL KIT"
"AMERICAN WOOL COUNCIL KIT"
"TEXTILES" (Filmstrip)
55 frames, Color, Encyclopedia Britannica Films.





CURRICULUM AREA: Home Economics - Clothing Selection and Construction
Textiles in Clothing

PURPOSES:

To provide students with an appreciation of woolen textiles.

To provide them with background knowledge about care, use and sewing of wool.

SYNOPSIS:

The material contained in these two kits provides for a fine unit on clothing. The history of wool and the wool industry, as well as processing and care of wool, is described. Breeds of sheep, types of wool, figure types and nine lessons for sewing wool are given. The eight steps of wool manufacture are illustrated by pictures and samples. Swatches of fabric are included.

SUGGESTED PREPARATION OF THE CLASS:

To interest students, explain: It was sheep which enabled nomadic man to break the fetters of the narrow world he inhabited on the plains of Mesopotamia, where it was warm, to find his ways further afield into colder areas. The Hebrews were the greatest shepherds of all time. Sheep became a part of their spiritual, as well as physical lives. Many references to shepherds, lambs and flocks of sheep are made in the Bible. Sheep and wool came to Europe by way of ancient Greece via Rome. Legend declares Hannibal crossed the Alps to attack Rome on paths beaten down by Roman sheep.

SUGGESTED PROCEDURE:

NOTE: (This lesson should be used after students have studied color, line and texture.)

1. Continue with the history of wool and its processing.

2. Display and explain the sample folder, "Eight Steps in Woolen Manufacturing."

3. Distribute the pamphlets in the American Woolen Council Kit for students to read and report on topics related to wool.

4. Utilize the booklet, "Tips for the Five Figure Types," to read and discuss suggestions for selecting patterns for colors and textures of wool; hints on the sewing of wool.

5. Utilize the nine sewing lessons and have students make a woolen garment.

PRESENT MEDIA.

SUGGESTED RELATED ACTIVITIES:

Show the CUE filmstrip, "Textiles." Have students do research on use of wool as an art form. Some subjects for study are:

Medieval and Renaissance tapestries.
The Bayeux Tapestry.
Persian and Chinese rugs.
Navaho, Alaskan and Peruvian blankets.
Mexican serapes and Early American hooked rugs.
Visit a museum to see tapestries.

SUGGESTED RELATED CREATIVE ACTIVITIES:

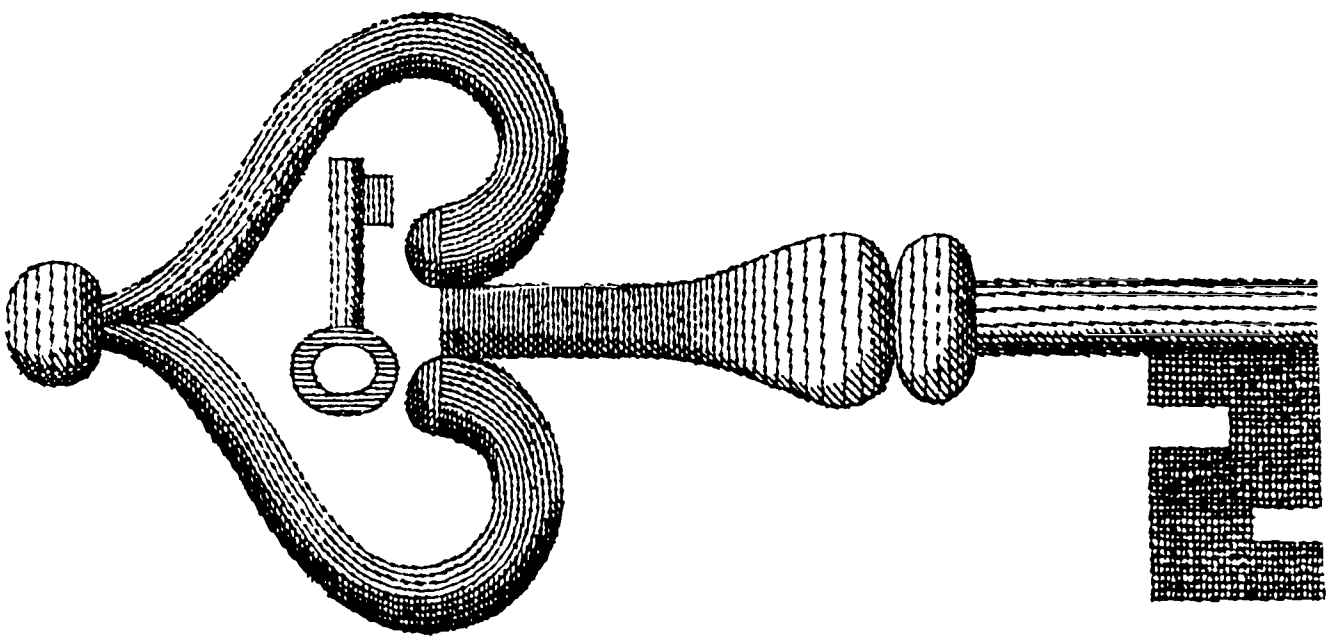
1. Secure bright colored scraps of wool from garment houses, or elsewhere, for a creative embroidery wall hanging. Make a design dividing space in an interesting way. Stretch background fabric on a wooden frame. Applique wool scraps on this background using creative embroidery stitches. Secure variety in color by dyeing material, if necessary. Secure variety in texture by using pile, napped, shaggy and looped fabrics and embroidery stitches.

2. View and learn how to do gros point, petit point and crewel embroidery.

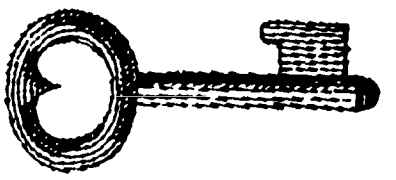
RELATED MATERIALS:

Filmstrip:

Textiles. (Encyclopedia Britannica Films)



CULTURAL ITEM: "THE ROMANCE OF CHEESE" (Film)
27 min., Color, Modern Talking Pictures.



CURRICULUM AREA: Home Economics - Family Food Patterns
Foods of Various Lands

PURPOSES:

To tell the stories of possible origins of one of man's oldest foodstuffs - cheese.

To reveal its history and variety in different cultures, and customs associated with it.

SYNOPSIS:

Legends concerning the creation of cheeses are almost as varied as cheeses themselves. This film illustrates a few of these with animation. One version is that of milk carried across the desert by a nomad in Arabia; when tasted, the soured milk had a curd which was a new taste delight, cheese. Another version is that of a shepherd boy who left his lunch of cheese in a cave in France. When he returned for it, much later, it had turned into Roquefort, "king of the cheese." Richard the Lion Hearted is thought to have brought cheese to England. Cheese plays an important part in American history as it was carried aboard the Mayflower and helped sustain the colonists through the first winter. This film shows the adventure of cheese in Holland, Italy and Switzerland, as well as its development in America. Most interesting are the customs involved with cheese, such as the Swiss Fondue party.

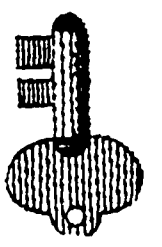
SUGGESTED PREPARATION OF THE CLASS:

1. To insure recognition of various cheese types, secure and display a cheese chart (see related materials) so that students learn to recognize the shapes and names of these cheeses: Cheddar, Edam, Provellone, Swiss, Muenster, Roquefort, cream cheese, brick cheese, Limberger, Camembert, processed cheese.

2. To arouse interest, explain that although most of us like some kind of cheese we rarely think of it as being romantic, yet in Switzerland if a boy and girl share a certain cheese dish it is almost the same as announcing their engagement. This film will show us more of the romance cheese.

PUPILS SHOULD LOOK AND LISTEN FOR:

. Legends about cheese and the area of world involved with each.
. The part cheese played in American history and economy.
. Kinds and variety of cheese and where they are produced.
. The tradition and customs of cultures in regard to the making and serving of cheese.
. Cheese markets and factories in Italy, Holland and Denmark.



. A modern cheese factory and procedures used in processing cheese.
. The variety of dishes served with or made with cheese.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To check on learnings from the film, have students see if they can identify the various cheeses on the chart. Ask them to give spontaneous reactions to the names of the cheeses now.

2. Obtain as many samples of the variety of cheeses as possible, for observation and sampling. Try to have each student characterize the flavor of each cheese, being sure to make clear distinctions of flavor descriptions.

3. Study the different cheeses to discover which are soft, hard, semi-hard or processed, and what qualities each classification offers in the way it is to be stored, handled and used.

SUGGESTED RELATED ACTIVITIES:

1. If possible, take a field trip to cheese factory, or obtain literature from the various companies for display and evaluation.

2. Invite a gourmet chef to talk to the class about his use of cheese in the preparation of different salads, main dishes and desserts.

SUGGESTED RELATED CREATIVE ACTIVITIES:

Have an international cheese fair.

1. Prepare a number of traditional cheese dishes, and discuss the customs and traditions, culture involved and nature of the cheese for each. Make collages or constructions for each cheese, with background information, photographs, clippings and so on, to serve as bulletin board decor or centerpiece for the table setting when serving the cheese dishes. (For instance, an Edam cheese dish might have a centerpiece of windmills and tulips.) Use a long table or a series of small ones each with a special cheese, matching decor and hostess in the costume of the country to serve it. Add appropriate music and customs and invite parents or other guests. This activity may be tied in with social studies.

2. Have a Swiss Fondue party. One specialty of Switzerland is a fondue made with butter, Swiss cheese and white wine. It should be eaten from a chafing dish and served with crusty French bread. Each guest breaks a piece from the bread, spears it with a fork, and dunks it in the fondue. If the lady's piece of bread falls off the fork, every gentlemen gets to kiss her. If the man's piece of bread falls in the Fondue, he must buy the party a bottle of wine. If a boy

and girl share a Fondue publicly, it is tantamount to announcing their engagement. Fondue is a delightful, delectable dish and one that is fun to serve.

SWISS FONDUE

1 lb. Swiss cheese, grated	1 cup very dry white wine
3 tbsp. flour	Salt
Garlic	Freshly ground pepper
2 tbsp. butter	Pinch nutmeg
3 tbsp. chopped chives	2 oz. kirsch

Mix together 1 pound of Swiss cheese, grated, and 3 tablespoons of flour. Put 2 tablespoons of butter in the top of a chafing dish, which has been lightly rubbed with a split clove of garlic. When the butter is hot, add 3 tablespoons of finely chopped chives, and saute them for 1 minute. Then add 1 cup of very dry California white wine, and bring the liquid just up to the boiling point, but do not allow to boil. Keep it simmering and add the cheese and flour mixture slowly, and stir constantly in one direction until the cheese is melted. Continue to stir while adding salt and freshly ground pepper to taste and a pinch of nutmeg.

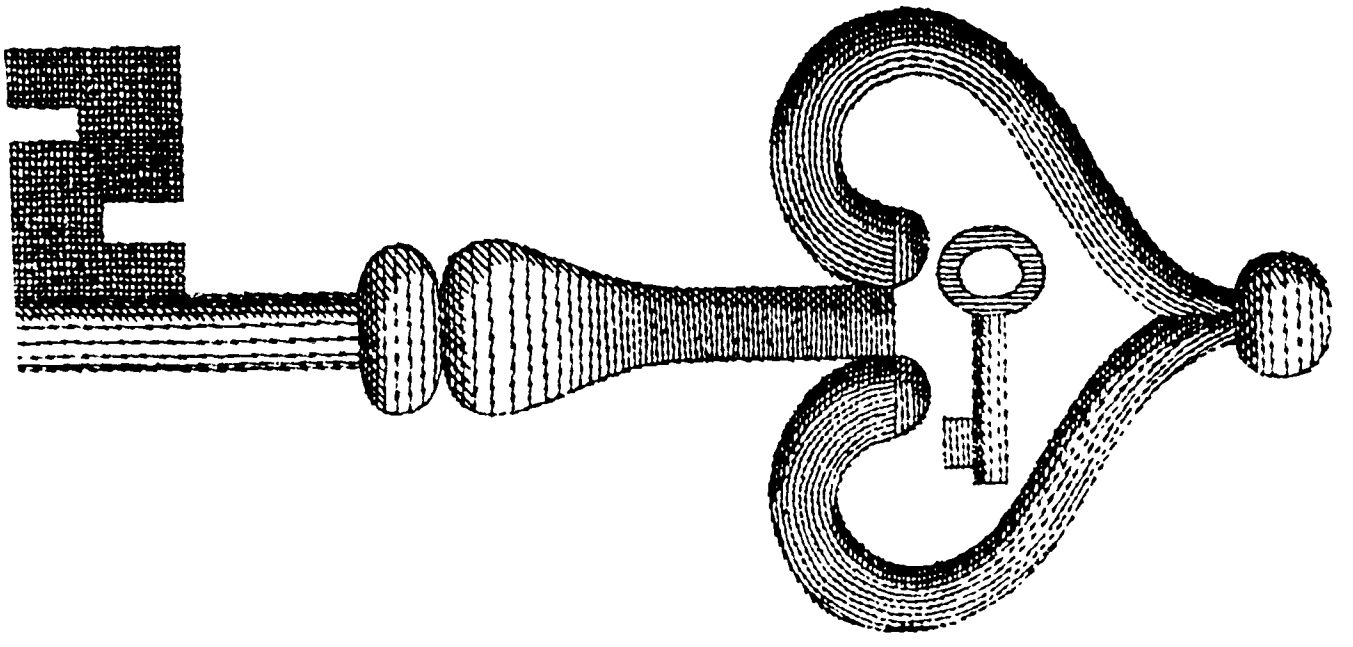
When the mixture starts to bubble (you're still stirring), add 2 ounces of kirsch and serve immediately.

RELATED MATERIALS:

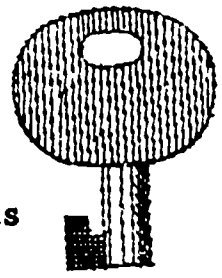
Pamphlet:

The Story of Cheese. (Kraft)

Poster photographs of Cheese. (Kraft)



CULTURAL ITEM: "SECRETS OUT OF THE BAG" (Film)
15 min., Color, Association Films Inc.



CURRICULUM AREA: Home Economics - Creative Cookery
Buying Food and Food Products

PURPOSES:

To promote appreciation for modern packaging.

To create interest in new ways of preparing "convenience" foods and conveniently packaged food.

SYNOPSIS:

In Neanderthal days, the cave man had many difficulties, not the least of which was food. Getting it was hard enough, but another big problem was how to store it safely from mishaps and keep it from spoiling. The cave man's problems are depicted in cartoon form in this film, as an introduction to modern packaging of food. Research has created plastic films, which not only permit us to see the food inside but preserve it indefinitely, ready at a moment's notice to be made into a delicious dish. The ease of preparation, international gourmet cookery, creative center pieces and table service shown in the film provide inspiration and guidance toward more gracious living.

SUGGESTED PREPARATION OF THE CLASS:

. To promote appreciation of modern packaged food, describe or show a picture of an oldtime grocery. Discuss the possibility of bacteria or other foreign matter getting into food. Discuss also how grandmother had to cook all foods from "scratch" without benefit of previous preparation.

. To promote appreciation of exotic foods, tell the class: all cultures have interesting and delicious dishes. If we learn to cook and eat these foods, our diets can be much more interesting.

PUPILS SHOULD LOOK AND LISTEN FOR:

. Why sanitary packaging of food is important to health.
. The development of packaging.
. How modern packaged foods speed up meal preparation.
. Special foods of Italy, Norway and Japan.
. Table decor.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To promote further knowledge of packaging: Secure and display packaged foods of various types, noting the advantages of each.

2. Have half the students prepare a meal with bulk foods, and the other half with packaged convenience foods. Compare time, work, costs and satisfactions involved.
3. Discuss: How does packaging of foods change our lives? What are the implications for the future?
4. Learn more about Italian, Norwegian and Japanese foods and food terms, such as smorgasbord, antipasto, sukiyaki and tempura.

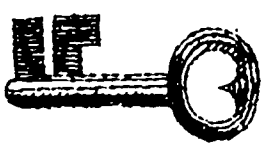
SUGGESTED RELATED CREATIVE ACTIVITIES:

1. Permit students to choose, prepare and serve a foreign meal, suiting the table service and centerpiece to the country chosen. Why not try a smorgasbord with kottbuller and other Scandanavian dishes? Use peasant and ski themes for decor.
2. Make a study of modern packaging. Secure the booklets on packaging from the CUE Industrial Arts Kit (see listing below). Assist students to learn that:

   . Packaging determines salability of a product.
   . Simplicity is the common denominator of all good designs.
   . New materials, especially plastics, make new, more efficient, pleasing and functional packaging possible.
   . Packages must have strong product identification as well as commercial appeal.

3. Study the prize winning packages in the Container Corporation booklet. Have students design a package of tagboard or other materials.

RELATED MATERIALS:



Books:

The Pleasures of Chinese Cooking, Grace Zia Chi. (Simon and Shuster)
The Art of French Cooking, Fernande Garvin. (Bantam Books Inc.)

Booklets:

Prize Package Designs. (Container Corporation of America) (CUE)
Discussions in Design. (Shell Chemical Co.) (CUE)
23 Ideas for Tomorrow's Packages. (Shell Chemical Co.) (CUE)

Foreign Recipes: (See CUE Home Economics Kit)

Pleasures of Chinese Cooking. (American Gas Association) (CUE)
Hawaiian Recipes. (American Gas Association) (CUE)
The complete Scandanavian Cookbook, Alice B. Johnston. (Recipes of Sweden, Norway, Finland, Denmark and Iceland.) (MacMillian Co., New York, 1964)

CULTURAL ITEM: "SIAM" (Film) - Disney Films.

CURRICULUM AREA: Home Economics - Family Traditions
Intercultural Understanding

PURPOSES:

To give insight into the rich culture of Thailand and promote appreciation for the arts and understandings of its people.

SYNOPSIS:

This is a beautifully filmed story of the land, people and cultures of Thailand. Here, plenty of rain and fertile soil provide food enough for the good life. We catch the flavor of this culture through the daily life of a houseboat family, complete with Siamese cat, as it works, eats and floats down the river, past rich rice fields to the noisy crowded klongs of Bangkok, toward the unbelievably rich and exotic architecture of the huge temple area where saffron-robed Buddhist monks pray while sloe-eyed dancers in lavish costume sway gracefully through the highly stylized forms of the Temple dance. We see a royal burial and coronation, and finally feel closer to this exotic yet progressive culture.

SUGGESTED PREPARATION OF THE CLASS:

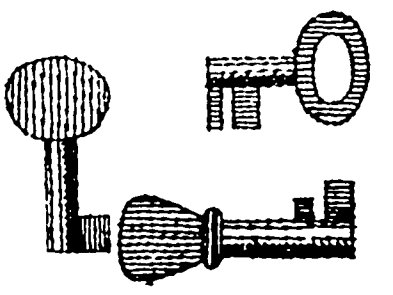
1. Food habits, tradition, preparation, and service are an inseparable part of the total culture. As pupils study meal preparation, and seek information on the art of cooking in other lands, this film may be used to present the beauty and charm of one such culture. In delightful color, the daily life of a family in Siam (Thailand) is portrayed, their foods, customs and creative ways of life.

2. Point out Thailand on the globe or map, and explain briefly the climate, the rivers, and the monsoon rains which bring life from the soil. Tell the pupils that the film they are about to see will help them understand life in another country.

PUPILS SHOULD LOOK AND LISTEN FOR:

. Kinds of food prepared in Siam.
. Color and cleanliness in meal preparation.
. Art and color in the making of umbrellas.
. Beauty and grace in dance forms.
. Religious worship and celebrations.
. Color in nature; flowers and trees.
. Forms of recreation in the family.
. A typical dress in Thailand.
. Music from bamboo instruments.

PRESENT MEDIA.



SUGGESTED FOLLOW-UP ACTIVITIES:

1. To check that students grasp the charm of the culture:

   . Divide the class into five groups with assigned topics suggested by the film - foods, arts and skills, dress, recreation and religious worship. Select a pupil to be recorder in each group. After five minutes, ask the groups to report their observations to the entire class.

2. Ask how students could tell the arts play an important part in the life of the Thais. (Arts in architecture, sculpture of Temple area, artistic serving of food, dancer's costumes, umbrellas, money tree dance and ceremonies.)

3. Ask students what they learned about life in Thailand in regard to food eaten, religion, and how people earn a living.

SUGGESTED RELATED ACTIVITIES:

. To further appreciation of Thai culture, try to secure samples of Thai silks, costume and jewelry for display.
. Do research on the Siamese dance, commonly regarded as the highest form of the dance.

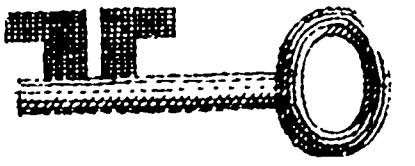
SUGGESTED RELATED CREATIVE ACTIVITIES:

To savor the flavor of the culture:

1. Plan with class to prepare a Siamese meal. Collect and select appropriate recipes. (See United Nations Cookbook.) Discuss table arrangements, centerpiece and serving, in relation to the film portrayal of Siamese culture. Use "The King and I" for musical background.

2. If time permits, plan a play, with the meal, including what students have learned about Thailand's culture. Perhaps some talented girls might create a Siamese-style dance.

RELATED MATERIALS:



Film:

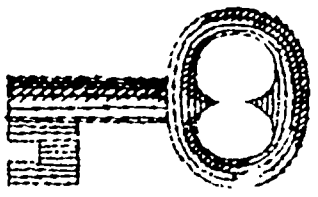
Camera in Thailand - (Eastman Kodak)

Book:

Southeast Asia - Life World Library. (New York, Time Incorporated, 1962)
Picture Cook Book - Life World Library.
The Pleasures of Chinese Cooking, Grace Zia Chee.
Oriental Cooking, Myra Waldo. (New York: Bantam Books, 1960)

CULTURAL ITEM: "SONG OF THE SALAD" (Filmstrip and record)
Home Economics Department,
H. J. Heinz Co., Pittsburg 30, Pa.

CURRICULUM AREA: Home Economics - Planning Nutritious Menus
Artful Meal Service



PURPOSES:

To show the importance of the salad for flavor, nutrition and the variety of salads that may be served.

To give some of the history and uses of salads, and some insight into how to make a variety of attractive ones.

SYNOPSIS:

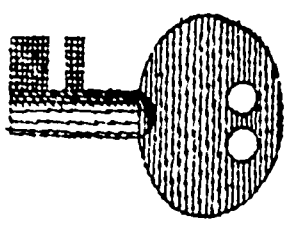
Man ate his first salad at the dawn of civilization when he gathered a handful of herbs and grasses and combined them with berry juices for a refreshing, satisfying dish. Ancient Romans dipped their greens in "sal" or salt. From this practice came the name salad. For centuries the French Italians, Spanish and Swedes served salads. It was only after World War I, when soldiers brought home the idea, that salads became popular in America. This film illustrates a number of attractive salads and shows how to make them.

SUGGESTED PREPARATION OF THE CLASS:

Explain to the class that salads are an important way of eating today because they are nutritious, are usually low in calories, and are so widely varied - they may be served as an appetizer, accompaniment or main dish.

PUPILS SHOULD LOOK AND LISTEN FOR:

- The history of salads.
- Why salads have become popular.
- Various kinds of salads.
- Various types of dressings, vinegars, spices used.
- Ways of making salads look attractive.
- How to prepare salad ingredients artfully.



PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

- Have a variety of greens ready for display and identification.
- Discuss favorite salads of class members. Ask them to list food forms, dressings, other ingredients and arrangements.
- Discuss use of various knives for salad preparation and demonstrate each.
- Ask why it is important to make a salad artistic and colorful.

SUGGESTED RELATED CREATIVE ACTIVITIES:

To utilize their knowledge:

1. Prepare salads in class.

2. Have students create groups of menus for a family, utilizing each type of salad.

3. Have students plan with both parent and teacher to prepare each of these types of salad at home.

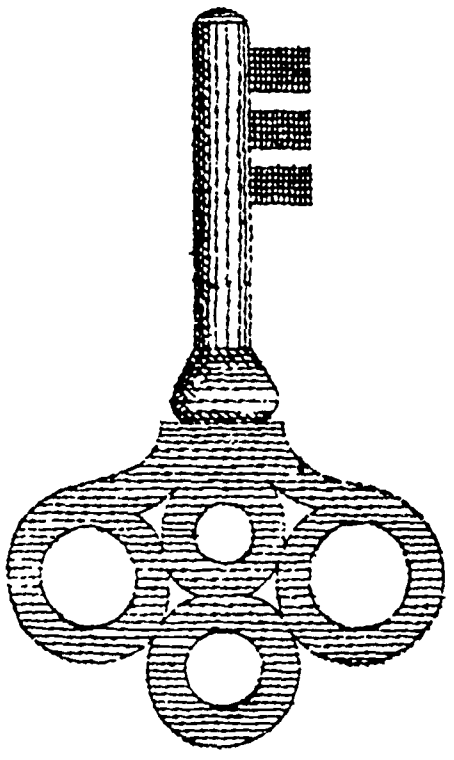
RELATED MATERIALS:

Book:

Better Homes and Gardens Salad Book. (Better Homes and Gardens)

Booklet:

On Camera. (Knox Gelatin)



CULTURAL ITEM: "SPACE" (Film)
10 min., Color, Bailey Films.

CURRICULUM AREA: Home Economics - Arrangement of Furnishings and Accessories

PURPOSES:

To assist students to understand space as presented in painting and drawing, either through linear or atmospheric perspective.

SYNOPSIS:

Through animation this film presents a number of sometimes difficult to understand concepts in a simple to understand way. These understandings are of extreme value in comprehending and appreciating space as shown in drawing and painting; vital to producing depth in two dimensional art work. Varied methods for portraying depth are illustrated and explained.

SUGGESTED PREPARATION OF THE CLASS:

To give students a background for deeper appreciation of the film, secure the following prints from the Metropolitan Seminars of Art:

Vol. 9 - Print 98, "Madonna Enthroned."
Vol. 12 - Print 133, "Giorgione's Tempest."
Vol. 12 - Print 139, "Bochlins "Island of the Dead."
Vol. 12 - Print 141, Cole's "In the Catskills."

Explain: Ancient Egyptians did not know how to show space or depth in their paintings. Everything was drawn on a flat plane. Although in classic times the Romans did try to display space and depth, the art of perspective was not developed. In Byzantine art, often flat looking figures are painted against a flat background (Print 98), which represented Heaven. No attempt was made at depth or movement as people thought of their world as rather small and static.

(Display Print 133) - However, in the Renaissance, a new scientific spirit took over. Columbus's explorations had proved that there was such more space in the world than people thought. New inventions like the telescope enabled man to see far into space and Copernicus to realize that the earth was not the center of the universe, but only a small planet revolving along with many others about a gigantic sun.

Architects and artists studied everything from these scientific points of view. By applying the principals of Euclidean geometry to the optical aspects of drawing, space could be made to conform to objective mathematical laws - or linear perspective discovered by Ghiberti, a Renaissance artist. Another artist, Masaccio, found that objects at a distance from us are grayer in color and less distinct in outline, since they are

separated from us by intervening layers of atmosphere. (Show Print 141) - This is called atmospheric perspective.

Immediately these ideas were universally adopted and have been used ever since. This film will show some ways in which artists indicate space.

STUDENTS SHOULD LOOK AND LISTEN FOR:

- Ways to indicate space by object placement.
- One and two-point perspective.
- Space suggested by color use, overlapping.
- Space by exaggeration.
- How artists vary these rules to make their work more personal and interesting.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To check for comprehension, let the pupils make five small sketches to show the various ways they have learned to indicate space. Let the class artist demonstrate at the board to help others. Show print 139 to demonstrate how an artist's suggestion of space can give an eerie feeling.

2. Assist students to further understanding of space by explaining: Space is nothing until a point of reference is established; to establish this point of reference, it is necessary to enclose the space around the point of reference. Space is all of the area within the enclosure or the outer fringe of our vision.

SUGGESTED PROCEDURE:

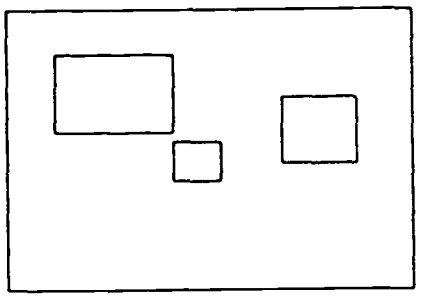
To further understanding of two-dimensional space, ask students to:

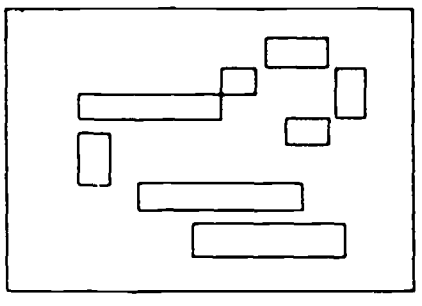
1. Draw a rectangle - (now we have enclosed space).

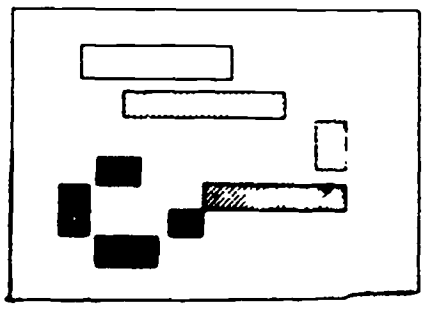
2. Put several contrasting shapes in the rectangle; as we add other shapes to space, tensions are created causing the eyes to move from one to the other in order of their importance. The closer the objects are, the more conscious we are of space.

3. Movement in space may be created by means of:

   - Contrast in size and shapes - (variety).
   - Changing the directions of the shapes.
   - Contrasting the values of the shapes.
   - Repetition of shapes.







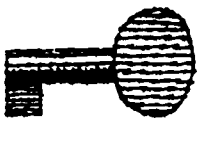
4. If one were planning the furnishings for a room, there are many ways to study the total space:

. The floor space and space taken by furniture in it.
. Wall space and space taken by furniture or architectural features on it.
. Ceiling space and space taken by beams and lighting fixtures.
. Smaller areas of space in shelves or on table or desk tops.

5. Now ask students to use what they have learned about space in doing a floor and wall plan of a room to make the room appear spacious and yet have variety, contrast, repetition and movement and emphasis. Specify the size of the room and the number of furniture pieces. Experiment with the class at the flannel board for the best arrangement.

6. Use the furniture models in the Penney Kit (CUE) to work out a model of the plan. Ask the students to do a room elevation. Stress how preplanning rooms with a sketch can prevent mistakes in buying furniture.

SUGGESTED RELATED CREATIVE ACTIVITIES:



To develop an awareness of space and the ways it can be expressed:

1. Find magazine pictures which give :

. A birdeye view of looking down on an area.
. A scene showing aerial perspective (objects in foreground bright, in background hazy).
. An artist's sketch which uses perspective to show distances from a vanishing point.

2. Find examples of optical illusions which express impressions of space.

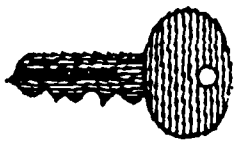
3. Make a list of as many words as you can which would describe different kinds of space - two-dimensional, three-dimensional, actual, relative, inner, outer, surface, imaginative, aerial, infinite, and hollow.

4. View paintings by Chirico, Dali, Yves Tanguey, Chagall for various feelings of space. View painting by Picasso for feelings of space - time given through use of various eye levels in perspective. View paintings by El Greco, Braque, Modigliani for distortion; personal interpretations of perspective and proportion.

5. To experiment with creating space and space divisions:

. Draw several rectangles of pleasing proportion. Divide these with straight lines to express a variety of size, repetition, variation; use shapes to express movement and distance.
. Use color to create effects of distance.
. Make a three-dimensional construction of cardboard or balsa wood to experiment with partially closed space.

CULTURAL ITEM: "THE STORY OF DOCTOR LISTER" (Film)
26 min., Color, Lambert Laboratories.



CURRICULUM AREA: Home Economics - Family Health
Home Care of Ill and Convalescent

PURPOSES:

To develop appreciations in students of how advances are made in medicine through research and trial.

To afford opportunity for knowledge and appreciation of science heroes of the past and their contributions to humanity.

SYNOPSIS:

Shocked over the sudden death from infection of a patient whose leg he had just successfully amputated, Dr. Joseph Lister determinedly set about finding a way to stop the tremendous loss of life from post-operative infection, which raged uncontrolled through the hospital wards of his day. With the aid of a chemistry professor, he found after a long search an antiseptic solution that he thought would stop the development of infection. He tried it on several cases successfully and was convinced it was the answer. Like many new discoveries, antiseptic surgery was slow to be adopted, and Dr. Lister suffered much ridicule from the medical profession before he was able to prove the import of his discovery.

Despite the fact that this film contains some advertising, it gives a fine depiction of medicine during the last half of the 19th Century, and serves as a good springboard for a discussion of home health practices.

SUGGESTED PREPARATION OF THE CLASS:

In order to promote the desirability of independent thought, review briefly with the class the fact that it is rarely easy to convince people of new ways of thinking. Recall and discuss such cases as Galileo, Columbus, the Wright Brothers or others.

Tell the class that in former times, scientists often found it difficult to get new ideas into practice because people knew little of science, and often persecuted those who tried to practice them. We do not often think of a man working quietly in a laboratory as a hero, but in many cases, such as Pasteur, Koch and Lister, it took real courage to as they did.

(Note: Alert students that the advertising for the patented antiseptic may not be in keeping with the research and testing of today's medical society.)

PUPILS SHOULD LOOK AND LISTEN FOR:

. The architecture and costume of 19th Century Scotland.

. The facilities of hospital and research laboratories.
. The contributions of Koch and Pastur.
. The dedicated struggle of science heroes as they tried to promote new ways of conquering disease.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To further understanding of the contributions of many scientists, have students give a "This Is Your Life" skit to tell the lives of Koch and Pasteur.

2. Have students assume they are in medical seminars of the day hearing speeches, explaining the new ideas in medical science given by important doctors, chemists, bacteriologists of the past. Have them use Lister's presentation as an example, then explore contributions of Koch, Pasteur, Jenner, Reed, Fleming and others.

3. Discuss with the class, proper health habits in the home such as:

   . Sterilization of articles used by the sick.
   . Sterilization of dishes and tableware.
   . Proper storage of food, (alert them to the dangers of botulism).
   . Proper oral hygiene.
   . The role of rest and diet in good health and beauty.
   . The importance of the periodical check-up.
   . The importance of health insurance and preventive medicine.

4. Discuss career opportunities in the medical field today, putting special emphasis on laboratory technicians.

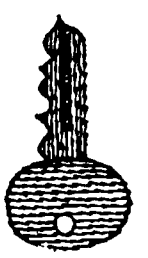
PRESENT MEDIA.

SUGGESTED RELATED ACTIVITIES:

1. Secure the Parke Davis "Famous Paintings in the History of Medicine Series" from the CUE Science Kit. Have each student choose a painting and the accompanying information to study and report to the class on the historical highlights of medicine, concentrating on the big breakthroughs. Emphasize that such breakthroughs are the result of independent thought and disciplined, unremitting research.

2. Collect the painting reproductions from "Today's Health" for bulletin board display of medical history.

RELATED MATERIALS:



Film:

Life of Louis Pasteur. (Encyclopedia Britannica)

CULTURAL ITEM: "THE STORY OF FLOWERS (Filmstrip) (Part 1)
Colorado Flower Growers Association.

CURRICULUM AREA: Home Economics - Arrangement of Home Accessories
Beauty in Home and Dress

PURPOSE:

To show tasteful floral uses and give a background knowledge of flower varieties and how to care for and arrange them for household and personal use.

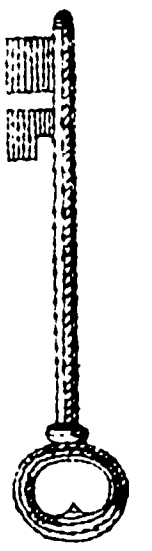
SYNOPSIS:

Part I of this filmstrip opens with a discussion of flower arranging as an art with a long history, and shows how to take care of cut flowers to make them last. Garden and greenhouse flowers, as well as tropical flowers and exotic blooms from other parts of the world, are pictured. Beautiful arrangements of flowers are shown as house decor and costume accessories.

SUGGESTED PREPARATION OF THE CLASS:

Little preparation is necessary, as this strip is really preparation for Part II.

PUPILS SHOULD LOOK AND LISTEN FOR:



- Kinds of garden flowers and their suitability for house decor.
- Use of arrangements and colors appropriate for seasonal flower displays.
- Problems involved in taking care of flowers.
- Why certain flowers are grown commercially.
- Types of exotic flowers.
- Comparative availability and costs of flowers.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

To crystallize concepts presented in the film; discuss:

- Garden flowers suitable for displays.
- Cut flowers, their relative costs and lasting qualities.
- Greenery and other materials which may be used with flowers, such as branches or driftwood.
- What flowers are appropriate for what occasions.
- How to cut and care for flowers.
- Simple materials used in making floral arrangements - scissors, knife, frogs, chicken wire; display materials.

SUGGESTED RELATED ACTIVITIES:

Permit students to work with materials, practicing cutting flowers properly, and gathering materials for an arrangement.

CULTURAL ITEM: "THE STORY OF FLOWERS" (Part II)

PURPOSE:

To enhance appreciation of flowers, and their contribution to elegance of dress and home decor, through understanding how to care for, arrange and wear them.

SYNOPSIS:

This segment of the film gives the beginner confidence that flower arranging is relatively easy, fun and a rewarding hobby. Six basic flower arrangements and step-by-step directions and techniques for making them are demonstrated. These and other beautiful arrangements are shown in home settings. The ABC's of corsage instruction and wear are also shown.

SUGGESTED PREPARATION OF THE CLASS:

For background of understanding, show Part I of this filmstrip.

PUPILS SHOULD LOOK AND LISTEN FOR:

. When and how to cut flowers, use of floral preservatives.
. Equipment needed for flower arrangements.
. How to securely anchor flowers in an arrangement.
. Types of foliage which may be used.
. How to suit the arrangement to the container.
. Vertical, horizontal, triangle, L, crescent and S arrangements.
. The use of floral tape, wire, clay.
. How to choose appropriate background and accessories for floral display.
. Special arrangements for special seasons.
. How to make and wear corsages.
. Appropriate use and wearing of flowers.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To secure wider appreciations and insure applications to daily life patterns, discuss:

   . How use of flowers in the home adds grace and enjoyment to our lives.
   . The use of flowers in other cultures.

2. The availability of flowers depends on climate, but bring out that flowers are an important part of many cultures by showing pictures of and discussing:

   . The flower carts and vendors of Paris, London, and Amsterdam.
   . The tulips of Holland (tell the story of the "tulip craze" in the 16th Century).
   . Beautiful flower paintings by Dutch painters.
   . Hawaiian leis; tell how a flower at the left ear means the Polynesian girl is married, but at the right ear, it means she's looking.
   . Leaves and flowers as part of food decor in Japan.

3. To help students realize that beauty is not always expensive, discuss and show pictures of displays using only a single bloom, berries, weeds, or branches easily available at low cost to all.

4. Discuss use of artifical flowers. Although everyone loves the beauty of fresh flowers they are often costly and caring for them is time-consuming. Artificial flowers used to be very ugly, and were considered in bad taste. Today, however, technology and new materials make beautiful plastic flowers available at low cost. When tastefully arranged, these too can add joy and grace to our lives.

SUGGESTED RELATED ACTIVITIES:

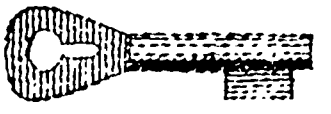
. For a deeper appreciation of flower arrangement as an art, have each student choose a favorite flower and do research on its origin, name and symbolic meaning.
. Show the CUE film "Ikebana" (see CUE lesson plan).
. Investigate job possibilities in this area: floral designer, buyer, shop owner.
. Practice identifying flowers with a garden identification book.
. Invite a local florist to talk, or take the class to a greenhouse for a lecture tour.
. Have students take turns in supplying the classroom with flower arrangements. Observe and discuss designs.
. Discuss factors to be considered when flowers are used at the table - coordination with china, silver and linen. Have students sketch table settings and write descriptions of flower decor appropriate for each.

SUGGESTED RELATED CREATIVE ACTIVITIES:

Have girls use real or plastic flowers, foliage, driftwood or other materials to create arrangements for school entrance, cases, cafeteria and auditorium, or as gifts for mother.

RELATED MATERIALS:

Film:
Ikebana. (Japanese Consulate) (CUE)
Book:
Ikebana.



THE TULIP

The tulip derived its name from the Turkish word "Tülbend" which means "turban"

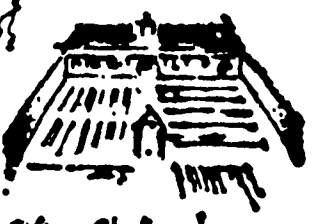
The first pictures of tulips were found on early 16th century ceramics from Persia

In 1554 Busbecq Ambassador to the Turkish Court, noticed some scarlet flowers-tulips-in a garden near Constantinople

Five years later Busbecq sent some sample tulip bulbs to Vienna, where the blooms were seen by the German botanist Gesner

In 1562 a merchant in Antwerp received a shipment of bulbs, arriving from Constantinople. Assuming that they were onions, he had some cooked, and planted the rest of them in his vegetable garden.

In 1573 Busbecq met the well-known botanist, Clusius, in Vienna, and gave him some bulbs.

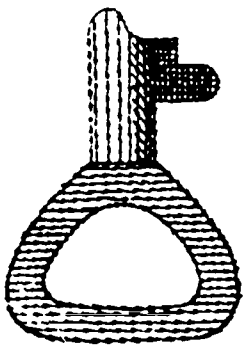


After Clusius became professor at Leyden University, he introduced the tulip in Holland officially, 1593

During the years 1634-1637 the tulip became the fashion in the Netherlands resulting in the "tulipomania" period. One paid a fortune for a dozen bulbs in order to be able to grow more varieties.... it was not unusual for a single bulb type or new kind of tulip to be sold for a house or a precious piece of jewelry. At last the governors of the States of Holland had to put an end to the enterprise..... from then on it became a serious and quiet business of growing and cultivating bulbs in numerous extended fields behind the sand dunes along the Dutch coast, where the soil is extremely well suited for this purpose.

Thus the Dutch succeeded in making the tulip one of the most popular flowers in the world.

CULTURAL ITEM: "THE STORY OF PETER AND THE POTTER" (Film)
21 min., Color, Contemporary Films.



CURRICULUM AREA: Home Economics - Selecting and Using Home Accessories

PURPOSE:

To provide a demonstration of the potter's art.

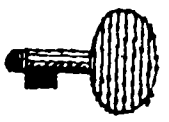
SYNOPSIS:

This film provides a good demonstration of the making of ceramics from clay, to potter's wheel, kiln, designing, glazing, and last firing in the kiln. The setting is a remote section of Canada and emphasis is put on the rustic small-scale production of pottery. Although the character in the film is of elementary age, secondary students can be alerted to look primarily for the ceramic processes and techniques which are well shown.

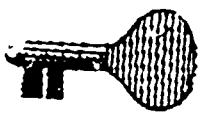
SUGGESTED PREPARATION OF THE CLASS:

1. This film is most appropriate for a class that is studying design in accessories for the home.

2. Indicate to pupils that they will view a film that will illustrate the work of artists in clay but that the setting and time are removed from them as they think of modern living.



PUPILS SHOULD LOOK AND LISTEN FOR:



. Materials used in the construction of pottery.
. Skills involved in the creation of ceramics.
. Methods of application of design.
. The time and patience involved in creating clay into ceramics.
. Beauty in contour, color, and design.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To check for understandings of ceramic processes, ask the pupils such questions as:

   . How would you describe the steps used in making pottery?
   . What shapes in pottery were created?
   . How was design added to the pottery?
   . How did the design enhance its beauty?
   . How and where would you use pottery in your home?
   . For what other accessories in the home could you apply the same rules of design as are shown in this film?

2. Ask the pupils to cut from magazines, illustrations which show pleasing design in ceramics. Have the pupils discuss these illustrations as they are placed on a flannel board.

3. Select a committee of pupils who will be responsible for bringing to class on the following day several types of ceramics. Evaluate the articles in terms of design and their use in the home.

SUGGESTED RELATED CREATIVE ACTIVITIES:

With aid of art instructor, have girls design and create some original ceramic pieces.

Utilize the New York Times Magazine "Art in the Home" - September 29, 1963 (CUE Home Economics Kit) to help students realize that while beauty is all around us in nature, art galleries, and parks, in the home is where we have our most frequent opportunities to enjoy beauty. Bits of beauty in pottery, paintings, candlesticks, lamp, rugs, or other home articles bring us continued satisfaction as we go about our daily routine.

No matter how beautiful your furniture, lamps, pictures, and pottery may be, they will never be really attractive unless well arranged. Good arrangement does not require the expenditure of money; it means making the best of what you have. Here are some points to remember in arranging a room:

- Clutter is rarely attractive - plan your arrangements.
- Flowers should be carefully arranged.
- Group pictures for interesting effect (consider the arrangement of the wall for harmony, balance, pleasing proportions).
- Furniture should be arranged to provide a feeling of spaciousness.
- Simplicity is desirable but not barrenness--have a few "conversation pieces" about, of pottery, figurines, glass, or metal.
- Be sure to include a few interesting contrasts of color and texture. Have students examine their living or bed rooms at home to see if they can suggest a more beautiful arrangement. Have them sketch it, and then put it into effect if possible.

RELATED MATERIALS:

Films:

The Ceramic Arts of Japan (CUE)

Pamphlet:

The Reference Book of Fine China (Lenox Inc.) (CUE Home Economics Kit)

Magazine:

New York Times Magazine - September 29, 1963 (CUE)

CULTURAL ITEM: "TAKE A LOOK AT COLOR" (Filmstrip)
J. C. Penney Co.

"COLOR AND YOU" (Filmstrip)
Mc Call's Patterns

"COLOR AS YOU WEAR IT" (Filmstrip)
Coats & Clark's Thread

CURRICULUM AREA: Home Economics - Wardrobe Planning
Color, Personality in Home and Dress

PURPOSES:

To present fundamental principles of color and reveal how to relate them to the individual to enhance personal appearance.

To show how to assemble attractive costumes through creative use of color principles and to use these principles in wardrobe planning.

SYNOPSIS:

These filmstrips are a comprehensive program on color, which can alert students to creative use of color as applied to sewing and buying clothing.

Film 1 - "Take a Look At Color" points out how increased use of color in our lives affects our moods and well-being. Using color successfully depends on knowledge of its fundamentals. The film explains the color wheel and various color schemes, warm and cool colors, after-images, rules for color intensification, graying, hue, intensity, value and various color schemes.

Film 2 - "Color and You" shows photos of skin and hair color types, so that girls may identify their own types, and illustrates the use of clothing color with each type. Use of color to minimize figure faults is illustrated.

Film 3 - "Color as You Wear It" illustrates how to use color balance in clothing, use of various color schemes, and gives advice in wardrobe planning.

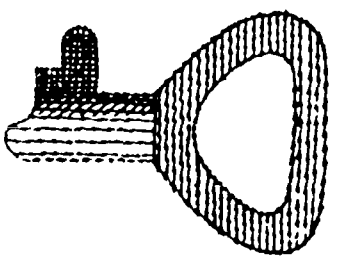
SUGGESTED PREPARATION OF THE CLASS: Film 1

(Note: Preparation, showing and discussion of each strip will take at least one class period.) Pupils should have seen CUE film, "Discovering Color," and learned the color wheel and color mixing.

PUPILS SHOULD LOOK AND LISTEN FOR:

. Increased use of color in our lives.
. Psychological use of color in hospitals and advertising.
. Complementary and analogous color schemes.

. How colors are mixed; meaning of chroma.
. Warm colors of Van Gogh, cool colors of Monet.
. After images; graying colors by adding complements.
. Monochromatic color schemes.
. The effect of light on color.



PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

Use flannel board and pieces of paper, cloth or paints to review learnings on:

. Primary and secondary colors and mixing.
. Complementary, analogous and monochromatic schemes.

SUGGESTED PREPARATION OF THE CLASS: Film 2

Select various complexion types to illustrate that blondes, brunettes, redheads may all be either cool or warm skinned. Explain that each can make herself more attractive by proper color selection in clothing.

PUPILS SHOULD LOOK AND LISTEN FOR:

. Their complexion type and colors which go best with it; Renoir's skin tones.
. Differences in effect possible with different values of a color.
. How light colors brighten and dark colors drain color from the face.
. Which types can wear high intensity color.
. How to accent hair and eye color.
. How to use color in separates.
. How to use color to camouflage figure faults.
. Use of repetition and contrast to bring out best points.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

Help each girl identify her color type. Have color collars or strips, so girls may experiment to choose their best color combinations. Have them collect swatches and assemble into color schemes for an interchangeable wardrobe.

SUGGESTED PREPARATION OF THE CLASS: Film 3

Review briefly what has been learned about color. Explain to the class that the fashion designer and stylist work with the same principles used by artists - dominance, unity, balance, proportion and rhythm. Use National Gallery prints to explain these principles:

. No. 17 - del Castigo - Portrait of a Man - shows dominance of red; unity and proportion.

. No. 703 - Charles A Friendly Call - shows balance of one figure and chair, against other figure, cushions and other elements; repetition of pinks throughout picture gives unity and accent; dominance of neutrals with accent of pinks. Show Van Gogh's Starry Night for rhythm.

PUPILS SHOULD LOOK AND LISTEN FOR:

. Weight of colors and ways to achieve balance.
. The importance of color matching and balance.
. Achieving harmonies with separates (sweaters, blouses, skirts).
. Accenting black, white and neutrals.
. Use of rhythm.
. The importance of wardrobe color plan.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To put students' color knowledge to work immediately, use the flannel board and color chips to demonstrate their knowledge of:

   . Intensity and grayed colors.
   . Balancing areas of color (a small area of intense color balances a much larger area of grayed color).
   . Color weight (high intensity colors appear heavier).
   . Monochromatic harmony (tones of one color).
   . Analogous harmony (related colors).
   . Complementary harmony (across from each other on the color wheel, with one of the colors grayed for use in large areas).

2. Use color shoulderettes to show how white near the face enables a person to wear colors otherwise not too becoming.

3. Use pieces of cloth to demonstrate how large persons should not wear bright colors all over but may use them as accents.

4. Discuss the usefulness of black and neutrals in the wardrobe.

SUGGESTED RELATED ACTIVITIES:

Plan a walking field trip near the school to observe color in nature. Collect various specimens - leaves, branches, stones and other objects that illustrate warm and cool colors, high intensity chroma, greyed colors and others. Utilize the collected materials to make arrangements illustrating various color schemes.

SUGGESTED RELATED CREATIVE ACTIVITIES:

. Display National Gallery Prints to the students. Have them study color harmonies and select a painting with a color scheme that

appeals to them and suits their complexion.

- Have them design an entire wardrobe around this color scheme, including coat, hat, shoes, three dresses, separates and accessories. They can sketch and paint the wardrobe and make one of the garments.
- Have a fashion show. Display the National Gallery prints along with the garments. (Paintings by Rembrandt and other artists using warm tones may be related to fall clothing; paintings by Renoir or other Impressionists may be related to spring and summer garments.) Use script relating garment color to painting. Use related music as background (e.g., Stravinsky's "Rites of Spring" for spring clothes; for a romantic party dress a Renoir painting and music by Debussy). Record the appropriate musical bits on tape beforehand. Have them timed for the showing of each garment.

RELATED MATERIALS:

Films:

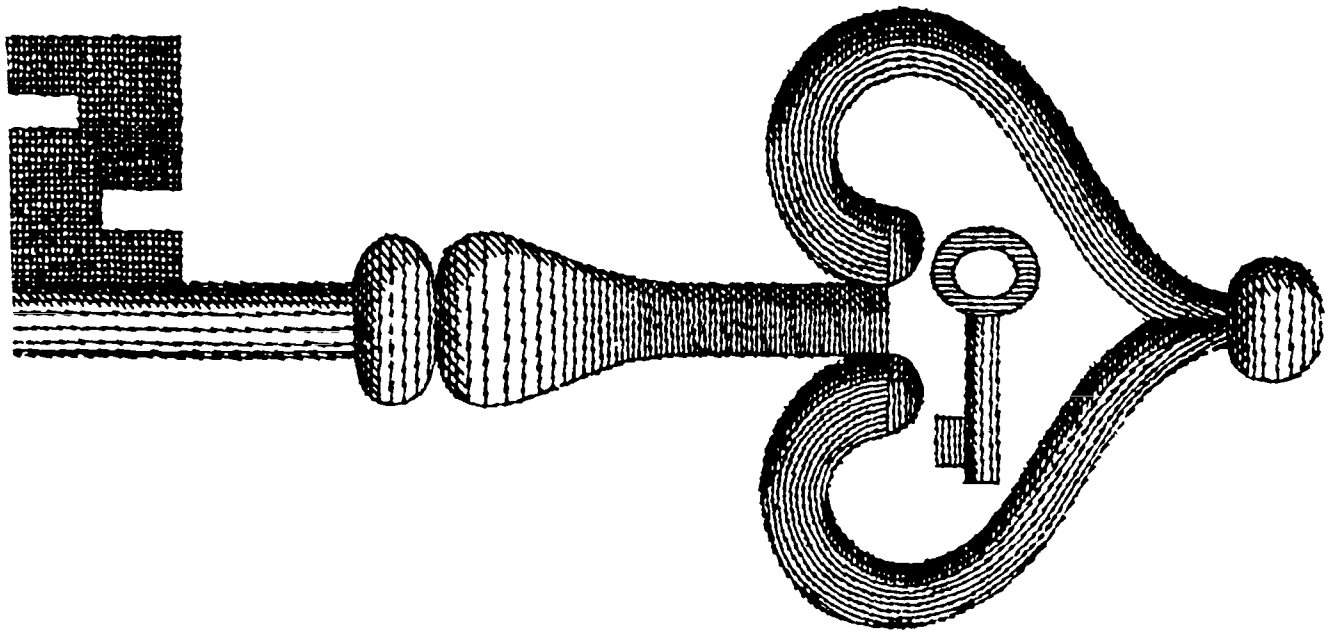
Discovering Color. (Film Associates of California)
Color Keeping in Art and Living. (Encyclopedia Britannica Films)

Filmstrips:

Color in Home Furnishings. (Part 1 and 2)
Line. (J. C. Penney Co.)

CUE Insights:

Color



CULTURAL ITEM: "TOURS OF THE WORLD - THAILAND" (Filmstrip - book - record)
Panorama - Columbia Records

CURRICULUM AREA: Home Economics - Intercultural Understanding
Personal and Family Living in Various Cultures

PURPOSES:

To give insight into the charming and exotic culture of Thailand.

SYNOPSIS:

Thailand, in spite of some westernization, still retains the splendor of glittering temples and opulent palaces. The monsoon rains and fertile soil help to make this the "rice bowl of the Orient." Nature has smiled on Thailand, and the gentle Thais smile back.

This filmstrip and colored slides and book present a wonderful introduction both to the country and the ancient splendors of Siam. Saffron-robed monks, gilded sculpture and architectural fantasies of the temple area, busy klongs, arts and crafts, palaces, family life, elephants at work in the teak forests, theatres, music and dance, kite and fish fighting are but a few of the visual delights of this many-splendored land.

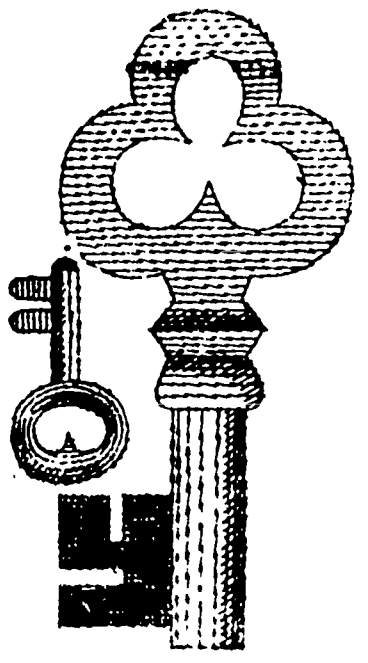
SUGGESTED PREPARATION OF THE CLASS:

Little preparation is needed for this film and record, since it forms a perfect introduction to a study of Thailand. It would be beneficial, however, to:

. Point out the location of Thailand on a map or globe.
. Explain the monsoon climate and its importance to the rice crop.
. Explain that Thailand means "freeland," and that it is a friend to the west and the home of the Southeast Asia Treaty Organization.
. Explain that Thailand is the home of a certain type of Buddhism, and that the central spirit of the Thais is religious.

PUPILS SHOULD LOOK AND LISTEN FOR:

. Temple of the Dawn - Wat Arun.
. Life on the canals (klongs).
. The Grand Palace, Temple of the Emerald Buddha.
. Dancers, spirit houses, Golden Buddha.
. Thai arts and crafts, games and sports.
. Buddhist monks, religious festivals.
. Royal Summer Palace, sacred cavern.
. The theatre, music and dance.



PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

To stimulate reflective thinking, ask students:

1. From what you have observed of Thailand, what do you understand about its people? (They are very religious, artistic, gay, energetic, calm, smiling, attractive; they are progressive, but still affected by their ancient culture.) Ask students to list why they have chosen these or similar characteristics. Make a chart:

Observations	Deductions
Many beautiful arts, crafts, dance and music.	The people are artistic.
Many fine crops, busy people, neat buildings.	The people are well fed, energetic and industrious.
Spirit houses to chase away evil spirits from main house.	Some people retain old superstitions.
Many temples and monks. People feeding monks.	The people are religious.

2. Discuss the arts of Thailand: painting, carving, lacquer, architecture, dance, costume, textiles, music and theatre.

3. Discuss the foods eaten, and manner of serving.

4. Discuss and explain main tenets of Buddhism (see Life's Book of the Wolds's Major Religions).

5. Ask a pupil to report on the history of Siam.

6. Ask students to report on kite and fish fighting or boxing with the feet, as done in Siam.

RELATED CREATIVE ACTIVITIES:

Take advantage of the artistic stimulation afforded by the film, and have students:

- Study and create a Siamese type dance. Show photographs of dancer's beautiful headdress and costumes.
- Have each student create objects typical of Thailand, such as a temple dancer's headdress, elephant, spirit house, chedding, dancer, monk, Buddha. Use these for bulletin board display or put together to form a mobile to create atmosphere for the rest of your study of Siam.
- Secure and display beautiful Thai silks and jewelry.
- Tell the story of "Anna and the King of Siam." Play parts of the recording of "The King and I" to illustrate the story. These later activities could be entertainment at a Siamese type meal.

CULTURAL ITEM: "WOMAN'S DAY DICTIONARY OF POTTERY AND PORCELAIN" (August, 1962)

CURRICULUM AREA: Home Economics - Selecting and Using Home Accessories
Appreciating the Heritage of Family Treasures

PURPOSES:

To widen students' horizons and possibilities of enjoyment through acquainting them with a wide variety of pottery and porcelain.

SYNOPSIS:

Much enjoyment of foods and life is intimately related to containers of pottery and porcelain. Although most of our containers today are mass produced, we gain much of interest, delight and enjoyment if we learn to appreciate the history of pottery and porcelain, and to recognize various types of it.

Every age and every race has done something to bridge the gap between the first crude stone age pot and the most delicate porcelain wares. The wares they have left tell us more than anything else about what they were like.

This 16-page "dictionary" covers the last four centuries of ceramics, with special attention to the last hundred years in the western world.

KEY WORDS:

- Pottery - soft earthenware made of clay mixtures that can take high temperatures in the kiln.
- Kiln - (pronounced kill) oven for baking pottery.
- Soft paste porcelain - made of white clay with glassy materials added to make it translucent; fired at relatively low temperatures.
- Hard paste - or "true" porcelain - made of china clay and ground up felspathic rock; fused at higher temperatures.

SUGGESTED PREPARATION OF THE CLASS:

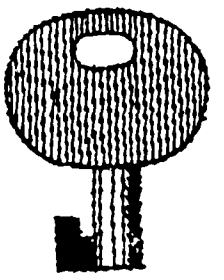
1. To prepare background for appreciation of the pieces shown in the article, show the CUE filmstrip "Ceramics." (See Lesson Plan.)

2. Display pottery and porcelain pieces. Explain the difference between pottery and porcelain.

3. Display dictionary photographs on opaque projector, or secure several copies from Woman's Day so all may see that Delft, Sevres, Staffordshire and Meissen are named after the places where they were made.

4. Explain: glaze, sgraffito, slip, lustre, stone ware, chinoiserie faience, bone china, ironstone, pâte-sur-pâte, Lenox, Royal Doulton, Royal Worcester.

PUPILS SHOULD LOOK AND LISTEN FOR:



- Delft, Sevres, Staffordshire, Wedgwood ware.
- Chinese and Japanese porcelains.
- Meissen, majolica, salt glaze and jasper ware.
- Staffordshire, lustre, stoneware and Spode.
- Early American wares and imports.
- Late European and American wares.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

To further sensitize students to the enjoyment of ceramics:

- Display and identify as many of the above types of ware as possible.
- Visit antique shops and museums for further acquaintance with these wares.
- Discuss the romance of china ware in the clipper ship days. It was ordered by the ship captains and sailors for their brides back in America.
- Discuss historical wares and their stories, such as the Willow Plate (a Chinese romance), or those honoring historical subjects (e.g., Seder Plate - see Home Economics CUE Kit).
- Have pupil select a ceramic type they have at home or see in the "Dictionary," do research, and report to the class on its background.

SUGGESTED RELATED ACTIVITIES:

1. To permit students to enjoy their new knowledge, take the class to a museum or antique shop to see and identify pottery and porcelain, or visit a department store to see modern American china.

2. Have students do research on Staffordshire figures, Toby jugs and lustre wares, Wedgwood, Meissen, Nymphenburg figures, Swedish and Danish modern, ironstone, Spode, Minton, Royal Doulton figures, Chinese blanc de chine figures.

3. Display "The Art of Ancient Greece," a book by Shirley Glubok (English CUE Kit), which includes illustrations of early Greek ceramics. Discuss the role of "shards," or pieces of pottery, in revealing the life of peoples of the past through archaeology.

4. Show file, "Ceramic Arts of Japan."

SUGGESTED RELATED CREATIVE ACTIVITIES:

1 Real appreciations come from involvement. Have students make a simple free-form sling ashtray. This requires little skill, and can be made in one class period. Secure aid of art teacher in firing and glazing or slip decorating.

2. Have students set up a ceramic display. Invite other classes to hear their reports of what they have learned about each of these pieces.

RELATED MATERIALS:

Films:

Ceramic Arts of Japan. (CUE)
The Making of Fine China. (Lenox China - Modern Talking Pictures) (Free)
Siam. (Walt Disney) (CUE)

Filmstrip:

Ceramic Art. (Encyclopedia Britannica Films)

Booklets:

The Reference Book of Fine China. (Lenox China)
Suggestions For Classroom Discussions of Fine China. (Lenox China)
An Introductory Reading Guide to Asia. (The Asia Society)

Gardens of Japan. (CUE)
Ceramics of Japan (CUE)
Ikebana. (CUE)
Japanese Family. (McGraw-Hill) (CUE)

Books:

Japanese House - Interior - Exterior, Ishimoto. (Crown Publishing Co., New York, 1963)
Japan. (Notebook CUE Social Studies Kit, Teachers Packet Japanese Consulate, $2.00)
Takashimaya. (525 Fifth Avenue, New York, New York for purchase of Japanese materials.

Periodicals:

The King and Us. (Horizon Winter '64)

CULTURAL ITEM: "WOMAN'S DAY: "DICTIONARY OF SANDWICH GLASS" (Pamphlet)
"POETRY IN CRYSTAL" (Book)

CURRICULUM AREA: Home Economics - Accessories for the Home
Heritage of Family Treasures

PURPOSES:

To acquaint students with the beauty and char. of Early American glass.

SYNOPSIS:

Pick up a piece of Sandwich glass, and you hold in your hand a piece of America's past. This 24-page "Dictionary" contains beautiful color photographs of glass made at Sandwich, and related types of glass, and gives the history of these collectors' items. Sandwich glass was created by people living in Sandwich, on Cape Cod, where a glass factory was built in 1825. Glassmakers there took pride in their work and the glass reflects this. The charm and astonishing variety of these pieces will show you why glass is the best loved of American antiques.

SUGGESTED PREPARATION OF THE CLASS:

To enable all students to share in viewing these beautiful pieces:

1. Secure an overhead projector and show the photographs from the article.

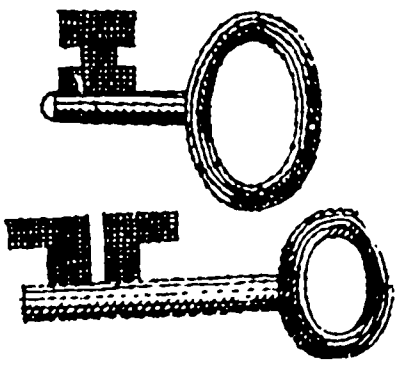
2. Prepare a bulletin board display of photos of glass articles; secure and display a variety of glass pieces.

3. Display a piece of cut glass and explain that it was decorated by cutting designs into the glass with burrs and cutting wheels. Cut glass was considered to be very beautiful and desirable at one time, but it was expensive because cutting and polishing required much work and effort. Some artists had the idea of creating cut glass design effects by pressing or blowing molten glass into molds, a much quicker and cheaper process. Much of this type of glass was made at Sandwich, Massachusetts. So beautiful are these pieces that today many people collect and display them as works of art.

PUPILS SHOULD LOOK AND LISTEN FOR:

. How to identify pressed glass from cut glass and from blown "three mold."
. Cup plates and miniatures, the importance of salts.
. Candlesticks, vase, lamp designs.
. Pressed pattern glass and paperweights.
. Cut engraved and etched glass, and fancy ware.

PRESENT MEDIA.



SUGGESTED FOLLOW-UP ACTIVITIES:

To widen pupil horizons in relation to glass as an art form:

- Display some Venetian glass, or pictures of it. Tell students that here glassmaking was considered so important an art that glassmakers and their families were impounded on the island of Murano near Venice, so they could not reveal their secrets.
- Show the book, "Poetry in Crystal," (CUE English Kit) and Corning booklet (CUE Industrial Arts Kit), and explain that crystal is a glass with a high lead content, which gives a ringing metallic sound when tapped sharply. Explain about the processes.
- View the films, "Sealed in Glass" and "Glass and You," for demonstrations and explanations of cutting crystalware.
- Visit a department store or gift shop or museum to see fine glassware.

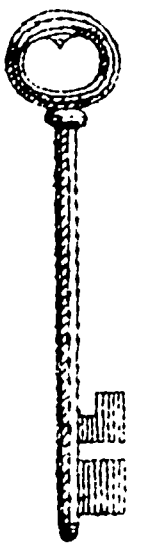
SUGGESTED RELATED CREATIVE ACTIVITIES:

1. To further appreciation of glass as an art form, secure some hydrofluoric acid in cream form and allow students to etch designs on glass.

2. Have students choose glassware as table settings, bearing in mind the beauty of color, form and light that glass can contribute.

3. Have students collect various colored glass bottles or broken dishes. Place between corrugated cardboard, and crush with hammer. Draw a simple design on a small sheet of clear glass. Fix broken bits of glass to it with Elmer's glue in mosaic fashion. Place in window for stained glass effect, or make mosaic ash trays or other small accessories for a room or table decor.

RELATED MATERIALS:



Films:

Sealed in Glass. (Netherlands Consulate)
Glass and You. (Corning, New York)

Filmstrip:

Glass and Mosaic Art. (Encyclopedia Britannica Films)

Trips:

Metropolitan and Brooklyn Museum Collections
Corning Glass - Corning, New York

Periodical:

Craft Horizons - November/December 1960. (CUE Industrial Arts Kit, articles on stained and contemporary glass.)

CULTURAL ITEM: "THE WORLD IS YOURS" (Film)
25 min., Color, Montgomery Ward.

CURRICULUM AREA: Home Economics - Fashion Around the World
Intercultural Influences on Dress

PURPOSES:

To acquaint the student with fashion merchandising and how it is practiced around the world.

To develop an appreciation for the role played by foreign designers in fashion design and merchandizing.

SYNOPSIS:

In colonial days, it was months before a "fashion doll" from Paris brought new styles to America. Today Parisian designs are reproduced in quantity on Seventh Avenue in weeks. Modern transportation and communication have compressed the fashion worlds as well as the political worlds into one. Mass production enables the wealthy and the budget-concious to wear relatively the same fashions.

The film takes us to a fashion show at a Parisian salon where buyers from round the world select their choices. A homeward jet brings buyers and selections back to a department store headquarters, where design selections are adopted for mass production and sale.

The film also gives insights into the various buying customs and traditions of other countries, as well as merchandising practices in our own country.

SUGGESTED PREPARATION OF THE CLASS:

To orient study and thinking, secure the World Book article on clothing, or a good book on costume. Show some of the costumes and explain that since the beginning of time man has had the desire to clothe himself. Strangely enough, his main reason was not warmth or modesty but the desire to look more impressive or more attractive. This desire lives on today and is the basis of the enormous fashion industry.

PUPILS SHOULD LOOK AND LISTEN FOR:

- The atmosphere and technique of a fashion show in a Parisian couture salon.
- The role of the fashion buyer.
- The special ways in which other countries buy and sell goods.
- The necessity for knowing these traditions when dealing with these cultures.
- The vastness and complexity of a large retail firm.

. The importance accorded to the consumer.
. The number of employees necessary to keep the firm competing.

PRESENT MEDIA.

SUGGESTED FOLLOW-UP ACTIVITIES:

1. Secure and exhibit the CUE display of Travel Posters. Have the class plan a buying trip for a fashion buyer. Include her flight schedule, countries she will visit, kinds of fashions or accessories she is to buy from each. Have students cut from magazines photographs of originals of each item on her list.

   Class artists might prepare several "proposed" copies or adaptations from these originals. The problem is to retain the smartness of the original design, but to reduce manufacturing costs in order to sell it as a medium-priced or budget item. If possible, trace one or more real fashion items belonging to students to the original design source.

2. To help students understand that many large businesses are now worldwide in their dealings, display pictures of fashion items from all over the world that are now available to us - beads or pearls from Hong Kong or Japan, shoes from Italy, silks from Italy or Thailand or Japan, wool from England or Austrailia, watches from Switzerland, jute bags and shoes from India, leather bags from South America. Consult mail order catalogs to find items from foreign lands for dress or decor. Note that it is no longer only the wealthy who can afford these items. Ask what implications this trend may have for developing new understandings and appreciations of other cultures.

   Note that American blue jeans are worn by the Queen of Thailand, all kinds of Japanese children. In exchange, American women are discovering the grace and charm of Indian saris, the Chinese "Cheong sam," split-sided sheaths, coolie hats and other foreign fashions.

   Discuss the role of mass production of clothing in furthering the processes of democracy. There are no longer great differences in styles of clothing between classes of people. When man understands and remains master of his technology, it can be made to serve humanitarian ends.

SUGGESTED RELATED ACTIVITIES:

To further appreciations of costume of other cultures:

. Have students bring in any foreign costumes they may have.
. Secure resources person, or show World Book costume plates, to acquaint students with the native costumes of various countries.
. Visit a museum of costume.

SUGGESTED RELATED CREATIVE ACTIVITIES:

- Plan a round-the-world fashion show, with designs inspired by world costumes. Items worn may be a real sari, a Japanese kimono, a muu muu, or designs inspired by foreign costume.
- Have students help write a script telling something about the original costume or country which inspired the designs.
- Secure records of music suggestive of each country, or make a tape containing music in keeping with the origins of the costume.
- Have a fashion buyer from a near-by concern explain her job, travel experience and adaptation of fashions for production to student.
- Investigate job opportunities such as stock girl, salesperson, buyer, sketcher, designer, fashion artist, stylist, fashion coordinator.

RELATED MATERIALS:

Films:

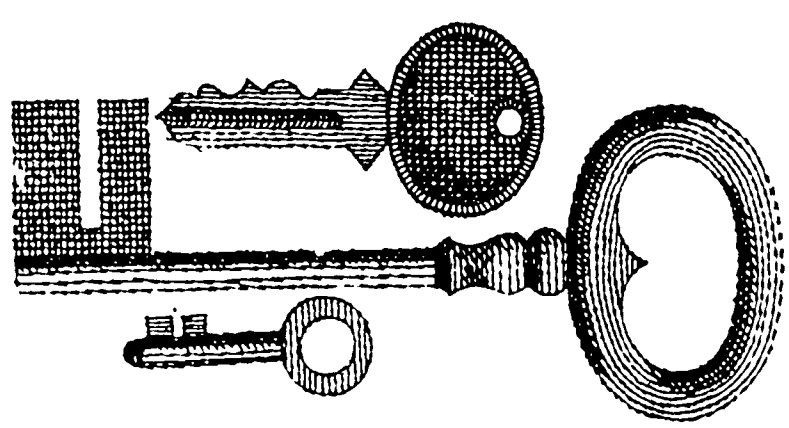
Spring Fashions 1963-4 (Modern Talking Films)
Fall Fashions 1962 - 3 (Modern Talking Films)

Filmstrips:

Looking Your Best for Spring '64 . (Consumer Education Division, Sears, Roebuck and Co.)
Colors You Series. (J. C. Penney Co.)

Books:

Historic Costume, Lester and Kerr. (Charles A. Bennett Co., Inc. Peoria, Illinois. 1961)
Costumes and Styles, Henry Harold Hansen. (E.P. Dutton and Co. Inc., New York. 1956)



CULTURAL ITEM: "SEVEN GUIDEPOSTS TO GOOD DESIGN" (Film)
14 min., Color, Contemporary Films
Tearsheets of industrial designs --Container display --
Design in Materials (See CUE Industrial Arts Kit).

CURRICULUM AREA: Esthetics in Home Furnishings
Development of Consumer Taste and Judgement

PURPOSES:

To alert students to what good industrial design is and to give them criteria for judging good design in home products.

SYNOPSIS:

This excellent film illustrates what good industrial design is and gives criteria by which it may be judged. It is a "must" for developing consumer judgement, taste and appreciations.

SUGGESTED PREPARATION OF THE CLASS:

Before pupils enter the room on the day of the film showing, place on a table in full view of the class two everyday articles of the home, such as paring knives and salt and pepper shakers. One set should illustrate good design; the other poor design, as described in the film, which has been previewed by the teacher. The purpose is to motivate pupils to ask questions. A brief discussion can be held during which questions are raised about the articles being displayed. The discussion may be directed toward having the class choose which of the articles they think are best designed and why.

Explain to the class: Inside each of us is a hunger for beauty in our lives. We all get an inner glow of pleasure when we encounter beautiful things such as a flaming sunset. But we do not need to depend on dramatic scenes alone for pleasure. Thanks to the industrial designer we can have pleasing beauty in all sorts of household products, appliances and furnishings if we know how to choose them carefully.

But no one would want to buy an appliance or chair for its looks alone. It must have many functional qualities. Does it do its job well? Is it easy to use? to clean? Is the material used appropriate? Can it be produced economically? Does it fit in with the rest of the room? All these are questions that come to mind when we consider purchase. Our film today will help us in judging what is good design in industrial products.

PUPILS SHOULD LOOK AND LISTEN FOR:

The answers to these questions:

. What does "form follows function" mean? Suitability to the job?
. What does humanization mean? Suitability to the user.?

. What do we mean by honest appropriate use of material?
. What is meant by shaping processes?
. What is meant by functional structure?
. What is meant by economy--as applied to material and effort?
. Is the appearance pleasing in color, texture and lines?

SUGGESTED FOLLOW-UP ACTIVITIES:

1. To help crystallize the criteria in the students mind, ask a pupil to list on the chalkboard the seven guideposts presented in the film as other class members contribute the information.

2. Ask the pupils:

   . What is the meaning of some of the words used in the film--humanization, function, structure?
   . What article of equipment or furnishing have you seen that was so decorative or so constructed that it was difficult to clean?
   . Can you describe the features of a chair which made it uncomfortable to use?
   . In selecting a piece of equipment or furnishing for our homes, should we buy it solely because it has eye appeal?

3. Ask the class to observe closely the objects on the table and decide which one is well designed, to identify those features that make it a good design in accordance with the seven guideposts and compare their conclusions with their choices made before seeing the film.

SUGGESTED RELATED ACTIVITIES:

Have the class assemble articles and containers or pictures of them for bulletin board and table display. Ask each to defend his choice on the basis of the seven criteria shown in the film. (See CUE Industrial Arts Kit, materials on Container and other designs)

SUGGESTED RELATED CREATIVE ACTIVITIES:

. Ask: Why are well designed attractively colored packages important? (A well designed attractively colored package suggests a high quality product inside and encourages more sales through their attractiveness.)
. Experiment with paper folding to design a container for a product. Work out your finished container in tagboard or cardboard. Use foils, colored papers or paint to give the package eye appeal. Try to make it meet with the design criteria you have learned.
. Ask students to choose any product or article and draw or model an improvement on its design bearing in mind the Seven Guideposts. Could it be larger, smaller, more functional, combined with another product (such as lamp fastened to table)? divided into two products? How about color? texture?

RELATED MATERIALS:
Film:
The American Look. (Ford Motor Company)

CULTURAL ITEM: "A TOUR OF THE WHITE HOUSE WITH MRS. JOHN F. KENNEDY" (Film)
McGraw-Hill Films
2 reels, 58 minutes, Black and White.

CURRICULUM AREA: Home Economics - Esthetic Qualities of Furniture.
Family Relationships.

PURPOSES:

To enable the student to share in their national heritage and to alert them to the significance of interior decor.

SYNOPSIS:

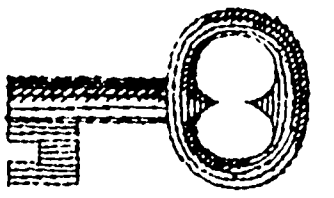
Jacqueline Kennedy takes us on a tour of the White House, newly decorated under her supervision. This film enlightens and motivates students toward a new understanding and appreciation of the cultural importance of furniture and interior decor. It also emphasizes cultural progress and American traditions. It may, therefore, be used for a study of family relationships.

SUGGESTED PREPARATION OF THE CLASS:

Although pupils will enjoy this film without preparation because of its emotional and patriotic appeal, far more will be obtained from it if students have previously learned something about period furniture. It is suggested that the teacher use the CUE lesson on "Furniture in History" and "Dictionary of Furniture" to provide an understanding of furniture as an art form.

Explain to the class that furniture and decor like other art forms reflects the society of its creators and users. The Kennedy interest in the arts which led to the redecoration of the White House is symbolic of the upsurge of interest in the arts burgeoning in our culture.

PUPILS SHOULD LOOK AND LISTEN FOR:



- Prints and pictures that relate to the history of our country.
- Kinds of tableware in use today.
- Kinds and conditions of furniture in stages of restoration.
- Selections in wallpaper and its significance in history.
- Particular pieces of furniture of importance.
  (Wing chairs, chests, sofas, mirrors, and pier tables)
- Functions of the rooms, and arrangements in furniture appropriate to functions.

PRESENT MEDIA

SUGGESTED FOLLOW-UP ACTIVITIES:

1. Discuss the film with pupils using questions such as:

   - Which pictures did you see that tell a story of our American heritage?
   - How would you describe some of the pieces of china and silverware which are used at state dinners?
   - What pieces of furniture are in the process of restoration?

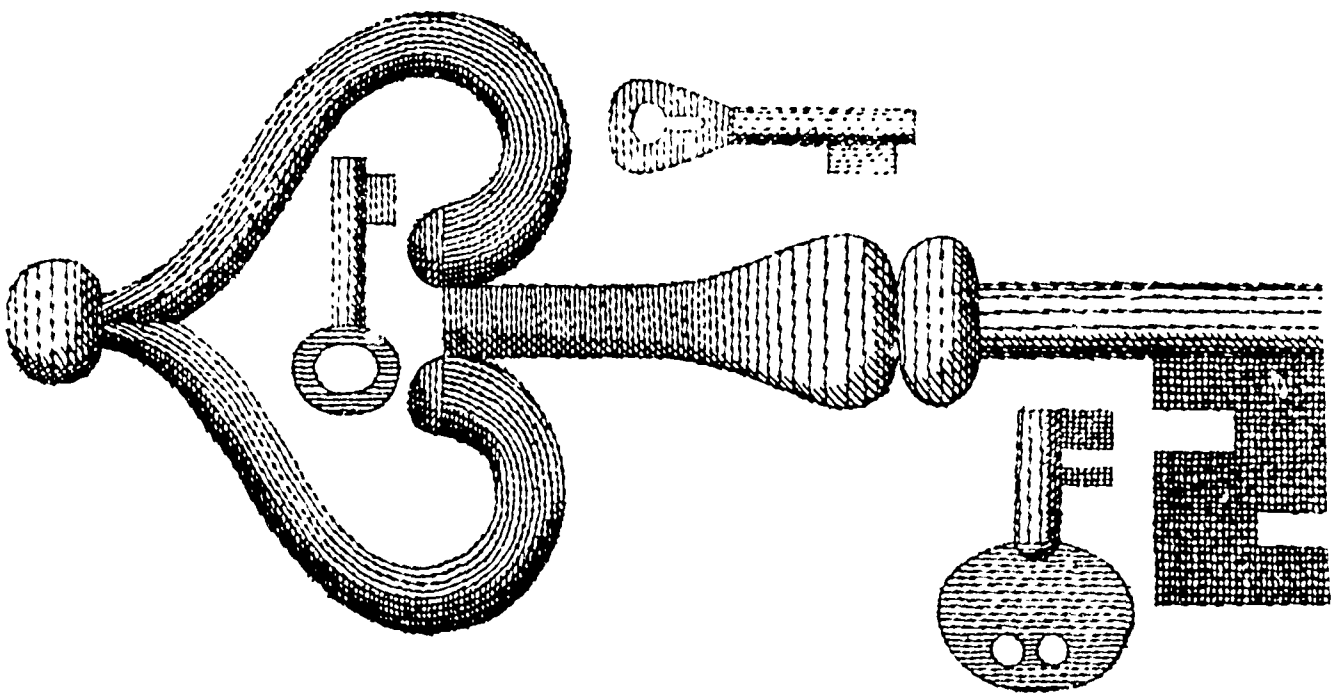
. Where have these pieces of furniture been found?
. What will happen to some of this furniture if it is not acceptable to future presidents?
. What is the significance of the wallpaper design?
. How does furniture arrangement affect the use of a room?
. In what ways has seeing this film enriched your understanding of American progress in culture?
. Why is it important that the White House be tasteful, beautiful, but not overly astentatious?

2. Compare the White House with Palace at Versailles, the art treasures of the Kremlin (CUE), to see how these structures reflect the lavish life of a monarchy as contrasted to the official residence of a democracy.

RELATED MATERIALS:

"Furniture in History" - Cultural History Research CIE Industrial Arts.

"Dictionary of Furniture" by Edith Gaines - Woman's Day, August 1960



List of Producers

Aluminum Company of America
230 Park Ave.
Manhattan, N. Y.

American Cyanamid Company
Fibers Division
111 West 40th St.
New York 18, N. Y.

American Wool Council
520 Railway Exchange Bldg.
Denver 2, Colo.

Association Films, Inc.
347 Madison Ave.
New York 17, N. Y.

Avon Corporation
Rye, N. Y.

Bailey Films, Inc.
6509 DeLongpre Ave.
Hollywood, Calif.

Colorado Flower Growers Association
901 Sherman St.
Denver, Colo.

Columbia Records
799 Seventh Ave.
New York, N. Y.

Contemporary Films, Inc.
267 West 25th St.
New York, N. Y.

Corning Glass Center
Walnut St.
Corning, N. Y.

Cultural History Research
Harrison 1, N. Y.

Walt Disney
16mm Film Division
477 Madison Ave.
New York, N. Y.

E. I. DuPont & Company
Film Distribution
Wilmington,Del.

Encyclopedia Britannica Films
1150 Wilmette Ave.
Wilmette, Ill.

Film Associates of California
11014 Santa Monica Blvd.
Los Angeles, Calif.

R. T. French
1 Mustard St.
Rochester, N. Y.

General Motors
1775 Broadway
New York, N. Y.

Hallmark Cards
Kansas City, Mo.

H. J. Heinz
Pittsburgh 30, Pa.

International Communications Foundation
9033 Wilshire Blvd.
Beverly Hills, Calif.

Japan Information Service
235 E. 42nd St.
New York, N. Y.

Japan Pub. & Trading Co.
Tokyo, Japan

Life Filmstrips
9 Rockefeller Plaza
New York, N. Y.

Lambert Laboratories
St. Louis, Mo.

Man-Made Fiber Producers Assn., Inc.
350 Fifth Ave.
New York, N. Y.

McGraw-Hill Co.
Text-Film Dept.
330 W. 42nd St.
New York, N. Y.

The Melamine Council
75 West St.
New York 6, N. Y.

List of Producers (concluded)

Montgomery Ward
Menands, N. Y.

National Gallery of Art
Washington, D. C.

Pendleton Woolen Mills
Portland, Ore.

Pittsburgh Plate Glass
632 Fort Duquesne Blvd.
Pittsburgh 22, Pa.

Platt-Munk Publisher
New York 10, N. Y.

Thorn Films
1229 University Ave.
Boulder, Colo.

Woman's Day Magazine
67 W. 44th St.
New York 36, N. Y.

*For a complete list of CUE media-materials with prices and sources, see the new Do-It-Yourself CUE Guide (1965).

ERIC

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ABSTRACT - Developed by State staff in conjunction with the staff of a water and sewerage technical school, this instructor's guide is for use in presenting courses in water and sewerage management in post high school technical schools. Sections are offered on: (1) related mathematics, (2) hydraulics, (3) chemistry, (4) water and sewerage laboratory techniques, (5) meters, (6) filters, (7) pumps, (8) electricity and electrical systems, (9) bacteriology, (10) water treatment, (11) chlorination, (12) water distribution systems and storage, and (13) sewage collection and treatment; with each section providing objectives, content, and references. Suggested experiments, a diagram of a sewerage treatment plant, a flow chart outlining treatment of sewage, and a bibliography including books, manuals, and magazine articles are also given. The instructor should have knowledge of the water and sewerage industry and students should be of above average ability. (AW)

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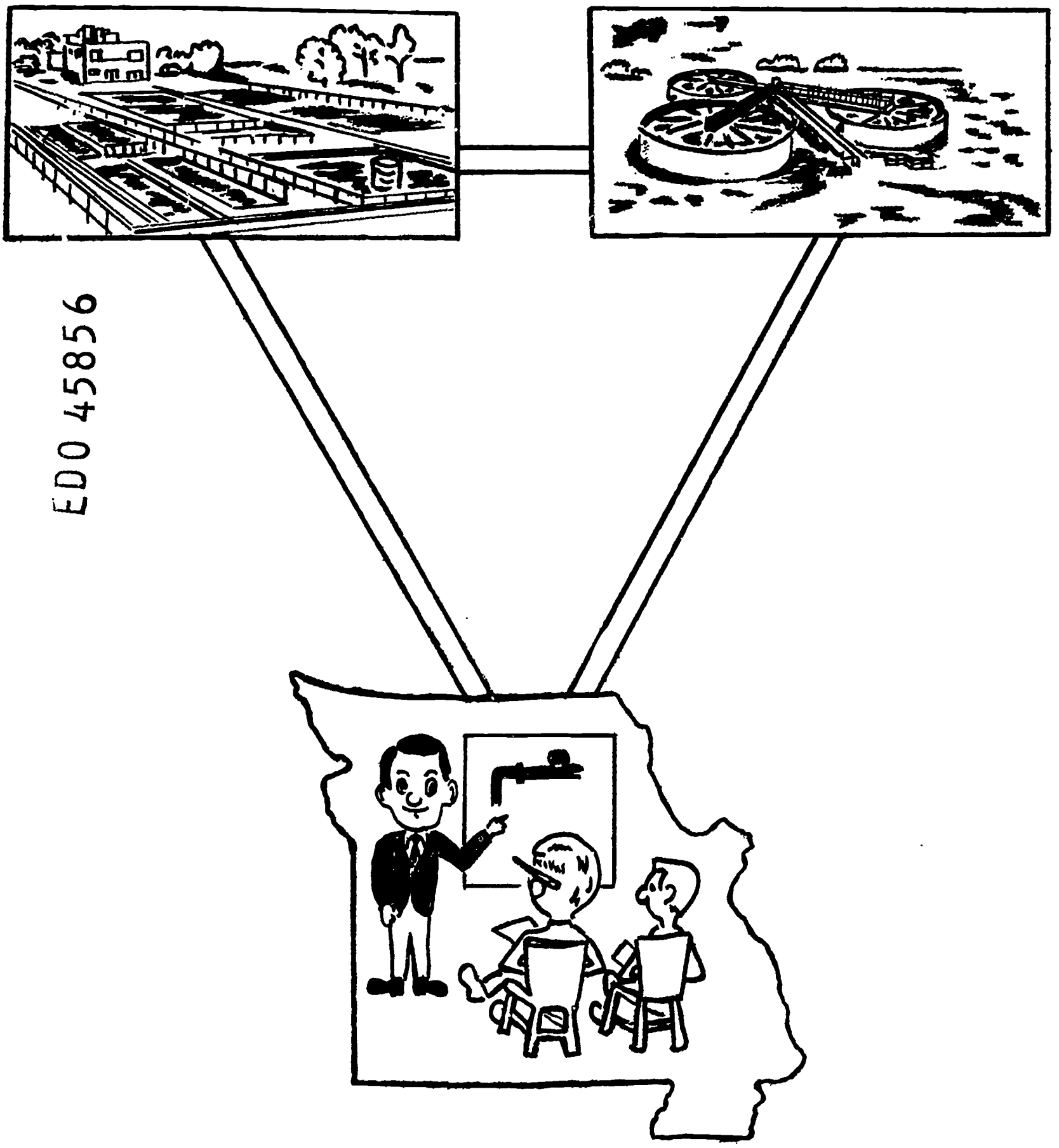

Water and Sewerage

a course of study.

VT 02053

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FOREWORD

This course of study has been prepared by the Missouri State Department of Education with funds provided by the provisions of the Manpower Development and Training Act of 1962.

It is intended to serve as a training guide to instructors in presenting content relating to water and sewerage plant maintenance and management.

Under the provisions of the Manpower Development and Training Act, the Missouri State Department of Education contracted with the Water and Sewerage Technical School of Neosho, Missouri, to provide training in water and sewerage plant management.

This school, formerly sponsored by the Missouri Water and Sewerage Conference, operates as a private non-profit school training nationally and internationally for water and sewerage plant operation and management.

Although Manpower Development and Training funds were made available to the State Department of Education and the writer was employed by them, the technical knowledge and cooperation of the Director, Mr. Lloyd Caughran, his staff and the Board of Directors of the Water and Sewerage Technical School made this publication possible.

Special credit is due Mr. James Cornett, Coordinator, Hillcrest High School of Springfield, Missouri, who in cooperation with the director and staff of the Water and Sewerage Technical School prepared the content.

Credit is also due Mr. Frank Drake and Mr. James Helmert, Supervisors of the Manpower Development and Training, for coordination and editorial activities. Mr. Merton Wheeler, Director of Industrial Education, provided over-all direction of the project.

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TOPICAL OUTLINE

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COURSE OF STUDY

ORIENTATION

TYPE: Lecture, discussion and demonstration.

OBJECTIVES:

To provide the trainee with a basic overview of the water and sewerage industry.
To develop a knowledge of the terminology and equipment used in the industry.
To review and develop basic knowledge and skills of courses to be taken.

CONTENTS:

A presentation of the water works and sewage industries' function, terminology, source of supply and equipment used. Also, an introduction is made to math, chemistry, water and sewage treatment, filtration, and laboratory control.

SUGGESTED APPROACH:

The water and sewerage industry has become one of the largest and most important industries in the world today. The fact that the world population has steadily increased and become more homogenious in nature has made water and waste control a more significant problem in societies the world over.

The rapid growth and technological change has had a tremendous impact on the industry and it is striving to advance with the times.

With this growth and new developments in equipment and structures there is an increasing demand for workers who possess the technical skills and knowledge to operate treatment plants.

The student entering this technical field should be given a thorough background of the growth of the industry and problems involved in providing these services for their communities.

It is not only important that discussions be given but exploratory field trips be taken to let the student see for himself how the industry actually operates. Appropriate films, demonstrations and practice should be provided to give the student ample background to enter training.

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. Orientation of the water and sewerage industry	
A. Terms	Discuss and explain each term.
1. Measurement 2. Turbidity 3. Chlorination 4. Coagulation 5. Flocculation 6. Filtration	
B. Sources of water supply	
1. Ground water a. Shallow wells b. Deep wells c. Springs	Take a field trip to a facility that uses ground water as its source.
2. Surface water a. Rivers b. Natural lakes c. Impounding reservoirs	Take a field trip to the intake sight of a facility that uses surface water as its source.
C. Chemical laboratory	
1. Equipment a. Jar test b. Comparators c. Turbidimeter d. Glassware e. Incubators f. Ovens	Discuss characteristics and functions of each type of equipment.
2. Technique	Demonstrate use of each type of equipment.
D. Mechanical laboratory	Discuss and demonstrate each type of equipment.
1. Valves 2. Chlorinators 3. Fire hydrants 4. Pipe cutting equipment 5. Tapping equipment 6. Altitude valves 7. Telemetering 8. Distribution equipment 9. Leak detectors - Pipe locators 10. Main cleaning apparatus 11. Meters	Allow students to practice using various pieces of equipment.

E. Field trips

1. Sewage plant a. Trickling filter plant b. Activated sludge plant c. Vacuum filtration equipment	Visit local plants for discussion and demonstrations by the plant operators.
2. Water filteration plant a. Source b. Treatment c. Filtration d. Pumping	Visit local plants for discussion and demonstrations by the plant operators.
3. Distribution system a. Line taping b. Storage c. Altitude valves d. Protection e. Hydrants f. Valves	Take students to watch a crew execute a line tap in a distribution system.
4. Lagoons and aerators	Take a field trip to an oxidation lagoon.

II. Orientation of water and sewage works courses.

A. Introduction to Chemistry 1. Metric system 2. Solutions	Discuss and explain
B. Introduction to Math 1. Expressions 2. Fractions	Discuss and explain Assign students problems to solve.
C. Introduction to sewage treatment	
D. Introduction to water treatment 1. Aeration 2. Filtration 3. Mixing, Coagulation, Flocculation, and Sedimentation 4. Rapid sand filtration a. Rate controller b. Loss of head gages c. Filter washing d. Pressure filters 5. Filters a. Sand b. Diatomaceous c. Authrafilt	Discuss and explain

6. Laboratory control
   a. Chemistry analysis
   b. Bacteriological examinators
   c. Coagulations

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COURSE OF STUDY

MATHEMATICS I

OBJECTIVES:

To present necessary mathematics and introduce other waterworks concepts by the use of example computations.

CONTENTS:

A review of arithmetic and geometry with particular application to the waterworks field.

REFERENCE MATERIALS:

1. Conversion Factors for Engineers, Dorr-Oliver, Inc.

2. Standard Methods for Examination of Water and Wastewater, American Public Health Association, 1960.

3. Philliber, John V., Waterworks and Sewage Works Mathematics.

4. Eglof, Warren K., Ph.D., Elementary Mathematics for Water and Sewage Works Operators.

5. Manual of Instruction for Sewage Treatment Plant Operators, Health Education Service, Albany 1, New York.

6. Manual of Instruction for Water Treatment Plant Operators, Health Education Service, Albany 1, New York.

7. Manual for Waterworks Operators, The Texas Water and Sewage Works Association, Pages 586-600.

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. What is the relation of arithmetic to water and sewage treatment?	Discuss and demonstrate to class.
A. What standard measure must be understood? What should the student know about terms?	
1. Definitions	
2. How they are used	
3. Where they can be found	
B. What other standard measures are a vital part of arithmetic information?	
1. Head and pressure	Explain
a. What are the constants?	Do sample problems
b. When are they used?	
c. What does the answer mean when found?	
2. Flow	
a. Flow in water lines varies dirrectly with the difference in the squares of the diameter of the pipes. (Excluding friction)	
b. To find: G.P.M. = M.G.D. x 700	
3. Conversions	
a. One cubic foot = 7.48 gal.	
b. 17.1 x G.P.G. = P.P.M.	
c. .058 x P.P.M. = Gr. per Gal.	
4. Conversion Factors	
a. $\frac{\text{Gr. per Gal. x 143}}{8.34}$ = 17.1 P.P.M.	
b. $\frac{\text{P.P.M. x 8.34}}{143}$ = .058 Gr. per Gal.	
5. Areas and Volumes	
a. Volume of rectangular basin in gallons = length x width x height x 7.48	Have students measure a basin and solve for volume in gallons plus chemical dosage.
b. Area of circle = πr^2	
II. What are the fundamentals of arithemetic in water and sewage treatment?	
A. What are the essentials in multiplication, division, addition, and subtraction?	
1. Accuracy	
2. Practice	
3. Checking	
4. Speed	

5. Confidence in oneself in the use of whole numbers, fractions, decimals, and percents.

B. Use of Fractions. The upper number of a fraction is called the numerator, and the lower number is called the denominator.

Assign various types of fraction problems to students

1. Multiplication
   a. To multiply a fraction by a fraction, multiply the numerators for the new numerator and multiply the denominators for the new denominator.
   b. To multiply a fraction by a whole number, multiply the numerator of the fraction by the whole number and place over the same denominator.

2. Division
   a. To divide a fraction by a fraction, multiply the dividend by the reciprocal of the divisor.
   b. To divide a whole number by a fraction, multiply the whole number by the reciprocal of the fraction.

3. Addition and Subtraction
   a. Only similar fractions can be added or subtacted. To add, add the numerators and place over the common denominator.
   b. Dissimilar fractions must be reduced to similar fractions.

C. Use of decimals. A decimal is a fractional part of a unit expressed by using tenths, hundredths, thousandths, etc.

Assign problems involving decimals to students.

1. Addition and subtraction
   a. Decimal fractions may be added by placing the numbers to be added in columns, being careful to have the decimal point of each number in the same column.

2. Multiplication
   a. Multiply the two numbers as if no decimal points were present.
   b. Count the decimal places in both numbers just multiplied. This total will be the number of demical places in the answer.

3. Division
   a. When a decimal place or places appear in the divisor, move the decimal place to the right in the dividend as many places as are in the divisor, then divide.

D. Use of Percent
   a. Percent means hundredths
   b. Indicated by symbol: %

III. Methods of solving for grains per gallon and parts per million

A. If given grains per gallon:
One grain per gallon = 1,000,000 grains per M G.
Since 1 lb.contains 7,000 grains
Then: 1,000,000 ÷ 7,000 =143 lbs.
Therefore: 143 lbs. to M.G. = 1 grain per gallon

B. If given parts per million
One P.P.M. = 1 part added to 1,000,000 parts (by weight)
Since 1 gallon of water weighs 8.34 lbs.
Then: 1,000,000 gallons weighs 1,000,000 x 8.34 = 8,340,000 lbs.
And: 1 P.P.M. = 8,340,000 ÷ 1,000,000 = 8.34 lbs.
Therefore: 8.34 lbs. to M.G. = 1 P.P.M.

IV. What general formulas should the student know and understand?

Assign students practical problems from plants in the area.

A. Grains per gal. = $\frac{\text{lbs. of chemical used}}{\text{water flow in M.G.D.}} \times 143$

B. P.P.M. = $\frac{\text{lbs. of chemical used}}{\text{waterflow in M.G.D.} \times 8.34}$

C. Lbs. of chemical required per day = 143 x waterflow in M.G.D. x dosage in gr. per gal.

D. Lbs. of chemical required per day = 8.34 x waterflow in M.G.D. x dosage in P.P.M.

COURSE OF STUDY

MATHEMATICS II

OBJECTIVES:

To provide the students with more advanced mathematical concepts for use in waterworks computations.

CONTENTS:

A continuation of General Mathematics with more advanced study and more complicated and expanded problems. The Course content is arranged so that students will be able to comprehend the more detailed hydraulic and water treatment studies.

REFERENCE MATERIALS:

1. Fallout and the Winds, Civil Defense Technical Bulletin TB-11-21

2. Conversion Factors for Engineers, Dorr-Oliver, Inc.

3. Philliber, John V., Waterworks and Sewage Works Mathematics.

4. Eglof, Warren K., Ph.D., Elementary Mathematics for Water and Sewage Works Operators.

5. Manual of Instruction for Sewage Treatment Plant Operators, Health Education Service, Albany 1, New York.

6. Manual of Instruction for Water Treatment Plant Operators, Health Education Service, Albany 1, New York.

7. Manual for Waterworks Operators, The Texas Water and Sewage Works Association, Pages 586-600.

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. What additional knowledge is needed by the student who wishes to advance in water and sewage treatment?	
A. What standard measures must be understood?	
1. Areas a. Sphere = $4\pi r^2$ b. Rectangle = length x width c. Circle = πr^2 d. Trapezoid = ½ sum of parallel sides x distance between parallel sides	
2. Volume a. Cylinder = $\pi r^2 L$ b. Cone = $1/3\ \pi r^2 A$ c. Rectangular Basin = Area of base x altitude or length x width x altitude d. Sphere = $1/6\pi d^3$	Assign students practical problems
3. Conversion Factors a. 1 cu. ft. = 7.48 gallons b. 1 gal. = 231 cu. in. c. 1 gal water = 8.34 lbs. d. 8.34 lbs. = one part per million by weight of one million gallons of water e. π = 3 1/7 or 3.14 and is called "pi"	
4. Horsepower a. The water horsepower is the actual brake horsepower required to do work with a pump of 100 per cent efficiency. (1) 1 horsepower = 0.746 kilowatts = 33,000 ft. lb. per min. (2) Water horsepower = $\frac{\text{GPM x Head in Feet}}{3960}$ (3) Brake horsepower = $\frac{\text{GPM x Head in Feet}}{3960 \text{ x Eff. of Pump}}$	Have students design a system and figure needed horsepower
5. Fire Flow a. The National Board of Fire Underwriters has adopted the following formula for determining the total quantity of water required for water service: G is the required amount of water in gallons per minute and P is the population expressed in thousands. b. $G = 1020\sqrt{P}\ (1.0 + 0.01\sqrt{P})$	Have students figure Fire Flow for hometown

6. Slope
   a. Slope is indicated by s in formulas.
   b. Slope is the rate of fall
   c. This indicates fall per 1,000 feet

Demonstrate a slope problem and have students work examples.

7. Detention Time
   a. Where flow remains constant, Dention time = $\frac{\text{volume of basin}}{\text{flow}}$

8. Velocity
   a. Velocity = $\frac{\text{distance}}{\text{time}}$
      (inches, feet, or miles)
   b. (hours, minutes, or seconds)

9. Discharge
   a. Discharge = $\frac{\text{volume of flow}}{\text{time}}$
   b. (gallons or cubic feet)
      (days, hours, minutes or seconds)
      (1) 1 cu. ft. per sec. = 647,000 gal. per day
      (2) 1 mgd = 1.54 cfs = 92.4 cfm

10. Weir Overflow Rate
   a. This means gallons per day per foot length of Weir
      $\frac{MGD}{\pi D}$ = gallons per day per foot

B. What should the student understand about Filtration?

To calculate rate of dosing or hydraulic loading in million gallons per acre-foot per day.

1. What is Filtration?

2. Discuss the Rate of Filtration.
   a. The MGD is divided by the acres of stone
   b. $\frac{MGD}{\text{Acre x day}}$ = Million gallons per acre per day

Explain acre-foot

COURSE OF STUDY

GENERAL INORGANIC CHEMISTRY

OBJECTIVES:

To provide an applied knowledge of Chemistry

CONTENTS:

A presentation of the elementary chemical fundamentals as found in a beginning chemistry course with special emphasis directed toward water and sewage treatment.

VISUAL AIDS:

1. McGraw-Hill, Film Strip series

2. Chemical Lab Safety, Film 16mm color-sound, 25 min. 1961

REFERENCE MATERIALS:

1. Dull, Charles E., Metcalfe, H. Clark, and Williams, John E., Modern Chemistry, Henry Holt and Company, New York, 1958

2. Ahrens, Maurice, Bush, Norris F., and Easley, Ray, Living Chemistry, Ginn and Company, Chicago, 1957.

3. Dull, Charles E., Metcalfe, Clark, and Williams, John E., Chemistry Workbook, Henry Holt and Company, Inc., New York, 1958.

4. Chemistry Handbook, Chemical Rubber Company

I. Chemistry Affects Our Daily Living -
The purpose of this unit is to help the student orient himself in the realm of chemistry which constantly affects his daily living. The unit also attempts to acquaint the students with some concepts of physical materials, to recognize their simplest forms, to observe how they react, and to learn how to measure and record these observations.

OUTLINE OF CONTENT	RELATED ACTIVITIES
A. Why Study Chemistry?	Discussion and Questions
1. Chemistry and consumer	Explain that a wise consumer learns to observe and evaluate properties of the product he buys. Emphasize the value of experimentation in the study of chemistry. Emphasize the need of thinking scientifically in all of life experiences. Check a laboratory manual for working procedures; discuss and illustrate its importance.
2. Chemistry and vocations	List some vocations dependent upon chemistry Show moving pictures such as: Chemistry in Agriculture, Chemistry in Medicine, Check on McGraw-Hill Chemistry series film strips.
3. Chemistry and industries	Name some products formed as a result of chemical change. Emphasize types of chemical industries: 1. Depending upon raw material. 2. Substituting for natural products. 3. Those changing natural products. Show film, "Safety in the Chemical Laboratory."
4. Chemistry for better living	Discuss the use of chemistry in the production of today's foods, clothing, materials for home, medicine, health and sanitation. Explain how chemistry could aid in our leisure time activities.

5. Chemistry and National Defense.	Explain the term "Chemical Warfare." List some of the modern defense accomplishments based on chemistry.
B. What basic unit of matter forms the basis for our study of chemistry?	
1. Elements	Develop a simple definition of a chemical element. Explain the division of elements into metals and non-metals. List the eight most abundant elements in order of their abundance. Discuss the number of known elements and identify those commonly used. Define an atom. Explain and use of chemical symbols.
2. Compounds	Indicate the procedures by which elements combine to form compounds. Explain the Law of Definite Proportions.
3. Mixtures	Show how mixtures occur. Make a chart of the differences between mixtures and compounds.
C. Why is Chemistry considered a science of matter and energy?	Discuss and explain
1. Nature of matter a. Properties of matter b. Physical change c. Chemical change	Discuss a definition of matter. Compare the density of materials know to the student. Give examples of matter in each of its three states. List types of energy useful in bringing about chemical change. Define molecule.
2. Nature of energy a. Potential b. Kinetic	Review explanation of potential and kinetic energy. Discuss relationship of matter and energy.

3. Relation of matter and energy	Explain laws of conservation of (a) matter, (b) energy, (c) mass energy.
D. How can we measure physical forms of matter and changes in matter?	
1. English System a. Length b. Area c. Volume d. Time e. Temperature	Explain, "Science uses the metric system in its measurements. Show films and summarize, such as: "Precisely So" "Years of Progress."
2. Metric System a. Length b. Area c. Volume d. Time e. Temperature	Determine the number of cubic millimeters in one inch. Demonstrate the use of the cubic centimeter as a measure of volume. Compare: liter - quart kilogram - pounds meter - yard centigrade - Fahrenheit Discuss the metric system as using units of 10. Review decimal arithmetic.

II. Water is a Chemical Compound Essential to Life - Water, one of the most abundant chemical compounds, is composed of two elements. One is the most abundant, the other the lightest. This chemical compound is well known to all of us; thus, it is an excellent form of matter to use in illustrating many of the elementary fundamental principals we consider basic in the teaching of chemistry.

A. What do we know about oxygen, our most abundant element?	Study suggested vocabulary.
1. Preparation a. Mercuric Oxide b. Potassium Chlorate c. Electrolysis d. Liquid air	Prepare and test oxygen in the laboratory. Discuss the storage and shipping of oxygen Explain word equations on preparation of oxygen
2. Physical properties	Review the physical properties of oxygen
3. Chemical properties	Discuss process of oxidation, and formation of oxides. Determine the percentage composition of oxygen in air and in potassium chlorate
4. Compounds a. Oxides of metals	Burn several substances in oxygen and observe the products.

b. Oxides of non-metals	Name some acids containing oxygen.
5. Uses	Dependence of plants and animals on oxygen.
6. Test	Make the glowing splint test to identify oxygen.
B. What do we know about hydrogen, our lightest element?	Discuss four ways to prepare hydrogen.
1. Preparation a. Electrolysis b. Replacement c. Acids	Prepare hydrogen in the laboratory. Explan the preparation and composition of "Water gas."
2. Physical properties	Name the physical properties of hydrogen
3. Chemical properties	Report on reduction and reducing agents.
4. Compounds	Discuss metals which will and will not replace hydrogen from acids.
5. Uses of hydrogen	List uses and evaluate their importance.
6. Test	Explain the test for hydrogen. Assign problems in chemical calculations.
C. Why do we consider water our most valuable compound?	Discuss the abundance and geographic distribution of water.
1. Abundance	
2. Physical properties	Make an oral report on turbidity of water and illustrate method of determination. Demonstrate the distillation of water.
3. Chemical properties	Distinguish between synthesis and analysis of water. Demonstrate propoerties of hard and soft water. Discuss hardness test and demonstrate Demonstrate to determine water of hydration in crystals.
4. Composition	Discuss composition of water by weight and by volume.
5. Uses of water	Explain the uses of water as a standard. Introduce pH concept.
6. Purification of water	Discuss the operation of the filtration plant.
D. Why do solutions usually have water as a solvent?	Distinquish between solvent, solute, solution.
1. Characteristics	Show McGraw-Hill filmstrip:"Laboratory Techniques" "Water Purification." Summarize films.

2. Properties	Show film on "Water Purification." Summarize film.
3. Uses	Discuss and illustrate chlorine residual. Discuss alkalinity

III. Carbon Is a Chemical Element Found in Many Forms - Carbon is an important element found in several forms. It enters into the formation of a large variety of well-known compounds. The study of this element also helps to emphasize: (1) that elements may exist as solids; (2) that existence as allotropic forms changes only the physical appearance of the element; (3) that carbon illustrates a non-metallic element (its oxides form acids); (4) that inorganic, as well as organic compounds, contain the element carbon.

A. What can we learn about carbon?	Study suggested vocabulary.
1. Physical properties a. Allotropic forms.	Experiment to illustrate properties of carbon.
2. Chemical properties a. Formation of compounds.	Explain formation and properties of carbon
3. Use	Explain the preparation or formation of carbon products in the electric furnace.
B. Which oxides and other compounds of carbon are important?	
1. Carbon dioxide a. Preparation	Prepare carbon dioxide in the laboratory. Contrast the various methods of preparation of carbon dioxide.
b. Properties	Demonstrate the lime water test for carbon dioxide Recognize "carbonate hardness of water as temporary hardness" and explain what happens when such water is boiled.
c. Uses	Formulate these uses into chemical equations
2. Carbon monoxide	Discuss preparation of carbon monoxide.
a. Preparation	Discuss the equations
b. Properties	
c. Uses	Write chemical equations to illustrate industrial uses of this compound. Perform experiment to illustrate destructive distillation of wood and coal. Work on type III and type IV of chemical calculation.

C. How do fire extinguishers illustrate the practical applications of some chemicals?

1. Carbon dioxide

2. Carbon tetrachloride. — "Pyrene" extinguisher uses carbon tetrachloride.

3. Foam-type extinguisher — List chemical substances used in the foam-type fire extinguisher.

IV. Sulphur and Halogens Make an Intere ..ng Comparison - Sulphur is considered an old element, one included in Biblical references and one found abundantly in nature.

The halogens are so chemically active that the elements are found only in compounds. We associate chlorine with World War I and fluorine with World War II.

In this unit the properties of these elements are outlined to provide guidance in teaching the importance of these non-metals.

A. Why is sulphur considered one of our most important elements? — Study suggested vocabulary.

1. Occurrence

2. Mining — Describe the Frasch method of mining sulphur

3. Refining

4. Physical properties
   a. Melting point, etc.

5. Allotropic forms — Experiment to prepare various allotropic forms.
   a. Rhombic
   b. Monoclinic
   c. Amorphous

6. Chemical properties — Discuss and explain
   a. Burns
   b. Action with metals and non-metals
   c. Oxides

7. Uses — Explain uses of sulphur in making acids, matches, fireworks, black gun powder, dyes, fungicides.

B. How may sulphur compounds be used to explain principles of chemistry? — Study the instructor's suggested vocabulary.

1. Hydrogen sulfide
   a. Occurrence — Explain the tarnishing of silver.
   b. Preparation — Experiment to prepare hydrogen sulfide.
   c. Physical properties

d. Chemical properties (1) Burns in various quantities of oxygen (2) Acts as oxidizing agent (3) Acts as reducing agent	
e. Test	Experiment to recognize action of hydrogen sulfide on lead acetate paper. Review colors of sulfides
f. Uses	Name and give formula of several sulfides of both metals and non-metals. Outline how hydrogen sulfide could be used in the analysis of a solution.
g. Other sulfides	Experiment to produce sulfides of metals.
2. Oxides of sulphur a. Sulphur dioxide b. Sulphur trioxide	
3. Sulphuric acid a. Preparation b. Physical properties c. Chemical properties d. Uses e. Test	Show filmstrip, "Sulphuric King of the Acids." Discuss the two methods of preparation. Experiment to illustrate the various chemical properties. Experiment to test for the presence of a sulphate by using barium chloride with dilute hydrochloric acid.
C. Why do we classify the elements Chlorine, Bromine, Iodine and Fluorine as the Halogen family?	Study the suggested vocabulary.
1. Chlorine - a greenish yellow gas a. Occurrence b. Preparation c. Physical properties d. Chemical properties e. Uses	
2. Hydrogen chloride - Colorless gas. a. Preparation b. Physical properties c. Chemical properties d. Uses e. Test	Experiment to prepare hydrogen chloride in Lab.

3. Bromide - a reddish brown liquid
   a. Natural source — Discuss the importance of the natural sources of bromine.
   b. Preparation
   c. Physical properties
   d. Chemical properties
   e. Hydrogen bromide
   f. Uses — Give name, formula, and uses of several of the many bromines
   g. Test for bromide — Demonstrate to test for bromine

4. Iodine as blackest solid
   a. Source
   b. Preparation
   c. Properties
   d. Uses
   e. Test — Demonstration to test for presence of iodine

5. Fluorine
   a. Preparation — Describe how fluorine can be prepared by electrolysis.
   b. Properties — Show McGraw-Hill filmstrip "The Fluorine Story."
   c. Uses — Explain the etching of glass
   d. Compounds

V. Chemistry is Scientifically Organized - The structure of matter has interested man since the time of the alchemists. Our present concept that atoms are complex combinations of small particles has been developed in less than one hundred years. The atom does, however, form the basis for chemical change, its structure is associated with electrical phenomena and we sometimes refer to the electrical atom. In this unit the results of our research are organized to illustrate our present-day thinking.

A. What is the modern concept of atomic structure? — Study instructor's suggested vocabulary. Discuss and explain.
   1. Concepts change
   2. Atomic theory
   3. Modern atomic theory — Discuss isotopes
   4. Atomic weights — Distinguish between polar and non-polar molecules.
   5. Atomic structure
   6. Complexity

B. How do elements combine to form molecules? — Study the instructor's suggested vocabulary. Discuss and explain.
   1. Definition
   2. Molecular weights
   3. Ions

C. How does a knowledge of valence help us understand chemical change?

Study the suggested vocabulary.

1. Identification
2. Chemical bonds
3. Types
4. Radicals
5. Variables
6. Uses

Discuss and explain

D. How has our knowledge of chemical elements been broadened in recent years?

Study suggested vocabulary.

Discuss and explain

1. Family groups
2. Early classification
   a. Atomic numbers
   b. Changes in elements
3. Value

Explain the arrangement of elements in the modern periodic table.

E. How do we represent the formula of a compound by combining symbols?

Know the formulas of the commonly used compounds.

1. Significance
2. Formula weight
3. Percentage composition

F. How do we use the chemical equation to tell all that takes place during a chemical change?

Study suggested vocabulary.

1. Chemical equation
   a. Elements - symbols
   b. Molecules - formula
   c. Written equations
   d. Balanced equations
   e. More difficult equations
   f. Equation limitations

Write balanced equations for some oxidation-reduction reactions.

List the types of changes which are not indicated in an equation: heat reactions, conditions of reactants, speed of chemical change, solubilities state of matter, necessary precautionary measures, types of resultant compound.

VI. Chemical Compounds Are Related - Compounds as well as elements may be classified according to their properties. We recognize some compounds as acids, bases, or salts by their physical and chemical properties. These characteristics help us to identify some substances and help predict how they will react. In this unit we expand our thinking concerning acids, bases, and salts, and attempt to learn more about them.

A. How do we evaluate acids when we consider that this group of compounds is one of our most important?

Study suggested vocabulary.

1. Abundant in nature 2. Important acids a. Sulphuric b. Nitric c. Hydrochloric	Experiment on preparation and properties of acids.
3. Definition 4. Properties	Discuss strong and weak acids
5. Names a. Binary b. Ternary	Explain what is meant by "acids anhydride." Tell how acids are named. Discuss the nomenclature of all chemical compounds.
B. What bases are important in everyday life?	
1. Definition 2. Important bases 3. Properties 4. Preparation	Experiment on preparation and properties of bases.
5. Names 6. pH value a. Pharmacy b. Bacteriology c. Medicine d. Soil	Explain the value of the pH factor of solutions.
C. What do we know about compounds formed when an acid interacts with a base?	
1. Definition of salt 2. Properties 3. Preparation 4. Names (suffixes)	
D. Do all liquids and solutions conduct electricity?	
1. Solutions 2. Theory of ionization 3. Electrovalent compounds 4. Difference in ionization 5. Strong and weak electrolytes	Experiment "Conductivity of Solutions" Filmstrip, "Ionization" Associate the charge on an ion with valence. Explain the difference between ionization and dissociation.
E. How do we use standard solutions?	Filmstrip "Solutions of Definite Concentrations."
1. Molal solution 2. Molar solution 3. Normal solution	Assign problems in "Chemical Calculations."

VII. Chemical Mathematics Is a Necessary Part of Chemistry - Chemistry becomes one of the more exact sciences when we add some quantitative work to the descriptive and the qualitative work. Previous to the chemical mathematics, the student must have acquired facility in the use of the metric system and a fundamental knowledge in the use of chemical shorthand with symbols, valence, and formulas.

He must also have received refresher work in mathematics such as fractions, decimals, proportion, addition, subtraction, multiplication, division, cross multiplication, and simplification of fractions. He must beware of taking short cuts until he has masterd the fundamentals.

He must thoroughly understand how to balance equations. He must memorize about forty elements and radicals for valence as well as the diatomic molecules.

Chemical mathematics will give the student practice in trial and error and a chance to show qualities of determination, patience, initiative, and cautions judgment. The student must realize that his mistakes become stepping stones to success if he learns to correct them and if he makes fewer and fewer of them as he gains experience and confidence.

A. How do we calculate chemical formulas?	Study suggested vocabulary.
1. Chemical formulas	Distinguish between coefficient and subscript
2. Molecular weights	
3. Percentage composition in a compound	
4. Simplest formula	Study "Chemical Calculation" type III and VII.
B. How do gas volumes vary with changes in temperature and pressure?	Study suggested vocabulary.
1. Variation of gas volumes	Review "Chemical Calculation" type IV
2. Standard temperature and pressure	
3. Vapor pressure	
4. Boyle's Law	Know these important laws.
5. Charles's Law	
C. What is the Molecular Composition of gases?	Study suggested vocabulary.
1. Gay-Lussac's Law	State Gay-Lussac's Law
2. Avogadro's Law	State Avogadro's Law
3. Gram-molecular weight	
4. Gram-molecular volume	
5. Gas densities	Review type IV "Chemical Calculation"
6. Molecular weight determinations	
7. Correct formula	Distinguish between simplest formula and correct formula

D. How can we solve chemical problems involving equations?	Study suggested vocabulary.
1. Weight - weight problems	Review "Chemical Calculation" type VIII
2. Weight - volume problems	Review "Chemical Calculation" type IX.
3. Volume - volume problems	Review "Chemical Calculation" type X

VIII. Nitrogen Forms Many Compounds - We are especially interested in nitrogen because it is an essential part of every protein molecule, which is part of every plant and animal. Because plants and animals cannot use atmospheric nitrogen, it must be made available in a soluble form. Nitrogen is diatomic, and the bond between these two atoms is very stable. This makes nitrogen rather inactive. However, under special conditions of high temperature, metal catalysts, electric discharges, and enzymes of certain plants, nitrogen forms many active compounds.

One of the milestones of chemistry occurred when chemists found out how to make such useful compounds as ammonia and nitric acid from free "inactive" atmospheric nitrogen. The process of nitrogen "fixation" furnishes raw materials for fertilizers, explosives, dyes, drugs, and textiles.

A. How is nitrogen secured from nature?	Study suggested vocabulary.
1. Preparation of nitrogen	Demonstration to prepare nitrogen
2. Properties a. Physical b. Chemical	Show filmstrip, "Nitrogen fixation"
3. Nitrogen cycle	
4. Dual nature of nitrogen	
B. Why can ammonia be considered the parent of many nitrogen compounds?	
1. Preparation of ammonia	Explain the Haber process Explain "LeChatelier's Principle." Prepare and test ammonia in the laboratory
2. Properties of ammonia	
3. Uses of ammonia	Show and summarize the movie "Principles of Refrigeration"
4. Ammonium compounds	Distinguish between ammonia and ammonium.
C. Why is nitric acid considered such a strong acid?	
1. Preparation of nitric acid	

2. Properties of nitric acid

3. Uses of nitric acid — Make a chart showing the uses of nitric acid. Verify the xanthoproteic test for proteins.

D. Why are nitrogen compounds so important? — Discuss and explain

1. Properties of nitrates

2. Important uses of nitrates

3. Oxides of nitrogen

4. Test for nitrates

IX. Organic Chemicals Affect Our Daily Living - Carbon is considered a wonder element because it occurs in so many different and useful forms. It is in more compounds than all of the other elements put together. It is exceptionally adaptable to synthesis and its synthetic compounds are numbered in the hundred thousands.

Carbon is utilized in its elemental form in oxides, carbonates and carbides, and in natural and synthetic organic compounds. Its variable and versatile uses are illustrated in foods, fuels, medicines, textiles, perfumes, dyes, insecticides, and plastics.

A. What are some common fuels? — Study suggested vocabulary.

1. Solid fuels
2. Coal products
3. Liquids (fuels)
4. Fuel gases

B. How are the hydrocarbons of value?

1. Characteristics of organics compounds

2. Hydrocarbons — Prepare and test methane and acetylene
   a. Homologous series
   b. Saturated and unsaturated compounds
   c. Substitution and addition organic compounds

C. How are petroleum products of value?

D. How do we find hydrocarbon substitution products useful?

E. What are some chemical properties of foods?
   1. Essential food groups - carbohydrates, fats, proteins, minerals, vitamins

X. Chemicals Are Used in Modern Life - There are so many facets of our modern living that have a chemical basis that a whole wonderful lifetime can be spent working with the chemistry of any one division. Whole industries have been built around the chemistry of colloids, textiles, dyes, paper, rubber, plastics, glass, pesticides, fertilizers, and clay products. We are so dependent upon the utilization of these materials that our homes would be quite bare and drab without them.

A. How are colloids important to modern life?	Study suggested vocabulary
1. Properties of colloids	Demonstrate dialysis, Brownian movement, Tyndall effect, Silica garden.
2. Formation of colloids	Prepare ferric hydroxide colloid
3. Precipitation of colloids	
4. Stabilizing colloids	
5. Examples of colloids	Experiment with the emulsifying action of soap
B. How are textiles, dyes, and paper important to modern life?	Study suggested vocabulary
1. Natural textiles 2. Synthetic textiles 3. Bleaching and dyeing 4. Paper	
C. How are rubber and plastics important in modern life?	Study suggested vocabulary
D. How does chemistry aid agriculture?	Study suggested vocabulary
1. Commercial fertilizers 2. Pesticides 3. Plant hormones	
E. What is the importance of glass?	Study suggested vocabulary
F. What is the importance of clay products, refractories, and abrasives?	Study suggested vocabulary

WATER AND SEWERAGE TECHNICAL SCHOOL

EXPERIMENTS

1. Techniques and Safety Sketches
2. Laboratory Procedures
3. Physical and Chemical Changes
4. Preparation and Properties of Oxygen
5. Preparation and Properties of Hydrogen
6. Electrolysis of Water
7. Chemical Properties of Water
8. Replacement of Metals from Their Compounds
9. Weight Relations in a Chemical Reaction
10. Replacement of Hydrogen by a Metal
11. Preparation and Properties of Carbon Dioxide
12. Solution and Crystallization
13. Water of Hydration in Crystals
14. Percentage of Water in a Hydrate
15. Conductivity of Solutions
16. Preparation and Properties of Acids
17. Preparation and Properties of Hydroxides
18. Titration of an Acid and a Hydroxide
19. Percentage of Acetic Acid in Vinegar
20. Flame Tests for Metals
21. Softening Hard Water
22. Preparation and Properties of Chlorine
23. Preparation and Properties of Hydrochloric Acid
24. Preparation and Properties of Hydrogen Sulfide
25. Properties of Sulphuric Acid
26. Preparation and Properties of Nitrogen
27. Preparation and Properties of Ammonia
28. Tests for Ferric and Ferrous Ions
29. Identification of Salts
30. Preparation of Esters

SUPPLEMENTARY OR ALTERNATE
EXPERIMENTS

1. Ionization
2. Methods of Separation
3. The Displacement (Electrochemical) Series
4. Preparation of Salts
5. Deliquescence and Efflorescence
6. Properties of Organic Compounds
7. Organic Acids, Alchols, and Esters
8. Purification of Water, I.
9. Purification of Water, II.
10. Tests for Carbohydrates

COURSE OF STUDY

WATER LABORATORY TECHNIQUE

OBJECTIVE:

To provide the students with an understanding of the procedures for testing, analysis, interpretation, and computation of chemical reactors for practical water works operation, including detection and treatment for hazardous chemical agents.

CONTENTS:

A presentation of more comprehensive chemical problems encountered in water quality, analysis, interpretation and treatment.

REFERENCE MATERIAL:

1. Manual of Instruction for Water Treatment Plant Operators, New York State Department of Health, Albany, N.Y.

2. Standard Methods for the Examination of Water and Wastewater, Prepared and Published Jointly by: American Public Health Association, American Water Works Association, and Water Pollution Control Federation.

3. Riehl, Merrill L., Hoover's Water Supply and Treatment, Ninth Edition, National Lime Association.

4. Cox, Charles R., Laboratory Control of Water Purification, The Reuben H. Donnelley Corporation, New York.

PROCEDURES

I. pH Values, two methods for determining Hydrogen Ion concentration or pH value.

A. Electrometric method

1. Standardize instrument against a buffer solution of known pH value.

2. After standardizing rinse electrodes thoroughly with distilled water.

3. Put appropriate indicator in sample.

4. Place electrodes in the sample and read directly from the instrument. (Note: Other instruments use a sample of distilled water to establish the zero position of the instrument. Important: Follow the instructions of the instrument manufacturer carefully.)

B. Colorimetric - Using color comparator

1. Place a sample of water in both cells to the prescribed level.

2. Place one milliliter of indicator (Phenol-red, Bromthymol Blue) in one cell.

3. Shake to mix.

4. Place in comparator and adjust color standards until colors match.

5. Read results as shown on instrument scale.

II. Total Alkalinity

A. Determine by titration method.

1. Fill the burette with 0.02 normal sulphuric acid.

2. Measure 50 ml. of the sample into an erlenmeyer flask or casserole.

3. Add 3 to 4 drops of Methyl Purple indicator.

4. Add acid to the sample slowly and stir continuously. Add the acid drop-wise as the end point is approached. Read the burette when the color changes.

5. Multiply the number of millileters of .02 N Sulphuric acid by 20 to determine total alkalinity in parts per million.

III. Total Hardness

A. Versenate method

1. Place 50 milliliter of sample in an erlenmeyer flask or casserole.

2. Fill burette with versanate hardness reagent.

3. Add one milliliter of buffer solution (Note: some manufactures have buffer solution in the indicator and thus this step is not necessary.)

4. Add three to four drops of the hardness indicator.

5. Titrate to an endpoint.

6. Multiply the number of milliliters of versenate hardness reagent by 20 to determine total hardness in parts per million.

IV. Residual Chlorine - Colorimetric and Electrometric

A. Colorimetric method

1. Place sample of water in comparator cells to marked levels.

2. Add 0.5 milliliter or 1.0 milliliter of orthotolidine to one cell as directed by instrument manufacturer.

3. Shake to mix

4. Place in comparator and adjust color standards until colors match.

5. Read results as shown on instrument scale.

B. Electrometric

1. Standardize instrument as directed by manufacturer.

2. Refer to Electrometric procedure for pH <u>except</u> use Orthotolidine reagent.

V. Turbidity

A. Using Jackson Turbidimeter

1. Mix sample to be tested.

2. Light candle on instrument

3. Pour small amount of sample into tube and place over candle.

4. <u>Slowly</u> pour sample down side wall of tube until flame image disappears.

5. Remove tube from instrument and read results of turbidity on tube scale in parts per million.

VI. Stability

A. Using Langlier Stability Index

1. Run pH on tap water and record as $pH_{(1)}$

2. Use erlenmeyer flask and almost fill with sample to be tested and place powdered Calcium Carbonate in flask.

3. Shake well to mix.

4. Allow Calcium Carbonate to settle.

5. Filter saturated solution.

6. Run pH on saturated solution and record as $pH_{(2)}$

7. Subtract $pH_{(2)}$ from $pH_{(1)}$ and record as plus or minus (Note: a plus indicates that water will leave a deposit on system - a minus indicates a corrosive water - a zero indicates a stable water.

COURSE OF STUDY

SEWAGE LABORATORY TECHNIQUE

OBJECTIVE:

To teach proper technique, interpret the results and application of tests for sewage purification.

CONTENTS:

Laboratory analysis and interpretation as used in plant operation and control. Practice in techniques and laboratory is presented by authentic problems similar to those to be encountered in normal and emergency operations of a sewage collection system and treatment plant.

VISUAL AIDS:

1. Handling and Use of Glassware, FS-35 mm color-sound 82 frames - 8 minutes, 1952, U.S. Public Health Service.
2. Chemical Lab Safety, MP-16 mm color-sound, 25 minutes, 1961, U.S. Public Health Service.

REFERENCE MATERIAL:

1. Standard Methods for the Examination of Water and Wastewater including Bottom Sediments and Sludges, American Public Health Association, Inc., 1960.

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. Settleable Solids Test	
A. Equipment used	
1. Imhoff Cones	Three cones on stand, 1000 ml or 1 liter capacity, graduated into ml's.
2. Quart Jars or Containers	Three jars are used.
B. Procedure	
1. Take three quart jars or containers and catch a sample in each of the following places a. Where the water or flow first enters the plant (raw sample) b. Just before the flow goes into the secondary treatment (primary) c. In the final tank (final sample)	
2. Pour the contents of each jar into their respective cones.	Ex. - Raw sample into first cone, primary sample into second cone, and final sample into third cone. Fill each cone to the Liter line.
3. Allow the solids to settle for at least thirty minutes	
4. After thirty minutes read and record the volume of solids in the bottom of the cone.	
II. pH Test or Hydrogen Ion Concentration Test	
A. Purpose	
1. The pH test indicates the degree of alkalinity or acidity.	
2. What to look for a. pH of 7.0 is neutral b. below 7.0 is acid c. above 7.0 is alkaline	
B. Equipment Used	
1. Hellige Comparator	Use comparator with precision tubes
C. Chemical Used	

1. Bromthymol blue D Indicator Solution range: 6.0-7.6 — In bottle with 0.5 ml pipette

D. Procedure

1. Collect 3 samples of sewage water
   a. One where the water first enters the plant (raw sample)
   b. One just before water enters the secondary treatment (primary sample)
   c. One from your final tank (final sample)

   Actually you must run a pH test on each of these samples, however, the procedure used in running a pH on the first sample is the same procedure to be used on each of the other two samples.

2. Place 10 ml of the raw sample into each of the precision tubes provided with the comparator.

3. Add 1 ml of Bromthymol Blue - D indicator to one of the tubes and shake it slowly to allow the indicator to mix with solution.

4. Place the tubes in the comparator in such a manner that the color standards are opposite the tube not containing the indicator. The color comparison must be made by looking through the same thickness of liquid having the same color and turbidity of the sample which contains the indicator solution.

5. Compare the colors and select the standard having a color nearest that of the sample containing the indicator solution.

   REMEMBER: Repeat the same method on each of the other two samples.

III. Dissolved Oxygen Test

A. Purpose

1. This test measures the oxygen present as a gas in a solution

2. This information may be used in
   a. Studies of septicity of sewage
   b. Odor control
   c. Operation of pre-aeration units
   d. Operation of secondary treatment facilities
   e. Pollution control

B. Procedure

1. Equipment used
   a. Pipette (one for each of the reagents)
   b. Burette
   c. Erlenmeyer Flask
   d. B.O.D. Bottle (300 ml. capacity)
   e. Graduated Cylinder, or
   f. Volumetric Flask (203 ml capacity)

   See diagram of D.O. Test at the end of this unit

2. Chemical Used
   a. Manganous Sulfate ($MnSO_4H_2O$
   b. Alkaline Iodide-Sodium Azide (NaN_3)
   c. Sulphuric Acid, concentrated (H_2SO_4)
   d. Soluble starch
   e. Sodium Thiosulfate (0.025N)

C. Making the Test

1. Fill completely a 300 ml B.O.D. bottle with the sample to be analyzed. (Avoid trapping air bubbles beneath the stopper.)

2. By holding the tip of the pipette below the surface of the liquid, add
   a. 2 ml of Manganous Sulfate solution
   b. 2 ml of Alkaline Iodide-Sodium Azide Solution

3. Replace the stopper, avoiding the trapping of air bubbles again, and shake well. Allow the floc to settle halfway then shake again.

4. After the floc has settled halfway again remove the stopper and add 2 ml of Sulphuric Acid, holding the tip of the pipette above the surface of the liquid. (Handle carefully to prevent burns.)

5. Replace the stopper, again avoiding the trapping of air bubbles again, and shake well to dissolve the floc. Allow the bottle to set for at least five minutes.

   Now you are ready to begin the process called, titration.

6. Now remove the stopper and pour a small amount of the sample into the volumetric flask, in order to rinse it out with the solution you will be using in it. Then pour the small amount out of the volumetric flask and into the erlenmeyer flask for the same reason.

7. Pour the small amount from the Erlenmeyer flask. Then pour the sample from the B.O.D. bottle into the volumetric flask and fill to the prescribed mark, (203 ml.) Then pour the excess sample out and rinse the bottle and stopper in hot water.

8. Make sure that your burette is filled with Sodium Thiosulfate up to the zero mark.

9. Take the Erlenmeyer flask in your right hand and hold it under the spout of the burette. Then contolling the flow of "thio" through the burette with your left hand, keep shaking the flask slowly to allow the "thio" to mix throughout the solution. Continue to add "thio" to the solution until the sample turns pale yellow or straw color.

10. Then add 2 ml of soluble starch to the solution in the flask. This should cause the solution to turn blue in color.

11. Now continue to add the "thio" to the solution, very slowly, until the solution turns white. Then read and record the reading on the burette. (Always remember to read the "Meniscus" or lowest point of the reading.)

IV. Sodium Thiosulfate Test

A. Chemicals Used

1. Potassium Iodide - KI
2. Sulphuric Acid - H_2SO_4
3. Potassium Dichromate - $K_2Cr_2O_7$
4. Sodium Thiosulfate - $Na_2S_2O_3 \times 5H_2O$

B. Equipment Used

1. Erlenmeyer Flask
2. Graduated Cylinder
3. Pipettes - (10 ml, 20 ml, 2 ml)
4. Burette
5. Gram measure

C. Purpose

1. This test is used to check the strength of the Sodium Thiosulfate used in the dissolved oxygen test as well as the B.O.D. test.

D. Procedure

1. Dissolve about 2 grams of KI (Potassium Iodide) in 100-150 ml distilled water in an Erlenmeyer Flask.

2. Next add 10 ml of diluted H_2SO_4 (1 ml Sulphuric Acid + 9 ml distilled water)

3. Then add exactly 20 ml of $K_2Cr_2O_7$ (Potassium Dichromate)

4. Allow to sit in the dark for 5 minutes

5. Add the total ml used in the solution thus far:

150 ml	-	distilled water
10 ml	-	diluted H_2SO_4
20 ml	-	$K_2Cr_2O_7$
180 ml		

6. Add enough distilled water to the solution to total 400 ml. (220 ml.)

The brown color which is developed is due to the liberation of iodine in solution.

7. Titrate this iodine with the sodium thiosulfate being tested. When the color changes from brown to pale yellow; add 1 or 2 ml of starch solution and continue adding thiosulfate solution until the blue color disappears.

8. Record burette reading.

E. Figuring the Reading

1. If the sodium thiosulfate is exactly the desired 0.025N, then the reading on the burette will be 20 ml. If more than 20.00 ml of thiosulfate is used, it is too weak; if less than 20.00 ml is used, it is too strong.

2. If the sodium thiosulfate is too weak, the following formula may be used to find the correct reading of a dissolved oxygen sample.

(1)

Formula: $\frac{0.025 \times 20}{25} = 0.020$

(ml thiosulfate used)

(2)

$$\begin{array}{r} .80 \\ .025 \overline{).020\ 00} \end{array}$$

(3)

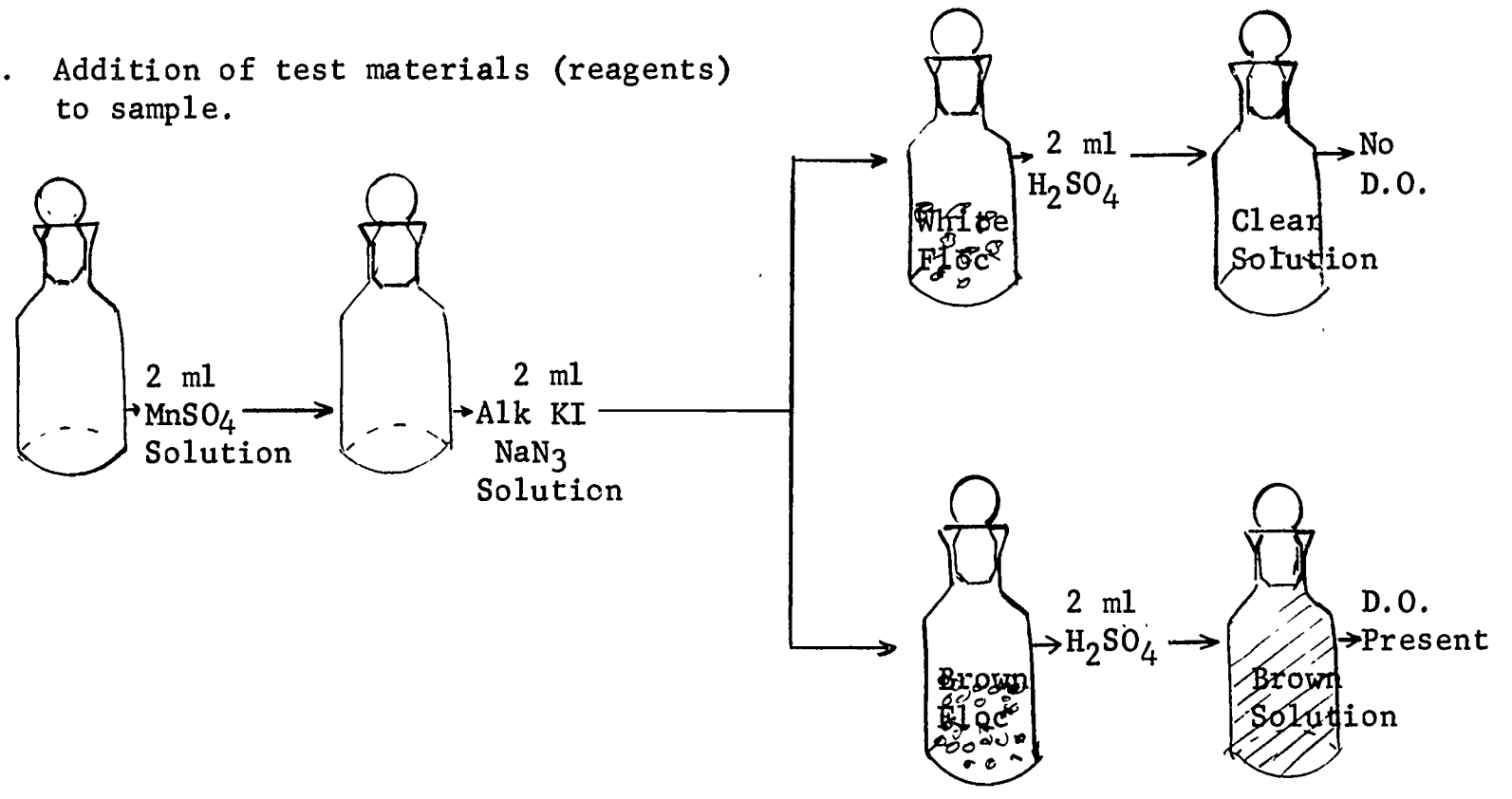
$$\begin{array}{r} .80 \\ \underline{43} \\ 3.440 \end{array}$$

initial reading in dissolved oxygen test

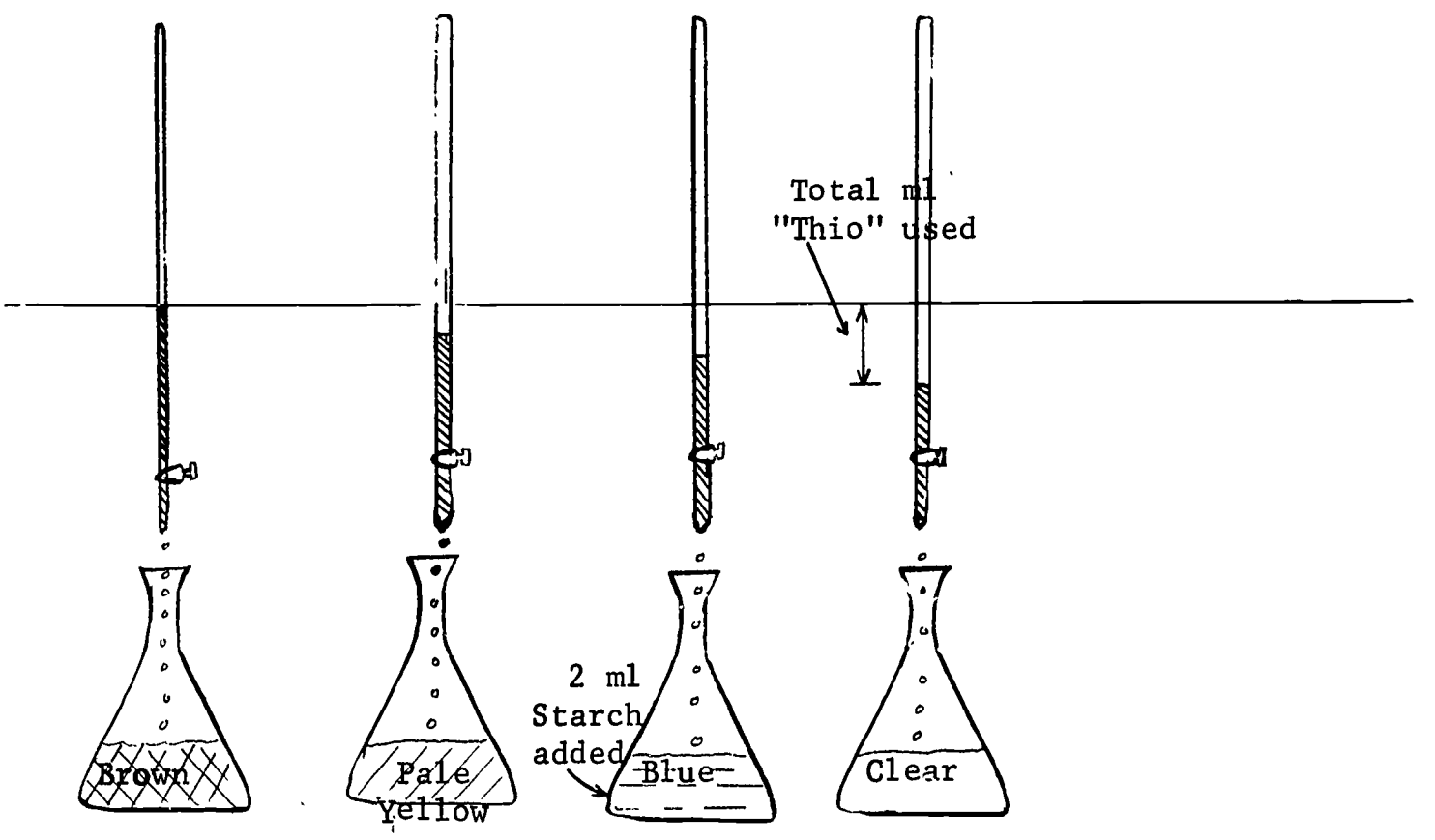
the correct reading in the dissolved oxygen test

DIAGRAM OF D.O. TEST

1. Addition of test materials (reagents) to sample.



2. Titration "Thio" ($Na_2S_2O_3x\ 5H_2O$)



3. Recording of results.
   (1) Record volume of sample titrated
   (2) Record volume of 0.025N Sodium Thiosulfate (thio) used

DILUTION CHART

Percent Dilution	Amount ml to add	Dilution Factor
1%	3 ml	100
2%	6 ml	50
3%	9 ml	33.33
4%	12 ml	25
5%	15 ml	20
6%	18 ml	16.66
8%	24 ml	12.5
10%	30 ml	10
12%	36 ml	8.33
15%	45 ml	6.6

I. Formula:

To find <u>amount ml to add</u>

Percent of Dilution x Total Volume Sample (ml) = Amount of ml to add

Ex: 2% x 300 ml = Amount ml to add
.02 x 300 ml = 6 ml

II. Formula:

To find <u>dilution factor</u>

100% ÷ Percent Dilution = Dilution factor

Ex: 2% dilution $\begin{array}{r} 50. \\ .02\overline{)1.00} \end{array}$

III. Formula:

To find <u>percent sample</u>

ml Dilution added ÷ Total Volume of Sample

Ex: 3 ml ÷ 300 ml = .01 or 1%

IV. Formula:

V. Formula:

COURSE OF STUDY

WATER HYDRAULICS I

OBJECTIVE:

To introduce the basic fundamentals of the hydrostatics and water flow of particular importance to waterworks personnel.

CONTENTS:

To present the theory and working formula of hydraulics, including pressure and heads both static and dynamic, forces, velocities, friction losses, and the application of pipe flow formulas.

REFERENCE MATERIAL:

1. Wolfe, Charles R., Applied Hydraulics for Water and Sewage Plant Operators, Burns and McDonnell Engineering Company

2. Taste and Odor Control Methods, West Virginia Pulp and Paper Company.

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. What is hydraulics?	Discuss and explain
A. Scope	
1. Deals mainly with water	
2. Concerned chiefly with its density.	
B. Density	
1. Varies little with pressure and temperature within ordinary ranges.	
2. Pure water averages about 62.4 lbs. per cubic foot	
3. The effect of pressure on the density of water is almost negligible	
C. Fluid Pressure	
1. Often estimated in terms of the "equivalent height" of some specified liquid.	
2. Mercury is often taken as the standard fluid	
D. Atmospheric Pressure	
1. It is common to reckon pressures as zero	
2. Intensity varies at any locality somewhat with weather conditions or elevation.	
E. Absolute Pressure	Study table showing elevation and its effect on Barometric pressure.
II. What is the relationship of force to pressure?	
A. Force versus pressure	
1. Pressure - the force exerted on a unit area.	
2. Force - the sum of all unit pressures acting over a given area.	

B. Static Head

1. The vertical distance between any selected point in a liquid at rest and the free surface exposed to the atmosphere.

2. Head and pressure intensity can be written as $h = p/w$

C. Floating Bodies

D. Pressure Transmitted By Liquids

1. Liquids have the power of transmitting pressure from one part of the liquid to all other parts.

2. Liquids press against surfaces which are vertical or slanting as well as against those which are horizontal

III. What happens to water when flowing through a pipe?

A. Friction loss

1. A certain amount of energy must be expended to overcome the friction between the water and the surface of the pipe.

Use example given on page 3-1 of reference one

2. Friction loss through a given pipe line varies approximately as the square of the flow through the pipe.

3. Loss of head in a pipeline is independent of the pressure existing in the pipe.

B. Thrusts at pipe bends

The resultant thrust can be expressed as $T=2p \sin \frac{\theta}{2}$

1. In a pipeline having bends, elbow, tees or dead-ends, a force is exerted which tends to open the joints nearest the fitting.

2. It is advisable to use the maximum working pressure anticipated in the pipe plus an allowance for surges or water hammer.

See table for common angles of bend and pipe sizes in reference one.

3. The purpose of the backing block is to spread the thrust over an area sufficiently large to be supported by the earth, and the backfill around the pipe, and to undisturbed earth.

C. Flow measurement

1. General flow is Q = V x A

2. Methods of flow measurement
   a. Weirs
   b. Pressure-Differential Producers
   c. Propeller meters
   d. Magnetic flow meters
   e. Parshall flumes
   f. Open nozzles

Q = rate of flow (gpm)

V = Velocity of water (feet per second)

A = cross-sectional area of the water (square feet)

See tables and graphs in back of reference one

COURSE OF STUDY

WATER HYDRAULICS II

OBJECTIVE:

To give the student practice in using hydraulic principles and techniques for waterworks design operation.

CONTENTS:

Theory and formulation for computing the flow of water in pipes and appurtenances and through filter media are presented in practical terms that enable students to apply these to problems encountered in waterworks operation.

REFERENCE MATERIALS:

1. Wolfe, Charles R., Applied Hydraulics for Water and Sewage Plant Operators, Burns and McDonnell Engineering Co.

2. Taste and Odor Control Methods, West Virginia Pulp and Paper Co.

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. What is elevated water storage?	Discuss and explain
A. Elevated tank storage is generally provided for wnat reasons?	
1. To maintain more uniform pressures on the distribution system under varying conditions of water usage	
2. To provide a reserve storage to insure against uninterrupted service.	Demonstrate using model water sphere and elevated tank
3. To provide economics in first cost and operating cost of pumping equipment.	
4. To equalize the variations in domestic and industrial demand.	
5. To provide a reserve for such emergencies as fire fighting or accidental breakdowns.	
B. How is the size of elevated tanks determined?	
1. The capacity depends on the load characteristics of the system. Some considerations: a. Equalize the pumping rate b. Allow a uniform rate throughout the day. c. Requires storage of 15 to 30 percent of the maximum daily use. d. Increases in demand	
2. Additional storage for fire fighting	
a. The National Board of Fire Underwriters	See Reference 1, page 5-3
b. Allowance must be made for fire demands.	
3. Satisfy the needs during peak hourly demands a. Improve pressure in remote areas of the community b. Permit one-shift or two operation of pumping station. c. Contributes to economy of operation.	

II. How does the pumping station operate?

A. What methods of operation are usually employed?

Draw a typical water distribution system.

1. Water is pumped directly into the system without the use of elevated storage.

2. Water may be pumped into an elevated tank.

3. Water is pumped into the distribution system at a uniform rate approximately equal to the day's average demand, with the excess over consumption going into an elevated tank or standpipe for use during peak periods.

B. Pump efficiency — See reference No. 1

C. Pumping costs — See reference No. 1

D. Centrifugal pumps — See reference No. 1

III. What are some pumping economics to be considered? — See reference No. 1.

A. Assumed cases for consideration

1. Equalizing storage available for 24 hour operation

2. Equalizing storage available for 8 hour operation

3. No elevated storage for 24 hour operation.

B. Annual costs — See reference No 1

1. Estimated cost of 125,000 gal. elevated tank = $31,250.

2. Estimated cost of 500,000 gal. elevated tank - $87,500. Estimated increase in cost of pumping station $30,000.

3. Estimated increase in cost of pumping station and equipment = $20,000.

COURSE OF STUDY

METERS AND METERING DEVICES

OBJECTIVES:

To familiarize the student with instruction in water metering equipment. To develop skill in the selection, installation, and maintenance of water meters.

CONTENTS:

A presentation of the types, uses, maintenance, and testing of meters commonly used in a water system. Actual meters of various manufacturers along with cut-away models should be used. Laboratory sessions include: familiarization with proper setting of meters, testing equipment and methods, practice with tools and equipment, and problems solving concerning the selection and placing of meters for various purposes.

VISUAL AIDS:

"Water Treatment" - color 16 mm, 18 min. Infilco Co.

REFERENCE MATERIAL:

By the Editors, "Trends in Water Consumption," Public Works, August 1961, 92:83-182

Smelser, Dale E., "Water Utility Distribution Loss," Water and Sewage Works, November 1961, 108:439-443

Aldrich, Henry V., "Sizing Water Meters," Southwest Water Works Journal, June 1961, 43:28-36

Mamrelli, Emil S., "Consumer Service Requirements," Journal American Water Works Association, April 1955, 47:398-405

Brennan, J.F., "How Often Should Water Meters by Checked and Rehabilitated?" Water Works Engineering, November 1961, 114:954-955

"Metal Cleaning and Surface Treatment," Oakite Products, Inc. 19 Rector St., New York 6, N.Y., 1961, 3-5

Porter, Fred S. "Long Beach Meter Repair Shop and Testing Facilities," Journal American Water Works Association, February 1955, 47:111-120

Meter Repair and Testing, Neptune Meter Company.

Water Meters, AWWA M6 Meter Manual, "American Water Works Association, Inc."

Horandt, Henry. Water Meter Practice.

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. What types of water meters are most commonly used for household, commercial and industrial service?	Explain and demonstrate each kind using cutaway models.
A. Where is the positive displacement meter used?	Discuss and explain
1. These meters, in 5/8" sizes, with ½" or 3/4" threaded spuds, are commonly used for household services.	
2. Larger sizes up to 6" may be used on commercial services.	
3. Greater use is being made of the 3/4" size for household use because of the increased demand.	
B. Where is the velocity type meter used?	
1. Normally limited to applications where higher and steadier flow rates are normal.	
2. Is considered a mainline meter.	
3. Wide commercial application in metering irrigation systems.	
4. Other specialized applications	
C. Where is the compound meter used?	
1. Used where low flow rates may be encountered.	
2. Wide variations in flow rates	
3. Typical applications are apartment buildings, institutions, office buildings	
D. Where are fire line meters used?	
1. On fire lines	
2. Combined domestic and fire line services.	
3. Master meters on distribution systems.	

II. Why is it so important to properly meter all services?

Show charts showing water usage before and after metering.

A. How is the growth in population affecting this?

1. By concentrating in certain areas
2. Expanding industrial use
3. Increased per capita use

B. How can water conservation be improved?

1. Modern leak-detection methods
2. Metering every use of water
3. Properly maintaining water meters.

III. What are the various ownership and installation practices that are in use?

A. What types of ownership are found in municipalities?

1. Water department purchases and installs all meters free of charge to the customer.
2. Water department purchases and installs but the customer pays a charge.

B. What factors are used in determining the size meter to install for various service categories?

1. Rules-of-thumb or practical experience
   a. Size of meter
   b. Type of meter
2. Based on the use of values or "fixture units." — Figures set up by the National Bureau of Standards.
3. Recording instruments fitted to a meter in place of the register. — Have students make some actual determinations.
4. Section of the country involved
   a. Northern area
   b. Southern climates

IV. How and when are meters tested and repaired?

A. How are meters tested?

1. In place testing on large meters
2. Smaller meters are removed and taken to the shop.

Describe how each of these tests are made.

B. When should meters be tested?

Have students make actual tests on meters.

1. Customer complaints
2. Optimum periods based on mathematical analysis for different types of meters.

C. How are repair operations conducted?

1. In small shop, complete repairs are made on each meter in turn
2. In large departments, a production line is set up

D. What are the steps in repairing a meter?

Have student go through steps of repairing in the laboratory using meters.

1. Properly identify with a tag
2. Give meter an incoming test
3. Disassembly and cleaning of meter parts.

E. What kinds of cleaning materials are available?

Discuss and demonstrate the various conditions which require different materials to remove.

1. Plain water
2. Ordinary household detergents
3. Alkaline and acid cleaners
4. Sand blasting
5. Fine glass beads
   a. Dry form
   b. Water based
6. Ultrasonic cleaners

F. What determines the specific repairs to be made on a meter?

Have students inspect and determine repairs needed on various meters and make out tags.

1. Length of service
2. The make of the meter
3. Inspection of the interior or chamber
4. Worn or corroded parts

V. How are meter records used and what information do they contain?

A. How are records used?

1. For repairs
2. Test records
3. Material used
4. Cost of repairs
5. Work orders
6. Identifying tags for repairs

B. What information is placed on master file?

Have student fill out a record on a meter for master file.

1. Its make
2. Size
3. Serial number
4. Cost and date of purchase
5. Reading
6. Addresses where installed
7. Repairs required and any other pertinent information.

COURSE OF STUDY

FILTERS AND FILTER OPERATION

OBJECTIVES:

To develop a knowledge of filter types, care and use of filtering equipment.

CONTENTS:

A presentation of the types of filters used, rate of filteration, loss of head, filter washing, care of filter beds and filter sand.

VISUAL AIDS:

1. "Trickling Filter Plants," film strip, 35 mm-black and white sound, 94 frames, 9 minutes, 1950.

REFERENCE MATERIAL:

1. Cox, Charles R., Laboratory Control of Water Purification, The Reuben H. Donnelley Corporation, New York 1959.

OUTLINE OF CONTENT	PROCEDURE AN · ·IED ACTIVITY
I. Types of filters	Discuss and explain
A. Slow sand filters	
1. Removed very fine particles	
2. Slow rate of filtration	
3. Rarely used now - requires too much area	
B. Rapid sand filters	
1. Under normal conditions filters 125 million gallons per acre daily	
a. 2 gallons per sq. ft. per min.	Show students samples of filter sand
b. Vertical drop in water level of 6" in 1 min. and 52 sec.	
2. Sand weighs 100 lbs. per cu. foot	
C. Anthracite coal - "Anthrafilt" filters	
1. Made from crushed coal	Show sample of coal filter media
2. Weighs 47 lbs. per cubic foot	
3. Less wash water necessary to clean	
D. Diatomaceous earth filters	
1. Pressure type filter	
2. Inner cone or plates are perforated or wire covered	Use filter disks from diatomaceous earth filter
3. A "pre-coat" of diatomaceous is applied before filtering	
4. Diatomaceous earth mat becomes filter medium.	
II. Rate of filtration	
A. Provide effective pre-treatments	
B. Conventional rate per acre of 125 m.g.d.	
C. Rate controllers & indicators	
1. Observing the rate of lowering of the surface of the water on a bed. Should be restricted to a distance of six inches below the normal level.	
2. Use a stop-watch	
3. Rod with two "hook gauges" attached with points exactly six inches apart.	Demonstrate a "hook gauge"
4. Normal filter rate of 2 gallons per minute per square foot will give a vertical drop in water level of 6" in 1 minute and 52 seconds.	

III. Loss of Head

A. Maximum loss of head

1. Depends upon the "freeboard" or depth of water over the sand
2. Size and condition of the sand
3. Effectiveness of pretreatment

Present Sanitation Graphic slides to illustrate filter operation

B. Air-binding

1. Minimized by keeping "freeboard" high as possible
2. Reduce the "negative head"
3. Low temperature increases the solubility of air in water

IV. Filter washing

A. Maintenance of filter beds. Sand grains freed from silt and deposited material

B. Wash Water Rate

1. 15 gallons per sq. foot per minute
2. 24 inches vertical rise per minute
3. Conventional rate not sufficient when water is warm and less viscous. 25 to 30 gallons per minute per square foot when temperature is about 70° F.

Demonstrate a model filter - showing filtering and backwashing

C. Washing facilities

1. Surface washing
   a. Horizontal header pipes suspended on wash water troughs
   b. Secondary pipes extend vertically downward
2. High pressure hose
   a. Breaks up surface
   b. Cut sand both directions
3. Hand rake
   a. Where high pressure hose unavailable
   b. Rake sand both directions
4. Filter bed agitators
   a. Revolving pipe located in filter bed about 1 inch above normal sand
   b. Water under pressure of 40 pounds forced through nozzles.

Take field trip to filtration plant to observe backwashing process

5. Air wash system
   a. Air forced through underdrains before the wash water
   b. Air through separate piping system placed between gravel and sand at same time water is forced through underdrains
   c. Three to five cubic feet of air per minute per sq. ft.

6. Mechanical Rakes
   a. Circular filters can be equipped with mechanical revolving rakes
      (1) Used at same time of wash water
   b. Normal rate of ten to twelve revolutions per minute.

V. Care of filter beds

A. Carefully inspected to determine

1. Craters or depressions
2. Shrinking
3. Cracking

B. Mud Balls

1. Filter not thoroughly and effectively washed
2. Minute balls will join together to form larger balls
   a. Sufficiently large and heavy to sink through the agitated sand

C. Sand Jet

1. Cleans sand effectively
2. Sand not removed from filter
3. Resizes sand
4. Economical to build

Show sand jet - pass out blueprints of sand jet

VI. Filter sand

A. A uniformity coefficeint of 1.5 to 1.6

B. Effective size of 0.50 to 0.60 mm

C. Bed of 30 inches depth

COURSE OF STUDY

PUMPS: INSTALLATION, MAINTENANCE AND OPERATION

OBJECTIVES:

To possess knowledge of the principles of operation, uses and applications of pumps commonly used in waterworks.
To develop skill in operation and maintenance of water pumps.

CONTENTS:

A presentation of types of pumps, selection, installation, operation, proper maintenance procedures, and emergency use and repair of pumps in waterworks systems.

VISUAL AIDS:

1. Technical Manuals
2. Cutaway Models

REFERENCE MATERIALS:

1. Pump Fundamentals, Goulds Pumps, Inc.
2. Handbook for Care of Centrifugal Pumps, Yeomans Brothers Company.
3. Sorrels, Joseph H., Manual For Waterworks Operators, The Texas Water and Sewage Works Association, Lancaster Press, Inc., Lancaster Pennsylvania, 1959.

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. Pump Classification	
A. General Classes	Explain each type of pump and its various characteristics.
1. Displacement a. Piston or plunger (1) Direct-acting steam (2) Crank-and-fly wheel (3) Power (a) Single (b) Duplex (c) Triplex b. Rotary (1) Cam (2) Screw (3) Gear (4) Vane	
2. Centrifugal or screw a. Single stage b. Multistage	Demonstrate models and cut-aways to show types of pumps
B. Fundamental terms	
1. Pump capacity a. Expressed in terms of gallons per minute b. Total head pumped against	
2. Total dynamic heads a. Discharge head b. Suction head (pressure) c. Suction lift (vacuum)	Demonstrate guages.
3. Definitions a. Discharge head (1) The total dynamic head divided by 2.307 equals the pressure in pounds per sq. inch. b. Suction head (1) Occurs where there is a pressure existing within the suction side of the pump. (2) Pressure in pounds per square inch, multiplied by 2.307 = feet head c. Suction lift (1) Occurs where a partial vacuum exists within the suction side of the pump d. Total dynamic head (TDH): The difference in elevation between the water level of the suction	

line and the level of the water in the discharge end plus the friction loss

e. Velocity
   (1) Applied to the rate of flow of water expressed in feet per second
   (2) Energy can be expressed in terms of water head in feet.

Work examples on board and let students practice on sample problems.

C. Power and Efficiency

1. Definitions

a. Power - the time rate of doing work
b. Horsepower - common unit for measuring power
c. Electric power - expressed in watts and kilowatts.
d. Water horsepower - a measure of the rate at which energy is required to be supplied to the water by the pumps.
e. Mechanical efficiency - the ratio or proportion of the water horsepower to the horsepower required to drive or operate the pump
f. Brake Horsepower - actual horsepower required to be applied to the pump shaft to drive the pump
g. Over-all efficiency - the water horsepower divided by the horsepower applied to the motor or the prime mover which drives the pump

II. Centrifugal pumps

A. Laws

1. The volume (GPM) will vary as the speed changes

2. The head (in feet or p.s.i.) will vary as the square of the speed change

3. The power (BHP) will vary as the cube of the speed change

B. Types

1. Stage type - has one impeller

Exhibit single and multi-stage pump cut-aways

2. Multistage type - has two or more impellers

3. Volute type - has the casing arranged to increase in cross section to the discharge pipe.

4. Turbine type - the casing does not increase in size, but the water moves from the impeller to the casing between fixed vanes.

Demonstrate turbine pump unit

C. Characteristics

1. Pump curves
   a. Head capacity
   b. Brake horsepower
   c. Efficiency

2. Reading pump curves: Determine by projecting lines vertically through the head-capacity condition to the respective points on the efficiency and BHP curves.

Have students draw pump curves

D. Suction piping

1. The greater the temperature, the greater the vapor pressure and the lower the allowable lift.

2. Should be as short as possible.

3. Should never be level, should slope upward toward the pump.

E. Pump discharge piping

1. Installation
   a. Such diameter that the water will not be required to exceed a velocity 5 to 7 feet per sec.
   b. As few bends as possible
   c. Equipped with a gate valve near the pump.
   d. Check valve between the gate valve and the pump

Show transparencies to illustrate proper pump piping

2. Alignment
   a. Each connection supported independently of pump
   b. Check pump alignment after installation

III. Pump maintenance

A. Planned maintenance and why

Use references 1 and 2.

B. Pump care

1. Check screen on suction pipe intake

2. Lubricate bearings according to manufacturers specifications

3. Never run pump dry

4. Examine wearing rings regularly

5. Replace packing per manufacturer's recommendations

6. Operate the pump near its rated head

7. Keep motor drive in good condition

8. Clean water passage when pump casing is open

9. Idle pumps should run under power weekly.

C. Setting up a maintenance program

1. Every month
   a. Check bearing temperature with thermometer
   b. Check lubrication procedure and alignment if running hot

2. Every three months — Demonstrate on pump model
   a. Drain lubricant and clean oil wells and bearings
   b. Replace bearings if defective
   c. Refill with lubricant
   d. Measure bearings for wear

3. Every six months
   a. Replace packing
   b. Be sure seal cages are centered in stuffing boxes at the entrance of water seal piping
   c. Check shaft sleeves for scoring
   d. Check alignment of pump and motor
   e. Check all piping supports

4. Every year
   a. Inspect rotating element for wear
   b. Check wearing ring cleaners — Assign students the preparation of a maintenance outline
   c. Remove any deposit or scaling
   d. Clean out water seal piping
   e. Measure total suction and discharge lifts as test of pipe conditions
   f. Inspect foot valves and check valves

IV. Pump cavitation and pump failures

A. Cavitation

1. Cause
   a. Air released at the impeller
   b. Increased wear of impeller blade at higher speeds

2. Correcting
   a. Check pump capacity
   b. Check pump speed
   c. Check pump head
   d. Check pump suction lift

Show Fairbanks-Morse Co. film on pumps

B. Pump failures

1. Causes
   a. Lack of prime
   b. Speed too slow
   c. Discharge head too high
   d. Suction lift too high
   e. Air leaks in suction piping and stuffing box
   f. Impeller plugged
      (1) Completely
      (2) Partially
   g. Defective wearing rings
   h. Defective impeller
   i. Defective packing
   j. Air or gas in liquid
   k. Mechanical defects
   l. Imcomplete priming
   m. Head lower than rating, pumps too much water
   n. Wrong direction of rotation
   o. Stuffing boxes too tight
   p. Liquid heavier than allowed for
   q. Casing distorted by excessive strains from suction or discharge piping
   r. Misalignment

Demonstrate with small centrifugal pump and tank

2. Locating causes
   a. No water delivered
   b. Not enough water delivered
   c. Not enough pressure
   d. Pump works for a while and quits
   e. Pump takes too much power

COURSE OF STUDY

ELECTRICITY

OBJECTIVES:

To gain a general knowledge of electricity.
To know and understand electrical terms.
To develop an understanding of electrical motors, transformers, and other equipment.

CONTENTS:

A presentation of general electricity, its functions and characteristics. Various types of electrical equipment for power, transmission, storage and control are studied by the student.

REFERENCE MATERIAL:

1. Rutledge, Simplified Electricity for Public Utility Works, Delmar Publishers, Albany 5, New York, 1962.

2. Graham, Kennard, Fundamentals of Electricity, American Technical Society, Chicago, Illinois, 4th Edition.

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. General Introduction to Electricity.	
II. Analogies of Electricity	
A. Liquid quantities versus electrical quantities	
B. Liquid flow versus electrical flow quantities	
C. Liquid pressure versus electrical potential	
D. Pressure drop versus voltage drop	
E. Pumping versus transformation	
F. Liquid storage versus storage of electricity	
G. Flooding versus short-circuits	
III. Conductors and Insulators	
A. Conductors	
B. Insulators	
IV. Kinds of Electricity	
A. Static electricity	
B. Radio waves	
C. Dynamic Electricity 1. Direct current 2. Alternating current 3. Induced current	
V. Electrical Quantities	
A. Volt	
B. Ampere	Display ohmeter and ammeter
C. Ohm	
D. Watt	
E. Kilowatt	
F. Watt-hour	Discuss the meaning of each term and how it can be applied
G. Kilowatt-hour	

H. Cycle

I. Frequency

J. Phase

K. Power (Direct Current)

L. Power (Alternating Current)

M. Power factor

N. Apparent Power

O. Real Power

P. Demand

Q. Maximum demand

R. Energy

S. KVA

T. KVAR

U. KV

V. Impedance

W. Resistance

X. Inductance

Y. Capacitance

Z. Reactance

AA. Megohms

BB. Ground

VI. Function of Electrical Equipment

A. Equipment to generate electricity
   1. Hydro-generator
   2. Steam-generator
   3. Diesel-generator
   4. Gasoline motor generator sets

B. Equipment to Store Electricity
   1. Battery
      a. Primary battery
      b. Storage battery
   2. Capacitor

C. Equipment to transport electricity
   1. Transmission lines
   2. Distribution systems
   3. Power cables
   4. Bus bars
   5. Bare wire

D. Equipment for conversion form one type of electricity to another
   1. Transformers
   2. Substations
   3. Regulators
   4. Converters
   5. Rectifiers

Exhibit transparencies showing various kinds of equipment

E. Equipment to protect other electrical facilities
   1. Lightning arresters
   2. Circuit breakers
   3. Fuses
   4. Relays

F. Equipment to change electric energy into some useful service
   1. Equipment to perform work
      a. Motors
      b. Thrusters
      c. Solenoids
   2. Equipment to furnish heat
   3. Equipment to furnish light
   4. Equipment for communications

G. Equipment to switch and distribute electrical energy
   1. Power circuit breaker
   2. Switchboard
   3. Distribution panel
   4. Lighting panel
   5. Fuse box

H. Equipment to control and operate other electrical equipment
   1. Circuit breakers
   2. Contactors
   3. Motor starters
   4. Relays
   5. Control switches
   6. Pushbutton stations
   7. Switches

I. Equipment to measure electric circuit parameters
   1. Voltmeter
   2. Ammeter
   3. Watt meter
   4. Varmeter
   5. Power factor meter
   6. Frequency meter

Demonstrate procedure involved in setting up and reading meters

7. Ohmmeter
8. Demand meter
9. Watt-hour meter

VII. Voltage Classifications of Electrical Equipment

A. High voltage

B. Medium voltage

C. Low Voltage

VIII. Common expressions using the term "Current"

A. Full load

B. Locked rotor

C. Starting

D. Inrush

E. Magnetizing

F. Short circuit

G. Fault current

H. Overload

I. Ground

IX. Electrical Equipment Enclosures

A. Indoor

B. Outdoor

C. NEMA classifications
1. General purpose
2. Special purpose
3. Explosion proof
4. Dust tight
5. Weatherproof

X. Fuse Panels

A. Purpose

B. Description

XI. Circuit Breaker

A. High voltage

B. Low voltage

XII. Lighting Panels

A. Purpose

B. Fuse type

C. Circuit breaker type

XIII. Lighting Transformers

A. Purpose

B. Description

XIV. Listribution Panelboards

A. Purpose

B. Description

XV. Switchboards

A. Purpose

B. Description

Exhibit switchboard showing components and method of operation

XVI. Low Voltage Switchgear

A. Purpose

B. Description
1. Manual operated
2. Electric operated

XVII. Medium Voltage Switchgear

A. Purpose

B. Description

C. Feeder breakers

D. Motor starters

XVIII. Power Transformers

Show transparencies to illustrate various systems

A. Single phase
1. Two wire systems
2. Three wire systems

B. Three phase
1. Delta-Delta, 3 wire
2. Wye-Wye, 4 wire
3. Delta-wye, 4 wire
4. Wye-delta, 3 wire

C. Transformer accessories
   1. Oil level gauges
   2. Oil temperature auges
   3. Taps
   4. Nameplates
   5. Ground lugs
   6. Filter press connections
   7. Overload alarm lights
   8. Protective devices

VIX. High Voltage Switchgear

A. Purpose

B. Description

XX. Motors

A. Single phase motors

B. Three phase motors
   1. Squirrel cage
   2. Wound rotor
   3. Synchronous

Demonstrate electric motors and parts with cut-away motors

C. Vertical

D. Horizontal

E. Motor enclosures
   1. Open
   2. Dripproof
   3. Splashproof
   4. Enclosed
   5. Totally enclosed
   6. Weather protected

F. Operating conditions
   1. Dripping and splashing liquids
   2. Excessive moisture
   3. Dust and gases
   4. Temperature limitations
   5. Noise level
   6. Wind driven particles, rain, snow, sleet, foreign particles

G. Special accessories
   1. Base extensions
   2. Pressed half couplings
   3. Special insulations
   4. Space heaters
   5. Special terminal boxes
   6. Bearing temperature relays
   7. Temperature indicators
   8. Special lubrication

H. Care and maintenance

I. Bearings

XXI. Motor Starters

A. Effect of motor starting on power systems
   1. Frequency of starting
   2. Border line of irritation

B. Effect of frequent starting on Motor

C. Description of a Motor starter
   1. Manual
   2. Magnetic

D. Types of Motor Starters
   1. Full voltage (across-the-line)
   2. Reduced voltage starters
      a. Auto-transformer type
      b. Reactor type
      c. Resistor type
   3. Part winding starters
   4. Reversing motor starters

Exhibit starters and explain the components

XXII. Control Equipment

A. Control Switches

B. Pushbutton stations

C. Indicating lights

D. Relays
   1. Overload
   2. Auxiliary
   3. Protective

E. Timers
   1. Manual time switch
   2. Repeat cycle timer
      a. Percentage timer
      b. Program timer
   3. Interval timer
   4. Multicircuit timers

F. Pressure switches

G. Differential pressure switches

H. Float switches

I. Thermostats

J. Alternators

XXIII.	Equipment Grounding	
XXIV.	One line diagrams	Show examples of one line diagrams
XXV.	Schematics	
XXVI.	Maintenance Hints	

COURSE OF STUDY

WATER AND SEWAGE PLANT ELECTRICAL SYSTEM

OBJECTIVES:

To present the various types of systems and equipment used in water and sewage plant electrical systems.

CONTENTS:

A presentation of plant electrical systems and power distribution, which includes types of equipment, proper use and maintenance, voltage systems, and grounding.

REFERENCE MATERIALS:

1. Nushaun, Bill, Water and Sewage Electrical System, Black and Veatch Engineering Company.

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. What is meant by the two district parts in a sewage plant electrical system?	Discuss and explain with blackboard diagrams.
A. Power distribution system	
1. To distribute and control the electric power	
2. Amount required by plant equipment	
B. Grounding system	
1. Strictly a matter of safety	
2. A network of conductors which should be connected to all frames and enclosures of electrical apparatus as well as piping and structural steel and ground to reduce shock hazard to personnel and damage to equipment due to short circuits, lightning, and insulation failures.	
II. Explain the power distribution system.	Show transparencies to illustrate diagrams
A. One-line diagram - describes your plant	
B. What other information is shown on a one-line diagram?	
1. Equipment used	
a. Power Source	
(1) Utility - know your local representative	
(2) Characteristics	
(a) Voltage	
(b) Phase	
(c) Frequency	
(d) Short circuit capability in amperes or kva.	
b. Power Supply Switching Arrangement	
(1) Power company responsibility	
(2) Your responsibility	
(3) Are switches rated for load or no load service?	
(4) Are proper safety features provided for switch operator?	
c. Fuses	
(1) Ownership	
(2) Size	
d. Power Transformers	Describe and illustrate each type of connection
(1) How many?	
(2) 1¢ or 3¢	
(3) Wye-Delta Connection	
(4) Wye-Wye Connection	
(5) Delta-Wye Connection	

(6) Delta-Delta Connection
(7) Open-delta Connection
(8) Primary voltage rating
(9) Secondary voltage rating
(10) Transformer taps - to adjust voltage
(11) KVA rating of each transformer
(12) Ownership
(13) Has oil ever been changed?

e. Lighting Arrestors

f. Service Entrance
(1) Overhead
(2) Underground
(3) Cable size and type
(4) Conduit size and type

g. Power Metering
(1) Demand (kilowatt) meter
(2) Demand interval (minutes)
(3) Energy (kilowatthour) meter
(4) Metering transformers
(a) Current transformer ratio
(b) Potential transformers ratio
(5) Become acquainted with your electric power rate structure
How do you buy power?

Illustrate with overhead projector different rate structures

h. Power disconnect device inside building
(1) Combination switch and fuse
(a) Switch rating (amperes)
(b) Fuse rating (amperes)
(c) Fuse interruption capacity (amperes)
(d) Are spare fuses on hand
(2) Circuit breaker
(a) Manufacture and style
(b) Trip setting (amperes)
(c) Interrupting capacity (amperes)
(3) Switchgear
(a) Manufacture and style
(b) Trip setting (amperes)
(c) Interrupting capacity (amperes)

2. Facilities available
a. Power Distribution Equipment Within Plant
(1) Switch and fuse panelboard
(2) Circuit breaker type panelboard
(3) Switchgear
(4) Motor control center (combination of motor starters and circuit breakers of switches and fuses).
(5) Bus duct with fuses or circuit breakers
(a) Number of circuits from this distribution equipment and the identification of each circuit
(b) Equipment served from each circuit
(c) Ampere rating of each fuse or circuit breaker
(d) Connected load on each circuit
(e) Knowledge of any spares

b. Power and Control Cable
   (1) Rubber insulation with neoprene jacket
   (2) Rubber insulation with braided jacket
   (3) Varnish combric with braided jacket
   (4) Varnish combric with lead jacket
   (5) Paper with lead jacket
   (6) Etc. regarding construction
   (7) Is cable routed in wet or damp locations
   (8) Underground direct buried
   (9) Cable sizes on each circuit
   (10) Condition of existing cables
c. Conduit
   (1) Rigid galvanized steel
   (2) Aluminum
   (3) Plastic
   (4) Corrosion of conduit
   (5) Tightness of conduit
   (6) Is conduit well grounded

III. What types of electrical equipment are found in Sewage plants?

Demonstrate starters with different fuse and switch boxes. Discuss the practical application of each

A. Motor Control Equipment

1. List motor starter for each item of electric operated equipment
2. Type of starter
   a. Full voltage
   b. Reduced
   c. Starter alone
   d. Combination starter (with switch and fuse, or with circuit breaker)
   e. Manual
   f. Magnetic
   g. Control voltage
   h. Pushbuttons
3. Type of Enclosures
   a. Indoor
   b. Outdoor
   c. Explosion proof
   d. Condition of starter
      (1) Is it clean
      (2) Is it dry
   e. Motor overload heaters
      (1) Two or three
      (2) Heater size (are they sized to protect the motors).
   f. Schematics of control circuit

B. Lighting Equipment

1. Lighting transformers
   a. Size (kva)
   b. Voltage
   c. Actual load

2. Lighting Panel
   a. Manufacturer
   b. Type
   c. Number of circuits
   d. Lighting voltage (actual)
   e. Lamp life
   f. Fixture cleaning and maintenance.

C. Motors

1. Nameplate ratings — Demonstrate with cut-away motor.
   a. Horsepower
   b. Voltage
   c. Full load current
   d. Full load speed
   e. Service factor
   f. Temperature rise

2. Actual operating conditions
   a. Voltage
   b. Full load current
   c. Full load speed
   d. Operating temperature
   e. Proper alignment

3. Physical Condition
   a. Adequacy of ventilation
   b. Cleanliness of air passages
   c. Cleanliness of motor frame
   d. Tightness of rotating parts
   e. Is motor frame grounded
   f. Is conduit connection tight
   g. Is insulation dry
   h. Is insulation cracked and brittle

4. Bearings
   a. Antifriction bearings — Show types of bearings
      (1) ball
      (2) roller
      (3) thrust
   b. Sleeve bearings
   c. Manufacturers recommended lubricant
   d. Procedure for relubrication

IV. How does the voltage system affect plant equipment operation?

A. The voltage on your system may be too high or too low.

1. Your local power company can generally correct this

2. What are some difficulties of abnormal voltage?

B. Generally, transformers are provided with taps on the high voltage windings which permit adjustment of the secondary voltage.

V. What is the importance of grounding?

A. Each piece of electrical equipment should be grounded.

B. Know where your plant electrical system is grounded.
   a. Ground rods (Where and how many)
   b. Buried copper cable
   c. Connection of copper cable to pipe-if so, can an isolation of this pipe destroy your connection to ground-it shouldn't
   d. Are the ground cable connections tight?

C. Proper grounding in accordance with the National Electric Code can make the difference between life and death.

D. The conduit system should be well grounded

E. If you are not sure, an electrical contractor should be employed to check out your grounding system as you would employ someone to periodically check over any other system such as heating or air conditioning. Grounding facilities are perhaps the most neglected of any systems ever installed. Don't neglect yours.

COURSE OF STUDY

BACTERIOLOGY I

OBJECTIVES:

To provide the student with theory in the characteristics associated with water and familiarize him with the techniques of water bacteriology.

CONTENTS:

A presentation of bacteriology, diseases caused by the presence of bacteria, where it is found, how it is measured, how it can be removed, and standards for drinking water.

VISUAL AIDS:

1. Sampling and Testing Drinking Water, film-strip 35 mm color-sound, 74 frames 8 minutes, U.S. Public Health Service, 1950

REFERENCE MATERIALS

1. Burchard, Jeanette, Bacteriological Examination of Water and Sewage, Missouri State Division of Health Laboratories

2. Standard Methods for Examination of Water and Wastewater, American Public Health Association, 11th Edition, 1960

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. What is Bacteriology?	
A. Are bacteria in reality plants?	
1. They must assimilate from their environment soluble food material	
2. Cannot digest complex organic matter as food, as in the case of animals.	
3. The organisms assimilate food like the related higher plants know as fungi	
B. Can bacteria be harmful?	
1. The great majority is harmless	
2. Those organisms which cannot live in nature except intimately associated with some higher organisms are called parasites.	
C. Are parasites harmful?	
1. Some are not, such as those which belong to the coliform group	
2. Others produce pathological conditions in their host which are responsible for pathological diseases.	
II. What diseases are included in the waterborne group?	Discuss how these diseases pollute the water supply and what treatment or protection is necessary
A. Typhoid	
B. Bacillary dysentery	
C. Amoebic dysentery	
D. Gastroenteritis	
E. Cholera	
III. Where is most normal water bacterial found?	Discuss pollution of flowing streams and larger lakes
A. What does water bacteriology include?	
1. Determination of the number of bacteria present in a sample of water which will develop at the blood temperature of 37° C.	
a. Dysentery	
b. Typhoid fever	

2. Determination of the number of miscellaneous intestinal bacteria present in water, because their presence indicates
   a. Pollution from intestinal wastes of human or animal origin
   b. Possibility of pathogenic intestinal bacteria present in water

B. How can the bacterical quality of water be measured?

1. By using coliform organisms as the indicator.

2. The use of this group requires administrative judgement and evaluation of bacteriological data in light of all factors surrounding the supply.

3. Possible sources of coliform organism to keep in mind when making the examination.
   a. Human feces and domestic sewage
   b. Seepage from cesspools, privies, etc. receiving human feces or sewage
   c. Surface drainage from occupied watersheds
   d. Pollution by fish, frogs, snakes and salamanders which may gain access to spring basins or reservoirs of water supply systems.
   e. Surface drainage from top soil
   f. Dust which may be blown into open reservoirs, etc.
   g. Certain bacteria of the coliform group which are know to develop upon washers of water faucets, packing of pumps, jute used in making pipe joints, etc.

IV. How is water purified by the removal of bacteria?

A. Large storage reservoirs

Show film "Sampling and Testing Drinking Water"

1. Exposure of bacteria to sunlight
2. Consumption of bacteria as food by higher forms of microscopic life
3. Unfavorable temperatures
4. Lack of suitable food

B. Sedimentation - equivalent to filtration

C. Coagulation followed by sedimentation

D. Chlorine treatment

1. Prechlorination-before filtration Discuss studies by the U.S. Public Health Service

2. Post-chlorination-after water has been filtered

V. What are bacterial standards of potability?

A. Statistical guide set up by the U.S. Public Health Service on Drinking Water Standards

1. A group of 20 samples must be taken for bacteriological examination.

2. It is optional whether five 10 ml. portions or five 100 ml. portions of each sample are examined.

3. The whole series of either 10 ml portions or 100 ml portions are considered as a statistical unit

4. Occasionally, single samples in a series will contain more coliform organisms than the average for the series without this being due to an actual increase in the degree of pollution of the supply as a whole

5. The Standards do not require that all portions of a series of samples examined be free of coliform organisms. A distinction must be made
   a. The sanitary safety and potability of a supply as a whole
   b. The bacterial content of samples of the effluent of water treatment plant

6. Therefore, the Standards provide for the appraisal of all factors surrounding a public water supply which may directly or indirectly affect its potability; and the bacterial standards therefore, are only one, although the most important aspect of the Drinking Water Standards.

B. Drinking Water Standards specifications for 100 ml. portions of a series of samples.

1. Not more than 60 per cent of the series of 100 ml. portions shall show the presence of organisms of the coliform group.

2. Occasionally, all five of the 100 ml. portions of a single sample may show the presence of organisms of the coliform group, provided this does not occur in consecutive samples in more than 20 per cent of the five or more samples or with more than one of five samples or less.

C. Alternate provisions of the Drinking Water Standards when 10 ml. portions of each of a series of samples are examined.

1. Not more than 10 per cent of the 10 ml. portions of samples examined shall show the presence of organisms of the coliform group.

2. Three or more of the five 10 ml. portions of samples may show the presence of organisms of the coliform group, if this does not occur in more than 5 per cent of a series of samples of 20 or more, or in more than one of a series of 20 or less samples. Limiting qualifications:

a. Less than 10 per cent of all 10 ml. portions of a series of samples should contain coliform organisms.
b. A coliform index of 6.0 to 8.8 per ml. of water shall not be exceeded in more than 5 per cent of a series of 20 or more samples, or in more than one sample in a series of 20 or less.

COURSE OF STUDY

BACTERIOLOGY II

OBJECTIVES:

To provide advanced theory and techniques of water bacteriology. To develop proficiency in the performance and utilization of the coliform determination, and the filter technique of water bacteria examination.

CONTENTS:

Demonstration and practice of techniques in the use of the coliform determination, and filter technique of water bacteria examination.

VISUAL AIDS:

1. U. S. Public Health Service, The Membrane Filter, film strip - color-sound, 80 frames, 12 minutes, 1959.

REFERENCE MATERIAL:

1. Burchard, Jeanette, Bacteriology Examination of Water and Sewage, Missouri State Division of Health Laboratories

2. Standard Methods for Examinations of Water and Wastewater, American Public Health Association, 11th Edition, 1960, pages 508-513.

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. Coliform Determination (Multi-tube technique)	
A. Laboratory Apparatus	
1. Type	
a. Sample bottles - 4 oz. square sides, with black plastic caps.	
b. Pipette - 10 ml.	
c. Fermentation tube - 150 x 25 mm and 150 x 18 mm.	
d. Insert vials - 75 x 8 mm or 75 x 10 and 45 x 10 mm or 50 x 6 mm.	
B. Sterilization	
1. All glassware is cleaned with a detergent in washing machine, rinsed in distilled water, and sterilized at 170° C. for at least one hour. (Exception sample bottles)	
2. Sample bottles are washed as above, but, are sterilized in autoclave at 15 pound steam pressure for one-half hour.	
C. Media	
1. Distilled water is used in the preparation of all media.	
2. Lactose Broth	
a. Dehydrated media is used	Dehydrated media is obtained from Difco Laboratories, Detroit, Michigan, and the Baltimore Biological Laboratories, Baltimore, Md. Dehydrated media, 19.5 gm. Distilled water 1000 ml.
b. Dehydrated media is adjusted to a pH of 7.0 before autoclaving. At periodic intervals the pH is checked after autoclaving, (approximately one each week).	
c. 20 ml. lactose broth is tubed into 150 x 25 mm tubes containing inverted vials.	
d. The lactose broth is sterilized at 15 pounds steam pressure for 15 minutes being careful not to expose the broth to more than 30 minutes total heat.	
3. Brilliant Green Bile	
a. Dehydrated Brilliant Green Bile 2% is used in the preparation of this media.	The dehydrated media is obtained from Difco Laboratories Detroit, Mich. & Baltimore Biological Laboratories, Baltimore, Md.
b. 10 ml. of the dissolved media is tubed in 150 x 18 mm tubes	

containing inverted vials

c. The media is autoclaved at 15 lbs. steam pressure for 15 min.

d. After cooling to room temperature the media is checked for pH 7.1 to 7.4

Dehydrated media, 40 gm.
Distilled H_2O, 1000 ml.

4. All media is stored in such a manner that dust and light do not reach the tubes.

D. Sampling

1. Sample Bottles
   a. 0.01 g. of sodium thiosulfate is added to each clean dry sample bottle.
      (1) NA_3SO_4 -- 100 g.
      (2) Distilled water -- 1000 ml.
      (3) Add .1 ml. of this solution to each bottle.
   b. The sample bottles are then autoclaved at 15 pounds steam pressure 30-40 minutes.

2. Samples of water should be taken as aseptically as possible and sent to the laboratory immediately.

E. Laboratory Procedure

1. On arrival at laboratory water samples are given chronological numbers.
2. A series of 5 lactose broth tubes containing 20 ml. lactose broth each is set up for each water sample
3. The water sample bottle is shaken 25 times.
4. 10 ml. portions of the water sample is placed in each of the 5 lactose broth tubes.
5. The lactose broth and sample are incubated at 35° C. for 24 plus or minus 2 hours. All tubes showing gas in the inverted vials are removed and read as positive presumptive tests. The tubes showing no gas are left in 35° C. incubator for a total time of 48 plus or minus 3 hours. At the end of 48 plus or minus 3 hours all tubes showing gas in inverted vials are removed. Those tubes showing no gas are read as negative tests.
6. All tubes showing gas within 24 to 48 hours are transferred to Brilliant Green Bile broth using a loop that is at least 3 mm. in diameter. Shake

lactose tube and transfer one loop of broth to Brilliant Green Bile tube. Use 1 tube of Brilliant Green Bile for each positive tube of lactose broth.

7. The Brilliant Green Bile tubes are incubated at 35° for 24 plus or minus 2 hours. At the end of the 24 plus or minus 2 hours all tubes showing gas in the inverted vial are read as positive confirmed tests. Those tubes showing no gas remain in 35° C incubator for a total of 48 plus or minus 3 hours. Al tubes showing gas at the end of 48 plus or minus 3 hours are read as positve confirmed test and those showing no change are read as negative tests.

8. The total number of positive confirmed tests for each sample is recorded and placed over the total number of tubes used (5). From the following table the most probable number of coliform are determined:

0/5	2.2 M.P.N.
1/5	2.2
2/5	5.1
3/5	9.2
4/5	16.0
5/5	16.0

Thus, if a certain sample of water had 3 confirmed tests out of 5 tubes of lactose broth planted then the MPN would be 9.2.

9. Positive confirmed tests. Eosin Methylene Blue Agar is streaked from each positive confirmed test. These plates are incubated at 35° C. for 24 ± 2 hours. One or more typical colonies are transferred to single strength lactose broth and an agar slant. The lactose broth is incubated at 35° ± 0.5 until gas formation is noted or until a total time of 48 ± 3 hours had elapsed. The agar slants are incubated for 24 hours at 35° C. A smear of each slant is made and stained with Grams stain. The formation of gas in the lactose plus the presence of Gram negative non-spore forming rods indicate a positive completed test.

II. Total Bacterial Count of Water

A. Sample bottles

1. Dilution bottles, 4 oz. resistant type glass with rubber stopper.

2. Pipette, 1.1 ml. milk transfer pipette.
3. Petri dish, 10 cm. in diameter. Bottom free from scratches or bubbles.

B. Laboratory Apparatus

1. All glassware is chemically cleaned and sterilized as in coliform determination.

C. Media and Dilution Blank

1. Media
   a. Tryptose Glucose Extract Agar
      (1) Contents
         (a) Beef Extract, 3 g.
         (b) Tryptone, 5 g.
         (c) Glucose, 1 g.
         (d) Agar, 15 g.

   Dehydrated media is used by this laboratory and is obtained from Difco Laboratories, Detroit Mich. and Baltimore Biological Laboratories, Baltimore, Md.

   b. 24 g. of the dehydrated media is dissolved in 1000 ml. distilled water

   The solution is placed in 100 ml. portions in flasks and autoclaved at 15 psi for 15 min.

2. Dilution Blank
   a. Dilution bottles
   b. Dilution water

   Dilution bottles are those recommended by Standard Methods for the Examination of Dairy Products. Rubber stoppers are used as closures.

   Buffered distilled water is used as dilution water.
   Stock Buffered distilled water
   KH_2PO_4, 34 gm.
   Distilled water, 500 ml.
   Dissolve, and approximately 175 ml. 1N NaOH is added
   Dilute to 1 liter and adjust pH to 7.2. Add 1 ml of stock to 800 ml. boiled and cooled distilled water for buffered distilled water.
   Tube in dilution bottles so that after autoclaving at 15 pounds steam pressure for 15 minutes the volume will be 99 $\pm$ 2 ml.

D. Laboratory Procedure

1. Melt TGE and temper to 42° to 44° C.
2. Make dilutions that will give plates in the range of 30-300 colonies per plate. Where dilutions are needed, the sample is shaken 25 times and 1 ml. transferred to a dilution blank or a

   Finished waters 1 cc and 0.1 cc undiluted. Other 1:100 and 1:1000

sterile petri dish as required. 10 ml. of the tempered TGE is added to each petri dish and the dish is rotated to give an even distribution of bacteria. The plates are allowed to solidify and are placed in 35° C. incubator for 24 ± 2 hours. After 24 ± 2 hours the total number of bacteria on each plate are counted with the aid of a Quebec Colony Counter and tally register. The plate showing a range of 30-300 colonies per plate is used. The number of colonies found is multiplied by the dilution factor and the count is reported to two significant figures as the total bacterial count per ml.

Example: If there are 194 colonies on the 1:10 dilution plate, then total bacterial count per ml. is 1900.

III. Membrane Filter Technique

A. Introduction

1. Research data conclusions
   a. Provides a means for improved control of water quality in water treatment plants.
      (1) Higher degree of precision than the multiple-tube fermentation test.
      (2) Can examine larger volumes of samples with increased sensitivity.
      (3) Definitive results are obtained in a shorter time than with the multiple-tube procedure.
   b. Method permits field filtration of the sample and shipment of the filters to the laboratory on a preservative medium.
   c. Applicable in disasters and in emergencies.
   d. At present has limitations
      (1) In waters with turbidity
      (2) In waters with a high density of noncoliform organisms.

Discuss development of the test in Germany

B. Standard Test

1 Laboratory apparatus
   a. Type
      (1) Sample bottles
      (2) Dilution bottles
      (3) Pipettes and graduated cylinders

(a) Error of calibration must not exceed 2.5 per cent
(b) Recommended that the mouth end of all pipettes be protected with a cotton plug.

(4) Containers for culture medium
(a) Should be of glass
(b) Screw-cap tubes, 25 x 150 mm are recommended.

(5) Culture dishes
(a) Laboratory
(I) Petri dish type (5 to 6 cm. in dia.)
(II) Glass should be horosilicate or equivalent
(b) Field work
(I) Disposable plastic dishes
(II) Seamless tin ointment boxes

(6) Filtration units
(a) Seamless funnel
(b) Receptacle bearing a porous plate
(c) 1 liter flask with a side tube
(d) Electric vacuum pump, filter pump operating on water pressure or hand aspirator

(7) Filter membrane
(a) Provide full bacterial retention
(b) Stability in use
(c) Freedom from chemicals inimical to the growth and development of bacteria
(d) Satisfactory speed of filtration

(8) Absorbent pads
(9) Forceps
(10) Incubators
(11) Microscopes

b. Sterilization

(1) All glassware and other apparatus used in bacteriologic analysis with the membrane filter should be composed of material free from agents having unfavorable effects on bacterical growth.

Any deviation from recommendations should be carefully noted

(2) Materials and culture media
(a) General procedures
(I) Storage
(A) Store in clean dry space

(B) Fermentation tubes which have been at low temperatures should be incubated over-night before use.

(C) Fermentation tubes may be stored at 25° C for about one week

(II) Adjustment of Reaction

(A) Potentiometrice method

(B) Colorimetric method

(III) Sterilization

(A) 121° C. - 15 minutes

(B) 100° C. - 20 minutes

(IV) Clarification

(A) Centrifugation

(B) Sedimentation

(C) Filtration

(b) Materials

(I) Distilled water

(II) Beef Extract

(III) Peptone

(IV) Sugar

(V) Agar

(VI) General Chemicals ACS or reagent grade

(VII) Dyes

(c) Media Specifications

(I) M-Endo

(A) Dehyrated Difco M-Endo Broth MF (No. 0749-02)

(B) Dehydrated BBL M-Coliform Broth MF (No. 01-494)

(II) Dissolve in 1 liter distilled water to which 20 ml ethyl alcohol has been added.

(III) Heat to boiling point and stop

(IV) Store at 2° to 10° C.

(3) Samples

(a) Collection

(I) Collect in glass bottle

(II) Add dechlorinating agent

(III) Sampling procedure

(A) Leave ample air space in bottle

(B) Keep unopened until time for filling

(C) Let water run for 2 or 3 minutes before taking sample from tap

(D) Samples taken from rivers, streams, lakes, etc. should be representative of the water taken for the purposes to supply consumers.

(E) If taken from a well with a hand pump, water should be pumped for about 5 minutes before taking.

(IV) Size of sample: 100 ml.

(V) Identifying data

(b) Preservation and Storage

(I) Maintain temperature of sample as close as possible to temperature of sample at the time it was taken.

(II) Use field examination if sample will have to wait longer than 24 hours

(4) Definition

(a) All organisms that produce a dark (purplish-green) colony with a metallic sheen in 20 $\pm$ 2 hours of incubation are considered members of the coliform group

(5) Procedure

(a) Preparation of culture dishes

(I) Place sterile pad in each culture dish.

(II) Pipette enough medium to saturate each pad.

(b) Selection of appropriate sample volume.

(I) Finished water: duplicate 100-500 ml volumes

(II) Well water: single filtrations of each portion examined - 0.1, 1 and 10 ml.

(III) Polluted water: reduction in volumes in accordance with degree of pollution

(c) Filtration of sample

(d) Incubation: 20 hours $\pm$ 2 at 35° C. $\pm$ 0.5° C.

(e) Counting - all dark colonies having a metallic surface luster are counted coliform colonies

1. Place filter over porous plate grid side up
2. Place funnel
3. Pass sample through membrane
4. Rinse funnel
5. Roll membrane onto surface containing M-Endo medium

(6) Estimation of coliform Density

$$\text{Coliform Colonies/100 ml} = \frac{\text{Coliform Colonies counted} \times 100}{\text{ml sample filtered}}$$

COURSE OF STUDY

METHODS AND EQUIPMENT OF WATER TREATMENT

OBJECTIVES:

To develop an understanding and knowledge of methods and equipment used in the treatment of water.

CONTENTS: A study of aeration, coagulation, sedimentation, taste and odor control and chemical feeding devices. The students should become familiar with the function, characteristic and equipment used in these methods of water treatment.

VISUAL AIDS:

1. "A Large Water Treatment Plant" film strip - 35 mm color sound - 84 frames - 12 minutes 1954.

2. "Filtration Plants" - film strip 35 mm color sound - 59 frames - 8 minutes 1953

3. "Modern Water Treatment" - Motion picture color 20 minutes, Infilco Co.

REFERENCE MATERIAL:

1. Cox, Charles R., Laboratory Control of Water Purification, The Reuben H. Donnelley Corporation New York, 1946.

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. Aeration	
A. Functions	
1. Degassing a. Carbon Dioxide b. Hydrogen Sulfide c. Methane d. Excess Chlorine e. Ozone	Show and summarize film, "A Large Water Treatment Plant
2. Oxidation a. Ferrous becarbonate b. Maganese	
3. Chemical Mixing	
4. Decorative devices a. Illuminated Fountain and Falls	
B. Equipment	Diagram different types on chalkboard
1. Spray type a. Spray towers (1) Water falls freely through air b. Spray nozzles (1) Water sprayed up against a solid deflector (2) Adjustable cone type (3) Floating Cone type	
2. Shelf Type a. Slat-shelf b. Cascade (trays) c. Coke-tray d Riffle-type	
3. Diffused Air type a. Air passed through water	
4. Mechanical type a. Aeromix b. Multicone c. Forced draft d. Degasifier	
II. Coagulation	
A. Function	Show and summarize film, "Filtration Plants"
1. Causing finely divided materials to cluster together.	
B. Mode	
1. Coagulant a. Chemical added to water (1) Aluminum Sulfate (2) Ferrous Sulfate b. Furnishes electrical charge	

2. Rapid Mixing
   a. At low lift pump suction
   b. Using an agitator or paddle
   c. At a hydraulic jump
   d. At a corner in a flume
   e. Passage through gate or orifice
3. Flocculation
   a. Slow stirring
   b. Floc formed
      (1) Coagulant undergoes chemical change to form a gelantinous precipitate.
   c. Surface adsorption of particles

C. Flocculation Equipment

1. Four types
   a. Baffles
      (1) Over and under flow
      (2) End around flow
   b. Tangential Flow basin
      (1) Circular of square
      (2) Water enters tangentially to cause a spiral flow
      (3) Velocity of 2-3 feet per second
   c. Compressed Air
      (1) Released through porous plates
      (2) Admitted by perforated piping
      (3) Advantage of securing aeration
   d. Power Driven Paddles or Agitators
      (1) Rotated by power unit
      (2) Give appreciable, but not undue agitation

Show and summarize film, "Modern Water Treatment"

Have students draw a treatment system

III. Sedimentation

A. Function

1. Reduce turbidity of water
   a. Retention time sufficient for floc to settle to bottom
2. Bacterial Reduction
   a. Retention time sufficient for prechlorination

IV. Taste and Odor Control

A. Mode

1. Aeration
2. Coagulation
3. Oxidize with Chlorine
4. Adsorption
   a. Activated Carbon
      (1) Organic impurities gather on surfaces and pores of activated carbon

V. Chemical Feeding Devices

A. Solution type

1. Dissolved chemicals measured into water
   a. Orifice under constant head
   b. Weir
   c. Venturi for other meter
   d. Professional flow meter

B. Dry Feed Machines

1. Dry chemicals measured into water
   a. Direct weighing machines
      (1) Screw conveyor
      (2) Drum wheel
      (3) Oscillating hopper type
          Electric vibrating

COURSE OF STUDY

CHLORINATORS AND CHLORINATION

OBJECTIVES:

To develop a knowledge of chlorine and its reactions with water and ammonia
To develop an understanding of chlorine tests for residuals.
To learn when to apply chlorine to the water and how much each application should be.
To develop a knowledge of equipment and maintenance of chlorinators.
To develop a respect of handling and storing chlorine gas.

CONTENTS:

This unit is a study of chlorine and its use in water purification. The student is also instructed in the operation and maintenance of equipment and proper handling of chlorine gas containers.

VISUAL AIDS:

1. Functioning of Gas Feed Chlorinators, Part I: Visible Vacuum Chlorinators, film strip - 35 mm color-sound, 57 frames 12 minutes, 1954.

2. Functioning of Gas Feed Chlorinators, Part II: Volume Metering Chlorinator, Film strip - 35 mm color-sound, 42 frames 10 minutes, 1954.

REFERENCE MATERIAL:

1. Hirsch, A.A., Manual for Water Plant Operators, Chemical Publishing Company, Inc., New York, 1945.

2. Sorrels, Joseph H., editor, Manual for Waterworks Operators, The Texas Water and Sewage Work Association, Lancaster Press, Inc., Lancaster, Penn. 1959.

3. Laubusch, Edmund, Jr., Chlorination Guide, Water and Sewage Works.

OUTLINE OF CONTENTS	PROCEDURE AND RELATED ACTIVITY
I. Chlorine	
A. An active gas	
B. Economical as a commercial sterilizer	
C. Heavier than air	
II. Reactions of Chlorine with water	Illustrate by equations on chalkboard
A. Forms hypochlorous acid and hydrochloric acid	
B. The hypochlorous acid ionizes or dissociates into hydrogen and hypochlorite ions.	
III. Testing chlorine residuals	Demonstrate the function of color comparators and other instruments
A. Ortho-tolidine arsenite (O.T.A.) test (colorimetric equipment)	
B. Amperometric titration test	
C. Methyl Orange Filtration Method	
D. Orthotolidine Filtration Procedure	
IV. Reactions of Chlorine with Ammonia	
A. Forms chloramines	
1. Where ammonia is added, the ratio is 4 parts Cl to one part ammonia	
2. Chloramines act slowly on organisms	
3. Ammonia retards action of chlorine	
B. Breakpoint process	
1. Addition of sufficient chlorine to destroy ammonia	Project slide showing chlorine curve
2. Produces free available chlorine	
V. Points of Application	
A. Pre-chlorination	Illustrate on chalkboard the points of application
1. Benefits	
a. Improved filter operation	
b. Control of slime and mudball formation	
c. Improved coagulation	
d. Reduction of taste, odor, and color producing materials	
e. Disinfectant	

2. Add chlorine to the raw water suction intake
3. Dosage depends on objective

B. Post-chlorination

1. Add following filtration
   a. Disinfection
   b. Provides active chlorine residual throughout entire system
2. Add to the filter effluent or at the filter well

VI. Uses of Chlorine

A. Kill pathogens

Illustrate uses of chlorine on chalkboard

B. Taste and Odor Control

C. Algae growths

D. Hydrogen Sulphide removal

E. Iron removal

F. Maganese removal

G. Maintain filter runs

H. Maintain carrying capacity of mains

I. Sewage

1. Odor control
2. BOD reduction
3. Chemical precipitation

VII. Computation of Chlorine dosages

Demonstrate a typical problem and have students work assigned problems.

A. Chlorine

1. Liquid or gas
2. Formula - $PPM = \frac{lbs.}{8.34 \times M6}$

B. Hypochlorite

Provide samples of different hypochlorites for identification

1. With 70 per cent available chlorine, each gallon of 1% solution will contain $\frac{1.34}{0.70}$ or 1.92 oz. of hypochlorite.
2. The rate of injection is given by the formula: Hypochlorite solution (ml./min.) = 378 x dosage (p.p.m.) x flow (g.p.m.)

VIII. Equipment

A. Hypochlorinators — Exhibit hypochlorite feeders

1. Applied with dry-feed machine
2. Solution feed apparatus used to apply calcium and sodium hypochlorite
3. Positive displacement diaphragm pumps.

B. Gas Chlorinators — Exhibit different chlorinators to acquaint students with types.

1. Measurement of gas flow
   a. Fixed orifice
   b. Variable orifice
2. Mechanical diaphragm principle
3. Water diaphragm principle
4. V-Notch principle

IX. Typical chlorinator installations — Project diagrams of chlorinator installations with overhead projector.

A. Semi-Automatic

B. Program control

C. Automatic proportional control

X. Servicing of equipment

XI. Handling chlorine gas — Demonstrate with cut-away chlorine cylinders

A. Chlorine containers

1. Cylinders and ton containers
2. Tank cars

B. Transfer and Storage

1. Shipping and moving
   a. Trucks
      (1) Position upright
      (2) Securely fastened
      (3) Hydraulic lift for uploading or suitable skid
      (4) Hoist for ton containers
   b. In building
      (1) Hand truck for moving
      (2) Avoid hoisting as much as possible
2. Storing
   a. Store in upright position
   b. Arrange so leaking container can be easily moved.
   c. Ton containers are stored on their sides
   d. Store in cool well-ventilated area
   e. Protect from sunlight and precipitation if stored outside
   f. Storage and feeding areas should be located above ground level and of fire resistant construction

g. Practice good housekeeping

3. Using containers
   a. Emptying containers
      (1) Temperature for opening should be equal to storage temperature
      (2) Discharge from cylinder in upright position
      (3) Use manifold systems to connect two or more systems together
      (4) Check weight frequently with scales
   b. Connecting and Disconnecting Exhibit different types of connecting equipment.
      (1) Clamp and adapter method is preferred.
      (2) Be sure outlet valve is closed before removing cap
      (3) Inspect gasket surfaces
      (4) Open valves slowly

C. Other appurtenances

1. Piping systems
   a. Check for corrosion
   b. Pipe lines, valves, containers, and other equipment should be tightly closed when not in use
   c. It is important to observe correct temperature conditions in conducting chlorine from source to point of use.
   d. For one and one-half inch pipe and smaller, connection may be screwed, welded, or flanged.
2. Evaporators and Feeders
   a. Have duplicate equipment, if possible
   b. Complete stock of spare parts and tools should be maintained for emergency
   c. Have routine program of inspection and maintenance of chlorine feeding equipment.

COURSE OF STUDY

WATER AND SEWAGE TREATMENT SAFETY

OBJECTIVE:

To present the importance of observing safety at all times and to be aware of safety practices and procedures to be followed.

CONTENTS:

Includes general safety rules, first aid, procedures for handling hand and power equipment, personal protective devices, and storage and handling of chemicals and blasting materials.

REFERENCE MATERIAL:

1. Safety Practice for Water Utilities, American Water Works Association, 2 Park Avenue, New York 16, N.Y., 1958.

2. Manual For Waterworks Operators, Texas Water and Sewage Work Association, 1959.

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. Generally speaking, what are some safe work practices to be practiced?	
A. Personal protective equipment	
1. Face and eye protection a. Eye and face shields for flying objects b. Proper shade for welding	Demonstrate face mask and discuss its importance.
2. Foot protection a. Well fitted work shoes b. Steel toed work shoes c. Sheet metal foot guards	Exhibit cut-away safety shoe to show method of construction
3. Hand protection a. Hand leather or heavy gloves or mittens b. Asbestos gloves for handling acids, alkalies, oils, solvents and other chemicals c. Do not wear gloves around revolving machinery	
4. Head protection a. Plastic or fiber glass hard hats b. Metal hats except where there are electrical hazards	Exhibit both types of hard hats
5. Respiratory equipment a. Some hazards (1) Dust from rocks, cement, coal, wood, and flour particles (2) Toxic materials dust such as lead, arsenic, and fluorides (3) Mists and fumes from chemicals and heated metals (4) Vapors and gases from chlorine, ammonia, and carbon monoxide (5) Oxygen-deficient atmospheres b. Types of respirators (1) Filter (2) Canister and cartridge (3) Supplied air (4) Air or oxygen breathing apparatus	Each student should put on a gas mask and other types of respirators
6. Safety belts a. Should be worn when working in high places such as cleaning windows	

b. When working on insecure platforms
c. Where there is unsuitable footing

Demonstrate approved techniques with a safety belt.

B. First aid procedures

Exhibit and discuss a proper First Aid kit and its contents.

1. New employees
   a. Thoroughly instructed in the job
   b. Informed of plant safety rules and requirements.
   c. Placed under the charge of a safety-minded employee
   d. Check on new employee to be sure he is practicing job safety
   e. Reinstruct, if necessary

2. Lifting or lowering
   a. The right way to lift by hand
   b. Use mechanical handling whenever possible
   c. Lowering anything should have the same rules apply as lifting

3. Wheelbarrows
   a. Place load well forward
   b. Do not underestimate weight when using planking or runway
   c. Keep pneumatic tires properly inflated
   d. Wear gloves or have hands equipped with protectors.

4. Hand trucks
   a. Refrain from riding on truck or using for horseplay
   b. Proceed slowly to prevent overturning
   c. Use metal hand protectors on the handles
   d. Watch out for other employees
   e. Report needed repairs

5. Falls
   a. Walk, never run
   b. Keep aisles and work areas clear of obstruction
   c. Keep floors clean of grease and oil
   d. Use hand rail when climbing stairs or ramps
   e. Use flashlight when moving in the dark
   f. Walk around, don't climb over obstructions
   g. Refrain from jumping from moving vehicle; be sure all passengers are seated before moving.

6. Scaffolds
   a. Types
      (1) Use safe planks on carpenter's horses.
      (2) A frame and two planks for heavy loads
      (3) Tubular steel or aluminum
   b. Safety practices
      (1) Inspect all material before using
      (2) Build to state safety codes
      (3) Supporting members should be properly designed to carry given load
      (4) A handline should be used to raise and lower tools and materials
      (5) Do not jump from scaffold
      (6) Adequate signs or barriers should be used.
      (7) Do not use for any other purpose but its intended use.

Diagram various types of scaffolds on chalkboard

7. Swinging Scaffolds
   a. Test before raising
   b. Fasten to building to prevent sway
   c. When in use, do not combine to swinging scaffolds by a bridge
   d. Keep excess rope coiled on the ground
   e. Use life belt or safety line
   f. Only work within reach of scaffold

8. Ladders
   a. Straight ladders should be tied at the top or held by someone.
   b. Properly maintained and inspected
   c. Conform to ASA Specifications
   d. Use stepladders for short lengths
   e. Should not take extension ladders apart
   f. Should not be painted
   g. Use warning signs or rope off danger areas
   h. Face ladder ascending or descending
   i. Only one on the ladder at a time
   j. Straight ladders should be so placed that the distance of the base of the ladder from the wall is 25 per cent the length of the ladder.
   k. Use nonskid ladder feet
   l. A level, stable base should be used for all ladders

Allow students to relate accidents they have known, and the preventative measures needed.

9. Stairways
   a. Never run, and use handrails
   b. Keep free of grease and obstructions
   c. Keep hand rails free of splinters and well fastened
   d. Take one step at a time
   e. Keep properly lighted at all times.

10. Machine Guards
    a. All moving parts should have protective guards
    b. Guards should not be removed when machine is operating

11. Running and jumping
    a. Run only when extreme emergency
    b. Do not run or jump across ditches, scaffolds, or platforms
    c. Do not jump into a trench, but use ladder

II. How can the proper use and care of hand tools help prevent accidents

Student should make a list of rules before discussing those outlined.

A. Basic rules

1. Select appropriate tool for the job
2. Inspect tool for defectiveness
3. Avoid maintenance or repair on moving machinery
4. Protect hands with gloves in confined places.
5. Carry sharp or pointed tools in covers.
6. Always wipe tools clean and put away after using
7. Do not lay tools where they could fall
8. Use tools made of nonsparking material where fire is a hazard

B. Rules for commonly used tools

1. Axes and Hatchets
    a. Keep axes sharp
    b. Be sure you are clear of any obstructions to deflect axe
    c. Use both hands and have feet firmly placed.
    d. Swing like a baseball bat - away from you.
    e. Lay the axe down with the blade down
    f. Carry axe by grasping the handle just behind the head.

2. Chisels and Punches
    a. Should always be in good condition
    b. Wear eye protectors
    c. Grip chisel with thumb and forefinger
    d. Use screens when other people are around
    e. Push away from body

3. Files
    a. Should have securely fitting handle
    b. Never hit a file with a hammer

c. Use a file only for its intended use
d. Keep clean and sharp to minimize slipping

4. Hammers
   a. Select proper hammer for the job
   b. Keep clean and free of grease
   c. Keep eyes on what you are hitting
   d. Hammer only on the face
   e. Use block of wood for leverage when pulling nails

5. Picks
   a. Be sure handle is secure
   b. Avoid striking toward or close to the feet
   c. Be sure you are clear of object which might deflect your swing

6. Saws
   a. Keep sharp, clean and properly set
   b. Use crosscut for cutting across the grain and rip saw for cutting with the grain
   c. Start cut with two long pulling strokes toward the body

7. Screwdrivers
   a. Never use if screwdriver has split or splintered handle
   b. Use a screwdriver that fits the screw head
   c. Dress the point when worn, bent or broken
   d. Never hold work in the hand
   e. Use insulated handles for electrical work

8. Shovels and spades
   a. Inspect handle for defect
   b. Use the ball of the foot for pressing into the soil
   c. Use leg muscles for lifting
   d. Never leave shovel or spade laying where others might sit on it.

9. Wrenches
   a. Select proper wrench for the job
   b. Be sure wrench is in good condition
   c. Do not use as hammer
   d. Pull on the wrench

III. What are the dangers in using portable electric power tools?

A. What precautions should be taken in using electric hand tools?

1. Should be in good condition and repair
2. Ground the tool when in use
3. Use only approved and inspected extension cord
4. Examine cord before using
5. Place the electric cord (outlet to tool) in a non-hazardous manner
6. Protect against contact with water oil, or chemicals
7. Wear goggles for drilling or grinding

B. What precautions should be taken in using pneumatic tools?

1. Should not wear gloves or loose fitting clothing
2. Keep tools and bits in good condition
3. Avoid feeding machine too fast
4. Place machine straight into the hole to avoid sticking
5. Wear toe guards and eye protection

C. What precautions should be taken for the use of metalizing and sandblasting?

1. Keep as much skin surface as possible covered when using metalizer.
2. Wear eye and face protection
3. Wear respirators
4. Keep sandblast booth closed while blasting is in operation

IV. How can storerooms and stockrooms be maintained to insure safety?

A. Good housekeeping

1. Keep all aisles and walkways clear
2. Keep fire-extinguisher accessable
3. Keep floors clear of loose objects and other materials
4. Do not permit any kind of waste material to be on the floor
5. Designate storage areas and aisles by painted line on the floors

Demonstrate different fire extinguishers according to type of fire.

B. Proper storage

1. Avoid overfilling storage bins
2. Material should not protrude into aisle.
3. Use wedges for anything which might roll.

4. Store glassware for accessibility and ease of handling
5. Stack materials properly
6. Stay within safe load limits of the floors

C. Safe Handling

1. Wear gloves
2. Remove nails and metal straps from boards when uncrating
3. Avoid overloading hand trucks
4. Securely fasten all skids and runways

D. Handling drums

1. Wear gloves
2. Keep hands at top center while rolling
3. Two men should handle heavy drums between them
4. Slide drums endwise down skids
5. Use a parbuckle to pull drums up skids
6. Use a bung wrench to loosen or tighten a bung

E. Power truck and fork lifts

1. Be certain brakes are working properly
2. Drive slowly and cautiously
3. Face direction of travel
4. Shut off power and remove key when leaving truck
5. Insist that loads be stacked and trimmed for proper clearance before hauling

V. What precuations and general rules should vehicle operators be constantly aware of?

A. Vehicle safety

1. Safe operating condition
   a. Brakes
   b. Lights
   c. Windshield wipers
   d. Horn
   e. Tires

2. Tire chain for hazardous road conditions

3. Equipped with
   a. Flares
   b. Flags
   c. Reflectors or lights

4. Do not overload. Use flags when objects extend beyond bed of truck

5. Observe local traffic regulations

6. Driver should be checked out on vehicle

7. Truck should carry accident forms

B. Operating rules for drivers

1. Always be able to stop in the assured clear distance ahead
2. Signal for changes of direction
3. Abide by the same rules as for driving your own car.

VI. What precautions are to be observed when working in manholes?

A. Use proper tools for opening manhole or vault

B. Use barricades, signs, and lights to warn traffic

C. Before entering a manhold, determine the presence of oxygen and the absence of toxic gases

D. Have adequate and efficient ventilation

E. Take suitable measure to be sure surface water or debris doesn't accidentally enter the vault

F. Use proper shoring and bracing to prevent cave-ins

G. Always wear protective hat

H. Use ladder for entering subsurface areas

I. Avoid smoking in manholes

J. Have a helper at manhole's entrance at all times

K. Helper should be trained in artificial respiration

VII. What measures should be taken to insure proper fire protection?

A. Keep a neat, orderly plant

B. Select fire extinguishers of appropriate size and type for the area of the building they are to be placed in.

C. Fire extinguishers should be located in hallways and near doorways and work-rooms.

D. Inspect extinguishers at least semi-annually

E. Recharge after use

F. Consult fire department for advice

G. Post phone numbers of the fire and police departments in conspicious places

H. Provide sufficient number of exits and clearly mark

Illustrate the type of signs used.

I. Store flammable materials in isolated areas of the building
   1. Explosion-proof lights
   2. No-smoking signal
   3. Keep area lighted at night
   4. All employees should be instructed in First Aid

VIII. What safety measures are taken in trench construction?

A. Hand digging

   1. Wear protective hats
   2. Use tools which are in good condition
   3. Keep safe distance between workers
   4. Careful not to leave over-hanging banks
   5. Place excavated material 2 feet back from bank on traffic side, if possible
   6. Use barriers, bridges and walks, warning signs, flags, flares, lights for protection.
   7. Run up bank in case of landslide never down.
   8. Exercise caution to prevent striking electric conduits, gas lines, or other substructures

B. Trenching machines

   1. Never attempt maintenance or repair while machine is in operation
   2. Guard all moving parts
   3. Be alert for falling material
   4. Use flags by day and flares by night
   5. Operate machine in true vertical position to prevent overhang

C. Shoring

   1. Do not take any chances

2. Use proper shoring for the type soil you may be working
   a. Tight sheet for sandy soil
   b. Closely placed plank for water saturated soil
   c. Vertical planking in hard clay or rock
3. Extend shoring below bottom of trench whenever possible
4. Use only good lumber

IX. What precautions should be taken in blasting operation?

A. Only experienced men should be permitted to do so.

B. Storage of explosives

1. Avoid purchase, possession, storage, transporation, handling or use except in accordance with local, state, and federal regulations
2. Store only in building that is well ventilated, properly located, substantially constructed, and securely locked
3. Keep area clean
4. No smoking or carrying of matches
5. Store cases of dynamite so that the cartridges lie horizontally

C. Handling of explosives

1. Handle with respect
2. Open kegs or cases away from storage area
3. Use wooden, rubber, or fiber tools for opening cases
4. Burn empty cases
5. Keep surplus explosives away from blasting area.

D. Use of explosives should be left up to an experienced, well-trained person.

X. What are precautions for power shovels and draglines?

A. Only authorized men should operate

B. Inspect equipment frequently

C. Do not walk or stand under suspended loads

D. Avoid overloading buckets

E. Never allow anyone to ride on loads or buckets

F. Use a dragline to prevent the load from swinging

XI. How should pipe be unloaded and stored?

A. Handling

1. Crews should work together
2. Use U-shaped carry bar, tongs, or pipe sticks
3. Use skids of ample strength
4. When unloading pipe from trucks or cars, lower individual pieces by snubs all the way down the skids
5. Wear gloves for all snubbing operations
6. Use wood chocks to prevent pipe from rolling
7. Guide pipe into a trench with rope slings
8. Never try to catch a pipe that is slipping

B. Storing

1. Store small pipe in racks
2. Block pipe to prevent from rolling
3. Handle threaded pipe with care
4. Pipe 2" or larger in diameter should be stacked in storage with spacing strips

XII. What precautions should be taken in lead and calking compound melting and handling?

A. Lead melting

1. Conduct melting operation away from general work area
2. Do not put wet material or water into molten material
3. Heat ladle to evaporate moisture
4. Preheat new lead before adding it to already molten metal
5. Wear gloves when drawing or adding lead
6. Make sure that the path of travel from the lead-melting operation to the point where the lead is to be poured is unobstructed
7. Wash hands before eating or drinking to prevent lead poisoning
8. Wear proper clothing, eye shield, and gloves

B. Calking

1. Only those men actually engaged in caulking should be permitted in the immediate area
2. Operation should be free of distractions or unsafe conditions
3. Use only tools in good condition
4. Wear eye protection
5. Have adequate work space

C. Compound melting

1. Avoid unnecessary contact with fumes
2. Carry hot materials in riveted, closed buckets
3. Use hand lines to raise or lower buckets
4. Open kettle valve slowly to avoid splashing
5. The kettle should never be left unattended while contents are hot.

XIII. How are barricade and warning signs placed?

A. Place well ahead of construction area

B. Protect work area by barricades, barriers, or planks, use flag men.

C. Use lighting when visibility is low.

XIV. What safety procedures should be adopted to minimize or eliminate hazards in chemical handling and storage?

A. Acids

1. Well-ventilated storage areas
2. Wear protective equipment and clothing

B. Alum

1. Protective dustproof equipment
2. Proper clothing should be worn
3. Use plenty of water in washing and bathing

C. Ammonia

1. Store cylinders in cool, dry ventilated place
2. Use protective equipment for handling
3. Handle with care
4. Only trained personnel should make repairs

D. Carbon

1. Storage should be in dry, fireproof space
2. Handle with protective dustproof equipment
3. No smoking
4. Use plenty of water in washing and bathing

E. Carton Monoxide

1. Work on engines using gas, gasoline or diesel fuel should be done in well ventilated area
2. Correct improperly-vented gas heaters

F. Chlorine

Demonstrate with a bottle of ammonia to show white cloud indicating presence of chlorine

1. Proper gas mask should be available
2. Two men should be available for leak repairs
3. Only proper fitting wrenches should be used on valves
4. Safety repair kits should be available
5. Close valves when leaks are detected
6. Use ammonia swab to detect leaks

G. Fluorides

1. Only trained personnel should handle
2. Storage should be in specifice, well-ventilated areas

H. Hydrofluoric acid

1. Use extreme care in handling
2. Anyone handling this material should be thoroughly familiar with the hazards

I. Lime

1. Use protective dust-proof equipment
2. Use dust collecting system, if possible
3. Store in well-ventitlated area
4. Bathe and wash in plenty of water

J. Phosgene gas

1. May be liberated when carbon tetrachloride fire extinguishers are used in confined areas on open flames or heated metals.
2. Has smell of musty hay

K. Soda ash - same as lime

L. Solvents

1. Area where used should be well ventilated
2. Clean from skin
3. Follow manufacturer's instructions for use.

COURSE OF STUDY

PIPING

OBJECTIVES:

To develop a knowledge of piping in distribution systems and the material from which pipe is made.

CONTENTS:

A presentation of the kinds of pipe found on the market today, methods of jointing, and other characteristics which will help the student to select the proper piping to do a particular job.

VISUAL AIDS:

1. Cast Iron Pipe Research Association, "Manufacture of Cast Iron Pipe" - color 20 minutes, film

2. Cast Iron Pipe Research Association, "Installation of Cast Iron Pipe" - color 20 minutes, film

3. Griffin Pipe Products Company, "Unetizing - Key to Better Piping Handling" - color 20 minutes, film

4. Reasby and Mattieson Company, "The Life Lines of Your Community" - color 12 minutes, film

REFERENCE MATERIAL:

1. Steel, E. W., Water Supply and Sewerage, McGraw-Hill Book Company Inc., New York, New York, 1960.

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. Cast Iron Pipe	
A. History of cast iron pipe	Show film "Manufacture of Cast Iron Pipe"
B. Molded by pit casting	
C. Centrifugally cast in metal molds	
D. Pipe thicknesses based on allowable working internal pressure 1. Classes are 50 - 100 - 150 - 200 250 - and 300 pounds per sq. inch. 2. Pipe is weighed and given hydrostatic test	
E. Cement-lined cast iron pipe 1. Effective against corrosive water 2. Lining is 1:2 Portland cement mortar applied centrifugally 3. Lining thicknesses a. 3 to 12 inch pipe - 1/8" thickness b. 14 to 24 inch pipe - 3/16" thickness c. 30 to 48 inch pipe - 1/4" thickness	Exhibit various cast iron pipe pieces
F. Cast Iron Pipe Joints 1. Flanged joint: used in treatment and pumping plants. a. Classes 150 and 250 pound pipe b. Put together with gasket and bolts 2. Bell and spigot joint a. Yarn used in joint - followed by pouring of hot lead. b. Lead is expanded by calking until tight fit is formed. c. Joint compounds made of sulphur, sand and other substances are used in place of lead. 3. Slip-on bell and spigot joint a. Seal made by rubber gasket b. Gasket lubricated then spigot forced into bell c. Requires no calking d. Deflection to form curves possible e. Jointing of pipe very rapid 4. Mechanical Joint a. Consists of rings, bolts, and gasket b. When assembled the bolts are tightened ring expands rubber joint c. Make tight joint d. Rapid jointing e. Allows some deflection of pipe	Exhibit different cast iron joints Show film "Unetizing - Key to Better Piping Handling" Demonstrate methods of joining pipe together

II. Asbestos Cement Pipe

Show film "The Life Lines of Your Community"

A. Composed of Portland cement and asbestos fiber

1. Formed on rotating steel mandrel
2. Compacted by steel pressure rolls

B. Advantage of being immune to action of

Exhibit asbestos cement pipe section

1. Soils
2. Acids
3. Electrolysis

C. Joints consist of

Disply cut-away joints of asbestos cement

1. Sleve which fits over ends of pipe
2. Two rubber rings compressed between sleeve and pipe barrels

III. Steel pipe

A. Steel pipe frequently used for pipe lines, trunk mains, and inverted siphons

1. Where pressures are high
2. Where sizes are large
3. Steel stronger than cast iron
4. Reasonably light in weight
   a. Not adapted to heavy external loads
   b. A partial vacuum may cause distortion or collapse

B. Steel Pipe Joints

1. Welded in the field
2. Flanges or couplings
3. 15" diameter, or less, with screwed couplings
4. Bell and spigot ends have been used

IV. Concrete Pipe

A. Plain concrete pipe and reinforced

1. Not subject to tuberculation
   a. Carrying capacity remains high
   b. Presents a smooth surface

2. Reinforcement consists of
   a. Welded steel cylinder
   b. Around cylinder is wound high tensile wire
   c. Lined inside with coat of concrete
   d. Outer coating of concrete placed over reinforcing
3. Precast reinforced concrete pipe made in sizes 16 to 108 inches
   a. Lengths 12, 14 or 16 feet
   b. Static heads from 100 to 600 feet

V. Plastic Pipe

A. Made of various plastic materials — Exhibit pieces of plastic pipe to show materials

1. Can be extruded in various lengths
2. Long lengths without fittings
3. Not subject to corrosive water

B. Joints made by:

1. Clamps and inserts
2. Compound applied to end of pipe

Demonstrate ways of making joints

VI. Pipe Lines

A. Profile of pipe line is drawn — Show Pipe profile with overhead projector

1. Attention given hydraulic grade
2. High pressures avoided
3. At low points blowoff valves provided
4. Air and vacuum valves and air relief valves are placed at high points of line

VII. Clay Pipe

A. Primary usage in sewage collection — Display clay pipes

1. History of clay pipe
2. Clay pipe composed of different clays
3. Pipe extruded under high pressure
4. Given a preliminary drying
5. Placed in kiln for vitrification
   a. Minute particles of clay are fused together
   b. Temperature of about 2000° F.

B. Has resistance to chemical action

1. Moisture and chemically active soils
2. Domestic sewage
   a. Bacterial action on human wastes gives off hydrogen gas

b. Hydrogen gas and oxygen makes sulphuric acid

C. Jointing Materials

Demonstrate different methods of jointing

1. Adhesion type joints
   a. Hot-pour compounds
   b. Die-cast joints (asphaltic)
   c. Cold applied mastic compounds

2. Flexible Compression Joints
   a. Resilient material same on bell and spigot ends
   b. Varied hardness and resiliency in bell and spigot materials
   c. Gasket or compression ring

Display cut-away pipe to show joints

VIII. Laying of Pipe

Show film "Installation of Cast Iron Pipe"

A. Four methods of bedding pipe

1. Pipe rests on trench bottom, backfill not tamped
2. Pipe rests on trench bottom, backfill tamped to centerline of pipe
3. Pipe supported on blocks, backfill not tamped
4. Pipe supported on blocks, backfill tamped to centerline of pipe

Draw diagrams on board showing different bedding

IX. Flow in Pipes

Demonstrate slide-rule, also charts and nomograms

A. Friction factor depend on roughness of pipe

Have class solve determinations.

1. Roughness coefficient (C) determined by Hazen-Williams formula
2. Coefficient varies with velocity and pipe size
3. Calculated by special slide rule, chart or nomogram

B. C values of different pipes

Put C factors on chalkboard

1. Extremely sommoth and straight -140
2. Cast iron
   a. New, 130
   b. 5 years old, 120
   c. 10 years old, 107-113
   d. 20 years old, 90-100
   e. 30 years old, 75-90
3. Concreté or cement lines - 120 to 140
4. Welder steel

COURSE OF STUDY

WATER DISTRIBUTION SYSTEMS

OBJECTIVE:

To develop a knowledge of water distribution systems, and the operation and maintenance of equipment.

CONTENTS:

Information is presented to enable the student to become familiar with the various distribution system components. Some of the specific items considered are: distribution and service fittings, tapping, valves, hydrants, main cleaning and pipe pushing. The students work in the laboratory using actual and demonstration components.

VISUAL AIDS:

1. "Water Main Cleaning" color - 16 mm 18 min., Flexible Co.

2. "Water Main Cleaning Equipment" color - 16 mm 16 min. National Water Main Cleaning Company

REFERENCE MATERIAL:

1. Wolfe, Charles R., Basic Principles in the Use and Design of Elevated Storage.

2. Rossum, J. R., Disinfection of New Mains, Water and Sewage Works, reprint.

3. Bassett, Richard, Steel Water Storage Tanks, Chicago Bridge and Iron Co.

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. Early history of water transportation	Diagram on chalkboard typical systems
A. Typical distribution systems of today	
B. Requirements of modern systems	
1. Capacity	
2. Pressures	
3. Storage	
4. Fire and domestic	
C. Distribution Piping Materials	Display pipe samples to show materials
1. Advantages	
a. Cast Iron	
b. Asbestos cement	
c. Plastic	
d. Steel	
e. Concrete	
2. Disadvantages	
a. Cast Iron	
b. Asbestos cement	
c. Plastic	
d. Concrete	
D. Terminology and operation procedures	Show a line profile with overhead projector
1. Proper installation procedure	
2. Use of hydrants, blow-offs, air points, etc.	
II. Methods of water transmission	
A. Transmission Mains - Design and Function	
1. Loads	
2. Valve use	
3. Pressure - gravity	
4. Expansion and contraction	
B. Electrolysis - Causes and effects	Exhibit pipe that was badly affected.
1. Stray currents	
2. Remedial action	
C. Forces acting upon transmission mains	
1. Unbalanced thrusts	
2. Earth loads	
D. Fire protection and requirements	Review fire flow formula

	E. Maximum flows and flow reversals	
	F. Effects of elevated storage on transmission	
	G. Carrying capacity and coefficients	Show films, "Water Main Cleaning" and "Water Main Cleaning Equipment
III.	Methods of Water distribution	
	A. Distribution of water	
	1. Basic requirements 2. Adequate design 3. Domestic service requirements	
	B. Valve location and operation	Exhibit different kinds of valves and usage
	C. Re-enforcing inadequate operation	
	D. Two-level systems	
	E. Distribution storage	
	F. Leakage	
	G. Mapping and records	Distribute samples of various maps and records

COURSE OF STUDY

SEWAGE COLLECTION SYSTEMS

OBJECTIVE:

To develop an understanding of the information and procedures used in the design of sanitary sewers.

CONTENTS:

A presentation of location, flow, hydraulics, design, trench load specifications and codes of sanitary sewer design.

VISUAL AIDS:

1. "Municipal Sewage Treatment Processes," Motion picture 16 mm black and white, sound, 13 minutes, 1951.

2. Charts and tables

REFERENCE MATERIAL:

1. Powers, John B., Structural Design of Clay Pipe Sewers, Public Works Magazine, January, 1960.

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. What are sanitary sewers?	
A. Sewage systems	
1. Vital to community living. 2. All communities produce water borne waste	Show film, "Municipal Sewage Treatment Processes"
B. Sewerage structures	
1. Collect and transport water borne waste to a point of discharge 2. Usually consist of laterals, mains and outfall sewers	
II. What are sewer location factors?	
A. Areas to be served	Illustrate location factors on chalkboard
1. Evaluate the character of the area to be served a. Kind of homes b. Location within the water shed c. How many homes per acre of land d. Future industrial locations	
2. Evaluate water shed a. Design size of sewer large enough for all the water shed b. Construction space large enough for future enlargement of need	
B. Minimum depths for required service	
1. Do the residents want their basements drained? 2. Is solid rock close to surface? 3. Will the minumun allowabel sewer grade fit into the "lay of the land"? 4. Will the available funds be sufficient to allow construction to please the desires.	
C. Surveys	
1. Need for survey a. To establish the grade along proposed route b. To locate sewer accurately	Distribute and study blueprints of surveys that have been made
2. Elevations a. Location of manholes b. Estimation of amounts of various trench depths c. Shows rock formations	

D. Obstacles

1. Special problems
   a. Highways
   b. Railroads
   c. Gas and oil lines
   d. Buried conduits of power and telephone companies
   e. Utilities structures

2. Proper permits — Discuss types of permits needed and what agencies to get them from.

III. How much flow can be expected?

A. Area

1. Determined in acres
2. Sewer size should be sufficient to pass quantity expected.
   a. Can only increase capacity by paralled construction
   b. Very expensive and many head-aches

B. Population — Assign sample problems, solve on chalkboard

1. Number of houses per acre
2. Number of people per acre

C. Figuring average per capita flows

1. Actually measure and record on an around the clock basis for three days in a wet season what the flow in your sample area is
2. Utilized the experience previously gained by the sewage industry and use an assumed flow

D. Flow distribution inside the pipe

1. In laterals the surge volume may reach four times the average flow — Show graphs on overhead projector
2. Peaks in the mains and out fall sewers range up to two and one half times the average flow rates

IV. What is the hydraulics of sewers?

A. Continuity formula

1. The volume of flow is equal to the velocity of flow times the cross sectional area of flow or $Q = V \times A$ — Assign students work on sample problems.

2. If the Q or volume of water to be handled and the A or square feet of cross sectional area of the pipe then all that has to be determined is the velocity in feet per unit of time

B. Hydraulic elements — Display monographs on loads on sewers in trenches

C. Determining velocities — Display a chart for discharge of circular pipes

D. What to do about critical flows

E. Effects of other added flows

V. How to go about the practical design of a system?

A. Define the word "design" using a standard dictionary

B. The use of the design chart — Demonstrate the design chart and its function

C. Limitations of the design chart

D. Appurtenant structures

E. House services

VI. What are trench loads on pipes?

A. Vertical loads

1. Horizontal loads
2. Short loads
3. Long loads

B. Strength of pipe

1. Pipe strengths test
   a. Three edge bearing
   b. Sand bearing

2. Earth embedment — Study charts and tables of various methods of embedment
   a. Used more than all other types
   b. Shape trench to fit the bottom quadrant of the pipe

3. Granular embedment
   a. To obtain additional supporting strength — Draw methods of pipe bedding on chalkboard
   b. To obtain a better foundation and working trench bottom
   c. To offset the effect of plastic soils

4. Concrete embedment
   a. Partial concrete embedment
   b. Concrete encasement

VII. What plans have to be made?

A. Specifications

B. Codes — Exhibit codes for class reference

COURSE OF STUDY

WATER STORAGE

OBJECTIVES:

To learn the advantages of adequate water storage in its proper location.

CONTENTS:

A presentation of the need for water storage and the advantages to the community, where to locate various types of storage facilities, and methods of selecting the type of water storage. The student also studies specifications and maintenance of storage tanks.

REFERENCE MATERIAL:

1. Sorrels, Joseph H., Editor, Manual For Waterworks Operators, The Texas Water and Sewage Works Association, Lancaster Press, Inc., Lancaster, Penn., 1959.

2. Horton Elevated Steel Storage Tanks, Chicago Bridge and Iron Company, Chicago, Illinois, 1960.

OUTLINE OF CONTENTS	PROCEDURE AND RELATED ACTIVITY
I. The need for water storage	
A. "Shortage" even though adequate water supply to deliver water system's daily requirements (caused by peak-loads)	
B. On-line-storage "floating" on system	
C. Advantages	
1. Improved pressure in remote areas	
2. Improved fire protection and low fire insurance rates	
3. Reduction of fluctuations in pressure	
4. Avoids interruptions in service during repairs to mains (Also power failures)	
5. Equalization of Pumping heads, permitting selection of pumps for operation at highest efficiency	
6. Operation of pumps and treatment plants at constant rates	
7. Possible use of one-shift or two-shift pumping operations	
8. Possible use of smaller supply mains	
9. Economies from operations at off-peak periods when power rates are lower	
II. Location of water storage	
A. Near pumping station	Draw a typical installation on chalkboard
1. Reduces operating pressure of pumping unit	
2. Will not raise line pressure in rest of system	
B. Near service area but between service area and pumping station	
1. May raise pressure in system	
2. Will not reduce operating pressure of pumps	
C. Beyond service area	
1. Reduces pressure variation	
2. Increases pumping head	
3. Avoids interruptions in service during repairs to mains	
D. Available natural ground elevation	
E. Public opinion	

III. Methods of selecting type of water storage

A. Capacity (charts)

Use overhead projector to show charts

1. Domestic use
2. Pumping capacity and period of pumping
3. Fire protection

B. Physical geography

1. Natural ground elevation available versus required line pressure
2. Allowable soil bearing pressure

C. Type Tanks

1. Reservoirs
2. Standpipes
3. Elevated tanks

Display models to illustrate types and construction

D. Tank comparisons

1. Relative costs
2. Capacities
3. Maintenance
4. Ground area
5. Appearance
6. Standard versus non-standard sizes

IV. Related Items

A. Governing specification

Provide sample specifications to cite different requirements

1. Consulting engineers
2. American Water Works Association
   a. Design stresses
   b. Accessories
   c. Wind loading
   d. Soil tests
   e. Obstruction lights (CAA)

B. Maintenance

Display a model maintenance contract

1. Steel preparation
2. Painting
3. Cathodic protection equipment
4. Inspection

C. Revamping used tanks

1. Moving tanks
2. Increasing height of existing tanks

COURSE OF STUDY

BLUEPRINT READING

OBJECTIVE:

To enable the student to interpret and make drawings to a limited degree of proficiency.

CONTENTS:

A presentation of working drawings, sketches, map drawings, graphs, and equipment used in the field.

VISUAL AIDS:

1. Drawing blocks and developments
2. T-Square
3. Angles (30° - 60° and 45°)
4. Chalkboard
5. Scales (Mechanical Engineer; Architectural; and Civil Engineer)
6. Drafting Tools and Instruments
7. Templates
8. Flip Charts
9. Transparencies
10. Projector
11. Large drawings and maps

REFERENCE MATERIAL:

1. Engineering Drawing, Thomas E. French and Charles J. Vierck, McGraw Hill Book Company, 8th Ed., 1953.

2. Blueprint Reading for the Machine Trades, John J. Weir, McGraw Hill Book Company, 1941.

3. Blueprint Reading at Work, William W. Rogers and Paul L. Welton, Silver Burdett Company, 1942.

4. Technical Drawing, Frederick E. Giesecke, Alva Mitchell, and Henry Cecil Spencer, Macmillan Company, 1942.

5. Mechanical Drawing, Thomas E. French and Carl L. Svensen, McGraw Hill Book Company, 1957.

OUTLINE OF CONTENTS	PROCEDURE AND RELATED ACTIVITY
I. What is drafting	
A. Why does a person need to understand drafting?	
1. Industrial language	
2. Pictorial language	
3. Universal language	
B. What are drafting standards?	
1. Graphic language	
2. American Drafting Standards Manual	Discuss how ADSM came about
C. Draftsman and knowledge of his job	
1. Graphic language	
2. Fundamental principles	
II. What is a reproduction?	
A. What types of reproduction are there?	
1. Blueprint	Exhibit prints to show to students and discuss characteristics of each
2. Ozalid print (white print)	
B. What is the need for reproductions?	
C. How does a blueprint describe an object?	
III. What are the conventional lines found on a drawing?	
A. What is the alphabet of lines and how are they used?	Demonstrate by using an actual drawing
1. Object lines	
2. Hidden lines	
3. Section lines	
4. Center lines	
5. Dimension, extension lines and leaders	
6. Cutting plane lines	
7. Break lines	
8. Phantom lines	
B. What is the importance of line density?	
C. Kinds of lettering found on drawings	Demonstrate how each letter is made
1. Vertical	
2. Inclined	

IV. What types of drawings will the student encounter?

A. Multiview projection — Demonstrate with drawing blocks

1. Orthographic projection
2. Planes of projection
   a. Frontal plane
   b. Horizontal plane
   c. Profile plane

B. Pictorial drawings — Demonstrate on the chalkboard how pictorial drawings are made

1. Isometric
2. Oblique
3. Perspective

C. Working drawings

1. Detail
2. Assembly

D. Symbol drawings — Display examples of drawings and discuss the symbols for the various areas

1. Electrical diagrams
2. Piping
3. Topographic
4. Welding

E. Complete set of drawings — Provide complete set of drawings from the local water works on a project.

1. Discuss different types of drawings

V. What are the basic views on a drawing?

A. Necessary views

1. Multiview drawings
   a. Width
   b. Height
   c. Depth

2. Two-view drawings

B. Selection of views

1. Those views which show best the essential contours or shape of the object.
2. The view which will have the least number of hidden lines

C. Layout of drawing

1. Alignment
2. Position

VI. Why learn freehand sketching?

A. Importance

1. Convey information
2. Means of communication

B. Techniques

Discuss kinds of pencils and how to sharpen

1. Position of the pencil
2. Sketching horizontal lines
3. Sketching vertical and slanted lines
4. Sketching circles and arcs.

C. Principles

Make sketches of assigned problems given by instructor.

1. Three view sketches
2. Pictorials

VII. What devices are used for measuring in drafting?

Demonstrate the use of each piece of equipment and discuss their various characteristics.

A. Rules
B. Scales
C. Micrometers
D. Dividers
E. Proportional dividers
F. Protractors

VIII. What are the basic practices used in dimensioning?

A. Importance of dimensions and notes

1. Shape description
2. Size description
3. Interchangeability

B. Types of dimensions

1. Over-all
2. Detail
3. Location

C. Placement

Demonstrate by use of a drawing where and how dimensions are placed on a drawing.

D. Systems

1. Aligned
2. Unidirectional

E. Symbols

1. Inches
2 Feet

F. Rules and exceptions

Provide a list of dimensioning rules to students and discuss

G. Leaders and Notes

1. Leaders
   a. Oblique line
   b. Use
      (1) Direct attention
      (2) Give size

2. Notes
   a. General notes
   b. Rules

Provide list of rules which generally apply for all notes and discuss

IX. What are cylinders, curves and combinations?

A. Curved surfaces

1. Cylinders
2. Cones
3. Sphere

B. Combinations of cylinders and rectangular pieces

C. Related Information

1. Ellipses
2. Intersections and tangents
3. How to draw holes

X. How are screws, rivets, keys, keyways and pins represented on a drawing?

A. Notes and dimensions

B. Symbols

XI. Why is tolerancing important for the student to understand?

A. Definitions of terms

Discuss interchangeable manufacturing

1. Nominal size - a close approximation to a standard size without any specified tolerance.
2. Basic size - the size from which limits of size are derived by the application of allowances and tolerances
3. Tolerance - the total permissable variation of a size, or the difference between the limits.
4. Limits - the maximum and minimum sizes indicated by a tolerance dimension
5. Allowance - the minimum clearance space or maximum interference intended between mating parts.

B. Fits between mating parts

1. Clearance fit - an internal member fits in an external member and leaves an air space or clearance between the parts
2. Interference fit - the internal member is larger than the external member such that there is an actual interference of metal.
3. Transition fit - the fit might be either a clearance fit or an interference fit

XII. Why should the student of water and sewage treatment have a knowledge of map drawings?

A. Information contained in a map

1. Elevations and depressions of ground areas
2. Locations and types of objects constructed by man
3. Hydrographic or water features
4. Vegetation such as forests, fields and swamps

B. Types of maps

1. Cadastral maps
   a. Show layouts of cities, towns or county districts
   b. Serve as records of land property ownership
   c. Frequently include location of all gas mains, water lines, sewage systems, and fire hydrants.

2. Plat or survey
   a. Part of a legal document and contains an accurate describtion of a tract of land
   b. Used for subdivision

3. Building site maps
   a. A plot plan to show the orientation of the building and its surrounding area.
   b. Features ground elevation contours, property boundaries, utilities, walks, drives and other distinguishing features.

Discuss and show examples of landscape, topographic, hydrographic, aeronautical, road and military maps.

C. Definition of terms

1. Traverse- a series of intersecting straight lines of accurately measured lengths.
2. Elevations- vertical distance above a common datum or reference plane.

3. Profile- a line contained in a vertical plane, and depicts the relative elevations of various points along the line.

4. Contours- lines drawn on a map to locate, in the plan view points of equal grand elevation

5. Hatchures- short, parallel or slightly divergent lines drawn in the direction of the slope

6. Monuments- special installations of stone or concrete to mark the locations of points accurately determined by precise surveying

7. Cartography-the science or art of map making

XIII. What is graphical representation?

A. The function of a graphic system is to diagram the relationships between a quantity of numerical values

1. Reduce the amount of mental effort
2. Makes the pattern of the data more easily remembered

B. Ways of using graphical construction

1. Presentation of date
2. Graphical analysis
3. Graphical computation

C. Types of graphs and charts

Study graphs and discuss their characteristics and use.

1. Rectangular coordinate
2. Semi-logarithmic
3. Logarithmic
4. Bar Chart
5. Percentage bar chart
6. Pie chart
7. Pictorial chart
8. Flow chart
9. Operation chart
10. Organization chart
11. Polar coordinate graph

COURSE OF STUDY

VALVES AND HYDRANTS

OBJECTIVES:

To develop an understanding of the types and uses of valves and hydrants

CONTENTS:

A presentation of the different types of valves and hydrants, how they are used, and where they are located

VISUAL AIDS:

1. Technical Manuals
2. Valve catalogs

REFERENCE MATERIAL:

1. Hardenbergh, W. A., Water Supply and Purification, International Textbook Company, Scranton, Pennsylvania, 1952.

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. What types of valves are found in piping?	Demonstrate a gate valve and explain how it works
A. Shut-off valves	
1. Used in all mains and submains so leaks or breaks can be repaired in case of accident	
2. Should be placed at intervals of not more than 500 to 800 feet	
3. Place valves on both sides of intersection where pipe lines intersect.	Illustrate on chalkboard and explain
B. Large Shut-off valves	
1. Is used to equalize the pressure on both sides of a main valve when one side is empty	Explain how water is by-passed around the main valve.
2. Is usually set with the main valve stem horizontal instead of vertical, and is enclosed in a brick chamber	
C. Check-valves	
1. Allows water to flow in one direction and prevents it from flowing back.	
2. These valves are placed in every pipe line through which water is forced by a pump to prevent it from running back into the pump if it is shut down	
3. In long lines place at intervals of 1000 feet	
D. Cone Valves or plug-type	Display a cut-away model and show how the valve works
1. Uses a. To maintain a constant level in a tank or reservoir b. To check back flow when pumps are stopped c. To prevent water hammer d. To reduce water pressure to any desired constant value	
2. Control a. Automatically b. Electrically c. Manually	

E. Air valves

Show cut-away of air valve and illustrate how it works

1. Installed to permit the escape of air which tends to accumulate at high points in a pipe line

2. Installed in steel pipe to let air into the pipe to prevent the formation of a vacuum

Discuss external pressures on steel pipe which could cause it to collapse if a vacuum formed in the line

F. Blow-offs

1. Placed in all depressions in the mains and at all dead ends.

2. Used to remove silt or sediment by allowing the water to run out until it is clear

3. Hydrants are often used as blow-offs

II. Hydrants

A. Construction

1. Its main purpose is for forming a connection for fire-hose.

2. Types
   a. Flush-hydrant is set entirely below the sidewalk or street and protected by a cast iron box
   b. Post-hydrant extends 2 or 3 feet above the surface

Use a cut-away model of hydrant to illustrate how it is constructed and how the operating valves work.

Discuss hydrant outlets

3. Operating valves
   a. Sliding gate
   b. Compression valve

Discuss drip holes in the barrel of a hydrant and how the water drainage should be handled.

B. Loss of pressure

1. Depends on the rate at which the hydrant discharges and on the make of the hydrant

2. The mains that supply the hydrants should be sufficiently large to deliver the required quantity of water with little loss of head in the main

3. The length of a line of hose should not exceed 400 feet

C. Location of Hydrants

1. Placement
   a. Street intersections
   b. Intermediate points if blocks are comparatively long
   c. Minimum distance of 18 inches from the curb
   d. Easily available for fire use but out of the way of traffic or pedestrians
   e. Never in front of buildings which presents a serious fire hazard

2. Prepared Map
   a. Shows position of all hydrants
   b. Draw circle of 200 or 300 feet radius around each hydrant to show protection given to the various areas in the city
   c. Discuss National Board of Fire Underwriters recommendations for hydrant locations

   Display a map of hydrant locations in a city

D. Firehose and Nozzles

   1. The generally used hose is made of two layers of heavy cotton fiber lined with rubber

   2. Inside hose diameter is 2½ inches, and the nozzle is 1-1/8 inches in diameter

E. Table for hydrant pressures

   Show table of pressure required for hydrants and demonstrate how it is used. Assign students problems to solve.

COURSE OF STUDY

SEWAGE TREATMENT

OBJECTIVES:

To have a knowledge of the types of waste to be treated.
To learn when waste should be treated.
To develop a knowledge of how to treat waste and the equipment used.

CONTENTS:

A presentation of information concerning primary and secondary sewage treatment units, including the oxidation pond. The study of sludge digestion, activated sludge, vacuum filtration and special industrial wastes treatment is included, as well as equipment operation and maintenance.

VISUAL AIDS:

1. "The Coilfilter Story" - color, 16 mm - 20 minutes Oliver.

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1. New York State Department of Health, Manual of Instruction for Sewage Treatment Plant Operators, Health Education Service, Albany 1, New York, 1963.

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6. Rankin, R. S., Sewage Sludge Digestion.

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9. Steel, E. W., Water Supply and Sewerage, McGraw-Hill Book Company, Inc., New York, N. Y.

OUTLINE OF CONTENT	PROCEDURE AND RELATED ACTIVITY
I. What is the value of the pre-treatment of sewage?	
A. Control of Sewage Treatment	
1. Industrial waste serving the sewerage system	
2. The storm water such as roof drains, storm sewers connected to the sanitary sewer and infiltration	Discuss inspection and enforcement of ordinances
B. Classes of industrial waste	
1. Organic waste	
2. Inorganic waste	
C. Savings can be made by in-plant waste reduction	
1. Conservation of materials used in the processes of manufacture	
2. Conservation of process water	
3. Separation of relatively clean waters from other waste water	
4. Equilization or regulation of waste discharge	Discuss control of sewage received at treatment plant and noncontrol of sewage received at the treatment plant.
II. What is the primary treatment of sewage?	
A. The importance of pretreatment	
1. Most of the inorganic and some of the organic waste will pass through the primary process.	
2. Secondary treatment would give a greater reduction of such waste before discharge into the receiving stream.	
B. Purpose of primary treatment	
1. Remove the suspended solids	
a. Floating	Demonstrate the difference between floating and settleable solids
b. Settleable	
2. Decompose the solids removed	
C. Steps of primary treatment	
1. Removal of floating solids and coarse suspended solids	
a. Rocks	
b. Medium screens	Discuss screens and their design
c. Grit Chambers	Discuss grinding and comminutors of sewage after screening
(1) Factors effecting the volume of grit	

(a) Type of sewer system separate or combined
(b) Condition of sewer system
(c) Type of soil
(d) Methods of street cleaning
(e) Frequency and violence of storms

(2) Benefit of grit removal
(a) Reduced wear in pumps
(b) Prevention of accumulation of sediment in settling tanks and digestors
(c) Prevention of clogging of sludge lines

d. Skimming Tanks
(1) Removes grease
(2) Force air into tank to help coagulate the oils on the surface
(3) Long bars called flights are used to skim off grease

Discuss the communities with plants which discharge oil and grease and the methods of removal before dump-into the sewerage plant or stream.

2. Removal of fine suspended solids by primary sedimentation
a. Plain sedimentation tanks with or without mechanical sludge removal devices
b. Septic tanks
c. Imhoff tanks
d. Chemical precipation
e. Raw sewage lagoons

3. Disposal of solids removed
a. Screenings
(1) Burial
(2) Incineration
(3) Sanitary land fill
b. Sludges
(1) Sludge digestion and sludge beds
(2) Raw sludge vacuum filtration and incineration
(3) Applying liquid digested sludge to land with tank trucks
(4) Lagooning of digested sludge

Discuss uses of sludge for soil conditioning

III. What are the factors in the sedimentation process?

A. Sedimentation

1. Uses of sedimentation
a. Primary treatment
b. Final treatment

2. Principles of sedimentation
   a. A particle of matter in a still fluid or less density will move vertically downward because of gravity
   b. Suspended solids in sewage are comparatively light in weight
   c. The density of water increases as temperature decreases

B. Detention period

1. Detention period of a settling tank is the theoretical time the sewage detained in it

Assign students sample problems

   a. $\text{Daily flow in gal.} \times \frac{\text{Detention period in hours}}{24} = \text{capacity required in gallons}$

   b. $\frac{\text{Capacity of tank in gal.} \times 24}{\text{Daily flow in gallons}} = \text{detention time in hours}$

   c. $\frac{\text{Capacity of tank in gal.}}{\text{GPM of flow}} = \text{detention time in minutes}$

C. The flowing through the period

1. Actual time required for the sewage to pass through the tank
2. Can be determined by placing Sodium Chloride in the influent and testing for chlorides in the effluent

D. Velocity

1. Discuss rate of flow

E. Septic sewage

1. Rate of settling of sewage solids will be adversely affected by septic conditions of the sewage

2. Septic action tends to break up the solids into finer particles and the formation of gases

3. Efficiency of the settling process is reduced by gas bubbles

F. Effect of design on settling

1. Tanks
   a. Shape
      (1) Circular
      (2) Rectangular
      (3) Square

Demonstrate the computation of these formulas and have students work examples

1. $\text{Displacement velocity} = \frac{93 \times \text{sewage flow (mgd)}}{\text{Cross section (sq. ft.)}}$

b. Determination of size
   (1) Amount of flow
   (2) Detention period required

2. Tank volume (cu. ft.) = 5570 x rate of sewage flow (mgd) x dention period (hours)

c. Determination of shape and depth
   (1) Velocities
   (2) Overflow rate
   (3) Type of sludge removal equipment

3. Detention period (hr.) = $\frac{\text{Tank volume (cu. ft.)}}{\text{5570 x rate of sewage flow (mgd)}}$

4. Surface loading (gpd per sq.ft.)= $\frac{\text{180 x tank depth (ft)}}{\text{detention period (hr.)}}$

d. Computation of velocities and overflow rate

Assign students some practice design problems to be solved

(1) $\frac{\text{gallons per minute}}{\text{sq.ft. area end section of tank x 7.48 x 60}}$ = velocity in ft. per. sec.

(2) $\frac{\text{gallons per day}}{\text{sq. ft. surface area}}$ = Overflow rate or surface loading

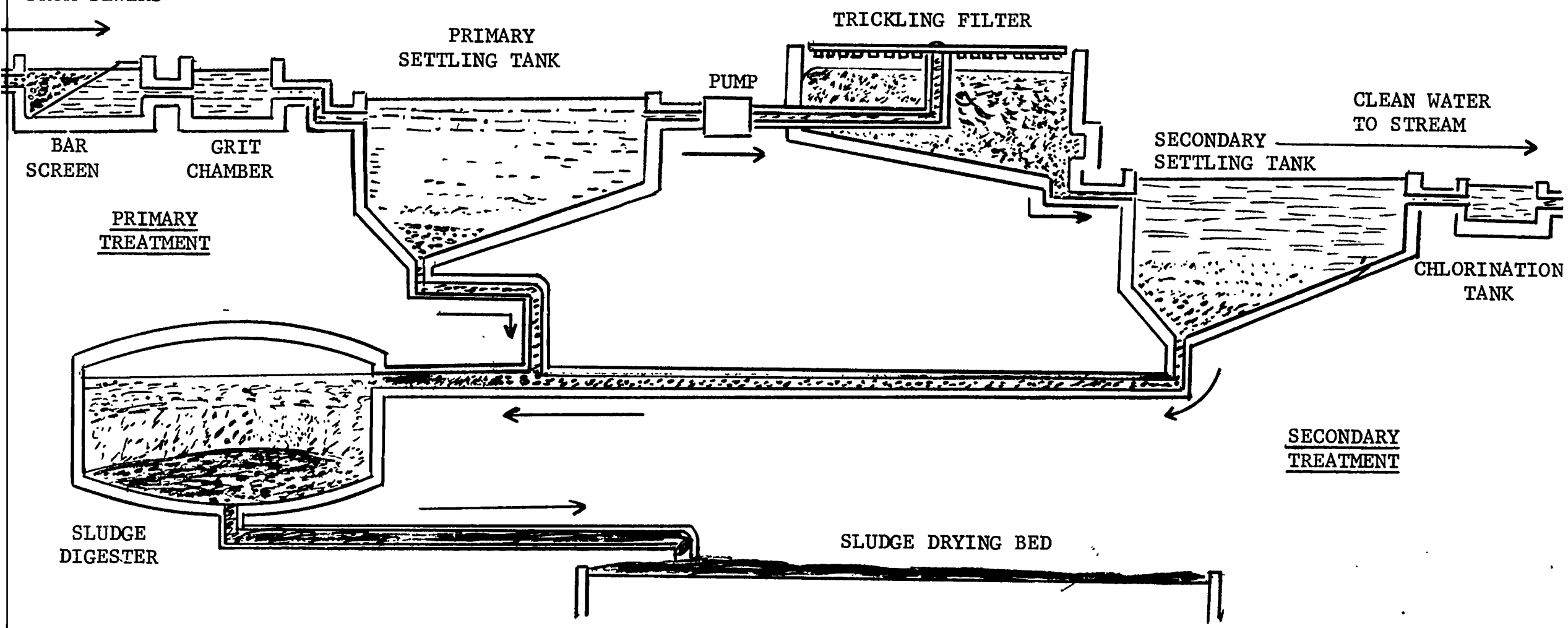
2. Good design of inlets and outlets is important
   a. Types
      (1) Inlets
         (a) Free falling inlet weir
         (b) Submerged openings in the end wall
         (c) Multiple openings
      (2) Outlets
         (a) Submerged weir
         (b) Free falling weir

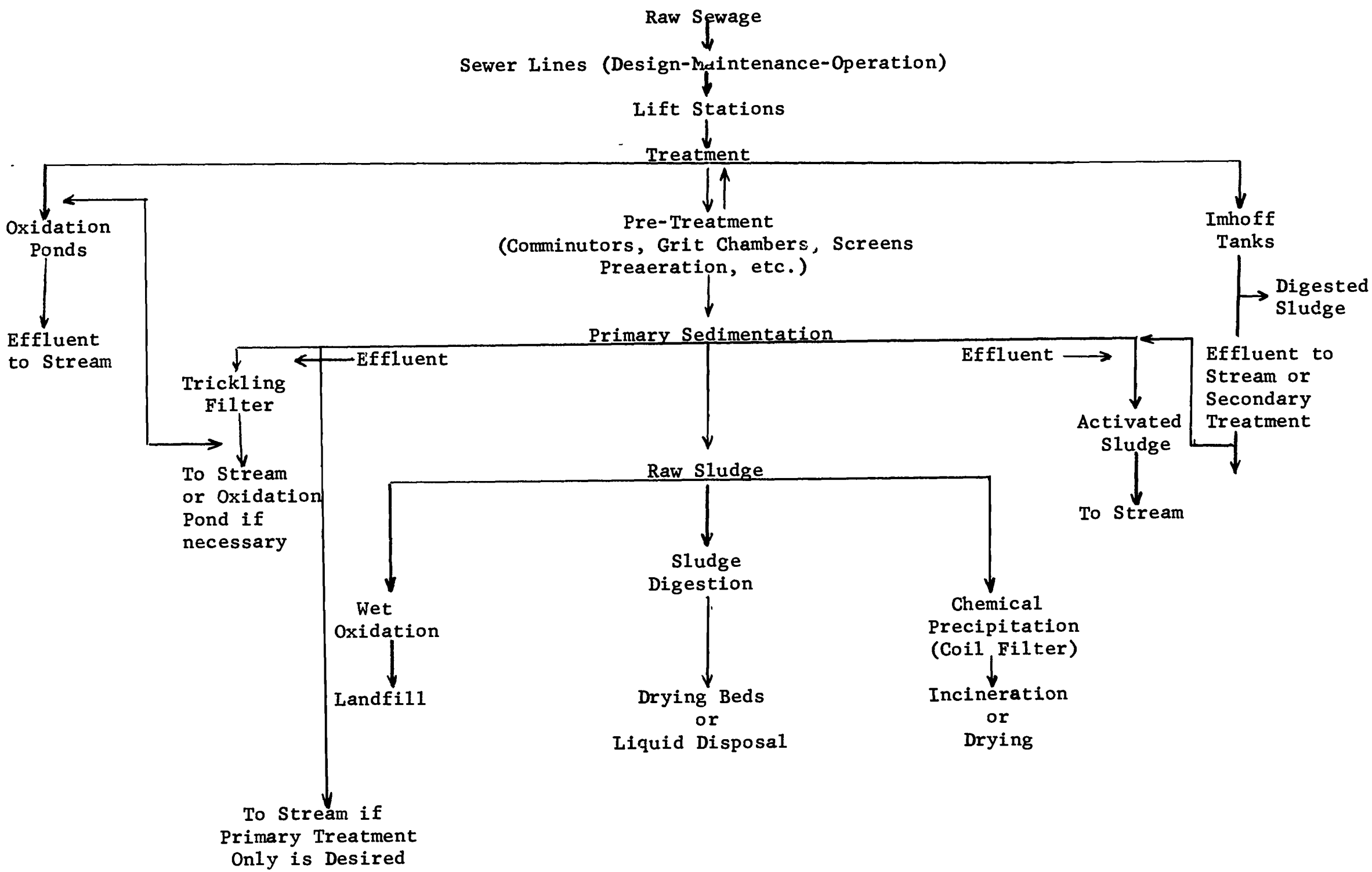
Demonstrate the weir loading formula and have students work some practical problems.

$\frac{\text{gallons per day}}{\text{length of weirs in ft.}}$ = gal. per day per ft. weir

   b. Good operation of a primary sedimentation tank will give these results for two hours sedimentation time.
      (1) Settleable solids removed - 100%
      (2) Suspended solids removed - 60%
      (3) B.O.D. removed - 35%

SEWAGE TREATMENT PLANT




Raw Sewage
Sewer Lines (Design-Maintenance-Operation)
Lift Stations
Treatment
Oxidation Ponds
Effluent to Stream
Pre-Treatment (Comminutors, Grit Chambers, Screens Preaeration, etc.)
Imhoff Tanks
Digested Sludge
Primary Sedimentation
Effluent
Trickling Filter
To Stream or Oxidation Pond if necessary
Effluent
Effluent to Stream or Secondary Treatment
Activated Sludge
To Stream
Raw Sludge
Wet Oxidation
Landfill
Sludge Digestion
Drying Beds or Liquid Disposal
Chemical Precipitation (Coil Filter)
Incineration or Drying
To Stream if Primary Treatment Only is Desired

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Indiana State Dept. of Public Instruction, Indianapolis
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ABSTRACT - Developed by a group of teacher educators, state and local administrators, and high school teachers, this guide is for teacher use in planning a course of study in power mechanics for grades 7 through 12. Following a list of general objectives is the teaching outline of units in: (1) Introduction to Power Mechanics, (2) Power Generation Through Prime Movers, (3) Power Measurement, (4) Power Transmission, (5) Fuels and Lubricants, (6) Internal Combustion Engines, (7) Steam, and (8) Atomic and Solar Energy. Each unit includes teaching activities, student activivies, junior high or senior high school level, technical content outline, text references, and audio-visual materials. A text and reference list, an audio-visual materials and source address list, suggested laboratory facilities and instructional equipment, sources for instructional materials, and sources for free and inexpensive teaching materials are appended. (GR)

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A Guide For Teaching POWER MECHANICS In Industrial Arts In Indiana

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PREFACE

POWER MECHANICS is one of the most significant areas of instruction in industrial arts education. Its importance in our industrial society and the need for a program with challenging standards led to the development of this guide.

Such a program must provide both depth and breadth. It is flexible and broadly applicable for use in grades seven through twelve. It is with this thought in mind that the Guide For Teaching Power Mechanics In Industrial Arts was prepared--a guide to learning opportunities with experiences.

SINCERE APPRECIATION is expressed to the teachers, the Core Committee, the Committee-at-Large, and the Central Curriculum Committee for assistance in preparing and reviewing materials for this guide.

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INTRODUCTION

Our society has evolved into an increasing industrial complex. The continuation and progress of this industrial movement is dependent upon power. It is, therefore, imperative that the knowledge of power production, transmission and utilization advance as rapidly as industrial technology.

Paralleling this dynamic and continuous change, there has been an evolution in general education, including industrial arts. In recent years leaders in the field of industrial arts have begun to assess the role of industrial arts in relation to the study of power. Thus, power mechanics is rapidly becoming an integral part of the industrial arts curriculum.

Power mechanics is a study of man's struggle to convert raw materials into products to meet his needs and desires. It should include not only the contemporary forms but also its history and future potential. The study should include the methods of production, transmission and utilization of power in transportation, communications, manufacturing and services connected with them. Through these studies the student will become aware of the influence of power upon industry as an all pervading element of our society.

OBJECTIVES

1. To develop an appreciation for the many applications of power in the modern world.

2. To develop an appreciation and awareness of good design and workmanship in power producing and power transmitting mechanisms.

3. To stimulate continual study and investigation of new processes and devices affecting our industrial society through the use of power.

4. To stimulate an understanding of the basic principles involved in the development and transmission of power.

5. To develop an understanding of the basic sources of power, their types, their development and their uses.

6. To increase the pupil's knowledge in the selection, purchase and care of various power units.

7. To impress upon the student the importance of safety rules and practices in operating various power units.

8. To provide experience in the selection, identification and safe utilization of tools used in the power mechanics field.

9. To develop within the students the ability to work both independently and cooperatively with other members of the class.

10. To provide experience in repair and maintenance of power units within the ability and environment of the pupil.

11. To provide occupational guidance relating to the Power Mechanics field.

PART I. TEACHING OUTLINE
(How to Use This Guide)

This guide was devised and constructed to aid the power mechanics teacher in constructing a course of study that will meet his particular needs. Part I, the teaching outline, is constructed so that the teacher may use the technical content outline as the basic reference for content material.

The texts and reference column is keyed to the "Texts and References" section in Part II. The "T" referring to text, and the "R" referring to accompanying books, booklets, pamphlets, etc. For example, R21:507 refers to reference 21, chapters 5 to 7. R3:pp. 1-80 refers to reference 3, pages 1 to 80.

The audio-visual column is keyed to the information listed in section two also. The "F" refers to films' the "FS refers to filmstrips' the "SF" refers to slide films; and the "C" refers to charts.

Opposite each page in the teaching outline are columns pertaining to teaching activities, student activities and two levels of teaching. This page is designed for the teacher's use in preparing learning activities to fulfill the objectives as stated on page two. Those interrelated facets of teaching, such as safety, occupational information, time allotment, review and testing can be inserted along with the already listed SUGGESTED ACTIVITIES. The columns referring to levels of teaching were included to afford a means of correlating the student activity with the level of teaching under consideration.

TEACHING ACTIVITIES	STUDENT ACTIVITIES	JR. H.S.	SR. H.S.
Discussion	Bring in articles, illustrations and models relating sources and application of power	X	X
	Construct bulletin board or display of these illustrations and articles	X	X
Discussion and Demonstration	Identification and familiarization	X	X
	Identification and familiarization	X	X
	Identification and familiarization	X	X

TECHNICAL CONTENT OUTLINE	TEXTS REFERENCES	AUDIO-VISUAL
I. Introduction to Power Mechanics		
A. History of Power	T1:1, R1:1, R1:2	
1. Nature's sources		F1
2. Development of external heat engines and power transmission		F2
3. Development of internal heat engines and sophistication of power transmission		FS 1
B. Future of Power		
1. Atomic and solar energy		
2. Direct heat-electricity energy converters		
C. Laboratory Management	R2, R13	F 3-5
1. Tools		
a. Hand tools		
1) Screwdrivers		C 1-3
2) Pliers		
3) Wrenches		
4) Hacksaws		
5) Files		
6) Chisels and punches		
7) Arbor press		
8) Reamers		F 6-10
b. Power tools		
1) Drills		
2) Grinders		
3) Buffers		
4) Lathes		
c. Precision measuring instruments		
1) Micrometer		F 11-17
2) Feeler gauge		FS 2
3) Dial indicator		C 4
4) Torque wrench		
d. Special tools and equipment (to be introduced as required)		
2. Safety	T1:4	F 18
3. Procedures		F 19
a. Soldering		
b. Cutting and chasing threads		
c. Stud removal		
4. Materials (to be introduced as required)		F 20-31

TEACHING ACTIVITIES	STUDENT ACTIVITIES	JR. H.S.	SR. H.S.
Discussion and Demonstration			
	Disassemble and reassemble 4-cycle and 2-cycle lab. engine	X	X
	Identification & familiarization of parts, systems	X	X
	Measurements:		
	Tolerances, I.D., O.D.,		X
	Clearances		X

TECHNICAL CONTENT OUTLINE	TEXTS REFERENCES	AUDIO-VISUAL
II. Power Generation Through Prime Movers		
A. Classification, designs and applications	R9	F 32,33
B. Operating principles of spark ignition engines		FS 3
1. 4-stroke cycle engines	R1:3-9	C 5,6
2. 2-stroke cycle engines	R21:5-7	

TEACHING ACTIVITIES	STUDENT ACTIVITIES	JR. H.S.	SR. H.S.
Discussion & Demonstration			
	Measure bore and stroke of an engine	X	X
	Problems in computing horsepower	X	X
	Test run engine on dynamometer		X

TECHNICAL CONTENT OUTLINE	TEXTS REFERENCES	AUDIO-VISUAL
III. Power Measurement	R1:2 & 10	
A. Introduction		
1. Mass		
2. Time		
3. Distance		
B. Measurements		
1. Linear		
2. Square		
3. Cubic		
4. Liquid		
5. Circular or degrees		
6. Electricity		
7. Temperature		
8. Weight		
9. Ratio		F 34,35
C. Terminology		
1. Work		
2. Energy		
3. Power		
4. Inertia		
5. Torque		
6. Horsepower		
D. Determining Engine Size		FS 4
1. SAE horsepower		
2. Indicated horsepower		
3. Brake or developed horsepower		
4. Friction horsepower		
E. Measuring Engine Efficiency		
1. Mechanical		
2. Thermal		
3. Volumetric		

TEACHING ACTIVITIES	STUDENT ACTIVITIES	JR. H.S.	SR. H.S.
Discussion			
Discussion and Demonstration	Disassemble bicycle components	X	
	Disassemble various gear arrangements:		
	1. Automotive transmission		X
	2. Steering sector	X	X
	3. Differentials	X	X
	4. Plastic planetary gears from commercial models	X	
	Check: Tooth alignment, clearance, backlash, contact, wear		X
	Identify types of bearings	X	X
Discussion	Check bearing conditions		X

TECHNICAL CONTENT OUTLINE	TEXTS REFERENCES	AUDIO-VISUAL
IV. Power Transmission		
A. Mechanical	R 3:pp 1-80	
1. Principles	T1:1, R1:8	F 36, 37
a. Simple machines		
1) Lever		FS 5
2) Wheel and axle		
3) Inclined plane		
4) Pulley		
5) Wedge		
6) Screw		
2. Basic mechanisms	T1:1	
a. Pulley and belt		FS 6
b. Sprocket and chain		
c. Cam and eccentric		
d. Bell crank and lever		
e. Piston and cylinder		
f. Spring		
g. Shafts		
1) Extension		
2) Crank		
3) Cam		
h. Couplers		
1) Positive		
2) Friction		
3) Fluid		
i. Gears		F 38
1) Types of teeth		
a) Spur		
b) Helical		
c) Spiral		
2) Arrangements		
a) Internal teeth		
b) External teeth		
c) Rack and pinion		
d) Worm		
e) Bevel		
f) Herringbone		
g) Idlers		
h) Planetary combinations		
j. Bearings		F 39-42
1) Plain		
a) Solid		
b) Bushing		
c) Split (insert)		
2) Antifriction		
a) Ball		
b) Roller		
c) Pin or needle		
3) Materials		
a) Requirements and conditions		
b) Metals		
c) Nonmetals		

TEACHING ACTIVITIES	STUDENT ACTIVITIES	JR. H.S.	SR. H.S.
Discussion and Demonstration			
	Hydraulic jack experiments	X	X
	Disassemble various types of pumps, valves, etc.	X	X
	Diagram simple hydraulic circuits	X	X
	Construct simple hydraulic circuit	X	X
	Trouble shoot hydraulic malfunctions		X
Discussion and Demonstration	Disassemble compressors and pumps	X	X
	Trace air supply circuit for laboratory.		
	Identify components service air supply system for laboratory	X	X
	Construct simple pneumatic circuit		X
Discussion			

TECHNICAL CONTENT OUTLINE	TEXTS REFERENCES	AUDIO-VISUAL
d) Lubricant impregnation		
4) Applications		
a) Radial		
b) Axial		
c) Load and speed		
3. Maintenance and lubrication of basic mechanisms		
B. Hydraulic	B 14	F 43-47
1. Principles		
a. Incompressibility of liquids		
b. Multiplication of forces		
c. Hydrodynamics		
2. Components and symbols		
a. Pumps		
b. Motors		
c. Valves		
d. Reservoirs		
e. Lines		
f. Cylinders		
g. Accessory components		
3. Circuitry		
4. Fluids		
5. Trouble-shooting		
6. Applications	R 22:12	
C. Pneumatic	R 15-18	F 48
1. Principles		
2. Components and symbols		
a. Reciprocating compressors		
b. Rotary compressors		
c. Lobe type		
d. Liquid piston		
e. Centrifugal		
f. Axial flow		
g. Vacuum pumps		
h. Combination vacuum pumps and compressors		
3. Circuitry		F 49-51
4. Maintenance and safety		
5. Applications		
D. Electrical		F 49-51
1. Magnetic	T 1:2	
2. Conductors		
3. Micro-wave		

TEACHING ACTIVITIES	STUDENT ACTIVITIES	JR. H.S.	SR. H.S.
Discussion and Demonstration			
	Construct display of products derived from fractionating tower	X	X
	Construct graphic display of various types of oils and greases emphasizing their application	X	X

TECHNICAL CONTENT OUTLINE	TEXTS REFERENCES	AUDIO-VISUAL
V. Fuels and Lubricants		
A. Introduction		F 54-66
1. Crude oil production		
2. Manufacturing process		
3. Fuels	R 1:4	
a. Gasoline		
b. Fuel oil		
c. Gas		
4. Lubricants	R 1:5,	
a. Oils	R 20	
b. Greases		

TEACHING ACTIVITIES	STUDENT ACTIVITIES	JR. H.S.	SR. H.S.
Discussion and Demonstration			
	Start, operate and stop small gasoline engine	X	X
	Troubleshoot small gasoline engine	X	X
	Tune-up small gasoline engine	X	X
Demonstration	Overhaul live air cooled engine		
	Disassemble outboard engine		X
Discussion	Inspect and reassemble engine		X

TECHNICAL CONTENT OUTLINE	TEXTS REFERENCES	AUDIO-VISUAL
VI. Internal Combustion Engines		
A. Small Gasoline Engines	T1:3,R1:	R 67
1. Introduction--History, Designs and Applications	3-9,R9, R21:2	
2. Operating procedures and safety		
3. Trouble-shooting procedures	R21:9	
a. Will not start		
b. Hard to start		
c. Vibrates		
d. Misses		
e. Surges		
f. Overheats		
g. Loss of power		
h. Uses oil		
i. Noises		
4. Tune-up	R19	
a. Compression		
b. Fuel system	R21:3	
c. Ignition system	R21:4	
5. Overhaul and repair procedures		SF 1
a. 4-stroke cycle		
1) Disassembly		
2) Dimensional inspection		
3) Reconditioning		
a) Valves		
b) Cylinder		
c) Bearings		
4) Reassembly		
5) Adjustment		
b. 2-stroke cycle		
1) Disassembly		
2) Dimensional inspection		
3) Reconditioning		
a) Valves		
b) Cylinder		
c) Bearings		
4) Reassembly		
5) Adjustment		
6. Maintenance	R21:9	
B. Outboard Engines	R4, R10	
1. Introduction--History, Designs and Applications		
2. Power Head		
3. Lubrication Systems		
4. Cooling Systems		
5. Fuel Systems		
6. Ignition Systems		
7. Charging Systems		
8. Cranking Systems		
9. Power Train		
10. Operational Safety		

TEACHING ACTIVITIES	STUDENT ACTIVITIES	JR. H.S.	SR. H.S.
Discussion and Demonstration	Make visual inspection of components		X
	Take precision measurements of components		X

TECHNICAL CONTENT OUTLINE	TEXTS REFERENCES	AUDIO-VISUAL
C. Automotive Engines	R23:26	F 68-73
1. Introduction--History, Designs and Applications	R5:pp 1-46 R1:11, R11,	C 7 F 74-76
2. Mechanical Systems	R22:1&2	F 77-81
3. Lubrication Systems	R22:5	
a. Types of lubrication systems		
1) Splash		
2) Pressure		
3) Combination		
b. Component parts		
1) Crankcase		
2) Strainer		
3) Pump		
4) Oil lines		
5) Relief Valve		
6) Oil gauge		
7) Filter		
8) Crankcase breather tubes		
4. Cooling Systems	R22:4	F 82-87
a. Transfer of heat		
1) Conduction		
2) Convection		
3) Radiation		
b. Types		
1) Air cooled		
2) Liquid cooled		
a) Thermal syphon circulation		
b) Pump or forced		
c. Component parts, their function and operation		
1) Water jacket		
2) Water pump		
3) Fan		
4) Radiator		
5) Pressure cap		
6) Thermostat		
7) Hoses		
d. Antifreezes and inhibitors		
1) Alcohol		
2) Ethylene glycol		
3) Rust inhibitor		
e. Cooling system troubles and remedies		
1) Overheating		
2) Overcooling		
3) Loss of Coolant		
4) Circulation system noisy		
5. Fuel Induction and Governor Systems	R22:6	
a. Component parts, their function and operation		
1) Gasoline tank		
2) Fuel lines		
3) Fuel pump		
4) Carburetor		

TEACHING ACTIVITIES	STUDENT ACTIVITIES	JR. H.S.	SR. H.S.
Discussion and Demonstration		X	X
	Disassemble and reassemble		X
	Disassemble and reassemble		X
	Disassemble and reassemble		X

TECHNICAL CONTENT OUTLINE	TEXTS REFERENCES	AUDIO-VISUAL
5) Intake manifold		
6) Combustion chamber		
7) Exhaust manifold		
8) Exhaust pipe		
9) Muffler		
10) Tailpipe		
b. Fuel pumps		F 88
1) Method of drive		
a) Pressure		
b) Vacuum		
c) Electric		
2) Theory of operation		
c. Carburetors		
1) Theory of operation		F 89
a) Float system		FS 7
b) Idle system		C 8
c) Main metering system		
d) Power system		
e) Accelerator pump system		
f) Choke system		
2) Maintenance and overhaul		
a) Automatic choke		
b) Adjusting idle valves		
c) Float level		
d. Air filters		
1) Oil wetted		
2) Oil bath		
3) Dry element		
e. Fuel injection		F 90-91
6. Ignition Systems	R6, R22:3	F92
a. Primary circuit		FS 8, 9
1) Battery		
2) Switch		
3) Coil		
4) Distributor		
5) Condenser		
b. Secondary circuit		
1) Coil		
2) Distributor		
3) Spark plug		
4) Ammeter		
c. Distributor		F 93
1) Rotor		
2) Breaker points		
3) Condenser		
4) Cap		
5) Spark advance mechanism		
6) Maintenance		
a) Lubrication		
b) Breaker points and condenser		
c) Rotor cap terminals		

TEACHING ACTIVITIES	STUDENT ACTIVITIES	JR. H.S.	SR. H.S.
Discussion and Demonstration		X	X
	Disassemble and reassemble		X
	Test components and systems		X
	Disassemble and reassemble transmission	X	X

TECHNICAL CONTENT OUTLINE	TEXTS REFERENCES	AUDIO-VISUAL
d. Spark plug		F 94-96
1) Inspection		
2) Cleaning		
3) Adjusting		
4) Heat range		
e. Transistorized ignition systems		
7. Charging and Cranking Circuits	R7, R8	F 97
a. Storage battery		
1) Construction		
2) Chemical action		
3) Ratings		
a) Ampere hour		
b) Cold rate		
4) Service and maintenance		
a) Water level		
b) Care of case and carrier		
c) Testing		
d) Charging		
b. Generator-AC. and DC.		FS 10,11
1) Theory of operation		
2) Service and maintenance		
a) Fan belt		
b) Wiring		
c) Brushes		
d) Commutator		
c. Cranking motor		FS 12
1) Theory of operation		
a) Motor		
b) Drive		
c) Switches		
d. Generator regulators-AC. and DC.		
1) Cut-out relay		
2) Amperage regulation		
3) Voltage regulation		
8. Power Train		
a. Location and relationship of units		F 98
b. Clutch	R 22:9	
1) Purpose		
2) Theory		
3) Causes of failure		
c. Standard shift transmission	R22:10	F 99,100
1) Purpose		
a) Torque		
b) Speed		
2) Theory of operation	R22:11	
a) Four shafts		
b) Positive clutch and sliding gear		
c) Gear ratio		
3) Power flow	R22:13	

TEACHING ACTIVITIES	STUDENT ACTIVITIES	JR. H.S.	SR. H.S.
	Disassemble and reassemble differential	X	X
	Disassemble and reassemble mock-up hydraulic brake system		X
Discussion	Disassemble model Diesel engine	X	X
Discussion	Construct and/or examine plastic model	X	X
	Disassemble, reassemble and operate model airplane engine	X	
Discussion	Construct and/or examine plastic model	X	X

TECHNICAL CONTENT OUTLINE	TEXTS REFERENCES	AUDIO-VISUAL
d. Automatic Transmissions		F 101-104
1) Fluid couplings and torque converters		
2) Planetary gear		
3) Valve body and servo mechanisms		
e. Drive shaft and universal	R22:14	
1) Purpose		
2) Maintenance		
f. Differential		F 105
1) Purpose		
2) Theory of operation		
3) Power flow		
g. Steering system		F 106
h. Braking system		F 107
D. Diesel		
1. Introduction--History, Designs and Applications	R1:12, R5: pp 79-100	F 108-112
2. Operating principles		
3. Induction and exhaust systems		
4. Fuel systems		
5. Starting procedures		
E. Aircraft--Reciprocating	R5:pp.47-78	F 113-114
1. Introduction--History, Designs and Applications		
2. Operating principles		
a) Spark ignition		
b) Compression ignition		
3. Lubrication systems		
4. Cooling systems		
5. Fuel systems		
6. Ignition systems		
7. Instrumentation		
F. Reaction	R1:13	F 115, 116
1. Introduction--History, Designs and Applications		C 9
2. Operating principles		
3. Systems and components		
a) Air inlet duct		
b) Compressor		
1) Centrifugal		
2) Axial		
3) Dual axial		
c) Diffusers		
d) Fuel manifolds and nozzles		
e) Burner section		
1) Combustion chambers		
2) Can-type burner		
3) Annular burner		

TEACHING ACTIVITIES	STUDENT ACTIVITIES	JR. H.S.	SR. H.S.
Discussion	Study classification of rocket engines utilized by NASA in space program	X	X
Discussion	Reports on applications	X	X

TECHNICAL CONTENT OUTLINE	TEXTS REFERENCES	AUDIO-VISUAL
f) Turbines g) Exhaust ducts h) Thrust reversers i) Engine noise suppressors j) After burner k) Accessories 1) Airbleed driver 2) Machine driver l) Starters m) Fuel systems n) Turboprop fuel controls o) Lubrication systems p) Ignition systems q) Engine cooling r) Engine insulation blankets s) Liquid injection		F 117-118
G. Rocketry 1. Introduction--History, Designs and Applications 2. Operating principles 3. Fuels a) Liquid b) Solid 4. Systems and components	R1:14	F 119-129
H. Gas Turbines 1. Introduction--History, Designs and Applications 2. Operating principles 3. Systems and components	R1:15	F 130-132

TEACHING ACTIVITIES	STUDENT ACTIVITIES	JR. H.S.	SR. H.S.
Discussion	Construct and/or examine model steam engine	X	X
Class tour through local power plant	Construct and/or examine model steam turbine engine	X	X

TECHNICAL CONTENT OUTLINE	TEXTS REFERENCES	AUDIO-VISUAL
VII. Steam A. Reciprocating 1. Introduction--History, Designs and Applications 2. Operating principles 3. Systems and components B. Turbines 1. Introduction--History, Designs and Applications 2. Operating principles 3. Systems and components	R1:16	F 133

TEACHING ACTIVITIES	STUDENT ACTIVITIES	JR. H.S.	SR. H.S.
Discussion	Construct and/or examine plastic atomic reactor model	X	X
	Construct and/or examine solar battery	X	X

TECHNICAL CONTENT OUTLINE	TEXTS REFERENCES	AUDIO-VISUAL
VIII. Atomic and Solar Energy		
A. Atomic Energy	R1:18,R28	F 134-148
1. Introduction--History, Designs and Applications		
2. Nature of matter		
3. Atomic fission	R28	
4. Nuclear reactor		
B. Solar Energy	R1:19	F 149,150
1. Introduction--History		
2. Solar Battery		

TEACHING ACTIVITIES	STUDENT ACTIVITIES	JR. H.S.	SR. H.S.
Discussion			
	Class reports and experiments	X	X
Demonstrate model fuel cell			

TECHNICAL CONTENT OUTLINE	TEXTS REFERENCES	AUDIO-VISUAL
IX. Experimental Power Sources A. Internal Combustion Engines B. External Combustion Engines C. Direct Energy Converters 1. Thermionic Converters 2. Magnetohydrodynamic Generators 3. Thermoelectric Converters 4. Thermophotovoltaic Converters 5. Fuel Cell D. Others	R1:20	

PART II. RESOURCE MATERIALS

The following lists of resource materials are by no means complete nor exhaustive. They merely represent a compilation of the best and most available materials known and used by the members of the committee.

The texts and references list was compiled to afford a more complete bibliography of reading material designed for Junior and Senior High School students.

The audio-visual materials list was assembled in order of use if the teacher follows the technical content outline in its logical sequence; that is, chronologically and from the simple to the complex. The sources for audio-visual materials were assembled alphabetically for convenient reference.

Laboratory facilities were listed according to the type of laboratory and level of teaching. The "N" refers to items considered needed, and the "D" refers to items considered desirable. A blank in the general shop column indicates it would ordinarily be available because of the nature of the program being offered within the laboratory. The "X" in the columns referring to the levels of teaching will identify the items required at that particular level. The quantity of each item was arbitrarily based upon sixteen students per class.

T1 Glenn, H. T., Exploring Power Mechanics, Chas. A. Bennett Co., Peoria, Illinois, 1962.

R1 Stephenson, G. E., Power Mechanics, Delmar Publishing Co., Albany, N.Y., 1963.

R2 ABC's of Hand Tools, General Motors Corp., General Motors Bldg., Detroit 2, Michigan.

R3 Power Goes To Work, General Motors Corp., General Motors Bldg., Detroit 2, Michigan.

R4 Venk, Complete Outboard Boating Manual, American Technical Society, Chicago, Illinois.

R5 A Power Primer, General Motors Corp., General Motors Bldg., Detroit 2, Michigan.

R6 20,000 Volts Under the Hood, Delco-Remy, Inc., Anderson, Indiana.

R7 Regulation and the Charging Circuit, Delco-Remy, Inc., Anderson, Indiana.

R8 The Cranking Circuit, Delco-Remy, Inc., Anderson, Indiana.

R9 Small Engines Service Manual, Technical Publications, Kansas City, Missouri.

R10 Outboard Motors Service Manual, Technical Publications, Kansas City, Missouri.

R11 Motors Auto Repair Manual, Motor Book Co., New York, N. Y.

R12 A Story of Power, General Motors Corp., General Motors Bldg., Detroit 2, Michigan.

R13 Precision, A Measure of Progress, General Motors Corp., General Motors Bldg., Detroit 2, Michigan

R14 Industrial Hydraulics Manual, 935100, Vickers, Inc., Detroit, Michigan.

R15 The Fundamentals of Compressed Air Power, Compressed Air and Gas Institute, 55 Public Square, Cleveland 13, Ohio.

R16 Compressed Air Power in Manufacturing, Compressed Air and Gas Institute, 55 Public Square, Cleveland 13, Ohio.

R17 Compressed Air Power in Construction, Compressed Air and Gas Institute, 55Public Square, Cleveland 13, Ohio.

R18 Compressed Air and Gas in the Process Industries, Compressed Air and Gas 55 Public Square, Cleveland 13, Ohio

R19 Factors Which Influence Engine Knock, Dupont and Co., Wilmington 98, Delaware.

R20 Know Your Motor Oil, American Petroleum Institute, 1271 Avenue of the Americas, New York 20, N. Y.

R21 Atteberry, P. H., Power Mechanics, Goodheart-Wilcox Co., 1322 S. Wabash, Chicago, Illinois, 1961.

R22 Stockel, M. W., Auto-Mechanics Fundamentals, Goodheart-Wilcox, 1322 S. Wabash, Chicago, Illinois.

R23 Venk, Automotive Fundamentals, American Technical Society, Chicago, Illinois.

R24 Glenn, H. T., Automechanics, Chas. A. Bennett Co., Peoria, Illinois, 1960.

R25 Crouse, W., Automotive Mechanics, McGraw-Hill Book Co., Chicago, Illinois, 4th Edition.

R26 Beeler, S., Understanding Your Car, McKnight and McKnight Publishing Co., Bloomington, Illinois, 1958.

R27 Stephenson, G. E., Small Gasoline Engines, Delmar Publishing Co., Peoria, Illinois, 1964.

R28 Habor & Heinz, The Walt Disney Story of Our Friend the Atom, Simon & Schester Publishing Company, 1956.

R29 Duffy, Joseph W., Power: Prime Mover of Technology, McKnight & McKnight Publishing Company, 1964

AUDIO VISUAL MATERIALS

Films (F)

TITLE	SOURCE
1. Introduction to the Heat Engine	Shell
2. Engines and How They Work	Coronet
3. ABC's of Hand Tools (Parts I and II)	GMC
4. Use and Care of Hand Tools (Part I-Wrenches) TF-9-2026	U. S. Army
" " " " " " (Part II-Pliers) TF-9-2027	" "
" " " " " " (Part III-Chisels) TF-9-2028	" "
" " " " " " (Part IV-Hammers) TF-9-2029	" "
" " " " " " (Part V-Punches) TF-9-2030	" "
" " " " " " (Part VI-Hacksaws) TF-9-2031	" "
5. Files, How to Choose and Use	Simonds
6. Bench Grinder, Hand Tools and Power Tools, Operation and Care, TF-10-929	U. S. Army
7. Grinding Wheels and Their Applications	Simonds
8. Electric Drills, Hand Tools and Power Tools, Operation and Care, TF-10-930	U. S. Army
9. Uses and Abuses of Twist Drills	Cleveland
10. Grinding Wheel Safety	Norton
11. Age of Precision	Cinn
12. Dial Indicator Gages	Fed Pro
13. Dimensional Gaging With Air	Fed Pro
14. Electronic Gaging	Brown
15. Gaging for Profit	Brown
16. Progress in Precision	Mi Ho Co
17. Optical Gaging	Mi Ho Co
18. Shop Safety, TF-9-2085	U. S. Army
19. Automatic Broaching	La Pointe
20. The Making, Shaping and Treating of Steel	USS

TITLE	SOURCE
21. Chemistry of Aluminum	Reynolds
22. Corrosion of Aluminum	Reynolds
23. Drama of Metal Forming	Shell
24. Drama of Steel	USBM
25. Heat Treatment of Steel	ASM
26. How Metals Behave	ASM
27. Iron Carbon Alloys	ASM
28. Lead from Mine to Mine	USBM
29. Modern Steel Making	USS
30. Rhapsody of Steel	USS
31. Tin Plate	USBM
32. ABC's of Internal Combustion Engine	GMC
33. Principles of Electricity	GE
34. Work, Energy and Power	UWF
35. Elementary Principles of Torque, TF-9-1286	U. S. Army
36. Simple Machines Series	Coronet
37. Lever Age	Shell
38. Automotive Gears, Principles of Operation, TF-9-1282	U. S. Army
39. Handle With Care	GMC
40. Mysterious Precision Ball	Ind. Tect.
41. Metallic Bearing Surfaces	Mi Ho Co
42. Manufacturing Planet Pinions	GMC
43. Harnessing Liquids	Shell
44. Principles of Hydraulic Systems, TF-9-2995	U. S. Army
45. Mechanical Refrigeration, MF-10-7527	U. S. Army
46. Torque Converter Story	Al Chal
47. High Temperature Hydraulic Systems	Autonetics
48. Compressed Air Power	Modern

TITLE	SOURCE
49. Air At Work	Gardner
50. Air Brakes, Principles of Operation, TF-9-2064	U. S. Army
51. Air Brakes, Operation and Maintenance, Parts I and II	Ben Wes
52. Magnetic Effects of Electricity	Ency. Brit.
53. Corrosion in Action, Parts I and II	Roth
54. Gasoline, Parts I and II	Ethyl
55. What Makes Today's Gasoline Good	Ethyl
56. Eye Witness Report (Gasoline Blending)	Sunoco
57. Make Me Useful	Pure
58. Story of Gasoline	USBM
59. Corrosive Action, Part III	Roth
60. Barrel Number One	API
61. Crude Oil Distillation	Shell
62. Prospecting For Petroleum	Shell
63. Rubber From Oil	USBM
64. Story of Lubricating Oil	USBM
65. Ten Thousand Feet Deep	Shell
66. Powering America's Progress (Coal)	Modern
67. Theory of Operation of Four Pole Magneto	Scintilla
68. Background For Leadership	PCC
69. The Rouge	Ford
70. The Secret Door	Ford
71. The American Road	Ford
72. Wolfsburg 221 (Volkswagon)	Modern
73. Challenge and Response (Engine Research)	GMC
74. Where Mileage Begins	GMC
75. ABC's of Automobile Engine	GMC
76. Story of Oil Filters	PCC

TITLE	SOURCE
77. Valves	Ethyl
78. Case of the Slippery Oil	PCC
79. Riding the Oil Film	Jam
80. Story of Oil Filters	GMC
81. The Why of Auto Lubrication	USBM
82. Cooling System	Ethyl
83. Cooling System Anti-Freeze	Union
84. The Rising Tide	Union
85. Anti-Freeze	National
86. Heat, Its Nature and Transfer	Ency. Brit.
87. Your Moving Target	Dynamic
88. Fuel Pump, Principles of Operation, TF-9-1447	U. S. Army
89. The Carburetor	Ethyl
90. Fuel Injection	Ethyl
91. Supercharging and Fuel Injection, TF-9-2240	U. S. Army
92. The Electrical System	Ethyl
93. The Distributor	Ethyl
94. Spark Plugs	Ethyl
95. Story of the Modern Spark Plug	Champion
96. Ignition and Spark Plugs, TF-25-152	U. S. Army
97. Story of the Storage Battery	Willard
98. Automotive Clutch, TF-9-1264	U. S. Army
99. Automotive Transmission, TF-9-1269	U. S. Army
100. Syncromesh Transmission, TF-9-1213	U. S. Army
101. Fluid Coupling, Principles of Operation, TF-9-1953	U. S. Army
102. Torque Converter, TF-9-1427	U. S. Army
103. Planetary Gears, Single Sets, TF-9-1855	U. S. Army
104. Planetary Gears, Multiple Sets, TF-9-1856	U. S. Army

TITLE	SOURCE
105. Bevel Gear Differential, TF 9-1268	U. S. Army
106. Hydraulic Steering, TF-9-2254	U. S. Army
107. Hydraulic Brakes, TF-9-2065	U. S. Army
108. The Diesel Story	Shell
109. Construction of the Diesel Engine, MF-9-1090	U. S. Army
110. ABC's of Diesel Engine	GMC
111. Diesel, the Modern Power	GMC
112. Giants In the Land	GMC
113. We Saw It Happen, SFP-355	United
114. Opposed Piston Horsepower	Modern
115. Introduction to Jet Engine	McGraw
116. ABC's of the Jet Engine	GMC
117. New Power for Flight	GMC
118. Horizons Unlimited	Modern
119. Rockets, How They Work	Ency. Brit.
120. Father of the Space Age	NASA
121. F-1, Mightiest Rocket Engine	Rocketdyne
122. Saturn, Giant Thrust Into Space	NASA
123. Saturn Propulsion	NASA
124. X-15 Documentary	NASA
125. Missiles, Fuels, Propellants and Oxidizers, TF-1-5384a	U.S.A.F.
126. Rocket Club, SFP-G-74	U.S.A.F.
127. The Solid Punch	Thickol
128. The Story of Thor	Sterling
129. Your Share in Space	Assn
130. Gas Turbine	Shell
131. Firebird III	GMC
132. 21st Century Power	Boeing

TITLE		SOURCE
133.	Powerhouse on Wheels	Modern
134.	Atomic Physics, History and Development of Atomic Power	AEC
135.	A Is For Atom	AEC
136.	Atom and Industry	AEC
137.	Atom and You	AEC
138.	Atom Comes to Town	AEC
139.	Atom Goes to Sea	AEC
140.	Atomic Metallurgy	AEC
141.	Atomic Physics, Parts I-V	AEC
142.	Atom Smashers	AEC
143.	Industrial Atom	AEC
144.	Petrified River	USBM
145.	Unleashing the Atom	GE
146.	Atomic Energy	AEC
147.	Atomic Furnace	AEC
148.	Basic Principles of Power Reactors	AEC
149.	Our Mr. Sun	Bell
150.	Solar Energy	Almanac

Filmstrips (FS)

1.	How Man Uses Fuel	Pop Sc
2.	Precision, The Measure of a Craftsman	Jam
3.	Operating Principles of the 4Cycle, Parts 1 and 2	Ford
4.	What Is Horsepower (1950)	Pop Sc
5.	Simple Machines Make Work Easier	Pop Sc
6.	Pulleys Make Work Easier (1950)	Pop Sc
7.	The Rochester Carburetor BAI	UMS
8.	Introduction to the Automotive Electrical System	Delco
9.	20,00 Volts Under the Hood	Delco
10.	Regulation and Charging Circuit	Delco

Filmstrips (FS) (cont.)

11. Delotron Alternator	Delco
12. The Cranking Circuit	Delco

Slide Films (SF)

1. Briggs and Stratton Series	Briggs

Charts (C)

TITLE	SOURCE
1. Tool Charts	Proto
2. Tool Charts	Snap-On
3. Tool Charts	Bonney
4. How to Read a Micrometer	Lufkin
5. Principles of Operation (4 cycle) (Series)	Briggs
6. Lawn Boy - 2 Cycle	Lawn-Boy
7. Automotive Systems (Series)	GMC
8. Carburetor Charts	Tillotson
9. Jet Engines (cut away pictures)	GE

SOURCES FOR AUDIO-VISUAL MATERIALS

CODE	ADDRESS
AEC	Atomic Energy Commission Film Library Portsmouth, Ohio
Al Chal	Allis Chalmers Mfg. Co. Milwaukee 1, Wisconsin
Almanac	Almanac Films 516 5th Avenue New York 18, N. Y.
API	American Petroleum Institute 50 West 50th St. New York 20, N. Y.
ASM	American Society For Metals Mr. T. C. DuMond Metals Park, Ohio
Assn	Association Films, Inc. 561 Hillgrove Ave. LaGrange, Illinois
Autonetics	Autonetics Division North American Aviation, Inc, Public Relations Dept. 9150 East Imperial Highway Downey, California
Bell	Indiana Bell Telephone Co. Indianapolis, Indiana
Ben Wes	Bendix-Westinghouse Automotive Brake Co. 901 Cleveland St. Elyria, Ohio
Boeing	Boeing Co. Industrial Products Div. P. O. Box 3655 Seattle 5, Washington
Bonney	Bonney Forge and Tool Works 2398 N. Rockhill Rd. Alliance, Ohio
Briggs	Briggs and Stratton Corp. Milwaukee 1, Wisconsin
Brown	Brown and Sharp Mfg. Co. 235 Promenade St Providence, Rhode Island

CODE	ADDRESS
Champion	Champion Spark Plug Co., Film Dept. 900 Upton Avenue Toledo 1, Ohio
Cinn	Cincinnati Milling Machine Co. Advertising Dept. 4701 Marbary Avenue Cincinnati 9, Ohio
Cleveland	The Cleveland Twist Drill Co. Mr. W. E. Wenger, Advertising Manager 1242 East 49th Street Cleveland 14, Ohio
Coronet	Coronet Films Coronet Bldg. Chicago, Illinois
Delco	Delco-Remy Div. General Motors Corp. Anderson, Indiana
Dynamic	General Dynamic Corp. Communications Dept. San Diego, California
Ency. Brit.	Encyclopedia Britannica Films, Inc. 1150 Wilmette Avenue Wilmette, Illinois
Ethyl	Ethyl Corp. 100 Park Avenue New York 17, N. Y.
Fed Pro	Federal Products Corp. Sales Promotion Dept. 1144 Eddy Street Providence, Rhode Island
Ford	Ford Motor Co., Film Library 16400 Michigan Avenue Dearborn, Michigan
Gardner	Gardner-Denver Co. Film Library Quincy, Illinois
GE	General Electric Co. Educational Relations Dept. M.H.W. Schenectady, N. Y.
GMC	General Motors Corp. Public Relations Staff, Film Library 3044 Grand Blvd. Detroit 2, Michigan

CODE	ADDRESS
Ind. Tect.	Industrial Tectonics, Inc. 3686 Jackson Road Ann Arbor, Michigan
Jam	Jam Handy Organization 2821 Grand Blvd. Detroit 11, Michigan
La Pointe	La Pointe Machine Tool Co. Education Dept. 34 Tower St. Hudson, Massachusetts
Lawnboy	Lawnboy, Inc. Galesburg, Illinois
Lufkin	Lufkin Rule Co. Saginaw, Michigan
McGraw	McGraw-Hill Book Co. 4655 Chase Avenue Chicago 46, Illinois
Mi Ho Co	Micromatic Hone Corp. Advertising Dept. 8100 Schoolcraft Avenue Detroit 38, Michigan
Modern	Modern Talking Pictures, Inc. 104 E. Vermont Street Indianapolis 4, Indiana
NASA	National Air and Space Administration Public Information Office Louis Research Center 21000 Brookpark Road Cleveland 35, Ohio
National	National Carbon Co. 230 N. Michigan Avenue Chicago 1, Illinois
Norton	Norton Co. Advertising Dept. Worcester 6, Massachusetts
PCC	Perfect Circle Corp. School Assistance Dept. Hagerstown, Indiana

CODE	ADDRESS
Pop Sc	Popular Science Publishing Co. Audio-Visual Division 353 Fourth Avenue New York 10, N. Y. (This is a 1954 source)
Proto	Proto Tools 2209 Santo Fe Avenue Los Angeles 54, California
Pure	Pure Oil Co. 35 East Wacker Drive Chicago 1, Illinois
Reynolds	Reynolds Metals Co. Motion Picture Dept. P. O. Box 2346 Richmond 18, Virginia
Rocketdyne	Rocketdyne Div. North American Aviation Canoga Park, California
Roth	Rothacker, Inc. 729 Seventh Avenue New York 19, N. Y.
Scintilla	Scintilla Div., Bendix Corp. Service Dept. Sidney, N. Y.
Shell	Shell Oil Co., Film Library 624 S. Michigan Ave. Chicago 5, Illinois (also) 50 West 50th St. New York 20, N. Y.
Simonds	Simonds Abrasive Co. Tacony and Fraley Streets Philadelphia 37, Pennsylvania
Snap-on	Snap-On Tools, Inc. Kenosha, Wisconsin
Sterling	Sterling-Movies U.S.A., Inc. 43 West 61st Street New York 23, N. Y.
Sunoco	Sun Oil Co. 1608 Walnut Street Philadelphia 3, Pennsylvania

CODE	ADDRESS
Thickol	Thickol Chemical Corp. P. O. Box 27 Bristol, Pennsylvania
Tillotson	Tillotson Mfg. Co. Parts and Service Div. 761 Berdan Avenue Toledo 12, Ohio
UMS	United Motor Service 3049 West Grand Blvd. Detroit 2, Michigan
Union	Union Carbide Consumer Products Co. 270 Park Avenue New York 17, N. Y.
United	United Aircraft Co. 35 East Monroe Street Chicago 3, Illinois
USAF	United States Air Force Film Library Center 8900 South Broadway St. Louis 25, Missouri
U. S. Army	U. S. Army Regional Signal Film and Equipment Exchange Fort Benjamin Harrison Indianapolis 49, Indiana
USBM	U. S. Bureau of Mines Graphic Services Div. 4800 Forbes Street Pittsburgh 13, Pennsylvania
USS	United States Steel Corporation 208 South LaSalle Street Chicago 90, Illinois
UWF	United World Free Film Service 1445 Park Avenue New York 29, New York
Willard	Willard Sales, Automotive Div. Electronic Storage Battery Co. Educational Film Service P. O. Box 6266 Cleveland 1, Ohio

FURNITURE

Gen. Shop	Unit Shop	Jr.High Level	Sr.High Level	Item	Quantity	Unit Price	Total Price
	N	X	X	Work stations per unit	16		
	D	X	X	Bookcase	1		
	D	X	X	Bulletin Board	1		
	D	X	X	Chairs (arm type) per unit	16		
	N	X	X	Chalkboard	1		
	D	X	X	Display Case	1		
	N	X	X	Instructor Desk	1		
	N	X	X	Instructor Chair	1		
	N	X	X	Instructor File	1		
N	N	X	X	Instructor storage cabinet	1		
D	D	X	X	Lockers (student) per class	16		
N	N	X	X	Storage Cabinets	1		
N	N	X	X	Storage Racks	3		
	N	X	X	Projection Screen	1		
	N	X	X	Tool Cabinets	2		
	N	X	X	Wash Basin (heavy duty trap)	1		

LABORATORY FACILITIES

EQUIPMENT							
Gen. Shop	Unit Shop	Jr. High Level	Sr. High Level	Item	Quantity	Unit Price	Total Price
D	N		X	Arbor Press	1		
D	N		X	Compressed Air System	1		
D	D		X	Drill Press	1		
D	N		X	Engine Stands for Various Types	5		
D	N	X	X	Engine Exhaust System	1		
N	N	X	X	Fire Equipment	1		
	D	X	X	Grinder	1		
D	N	X	X	Parts Washer	1		
N	N	X	X	Tote Boxes, per class	16		
	N	X	X	Vises	8		
	D		X	Buffer	1		
				Safety Equipment			
N	N	X	X	Face Shields	3		
				Goggles	3		
D	D	X	X	Aprons per class	16		
D	D		X	Gloves	4		
N	N	X	X	Gasoline can (1gal.,2gal)	1 ea.		
N	N	X	X	Waste Cans, Safety	2		
N	N	X	X	Can 5 gal., oil dram	2		
D	N		X	Outboard Test Tank	1		

TOOLS

Gen. Shop	Unit Shop	Jr. High Level	Sr. High Level	Item	Quantity	Unit Price	Total Price
N	N	X	X	Wrench Combination, Set	2		
N	N	X	X	Open End, Set	2		
N	N	X	X	Adjustable	2		
D	N		X	Torque	1		
N	N	X	X	Pipe	1		
N	N	X	X	Spark Plug, socket	1		
N	N	X	X	Socket Set, ¼" Drive	1		
N	N	X	X	Socket Set, 3/8" Drive	1		
D	N		X	Socket Set, ½" Drive	1		
N	N	X	X	Allen, Set	1		
				Pliers			
	N	X	X	Combination	3		
	N	X	X	Diagonal	1		
D	N	X	X	Locking	1		
	N	X	X	Needle Nose	2		
D	N		X	Snap Ring	1		
D	N	X	X	Truarc	1		
				Hammer			
	N	X	X	Ball Peen	2		
N	N	X	X	Sledge, 3 pound	1		
				Mallet			
	N	X	X	Rawhide	2		
	N	X	X	Rubber	2		

LABORATORY FACILITIES

TOOLS (cont.)							
Gen. Shop	Unit Shop	Jr. High Level	Sr. High Level	Item	Quantity	Unit Price	Total Price
				Mallet (cont.)			
	N	X	X	Plastic	2		
				Screwdriver			
N	N	X	X	Standard Tip (various sizes)	10		
D	N	X	X	Phillips Head Tip Set (various sizes)	2		
D	N		X	Clutch Type Set (various sizes)	1		
D	N	X	X	Offset			
				Standard	1		
				Phillips	1		
	N	X	X	Tin Snips, Aircraft	1		
	N	X	X	Pry Bar, large, small	1 ea.		
	N	X	X	Hacksaw	2		
	N	X	X	Chisels, Cold, Set (various sizes)	1		
	N	X	X	Files (various types and sizes)			
D	N	X	X	Nutdriver, Set	2		
	N	X	X	Tap and Die, Set	1		
D	N		X	Screw Extractor, Set	1		
				Punch			
	N	X	X	Center (set various sizes)	1		
	N	X	X	Pin(set various sizes)	1		
				Brass Drift (set various sizes)	1		
D	D		X	Gasket, set			
	N	X	X	C Clamps (various sizes)	6		
D	D		X	Torch, Propane	1		
	N	X	X	Soldering Gun	1		

TOOLS (cont.)							
Gen. Shop	Unit Shop	Jr. High Level	Sr. High Level	Item	Quantity	Unit Price	Total Price
	N	X	X	Putty Knife	3		
D	N	X	X	Puller, Gear Type, Set (various sizes)	1		
D	D	X	X	Magnetic Pencil	1		
				Twist Bits, HSS, Set			
	N	X	X	Fractions	1		
	D		X	Letters	1		
	D		X	Numbers	1		
	N	X	X	Drill, Portable, ¼"cap.	1		
D	D	X	X	Drill, Portable, ½" cap.	1		
	D		X	Flaring Tool	1		
	D		X	Tube Cutter	1		
N	N	X	X	Funnel, large, small	1 ea.		
D	N		X	Valve Lapping Equipment	1		
D	N		X	Valve Seating Equipment	1		
D	N		X	Ridge Reamer	1		
D	N		X	Deglazing Hone	1		
N	N	X	X	Scribe	3		
N	N	X	X	Wire Brush	3		
N	N	X	X	Piston Ring Compressor, Small	3		
D	N		X	Piston Ring Compressor, Auto	3		
N	N	X	X	Valve Spring Compressor, Small	1		
D	N		X	Valve Spring Compressor, Auto	1		
D	D		X	Impact Wrench, Set	1		

LABORATORY FACILITIES

TEST EQUIPMENT							
Gen. Shop	Unit Shop	Jr. High Level	Sr. High Level	Item	Quantity	Unit Price	Total Price
D	D		X	Battery Hydrometer	1		
D	D	X	X	Calipers, Inside	1		
D	D	X	X	Calipers, Outside	1		
D	N		X	Coil & Condenser Tester	1		
N	N	X	X	Combination Square	1		
D	N		X	Compression Gauge	1		
D	D		X	Dial Indicator	1		
D	D		X	Dynamometer (Water Brake)	1		
D	D		X	Micrometers, Inside, Set	1		
D	D		X	Micrometer, Depth, Set	1		
N	N	X	X	Micrometers, Outside, Set (0-4)	1		
D	D	X	X	Micrometers, Outside (0-1)	6		
N	N	X	X	Spark Plug Gauges	1		
D	D		X	Tack and Dwell Meter	1		
				Tachometer			
D	D		X	Centrifugal	1		
D	N	X	X	Vibrating	1		
N	N	X	X	Telescoping I.D. Gauges	1		
N	N	X	X	Thickness Gauge	3		
D	D		X	Timing Light	1		
D	D		X	Vacuum Gauge	1		
N	N	X	X	Volt-ohm Meter	1		

SUPPLIES

Gen. Shop	Unit Shop	Jr. High Level	Sr. High Level	Item	Quantity	Unit Price	Total Price
N	N	X	X	Oil, Lubricating			
	N		X	Oil, Penetrating			
	D		X	Oil, Cutting			
N	N	X	X	Gasoline			
N	N	X	X	Stoddard Solvent			
	N	X	X	Bolts, assorted sizes			
	N	X	X	Nuts, assorted sizes			
	N	X	X	Washer, Cut, assorted sizes			
	N	X	X	Washer, Lock, assorted			
N	N	X	X	Cotter Pins, assorted			
	N	X	X	Abrasive Cloth, Emery			
N	N	X	X	Abrasive Cloth, Crocus			
	N	X	X	Steel Wool			
D	N	X	X	Gasket Material (various thicknesses)			
D	N	X	X	Gasket Sealer			
D	N	X	X	Gaskets, Spark Plug			
D	D		X	Valve Lapping Compound			
D	D	X	X	Graphite			
	N	X	X	Solder, Rosin Core			
	N	X	X	Solder, Acid Core			
	N	X	X	Soldering Paste			
	N	X	X	Tape, plastic			
	D	X	X	Keys, Woodruff, assorted			

LABORATORY FACILITIES

SUPPLIES (cont.)							
Gen. Shop	Unit Shop	Jr. High Level	Sr. High Level	Item	Quantity	Unit Price	Total Price
	D		X	Keys, Square, assorted			
	D	X	X	Springs, assorted			
	N	X	X	Wiping Cloths			
N	N	X	X	Starter Ropes			
D	N		X	Plastigage			
N	N	X	X	Brushes, Parts Cleaning			

INSTRUCTIONAL EQUIPMENT

ITEM	SOURCE
Small Gasoline Engines	Briggs Tecumseh Lawnboy Local lawnmower repair shops
Carburetors for small gasoline engines	Tillotson
Dynamometer	Go-Power
Bicycle components	Local repair shop
Automotive Components, such as Engines and accessories Standard shift transmissions Automatic transmissions Differentials Steering sectors Hydraulic brake components Bearings (various types)	Local auto dealers Local salvage companies
Hydraulic and Pneumatic components, such as Pumps, motors, valves, compressors, etc.	Local distributors Local farm implement dealers
Outboard Engines	Local marinas
Diesel (model airplane engine)	Hobby Shop
Aircraft - plastic model of airplane reciprocating engine, used engine from small private plane	Hobby Shop Local airport
Pulse jet (Dynajet)	Hobby Shop
Turboprop (plastic model)	Hobby Shop
Rockets (plastic model)	Hobby Shop
Steam Engine	Hobby Shop
Atomic and Solar Energy Demonstration Kits	IASC
Fuel Cell	Alcham

SOURCES FOR INSTRUCTIONAL EQUIPMENT

CODE	ADDRESS
Al Chal	Allis Chalmers Industrial Relations & Public Relations Div., Dept. 3191 Milwaukee 1, Wisconsin
Briggs	Briggs and Stratton Corp. 2711 N. 13th Street Milwaukee 1, Wisconsin
Go Power	Go Power Corp. 1905 Bay Road at Pulgas P. O. Box 613 Palo Alto, California
IASC	Industrial Arts Supply Co. 3002 Hennepin Avenue South Minneapolis 8, Minnesota
Lawnboy	Lawnboy Corp. Galesburg, Illinois
Tecumseh	Tecumseh Products Co. 1043 N. 13th Avenue Grafton, Wisconsin
Tillotson	Tillotson Manufacturing Co. Parts and Service Div. 761 Berdan Avenue Toledo 12, Ohio

SOURCES FOR FREE AND INEXPENSIVE TEACHING MATERIALS

SOURCE	AREA	ITEMS
1. A.C. Spark Plug Division General Motors Corp. 1300 N. Dort Highway Flint 2, Michigan	Spark Plugs	Chart Pamphlet Manual
2. Air Research 402 South 36th St. Phoenix 34, Arizona	Gas turbine	Pamphlets Pictures
3. Allis Chalmers Mfg. Co. Dept.3191 Milwaukee 1, Wisconsin	Fuel cell	Demonstration Fuel Cell Kit Booklet
4. Allison Engine Div. General Motors Corp. 4800 West 10th St. Indianapolis, Indiana	Small gas turbine	Pamphlet Pictures
5. Alcondra, Incorporated 959 Crenshaw Boulevard Los Angeles 9, California	Electricity	Pamphlet
6. American Oil Co. Sales Training Dept. File MER - T - 5 910 South Michigan Ave. Chicago 80, Illinois	Fuels and Lubricants	Charts Booklets Films
7. American Petroleum Institute 50 West 50th St. New York 20, New York	Fuels and lubricants	Charts Booklets Films
8. Ammco Tools, Inc. 2100 Commonwealth Ave. North Chicago, Illinois	Brakes	Manual
9. Ass'n. of American Battery Manufacturers, Inc. 19 North Harrison St. East Orange, N.J.	Batteries	Booklet
10. Autolite Co. Toledo 1, Ohio	Spark plugs	Charts Pamphlets
11. Automotive Manufacturers Ass'n, Inc. 320 New Center Bldg. Detroit 2, Michigan	Automotive	Booklets

SOURCE	AREA	ITEMS
12. Automotive Service Industry Ass'n 168 N. Michigan Ave. Chicago 1, Illinois Att: Richard Buckley Educational Supervisor	Automotive	Pamphlet
13. Black & Decker Mfg. Co. Towson, Maryland	Valves	Pamphlet
14. Briggs & Stratton Corp. 2711 N. 13th St. Milwaukee 1, Wisconsin	Small gas engines	Booklets Charts Manuals
15. Carter Carburetor Div. of ACF Industries, Inc. Education Dept. 2840 N. Spring Ave. St. Louis 40, Missouri	Carburetors	Manual
16. Champion Spark Plug Co. Toledo 1, Ohio	Spark plugs	Charts
17. Chevrolet Motor Div. General Motors Corp. Detroit 2, Michigan	Automotive	Manual
18. Chrysler Corp. Detroit, Michigan	Automotive	Booklet
19. Clinton Engines Corp. Maquoketa, Iowa	Small gas engine	Booklets Manuals
20. The Columbus Parts Corp. 1801 Spielbusch Ave. Toledo 1, Ohio	Shock absorber	Plastic model
21. Continental Motor Corp. 12800 Kercheval Ave. Detroit 15, Michigan	Small gas engines	Mechanics manual
22. Cummins Engine Co., Inc. Columbus, Indiana	Diesel	Charts Booklets
23. Delco-Remy Div. General Motors Corp. Anderson, Indiana Att: Marshall T. Huntzinger Supervisor of Technical Literature	Automotive electrical	Charts Pamphlets Manuals Records Filmstrips Parts
24. Detroit Diesel Engine Div. Detroit, Michigan	Diesel	Chart

SOURCE	AREA	ITEMS
25. Doyle Electric Products Co. 445 E. 189th St. New York 58, New York	Automotive wheel alignment	Chart
26. Dupont & Co. Wilmington 98, Delaware	Cooling system	Booklets Films
27. Esso Research & Engineering Co. Box 45 Linden, New Jersey	Fuel cell	Pamphlet
28. Ethyl Corp. 100 Park Ave. New York 17, New York	Gasoline	Films Booklets
29. Evenrude Motors 4143 N. 27th St. Milwaukee 16, Wisconsin	Outboard	Charts Manuals
30. Exide Sales Automotive Div. The Electrical Storage Battery Co. Box 6266 Cleveland, Ohio	Batteries	Pamphlet Chart
31. Ford Motor Co. American Road Dearborn, Michigan	Automotive	Pamphlets Charts Booklets Films
32. General Electric Co. c/o Grant Eberle Promotion and Publicity Bldg. 501 Cincinnati 15, Ohio	Steam turbine	Booklet
33. General Motors Corp. General Motors Bldg. Detroit 2, Michigan	Automotive	Films Charts Booklets
34. International Harvester Co. 150 W. Market St. Indianapolis 6, Indiana	Trucks	Booklet
35. John Deere Moline, Illinois	Tractors	Booklets
36. Jacobsen Mfg. Co. 1721 Rackard Ave. Racine, Wisconsin	Small 2-cycle engines	Charts Booklets Manuals
37. Johnson Motors 2600 Pershing Rd. Waukegan, Illinois	Outboard	Charts Charts

SOURCE	AREA	ITEMS
38. Kiehaefer Corp. Beaver Dam, Wisconsin	Outboard	Charts Manuals
39. Lawnboy Galesburg, Illinois	Small gas engines	Manuals Charts Booklets
40. Lee Mfg. Co. 1527 26th St. Santa Monica, California	Brakes	Parts
41. McQuay - Norris Mfg. Co. Service Engineering Dept. St. Louis 10, Missouri	Piston rings	Booklet
42. NASA (National Aeronautics & Space Administration) Washington, D. C.	Rocketry	Booklets Films
43. National Carbide Div. Union Carbide Corp. 30 E. 43nd St. New York 17, New York	Cooling systems	Charts Slides
44. New Departure Div. General Motors Bristol, Connecticut	Bearings	Booklets Films
45. Ohio Trade & Industrial Education Service Div. of Vocational Education State Department of Education Columbus, Ohio	Hydraulics	Manual Teaching guide
46. Perfect Circle Corp. Hagerstown, Indiana	Piston rings	Booklets Charts
47. Perfection Gear Co. 152nd St. & Vincennes Ave. Harvey, Illinois	Transmissions	Manual Chart
48. Ramsey Corp. P. O. Box 513 St. Louis 66, Missouri	Automotive	Slidefilms
49. Raybestos Division of Raybestos-Manhattan, Inc. Bridgeport 2, Connecticut	Brakes	Chart
50. Renwall Blueprint Model Minneola, New York	V-8 automotive engine	Plastic model
51. Saginaw Steering Gear Div. General Motors Corp. Saginaw, Michigan	Steering sectors	Pamphlet

SOURCE	AREA	ITEMS
52. Shell Oil Co. 50 W. 50th St. New York 20, N. Y.	Fuels and lubricants	Films Booklets
53. Tecumseh Products Co. 1043 N. 13th Ave. Grafton, Wisconsin	Small gas engine	Parts manual Service manual
54. Tillotson Mfg. Co. Parts and Service Div. 761 Berden Ave. Toledo 12, Ohio	Carburetors	Booklets Carburetors
55. Union Carbide Consumer Products Co. Div. of Union Carbide Corp. 30-20 Thomas Ave. Long Island City 1, New York	Battery	Pamphlet Booklet
56. United Air Lines 35 E. Monroe St. Chicago 3, Illinois	Aircraft	Pamphlets
57. United Motor Service Att: Supply Purchasing Dept. 3044 West Grand Blvd. Detroit 2, Michigan	Rochester Carburetors	Filmstrips Charts Carburetors
58. West Bend Aluminum Co. Outboard Motor Div. Hartford, Wisconsin	Outboard	Manual

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ABSTRACT - Based upon a study conducted by the author, a consultant in industrial arts education, this guide is for teacher and student use in providing safety instruction and evaluation of safety instruction in the use of tools and equipment in industrial arts courses was prepared to: (1) help the industrial arts teacher in small schools meet safety needs, (2) serve as a basis for reorganizing existing safety programs, (3) meet certain legal requirements of accident liability and required safety instruction, and (4) provide a basis for carrying out the rules and regulations of the state safety division. Sections include safety instructions for metalworking equipment, woodworking equipment, automotive and power mechanics equipment, electrical and electronic equipment, and graphic arts equipment. The sections also include safety test questions and answers. (GR)

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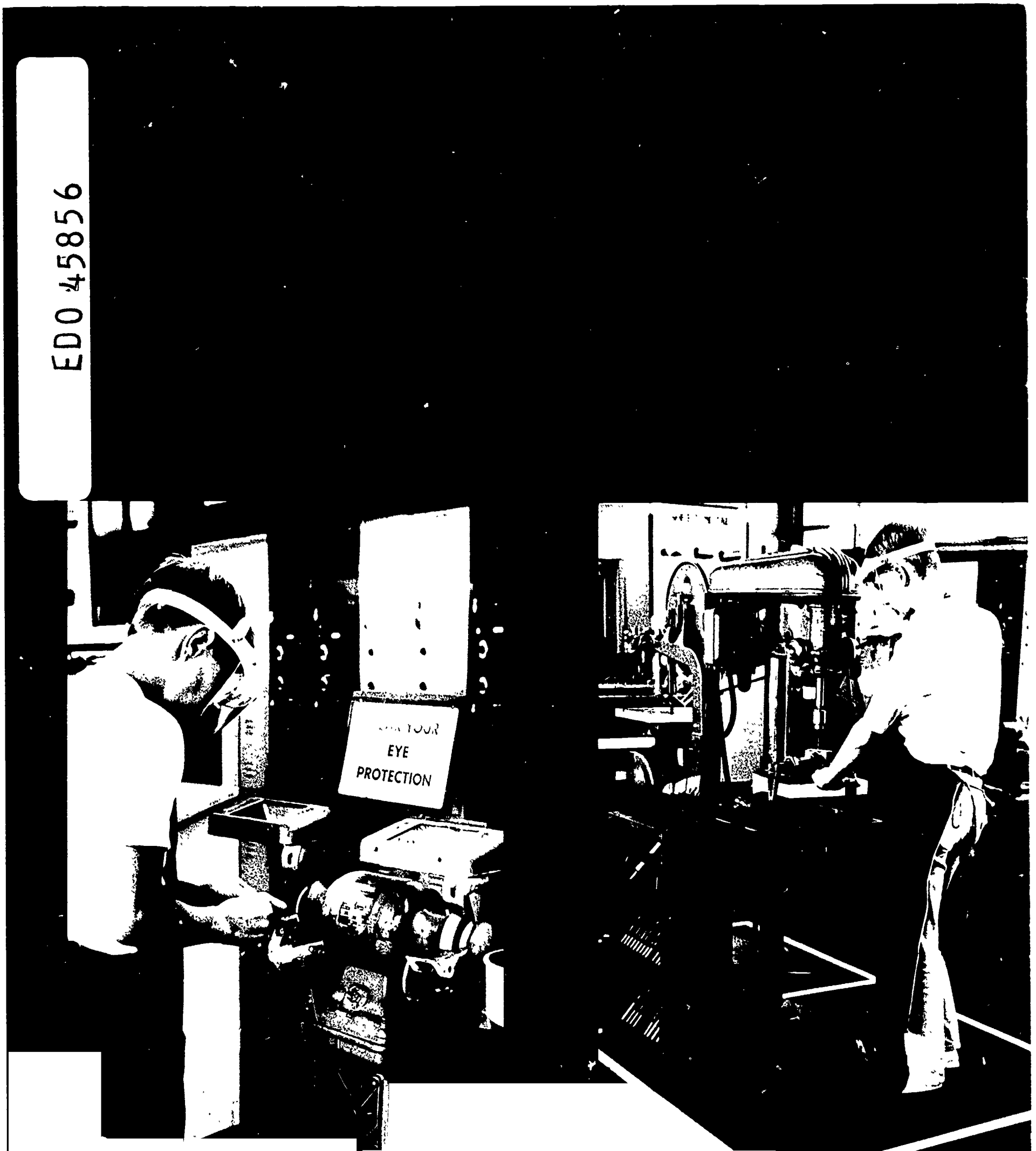

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INDUSTRIAL ARTS SAFETY INSTRUCTION

Robert L. Woodward
Consultant in Industrial Arts Education
California State Department of Education

ERIC

FOREWORD

Educators in California are always looking for ways to improve their services to the students enrolled in their schools. This commendable professional attitude helps explain why California's educational program in general and the industrial arts program in particular have gained wide recognition for their extent and quality.

Every teacher desires to protect his students and train them to live increasingly efficient and happier lives. By the very nature of the subject he teaches, the industrial arts teacher can make training in safety an integral part of every task performed.

Industrial Arts Safety Instruction presents essential safety instruction in the use of tools and equipment. Emphasis is given to the importance of relating safety instruction to the daily life of the student, both in and out of school.

The purpose of the publication is to provide a guide for safety instruction and a means of evaluating the instruction. The material in the publication was prepared (1) to meet the requirements of the industrial arts teacher, particularly in the small schools; (2) to serve as a basis for reorganizing existing safety programs; (3) to meet certain of the legal requirements set forth in the Education Code and Government Code of the State of California, both from the standpoint of accident liability and required safety instruction; and (4) to provide a basis for carrying out the rules and regulations of the Division of Industrial Safety of the California State Department of Industrial Relations. I am certain that the information presented in this publication will be of great value in the preparation of safety instruction in industrial arts.

Max Rafferty

Superintendent of Public Instruction

PREFACE

Industrial Arts Safety Instruction provides a guide for safety instruction and a means of evaluating the instruction. This publication replaces *Safety Instruction in Industrial Arts Education* from which it derives much of its content; however, it makes use of current industrial arts terminology and equipment nomenclature and presents additional safety instructions and test questions. The content is based upon the findings of a study conducted by Robert L. Woodward, Consultant in Industrial Arts Education, California State Department of Education.

In Dr. Woodward's study, an analysis was made of publications on industrial arts safety prepared by school districts, material issued by public and private safety groups, and commercial publications pertaining to safety to determine the safety rules most often found in them. The safety rules selected were then checked against reports of accidents occurring in industrial arts facilities to make sure all danger areas were covered and sufficient emphasis was placed on using the tools and machines listed as major sources of injuries incurred in the accidents. An advisory committee composed of California teachers and supervisors of industrial arts was asked to criticize the preliminary draft of the safety instructions. The criticisms received were taken into consideration in revising the material.

The revised material was submitted for study to a panel of industrial arts teachers of metals and woods courses in the smaller school districts of California. Their suggestions based on their daily approach to safety in industrial arts courses were used in making additional improvements in the safety material. The advisory committee then reviewed the material to make certain that the revisions were technically correct.

Another phase of Dr. Woodward's study was devoted to determining the type of test preferred by California teachers, supervisors, and teacher educators of industrial arts for evaluating safety instruction. This information was obtained by a questionnaire.

Appreciation is expressed to the editor of *School Shop* and William M. Bateson for use of the diagrams showing standards for space allocation of equipment and to all those who participated in Dr. Woodward's study and assisted in developing the material for *Safety Instruction in Industrial Arts Education* and *Industrial Arts Safety Instruction*. The names of the teachers, supervisors, and administrators currently employed in California schools who served as members of the original panels of advisers and critics, many of whom assisted in the development of the material for both publications, follow:

Panel of Advisers on Safety Instructions. *A. W. Ehrhorn,* Sacramento City Unified School District; *Milo P. Johnson,* Mt. San Jacinto College, Banning; *D. Dale Easter* and *Henry O. Hall,* Office of Kern County Superintendent of Schools, Bakersfield; *Jess E. Rathbun,* San Francisco Unified School District; *David O. Taxis,* Office of Los Angeles County Superintendent of Schools; and *Wallace Theilmann,* State Department of Education, Sacramento.

Panel of Critics on Metalworking Safety Instructions. *Orville Beutel,* Mt. Diablo High School, Concord; *Lyman B. Curtis,* Bakersfield High School; *Charles Dreyer,*

Analy High School, Sebastopol; *James A. Farley,* Visalia Union High School District; *O. J. Flesher,* Palm Springs High School; *John Gerard,* Mount Shasta High School; *John B. Hayner,* Arvin High School; *Charles C. Hooks,* Ramona High School, Riverside; *Robert J. Hughes,* Albany High School; *Martin Krikorian,* Kings Canyon Junior High School, Fresno; *Curtis E. Lackey,* Fresno City College; *Fred W. Meischke,* Marshall High School, West Sacramento; *Arthur R. Nelson,* Shasta Union High School, Redding; *Herman Phelps,* California Junior High School, Sacramento; *Paul B. Powell,* Downey East Junior High School; *Harold Rasmussen,* Rosemead High School; *Isaac E. Rhoads,* San Juan High School, Citrus Heights; *A. Neil Royce,* Huntington Beach Union High School; *Herman S. Siegel,* Inglewood High School; *Richard Stutzman,* East Bakersfield High School; *Lester Talbot,* Emery Junior-Senior High School, Emeryville; *Richard W. Thomas,* Northern Reception Center, Sacramento; and *Lee Vandenberg,* Rim of the World High School, Lake Arrowhead.

Panel of Critics on Woodworking Safety Instructions. *Forrest Bingham,* West High School, Bakersfield; *Mitchell C. Burnett,* Merced Union High School; *Wilbur S. Day, Jr.,* John Burroughs High School, Burbank; *William O. Green,* Wilson High School, Long Beach; *Clarence M. Haan,* Yuba City High School; *Forest C. Hahn,* Paso Robles Union High School; *William T. Hamilton,* Mt. Whitney High School, Visalia; *Robert Heeren,* Roosevelt High School, Fresno; *Donald Johnstone,* Mt. Diablo High School, Concord; *Harry F. Livezey,* Burbank High School, Sacramento; *Alex V. MacDonald,* Madera Union High School; *Ray H. Marxmiller,* Central Union High School, Fresno; *Peirino Merlo,* Allan Hancock Junior College, Santa Maria; *Robert G. Milliken,* South High School, Bakersfield; *Warren Newkirk,* Roosevelt High School, Fresno; *Carl B. Peterson,* Cooper Junior High School, Fresno; *Glenn Thornstrom,* Los Altos High School, La Puente; *Frank Turner,* Albany High School; *Wilbur L. Turney,* North High School, Bakersfield; and *Ray J. Zosel,* Hemet Union High School.

Panel of Advisers on Safety Test Questions. *J. Lyman Goldsmith,* Los Angeles Unified School District; *Jess E. Rathbun,* San Francisco Unified School District; *William B. Steinberg,* San Diego Unified School District; and members of the San Francisco Unified School District Industrial Education Safety Committee: *E. A. Anderson, Luke Angelich, Angelo Bertucci, John Boghosian, Robert V. Brand, Joseph Branstetter, William Cashman, John C. Cosgriff, Lawrence C. Crocker, William Dodge, Rudolph Faltus, Paul Freiermuth, Robert Frierson, Nicholas D. Germano, Clifford L. Gibson, John Lindquist, Bert Mason, Joseph W. Menconi, Frederick B. Peterson, Arthur Rasmussen, Wilbur D. Russell, Arthur St. Peter, Vincent P. Slattery, Albert C. Smith, Leslie Speed, Orville Z. Stocker,* and *Alvan L. Waltz.*

Photographs in this publication were provided by the Los Angeles Unified School District, San Francisco Unified School District, San Juan Unified School District (Carmichael), and the Bureau of Audio-Visual and School Library Education, California State Department of Education.

Industrial Arts Safety Instruction should be of invaluable assistance in the improvement and evaluation of safety instruction in the industrial arts courses conducted by California schools.

DONALD E. KITCH
Acting Chief, Division of Instruction

RICHARD S. NELSON
Chief, Bureau of Industrial Education

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SECTION 1

Introduction to a Program of Safety

A plan coordinated with the course of study and in which safety instruction is geared to the activities and the correct use of the equipment in the industrial arts facility will:

- Help the student to work more efficiently
- Cause the student to become aware of safety practices that apply to his daily living in and out of school
- Aid in protecting the teacher and school district from legal actions claiming negligence
- Make it easier for the teacher to offer required instruction in accident and fire prevention

Safety should be emphasized in every phase of instruction. And no teacher has better opportunity than the industrial arts teacher to give real meaning to safety, for in all industrial arts activities the need for strict adherence to safety rules is apparent.

Whenever possible, the teacher should explain how certain safe practices of the shop relate to other daily activities of the student, both in and out of school. A survey report of the University of Michigan titled *Home Injuries* illustrates the need for more of this type of instruction. In this survey it was found that 41 percent of major injuries occurring in the home were cuts and piercing wounds resulting from sharp-edged objects. The principal sharp-edged objects were water glasses, knives, tin cans, and bottles. Each of these items is commonly found in industrial arts facilities.

A report of the California State Department of Education titled *Required Courses and Other Required Instruction in California Public High Schools* states that required instruction in public safety and accident prevention is most often presented as a phase of the instruction in social science, industrial arts, science, and homemaking courses. It also reports that required instruction in fire prevention is most frequently presented in social science, English, industrial arts, homemaking, agriculture, and physical education courses. Safety instruction has an influence beyond the bounds of the industrial arts facility into other daily activities and assists in developing a safety consciousness in each student that will aid in making his life more satisfying.

Explanation of Certain Safety Instructions for All Areas of Industrial Arts

A successful industrial arts program results from an understanding by the students of the reasons and advantages of the activities that take place. In explaining and demonstrating the correct, safe procedure to follow in using a tool or a machine, the teacher should give the reasons and advantages for each step. Listed below are explanations of some of the instructions appearing under the heading of "Safety Instructions for All Areas of Industrial Arts."

To "ask the teacher to approve all work that you plan to do" will:

- Assure the best, easiest, and safest way to do a job successfully
- Protect all class members from accidents caused by careless or incompetent use of tools and machines

Requiring approval of all work to be performed makes it possible for the teacher to assist the student in planning his project. One of the aims of industrial arts education is to help the learner

develop an orderly procedure. Submitting a drawing or sketch, bill of material, and plan of procedure should be required steps for the student to take in securing the teacher's approval of his project. Whether approval should be given for the entire job depends upon the competence and maturity of the individual. Under no circumstances should a student be allowed to use tools or machines without the teacher's approval. Accident reports show that many mishaps in industrial arts facilities are caused by students using tools and machines for unapproved purposes.

To "report all injuries, even though slight, to the teacher immediately" will:

- Make it possible for the teacher to give immediate attention to injuries
- Permit first aid treatment which helps prevent minor cuts, abrasions, burns, or bruises from becoming infected
- Assist the teacher in correcting situations causing accidents

Adherence to the practice of having all injuries, even though slight, reported to the teacher protects the students and the school. Good judgment should be used in deciding upon the seriousness of an injury and the type of action that should be taken. Usually each school district has a definite procedure that must be followed in case of a serious injury. Each shop should be equipped with a first aid kit containing a fresh, complete supply of first aid materials. All cuts, abrasions, burns, or bruises received by students should be inspected by the teacher, and when necessary first aid treatment should be given.

In an industrial arts facility the operator's zone is an area designated by the teacher where only the operator is permitted when the machine is in use.

To "observe rules concerning operators' zones" will:

- Prevent crowding and bumping the operator
- Give students complete responsibility in the use of the machine
- Protect all class members from injuries caused by moving machine parts and flying pieces of material

Operators' zones set apart by instructions or preferably designated by tape or painted lines protect the students and the school. Operators' zones provide an easier way to carry out the following safety instructions: "Make sure that all students are clear of the machine before turning on the power," "Start your own machine and remain with it until you have turned it off and allowed it to come to a dead stop," and "Stay clear of machines being operated by others." In spite of the accepted practice of designating operators' zones, accident reports reveal that injuries were received by students, other than the operators, in areas that were or should have been indicated as operators' zones.

To "cooperate with your classmates in the student management of your shop" will:

- Make the sharing in the responsibilities of shop management a satisfying experience
- Bring about by efficient handling of tools and materials a greater amount of time for shop work
- Cause an equal division of the tasks necessary in maintaining a desirable place to work

Carrying out a successful program of student participation in shop management requires that each student understand the advantages of cooperating with his classmates. Students should share in the responsibilities of maintaining not only an orderly shop but also a safe one. Safe practices are an integral part of the total operation. Each class member should be instructed to "caution any student violating a safety practice."

To "obtain permission from the teacher before using any power equipment" will:

- Provide assurance that the machine selected will provide the best, easiest, and safest method for doing the job

- Give the teacher opportunity to check the condition of a machine
- Give the teacher opportunity to make certain that all class members are protected from accidents caused by careless or improper use of equipment

Requiring students to obtain permission before using equipment provides the teacher opportunity to give the student additional instruction. Whether permission should be given the student for the entire job depends upon his competence and maturity. The first statement in each list of safety instructions in this publication directs the student to "obtain permission from the teacher before using" the specified machine. This is followed by instructions concerning steps to be taken before operating the machine. After the preparatory directions is the statement "turn on the power (after permission is given)" which serves as a double check. Permission may have first been given provided certain instructions were followed concerning the use of jigs, special setups, or safety devices. A second check may be necessary, particularly for the inexperienced operator. Accident reports disclose that accidents are often caused by students using machines without permission and for unapproved purposes.

How to Plan the Teaching of Safety Instruction

1. *Refer to the contents, page vii, in this publication to locate pages concerning the hand tools and machines you have in your industrial arts program.*
2. *Turn to designated pages which list safety instructions pertaining to your tools and machines.*
3. *Use selected safety instructions as a guide in preparing your complete lesson plans on the correct use of the equipment.*
4. *Plan your instruction so it will emphasize safe practices which will be covered in your safety test.*
5. *Duplicate your set of safety instructions.* The safety instructions should be printed on one side of a single sheet of paper. These instruction sheets can be used for (1) reviewing by class members; (2) orienting new students; and (3) posting on equipment.

Evaluation of Safety Instruction

An industrial arts safety test given to all students will:

- Make it possible for the teacher to evaluate his safety instruction
- Cause each student to acknowledge his understanding of the correct way to work in an environment of tools and machines
- Furnish written proof that safety instruction has been given

In a statewide study it was found that the majority of California industrial arts teachers and supervisors preferred the objective type of safety test. Of all the types of objective tests, the teachers overwhelmingly selected multiple-choice and completion tests, in that order, as the most valuable and most applicable.

Following each set of safety instructions in this publication are test questions designed for use in a safety test. The selection of these questions is based upon a frequency count of the items most often asked in safety tests printed in materials prepared by schools and in commercial publications. Further, the questions chosen were checked against school district industrial arts accident reports to make sure all danger areas were covered.

Safety is a positive and personal matter. Whenever possible the safety test questions included in this publication emphasize the positive approach to safety education: You *should do* this for one of these reasons. The student's personal responsibility for safety is stressed by aiming the questions at him rather than at an impersonal someone: *You* should do this for one of these reasons.

How to Prepare a Safety Test

1. *Provide spaces for the student to place his name and class period.* By placing this line near the top of the first page of the safety test, it will be easier to record, file, and later readily identify.

   Example:

   STUDENT'S NAME ..... PERIOD .....
   (Last name first)

2. *Include in test title the name of your school, the area of industrial arts followed by "Safety Test," and, if desired, your name. Example:* California High School, Woodworking Safety Test, John T. Jones, Teacher.

3. *List directions for answering test questions.*

   Example for multiple-choice questions:

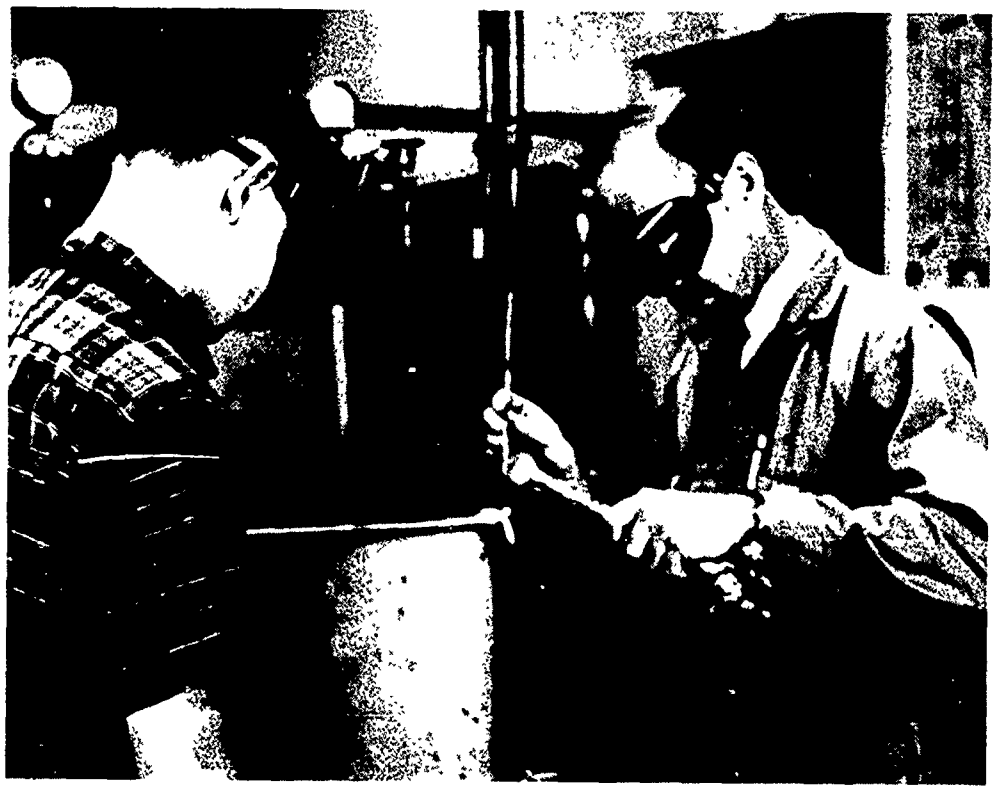
   DIRECTIONS: Each item has four possible answers. Only *one* answer is correct. Place the letter of the correct answer in the parentheses to the left.

   Example for completion questions:

   DIRECTIONS: Each of the following statements may be completed with a single word or figure. Write the correct word or figure in the space provided to the left.

4. *Select questions covering general safety instructions as well as specific hand tool and power machine safety instructions for your particular industrial arts program.* The following steps may be used to select questions:

   a. Refer to contents in this publication to locate pages concerning the hand tools and machines you have in your industrial arts facility.
   b. Turn to the designated pages which list questions pertaining to your tools and machines.
   c. Choose questions for your safety test. Multiple-choice or completion-type questions may be used. To offer a variety in your testing program, it is suggested that in one section multiple-choice questions be used and in another completion questions be employed. The number of questions used for hand tools and for each machine will depend upon the number of pieces of equipment to be covered in the safety test.



Demonstrating the correct way

5. *Conclude the safety test with a statement of acknowledgment to be signed by the student. Example:*

THIS IS TO CERTIFY that I have received safety instructions in WOODWORKING.

My teacher has demonstrated to me how to operate each machine correctly and safely. I promise to observe all safety precautions and if ever in doubt regarding any operation, I will get the necessary information from my teacher.

SIGNED.....

DATE..... 19.....

6. *Duplicate your test.* Printed forms are preferred rather than questions asked orally, written on the blackboard, or copied by students.

7. *Prepare a test answer key.* A test answer key fitted to a duplicated test provides an efficient means of checking answers.

Liability of School Districts, Officers, and Employees

California is one of the few states in which school districts have legal responsibility for accidents that involve students while they are participating in school activities to which they have been lawfully assigned. Government Code sections 815.2 and 820.2 (Statutes 1963, Ch. 1681) provide in part:

> A public entity is liable for injury proximately caused by an act or omission of an employee of the public entity within the scope of his employment if the act or omission would . . . have given rise to a cause of action against that employee or his personal representative.
>
> A public employee is not liable for an injury resulting from his act or omission where the act or omission was the result of the exercise of the discretion vested in him, whether or not such discretion be abused.

To meet the provisions of these sections of the Government Code, school districts should provide working conditions that are safe and instruction that is appropriate for the type of work students are doing. However, Section 1017 of the Education Code, part of which follows,

Supervising student performance

requires that school districts protect themselves and their employees by carrying liability insurance:

The governing board of any school district shall insure against:

(1) The liability . . . of the district for damages for death, injury to person, or damage or loss of property; and

(2) The personal liability of the members of the board and of the officers and employees of the district for damages for death, injury to a person, or damage or loss of property caused by the negligent act or omission of the member, officer or employee when acting within the scope of his office or employment.

Legal provisions concerning "School Eye Safety" are presented in sections 12090 through 12094 of the Education Code. The provisions that merit major attention follow:

It shall be the duty of the governing board of every school district, and of every county superintendent of schools . . . to equip schools with eye protective devices . . . for the use of all students, teachers, and visitors. . . . It shall be the duty of the superintendents, principals, or teachers charged with the supervision of any class in which any such course is conducted, to require such eye protective devices to be worn by students, teachers, and visitors. . . .

The eye protective devices shall be worn in courses including, but not limited to . . . industrial arts shops or laboratories . . . at any time at which the individual is engaged in, or observing, an activity or the use of hazardous substances likely to cause injury to the eyes.

Hazardous substances likely to cause physical injury to the eyes include materials which are flammable, toxic, corrosive to living tissues, irritating, strongly sensitizing, radioactive, or which generate pressure through heat, decomposition or other means as defined in the California Hazardous Substances Labeling Act.

Activity or the use of hazardous substances likely to cause injury to the eyes includes, but is not necessarily limited to, the following:

(1) Working with hot molten metal.

(2) Milling, sawing, turning, shaping, cutting, grinding and stamping of any solid materials.

(3) Heat treating, tempering, or kiln firing of any metal or other materials.

(4) Gas or electric arc welding.

(5) Repairing or servicing of any vehicles, or other machinery or equipment.

(6) Working with hot liquids or solids or with chemicals which are flammable, toxic, corrosive to living tissues, irritating, strongly sensitizing, radioactive, or which generate pressure through heat, decomposition, or other means.

For purposes of this article the eye protective devices utilized shall be industrial quality eye protective devices which meet the standards of the American Standards Association Safety Code for Head, Eye and Respiratory Protection (Z2.1-1959), promulgated by the American Standards Association, Incorporated.

The table "Selection of Eye- and Face-Protective Devices" presented in *American Standard Safety Code for Head, Eye, and Respiratory Protection* published by the American Standards Association, Inc., New York, lists types of permissible eye protective devices for certain hazards as follows:

Selection of Eye- and Face-Protective Devices

Hazard involved	Part to be protected	Types of permissible protective devices
Relatively large flying objects	Eyes, Face	Goggles, Spectacles, Face Shields
Dust and small flying particles	Eyes, Face	Goggles, Spectacles, Face Shields
Dust and wind	Eyes	Goggles, Spectacles
Molten metal	Eyes, Face	Goggles, Spectacles, Face Shields
Gases, fumes, and smoke	Eyes, Face	Goggles
Liquids	Eyes, Face	Goggles, Face Shields
Reflected light or glare	Eyes	Goggles, Spectacles
Injurious radiant energy (moderate)	Eyes	Goggles, Helmets, Hand Shields, Face Shields
Injurious radiant energy (intense)	Eyes, Face	Helmets, Hand Shields

Industrial arts teachers are urged for their own protection and the protection of the school district in which they are employed to exercise every precaution to make certain that students are not involved in accidents. These precautions should include (1) appropriate instruction in safe practices students should use in their industrial arts activities; and (2) maintenance of safe working conditions.

Prevention and Extinguishment of Fire

The prevention of fire in an industrial arts facility depends upon good housekeeping and proper maintenance. Correct storage and use of combustible materials will prevent most school shop fires. Rubbish and waste material of various kinds contribute to a large number of fires and are frequently classified as a fire cause, although such material does not cause fires but rather furnishes the fuel for the spread of fire (spontaneous ignition is an exception). The maintenance of a high standard of cleanliness and order is a basic element of fire prevention.

Storage of combustible materials should be limited to rooms properly designed for storage purposes only. Flammable liquids should be stored in fireproof rooms, and only the amount needed for immediate use should be kept in the shop and then only in approved safety containers bearing the Underwriters' Laboratory (UL) label. In any area where explosive vapors may accumulate, enclosed vapor-proof switches and fixtures should be used.

Accumulations of refuse, waste paper, shavings, and other combustible material should be removed daily from the building and destroyed in approved incinerators or hauled away. Oily rags and waste should be kept in metal containers with tight fitting lids, preferably those bearing the Underwriters' Laboratory (UL) label. Oily rags and waste should be disposed of frequently, preferably daily.

All shops should be equipped with an adequate supply of first-aid fire extinguishers of an approved type suitable for the type of fire they are to be used on. Extinguishers should be located in the vicinity of the hazard but far enough away so they can be reached if and when fire does occur. Extinguishers should be inspected and checked regularly. If they have not been used within a year from recharging, they should be recharged and the date should be entered on the card.

To make an intelligent and safe use of the methods of fire extinguishment, it is necessary to be familiar with the types of fires. All fires are classified into three general categories. Class A fires are those involving ordinary combustible materials like paper, wood, and cloth. To extinguish a fire in such materials, a Class A extinguisher consisting of water or water solutions provides the greatest cooling and quenching effect. Pump tanks and soda and acid extinguishers are types of Class A fire extinguishers.

Class B fires are fires involving flammable liquids such as gasoline, kerosene, greases, and paints. Class B extinguishers provide a smothering effect by separating the oxygen of the air from the burning fuel. Foam, carbon dioxide, and dry chemical are Class B extinguishers.

Class C fires include all blazes involving electrical installations. Class C extinguishers use a nonconducting medium as an extinguishing agent, such as carbon dioxide and dry powder. These extinguishers do not cause damage to electrical equipment and can be used without danger before the current is cut off.

A regular check should be made to ascertain that hose on racks and reels is in good condition; particularly that part of the hose nearest the standpipe outlet should be examined for rotting, mildew, and broken fibers.

A regular check should be made by the teacher to be sure exit doors work properly and that aisles or passageways are kept clear. He should appoint at least two students in each class who in the event of a fire would notify the office and turn in the fire alarm.

Fire exit drills should be held frequently and the plan of egress from the building should be made so that students will be familiar with the route they have to travel to get out of the building.

It should be remembered that fire is always unexpected. When the fire alarm signal sounds, the teacher should require everyone to leave the building. There should be no intersecting lines of egress traveled by students. The teacher should check the roll to make certain that all students are accounted for.

General Safety Instructions for All Areas of Industrial Arts

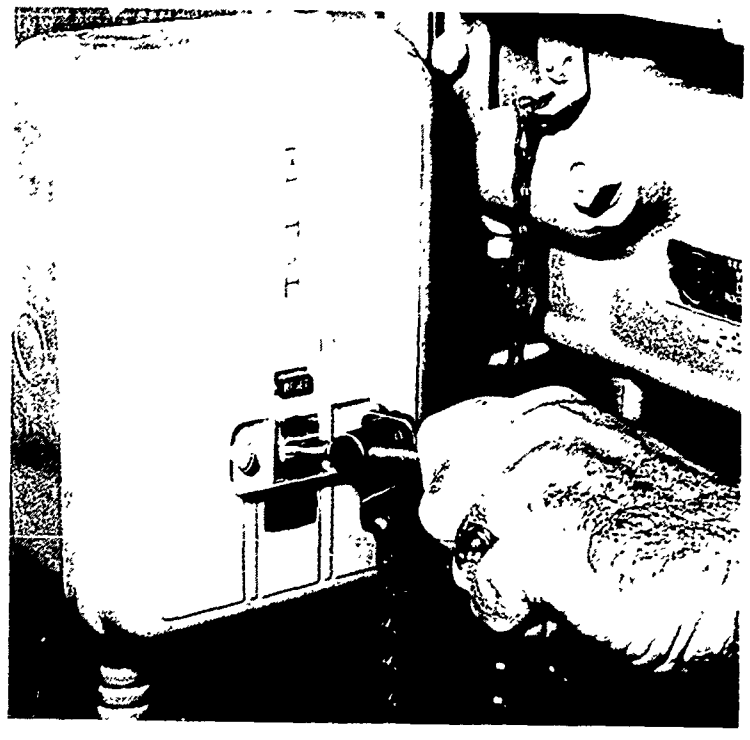
Earlier in this section certain safety instructions were explained in detail. General safety instructions for students which apply to all areas of industrial arts and cover shop practices, hand tools, and machine tools follow.

Shop Practice

1. Ask your teacher to approve all work that you plan to do.
2. Report all injuries, even though slight, to your teacher immediately.
3. Wear suitable eye protection when engaged in any activity where eye hazards may exist.
4. Be sure clothes are safe and suitable for shop work. Remove or fasten any loose clothing. Roll loose sleeves above elbows. Keep hair away from equipment in operation. (Girls must confine their hair.)
5. Observe rules concerning operators' zones.
6. Cooperate with your classmates in the student management program of your shop.
7. Caution any other student you see violating a safety rule.
8. Report to the teacher or shop foreman any equipment that does not seem to work properly.
9. Keep tools and materials from projecting over the edge of benches whenever possible.
10. Use a brush or piece of wood to clear away dry chips and use a rag to clean oily areas.

The student safety engineer reminds the operator that he should remove chuck wrench immediately after using.

11. Keep the floor clear of scraps and litter.
12. Wipe up immediately any liquids spilled on the floor.
13. Keep bench and cabinet drawers and locker doors closed.
14. Place oily rags and other combustible materials in a covered metal container.
15. Exercise care in handling large, heavy, and long pieces of material.
16. Practice procedures to follow in case of earthquake, fire, or other disasters.



Use of chuck key to push start button on switch eliminates possibility of key being in chuck when drill press starts.

Hand Tools

1. Be sure your hands are as free as possible of dirt, grease, and oil when using tools.
2. Use proper type and size of hand tool.
3. Make sure that the tools you are going to use are sharp and in good condition.
4. Handle edged or pointed tools with care.
5. Make sure when using a sharp-edge tool to point the edge away from yourself and your classmates.
6. Clamp small work on bench or secure in vise when using gouge or wood chisel.
7. Control chisels, gouges, and carving tools with one hand while the other hand supplies the power.
8. Wear a face shield or safety glasses (goggles, spectacles) when chipping or cutting with a cold chisel. Arrange your work so that classmates are protected from flying chips.
9. Pass tools to classmates with the handles first.
10. Clamp small work on bench or secure in vise when driving screws.

Machine Tools

1. Qualify as a safe machine operator.
2. Obtain permission from your teacher before using any power equipment.
3. Check adjustments on machines before turning on the power. (Rotate machine one revolution by hand whenever possible without danger.)
4. Make sure that all other students are clear of the machines before turning on the power.
5. Keep all machine safety guards in correct position.
6. Start your own machine and remain with it until you have turned it off and it has come to a dead stop.
7. Stay clear of machines being operated by others.
8. Notify teacher or shop foreman when a machine does not seem to work properly.
9. Wait for machines to come to a dead stop before oiling, cleaning, or adjusting.

Test Questions Covering General Safety Instructions for All Areas of Industrial Arts

Questions that may be used in preparing a test covering general safety instructions for all areas of industrial arts follow. (Reference should be made to the information on testing and methods of preparing safety tests presented in this section under the heading of "Evaluation of Safety Instruction.")

I

( ) 1. You should report all injuries, even though slight, to: (a) an advanced student; (b) your principal; (c) your teacher; or (d) the office.

( ) 2. You should wear suitable eye protection: (a) to improve your vision; (b) when engaged in any activity where eye hazards may exist; (c) to avoid myopia; or (d) when you desire to improve your appearance.

( ) 3. It is best to fasten or remove loose clothing and roll sleeves above your elbows: (a) before operating any machine; (b) during the operation of the machine; (c) after operating a machine; or (d) only when you are assisting the teacher.

( ) 4. The designated area or operator's zone around a machine is to protect: (a) the power equipment; (b) all the students and the teacher working in the shop; (c) only the teacher; or (d) only the student operating the machine.

( ) 5. It is best that any liquid spilled on the floor should be wiped up immediately because it: (a) looks unsightly; (b) will stain the floor; (c) causes more work for the custodian; or (d) may cause someone to slip and injure himself.

( ) 6. Rags containing oil, gasoline, alcohol, shellac, paint, varnish, or lacquer must be: (a) kept in a covered metal container; (b) stored in a wastebasket; (c) folded neatly and placed on a shelf; or (d) stored in a cool, dry place.

( ) 7. Before using any power equipment, you should obtain permission from: (a) an advanced student; (b) your principal; (c) your teacher; or (d) the office.

( ) 8. If you notice any breakage or damage to a tool, instrument, or machine, you should: (a) ask an advanced student to repair it; (b) be careful when you use it; (c) say nothing because you might be blamed; or (d) notify your teacher.

( ) 9. When using a knife, you should: (a) pull the knife toward you; (b) strike the blade with a hammer to make large cuts; (c) use pointed end only; or (d) cut away from your body and hands.

( ) 10. You should grind off a mushroomed head on a chisel or punch so as to prevent: (a) inaccuracies in your work; (b) spoiling the looks of the tool; (c) making the tool difficult to hold; or (d) particles of metal from flying when you strike the head with a hammer.

II

..... 1. All work that you plan to do should be approved by the ..... .

..... 2. You should clear away dry chips with a piece of wood or a ..... .

..... 3. When using a wood chisel or gouge, you should point the sharp edge of the tool away from your classmates, teacher, and ..... .

4. You should pass tools to classmates with the handles _____.

5. You should make sure that all students are clear of the machine before turning on the _____.

6. Before oiling, cleaning, or adjusting a machine, you should allow the machine to come to a complete _____.

Answers to Test Questions

I: 1. (c); 2. (b); 3. (a); 4. (b); 5. (d); 6. (a); 7. (c); 8. (d); 9. (d); 10. (d).

II: 1. teacher; 2. brush; 3. self (yourself); 4. first; 5. power (switch); 6. stop.

SECTION 2

Metalworking Equipment

This section contains specific safety instructions for operating equipment used in working with metal. Many of these pieces of equipment are found in the following industrial arts facilities: automotive mechanics, electronics, industrial crafts, metals, power mechanics, woods, and general industrial arts. Each set of safety instructions relating to the operation of a particular piece of equipment is followed by safety test questions and answers.

Bar Folder

Safety Instructions

1. Obtain permission from your teacher before using the bar folder.
2. Remove sharp burrs and edges on sheet metal before folding.
3. Fold only single thickness of sheet metal within capacity of the bar folder. (Follow manufacturer's gauge limit specifications.)
4. Make sure that no one but you is inside the operator's zone.
5. Keep your hands clear of movable parts.
6. Hold handle firmly.
7. Let the bar down slowly after completing a bend.

Safety Test Questions

I

( ) 1. When folding metal in the bar folder, you should: (a) keep your fingers away from the folding bar; (b) let the folding bar drop; (c) always fold across a hem; or (d) feed the work as rapidly as possible.

( ) 2. When you are using the bar folder, the handle should be: (a) held by another person at all times; (b) let down slowly; (c) thrown back; or (d) rotated.

II

_____ 1. You should always keep your hands clear of movable _____.

_____ 2. When using the bar folder, you should let the handle down _____.

Answers to Test Questions

I: 1. (a); 2. (b).
II: 1. parts; 2. slowly.

Brake

Safety Instructions

1. Obtain permission from your teacher before using the brake.
2. Keep fingers clear of clamping bar and blade.

3. Make sure no one but you is inside the operator's safety zone (clear of counter balance).

4. Fold only single thickness of sheet metal within capacity of the brake (follow manufacturer's specifications as to gauge limits).

Safety Test Questions

I

( ) 1. Before operating the brake, you should: (a) drop the leaf; (b) make sure that everyone is clear of the counter balance; (c) remove the counter balance; or (d) remove the bending leaf.

( ) 2. When using the brake, make sure you keep your fingers: (a) on the clamping bar; (b) on the bending leaf; (c) on the counter balance; or (d) clear of the clamping bar.

II

..... 1. When using the brake, you should keep fingers clear of clamping .....

..... 2. Before operating the brake, you should make sure that everyone is clear of the counter .....

Answers to Test Questions

I: 1. (b); 2. (d).
II: 1. bar; 2. balance.

Buffer

Safety Instructions

1. Obtain permission from your teacher before using the buffer.
2. Hold work with both hands.
3. Ask your teacher for special instruction and permission to buff small pieces.
4. Make sure that no one but you is inside the operator's zone.
5. Wear face shield or safety glasses (goggles, spectacles).
6. Turn on power after permission is given.
7. Apply compound sparingly.
8. Keep hands away from the wheel while it is in motion.
9. Hold work below center (horizontal axis) as wheel revolves toward you.
10. Buff flat surfaces from center toward lower edge. Sharp edges should point downward.
11. Press material against wheel with correct amount of pressure.
12. Turn off power after using buffer.
13. Clean buffer and area with a brush.

Safety Test Questions

I

( ) 1. When buffing, you should hold your work: (a) on top of wheel; (b) below center (horizontal axis) of wheel; (c) above center (horizontal axis) of wheel; or (d) on bottom of wheel.

( ) 2. You must wear goggles or a face shield when using buffer because either of these will: (a) magnify your work; (b) remove glare; (c) help avoid distraction; or (d) protect your eyes from flying particles.

( ) 3. Special permission to buff small pieces must be obtained from: (a) foreman; (b) teacher; (c) student; or (d) monitor.

( ) 4. When using buffer, you should point sharp edges of your work: (a) upward; (b) sideways; (c) horizontal; or (d) downward.

II

..... 1. When using buffer, you should always keep your hands away from .....

..... 2. Work being buffed should be held against the wheel just below .....

..... 3. Be sure when using buffing wheel to wear face shield or .....

..... 4. Special permission to buff small pieces must be obtained from the .....

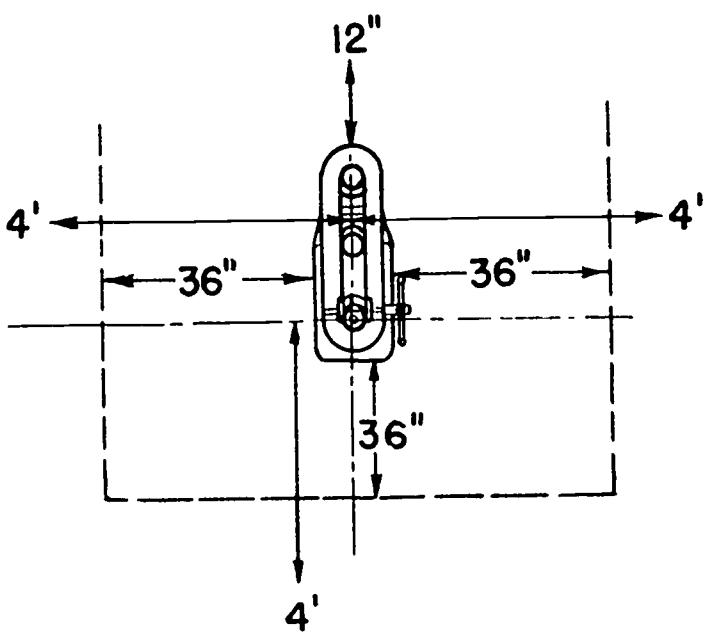
Answers to Test Questions

I: 1. (b); 2. (d); 3. (b); 4. (d).
II: 1. wheel; 2. center; 3. goggles; 4. teacher.

Drill Press

Safety Instructions

1. Obtain permission from your teacher before using the drill press.
2. Shift belt and make other adjustments only when power switch is turned off.
3. See that belt guard is in place.
4. Be certain that the table and head of drill press are secure.
5. Select proper drill (be sure it is sharp) and coolant.
6. Remove chuck key immediately after using it.
7. Use drill press vise whenever possible. Clamp vise or work to drill press table.
8. Make sure that no one but you is inside the operator's zone.
9. Wear face shield or safety glasses (goggles, spectacles).
10. Turn on power after permission is given.
11. Keep hands away from revolving spindle, chuck, drill, and chips.



MINIMUM SPACE REQUIREMENTS FOR DRILL PRESS
Aisles, if necessary, should be outside this allocated space.

12. Operate feed handle so that drill cuts evenly into work.
13. Ease up on feed pressure when drill begins to break through material.
14. Back drill out as soon as hole is drilled.
15. Stop the drill press before attempting to remove work, chips, or cuttings.
16. Use a brush to remove chips or shavings.
17. Keep floor clean around drill press.
18. Step away immediately if work comes loose and is seized by drill; shut off power if possible without endangering self.
19. Turn off power after using drill press and stand by until the machine has stopped.
20. Clean off drill press table and surrounding area. Return cleaned drills, coolants, and clamping devices to designated place.

Safety Test Questions

I

( ) 1. Drill press work should be held: (a) with a pair of tongs; (b) by the hands; (c) in a vise or firmly clamped to the table; or (d) by an assistant at all times.

( ) 2. When the drill begins to break through the work, you should: (a) ease up on the feed pressure; (b) maintain the same feed pressure; (c) stop the drill press immediately; or (d) apply more pressure.

( ) 3. The best way to remove chips from the drill press is with: (a) your fingers; (b) a small drill; (c) a long ruler; or (d) a brush.

( ) 4. By removing the chuck key from the chuck before turning on the power, you will prevent: (a) the chuck from being damaged; (b) the drill from breaking; (c) the chuck key from being thrown out at a terrific speed; or (d) the chuck from becoming unbalanced.

( ) 5. If work is seized by the drill, you should (without endangering yourself): (a) exert more feed pressure; (b) stop the machine immediately; (c) grab it with your hands; or (d) decrease the feed pressure.

II

_____ 1. Work being drilled on the drill press should be securely clamped to the table or in a _____.

_____ 2. Be sure to remove chuck key from the drill press before turning the power _____.

_____ 3. You should remove chips from the drill press table with a _____.

---------- 4. When the drill begins to break through the work, you should ease up on the ----------.

---------- 5. If work is seized by the drill, you should (without endangering yourself) immediately turn the power ----------.

Answers to Test Questions

I: 1. (c); 2. (a); 3. (d); 4. (c); 5. (b).
II: 1. vise; 2. on; 3. brush; 4. feed (pressure); 5. off.

Forge

Safety Instructions

1. Obtain permission from your teacher before lighting gas forge.
2. Clear area of all flammable material.
3. Keep area well ventilated.
4. Make sure no one but you is in operator's zone.
5. Light gas forge by following this procedure:
   a. Wear face shield or safety glasses (goggles, spectacles).
   b. Run air for two minutes in unlighted forge.
   c. Turn air off.
   d. Place a lighted piece of paper in the forge.
   e. Create draft by turning on air slowly.
   f. Turn on the gas slowly.
   g. Adjust the flame so that all fire is confined within forge.
6. Handle long and heavy pieces of steel with great care.
7. Use tongs or pliers to handle hot metal.
8. Be careful when carrying hot metal. Warn students who may be in the way. Consider all metal around the furnace as being hot.
9. Mark hot metal with chalk or soapstone with the word "hot" if it is necessary for you to leave your work.
10. Use only tools with safe handles and properly dressed heads.
11. Keep anvil face clear of scraps and flakes of metal.
12. Hammer metal being forged only. *Striking hammer on face of anvil may cause chips of steel to fly.*
13. Stand so that your face is protected when quenching metal.
14. Shut off GAS first and then AIR when you have finished using the forge.
15. Quench hot tongs before putting them away.
16. Clean up working area.

Safety Test Questions

I

( ) 1. Before leaving heated metal unattended, you should use chalk or soapstone to label it with the word "hot" because: (a) someone may be burned if he touches it; (b) other work may be placed on it; (c) you can tell to whom it belongs; or (d) chalk will help cool it.

( ) 2. You should only hammer the metal being forged because striking directly on the face of the anvil may: (a) cause a disturbing sound; (b) damage the hammer; (c) cause chips from the anvil and the hammer to fly and injure someone; or (d) damage the anvil.

( ) 3. You must wear a face shield or safety glasses (goggles, spectacles) when using the forge or hammering on metal because these: (a) are becoming to you; (b) magnify the work, thus making it easier for you to see; (c) protect your eyes from bright light; or (d) protect your eyes from flying particles.

( ) 4. When preparing to light the gas forge, you should *first:* (a) turn on the gas; (b) run air through the forge; (c) place a lighted piece of paper in the forge; or (d) close all vents.

( ) 5. You must cool tongs before placing them on the tool rack so as to prevent: (a) warping of the tongs; (b) burning someone; (c) heating the tool rack; or (d) disorganizing the tool rack.

II

..... 1. Before leaving heated metal unattended, you should use chalk or soapstone to label it with the word: .....

..... 2. You should hold hot metal with pliers or .....

..... 3. In preparing to light a gas forge, you should turn on the air before turning on the .....

..... 4. Before placing tongs on tool rack, you should make sure that they are .....

..... 5. When you finish using the gas forge, you should shut off the gas first and then the .....

Answers to Test Questions

I: 1. (a); 2. (c); 3. (d); 4. (b); 5. (b).
II: 1. hot; 2. tongs; 3. gas; 4. cool (cold); 5. air.

Furnace (Bench)

Safety Instructions

1. Obtain permission from your teacher before lighting furnace for soldering.
2. Secure soldering copper in a vise when it is necessary to file tip.
3. See that area is properly ventilated.
4. Light furnace by following this procedure:
   a. Stand to one side of furnace.
   b. Place a lighted piece of paper in the furnace if furnace does not have a pilot light.
   c. Turn on the gas slowly.
   d. Adjust the flame so that all the fire is confined within furnace.
5. Place the soldering copper on the prescribed rest when not in use.
6. Determine heated readiness of a soldering copper by testing it with a piece of solder.
7. Use care in handling heated soldering copper.
8. Select correct flux for soldering job you are planning to do.
9. Stand so that you will be protected from any fumes while tinning a copper or soldering.
10. Use care when wiping off excess solder.
11. Wipe up immediately any spilled flux.
12. Shut off gas when you have finished using soldering furnace.
13. Clean area when you have completed your soldering.

Safety Test Questions

I

( ) 1. Before lighting the gas furnace, you should make sure: (a) all windows are closed; (b) electric lights are turned on; (c) there is a spare soldering copper; or (d) the area is properly ventilated.

( ) 2. When lighting the gas furnace, you should: (a) close all vents; (b) stand to one side; (c) immediately turn on gas full force; or (d) preheat furnace before turning on gas.

( ) 3. In passing a soldering copper to another person, you should: (a) hand it to him point first; (b) grasp it by the middle so that he can take hold of the handle; (c) place it on a rest or in the furnace so that he can pick it up; or (d) wrap a cloth around it so neither of you will be burned.

( ) 4. You should always pick up a soldering copper: (a) by its handle; (b) only when it it hot; (c) only when it is cold; or (d) by its shank.

( ) 5. To determine whether a soldering copper is hot enough to use, you should: (a) test with a piece of solder; (b) dip in water; (c) hold close to face; or (d) look at the flame.

II

..... 1. When lighting the gas furnace, you should stand to one .....

..... 2. You should always pick up a soldering copper by its .....

..... 3. When the soldering copper is not in use, you should place it in the furnace or on the ..... .

..... 4. You should determine the heated readiness of a soldering copper by testing it with a piece of .....

Answers to Test Questions

I: 1. (d); 2. (b); 3. (c); 4. (a); 5. (a).
II: 1. side; 2. handle; 3. rest; 4. solder.

Furnace (Crucible)

Safety Instructions

1. Use caution in handling tools, castings, or other metal in the foundry area, as they may be hot.
2. Obtain approval from your teacher before closing a mold.
3. Keep molds covered until ready for pouring.
4. Obtain permission from your teacher before lighting gas furnace.
5. Keep all flammable material away from the working area.
6. Light gas furnace by following this procedure:
   a. Wear face shield or safety glasses (goggles, spectacles).
   b. Run air for two minutes in unlighted furnace.
   c. Turn off air.
   d. Place a lighted piece of paper in the furnace.
   e. Create draft by turning on air slowly.
   f. Turn on the gas slowly.

g. Adjust the flame so that all fire is confined within furnace.

7. Preheat metal to remove moisture before placing in a crucible containing any molten metal.

8. Preheat skimmer before using.

9. Shut off GAS first and then AIR when you have finished using the furnace.

10. Wear face shield or safety glasses (goggles, spectacles), gloves, and protective covering for the feet when handling ladles or crucibles of molten metal.

11. Move with care and carry molten metal close to the floor to reduce possible dangers.

12. Have mold on floor when pouring metal.

13. Stand so that your face is protected when pouring metal.

14. Allow casting to cool before breaking it out of mold.

15. Clean working area.

Safety Test Questions

I

( ) 1. If water comes in contact with molten metal, it will: (a) discolor the material; (b) cause an offensive odor; (c) cause an explosion; or (d) make the material nonmetallic.

( ) 2. When preparing to light the gas furnace, you should *first:* (a) turn on the gas; (b) run air through the furnace; (c) place a lighted piece of paper in the furnace; or (d) close all vents.

( ) 3. You must wear a face shield or safety glasses (goggles, spectacles) when you handle ladles or crucibles of molten metal because these: (a) are becoming to you; (b) magnify the work, thus making it easier for you to see; (c) protect your eyes from bright light; or (d) protect your eyes from metal that may splatter.

( ) 4. When pouring metal, you should have the mold placed: (a) on the bench; (b) on the floor; (c) even with your waist; or (d) even with your shoulders.

( ) 5. You should preheat metal before placing it in a crucible containing any molten metal so as to remove: (a) moisture; (b) impurities; (c) oxides; or (d) carbon.

II

..... 1. In preparing to light a gas furnace, you should turn on the air before turning on the ..... .

..... 2. When you have finished using the furnace, you should shut off the gas first and then the ..... .

..... 3. If water comes in contact with molten metal, it will cause an ..... .

..... 4. When pouring metal, you should have the mold placed on the ..... .

..... 5. You should preheat metal before placing it in a crucible containing any molten metal so as to remove ..... .

Answers to Test Questions

I: 1. (c); 2. (b); 3. (d); 4. (b); 5. (a).
II: 1. gas; 2. air; 3. explosion; 4. floor; 5. moisture.

Grinder

Safety Instructions

1. Obtain permission from your teacher before using grinder.
2. Set tool rest 1/16 in. to 1/8 in. from the wheel.
3. Dress wheel when necessary.
4. See that guard is in place.
5. Make sure that no one but you is inside the operator's zone.
6. Wear face shield or safety glasses (goggles, spectacles) and use glass safety guard on grinder.
7. Stand to one side of wheel.
8. Turn on power after permission is given.
9. Keep hands away from the wheel while it is in motion.
10. Hold work with your hands. Ask your teacher for special instruction and permission to grind small pieces.
11. Use the face of the wheel only.
12. Press material against wheel with correct amount of pressure.
13. Keep work in motion across face of wheel.
14. Turn off power after using grinder.

While using a grinder, the student protects his eyes by wearing a face shield and looks through glass safety guard.

Safety Test Questions

I

( ) 1. You must wear a face shield or safety glasses (goggles, spectacles) when using grinder because these: (a) are becoming to you; (b) magnify the work, thus making it easier for you to see; (c) protect your eyes from bright light; or (d) protect your eyes from flying particles.

( ) 2. The grinder tool rest must be securely fastened: (a) immediately after grinder is turned on; (b) 1 in. away from wheel; (c) when wheel is not in motion; or (d) after power is turned off and the wheel is coasting.

( ) 3. You should set grinder tool rest: (a) 1/4 in. away from wheel; (b) so wheel rubs lightly against tool rest; (c) 1/2 in. away from wheel; or (d) no more than 1/8 in. from wheel.

( ) 4. To grind small pieces of stock, you should: (a) hold them in your bare hands; (b) hold them with a rag; (c) use a very coarse wheel; or (d) receive special instruction and permission from your teacher.

( ) 5. You should stand to one side of grinding wheel while it is gathering speed because: (a) if it has a defect, the wheel may fly to pieces; (b) the air currents from wheel are unhealthful; (c) it will tempt you to use the wheel too soon and cause it to stop; or (d) you can see if the wheel is running true.

II

_____ 1. You must wear a face shield or safety glasses (goggles, spectacles) when using the grinder because these will protect your _____.

_____ 2. The grinder tool rest should be set away from grinding wheel no more than _____ inch.

_____ 3. When using the grinder, you should keep your hands away from the _____.

_____ 4. To grind small pieces of stock, you should obtain special permission from the _____.

_____ 5. When starting the grinder, you should stand to one _____.

Answers to Test Questions

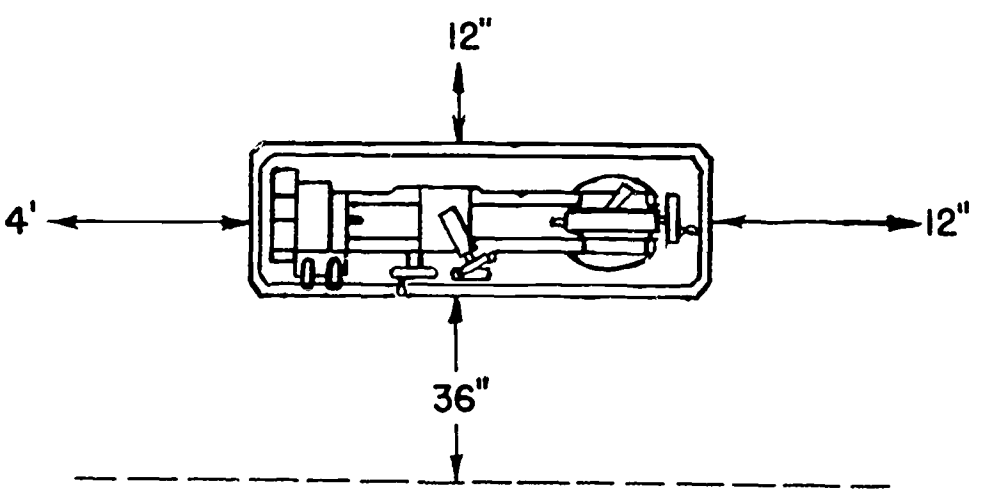
I: 1. (d); 2. (c); 3. (d); 4. (d); 5. (a).
II: 1. eyes; 2. 1/8; 3. wheel; 4. teacher; 5. side.

Lathe (Metalworking)

Safety Instructions

General Turning Instructions

1. Obtain permission from your teacher before using the lathe.
2. Roll sleeves above elbows and remove or fasten any loose clothing.
3. Make all adjustments only when machine is at a dead stop.
4. Check to see that all guards are in place.
5. Be sure that all parts of the carriage will clear any rotating part during full length of cut.
6. *Remove chuck key or wrench immediately after using.*



MINIMUM SPACE REQUIREMENTS FOR METAL LATHE
Aisles, if necessary, should be outside this allocated space.

7. Set tool on center of work to be turned.
8. Wear a face shield or safety glasses (goggles, spectacles).
9. Make sure that no one but you is inside the operator's zone.
10. Turn on power after permission is given.
11. Place your hands on the controls or at your sides except when filing or polishing.
12. Keep hands away from chips.
13. Finish your cuts that are close to chuck or against a shoulder by hand feed.
14. Bring lathe to a complete stop before reversing.
15. Remove toolholder and tool post before filing or polishing.
16. Shut off power after using lathe and stand by until the machine has stopped.
17. Clean machine and area.

Between-Centers Turning Instructions

1. Use safety dog to drive work.
2. Clamp tailstock securely.
3. Adjust and lubricate the tailstock center.
4. Regulate depth of cut according to size and type of metal.
5. Use tools that are properly ground for the particular job.

Chuck and Faceplate Turning Instructions

1. Place a board under chuck when threading it on or off spindle. Keep your fingers clear.
2. Secure work firmly in chuck.
3. *Remove chuck key or wrench immediately after using it.*
4. Counterbalance work on the faceplate if it is irregular in shape.
5. Turn chuck or faceplate by hand through one complete cycle to make sure work is clear.
6. Regulate depth of cut according to size and type of metal.
7. Stand to one side of revolving faceplate.
8. Stop power feed before tool reaches jaws of chuck.

Safety Test Questions

I

( ) 1. Measurements should be made when the lathe is at a dead stop so as to: (a) avoid damaging measuring tool; (b) prevent measuring instrument from getting caught and flying out; (c) make faster measurements; or (d) keep chuck tight.

( ) 2. When the lathe chuck or faceplate has been removed from the lathe, you should place it: (a) on the ways; (b) in such a manner that it will not roll and fall onto the floor; (c) on the carriage; or (d) in the chip pan.

( ) 3. Before cleaning your work with a rag, be sure the lathe is: (a) operating slowly; (b) rotating in reverse; (c) at a dead stop; or (d) revolving at full speed.

( ) 4. To prevent the possibility of the chuck key or wrench from flying out of the lathe chuck, you should: (a) operate the lathe at low speed; (b) tighten the chuck; (c) remove the key or wrench immediately after using; or (d) use a key or wrench that fits securely.

( ) 5. Lathe chips are: (a) cool when the lathe is operating slowly; (b) cut from aluminum and brass only; (c) likely to burn and cut if you grasp them; or (d) safe to handle.

II

..... 1. Shifting gears and changing levers on the lathe should only be done when the machine is .....

..... 2. Before starting the lathe, you should see that it turns freely by rotating it by .....

..... 3. When making cuts where flying chips are a hazard, you must wear .....

..... 4. Before filing or polishing, the toolholder and tool post should be .....

..... 5. You should remove the chuck key or wrench from the lathe chuck immediately after .....

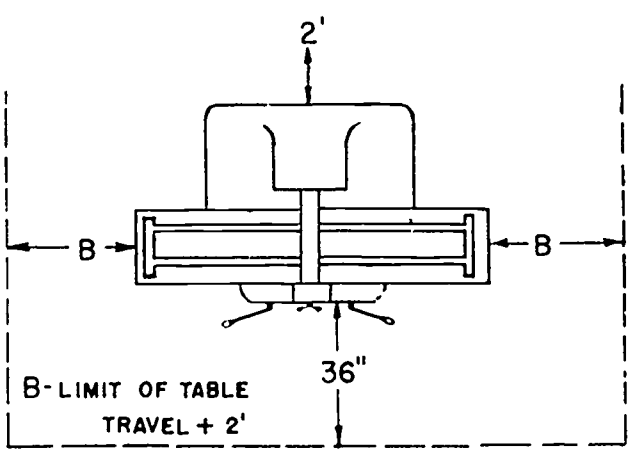
Answers to Test Questions

I: 1. (b); 2. (b); 3. (c); 4. (c); 5. (c).
II: 1. stopped; 2. hand; 3. face shield (safety glasses); 4. removed; 5. using.

Milling Machine

Safety Instructions

1. Obtain permission from your teacher before using milling machine.
2. Make adjustments or setup only when machine is at a dead stop. Check with the teacher.
3. Use correct fitting wrenches on machine parts.
4. Handle all cutters carefully.
5. Select proper cutter; be sure it is sharp.
6. Use only a soft hammer or mallet to seat work against the parallels or bottom of vise.
7. Be sure that job is securely fastened.
8. Make certain that work, milling machine table, and any holding device will clear arbor and support during cut.



MINIMUM SPACE REQUIREMENTS FOR HORIZONTAL MILLING MACHINE
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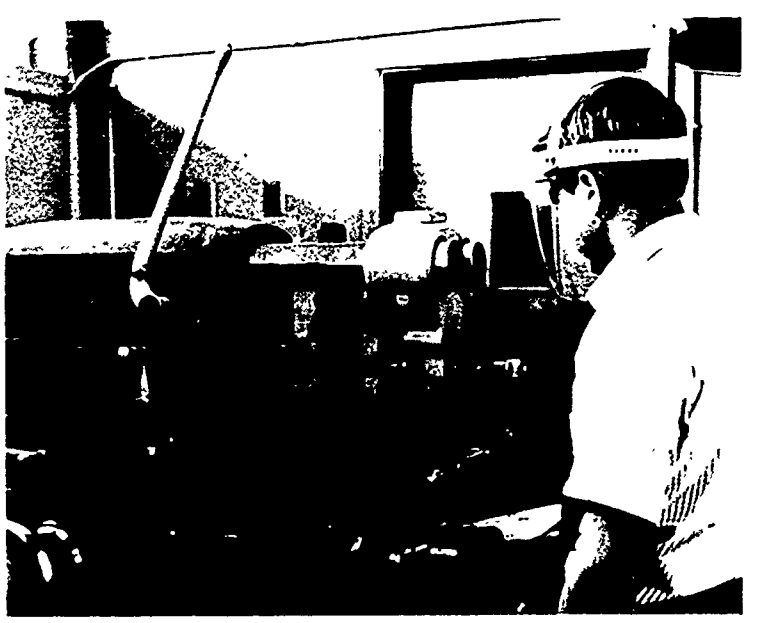


9. Set machine for proper depth of cut.
10. Select correct feed.
11. Disengage handles when automatic feed is to be used or table is to be locked.
12. Make sure no one but you is inside the operator's zone.
13. Stand to one side of machine.
14. Turn on power after permission is given.
15. Be sure that cutter is turning in proper direction.
16. Feed against or opposite to direction of rotation of cutter.
17. Use a brush to remove chips from work when machine is at rest.
18. Keep floor clean around milling machine.
19. Turn off power after using milling machine and stand by until the machine has stopped.
20. Release all automatic feeds.
21. Clean machine and area with a brush.

Safety Test Questions

I

( ) 1. You should check all attachments and clamps on the milling machine for tightness before: (a) turning on the power; (b) oiling the machine; (c) changing the spindle speeds; or (d) turning off the automatic feed.

( ) 2. When cutter of milling machine is revolving: (a) clean the table; (b) oil the bearings; (c) clean the arbor with a cloth; or (d) stand to one side of machine.

( ) 3. The best way to remove metal cuttings or chips from your work is to use: (a) your hand ; (b) a clean rag; (c) a brush or (d) a tool.

( ) 4. Striking a mill cutter with a steel hammer may: (a) cause pieces of steel to fly; (b) break the cutter; (c) damage the arbor; or (d) damage the hammer.

( ) 5. When you have finished using the milling machine, you should: (a) speed up all clutches and feeds; (b) seat work against the parallels; (c) release all automatic feeds; or (d) select proper cutter.

II

_____ 1. You should check all attachments and clamps on the milling machine before turning on the _____.

_____ 2. When milling machine cutter is revolving, you should stand to one _____.

_____ 3. The best way to remove metal cuttings or chips from your work is to use a _____.

_____ 4. When you have finished using the milling machine, all automatic feeds should be _____.

_____ 5. You should make adjustments or setup only when milling machine is _____.

Answers to Test Questions

I: 1. (a); 2. (d); 3. (c); 4. (a); 5. (c).
II: 1. power (switch, machine); 2. side; 3. brush; 4. released; 5. stopped.

Planer (Metalworking)

Safety Instructions

1. Obtain permission from your teacher before using planer.
2. Make adjustments or setup only when machine is at a dead stop.
3. Secure work firmly in the machine.
4. Select proper tool for the job.
5. Set machine for proper depth of cut.
6. Make sure that work clears cross rail and sides of machine.
7. See that stops are set for controlling the movement of table.
8. Make sure no one but you is inside the operator's zone.
9. Protect your eyes with a face shield or safety glasses (goggles, spectacles).
10. Check to see that lever is in neutral position before starting the motor.
11. Turn on power after permission is given.
12. Keep your hands away from cutting tool and line of travel of moving parts of machine.
13. Turn off power after using planer and stand by until the machine has stopped.
14. Clean machine and area with a brush.

Safety Test Questions

I

( ) 1. When setting up a job on the planer, be certain: (a) there are no chips on the table; (b) your work is securely fastened on the table; (c) the platen travels at least 6 in.; or (d) the machine is in gear.

( ) 2. Before starting the planer, you should make sure the work will clear the: (a) starting lever; (b) operator; (c) table; or (d) cross rails and sides of machine.

( ) 3. When operating the planer, you should: (a) oil the machine; (b) sweep the chips from the floor immediately; (c) wear a face shield or safety glasses; or (d) increase the cutting speed.

( ) 4. You should use a file to remove sharp burrs and corners from your work so as to: (a) prevent work from being marred; (b) avoid tearing your clothes; (c) prevent your fingers from being cut; or (d) speed up production.

( ) 5. When the planer is in motion, you should: (a) lean on the cross rail; (b) sit nearby and watch; (c) stop the table each time it returns; or (d) keep your hands away from the work.

II

_____ 1. In setting up a job on the planer, you should be certain that your work is securely _____.

_____ 2. Before starting the planer, you should make sure the work clears the sides of machine and the cross _____.

_____ 3. When operating the planer, you should wear a face shield or _____.

_____ 4. When the planer is in motion, you should stand to one _____.

_____ 5. Sharp burrs and corners should be removed from your work with a _____.

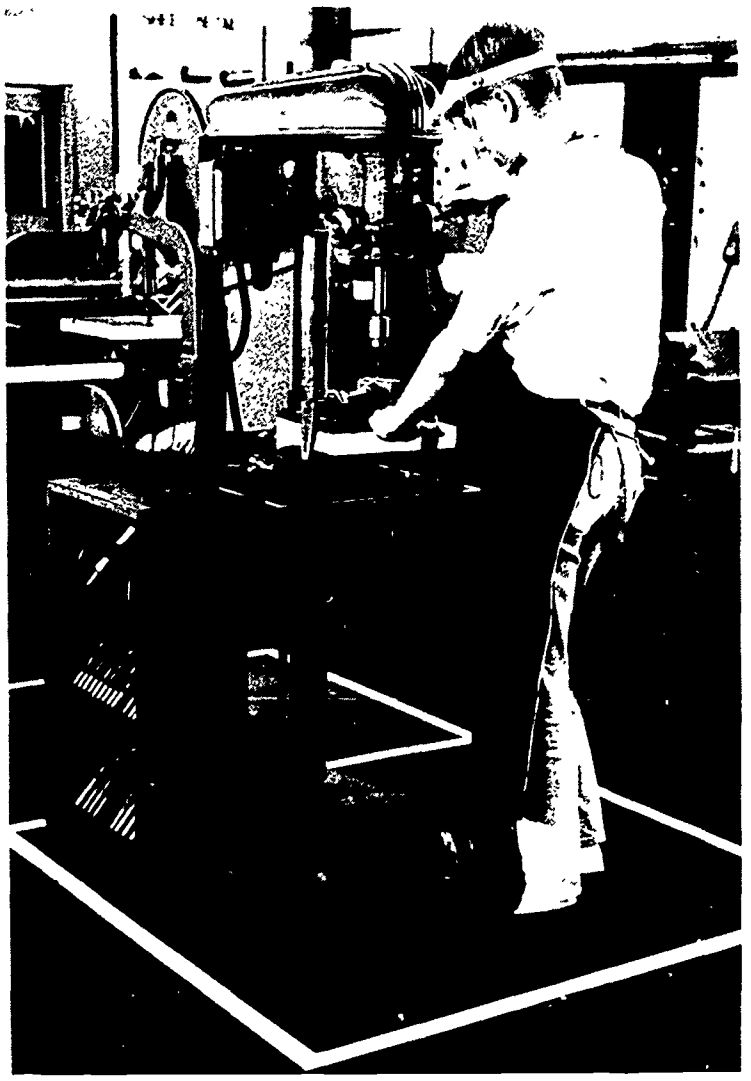
Answers to Test Questions

I: 1. (b); 2. (d); 3. (c); 4. (c); 5. (d).
II: 1. fastened (held); 2. rail; 3. safety glasses (goggles, spectacles); 4. side; 5. file.

Portable Electric Drill

Safety Instructions

1. Obtain permission from your teacher before using portable electric drill.
2. Select proper drill (be sure it is sharp) and coolant.
3. Make sure switch is in an "off" position.
4. Remove chuck key immediately after using it.
5. See that a grounded wire is connected to the portable electric drill.
6. Keep drill, electric cord, and plug dry at all times.
7. Plug in electric cord.
8. Hold the machine firmly.
9. Turn on power after permission is given.
10. Keep hands away from revolving spindle and drill.
11. Apply straight and steady pressure on the drill.
12. Ease up on pressure just before drill begins to break through material.
13. Back drill out as soon as hole is drilled.
14. Turn off power and hold machine firmly until it comes to a dead stop—then rest machine on its side.
15. Disconnect electric cord. Clean and return machine to designated place.



Only the user of a machine is allowed in the operator's zone.

Safety Test Questions

I

( ) 1. You should select a location that is dry and not grounded for using a portable electric tool or appliance so as to avoid: (a) soiling the equipment; (b) serious electric shock; (c) motor bearings deterioration; or (d) discoloring the electric cord.

( ) 2. By removing the chuck key from the drill chuck before turning on the power, you will prevent the: (a) chuck from being damaged; (b) drill from breaking; (c) chuck key from being thrown out at a terrific speed; or (d) chuck from becoming unbalanced.

( ) 3. Before plugging in the portable electric drill, you should: (a) remove the drill; (b) check the armature; (c) make sure the switch is off; or (d) disconnect the ground wire.

( ) 4. When you turn off the switch on the portable electric drill, you should: (a) disconnect electric cord; (b) inspect rotor; (c) blow the sawdust out of the armature opening; or (d) hold the machine firmly until it comes to a dead stop.

II

..... 1. You should select a location that is dry and not grounded for using a portable electric tool or appliance so as to avoid serious electric ....

..... 2. Be sure to remove the chuck key from the drill chuck before you turn the power ....

..... 3. Before plugging in the electric drill, you should make certain the switch is ..... .

..... 4. When you turn off the switch on the portable electric drill, you should hold the machine firmly until it comes to a ....

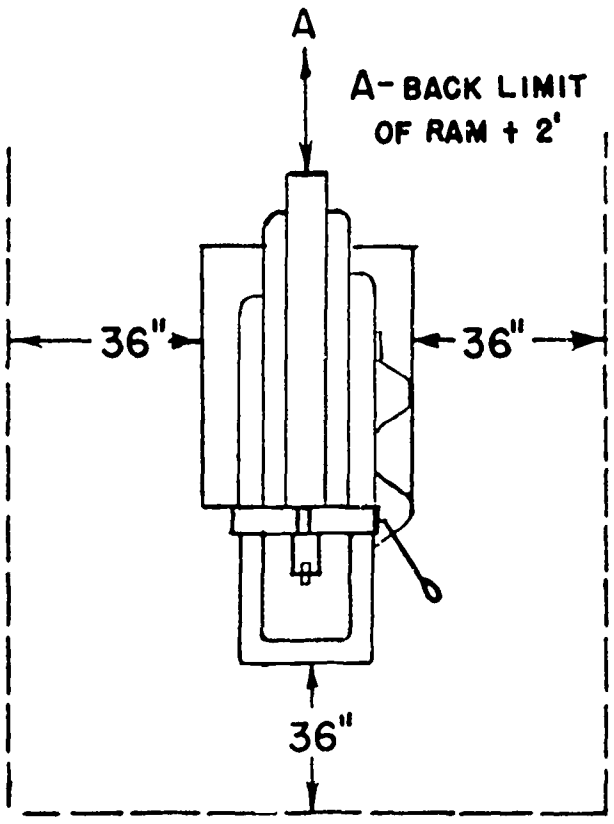
Answers to Test Questions

I: 1. (b); 2. (c); 3. (c); 4. (d).
II: 1. shock; 2. on; 3. off; 4. stop.

Shaper (Metalworking)

Safety Instructions

1. Obtain permission from your teacher before using shaper.
2. Make adjustments or setup only when machine is at a dead stop.
3. Use soft hammer or mallet to set work on the parallels.
4. Secure work firmly in the machine.
5. Select proper tool for the job.
6. Set machine for proper depth of cut.
7. Be sure that ram and head will clear your work and any holding device.
8. Make sure no one but you is inside the operator's zone.
9. Protect your eyes with a face shield or safety glasses (goggles, spectacles).
10. Check to see that lever is in neutral position before starting the motor.
11. Stand to one side of machine.
12. Turn on power after permission is given.
13. Keep your hands away from cutting tool and line of travel of all moving parts.
14. Turn off power after using shaper, and stand by until the machine has stopped.
15. Clean machine and area with a brush.



MINIMUM SPACE REQUIREMENTS FOR
METAL SHAPER

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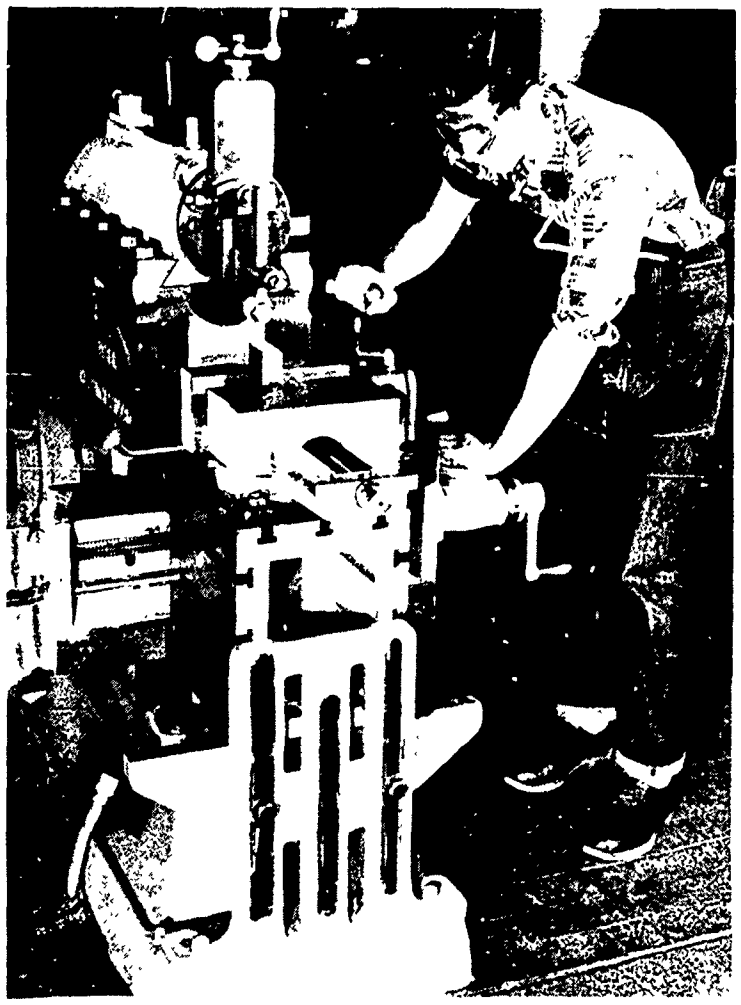


Safety Test Questions

I

( ) 1. When setting up a job on the shaper, be certain: (a) there are no chips on the vise; (b) your work is securely fastened in the machine; (c) the stroke of the ram is at least 3 in. long; or (d) the machine is in gear.

( ) 2. Before starting the shaper, you should make sure the ram and head will clear the: (a) starting lever; (b) ram clamp; (c) operator; or (d) work and holding device.

( ) 3. When operating a shaper, you should: (a) oil the machine; (b) sweep the chips from the floor immediately; (c) wear a face shield or safety glasses; or (d) increase the cutting speed.

( ) 4. You should use a file to remove sharp burrs and corners from your work so as to: (a) prevent work from being marred; (b) avoid tearing your clothes; (c) prevent your fingers from being cut; or (d) speed up production.

( ) 5. When the shaper is in motion, you should: (a) lean on the ram; (b) sit nearby and watch; (c) raise the tool holder on each back stroke; or (d) keep your hands away from the work.

II

1. In setting up a job on the shaper, you should be certain that your work is securely _____.

2. Before starting the shaper, you should make sure the ram and head clear your _____.

3. When operating a shaper, you should wear a face shield or _____.

4. When the shaper is in motion, you should stand to one _____.

5. Sharp burrs and corners should be removed from your work with a _____.

Answers to Test Questions

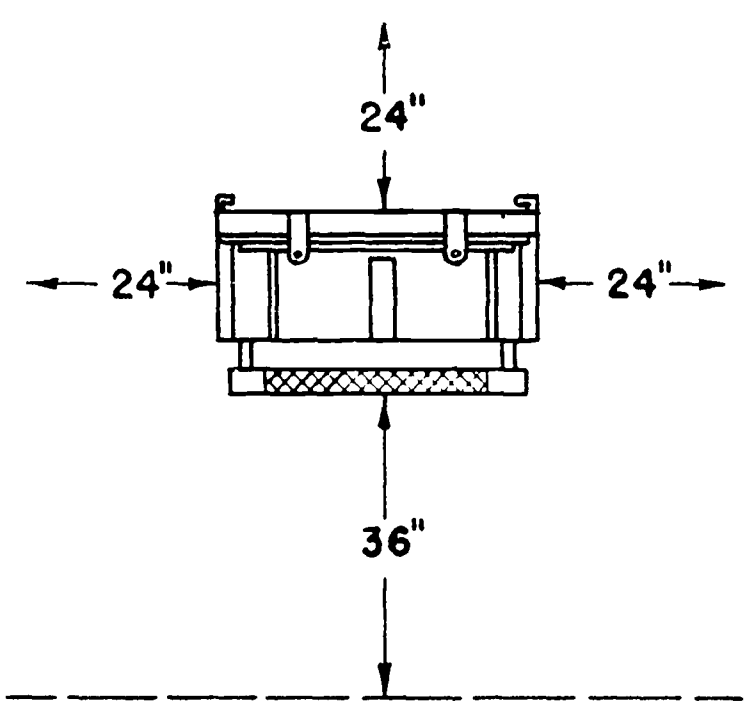
I: 1. (b); 2. (d); 3. (c); 4. (c); 5. (d).

II: 1. fastened (held); 2. work; 3. safety glasses (goggles, spectacles); 4. side; 5. file.

Shear

Safety Instructions

1. Obtain permission from your teacher before using the shear.
2. See that guards are in place.
3. Follow manufacturer's specifications as to gauge of sheet metal that can be safely cut.
4. Cut narrow strips of metal crosswise only.
5. Make sure that no one but you is inside the operator's zone.
6. Stand directly in front of machine.
7. Feed pieces of metal into shear from front (operator's position).
8. Keep your fingers away from clamp and blade.
9. Hold stock securely against guide.
10. Make sure the foot that is not being used to operate treadle is clear before pushing down on treadle.
11. Regulate pressure on treadle according to gauge and type of stock. Keep foot on treadle to ease its return to normal position.
12. Allow small pieces of metal being cut to drop to the floor or into a container.
13. Use care when picking up trimmings.



MINIMUM SPACE REQUIREMENTS FOR SQUARING SHEAR
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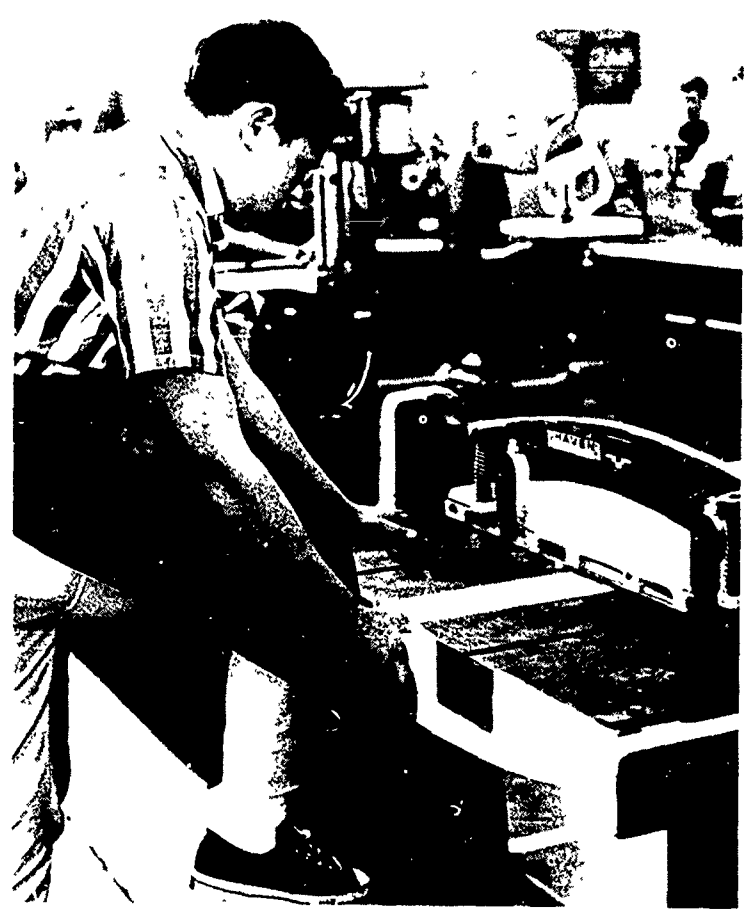


Safety Test Questions

I

( ) 1. The shear must be operated by: (a) several students at once; (b) an advanced student and the shop foreman; (c) one student and a helper; or (d) only one person at a time.

( ) 2. You should make sure that the foot that is *not* being used to operate the foot treadle of the shear is kept: (a) on the treadle; (b) under the treadle; (c) clear of the treadle; or (d) away from the floor.

( ) 3. When using a shear, you should keep your fingers: (a) near the clamp and blade; (b) under the clamp and blade; (c) away from the clamp and blade; or (d) between the clamp and blade.

( ) 4. After pushing down on the shear's treadle for a cut, you should allow the treadle to: (a) stay down; (b) return to its normal position as fast as possible; (c) return only part way; or (d) return slowly to its normal position.

II

..... 1. The shear must be operated by only one ..... .

..... 2. You should make sure that the foot that is *not* being used to operate the foot treadle is clear of the ..... .

..... 3. When using the shear, you should keep your fingers away from the clamp and ..... .

..... 4. After pushing down on the shear's treadle for a cut, you should allow the treadle to return to its normal position ..... .

Answers to Test Questions

I: 1. (d); 2. (c); 3. (c); 4. (d).
II: 1. person (student); 2. treadle; 3. blade; 4. slowly.

Welder

Safety Instructions

Oxygen-Acetylene Welding

1. Obtain permission from your teacher before using welding equipment.
2. Fasten cylinders with a chain or other suitable device as a protection against falling or rolling.
3. Close cylinder valve and replace protective cover before moving cylinder.
4. Keep welding equipment free of oil and grease. Use only clean rags for wiping off welding equipment.
5. Inspect hose before using.
6. Make sure that hose is properly connected and that all connections are tight.
7. Report any leaking of cylinders or connections to teacher immediately.
8. Make sure you have ample ventilation.
9. Keep all flammable material away from working area.

10. Be sure that you wear welding goggles. All assistants and observers must also wear welding goggles.

11. Release regulator pressure screw. Open cylinder valves *gradually.*

12. Open acetylene cylinder valve one and one-fourth turns or less. Keep wrench in place so that valve may be shut off quickly if necessary.

13. Keep acetylene pressure in the hose *below 15 pounds per square inch.*

14. Use a friction torch lighter to ignite torch.

15. Close acetylene valve first if torch backfires.

16. Make certain lighted torch always points away from yourself and other students.

17. Keep sparks and flame away from cylinders.

18. Close cylinder valve when you have finished your welding job.

19. Quench section of metal that has been welded or mark with chalk or soapstone the word "hot" on the metal if it is necessary for you to leave your work.

Safety Test Questions

Oxygen-Acetylene Welding

I

( ) 1. You should make sure welding equipment is: (a) lubricated with oil; (b) tightened by hand; (c) kept free of oil and grease; or (d) lubricated weekly.

( ) 2. Welding goggles are worn because they: (a) magnify your work; (b) protect your eyes from dust; (c) help you concentrate on your work; or (d) protect your eyes against heat, rays, and sparks.

( ) 3. The valve on a cylinder of acetylene should be opened: (a) with a pair of pliers; (b) three full turns; (c) one and one-fourth turns or less; or (d) as many turns as possible.

( ) 4. When you light a welding torch, you should use a: (a) friction torch lighter; (b) match; (c) fluid lighter; or (d) piece of lighted paper.

A wire glass shield between the grinder and lathe protects students but does not obstruct the teacher's view of entire shop.

( ) 5. If a welding torch backfires, you should: (a) dip the torch in water; (b) inspect the hose; (c) hang an out-of-order sign on equipment; or (d) close the acetylene valve first.

II

..... 1. Before moving a cylinder, you should close the valve and replace ..... .

..... 2. You should report any leaking of cylinders or connections immediately to the ..... .

..... 3. You should keep the acetylene pressure in the hose below ..... pounds per square inch.

..... 4. The valve on a cylinder of acetylene should be opened not more than ..... turns.

..... 5. Anyone watching a welding flame must wear welding ..... .

Answers to Test Questions

I: 1. (c); 2. (d); 3. (c); 4. (a); 5. (d).
II: 1. cover (cap); 2. teacher; 3. 15; 4. 1¼; 5. goggles.

Safety Instructions

Electric Welding

1. Obtain permission from your teacher before using welding equipment.
2. Wear a helmet with proper observation window, treated gauntlet gloves, and treated leather apron. All assistants and observers must also wear this equipment.
3. Keep your sleeves and pants cuffs rolled down. Wear leather jacket.
4. Make sure electric welding is done only in a correctly constructed booth or room or behind proper screens.
5. Be sure there is ample ventilation.
6. Keep all flammable material away from working area.
7. See that floor area is clear of all obstructions.
8. Report to your teacher at once if electrode holder, holder cable connection, cable or cable terminals at the welding machine, ground clamp, lugs, or cable get hot.
9. Hang up electrode holder and turn off welder when work is being changed or when work has been completed.

The student wears a helmet (with proper observation window) and treated gauntlet gloves and leather apron while doing electric welding.

Safety Test Questions

Electric Welding

I

( ) 1. If observation window in your welding helmet is cracked, it will: (a) allow dust to pass through it; (b) obstruct your view; (c) transmit infrared and ultraviolet rays; or (d) rattle every time the helmet is flipped up.

( ) 2. When you are through using the electrode holder, you should: (a) place it on a metal workbench; (b) clamp it on the metal frame of the workbench; (c) rest it on the floor; or (d) suspend it so that it will not touch any metal.

( ) 3. If a cable or the electrode holder overheats, you should: (a) notify your teacher; (b) turn the voltage down; (c) stop welding and wait until it cools; or (d) change the electrode holder.

( ) 4. You should always draw the curtains on the welding booth before you strike an arc so as to: (a) protect your eyes from the infrared and ultraviolet rays; (b) keep the work from getting cool; (c) prevent anyone from noticing any mistakes; or (d) protect anyone nearby from the infrared and ultraviolet rays.

( ) 5. Before leaving heated metal unattended, you should use chalk or soapstone to label it with the word "hot" because: (a) someone may be burned if he touches it; (b) other work may be placed on it; (c) you can tell to whom it belongs; or (d) chalk will help cool it.

II

..... 1. For eye protection against infrared and ultraviolet rays, you must wear a welding ..... .

..... 2. If a cable or the electrode holder overheats, you should notify the ..... .

..... 3. When chipping slag, you must wear ..... .

..... 4. Arc welding should be done only behind proper screens or in a ..... .

..... 5. If your skin is exposed to electric arc rays, you will be ..... .

Answers to Test Questions

I: 1. (c); 2. (d); 3. (a); 4. (d); 5. (a).
II: 1. helmet; 2. teacher; 3. goggles; 4. booth; 5. burned.

SECTION 3

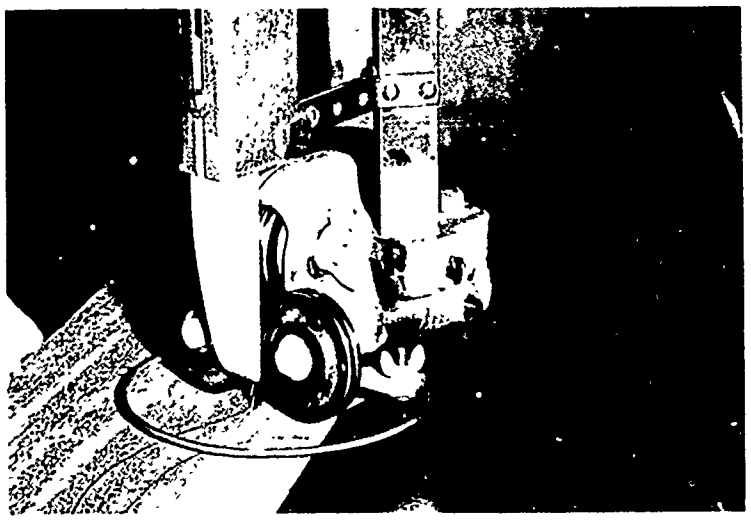
Woodworking Equipment

This section contains specific safety instructions for operating equipment used in working with wood. Many of these pieces of equipment are found in the following industrial arts facilities: electronics, industrial crafts, woods, and general industrial arts. Each set of safety instructions relating to the operation of a particular piece of equipment is followed by safety test questions and answers.

Band Saw

Safety Instructions

1. Obtain permission from your teacher before using the band saw.
2. Plan sawing procedure so there may be a maximum forward feed with a minimum of backing out of cuts.
3. Cut only stock with a flat surface.
4. Make sure the proper width saw is on the machine for your particular job.
5. Check to see that all guards are in place.
6. Make adjustments only when machine is at a dead stop.
7. Set upper saw guide ¼ in. or less above the stock to be cut; check with teacher if stock is rough or warped.



A band saw guard helps the operator keep his fingers a safe distance from the saw blade.

8. Ask your teacher to approve all special setups.
9. Make sure that no one but you is inside the operator's zone.
10. Wear face shield or safety glasses (goggles, spectacles).
11. Turn on power after permission is given.
12. Hold material firmly.
13. Keep fingers a safe distance from saw blade.
14. Feed material into machine at a moderate rate of speed.
15. Keep saw blade from twisting or binding when cutting curves.
16. Allow machine to come to a dead stop before backing saw out of a long cut.
17. Keep waste from accumulating on the saw table.
18. Step away immediately if the saw breaks or comes off. Shut off power if possible without endangering self. Notify your teacher.
19. Turn off power after using band saw (use brake if provided) and stand by until machine has stopped.
20. Clear away scraps of wood on the table only after saw stops running.

Safety Test Questions

I

( ) 1. You should make all adjustments on the band saw: (a) only when the machine is at a dead stop; (b) more than ½ in. above the stock; (c) while the machine is coasting; or (d) only when the power is on.

( ) 2. It is best to set upper saw guide of the band saw: (a) when the power is off and the saw is coasting; (b) ¼ in. or less above the stock; (c) tight against the stock; or (d) ½ in. or more above stock.

( ) 3. You should plan your sawing procedure on the band saw so that: (a) small curves can be cut easily with wide blades; (b) there will be a maximum forward feed with a minimum of backing out of cuts; (c) there will be little scrap left on the table; or (d) back-outs can be made after each ½ in. of forward feed.

( ) 4. When it becomes necessary to back out stock from a long cut on the band saw, you should: (a) carefully back the stock away while the blade is in motion; (b) stop the machine, then back out the stock; (c) try to turn the stock on the table; or (d) continue to saw forward.

( ) 5. If the band saw blade breaks or comes off, you should: (a) call another student to shut off the power; (b) back your stock away from the blade immediately so as to avoid damage to your work; (c) continue cutting until the blade comes to a stop; or (d) step away immediately, shut off power (without endangering yourself), and then notify your teacher.

II

_____ 1. You should make adjustments on the band saw only when the machine is _____.

_____ 2. The proper height at which to set the band saw's upper guide above the stock being cut is _____ inch or less.

_____ 3. You should plan your sawing procedure on the band saw so that you will have a maximum of forward _____.

_____ 4. Before backing out stock from a long cut on band saw, you should allow the machine to come to a complete _____.

_____ 5. If the blade breaks or comes off while you are operating the band saw, you should, without endangering yourself, turn the power _____

Answers to Test Questions

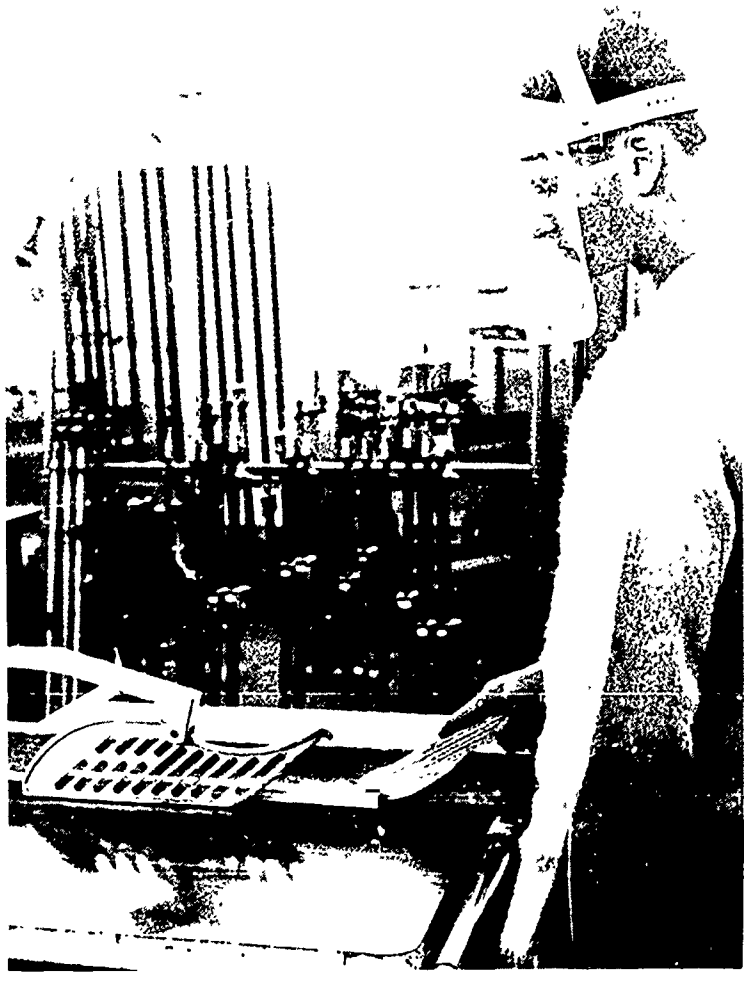
I: 1. (a); 2. (b); 3. (b); 4. (b); 5. (d).
II: 1. stopped; 2. ¼; 3. feed; 4. stop; 5. off.

Circular Saw

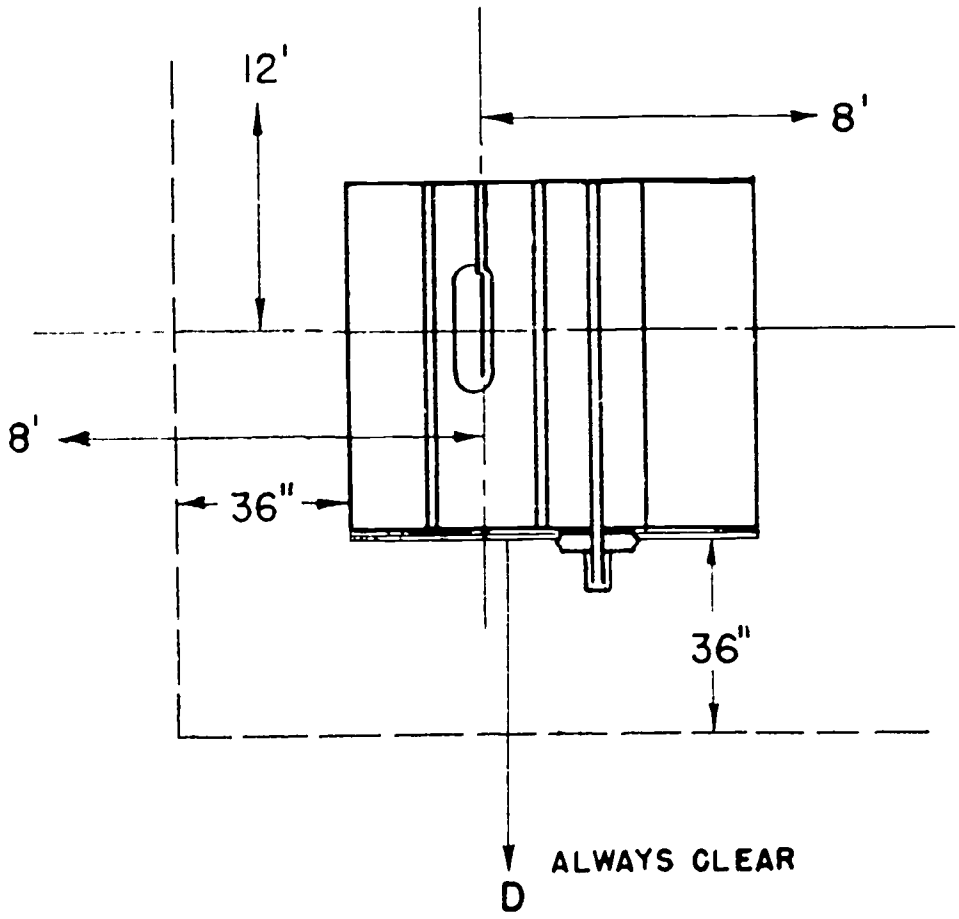
Safety Instructions

1. Obtain permission from your teacher before using the circular saw.
2. Be sure that all lumber is free from loose knots, nails, sand, or paint.
3. Select and install proper saw blade for ripping material or cutting across the grain. Make sure blade is sharp and free of cracks or other defects.

4. Make adjustments onl, ·hen the machine is at a dead stop.
5. Limit saw blade extension to 1/8 in. or less above the stock being cut.
6. See that all guards and other safety devices are in their proper position.
7. Ask your teacher to approve all special setups and dado heads.
8. Use ripping fence or cutoff gauge when cutting material. See that a cutoff board is properly mounted on cutoff gauge.
9. Fasten a clearance block ro ripping fence when multiple cutting stock to length—when ripping fence is used as gauge.
10. Use a holding jig or a method of clamping for cutting cylindrical stock. Check with your teacher.
11. Be certain there is an adequate number of proper push sticks immediately available.



The student uses an approved push stick to feed a narrow piece of stock through the circular saw.



MINIMUM SPACE REQUIREMENTS FOR CIRCULAR SAW

Aisles, if necessary, should be outside this allocated space. Area (following arrow "D") should be clear all the way to a wall or protective shield.

12. Make sure that no one but you is inside the operator's zone.
13. Stand to one side of the line of the saw.
14. Wear face shield or safety glasses (goggles, spectacles).
15. Turn on power after permission is given.
16. Keep fingers clear of path to the saw blade.
17. Stop saw and move out of operating zone before responding to anyone trying to attract your attention.
18. Use approved push stick when ripping narrow pieces of stock.
19. Feed stock only as fast as the saw will freely cut.
20. Push the stock by yourself.
21. Make certain that a helper tailing off only supports the material.
22. Turn off power after using circular saw and stand by until the machine has stopped.
23. Clear away scraps of wood on the table only after saw stops running.
24. Reset saw adjustments to a normal position when completing an operation requiring a special setup.

Safety Test Questions

I

( ) 1. The guard must always be in place over the saw blade of the circular saw except when: (a) cutting stock with a thickness of more than 1 in.; (b) short pieces tend to catch under the guard; (c) using a thick blade; or (d) your teacher has authorized its removal for special setups.

( ) 2. All adjustments on the circular saw are made: (a) while the machine is coasting; (b) by the shop foreman; (c) while the machine is at a dead stop; or (d) while the power is on.

( ) 3. You should limit the extension of the circular saw blade above the stock being cut to: (a) 1 in.; (b) ¼ in.; (c) ⅛ in.; or (d) ½ in.

( ) 4. When tailing off on the circular saw, the helper must: (a) support stock from underneath but not grasp it; (b) pick up all tailings that might cause an accident; (c) use a brush when cleaning up tailings; or (d) hold the stock and pull gently.

( ) 5. You should use a push stick when operating the circular saw to: (a) rip short and narrow pieces of stock; (b) adjust the saw; (c) turn on the power; or (d) remove scraps.

II

1. Adjustments on the circular saw are made only when the saw blade has _____.
2. Dadoing and tilting the arbor are special setups; therefore, you must obtain the approval of your _____.
3. To avoid being hit by flying material, you should stand to one side of the line of the saw _____.
4. You should limit the extension of the circular saw blade above your work to _____ inch.

5. It is best to use a push stick when ripping pieces of stock on the circular saw if they are short or .... .

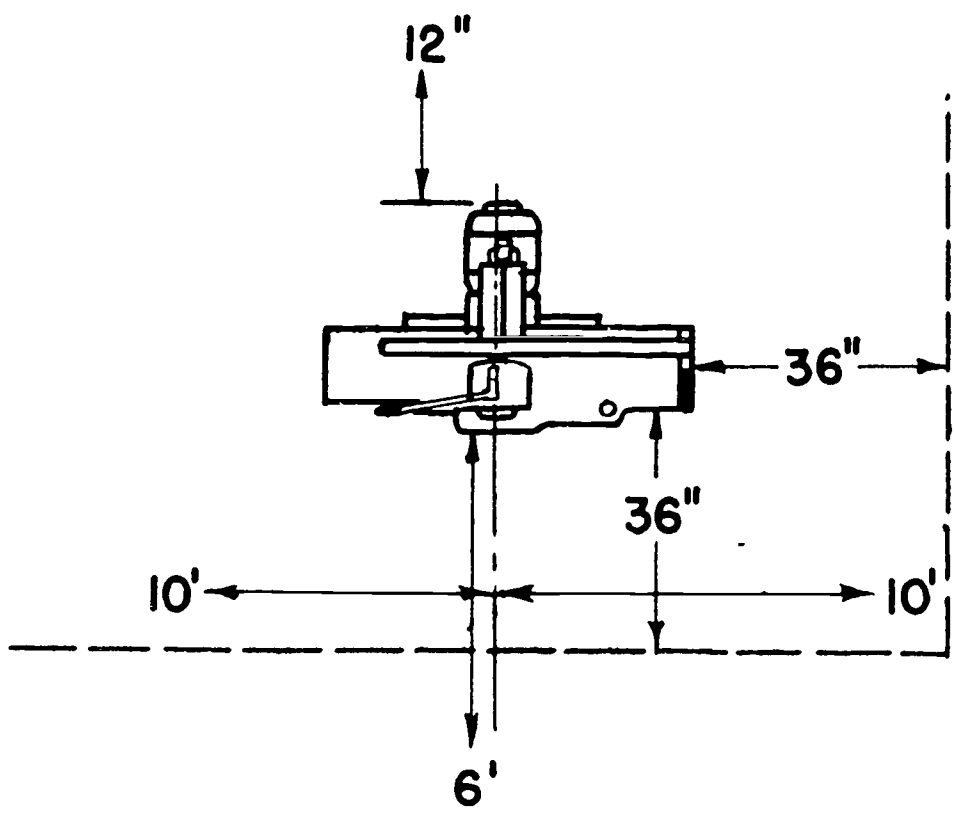
Answers to Test Questions

I: 1. (d); 2. (c); 3. (c); 4. (a); 5. (a).
II: 1. stopped; 2. teacher; 3. blade; 4. 1/8; 5. narrow.

Jointer

Safety Instructions

1. Obtain permission from your teacher before using jointer.
2. Use only clean lumber.
3. Inspect all wood for checks, loose knots, or other defects.
4. Make sure that only stock 12 in. or longer is used on the jointer.
5. Clamp fence firmly.
6. See that guard is in place over the knives.
7. Make adjustments only when machine is at a dead stop.
8. Limit cuts to 1/8 in. or less.
9. Ask your teacher to approve all setups involving stop-cuts, beveling, tapering, or rabbeting.
10. Make sure that no one but you is inside the operator's zone.
11. Wear face shield or safety glasses (goggles, spectacles).
12. Turn on power after permission is given.
13. Keep hands at a safe distance from the revolving head.
14. Use an approved push stick whenever possible.



MINIMUM SPACE REQUIREMENTS FOR JOINTER
Aisles, if necessary, should be outside this allocated space.

15. Whenever possible, allow two fingers of the right hand to ride along top of fence when push stick is not being used.
16. Feed the stock slowly; consider the grain.
17. Push the stock far enough past the knives so that the guard will return before picking up the stock.
18. Turn off power after using jointer and stand by until the machine has stopped.

The students sanitize their safety glasses.

Safety Test Questions

I

( ) 1. The jointer is used for smoothing: (a) painted stock; (b) lumber containing knots or cracks; (c) warped stock; or (d) clean lumber.

( ) 2. In adjusting the depth of cut on the jointer, you should limit cut to: (a) 1/16 in.; (b) 1/8 in.; (c) 1/4 in.; or (d) 3/16 in.

( ) 3. The shortest length of stock that can be safely cut on the jointer is: (a) 6 in.; (b) 4 in.; (c) 18 in.; or (d) 12 in.

( ) 4. When facing stock on the jointer, you should: (a) use an approved push stick whenever possible; (b) remove the guard from over knives; (c) limit depth of cut to 1/2 in.; or (d) feed stock as fast as possible.

( ) 5. Before picking up stock that has been surfaced on the jointer, you should make sure you have pushed the stock far enough past the knives so that the: (a) stock drops clear of the table; (b) outfeed table raises the material above the level of the knives; (c) fence will cover the work; or (d) guard will return over the cutter knives.

II

_____ 1. You should make sure the jointer cutter knives are covered by the _____.

_____ 2. In adjusting the depth of cut on the jointer, you should limit cut to _____ inch.

_____ 3. The shortest length of stock that can be safely cut on the jointer is _____ inches.

_____ 4. The rear or outfeed table of the jointer is preset and needs no further _____.

_____ 5. End grain should be surfaced with a _____.

Answers to Test Questions

I: 1. (d); 2. (b); 3. (d); 4. (a); 5. (d).
II: 1. guard; 2. 1/8; 3. 12; 4. adjustment; 5. plane.

Lathe (Woodworking)

Safety Instructions

1. Obtain permission from your teacher before using lathe.
2. Roll loose sleeves above elbows and remove or fasten any loose clothing.
3. Make sure the stock is free from checks, loose knots, or other defects.
4. Make certain that all glued work is properly glued and dry.
5. Be sure stock is correctly mounted in lathe.
6. Clamp tool rest holder firmly.
7. Be certain tool rest is adjusted correctly.
8. Make adjustments of tool rest only when lathe is at a dead stop.
9. Shift belt on belt-driven lathes (for changes of speed) only when lathe is at a dead stop. Some machines must be in operation; check with teacher.
10. Check sharpness of turning tools and condition of handles.
11. Wear face shield or safety glasses (goggles, spectacles).
12. Start lathe at lowest speed when beginning operation.
13. Stand to one side when power is first turned on.
14. Grasp turning tool firmly with both hands while cutting stock.
15. Hold turning tool firmly against the rest.
16. Keep hands away from stock while it is revolving.
17. Use correct amount of tool pressure against stock.
18. Stop lathe when using inside or outside calipers.
19. Maintain tool rest as close as reasonably possible to the stock by making frequent adjustments.
20. Remove tool rest when sanding and finishing.
21. Use for polishing only a small rag folded into a pad.
22. Shut off power after using lathe and stand by until the machine has stopped.
23. Clean machine.

In faceplate turning, the student sets the lathe speed according to the diameter of the stock.

Spindle Turning Instructions

1. See that centers are properly embedded in the stock.
2. Use oil or beeswax on the dead center.
3. Clamp tailstock firmly in place and tighten screw.
4. Turn spindle (rough stock) one revolution by hand.

5. Start lathe at lowest speed when beginning operation.
6. Rough stock down to cylindrical form before using a higher speed. Maintain correct tool rest adjustment.
7. Govern speed according to the diameter of the work.

Faceplate Turning Instructions

1. Cut stock circular on band saw or scroll saw.
2. Select proper size and style of faceplate.
3. Choose the correct size and number of screws according to design of work.
4. Fasten stock or subbase glued to stock (through paper) to faceplate with screws.
5. Be sure screws are tight.
6. Have teacher check fastenings and adjustments.
7. Keep an accurate check on depth of cut in work to avoid striking screws.
8. Be certain that tool rest adjustment is correct and is correcly maintained.
9. Revolve work once by hand.
10. Use the *lowest* speed when beginning operation.
11. Use correct speed in relation to diameter of stock.
12. Make frequent inspection of screws to be sure they do not loosen.

Safety Test Questions

I

( ) 1. As soon as stock is located between centers for spindle turning, you should: (a) clamp tailstock firmly in place and tighten screw; (b) remove tailstock and mount steady rest on the ways; (c) rotate stock counterclockwise to avoid burning; or (d) have it inspected by another student.

( ) 2. You should make all adjustments of the lathe tool rest: (a) while machine is rotating slowly; (b) after initial cuts are made; (c) when lathe is at a dead stop; or (d) 2 in. below center of stock.

( ) 3. It is best to set lathe tool rest so it is: (a) in slight contact with the stock, thus reducing chatter; (b) below and to right of center; (c) the same width as the lathe tool being used; or (d) ¼ in. or less from the rough stock.

( ) 4. When starting lathe for a beginning operation, you should use: (a) the highest speed; (b) the lowest speed; (c) any belt or gear ratio; or (d) a tool rest with a 3:1 ratio.

( ) 5. You should hold lathe turning tool: (a) to the right of the tool rest; (b) flat on the tailstock; (c) firmly against the tool rest; (d) just above the tailstock.

II

1. Before using the lathe, you should roll loose sleeves above elbows and remove or fasten any loose _____.
2. When starting the lathe, you should stand to one _____.
3. Tool rest adjustments on the lathe must be made when the machine is _____.

..... 4. Prior to starting lathe, you should turn rough stock one revolution by ..... .

..... 5. Before sanding and finishing on the lathe, you should remove tool ..... .

Answers to Test Questions

I: 1. (a); 2. (c); 3. (d); 4. (b); 5. (c).
II: 1. clothing; 2. side; 3. stopped; 4. hand; 5. rest.

Mortiser

Safety Instructions

1. Obtain permission from your teacher before using mortiser.
2. Clamp all stock securely on table.
3. Make adjustments only when machine is at a dead stop.
4. Check with your teacher for correct method of installing mortiser bit and chisel.
5. Make adjustments for depth stops and lateral travel.
6. Make sure that no one but you is inside the operator's zone.
7. Wear face shield or safety glasses (goggles, spectacles).
8. Turn on power after permission is given.
9. Keep hands away from chisel when the machine is turned on.
10. Feed chisel only as fast as machine will easily cut.
11. Turn off power immediately if cutting is difficult or the chisel burns. Check with your teacher.
12. Lift bit clear of the mortise before moving table.
13. Turn off power after using mortiser and stand by until machine has stopped.
14. Clean off mortiser table.

Safety Test Questions

I

( ) 1. You should make sure the chisel and bit of the mortiser are: (a) sharpened before and after each use; (b) properly aligned; (c) adjusted so that the chisel leads the bit; or (d) cooled after each cut.

( ) 2. It is best that all stock used on the mortiser is: (a) free of warps and checks; (b) big enough to hold with both hands; (c) at least 1 in. thick and 1 ft. long; or (d) securely clamped on the table.

( ) 3. If cutting on the mortiser becomes difficult or the chisel starts to burn, you should: (a) turn off machine and notify the teacher; (b) wax or grease chisel; (c) press harder on the pedal; or (d) release depth stop.

( ) 4. When the mortiser is turned on, you should: (a) adjust for depth of cut; (b) change alignment of chisel and bit; (c) keep away from table; or (d) keep your hands away from bit and chisel.

II

1. You should make sure mortiser bit and chisel are properly ..... .

---------- 2. Before cutting on the mortiser, you should make sure your work is securely clamped on the ---------- .

---------- 3. If cutting on the mortiser becomes difficult or the chisel starts to burn, you should turn off machine and notify ---------- .

---------- 4. When mortiser is turned on, you should keep your hands away from chisel and ---------- .

Answers to Test Questions

I: 1. (b); 2. (d); 3. (a); 4. (d).
II: 1. aligned (lined up); 2. table; 3. teacher; 4. bit.

Planer (Surfacer)

Safety Instructions

1. Obtain permission from your teacher before using planer.
2. Use only clean lumber.
3. Be sure that all wood is free from loose knots or other defects.
4. See that length of stock is longer than the distance between centers of feed rolls.
5. Make adjustments only when machine is at a dead stop.
6. Adjust cut to measurements taken on thickest part of the board.
7. Limit cuts to 1/8 in. or less on narrow stock.
8. Limit cuts on wide stock to 1/16 in. or less.
9. Run thin stock through planer on top of a thick surfaced board.
10. Make sure that no one but you is inside the operators' zone.
11. Wear face shield or safety glasses (goggles, spectacles).
12. Turn on power after permission is given.
13. Stand to one side of planer when machine is in operation.
14. Keep hands away from feed rolls and away from board(s) already gripped by the feed rolls.
15. Turn off power and call your teacher if machine does not seem to operate correctly.
16. Allow material to travel completely through planer before making any additional depth of cut adjustment.
17. Turn off power after using planer and stand by until the machine has stopped.

Safety Test Questions

I

( ) 1. Stock to be run through the planer must have a minimum length which is: (a) longer than the distance between centers of the feed rolls; (b) determined by the width of the lumber; (c) left up to the decision of the operator; or (d) determined by depth of cut.

( ) 2. When operating the planer, you should stand: (a) behind the machine; (b) in the area marked off for the machine; (c) in front of the machine, provided you have someone to tail off; or (d) in an upright position and to one side of the machine.

( ) 3. You should limit your cuts on the planer to: (a) the amount specified on the depth gauge; (b) 1/8 in. on narrow and medium width stock; (c) three turns of the depth adjustment wheel; or (d) half the width of the board.

( ) 4. When board is gripped by the feed rolls of the planer, you should: (a) push the stock through; (b) readjust depth of cut; (c) increase cutting speed; or (d) keep your hands away from the feed rolls.

( ) 5. If stock jams in the planer or fails to feed, you should: (a) apply more pressure on feed rolls; (b) push the stock through; (c) adjust depth of cut; or (d) turn off power and call your teacher.

II

_____ 1. Stock to be run through the planer must be longer than the distance between the centers of the feed _____.

_____ 2. When operating the planer, you should stand to one _____.

_____ 3. On narrow or medium width boards, you should limit planer cut to _____ inch.

_____ 4. On wide boards, you should limit planer cut to _____ inch.

_____ 5. If planer does not seem to operate correctly, you should turn off the power and call the _____.

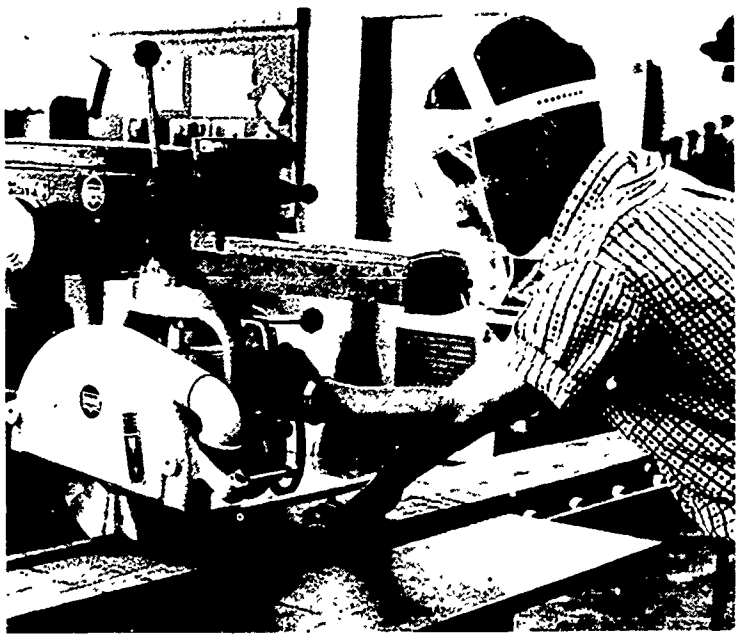
Answers to Test Questions

I: 1. (a); 2. (d); 3. (b); 4. (d); 5. (d).
II: 1. rolls; 2. side; 3. $\frac{1}{8}$; 4. $\frac{1}{16}$; 5. teacher.

Radial-Arm Saw

Safety Instructions

1. Obtain permission from your teacher before using radial-arm saw.
2. Ask your teacher to approve all special setups.



Student stands to one side and keeps the hand holding the stock a safe distance from the radial-arm saw.

3. Make sure that no one but you is inside the operator's zone.
4. Wear face shield or safety glasses (goggles, spectacles).
5. Hold stock firmly against fence.
6. Stand to one side and keep hands away from the direction of travel of saw.
7. Feed saw into material only as fast as it will easily cut.
8. Cut only one piece of stock at a time.
9. Use a piece of wood to remove scraps from path of saw blade only when saw is at a dead stop.
10. Turn off power after using radial-arm saw, return saw to beginning position carefully, and stand by until the machine has stopped.
11. Clean working area.

Safety Test Questions

I

( ) 1. The radial-arm saw is used primarily for: (a) cutting short stock; (b) ripping lumber into smaller strips; (c) crosscutting stock too long for a table saw; or (d) curved cuts that cannot be done on band saw.

( ) 2. In operating the radial-arm saw, you must take great care: (a) not to take too deep a cut, especially with a combination blade; (b) to cut on the line you have intended to follow so as to avoid burning the blade; (c) in feeding material only as fast as it will easily cut; or (d) when ripping lumber into short lengths.

( ) 3. You should remove scraps from the path of the radial-arm saw blade with: (a) your fingers; (b) a tool, such as a rule; (c) an air hose; or (d) a piece of wood only while saw is at a dead stop.

( ) 4. At the completion of each cut, the radial-arm saw blade must be: (a) returned to its position behind the guide fence; (b) removed and placed in its proper place; (c) rotated below guide fence; or (d) left at a point nearest to the operator.

II

..... 1. The type of cutting done on the radial-arm saw is .....

..... 2. You should hold stock firmly against the radial-arm saw .....

..... 3. You should stand to one side and keep your hands away from the direction of travel of the radial-arm saw .....

..... 4. It is best to remove scraps from the path of the radial-arm saw blade with a piece of wood while the saw is .....

Answers to Test Questions

I: 1. (c); 2. (c); 3. (d); 4. (a).
II: 1. crosscutting; 2. fence; 3. blade; 4. stopped.

Router

Safety Instructions

1. Obtain permission from your teacher before using the router.
2. Fasten stock firmly with vise or clamp.
3. Make adjustments only when electric cord is disconnected from power source.
4. Tighten all bits and cutters with proper wrenches.
5. Ask your teacher to approve setup and adjustments.
6. Be sure that the switch is in an off position and machine is on its side before plugging in electric cord.
7. Wear face shield or safety glasses (goggles, spectacles).
8. Hold the machine firmly.
9. Turn on power after permission is given.
10. Keep hands clear of revolving cutters.
11. Feed the cutter slowly into the material.
12. Turn off power and rest machine on its side when a desired cut has been finished.
13. Disconnect electric cord. Clean and return machine and its parts to designated place.

Safety Test Questions

I

( ) 1. You should select a location that is dry and not grounded for using a portable electric tool or appliance so as to avoid: (a) soiling the equipment; (b) serious electric shock; (c) motor bearing deterioration; or (d) discoloring the electric cord.

( ) 2. Prior to using the router, you should: (a) request other students to stay at least ten feet from the area of operation; (b) turn blades by hand; (c) have machine turned on before connecting electric cord; or (d) obtain permission from teacher.

( ) 3. Before changing bits or cutters or making adjustments on the router, you should make sure: (a) the electric cord is disconnected from the power source; (b) other students are at a safe distance; (c) to turn blades by hand; or (d) one hand is free.

( ) 4. When turning on the power to the router, you should: (a) attempt to make as deep a cut as possible; (b) hold the machine firmly with both hands; (c) readjust bits and cutters; or (d) reverse motor rotation.

( ) 5. When cutting with the router, you should: (a) feed the cutter as fast as possible; (b) hold electric cord with one hand; (c) keep hands clear of the revolving cutters; or (d) rest machine on its side.

II

_____ 1. You should select a location that is dry and not grounded for using a portable electric tool or appliance so as to avoid serious electric _____.

_____ 2. You should make adjustments on the router only when the electric cord is _____.

_____ 3. While using the router, you should hold it firmly with both _____.

_____ 4. It is best to feed the cutter of the router into the material _____.

_____ 5. When cutting with the router, you should keep your hands clear of the revolving _____.

Answers to Test Questions

I: 1. (b); 2. (d); 3. (a); 4. (b); 5. (c).
II: 1. shock; 2. disconnected; 3. hands; 4. slowly; 5. cutters.

Sander

Safety Instructions

1. Obtain permission from your teacher before using sanding machine.
2. Hold work securely.
3. Make adjustments only when sander is at a dead stop. Portable sander electric cord should be disconnected.
4. Check belt or disc for breaks or tears.
5. Be sure that the switch is in an off position and machine is on its side before plugging in electric cord on a portable sander.
6. Wear face shield or safety glasses (goggles, spectacles).
7. Turn on power after permission is given.

8. Keep fingers away from the abrasive surface on the sander.
9. Sand on downward motion side of disc sander.
10. Use special care in sanding small or irregular pieces. Check with your teacher.
11. Feed stock into the abrasive material at a moderate rate of speed and pressure.
12. Turn off power and rest portable sander on its side while changing position of board.
13. Turn off power after using sander and stand by until the machine has stopped.
14. Disconnect electric cord of portable sander and return cleaned machine to designated place.

The student keeps his fingers clear of the sanding belt.

Safety Test Questions

I

( ) 1. You should make all adjustments on the portable sander: (a) while the electric cord is disconnected; (b) only when other students are at a safe distance; (c) with one hand; or (d) while it is in gear.

( ) 2. Before you plug in the electric cord of the portable sander, you should be certain: (a) machine is free of sawdust; (b) machine is resting on its abrasive surface; (c) sanding belt or disc has been removed; or (d) switch is turned off and machine is on its side.

( ) 3. When operating a disc sander, you should hold your work against the disc: (a) rim; (b) center; (c) upward motion side; or (d) downward motion side.

( ) 4. While sander is in motion, you should: (a) blow away the sawdust; (b) remove abrasive surface; (c) use extreme feed pressure; or (d) keep your fingers away from abrasive surface.

( ) 5. You should feed stock into the abrasive material of the sander: (a) as fast as possible; (b) at a moderate rate of speed and pressure; (c) both upward and downward; or (d) both forward and backward.

II

_____ 1. You should make adjustments on the portable sander while the electric cord is _____.

_____ 2. When operating a disc sander, you should hold your work on the side where the motion is _____.

_____ 3. While sander is in motion, you should keep your fingers away from the abrasive _____.

---------- 4. You should feed stock into the sanding machine at a moderate rate of speed and _____.

---------- 5. Before plugging in the portable sander, you should make sure the switch is _____.

Answers to Test Questions

I: 1. (a); 2. (d); 3. (d); 4. (d); 5. (b).
II: 1. disconnected; 2. downward (down); 3. surface (face); 4. pressure; 5. off.

Scroll Saw

Safety Instructions

1. Obtain permission from your teacher before using the scroll saw.
2. Cut only stock with a flat surface on bottom.
3. Make adjustments only when machine is at a dead stop.
4. Make sure the saw blade is the proper size for the job.
5. Check blade for correct tension.
6. Adjust hold-down so it will be as close as possible to the work.
7. Turn machine by hand to make sure all parts are clear.
8. Make sure that no one but you is inside the operator's zone.
9. Select correct machine speed.
10. Wear face shield or safety glasses (goggles, spectacles).
11. Turn on power after permission is given.
12. Hold material firmly.
13. Feed the material into the machine at a moderate rate of speed.
14. Keep fingers away from saw and hands out of the path of saw.
15. Report mechanical defects or a broken blade to your teacher.
16. Turn off power after using scroll saw and stand by until the machine has stopped.
17. Clear away scraps of wood on the table only after saw stops running.

Safety Test Questions

I

( ) 1. You should install the scroll saw blade to cut: (a) on the down stroke of the saw; (b) at minimum speed; (c) on the up stroke of the saw; or (d) on both the up and down stroke of the saw.

( ) 2. Before you start the scroll saw, you should check the hold-down adjustment to make certain: (a) there is a half-inch clearance between it and the stock; (b) it is as close as possible to the work; (c) the correct size of blade is installed; or (d) it is against the table.

( ) 3. Prior to starting the scroll saw, you should turn machine by hand to be sure: (a) saw blade teeth point upward; (b) hold-down moves up and down; (c) the beginning cut is on the line marked on stock; or (d) all moving parts are clear.

( ) 4. Stock to be cut on the scroll saw should be: (a) soft; (b) hard; (c) flat on the bottom; or (d) round on the bottom.

( ) 5. You should feed stock into scroll saw: (a) in rhythm with motion of hold-down; (b) at a rate dependent upon pulley speed; (c) as fast as possible; or (d) at a moderate rate of speed.

II

..... 1. You should install scroll saw blade so it will cut on the ..... stroke.

..... 2. After installing scroll saw blade, you should check blade for correct .....

..... 3. To ensure that all moving parts are clear after making adjustments on the scroll saw, you should turn machine by .....

..... 4. Stock to be cut on the scroll saw should have a flat surface on the .....

Answers to Test Questions

I: 1. (a); 2. (b); 3. (d); 4. (c); 5. (d).
II: 1. downward (down); 2. tension; 3. hand; 4. bottom.

Shaper (Woodworking)

Safety Instructions

1. Obtain permission from your teacher before using the shaper.
2. Make sure the stock is free from loose knots, cracks, or other defects.
3. See that knives are correctly seated before tightening the lock nut.
4. Use fence whenever possible.
5. Employ fixed collar whenever possible.
6. Ask your teacher to approve all setups.
7. Remove all loose articles from the bed of the shaper before starting operations.
8. Make sure that no one but you is inside the operator's zone.
9. Wear face shield or safety glasses (goggles, spectacles).
10. Turn on power after permission is given.
11. Keep hands well away from revolving cutters; use spring guard whenever possible.
12. Use push stick whenever possible.
13. Enter all work opposite to the direction of the rotation of the cutter.
14. Test setup on sample piece of safe size.
15. Turn off power after using shaper and stand by until the machine has stopped.
16. Clean shavings from the table.

Safety Test Questions

I

( ) 1. In selecting stock for use on the shaper, you should make sure the stock is: (a) at least 2 in. by 4 in. by 18 in.; (b) correctly seated under lock nut; (c) grained; or (d) free from loose knots, cracks, or other defects.

( ) 2. You should make sure the shaper knives are: (a) correctly seated before tightening lock nut; (b) all of the tang type; (c) tightened with a fixed collar; or (d) flush with the table top.

( ) 3. Prior to starting shaper, you should: (a) request the assistance of another student, especially on long stock; (b) check the hold-down attachment for rigidity; (c) remove all loose articles from the shaper bed; or (d) loosen the lock nut.

( ) 4. In operating the shaper, it is best to: (a) enter all work in the direction the knives are rotating; (b) use fence or fixed collar whenever possible; (c) back up work, especially in corners of small radii; or (d) enter all work above fixed collar level.

II

..... 1. Before a shaper is started, all setups must be examined by the ..... .

..... 2. Make adjustments on the shaper only when the machine is at a dead ..... .

..... 3. In shaper operation, whenever possible, you should use a push ..... .

..... 4. Prior to starting shaper, you should remove all loose articles from the shaper ..... .

Answers to Test Questions

I: 1. (d); 2. (a); 3. (c); 4. (b).
II: 1. teacher; 2. stop; 3. stick; 4. bed.

SECTION 4

Automotive and Power Mechanics Equipment

This section contains specific safety instructions for operating certain equipment used in the areas of automotive and power mechanics. Each set of safety instructions relating to the operation of a particular piece of equipment is followed by safety test questions and answers. *The general safety instructions as well as instructions in oxygen-acetylene welding, electric welding, and the operation of certain metalworking equipment presented in earlier sections of this publication also apply to the areas of automotive and power mechanics.*

Car Lifts, Hoists, and Cranes

Safety Instructions

1. Obtain permission from your teacher before using a car lift, hoist, or crane.
2. Ask your teacher to inspect blocking of car before it is raised.
3. Place crane or hoist directly over the object to be lifted.
4. Determine that chain, cable, or rope to be used in lifting is in good condition.
5. Double-check fastening of chain, cable, or rope to the object to make sure it is secure before lifting with crane or hoist. Balance object before lifting.
6. Make sure all persons and obstructions are clear before raising or lowering an engine or car.
7. Support car with stands or blocks before doing work under the car or removing wheels.
8. Obtain permission from your teacher before getting under a raised car.
9. Wear face shield or safety glasses (goggles, spectacles) when working under a car.

Safety Test Questions

I

( ) 1. Before doing work under a car that has been raised, or removing wheels, you should make sure the: (a) transmission is in neutral; (b) car is adequately supported; (c) car is raised enough for the use of a creeper; or (d) hand brake is applied.

( ) 2. When you are about to raise an engine or car by hoist or crane, you should be certain the: (a) battery is disconnected; (b) transmission is in neutral; (c) hand brake is set; or (d) object to be lifted is securely tied and balanced.

( ) 3. You should place crane or hoist directly over the object to be lifted so: (a) weight may be raised faster; (b) crane, hoist, or object will not tip over; (c) there will be less wear on the chain; or (d) less room will be needed.

( ) 4. After you have raised a car by crane or hoist, you should place sufficient support under the car so you will be sure the: (a) car will not roll away; (b) strain will be elimi-

nated on the springs and shock absorbers; (c) hoist will last longer; or (d) car will remain in the raised position.

II

_____ 1. When you are about to raise an engine or car by hoist or crane, you should be certain the object to be lifted is securely _____.

_____ 2. After raising a car by hoist or crane, you should support the car with blocks or _____.

_____ 3. When lifting an engine with a chain sling, you should be sure the sling is securely _____.

_____ 4. Before getting under a raised car, you must obtain permission from the _____.

Answers to Test Questions

I: 1. (b); 2. (d); 3. (b); 4. (d).
II: 1. fastened (tied); 2. stands; 3. fastened (tied); 4. teacher.

Engine

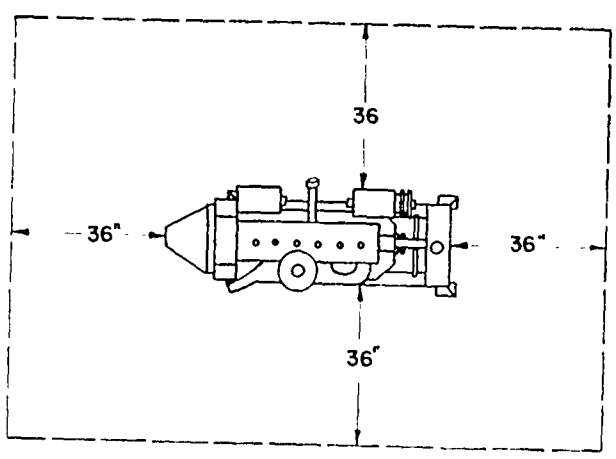
Safety Instructions

1. Obtain permission from your teacher before starting an engine whether engine is in a test stand or in a car.
2. Check fuel line for possible leaks.
3. Vent exhaust to the outside of building and provide adequate ventilation whenever running an engine whether engine is in a test stand or in a car.
4. Keep your head and hands away from revolving fan.
5. Be sure to block wheels of any mobile engine test stand you may use.
6. Use, when necessary, a carbon dioxide (CO_2) extinguisher for flammable liquid fires.

Safety Test Questions

I

( ) 1. You should vent exhaust to the outside of building and provide adequate ventilation whenever running an engine because: (a) an engine needs this air to produce a proper



MINIMUM SPACE REQUIREMENTS
FOR ENGINE STANDS
(Exercise and Running)
Exhaust fumes must be vented
to outside of building.

mixture; (b) the noise of the exhaust will be reduced; (c) back pressure on the manifold will be lessened; or (d) it will prevent the release of exhaust gas in the shop.

( ) 2. When working on an engine that is running, you should: (a) remove blocks from the wheels; (b) keep the car in low gear; (c) make sure tank is full of gasoline; or (d) keep head and hands away from revolving fan.

( ) 3. It is best to use a carbon dioxide (CO_2) extinguisher because: (a) it will extinguish flammable liquid fires; (b) carbon dioxide can be mixed with the exhaust to reduce carbon monoxide; (c) carbon dioxide can be used to make the fuel richer; or (d) it can be used to cool muffler.

II

..... 1. Before starting an engine, you should obtain permission from .....

..... 2. When running an engine, you should vent exhaust to the outside of building and provide adequate .....

..... 3. When working on an engine that is running, you should keep your head and hands away from the revolving .....

Answers to Test Questions

I: 1. (d); 2. (d); 3. (a).
II: 1. teacher; 2. ventilation; 3. fan.

Storage Battery

Safety Instructions

Servicing

1. Obtain permission from your teacher before servicing or charging a storage battery.
2. Use proper instruments for testing a storage battery.
3. Avoid overfilling a battery, especially if it is to be charged.
4. Use water and baking soda (a neutralizer) to clean off the top of a battery.
5. Remove and transport a battery with a battery lifter.
6. Handle battery or acid with care. Wash immediately any part of your body or clothing that comes in contact with acid.
7. Wash hands immediately after handling a battery.

Charging

1. Wear goggles when using a charger.
2. Provide ample ventilation when using a charger.
3. Remove cell covers before charging a battery (unless the covers have other instructions upon them).
4. Keep open flames and sparks away from a battery being charged.
5. Turn off charger before disconnecting leads (wires) from charger to battery.
6. Replace cell covers before moving battery.

Safety Test Questions

I

( ) 1. You should test a storage battery with: (a) a pair of pliers; (b) a screw driver; (c) an analyzer or tester; or (d) a piece of wire.

( ) 2. A good neutralizer for cleaning off the top of a storage battery is water and: (a) borax; (b) baking soda; (c) lye; or (d) lime.

( ) 3. It is best to charge storage batteries in a well-ventilated room because the gas given off during charging is: (a) explosive; (b) not dangerous; (c) nonexplosive; or (d) carbon monoxide.

( ) 4. Before disconnecting leads (wires) from charger to storage battery, you should: (a) replace cell covers; (b) check with tester; (c) close windows; or (d) turn off charger.

II

..... 1. It is best to clean top of storage battery with water and baking ..... .

..... 2. After handling a storage battery, you should wash your ..... .

..... 3. An open flame near a storage battery may cause an ..... .

..... 4. Before disconnecting leads (wires) from charger to storage battery, you should turn off ..... .

Answers to Test Questions

I: 1. (c); 2. (b); 3. (a); 4. (d).
II: 1. soda; 2. hands; 3. explosion; 4. charger (power).

Use, Storage, and Disposal of Flammable Liquids

Safety Instructions

1. Store flammable liquids in a fireproof room or cabinet.
2. Bring into the shop only sufficient flammable liquid for immediate use. Keep only in a safety container approved by the Underwriters' Laboratory. Label container with name of contents.
3. Use only approved cleaning solutions.
4. Avoid contact of carbon-removing or paint-stripping compounds with your skin.
5. Place rags containing oil, gasoline, paint, solvents, and other combustibles in designated (approved) metal containers.
6. Keep the top of oil drums and the surrounding area clean and free of combustible materials.
7. Dispose of unwanted flammable liquids and combustible materials daily.

Safety Test Questions

I

( ) 1. Gasoline should be kept in a safety container approved by the Underwriters' Laboratory because: (a) the odor of gasoline makes some people ill; (b) gasoline vapor is

highly combustible; (c) it will not evaporate; or (d) the container is difficult to tip over.

( ) 2. You should use approved cleaning solutions instead of gasoline because: (a) gasoline does not clean as well as solvent; (b) gasoline is too expensive to use for cleaning purposes; (c) parts will be tinted by the red dye in leaded gasoline; or (d) there is danger of an explosion when using gasoline.

( ) 3. Rags containing oil, gasoline, paint, solvents, and other combustibles should be: (a) folded neatly and placed on a shelf; (b) left on the workbench; (c) thrown on the floor; or (d) placed in an approved metal container.

II

---------- 1. You should store flammable liquids in a room or cabinet that is ----------.

---------- 2. When using carbon-removing or paint-stripping compounds, you should avoid contacting material with your ----------.

---------- 3. You should place rags containing oil, gasoline, paint, solvents, and other combustibles in a designated (approved) metal ----------.

Answers to Test Questions

I: 1. (b); 2. (d); 3. (d).
II: 1. fireproof; 2. skin (hands); 3. container.

SECTION 5

Electrical and Electronic Equipment

This section contains specific safety instructions for servicing, repairing, and operating certain equipment used in the area of electronics. Each set of safety instructions is followed by safety test questions and answers. *The general safety instructions as well as instructions concerning the operation of a battery charger and certain metalworking equipment presented in earlier sections of this publication also apply to the area of electronics.*

Circuits

Safety Instructions

1. Consider all wires and other conductors in a circuit live until proved dead by a safe method of testing.
2. Use test lamp or suitable meter for testing a circuit.
3. Turn on switch only when you know what it operates.
4. Turn off power before replacing a fuse.
5. Locate and correct fault that caused circuit breaker to open or fuse to blow before turning on power.
6. Be sure circuit is protected against overload by a fuse or circuit breaker of correct current-carrying capacity.
7. Make changes in the wiring of a circuit only when power is turned off.
8. Select and use wire of correct current-carrying capacity.

Safety Test Questions

I

( ) 1. When replacing a fuse in a switchboard, always: (a) turn off power; (b) replace with a fuse of lower rating; (c) check the lights; or (d) check the voltmeter.

( ) 2. All electrical circuits must be protected from overload damage through the use of: (a) fuses or circuit breakers; (b) jumpers; (c) a penny; or (d) other metal objects.

( ) 3. When testing for live wires, a suitable device to use would be a: (a) pencil; (b) wire; (c) test lamp; or (d) screwdriver.

( ) 4. All wires in a circuit must be considered to be: (a) dead; (b) live; (c) safe; or (d) harmless.

II

..... 1. Before working on a circuit, you should make sure it is dead by using a suitable meter or a test .....

..... 2. When replacing a fuse, you should be certain that the power is turned .....

..... 3. A fuse or circuit breaker protects a circuit against .....

Answers to Test Questions

I: 1. (a); 2. (a); 3. (c); 4. (b).
II: 1. lamp; 2. off; 3. overload.

Electrical Equipment

Safety Instructions

1. Disconnect portable, electrically powered equipment from power source before servicing or repairing the equipment.
2. Examine electric cord for possible defects and correct any defects found before using.
3. Make certain frame or housing of portable, electrically powered equipment is properly grounded before operating it.
4. Connect with power source and turn on your own equipment.

Safety Test Questions

I

( ) 1. You should make certain that the frame or housing of portable, electrically operated equipment is: (a) painted green; (b) polished; (c) undergrounded; or (d) grounded.

( ) 2. Before servicing or repairing electrical equipment, be sure that: (a) electric cord has been disconnected from power source; (b) batteries are discharged; (c) fuse has been replaced; or (d) gas has been shut off.

II

..... 1. Frame or housing of a portable, electrically operated piece of equipment must be .....

..... 2. Only an electric cord free from defects should be .....

Answers to Test Questions

I: 1. (d); 2. (a).
II: 1. grounded; 2. used.

Electronic Devices

Safety Instructions

1. Keep chassis of an AC-DC radio clear of ground wires and other grounded conductors.
2. Avoid coming in contact with grounded objects when making adjustments on an AC-DC radio connected to a power source.
3. Be sure capacitor is discharged before touching its terminals or connections.
4. Disconnect electric cord from power before touching anything behind transmitter panel.
5. Remove headphones while working on a transmitter or receiver.
6. Keep one hand behind your back or in your pocket when testing high voltage circuits.
7. Make certain chassis, cabinet, and cable shields of a transmitter or receiver are grounded.
8. Wear gloves and a face shield when handling a cathode-ray tube.

Safety Test Questions

I

( ) 1. If you are working on a transmitter or receiver, the headphones should always be: (a) worn; (b) removed; (c) placed on the floor; or (d) hung around your neck.

( ) 2. Before touching anything behind transmitter panel, be sure: (a) electric cord is disconnected from power; (b) switch is off; (c) stand-by switch is off; or (d) filaments are off.

( ) 3. When testing high voltage circuits, keep one hand behind your back or: (a) on the ground; (b) in your pocket; (c) on the switch; or (d) on your head.

( ) 4. Chassis, cabinet, and cable shields of a transmitter or receiver must be: (a) taped; (b) tuned; (c) ungrounded; or (d) grounded.

II

..... 1. Servicing or repairing a transmitter can be dangerous because of .....

..... 2. Care must be used in handling a cathode-ray tube because it might .....

Answers to Test Questions

I: 1. (b); 2. (a); 3. (b); 4. (d).

II: 1. high voltage; 2. implode.

SECTION 6

Graphic Arts Equipment

This section contains specific safety instructions for operating certain equipment used in the area of graphic arts. Each set of safety instructions relating to the operation of a particular piece of equipment is followed by safety test questions and answers. *The general safety instructions presented in the first section of this publication also apply to the area of graphic arts.*

Lead and Rule Cutter, Hand Miterer, Trimming Board, and Proof Press

Safety Instructions

1. Be sure that your fingers are clear of the moving parts of the lead and rule cutter and the hand miterer.
2. Keep your fingers away from the blade when cutting stock on the trimming board.
3. Make certain that when you are ready to use the proof press your hands are clear of the track and ends of press.

Safety Test Questions

I

( ) 1. As a protection against the knife action of the lead and rule cutter, you should: (a) operate cutter as fast as possible; (b) keep fingers clear of moving parts; (c) cut rules with a hack saw; or (d) place a wedge in cutter to stop knife action.

( ) 2. When using the proof press, you should protect your hand[illegible] handling the brayer correctly; (b) moving the roller fast; (c) asking [illegible] to operate the roller; or (d) keeping them clear of track and ends o[illegible]

II

..... 1. When using the proof press, you should proto[illegible] hands by keeping them clear of the ends of the press and the .....

..... 2. You should make sure that when you are cutting on the trimming board your hands are away from the .....

Answers to Test Questions

I: 1. (b); 2. (d).
II: 1. track; 2. blade.

Paper Cutter

Safety Instructions

1. Obtain permission from your teacher before using the paper cutter.
2. Make sure that no one but you is inside the operator's zone.

3. Be certain the handle (lever) controlling blade is in its proper position and the safety lock is engaged before setting back gauge.
4. Keep hands clear of blade at all times.
5. Limit amount of stock to be cut at any one time.
6. Use care when jogging stock against back gauge and side so as to avoid being cut by the paper.
7. Keep both hands on the handle (lever) controlling blade during cut and return to proper position.
8. Be sure handle (lever) controlling blade is returned to its proper position before reaching for cut stock.
9. Check to see that safety lock engages after using cutter.

Safety Test Questions

I

( ) 1. Before adjusting the paper cutter, you should be sure that the handle (lever) controlling the blade: (a) is in its farthest downward position; (b) is locked in its proper position; (c) and the clamp are down; or (d) and the knife are down.

( ) 2. When using the paper cutter, you should: (a) limit setting of back gauge to 2 in.; (b) cut all the stock necessary for a job at one time; (c) place the stock against the back gauge without jogging it; or (d) limit the amount of stock to be cut.

( ) 3. While you are operating the paper cutter, you should have: (a) both hands on the handle (lever); (b) only one hand on the handle (lever); (c) one hand on the stock; or (d) one hand on the back gauge adjuster.

( ) 4. You should reach for the cut stock when: (a) blade is on the downward stroke; (b) clamp is tight against stock; (c) blade is being brought upward; or (d) handle (lever) controlling blade is returned to its proper position.

II

..... 1. You should always keep hands clear of paper cutter clamp and .....

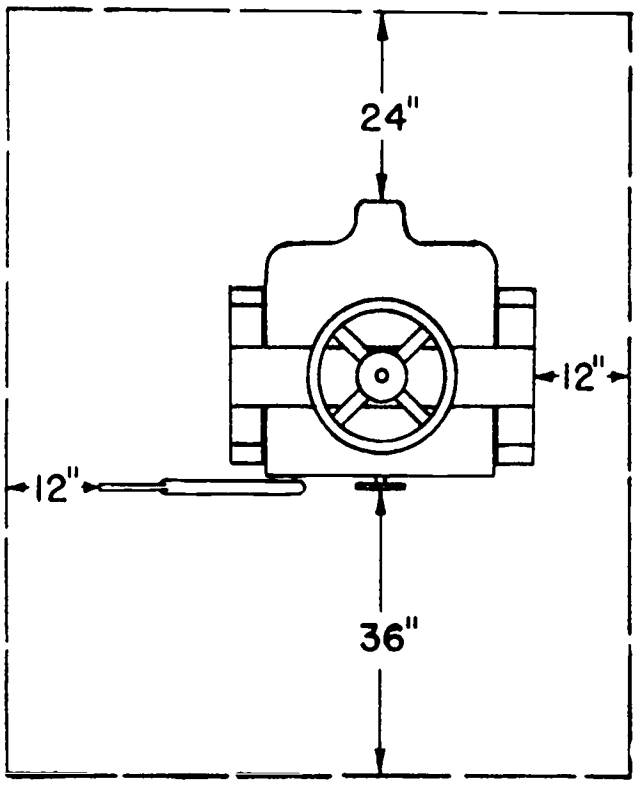
..... 2. You should place stock in the paper cutter only when the handle (lever) controlling blade is in its proper ..... .

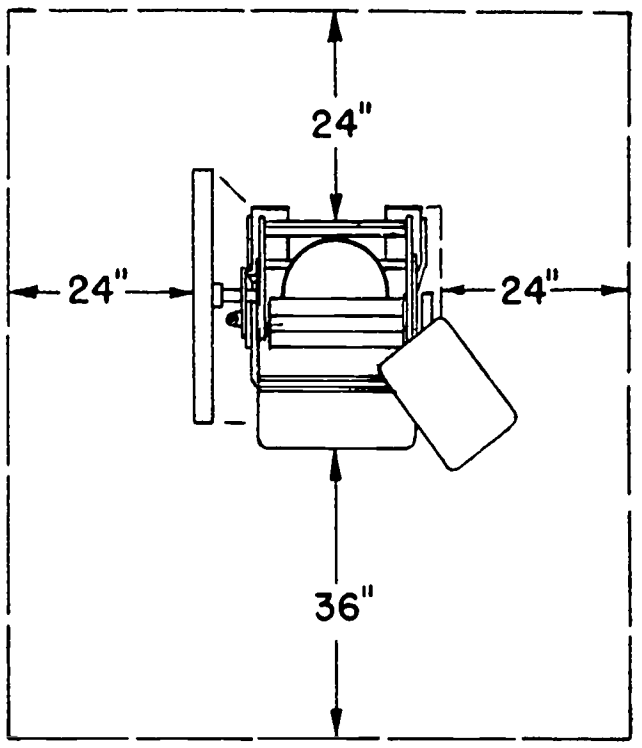
..... 3. When operating the paper cutter, you should keep both hands on the .....

..... 4. The clamp bar on the paper cutter should always be lower than the .....

Answers to Test Questions

I: 1. (b); 2. (d); 3. (a); 4. (d).
II: 1. blade; 2. position (place); 3. handle (lever); 4. blade.





MINIMUM SPACE REQUIREMENTS FOR **PAPER** CUTTER (left) AND PLATEN PRESS (right)
Broken lines around the drawings indicate work space recommended for each station. Aisles, if necessary, should be outside this allocated space.

Platen Press

Safety Instructions

1. Obtain permission from your teacher before using the press.
2. Oil press only when the power is turned off and machine is at a dead stop.
3. Be certain form is locked securely in bed.
4. Apply ink to disc only when press is at a dead stop.
5. Make sure that no one but you is inside operator's zone.
6. Turn on power after permission has been given.
7. Gauge speed of press according to your ability to feed.
8. Use throw-off lever and wait for platen to open before adjusting misfed stock.
9. Stop press before attempting to remove paper picked up by the ink rollers.
10. Stop press before retrieving stock that has fallen between the platen and delivery board or under the press.
11. Turn off power after using press and stand by until the machine has stopped.
12. Check with your teacher to find out whether you should clean ink rollers and disc.

Safety Test Questions

I

( ) 1. You should oil the press only when: (a) the power is turned off and the machine is at a dead stop; (b) the machine is in motion; (c) it is noisy; or (d) the ink rollers pass across the delivery board.

( ) 2. It is best to ink the disc when the press is: (a) operating slowly; (b) operating fast; (c) at a dead stop; or (d) coasting.

( ) 3. When feeding the press, you should: (a) lean over press; (b) rest on the delivery board; (c) sit down; or (d) stand erect.

( ) 4. You should gauge the speed of the press according to: (a) the quantity of work to be done; (b) the amount of time you have to do the job; (c) your ability to feed; or (d) the rate of the previous operator.

( ) 5. If paper is picked up by the rollers, you should: (a) let the press run slowly and remove the paper; (b) stop the press completely and remove the paper; (c) reach for it quickly; or (d) disregard it and use a new piece of paper.

II

..... 1. You should make sure that the form is locked securely in the press .....

..... 2. Before adjusting misfed stock, you should use throw-off lever and wait for platen to ..... .

..... 3. If you should find it necessary to leave the press for a moment, you should turn off the power and wait for the machine to come to a complete .....

..... 4. Before retrieving stock that has fallen between platen and delivery board or under press, you should stop the .....

..... 5. The power must be off and the press at a dead stop before you clean the ink from the rollers and .....

Answers to Test Questions

I: 1. (a); 2. (c); 3. (d); 4. (c); 5. (b).

II: 1. bed; 2. open; 3. stop; 4. press; 5. disc.

Stapling Machine

Safety Instructions

1. Obtain permission from your teacher before using the stapler.
2. Adjust machine only when power is turned off.
3. Wear face shield or safety glasses (goggles, spectacles).
4. Make sure that no one but you is inside operator's zone.
5. Keep your fingers away from movable parts of the stapler.
6. Place your foot firmly on lever control.
7. Turn off power after using stapler.

Safety Test Questions

I

( ) 1. You should adjust stapling machine: (a) when it is in motion; (b) after each staple; (c) when the power is turned off; or (d) while the power is turned on.

II

.... 1. In operating the stapler, you should keep your fingers clear of all movable ....

Answers to Test Questions

I: 1. (c).

II: 1. parts.

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Durham, William H., Jr.
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ABSTRACT - Developed by a professor of marketing and validated by a committee of state supervisory personnel and high school teacher-coordinators, this guide is for teacher use in planning an occupationally-oriented course in advanced marketing. A bibliography and suggested time allotment (covering a total of 36 weeks) are provided for these units: (1) Introduction to Marketing II, (2) Merchandising, (3) Market Analysis, (4) Warehousing, (5) Transportation, (6) Finance, Credit, and Risk Taking, (7) Personnel, (8) Agricultural and Industrial Marketing, (9) Government and Marketing, and (10) Marketing Careers. Each unit contains objectives, topical outline, teaching suggestions, and a list of materials and equipment needed. A related document is available as VT 002 683 (also in this issue). (SB)

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TEACHERS MANUAL

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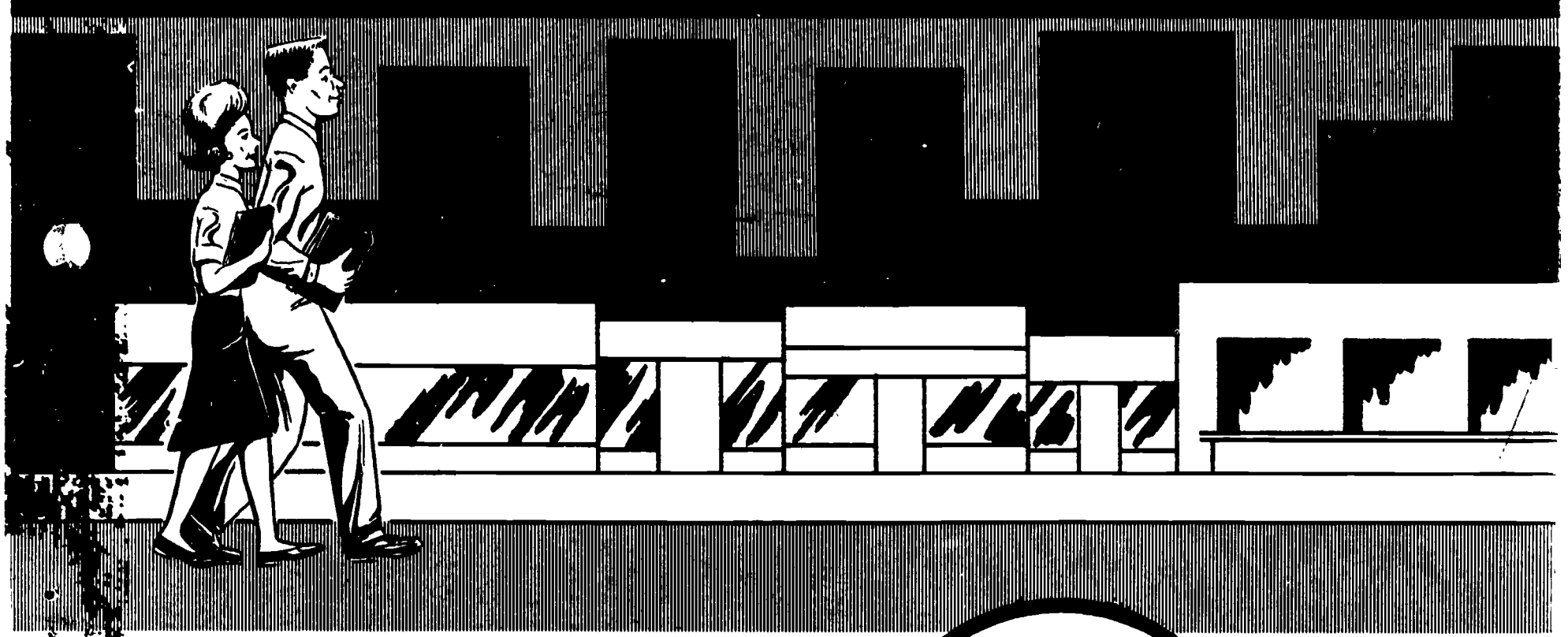
MARKETING II

Distributive Education Series



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PREFACE

The Teacher's Manual for Marketing II is constructed as a guide for teacher-coordinators in the preparatory distributive education program. Teaching suggestions are given for each of the units to assure active student participation on a vocational level.

This manual was prepared by Dr. William H. Durham, Jr., Professor of Marketing, School of Business, East Carolina College, Greenville, North Carolina.

Mrs. Joan K. Smith, Assistant State Supervisor of Distributive Education and a validating committee work closely with Dr. Durham in the development of the manual. The validating committee was particularly helpful in ascertaining that course content, teaching suggestions and projects were on the comprehension level of secondary school students.

Grateful acknowledgement is made to the following persons for their work on the validating committee:

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1965

INTRODUCTION

The scope of distributive education has been expanded to meet the changing needs of an increasing number of youth in North Carolina whose employment will be concerned directly with some aspect of the distribution of goods and services. Sequences of courses in distributive education are designed to (1) prepare many students for employment in marketing or distribution immediately on graduation from high school, (2) to prepare other youth for post-high school specialized education in marketing, and (3) to provide a base for intelligent study of marketing or other phases of business administration in colleges and universities. Marketing II is a continuation of the sequence begun in the study of Marketing I which deals with selected marketing activities and preparation for employment in various marketing activities.

There are three basic reasons for teaching marketing as outlined in these teachers' manuals. One is to prepare students for initial employment. A second is to provide a broader basis for the development of business competence, and a third is to develop an understanding of the relationship between marketing and the free enterprise system in a democracy.

Vocational preparation is a primary concern in both Marketing I (marketing activities) and Marketing II. The instructional program is occupationally oriented; it is not a study of theoretical concepts of marketing alone. To some extent, the instructional program should be personalized; that is to say, the student should be encouraged to study marketing activities in terms of a personal career objective. Various projects are suggested in this manual in which students should become directly involved. The teacher-coordinator must work very closely with the local business community in developing these projects. In addition, it is suggested that teacher-coordinators arrange part-time work experiences on Saturdays or during school holidays for as many students as possible.

The development of business competence requires a broad study of concepts of marketing. In today's markets, innovation and change are the rule rather than the exception. No longer can a person achieve competence through the restricted study of specialized techniques and methods. Nor will the "how to do it" approach, typical of most vocational education in past years, suffice. Therefore, in keeping with current trends in the teaching of marketing, this manual focuses attention on the business, economic, social, and legal aspects of marketing. Through simple marketing problems, attempts are made to introduce students to elementary concepts in the decision-making process of management. Since the study of management principles and management decisions are necessarily limited by the immaturity of high school students, capable students should be encouraged in every way to pursue their studies beyond the high school level.

Marketing concepts can be understood only in relationship to the type of economy in which marketing practices develop. It is essential, therefore, that students and practitioners in marketing have some understanding of the relationships which exist between freedom of choice in a democracy and marketing concepts and practices. The true nature of competition as a keystone of the free enterprise system is treated in theory and in suggested projects.

T. Carl Brown, State Supervisor
Distributive Education

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NEW YORK TIMES (Sunday Edition)
PRINTERS INK
SALES MANAGEMENT
U.S. NEWS AND WORLD REPORT
WALL STREET JOURNAL
CHANGING TIMES

HARPER'S
NATIONS BUSINESS
ADVERTISING AGE
HARVARD BUSINESS REVIEW

ITALY PRESENTS
c/o Italian Trade Commission
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$3 - English Text

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SUGGESTED TEACHING TIME FOR UNITS IN MARKETING II

I.	Introduction To Marketing II	3 weeks
II.	Merchandising	5 weeks
III.	Market Analysis	6 weeks
IV.	Warehousing	2 weeks
V.	Transportation	4 weeks
VI.	Finance, Credit, and Risk Taking	4 weeks
VII.	Personnel	4 weeks
VIII.	Agricultural and Industrial Marketing	4 weeks
IX.	Government and Marketing	2 weeks
X.	Marketing Careers	2 weeks
		36 weeks

I. INTRODUCTION TO MARKETING II

Materials and Equipment Needed

1. Want ad section of Sunday edition of a newspaper for employment opportunities in the marketing area.

2. Phillips and Duncan, Marketing Principles and Methods, 5th Edition.

ERIC

I. INTRODUCTION TO MARKETING II

Objectives

1. To review and reinforce major marketing concepts presented in Marketing I
2. To acquaint students with the nature and scope of Marketing II

Teaching Suggestions

General Introductory Comments

In teaching Marketing II, as in teaching any course, your success will depend largely upon the interest and enthusiasm you exhibit personally in the classroom. Leave personal troubles at home. For the next nine months, your students should be uppermost in mind; you have been entrusted with a major responsibility--live up to it!

Keep Instructional Materials Current

Marketing is a dynamic field -- a field that affects you and your students personally, whether you are businessmen or consumers. Keep abreast of changes and new developments through professional readings in current periodicals. Do not overlook your daily newspaper as a source of living instructional materials. Request the Small Business Administration (Address: Field Office, Small Business Administration, Charlotte, North Carolina 28202) to send you a list of free publications and to add your name to the mailing list to receive forthcoming publications. While you are keeping yourself professionally competent through current readings, encourage your students to read widely from current literature relating to marketing.

Vary Teaching Procedures

To retain student interest, avoid overuse of the lecture as a teaching method--but do not hesitate to lecture when necessary. Encourage student participation in classroom session through use of developmental questions--avoid questions that solicit "yes" or "no" answers. Skillful questioning will help students to learn to express themselves; skillful questioning will help you to evaluate your teaching for purposes of determining areas in which reteaching is needed.

Buzz sessions, committee work, individual reports, visiting speakers, role playing, films, case problems, field trips--all are effective practices and should be used in teaching Marketing. Encourage as much student contact with local businessmen as possible; when students challenge concepts you are presenting, encourage them to contact local marketers in an attempt to learn from the man who is practicing the theory you are presenting.

Do not use any one teaching procedure excessively. All effective procedures become ineffective when practiced to the point of boredom. Imagine how you personally would feel after 180 days of nothing but questions--or nothing but individual oral reports! It's your class--teach it wisely and effectively.

Visual Aids and Student Participation

To help your students learn, use visual aids as frequently as possible; encourage students to participate in classroom work at every opportunity. Many helpful suggestions are presented in this manual--many more are probably needed. Use your ingenuity when you find the manual to be inadequate to meet your needs.

In getting Marketing II off to a good start, prepare bulletin board displays relating to major topics to be covered in the introductory phase. Change displays often (throughout the year); ask students

Topical Outline	Teaching Suggestions
to plan and prepare displays when practicable. In Marketing I you taught students the values of the retailer's frequently changing window displays in making window-display space effective. Practice the theory you have taught! Make your bulletin board a major asset to promote learning. Come Alive--Organize! Organization is half the battle in teaching. A disorganized teacher results from inadequate planning. Know what you plan to do, then organize to place that plan into action. Use this manual wisely; the manual will be of help--but it will not solve all your teaching problems. Rely on the manual and use it as a guide--but be aware that the manual is a teaching aid, not a device designed to stifle your initiative and to place you in a teaching straight jacket. The First Few Days-- --will probably he hectic! Keep a smile on your face to go with your pleasant personality. During the first few days of classroom work, you will frequently be sidetracked by necessary administrative details--but do not permit these details to cause you to forget that you have an energetic, ambitious, and anxious group of young people awaiting your attention. The pace you set during the first few days will have a great deal of bearing on your success--or failure--with your students. Begin early to accustom your students to participating in classroom activities--seek their assistance in handling administrative details when possible. Review at the Refresher Level During the introductory stages in	Marketing II, it will be necessary to refresh students' memories of concepts introduced in Marketing I. Please note the term "refresh"--this does not imply exhausive reteaching of concepts that students learned in Marketing I. To hold depth and exhaustive review is to insult your students' intelligence; if students received credit for Marketing I, a refresher level review is all that is necessary. Unless you use care in reviewing concepts covered in Marketing I, it is conceivable that Marketing II can become a rehash of Marketing I. Throughout Marketing II there will be many opportunities for reviewing concepts presented in Marketing I. Do not hesitate to review--at the refresher level--as needed. Keep in mind that the purpose of reviewing concepts presented in Marketing I is to find common grourd as a springboard for the introduction and development of new and more complex marketing concepts. Be an Optimist Believe in yourself and in your students--even Johnny Slowboy, if he is in your class. You will be only as effective as you believe you can be. Your students will meet the standards you set for them--low standards beget low-quality work. Look for only the best from your students, expect only the best from them--and you will get only the best. It's all up to you. Good luck with your class! Now, let's get down to the business of teaching Marketing II...

Topical Outline	Teaching Suggestions
A. Review and Overviews	Use a dynamic introduction--use some of the outstanding visual aids from last year to secure attention and interest. Ask students to define pertinent terms--fill in gaps in definitions where necessary.
1. Marketing I "Marketing includes those business activities involved in the flow of goods and services from production to consumption."	1. Definition quoted from Marketing I Manual. To emphasize the vastness of the Marketing field, compare Marketing to other fields of endeavor: Marketing is a borad field of endeavor. Like most other occupational fields (use farming, manufacuring, mining, etc.) marketing can be broken down into many types of activities. Question: What were some of the marketing activities covered in Marketing I? Which activity appealed most to you? Why?
2. Marketing II	Give a preview of topics to be covered in Marketing II. See table of contents. Perhaps a bulletin board display featuring major topics to be covered in Marketing II will be helpful--displays featuring marketing functions, institutions, channels of distribution will fit here. After presenting the course preview, ask students to check today's local newspaper for articles relating to marketing--it will be difficult not to find related articles--ask students to bring the newspaper to class with marketing-related articles circled in red. Have students prepare a bulletin board display--either with clippings from the paper or the paper itself. Keep the display up to date for a few days by posting current items. Take five minutes each day during this time for students to present newspaper items and to bring display up to date.
a. Management considerations	a. Stress the point that in Marketing II students will be challenged to develop knowledge of management considerations

Topical Outline	Teaching Suggestions
	involved in planning the firm's total marketing effort. For instance:
	(1) What role shall credit play in the retail business?
	(2) What are best sources of merchandise for resale? What does the buyer look for in selecting his merchandise source?
	(3) What factors must be considered in pricing a product for resale?
	(4) What shall the downtown store do to compete with suburban shopping centers?
	(5) What does management need and want in personnel to staff the firm?
	(6) What transportation media shall be utilized in getting goods from where they are produced to the point needed for resale purposes?
	(7) What governmental regulations affect marketing? etc.
b. Economic considerations	b. Emphasize that this is not a course in basic economics; instead, it is a course in practical or applied economics. Also stress, though, that marketing practices must be based upon economic considerations. For instance:
	(1) What is the significance of income levels in a city to someone who is considering establishing a retail store?
	(2) What do population shifts have to do with marketing management considerations?
	--If your community is experiencing problems in retaining population--especially its young people--explore the topic "What's wrong with our community--why are people leaving?"

Topical Outline	Teaching Suggestions
	Ask students why they plan to move to other places upon graduation (if applicable to your students); what needs to be done to keep them home? Is your community doing anything in the area of economic development? What? Pursue the area economic development concept in as much depth as you like--this is certainly a topic that should be of vital concern to students. In discussion, cite transportation needs of the area from the angle of getting area products to the market? For instance, what handicaps do North Carolina farmers encounter in attempting to market produce to New York markets? Do the farmers have the necessary natural resources and labor supply to meet adequately fruit and vegetable needs in the New York area? What will it take for Eastern North Carolina farms to become the garden spot for New York consumers? Cite location of Texas Gulf Sulphur industry in eastern North Carolina. Have students explore the economic effects of this industry on eastern North Carolina. (3) What happens in the business community when consumer income rises in that community? What role should the businessmen play in promoting economic development? (4) Point out that in the introductory stages you are attempting to give students a preview of what will be discussed later in the course. Stress the point that, during the course, economic concepts and their marketing significance will be developed and discussed.
c. Career considerations	c. Challenge students to be ever alert to

Topical Outline	Teaching Suggestions
	the career potential afforded in the various phases of marketing; as you proceed through the course, constantly attempt to call students' attention to entry jobs in the various marketing areas. Constantly impress students with the necessity for continuous study after graduation--either on an individual basis or in formal programs. Cite industrial education centers, business schools, colleges. Assignment: Ask students to examine the Sunday newspaper want ad section for jobs currently available in the marketing area. Have them prepare a list of these marketing positions. Discuss this assignment in class; speculate upon the nature of some of the jobs. If your school has a guidance counselor, seek his assistance in helping your students explore their career potential in the general field of marketing.
3. Marketing institutions	3. Definition: Those business establishments engaged in the performance of basic marketing functions and activities necessary in getting goods and services from point of production to point of consumption.
a. Merchant middlemen	2. Definition: Middlemen who buy goods for purposes of resale. Stress the point that the merchant middleman takes title to merchandise he stocks (functional middlemen do not take title).
(1) Wholesalers	(1) Review at the <u>refresher level</u> from Marketing I Manual, section on Wholesaling Structure, pp. 158-161. Student discussion: Have students describe their impressions of the general nature of wholesaling. Guide their discriptions with pertinent developmental questions.
(2) Retailers	(2) Emphasize that the retailer is regarded as middleman--point out

Topical Outline	Teaching Suggestions
	that laymen often think of middlemen as existing only between the producer and the retailer; Review Retail Structure, Marketing I Manual, pp. 161-171. Single out one or two of the major retailers (not by name, but by store classification) operating locally-discuss elements of operational strategy associated with the types of retailers; for instance: Supermarkets Self-service Wide merchandise offerings, both in food and non-food items Emphasis on national brands Extensive parking area Customer conveniences: electrically operated doors; music while shopping; comfortable shopping atmosphere, etc. Many departments etc. Ask students to write a short paper on the topic: The impact of self-service on retailers other than supermarkets Serious-minded students should be able to write this paper without use of reference material. In later discussions of this paper, point out the impact of self-service on discount houses, durg stores, variety stores. Speculate upon the success a local clothing store might have if the management of that store were to adopt self-service tactics. * * * * <u>Buzz Session</u>: Have students set up a plan for applying self-service techniques

Topical Outline	Teaching Suggestions
	to some unusual product or service not commonly marketed locally on a self-service basis.
b. Functional (agent) middlemen (1) Brokers (2) Food brokers (3) Manufacturers agents (4) Selling agents	b. For specific descriptions of the individual functional or agent middlemen, consult a basic marketing textbook. (In Phillips & Duncan: Marketing Principles and Methods, 5th Ed., see pp. 335 - 341). Functional middlemen generally do not take title to the merchandise in which they deal; many do not take physical possession of the goods. Emphasize that functional middlemen are often used by manufacturers as a supplement to their sales force, and in some cases, as a substitute for a sales force. In discussing functional middlemen, the following factors are pertinent: 1. Functional middlemen are part of our nation's wholesale structure. 2. Functional middlemen negotiate concerning exchange of title; they ordinarily do not take title. 3. They generally do not take physical possession of merchandise. 4. Most functional middlemen represent the seller (manufacturer) only; however, brokers may represent either buyer or seller--they generally do not act for both parties in the same transaction. 5. The functional middleman's job is to bring about a meeting of minds between buyer and seller. 6. Functional middlemen represent many companies, not just one. 7. Functional middlemen are generally paid for their services in the form of a commission based on dollar volume of sales.

Topical Outline	Teaching Suggestions
4. Channels of distribution (consumer's goods)	4. Definition: Course taken by a product in its journey from producer to final user. Preparatory to reviewing and discussing distribution channels, prepare a bulletin board display showing distribution channels used by a manufacturer that distributes to both the consumer market and the industrial market. See Scott Paper illustrated channel, Phillips & Duncan, p. 447; Also channels used by Manufacturer of Electrical Equipment, p. 448.
a. Producer directly to user (Example--Manufacturer sells door to door)	Use chalkboard to plot channels of distribution common in the American marketing system.
b. Producer to retailer to consumer	Plot in this manner:
c. Producer to wholesaler to retailer to consumer	Manufacturer ⟶ Wholesaler ⟶ Retailer ⟶ Consumer
d. Producer to functional middlemen to wholesaler to retailer to consumer	Inform students that in Marketing II we will attempt to learn of the considerations and problems facing manufacturers in choosing the best channel of distribution to use in moving their products to market.
	Individual reports:
	--Ask a student to visit a local wholesaler to find out why, from the wholesaler's viewpoint, manufacturers have chosen to use his services in their distribution channel.
	--Is there a manufacturing organization in your community? If so, ask a student to talk with someone in the marketing department concerning the distribution channels the manufacturer uses for his products. Encourage student to find out why the particular channels are used.
	--Are you in an agricultural area? Have a student with a farm background investigate marketing channels used by local farmers.

Topical Outline	Teaching Suggestions
5. Basic marketing functions	5. Definition: Necessary activities that must be performed as goods flow from producer to user. Emphasize that marketing institutions are engaged in the performance of basic marketing functions. The existence of a middleman in the channel of distribution is dependent upon the efficiency and economy with which he performs the functions. The eight basic marketing functions are discussed in the next section of the outline.
B. Marketing Functions	B. It is highly important that your students understand the basic marketing functions and the pervasiveness and interdependence of these functions throughout the entire marketing process. Emphasize that the performance of marketing functions is the marketing insititution's excuse for being (try "raison d'etre" if you have any French student in class). Make your discussion as simple and as elementary as necessary to help your students understand the functions concept. Developing discussion along the following lines might be helpful: 1. The American marketing institutions, whether wholesalers or retailers, are profit-making institutions; profit making is the dominant motive for establishing a distributive business. 2. Profits must be <u>earned</u>--nobody gives profits. (Cite the rugged battle the team had on the football field last week in <u>earning</u> the victory--nobody gave the team anything--they worked hard to win.) 3. To <u>earn</u> profits, the American marketing institution must effectively, and as economically as is practicable, perform the eight basic marketing functions. 4. Redefine "functions" as necessary activities that must be performed <u>at each level</u> in channels of distribution

Topical Outline	Teaching Suggestions
	as goods move from producer to user.
	5. Stress the concept that each marketer adds value to products through the performance of the basic marketing functions.
	6. Point out that in Marketing I a great deal of emphasis was placed on the performance of one basic marketing function, the selling function. In Marketing II, the selling function will be explored further; the other functions will be emphasized heavily.
	7. Each marketer adds value to products (and earns his profits thereby) through the performance of the basic functions. To illustrate this point: The fact that a retailer performs the buying function through buying merchandise so that it is convenient for me, the consumer, in turn to buy that merchandise from him locally makes the merchandise more valuable to me than if I had to go several hundred miles away to buy it. For this valuable service the retailer is performing for the consumer, he is entitled to a profit. In the same line of throught, the wholesaler who makes that merchandise available to the retailer so that the retailer can meet the consumer's needs is also performing a valuable service and is also entitled to a profit.
1. Functions involving exchange of title a. Buying B. Selling 2. Functions involving physical supply a. Transportation b. Storage	Since these basic functions are discussed in depth at other places in the manual, no attempt is made to define them here. Merely classify and list the functions on the chalkboard for the convenience of your students--develop the detail relative to performance of the individual function later. * * * * Re-emphasize the value-added concept cited above.

Topical Outline	Teaching Suggestions
3. Facilitating functions	
a. Standardization and grading	a. Standardization and grading is not developed in this manual. To insure coverage, ask a small committee to investigate this marketing function and report their findings to the class.
b. Marketing research	
c. Finance (credit)	
d. Risk	
C. Facilitating agencies in marketing	C. Perhaps it will be wise to have a student check a dictionary for the definition of "facilitate." Facilitating agencies in marketing are agencies that help in the performance of the marketing task.
1. Advertising agencies	Stress the following:
2. Transportation agencies	1. Facilitating agencies are engaged in the performance of certain marketing functions.
3. Banks	2. Facilitating agencies are not middlemen.
4. Insurance companies	3. Facilitating agencies do not take title to merchandise, nor do they negotiate concerning purchase or sale.
5. Marketing research firms	4. Give examples of the facilitating role played by the institutions listed:
6. Public warehouses	a. Advertising agencies--assist in performing the selling function by preparing advertisements that help create demand, etc.
	b. Transportation agencies are specialists in transporting goods from where the goods are produced to point where they are needed.
	c. Use other examples as you see fit.
	* * * *

Topical Outline	Teaching Suggestions
	Preparatory to introducing the next topic, Pricing, give students a chance to relate some of their summer experiences of a marketing nature. For instance: 1. Did any student have a marketing job? What was the nature of his work? Was he able to use any of the knowledge he gained from Marketing I on his job? What knowedge, and how did he ust it? Etc. 2. Did any students visit stores in other cities during the summer? How alert were salesmen in those stores? Did salesmen use effective selling techniques? Did anyone "pick up" any window display ideas that he throught were especially effective? Etc.

II. MERCHANDISING

Materials and Equipment Needed

1. Markup table
2. Copies of the "Wall Street Journal"
3. Manufacturer's regular prospectus to stockholders
4. The Merchandise Mart News Bureau, Chicago, for descriptive literature concerning the Merchandise Mart
5. Literature from a resident buying office
6. Sunday editions of New York Times
7. Local telephone company for manuals: "The Yellow Pages as an Advertising Medium"
8. Shilt and Wilson - Business Principles and Management, 4th Edition
9. Wingate and Weiner - Retail Merchandising, 6th Edition
10. Richert, Meyer, and Haines - Retailing, 4th Edition
11. Phillips and Duncan - Marketing Principles and Methods, 5th Edition
12. "Italy Presents" - Italian Trade Magazine
13. Trade Journals - Manufacturers ads
14. Modern Talking Picture Service, Charlotte, North Carolina for the following films:

    #1634 - "A Crown For Catherine"
    #1126 - "The Care and Handling Buyers"
    #1125 - "A Little Time For Henry"
    #1001 - "Of Time and Salesmen"

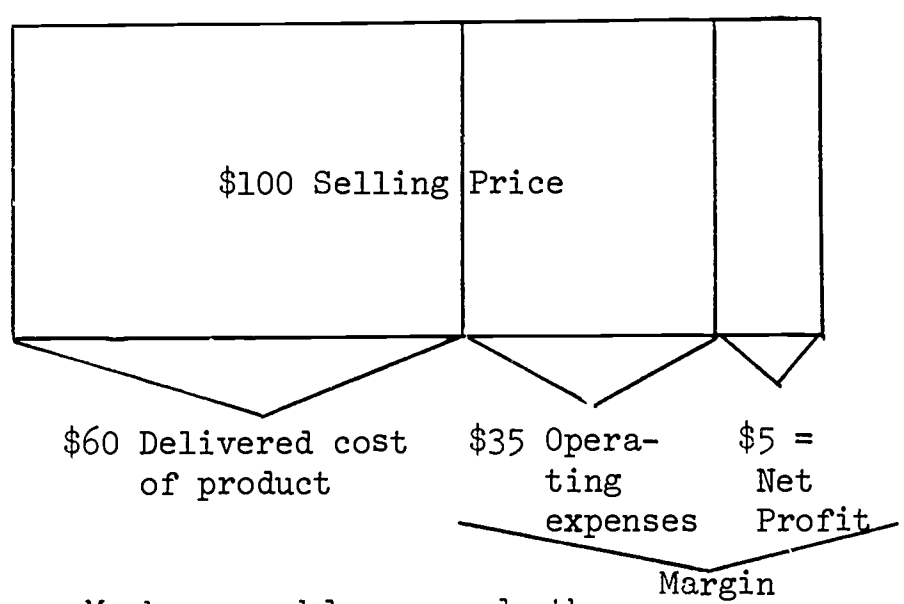
II. MERCHANDISING

Objectives

1. To promote understanding of simple merchandise pricing techniques
2. To acquaint students with common pricing policies
3. To help students gain insight into the effects of competition on pricing
4. To acquaint students with basic considerations involved in the performance of the buying and selling functions in the overall marketing process
5. To assist students in exploration of the career potential in buying and selling positions

Topical Outline	Teaching Suggestions
	NOTE TO COORDINATOR: Pricing, the first topic discussed in this segment of the teaching outline, can evolve into a complex topic much too advanced for the maturity and experience levels of your students. For instance, your discussion could range into the field of cost accounting--an area for the expert accountant. Keep this factor in mind as you present "Pricing," and adjust the content to your students' levels of understanding. Students will profit more from their study of pricing if only simple pricing concepts are presented. Although some of the concepts included in the outline could conceivably apply at the wholesale or manufacturing levels, you will probably accomplish more with your students if you keep the discussion at the retail level.
	* * * *
A. Pricing	A. Introduce "Pricing" by pointing out that, when a businessman has a product to sell, he must determine--or set--a price at which he is willing to sell that product. Emphasize that the price to be charged must be high enough to enable the businessman to recover the cost of the product to him, the expenses he encounters in handling the product, and high enough to enable him to earn a reasonable profit from his efforts.

Topical Outline	Teaching Suggestions
	Stress the profit-making motive--the businessman is not in business for charitable purposes; he expects to profit from his efforts.
	Stress the concept that the price ultimately set for the product must be low enough--or reasonable enough--that potential buyers will be willing to buy the product.
	Have students give examples of products that have been marketed locally that have been priced too high for a large segment of the local market. An example that might illustrate this concept is color TV. Would it have been profitable for local retailers to have stocked color TV when the product was first introduced to the market at a price of around $800?
1. Considerations in determining selling price	
a. Delivered cost of merchandise	a. Emphasize that the marketer's cost includes the price he paid for the product plus transportation costs incurred in getting the merchandise to his place of business. For example, the invoice cost of a certain lot of merchandise was $1,000. Freight costs on that merchandise were $15. What did the merchandise actually cost the businessman?
b. Operating expenses Costs inclurred in operating a business.	b. Once the concept of operating expenses is clear to students, they should encounter little difficulty in recognizing normal expenses. Hold a five- to ten-minute buzz session, dividing class into small groups, for the purpose of listing normal operating expenses. Ask students to think in terms of a local retailer and to list the operating expenses that retailer will encounter in the operation of his business. When students compare their lists, many of the following operating expenses should be therein:

Topical Outline	Teaching Suggestions
	Rent, Interest, Telephone Taxes, Utilities, Repairs Salaries, Insurance, Etc.
c. Net profit The difference between the selling price and the costs and expenses of the business	c. The following formula will help to explain this concept: Net profit = Selling price - cost of goods sold - operating expenses Do you have any bookkeeping students in class? If so, ask these s udents to comment on the way to determine net profit. Have them explain the difference between gross profit and net profit.
d. Margin The difference between the cost of the merchandise and the selling price. Sometimes called gross profit.	d. Illustrate by chalkboard drawing. A product sells for $100. The product costs $60. Operating expenses apportioned to the product is $35. Net profit on the product is $5. In your illustration, draw an enlarged $100 bill on chalkboard to indicate the selling price of the product. Section off the various components that made up the selling price as follows: 
e. Markup f. Markdown	e. Markup, markdowns, and other f. pricing terms are adequately defined and illustrated in Shilt & Wilson: Business Principles and Management, 4th ed., see Chapter 15.

Topical Outline	Teaching Suggestions
	Also defined and illustrated in Wingate & Weiner: Retail Merchandising, 6th Ed., see Chapter 10. A third source is Richert, Meyer, & Haines: Retailing, 4th Ed., Part 64. Require students to read at least one of the above sources; perhaps it will be helpful and desirable for you to consult these sources for professional reading if you need to refresh your memory of these terms as applied in pricing. Student Activity To help students understand the arithmetic involved in pricing a product, permit them to do several markup problems. Handle this two ways: (1) Use a prepared markup table. This exercise will be more effective if you can obtain a markup table used in a local retail store; if you cannot secure the table locally, use the markup table presented on page 288 in the Shilt & Wilson text. Problems to get the class started follow; prepare additional problems if needed.

Cost price, including transportation	Desired margin (percentage of selling price)	Markup (from table)	SOLUTION
$250	25%	33-1/3%	($250 x .33 1/3 = $83.33 + $250 = $333.33)
50	40%	66-2/3%	(50 x .66 2/3 = 33.33 + 50 = 83.33)
10	33-1/3%	50%	(10 x .50 = 5.00 + 10 = 15.00)
30¢	50%	100%	(30¢ x 1.00 = .30 + .30 + .60)

Topical Outline	Teaching Suggestions
	(2) Using the same cost figures as in table above, explain how to determine the selling price when a markup table is not available and when the desired margin is to be based on the selling price. Place on the chalkboard and explain the following formula: $S = \frac{C}{1.00 - M}$ S is retail selling price; C is cost price; M is desired margin Illustration: Assume the cost price of the product is $250. A 25% margin, based on selling price, is desired. $S = \frac{\$250}{1.00 - .25}$ $S = \frac{\$250}{.75}$ $S = \$333.33$ Using the same cost figures given in the table above, permit students to work with the formula. Point out that the formula yields the same selling price as was derived in using the markup table. <u>Brain twister for sharp students</u> Brown's Manufacturing Company makes an air conditioning unit that sells for $250. Because of increases in costs, it is necessary to increase the selling price of the unit if the current margin of 60 percent of selling price is to be maintained. Materials costs have increased 10 percent; labor costs have increased 15 percent. Under the present selling price of $250, materials costs have been 50 percent of the cost of sales; overhead, 15 percent of the cost of sales. What should be the new selling price? (Answer: $275.63)

Topical Outline	Teaching Suggestions

SOLUTION

Present situation:

Present margin:	60% of selling price =	$150	(60% x $250)
Cost of sales:	$100		($250 - $150)
Materials costs:	50% of cost of sales =	50	(50% x $100)
Labor costs:	35% of cost of sales =	35	(35% x $100)
Overhead:	15% of cost of sales =	15	(15% x $100)
	Present selling price =	$250	

Determining new selling price

Materials costs increased 10%	= $50 + 10%	= $50 +	$5.00	=	$55.00
Labor costs increased 5%	= $35 + 5%	= 35 +	5.25	=	40.25
Overhead--no change					15.00
		Cost price			$110.25

$$S = \frac{C}{1.00 - m}$$

$$= \frac{\$110.25}{1.00 - 60}$$

$$= \frac{\$110.25}{.40}$$

$$= \$275.63$$

Consult texts previously cited (Shilt & Wilson; Wingate & Weiner; and Richert, Meyer, & Haines) for additional discussion and problems pertaining to the arithmetic of pricing.

2. Pricing objectives

a. To maximize total profits

a. Emphasize that the maximization of total profits from overall operations is the basic objective of pricing. All other pricing objectives are secondary to the maximization of total profits objective. The importance attached to this basic pricing objective leads the marketer to adopt a wide variety of pricing strategies. Some of the following should be helpful in illustrating the basic pricing objective:

Topical Outline	Teaching Suggestions
	(1) All products do not bear the same percentage of markup. Some have low markups; others, high markups. Items with low markups draw people to the store; the assumption is that customers will also buy items bearing higher markups at the same time they purchase the low markup items.
	(2) Cite dairy practices as an example. At the dairy, milk can be separated from cream, with the result that the dairy has three or more products to sell at different prices: Cream sells at a high price; milk containing some cream sells at another price; skimmed milk sells for another and lower price. The dairy could have realized profits merely by selling milk only, yet the desire to maximize total profits cause the dairy to make many products from one basic product--greater profits are assumed to be the result.
	(3) Apply the same concept as in (2) to the supermarket practice of cutting up chickens and then selling different parts of different prices. For instance, chickens, whole, as priced at 29 cents per pound. If the supermarket cuts up the chickens and sells breasts at one price, legs and thighs at another price, and then the less choice pieces at lower prices--the end result should be higher total profits from overall chicken sales.
b. To develop store image	b. Ask students to describe their images of certain local stores. Follow with a question concerning the role of pricing in the development of the images students hold of these various stores. (Caution: Don't criticize

Topical Outline	Teaching Suggestions
	local stores--merely analyze, or help your students to analyze, pricing practices.) Ask students to list some of the pricing strategies they have observed in local retail stores which, when analyzed, reveal a long-rang profit-maximization objective. In all probability students will list many of the practices outlined in the "Topical Outline" section of this page and the next few pages. When students have listed the pricing practices of which they are aware, compliment them for being so observant of the pricing world in which they function as consumers now but as businessmen and women tomorrow.
(1) Bargain store image	
(a) Loss leading	(a) If students have not already listed "leaders" in their list of pricing practices, explain that many retailers often will sell certain items at low prices, often at less than cost, as an inducement to get customers into the store; once customrs come to buy the "leader," the assumption is that they will buy other items bearing higher markups; increased traffic will, supposedly, more than make up for any losses incurred in the sale of leaders; the long-range effect, then, is to enable the store to maximize total profits. Do not treat "loss leading" lightly; the practice is an irritant in many business communities. Analyze the pros and cons of the practice. Begin by asking students to list leading items that have been used in local stores in recent weeks. Next, ask students to express opinions concerning the practice, if possible, from a businessman's point of view.

Topical Outline	Teaching Suggestions
	Once students have become enmeshed in the discussion of loss leading, guide their thinking into consideration of the <u>effects</u> of the practice; for instance: i. How does loss leading affect the image the store is attempting to build? Point out that the practice can serve to promote an image of a cut-rate store--a store that appeals only to the bargain hunter. Stress the importance of the retailer's need to define the market to which he will cater and then giving that market what it desires--if the bargain hunter is the customer the retailer desires to cultivate, then loss leading is perhaps effective pricing strategy. ii. How does loss leading affect customer goodwill? Is there a danger that the customer will develop a feeling that if he buys products other than the leaders, he is being overcharged--and therefore develop a feeling of antagonism toward the store?
(b) Bait pricing	(b) iii. Avoid citing local stores in class, but ask students their reactions to stores that sometimes advertise a leader but have always "just sold the last one" when a customer comes to buy the product advertised. How will "bait pricing" affect long-range profits for the retailer who consistently follows the practice?

Topical Outline	Teaching Suggestions
	iv. How will loss leading and baiting be regarded by the retailer's competitors? Is there a danger of a price war developing? Who profits from a price war?
	v. How do manufacturers of prestige products react to the use of their products as "bait" to get customers into the store? Is there a possibility that consumers will begin to wonder what is happening to the quality of prestige products? Will consumers begin to become suspicious that the manufaturer's product is no longer "quality" merchandise? Will the quality image the manufacturer has spent millions of dollars to create for his product begin to deteriorate in the minds of consumers?
(c) Discount pricing	(c) Perhaps pricing strategies of the discount house fit best into this section. If necessary, review some of the common types of discount houses: <u>Open door discount house</u>--a retailer that offers merchandise to all comers at prices considered below regular retail price <u>Discount broker</u>--a retailer who obtains merchandise for the consumer at "cost plus 10 percent." <u>Closed door discount house</u>--a retailer that caters to special groups of consumers; example GEX (Government Employees' Exchange, Norfolk, Va.) To buy at GEX, the consumer must be a government

Topical Outline	Teaching Suggestions
	employee, either city, county, state, or federal, or he must work for a firm that currently holds a government contract. Point out that the pricing strategy of the discount house is to maximize total profits by getting volume business, thus promoting a rapid stockturn. Emphasize low markup, rapid merchandise turnover. Stress the need for a concentration of population in the area to enable profitable discount operation.
(2) Prestige--or quality--store image	(2) Remind students again of the need for the retailer to define the market he will serve and of the need to give his market what it demands. Stress the folly of attempting to cater to both "Mrs. Got Rocks" and her maid. Point out that "quality" merchandise requires "quality" prices; pricing strategy can do much towards keeping undesirable customers out of the store. Stress the necessity of creating a desirable atmosphere if the higher-income, quality-conscious consumer is to be the major customer served by the retailer. You might find it desirable at this point to continue discussion along the lines "What can the retailer do to build and maintain the "quality" image?" Hold the discussion to pricing tactics for the most part. Some examples that can be metioned are: i. Avoid posting sales posters on windows ii. Mailing letters to regular customers announcing sales clearances before announcing to the general public

Topical Outline	Teaching Suggestions
	iii. Divert end-of-the-season merchandise to bargain centers; department stores often use basement stores for this purpose.
c. To minimize normal anticipated loss	c. Remind students that risk taking is one of the basic functions of marketing. Risk cannot be eliminated, but, through pricing merchandise, normal anticipated losses can be absorbed before they occur.
(1) Fashion obsolescence	(1) The retailer of fashion merchandise anticipates some loss on seasonal items. To cushion himself to absorb the loss, fashion items generally are sold at high markups at beginning of the seasion-- markups high enough to absorb end-of-the-season losses long before those losses occur. <u>For discussion</u>: If a retailer is "caught" with fashion merchandise at the end of the season, is this an indication of poor buying? Answer: Not necessarily. It is probably better to have some items left over than to miss sales of high markup items.
3. Pricing under different competitive conditions	
a. Pure competition	a. Pure competition is highly theoretical in nature and is practically nonexistent in our country. Teach the concept, however, emphasizing the major points cited in the outline. Some understanding of the theory of pure competition will help your students understand and appreciate pricing under conditions of monopoly and imperfect competition. It is doubtful that much time should be exerted attempting to examine the theoretical concept of pure competition-- you will be hard pressed to
(1) Nature of pure competition	
(a) Large number of sellers and buyers	
i. Individual seller has small supply to sell	

Topical Outline	Teaching Suggestions
ii. Individual seller has little control of total supply of the goods.	give practical examples. Perhaps the best example, or the nearest you can approach a respectable example, is to cite wheat marketing: Many producers, none has a major advantage in the market place; whether an individual seller of wheat sells his wheat or withholds his supply has literally no effect on the market price.
(b) Similar products offered by all sellers are--	
i. Identical in minds of buyers	
ii. Sold under similar conditions	
--Price is buyer's sole consideration	
(2) Pricing under pure competition	(2) Point out that since the seller controls only a small amount of total supply of the product, he is in no position to influence the market price--he either sells at the going price, or he withholds his supply from the market in hopes that price will increase at later time.
(a) Seller cannot set the price--has no influence on price	
(b) Seller either sells or refuses to sell at going market price	<u>Question</u>: If seller attempts to set a price higher than the going market price, what will happen? <u>Answer</u>: Buyers will shift to another source of supply, since price is the basic consideration.
(3) Marketing implications	
(a) Seller must be able to sell profitably at going market price.	(a) Point out that one individual can do little, practically nothing, to influence the market price--to increase profits, he must decrease costs
(b) Advertising does not help to increase individual profits--	(b) Remind students that, in the minds of buyers, products of all producers are alike--no differences; therefore, individual advertising becomes an

Topical Outline	Teaching Suggestions
merely adds to selling costs.	expensive selling cost. You will be hard pressed to give examples--perhaps farm products will help to illustrate this concept. For instance: Wheat--How does one producer's wheat differ from that of another producer? In the mind of the buyer, all wheat is alike.
(c) Seller increases income by cutting costs and selling more units of the product.	
b. Monopoly	b. Point out that we are much concerned about monopoly in our country and that much legislation has been enacted to control and prevent the formulation of monopoly. (See section on Government and Marketing elsewhere in this manual.)
(1) Nature of monopoly	
(a) One company controls completely the source of supply of a product.	Perhaps an effective teaching device to explain monopoly is to divert students' thinking to a store that has exclusive rights to distribute a highly popular product locally. Ask students to list several reasons why they as a retailer, would seek exclusive rights to distribute a popular product locally. The points the students list should serve to illustrate the nature of monopolistic competiton since, in essence, the exclusive dealer does have a monopoly in his territory.
(b) Buyers must buy from the firm controlling source of supply.	
(2) Pricing under monopoly	
(a) Seller sets the price.	* * * *
(b) Seller controls price by adjusting supply.	Suggest that students talk with local businessmen who serve as exclusive agents for certain products. Have them ask these exclusive agents why they are the only dealers handling the products in town. Compare findings.
(c) Basic objective: maximizing total profits in long run	
(d) Basic problem: finding price	

Topical Outline	Teaching Suggestions
that will yield maximum profits in long run	* * * * Suggested topic for student debate: Exclusive dealing is a monopolistic practice and should be eliminated * * * * Much inforamtion concerning pricing in our country today (as well as much other information that will be of considerable interest to marketing students) is available in the Wall Street Journal. Obtain some copies (a library subscription if possible) for students to examine. Many local businessmen take the Wall Street Journal; unless the businessmen maintain files of this daily newspaper, they probably will be happy to give your students copies. Arrange for students to collect these Journals; file the Journals for use by other classes.
(3) Marketing implications (a) Government regulation and control probable (b) High markups probable (c) Advertising helps to increase demand--and profits.	Some students are likely to raise questions concerning legality of monopolies in railroads, public utilities, etc. If these questions come, point out that these organizations are carefully regulated, though permitted. Our government does permit monopoly in such organizations because of expensive facilities (for instance, how much does it cost to lay a roadbed for the railroad? How much of a problem would it be if three separate railroads had to serve our town with different facilities for each?) Ask students to defer other questions until the time you plan to discuss the section on Government and Marketing.
c. Imperfect competition	
(1) Nature of imperfect competition	
(a) Producers attempt to gain monopolistic conditions.	(a) Cite product differentiation--attempts to make product different from competitors' products and placing great emphasis on these differences.

Topical Outline	Teaching Suggestions
(b) These are producers of highly similar products.	
(c) Buyer ofter has the advantage in the market place.	(c) Develop "Buyers' Market" concept.
(d) Products of different producers are different in minds of buyers.	
(e) Buyer has freedom of choice in selecting source of supply.	
(2) Pricing under imperfect competition	
(a) Basic objective: Maximizing total profits in long run	
(b) Minimizes effects of competition	(b) Proving product to be better than competitors; developing brand preference; etc.
(c) Price is not buyers' only major consideration.	
(3) Marketing implications	(3) In that our marketing system is a condition of imperfect competition, almost any example you care to give will fit here.
(a) Product differentiation	
(b) Extensive advertising	
(c) Nonprice competitive practices	(c) Have students give examples of local nonprice competitive practices. Examples:
i. Trading stamps	Cashing payroll checks
ii. Premiums	Providing strollers for shopping mothers
iii. Credit extension	Gift wrappting service
iv. Services	Charge accounts Delivery service etc.
v. Others	

Topical Outline	Teaching Suggestions
4. New product pricing	
a. Major considerations	a. Point out that at its simplest level pricing a new product is still a highly complicated undertaking; pricing a new product is a subject that can easily fill volumes of books.
	Much information concerning the marketing of new products can be obtained from manufacturers. Write several manufacturers for free copies of each manufacturer's regular prospectus to stockholders. Permit students to examine this literature and report to class some of the new product marketing plans discussed in this literature.
(1) Unit production costs	(1) The new product price must cover production costs in the long run. Point out that developmental and production costs are not always recovered in the first products produced. Producing the first in a line of products, the first refrigerator, for instance, is tremendously expensive--with mass production, however, developmental costs are recovered over a period of time. To emphasize this concept, ask students how much the first dose of penicillin cost to produce? Challenge them to seek the answer. How many average consumers could have availed themselves of one dose of penicillin if total developmental and production costs had been included in the first few doses produced?
(2) Selling costs	(2) Salesmen's salaries, etc.
(3) Acceptance in the market	(3) Will the product be accepted by potential users? How much advertising is needed to create market acceptance?
(4) Competitors' reactions	(4) Competitors will quickly copy the new product if it is accepted in the market. The producer must consider how quickly a competitor will develop a product to compete

Topical Outline	Teaching Suggestions
	with the new product to estimate how quickly developmental costs must be recovered. If the product bears a patent, the producer might have a longer period of time in which to recoup developmental costs--therefore, it might be possible to introduce the product at a lower price level and thereby capture a larger share of the market for that kind of product.
b. Pricing procedures	
(1) Studying prices of comparable products	(1) Some help in determining the price to charge for a new product can be obtained by studying other products used for essentially the same purposes as the new product. If another product is already doing the job satisfactorily, setting higher prices for the new product could lead to a very limited market for the new product, unless it can be shown through advertising and salesmanship that the new product is clearly superior to existing products. Perhaps a Proctor & Gamble illustration might be helpful here. In P & G's line of detergents and household cleaning aids, how do prices of comparable P & G products compare? Although the advertising accentuates major differences for the new detergent, will consumers accept the new product if considerably higher priced than the older, accepted product? How about P & G toothpastes, Crest and Gleem? Did new Crest with Fluoride merit a higher price than Gleem, even though Crest had the seal of approval of the American Dental Association?
(2) Test marketing the product	(2) A fairly common pricing procedure in introducing the new product is to test prices in different market areas for purposes of determining

Topical Outline	Teaching Suggestions
	the price that consumers will pay for the product. The test market plan is not altogether flawless--many variables do exist from one limited marketing area to another limited area--but much helpful information to guide pricing decisions can be obtained.
(3) Market review	(3) Once the product has been introduced, market reviews are necessary. Did management overestimate the market for the product? Understimate the market? Do prices need to be increased? If prices increased, what will be the effect? If decreased, what effect?
c. Two common new-product pricing policies	
(1) Skimming the cream (2) Penetration pricing	(1) Skimming the cream implies pricing (2) the product high in order to capture only the higher income groups; penetration pricing implies mass distribution with prices low enough to make the product attractive to larger segments of the population. Point out that skimming policy is often used when it is necessary to recoup costs rapidly because of competitors' activities in bringing out a similar product; if product tends to have faddish characteristics, skimming the cream might be desirable. Cite Hoola Hoops as an example. Retail prices went from $2.98 to 49¢ in a period of a few weeks. Use color TV as an illustration. When first color TV was introduced, what was the price level and probably policy followed? Once developmental costs were apparently recouped, or once it was obvious that developmental costs would be recouped; what happened to price? Was there a shift to a penetration policy?

Topical Outline	Teaching Suggestions
	Question: What pricing policy should the retailer selling skateboards adopt?
5. Some common pricing policies	5. Although some of the pricing policies will apply at all distribution levels, place emphasis on retailing price policies that can be noted by students in local stores.
a. Psychological pricing	
(1) Odd pricing	(1) In odd pricing, the price is expressed in odd figures: 39¢, $2.98; $4.95.
(a) General rule	(a) General rule: Prices below the $4.00 level are expressed in terms of one or two-cent reductions from next highest price point: 39¢ instead of 40¢; Above $4.00 level, express price in terms of 5¢ reductions from even point. To illustrate, bring an advertisement from local retailer to class. Prices in the advertisement will probably illustrate the general rule.
(b) Reasons for use	
i. To create bargain image	i. Psychologically, the odd price creates idea of a bargain. Because of overuse of the policy, the odd price is not considered as effective as it once was. Ask students what price they see when they drive along the road and see gas signs reading 31¢
ii. To promote honesty	ii. Point out to students that when odd prices are used, most sales result in a necessity for the clerk to make change; therefore, to give the customer his proper change, the clerk must go to

Topical Outline	Teaching Suggestions
	the cash register for the change. If price happens to be 50¢ or $5; it will be easy to casually give the customer his package, drop the money in a convenient pocket, and then go to wait on another customer.
(2) Even pricing	(2) Relatively new idea; aim is to create an impression of quality item instead of bargain image. Price is rounded: $2; $5; $100; etc.
b. One-price policy	b. The one-price policy is widely observed at the retail level; the policy is almost forced upon marketers at other distribution levels because of the Robinson-Patman Act (act pertaining to price discrimination.) Because of the legal significance of the one-price policy in interstate competition, and to help promote understanding of price discrimination and the Robinson-Patman Act, be especially careful in discussing the one-price policy. Have students copy the following as you dictate: Under the one-price policy, the same selling price is charged all buyers who purchase similar goods under the <u>same conditions</u>. Place much emphasis on the phrase "same conditions." Point out that "same conditions" means that buyers must buy in essentially the same quantity, the same quality merchandise, under the same terms, during the same period of time to get the same price. Emphasize that the marketer does not have to charge all buyers the same price to be following the one-price policy. The price might be changed for <u>different types of buyers</u>, but so

Topical Outline	Teaching Suggestions
	long as like buyers (same conditions concept) receive the same price, the one-price policy is being followed. * * * * Perhaps an illustration similar to the following will help to promote understanding of the one-price policy: I went into my favorite store today and bought a shirt for $4.95. Everybody else who bought the same kind of shirt at that store today, if he bought just one shirt, paid $4.95 for it. My brother went to the same store and bought a dozen shirts today--he paid $4.75 per shirt. All who bought a dozen shirts at that store today paid $4.75 per shirt. In the illustration, two types of buyers are involved--one type bought in lots of one; the other, in lots of 12. These two types of buyers were not "like buyers" in that same conditions did not prevail--the quantities purchased differed between the two types of buyers. All buyers of the same type, however, received the same price; therefore, the one-price policy was being followed although there was a difference in price between the two types of buyers. * * * * Point out that when <u>like buyers</u> do not receive the same price, price discrimination is taking place.
c. Varying price policy (1) Generalization: Price differs with each buyer	c. The varying price policy is a policy based on a philosophy of haggling over the price. Perhaps a good illustration of this policy is the much-publicized retailing practices of Mexico; it is said that if

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	the Mexican receives the price he asks, he gets no enjoyment out of the sale. Apparently the Mexican likes a good pricing argument. Have any of your students visited Mexico? If so, ask students to describe Mexican price haggling if he had an opportunity to observe it.
(2) Common when trade-ins involved	(2) Varying price policies are common at the retail level, especially when a trade-in is involved in the sale (automobiles, home appliances, etc.).
(3) Limitations	
(a) Attracts the bargain hunter	(a) If the retailer yields too often on prices, he develops reputation of being a price cutter. With this reputation, it becomes nearly impossible to make sales at stated markups.
(b) Encourages poor salesmanship	(b) There is an old saying that anybody can give things away, but just anybody can't sell. Salesmen working under a variable price policy often are accused of forgetting that their job is to justify the price of a product in terms of the product's qualities or values--in other words, they don't sell, they give the product away.
(c) Encourages consumer ill will	(c) Cite dangers of customers comparing prices they paid for the same product--the possibility that the customer who did not receive the favorable price will resent it and take his future business elsewhere. Questions for students to consider: 1. What effect will a varying price policy have upon the retailer who is attempting to create a prestige image for this store? 2. How will the policy affect the retailer's plan for developing customer loyalty?

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	3. Are bargain hutners desirable customers?
	* * * *
d. Single-price policy	d. Emphasize that a single-price policy and a one-price policy are not the same thing.
(1) Definition	(1) Pricing certain categories of merchandise to sell at a fixed price over a period of time. Examples: Every suit in this store: $29.95 Every hat in this store: $2.98
(2) Advantages	
(a) Draws desired customers	(a) Customers quickly learn the prices and quality of merchandise offered. Undesirable customers (those who desire better quality or lower quality than that offered) tend to go elsewhere; therefore, sales clerks spend their time working with live prospects.
(b) Simplifies merchandising problems	
i. Reduces inventory investment	i. Seller does not have to invest in wide ranges of merchandise.
ii. Cuts selling time and expense	ii. Live prospects buy quicker; this saves clerks' time.
iii. Reduces buying expense	iii. There are fewer sources to contact.
(3) Limitations	
(a) Narrows the market	(a) It narrows the market to those customers who desire the particular quality of merchandise handled (which actually might not be a disadvantage if that customer group is adequate--this could be a problem, though, in small towns.)

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(b) Creates problem when prices increase	(b) When price of merchandise is increased because of general cost increase, the image that has been created is destroyed; an image rebuilding job has to be done. Case problem for discussion: A local men's clothing store has for the past ten years sold all its suits for $29.95; a profitable market for this suit has been developed. The major supplier has just announced a price increase on these suits. It is now necessary for the retail price to be increased to $39.95. The local store has contacted another supplier that can furnish a <u>lower quality</u> suit that can be retailed at the $29.95 price. Should the store maintain its present quality suits at the $39.95 price, or should the store maintain the $29.95 price by switching to the lower quality product? * * * *
e. Price lining (1) Explanation	e. Price lining is to be found in most retail stores today, especially clothing stores. In essence, price (1) lining is a single-price policy, but instead of carrying one category of merchandise at a fixed price, the retailer builds his clientele around three or four well established prices that remain stable over a period of time. Example: The ladies' dress shop carries dresses at three or four prices--one group is priced at $7.95; another at $10.95; another at $14.95, etc. At each price level, customers are provided a selection of dresses within the price line.
(2) Strategy	(2) By offering customers a wide selection within the individual price lines, the store does not narrow its market

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	to the extent that a single price line does. Basic strategy, then, is to cater to more than one income group through providing several price lines of merchandise. <u>Student Activity</u>: Ask two or three students to talk with local retailers that follow a policy of price lining. Have them find out what these retailers consider the advantages of price lining to be. Do the retailers recognize any limitations in price lining? Ask these students to report their findings to the class.
f. Lowest price policy (A policy of meeting or beating competitors' prices)	f. To illustrate the lowest price policy, cite a local retailer if possible; if not cite Macy's, New York City--Macy's advertises the slogan "We will not be undersold." City local gasoline price wars as an example of lowerst price policy.
(1) Application	
(a) Requires well-financed business	(a) Emphasize that this is a dangerous policy for the poorly financed retailer; it could easily lead to bankruptcy if competitors engage in a way of price cutting. Unless you can afford this policy, leave it to the retailer who can.
(b) Can broaden market to tap new income groups	(b) A lowest price policy can serve to enable its user to broaden markets through attracting customers from income groups that ordinarily could not afford to buy the product. Use an example like the following to illustrate this concept: Electric mixers sell for $39.95. At the $39.95 price, the market for the product is well established with certain groups. Assume the price is dropped to $29.95. What effect will the price reduction have on the market?

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	Two probable effects: 1. A lower income group will be able to buy the product--thus market is broadened and more units will be sold. 2. Increased volume might possibly offset the price reduction.
(2) Major limitation	(2) Cite the danger again that price wars might develop and ultimately lead the poorly financed retailer into bankruptcy. <u>Problem for discussion</u> There are 12 barbershops in town. As a group, the owners of these shops believe that it is necessary to increase the price of haircuts from $1.50 to $2.00. Eleven of the 12 shops did advance the price. The one barbershop owner who did not cooperate in the price increase was of the opinion that if he continued the price of $1.50 (thereby following a lowest price policy,) many customers would switch to his barbershop. The increased volume, according to the proprietor's throughts, would be more than adequate to offset the increased costs of operation that had caused the other barbers to advance their prices. Do you think the 12th barbershop proprietor made a wise decision? Why?
g. Miscellanceous pricing policies	
(1) Pricing according to what the traffic will bear	(1) Stress scarce items. For example, if this year's peach crop is severely damaged by a late freeze and the supply of peaches is short (considerably below demand), how would you, as a peach producer, price the peaches?
(2) Pricing according to customary prices	(2) If you are marketing a new soft drink that will compete with Coca Cola and Pepsi Cola, to price the product higher than existing prices on highly

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	similar products will probably severely limit the market for the new soft drink.
(3) Pricing according to intuition	(3) This is trial-and-error pricing. You try a price; if the price is not satisfactory, try another price. Eventually, the "right" price might be found.
6. Price legislation	
a. Robinson-Patman Act	a. The Robinson-Patman Act is discussed later in the section on Governmental Relationships to Marketing. If desired, cover the Act at this point. The main points to emphasize are: 1. The Act is federal legislation of concern primarily to marketers engaged in interstate competition. 2. Basic purpose of the Act is to place curbs upon discriminatory pricing practices (discounts, promotional allowances, etc.) --practices which in effect favor large buyers to the detriment of small buyers. 3. Under the Act, like buyers must be treated alike in the extension of discounts, allowances, freight terms, etc. 4. The Act tends to require marketers engaged in interstate competion to follow a one-price policy when selling to buyers who are in competition with each other (see one-price policy, preceding section 5b above). 5. Under the provisions of the Act, a buyer who knowingly accepts a discriminatory price is guilty of violation of the Act.
b. Fair trade legislation	

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(Also know as resale price maintenance; vertical price fixing)	b. See Fair Trade legislation under Governmental Relationships to Marketing. Emphasize manufacturers' role in setting retail prices. Point out that Fair Trade laws vary from state to state.
c. Unfair sales practices acts	c. These acts are <u>state</u> laws passed in some states. Where in effect, the law is mandatory legislation (fair trade is enabling legislation.) Typical of the provisions of unfair sales practices acts are requirements that retailers observe at least a minimum markup on products; for instance, in some states the retailer is required to mark up his products at least 6% above invoice cost. <u>Question</u>: How would such a law affect the retailer who engages in loss leading? * * * * <u>Professional reading</u>: Phillips & Duncan: MARKETING PRINCIPLES AND METHODS, 5th Ed., Chapters 29, 30, 31.
B. Buying	B. In presenting the buying function, capitalize on students' personal buying experiences where possible. * * * * Emphasize that the success of any marketing venture depends upon making merchandise available to customers in desired quantities where customers want it, when they want it, and at prices they are willing to pay. Stress the axiom that "Goods well bought are half sold."

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1. Basic activities essential to successful buying	
a. Determining merchandise needs	a. Point out that the seller may, through advertising and/or salesmanship, create demand for his goods; in so doing, the seller is helping the buyer to determine needs.
(1) Kinds of goods needed to meet customer demand	* * * *
(2) Qualities needed	
(3) Quantities needed	Assist students in analyzing their personal buying procedures. For example: I noticed my shirt collar and cuffs were frayed, recognized a need for a shirt; considered possible places from which I could obtain shirts--many sources were available; visited several stores, inspected offerings in terms of my quality standards; selected a shirt, paid for it, and took it with me.
(4) When needed (time element)	
	Emphasize similarities between students' personal buying procedures and the buying procedures of the business firm.
b. Selecting sources of supply that will	b. Discussion pointers:
(1) Be continuous	Assume the store has widely advertised a promotional event for which special merchandise must be obtained. What would happen if the merchandise to be featured in the promotional did not arrive until three days after the event?
(2) Provide consistant quality	
(3) Be reliable in observing delivery dates	* * * *
(4) Be acceptable to customers	(4) Would customers resist Japanese-made products? Non-union made products? If so, sources providing such products might be undesirable sources.
c. Determining suitability of goods to meet needs by	c. Have students give personal examples of how they have determined suitability. For example: I determined suitability by description when I ordered from the catalog; my parents bought by specification when our house was built according to our directions.
(1) Inspection	
(2) Sample	

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(3) Description (4) Specification (5) Recommendation of others	Compare these personal examples with procedures followed by the retailer.
d. Negotiating terms and transferring title (1) Price (2) Invoice due date (3) Discounts (4) Shipping charges	
2. Buying as related to other marketing functions	2. Review the basic marketing functions and activities introduced in Marketing I. Discuss relationships of buying to other functions. For instance:
a. Selling and sales promotion	a. Buying facilitates selling--"Goods well bought are half sold."
b. Storage	b. Availability of economical and adequate storage facilities influences buying policies and practices.
c. Research	c. Performance of marketing research function provides pertinent information relative to market needs, sources of supply, and in general, information concerning what the market will absorb.
d. Other functions	
3. Buying practices	
a. Buying from salesmen	a. Stress importance of salesmen as a means of keeping abreast of developments in buyer's major merchandise interests, i.e., use of salesmen as means of obtaining market information. Stress values of buyer's making himself available to salesmen, but also point out that the smart buyer will avoid being overly influenced

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	by salesmen--he must remember that salesmen, though perhaps well meaning in attempts to help the buyer maintain complete stocks, are under pressures to meet quotas and earn commissions.
b. Mail order buying	b. Stress value of mail order buying for obtaining fill-in merchandise between salesmen's calls and buyers' visits to market centers. Perhaps some local merchants will provide you with catalogs and other literature they have received from maufacturers. If obtainable, permit students to examine the catalogs and sales literature. Point out terms and other pricing information presented in these materials.
c. Buying trips	
(1) Central market facilities	(1) An excellent example of central market facilities is the Merchandise Mart in Chicago. The Mart is known as "a storehouse for storekeepers"; more than 3,000 manufacturers have selling space here. A department store buyer can make enough direct contacts in the Mart to stock most of the departments in the store. Discriptive literature concerning the Merchandise Mart can be obtained by writing the Merchandise Mart News Bureau, Chicago. (Teacher: If you are not familiar with the Merchandise Mart, by all means place it on your list of places to visit and tour during your next visit to Chicago.) Cite other central market facilities: Furniture Mart in N. C.; Charlotte facilities; New York facilities--all attract buyers from great distances.
(2) Trade shows and fairs	(2) Trade shows and fairs are held periodically in a variety of merchandise

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	fields (toys, housewares, office equipment, etc.) in major cities. These shows and fairs afford opportunities for hundreds of exhibitors to display their offerings in central points readily accessible to buyers. An oral report on a trade show or fair should be of considerable interest to students. Students should encounter little difficulty in locating materials for this report--refer them to recent issues of business periodicals.
d. Buying through resident buying offices (1) Nature of resident buying offices (a) Composed of buying specialists (b) Located at major central markets (c) Especially important in ready-to-wear business (d) Render many services to their clients (e) Paid for their services on flat yearly fee or commission base	d. Have any students been employed in stores that used services of resident buying offices? If so, ask these students to make a report of the store's experiences with these offices. Report should over type of resident buyer used, kinds of merchandise obtained through this source, nature of services provided by the resident buyer, and, if this is not confidential information, costs encountered in using the resident buyer.
(2) Nature of services rendered to clients (a) Economical purchasing arrangements (b) Keep clients posted on developments in the market (c) Keep clients in touch with best sources of supply	(a) Explain that resident buying offices, since they represent many firms in related lines of business, can buy in large quantities and thereby secure discounts for clients that individual buyers would be unable to obtain; can take advantage of special sales for their clients; can help reduce transportation charges by arranging for bulk shipments of merchandise to central locations near retail outlets.

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(d) Serve as headquarters for buyers on buying trips (e) Supply clients with style bulletins and other market information (f) Arrange special orders for clients (g) Assist in obtaining promotional materials and assistance from manufacturers	(b) Contact a buyer from a local department or ready-to-wear store that uses a resident buying office. Ask buyer to give you, for class examination, some of the literature (non-current materials will be easier to get) furnished by the resident buying office. Ask especially for copies of daily bulletins furnished by these offices, plus other literature the buyer does not deem to be confidential. * * * * Invite a local ready-to-wear retailer to talk with your students concerning his experiences with resident buying offices.
e. Buying from service wholesalers (1) Major merchandise source for small scale retailers (2) Service wholesaler as retailer's buying agent (a) Anticipates retailers' needs (b) Helps retailers plan merchandise assortments (c) Assembles merchandise assortments (d) Furnishes merchandising assistance (e) Provides much promotional assistance	e. For class discussion: (1) Why do some retailers frequently concentrate their buying with service wholesalers? (2) What problems would a manufacturer encounter in attempting to deal direct with small retail buyers? Invite a representative from a local wholesale firm to speak to the class on the subject: Why Retailers Buy From Service Wholesalers. * * * *
(3) Service wholesalers' assistance in cost reduction	(3) Explain that service wholesalers enable retailers to cut costs of doing business by rendering assistance in the performance of certain

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	retailing functions. For example, service wholesalers help --
(a) Storage function	(a) reduce cost of storage function by maintaining adequate stocks near retailer's firms.
(b) Finance function	(b) reduce cost of finance function through credit extension. Retailers often have sold goods before paying for them. The cost of the finance function is therefore reduced in that retailer is actually permitting the wholesaler to finance the retail operation.
(c) Risk bearing function	(c) reduce risk in that the retailer is able to operate with reduced inventory, thereby reducing loss from shrinkage, etc.
(d) Other functions	Give other examples showing how the wholesaler helps reduce costs of performing the marketing functions.
f. Buying in groups	f. Point out that some businesses--wholesalers and retailers--pool their buying power in attempts to obtain quantity discounts and other price concessions from suppliers. Group buying practices sound effective in theory, but do not always work in practice because of differing needs in the group and frequent lack of cooperation among group members.
g. Centralized buying	g. Central buying (primarily buying for units in a corporate chain) implies that authority for buying lies outside the local unit of the chain. Discuss the following question: What is the local chain manager's role when central buying practices are followed? It might be desirable to contrast corporate central buying with buying practices in the voluntary chain. If discussed, emphasize the angle of the independence of the voluntary chain member.

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4. Factors influencing buying	
a. Customers' needs and wants	
Keeping up with changes in customer demand and market trends	Consult Sunday editions of New York Times for new fashion trends, etc. * * * * Capitalize on students' work experience in discussing customers' needs and wants. Project students into buying positions for the stores in which they might be employed. What sources could be tapped to obtain information to guide buying decisions? Students can be expected to list sales records, want slips, customer requests, etc. * * * * Emphasize the following concepts (and other concepts as you see fit) in discussing customers' needs and wants: The buyer must forget his own likes and dislikes--it's the customers' wants that are important. The retailer who offers what the customer wants <u>first</u> is generally the one that "skims the gravy" (profits) in the market. Cite, for example, recent successes with hair pieces. <u>Case for discussion</u> Last year Joe's Bootery was unable to meet customer demand for size 4 shoes. Many customers went to other shoe stores to get children's shoes. Joe vowed he would not be caught napping this year--and he wasn't. He stocked ample supplies of size 4 shoes. The size 4 shoes didn't sell, though; everybody appeared to want size 5. What mistake did Joe make in buying?

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	The answer is obvious, but the simple lesson is worth remembering in a buying situation.
b. Firm's merchandising policy	b. Among factors influencing buying are policies relative to the image the firm is attempting to create; to price ranges, and to the number of lines to be carried.
c. Economic conditions	c. For discussion purposes, raise questions similar to the following: Assume the community's major source of consumer income (a major manufacturing plant, for example) finds it necessary to curtail operations for about three months. With curtailment of operations, many layoffs will occur. What effect, if any, will the curtailment of operations have upon your store's buying? If located in an agricultural area, how will a crop failure affect the retailer's buying?
d. Competitors' activities	d. For discussion: Assume your store is located in a downtown area. Many of your competitors will open outlets in a shopping center slated to begin operations at the beginning of the spring selling season. How will this development affect your buying of spring merchandise?
5. Saving money in buying	
a. Negotiating to return unsold merchandise	a. Emphasize importance of investigating suppliers' policies concerning returns of unsold merchandise. What conditions does the supplier impose returning goods?
b. Consignment buying	b. Consignment buying serves to reduce inventory investment and thereby makes capital available for other purposes; also is a protection in the event that merchandise does not sell.

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c. Shipping methods d. F. O. B. terms	c. The efficient buyer will plan ahead d. in order that the most economical method of shipment in keeping with store's needs can be utilized. Emphasize that both methods of shipment and F. O. B. terms must be considered in determining the delivered cost of merchandise. Raise questions concerning when the buyer should use the various transportation services. For instance: Under what conditions is a buyer justified in having merchandise delivered by air transportation? (When expensive fashion merchandise or perishable items are ordered; in general, when speed of delivery is more important than cost of the service.) F. O. B. terms were discussed in Marketing I Manual. Review as necessary. Point out that F. O. B. point is important in two ways: (1) indicates point to which shipper pays transportation charges; (2) indicates, in a legal sense, point at which title passes to buyer. F. O. B. Factory: Buyer pays transportation charges. Title passes when goods leave factory. F. O. B. Destination: Shipper pays transportation charges. Title passes when goods reach destination.
e. Discounts and promotional allowances	e. Discuss some of the common discounts and the <u>importance of taking discounts</u>. Cash discount: Discount given by seller to encourage prompt payment. Terms 2/10, n/30 are common (2% cash discount if invoice is paid in 10 days; entire amount is due in 30 days. Quantity Discounts: May be a <u>cumulative quantity discount</u>--the seller grants buyer a discount on all purchases made during a specified

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	period of time--to encourage buyer to concentrate his buying with the seller; noncumulative quantity discount--the discount applies only the individual order--given to encourage large orders. Promotional Allowance: An allowance granted by seller to encourage buyer to promote the product. Example: (1) Cosmetic manufacturer pays salary of cosmetologist to "push" his product in the retailer's place of business. (2) Manufacturer pays part of the retailer's advertising bill. Explain that manufacturers are willing to pay part of retailer's advertising bill because it enables them to advertise their product at local rates instead of the more expensive national rates.
6. Career opportunities	
a. Opportunities for women	a. For guidance purposes, point out that many retail buyers are women. Suggest that female students consider department store buying for its career potential.
b. Knowledge required (1) Fashion trends (2) Advertising and salesmanship (3) Budgeting (4) Business Law	b. Point out that general knowledge of merchandise and merchandising techniques is essential to successful buying.
c. Entry into the position	c. Stress need for advancing education beyond high school diploma. It is possible for person to "work his way" into a buying position from sales clerk level--but it takes time and a quality of work that proves ability. Most larger stores will require education beyond the high school level as pre-requisite to a buying position.

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	* * * * To add interest to the general area of merchandising, consider the following publication for classroom use: ITALY PRESENTS Italy Presents is an Italian Trade magazine published quarterly (English text) by the Italian Foreign Trade Ministry. Each issue is devoted to the development, promotion, and distribution of various Italian products. Student interest in examining this novel and attractive periodcial will be well worth the $3 subscription price. Send check or money order to: ITALY PRESENTS c/o Italian Trade Commission 820 Statler Office Building Boston 16, Mass. * * * * Professional Reading: Phillips & Duncan: MARKETING PRINCIPLES AND METHODS, 5th Ed., Chapter XXV. Student Reading: Shilt & Wilson: BUSINESS PRINCIPELS AND MANAGEMENT, 4th Ed., Chapter 13. Current magazine articles related to buying .

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C. Selling	C. NOTE: In that selling and sales promotion were treated in depth in Marketing I, it is doubtful that major treatment should again be accorded the topic in Marketing II. Do not, however, leave an impression that the selling function is unimportant--continue to stress the concept that selling is the heart of marketing. Treat the topic in a general manner in Marketing II. Review at the refresher level from Marketing I Manual, pp. 54-127 as you deem necessary to meet the needs of your students. * * * * In treating Selling in a general manner, attempt to stress basic principles applicable at all distribution levels; then, if desirable, concentrate emphasis upon the retail level. * * * *
1. Determining market needs	1. Call attention to the close relationship that exists among all the functions, but especially the close relationship between selling and the buying and research functions.
a. Manufacturer's view	a. For the manufacturer, selling begins when he answers the question "What shall I make?"
(1) New product development	(1) Stress the need for the manufacturer to research his market as a guide to product development. Emphaszie that if the manufacturer is to be successful, he must design products with the consumer in mind. To survive in today's world, the manufacturer must continuously introduce new and better products. <u>Student participation</u> Did any students attend the New York World's Fair? Did they visit any exhibits featuring products for

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	"tomorrow"? What were some of the interesting products they saw or heard about? What companies were sponsors of these exhibits?
(2) Technological developments	(2) Emphasize that not only must a manufacturer be a developer of new products if he is to survive in the market place--he must also keep abreast of technological developments that affect his position in the market. For instance, how will changes in other industries affect the manufacturer? To illustrate, go back to the horse and buggy days. How did the introduction of the automobile affect the manufacturer of buggy whips? As a thought problem, ask students to speculate upon the effect all-electric homes might have upon the manufacturer of oil furnaces. What effect did consumer acceptance of oil furnaces and heaters have upon the manufacturer of coal heaters used in the home?
b. Wholesaler's view	b. Emphasize the necessity for the wholesaler to study his market carefully for purposes of determining the merchandise needs of the businesses to which he will cater. Reemphasize the concept that, to sell profitably, the businessman must buy in accordance with the needs of his market. Point out that one of the wholesaler's basic tasks is to help his customers keep abreast of their needs. The implication, then, is that wholesalers must not only be alert to the needs of the businesses to which they cater--the wholesaler must also be alert to the needs of consumers to whom the retail customers will be catering.
c. Retailer's view	c. Again draw a relationship between studying customers' needs in order to sell profitably. Cite the following examples: (1) Joe's Corner Grocery had an opportunity

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	to take advantage of a dog food package deal. Although Joe had not previously stocked dog food, the deal was so attractive he could not resist it (the deal provided especially attractive prices for customers--and potentially high profits for Joe). Unfortunately, the dog food did not sell. Why was Joe's venture a "misadventure"? (Answer--Joe's customers were from "no-pet" neighborhoods. How could Joe have determined this prior to buying?) (2) Joe had another "good deal" opportunity--a special price on baby food. Prior to this opportunity, Joe had not stocked baby food because he had so few calls for it--but this deal was "too good to miss." Joe purchased the baby food, but even though the attractive retail price was featured in his weekly advertisement and the baby food was prominently displayed in the store, only a few grandmothers took advantage of the deal. Joe lost money on the deal. Why? What should Joe have learned from his two misadventures? (To analyze his market before buying) Note: Take advantage of the second case involving the baby food to call students' attention to the effects of population shifts on the retail market. In the case of the baby food, possibly the younger married couples with babies were following the trend toward suburban living--Joe's Corner Grocery was probably located in and older section of town that had few young married couples with babies. Perhaps Joe would have been wiser to have considered stocking dietetic foods. . . How could he have determined whether or not he should have stocked dietetic foods? * * * *

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	Through class discussion, make it obvious beyond any doubt that, regardless of the level of distribution, the basic selling function begins with the determination of the needs and wants of the particular market to which the individual business firm will cater.
2. Creating demand	2. Emphasize the point that the marketer of today cannot rest upon his laurels. He must promote the merchandise he stocks: he must also promote his business generally. If today's marketer has a good product to offer his potential market, he must inform potential customers of that product. Stress the concept that the world no longer "beats a path to your door." This is true for manufacturers, wholesalers, and retailers--all must engage to some extent increating demand. Again draw relationships between the buying function and the selling function. Remind students that an initial step in the performance of the buying function was <u>determining needs</u>--an initial step in the performance of the selling function is <u>creating demand</u>, which can be interpreted to mean "helping prospective buyers determine needs for your products."
a. Advertising	a. Emphasize advertising as a part of the selling function. Stress the point that advertising <u>helps</u> prospects recognize needs for products; through advertising, consumer motives (buying motives) are aroused. Refresher level review as desired from Marketing I Manual, pp. 92-108. Preferably, treat this topic in a general manner--it is assumed that students who received credit for Marketing I are already familiar with the material.

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(1) Aims	
(2) Types of Media	(2) In discussing types of media, expand coverage to place more emphasis upon the use of classified telephone directory advertising at the retail level. An effective teaching aid can be secured through the offices of your local telephone company; if not available locally, write: Mr. Walter Corry Southern Bell, Charlotte Ask for: THE YELLOW PAGES AS AN ADVERTISING MEDIUM Both a Student's Manual containing information and projects, and an Instructor's Manual are included in the materials to be obtained from the source indicated.
(3) Steps in advertising	
(4) Types of copy	
b. Salesmanship (Helping prospects buy)	b. Review briefly from Marketing I Manual, pp. 55-65, as desired to meet the needs of your students.
(1) Role of salemanship in our economy	(1) Stress relationship between our nation's high standard of living and salesman.
(2) Types of salesmen	(2) Stress career potential--there is a place for everybody somewhere in selling. Implant the idea that an individual's success in selling is limited only by his own ability, vision, and resourcefulness. Cite financial rewards of selling. See also Marketing I Manual, pp. 56-57.
(3) Sales management problems	(3) Place emphasis upon management considerations re: recruiting, selecting, and motivating the sales force. See Marketing I Manual, p. 58.
(4) Importance of personality in selling	(4) Constantly work to help your students appreciate the role of personality, especially in selling. Many helpful

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	hints can be found in Marketing I Manual, pp. 59-60. Encourage students to implement an analysis of their own personalities with the view to setting up a plan for self-improvement.
c. Publicity	c. Publicity could be loosely defined as a form of advertising the business gets free of charge. Technically, any form of news item favorable to a company or its products published or broadcast without charge is publicity. Perhaps you, or your students, can locate news items concerning local marketers to illustrate the publicity concept. News items on the new automobiles are good examples. Ask students to list retailer activities that are newsworthy as publicity. For instance: Enlargements of store facilities Lengthening store hours for customer convenience Using a window display for civic purposes
d. Sales promotion "The coordination of publicity, personal salesmanship and customer services in order to promote profitable sales."	d. Review from Marketing I Manual, pp. 88-91, as necessary to reinforce learnings in this area.
e. Product innovations	e. Emphasize that product innovations and technological developments are highly important to the manufacturer in creating demand for his line of products. For instance, have students consider the effects of Westinghouse advertisements featuring the "kitchen of tomorrow" upon the housewife

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	when she is planning for her kitchen appliances. How does Du Pont's "Better living through chemistry" motto affect the demand for Du Pont's products generally?
	Reemphasize that we are today living in a world of constant change. To survive in marketing, the marketer must accept, not resist, change. In this dynamic field of marketing, no marketer stands still--he either goes up--or he goes down--he goes not retain the status quo.
3. Locating buyers	3. Approach from manufacturer's, wholesaler's, and retailer's points of view. Have students in group buzz sessions, list some of the ways sellers can locate buyers. In subsequent discussions, cite the following if not already listed by students:
a. Manufacturer	(1) Advertising in trade journals
	(2) Inquiry letters received from potential customers--especially letters requesting pricing information
	(3) Use of wholesalers and agent middlemen to locate buyers
	(4) Use of the endless chain prospecting system (getting referrals from satisfied customers)
	(5) Direct mail advertising
	(6) How does the encyclopedia company locate potential buyers? Cite offers to provide free literature made by some encyclopedia companies--when customers write to request the free literature a list of potentially "live prospects" can be developed.
b. Wholesaler	(1) Use of classified section of telephone directory

Topical Outline	Teaching Suggestions
	(a) as a source of locating businesses that can be converted into customers (b) as a source to enable customers seeking suppliers to locate the wholesaler who can supply their needs (2) Cold-Turkey canvass--in effect, having salesmen call on every business firm that is a potential buyer of the products the wholesaler stocks (3) Leads from manufacturers--manufacturers will frequently refer orders from small retailers to the wholesaler who services the area in which the retailer is located.
c. Retailer	(1) Telephone calls and direct mail advertising to charge account customers (2) Use of outside salesmen to conduct cold-turkey canvass (especially for retailers in home applicances) (3) Advertising gimmicks--registrations for mystery prizes often provide leads to customers interested in the retailer's product lines (4) Use of "spotters"-- or "bird dogs" as they are frequently called; for instance, the service station operator is in a good position to provide the automobile dealer with leads to prospects for new cars. (Dealers usually pay for these "leads".) (5) Frequent checks with public utilities office to obtain names of newcomers to the mmunity. * * * * If you can cement good relations with local Chevrolet dealer, you might be able to

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	borrow training films (and other helpful marketing instructional aids as well_ on prospecting. Ask for permission to use their "Jam Handy" training aids.
4. Conducting the sales presentation a. Pre-approach b. Approach c. Demonstration d. Handling objections e. Trial close f. Closing the sale	4. Teach at the review level only. To avoid spending an excessive amount of time on this subject, perhaps a game or contest will be helpful to give you leads into areas where extended reteaching efforts are needed. Divide students into small groups; have each group prepare a list of general rules to be followed in conducting the various segments of the sales presentation. To help you fill in gaps, review Marketing I Manual, pp. 63-78. ANOTHER NOTE OF CAUTION: Of necessity, you must spend some time discussing the all-important selling function if you are to achieve your objective of giving students a total picture of the basic marketing functions. Keep this function in its proper perspective--it is one of many topics to be covered in Marketing II. Do not become so involved with this function that you permit it to take a disproprotional amount of time.
5. Negotiating terms and transferring title a. Who pays freight? b. What discounts apply? c. Are goods returnable?	5. Compare the negotiating step of the selling function with the final step in the performance of the buying function (present in Section B, above). Point out that buyer and seller are "on opposite sides of the fence"; each is working to get the best "deal" possible for his firm where transactions between businesses are involved. Relate negotiating terms to the "total profits pricing objective" discussed in preceding section on pricing. <u>Thought problem for discussion</u>: Should buyers and sellers haggle over

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	who pays the freight? What discounts are to be extended? Are goods returnable if they cannot be sold? Why? Why should the manufacturer be concerned with these questions? The wholesaler? The retailer?
	Films
	Many sources of free or inexpensive training films are available to you. Perhapds some of the local larger stores will lend you training films used with their employees.
	Several effective films related to merchandising generally and to the buying and selling function specifically can be obtained for postage charges only from Modern Talking Picture Service, Charlotte. Films marked with an asterisk below are especially good. If you order any of these films, be sure to do so several weeks ahead of the planned screening date; also specify the alternate dates on which you can use the films. Order by number and title.
	#1634 A CROWN FOR CATHERINE--stress selling function from manufacturer's angle: product planning with the consumer in mind. (20 minutes)
	#1126 * THE CARE AND HANDLING OF BUYERS--emphasizes both the buying and the selling functions. (45 minutes)
	#1125 A LITTLE TIME FOR HENRY--stresses necessity for salesman to manage his time properly. (17 minutes)
	#1001 * OF TIME AND SALESMEN--Dun & Bradstreet film; stresses planning the selling day in order to get most from it. (35 minutes)
	#1403 * SMALL BUSINESS, U.S.A.--THE STORY OF MAIN STREET--This film is dated

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	but still is an excellent film for DE classes. Stresses sales promotion; can be used with discussions of the buying and selling functions or as a general film elsewhere in the course. (33 minutes) #1450 THE WORLD IS YOURS--General film that will tie in with merchandising generally (Montgomery Ward film). (27 minutes) One or two of these films should be adequate to meet your needs.

III. MARKET ANALYSIS

Materials and Equipment Needed

1. "Marks of Merit" - 16mm film showing various trademarks and brandnames, noting their value in selling merchandise. Order from Modern Talking Pictures.

2. "Employment Outlook For Advertising Workers, Marketing Research Workers, Public Relations Workers" - 10¢ - Superintendent of Documents, Washington, D. C.

3. Statistical abstract of the United States

4. Current Population Characteristics published by U. S. Bureau of Census

5. "Sales Management" magazine

6. Advertising jingles to use in classifying buying motives appealed to

7. Richert, Meyer, and Haines, Retailing Principles and Practices

8. Phillips and Duncan, Marketing Principles and Methods

9. Wingate and Weiner, Retail Merchandising

10. "How Good Are Your Servicemen?" Small Marketers Aids No. 55, Small Business Administration

11. Shilt and Wilson, Business Principles and Management

12. Creative Marketing Project - Sales and Marketing Executives International, 630 Third Avenue, New York, New York 10017

III. MARKET ANALYSIS

Objectives

1. To develop an appreciation of the wide variety of consumers' wants and needs to be satisfied in the American market place
2. To develop some insight into the major tasks encountered by marketers in identifying and reaching their market targets
3. To develop an understanding and appreciation of the varied factors that influence consumer buying behavior
4. To develop an understanding of the kinds of consumers' goods and marketing strategies employed in marketing those goods
5. To develop an appreciation of the importance of marketing research and an understanding of the techniques of marketing research

Topical Outline	Teaching Suggestions
A. The Consumer and Marketing 1. The current marketing concept	A.1. In discussing the consumer and marketing, place special emphasis on the concept that manufacturers and marketers are in business to serve the consumer, not to dictate to him. In other words, emphasize that the consumer is the major factor in marketing <u>today</u>--no matter how good a product might be, if consumers will not buy the product there is little point in producing it. This marketing concept will be readily recognized by the students because it is the concept that has dominated in their lifetime; the <u>marketing concept</u>, though, has only been accepted since the 1950's. In the evolution of the current marketing concept, producers of consumers' goods have passed through at least two other recognizable stages of consumer market orientation. Those stages were: (a) Producers were primarily production conscious--they made products and expected consumers to buy those products. Explain that manufacturers can afford to be production minded when there is little competition. To illustrate: Cite Ford Motor Company. Henry Ford liked black cars. As long as he had no competition,

Topical Outline	Teaching Suggestions
	he produced black cars. When competition emerged, Ford nearly went bankrupt before he recognized a need to give consumers what they wanted. This is a good argument to use to explain why our nation has laws to prevent formulation of monopoly. When we have manufacturer dominance (only a few producers of a given product), there is little competition for the consumer's business, therefore, the consumer is of only minor significance. (b) As additional producers entered the marketing picture, consumers were given a variety of similar products to satisfy their wants. With competition, producers had to change their concept of the consumer's role in marketing. He had to be sold on the merits of individual producer's products. With this development, manufacturers entered a period of sales orientation. Emphasis under this concept was upon providing the consumer, through advertising and salesmanship, with information showing him why he should buy this manufacturer's product instead of the competitor's product. After the end of World War II when producers were again producing consumers' goods instead of engaging in large-scale defense production, the marketing concept gained acceptance. This concept holds that the consumer is the all-important factor in marketing, that there is a vital need for finding out what he is, where he is, what he wants, and how he wants it. This concepts accentuates the importance of analyzing the consumer market and brings into focus the major role of marketing research. The current marketing concept serves to change management thinking from thoughts of "selling products to consumers" to thoughts of "selling products for consumers." Point out that General Electric is expressing

Topical Outline	Teaching Suggestions
	recognition of the market concept in their motto, "Progress is our most important product."
2. Population factors and trends	2. Much has been written about the "Population Explosion," resulting from the high birth rate in the early 1940's (cite war scare, early marriages), especially from the point of view of the social problems created. From a marketing point of view, however, population means potentially fertile markets for wide varieties of consumers' goods. Emphasize the major task involved in determining and providing for the needs and wants of the population and the career potential afforded thereby. Meeting the needs of our population of 192,000,000 plus affords many highly rewarding career opportunities. Student Activity Encourage student participation in discussing population factors. Assign students to present oral reports, with accompanying visual aids they can locate or prepare to support their reports, on the various population segments and the effect of these population segments on the marketing of consumers' goods. (For instance, a report on the Teenage Market might be supported by advertisements appealing to teenagers.) To make these reports informative and valuable contributions to your marketing class, assign them now with instructions that reports are to be presented at the conclusion of this unit on the consumer and marketing. Assign the following population segments as report topics: The Teenage Market The Over-65 Market The Negro Market--Be sure to get a copy of Ebony or some other Negro periodical for class examination if your class is composed primarily

Topical Outline	Teaching Suggestions
	of white students The Leisure Market The Suburban Market Others as you see fit For precise statistical data relating to population, the following sources can be tapped: Statistical Abstract of the United States Current Population Characteristics, published by U. S. Bureau of Census Sales Management Magazine (Consult local merchants' Associations or Chambers of Commerce for local statistics) * * * * Perhaps your local Chamber of Commerce will help you locate a speaker to discuss market segmentation in your local area. * * * *
a. Increasing population b. Westward movement of population c. Rural to urban migration d. Increasing age of population e. Average family size decreasing f. More women entering the work force g. Educational level rising	<u>Population factors and trends</u>: Reference material for the factors and trends listed in the topical outline can be located in almost any basic marketing text on your professional bookshelf. Each of the factors and trends can be explored for marketing implications. For example and illustration, (f) "More women working" has major marketing implications: helps increase family income, creates demand for labor-saving devices, frozen dinners, etc.
3. Consumer Income and Expenditures	
a. Current income and expenditures	a. Consult current periodical literature and current marketing textbooks (Phillips

Topical Outline	Teaching Suggestions
	& Duncan; Beckman & Davidson; others) for detailed statistical breakdowns of consumer income and expenditure data. Note trends. Perhaps your local merchants' association or a local banker can provide you with statistics for your immediate locale.
	For Bulletin Board
	Either from a marketing text or from periodical lieterature, prepare a display showing how the consumer divided his expenditure dollar in the most recent year for which you can locate statistics. Do this by means of either (a) a pie chart or (b) an exaggerated drawing of a one dollar bill segmented to show proportions of the dollar expended for the major categories of consumers' goods.
b. Marketing principles relating to consumer income	b. While accurate statistice relating to consumer income and expenditures are desirable, sound marketing principles relating to income and expenditures are equally desirable. While income and expenditures vary from year to year, basic principles will tend to hold true--these principles should be the key ideas to be retained by your students. Stress these principles and attempt to relate them to practical marketing situations.
(1) Man's income is limited; his wants are unlimited	(1) This principle probably explains man's major reason for working. No matter how much we have, we always want more--our capacity to satisfy our wants is dependent upon our income level.
(2) Man's standard of living is determined by his disposable income	(2) (Disposable income: income after taxes) We as individuals or family units can consume goods and services only to the extent that our disposable incomes permit us to do so. If we measure our standard of living in terms of our ability to satisfy our needs and

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	wants with consumers' goods and services, then disposable income sets the limits for a family's or individual's standard of living. It should be obvious to students from personal experience and observation that families from higher income groups enjoy a higher standard of living..It should be obvious, too, that most individuals are constantly seeking a higher standarad of living. Stress the concept that people alone, even though people have need or demand for goods and services, do not constitute a market. For a market to exist, people must have effective demand--in other words, they must have the money necessary to satisfy their demand. Illustrate this concept by asking a student if he would like to have one of the more expensive automobiles--his answer will probably be "Yes!" Inquire further as to whether or not the local dealer should send a salesman to attempt to sell the student an automobile. If the anticipated "No" answer comes, ask why. Stress the need for salesman to investigate income of prospects before wasting selling time on the individual who can only say "No" to the proposition. Ask also why General Electric does not attempt a large-scale selling campaign to sell refreigerators and washing machines to Chinese families. These questions should help to impress students with the idea that people alone do not necessarily constitute markets--and this is a key concept for the beginner in marketing.

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(3) Expenditure patterns for families and individuals in the same income group tend to be similar	(3) This generalization tends to hold true generally even though educational and occupational differences exist within the group. Marketing significance: major mass market within income groupings--big question: how does the marketing agency keep abreast of changes taking place within the group itself? Emphasize that different income groups tend to set their own quality standards for consumer goods. The higher income group will perhaps set higher quality standards than other groups. Relate this concept to clothing retailer. Emphasize the need for the retailer to define his market and cater to it. Stress the folly of trying to be all things to all customers--the folly of attemtping to cater to Mrs. "Gotrocks" and her maid at the same time.
(4) As an individual or family moves up the income ladder, he will tend to assume the characteristics of the group into which he moves	(4) This concept is not difficult to present. Ask a student to assume that his family's income is increased by a pay raise from $3,000 a year to $6,000 a year. Will his family save the increased portion? How will the increased income be expended? <u>For discussion</u>: A leading industry in your locality has announced an across-the-board salary increase of $1,000 for every employee on the payroll. What would this mean to retailers in the local area? You may desire to continue this discussion by referring to Engel's law of consumption. To refresh your memory of these laws, refer to a basic marketing textbook. <u>For discussion</u>: A chain store in the ready-to-wear field is considering locating in your community. Prior to coming into the area, though, the chain must determine whether or not

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	your community is profitable? What would the chain want to know about income in the area? Discussion should include: Income groups. Are there only two groups--the extremely rich and low income groups? If so, since chains ordinarily appeal to the middle income group, who would be customers? Income source. Are there many income sources, or only one major source? * * * * The National Underwriters Training Counsel film "You'll Earn a Fortune" will tie in well at this point. Obtain the film from a local insurance firm.
4. The fashion-conscious consumer	
a. Definitions	a. Insturct students to consult dictionaries for definitions of terms "style" and "fashion." Emphasize that a fashion is a style that is popular at a given time; styles do not change, fashions do change. Give examples of styles in furniture, home appliances, homes, clothing, etc.
b. Fashion and the consumer	b. Emphasize that fashion consciousness is a mark of a high standard of living and that fashions change rapidly in the United States. Rapid communication, in the U. S. (TV, movies, magazines, newspapers) help to introduce new fashions almost instantaneously throughout the nation, and these new fashions are rapidly accepted by our fashion-conscious populace. The fashion-conscious consumer is, obviously, a factor of major concern

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	for manufacturers of fashion goods and for middlemen engaged in marketing those goods.
c. The fashion cycle	c. See a basic marketing text for the stages in the fashion cycle. Relate the fashion cycle to marketing considerations. For instance, (1) How rapidly do goods move through the cycle? (2) To what extent should a local department store buyer of ladies' ready-to-wear merchandise be influenced by the cycle? (3) At what stage in the fashion cycle should the maufacturer begin curtailing production? (4) What is "fashion obsolescence"? (5) What kinds of risks are involved for the retailer engaged in marketing fashion merchandise? How can he protect himself against these risks?
d. Fashion and marketing costs	d. In class discussion ask the question "To what extent does fashion influence marketing costs?" Emphasize: (1) Costs of promoting a fashion; (2) Need for adequate merchandise control system to insure that adequate supplies of fashion goods are available to meet customer demand at all times; (3) High buying costs incurred when hand-to-mouth buying is needed near the end of the fashion cycle; (4) Need for high retail markups at beginning of cycle to protect against risks of loss at end of cycle (bring in an advertisement showing end-of-season sales event

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	for local retail store).
5. Consumer motivation and behavior	
a. The complex ultimate consumer	a. Stress the term "ultimate consumer". The ultimate consumer buys to satisfy personal and household needs. Contrast with the "industrial user" who buys for business purposes (the industrial user is discussed later in connection with industrial marketing.) Stress the concept that today's ultimate consumer is a complicated individual whose buying behavior is conditioned by a variety of social, psychological, and economic factors. Point out, too, that consumers' wants and needs are constantly changing in our dynamic economy and that factors that motivate consumers to behave one way today may cause them to act in a contradictory manner tomorrow. Emphasize that determining what will cause "King Consumer" to spend his limited dollars for a given product in a given store is a formidable, but highly essential, undertaking. Stress the need for manufacturers to study consumers in attempting to develop or modify products in keeping with the needs and wants of "King Consumer" (refer to the <u>marketing concept</u> above). <u>For Class Discussion</u> How do manufacturers determine what to say in their advertisements to stimulate consumer interest in their products? Stress the need for retailers to

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	analyze consumers for purposes of store location, creating an atmosphere necessary to get desirable customers into the store and to keep undesirable customers out, and for purposes of developing sales talks that will cause customers to part with their dollars for the goods the retailer sells.
b. Consumer buying motives	b. (Review from Marketing I outline--don't get too involved.) Buying motives--those influences or considerations that explain why consumers buy.
(1) Product motives	(1) Motives that cause consumers to buy the products they buy.
(a) Emotional product motives	(a) Emotional motives influence the buyer to buy without consciously analyzing his reasons for doing so--he buys to satisfy the dictates of his heart. Examples: --pride --prestige --romance --social acceptance --fear
(b) Rational product motives	(b) Rational motives are reasoned motives--the consumer buys to satisfy the dictates of his brain. Examples: --economy of purchase --economical to operate --dependable performance --durability --variability of uses --reliable repair service available In discussing emotional and rational product motives, point out that both kinds of motives tend to be present when the buying decision is made. Some writers in this field hold that the

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	consumer is essentially a rational buyer; others, that he is essentially an emotional buyer. Writers generally agree that ultimate consumers buy in satisfaction of emotional motives more than industrial buyers. Emphasize that motives differ with different buyers, and that in selling the consumer, the salesman must make a decision as to the types of motives he most needs to stimulate in his sales presentation. <u>Student activity</u> 1. Have students collect several advertisements from periodicals and analyze these ads for purposes of determining the motives aroused or appealed to in the ads. 2. Have students construct an advertisement in which they make appeals to certain rational or emotional motives. 3. Have students assume they are selling certain products to the ultimate consumer. Either as a written assignment or for oral presentation, explain the motives and demonstrate the appeals that would be used to arouse those motives in the sale of certain products like an engagement ring to the prospective groom; a work shoe to a farmer; a polaroid camera to an amateur photographer, etc. 4. Collect several advertising jingles and classify the motives appealed to in these jingles. For instance: --Wheaties, Breakfast of Champions --Tastes good like a cigarette should (reliability) --Same low prices every day of the week (economy)

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(2) Patronage motives	(2) Motives that stimulate consumers to concentrate their buying at certain retail stores.
(a) Emotional patronage motives	(a) Motives that influence the consumer to buy at a particular store without considering his reasons for doing so. Examples: --habit --pride --prestige --emulation
(b) Rational patronage motives	(b) Motives that consumers satisfy, as a result of thought and reason, in selecting the retailers with whom they will concentrate their buying. Examples: --wide selection of goods --high quality merchandise --wide range of services --courteous sales person --low prices, economy <u>Student activity</u> 1. In all probability there is a retail store in the local area that is a gathering place for students. Ask students to analyze their personal motivations for patronizing this store. Are the dominant patronage motives emotional or rational? Is there a combination of both types? 2. Ask students to study their own personal family's grocery-buying practices. Is there a tendancy for the family grocery dollar to be concentrated with one grocery retailer? What patronage motives are recognizable? 3. Assign students to write a paper on a topic similar to the following:

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	"The significance of consumr buying motives in building an image for a retail (clothing, furniture, etc.) store."
6. Classifications of Manufactured Consumers' Goods (Agricultural Consumers' Goods will be discussed in Section VIII.)	6. Point out that consumers' goods may be classified according to characteristics of the goods (durable, nondurables; hard, soft) or in accordance with consumer buying habits (how, when, and where the consumer buys) practiced by most consumers when buying the goods.
a. Classified according to characteristics of the goods	a. Give several examples
(1) Durable, or hard goods	(1) Generally long-lasting goods like home applicances, furniture.
(2) Nondurables, or soft goods	(2) Clothing items, piece goods, food lines.
b. Classified according to consumer buying habits	b. The topic was developed in Marketing. Develop in accordance with retention for last year. Define each classification and discuss marketing significance of each classification to both manufacturers producing the goods and retailers selling the goods.
(1) Convenience goods	(1) Characteristic buying habits: --bought at most convenient store --bought in small lots generally --require little effort to sell --handled by many retailers --often bought on impulse --consumer readily accepts substitue brands
	(2) Marketing significance of characteristics -- Manufacturer needs a channel of distribution that will get the goods in every available retail outlet handling such goods (implies use of wholesaler in channel) if he is to maximize profits. Consumers readily accept substitutes for consumer goods; for example, I prefer Crest Toothpaste, but

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	if the retailer does not have Crest, I will take a substitute brand. -- Manufacturer must create brand preference for his product; must presell the consumer by advertising extensively--retailers will rarely push convenience goods agressively. -- If retailer handles primarily convenience goods, should locate where he is readily accessible to customers (use as an example an independent grocer who has survived chain competition primarily because of his location).
(2) Shopping goods	(2) Characteristic buying habits: --consumer "shops" for the good --compares prices, qualities of similar goods before purchasing --consumer deliberates before purchasing (goods, therefore, less subject to impulse buying) --consumer does not buy as frequently as convenience goods --consumer needs "help' in reaching buying decision--salesmanship necessary at retail level Marketing significance of characteristics --Women tend to do more shopping than men, therefore, manufacturer will desire retail outlets that attract women; department stores, for example. --Since consumers will go to retail area where shopping is possible, shopping goods do not require widespread distribution required for convenience goods. Manufacturer will possible consider elimination

Topical Outline	Teaching Suggestions
	of wholesalers from distribution channels. --Retailers of shopping goods must locate in areas that facilitate shopping--implies locating near competition. --Retailers will tend to offer wide assortments of shopping goods to permit shopping within the store. --Catering to the woman shopper might require creating atmosphere, variety of customer services.
(3) Specialty goods	(3) Characteristic buying habits: --Consumer goes"out of his way" to buy these goods --Consumer specifically intends to buy the good --Consumer does not willingly accept a substitute --Consumer believes the good is superior to other similar goods Marketing significance of characteristics: --Manufacturer must create an exclusive reputation for his product; product prestige is frequent result of extensive advertising effort --Manufacturer must be concerned with quality of retail outlets handling his good if prestige is to be maintained --Since consumer will go out of his way to get the good, limited distribution implied with direct (manufacturer to retailer) distribution channel employed in exclusive agency relationship --Retailer will probably attempt to build an atmosphere of exclusiveness with appeals primarily to higher

Topical Outline	Teaching Suggestions
	income groups (Emphasize importance of retailer defining his market and catering to it). --Retailer will attempt to get exclusive rights to distribute good in his marketing or trading area If possible, locate an advertisement for Steuben Glass (see a new Yorker magazine). Post this advertisement and ask students to discuss the most profitable distribution channels to be used in marketing the product. Discuss also the merchandising techniques to be employed in handling this product at the retail level. <u>Suggested student activity</u> Designate small, workable committees to investigate and report to class the following: 1. Examples of attempts to capitalize upon impulse buying in a supermarket. (Example razor blades placed at cash register; related items placed together, like ice cream and ice cream cones together, etc.) 2. Customer services offered by a local retailer in his attempt to attract the shopping consumer. (Encourage students to look for credit service, luncheon facilities, beauty salons, stroller service for mothers with small children, etc.) Reading Assignment: Richert, Meyer, and Haines: RETAILING, PRINCIPLES & PRACTICES, Part 14, pp. 85-92 * * * * Have student reports on population segments from page 67.

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B. Marketing Policies	B. Define marketing policy. Stress the following concepts:
1. General Concepts	1. A marketing policy is a guide post, or rule of action, adopted by management to insure uniform action in similar and recurring situations. Sound policies facilitate decision making at mid-management levels. Example: A manufacturer might adopt a freight policy of F.O.B. factory terms. This policy is a guide to action for all salesmen when negotiating concerning sales terms. All buyers will receive same freight terms under the policy. 2. Marketing policies should be based on sound marketing principles. Example: In marketing specialty goods, it is recognized that consumers will go "out of their way" to by the goods; therefore, the manufacturer, in order to maximize profits, might adopt a policy of exclusive distribution. The policy will guide him in the selection of retail outlets to handle his product. (Example: London Fog) 3. Marketing policies should be reviewed periodically and revised when necessary. Cite J. C. Penney Company. Penney's policy of "all sales cash--no charge accounts" was, until recently, part of the company's basic management philosophy. Ask students to speculate concerning why Penney's has made such a basic change in policy by offering charge account service to its customers.

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2. Product policies	Emphasize the need for business firms (Manufacturers, wholesalers, retailers, and service establishments) to give major consideration to establishing guidelines for profitably providing the market with what it wants, when and where it wants it, and at prices it is willing to pay. Product policies might well be conceived as guides to merchandising activities--guides to follow in helping the manufacturer answer questions concerning what to make, what quality to make, how much to diversify, etc.; guides to follow in helping wholesalers and retailers solve problems relative to how many lines to stock, how much "scrambled merchandising" (the bringing in of products not related to major line of business, as the supermarket bringing in shrubbery; the drugstore bringing in phonograph records), how many different pattersn, styles, colors, etc., to make available to customers. <u>Suggested Student Activity</u> Have students project themselves into the role of a high school graduate who recognizes potential profits to be obtained from the high school market. As the graduate, the student plans to establish a store near the school. Ask students to prepare written statements of product policy to be observed in the operation of the store. In class discussion, consider the following: (1) What product lines will be stocked? --Refreshments? Notebooks? Carbon paper? Shorthand Pads? Musical instrucments? School sweaters? Gym clothes? (2) What kinds, if any, of marketing research activities will have to be undertaken preparatory to developing

Topical Outline	Teaching Suggestions
	sound and profitable product policy for the store? --Studies of: students' needs? students' ability to buy? competitors' policies? (3) What related policies will have to be formulated when the business begins operation? --Credit policy? Returned goods policy? * * * *
3. Brand policies	3. Point out that the practice of branding products dates back to the days of the guilds. In those days, as now, the brand helped to identify the product and its producer in the market place. The brand served to protect both the guilds and consumer in that it made possible the recognition of producers of inferior quality products. Professional reference: See Phillips & Duncan, MARKETING PRINCIPLES AND METHODS, 5th Ed., Chapter XXIII.
a. Advantages of branding	
(1) For the consumer	(1) Stress the concept that brands help consumers identify products that will meet his personal quality standards. (Point out that all consumers do not have the same quality standards; therefore, manufacturers find markets for goods of varying qualities.) Brands make it easier for the shopping consumer to insure that he will obtain products in keeping with his standards--therefore, branding facilitates, perhaps simplifies, the shopping task.

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(2) For the brander	(2) Since brands help to facilitate consumer shopping, brands assist middlemen in determining what the market desires; therefore, branding helps to reduce selling time and effort in marketing products. Brands, once the brander creates acceptance and preference for his product, help the brander to obtain a degree of monopolistic control of products bearing the brand. Brands help the brander to accentuate differences in products (product differentiation). For instance, what is so outstanding about Ban Deodorant? Branding helps manufacturers to use production facilities at optimum capacity by producing their own branded products and products for private branding by distributors.
b. Brand classifications	b. Define, explain, and illustrate each brand classification.
(1) National brand	(1) The terms "national" and "private" generally are used to classify the brand according to its ownership. The national brand is owned by the manufacturer. Examples: Winston Cigarettes; Ford; I B M: Crest Toothpaste.
(2) Private brand	(2) The private brand is the distributor's brand--i.e., it is owned by a middleman. Examples: I G A brands; Coldspot, owned by Sears: Jane Parker, owned by A & P.
(3) Family brand	(3) Also known as a house brand or a blanket brand. The family brand is a brand name that applies to

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	several products produced by the manufacturer. Generally family brands are used when the products are related in quality and use. Examples: Mennen--applies to a line of products: Cannon--sheets, towels; Campbell--applies to a line of soups.
(4) Individual brand	(4) Although a manufacturer might produce many products, he might give each product an individual brand name rather than a share in a family brand. Examples: Proctor & Gamble's Tide, Cheer; Cigarette companies: Winston, Salem, Camel, Cavalier--all products of R. J. Reynolds.
c. Manufacturers' brand policies	
(1) Producing private brands	(1) Ask students to consider the following question: Why do some manufacturers produce products to bear distributors' brand when those brands will give the manufacturers' brands competition in the market place? The following concepts should be included in discussing this question: (a) Producing for private label enables manufacturers to use production facilities at optimum capacity--gets better utilization of plant and equipment; helps to stabilize employment. (If, in his personnel policies, the manufacturer follows a policy of full-time, or stabilized employment, producing for private label often helps to implement that policy.) (b) Producing for private lable enables some manufacturers to market second quality or imperfect goods without associating a quality brand name with those goods. (Do not leave the impression that all private brands are of poor quality--many are high-quality goods.)

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	(c) Producing for private label enables the manufacturer to move surplus goods to market and thereby minimize inventory risks and expenses and reduce risk of obsolescence.
	(d) Manufacturers frequently, because of competition from other manufacturers of similar goods, are literally forced into producing for private label in that if one manufacturer will not accommodate the distributor desirous of the private brand merchandise, another will provide the goods. To refuse is to lose business to a competitor.
(2) Producing family brands	(2) Cite several manufacturers of family-branded products (Avon, Kellogg, Heinz). The following should help to explain management throught in adopting family branding policies:
	(a) Family branding enables manufacturers to publicize many products in one advertisement (for example, the Heinz advertising dollar, while perhaps focusing attention on one particular product, is spread over "57" products.)
	(b) The prestige the brand name enjoys is extended to many products. (Stress that family branding requires manufacturers to protect the prestige of the family through rigid quality-control procedures to insure that each product in the family is of a quality consitent with other family members.)
	(c) A family brand associated with a given quality facilitates the introduction of new products of similar quality. (For example, if the consumer accepts the Mennen family, he will usually accept a new Mennen product with little reservation.)

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	Point out that family branding could have the opposite effect--if the consumer tries one of the family and does not like it, he might be reluctant to accept other products bearing the family brand name.
(3) Producing individual brands	(3) Cite several manufacturers that follow policies of individual branding (Proctor & Gamble, R. J. Reynolds Tobacco, General Foods). Discuss management thought underlying individual branding policies. Include the following concepts: (a) By following a policy of individual branding, the manufacturer can produce related products and thereby capture a larger share of the total market for these products. To explain this concept, use the following discussion guides: --If there were only two brands of a product on the market, what portion of the market is each likely to capture? Would either brand get 100 per cent of the market? --Take a class preference poll on the following: Assume there are only three candy bars marketed: Milky Way, Snicker, and Clark Bar. What division of consumer preference of these candy bars exists in the class? What is the significance of these findings from the manufacturer's point of view? Significance: Milky Way and Snicker are produced by the same manufacturer; therefore, it is reasonable to assume that through his policy of individual branding, the manufacturer will probably capture a larger share of the total candy market.

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	(b) Individual branding helps the manufacturer to appeal to larger segments of the market. (For instance, a manufacturer might appeal to different income groups by offering individual brands at different prices--the quality of the brands might be the same or it might be different, but the image he creates for the brands is different and the effect is that his total share of the market is probably increased.)
	(c) The individual brand policy might enable the manufacturer to market second, or imperfect, quality products under a brand name and still enable him to create prestige for the first-quality brand.
d. Distributors' private brand policies	d. Review manufacturers' policies of producing private brands (above) and relate to distributors' private brand policies. Guide discussion to answer one basic question: "Why do wholesalers and retailers engage in distributing private brands?" The following reasons should emphasized:
	(1) To survive. Cite trend toward elimination of wholesalers by both manufacturers and large retail groups. If the private brand is popular with consumers, retailers have no alternative but to buy the brand from the wholesalers.
	(2) Private brands, since they do not bear the expense of major advertising campaigns that some national brands incur, often have a larger margin of profit.
	(3) More bargaining power in selecting sources of supply. Manufacturers, to secure and hold distributors'

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	private brand contract, will make many concessions because of the volume involved; thus, these contracts give distributors a great deal of freedom to negotiate in selecting sources of supply (use Sears' private brand contracts as an example).
4. Packaging policies	4. In discussing packaging policies, emphasis should be placed upon the vital role of the package in a firm's total marketing program; cite the variety of problems to be solved through sound packaging policies.
a. Purposes of packaging	
(1) To protect the product	(1) Stress the need for protecting the product to withstand rough handling in shipment and in storage. Also stress need for protecting some products until they are consumed--for instance, problem of keeping bread fresh until used.
(2) To effect economies in shipping the product	
(3) To make product available in proper amounts to meet consumer demand	(3) For discussion purposes, ask students whether or not different groups of consumers will prefer different package sizes. For instance, will a retail grocer catering primarily to young married couples find package size preferences to be different from preferences of another customer grouping?
(4) To help sell the product	(4) Cite current trend towards self-service merchandising. Point out that much of the selling job for self-service merchandise rests upon the package. The package must attract customers' attention, make an eye-appealing display, and aid customers in identifying the product.

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(5) To help create a favorable image for the product	
b. Legal considerations	b. Emphasize that legal requirements must be considered in establishing packaging policy.
(1) Labeling legislation	(1) Ask students to bring to class several labels from products recently purchased. Explore these labels for purposes of determining the nature of information contained thereon. Assign one student an oral report from current periodial literature on the topic "Labeling Legislation". (What information must a product label show?)
(2) The Wheeler-Lea Act and the Federal Trade Commission	(2) The Wheeler-Lea Act is enforced by the Federal Trade Commission. Call attention to Wheeler-Lea provision realting to false and deceptive packaging. A student could be assigned a report on this act to present to the class.
c. Packaging trends	
(1) Multiunit packaging	(1) Gives examples: Beer; frozen orange juice. Question: How do multiunit packages affect sales of product involved?
(2) Consumer designed packages	(2) Cite research done at consumer level for purposes of determining consumer reaction to packages; cite emphasis on sanitation for consumer protection--pickles no longer sold from the barrel, etc.
5. Consumer service policies	5. Stress concept that consumer service policies are an expression of the attitude the store will take toward its customers. Emphasize the need

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	for careful management consideration of the kinds of service policies to be adopted; stress costs of providing the various services in terms of their values in creating consumer goodwill, store traffic, and sales.
a. Basic philosophy	a. To keep customers satisfied with the firm at all times; before the sale; during the sale; and after the sale.
b. Expense of services	b. Exmphasize heavily that services are expensive. As you present the types of services later, emphasize costs involved. Customer lounges, for instance, are customer services. What does maid service to care for the lounge cost?
	Point out that any attempt to build sales through providing services is probably worthwhile and perhaps desirable; too much service, especially in an inadequately financed firm can eat heavily into profits. In many instances it is not a question of what services are desirable; instead, it is a question of what services can the store provide profitably in attempting to gain favor with the consumer.
c. Effect on store image	c. Point out the need for treating customers alike--in a uniform way--for instance, ask a student if he would feel resentment toward the store if a friendmade a purchase and the store gift-wrapped it, yet the student makes a similar purchase and the store refused to gift wrap the item. Policies, then, result in customers receiving what they consider to be fair treatment; service policies help in impressing the store image on the customer.

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	Point out, too, the need for the store to adopt policies consistent with the image it is attempting to create.
d. Types of consumer services	d. In preparing to discuss types of consumer services, assign students into small committees to investigate services offered by local stores. In subsequent buzz sessions, ask students to draw conclusions concerning the relationship between services offered by certain local retailers and the store images the retailers are attempting to develop. In addition, ask students to prescribe other services these retailers should offer (1) to enhance store image; (2) to draw more customer traffic into these stores; (3) to draw more customers into the business district.
(1) Selling services	(1) Providing sales personnel to assist customers in buying is actually a customer service--and an expensive one. To emphasize the service angle, contrast self-service estalbishments with establishments that provide courteous sales personnel. Raise question concerning kinds of merchandise that require services of sales persons to help customers buy. What kinds of merchandise can customers buy without assistance? Ask a student if he needs sales help in buying a can of tomatoes? In buying a refrigerator? An automobile? Why does the student need help in buying some products but can buy others without assistance? Pursue this line of discussion a bit further by inquiring as to whether or not it is possible

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	that customers patronizing a given store will need help in buying some of their products but will not need help in buying others. Is the implication such that the store management should provide selling assistance in some sections of the store but operate other sections on a self-service basis? Explain.
(2) Mail order service	(2) What are the management implications if mail order service is provided the customer? Will a mail order catalog have to be published? If so, how expensive will this be? How much does it cost Sears to publish its catalogs? What kinds of problems will providing mail order service pose for a local retailer?
(3) Personal shopping service	(3) Should a local store consider providing shopping advisory service to male customers buying Christmas gifts for wives and sweethearts? Services for brides? Interior decorating service? etc.
(4) Credit service	(4) Explore costs involved in providing this service. Delay depth discussion of charge accounts until later in the course (Section VI).
(5) Adjustment service	(5) When should a retailer grant consumers returned goods privileges? Should a mail order retailer provide for retuned good privileges? How liberal shall a returned goods privilege be? If goods are to be accepted when customers desire to return them, how should the refund be made? Is any "red tape" necessary? Should the refund be made in the form of

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	a credit slip to be applied on other purchases in the store, or should a cash refund be made? <u>Thought problems</u>: A customer purchases a hat that was priced at $25 on Easter Friday. On Easter Monday she returned the hat and commented that one of her acquaintances had worn a similar hat to Easter servies "yesterday". The customer had likelthe hat until she and her acquaintance had met at church. The customer desires a cash refund of the full purchase price. Should she receive the refund? * * * * A local chain store advertises "Money Back If Not Satisfied." A farmer, in late October, requests his money back for a straw hat he had purchased in April. The sweatband in the hat was stained with perspiration, and the hat showed other signs of wear. The farmer explained that because of his busy schedule, he had been unable to return the hat earlier. If you were the chain store manager, would you refund the purchase price? (This is an actual case, and the store did refund!) * * * * Marie's Fashion Shoppe is an atmospheric retailing institution that handles exclusive and very expensive ladies' dresses. The store caters to higher income groups. Mrs. Sorta Gotrocks was in the store yesterday trying to find "just the right thing" for a party she planned to attend. Because of uncertainty as to whether or not her husband would like the dress she finally selected, she asked, and was granted, permission to take the dress "on

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	approval." The dress was a beautiful cocktail dress priced at $275. Last night Marie, the owner of the shop, saw Mrs. Sorta Gotrocks wearing the dress into a local nightspot. This morning the customer returned the dress, saying that her husband thought the dress was a "bit youthful." A stain was visible on the front of the dress. Should Mrs. Sorta Gotrocks be permitted to return the dress? * * * *
(6) Shopping conveniences (a) Parking space (b) Lounges (c) Gift wrapping (d) Restaurant facilities (e) Package checking (f) Day nursery care (g) Credit	(6) Discuss from the expense and problems angle in terms of effect on creating store traffice, customer goodwill, and increased sales. For instance, What is the store's liability in the event a customer is struck by a car and is injured seriously while returning to his car parked in the store's parking lot? Have a group of students check with local retailers on this question.
(7) Group services (a) Civic groups use of store facilities	(7) Stress goodwill building angle as well as possibilities for increasing store traffic. (a) Example: Providing conference room for meetings; use of window display space to promote civic projects like Blood Donations, Boy and Girl Scouts, etc.

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(b) Education projects	(b) Sewing maching department provides lessons to those who buy the machine; lectures on home decoration, gardening, etc.
(8) Product servicing	(8) Explain that in the marketing of high unit value mechanical products to both the consumer market and to the industrial market it is essential that carefully considered servicing policies be established and publicized to buyers. Discuss some of the major problem areas relative to product servicing. Include the following: finding efficient servicemen; maintaining adequate inventories of repair parts; training servicemen to be good public reltions agents for the firm. Do not overlook the cost angle. * * * *
(a) Installation service (b) Maintenance service (c) Repair service (d) Repair parts inventory service (e) Instructional service	Thought problem: High's Discount House is considering locating a store in your community. Among products to be offered are electric toasters, electric hand mixers, washing machines, TV sets, and power lawn mowers--all bear the High trade name. Regular discount house strategy (low markup, no service) will be followed. How important will the service factor be in determining the success or failure of this retailing venture in your community? Will this business succeed in your community? Why--or why not? * * * * (e) Instructing the consumer or industrial user concerning proper care and use of the machine or the product. For discussion: What is the serviceman's role?

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	Include the following points: 1. A goodwill building agent for the firm; his job is in part one of building the buyer's confidence in the product and the firm. 2. A salesman. Through visiting buyers in their place of business and in their homes, he is in a position to obtain many leads. 3. A teacher. His is a job of informing buyers concerning what they can do to insure getting the most service from the product purchased. You might pursue this duscussion in more depth (but use discretion in so doing) by asking students to discuss some of the things they liked or disliked about servicemen who have made calls at the students' homes. Permit students to role play. Have them project themselves into the role of a retailer who sells home applicances (refrigerators, washing machines, dryers); in their capacity as the proprietor of the store, draw up a list of suggestions for servicemen to follow. Perhaps a list of Do's and Don'ts for Servicemen will help students recognize the importance of this major customer service. * * * * Although the concern in this course is primarily with the marketing of tangible goods; it might be appropriate to invite a local serviceman to discuss his business with the class. Let class interest be your guide in this instance. * * * * Student reading assignment: Wingate & Weiner: RETAIL MERCHANDISING, 6th Ed., pp. 138-142.

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	Professional Readings: Phillips & Duncan: MARKETING PRINCIPLES AND METHODS, 5th Ed., pp. 557-559. and Small Business Administration: Small Marketers Aids, No. 55, entitled "How Good Are Your Servicemen?" (To obtain this free Small Business Administration publication, write to: Field Office Small Business Administration Charlotte, North Carolina While writing, request that your name be added to their mailing list to receive forthcoming publications. You might also request a list of the Administration's free publications currently abailable; many of these free publications relate to various topics covered in Marketing I and Marketing II.)
6. Distribution policies	6. Since the selection of channels of distribution to be used in marketing a product is primarily the manufacturer's problem, approach "Distribution policies" from the manufacturer's point of view.
a. Blanket distribution policy (Also often referred to as general or intensive distribution policy)	a. When the manufacturer adopts a blanket distribution policy, he "blankets" the market with his product; i.e., the product is placed for sale at every possible outlet where products of that type are ordinarily purchased. Use convenience goods (candy bars, toothpaste, etc.) as examples of products generally given blanket, or intensive, distribution.

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	Analyze the policy and the marketing implications thereof by discussing the following questions: (1) When does a manufacturer need to follow a blanket distribution policy? --When his product falls into the convenience goods category--his product(s) are bought by consumers at the most convenient outlet. (2) Where would you, as a consumer, expect to buy toothpaste? --Have students list the possible places where they would expect to buy toothpaste. (3) If you were to go into a store expecting to buy (list a specific brand) toothpaste and that store happened to be out of that brand, would you accept another brand? --Students probably will accept other brands. Point out this fact and ask students to analyze the implications of the fact from the manufacturer's point of view. Obviously, if the product is not available and consumers will accept substitute brands where the product is not available, the implications are that the manufacturer loses many sales for his products and many of the advertising dollars spent to create acceptance for the products are wasted. (4) Refer again to the list of places students would expect to buy toothpaste. Ask students whether or not the manufacturer could profitably sell direct to each of the retail outlets in which consumers might normally buy the product.

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	--Stress the concept that the manufacturer often needs help from other middlemen in order to place ' 's product economically in the many small stores that can sell his product (cite the expense involved for the manufacturer in attemtping to service small accounts, plus the fact that it would be almost impossible for the manufacturer to locate every available outlet that should stock his products).
	(5) What kind of middleman should the toothpaste manufacturer use in order to get his product to (<u>list a small local retail store that sells toothpaste</u>)?
	--Students should recognize the need for a service wholesaler to enable the manufacturer to help him reach small retail stores.
	(6) When marketing convenience goods, whose responsibility is it to create consumer acceptance and preference for the product?
	--Reemphasize the need for the manufacturer to promote his product extensively through advertising in order to secure consumer favor for the product; emphasize the concept that it is the manufacturer's job to let the consumer know the product is a good product; it is the retailer's job to let the consumer know he carries the good in stock.
	(7) For the toothpaste manufacturer, what channel of distribution is implied when the blanket distribution policy is adopted?

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	--Point out that several channels might be used: --Manufacturer to retailer, when the retailer is large enough to buy in adequate quantities to make it economical to service the account. (Cite chain store buying practices--buying in quantity, accepting delivery at a central point for redistribution to retail outlets.) --Manufacturer to wholesaler to retailer, when retailers are small and when scattered over wide areas.
b. Limited (or restrictive) distribution policy	b. Point out that in a blanket distribution policy, products are given maximum exposure to the market; under a limited, or restrictive, policy, the products are given narrow market exposure. Emphasize that for many kinds of products, narrowing the exposure of those products to sale tends to enhance the prestige of the product, thereby making the product more desirable to the consumer. Limited distribution policies generally are followed in the marketing of shopping and specialty goods.
(1) General considerations	(1) Cite the following general considerations applicable to limited distribution policies:
(a) Maintaining product quality image	(a) The manufacturer is often desirous of maintaining a quality concept, or image, for his product; to expose the product for sale in every available outlet often serves to "cheapen" the product in the mind of the consumer

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	Student Activity Are the boys in class familiar with Wilkinson Roger Blades? These blades were originally distributed exclusively through barber shops. Ask a student to get his barber's reaction to the product image created by this limited distribution policy. As a followup, have a student check with Consumers' Reports or the Consumers' Research Bulletin for a report on razor blades. How are Wilkinson Razor Blades rated by the consumer agencies? * * * *
(b) Obtaining channel cooperation	(b) The manufacturer often needs much "channel cooperation" in order to market the product efficiently. Examples: Cite automobiles and the need for garage (service) facilities--cite expensive equipment needed in garages--in connection with sale of the product; cite also the inventory investment required to stock automobiles. Ask student to assume they have suddenly come into possession of $100,000. Would they be willing to invest their money in an automobile business, with complete repair service facilities, if every "Tom, Dick, and Harry" were permitted to sell the automobile manufacturer's product? What would the manufacturer need to do to induce the students to become a retail outlet for his product?
(c) Obtaining agressive promotion	(c) The manufacturer often needs aggressive promotion of his product at the market level. Through limiting the number of outlets handling his product, the retailer, since he will be the one to profit most from his own aggressiveness, is encouraged to give the aggressiveness required. (For instance, if

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	there are no other Ford dealers in the area, the one dealer who retails Ford products is eager to promote these products since he will personally profit from all promotional effort in the territory.) To emphasize this concept, contrast the Ford dealer with the dealer handling the tooth-paste item referred to earlier. What is the difference between the two products and incentives to promote them aggressively?
(2) Types of limited distribution policies	(2) Point out that limited policies are followed by manufacturers in selecting wholesalers, industrial marketers, and retailers to handle their products.
(a) Exclusive agency policy	(a) Under the exclusive agency policy, the manufacturer distributes his product through one dealer within a given market area (territory); the territory in which the agent has exclusive rights to distribute the product is generally determined on a population basis. Have students name some of the products that are distributed locally on an exclusive agency basis.
i. Advantages to the manufacturer	i. Some of the advantages of an exclusive distribution policy to the manufacturer are: --Gets cooperation from agents; agents are willing to concentrate aggressive selling efforts on the product since they alone will profit from their selling efforts --Through setting quotas (number of units agents must sell in order to retain exclusive rights to sell the product) manufacturer is insured a market for his products; therefore he is able to make more realistic production plans and gear production to optimum efficiency

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	--Manufacturer is able to induce agents to make the capital investment required to make the product available within the specific market area
ii. Advantages to the exclusive agent	ii. Some of the advantages from the agent's point of view are: --Agent will get close cooperation from the manufacturer (selling aids and other helps) --No competition from the product in the agent's territory (almost monopoly conditions) --Customers who come to buy the product often buy related products (The retailer has exclusive rights to sell a name-brand suit, for instance; when the customer comes to buy the suit of clothes, he might posibly buy accessories--shirt, shoes, hosiery, hat, etc.)
(b) Selective distribution policy	(b) Point out that the selective distribution policy is similar to the exclusive agency policy in many respects--under the selective policy, however, the manufacturer does not restrict the product's exposure to sale as much as the exclusive policy does; under the selective policy, three or four outlets within a market area will handle the product. To illustrate, cite a name brand shopping good that is sold in two or three stores locally; emphasize that the manufacturer is concerned generally that his product not be placed in stores where the atmosphere will tend to cheapen the product's image.
(c) Leasing as a distribution policy	(c) Leasing is becoming more common today as a distribution policy, especially in the marketing of expensive products; the policy is perhaps more common in industrial marketing.

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	Has a local firm installed IBM equipment recently? Have any rental figures been publicized re that equipment?
i. Conditions favoring leasing	i. Several conditions favor leasing as a distribution policy: --When the product is so expensive that few users could buy it; to market the product profitably, the only answer is to rent it to users --When the product is used only for short periods of time Do any farmers in your area lease expensive farm equipment during the season when the equipment is needed? What are some of the items of equipment leased? Should those farmers buy the equipment, or is it to their advantage to keep finances more flexible by leasing that equipment for just that period of time in which it will be used? Cite sectional trends. (Call student's attention to the application of leasing at the retail level. Does a local retailer "rent" a floor polisher to housewives on an hourly basis?)
ii. Trends	ii. It appears that leasing is beomcing more popular, especially in the industrial market. Cite current trend for many firms to lease automobiles--instaed of buying them--for use of salesmen and other company officials. * * * * <u>Professional reading:</u> Phillips & Duncan: MARKETING PRINCIPLES AND METHODS, 5th Ed., Chapter 24.

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C. Marketing Research	C. Compare marketing research to scouting activities undertaken by the school's athletic department. The scouts gather, analyze, and interpret pertinent informtion as an aid to plotting strategy necessary to win ball games. The business firm conducts marketing research to enhance possibilities of winning in the profit-making venture.
1. The nature of marketing research	
a. A basic marketing function involving the collection, analysis, and interpretation of factual information as an aid to management judgment in solving marketing problems	
b. A systematic and scientific investigation for the purpose of solving varied marketing problems	
c. An aid to, not a substitute for, good management judgment	
2. Objectives and uses of marketing research	
a. To enable the business to keep abreast of changes affecting it, such as:	Student Assignment: Divide class into small groups to investigate ways to solve the following problems:
(1) Changes in general economic conditions	(1) Ask: How will income tax reductions affect local retailers?
(2) Changes in market characteristics	(2) Ask: How will population shifts to suburbs affect local retailers?
(3) Changes in marketing methods	(3) Ask: A manufacturer is considering a change in his distribution channel from the use of wholesalers to direct to retailer channel. What kinds of information should he have before making the decision to change his channel?
(4) Product changes	(4) Ask: Union Carbide Corporation has developed a battery that can be used in many appliances, (clocks, mixers,

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	etc.) to replace electrical cords. Should General Electric discontinue making appliances with cords and use the battery instead? Upon what base should this decision be made?
(5) Changes in competition	(5) Ask: A discount house has recently opened in your town. Should the local department store meet this competitor's prices? How should this management problem be answered? In discussing marketing research and changes affecting business, concentrate emphasis on local changes. Ask students to list the research needs of local manufacturers, wholesalers, and retailers. Does there tend to be a similarity in the nature of these needs?
b. To minimize guessing in making marketing decisions	b. Emphasize the need for increasing the probablility of being right in the making of marketing management decisions
c. To provide sound guides for meeting and solving solving daily marketing problems	
3. Types of marketing research studies	3. Point out that every phase of the marketing process merits research and that all marketers (manufacturers, wholesalers, and retailers) can profit from research.
a. Product research b. Market studies c. Research of sales methods d. Advertising research	a. to d.: See Phillips & Duncan: MARKETING PRINCIPLES AND METHODS, 5th Ed., pp. 527-530, for classification and examples of basic types of marketing research studies. * * * * Student Reading Assignments: Richert, Meyer, Haines: RETAILING, 4th Ed., Unit 15: The Changing American Market.

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	Shilt & Wilson: BUSINESS PRINCIPLES AND MANAGEMENT, 4th Ed., Chapter 35: Success Factors in Business * * * * Student committees: Condust interviews with local businessmen to determine types of marketing research studies conducted locally. * * * * Invite a local businessman to discuss "The importance of marketing research in our business."
4. Marketing research methods and techniques	
a. Surveys--depend upon answers to questions to obtain data to be used in the study	
(1) Questionnaire surveys--probably most widely used and most abused	(1) Obtain sample questionnaires for class examination. If samples not available, have students analyze questionnaire in Shilt & Wilson, BUSINESS PRINCIPLES AND MANAGEMENT, 4th Ed., p. 673.
(a) Advantages	
i. Economical	
ii. Speedy	
(b) Limitations	
i. Limited returns	
ii. Returned by people with partial interests and points of view (bias)	
(c) Constructing the questionnaire	
i. Determining data needed	

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ii. Be brief	
iii. Make it easy for respondent to answer questions --preferably "yes", "no", and check marks	iii. Point out need to consider tabulating answers during construction of the questionnaire
iv. Avoid questions that bias by suggesting answers	
(2) Personal interviews--commonly used in making consumer surveys	
(a) Advantages	
i. Control of the sample	i. Interviewer can call back if desired respondent is not home; in use of questionnaire, if respondent doesn't reply, can't do much about it.
ii. Interviewer is able to verify some data	ii. Especially data relating to income level of respondent
iii. Better able to obtain depth information	iii. Especially in case of free-response questions--interviewer can probe
(b) Limitations	
i. Expensive	
ii. Securing competent interviewers	ii. Emphasize need for close supervision of interviewers and many abuses charged to interviewers--for example, falsifying data, not interviewing, etc.
iii. Danger of bias on part of the interviewer	
(3) Telphone surveys	

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(a) Often used to check radio listening, TV viewing	
(b) Respondents limited to families with telephones	(b) Point out that using respondents with telphones might not yield a cross section of the population, and, therefore, data might not be totally representative of the universe being surveyed
(c) Interviewers might encounter problems in keeping respondent on the phone until all questions are answered	
(4) Other survey techniques	
(a) Panels	
(b) Consumer juries	
b. Experimental methods	
(1) Nature: trial effort made with controlled and uncontrolled groups	(1) Stress the idea of testing something--for instance, a test marketing of varying package sizes to determine the size of packaged product most desirable to the housewife
(2) Application: can be used to test many elements of marketing programs as bas for determining course of action to be taken re:	
(a) Product variations	
(b) Package designs, sizes	
(c) Advertising schemes	
c. Observation	c. Discuss values to be derived from data obtained through use of observational techniques; for example, meter on radio and TV will help to determine when people listen or view. This information will be
(1) Inventory techniques, for instance, making a list of products in the consumer's pantry	

Topical Outline	Teaching Suggestions
(2) Time and duty studies (3) Using meters on radio and TV	of value to manufacturer in determining shows to sponsor, etc. * * * * Emphasize the need for every firm to conduct marketing research investigations but caution students about the dangers of permitting inexperienced and untrained researchers to take over the program. Stress survey techniques for use by your students and small businesses generally and leave the more complex methods to professionals.
5. Marketing research procedure a. Recognizing the problem (1) Define the problem (2) State objectives sought b. Determining how to approach the problem and its cost c. Assemble and study available data relating to the problem (use of secondary sourses) d. Planning the investigation (1) What data are needed to solve the problem? (2) What methods can be used to obtain needed data? (3) What kind (size and composition) of sample is needed? (4) What forms are needed for recording data as they are collected?	5. This topic is a bit advanced for the high school student--it belongs at the senior college and graduate school levels. Present a skeleton outline of marketing research procedure, answer pertinent questions that are asked by students. If desired, emphasize the scientific method of problem solving as it might be applied by a local merchant. For instance, a local department store is losing sales. It wants to know why. How should it procede to solve its problem? One solution might be to examine charge account records. Customers who have not made purchases recently might be sent questionnaires requesting information concerning why they have not used their charge accounts; customers could also be asked what they like and dislike about the store, etc.

Topical Outline	Teaching Suggestions
(5) How will investigators be selected and trained?	
(6) Is a "pilot study" needed?	
e. Determining the sample	
(1) Representative sample	(1) Cite law of sampling: A number of items randomly selected from a large group (universe) is almost sure to have characteristics of the group.
(2) Selecting the sample	(2) For discussion: A local store is attemtping to determine the image it has developed with its customers. To obtain data, interviewers were hired to question every 10th customer as he walked into the store. Is this good research procedure?
(3) Statistical techniques	* * * *
f. Gathering the data	
(1) Procedure decisions	
(2) Recording data	
(3) Supervising investigators	
g. Summarizing and analyzing the facts	
(1) Eliminate unusable forms (incomplete questionnaires)	
(2) Tabulating data	
(3) Analysis of data--might require statistical summaries	

Topical Outline	Teaching Suggestions
h. Interpreting data and making recommendations (1) Valid interpretation of data depends upon skill and ability of the researcher (2) Conclusions and recommendations must be based on facts--not hunches i. Preparing the research report	
	Summary: Summarize marketing research procedure in 1, 2, 3, 4 order as follows: Marketing research is conducted to enable marketers to solve marketing problems. The research might be highly formal--it might be informal (especially in small firms). The basic steps in marketing research are: 1. Recognition of and defining the problem on which research is needed 2. Investigating what is already known about the problem 3. Constructing instruments needed to obtain data necessary to solve the problem 4. Gathering data needed for solution of the problem 5. Analyzing and interpreting data obtained 6. Drawing conclusions based on sound facts.
6. Sources of marketing information a. Secondary sources--provide	a. Point out that often answers to

Topical Outline	Teaching Suggestions
published data often relating to the problem under study	problems can be found through studying published materials relating to the problem. Too often needless expense in solving problems is encountered because of failure to survey that which has already been determined by others who had similar problems.
(1) Libraries	
(2) Trade publications	
(3) Government publications	
(4) U. S. Small Business Administration publications	(4) Contact the nearest office of this agency. Ask that your name be placed on the mailing list for its publications. Keep a file of these publications; many of these reports can be used elsewhere in your marketing course as reference materials.
(5) Trade Association publications	
b. Primary sources--in effect, going to the man who has the data you need	
(1) Individuals or groups of individuals who have information you seek	
(2) Company records--for data relating to past business transactions, historical data	
	<u>Research Project for Students</u> Perhaps you are already familiar with the Creative Marketing Project sponsored by the Sales and Marketing Executives Organization (Sales and Marketing Executives-International, 630 Third Avenue, New York, New York 10017) and the Distributive Education Clubs of America. As a major activity for the year, have your students participate in this project. For complete details, contact the Sales and Marketing Executives Club nearest you. Clubs in North Carolina are located in Asheville, Charlotte, Durham, Raleigh, Salisbury, Wilmington, Wilson, and Winston-Salem.

Topical Outline	Teaching Suggestions
	To enable you, the coordinator, to be of as much help as possible to your students while they are participating in the research project, consult at least one current marketing research reference. Consider the following: Brown, Lyndon O., Marketing and Distribution Research Crisp, Richard D., Marketing Research Luck, David J., and Wales, Hugh G., Marketing Research, 2nd Ed. Check with the Small Business Administration Field Office, Charlotte, for literature devoted to marketing research.

IV. WAREHOUSING

Materials and Equipment Needed

Trade Journals on Warehousing

ERIC

IV. WAREHOUSING

Objectives

1. To develop an appreciation for and understanding of the pervasiveness of the storage function throughout the marketing process
2. To develop and understnading of the economic significance of the storage function
3. To broaden understanding of storage faculities available and utilized by marketing firms
4. To explore governmental regulation of public storage facilities

Topical Outline	Teaching Suggestions
	NOTE TO COORDINATOR: In preparation for presenting this topic, review the Teachers Manual for Marketing I, Section entitled STORAGE ACTIVITIES, pp. 37-40. Review with your students the following concepts as presented in Marketing I Manual: 1. Storage: Storage is the marketing function that involves holding goods between the time of their production and their final sale. Emphasize the point that storage is a vital marketing function that must be performed at each level in the channel of distribution as goods move from place fo production to point of ultimate consumption or industrial use. Manufacturers perform the storage function; wholesalers perform the function; and retailers perform the function--indeed, consumers perform the storage function when they buy a week's supply of goceries and place them in the pantry. 2. Time utility: A commodity has time utility when it is available when needed. The retailer is

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	creating time utility, the retailer (wholesalers too) add value to the product. To illustrate, the retailer is entitled to his profits in part because he is investing in and maintaining an inventory to meet the needs of the buyer on demand. When the consumer buys the product, he pays the retailer, at least in part, for the performance of this vital consumer service.
	3. Place utility: A commodity has place utility when it is in the place where it is needed and can be used. Ordinarily, when a change in title to merchandise takes place, a change in the location of the merchandise must also occur. Effecting this change is creating place utility. The creation of place utility gives birth to the transportation industry and many jobs attendant thereto. Transportation agencies, then, are engaged primarily in the creation of place utility--a highly expensive marketing service.
	4. Review and discuss other pertinent concepts from Marketing I Manual as is deemed necessary.
	* * * *
A. Storage Purposes and Their Economic Significance. 1. The equalization process in marketing 2. Affords a relatively stable market price	1. Storage is the function that enables 2. marketers to equalize supply and demand. Perhaps a good illustration to use to impress students with the importance of storage as an equalizing factor and as a price stabilization factor is the well-known egg illustration. Point out to students that at certain times during the year eggs are quite

Topical Outline	Teaching Suggestions
	plentiful--at other times, relatively scarce. Using this illustration, guide discussion along the following lines. a. If the producers try to market all their eggs immediately after production, how would this affect the consumer market for eggs? b. If all eggs are sold when produced, how will the price of eggs be affected? Resulting class discussiong should emphasize these points: Many consumers could buy eggs only when eggs were plentiful; consumers would be unable to buy eggs during periods of scant supply. Price of eggs would be low during periods of great supply (dime a dozen); price would be extrmely high during periods of short supply. Because of the performance of the storage function, then, the consumer benefits in that he is able to obtain eggs all year long with little variation in price.
3. Facilitates stabilized employment	3. Stabilized employment is highly desirable in our economy. Cite as your illustration a company that produces a seasonal item. As a hypothetical example, use a manufacturer that produces electric fans. Fans are sold only in hot weather. The manufacturer of electric fans, through producing for storage, is enabled to maintain a skilled work force on a year-round basis. Discuss the economic implications of this illustration.
4. Affords protection against delays in delivery	4. The marketer must maintain an inventory adequate to meet customer needs until he can obtain more goods from his source of supply. The marketer

Topical Outline	Teaching Suggestions
	must anticipate and prepare for delays in delivery resulting from strikes, acts of God, and routine shipping delays. Through performance of the storage function, the marketer is enabled to meet customer demand--and consequently, to retain customer good will. Stress the fact that customers will tend to shift sources of supply if the dealer is constantly "out-of-stock" of the item desired.
5. Storage facilitates more efficient and more economical buying practices and procedures.	5. Emphasize that through buying for storage, marketers are often enabled to obtain more favorable prices, discounts, and other concessions from their sources of supply. In presenting this concept, however, caution students that it is entirely possible that quantity buying could have an adverse, boomerang effect; that is, costs incurred could be higher than savings resulting from quantity buying. For instance, costs of performing the storage function must be considered; funds invested in slow-moving inventories perhaps could be used more effectively in other ways; insurance costs might have to be increased; etc. The following true story will be of some value in illustrating this concept: A grocery wholesaler was able to take advantage of a special deal on 10-pound bags of flour. To do so, however, he had to rent additional storage facilities. In these rented facilities, evidence of rats was noted (rats gnawed the bags, flour spilled out.) A blue powdered rat poison was used effectively to exterminate the rats, but before the rats died they crawled over the bags of flour leaving traces of the blue poison. Health officials condemned the entire lot of flour.

Topical Outline	Teaching Suggestions
	In this instance, what did it cost the wholesaler to take advantage of a special deal?
B. Types of Warehourses	
1. Private warehouses	1. Explain that most marketers (manufacturers wholesalers, retailers) maintain inventories of goods and must, therefore, make provisions for storing those goods. Private storage space is usually provided upon the marketer's business premises, but many marketers must maintain additional warehouse space in their privately-owned warehouse, especially in cases where large volumes of goods must be stored regularly. Place special emphasis upon the high costs involved (the inflexibility of funds) in private warehouse ownership. Possibly there is an example of private warehousing near your school. Perhaps a student will recall having visited a private warehouse at some time to secure an item he had purchased in the owner's retail store. You might raise some questions concerning why a retail operation has its private warehouse facilities located on the outskirts of the city in many cases--the answer is, obviously, lower real estate costs, tax advantages, etc.
2. Public (or commercial) warehouses	2. As the term implies, public warehouses are storage facilities available to the public. As is noted below, public warehouses are subject to government regulation. Discussion of public warehouses should include types of public warehouses, the nature of services that can be obtained from such warehouses, and conditions favoring the use of these storage facilities.

Topical Outline	Teaching Suggestions
(a) General merchandise warehouses	(a) General merchandise warehouses most frequently store goods for manufacturers until those goods are sold and delivered to buyers. These warehouses will store a wide variety of goods.
(b) Bonded warehouses	(b) Also stores general merchandise, but merchandise on which a tax must be paid before the goods are released. For example, whiskey, imported goods usually are stored in bonded warehouses.
(c) Commodity warehouses	(c) Warehouses used for storage of agricultural commodities--cotton, tobacco.
(d) Cold storage warehouses	(d) Warehouses used for storage of perishable commodities. Do not confuse with cold-storage lockers. Lockers most often sell storage space to consumers instead of business firms.
3. Field (or custodian) warehousing	3. Field warehousing is a type of public warehousing. Because of the somewhat unique character of field warehousing, the topic merits special emphasis and discussion.
(a) The nature of field warehousing	(a) The following points should help to clarify the field warehousing concept:
	(1) The use of warehouse receipts as collateral for loans has lead to the development of field warehousing.
	(2) Field warehousing, in effect, brings the public warehouse (with its negotiable warehouse receipts) onto the premises of the owner of the goods.
	(3) The owner of the goods leases a portion of his own storage space

Topical Outline	Teaching Suggestions
	to a warehouseman. The warehousemen segregates that space from other storage space on the owner's premises--might actually enclose the field area with a wire fence or other enclosure; the area is locked and remains under the supervision of the warehouseman.
	(4) Goods are added to or withdrawn from the field area only upon consent of the lending agency that has granted a loan with the stock used as collateral.
	(5) The field warehouseman is covered by a fidelity bond; thus, a regular employee of the owner of the goods could serve as field warehouseman in additon to other duties he regularly performs. This arrangement permits the owner to pledge certain portions of his inventory as collateral for loans and at the same time minimize expense necessary to secure that loan.
	(6) Field warehousing, then, is actually a credit, or financing, arrangement more than it is a storage arrangement.
(b) Major advantages of field warehousing	(b) Once the nature of field warehousing is understood, students should have little difficulty in logically arriving at some of its advantages and limitations. Group activity: Divide students into small discussion groups. Instruct each group to elect a chairman and to discuss field warehousing advantages and limitations. Permit group chairmen to present group findings. Some of the advantages are: Field warehousing is an economy measure in that goods do not have to be moved from owner's premises; no special

Topical Outline	Teaching Suggestions
	packaging and transportation problems are involved; lenders of money might be more willing to lend when goods are used as collateral; lower interest rates might be obtained than when company has no collateral to offer to secure the loan.
(c) Major limitations of field warehousing	(c) Some of the limitations are: Large inventory volume necessary to justify this service. Some of the costs are: labor costs to segregate field area; costs of equipment needed to segregrate the area; bonding the warehouseman; and costs of periodically auditing the stored goods. When large inventories are involved, field warehousing represents an economical means of financing; otherwise, costs are prohibitive.
C. Services Provided by Public Warehouses	C. In discussing services provided by public warehouses, emphasize that these warehouses can and do provide a wide variety of services; the client selects those services he desires and pays accordingly. Place special emphasis on the cost angle--the services are not provided merely for routine storage fees. Consider the analogy of the cafeteria line--the customer selects what he wants, pays accordingly. Emphasize, too, that in instances when warehouse services are purchased, the purchaser generally uses the services as an economy measure--the warehouse can perform the services more economically than the purchaser can perform them.
1. Storage	1. Providing storage space is the major service provided by public warehouses.
2. Bonded service	2. Bonded service is available from

Topical Outline	Teaching Suggestions
	many public warehouses. These warehouses are bonded by the U. S. Treasury Department. Bonded service is especially valuable to importers of foreign goods, and to marketers of liquor and tobacco (products that must be aged before marketing), in that the owners of these goods can use warehouse receipts as collateral in securing bank loans, yet owners do not have to pay customs duties on imported goods or internal revenue taxes on products being aged until those goods are withdrawn from storage. In presenting the bonded service concept, stress the following: (a) Bonded warehouses are bonded by the U. S. Treasury Department. (b) A bonded warehouse is a private business enterprise, but it must be either a separate building or a completely segregated and partitioned area within a building. (c) A representative of the Treasury Department is in custody of goods stored in the bonded areas of public warehouses. (d) A substantial surety bond is required of bonded organizations. (e) The owner of goods stored in bonded warehouses can use his warehouse receipts as collateral for securing loans. (f) Payment of customs duties, internal revenue taxes can be delayed until the goods are ready to be withdrawn from storage.

Topical Outline	Teaching Suggestions
3. Reshipping and packaging	3. The public warehouse will receive shipper's goods in quantity, sort and package those goods into smaller lots for local delivery or reshipment to other points. Discussion: Ask students to explain why the reshipping service is valuable and how it represents an economy measure for a manufacturer. Stress the economy angle--savings in freight costs that will accrue from bulk shipments to a central point.
4. Filling orders for owner's customers	4. Seller may ship unsold goods to public warehouse for storage until sold. Warehouse then serves as order-filling agent. The obvious advantage of this service is that it helps the owner of the goods to reduce cost of serving accounts in the warehouse vicinity--espcially accounts of small buyers in the area.
5. Providing office and display space	5. Public warehouse may provide space for lease to sellers for office and display purposes. Advantage of this service is that physical facilities for servicing accounts are near those accounts, but the user of the facilities does not have to make a sizable investment for this purpose.
6. Fumigation	6. Government regulations require that certain types of cargo or freight be fumigated (especially true of imported goods). Some public warehouses provide this service. In concluding presentation of public warehousing services, call attention to the trend for many manufacturers today to eliminate wholesaling middlemen in channels of distribution. The following suggested assignment should be of considerable value in impressing students with the role

Topical Outline	Teaching Suggestions
	of the public warehouse in today's marketing scene: Either as an outside written assignment or as an essay test question, have students write on the topic, "The Role of Public Warehousing in the Elimination of the Wholesaler."
D. Government Regulation of Public Warehouses	D. Many times in the study of business, the subject of governmental control will be encountered. Students, depending upon their backgrounds, will have varying philosophies on this subject. It is doubtful whether the teacher should impose his own philosophy on his students; instead, it is the teacher's function to challenge the students to develop a responsibile and defensible philosophy on this highly important subject.
1. The need for government regulation of public warehousing	1. Lead into the discussion of government regulation of warehousing by asking several students to express their thoughts concerning government regulation of business generally. Permit other students to challenge philosophies expressed. As students defend their philosophies, raise questions concerning the need for regulation of warehousing. For example, what should be the degree of warehousemen's responsibilities for goods stored in their warehouses? Is it conceivable that warehousemen might be unscrupulous in their business dealings with owners of stored merchandise? (Beware of accusing--just raise questions.) If so, how? If warehouse receipts are to be used as collateral for loans, is there need for governmental intervention to protect lenders? Etc. As discussion progresses, point out that scandals in the warehousing business do make the headlines periodically and that there is need for marketing managers to exercise care in selection of reputable

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	warehouses when storage services are required.
2. Federal Legislation--The United States Warehouse Act of 1916	2. SPECIAL NOTE TO INSTRUCTOR: The following is presented for the teacher's information primarily. It is doubtful whether students should be required to master the intricacies of the law or should be held responsible for the law in a testing situation. Teach at the introductory level only. Re-emphasize the point that Federal Legislation applies to merchandise that enters into interstate and foreign trade. This law, then, applies to warehouses engaged in storing certain agricultural products that enter into interstate competition.
(a) Background of the Act	(a) This legislation was deemed necessary because of unscrupulous practices employed by some warehouse operators--for instance, some operators were guilty of selling goods left in their custody; some provided inadequate protection for goods stored. The result of these practices was that bankers were reluctant to lend money with warehouse receipts as collateral.
(b) Provisions of the Act	(b) The Act protects to some degree owners of certain agricultural commodities stored in public warehouses and therefore makes it a bit easier for those owners to obtain loans using their warehouse receipts as collateral. The Act provides for licensing and bonding of public warehouses storing certain agricultural commodities (tobacco, cotton, wool, grain). In effect, the Act attempts to provide a uniform system for warehousing these

Topical Outline	Teaching Suggestions
	products, so that acceptable warehouse receipts can be obtained by owners for finance purposes.
(c) Limitations of the Act	(c) The Act is permissive or optional, not mandatory legislation. In other words, the warehouse can be (but is not required to be) licensed under the Act. Many small warehouses are not licensed under the Act and users of the storage space often are not aware of the fact until it is too late to protect themselves from loss or inconvenience. Warehouses licensed under the Act have met certain protective specifications that help to make their receipts more acceptable. When licensed under the Act, the warehouse is subject to inspection and supervision by the United States Department of Agriculture.
3. State Legislation--Uniform Warehouse Receipts Acts	3. Emphasize that state legislation applies to intrastate commerce. These laws, which are currently in force in all states except South Carolina and New Hampshire, apply to public warehousemen of all types (not just to storers of agricultural commodities as in the case of the United States Warehouse Act). These state laws cover the warehousemen's obligations as custodians of property of the public. The effect of these laws is that warehouse receipts are of more value for financing purposes.
E. Current Problems and Trends in Warehousing	
1. Reducing costs 2. Improving efficiency	1. Reducing costs and improving efficiency 2. are continuous problems for businesses engaged in storing merchandise, whether those businesses be retail

Topical Outline	Teaching Suggestions
	or wholesale with their own private warehouse facilities or commercial warehouses existing solely to sell storage services. Constructive steps to meet the challenges of costs and efficiency have been in the making since World Ware II. In all probability you will be able to use local warehousing facilities as examples to pinpoint some of these trends for your students: 1. Locating warehouses in less congested and less expensive areas of towns. 2. Building warehouse facilities on one level instead of using multi-story buildings. Note: Multiple store buildings make for vertical movements of merchandise--alot of handling--which breeds inefficiency. One-story buildings permit a horizontal flow of merchandise and more efficient use of labor-saving modern equipment for materials handling purposes. 3. Use of automated processes for various purposes: Many current business periodicals contain articles relating to automation and storage. Require students to report on current ariticles on this subject. Can a field trip to be arranged for a local public warehouse? Professional Reading: Phillips and Duncan: MARKETING PRINCIPLES AND METHODS, 5th Ed., pp. 667-671.

V. TRANSPORTATION

Materials and Equipment Needed

1. Shilt and Wilson, Business Principles and Management
2. Mail order catalogs
3. Phillips and Duncan, Marketing Principles and Methods
4. Locklin, Economics of Transportation

ERIC

V. TRANSPORTATION

Objectives

1. To develop an appreciation for the role of transportation in America
2. To develop an acquaintance with the American Transportation system
3. To develop understanding of marketing considerations in the selection of transportation agencies
4. To develop understanding of services available from transportation agencies
5. To develop insight into transportation problems and trends in our dynamic marketing scene

Topical Outline	Teaching Suggesations
	NOTE TO COORDINATOR: In preparation for presenting this topic, review the Teachers Manual for Marketing I, Section entitled RECEIVING, CHECKING AND MARKING ACTIVITIES, pp. 27 - 30. Review with your students the terminology presented. In covering transporation, encourage students to develop their library skills by finding information relating to the various segments of our transportation system. Use of encyclopedias and indexes to periodical literature is suggested. Give special emphasis to current and recent literature relating to current developments in the transportation industry. Encourage students to consult daily newspapers for articles relating to transportation. If student interest in transportation is high, permit students to prepare notebooks or scrapbooks on the segment of the American transportation system in which they are most interested. Show students how to read Stock Market Reports in daily newspapers. Have students select a transportation company (a railroad, air line, motor carrier) and keep a record of fluctuations in the stock. When the student presents his findings, can he offer explanations for the behavior of his stock? Would the student be willing to invest in the company? Why? or Why not?

Topical Outline	Teaching Suggestions
A. The Importance of Transportation	
1. Vital to a mass-production economy	1. Point out that mass production is not economically feasibile unless mass distribution facilities are available. Without adequate means for transporting goods to markets, there is no point in producing those goods.
2. A major factor in the high standard of living in the United States	2. Contrast today's high standard of living with that of the pioneer family. To what extent is today's high living standard traceable to efficiencies in transportation? Point out that early settlers had to be largely self-sufficient because of difficulties involved in obtaining goods. Student assignment: Assign one student an oral report on the topic, "Early American Transportation." Suggest that he consult Compton's or some other Encyclopedia. Call attention to the fact that, as our country developed, major cities tended to develop around major transportation arteries (example: Cincinnati on the Ohio River). Contrast the American standard of living with that of under-developed countries. How does the American transportation system differ from that of underdeveloped countries?
3. Affords millions of job for the American people	3. Can you locate current statistics showing numbers of people employed in jobs relating directly to transportation? (More than 3 million people are employed by common carriers alone.)
4. Adds value to goods through the creation of place utility	4. Explore again the concept "place utility." Transportation agencies are engaged primarily in the

Topical Outline	Teaching Suggestions
	creation of place utility and incidentally in the creation of time utility. Through the creation of place utility, value is added to goods in that they are made available where and when desired by users of the goods. Stress the concept that goods at their point of production have literally no utility for potential users in areas at great distances from that point. In illustration: Of what utility or value to me, a consumer, is an automobile at the manufacturer's plant? Until place utility has been created, the product is nonexistent as far as the consumer is concerned.
5. A major determinant in the delivered price of merchandise.	5. This could, and probably should, lead into a discussion of the high costs of distribution. Emphasize that transportation costs must be recovered by sellers of goods in the prices they set. Ask students to speculate upon the widely-publicized feather-bedding practices in the railroad industry. (Use good judgment; avoid political argument.) How do such practices affect the student personally? Does the student, as a consumer, have to pay a higher price for goods because of feather-bedding practices? * * * * To emphasize further the importance of transportation in our economy, have students discuss the following question: "What would happen in our country if every transportation agency were to suspend operations for three months?" * * * * Have there been rumors of a strike in a transportation agency servicing your

Topical Outline	Teaching Suggestions
	community? If so, have students discuss the possible effects the strike might have on the local business community. Suggest that students interview local businessmen on this question.
B. The American Transportation System (five segments)	B. No attempt is made hereto discuss intracity transportation systems. Consult your local Chamber of Commerce for information relating to in-city transportation.
1. Railroads	1. Include the following facts in discussing railroads: (a) The railroad has played a dominant role in the development of our nation. (Cite some of the TV and motion pictures that have used this theme.) (b) Railroads have been federally subsidized (mail contracts, defense purposes). (c) The railroad is the "backbone" of the transportation industry. The relative position of railroads, however, has declined greatly in recent years. (From about 75% of intercity domestic freight in 1930 to less than 50% in early 1960's). See Shilt & Wilson: Business Principles and Management, 4th Ed., p. 386. Graph here shows changes in proportions of freight carried by the various segments of the transportation system in recent years. Call these changes to attention of class. (d) Nearly half of today's intercity freight is shipped by rail. (e) Railroads are of primary importance as long-distance haulers of large-quantity freight shipments. For short hauls, truck transportation is more frequently used.

Topical Outline	Teaching Suggestions
	(f) Railroads are limited to fixed routes and cannot service customers located away from main and spur lines without using trucks.
	(g) Railfreight tends to move at slow speed. Shippers desirous of rapid service tend to turn to other means of transportation.
	(h) Bulky products (coal, steel, gravel, etc.) are major freight items for railroads.
	(i) There is a bitter rivalry for freight business today, especially between railroads and motor carriers.
	(j) To enhance and improve competitive position, railroads have, in recent years, introduced many special services. (If desired, discuss special services at this point. Special services appear elsewhere in this outline.)
2. Motor carriers	2. Motor freight is especially adaptable to short-haul freight shipments (two or three hundred miles). Some truck lines do compete favorably with railroads on long-haul shipments.
(a) Trucks	Contrast motor carriers with other segments of the transportation system: Include the following in your discussion:
	(a) More than one-fifth of the ton mileage of intercity freight moves by truck. (Most <u>local</u> freight--wholesale and retail deliveries--moves by truck.)

Topical Outline	Teaching Suggestions
	(b) Flexibility (not being bound to a railroad roadbed, for example) is the major advantage of motor transportation. Trucks provide both speedy and low cost freight movement on short hauls (on short hauls, trucks may charge the same or lower rates as railroads but provide faster service.) (c) Trucks are not limited to fixed routes as are rail carriers and water carriers. (d) Trucks provide for a minimum of handling of merchandise--can load at shipping point, unload at destination; this generally results in less damage to merchandise and faster service. (e) The trucking industry, historically, has been composed of many small independent truckers; many have developed poor reputations for dependability. The development of large trucking lines has helped somewhat in overcoming that reputation. (f) Motor carriers have been criticized as the cause of highway congestion (ever been behind a truck in the mountains?) and road damage. (g) Motor carriers, though charged high taxes and license fees, are frequently accused of being subsidized in that they do not bear a fair share of the burden in cost of constructing roads. (h) Trucks are of major importance in the economic development of small towns and rural areas not serviced by other means of transportation. SUGGESTION: Road building and area economic development are constant political platforms

Topical Outline	Teaching Suggestions
	in most states. Have students review political speeches made by gubernatorial candidates in the most recent campaign. Was any emphasis given to road building? What were the candidates' major points?
	(i) In recent years motor carriers have taken a great deal of freight business from railroads. Some say that trucks have taken the "cream" shipments from railroads. With the development of air freight, air lines now appear to be taking the "top of the cream" from the motor carrier.
(b) Passenger bus freight	(b) Some passenger bus lines transport small freight shipments as well as passengers. Have a student contact the local bus station to find out and report to class the cost of this service and the nature of the freight coming into town by bus.
3. Air carriers	3. The potential of air carriers is almost unlimited--this is an artery of freight movement that is as yet virtually untapped. In discussing this segment of the transportation system, the following factors are pertinent:
	(a) Air freight is the most expensive means of freight transportation.
	(b) Although air freight still accounts for only a minor proprotion of inter-city freight movement, the volume of goods moving by air increases each year.
	(c) Air freight is used when speed of delivery is more important more than cost of delivery.
	(d) Air transportation tends to be used most often when merchandise has

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	perishable or fashionable characteristics (flowers from Hawaii, ladies' dresses). (e) Pakcaging costs can be reduced by using air freight. For example, a shipment of ladies' dresses from New York to Chicago can be made by simply leaving dresses on rack, taking rack to plane and loading it, then unloading rack to receiver's truck at distination. (f) Air lines have been instrumental in promoting the "total cost" concept in physical distribution. In other words, they have promoted the idea that immediate transportation costs alone are inadequate as a basis for selecting a transportation medium. For instance, water transportation is cheap, but slow. To use water, or truck, or rails, might require expensive packaging, high warehousing costs at distination, etc. Therefore, total costs of distribution might actually be in excess of the higher, more efficient, air service. This "total cost" concept is attracting managerial attention and is perhaps ushering in a new era in transportation which might be somewhat revolutionary in nature. (g) Other transportation agencies, especially railroads, allege that air freight is being subsidized to the detriment of these other agencies. These critics also point to the fact that towns will build airports, but not railroad stations. General thinking seems to be that it is in the best interest of the public and national defense that air transportation be aided in its development through federal subsidy. (h) As newer planes are developed and improved, air carriers, it is believed, will enjoy a more prominent position in the national transportation system.

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4. Water carriers	4. The following pertinent factors should be included in discussing water carriers: (a) The United States has well-developed water transportation facilities: Great Lakes system River Systems (Ohio, Mississippi Rivers) Inland waterways Intracoastal and coastal waterways (for instance, from New York and other Atlantic Ports to Gulf of Mexico ports) Note: For general information purposes, ask a student to present an oral report on the St. Lawrence Seaway. This facility, developed through cooperation between the U. S. and Canadian governments, provides for ocean vessels to service Great Lakes ports. (b) Water transportation is the lowest-cost transportation medium--it is also the slowest. (c) Some waterways are iced in during winter months; therefore, other transportation mediums must be used to supplement water transportation in many places. (d) Cities, states, and the federal government help to maintain waterways. Is this a form of public subsidy? (e) Low-unit value, bulky, non-persihable products comprise major freight items for water carriers (iron ore, grain, petroleum products, sand, gravel, coal, coke). * * * * Although domestic transportation is of primary concern in this course, it might be desirable to spend some time discussing State facilities for foreign shipments.

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	For instance, a citizen of North Carolina should be well informed and concercerned with the economic potential of foreign trade through the North Carolina ports at Morehead City and Wilmington. He should be concerned with the following: 1. How valuable are the State's ports? 2. What kinds of cargo pass through local ports--imports and exports? 3. Why are local ports not used more extensively? 4. What needs to be done, and how can we do it, to develop our ports better in the interest of area economic development? 5. For North Carolina ports, why is the area adjacent to one of the ports known as the "graveyard of lost ships?" 6. How do local ports compare with ports in neighboring states? How much is our State losing to ports in neighboring states because of inadequacies in local facilities? A three- or four-member panel discussion of these questions will be highly informative and well worth the investment of time required. Write to: Department of Conservation and Development, Raleigh, for literature and possibly a speaker on this topic.
5. Pipelines	5. The following factors should be included in discussing pipelines: (a) Pipeline transporation is used primarily in the petroleum industry. (b) Greatest utilization of pipeline transportation is in the Nation's oil producing areas; used in these

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	areas to bring oil from oil fields to refineries. (c) Pipelines are legally common carriers, but because of the inflexibility fo the line routes, most lines are used by their owners (the major gas and oil companies) to transport owners' product. (d) Pipelines are considered an economical means of transporting liquid materials from one plant to another plant where the materials are either to be processed or to be used in manufacturing. (e) Pipeline transportation is generally considered more economical than rail transportation, but water transportation is considered more economical than pipeline transportation. Because of the economy angle, pipelines are frequently used to transport liquid petroleum to Gulf ports where the product is loaded on tankers for shipment to Atlantic ports. (Cite Greensboro Terminal facilities.) (f) Pipeline transportation is believed to have potential for transporting bulky products other than petroleum (coal, wood pulp, and other bulky products). <u>Question</u>: If pipeline transportation for bulky products proves economically feasible, how will this affect railroads? <u>Bulletin Board Suggestions</u> As the transportation system is being presented and discussed, utilize bulletin boards extensively. The following suggestions may be of value: 1. Contact transportation agencies

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	servicing your area for maps showing territory serviced and for other public relations materials the agency makes available.
	(2) Clip and post current news stories relating to transportation generally and to the various segments of the transportation system.
	(3) Assign student groups responsibility for preparing a bulletin board on segments of the transportation system of major interest to the group. Caution students about abuse of materials available through the school and public libraries.
	* * * *
	Some transportation agencies have free films for screening by educational groups. Although these films obviously can be oriented in favor of the specific agency preparing it, contact agencies operating in your area re use of these films.
	Free films on the general topic of transportation can be secured from: Regional Office, Interstate Commerce Commission, Richmond, Virginia. Write for a copy of their film catalog.
C. Legal Classifications of Carriers	C. In discussing classifications of carriers, refer to Shilt & Wilson, Business Principles and Management, 4th Ed., pp. 402-404.
1. Common carriers	1. Common carriers are legally required to serve all who desire to use their services. Common carriers must--
	(a) accept shipments from any party.
	(b) publish their rates.

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	(c) maintain regular service over established routes. Generally common carriers must obtain legal permission to abolish service. For class discussion: What kinds of problems does requirement (c) create for railroads? Is it fair for common carriers to be required to provide service to unprofitable areas? Refer to Shilt & Wilson for reference material. Discuss "Duties and Rights of Common Carriers"; "Factors Limiting the Liability of Common Carriers," See pp. 402-404.
2. Contract carriers	2. Contract carriers do <u>not</u> hold themselves out to serve all who desire their services--these carriers haul freight for users if terms satisfactory to both parties can be negotiated. These carriers have flexible rates which can be varied to meet the needs of the circumstances.
3. Private carriers	3. Private carriers are not in the transportation business per se. The private carrier is generally owned by the party whose goods it carries. Examples: trucks owned by a supermarket chain and used to transport merchandise from central warehouse point to retail outlets; a railroad operated by a steel company to transport its product. Private carriers may serve as contract carriers--for instance, the company truck that transports company merchandise may, to avoid making the return trip empty, contract to transport another company's merchandise on the return trip. Businesses that use private carriers on a contract basis should investigate

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	carrier's responsibility carefully before employing their services.
D. Freight Rate Structures	D. It is doubtful whether the complicated mechanics of rate structure merit depth discussion at this level in students' development. If depth discussion is deemed desirable, consult a college textbook on transportation as source material. Since railroad rates tend to set a competitive standard and most rate structures have characteristics similar to rail freight structure, concentrate emphasis on rail rates. Point out that there are three <u>basic types</u> of rates: class, commodity, and exception rates. These rates are quoted for carloads (CL), Truckloads (TL), Less than carload (LCL) and Less than truckload (LTL). Generally, rates on smaller shipments are much higher than those on larger shipments.
1. Rail common carrier rates	
(a) Class rates	(a) Because of the wide variety of products handled by railroads, a freight classification system has been developed. This system covers more than 10,000 different articles or groups of articles. Freight rates are assigned these classes on the basis of the cost and value of the transportation service, the size of shipment, and distance to be shipped. Goods subject to class rates are primarily manufactured items that move in small volume. A relatively minor proportion of rail freight volume comes under class rates--about 4 or 5 percent.

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(b) Commodity rates	(b) Point out that many kinds of goods are bulky, low unit value products and that if freight rates are exceptionally high, the cost of shipping would almost prohibit distribution of these products. (1) More than 4/5 of rail freight volume moves at commodity rates. (2) Rates are set for specific commodities, generally between specific points and over specific routes. (3) Commodity rates are often the result of negotiations between shippers and railroads. (4) "Blanket rates" are common--the rate applies over a large area regardless of distance product is shipped. For instance, California oranges, under commodity rates, can be shipped to almost any point on the Atlantic Coast for the same cost. (5) The major concept to be stressed is that commodity rates apply to bulky, low unit value products like fruits, vegetables, wheat, coal, lumber, etc.
(c) Exception rates	(c) Point out that exception rates may be grated by the carrier under certain circumstances: (1) When competition from other methods of transportation is so strong that the carriers cannot obtain shippers' business unless rates are lowered to meet those of competitors' rates (especially railroad and truck competition on same freight items). (2) When a shipper is unable to compete in a given market area primarily because transportation costs prohibit his being able to meet more favorably

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	located competitors' prices in that area. Example: Local manufacturers distributing in the area have competitive advantages in that freight costs are relatively minor. A manufacturer 1000 miles away producing the same or better product cannot service the area, since his delivered price is excessive because of freight rates. The distant manufacturer may obtain exception rates to enable him to compete in the market area.
2. Contract carrier rates	2. Re-emphasize the concept of the contract carrier and point out that private carriers sometimes serve as contract carriers. These carriers do not maintain regular schedules and are not regulated as strictly as common carriers. Because of these characteristics and because rates are the result of negotiation between shipper and user, contract carrier rates may vary to meet the demands of the situation. Emphasize that the inflexibility of railroad routes makes it extremely difficult for railroads to serve as contract carriers; however, water carriers, trucks, and airplanes frequently serve as contract carriers with rates set as a result of negotiation.
E. Special Freight Services	E. The emphasis in this section will be primarily on rail services. Approach this section by citing the declining market position of railroads and the continuing need for railroads to improve services to maintain market position.
1. Express service	1. The Railway Express Agency, Inc., is a separate corporation (set up by railroads) to provide premium

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	freight service for highly perishable and valuable items moving in small quantities. This rapid service is more costly than regular freight but is worth more because of speedy shipment. Pick up and delivery service is provided. This agency is currently conducting an "all-out" campaign to improve its services and its competitive position.
2. Pool car service	2. The railroad assists several small shippers (whose individual shipments would have to move at LCL rates) to consolidate shipments to same destination so that CL rates can be obtained. (Point out that the railroad can provide faster and more efficient service when a full car can be routed through to destination). Pool car service can be used by either the seller or the buyer of merchandise. For instance, to effect transportation economies, several retailers in the same city may consolidate their shipments from suppliers in another city so that CL rates can be obtained. Pool car service is also available for commodity shipments. When different kinds of commodities are shipped via pool car, the term "mixed car" is used; the highest freight rate for commodities included is charged for the whole car.
3. Diversion in transit	3. This service provided for redirection of carloads of freight in transit. <u>Explain</u> this concept <u>by illustration</u>. A shipper of apples from the West Coast ships a carload of apples to Eastern markets. Since market conditions change daily, he is not certain of his most effective market target. When the best market is known, the CL shipment can be <u>diverted</u> to that market.

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4. Business-door delivery	4. The railroad provides for pickup of goods at shipper's place of business, delivers these goods to the railroad, loads the goods and ships them to destination, unloads and delivers goods by truck to the person or business for whom they are intended.
5. Terminal service	5. The railroad will deliver a car to a private track owned by the business to which the car has been shipped. If the company has no private railroad track or siding, the railroad will leave the car for unloading on a "team track," which can be reached by a truck.
6. Piggy-back service (Fishy-Back: same idea, but trailers are loaded on boats.)	6. Truck trailers are picked up at shipper's location, loaded onto flat cars, and transported by rail to destination. A loaded truck trailer can be shipped this way more economically than it can be driven over the highways (at about half the cost of driving it.) Stress reduced handling costs that can accrue from this service.
7. Freight forwarders	7. Freight forwarders are wholesalers of transporation service. (They handle rail, ship, air, and truck shipments.) The frieght forwarder obtains cars from railroad at CL rates; consolidates small shipments into carload lots to same destination; shipper pays LCL rates, but get more rapid delivery.
F. Some Common Freight Policies	F. Point out--(1) that freight costs must be considered in determining the delivered cost of merchandise; therefore, both buyers and sellers of merchandise are vitally concerned with transportation costs. Generally, negotiations between buyers and sellers will involve discussions of who will pay transportation costs on goods involved.

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	(2) that freight policies, because of their relationship to delivered prices, come under the provisions of the Robinson-Patman Act when interstate competition is involved. (See Section VIII C Governmental Relationships to Marketing for discussion of the Robinson-Patman Act.) (3) that a manufacturer's ability to compete in certain market areas is dependent upon his ability to adapt his freight policies to make the delivered price of his product competitive with similar products marketed in that market area. In discussing freight policies generally, point out the advantages and disadvantages associated with each policy.
1. F. O. B. Factory (Free on board)	1. When the seller follows an F. O. B. Factory freight policy, the buyer pays the transportation costs; title to merchandise passes when the goods are delivered to the common carrier. The effect of this policy is that buyers located a great distance from the seller will pay a higher delivered price for merchandise than will buyers located close to the seller. This pricing policy can have the effect of limiting the seller's market to buyers located near the seller's place of business.
2. Postage stamp freight policy (F.O.B. Destination)	2. Seller pays the freight costs to destination. Usually used by the seller when transportation costs are relatively low--in effect, freight costs throughout the marketing area are averaged. This policy is especially desirable when the seller desires to advertise

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	his product throughout the market area at one delivered price. The manufacturer, for instance, can advertise his product in Life Magazine--the delivered price of the product can be advertised.
3. Freight absorption policy	3. Under a freight absorption policy, seller and buyer "split" freight costs. Often used by sellers who follow F. O. B. Factory terms for the immediate market area but who find such terms prevent expansion into more distant marketing areas. To expand his market area, the seller may adopt a policy under which he absorbs the freight costs to his competitor's city (F. O. B. Competitor's place of business) and the buyer pays the freight from that point. This absorption policy enables the seller to compete with other sellers on an equal basis insofar as transporation costs are concerned. Point out that these terms work to the advantage of the consumer in that the terms help to make it impossible for a local manufacturer or wholesaler to gain a monopoly in the immediate market area--these terms help to keep local or nearby seller "on his toes" in providing good products, as well as effective prices, to the immediate market area.
4. Zone freight policy	4. Under a zone freight policy, an <u>average</u> freight charge is made to all buyers within the zone. The effect of this policy is that prices tend to be stablilized for all buyers within the area. NOTE: Check a Sears' or other mail order catalog for a practical illustration of a zone freight policy.
G. The "Total Cost" Concept in Physical Distribution	G. The "Total Cost" concept may be a

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	little difficult to get across. The idea is relatively new in management circles, but is fast catching on. Students are likely to believe that cost of the transportation medium is the primary consideration in selecting the transportation agency to be used. Today's management thinking, however, must consider not only transportation costs involved in getting goods to their distinations, but also warehousing costs, special packaging costs, insurance costs, etc., necessitated by the use of a given transportation medium. In other words, to reduce transportation costs by selecting a low-cost transportation medium could easily necessitate increased warehousing and general handling costs. The reduction of costs in one segment of the physical distribution picture could be more than offset by increased costs in another area. Management's objective, then, is to reduce <u>total</u> distribution costs. When physical distribution costs are viewed in this light, it is conceivable that more expensive air transportation, for instance, might be more desirable than a less expensive transportation medium that requires a high inventory investment, expensive packaging and warehousing costs, as well as high insurance costs. * * * * If desirable, the coordinator may conclude the unit on transportation with a discussion, using illustrations, of typical forms used in connection with freight shipments.

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	It might also be desirable to discuss procedures to follow in making claims when merchandise arrives in a damaged condition. * * * * Student reading assignment: Shilt & Wilson: Business Principles and Management, 4th Ed., Chapter 21. Professional reading: Phillips and Duncan: Marketing Principles and Methods, 5th Ed., Chapter 26.

VI. FINANCE, CREDIT, AND RISK TAKING

Materials and Equipment Needed

1. Film No. 138 - "Credit -- Man's Confidence in Men", Modern Talking Picture Service

2. Shilt and Wilson, Business Principles and Management

3. Wingate and Weiner, Retail Merchandising

ERIC

VI. FINANCE, CREDIT, AND RISK TAKING

Objectives

1. To develop understanding of elementary concepts relative to the finance and risk-taking functions of marketing
2. To develop understanding of the importance of credit in the marketing system, especially at the retail level
3. To develop understanding of credit and collections work at the retail level
4. To develop an appreciation of the importance of establishing and maintaining personal credit standing in the community
5. To develop insight into the nature of business risks and means of minimizing those risks.

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A. Finance	A. Preparatory to discussing the finance function in marketing, secure from Modern Talking Picture Service, Inc., Charlotte, the following free film: #138--Credit--Man's Confidence in Man (30 minutes) The film will be helpful in emphasizing the importance of credit in the performance of the finance function. Special emphasis is accorded the need for establishing sound credit ratings (both for the business and for the individual) as a base for financing business transactions.
1. Capital needs	1. Emphasize and reemphasize that one of the major causes of business failure today is insufficient capital--and the proprietor's inability to secure that capital--to meet the financial needs of the business. This is a major problem for a business that is just getting started. Impress upon students that, before attempting to go into business for themselves, they must either have the capital necessary, or have the ability to obtain that capital, to launch the undertaking and to see it through the "lean" period that generally follows before the business begins to make a profit.

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a. Fixed capital needs	a. Define as money required for investment in fixed assets (land, building, fixtures, and equipment). Point out that fixed capital needs vary with different kinds of business establishments. Have students speculate upon the fixed capital needs of different kinds of retailers: a service station; furniture store; small grocery stores; etc. Discuss the question: Is it better for a new business to invest funds in store ownership--or is it better to rent the facilities at first? Stress the concept that funds invested in fixed assets are "tied up" in such a way that it might be difficult to obtain them for emergency use.
b. Working capital needs	b. Definition: Money that is <u>worked</u> in order to make profits. Cite investment in inventory required to maintain an adequate supply of goods to be sold.
c. Liquid capital needs	c. Definition: Cash on hand and other assets that can be quickly converted into cash. Stress the need for the business firm to have enough liquid capital to enable it to meet expenses that arise before profits from sales occur.
2. Sources of capital	2. Treat this topic in as much depth as you see fit in accordance with the maturity level of your students. It is doubtful that depth discussion of financing is justified at the current level of your students' professional development.
a. Banks	a. You might best handle this source by stressing factors to look for in

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	selecting a bank from which to borrow money--See Shilt & Wilson: BUSINESS PRINCIPLES AND MANAGEMENT, P. 221).
b. Partners c. Corporate funancing	b. c. Approach from the angle of the sole proprietorship that is in need of funds for expansion purposes. Although sole proprietors frequently object to bringing others into the business, it might well pay the sole proprietor to consider the advisability of seeking additional capital by permitting another person (a partner) to "buy into" the business--or it might be to the proprietor's advantage to consider incorporating his business. Explore this angle as you see fit, stressing advantages and disadvantages that might accrue to the business.
d. Warehouse receipts	d. Remind students of the use of warehouse receipts as collateral for loans--refer to earlier section on Warehousing.
e. Suppliers	e. Stress the value of establishing and maintaining a good reputation with suppliers as a basis for obtaining merchandise on credit. Pursue this by asking students what effect certain practices like those listed below might have upon a retailer's reputation as a good credit risk: (1) Taking cash discounts after the discount period has expired (2) Making unfair claims and requesting unreasonable adjustments (3) Constantly overbuying and then returning the merchandise to the supplier (4) Offering no explanation when bills cannot be paid on the due date

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f. Finance companies	
g. Small business investment companies	
B. Credit	B. Define types of credit and explain the characteristics of each type; concentrate emphasis upon credit and collections work at the retail level.
1. Types of credit	
a. Merchantile credit	a. Merchantile credit is business credit--credit extended by one business firm to another business firm. Stress the following characteristics: --Sometimes called long-term credit; terms of 60 to 90 days not unusual; some firms extend credit to business customers for a period of time long enough to enable the goods to be sold before the account is settled. --CiteDun & Bradstreet as a source of information concerning credit standing of business firms. This topic is a worthwhile subject for an individual oral report.
b. Consumer credit (Retail credit)	b. Definition: Credit extended by the retailer to the consumer; used by individuals or families for the satisfaction of their personal wants. Emphasize that consumer credit is a business service to customers; stress the necessity for the retailer to adopt a workable policy relative to the role of credit extension in his business.
(1) Charge accounts	
(a) Characteristics	(a) Stress the following characteristics: (1) A charge account is a service, or a convenience, provided for the consumer buyer. (2) Charge accounts are generally considered to be short term

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	credit extensions--usually extended for that period of time between customer's paydays. Two weeks to 30 days are probably the most common terms.
(b) Significance	(b) To illustrate the importance or the significance of charge accounts to the retailer, ask students what effect the availability of a charge account has upon the consumer. Cite the following effects that are alleged to accrue to the retailer who grants a charge account privilege: (1) Consumer concentrates buying at the store where he has a charge account. (2) Consumers with charge accounts have less sales resistance and tend to spend more at a given store than those who do not have the charge account. (3) Consumers with charge accounts are more quality conscious and less price conscious than those without charge accounts. To emphasize further the significance of charge accounts, cite a local small grocery store that extends the charge account privilege; ask students to analyze the role that charge accounts have played in enabling that grocer to stay in business despite competition from chain store giants like A & P. Ask students to speculate further concerning why the J. C. Penney chain has, after doing business on a cash basis over the years, recently begun extending the charge account privilege. (Strictly from the students' personal angle, emphasize the concept that receiving a charge account is a

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	privilege-a privilege that students should, throughout their lives, work diligently to protect and deserve.)
(2) Installment accounts	(2) Definition: Long-term consumer credit. Point out that there are many variations. Have students investigate the variety of installment accounts available through local retailers.
(a) Personal considerations	(a) Although this course is not a course in consumer education or personal finance, take time out to caution students to use installment credit wisely; cite dangers of the "dollar down, dollar-a-week" financial "trap". Point out that this "trap" tends to be a quick route to personal bankruptcy--even a quicker route to divorce for young married couples. Point out the high interest rates some installment accounts bear.
(b) Retail considerations	(b) The retailer is in business to meet the customers' needs; customers today tend to want installment accounts. Since installment accounts generally bear interest charge and carrying charges, these accounts provide a source of income for the retailer granting them. (The cost of the service is offset and additional profits are generated by these accounts.)
(c) Major consumer users	(c) What consumer groups tend to us installment accounts? --Middle income group. Lower income groups often cannot qualify; higher income groups don't need it. --Young married coupled with children --Skilled and semi-skilled workers

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(d) Selling on the installment plan	(d) Stress the following as elements of retail strategy to be employed in selling on the installment plan: (1) Price set must be adequate to cover costs of merchandise and expense encountered in carrying the account. (2) Sell the merchandise, not the installment plan. (3) Obtain a sizable down payment--point out the need for encouraging the consumer to invest enough in his down payment to give him a sense of ownership in the product; if the customer invests in the product, he will want to protect his investment by observing terms of sale. (4) Make terms as short as possible--point out that no one likes to continue paying for merchandise that has already been consumed. (Use automobiles as an example--it is discouraging to have to make car payments for long periods of time after major repair bills begin.) (5) Conduct careful credit investigation--cite the fact that merchandise can be repossessed, but repossessed merchandise cannot always be sold for the full amount due; second-hand merchandise does not always bring a good market price, especially if the original buyer has damaged the product. (6) Insist upon prompt payments--if the customer is allowed to become deliquent, it is possible that he will owe more than merchandise is worth and will prefer that it be repossessed so that he will not have to continue payments.

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2. Conducting the credit investigation	2. Cite the need for the retailer to exercise extreme care in extending credit to customers. Stress the point that customers with "honest faces" and "sob stories" are not necessarily good credit risks. A few mistakes in selecting charge account customers or installment account customers can eat heavily into profits.
a. Sources of credit information	
(1) The customer himself	(1) Secure several credit application blanks from local firms. Post these on the bulletin board. Call students' attention to the kind of information local retailers desire from credit applicants and the types of information the applicant can furnish.
(2) The customer's references (especially local references)	(2) Stress the need for local retailers to cooperate with each other in furnishing information relating to their experiences with customers who are applying for credit.
(3) Local credit associations	(3) Invite a representative from the local credit association (or a credit manager from a local store) to discuss with your students the procedures followed in conducting a credit investigation. Ask the speaker to place some emphasis upon the need for students to learn early to manage their personal finances with a view to establishing and maintaining their personal credit reputation. Your local credit association probably holds membership in a National Retail Credit Association.
b. Information needed	
(1) Character	(1) Some authorities list character as the major factor in determining whether or not the applicant for

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	credit merits it. Character tends to be interpreted in terms of the way the applicant pays his bills; if the retailer finds that the applicant has been "good pay" in dealing with other retailers, the assumption is all too often that the applicant is a good credit risk. Don't underplay the role of character, but ask students what the charge account applicant will do about his bills in a case where the applicant "owes everybody in town." What can the applicant do about them if he has a family emergency requiring a great deal of cash? What if he becomes ill? If he loses his job? Point out that in investigating character, the retailer needs to learn everything possible about the past life and record of the prospective customer--his integrity, his obedience to the law, clean living, etc. How good is his word? What is his manner of living--does he live within his income?
(2) Capital	(2) Too often the retailer finds that the applicant who "has money" and lives in the "right section of town" does not always pay his bills. Routine credit checks generally involve checking applicant's financial condition--his bank accounts, his "liquid capital," and his salary.
(3) Capacity	(3) This refers to the applicant's physical and mental power--his ability to earn. The applicant in good physical condition is assumed to have the ability to earn; this is perhaps his strongest credit recommendation.

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	Have students copy the following statement--impress upon students that the lesson contained in the statement is a good one to learn and practice throughout life: "Capacity stands next to character, for the man of character, having a will to pay, and capacity, will find a means to pay. Moreover, a man with high capacity may be relied upon not to obligate himself to such an extent that he cannot find the means to pay."
3. Setting up the account	3. Stress the need for the retailer to follow a definite routine when customers request credit extension. This routine should be followed for <u>all</u> credit applicants.
a. Hold an interview b. Complete a credit application blank	a. b. When the customer requests credit, interview him to obtain as much information as possible from the applicant personally. During the interview, the credit application form can be prepared: Secure applicant's mailing address and other identifying information; ask applicant to provide sources of information concerning his character, capital, and capacity. A list of local charge accounts in the customer's name is a <u>must</u>.
c. Get outside information	c. Get a credit report on the applicant from local credit association; contact charge account and other references. (Perhaps a telephone call to local references will be satisfactory; obtain information concerning amount of applicant's indebtedness to other retailers and information concerning the manner in which applicant has handled accounts with those retailers.)
d. Approve or disapprove the application	d. Analyze the information obtained; if the account must be refused, write the customer a letter informing him of

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	the action. Take care to retain applicant's goodwill--invite him to buy on a cash basis until his present financial situation improves; encourage him to apply for another account at some later date.
e. Establish a credit limit	e. This is of major importance. Beware of permitting the customer to become overburdened with debt to the point that the firm might lose money on the account. Credit limit rule-of-thumb: If applicant's family income is $3,000 to $5,000, credit limit of $150-$200 is maximum justified. Conservative rule: Limit should be set at about twice the estimated weekly income of the applicant.
f. Notify customer that account is ready for use	f. Write a letter stating the action taken on the credit application and state clearly the credit limit. Inform the customer of the rules by which he must abide; for instance, "Statements will be sent on the first of each month; payment is due within ten days. Please protect your credit standing by observing this policy." <u>For Discussion</u>: As credit manager for a local department store, what action would you take on the following customer requests for charge accounts? 1. Mrs. Jones, age 50, desires to open an accunt in her husband's name; she wants to buy, on credit, a winter cost priced at $39.95. The routine credit investigation yielded the following information: Mr. Jones sells encyclopedias on a door-to-door basis; he has held this job for two years.

Topical Outline	Teaching Suggestions
	The family has no checking account; there is a savings account in the husband's name; balance, $125. No withdrawals have been made recently. Mr. Jones has an installment account with the local furniture store two years ago. This account involved a purchase price of $175; payments were made promptly on due date. No other charge accounts exist in either the husband's or the wife's name. After discussion has been completed, have students write a letter to Mrs. Jones telling her of the action you are taking on her request for a charge account. * * * * 2. Mr. Smith, age 28, has requested an account to be opened so that he can purchase a man's wristwatch costing $59.95. The routine credit investigation yielded the following information: Smith has been unemployed for five years except for short periods of time; he can't seem to find the job he really wants. He has no bank account; his wife does not work. Mrs. Smith receives $275 every month from her father's estate. Smith has no record of charge accounts with local stores. The preceding cases should provoke considerable argument; chances are that some firms would extend charge accounts in both cases. It might be interesting to have some students volunteer to present the cases to local credit managers to determine what action local stores would take in each situation. * * * *

Topical Outline	Teaching Suggestions
4. Collecting the debt	
b. Value of prompt collections	
(1) Maintaining adequate working capital	(1) Stress the concept that if the firm is to pay its own obligations, the firm must collect promptly from customers. Too much capital tied up in accounts receivable might necessitate heavy borrowing with considerable interest expense.
(2) Preventing bad debts	(2) Lax collection procedures encourage customers to delay payments. Customers generally expect to be reminded when accounts are due; if not reminded, they tend to "forget." Over-credit extensions to customers who are encountering difficulties in meeting their financial obligations is actually a disservice to the customer that can easily result in considerable loss to the firm; it just is not good business judgment.
(3) Retaining goodwill	(3) The store with lax collection procedures often loses the goodwill of its customers; when customers are allowed to "forget", they become irritated and transfer their business to other stores.
(4) Maintaining profits	(4) Stress the expense of maintaining credit departments; emphasize high costs encountered in collecting from past-due accounts and losses that can accrue from sale of repossessed merchandise.
b. Methods of collection	
(1) Monthly statements	
(2) Telephone reminders	
(3) Collection letters	(3) If desirable, construct some practical collection problems and have students write collection letters to fit the problems.

Topical Outline	Teaching Suggestions
(a) Collection letter appeals	
i. "You attitude"	i. This correspondence technique means writing from the reader's point of view. Applied to collection correspondence, the "you attitude" implies answering the question "What'sin it for the customer if he does pay the bill?" Stress the point that the customer's most valuable asset is his good credit standing--appeal to customer's desire to protect that credit standing.
ii. Appeal to pride	ii. Flattery is a good technique if not overdone: Commend customer on past performance in meeting his obligations. Tell him it was a pleasure for you to give him an excellent credit when you were contacted last month. . .
iii. Appeal to sense of honor and fair play	iii. Basic idea: We must treat all customers alike--you don't want special treatment at the expense of other customers. . .
iv. Appeal to fear	iv. An appeal to fear of lawsuit can serve to collect debts but will often result in loss of customer's goodwill; before using this appeal, determine whether or not customer's goodwill is worth retaining.
v. Gimmicks	v. Humorous reminders to pay the bill-for instance, enclosing a piece of string for the customer to tie around a finger to remind him to get his check in the mail today.
(b) Collection correspondence stages	
i. Notification	i. Routine; send the monthly statement.
ii. Reminder	ii. Send second statement; attach gummed label reading "This amount past due"--or begin the letter-writing sequence; a sales material softener

Topical Outline	Teaching Suggestions
	is often used in this stage. To use this technique, remind the customer that his account is past due, but cushion the request for immediate payment by calling attention to some article that is currently on sale.
iii. Strong reminder	iii. A memory job with nothing to cushion the request for payment; for example: "You will note from the attached statement that our September statement has apparently been overlooked. We feel that we can rely on you to make payment now in order to avoid the embarrassment of further correspondence. Please send us your check today."
iv. Discussion stage	iv. Basic idea: Let's discuss your account. The assumption is that the debtor has a good reason for not paying. Is he dissatisfied with the goods? Is he in financial difficulties? The objective of correspondence in this stage is to get the debtor to express his attitude toward the account.
v. Urgency stage	v. Basic assumption: The customer does not recognize the danger he is doing to his credit rating by not paying his bill. Urge him to protect his credit standing.
vi. Action stage	vi. Through goodwill out the window--Yell for the law! In discussing collection correspondence, attempt to obtain collection correspondence samples from local firms fo· students to examine. If firms do not desire to have you exhibit letters bearing their letterheads; ask for permission to reproduce these letters and assure the officials that you will keep the firm name confidential.

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Topical Outline	Teaching Suggestions
	In discussing the collection correspondence stages point out that there are many factors that must be considered in writing collection letters: Is this the first time the customer is deliquent? If so, perhaps the customer should be treated with more consideration than a customer that has a long record of deliquency. What kind of merchandise was involved in the transaction? If fashion merchandise, perhaps the customer should be pressed for payment sooner than if the merchandise is not subject to the fashion cycle.
C. Risk taking	C. Emphasize that the marketing of goods involves a great many risks; because of the expensiveness of performing the risk function, such performance represents a major marketing cost.
1. Types of risks	
(a) Physical destruction	(a) Physical destruction of inventory and physical facilities happens daily in the business world. Have there been any business fires in your area lately? What was the estimated loss from those fires? Post clippings from local paper on bulletin boards; underline estimated losses reported in those clippings with red pencil. Acts of God result in physical destruction--cite floods, tornado and hurricane damage to business. Emphasize the need for the marketer to take steps to minimize losses from the risk of physical destruction (other risks, too.)
(b) Merchandise deterioration	(b) Merchandise becomes shopworn, dirty; gets lost in inventory because of inadequate storage facilities and handling procedures.

Topical Outline	Teaching Suggestions
(c) Fashion obsolescence	(c) The retailer of fashion merchandise, especially if overstocked at the time of a major change in the fashion cycle, runs a risk of losing heavily. Cite end-of-the season sales of fashion merchandise.
(d) Theft	
(1) Burglary	
(2) Employee theft	(2) Ask a student to consult current periodical literature for an article on employee theft. (See Business Week, August 15, 1963, p. 104) Cite some devices employees sometimes use in stealing from employers; for instance: <u>Concealing merchandise and money on the person</u>. <u>Conspiring with outsiders</u>--especially common at retail level: Sales clerk pretends to sell to a customer, marks sales ticket with incorrect price; the two later sell the merchandise, split the money. Give students a chance to relate some of the employee thefts they have heard of or read about. Beware of holding a confessional!
(3) Shoplifting	(3) Shoplifting is a major problem in most cities and towns. Check with the local merchants' association for estimates of amounts of loss occuring annually through shoplifting. <u>Suggestions</u>: Invite a local police officer to talk to the class on the subjects of employee theft and shoplifing. Ask him to indicate the usual penalties imposed by local courts when defendants are convicted on either of these charges.

Topical Outline	Teaching Suggestions
(e) Bad debts	(e) No matter how careful a credit department might be, eventually the department will make a few bad guesses in selecting credit customers; this is normal.
2. Methods of minimizing risks	2. Risks cannot be eliminated by the marketer; they can, however, be minimized in a number of way.
a. Physical destruction	a. This risk can be minimized through shifting the risk to an insurance company. Consult a local insurance establishment for descriptive literature on the kinds of insurance available to local business-men. Discuss the types of insurance protection available and the cost of that protection.
b. Merchandise deterioration	b. This risk can be minimized by avoiding overstocking of of merchandise. Cite Hand-to-mouth buying (buying in small quantities frequently instead of buying in large quantities) as a means of mini-mizing this risk. Cite also the necessity of adequate failities for storing merchandise so that it can be found quickly and efficiently when needed. To impress students with the importance of adequate physical facilities for storing merchandise to protect it, plan a field trip to a recently remodeled wholesale establishment. Ask your guide at the wholesale establishment to comment on differences between the present facilities and the older facilities; inquire as to the efficiency of the present facilities in comparison with the older ones.
c. Fashion obsolescense	c. This risk can be minimized by careful buying and close attention to the fashion cycle. Cite the need for high markups on fashion items at the beginning of the cycle in order that losses can be recouped before they occur.

Topical Outline	Teaching Suggestions
d. Theft (1) Burglary (2) Employee theft (3) Shoplifting	(1) Burglary: This risk can be minimized by locating the business where police protection is available; by insuring against burglary losses; by installing burglar alarms. Have students discuss the effectiveness of these measures. (2) Employee theft: This risk can be minimized by careful selection, training, and supervision of employees; by making theft difficult; by reducing the incentives for theft. Have students, in small group buzz sessions, discuss the question, "What can management do to minimize employee theft?" In subsequent class discussion, cover the following points: Selecting the employee: Investigate before hiring him--Why did he leave his previous job? Does he have a police record? Training the employee: Help him to see his role in the business. Beware of setting a bad example for the employee by taking items from stock for personal use without making a record of the transaction. Supervising the employee: Visit him on the job; avoid being a policeman, but make your presence felt. Position the cash register so that amounts rung up can be seen by both customer and supervisory persons. Other deterrent measures: Use an odd-price policy, which generally makes it necessary for employees to make change.

Topical Outline	Teaching Suggestions
	Require employees to make change from cash registers, not from personal funds. Use a locked sales register-- Require the clerk to give the original copy of the sales ticket to the customr; the carbon copy rolls into the locked register. Check to see that cash and carbon copy figures agree. Discipline dishonest employees-- to be liberal with those caught stealing is to encourage other to do so. Pay a fair salary --
3. Shoplifting	3. BEWARE OF TRAINING YOUR STUDENTS TO BE SHOPLIFTERS. Give students some ideas as to how they can detect shoplifters and what they, as salespersons are expected to do when they suspect a customer of shoplifting. Emphasize that the student, as a retail employee, should not take any action to apprehend a shoplifter until he knows what managment policy relative to this problem is in the store in which he is employed. <u>Special Report</u>: Have a student investigate current law covering shoplifting in North Carolina. Have him look for the following things: 1. Can a shoplifting suspect be approached in the store? 2. Is the store risking a slander suit if a customer is falsely accused of shoplifting? <u>For Discussion</u> 1. Who are the shoplifters today? Just about anyone you care to name--the poor man, rich man, doctor, policemen--quite often, the middle income housewife.

Topical Outline	Teaching Suggestions
	Teenage shoplifters are a common problem.
	2. What am I, as a retail salesperson supposed to do if I suspect a customer has shoplifted an item? Notify your superior; do not approach the customer unless your superior has instructed you to do so. EMPHASIZE THIS POINT:
	3. How can I detect shoplifting? Look for clues in clothing, customer behavior; for instance:
	a. Watch for shoppers who wear heavy coats or raincoats, when weather doesn't merit it.
	b. Watch customers with umbrellas--umbrellas make good hiding places.
	c. Watch women with large pocketbooks--especially those who walk around with the catch open.
	d. Watch men with loose-fitting clothing--dungarees with large pockets.
	e. Watch customers who loiter around counters near exits--they grab and leave quickly.
	f. Watch customers who have a tendancy to roam behind counters--they have no business there or near cash registers.
	g. Watch people who whistle nevously; who puff rapidly on a cigarette, who juggle something in one hand.
	h. Watch juveniles--especially those who appear to linger too long doing nothing.
	i. Watch customers with baby carriages.
	j. Watch customers who keep dropping things--the customer can conceal items while stooping to pick things off the floor.

Topical Outline	Teaching Suggestions
	Suggested student readings: Wingate & Weiner: RETAIL MERCHANDISING, 6th Ed., Chapter 4, Parts A, B, C, and D Professional Reading: Shilt & Wilson: BUSINESS PRINCIPLES AND MANAGEMENT, 4th Ed., Chapters 23, 24, 25, and 27 If you desire your students to write any credit and collection letters, any recent Business Correspondence textbook will provide sample letters and suggestions for writing the letters.

VII. PERSONNEL

Materials and Equipment Needed

1. Employment application blanks from various businesses

2. Want ads for employment from "New York Times" and Sunday edition of the Raleigh "News and Observer" or "Charlotte Observer"

3. Shilt and Wilson, Business Principles and Management

4. The following Small Marketers Aids:
   "Handling the Problem Employee" - No. 77
   "What Happens When You Hire People?" - No. 98
   "How To Write A Job Description" - No. 171

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VII. PERSONNEL

Objectives

1. To promote understanding of management considerations in the employment and development of personnel
2. To familiarize students with the job-getting process

Topical Outline	Teaching Suggestions
	Note to coordinator: Since many of your students will be seeking their initial positions upon the completion of the school year, this topic should be of considerable interest to them. Capitalize upon your students' personal interests by approaching Personnel along the lines of "What's going to happen to me when I am ready to go to work?"
	* * * *
A. Employee Selection	
	1. Discuss management's concern with the selection of proper employees to fill jobs available. Emphasize the cost of employee selection and training and the needless waste encountered as a result of improper employee selection.
	Thought problems:
	--When management hires the wrong persons to fill the jobs available, what kinds of problems are being invited?
	Consider: Employee morale Unionization possibilities Low production Selection and training costs
	--When a person is seeking work, should he make any evaluations of prospective employers before accepting their jobs? Why? What are some of the factors one should investigate concerning potential employers?
	Consider: Promotional policies Employee benefits Company reputation Progressiveness

Topical Outline	Teaching Suggestions
	Assignment: From the management angle, have students investigate the costs of selecting and training workers for specific jobs that appeal to the students individually. For instance, assume that a female student is interested in becoming a demonostrator for Stanley Products. What will be the approximate selection and training costs management will encounter before permitting the young lady to demonstrate for a Stanley Party?
	Magazine articles and local firms can be used as sources of information for this material. Students might protest that some firms do not have elaborate selection and training procedures. If so, ask students to consider the approximate cost of inadequate selection and training programs.
1. Sources of employees	1. Stress the need for management's use of a variety of sources in staffing jobs available. Stress also the necessity for constant evaluation of the quality of personnel obtained from various sources. Along this line, impress students with the importance of their roles as public relations agents for their school. Some employers will hire graduates of your D. E. program--if those graduates perform effectively on the job, more garduates will possibly be hired; the reverse can also be true (it might be worthwhile for you, the teacher faced with a problem of justifying your work to the school and community, to remember this factor when you are called upon to recommend students for employment).
	Ask students to list the possible places they might go for help in seeking jobs. How are your students going to go about getting initial jobs?
a. Reference by present employees	a. From a management angle, how good is a present employee's recommendation of a

Topical Outline	Teaching Suggestions
	potential employee? (It should be a good source in that present employee desires to enhance his position with the company--the present employee will be reluctant to recommend others unless he is reasonably certain those he recommends will perform in a satisfactory manner on the job.)
b. Written applications (1) Application blanks (2) Letters of application	b. Point out that most firms receive applications for positions daily. From the management angle, stress the need for filing applications for future reference if no positions are available when applications are received. Also stress the need for care in refusing applicants jobs--the applicant is a potential customer, therefore, his goodwill must be maintained. (1) Secure copies of application blanks from several sources. Call attention to the nature of the information sought on these blanks. Why is each item of data sought? From a management angle, discuss these questions: Should the application blank have a place for the applicant to indicate his race? Are there Civil Rights implications here? Explore as desirable. How can an application blank be effective in eliminating undesirable job applicants? (Draw a relationship here between job specifications and information to be incorporated into application blanks.) Also stress that careless and sloppy completion of application blanks is, to management, an indication of a careless and sloppy quality of worker. Stress the need for accuracy in completing application blanks; also strongly emphasize the need for legibility and neatness in completing the blanks.

Topical Outline	Teaching Suggestions
	(2) Letter of application: What can management tell about a person from his letter of application? What effect will grammatical and spelling errors in the letter have upon management's decision whether to invite an applicant to come for an interview? <u>Activity</u>: Have students prepare letters of application for jobs of interest to them. Have them rewrite these letters as needed. Avoid giving students a form letter to copy--and do not accept a form letter copies from some source. For suggestions as to the proper form of letter of application, consult a business correspondence text; typing manuals also helpful.
c. Advertising	c. Have student examine want ads in local and major newspapers to determine the kinds of jobs available through this source. (New York Times, Sunday edition of News and Observer, etc.)
d. Employment agencies (1) Private agencies (2) Public agencies	d. Point out that employment agencies, especially private agencies, are a source of experienced employees who are ready for executive positions. Individual report: Ask a student to visit the nearest public employment office to obtain information concerning the services of that office to management and to the job-seeking applicant.
2. Selection procedure	2. Point out that the larger the organization, the more complicated will be that organization's selection procedure. Formal personnel departments have been established in the larger organizations. Regardless of company size, though, the basic principles of selection are the same.

Topical Outline	Teaching Suggestions
a. Personnel requisition	a. This is formal request for employees form used in larger businesses. A department head needs a new employee in his department; he requests that employee by using a requisition form. The form provides space for indicating the nature of the work involved, qualifications desired in applicants to be recruited for the job. (Why not prepare a bulletin board display on the topic "What happens in a business when a new employee is needed"-- Obtain copies of all forms used in the employment process for display).
b. Determining qualifications	b. Cite management's need for job descriptions and job specifications to insure selection of best possible applicants. Emphasize that employee selection is actually a process of matching job requirements with applicants' human qualities for purposes of selecting applicants most likely to succeed on those jobs. (Emphasize need for management to maintain records of present employee's skills which can be tapped when new jobs are created, when vacancies occur, etc.) Refer to Marketing I Manual: Job Analysis for Marketing, pp. 186-188. In that section, students were assigned a project to analyze certain marketing jobs. Add to that project now--ask students to prepare a statement of human qualifications necessary for successful performance of the job of interest to them.
c. Recruiting applicants	c. Cite the need for recruiting more applicants than jobs available in order that a choice of applicants is possible. Stress to students that getting jobs is a competitive undertaking--students must have something to offer an employer if they expect to get good jobs.
d. Selection tools	d. Project students into management roles.

Topical Outline	Teaching Suggestions
(1) Application blank	Divide into buzz groups: Discuss each of the selection tools from the angle "How effective are these selection tools in weeding out undesirable job applicants".
(2) Interview	(2) Treat the employment interview from the students' angle: answer the question "What am I supposed to do in the employment interview?" Reemphasize suggestions from Marketing I Manual, Job Application, pp. 9-15.
(3) Testing	(3) If possible, obtain sample employment tests from local employers for class examination.
(4) Reference letter	
(5) Physical examination	
B. Employee training	B. Cite management's need for a formal training program--even for the simplest jobs. Stress that learning takes place whether or not a training program is organized; to insure proper learnings, a training program is highly desirable.
1. Orientation	1. Stress management's recognition of employee's need to develop a sense of belonging in the firm. Orientation helps promote a sense of belonging, helps develop employee loyalty. Stress values of employee handbook; ask local firms, especially those that might possibly hire your graduates, to provide your class with employee handbooks for students to examine.
2. Training	2. Reemphasize cost of training employees and the need for careful selection of employees to insure management a satisfactory return from funds expended for training purposes. Suggest to students that they investigate training programs provided in local firms--have them report findings to class. Also,

Topical Outline	Teaching Suggestions
	have students write letters to major companies like General Motors, DuPont, etc. for information concerning their training programs in the marketing area for both high school and college graduates.
	In class discussion, analyze the advantages that will accrue to the student if he accepts employment with firms that do attempt to provide adequate training. Emphasize that an effective company training program can be of much value to the student; the student will be wise to be as selective in choosing his prospective employer as the prospective employer will be in selecting employees.
	Individual assignment: Assign students to contact local IGA Stores, Grant stores, Walgree stores, etc. for information concerning their employee training programs.
C. What do employees want from their jobs? 1. Secutiry 2. Fair pay 3. Interesting work 4. Good working conditions 5. Recognition a. On the job b. In the community 6. Feeling "in" on things 7. Promotional opportunities	C. Preparatory to discussing this topic, aks students to make a list of things they want from their jobs. Many surveys have been made on this topic. Point out that the salary factor rarely tops the list of employee expectations from his job--pay frequently ranks between 4th and 7th place on such lists. Take a survey in class. How did students rank the pay factor? What are the implications of lists such as this to management? Discuss.
D. Why do employees get promoted?	D. Buzz session: Have groups make a list of factors leading to promotion.
E. Why do employees get fired?	E. Buzz session: Have groups make a list of factors leading to dismissal.

Topical Outline	Teaching Suggestions
1. Too ambitious	1. Stress dangers of accepting jobs above ability and experience levels
2. Low productivity	2. Stress concept, "A fair day's work for a fair day's pay."
3. Disloyalty	3. Stress concept, "Don't bite the hands that are feeding you"--cite dangers of criticizing employer.
4. General indifference	4. "I don't care" attitude. Activity: How Long is a Minute? Have students project themselves into role of a customer in a variety store. The customer is ready to make his purchase; he is double-parked in front of the store. The sales person is chatting with another clerk and is totally indifferent to the customer. As the customr is waiting for the salesperson to wait on him, he notices a policeman walking in the direction of his car. When students appreciate the setting, have them stand for what seems to them to be one minute; when they feel that a minute has passed, they are to sit. You, the teacher, take your seat after about 15 seconds. If this can be timed near the end of the class period so that most students will still be standing after the bell rings, it will really create an impression--it will be the longest minute in history! It will also serve to promote some understanding of the effects of an employee's indifference on the customer.
F. Getting work done through people	F. Approach from the angle that students aspire to executive positions; in those positions they find it necessary to get work done through subordinates. What are some good human relations pointers an executive should keep in mind in working with and supervising subordinates?

Topical Outline	Teaching Suggestions
	Permit students to discuss this topic in small group buzz sessions. In subsequent class discussion, develop a list of pointers to be remembered, including the following:
1. Be a good listener.	1. Be a good listener--the executive can learn more about his employees by listening; the best and fastest way to know employees and what makes them tick is to listen when they talk. A good human relations pointer: If both you and a subordinate start to say something at the same time, yield the floor to the subordinate.
2. Criticize constructively.	2. Give praise when due; give cirticism when merited. To criticize without giving leadership toward a positive course of action is a waste of time; a leader must lead--destructive criticism is providing leadership in the wrong direction.
3. Criticize or reprove in private.	3. Public criticism of the subordinate often serves to place the work force on the employee's side and against the executive. Never humiliate or shame an employee before his co-workers.
4. Give praise in public.	4. Most people like to be told they have done a job well; they like others to hear that praise. Praise can be an effective morale builder. One major caution: Be sure the person praised deserves it--a "fair-haired boy" causes morale problems. ("teacher's pet" idea)
5. Be considerate.	5. Consideration for the other fellow is a trait we all should develop. The considerate boss is courteous to subordinates--he recognizes them as living, capable individuals; he does not trample on them.
6. Give credit where credit is due.	6. Never take credit for a subordinate's accomplishments--to do so is to destroy his initiative. Your superiors will praise you for your excellence in

Topical Outline	Teaching Suggestions
	developing subordinates when those under your supervision accomplish feats worthy of recognition.
7. Avoid dominating subordinates.	7. Domination of subordinates breeds "yes men." Think of your subordinates as working with you, not for you.
8. Set a good example.	8. The executive who is irregular in his habits, late for appointments, bored in attitude, careless in general, invites subordinates to be the same. If the executive is to get good work from subordinates, he must set the pace.
9. Believe in subordinates.	9. Most subordinates will perform according to what is expected of them. If employees know the superior has the confidence in them to expect a first-rate job, that's what the superior will usually get.
10. When wrong, admit it.	10. Don't be wrong too often, or subordinates will lose faith in you. When wrong, though, admit it--don't pass the buck, don't blame others.
	* * * *
	Many other topics can be included if time permits and you desire to broaden the scope of this section. For instance, you might desire to treat some of the following topics: Merit rating (Employee performance approaisal) Employee Compensation Unionization Fair Employment Practices Personnel Problems Fringe benefits Numerous Personnel Management textbooks (college level) are available and can be tapped for reference materials. For student readings, use Shilt and Wilson text.

Topical Outline	Teaching Suggestions
	Students will probably be interested in fringe benefits they can expect to receive in their initial jobs. If desirable, have students conduct a survey of fringe benefits offered by marketing establishments locally. Impress upon students that, in their initial jobs, they should be more concerned with developing their abilities to be of more value to the employer than with whether or not they will receive a vacation in July. Competition for employees has caused most sizable companies to adopt liberal fringe benefits and salary scales; the new employee in these companies will receive the benefits without haggling over them. Caution students to use good judgment in their employment interviews by not placing too much emphasis on fringe benefits. Management tends to have a negative reaction to the job applicant whose only questions during the interview are: "How much will I be paid?"; "How much vacation do I get?"; "Will I get extra pay for overtime work?"; etc. Job interviewers often ask the question: "Well, young man, what makes you think you want to work for our company?" Suggest that students consider this question when they begin the job-getting process. * * * * Student Readings: Shilt & Wilson: BUSINESS PRINCIPLES AND MANAGEMENT, 4th E., Chapter 29. Professional Readings: Secure from the Field Office, Small Business Administration, Charlotte, the following: Personnel Management Guides for Small Businesses--SBM Series No. 26 (35 cents) and The following free Small Marketers Aids (order enough for your students):

Topical Outline	Teaching Suggestions
	No. 77: Handling the Problem Employee No. 98: What Happens When You Hire People? No. 171: How to Write a Job Description

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VIII. AGRICULTURAL AND INDUSTRIAL MARKETING

Materials and Equipment Needed

1. Order the following from:
   Public Relations Department
   Chicago Board of Trade
   141 Jackson Boulevard
   Chicago 4, Illinois
   "Marketing Grain Through a Grain Exchange"
   "A Commodity Exchange"
   "The Marketplace"
   "Hedging Highlights"

2. Phillips and Duncan, Marketing Principles and Methods

3. Following industrial goods catalogs
   MacRae's Blue Book
   Thomas' Register of Manufacturers

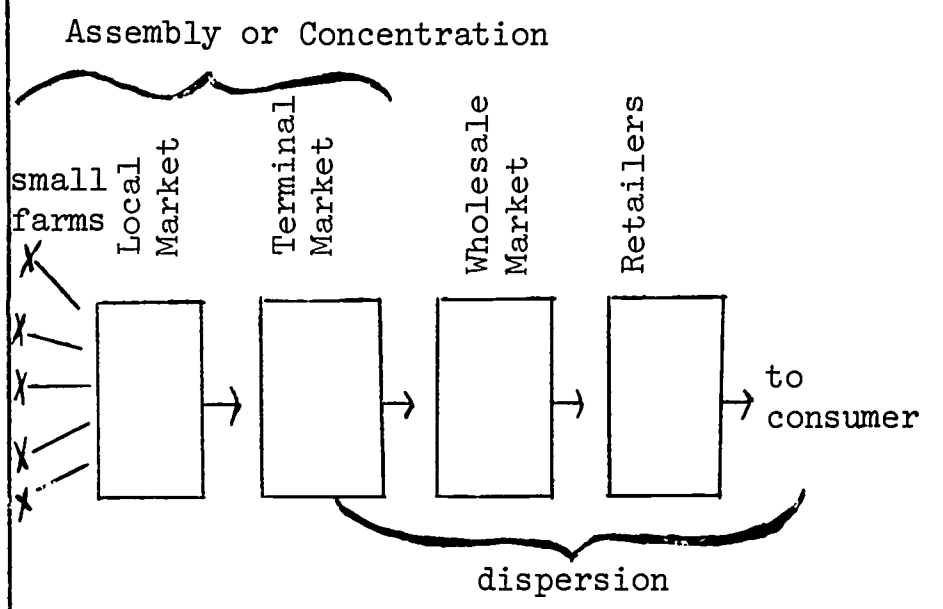
VIII. AGRICULTURAL AND INDUSTRIAL MARKETING

Objectives

1. To develop understanding of basic considerations affecting the marketing of agricultural and industrial products
2. To develop awareness of the vast industrial market and its characteristics
3. To develop awareness of distribution channels used in the marketing of agricultural and industrial products

Topical Outline	Teaching Suggestions
A. AGRICULTURAL MARKETING	SPECIAL NOTE: Because of variations in community needs, both agricultural and industrial marketing do not necessarily merit equal emphasis in your classes. To insure that your students gain some insight into these two major marketing areas, both topics should be discussed. In agricultural communities, students will perhaps be more receptive to agricultural marketing than will students in predominatly industrial areas. Treat these two topics as you see fit in keeping with the needs of your students.
1. Classifications of agricultural products	1. Give examples of products falling within each classifciation; use products produced locally if possible.
a. Agricultural consumer products	a. Fruits, vegetables
b. Agricultural raw materials	b. Cotton, tobacco, peanuts
2. Basic consideration in the marketing of farm products	2. For class discussion: How do these basic considerations affect the selection of channels of distribution?
a. Many small producers	a. To illustrate, cite farmer who picks three bushels of beans every morning. Use other local examples.
b. Producers located in areas remote from market areas	
c. Problems in controlling quality of products	

Topical Outline	Teaching Suggestions
(1) Uncontrollable weather conditions	
(2) Insect and plant disease control problems	
d. Inability of many producers to market products economically and efficiently	d. Point out that the small producer has little or no bargaining power with his small amount of produce--has to take the "going market price."
(1) Inadequate storage facilities	
(2) Perishable products	
(3) Transporting goods to market areas	
e. Seasonality of production	
f. Product characteristics	
(1) Low unit value products	
(2) Bulky products for their value	
(3) Perishable nature	
g. Government price supports-parity	g. Avoid becoming entangled in an argument in discussing price supports--give facts and some of the arguments pro and con, but let students make up their own minds!
3. Markets and middlemen for farm products	3. If any of the markets described are near your school, arrange a field trip to the market.
a. Local markets and middlemen--agricultural consumers' goods	Point out that because of basic considerations discussed in A.2. above, the marketing of agricultural products often divides itself into two stages: concentration (or assembly) stage and dispersion stage. As goods move from farm to local markets to other wholesale
(1) Focal points are near growing areas where farmer and buyers meet.	

Topical Outline	Teaching Suggestions
(2) Many kinds of middlemen (or their representatives) are present at the local market. (a) Industrial buyers who buy for food processing plants (example: a food cannery) (b) Assembling wholesalers (c) Chain store buyers (d) Agents (brokers) (e) Farmers' marketing cooperatives	markets, the goods are being concentrated; (or assembly) stage and dispersion stage. As goods move from farm to local markets to other wholesale markets, the goods are being concentrated; from terminal markets, the dispersion phase begins. The following sketch can be used to show movement of agricultural consumers' goods from farm to the ultimate consumer: 
(3) Many local markets have developed in areas where special facilities (grain elevators, for example) have been provided.	(3) Cite local examples; for instance, cucumber grading stations, peach grading stations, etc.
b. Terminal markets and middlemen--Agricultural consumers' goods	
(1) Major terminal markets are located in population centers like New York City, Boston, Houston, etc.	
(2) Washington Street Wholesale Produce Market is one of the largest in the United States	(2) Assign one student an oral report from current periodical literature on this topic (Washington Street Wholesale Produce Market, New York City)

Topical Outline	Teaching Suggestions
(a) Concentration point for produce from nearly every state and at least 37 foreign countries	
(b) Prices set here tend to determine produce prices throughout the nation.	
(3) Many large wholesale produce markets are criticized for permitting unsanitary conditions to exist.	(3) Stress highly perishable nature of produce and the difficulty involved in maintaining sanitary conditions.
(4) Variety of middlemen present in wholesale produce markets	(4) In presenting the types of middlemen operating in wholesale markets (both for agricultural consumers and industrial goods), review the functions and operational setup of the middleman if necessary.
(a) Car-lot wholesalers Generally buy in carload lots; sell in smaller lots to other wholesalers and chain stores	
(b) Commission men Negotiate sales on a commission basis; do not take title to goods but sometimes take physical possession of the goods.	(b) Example: A "factor" in cotton markets. Also, found frequently in central markets--sell livestock, fruits and vegetables. As the term implies, these are agent middlemen who sell on a commission basis.
(c) Brokers Often used by growers who bypass local markets to sell direct to buyers in central markets	

Topical Outline	Teaching Suggestions
(d) Cooperative agencies	
(e) Auction companies	
c. Secondary central markets and middlemen--Agricultural consumers' goods	c. Review the concentration-dispersion stages in marketing farm products. Point out that once agricultural consumers' goods have been concentrated in central, or terminal, markets, the dispersion stage begins. Secondary central markets are composed of wholesale middlemen, or jobbers, who buy for resale to retailers.
(1) Located in almost every sizable city, including terminal market cities	
(2) Middlemen obtain goods from either terminal or local markets for sale to other wholesalers and retailers.	
(3) Variety of markets and middlemen	
(a) Wholesale jobbers	
The equivalent of a full-service wholesaler	
(b) Farmers markets	(b) Differentiate between "farmers market" and "local market." Cite examples of each.
Market which provides for direct channel for farmer to sell either to wholesalers or retailers	
d. Local markets and middlemen-Agricultural raw materials	d. Emphasize differences between agricultural consumers' goods and agricultural industrial goods; point out that different marketing channels are used in marketing the two kinds of products. (A good opportunity exists here to dwell on area economic development.)
(1) Focal points near growing areas where producer and buyers meet	(1) Examples: Local cotton markets, local livestock markets, local tobacco markets, local grain markets
(2) Many kinds of middlemen	(2) Emphasize concentration of goods angle

Topical Outline	Teaching Suggestions
	as was emphasized in markets for consumers' agricultural products.
(a) Some buyers of consumers' agricultural products	(a) Middlemen who buy consumers' agricultural products were discussed in 3.a. above.
(b) Independent buyers	(b) Explain that independent buyers often serve local markets on a part-time basis. Their function is that of assemblyman. They buy from many producers and consolidate purchases for more economical marketing in other markets. Students can probably cite a local businessman who acts as an independent buyer during growing seasons.
(c) Commission agents acting for central market buyers and for large users of the industrial goods	* * * * SUGGESTED TOPICS FOR ORAL REPORTS: 1. Marketing Tobacco 2. Marketing Livestock 3. The Cotton Market
(d) Local cooperative associations	
(e) Local manufacturers who buy direct from producers	
e. Central markets and middlemen--Agricultural raw materials	
(1) Major concentration points usually located in large cities near producing regions	(1) Examples: Memphis Cotton Market; Kansas City, livestock; Minneapolis, wheat.
(2) Variety of middlemen	
(a) Independent merchants (of major importance)	(a) Definition: independent businessmen why buy and sell for themselves--the cotton merchant; wheat merchants.
(b) Brokers	
(c) Cooperative Associations	

Topical Outline	Teaching Suggestions
4. Farmers' marketing cooperatives	4. Review basic principles of cooperatives. Stress concept that small farmers marketing cooperatively can derive many benefits that the small farmer working independently cannot obtain.
a. Basic objective-- To improve the financial position of the farmer	
b. Accomplishing the objective	
(1) Striving for higher prices	
(2) Eliminating middlemen and absorbing their profits	
(3) Reducing marketing costs	
(4) Reducing production costs	(4) Point out that the cooperative also buys for its members-- equipment, seed, fertilizers, etc. Savings from group buying are passed on to members.
c. Types	
(1) Local associations	(1) Give local examples; for instance, cite the blueberry cooperative (Bonnie Blue Blueberries) in eastern North Carolina.
(a) Most numerous and simplest type of organization	
(b) Often composed of small farmers who appoint one of the group to manage marketing activities for the group	
(c) Strategy: to eliminate certain local market middlemen and	

Topical Outline	Teaching Suggestions
thereby permit group to absorb middlemen's profits	
(2) Federated associations	
(a) Composed of a group of local associations (an association of associations)	
(b) Assume middlemen's functions in central markets--set up sales offices, etc.	
(c) Aid members through advertising, giving assistance with transportation and handling problems	Suggested subjects for oral reports: 1. Land O' Lake Creameries, Inc., a Federated Association 2. Sunmaid Raisin Growers' Association, a Centralized Association * * * *
(3) Centralized Associations	
(a) Initiates marketing agreements with many individual producers	Bulletin Board Suggestions: Prepare a display featuring products marketed through cooperative organizations. Use either advertisements featuring the products or labels from the packaged products. Some of the following brand names are cooperatively marketed:
(b) Attempts to accomplish same functions performed by local and federated associations	Land O' Lake Butter Eatmor Cranberries Ocean Spray Cranberry Sauce Diamond Walnuts Sunkist Citrus Fruits Sunmaid Raisins Bonnie Blue Blueberries
(c) Through its membership, controls sufficient volume of production to provide for efficient and profitable marketing practices	* * * *

Topical Outline	Teaching Suggestions
d. Recognized limitations	
(1) Inefficient management	(1) Stress farmers' reluctance to pay adequate salaries to attract high caliber management personnel (true of most cooperative movements--not just in agriculture.)
(2) Poor business practices	
(3) Lack of "cooperative spirit" among members--too many "individuals"	Note: This could be a touchy subject, especially if students are from cooperative backgrounds. Handle it by pointing out that these limitations are often true of cooperatives, not necessarily true of all cooperatives. Use discretion and good jubgment.
(4) Questionable monetary benefits--farmer does not improve income in line with expectations.	
5. The commodity exchange as a marketing agency	5. This is a complex subject to explain to students. Perhaps the best way to treat the topic is to use The Chicago Board of Trade as an example of a typical commodity exchange. Materials explaining the mechanics of the commodity exchange can be obtained by writing (use your school's letterhead) to: Public Relations Department Chicago Board of Trade 141 Jackson Boulevard Chicago 4, Illinois. From this source, request the following materials in quantities adequate to meet the needs of your class: 1. Marketing Grain Through A Grain Exchange 2. A Commodity Exchange 3. The Marketplace 4. Hedging Highlights * * * * Professional Reading: Phillips and Duncan: Marketing Principles and Methods, 5th Ed., Chapters 16, 19, 20, 21. Also check locally for literature available from various farm marketing organizations.

Topical Outline	Teaching Suggestions
B. Industrial Marketing Includes the marketing of goods and services used in the production of consumers' or industrial goods and goods used in the operation of a business enterprise.	B. Discuss the kinds of buyers that fall within the scope of the industrial market. A partial listing of such buyers follows: Manufacturers; public utilities; transportation agencies; extractive industries; construction industries; distributive trades--retailers and wholesalers who buy for use in the business, not for resale; institutional buyers--hospitals, schools; agricultural producers; governmental (federal, state, local) units.
1. Classifications of industrial goods	
a. Capital investment items	a. Purchases of these items represent major capital outlays.
(1) Installations	(1) Installations are generally considered to be part of the fixed plant of the purchaser. Basic plant equipment, represeting investments of several thousand dollars, fall into this category. Examples: the printing press used by the local newspaper publisher; data processing equipment; the loom in a textile mill; the generator in a power plant. Installations are generally purchased for long-term use--life expectancy for installations is 20 to 30 or more years.
(2) Accessory equipment	(2) These industrial goods are also capital investment items, but their useful life is generally shorter than than of installations. Accessory equipment is not regarded as part of the fixed plant. Examples: typewriter; store fixtures; farm tractors; time clock punched by employees.
b. Supplies and services	b. Industrial supplies and services are used to facilitate the operation of a business. Items in this category are consumed daily and therefore, have a short life; these goods and services

Topical Outline	Teaching Suggestions
	are regarded as a normal expense of business operation.
(1) Maintenance items	(1) Items consumed in the normal upkeep of plant and equipment. Relatively inexpensive, generally standardized items. Examples: Paint, machine lubricants, nuts and bolts, cleaning compounds.
(2) Operating supplies	(2) Items used in daily business operations. Examples: office supplies--stationery, adding machine tape, paper clips; fuel used to heat the plant.
(3) Business services	(3) Services provided by outside agencies. Examples: services of microfilming agencies; office services such as printing; equipment services.
c. Manufacturing items	c. Manufacturing items enter directly into manufacturing processes that result in finished goods, either industrial or a consumers' goods.
(1) Raw materials	(1) Raw materials are basic materials (farm products, forest products, ores, etc.) which have been processed only to the extent necessary to make them convenient to market. Examples: cotton, iron ore, cowhides, etc.
(2) Fabricating materials (often referred to as "semimanufactured goods")	(2) Fabricating materials (or semi-manufactured goods) are finished products but, as such, have limited utility until incorporated into some other product. Examples: Leather is a finished product for its manufacturer, but leather, as such, has little utility for the consumer until it is converted into a belt, a billfold, or some other finished product. Other examples are sheets of steel, cotton cloth.
(3) Parts	(3) Parts are finished products that can be incorporated into another product. The automobile industry

Topical Outline	Teaching Suggestions
	affords an excellent example of the parts market. The automobile is a finished product composed of many parts--tires, batteries, radios, spark plugs, etc. The parts manufacturer often has two major markets to which he will cater: (a) the original equipment market (b) the repair and replacement market (often referred to as the "after market") The term "multiple market" is frequently used in periodical literature. The term means that the manufacturer markets goods in more than one market. For instance, when the automobile manufacturer produces an automobile, spark plugs are incorporated into the original equipment. The consumer, after using the automobile, eventually must replace the spark plugs; thus, the consumer becomes a part of the "after market". (At this point, it might be wise to remind students that manufactured goods can be classified as either consumers' or industrial goods, depending upon the destination of the goods. If the goods are destined for use in the industrial market, they are industrial goods; if destined for use in the consumer market, they are consumers' goods. Spark plugs incorporated into the new automobile are industrial goods; spark plugs sold to the consumer to replace worn plugs are consumers' goods. It is highly probable that manufacturers that service both markets will use separate channels to reach the different classes of buyers.)
(4) Contract services	(4) When contract services are used by a manufacturer, he contracts part of the manufacturing job to an agency outside his firm. For instance, a small textile

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	manufacturer might contract with an outside agency to dye the fabrice * * * * Upon completing the presentation of industrial goods, try a game technique to assist students in recognizing and classifying different industrial goods. Select several industrial goods, have students, either as a group or individually, respond with the proper classification of the goods. For example: Teacher calls — Student responds loom for a textile mill — installation paper clips — operating supplies wheat — raw matierial typewriter repair service — business services time clock — accessory equipment oil used to heat plant — operating supply etc. * * * *
2. General characteristics of the industrial market	2. Industrial marketing differs in many respects from the marketing of consumers' goods. A flannel board presentation of the characteristics of the industrial market will be of value in helping students to understand these differences and to appreciate marketing strategies implied by the characteristics.
a. The demand for industrial goods is a derived demand.	a. The demand for industrial goods is highly dependent upon the demand for those consumers' goods in the production of which the industrial goods are used. Several examples can be used to illustrate this characteristic: (1) There would be no demand for fertilizer if there were no demand for products grown with the use of fertilizer.

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	(2) There would be no demand for glass food containers if there were no demand for foods packaged in glass containers. <u>Thought problem for class discussion</u>: Ask students to assume that they are in the business of producing soft drink bottle caps. What will the market for bottle caps be dependent upon? What marketing strategy will the manufacturer probably find most effective to enable him to increase his market for bottle caps? Will reducing the price of bottle caps below the prices of a competing bottle-cap manufacturer affect the market for bottle caps? If so, how? <u>Guide discussion along the following lines</u>: The market for soft drink bottle caps will be derived from consumer demand for soft drinks. To broaden the market for bottle caps, the manufacturer might find it necessary to advertise the soft drink(s) which his product caps. As the market for these soft drinks broadens, so will the manufacturer's market for bottle caps. Reducing bottle cap prices below competitors' prices could cause buyers to shift their source of supply, but the price cut would not necessarily increase the total demand for bottle caps. A price reduction would probably cause competitors to retaliate with price cuts, and a price war could easily develop--with the bottle cap industry as a whole suffering. <u>Suggestion</u>: Examine current periodical literature for advertisements in which manufacturers of industrial goods have advertised finished consumers' goods in which the industrial goods are incorporated. (Example: DuPont's advertising of finished products made from nylon) Use the advertisements to illustrate marketing strategy

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	followed by some industrial good producers to increase sales of the industrial goods. Post these advertisements on the bulletin board.
	* * * *
b. The demand for industrial goods fluctuates with the demand for consumers' goods	b. Since the demand for industrial goods is a derived demand, the industrial market is highly sensitive to consumer market conditions. In periods of prosperity, industrial production is high, investment in plant facilities accelerates, employment is high. In periods of depression or recession, consumers curtail buying, industrial production is curtailed. Relate the "fluctuating demand" concept to Federal tax reduction proposals. Emphasize, for example, that cuts in income taxes result in more consumer take-home pay--and more consumer spending on goods. High-level consumer spending enables manufacturers to expand plants and production, employment is high, etc. ("Keeping the economy moving ahead" idea.)
c. Industrial purchases generally involve large sums of money.	c. Contrast buying practices of consumers with those of industrial buyers. Industrial buyers buy in large quantities and many thousands of dollars are often involved in the transaction.
d. Industrial buyers may be limited in number and concentrated geographically.	d. This concept can be satisfactorily presented by using simple illustrations like the following. Contrast the market for shoes with the market for shoemaking equipment. (Most consumers are buyers of shoes, but there are only a limited number of industrial buyers of shoemaking equipment)
(1) Vertical market (narrow market)	(1) Vertical market: the market for an industrial product is a narrow market--

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	very limited number of users of the industrial product. Example: textile machinery--only textile manufacturers will buy the machinery.
(2) Horizontal market (Broad market)	(2) Horizontal market: the industrial good is bought and used by many different kinds of industrial organizations. Example: carbon paper is used by almost all business firms, therefore, the market for carbon paper is a horizontal market.
e. There tends to be a need for and a reliance upon service in marketing industrial goods. (1) Pre-sale service (2) After-sale service	e. Cite local industries in which both pre-sale and after-sale service is provided by the manufacturer. Example: A company purchasing basic plant equipment might need pre-sale service (perhaps technical engineering service) from the seller to determine what needs to be done to strengthen floors sufficiently to accommodate the machinery; the company installing automated equipment needs pre-sale service for purposes of designing systems and procedures to fit the equipment. After-sale service is needed to insure that the machinery performs satisfactorily and to insure that the buyer's good will be maintained until that time the machinery must be replaced.
f. Rational buying motives generally govern the purchase of industrial goods.	f. Consumers buy many products in satisfaction of emotional buying motives: pride, prestige, emulation, etc. The industrial buyer, however, buys primarily to satisfy the profit-making motive. <u>Problem</u>: Have students analyze the sale of an air conditioning unit to an office manager. Can they relate the sale of the air conditioning to the profit-making motive? How will air conditioning assist in making profits? Permit one student to conduct a sales presentation in which he demonstrates appeals to the profit-making motive.

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g. The purchase of industrial goods is frequently subject to a multiple purchasing influence (sometimes referred to as "diffused buying responsibility").	g. More than one person in the firm must approve purchases. Perhaps a good example of this characteristic is available in your local school system. If new classroom desks are to be purchased, who has to approve the purchase? How many people are involved? Encourage students to speculate upon the kinds of problems they would, as salesmen, encounter in selling industrial goods to a firm in which the multiple purchasing influence is present.
h. Reciprocity is common in the industrial market.	h. Reciprocity: You buy from me and I'll buy from you--You scratch my back and I'll scratch yours. Example: The steel manufacturer needs office machines--the office machines manufacturer uses steel in the manufacture of machines. The two companies agree to buy from each other. How difficult will it be for a salesman to sell to a company that has a reciprocal agreement with the salesman's competitor?
Standardized industrial goods are frequently purchased from catalogs.	Perhaps a local industrial firm will lend you a catalog for class examination. Two well-known industrial goods catalogs are MacRae's Blue Book and Thomas' Register of Manufacturers.
3. Channels of distribution for industrial goods	3. In presenting channels of distribution, attempt to relate characteristics of the industrial market to the various distribution channels.
a. Manufactured industrial goods	
(1) Direct from producer to industrial user	(1) The direct channel is perhaps the most commonly used channel in the industrial market. This is particularly true of installations and of ther industrial goods when large amounts of money are involved in the transaction. Here are some of the characteristics that lead to a direct channel: --Large sums of money involved --Limited number of buyers --Pre-sale and after-sale service required --Reciprocity

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(2) From producer to user through manufacturer's sales branch	(2) Is a manufacturer's sales branch located near your school? Invite a speaker from this branch to discuss "The Function of the Sales Branch." If no speaker is available, explain that the sales branch serves as headquarters for salesmen operating within the area, serves as a distribution point near buyers' places of business, serves as a convenient source from which repair parts and service can be obtained rapidly by purchasers and users of the specific industrial goods.
(3) From producer to user through agent (or functional) middlemen	(3) If desirable, spend some time defining and discussing agent middlemen. The key idea to be stressed is that agent middlemen assist with negotiations concerning transfer of title. Agent middlemen in most cases do not take title to goods in which they deal, nor do they generally take physical possession of those goods. Their function is purely negotiatory in nature. Examples of agent middlemen are brokers, commission merchants, selling agents, manufacturers agents. Consult any marketing text for difinitions, characteristics, and services of these agent middlemen. Some students will find it wothwhile to explore the career potential of these middleman occupations, particularly that of the manufacturers agent.
(4) From producer to user through industrial distributors	(4) Industrial distributors are, in the field of industrial marketing, essentially the same as full-service wholesalers in the marketing of consumers' goods. The term will apply to almost any wholesale establishments engaged primarily in the sale of industrial products to buyers who buy for use rather than for resale of the product in its same form.

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b. Non-manufactured industrial products	b. Non-manufactured industrial products include agricultural raw materials, extractive products, and products for industry which are marketed in their natural state.
(1) Agricultural industrial goods	(1) See VIII.A., above for discussion of agricultural marketing.
(2) Natural products other than agricultural	(2) In the marketing of natural products (products of mine, forest, sea) for industrial purposes, users are relatively few as compared with users of finished consumers' goods. Most large producers distribute directly; in fact, industrial users will frequently control their sources of supply of these goods. Small producers may use agent (functional) middlemen; some will use the drop shipper. <u>Drop shipper</u>: a wholesaling middleman who operates in a manner similar to the agent middleman. The major difference is that the drop shipper takes title, whereas the agent middleman negotiates without taking title to products in which he deals. Pupil-participation project: Instruct pupils to prepare short reports for oral presentation on distribution channels uses in marketing certain industrial goods (cooper, iron ore, lumber, cotton, tobacco, etc.) Use local resouraces where possible--perhaps a local lumber dealer can be used as a source of information on the marketing of lumber. Perhaps, too, a local dealer might be desirable as a visiting classroom speaker.
c. Business services	
(1) Direct channel	(1) Since most services are marketed as they are created, the producer of those services will generally market them directly. Examples: banking services; machine repair services.

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(2) Producer to user, through brokers (agents)	(2) Example: Travel agency that makes business travel arrangements for the businessman. * * * * <u>Professional Reading</u>: Phillips and Duncan: <u>Marketing Principles and Methods</u>, 5th Ed., Chapters 17, 18.

IX. GOVERNMENT AND MARKETING

Materials and Equipment Needed

1. Shilt and Wilson, Business Principles and Management
2. Phillips and Duncan, Marketing Principles and Methods
3. "Wall Street Journal"

ERIC

IX. GOVERNMENT AND MARKETING

Objective
To develop insight into the role of government in marketing activites

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	NOTE: Many political philosophies are probably represented in your class--keep in mind that you are not a crusader for any cause and that your function is not to impose your personal convictions on your students. Governmental relationships to business is controversial--do not be an agitator; on the other hand, you will not be performing your job if you shrink from intelligently discussing pertinent legislation as it affects marketing. Civil rights legislation, for example, affects marketing and should be explored for its effects on marketing activity--and for that purpose alone. Many people, including your students perhaps, believe there is too much governmental interference with business activity--whether this is true or not is immaterial; your job is to present facts as these facts affect marketing management decisions. If you present arguments relating to governmental regulation, present the pros and the cons--then permit students to formulate their own philosophies and convictions.
	* * * *
	Student activity: Assign some of your better students a debate on the topic: "There is too much government interference with business activities." (Are you personally responsible for a chapel program in your school? If so, a well prepared debate on this topic will serve as a worthwhile program for all students, not just your business students.)
	* * * *
A. Roles of government in marketing	
1. Role of a facilitating agency	1. Define "facilitate"--to facilitate is to help; to make easier--thus government "helps" marketing.

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a. Collection of business data	a. To illustrate the facilitating role, cite the vast amounts of data made available to Amereican businesses through governmental offices. Census data, for instance, are of great help to marketers in pinpointing potentially profitable market areas. Emphasize that data provided the businessman are not collected primarily for his benefit--these data are a by-product of governmental activity.
b. Publication of standards for manufactured goods	b. The Commodity Standards Division of the U. S. Department of Commerce cooperates with industry groups by publishing standards adopted by the group--point out that standards set by this agency are not legal standards in the sense that manufacturers must manufacture goods to conform with published standards; instead, these are permissive standards--the manufacturer might produce according to those standards. When 65 per cent of the members of a given industrial group agree to a certain standard, then the Department of Commerce publishes the agreed upon standard as the standard for the group. Question: Of what value are standards to manufacturers? In discussing the question, point out that a new manufacturer of electric light bulbs would have difficulty in marketing his product if the bulbs did not fit most electrical outlets--in this illustration, standards help the new manufacturer to make a product more acceptable to a larger segment of the consuming public.
c. Sponsoring educational programs	c. Your school's D. E. program is, in essence, a governmental aid to marketing.

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d. Promoting competition	d. Though the controlling role of government is often criticized by marketers, in essence, this controlling role can be considered as a facilitating role in that its basic objective is to help competition work in our economy.
2. Role of a regulatory agency	2. There is much regulation of business activity--so much that some ask the question: "Are we heading in the direction of Socialism?" (You might ask students to express their opinions as to whether or not they would prefer the government--as in England--to operate railroads, or would the prefer private industry to operate the railroads. Have students defend their points of view.) To illustrate the role of government as a regulatory agency, ask students to check current literature (today's newspaper could easily have the material needed.) for actions of the Federal Trade Commission, particularly actions relating to deceptive advertising practices.
3. Role of a marketing agency	3. Treat this topic in as much depth as you desire--the topic is broad enough to permit you to expand into the area of international trade if you like. The topic can quickly lead to controversy, especially if you are teaching in an agricultural area where government price supports are considered vital. Beware taking sides should an argument develop.
a. Marketing surplus farm commodities	a. This is a touchy topic--and a potentially explosive one. To set off the "fireworks," raise the question: "Should our government buy surplus cotton and then sell it to manufacturers in Japan at lower prices than it will sell to American manufacturers and then permit Japanese cotton goods to enter American markets and be sold at lower retail prices than American goods?" To emphasize and dramatize this question, bring a Japanese-made cotton item and a similar American-made item to class. Note differences in retail price on the

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	two items. (The assumption is that you will, for purposes of emphasis, bring a considerably higher priced American-made product to class.) Encourage students to argue the pros and cons of the question raised above. encourage a small committee to investigate local retailers' opinions on the question. * * * * <u>Thought question</u> (for class discussion) We often read about the abundance of surplus commodities in our nation--we see estimates that these commodities are costing in excess of a million dollars a day in storage expenses. We also read about starvation in India, China, and other countries. Why don't we cut our storage bill and give these surplus commodities to needy countries?
b. Marketing electrical power	b. If you desire to introduce more "fireworks" into your class, refer your students to the TVA (Tennessee Valley Authority) project. Refer students to Compton's (or some other reference) Encyclopedia for background material on the project; then encourage students to check with your school library for articles written pro and con on this subject. Although these articles will date back many years (some as early as 1933), the effort will be justified in that students will get a good picture of popular thinking on the role of government as a marketing agency. * * * * Communications Satellite (COM SAT) was much in the news in 1964-1965. Students are probably aware that this vital communications media was developed at government expense and is now controlled

Topical Outline	Teaching Suggestions
	by private industry. Have students investigate COM SAT and then express opinions as to whether or not this media developed at tax payers' expense, should now be in the hands of private industry.
B. Regulation of Competitive and Business Practices	B. To introduce this topic, raise the question "Why does government need to regulate competition?" Seek to answer this question as you discuss the various Acts listed in this section. Emphasize the concept that American business, through many questionable and perhaps unscrupulous practices, has brought governmental regulation and control upon itself. For current and living material to illustrate this concept, see issues of the Wall Street Journal--call students' attention to companies currently accused of violating laws cited in the topical outline section. * * * * In discussing the various laws included herein, avoid getting into depth discussions--teach the laws at the introductory level only. Cite differences between <u>interstate</u> and <u>intrastate</u> competition. Emphasize that Federal legislation applies to <u>interstate</u> competition. * * * *
1. Federal legislation a. Sherman Antitrust Act b. Clayton Act	a. Both Sherman Act and Clayton Acts, from a b. maketing point of view, relate to the control and prevention of monopolies. <u>Assignment</u>: Ask students to write a paper of the following topic: The Evils of Monopolistic Businesses Encourage students to consider the effects of monopoly on prices, new businesses

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	desiring to enter the field, etc., as they write their papers. * * * * Point out that in some lines of business, utilities and railroads, for instance, monopoly is permitted. Why is this permitted? Guide answers to point out heavy capital investment required by railroad company, problems of duplicated facilities--can you imagine three different railroad stations in town--plus the fact that if too many companies are allowed in the transportation business, there might not be enough profit in given areas to justify the competition--no company would profit.
c. Federal Trade Commission Act d. Wheeler-Lea Act	c. This Act established the Federal Trade Commission. It gave the Commission the authority to d. investigate business practices which allegedly resulted in injury to competition. The Wheeler-Lea Act, passed in 1938, broadened the powers of the Federal Trade Commission to include investigation of competitive practices which resulted in injury to the public. In discussing the Federal Trade Commission, include the following points: 1. The Commission is concerned with businesses engaged in interstate competition. 2. The Commission administers most of the federal laws concerned with unfair competitive practice. 3. Competitive practices often considered unfair competitive practices by the Commission are:

Topical Outline	Teaching Suggestions
	a. Price discrimination b. False and deceptive advertising c. Some product labeling practices d. Misbranding (Perhaps some students will recall Carter's Little Liver pills--"liver" had to be removed from product name.) 4. The Commission organizes industry conferences at which industry members, with the help of the Commission, establish codes of fair business competitive practices. Encourage students to consult current and recent periodical literature--include the daily newspaper-- for articles and items relating to the Federal Trade Commission. Articles relating to deceptive advertising will add much interest to this topic.
e. Robinson-Patman Act	e. The Robinson-Patman is an involved piece of legislation that is difficult to interpret. Avoid becoming too deeply involved in the peculiarities of the Act. The Act is an amendment to the Federal Trade Commission Act and is concerned with the prevention of price discrimination; it is administered by the Federal Trade Commission. Illustrate price discrimination. Cite as an example a manufacturer that gives special price concessions to one buyer but does not give similar concessions to a comparable buyer. (These concessions might be in the form of discounts or promotional allowances.) The effect of these price concessions is that the receiver of the

Topical Outline	Teaching Suggestions
	concessions is placed in a more favorable competitive position than his competitor who did not receive them. Point out that a buyer who knowingly accepts a discriminatory price is just as guilty of violation of the Act as is the seller who grants the price concession.
f. Food, Drug, and Cosmetic Act	f. Regulates food drugs, and cosmetics sold across state lines. Administered by the Department of Health, Education and Welfare.
g. Trade Mark Act	g. Provides protection for owners of trade marks and trade names. (The name "Camel" is a trade name for cigarettes--is registered under the Trade Mark Act by R. J. Reynolds. Law suit is currently brewing against a liquor distributor why has branded his product "Camel.") Act enforced by U. S. Patent Office in the Department of Commerce.
2. State legislation	2. Many companies are not engaged in interstate competition and do not, therefore, come under the provisions of much of the federal legislation. In such cases, state legislation, patterned after federal legislation, has been passed for regulatory purposes.
a. Printers' Ink Model Statute	a. Printers' Ink is a magazine well known in advertising circles. The editors have long promoted a truth-in-advertising campaign. The Model Statute attempts to prevent dishonesty in advertising--it outlaws deceptive and misleading advertising. The Model Statute as designed by the Editors of Printers' Ink has been adopted as state legislation in more than 40 states; most other states have enacted similar legislation based on the Model Statute. Stress the concept that states have passed laws to promote truth in

Topical Outline	Teaching Suggestions
	advertising and that these laws pertain to companies engaged in intrastate competition.
b. Fair Trade Laws	b. Many states have passed Fair Trade Laws; North Carolina does have such laws. Although Fair Trade is state legislation, it is supported by Federal Legislation. Fair Trade enables manufacturers to make contracts with retailers relative to retail prices to be charged for products. A point on controversy in Fair Trade is the "nonsigners' Clause"--in essence, this means simply that a manufacturer is permitted to sign a contract with one retailer in a state re retail price. When the retailer signs the contract, his action binds every retailer who handles the product to observe the agreement--even though only one retailer signed. Stress the concept that Fair Trade is enabling, or permissive, legislation. The manufacturer does not have to Fair Trade his product in a state, but if he desires to do so, he is enabled or permitted to do so. Student Activity: Have students visit local stores for the purpose of preparing a list of products that are Fair Trade items. Many known brands will appear on these lists; among these brands will probably be: Botany 500 men's uits Gorham Silver Magnavox London Fog When these lists have been compiled, ask students questions concerning the effect of Fair Trade on price competition. If the students were operating a discount house, would they be for or against Fair Trade? If he were operating a small-scale

Topical Outline	Teaching Suggestions
	retail store, what position would he take on Fair Trade? How does Fair Trade affect the student as a consumer? A debate on the topic "We should abolish Fair Trade in North Carolina" will be interesting and informative. Call to students' attention that for many years, a bill has been "kicked around" in Washington that, if ever passed or enacted, would be, in effect, a national Fair Trade law. The bill is know as the "Quality Stabilization Bill." You might have students investigate this proposed legislation. Are students for or gainst such a law? Why?
c. Licensing laws	c. Point out that state, county, and city governments use licensing as a device to limit and control entry into various kinds of businesses.
d. Chain store tax laws	d. In some states highly discriminatory chain store licensing taxes have been imposed on chains. The typical situation is a graduated tax rate. For extreme examples of these laws, check into chain store tax laws in Louisiana and Indiana.
e. State Food, Drug, and Cosmetic Acts	e. Similar to, and patterned after the Federal Act; pertains to intrastate competition.
f. Antitrading stamp laws	f. Variations in these laws exist in the various states. Some states require bonding of stamp companies to insure redemption of stamps by stamp savers; some states require that stamps be redeemed in cash only; Kansas prohibits stamps. Many legislatures have attempted to abolish stamps (has been attempted in North Carolina) but housewives generally come to the rescue of this trade promotion device.
3. City legislation	3. Have students check with local city authorities to find out the nature of the regulations that must be observed by local businesses.

Topical Outline	Teaching Suggestions
a. Licensing laws	
b. Zoning laws	b. Concerned with where businesses can locate in the city. Business cannot locate in a residential zone; must locate in section of city zoned for business. (Obtain a city map. Where are busines zones? Outline in red. Post on bulletin board.)
c. Building regulations	c. Regulations regarding type and construction of buildings; primarily concerned with safety factors.
d. Green River ordinances	d. Green Riber (Wyoming) Ordinance is a model law concerning control of door-to-door peddlers. Most cities have laws regulating door-to-door selling--many have adopted the model Green River Ordinance.
e. Blue Laws	e. Concerned with Sunday business hours.
	* * * *
	Student reading assignment:
	Shilt & Wilson: Business Principles and Mangement, 4th Ed., Chapter 33.
	Professional reading:
	Phillips and Duncan: Marketing Principles and Methods, 5th Ed., Chapter 32.
	The Wall Street Journal will prove to be a valuable source of current information on government and marketing. Look especially for items relating to changes lodged against companies that are in violation of acts cited in the topical outline.

X. MARKETING CAREERS

Materials and Equipment Needed

1. Dictionary of Occupational Titles
2. Standard Industrial Classification Manual
3. Job Guide For Young Workers
4. Career Kit - Largo, Florida
5. Chronicle Career File
6. Science Research Associates Career File
7. Career pamphlets from Employment Security Commission
8. Occupational Outlook Handbook

X. MARKETING CAREERS

Objectives

1. To acquaint students with the wide variety of jobs available in marketing
2. To impress upon the student the need for studying after he has completed his high school program

Topical Outline	Teaching Suggestions
	General Comments: 1. Be fair with your students. Do not lead them to believe that, upon completion of this course, they are ready to solve the problems of the business world. Students have merely been introduced to the world of marketing--much more preparation is needed before they will be ready for a high-salaried marketing position. 2. If you have not already done so, begin preparing an occupational file in each of the marketing areas; add new materials to the file at every opportunity. 3. A student does not necessarily have to have a college degree to "go places" in marketing--he will, however, find more doors open to him if he does have the degree. 4. A person can, with application and continued study on the job, advance into supervisory postions. Before the supervisor position comes, though, the individual will have to prove his worthiness for the position. 5. Seek assistance with career preparation topics from school guidance counselors--if these people are available in your school, solicit their cooperation. 6. Cite places where your students can go, after high school graduation, to obtain additional preparation for higher level marketing jobs--for instance, cite preparation available from industrial education centers. 7. For those students in your classes who

Topical Outline	Teaching Suggestions
	have the potential for successful college work, urge-beg-plead with them to enhance their earning potential by going to college; if financial difficulties prevent students from seriously considering college, help these students locate financial aid (investigate loan funds, scholarships, etc. Ask for help from school counselor). 8. Impress students with the wisdom of constant and continuous study to prepare themselves for advancement once they have accepted their initial positions. Stress the concept that the worker who progresses up the promotional ladder is the one who prepares himself to take over the job immediately above his present job level; when promotional opportunities arise, the employee who has prepared himself for promotion is the employee most likely to receive the promotion. 9. Encourage students to exercise care in selecting their initial positions. Stress advantages of obtaining employment with firms that offer training and in-service development opportunities. Encourage students to avoid firms that can offer only dead-end possibilities. <u>Review work</u> Many of your students will, upon completion of this year's work, enter the labor force. It will be helpful to these students if you will again discuss some of the following topics: 1. From Marketing I Manual, review Job Application, pp. 9-15. 2. From Marketing I manual, review Personality and Marketing, pp. 182-185. Assist students in setting up a plan for edveloping acceptable personality traits. * * * *

Topical Outline	Teaching Suggestions
	In Marketing I, students were assigned a project in which they were to prepare a job analysis for marketing jobs of individual personal interest. Have students to reconsider their interests and direct their attention to a supervisory or management position in marketing. Instruct students to prepare another job analysis for this supervisory or management level position that is now of interest; using the job analyses, prepare job specifications for the respective jobs (by definition, a job specification is a statement of minimum human qualifications necessary for success in the job; a sample job specification appears on the next page). Students are no doubt aware of the fact that they are not equipped to assume a management or supervisory position immediately upon graduation from high school. Encourage students, however, to get a career objective and constructive plans for acquiring the human qualities necessary for success in the job for which they have made their job analyses.

JOB SPECIFICATION

Job: Messenger Department: Plant Date of issue: Jan. 31, 1966

Hours: Varies Job Location: X City Wage schedule: R-5

Job summary: Picks up mail and packages. Sorts mail and maintains schedule of delivery. Drives light delivery truck. May wrap packages, run postal metering machine, and handle valuable documents.

Training: OJT

Promotional opportunities: Various clerical jobs

Experience:

Required: None

Helpful: Experience in driving and/or messenger service

Qualifications

Age: 18 to 25 years
Height: 5'9" to 6'1"
Reach: Long reach desirable
Weight: 150 to 195 lbs.
Vision: Good; color discrimination
Hearing: Good
Voice: Average
Handedness: Right-handedness
Hand and finger dexterity: Average or above
Education: High School or Equivalent

Intelligence: Average
Special qualifications: Posses a chauffeur license
Handwritten: Legible
Conversational ability: Average ease of conversation
Adaptability: Adaptable to new and changing condition of the job
Appearance: Average, neat and clean
Manner: Suitable for meeting and dealing with the public

Topical Outline	Teaching Suggestions
A. Sales Promotion	
1. Personal characteristics needed	
a. Imagination	
b. Creative thinking	
c. Wide interest range	
d. Mastery of English fundamentals	
2. Educational preparation	
a. English	
b. Literature	
c. Sociology	
d. Psychology	
e. Marketing	
3. Employment sources	
a. Advertising firms	a. Businesses engaged in the preparation of advertising for many clients--an advertising agency.
b. Media agencies	b. (Radio & TV stations; newspapers, magazines, etc.)
c. Marketing firms	c. (Retailers, wholesalers, service establishments.)
B. Sales and Personnel Management	
1. Personal characteristics	
a. Critical mind	
b. Ability to plan	
c. Ability to motivate others	
d. Work experience	

Topical Outline	Teaching Suggestions
2. Educational preparation	
a. Marketing-Management courses	
b. Liberal arts courses	
c. Psychology courses	
3. Employment sources	3. Every business of any relative size is in need of management personnel in the sales and personnel areas. The level of the positions available will be largely dependent on the nature of the individual establishment
C. Merchandise Management	
1. Nature of the position	1. Merchandise managers control the buying and selling of goods; their job is to insure that the store has goods necessary to meet customer demand.
2. Experience necessary	2. Perhaps the best way--indeed the only way to understand merchandise management--is to gain a wealth of experience in selling to the public and then gain experience in buying for the public. This is one of those positions that can best be prepared for by "working your way up" the ladder. Emphasize that additional preparation helps one in "working his way up."
a. Selling experience	
b. Buying experience	
D. Marketing Research	D. Marketing researchers must develop analytical abilities and the ability to utilize analytical tools. Some lower level marketing research jobs can be performed satisfactorily (for instance, conducting research interviews) without a great deal of preparation. Success in the majpr marketing research positions requires a scientific mind. Key jobs require college preparation.
E. Warehousing	
1. Marketing institutions	1. Every business must provide some storage facilities; larger businesses will require specialized warehousing

Topical Outline	Teaching Suggestions
	personnel. Responsibilities include control of inventory, efficient storing of merchandise. Lower level clerical jobs provide entry into warehousing divisions of business; promotional possibilities present for energetic and ambitious workers.
2. Public warehousing	2. Opportunities for the individual to go into business for himself--if capital is available. Promotional possibilities into supervisory positions present for the worker who exerts himself to learn the storage business.
F. Transportation	
1. Traffic management	1. The traffice manager's job is a key job in larger businesses. (manufacturer level especially)
a. Responsibilities	
(1) Learning freight classifications, rate structures	
(2) Selecting proper means of transporting products	
(3) Tracing lost shipments	
(4) Supervising packaging, and loading	
b. Preparatory work experience	b. Entry level jobs include clerical work in traffic departments. The efficient and ambitious worker can climb the ladder of promotion into supervisory and management positions.
2. Transportation companies	2. Encourage students interested in transportation to investigate the wide range of jobs available with railroad companies, motor carriers, air lines, etc. Entry positions in these companies can, for the energetic employee, lead to supervisory and management positions.
a. Railroads	
b. Motor carriers	
c. Air lines	

Topical Outline	Teaching Suggestions
G. Credit	
1. Knowledge required	
a. Credit and collection principles and procedures	
b. Accounting	
c. Business law	
d. Finance	
e. Letter writing	e. Stress the need for developing ability to write courteous, tactful, and effective business letters.
2. Job opportunities	
a. Credit bureaus	
b. Credit & collections departments in marketing firms	b. In credit & collection work there is a wide variety of jobs with promotional possibilities:
c. Collection agencies	(1) Credit interviewers
	(2) Credit investigators
	(3) Collectors
H. Finance	H. Invite a representative of a local bank to speak to the class on the topic: Entry jobs in banking. Encourage the speaker to generalize on promotional possibilities.
1. Banks	
2. Lending agencies	
I. Risk Taking	I. Concentrate emphasis on jobs in the insurance field. Point out that the insurance field is highly competitive--but opportunity is there for the individual who will exert himself to succeed. Call students attention to the fact that, in some towns and cities, insurance men are a "dime a dozen."
1. Insurance firms	
2. Claims adjusting firms	Occupational information which may be used and which should be available in your school:

Topical Outline	Teaching Suggestions
	Dictionary of Occupational Titles Standard Industrial Classification Job Guide for Young Workers Career Kit Largo, Florida Chronical Career File Science Research Associates Career File (Science Research Associates 259 E. Erie Street Chicago 10, Illinois) New York Life Insurance Career Planning materials Career pamphlets from Employment Security Commission Occupational Outlook Handbook--Obtain from Superintendent of Documents, U. S. Government Printing Office Washing, D. C. 20402 ($4.75) Many of the above materials will be available through the school counselor.

VT 002 588
Cooperative Distributive Education; Teacher's Guide to Student Activities.

North Carolina State Dept. of Public Instruction, Raleigh. Distributive Education Service
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ABSTRACT - The teacher's guide is designed to aid the teacher-coordinator in planning individual and group activities for students in Distributive Education I and II. The teaching techniques suggested include case studies, structured reports, and assignments related to class study, the students' jobs, and club contests. Units containing suggested activities for Distributive Education I are: (1) School and Business Relationships, (2) Sales Development, (3) Business Communications, and (4) Organizations for Distribution. Units containing suggested activities for Distributive Education II are: (1) Career Planning for Professional Growth, (2) Economics for Distribution, (3) Merchandising, and (4) Business Psychology. Each unit contains teacher information and student forms for the suggested activities. (SB)

VT 002 588

ED0 45856

COOPERATIVE
DISTRIBUTIVE
EDUCATION

TEACHER'S GUIDE to

STUDENT

ACTIVITIES

U S. DEPARTMENT OF HEALTH, EDUCATION
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VT 025588

Distributive Education Service
State Department of Public Instruction
Raleigh, N. C.
1966

INTRODUCTION

The objective of the distributive education program is to provide sound vocationally-directed instruction for high school students who are preparing to enter some phase of the distributive world. As the coordinator of a distributive education program, you will have for your program of instruction four basic channels to work through: (1) classroom instruction, (2) supervised work experience, (3) club work, and (4) individual study and research.

Your classes will be composed of students whose vocational objectives and interests include widely different areas of activity. Since time will not permit a depth study of any one activity, the goal of general classroom instruction will be to teach the basic principles and theories of marketing goods and services in our economy.

Work experience provides the student an opportunity to learn actively, use, and improve information and skills relative to his job. Under proper direction and guidance from his employer, the student learns not only what to do, but also how to do it.

The club is designed to provide the student with opportunities to improve his leadership skills, to increase his participation in civic affairs, to improve his social competencies, and to allow for further vocational growth through special contests, projects, and club programs.

The fourth element in the distributive education program is individual study. No area provides greater challenge to the coordinator or greater benefit to the student. Individual study under proper supervision allows the student to relate general facts and theories learned in class to the specific situations and characteristics of his chosen vocation.

The STUDENT ACTIVITIES MANUAL, hereafter referred to as the Manual, is designed to aid the coordinator in the fourth channel of instruction--individual study. Realizing that for every coordinator, and especially the beginning one, the designing of individual activities can be an overwhelming task, the writers hope that the Manual will be a useful source of individually-directed activities. The activities described and outlined are not intended to dictate a rigid structure for the coordinator to follow through the year. Rather, it is hoped that it will be a springboard from which the coordinator can evolve an ever-wider variety of student learning experiences. Creativity on the part of the teacher is still a necessity; the Manual, therefore, is intended to stimulate originality, not to replace it.

The activities suggested in the Manual include a wide variety of teaching techniques. Some lend themselves best to group activities; others to individual study. You will probably not want to use all of these suggestions,

nor would you want all students to do the same assignments. The student's vocational objective should be the key factor in deciding which areas to emphasize for individual study. There will be times, particularly at the beginning of a unit, when the entire class may work on the same assignment in order to achieve general understanding; later assignments may be planned to meet individual needs. The teaching techniques suggested include case studies, structured reports, and assignments related to general class study, the students' jobs, and DECA contests. The teacher will want to expand this list of activities to include films, field trips, interviews, trade journal reading, panel discussions, buzz sessions, and other forms of directed observation, analysis, discussion, and practice. Several forms which lend themselves to continued use throughout the year are included in the first section; these might well be included in the students' D.E. notebooks. The weekly self-evaluation forms can help the coordinator keep up with what each student is doing on the job. These forms can point up times when extra attention on the part of the coordinator is needed; they can also aid the student in recognizing the importance of his job. The other forms are designed to help give more meaning to such things as field trips, speakers, and reading assignments. Case studies were included in order to help the student develop his ability to make sound decisions. The procedure for handling cases is given with the first case in Unit I. This case might be solved by the entire class to establish the method to be used in solving the other cases in the Manual. Also included are some practice work sheets which may be used to increase the students' skills in certain areas of study.

In using these activities and developing your own, you might bear in mind the following guidelines:

1. Keep the student's vocational objective the controlling factor in assigning these activites.

2. Always make assignments clear.

3. Have a time limit which will allow adequate time for the student to finish, but will not allow the assignment to absorb an amount of time out of proportion to its importance.

4. Make clear to the student how the activity will be used in determing his grade.

5. Set high standards and do not allow the student to look on assignments as "busy work."

6. Always clear an assignment first with an employer if it is to involve either his cooperation or information about his business.

7. Explain in detail to the student how to get any necessary information from his employer.

8. Allow some class time for these activities. Remember, these students are working as well as going to school: don't load them down and allow what is intended to be a challenge to become a burden which discourages rather than encourages.

9. Have each student keep a record of the activities he undertakes during the year.

10. Be enthusiastic. If you think an activity is interesting and worthwhile, your students probably will, too.

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THE USE OF STUDENT EVALUATION FORMS

In the broadening concepts of education, increased emphasis on student evaluations, both of themselves and their curriculum, is advisable. Therefore, included in this manual are six evaluation forms that could be of great help to students and teachers.

Weekly Self-Evaluation - It is suggested that a portion of class time be allotted for students to complete this form once a week. You will see that this evaluation serves two purposes: (1) it creates a job-learning situation for students, and (2) it makes coordinators aware of students' work problems. It is also suggested that this information be confidential between the student and the coordinator. This information will help to keep you informed on the students' progress between coordination visits, and it might also point up situations that would merit a visit to the training station.

Periodic Review of Job Performance - This form provides a summary of weekly self-evaluations. It is designed to be a review for students and a checklist for training sponsors. It is suggested that training sponsors be given the opportunity to examine these forms when they are completed to make corrections or additions, and that they sign where indicated.

Report on D.E. Fieldtrip, Supplementary Reading Report, Report on Guest Speaker, and Audiovisual Report - These four reports are designated to make students more aware of the information to be gained from these related activities. To be successful, they must be used regularly and followed up with individual or class discussion.

Please note that the report on D.E. Fieldtrip calls for information prior to the trip as well as a summary after the event.

Use of these forms is optional. They are presented in the hope that you will find them beneficial learning experiences for your students and a guide for you in planning future activities.

CDE I. UNIT I: SCHOOL AND BUSINESS RELATIONSHIPS

WEEKLY SELF-EVALUATION

Student-learner:_____For week ending:_____

1. What major responsibilities or duties did you perform this week:

Responsibility or Duty	Approximate Time Spent
a._____	_____
b._____	_____
c._____	_____
d._____	_____

2. What new skill, information, or knowledge did you acquire on the job? Describe._____

_____

_____

_____

3. From individual study or classroom discussion, what did you learn that could be applied on the job?_____

_____

_____

4. What problems did you encounter and how did you solve them?

_____

_____

_____

5. In what ways could your job sponsor and your coordinator help you improve your job performance?_____

_____

_____

PERIODIC REVIEW OF JOB PERFORMANCE

Directions: Check back over your weekly self-evaluation reports for the past grading period (six weeks or nine weeks) and make a summary of the duties and responsibilities you have performed. List the new things you have learned during this period of time. Have your job sponsor sign this form below.

Training station: _____

Job sponsor: _____ Period of time: _____ _____
(From) (To)

What have been your major duties or responsibilities during the past grading period?

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

Comments: _____

_____

_____

_____

_____

_____

(continued on next page)

During this time, what new skills or knowledge have you acquired on the job?

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

_____

5. _____

_____

6. _____

_____

REPORT ON D. E. FIELD TRIP NUMBER_____

(Fill out this page before field trip.)

Name of organization:_____

Address:_____

Host:_____

Date:_____Time:_____

1. The objectives of our trip are:_____

_____

_____

2. Permission slips from parents, training station, and other classes are due:_____. Make-up work for other classes will be due:_____

3. Information we hope to gain._____

_____

_____

4. Specific questions to ask in gaining this information._____

_____

_____

_____

_____

_____

_____

_____

(continued on next page)

(Fill out this page after the field trip.)

5. Summary of the field trip. _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

6. What was the most valuable aspect of the trip for you? _____

_____

_____

_____

_____

_____

_____

_____

7. This field trip could have been improved by: _____

_____

_____

_____

_____

_____

_____

ERIC

SUPPLEMENTARY READING REPORT NUMBER _____

Name of book or publication: _____

Article or chapters covered: _____

Author or publisher: _____

Publication date: _____

Pages read: From _____ To _____

1. Give a brief resumé of the material you read. _____

_____

_____

_____

_____

_____

2. How will you apply this information:

   a. In the classroom? _____

   _____

   _____

   b. On-the-job? _____

   _____

3. What points would you like to investigate further? _____

_____

_____

4. Coordinator's comments: _____

_____

_____

(continued on next page)

Place here reading notes or clippings which are important to you and which were gained from your individual reading.

REPORT ON GUEST SPEAKER NUMBER _____

Name _____

Title or occupation _____

Company _____

Presentation topic _____

Reason for presentation _____

_____

1. Give a brief resume of the presentation. _____

_____

_____

_____

_____

_____

2. How will the information learned be of use to you:

   a. In the classroom? _____

   _____

   b. On the job? _____

   _____

   _____

3. What points would you like to investigate further? _____

_____

_____

_____

ERIC

AUDIO/VISUAL REPORT NUMBER _____

1. Type of presentation: _____

2. Title of presentation: _____

3. What knowledge did you gain from this presentation? _____

_____

_____

_____

_____

4. List questions you will want to ask. _____

_____

_____

_____

_____

5. What points would you like to see discussed? _____

_____

_____

_____

_____

6. Do you think that this material should be used in the future? _____

_____

_____

_____

_____

THE USE OF CASE STUDIES

A student of business with tact
Absorbed many answers he lacked
But acquiring a job,
He said with a sob,
"How does one fit answer to fact?"

This sad limerick describes the plight of a student who had not had the benefit of learning by the case method. As shown in Case Number One in School and Business Relationships, case studies are valuable to students in learning to make sound decisions because they encourage the use of logical thinking rather than methodical memorizing.

Cases may be presented to the class in three ways: (1) the case may be given to the students to be solved individually; (2) it may be given to the students and then solved by the entire class; (3) it may be elaborated upon by having the class members role-play various parts and then have other students question the role-players to get additional facts not presented in the original case. This last method should not be used until students have had varied experience in solving cases individually and as a group.

There are many ways of solving a case problem, such as the Four-Step Method in Human Relations and the DICE method suggested in Marketing, Sales Promotion, and Advertising. If you are not familiar with these methods, you might follow the steps suggested below:

1. List problems
2. List facts
3. List assumptions
4. List possible courses of action
5. Determine definite course of action

Care should be taken to see that all terms used are understood, and that all important facts are brought out. There is not necessarily one correct way to solve any given problem. The reasons behind the decisions should be considered fully as important as the decisions themselves.

C. D. E. I. UNIT I: SCHOOL AND BUSINESS RELATIONSHIPS

Activity 1: Preparation for Job Interview

There are many factors to consider in getting ready for your job interview. In preparation for your interview, you should plan carefully. Complete the following assignment as preparation for the interview.

1. Complete the attached application blank.

2. Answer the following questions:

   a. What are the factors that will make this job acceptable as a DE job?

   b. What is the name and title of the person to whom you are applying?

   c. What forms and other articles will you take with you to the interview?

   d. How will you dress? Be specific.

   e. List as many as you can of the duties of the job for which you are applying.

   f. What are the qualifications required to fill this position successfully?

   g. List the qualifications you have which are required for the job you seek. Underline those you think to be most important.

   h. List some of the things you should and should not do during the interview.

3. State your plan of action for the interview, beginning with your initial approach to the interviewer and ending with the conclusion of your interview.

4. During the course of your job interview, you are asked the following questions. How would you answer them?

   a. What is Distributive Education? Marketing?

   b. How do you spend your spare time?

   c. What are your future vocational plans?

   d. Why do you think you might like to work for our company?

   e. Have you ever had any difficulty in getting along with fellow students and faculty?

   f. Do you think grades should be considered by employers? Why or why not?

(continued on next page)

g. Who has had the most influence on your life? Why?

h. Define cooperation!

i. In what school activities have you participated? Why? Which did you enjoy the most?

j. Tell me about yourself!

k. Why do you think you are qualified for this position?

5. Practice your interview in class.

6. Write a thank you letter to your interviewer.

Notes to the instructor:

1. Have students demonstrate the right and wrong way to handle a job interview. You might ask the personnel director of a business to speak to the class and then role-play this situation with the students.

2. Have each student role-play at least one (more if time permits) job interview.

3. Have other students evaluate by using the "Job Interview Rating Sheet" found in DECA Contests and Awards Handbook.

ERIC

To receive proper consideration all questions must be answered.
Please complete this application in your own handwriting.

APPLICATION FOR EMPLOYMENT

Attach recent photograph here.

Date:_____

Social Security Number:_____

Name in full: _____
(Last) (First) (Middle)

Married woman give maiden Name: _____

Present address: _____ Phone: _____
(Street) (City) (State)

Are you a U.S. citizen?____ How long have you lived in this state?_____
In this city? _____

Date of birth:_____ Place:_____ Age last birthday:_____

Marital status: Single ____ Married ____ Separated____ Divorced_____ Widowed____

Dependents: None____ Self____ Husband____ Wife____ Boys(number)____ Girls(number)___

Residence: With parents___ Board___ Room___ Rent____ Own Home_____

Do you own other real estate? _____ Do you own an auto?_____

Were you ever employed here?_____ From_____ To _____

Have you any relatives or friends in our employ? Name:_____ _____ Relationship_____
Name:_____ Relationship_____

Physical information: Height:_____ Weight:_____. Have you heart trouble, hernia, kidney trouble, or high blood pressure? _____ Have you ever had TB?____

Physical defects, if any: Sight_____, Hearing_____, Speech_____, Hands ____,

Arms_____, Feet_____, Legs_____.

Nature and date of any serious operation or illness:_____

Have you ever had a back injury?_____

In case of accident, notify: _____ Phone:_____

Address: _____
(Street) (City) (State)

(continued on next page)

Kind of work desired: _____ Date available for work: _____
Salary you will consider: _____

What are your qualifications for this work? _____

Are you willing to live wherever you may be sent? _____ What location would you prefer? _____

Have you ever made application for a bond which was refused? _____

Have you ever been arrested? _____ Explain: _____

Are you currently receiving unemployment compensation? _____ If yes, give state _____

EDUCATION	NAME OF SCHOOL	CITY AND STATE	NO. OF YEARS	DID YOU GRADUATE?	DATE OF LEAVING	MAJOR COURSES OR SUBJECTS
Grammar school						
High school						
College or university						
Business or vocational school						
Other (specify)						

List any honors received: (1) Academic: _____ (2) Other: _____

Are you now studying? _____ Where? _____

What foreign languages do you speak? _____ Read? _____ Write? _____

List special skills you have (typewriting, machine operation, etc.): _____

List the organizations or clubs to which you belong and offices held: _____

What are your hobbies or special interests? _____

Have you served in the Armed Forces? _____ How long? _____

(continued on next page)

Branch:_____ Discharge date:_____ Present status: _____

Rank on entering service: _____ On leaving service:_____

Are you in the Reserves or National Guard? _____

Remarks (include campaigns, awards, decorations, etc.): _____

_____

_____

_____

_____

Employer	Nature of your work	Starting date	Starting salary	Date left	Leaving salary	Reason left
PRESENT EMPLOYER Address _____ City _____ State _____						
LAST EMPLOYER Address _____ City _____ State _____						
SECOND TO LAST EMPLOYER Address _____ City _____ State _____						

References (do not list relatives)

	Name and Title	Address	Occupation
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____

Give a detailed description of your previous experience and training. Specify the type of work you have done:

_____

_____

_____

(continued on next page)

I certify that the information contained in this application is correct to the best of my knowledge. The acceptance of this application does not indicate there are positions open and does not in any way obligate the company.

Signature

date

C.D.E. I. UNIT I: SCHOOL AND BUSINESS RELATIONSHIPS

Activity 2: Case Study

"Help Wanted"

A local farm machinery company has a vacancy in the sales department. Mr. Allman, Director of Sales Personnel, calls the high school and asks that interested young men in the distributive education program submit letters of application and data sheets. When the letters arrive, he narrows them down to two, one from Frank Brown and one from John Hobbs.

The letter from Frank Brown contains the following: "I am certain that I can sell the machinery. I get along well with people. I have always been interested in selling, so I believe that I can sell the machinery. Since I am about to be married, I would like a permanent position."

John Hobbs' letter contained the following statements: "Since I live on a farm, I have had the opportunity to use all types of farm equipment. This experience has enabled me to appreciate the quality of Pell's farm equipment. Although I have not sold farm equipment, I have studied salesmanship in D.E. and have worked part-time in a garden shop."

Questions to Discuss:

1. Is it better to use general or specific statements in a letter of application? Why?

2. If you were Mr. Allman, which student would you hire? Why?

3. How could Frank Brown have used specific statements as evidence that he gets along well with people?

4. Is marriage a good selling point? Why or why not?

Notes to the instructor:

With this first case, give each student a copy and have them answer the questions. Through class discussion, guide the group to agreement in light of the possible solutions.

Activity 3: Personality Inventory

Name_____ Date_____ Score_____

Directions: This is an inventory of your personality. Each question is to be answered yes or no in the space provided. If you cannot honestly answer the question, put a question mark in the space. This survey is an effort to find out about you and your individual qualities. Answer the questions honestly. These will not be taken up. They are for your own use.

___1. Do you tend to argue or disagree when someone gives his point of view about which you disagree?
___2. Can you always trust yourself when handling money that does not belong to you?
___3. Do you usually hate to see the other fellow get promoted or get something you don't have?
___4. Do you usually want to share your responsibility with someone?
___5. Are you easily discouraged?
___6. Do you go out of your way to give assistance to a friend?
___7. Do you tell people who have done you a favor that you appreciate it?
___8. If you dislike a person, do you enjoy telling him what you think of him?
___9. Do you usually feel tired and dull?
___10. Do you mostly have to be coaxed to talk about yourself or the things you have done?
___11. Can you stand to have someone else, other than your close friend, be the center of attraction in a crowd?
___12. Have you ever copied from someone else in any of your school work?
___13. Are you willing to devote extra time and effort to your work even though it means giving up some pleasure?
___14. Can you always be depended upon to carry out an assignment without assistance from anybody?
___15. Do you feel as ambitious at three o'clock in the afternoon as you felt at ten in the morning?
___16. Are you always glad to help new people in their school work or in finding their way around and in meeting other people?
___17. Have you often gone out of your way to express your gratitude to someone?
___18. Would you sooner quit a job than be "bawled out" by your employer?
___19. Are you always cheerful when you are trying to "cheer up" your friends?
___20. Do you ever cross the street to avoid meeting people you do not like?
___21. Are you inclined to tell a bigger story than the other fellow?
___22. Do your friends ever trust you with their personal belongings?
___23. If you worked in a store and your neighboring clerk, whom you knew rather well, wanted to exchange lunch hours with you, would you oblige if the manager had no objections?
___24. Do you seek and depend upon the advice of others in most things which you are asked to do?
___25. Are you anxious to get to work or start a project which you know is going to take a long time?
___26. Do you avoid the responsibility of offering or volunteering your time and services for such things as the school patrol, Red Cross, and Community Chest?
___27. If a customer should call your attention to a mistake you had made in favor of the store, would you thank him?

(continued on next page)

____28. When your friends and the people you meet are sad or unhappy, does this tend to make you unhappy?
____29. If you were working in a store, could you restrain your feelings toward a customer if he had made you show him twenty samples of yard goods and then refused to buy?
____30. Do you exaggerate your abilities when talking at home or to friends?
____31. Have you ever shut off the radio or television or changed stations because you could not stand the program, even though others in the room may have been listening?
____32. Have you ever misrepresented the facts to your parents or friends in order to get them to allow you to do something?
____33. Do you habitually eat in the presence of others without sharing with them?
____34. If you were going to buy some clothes for yourself, would you ask someone to go along, other than your parents, to help you make a selection?
____35. Can you stick to a tiresome task for a long time without someone's prodding or encouraging you?
____36. Do your parents or your employer have to tell you everything they want you to do?
____37. Are you slow to show your appreciation for others because you do not want to feel obligated to them?
____38. Is it hard for you to refrain from whistling, stamping your feet, or loud clapping when you are in assembly, at a show, or in other public places?
____39. Can you take fair criticism smiling?
____40. Do you ever hesitate to offer your services for something because you feel you might not do the job correctly?
____41. Can you stand to have someone younger than you give you good advice?
____42. If you were selling a garment containing 60 per cent wool and the customer asked whether the article was woolen, would you be telling the truth if you answered yes?
____43. Do you share or lend your prize possessions to others?
____44. Can you make hurried decisions alone without outside help?
____45. Are you one of those who never do anything today that can be put off until tomorrow?
____46. Are you willing to give up your spending money for a worthy cause, such as the Red Cross, Community Chest, and Foreign Relief?
____47. Do you pass out compliments in the hope of receiving one yourself?
____48. At church or Sunday school, do you give your undivided attention to the teacher or minister?
____49. Does the weather usually affect your disposition?
____50. Have you ever "invited yourself" to visit or go along with a group when an invitation was not forthcoming?
____51. When you are in a group, can you listen to a conversation that does not interest you but that seems to be of interest to other people?
____52. Have you ever found a small article that you did not return or attempt to return?
____53. Do you expect attention at home from the family before other members of the family?
____54. Do you usually work things out for yourself rather than get someone to show you?
____55. Do you take advantage of every opportunity to do extra work for extra credit?
____56. Would you be willing to offer your services for charity without pay?
____57. Do you usually "Do unto others as you would have others do unto you?"
____58. Are you in the habit of using sarcasm?
____59. Are you always in a good humor when you get out of bed?
____60. Have you ever hesitated to call a person or nodding acquaintance of the opposite sex on the telephone because they might think you were being fresh?

____61. Does it bore you to listen to a joke which you have already heard?
____62. Do you have trouble in keeping your eyes on your own paper when taking a test?
____63. Do you make contributions to school requests for money, canned goods, services, etc., for needy people?
____64. Do you depend on your parents for money for current-events magazines, school plays, or athletics?
____65. Does it usually tire you to concentrate?
____66. Does the fact that you have to stop to help others usually annoy you?
____67. Do you usually just say "Thank you" because it is the polite thing to say?
____68. Do you always enjoy playing petty jokes on your friends?
____69. Do you show irritation easily over little things?
____70. When you make high grades on a test, do you tell everybody about it?
____71. Do you become impatient when a friend for whom you are waiting is late?
____72. When people ask for opinions concerning their appearance, do you tell them exactly what you think?
____73. When you work with a group, do you want all the credit yourself for the work the group has accomplished?
____74. Do you always shift the blame to somebody else even when you know you are really guilty?
____75. Do you ever plead headaches or sickness to get out of doing mental or physical work.
____76. Do you ever do something for your neighbor without feeling you should be paid for it?
____77. Do you feel that your parents owe you a living until you are able to get a job?
____78. Do you always talk in a calm, pleasant voice?
____79. Do you usually keep your troubles to yourself?
____80. Do you tell everyone about all the places you have visited and the good times you have had?
____81. Are you a "know-it-all" person who won't accept other people's advice?
____82. Are you ever tempted to copy other people's homework?
____83. Did you ever take something belonging to your mother or father without their permission?
____84. Do you do things which make others confide in you?
____85. Do you participate actively in school activities, such as plays, athletics, music, and clubs?
____86. If your friend had two hours of housework to do and he could not go with you until he had completed it, would you assist him?
____87. Do you always return favors?
____88. Would you find yourself at a loss to know what to do in case of an accident, or if your house caught fire?
____89. Is it easy for you to keep secret something a person tells you?
____90. Are you shy and backward?
____91. Can you find something good in people after you know them?
____92. If you saw the answers to a test on the teacher's desk, would you be tempted to copy them?
____93. Are you habitually tardy for school?
____94. Do you usually have others help you with your work?
____95. Do you work as hard as you play?
____96. Is it easy for you to check your own test paper without any desire to make a change?
____97. Are you conscious of the fact that there are people who have gone out of their way to help you?
____98. Do you have to be forced into a position of responsibility?
____99. Do you find it harder to control your temper when you are tired?
___100. Do compliments from others tend to make your head feel bigger?

Notes to the instructor:

1. Have each student fill out the personality inventory individually.

2. Be certain to stress the fact that they are for student use only. They will not be taken up. Therefore, students should be completely honest with themselves.

3. The questions have been constructed in such a manner that the student is actually being evaluated on ten positive traits of personality.

4. As class discussion, have students decide what the ideal person would do under the circumstances.

5. Have students mark answers to questions that they failed to "measure up" to as an ideal person.

6. From this chart, students will be able to determine which personality traits they need to improve.

The chart shown below will help you diagnose your shortcomings. Circle the number of the question where your answer did not agree with the one decided upon in class. Total the circled numbers and note the personality traits in which you showed the greatest weakness. Use this chart to analyze and improve your weak points.

Personality Traits	Question Numbers										Total Errors
Forbearance	1	11	21	31	41	51	61	71	81	91	_____
Integrity	2	12	22	32	42	52	62	72	82	92	_____
Unselfishness	3	13	23	33	43	53	63	73	83	93	_____
Confidence	4	14	24	34	44	54	64	74	84	94	_____
Vigor	5	15	25	35	45	55	65	75	85	95	_____
Helpfulness	6	16	26	36	46	56	66	76	86	96	_____
Gratefulness	7	17	27	37	47	57	67	77	87	97	_____
Self-restraint	8	18	28	38	48	58	68	78	88	98	_____
Cheerfulness	9	19	29	39	49	59	69	79	89	99	_____
Modesty	10	20	30	40	50	60	70	80	90	100	_____

Total Errors _____

C.D.E. I. UNIT I: SCHOOL AND BUSINESS RELATIONSHIPS

Activity 4: Physical Characteristics

Frequently we offend others unknowingly. The list below was compiled from the results of hundreds of answers to the question, "What physical traits keep people from presenting a good appearance and hence hurt their personalities?" Place a check mark before each thing that applies to you.

_____ Dirty fingernails
_____ Dirty hands
_____ Beard
_____ Excessive makeup
_____ Powder smears or dabs
_____ Yellow or unclean teeth
_____ Food between teeth
_____ Visible blackheads
_____ Pimples on face
_____ Dirty neck
_____ Dirty ears
_____ Greasy hair
_____ Dirty scalp
_____ Dandruff
_____ Hair too long
_____ Ragged fingernails
_____ Dirty shirt
_____ Soiled underclothes
_____ Dirty collar and cuffs
_____ Baggy trousers or skirt
_____ Soiled suit or dress
_____ Runs visible in hose
_____ Hose seams crooked
_____ Run-Over heels

_____ Unshined shoes
_____ Dirty, dusty shoes
_____ Body odor
_____ Bad breath
_____ Too few baths
_____ Inappropriate clothes
_____ Stoop shoulders
_____ Slouchy walking
_____ Awkward posture
_____ Hair not combed
_____ Greasy skin
_____ Gaudy fingernails
_____ Broken shoestring
_____ Buttons missing
_____ Tie poorly tied
_____ Tie crooked
_____ Tie wrinkled
_____ Collar wrinkled
_____ Clothes fitting poorly
_____ Dirty handkerchief
_____ Wrinkled suit or dress
_____ Soiled, dusty purse
_____ Torn gloves
_____ Too much perfume
_____ Dirty gloves

Number of Checks_____

If you checked fewer than five items, you are neater and better groomed than the average college student.

If you checked between five and ten items, you are below average in neatness and should do something about it now.

If you checked more than fifteen, you are in pretty bad shape. Drastic action is necessary.

Look over the items that you checked. Each one is a personality defect in the eyes of other persons. Every one of these defects can be eliminated.

CDE I. UNIT I: SCHOOL AND BUSINESS RELATIONSHIPS

Activity 5: Personality Survey

Ask five adults (about the age of your parents) and five of your friends to make a list of the personality traits they like best and the ones they object to most in young people. Tally all of the replies. Then compare the list compiled from the older group with that compiled by the younger group.

Answer the following questions:

1. What are the similarities in the lists?

2. What are the dissimilarities?

3. If there are differences, what do you think are the reasons for them?

4. How can a study of these differences help you in your plan for personality improvement?

- - - - - - - - - - - - -

Notes to the instructor:

After each student has tallied his results individually, tally the results for the entire class to find the traits people like most and least in young people.

This survey and results would be appropriate for a news story in the school or local papers.

C.D.E. I. UNIT I: SCHOOL AND BUSINESS RELATIONSHIPS

Activity 6: Knowing Your Company

A beginning employee should become acquainted with certain aspects of his company as soon as possible. Complete the information called for in the following questionnaire.

KNOWING YOUR COMPANY

I. The History of the Company

A. Who organized the company?

B. Where was it organized?

C. When was it organized?

II. The Organization of the Company

A. Is it a local or national concern?

B. Where is the main office? Regional offices?

C. How many employees are there?

D. List the names of the officers, managers, or supervisors of your company.

LARGE COMPANIES	SMALL COMPANIES
Manager _____	Manager _____
Operating Superintendent _____	Assistant Manager _____
Personnel Manager _____	Audit Manager _____
Training Supervisor _____	Advertising Manager _____
Controller _____	Personnel Assistant _____
Credit Manager _____	Customer Service Manager _____
Advertising Manager _____	Unit Control Manager _____
Merchandise Managers _____	Cashier _____
_____	Credit Manager _____
Unit Control Manager _____	Receiving Room Manager _____

Display Manager _____

Customer Service Manager _____

Head Cashier _____

Receiving Room Manager _____

Security Supervisor _____

Your Floor Manager _____

Your Department Manager _____

Department Managers _____

_____

_____

_____

Other Key People _____

_____

_____

FOR COMPANIES WITH LOCAL OFFICER ORGANIZATIONS

Chairman of the Board _____

President _____

Vice Presidents _____

_____

_____

Secretary _____

_____

Treasurer or Cashier _____

_____

Department Heads _____

_____

_____

Supervisors and Other Key People _____

_____

_____

_____

_____

III. What services does the company offer its customers?

_____

_____

_____

_____

IV. If your company is a retail or wholesale store, what merchandise lines are carried and where are they located? If your company is a service business identify the services sold by your company.

_____

_____

_____

_____

V. What are the practices of the company concerning:

A. Hours open for business: _____

_____

B. Employee hours per week _____

Your schedule _____

C. Absence and tardiness

Rules Applying _____

To Whom do you Report _____

By What Time _____

D. Time Cards and Time Clocks

Where do you punch clock _____

When do you punch clock _____

Rules Applying _____

E. Rest Periods

When taken _____

How long _____

Rules Applying _____

F. Lunch and Supper Periods

When taken _____

How long _____

Cafeteria or lunchroom _____

G. Employee Purchases

Discount _____

When eligible _____

When can you shop _____

H. Employees' Packages

Where to put _____

Checking procedure _____

I. Employee Accounts

What accounts allowed _____

When eligible _____

Rules applying _____

J. Dress Regulations

In general what you should wear _____

Specific regulations applying to dress and grooming _____

K. Safety Regulations

_____

_____

L. Telephone Procedure

How to answer _____

Other rules applying _____

M. Personal Business on Company Time

Rules on use of telephone for personal calls _____

_____

Mail delivered to company _____

Shopping in store _____

N. Regulations of Your Employer

Breaks _____

Smoking _____

Visiting with friends _____

Pilfering _____

Dishonesty _____

Damaging company property _____

Soliciting subscriptions, pledges, or contributions _____

Playfulness and inattention to duties _____

0. Keeping Confidential Information

What is confidential _____

VI. What Are the Company Benefits for Full-Time Employees?

1. Life insurance _____

2. Health insurance _____

3. Retirement policy _____

4. Vacations _____

5. Paid absences for illness, jury duty, etc. _____

_____

6. Holidays _____

_____

VII. What Are the Opportunities for the Future in the Company?

1. Possible careers _____

_____

_____

2. Education and training provided _____

_____

_____

3. Promotion policy _____

_____

_____

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Activity 7 -- Making Change

A. Using the fewest coins and pieces of currency, what change would you give the customers?

EXAMPLE:

Amount of Sale	Amount Received	Change in Coins					Change in Bills				Total Change
		1¢	5¢	10¢	25¢	50¢	$1	$5	$10	$20	
$ .61	$ 1.00	4		1	1						$ .39
5.22	10.00										
1.64	20.00										
8.77	10.00										
.39	1.00										
1.13	1.50										
.77	5.00										
7.52	7.75										
1.04	5.00										
3.82	5.00										
23.45	50.00										
6.05	20.00										
.23	5.00										
.34	2.00										
.12	1.00										
8.35	10.00										
4.11	4.50										
5.52	6.75										
5.01	8.01										
.74	10.00										
1.64	20.00										

(Continued on next page)

B. Answer the following questions before making change.

1. Put the money received for a purchase _____

_____

2. Repeat to the customer _____

_____

3. Build up change from _____

4. Use as _____ coins and bills as possible.

5. In the cash drawer, keep all bills _____

_____

6. The last thing you say to the customer is _____

7. Be accurate in order to: _____

_____

_____

_____

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Activity 8: Skit on Parliamentary Procedure

COMEDY OF ERRORS

The skit you are about to see is the scene from one of the meetings of a newly organized DECA Club and the officers are trying to conduct the meeting by using the correct parliamentary procedure. As all of you know, organizations have parliamentarians only to be called on when needed; and they should always be seated directly in front of the president, or as nearly as possible, as many times the president may have some doubt about the correct procedure. The simplest way for him to get the information is by writing a note to the parliamentarian. However, in this skit, the parliamentarian will speak up and try to correct some of the most common mistakes made in the meeting.

CAST

President:	Miss Hope To Do Better
First Vice President:	Miss Nearly All Wrong
Second Vice President:	Mr. Alone Champion
Secretary:	Miss Talk A Lot
Treasurer:	Mr. Do It Your Way
Parliamentarian:	Mr. Would Be Orderly

For your approval or disapproval,

A COMEDY OF ERRORS

PRESIDENT comes dashing in late, books in arm, apologizing____ ____ ____ After placing things on the table, thumbs through as if to find procedure. She is dressed in loud colors, hat with veil over the face, lots of jewelry.

SECRETARY, FIRST VICE PRESIDENT, AND TREASURER come up from the assembly in every direction and take their places at the table. Everybody places pocketbooks on table or in front of her to give a cluttered look.

PRESIDENT: (raps many times with the gavel--gloves on) Will the meeting please come to order?

PARLIAMENTARIAN: Madam President, the presiding office is to rap the gavel only once, and she does not wear gloves while presiding. And please! Will you lift the veil from your face, and kindly take the lovely display of bags from the table and the jewelry from your arm?

PRESIDENT: We shall now have the roll call and minutes of the last meeting. The Secretary will call the roll. (Members say HERE in answer to the roll call.)

PARLIAMENTARIAN: Madam President, I don't believe the minutes were your <u>last</u> - If they had been, you would not have been here today. A presiding officer always invites the attention of the Club to the reading of the minutes of the regular Executive Board Meeting or General Meeting of such and such a date -- correct wording would be, "Will you please listen to the reading of the minutes of the June 4 meeting of the Executive Board or General Meeting. . ." Please never ask for roll call and minutes at the same time. . . .and WOMEN, for goodness' sake, don't respond to roll call by saying <u>HERE</u>. We know you're here because we see you, but are you really present in mind.

SECRETARY (stands, addresses the Club, and reads:) The last meeting of the Poduct Center was held at the school November 3, 1964. Minutes of the organization were read and several corrections were made before being approved. The First Vice President, Miss Nearly All Wrong, asked all Committee Chairmen to meet with her following the meeting to discuss plans for future programs. Associate President reported on duties assigned to the four committees. Treasurer, Mr. Do It Your Way, in making his report, said he thought we had about $35. Before the meeting began, we ate a sumptuous dinner; and after the business was attended to, the President turned the meeting over to the Chairman of Stewardship, who presented the speaker of the day, Mr. Goode. Mr. Goode was a good speaker, and he told us how to be good retailers and make money. The meeting closed. Respectfully submitted, Miss Talk A. Lot, Secretary.

PARLIAMENTARIAN: Madam President, we discussed the previous meeting just before the reading of the minutes. A secretary records only the business transacted--what is done and not what is said. They should be brief and concise. No adjectives--the dinner or meal may have been sumptuous to her, but not to someone else. The treasurer should have had an accurate and recorded report. All motions should be recorded in full with name of person offering said motion and the name of the person seconding the motion. This is not true, however, of the lost or withdrawn motions. Much of the information given was not necessary at all, and I noted one of the most common of all mistakes made by presiding officers--that of "turning the meeting over." We are not playing fruit basket turn-over or frying an egg. You simply ask Mrs. So and So to take charge of the meeting. And, Madam Secretary, never respectfully submit your minutes from this day on, nor address the Club when you read them.

PRESIDENT: You have heard the reading of the minutes. Are there any corrections? If not, they <u>are</u> approved.

PRESIDENT: You will please listen to the report of the Treasurer.

TREASURER: Madam Chairman, I think we have about $50 now. I'll bring a written report next time, I promise!

PARLIAMENTARIAN: You addressed the Chair as "Madam Chairman." At meetings other than Board Meetings, she is "Madam President"--at Board Meetings she is "Madam Chairman." And the Treasurer should give a typed, itemized report to the Secretary of all receipts and disbursements. He should always know the balance on hand.

PRESIDENT: You have heard the report of the Treasurer. All in favor of adopting this report, say "aye"; opposed "no."

PARLIAMENTARIAN: Madam President, the Treasurer's report is <u>never</u> adopted; and even if it were, you did not complete the action of the assembly. You should state results after the vote.

PRESIDENT: At this time, we'll hear from our Projects Committee Chairman.

SECOND VICE PRESIDENT: Well, the Projects Committee just couldn't get together, so Bob and I met and decided to go on by ourselves. We had a good meeting; and without consulting you or the other members of the committee, we are planning to buy books for the library. I think we ought to buy at least 20. Do we have enough money? (Much discussion over money.)

TREASURER: We just don't have enough money for 20 books. We would do well to buy three.

SECOND VICE PRESIDENT: (Makes motion to buy as many books as money will permit.)

PRESIDENT: (Instructs Treasurer to make purchase without voting. Much conversation is going on while President talks.)

PRESIDENT raps gavel many times to bring order out of them.

PARLIAMENTARIAN: Madam President, the Chairman of the Projects Committee is only one of her committee and should not have had a meeting to make this or any other decision without a majority present. And may I remind all that there are seven steps in the making of a motion.

1. Recognition by the Chair before speaking. No one had the privilege of the floor until recognized by the Chair.
2. Statement of the motion is always in the affirmative. I move to . . . , or I move that . . . .
3. Second to the motion. Some member should second the motion, whether in agreement or not. AFTER AND NOT BEFORE the motion is made, comes the discussion.
4. Statement by the Chair. It has been moved by Mrs. _____ and seconded that . . . .
5. Discussion. Every member has the right to debate on debatable motions.
6. Vote. In taking the vote, the Chair says, "All in favor say 'aye'; opposed, 'no'." It may be necessary to ask for a show of hands or a request for members to stand.
7. The Chair rules on the vote and states results. No motion is a rule until stated by the Chair.

PRESIDENT: Our program is in charge of the First Vice President, so at this time I will turn the meeting over to Miss Nearly All Wrong.

FIRST VICE PRESIDENT: Madam President, I am happy to introduce our speaker of the afternoon, Mr. Intelligentsia. Mr. Intelligentsia is a young man, married, and lives with his charming wife and five children at Dead End. Mr. Intelligentsia graduated from Round Bend High School. Upon graduating, he served his term in the Armed Forces, and he is now merchandise manager at GrabEm Brothers. The momentoes he purchased are on display in the hall. We are indeed fortunate to have Mr. Intelligentsia speak to us on the importance of Parliamentary Procedure.

FIRST VICE PRESIDENT makes the introduction rather hurriedly and breathlessly and dashes to her seat.

PARLIAMENTARIAN. Madam President, the first thing to remember in making an introduction is to keep the speaker's name until the very last thing. Our First Vice President told everying of no importance about the speaker and told absolutely nothing of his qualifications as a speaker. The briefer the introduction, the better. Avoid flowery words. Make an introduction meaningful and sincere. The assembly is anxiously awaiting the message and is not interested in lengthy introductions. It is good, however, to know something of the speaker's background pertaining to the given subject. The person making the introduction should remain standing until the speaker reaches the place from where he is to speak.

- - - - - - - - - - - - - - - -

PRESIDENT: Well, I'm glad this meeting is over. Let's adjourn.

CLOSING REMARKS BY LEADER: If you are thoroughly confused, I do hope it is on a higher level. Surely, you will agree with me that a little learning is a dangerous thing. Drink deep or taste not of the Parliamentary Law Spring.

- - - - - - - - - - - - - - - -

Notes to the instructor:

1. This skit may be used with individual classes or for a club meeting program.

2. You might also have a student play the part of Mr. Intelligentsia and have him present additional information concerning Parliamentary Procedure.

CDE I - UNIT II SALES DEVELOPMENT

Activity I: Receiving, Marking, and Stocking Merchandise

Merchandise, from the time it is manufactured until it is finally sold, is handled many times. Using the form below, relate the various handlings that some particular item your store sells receives before it finally reaches the consumer.

Merchandise description _____

_____

How it is bought:
- Name of manufacturer _____
- Address of manufacturer _____
- Bought from (check) market _____, salesman _____, wholesaler _____, jobber _____.

How it is shipped:
- From the manufacturer _____
- Delivered to the store by _____
- Packed in _____

How it is received:
- By whom _____
- What record is made _____
- How package is opened _____
- How merchandise is checked _____
- How damage or shortage is reported _____

_____

How it is marked:
- On ticket or article _____
- With what tool _____
- By whom _____

Where it is placed:
- As reserve stock _____
- As under stock _____
- As forward stock _____

How it is protected:
- As reserve stock _____
- As under stock _____
- As forward stock _____
- How packaged for customer _____

_____

Notes to the instructor:

This report could be accompanied by samples of shipping, receiving or checking forms, tickets or tags, wrapping paper or bags--if available.

The instructor could also suggest that students select a product for this study which they would like to use in a future sales demonstration. This item should be from $5 to $75 in value and small enough in size to be borrowed and brought to the classroom for the sales demonstration.

C.D.E. I. - UNIT II SALES DEVELOPMENT

Activity 2: Review of Mathematical Skills

1. Find the next number in each series by determining the previous order of addition, subtraction, multiplication, or division.

Example: 10, 8, 11, 9, 12, 10, 13

Order: -2, +3, -2, +3, -2, +3

a. 1, 2, 3, 6, 7, 14, ___
b. 18, 17, 16, 15, 14, 13, ___
c. 6, 9, 7, 10,8, 11, ___
d. 40, 30, 35, 25, 30, 20, ___
e. 3, 4, 8, 9, 18, 19, ___
f. 60, 30, 36, 18, 24, 12, ___

2. Simple Addition:

a. 9252 2722	b. 28232 42126	c. 3383 3531	d. 37323 93634
e. 8414 4543	f. 46474 44249	g. 5575 5253	h. 59525 45658
i. 1626 6368	j. 65646 96766	k. 2747 7677	l. 78717 97375
m. 2868 8784	n. 85888 38189	o. 3959 9297	p. 98949 19699

3. Find the selling price for:

a. 12 lemons @ 4 for 25¢ _____
b. 4 notebooks @ 29¢ each _____
c. 7 oranges @ 35¢ doz. _____
d. 8 oz. candy @ 58¢ lb. _____
e. 8 oz. milk at 12¢ pt. _____
f. 6 pr. hose @ 3 pr. for $1.00 ___
g. 9 handkerchiefs @ $4.80 doz. ___
h. 2-3/4 yds. lace @ 40¢ yd. ___
i. 10 in. of ribbon @ 35¢ yd. ___
j. 3 lb. potatoes @ 4 lb. for 56¢ ___

4. Obtain these answers without the numbers:

a. 6 plus 12 plus 5 less 4 ___
b. 9 plus 8 less 3 less 7 ___
c. 54 divided by 9 plus 8 less 5 ___
d. 9 times 8 less 10 plus 3 ___
e. 4 plus 2 times 8 less 9 ___
f. 18 less 7 plus 9 less 6 ___
g. 21 less 6 less 4 less 9 ___
h. $\frac{1}{4}$ of 20 plus 11 minus 4 ___
i. 2/3 of 6 less 2 plus 15 ___
j. 16 divided by 4 plus 2/3 of 10 ___

5. Applied Mathematics:

a. Helen sold her bicycle for $25, which was $8.54 less than it cost. What did the bicycle cost? $_____

b. Bob and Jim are putting their savings together to buy a basketball. This amounts to $15. Jim is contributing twice as much as Bob. How much is Bob contributing? $_____

(continued on next page)

c. Susan has 45 curlers. Jane has only one-third as many. How many curlers does Jane have? _____

d. If Jim had three times as many pencils as Sam, he would have 21. How many pencils does Sam have? _____

e. Peggy had written 17 pages for her term paper, but she discarded three pages before she turned it in. She also added a title page and an introductory page. Jack had written 12 pages. He added four pages of new material at the last minute. He also made a contents page. Who turned in the most pages and how many more? _____ _____

f. At a summer clearance sale, bathing suits were sold at a one-third discount. What was the sale price for a suit that originally sold for $19.95? _____

g. What was the original price of a bathing suit that was marked down to $12.00? _____

h. The area of the manager's office is 320 square feet. It is 20 feet long. How wide is it? _____

Notes to the instructor:

Your students may need drills in simple mathematics. Section II of this exercise might be helpful in determining a particular addition-family weakness. These problems are made by family: a, b - 2; c, d -3; e, f - 4; g, h - 5; i, j - 6; k, l - 7; m, n - 8; o, p - 9. Of course, errors can be in carrying altogether.

When weaknesses are noted, assign elementary drills and exercises to those students.

C.D.E. I - UNIT II SALES DEVELOPMENT

Activity 3: Getting to Know Your Merchandise

It is not enough to know what merchandise your store or department has. You must know where it is and what it is. Using the product you followed through receiving, marking, and stocking, answer the following questions. Record your sources of information at the end of the questionnaire.

How it is identified:

Brand Name _____

Style Name or Model Number _____

How it is sold in your store:

Colors _____

Sizes _____

Prices _____

How it is sold in your competitor's store:

Colors _____

Sizes _____

Prices _____

History of the product:

When it was first manufactured _____

How it has been developed _____

_____

_____

_____

_____

What it is made of:

Materials used and amounts _____

_____

_____

Source of raw materials _____

Manufacturing processes _____

_____

_____

Who uses it:

Ages _____

Sex _____

Any limitation _____

How it performs:

What it accomplishes _____

_____

_____

How it accomplishes these things _____

_____

_____

_____

_____

(continued on next page)

What it cannot accomplish _____

_____

_____

What care it requires:

Necessary upkeep _____

_____

Precautions to be taken _____

_____

Warranties or guarantees given:

By the manufacturer _____

_____

_____

_____

By your store _____

_____

_____

_____

How it can be purchased:

Kind of charge account _____

Lay-away terms _____

Trade-in allowances _____

_____

Cash discount _____

Where I got my information:

_____

_____

_____

_____

_____

_____

Note to the instructor:

If students use the same produce they selected for the stockkeeping research, they should have a good background for a sales demonstration of this merchandise, particularly if they follow it through the fact-benefit-motives project.

C.D.E. I. - UNIT II SALES DEVELOPMENT

Activity 4: FACT - BENEFIT - MOTIVE STUDY

Now that you have acquired a number of facts about a certain product that you sell, are you ready to meet your public? No, you are not! Your customer wants to know more than what the item is--he wants to know what it will do for him.

Of further help to you is a classification of buying motives to which the customer benefits would appeal. This knowledge could inspire just the words you need for persuasive selling.

You will be provided with a number of forms on which to record facts, benefits, and buying motives for some of the items which you sell. Use one form per item. Be sure to include the product you have chosen for your sales demonstration.

Here is a portion of a Product-Fact Sheet. Study it carefully before you begin your project.

FACT-BENEFIT SHEET
Name of Product or Service: Suave Hair Spray

FACTS	BENEFITS	BUYING MOTIVES
Crystal clear	Will not dull natural hair color	Beauty
Holds hair firmly	Hair will stay arranged	Security and beauty
Feels natural	Hair does not get stiff and irritate skin	Comfort

Notes to the instructor:

Determine the number of articles to be reviewed and give each student that quantity of forms. This could be a continuing project, with students responsible for completing a certain number of forms per week and keeping them in a separate section of their D. E. notebooks.

You will note that this exercise treats buying motives per benefit.

As an additional exercise to this project, instruct students to write selling statements for each of the facts listed on their sheets.

(continued on next page)

C.D.E. I. - UNIT II

Activity 4: FACT-BENEFIT SHEET

Name of Product or Service:_____

FACTS (What it IS, HAS, or DOES)	BENEFITS (What it GIVES TO or DOES FOR the customer)	BUYING MOTIVES (What customer is SEEKING)

C.D.E. I. - UNIT II SALES DEVELOPMENT

Activity 5: Approaching Your Customer and Determining His Needs.

1. The first step in your sales presentation is meeting your customer. You have learned that there are three basic forms of approach: Greeting, Service, and Merchandise. You have also learned the importance of "starting your sale off on the right foot!"

Here is a list of often-heard approaches. Rate each approach with a check mark for "good," an X for "poor," and an O for "maybe." Identify the form of each approach by writing Greeting, Service, or Merchandise to the right of the approach.

RATING	APPROACH	FORM OF APPROACH
_____a.	Are you looking for something?	_____
_____b.	Is anyone helping you?	_____
_____c.	Good morning, Mrs. Riddle, May I help you?	_____
_____d.	Are you being taken care of?	_____
_____e.	May I show you some of these socks?	_____
_____f.	May I help you?	_____
_____g.	Something for you?	_____
_____h.	Anything in particular you wanted?	_____
_____i.	Now, Dearie, what may I do for you?	_____
_____j.	Are you next, lady?	_____
_____k.	Do you wish attention?	_____
_____l.	What did you want?	_____
_____m.	Something in handkerchiefs?	_____
_____n.	One ninety-three	_____
_____o.	Yes, ma'am?	_____
_____p.	Are you just looking, or did you wish to buy something?	_____
_____q.	Garden tools?	_____
_____r.	Can I tempt you with anything today?	_____
_____s.	That's $2.87! How do you like it?	_____
_____t.	Good morning!	_____
_____u.	This portable phonograph is specially priced today!	_____
_____v.	This is a dandy value.	_____
_____w.	Shirts today?	_____
_____x.	Do you want to buy some of them cards?	_____
_____y.	Is someone waiting on you?	_____
_____z.	What can I do for you?	_____

2. The next step is finding out what your customer wants and needs. Many times it will be necessary for you to ask questions that will provide information, such as: Who will use the item; how will it be used; what size or shape is necessary; what is preferred in color and style?

Picture yourself as the salesperson in each of the situations described on the next page. Write a suitable approach. Then compose a series of questions to determine the customer's needs, assuming that the customer gives a direct answer to each of your questions.

(continued on next page)

A. Mr. Hill, your next-door neighbor, comes into your bookstore.
Your approach: _____

Mr. Hill then says, "I should like to get a good book."
Your questions: _____

B. An elderly housewife comes into your home furnishings department.
Your approach: _____

The housewife says, "We need a rug for the house."
Your questions: _____

C. An Army captain enters your drugstore.
Your approach _____
The captain then says, "Let me have some cough medicine."
Your questions: _____

D. A man and his son come into your clothing store.
Your approach: _____

The man states, "I want to get a hat."
Your questions: _____

E. An expensively-dressed woman comes into your toy department and stops to examine a display of pull toys.
Your approach: _____

She says, "I should like some type of educational toy for my child."
Your questions: _____

CDE I. - UNIT II SALES DEVELOPMENT

Activity 6: Presenting the Merchandise

"Look before you leap" has been used as a warning to purchasers as well as leapers. Your customers want to see the merchandise before they buy. Demonstrating how your merchandise does what it is made to do is a most convincing method of selling, especially when followed with actual use or handling by the customer.

For several products that you sell, including the article you have selected for your sales demonstration, plan the following action:

DEMONSTRATION OF _____

1. How I shall demonstrate this product, step by step: _____

2. How I shall get the customer to handle the merchandise: _____

3. What I shall point out while the customer is handling the merchandise: _____

4. To which of the five senses I shall make appeals: _____

Notes to the instructor:

Give students as many forms as you wish projects completed, or have them use other paper.

Having some or all of the students play their scenes for the class would be valuable.

C.D.E. I. - UNIT II SALES DEVELOPMENT

Activity 7: ANSWERING OBJECTIONS

1. Objections can help you! They tell you what the customer is thinking and and what questions still need an answer.

   Below are sincere objections that a customer may give as reasons for not buying the merchandise. Answer each objection according to the method suggested.

   A. Turning objections into selling points:

      Customer: This washing machine is just too large.

      Salesperson: _____

      Customer: Everybody in town will have a coat just like it.

      Salesperson: _____

   B. Agreeing with the customer but presenting another angle:

      Customer: This jacket is so lightweight that it just can't be warm!

      Salesperson: _____

      Customer: The price is just too high.

      Salesperson: _____

   C. Requesting the customer to explain the objection:

      Customer: This vacuum cleaner is nice, but I don't think it will do the job for me.

      Salesperson: _____

      Customer: This wagon is not build strong enough for my boy.

      Salesperson: _____

   D. Admitting the objection and giving a superior point:

      Customer: This overstuffed chair seems bulky and heavy.

      Salesperson: _____

      Customer: This broom has such a thick handle.

      Salesperson: _____

   E. Asking a question that when answered overcomes the objection:

      Customer: I do not believe that this hi-fi phonograph has the same tone qualities as the one we looked at down the street.

      Salesperson: _____

(continued on next page)

Customer: I don't think I want a tinted windshield on my car.

Salesperson: _____

2. The wise salesperson will anticipate the customer's objections and be prepared to answer them. In studying your merchandise, you should consider all the possible objections that customers might express and plan your statements carefully.

   Refer to the items used in your Presentation-of-Merchandise Project. For each of these, make a list of all objections you might hear from the customers and compose your reply to each objection.

C.D.E. I _ UNIT II SALES DEVELOPMENT

Activity 8: Suggesting Additional Merchandise

1. In order to give you practice in suggestive selling, some articles of merchandise are listed below. Indicate after each article at least five related items that you might suggest to the prospective customer.

   A. Toothpaste: _____ _____ _____

   _____ _____

   B. Fountain pen: _____ _____ _____

   _____ _____

   C. Cleansing cream: _____ _____ _____

   _____ _____

   D. Pipes (tobacco): _____ _____

   _____ _____ _____

   E. Shoes: _____ _____

   _____ _____ _____

   F. Shampoo (for men or women): _____ _____

   _____ _____ _____

   G. Iodine: _____ _____ _____

   _____ _____ _____

   H. Playing cards: _____ _____

   _____ _____ _____

   I. Shaving cream: _____ _____

   _____ _____ _____

   J. Tennis racket: _____ _____

   _____ _____ _____

2. Select five articles that you sell, including your choice for your sales demonstration. Write at least five related items for each article.

   A. _____:

   B. _____:

   C. _____:

   D. _____:

   E. _____:

C.D.E. I - UNIT II SALES DEVELOPMENT

Activity 9: Individual Sales Demonstration

Now you are ready to demonstrate your powers of persuasiveness to your classmates.

If you selected the article you wish to sell when you began your study of "Sales Supporting Activities", you have already conducted a thorough research on its history, manufacture, shipment, receipt, stockkeeping, facts, and benefits.

Your sales presentation of this article should not exceed 10 minutes, so you must organize your demonstration carefully. This can be accomplished by writing your plans according to the following outline.

Basic Steps in Selling

1. Approach:
   - Studying the customer
   - Greeting the customer
   - Finding the customer's needs and interests
   - Getting information that is as specific as possible
   - Selecting merchandise to be shown

2. Presenting the Merchandise:
   - Showing the merchandise--one item or several, depending on the circumstances
   - Demonstrating the merchandise in use
   - Giving selling points of the product--its benefits and features
   - Getting the goods into the customer's hands

3. Handling Objections:
   - Answering questions about the product
   - Answering objections
   - Meeting resistance
   - Repeating selling points, as required

4. Completing the Sale:
   - Narrowing the selection of goods in which the customer shows interest
   - Getting agreement from the customer
   - Helping the customer decide

5. Suggesting Additional Merchandise:
   - Giving justifications for the suggestion
   - Demonstrating the merchandise in use
   - Sensing acceptability or nonacceptability to the customer

6. Recording the Sale:
   - Ringing up the sale, or
   - Making out charge sales ticket
   - Performing cashiering duties

7. Closing the Sale:
   - Assuring the customer of value, pleasure, or wisdom of the purchase (this may be guaranteed for certain types of merchandise)
   - Thanking the customer
   - Inviting the customer to return

(continued on next page)

Notes to the instructor:

Students may have written methods of demonstrating and answering objections for their selected merchandise in past projects. This is good. They can refer to these projects while working on this assignment and revise their actions.

Each class demonstration requires a "shopper." This can be the instructor, a benevolent adult friend, a faculty member--someone who will take the job seriously! You should have a timekeeper.

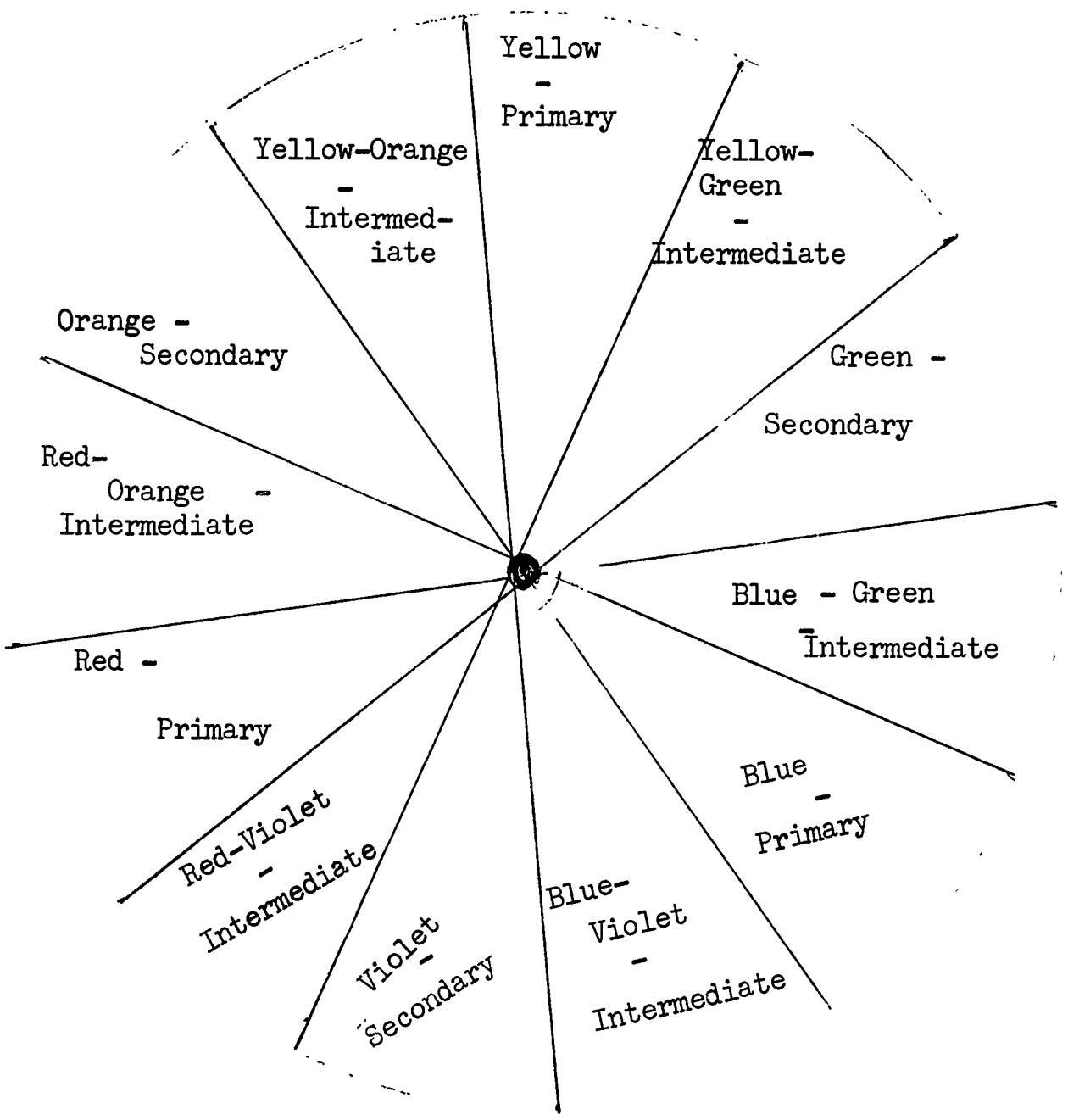
Before beginning the demonstrations, give each student a rating sheet. Discuss the qualities and skills on which they will be judged, the point distribution, and directions for use of the form Class discussion and tally of points should follow each demonstration. A copy of the sales demonstration rating sheet may be found in the DECA Contest and Awards Handbook.

CDE I. - UNIT II SALES DEVELOPMENT

Activity 10: The Color Wheel

The study of color and its significance is vitally important to the field of distribution; and for this study, you must know the Color Wheel.

Here is a basic form of the color wheel for you to color.



What are the primary colors?
the secondary colors?
the intermediate colors?

How can you use the color wheel in your business?

How can you use the color wheel in your personal life?

(continued on next page)

Color Wheel (continued)

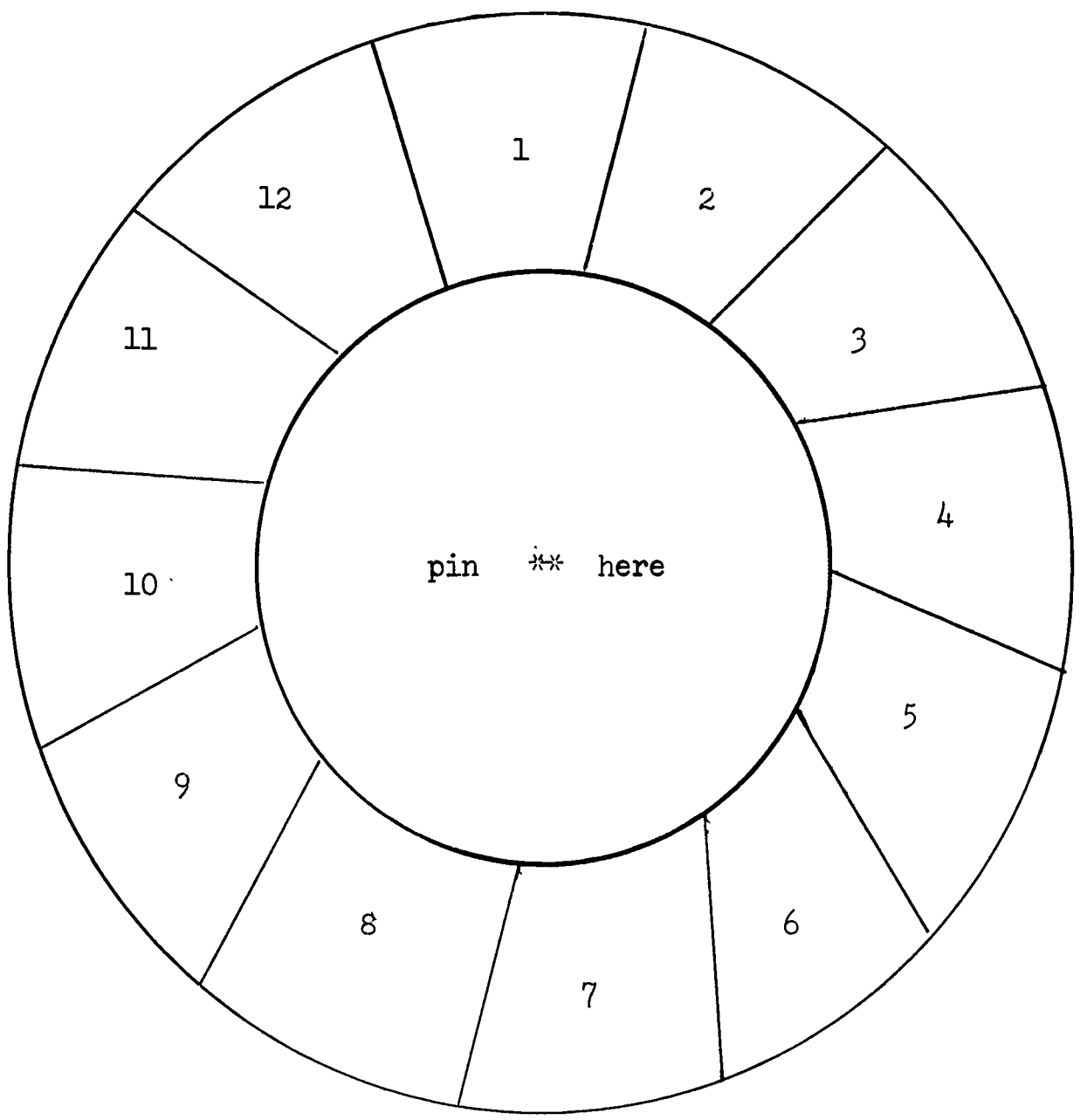
Select a color or combinations of colors that will:
denote a holiday:
denote a season of the year:
denote an age group:
bring out another color:
symbolize an emotion:

Note to the instructor:

Furnish crayons or water colors for the students. Let them color in the three groups of colors as you discuss them.

To study color schemes, make five masks for the wheel by the pattern below. For complementary color scheme, cut out sections 1 and 7 (from outer circle to inner circle); for analogous, cut out sections 1, 2, and 3; for triadic, sections 1, 5, 9; for adjacent, sections 1, 7, 8; for split complementary, sections 1, 6, 8.

To use masks, glue color wheel to heavy cardboard. Each mask can be pinned to the wheel with a thumb tack in the center.



C.D.E. I. - UNIT II SALES DEVELOPMENT

Activity 11: Advertising Media

1. Below are listed various advertising media. To the right of these media are shown different classes of stores. After each advertising media, place a check mark in the appropriate column or columns showing which stores could use each media to the best advantage.

ADVERTISING MEDIA	KINDS OF BUSINESSES								
	Grocery	Women's Apparel	Hardware	Auto Supply	Appliance	Drug	Office Supply	Stationery	Furniture
a. Newspapers									
b. Magazines									
c. Handbills									
d. Direct mail letters & circulars.									
e. Door-to-door circulars									
f. Billboards									
g. Car-cards in buses & streetcars.									
h. Radio									
i. Television									
j. Coupons, stamps, premiums. . . . (and other special promotions)									

2. List below the advertising media that seem to lend themselves best to all kinds of businesses. State what you believe to be the reasons for this.

Notes to the instructor:

This exercise should follow lecture or discussion of the various media in order to familiarize students with terminology. It would be of great value if students brought examples of promotional literature to class.

C.D.E. I. - UNIT II SALES DEVELOPMENT

Activity 12: BRAND NAMES

Below is a list of articles of merchandise. Opposite each article, write the trade name, brand name, or manufacturer that first comes to your mind. If you cannot immediately think of a name, move on to the next article.

Articles of Merchandise	Brand Name, Trade Name, or Manufacturer's Name
a. Baby food	
b. Battery	
c. Bicycle	
d. Camera	
e. Cereal	
f. Cigarettes	
g. Fountain pen	
h. Light Bulb	
i. Lock	
j. Milk	
k. Paint	
l. Paper towels	
m. Salt	
n. Silverware	
o. Shampoo	
p. Shirt	
q. Shoes	
r. Soft drink	
s. Spark plug	
t. Sugar	
u. Tires	
v. Toothpaste	
w. Towels	
x. Television Set	
y. Washing machine	
z. Watch	

Notes to the instructor:

You can use this "fun exercise" as a survey of the brand names best remembered. Discuss reasons (catchy? emotional association? short, simple words? related to use or benefit of product?)

Discuss reasons for least-remembered names and let students make up new trade names for those products.

C.D.E. I. - UNIT II SALES DEVELOPMENT

Activity 13: ADVERTISING SLOGANS

Below is a list of well-known advertising slogans. Test your knowledge of slogans by writing in the spaces provided the name of the product and the buying motives to which it appeals.

ADVERTISING SLOGAN	BRAND OF PRODUCT	BUYING MOTIVE
a. The (?) for lunch bunch!		
b. 97% caffeine free		
c. The active soap for active people		
d. Things go better with (?)		
e. So complete that all you add is love		
f. For those who think young		
g. Beautiful hair		
h. (?) tastes good, like a cigarette should!		
i. Happy Motoring		
j. 57 varieties		
k. Tan, don't burn		
l. (?) melts in your mouth, not in your hand!		
m. Take (?), when you can't afford a headache.		
n. See the U.S.A. in your (?)		
o. (?) is good to the last drop.		
p. The breakfast of champions		
q. They always eat better when you remember the (?)		
r. 99-44/100% pure		
s. When it rains, it pours		
t. Does she. . . or doesn't she?		
u. Progress is our most important product.		
v. Get the best, get (?)		
w. For a taste that's Springtime Fresh, turn to (?)		
x. The long cigarette that's long on flavor		
y. You're in good hands with (?)		
z. The best to you each morning, from (?)		

Notes to the instructor:

Analyze these slogans for effectiveness, poetic meter, and emphasis. Let students name those that are jingles and discuss whether or not the lively tune helps them to remember the slogan. (This could be set up as a debate.)

KEY: a. Metrecal; b. Sanka; c. Dial; d. Coca-Cola; e. Purina Dog Chow; f. Pepsi; g. Breck Shampoo; h. Winston; i. Esso; j. Heinz; k. Coppertone; l. M & M Chocolate Candies; m. Anacin; n. Chevrolet; o. Maxwell House Coffee; p. Wheaties; q. Campbell Soup; r. Ivory Soap; s. Morton Salt; t. Clairol; u. General Electric; v. Sealtest; w. Salem; x. Pall Mall; y. Allstate; z. Kellogg's.

C.D.E. I. - UNIT II SALES DEVELOPMENT

Activity 14: TRADEMARKS

According to the trademark statutes of the United States, a trademark is some figure, emblem, design, invented word or words, distinctive arrangement of initials, or a written signature, used by manufacturers to distinguish their products.

1. From your place of business, collect as many trademarks as you can. (Trace the ones you cannot cut out.) Paste these on cardboard or heavy paper. Number each trademark and write the names of the companies by number on the back of the card. You will exchange trademark cards with other students in class and try to name their trademarks, checking your answers with the keys on the back of the cards.

2. From the trademarks that you mounted, select one that you feel could be improved.

   a. Consider the image that your trademark should project, as related to the nature, use, and users of the product.

   b. Design the trademark.

   c. Select two or three colors. (Recall your study of color association and harmony.)

   d. Make a large colored rendering of your trademark design on 8½" x 11" paper.

3. List the ways your trademark can be used:

   a. By the manufacturer.

   b. By your business.

Notes to the instructor:

On page 332 of the text, Marketing, Sales Promotion, and Advertising, you will find a page of trademarks to be identified that you could use instead of the above activity.

C.D.E. I. - UNIT II SALES DEVELOPMENT

Activity 15: COPY THAT SELLS

Retail advertising requires descriptive phrases or sentences which attract attention and arouse interest. Successful radio advertising must depend solely upon spoken words; newspapers, magazines, and television have the advantage of visual stimuli.

1. In the space provided below, copy the descriptive phrases or sentences applied to these products in newspaper, magazine, radio, or television advertising.

PRODUCT	DESCRIPTIVE PHRASE OR SENTENCE	SOURCE
a. ice cream		
b. men's suits		
c. diamonds		
d. bath soap		
e. perfume		
f. bread		
g. ham		
h. sofa		
i. auto tires		
j. towels		

2. Using an unabridged dictionary, find synonyms for the following words. Use simple one- or two-syllable words that really "pack a punch!"

a. good:

b. pretty:

c. fine:

d. cheap:

e. tasteful:

3. Rewrite the following statements, giving them more pep and zip:

a. Our candy is very good.

b. You will be happy with our new electric sweeper.

c. Try a bottle of our fine ginger ale.

d. Our new sports sweaters are both comfortable and stylish.

e. Our beauty salon will make you more glamorous.

(continued on next page)

4. From newspaper advertisements, select five headlines that do not catch attention. Copy them below and rewrite them, in not more than five words, if possible.

a.

b.

c.

d.

e.

5. Select an article that you sell. For this article, prepare the following advertising:

a. Catalogue Description:

b. Newspaper Headline:

c. Newspaper Copy:

d. Radio Copy:

e. Television Copy with Accompanying Action:

C.D.E. I - UNIT II SALES DEVELOPMENT

Activity 16: ANALYSIS OF A NEWSPAPER AD

In order to evaluate the effectiveness of a particular newspaper advertisement, select from a recent ad an item in your department or area for a survey. Clip out the entire page on which the ad appeared and save it. But first, discuss this project with your employer and obtain his permission!

1. Keep a record of the number of sales of that item. (Ask cooperation of other salespeople.)

2. Ask every customer you serve if he saw this item in your ad. (If your duties are other than selling, ask a number of friends and relatives.) Keep a record of the number of people you ask and their answers.

3. Analyze the advertisement by answering the following questions:
   a. Selection of merchandise
      (1) Was it timely?
      (2) Was it a good value?
      (3) To whom would it appeal?
      (4) Could it be reordered quickly?
      (5) Could special orders (for size, color, etc.) be taken?

   b. Preparation for advertisement
      (1) Was stock conveniently located?
      (2) Was the article prominently displayed?
      (3) Were showcards made for the counters?
      (4) Were salespeople informed of the ad?
      (5) Was the article displayed in a window?

   c. The advertisement itself
      (1) Did the headline catch attention?
      (2) Was the illustration clear and accurate?
      (3) Was the copy informative?
      (4) Did the copy create desire to buy?
      (5) Was there too little or too much white space?

   d. Position of the advertisement
      (1) On what page of the paper did it appear?
      (2) In what position on that page?
      (3) Did it stand out or was it overshadowed by other ads?

   e. Value of the advertisement
      (1) Do you think it was worthwhile?
      (2) Do you anticipate future sales or good will from this ad?

Notes to the instructor:

Be very sure that students have employers' permission to conduct this survey. If they do, let them show their completed analysis to their employers. There will be cases in which students' suggestions for improvement would not be received with pleasure, but this could certainly be a classroom activity to be turned in to you.

C.D.E. I - UNIT II SALES DEVELOPMENT

Activity 17: NEWSPAPER ADVERTISING LAYOUT

1. From any newspaper that you have seen recently, take an advertisement that you think could be improved. Cut closely around each part of this ad. Place these parts on a layout sheet and shift them around until you have a good layout. Do not paste any part until you have analyzed your layout by the guidelines on page 309 of Retailing Principles and Practices.

2. Plan and lay out a full-page newspaper advertisement (group or omnibus) for some promotional event your business might have. Follow these steps in preparing your advertisement:

a. Decide what to advertise. (see page 291, Retailing Principles and Practices.
b. Complete a Fact-Benefit Sheet on each article.
c. Make a list of adjectives describing the articles.
d. Compose the headline and copy.
e. Get illustrations of the articles from other newspaper ads, catalogues, or sketches.
f. Get a print of your business logo, the business address and telephone number (if this is to be included.)
g. List customer services to be mentioned in the ad (store hours, credit terms, free alterations, guarantees, etc.)
h. Make your layout, lettering very lightly until you are certain of placement, size, and style of type. (Refer to your newspaper type book for examples of styles available at your newspaper plant.
i. Evaluate your layout with the Advertising Rating Sheet.

Notes to the instructor:

Prepare a supply of Fact-Benefit forms and Advertising Rating Sheets (see DECA Contest and Awards Handbook.)

Use your own judgment in designating the size of the ad in #2.

Students could be permitted to use color (usually one color and black.)

C.D.E. I. - UNIT II SALES DEMONSTRATION

Activity 18: SALES PROMOTION FOR ASHLEY'S ANNIVERSARY

Ashley's is a downtown department store in a city with 60,000 population. It is not the largest department store in town, nor the newest. In fact, in six months Ashley's organization will be 75 years old.

Several years ago a department store chain opened a branch in this city. The chain organization remodeled a building, installed modern fixtures, and conducted an extensive advertising campaign. Since that time, Ashley's net sales have decreased, even though they still carry the high quality, conservative merchandise they have always sold. The largest loss in customers appears to be in the younger age group, from 15 to 25 years old.

The owners of Ashley's want to capitalize on the 75th anniversary to increase sales and to entice their lost patrons. At a recent department managers meeting, they asked for ideas. Someone remarked that since this is the Diamond Anniversary, they could use the diamond shape in some way. It was suggested that the store signature could be redesigned for the occasion and perhaps packaging materials could carry the special design. The owners seemed a little uneasy about the cost of such a project.

The advertising manager suggested that they use several advertising media. They now advertise only in the local daily newspaper, even though there are three radio stations and one television station in the community.

The cosmetics buyer mentioned a "flyer" she had received in the mail announcing a new cleansing cream. Then someone recalled that their competitor had mailed out a four-page newssheet that contained illustrations and descriptions of merchandise. The office manager reminded everyone that a chain organization operates a larger advertising budget than an independent retailer. Everyone agreed that a slogan could be used in all promotional activities at no extra cost.

Questions were raised about special purchase merchandise for the anniversary celebration, price reductions from stock, something for the teen-age and young adult shoppers, souvenirs, prizes, contests, fashion shows, famous personalities.

When someone asked what length of time the event would run, several views were expressed: a week; a month; a year.

No definite decisions were reached. The owners have dropped the problem in your lap!

YOUR PROBLEM: to suggest a sales promotion plan for Ashley's 75th anniversary. You know that Ashley's has confined its advertising to the newspaper and has kept the cost to 3 per cent of estimated sales. But an anniversary sale would raise sales estimates and justify more advertising expense. You also know that Ashley's is facing great competition.

1. What length of time would you advise for the anniversary observance, and what reasons for this choice will you give to Ashley's owners?

2. What budget would you set for the promotion?

3. Evaluate the suggestions from departments managers and decide:

   a. What media should be used?
   b. Should the promotion budget include special wrappings, prizes, gifts, or any of the other events suggested?
   c. What percentage of the budget will be spent on each method of promotion?

4. What type of merchandise should be promoted?

5. Will the promotion maintain or change the existing image?

6. Develop a schedule for this promotion, including the advertising and in-store events.

7. Design a special signature or symbol for this event.

8. Write a slogan to be used in all newspaper ads, on window and counter signs.

9. On layout paper, prepare two newspaper advertisements: a small institutional ad announcing the anniversary and a full-page ad showing merchandise.

10. Write two one-minute spot announcements for radio advertising and make a schedule for interchanging these on the first day of the anniversary. (You must consider listening times and age of listeners at these times.)

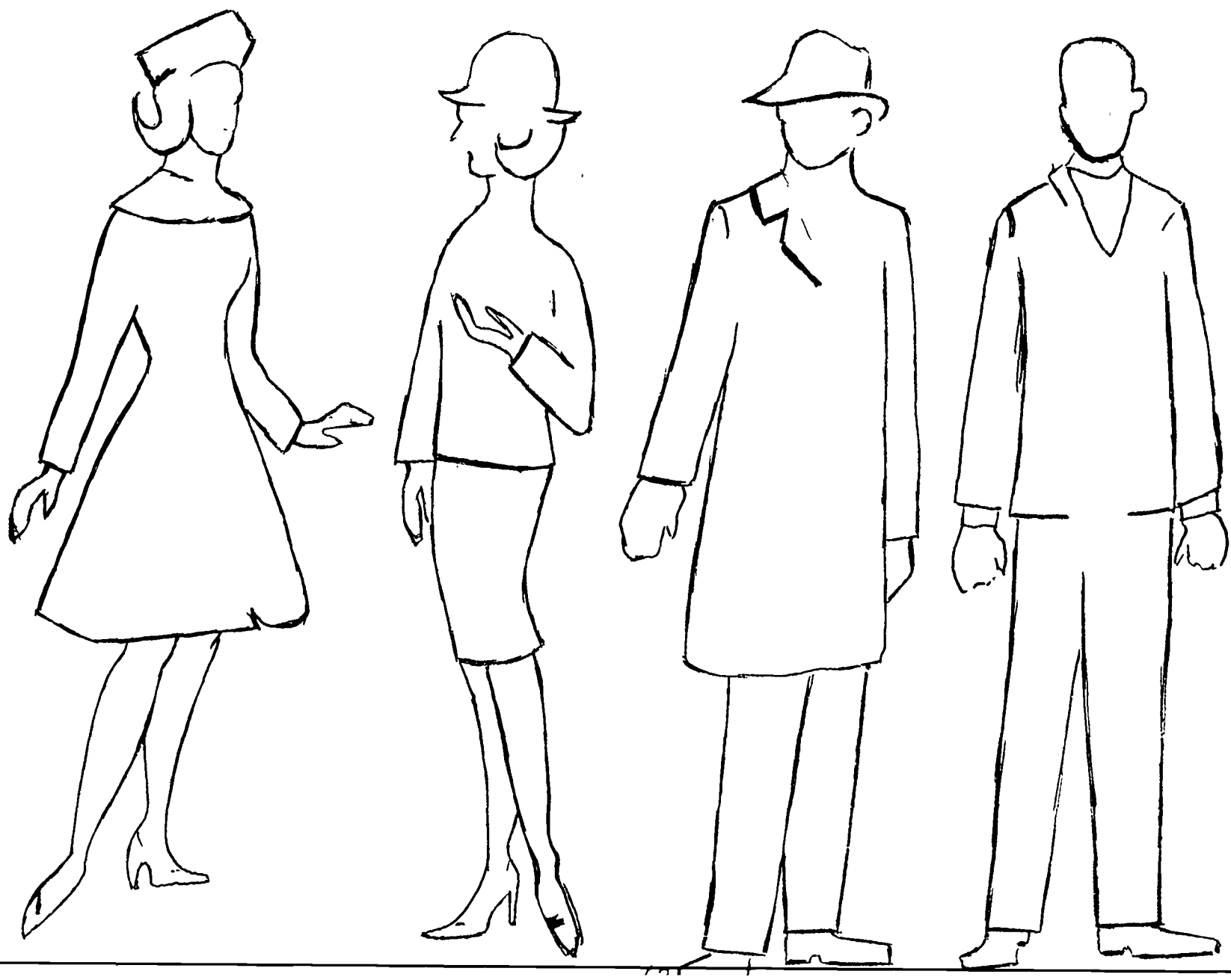
C.D.E. I. - UNIT II SALES DEMONSTRATION

Activity 19: DESIGN IN WINDOW DISPLAY

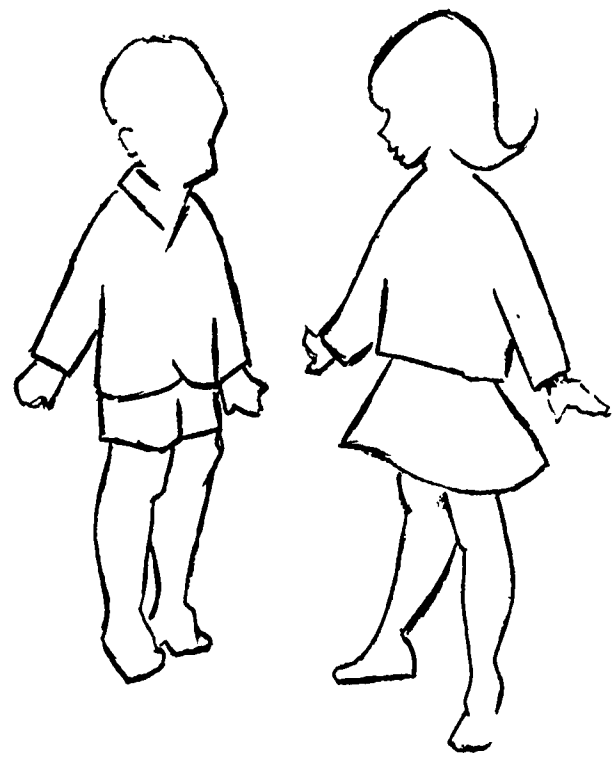
Display windows are the first contact between the store and its customers. Thus, they establish the personality and character of the store. More than that, they represent an effective and relatively economical form of advertising the store's merchandise. Therefore, it is most important that principles of design be employed to create a pleasing image and to bring out the best features of the merchandise.

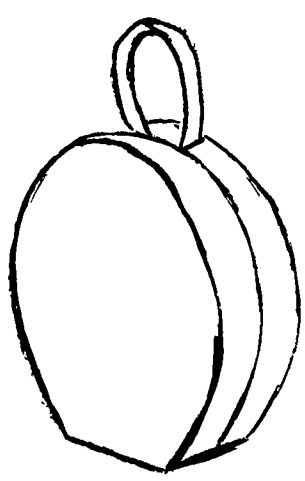
For your study of window display, cut out each of the items below. You may duplicate as many as you wish. On sheets of unlined paper, rule off blocks to represent display windows of different sizes in proportion to the figures. Place these items in various displays. You must have at least one example of: Radiation, Stair-step, Pyramid, Zig-Zag, and Repetition. Label each display by type of arrangement and balance. Sketch in any background material or props you wish to use.

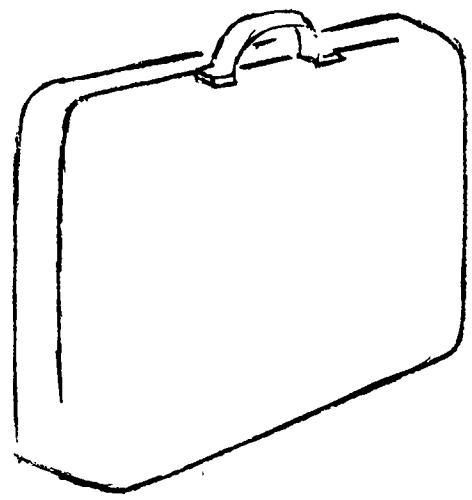
(continued on next page)

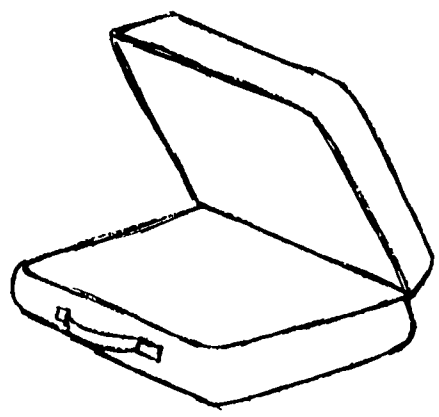


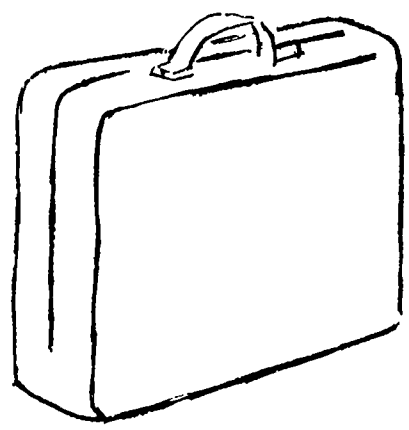
Design in Window Display (continued)











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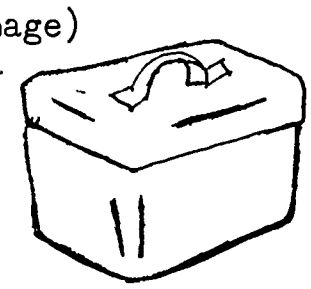

Notes to the instructor:

You may instruct students to color these items and backgrounds as a study of color balance, receding backgrounds, contrast, and harmony.

If you desire additional practice, instruct students to create a miniature window or built-up display in a box, no smaller than a shoebox nor larger than 20" square. They can use model cars, dolls, paper dolls, doll furniture, or numerous other toys or create their own furniture from small boxes, spools, etc. Have them demonstrate to the class their use of the principles of color and design.

Actual merchandise displays can be assigned as group projects--in classroom and hall showcases, on counter tops and shelves. If these facilities are consistently available to you, schedules could be followed throughout the school year, giving all students one or more chances to participate.

You may use the Window Display Rating Sheet as individual or group assignments, concurrent with any of the above activities.

C.D.E. I. - UNIT II SALES DEVELOPMENT

Activity 20: WINDOW DISPLAY RATING SHEET

Store _____ Date _____

Description of Display _____

_____

Directions: Rate only one window per sheet. Consider all questions under a heading before determining points to be given. There are 100 possible points. Record the total actual points you give this display.

1. POWER TO ATTRACT ATTENTION (Value - 20 points) Actual Points _____

Is background appropriate?
Is theme or idea clever?
Is theme or idea well executed?
Are display props suitable and attractive?
Is floor appropriate to display?

2. ARRANGEMENT (Value - 20 points Actual Points _____

Is there a proper amount of merchandise in window?
Do props enhance, rather than detract from, the merchandise?
Is related merchandise used?
Are appropriate "dealer helps" or show cards used?
Does the window make use of several vantage points?

3. CLEANLINESS (Value - 10 points) Actual Points _____

Is window glass clean?
Is clothing (if displayed) clean and well pressed?
Are forms and fixtures clean and in good repair?
Is background clean and fresh?
Are painted or colored surfaces fresh and clean?

4. TIMELINESS (Value - 10 points) Actual Points _____

Does it motivate you to purchase now?
Is merchandise well chosen?
Are colors in the window appropriate for season and merchandise?
Is the theme right for the season and merchandise?
Are "dealer helps" or show cards related to the season?

5. SELLING POWER (Value - 20 points) Actual Points _____

Are merchandise features clearly shown.
Do show cards bring out important selling points of the merchandise?
Does the theme aid the features of the merchandise in the window?
Is it possible to find and concentrate on most important item?
Is merchandise displayed as it would be used?

(continued on next page)

6. LIGHTING (Value - 5 points) Actual Points _____

Does the lighting draw attention?
Does lighting enhance the colors used in the window?
Is lighting equipment adequate?
Are lighting fixtures clean?
Does lighting focus attention on merchandise, rather than detract from it?

7. TECHNICAL EXCELLENCE (Value - 15 points) Actual Points _____ _____

If there is a unique item such as chicken wire, pipe, or string used, is it used effectively?
Does arrangement of merchandise add to appearance of the merchandise?
Is the merchandise well folded, draped, placed, or suspended?

TOTAL POINTS _____

C.D.E. I. - UNIT III BUSINESS COMMUNICATIONS

Activity 1: Written Communications

On a sheet of notebook paper, rewrite correctly the following introductory (or inside) addresses and salutations:

1. Moore & Seeking Company
84 Beford Street
Seattle, Washington

Attention of Mr. Carl L. Green

Dear Sir:

2. Prof. E. N. Perkins
22 Marshall Road
Portland, Oregon

Dear Prof.

3. Princ. T. L. Martin
Somerville High School
Somerville, Mass.

Dear Princ.:

4. Helen Freeman
242 Parkway
Denver, Colorado

Dear Miss:

5. John R. Knotts Company
48 Marlboro St.
San Diego, California

Dear Mr. Knotts:

6. Major Craig Walker
Austin, Texas

Dear Mr. Walker:

7. Harold O. Fish, Supt.
Boston Albany Railroad
Boston, Mass.

Gentlemen:

8. Rev. J. N. Knotts
78 Mount Vernon Street
Phoenix, Arizona

Dear Reverand:

9. John S. Taylor
Greenville, North Carolina

Dear Mr. Taylor

10. H. L. Jones
Jones, Jones, & Jones
2222 W. 3rd St.
Hopewell, Va.

Sir:

11. Congressman J. T. Booker
U. S. Senate
Washington, D. C.

Dear Mr. Booker:

Activity 2: Written Communications

Dear Mrs. Blank:

The writer wishes to take this opportunity to thank you for opening a charge account at this store. In accordance with our established policy, we shall strive constantly, in fact in every way possible, to make your account a real and lasting convenience to you in the future; and we are fully confident that it will prove to be a source of continued satisfaction to you when you shop at Brown's.

Please be assured that all our various facilities are at your disposal at all times, and that we hope you will find it convenient to use them often in order to make your visits to the store more enjoyable in the future.

In addition, please permit me to state that we shall welcome your suggestions at any time if you think of any possibilities for the improvement of our services to our patron.

We are fully aware of the fact that the opening of your account is an expression of your confidence in our merchandise and in our service, and we give you our unqualified pledge that we shall do our best at all times to justify your faith in us.

Sincerely yours,

Here is a flabby, overstuffed letter written by a credit correspondent who lacked either the time or the initiative to trim off the excess weight.

Let's revise this letter. Mark out the surplus words.

Notes to the instructor:

1. Original letter contains 190 words.

2. Revised letter should not contain more than 95 words.

Activity 3: Written Communications

John Smith, of the Post and Hargrave Company, was severely criticized by an executive of his company for acknowledging a letter of inquiry in the following manner:

Dear Sir:

We do not manufacture the kind of kitchen electric clock which you inquired about. Furthermore, we have only fifteen electric clocks left in stock. You could probably use one of these. Look over the illustrations in the folder enclosed.

Yours truly,

1. Criticize this as a business letter.

2. Rewrite this letter, improving the English, the tone, and the point of view.

3. Check with your business teacher for examples of business letters.

4. Submit your final draft to your teacher.

Notes to the instructor:

1. Check with several firms in town and see if they have examples of letters that they send to their customers.

2. Have your English teacher teach a lesson on writing in your class.

C.D.E. I - UNIT III BUSINESS COMMUNICATIONS

Activity 4: Written Communications

Imagine that you have completed your high school training and are ready to go to work. Write a letter of application for an ad in your local newspaper for a job in your chosen career objective, including data sheet.

Notes to the instructor:

1. Emphasize the "you" approach in letter-writing to the student.

2. Emphasize the parts of the personal data sheet.

Activity 5: Oral Communications in Business

Choose a product in which you are interested and write a one-minute commercial about it to be broadcast over either radio or television. Make it commercially appealing and attention-getting. Be prepared to give your commercial to the class.

Notes to the instructor:

1. Let the student select a product with which he is familiar.

2. Select the best commercials and submit them to your local radio or television station for evaluation.

Activity 6: Oral Communications in Business

Choose a guarantee of a commercial product. Your goal is to persuade your classmates that this is, or is not, a reliable guarantee. Interview students, teachers, merchants, and housewives and secure their opinions on the guarantee. Then prepare a two- to four-minute talk, following these steps:

1. Write out your intended audience response.
2. Write out your central idea.
3. Compose a title.
4. Formulate a speech outline, dividing the outline into an introduction, body, and conclusion.
5. Prepare a set of notes on 3 x 5 cards.
6. Deliver the speech to the class.

Notes to the instructor:

1. Suggested Speech Outline Form may be used and submitted to the instructor.

2. If the student appears to have reached a good conclusion to the guarantee of a product, submit the findings to the company in question.

3. Have the students evaluate the guarantee, the presentation of the speech according to the DECA rating form, and the method of investigation.

C.D.E. I. - UNIT IV ORGANIZATION FOR DISTRIBUTION

Activity 1: Leaders in the Field of Distribution

Since a good many modern stores practice the principles and techniques introduced by the early leaders in the field of distribution, it is important that you become familiar with some of the outstanding contributions that these leaders have made. A list of outstanding contributors follows. Study the biographies of the leaders in your text and other references. Prepare a report to be delivered orally on one of these pioneers assigned by the teacher. As the reports are presented in class, list the contributions the person made beside his name. You will be asked later on to recognize each person with his contribution.

Leaders in Distribution	Contributions to Distribution
William Henry Belk	
Timothy Eaton	
Miss Elizabeth Fairall	
Marshall Field	
Lincoln Filene	
Isaac Gimbel	
Joseph B. Hall	
George Huntington Hartford	
Conrad Hilton	
J. L. Hudson	
S. H. Kress	
Fred Lazarus, Jr.	
Morton J. May	
Mrs. Carrie Neiman	
John Patterson	
J. C. Penney	
Morris Rich	
Richard W. Sears	
Miss Dorothy Shaver	
Mrs. Ora Snyder	
John Rodman Wanamaker, Jr.	

Leaders in Distribution	Contributions to Distribution
Aaron Montgomery Ward	
Frank W. Woolworth	

Notes to the instructor:

This project may be elaborated upon to include leaders in your own community or people students might have a particular interest in.

C.D.E. I. - UNIT IV ORGANIZATION FOR DISTRIBUTION

Activity 2: Organizational Survey

Have the class make a survey of businesses to find out if the organization is a sole proprietorship, a partnership, a cooperative, or a corporation. In small towns they will be able to survey all of the businesses. In larger towns, they might use one section of town or one type of business, such as all of the grocery stores. Tabulate the results to find the percentage of businesses using each type of organization.

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Notes to the instructor:

If you have completed your community survey, students may take part of this information directly from your survey cards.

Activity 3: Organization Chart

Make an organization chart of the business in which you are employed. Begin by making a rough draft of the organization so that your coordinator can check it for accuracy before you proceed to the finished chart.

Answer the following questions:

1. Is your company organized structurally along the lines of a functional organization, a line organization, or a line and staff organization. Explain the differences.

2. What are the advantages and disadvantages of this type of organization?

C.D.E. I. - UNIT IV ORGANIZATION FOR DISTRIBUTION

Activity 4: Chain Stores Versus Independents

There is a store to fill every need of every customer. Some of these are independently owned; some are chain store operations. Interview the owners of several independent stores and the managers of several chain stores. Find out what they consider the advantages of their type of store. Using this material and other material you have obtained through research, list all of the advantages and disadvantages of each type.

- - - - - - - - - - - - - - - - - -

Notes to the instructor:

1. Assign students to visit specific stores, possibly in groups.

2. Select four students to debate the question "Resolved: that the chain store is a better form of retailing organization than the independent store." Assign students for both the affirmative and negative. You might use students who are employed in chain and independent stores for the debate.

3. Be cautious not to set up a competitive attitude. The purpose is to compare.

Activity 5: Chain Store Case Study

In 1938, George F. Flower, who had worked his way from stock boy to merchandise manager with the Fisher Drug Company, purchased a store of his own in Winthrop. About that time, a brother of Mr. Flower inherited a sum of money which he invested in the business. Soon afterward, a second store was opened in Crandon, followed closely by the opening of a third store in Lawndale. At present the brothers operate a chain of 49 stores. Last year this chain was reported to have had sales of over $28,000,000. Each year a certain percentage of the profits of the company is turned back into the organization for the expansion of inventory.

The original plan for locating Flower Drug outlets called for establishing stores in towns of not more than 20,000 population. The location of the first five or six stores was determined by their proximity to each other more than anything else. Later, a warehouse and head office were established as the chain began to grow and expand. In 1940, the first large store was opened.

In order to accommodate the type of customer served, nationally known convenience goods of the drug and cosmetic trade are stocked. These goods are of relatively small unit price, and because of the low profit margin, it is necessary to obtain a high volume of sales.

Merchandise control is handled in the local outlets by the individual manager, who maintains a Daily Receipt of Goods report by departments and a Daily Sales Record, also by departments. Each manager places his order with the Division Supervisor, who takes the orders to the central warehouse. About three or four times a year, a physical inventory of the stock of each retail unit is taken by the company, recorded on Dictaphone records, and placed on file in the central office. For quick information on the amount of stock on hand at any given time, the manager may refer to the running inventory which he is required to maintain at all times.

The buying of merchandise for this drug chain is handled by four buyers. This division of the company is capably headed by Mr. Robert Hay, who has worked his way up from assistant manager of a store to Vice-President in Charge of Merchandising. Mr. Hay himself often does the buying for the company in the New York market. One particular buying technique employed by Flower Drug is that of buying up large quantities of "distress merchandise." This is the merchandise which the manufacturer has unintentionally overproduced and which he is willing to dispose of at cost or at a small loss rather than to get caught with large inventories. An excellent example of this technique was a recent sales campaign in all Flower drugstores for a fountain pen.

The general layout for all Flower drugstores is designed by the central office and adapted to the style of the building housing the individual unit. The local manager, of course, has the privilege of making minor changes in his layout if he sees that some item, such as greeting cards, is misplaced.

The window displays for all Flower drugstores are also sent out from the central office and very often feature items for which the manufacturer supplies the promotional window-display materials.

Flower Drug follows a policy of promoting from the ranks so that a man may work his way up from clerk to assistant manager and eventually to manager. Or, as in the case of Mr. Hay, he may someday hold the position of Vice-President in Charge of Merchandising or other executive office.

A personnel department is maintained in the central office. Here, such key employees as managers, assistant managers, fountain managers, cosmeticians, and cashiers are carefully selected and placed in the stores. All cashiers are bonded. The local manager has the authority to hire at his discretion such people as fountain help and merchandise clerks as needed in the operation of the local unit. Everyone who is on the payroll over six months is enrolled in the company's life insurance and hospitalization plans. The vacation benefits are considered generous, and salaries are up to the prevailing standards, although the payroll of any unit is not to exceed 9 per cent of the total sales volume.

What principles of chain-store merchandising and operation are illustrated in the methods of Flower Drug Company?

Note to the instructor:

The case studies on a chain store and a corporation go into more detail than the average D.E. I. student will be able to handle individually. They might be used as additional work for better students, or they might be presented to the class to be handled as a group. You might possibly divide the class into committees to study various policies of the company and make recommendations with the entire class deciding on the handling.

C.D.E. I. _ UNIT IV ORGANIZATION FOR DISTRIBUTION

Activity 5 Corporation Case Study

The General Store Company, a corporation chartered for the retailing of general merchandise, was organized in 1896 by a group of farmers and townspeople at Blandinsville. These people felt the need for a store that would sell merchandise of various types at low prices.

This corporation now comprises a group of 26 stores. These stores are located in cities and villages of varying sizes, with the largest store in a city of about 45,000 population and the smallest in Hardy Creek, an unincorporated village. Most of the stores are located in large farm trading areas; and much of their trade is, therefore, dependent upon the farmers.

The stores located in the larger cities are department stores with very strict departmental divisions, while the smaller stores are more of the general-store type with a loose departmental organization. In the latter type of store, the clerks wait on customers in more than one department.

The company also has a wholesale department, which sells staple grocery and hardware goods and provides a weekly delivery service to all the stores in addition to providing special-order service as required.

The General Store Company issues common and preferred stock. The holders of the common stock retain all voting rights, and these rights are exercised each year at the annual meeting to elect the members of the Board of Directors, the President, Vice-President, and Secretary. They also vote on any other important question that may require their approval. Most of the stock of the company is held by the farmers and townspeople in and around the cities served by the stores, and by the officers and employees of the company. The common stock is in great demand, as dividend payments have been very good. A dividend of 8 per cent was paid this year; and even during the depression, dividends were never much lower than this.

The General Manager is the direct representative of the Board of Directors. He is responsible for the general management of the business of the corporation and has charge of the general correspondence. He receives and is responsible for the safe-keeping of all money, notes, securities, credits, and property of the corporation. The General Manager also sees that proper accounts and records of all money received and disbursed are kept as required by the Board of Directors and as may be prescribed by the rules and bylaws of the corporation. The General Manager has direct charge over all store managers and over the manager of the wholesale department.

The store manager is the representative of management at each individual store. Some of the stores have assistant store managers, but this is the exception rather than the rule. The store manager has direct charge of all employees, property, and merchandise within his store and is responsible for the success or failure of his business. Each year his accomplishments are evaluated on the basis of the sales and profits of the store in his charge and then compared with the results of the other store managers.

The position of assistant store manager is found only in the larger stores. His duties are much the same as those of the store manager, except that he does not exert as much authority and is subordinate to the store manager. One of his most important functions is to maintain closer contact between management and the customer.

In the smaller stores, the store manager personally takes charge of most of the buying. He is aided by the more experienced salespeople, and he also delegates some of the buying of staple goods to the salespeople. The store manager's approval is required on all of the larger orders and on any of the purchases that are not regular and reasonable.

In the larger stores, each department has a buyer who is also the department manager. His duties include selling in addition to his buying and supervisory capacities. Buyers are aided in their purchasing by suggestions from their salespeople, from want books, and from customers.

Some of the policies of the company are as follows: one price to all; absolute honesty in all dealings; offering extra services such as credit, telephone-order service, and delivery service; and encouraging store managers and employees to enter into community activities.

Since the General Store Company was first organized, it has followed a policy of not advertising; it is still adhering to this policy. No definite policy is set forth by the main office concerning window displays. Inside store displays have not been very good in the past, but there has been a real effort to improve them and these displays are now much better.

All the stores pay their invoices through the main office. Some discounts are lost because they are not taken on time. It always takes a day or two more for the stores to send their invoices to the main office and to pay them from there than it would if the store paid its own invoices.

For many years the company did not make any real effort to improve its relations with its employees, but lately the situation has become somewhat better. Before the war, the salaries paid to employees were very low and no discounts were given. Now, wages are as high or higher than those paid by similar businesses. Bonuses are given at frequent intervals; but as yet, no discounts are given to employees. The attitude of the employees toward the company has improved. Each year since 1945, the company has given each employee a Christmas bonus. The General Store Company did not publicize the bonus. The only ones who heard of the bonus were the friends and families of the employees.

The company has been very slow to take markdowns on goods. Goods are marked, and these same prices are then retained until the merchandise becomes out-of-date or shopworn.

The company does not follow a policy of having special sales. Instead, low prices are depended upon to draw the customers to their stores. This policy has proven rather successful in the past.

Most of the buying of merchandise is left up to the individual store, although there have been many attempts at central purchasing for the company.

During the war, a buyer for all of the stores was hired. He was to purchase clothing and dry goods for the stores, but this attempt at central buying ended as the others had. The stores combine their buying power on some items where the additional saving makes it worthwhile; but the usual practice is for each store to purchase for its own needs, regardless of the needs of the other stores. They shift goods back and forth between the stores when one store runs out of stock, provided there is an ample supply at one of the other stores. The wholesale department represents, of course, a type of central buying; but this is only for staple commodities, and the stores take only what they want.

If you were appointed general manager of this company, what policies and methods of operations would you change? Why?

Activity 6: Selecting a Store Site

The U. S. Department of Commerce has developed a checklist for guidance in selecting a site. Most of the information required for this checklist is easily acquired. However, check only those items which have been starred(*).

For each of the points below, make a check mark in the rating column showing how it reflects your appraisal of the answer in the first column.

Points Deciding Site Choice	Answer	Rating			
	Check: Yes or No, Numerical, or Qualitative Answer	Excl.	Good	Fair	Poor
A. Competition					
*Number of independent stores of same kind					
*Same block					
*Same side of street					
*Across the street					
*Number of chain stores					
*In same block					
*Same side of street					
*Across the street					
*Kinds of stores next door					
*Number of vacancies					
*Same side of street					
*Across the street					
*Next door					
Dollar sales of nearest competitors					
B. Traffic flow (see attached form)					
*Sex of pedestrians					
*Age of pedestrians					
*Destination of pedestrians					
*Number of passers-by					
*Automobile traffic count					
*Peak hours of traffic flow					
Percentage locations of site					
100 per cent					
90 per cent					
80 per cent					
60 per cent					
other					
C. Transportation					
*Transfer point					
*Highway					
*Kind (streetcar, bus, subway, auto)					

* Check only items starred (*)

(Table continues on next page)

Points Deciding Site Choice	Answer	Rating			
	Check Yes or No, Numerical, or Qualitative Answer	Excl.	Good.	Fair	Poor
D. Parking facilities					
*Large enough and convenient					
*Large enough but not convenient					
*Convenient but too small					
*Inadequate in all respects					
E. Side of street					
F. Plant					
Frontage (in feet)					
Depth (in feet)					
Shape of building (for efficient operation)					
Condition					
Heat (type)					
Light					
Display space					
Back entrance					
Front entrance					
Display windows					
G. Rent and lease					
H. Corner location (if not, what is it?)					
I. Unfavorable site characteristics					
*Fire hazards					
*Cemetery					
*Hospital					
*Industry					
*Relief office					
*Undertaking establishment					
*Vacant lot (unless usable for parking)					
*Garages					
*Playground					
*Smoke, dust, disagreeable odors, etc.					
*Poor sidewalks and pavement					
*Old and worn out neighboring structures					
J. Number of professional men in block					
*Medical doctors					
*Dentists					
*Lawyers					
*Veterinarians					
*Others					
K. History of site					

*Check only items starred (*)

AUTOMOBILE AND PEDESTRIAN TRAFFIC COUNT

Below are two forms published by the U. S. Department of Commerce to check pedestrian and automobile traffic. Fifteen-minute tallies are recommended. You must be careful to check traffic at different times of the day to get a true picture of the real situation. Clockings should be made at various points in the block--one in front of the proposed site and one at each end of the block. Counts should also be made in front of competitors' stores. Days of the week, weather conditions, seasons, holidays, special events, etc. affect the quantity and quality of traffic that passes a given site. Note that automobile traffic is taken at a corner site.

Automobile Traffic at a Corner Site

Date _____ Day of Week _____ Temperature_____ Time*_____

Weather Conditions _____

Type	Northbound			Southbound			Eastbound			Westbound			Total
	Number	Estimated Passengers	Total	Number	Estimated Passengers	Total	Number	Estimated Passengers	Total	Number	Estimated Passengers	Total	
Autos													
Streetcar													
Bus													
Total													

Pedestrian Traffic at Site

Date _____ Day of Week _____ Temperature _____ Time*_____

Weather Conditions _____

Sex	Older				Younger				Children				
	Passers-by	Customers	Don't Know	Total	Passers-by	Customers	Don't Know	Total	Passers-by	Customers	Don't Know	Total	
Male													
Female													
Total													

*Indicate the beginning and the end of the period. Use a separate sheet for each project; i.e., 10 a.m. to 10:15 a.m. to 10:30 a.m., etc.

Notes to the instructor:

1. Select an available site or a particular store in your community to have students evaluate on the basis of the checklist.

2. Divide students into committees to work on different sections of the checklist.

3. All students should work on the traffic-flow section to get a true picture.

4. Have one committee check with the Chamber of Commerce to find out what advantage the town offers a new business which is considering locating there.

Activity 7: Business Layout

Prepare a drawing of the layout of the business in which you work, showing location of equipment, fixtures, cash registers, and the like.

Study the exterior and interior of the store, and complete the following questionnaire. After finishing the report, evaluate the good and bad features of the store exterior and interior as revealed by your investigation.

1. Style of architecture (describe the exterior of the building in which the business is located)
2. Business front and sign (describe the type and design of the main building front)
3. Show windows (give the number and approximate size of each)
4. Approach to the business (describe the main entrance)
5. Floor construction and floor covering (describe by floors or departments, including basement)
6. Lighting (main floor only)
   a. Natural (describe)
   b. Artificial (describe style and indicate whether direct, indirect, or semi-indirect)
7. Heating (indicate whether hot-air registers, radiators, unit heaters, etc.).
8. Air conditioning (describe briefly)
9. Interior decorations (describe style and color scheme for main floor only)
10. Elevators and escalators (give locations and general descriptions)
11. Showcases (give number and describe style and type of articles displayed on main floor only)
12. Open display tables (give number and describe style and types of articles displayed on main floor only)
13. Counters (give number and describe style and type of articles displayed on main floor only)
14. Shelves and cupboards (describe briefly)
15. System for handling cash and credit
    a. Overhead carrier
    b. Cash registers (number, types, and location)
    c. Pneumatic tube system
    d. Others
16. Width and convenience of aisles (describe briefly and indicate the number of people who can walk abreast)

- - - - - - - - - - - - - - - -

Notes to the instructor:

An additional project might be to assume that your store is opening a branch store in a new shopping center and to plan a layout for the new store.

Activity 8: Trends in Distribution

From the trade periodicals, textbooks, and reference books available to you, prepare a report on one of the following topics, with particular emphasis on its implications for your business.

A. Night openings

B. Self-service

C. Shopping centers

D. Automation

E. Wage plans

F. Discount houses

G. Modernization of business buildings

H. Trading stamps

I. Packaging

J. Vending machines

K. Suburban living

L. Credit

M. Customer services

Activity 9: Customer Characteristics

ANALYSIS SHEET FOR _____
(list type of merchandise)

Listed below are the characteristics of today's customer. After each characteristic, list the ways in which this characteristic might be applied to your job.

CUSTOMER CHARACTERISTIC	HOW I CAN MAKE USE OF THIS CHARACTERISTIC IN MY JOB
Example:	
1. He has an urge to enjoy the best.	1. Learn the selling points of my quality lines, so I can show the customer how it is really economical to buy the best merchandise. Always show the customer the better line before the sale is complete, in order to appeal to this urge.
2. He has an urge to purchase.	2.
3. He has an urge to conform.	3.
4. He has an urge for identity.	4.
5. He has more money.	5.
6. He's older and he's younger.	6.
7. He has a larger family.	7.
8. He is better educated.	8.
9. He has more leisure	9.
10. He lives in a different place.	10.
11. He has fewer loyalties.	11.
12. He has more credit.	12.

C.D.E. II. - UNIT I CAREER PLANNING FOR PROFESSIONAL GROWTH

Activity 1: Relation of School Courses to Employment

Each school activity contributes in some way to work that you are doing now or will do in the future.

Make a list of the subject areas that you have studied in the ninth, tenth, and eleventh grades. (Example: English would be treated as one subject area, rather than as three subjects.)

Tell what you have learned in these subject areas that you can apply to your particular job or to working in general.

Then add to this list the subject areas you are studying this year and tell what you hope to learn and how it can be applied to your professional life.

SUBJECT AREA	OCCUPATIONAL RELATIONSHIP

Notes to the instructor:

Tell the different classroom teachers that you are planning this activity. (Good public relations!) The teachers will probably be glad to discuss occupational relationships in their class periods and might offer you some resource material. Let them see the results of this study.

C.D.E. II - UNIT I

Activity 2: What Am I Looking For In A Job.

1. Since this questionnaire is designed to help you in choosing a career, be absolutely honest with yourself. For each job satisfaction listed, check the one degree to which you consider it important.

	Greatest	High	Medium	Little or No
a. An opportunity to use my special abilities				
b. A chance to earn a good deal of money				
c. An opportunity to be creative and original				
d. Social status and prestige				
e. An opportunity to work with people				
f. A stable, secure future				
g. Relatively little supervision by others				
h. A chance to exercise leadership				
i. Excitement and adventure				
j. An opportunity to be helpful to others				

2. Now that you know what you are looking for, let's see what employers are offering. From the classified section of a newspaper, select ten advertisements for help. What satisfactions and benefits do they offer? List these below, and underline the benefit which is given the most emphasis.

NAME OF COMPANY	POSITION OFFERED	PROPOSED SATISFACTIONS & BENEFITS

Notes to the instructor:

The first exercise was taken from a survey of 4,585 college students. These are the results of that survey, with job satisfactions listed in the same order:

	Most Important	Highly Important	Medium Importance	Little or No Importance
A.	27%	78%	20%	2%
B.	10	39	48	13
C.	10	48	39	13
D.	2	26	53	21
E.	7	44	36	20
F.	24	61	31	8
G.	3	38	48	14
H.	4	32	53	15
I.	1	16	40	44
J.	10	43	44	13

C.D.E. II. - UNIT I

Activity 3: Analysis of Interests and Abilities

You are a high school counselor, interviewing students who want help in choosing a career. Here are some of the students:

1. Lucy is a very attractive girl, always clean and neat. Her grades range from "Excellent" to "Below Average," but her work is always complete and in order. English is her favorite subject and her strongest. She made good grades in typing and shorthand courses. Science is her weakest subject.

She worked in a doctor's office last summer, assisting the receptionist. She thoroughly enjoyed this work.

Lucy is the oldest child in a large family. Her father is a machine shop foreman. She seems to be well adjusted and very fond of her younger brothers and sisters. She has been baby-sitting for neighbors since she was in the ninth grade.

Lucy would like to be a baby doctor or a child psychologist, but she knows nothing of the requirements in these fields.

Answer these questions:

(1) Is Lucy interested in working with people, ideas, or things?
(2) Where would you tell Lucy to get information about the careers she mentioned?
(3) Do you think she should pursue one of these fields? Why?
(4) If she is unable to go to college, what jobs would you suggest for her?
(5) How would you plan her last year in high school?

x x x

3. Doris is an extremely neat girl, both in appearance and performance. Her teachers say they can always depend on her to do her work promptly and accurately. She had the highest average in her junior class. She enjoys writing evaluations and compositions, but she is a poor speaker.

Doris does not have a large number of girl friends. She prefers to have a few close friends. She was going steady with a boy in her homeroom class last year; but they broke up, probably because he resented her superior intellectual ability.

Doris helps her father in his small grocery store every afternoon. She does all of his bookkeeping. Last summer she had a job typing in an insurance company. She has always wanted to be a teacher, but her father says he can't send her to college.

Answer these questions:

(1) Does Doris work best with people, things, or ideas?
(2) Do you think she would make a good teacher? Why?
(3) Would you advise her to work her way through college?
(4) If she does not go to college, what occupations should she consider?
(5) Based on your recommendations, plan her program for her senior year.

x x x

(6) Would it be wise for you to go into a field of work where you have some ability but little interest? What about a field where you have great interest but little ability?

(7) In your school work, how can you see the relationship between your ability and interest operating?

Activity 3: Self-Rating of My Interests and Skills

FIELDS and Types of Jobs	My Interests			My Skills			*
	Low	Med.	High	Low	Med.	High	
1. CLERICAL - typist, clerk, bookkeeper							
2. PERSUASIVE - salesman, politician, foreman							
3. SCIENTIFIC - technician, biologist, pharmacist							
4. ARTISTIC - MUSICAL - actor, designer, musician							
5. MECHANICAL - construction worker, machine operator							
6. LITERARY - author, reporter, copywriter							
7. PERSONAL SERVICE - butler beautician, barber							
*8. AGRICULTURE - rancher, farmer dairyman, forester							
9. SOCIAL SERVICE - minister, teacher, nurse							
10. ATHLETIC - professional athlete, playground director, coach							

* In this column, check those fields in which both interests and skills are high.

Activity 4: Variety of Opportunities in Distribution

With how many jobs in distribution are you acquainted? Each member of the class will make a list of all of the vocations that he can think of (or it may prove more interesting to select a 24-hour period and make a list of all the vocations that were observed by each student during that period).

Notes to the instructor:

1. This project could be handled in two ways:

   A. Spelling Bee Approach:

      (1) Divide the class into two teams.
      (2) Ask each member of the team, one at a time, to name a vocation that has not previously been named.
      (3) A student who cannot come up with a new vocation must sit down.
      (4) The team with the last student standing is the winner.

   B. What's My Line Approach:

      (1) This type will work in the same way as the TV show.
      (2) Select a panel of 4 - 5 students. (These students should have done research on certain jobs, requirements of each, etc. so they will be able to ask questions).
      (3) Each student will select a career with which he feels he can "stump" the panel.
      (4) The panel will begin asking questions that may be answered by "yes" or "no."
      (5) The panel is entitled to five "no" answers. If they have not determined the job at that time, they lose.

2. This project is a good way in which to acquaint the students with a number of jobs available to them that they normally would not consider.

Activity 5: Developing a Job Description

Visit a business or a department where something is sold in which you are interested. (This may be the place of students' employment). From a study of what you see and from your own good judgment, develop a job description for a salesman of that merchandise. Write down all of your observations, and from these develop the job description using the form below.

JOB DESCRIPTION REPORT

1. The job title

2. Work outlined:
   a. Stock duties
   b. Selling duties
   c. Other responsibilities

3. Working conditions:
   a. Hazards
   b. Social environment

4. Possible promotions

5. Education

6. Special training necessary

7. Previous experience

8. Physical qualifications:
   a. Sex
   b. Age limits
   c. Weight
   d. Appearance
   e. Eyes (color blindness)

9. Voice

10. Grammar

Notes to the instructor:

1. Through the job descriptions stress that success in selling depends on the following:

   a. Good personal appearance
   b. Interest in and the ability to understand people
   c. Good health
   d. Product knowledge

2. The finished report could be read to the class.

Activity 6: Interview of Successful Person in Occupation of Interest to Student

Select a businessman from your training agency, other than the one used in the Organization for Distribution Unit. Make an outline of his career. At the conclusion, state in a few words the outstanding characteristics which are largely responsible for his success. Construct your outline around the following topics:

1. Personal Information
2. Educational Background
3. Work Experience

Notes to the instructor:

1. Plan the interview with the student, using the steps listed on page 7, Section III, Job Analysis As Related to Career Planning, "B."

2. Have the students develop a chart of the characteristics that lead to a successful career.

3. This project lends itself to classroom discussion.

Activity 7: Continued Education After Graduation

Divide the class into groups, then divide the State according to the number of students you have in the groups. Have each group obtain the names, locations, and general information on all colleges in their area. Separate the schools as to four-year, two-year, business, or technical.

After this information has been obtained, place a map of North Carolina on a bulletin board. Each group will locate the different colleges by a special-colored flag. For example: yellow flag--4-year school; blue flag--2-year school.

Select a chairman from each group. He will give a statistical report to the class concerning the number and the type of schools his area offers. The other members of the group may give reports on the schools pertaining to the courses the school offers in the field of distribution, for example: data processing, commercial art, etc., or they may give reports on other areas that relate to the students' interests. The following form may be helpful in obtaining the necessary information:

Name of School _____ Year Founded _____

Type (4-year, 2-year, Business, Technical) _____

Location _____ Enrollment _____

State or Privately Owned _____

Requirements for Admission _____

_____

Courses Offered in Distribution _____

_____

_____

Other _____

_____

Notes to the instructor:

1. This information may be obtained through the Guidance Department in your school.

2. This project would lend itself to your annual "College Day" held in your school.

3. Present this as a gift to the Guidance Department. It will prove very helpful to them having all of the schools pin-pointed.

Activity 8: Career Chart

Each student will select a field of work in which he is interested, then he will follow the following three steps:

Step 1 - List the jobs in the field that are open to beginners.
Step 2 - List the jobs in the field that require special training and experience.
Step 3 - List the jobs that lead to the chosen career objective.

1. Once this information has been assembled, prepare a chart showing the areas in which one would advance in that particular field if chosen for a career.

2. With the information that you have assembled, outline an ideal plan of preparation for the work that you have chosen, classifying the preparation under the two heads "education" and "training." The following questions should be answered:

   a. How long a time is required for education and training?
   b. Where can each be secured?
   c. How much will the preparation cost?

Notes to the instructor:

1. This information may be obtained through the school's guidance department, pamphlets from the Employment Security Commission Office on the various fields of employment.
2. The following is an example of a career chart:

Basic Terminal Jobs	Supplementary Terminal Jobs	Related Jobs
Professional Photographer		News Photographer
1. Illustrative	Demonstrator	Instructor in Photography
2. Commerical	Salesman	Lab Technician
3. Portrait	Foreman	

Intermediate Jobs	Training Jobs
Assistant Photographer	Chemical Mixer
Cameraman	Assistant Printer
Proof Retoucher	Lab Assistant
Salesman	Studio Helper
	Salesclerk

This is not a complete chart, but a sample of a career chart.

C.D.E. II - UNIT II ECONOMICS FOR DISTRIBUTION

Activity 1: Economics Systems

The following questions are to be answered by your group. Your group leader will present your answers to the other class members. You will turn in a written report of the materials that you develop for the presentation.

Questions to be answered about each economic system:

1. Is it a free or centrally planned economy?

2. Who makes the economic decisions and how?

3. What is the role of government?

4. Can an individual choose to go into business for himself?

5. Is private property ownership possible? To what extent?

6. Can individuals join a union?

7. What about the historical background of the economy?

8. What about the political freedoms, such as freedom of the press freedom of religion, and trial by jury?

9. What is the role of private enterprise?

10. Can an individual choose to go into business for himself?

Notes to the instructor:

1. Divide the class into four groups and assign each group one of the four economic systems.

2. Let each group select a leader for its group.

3. Let each group work on the questions together.

4. Lab work in the library will be necessary.

5. Have each member turn in to you a written report of his activity.

6. Permit the leader of each group to present his findings to the class.

C.D.E. II - UNIT II ECONOMICS FOR DISTRIBUTION

Activity 2: Production, Distribution, and Consumption

Your teacher will assign you one article of merchandise such as those listed below. Prepare a chart showing the channels of distribution through which the article passes from the producer to the consumer. Check with several wholesalers and retailers in your town in order to receive first-hand information.

1. Radios
2. Sporting equipment
3. Cigarettes
4. Gasoline
5. Farm equipment
6. Seeds
7. Wallpaper
8. Hats
9. Automobiles
10. Furniture

Notes to the instructor:

1. Assign the student a product that he sells in his training station.

2. Secure a local merchant who is familiar with distribution and have him speak to the class.

3. Do not expect the student to plot every agent in the channel of distribution of his product.

4. Have student present his findings to the class.

Activity 3: Laws of Supply and Demand

Assume the following to be true of the demand for and the supply of a farm product that is sold in the local supermarkets at a given time. Plot the demand and supply schedule and determine the market price at this given time.

Demand Schedule	Price	Supply Schedule
24	.10	1
20	.15	3
18	.20	5
16	.25	7
14	.30	9
12	.40	11
10	.60	13
8	.70	15
6	.80	17
4	.90	19
2	1.00	23

Answer the following questions:

1. What are some factors that may cause the demand and supply schedule to change?
2. Explain how the buyers and sellers fix the market price.

Notes to the instructor:

1. Suggest to the student that he visit a local farm market if possible.
2. Use this activity in discussing the unstable prices in food merchandising.

Activity 4: Business Cycles

The Great Depression
1929-1936

Within a few months after the stock market collapse of October, 1929, unemployment was a national concern. In March, 1930, the estimates ranged from 3,000,000 to 4,000,000 people unemployed. In less than a year, estimates were between 11,500,000 and 12,500,000. Wages dropped from an average of $28.50 a week to $22.64 a week.

On the farm scene thousands of farmers were destroying their crops for lack of adequate prices, while millions of city dwellers were begging for food in the streets.

Homes were lost, businesses closed, insurance policies were cancelled, savings were lost, banks closed, aid from relatives and friends had been terminated, families were forced to exhaust and destroy indefinitely their credit, and no relief was in sight.

Questions:

1. Can such an economic situation develop again in this country? Why or why not?
2. What steps has the government taken to prevent such a downturn in economic activity?
3. What caused overproduction in one area and underconsumption in another?
4. What is meant by deflation and inflation?

Notes to the instructor:

1. This activity is designed to stress the importance of government control of the economy.
2. Permit various students to present parts of the business cycle to the class.
3. Have the students evaluate the effects of the business cycles upon their training station.
4. Secure the book, The Great Depression, Edited by David A. Shannon, A Spectrum Book, Prentice-Hall, Inc., Englewood Cliffs, N. J.

Activity 5: Government's Role in U. S. Business

As a student in distributive education, you should be familiar with the various Federal, State, and local regulations that govern the distributive businesses. In this activity, you should try to find all of the answers to the following questions concerning government regulations. Your teacher, your training sponsor, and your textbooks should be a great aid to you. You will need to know how the law protects you, your customers, and your firm, and how to avoid unnecessary problems.

Questions:

1. What safety regulations are observed at your training station, and what government agency enforces them?

2. What government grades or standards must your training sponsor observe, and what government agency enforces them?

3. What kind of records does your training sponsor keep for the local, State, and Federal government?

4. Does your training station conduct intrastate or interstate trade? If so, how does it affect the operation of the firm?

5. Does any government agency regulate the sale of any merchandise handled by your firm. If so, what merchandise and what government agency? Why?

6. What regulations concerning weights and measures must your training sponsor observe and why?

7. List any government regulations pertaining to your training station and explain them if you have not answered them in the above questions.

Notes to the instructor:

1. Be sure to check with the training sponsors before you assign this activity.

2. Secure some booklets on government regulations and present them to the class.

3. Secure a speaker from some government agency which has regulatory powers affecting distributive businesses.

Activity 6: Insurance, Credit, and Financial Practices in Business

One day you may be the owner of a retail, wholesale, or service establishment. One of the first questions that will come to your mind will be: "What kind of insurance should I carry on my business operation?" Therefore, your activity is to determine what kinds of insurance a merchant should carry on his business. Call one of the insurance agencies in town and make an appointment with the agent at his office at his convenience. You should plan your questions in advance so that you will not take up too much of the insurance agent's time.

Notes to the instructor:

1. Be sure to brief the student on the proper manner of questioning the insurance agent.

2. Check with the agent after the student has contacted him.

3. Let the student present his findings to the class.

C.D.E. II - UNIT II ECONOMICS FOR DISTRIBUTION

Activity 7: Insurance, Credit, and Financial Practices in Business

Banks provide a vital service to business in the form of short-term loans. Determine whether this service should be used in the following situation: Suppose you have an invoice for merchandise received for $850. If you pay the invoice within 30 days, you may take advantage of a 3 per cent discount. You do not have the cash on hand to pay this invoice, but you can borrow the money from your bank at the rate of 6 per cent per year. Determine whether it would be advisable for you to borrow from the bank, using a 60-day note and pay the invoice in 30 days. If it proves to be advisable, show how much you would save. (Show all figures.)

Notes to the instructor:

1. Summary of calculation:

$850.00	Cost of merchandise	$824.50	Loan
- 25.50	Discount	+ 8.25	Interest on loan
$824.50	Cost after discount	$832.75	Loan plus interest

$25.50	Discount
- 8.25	Cost of loan
$17.25	Savings

2. It appears that a savings of $17.25 would result if the student borrows the money from the bank on a 60-day note.

3. Let the student calculate the cost on 90-day and six-month notes, and draw a conclusion as to the advisability of each such loan.

4. Secure a speaker from a local finance institution to discuss this topic.

Activity 8: Taxes

Use your training station to help you answer the following questions on taxes.

Questions:

1. Local taxes:

   a. What local taxes are levied against your training station and on what basis?

   b. Are any taxes parallel to the profits of the business?

2. State taxes:

   a. What State taxes are levied against your training station and on what basis?

   b. Is any group of items exempt from the State taxes?

   c. Are any State taxes parallel to the profits of the business?

3. Federal taxes:

   a. What Federal taxes are levied against your training station and on what basis?

   b. Are any taxes parallel to the profits of the business?

   c. Are the Federal taxes hidden from the buying public?

   d. When are the Federal taxes payable to the Federal Government?

Notes to the instructor:

This would be a good place to invite a tax agent to speak to the class.

Activity 9: Financial Markets

The following terms pertain to the stock market. You should check on the definitions of each word for future reference.

1. S. E. C.
2. Odd lot
3. Round lot
4. Bear
5. Bull
6. Stock
7. Broker
8. Proxy
9. Common stock
10. Amortize
11. Dividends
12. Commission

Notes to the instructor:

1. This is a simple drill in order for the student to learn stock market terms.

2. Secure Portfolio of Teaching Aids to accompany "You and the Investment World" from the New York Stock Exchange, 11 Wall Street, New York, N. Y. 10005

C.D.E. II - UNIT III MERCHANDISING

Activity I: Modern Merchandising

TIMES ARE CHANGING

Mr. and Mrs. Johnson own the local "Kingsville 5 & 10." Kingsville is a town of about 6,000 population. The Johnsons' variety store is one of two located in the community; both stores are located in the downtown business district and are about equal size, volume, and customer traffic. Kingsville is about 20 miles from Centerville, a large town of about 50,000. The development of a modern shopping center in Centerville has taken business from the downtown area of Kingsville. A large discount store has had particularly hard effects on Kingsville's two variety stores. Mr. and Mrs. Johnson are quite concerned that they may not be able to continue operating; they are afraid that their old method of operation will no longer be profitable. Sales have been particularly poor in such items as cosmetics, kitchenware, and household items such as towels, sheets, and curtains--all of which are priced at considerably lower prices at Centerville's discount store. The Johnsons have considered cutting their prices to meet those of the discount store, but this would mean that the price they would be getting would only cover basic costs and would leave no room for such things as shortages, shopworn or damaged merchandise, or poorly bought items. Both variety stores in Kingsville carry the standard assortment of merchandise one would expect to find there; in fact, many of the same lines are carried in both stores. While there remains some volume in most of these items, the Johnsons do not think that it is enough to support both stores. The owner of the other store has given no indication that he plans to change his method of business.

One department to which the Johnsons have had particularly good response has been a small candy counter. They handle a small assortment of loose candies and the more popular candy bars; they also have a local dealership to sell an excellent, medium-priced, line of packaged candies. Mrs. Johnson feels that if they expanded this department, they would be able to get a substantial increase in sales, as they already have a number of steady customers for their candies and no other store in town carries any sizable assortment of candy. Mr. Johnson says she may be right, but expanding the candy lines would mean eliminating some other items. While Mr. Johnson admits that all to often a customer goes out empty-handed because she has been unable to find what she wants, he is afraid to lose even a few more sales by dropping any of their present lines. Mr. Johnson is proud of the fact that customers often tell him he has the best stock of artificial flowers anywhere around. He also does a small, but profitable, business with bulbs and bedding plants in the spring. He says that since there is no gardening store in town, he might be able to increase this business considerably as well as add house plants to his stock. He has often considered building a greenhouse as a hobby when he retires. Several other items carried by the Johnsons which tend to be distinctive and unavailable elsewhere in town have also maintained or increased their sales volume. Included among these items are greeting cards, gift wrapping supplies, unusual party supplies and decorations, and some hobby items.

QUESTIONS TO CONSIDER

1. Has the place of the small variety store in Kingsville changed with the coming of the shopping center and its discount store? If so, how has it changed?

2. Should the Johnsons leave things as they are and hope business picks up?

3. Should the Johnsons accept the fact that the discount store is driving them out of business, sell out, and try to make their living some other way?

4. Should the Johnsons continue to carry all of their present lines of merchandise? If so, should they consider adding a wider variety of styles and price ranges in order to attract more sales?

5. Should the Johnsons cut their prices to meet those of the discount store? What effect would this probably have on their profits?

6. Should the Johnsons assume a fight-to-the-finish attitude and try to drive the other variety store out of business? If they were to attempt to do this by cutting prices, what might result?

7. If the Johnsons decide to stick it out, do you think they might consider dropping some lines, but adding or expanding others? If so, what lines do you think they might try?

8. Would it benefit the store to establish a specialty image and emphasize those items they have which are most profitable and have achieved some degree of acceptance? If they do this, should they consider a change in the store name?

On the basis of the answers you have given to the above questions, summarize your recommendations to the Johnsons as to what they should do. Include any suggestions you think might help make your recommendations work.

Notes to the instructor:

1. It is not probable that Mr. and Mrs. Johnson can compete with the discount store on the basis of price. The problem gives no indication of any factors which would enable them to take any substantial amount of trade away from their competitor. (If they cut prices, he would probably follow suit. It is quite possible that, unless they beat the discount store's prices, the two stores would end up with about the same unit volume of business and an even lower dollar profit.) The situation has possibilities and certainly does not dictate surrender, although you may have a student who recommends selling out and opening a nursery. Other possibilities include creating a new type of operation which would call for a new public image and a new name. They might develop into a variety-type store, specializing in items they are now doing well with. They might establish a specialty store such as a party supply store, a gardening shop, a candy shop, or some combination or adaptation of one of these. Don't hold students to any "pat" answer; there is no single solution. This is a very real problem facing many variety stores today.

2. The Retail Revolution, published by Fairchild Publications, can be most valuable in introducing some of the trends and problems of modern merchandising to your students.

C.D.E. II - UNIT III MERCHANDISING

Activity 2: Buying Plan

In order to merchandise successfully, the buyer must carefully formulate a buying plan. In making an effective buying plan, the buyer must become familiar with his customers, his merchandise, his store and its policies, and the success of previous merchandising tactics. The good buyer must also be familiar with his possible sources of supply; he must be always on the lookout for new and better merchandise with which to satisfy his customers.

The following sets of questions are designed to give you a clearer picture of your business and its merchandising pattern.

1. WHO ARE YOUR CUSTOMERS?

   a. Are most of your customers women, or are most of them men?

   b. To what general income group or groups do most of your customers belong?

   c. What are the main age groups of your customers?

   d. What plans or preparation, if any, do your customers make before doing business with you? (Dress up, make lists, make appointments, etc.)

   e. What are some of the things your customers are interested in?

   f. What other characteristics do your customers have? (Occupations, needs caused by climate, etc.)

   g. How does the answer to each of these questions determine what you will buy and how you will sell it?

2. WHAT ARE YOUR PRICING POLICIES?

As you answer each of these questions, explain why your business does or does not use each of these techniques. In the case of a "yes" answer, give examples:

   a. Does your business follow manufacturers' suggested or advertised prices?

   b. Does your business have leaders or loss leaders?

   c. Does your business price in odd numbers?

   d. Does your business price in even numbers?

   e. Does your business bundle prices?

   f. Does your business stress price lining?

   g. Does your business show prices in displays?

3. WHAT KIND OF MERCHANDISE DO YOU STOCK?

   a. Name some of the staple goods your business keeps in stock.

   b. Does your business always try to have the same amount of staple goods on hand?

   c. Can you name times when the basic supply of staple goods would increase or decrease?

d. What types of seasonal or fashion merchandise does your business handle?

e. Does your business have any private brands in its stock? If so, name some. Name the national brands of similar goods which you carry.

f. Do these private brands compete directly with the national brands?

g. Which are lower in price, the private or the national brands? Give examples.

h. What advantages, if any, do the private brands have over the national brands in your business?

4. WHAT DOES IT TAKE TO HAVE A COMPLETE STOCK?

a. Select one of the following items which your business stocks in depth. (If none is carried by your business, your coordinator will give you another.)

aspirin	socks	paint	ballpoint pens	cardigan sweaters
tee shirts	cigarettes	canned fruit	cake mix	notebook paper
shampoo	screw drivers	mattresses		

b. Find out what varieties, prices, brands, sizes, colors, etc., are carried for the item you have selected.

c. Find out how many of each type your business has in stock. Do you think more or less is needed for the stock to be adequate, or do you feel the present assortment is sufficient?

d. Make a chart showing the results of what you have found out.

5. WHAT CAN YOU LEARN FROM EXPERIENCE?

a. Select a department in your firm with which you are familiar to use in answering the following questions.

b. List the items or events which have been successful this year and which you think should be repeated next year. (Give any necessary details of timing, promotion, or advertising.)

c. What have been some of the successful items or events of your competitors?

d. List any unsuccessful items or events; and, if possible, give reasons for their lack of success.

e. What items should have been carried that were not?

f. How could the department be improved? Give suggestions for advertising, display, merchandise, service, etc.

6. WHERE CAN YOU LOOK FOR NEW RESOURCES?

a. List five types of merchandise or supplies your business carries or uses.

b. Using trade journals, determine at least five sources from which you might consider buying each of these items.

c. What factors would you need to consider with each type of merchandise in determining from which sources to buy?

d. Where else might you look to find other possible resources?

Notes to the instructor:

1. Be sure to get permission from the employer involved in this assignment. Encourage each student to be thorough and resourceful in his investigation; but don't let him become a nuisance to his employer.

2. Tailor this assignment to the individual. It may be lengthened or shortened to meet special needs. Each group of questions might be used as an individual assignment, or the entire series may be used as a major activity to give the student better insight into his own place of work. It may be a little difficult to adapt questions to students working in businesses which do not sell merchandise, but a little ingenuity will often solve the problem.

3. Such questions as those in group three on private and national brands might lead to an interesting class debate.

4. After students have finished writing their answers, it might be interesting to have a panel discussion by students from various businesses to see the similarities and differences in their findings.

Activity 3: Open-to-buy

You are a merchandise manager planning the open-to-buy figures for the ready-to-wear department of a large store. Last year's figures show that the department sold $80,000 during April. You are planning for a 10 per cent increase over last year's figures. Stock on hand on April 1 (determined from a book inventory) is $125,000; the desired stock on hand for April 30 is $95,000. Orders totaling $18,000 have already been placed for delivery in April. Determine the open-to-buy figure for the ready-to-wear department for April.

1. What are your planned sales for April of this year?
2. How much merchandise should come into the store during April?
3. What is the open-to-buy figure?

Assume that you are projecting the figures for May at the same time. Last year's sales figures were $69,000; you are aiming for the same 10 per cent increase in sales. The desired ending inventory for May is $92,000. You have on order for May delivery $4,500. What would your projected open-to-buy for May be?

1. Follow the same steps as for April.

2. What effect would it have on the open-to-buy for May if sales for April were larger than expected at this time? What effect if they were smaller?

Activity 4: Selecting Vendors

It is often necessary to decide between two or more vendors when buying an item. A rating sheet might provide a useful tool in making this decision. Giving points on the basis of the following scale, rate the following suppliers on the 10 factors given. (Excellent - 10, Good - 7, Fair - 4, Poor -1.)

	QUALITY OF GOODS	COMPLETENESS OF LINE	SHIPS RIGHT QUANTITIES	FAVORABLE PRICING	HAS UP-TO-DATE ITEMS	DELIVERY DEPENDABLE	CREDIT TERMS FAVORABLE	SUPPLIES DEALER AIDS	CARRIES NAME BRANDS	ACCEPTS RETURNS	TOTAL
SUPPLIER A	Good	Fair	Exce	Good	Poor	Good	Good	Poor	Fair	Good	
Points											
SUPPLIER B	Fair	Good	Fair	Exce	Good	Exce	Good	Good	Poor	Fair	
Points											
SUPPLIER C	Poor	Fair	Exce	Good	Good	Exce	Exce	Exce	Fair	Fair	
Points											

1. On the basis of points, which supplier would rate the highest?

2. What is the danger of relying too heavily on this type of system?

Notes to the instructor:

The choice of the supplier with the highest number of points in this case would probably be a mistake, because the quality of the goods involved should probably be given more weight in determing the answer. Point up that such a rating sheet can be very valuable, but its weaknesses must be kept in mind when using it.

Activity 5: Discounts

Knowing Your Discounts Can Save You Money

As the buyer of a sportswear department, you have a chance to buy 600 blouses in either of the following ways. The blouses are comparable, and price is your only consideration. Look over the two offers and decide which one you will accept. Show how much the blouses would cost in each case and show how much you would save by your decision. Assume in both cases that the invoice would be paid within 30 days.

(1) The list price is $5 for each blouse. There is a trade discount of 40 per cent and a quantity discount of 5 per cent for all orders of 500 or more. There is also a cash discount of 1 per cent if payment is made within 30 days.

(2) The list price is $5 per blouse. There is a trade discount of 30 per cent, and a quantity discount of 15 per cent on orders of 300 or more blouses. There is a cash discount of 3 per cent if payment is made within 30 days.

Notes to the instructor: (Solution)

(1)	600	blouses
	x $5	price
	$3000	total list price
	-1200	40% trade discount
	$1800	
	- 90	5% quantity discount
	$1710	
	17.10	1% cash discount
	$1692.90	net price

(2)	600	blouses
	x $5	price
	$3000	total list price
	- 900	30% trade discount
	$2100	
	- 315	15% quantity discount
	$1785	
	- 53.55	3% cash discount
	$1731.45	net price

Savings of $38.55

Point up that if the percentages are added together and compared, (a common mistake) they give an inaccurate picture of the actual cost situation.

Activity 6: Discounts

Practice Sheet For Determining Discounts

	AMOUNT	TERMS	INVOICE DATE	RECEIVING DATE	LAST DAY OF DISCOUNT PERIOD	AMOUNT OF DISCOUNT	AMOUNT TO BE PAID
1.	$ 100	8/10 EOM	Oct. 14	Oct. 26	_____	_____	_____
2.	$ 660	2/10 ROG	Nov. 18	Nov. 19	_____	_____	_____
3.	$ 75	3/15 n30	Sept. 8	Sept. 11	_____	_____	_____
4.	$ 250	2/10 EOM	Dec. 1	Dec. 31	_____	_____	_____
5.	$ 300	1/10 n30	June 20	June 24	_____	_____	_____
6.	$1500	8/10 ROG	Feb. 25	March 4	_____	_____	_____
7.	$7500	2/10 EOM	May 21	May 23	_____	_____	_____
8.	$ 500	6/10 n30x30	July 10	July 29	_____	_____	_____
9.	$ 650	8/10 EOM	Oct. 12	Oct. 12	_____	_____	_____
10.	$ 200	2/10 EOM	Nov. 4	Nov. 10	_____	_____	_____
11.	$1200	2/10 ROG	Aug. 15	Aug. 20	_____	_____	_____
12.	$ 60	5/10 EOM	Dec. 1	Dec. 4	_____	_____	_____
13.	$5250	1/10 n20	Jan. 10	Jan. 13	_____	_____	_____
14.	$ 90	2/10 ROG	Nov. 5	Nov. 7	_____	_____	_____
15.	$ 850	8/10 n30	Sept. 15	Sept. 15	_____	_____	_____
16.	$ 900	3/15 EOM	Nov. 28	Nov. 28	_____	_____	_____
17.	$4500	2/10 ROG	Dec. 10	Dec. 12	_____	_____	_____
18.	$ 550	8/10 EOM	March 1	March 6	_____	_____	_____
19.	$ 950	2/10 n30x60	Aug. 3	Aug. 9	_____	_____	_____
20.	$1250	1/10 n30	July 6	July 10	_____	_____	_____

Activity 7: The Buying Process

Writing an Order

You are the assistant buyer in the men's department of a department store. You have just been assigned the task or ordering your spring assortment of short-sleeve dress shirts from your major resource. Because the line is very popular and has a greater demand than it can meet, the salesman has warned you that after the beginning of the season, deliveries may be slow, and in some cases, nonexistent. On the basis of this information, you have decided to place your order for the entire season at this time. Based on last year's figures, you have decided, and received the agreement of your buyer, that a stock of about $6000 will be needed.

In figuring, you will need to bear in mind that a minimum of two shirts in any given category may be ordered. Design your own order form appropriate for the store or department. You will want to include a place for such things as name and address of the buyer and the seller, department number, date of the order, description of the merchandise, quantity, color, size, style number, unit cost, extension cost, total cost, credit terms, discounts, transportation arrangements, delivery and cancellation dates, special terms (if any), and buyer's signature. After designing your form, fill in your order. You have the following information available to you. Your department carries shirts from this company in three prices: $3.95, $4.95, and $5.95. Half of the dollar volume of business in these shirts is done with the $4.95 shirt; one-third is with the $3.95 shirt; and one-sixth is with the $5.95 shirt. White shirts account for 50 per cent of all shirt sales; blue for 30 per cent; tan for 10 per cent; and green for 10 per cent. The sizes sell in the following percentages: 14 - 5%; 14½ - 15%; 15 - 30%; 15½ - 20%; 16 - 15%; 16½ - 10%; and 17 - 5%.

Notes to the instructor:

Point out to student that percentages of this kind will not always come out even. Let him use his own judgment in rounding off.

Activity 8: Markup

Modern grocery stores carry a wide assortment of merchandise. Because of the widely different characteristics of these items, they carry vastly different markups. Make a list of at least 30 different items you would expect to find in a grocery store. Make a chart dividing these items into three groups: those with high, low, and medium markups. Why doesn't the grocer simplify things for himself and give everything the same markup?

Notes to the instructor:

1. You might have some of your students in supermarkets do this one and then have them check with their employers to see how accurate their ratings were.

2. A variety of other businesses may be substituted for the grocery store.

Activity 9: Markup

Practice Sheet for Figuring Markup

Fill in the missing figures.

	COST	MARKUP ON COST	MARKUP ON RETAIL	RETAIL PRICE
1.	$ 100	50%	_____	_____
2.	$ 175	_____	50%	_____
3.	$ 550	_____	45%	_____
4.	$ 20	40%	_____	_____
5.	$ 55	60%	_____	_____
6.	$2250	_____	50%	_____
7.	$ 300	_____	40%	_____
8.	$ 15	_____	25%	_____
9.	$ 72	50%	_____	_____
10.	$ 90	_____	33 1/3%	_____
11.	_____	_____	50%	$ 50
12.	_____	_____	40%	$225
13.	_____	33 1/3%	_____	$100
14.	_____	_____	25%	$ 60
15.	_____	50%	_____	$ 90
16.	_____	_____	33 1/3%	$150
17.	_____	66 2/3%	_____	$250
18.	_____	_____	40%	$125
19.	_____	50%	_____	$ 75
20.	_____	_____	40%	$190

C.D.E. II - UNIT III MERCHANDISING

Activity 10: Markdowns

1. List five items which have been recently marked down in your business.
2. Why was each marked down?
3. How might some of these markdowns have been avoided?
4. Should good planning totally eliminate markdowns? Why?

Notes to the Instructor:

Markdowns serve an important function to the merchant. It is quite probable that in totally eliminating markdowns, the merchant might also eliminate much of his profit. Point out to the student that if a merchant doesn't have anything left over at the end of the season, he probably didn't have enough to sell during the season. The key point is that markdowns should be a part of the overall merchandising plan.

Activity 11: Returns

Mr. Gay's Sad Problem

Mr. Gay has operated "Gay's Family Store" for over 20 years. Over the years, "Gay's" has been an easy going, friendly store and has received very few complaints. The town in which it is located was, until recently, small and had a very stable population. The opening of an army base nearby five years ago and the building of a factory just outside town has not only increased the population, but has also created a population that is constantly changing. The salespeople in "Gay's Family Store" have been there for many years and have know "Gay's" customers as old friends. Mr. Gay has always done most of the buying, using his judgment, and rarely depending on brand names for assurance of quality. He had been quite successful until the recent development of so many new fibers made it almost impossible to judge a fabric on appearance alone. New customers complain that the clerks seem overly casual and often uninformed; customers sometimes leave the store irritated because a popular brand they are accustomed to buying is unavailable. The number of returns has increased alarmingly. Since Mr. Gay has always made a habit of being on the selling floor as much as possible, he hears first-hand many of these complaints. Mr. Gay has asked Mr. Jones, the assistant manager, to analyze the situation.

At the present time, returns of unused merchandise which are accompanied by the salescheck are either exchanged for a similarly priced item (without any written notation being made) or credited to the customers' accounts; cash refunds must be approved by the department head. A charge credit is made by means of a credit memo which gives only the customer's name and address and the price and description of the merchandise to be credited. In the case of a cash refund, a ticket marked cash refund and bearing the same information as the credit memo is the only record of the transaction. Returns of used or damaged merchandise are handled by the department buyer, but are recorded on the same forms.

Mr. Jones has begun his investigation. The first thing that has become evident is that nowhere is there any record of why merchandise has been returned. The fact that often a customer returns something "that doesn't fit" but doesn't want an exchange made indicates that the problem could stand investigation. Some of the salespeople seem to feel vaguely that prices are just too high these days, but further questioning of employees has brought out no really worthwhile facts. Mr. Jones has taken the names from the credit memos and cash refund slips; he has called these customers to ask why they made the returns. Out of one-hundred calls, he has had the following results:

Number he was unable to reach:		14
Number who refused to discuss problem:		9
Number of purchases returned		47
Didn't fit	19	
Wrong color	7	
Found something better	5	
Poor quality	8	
Decided didn't like it	8	
Number of approvals returned		25
Decided didn't like it	10	
Didn't really want it	8	
Found something better	5	
Family didn't like it	2	
Delivered and charged to wrong person		5

1. Do you think this information is of any value?

2. Do you think the present system of handling returns is satisfactory?

3. On the basis of the information given, what would seem to be the main causes of Mr. Gay's return problem? (Consider each reason given for returns individually and decide what significance each has.)

4. What changes might help in solving this problem of returns?

5. What other store policies might Mr. Gay look into and consider changing?

Notes to the instructor:

Returns are not emphasized in the course of study, but they are important; and when analyzed, can often point out many weaknesses in both buying and selling policies.

Activity 12: Stock Turnover

Practice Sheet for Computing Stock Turnover

In each of the following problems, figure the yearly turnover to the nearest tenth.

	SALES		INVENTORY	
1.	Jan. - Mar.	$10,600	Jan. 1	$25,000
	Apr. - June	14,000	Mar. 31	35,000
	July - Sept.	18,000	June 30	42,000
	Oct. - Dec.	13,500	Sept. 30	39,000
			Dec. 31	23,000
2.	Jan. - Feb.	$13,200	Jan. 1	$10,000
	Mar. - Apr.	14,500	Feb. 28	13,000
	May - June	12,900	Apr. 30	14,000
	July - Aug.	11,700	June 30	13,000
	Sept.- Oct.	14,100	Aug. 31	13,000
	Nov. - Dec.	16,300	Oct. 31	14,000
			Dec. 31	11,000
3.	Jan.-June	$47,350	Jan. 1	$12,500
	July-Dec.	53,920	June 30	19,200
			Dec. 31	14,300
4.	Jan.-Apr.	$21,000	Jan. 1	$ 9,300
	May - Aug.	24,000	Apr. 30	10,100
	Sept.-Dec.	36,000	Aug. 31	14,200
			Dec. 31	10,700
5.	Jan.-Mar.	$ 6,000	Jan. 1	$ 3,100
	Apr.-June	7,100	Mar. 31	3,500
	July-Sept.	6,800	June 30	3,400
	Oct.-Dec.	8,700	Sept. 30	4,100
			Dec. 31	2,900
6.	Jan.	$12,000	Jan. 1	$20,000
	Feb.	13,000	Jan. 31	25,000
	Mar.	17,000	Feb. 28	29,000
	Apr.	18,500	Mar. 31	33,000
	May	20,500	Apr. 30	35,000
	June	21,000	May 31	40,000
	July	20,000	June 30	42,000
	Aug.	19,500	July 31	42,000
	Sept.	22,000	Aug. 31	43,000
	Oct.	21,500	Sept. 30	41,500
	Nov.	23,000	Oct. 31	39,000
	Dec.	26,000	Nov. 30	40,000
			Dec. 31	23,000
7.	Jan.-Mar.	$ 9,000	Jan. 1	$ 8,000
	Apr.-June	8,400	Mar. 31	6,700
	July-Sept.	8,700	June 30	7,100
	Oct.-Dec.	10,100	Sept. 30	9,600
			Dec. 31	7,800

(continued on next page)

SALES		
8.	Jan.-Apr.	$ 92,000
	May-Aug.	81,500
	Sept.-Dec.	108,200

INVENTORY	
Jan. 1	$41,500
Apr. 30	39,100
Aug. 31	45,600
Dec. 31	40,700

Activity 13: Stock Turnover

Turnover Tells the Tale

Merchant A has a stock of $30,000 and a yearly turnover of 3.5. His net profit is 9 per cent of his sales. Merchant B also has a stock of $30,000. His net profit is 12 per cent of his sales. His yearly turnover is 2.2.

1. Who has the highest profit percentage?
2. Who is actually making the most money?

Notes to the instructor:

It is very easy to underestimate the importance of turnover. Don't let your students make this mistake.

A.		B.	
$30,000	stock	$30,000	stock
3.5	turnover	2.2	turnover
$105,000	sales	$66,000	sales
.09	profit percentage	.12	profit percentage
$ 9,450	profit	$ 7,920	profit

If you want to emphasize the point a little more strongly, you can use both the same stock and the same profit percentage.

C.D.E. II - UNIT III MERCHANDISING

Activity 14: Merchandise Control

OH, DEAR! WHAT DO I HAVE IN STOCK?

As the manager of a small sportswear shop, you have decided that your present system of keeping most of your stock information in your head is highly inadequate. You are convinced that what you need is a simple but worthwhile stock-control system. Since you make a habit of marking all merchandise that comes into your store; and since you feel that you do not have the time to take weekly inventories, you feel that some system involving the use of ticket stubs would work best for you. You plan to use both pin tickets and string tickets. The things you have decided are necessary to have on these tickets are retail price, manufacturer's number, style number, size, color, and the month the merchandise came in. In recording information from the ticket halves, you have decided to sort out all information and group it according to manufacturer. Wholesale cost is to be recorded with the information in your records, but is not to be put on the tickets.

1. Design a two-piece ticket (perforated in the middle) which would provide the information you require.

2. Design a form on which you might record information from the ticket stubs once a week and thus keep a running record of the facts you need.

Activity 15: Merchandise Control

THE TOY-COUNTING GAME

You are in charge of taking stock in the toy department of a variety store. Physical inventory is routinely taken every two weeks, and orders are made up by the manager from the information on these sheets. Do not be concerned with back orders. Assume that these bi-weekly orders automatically cancel unfilled part of previous order. Items must be ordered to nearest packing number; if over half a packing short, order; if less, do not. For this problem, we will leave the cost line blank. As you count, you find the following items in stock:

Top	#1278	@ 10¢	21
Yo-Yo	#1413	@ 50¢	29
Yo-Yo	#1411	@ 25¢	26
Shovels	#1631	@ 10¢	11
Sand pails	#1611	@ 29¢	23
Sand pails	#1610	@ 19¢	2_
Sand pails w/ shovel	#1623	@ 59¢	15
Top	#1276	@ 29¢	8
Top	#1271	@ 39¢	13
Softball bat	#1016	@ $1.59	9
Ball	#1196	@ 59¢	11
Softball	#1009	@ 79¢	11
Ball	#1193	@ 15¢	29
Ball	#1195	@ 39¢	15

The previous inventory has been done for you s an illustration.

1. Fill in the number of each item on hand.

2. Show how many of each item is to be ordered.

* OH - On hand
ORD - To be ordered

Date is February 14

BIG TOWN VARIETY STORE

STOCK CONTROL SHEET

MANUFACTURER XYZ Toy Co. DATE FROM February 7 TO April 18

STOCK NUMBER	ITEM	PACKING	COST	RETAIL PRICE	BASIC SUPPLY	*	Feb. 7							
1009	Soft-ball	6		79¢	18	OH	8							
						ORD	12							
1016	Soft-ball bat	2		$1.59	12	OH	6							
						ORD	6							
1193	Ball	12		15¢	48	OH	31							
						ORD	12							
1195	Ball	6		39¢	24	OH	14							
						ORD	12							
1196	Ball	6		59¢	24	OH	19							
						ORD	6							
1271	Top	6		39¢	24	OH	11							
						ORD	12							
1276	Top	12		29¢	24	OH	16							
						ORD	12							
1278	Top	24		10¢	48	OH	15							
						ORD	24							
1411	Yo-Yo	12		25¢	48	OH	35							
						ORD	12							
1413	Yo-Yo	12		50¢	36	OH	13							
						ORD	24							
1610	Sand Pail	12		19¢	36	OH	12							
						ORD	24							
1611	Sand Pail	12		29¢	36	OH	21							
						ORD	12							
1623	Sand Pail & Shovel	6		59¢	24	OH	7							
						ORD	18							
1631	Shovel	12		10¢	36	OH	21							
						ORD	12							

Activity 16: Merchandise Control

PRACTICE SHEET FOR USING PERPETUAL AND PERIODIC INVENTORY

PERPETUAL INVENTORY

	MONTH	PURCHASES	SALES	RETURNS	MARKDOWNS
1.	January	$5,200	$2,300	$260	$560
	February	3,460	3,670	190	190
	March	5,420	3,470	150	50
	April	4,670	4,960	210	40
	May	5,230	5,370	340	110
	June	3,960	4,810	270	60

Theft is estimated at 2% of total sales.
The beginning inventory for the six-month period was $8,700.
What should the book inventory at the end of this six-month period be?

2.	July	$4,230	$4,680	$130	$260
	August	4,450	4,130	90	130
	September	5,620	5,860	150	90
	October	5,970	5,390	210	20
	November	5,600	6,720	140	90
	December	4,690	6,910	220	150

Theft is estimated at 1% of total sales.
The beginning inventory for the six-month period was $9,890.
What should the book inventory for the ending date of this six-month period be?

PERIODIC INVENTORY

3. The beginning inventory on January 1 was $50,900.
Purchases: January, $5,600; February, $6,200; March $6,700; April, $7,200; May, $7,100; June, $6,400.
The inventory on June 30, showed a stock on hand of $49,600.
What should the unadjusted sales figure for this period be?
If theft is estimated at 1% of sales, what would the adjusted sales figure be?

4. The beginning inventory on July 1 was $40,500.
Purchases; July, $21,800; Aug., $24,800; Sept., $27,300; Oct. $29,500; Nov., $27,400; Dec., $21,300.
The ending inventory on December 31 was $32,900.
What would the unadjusted sales figure be?
If markdowns totaled $4,650, what would the sales figure be?

Activity 17: Merchandise Control

The Dress Shop Dilemna

When the Fashion Shoppe took inventory on January 31, merchandise was valued at $10,000 at retail. During February, the store purchased the following (as determined from retail prices marked on invoices).

Allison Dress Co.	$2,500
Fair Lady, Inc.	5,000
Brown Shoe Co.	2,500
Avalon Cosmetics	500
Sport Time, Inc.	1,500

Sales, by departments, during the month of February, were as follows:

Dress Dept.	$4,250
Coat dept.	1,000
Sportswear dept.	2,350
Accessories & cosmetics	3,500

1. What should the store's inventory be at the end of February?

2. If you were the store manager and decided to take another inventory at the end of February, and a physical inventory showed the inventory to be $10,000, what are some of the possible explanations you would consider?

3. What action might you take as a result of what your inventory has shown?

Notes to the instructor:

1. Solution:

$10,000	beginning inventory
12,000	purchases
$22,000	merchandise available for sale in February
11,100	sales
$10,900	book inventory
10,000	physical inventory
$ 900	shortage

2. Your students' first reaction will probably be to blame theft (either customer or employee), but shortage could also be caused by improper bookkeeping, failure to record markdowns or returns to vendor, failure to count something, etc. Action taken would have to be suited to the possible causes of shortage, students might want to consider making a number of changes.

3. It might be advisable to avoid bringing up the possibility of having a larger physical inventory than book inventory. This might involve information you would do best to stay away from in class.

Activity 18: Merchandise Control

THE CASE OF THE STORE WHICH WAS COMPETING WITH ITSELF

As the manager of a department store, you have just become aware of the extent to which some items are carried in many different places in your store. A case in point is straw sun hats. The hat department, of course, has a large selection. The hat buyer says, "Naturally." The shoe department has a small selection, bought to match their shoes. The shoe department manager says that his customers often like shoes and hats that match. (He also carries matching handbags.) The handbag department has a fairly good assortment. The buyer of handbags says that her customers often comment on how nice it is to be able to buy the hats and bags to match. The sportswear department also bought some hats from a bathing suit manufacturer (some of these are priced spearately, and some are sold in sets with the bathing suits.) The sportswear buyer claims that the bathing suit salesman pressured her into buying the straw hats. The notions department has a wide variety of "wild" sun hats. The notions buyer defends having them on the basis that they are being sold by notions and novelty salesmen and are listed in the wholesale catalogs of such items. The children's department has a good selection in child sizes; the children's wear buyer explains that the hat department does not carry children's hats.

1. What are some of the problems involved in a situation of this type?

2. Why is so much overlapping of the same product undesirable? Or is it?

3. What action, if any, would you take to remedy each of the above situations. Explain why you have decided as you have.

C.D.E. II - UNIT IV BUSINESS PSYCHOLOGY

Activity I: Objective Observation of Human Behavior in Selling

Choose an introvert and an extrovert on the sales force in your local training agency. Study these two individuals over a given period of time and make comparisons as to:

1. Sales techniques of each
2. Success of sales techniques
3. Establishment of rapport between salesman and his customers
4. Attitudes to different situations
5. Do the customers return to that salesperson?

Summarize your findings in a report to be given to the class. The following is an example of the form that you will use to record your observations daily:

OBSERVATION SHEET

1. Manner of greeting customer:
   a. Is rapport established? Yes_____ No_____
   b. Is he courteous, friendly, polite? Yes_____ No_____
   c. Is his approach:
      (1) aggressive? Yes_____ No_____
      (2) apologetic? Yes_____ No_____

2. Sales techniques:
   a. Is he a smooth talker? Yes_____ No_____
   b. Is he sincere? Yes_____ No_____
   c. Does he push unwanted items? Yes_____ No_____
   d. Do his customers return? Yes_____ No_____
   e. Are unpleasant situations handled adequately (i.e., angry customer, complaints)? Yes_____ No_____
      Give examples_____
      _____
      _____.

Notes to the instructor:

1. This will be used as an individual project.
2. Give the students sufficient observation sheets to be filled out daily. At least one full week of observations should be recorded.
3. It may prove interesting to have the students observe the salesmen for a couple of days, then ask the salesmen's permission to be observed. See if any noticeable changes in their selling techniques occur.
4. The instructor may add or delete from the form to fit each student's individual needs.

Activity II: Factors That Affect Personality

Compare four of your friends, concentrating on traits of personality that seem most striking or noticeable. Opposite each characteristic, write an A for "asset" or an L for "liability" for each friend.

Characteristic	Friend A	Friend B	Friend C	Friend D
1. Appearance	_____	_____	_____	_____
2. Self-confidence	_____	_____	_____	_____
3. Emotional control	_____	_____	_____	_____
4. Manners	_____	_____	_____	_____
5. Speech	_____	_____	_____	_____
6. Cooperation	_____	_____	_____	_____
7. Courtesy	_____	_____	_____	_____
8. Good sportsmanship	_____	_____	_____	_____
9. Loyalty	_____	_____	_____	_____
10. Sense of humor	_____	_____	_____	_____
11. Sincerity	_____	_____	_____	_____
12. Unselfishness	_____	_____	_____	_____
13. Politeness	_____	_____	_____	_____
14. Sympathy	_____	_____	_____	_____
15. Tact	_____	_____	_____	_____

How do you feel that you rate with your friends?

Notes to the instructor:

1. This exercise will help students become aware of the many types of personalities and the factors that make up a person's personality.
2. It is good to enable the students to start evaluating their own personality, learning the importance it has in making and keeping friends, jobs, etc.

Activity III: Emotional Stability

On his morning break, Jim Hanford got a container of milk at the canteen and sat down to drink it. After a few minutes, Foreman Grimes came over to him and said, "You made your purchase; now get back to work."

Hanford did not work for Grimes. He continued to sit there.

Grimes came by again and snapped, "I told you to get back to work. Now get going!" Hanford jumped up and splashed milk into Grimes' face. The next day Hanford was fired. He objected, saying:

1. "Grimes was not my foreman and had no right to give me orders.
2. "Grimes is a mean guy. Nobody likes him. He talks to people like they're dirt."

The foreman answered:
1. "Any foreman has the right to tell any goldbricking worker to get back on the job.
2. "Maybe I would not win any popularity contest, but I said nothing out of the way to Hanford that time."

Review the case by considering the following questions:
1. Was Grimes right to assume Hanford was goldbricking?
2. Should Hanford have been fired?
3. Was Hanford right to ignore Grimes?
4. Where do you feel the problem lies?
5. Did Grimes assume too much authority?

Notes to the instructor:

1. Select students to represent the two men. Also select a student to represent the personnel manager of the company. Review the case with these students.
2. Select two or three students to act as arbitrators to settle this case. They will not be familiar with the case. They will make their decision from the information presented by the other students.

Activity IV: Ethical or Unethical:

Craig Downs and Mike Huddy are distributive education students enrolled in the cooperative high school program. They are placed in the produce department of the Davis Supermarket and work from 8:30 a.m. until 11:30 a.m. every day except Tuesday. They attend Jones High School from noon until 4:30 p.m. every afternoon.

The training plan, as outlined to the students, in addition to sales, includes removing coverings, putting out fresh produce, spraying and replacing ice for those perishables requiring such care, and arranging eye-appealing displays. The manager, however, stressed his need for an inventory of produce on hand as soon as possible after the boys' arrival in the morning. This list was needed to order the following day's supply for delivery to the store late that afternoon.

Both boys are congenial, and they work well together on the job. Craig hopes to be employed full-time by the store immediately upon graduation from high school. Mike is taking distributive education as preparation for advanced study in food distribution in the mid-management program of the nearby junior college.

One morning Craig is delayed in leaving his home, first by neglecting to assemble his books and other needed equipment the night before. He searched a long time for a missing paper which he had completed and which was due that day. Frequently Craig seems to find himself pushed in the mornings. Second, Mike had telephoned asking to be picked up that morning because his car had failed to start. This drive required an additional five minutes. On the way to the store the students are further delayed at a railway crossing by a long freight train.

Craig suggests that they stop and telephone the store, explaining their delay and stating they would be approximately half an hour late. Mike believes that stopping to call would cause them to be even later and says that they should just continue on their way. He reasons that the manager himself had been known to arrive one-half to three-quarters of an hour after the store opened. He also suggests that if they entered through the back and did not go by the time clock, they could later explain that they had forgotten to check in their time cards. Perhaps nobody would even know that they were late. Finally, Mike says that he thinks he has learned all that he needs to know about produce and he would not miss much in half an hour.

Questions to consider:
Taking the position of Craig, what would you do in a situation such as this? Why? How do you feel about Mike's attitude? Do you feel this attitude could damage his chance for a successful career?

Notes to the instructor:

1. Divide the class into two groups, each group taking either Craig or Mike's position.
2. Through group discussion, have the students decide the problem in favor of the boy they represent. Select a representative for the group, then open it for classroom discussion.

Activity V: The Case of Who's Fooling Whom?

Lee Hodges is a distributive education student enrolled in the cooperative program. His long-range career goal is small business management, and his training station is the local pet shop. The store carries a complete line of all pet supplies and foods, an outstanding inventory of fresh water topical fish with tanks and tank equipment, and a good inventory of various birds, bird cages, and supplies.

The store is organized as a corporation with Mr. Jenkins as the President and principal owner. Many years prior to his semi-retirement Mr. Jenkins had owned a large pet supply wholesale distributorship covering 10 states as well as owning another pet shop. He had authored books on pet store organization, operation, and management. His interest in testing the theories he had outlined in his books along with his other business interests kept him from taking full responsibility of operating the pet shop; therefore, he hired an experience manager, Mr. Joe Wallace, to relieve him of some of the duties at the pet shop.

Mr. Jenkins does spend some time in the store, usually arriving about 7:30 in the morning. While there he plans the buying, promotions, advertising, store layout changes, and organizes the day's work. He discusses these matters with Joe Wallace, who usually arrives around 9:00 a.m. Mr. Jenkins then is free to leave about 11:00 a.m. to attend his other interests.

Lee arrives at the store at 1:30 p.m. and works until 5:30 p.m. every afternoon except Wednesday, his regularly scheduled day off. He also works all day Saturday from 9:00 to 5:30. Although Lee reports directly to Mr. Wallace, Mr. Jenkins has named himself Lee's training station sponsor.

After Lee became familiar with the store, knew the merchandise, and was able to handle most sales situations, Mr. Wallace occasionally would tell Lee that he was going out "on an errand" or "for a cup of coffee," and would leave Lee alone in the store. These "errands" and "coffee breaks" became more and more frequent and also longer. Sometimes Mr. Jenkins calls the store when Joe Wallace is out and Lee "covers" for him, saying that Mr. Wallace is busy with a customer and will return his call later. In a short time the various duties assigned by Mr. Jenkins start to accumulate and Mr. Wallace begins asking Lee to work Wednesdays and in the evenings to clear up the unfinished tasks.

One morning Mr. Jenkins asks Joe Wallace why the work that he has planned for Lee is not completed during the regular time he is scheduled to be there. Mr. Wallace's answer is that perhaps Lee is a "little slow" in performing his duties. Mr. Jenkins reports this matter to Lee's teacher-coordinator during one of their regular conferences, saying, "Lee will need to speed up or we'll have to find someone else!" The teacher-coordinator, in his next interview with Lee, informs him of Mr. Jenkins' statement.

What is the major problem as you see it? How would you solve it?

Notes to the instructor:
Have each student solve this problem with a basic problem-solving formula. For example: (1) define problem, (2) gather facts (3) act.

Activity VI: Human Relations Situation

Mr. Carmen, a mature man around 40 years old, and I were assigned to the Shoe Department of the Allen Department Store. Mr. Carmen was a perfectionist who insisted on carrying out his duties to a "T", but at the same time went around with a half-crocked look on his face which often, if not always, invited unfavorable criticism behind his back. He irritated everyone he came in contact with, including Mrs. Dolley, the permanent floor manager. Even I was quite angry with him at times, and had to force myself to be nice to him. Through his insistence in carrying out his duties as assigned by our training class, he irritated Mrs. Dolley to the point where she and Mr. Carmen had words. He had disrupted her supply system, insulted customers (unintentionally), and had sales personnel talking back to him. It happened that I was caught in the middle of the feud between Mr. Carmen and Mrs. Dolley. I found that I got along quite well with Mrs. Dolley and was on speaking terms with Mr. Carmen. The friction mounted daily between the two, and I would hear both sides of the story as each confided in me. As time passed, I found that Mr. Carmen's outer appearance masked a sincere, fun-loving person. As I enjoyed working with both of these people, I felt that if it was at all possible, I would bring these two together into a better working harmony.

Describe the steps that you would go through in bringing these two personalities together. Be able to defend your solutions.

Notes to the instructor:

1. After the students have come up with their possible solutions to this problem, open it up for classroom discussion.
2. Serves as a good project to stress the importance of getting along with people, not only at work, but also in all walks of life.

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ABSTRACT - This field book contains hand-lettered plate notes to be used with mapping plate assignments contained in VT 002 656, also in this issue. A chart showing distances from side stakes for cross sectioning and a table for computing trigonometric formulas are appended. (GR)

VT 002 645

ED 045856

CIVIL ENGINEERING TECHNOLOGY

MAP DRAFTING and RELATED COMPUTATIONS

FIELD BOOK

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Notes for Fig. 1, Plate 1

Sta.	Def. ∡	Mag. B.	Cal. B.	Remarks
20				
19				
⊙18+79	47°45'L	N55°30'E	N55°27'E	Point D
18				
17				
16				
15				
14				
13				
⊙12+42	48°05'R	S76°45'E	S76°48'E	Point C
12				
11				
10				
9				
8				
7				
⊙6+27	97°45'L	N55°15'E	N55°07'E	Point B
6				
5				
4				
3				
2				
1				
⊙0+00		S27°08E	S27°08E	Point A

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No. 601652 G. Carrier, R.C.

June 18, 1964

Wx. Fair - Warm

Note: 1. Hubs set at lettered points and tack pointed. Guard stakes set and marked.

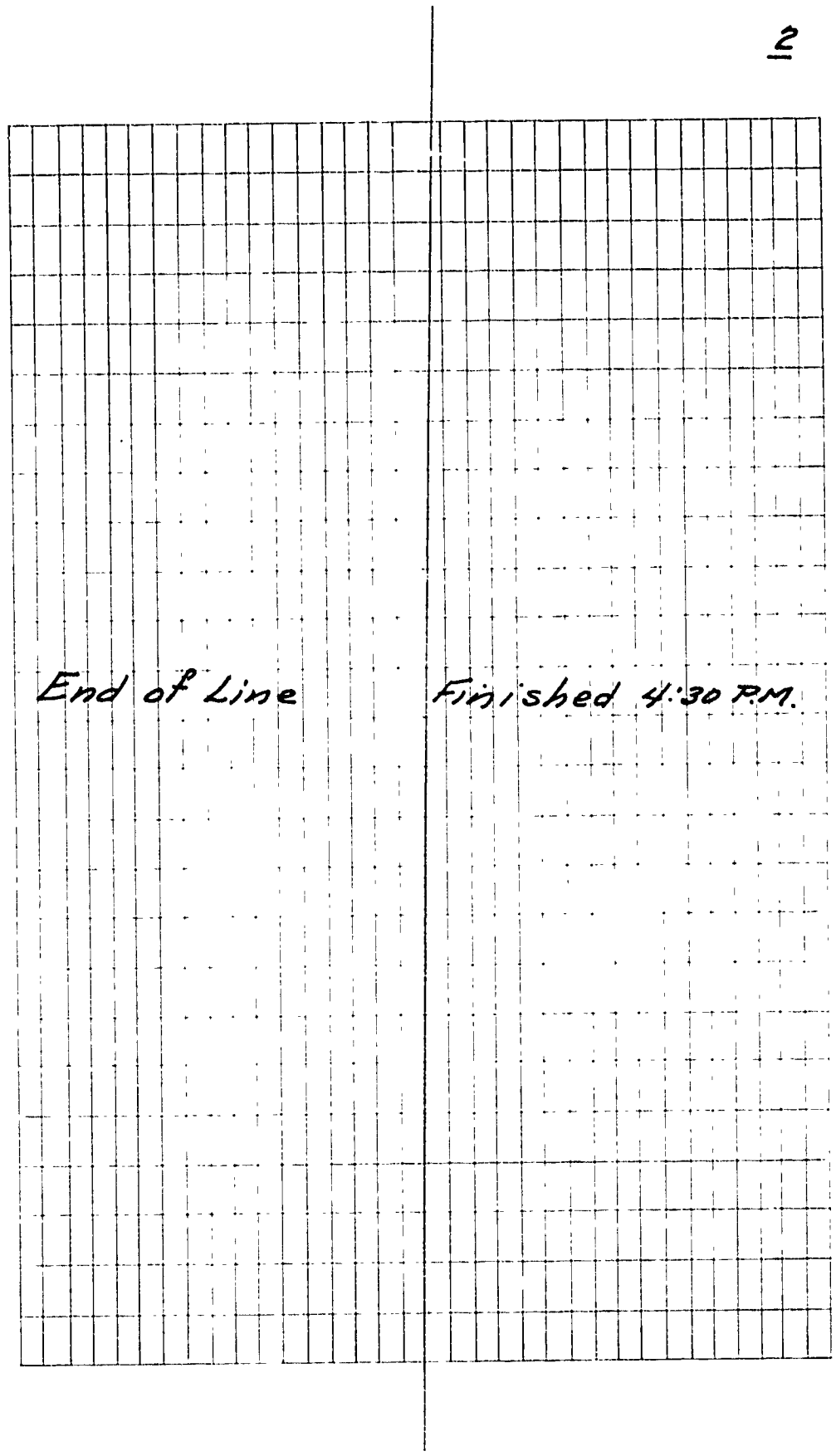
2. Bearing of line A-B determined by Solar Obseriation

3. Line stakes set at station points and tacked.

Beginning of Line

Notes for Fig. 1, Plate 1, con't.

Sta.	Def ∡	Mag. B	Col. B	Remarks
32+97				Point F
32				
31				
30				
29				
28				
27				
⊙26+09	104°15'R	S20°15'E	S20°18'E	Point E
26				
25				
24				
23				
22				
21				


End of Line
Finished 4:30 P.M.

Notes for Fig. 2, Plate 1

Sta.	Cal. Bearing			Remarks.
20				
19				
18				
17				
⊙16+41	N66°51'E			Point D
16				
15				
14				
13				
12				
11				
⊙10+20	S24°35'E			Point C
10				
9				
8				
7				
6				
5				
⊙4+25	N46°52'E			Point B
4				
3				
2				
1				
⊙ 0+00	S56°27'E			Point A

C. Richard, ⊼

Gurley Transit
No. 601652

G. Carrier, H.C
J. Soileau, R.C.
June 18, 1964
Wx. Fair-Warm

Note: Bearings calculated from Deflection Angle Survey made today by above listed field crew

Beginning of Line

Notes For Fig 2, Plate 1, con't.

Sta.	Cal. Bearing		Remarks
32+57			Point H
32			
31			
30			
29			
28			
⊙27+36	S 29° 35' E		Point G
27			
26			
25			
24			
⊙23+69	N 84° 31' E		Point F
23			
22			
21			
⊙20+31	N 55° 08 E		Point E

End of Line Finished work 3:20 P.M.

Notes for Fig. 3. Plate 1

Sta.	Def ∡	Mag. B.	Cal. B	Remarks
19				
18				
17				
16				
15+80	59°32'L	N66°00'E	N66°25'E	Point J
15				
14				
13				
12				
⊙11+35	32°38'R	S54°30'E	S54°03'E	Point G
11				
10				
9				
8				
7				
6				
5				
⊙4+74	57°22'R	S86°45'E	S86°41'E	Point D
4+25				
4				
3				
2				
1				
⊙0+00		N35°57'E	N35°57'E	Point A

	J. Fontanot, π
K&E Transit	M. LeBlanc, H.C.
No. 151205	L. Cormier, R.C.
	June 19, 1964
	Wx. Cloudy-Warm

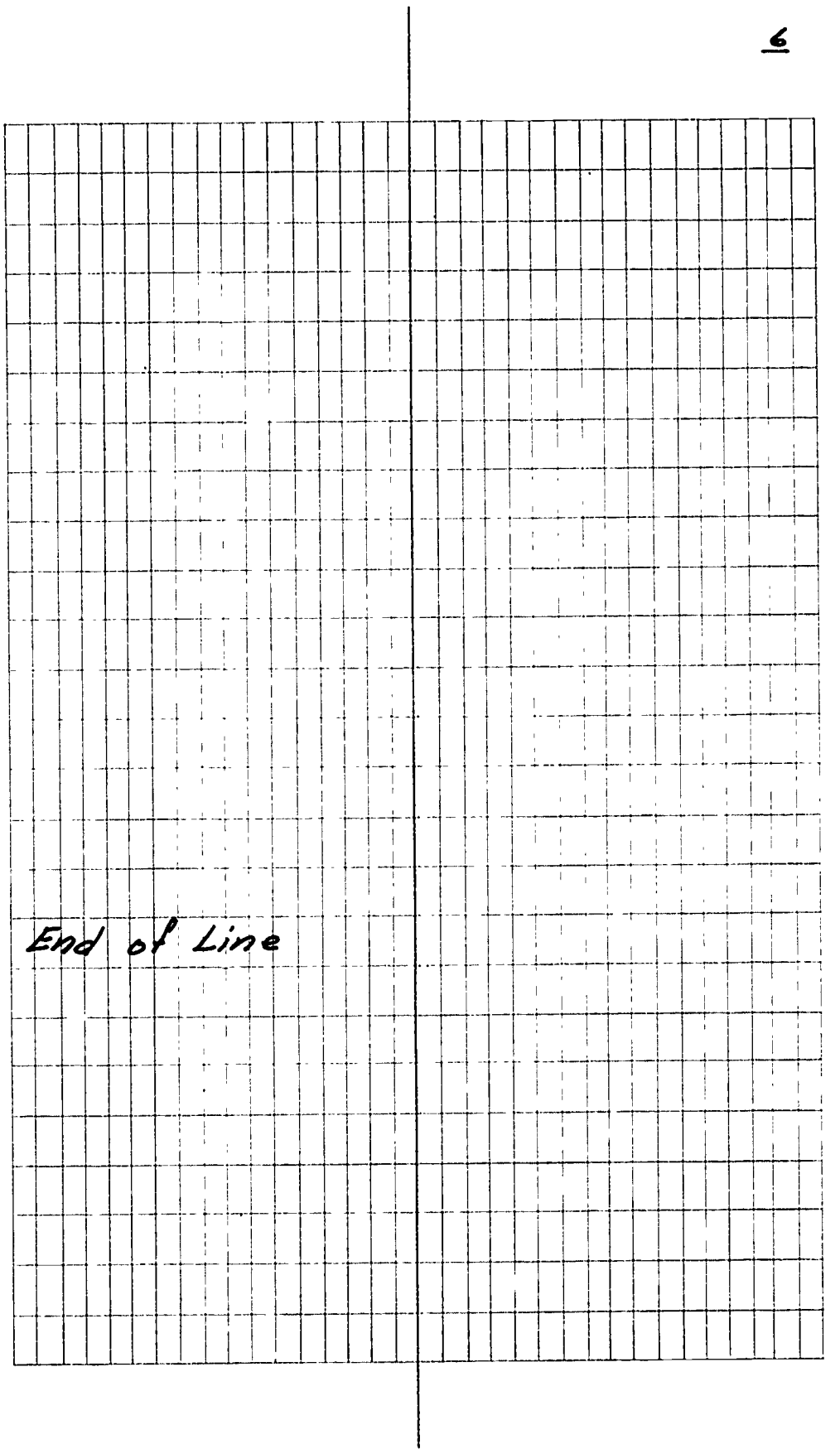
Note: Hubs set and tacked at changes in direction of line and Guard Stakes set over hubs

Drainage ditch ═══ 2' wide, 1' deep

Beginning of Line

Notes for Fig. 3, Plate 1, con't.

Sta.	Def. ∡	Mag. B	Cal. B.	Remarks
27+05				Point M
27				
26				
25				
24				
23				
22				
21				
20				


End of Line

Notes for Fig. 4, Plate 1

Sta.	Dist. Ft.	Cal. B.	Cal. Lat.	Cal. Dep.
1				
	793	N33°59'E	657.6N	443.3E
2				
	490	N59°14'E	250.7N	421.0E
3				
	764	S18°36'E	724.1S	243.7E
4				
	700	N66°15'E	281.9N	640.7E
5				
	567	S24°10'E	517.3S	232.1E
6				
	496	N48°26'E	329.1N	371.1E
7				

J. Fontenot, Computor
M. LeBlanc, Assistant

Monroe Calculator June 9, 1964

Note: Latitudes and Departures calculated for each course from Deflection Angle Traverse ran June 19, 1964 by J. Sonnier, P. LeBlanc and J. Zeranguo

Notes for Fig. 5, Plate 1

Sta.	Def. ∠	Mag. B	Cal. B	Remarks
⊙ 19+99	26°30' R	S66°30'E	S66°20'E	Point Q
19				
18				
17				
16				
15				
14				
⊙ 13+99	23°20' L	N87°00'E	N87°10'E	Point M
13				
12				
11				
10				
9				
⊙ 8+85	41°00' R	S69°30'E	S69°30'E	Point K
8				
7				
6				
⊙ 5+29	45°00' R	N69°30'E	N69°30'E	Point C
5				
4				
3				
2				
1				
⊙ 0+00		N24°30'E	N24°30'E	Point A

K&E Transit
No. 151205

J. Fontenot, 木
P. LeBlanc, H.C.
M. LeBlanc, R.C.
June 20, 1964
Wx. Hot-Clear

Note: Bearing of
Line A-C determined
with Gurley Solar Transit
112T No. 600500

Notes for Fig. 5, Plate 1, con't.

Sta.	Def. ∡	Mag. B	Cal. B.	Remarks

End of Traverse

Finished Work
at 3:05 P.M.

Notes for Plate 2

Azimuth Control Traverse

Sta.	Obj.	Dist. Ft.	Azimuth	Mag. B	Cal. B.
M	N		150°23'	S29½°E	S29°37'E
	13	488.32	96°04'	S84°E	S83°56'E
13	M		276°04'	N84°W	N83°56'W
	14	545.44	93°01'	S87°E	S86°59'E
14	13		273°01'	N87°W	N86°59'W
	15	525.88	82°19'	N82¼°E	N82°19'E
15	14		262°19'	S82¼°W	S82°19'W
	16	134.95	82°49'	N82½°E	N82°49'E
16	15		262°49'	S82½W	S82°49'W
	T	98.51	108°11'	S71½°E	S71°49'E
T	16		288°11'	N71½°W	N71°49'W
	U	403.97	184°52'	S5°W	S4°52'W
U	T		4°52'	N5°E	N4°52'E
	V	195.57	178°40'	S1½°E	S1°20'E
V	U		358°40'	N1½°W	N1°20 W
	W	210.67	181°41'	S1½°W	S1°41'W
W	V		1°41'	N1½°E	N1°41'E
	X	76.26	184°57'	S5°W	S4°57'W
X	W		4°57'	N5°E	N4°57'E
	Y	706.96	277°24'	N82½°W	N82°36'W
Y	X		97°24'	S82½°E	S82°36'E
	Z	345.07	268°37'	S88½W	S88°37'W

South City Park, Opelousas, La.

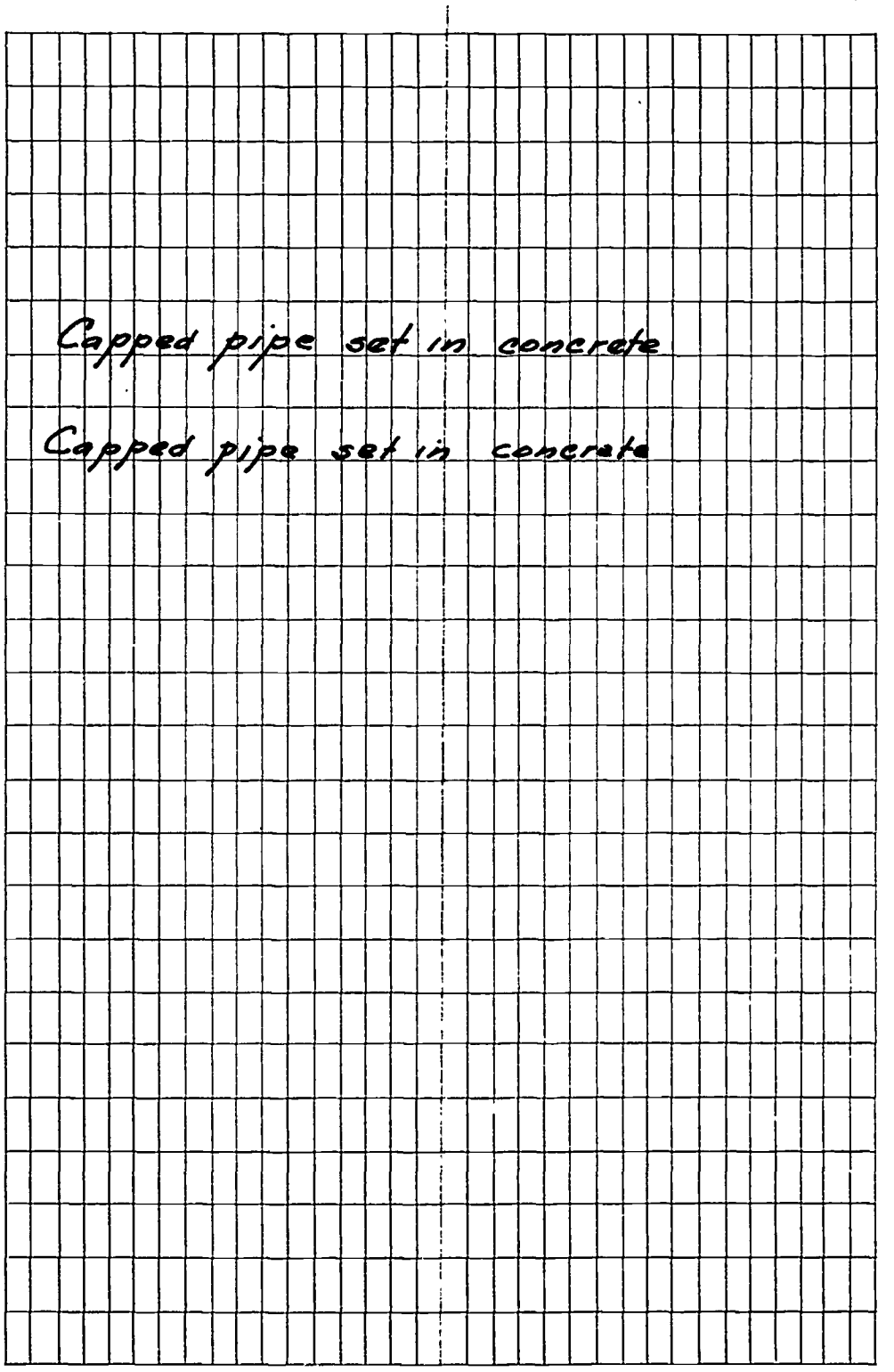
Gurley Transit No. 601652

J. Zerangue, TM
A. Soileau, H.C.
G. Carrier, R.C.
June 17, 1964
Wx. Hot - Clear

Note:
1. Azimuth from North
2. Azimuth of line M-13 determined with Gurley Solar Transit 112T, No. 600500
3. Declination determined to be 7½° East. Compass ring set for needle to read true bearings
4. Hubs set and tacked at corners.

Notes for Plate 2 con't.

Sta.	Obj.	Dist. Ft.	Az.	Mag. B	Cal. B.
Z	Y		88°37'	N88½°E	N88°37'E
	C	417.72	268°37'	S88½W	S88°37'W
C	Z		88°37'	N88½°E	N88°37'E
	B	228.73	359°20'	N0½°W	N0°40'W
B	C		179°20'	S0½°E	S0°40'E
	A	99.87	0°00'	North	North
A	B		180°00'	South	South
	N	383.47	332°45'	N27¼°W	N27°15W
N	A		152°45'	S27¼°E	S27°15'E
	M	191.35	330°23'	N29¼°W	N29°37'W
M	N		150°23'	S29¼°E	S29°37'E
	Az.	Error	0°00'		



Capped pipe set in concrete

Notes for Plate 3

Deflection Angle Traverse

Sta.	Dist. Ft.	Def ∡	Cal. B.	T. Lat.	T. Dep.
A		27°15'L		0.0	0.0
	383.47		N27°15'W		
N		2°22'L		340.9N	175.6 W
	191.35		N29°37'W		
M		125°41'R		507.3N	270.2 W
	488.32		S83°56'E		
13		3°03'L		455.6N	215.4E
	545.44		S86°59'E		
14		10°42'L		426.9N	760.1 E
	525.88		N82°19'E		
15		0°30'R		497.2N	1281.3E
	134.95		N82°49'E		
16		25°22'R		514.0N	1415.2E
	98.51		S71°49'E		
T		76°41'R		483.3N	1508.8E
	403.97		S4°52'W		
U		6°12'L		80.7N	1474.5E
	195.57		S1°20'E		
V		3°01'R		114.8S	1479.1E
	210.67		S1°41'W		
W		3°16'R		325.4S	1472.9E
	76.26		S4°57'W		
X		92°27 R		401.3S	1466.3E

J. Sonnier, π
J. Fontenot, H.C
M. LeBlanc, R.C
Wx. Fair-Warm
July 17, 1964

Note: 1. Latitudes and Departures computed by Sonnier and Fontenot on 7-16-64 and entered in columns 5 & 6 of these notes for plotting purposes.

2. True Bearing of Line A to N known from Solar Observation

Notes for Plate 3, con't.

Sta.	Dist. Ft.	Def. ∠	Cal. B	T. Lat.	T. Dep.
X		92°27'R		401.3S	1466.3E
	706.96		N82°36'W		
Y		8°47'L		310.1S	765.3E
	345.07		S88°37'W		
Z		0°00'		318.5S	420.3E
	417.72		S88°37'W		
C		90°43'R		328.6S	2.7E
	228.73		N0°40'W		
B		0°40'R		99.9S	0.00
	99.87		North		
A					

Capped pipe set in concrete

" " " " "

Notes for Fig. 1, Plate 4

Deflection Angle Traverse 1

Sta.	Dist. Ft.	Def ∡	Col. B	Total Lat	Total Dep.
76+33.92				2195.1S	5227.2E
	831.22				
68+02.70		66°16L	N51°12E	2715.9S	4579.4E
	1353.00				
54+49.70		44°56'R	S62°32'E	2091.9S	3378.9E
	1389.90				
40+59.80		36°46'R	N72°36'E	2507.5S	2052.6E
	804.00				
32+55.80		72°30'L	N36°46'E	3151.6S	1571.4E
	853.60				
24+02.20		62°48L	S70°44'E	2870.0S	765.6E
	1495.20				
9+07.00		30°08R	S7°56'E	1389.1S	559.2E
	907.00				
0+00			S38°04'E	675.0S	0.0

Gurley Transit
No. 601652

Marks, T
Johns, H.C
Briggs, R.C.
June 12, 1964
Wx. Warm - Clear

Note: Bearing of Line
0+00 to 94+07.00 determined
by Solar Observation on 6-11-64

Notes for Fig. 2, Plate 4

Deflection Angle Traverse 2

Sta.	Dist. Ft.	Def. ∡	Cal. B	Total Lat.	Total Dep.
73+43.35				660.8 S	5255.1 E
	850.00				
64+93.35		75°00′ R	S58°32′E	217.1 S	4530.1 E
	982.95				
55+10.40		43°06 L	N46°28′E	894.1 S	3817.5 E
	925.00				
45+85.40		45°16′ R	N79°34′E	1061.6 S	2907.8 E
	800.00				
37+85.40		48°26′ L	N34°18′E	1722.5 S	2457.0 E
	1025.00				
27+60.40		52°46′ L	N82°44′E	1852.1 S	1440.2 E
	728.67				
20+71.33		33°42′ L	S44°30′E	1932.4 S	929.5 E
	1356.43				
6+75.30		79°12′ R	S10°48′E	0.0	675.3 E
	675.30				
0+00			East	0.0	0.0

Marks, T
Briggs, H.C
Anderson R.C.
Wx. Warm - Cloudy
June 14, 1964

Note: Line 0+00 to 6+75.30
staked out due East
with Gurley Solar Transit

Notes for Curve Data Fig. 1, Plate 4

Sta.	Point	Def. ∡	Bearing	Curve Data.
20		1°46'		
19+56.0	⊙ P.C			
19				
18				
17				
16				
15				
14				
13				
12				
11				
10+70.4	⊙ P.T	15°05	S7°56'E	D=9°R
10		11°55'		I=30°10'
9		7°25'		T=171.8'
8		2°55'		R=637.3'
7+35.2	⊙ P.C.			L=335.2'
7				
6				
5				
4				
3				
2				
1				
0+00			S38°04'E	

Marks, Computor
Briggs, Ass't. Computor
Friden Automatic Anderson, Checker
Calculator $\sqrt{SRW}$ June 20, 1964

Curves calculated and entered by above men. Notes prepared for staking out curves in field and for plotting. Chord Method and Chord Definition used.

Marks, T
Briggs, H.C.
Anderson, R.C.
June 24, 1964

Curves for Traverse 1 staked out in field - Marks

Notes for Curve Data, Fig 1, Plate 4 con't.

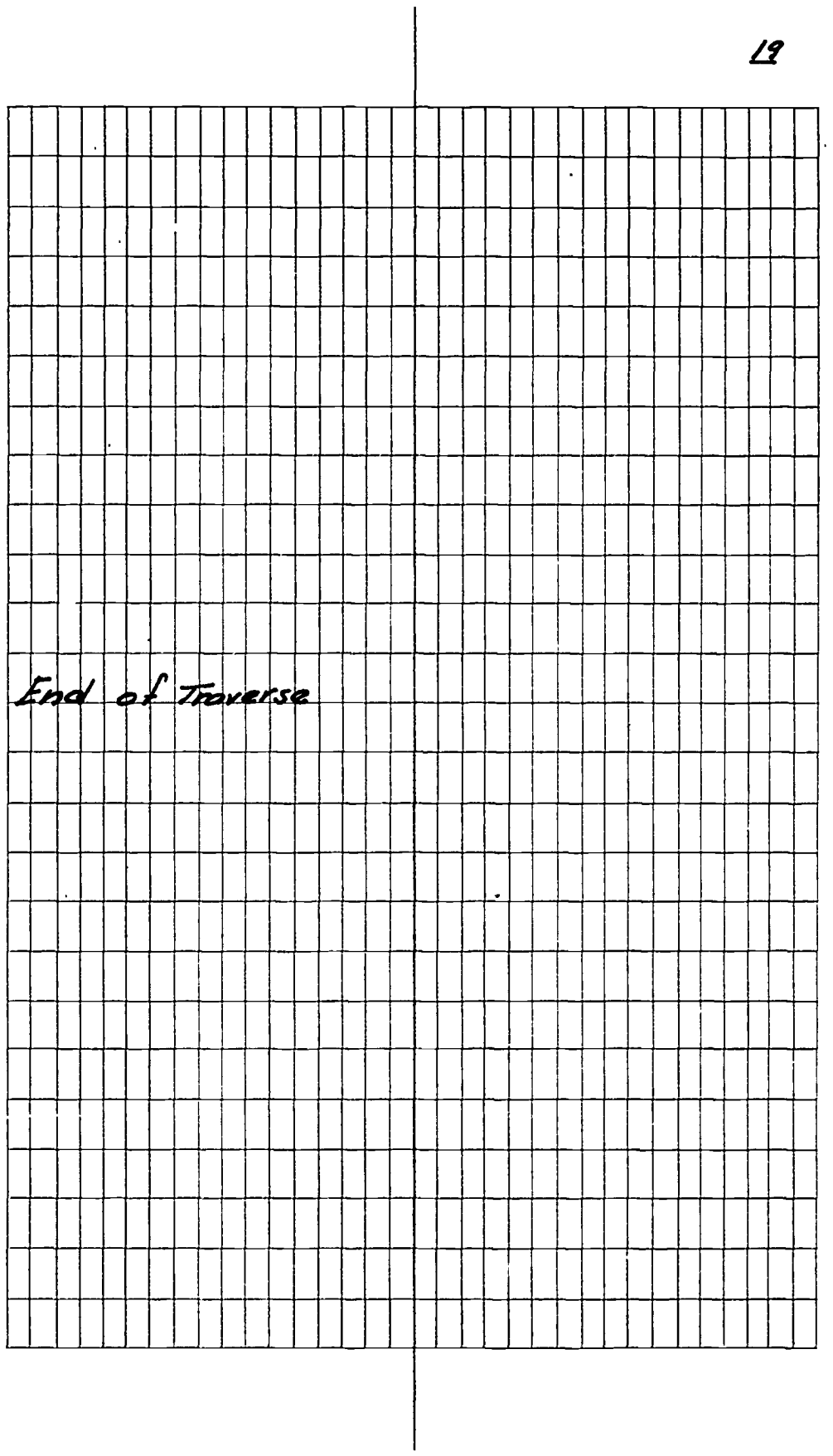
Sta.	Point	Def. ∠	Bearing	Curve Data
41		15°16'		
40		12°53'		D = 4°46' R
39		10°30'		I = 35°46'
38		8°07'		T = 388.2
37		5°44'		R = 1203.1
36		3°21'		L = 750.4
35		0° 58'		
34+59.2	P.R.C.	36°15'		
34		33°16'		
33		28°13'		D = 10°06' L
32		23°10'		I = 72°30'
31		18°07		T = 415.8
30		13°04		R = 567.1
29		8°01'		L = 717.8
28		2° 58'		
27+41.4	⊙ P.C.C.	31°25'		
27		29°46		
26		25°46'		D = 8° L
25		21°46'		I = 62°50'
24		17°46'		T = 437.8
23		13°46'		R = 716.7
22		9°46'		L = 785.4
21		5°46'		

Notes for Curve Data Fig 1, Plate 4, con't.

Sta.	Point	Def. ∡	Bearing	Curve Data.	
61					
60					
59					
58					
57					
56					
55+65.2	⊙ P.T	22°28'	S62°32'E		
55		20°31'		D = 6°	R
54		17°31'		I = 44°	56'
53		14°31'		T = 395.0	
52		11°31'		R = 955.3	
51		8°31'		L = 748.9	
50		5°31'			
49		2°31'			
48+16.3	.P.C.				
48					
47					
46					
45					
44					
43					
42+09.6	⊙ P.T.	17°53'	N72°36'E		
42		17°39'			

Notes for Curve Data, Fig 1, Plate 4, con't.

Sta.	Point	Def. ∡	Bearing	Curve Data
72+55.82				
72				
71				
70				
69				
68				
67+85.1	⊙ P.T.	33°08'	N51°12'E	
67		28°27'		D=11°L
66		22°27'		I=66°16'
65		17°27'		T=340.5
64		11°57		R=521.7
63		6°27'		L=602.4
62		0°57'		
64+82.7	⊙ P.C.			


End of Traverse

Notes for Curve Data, Fig 2, Plate 4

Sta.	Chord	Def. ∡	Point	Curve Data	
20	99.96	11°13'		D = 5°31'L	
19	99.96	8°28'		I = 33°42'	
18	99.96	5°43'		R = 1041.74	
17	99.96	2°58'		T = 315.51	
16	7.72	0°13'		L = 612.73	
15+92.28			⊙ P.C.		
15					
14					
13					
12					
11					
10					
9+57.7	57.64	39°36'	⊙ P.T.		S10°48'E
9	99.83	36°17'		D = 11°30'R	
8	99.83	30°32'		I = 79°12'	
7	99.83	24°47'		R = 498.22	
6	99.83	19°02		T = 406.34	
5	99.83	13°17'		L = 688.70	
4	99.83	7°32'			
3	31.01	1°47'			
2+69.0			⊙ P.C.		
2					
1					
0+00					East

Sonnier, Computer
Friden Automatic LeBlanc, Ass't. Computer
Calculator $\sqrt{5RW}$ Zerangue, Checker
June 21, 1964

Note: Curves for Traverse 2 calculated and entered in notes for staking out and plotting Arc Definition of degree of curve used. Curve tables used.

Sonnier, ⊼
LeBlanc, H.C
Zerangue, R.C.
Wx. Fair-Warm
June 25, 1964

Curves for Traverse staked in field – Sonnier

Notes for Curve Data, Fig 2, Plate 4, con't.

Sta.	Chord	Def ∡	Point	Curve Data.	
40					
39+07.72	7.72	24°13'	⊙P.T.		N34°18'E
39	99.94	23°57'		D = 7°	
38	99.94	20°27'		I = 48°26	
37	99.94	16°57'		R = 818.58	
36	99.94	13°27'		T = 368.17	
35	99.94	9°57'		L = 691.90	
34	99.94	6°27'			
33	84.14	2°57'			
32+15.82			⊙P.C.		
32					
31					
30					
29+72.15	72.13	26°23'	⊙P.T.		N82°44'E
29	99.94	23°54'			
28	99.94	20°28'		D = 6°52.7'	
27	99.94	17°01'		I = 52°46'	
26	99.94	13°35'		R = 832.98	
25	99.94	10°09'		T = 413.19	
24	99.94	6°42'		L = 767.14	
23	94.96	3° 16'			
22+05.01	5.01	16°51'	⊙P.C.C.		
22	99.96	16°43'			
21	99.96	13°58'			

Notes for Curve Data Fig. 2, Plate 4, con't.

Sta.	Chord	Def ∡	Point	Curve Data
59	99.83	16°07'		D=11°30'
58	99.83	10°22'		I=75°00'
57	99.83	4°37'		R=498°22'
56+19.64	80.25		⊙P.C.	T=382.30, L=652.17
56				
55				
54+73.11	73.08	16°33'	⊙PT	N46°28'E
54	99.94	14°06'		D=6°42'
53	99.94	10°45'		I=33°06'
52	99.94	7°24'		R=855.16
51	99.94	4°03'		T=254.12
50	20.92	0°42'		L=494.03
49+79.08			⊙P.C.	
49				
48				
47				
46+06.81	6.81	22°38'	⊙P.T.	N79°34'E
46	99.92	22°22'		D=8°
45	99.92	18°22'		I=45°16'
44	99.92	14°22'		R=716.20
43	99.92	10°22'		T=298.61
42	99.92	6°22'		L=565.84
41	59.01	2°22'		
40+40.97			⊙P.C.	

Notes for Curve Data, Fig. 2, Plate 4, con't.

Sta	Chord	Def. ∡	Point	Curve	Data

End of Line.

Notes for Plate 6

DEFLECTION ANGLE TRAVERSE

Sta.	Def. ∡	Mag. B.	Cal. B		
34+48.4					
26+00	22°13' L	N75°45'E	N75°45'E		
11+89.0	12°32' R	S82°0'E	S82°02'E		
0+00		N85°30'E	N85°26'E		

Gurley Transit G. Carrier, ⊼
112T No. 600500 J. Fontenot, H.C
J. Zeranque, R.C.
Wx. Fair-Warm
July 18, 1964

Note: Bearing of Line
0+00 to 11+89 from Solar
Observation

Tacked hubs set at
changes in direction.
Stakes set at all other
stations

Hub set

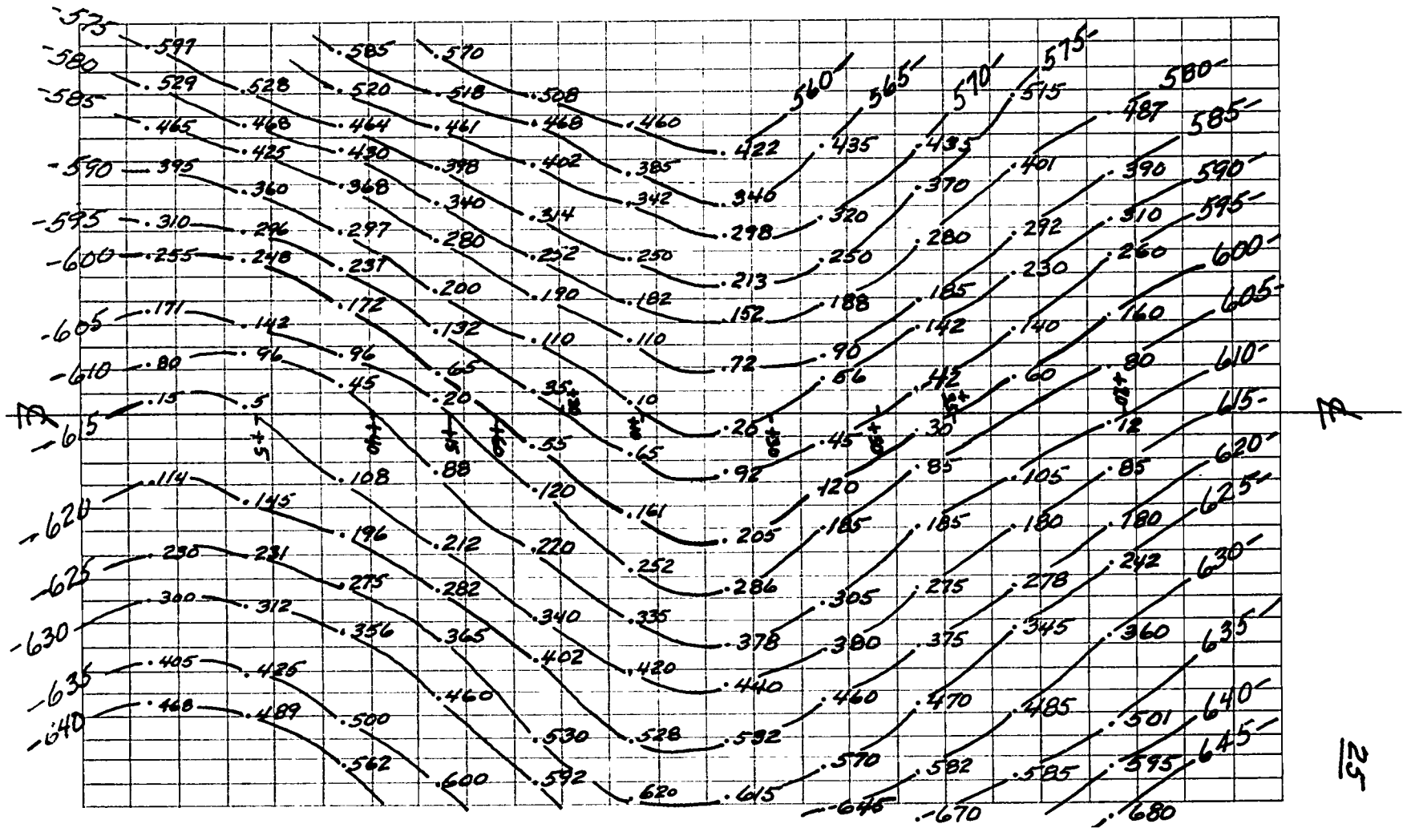
Hub set

Hub set

Iron pipe

NOTES FOR PLATE 6
CROSS SECTIONS

Sta.	Def. ∡	Cal. B	Elev.		
10			609.3		
9			605.0		
8			598.2		
7			593.3		
6			589.2		
5			590.2		
4			597.2		
3			605.8		
2			611.9		
1			615.1		
0+00		N85°26E	615.8		


-575
-580
-585
-590
-595
-600
-605
-610
-615
-620
-625
-630
-635
-640
560
565
570
575
580
585
590
595
600
605
610
615
620
625
630
635
640
645

Notes for Plate 6, con't.

Sta.	Def ∆	Cal. B	Elev.		
20			625.3		
+90			625.0		
19			620.0		
18			615.0		
+10			610.0		
17			609.5		
16			606.1		
+40			605.0		
15			606.1		
+45			610.0		
14			612.2		
+12			615.0		
13			615.8		
12			617.8		
11+89	12°32'R	S82°02'E	617.8		
11			615.0		

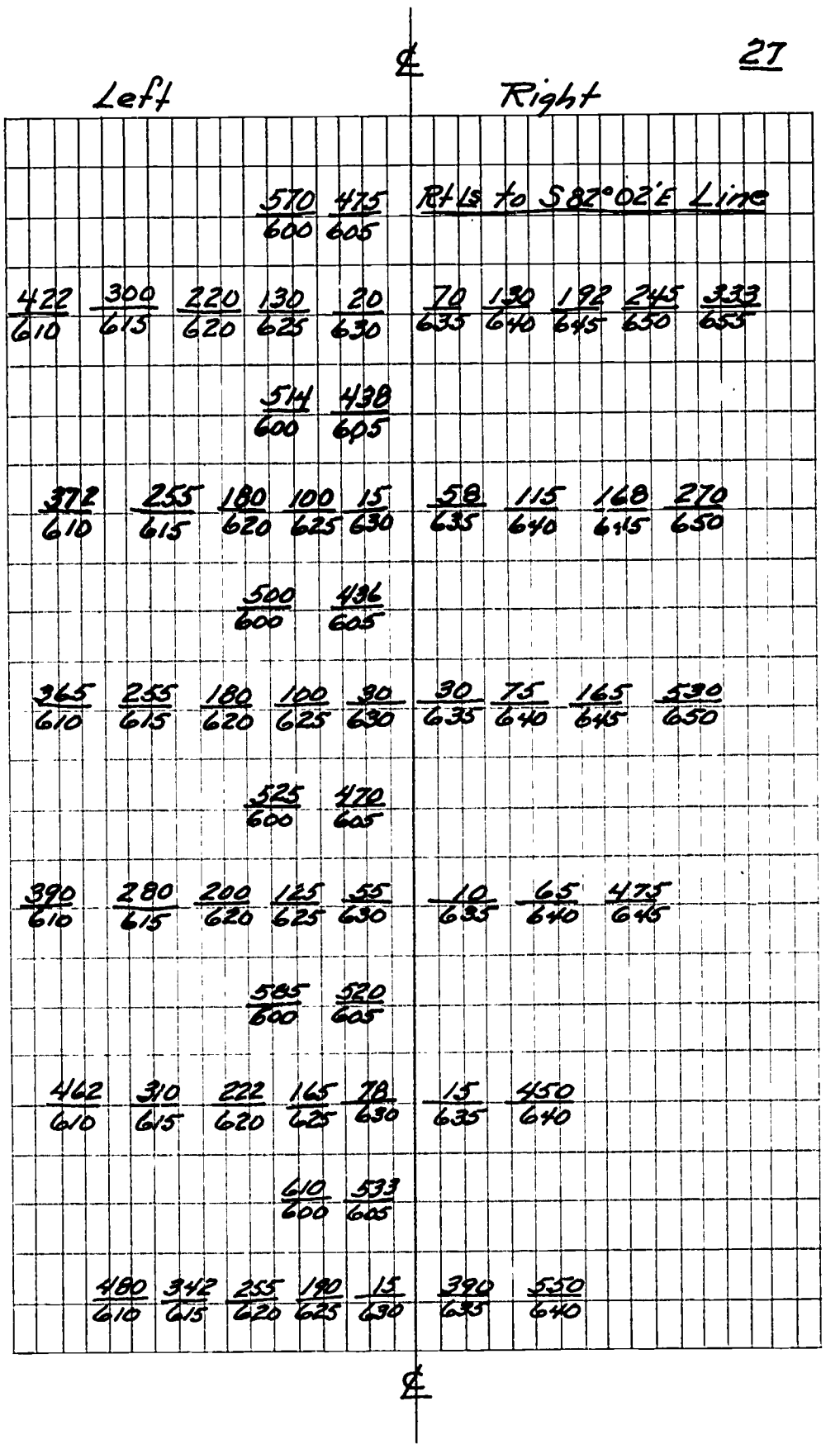
Left ℄ Right

590/600	510/605	465/610	375/615	295/620	30/625	320/630	530/635					
605/595	545/600	470/605	420/610	350/615	350/625	472/630	600/635					
575/595	500/600	410/605	320/610	335/620	460/625	540/630						
575/590	505/595	375/600	240/605	30/610	285/615	390/620	490/625	572/630				
540/585	480/590	310/595	170/600	32/605	132/610	262/615	352/620	443/625	540/630			
450/585	370/590	235/595	145/600	30/605	75/610	180/615	260/620	360/625	480/630	555/635	622/640	
435/585	370/590	302/595	225/600	137/605	60/610	80/615	170/620	260/625	390/630	470/635	540/640	
500/585	440/590	378/595	300/600	245/605	145/610	20/615	100/620	185/625	255/630	345/635	410/640	500/645
480/590	425/595	340/600	250/605	140/610	60/615	55/620	162/625	235/630	380/635			
468/590	410/595	330/600	208/605	112/610	48/615							
Dist. 470/585	395/590	350/595	255/600	145/605	45/610	85/620	175/625	262/630	400/635	522/640	575/645	
Elev.												

℄

Notes for Plate 6, con't.

Sta.	Def ∡	Cal. B.	Elev.		
26					
26+00	22°13'L	N75°45'E	631.4		
25					
25			631.0		
24					
24			632.5		
23					
23			634.9		
22					
22			634.5		
21					
21			630.4		


℄
Left
Right
570/600 475/605 Rt Ls to S 82°02'E Line
422/610 300/615 220/620 130/625 20/630 70/635 130/640 192/645 245/650 333/655
514/600 438/605
372/610 255/615 180/620 100/625 15/630 58/635 115/640 168/645 270/650
500/600 436/605
365/610 255/615 180/620 100/625 30/630 30/635 75/640 165/645 530/650
525/600 470/605
390/610 280/615 200/620 125/625 55/630 10/635 65/640 475/645
585/600 520/605
462/610 310/615 222/620 165/625 78/630 15/635 450/640
610/600 533/605
480/610 342/615 255/620 180/625 15/630 390/635 550/640
℄

Notes for Plate 6, con't.

Sta.	Def ∡	Cal. B	Elev.		
31					
31			640.8		
30					
30			638.9		
29					
29			635.8		
28					
28			632.5		
27					
27			630.8		
26					
26					

℄

Left					Right				
			560/610	500/615	435/665	520/670			
420/620	538/625	200/630	120/635	25/640	78/645	170/650	265/655	330/660	
			582/605	525/610	535/665	610/670			
448/615	360/620	275/625	152/630	75/635	30/640	130/645	240/650	330/655	400/660
		610/600	485/605	460/610	460/660	560/665			
370/615	300/620	216/625	100/630	20/635	80/640	202/645	302/650	400/655	
					470/660	532/665			
409/610	320/615	260/620	156/625	45/630	40/635	135/640	245/645	342/650	430/655
					455/660	505/665			
			125/625	20/630	75/635	150/640	250/645	340/650	410/655
					422/660	505/665			
Rt Is to N 75°45' E. Line					65/635	140/640	220/645	300/650	372/655

℄

Notes for Plate 6, con't

Sta.	Def. X	Cal. B	Elev.		
34+48.4					
34+48.4			638.3		
34					
34			638.8		
33					
33			640.3		
32					
32			642.3		

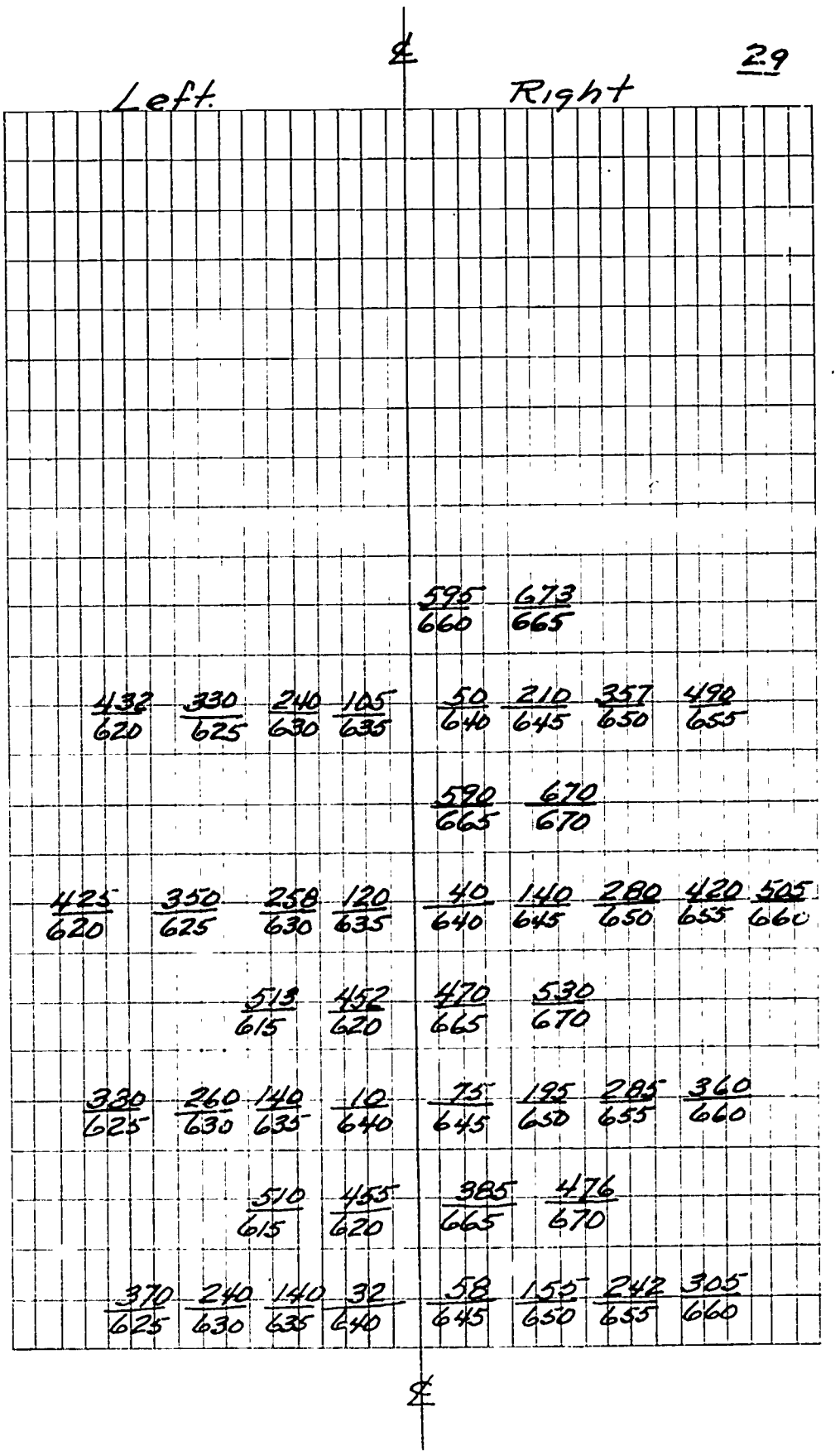

℄
Left
Right
595/660 673/665
432/620 330/625 240/630 105/635 50/640 210/645 357/650 490/655
590/665 670/670
425/620 350/625 258/630 120/635 40/640 140/645 280/650 420/655 505/660
513/615 452/620 470/665 530/670
380/625 260/630 140/635 10/640 75/645 195/650 285/655 360/660
510/615 455/620 385/665 476/670
370/625 240/630 140/635 32/640 58/645 155/650 242/655 305/660
℄

PLATE 7

Deflection Angle Control Traverse

Sta	Dist. Ft.	Def. ∡	Cal. B	Cal. Az.
A		31°01'R		
	575.30		N8°58W	351°02'
B		18°29'R		
	686.76'		N9°31'E	9°31'
C		33°28'R		
	552.35		N42°59'E	42°59'
D		76°53'R		
	712.24		S60°08'E	119°52'
E		60°04R		
	375.47		S0°04'E	179°56'
F		9°34'L		
	491.12		S9°38'E	170°22'
G		64°02R		
	781.86		S54°24'W	234°24'
H		35°37R		
	461.90		N89°59W	270°01'
A				
		Σ 360° ck.	o.k.	

K.&E. Transit
No. 62500

L. Cormier, ⊼
M. LeBlanc, Notes
P. LeBlanc, H.C.
G. Carrier, R.C
Wx. Warm-Cloudy
June 8, 1964

Note: 1. Bearing of Line A-B determined with Gurley Solar Transit 112T #600500

2. Bearings and Azimuths calculated by F. Bodreaux on 6-9-64

PLATE 7

CALCULATION OF COORDINATES FOR

Sta	Adjusted Lat. N	Adjusted Lat. S	Adjusted Dep. E	Adjusted Dep. W
A				
	588.02			92.81
B				
	677.29		113.63	
C				
	404.08		376.57	
D				
		354.70	617.54	
E				
		375.47	0.40	
F				
		484.20	82.17	
G				
		455.18		635.70
H				
	0.16			461.90
A				
Σ's	1669.55	1669.55	1190.41	1190.41

checks o.k.

HORIZONTAL CONTROL TRAVERSE

Total Lat.	Total Dep.	
		J. Zerangue, Computor
370.00N	450.00E	P. LeBlanc, Ass't Comp.
		June 10, 1964
958.02N	357.19E	
		Monroe Calculator
1635.31N	470.82E	
2039.39N	847.39E	
1684.69N	1465.03E	
1309.22N	1465.43E	
825.02N	1547.60E	
369.84N	911.90E	
370.00N	450.00E	

NOTES FOR PLATE 7

Inst. at Sta. A Elev. 4635 H.I. 4.7

Obj.	Az	Vert. ∡	Rod Int.	Diff. El.	Hor. Dist.
		Azimuth from North			
B	351°02'				
1	115°14'	-2°32'	3.06	-13.5	305
2	121°30'	-2°50'	2.74	-13.5	273
3	133°16'	-2°52'	2.71	-13.5	270
4	148°35'	-3°12'	2.43	-13.5	242
5	162°40'	-2°48'	2.77	-13.5	276
6	178°31'	-2°29'	3.13	-13.5	312
7	185°00'	-2°08'	3.63	-13.5	362
8	122°55'	-2°36'	2.07	-9.4	207
9	132°10'	-2°46'	1.94	-9.4	194
10	139°12'	-2°53'	2.06	-10.3	205

Elev.		
		L. Cormier, ⊼
		E. Anderson, Rod
		A. Soileau, Notes
		June 15, 1964
		Wx: Fair-Clear
450.0	Water Edge	
450.0	" "	Note: 1. At each set-up Rod Index always same as HI to simplify elevation calculations
450.0	" "	2. Azimuth from North
450.0	" "	
450.0	" "	
450.0	" "	
450.0	" "	
454.1	N.E. Cor 20'x30' Camp - Rear	
454.1	N.W Cor 20'x30' Camp with 15'x10' Porch	
453.2	℄ 10' Road	

PLATE 7, con't

Inst. at Sta. A Elev. 463.5 H.I 4.7

Obj	Az.	Vert. ∡	Rod Int.	Diff. El.	Hor. Dist.
11	173°05'	-2°24'	1.36	-5.7	136
12	223°38'	-0°22'	1.56	-1.0	156
13	250°33'	+1°04'	2.62	+4.9	262
14	289°05'	+2°29'	0.92	+4.0	92
15	37°04'	+0°48'	2.51	+3.5	251
16	44°03	+0°32'	4.11	+3.8	411
17	246°42'	+0°45'	3.68	+4.8	368
18	243°45'	+0°27'	4.72	+3.7	472
19	18°00'	+1°41'	2.52	+7.4	252
20	328°04'	+2°56'	2.41	+12.3	240
21	305°10'	+2°51'	3.65	+18.1	364
22	300°04'	+2°35'	4.86	+21.9	485

Elev.	
457.8	℄ 10' Road
462.5	" " "
468.4	℄ Junction of Roads
467.5	℄ 10' Road
467.0	" " "
467.3	" " "
468.3	" " "
467.2	GP
470.9	"
475.8	"
481.6	"
485.4	"

PLATE 7, con't

Inst. at Sta A Elev. 463.5 H.I. 4.7

Obj	Az.	Vert. ∡	Rod Int.	Diff. El.	Hor. Dist.
23	276°15'	+2°02'	3.82	+13.6	382
24	288°52'	+2°41'	2.10	+9.8	209
25	63°40'	-0°35'	1.68	-1.7	168
26	226°47'	-0°10'	3.02	-0.9	302
27	230°04'	-0°08'	4.90	-1.1	490
28	209°38'	-1°06'	3.72	-7.1	372
29	188°47'	-1°54'	2.26	-7.5	226
30	130°58'	-2°44'	1.28	-6.1	128
31	105°15'	-2°09'	2.50	-9.4	250

Elev.	
477.1	GP
473.3	"
461.8	"
462.6	"
462.4	"
456.4	"
456.0	"
457.4	"
454.1	"

PLATE 7, con't.

Inst. at Sta. B Elev. 490.6 H.I. 5.0

Obj	Az.	Vert ∡	Rod Int.	Diff. El.	Hor. Dist.
A	171°02'				
1	51°51'	-1°21'	6.65	-15.6	665
2	50°52'	-1°03'	5.87	-10.7	587
3	38°24'	-0°52'	4.20	-6.3	420
4	16°34'	-0°27'	3.90	-3.1	390
5	345°34'	+0°39'	3.86	+4.4	386
6	330°47'	+1°50'	3.61	+11.5	361
7	316°32	+2°54'	2.32	+11.4	232
8	353°33'	+1°16'	1.98	+4.4	198
9	31°20'	+0°08'	2.10	+0.5	210
10	56°43'	-0°39'	3.01	-3.4	301
11	67°46'	-1°09'	4.60	-9.2	460

Elev.	
475.0	G.P.
473.9	"
484.3	"
487.5	"
495.0	"
502.1	Crest of Hill
502.3	" " "
495.0	G.P.
491.1	"
487.2	"
481.4	"

PLATE 7, con't.

Inst. at Sta. B Elev. 490.6 H.I. 5.0

Obj	Az.	Vert. ∠	Rod Int.	Diff. El.	Hor. Dist.
12	92°05'	-2°07'	4.91	-18.1	490
13	103°10'	-2°19'	3.32	-13.4	332
14	91°20'	-2°10'	1.58	-6.0	158
15	231°53'	-0°29	0.72	-0.6	72
16	272°10'	+1°15'	2.38	+5.2	238
17	286°20'	+0°32'	3.57	+3.3	357
18	246°19'	+0°06'	3.49	+0.6	349
19	209°01'	-1°13'	2.31	-4.9	231
20	185°31'	-2°11'	3.88	-14.8	387
21	136°00'	-2°56'	3.04	-15.5	303

472.5	GP
477.2	"
484.6	"
490.0	"
495.8	"
493.9	"
491.2	"
485.7	"
475.8	"
475.1	

PLATE 7, con't

Inst. at Sta. C, Elev. 483.4, H.I. 5.0

Obj	Az.	Vert ∠	Rod Int.	Diff. El.	Hor. Dist.
D	42°59'				
1	346°59'	-0°08'	6.21	-1.4	621
2	334°27'	+0°19'	6.62	+3.6	662
3	352°26'	-0°07'	4.53	-0.9	453
4	336°10'	+0°43'	4.55	+5.7	455
5	322°10'	+0°59'	5.18	+8.9	518
6	18°30'	-1°02'	2.92	-5.3	292
7	353°40'	+0°02'	2.39	+0.1	239
8	322°51'	+1°17'	2.94	+6.6	294
9	302°26'	+1°59'	3.99	+13.8	398
10	292°41'	+2°55'	3.66	+18.6	365
11	263°30'	+3°05'	3.47	+18.6	346

Elev.	
482.0	GP
487.0	"
482.5	"
489.1	"
492.3	"
478.1	"
483.5	"
490.0	"
497.2	" Ridge Top
502.0	" " "
502.0	" " "

PLATE 7 con't.

Inst at Sta C Elev. 483.4 H.I. 5.0

Obj	Az.	Vert ∡	Rod Int.	Diff. El.	Hor. Dist
12	278°31'	+2°30'	2.60	+11.3	260
13	321°42'	+1°02'	0.78	+1.4	78
14	77°06'	-3°11'	1.52	-8.4	151
15	109°53'	-2°19'	3.20	-12.9	319
16	131°41'	-1°33'	1.89	-5.1	189
17	201°00'	+0°59'	1.34	+2.3	134
18	238°42'	+2°07'	1.78	+6.6	178
19	249°31'	+2°10'	3.61	+13.6	360
20	232°51'	+2°00'	3.93	+13.7	393
21	247°37'	+1°16'	4.72	+10.4	472
Sta I	281°54'	+3°17'	3.42	+19.6	341

Elev.	
494.7	GP
484.8	"
475.0	"
470.5	"
478.3	"
485.7	"
490.0	"
497.0	" Ridge Top
497.1	" " "
493.8	GP
503.0	Set Sta. I - needed to get data back of hill

PLATE 7 con't

Inst. at Sta D, Elev. 463.8 H.I 5.4

Obj	Az.	Vert ∡	Rod Int.	Diff. El.	Hor. Dist
Sta. E	119°52'				
1	55°47'	-2°19'	4.66	-18.8	465
2	64°22'	-2°26'	4.42	-18.8	441
3	76°01	-2°21'	4.58	-18.8	457
4	90°06'	-2°12'	4.91	-18.8	490
5	94°15'	-2°00'	5.41	-18.8	540
6	88°02'	-2°11'	4.28	-16.3	427
7	90°54'	-2°07'	4.43	-16.3	442
8	94°58'	-1°59'	4.56	-15.8	455
9	104°50'	-1°39'	4.79	-13.8	479
10	49°06	-2°03'	3.87	-13.8	386
11	32°00'	-1°18'	2.90	-6.6	290

Elev.	
445.0	Lake Edge
445.0	" "
445.0	" "
445.0	" "
445.0	" "
447.5	N.W. Cor., Rear, 30'x20' Camp
447.5	S.W. Cor. Rear, 30'x20' Camp
448.0	℄ and end of 10' Road
450.0	℄ 10' wide Road
450.0	GP
457.2	"

PLATE 7, con't

Inst at Sta D Elev. 463.8 H.I. 5.4

Obj	Az.	Vert ∡	Rod Int.	Diff. El.	Hor. Dist.
12	0°06'	-0°34'	2.20	-2.2	220
13	323°32'	+0°29'	2.71	+2.3	271
14	307°14'	+0°56'	3.81	+6.2	381
15	298°08'	+1°23'	4.47	+10.8	447
16	282°17'	+2°11	2.60	+9.9	260
17	311°14'	+1°25'	1.21	+3.0	121
18	75°07'	-2°10'	1.22	-4.6	122
19	85°02'	-2°02'	3.00	-10.6	300
20	104°58'	-1°41'	3.90	-11.5	390
21	126°24'	-1°16'	2.58	-5.7	258
22	184°30'	+0°24'	1.67	+1.2	167
23	207°52'	+1°13'	2.51	+5.3	251

Elev.	
461.6	GP
466.1	"
470.0	"
474.6	"
473.7	"
466.8	"
459.2	"
453.2	"
452.3	"
458.1	"
465.0	"
469.1	"

PLATE 7, con't.

Inst. at Sta D		Elev. 463.8		H.I 5.4	
Obj	Az.	Vert. ∡	Rod Int.	Diff. El	Hor. Dist
24	195°58'	+0°46'	4.29	+5.8	429
25	161°13'	+0°03'	4.35	+0.4	435
26	123°40'	-1°03'	4.42	-8.1	442
Inst. at Sta E		Elev. 451.5		H.I 4.9	
Sta. F	179°56'				
1	358°11'	-1°31'	2.45	-6.5	245
2	28°12'	-2°20'	1.60	-6.5	160
3	59°10'	-1°36'	2.32	-6.5	232
4	74°51'	-1°12'	3.09	-6.5	309
5	81°25'	-0°45'	5.02	-6.5	502
6	86°15'	-0°32	4.84	-4.5	484
7	88°31	-0°28'	4.89	-4.0	489

Elev.	
469.6	GP
464.2	"
455.7	"
445.0	Waters Edge
445.0	" "
445.0	" "
445.0	" "
445.0	" "
447.0	N.W. Cor. 30'x20' Camp
447.5	S.W. Cor. 30x20' Camp

PLATE 7. con't.

Inst. at Sta. E Elev. 4515 H.I. 4.9

Obj.	Az.	Vert. ∡	Rod Int.	Diff. El.	Hor. Dist.
8	89°27'	-0°22'	5.21	-3.3	521
9	99°03'	-0°05	3.79	-0.6	379
10	119°26'	+0°30'	2.57	+2.2	257
11	159°43'	+1°12'	2.06	+4.3	206
12	201°28'	+1°21'	2.86	+6.7	286
13	236°04	+1°38'	1.58	+4.5	158
14	307°58'	+0°21'	1.81	+1.1	181
15	337°49'	-0°53'	0.98	-1.5	98
16	87°03'	-0°40'	1.62	-1.9	162
17	108°21'	+0°12'	4.45	+1.5	445
18	247°39	+1°43'	4.52	+13.5	452

Elev	
448.2	℄ 10' wide road trail
450.9	" " " " "
	"
453.7	" " " " "
455.8	" " " " "
458.2	℄ Junction road trails
456.0	℄ road trail
452.6	" " "
450.0	GP
449.6	"
453.0	"
465.0	"

PLATE 7 con't.

Inst at Sta. F Elev. 462.1 H.I. 5.0

Obj	Az.	Vert. ∡	Rod Int.	Diff. El.	Elev.
Sta. G	170°22'				
1	278°49'	0°08'	2.70	+0.6	462.7
2	257°33'	+0°30'	3.31	+2.9	465.0
3	235°40'	+0°38'	5.45	+6.0	468.1
4	253°30'	+1°12'	5.00	+10.4	472.5
5	229°58'	+1°07	2.78	+5.4	467.5
6	178°29'	+1°55	2.37	+7.9	470.0
7	125°38'	+0°35'	3.78	+3.8	465.9
8	114°39'	+0°12'	5.60	+2.0	464.1
9	98°51'	−0°15'	4.91	−2.2	459.9
10	98°08	−0°10'	2.70	−0.8	461.3
11	106°05'	+0°10'	1.35	+0.4	462.5

Hor. Dist.	
270	Bend in road ℄
331	℄ road
545	" "
500	GP
278	"
237	"
378	"
560	"
491	"
270	"
135	"

PLATE 7 con't.

Inst at Sta. F Elev. 462.1 HI 5.0

Obj	Az.	Vert. ∡	Rod. Int.	Diff. El.	Elev.
12	253°23'	+0°32'	1.80	+1.7	463.8
13	267°33'	+1°04	4.26	+7.9	470.0
14	287°46'	+0°01'	3.60	+0.1	462.2
15	61°32'	-1°02'	2.55	-4.6	457.5
16	74°45'	-0°45'	4.60	-6.0	456.1

Hor. Dist.	
180	GP
426	"
360	"
255	"
460	"

PLATE 7, con't

Inst. at Sta G Elev. 481.7 H.I. 4.7

Obj	Az.	Vert ∡	Rod Int.	Diff. El.	Hor. Dist
Sta H	234°24'				
1	84°15'	-1°45'	3.92	-12.0	392
2	86°12	-1°55'	2.00	-6.7	200
3	300°32'	-0°53'	1.10	-1.7	110
4	278°47'	-0°49'	2.96	-4.2	296
5	301°26	-1°36'	4.86	-13.6	486
6	274°32'	-1°29	5.62	-14.6	562
7	244°13'	-1°06	3.49	-6.7	349
8	239°28	+1°31'	1.25	+3.3	125
9	190°27	+2°41'	1.62	+7.6	162
10	168°04'	+2°14'	2.92	+11.4	292
11	204°50'	+0°10'	2.82	+0.8	282

Elev.	
469.7	GP
475.0	"
480.0	"
477.5	" Ridge Top
468.1	GP
467.1	"
475.0	"
485.0	" Ridge Top
489.3	" " "
493.1	" " "
482.5	GP

PLATE 7, cont

Inst. at Sta. G Elev. 481.7 H.I 4.7

Obj	Az.	Vert ∡	Rod Int.	Diff. El.	Hor. Dist.
12	179°40'	+1°34'	3.04	+9.3	304
13	134°44'	+0°36'	3.59	+3.8	359
14	122°28'	+0°05	4.96	+0.7	496
15	107°47'	-0°50'	3.86	-5.6	386
16	118°55	-0°19'	1.97	-1.1	197
17	163°03	+2°23'	4.33	+18.0	432
18	160°45'	+2°16'	5.13	+20.3	512
19	139°25'	+0°51'	5.63	+8.3	563
20	169°32'	+1°35'	4.82	+13.3	482
21	190°50'	+0°22'	4.65	+3.0	465
22	154°27	+1°53	1.00	+3.3	100

Elev.	
490.0	GP
485.5	"
482.4	"
476.1	"
480.6	"
499.7	" Ridge Top
502.0	" " "
490.0	"
495.0	"
484.7	
485.0	

PLATE 7, con't.

Inst. at Sta H Elev. 458.6 HI 4.6

Obj	Az.	Vert ∠	Rod Int.	Diff. El.	Hor. Dist.
Sta. A	270°01'				
1	225°30'	-2°11'	2.25	-8.6	225
2	222°12'	-1°49'	2.70	-8.6	270
3	213°17'	-1°38	3.02	-8.6	302
4	213°17	-1°29'	3.32	-8.6	332
5	207°54'	-1°19'	3.75	-8.6	375
6	194°34'	-0°38'	3.28	-3.6	328
7	157°31'	+1°03'	3.13	+5.7	313
8	127°19	+2°11'	1.68	+6.4	168
9	215°33'	-1°43'	1.02	-3.0	102
10	321°14'	-0°43'	1.20	-1.5	120
11	356°11'	+0°20'	2.45	+1.4	245

Elev.	
450.0	Lake water edge
450.0	" " "
450.0	" " "
450.0	" " "
450.0	" " "
455.0	G.P.
464.3	"
465.0	"
453.6	"
457.1	" Valley Line
460	" " "

PLATE 7, con't.

Inst at Sta. H		Elev. 458.6		H.I 4.6	
Obj	Az.	Vert. ∡	Rod Int.	Diff. El.	Hor. Dist.
12	2°42'	+0°56'	4.02	+6.6	402
13	358°30'	+0°56'	4.20	+6.8	420
14	23°08'	+1°34'	4.38	+12.0	438
15	45°20'	+2°05'	3.06	11.1	306
16	34°00'	+1°55'	1.85	+6.2	185
17	84°46'	+2°36'	3.06	+13.9	305
18	68°02'	+2°21'	4.20	+17.2	419
Inst at Sta. I		Elev. 503.0		H.I. 4.9	
Sta. C	101°54'				
1	191°53'	-1°10'	4.68	-9.6	468
2	269°07	-4°17'	1.21	-9.0	120
3	338°57'	-2°40'	3.21	-14.9	320

Elev.	
465.2	GP Valley Line
465.4	" Bend in 10' road
470.6	"
469.7	"
464.8	"
472.5	"
475.8	"
493.4	GP
494.0	"
488.1	"

PLATE 7, con't

Inst at Sta. I Elev. 503.0 H.I. 4.9

Obj	Az.	Vert. ∡	Rod Int.	Diff. El.	Hor. Dist.
4	350°30'	-1°57'	4.61	-15.7	460
5	350°50'	-2°00'	5.71	-19.9	570

Elev.	
487.3	G.P.
483.1	"

NOTES FOR PLATE 8

Cross-Sections, King Street

Sta	B.S.	H.I.	F.S.	Elev.	
B.M.	4.7	68.3		63.6	
					(Elev.)
0+00					(Dist.)
					(Rod)
0+25					
0+50					
0+75					
1+00					
1+25					

J. Zerangue, ⊼
G. Carrier, Rod
M. LeBlanc, Tape
July 14, 1964
Clear - Warm

61.5	59.8	60.0	59.7	61.3
0	5	17	29	34
6.8	8.5	8.3	8.6	7.0
62.4	60.2	60.4	60.0	61.5
0	5	17	29	34
5.9	8.1	7.9	8.3	6.8
63.2	60.4	60.8	60.4	61.8
0	5	17	29	34
5.1	7.9	7.5	7.9	6.5
63.8	60.4	61.0	60.6	61.3
0	5	17	29	34
4.5	7.9	7.3	7.7	7.0
63.8	60.8	61.2	60.8	63.0
0	5	17	29	34
4.5	7.5	7.1	7.5	5.3
64.1	61.0	61.4	60.9	63.3
0	5	17	29	34
4.2	7.3	6.9	7.4	5.0

PLATE 8 Con't.

Sta.	B.S	H.I.	F.S.	Elev.	(Elev.) (Dist.) (Rod)
1+50					
T.P.1	4.0	68.0	4.3	64.0	
1+75					
2+00					
2+25					
2+50					
2+75					

64.0	61.2	61.6	61.1	63.3
0	5	17	29	34
4.3	7.1	6.7	7.2	5.0
64.3	61.4	61.8	61.3	63.3
0	5	17	29	34
3.7	6.6	6.2	6.7	4.7
64.4	61.7	62.1	61.8	63.6
0	5	17	29	34
3.6	6.3	5.9	6.2	4.4
64.6	61.9	62.3	61.9	63.7
0	5	17	29	34
3.4	6.1	5.7	6.1	4.3
64.7	62.1	62.6	62.1	63.6
0	5	17	29	34
3.3	5.9	5.4	5.9	4.4
64.6	62.2	62.6	62.2	62.5
0	5	17	29	34
3.4	5.8	5.4	5.8	5.5

PLATE 8 con't

Sta.	B.S	H.I.	F.S.	Elev.	
		68.0			(Elev.)
3+00					(Dist.)
					(Rod)
3+25					
3+50					
T.P. 2	4.2	68.9	3.3	64.7	
3+75					
4+00					
4+25					

64.7	62.2	62.6	62.3	63.3
0	5	17	29	34
3.3	5.8	5.4	5.7	4.7
64.7	62.3	62.7	62.4	64.0
0	5	17	29	34
3.3	5.7	5.3	5.6	4.0
64.7	62.4	62.8	62.4	64.1
0	5	17	29	34
3.3	5.6	5.2	5.6	3.9
64.6	62.5	62.9	62.5	63.1
0	5	17	29	34
4.3	6.4	6.0	6.4	5.8
64.7	62.6	63.0	62.5	63.5
0	5	17	29	34
4.2	6.3	5.9	6.4	5.4
64.9	62.6	63.0	62.6	63.3
0	5	17	29	34
4.0	6.3	5.9	6.3	5.6

PLATE 8 con't.

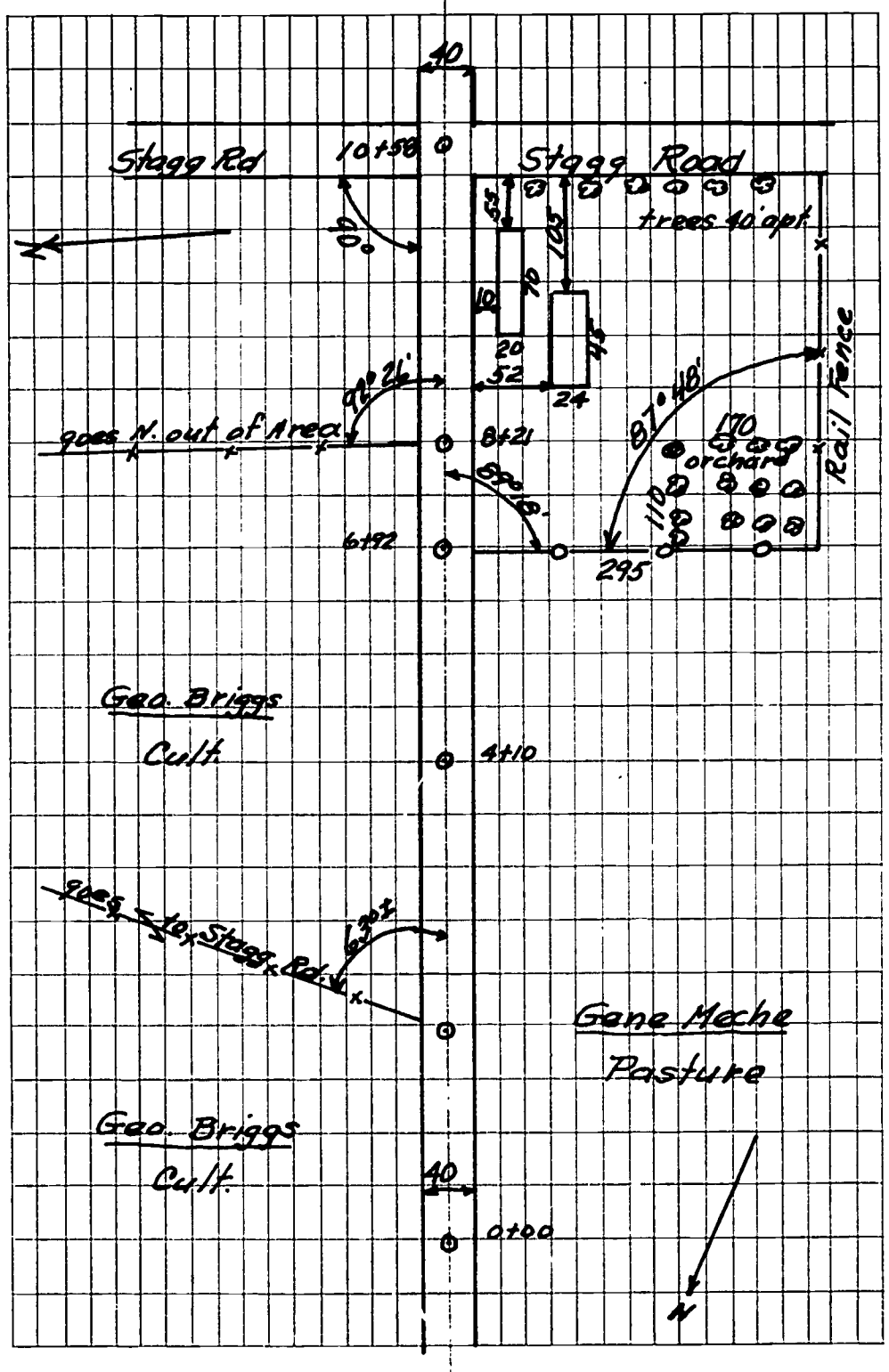
Sta.	B.S.	HI	FS	Elev.	
		68.9			(Elev.)
4+50					(Dist.)
					(Rod)
4+75					
5+00					
5+33					

64.8	62.6	63.0	62.6	63.4
0	5	17	29	34
4.1	6.3	5.9	6.3	5.5
64.7	62.6	63.0	62.5	64.0
0	5	17	29	34
4.2	6.3	5.9	6.4	4.9
64.7	62.6	63.0	62.6	64.0
0	5	17	29	34
4.2	6.3	5.9	6.3	4.9
64.0	62.7	63.0	63.0	64.0
0	5	17	29	34
4.9	6.2	5.9	5.9	4.9

NOTES FOR PLATE 9

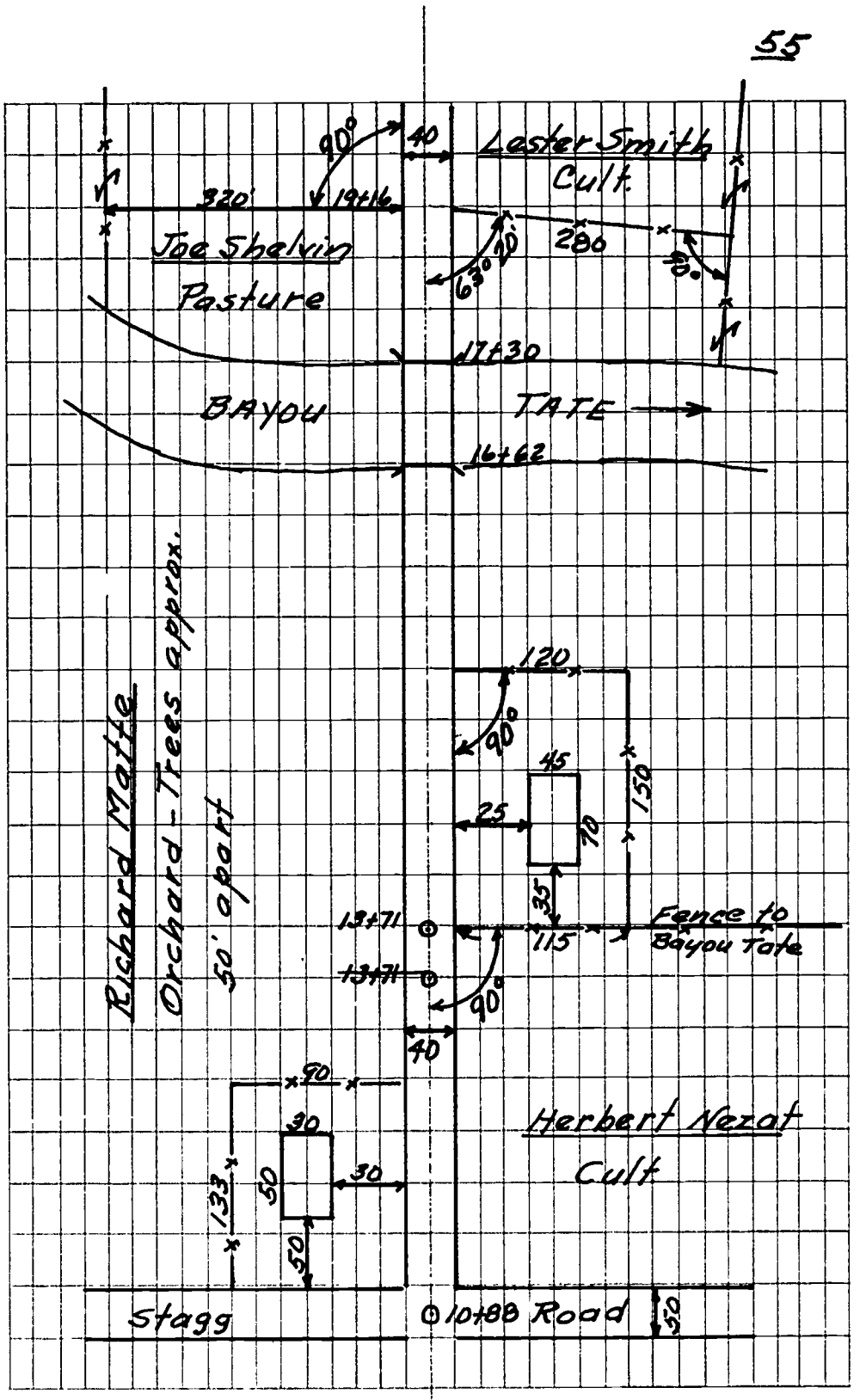
Wilson Road Traverse

Sta	Def. ∡	Cal. B	Remarks
10+58			Sta 10+58 ℄ Stagg & Wilson Roads
8+21			Fence goes N. out of Area
6+92			Smooth wire fence
4+10	60°22'L	S87°18'E	Bend in Road
1+31			
0+00		S26°56'E	Sta 0+00 on map is on north border and 2½ in. East of left border


40
Stagg Rd
10+58
Stagg Road
trees 40' apt.
90°
55
142
10
70
20
52
45
24
98° 26'
goes N. out of Area
8+21
87°48'
170
orchard
Rail Fence
110
82°18'
6+92
295
Geo. Briggs
Cult.
4+10
goes to Stagg Rd.
Gene Meche
Pasture
Geo. Briggs
Cult.
40
0+00
N

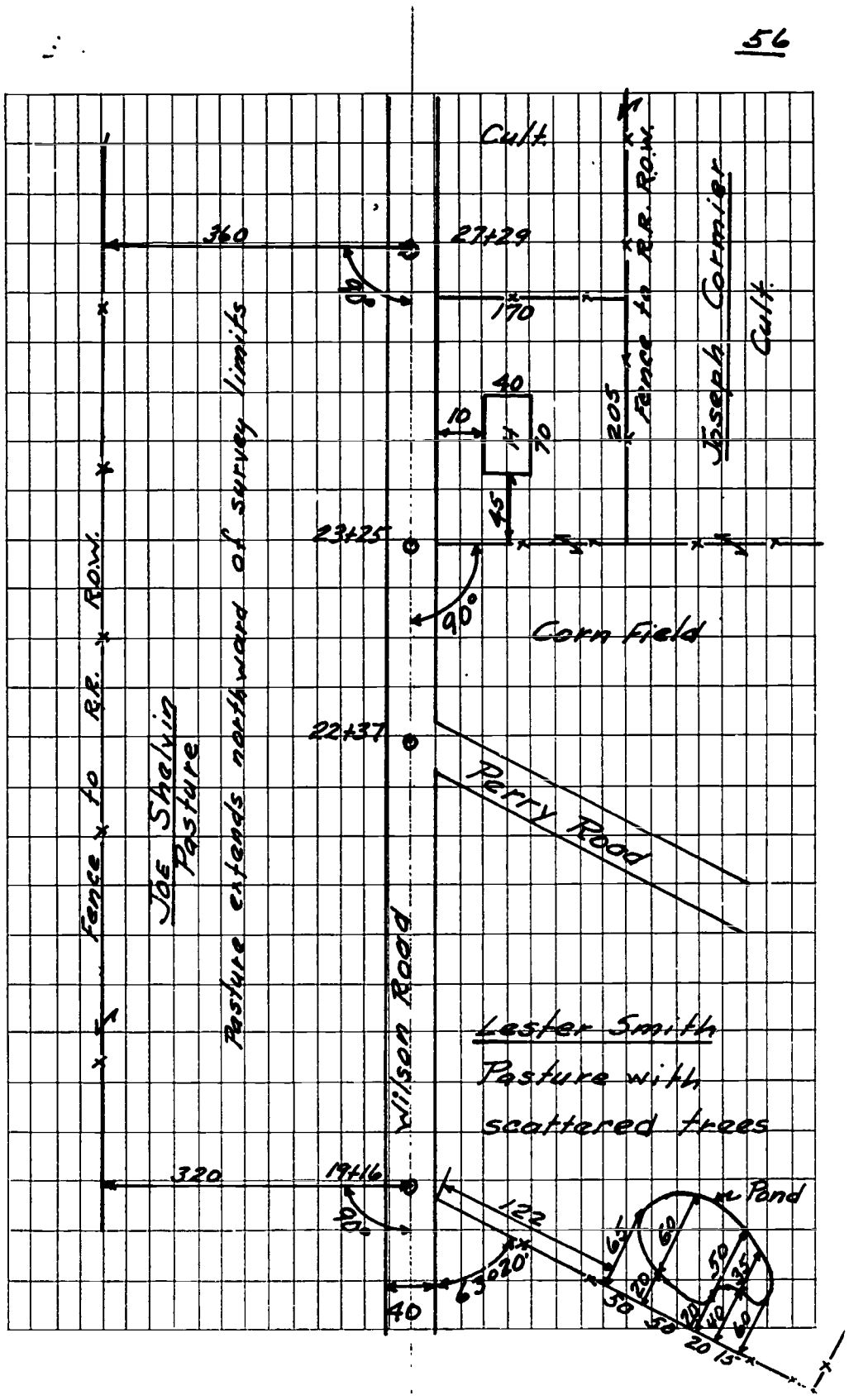
Wilson Road Traverse, Con't

Sta.	Def.∡	Cal.B	Remarks
19+16			
17+30			East end bridge
16+62			West end bridge
13+71			
10+58			℄ Stagg & Wilson Rds.


90°
40
Lester Smith
Cult.
320'
19+16
Joe Shalvin
Pasture
10
280
63°
50°
17+30
BAYOU
TATE
16+62
Richard Matte
Orchard - Trees approx.
50' apart
120
90°
45
25
70
150
35
13+71
115
Fence to
Bayou Tate
13+71
90°
40
90
30
30
133
50
50
Herbert Nezat
Cult
Stagg
10+88 Road
50

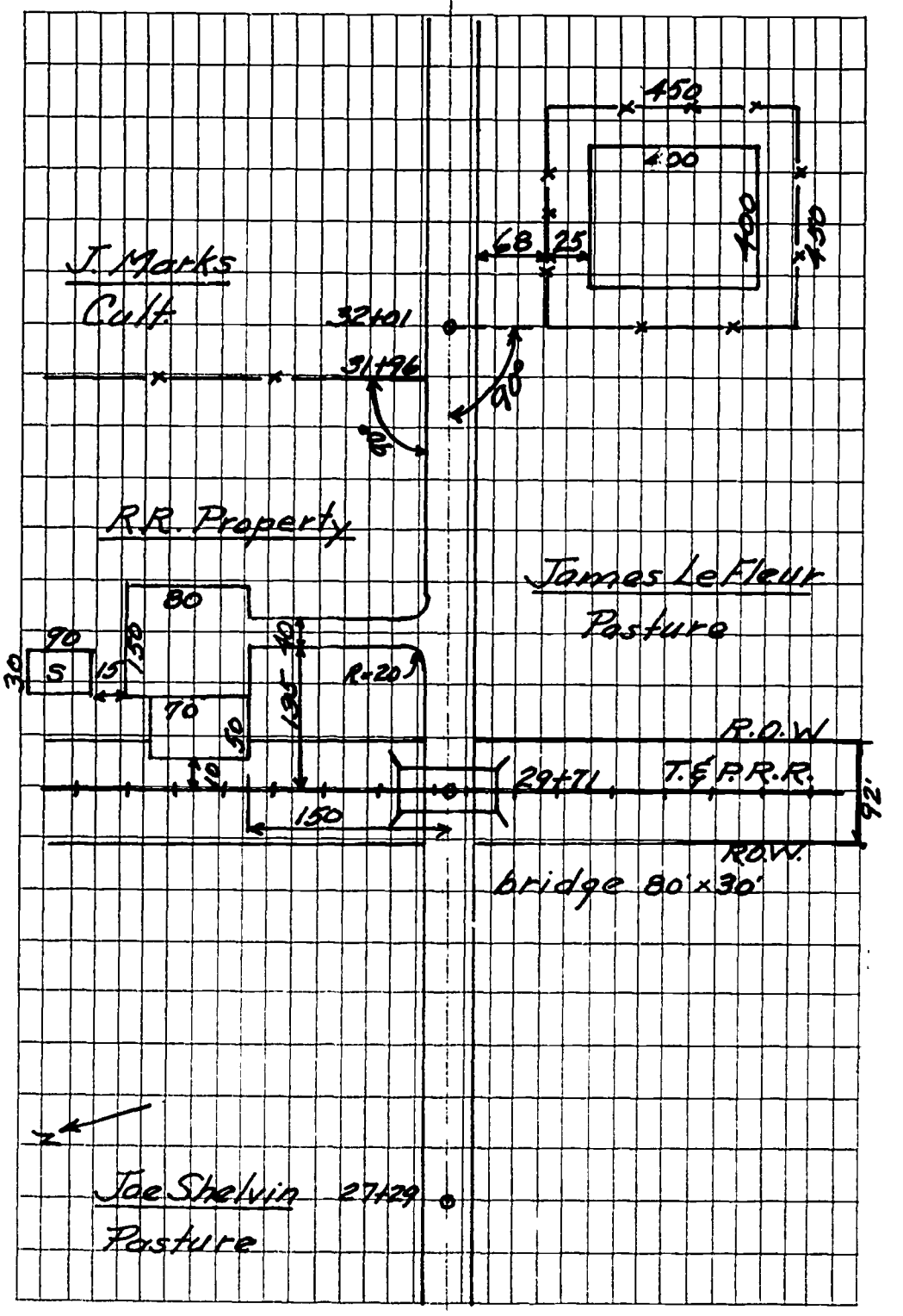
Wilson Road Traverse, Con't.

Sta.	Def. ∡	Cal. B	Remarks
27+29	29°21'R	S57°57E	Bend in road
23+25			
22+37			℄ Wilson & ~~Hancott~~ Perry Rds.
19+16			


Cult.
360
27+29
90°
170
Fence to R.R. R.O.W.
205
40
10
70
45
Joseph Cormier
Cult.
23+25
90°
Corn Field
Fence to R.R. R.O.W.
Joe Shalvin
Pasture
Pasture extends northward of survey limits
22+37
Perry Road
Wilson Road
Lester Smith
Pasture with
scattered trees
320
19+16
90°
122
63°20'
40
Pond
63
60
50
135
20
30
50
40
60
20
15

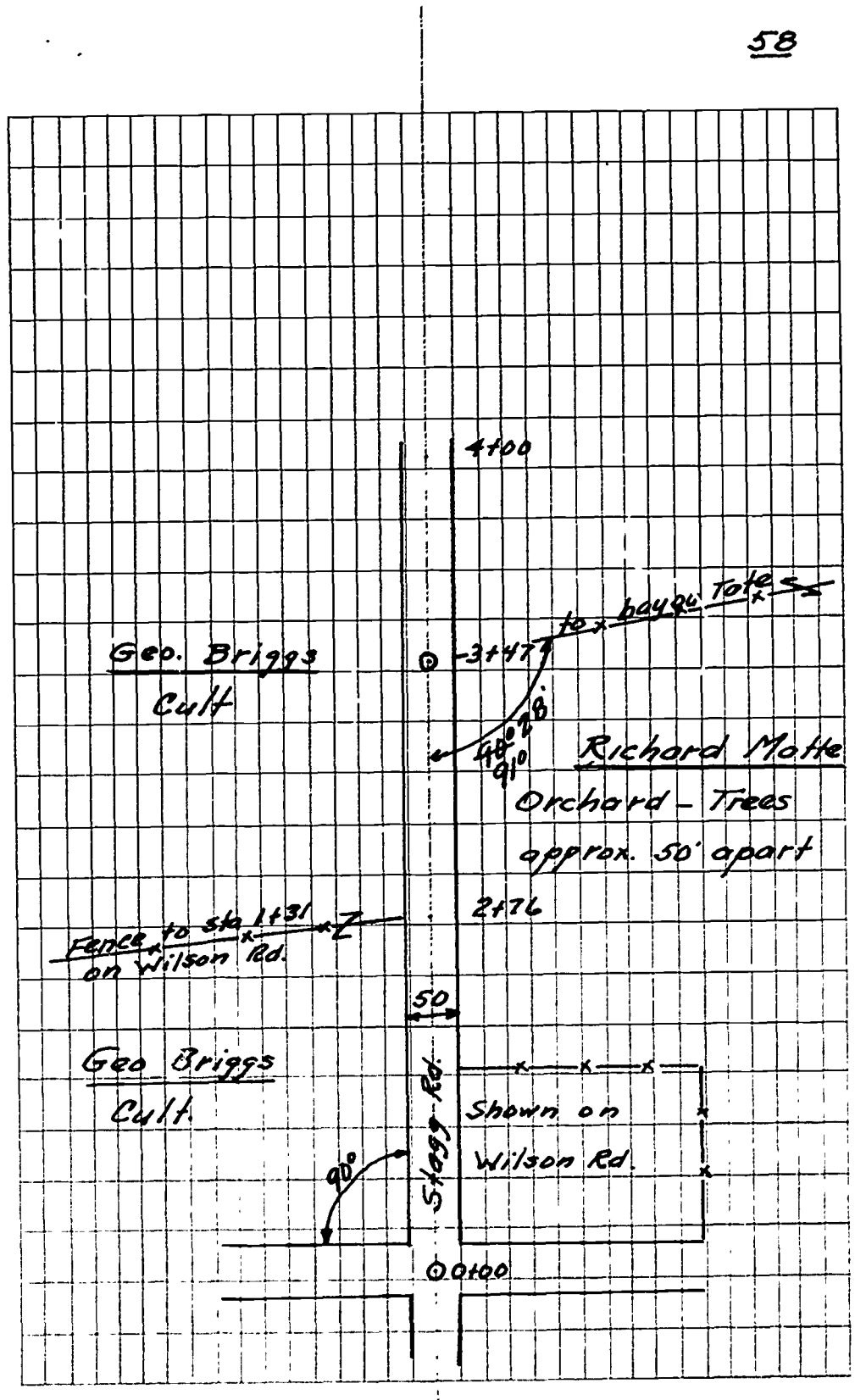
Wilson Road Traverse, Con't

Sta.	Def.∠	Cal.B	Remarks
36+51			End of Survey
32+01			
31+96			
29+71			Sta. 29+71 ℄ R.R. tracks ℄ Wilson Rd.
27+29			


450
400
400
450
68
25
J. Marks
Calf
32+01
31+96
90°
90°
R.R. Property
James LeFleur
Pasture
80
90
30
S
15
50
40
R=20
70
50
135
10
R.O.W
29+71
T.&P.R.R.
92'
150
R.O.W.
bridge 80'x30'
N
Joe Shelvin
27+29
Pasture

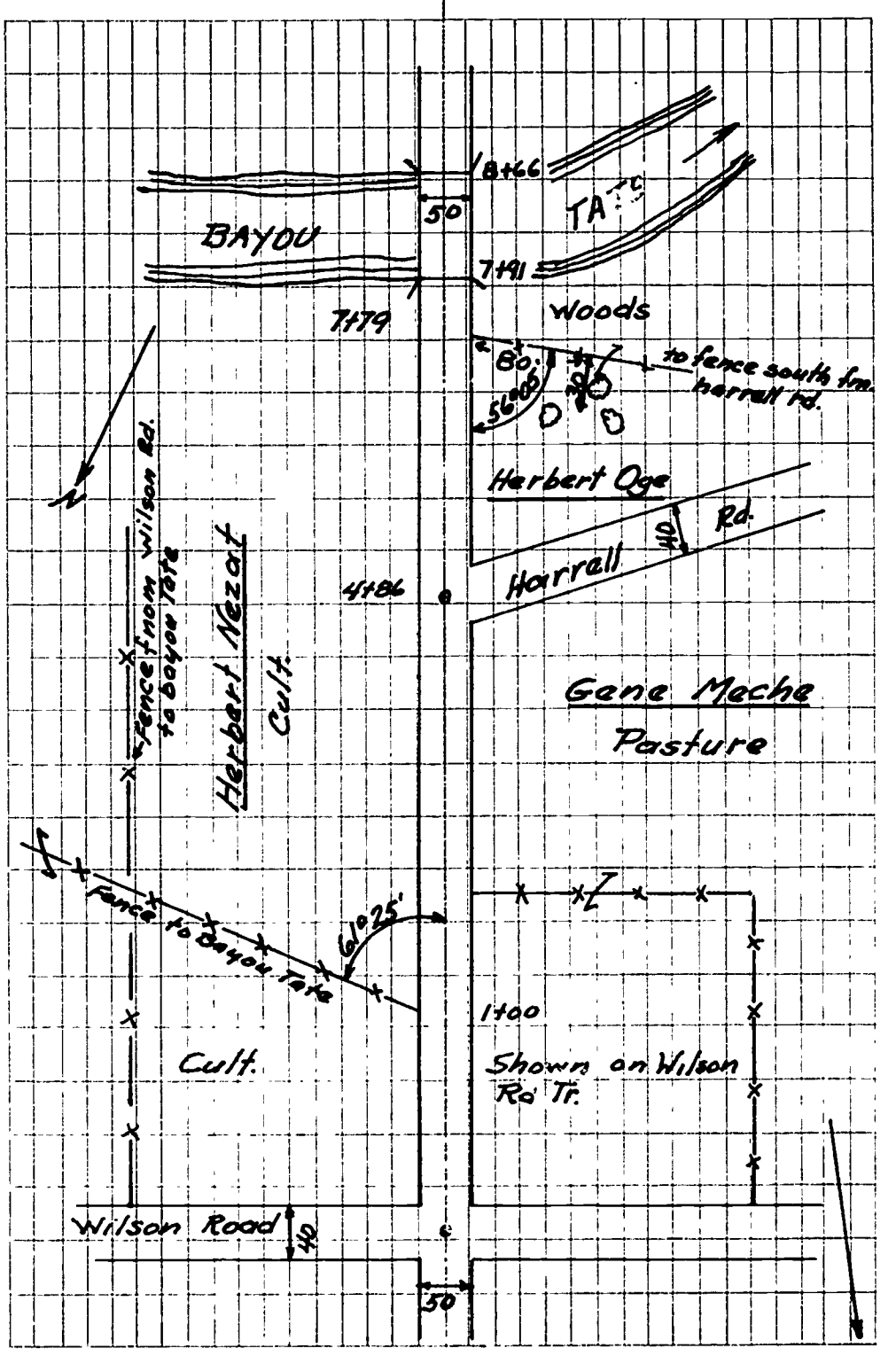
Stagg Road North

Sta	Def ∡	Cal. B	Remarks
4+00			End of Survey
3+47			
2+76			
0+00	90°L	N2°42'E	℄ Stagg & Wilson Rd 0+00 is Sta. 10+58 on Wilson Rd. Traverse


4+00
to bayou Tate
Geo. Briggs
Cult
3+47
48°28'
91°
Richard Motte
Orchard - Trees
approx. 50' apart
2+76
Fence to sta 1+31
on Wilson Rd.
50
Geo Briggs
Cult.
Stagg Rd.
Shown on
Wilson Rd.
90°
0+00

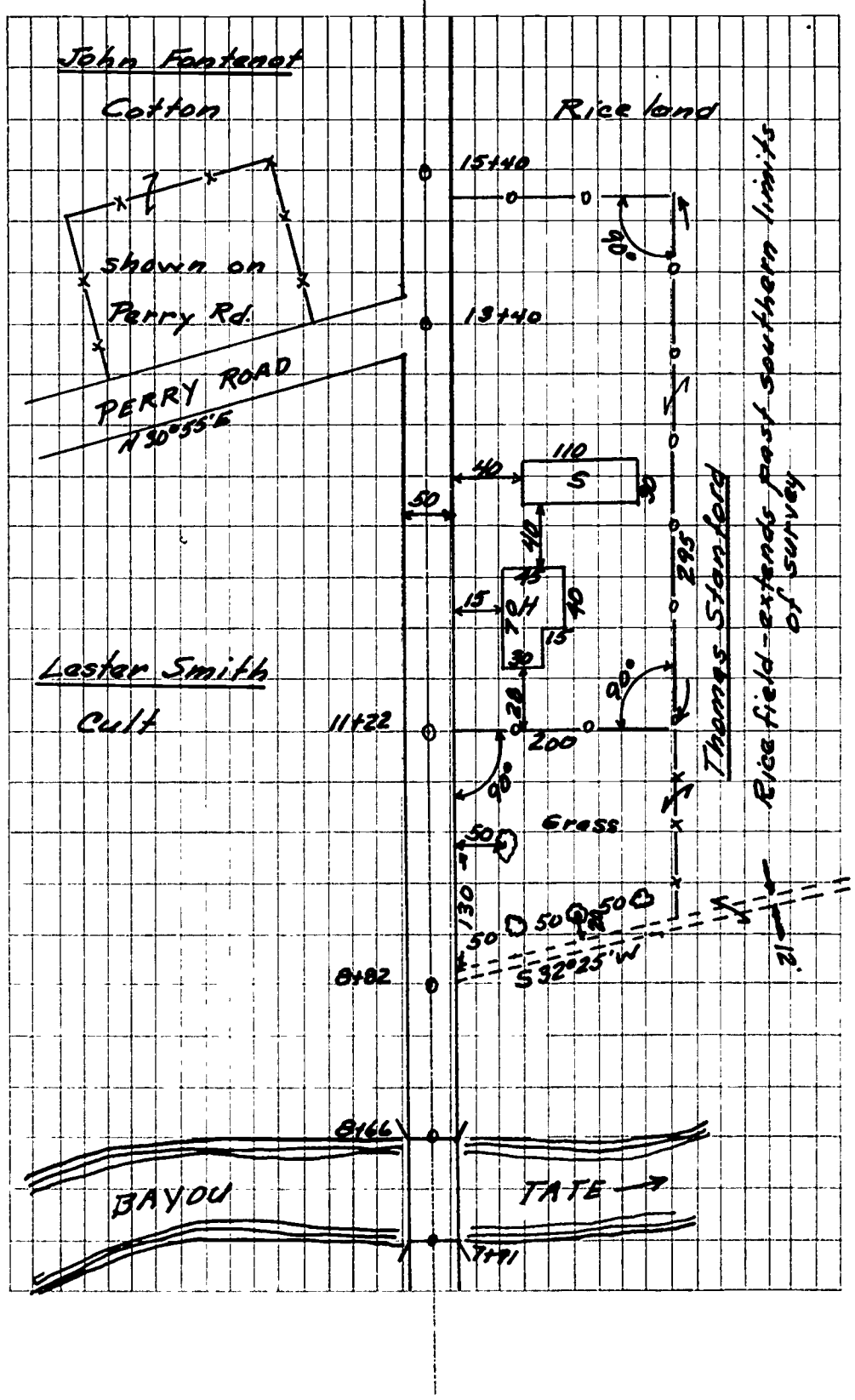
Stagg Road South Traverse

Sta	Def. ∡	Cal. B	Remarks
8+66			S.E. end bridge
7+91			N.W end bridge
7+79			86' westward and 30 northly to center group 3 trees 30' apart
4+86	43°33'L	S40°51'E	℄ Stagg Rd & Harrell Rd. Bend in Stagg Rd.
1+00			
0+00	90°00'R	S2°42'W	0+00 is same as Sta. 10+58 Wilson Rd. Tr.


8+66
50
BAYOU
TA
7+91
7+79
Woods
80.
56°00'
to fence south from harrall rd.
Herbert Oge
Rd.
40
Harrall
4+86
Herbert Nezat
Cult.
Gene Meche
Pasture
fence from Wilson Rd. to Bayou Tate
fence to Bayou Tate
61°25'
1+00
Cult.
Shown on Wilson Rd Tr.
Wilson Road
40
50

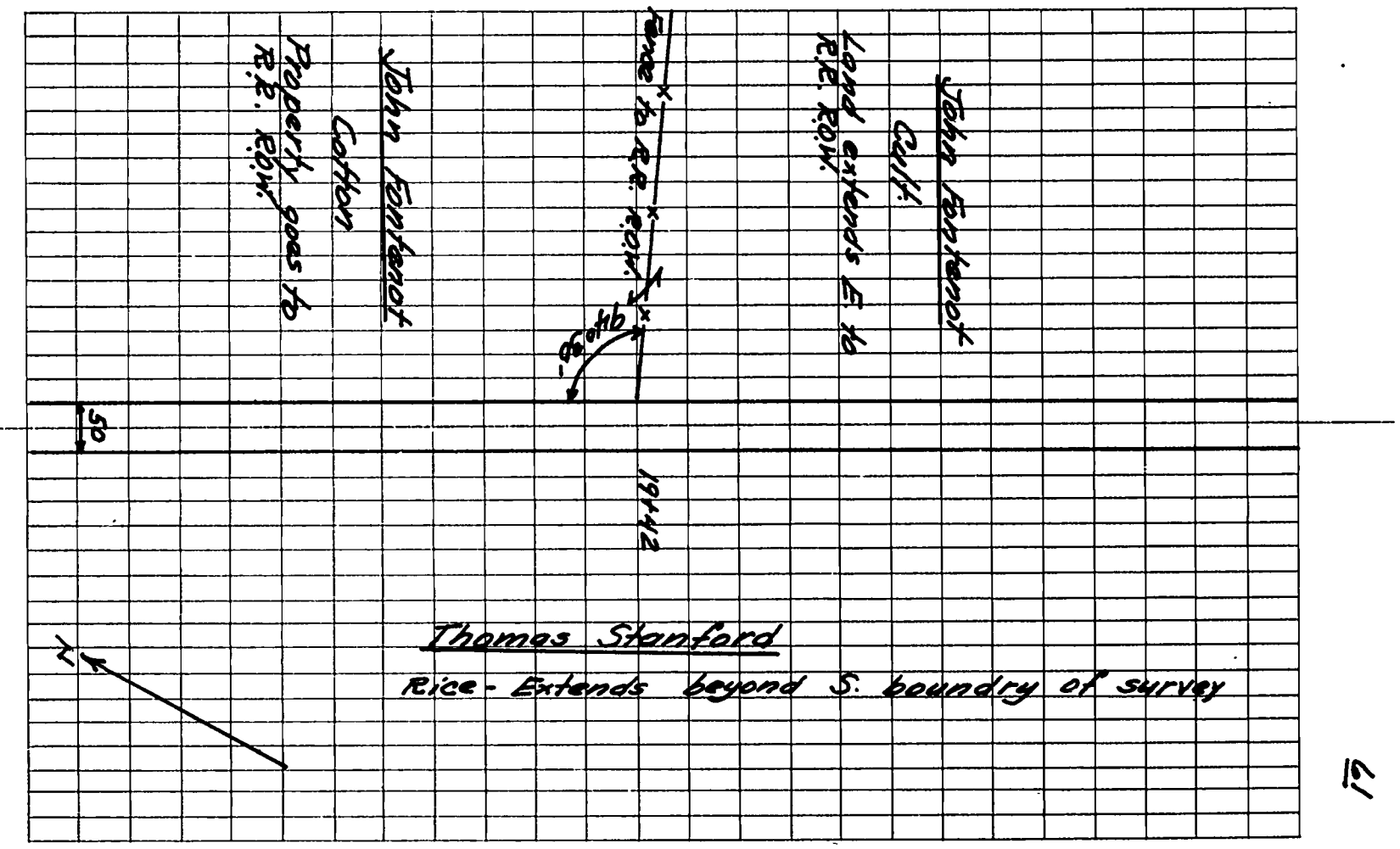
Stagg Road South, Con't.

Sta	Def. ∡	Cal. B.	Remarks	
15+40				
13+40	11°34'R	S29°17'E	℄ Stagg & Parry	Roads &
			Bend in Stagg Rd.	
11+22				
8+82			N. side 12' dirt road	
8+66				
7+91				


John Fontenot
Cotton
Rice land
15+40
shown on
Perry Rd.
13+40
PERRY ROAD
N 30°55'E
110
40
5
50
40
45
15
70
H
40
15
30
295'
Thomas Stanford
Rice field - extends past southern limits of survey
Lester Smith
Cult
11+22
200
90°
Grass
130
50
S 32°25' W
8+82
8+66
BAYOU
TATE
7+91

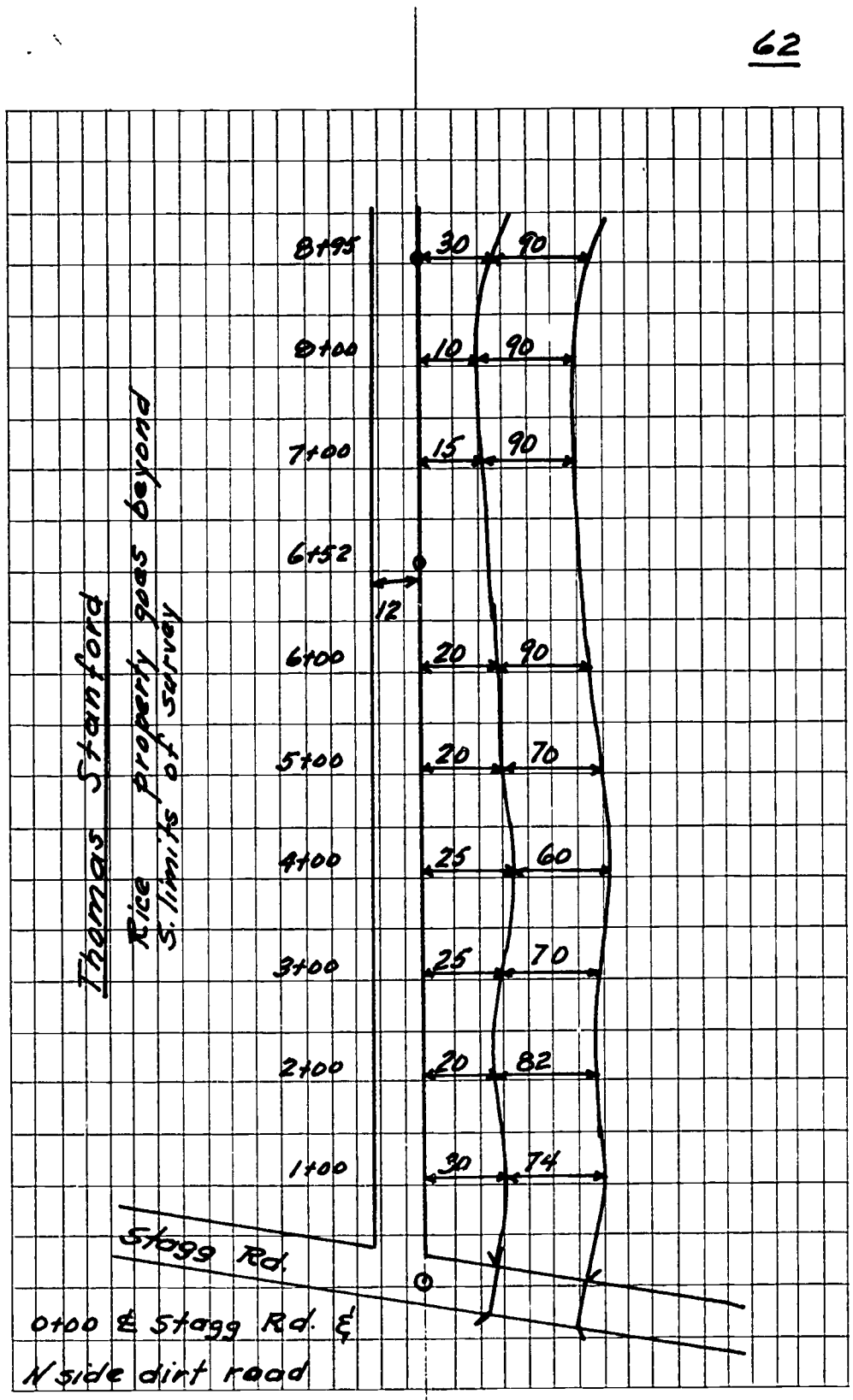
Stagg Road South, Con't

Sta.	Def ∡	Cal. B.	Remarks
25+55			Traverse end, road continues
19+42			
15+40			


John Fontenot
Gulf
Land extends E to
R.R. R.O.W.
Fence to R.R. R.O.W.
qhose
John Fontenot
Cotton
Property goes to
R.R. R.O.W.
50
19442
Thomas Stanford
Rice - Extends beyond S. boundry of survey
N

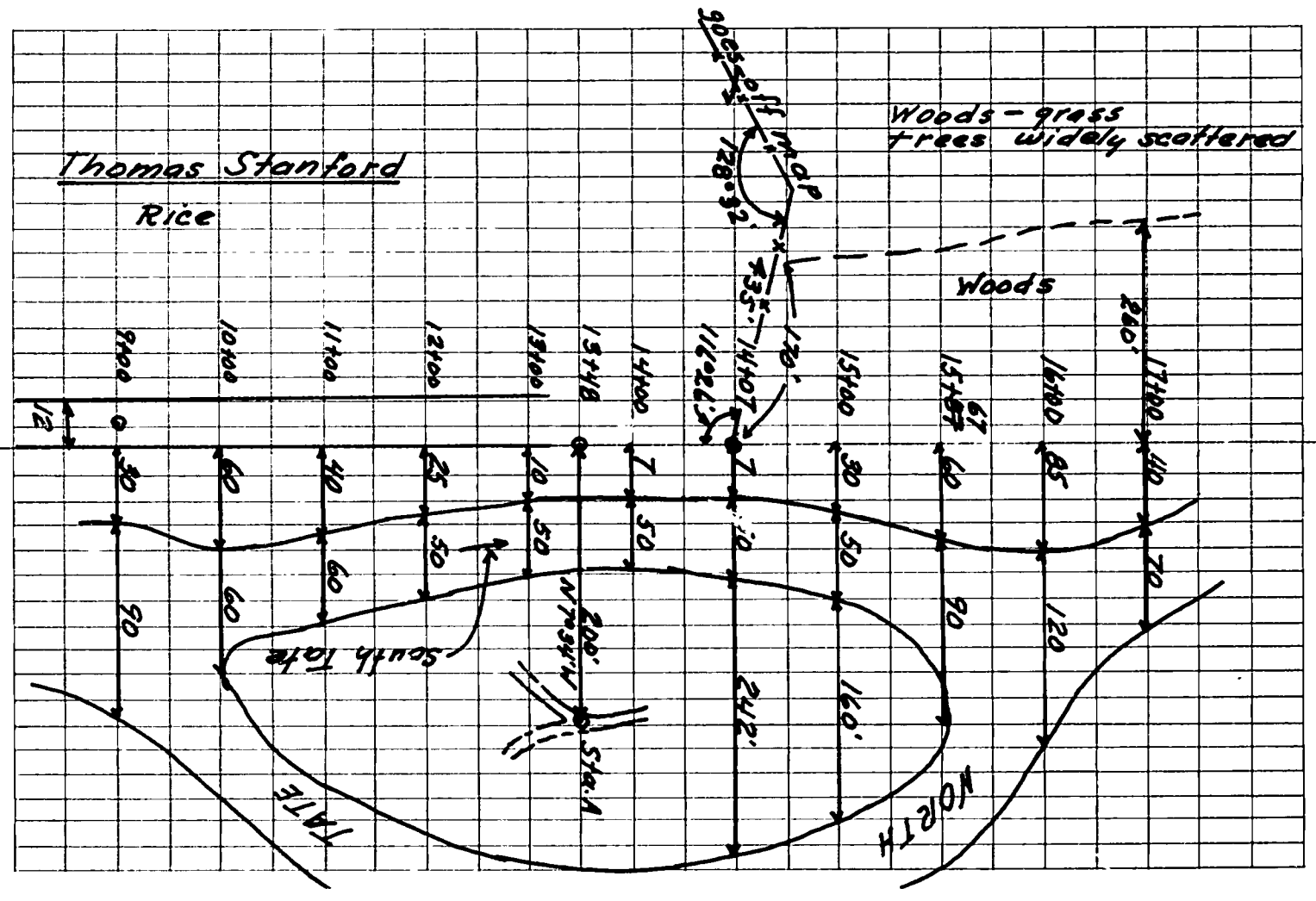
Bayou Tate Meander Line - South

Sta.	Def. ∡	Cal. B.	Remarks
8+95	3°53'R	S82°26'W	Bend in Road
8+00			
7+00			
6+52	46°08'R	S78°33'W	Bend in Road
6+00			
5+00			
4+00			
3+00			
2+00			
1+00			
0+00	73°16'R	S32°25'W	0+00 is same as Sta. 8+82 on Stagg Rd. S. Traverse on N. side of 12' dirt road


Thomas Stanford
Rice property goes beyond
S. limits of survey
8+95
30
90
8+00
10
90
7+00
15
90
6+52
12
6+00
20
90
5+00
20
70
4+00
25
60
3+00
25
70
2+00
20
82
1+00
30
74
Stagg Rd.
0+00 & Stagg Rd. ℄
N side dirt road

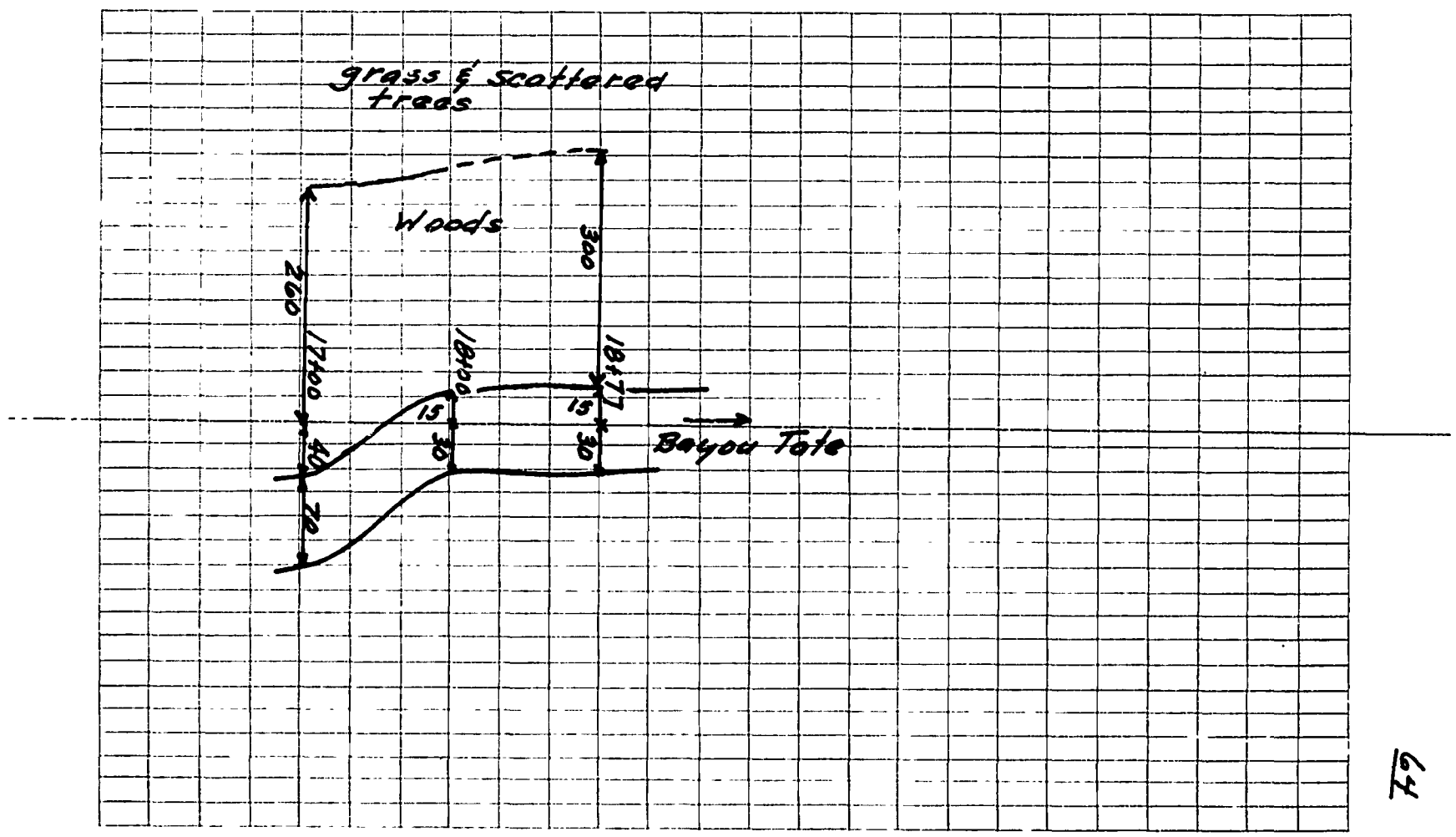
Bayou Tate Meander Line - South, Con't

Sta.	Def. ∡	Col. B	Remarks
17+00			
16+00			
15+~~87~~ 67			
15+00			
14+07			
14+00			
13+48			Set Sta. A to be used later N 7°34'W dist. 200' ℄ to line
13+00			
12+00			
11+00			
10+00			
9+00			


Woods - grass
trees widely scattered
Thomas Stanford
Rice
Woods
Spoom
off map
128°32'
NORTH
TATE
South Lake
N.Tash.W
Sta.5
242'
160'
200'
120'
280'
1/2
0+00
10+00
11+00
12+00
13+00
13+18
14+00
15+00
15+87
16+00
17+00
30
60
40
25
10
0
7
30
17
85
110
50
50
50
50
50
0
90
120
70
60
60
60
90

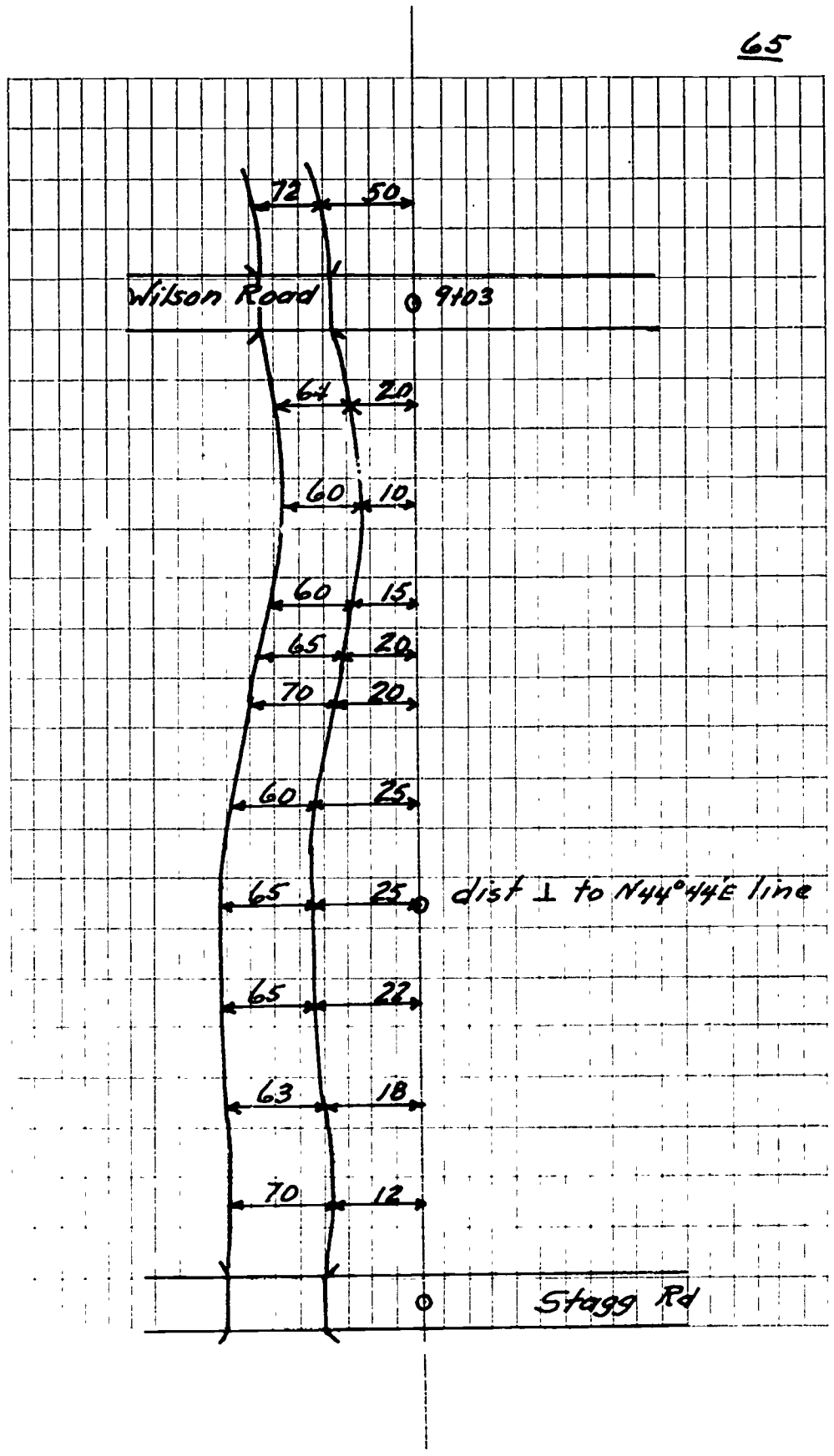
Bayou Tate Meander Line-South, Cont.

Sta.	Def. &	Cal. B	Remarks		
18+77			Survey ends - bayou continues on		
18+00					
17+00					


grass & scattered trees
Woods
260
300
17+00
18+00
18+77
15
15
30
30
40
70
Bayou Tate

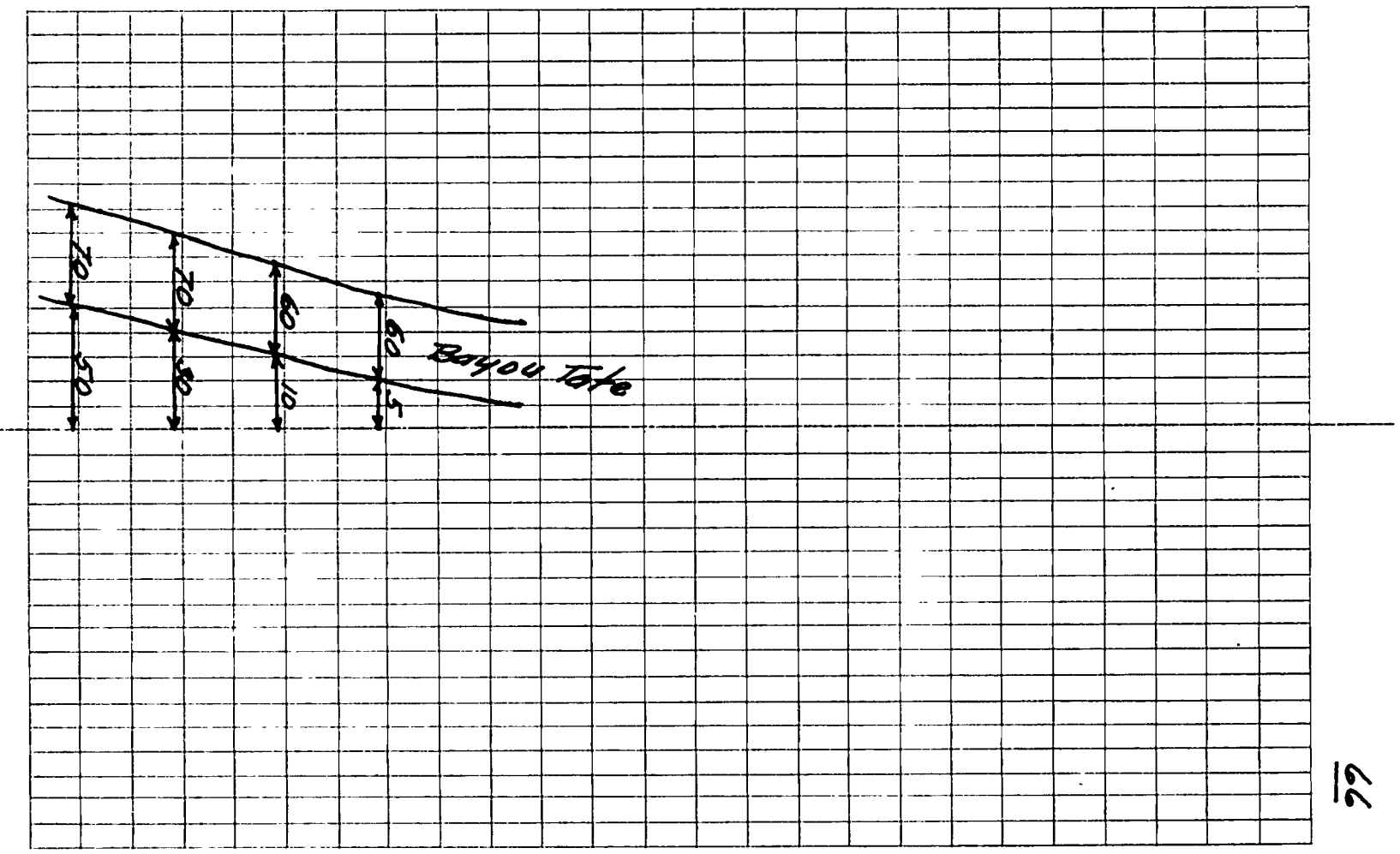
Bayou Tate Meander Line - North

Sta.	Def. ∡	Cal. B.	Remarks
10+00			
9+03	13°00'L	N12°00E	Ties to Sta. 17+68 on Wilson Rd. Tr. which is 38' East of bayou
8+30			
7+30			
6+30			
5+80			
5+30			
4+30			
3+30	19°44'L	N25°00'E	
3+00			
2+00			
1+00			
0+00	94°25'L	N44°44'E	0+00 is Sta. 8+82 on Stagg Rd. S. Tr.


72
50
Wilson Road
9+03
64
20
60
10
60
15
65
20
70
20
60
25
65
25
dist ⊥ to N44°44E line
65
22
63
18
70
12
Stagg Rd

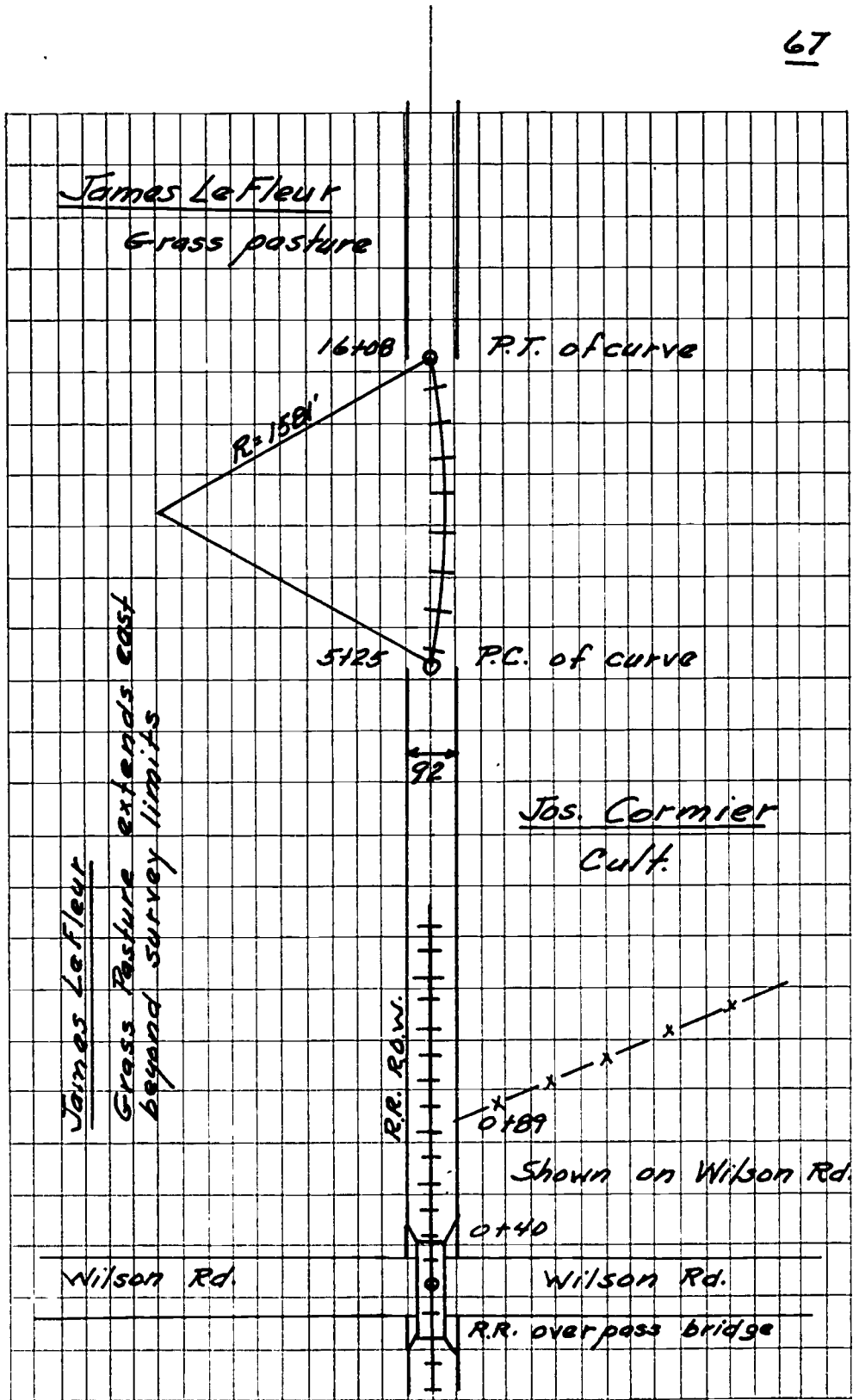
Bayou Tate Meander Line - North, Con't.

Sta	Def 4	Col. B	Remarks	


Bayou Tete
5
10
60
60
70
70
80
80
90
90

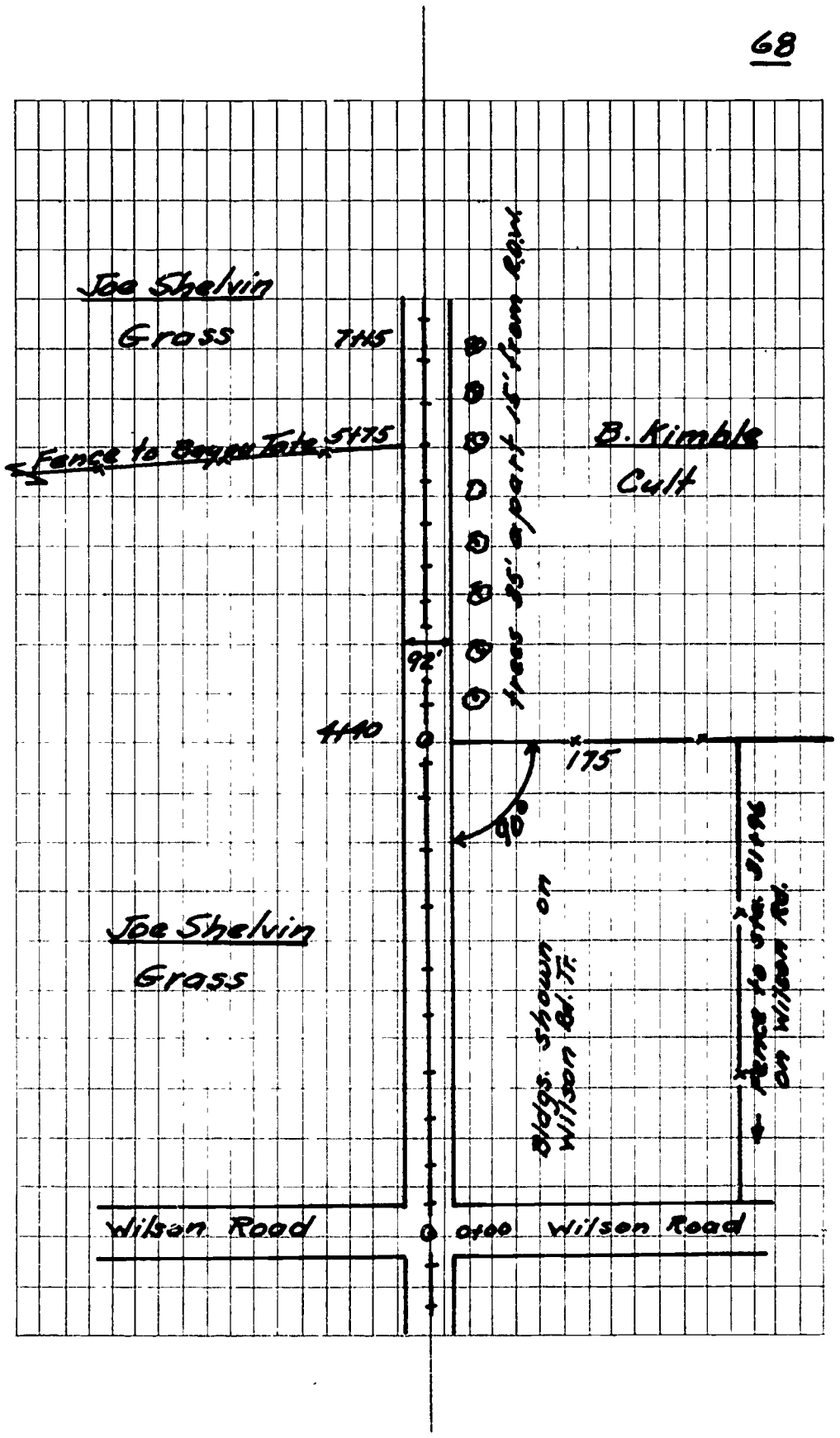
T.& P. R.R. Traverse - Southward

Sta.	Def.∡	Cal.B.	Remarks		
20+95			Survey Ends		R.R. con'ts
16+08	19°30'L	S7°42'E	R.O.W. 92' wide and tangent		on curve
5+25	19°30'L	S11°48'W	Survey line on long chord of curve		
0+89					
0+40			R.R. bridge 80' x 30'		
0+00	89°15'R	S31°18'W	0+00 is sta. 29+71 on Wilson Rd. and ℄ R.R. tracks.		


James LeFleur
Grass pasture
16+08
P.T. of curve
R=1581'
5+25
P.C. of curve
92
Jos. Cormier
Cult.
James LeFleur
Grass Pasture extends east
beyond survey limits
R.R. R.o.W.
0+89
Shown on Wilson Rd.
0+40
Wilson Rd.
Wilson Rd.
R.R. overpass bridge

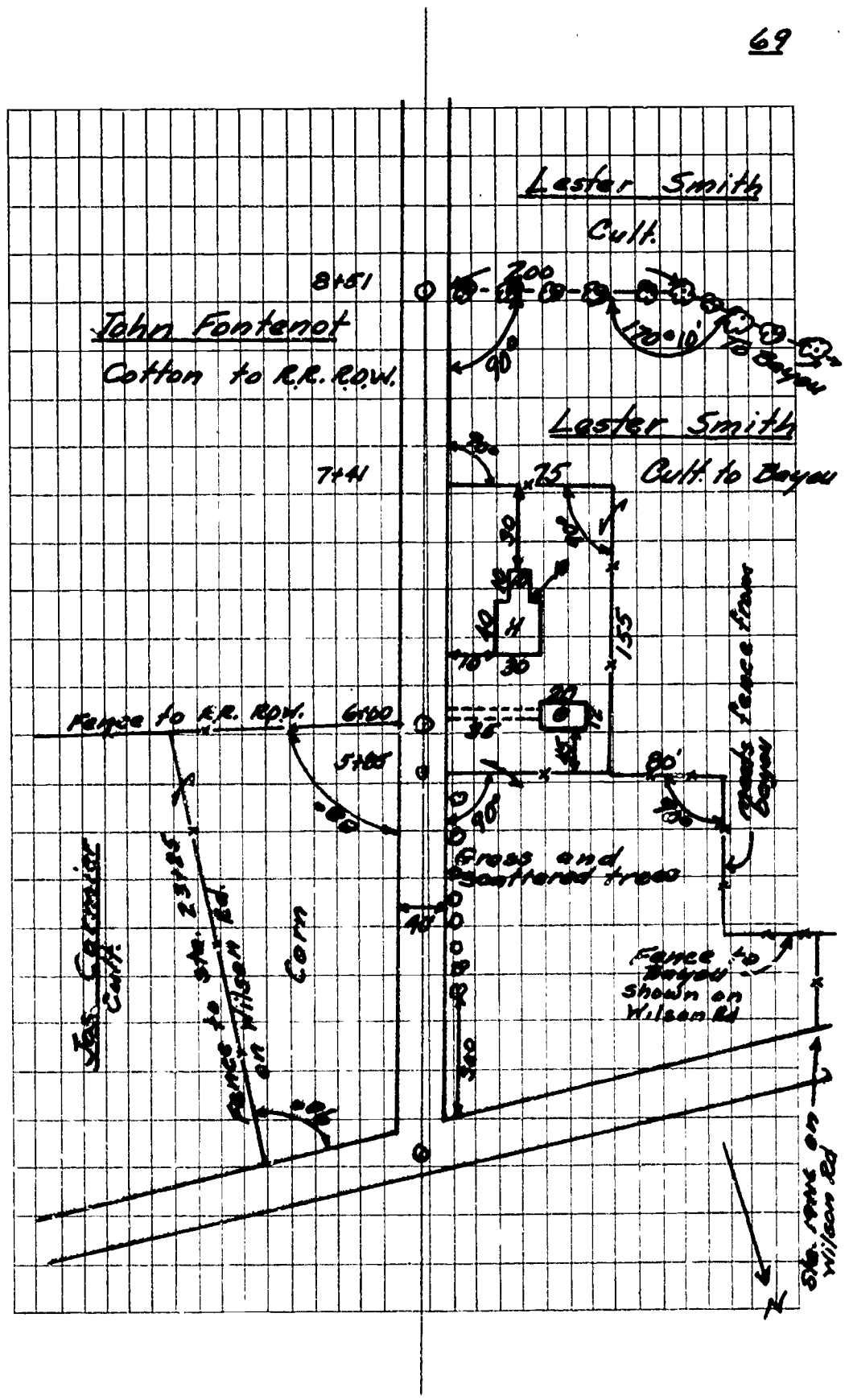
T.&P. R.R. Traverse - North

Sta	Def. ∡	Cal. B.	Remarks
7+15			End of Survey
5+75			Ties to this fence made on Wilson Rd. Tr.
4+40			
0+00	90°45'L	N 31°18'E	0+00 is Sta. 29+71 on Wilson Rd. and ℄ R.R. tracks


Joe Shelvin
Grass
7145
Fence to Bogue Tate 5475
trees 25' apart along River
B. Kimble
Cult
92'
4140
175
90°
Joe Shelvin
Grass
Bldgs. shown on Wilson Rd. Tr.
fence of one strand on Wilson Rd.
Wilson Road
0+00
Wilson Road

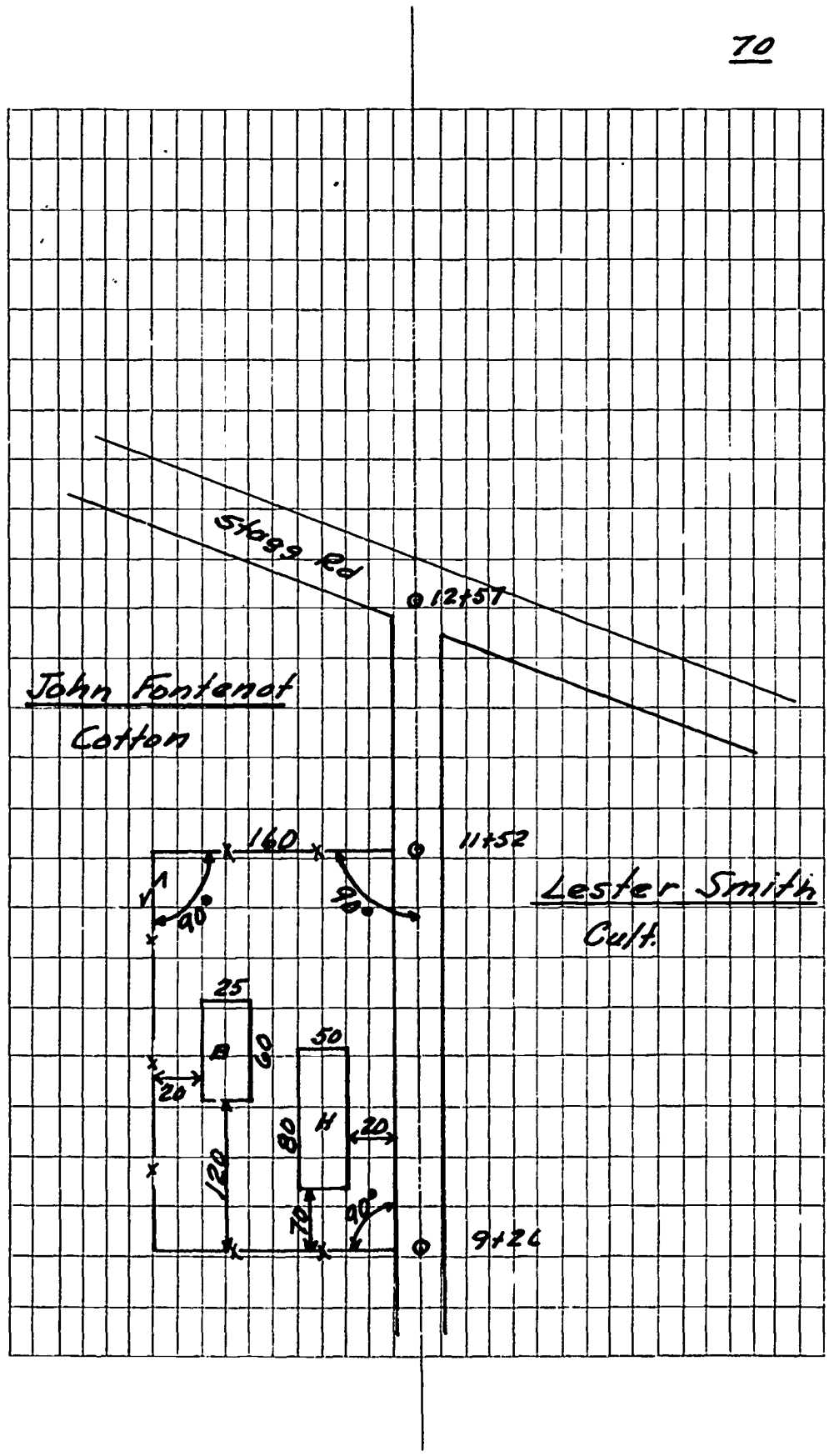
Perry Road Traverse

Sta	Def. ∡	Col. B.	Remarks
8+51			
7+41			
6+00			
5+85			
0+00	118°13'R	S30°55'W	0+00 is Sta. 22+87 on Wilson Road ℄ ⊥ Wilson & Perry Roads


Lester Smith
Cult.
8+51
John Fontenot
Cotton to R.R. R.O.W.
7+41
Lester Smith
Cult. to Bayou
Fence to R.R. R.O.W.
6+00
5+85
Fence to Sta. 2+85 on Wilson Rd.
Corn
Fence to Bayou shown on Wilson Rd
Sta. runs on Wilson Rd
Grass and Scattered trees
Bayou
200
120
10'
90'
155
25
30
40
35
300

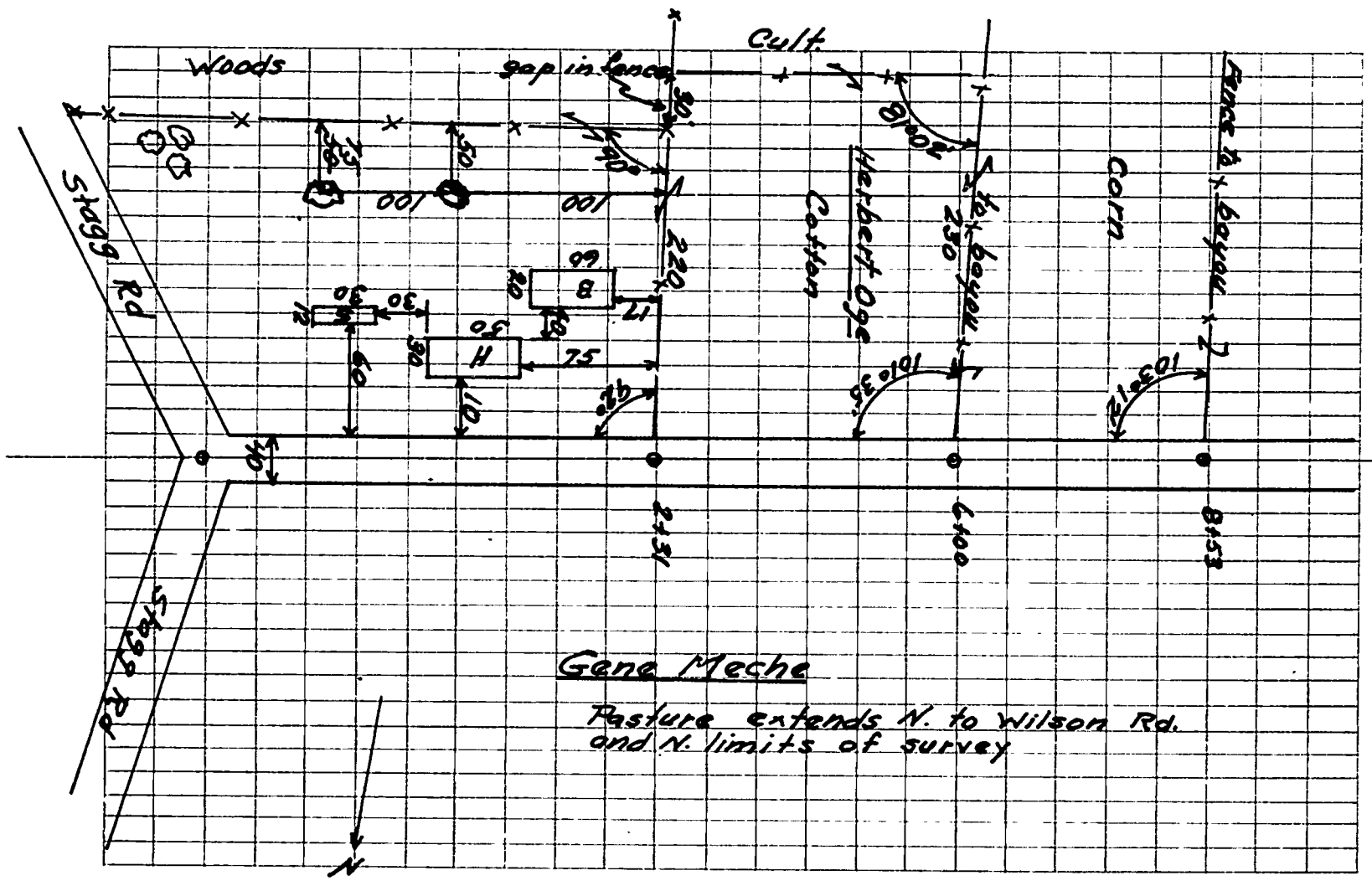
Perry Road Traverse con't.

Sta.	Def. ∡	Cal. B	Remarks		
12+57			Ties to Sta 13+40 on Stagg Rd. Tr.		
11+52					
9+26					


Stagg Rd
12+57
John Fontenot
Cotton
160
11+52
90°
90°
Lester Smith
Cult.
25
B
60
20
50
H
80
20
120
70
90°
9+26

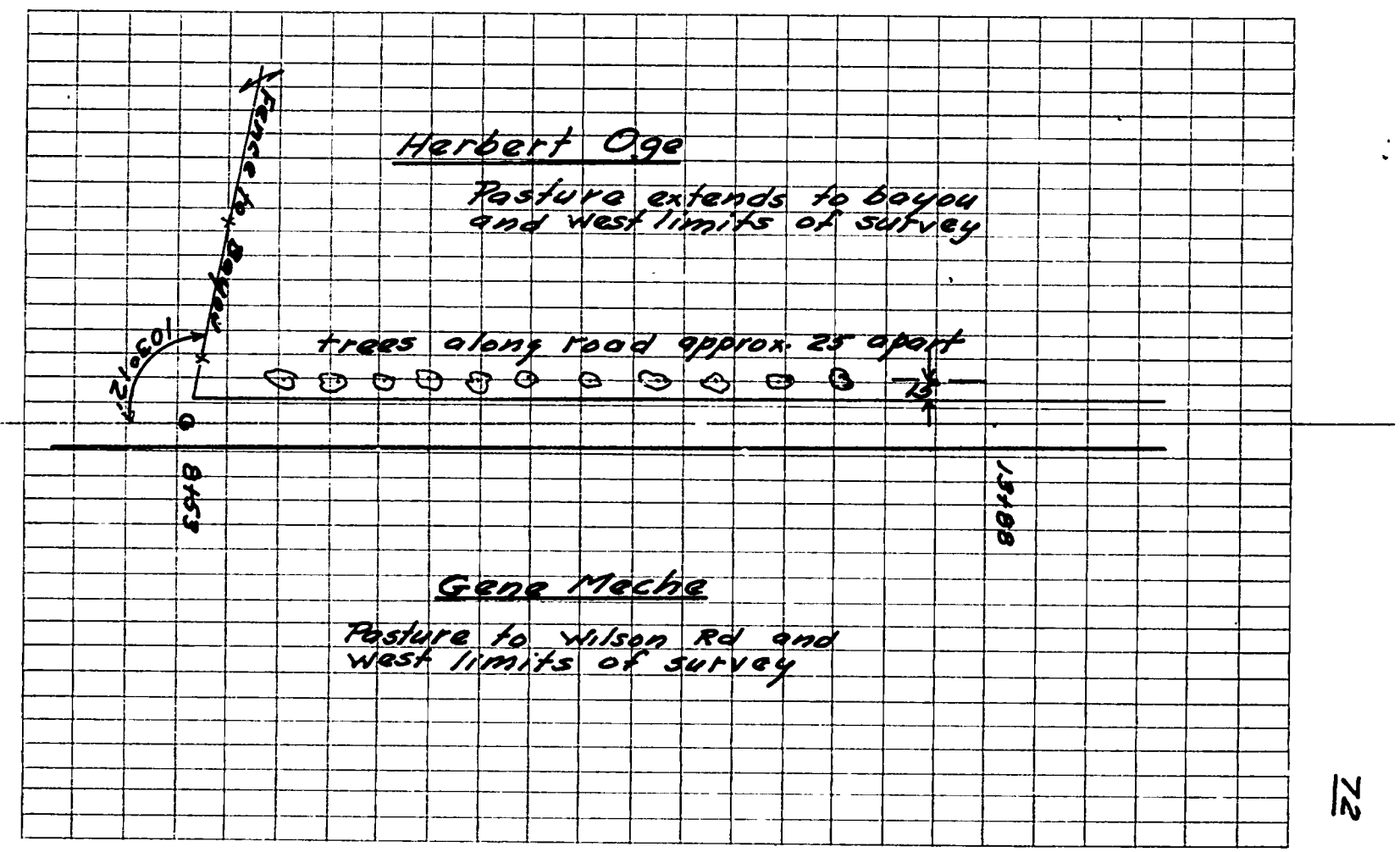
HARRELL ROAD TRAVERSE

Sta	Def ∡	Col. B	Remarks
8+53	39°10'R	N59°28'W	Bend in road
6+00			
2+31			Fence goes straight to bayou, has 30' gap as shown
0+00	78°40'R	S81°22'W	℄ Stagg & Harrell Rds. 0+00 is Sta. 4+86 Stagg Rd. South


Woods
gap in fence
Cult.
Stagg Rd
Cotton
Harbert Ogs
Corn
Fence to bayou
Gene Meche
Pasture extends N. to Wilson Rd.
and N. limits of survey
N

HARREL ROAD TRAVERSE, Con't.

Sta.	Def ∡	Cal. B.	Remarks
13+88			End of Survey Rd. con'ts.
8+53	39°10'R	N59°28'W	Bend in rd.

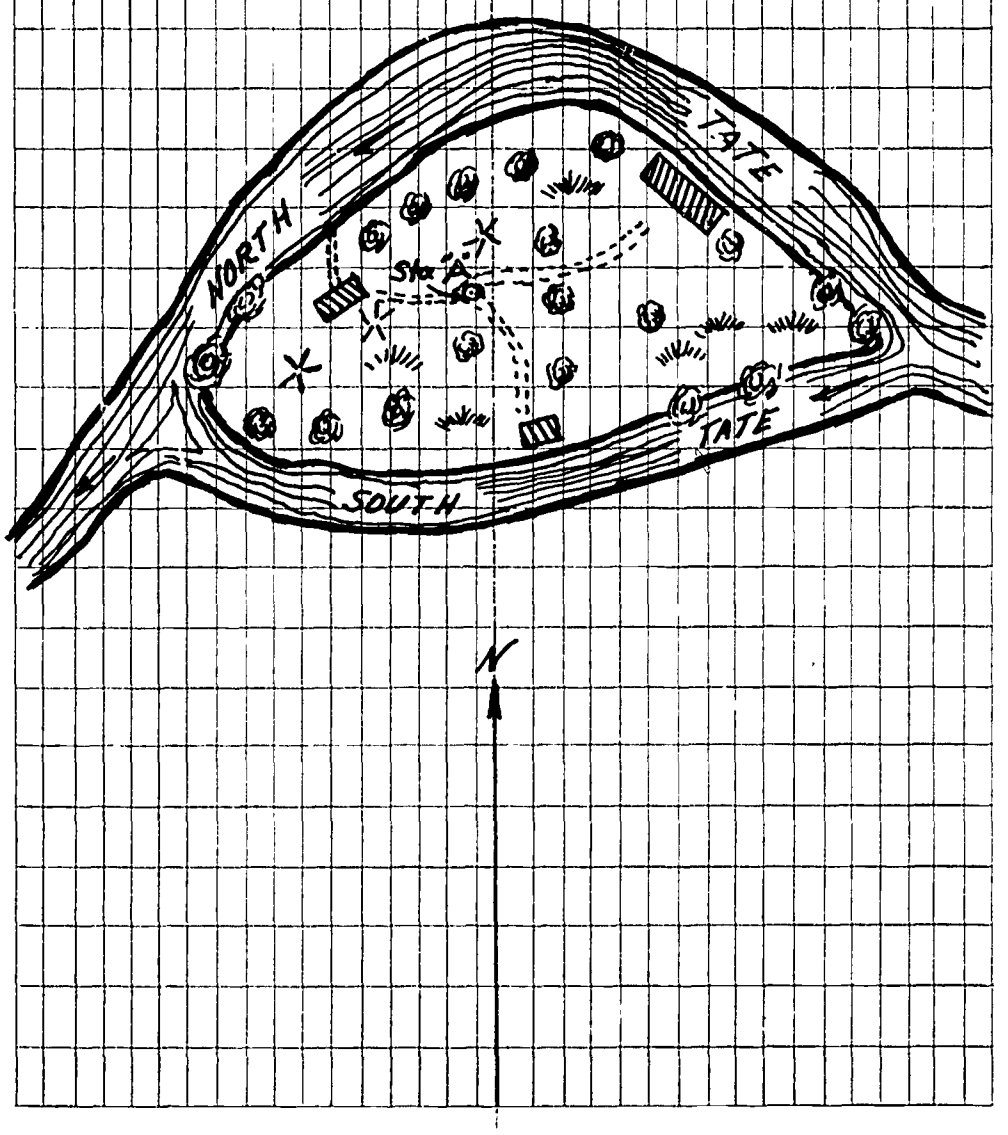

Herbert Oge
Pasture extends to bayou
and west limits of survey
fence to bayou
road
103°12'
trees along road approx. 25 apart
8+65
15+88
Gene Mache
Pasture to Wilson Rd and
West limits of survey

Island Survey

Inst. at Sta "A"

Sta	Az	Dist	Remarks
1	358°00'	90	⊗ Az from North
2	358°00'	130	S. side Bayou
3	358°00'	220	N. " "
4	14°28'	50	*
5	23°28'	120	⊗
6	23°28'	175	S. side Bayou
7	23°28'	242	N. " "
8	43°50'	170	⊗
9	43°50'	200	S. side Bayou
10	43°50'	260	N. " "
11	56°53'	200	N.W. Cor. 70'x20' camp
12	56°53'	80	⊗
13	56°53'	210	S. side Bayou
14	56°53'	285	N. " "
15	77°10'	212	S.E. Cor. 70x20 camp
16	77°10'	260	S. side Bayou
17	77°10'	350	N. side Bayou
18	80°55'	225	⊗
19	93°00'	80	⊗
20	90°25'	315	⊗ at edge bayou
21	84°30'	280	S. side bayou
22	98°15'	160	⊗
23	95°21'	340	⊗ at bayou edge

Sta "A" located from Sta. 19+48 on Bayou Tate South Tr.
Sta. in ℄ trail junations - trail goes from Sta. "A"
to each camp and to bayou at camp N.W. on island



Island Survey, Con't.

Sta.	Az.	Dist	Remarks		
24	106°10'	260	⊗		
25	116°23'	210	⊗		
26	130°15'	105	⊗		
27	145°18'	130	N.E. Cor.	30'x20'	camp
28	158°24'	120	NW cor.	30'x20'	camp.
29	328°22'	85	⊗		
30	328°22	110	S. side	bayou	
31	328°22'	195	N. "	"	
32	300°54'	90	⊗		
33	300°54'	120	S. side	bayou	
34	300°54'	200	N. "	"	
35	278°00'	100	N.E. Cor.	40'x18'	camp
36	278°00'	160	S. side	bayou	
37	278°00'	235	N. "	"	
38	269°05'	190	⊗ on side	bayou	
39	269°05	260	N. side	bayou	
40	260°23'	125	S.W. Cor.	40'x18'	camp
41	260°23'	210	E. side	bayou	
42	260°23'	290	W. "	"	
43	253°50'	90	*		
44	246°26'	160	*		
45	238°05'	220	⊗		
46	226°12'	168	⊗		
47	210°02'	120	⊗		
48	256°18'	295	⊗		
49	180°00'	45	⊗		

NOTES FOR PLATE 10 & 10A

Deflection Angle Traverse

Sta.	Dist. Ft.	Def ∡	Mag. B	Cal. B.
A		81°01'R		
	595.2		N9°W	N9°02'W
B		18°29'R		
	686.4		N9½°E	N9°28'E
C		33°28'R		
	551.8		N43°E	N42°57'E
D		76°53'R		
	711.7		S60°E	S60°05'E
E		60°04'R		
	375.6		S	South
F		9°34'L		
	491.2		S9½°E	S9°34'E
G		64°02R		
	782.7		S54½°W	S54°25'W
H		55°37'R		
	462.4		W	West
A		81°01R		
		Σ 360° ck.		

K&E Transit
No.

L. Carmier IN
P. LeBlanc, H.C.
G. Carrier R.C.
Warm - Cloudy
June 20, 1964

Note: Bearing of Line A-B by Solar Observation with Gurley Solar Transit 112T #600500

NOTES FOR PLATE 11

Line	Length	Bearing
A-B	349.40	Due South
B-C	541.21	S 6° 50'E
C-D	158.82	N 87° 23'E
D-E	412.47	N 72° 00'E
E-F	313.04	S 50° 44'E
F-G	504.51	N 82° 07'E
G-H	471.47	N 15° 14'E
H-I	293.90	N 11° 59'W
I-J	106.84	S 88° 36'W
J-K	319.90	N 74° 28'W
K-L	350.33	S 74° 54'W
L-M	348.37	N 64° 53'W
M-A	349.00	Due West

NOTES FOR PLATE 12

Sta.	B.S.	H.I.	F.S.	Elev.	
BM	7.2	57.2		50.0	
					(Elev.)
0+00					(Dist)
					(Rod)
1+00					
2+00					
3+00					
4+00					
5+00					

Marks - ⋔
Henry - Rod
Wyble - Chain
Jan. 14, 1965
Cool - Clear

50.0	48.0	48.0	50.0
0	5	20	30
7.2	9.2	9.2	7.2
51.0	48.4	48.3	51.0
0	7	20	30
6.2	8.8	8.9	6.2
51.8	48.4	48.3	51.0
0	7	20	30
5.4	8.8	8.9	6.2
52.5	49.7	49.8	52.0
0	7	20	30
4.7	7.5	7.4	5.2
52.8	50.3	50.5	52.5
0	7	20	30
4.4	6.9	6.7	4.7
53.0	50.5	50.7	52.7
0	5	20	30
4.2	6.7	6.5	4.5

Notes for Plate 12, con't.

Sta.	B.S.	H.I	F.S.	Elev	
		57.2			(Elev.)
6+00					(Dist.)
					(Rod)
T.P.1	4.9	57.5	4.6	52.6	
7+00					
8+00					
9+00					
10+00					
11+00					

53.0	50.7	50.8	52.6
0	5	19	30
4.2	6.5	6.4	4.6
52.6	49.4	49.6	52.0
0	4	19	30
4.9	8.1	7.9	5.5
52.4	49.5	49.7	52.3
0	5	20	30
5.1	8.0	7.8	5.2
53.3	50.4	50.6	52.4
0	6	20	30
4.2	7.1	6.9	5.1
52.3	49.3	49.4	51.9
0	6	22	30
5.2	8.2	8.1	5.6
52.0	49.6	50.0	51.7
0	6	22	30
5.5	7.9	7.5	5.8

Notes for Plate 12, con't.

Sta.	B.S.	H.I.	F.S.	Elev.	
		57.5			(Elev.)
12+00					(Dist.)
					(Rod)
$T.P_2$	4.7	57.1	5.1	52.4	
13+00					
14+00					
15+00					
16+00					
TP_3	4.8	58.4	3.5	53.6	
17+00					

52.5	50.2	50.5	52.4
0	6	22	30
5.0	7.3	7.0	5.1
53.0	50.6	50.7	53.0
0	6	22	30
4.1	6.5	6.4	4.1
53.0	49.7	49.9	52.5
0	5	21	30
4.1	7.4	7.2	4.6
53.6	50.5	50.6	53.2
0	5	21	30
3.5	6.6	6.5	3.9
53.6	50.8	51.0	53.6
0	5	21	30
3.5	6.3	6.1	3.5
52.8	50.2	50.4	52.6
0	5	21	30
5.6	8.2	8.0	5.8

Notes for Plate 12, con't.

Sta.	B.S.	H.I.	F.S.	Elev.	
		58.4			(Elev)
18+00					(Dist)
					(Rod)
18+45					

52.8	50.1	50.4	52.6
0	6	21	30
5.5	8.3	8.0	5.8
53.6	50.4	50.7	53.0
0	6	21	30
4.8	8.0	7.7	5.4

NOTES FOR PLATE 14

	DEFLECTION		ANGLE	TRAVERSE	
Sta.	Defl. ∡	Dist. Ft.	Cal. B.	Cal. Az.	Cal. Int. ∡
A	90°00'L				
		349.40	Due South		
B	6°50'L				
		541.21			
C	85°47'L				
		158.82			
D	15°23'L				
		412.47			
E	57°16'R				
		313.04			
F	47°09'L				
		504.51			
G	66°53'L				
		471.47			
H	27°13'L				
		293.90			
I	79°25'L				
		106.84			
J	16°56'R				
		319.90			
K	30°38'L				
		350.33			
L	40°13'R				

BOY SCOUT CAMP, WASHINGTON, LA

C. Mattie, π
J. Guillory, Notes
M. Shanneck, H.C.
C. Ellis, R.C.
June 16, 1963
Fair- Warm

Line AtoB staked due south with Solar Transit

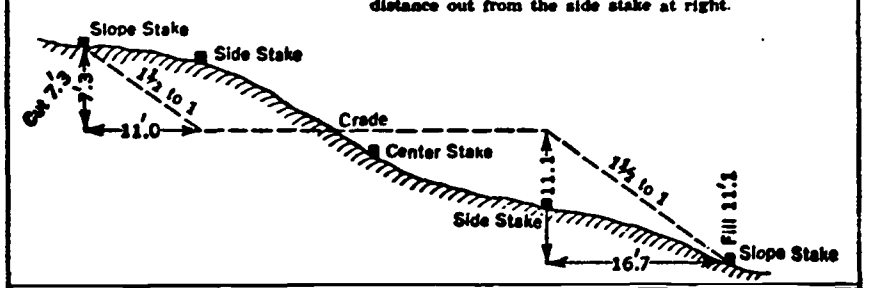
Notes for Plate 14, con't

Sta.	Defl. ∡	Dist., Ft.	Cal. B.	Cal. Az.	Cal. Int. ∡
		348.37			
M	25°07L				
		349.00			
A					
	∑ 360°00'				

DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING

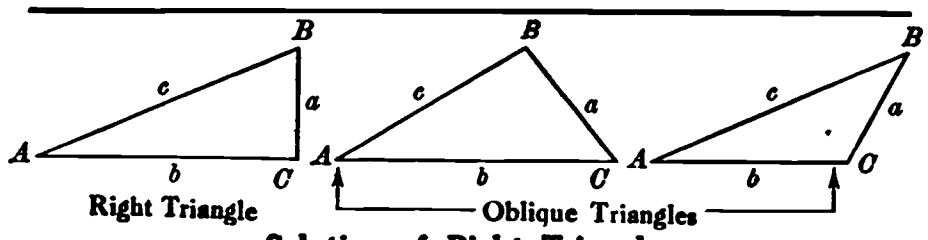
Roadway of any Width. Side Slopes 1½ to 1.

In the figure below: opposite 7 under "Cut or Fill" and under .3 read 11.0, the distance out from the side stake at left. Also, opposite 11 under "Cut or Fill" and under .1 read 16.7. the distance out from the side stake at right.



Cut or Fill	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	Cut or Fill
	Distance out from Side or Shoulder Stake										
0	0.0	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	0
1	1.5	1.7	1.8	2.0	2.1	2.3	2.4	2.6	2.7	2.9	1
2	3.0	3.2	3.3	3.5	3.6	3.8	3.9	4.1	4.2	4.4	2
3	4.5	4.7	4.8	5.0	5.1	5.3	5.4	5.6	5.7	5.9	3
4	6.0	6.2	6.3	6.5	6.6	6.8	6.9	7.1	7.2	7.4	4
5	7.5	7.7	7.8	8.0	8.1	8.3	8.4	8.6	8.7	8.9	5
6	9.0	9.2	9.3	9.5	9.6	9.8	9.9	10.1	10.2	10.4	6
7	10.5	10.7	10.8	11.0	11.1	11.3	11.4	11.6	11.7	11.9	7
8	12.0	12.2	12.3	12.5	12.6	12.8	12.9	13.1	13.2	13.4	8
9	13.5	13.7	13.8	14.0	14.1	14.3	14.4	14.6	14.7	14.9	9
10	15.0	15.2	15.3	15.5	15.6	15.8	15.9	16.1	16.2	16.4	10
11	16.5	16.7	16.8	17.0	17.1	17.3	17.4	17.6	17.7	17.9	11
12	18.0	18.2	18.3	18.5	18.6	18.8	18.9	19.1	19.2	19.4	12
13	19.5	19.7	19.8	20.0	20.1	20.3	20.4	20.6	20.7	20.9	13
14	21.0	21.2	21.3	21.5	21.6	21.8	21.9	22.1	22.2	22.4	14
15	22.5	22.7	22.8	23.0	23.1	23.3	23.4	23.6	23.7	23.9	15
16	24.0	24.2	24.3	24.5	24.6	24.8	24.9	25.1	25.2	25.4	16
17	25.5	25.7	25.8	26.0	26.1	26.3	26.4	26.6	26.7	26.9	17
18	27.0	27.2	27.3	27.5	27.6	27.8	27.9	28.1	28.2	28.4	18
19	28.5	28.7	28.8	29.0	29.1	29.3	29.4	29.6	29.7	29.9	19
20	30.0	30.2	30.3	30.5	30.6	30.8	30.9	31.1	31.2	31.4	20
21	31.5	31.7	31.8	32.0	32.1	32.3	32.4	32.6	32.7	32.9	21
22	33.0	33.2	33.3	33.5	33.6	38.8	33.9	34.1	34.2	34.4	22
23	34.5	34.7	34.8	35.0	35.1	35.3	35.4	35.6	35.7	35.9	23
24	36.0	36.2	36.3	36.5	36.6	36.8	36.9	37.1	37.2	37.4	24
25	37.5	37.7	37.8	38.0	38.1	38.3	38.4	38.6	38.7	38.9	25
26	39.0	39.2	39.3	39.5	39.6	39.8	39.9	40.1	40.2	40.4	26
27	40.5	40.7	40.8	41.0	41.1	41.3	41.4	41.6	41.7	41.9	27
28	42.0	42.2	42.3	42.5	42.6	42.8	42.9	43.1	43.2	43.4	28
29	43.5	43.7	43.8	44.0	44.1	44.3	44.4	44.6	44.7	44.9	29
30	45.0	45.2	45.3	45.5	45.6	45.8	45.9	46.1	46.2	46.4	30
31	46.5	46.7	46.8	47.0	47.1	47.3	47.4	47.6	47.7	47.9	31
32	48.0	48.2	48.3	48.5	48.6	48.8	48.9	49.1	49.2	49.4	32
33	49.5	49.7	49.8	50.0	50.1	50.3	50.4	50.6	50.7	50.9	33
34	51.0	51.2	51.3	51.5	51.6	51.8	51.9	52.1	52.2	52.4	34
35	52.5	52.7	52.8	53.0	53.1	53.3	53.4	53.6	53.7	53.9	35
36	54.0	54.2	54.3	54.5	54.6	54.8	54.9	55.1	55.2	55.4	36
37	55.5	55.7	55.8	56.0	56.1	56.3	56.4	56.6	56.7	56.9	37
38	57.0	57.2	57.3	57.5	57.6	57.8	57.9	58.1	58.2	58.4	38
39	58.5	58.7	58.8	59.0	59.1	59.3	59.4	59.6	59.7	59.9	39
40	60.0	60.2	60.3	60.5	60.6	60.8	60.9	61.1	61.2	61.4	40

TRIGONOMETRIC FORMULÆ



Solution of Right Triangles

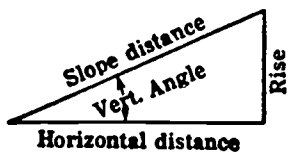
For Angle A. $\sin = \frac{a}{c}$, $\cos = \frac{b}{c}$, $\tan = \frac{a}{b}$, $\cot = \frac{b}{a}$, $\sec = \frac{c}{b}$, $\operatorname{cosec} = \frac{c}{a}$

Given	Required	
a, b	A, B, c	$\tan A = \frac{a}{b} = \cot B,\ c = \sqrt{a^2+b^2} = a\sqrt{1+\frac{b^2}{a^2}}$
a, c	A, B, b	$\sin A = \frac{a}{c} = \cos B,\ b = \sqrt{(c+a)(c-a)} = c\sqrt{1-\frac{a^2}{c^2}}$
A, a	B, b, c	$B = 90° - A,\ b = a \cot A,\ c = \frac{a}{\sin A}.$
A, b	B, a, c	$B = 90° - A,\ a = b \tan A,\ c = \frac{b}{\cos A}.$
A, c	B, a, b	$B = 90° - A,\ a = c \sin A,\ b = c \cos A,$

Solution of Oblique Triangles

Given	Required	
A, B, a	b, c, C	$b = \frac{a \sin B}{\sin A},\ C = 180° - (A+B),\ c = \frac{a \sin C}{\sin A}$
A, a, b	B, c, C	$\sin B = \frac{b \sin A}{a},\ C = 180° - (A+B),\ c = \frac{a \sin C}{\sin A}$
a, b, C	A, B, c	$A+B = 180° - C,\ \tan \frac{1}{2}(A-B) = \frac{(a-b)\tan\frac{1}{2}(A+B)}{a+b},$ $c = \frac{a \sin C}{\sin A}$
a, b, c	A, B, C	$s = \frac{a+b+c}{2},\ \sin\frac{1}{2}A = \sqrt{\frac{(s-b)(s-c)}{bc}},$ $\sin\frac{1}{2}B = \sqrt{\frac{(s-a)(s-c)}{ac}},\ C = 180° - (A+B)$
a, b, c	Area	$s = \frac{a+b+c}{2}$, area $= \sqrt{s(s-a)(s-b)(s-c)}$
A, b, c	Area	area $= \frac{b\,c \sin A}{2}$
A, B, C, a	Area	area $= \frac{a^2 \sin B \sin C}{2 \sin A}$

REDUCTION TO HORIZONTAL



Horizontal distance = Slope distance multiplied by the cosine of the vertical angle. Thus: slope distance = 319.4 ft. Vert. angle = 5° 10′. From Table, Page IX. cos 5° 10′ = .9959. Horizontal distance = 319.4 × .9959 = 318.09 ft.

Horizontal distance also = Slope distance minus slope distance times (1 − cosine of vertical angle). With the same figures as in the preceding example, the following result is obtained. Cosine 5° 10′ = .9959. 1 − .9959 = .0041. 319.4 × .0041 = 1.31. 319.4 − 1.31 = 318.09 ft.

When the rise is known, the horizontal distance is approximately:—the slope distance less the square of the rise divided by twice the slope distance. Thus: rise = 14 ft., slope distance = 302.6 ft. Horizontal distance $= 302.6 - \frac{14 \times 14}{2 \times 302.6} = 302.6 - 0.32 = 302.28$ ft.

VT 002 650
Guide Lines for the Junior High School Industrial Arts Program of Champaign Community Unit No. 4, Champaign, Illinois.

Champaign Community Unit 4 School District, Ill.
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ABSTRACT - Developed by a committee of industrial arts teachers, this curriculum guide is for teacher use in co-ordinating junior high school industrial arts programs. General objectives and a course analysis as well as unit outlines containing specific objectives, study outline, and references are offered for these subjects: drafting, electricity, general metals, plastics, power mechanics, printing, and woodworking. The material is designed to be used over one semester or a full year by individual units. (GR)

VT 002 650

ED0 45856

302

CHAMPAIGN COMMUNITY SCHOOLS

INDUSTRIAL EDUCATION

SUGGESTED GUIDE LINES

FOR

JUNIOR HIGH SCHOOL

INDUSTRIAL ARTS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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CHAMPAIGN COMMUNITY SCHOOLS

UNIT NO. 4

CHAMPAIGN, ILLINOIS

VT02650

ED0 45856

GUIDE LINES FOR THE JUNIOR HIGH SCHOOL INDUSTRIAL ARTS PROGRAM OF CHAMPAIGN COMMUNITY UNIT #4 CHAMPAIGN, ILLINOIS.

DATE: June 16, 1966

COMMITTEE: Mr. Charles Griest
Mr. William Isom
Mr. Dwight Keele
Mr. Arnold Schultz

Printed in the Prevocational Work-Experience Laboratory

ERIC

Philosophy Of Education
Unit #4
(From: Handbook of Policies and Procedures, Board of Education
Champaign Community Unit District No. 4-703
703 South New Street, Champaign, Illinois

The Board of Education of the Champaign Community Unit School District No. 4 is pledged to the following philosophy of education:

(1) We are committed to the education of all the children in Unit School No. 4 who can benefit from public school education.

(2) We are committed to the task of providing as solid a foundation of both academic and vocational knowledge and skills as each individual child's abilities will permit.

(3) We are committed to the belief that individual differences exist in school populations and that differentiation of instruction is imperative if individual needs are to be met adequately; further that atypical pupils should be discovered, encouraged, and challenged.

(4) We are committed to the belief that every child should be encouraged and stimulated to grow in his ability to think clearly, logically, and independently.

(5) We are committed to the task of developing in every child an understanding and appreciation of the forces and ideals which have made America great and a sense of personal responsibility as future citizens of the community, of Illinois, of the United States, and of the world.

(6) We are committed to the provision for guidance that will foster the best possible vocational choices commensurate with the child's ability.

It is the opinion of this committee that the Industrial Arts Program of Champaign Community Unit 4 Schools offer a unique contribution to the following objectives taken from (Statement of the History and Objectives of the School District) Handbook of Policies and Procedures, Board of Education, Champaign Community Unit #4.

GENERAL OBJECTIVES OF UNIT 4

1. To master the basic skills of reading, writing, Mathematics, and speech.
2. To develop the ability to think clearly, critically, and creatively.
3. To acquire a desire for knowledge that will lead to continued growth and to the best development of one's potentialities for the common good.
4. To develop a respect for high moral values and to incorporate them into a personal code of living.
5. To understand the rights and duties of members of a democratic society in order to become a responsible citizen.
6. To gain a knowledge of our history and an appreciation of our culture.
7. To acquire an understanding of the people and culture of other countries.
8. To develop habits of safe and healthful living, including the wholesome use of leisure time.
9. To develop respect for other persons and to be able to live and work cooperatively with them.
10. To develop skills, understanding and attitudes that will help one to make a constructive contribution to society.
11. To learn about the natural resources of the world and to develop a feeling of social responsibility toward their use and conservation.
12. To understand the significance of the family for the individual and society, and strive to become a worthy family member.

GENERAL OBJECTIVES OF INDUSTRIAL ARTS

1. To provide experiences with tools and materials of industry so students may explore their interests and abilities in industrial work.
2. To develop ability to recognize quality, good design, and workmanship in the products of industry.
3. To develop desirable social attitudes, understandings and practices in working with others.
4. To develop hand tool and machine skills that represent good current industrial practice.
5. To develop in each student desirable attitudes and practices with respect to health and safety.
6. To develop an understanding of drawings and to become skillful in making and reading drawings, charts, and graphs.
7. To provide opportunities for students to develop an interest and pride in their work and to develop worthy use of leisure time.
8. To develop in students the ability to measure, calculate and use scientific data.

WRITING

NINTH
GRADE

TABLE OF CONTENTS

DRAFTING
NINTH GRADE

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SPECIFIC OBJECTIVES FOR DRAFTING

1. To provide more experience in the use of drafting tools and materials through the making of working drawings.

2. To acquaint the student with the specific terms used by the draftsman.

3. To develop a methodical procedure in the making of working drawings.

4. To develop an appreciation of a good design.

5. To inform the student about the relationship between industrial planning, process, and organization.

6. To develop a technique of sketching so as to express creative ideas.

DRAFTING

COURSE ANALYSIS

LEARNING TECHNIQUES	RELATED INFORMATION	SUGGESTED ACTIVITIES	Lettering	Sketching	Multi-View	Oblique	Isometric	Architectural	Sheet Metal Develop
Sharpen a Drawing Pencil	Tools & Instruments		x	x	x	x	x	x	x
Fasten Paper to Board	Kinds & Grades of Paper		x	x	x	x	x	x	x
Measure With the Scale					x	x	x	x	x
Mechanical	Pencils & Their Hardness				x	x	x	x	x
Architectural	Job Opportunities				x	x	x	x	x
Follow a Plan of Procedure			x	x	x	x	x	x	x
Draw Horizontal Lines With T-Square				x	x	x	x	x	x
Draw Vertical Lines	Types of Drawing			x	x	x	x	x	x
Draw Lines With Irregular Curve	Multi-View				x	x	x	x	x
Draw Lines With Compass	Oblique				x	x	x	x	x
Check Angles With Protractor	Isometric				x	x	x	x	x
Layout Drawings For Border Lines	Sheet Metal Dev.				x	x	x	x	x
Layout Geometrical Figures	Architectural				x	x	x		
Measure & Layout Border Line	Duplicating Drawings				x	x	x	x	x
Select Necessary Views of Object	Blueprint Reading				x	x	x		
How to Sketch Objects	Inking Drawing			x					
Make Multi-view Drawing	Tracing Drawing				x				
Make Pictorial Drawing						x	x	x	
Oblique (Cabinet-Cavaliar)						x			
Isometric							x		
Make an Architectural Drawing								x	
Develop a Sheet Metal Pattern									x
Parallel Line									x
Radial Line									x
Triangular									x
Dimension Different Types of Drawing				x	x	x	x	x	x
Make Section Views					x	x	x		
Make Auxillary Views					x	x	x		
Erasing on a Drawing				x	x	x	x	x	x
Cleaning a Drawing				x	x	x	x	x	x
Care of Tools & Equipment				x	x	x	x	x	x

UNIT ONE

SKETCHING

UNIT OBJECTIVE: To develop basic skills and techniques by student experiences which will increase their ability to sketch shapes and permit them to express themselves more creatively through sketching.

STUDY OUTLINE: The students will produce several sketches using the skills and techniques discussed in class and through reading material contained in their textbook and reference material.

I. Sketching As Communication

A. Man sketched before he learned to write

B. The true test for the accuracy of a sketch

1. Can the object be made without questions arising from the reading of the sketch

C. The sketch is used by architects, draftsmen, mechanics, builders and students

II. Techniques Used In Sketching

A. Sketching with soft pencil

B. Sketching to a point

C. Sketching with short strokes

D. Sketching center lines first

E. Knowing how to select proper view

III. Sketching Basic Geometric Forms

A. Square

B. Triangle

C. Circle

D. Lines and curves combining

1. Tangent
2. Round
3. Fillet

E. Hexagon

F. Octagon

G. Ellipse

IV. Procedure in Shop Sketching

A. Sketch ideas as soon as they come

B. Complete center lines first (if symmetrical object)

C. Use construction line to outline shape

D. Darken visible lines

E. Add notes and dimensions

V. Architectural Sketches

A. Floor plans

B. Elevation

C. Landscaping

D. Electrical

E. Plumbing

VI. Sheet Metal Sketches

A. Stretch-outs

B. Patterns and Templates

C. Parallel line development

D. Radial line development

V. Pictorial Sketches

A. Isometric

B. Oblique

1. Cabinet
2. Cavalier

C. Isometric

VI. Mechanical Sketches

A. Design

B. Fasteners

C. Thread symbols

D. Keys

VII. Electrical Sketches

A. Symbols

B. Diaghrams

REFERENCES: Coover, S.L., Industrial Arts Drawing and Blueprint Reading, Pp. 197-213

UNIT TWO

ALPHABET OF LINES

UNIT OBJECTIVE: To further the students knowledge with the language of lines.

STUDY OUTLINE: Subject matter information the student should acquire concerning lines with respect to:

I. Different Lines

A. Border

B. Visible object

C. Hidden edge

D. Extension

E. Dimension

F. Center line

G. Cutting plane

H. Horizontal

I. Vertical

J. Slanting

K. Section lines

L. Construction and guide lines

II. Meaning and Use of Each

A. Purpose

B. Length

C. Weight

D. Pencil to use

E. Guiding tools used

F. Procedure to follow

G. Method of drawing

1. For right-handed people
   a. horizontal left to right
   b. vertical bottom to top
   c. slanting bottom to top, usually may be either

REFERENCE: Coover, S.L., Industrial Arts Drawing & Blueprint Reading, Pp. 30

UNIT THREE

LETTERING

UNIT OBJECTIVE: To acquaint the student with the various methods of lettering and communication in the drafting medium.

STUDY OUTLINE: To learn the fundamentals and techniques of good lettering.

I. Requirements of Lettering

A. Accuracy

B. Legible

C. Speed

II. Characteristics of Good Lettering

A. Neatness

B. Smoothness

C. Uniformity of lines and sizes

D. Good Construction

E. Correct proportion

F. Proper spacing

III. Lettering Instruments

A. Pencil

1. H
2. 2H
3. HB

B. Lettering triangle

C. Ames Lettering Guide

IV. Lettering

A. Types

1. Gothic alphabet
2. Architectural lettering
   a. expanded
   b. condensed

B. Strokes

1. Vertical
2. Horizontal
3. Curved

C. Order of standing

1. Vertical
2. Slanting

D. Spacing

1. Space between words equal to height of letters
2. Space between sentence equal to twice the height of letters
3. Uniform amount of space

E. Guide lines

1. Control height of letters
2. Keep letters uniform in
   a. size
   b. shape

REFERENCE: Coover, S.L., Industrial Arts Drawing & Blueprint Reading, Pp. 92-99; P. 230

UNIT FOUR

MULTI-VIEW PROJECTION

UNIT OBJECTIVE: To teach the student how to visualize the different views needed for multi-view drawing and then relationship to each other.

STUDY OUTLINE: To learn more about the different views in orthographic projection and their relationship

I. Types of Drawing

A. Two view

1. Circular objects
2. Square objects

B. Three view

1. Rectangular objects
2. Multi-sided objects

II. Instruments

A. T-square

B. Triangle

1. 30 degree - 60 degree - 90 degree
2. 45 degree - 90 degree

C. Pencil

1. 4H
2. 2H
3. H

D. Eraser

1. Red Ruby
2. Art gum

E. Drawing board

F. Paper

1. 9-12
2. Buff

G. Projection box

III. Views of the Object

A. Front

B. Top

C. Right end

D. Left end

E. Rear

F. Bottom

IV. Placement of Views

A. Allows 1" between border and object
B. Allows 1" between views

C. Add width of object and length of object +2".
Subtract from surface area; divide by 2.
This is the starting point for the left horizontal line.

D. Repeat above (C) for bottom vertical line

V. Selection of Views

A. Shows correct shape of object

B. Shows isze of object

C. Gives most information about object

REFERENCE: Coover, S.L., Industrial Arts Drawing and Blueprint Reading, Pp. 73-78

UNIT FIVE

PICTORIAL DRAWINGS

UNIT OBJECTIVE: (1) To provide student experiences in the production of pictorial drawings which show the finished product and in some cases how to assemble the product.

(2) To develop the skills involved to the degree that the student can express creatively their ideas in a pictorial form which more nearly represents the object as it appears to the eye.

STUDY OUTLINE: The student will make one or more drawings of each of the following types of pictorial drawings: (1) Isometric, (2) Oblique, (3) Perspective. Information may be obtained by reading the text and in most other drafting books.

I. Isometric Drawing

A. Axis angles

B. Measurement along axis

C. Non-isometric lines

D. Ellipses

1. Major and minor axis
2. Ellipse production methods

II. Oblique Drawings

A. Axis angles

B. Cavalier projection

C. Cabinet drawings

D. Four-center ovals

E. Advantage of oblique drawing

III. Perspective Drawings

A. Optical illusion involved

B. Uses

C. Vanishing point

D. Parallel perspecitive

E. Angular perspective

F. Location of vanishing point

REFERENCE: Coover, S.L. Industrial Arts and Blueprint Reading, Pp. 257-260

UNIT SIX

DIMENSIONING OF DRAWINGS

UNIT OBJECTIVE: To further the student's techniques in dimensioning multi-view, pictorial, and architectural drawings.

STUDY OUTLINE: Information will be given in the correct procedure of dimensioning different types of drawings.

I. Characteristics, and Placement of Extension Lines

A. Show what is to be measured

B. They point out length, width, and thickness

C. They show location of detail

D. Extension lines do not touch visible lines

E. They may cross each other without a break

F. They may cross object line without break

G. Extension lines are thin drawn with 4H pencil

H. Center lines may be used as extension lines but not dimension lines

II. Characteristic, and Placement of Dimension Lines

A. Dimension lines are thin, drawn with 4H pencil

B. Arrowhead at end of dimension line always touch extension line and 2½ times longer than wide

C. Dimension lines should be 3/8" away from object and 1/4" apart

D. Dimension lines are broken to allow space for the dimension numbers and fractions

E. Dimension lines should be kept in line

F. Over-all dimensions are placed on the outside

G. Dimension numerals should be staggered

H. Arcs are drawn to show angular measurement

I. Leaders are usually drawn at 60 degree occasionally 45 degree

J. Leader arrow is placed on the outside of small arcs and inside of larger ones

III. Dimensioning Fractions and Notes

A. Fractions are 1 2/3 times height of whole number

B. Vertical dimensions are read from right

C. Inch marks are omitted except when a dimension may be misunderstood

D. Dividing line for fraction is always in line with the dimension line

E. Notes are usually placed parallel to bottom of sheet

F. Notes supply much information

IV. Dimensioning Circles, Radii, Cylinders, and Holes

A. Round holes, cylindrical parts, and arcs are dimensioned from the center

B. Horizontal and vertical center lines are used as base lines for dimensioning objects

C. Radii of arcs or segments of a circle are given. Diameter of arcs should not be given

D. "R" follow all radii dimensions

E. Diameter of holes and complete circles should be given

F. Notes are used to tell how many holes have the same diameter

V. Multi-view Dimensioning

A. Dimension should be placed between views whenever possible

B. Do not repeat dimensions

C. Hidden lines are not dimensioned

D. Detail dimensions should be kept in line

E. Avoid dimensioning in shaded areas

F. Angles are dimensioned by means of arcs and degrees read from bottom

VI. Dimensioning Isometric Drawings

A. General rules for dimensioning multi-view drawings apply also to isometric

B. All the dimensions and notes that the workman will need to make the object are to be given

C. Additional rules

1. Dimensions are kept in the isometric plane
2. Vertical isometric letters are used
3. Dimension and extension lines run parallel to the isometric axis
4. Dimension lines should be kept off the view
5. Holes and keyways should be dimensioned by means of notes
6. Regular vertical lettering used in notes
7. The isometric arrowhead should be drawn as if it were enclosed in a parallelogram

VII. Architectural Dimensioning

A. Architectural dimension lines are unbroken and dimensions are placed above them

B. Dimensions over one foot are expressed in feet and inches foot (') and inch (") are used

C. Dimensions less than one foot are shown in inches only

D. Dimensions read from the bottom or from the right

E. When dimensioned area is too small for the numerals, they are placed outside of extension lines

F. When space is small, arrowheads are placed outside of extension lines

G. Dots may be used to indicate dimension limits

H. Windows, doors, pilasters, beams are dimensioned to their center lines

I Rooms are dimensioned from wall to wall. Does not include wall thickness

J. Beams, columns, and pilasters dimensions are placed on leaders

. Curved leaders are often used to eliminate confusion

. Bricks or stone veneer dimensions must be added to the framing dimensions

M. Foundation dimensions must be the same as the overall dimension

N. Where distances are optional, maximum or minimum dimensions should be given

REFRENCE: Coover, S.L., Industrial Arts Drawing and Blueprint Reading, Pp. 44-48; 253-255; 228-230

UNIT SEVEN

INDUSTRIAL AND MACHINE DRAWING

UNIT OBJECTIVE: To develop an understanding of the many processes involved in industrial production and assembly of machines.

STUDY OUTLINE: Subject matter information the student should acquire concerning the industrial process of machine production.

I. Production Cycle

A. Begins in drafting room - ideas are sketched, drawn, and blueprinted

B. Wooden patterns must be made if the machine requires castings

C. Patterns are taken to the foundry number of castings made from each

D. The casting are machined

E. Machines are assembled

F. Finish is applied

II. Working Drawings

A. Give the craftsman the necessary information to make and assemble the many pieces

B. Kinds of Working drawings

1. Detail drawing
   a. picture of the part
   b. usually a multi-view
   c. dimensions and information needed to make part
2. Assembly drawing
   a. shows where and how parts fit into the completed [illegible]
   b. used to show what the completed object looks like
3. Sub-assembly
   a. shows assembly of a small portion of the completed part

C. Part identification by

1. Numbered may be circled
2. Parts list or bill of material
   a. upper right corner - information reads down
   b. above title block - read from bottom to top
   c. parts are listed in order of importance or according to their size

III. Metal Fasteners of Machine Parts

A. Bolts, screws, rivets, pins and keys are standardized by the American Standards Association

B. Information the draftsman should know

1. Use
2. When to specify each kind
3. How shown in conventional form
4. Thread (shapes)
5. Screw thread terminology
6. Thread series - class of fit
7. Identification of standard threads

C. Draw conventional threads

D. Draw simplified thread symbols

E. Draw welding symbols

REFERENCE: Coover, S.L. Industrial Arts Drawing and Blueprint Reading Pp. 194-312

UNIT EIGHT

ARCHITECTURAL DRAWING

UNIT OBJECTIVE: To develop the ability to recognize different types of architecture. To show how these are graphically illustrated.

STUDY OUTLINE: Subject matter information the student should acquire concerning architectural drawing with respect to

I. Different Styles of Houses

A. Cape Cod

B. Southern Colonial

C. Block Modern

D. Ranch

E. Split level

F. Other styles

1. Spanish
2. Italian
3. Tudor
4. Elizabethan

II. Description and Characteristics of Styles

III. Methods Used in Drawing

A. Floor plan

1. Usually 1/4" = 1'
2. Size of house determined by number and size of rooms
3. Block in outline (4H)
4. Lay out partitions
5. Locate doors and windows
   a. symbols
6. Locate stairways
7. Darken lines (2H or H)
8. Erase layout lines
9. Locate fireplace, kitchen fixtures, bath fixtures
   a. use template
10. Put in dimensions
11. Do lettering
12. Erase guide lines

B. Second floor plan

1. Must line up over first floor
2. Stairways outside walls and plumbing must be aligned

C. Basement plan

1. How foundation is to be constructed
2. Symbols for footing, pilaster columns and etc. must be shown

D. Common building terms

1. Frame work is shown
2. Shows section of house in detail

E. Elevator drawing

1. Front elevation (front view)
2. Rear elevation (rear view)
3. Right elevation (right view)
4. Left elevation (left view)

F. Designing from inside out

1. Elevation projected from floor plan
2. Correct symbols are used

G. Roof types

1. Shed
2. Flat
3. Hip
4. Gable

IV. Elevation Dimensions Required

A. Ceiling and floor height

B. Door and window height

C. Chimney height

D. Footer depth

E. Ground line location

F. Roof pitch

REFERENCE: Coover, S.L., Industrial Arts Drawing and Blueprint Reading, Pp. 213-236

UNIT NINE

SHEET METAL DEVELOPMENT

UNIT OBJECTIVE: To acquaint the student with the language, art, fundamentals and techniques involved in becoming a skilled sheet metal worker.

STUDY OUTLINE: To know more about sheet metal development; the kinds and ways to lay out patterns; where to find information on the ways and methods of accomplishment in this project.

I. Methods of Laying Out Patterns

A. Simple layout

1. Rectangular objects
2. Square corners

B. Parallel line

1. Cylinder
2. Rolled objects

C. Radial line development

1. Tapering forms
2. Irregular curved objects

D. Triangulation

1. Transition pieces
   a. square to round objects

II. Tools Required

A. Layout instruments

1. Compass
2. Trammel points
3. Triangle
   a. 30 degree - 60 degree - 90 degree
   b. 45 degree - 90 degree
4. T-square
5. Drawing board

B. Layout medium

1. Paper
   a. vellun
   b. tracing cloth
2. Metal

C. Transfer tools

1. Prick punch
2. Ball peen hammer

3. Scriber
4. Straight edge

III. Tips On Layout

A. Keep numbers legible and accurate

B. Allowance of metal

1. Seams
2. Hems
3. Wire edge
4. Notching

REFERENCE: Coover, S.L., Industrial Arts Drawing and Blueprint Reading, Pp. 132-154

UNIT TEN

OCCUPATIONAL OPPORTUNITIES

UNIT OBJECTIVE: To better inform the student of the occupations that involve drawing and design.

STUDY OUTLINE: Subject information the student should know concerning the many occupations that involve drawing, designing, and the ability to read blueprints.

I. Draftsman

A. Makes working drawing and detailed drawings from sketches, and information furnished by the architect, engineer, or designer

B. Usually starts as a tracer

C. Advance to detailer

D. Junior draftsman

E. Senior draftsman

F. Head or chief draftsman

II. Characteristics of a Good Draftsman

A. Accurate and neat

B. Specializes in a particular field

C. Must be familiar with materials and manufacturing methods

D. Thorough knowledge of math, science, English, and manufacturing processes

E. Usually work for engineering concerns, manufacturers, architects, or for the government

III. Industrial Designers

A. Job is to simplify and improve appearance

B. Artistic and technical ability to create

C. Be a good draftsman

IV. Tool Designers

A. Starts as detailer (small assemblies)

B. Minor layout man

C. Full-fledged designer

V. Teachers

A. Industrial arts teacher

1. Advantages
2. Disadvantages

VI. Architects

A. Plan and design all kinds of structures

B. An architect is considered in a professional capacity similar to that of a lawyer or doctor

C. Does detail drawings, see that contractors meet specifications

D. Most states require architects to be licensed and pass special examinations

VII. Engineers

A. Most engineers specialize such as mechanical, civil, aeronautical, electrical

B. Must be licensed and registered

C. College degree-four years experience-pass special examination

REFERENCE: Walker & Plevyak, Drafting, Pp. 191-195

WRITING

SEVENTH & EIGHTH
GRADE

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SEVENTH AND EIGHTH GRADE

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SPECIFIC OBJECTIVES FOR DRAFTING

1. To provide experiences in the use of drafting tools and materials through making of working drawings.

2. To develop the habit of making sketches and drawings for personal use and to convey ideas to others.

3. To develop a methodical procedure in the making of working drawings.

4. To give information about occupations dependent upon drawings.

5. To develop an appreciation of good design.

6. To teach the relationship between industrial planning, processes, and organization.

DRAFTING
COURSE ANALYSIS

LEARNING TECHNIQUES	RELATED INFORMATION	SUGGESTED ACTIVITIES: Measurement	Instruments	Geometric Const.	Orthographic	Pictorials	Production
Sharpen a Drawing Pencil	Rules and Symbols	x	x	x	x	x	x
Fasten Paper to Board With Tape		x	x	x	x	x	x
Measure With the Scale	Pencil Grades & Hardness	x	x	x	x	x	x
Follow a Plan of Procedure		x	x	x	x	x	x
Draw Horizontal Lines With T-Square	Paper Grades & Surface	x	x	x	x	x	x
Draw Vertical Lines With Triangle & T-Square		x	x	x	x	x	x
Draw Lines With Irregular Curves	Structure Scales			x		x	x
Draw Circles With Compass	T-squares & Triangles		x	x	x		x
Check Angles With Protractor				x			x
Lay Out Drawing With Border Line	Alphabet of Lines	x	x	x	x	x	x
Construct Hexagon, Pentagon & Octagon				x			
Bisect Line, Angle & Arc	Advantage of Sketches			x			
Measure & Layout Border Lines		x	x	x	x	x	x
Choose Necessary Views of Object	Projection Box Technique				x		x
Draw simple Object 3-view Projection					x		x
Project From Given View to Find Missing View					x		x
Identify Planes & Lines By Number	Shop Math				x		
Dimension Two & Three View Drawings					x		x
Sketch Letters, Numerals, & Arrowheads	Story of Pencil	x	x	x	x	x	x
Draw Isometric of Simple Object						x	
Draw Oblique of Simple Object						x	
Dimension Pictorial Drawings						x	
Draw Section Views							x
Make a Working Drawing							x
Clean & Care For Tools		x	x	x	x	x	x

GLOSSARY OF DRAFTING TERMS

1. Acute angle
2. Angle
3. Arc
4. Axis
5. Blueprint
6. Circumference
7. Chord
8. Concentric
9. Conical
10. Contour
11. Diagonal
12. Diameter
13. Eccentric
14. Equilateral
15. Floor Plan
16. Hexagon
17. Inclined
18. Inscribe
19. Obtuse angle
20. Octagon
21. Pentagon
22. Perimeter
23. Perpendicular
24. Plate
25. Radius
26. Rectangle
27. Right angle
28. Sketch
29. Square
30. Symbol
31. Template
32. Triangle
33. Truncate
24. Vertical

REFERENCE: Walker-Pleryak, Industrial Arts Drafting, Pp. 195-198

UNIT ONE

PENCIL GRADES AND HARDNESS

UNIT OBJECTIVE: To introduce to the student some information about drawing pencils in order that he may select and use them intelligently.

STUDY OUTLINE: Subject matter information the student should acquire concerning pencils with respect to brands, grades, uses, and care.

I. Commercial Brands

A. Venus

B. Dixon

C. Turquoise

II. Grades

A. 6B (very soft

B. 5B

C. 4B

D. 3B

E. 2B

F. HB

H. F

I. H (darken lines)

J. 2H (lettering)

K. 3H

L. 4H (use lay out work)

M. 5H (use dimensions)

N. 6H

O. 7H

P. 8H

Q. 9H (very hard)

III. Uses

A. Drawing

B. Sketching

C. Lettering

IV. Care

A. Sharpening

1. Conical
2. Wedge or chisel
3. Pencil pointer
4. Soft pencils smear easily
5. Do not remove number that denotes hardness

REFERENCE: Walker & Plevyak, Industrial Arts Drafting, Pp. 28-29

UNIT TWO

DRAFTING INSTRUMENTS

UNIT OBJECTIVE: To acquaint the student with some of the various drafting instruments.

STUDY OUTLINE: Subject matter information the student should acquire concerning the following drawing instrments with respect to:

I. Scales

A. Kinds

1. Architect
2. Civil engineer
3. Mechanical engineers

B. Material

1. Boxwood
2. Hardwood
3. Plastic
4. Wood and plastic

C. Divisions

1. Architect
   a. each division represents 1 foot
   b. one division into 12 parts
   c. each part being equal to one inch
2. Civil engineers
   a. 10, 20, 30, etc. feet to the inch
3. Mechanical engineers
   a. graduated 1/8 size (1 1/2 in. equals 1 ft.)
   b. 1/4 size (3 in. equals 1 ft.)
   c. 1/2 size (6 inch equals 1 foot)

II. T-Squares

A. Kinds

1. Built-in T-squares
2. Common T-squares

B. Materials of head

1. Walnut
2. Bakelite

C. Material of blade

1. Maple center
2. Transparent edges

D. Core and use

III. Triangles

A. Kinds

1. 45 degree
2. 30-60 degree

B. Materials

1. Transparent plastic

C. Size

1. Variety of sizes
2. Common 6 & 8 inch

IV. Compass

A. Use

1. Draw circle and arc
2. Can be converted to divider

B. Size

1. Common 6"

V. Protractor

A. Shape

1. Semi-circular
2. Circular

B. Material

1. Metal
2. Plastic

C. Use

1. Measure angles
2. Guide for drawing angles

VI. French or Irregular Curve

A. Material

1. Transparent plastic

B. Uses

1. Used to draw curved lines

C. Size

1. Few inches to several feet

VII. Cleaning Tools

A. Kinds cf erasers

1. Art gum
2. Rubber (Red Ruby)

B. Erasing shield

1. Material
   a. metal (german silver & stainless steel)
   b. plastic
2. Use
   a. possible to erase small mistakes without spoiling large portion

C. Dusting brush

1. Size
   a. usually 14" overall
   b. handle 6"
2. Use
   a. to remove rubber crumbs and loose dirt particles

REFERENCE: Walker & Plevyak, Industrial Arts Drafting, Pp. 26-29

UNIT THREE

ALPHABET OF LINES

UNIT OBJECTIVE: To help the student become acquainted with the language of lines.

STUDY OUTLINE: Subject matter information the student should acquire concerning lines with respect to:

I. Different Lines As To Use And Weight

A. Construction and Guide lines

1. Lay out drawing
2. Keep lettering uniform
3. Light lines

B. Border line

1. Draw in border and outline title block
2. Approximately 1/32" wide

C. Visible object

1. Indicate visible edges
2. Heavy weight but less than border

D. Hidden object

1. Used to indicate edges not visible from view
2. Series of dashes 1/8" with space 1/16" between each
3. Same weight as object line

E. Dimension line

1. Used to indicate dimension figure
2. Capped at each end with arrowheads
3. Placed between two extension lines
4. 1/4" to 1/2" from drawing
5. Broken in center to receive dimension figures
6. Light line heavier than construction and guide lines

E. Extension line

1. Used to extend the dimension beyond the outline of a view
2. Starts 1/16" beyond object and extends about 1/8" beyond dimension line
3. Same weight as dimension line

F. Extension line

1. Used to extend the dimension beyond the outline of a view
2. Starts 1/16" beyond object and extends about 1/8" beyond dimension line
3. Same weight as dimension line

G. Center line

1. Used to indicate center of symmetrical objects
2. Dark fine line composed of alternate long 3/4" & short 1/8" dashes with 1/16" spaces between

H. Cutting plane line

1. Used to denote where sectional view will be taken
2. Composed of a series of long (3/4 to 1 1/2) and short 1/8 with 1/16 space dashes
3. Is a heavy line

I. Section lines

1. Used when drawing inside features of an object
2. Indicates material cut by the cutting plane line
3. Fine dark lines

REFERENCE: Walker & Plevyak, Industrial Arts Drafting, Pp. 7-8; 30-31

UNIT FOUR

PAPER GRADES, SURFACES AND SIZES

UNIT OBJECTIVE: To provide information to the student that will enable him to be a wiser purchaser and consumer of paper.

STUDY OUTLINE: Subject matter information the student should acquire concerning drafting paper with respect to:

I. Detail Paper

A. Weight

B. Color

1. Buff
2. Pale green
3. White

C. Size

1. Sheets or roll
2. Sheet size designated by letters
   a. A. $8\frac{1}{4}$ x 11 in.
   b. B. 11 x 17 in.
   c. C. 17 x 22 in.
   d. D. 22 x 34 in.
   e. E. 28 x 40 in.
   f. F. 34 x 44 in.

II. Coordinate

A. Types

B. Size

C. Use

III. Tracing

A. Cloth

B. Paper

C. Size

D. Use

REFERENCE: Walker & Plevyak, Industrial Arts Drafting, Pp. 28

UNIT FIVE

SKETCHING

UNIT OBJECTIVE: To familiarize the student with the art of sketching, to instill upon him the value of a good sketch, why it is helpful and useful to both the beginner and the master craftsman.

STUDY OUTLINE: To learn the fundamentals of sketching and to practice sketching and develop techniques.

I. Sketching

A. Why do we sketch

1. To formulate an idea of the finished product
2. To have a rough draft so as to determine
   a. size
   b. proportion
3. To use as a plan for making a finished drawing
   a. product is too large to bring into drafting room
   b. drafting room too far from object

B. How do we sketch

1. Straight line
   a. series of short strokes
   b. sketch to a reference point
   c. sketch lightly then darken line
2. Circles
   a. sketch vertical, horizontal, and incline axis
   b. mark off units equal to the radius of circle on each axis
   c. sketch a construction line through the points
3. Other objects to be sketched
   a. square and rectangles
   b. angle
   c. arc
   d. ellipse
   e. hexagon
   f. octagon

C. What will a sketch show

1. What the object looks like
2. Size of product
3. All necessary information required to build the object

D. Instruments needed to sketch

1. Soft lead pencil
   a. No. 2 pencil
   b. HB

2. Steel rule or pocket tape
   a. to take dimension from object
3. Sketching pad or paper

REFERENCE: Walker & Plevyak, Industrial Arts Drafting, Pp. 7-24

UNIT SIX

LETTERING

UNIT OBJECTIVE: To acquaint the student with the art of lettering and to stress the value of lettering which is legible and accurate.

STUDY OUTLINE: To learn the fundamentals of lettering and to develop a technique and style of your own through practice.

I. Lettering

A. Why do we letter

1. Enhances the appearance of a drawing
2. Supplements the graphic description of the object which shows shape

B. Requirements for lettering

1. Legible
2. Neat
3. Accurate
4. Constant practice
5. Artistic appearance

C. Types of lettering

1. Single stroke gothic
2. Architectural lettering

D. Strokes

1. Vertical
2. Inclined

E. Guide lines

1. Drawn very very light
2. 4H or 6H pencil
3. Regulate height and size of letter

F. Spacing

1. Between words
   a. equal to height of letters
2. Between sentence
   a. equal twice height of letters

G. Height of lettering

1. Notes and Dimensions
   a. 1/8" high
   b. 1/8" between lines

2. Titles
   a. 3/16" - 1/4" high
3. Numerals
   a. same height as letters
   b. fractions twice the height of letters

H. Instruments

1. Pencils
2. Pencil sharpener
3. Lettering instruments or triangle
4. Erasing shield

II. Special Lettering Equipment

A. Special typewriters

B. Lettering set

1. Zephyr
2. Wrico

REFERENCE: Walker & Plevyak, Industrial Arts Drafting, Pp. 65-68

ERIC

UNIT SEVEN

MULTI-VIEW
(Orthographic)

UNIT OBJECTIVE: To acquaint the student with one type of drawing called multi-view, its techniques and fundamental skills involved. To show the student how to visualize the object and place it on paper in its correct prespective.

STUDY OUTLINE: To learn more about the different views, their relationship, and the placement of the views on paper.

I. Multi-View

A. The value of a multi-view drawing

1. To visualize the six sides of an object independently
2. More than one view is used to describe the plate

B. Directions of sight

1. Front
2. Top
3. Right end
4. Rear
5. Left end
6. Bottom

C. Size of object

1. Front view
   a. length
   b. height
2. End view
   a. height
   b. depth
3. Top view
   a. length
   b. depth

D. Centering your drawing on the paper

1. Observe dimension
   a. length
   b. depth
   c. height
2. Determine position of object
3. Allowance
   a. 1" between views
   b. 1" between object and border
4. Add the width of front view plus depth of end view plus 1" between view; subtract this total from the horizontal width of working surface. Divide this answer by two. This is the starting point for laying out the sheet horizontally.

5. Repeat above for vertical arrangement.
6. Glass projection box
   a. shows views in relationship to each other
   b. shows spacing between views

REFERENCE: Walker & Plevyak, Industrial Arts Drafting, Pp. 71-79

UNIT EIGHT

PICTORIAL DRAWINGS

UNIT OBJECTIVE: To familiarize the student with some of the methods of showing an object as it would appear to the eye.

STUDY OUTLINE: Subject matter information the student should acquire concerning pictorial drawings as to types and uses.

I. Types of Pictorial Drawings

A. Perspective

1. One point
2. Two point
3. Three point

B. Isometric

C. Oblique

1. Cavalier
2. Cabinet

II. Advantage of Isometric Drawings

A. Simple to make

B. Drawings are drawn about three base lines - 120 degree axis

C. Base line may be reversed if more information can be shown

III. Characteristics of Isometric

A. Three isometric axis or 120 degrees apart

B. May be shown looking down or up at object

C. May be shown looking at left or right end

D. Draw isometric axis first then draw lines that represent the other edges parallel to the isometric axis

E. Angles in isometric may appear larger or smaller

F. Isometric circles appear elliptical in shape

IV. Characteristic of Oblique

A. Angle of the depth axis may be any angle, but 30 degree, 45 degree, or 60 degree are usually used. Can be drawn with triangles

B. Front view appears in multi-view form and not distorted

C. Arcs and circles can be drawn with a compass if they face the front

D. Cavalier drawings depth axis is drawn full size

E. Depth axis on cabinet drawing is half size

V. Centering Pictoral Drawings

A. Isometric

1. $TH = \frac{W + D}{2} + H$

2. $TW = W + D \times .866$

3. $A = \frac{\text{Width of sheet} - TW}{2}$

4. $B = \frac{\text{Height of sheet} - TH}{2}$

5. To locate the starting X of the isometric drawing divide the depth by two and measure upward from O to locate point Y. from Y draw 30 degree line until it intersects the base line of the rectangle. The point of intersection is X.

B. Pictoral drawings centering

1. When the receding angle is 45 degree

a. $TH = \frac{H + D \times .866}{2}$

b. $TW = W + \frac{(D \times .707)}{2}$

REFERENCE: Walker & Plevyak, Industrial Arts Drafting, Pp. 97-106

UNIT NINE

DIMENSIONING

UNIT OBJECTIVE: To develop an understanding of the methods of dimensioning a drawing.

STUDY OUTLINE: Subject matter information the student should acquire concerning dimensioning of a drawing.

I. Methods of Dimensioning

A. Letter the dimensions so they are read from bottom or the right of the sheet

B. Dimension the drawing so that all the dimensions are read from the bottom of the sheet

1. Latter method gaining in popularity

II. Characteristics of Dimension Lines

A. Fine solid line used to indicate distance

B. Fine enough to contrast with the object line

C. Broken near center to allow for the insertion of the dimension

D. Line is capped with arrowheads

III. Characteristics of Extension Line

A. Light line extending out from drawing but does not touch drawing

B. Line extends 1/8" beyond the last dimension

IV. Placing of Dimension Lines

A. Smaller detail are nearest view

B. Overall dimension are farthest from view

C. Unless necessary dimensions should not be placed within the views

D. Keep dimensions between views

E. Do not repeat dimensions

F. Dimension lines placed at least 3/8" from visible line and 1/4" away from each other

G. Arrowheads $2\frac{1}{2}$ times as long as they are wide should cap the dimension line

H. All dimensions should be grouped rather than scattered about the drawing

V. Dimensioning of Arcs, Angles, and Circles

A. Arcs are dimensioned by giving the radius

B. Angles are dimensioned according to their size

C. Circle or holes are dimensioned by giving the diameter

D. Leaders are used most often when dimensioning arcs, radii, and circles

E. When all dimensions are in inches the inch symbol (") need not be used

F. Numerals and fractions must be drawn in proper relation to one another

REFERENCE: Wlaker & Plevyak, Industrial Arts Drafting, Pp. 81=85

UNIT TEN

DUPLICATING PROCESS

UNIT OBJECTIVE: To provide student experiences in the use of duplicating processes connected with the dry process of duplication. To provide experiences with the use of different tracing materials.

STUDY OUTLINE: The student will use the process of dry print and then make a pencil drawing on a tracing medium. Information can be obtained in the text and in most drafting books.

I. The Tracing Medium

A. Selecting medium

1. Cloth
   a. linen
   b. glass fiber
2. Tracing paper
3. Plastic sheet

B. Attaching paper

1. Back-up sheet
2. Fastening methods

II. Line Weights

A. Importance of

B. Alphabet of lines

C. Erasing

III. Light Sources

A. Natural

B. Artifical (Electric)

IV. Methods of Duplicating

A. Ozalid

1. Why used in this shop
2. Advantages
3. Disadvantages

B. Van Dyke Process

C. Moist print process

V. Dry Process

A. Adjusting Roto Lite Printer

B. Adjusting ammonia tube

C. Running print

D. Developing print

VI. Analysis

A. Necessity of duplicating

B. Storing

REFERENCE: Walker & Plevyak, Industrial Arts Drafting, Pp. 129-133

LIBRARY

NINTH
GRADE

ERIC

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UNDERSTANDING ELECTRICITY AND ELECTRONICS

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ELECTRICITY ELECTRONICS
Ninth Grade

Specific Objectives:

1. To provide opportunities for the student to do further exploration in electric circuits.

2. To provide basic information the student may use to better understand our communications systems.

3. To familiarize the student with some circuits that are used to distribute electricity within our homes.

4. To increase the opportunities for the student to become more expedient in measuring and solving electrical computations.

5. To provide manipulative techniques that will improve the student's skill in working with tools and materials involved in electrical circuity.

UNDERSTANDING ELECTRICITY AND ELECTRONICS

SPECIFIC SAFETY RULES

1. Do not open or close a main switch without permission from your instructor.

2. Report immediately any defective equipment such as worn cords or plugs.

3. Be sure your hands are dry before you handle electrical equipment.

4. Consider all electric wires "live" until they have been checked.

5. Replace fuses only after the current is turned off.

6. When skinning wire (removing insulation), but away from the body as if you were sharpening a pencil.

7. If in doubt about any connection, call your instructor for specific instructions and directions.

8. Do not operate any transmitting equipment without a proper license.

9. In case of electrical shock where breathing stops, artificial respiration must be started immediately. Send for a doctor as soon as possible. Be extremely careful when removing the victim from the high voltage that caused the shock.

ELECTRICITY ELECTRONICS

COURSE ANALYSIS

LEARNING TECHNIQUES	RELATED INFORMATION	SUGGESTED ACTIVITIES: D.C. Power Supply	Continuity Tester	D.C. or A.C. Motor	Lamp	Crystal Diode set	House Wiring	Electrical Math	Computations	Provide First-Aid			
Plan a Procedure	Insulation removing tools	x	x	x	x	x	x						
Read working drawings		x	x	x	x	x	x						
Make a bill of material		x	x	x	x	x	x						
Remove insulation	Purpose & kinds of	x	x	x	x	x	x						
Attach wires to binding posts	insulating materials	x	x	x	x	x	x						
Tie the rewriters knot		x			x								
Make splices	Purpose of NEC, UL, FCC		x				x						
Solder splices			x										
Tape splices	Kinds & sizes of wire						x						
Wind coils				x									
Make schematic diagrams	Purpose & use of	x	x	x		x							
Identify electrical symbols	symbols & schematics	x	x	x	x	x	x	x					
Test & replace fuses							x						
Install switch & boxes	Action of coils &						x						
Install duplex outlets	electro magnets						x						
Read watthour meter							x	x					
Compute monthly power bills	Care & use of meters							x					
Compute amount of current used by an appliance	Use of electron tubes							x					
Connect devices in series	& semiconductors		x	x		x							
Connect devices in parallel		x			x		x						
Measure volts, amps, & ohms	Purpose & types of fuses	x		x									
Compute volts, amps & ohms								x					
Compute power in watts								x					
Interpret radio symbols	How radio programs are							x					
Identify coded electronic parts	are broadcasted							x					
Solder diodes in circuits								x					
Solder transistors in circuits	Consumer's use &							x					
Layout metal	knowledge of T.V.	x		x	x								
Cut metal		x		x	x								
Form metal	Job qualifications	x		x	x								
Finish metal	& opportunities in	x		x	x								
Treat for shock	the field								x				
Treat for shock									x				
Treat for burns									x				

UNIT ONE

HISTORICAL LANDMARKS

UNIT OBJECTIVE: To familiarize the student with some of the historical developments and their implications on our technological society.

STUDY OUTLINE: Subject matter information the student should acquire concerning concerning discovery and inventions of electrical devices that have changed our lives.

I. The Beginning

A. Loadstones (Lodestones)

1. 634 B.C. Thales
2. 62 A.D. (Pleny)

B. How electricity got its name

1. William Gilbert
2. Elektron

C. Positive and negative charges

D. First electric current

1. Alessandro Volta

E. Electromagnetism

1. Field of force
2. Andre Marie Ampere
   a. ampere
3. Electromagnetic induction
   a. Michael Faraday (induced currents)
   b. Joseph Henry (self-induction)

F. George Simon Ohm

1.

G. Atomic theory

1. John Dalton

H. Samuel Morse

1. Telegraph

I. Thomas Alva Edison

1. First central-light power plant

J. Electron theory

1. Niels Bohr
   a. Atom
      (1) nucleus
      (2) electron flow

K. Radio

a. Hertzian wave (Hertz)
b. Transmitter (Marconi)
c. Vacuum tube (Fleming)
d. Triode (Lee De Forest)

L. Television

a. Patent (V.K.Zworykin)

M. Transistors

a. Pickard and Benedicks
b. Brattain

REFERENCES: Bubon & Schmitt, Understanding Electricity and Electronics, Pp. 6-12

UNIT TWO

HOW ELECTRONS FLOW

UNIT OBJECTIVE: To add to the student's knowledge electrical and electronic terms and principles.

STUDY OUTLINE: Basic units, such as voltage, current, and resistance are defined and discussed. What are electrons? What makes them flow? How do they flow? Materials they flow through easily. Materials that oppose their flow.

I. Electrical Current

A. Movement of electrons from one atom to another

B. Energy

1. Ability to do work
2. Ampere
   a. milliampere

C. Direct Current (DC)

1. Electrons flow in one direction only
2. Battery

D. Alternating current (AC)

1. Electrons change directions at regular intervals
2. Generator
3. Frequency
4. Sine wave

E. Electromotive force

1. Opposite charged objects
2. Electrical pressure
3. Electromotive force or voltage
4. Polarity
5. Volts

II. Electron Theory

A. Atom

1. Electron
2. Proton
3. Nucleus
4. Charges
   a. positive (+)
   b. negative (-)
5. Neutral
6. Charged

III. Conductors and Insulators

A. Conductors

1. Silver
2. Copper
3. Aluminum
4. Other conductors

B. Insulators

1. Rubber
2. Porcelain
3. Glass
4. Other conductors

REFERENCES: Bubon & Schmitt, Understanding Electricity and Electronics. Pp. 115-131

UNIT THREE

MATERIALS, TOOLS, AND PROCESSES

UNIT OBJECTIVE: To acquaint the student with some of the various tools, materials, and processes used in the electric and electronic field.

STUDY OUTLINE: Subject matter information the student should know concerning electrical tools and materials with respect to:

I. Tools Used In Electricity

A. Hammers

1. Claw hammer
2. Ball peen hammer

B. Screwdriver

1. Electrician 6" - 8"
2. Stubby

C. Pliers

1. Needle nose
2. Side cutting
3. Diagonal
4. Insulated
5. Wire strippers

D. Soldering tools

1. Copper
3. Electrical gun
3. Electrical iron

E. Sloyd knife

II. Materials Used In Electricity

A. Soldering material

1. Solder
   a. bar
   b. wire
      (1) core
      (2) solid
2. Cleaning
   a. wire brush
   b. sal-ammonia block

B. Insulating material

1. Enamel
2. Cotton braid
3. Rubber
4. Plastic
5. Polyethylene
6. Neophrene
7. Asbestoes

C. Tape

1. Rubber
2. Friction
3. Plastic

III. Conductors

A. Wire

1. Designation of size
   a. american wire gage
   b b. circular mil
2. Kind
   a.
   b. magnet
   c. non-metallic sheath cable
   d. armored cable
   e. coaxial cable
3. Unit of measure
   a. pound
   b. foot
4. Type
   a. stranded
   b. solid

B. Material

1. Silver
2. Copper
3. Aluminum
4. Iron

IV. Splices

A. Western Union

B. Tap

C. Pigtail

V. Electronic Parts

A. Resistors

1. Fixed
2. Variable

B. Capacitors

1. Fixed
2. Variable

C. Diodes

D. Crystals

E. Transistors

1. PNP
2. NPN

F. Chokes

1. RF
2. Choke

REFERENCE: Bubon & Schmitt, Understanding Electricity and Electronics, Pp. 42 & 114

UNIT FOUR

ELECTRICAL TEST AND MEASUREMENT

UNIT OBJECTIVE: To improve the student's knowledge and proficiency in various tests and measurements in electricity.

STUDY OUTLINE: Subject matter information the student should know concerning continuity tests, locating shorts and make various voltage, current, resistance tests and computing electric bills.

I. Formulas

A. Ohms Law

1. Shows mathematical relationship between volts, amps, & ohms

2. $\frac{E}{I \times R}$

B. Watts Law

1. Shows relationship between energy and voltage and current

2. $\frac{P}{I \times E}$

C. Kilowatthours

1. Kwhr = $\frac{\text{wattage of appliance X No. of hours used}}{1{,}000}$

2. Shows number of kilowatthours of power used by an electrical appliance during any period of time

II. Measuring Devices

A. Kinds

1. Ammeter
2. Volt meter
3. Galvanometer
4. Ohmmeter
5. Multimeter (VOM)
6. Vacuum tube voltmeter

B. Connecting meter into circuit

1. Series
2. Parallel

C. Safety precautions

1. Hook each meter into a circuit the correct way
2. Have power turned off when connecting meters
3. Power must be off when checking resistance

D. Common test

1. Visual inspection
   a. loose connections
   b. broken
2. Continuity test
   a. ohm meter
   b. electrical connection between
   c. open circuit
   d. short circuit
3. Voltage test
4. Wattmeter
5. Watthour meter
   a. 4 dial type
   b. direct-reading cydometer type
   c. computing an electrical bill

E. Other testing instruments

a. Tube tester
   1. test for gas
   2. test for weak tube
   3. filament voltage

E. Oscilloscope

1. Wave form

C. Signal generator

1. Produce alternating currents & voltage
2. Produce certain frequency

D. Signal tracer

REFERENCE: Bubon & Schmitt, Understanding Electricity & Electronics, Pp. 237-259

UNIT FIVE

HOUSE WIRING SYSTEM

UNIT OBJECTIVE: To bring to the student's attention the kind of circuits used in his home. To show some of the jobs that are performed by electricians.

STUDY OUTLINE: Information and manipulative techniques the student should gain with respect to distribution of electricity, circuits involved, symptoms of inadequate wiring and fuse safety rules.

I. National Electrical Code

A. Purpose

II. Service Drop

A. Three wire service

1. Why?
2. How?

III. Service Entrance

A. Watthour meter

B. Load center

C. Circuit breakers

IV. Branch circuits

A. General - Purpose

1. Use
2. Wire size
3. Fuse size

B. Appliance circuits

1. Use
2. Wire size
3. Fuse size

C. Individual circuits

1. Uses
2. Wire size
3. Fuse size

D. Branch circuit wire

1. Nonmetallic sheathed cable
2. Armored cable
3. Electrical metallic tubing

E. Wiring devices

1. Switch boxes
   a. purpose
   b. kind
2. Junction boxes
   a. purpose
   b. other uses
3. Box connectors
   a. where used
   b. why used
4. Wire connectors
   a. purpose
   b. advantages

V. Appliance Grounding

A. How done

B. Why done

VI. Symptoms of Inadequate Wiring

A. Undesirable conditions

1. Wastes electricity
2. Creates fire hazard
3. Improper operation of appliances

B. Noticeable symptoms

1. Fuses flow often
2. Heating appliances do not heat quickly
3. Lights dim when appliances are used
4. Television picture shrinks when appliances are used
5. Motors start with difficulty
6. Motors overheat

VII. Fuse Safety Rules

A. Proper size and kind

B. Things to do before replacing

C. How to replace

D. Care in replacing

REFERENCE: Bubon & Schmitt, Understanding Electricity and Electronics, Pp. 260-271

UNIT SIX

COMMUNICATION SYSTEMS

UNIT OBJECTIVE: To make the student aware how man solved the problem of rapid communication between distant points.

STUDY OUTLINE: Subject matter the student should acquire with respect to telegraph, telephone, radio, television, and other message relaying devices.

I. Telegraph

A. Types

1. Open-circuit system
   a. Current passes while measage is sent
   b. Used in Europe
2. Closed circuit system
   a. Circuit closed until key is opened
   b. Used in United States
3. Telegraph parts (simple)
   a. Key
   b. Receiver
   c. Line
   d. Battery
4. Morse code
   a. Inventor
   b. Method (short or long pulses of electric current)
      (1) dot 1/4 sec.
      (2) dash 3/4 sec.

II. Sending The Telegram

A. Teletypwriter

B. Facsimile machine

C. Automatic switching centers

D. Radio relay towers

1. Purpose of above machines
2. Where used

III. The Telephone

A. Inventor

B. Sound waves

C. Parts

1. Early telephone
    a. cone
    b. iron strip
    c. coil
    d. membrane
    d. air gap
2. Carbon transmitter
    a. metal diaphrogm (transmitter)
    b. carbon granulars (powder)
    c. cup
    d. battery
    e. permanent magnet
    f. metal diaphragm (receiver)
    g. electromagnet

D. Dial system

1. Dial
2. Exchange

E. Types of service

1. Local service
2. Toll service
3. Long-distance service

F. Recent improvements

1. Electron tubes
2. Transistors

IV. Transmitting By Radio

A. Transmitter

1. Energy source
2. High-frequency oscillator (vibrator)
    a. coil
    b. capacitor
3. Electromagnetic waves (carrier)
4. Wave length
5. Frequency transmitting
    a. 10,000 cycles per second
    b. 186,000 miles per second
    c. broadcast band
        (1) assigned by F.C.C.
        (2) range 550,000-1,600,000
6. Frequency abbreviations
    a. metric system
        (1) Kilo (1,000)
        (2) mega (1,000,000)
        (3) milli (1/1,000)
        (4) micro 1/1,000,000)

B. Modulation

1. Process of molding electron stream for speech or music
   a. amplitude moxulation (a-m)
   b. frequency modulation (f-m)
2. Microphone
   a. device used to change sound waves into varying direct current

V. Receiving By Radio

A. Antenna

1. Purposes
2. Types

B. Headset

1. Purpose
2. How it works

C. Detector

1. Purpose
2. How it works

D. Ground

1. Purpose

E. Tuner

1. Purpose
2. Parts
   a. coil
   b. capacitor

VI. Television

A. History

1. Early discovery (Selenium)
2. Patent (1928) V.K. Zworykin

B. Camera (orthicon tube)

1. Image section
2. Scanning beam
3. Return beam
4. Scanning section

C. Receiver

1. Antenna
   a. types
   b. purpose
2. R.F. Amplifier
   a. purpose
   b. switching system
3. Local oscillator and mixer
   a. purpose
4. Picture and sound separator
5. Sound section
   a. intermediate frequency amplifier
   b. discriminator
   c. audio amplifier
6. Picture section
   a. intermediate frequency amplifier
   b. frequency amplifier
   c. video detector
   d. video amplifier
7. Synchronism and sweep section
   a. horizontal hold
   b. vertical hold
8. High voltage system
9. Picture tube
   a. how it works
   b. electron gun
   c. deflection plates
   d. chemical screen

VII. Consumer's Uses and Knowledge of Television

A. Purchasing information

1. Brand name
2. Size of screen
3. Black and white or color
4. Where set is to be used
5. Controls conveniently located
6. Size of speaker
7. Boosting power
8. Special features such as portable, console, all channel

B. Use

1. Proper antenna
2. Locating set
3. Tuning controls
4. Eliminating interference

REFERENCE: Bubon & Schmitt, Understanding Electricity and Electronics
Pp. 303-358

UNIT SEVEN

SOURCES OF ELECTRICITY

UNIT OBJECTIVE: To acquaint the student with the basic sources of electricity and the basic principles of their operations.

STUDY OUTLINE: The student have an opportunity to read about, participate in discussions, observe demonstrations, and experiment with several of the common sources of electricity.

I. Battery

A. Historical development

B. Principle of electrical production

C. Primary cell

1. Wet type (1 cell)
   a. uses
   b. voltage
2. Dry type
   a. ingredients
   b. principle of operation
   c. function of manganese dioxide
   d. voltage
   e. amperage
   f. shelf life
   g. battery pack
   h. series parallel hook up

D. Mercury cells

1. Uses
2. Voltage sizes

E. Secondary cells

1. Uses
2. Ingredients (lead-acid)
3. Current-delivering capacity
4. The battery charger
   a. reverse polarity
   b. principle
5. The hydrometer
   a. principle
   b. specific gravity
6. Preventive maintainence

II. The Generator

A. Electromagnetic induction

B. Voltage value

1. Magnetic lines of force
2. Speed of armature
3. Number of wires

C. Alternating-current generator

1. Armature
2. Slip ring

D. Direct current generator

1. Commutator
2. Connection
3. Uses
4. Magnetic field (magneto type)
5. Magnetic field (field windings)
Excitation current
7. Armature

F. Generator

1. Frequency
   a. single phase
   b. three phase
2. Industrial uses

III. Photo Electric Cell

A. Photo tube principle

B. Uses

IV. Solar Cell

A. Selenium

B. Uses

V. Thermocouple

A. Principle

B. Use

VI. Piezo Electricity

A. Function of crystal

B. Uses (record player)

V. Bio-Electricity

A. Theory of operation (eels - brain waves)

B. Uses

REFERENCE: Bubon & Schmitt, Understanding Electricity and Electronics, Pp. 207-236

UNIT EIGHT

OCCUPATIONS IN ELECTRICITY AND ELECTRONICS

UNIT OBJECTIVE: To acquaint the student with the various occupations and opportunities available to them in the electrical and electronics field.

STUDY OUTLINE: Information the student should gain with respect to job offering and training of production and non-production workers in electrical and electronic industires.

I. Types Of Workers

A. Production workers

1. Assembly
2. Machining
3. Fabricating
4. Processing
5. Inspection
6. Materials - handling
7. Clerical
8. Maintenance
9. Custodial

B. Non-production workers

1. Professional
2. Technical
3. Supervisory
4. Research and development
5. Accounting
6. Administrative and office work

II. Electrical Occupations

A. Engineering

1. Qualifications
   a. mathematics
   b. chemistry
   c. physics
2. Work
   a. design and develop equipment

B. Construction electricians

1. Qualifications
   a. on the job training (apprenticeship)
   b. night school run by union
2. Work
   a. layout
   b. assemble
   c. install
   d. connect
   e. test

C. Maintenance electricians

1. Inspect
2. Trouble shoot
3. Repair
4. Maintain
   a. electric wiring
   b. machinery
   c. motors
   d. generators
5. Location of work
   a. commercial building
   b. residential building
   c. government operated establishments

D. Electric light and power industry

1. Transmission and distribution equipment
   a. construct
   b. install
   c. maintain
2. Customer-servicing

E. Power plant jobs

F. Electrical household appliance service men

1. Repair
2. Install
3. Rebuild appliances

III. Telephone Industry

A. Central office workers

B. Installers and repairmen

C. Linemen and cable splicers

IV. Electronic Occupations

A. Radio and television repairmen

1. Installing
2. Troubleshooting
3. Testing
4. Adjusting
5. Repairing

B. Broadcasting jobs

1. Electronic technicians
   a. set up
   b. operate
   c. maintain

2. Qualifications
   a. first class radio-telephone license from (FCC)

C. Electronic equipment manufacturing job

1. Assembly line workers
   a. skilled
   b. unskilled
2. Set up
3. Maintain
4. Operate

D. Research jobs

E. Military occupations

V. Training

A. School

1. High school
2. College - BS, MS, PhD
3. Technical school

B. On the job training

1. 4-6 years apprentice
2. 4-6 years supervisor

C. Military service training

VI. Monetary Value

A. On the job training

1. Years experience
   a. good
   b. adequate

B. School

1. Higher degree
   a. excellent

REFERENCE: Bubon & Schmitt, Understanding Electricity and Electronics, Pp. 380-388

ELECTRICITY

SEVENTH & EIGHTH

GRADE

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SPECIFIC OBJECTIVES OF ELECTRICITY

Seventh and Eighth Grade

1. To stress safety and safe working procedures as related to the field of electricity.

2. To provide information regarding the theory of electricity and how it functions.

3. To develop some familiarity with the common tools and materials used in electrical work.

4. To provide opportunities for the student to do exploration in simple electric circuits.

5. To familiarize the student with the language of electricity and some jobs done by electricians.

6. To stimulate the student to desire further experiences in the field of electricity.

ELECTRICITY

COURSE ANALYSIS

LEARNING TECHNIQUES	RELATED INFORMATION	SUGGESTED ACTIVITIES: Simple Circuit	Series Circuit	Parallel Circuit	Stairway Circuit	Return Call System	Check E,I,R,&W	Compute E,I,R,&W	Project With	Solenoid or	Electromagnet
Follow a Plan of Procedure	What is the Nature	x	x	x	x	x	x		x		
Remove insulation	of Matter	x	x	x	x	x			x		
Uncoil Wire		x	x	x	x	x			x		
Wind a Coil	The Electron Theory								x		
Attach Wire to Binding Post		x	x	x	x	x			x		
Connect Batteries for Power	How electric currents						x				
Connect Devices in Series	Flow Through a Wire		x								
Connect Devices in Parallel	or Conductors			x							
Plan & Draw Wiring Diagnosis	Kinds of Conductors	x	x	x	x	x			x		
Read Electrical Symbols	Kind of Insulators	x	x	x	x				x		
Check Voltage	How Electricity is						x				
Check Amperage	Produced						x				
Check Resistance	What is Power						x				
Make Tap Splice	Relationship Between								x		
Make Western Union	Ohm & Watts Law								x		
Make rat-tail splice	Laws of Series Circuits								x		
Solder Splices	Laws of Parallel Circuits								x		
Tape Splices	Magnets and Uses								x		
Compute Voltage	Construction & Use of							x			
Compute Amperage	Batteries							x			
Compute Resistance	Operation of Generator							x			
Recognize Electrical Hazards		x	x	x	x	x			x		
Connect Electrical Hazards	Operation of Electric	x	x	x	x	x			x		
Replace a Blown Fuse	Motor								x		

UNIT ONE

SAFETY RULES

All the rules of general safety used in other school shops apply equally to the electrical shop. Some of the more important ones will be repeated.

I. Dress Safely

A. Shirt tails tucked inside trousers

B. Sleeves buttoned at wrist or rolled above elbow

C. Wear safety glasses at all times

D. Soft sole shoes are a hazard in many parts of the shop

II. Don't Try To Be A Clown

A. Think before you act

B. Do not talk to or attract the attention of a buddy when he is operating a machine

C. Report an injury at once, no matter how slight

III. Keep The Shop Clean

A. Return tools and materials to proper location after use

B. Keep floor around your work area clean and free of litter

IV. Special Rules For Electricity

A. Electricity has no respect for ignorance.
Do not turn on any device until it has been checked by the instructor

B. Do not work around electrical equipment if floors are damp or wet

C. Do not work on electrical circuits with the power on

D. Be sure equipment is in proper working order before use.
Frayed cords and plugs are a major source of accidents

E. Ask for instruction before using test equipment. One wrong connection can destroy an expensive piece of equipment

F. Be humble. Electricity is such a tremendous field, you will do well to understand only small divisions of it. Ask questions and remember:

"Fools Rush In Where Angels Fear To Tread"

REFERENCES: Gerrish, Howard H., Electricity

UNIT TWO

THEORIES OF ELECTRICITY

UNIT OBJECTIVE: To provide information regarding electricity and how it functions.

STUDY OUTLINE: Subject matter the student should acquire concerning tne nature of matter electron theory, and how electric current flows through a conductor.

I. What is the Nature of Matter

A. Occupies space

B. Has weight

1. Molecule
2. Atoms
   a. nucleus
   b. protron
   c. neutron
   d. electrons

C. Classification of element

1. Atomic number
2. Atomic weight

II. Kinds of Conductors and Insulators

A. Conductors

1. Silver
2. Copper
3. Aluminum
4. Brass

B. Insulators

1. Glass
2. Porcelain
3. Rubber
4. Bakelite

C. Semi-conductors

1. Air
2. Germanium
3. Selenium
4. Silicon

III. Law of Charges

A. Like charges repel

B. Unlike charges attract

IV. Electrical Terms

A. Volt "E"

1. Potential difference
2. Electromotive force
3. Electrical pressure

B. Ampere "I"

1. Quanity of electron flow
2. Coulomb

C. Ohms

1. Resistance to electron flow
2. Resistance of a conductor
   a. length
   b. size
   c. size of material
   d. heat

V. Early Contribution to Electricity

A. Alessandro Volta

B. Andre Marie Ampere

C. George Simon Ohm

REFERENCE: Gerrish, Howard H., Electricity, Pp. 4-13

UNIT THREE

LANGUAGE OF ELECTRICITY

UNIT OBJECTIVE: To develop an understanding of the electrical symbols used in the graphic representation of electrical circuits and the terminology used by the technical men in the field of electricity.

STUDY OUTLINE: Subject matter information the student should know concerning when, how, where, and why electrical symbols are used.

I. Symbols: The symbols used in the electrical diagram fall into several catagories and are quite numerous; for that reason only those symbols which could be used and applied in a basic electricity course should be considered.

A. Signaling devices

1. Bell
2. Buzzer
3. Chime

B. Power devices

1. Battery
2. Generator
3. Transformer
4. Thermocouple
5. Pizoelectric device
6. Solar cell

C. Connections

1. Cross-over
2. Connection
3. Terminal
4. Tap

D. Electrical Properties

1. Voltage
2. Amperage
3. Resistance
4. Watts
5. Impedance

E. Measuring devices

1. Ohmmeter
2. Voltmeter
3. Ammeter
4. Multi-meter

F. Electrical devices

1. Resistors
2. Motors
3. Light outlets
4. Duplex outlets

G. Switching devices

1. Single pole switch
2. Double pole switch
3. Three-way switch
4. Double pole double throw switch

II. Terminology

A. The following is a list of electrical terminology commonly used in a basic electricity course. The instructor using this guide should add those terms not mentioned but which are pertinent to the course he is teaching.

1. Voltage
2. Amperage
3. Resistance
4. Wattage
5. Electric current
6. Electro motive force
7. Electrons
8. Protons
9. Neutrons
10. Atom
11. Conductors
12. Insulators
13. Semi-conductors
14. Impedance
15. Capacatance (capacitor)
16. Eddy currents
17. Electromagnet
18. Motors
19. Armature
20. Poles
21. Terminals
22. Commutator
23. Multi-meter
24. Ammeter
25. Volt meter
26. Flux
27. Transformer
28. Parallel circuits
29. Series circuits
30. Primary cell
31. Secondary cell
32. Horsepower
33. Specific gravity
34. Ionization
35. Shunt
36. Ohm's Law
37. Selenium
38. Solernoid
39. Sine wave
40. Circular-mil
41. Potential difference
42. Relay
43. Static electricity
44. Dynamo
45. Thermocouple
46. Pizeoelectric
47. Voltage drop

B. These and other electrical terms should be used while discussing electricity in class, while working on electrical projects, and in as many situations as possible so that the student attaches them to his vocabulary and can better understand what he reads and talk more specifically about electrical processes.

REFERENCES: Gerrish, Howard H., Electricity

UNIT FOUR

MAGNETISM

UNIT OBJECTIVE: To show how an electric current can produce magnetism and some common applications of an electromagnet.

STUDY OUTLINE: Subject matter information the student should acquire concerning magnetism, its sourse, function, behavior and uses.

I. What is Magnetism

A. Origin

B. Function

C. Lodestones

D. Poles

1. North
2. South
   a. magnetic field
   b. flux

E. Material

1. High carbon steel
2. Special alloys
   a. conductivity
   b. reluctance

F. Law of Magnetism

1. Like poles repel
2. Unlike poles attract

II. Applications of Magnetism

A. Solenoid

1. Left-hand rule
2. Magnet field was produced around a conductor when a current was flowing

B. Electromagnet

1. Iron core inserted in a solenoid
2. Residual

C. Relays

1. Magnetic switch
2. Protestive device

D. Solenoid Sucking Coil

E. Magnetism By Induction

F. Magnetic Shielding

REFERENCE: Gerrish, Howard H., Electricity, Pp. 42-47

UNIT FIVE

TOOLS AND MATERIALS

UNIT OBJECTIVE: To acquaint the student with the various tools and instruments used in electrical work and to give him practical experiences with the tools.

STUDY OUTLINE: To acquire information and experiences with the various tools and their uses. To learn about new techniques and read about new discoveries in the electrical field.

I. Tools Used By Electricians

A. Pliers

1. Needle nose
2. Side cutting
3. Diagonal
4. Wire stripping
5. Insulated

B. Hammers

1. Ball peen
2. claw

C. Steel rule

D. Try square

E. Screw driver

1. Electrician 6" - 8"
2. Stub

F. Soldering

1. Equipment
   a. copper
   b. electrical iron
   c. electrical gun
2. Material
   a. rosin core solder
      (1) wire
      (2) bar
   b. flux
      (1) rosin
      (2) solder paste

G. Tape

1. Rubber
2. Friction
3. Plastic

II. Wire

A. Determining Size

1. American Standard Wire Gage
2. Diameter (circular mil)

B. Types

1. Magnet
2. Coaxial cable
3. Ground wire
4. High voltage wire
5. Shielded wire
6. Non-metallic sheath cable
7. Armored cable
8. Nichrome wire

C. Insulating material

1. Enamel
2. Cotton braid
3. Plastic
4. Rubber
5. Polyethylene
6. Neophrene

REFERENCE: Supply House Catalog

UNIT SIX

SOURCES OF ELECTRICITY

UNIT OBJECTIVE: To provide information to the student the various methods used to produce electricity.

STUDY OUTLINE: Information the student should know concerning sources and production of electric power.

I. Sources of Power

A. Cells and Batteries

1. Dry cell (Primary)
   a. size
   b. description
   c. plates
   d. electrolyte
   e. uses
2. How power is produced within cells
   a. defects of dry cell
      (1) local action
      (2) polarization
   b. cannot be recharged

B. Storage battery (secondary cell)

1. Negative and positive plates
   a. size
   b. description
2. Electrolyte used
   a. H_2SO_4
      (1) hydrometer
      (2) specific gravity
3. How battery can be charged
4. Kind of current produced

C. Generator

1. Function
   a. [illegible] mechanical energy to electrical energy
2. Parts
   a. field windings
   b. armature
   c. commutator or slip rings
   d. brushes
3. Types of generators as to excitation
   a. independently
   b. shunt
   c. series
   d. compound

4. Power sources for generators
   a. water
   b. steam
   c. atomic

II. Other Sources of Electricity

A. Friction

1. Static charges

B. Heat

1. Thermocouple

C. Light

1. Photo electric cell
2. Selenium

D. Pressure

1. Crystals

REFERENCE: Gerrish, Howard H., Electricity, Pp. 32-39; 59-65

UNIT SEVEN

ELECTRICAL CIRCUITS AND CONTROLS

UNIT OBJECTIVE: To demonstrate to the student the following properties and characteristics of series and parallel circuits.

STUDY OUTLINE: Subject matter information the student should gain concerning the parts of an electric circuit. How electrical devices are connected in series and parallel.

I. Circuits

A. Parts

1. Source of power
2. Paths (conductors)
3. Load (anything that uses current)
4. Control (switches)

II. Series Circuit

A. How devices are connected in series

B. Laws of series circuit

1. Total resistance is equal to the sum of all the resistors
2. Current must be same at any point in the circuit
3. Sum of the voltage drop is equal to the applied voltage

III. Parallel Circuit

A. How devices are connected in parallel

B. Laws of parallel circuits

1. The voltage across all branches of a parallel circuit is the same
2. The total current is equal to the sum of all the currents flowing in the branches

IV. Controls

A. Types of control

1. Switches
   a. single pole single throw (SPST)
   b. Double pole double throw (DPDT)
   c. 3-way switches
   d. rotary

2. Safety devices
   a. fuses
      (1) plug
      (2) cartudge
      (3) dual element
      (4) circuit breaker

REFERENCE: Gerrish, Howard H., Electricity, Pp. 21-31; 40-42

UNIT EIGHT

MEASUREMENT AND COMPUTATION

UNIT OBJECTIVE: To show the mathematical relationship between volts, amps, ohms, and watts.

STUDY OUTLINE: To learn how to measure and figure electrical computations.

I. Ohms Law

A. $\frac{E}{I \times R}$

1. E = Volts
2. I = Current (amps)
3. R = Resistance (ohms)

B. George Simon Ohm

II. Watts Law

A. $\frac{P}{I \times E}$

1. P = Power (watts)
2. I = Current (amps)
3. E = Volts

III. Horsepower

A. James Watt

B. 33,000 foot pounds per minute

C. 746 watts of electrical power

IV. Meters

A. Volt meter

B. Ammeter

C. Ohmmeter

D. Multimeter

E. Watt-hours

F. Meter Movements

1. D'Arsonval meter
   a. fixed permanent magnet
   b. moving coil
2. Iron-Vane meter
   a. fixed and movable iron vane
   b. suspended within a solenoid coil

G. Meter shunts

V. Meter Connections

A. Series

B. Parallel

VI. Meter Precautions

A. Do not drop it or treat it roughly

B. Observe polarity when connecting a meter
   "negative to negative" --- "positive to positive"

C. When making unknown measurements always start with the highest range on the meter

D. Do not attempt to measure resistance in a circuit, if the circuit is "alive" with the power turned on

E. Be sure all switches are correctly set for range and type of measurement to be made

REFERENCE: Gerrish, Howard H., Electricity, Pp. 14-20; 54-57

CURRICULUM MATERIALS

NINTH

GRADE

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NINTH GRADE

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NINTH GRADE METAL

SPECIFIC OBJECTIVES OF METAL

1. To increase the student's knowledge and techniques in casting metal.

2. To further skills and techniques developed in sheet metal work.

3. To develop an understanding of some of the jobs performed in a machine shop.

4. To develop basic techniques of a welder and an increased understanding of the duties and skill requirements of the welder.

INDUSTRIAL ARTS SAFETY RULES

General Metals Area

You will get more out of shop activities if you avoid accidents. It is smart to be careful, for an accident can change your life.

1. Remember that the shop is a place for work, not horse play.
2. Dress safely. No loose clothing.
3. Protect your eyes. Wear goggles.
4. Take proper care of hand tools.
5. Use all tools correctly.
6. Observe safety rules when running machines.
7. Be a good housekeeper.
8. Ask for first-aid every time you need it.

To have an accident-free shop --- Remember the A.B.C.'s of Safety

A L W A Y S B E C A R E F U L

SHEET METAL
COURSE ANALYSIS

LEARNING TECHNIQUES	RELATED INFORMATION	SUGGESTED ACTIVI	Flower Planter	Dust Pan	Hose Holder	Exercises			
Follow a Plan of Procedure	Guidance Pertaining		x	x	x	x			
Read a Working Drawing	To Metal Occupations		x	x	x				
Make A Bill of Material			x	x	x				
Make A Layout	Metal Working Hobbies		x	x	x				
Cut Metal With Snips			x	x					
Cut Metal With Shears	Transportation Methods		x	x	x				
Drill and Punch Holes	of Iron Ore			x	x				
Ream Holes					x				
File Metal	Space Age Metals		x	x	x				
Fold a Hem			x	x					
Bend & Form With Hand Seamer	Future Courses in		x	x					
Bend & Form With Brake	Sheet Metal At H.S.		x	x	x				
Form on Forming Rolls				x		x			
Form Metal With Diacro	Electroalisis				x				
Form a Bead With Rotary Machine				x					
Tin a Soldering Copper	Characteristics of Metal		x			x			
Solder Common Metals			x			x			
Fasten With Rivets	Use of Forming Machines			x		x			
Clean & Polish Metal	In Industry		x	x	x	x			
Apply A Finish			x	x	x				
Clean & Care For Brushes	Care and Maintenance		x	x	x				
Cut Metal With Hacksaw	of Tools				x				

WELDING
COURSE ANALYSIS

LEARNING TECHNIQUES	RELATED INFORMATION	SUGGESTED ACTIVITIES: Edge Weld W/o Rod	Butt Weld	Lap Weld	Fillet Weld	Brazed Joint	Cutting Exercise	Project		
Turn on Oxygen Tank		x	x	x	x	x	x	x		
Turn on Acetylene Tank	How Acetylene is Made	x	x	x	x	x	x	x		
Set Oxygen Regulator		x	x	x	x	x	x	x		
Set Acetylene Regulator	Fluxes	x	x	x	x	x	x	x		
Light Welding Torch		x	x	x	x	x	x	x		
Adjust for Neutral Flame		x	x	x	x		x	x		
Run a Bead Without Rod Distortion From Heat		x						x		
Clean Metal		x	x	x	x	x	x	x		
Make an Edge Weld With A Rod		x						x		
Make A Butt Weld With A Rod			x	x	x			x		
Make A Fillet Weld	Industrial Employment				x			x		
Adjust Torch For Brazing						x		x		
Select Brazing Rod	Test Metal Strength					x				
Braze A Joint	Selection of Brazing Rod					x		x		
Clean Welds		x	x	x	x	x	x	x		
Clean Tips	Other Types of Welding	x	x	x	x	x	x	x		
Light and Adjust Cutting Torch							x			
Cut Scrap Metal	Film: Oxy-Acetylene "Master of Metal"						x			

MACHINE METAL
COURSE ANALYSIS

LEARNING TECHNIQUES	RELATED INFORMATION	SUGGESTED ACTIVITIES: Bushing Remover	Center Punch	Candle Holder	Key Holder	Pen Base
Follow A Plan Of Procedure	Popular Brand Name	x	x	x	x	x
Read A Working Drawing Of Metal Working Tools		x	x	x	x	x
Make A Layout On Metal and Machines		x	x	x	x	x
Locate and Center Drill		x	x	x	x	
Cut Stock With Power Hack Saw	Guidance Pertaining To Metal Occupations	x	x	x	x	x
Mount Stock Between Centers		x	x	x	x	
Face Metal		x	x	x	x	
Turn Metal Straight	Metal Working Hobbies	x	x	x	x	
Turn A Taper			x	x		
Grind A Facing Tool	Future Courses in Machine Shop At High School	x	x	x	x	
Grind A Cutting Tool		x	x	x	x	
Run A Knurl		x			x	
Adjust For Speed	Care & Maintenance of Machines	x	x	x	x	x
Adjust For Feed		x	x	x	x	x
Measure With Calipers		x	x	x	x	x
Read A Micrometer	Lubricants Used With Milling Machine	x				
Mount Stock In Mill Set For Depth of Cut						x
Make Slab Cut	Function of Mill in Industry					x
Mill A Chamfer						x
Anneal Steel	Film "The Lathe"		x			
Harden and Temper Steel			x			
Case Harden Mild Steel		x				
Mount Stock In Chucks			x	x		
Drill Holes				x	x	x
Tap Holes					x	

MACHINE METAL (Con't.)
COURSE ANALYSIS

LEARNING TECHNIQUES	RELATED INFORMATION	SUGGESTED ACTIVIEIES	Bushing Remover	Center Punch	Cancle Holder	Key Holder	Pen Base
Thread A Rod						x	
Check Threads With Gauge						x	
Check Tool Bits With Center Gauge			x	x	x	x	
Use Depth Gauge					x		x
File Metal On Lathe			x	x	x	x	
Polish Metal			x	x	x	x	x
Buff Metal			x	x	x	x	x
Apply A Finish			x	x	x	x	x
Clean and Care of Machines			x	x	x	x	x

FOUNDRY
COURSE ANALYSIS

LEARNING TECHNIQUES	RELATED INFORMATION	SUGGESTED ACTIVITIES		
		Flat Pattern	Split Pattern	
Prepare Molding Sand		X	X	
Select a Pattern	Types of Patterns	X	X	
Ram a Mold		X	X	
Draw a Pattern	Types of Foundry Sand	X	X	
Touch Up Mold		X	X	
Melt Metal		X	X	
Pour a Mold		X	X	
Shake Out Mold			X	
Clean Casting	Casting Metals	X	X	
Remove Gates, Sprue, & Riser		X	X	
Finish Casting		X	X	
Buff & Polish	Influence of Foundry on	X	X	
Apply Desired Finish	American History	X	X	
	Molding With Loose Pattern			

UNIT ONE

PROPERTIES, CHARACTERISTICS, AND USES OF METAL

UNIT OBJECTIVE: To provide a better than average understanding of the General Metals area through study, research, and actual participation with the various metals.

STUDY OUTLINE: To acquaint the student with the facilities used by industry to acquire information on the various aspects of General Metals.

I. Raw Materials

A. Coal

B. Iron Ore

C. Limestone

II. Alloys

A. Silicon

B. Nickel

C. Chromium

D. Manganese

E. Tungsten

F. Molybdenum

G. Vanadiun

III. Smelting Iron and Steel

A. Blast Furnace

B. Electric Furnace

C. Open-hearth Furnace

D. Bessmer Converter

E. Basic Oxygen Furnace

IV. Forming Steel

A. Sizing Mills

1. Blooms
2. Slabs
3. Billets

B. Roll Mills

1. Hot Rolled
2. Cold Rolled

C. Drop Forgeing

D. Continuous Casting Process

V. Shapes of Steel

A. Construction Shapes

1. I Beams
2. H Iron
3. Z Iron

B. Standard Shapes

1. Rods
2. Bars
3. Flats
4. Sheets
5. Hexagon
6. Octagon
7. Wire
8. Pipe
9. Angle Iron
10. Channel

VI. Identification of Steel

A. Color Code

B. Number System

C. Manufacture Handbook

D. Spark Test

VII. Non-Ferrous Metal

A. Kinds

1. Copper
2. Aluminum
3. Copper Alloy
   a. brass
   b. bronze

B. Refining Non-Ferrous Metal

1. Smelting
2. Electroylsis

REFERENCE: Ferrier, John L., General Metals, Second Edition
Pp. 29-37

Filmstrip: Chemistry of Iron - U.S. Steel
Chemistry of Steel - U.S. Steel
Steel in America - U.S. Steel

UNIT TWO

TOOLS AND THEIR USES

UNIT OBJECTIVE: To review and reinforce the student's knowledge and skill in the use of hand tools, techniques, and fundamentals.

STUDY OUTLINE: To give the student more information and to further his ability in the use of hand tools.

I. Layout Tools

A. Rules

1. Steel Rules 6" - 12" - 24"
2. Circumference Rule
3. Steel Tapes 6' - 8' - 10'
4. Machinist Rules 6" - 12"

B. Square

1. Try Square
2. Machinist Square
3. Combination Square
   a. centering head
   b. protractor head
   c. squaring head
   d. blade
   e. level

E. Punches

1. Prick
2. Center
3. Bell Center Punch

D. Marking Tools

1. Layout Dye
2. Scratch Awl
3. Scriber

II. Hammers

A. Ball Peen

B. Cross Peen

C. Straight Peen

D. Sledge

E. Mallet

F. Setting

III. Cutting Tools

A. Snips

1. Tin
2. Avaition
   a. left-hand
   b. right hand
   c. straight
3. Chisels
   a. flat
   b. cope
   c. round
   d. diamond
4. Hacksaws
   a. power
   b. hand
      (1) adjustable
      (2) solid
5. Files
   a. classified according to degree of coarseness
   b. geometrical shape

IV. Precision Measuring Instruments

A. Micrometer

1. Inside
2. Outside

B. Depth Gauge

C. Dial Indicator

D. Calipers

1. Inside
2. Outside
3. Dividers

B. Sheet Steel Gauge

1. U.S. Standard
2. Brown and Sharpe or American

V. Holding Instruments

A. Parallel Clamps

B. C-Clamps

C. V-Block

REFERENCES: Feirer, John L., General Metals, Second Edition, McGraw-Hill Book Company,

L.S. Starrett Company, How To Read A Micrometer

UNIT THREE

PATTERN DEVELOPMENT AND LAYOUT WORK

UNIT OBJECTIVE: To present to the student the various ways, methods, and techniques in layout work.

STUDY OUTLINE: To guide the student in selecting information suitable to his interest in respect to.

I. Kinds of Sheet Metal Development

A. Parallel Line or Cylinderical

1. Bands
2. Tubes
3. Pipes
4. Scoops

B. Straight Line or Angular

1. Boxes
2. Containers
3. Trays

C. Radial Line or Cone

1. Funnels
2. Tapered sided objects

D. Triangulation or Transition

1. Objects which are round on one end and square on the other

II. Tools Required

A. Steel Rule

B. Scriber

C. Layout Dye

D. Try Square

E. Combination Square

F. Prick Punch

G. Center Punch

H. Hammer

III. Template or Pattern

A. Metal

B. Cardboard

IV. Machine Layout

A. Tools Required

1. Layout dye
2. Scriber
3. Machinist steel rule
4. Machinist square
5. Combination square
6. Dial indicator
7. Surface plate
8. Surface gauge
9. Calipers
   a. inside
   b. outside
   c. hemaphedits

B. Layout Position

1. Work mounted in machine
2. Work on surface plate

V. Foundry Layout

A. Material

1. Wood
2. Metal
3. Plaster mold

B. Manufacture of Pattern

1. Allow for shrink of metal
   a. alunimun 1/8" per foot
   b. bronze
2. Allow for machining of metal

VI. Welding Layout

A. Allow for Decrease in Metal When Bending

1. 1/2 thickness of metal on 90 degree bend
2. 1/4 thickness of metal on 45 degree bend

B. Notch Cones for Inside Bend

C. Allow for Weld Build-up on Metal

REFERENCE: Feirer, John L., General Metal, Second Edition

UNIT FOUR

FOUNDRY SAFETY RULES

1. Wear proper safety glasses when pouring hot metal.
2. Always place flask in pouring pit before pouring metal.
3. Never overload crucible when changing metal.
4. Light gas first then turn on air.
5. Turn off gas first then turn off air.
6. Allow cast sufficient time for cooling before shaking out.
7. Never look directly into a furnace.
8. Dress safely when working in the foundry area.
9. Observe and practice all Safety Rules.

To Have An Accident Free Shop - Remember The A B C's of Safety:

A L W A Y S B E C A R E F U L

FOUNDRY

UNIT OBJECTIVE: To present to the student information on foundry skills and techniques. To allow the student an opportunity to work in the foundry area by making a casting.

STUDY OUTLINE: To give the student additional information to improve his technique and fundamental skills.

I. Introduction Into Foundry

A. Casting

1. Green sand
2. Permanent molding
3. Precision investment casting
4. Shell molding
5. Die casting

B. Metals Used in Casting

1. Ferrous metal
   a. grey iron
   b. steel
   c. malleable iron
2. Nonferrous metal
   a. copper alloys
   b. aluminum
   c. magnesium
   d. lead
   e. zinc

C. Foundry Occupations

1. Quality control of metal
   a. metallurgist
   b. engineers
2. Pattern makers
   a. skilled metal worker
   b. skilled wood worker
3. Molders
4. Core makers
5. Melter
6. Pourer
7. Finisher
   a. chipper
   b. grinder
   c. finisher

D. Types of Foundries

1. Jobbing foundry
2. Production foundry
3. Captive foundry

II. Making A Casting Project

A. Pattern Making

1. Material

a. mahogony
b. white pine
c. styrofoam

2. Lagged up
a. allow extra material for shrinkage
b. shrink rule

3. Draft

4. Fillets
a. wax
b. leather
c. wood

B. Kinds of Patterns

1. Simple or one piece patterns
2. Split patterns
3. Match plate patterns

C. Molding Sand

1. Synthetic
2. Natural

D. Condition of Sand

1. Permeability
2. Moisture content

E. Parting Compound

IV. Foundry Equipment

A. Flask

B. Molding Board

C. Bottom Board

D. Bench Rammer

E. Sprue Pin

F. Riser Pin

G. Riddle

H. Slick and oval

I. Spoon and Gate Cutter

J. Crucible

K. Furnace

L. Safety Devices

M. Lifting Tongs

IV. Foundry Metals

A. Every Metal That Can Be Melted

B. Types of Metal

1. Lead
2. Antimony
3. Aluminum
4. Copper alloys

C. Elimination of Gas

1. Flux
2. De Gasser Pills

V. Finishing A Casting

A. Cut-off Gates, Sprues, Rises

B. File Off Parting Line

C. Finish

1. Wire brush
2. Paint
3. Enamel
4. Machine

REFERENCE: Feirer, John L. General Metals, Pp. 234-248
Second Edition, McGraw-Hill Book Company

UNIT FIVE

WELDING SAFETY RULES

1. Always wear the correct glasses when welding or observing welding.
2. Dress safely.
3. The welding area is a serious work station: Do Not Play Around.
4. Be sure all hose connections are tight.
5. Use recommended pressure on regulators and hoses.
6. Keep all equipment in good repair and clean.
7. Keep welding area free from waste material and inflammable material.
8. Be sure welder is shut off and all hoses bled before leaving classroom.
9. Always use a spark lighter when lighting the torch.
10. Always return the torch to proper place when not in use.

WELDING

UNIT OBJECTIVE: To instill within the student self-confidence and to be an oxy-acetylene welder with respect to its capabilities.

STUDY OUTLINE: To give and acquaint the student with information relative to the oxy-acetylene welder.

I. Nomenclative of the Welder

A. Fuels

1. Oxygen
2. Acetylene
3. Propane
4. Natural Gas

B. Hoses

1. Red
   a. acetylene
   b. propane
   c. natural gas
2. Green
   a. oxygen

C. Torches

1. Blow pipes
2. Cutting torch

D. Welding Glasses

E. Spark Lighter

F. Regulators

1. Oxygen
2. Acetylene
3. Propane
4. Natural gas

G. Gloves

H. Wrenches

I. Welding Tip Cleaners

II. Types of Flame

A. Carburizing

B. Oxidizing

C. Neutral

III. Types of Welds

A. Butt

B. Lap

C. Edge

D. Fillet

E. Flange Butt

IV. Welding Positions

A. Flat

B. Horizontal

C. Vertical

D. Overhead

V. Welding Rod

A. Mild Steel

B. Bronze

C. Cast Iron

VI. Flux

A. Brazing

B. Borax

REFERENCE: Feirer, John L., General Metals, Second Edition,
Oxy-acetylene Welder Handbook, Smith Welding Company
Welding Charts - Victor Welding Company

UNIT SIX

MACHINE SAFETY RULES

1. Stop machine before it is oiled, lubricated, or adjusted.
2. Never feel the surface of metal while it is being machined.
3. Clean chips off with a brush, never with a rag or your hand.
4. Never allow anyone to stand near the machine you are using.
5. Never use measuring tools on metal while it is being machined.
6. Always have metal clamped securely in a vise or clamped to the table before machining.
7. Wear safety glasses when grinding, buffing, drilling, turning, and milling.
8. Wipe up any oil or grease on the floor.
9. Do not leave tools on machine tables and/or beds.
10. Do not attempt to change fuel or direction of lathe when machine is running.

MACHINING METALS

UNIT OBJECTIVE: To develop in the student an understanding of the most common way of producing metal parts to specific size.

STUDY OUTLINE: Subject matter information the student should acquire concerning basic machining operations and the machines used for each.

I. Drilling Machines

A. Drill Press

1. Bench
2. Floor
3. Portable electric
4. Hand drills
5. Radial-drill

B. Twist Drills

1. Parts
2. Sharpening
   a. lip clearence
   b. cutting angle
3. Designation of size
   a. fraction
   b. letter
   c. number
4. Drill shanks
   a. straight
   b. taper
   c. square
   d. blacksmith
5. Drill chucks
   a. Jacobs
   b. More Taper
6. Identification of drill sizes
   a. drill gage
   b. drill index
   c. stamped on shank
7. Material drills are made of
   a. carbon steel
   b. high speed steel

II. Turning Machines

A. Turret Lathes

B. Screw Machines

C. Engine Lathe

1. Purpose
2. Size

3. Parts
   a. bed
   b. head stock assembly
   c. tail stock assembly
   d. carriage
   e. feeding and threading mechanism
4. Tool holders
   a. straight holder
   b. left-hand holder
   c. right-hand holder
   d. knurling
   e. cutoff
   f. boring
   g. threading
5. Tool bits
   a. left and right facing
   b. left and right cut roughing
   c. left and right cut finishing
   d. round nose
6. Tool angle
   a. side-relief (side clearence)
   b. end relief (front)
   c. back rake
   d. top rake
7. Turning between centers
   a. preparation for mounting
   b. mounting
   c. selecting speed
   d. selecting feed
8. Machining work in a chuck
   a. chucks
      (1) three-jaw universal
      (2) four-jaw independent
      (3) Collett chuck
   b. mounting
      (1) normal
      (2) reverse
      (3) internal
9. Suggested operations
   a. facing
   b. drilling
   c. parting
   d. knurling
   e. straight turning
   f. taper turning
      (1) tail stock set over
      (2) compound rest
10. Filing and polishing
   a. mill-file
   b. long-angle lathe file
   c. abrasive cloth and oil
   d. filing procedures
      (1) right-hand (more natural)
      (2) left-hand (safer)

III. Milling Machine

A. Horizontal

B. Vertical

1. Purpose
2. Parts
3. Controls
4. Cutters and holders
5. Cutting speeds and feeds

C. Conventional Milling

D. Climb (hook) Milling

REFERENCE: Feirer, John L., General Metals, Pp. 268-274; 277-298; 305-312

UNIT SEVEN

HEAT TREATING METAL

UNIT OBJECTIVE: To make the student aware of heat treating operations that will improve the quality and usefulness of machined parts and tools.

STUDY OUTLINE: Subject matter the student should know to make tools more useful.

There are three steps in heat treating:

1. Heating to the correct temperature.

2. Holding or soaking at this temperature for a certain length o f of time.

3. Cooling in a way that will produce the desired results.

I. Annealing

A. Purpose

1. To soften
2. Relieve stress

II. Normalizing

A. Purpose

1. To put steel in a normal condition

III. Hardening

A. Purpose

1. Increase hardness
2. Increase tensil strength
3. Reduce ductility
4. Obtain fine-grain structure

B. Technique

1. Heat to critical temperature, check with magnet, Pyrometer, or by observing color 1400degrees-1600 degrees F.
2. Cool quickly
   a. tempering oil
   b. water
   c. brine (salt water)

IV. Tempering

A. Purpose

1. Remove brittleness

2. Increase toughness
3. Regulate degree of hardness

B. Technique

1. Reheat to proper color
2. Cool quickly (correct medium)

V. Casehardening

A. Purpose

1. Hardening outer surface, leave core soft

B. Methods Used in Industry

1. Cyaniding
2. Carburizing
   a. pack method
   b. gas method
   c. liquid-salt method

VI. Testing Hardness

A. Methods Used

1. New file press
2. Brinell
3. Rockwell
4. Shore Scleroscope

REFERENCES: Feirer, John L., General Metals, Pp. 225-230.

UNIT EIGHT

CUTTING THREADS

UNIT OBJECTIVE: To familarize the students with the kinds and uses of threads and how they are produced.

STUDY OUTLINE: Subject matter the student should know concerning use, kinds, and hand tools used to produce desired threads.

I. Threads As To Use

A. To Assemble Parts

B. To Transmit Motion

C. To Make Adjustments

II. Forms of Threads

A. American National

1. National coarse
2. National fine
3. Unified system
4. Acme
5. American pipe thread

B. Screw Thread Terms

1. Internal thread
2. External thread
3. Major diameter (O.D.)
4. Minor diameter (Root dia.)
5. Pitch diameter
6. Crest
7. Root
8. Depth
9. Axis
10. Thread angle
11. Pitch
12. Lead

III. Measuring Numbers of Threads Per Inch

A. Rule

B. Screw-Pitch Gage

IV. Cutting Threads

A. Tools Required

1. Taps
   a. taper
   b. plug
   c. bottoming

2. Dies
   a. round, adjustable split die
   b. solid square die
3. Tap wrenches
   a. T-tap wrench
   b. bar tap wrench
4. Diestock
5. Machinist vise
6. Pipe vise

REFERENCE: Feirer, John L., General Metals, Pp. 110-117

UNIT NINE

METAL FASTNERS

UNIT OBJECTIVE: (1) To develop an awareness of ways and means of fastening metal with metal fastners and of the characteristics of these fastners.

(2) To provide those experiences through projects and exercises which will give the student basic skills in the application of metal fastners.

I. Rivets

A. Kinds of and Purchasing Units

B. Metal Preparation for Receiving Rivet

C. Tools Necessary

D. Procedure for Setting

E. Removal of Rivets

F. Evaluation of Results

II. Sheet Metal Screws

A. Consumer Knowledge

1. Head types
2. Correct screw kind for job
3. Root-diameters
4. Self-tapping ability

B. Metal Preparation

C. Tools for Job

D. Evaluation of Procedure

III. Bolts

A. Types

1. Machine
2. Carriage
3. Stove
4. Stud

B. Thread Types

1. Standards (NC, SAE, NF)
2. Tolorances of fit

C. Nut Types

1. Cap nut
2. Jam nut
3. Wing nut
4. Hexagon
5. Square
6. Acorn

IV. Washers

A. Common

B. Lock

V. Tools

A. Open-end Wrench

B. Box-end Wrench

C. Cresent Wrench

D. Socket Tools

E. Spanner Wrench

F. Impact Tools

VI. Installation

A. Metal Preparation

B. Speed Methods Where Many Bolts Involved

C. Pressure Requirement of Tightening

REFERENCE: Feirer, John L., GENERAL METALS, Second Edition, Pp. 117-120, 162-164

UNIT TEN

METAL FINISH

UNIT OBJECTIVE: To show the student the various methods and ways to finish different types and kinds of metal. To relate to industry our methods of finish and their value.

STUDY OUTLINE: To provide information regarding finishing supplies and procedures.

I. Reason For Finishing Metal

A. Decoration

B. Prevent Oxidation

II. Types of Finish

A. Transparent

1. Lacquer
2. Varnish
3. Spot finish
4. Blueing
5. Wax

B. Opaque

1. Enamel
2. Colored lacquer
3. Oil finish
4. Suede-Tex
5. Oil finish

C. Types of Decorative Finish

1. Spot finish
2. Liver of sulpher
3. Suede-tex
4. Oil finish
5. Peen finish
6. Hammered finish
7. Antiqueing
8. Wire brush

III. Brushes

A. Bristles

1. Natural
2. Synethetic

B. Vulcanized in Rubber

C. Cleaning Brushes

1. Lacquer thinner
2. Turpentine
3. Kerosene
4. Paint remover
   a. warm water
   b. soap

D. Applying Paint

1. Apply from dry to wet area
2. Apply from center to edge
3. Avoid runs
4. Drying time
   a. ten minutes
      (1) lacquer
      (2) wax
   b. twenty-four hours
      (1) enamel
      (2) varnish
      (3) other finishes
   c. manufacturers recommended time
5. Apply finish in well ventelated room

IV. Storing Finishes and Material

A. Flammable Material

1. Paints
2. Lacquers

B. Cleaning Solvents

1. Lacquer thinner
2. Turpentine
3. Kerosene

C. Decorative Material

D. Have All Materials and Supplies Labeled

REFERENCE: Feirer, John, L., General Metals, Pp. 102-104, 123.

GENERAL METALS

Seventh & Eighth Grade

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Seventh and Eighth Grade

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SPECIFIC OBJECTIVES OF METAL

1. To increase the student's knowledge of the importance of metal in our industrial society.

2. To develop in each student a proper attitude toward the care and upkeep of tools and equipment.

3. To acquaint the student with the various fundamental processes involved in fabrication of metal products.

4. To develop habits of health and safety as they apply to metal working industry.

INDUSTRIAL ARTS SAFETY RULES

General Metals Area

You will get more out of shop activities if you avoid accidents. It is smart to be careful, for an accident can change your life.

1. Remember that the shop is a place for work, not horse play.
2. Dress safely. No loose clothing.
3. Protect your eyes. Wear goggles.
4. Take proper care of hand tools.
5. Use all tools correctly.
6. Observe safety rules when running machines.
7. Be a good housekeeper.
8. Ask for first-aid every time you need it.

To have an accident-free shop --- Remember the A.B.C.'s of Safety

A L W A Y S B E C A R E F U L

Seventh and Eighth Grade

GENERAL METALS

COURSE ANALYSIS

LEARNING TECHNIQUES	RELATED INFORMATION	SUGGESTED ACTIVITIES: Pencil Tray	Letter Holder	Metal Box	Soldering Exercise	Rivet Exercise	Flower Stand	Forging-punch, chisel	Casting-1 pg. pattern	Hose Holder		
Follow a Plan of Procedure	Safety in the school shop	x	x	x			x		x	x		
Read a Working Drawing	Processes of mining and manufacturing of ferrous metals	x	x	x			x			x		
Make a Bill of Material		x	x	x			x		x	x		
Make a Simple Layout	Selecting & Purchasing solder	x	x	x			x			x		
Punch & Drill Holes	Kinds & sizes of rivets			x		x	x			x		
Cut Metal With Snips	Selecting Metal Fasteners	x	x	x	x	x	x			x		
Cut Metal With Sq. Shears		x	x	x	x	x	x			x		
File Metal	Purchasing & storing finishes	x	x	x			x			x		
Fold a Hem	Necessity of Preventing Oxidation & Corrosion			x								
Bend & Form With Stokes	Types of Abrasives Used on Metal									x		
Bend & Form With Brake	Consumer's Knowledge of Files	x	x	x			x					
Form a Bead Rotary Machine	Space Age Metals									x		
Tin & Soldering Copper	Metal Alloys & Modern Uses				x							
Solder Common Metals	The Effects of Carbon Content of Steel				x							
Rivet Metal Together	Mining & Smelting Copper			x		x				x		
Apply a Finish	Mining Bauxite & Processing Aluminum	x	x	x			x	x	x	x		
Form With Diacro	Processing of Foundry Sand						x					
Spot Weld Metal	Relationship of Pattern-making to Foundry Work			x								
Polish & Buff Metal	Lubricants &							x	x			
Cut Metal With Hacksaw	Standard Threads of Taps and Dies							x		x		
Light & Operate Forge	Occupational Characteristics							x				
Draw Out Metal								x				
Anneal Steel								x				
Harden Metal								x				
Temper Metal								x				
Caseharden Mild Steel								x				
Decorate Metal		x	x	x			x			x		
Cut Threads								x				
Tap Holes												
Prepare Molding Sand									x			
Ram a Mold									x			
Finishing a Casting									x			
Working From a Template		x	x	x			x			x		

UNIT ONE

PROPERTIES, CHARACTERISTICS AND USES OF METAL

UNIT OBJECTIVE: To acquaint the student with the properties and characteristics of the more common metals.

STUDY OUTLINE: Subject matter information the student should acquire concerning the different properties and characteristics of metal.

I. Types of Metal

A. Ferrous Metal

1. Steel
   a. hot rolled
   b. cold rolled
      (1) galvanized
      (2) tinplate

B. Non-ferrous Metal

1. Aluminum
2. Copper
3. Zinc
4. Brass
5. Bronze

C. Properties

1. Hardness
2. Mallability
3. Elasticity
4. Ductility
5. Fatigue resistance
6. Corrosive resistance

D. Characteristics

1. Color
2. Carbon content
3. Standard shapes

REFERENCES: Metalworking, Boyd, T. Gardner, Pp. 9-11
Film - Steel In America - Walt Disney
Filmstrip - Raw Material Used in Steel Making - U.S. Steel

UNIT TWO

LAYOUT AND MEASURING TOOLS

UNIT OBJECTIVE: To bring to the student's attention the necessity of accurate work, and the tool techniques of the sheet metal industry.

STUDY OUTLINE: Subject matter information the student should acquire concerning measuring and layout tools.

I. Measuring Tools

A. Rules

1. Steel rule - 24"
2. Steel tape - 6' & 12'
3. Circumference - 3'
4. Thickness Gauge - U.S. Standard; Brown & Sharpe

B. Squares

1. Combination Square
   a. square head - 45° & 90°
   b. protractor
   c. center head
   d. blade - 12"
2. Try square

C. Marking Tools

1. Scriber
2. Scratch awl
3. Dividers

D. Punches

1. Center punch
2. Prick punch

II. Sheet Metal Development

A. Parallel Line

B. Radial Line

REFERENCE: Boyd, Gardner, Metalworking, Pp. 14-19, Pp. 48-49

UNIT THREE

METAL CUTTING TOOLS

UNIT OBJECTIVE: To increase the student's knowledge and skill in safe and efficient use of cutting instruments.

STUDY OUTLINE: Subject matter information the student should acquire concerning cutting and shearing tools.

I. Tin Snips

A. Straight

B. Curved

C. Avaition

1. Left-handed
2. Right-hand
3. Straight

II. Cold Chisels

A. Flat

B. Cape

C. Diamond

D. Round

III. Shears

A. Bench Lever

B. Throatless Bench Lever Shear

C. Squaring Shear

IV. Hacksaw

A. Power

1. Continuous blade
2. Reciprocating

B. Hand

1. Frame
   a. solid
   b. adjustable
   c. deep set

2. Blade
   a. flexible
   b. all-hard
3. Set
   a. raker
   b. double alternate
   c. wave
   d. alternate

V. Files

A. Kind

1. Geometrical classes
   a. quadrangular
   b. circular
   c. triangular

B. Length

C. Cuts

1. Single
2. Double
3. Rasp
4. Curved tooth

D. Coarseness

1. Bastard
2. Second cut
3. Smooth

E. Methods of Filing

1. Straight
2. Draw file

REFERENCE: Boyd, Gardner, Metalworking, Pp. 19-26, 48-49

UNIT FOUR

DRILLING AND PUNCHING METAL

UNIT OBJECTIVE: To acquaint the student with some of the tools and machines used to make holes in metal.

STUDY OUTLINE: Subject matter information the student should acquire concerning tools and machines used for drilling and punching metal.

I. Drills

A. Power

1. Bench model
2. Floor model
3. Changing speeds of the drill
4. Operational procedure
5. Portable electric

B. Self Power Drills

1. Breast drill
2. Hand drill

C. Twist Drills

1. Parts
2. Sharpening of a drill
   a. lip clearance
   b. cutting angle
   c. ways to check a sharpened drill
3. Designation of drill size
   a. fraction
   b. letter
   c. number
4. Drill shank
   a. straight
   b. taper
   c. square
5. Drill chuck
   a. Jacobs Key
   b. Morse Taper
6. Identification of drill sizes
   a. drill gage
   b. drill index
   c. stamped on shank
7. Material drills are made of
   a. carbon steel
   b. high speed steel

II. Punches

A. Hand Mechanical Punch

B. Solid

C. Hollow

REFERENCE: Boyd, Gardner T., Metalworking, Pp. 26-31

UNIT FIVE

BENDING AND FORMING METAL

UNIT OBJECTIVE: To present to the student the various methods and ways metal can be shaped either by hand or by machine.

STUDY OUTLINE: The student should acquire knowledge concerning the shaping of metals, the tools, techniques and processes involved both at home and in industry.

I. Bending Machine

A. Pan Brake

B. Bar Folder

C. Forming Rolls

D. Rotary Machine

E. Diacro Bending Machine

II. Bending By Hand

A. Sheet Metal Stake

1. Conductor
2. Blowhorn
3. Hatchet
4. Beakhorn
5. Candle mold
6. Common square

B. Hand Groover

C. Hand Seamers

D. Auxillary Tools

1. Rawhide mallet
2. Setting hammers
3. C-clamps
4. Wood blocks or jigs
5. Adjustable wrench

III. Bending Operations

A. Hems

1. Single
2. Double
3. Wired edge

B. Seams

1. Double
2. Grooved lock seam
   a. inside
   b. outside
3. Lap
4. Butt

C. Scrolls

D. Twisting

REFERENCE: Boyd, Gardner T., Metalworking, Pp. 50-58

UNIT SIX

METAL FASTENERS

UNIT OBJECTIVE: To familiarize the student with the various fastening materials, tools, techniques, and fundamentals that are involved.

STUDY OUTLINE: Subject matter information on the fastening of various metals, tools, and techniques involved.

I. Cold Metal Fasteners

A. Rivets

1. Kinds
   a. solid
   b. tinner
   c. pop-rivet
2. Heads
   a. flat
   b. round
3. Ways rivet sizes are determined
   a. ferrous rivets
      (1) weight per 1000
   b. non-ferrous
      (1) length
      (2) diameter
4. Setting rivets
   a. rivet tools
      (1) riveting hammer
      (2) rivet set

How To Determine The Correct Length of a Rivet

II. Screws

A. Machine

1. Heads
   a. flat
   b. round
2. Designation of sizes

B. Sheet Metal (self-tapping)

1. Points
   a. sharp
   b. blunt
2. Heads
   a. slotted
   b. phillips

C. Drill Size For Tapping

III. Soldering

A. Tools

1. Copper
2. Electric soldering iron
3. Electric soldering gun
4. Propane torch

B. Kinds As To Shape

1. Bar
2. Wire solid
3. Acid or resin core wire

C. Kind As To Composition

1. Tin
2. Lead

D. Fluxes

1. Types
2. Uses

E. Process

1. Metal must be clean
2. Hot enough to melt solder
3. Preventing oxides and controlling solder flow

F. Soldering Techniques

1. Soldering a seam or joint
2. Sweat soldering a joint

IV. Resistance Welding (Spot Welding)

A. Amperage Setting

B. Thickness of Metal

C. Kinds of Metal

REFERENCES: Boyd, Gardner T., Metalworking, Pp. 58-62

UNIT SEVEN

FORGING AND CASTING

UNIT OBJECTIVE: To provide learning experiences in which the student will learn basic reactions of metal when it is heated and shaped or heated and poured.

STUDY OUTLINE: Subject matter pertinent to this unit (text and references) experimentation through exercises with heated metal.

I. Forging Tools

A. Johnson Furnace and/or Forge

B. Anvil

1. Hardy
2. Swage
3. Fuller

C. Hammer

1. Ball peen
2. Cross peen
3. Sledge

D. Forging Tongs (Kinds)

II. Forging Process

A. Heat to Critical Temperature

1. (Mild steel) bright cherry red
2. Do not heat metal too hot (sparks appear)
3. Do not hammer on metal when it starts to turn black (causes cracking)
4. Heat metal as few times as possible

B. Learn Forging Techniques and Safety Suggestions Before Attempting to Forge Metal

III. Forging Jobs

A. Upsetting Metal

B. Drawing Out

C. Bending

D. Forming An Eye

IV. Foundry

A. Tools

1. Flask
   a. cope
   b. drag
2. Sprue cutter
3. Slick and spoon
4. Molding sand
5. Parting compound
6. Rammer
7. Riddle
8. Speedy melt furnace
9. Crucible
   a. bottom pour
   b. top pour
10. Molding board
11. Tongs
12. Molder's bulb
13. Molder's bench
14. Shovel
15. Patterns
16. Pyrometer

B. Types of Casting

1. Green sand casting
2. Permanent molds
3. Investment casting
4. Die casting
5. Shell molding

C. Casting Process

1. Patterns
   a. materials made of
      (1) white pine
      (2) styro foam
   b. relief
   c. types
      (1) solid
      (2) split
2. Cores
3. Molding sand
   a. moisture content
   b. permability

REFERENCES: Boyd, Gardner T., Metalworking, Pp. 63-67, 73-79

UNIT EIGHT

METAL FINISHING

UNIT OBJECTIVE: To make the student aware of the various methods of finishing metal, and to enable him to see by self-application the results of properly finished metal.

STUDY OUTLINE: To allow the student to have a deeper understanding of metal finishes, techniques, and application.

I. Types of Finish

A. Transparent

1. Clear lacquer
2. Varnish
3. Spot finish
4. Wax

B. Opaque

1. Colored lacquer
2. Enamel
3. Suede-tex
4. Blued finish
5. Wrinkle

C. Decorative

1. Peened
2. Hammered
3. Wrinkle
4. Suede-tex
5. Marble tone

II. Preparation of Surface

A. Cleaning Metal

1. Pickleing
2. Steel wool
3. Emery cloth
4. Warm water

B. Preventing Oxidation

1. Buffing
   a. jeweler rouge
   b. emery paste
   c. tripoli
2. Washing
   a. soap
   b. warm water

3. Handling metal
   a. hold with cloth
   b. do not touch with fingers

III. Finishing Metal

A. Applying Finish

1. Brush
   a. center to edge
   b. dry to wet area
2. Spraying
   a. pressure can
   b. air gun
      (1) keep nozzle about 8-10" away from project
      (2) use arm action not wrist
3. Suede-tex
   a. box to collect excess
   b. base finish
      (1) enamel
         (a) color of suede tex
         (b) white
      (2) white glue

IV. Brushes

A. Bristles

1. Natural
2. Synethetic
3. Cleaning
   a. lacquer thinner
   b. turpentine
   c. kerosene

V. Safety Practices

A. Well Ventelated Room

1. Exhaust fan
2. Open windows

B. Work Away From Open Flame

C. Avoid Inhaling Fumes

D. Clean Brushes in Solvent Used to Thin Finish

E. Clean Up Any Paint That Spilled On Table Or Floor

G. Have All Cans Properly Labeled

REFERENCE: Boyd, Gardner T., Metalworking, Pp. 37-39

UNIT NINE

HEAT TREATMENT OF METAL

UNIT OBJECTIVE: To make the student aware of the variety of heating and cooling operations by which the characteristics of metal are changed.

STUDY OUTLINE: Subject matter the student should know to make a tool useful.

I. Annealing

A. Purpose

1. To soften
2. Relieve stress

B. Technique

1. Heat to critical temperature (cherry red) and cool slowly.

II. Hardening

A. Purpose

1. Increase hardness
2. Increase tensil strength
3. Reduce ductility
4. obtain fine-grained structure

B. Technique

1. Heat to critical temperature (cherry red)
2. Cool quickly
   a. tempering oil
   b. water
   c. brine

III. Tempering

A. Purpose

1. Remove brittleness
2. Increase toughness
3. Regulate degree of hardness

B. Technique

1. Reheat to proper color
2. Cool quickly (correct medium)

III. Casehardening

A. Purpose

1. Harden outside leave core soft

B. Techniques

1. Cyaniding
2. Carburizing
3. Kasenite

C. Pack Method

1. Place metal in box with Kasenite
2. Heat to about 1650 degrees F.
3. Soak 15 to 60 minutes
4. Remove and quench

REFERENCE: Boyd, Gardner T., Metalworking, Pp. 68-72.

UNIT TEN

OCCUPATIONAL OPPORTUNITIES

UNIT OBJECTIVE: To provide the student with an insight as to the opportunities available to him in industry. To impress upon the student the value of a good education and its meaning both to him and industry.

STUDY OUTLINE: To enable the student to find information concerning jobs and their various requirements.

I. Application

A. Legible Writing

B. Accurate Information

C. Appearance

1. Neat
2. Orderly
3. Pleasant
4. Humble

II. Opportunities

A. Helper

B. Worker

C. Foreman

D. Inspector

E. Superintendent

III. Areas

A. Sheet Metal

1. Layout man
2. Shear operator
3. Set up man
4. Machine operator
5. Assembler

B. Forging

1. Heaters
2. Hammer operator
3. Trimmers
4. Finishers
5. Blacksmith
6. Heat treaters

C. Foundry

1. Molders
2. Core makers
3. Ladle man and pourers
4. Finishers
5. Pattern making

REFERENCE: Boyd, Gardner T., Metalworking, Pp. 4-5

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SPECIFIC OBJECTIVES FOR PLASTIC

1. To familiarize the student with hand and power tools and procedures used in working plastic.

2. To develop in each student a knowledge of an appreciation of the valuable contribution plastic plays to our modern society.

3. To develop in each student habits of personal health and safety in a laboratory situation.

4. To impart to the student knowledge of properties and characteristics of plastics.

PLASTICS

COURSE ANALYSIS

LEARNING TECHNIQUES	RELATED INFORMATION	SUGGESTED ACTIVITIES: Candy Dish	Desk Set	Laminated Paper Weight	Coin embedded in cast-olite	Free Form Bowl
Select a Project	Polishing Compounds	x	x	x	x	x
Make a bill of material		x	x	x	x	x
Follow a plan of procedure	Solvents and cements	x	x	x	x	x
Measure with rule		x	x	x	x	
Lay out a Pattern	Heating Equipment	x	x		x	x
Hold Stock in Vise		x	x	x	x	x
Saw to a line-coping saw		x	x	x		x
Saw to a line-jig saw	How plastics are sold	x	x	x		x
Shape curves with file		x	x	x		x
Smooth surface with sandpaper		x	x	x		x
Drill holes with drill	Abrasives	x	x		x	
Prepare surface for cementing				x		
Apply cement				x		
Join surfaces				x		
Rough buff edges		x	x	x	x	x
Polish cotton flannel buff		x	x	x	x	x
Heat plastic		x			x	x
Form with jigs and clamps		x				x
Form by hand		x				x
Color Laminating				x		x
Cast with Polyester Resins						
Pressure Forming					x	x

UNIT ONE

HISTORY AND USE OF PLASTIC

UNIT OBJECTIVE: To develop an understanding in the student on appreciation of the rapid developments of plastic from conception to future.

STUDY OUTLINE: Subject matter information the student should know concerning plastic with respect to:

I. Genessis of Plastic

A. John Wesley Hyatt (1868)

1. New material for billiard balls
2. Celluloid
   a. nitric acid
   b. cotton cellulose
   c. camphor
   d. pressure and heat

B. Adolph Spittler

1. Casein plastic
   a. sour milk
   b. formaldehyde

C. Dr. Leo Bakeland (1909)

1. Bakelite (synthetic resin)
   a. phenol
   b. formaldehyde

II. Advances in Plastic

A. Present

1. 20 kinds
2. Production up 2000% since 1909
3. Millons spent yearly on research to find new ones and improve existing ones

B. Future

1. Increased use
2. Lower cost
3. Plastic age

III. Classification As To Physical Properties

A. Thermoplastic

B. Thermosetting

IV. Classification As To Chemical Source

A. Cellulose plastic

B. Synthetic resin plastics

C. Protein plastics

D. Natural resins

REFERENCE: Cope and Conway, Plastics, P. 81

UNIT TWO

PLASTICS IN INDUSTRY

UNIT OBJECTIVE: To acquaint the student with the groups and many types of plastic used in industry.

STUDY OUTLINE: Subject matter information the student should acquire concerning plastic with respect to:

I. Groups of Plastic

A. Thermoplastic

1. Characteristics
   a. becomes soft when sufficient heat is applied
   b. hardens when cool
   c. has plastic memory - can be repeated
2. Types
   a. ABS plastic (acrylonitrile-butadiene-styrene)
   b. acetal resins
   c. acrylic
   d. cellulosics
   e. flurocarbons
   f. nylon (polyamides)
   g. polycarbonate resins
   h. polyethylene
   i. polystrene or stryrene
   j. polypropylines
   k. silicones
   l. vinyls

B. Thermosetting

1. Characteristics
   a. set in permanent shape
   b. re-heating will not soften
2. Types
   a. alkyds
   b. allyics
   c. amino plastic
      (1) melamine
      (2) urea
   d. casein
   e. cold molded
      (1) bitumin
      (2) phenolic
      (3) cement asbestos
   f. epoxy
   g. phenolics
   h. polyesters

II. Forming Plastic

A. Injection molding

1. Description

B. Compression molding

1. Description

C. Transfer molding

1. Related to compression molding

D. Blow forming

1. Description

E. Extrusion

1. Description

F. Calendering

1. Definition

G. Slush molding

1. Description

H. Basic casting

1. Used to form resins

I. Thermoforming

1. Description

III. Some Uses of Plastic

A. ABS plastics

1. Pipes, wheels, safety helments

B. Acetal resins

1. Gears, carburetor parts, door handles

C. Acrylics

1. Airplane canopies, costume jewelry, auto taillights

D. Alkyds

1. TV tuning devices, tube supports, switches

E. Allyics

1. Electrical connectors, appliance handles

F. Melamine and Urea

1. Tableware, buttons, table tops
2. Radio cabinets, lamp reflectors

G. Casein

1. Toys, novelties, adhesives

H. Cellulosics

1. Containers and insulators

I. Epoxy

1. Adhesives, protective coverings

J. Fluorocarbons

1. Valve seats, gaskets, pump diaphagms

K. Nylon

1. Tumblers, faucet washers, brush bristles

L. Phenolics

1. Radio and TV cabinets, brake linings

M. Polycarbonate

1. Business machines, electronics

N. Polyesters

1. Sky lights, developing trays, luggage

O. Polyethylene

1. Rain capes, freezer bags, toys

P. Polystrene or styrene

1. Kitchen items, food containers

Q. Silicones

1. Coil forms, switch parts

R. Urethones

1. Cushioning, mattresses, insulated clothing

S. Vinyls

1. Garment bags, water toys, garden hoses

REFERENCE: Cope & Conaway, Plastics, Pp. 81-93

UNIT THREE

WORKING WITH PLASTIC

UNIT OBJECTIVE: To develop in each student manipulative techniques through the use of hand and power tools

STUDY OUTLINE: Information the student should acquire through use of hand power tools, that will enable him to be more adept in working with plastic.

I. Acrylic Plastic Shapes

A. Sheets

B. Rods

C. Tubes

II. Storing Plastic Stock (Sheets)

A. Flat

B. Vertical

C. Slight angle

D. Brush sides to remove grit from marking paper

E. Do not store plastic near heat pipes or with organic solvents

III. Transferring Designs

A. Directly on marking paper with pencil

B. Designs may be traced on marking paper using carbon paper

C. China marking pencil may be used directly on unmarked sheets

D. Lines may be scratched or scribed directly on plastic with scriber or scratch awl

IV. Sawing Plastic

A. Hand and power saws

1. Hand cross cut, coping saw, hack saw
2. Jigsaw
3. Band saw
4. Circular saw
   a. metal-cutting blades work better
   b. hollow ground blades
   c. 1750 R.P.M.
   d. all tools should have a scraping action rather than cutting
   e. care in generating heat must be observed

B. Safety involved using cutting tools

V. Drilling Plastic

A. Twist drill designed for drilling metal

1. Cutting edge of drill should be ground to a "zero" rake angle
2. Cutting edges of the drill should be perpendicular to the face of the material

B. Threading and tapping rods and holes

1. Standard tapping and threading tools
2. Lubricant
   a. 10% soluble oil in water
   b. liquid soap

VI. Sanding Plastics

A. Rough sanded

1. Grit size
   a. 80-150 garnet or aluminum oxide
   b. wet or dry paper or cloth

B. Final sanding

1. Grit size
   a. 320-400 wet or dry

C. Care in sanding

1. Prevent overheating
2. Wet paper is best

VII. Buffing and Polishing

A. Motor driven buffer

1. Muslin cloth wheel 6" dia. 1300 R.P.M.
2. Tripoli
   a. volcanic rock containing silica
   b. tallow
3. Final polish
   a. done on flannel wheel
   b. white rouge
   c. keep plastic moving to prevent overheating

VIII. Cementing and Bonding

A. Solvents used

1. Ethylene dichloride
   a. soak method
   b. capillary method
   c. dip method

B. Safety involved

1. Do not inhale flumes
2. Keep solvents away from open flames
3. Avoid contact with eyes, skin, and clothing
4. In case of contact wash with soap and water

IX. Cleaning and Waxing

A. Lukewarm water and pure soap

B. Do not attempt to clean plastic surfaces by dry rubbing

C. Use clean cloth

D. Do not use strong solvents

E. Use good grade of comerical wax

F. Antistatic treatment

1. Washing
2. Waxing

X. Forming Plastic

A. Acrylic

1. Remove masking paper
2. Heat uniformly

B. Heating devices

1. Electric or gas oven
2. Cermanic kiln
3. Strip heaters

C. Temperature

1. 275 - 325 degrees

D. Press forming

E. Blow forming

REFERENCE: Cope and Conaway, Plastics, Pp. 4-17

UNIT FOUR

SPECIAL TOOLS AND EQUIPMENT

UNIT OBJECTIVE: With the ever increasing uses of plastic in the products we buy, many special tools have been invented to work plastics. The objective of this unit is to increase the student's understanding of the function and uses of these tools.

STUDY OUTLINE: The students may obtain this understanding through reading the text, through class participation, reference books, films and magazines on the subject.

Special Machines Commonly Used In Shop Classes

I. Buffing Wheel (Motor Driven)

A. Safety

B. Speeds

C. Kinds of wheels

D. Abrasives

II. Heating Devices

A. Oven

1. Removal of masking
2. Temperature for specific job

B. Strip heater

1. Removal of masking
2. Operalion

III. Di-Acro Former

A. Namenclature

B. Suction forming principle

C. Below forming principle

D. Heat settings

E. Air pressure settings

F. Jigs and forms

G. Machine adjustments

IV. Injection Molder

A. Granular thermoplastic material

B. Molds

C. Heat settings

D. Machine nomenclature

E. Machine operation

F. Removal of project

Machines Commonly Used In Industry

I. Injection Molding Machine

A. Granular form of plastic

B. Operation of machine

C. Principles of injection molding

D. Products produced

II. Compression Molding Machines

A. Pressure required

B. Principle of operation

C. Heat required

D. Products produced

III. Blow Forming Machines

A. Materials Used

B. Principle of machine operation

C. Vacuum forming

D. Free blow forming

E. Products produced

IV. Extrusion Machines

A. Materials used

B. Dies

C. Heat required

D. Operation procedure

E. Products manufactured

V. Transfer Molding Machine

A. Heat required

B. Pressure required

C. Principle of operation

D. Products produced

VI. Calendering Machine

A. Heat required

B. Operation principle

C. Surface which can be produced

D. Products produced

VII. Slush Molding Machine

A. Material used

B. Semi-liquid state of material

C. Machine operation

D. Heat requirements

E. Productd produced

VIII. Thermoforming Machine

A. Materials used

B. Principle of operation

C. Products produced

D. Heat requirements

REFERENCE: Cope and Conway, Plastics

MATHEMATICS

SEVENTH & EIGHTH

GRADE

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SPECIFIC OBJECTIVES OF POWER MECHANICS

Seventh and Eighth Grade

1. To enlargen the student's understanding of the role of power in our society.

2. To develop basic skills in the assembly and disassembly of small gasoline engines.

3. To familiarize the student with the processing of fuel and lubricants used in the internal combusion engine.

4. To acquaint the student with the measurement and transmission of power from the internal combusion engine.

SAFETY RULES OF POWER MECHANICS

Seventh and Eighth Grade

1. Dress safely; shirt tails tucked inside, shirt sleeves buttoned at the wrist, wear hard sole shoes.
2. Wear safety eye protection at all times.
3. Keep all waste material in an enclosed container.
4. Keep all fuels and solvents in an explosive proof can.
5. Clean and return all tools to their proper place after using.

POWER MECHANICS
COURSE ANALYSIS

LEARNING TECHNIQUES	RELATED INFORMATION	SUGGESTED ACTIVITIES: Lecture	Demonstration	Discussion	Slides & Films	Mock-ups	Live Engines	Tests
Principle of Heat Engines		x			x			x
How Power Affects You	History of Power	x		x	x	x		
How External Engines Operate	Role of the Steam Engine	x	x	x		x	x	
How Internal Engines Operate		x	x		x	x		
Four-cycle engine	Small Engine Manuf.	x		x	x			
Two-cycle engine		x		x	x			
How the Turbine Eng. Operate	Turbine Engines of Today	x			x			
How Engine Size is Measured			x			x		
How Engine Output is rated		x	x					x
How Engine Horsepower is Measured		x	x					
Dissemble of Engine	Kinds & Types of Engine Fuels	x	x	x	x			x
How to Drain Oil	Lubricants & Oils & its Properties	x	x				x	
How to Remove a Spark Plug	Major Adjustments of a Motor						x	
How to Remove Blower Housing	Minor Adjustments of a Motor						x	
How to Remove a Head							x	
How to Remove an Oil Pan							x	
How to Remove Piston & Rod	Specific Tools Used by Automotive Industry						x	
How to Remove Fly Wheel							x	
How to Remove Coil	Testing & Measuring Instruments						x	
How to Remove Crankshaft							x	
How to Remove Valves							x	
How to Remove Cam shaft & Tappets							x	
How to Remove Carburetor & Filter							x	
How to Remove Electrical System							x	
Over Haul Procedures		x			x			x
Clean all Parts			x	x		x	x	
Check all Parts for Wear			x				x	
Check all Gaskets for Wear			x				x	

POWER MECHANICS
COURSE ANALYSIS
(Con't)

LEARNING TECHNIQUES	RELATED INFORMATION	SUGGESTED ACTIVITIES	Lecture	Demonstration	Discussion	Slides & Films	Mock-ups	Live Engines	Tests
Assemble of Engine			x			x			x
Replace Cam shaft and Tappets								x	
Replace Valves								x	
Replace Crankshaft								x	
Replace Piston & Rod								x	
Replace Coil								x	
Adjust Breaker Points								x	
Replace Fly Wheel								x	
Check Clearance Between Flywheel & Coil								x	
Replace Head								x	
Replace Blower Cover								x	
Check Gap & Replace Plug								x	x
Clean & Replace Carburetor								x	
Clean & Replace Filter								x	
Add Oil & Gasoline								x	
START MOTOR								x	
Adjust Carburetor Jets								x	
TROUBLE SHOOTING			x		x	x		x	x
Engine Fails to Start or Starts with Difficulty			x					x	
Engine Knocks			x					x	
Engine Misses Under Load			x					x	
Engine Lacks Power			x			x		x	
Engine Overheats			x					x	
Engine Surges or Runs Unevenly			x					x	
Engine Vibrates Excessively			x					x	
Poor Compression			x					x	

UNIT ONE

HEAT ENGINES

UNIT OBJECTIVE: (1) To present to the student information on heat engines and their operating principles, (2) to show how Power Mechanics affects our daily living.

STUDY OUTLINE:
(1) How does Power Machines affect you?
(2) How is power developed?
(3) What are the operating principles of the heat engine?
(4) How jets and rockets operate

I. Heat Engine

A. External combusion

B. Internal combusion

II. Types of Engines

A. Piston engine

1. 2-stroke cycle
   a. intake-compression
   b. power-exhaust
2. 4-stroke cycle
   a. intake
   b. compression
   c. power
   d. exhaust

B. Diesel engine

1. 2-stroke cycle
   a. intake-compression
   b. power-exhaust
2. 4-stroke cycle
   a. intake
   b. compression
      (1) injection
   c. power
   d. exhaust

C. Jet engine

D. Turbo jet

REFERENCE: Atteberry, Pat H., Power Mechanics, Pp. 4-15
Briggs & Stratton Corp., General Theories of Operation,
Briggs & Stratton Corp., Repair Instruction

UNIT TWO

TOOLS AND USES IN POWER MECHANICS

UNIT OBJECTIVE: To acquaint the student with the various kinds of tools used in Power Mechanics, their care, up-keep, and cost.

STUDY OUTLINE: To acquire information on the different tools used by mechanics in respect to care, up-keep and cost and storage.

I. Tools Common To Industry

A. Steel Rule

B. Combination Square

C. Hammers

1. Mallets
   a. plastic
   b. rawhead
2. Peen hammers
   a. cross peen
   b. ball peen
3. Sledge

D. Files

E. Hacksaws

F. Pliers

G. Tin snips

H. Avaition snips

I. Cold chisel

J. Tubing cutters

K. Flaring tools

L. Portable electric drill

M. Twist drills

N. Center punch

O. Wire brushes

P. C-clamps

Q. Bench grinder

R. Tap and die set

II. Tools Common To Automotive Industry

A. Wrenches

1. Socket
2. Open end
3. Box end
4. Torque
5. Nut driver sets

B. Valve grinders

C. Valve spring compressors

D. Ring compressors

E. E-Z-out screw extractors

F. Calipers

1. Inside
2. Outside

G. Micrometers

1. Inside
2. Outside

H. Depth gauge

I. Feeler gauge

J. R P M indicator

K. Electrical test equipment

1. Kind coil tester

L. Wheel pullers

REFERENCE: Atteberry, Pat H., Power Mechanics,
Briggs & Stratton Corp. General Theories of Operation
Briggs & Stratton Corp. Repair Instruction

UNIT THREE

PISTON ENGINES

UNIT OBJECTIVE: (1) To acquaint the student with the operation of a small engine, (2) how to disassemble and assemble it and measure the horsepower.

STUDY OUTLINE: To acquire information concerning nomenclative of an engine, displacement and horsepower rating.

I. Measurement of Power

A. Horsepower (an output of 33,000 foot-pounds per minute)

1. Torque

a. $\frac{D^2N}{2.5}$

(1) D = Diameter of bore
(2) ^{2} = Square
(3) N = Number of cylinders
(4) 2.5 = Constant (related to 33,000

2. Brake

a. $\frac{F \times 2L \times 3.14 \times RPM}{33,000}$

(1) F = Force exerted
(2) L = Length of lever arm
(3) 3.14 = π (pi)
(4) RPM = Revolutions per minute
(5) 33,000 = 1 Hp

B. Displacement

1. $\frac{3.14 \times D^2 \times L}{4}$

a. 3.14 = Pi
b. D = Bore diameter
c. ^{2} = Square
d. L = Length of stroke

C. Apparatus used to measure output of work

1. Prony brake
2. Dynamometer

II. Moving Parts Of The Engine

A. Pistons

1. Connecting rod
2. Connecting pin
3. Rings
   a. compression ring
   b. oil scraper ring
   c. heat expander
4. Oil dipper

B. Crankshaft

1. Throws
2. Bearings

C. Valves

1. Poppet
2. Reed

D. Valve lifters types

1. Tappets
2. Hydraulic

E. Cam shaft

REFERENCE: Atteberry, Pat H. Power Mechanics, Pp.16-24
Briggs & Stratton Corp., General Theories of Operation
Briggs & Stratton Corp,, Repair Instruction

UNIT FOUR

TROUBLE SHOOTING IN A SMALL ENGINE

UNIT OBJECTIVE: To make the student aware of some of the problems, their causes and remedies in small engines.

STUDY OUTLINE: To ascertain and fix the problem of a malfunction in a small engine, and to decide what damages could be done by said malfunction.

I. Before Starting Engine

A. Check level of oil

B. Fill new engine to correct level

1. Use oil recommended by manufacturer
2. Weight and type

C. Check air cleaner

1. Oil bath
2. Felt
3. Moss
   a. clean all parts
   b. replace worn parts
   c. fill with oil (oil bath)

D. Check fuel tank

1. Clean tank
2. Fill with gas
3. Mix gas for 2-cycle motor
   a. 1/2 pint oil - 1 gallon gas
   b. never interchange gasolines

E. Check spark plug

1. Clearance
2. Corrosion

II. Engine Fails To Start Or Starts With Difficulty

A. Causes

1. No fuel in tank
2. Obstructed fuel line
3. Tank cap vent obstructed
4. Water in fuel
5. Engine overchoked
6. Improper carburetor adjustment
7. Loose or defective wire
8. Faulty magneto
9. Spark plug fouled
10. Spark plug porcelain cracked
11. Poor compression

B. Engine knocks

1. Carbon in combustion chamber
2. Loose or worn connecting rod
3. Loose flywheel
4. Worn cylinder
5. Improper magneto timing

C. Engine misses under load

1. Spark plug fouled
2. Porcelain cracked
3. Improper plug gap
4. Pitted magneto breaker points
5. Faulty condenser
6. Improper carburetor adjustment
7. Reed valves fouled

D. Engine lacks power

1. Choke partially closed
2. Improper carburetor adjustment
3. Improper timing
4. Worn piston and rings
5. Lack of lubrication
6. Valves leaking

E. Engine overheats

1. Improper timing
2. Carburetor improperly adjusted
3. Cooling fins clogged
4. Carbon in combustion chamber

F. Engine surges or runs unevenly

1. Fuel tank cup vent hole clogged
2. Governor parts sticking or binding
3. Carburetor throttle linkage sticking

G. Engine vibrates excessively

1. Engine not securely mounted
2. Bent crankshaft
3. Associated equipment out of balance

H. Poor compression

1. Loose spark plug
2. Loose head or blown gasket
3. Piston rings carboned, worn or broken
4. Worn cylinder

5. Poor lubrication
6. Damaged piston ring
7. Defective seals

REFERENCE: Atteberry, Pat H., Power Mechanics, Pp. 77-85
Briggs & Stratton, General Theories of Operation
Briggs & Stratton, Repair Instruction

UNIT FIVE

DISASSEMBLY AND ASSEMBLY OF A SMALL MOTOR

UNIT OBJECTIVE: (1) To demonstrate to the student the proper way to disassemble an engine and the value of being careful handling various parts, (2) to develop an understanding of the relationship between the different parts.

STUDY OUTLINE: To demonstrate the relationship between the different parts and their importance in the operation of a small engine.

I. Disassembly of a Motor

A. Drain oil and gas

B. Remove blower housing

C. Remove carburetor

1. Remove gas tank if attached to carburetor
2. Take care in removing gas line from gravity feed system

D. Remove recoil starter mechanism

E. Remove fly wheel

F. Remove electrical system

1. Condenser
2. Coil
3. Points

G. Remove oil pan

1. Take care in removing gasket
2. Remove excess oil with rag

H. Remove head

1. Take care in removing gasket

I. Remove cam shaft

1. Tappets will fall out

J. Remove bolts holding connecting rod to crankshaft

1. Remove oil splasher
2. In vertical shaft motors the oil dipper is mounted on cam shaft

K. Remove piston

L. Remove rings

M. Remove crankshaft

1. Ball bearing motors
   a. o-rings must be removed
   b. seals must be removed

N. Remove valves

II. Clean Motor

A. Remove carbon

1. Head
2. Block
3. Valves
4. Exhaust parts on 2-cycle motor

B. Tools to remove carbon

1. Wire brush
2. Emery cloth

C. Check cylinder wall

1. Excess wear
2. Scratch mark or scores

D. Check rings

1. Cracks
2. Clearance

E. Spark plug

1. Clean plug
2. Check clearance
3. Check porcelain for cracks

F. Check crankshaft

1. Alignment
2. Excess wear
3. Scratch marks or scores

III. Assemble Motor

A. Install rings on piston

1. Rings in proper order
2. Grooves facing correct way

B. Install crankshaft

C. Install piston

1. Flat side away from carburetor
2. Consult manual

D. Replace oil dipper

E. Replace valves

F. Replace tappets

1. Check clearance

G. Replace cam shaft

(Consult Manual For:)
1. Match timing marks
2. Align key ways and timing mark
3. Replace oil splasher on vertical shaft motor

H. Replace oil pan

1. Take care in replacing gaskets
2. Draw bolts snugly never too tight

I. Replace head

1. Take care in replacing gaskets
2. Draw bolt snugly
3. Tighten bolts in proper sequence
4. Use recommended torque pressure when available

J. Replace carburetor

1. Check gaskets
2. Check air gap
3. Check air breather
4. Check air cleaner
   a. oil bath
   b. felt type
   c. moss type

K. Replace electrical system

1. Condensor
2. Coil
3. Points
   a. check for proper clearance
   b. check wire for breaks
   c. clean all wire from oil

L. Replace electrical cover

M. Replace fly wheel

1. Check key way
2. Replace key

N. Check clearance between coil and fly wheel

1. .008 - Briggs
2. .015 - Lawn Boy
3. .008-.010 - Clinton

O. Replace recoil starter mechanism

P. Replace blower housing

Q. Install gas line on gravity flow carburetor

R. Replace spark plug

1. Check clearance .025
2. Clean plug

IV. Above Procedure for 4-Cycle Engine

A. Changes for 2-cycle engine

B. Design of motor manufacture differ

C. Ball bearing motor

D. Oil pump instead of dipper or splasher

REFERENCE: Atteberry, Pat H., Power Mechanics,
Briggs & Stratton Corp, General Theories of Operation
Briggs & Stratton Corp. Repair Instruction
Briggs & Stratton Corp. Film Strip on Disassemble and Assemble

UNIT SIX

ELECTRICAL SYSTEM

UNIT OBJECTIVE: To acquaint the student with the electrical system and its component parts of a small engine and automobile.

STUDY OUTLINE: (1) To study electricity and how it is made.
(2) To relate to every day use the small (a) types of ignition system and (b) magneto ignition and battery ignition.

I. Magneto Ignition (Small Engine)

A. Self-contained generating unit

1. Ignition coil
2. Condenser
3. Breaker point assembly
4. Permanent magnet

II. Battery Ignition (Automobile)

A. Storage battery

1. Wet
2. H_2SO_4
3. Plates
   a. negative
   b. positive

B. Dry cell

1. Carbon rod
2. Electroylete process

C. Charging a battery

1. Electrolyte
2. H_2SO_4
3. Hydrometer
   a. specific gravity

III. Circuits

A. Lighting

B. Service

C. Starter

D. Ignition

E. Generator

IV. Alternator

V. Spark Plug

A. Hot

B. Medium

C. Cold

VI. Measuring Electricity

A. Coil tester

B. Ammeter

REFERENCE: Atteberry, Pat H., Power Mechanics, Pp. 36-46
Briggs & Stratton: General Theories of Operation
Briggs & Stratton: Repair Instruction

UNIT SEVEN

FUEL AND FUEL SYSTEMS

UNIT OBJECTIVE: To focus the student's field of studies on the fascinating subject of the processing of fuel from crude oil.
To develop an understanding in the students of the ratio of fuel to air requirements of internal combustion engines and of the devices used to maintain this ratio.
To provide students with experiences in the disassembly, assembly, and adjustments of a simple carburetor.

STUDY OUTLINE: The students could find information concerning fuels and fuel systems in their texts, library reference material, shop reference material, through films and by writing for information from the company.

I. Crude Oil

A. From where it comes

B. How it is transparted

C. What it is composed of

II. Distillation

A. Molecular breakdown

B. Heat affects in breakdown

C. Coolant section

D. How different fuels are drawn out

E. The cracking system

III. Gasoline

A. Greater demand

B. Colorless liquid

C. Liquid to vapor temperature

D. Regular gasoline (uses)

E. Ethyl gasoline (uses)

IV. The Carburetor

A. Function

B. Average operation
air to fuel ratio

V. Principles Of Carburetion

A. Venturi

1. Vacuum principle
2. Principle of atmospheric pressure
3. Air horn
4. Carburetor bowl
5. Nozzle
6. How fuel and air are mixed

B. Float

1. Importance of correct fuel level
2. Needle valve
3. Float

C. Carburetor circuits

1. Low speed (idline)
2. High speed (power)

D. Pump circuits

1. Parts of
2. Principle of operation
3. Advantages and disadvantages

E. Choke

1. Purpose
2. Hand choke
3. Automatic choke

F. Carburetor modification

1. Up draft
2. Down draft
3. Super chargers

G. Transporting gasoline from tank to carburetor bowl

1. Gravity fed
2. Atmospheric pressure lift
3. Fuel pump

H. Fuel pump

1. Principles of operation
2. Location

VI. Fuel Line Filters

A. Screen

B. Sediment bowl

C. Cleaning procedure

VII. Air Cleaner

A. Necessity

B. Cleaning procedure

C. Crankcase vent tube filter

VIII. Governors

A. Function

B. Principle of operation

IX. Assembly and Disassembly of Carburetor

A. Inspect parts of a carburetor

B. Adjustments

REFERENCE: Atteberry, Pat H., Power Mechanics, Pp. 25-35
Briggs & Stratton Corp., General Theories of Operation
Briggs & Stratton Corp., Repair Instruction

UNIT EIGHT

LUBRICATING SYSTEM

UNIT OBJECTIVE: To bring to the student's attention the necessity of a lubricating system in an internal combustion engine.

STUDY OUTLINE: Information the student should gain in respect to the function of lubricants, and the types of circulating devices used.

I. Function of Lubricants

A. Reduce wear

B. Permits parts to move freely

C. Helps cool by reducing friction

D. Lubricants wash and clean parts

E. Lubricants provide seals between rings and wall

II. Small Engine Lubrication

A. Four stroke cycle

1. Splash system
2. Barrel type pump
3. Oil slinger

B. Two stroke cycle

1. 1/2 pint per gallon of gas

III. Pressure Feed Lubricating System

A. Oil pumps

1. Gear type
2. Rotor type

IV. Oil Filters

A. Purpose

B. Types

1. By-pass filter
2. Shunt filter
3. Full flow

V. Oil Viscosity

A. S.A.E.

B. Viscosimeter

C. Letter W

REFERENCE: Atteberry, Pat H., Power Mechanics, Pp. 56-62.

UNIT NINE

COOLING SYSTEM

UNIT OBJECTIVE: (1) To acquaint the student with methods used to carry away excess heat caused by the internal combustion engine.
(2) Provide experiences whereby the student can gain understanding of preventative maintenance requirements of the cooling system.

STUDY OUTLINE: The student may seek further information by reading the textbook, reference material in the library, charts and graphs published by automobile companies, and literature available at local service stations.

I. Operating Temperatures

A. Necessity for cooling system

B. Temperature of air cool engines

C. Temperature of liquid cooled

D. Effects of heat on tolerance of moving parts

II. Air Cooled Engines

A. Uses

B. Principle parts

1. Fins
2. Shroud
3. Fan

III. Liquid Cooled Engine

A. Uses

B. Principle parts

1. Radiator
2. Fan
3. Water pump
4. Thermostat
5. Water jacket
6. Overflow
7. Pressure cap
   a. purpose
   b. safety in removal

IV. Antifreeze Solution

A. Purpose

B. Types

1. Alcohol base
2. Ethylene glycol base
   a. advantage of each
   b. disadvantage of each

REFERENCE: Atteberry, Pat H., Power Mechanics, Pp. 47-51.

WRITING

SEVENTH & EIGHTH
GRADE

T A B L E O F C O N T E N T S

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SEVENTH AND EIGHTH GRADE

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SPECIFIC OBJECTIVES OF GRAPHIC ARTS

1. To acquaint each student with the use of tools, materials, and machines used in the graphic arts field.

2. To develop in each student knowledge regarding basic processes, materials, equipment and products in the graphic arts field.

3. To develop an appreciation of printed products from the consumer's point of view as well as to learn to appreciate the contributions of graphic arts to all phases of life.

4. To instill in each student an awareness of the potential health and safety hazards in a graphic arts laboratory.

GRAPHIC ARTS

COURSE ANALYSIS

LEARNING TECHNIQUES	RELATED INFORMATION	SUGGESTED ACTIVITIES: Calling Card	Stationary	Name Plate	Book Binding
Plan a job	History of printing	x	x	x	x
Set a composing stock		x	x	x	
Hold a stick properly	Job opportunities	x	x	x	
Dump a stick		x	x	x	
Tie up a form	Type cases	x	x	x	
Plane a form		x	x	x	
Pull a proof	Type faces and use	x	x	x	
Make corrections		x	x	x	
Move job from galley to stone	Type character	x	x	x	
Lock up a form in chase		x	x	x	
Ink a press	Point system	x	x	x	
Put form on platten press		x	x	x	
Set guide pins	Use of layouts	x	x	x	
Regulate impression		x	x	x	
Adjust gripper bars	Types of presses	x	x	x	
Feed the platten press		x	x	x	
Wash a press	Types of inks	x	x	x	
Move job from stone to galley		x	x	x	
Wash type	How paper is made	x	x	x	
Distribute type		x	x	x	
How to jog paper	Cover materials	x	x	x	
How to cut paper		x	x	x	
Select materials	Adhesives and uses	x	x	x	
Lay out center materials		x	x	x	
Glue and paste end sheets	History of bookbinding				x
Fold					x
Score	Printing tools				x
Make a pad					x
Hang pad in cover					x

GLOSSARY OF TERMS

1. ampersand
2. apprentice
3. ascender
4. brayer
5. California Job Case
6. capital letter
7. case
8. chase
9. composition
10. composition roller
11. copy
12. corner marks
13. descender
14. distribution
15. EM
16. EN
17. face
18. family
19. feeder
20. font
21. foundry
22. foundry chase
23. furniture
24. galley
25. gauge pin
26. grippers
27. Gutenberg
28. hand proof
29. imposing stone
30. Intaglio printing
31. kern
32. letterpress printing
33. ligature
34. make up
35. nick
36. offset
37. old style
38. pica
39. platen press
40. planography
41. point system
42. quad
43. ream
44. relief printing
45. serif
46. shoulder
47. slug
48. stone
49. typan
50. type metal
51. type high

UNIT ONE

FUNDAMENTALS OF PRINTING PROCESS

UNIT OBJECTIVE: To famaliarize the student with the fundamental processes of printing.

STUDY OUTLINE: Subject matter information the student should acquire concerning printing processes with respect to:

I. Printing Processes

A. Letter Press (Relief Printing)

1. Description
   a. letters and designs are raised above non-printing area
   b. ink is applied only to raised area
   c. type set by hand or machine
   d. engraving or plate of copper, zinc, or other metal may be used
2. Type of presses
   a. platten
   b. flat-bed cylinder press
   c. rotary press

B. Lithography (Offset)

1. Description
   a. press plate is smooth
   b. printing and non-printing areas on same level
   c. based on the principle oil (printing ink) and water will not mix
   d. no image is picked up from second cylinder onto which it has been offset, instead of from the plate cylinder

C. Intaglio (Grovure) Printing)

1. Description
   a. uses a depressed or sunken surface for transferring ink to the paper
   b. ink is applied to the entire plate, and the surface is then wiped or scraped, leaving ink only in depressions
   c. suction lifts the ink up on the paper

D. Skil screen

1. Description
   a. printing medium (ink, paint, etc.) is forced by a rubber squeeze through fine mesh of a silk or metal screen stretched over a frame
   b. designs may be silk screened onto paper, metal, wood, and other surfaces
   c. design may be made either by hand or photographic method

II. Print Shop Work Division

A. Composing room

1. Type is set and assembled here

B. Press room

1. Printing done here

C. Binding department

1. Cutting
2. Folding
3. Gathering
4. Sticking

REFERENCE: Kagy, Frederick D., Graphic Arts, Pp. 4-6

UNIT TWO

TYPESETTING FUNDAMENTALS

UNIT OBJECTIVE: To help the student become familiar with the various principles and fundamentals of setting type.

STUDY OUTLINE: To become acquainted with the various terms, tools, and processes used by the printing trade through study and practice.

I. Printing Tools

A. Line guage

1. Measure length and width of form
2. Point
3. Pica

B. Composing stick

1. Holds type when assembling letters to form words
2. Knee

C. Type (parts of type character)

1. Feet
2. Groove
3. Nick
4. Shoulder
5. Heavy element
6. Light element
7. Counter
8. Serif
9. Type high - .918"
10. Point size

D. Spacing material

1. Separating words in a line
2. Indenting paragraph
   a. quads
   b. spaces

E. Lead and slugs

1. Separating lines of type
2. Thickness given in points
   a. leads 1-4 pt. thick
   b. slugs 6, 9, 12 pt. thick

II. Storing Type

A. California Job Case

B. Italic Job

C. News Cap

III. Type character

A. Ligeratures

B. Punctuation mark

C. Ampersand

D. Parentheses

IV. Type Demons

A. Letters difficult to read

B. b, d, p, q, r, v

1. Acender
2. Decender

V. Justification of a Line

A. Insert spacing material

B. Right hand margin should be straight

VI. Safety

A. Ask your teacher to approve all work you plan to do

B. Report any machine to your instructor that is mal-function

C. Do not talk to person that is operating a machine

D. Adjust machine only when power is off

E. Throw all oil rags and waste material in enclosed can

REFERENCE: Kagy, Frederick D., Graphic Arts, Pp. 7-13

UNIT THREE

MATHEMATICS FOR PRINTERS

UNIT OBJECTIVE: To acquaint the student with the printer's system of measure, and to acquaint the student with the different problems he will face when selecting and storing paper.

STUDY OUTLINE: To learn the printer's system of measure and the different grades of paper, how to store and cut paper, by study and actual work.

I. Point System

A. Point = 1/72"

B. Pica = 12 points
1.6 Pica = 1"

C. Changing Fractions to Points

1. To change pica to points multiply pica by 12
2. To change pica to inches divide pica by 6
3. To change points to pica divide points by 12
4. To change points to inches divide points by 72

II. Cutting Paper

A. $\frac{\text{Dimensions of stock sheet}}{\text{Dimensions of press sheet}}$ = Pieces cut

B. Allow 6% for spoilage

C. Plan work so folds are with grain

D. Finding cost of paper

1. Weight
2. Sheets (Bristol)
3. Per 100 (Envelopes)

REFERENCES: Kagy, Frederick, D., Graphic Arts, Pp. 96-101

UNIT FOUR

IDENTIFY TYPE FACES

UNIT OBJECTIVE: To familiarize the student with the different type faces and their characteristics.

STUDY OUTLINE: To learn more about the different type faces, how to select type and to utilize the face to its best advantage.

I. Basic Styles

A. Oldstyle

B. Modern

C. Transitional

D. Text

E. Square serif

F. Sans-serif

G. Script

H. Decorative

I. Italics

II. Purchasing

A. Fonts

1. An assortment of characters of one size, style and one type face

B. Series of type

1. Several fonts of different sizes but same face

C. Family

1. Collection of various sizes and styles of one design of type

III. Selection of Type

A. Legibility

B. Appropriate for job at hand

C. Type harmony

IV. Printing Layouts

A. Insurance against wasted time in production

B. Poor design

C. Type of layouts

1. Rough sketch
2. Finish layout
   a. composition
   b. designer
      (1) kind of paper
      (2) color of paper
      (3) color and kind of ink
      (4) kind of type

REFERENCE: Kagy, Frederick D., Graphic Arts, Pp. 32-40

UNIT FIVE

LOCKING FORMS, OPERATING A JOB PRESS

UNIT OBJECTIVE: To acquaint the student with the operations included in locking up forms and running a job press. To stress the inportance of the correct safety practices that is associated with printing.

STUDY OUTLINE: To observe and do actual operations on the different types of printing presses which are located in our shop. To practice safety and become conscious of it.

I. Locking up a Type Form

A. Equipment

1. Imposing stone
2. Chase
3. Furniture
   a. wood
   b. metal
   c. reglet
4. Quoins and keys
5. Planer
6. Proof press
7. Platen press
   a. hand operated
   b. power operated
8. Brayer
9. Gally-tray

II. Platen Press

A. Small job shape

B. Letterpress equipment

C. Operating

1. Inked rollers
2. Inked disk
3. Spread ink or type
4. Operator inserts sheet of paper
5. Press will press paper against type

D. Parts

1. Delivery board
2. Feed board
3. Platen
4. Top chase clamp
5. Ink disk
6. Bed
7. Ink roller
8. Hand operating lever
9. Grippers

III. Setting Press

A. Gage pins

1. Holds proof in desired location

B. Grippers

1. Holds paper tight against typan

IV. Feeding Press

A. Fan sheets so as to prevent paper from sticking together

B. Feed one sheet at a time

C. Feed slowly

VI. Cleaning Press

A. Rollers

B. Type

1. Solvent
2. Kerosene

C. Storing rollers

1. Rack
2. On end
3. No weight on roller
4. Store in lowest position of left on press

VI. Safety

A. There is only one operator on the press at all times

B. Keep hands away from all moving parts of the machine

C. Dress safely

1. Shirt tails tucked inside trousers
2. Sleeves buttoned at wrist
3. Wear safety goggles

D. Throw all waste in explosive proof can

REFERENCE: Kagy, Frederick P., Graphic Arts, Pp. 19-31

UNIT SIX

BOOK BINDING

UNIT OBJECTIVE: To famaliarize the student with some of the operations performed in the binding department.

STUDY OUTLINE: Subject matter information the student should acquire that will enable him to construct and bind a notebook.

I. Paper cutting

A. Most common job performed in binding department

B. Hand lever cutter

1. Parts
2. Set up

C. Safety

1. Obtain permission from instructor before use
2. Make sure only one person is in safety zone
3. Make certain lever controlling blade is in proper position and safety lock is engaged before setting gauge
4. Use care when jogging paper to avoid being cut on sharp edges
5. Keep hands clear of blade all times
6. Limit amount of stock to be cut at any one time
7. Keep both hands on lever when making cut, return lever to proper position
8. Check to see that safety lock engages after using cutter
9. While operating paper cutter is not the time to visit

II. Paper folding

A. Hand folded

1. Eight basic folds
2. Bone folder

B. Machine folded

III. Binding

A. Saddle sticked

B. Side sticked

1. Flexible covers

D. Case binding

1. Hard covers

E. Mechanical bindings

1. Metal
2. Plastic
3. Wire

F. Loose-leaf

1. Advantages
   a. sheets may be added or removed
2. Binding post and ring-binder

IV. Padding

A. Description

1. Putting special adhesive on one edge of stock of paper sheets

B. Other binding operations

1. Perforating
2. Punching
3. Drilling and wrapping

V. Commercial Book Binding

A. Major steps

1. Printed sheets folded 8, 16, 32 page section
2. End sheets tipped to first and last section
3. Gathering
   a. Sections are gathered in sequence
4. Sewings
5. Smashing
   a. Reduce bulk and swelling
6. Back glueing and trimming
7. Rounding and backing
8. Super and liner
9. Casemaking and stamping
10. Casing in
11. Inspection

REFERENCE: Kagy, Frederick D., Graphic Arts, Pp. 81-89

UNIT SEVEN

PRINTING PAPER AND INK

UNIT OBJECTIVE: To develop an understanding how printing paper is made. To famaliarize the student with the terms used in dealing with printing inks

STUDY OUTLINE: Subject matter information the student should acquire concerning how paper is made, its contents, and types. Printing ink ingredients and type of ink to use for jobs.

I. Paper Making

A. Source

1. Wood pulp
   a. fir, spruce, hemlock, poplar, pine and tamrock
2. High grade paper
   a. has high rag content

B. Classroom paper making

1. Wood pulp
2. Soak in water, mix with egg beater
3. Wet fibers formed into sheets using mold and deckle
4. Blot
5. Pressed with blotter both sides
6. Iron dry between two sheets of smooth uncoated paper
7. Submerge 1 second 5% glue and water solution
8. Iron dry again

II. Kinds of Printing Paper

A. Newsprint

B. Book paper

1. Machine finished
2. Supercaldered
3. Sized and supercalendered
4. Coated enamel
5. Offset paper
6. Antique paper
7. English finished paper

C. Writing papers

D. Cardboards

1. Index and printing bristols
2. Railroad board
3. Chipboard

E. Cover paper

III. Basic Sizes and Weights

A. Ream 500 sheets

B. Each type of stock has a different basic size

C. Book stock

1. 25" x 38" basic size
   500 sheets weighs x no. lbs.

IV. Printing Inks

A. Ingredients

1. Pigments
   a. organic (animal or vegetable matter)
   b. inorganic (mineral matter)
   c. gives color
2. Vehicle (varnish)
   a. linseed oil
   b. tung oil
   c. rosin
   d. pitch
   e. asphalt
   f. gum
3. Driers
   a. cobalt
   b. manganese
   c. lead

B. Types of ink and uses

1. News ink (news stock)
2. Job ink (average run of work)
3. Bond (bond and ledger paper)
4. Half tone ink (coated paper)
5. Cover ink (cover paper)
6. Speciality ink (cellophane and wax paper)

REFERENCE: Kagy, Frederick D., Graphic Arts, Pp. 56-60

UNIT EIGHT

OCCUPATIONAL OPPORTUNITIES

UNIT OBJECTIVE: To inform the student of the various opportunities awaiting him in the printing industries and the major requirement of each.

STUDY OUTLINE: To learn about the different jobs awaiting the student and to meet the requirement of some of these jobs by study and practice.

I. Training

A. Specialized area

1. Basic printing
2. Letter press
3. Gravine
4. Lithography
5. Silk screen

B. Apprenticeship

1. 4-6 years
2. Depends on area and shop

C. Work with printing craftsman

D. Requirements

1. High school education or equivalent
2. Knowledge of:
   a. spelling
   b. grammar
   c. punctuation
   d. courses in
      (1) art
      (2) design
      (3) color
      (4) physics
      (5) chemistry

II. Location of Jobs

A. Large cities

1. Newspapers
2. Magazines
3. Special job shops
   a. stationary
   b. photo-engravers
   c. commercial artist

B. Small towns or communities

1. Weekly newspaper
2. Job shops

C. Home print shops

1. Stationary
2. Invitations
3. Programs
4. Tickets

III. Reason for Job Expansion

A. Mobility of people

B. Increased population

C. New and better printing methods and equipment

D. More and better education for the public

REFERENCE: Kagy, Frederick D., Graphic Arts, Pp. 103

WRITING

NINTH
GRADE

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SPECIFIC OBJECTIVES FOR PRINTING

1. To familiarize the students with the fundamentals of tools and machines used in printing.

2. To develop in each student a knowledge of specific terms of the printing industry.

3. To develop in each student a general knowledge of the printing industry.

4. To develop in the student an awareness of the danger when operating the machines.

5. To develop in each student the ability to do research.

PRINTING

COURSE ANALYSIS

LEARNING TECHNIQUES	RELATED INFORMATION	SUGGESTED ACTIVITIES	Letter Head	Name Card	Napkins	Book Binding	Silk Screen	Rubber Stamp
Plan a Printing job	History of Printing		x	x	x	x	x	x
Learn the Typecase			x	x	x			
Hold a composing stick	Ink and their properties		x	x	x			
Set a composing stick			x	x	x			
Set type	Paper grades and their		x	x	x			
Justify a Line	Characteristics		x	x	x			
Make a Line stand by itself			x	x	x			
Tie up a form	Type, their family		x	x	x			
Take a Proof	and series		x	x	x			
Make corrections	Identification of type		x	x	x			
Read a form	faces		x	x	x			
Lock up a form in a Chase			x	x	x			
Inking a Press	Parts of Printing Press		x	x	x			
Inking a Brayer or Squeege			x	x	x			
Setting Chase in Platen Press	Setting up a platen press		x	x	x		x	
Setting Gauge Pins			x	x	x			
Running a Job	Slugs & leads		x	x	x		x	
Cleaning type			x	x	x		x	x
Cleaning a Press	Printing system of measure		x	x	x			
Distribution of type			x	x	x		x	
Planeing a job	Printing Tools & their use		x	x	x			
SILK SCREEN								
Laying out a Design	Types of Lacqued film		x	x	x		x	
Cutting Design	Type of printing surface		x	x	x		x	
Attaching silk to frame			x	x	x		x	
Attaching design to silk	Stencil material		x	x	x		x	
Locate guides	Designing		x	x	x		x	x
Running a Job	Solvents		x	x	x		x	x
Cleaning a Screen							x	
Removing Design from Silk							x	
RUBBER STAMP								
Layout stamp	Practical Operations							x
Cut Matrix	Material & Tools							x
Adhere Matrix to Holder								x
Take Proof	Solvent & Adherents							x
Run Job			x	x	x	x	x	x

UNIT ONE

HISTORY OF PRINTING

UNIT OBJECTIVE: To develop an appreciation in the student the contribution early men made to the printing industry.

STUDY OUTLINE: Subject matter information the student should acquire from the text, discussion and resource material available.

I. Printing From Movable Types

A. Johannes Gutenberg

1. Mainz, Germany
2. Years 1435-1445

B. Laurens Carter

1. Haarem, Netherlands
2. About same time

II. Pre-Movable Type

A. Manuscripts

B. Hand written scrolls

1. Egyptians 300 B.C.

C. Europe

1. Fourteenth Century
2. Manuscript was a fine art

D. Printing from wood engraving

1. Japan
   a. 770 A.D.
2. China
   a. 400 A.D.

E. Separate character

1. Pi-Cheng
   a. porcelain
2. Wang Chen
   a. moveable wood
3. Kind of Korea
   a. foundry ~~for type~~ casting
   b. 1403

II. Genessis of Type Faces

A. Based on handwritten letters used in producing manuscript

B. Roman (lower case)

1. Nicholas Jenson
2. Referred as Venetian type

C. Gothic

1. Northern Europe
2. Imitate religious scriber

III. Early Printing In England

A. William Caxton

B. Richard Pynson

C. William Caslon

1. New type face
2. Type is still used also his style of printing

IV. Early Printing In America

A. Reverend Jose Glover

B. Stephen Daye

C. Samuel Green

D. William Nuthead

E. Isahia Thomas

F. Benjamin Franklin

1. Contributions to printing
2. Other contributions to society

REFERENCE: Cleeton & Pitkin, General Printing, Pp. 128-146

UNIT TWO

LETTER PRESS PRINTING

UNIT OBJECTIVE: To develop an awareness in the students of the machines used to set type and the part hand-set composition plays in commercial print shops.

STUDY OUTLINE: Subject matter information the student should know concerning machines used in the printing industry.

I. Hand Composition

A. Use

1. Titles
2. Headlines
3. Spots when few words are needed

II. Machine Set Text Copy

A. Commonly used machines

1. Linotype slug casting
2. Intertype slug casting
3. Intertype line casting
   a. operates from teletype tape

B. Operation

1. Linotype and intertype cost complete line slugs from matrices
   a. matrix brass or bronze
   b. type character is formed in reverse on matrix
   c. operator works keys
   d. matrices are dropped into a mold
   e. a solid slug is then cast using molten type metal, which bears a line of raised letters
   f. after casting, the matrices are automatically re-distributed
   g. type slugs are assembled by hand into type forms ready for printing
   h. the metal is melted and used again

C. Intertype

1. Operated from teletype tape
2. Has no keyboard
3. Tape may be purchased elsewhere
4. Use
   a. news service
   b. newspapers

III. Other Machines

A. Monotype

1. Use
   a. type looks like hand compositon
   b. letters come out spaced and lines justified

B. Ludlow

1. Use
   a. advertisement and newspaper headlines

C. Cold-type machines

1. Set type without use of hot metal

REFERENCE: Cleeton & Pitkin, General Printing, Pp. 153-157

UNIT THREE

LITHOGRAPHIC PRINTING

UNIT OBJECTIVE: To famaliarize the student with one of the important printing processes.

STUDY OUTLINE: Subject matter information the student should know concerning lithographic printing with respect to:

I. Design Reproduction

A. Reproduced on flat plate

B. Design is neither raised nor sunken

C. Non printing areas do not print because they are chemically heated and repel ink

II. Rotary Press

A. Description

1. Ink roller and ink fountain
2. Water roller and water fountain
3. Three metal cylinders
   a. top cylinder plate is attached
   b. center cylinder rubber blanket
   c. bottom cylinder carries the paper

III. Operation of Rotary Press

A. Cylinders revelve when press is on

B. Plate is carried under water roller and ink roller, and finally the rubber blanket

C. The water roller keeps the non printing areas of the plate wet so they will not take ink

D. Only the image is inked

E. Inked image transfers to blanket

F. The blanket, in turn offsets the wet image on the paper which is forced against it by the impression cylinder

G. Offset printing

1. Image faces right
2. Impression made on blanket is in reverse
3. The blanket offset an image on the paper which reads right

H. Different names of lithographic processes

1. Planography
2. Photolithography
3. Zincography

III. Making Lithographic Print Without Offset Machine

A. Reverse design

1. Place piece of carbon paper back of design with carbon up
2. Trace over design
3. Using carbon paper again, trace reversed design onto direct image plate
4. Go over lines to be printed, using a litho-reproducing pencil
5. Spread litho ink on slab and ink broyer
6. Use sponge moisten plate with fountain solution. Plate must be damp not wet
7. While plate is damp ink plate
8. Print may now be made on etching press or type proof press
9. Pull print and plate apart
10. Put print under weight to straighten

REFERENCE: Cleeton & Pitkin, General Printing, Pp. 11-12

UNIT FOUR

SILK SCREEN PRINTING

UNIT OBJECTIVE: To acquaint the student with the art of silk screening, its technique on the opportunities offered in this area.

STUDY OUTLINE: To acquire information and knowledge on silk screening through study and practice.

I. Tools and Equipment

A. Frame

1. Wood
2. Metal

B. Squeege

C. Knife

D. Line gauge

E. Spatula

F. Lacquer film

G. Solvent

H. Silk

II. Printing Medium

A. Ink

B. Paint

C. Lacquer

D. Varnish

III. Printing Material

A. Wood

B. Plastic

C. Leather

D. Glass

E. Textile

IV. Making A Silk Screen Print

A. Operations

1. Design project
2. Cover nonprinting areas with lacquer film
3. Tape film over design
4. Cut design into film
   a. cut design with knife
   b. do not cut into wax paper backing
5. Remove lacquer film from areas to printing
6. Do not remove wax paper from film
7. Place film on silk
8. Remove wax paper
9. Locate gauge pins

B. Making prints

1. Place stock in frame
2. Pour ink into frame
3. Insert paper stock
4. Run squeege across frame
5. Compare completed print with original
6. Work as a team
   a. one places stock into guides
   b. one runs squeege
7. Hang prints on drying rack

C. Cleaning frame

1. Moisten with solvent
   a. kerosene
   b. white gasoline
2. Will not remove design
3. To remove design
   a. pour lacquer thinner on top side of frame
   b. place newspaper over frame to prevent evaporating
   c. pour more lacquer thinner
   d. repeat above process until film comes loose

REFERENCE: Kagy, Frederick, Graphic Arts, Pp. 75-80

UNIT FIVE

INTAGLIO (GRAVURE) PRINTING

UNIT OBJECTIVE: To acquaint the student with the method of printing from a depressed design

STUDY OUTLINE:
1. To learn more about the intaglio printing principle
2. How the intaglio industry produces its printing
3. Making an intaglio print in the classroom

I. Intaglio (Gravine) Printing

A. Procedure

1. Letters carved or etched into material
2. Ink squeezed into these depressions
3. Excess wiped from plate
4. Ink forced onto paper under pressure

B. Material

1. Copper
2. Steel

C. Jobs

1. Fine letter heads
2. Professional calling cards

D. Rotogravine

1. Jobs
   a. printing wallpaper
   b. textiles
   c. cellophane
   d. aluminum foil
   e. money
2. Limitations
   a. expensive
   b. best suited for work that requires long runs (many thousand)
3. Procedure
   a. plate cylinder with copper
   b. polish cylinder
   c. prepare negative and positives
   d. sensitize carbon material
   e. expose screen to tissue
   f. expose screen to positive
   g. this makes pot pattern
   h. carbon tissue is then placed on cylinder
   i. remove backing paper
   j. cylinder placed in etching bath
   k. stageing is now completed
   l. cylinder put into proper places

E. Collotype

a. No halfton
b. No screen pattern
c. Variations of tone obtained by controlling depth of etching

F. Dry point etching

a. Possible to do this in school shop
b. Plate material
   1. celluloid
   2. acetate
c. Tools
   1. sharp pointed tools
   b. spatula

REFERENCE: Kagy, Frederick, Graphic Arts, Pp. 69-74

UNIT SIX

RUBBER STAMP MARKING

UNIT OBJECTIVE: To develop additional skills in making printing plates.

STUDY OUTLINE: Student should follow procedure below to make rubber stamp.
Materials Needed: Press, matrix, holland cloth, rubber stamp gum, dusting powder

I. Procedure

A. Select style, design, and size type

B. Secure composing stick and set for job

C. Set job

D. Tie up job

E. Place job in galley and take proof

F. Return job to stick to make necessary corrections

G. Placed tied job in rubber stamp press chase

1. Place at least one reglet between end of chase and job
2. Leave string on job

H. Lock job in chase

I. Plug in rubber stamp press and allow to heat until light goes off

J. Cut a piece of matrix board slightly larger than job

1. Use vibrator jig saw

K. Place matrix board over type red side down

L. Place holland cloth over back of matrix board to prevent sticking

M. Place chase, matrix board, and holland cloth in press

1. Place it in from back side
2. Do not allow matrix board or holland cloth to slip
3. Be careful not to touch press

N. Force job up against the heating plate by pressing lightly on handle

1. Allow matrix to be warmed approximately two minutes

O. After matrix is warm, begin applying pressure gradually

1. At the end of two minutes lock handle in down position

P. Allow job to remain in press ten minutes

Q. Remove from press allow to cool three minutes

R. Remove matrix board from type by prying it up slowly and evenly

S. Turn chase over and place the newly made matrix on the back of the chase imprinted side up

T. Cut a piece of rubber stamp material slightly larger than the letter imprinted on the matrix board

U. Place parting powder on the rubber

V. Place rubber on top of matrix

1. Put a piece of holland cloth on top of rubber

W. Insert entire job into press and apply light pressure for two minutes

X. Lock handle in down positon allow to remain eight minutes

Y. Release pressure and remove job

1. Turn off press
2. Allow to cool approximately three minutes
3. Separate rubber from the matrix board

Z. Select mount suitable in size

1. Attach knob to mount
   a. drill 3/8" hole in center of mount
   b. glue handle in place
   c. flat side of handle is to be bottom side of stamp print
   d. trim rubber close to letters
   e. cement rubber print to mount
   f. allow cement to set
   g. try out stamp

REFERENCE: Kagy, Frederick D., Graphic Arts, Pp. 52-54

UNIT SEVEN

MODERN PRINTING MACHINES

UNIT OBJECTIVE: (1) To develop the student's appreciation of the multitude of kinds of machines used to produce the vast amount of printing material used in our society.
(2) To develop a basic understanding of the principles upon which these machines operate.

STUDY OUTLINE: The student may read about these machines and associate them with the pictures in the text and in other reference material. A field trip to a modern printing company which uses some or all of these machines would seem in order.

I. Modern Platen Press

A. Inventor

B. Action of plate and form

C. Press production capabilities

D. Brand names

II. Cylinder Press

A. Inventor

B. Sheet fed

C. Roll fed

D. Brand name

E. Capacity

III. Web-Fed Presses (Modern)

A. Inventor

B. Advantages

1. Multi-color
2. Production capabilities
3. Folding attachment

C. Brand names

IV. Offset Press (Modern)

A. Inventor

B. Principle underlying method of printing

C. Production capabilities

D. Brand names

E. Advantages

V. Gravure (Modern)

A. Principle underlying method of printing

B. Production capabilities.

C. Brand name

D. Sequeege or "doctor blade"

VI. Composing Machines

A. Linotype

1. Keyboard
2. Matrices
3. Distribution thechnique

B. Intertype

1. Keyboard
2. Matrices
3. Distribution technique

C. The ludlow typegraph

A. Slug-casting

B. Matrices distribution

VII. New Methods of Copy Composition

A. Composition of characters

B. Justifying typewriter

C. Coxhoad composing machine

D. Justowriter

E. IBM executive typewriter

F. Fairchild lithotype

G. ATF Hadego Photocompositor

H. Fotosetter

REFERENCE: Cleeton, Atkin, General Printing, Pp. 149-163

UNIT EIGHT

MANUFACTURE OF PAPER AND INKS

UNIT OBJECTIVE: To develop a basic understanding by the students of the raw materials and processes used in making paper.

STUDY OUTLINE: The student may find information concerning this unit in most other printing books. In addition, films and charts may help in the understanding.

I. Importance of paper

A. Smount used world wide

B. Amount used by individual per year (average)

II. History of Papermaking

A. Contribution to manufacture from China

B. Ingredients used in ancient paper making

C. Machines used in the manufacture

III. Modern Practices in Paper Making

A. Use of wood pulp (products produced)

B. Use of rags (products produced)

C. Fourdrinior machine

D. Use of ground pulp

E. Chemical pulp (uses)

IV. Factors in Quality of Paper

A. Celluose content

B. Preparation of the pulp

C. Reclaimed waste paper

V. Paper Making

A. By hand

1. Materials used
2. Frame and wire cloth
3. Dried

B. By machinery

1. Materials used
2. Color added
3. Machines
   a. Jordans
   b. fourdrainior

VI. Paper Finishes

A. Calendered

B. Coated

C. Antique

D. Plater

E. Embossed

F. Linen

G. Wove

H. Laid

I. Special finishes

1. Special Machines
2. Kinds of material
3. Methods of drying

J. Water marks

VII. Specifying, estimating, and using paper

A. Unit of weight (per ream)

B. Cost per pound, ton, hundred weight

C. Sheet size (standard)

D. Weight per 1000 unit

1. "New basis"
2. American conference board

E. Standard size of roll paper

VIII. Moisture Content

A. Percentage of moisture (from machine)

B. Separate sheet

C. Effects on ink colors

IX. Characteristics on Paper for Specific Job

A. Book paper

B. Covers

C. Bonds

D. Ledgers

E. Writings

F. Offset

G. Index bristol

H. Weddings

I. Blotting and mimeographing

X. Estimating The Quality of Paper

PRINTING INK

I. History of Inks

A. Chinese inventions

B. Inks during the Guttenberg era

II. Composition of Ink

A. Pigments

B. Vehicles

C. Solvents

D. Driers

III. Modern Manufacture

A. Complexity of manufacture

B. Special inks

C. Inks for printing on materials other than wood

REFERENCE: Cleeton, Pitkin, General Printing, Pp. 169-176

WOODWORKING

SEVENTH & EIGHTH
GRADE

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Seventh and Eighth Grade

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SPECIFIC OBJECTIVES FOR WOODWORKING

1. To provide experience in manipulative phases of Woodworking, and give information about a variety of Woodworking Industries.

2. To teach certain general and usable skills in handling and modifying wood in order to make it conform to one's needs.

3. To foster development of intelligent discrimination in the selection and use of wood products, such as woodwork in the home and furniture.

4. To develop appreciation of one's dependence upon wood products, and upon importance of conservation.

5. To give training in the reading of working drawings used in Woodworking.

6. To inspire avocational interest in Woodworking.

SAFETY RULES FOR WOODWORKING

1. Dress safely: Shirt tails tucked inside trousers, sleeves buttoned at wrist, wear hard sole shoes.

2. Wear proper eye protection at all times.

3. There will not be any Horseplay in the shop. It is a place to learn and work - not misbehave.

4. Use all tools for their intended use.

5. Keep all tools sharp and in good repair.

6. Return all tools to their proper place after using them.

7. Throw all waste material in the scrap barrel. Keep the floor and table free from litter.

8. Obtain permission from the instructor before using any piece of equipment in the Industrial Arts Laboratory.

9. Report all injuries to the instructor immediately.

10. Remember, at all times, the ABC's of Safety:

A L W A Y S B E C A R E F U L

WOODWORKING
COURSE ANALYSIS

LEARNING TECHNIQUES	RELATED INFORMATION	SUGGESTED ACTIVITIES	Candleabra	Book Rack	Lamp Tripod	Wall Shelf
Guide Lines to Planning	Modern Trends in Design		x	x	x	x
Present Thoughts In Design	How Trees are made into		x	x	x	x
Make a Plan of Procedure	Lumber		x	x	x	x
Make a Bill of Material	How Wood Products are Sold		x	x	x	x
Figure Cost of Project	Calculating Bd. Ft., Sq.		x	x	x	x
Estimate of Completion Time	Ft. & Linear Measure		x	x	x	x
Lay out Stock	Kinds of Saws & Uses		x	x	x	x
Cutting Stock Rough Size	Checking & Grinding Plane Irons		x	x	x	x
Planing Stock to Finish Size	How to Square Stock		x	x	x	x
Making Wood Joints	Types of Joints and Their Use			x	x	x
Methods of Forming Curves	Types & Sizes of Auger Bits		x	x	x	x
Methods of Forming Chamfers and Bevels	Kinds of Glue Used For Wood		x	x		
Methods of Drilling & Boring Holes	Kinds & Sizes of Screws		x	x	x	
Preparing Wood for Glueing	Special Fasteners		x	x	x	x
How to Glue Up Stock	Types of Clamps		x	x	x	x
Methods of Clamping Stock	Kinds & Grades of		x	x	x	x
Fastening Wood With Nails & Nails	Abrasive Paper			x		x
Preparing Wood for a Finish	Kinds of Wood Fillers		x	x	x	x
How & When To Apply Filler	Types of Stains		x	x	x	
How to Apply Stains	Types of Sealers		x	x	x	x
How to Apply an Opaque Finish	Sources of Wood Finishes					x
How to Apply a Translucent + Finish	Solvents Used for Finishes		x	x	x	x
How to Care for Rags & Brushes			x	x	x	x

UNIT ONE

PLANNING

UNIT OBJECTIVE: To provide experiences requiring the student to plan the procedure, select wood for specific project, figure cost of material, and to develop an appreciation for the necessity of planning prior to starting any project work dealing with wood and its by-products.

STUDY OUTLINE: The student may find information dealing with this unit in the textbook and most reference books dealing with wood working. An application phase of the planning unit will be conducted prior to each unit.

I. Planning

A. Necessity for completion

B. Factors to consider in the selection of any project

1. Materials available
2. Space for work and storage
3. Cost of project
4. Abilities of worker
5. Tools available

C. Project design

1. Function (usefulness)
2. Beauty

D. Sketches and working drawings

1. Usage
2. Difference between sketches and drawing

II. Making A Plan Procedure

A. Importance of making plan

B. Degree of completness

1. Outline form
2. Detailed form

III. Making A Bill of Materials

A. Kind of wood for specific project

B. Hardware needed

C. Figuring board feet and square feet

D. Time estimate

REFERENCES: Wagner, Willis H., Woodworking, Pp. 4-10.

UNIT TWO

WOOD, THE FOREST, AND ITS PRODUCTS

UNIT OBJECTIVE: To provide the student with knowledge of wood and its properties and characteristics.

STUDY OUTLINE: To learn about the wood industry, its products, and by-products, by study, research, films, and actual participation in project work.

I. Forest Regions

A. West coast forest

1. Douglas fir
2. Red cedar
3. Redwood
4. Spruce

B. Western forest

1. Pine
   a. white
   b. ponderosa
2. Soft wood

C. Northern forest

1. Red spruce
2. Hemlock

D. Central hardwood forest

1. Central-eastern section of United States
2. Hardwood
   a. oak
   b. walnut

E. Southern forest

1. Cypress
2. Pine
   a. longleaf
   b. shortleaf

II. Common Woods

A. Types

1. Hardwoods
   a. Broad leaves that fall in winter
   b. used for furniture
      (1) kinds
         (a) oak
         (b) walnut
         (c) mahogany

(d) gum
(e) maple

2. Soft woods
   a. needle like leaves
   b. remain green year around
   c. called evergreen
      (1) kinds
         (a) pine
         (b) fir
         (c) spruce
         (d) cedar
         (e) redwood

B. Uses

1. Veneers
   a. plywood
   b. compreg
2. Paper
   a. wood pulp
   b. papreg
3. Insulation and fuel
4. Rayon
5. Construction
   a. houses
   b. furniture

C. Extractions

1. Solvents
2. Sugar
3. Dyes
4. Turpentine
5. Resin

III. The Tree

A. Parts of the tree

1. Annular rings
2. Cambium layer
3. Sapwood
4. Heart wood

B. Moisture content and shrinkage

1. Types of drying
   a. air dry
   b. kilm dry
   c. steaming walnut
2. Moisture content
   a. furniture - 6-10%

C. Methods of sawing

1. Plain sawing
2. Quarter sawing
3. rotary sawing

REFERENCE: Wagner, Willis H., Woodworking, Pp. 83-90
Gronenar, Chris, General Woodworking 2nd Edition, Pp. 185-210
Slides, Weyhouser Tree Co., The Forest & Its Products

IV. Cutting Stock To Rough Length

A. Selection of correct hand saw

1. Kerf
2. Set
3. Cross cut saw
4. Rip saw
5. Saws for special cutting requirements

B. Procedure used when sawing

C. Allowance for final planing

D. Precautions when cutting plywood with a saw

REFERENCE: Wagner, Willis H., Woodworking, Pp. 10-14

UNIT THREE

SELECTING AND ROUGHING OUT STOCK

UNIT OBJECTIVE: (1) To develop an understanding of the classification of various kinds of wood and wood products.
(2) To provide experiences concerning techniques used in the selection and cutting of stock to rough lengths.

STUDY OUTLINE: The student may find information concerning this unit in the textbook, in reference magazines, charts, and most reference wood working books.

I. Kinds Of Wood

A. Classification of woods

B. Grading of wood

C. Size and surfacing

D. Methods of drying

II. Wood Materials

A. Plywood

1. Composition
2. Unit of measurement
3. Construction
4. Advantages
5. Classification

B. Masonite

1. Construction of
2. Possible uses

C. Compress

III. Selection and Lay Out

A. Checking for defects

B. Grain patterns

C. Matching grain

D. Lay out rough sketch of pieces needed

UNIT FOUR

PLANING AND SAWING STOCK TO FINISH DIMENSION

UNIT OBJECTIVE: (1) To acquaint the student with the parts of and types of planes, their uses, and function to the woodworker.
(2) The basic steps he will have to know to cut stock to finish stock.

STUDY OUTLINE: To learn how to sharpen and adjust a plane.
To learn how to plane on surface and edges.
To learn how to cut stock to finish length.

I. Plane

A. Types

1. Smooth
2. Jack
3. Fore
4. Jointer
5. Block
6. Rabbet
7. Circular
8. Router

B. Parts of the plane

1. Plane bottom
2. Mouth
3. Toe
4. Heel
5. Frog
6. Adjusting nut
7. Y adjusting lever
8. Lateral adjusting lever
9. Plane iron and plane iron cap
10. Cam
11. Lever cap
12. Cap iron screw
13. Lever cap screw

C. Sharpening

1. Grinding
   a. sharpening cutter edge and bevel
   b. forming cutting edge and bevel
   c. keep plane iron cool while grinding by dipping into water
   d. grind to 22 degree - 25 degree angle
2. Honing
   a. oilstone
   b. makes cutting edge razor sharp
   c. hone to 35 degree angle

D. Operating a plane

1. Remove mill marks from wood
2. Remove warp and other imperfections
3. Shavings should be light and feathery
4. Plane with grain
   a. grain runs uphill
   b. on end grain plane 1/2 width of board then reverse and plane other half or plane from edge to middle

II. Back Saw

A. Clamp wood securely

1. Vise
2. Hand screw clamp

B. Mark line

1. Try square
2. Knife
3. Marking gauge

C. Making straight cuts

1. Use long steady strokes
2. Cut perpendicular to wood

III. Steps in Squaring a Board

A. Face

B. Edge

C. End

D. End

E. Edge

F. Face

REFERENCE: Wagner, Willis H., Woodworking, Pp. 15-21

UNIT FIVE

WOOD JOINTS

UNIT OBJECTIVE: To familiarize the student with the different types of wood joints, the methods of their construction, and characteristics of each joint.

STUDY OUTLINE: To learn how to select and construct different wood joints, the tools required and the safety procedures that should be followed in using the tools.

I. Types of Joints

A. Edge

B. Butt

C. Dado

D. Groove

E. Miter

F. Lap

1. Cross
2. 1/2 lap

G. Rabbet

H. Dowell

II. Uses of Joints

A. To hold different pieces of wood together permanently or temporarily

B. Furniture

C. Construction work

III. Fastening Joints

A. Glue

1. Polyvinyl-resin glue (white glue)
2. Animal glue

B. Wood screws

1. Standard slotted screws
2. Phillips head screws

C. Nails

1. Finishing
2. Brads

D. Wood dowels

1. Spiral dowel
2. Common dowel

E. Corrugated metal fastener

IV. Tools Required

A. Bench rule

B. Try square

C. Mitre square

D. Back saw

E. Wood chisel

F. Mallet

G. Hand brace

H. Set of auger bits

I. Marking gauge

J. Knife

K. Doweling jig

L. Jack plane

M. Wood clamps

1. Bar
2. Pipe
3. Mitre
4. Hand screw clamp

V. Testing Joints

A. Strength

Moment of shear

REFERENCE: Wagner, Willis H., Woodworking, Pp. 22-29

UNIT 8

FORMING CURVES, CHAMFERS AND BEVELS

UNIT OBJECTIVE: To familiarize the student with the terms, practices, and procedures used to make curves and irregular shapes in wood.

STUDY OUTLINE: Subject matter information and manipulative procedures that should enable the student to perform better shapes and forms in woodwork.

I. Definition

A. Chamfer: Removes sharp cover from edge and improves appearance

B. Bevel: A sloping edge that connects two surfaces of stock

C. Taper: Runs along the length of stock causing it to be smaller at one end than the other

D. Pattern: Full size outline of an object drawn on paper

E. Template: A pattern made from heavy material such as wood, metal, cardboard

II. Layout Work

A. Circle and arc

1. Divides
2. Pencil compass
3. Trammel points

B. Curves

1. Dividers
2. Trammel points
3. Thin wood strip
4. Irregular curve

III. Pattern and Template

A. Material

1. Paper
2. Wood
3. Metal

B. Method

1. Enlarging by square
2. Transfer by carbon paper
3. Drawing around edge of pattern

IV. Cutting Tools

A. Saw

1. Coping
2. Jig saw

B. Chisel

1. Wood chisel
2. Gauge

C. Smoothing

1. Spoke
2. Plane
3. Wood rasp

REFERENCE: Wagner, Willis H., Woodworking, Pp. 29-34

UNIT SEVEN

DRILLING AND BORING HOLES

UNIT OBJECTIVE: To familiarize the learner with the various processes and tools used in boring and drilling holes in different types of material.

STUDY OUTLINE: To learn more about the different methods used in various types of shops. To gain skill in using boring tools and drilling machines.

I. Definition

A. Drilling: Cutting small holes 1/4" diameter or less in wood and is performed with a twist drill held by a hand drill or drill press.

B. Boring: The term used for cutting larger holes with the brace and auger bit.

II. Tools

A. Brace

1. Bow
2. Handle
3. Head
4. Quill
5. Shell
6. Jaws
7. Cam ring
8. Pawl
9. Ratchet end

B. Size

1. Determined by its sweep
2. 8" or 10" sweep

C. Auger bits

1. Types
   a. double twist
   b. solid center
   c. single twist
   d. expansive bit
   c. foerstner
2. Parts
   a. tang
   b. shank
   c. twist
   d. spur
   e. cutting edge
   f. feed screw

II. Sizing

A. Range

1. No. 3 - 32
2. Stamped on tang
3. Indicates sixteenth of an inch

B. Standard set

1. No. 4 - 16
2. No. 4 = 4/16 or 1/4

III. Sharpening An Auger Bit

A. Auger bit file

B. Stroke upward through throat

C. File spurs on inside surface only

IV. Drilling And Boring

A. Marking holes

1. Scratch awl
2. Dividers

B. Position of drill

1. Vertical
2. Horizontal
3. Angle
   a. jig
   b. sliding t-bevel

C. Counter boring

1. Setting screws
2. Plugging holes

V. Using A Foerstner

A. No feed screw

B. Drill holes that go only part-way through stock

VI. Care In Drilling

A. Clamp all work securely

B. Block back of work so drill will not splinter out edge of hole

C. Drill through wood till screw point breaks through wood, then drill from other side to finish hole

D. Use depth gage to regulate depth of hole

REFERENCE: Wagner, Willis H., Woodworking, Pp. 35-40

UNIT EIGHT

CLAMPING AND GLUING WOOD

UNIT OBJECTIVE: To show how research has benefited industry in the proper way to secure wood joints by using the desired type of glue at the right time.

STUDY OUTLINE: To learn more about gluing and clamping wood through projects, exercises, and research on material testing.

I. Wood Glues

A. Polyvinyl resin emulsion glue (white glue)

1. Sets up quickly
2. Is not waterproof
3. Does not resist high temperature
4. Liquid form (ready to use)

B. Urea-formaldehyde resin glue

1. Powder form
2. Mix with water
3. Suited for articles subjected to moisture a short period of time

C. Resorcivol resin glue

1. Two components
   a. dark reddish liquid(resin)
   b. powdered or liquid hardener (catalyst)
2. Working life (2-4 hours)
3. Waterproof

D. Animal glue

1. Composed of animal
   a. hides
   b. bones
   c. trimmings
2. Refined units
   a. sheets
   b. flakes
   c. powder
3. Apply hot
4. Working time (10-15 minutes)

II. Applying Glue

A. Spread evenly on both surfaces

1. Scrap wood
2. Hacksaw blade

B. Reverse end grain

1. One up
2. One down

III. Clamping Wood

A. Bar clamps

1. Alternate setting of clamps
   a. one on top
   b. next on bottom
2. Alternate ends for tightening
3. Tightening till glue squeezes out along edge

B. Hand screw clamps

1. Prevents wood from bowing
2. Clamp both ends

C. Clamping jigs

1. Curved surfaces
2. Irregular surfaces

IV. Preparing Surface

A. Plane and true surface

B. Cover surface of wood with wax

1. Prevents absorbation of glue into surface
2. Expediates removal of excess glue

REFERENCE: Wagner, Willis H., Woodworking, Pp. 41-45

UNIT NINE

METAL FASTENERS FOR WOODWORKING

UNIT OBJECTIVE: To familiarize the student with the many different types of wood fasteners both old and new and how to apply them to their specific purpose.

STUDY OUTLINE: To learn more about securing wood by the use of metal fasteners with actual participation in exercise and projects.

I. Types of Fasteners

A. Common nails

1. Common
2. Box
3. Casin
4. Finish
5. Brad

B. Special Purpose

1. Annular thread
2. Spiral thread
3. Double head
4. Masonry
5. Annular thread roofing

C. Size

1. Common nail
   a. penny (d)
   b. 2 d (penny) is 1" and increases 1/4" for each penny
   c. 4 d length = $1 + 2 \times \frac{1}{4} = 1\ 1\ \frac{1}{2}$" length
2. Brads
   a. actual length
   b. wire gauge number

D. Material nails are composed of

1. Common
   a. mild steel
   b. iron
2. Special purpose nails
   a. copper
   b. bronze
   c. aluminum
   d. stainless
   e. have special coating
      (1) resin
      (2) zinc

II. Wood Screws

A. Size

1. Length
   a. 1/4" - 6"
2. Diameter gauge number
   a. 0-24 - with 24 largest

B. Classified

1. Shape of head
   a. flat
   b. round
   c. oval
2. Surface finish
   a. machine
   b. blued
3. Material composed of
   a. steel
   b. b. brass
   c. bronze
   d. plated screws

C. Setting screws

1. Two holes for each screw
   a. one fits screw shank (shank hole)
   b. one fits root diameter of screw (pilot hole)
2. Countersinking
   a. flat
   b. oval head screw
3. Driving screws
   a. standard slotted screwdriver
   b. phillip head screwdriver
   c. cabinet tip

III. Special Fasteners

A. Lag screws

B. Carriage bolts

C. Stove bolts

D. Corrigated fasteners

E. Wood joiners

F. Chevrons

IV. Tips On Metal Fasteners

A. Work slowly so as not to mar the wood

B. Coat screws with wax or soap for easier driving

C. Blunt point of nail to prevent splitting of wood

D. Use nail set to drive nail below surface of wood

REFERENCE: Wagner, Willis H., Woodworking, Pp. 46-50

IV. Wood Scraper

A. Used before sanding begins

B. Sharpening (draw filing)

C. Burnisher

1. 85 degree angle
2. Use oil

V. Repair Damage To Wood Surface

A. Place water on dents (small dents)

1. Causes wood to swell
2. Sand out slight imperfections

B. Soldering iron and wet cloth (large dents)

C. Checks - cracks and holes

1. Stick shellac
2. Wood putty
3. Plastic wood
   a. keep lid closed
   b. select color
4. These repair materials will not stain correctly, therefore, as close shading as possible should be considered at time of purchase

V. Final Touch

A. "Soften" all corners to remove sharpness

B. Dust project

C. Swell grain slightly

D. Sand with extra fine sandpaper

E. Dust

F. Apply finish

REFERENCE: Wagner, Willis H., Woodworking, Pp. 51-56

UNIT TEN

SANDING AND PREPARING FOR FINISH

UNIT OBJECTIVE: (1) The students will develop an understanding of the materials both natural and man made and the classification used in sizing abrasives.
(2) The student will apply the selection of an abrasive for a specific project and sharpen and use a hand scraper.
(3) The student will study about and use the process of raising the grain of wood with water.

STUDY OUTLINE: The student will find information about this unit in the text, by actual use of the abrasive and wood repair techniques on wood. Literature from the company woodworking magazines and reference books would also be of aid.

I. Sanding

A. Purpose

B. When to start usage

C. List of abrasives (working from coarse to fine)

II. Kinds and Grades of Abrasives

A. Natural

B. Man made

C. "Aught" system of grading

D. Mesh system

E. Packaging

III. Sanding Operation

A. Sanding prior to assembly

B. "Touch-up" sanding

C. Sand with the grain

D. Cutting sheets of abrasive to size

E. Sanding block

F. Sanding small pieces

IV. Wood Scraper

A. Used before sanding begins

B. Sharpening (draw filing)

C. Burnisher

1. 85 degree angle
2. Use oil

V. Repair Damage To Wood Surface

A. Place water on dents (small dents)

1. Causes wood to swell
2. Sand out slight imperfections

B. Soldering iron and wet cloth (large dents)

C. Checks - cracks and holes

1. Stick shellac
2. Wood putty
3. Plastic wood
   a. keep lid closed
   b. select color
4. These repair materials will not stain correctly, therefore, as close shading as possible should be considered at time of purchase

V. Final Touch

A. "Soften" all corners to remove sharpness

B. Dust project

C. Swell grain slightly

D. Sand with extra fine sandpaper

E. Dust

F. Apply finish

REFERENCE: Wagner, Willis H., Woodworking, Pp. 51-56

UNIT ELEVEN

WOOD FINISHING

UNIT OBJECTIVE: (1) To make the student aware of the different types of finishes used in Woodworking.
(2) Subject matter information and manipulative techniques in selecting and applying a finish to wood.

I. Wood Finishing

A. Translucent finish

1. Usually used on open grain
2. Brings out natural beauty of grain

B. Opaque finish

1. Usually used on closed grain
2. Covers grain and hides imperfections

II. Applying A Translucent Finish

A. Types of stains

1. Water
2. Oil
3. Spirit

B. Applying stain

1. Penetrating
   a. brushed on, excess wiped off
   b. drying time 24 hours
2. Pigment stains
   a. brushed on
   b. drying time 12 hours
   c. sealer usually not necessary
3. All stains
   a. study manufacturer's instructions
   b. try out stain on scrap wood
   c. use proper solvent for each type

C. Applying paste filler

1. Composition
   a. silex
   b. linseed oil
   c. turpentine and driers
   d. purchased in natural shade or several colors
2. Method of application
   a. pour small amount on wood surface
   b. spread and rub it into wood
   c. allow to dry 10-20 minutes
   d. excess wiped off across grain with coarse rag
   e. remove filler from corners
   f. finish by wiping lightly with grain
   g. sand lightly with sandpaper after overnight

D. Sealers

1. Shellac (4 lb. cut)
2. Lacquer based (sanding sealer)
3. Applied by brush
4. Four pound cut shellac reduced with equal amount of alcohol
5. Flow in shellac
6. Do not brush back over the work
7. Allow to dry two hours or more
8. Rub down with fine steel wool

E. Shellac finish

1. Apply second and third coats
2. Allow overnight drying
3. Rub each down with steel wool
4. Apply coat of paste wax

F. Lacquer and varnish finish

1. Stain, fill and seal project
2. Clean surface
3. Thin finish (proven solvent)
4. Use fairly long strokes
5. Complete one section at a time
6. Do not go back over a surface once it has been coated
7. Work from center to edges
8. Keep surface between you and light source
9. Apply at least two coats
10. Allow plenty of drying time
11. Sand down between coats
12. Rub lightly after final coat with pumice stone and oil
13. Apply a good grade of paste wax

F. Penetrating sealer (rub-on "finish")

1. Manufactured under many names sealocell, varnowax, royal finish, Duro-seal, Deft, and etc.)
2. Will produce a good finish
3. Easy to apply
4. For best results follow manufacturer's recommendations

III. Apply An Opaque Finish

A. Paints and enamel

1. Used on closed grain usually
2. Seal in knots with shellac
3. Brush on coat of enamel undercoater
4. Allow to dry
5. Sand lightly
6. Apply second coat
7. When sanding second coat use wet-or-dry fine paper
8. Finishes should always be rubbed in the direction of the wood grain

B. Latex emulsions

1. Advantages
   a. easy to apply
   b. dry quickly
   c. requires no undercoat
   d. water is used for thinner

REFERENCE: Wagner, Willis H., Woodworking, Pp. 56-63

WORKING

NINTH
GRADE

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NINTH GRADE

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SPECIFIC OBJECTIVES OF GENERAL WOODWORKING

1. To provide experience in the manipulative use of both stationary and portable power equipment found in the woodworking area.

2. To provide experience for the student to become familiar with specific terms used in woodworking.

3. To impress upon the student the value of a good safety program.

4. To develop an appreciation of one's dependence upon wood products and the importance of conservation.

5. To increase the student's knowledge in techniques and fundamentals associated with woodworking tools and equipment.

SAFETY RULES FOR GENERAL WOODWORKING

1. Dress Safely; shirt tails tucked inside trousers, sleeves buttoned at wrist, wear hard sole shoes.

2. Wear proper eye protection at all times.

3. There will not be any horseplay in the shop. It is a place to learn and work not misbehave.

4. Use all tools for their intended use.

5. Keep all tools sharp and in good repair.

6. Return all tools to their proper place after using them.

7. Throw all waste material in the scrap barrel.
   Keep the floor and table free from litter.

8. Obtain permission from instructor before using any piece of equipment in the Industrial Arts Laboratory.

9. Report all injuries to the instructor immediately.

10. Remember the ABC's of Safety,

A L W A Y S B E C A R E F U L

GENERAL WOODWORKING
COURSE ANALYSIS

LEARNING TECHNIQUES	RELATED INFORMATION	SUGGESTED ACTIVITIES	Shoe Shine Stand	Knife Holder	Gunrack	Bookcase	Record Cabinet	Coffee Table	
Purchasing & Measuring Lumber	Grading Associations		x	x	x	x	x	x	
Designing	Types of Lumber		x	x	x	x	x	x	
Make Plan of Procedure	Forest Location & Conservation		x	x	x	x	x	x	
Make a Bill of Material	How Lumber is Sold		x	x	x	x	x	x	
Figure Cost of Project	Calculating Bd. & Sq. Ft.		x	x	x	x	x	x	
Lay out Stock	Lay Out Tools		x	x	x	x	x	x	
Cutting Stock To Rough Size	Cross Cut & Rip Saws		x	x	x	x	x	x	
Planing on the Jointer	Jointer Parts & Safety					x	x	x	
Glueing Stock Edge to Edge	Kinds & Contents of Glue					x	x	x	
Make Edge Dowel Joint	How Dowels are Made & Used					x	x	x	
Glue & Clamp Stock	Types of Clamps		x	x	x	x	x	x	
Surface Face of Stock	Planes, Scrapers & Chisels		x	x	x	x	x	x	
Square Stock on Table Saw	Safety on Table Saw		x	x	x	x	x	x	
Lay Out Joints	Kinds of Saw Blades		x	x	x	x	x	x	
Make Butt Joint	Parts of the Saw		x	x	x	x			
Cut Rabbet Joint	Where Different Joints		x			x	x		
Cut [illegible]	Are Used in Furniture		x			x	x		
Cut [illegible]	Construction							x	
[illegible]ing:	Safety on Jig Saw								
Curves	Types of Blades		x	x	x			x	
Chamfers	Adjusting Saw							x	
Bevels	Safety on Bandsaw							x	
Sawing on Jig Saw	Parts of Band Saw		x						
Sawing with Bandsaw	Adjustment of Saw		x	x	x			x	
Boring & Drilling Drill Press	Safety Involved		x			x	x	x	
Drilling Portable Electric	Changing Speed		x			x	x	x	
Shaping & Routing With Router	Types of Bit & Their Use			x	x			x	
Fastening With Screws	Safety, Knives, & Use		x				x	x	
Fastening With Nails	of Router								
Sanding With the Disc Sander	Kind & Types of Abrasives		x	x	x			x	
Sanding With Orbital & Belt Sander	Safety & Use of Sanders		x	x	x	x	x	x	
Fastening Devices, Hinges & Other Cabinet Hardware	Kind & Types of Fastening Devices		x	x					
Selecting Finishing Materials	Types of Finish		x	x	x	x	x	x	
Applying a Finish	Finishing Materials		x	x	x	x	x	x	
Care & Use of Finish Materials	Cleaning Finishing Equip.		x	x	x	x	x	x	

UNIT ONE

PURCHASING AND MEASURING LUMBER

UNIT OBJECTIVE: To present to the student the accepted method of purchasing and measuring lumber, also, the fundamental knowledge required to figure a bill of material.

STUDY OUTLINE: To learn the various methods used in figuring a bill of material and how the various woods are bought and sold by study, research, field trips and movies.

I. Measuring

A. Board foot

1. $\frac{Th'' \times wd'' \times l'}{12}$
   a. th = thickness
   b. wd = width
   c. l = length
   d. 12 = common denominator for L in feet
      144 = common denominator for L in inches
2. One board foot = 1 pc. wood 1" x 12" x 12"
3. Thickness
   a. under 1" figured as full 1"
   b. over 1" figured to correct size $1\frac{1}{4}$" th. - figured as $1\frac{1}{4}$"
4. Used to figure all hardwood and soft wood

B. Square foot

1. Plywood
2. Masonite
3. Composition wood
4. Price per square foot

C. Lineal or running foot

1. Molding
2. Trim
3. Price per foot

II. Types Of Lumber

A. Hardwood

1. Architectural woodworking
2. Furniture
3. Cabinet making
4. Does not contain resin
5. Cut in standard thickness and width

B. Softwood

1. Construction work
2. Interior of cabinets and furniture
3. Outdoor furniture
4. Early american furniture
5. Cut in even width and length

C. Plywood

1. Thin sheets of wood glued together
2. Each sheet is perpendicular to the other
3. Used both inside and outside depending on glue used in construction of plywood

III. Grades Of Lumber

A. Hardwoods

1. National Hardwood Association
2. American Walnut Association
3. Amount of usable lumber in piece
   a. first = highest grade
   b. second = next grade
   c. FAS = first and seconds

B. Softwoods

1. California Redwood Association
2. West Coast Lumberman's Association
3. Western Pine Association
4. Southern Pine Association
   a. select = best grade
      (1) No. 1 - No. 2 clear
      (2) C Select - D Select
   b. shop
      (1) 3rd clear (3rd clear and factory select)
      (2) No. 1 shop
      (3) No. 2 shop

C. Common

1. No. 1 common
2. No. 2 common
3. No. 3 common

IV. Surfacing

A. Rough

1. Has not been planed
2. As it comes from the mill

B. S2S - S4S

1. Surfaced on 2 sides
2. Planed on 4 sides

V. Drying

A. Air dry (AD)

1. Weeks to month
2. Depends on
   a. type of lumber
   b. moisture content

B. Kilm dry (KD)

1. Artifically dried by air
2. Time required
   a. one week
   b. depend on moisture content

VI. Plywood

A. Thickness

1. Plies 3 - 7
2. 1/8" - 3/4"

B. Types

1. Fir
2. Hardwood

C. Grade

1. Sound 1 side (S1S)
2. Sound 2 side (S2S)
3. Fir face veneer
   a. A = best face
   b. D = worst face
4. Hardwood
   a. good 1 side
   b. good 2 sides

REFERENCE: Gronenan, Chris, General Woodworking, Pp. 5-8

UNIT TWO

DESIGNING AND PLANNING A PROJECT

UNIT OBJECTIVE: (1) To acquaint the student with the various aspects of design, its function and beauty.
(2) To make the student aware of the necessity of proper planning procedures.

STUDY OUTLINE: To learn more about planning and design through application of it within projects, exercise and study.

I. Design

A. Beauty

1. Line
2. Mass
3. Shape
4. Balance

B. Function

1. Decorative
2. Useful

II. Planning

A. Bill of material

1. Kind of material
2. Number of pieces
3. Size of each piece
4. Board feet or square feet of each piece

B. Worksheet

1. Plan of procedure
   a. outline of work in the order performed
   b. working sketch complete with all dimensions
2. List of tools required to complete this project
3. Special machines that may be used

REFERENCES: Groneman, Chris, General Woodworking, Pp. 9-11; 174-184

UNIT THREE

SELECTING AND CUTTING STOCK TO ROUGH SIZE

UNIT OBJECTIVE: To teach the student the correct way to use the woodworking tools in measuring, laying out, and cutting stock to rough size.

STUDY OUTLINE: To learn more about the tools used in the woodworking profession through actual use and demonstration by the instructor.

I. Tools

A. Bench rules

1. One foot
2. Two foot
3. Folding rule
4. Zigzag rule
5. Steel rule

B. Squares

1. Try square
2. Sliding t-bevel
3. Framing square

C. Marking tools

1. Knife
2. Marking gauge
3. Compass or dividers

D. Cutting tools

1. Cross cut saw
   a. cut across grain
   b. cut 45 degree angle
2. Rip saw
   a. cut with grain
   b. cut 60 degree angle
3. Backsaw
   a. cut across or with grain
   b. cut perpendicular to wood
   c. hold wood in miter box or bench hook
4. Power saws
   a. jig saw
   b. band saw
   c. table saw
   d. sabre saw
   e. (DeWalt) radial saw
5. Special saws
   a. keyhole
   b. coping

II. Selecting Wood

A. Match grain

B. Match color

C. Reverse end grain

III. Cutting Wood

A. Length - $\frac{1}{4}$" oversize

B. Width - $\frac{1}{4}$" oversize

C. Thickness - 1/32" oversize

REFERENCE: Groneman, Chris, General Woodworking, Pp. 14-20

UNIT FOUR

PLANING ON THE JOINTER

UNIT OBJECTIVE: To provide necessary information and safe working habits in preparing wood edges for joining.

STUDY OUTLINE: Subject matter information the student should acquire for safe efficient use of the jointer, through study and demonstration.

I. Jointer

A. Parts

1. Base
2. Front table
3. Rear table
4. Cutter head and blades
5. Fence
6. Safety guard

B. Use

1. To do the machine work of a hand plane
2. Cut rabbits, tapers, bevels, and chamfers

C. Safety rules

1. Keep guard in place at all times
2. Plane only boards 12" or longer
3. Use push block in surfacing boards on jointer
4. Always hold board firmly against fence of table
5. Surface concave side of warped boards first
6. Stand to the left of machine never at end of front table
7. Do not attempt to plane end grain
8. Always try to plane with grain

II. Planing

A. Adjust front table 1/32" for surface 1/16" for edge

B. Rear table even with top of blades (Do not change setting without permission)

C. Test fence for squareness to surface of table

D. Take trial cut on scrap wood

E. Hold face of board firmly against fence and feed slowly

F. Repeat Step E if necessary

REFERENCE: Groneman, Chris H., General Woodworking, Pp. 120-122

UNIT FIVE

WOOD JOINT CONSTRUCTION

UNIT OBJECTIVE: To familiarize the student with the various joints and how they are made in the construction of a piece of furniture or cabinet work.

STUDY OUTLINE: Information the student should know concerning when, how, and why certain types of joints are used for best results.

I. Types of Joints

A. Edge

B. Butt

C. Rabbet

D. Dado

E. Doweled

F. Cross lap

G. Middle lap

H. Miter

I. Splined

J. Mortise and tenon

K. Dove tail

II. Purpose of Joints

A. To hold pieces of wood together permanent or temporary

B. Furniture construction

C. Cabinet work

D. General woodworking

III. When To Use Certain Types of Joints

A. Edge joint

1. To join two pieces of wood edge to edge
   a. simple to make
   b. it is weak
   c. to make stronger insert dowels

B. Butt joint

1. Used when end grain meets surface
   a. simple to make
   b. it is weak
   c. can be fastened with
      (1) glue
      (2) nails
      (3) screws
      (4) dowels
      (5) corrugated fasteners

C. Dado

1. Used in drawers, shelves, bookcases and step ladders
2. Description
   a. groove cut across the grain of one piece of wood into which another piece is fitted

D. Rabbet

1. Used in corner construction
2. Similar to dado but pieces are joined together at ends

E. Lap joints

1. Kinds
   a. middle lap
   b. cross lap
      (1) one of the most common joints in furniture and carpentry

F. Mortise and tenon

1. Use
   a. furniture and cabinet work
   b. doors and window sash
2. Types
   a. through mortise and tenon
   b. blind mortise and tenon
   c. haunched mortise and tenon
   d. stub mortise and tenon
   e. mitered mortise and tenon

G. Miter joint

1. Used where you do not want end grain to show
2. Picture frames, door moldings
3. Strengthened with nails, dowels, and splines

H. Dove tail

1. Used in drawer construction
2. Has beauty and strength
3. Special equipment needed to make

REFERENCE: Groneman, Chris H., General Woodworking, Pp. 73-85

UNIT SIX

GLUING AND CLAMPING

UNIT OBJECTIVE: (1) To provide experiences which would make the student more aware of different kinds of glues available for specific jobs and of the criteria used in the selection of a specific glue.

(2) To provide experiences in which the student is exposed to and uses several of the clamping techniques used in holding wood while the glue dries.

STUDY OUTLINE: The student may find reading material in the textbook, reference books, and through literature provided by the companies. Practical application of the selection of glues and clamping operations will be conducted in the course.

I. Kinds of Glues

A. Classification and uses

1. Animal glue
2. Casein glue
3. Plastic-resin glue
4. Polyvinyl-resin glue
5. Resorcinol-resin glue
6. Fish glue
7. Contact cement
8. Instant electronic gluing

B. Manufacturers instruction

1. Implications for purchasing
2. Implications for usage

II. Gluing Operations

A. Making boards wider

B. Making boards thicker

C. Problems encountered with gluing end grain

D. Double spread glue joint

E. Single spread

F. Water proof and non-water proof gluing

III. Clamping

A. Kinds

1. C-clamp
2. Cabinet or bar
3. Hand-screw
4. Clamping jigs

B. Operations

1. Mix glue
2. Set clamps
3. Trial assembly (positioning of clamps)
4. Applying glue
5. Locate scrap blocks to protect edges
6. Using paper between board and clamp to avoid clamp becoming glued
7. Wipe off surplus glue
8. Necessity of getting all glue off surface prior to finish
9. Necessity for working neatly

REFERENCE: Groneman, Chris, General Woodworking, Pp. 94-96

UNIT SEVEN

SAFETY RULES FOR THE TABLE SAW

1. Never use the table saw without permission.

2. Make certain that the safety guard is in place and properly adjusted.

3. Set the saw blade so that it will extend approximately 1/8" - 1/4" above the stock.

4. Stand to one side of the saw. If the board kicks back from binding it will not hit you.

5. Turn off machine before making adjustments.

6. Keep your hands away from the blade.

7. Use a push stick when necessary.

8. Always use the ripping fence or cut-off guide.
   Never Saw Free Hand.

MACHINE TOOL PROCESSES

UNIT OBJECTIVE: To familiarize the student with power tools, their operations, the safety procedures, and the cutting operations that can be performed on said machine.

STUDY OUTLINE: To become acquainted and familiar with the different machines used by the woodworking industry. To learn the value of safety practices and to study the related information concerning the various machines.

I. Table Saw

A. Operations

1. Ripping
2. Cross cutting
3. Rabbeting
4. Dadoing
5. Making tenons
6. Angular cuts

B. Parts of saw

1. Cut off guide (miter gage)
2. Guard
3. Ripping fence
4. Table
5. Hand wheel
   a. blade-tilting wheel
   b. blade-raising wheel
6. Frame

C. Sizes

1. Diameter of blade
2. Table size
3. Kind of blade
   a. rip
   b. cut off
   c. combination

D. Tips on sawing

1. Measure twice before sawing once
2. Cut on outside edge of line
3. Use correct saw blade for cut

II. Band Saw

A. Safety

1. Check tension on blade according to manufacturer's instructions
2. Keep machine well lubricated
3. Do not feed work into blade too fast
4. Avoid backing out of a cut
5. Make curves gradually

B. Operations

1. Straight sawing
2. Cutting curves
3. Cutting irregular cuts

C. Parts

1. Frame
2. Two wheels
3. Adjustable table
4. Two adjustable saw guides
5. Adjustment levers
6. Blade
7. Safety guards
8. Ripping fence
9. Miter gauge

D. Sizing

1. Diameter of wheels

III. Jig or Scroll Saw

A. Safety

1. Teeth point down when properly installed
2. Maintain proper tension on blade
3. Handle the board being cut with both hands
4. Adjust hold down device so it will barely clear work

B. Parts

1. Base
2. Frame
3. Table
4. Chucks
   a. upper
   b. lower
5. Tension sleeve and guide
6. Hold down device

C. Size

1. Horizontal distance between saw blade and arm of frame
2. Length of blade

Operations

1. Curves
   a. internal
   b. external
2. Cut off work (small)

IV. Drill Press

A. Safety

1. Remove key from chuck before starting to drill
2. Check pulley combination to see if proper speed is set up
3. Dress safely
4. Cover pulleys with guard
5. Secure work firmly with vise or clamp
6. Never touch spindle, chuck or pulley while machine is in motion

B. Parts

1. Base
2. Column
3. Table and lock
4. Chuck
5. Motor
6. Depth gage
7. Belt and spindle guard
8. Adjusting device

C. Operations

1. Boring
2. Drilling
3. Mortising
4. Shaping
5. Routing
6. Sanding

D. Classification

1. Table model
2. Floor model
   a. chuck sizes

E. Drills

1. High speed drills
2. Spade type wood bit

REFERENCE: Groneman, Chris, General Woodworking, Pp. 104-124

UNIT EIGHT

PORTABLE POWER TOOL PROCESSES

UNIT OBJECTIVE: To familiarize the student with the portable power tools, their operations, the safety procedures and their cutting operations that can be performed on said machine.

STUDY OUTLINE: To become acquainted and familiar with the different machines used by the woodworking industry. To learn the value of safety practice and to study the related information concerning the various machines.

I. Electric Handsaw

A. Safety

1. Disconnect the plug from the electric power outlet when the the tool is not in use
2. Check to see that the electrical connection is grounded
3. Keep the retractable safety guard operating freely
4. Use a guide in ripping
5. Allow the blade to come to full speed before cutting
6. Never make adjustments until machine has come to full stop
7. Protect your clothing

B. Operations

1. Ripping
2. Cross cutting
3. Beveling
4. Rabbeting
5. Dadoes
6. Miter
7. Sanding

C. Parts

1. Blade
2. Base plate
3. Safety guard
4. Bevel adjustment
5. Motor
6. Handle
7. Trigger release switch

D. Sawing tips

1. Make sure work is level when sawing
2. Hold work securely when sawing
3. Do not pinch saw blade

II. Jig Saw (Sabre Saw)

A. Safety

1. Hold tool firmly
2. Concentrate on what you are doing
3. Hold or clamp board so it will not vibrate

B. Parts

1. Vents
2. Brushes
3. Handle
4. Base
5. Switch
6. Blade

C. Operations

1. Piercing
2. Internal cutting
3. External cutting
4. Scrolling

III. Portable Electric Drill

A. Safety

1. Do not use bits larger than one recommended by manufacturer
2. Fasten the bit firmly in the chuck
3. Keep the air-cooling vents on the drill housing free of dirt

B. Parts

1. Handle
2. Body
3. Chuck
4. Twist drill
5. Key
6. Instant release trigger switch

C. Operations

1. Drilling
2. Polishing
3. Sanding
4. Mortising

IV. Router

A. Safety

1. Be sure machine is shut off and disconnected when making adjustments
2. Be sure machine is grounded
3. Keep air vents free from dirt
4. Wear safety glasses when operating this machine
5. Maximum depth of cut is 1/4"

B. Operations

1. Common cuts
   a. straight
   b. chamfer
   c. bevel
   d. rabbet
   e. dado
   f. veining
   g. mortising
   h. formica cutting
2. Decorative
   a. dove tail
   b. ogee
   c. cove
   d. beading
   e. round over

C. Parts

1. Base
2. Chuck
3. Handle
4. Depth sleeve
5. Motor
6. Brushes
7. Switch
8. Cord
9. Template guide

V. Sanders

A. Portable belt

1. Safety
   a. always pick up the sander before you plug it in
   b. hold sander off wood when you turn on the switch
   c. lay belt sander on its side when not in use
2. Parts
   a. pulleys
      (1) drive
      (2) idler
   b. belt tension release lever
   c. switch
   d. handle-front ball knob

e. housing
f. brushes
g. dust bag
h. abrasive
(1) size
(a) width
(b) circumference
(c) grit
(d) coarseness of grit

3. Size
a. width of belt
b. circumference of belt

4. Operations
a. sanding
b. bevel
c. chamfer

B. Orbital

1. Parts
a. handle
b. switch
c. vents
d. brushes
e. base pad
f. abrasive locking device front and rear

C. Size

1. Width of pad
2. Length of pad

D. Operations

1. Sanding
2. Polishing
3. Buffing

E. Tips on sanding

1. Keep sanding machine moving, never let it run in one place
2. Use coarse grit paper first; work to fine grit
3. Keep work free from dust
4. Work in well ventilated room

REFERENCE: Groneman, Chris, General Woodworking, Pp. 136-146

UNIT NINE

FASTENERS AND CABINET HARDWARE

UNIT OBJECTIVE: To provide information that enables the student to choose, purchase, and use common hardware fasteners.

STUDY OUTLINE: Subject matter information the students should know concerning hardware that may be obtained from the text, industrial supply catalog and local hardware stores.

I. Screws

A. Types as to head

1. Head
2. Flat
3. Oval
4. Phillips

B. Size

1. 1/4" to 6" length
2. 0-24 gage

C. Finish and composition

1. Mild steel (bright) F.H.B.
2. Mild steel (dull blue) R.H.B.
3. Plated finish (brass)

D. How sold

1. Variety stores and hardware by dozen
2. By the box 1 gross (144)

II. Nails

A. Types

1. Box
2. Common
3. Finishing
4. Brad
5. Casing

B. Size

1. Indicated by term Penny or abbreviation d
2. Brad 1/4" - 1 1/4"
3. a two-penny or 2d 1" long for each additional penny add 1/4" up to 3"
4. 1000 2d nail weigh 2 lbs.
5. Usually sold by lb. and box

III. Cabinet Hardware

A. Hinges

1. Butt
2. Surface
3. Half surface
4. Chest (combination hinges)
5. Cabinet hinges
6. Invisible hinges
7. Embossed surface

B. Finish

1. Bright
2. Blued
3. Plated
4. Antique

C. Drawer pulls and knobs

1. Composition
   a. wood
   b. plastic
   c. composition
   d. metal

IV. Special Fasteners

A. Mounting plate

B. Hanger bolts

C. Lag screws

D. Carriage bolts

E. Dowell screws

F. Splines

G. Corrugated fasteners

H. Wood joiners

I. Chevrons

REFERENCE: Groneman, Chris H., General Woodworking, Pp. 65-72; 97-100

UNIT TEN

FINISHING WOOD

UNIT OBJECTIVE: To increase the student's knowledge of materials used for finishing wood, and methods of application.

STUDY OUTLINE: Subject matter information the student should acquire concerning wood finishing materials with respect to:

I. Types of Finish

A. Transparent

B. Opaque

II. Purpose of Finish

A. Preserve

B. Beautify

C. Protect

D. Harmonize

III. Finishing Materials

A. Stains

1. Purpose
2. Kinds
   a. oil
   b. spirit
   c. water
3. Thinning agent
4. Method of application
   a. brush
   b. rags
   c. follow manufacturer's directions

B. Fillers

1. Purpose
2. Types
   a. transparent
   b. liquid
   c. paste
3. Method of application
4. Time required for drying

C. "Rub-on" finish

1. Method of application
   a. pour small amount on surface
   b. spread with soft cloth
   c. allow to dry 24 hours

d. rub down with steelwool
e. second and third coats same manner
f. finish with wax

D. Shellac

1. Source
2. Liquid used for thinning
3. Time required for drying
4. Its uses

E. Varnish

1. Main ingredients
2. Thinning liquid
3. Purposes of each
   a. cabinet rubbing varnish
   b. flat varnish
   c. spar varnish
   d. color varnsih
4. Applied with brush

F. Spraying lacquer

1. Characteristics
   a. dries quickly
   b. clear or variety of colors
   c. thinner
      (1) special type for manufacturer
   d. gloss, semi-gloss, dull finish

G. Equipment for spraying

1. Spray gun
2. Stationary or portable compressor
3. Safety
   a. adequate ventilation must be provided
   b. lacquer should be stored in closed containers

H. Method of application

1. Seal project (sandy sealer)
2. Dust and clean of sanding
3. Pour lacquer in gun cup 1/3 full, add equal amount of thinners
4. Fasten gun to cup check all connections
5. Turn on compressor, regulate air pressure 35-45 lbs.
6. Hold gun 6"-8" from work
7. Begin stroke, pull trigger
8. Move gun in straight line
9. Release trigger before completing stroke
10. Move gun from left to right and/or top to bottom
11. Allow to dry two hours
12. Remove container, pour remaining lacquer into original can
13. Clean gun and container by spraying lacquer thinner through it

14. Sand lightly
15. Spray two or more coats over entire project, allow each coat to dry four hours
16. If desired rub final coat with commercial rubbing compound
17. Apply paste wax, allow to dry 20 minutes, polish with clean cloth

IV. Opaque Finish

A. Painting or enameling

1. Use
   a. protective or decorative
   b. less expensive woods
   c. paint exterior work
   e. interior work use enamel
   f. enamel contains varnish
2. Application
   a. prepare surface
   b. follow directions on container
   c. use long even strokes
   d. brush from wet areas to dry
   e. work from center to edge
   f. allow plenty of drying time
   g. sand lightly between coats
   h. apply second and third coats if needed
   i. clean brush in turpentine

REFERENCE: Groneman, Chris H., General Woodworking, Pp. 149-163

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ABSTRACT - This curriculum guide will acquaint the civil engineering technology student with plane surveying, giving him a working practical knowledge of the drawings and related calculations needed for map drafting and map plotting. After presenting basic information, sections discuss fixed line direction and description, angle plotting, traverse plotting, latitudes and departures, calculation of areas, route surveys with circular curves, topographic maps, profiles and cross sections, area maps, and reproduction of drawings. The final section consists of 14 mapping plate assignments based on references to preceding sections and on notes included in the field book (VT 002 645, also in this issue) that should be used with this document. (GR)

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ED0 45856

CIVIL ENGINEERING TECHNOLOGY

MAP DRAFTING and RELATED COMPUTATIONS

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CIVIL ENGINEERING TECHNOLOGY

INTRODUCTION

The object and purpose of this manual is to acquaint the student with, and give him a working practical knowledge of the drawings and related calculations that are connected with plane surveying. Plane surveying deals with areas of limited extent where it is unnecessary to consider the curvature of the earth. It deals with the relative location of points on or near the earth's surface. Geodetic surveying takes into consideration the shape of the earth and this manual will not go into that part of surveying drafting.

It is assumed that the student is familiar with the use and care of drafting instruments and equipment such as are used in a good basic course in mechanical drafting. Greater care in the execution of the drawings of surveying is usually required than in ordinary mechanical or architectural drafting. In order to keep the desired consistent relation between the field measurements and the completed map, considerable care and skill in plotting and drafting is required.

In mechanical drafting dimensions are usually noted and scaled dimensions from the drawings are not frequently used. In the drawings connected with surveying, many dimensions are omitted and it is necessary for the users of the maps to rely on scaled distances and angular values that are obtained by measurement from the map.

Drawings of Surveying:

The ordinary drawings connected with plane surveying consist of maps, profiles and cross-sections.

Maps:

A map is a graphical representation, by means of lines and symbols, of a certain portion of the earth's surface. Since the earth's surface is curved, the shape of the earth being that of an oblate spheroid of revolution, and the surface must be presented on the plane of a sheet of paper, there will always be some distortion in the finished map. In the relatively small areas considered in plane surveying, this distortion cannot be measured by ordinary means. The drawings are therefore made as though the earth's surface, over the area being surveyed and mapped, is flat. All measurements made in surveying are horizontal measurements or the measurements are reduced to the equivalent horizontal measurements before being used in map plotting.

Profiles:

A profile in survey drafting is a drawing showing a vertical section along a certain surveyed line. These are usually made by plotting the elevations of points located at relatively short measured distances along a certain located line, such as the centerline of a highway, railroad or canal. An elevation, as the term is used in surveying, is the vertical distance of a point above or below a fixed reference plane. The reference plane most commonly used in surveying is mean sea level. Profiles are along and in the direction of the line surveyed and are plotted as a vertical section. Horizontal and vertical scales are necessary. The roughness of the earth's surface along the line surveyed determines the scales to be used. The horizontal and the vertical scales used are not usually the same. Profiles are usually plotted on squared, cross-section paper, or plan-profile paper.

Cross Sections:

A cross-section is a drawing showing a vertical section usually at right angles to the survey line. Information for plotting cross-sections is obtained by running elevations along lines usually located at right angles to the survey line and out to sufficient distance on each side of the survey line to obtain the desired information. Readings for elevations are taken on the cross line at places where there is a change in the slope of the terrain. Another method is to take different readings and record the elevations only where the readings show a selected contour value. The cross-lines to the survey line are spaced or located at whole station numbers on the survey line and at changes in direction of the survey line. These cross-lines are also placed at any other locations along the line where additional information is desired or the topography indicates that they are needed. The purpose of the cross-lines is to furnish information for location studies, earthwork calculation, drainage studies and locations. They give primary information to determine the shape and configuration of the ground surface on each side of the survey line. Figure 1 shows a typical location of the cross-lines on which elevations are taken on a survey line for plotting cross-sections. In Figure 1 the full line represents the traverse line and the dashed lines represent the cross-section lines.

Traverses:

The expression "traverse" has been mentioned in the preceding discussion. A traverse is, as used in surveying, a succession of points, at more or less regular measured intervals, connected by straight lines the directions of the lines and the distances between points having been measured. There are two types of traverses. A traverse

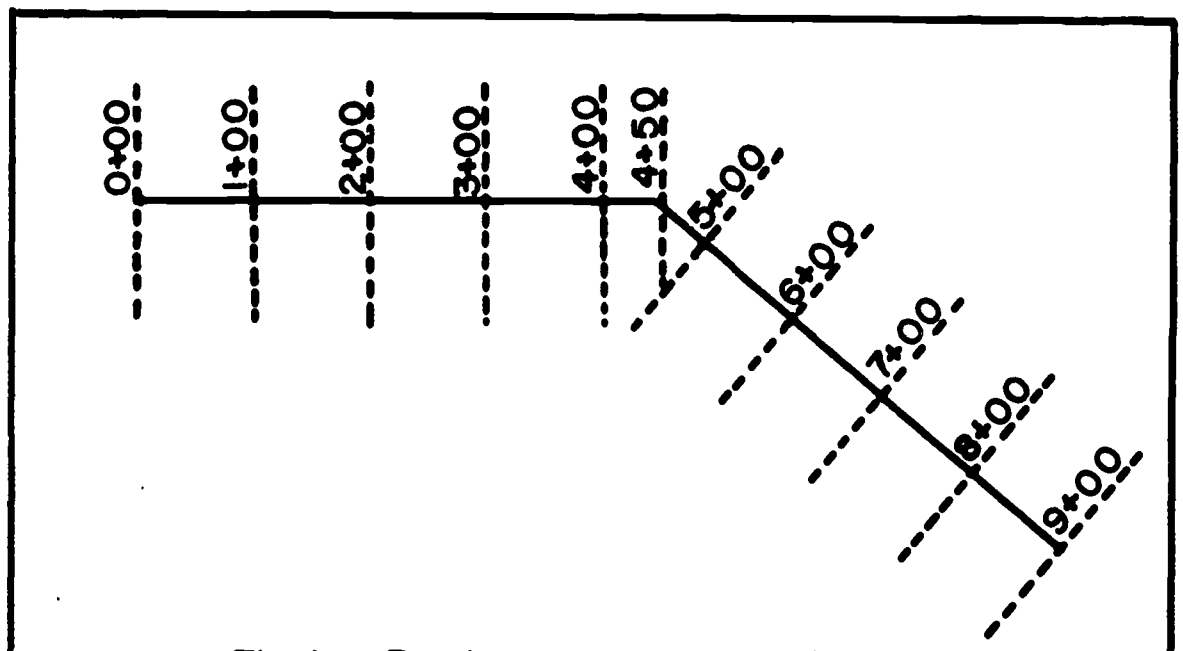


Fig. 1 — Route cross-sections

that begins at a certain point and returns to the point of beginning is called a closed traverse. This is the type traverse encountered in the survey of a tract or parcel of land. A traverse that does not return to the point of beginning is known as an open or continuous traverse. Station numbers are usually used to indicate distances along an open traverse. A station is a unit of 100 feet. This is known as a full station. The fractional part of a full station is known as a plus station. The beginning or starting point in an open traverse is called station 0+00. Open traverses are usually numbered in stations continuously from the beginning point to the end of the traverse. A point at a distance of 782.52 from the beginning of an open traverse would be numbered 7+82.52. The seven indicates the number of full stations and the 82.52 indicates the fractional part of a full station.

During the operation of running a traverse, stakes or markers are set at regular intervals on the line, usually 100 feet apart. Sometimes the distance between stakes is reduced to 50 feet or 25 feet or less. Figure 1 illustrates the method of numbering stations on an open traverse. Each line on a traverse is known as a course. Thus in Figure 8, AB would be called a course.

Examples of open traverses are the surveys for highways, railways, canals and pipelines.

Distances:

Distances are measured in the field with a steel tape, usually 100 feet long. The process of measuring distances is called taping or chaining. Distances are almost always measured

in feet. Another unit of measurement used widely at one time was the Gunter's chain. This was a linked wire chain which was 66-feet long broken down into 100 links. Each link was 7.92 inches long. This unit of measurement was used, by law, in the original surveys authorized by the U.S. Government.

Two types of measurement of angles and distances are encountered. These are observed quantities which are actually observed or measured in the field. The others are calculated quantities which are calculated from measured quantities.

The actual distance between any two stations is found by substracting the smaller station number from the larger station number.

In closed traverses, the actual distances between changes in directions of the lines are recorded in feet instead of station numbers.

Figure 8 is an example of a closed traverse.

All measurements made during the survey are recorded as they are made in a durable notebook. The notebook is known as a Field Book. Notes and figures from this field book are used by the draftsman in making the drawings and maps required. Erasures are not permitted in a field book. A line is drawn through the figure to be corrected and a new figure written.

Kinds of Maps:

It has been stated before that a map is a graphical representation, by means of lines and symbols, of a portion of the earth's surface. A map shows the location of objects, both natural and artificial, on or near the surface of the earth.

There are several types of maps such as topographic, geographic, planimetric, real estate, road maps, land survey maps and many others. If the shape or configuration of the ground surface is shown or indicated on the map, it is known as a topographic map. If the relief of the ground surface is not shown on the map it is known as a planimetric map. Geographic maps show the location of communities, roads, railroads, political subdivisions and much other information.

Scales:

Practically all drawings related to surveying are drawn to scale, that is, a certain distance on the map represents a proportional distance on the ground. The ratio of a distance on the map to the corresponding distance on the ground is known as the scale of the map. We may state the scale as 1" on the map represents 100 ft. on the ground or 1 inch represents any other desirable distance on the ground. The scale may also be stated in another manner such as $\frac{1}{5000}$. This means

that one unit of measurement on the map represents 5000 units of measurement on the ground, the same units of measurement being used, whether they be inches, yards or miles. Another type scale used is a graphical scale. The scale is drawn on the map and represents actual distances. The advantage of this scale is that any distortion due to shrinkage or expansion of the paper also distorts the scale equally and the scale or ratio remains true. A noted scale is one that states that 1 inch represents so many feet such as 1 inch equals 1000 feet. This means that one measured inch on the map represents 1000 feet on the ground. Figure 2 shows some typical graphical scales.

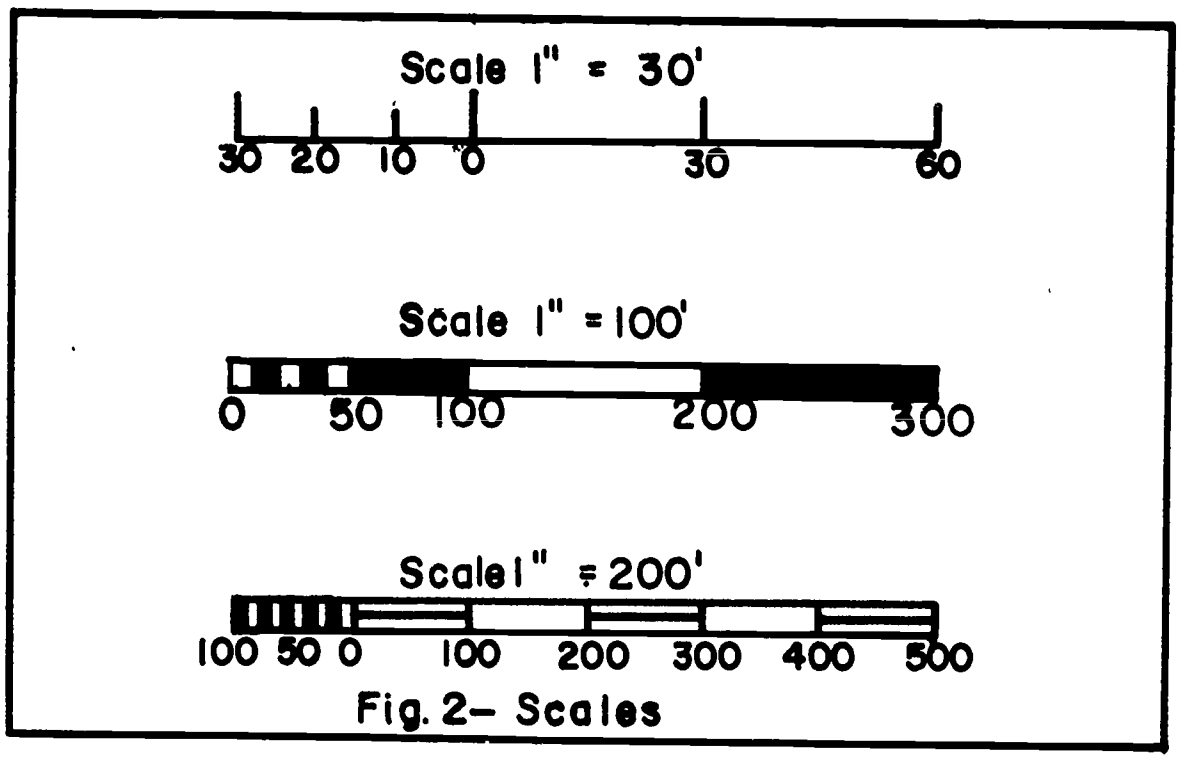


Fig. 2– Scales

North:

All maps should show in which direction the north is in order that the user may orient the map with direction on the ground. The north is indicated by an arrow with the head pointing north. The subject of meridians, or north-south lines, will be discussed later under the subject of direction of lines.

Titles:

Each map should include a title. This gives enough information for the map to be used intelligently. The title should show the name or subject of the map, the authority or who made the map, the direction of the meridian, the scale and any other information needed to use the map.

If conventional signs out of the usual are used, a legend is given showing exactly what the signs or symbols mean or represent. Anything shown out of the ordinary should be explained by a notation at a convenient place on the map.

Symbols:

Objects are represented on a map by certain signs and symbols. Many of these are conventional, that is they are so widely used that they are easily recognized. When a certain sign or symbol becomes accepted widely to mean a certain feature or structure it becomes conventional. The student will soon make a plate showing many generally accepted signs and symbols to represent works, structures and vegetation.

Map Projections:

This manual and the drawings to be made will deal only with plane surveying. To more accurately represent large and extensive portions of the curved earth's surface various map projections have been devised to reduce distortion. Geodetic survey mapping is not considered or discussed in this manual.

Lettering:

Lettering on a map is of great importance. Poor lettering will ruin the appearance of an otherwise perfect drawing. Good lettering ability can be acquired only by studied and frequent practice. It is assumed here that the student has learned the principles of lettering in his basic course in drawing and can continue with the required practice to become skilled in lettering.

Notes and Legends:

Notes and legends are used on a map for explanatory purposes to avoid any doubt in the map users mind. They should be brief but clearly understandable. A key to any but widely accepted symbols should be shown on the map. An acceptable place for notes and legends is near the title block where they are easily seen.

DIRECTIONS OF LINES

Meridians:

The direction of a line in surveying is usually referred to some fixed line. This fixed line to which other lines are referred is usually a meridian. For any point on the earth's surface there is a fixed meridian, that is a north-south line. A meridian is a north-south line. If this line runs through the observers point on the earth and the geographic poles, that is the axis on which the earth rotates, it is known as a true meridian. If the line passes through the observer's point on the earth and in the direction that a compass needle points, it is known as a magnetic meridian. The true meridian and the magnetic meridian coincide only at certain positions on the earth. A compass needle points to the magnetic north pole. The magnetic pole and the geographic pole are not located at the same place on the earth. The geographic north pole is unvarying and remains constant. The magnetic pole is not constant but changes approximately systematically in cycles over periods of time.

The direction of the magnetic meridian may be obtained by noting the direction of the north seeking end of an ordinary compass. The direction of the true meridian can be obtained by astronomical observation.

Another type meridian sometimes used is called an assumed meridian. On small surveys when the exact meridian is unknown, a meridian approximately north is assumed and the lines of the survey are referred to this meridian which is then called an assumed meridian.

Declination:

The angular difference between the true north and the magnetic north is known as the magnetic declination. If the compass needle points to the east of true north, the declination is called east declination. If the needle points to the west of true north, the declination is said to be west. In the United States the declination varies from approximately 24 degrees east of true north to approximately 24 degrees west of true north. The U. S. Government publishes and has for sale, charts showing the declination, annual changes in declination and a line through the U. S. where the declination is zero. These charts are available from the Government Printing Office in Washington, D. C.

Fig. 3 shows how true north, magnetic north and the magnetic declination are indicated. True north is indicated by an arrow

with a full head and tail. Magnetic north is indicated by an arrow with a half head and a half tail. The angular value of the declination is written in the space between the north ends of the arrows.

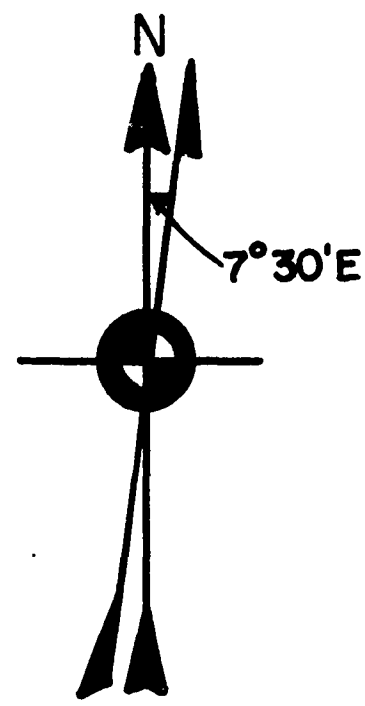


Fig.3.— Meridian arrows

The directions of lines may be shown by several means. These are usually bearings, azimuths, interior angles, azimuth from back line or angles to the right and deflection angles.

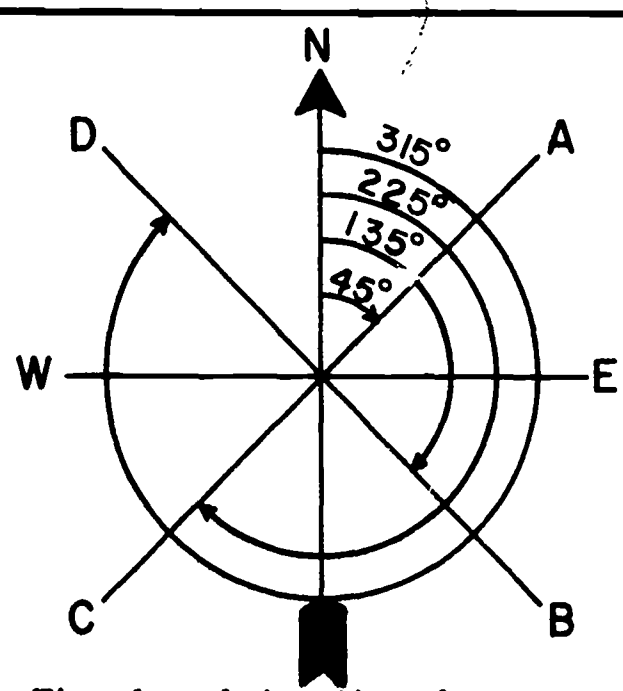


Fig. 4 — Azimuths from north

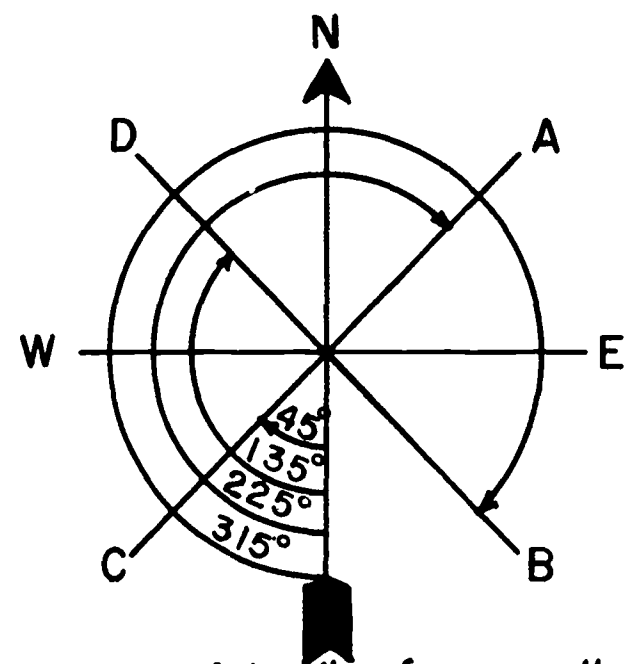


Fig. 5 — Azimuths from south

Azimuths:

The azimuth of a line is the direction of the line given by the angle between the meridian and the line, measured in a clockwise direction from the meridian. This value can vary from 0° to 360°. Azimuths can be measured from either the north or from the south. Figure 4 illustrates azimuths of lines in each quadrant measured from the north. Figure 5 shows the azimuths of the same lines reckoned from the south. Azimuths are called true azimuths, magnetic azimuths, or assumed azimuths depending on whether they are reckoned from the true meridian, the magnetic meridian or an assumed meridian.

Bearings:

The direction of a line may be defined by its bearing. The bearing of a line is indicated by the acute angles between the line and the meridian in each quadrant in which it falls. If the line falls in the N. E. quadrant the bearing is north and east, in the S. E. quadrant the bearing is south and east, in the S. W. quadrant the bearing is south and west, and in the N. W. quadrant the bearing is north and west. The angular value is the size of smaller angles between the meridian and the line. Figure 6 illustrates the bearing of a line in each quadrant. Thus, the bearing of line OA is written N45°E, OB is S45°E, OC is S45°W and OD is N45°W. The numerical value of the bearing angle can vary only from zero degrees to 90 degrees. At 90 degrees the direction of the line becomes either due east or west and is so written. The values illustrated are in even degrees. If the angular value measured contains minutes it is written to include the minutes in the measured value. Thus, a measured angle of 38°41' in the S. E. quadrant would be written S38°41'E.

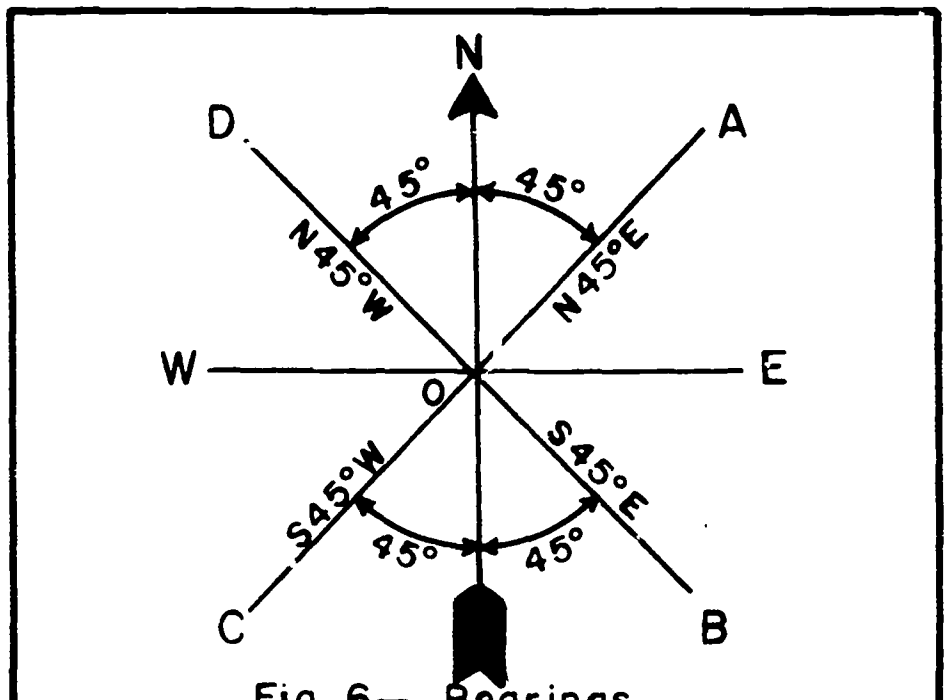


Fig. 6— Bearings

Bearings are called true bearings, magnetic bearings or assumed bearings depending on whether they are reckoned from the true meridian, the magnetic meridian or an assumed meridian.

A line running due north can be written as N. or north. A line due east can be written N90°E or east. The same goes for a line running due south or due west.

Deflection Angles:

A deflection angle is the angle between the extension of the preceding line and the new line. Deflection angles are always stated as being right or left. If the angle between the extension of the preceding line and the line is turned in a clockwise direction it is recorded as right. When turned counterclockwise it is recorded as left.

Figure 7 illustrates deflection angles to the right and to the left. The deflection angle at B is 30°L, at C is 45°R and at D 20°L. The value of deflection angles may vary between zero and 180 degrees.

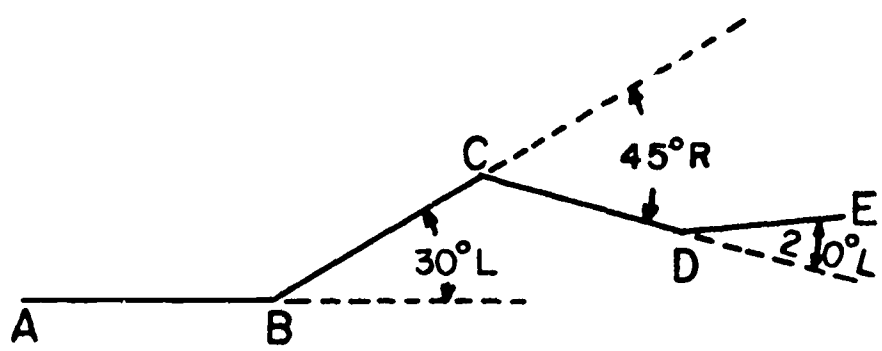


Fig. 7 – Deflection angles

If a closed traverse is surveyed using deflection angles a check on the accuracy of the measurement of the angles is easily made. In any closed figure the algebraic sum of the deflection angles is 360 degrees. The angles to the right are considered positive and the angles to the left are considered negative. The algebraic sum of the angles is 360 degrees, the sign is of no importance; it only indicates the direction taken around the figure.

Interior Angles:

In a closed figure the included angle between two sides inside of the figure is known as an interior angle. This method of measuring angles is used on many property surveys. Figure 8 illustrates interior angles. Interior angles may be of almost any size.

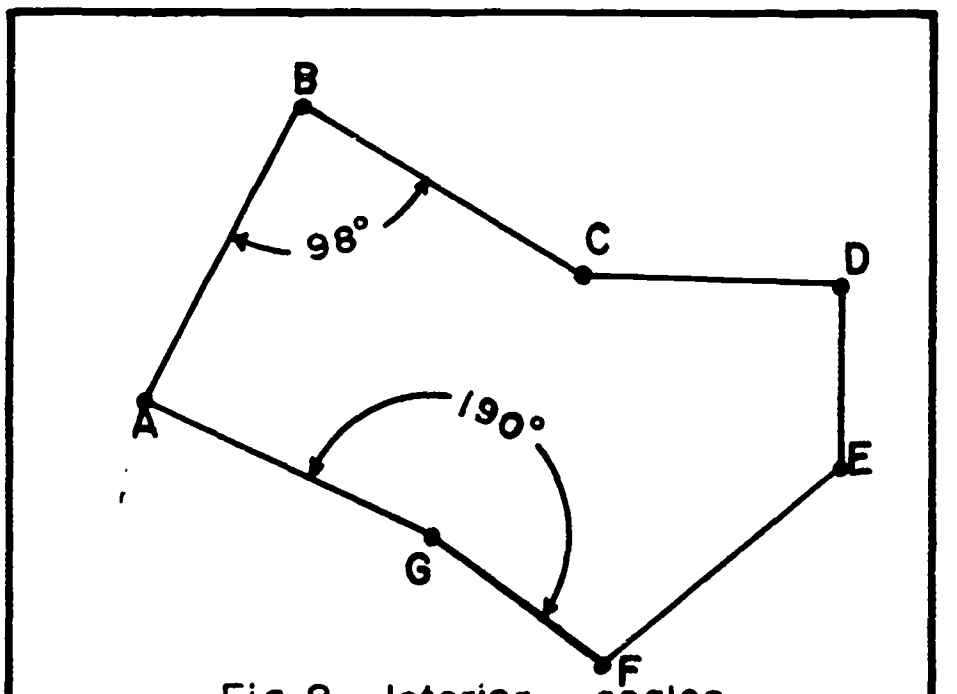


Fig. 8— Interior angles

In any closed figure the sum of the interior angles is equal to the number of sides minus two tir 3 180°. This is usually written (n-2) x 180°, n being the number of sides in the figure. This is a definite check on the accuracy of the measurement of the interior angles in the survey of a closed traverse. This check is usually made at the time of the measurement of the last angle. It is always applied before any other calculations are made. The sum of the measured angles usually does not equal (n-2) x 180° since there is usually some small error in reading angles. If the misclosure in angular value is small and all of the angles were measured under equal conditions, the error is usually distributed equally among the angles to give a mathematically closed angular value. This is known as the angular adjustment of the traverse. Sometimes the error of angular closure is arbitrarily placed in one angular measurement that was made under difficult conditions.

Angles to Right:

Angles which are measured in a clockwise direction from the preceding to the following line are known as angles to the right or azimuths from the back line. These angles may be of almost any value. Figure 9 illustrates angles of this type.

Angles in General:

Angles in general are measured in the field by use of several special types of surveying equipment. They are measured most commonly by means of a surveyor's transit. This instrument is known as the universal surveying instrument and can be used to measure horizontal and vertical angles, stadia distances, differences in elevation and magnetic bearings. Other means of measuring angles are by tape, plane table alidade, sextant, and magnetic compass.

Values that are measured directly in the field are known as observed values. Values that are obtained indirectly by some form of calculation are known as calculated values.

Any of the above discussed systems of measuring angles or directions can be converted to another system most easily by drawing a simple sketch and making a simple calculation. Thus in Figure 7 if the bearing of line AB is east, then the bearing of line BC is $90^{\circ}-30^{\circ} = 60^{\circ}$. The line is in the N. E. quadrant and the bearing is N60°E. The beginner should always use a sketch to show the existing relations between the systems under consideration.

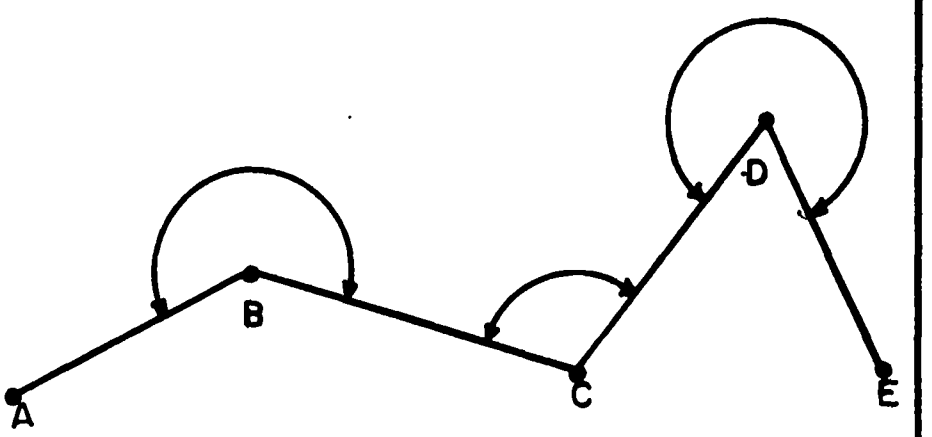


Fig. 9– Azimuth from back line or angles to the right.

PLOTTING ANGLES

After measurements are made in the field and recorded in the notebook it is the job of the draftsman to transform this field information into a map or other drawing. Two of the primary operations are the scaling of distances and the plotting of angles. Sometimes the use of conventional signs and symbols is involved. Usually the map is plotted on a heavy good grade of drawing paper. The drawing is then checked and a tracing made. From the tracing reproductions are made by one of the methods to be discussed in Section 11 of this manual. In some cases a skilled draftsman will work directly on tracing paper or cloth.

The drawings assigned in this manual will be drawn first on drawing paper and then traced in ink on a good grade tracing paper.

The plotting of angles will be taken up first. There are several methods of plotting angles. Some are widely used and some are not often used in plotting. The methods of plotting angles to be discussed are the protractor method, tangent method, chord method and the use of the drafting machine.

Protractor Method:

The protractor method of plotting angles in survey drawings is not widely used except where the map is fairly small or unimportant. With an ordinary six-inch protractor the error in plotting may be as much as 15'. The larger the diameter of the protractor used, the smaller the accidental error introduced will be. Figure 10 is used in discussing the use of the protractor in plotting deflection angles. The first line is fixed by instructions or by estimation. The distance from A to B is then scaled using a needle point to mark the location of B. It is good practice to extend the line AB very lightly in either direction from B to properly orient the protractor at point B. The deflection angle at B is then laid off and marked with a needle point. A light line of indefinite length is then drawn through B and the marked needle point. The recorded distance from B to C is then scaled off along this line. When point C has been located and checked the protractor is then oriented at C and the process of laying off the deflection at C is then repeated as was done at point B. The other points on the line are then located in a like manner until the complete traverse is plotted. The main objection to this method of plotting a traverse is that if an error is made in plotting an angle at any point it affects to a similar degree the direction of all of the succeeding lines. The linear error in plotted position of succeeding points increases with distance.

In plotting the directions of lines from a meridian using either bearings or azimuth it is customary to draw lightly a meridian through each point. The bearing or azimuth is then measured with the protractor to the next point. The distance to the next point is then scaled off. A meridian is then drawn through the located point and the process continued until the full traverse is plotted. An error in the plotting of one direction by this method does not introduce an error in the direction of the following lines but it does introduce a constant linear error in the plotted locations of succeeding points.

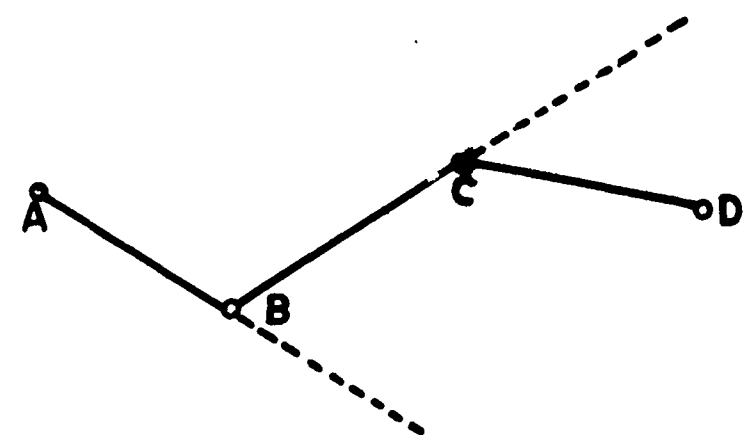


Fig.10-Protractor method of plotting deflection angles.

Tangent Method:

In the plotting of angles by the tangent method linear measurements and a table of the natural tangents are used. These angles plotted are as accurate as the linear measurements can be made. A large enough scale unit is used so as to make the error introduced in the plotting to be negligible. Figure 11 is used in discussing the tangent method of plotting angles. AB represents the plotted position of the initial line of a deflection angle traverse. The line AB is then extended lightly for an indefinite length. Ten units are then scaled off on the prolongation of line AB and point E located with a needle point. Any units on the engineers scale can be used and a scale is usually selected to give sufficient room to work on the sheet of drawing paper. From a table of natural tangents the tangent of 20° is found to be .364. A perpendicular of indefinite length is erected at point E. From point E a distance of 10 x .364 or 3.64 inches is scaled off on the perpendicular line erected at E and marked with a needle point. This locates point F. A line of indefinite length is now drawn lightly through points B and F. The distance between BC is now scaled along the line through B and F. This locates point C in the proper plotted position. The angle between the extension of line AB and the line BF is the required 20° angle. In a right triangle the length of the opposite side from an angle divided by the length of the side adjacent to the angle is equal to the natural tangent of the angle. In this case 3.64 divided by 10 is equal to .364 which is the tangent of 20°.

The tangent method works well on angles up to 45°. For angles above 45° the size of the tangent of angle increases rapidly. Above 45° the length of the perpendicular erected would become too long to be plotted readily. Point C in Figure 11 will be used in discussing a method of plotting deflection angles greater than 45°. The deflection angle at C is taken as 75°R. In this case the base line of 10 units instead of being a prolongation of BC is a base line of 10 units in length erected at C perpendicular to line BC. Point G on the perpendicular at C is located at 10 units from C. The perpendicular offset at G in this case is 10 times the cotangent of 75°. In this case the cotangent of 75° is .268 and the length of the perpendicular offset at G is equal to 10 x .268 which is 2.68 inches which is scaled off from G to point H. A line drawn through C and H plots a deflection angle of 75° to the right at C. The distance from C to D is scaled off along the line through C and H and this locates point D. The plotting of deflection angles by the tangent method is much more accurate than plotting angles by the protractor method provided long enough units are used. It is subject to the same objections brought out in the protractor method in that an error in plotting of the directions of one line affects to the same degree the directions of all following lines.

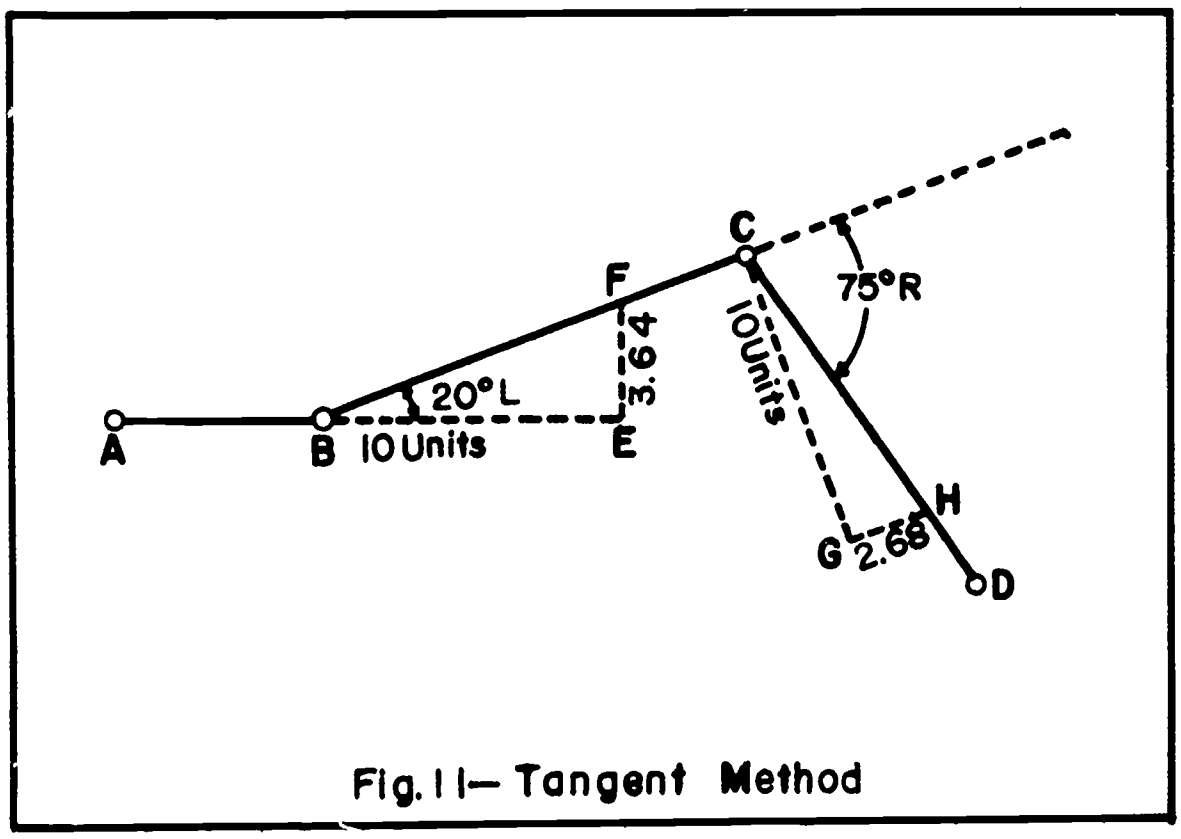
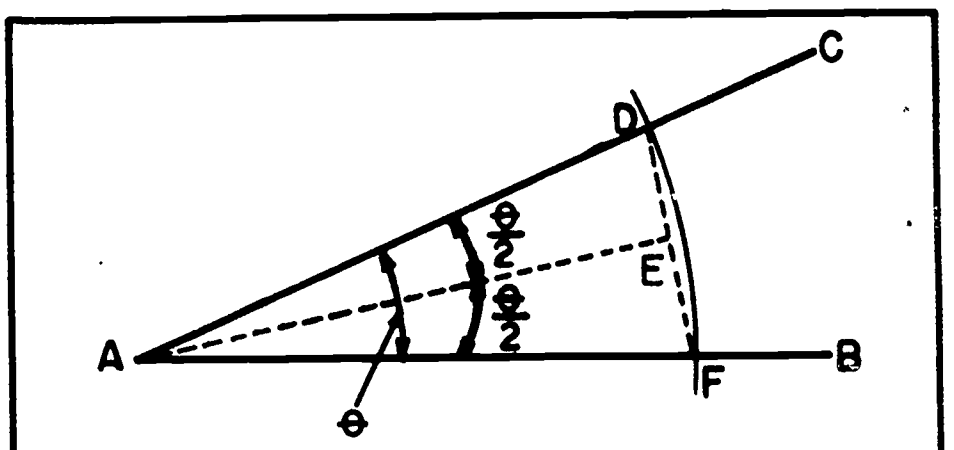


Fig. 11— Tangent Method

Chord Method:

The chord method of plotting angles is sometimes used. It is similar to the tangent method. There is slightly more

calculating to do than in the tangent method. Some engineering handbooks give a table of chord lengths for various angles. When a table of chords is available, the method is as quick or quicker than the tangent method. In a circle of a given radius there is a definite relation between the chord and the chord's subtended angle. Figure 12 shows the theory and mathematics used for obtaining the chord length when a radius of five units is used. It is to be noted that any length units can be used. The reason five units is selected for the radius is that in the end, multiplication by ten is involved which simplifies the calculations. The sine of 1/2 the angle to be plotted is obtained from a table of natural sines.



$DE = AD \sin\frac{\theta}{2}$, $2DE = \text{Chord } DF = 2AD \sin\frac{\theta}{2}$. If AD is taken as 5 units Chord $= 10 \sin\frac{\theta}{2}$.

Fig.12— Chord Method Proof

The multiplication by ten is then a simple matter of moving the decimal place one place to the right and the chord length for the particular angle is obtained for use in plotting the angle. It is to be noted that the sine of 1/2 of the angle is to be used and not 1/2 the sine of the angle.

Figure 13 is used in discussing the procedure to be used or followed in plotting a deflection angle by the method of chords. The deflection angle at B to be plotted is 32° to the left. The line AB is extended lightly far enough to be at least five units in length. Inches can be used as the unit or any other unit on the engineers scale. The units used must be long enough to allow accurate scaling of the calculated chord length. With the drawing compasses set to give a radius of five units the arcs FG and DE are

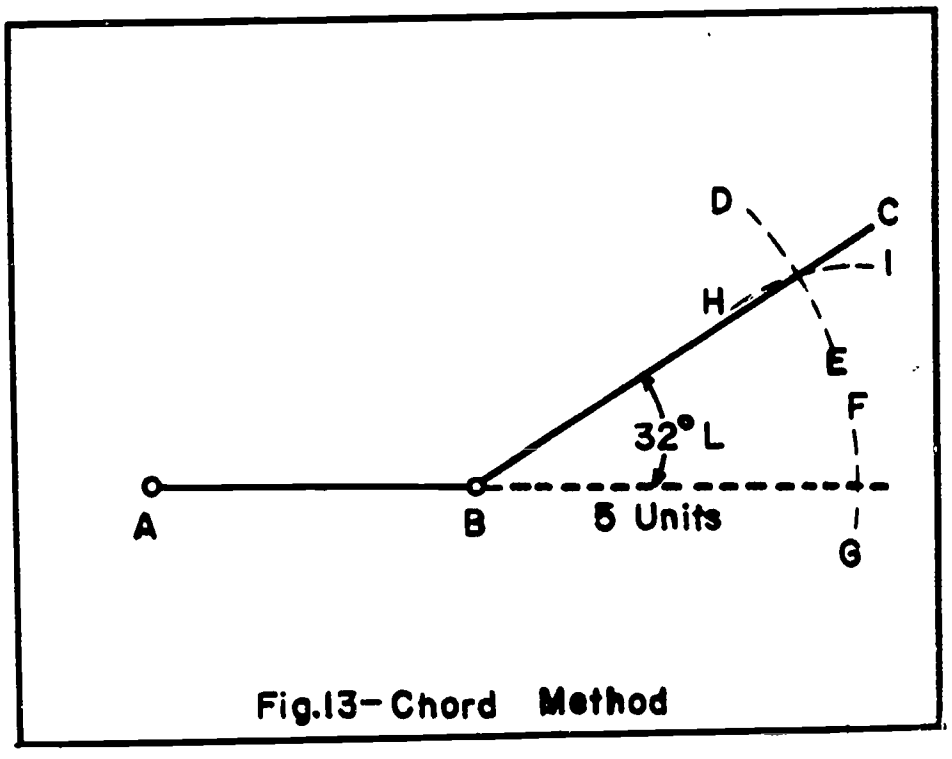


Fig.13— Chord Method

drawn. The length of arc DE is drawn long enough so that an angle of around 32° at B will intersect the arc DE. The next operation is to find in the tables the sine of 1/2 of 32° which is 16°. The sine of 16° is found to be .276. Now 10 x .276 = 2.76 inches which is the required chord to give a deflection angle at B of 32°. Now with the compasses set to draw an arc with a radius of 2.76 inches use the intersection of arc FG with the extension of line AB as the center and describe an arc HI intersecting arc DE. Next draw a light line of indefinite length through point B and the intersection of arcs DE and HI. This line gives the direction of line BC and a deflection angle of 32° to the left at B. The recorded length of line BC is now scaled from point B along the line through B and the intersection of the two arcs DE and HI. This gives the proper location of point C as plotted by the chord method.

Latitudes and Departures:

Another method of plotting sometimes used is known as plotting by latitudes and departures of individual courses. This method is very similar to plotting by the method of tangents. In this case the hypotenuse of the right triangle is made equal to the length of the course and the legs of the right triangle are calculated. Figure 14 is used in discussing this method. The side of the right triangle parallel to the meridian is called the latitude. The side perpendicular to the meridian is called the departure.

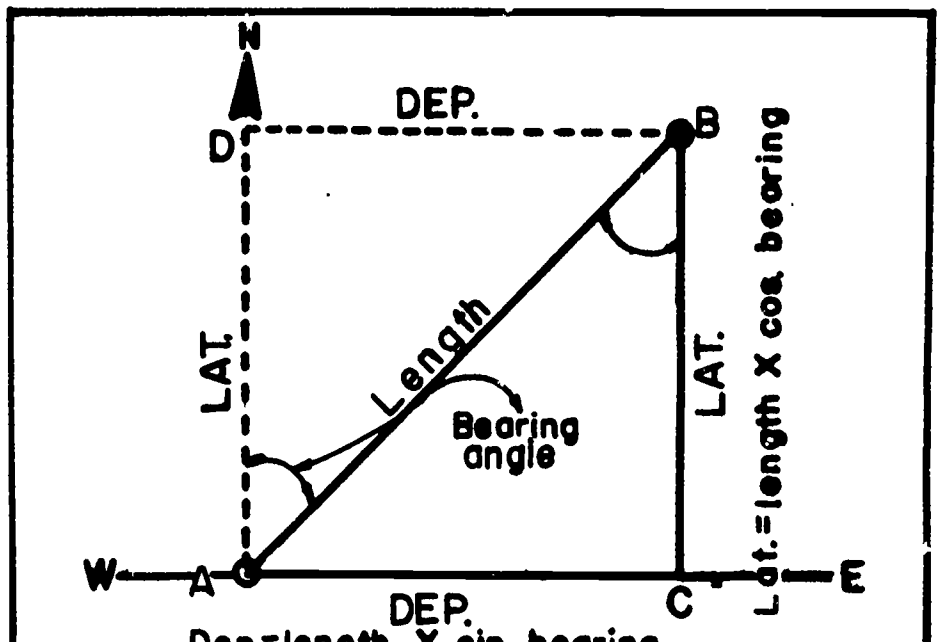


Fig.14 – Latitudes and Departures

The numerical value of the latitude is equal to the product of the length of the course and the cosine of the bearing angle. The numerical value of the departure is equal to the product of the length of the course and the sine of the bearing angle.

In plotting point B the calculated length of the departure is first scaled along a line perpendicular to the meridian at point A to establish point C. A meridian line is then drawn through point C and the calculated length of the latitude of the course scaled from point C. This locates point B. The line for the course AB is now drawn from A to B.

Other uses of latitudes and departures in mapping will be discussed later in this manual.

Drafting Machines:

In the above discussed methods of plotting angles only ordinary drafting equipment such as the T-square, triangles, protractors and scales were used. Most engineering and drafting offices today are equipped with drafting machines. This instrument combines in one piece of equipment, which attaches to the drafting board, the functions of the T-square, triangles, scale and protractor. Simply, a drafting machine consists of two arms with a pivoted protractor head attached. The pivoted protractor head is equipped with receptacles for two scales at right angles to each other, one for vertical lines and the other for horizontal lines. The mechanical linkage by bands is such that each scale remains parallel to its original preset direction as the protractor head is moved to any position on the drafting board. The protractor head can be simply and quickly oriented to any base and locked and angles measured from this base.

A drafting machine with a civil engineers protractor head is available which is designed with map drafting in mind. With this machine angular and linear measurements made in the field by the survey crew can quickly be reproduced on the drawing board. The protractor circle is equipped with a vernier so that angles can be plotted or read to one minute. It is estimated that 50 per cent or better of mapping drafting time is saved by the use of a drafting machine as compared with regular T-squares, triangles, protractors and scale equipment. Any person with a basic knowledge of mapping drafting can be taught to operate these drafting machines in a very short period of instruction.

Since drafting machines are now almost universally used this is the type equipment drafting students will certainly use when they enter industry. They should be part of the equipment of any school teaching map drafting to the students who are to enter industry well prepared as draftsmen.

PLOTTING TRAVERSES

In most present-day surveys the lengths of the courses are measured in feet and decimals of a foot. By law, most of the original government surveys used as the unit of measurement the surveyor's or Gunter's chain. The Gunter's chain is 66 feet in length, called 1 chain, and made up of 100 links; each link being 0.66 of a foot, or 7.92 inches.

Open traverses are numbered in stations continuously from the beginning. In dealing with closed traverses it is customary to give the length and direction of each course and to assign to each change in direction, or corner, a lettered or numerical identification.

Open Traverses:

Open traverses may be plotted by any of the methods of plotting angles previously discussed. The direction of the line is established and the distance of the course is scaled. An appropriate scale ratio is used to make the finished drawing of the desired size.

Closed Traverses:

Closed traverses may be plotted by any of the previously discussed methods of plotting angular values and using the selected scale for plotting distances.

Coordinates:

There is another very important method of plotting traverses, both open and closed that has not been previously discussed. This is the method of plotting points by coordinates. This is based on the method of latitudes and departures touched upon previously and using Figure 14 to illustrate what latitudes and departures are.

By definition the latitude of a course is parallel to the meridian and the departure of a course is perpendicular to the meridian. For this reason in plotting by coordinates, or total latitudes and total departures, a system of rectangular coordinates is used. The meridian is used for one axis of the system and a line perpendicular to the meridian, as an east west line, the other axis. It is customary, in order to avoid negative coordinates, to select the origin of the coordinates in such a location as to place the entire survey in the northeast quadrant. This is not of necessity but only of convenience. Any point on the traverse may be selected as the origin. North is considered positive and south is considered negative. Also east is considered positive and west negative. Figure 20A shows the signs in each quadrant.

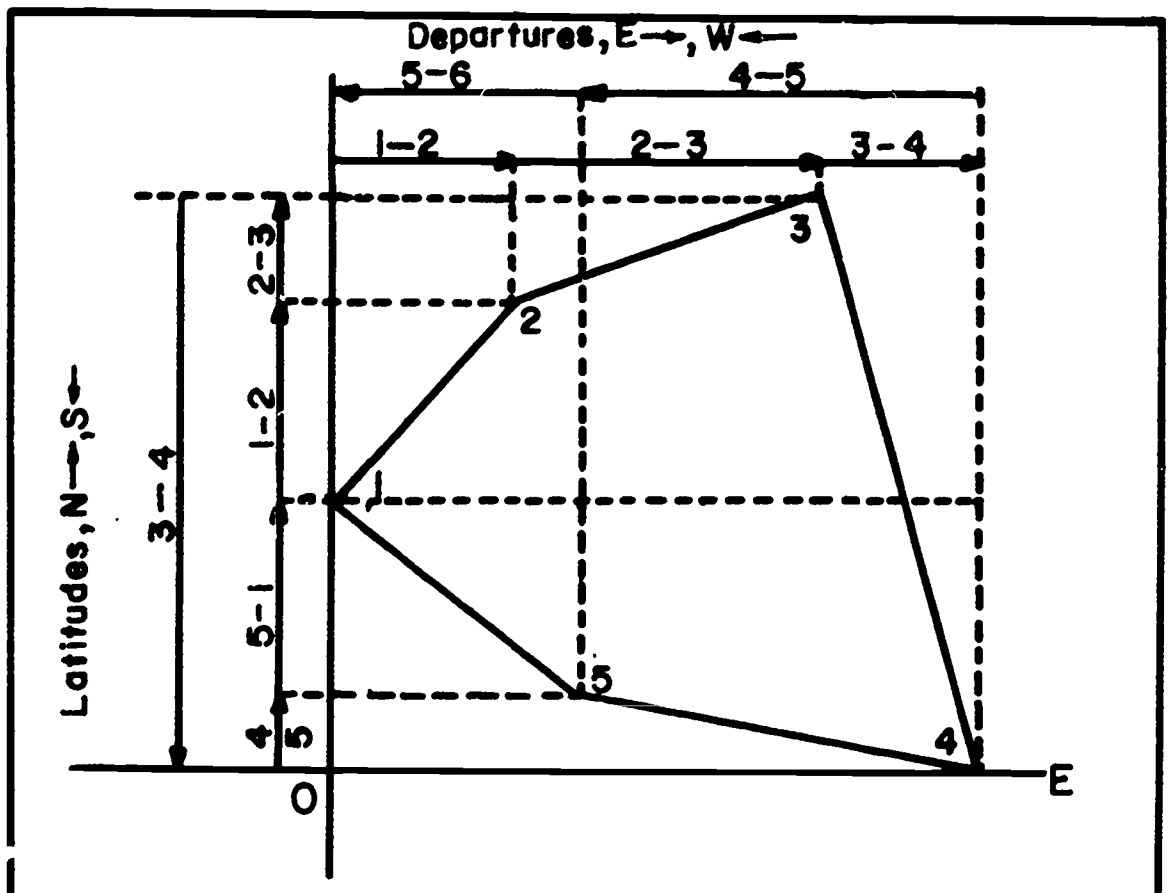


Fig.15.—Closed traverse—Latitudes and Departures

Figure 15 is used in discussing the method of plotting points by coordinates. Coordinates are sometimes referred to as total latitudes and total departures from the point of origin. Using Figure 15 to illustrate, the first procedure is to compute the latitude and departure of each course of the traverse. This is done by the method illustrated in Figure 14 and described in the previous discussion of latitudes and departures and their calculation from the course length and bearing. It is seen from Figure 15 that the location of point 1 is on the meridian and is north of the origin a distance equal to the sum of the latitudes of course 4-5 and course 5-1. The distance east of the meridian is 0 since the meridian axis was selected as passing through point 1. The location of point 2 north of the origin is the sum of the latitudes of courses 4-5, 5-1, and 1-2. The location of point 1 east of the origin is equal to the departure of course 1-2. We now have the coordinates of point 2. This point can be plotted by rectangular coordinates. This is done by scaling the proper distances north from the origin and east from the origin.

In a like manner the north coordinate of point 3 can be found by adding the latitudes of courses 4-5, 5-1, 1-2, and 2-3 and the east coordinate by adding the departures of courses 1-2 and 2-3.

In normal practice latitudes and departures along with coordinates are calculated by machine using special calculation sheets designed for this purpose. The student will be assigned problems of this type later and the calculations and forms used will be discussed and illustrated.

From the above discussion and from the geometry of Figure 15 it is seen that, in plotting a closed figure by coordinates, the sum of the north latitudes must be equal to the sum of the south latitudes and also the sum of the east departures must be equal to the sum of the west departures. In actual practice some errors always exist in field measurements. This will cause the sum of the computed north and south latitudes to be of different values. The same holds for the computed east and west departures. This is normal and to be expected. The differences found are known as the error of closure in latitudes and departures. This will be brought out more clearly under the adjustment of surveys.

The use of coordinates in surveying computations and plotting is now considered standard. It is the most widely used of any method and also the most accurate. An error in the plotting of any one point does not affect the plotted position of any other point.

In this method of plotting the position of any point from the origin is given by stating the distance the point is either north or south of the origin and the distance the point is either east or west of the origin. This is very much like graph plotting in elementary algebra.

LATITUDES AND DEPARTURES

The method of calculating the latitude and departure of an individual course of a survey was discussed briefly in Section 3 and was illustrated by Figure 14. In Section 4 the meaning of total latitude and total departure was briefly discussed using Figure 15 to illustrate their meaning. Figure 15 illustrates that in any closed traverse the algebraic sum of the latitudes must be equal to zero. Also the algebraic sum of the departures must be equal to zero. It must be kept in mind that north latitudes are considered positive and south latitudes are considered negative. Likewise east departures are positive and west departures are negative.

In going around any tract of land it is obvious, from Figure 15, that the distances traveled north and traveled south must be equal in order to arrive back to the point of beginning. This also is true for distances traveled east and west.

In general, when the algebraic sum of the north latitudes and south latitudes are calculated for any closed traverse that has been surveyed in the field, they will not be numerically equal. That is, the algebraic sum of the positive and negative latitudes will not usually be equal to zero. This same condition is also encountered when the algebraic sum of the departures are calculated. Theoretically, the algebraic sum of the latitudes must be equal to zero and the algebraic sum of the departures must be equal to zero if there are no errors in the measurement of distances or angles in the field work. However, in actual practice, there are always some errors present in the measurement of both distances and angles. This is due to numerous reasons both instrumental and personal. Due to these normal errors, an unadjusted traverse will not usually close in either plotting on drawing paper or by calculation of latitudes and departures. It is seen from Figure 16 that the amount of misclosure can be calculated mathematically.

Error of Closure:

Figure 16 shows a closed unadjusted traverse for which the latitudes and departures have been calculated. The algebraic sum of the latitudes is not equal to zero and the algebraic sum of the departures is not equal to zero. In this case the distance AF in the right triangle AFA' is the amount the north latitudes and the south latitudes fail to agree. The distance FA' in the same right triangle is the amount the algebraic sum of the east and west departures fail to agree. AF is the misclosure in latitude and FA' is the misclosure in departure. The linear misclosure is shown by the line AA' which is the hypotenuse of the right triangle AFA'. Since the misclosure in both latitude and departure is known, the length and direction the linear misclosure represented by line AA' can now be calculated.

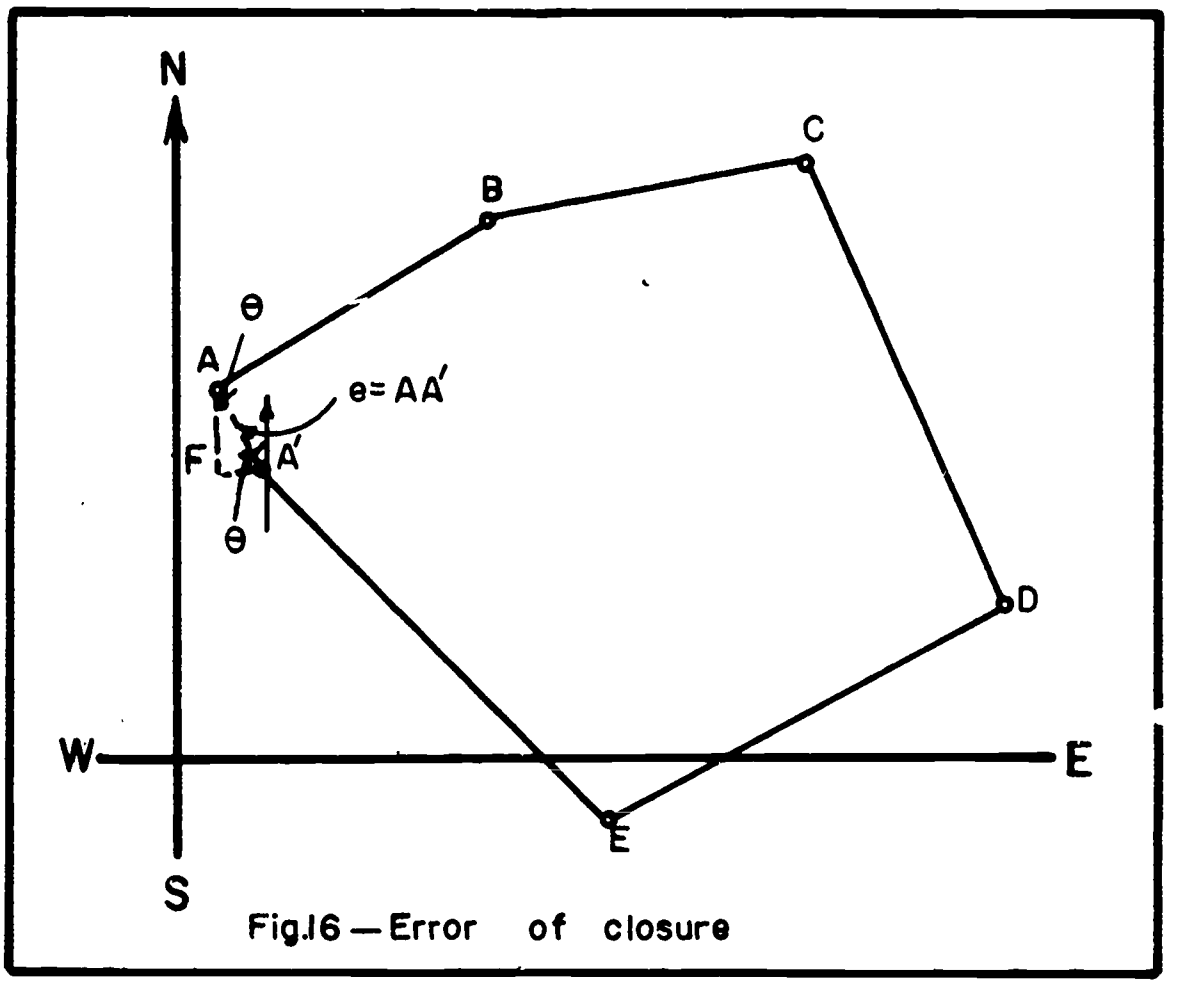


Fig.16 — Error of closure

In this case, the misclosure represented by line AA' is equal to $\sqrt{\overline{AF}^2 + \overline{FA'}^2}$ in distance. The direction of the line AA' is given by the angle FAA' and the tangent of this angle is equal to $\frac{FA'}{FA}$. The tangent of the angle being known, the angle can be found from a table of natural tangents. This angle gives the bearing of the line of misclosure. In this case the bearing would be in the southeast quadrant. A rough sketch will show in which quadrant the direction of misclosure lies.

Balancing the Survey:

The unadjusted traverse must now be adjusted or balanced to make it close mathematically. It is assumed that the angular adjustments have been made before calculating the latitudes and departures. This angular adjustment is made by the method previously explained. That is, in any closed figure, the sum of the interior angles must be equal to (n-2) x 180°, where n is the number of sides. If the sum of the measured angles fail to meet this condition, the difference or misclosure is usually divided equally among the angles to make this condition exist. In the case where deflection angles are measured for a closed traverse, the algebraic sum of the deflection angles must equal to 360 degrees. Angles to the right are considered positive and to the left, negative. It is of no consequence whether the sign of the sum is negative or positive.

When the latitudes and departures for a traverse have been computed and the misclosure in latitude and departure have been determined the survey is then balanced in order for the traverse to create a mathematically closed geometric figure. The balanced survey will cause the sum of the north latitudes to equal to the sum of the south latitudes and the sum of the east departures to equal to the sum of the west departures.

There are several rules for balancing a survey such as the compass rule, transit rule and the Crandall method. The compass rule is probably the most widely used and assumes that the misclosure is due to angular errors as much as to distance measurement errors. The compass rule will be given and illustrated here. This rule distributes the error of closure proportional to the length of each line. The compass rule states that the correction to be applied to the latitude or departure of each course is to the total correction in latitude or departure as the length of each course is to the total length of the traverse. Sample plate 10 illustrates the method of balancing a survey. The individual latitudes and departures of each course are calculated. The sum of the north latitudes is shown to be 1668.76 feet and the sum of the south latitudes is shown to be 1670.37 feet. These are not equal and show an error in latitude of 1.61 feet too much south. Likewise, the sums of the departures show an error in departure of 5.03 feet too much west. These errors are distributed among the courses, proportional to their lengths, so that the latitudes and departures will balance.

The linear error of closure is equal to $\sqrt{1.61^2 + 5.03^2}$ which is equal to 5.28 feet. The total length of the traverse is 4657.0 feet. Since the total error in latitude is 1.61 feet the correction to be applied to the line BC in lattitude is equal to $\frac{686.4}{4657.0} \times 1.61$ which is .237 feet. Since the total error is too much south, the corrections are subtracted from the south latitudes and added to the north latitudes. The correction in departure to be applied to the line BC is equal to $\frac{686.4}{4650.0} \times 5.03$ which is equal to .741 feet. Since the error in departure is too much west, the corrections are subtracted from the west departures and added to the east departures. The corrections in latitude and departures are shown in the column of corrections. The corrections are given the proper plus or minus signs showing if they are to be added or subtracted from the unadjusted latitudes or departures to give the corrected latitudes or departures. When the corrections are applied properly to the unadjusted latitudes and departures the adjusted latitudes and departures are obtained and the sum of the north latitudes should be equal to the sum of the south latitudes.

Likewise the sum of the east departures and the sum of the west departures should be equal. When these conditions exist, the survey is balanced and the adjusted latitudes and departures are considered correct and can be used in calculating areas and coordinates.

The numerical sum of the individual corrections in latitude, without regard to sign, must be equal to the total correction in latitude. Also the numerical sum of the corrections in departure must be equal to the total correction in departure.

Since the correction in latitude or departure for each line is proportional to its length a constant can be calculated which simplifies the calculations. On sample plate 10, the constant for latitude correction is the total error in latitude divided by the total length of the traverse. This gives the correction per foot of line to be applied. This constant is multiplied by the length of each line which gives the correction in latitude to be applied to the unadjusted latitude of the line to obtain the adjusted latitude. The constant for departures is employed in the same way.

Sample plate 10 shows the adjusted latitudes and departures of an actual survey and how they were obtained. The right-hand side of sample plate 10 concerns the calculation of the area within the closed traverse. This will be discussed under the subject of calculation of areas.

The computation of coordinates from the adjusted latitudes and departures is usually next in order after the latitudes and departures have been adjusted. The coordinates of points on a survey are sometimes referred to as total latitudes and total departures and have the same meaning.

The use of latitudes, departures and coordinates is now standard practice in most surveying and mapping work. For this reason every mapping draftsman should be acquainted with their use and computation.

In computing coordinates for a survey it is first necessary to select an origin for the coordinates. It is usually selected so as to place the entire survey in one quadrant. It is convenient to select the northeast quadrant to avoid negative coordinates. Sometimes the origin is a fixed monument on the ground such as is the case when surveys are tied to a state coordinate system. After the latitudes and departures have been adjusted the coordinates are calculated by simple addition and subtraction.

Sample plate 10A shows the calculation of the coordinates for the traverse for which the latitudes and departures were calculated on sample plate 10. The coordinates calculated on

sample plate 10A are the coordinates used in plotting the control traverse on sample plate 7P. The control traverse on plate 7P (the P being for preliminary) is the horizontal control used for constructing the contour map shown on sample plate 7. The origin here selected is the lower left hand corner of the rectangle enclosing the topographic map to be constructed for sample plate 7. The coordinates of point A were selected to be 370 feet north of the origin and 450 feet east of the origin so that the traverse would fit the space on the map. The coordinates for point A are 370'N and 450'E. The process of determining the coordinates of the other points on the traverse is a matter of adding algebraically the individual adjusted latitudes and departures to the coordinates of point A. Thus the total latitude of point B is the total latitude of point A plus the latitude of the line AB. The total latitude of point B is 370.00 + 588.02 which is 958.02. The total latitude of point C is 958.02 + 677.29 which is 1635.31. The total latitude of point D is 1635.31 plus 404.08 which is 2039.39. The total latitude of point E is 2039.39 + (-354.70) which is 1684.69. The addition is continued on around the traverse until all total latitudes are obtained. This is continued back to the point of beginning. A check on the arithmetic is obtained here because if there is no mistake in arithmetic, the calculated total latitude of point A will be the same as that assigned to it in the beginning.

The total departures are calculated in exactly the same manner as are the total departures. It must be kept in mind that the sums are algebraic, that is, a positive value is assigned to north latitudes and a negative value is assigned to south latitudes. Departures are considered positive if east and negative if west.

When the latitudes and departures are adjusted this will change slightly the distances and bearings of the courses of the traverse. In land surveys this alteration of lengths and bearings is sometimes made. This is a laborous computation and is not necessary when areas, closure and coordinates only are needed. When this correctinn is required the calculation is simple but tedious. The adjusted latitude is one leg of a right triangle and the adjusted departure is the other. For example, the measured length of the course AB is 595.2 feet. The altered length is $\sqrt{588.02^2 + 92.81^2} = 595.30$ In the same right triangle, the tangent of the altered bearing is the corrected departure divided by the corrected latitude. In this case the altered bearing line AB is obtained thus: tangent of altered bearing angle is equal to $\frac{92.81}{588.02}$ which is .15783. From a table of natural tangents the angle is found to be 8°58'. A sketch will show in which quadrant the bearing angle is located. In this case, the bearing is N8°58'W. These altered

distances and bearings are given in the last two columns of sample plate 10A. The altered bearings and distances are calculated exactly as was the linear misclosure and direction of misclosure which was previously discussed and was illustrated by Figure 16.

In making any calculations the use of a suitable form saves time, eliminates unnecessary work, makes the calculations systematic and allows easy checking of the calculations by another person.

The form used on sample plates 10 and 10A are convenient to use. The calculations are made by the use of some type of calculating machine. The rotary type calculator is almost essential for these type calculations. Slide rule work is not satisfactory for these calculations.

Before the time when the use of the calculating machine became almost universal logarithms were used for these types of computations. Today the high cost of labor and the moderate cost of calculating machines prohibits the use of logarithms and hand calculations and these methods will not be discussed.

Plotting by Coordinates:

The method for computation of coordinates has been given. Plotting by coordinates is the most reliable method of plotting. It is recognized as the only practical method of plotting extensive surveys covering large areas. Rectangular coordinates are also used in calculating areas of land and cross-sections. The coordinate axes are usually north-south and east-west reference lines. The origin of this system of rectangular coordinates may be at any desired place inside or outside the survey.

In plotting by coordinates a grid system of lines is first drawn. The coordinate lines for this system must be carefully constructed to insure that the coordinate squares are actually square. The sides and diagonals should be measured for each square. To insure accurate plotting the coordinate lines must be constructed as accurately as possible. The sizes of the coordinate squares will depend upon the extent of the survey, the scale used and the type mapping being done.

In plotting by coordinates the coordinate line nearest the plotted point is used to measure from rather than measuring from the origin.

Systems of coordinate squares are shown on sample plates 3, 4 and 7P together with the procedure of plotting from the coordinate lines.

In plotting by coordinates each point is plotted by its total latitude and total departure. The location is checked by scaling the distance between points given in the survey notes. This check should always be applied as the plotting progress.

ERIC

CALCULATION OF AREAS

Many times the main object of a survey is to determine the area of a tract of land. Several methods are available for determining area. The method used depends upon the type survey made, the shape of the tract and the precision of the desired results.

The usual units of area are the acre and square foot. An acre is equal to 43,560 square feet. Some original surveys were measured with a Gunter's chain which is 66 feet long. One acre is equal to 10 square chains.

Triangles:

A simple method of determining area is to plot the boundaries to scale and divide area into triangles. Scale the base and altitude of each triangle. Compute the area of each triangle and add the area of all triangles to obtain the total area. The area of a triangle is found by multiplying the base by the altitude and dividing by two. This is not a very accurate method and is not used where accurate results are desired. It is sometimes used in determining the area of irregular cross-sections for earthwork calculations and will be discussed in Section 9.

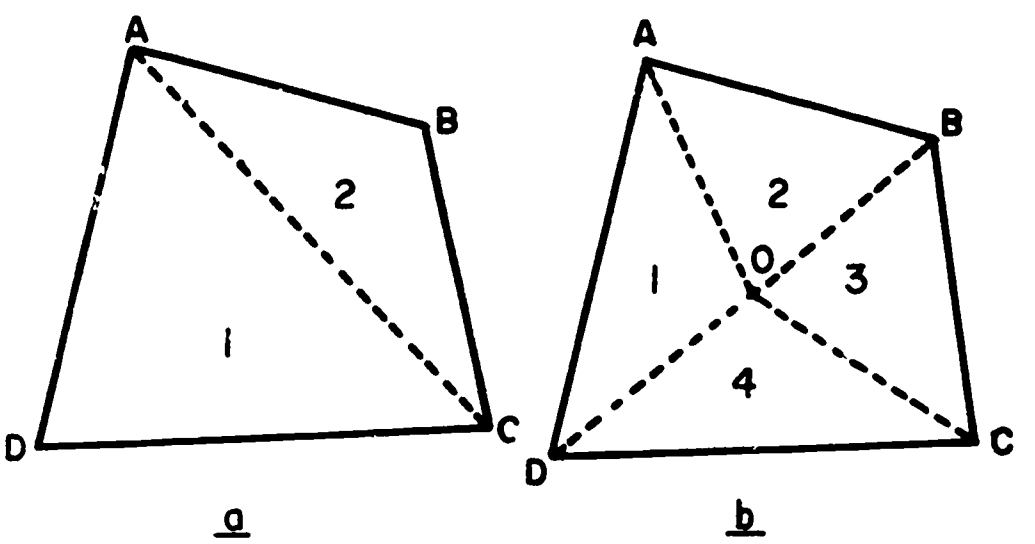


Fig. 17 —Areas by triangles

Sometimes a small tract of land can be divided into triangles and two sides and the included angle measured for each triangle. Figure 17a shows such a tract. A transit is set up at C and the sides CD and CA and the included angle DCA are measured for triangle 1. The same is measured for triangle 2. The area of each triangle is computed and the areas of the two triangles are added to get the total area.

When the lengths of two sides and the included angle in a triangle are determined the area is found by the formula $A = 1/2\ ab \sin C$ where a and b are the two sides and C is the included angle.

Occasionally in the survey of a small tract of land, where the boundaries are grown over with brush or otherwise obstructed, it may be convenient to set up the transit in the interior of the tract and measure the distance to each corner. The angle between each pair of lines to corners is also measured. Figure 17b shows an example of this condition. Two sides and the included angle for each triangle are then known. The area of each triangle is then determined and the areas added to obtain the total area.

Where the lengths of the three sides of a triangle are known the area is given by the formula $A = \sqrt{s(s-a)(s-b)(s-c)}$ where

$s = \frac{a + b + c}{2}$ and a, b, and c are the lengths of the three sides.

Coordinates:

Where the coordinates of the corners of a tract of land have been determined the area of the tract can readily be determined by the coordinate method.

Figure 18 is used in discussing this method. ABCD is a tract of land for which the area is to be determined. The total latitudes and departures, or coordinates, of corners ABCD are calculated by the method proviously discussed under the subject of latitudes and departures in Section 5. NS is the reference meridian and WE the reference parallel. These are the reference meridian and reference parallel from which the total latitudes and total departures are calculated. The total latitude is referred to as the parallel distance and the total departure is referred to as the meridian distance. Thus for point A the meridian distance is represented on Figure 18 as M_1, and the parallel distance by P_1. Likewise the location of point B from the reference lines is indicated by M_2P_2, C by M_3P_3 and D by M_4P_4.

Meridian distances are considered positive if they lie east of the reference meridian and negative if they lie west of the reference meridian. Parallel distances are considered positive if they lie north of the reference parallel and negative if

south. For convenience the reference meridian and parallel should be selected so that all meridian and parallel distances are positive. This simplifies the computations.

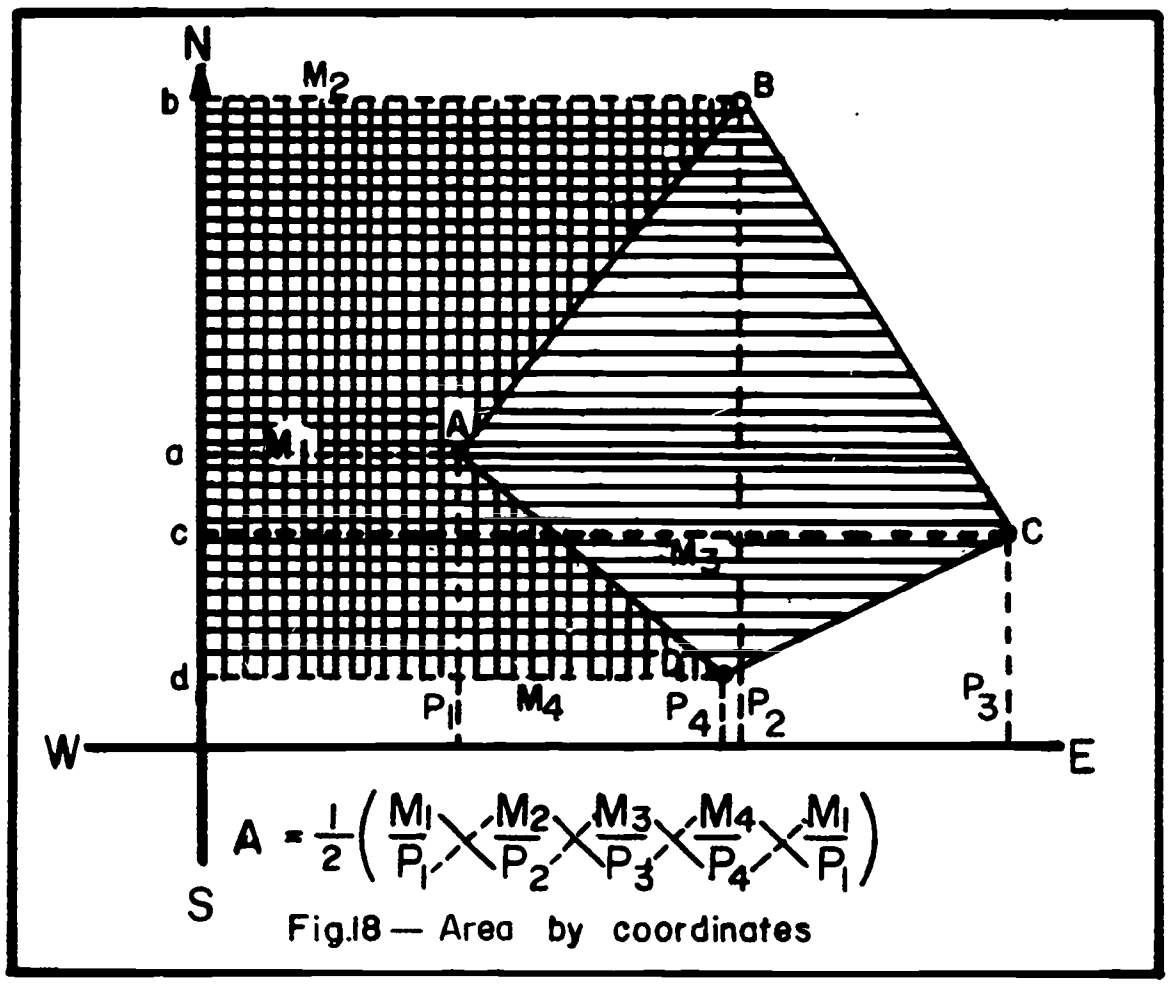


Fig.18 — Area by coordinates

In Figure 18 the reference lines were selected to have all of the meridian and parallel distances positive.

When all of the meridian distances and parallel distances have been determined they can be tabulated in a convenient conventional determinate form that has been developed in analytic geometry that simplifies the area calculation. In using this form each meridian distance is tabulated above the corresponding parallel distance as is shown in Figure 18. After the tabulation is made the coordinates connected by solid lines are multiplied together and all of the coordinates connected by dashed lines are multiplied together. The solid line products are added together and the dashed line products are added together. One-half the difference of these sums gives the area within the figure. The tabulation shown on Figure 18 may be written in the equation form $A = 1/2 \left[(M_1P_2 + M_2P_3 + M_3P_4 + M_4P_1) - (M_2P_1 + M_3P_2 + M_4P_3 + M_1P_4)\right]$

In tabulating the meridian distances and corresponding parallel distances the first must be repeated at the end as shown by Figure 18.

Another method of computing the area within a closed traverse that is almost universal in the surveying practice is the double-meridian distance method. This is called the DMD method. It is a convenient form of the coordinate method just described but does not involve the direct use of coordinates.

DMD:

The meridian distance of a point is its total departure from the reference meridian. The meridian distance of a straight line is the meridian distance to its mid-point. The double meridian distance of a straight line is the sum of the meridian distances to its two ends. Thus in Figure 19 the meridian distance of line AB is cC, the meridian distance of A is aA and the meridian distance of B is bB. The double meridian distance of the line AB is aA plus bB.

It is obvious from Figure 20 that if the reference meridian is passed through the most westerly corner of the survey all of the double meridian distances to each course of the traverse will be positive. This is a convenience in computing and the practice of passing the reference meridian through the most westerly corner is usually followed. However, this is not necessary if one wants to deal with both positive and negative meridian distances.

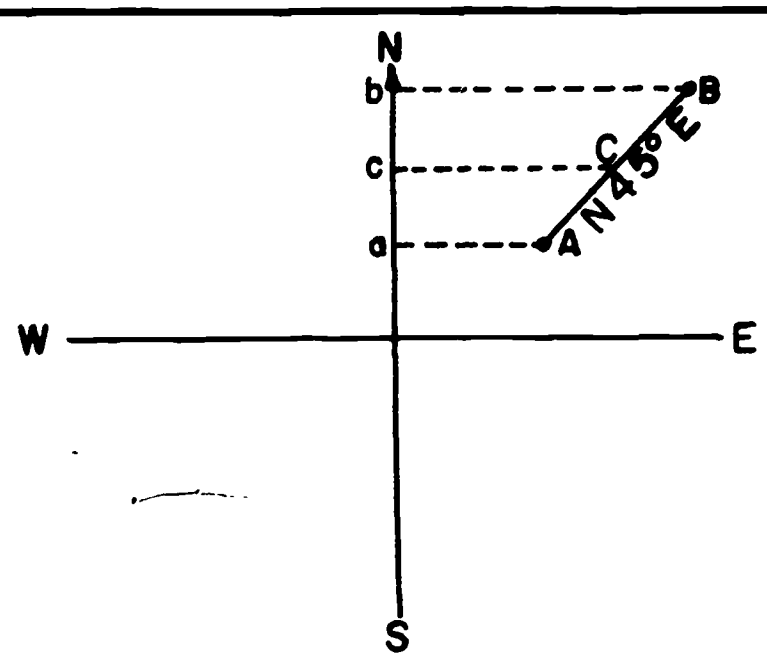


Fig 19 — Meridian Distances

Calculating areas by the DMD method is a matter of computing the areas of trapezoids or triangles and summing the individual areas. In Figure 19 it is seen that the orthographic projection of a line upon the meridian is the latitude of the line. This forms, in Figure 19, the trapezoid abBA whose area is $\frac{aA + bB}{2} \times ab$. The distances aA + bB is the DMD of the course AB. Thus the double area of any trapezoid or triangle formed by projecting a course on the meridian is equal to the product of the double meridian and the latitude of the course. That is, the double area = DMD x latitude.

In Figure 20 the areas of the trapezoids formed by projecting the northerly bearing lines on the meridian are hatched with horizontal lines. The trapezoids formed by projecting southerly

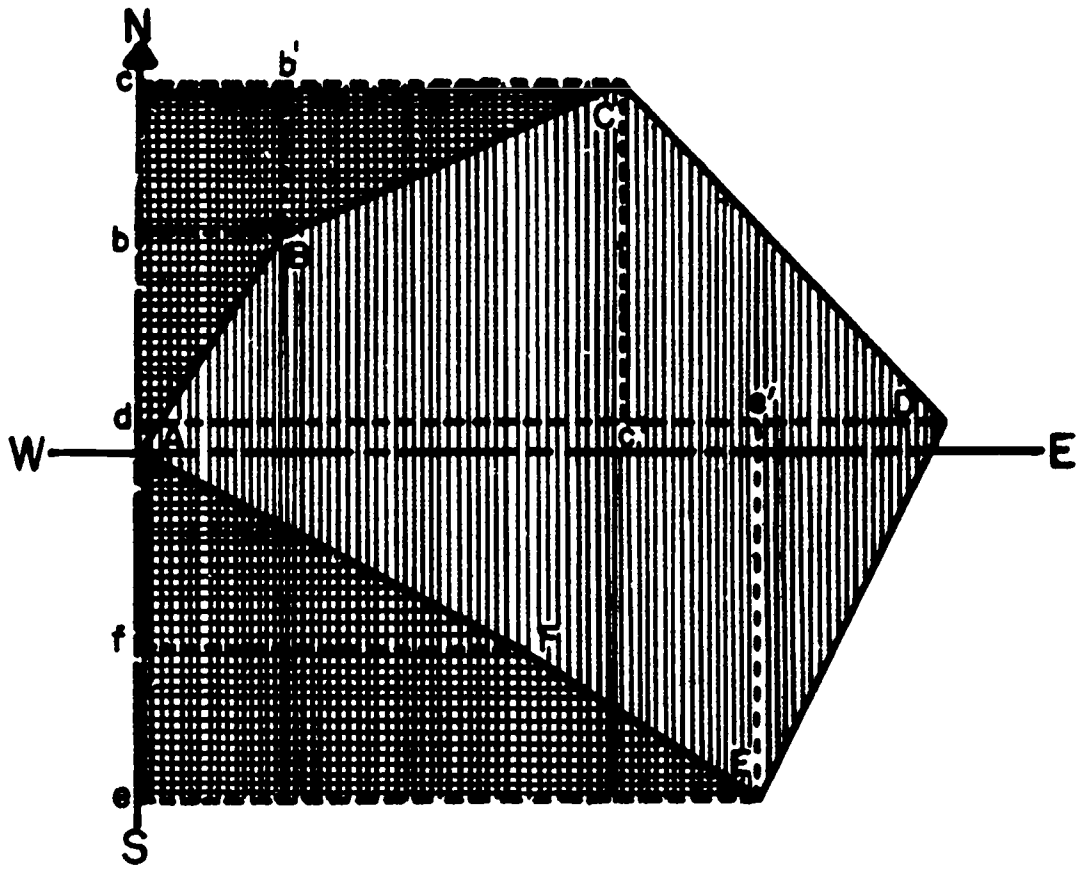


Fig. 20 – Area by D.M.D Method

bearing lines are hatched with vertical lines. North can be considered positive and south negative. Where the cross-hatching is shown, that portion of the area has been computed once as positive and once as negative and therefore cancels out, leaving the area only within the traverse.

Again looking at Figure 20, the double area of triangle ABb is the product of bB and bA which is equivalent to the product of the DMD of course AB and the latitude of AB. When the course BC is projected on the meridian, it forms the trapezoid bBCc. The double area of this trapezoid is bB plus cC times bc. Again this area is the DMD of course BC times the latitude of BC. The area of these trapezoids formed by projecting courses bearing north are hatched with horizontal lines.

The trapezoid formed by projecting the south bearing line CD is shown by the letters dDCc. The double area of this trapezoid is equal to dD plus cC times dc. Again the double area of the trapezoid is the product of the DMD of the line CD and its latitude. This time where the hatched lines cross, the double area has been computed twice, once negative and once positive so it cancels out the portion of the area outside of the traverse. Likewise, the computation of the double areas of the trapezoids formed by projecting the remaining lines DE, EF, and FA upon

the meridian can be continued. In the end all of the area projected upon the meridian and outside the traverse will be canceled out, leaving only the double area within the closed traverse. This double area divided by two gives the required area.

Sample plate 10 shows a convenient form for calculating DMD's from adjusted departures and double areas from the DMD's and the adjusted latitudes.

There are three easy convenient rules for determining DMD's that are arrived at from the above discussion and Figure 20. These rules are listed in any ordinary textbook on surveying and are given below.

1. The DMD of the first course is equal to the departure of the first course. For example on Figure 20 the DMD of course AB is equal to bB which is the departure of course AB.

2. The DMD of any other course is equal to the DMD of the preceding course plus the departure of the preceding course plus the departure of the course itself. For example, the DMD of course BC on Figure 20 is seen to be bB plus cC. Now, the DMD of the preceding course AB is bB, the departure of the preceding course AB is equal to cb; and the departure of the course BC itself is equal to b'C. These added together, bB plus cb' plus b'C are equal to bB plus cC which is the DMD of course AB.

3. The DMD of the last course is equal to the departure of that course but of opposite sign. For example, the DMD of the last course FA, on Figure 20, is seen to be the distance fF. The departure of course FA is Ff, or west, which is the same as fF but is considered of opposite sign.

Referring now to the calculation form shown on sample plate 10 it is seen that the double areas of each projection on the meridian is obtained as the product of the DMD and the latitude. Point B was selected as the beginning point as it is the most westerly point and all DMD's will be positive.

Two columns are shown for the double areas, one being north and the other south. If the latitude is north, the product of the DMD and the latitude is entered in the north column. If south, the product or double area is entered in the south column. As an example, for course BC the latitude is 677.29N and the DMD is 113.63. The product of these is 76,960.46 which is the double area of the trapezoid. This number is entered in the north column. This process is continued until all courses have been calculated. The north and south columns are then each added. The difference of the two columns is double the area in

the traverse. The difference is divided by two to obtain the area. Since the measurements were made in feet the answer is in square feet. The square feet are converted to acres by dividing by 43,560. This gives the area in acres which it was desired to compute.

In some printed forms, north is listed as positive and south as negative. Likewise, west is considered negative and east as positive.

Figure 20A shows the signs of both the latitude and departure for a line in each of the four quadrants in which bearings are located.

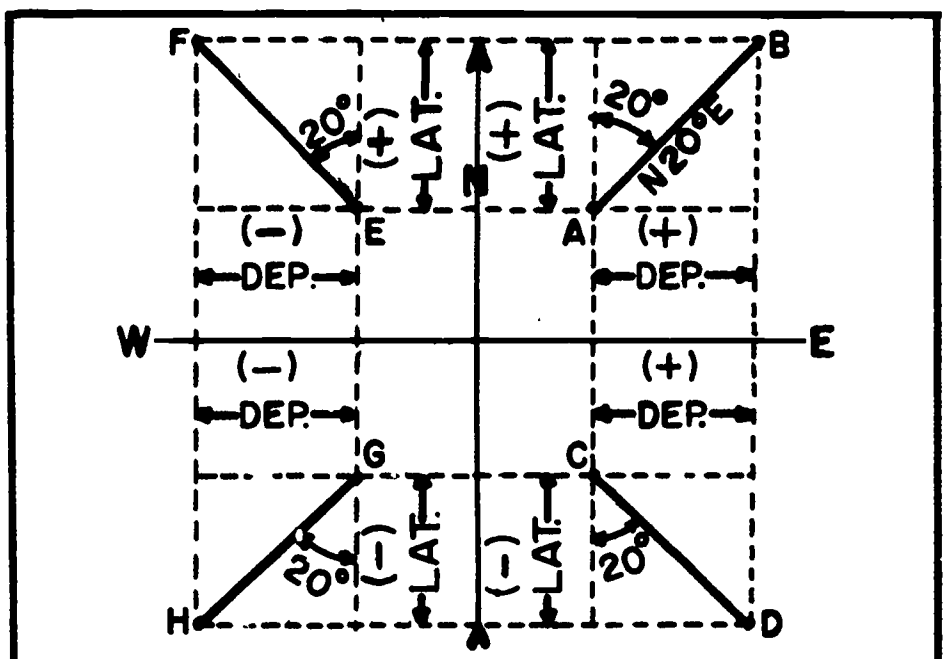


Fig.20A— Latitudes and Departures

ROUTE SURVEYS WITH CIRCULAR CURVES

Fundamentals of Route Surveys:

Route surveys are surveys of relatively narrow and long strips of territory. They are made for the purposes of making studies for the location and construction of such public utilities as highways, railways, canals, pipelines and power lines. They are conducted to obtain information such as topography, location of structures and objects and to establish a survey line on the ground. Probably the most wide use of route surveys at present is for highway location and construction.

Generally an open traverse survey is made along the proposed location. A relatively narrow strip on either side of the proposed general route is mapped showing all features such as streams, buildings, structures and other natural and artificial features. Ground configuration is usually obtained by running cross lines to the traverse for obtaining elevations. Using the information developed in the field survey, the draftsman constructs the maps, profiles and cross-sections. He also constructs the contour maps. The drawings made by the draftsman are used by the engineers in selecting the final location, working earthwork calculations and estimating costs. Sample plate 6 shows a typical plan-profile construction. These are usually made on plan-profile or cross-section paper.

Open traverses for route surveys are plotted in the same manner as was explained for the plotting of angles and open traverses. These open traverses are sometimes plotted by coordinates as is illustrated on sample plate 4. Open traverses must be plotted carefully and thoroughly checked since there is no check by closing the traverse.

Plate 1 shows the plotting of a group of open traverses by different methods. The method used in plotting an open traverse will depend upon the information given in the field notes of the survey and how they are computed in the final form.

The field method used in route surveying is usually the transit-tape method. Usually a level party follows the transit party and runs profile levels on the centerline of the survey. Thirdly, another crew follows and runs the levels on the cross-lines. Notes from each group are used by the draftsman in making the maps.

Fundamentals of Curves:

In route surveying, the traverses are first staked out as a series of straight lines. In highway and railway locations

it is necessary to employ curves at the points of change in direction of the straight lines. This is necessary to avoid sharp angular bends and to allow vehicles to change directions of travel gradually and safely. The arcs of circular curves are usually employed for this purpose. Spiral easement curves are often employed to make the transition from the straight line to the circular curve more gradual. Only circular curves will be discussed in this manual.

A survey draftsman will be required to plot route surveys including circular curves and should therefore be acquainted with the basic principles of circular curves.

In offices where curves are plotted frequently, curve templates are used. These are obtainable in sets for various degrees of curves. In the problems given in this manual curves will be plotted from the given radii.

The sharpness of a curve may be stated in two ways. These are the length of the radius and the degree of curve. The degree of curve has two definitions. The longer the radius of a curve, the more gentle is the change in curvature.

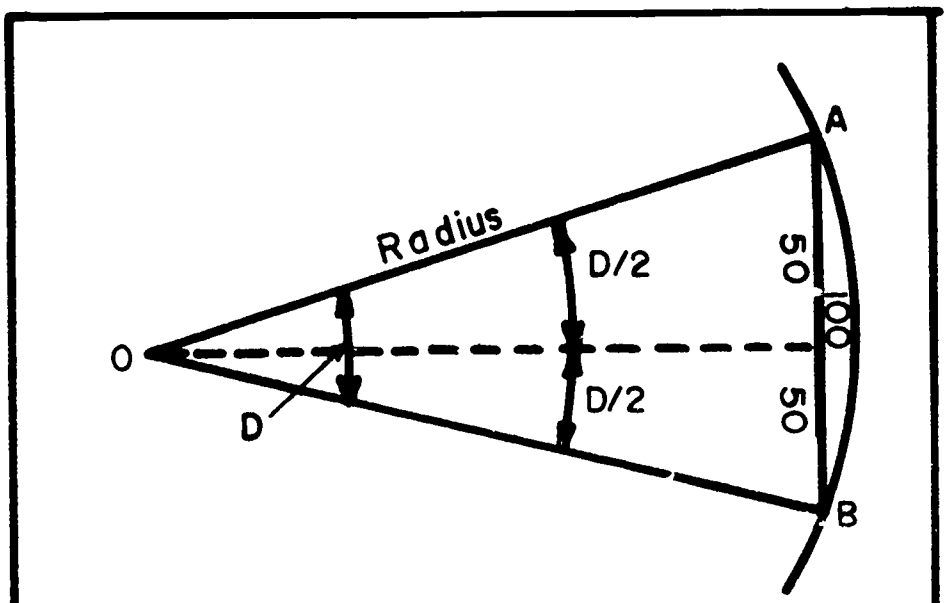


Fig.21 — Degree of Curve-chord basis.

The two definitions of degree of curve are by the arc basis and the chord basis. The degree of curve by the chord basis means the angle subtended at the center of the curve by a chord 100 feet long. This is illustrated by Figure 21. Here D represents the degree, or angle subtended at the center, by a chord of 100 feet represented by the line AB. The degree of curve by the arc definition means the angle subtended at the center by an arc length of 100 feet. This is shown by Figure 22 where D is the degree of curve, AB is the arc of 100 feet and R is the radius.

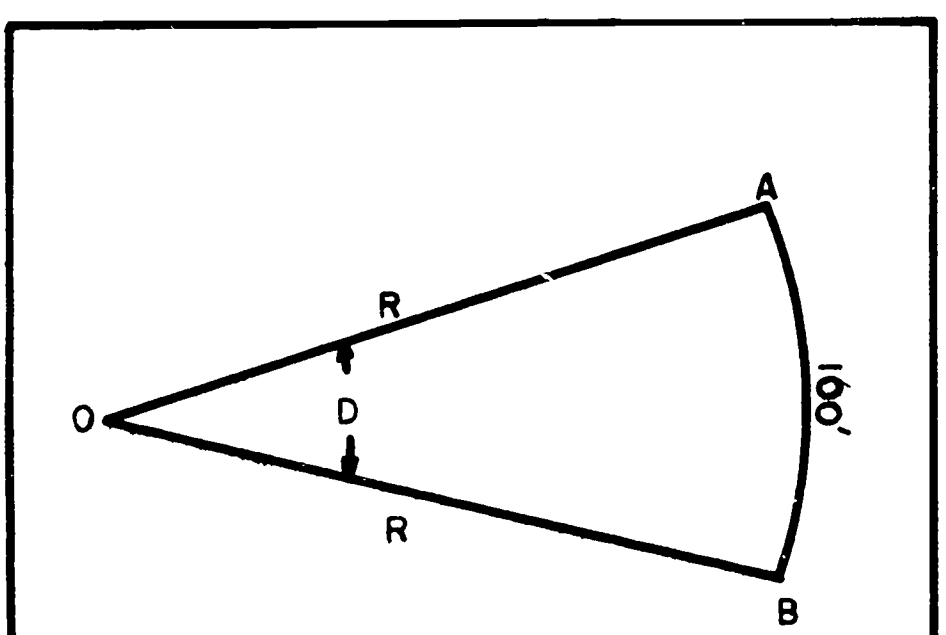


Fig.22—Degree of curve-Arc basis.

The straight lines connecting circular curves are called tangents because they are tangent to the circular curves.

The point where the two tangents intersect when extended is called the vertex or point of intersection and is abbreviated V or PI. Figure 23 represents two tangents with a circular curve joining the two tangents. The intersection angle I is measured in the field during the route survey. The curves are calculated in the office. The beginning of the circular curve is called the point of curve and is written PC. The ending of the curve where it becomes tangent to the straight line is called point of tangency and abbreviated PT. The distance from the PC or PT to the vertex is called the tangent distance and is shown as T. R represents the radius of the curve. E is the external distance and is the distance from mid-point of the circular arc to the vertex. M is called the middle ordinate and is the distance from the mid-point of the long chord to the mid-point of the arc. The long chord is the line from the PC to the PT. By plane geometry the intersection angle is equal to the central angle subtended by the curve.

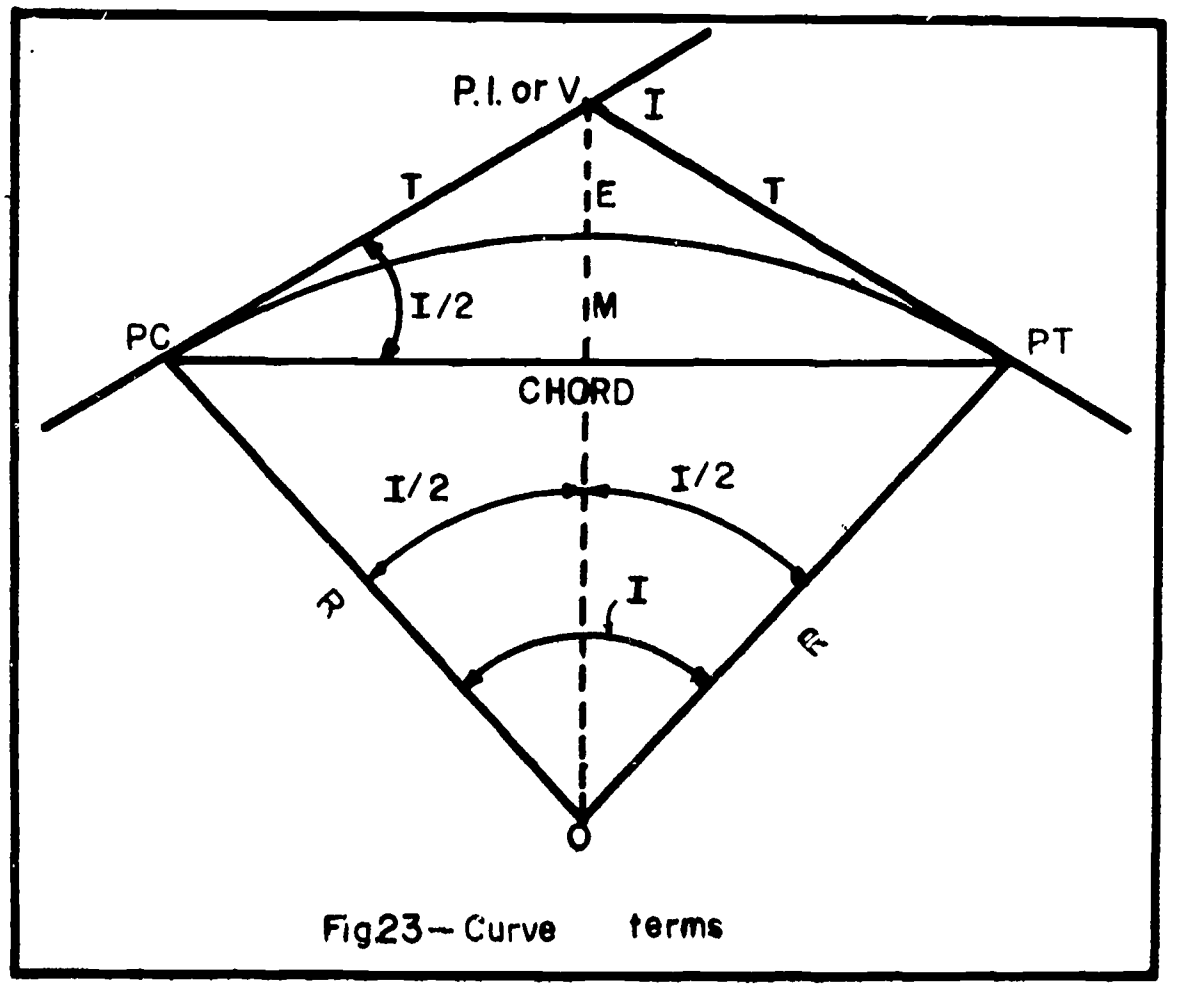


Fig23— Curve terms

Figure 24 shows how the length of a circular curve is found. The length of the curve is $\frac{I}{D} \times 100$ where 100-foot chords are used in the chord definition of degree of curve. This is a close approximation of the length of the curve since it sums up the chords. This formula gives the exact length of the curve by the arc definition.

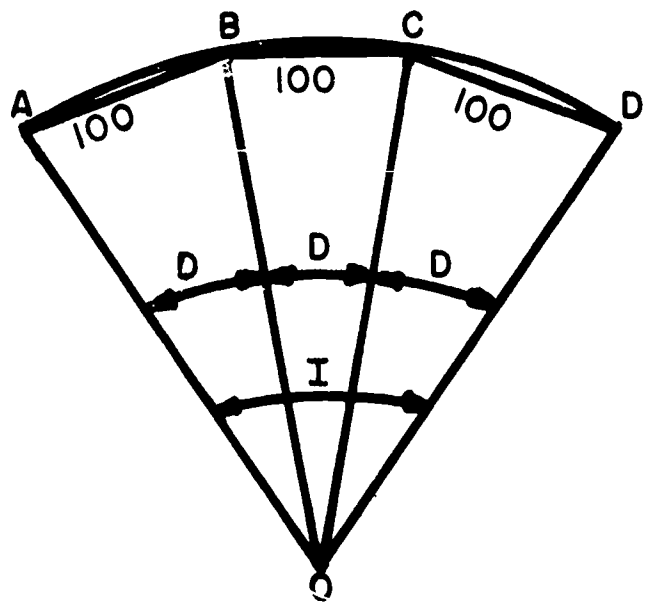


Fig24—Length of curve.

Figure 25 shows a horizontal circular curve with the formulas for computing the values of the various parts of the curve. This is the third curve from the point of beginning shown by Figure 1, sample plate 4.

Plotting Route Surveys with Circular Curves:

After the final curve computations have been made, the station numbering around the curve is the same as for tangents and is continuous around the curve. The final station numbers of the survey show continuously the distance at any point from the beginning of the survey. In Figure 25 the PC is station 27 + 41.4, the length of the curve is 717.8. The station number at the PT is 27 + 41.4 plus 7 + 17.8 which is 34 + 59.2. The final stationing is continued from here to the next curve and then continuously on to the end of the line.

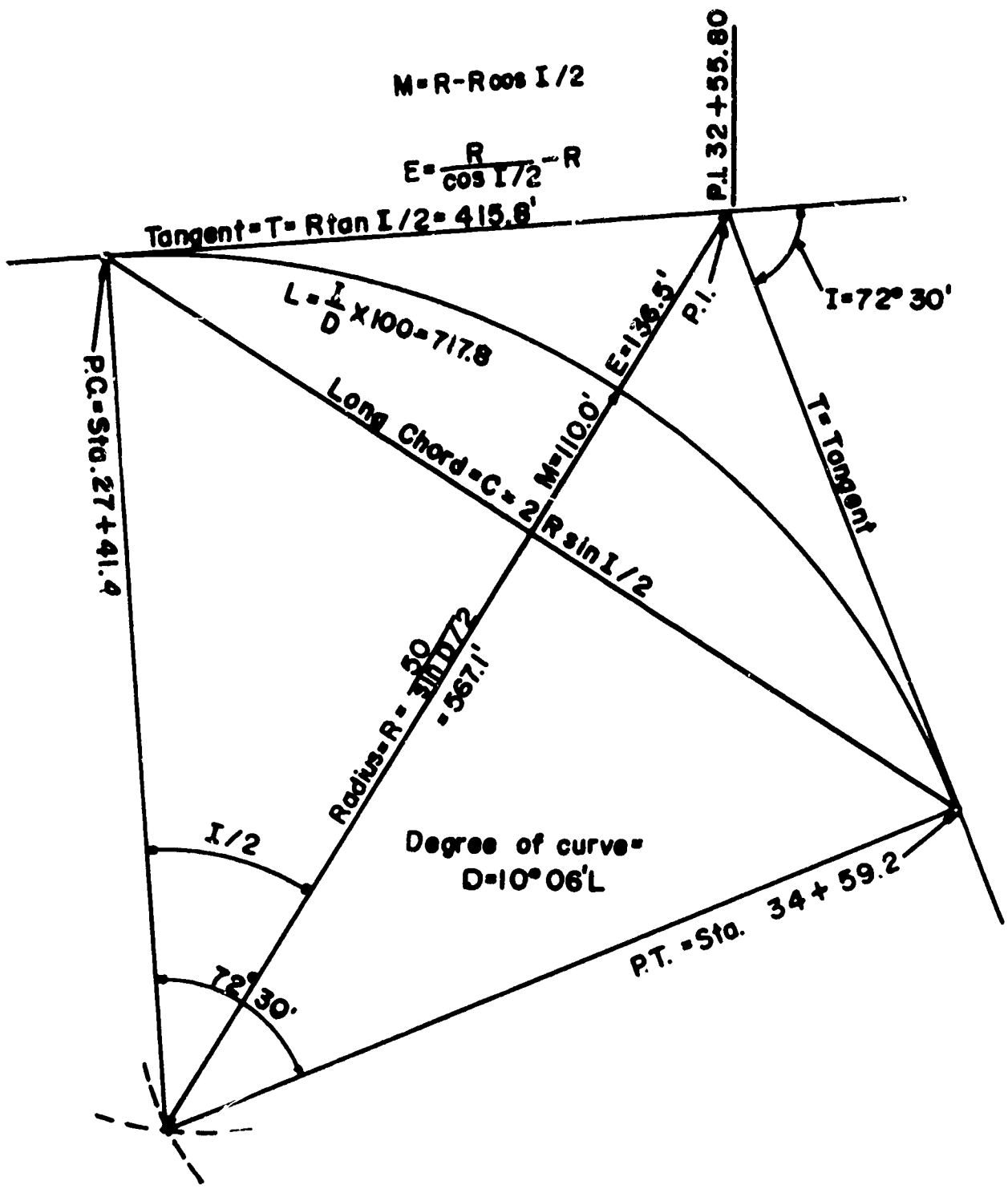


Fig.-25 Horizontal Circular Curve

In plotting route surveys, the traverse is first plotted. The curve data is obtained from the curve calculations usually shown in the field book. Examples of this is shown in the field notes for drawing plate 4. The curves may be drawn by using a set of curve templates and selecting a template to fit the curve to be drawn. When curve templates are not available, it is easy to draw in the curve with a beam compass. In each method the PC and the PT must be located on the traverse for the curve being drawn. It is to be noted that the tangent distances on each side of the vertex must be the same. The tangent distance is obtained from the curve data in the field book. The tangent distance is then scaled off each way from the vertex to locate the PC and the PT. The radius of the curve is then obtained from the curve data in the field book. With the length of the radius set off on the beam compasses an arc is described with the center at the PC and then with the center at the PT. The intersection of these arcs locates the center of the curve O shown on Figure 25. Now with this same radius of the curve and O as the center, the curve is drawn in from the PC to the PT.

It is to be noted that the PI for this curve is at station 32 + 55.80 and the tangent distance of the curve given in the field notes is 415.8 feet. When this tangent distance is subtracted from the station number of the PI it does not give the station number of the PC. Also when the tangent distance is added to the station number of the PI, it does not give the station number of the PT. This is due to the necessary condition that the open traverse must be first run before information is available for selecting the proper curves and computing the curve data. In making the survey for the traverse, the stationing is started at the beginning with 0 + 00 and the stations are numbered continuously from beginning to end. After the open traverse was run, the coordinates of the PI's were computed and used for plotting the traverse. The station numbers of the PI's were numbered as they were in the field notes for the traverse survey. After the traverse was plotted, curves to fit the field conditions were selected and the curve data computed. It is then necessary to go back into the field and stake out or run in the curves. It is to be noted from Figure 25 that the length from the PC to the PT following the tangents is 415.8' + 415.8' is equal to 831.6'. The length of the arc from PC to PT is given as 717.8. The difference in distance along the tangents and along the curve is then 831.6' - 717.8' = 113.8'. The distance around the curve is 113.8' shorter than by way of the tangents. When the curves are plotted, the stationing is now numbered from the beginning of the traverse continuously and around the arcs of the curves. This changes the original stationing after the PC of the first curve.

On Figure 1 of sample plate 4 the first curve has a tangent distance of 171.8. The PI is station 9 + 07.0. Therefore, since

no curves occur from the beginning, the PC is found to be at station 7 + 35.2. This is determined by subtracting the tangent distance from the station number of the PI or 9 + 07.0 - 171.8 = 7 + 35.2. The curve data gives the length of the curve as 335.2'. This is the length of the arc. Continuing the stationing around the curve, the PT station number is the PC station number plus the length of the curve or 7 + 35.2 + 335.2 = 10 + 70.4. It is now necessary to find the distance from the PT of the first curve to the PC of the second curve in order to find the station number of the PC of the second curve if the stationing is now to be carried continuously on the tangents and around the curves from the beginning to end. The distance from the PI of the second curve to the PI of the first curve is 24 + 02.20 - 9 + 07.00 = 1495.20 feet. These stations are from the first traverse survey and are correct for the traverse. Now by adding the tangent distance of the first curve and the tangent distance of the second curve and subtracting this sum from the distance between PI for curve 1 and PI for curve 2, we obtain the distance from the PT of the first curve to the PC of the second curve. That is, 1495.20 - 171.8 - 437.8 = 885.6. By adding this distance between the PT and the PC to the station at the PT of the first curve we obtain the station number of PC of the second curve which is 10 + 70.4 + 885.6 = 19 + 56.0. This process is continued for the other curves, tangents and tangent distances to the end of the traverse. The last reworked station number then gives the distance from the beginning to the end with the distances measured around the curves where they occur.

Figure 2 is plotted and worked in exactly the same manner.

Figure 1 is the survey for a railway and the curves are calculated using the chord definition of the degree of curve. Figure 2 is the route survey for a highway and using the arc definition of the degree of curve. Each figure shows the survey of the centerline of the roadways.

TOPOGRAPHIC MAPS

Fundamentals:

Topographic maps differ from the other usual maps in that in addition to the natural and artificial surface features they show the configuration of the ground surface. Topographic maps show, by suitable and appropriate symbols, streams, vegetation, cultivation, structures and relief. The configuration of the earth's surface such as hills, valleys and depressions is called relief. Topographic maps are required for the study and design of engineering projects that involve land forms. They are a necessary aid to military commanders in planning and executing military operations. They are necessary for geological studies and have many other uses.

Relief:

The relief on a map can be represented by shading, hachures and contour lines. Pictorial means of indicating relief do not directly indicate elevations. Contour lines on a map are the only symbols that directly indicate elevations on the ground surface. Contour lines are the most widely used method of indicating relief on a map and is the most practical method.

Hachures:

Hachures are rows of short lines drawn parallel to the steepest slope. The thickness, spacing and direction indicating the direction and degree of slope. Hachures are rarely, if ever, used on modern topographic maps. Hachures are shown on Figure 26.

Contours:

A contour is an imaginary line on the ground all points on the line being of the same elevation. It can be thought of as a line formed by the intersection of a level surface with the ground such as the shoreline of a lake without waves on the water. If the water should fall, say 5 feet, then the new shoreline would represent another contour five feet less in elevation.

Contour Interval:

The contour interval is the vertical distance between contours. The selection of the contour interval depends upon the scale of the map, the purpose of the map and the configuration of the ground which the contours represent. In flat country

the interval would necessarily be small. For small-scale maps in rugged areas the contour interval would have to be large. It is customary to make each fifth contour line on a map much heavier than the other lines and to label it with its value.

Symbols:

Objects shown on a map are represented by signs and symbols. Some of the conventional signs and symbols representing structures, works, land forms, vegetation and water are shown on Figure 26 and sample plate 5.

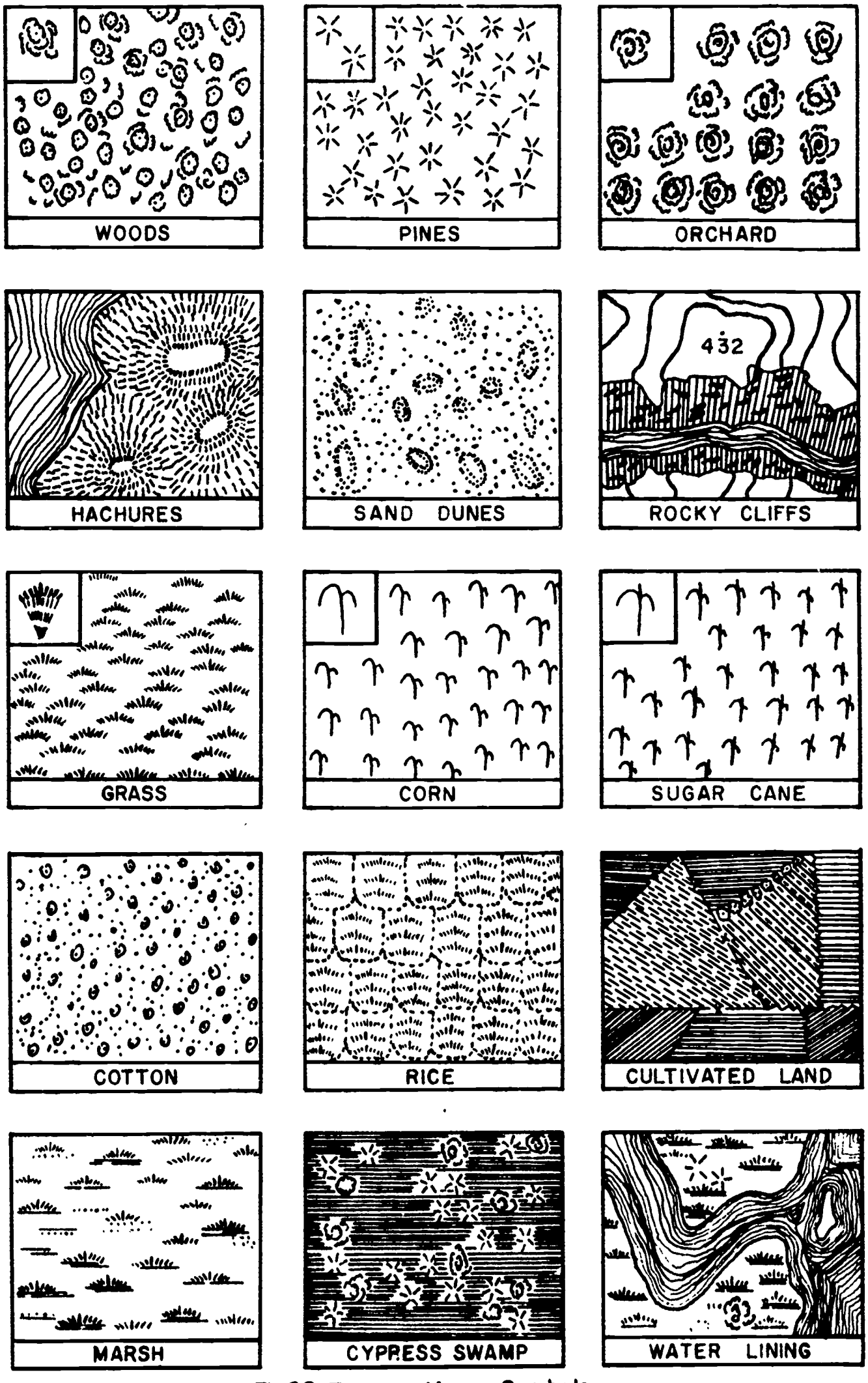


Fig26—Topographic Symbols

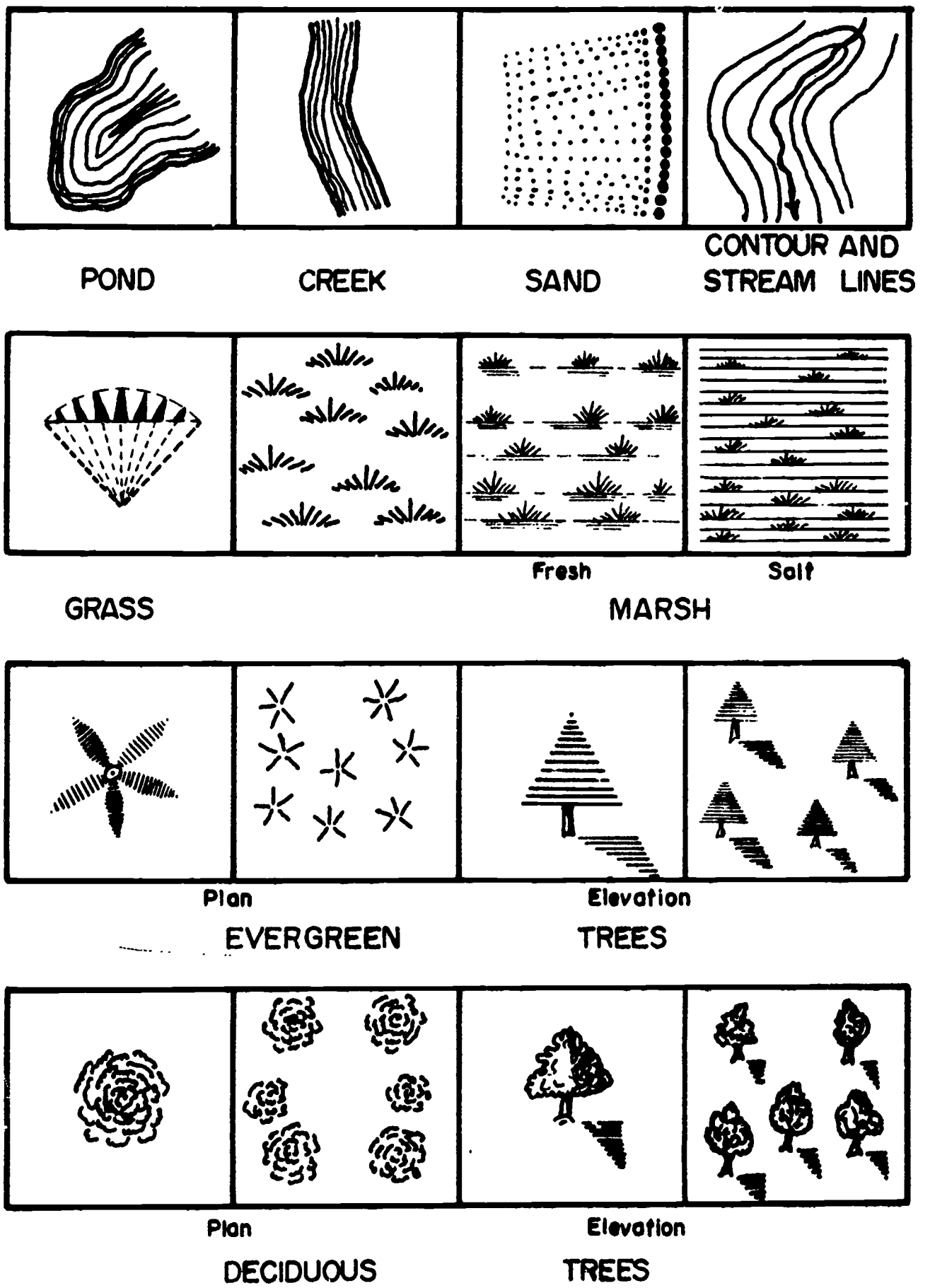


Fig. 26-A CONVENTIONAL SIGNS AND SYMBOLS — DETAILS

Topographic Control:

In obtaining information for the construction of a topographic map it is good practice to first run an accurate traverse within the area to be mapped. The traverse is usually closed. Latitudes and departures are calculated, the traverse adjusted and coordinates are calculated. From the coordinates the traverse is plotted accurately. This is known as the horizontal control. An example of this is the control traverse plotted on sample plate 7P used for constructing the contour map for plate 7. From the points located by the horizontal control traverse a survey of somewhat ess accuracy, usually stadia, is made locating all of the details of features to be shown on the map. The field notes for plate 7 show the results of such a survey.

In addition to the horizontal control it is necessary to have what is known as vertical control. Vertical control consists of establishing bench marks, or markers of a more or less permanent character the elevations of which are determined, at convenient intervals. These are used as control in determining the elevations of the ground points used in constructing a contour map.

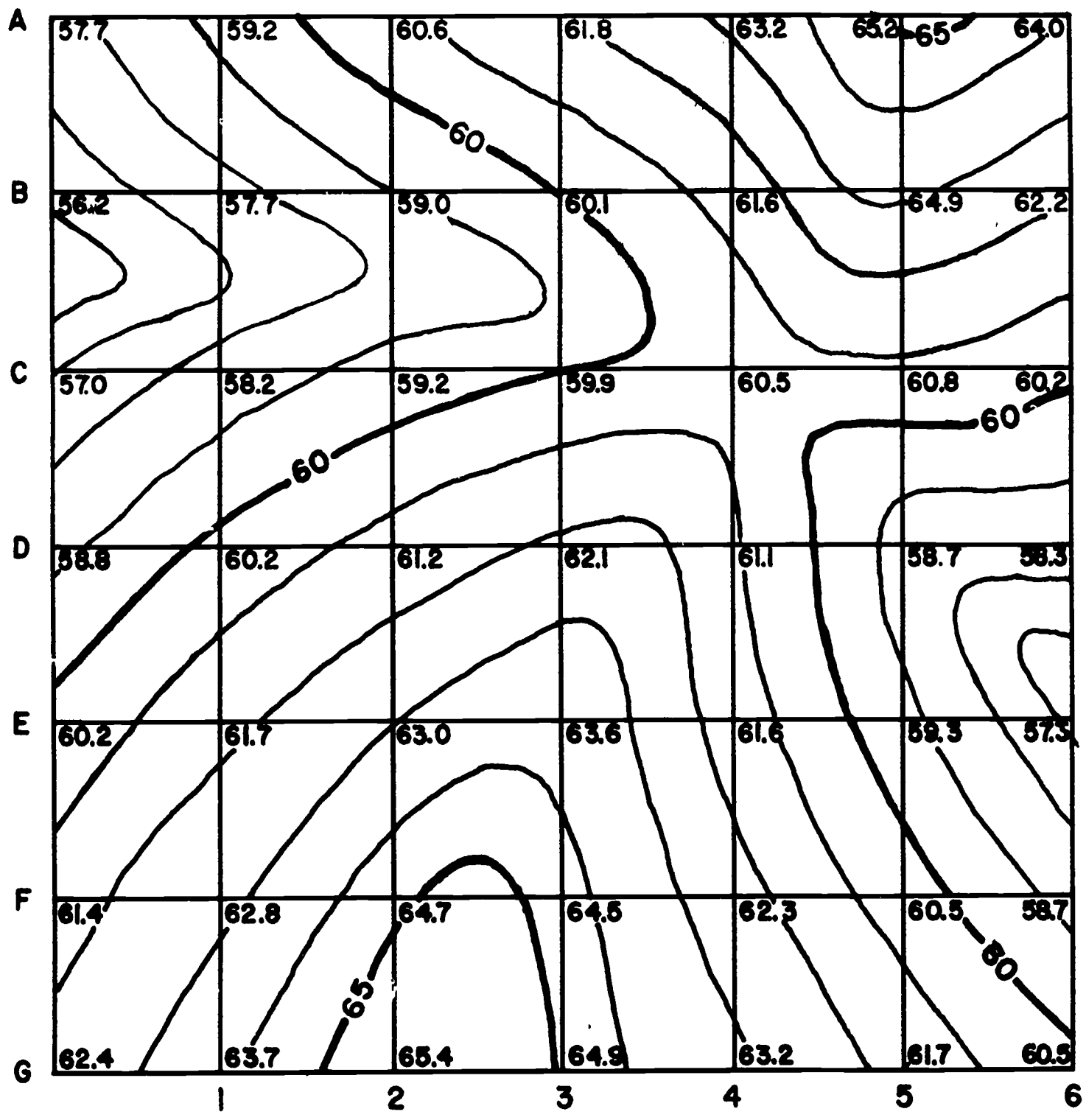
Topographic Details:

The usual means of obtaining topographic details are by transit and stadia or the plane table. In the use of the plane table the contour map is made in the field. Since, by the plane table method, the field drafting is done by the plane table operator this means will not be discussed.

The usual systems used for locating and obtaining elevations of ground points for constructing a contour map are the trace-contour, grid or checkerboard, cross-profile and random shot systems.

In the trace-contour method points on the ground whose elevation is that of the contour desired are located on the ground then plotted on the map. Lines on the map are drawn, connecting points of the same elevation. This method is illustrated on sample plate 6.

In the grid or checkerboard system the area to be mapped is divided into a system of squares or rectangles. The elevations at the corners and of critical points on the lines between the corners are determined by some convenient means. This grid system is plotted and the elevations determined are indicated in the proper location on the grid. The contours are then drawn by interpolating or estimating the position of the desired contours. Figure 27 shows an area contoured using the grid system.



Contours — grid system

Fig. 27

In the cross-profile method lines are run out at right angles to the traverse line far enough to obtain the desired information. On these lines the contour points or the elevations at changes in slope are determined with their distances out from the traverse line. The points are then plotted and points of equal elevation on the map are joined by contour lines. The method of cross profiles is illustrated by Figure 1 and on sample plate 6.

The random shot method is employed by first establishing a horizontal and vertical control system. From this control system the details are located. This is done by locating ground points and their elevations. Usually they are located by means of a direction and distance from a control point. The transit-stadia method is usually employed. The stadia distance to the point is recorded and the vertical angle is read and recorded. From these recordings the horizontal distance to the point and its elevation are calculated. The field notes to be used in plotting plate 7 is an example of the note keeping and elevation and horizontal distance calculations. In this case, directions are shown by azimuths.

In plotting by this method, the control traverse is first plotted carefully by coordinates. The field notes for the control traverse are shown on page 30 of the field book. The calculated latitudes and departures for plotting the traverse are shown on page 31 of the field book. After the control traverse is plotted, the notes for the detail, shown on beginning on page 32 of the field book, are used for plotting the detailed information. The plotted control traverse is shown on sample plate 7P and is used in discussing the method of plotting.

The field notes on page 32 show at the top of the page that the instrument was at station A of the control traverse. The first column headed obj. is the object to which readings were taken. Column 2, headed Az is the azimuth of the object sighted. The notes indicate that azimuth angle is from the north. Column 3 shows the vertical angle read and it is indicated whether the sign of the angle is positive or negative, that is, up or down. Column 4 is the rod interval which indicates the slope distance. Column 5 shows the calculated difference in elevation between the center of the instrument and point read on the rod, known as the rod index. By taking the rod index the same as the height of instrument, or HI, above the ground the calculated difference in elevation gives the difference in elevation between the point on the ground at the rod position and the station under the instrument. Column 6 shows the horizontal distance calculated from the rod interval and the vertical angle. This is the same for small angles but is shorter for larger angles. The seventh column shows the calculated elevation of the point under the rod. This is obtained by taking or adding, depending on the sign, the

difference in elevation and the elevation of station A. A set of notes is given for each station from which details were obtained. The right-hand side of the sheet gives a description of the point.

The five items used in plotting the detail are the object, azimuth, distance, elevation, and description of the point. Now, using the notes showing the instrument at station A as shown on sample plate 7-P, the first point is plotted by measuring on azimuth of 115°14' from the north. On the line in this direction from A, a distance of 305 feet is scaled which locates point 1. The elevation of point 1 is shown in the notes to be 450.0 feet. This is best written by making the located point the decimal in writing the elevations. The remarks show point 1 to be the edge of the water of the lake. The first seven points show the outline of the lake. From the remarks column the buildings, roads and water edge can be drawn in. In many instances, the remarks column list points as GP. This is a ground point for which the elevation was obtained. All of the other points are plotted in the same manner. From the elevations written at the ground points, the contours can be drawn by interpolation or estimation connecting all points of equal elevation.

Contouring:

The process of connecting points of equal elevations on a map by contour lines is generally known as contouring. There are several rules that must be followed in contouring and these are listed.

1. The distance on the map between contour lines varies inversely as the slope of the ground. On steep slopes the contour lines will be close together and on gentle slopes farther apart. On regular and uniform slopes the contour lines will be even distances apart and on uneven slopes uneven distances apart.

2. The slope between points on the map, where elevation control is given, is assumed to vary uniformly. This is used in spacing contours and locating the contours which are to be drawn. The contours are best located by eye and the distances out from ground points is only estimated.

3. Contour lines do not cross one another since each contour represents a different elevation on the ground and if allowed to cross it would present the impossible situation of having a point on the ground with two different elevations. There is the special case of an overhanging cliff where the contours would appear to cross but actually do not as one would actually be above the other. The contour underneath is dashed to clear this seemingly crossing of contours. This is illustrated on sample plate 7 as the pictorial condition of contours appearing to cross by the feature labeled "overhang."

4. Contour lines do not merge with one another of the same or different values. In the case of a vertical cliff or cut they would appear to merge but would not as they are spaced vertically at different elevations.

5. Contour lines always close either on or off the map. Since a contour can always be visualized as the shoreline of a body of water, it can be seen that it always must close as there can be no ending of a shoreline and it must close back on itself.

6. A single contour line alone cannot lie between contours of lower or higher elevation. For the feature labeled "saddle" on sample plate 7, it can be seen that if a contour is thought of as a shoreline and the hills were inundated part-way up there would be contours on either side of the valley of equal value representing the two summits. As the water is imagined lowered, there would be contours of equal value to represent each side of the shoreline. As long as there was even a minute amount of water in the valley between the hills, there would be two contours of equal value representing the shoreline. At no time could there be a shoreline of only one side.

The preceding discussed rules must be followed in contouring a map. In contouring it is considered good practice to first outline lightly the ridge lines and the valley lines. The position of each contour value to be used can then be located on these ridge and valley lines. After this is done, contour lines can be drawn connecting points of equal value following the general rules listed above.

Sample plate 7 shows some typical land forms and how they are represented by contour lines. The contours representing the land forms are general and no values are indicated. The arrows show the direction of slope.

PROFILES AND CROSS SECTIONS

The definitions, as used in surveying drafting, of a profile and of a cross section were given in the beginning of the text in the introduction. They will be repeated here for convenience. A profile is a drawing showing a vertical section along a certain surveyed line. A cross section is a drawing showing a vertical section usually at right angles to the survey line.

Profiles and cross sections have been previously discussed in relation to obtaining information for the construction of the plan profile of a route survey. Sample plate 6 illustrates how cross lines to a survey line were used in mapping the topography on either side of a survey line. It also illustrates how a profile was constructed along the line of the survey. This section will deal with profiles and cross sections in their use in computing earthwork, fixing grades and vertical curves.

Plotting Profiles:

Profiles are plotted from level notes. The level notes show the elevations along the survey line obtained by a level crew. They may also be plotted from elevations taken from a contour map. They are usually plotted on regular profile paper. The vertical lines are usually 1/2 inch apart and the horizontal lines 1/10 or 1/20 inch apart. Printed sheets of this paper are available at any drafting supply store. This is sometimes called plan-profile paper. The bottom portion is ruled with horizontal and vertical lines for plotting the profile and the top portion is unruled and left blank. The unruled portion at the top is used for plotting the plan view of the survey.

The horizontal and vertical scales used are not usually alike. The vertical scale is exaggerated because the horizontal distances are very great as compared to the changes in elevation. Sample plate 6 shows a plan profile where the horizontal scale is 1 inch equals 200 feet while the vertical scale is 1 inch to 10 feet. On this drawing the profile is shown for the surveyed route and the alternate route which is a straight line from the beginning to the end of the traverse. The unruled portion of the sheet shows the plan view of the survey and the contoured area on either side of the survey line. The station numbers increase from left to right. Many sheets are sometimes necessary if the route survey is of any extent lengthwise. Sometimes rolls of paper are used.

In the case of sample plate 6 the plan is drawn to scale and the horizontal profile distances are not exact. Elevations for

profile plotting were obtained from the contour map. These were projected vertically downwards from the plan view to obtain the location on the ruled section. This is customary. When the elevations of the ground points have been plotted on the ruled paper, the line connecting the ground points is drawn in freehand. The ground points connected by a line gives a profile of the route plotted.

Fixing Grades:

The ground profile is used as a basis of study to fix the grade location. Several factors control the location of the grade line. Some of the factors controlling grade location are stream crossings, beginning and ending points and routes through towns and villages. Maximum rates of grade for the type traffic for which the road or railway is used is an important controlling factor in grade selection. In as far as possible the grade is selected and fitted to the ground so that as nearly as possible the cuts will equal the fills. The amount of dirt removed from the cuts should just about be the amount required to fill the low places. This avoids costly long hauls for dirt to fill low places or to dispose of dirt from the cuts. A grade line is shown on sample plate 6.

Plotting Cross Sections:

Cross sections are usually plotted on regular cross-section paper. This is usually ruled 10 x 10 to the inch. The cross sections are usually plotted from the cross-section field notes. The horizontal and vertical scales may or may not be the same. The scales used depend on the accuracy required in computing the cross-sectional areas and upon the amount of relief. Sample plate 8 is an example of the plotting of a series of cross sections for the purpose of calculating earthwork.

Cross sections are sometimes taken from the center line out in each direction from the center line. Sometimes in the case of a borrow pit they are taken out from a survey line at the edge of the pit. Sample plate 8 shows cross sections taken from the edge. They were taken to determine the amount of dirt to be excavated for a street that would allow drainage.

The field notes for sample plate 8 are given beginning on page 50 of the field notes. The left-hand sheet shows the notes used in determining the height of the instrument. The right-hand sheet shows the elevation of the point on which a reading was taken, the distance out from the control line and the rod reading. The elevation was obtained by subtracting the rod reading from the height of instrument. Only the distance and elevation are used in plotting the cross sections. The station number of the section is shown on the left-hand page.

The vertical scale is 1 inch equals 1 foot and the horizontal scale is 1 inch equals 5 feet. The first section at station 0 + 00 is placed in the upper left-hand corner of the sheet and the following sections are placed one underneath the other. When one line-up of sections fills the space to the bottom of the sheet a new line is started at the top of the sheet. A horizontal line is drawn at each plotted elevation and distance. The distance out is written at the bottom of the line and the elevation at the top. Actually this distance out from the line, together with the elevation, gives the coordinates of the point. These coordinates are used when a calculating machine is used to find the area of the cross section.

The station number of each cross section is listed under the cross section. The area of each cross section is indicated within the section and states if it is cut or fill. The volume of earth between each two sections is shown between the two sections and whether it is cut or fill.

Areas of Cross Sections:

In order to calculate the volume of earthwork it is first necessary to calculate the areas of the cross sections. The areas are in terms of square feet usually. There are three usual methods of computing the areas of irregular cross sections. The first method is by use of the planimeter. This is a mechanical device for finding irregular areas. The tracing point is used to make a trace around the closed figure. The dial readings are a measure of the area. A description of and a discussion on the use of the polar planimeter can be found in any standard text on plane surveying.

Another method formerly widely used in determining the area of cross sections was to divide the irregular section into triangles, scale the base and altitude, compute the area of each triangle in the section and sum up the individual areas to obtain the area of the section.

Figure 28 is an example of the method of triangles. The base and altitude are scaled in inches. These figures are used to obtain the areas of the individual triangles in the section. When the areas are summed the sum gives the area of the section in square inches. Now the vertical scale is 1 inch to 1 foot and the horizontal scale is 1 inch to 5 feet so the area in square feet represented by 1 square inch on the paper is 1 x 5 or 5 square feet. The area calculated in inches is multiplied by 5 to obtain the area in square feet.

The most widely used method today is the calculating machine method. It is the fastest and most accurate method. This method employs a form of the calculation by coordinates method discussed in Section 6. Today practically all area calculations are done by machine and this method will now be explained.

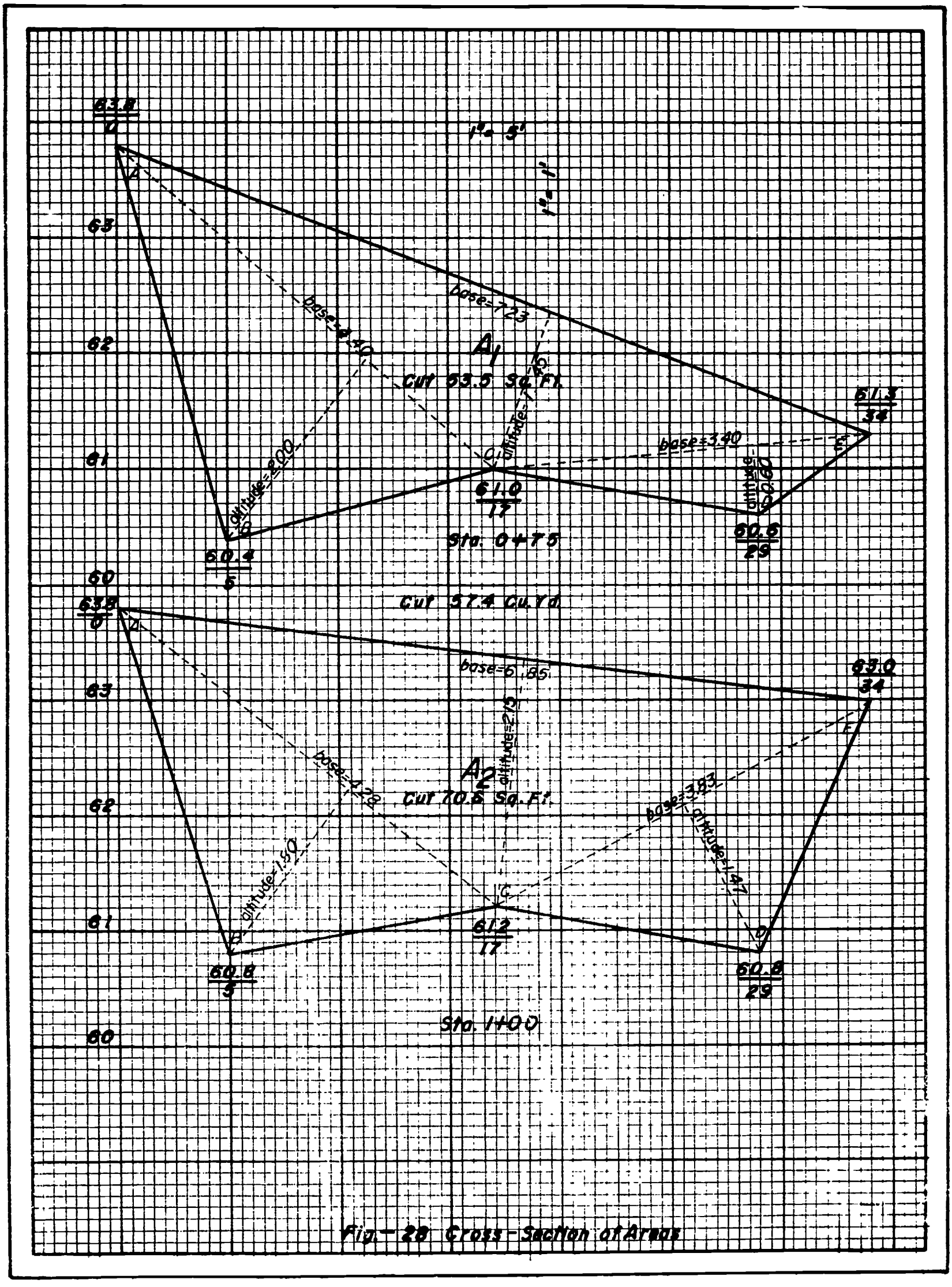


Fig. — 28 Cross-Section of Areas

Again Figure 28 will be used in describing the machine method. The computation of the area of the cross section at station 1 + 00 in Figure 28 will be used as an illustration.

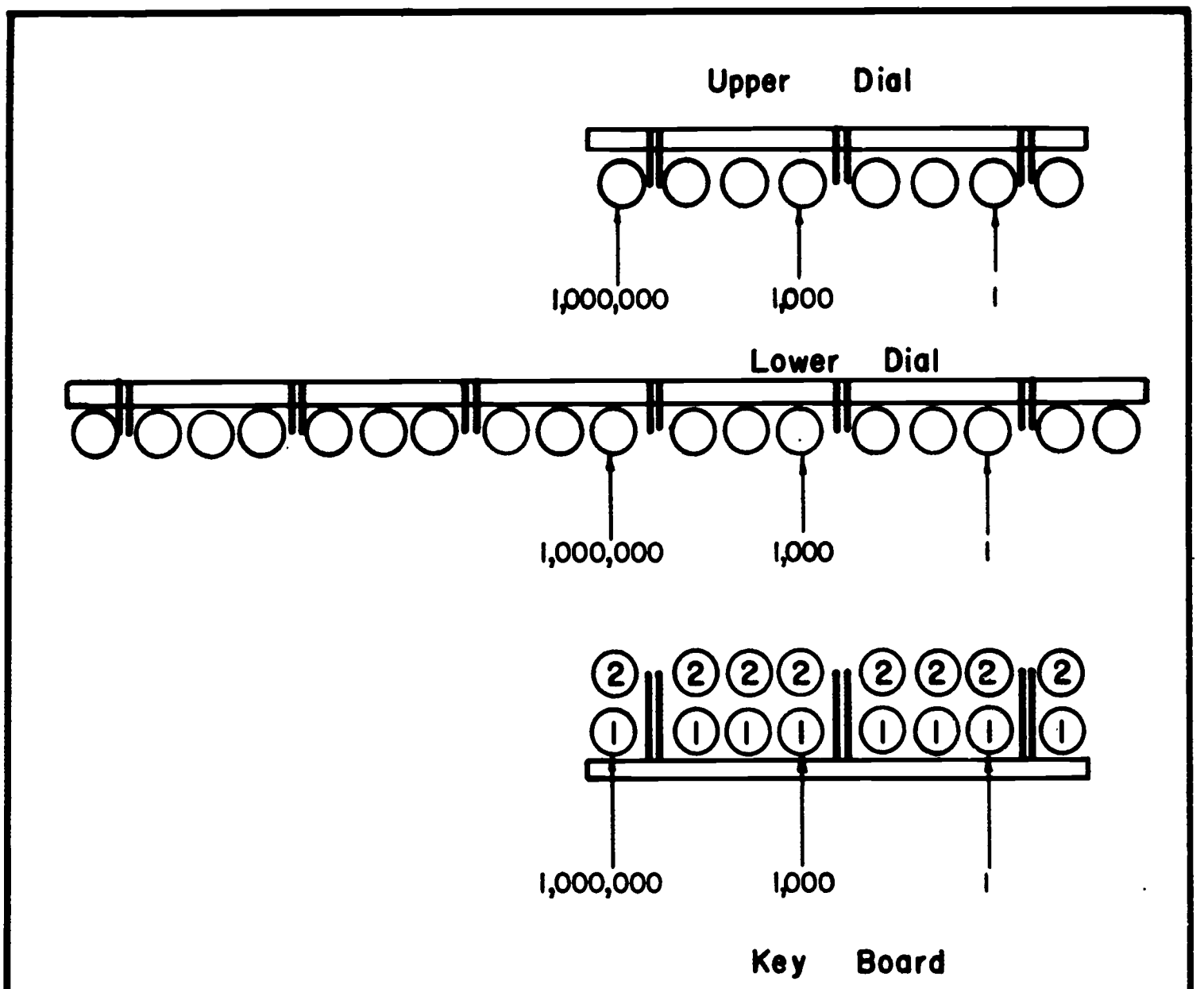


Fig.- 28-A

Figure 28-A represents the dials and keyboard of a rotary calculating machine. The first operation in calculating the area of the cross section is to set the decimal indicators on the dials and keyboard as shown by Figure 28-A. The operations will be explained step by step following.

1. Set the decimals on the machine as shown by Figure 28-A.
2. With the keyboard clear run the elevation "63.8", shown at "0" distances in the upper dial. The dials now will read as follows.
   Upper 000 000 063.8
   Lower 000 000 0000.00
3. Place "5.0" in the keyboard and depress the repeat key on the machine. The "5.0" placed in the keyboard is the sum of "0" and "5.0", the distances from the axis to each end of the line AB and can be thought of as the DMD of the line AB. Now with the "63.8" still in the upper dial and the "5.0" in the keyboard run the upper dial to the next elevation "60.8" shown at B. The elevations are taken around the figure in a counterclockwise direction. The dials will now read as follows.
   Upper 000 000 060.8
   Lower 999 999 985.00
   The elevation of "60.8" now in the upper dial is lower than the elevation "63.8" which was initially in the upper dial so the reading in the lower dial is negative. This is of no importance in the final answer. In running the upper dial from "63.8" to "60.8" with "5.0" by (63.8 - 60.8) or 3 with the dials turning in the opposite direction from normal multiplication on the machine.
4. Replace the "5.0" in the keyboard with "22.0" which is the sum of "5" and "17" and is equivalent to the DMD of the line BC. Now with the dials as above run the upper dial to the next elevation "61.2". The difference between the elevation of "60.8" and "61.2" is equivalent to the latitude of the line BC. The dials will now read as follows.
   Upper 000 000 061.2
   Lower 999 999 993.80
5. Replace the "22.0" in the keyboard with "46.0" which is the sum of "17" and "29" and run the upper dial to the next elevation "60.8". The dials will now read as follows.
   Upper 000 000 060.8
   Lower 999 999 975.40
6. Replace the "46.0" in the keyboard with "63.0" which is the sum of "29" and "34" and run the upper dial to the next elevation "63.0". The dials will now read as follows.
   Upper 000 000 063.0
   Lower 000 000 114.00
7. Replace the "63.0" in the keyboard with "34.0" which is the sum of "0" and "34" and run the upper dial to the next elevation "63.8" which brings us back to the point of beginning. The dials will now read as follows.
   Upper 000 000 063.8
   Lower 000 000 141.20

Again Figure 28 will be used in describing the machine method. The computation of the area of the cross section at station 1 + 00 in Figure 28 will be used as an illustration.

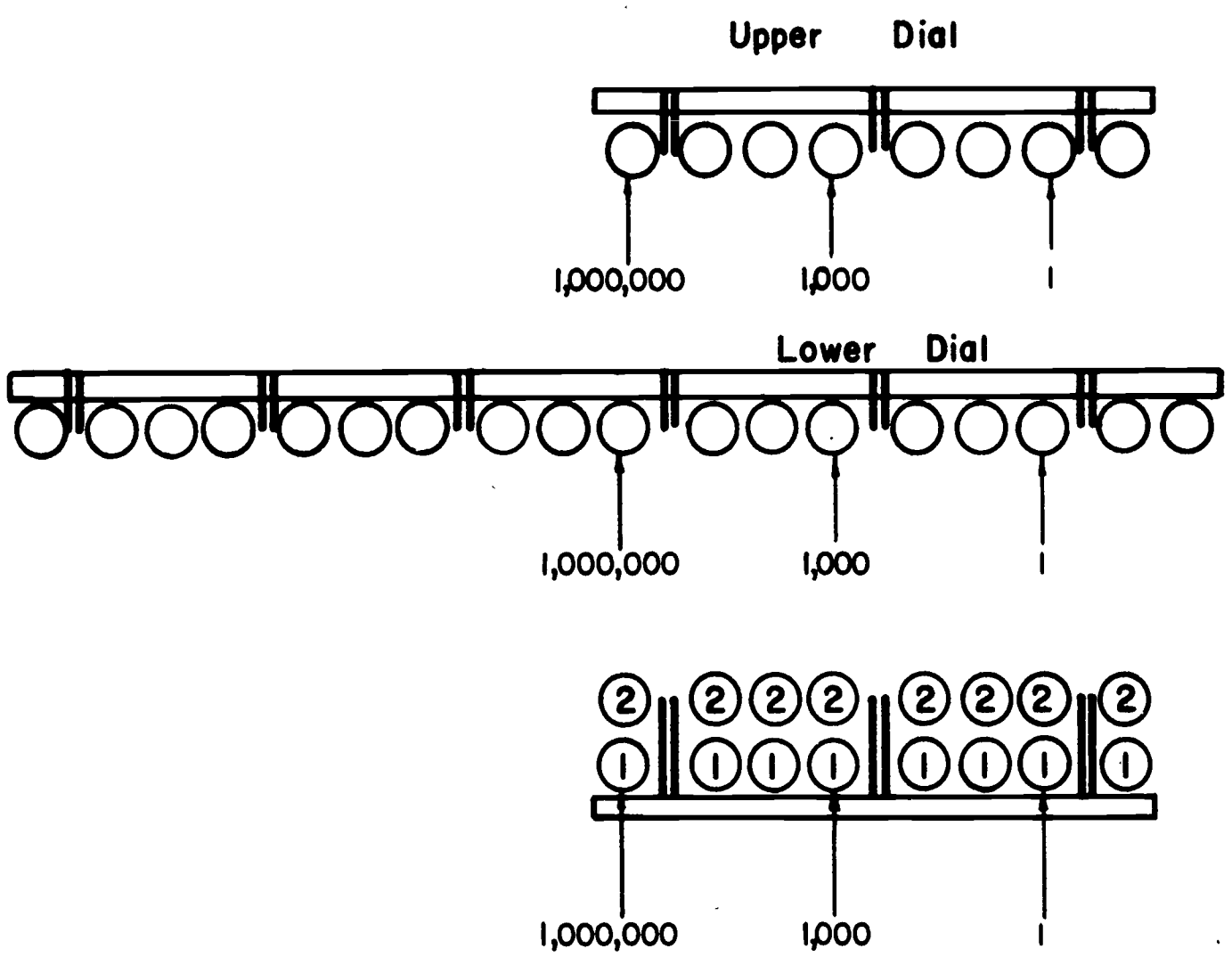


Fig.- 28-A

Figure 28-A represents the dials and keyboard of a rotary calculating machine. The first operation in calculating the area of the cross section is to set the decimal indicators on the dials and keyboard as shown by Figure 28-A. The operations will be explained step by step following.

The result in the lower dial is the double area of the cross section. Divide this double area by 2 and this gives the area of the cross section as 70.6 square feet.

When cross sections are taken out in each direction from the center line the areas are found in essentially the same way. The area of the right portion is computed first then the area of the left portion is computed. The instructor can point out various other special conditions.

Volumes of Earthwork:

The most commonly used method of computing volumes of earthwork is by the method of average end areas. In Figure 28 the volume of earth between stations 0 + 75 and 1 + 00 is equal to the average of the end areas multiplied by the distance between them. The volume is equal $\frac{A_1 + A_2}{2} \times 25$. Since the units of measurements are in feet the volume will be in cubic feet. This is converted to cubic yards by dividing by 27.

Figure 29 illustrates a convenient form for the calculation of earthwork. Column 1 is the station number. Column 2 gives the distance between successive stations. Column 3, opposite the station number, shows the area of the cross section. Column 4 is the sum of the two areas. Column 5 gives the volume of earth between the two stations. To obtain the volume the sum of the areas is multiplied by the distance then divided by 54. This is equivalent to averaging the two areas by dividing the sum by two then multiplying by the distance to obtain the volume in cubic feet and dividing by 27 to convert cubic feet to cubic yards. The individual volumes between stations are then added to get the total volume from beginning to end of line.

Vertical Curves:

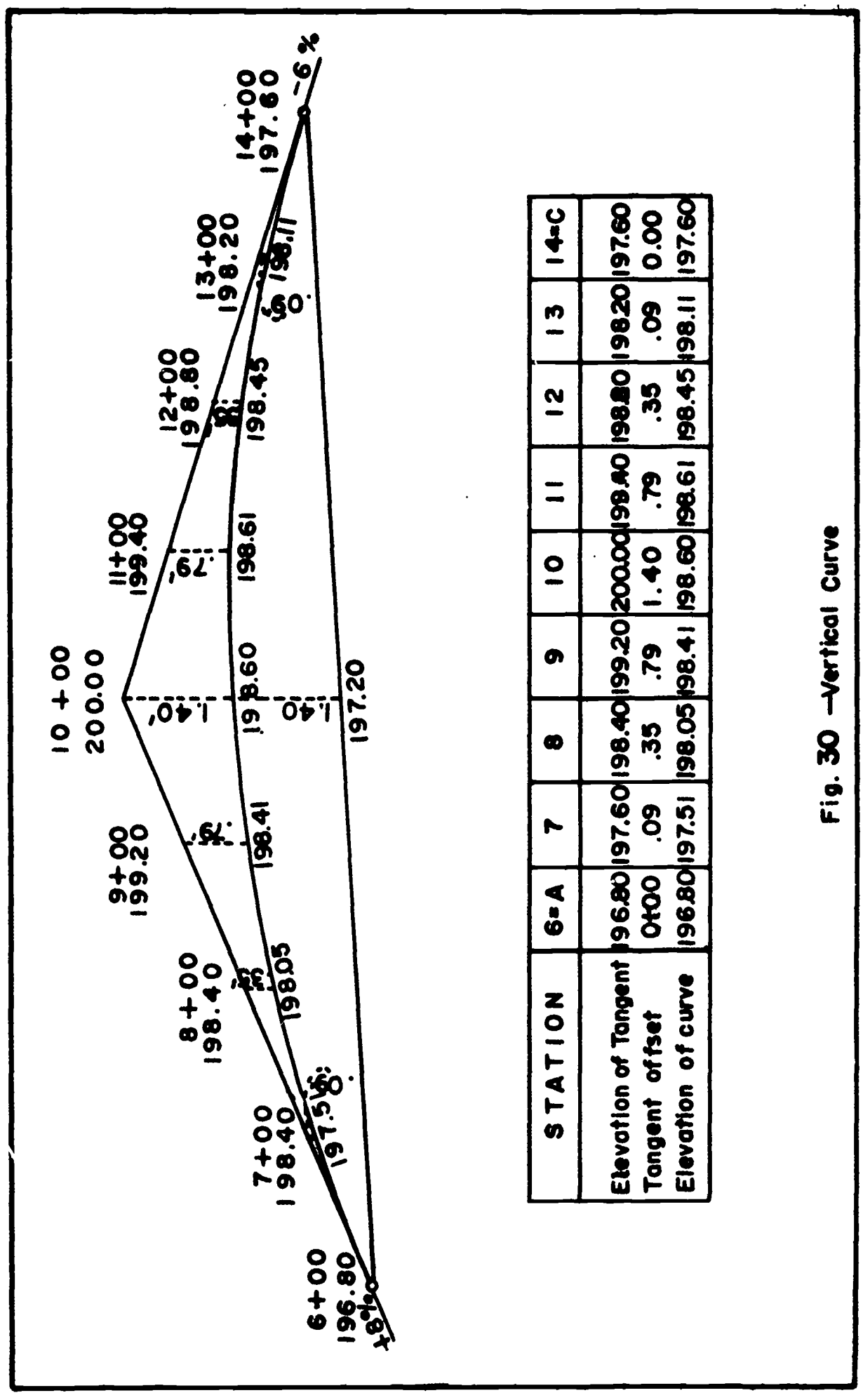
At the changes in gradient of the selected grade for railways and highways, curves in a vertical plane are necessary to prevent abrupt changes in direction of the vehicle in a vertical direction. The vertical curve is almost always an arc of a parabola since it gives a gradual change in the vertical direction of the curve. The maximum allowable change in grade per station commonly governs the selection of a vertical curve. In computing a vertical curve the tangent offsets to various points on the curve are calculated from the properties of the parabola. Since the plotting of vertical curves by the draftsman is not to often encountered the interested student is referred to a standard textbook on surveying. The example of a vertical curve calculation is shown by Figure 30. Such curves do not mean much plotted to scale on a profile. It can be seen that the offsets from the tangent to the curve are small when compared to the length of the curve.

EARTHWORK CALCULATIONS

STATION	Dist.	Excavation Area	Excavation Sum of Areas	Cu. Yds.
0+00		43.4		
	25		93.5	43.3
0+25		50.1		
	25		106.2	49.1
0+50		56.1		
	25		109.6	50.7
0+75		53.5		
	25		124.1	57.4
1+00		70.6		
	25		145.0	67.1
1+25		74.4		
	25		141.5	65.5
1+50		67.1		
	25		132.8	61.5
1+75		65.7		
	25		126.8	58.7
2+00		61.1		
	25		121.6	56.3
2+25		60.5		
	25		112.5	56.7
2+50		62.0		
	25		96.4	44.6
2+75		34.4		
	25		81.0	37.5
3+00		46.6		
	25		101.9	47.1
3+25		55.3		
	25		108.5	50.2
3+50		53.2		
	25		87.6	40.5
3+75		34.4		
	25		74.0	34.2
4+00		39.6		
	25		78.3	36.2
4+25		38.7		
	25		77.4	35.8
4+50		38.7		
	25		85.5	39.6
4+75		46.8		
	25		93.6	43.3
5+00		46.8		
	33		78.4	38.3
5+33		31.6		
				1011.6

$$\text{Cubic yards} = \frac{\text{dist. x sum of areas}}{2 \times 27} = \frac{\text{Dist.}}{54} \text{ x sum of areas}$$

Fig. 29– Calculation of Volumes



STATION	6=A	7	8	9	10	11	12	13	14=C
Elevation of Tangent	196.80	197.60	198.40	199.20	200.00	198.40	198.80	198.20	197.60
Tangent offset	0+00	.09	.35	.79	1.40	.79	.35	.09	0.00
Elevation of curve	196.80	197.51	198.05	198.41	198.60	198.61	198.45	198.11	197.60

Fig. 30 —Vertical Curve

AREA MAPS

In the section on route surveying and mapping we were interested in long and very narrow strips of land. In this section on area maps we deal with areas where the width and length are comparable. Area maps cover specific areas the size of which may vary from a single tract, such as a farm, to a city, county, state or larger. In the drafting related to plane surveying we are interested only in areas of limited extent where the distortion due to the earth's curvature will not be appreciable.

Kinds of Area Maps:

There are innumerable kinds of area maps such as political maps, city maps, economic study maps, statistical maps, charts for air and sea navigation, highway maps, land survey maps, subdivision maps and many other types. Again the survey draftsman is interested only in maps of limited extent such as route survey maps, land survey maps, topographic maps and subdivision maps.

Purpose of Area Maps:

Maps are part of the working equipment of every industry, military organization, educational organization, engineering organization and business. Maps are required for every engineering project except the most simple. Practically every land survey, subdivision survey and topographic survey requires that a draftsman construct a map from the field survey notes. Many transfers of property require maps describing the property. Maps are used for the purpose of numerous studies.

Surveys for Area Maps:

Since area maps cover considerable territory it is usually necessary first to run a skeleton control survey. This survey is rather precise. Level parties determine the vertical control. Reference horizontal and vertical control markers are set throughout the area. From these control points the details in the area are obtained. Sometimes the control traverses are run simultaneously with the details. This is the case for the notes for making Plate 9.

Plotting Area Maps:

Sample Plate 9 will be used in discussing the plotting of area maps. In this case the control traverses were run at the same time the detail was obtained. When this method is used

it is best to plot all of the traverses and check them for error before plotting any of the detail. It can be seen that some of the traverses form closed figures and these should close when plotted on the map. It will be noted that the traverse for Wilson Road was run first and then the Stagg Road traverse was run. Wilson Road should be plotted first. The second plotted should be Stagg Road since it takes off from a station on Wilson Road. The other traverses all take off from stations on these two roads. The location of the notes in the field book is indicated in the index. The left-hand page shows the survey notes for the traverses and the right-hand page shows sketches with distances and angles to the details being mapped. The calculated bearing of each line is given together with the station numbers. The traverses should be carefully plotted from this information. After all of the traverses have been plotted and checked the detailed information can be plotted. This requires careful reading of the remarks and the labeled sketches. After the detail is completed culture symbols can be drawn in.

Maps of Public Record:

Many maps showing property sales, easements, rentals and leases are filed in the clerk of court's office. Here they become a matter of public record and are open to inspection by the public. Figure 31 shows a map of the division into seven parts of a piece of property. The map was drawn from the survey field notes. This map was recorded and became a part of the public record.

Survey Plats:

Maps showing the results of the survey of small tracts of land such as lots are referred to as plats. Figure 32 shows a survey plat required for a F.H.A. loan.

City Maps:

City maps show usually the location of streets, public utilities, lots and blocks. The mapping and surveying procedures are usually more accurate than for less valuable country property.

Contents of Maps:

The contents of a map depends on its purpose. All information should be shown on a map that is needed to satisfy its purpose. Sometimes, too much information shown on a map that is not required to serve the purpose of the map only tends to be confusing.

The following information should appear on any type map: a suitable title, the direction of the meridian, a suitable scale, preferably graphical, and a legend showing symbols used other than conventional symbols.

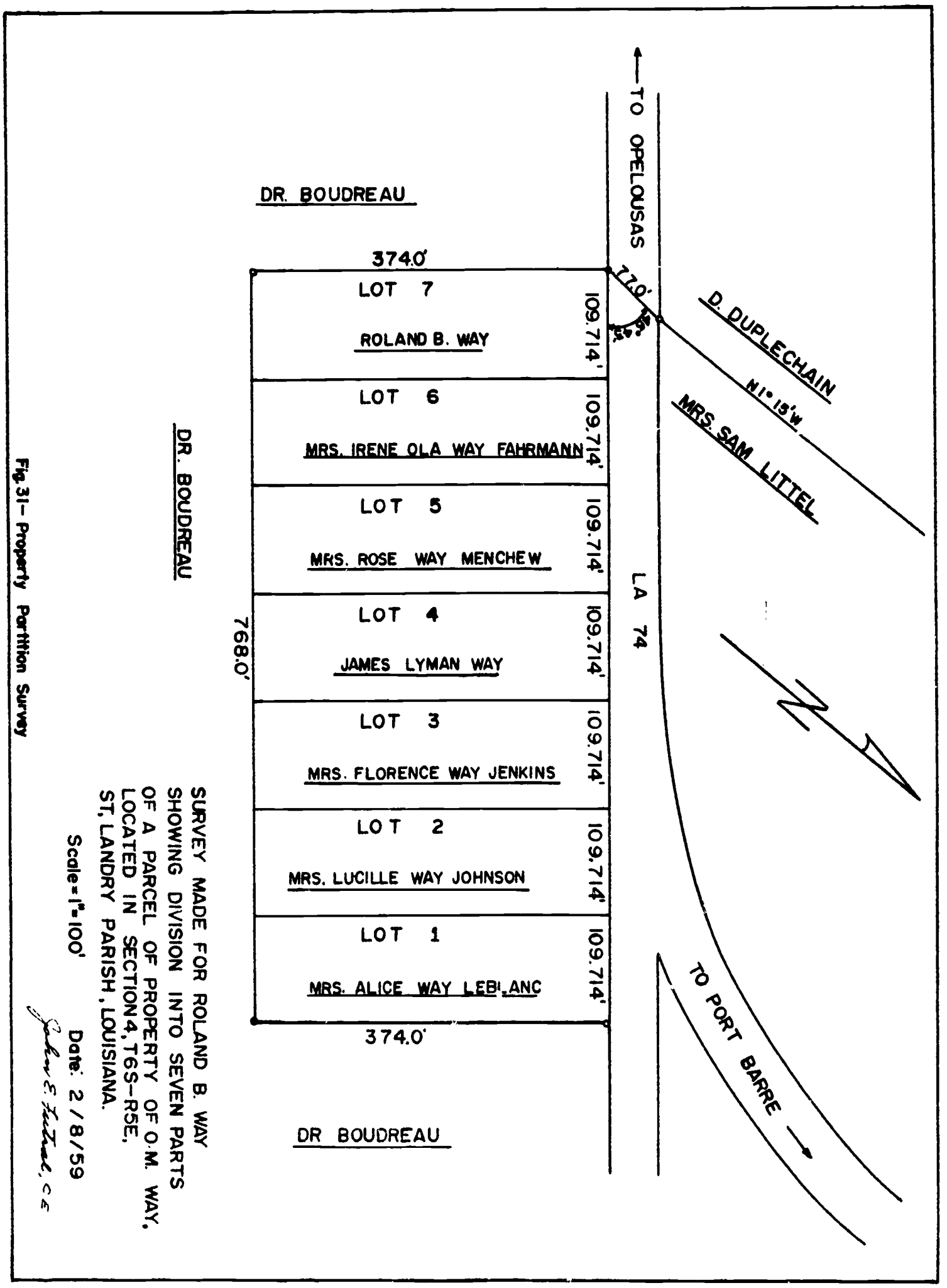
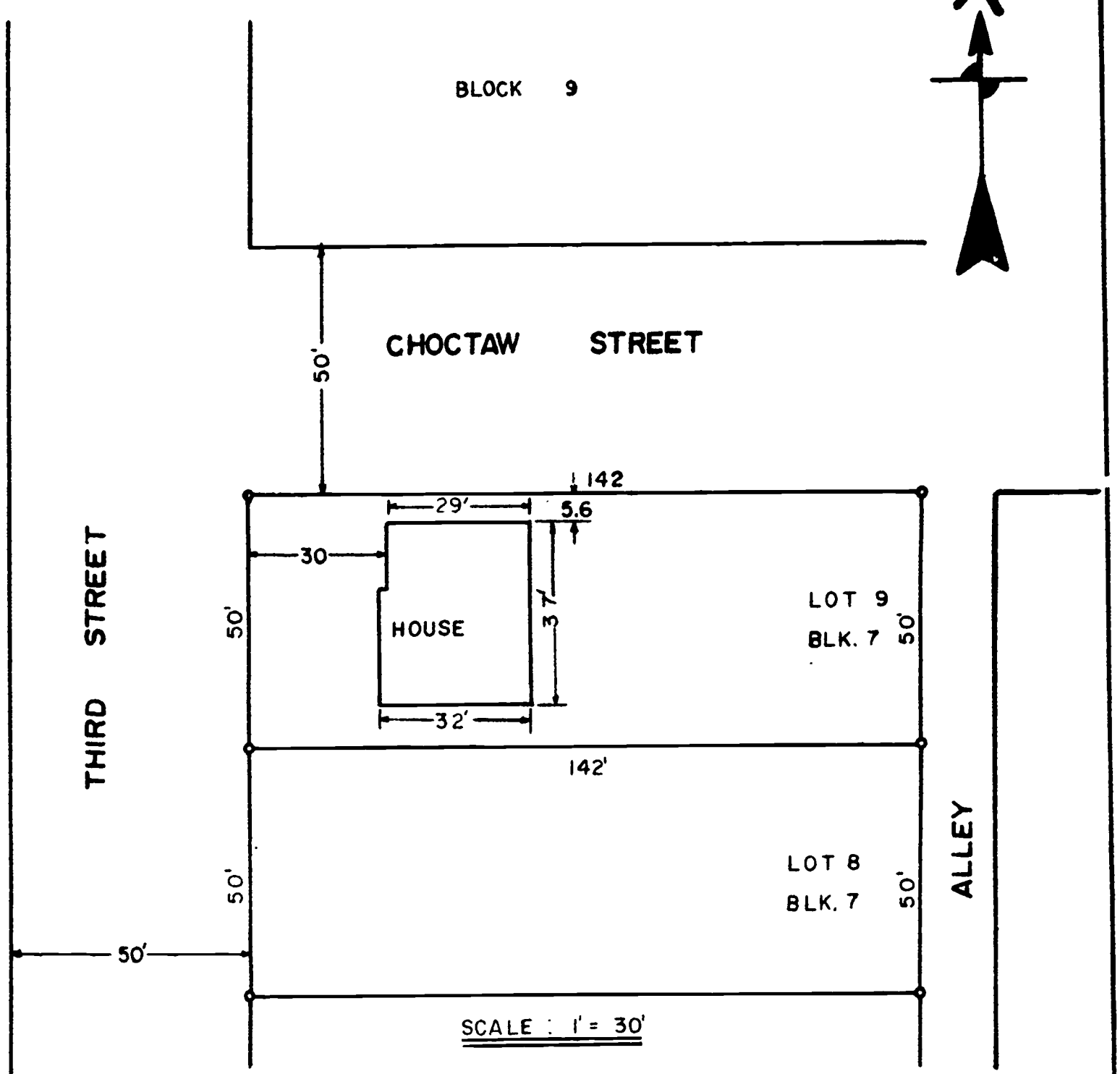


Fig. 31 – Property Partition Survey



SURVEY SHOWING LOCATION OF
RESIDENCE OF JOHN C. RICHARD IN
LOT 9, BLOCK 7, LEBLANCE SUBDIVISION
IN PORT BARRE, ST. LANDRY PARISH, LOUISIANA.

John E. Fontenot, C.E
6-16-63

Fig. 32– Survey Plot

Any map that is to be made a part of the public record should show in addition to general information for maps the following items:

1. The length and direction of each line.
2. The location and kind of corner markers used.
3. The distances and directions to the corner reference marks.
4. The subdivision description of the property such as lot, block and section number. In rural property the county, ward, township and range as well as section should be shown.
5. The name of the property owner and the names of the owners of the adjoining properties.
6. The signature and seal of the surveyor together with his registry number.

Subdivisions:

Subdivisions of property are divisions into smaller parcels than the previous or original survey. A piece of property may be made into a subdivision of a town by dividing it into lots and blocks with streets and utilities and having it incorporated as part of the town. Maps made of these subdivisions then serve as the basis for a legal description of the various lots.

REPRODUCTION OF DRAWINGS

Maps are usually drawn on buff detail paper or on a good grade heavy white paper. The simpler maps are sometimes drawn directly on tracing paper or tracing cloth. It requires a skilled draftsman to work directly on tracing medium.

The map as drawn on the heavy drawing paper can be reproduced only by photographic methods or by tracing.

It is necessary to reproduce most drawings in quantity since many copies are usually required. It would not be wise to allow the original to be taken from the office as it could be damaged or lost. By keeping the original safe in the office, additional reproductions can be made at any time they may be needed.

Several methods are used in reproducing drawings in quantity. This reproduction can be made by privately-owned equipment or by more elaborate commercial equipment.

Photostats:

A drawing that is reproduced by photographing it is known as a photostat. The photostats can be made of the drawing to almost any scale. The drawings can be enlarged or reduced in size. It is very desirable to have a graphic scale on any drawings that are to be enlarged or reduced in size by reproduction. Imperfections in the drawing are exaggeratdd when the drawing is enlarged and they are minimized when the size is reduced. The drawings shown in this manual are examples of reproduction by photography.

Blueprints:

A blueprint reproduction gives a white line on a blue background. A tracing of the drawing on transparent tracing paper or tracing cloth is required to produce a blueprint. The tracing is placed in contact with the sensitized paper and exposed to a strong light. The lines on the tracing protects that portion covered by lines from exposure to the light. The exposed sensitized paper is then developed in a solution of water usually with some chemicals added.

Blueprints are known as contact prints since the tracing is in direct contact with the sensitized paper.

Bluelines:

Bluelines are reproductions in which the lines are shown in blue color on a white background. These are contact prints and are usually developed in an ammonia vapor. The reproduction is rapid and the print is delivered dry.

Blacklines:

Blackline reproductions are similar to bluelines. The special chemical on the sensitized paper and the chemical used for developing in each case controls the color of the line and the background.

Vandykes:

This type is made from vandyke sensitized paper and a tracing of the drawing. The lines are white. The background is dark brown. Light can pass through the white lines while the background is impervious to light. This vandyke print can be used as a negative from which other contact prints can be made.

Ozalid Prints:

Ozalid prints are prints from special sensitized paper. This paper can be purchased which will give either red, brown, blue or black line prints. These are contact type prints and are developed by ammonia vapor. The prints are delivered dry and are inexpensive.

There are other types of duplication available and any large city or town has shops that specialize in this type work.

There is usually some distortion in prints made by any of the duplication methods. This is due to shrinkage or expansion of the reproduction paper. Some prints such as blueprints are rather permanent and other are sometimes less permanent.

ASSIGNMENTS AND DIRECTIONS

General Directions for Preparing Mapping Plate Assignments:

These instructions for preparing plates are general. Directions will be given for each plate including the necessary information to complete each plate. The usual size of plates, unless otherwise stated, will be 14 by 20 inches. The size sheet of paper will necessarily be slightly larger. The outside border or lines along which the plate is trimmed will be 14 inches wide and 20 inches long. A one-half inch border will be left all around and inside of the outside border. The inside border will then be 13 inches wide and 19 inches long. The plate title will be enclosed in a rectangle in the lower right-hand side of the plate. The size of the title rectangle will be 2 inches high and 5 inches long. The title will include the student's school, school location, the scale or scales to which the drawings are made, the date the drawing is completed and the student's name.

Some of the drawings will be made with the longer side of the border parallel to the bottom side of the drafting table. Others will be made with the shorter side of the drawing parallel to the bottom side of the drafting table. Directions for each plate are given.

The drawings should first be made in pencil on a good grade of drawing paper. The plotted points should be marked with a needle point and the point circled lightly with the pencil so they may be readily found again when needed. The pencil used should have the hardness of above a 3H good grade drawing pencil. The use of too soft a pencil lead will cause an unsightly and dirty looking drawing due to pencil marks smearing over the paper.

After each plate is completed in pencil it should be carefully checked for measurement of lines and angles.

Inked tracings on a good grade of tracing paper should then be made striving for neatness and a pleasing appearance.

Accuracy in the plotting of both angles and line measurements is highly essential in the drawings of surveying.

Any necessary erasing on the inked drawing should be done willingly and carefully. The ability to erase and re-ink neatly is the mark of a good draftsman. The unwillingness of a beginning draftsman to erase carefully and neatly usually causes his first trouble with his employer.

Lettering should be done neatly and with great care. Poor and unsightly lettering can spoil a map that is otherwise perfect.

Lettering skill can be acquired only by much diligent practice. Mechanical lettering sets are widely used by most drafting offices. If they are available in the student's school they should be used. They should be available.

The student should refer to the reduced-size drawing plates in this manual for the general layout of the drawings. These reduced-size drawings should be used only as a guide. All drawings should be plotted directly from the field survey notes for each plate. Do not attempt to measure angles or distances from the reduced drawing and transfer them to your drawing being plotted or constructed.

The text should be studied thoroughly before the plates are drawn. The plates are assigned to be made in the order in which they are numbered.

Any particular method of assignments from text is left to the instructor.

DIRECTIONS FOR PLATE 1
PLOTTING OPEN TRAVERSES AND THE USE OF THE FIELD BOOK

The outside border or trim line is to be 14 by 20 inches. The inside border will be 19 by 13 inches. The size sheet should be large enough to allow mounting on the drawing board so that no marks or thumb tack holes will appear within the outside border or trim line. The longer side of the border will be vertical on the drawing board. North direction will be parallel to the left border and pointing upward. The title block will be 2 inches high and 5 inches long and is located in the the lower right-hand corner. The title block will show the plate number, the student's school and location, the scale or scales used, the date the drawing is completed, the student's name, and any other information wanted by the instructor.

Five open traverses are to be plotted on this plate and are shown on the reduced guide plate as Figures 1 through 5. All initial points of the traverses will be located 3/4 inches from the left vertical border. The first step after the border and title block layout are completed is to draw a light line 3/4 inches from and parallel to the left border. A true north arrow is drawn on this line between Figures 1 and 2. Avoid fancy or flourishing arrows. The trend in modern drawing is towards simplicity. In this and other drawings, the inside border will be referred to only as the border and the outside border will be referred to as the trim line. The initial point of Figure 1 is called point A and the station number is 0 + 00. It is located on the line 3/4 inch from and parallel to the left border and 1.25 inches from the top border.

Figure 1 is a deflection angle open traverse and is to be plotted by the protractor method. The protractor method was discussed in Section 3 and should be referred to as needed.

Information for plotting the deflection angle traverse by the protractor method is given in the field book notes. The contents of the notebook under subject gives notes for Plate 1, Figure 1 to be located on pages 1 and 2. Each double sheet in the notebook is considered as one page and is so numbered.

The notebook will be briefly discussed here in order that the student will become familiar with its role by the draftsman. The subject of the survey is listed at the top of the page. In this case it is "Notes for Plate 1, Figure 1." The subject and page numbers of the survey are listed in the contents. The contents show the subject of all surveys in the notebook and the respective pages on which they are located. This contents is shown in order that any survey in the book can be readily located without searching throughout the book.

Column 1 is headed "sta." It lists each station on the traverse. The stations are listed continuously from the beginning to the end of the traverse. Any plus stations are also listed. The notes start at the bottom of the page. This is done to facilitate the drawing of any needed sketches on the right-hand rectangular-ruled sheet. The small round circle shown to the left of some station numbers indicates where the surveying instrument was set up for the purpose of making angular measurements. The distance between any two stations may be found by taking the difference between station numbers. For example the distance in feet between station 6 + 27 and station 12 + 42 is equal to 1242 - 627 which is 615 feet.

Column 2 shows the deflection angle at the station measured between the extension of back line and the forward line. These deflection angles are shown as right or left depending whether the angle is turned in a clockwise or counterclockwise direction.

Column 3 shows the magnetic bearing which was obtained by taking a compass reading at the station to obtain the direction of the line. Compass readings are taken as a check against mistakes in angular measurements. This will not show small errors as the compass needle can be read to only approximately 15 minutes.

Column 4 is the calculated bearing. This bearing is calculated from the bearing of the back line and the deflection angle to the forward line. The calculated bearing is compared with the magnetic bearing to detect mistakes in reading or recording the deflection angle.

Columns 4 and 5 are for remarks. In these columns are entered any notes necessary to make the details of the survey clear to the people who will use them.

The right-hand cross-ruled page is used for notes and sketches. On this sheet is shown the names of field personnel and their duties. In the notes for Figure 1, Richard is instrument man, Soileau is head chainman and Carrier is rear chainman. The date of survey and the general weather conditions are shown. The scale to be used for Plate 1 is 1 inch equals 200 feet. Point A is located 3/4 inch from the left border and 1.25 inches from the upper border. The notes show the bearing of line AB to be S27°08'E. The protractor is oriented at point "A" and an angle of 27°08' is measured off in the southeast quadrant by making a needle mark at 27°08' from the south towards the east. A line of indefinite length is drawn through point "A" and the needle mark. A distance of 627 feet, using a scale of 1" equals 200 feet, is scaled on the line. This locates point B. Line AB is then prolonged lightly on the drawing paper. The protractor is then oriented at point B and a deflection angle 97°45' to the

left is marked with the needle point. Again a line of indefinite length is drawn through points B and the needle mark at 97°45'L. On this line from point B a distance of 12 + 42 - 6 + 27 or 615 feet is scaled to locate point C. The same procedure is followed to locate the other changes in direction of the traverse. Use calculated bearings for plotting.

For Figure 2, point A is located 3/4 inch from the left border and 5 inches from the top border. The notes for Figure 2 are found by the index to be on pages 3 and 4. Only calculated bearings and stations are given and these are used in plotting. These are to be plotted by the protractor method. A meridian is drawn through each lettered point as it is located. When point A is located the protractor is oriented to the meridian at point A and an angle of 56°27' is constructed in the southeast quadrant. Along the line with a bearing of S56°27'D a distance of 425 feet is scaled to locate point B. A meridian is now drawn through point B and an angle of 46°52' is constructed in the northeast quadrant. A distance of 595 is scaled on this line to locate point C. In a like manner the other points on the line are located.

Figure 3 is to be plotted by the tangent method of plotting angles. The notes for Figure 3 are shown in the notebook on pages 5 and 6. Use the deflection angles given in Column 2 for plotting. Point A for this figure is located 3/4 inch from the left border and 8.25 inches from the lower border. A table of natural tangents is needed for plotting this figure. Use the 40 scale for scaling the legs of the right angle construction triangle. From point A a distance of 10 units is measured northward to point B. A perpendicular to the meridian of indefinite length is erected eastward at point B. Now, from a table of natural tangents it is found that the tangent of 35°57' is .725 which is multiplied by 10 to obtain 7.25. This number of units is scaled on the perpendicular from B. To locate point C a line is drawn through points A and C. On this line a distance of 474 feet is scaled, using 1 inch equals 200 feet, to locate D. The other points are located in the same manner to complete the plotting of the traverse.

For Figure 4 the notes are located on page 7 in the field book. The scale for all parts of this figure is 1 inch equals 200 feet. Use the calculated latitudes and departures for each line shown in columns 4 and 5 of the notes. Point 1 for Figure 4 is located 3/4 inches from the left border and 4.25 inches from the lower border. Review the method of plotting by latitudes and departures of individual courses and plot the traverse for Figure 4 accordingly.

Point A of Figure 5 is located 3/4 inches from the left border and 0.95 from the lower border. In this figure the angles

are plotted by the chord method. Review the discussion dealing with the chord method before attempting this traverse. The notes for Figure 5 are on pages 8 and 9 in the field book. The deflection angles given in Column 2 are to be used except the first line, AC. For this use the calculated bearing given in Column 4 of the notes.

The scale for the traverse is 1 inch equals 200 feet and the scale for the unit measurements in constructing the angles is the 20 scale. A meridian is drawn northward through point A and a distance of 5 units on the 20 scale is measured to locate point B. With the distance from A to B, 5 units, set on the compasses describe the arc DE. Now a table of natural sines is needed and from this table the sine of 1/2 of $24^{\circ}30'$ or the sine of $12^{\circ}15'$ is found to be .212. Three places in the sine is as close as can be plotted. Then 10 x sine of 1/2 angle to be plotted is equal to 10 times .212 which is 2.12 units. With the compasses set to 2.12 units on the 20 scale describe the arc FG with the center at point B. A line of indefinite length is now drawn through point A and the intersection of arcs DE and FG. On this line a distance of 529 feet is scaled from Point A. This locates point C on the traverse. The other points on the traverse are located in a similar manner. This completes the traverses for Plate 1.

Unless otherwise directed by the instructor this plate should be inked on tracing paper. The construction lines are dashed and the traverse lines are solid. Use the reduced size drawing of Plate 1 as a guide as to what should be included on the inked copy of the plate.

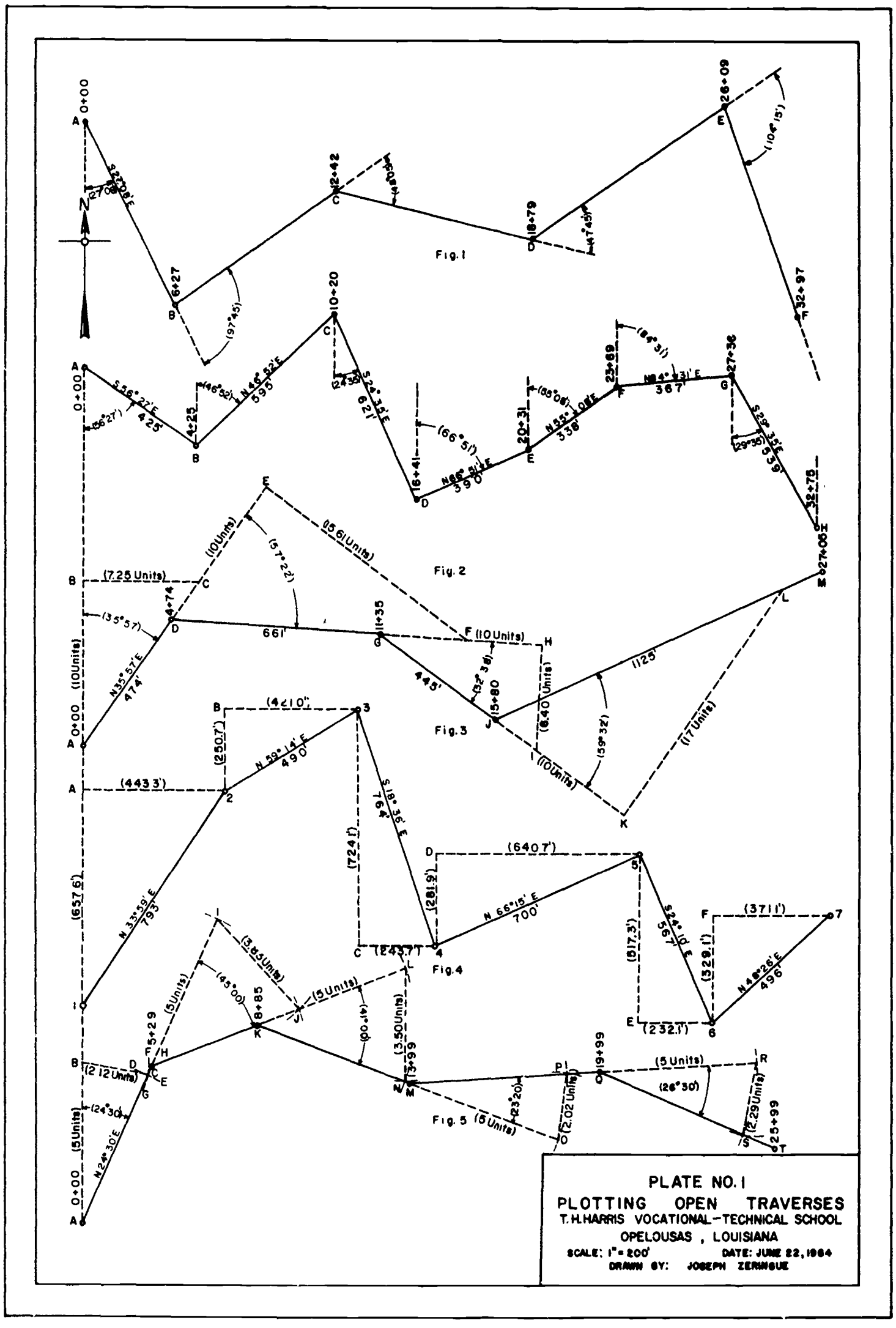


Fig. 1
Fig. 2
Fig. 3
Fig. 4
Fig. 5
PLATE NO. 1
PLOTTING OPEN TRAVERSES
T. H. HARRIS VOCATIONAL-TECHNICAL SCHOOL
OPELOUSAS, LOUISIANA
SCALE: 1" = 200'
DATE: JUNE 22, 1984
DRAWN BY: JOSEPH ZERINGUE

DIRECTIONS FOR PLATE 2
PLOTTING CLOSED TRAVERSES

The size sheet for Plate 2 and the border dimensions are the same as for Plate 1. However, in this case the short border is placed vertical on the drafting board. The title block is placed in the lower right-hand corner of the inside border. True north is parallel to the left border. The scale to be used is 1 inch equals 100 feet. The notes for plotting are on pages 10 and 11 of the field book. The notes are from a traverse that has been adjusted to give mathematical closure, that is with careful plotting, the plotted traverse should return to the point of beginning. The distance between points was measured in the field and the direction of each line was measured by an azimuth from the north. The compass bearing of each line was recorded as a check on mistakes in recording or reading the azimuths. The azimuths were converted to bearings and recorded as a calculated bearing in column 6 of the notes. This traverse is to be plotted by the use of distances and calculated bearings shown in Column 3 and 6 in the notes.

In plotting this traverse start with point M which is located 0.52 inch from the left border and 0.92 inch from the upper border. After point M is located a meridian is drawn south through point M and an angle of 83°56' is laid off in the southeast quadrant from the meridian. A line is drawn through the point established by the angular measurement and point M. This gives the direction of line M to 13, the bearing of which is S83°56'E.

In the notes under the column marked "sta." is shown the station at which the surveying instrument, in this case a transit, is set up. Column 2, marked "obj." gives the object to which the measurement was made. The distances were measured in a forward direction only. From the notes it can be seen that with the transit at M a back azimuth was taken to N and a compass reading also recorded. The instrument was then turned to the forward point 13 and an azimuth and compass reading recorded. The bearings to the points were calculated from the azimuth readings.

After the direction of line M to 13 has been drawn of indefinite length, the distance of 488.32 feet is scaled from M and this establishes point 13. When point 13 has been located a meridian is then drawn through the point, the bearing laid off and point 14 located by scaling the given distance from 13 to 14. The other points are located in the same manner until all of the points have been plotted.

The dashed meridians and angular values given on the sample plate at point 14 are to illustrate again the procedure for plotting bearings.

In plotting always use the field notes for measurements and not values from the sample plate. The sample plates are given only as a general guide and an approximate comparison for the student with his completed plate.

As soon as each forward point in the survey is located on the drawing the plotted scaled distances and angular values should be checked. Any error in locating a point on the plotted traverse will appear in the plotted points following the error. This will cause the plotted traverse not to return to the point of beginning.

When all of the points have been plotted and checked an inked tracing should be made on tracing paper. All of the lines and figures included on the sample plate should be inked on the tracing. Bearings and distances are shown as indicated on the sample plate.

In the actual practice of tracing a traverse only the traverse with directions and distances of the courses would be shown. The construction lines such as shown at point 14 would not be shown.

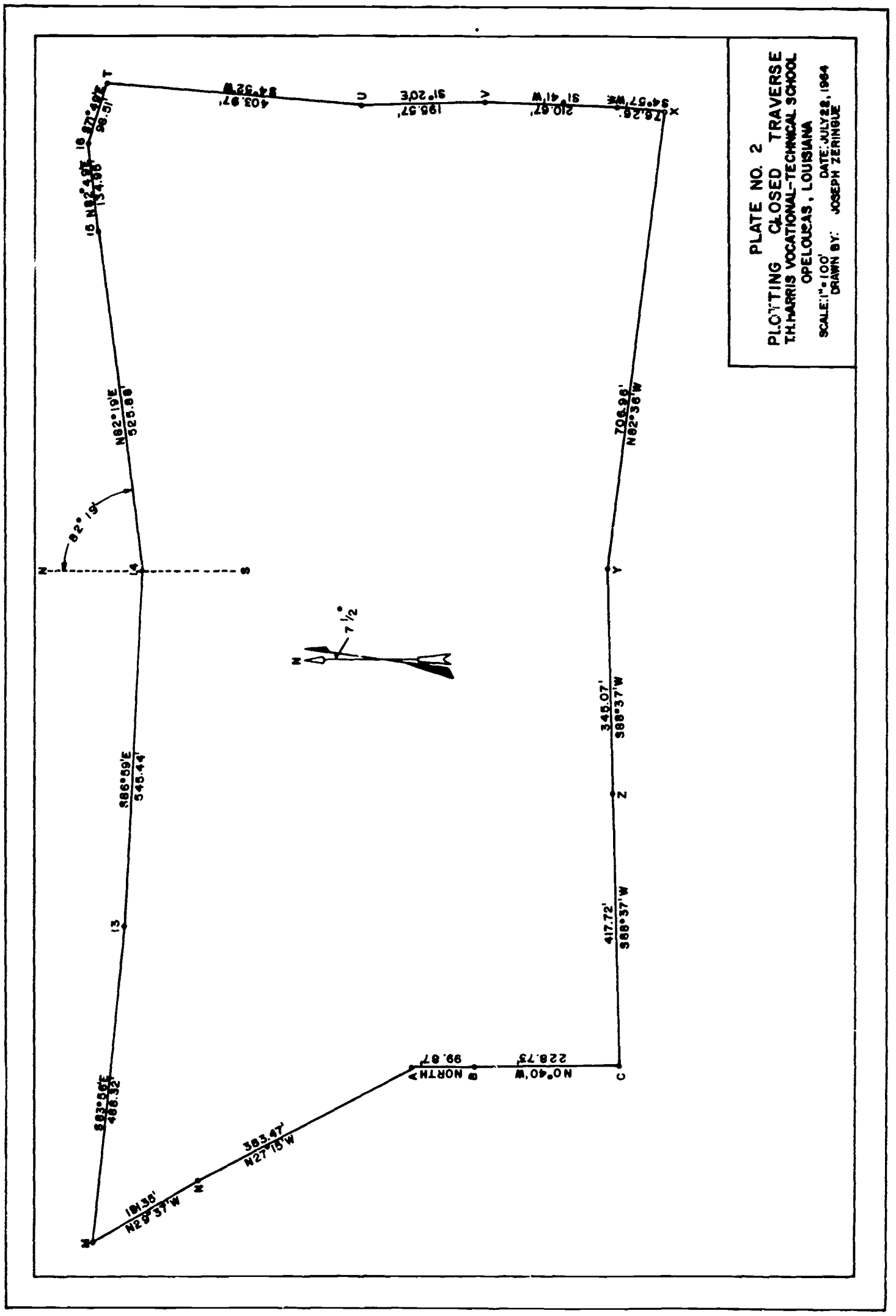


PLATE NO. 2
PLOTTING CLOSED TRAVERSE
T.H. HARRIS VOCATIONAL-TECHNICAL SCHOOL
OPELOUSAS, LOUISIANA
SCALE: 1" = 100'
DATE: JULY 28, 1964
DRAWN BY: JOSEPH ZERINGUE
N82°19'E
525.88'
82° 19'
N
S
L4
S86°59'E
545.44'
L3
S83°56'E
488.32'
M
N28°37'W
184.38'
N
N27°15'W
383.47'
NORTH
B
N0°40'W
228.73'
99.87'
C
N82°36'W
708.96'
Y
S88°37'W
345.07'
Z
S88°37'W
417.72'
7 1/2°
N
T
S24°52'W
403.97'
U
S1°20'E
195.57'
V
S1°41'W
210.67'
W
S4°57'W
76.26'
X

DIRECTIONS FOR PLATE 3
PLOTTING CLOSED TRAVERSES

The size of this plate is the same as was used for Plates 1 and 2. The short border is placed vertical on the drawing board. The scale used is 1 inch is equal to 100 feet. The true meridian is parallel to the left border and the magnetic declination is 7 1/2 degrees to the east. The notes to be used for plotting this plate are on page 12 and 13 in the field book.

The notes show the results of a deflection angle survey. In Column 5 and 6 are the computed total latitudes and total departures. These were computed from the notes of the survey. The origin for the coordinates of the points is located at point A of the survey. Column 5 shows the distance of each point north or south of the origin. Column 6 shows the distances east or west of the origin. From the notes it is seen that the coordinates or total latitude and departure of point M is 507.3 feet north of the origin and 270.2 feet west of the origin.

In plotting this traverse point A is first located on the drawing paper and within the border. Point A is located 3.25 inches from the left border and 6.04 inches from the top border. Through point A a system of rectangular coordinates is constructed placing the dashed lines of the system 250 feet apart to scale as shown on the sample plate. The horizontal lines are labeled respectively 250N, 500N, 250S and 500S in a north-south direction from Point A. These are true east-west lines and are perpendicular to the meridian. The vertical lines are meridian lines and are labeled each 250 feet both east and west of the origin. The purpose of this system of coordinates is to facilitate plotting. This eliminates the necessity of scaling the complete distance from the origin. Each point can be scaled from the nearest line in the rectangular system. The coordinates of point N from the notes are 340.9 North and 175.6 West. In plotting point N a distance of 340.9 is scaled north from the origin and 175.6 west from the origin; this locates point N. Since the rectangular system already drawn shows a line at 250 feet north of the origin the best procedure is to scale from this already plotted line. It is done by scaling a distance from the 250N line a distance of 340.9 minus 250 which is 90.9 feet north of the line. When the point 340.9 feet north of the origin is located, a light line is drawn west from the located point and a distance of 175.6 feet is scaled to locate point N. The method of locating point W of the survey is illustrated also on the sample plate.

All of the points are located on the drawing by coordinates using information from the notes. The method of plotting the points is as described above.

As the points are plotted they are lettered and the bearings and distances are shown for each line on the drawing.

Arrows representing true north and magnetic north are drawn near the center of the plate.

When the drawing is completed an inked tracing should be made using the sample plate as a guide.

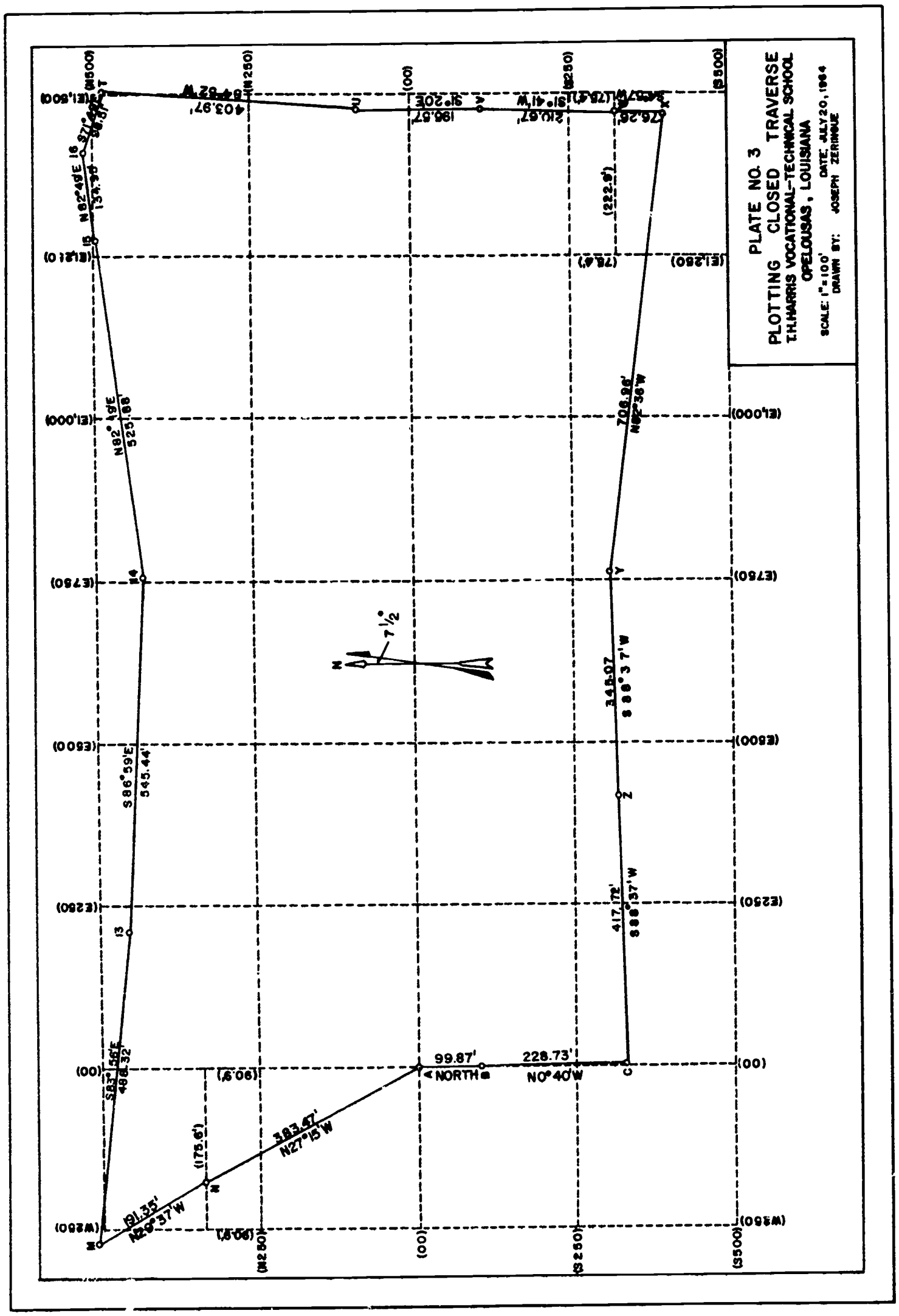


PLATE NO. 3
PLOTTING CLOSED TRAVERSE
T.H.HARRIS VOCATIONAL-TECHNICAL SCHOOL
OPELOUSAS, LOUISIANA
SCALE: 1" = 100'
DATE: JULY 20, 1964
DRAWN BY: JOSEPH ZERINGUE
(E1,800)
(E1,540)
(E1,000)
(E780)
(E600)
(E260)
(W260)
(W500)
(N500)
(N250)
(00)
(S250)
(S500)
(E1,260)
N82°49'E 16
134.34'
N82°19'E
525.88'
S86°59'E
545.44'
S83°56'E
488.32'
403.97'
N82°42'W
196.57'
N1°20'E
214.67'
N1°41'W
276.26'
S88°37'W
(222.8')
(76.4')
709.96'
N8°36'W
348.07
S88°37'W
417.72'
S88°37'W
7½°
N
99.87'
228.73'
NORTH
N0°40'W
383.47'
N27°15'W
(175.6')
(5.06)
191.35'
N20°37'W
M
N
C
X
Y
Z
13
14

DIRECTIONS FOR PLATE 4
PLOTTING ROUTE SURVEYS

The sheet for Plate 4 is of standard size. The longer border is placed parallel with the bottom of the drawing board. True north is parallel to the shorter border and is towards the top of the drawing board.

Before attempting to draw Plate 4 the student should review thoroughly Section 7 on Route Surveys With Circular Curves. In this section under the topic of Plotting Route Surveys With Circular Curves are given the directions for plotting the curves on Plate 4.

The scale of the drawing is 1 inch equals 300 feet. The notes for the traverse for Figure 1 are given on page 14 and the notes for the traverse for Figure 2 are given on page 15. The notes for the curves for Figure 1 are given beginning on page 16 of the notebook. The notes for the curves for Figure 2 are given beginning on page 20. The curves for Figure 1 use the chord definition of the degree of curve and Figure 2 uses the arc definition of the degree of curve. Both are plotted in the same manner.

In drawing Plate 4 the first operation is to construct the system of rectangular coordinates. The origin of the system is located 0.75 inch from the left border and 0.85 inch from the top border. The coordinate lines are drawn 1000 feet apart south from the origin and 1000 feet apart east from the origin.

The coordinates, or total latitudes and departures, are given in Columns 5 and 6 of the notes. The traverses are first plotted by the method of coordinates to locate the PI's. The same method of plotting is employed as was used in plotting the points on Plate 3.

After the traverses have been plotted the curves are then plotted by the method described in Section 7 under the topic of "Plotting Route Surveys With Circular Curves."

It is to be noted that in the final plotting that the stationing in the curve notes is carried continuously from the beginning to end and around the curves. Figure 1 on Plate 4 shows the location for a railway using the chord definition and Figure 4 on Plate 4 shows the centerline of a highway location using the arc definition of the degree of curve.

When the drawing is completed it is to be inked showing all of the curve data as is shown on the sample plate and in the field notes.

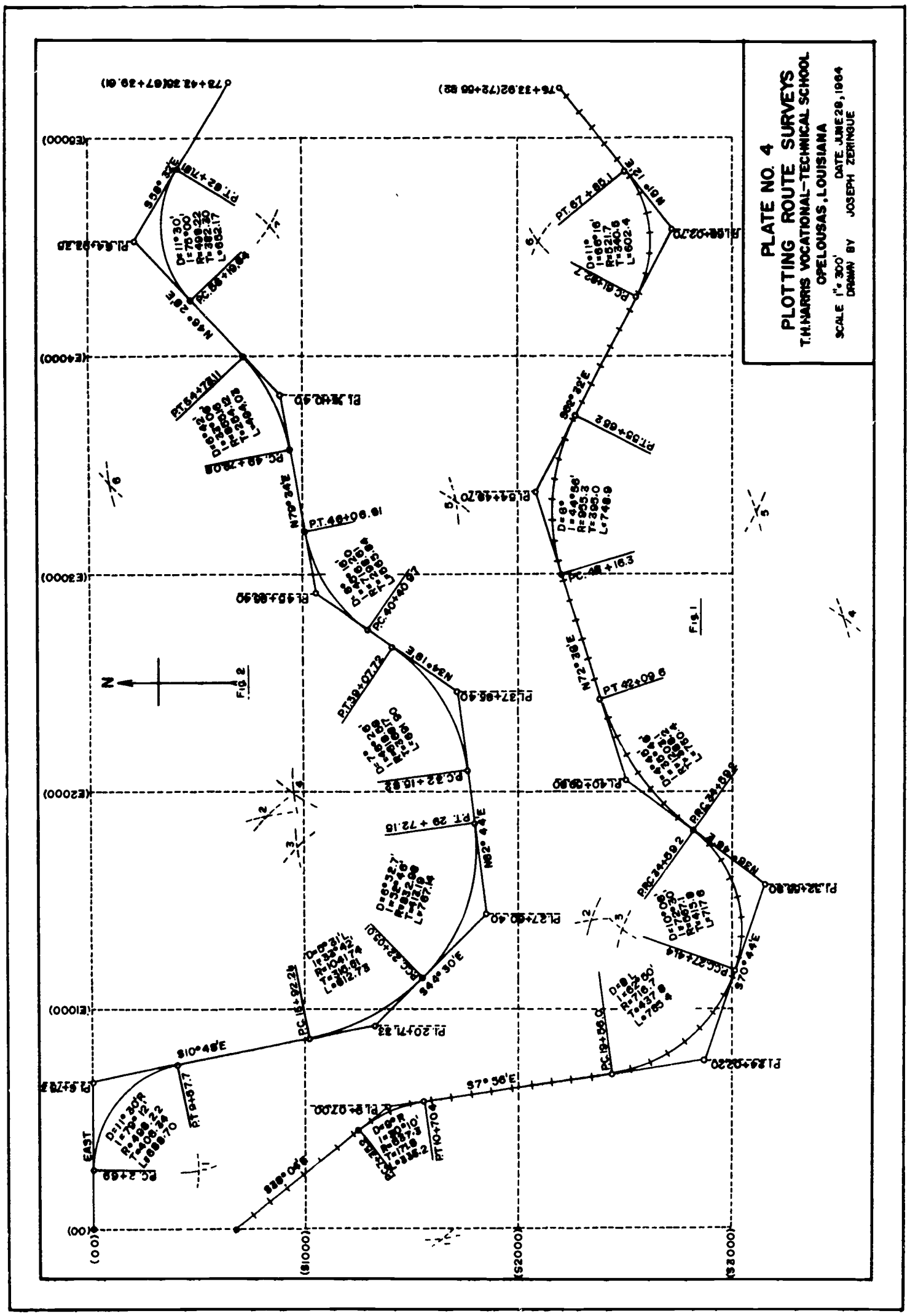


PLATE NO. 4
PLOTTING ROUTE SURVEYS
T.H.HARRIS VOCATIONAL-TECHNICAL SCHOOL
OPELOUSAS, LOUISIANA
SCALE 1" = 300'
DATE JUNE 28, 1964
DRAWN BY JOSEPH ZERINGUE
N
EAST
(00)
(S1000)
(S2000)
(S3000)
(E1000)
(E2000)
(E3000)
(E4000)
(E5000)
Fig. 1
Fig. 2

DIRECTIONS FOR PLATE 5
CONVENTIONAL SIGNS AND SYMBOLS

A standard size sheet and layout is used for Plate 5. The long border is placed parallel to the bottom of the drawing board. There is no scale.

This plate consists of the drawing of certain signs and symbols used in topographic mapping.

The layout of this plate is left to the student using sample Plate 5 as a guide to the arrangement and location of the signs and symbols. Before attempting to draw any but the very simple symbols on the plate, the student should first practice making them until he can make a reasonably good symbol.

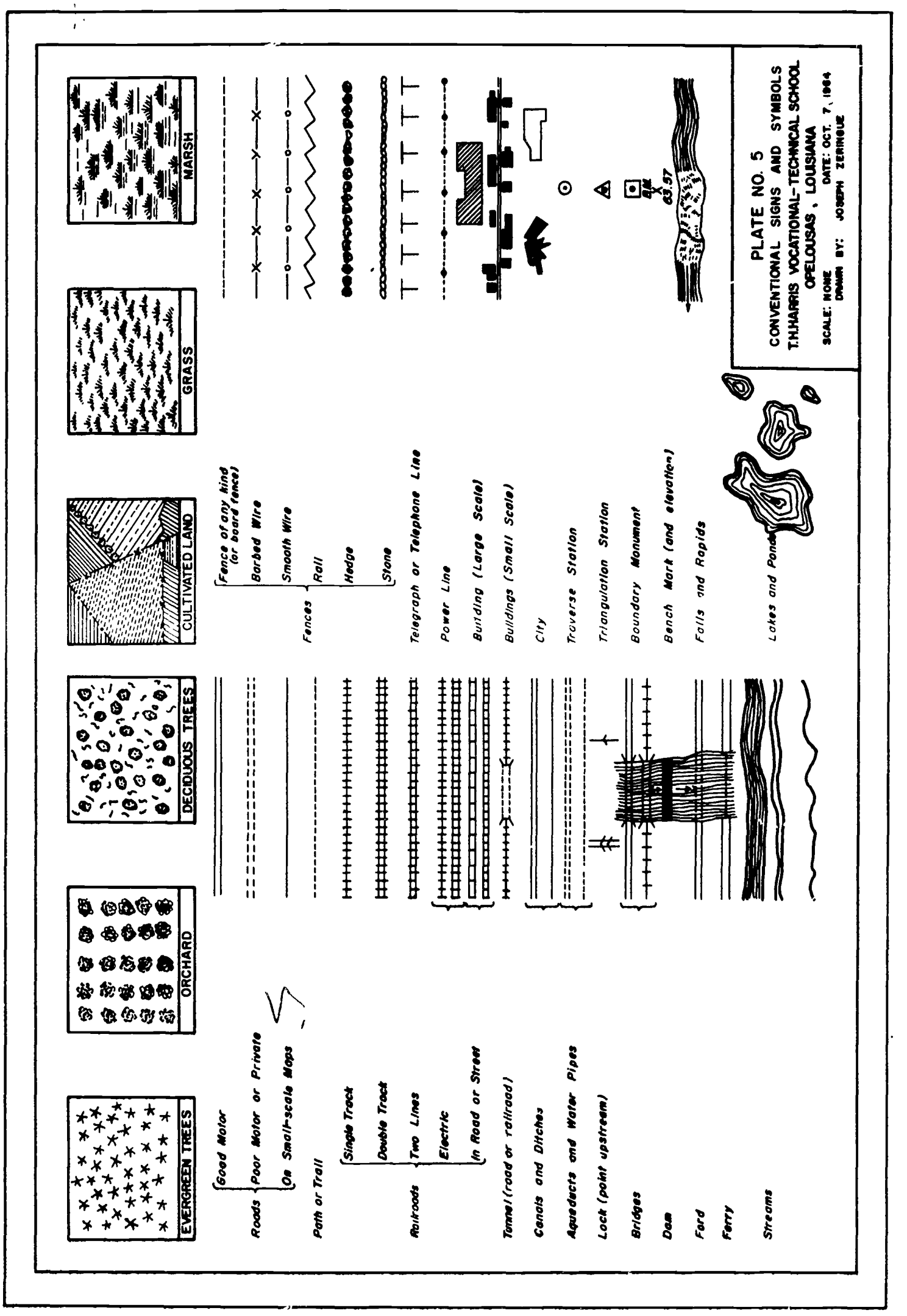
In arranging the distribution of the symbols on his full-size sheet the student can get an accurate estimate from the reduced-size drawing by remembering that the unreduced size of the title block is 2 inches high by 5 inches long.

Symbols and conventional signs were discussed under this topic in Section 8 of the manual.

This plate should be done in pencil and then traced in ink on tracing paper.

Many other signs and symbols not listed may be found in various texts on drawing and surveying.

There are no notes in the field book for this plate.


EVERGREEN TREES
ORCHARD
DECIDUOUS TREES
CULTIVATED LAND
GRASS
MARSH
Roads
Good Motor
Poor Motor or Private
On Small-scale Maps
Path or Trail
Railroads
Single Track
Double Track
Two Lines
Electric
In Road or Street
Tunnel (road or railroad)
Canals and Ditches
Aqueducts and Water Pipes
Lock (point upstream)
Bridges
Dam
Ford
Ferry
Streams
Fences
Fence of any kind (or board fence)
Barbed Wire
Smooth Wire
Rail
Hedge
Stone
Telegraph or Telephone Line
Power Line
Building (Large Scale)
Buildings (Small Scale)
City
Traverse Station
Triangulation Station
Boundary Monument
Bench Mark (and elevation)
Falls and Rapids
Lakes and Ponds
63.57
PLATE NO. 5
CONVENTIONAL SIGNS AND SYMBOLS
T.H.HARRIS VOCATIONAL-TECHNICAL SCHOOL
OPELOUSAS, LOUISIANA
SCALE: NONE
DATE: OCT. 7, 1964
DRAWN BY: JOSEPH ZERINGUE

DIRECTIONS FOR PLATE 6
PLAN-PROFILE OF PROPOSED ROADWAY

The sheet for this drawing is standard size and layout. The long side of the sheet is placed parallel to the bottom of the drawing board. True north is parallel to the left border and upwards. The notes for this plate are given beginning on page 24. The traverse notes are given beginning on page 24. The traverse should be plotted first using the calculated bearings and the station numbers from the notes.

Station 0 + 00 is located on the drawing 0.75 inches from the left border and 3.2 inches from the top border.

When the traverse is plotted, lines at right angles to the traverse are drawn extending out from the traverse as illustrated by Figure 1, Section 1. At the changes in directions, lines at right angles to each line are drawn in some cases. When the traverse is plotted and the cross lines are drawn, the extremities of the traverse are connected by a straight line and this straight line is labeled "alternate route." The scale for the traverse is 1 inch equals 200 feet.

The student should review the topics of "Cross Sections" in Sections 1 and 9 of the manual.

The next operation is to plot the elevations obtained from the field notes shown beginning on page 25 of the field book. The notes on page 25 show the trace-contour method of obtaining information for plotting contours. This method is discussed under "Topographic Details" in Section 8 of the manual.

The distance out to each contour is located on the ground. This distance out is shown on the sketch on the right-hand sheet. The contour elevation is labeled at each contour end.

In plotting, the distance out from the center line is scaled, a point is located and the elevation of the point is written at the point. The points of equal elevation are then joined by a contour line. The plus distances at the center line in the notes show the distance from the last station where the contour crosses the center line.

The form of notes changes on page 26 of the notes. Here the station numbers are shown on the left-hand sheet and the cross profiles are shown on the right-hand sheet.

Column 1 shows the sta., Column 2 shows the deflection angle, Column 3 shows the calculated bearing and Column 4 shows the

elevations along the center line. These same items are shown on the left-hand page of all of the notes for this plate. On the right-hand page beginning on page 26, two figures are shown out in both the left and right direction from the center line. The figure on top of the bar is the distance out and the figure under the bar is the elevation of the point.

The plotting is done at each station in this manner. The distance out is plotted as a point. The elevation of the point is written at the point. After several stations have been plotted the points of equal elevations are joined by contour lines. Thus at station 11 at a distance out to the left from the center line of 45 feet the elevation is 610 feet, at 145 feet out the elevation is 605 feet and at 470 feet out the elevation is 585 feet.

The top unruled portion of the drawing is known as the plan portion of the drawing. The bottom ruled portion is known as the profile.

The bottom portion is ruled to represent profile paper. Plan-profile paper may be purchased from any engineering supply office. In the drawing horizontal lines are drawn each tenth of an inch apart and each fifth line is drawn heavy. Vertical lines are drawn each half-inch apart and every other line is drawn heavy. The horizontal scale is 1 inch equals 200 feet and the vertical scale is 1 inch equals 10 feet.

In plotting the profile a vertical line is dropped from each point on the traverse where a contour crosses the traverse. The elevation of the contour is plotted on the ruled profile section. Thus at "a" between stations 1 and 2 a vertical line is dropped to the ruled profile paper. The elevation of "a" is between 610 and 615, say 613. This elevation of 613 is plotted on the ruled paper.

When points on the profile paper have been plotted for each point where a contour crosses the traverse, they are connected by a solid line. This gives a profile along the traverse line. The same procedure is used in plotting a profile along the alternate route. The profile of the alternate route is shown as a broken line.

The grade line is then drawn in to show the finished grade of the final roadway. The location of this grade line is discussed in Section 9 under the topic of "Fixing Grades."

The plotting of profiles such as is to be done on Plate 6 is discussed in Section 9 under the topic of "Plotting Profiles." This should be reviewed thoroughly before plotting the profiles on Plate 6.

When Plate 6 has been completed in pencil it should be traced in ink on tracing paper.

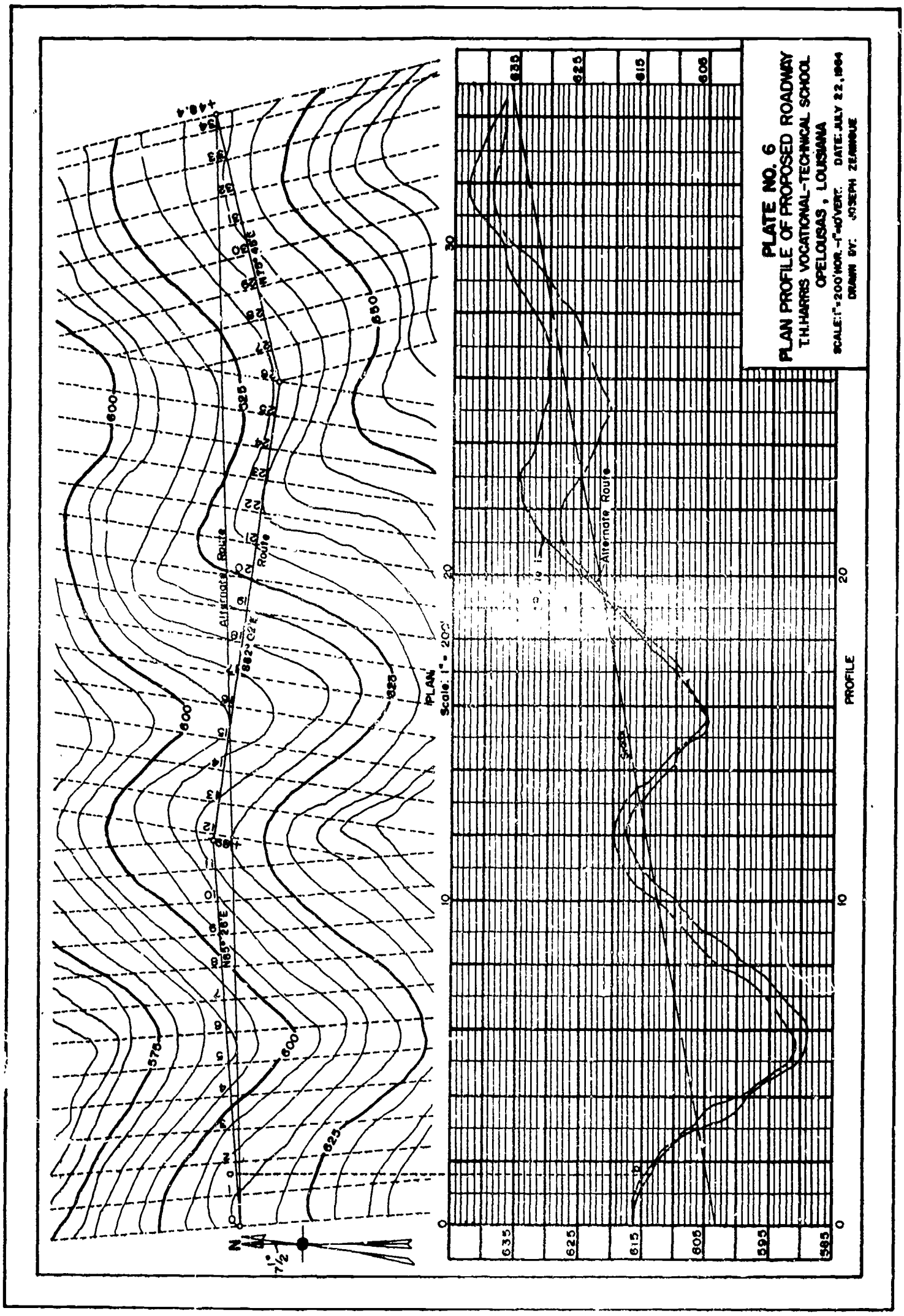


PLATE NO. 6
PLAN PROFILE OF PROPOSED ROADWAY
T.H.HARRIS VOCATIONAL-TECHNICAL SCHOOL
OPELOUSAS, LOUISIANA
SCALE: 1"=200' HOR. -1"=10' VERT. DATE: JULY 22, 1964
DRAWN BY: JOSEPH ZERINGUE
PLAN
Scale: 1" = 200'
PROFILE
Alternate Route
Alternate Route
N85° 28'E
S82° 02'E
N
635
625
615
605
595
585
0
10
20
30

DIRECTIONS FOR PLATE 7
FEATURES AND CONTOUR MAP

The size sheet for Plate 7 is the regular standard size. Two sample sheets are shown for this drawing. Sample Plate 7P is to be made first. The "P" in this sheet is for preliminary. It is to be made first and then this same Plate 7P is to be completed to make Plate 7. The long size of the sheet is placed parallel to the bottom of the drafting board. North is parallel to the short border and towards the top of the drafting board. Two rectangles are first drawn within the border. The first is one-half inch from the left border and begins one-half inch from the bottom border. That is, the lower left-hand corner is 1/2 inch from the left and bottom border. The size of the rectangle is 11.60 inches by 7.52 inches with the longer side parallel to the left border. This rectangle is to be divided into six equal portions.

The rectangle next to the right border is 11.60 inches by 10 inches with the longer side parallel to the right border. The lower right-hand corner of this rectangle is located one half inch from the lower border and one-half inch from the right border. Refer to the sample plate for this construction. The title block is taken out of this rectangle. The left rectangle is for drawing the various land forms and their representation by contour lines. The right-hand rectangle is to be used for the construction of a contour map from field notes.

After the border and rectangle layout within the border is complete, the next step is to plot the control traverse for the construction of the contour map within the right-side rectangle. The coordinate grid is constructed carefully with the origin at the lower-left corner of the rectangle. The grid lines are drawn 500 feet apart each way from the origin. The control traverse is then plotted by coordinates. This traverse is plotted in the same manner as was the traverse for Plate 3.

The field notes for the traverse are shown on page 30 of the field book. On page 31 are shown the calculated total latitudes and departures. These are the coordinates to be used in plotting the traverse. These notes give the location of each point to be plotted. The corners of the traverse are plotted by using the grid system and the notes on page 31 of the field book.

When the control traverse has been plotted the next step is to plot the ground points shown on pages 32 to 49 of the field book. These notes show the field survey notes and the calculated horizontal distance to each point, the azimuth to the point, the elevation of the point and remarks describing the point. A series of observations are taken from each corner of the traverse.

The notes on page 32 show the instrument was located at Station "A." Pages 32 through 34 were taken from Station "A." When sufficient detail was obtained at Station "A" the instrument was then moved to Station "B" and observations were taken from Station "B." T' - heading of each sheet of notes shows the location of the instrument.

It is to be noted that when the instrument was at Station "C" information could not be obtained to the west of a hill so it was necessary to locate another instrument station. This is shown as Station "I" at the bottom of page 38. The notes to be plotted from this additional Station "I" are shown on pages 48 and 49.

An example of plotting a point is given. Page 32 shows the instrument set at Station "A." Column 1 gives the object sighted. Column 2 gives the azimuth from the north, Column 6 gives the calculated horizontal distance from "A" to the point, Column 7 gives the calculated elevation of the point and Column 8 gives a description of the point. Object 1 shows an azimuth of 115°14', a horizontal distance of 305 feet, an elevation of 450.0 feet and a description of the point as being the waters edge of a lake. In plotting the point the drafting machine is oriented to the north, an azimuth of 115°14' is turned to the right and a distance of 305 feet is scaled along the line from Station "A." This locates the point. The point is labeled A-1 and the points elevation of 450.0 is written at the point. The elevation can be so written at the point as to make the located point the decimal point of the written elevation. All points from each station are located in the same manner.

When all of the points have been located and labeled the map is then contoured. The points of equal elevation are joined by contour lines following the rules for contouring given in Section 8 and using a contour interval of 5 feet.

Section 8 should be reviewed thoroughly in a studious manner before attempting to do the contouring.

It is recommended that the contouring of the plate be done by laying a piece of tracing paper over the area to be contoured and copying the points and elevations free hand in ink and using this as a work sheet. This inked copy will allow much erasing and realigning of contours without any erasing of points or written elevations.

The left-hand portion of the plate showing the various land forms and their representation is to be done freehand using the sample plate as a guide. These should be done several times for practice before attempting to put them on the plate to be inked.

When the plate has been completed it should be traced on tracing paper using ink. Each fifth contour line should be made heavy and the contour value indicated as shown on the sample plate.

ERIC

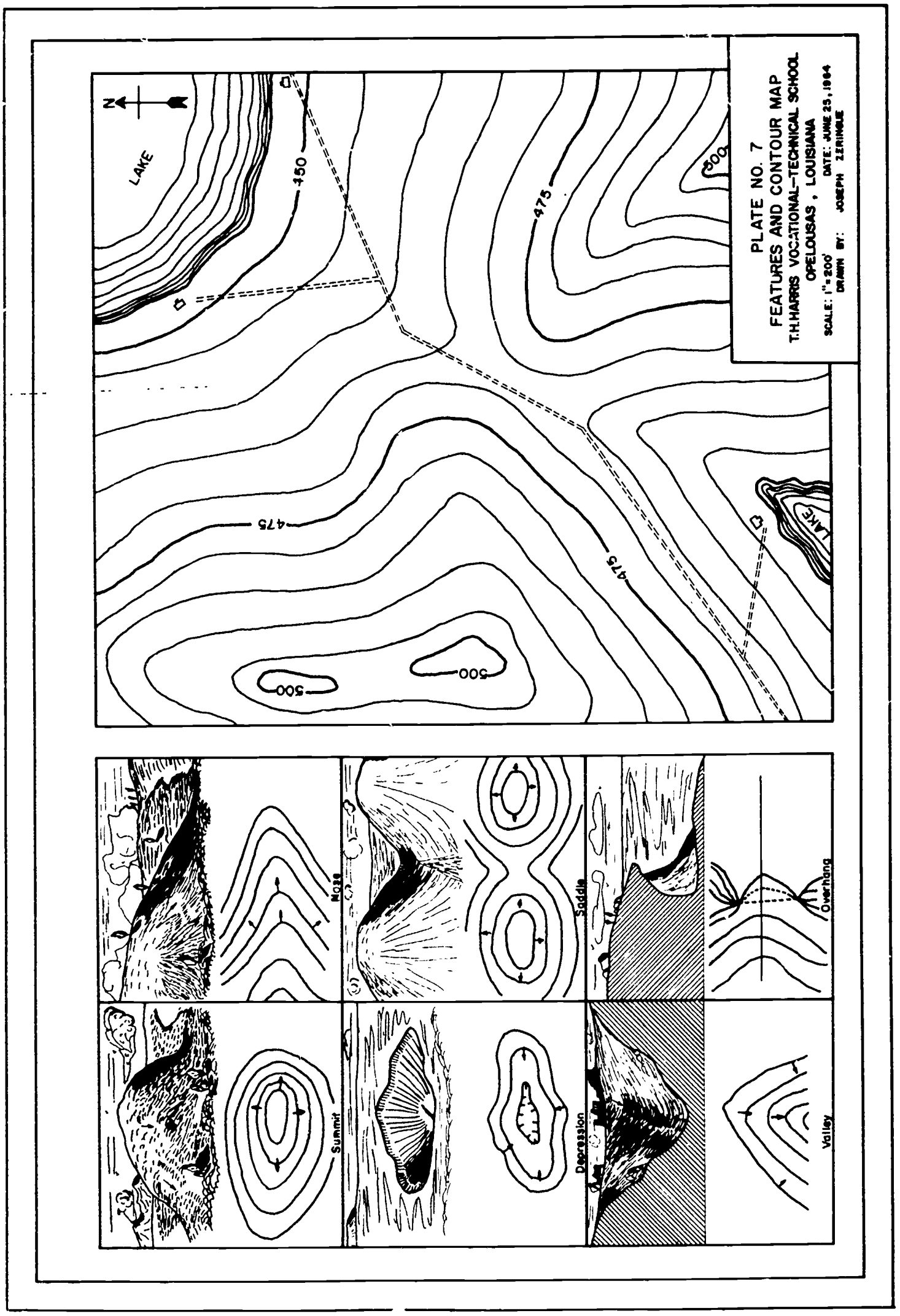


PLATE NO. 7
FEATURES AND CONTOUR MAP
T.H.HARRIS VOCATIONAL-TECHNICAL SCHOOL
OPELOUSAS , LOUISIANA
SCALE: 1" = 200'
DATE: JUNE 23, 1964
DRAWN BY: JOSEPH ZERINGUE
N
LAKE
450
475
500
Summit
Nose
Depression
Saddle
Valley
Overhang

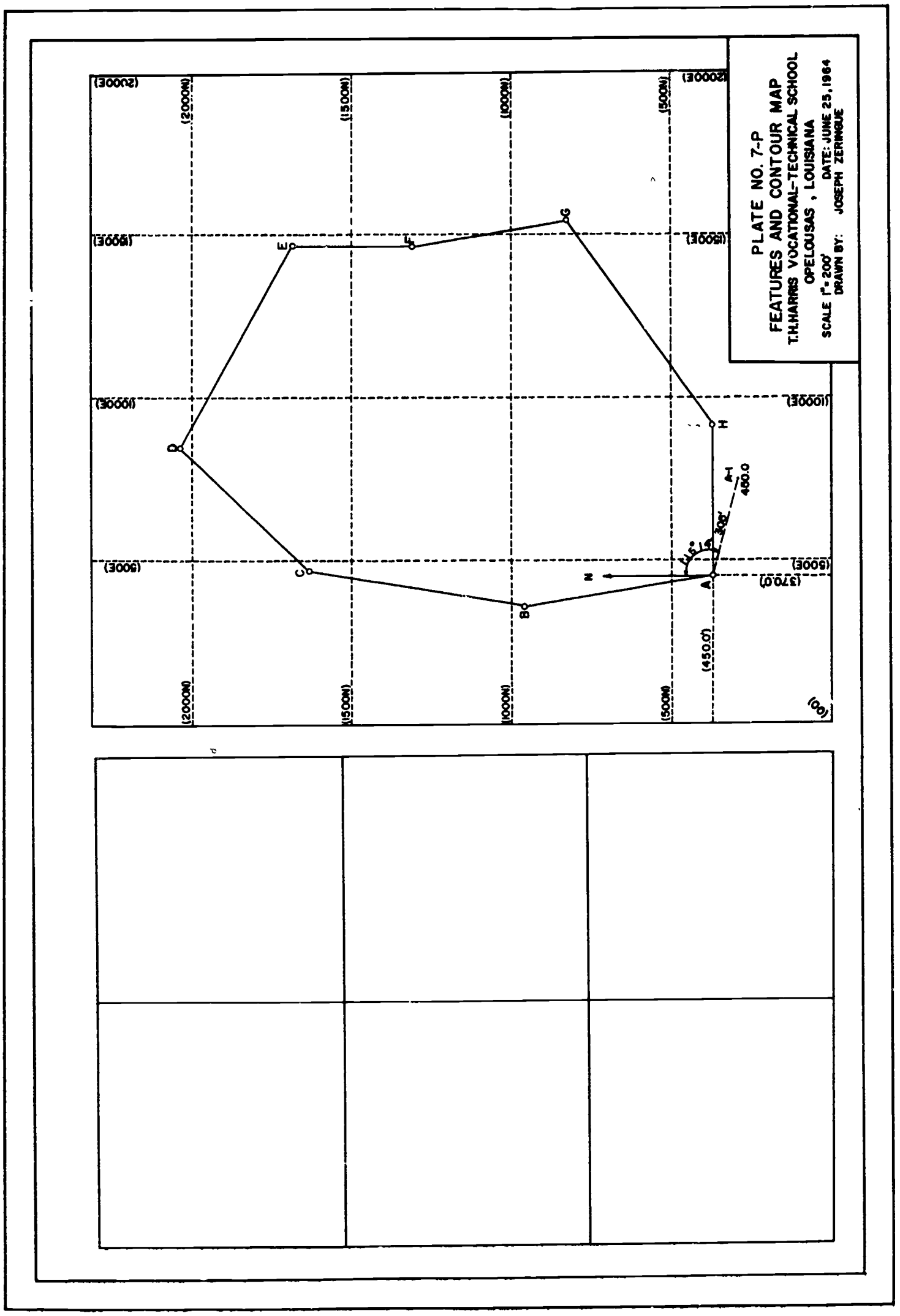


PLATE NO. 7-P
FEATURES AND CONTOUR MAP
T.H.HARRIS VOCATIONAL-TECHNICAL SCHOOL
OPELOUSAS , LOUISIANA
SCALE 1" = 200'
DATE: JUNE 25, 1964
DRAWN BY: JOSEPH ZERINGUE
(2000N)
(1500N)
(1000N)
(500N)
(00)
(450.0')
(3700'E)
(3000'E)
(2000'E)
(1000'E)
(500'E)
(3700.0')
A
B
C
D
E
F
G
H
N
A-1
450.0
306'
45°

DIRECTIONS FOR PLATE 8
PLOTTING CROSS SECTIONS

Before attempting to draw this plate Section 9 should be reviewed thoroughly. This plate is to be done on 10 x 10 to the inch cross-section paper 20 inches wide. The length of paper required is approximately 42 inches.

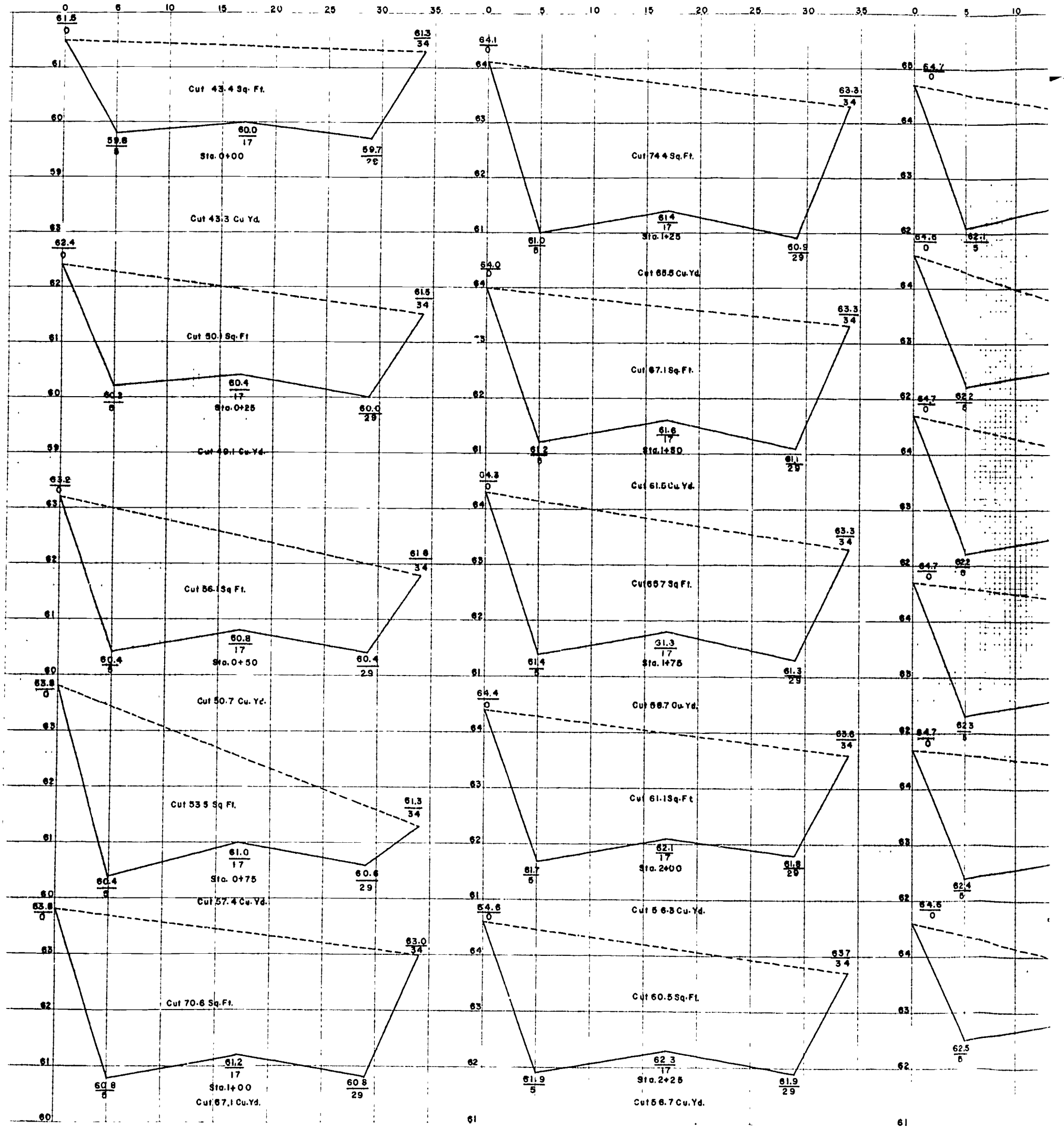
The notes on pages 50-53 show the results of cross sections taken for the construction of a street. The street was excavated to join two existing streets and for drainage. The cross sections were taken from one edge of the excavated street. The sections were taken every 25 feet along the length of the street except for the last section which was at the end. The left-hand sheet was used for running the levels. The right-hand sheet shows three lines of figures at each station. The bottom line shows the rod reading taken with a level, the middle line shows the distance out to the point from the left edge of the street and the top line shows the calculated elevation of the point. The figures to be used in plotting are the distance out from the left-hand edge of the street and the elevation of the point. The horizontal scale is 1 inch equals 5 feet and the vertical scale is 1 inch equals 1 foot. The horizontal and vertical scales are indicated at each cross section. Assuming that the original grade was uniform from the first point to the last point of each section, they are connected by a dashed line.

Each section is plotted individually beginning at the top and left-hand side of the sheet. The sections are then plotted under each other and when the sheet is completed to the bottom, another row of sections is then started at the top of the sheet. The elevation is plotted using the vertical scale and the distance out is plotted using the horizontal scale. Sample Plate 8 is to be used as a guide in the arrangement of the plotted sections. The area of each section is written within the section and the volume of earth between each two sections is written between the sections.

Figure 29 shows the calculated areas of the sections, the volume in cubic yards between each two adjacent sections and the total volume of removed dirt. The areas and volumes to be placed on the drawing may be obtained from this source. The cross sections should be plotted lightly in pencil and then the cross sections and other information should be inked as illustrated by the Sample Plate No. 8.

At each plotted point both the elevation and the distance are indicated. In this case the elevation is above the bar and the distance is below the bar.

Civil Engineering Technology
Map Drafting and Map Plotting



PERFECT CROSS SECTION
10 X 10 ONE INCH
EUGENE DIETZGEN CO.

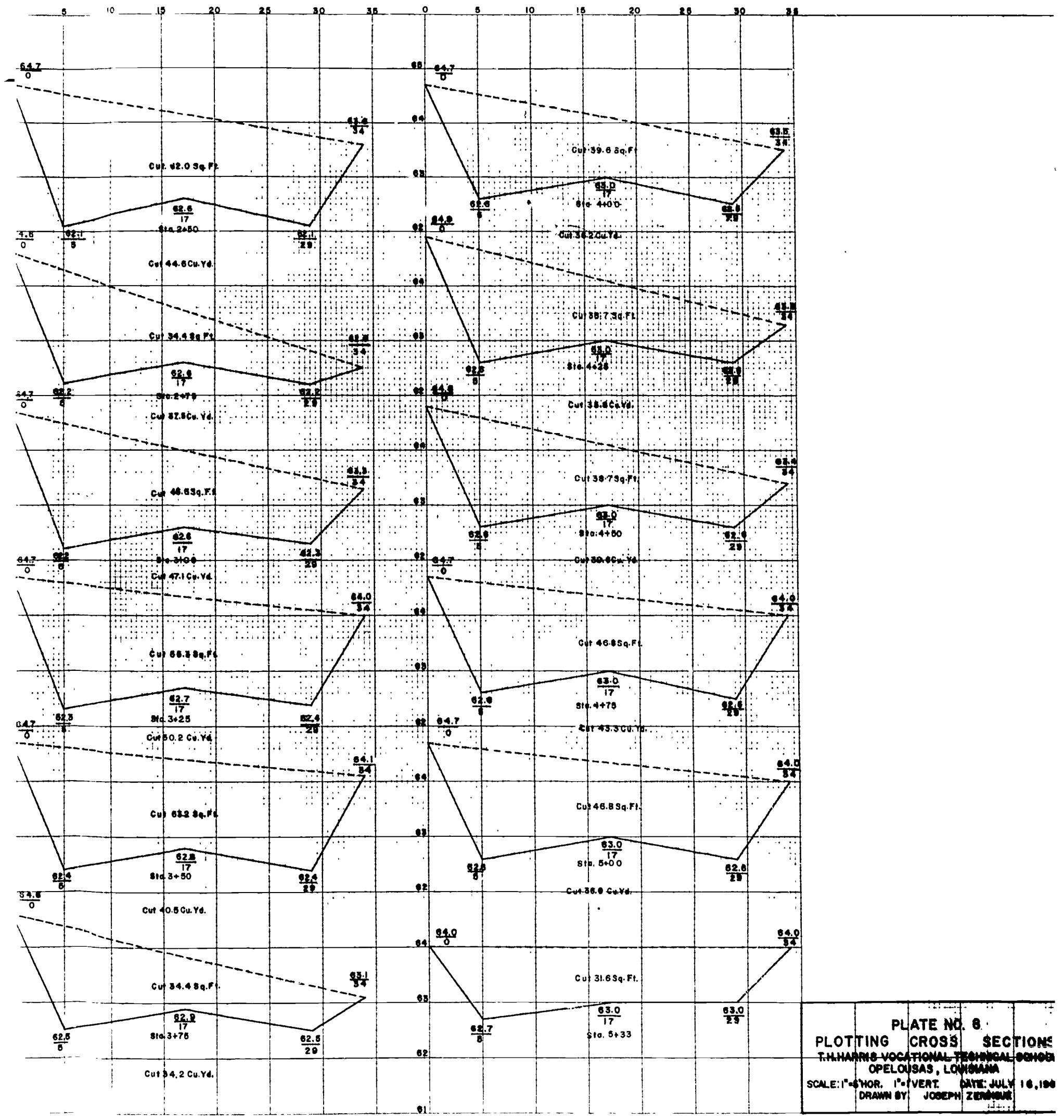


PLATE NO. 8
PLOTTING CROSS SECTIONS
T.H.HARRIS VOCATIONAL TECHNICAL SCHOOL
OPELOUSAS, LOUISIANA
SCALE: 1"=5' HOR. 1"=1' VERT. DATE: JULY 16, 196
DRAWN BY: JOSEPH ZERINGUE

PRINTED IN U.S.A.
ON 100% RAG PAPER MADE IN U.S.A.
PERFECT CROSS SECTION
10 X 10 ONE INCH
EUGENE DIETZGEN CO.

DIRECTIONS FOR PLATE 9
BAYOU TATE AREA MAP

Before attempting to plot this area map Section 10 should be reviewed thoroughly. The drawing sheet is standard size with the longer border parallel to the bottom of the drawing board. North is parallel to the shorter border and upward.

The notes for this plate are on pages 54-74 of the field book. Plot the traverses first, check them against Sample Plate 9 for general correctness, then plot the details by the method described in Section 10. Plot Wilson Road traverse first as the starting point for this traverse is given as being on the north border and 2 1/2 inches from the west border. Use the calculated bearing given in Column 3 of the notes for the directions of the lines and the station numbers given in Column 1 for the distances.

After the traverses are plotted and checked then plot the details along the lines. Study the notes, remarks and sketches carefully as this information is used in plotting the details.

Review Section 8 for culture symbols.

When the drawing is completed trace the map in ink.

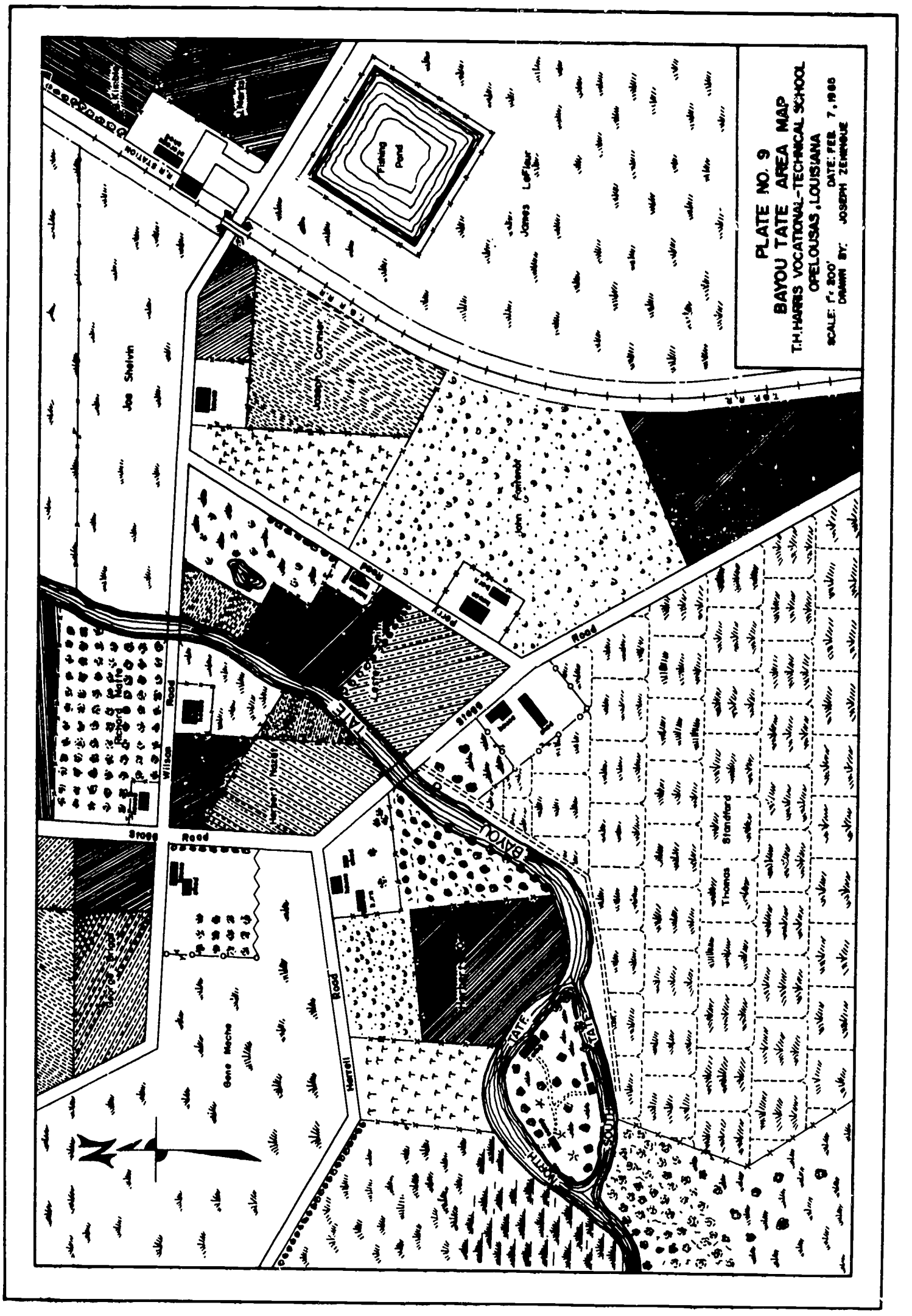


PLATE NO. 9
BAYOU TATE AREA MAP
T.H. HARRIS VOCATIONAL-TECHNICAL SCHOOL
OPELOUSAS, LOUISIANA
SCALE: 1" = 200'
DATE: FEB. 7, 1986
DRAWN BY: JOSEPH ZENHNUE
Fishing Pond
Joe Shelvin
Joseph Cormier
John Fontenot
Port Road
Stoll Road
Wilson Road
Stogo Road
Harrell Road
Gene Mache
Thomas Standford
BAYOU TATE
NORTH
SOUTH

DIRECTIONS FOR PLATE 10 and 10-A

These are plates which are given completed showing the method of calculating areas by the DMD method, the calculation of the total latitudes and departures and the adjusted bearings and lengths.

Review thoroughly Sections 5 and 6 which describe how the calculations are made. With the information given in Sections 5 and 6 and the use of a calculating machine, redo and check all of the figures given on Plates 10 and 10-A in order to satisfy yourself that you understand the computations done on these plates. This is in preparation for doing the calculations for Plate 11 for which you will be given only the lines, lengths and bearings of a closed traverse.

The field notes for Sample Plates 10 and 10-A are given on page 75 of the field book.

The only information needed for these calculations are the line, its length and bearing.

LINE	LENGTH FEET	BEARING	COSINE	SINE	UNADJUSTED LATITUDES N	UNADJUSTED LATITUDES S	UNADJUSTED DEPARTURES E	UNADJUSTED DEPARTURES W	CORRECTION FEET LATITUDE	CORRECTION FEET DEPARTURE	ADJUSTED LATITUDES N	ADJUSTED LATITUDES S	ADJUSTED DEPARTURES E	ADJUSTED DEPARTURES W	D. M. D.'s	DOUBLE-AREAS NORTH	DOUBLE-AREAS SOUTH
B-C	686.4	N9° 28'E	98638	16447	677.05		112 89		+.237	+741	677.29		113.63		113.63	76,960.46	
C-D	551 8	N42°57'E	.73195	68136	403.89		375.97		+.191	+.596	404 08		376.57		603.83	243,995.63	
D-E	711. 7	S60°05'E	.49874	.86675		354.95	61687		-.246	+.769		354 70	617.64		1598.04		566,824.79
E-F	375.6	South	1.00000	.00000		375.60			-.130	+.406		375.47	0.40		2216.08		832,071.56
F-G	491.2	S9° 34'E	98609	.16620		484.37	81 64		-.170	+.530		484.20	82.17		2298.65		1,113,006.33
G-H	7827	S54°25'W	.58189	.81327		455.45		636.55	-.270	-.846		455.18		635.70	1745.12		794,343.72
H-A	4624	West	.00000	1.00000				462.40	+.160	-.499	016			46190	647.52	103.60	
A-B	595.2	N9° 02'W	98760	.15701	587.82			9345	+.206	-.643	588.02			9281	92.81	54,574.14	
	46570				1668.76	167037	1187 37	1192.40	1 610	5.030	1669.55	1669.55	1190.41	1190.41		375,633.83	3,306,246.40
						-166876		-1187.37									-3756383
						1 61		5.03	Double Area in Acres = $\frac{2930612.57}{43,560}$ =					67.278 Ac		Double Area =	2930612.57 sq ft
											Area in Acres = $\frac{67.278}{2}$ = 33.639 Acres						

ERROR IN LATITUDE = 1.61 South

ERROR IN DEPARTURE = 5.03 West

ERROR OF CLOSURE = $\sqrt{1.61^2+5.03^2} = 5.28$

$\frac{1.61}{4657}$ = .0003457 corr/ft. in Lat.

$\frac{5.03}{4657}$ = .0010801 corr./ft. in Dep.

PLATE NO. 10
CALCULATION OF AREAS
T.H.HARRIS VOCATIONAL—TECHNICAL SCHOOL
OPELOUSAS , LOUISIANA
DATE: FEB. 26, 1965
DRAWN BY: JOSEPH ZERINGUE

Sta.	Adjusted Lat.		Adjusted Dep.		Total Lat.		Total Dep.		Adj. Bearing	Adj. Length
	N	S	E	W	N	S	E	W		
A					370.0		450.0			
	588.02			92.81					N 8° 58' W	595.30'
B					958.02		357.19			
	677.29		113.63						N9° 31' E	686.76'
C					1635.31		470.82			
	404.08		376.57						N42° 59'E	552.35'
D					2039.39		847.39			
		354.70	617.64						S60° 08'E	712.24'
E					1684.69		1465.03			
		375.47	0.40						S 0° 04'E	375.47'
F					1309.22		1465.43			
		484.20	82.17						S 9° 38'E	491.12'
G					825.02		1547.60			
		455.18		635.70					S 54° 24'W	781.86'
H					369.84		911.90			
	0.16			461.90					N89° 59'W	461.90'
A					370.00		450.00			
	1669.55	1669.55	1190.41	1190.41						

PLATE NO. 10-A
COORDINATE CALCULATIONS
T.H.HARRIS VOCATIONAL-TECHNICAL SCHOOL
OPELOUSAS , LOUISIANA

SCALE: NONE DATE: MARCH 15, 1965
CALCULATIONS BY: JOSEPH ZERINGUE

DIRECTIONS FOR PLATE 11
CALCULATION OF AREAS AND COORDINATES

This plate is similar to plates 10 and 10-A. No specific directions will be given for this exercise.

Using the forms illustrated by Sample Plates 10 and 10-A and the information given in Sections 5 and 6 the student should complete this problem without a sample plate.

The directions to be given are as follows:

1. Draw forms as shown on the sample forms illustrated in the Sample Plates 10 and 10-A.
2. From the notes given on page 76 calculate the latitudes and departures of each course.
3. Determine the error of closure.
4. Adjust the latitudes and departures to form a mathematically closed figure.
5. Determine the double meridian distances.
6. Compute the area of the closed figure.
7. Compute the total latitude and departure of each corner of the figure.
8. Compute the adjusted length and bearing of each course.

DIRECTIONS FOR PLATE 12
CROSS SECTIONS

Again this problem will be left to the student. The notes for this problem are given on page 77-80 in the field book. The student is to do the following:

1. Plot the cross sections on ruled cross-section paper as was used for Plate 8.
2. Calculate the areas of the cross sections.
3. Compute the volumes of earth between each two adjacent sections using a form as shown in Figure 29.
4. Compute the total volume of earth along the total line given in the notes by adding the volumes between adjacent sections.

DIRECTIONS FOR PLATE 13
PLOTTING PROFILES

Take Plate 7 and draw a straight line from the northwest corner of the rectangle surrounding the contour map to the northeast corner of the 2 x 5 inch title block. Let the northwest corner of the rectangle be Station 0 + 00. Station and number the stations from 0 + 00 to the end of the line at the northeast corner of the title block. This is to be done by scaling and marking each full 100-foot station. Use the scale to which the map is drawn.

From information taken from the map along the line drawn, plot a profile of this line using 10 x 10 to the inch cross-section paper. Plot points on the profile at each station along the line and at each point on the line where a contour crosses the line.

The selection of the horizontal and vertical scales is left to the student and his instructor.

This problem is similar to the profile plotted in drawing Plate 6.

DIRECTIONS FOR PLATE 14

The notes for Plate 14 are given on pages 81 and 82 of the field book. The notes show the results of a deflection angle traverse. One of the purposes of this exercise is to give the student practice in converting angles measured in the field into bearings and into azimuths.

The size of the sheet required is 15 inches by 18 inches. The border is drawn one-half inch inside the sheet which gives a working space of 17 inches by 14 inches. The short border is placed vertical on the drawing board. North is parallel to the short border and upward.

Point A is located 1.25 inches from the west border and 2 inches from the north border. Scale: 1" = 100'.

1. Plot the closed traverse by deflection angles.
2. Compute the bearing of all lines from the deflection angles. The bearing of line AB is due south.
3. Compute the azimuths of each line from the north from either the bearings or deflection angles.
4. Enter the bearings and deflections on each line of the drawing.
5. Calculate the interior angles.
6. Complete the set of field notes shown on page 81 of the field book.
7. Complete the map as the instructor may direct.

VT 002 658
Trade Preparatory Training Curriculum Guide, Commercial Cooking and Baking 1 and 2, Course No. 781.1 and 781.2.

North Carolina State Dept. of Public Instruction, Raleigh. Trade and Industrial Education.
MF AVAILABLE IN VT-ERIC SET.
T.I.E. Series No. 68
PUB DATE - Jul66 28p.

DESCRIPTORS - *STATE CURRICULUM GUIDES; TRADE AND INDUSTRIAL EDUCATION; FOOD SERVICE INDUSTRY; *FOOD SERVICE OCCUPATIONS; *FOODS INSTRUCTION; *COOKS; RESOURCE MATERIALS; AUDIOVISUAL AIDS; VISUAL AIDS

ABSTRACT - Designed to assist the teacher of commercial cooking and baking, this curriculum guide provides an outline of subject material to be covered in 2 years or 1,080 hours. Content, teaching methods, and information and skills to be taught are outlined for units on salad, vegetable, and main dish preparation in the first year, and baking and foods management in the second year. Appended are listings of textbooks, manuals, charts, films, and bulletins and pamphlets. (GR)

VT 002 658

ERIC

ED0 45856

TRADE AND INDUSTRIAL EDUCATION

July, 1966

TIE Series No. 68

TRADE PREPARATORY TRAINING

CURRICULUM GUIDE

COMMERCIAL COOKING AND BAKING 1 and 2

Course No. 781.1 and 2

Trade and Industrial Education
Charles D. Bates, State Supervisor

DIVISION OF VOCATIONAL EDUCATION
STATE DEPARTMENT OF PUBLIC INSTRUCTION
Room 436 Education Building
Raleigh, N.C. ZIP CODE 27602

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VT 026 658

PREFACE

This Trade Preparatory Training Curriculum Guide has been prepared to provide a general outline of subject material to assist the teacher of Trade and Industrial Education presenting this subject area in a meaningful and organized manner. It also contains specific basic subject content that should be covered during the year, including various methods and aids that can be employed.

We are grateful to the teachers in the field who served on the Curriculum Guide Committee.

To keep this Curriculum Guide as current as possible and abreast of industrial methods, we request that our teachers submit their recommendations for change and modification.

Charles D. Bates, State Supervisor
Trade and Industrial Education

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INTRODUCTION

The training program for the food service industry, like other training areas, must be broad in scope with emphasis on the basic fundamentals, since even the journeyman transferring from establishment to establishment will find each establishment has its own menu and special way of food preparation. A broad scope of training is further necessary because the larger area of employment is in the general field rather than the specific.

OBJECTIVES

1. To provide the necessary skills, technical information and job judgment that is required for employment.

2. To develop an appreciation for accuracy and the use of standards in quantity food preparation.

3. To develop occupational competence and high standards of workmanship.

4. To develop safe, orderly and reliable work habits.

5. To develop good habits of sanitation and personal hygiene.

6. To teach the necessary related subject matter pertaining to food preparation.

PRESENTATION OF INSTRUCTIONAL MATERIAL

The subject matter content suggested in this curriculum guide may be presented in several ways. Basic principles of food preparation can be taught according to:

1. Classification of foods, composition of foods, and/or the type of product.
2. Cooking procedure.
3. Production station or serving area.
4. Menu position.

Regardless of the teaching approach used, instruction in preparing food in all categories should be included. The main objective is to teach the basic steps of sound preparation methods rather than to familiarize the student with a large number of stations or jobs in the production area.

OUTLINE OF THE SUGGESTED PROGRAM OF INSTRUCTION

The curriculum outline is adopted for both boys and girls, 16 years of age or over. The class meets 5 days a week for three hours per class. One hour is spent for related study and two hours for laboratory practice.

The course is for two years based on 1080 clock hours; however, it may be adapted to serve a 3 to 4 year course, where circumstances permit, as part of a high school program or to a specialized trade program.

Throughout the course, illustrations, quotations, visiting specialists from the Food Industry, textbooks, manuals, charts, motion pictures, demonstrations and problems are used to add force and interest to the subject matter. This, however, does not limit the scope of instruction, nor does it include every possible unit which can be taught in quantity food preparation. The instruction will determine what specific topics and references should be added to the guide to produce a complete all inclusive course of study in food training.

FIRST YEAR

Commercial Cooking and Baking 1

781.1

ERIC

Course: Commercial Cooking and Baking # 781.1 Year: 1

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
Orientation of Trainee	Explanation of, and assignment to a work station (Class hours, test, attendance, notebook.)	Lecture Text	
	Brief explanation of the machines, equipment and storage.	Lecture - Demonstration Tour of laboratory	
	Importance of safety: (Accident causes) (Accident prevention)	Posters Slides Motion pictures	
	Sharpening and care of tools	Demonstration	
	Study of the history of, and development of Food Services.	Discussion Group reports	
	Study of the advantages and and disadvantages of jobs in the Hotel and Restaurant industry.	Guest speakers from labor association (Restaurant Assoc. if available)	
Science Related to Food Preparation	To understand the digestion	Motion Picture	
	To understand scientific principles invloved in food preparation.	Practical Demonstrations Films	
	The importance of good personal hygiene as related to: Bacteria Grooming Health Habits	Text Posters Films Lecture School Nurse	
	State and Local sanitation laws	Movies from state and local health departments Guest speaker - local health officer	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	Proper house keeping procedures (in the use of detergents, insecticides, sanitizing agents, purification agents, and other precautions.)	Visiting wholesale equipment and supply company Guest speaker from soap firm	
Coffee and Other Beverages	Selecting and purhase of coffee	Discussion (class)	
	Formulas, methods of brewing coffee	Experiment	
	Sanitation and care of coffee making equipment	Demonstration Text	
	Methods of brewing hot and cold tea	Experiment - Leaflets about tea	
	Selection, purchasing and cocoa and chocolate drinks	Job assignment	
	Receiving, storing and serving milk and cream	Written assignment Movie Guest speaker from dairy industry	
Breakfast Dishes	Recipes for pancakes and waffles, methods of making batters.	Class discussion · job assignment	
	Information concerning various kinds of cooked cereals and dry cereals	Literature - Group dynamics	
	Kinds of toast and how to prepare	Demonstration Job assignment	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	Fried breakfast dishes	Written assignment	
	Duties of breakfast cook	Lecture (if possible have a graduate student as guest)	
	Preparation and procedures in cooking cured meat items	Class discussion Job assignment	
	How to prepare eggs	Demonstration Job assignment	
	Selection and care of eggs	Group assignment Film	
	Importance of eggs in the diet composition and nutritutional value	Written assignment Discussion	
Soups and Chowders	How to prepare soup stock	Demonstration	
	How to prepare the more popular soups	Discussion Job assignment	
	Methods of serving	Lecture and class discussion Demonstration	
Vegetable Preparation	Knowledge of various kinds of fresh vegetables, names, variety, quality	Film Group study Followup	
	Nutritive value of fresh and canned vegetables	Charts Class assignment	
	Equipment and utensils used in cleaning and preparing vegetables	Demonstration Discussion	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	Effect of different cooking methods on leaf, stalk, seed and fruit vegetables	Class discussion - Demonstration Job assignment	
	Sauces used with vegetables	Written assignment Job assignment	
Salad and Sandwiches	Various kinds of salads, names, ingredients, when to serve, etc.	Study assignment text	
	Dietetic and nutritional values of salads and sandwiches	Class assignment Discussion	
	Commonly used salad dressings	Demonstration	
	Constructing special salads	Demonstration	
	Storing and chilling salads and salad materials	Job assignments	
	Equipment and tools used to make sandwiches	Demonstration Text	
	Preparation of fillings and and garnishes	Job assignment	
	Cost factors	Problem solving	
	Preparation of sandwiches (Open face, club, toasted, finger, rolled, hot grilled)	Demonstration Job assignment Follow up	
Fish and Shell Fish	Classification	Chart - lecture	
	Selection of types	Discussion	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	Methods of cooking and and serving fish	Demonstration - job assignment	
	Methods of cooking and serving "shell fish" (Lobsters, oysters, shrimp, clams, crabs)	Demonstration Guest speaker from a restaurant using sea food as a speciality Job assignment	
	Methods of preparing and serving sauces	Demonstrations of special displays	
	Calculation of cost	Problem solving Follow up	
Poultry	Classification and kinds (chickens, ducks, turkeys)	Text Printed materials Film	
	Judging quality	Group dynamics	
	Preparation and trussing	Demonstration Job assignments	
	Methods of cooking	Demonstration Job assignments	
	Varieties of and preparation of stuffings	Demonstration Clippings Job assingments	
	Preparation and cookings of special poultry (squabs, guinea, game birds)	Demonstration Written assignment	
	Calculation of costs	Problem solving	
	Nutritive value	Class discussion	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	Methods of testing doneness	Demonstration - Text	
Meat	Grades and classification (Beef, Veal, Pork, Lamb)	Charts Lecture	
	Inspection	Filmstrip	
	Selection of various cuts found in the carcass	Group study Class discussion	
	Tools and equipment used in meat cutting	Demonstration Class discussion	
	Safety and work precuations	Class written assignment	
	Sanitation	Motion picture	
	Preparation, cooking and use of all kinds of stocks and glazes	Demonstration Job assignment	
	Preparation and use of roux sauces and gravies	Class study and discussion Job assignment	
	Methods of cooking (Veal, beef, lamb, pork)	Demonstration Job assignment Filmstrip	
	Methods of testing doneness	Group experiment	
	Calculating cost	Problem solving Test Follow up	

SECOND YEAR

Commercial Cooking and Baking 2

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Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
Breads and Rolls	Terminology of the baking trade	Baking dictionary Class study Class discussion	
	Kinds of rolls and bread	Lecture and class discussion	
	Kinds of muffins and hot breads	Written assignment	
	Quality, grades, kinds of flours	Film Blackboard sketches Text	
	Ovens, gas, electric (operation and care)	Demonstration Group dynamics	
	Temperatures, leavening, use of thermometers	Class study Text	
	Yeast, powders, etc.	Text	
	Formulas, and recipes for bread, rolls and hot breads	Black board Class discussion Class assignment	
	Purchasing and storing bakery goods	Class assignment	
	Duties of the hotel baker	Lecture	
	Preparation of doughs and baking of various kinds of rolls and bread. (Parker House, Pan, Twist, Hard) Clover Leaf and Sweet Rolls	Demonstration Job assignments Text	
	Food values of bread	Film	
	Weights [illegible]	Filmstrip	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	Fermentation	Written assignment	
	Composition of flours	Class discussion	
	Sugars	Written reports	
	Related chemistry	Demonstration Class discussion	
	Cost factors	Problem solving Test Follow up	
Cakes and Cookies	Kinds of cakes and cookies	Demonstration Class discussion Text	
	Cake and pastry flour	Class written reports	
	Methods of combining cake ingredients	Demonstration Class discussion	
	Milk - eggs - fats	Written report	
	Flavorings - spices - sugars	Film Class discussion	
	Over temperatures, time tables	Group dynamics Chart	
	Safety and sanitation	Text	
	Cake decoration	Group dynamics	
	Equipment, theory, formulas	Class assignment Class discussion	
	Duties of hotel pastry cook	Lecture (a graduate student if	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
		possible)	
	Preparation and procedures (cakes - cookies - tortes - icings - frostings & fillings	Demonstration Job assignments	
	Cost factor	Problem solving	
Pie Making	Kinds of pies (one crust - cream custard, two crust - fresh fruit, dried, canned)	Lecture Class discussion Text	
	Types of pie doughs	Demonstration	
	Ingredients and methods of mixing pie doughs	Class experiments	
	Fats and water in pie dough	Class discussion	
	Reasons for failure in pie making	Class notes Class discussion	
	Formulas for cream and custard fruit pies	Written assignment Class discussion	
	Temperatures for baking various kinds of pies	Assignment sheet	
	Care and storage of cream and custard pies	Group discussion and reports	
	Preparation and baking pie doughs for various kinds of pies	Demonstration Job assignment	
	Preparation and cooking of custards and cream mixtures for cream pies	Demonstration Job assignment	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	Preparation & cooking of fruit fillings	Class discussion Demonstration Job assignment	
	Methods of serving	Demonstration Group dynamics Role playing	
	Cost factor	Problem solving	
Menu Planning and Making	The menu card (sizes, styles construction)	Group discussion	
	Types of menus (A la carte, table d' hote, etc.)	Lecture Sketches on blackboard	
	Building balanced menus	Demonstration Film	
	Use of foreign terms (A la, canape, compote, etc.)	Class study Class written assignment	
	Use of descriptive words (new, green, young, fresh, etc.)	Group study	
	Nutritional requirements of group to be fed, & their effect on the choice of menu (laborers, office workers, etc.)	Written report Motion picture Text (discussion)	
	Planning menu cycles	Question and answer	
	Keeping a menu file	Demonstration	
	Pre-paration for several days ahead	Text Problem solving Class discussion	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	Wisdom of limiting menu to a few well prepared dishes	Problem solving Chalk board sketches	
	Suiting menu to the ability of the personnel	Lecture Class discussion	
	Serving food in season	Class assignment	
	Limiting prices to customers ability to pay	Role playing	
	Planning of daily and special menus	Job assignment	
	Computing the prices of items on the menu	Job assignment Demonstration	
	Checking food supplies to determine menu for the day	Demonstration Job assignment	
	Food control - use of items in season	Job assignment	
	Preparation and use of left-overs	Job assignment	
Controlling Food Cost	Fundamental mathematical processes (weights, measures addition, substraction, multiplication, division, fractions, decimals, per-centages)	Text Class discussion Charts Assignment sheet	
	Calculation of raw food cost	Demonstration Assignment sheet	
	Calculation of portion costs or cost per serving (ready to serve cost)	Class assignment Class discussion	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	Maintenance of records necessary for adequate control (cost within the kitchen)	Demonstration Class assignment Class discussion	
Receiving Food Deliveries	Procedures for checking deliveries	Demonstration Role Playing	
	Grades, sizes, quality, count, etc. for the various food products	Class discussion Written report	
	Invoices - checking, filing and paying	Assignment sheet	
	Bookkeeping methods for food deliveries	Class demonstration Assignment sheet	
	Record forms for daily food cost; purchasing and sales	Chalk board Class discussion Assignment sheet Text	
Requisitions and Keeping Perpetual Inventory	Types of storeroom control systems	Guest speaker from school's Business Department	
	Store requisition systems requisition forms, record keeping for storerooms	Visitation to a large hotel's storeroom Role playing	
	Keeping perpetual inventory	Discussion Role Playing	
Banquet and Party Table Setting and Service	Various ways of arranging banquet and party tables, table coverings, napkins silverware, dishes & glasses	Lecture (Guest speaker - Catering service manager) Demonstration Film Class assignment Text	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	Correct styles of table setting	Written reports Role playing Filmstrip	
	Theory of placing foods and beverages on the tables to facilitate speed, lack confusion and freshness	Lecture Demonstration Class discussion Role Playing	
	Correct and dignified conduct and dress while serving	Film Class discussion Test	
	Methods of serving buffet meals and banquets	Demonstration Job assignment	
	Preparation of special food displays for the banquet and buffet tables	Job assignment	
Establishing and Operating a Restaurant	Scope of the restaurant business	Visit large hotel and restaurant kitchens	
	Selection of location and furnishings and equipment needed	Visit newly constructed restaurant or hotel dining room and kitchens Class assignment	
	Laws, taxes, insurance and labor policies	Brochures from Chamber of Commerce City ordinance directory Labor bulletins	
	Merchandising good food and good service	Text Lecture Written assignment	
	Personnel and personnel practices	Class discussion Role playing	

Course: Commercial Cooking and Baking # 781.2 Year: 2

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	Layouts and floor plans	Demonstration Job assignment	
	Layout sample advertisement and window signs to advertise the business	Booklets Hand outs Job assignment	
	Forms for a simple record keeping plan	Chalk board sample Job assignment Test Follow up	

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OF

INFORMATION

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IDENTIFIERS - *TAILORING

ABSTRACT - Trade and industrial education teachers served on the committee helping to develop this curriculum guide containing first and second year course outlines for tailoring. The teacher is given an outline of basic subject content as well as suggestions for teaching methods and aids. A list of references is included. (GR)

VT 002 659

ED 045856

TRADE AND INDUSTRIAL EDUCATION

July, 1966 T. I. E. Series No. 67

TRADE PREPARATORY TRAINING

Curriculum Guide

Tailoring 1 and 2

Course No. 788.1 and 788.2

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PREFACE

This Trade Preparatory Training Curriculum Guide has been prepared to provide a general outline of subject material to assist the teacher of Trade and Industrial Education in presenting this subject area in a meaningful and organized manner. It also contains specific basic subject content that should be covered during the year, including various methods and aids that can be employed.

We are grateful to the teachers in the field who served on the Curriculum Guide Committee.

To keep this Curriculum Guide as current as possible and abreast of industrial methods, we request that our teachers submit their recommendations for change and modification.

Charles D. Bates, State Supervisor
Trade and Industrial Education

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Course: Tailoring I # 788.1 Year: First

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
Basic Tailoring - Orientation	Basic types of hand tools. Proper selection of tools and machines to be used. Location of tools, machines, furniture, reference material, etc.	Lecture - discussion Questions & answers	
Nature and Scope of Tailoring	Basic types of operations, minimum projects to be completed, purposes of course, calculating cost of materials, tools, and machinery. History and advantages of course. Developing proper attitudes towards work.	Lecture - discussion Questions and answers Supervised research chalkboard. Written assignment	
Hand-Sewing Techniques	Proper selection of thimbles, needles, thread, and wax. Correct thread length and posture.	Lecture - demonstration Questions and answers	
Sewing Method	Basic method of picking up needles, needle threading, knoting and waxing. Eight basic stitches, proper uses of each. Execute several samples of each satisfactory.	Lecture - demonstration Supervised laboratory Assignment Reference material	
Tailored Buttonhole	Cutting proper sizes. Selection of material Execute and complete Several samples of each satisfactory.	Lecture - demonstration Supervised laboratory Assignment Reference material	

Course: Tailoring I # 788.1 Year: First Page

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
Technique of Button Sewing and Size	Service button with proper neck decoration; without neck decoration. Types and sizes of buttons and where they are used.	Lecture - discussion Demonstration Charts Laboratory assignment	
Hand Patching Technique	Selection of material; matching plaids, stripes and nap. Cut damage place and patch. Sew in with backstitch.	Lecture - demonstration Laboratory assignment	
Hand Pressing	Basic Operation. Press seams, press darts, shrink materials, care for iron.	Demonstration Lecture Question and Answers	
Sewing Machine Operations	Basic requirements; type of machines, description of machine parts, purpose of each part, control of machine threading, threading the bobbin mechanism, removing bobbin and bobbin case and winding bobbin. Clean, oil, and adjust machine. Replace needle.	Lecture - demonstration - Threading exercises supervised. Charts -Manuals Laboratory assignment supervised - Chalkboard Unit text.	
Stiching Exercises	Plain stitching, curved stitching, corner stitching, border stitching, and bartacking. Execute several samples of each satisfactorily.	Demonstration -Stitching charts Student practice	
Types of Seams	Eight basic tailors' seams. Esecute several of each satisfactorily.	Demonstration Laboratory assignment.	

Course: Tailoring I # 788.1 Year: First

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
Machine Patching Exercises	Selection of material. Repairing damage place by trimming, measuring, and cutting patch. Stitch by machine. Execute several satisfactory	Lecture - demonstration Reference books Laboratory assignment	
Bound Buttonholes	Basic types; one-piece and two piece. Complete several of each satisfactory.	Demonstration Student exercise Reference books	
Trouser Pocket Exercises	Note: Practice on swats Design and execute various styles of pockets.	Lecture - discussion	
	Front pockets, side, quarter (1/4), one-half (1/2), three quarters (3/4) and top. Back pockets; piped, welt, and flap.	Lecture - discussion Style chart Demonstration Supervised laboratory Assignment	
	Measure facings and linings Execute several of each satisfactory.		
Basic Suiting Material	History of natural and and synthetic fibers. Blends of various types of fibers. Advantages and disadvantages of different blends.	Lecture - discussion Reference material Assigned research Field trip Written report Unit test	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
Selection of Material	Appearance, wearability, weight, and use of material. Personality, height, and weight are to be considered.	Lecture - discussion Questions and answers	
Trimming for Trousers	Note: Practice on swats Design various styles; fly front, slide and button closure. Measurement for fly facing, waist band, and curtin. Execute and complete various styles satisfactory.	Lecture Demonstration Style charts Laboratory assignment	
Measuring for Skirt Patterns	Responsibility of the tailor is to get subject to stand in relaxed and comfortable position in order to obtain accurate measurement.	Demonstration Laboratory assignment	
Drafting Skirt Pattern	Design and draft several workable patterns satisfactory and manipulate for pleats.	Discussion Model Style charts Skirt formula Laboratory assignment	
Layout and Cutting	Matching pattern and weave of material; plaid, stripe, nap, etc. Marking pleats, outlets, notches, etc. Cutting and markstitching	Demonstration Laboratory assignment	
Try on and Fit Skirt	Basting seams, fitting, making necessary changes, Putting in zippers, attaching	Demonstration	

Course: Tailoring I # 788.1 Year: First

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
Try on and Fit Skirt (Con't.)	band, hemming, finishing and pressing. Calculating cost of skirt	Laboratory assignment	
Measuring for Trousers	The basic requirement and responsibility of the tailor is to get the subject to stand in a relaxed and comfortable position in order to obtain accurate measurement.	Lecture - discussion Demonstration Models Student practice	
Trouser Pattern	Design trouser pattern. Execute and complete several working drafts. Manipulate for pleats satisfactory.	Discussion Models Demonstration Laboratory assignment	
Layout pattern and Cut	Match pattern and weave of material; plaid, stripe, nap. Mark outlets, pleats, notches, etc. Cut, markstitch, and hand serge.	Lecture Layout chart Demonstration Laboratory Assignment	
Trouser Pockets and Finishings	Mark off opening for pockets. Attach facings and pocket lining. Notch, press, and finish pockets. Complete side seams, fly band, inseam, and cuffs, Press Calculate cost of trousers.	Demonstration Reference books Laboratory assignment Supervision	
Nature and Scope of Bushling	Bushling signs and symbols. Purposes of alteration How and where to make them.	Lecture - discussion Questions and answers	

Course: Tailoring I # 788.1 Year: First

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
Simple Alterations	Basic types of simple alterations. Trousers; waist, and seat, smaller or larger. Legs; longer or shorter, French or regular. Skirt waist; smaller or larger. Hems; shorter or longer. Coat sides; smaller or larger. Sleeves; longer or shorter.	Lecture - discussion Supervised laboratory assignment Reference material Unit test	
Simple Repairs	Basic types of simple repairs. Replacing trouser pockets, restitching seams, turning cuffs, repairing holes, etc.	Demonstration Laboratory assignment Reference materials Course examination.	

SECOND YEAR

ERIC

Course: Tailoring II # 788.2 Year: Second

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
Nature and Scope of Tailoring Basic Tailoring and Bushing, from simple to complex	Review first year, simple alterations and repairs. Skirts and trouser making. Improve skills, workmanship, and speed.	Lecture - discussion supervised Laboratory Assignment Questions and answers	
Measurement for Vests and Coats	Basic requirements. Importance of obtaining accurate measurements by having subject stand in a relaxed comfortable position.	Lecture - demonstration Diagram Charts Discussion Student practice	
Vest Pattern	Design and draft vest pattern. Execute several drafts. Final must be satisfactory to work from.	Demonstration Style charts Vest formula Laboratory assignment	
Pattern Layout and Cutting	Placing pattern on material Matching plaids, stripes, nap, etc. Marking outlets, pockets button holes, and notches. Cutting and markstitching. Cutting trimmings, making pocket, and lining.	Lecture - discussion Demonstration Laboratory assignment	
Vest Pockets	Note: Practice on swats. Selection of pocket lining. Cutting facing and lining proper size. Making a series of various sizes and styles. Final pocket must be suitable for use in production of vest.	Lecture - demonstration Reference books. Laboratory assignment	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
Vest Making	Selection of material suitable to design and style of pattern. Selection of lining material, shrinking and pressing material.	Lecture - discussion Research assignment Questions and Answers	
Fitting	Baste for try-on. Design and make pockets. Make necessary corrections. Finish and press.	Demonstration Laboratory assignment	
Coat Pattern	Design and draft several patterns complete with sleeve and collar. Final draft must be suitable for production.	Lecture - discussion Demonstration Coat formual models Style charts Laboratory assignment	
Pattern Layout and Cutting	Placing pattern on material. Matching plaids, stripes, nap, etc. Marking outlets, pockets, buttonholes, and notches. Cutting and markstitching. Cutting, trimming, and lining.	Demonstration Laboratory assignment	
Coat Pockets	Note: Practice on swats. Selection of pocket lining. Design and execute several styles of pockets, cutting facings and flaps of proper size. The final must be by production quality.	Lecture- discussion Demonstration Reference material Laboratory assignment	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
Canvas	Make up front; attach canvas, pad reverse, and attach bridle. Make sleeve, lining, and collar.. Give purpose of each parts.	Lecture - discussion Demonstration Laboratory & assignment Questions & answers	
Coat Making	Selection of material Suitable to design and style of pattern. Selecting lining, shrinking material, and pressing.	Lecture - discussion Demonstration Laboratory assignment	
Fitting Procedures	Execute fitting procedures: Purposes of fitting. 1. Balance of coat 2. Shoulder capacity 3. Coat size 4. Coat length 5. Collar base 6. Sleeve pitch 7. Pockets and button location.	Lecture - discussion Demonstration Reference books Laboratory assignment	
Alter and Finish Coat	Making necessary changes. Execute finishing procedures; lining, collar, sleeves, buttonholes, buttons, and pressing.	Laboratory assignment Inspection Evaluation	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
Special Machine Operation	Basic types of special sewing machines; blind stitchers, serger, buttonhole, button sewer, and flat feller. Operation and control, cleaning, oiling, and adjusting machine. A knowledge of the function of the machine and its parts.	Lecture - demonstration Charts and sewing machine manuals. Laboratory assignment	
Steam Pressing Machine	Basic operation. Understand the function of the machine, garment layout, control head and buck steam, and operation of vacuum and pressure pedal. Checking steam guage, cleaning, and oiling machine.	Demonstration Lecture - discussion Charts and manuals Questions and answers	
Alteration and Repair; Simple	Basic minor alteration and repairs. Simple types of operation and alteration. Execute the following: cuffing pants, changing waist size, shortening sleeve, and lengthening sleeve. Changing coat size; smaller or larger Shortening and lengthening skirts. Changing waist size of skirt, replacing zippers. Patching and darning.	Discussion Questions and answers Illustration Demonstration Laboratory assignment	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
Alteration and Repair; Complex	Basic major alteration on all garments; reducing front and back of pants, shortening crotch, taking out pleats, shortening collar reducing chest, shortening shoulder, and changing double breast to single breast	Lecture - demonstration Class discussion Laboratory assignment Evaluation	
Final Assignments	Final operation or projects should incorporate student's past experiences, giving each student the opportunity to design his own garment or plan his own projects according to his ability and interest under the guidance of the instructor or monitors. This gives a more capable student an opportunity to work up to his capability and provides a plan for students to evaluate their own projects and workmanship.	Class discussion Individual assignments Individual assignments Supervised research Student evaluation Instructor evaluation Course examination	

REFERENCE INFORMATION

ERIC

SOURCES OF INSTRUCTIONAL MATERIALS

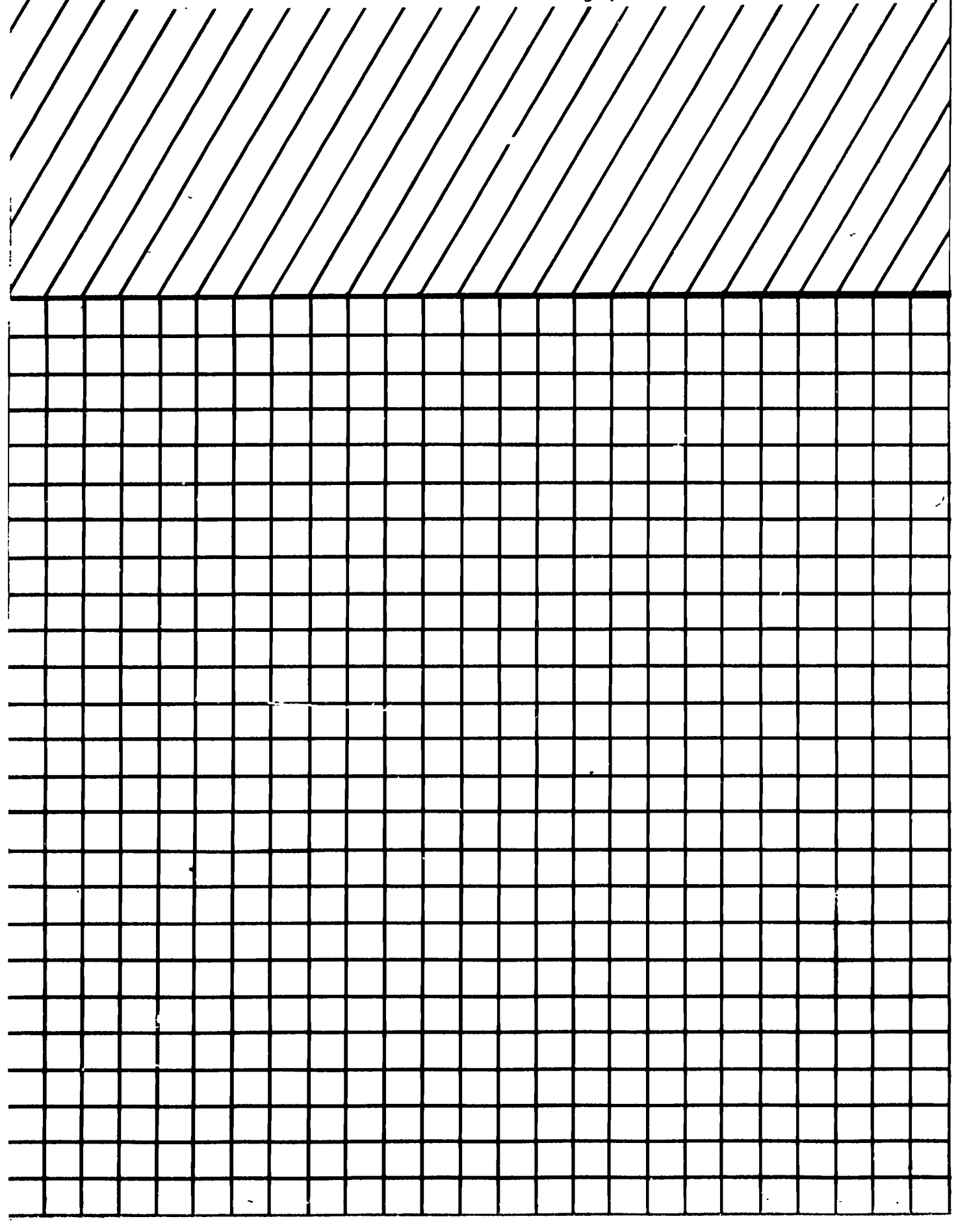
BOOK REFERENCES

Title	Author	Publisher
Course Construction In Industrial Arts and Vocational Education	Giachine	American Technical Society
Tailoring For the Family	Goodman	Prentice-Hall
The Methods of Sewing	Hannan	Kurt Salmon Associates
The Mechanics of Pressing and The Modern Pressing Room	Kogas	Kogas International Corp.
How to Service and Repair Your Sewing Machine	Levy	Kogas International Corp.
Modern Tailoring For Women	Manck	MacMillian Company
Designing and Drafting Men's Suits	Pizzuto	Kogas International Corp.
Tailoring Suits the Professional Way	Poulin	Charles A. Bennett
How To Tailor	Schwefke	Bruce Publishing Company
Modern Custom Tailoring for Men	Waisman	The Master Designer
General		
A Course of Study In The Manufacture of Ready To Wear Clothing		Delmar Publishers, Inc.
Applied Science - Essential to The Needle Trades		Delmar Publishers, Inc.
Hand Sewing Operations for Garment Making		The State Education Dept., N.Y.
How To Make and Mend Trousers, Vests, and Coats		The Master Designer
Job Sheets for Garment Making		The State Education Dept., N.Y.
Lock-Stitch Sewing Machine Operations For Garment Making		The State Education Dept., N.Y.

Title	Author	Publisher
Mathematics: A Course of Study Essential to the Needle Trade		Delmar Publishers
Pressing, Special Machine and Cutting Operations For Garment Making		The State Education Dept. N.Y.
Student's Manual of Machine Sewing		Singer Sewing Machine Co.
The American Gentleman Pattern Grader		American Gentleman, Publishing Corporation
Principles of Tailoring		International Correspondent School, Scranton, Florida
Regal's American Garment Cutter, I and II		American Gentleman Publishing Corporation
Singer Dressmaking Guide		Singer Sewing Machine Co.
The Master Designer's System of Designing and Cutting Ladies Garments		The Master Designer
Vocational and Practical Arts Education		Harper and Row
The Instructor and His Job		American Technical Society
Esquire Magazine		

PROGRESS CHART

Trade & Industrial Education
Department of Public Instruction
Raleigh, North Carolina 27602



PROGRESS CHART

Trade & Industrial Education
Department of Public Instruction
Raleigh, North Carolina 27602

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VT 002 660
Trade Preparatory Training Curriculum Guide, Marineology, Course No. 784.1 and 784.2.

North Carolina State Dept. of Public Instruction, Raleigh. Trade and Industrial Education
MF AVAILABLE IN VT-ERIC SET.
T.I.E. Series No. 86
PUB DATE - Nov66 17p.

DESCRIPTORS - *CURRICULUM GUIDES; TRADE AND INDUSTRIAL EDUCATION; *MARINE TECHNICIANS; TECHNICAL EDUCATION; *BOATMEN; NAVIGATION; SEMISKILLED WORKERS
IDENTIFIERS - *MARINEOLOGY

ABSTRACT - Designed for high school students interested in seamanship either as a vocation or an avocation, this curriculum guide provides an outline of subject material for a marineology course covering 1 or 2 years. Units outline content, teaching methods, and information and skills to be taught. The recommended text for the course is "Piloting, Seamanship, and Small Boat Handling," by Charles F. Chapman, from which this course outline was taken. (GR)

VT 002 660

ED0 45856

TRADE AND INDUSTRIAL EDUCATION

November, 1966 T.I.E. Series No. 86

U.S. DEPARTMENT OF HEALTH, EDUCATION
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TRADE PREPARATORY TRAINING

Curriculum Guide

Marineology

Course No. 784.1 and 784.2

Trade and Industrial Education
Charles D. Bates, State Supervisor

DIVISION OF VOCATIONAL EDUCATION
STATE DEPARTMENT OF PUBLIC INSTRUCTION
Room 436 Education Building
Raleigh, N. C. ZIP CODE 27602

VT 02660

PREFACE

This Trade Preparatory Training Curriculum Guide has been prepared to provide a general outline of subject material to assist the teacher of Trade and Industrial Education in presenting this subject area in a meaningful and organized manner. It also contains specific basic subject content that should be covered during the year, including variour methods and aids that can be employed.

We are grateful to the teachers in the field who served on the Curriculum Guide Committee.

To keep this Curriculum Guide as current as possible and abreast of industrial methods, we request that our teachers submit their recommendations for change and modification.

Charles D. Bates, State Supervisor
Trade and Industrial Education

INTRODUCTION

This Curriculum Guide is planned for the use of the Marineology classes under Trade and Industrial Education, Department of Public Instruction. It is particularly designed for those students in high school who are interested in following the sea as a livelihood. The course will also be beneficial to those who plan to enter the Navy, Coast Guard or the Maritime service. It is presented in such a manner as to be of interest and importance to commercial fishermen, sports fishermen, tug boatmen, or those who ply the inland or international waters on any type of craft. The outline is taken from the book, Piloting, Seamanship, and Small Boat Handling by Charles F. Chapman. This book is used by the United States Coast Guard Auxillary for their public instruction courses and is recommended as the text for this curriculum course.

This course should enable any student to appear before the U.S. Coast Guard examiner and pass the examination for motorboat operators license.

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Course: Marineology # 784.1-2 Year: 1-2 Page

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
Orientation	Orientation of class on marineology and discussion of marine occupations.	Lecture and discussion	
Nautical Terms	Various expressions used afloat Names of parts of a boat's construction. All the common nautical terms and what they mean. Types of sailing vessels	Lecture using opaque projector with illustrative pictures.	
The Art of Anchoring	Types of anchors Manilla, chain, and wire rope rodes Storage and care Number and weight of anchors Holding power The technique of anchoring Recommendations for permanent moorings.	Lecture using different types of anchors or pictures for demonstrating	
Equipment and Government Regulations	Equipment required by law Other equipment which should be on board. Equipment required for CG Aux decal The Federal Boating Act of 1958 Documentation License to operate motorboats Carrying passengers for hire Customs and immigration regulations The Motorboat Act Digest of State boating laws Equipment carried by U.S.C.G. facilities.	Lecture and exhibit and demonstration of equipment	

Course: Marineology # 784 Year: First

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
Lights for all Classes of Boats	Illustrations of lights for all types of boats Tables showing lights carried by various types of craft under inland and international rules Lights for towing vessels Changes in International regulations.	Lecture showing lights of different points for all types and classes of boats.	
Rules of the Road, Right-of-Way, Whistle Signal	Rules governing right-of-way Whistle signals Various situations explained diagrammatically; meeting head-on Obliquely, overtaking, passing to port or starboard Table of passing whistle signals for motor and steam vessels. Table of differences between international, inland and Great Lakes rules.	Lecture Films(U.S.C.G. Aux)	
How Pilot Rules Differ	Comparison of rules of the road, showing points of similarity and conflict between rules for the high seas, inland waters, Great Lakes, and Western rivers.	Lecture	
Fog Signals, Day Marks, Lifesaving, and Distress Signals	Tables and illustrations of fog signals given by various types of craft under international, inland, Great Lakes, and Western Rivers rules. Fog signal equipment for motorboats.	Lecture	

Course: Marinaology # 784 Year: First

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	Day marks Lifesaving and distress signals Signals for a pilot		
Motorboat Handling	Effect of design, trim, and other factors Rudder and propeller action in steering Screw current Unequal blade thrust Getting underway Checking headway Backing Turning in close quarters Leaving and picking up moorings Docking and mooring under various conditions of wind and current Mooring lines and springs Making fast Heaving lines Winding ship Fenders and sideboards Maneuvering around piles Orders when docking Duties and responsibilities of skipper Boat maintenance	Lecture (Demonstrations where practical)	
Marlinspike Seamanship; Knots, Bends, Hitches, and Splices; Care of Rope; Blocks and Tackle	The common knots - overhand, figure eight, square knot, sheet bend, bowline, clove hitch, two half hitches, reeving line bend, and fishermans bend How to make fast to a cleat whipping.	Lecture, demonstration and student participation	

Course: Marineology # 784 Year: First

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	Proper installation of fuel system Ventilation of engine and fuel compartments Handling gasoline safely Fire-fighting and life-saving equipment Man overboard Tools and spare parts Help from Coast Guard Signaling for aid Signaling equipment Radio First Aid Artificial respiration Safety practices in the construction, care, fueling, and operation of motorboats		
Weather	Reading and analyzing the daily weather map Storms - extra-tropical cyclones, thunderstorms, hurricanes, and tornadoes Fog - how, why, when, and where it forms. Weather observations afloat Weather instruments - barometer, anemometer and psychrometer Visual weather signs Preparation of local forecast Cold and warm fronts Predicting thunderstorms and fog Storm and weather signals	Lecture (Use weather instruments)	
Lighthouses, Lightships, Bouys, and Other Aids to Navigation	Aids to navigation maintained by Coast Guard History of aids	Lecture (Field trips)	

Course: Navigation # 784 Year: First

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	Significance of coloring, lights, and sound signals Characteristics of lights Visibility Radio beacon signals Range lights Unlighted aids Intra-coastal waterway aids		
Bouys - What they mean and How to Use Them	Various types The spar, can, nun, bell, gong, whistle, lighted and combination bouys Coloring and numbering Their light characteristics Shapes and sizes Reflectors	Lecture (Field Trips)	
Government Publications	Notice to marines Tide tables Current tables Tidal current charts Current diagrams Coast pilots Light list Chart catalog Pilot rules Other publications Cause and effect of tides	Lecture	
The Compass	Types of compasses Their construction Installation and care Boxing the compass Various kinds of cards Points and degrees Placing the compass on the boat	Lecture	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	Table showing comparison of points and degrees		
Compass Errors	Variation and deviation True and magnetic courses Allowing for compass errors Methods of determining deviation The sun compass Deviation by bearing of sun at sunrise and sunset. Application of variation, deviation, and compass errors Rules for applying errors The Napier diagram Deviation card Compensating the compass Compass comforts	Lecture	
The Chart	Reading and interpreting the chart How charts are made What to look for on them Meaning of the symbols and marks Notes on charts New charts for small craft	Lecture	
Piloting Instruments	The lead and lead line Logs Course protractors Parallel rules Dividers The pelorus, bearing finder and sight vane Difference between clock and sun time The sounding machine The chronometer	Lecture	

Course: Marine Ology # 784 Year: First

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
Piloting	Piloting methods Locating position by bearings Cross bearings Bow and beam bearings Two bearings and the run between Doubling the angle Danger bearings and danger angles Local marks and ranges Chain of soundings Radio position finding Keep track of your position	Lecture	
Tides and Currents	Allowing for tides and currents The current diagram Leeway Speed of boat through water and over the bottom Short cuts in piloting Time and tide Calculating time of high water from the moon Points to remember about currents and tide	Lecture	
Flag Etiquette	Flying of flags and colors on various types and rigs of boats The flag of your country Various United State flags Flag etiquette for U.S. boats in foreign waters Dressing ship Honoring an allied ensign	Lecture	

Course: Marigeology # 784 Year: First

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
Yachting Customs and Etiquette	Yachting, Naval and Coast Guard custom and etiquette Official courtesy Service customs Social customs Salutes Procedures	Lecture	
Clothing for Yachtsmen	Yachting and squadron uniforms, cap devices and sleeve insignia Designation of rank Dress and service clothes Wet weather clothing	Lecture	
Keep a Log	Recording cruise on log sheet form How to record clouds, state of sea, wind force, weather, speed, distance run, etc. Table of speeds over measured mile	Lecture	
Signaling	International code flags and pennants Methods of communicating by means of International Code flags, semaphore, flashing lights, and sound signals using the International Morse Code. The signal code Typical signals Special Navy Signals Signaling Navy and Coast Guard vessels	Lecture and demonstration	
Communications by Radio	Rules of FCC Coast Guard Communications	Lecture	

Course: Marineology # 784 Year: First

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
Other Additional Features	Mechanical and Electronic aids for piloting Review	Lecture	

GRESS CHART

Trade & Industrial Education
Department of Public Instruction
Raleigh, North Carolina 27602

No. Course

School

Teacher

NAMES

PROGRESS CHART

Trade & Industrial Education
Department of Public Instruction
Raleigh, North Carolina 27602

VT 002 661
Trade Preparatory Training Curriculum Guide, Graphics and Industrial Communications 1 and 2, Course No. 786.3 and 786.4.

North Carolina State Dept. of Public Instruction, Raleigh. Trade and Industrial Education
MF AVAILABLE IN VT-ERIC SET.
T.I.E. Series No. 81
PUB DATE - Jul66 24p.

DESCRIPTORS - *TRADE AND INDUSTRIAL EDUCATION; *STATE CURRICULUM GUIDES; *TEACHING GUIDES; COURSE OBJECTIVES; COURSE DESCRIPTIONS; *GRAPHIC ARTS; *COMMUNICATIONS

ABSTRACT - This curriculum guide, prepared by a curriculum guide committee, provides a general outline of subject material to assist the trade and industrial education teacher in planning two courses of graphics and industrial communications at the secondary level. Content, information and skills to be taught, and teaching methods are outlined for units covering: (1) layout, (2) composition, (3) proofing, (4) camera use, (5) preparation for press, (6) press work, (7) safety, (8) employment, and (9) legal restrictions on copying. Resource information includes a bibliography and a suggested equipment list. (GR)

VT 002 66

ED0 45356

TRADE AND INDUSTRIAL EDUCATION

July, 1966 T.I.E. Series No. 81

TRADE PREPARATORY TRAINING

Curriculum Guide

GRAPHICS AND INDUSTRIAL COMMUNICATIONS 1 AND 2

Course No. 786.3 and 786.4

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Trade and Industrial Education
Charles D. Bates, State Supervisor

DIVISION OF VOCATIONAL EDUCATION
STATE DEPARTMENT OF PUBLIC INSTRUCTION
Room 436 Education Building
Raleigh, N. C. ZIP CODE 27602

VT 02661

PREFACE

This Trade Preparatory Training Curriculum Guide has been prepared to provide a general outline of subject material to assist the teacher of Trade and Industrial Education in presenting this subject area in a meaningful and organized manner. It also contains specific basic subject content that should be covered during the year, including various methods and aids that can be employed.

We are grateful to the teachers in the field who served on the Curriculum Guide Committee.

To keep this Curriculum Guide as current as possible and abreast of industrial methods, we request that our teachers submit their recommendations for change and modification.

Charles D. Bates, State Supervisor
Trade and Industrial Education

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GRAPHICS AND INDUSTRIAL COMMUNICATIONS

Offset printing is known by many names: photo offset, lithography, photo lithography, photo offset lithography, and offset lithography. It is one of the newest phases of producing printed matter and its phenomenal growth in the graphic arts is evidenced each day as it replaces letter press productivity. In the offset process (a planographic method of printing involving the use of three cylinders, plate, blanket and impression) the printed image is drawn by hand, pasted up, typed or prepared photographically on the surface of a thin plate (paper, aluminum, plastic or zinc) plus the use of ink and a repellent water mixture.

I

The course is planned to give learners an opportunity to probe into its many diversified facets, which are utilized in the following:

1. Operate and use safely and correctly the various kinds of equipment, tools and materials.

2. Acquire such necessary knowledge as to the care, selection, etc. of film, paper, ink for each job, measuring type areas, reducing and enlarging, straight line and screen shots, figuring and cutting stock, burning plates and operating presses, duplicators and accessory equipment.

3. To become knowledgable of the various paper work system that incorporates the use of offset duplicating - printing equipment in business and industry.

4. To become knowledgable in the use of allied equipment used in conjunction with offset pressors - duplicators, copiers, computors, etc.

5. Develop a sympathetic attitude toward the trade and an appreciation for well designed, clean and quality workmanship in the produced product.

O B J E C T I V E S

1. To develop the necessary skills, technical information and job know how required to meet employment as an advanced learner in the field of offset printing in any of its many phases:

   a) Layout b) Composition c) Paste up d) Proofing

   e) Use of camera f) Stripping g) Platemaking h) Figuring & Cutting paper

   i) Operation of Duplicator and Presser

2. To provide necessary "live" projects to give true meaning and enliven learning.

3. To develop safe and orderly work habits and a constant reminder that reliability is expected to carry out job orders.

4. To develop a state of alertness and an awareness of working together to produce a job.

5. To develop a keen insight of the close relationship to other allied graphic arts and as well the awareness of the need for the quality product.

GRAPHICS AND INDUSTRIAL

COMMUNICATIONS

Course: Graphics & Industrial Communications # 786.3-4 Year: 1-2

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
INTRODUCTION AND ORIENTATION	Technical Information Major Printing Processes Basic Theories	Explanation Personal experience of teacher Text Assignment Discussion	
	Technical Information Brief history and background	Text assignment Discussion	
	Technical Information Industry as of Today a) Divisions of work	Text assignment Discussion Visit plants and businesses	
	Measurements (Printers' System)	Explanation Demonstration Discussion Math Problems	
JOB PLANNING AND LAYOUT	1. Equipment and materials 2. Thumb Nail sketches 3. Rough Layout 4. Comprehensive Layout 5. Copyfitting 6. Dummy	Explanation Demonstrations Text assignment Discussion Student practice Tests	
METHOD OF COMPOSITION	1. Metal type (hand or machine) 2. Wood type 3. Hand lettering 4. Typewritten 5. Vari-Typer 6. Individual printed paper type	Explanation and demonstrations Text assignment Discussion Student practice Tests (For each phase of composition)	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	7. Photographic strip type 8. Photographic page (composed)		
COPYREADING AND PROOFREADING	1. Kinds 2. Proofreaders' Marks 3. Reading and marking	Explanation and demonstrations Text assignment Student practice Discussion Tests	
THE CAMERA (Vertical or Horizontal)	1. Preparing the copy a) Kinds b) Reductions c) Enlargements d) Specifying e) Line Copy f) Halftone copy g) Combinations (line and halftone)	Explanation and demonstrations Text assignment Student practice Discussion Tests	
	2. Line Photography a) As to kinds of cameras <u>Technical Information</u> b) Theory c) Parts of camera Copyholder Back Lights Bellows	Explanation Demonstrations Text assignment Student practice Discussion	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	3. Basic Setting a) Angle and distance of lights b) Exposure (how arrived) c) F/Stop (how arrived) d) Bellows (extension) e) Copyboard (extension	Explanation Demonstrations Text assignment Student practice Discussion Tests	
	4. Procedure in Shooting a) Prepare the camera (how) b) Make necessary calculations c) Checking on all points d) Loading film e) Making exposure	Explanation Demonstrations Text assignment Student practice Discussion Tests	
	5. Halftone Photography Technical Information a) Theory b) Screens and their uses c) Shooting single color d) Making the negative e) Using exposure computer f) Making multi-colored negatives (register work)	Explanation Demonstrations Text assignment Student Practice Discussion Tests	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	Technical Information Kinds of films used	Explanation Text assignment	
	6. Darkroom Procedure a) Preparation of solutions b) Order of trays c) Developing negatives Film positives Screened Open areas	Explanation Demonstrations Test assignment Student practice Discussion Tests	
PREPARATION FOR PRESS	1. Laying out and stripping a flat a) Kinds and uses of paper b) Equipment and supplies used c) Kinds, types of tables used d) Getting ready for stripping e) Laying out the flat f) Stripping the negative Emulsion side Opaquing & trimming Scribing Typing Cutting g) Cutting reference marks Gripper edge Cylinder markings Trim marks Fold marks Cut marks	Explanation Demonstrations Text assignment Student practice Discussion Tests Explanation Demonstrations Test assignment Student practice Discussion Tests	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	h) Stripping for 2 or more colors (Follow operations as for singler color) Repeat	Explanation and demonstration Text assignment Student practice Discussion Tests	
	2. Platemaking a) Types of flats used b) Surface grained c) Exposing the plate d) Developing the plate	Explanation Demonstrations Text assignment Student practice Discussion	
	Technical Information 3. Offset Inks a) Requirements to be met b) Composition c) Manufacturing	Explanation Text assignment Discussion	
	d) Mixing and terminology	Explanation Demonstrations Text assignment Student practice Discussion Tests	
	Technical Information 4. Offset Papers a) Requirements to be met b) Meaning and purpose of pulp c) Manufacturing d) Terminology used	Explanation Test assignment Discussion	
	e) Cutting paper Selecting for specific job Figuring stock Using and setting cutter	Explanation Demonstrations Test assignment Student practice Discussion Tests	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
PRESS WORK	Technical Information 1. Basic parts of the offset press	Explanation Text assignment	
	2. The blanket (Cylinder) a) Preparing b) Installing c) Use and care	Explanation Demonstration Text Assignment Student practice Discussion Tests	
	3. The Plate (Cylinder) a) Installing b) Removing c) Use and care	Explanation and demonstration Text assignment Student practice	
	Technical Information 4. Dampening mechanism 5. Inking mechanism	Explanation Demonstration Text assignment Discussion	
	6. The Ink Rollers Technical Information a) Composition	Explanation and demonstration Text assignment Student practice Discussion Tests	
	b) Setting c) Resurfacing d) Washing up e) Storing and care		
	7. Molleton Covered Dampening Rollers a) Composition	Explanation Text assignment	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	b) Setting c) Installing new covers d) Storing and care	Explanation and demonstrations Text assignment Student practice Discussion Tests	
	8. Lubricating the press	Explanation and demonstrations Student practice	
	9. Fountain functions (Dampening) a) Preparing solution b) Controlling flow c) Washing and cleaning	Explanation and demonstrations Text assignment Student practice Discussion Tests	
	10. Fountain functions (Ink) a) Placing ink b) Adjusting flow of ink c) Washing and cleaning	Explanation and demonstration Student practice	
	11. Operating the press a) Inserting stock b) Setting up feeder unit c) Setting guides d) Trial proof of run e) Setting delivery f) Setting counter g) Running press to complete run	Explanation and demonstrations Textbook assignment Student practice Tests	
	12. Washing up the press	Explanation and demonstration Student practice	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	13. Problems which may occur in operation of press a) Scumming b) Tinting c) Filling up d) Setting off e) Piling f) Vanishing image g) Sticking h) Picking i) Roller stripping j) Spraying k) Mottling l) Graying image m) Chalking n) Running	Explanation and demonstrations Textbook assignment Student practice Discussion Tests (This procedure may be followed to correct each fault or trouble)	
SAFETY	1. Personal Conduct a) To instructor b) To others	 Explanation Example of instructor	
	2. Permissions a) From instructor b) From office	 Explanation Discussion	
	3. Fire Safety a) At home b) Classroom and shop	Explanation and demonstrations Textbook assignment Student participate Discussion	
	4. Machinery a) Clothing to be worn b) Starting and stopping c) Care	Explanation and demonstration Textbook assignment Student practice Discussion Tests	

Course: Graphics & Industrial Communications # 786.3-4 Year: 1-2

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	5. Chemicals a) Care in mixing and use b) Storing 6. Cleanliness a) As to person b) As to equipment c) As to materials used 7. State rules and regulations governing work places and working conditions Related Information a) As to authority b) As to First aid c) As to hours of Labor posted d) As to heating e) As to lighting f) As to escapeways g) As to Ladders h) As to restrooms i) As to drinking water j) As to floors k) As to working aisles l) As to electrical installations m) As to power transmission n) As to cleanliness and maintenance of building & workrooms	Explanation and demonstration Text assignment Student practice Explanation and demonstration Example of instructor Text assignment Student practice Explanation Notes to be made by each student Study Review Tests	

Course: Graphics & Industrial Communications #786.3-4 Year: 1-2

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
EMPLOYMENT	1. Applying for a job a) By letter b) Personal interview	Explanation and demonstration Student practice Discussion	
	2. Getting the job a) Reporting for work b) Learning rules of shop c) Leaving for the day	Explanation Personal conduct of instructor Discussion	
	3. Holding and growing on job a) Upgrading by attending evening or special classes	Explanation Discussion	
LEGAL RESTRICTIONS ON COPYING	Technical Information 1. Copyright material 2. Photographs for advertising 3. Counterfeiting 4. U.S. Bonds, certificates, ets. 5. Documents a) Drivers Licenses b) Amateur radio operator's license c) Classified government documents, maps, photographs, etc.	Explanation Text assignment Discussion Tests (This procedure can be followed for each phase of instruction)	

Content	Information and Skills To Be Taught	Methods of Teaching Information and Skills	Sources of Information
	d) Draft registration cards e) Badges, I.D. cards, passes, etc. carried by individuals, issued by any government or its agency.		

RESOURCE

INFORMATION

ERIC

BIBLIOGRAPHY

It will be necessary for each student to have a textbook treating the various areas of the offset reproduction processes. In addition, a library should be established and maintained in the related study classroom. The library should have several types of books on offset printing as well as books on printing, photography, layout and design, bindery etc.

SUGGESTED REFERENCES

Photo-Offset Fundementals, John E. Cogoli, McKnight & McKnight

The Practice of Printing, Ralph W. & Edwin Polk, Chas. A. Bennett Co., Inc.

Graphic Arts Procedures, R. Randolph Karch, American Technical Society

Graphic Arts, Frederick D. Kagy, Goodheart-Wilcox

Printing Layout & Design, Delmar Publishers, Inc.

Arithmetic For Printers, J. Woodard Auble, Chas. A. Bennett Co., Inc.

Practical Photography, Robert A. McCoy, McKnight & McKnight

Career in Graphic Reproduction, Earl Bedue, D. Von Nostrand Co.

Offset Printing information can be secured from the manufacturers of cameras, plates, etc. to supplement teaching program and also several subscriptions to any of the following magazines: "Photo Methods for Industry", Printing Magazine, National Lithographer", "Inland Printer, American Lithographer", "Visual Communications Instructor", "Reproductions Review", "Printing Impressions".

SUGGESTED EQUIPMENT

The equipment in an offset press department is controlled by money available and it is possible to build a number of need equipment, such as: layout tables, Press work tables, Vacuum frames, etc.

2 - VariTypers or typewriters (or more dependent on need)

1 - Camera (Horizontal or vertical type..size dependent on size of presses)

2 - Layout Tables (More if needed)

1 - Developing Sink

2 - Safelights

1 - Plate Makers

2 - Offset Presses (9x12 and/or 11x17, or larger)

2 - Press Work Tables

1 - Hand Lever Paper Cutter (Power Cutter)

1 - Electric Stitcher.. to 3/4" capacity

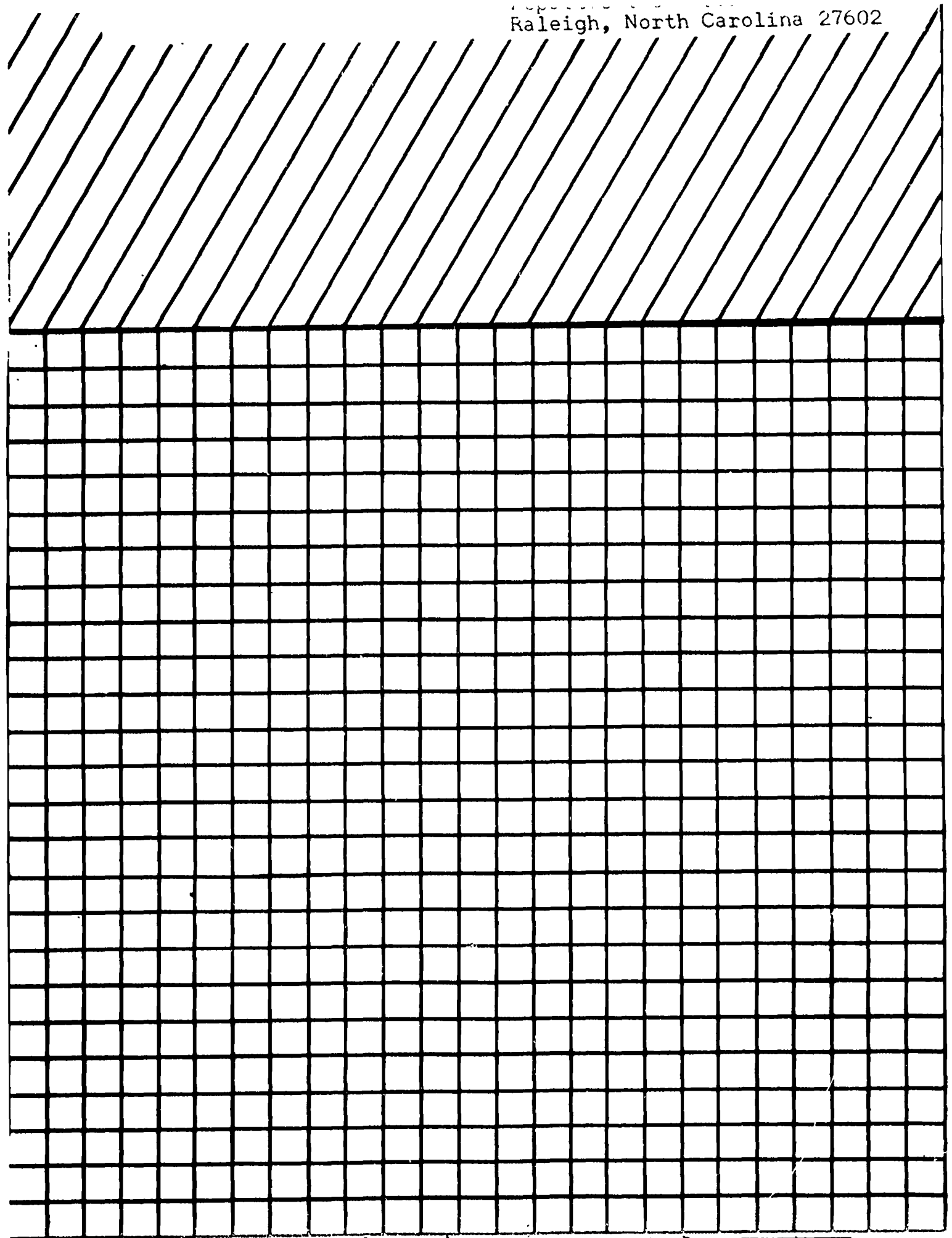
1 - Foler (Dependent upon size of presses)

1 - Paper Drill

1 - Collator

and other equipment may be purchased to supplement growth of shop and promote special instructional procedures.

Raleigh, North Carolina 27602



PROGRESS CHART

Trade & Industrial Education
Department of Public Instruction
Raleigh, North Carolina 27602

No. _____ Course _____

School _____

Teacher _____

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VT 002 683
Marketing I; Teachers Manual. Distributive Education Series.

North Carolina State Dept. of Public Instruction, Raleigh. Div. of Vocational Education
MF AVAILABLE IN VT-ERIC SET.
PUB DATE - ND 247p.

DESCRIPTORS - *DISTRIBUTIVE EDUCATION; *TEACHING GUIDES; *MARKETING; SALES OCCUPATIONS; SALESMANSHIP; MERCHANDISING; CAREER OPPORTUNITIES; GRADE 11

ABSTRACT - Developed by a committee of high school teacher-coordinators, this teacher's guide is for use in planning a first-year course in marketing for juniors who expect to enter some form of distribution, but who cannot, for various reasons, participate in a cooperative program of on-the-job training. A suggested time allotment and bibliography are provided for these units: (1) Introduction to Marketing I, (2) Sales Supporting Activities, (3) Salesmanship, (4) Sales Promotion, (5) Business Organization, and (6) Careers in Marketing. Each unit contains a list of materials and equipment needed, objectives, topical outline, and teaching suggestions. Supplementary forms and information for students are appended. A related document is available as VT 002 568 (also in this issue). (SB)

VT 002 683

ERIC

ED 045856

TEACHERS MANUAL

MARKETING I

NORTH CAROLINA DEPARTMENT OF PUBLIC INSTRUCTION

DIVISION OF VOCATIONAL EDUCATION
RALEIGH, N. C.

VT 02883

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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ED0 45856

PREFACE

The Teacher's Manual for Marketing I is constructed as a guide for teacher-coordinators in the preparatory distributive education program. Teaching suggestions are given for each of the units to assure active student participation on a vocational level.

This Manual was prepared by a committee of teacher-coordinators under the direction of Mrs. Joan K. Smith, Assistant State Supervisor of Distributive Education, Raleigh, North Carolina.

Grateful acknowledgement is made to the following teachers for their excellent work.

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The committee is indebted to the Distributive Education services of Texas and Virginia for the use of some of their materials and especially to the personnel in North Carolina who developed the courses of study for Cooperative Distributive Education I and II.

FOREWORD

The controlling purpose of vocational education is to fit the student for useful employment. This implies that the instruction must be related to a specific occupational goal or career objective.

"Career objective" suggests that there is an ongoing process of development within the framework of the student's chosen endeavor in which he is interested and for which he is well qualified. To this end, the distributive education program will serve effectively by providing the necessary instruction and experience for a variety of talents possessed by students who have selected distribution as an avenue for employment.

Distributive education has expanded its scope to meet the needs of all youth in North Carolina whose career objectives are in the field of distribution and marketing. North Carolin has the traditional cooperative programs, specialized cooperative programs, and preparatory programs.

The preparatory program meets two needs. First, many high school youth have career objectives in the field of distribution and marketing but live in an area which does not have on-the-job training opportunities. Through the study of marketing, students gain acquaintance with basic concepts that will prepare them to enter the field of distribution and marketing either immediately upon graduation from high school or upon completion of a program of study beyond the high school level. Secondly, many students with career objectives in the field of distribution and marketing want to take many additional subjects to broaden their education and thus their schedules are not flexible enough to permit on-the-job training. Since marketing does not require regular on-the-job training, it makes it possible for students to remain in school all day.

This Manual is designed for Marketing I, a course which noramlly should be offered for juniors who expect to enter eventually some field of distribution. The subject matter parallels to a great extent the subject matter in Cooperative Distributive Education I but is not related to regular on-the-job experiences. After completing this course in the junior year, students may enroll in either Marketing II or in Cooperative Distributive Education II in the senior year.

The projects suggested in this Manual are applicable to both large and small communities. The teacher-coordinator should work very closely with the local business community in the suggested projects to afford each student a variety of experiences which will contribute to attainment of his career objective.

MARKETING I

Course of Study

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Salesmanship	54
Sales Promotion	87
Business Organization	127
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INTRODUCTION TO MARKETING I

I. Introduction To Vocational Education
   A. Background of Vocational Education
   B. Distributive Education

II. Meaning And Importance Of Marketing
   A. Definition of Marketing
   B. Importance of Understanding Marketing

III. Job Application
   A. Getting Ready To Apply For The Job
   B. Prepare For The Employment Interview

IV. Changing Nature Of Marketing
   A. Early History
   B. Medieval History
   C. Modern History
   D. Early American Trade
   E. Yankee Peddler
   F. General Store
   G. The Industrial Revolution's Effect on Trade

V. Channels of Distribution
   A. Producer
   B. Wholesaler
   C. Retailer
   D. Middleman

SALES SUPPORTING ACTIVITIES

I. Introduction To Sales Supporting Activities
- A. Introduction To the Unit
- B. Sales Supporting Activities
- C. Effects of Careless Handling Of Sales Supporting Activities On Business Success
- D. Job Requirements in Handling Sales Supporting Activities

II. Receiving, Checking And Marking Activities
- A. Points To Consider In Shipping Merchandise To The Business
- B. Receiving Merchandise
- C. Checking Merchandise
- D. Marking Merchandise

III. Storage Activities
- A. Importance of Storage To Businesses
- B. Results of Storage
- C. Storage Standards
- D. Kinds of Storage - Classified by Ownership and Use

IV. Wrapping And Packing Activities
- A. Importance of Wrapping and Packing Activities
- B. Development of Prepacking
- C. Organization for Wrapping and Packaging
- D. Layout, Equipment and Supplies

V. Delivery Activities
- A. The Importance of Delivery Service in Building Customer Good Will
- B. Delivery Systems
- C. Store Delivery Practices
- D. Organization of Department Store Delivery System

SALESMANSHIP - (Personal Selling)

I. Introduction To The Marketing Function-Personal Selling
   A. Definition of Selling
   B. Selling as a Marketing Function
   C. Selling Appeals

II. Organization Of A Sales Department
   A. Types of Salesmen
   B. Similarities and Differences-Salesmen
   C. Organization
   D. Functions and Responsibilities-Sales Manager

III. Sales Personality-Getting Ready To Sell
   A. Definition of Personality
   B. Types of Customers

IV. Know Your Product
   A. Merchandise Knowledge

V. Sales Presentation
   A. Essentials of a Good Demonstration
   B. Types of Presentation
   C. Methods of Presentation
   D. How to Win Confidence
   E. Steps in a Sale

VI. Finding Prospects
   A. Sources of Prospects
   B. Evaluating Your Prospects
   C. Prospecting Systems
   D. Managing Time Schedule

VII. Gaining Attention (Approach)
   A. Objectives of the Approach
   B. Elements of a Good Approach
   C. Essentials of a Good Approach
   D. Types of Approaches
   C. Shopping Report

VIII. Conducting The Demonstration
   A. Rules for a Successful Demonstration
   B. Results of Well Planned Demonstration

IX. Handling Objections
   A. Real Objections-Excuses
   B. Types of Objections
   C. Handling Objections
   D. General Procedure in Answering Objections

X. Suggestion Selling
   A. Definition
   B. What to Suggest-types
   C. Rules to Follow in Making Suggestions

D. Call-backs
E. When to Increase Sales
F. Monetary Value of Plus Selling

XI. Closing The Sale
A. Buying Signals
B. Methods of Closing Sale
C. Why Buying Actions Fail
D. Do's and Don't's in Closing a Sale

XII. Selling Ideas
A. Communications-definition
B. Necessity for Communications
C. Elements of Communications
D. Communicating Without Words
E. Methods of Communications
F. Approach to Good Communication
G. Ten Commandments to Good Communications
H. Mechanics of Oral Communication
I. Gestures to Avoid - Mannerisms
J. Telephone Selling
K. Types of Oral Communications
L. Public Speaking
M. Aims of Speeches
N. Outlining Speeches

SALES PROMOTION

I. Sales Promotion
   A. Introduction to Sales Promotion
   B. Purposes of Sales Promotion
   C. Factors That Contribute to Successful Sales Promotion
   D. Types of Sales Promotional Events

II. Advertising
   A. Introduction to Advertising
   B. Aims of Advertising
   C. Importance of Advertising
   D. Types of Media
   E. Use of Periodicals
   F. Use of Mass Media
   G. Use of Direct Advertising
   H. Factors That Decide Selection of Media
   I. Types of Advertising Copy
   J. Aims and Measurement of Each Type of Copy
   K. What is Advertised in Each Type of Copy
   L. Advantages of Each Type of Copy
   M. How to Use Information About Each Type of Copy
   N. Steps in Advertising
   O. Using Professional Advertising Services

III. Display
   A. Introduction to Display
   B. Classifications of Display
   C. Basic Principles Underlying all Display
   D. Facts About Design or Arrangement
   E. Five Aspects of Harmony and Their Application
   F. Facts About Proportion as Used in Display
   G. Use of Four Arrangements in Display
   H. Use of Emphasis in Display
   I. Use of Rhythm to Hold Interest
   J. Use of Balance in Display
   K. Important Color Terms
   L. Facts About Hue
   M. Facts About Value
   N. Facts About Intensity of Chroma
   O. Use of Color Harmony in Display
   P. Principles of Combining Colors
   Q. Principles of Balance and Emphasis
   R. Effect of Artificial Light on Colors
   S. Steps in Creating a Display
   T. Window Display Judging

BUSINESS ORGANIZATION

I. Background And Growth Of Marketing In America
   A. Growth of Retailing
   B. Twentieth Century Marketing Prior to World War II
   C. Marketing Since World War II

II. Types Of Legal Organization (According to Ownership)
   A. Sole Proprietorship
   B. Partnerships
   C. Corporation
   D. Cooperatives
   E. Mutual Companies

III. Internal Organization Of A Business (Organizational Structures)
   A. Definition and Importance of Organization
   B. Types of Internal Structures
   C. Principles of Good Organization
   D. Methods of Organization
   E. Major Functional Divisions
   F. Small Business Versus Large Business Organization

IV. Types Of Distributive Businesses
   A. Wholesale Structure
   B. Retail Structure
   C. Services
   D. Special Areas
   E. Financing, Insurance and Real Estate
   F. Manufacturing

CAREERS IN MARKETING

I. Introduction To Careers In Marketing
   A. Entry Jobs in Marketing
   B. Job Survey
   C. Treatment of Guest Speaker
   D. Guest Speakers

II. Personality In Marketing
   A. Personality
   B. Student Interests, Abilities, and Limitations for Careers in Marketing

III. Job Analysis For Marketing
   A. Job Interview
   B. Job Analysis
   C. Making a Job Analysis
   D. Special Report

SUGGESTED TEACHING TIME FOR

UNITS IN MARKETING I

I. Introduction To Marketing I - 3 weeks teaching time

II. Sales Supporting Activities - 2 weeks teaching time

III. Salesmanship - 9 weeks teaching time

IV. Sales Promotion - 7 weeks teaching time

a. Advertising - 4 weeks teaching time - end first semester

b. Display - 3 weeks teaching time - begin second semester

V. Business Organization - 10 weeks teaching time

VI. Careers in Marketing - 5 weeks teaching time

BIBLIOGRAPHY

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3. Haas and Perry, Sales Horizons, 1958 Copyright, Prentice Hall and Company.

4. Heckman, The Economics of American Living, 1959 Copyright. Rand McNally and Company.

5. Laird and Laird, Practical Business Psychology, 3rd Edition. McGraw Hill Book Company.

6. Logan and Moon, Facts About Merchandise. Prentice Hall and Company.

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9. Robinson, Blackler, and Logan, Store Salesmanship, 5th Edition. Prentice Hall and Company.

10. Ruch, Psychology and Life, 5th Edition, Scott Foresman, 433 East Erie Street, Chicago 11, Illinois.

11. Russell and Beach, Testbook of Salesmanship, 6th Edition. McGraw Hill Book Company, Inc., 330 West 42nd Street, New York 36, New York.

12. Tonne, et al, Business Principles, Organization and Management. Gregg Division, McGraw Hill and Company.

13. Wingate, et al, Retail Merchandising, 5th Edition. Southwestern Publishing Co.

14. Occupational Outlook Handbook, 1961. Superintendent of Documents, U. S. Printing Office, Washington 25, D. C. (under revision)

15. Job Guide for Young Workers, 1963-64 Edition. U. S. Department of Labor, Bureau of Employment Security, Superintendent of Documents, U. S. Printing Office, Washington 25, D. C. (under revision)

16. Wright and Warner, Advertising, McGraw Hill Book Company, Inc., 330 West 42nd Street, New York 36, New York.

17. Robert, Robert's Rules of Order, 1956 Edition. Scott.

18. DECA Handbook, Distributive Education Clubs of America, 1010 Vermont Avenue, Washington, D. C.

I. INTRODUCTION TO MARKETING I

INTRODUCTION TO MARKETING I

MATERIALS AND EQUIPMENT NEEDED

1. DECA Handbook

2. American Vocational Journal, January, 1964.

3. The Balance Sheet, February, 1964, and March, 1964.

4. Following forms in sufficient number for each student:

   a. "Organizational Chart - Vocational Education Division of the United States Office of Education"

   b. "Organizational Chart - Vocational Education Division of the State Department of Education"

   c. "Self-Inventory"

   d. "Employment Application"

   e. "Personal Data Sheet"

   f. "Your Interview"

   g. "Channels of Distribution Chart"

   h. Withholding Exemption Certificate (W-4 Form)

5. Order for each student: (free)

   "The Man for the Job"
   "The Girl for the Job"
   Bristol Myers Products Division
   45 Rockefeller Plaza
   New York 20, New York

6. Order for each student: (free)

   "Sell Yourself"
   North Carolina Employment Security Commission
   or
   Merchants Division
   National Cash Register Company
   Dayton 9, Ohio

7. Film: "The Clean Look " - (free) book four weeks in advance

   Armour and Company
   Audio-Visual Director
   P. O. Box 9222
   Chicago 9, Illinois
   or

Modern Talking Picture Service, Inc.
501 North College Street
Charlotte, North Carolina

8. "Good Grooming Charts"
Educational Service
Bristol-Myers
630 Fifth Avenue
New York, New York

9. "Through the Looking Glass to Good Grooming"
Proctor and Gamble
Cincinnati, Ohio

10. "Good Grooming Make-Up Manual"
Pond's Extract Company
60 Hudson Street
New York, New York

11. "The What, When, and Wear of Men's Clothing"
Cluett-Peabody and Company
10 East 40th Street
New York, New York

12. "The Girl With the Halo"
Underwood Corporation
1 Park Avenue
New York, New York

13. Copies of the following:

a. Social Security Card
b. Work Permit Form
c. Health Certificate Form
d. Intention to Employ Card

I. INTRODUCTION TO VOCATIONAL EDUCATION

Objectives

1. To acquaint the student with background information on the vocational program at the high school level
2. To explain to the student what distributive education is and how it operates
3. To provide students with an understanding of DECA
4. To acquaint student with the importance of DECA chapter work

Topical Outline	Teaching Suggestions
A. Background of Vocational Education	
1. Vocational Division -- U. S. Office of Education	1. See organizational chart, pass out sheet No. 1.
2. Vocational Division -- State Department of Education	2. See organizational chart, pass out sheet No. 2.
3. Federal legislation	Have students find out names of persons who are in charge of each division -- use charts.
a. Smith-Hughes Act, 1917, provided the first federal aid to Vocational Education on the high school level; included training in agriculture, trade and industries and home economics.	Have students do short reports on vocational education acts. Check the following magazines for information:
b. George-Deen Act, 1936, provided for training in distributive education for the first time.	American Vocation Journal, January, 1964, p. 6
c. George-Barden Act, 1946, amended the George-Deen Act to give additional funds to include the administration of vocational education; provided for rental or purchase of equipment and supplies.	The Balance Sheet, March, 1964, p. 305
d. The Perkins Act, 1963, provides for an expansion of the high school distributive education program,	The Balance Sheet, February, 1964, p. 256
	American Vocation Journal, 1964, p. 8

Topical Outline	Teaching Suggestions
vocational technical schools and community colleges. The monies involved will amount to: $60 million for fiscal year 1964 $118.5 million for fiscal year, 1965 $177.5 million for fiscal year 1966 $225 million for subsequent fiscal years.	
4. Distributive education	
a. Definition: Distributive education is a part of the vocational training program of the school, which combines classroom instruction with on-the-job training in a distributive occupation, and is intended to develop skilled workers in the field of distribution.	
(1) Distributive jobs are in the field of retail wholesale, and service i.e., field in "which goods or services are bought or sold."	
(2) Distribution is a phase of marketing, having to do with the getting of goods and services to the ultimate consumer.	
b. Functions of distributive education:	b. Write the functions on the board.
(1) To train students for vocations in the field of distribution	
(2) To give better service to the customer	(2) Ask students why it is so important to

Topical Outline	Teaching Suggestions
	give good service to customers.
(3) To give employees greater job satisfaction	
(4) To reduce business losses due to inefficient employees	(4) Through group discussion bring out ideas of how to strengthen the program of D.E. and give it added status.
(5) To promote community, school, business public relations	
5. Marketing is a part of the vocational education program in the school which gives the student a knowledge of marketing functions and an awareness of job opportunities.	5. Briefly mention, as the various definitions and further discussion will come later.
6. DECA	6. Ask students the meaning of "DECA".
a. Definition: Distributive Education Clubs of America	
b. History of DECA	
(1) Local clubs started between 1936 and 1948 to give students on a cooperative program organized activity.	
(2) In 1948, the National Association of D.E. Clubs was formed. Seventeen states were charter members and N.C. was one of those charter states.	(2) See DECA handbook.
(3) The State Association of D.E. Clubs	(3) See DECA handbook.
(4) The local club organization	(4) This would be a good time to discuss such things as dues, etc.

Topical Outline	Teaching Suggestions
	(a) Dues-- how much and method of payment (b) State and national dues (c) Bosses banquet--depends on size of club as to how much each student will have to pay (d) Annual picture (e) Conduct of meetings--the use and practice of parliamentary procedure; who will introduce guests or guest speakers (f) Election of officers--see DECA handbook for requirements of candidates for office and what offices to fill (g) Projects--fund raising; school projects, community projects

II. MEANING AND IMPORTANCE OF MARKETING

Objectives

1. To explain to the student what marketing is; what a market is
2. To show the importance of understanding marketing and its place in our economy

Topical Outline	Teaching Suggestions
A. Definition of marketing:	
1. "Marketing includes those business activities involved in the flow of goods and services from production to consumption."	1. Ask students what their concept of "marketing" is.
2. The study of marketing also includes the study of agencies which get or have a hand in getting goods and services from producers to consumers.	2. Mention such agencies as wholesale houses, retail stores, banks, railroads, insurance companies, etc.
3. A market may mean one of three things:	
a. All the buyers of a product	
b. All the people living in a given area	Now, ask students to help you arrive at the definition to be used by the class for all further references.
c. An organized trading place for one or more commodities	
B. Importance of an Understanding of Marketing	
1. To satisfy human wants, needs, and desires	1. Point out that we all have certain physical and psychological needs.
2. To realize a profit from the distribution of goods and services	2. Why does a person invest money, time, and energy in a business? See Chpter 7 in The Economics of American Living.
3. To understand the various marketing functions/activities:	3. Mention only briefly, as these will be discussed thoroughly later.
a. Sales supporting activities	Marketing I will cover sales supporting activities, salesmanship and sales promotion. The other marketing functions will be covered in Marketing II.
b. Salesmanship	
c. Sales Promotion	
d. Merchandising	
e. Personnel	

Topical Outline	Teaching Suggestions
f. Market research g. Warehousing h. Transporation i. Credit, financing, and risk bearing	

III. JOB APPLICATION

Objectives

1. To help the student "look the part" for the employment interview
2. To prepare the student for his first interview
3. To teach the student how to fill out completely an application blank and a withholding tax form.

Topical Outline	Teaching Suggestions
A. Getting Ready to Apply for the Job	
1. Information needed	1. Show samples of each type of form to the class and explain the need for each. Tell students where each may be obtained.
a. Social Security card	
b. Work permit	Check each pupil for compliance.
(1) Health certificate	
(2) Record of birth	
(3) Parents' permission	
(4) Intention to employ	
c. W-4 Form	
2. Look the part	If possible, have girls in one group and boys in another to develop points applicable. Later the two groups should be brought together to discuss findings and add any important points not mentioned.
a. Good grooming rules	
(1) Have a daily bath.	
(2) Use a good deodorant.	
(3) Brush teeth after each meal.	
(4) Have hands and nails clean.	
(5) Choose a hair style that is becoming	(5) Invite a beautician in for questions, answers, and demonstration with the girls.
(6) Practice good posture: standing and sitting.	
(7) Dress appropriately, conservatively.	
b. Good grooming for girls	
(1) Underarms -- clean and clean shaven, free of odor by use of deodorant	

Topical Outline	Teaching Suggestions
(2) Hair -- clean, neat, suitably styled for day-time wear	
(3) Skin -- clean and clear	Write the American Dairy Council in your area, or in Winston-Salem, for charts and posters on "Guide to Good Eating."
(4) Brows -- following natural line	
(5) Teeth -- clean and free of stains	Order for each student The Man for the Job, The Girl for the Job, Bristol Myers Products Division, 45 Rockefeller Plaza, New York 20, New York (Good Grooming Booklets)
(6) Nails -- well manicured, free of nicotine stain, light shades of polish	
(7) Make-up -- not too much, suited for daytime wear, suited for natural coloring	"The Clean Look," 16mm. sound, 30 mins., color, free - - Modern Talking Picture Service, Inc., 501 North College Street, Charlotte, North Carolina
c. Good grooming for boys	
(1) Face -- clean-shaven	
(2) Teeth -- clean, free from stain	
(3) Hair -- freshly shampooed, no dandruff, well combed, businessman haircut	
(4) Hands and nails -- clean, no nicotine stains	
	Have each student fill out self-inventory. Pass out sheet No. 3.
d. Wearing apparel for girls	
(1) Coat -- conservative cut and color	
(2) Dress	
(a) Conservative cut and color	
(b) Modish	(b) Define modish: in style or fashion
(c) No extreme skirt or sleeve lengths	
(d) Reasonably high neck	
(e) Even hemline	

Topical Outline	Teaching Suggestions
(3) Accessories	(3) Bring in a pair of tattered gloves and handbag with handles broken -- get the point across!
(a) Immaculate	
(b) Free from rips or tears	
(c) Femine	MEN: It might be a good idea to invite your home economics teacher to teach this section to the girls. (Good team-teaching situation!)
(4) Hat	
(a) Smart and becoming	
(b) Not rakish and bizarre	
(5) Shoes	
(a) Clean	
(b) Conservative	
(c) No run-over heels	
(6) Jewelry	
(a) Appropriate to costume	
(b) Unobtrusive	
(7) Foundation garments	
(a) Suitable girdle	
(b) Suitable brassiere	
e. Wearing apparel for boys	e. Invite a boys' clothing buyer or a professional man to discuss "Wearing Apparel" with the boys.
(1) Suit	
(a) Conservative in cut	
(b) Conservative in color	
(c) Spotless	
(d) Well pressed and brushed	
(e) Sport coats and jackets permissible if conservative in cut and color	

Topical Outline	Teaching Suggestions
(f) Pocket hankerchief - optional	
(2) Hat	
(a) Optional	
(b) Never a cap	
(c) Hold in hand while being interviewed	
(3) Linen	
(a) Immaculate	
(b) No frayed colars and cuffs	
(c) Clean handkerchief always	
(4) Tie	
(a) In harmony with suit	
(b) Single or double Windsor know or four-in-hand knot	
(c) No fads such as string bow tie or exaggerated colors	
(5) Shoes	Use the following fashion magazines and periodicals for new ideas:
(a) Oxfords -- black, brown, cordovan	Seventeen — McCall's
(b) Well shined	Charm — Mademoiselle
(c) Heels in good repair	Women's Wear Daily — Harper's Bazaar
	Menswear — Vogue
	Modern Miss — Glamour
	Newspapers
B. Prepare for the Employment Interview	B. Use lecture and discussion methods to develop this. Provide practice filling

Topical Outline	Teaching Suggestions
1. Go alone	out application blanks. (Use pass out sheet No. 4.) Stress importance of legibility and completeness.
2. Be prepared to fill in application blank completely.	
3. Take the following data needed to complete application blank:	(This is a more detailed and broader picture of "getting ready for the job" discussed earlier.)
a. Social Security card	
b. Full names of both parents	
c. Mother's maiden name	
d. Birthplace and date	Show students how to fill out Employee's Withholding Exemption Certificate (W-4 Form.) See that each student has one of these forms and knows how to complete it.
e. Address	
f. Referral slip--secure from coordinator	
g. Permission to use names as references	Note to coordinator: Suggest that parent contact collector of internal revenue regarding exemption of distributive education students.
h. Name, address, position, and telephone number of three references	
i. Complete data about former jobs	i. Have students complete a personal data sheet -- see pass out sheet No. 5.
(1) Name of company	
(2) Dates of employment	
(3) Name of supervisor	
(4) Wages received	
(5) Nature of work	
(6) Reason for leaving	
4. Know facts about interview	
a. Name	Use discussion method. Ask each student to give point 2.b.c. to see if each is actually prepared for interview.
b. Title	
c. Location of office	
5. Meet the interviewer	

Topical Outline	Teaching Suggestions
a. Be on time. b. Enter with poise. c. Introduce self. d. Be seated ONLY at interviewer's invitation. (1) Do not slump or slough in chair. (2) Do not cross knees (girls). (3) Do not drum on desk. (4) Do not smoke or chew gum.	Obtain enough booklets entitled "Sell Yourself" from the N. C. Employment Commission or the National Cash Register Company so that each student will have one.
(5) Look alert and interested. (6) Be confident, but avoid any appearance of over-confidence. (7) Do not be critical of former employers. (8) Look at interviewer while talking to him. (9) Speak in a clear, moderate tone. (10) Do not talk about personal, domestic or financial troubles. (11) Save questions about vacations, coffee breaks, etc. until later. (12) Look and act healthy. (13) Answer questions accurately respectfully and in full sentences. (14) Sell yourself and your services. Analyze yourself your capacities, your abilities, and your interests.	Have role playings on "Applying for a Job," letting each student apply for a job. Discuss the correct and the incorrect things that were done during the role playings. (Remember: praise and then criticize!) Check these things: Voice Carriage Appearance: dress, grooming Interest Toward end of the "role playing" part, invite a personnel director from local store to come to the class and conduct the interviews. (13) Avoid "yes" and "no" answers. "Some interviewees are like nuts one has to crack and crack to get the meat." Distribute pass out sheet No. 6 "Your Interview" -- to students. Discuss the fact that this is a guide sheet to use <u>BEFORE THE INTERVIEW</u>!

Topical Outline	Teaching Suggestions
(15) Know the company	(15) Suggest that students get information about a company or store from the community in which the business is located, or from the library. (Here is an opportunity to use the library and show students how to use.)
6. Have application blank filled out completely.	
7. Take leave of the interviewer. a. Thank the interviewer. b. Express appreciation for time spent.	7. Point out that student will know when the time comes to go -- go! Emphasize leaving promptly at end of interview and leaving gracefully.
8. How to follow up the interview: a. Write a brief letter. b. Telephone.	8. Discuss with class that the interviewer usually tells the interviewee when he will give you his decision; however, if a few days elapse and you have not heard, a letter or a telephone call may be advisable.

SUMMARY: MASTER THE MAIN IDEAS

A. A clean, neat, and modest appearance is necessary when applying for a job.

B. Good appearance and grooming are necessary in business.

C. An employment interview is important and takes planning and preparation.

D. Application blanks must be filled out accurately, completely, and neatly.

E. Know yourself, sell yourself, and thank the interviewer for time given.

IV. CHANGING NATURE OF MARKETING

Objectives
1. To acquaint the students with the history of marketing
2. To give an insight into the background and growth of marketing

Topical Outline	Teaching Suggestions
A. Early History	Do not spend much time on this unit. Use lecture method primarily but make provisions for discussion and questions. This information ties in with material students have studied in history classes.
1. Barter	1. Explain that barter means exchanging one item for another.
a. First type of exchange	
b. Used by primitive man	Example of barter: The price of an automobile, for a farmer, might be 4 cows and 15 pigs, or 7 cows and 1 pig, instead of $3,000.
c. Sufficient method trade in primitive society	
2. Medium of exchange	
a. The Greeks were the first to do away with barter and put commerce on a medium of exchange, or money, basis.	
b. The medium of exchange varied from country to country, depending upon the scarcity and value of different items.	b. Examples: Diamonds from Africa were exchanged for tobacco; cows for dry goods; salt, gold, silver, women, perfume for other commodities needed by people of many nations.
3. Trade from 3,000 B.C. to the fall of the Roman Empire	
a. Earlier trading centers -- Athens, Alexandria, Rome, Carthage (area around the Mediterranean Sea)	Make some use of lecture method; but draw as much history from students as possible.
b. The Phoenecians followed the Cretans as traders in this area.	
c. The early shops were simply stalls along the more traveled streets.	
d. There was no standard of quality and price.	

Topical Outline	Teaching Suggestions
e. "CAVEAT EMPTOR" -- Latin slogan from this period meaning "Let the buyer beware."	
B. Medieval History	
1. The dark ages followed the fall of Rome.	
a. There was utter chaos everywhere.	
b. Towns had few laws.	
c. Robers were numerous.	
d. Caravans were formed.	d. Point out that traders traveled in groups for protection.
e. Trade was maintained by Jews and Syrians.	
f. Eventually growth of towns and caravans caused trade to grow.	f. Ask what great traveler and adventurer influenced trade with far away countries. (Marco Polo)
2. Markets and fairs	
a. Began in the middle ages	a. Ask class what brought about fairs and markets.
b. Religious foundation -- Goods were exchanged at religious ceremonies, celebrations.	
c. United Nations atmosphere -- merchants came from many lands to sell goods.	c. Mention the World's Fair in New York City -- people from all nations attend and companies from all over the world show their goods.
3. Stalls and shops	
a. Stalls were open rooms on the streets -- closed when not being used.	
b. Shops were an outgrowth of stalls.	
c. England -- Family's surname often designated the trade.	c. Examples: Miller, Carpenter, Goldsmith, Baker, Shoemaker Sons usually carried on the trade of fathers.
C. Modern History	

Topical Outline	Teaching Suggestions
1. Guilds - definition: Merchants' organization -- regulated price and competition	
2. Guilds - history	
a. Began in 14th and 15th century	a. Point out that members often cut themselves and sealed their brotherhood with blood.
b. "The Hanseatic League" -- the first known organization among retailers -- Germany	b. Bring out in class discussion that this organization covered wholesalers, importers, exporters and some retail shops.
D. Early American Trade	
1. Traced back to England; most of our customs come from England	1. Draw information from class by asking from whom did we receive our laws; our customs; our spoken language.
2. Columbus discovered America looking for a shorter trade route to Asia.	
3. Indian trade -- barter system	3. Refer back to definition of "Barter".
4. Trading posts	
a. Outgrowth of activities of fur traders	
b. Forerunner of general store	
c. Commercial and industrial centers which started as trading centers	c. Ask students what the first trading centers were in America. St. Louis Detroit Chicago
E. Yankee Peddler	Assign a student to give a report on the Yankee Peddler from Richardson Wright's <u>Hawkers and Walkers in Early America</u>.
1. Was the forerunner of the general store proprietor Carried imported and domestic goods from the North and New England states to the South and to the West	
2. Inter-colony communicator Carried news and customs from one part of the country to another.	

Topical Outline	Teaching Suggestions
F. General Store	F. Examples: General store often housed the post office.
1. Served as the social center of the community	
2. Bulk merchandise and staples chiefly sold	2. Ba_ els of salt fish, sugar, flour, bolts of dress material, axes, jars of candy, kegs of nails, patent medicines, etc.
3. No orderly display or arrangement of merchandise	
4. Long term credit was the rule.	
G. The Industrial Revolution's Effect on Trade	
1. Brought more and better machinery	
2. Brought more building materials	
3. More small stores were built and from these department stores developed.	
4. More people left the farms to work in the stores or in factories.	

V. CHANNELS OF DISTRIBUTION

Objectives
1. To acquaint the students with the meaning of distributive channels
2. To show that goods are distributed through many channels

Topical Outline	Teaching Suggestions
A. Producer: Person who creates goods and services for consumption or to be used in the making of other goods through the use of goods; i.e. raw materials, capital, labor, machinery, and money	A. Draw from class a good definition of producer -- put on board in chart form.
1. Function: To sell directly to the concern needing his product (wholesaler and retailer)	Explain the difference between consumer goods and industrial goods; also, the difference between capital and money. 1. Point out that occasionally, as in the distribution of Fuller brushes, it has been accepted as the distribution of goods to the ultimate consumer.
2. Route: The goods produced may be sold to wholesaler, who in turn sells to the ultimate consumer.	
B. Wholesaler: Generally a merchant middleman who buys goods from the producer in large lots and carries stocks of this merchandise in his own place of business.	
1. Function: To supply goods for retailers through the use of middlemen	
2. Types of middlemen	Refer to Business Principles, Organization, and Management -- Second Edition, Tonne, Simon, McGill, p. 80-83.
a. Salesmen	
b. Jobbers	
c. Commission merchants	
d. Wholesale auctioneer	
e. Manufacturers' agents and selling agents	
C. Retailer: One who buys from manufacturers or wholesalers and sells to consumers	
1. Functions:	
a. To keep on hand the goods needed or desired by the consumer	

Topical Outline	Teaching Suggestions
b. To extend to customers various services	b. Draw from class the many services extended to consumers by retailers.
c. To stimulate desire for goods and services	Bring out the importance of advertising.
d. Risk bearer	d. Point out that the retailer must bear the risks of ownership, the dangers of price change, of style change, and of deterioration of merchandise.
e. To understand and interpret consumer demand	e. Point out that the retailer must endeavor to satisfy the demand of the consumer by skillful purchasing.
2. Types:	
a. Single-line	Refer to Tonne, Simon, and McGill, Business Principles, Organization, and Management -- Second Edition, P. 77.
b. General	
c. Department	
d. Discount	
e. Specialty	What kinds of goods can best be sold through the various types of retail stores? Why?
f. Supermarket	
g. Chain	
h. Mail-order	
D. Middlemen: (refer to "A" -- producer)	Use pass out sheet No. 7 to explain this channel; this would make an excellent chart for a bulletin board.
1. Salesmen	
2. Mail	
3. Catalogue	Have students make a chart of the channels of distribution which are employed in respective businesses.
4. Retail Branch	Assign students to write the name and location (approximate) of as many firms, locally, as possible that fit under each of the following types of distribution: a. Mail-order house b. Chain store c. Supermarket d. Department store

Topical Outline	Teaching Suggestions
	e. Cooperative f. Broker g. Independent retailer h. Wholesaler

II. SALES SUPPORTING ACTIVITIES

SALES SUPPORTING ACTIVITIES

MATERIALS AND EQUIPMENT NEEDED

Secure the following supplies and forms for demonstration purposes:

1. Samples of invoices
2. Bills of lading
3. Packing slips
4. Gummed label price tickets
5. Pinprice tickets
6. Tag price tickets
7. Types of wrapping supplies

I. INTRODUCTION TO SALES SUPPORTING ACTIVITIES

Objectives

1. To create an awareness of the importance of sales supporting activities in the business world.
2. To bring out the effect of careless handling of sales supporting activities on business success.
3. To build up a respect for sales supporting activities by considering job requirements for such work.

TOPICAL OUTLINE	TEACHING SUGGESTIONS
A. Introduction to the Unit	
1. Sales supporting activities	State that these deal with the physical handling of merchandise
2. Activities included	
a. Receiving, checking and marking	Just mention briefly; will be discussed in more detail shortly.
b. Storage	
c. Wrapping and packing	
d. Delivery	
B. Sales Supporting Activities	
1. Definition: Sales Supporting Activities are those which deal with the receipt, checking, marking, storing, wrapping and delivery of all goods, thus making merchandise available to the customer and supporting sales.	1. Put definition on board. Old term "non-selling" activities Explain that old term implied that activities were unimportant to business success, with no relation to sales.
2. Importance in terms of personnel involved	
a. In department stores, about 60% are in sales activities, 40% in selling and merchandising.	a. Have students check with various businesses to ascertain approximate percentage of personnel in sales supporting activities.
b. In self-service establishments and small stores, a large proportion of time is spent on sales supporting activities.	b. Ask how the development of open displays has increased time spent on these activities.

Topical Outline	Teaching Suggestions
3. Functions performed in relation to sales	
a. Keeping merchandise in salable condition	
b. Making merchandise available when wanted	
c. Completing the sales transaction in case of wrapping and delivery	c. Draw examples from class members.
C. Effects of Careless Handling of Sales Supporting Activities on Business Success	Refer to each of the four activities in discussing effects. (See A-2).
1. Results in terms of merchandise	1. Point out that these may occur because of poor handling of any of the four activities.
a. Stock shortages	
b. Damaged merchandise	
2. Results in terms of customers	
a. Dissatisfaction and complaints	a. Ask whether customers ever complain about incorrectly marked merchandise or poorly wrapped packages.
b. Returned goods	b. Ask what errors in delivery might result in returned goods.
3. Results in terms of business profit	3. Point out that all of these will result in loss of profit to business.
a. Increased markdowns	
b. Lost sales	
c. Increased expense	
D. Job Requirements in Handling Sales Supporting Activities	
1. Personal qualifications needed	
a. Physical qualifications	

Topical Outline	Teaching Suggestions
(1) Good health	Class discussion; application to jobs held by members.
(2) Strength	
(3) Manual dexterity	
b. Mental abilities	
(1) Accuracy	
(2) Alertness	
(3) Visual perception	Draw examples from class.
2. Types of equipment handled	
a. In receiving, checking and marking merchandise	
b. In storing and warehousing	
c. In wrapping and packing	Bring out examples of "know-how" needed in these areas.
d. In delivery	

II. RECEIVING, CHECKING AND MARKING ACTIVITIES

Objectives

1. To develop awareness of different types of transportation used in shipping merchandise from vendor to business.
2. To acquaint members with behind-the-scene aspect of receiving merchandise.
3. To familiarize students with methods of marking merchandise in use today

TOPICAL OUTLINE	TEACHING SUGGESTIONS
A. Points to Consider in Shipping Merchandise to the Business	Explain that the receiving procedure is dependent upon the type of common carrier used in shipping merchandise.
1. Meaning of terms	Put definitions on board, or dictate:
a. Shipping	a. Shipping refers to the transportation of merchandise from vendor to the place of business.
b. Common carrier	b. Common carrier is anyone who offers to carry persons, property or messages for pay.
c. Vendor	c. Vendor is any individual, firm or corporation from which/whom purchases are made, whether manufacturer, manufacturer's agent, wholesaler, or commission merchant.
d. Vendee or buyer	d. Vendee is the buyer in such transactions.
2. Choice of common carrier	Board work -- that a combination of these may be used.
a. Rail	a. Point out the importance of rail transportation--over half of all goods received by businesses are shipped via rail. Mention piggy-back and other large-volume type of freight.
b. Truck	b. Mention that speed is the main attraction to this means of shipping. Example: Trailers loaded during the day are picked up by tractors, and the goods are in the hands or place of business the following

Topical Outline	Teaching Suggestions
	morning, and in the more distant businesses the second morning. In contrast, it takes from 2 to 14 days for goods to reach the business using railroad express.
c. Air	c. What is the big advantage of air transportation? Are schedules dependable? Have students call the railroad company, airlines, and trucking firms to find the cost of transporting goods - cost per one hundred pounds.
d. Water	d. Good for long hauls, especially for transporting goods being imported from abroad. Point out that this mode of transportation might be feasible for businesses located close to water-routes.
e. Parcel post	e. State that it is both rapid and rather safe (handled carefully). Mention limitations on size of unit packages in terms of poundage and footage. Outside limit 40 lbs.; size 100 inches. Limitations vary with types of merchandise and distance.
f. Pipelines	f. Explain that these carry natural gas, crude oil and gasoline and account for 1/7 of freight total. Lines may run from field to refinery and from refinery to a central shipping point.
3. Speed of shipment necessary	
a. Freight, by rail, truck, air or boat - slower but less costly.	a. Ask under what conditions freight would be satisfactory.

Topical Outline	Teaching Suggestions
	Freight refers to goods being shipped on a freight line or in freight cars, many of which are especially constructed for the type of cargo being carried.
b. Express, by rail, truck or air - quicker but rates are higher.	b. Stress importance for perishable goods and rush orders. Express is a service provided by REA (Railway Express Agency), a private company, which affords the advantage of pickup and delivery of articles and is fully liable for loss or damage in transit. The shipments are made in special cars attached to a fast passenger train.
c. Air mail -- expensive	c. Explain that due to the expense involved the service has been used mainly for the transportation of valuables, highly perishable goods, emergency parts for machinery, and medicine.
4. Rates as related to size of shipment In all modes of transportating goods, the cost involved will depend upon the shipment - direct or consolidated.	4. Call to the attendion of the class that different rates are charged for carload lots (C.L.) and less-than-carload lots (L.C.L.); also, that goods shipped directly will cost more than goods that may take a detour (allowance for the unloading of other goods).
5. Importance of clear shipping agreement as to:	
a. Who is to pay for transportation	a. When should the transportation costs be discussed between vendor and vendee? Point out to class that cost of transportation is considered in figuring markup.
b. Method of transportation	
c. Route of shipment	c. Refer to A. 4 above.

Topical Outline	Teaching Suggestions
d. F.O.B. destination or shipping point	d. Explain that this term means "free on board"; i.e., the shipper pays the freight to the buyer's freight station.
B. Receiving Merchandise	
1. Receiving area: The place where all merchandise is received, unpacked, checked, marked, and from which point is distributed.	Give definition to class. Point out to the students that the receipt for the goods is signed and given to carrier. "See Retail Merchandising, p. 281 ("receipt").
a. Need for definite place	a. Ask students why it is necessary to have a place designated for such purposes.
b. Platform (large business)	Discuss the benefits of such areas.
(1) Proper height for truck prevents damaged goods	
(2) Use of hand truck, scales, booths, bright lights, elevators, etc. facilitates movement to receiving room.	
c. Rear door (small businesses) with chute or conveyor belt direct to receiving room.	
2. Receiving record	
a. Definition: A receiving record is a form on which is entered each shipment of merchandise received.	a. Cite definition.
b. Importance of records and controls	b. Compare with customer receipt in sales transactions.
(1) Prevents loss of merchandise	(1) Ask how this is true.

Topical Outline	Teaching Suggestions
(2) Aids in taking advantage of discount	(2) Give an example of discount and how a record would prevent its loss to the company.
(3) Is a check on inventory control	(3) Ask how it might aid in checking shortages.
	Note to coordinator: Refer to Retail Merchandising, Fifth Edition, Chapter 9, Part A.
c. Bill of lading	c. Show typical bills of lading from express, freight, or motorized truck lines.
(1) Definition: a common carrier's receipt of goods accepted from vendor.	
(2) Purpose - as a check on shipment during transit	
(3) Points to check	Point to the things to be checked on the samples.
(a) Address on package	
(b) Condition of package	
(c) Weight of package	
(d) Number of packages	
d. Invoice	
(1) Definition: an itemized price list of merchandise sent to purchaser from vendor.	
(2) Purpose - as a record of sale	Compare with salescheck.
3. Terms appearing on receiving records	
a. Discounts	

Topical Outline	Teaching Suggestions
(1) Quantity - for buying in large quantity	Draw examples from group.
(2) Seasonal - for buying in dull season	Point out need for business to make sure the proper discount has been deducted on invocie.
(3) Trade - because buyer belongs to certain trade or does business in certain way	
(4) Cash - because buyer pays within period of days allowed by seller for quick payment	
b. Credit terms	Put terms on board and have members explain meaning of each.
(1) C.O.D. - Cash on delivery	
(2) Regular dating -- 30 days after shipping.	
(3) E.O.M. - end of month	(3) Cite example to show how discount is indicated - 2/10/N 30 - two per cent deducted if bill paid within 10 days from date of invoice - full amount to be paid 30 days after date of invocie.
(4) R.O.G. - receipt of goods	
(5) Extra dating - extension of time	Note to Coordinator: Refer to Retail Merchandising, Fifth Edition, Chapter 8, Part C.
(6) Advance dating - invoice dated ahead of shipping	
C. Checking Merchandise	
1. Merchandise checker: One who checks each item of goods received from vendor for quantity, kind and condition against what was ordered	1. Put definition on board. Point out that the purpose is to see that merchandise received is as ordered and in good condition.

Topical Outline	Teaching Suggestions
2. Check systems in use	2. State that there are three kinds.
a. Blind check	a. Put definition on board: The process of listing contents of shipment, the list being afterwards checked against the invoice
(1) Invoice registered in office book by date and given number.	Point out that blind check system makes for accuracy since checker does not know how many items to expect. It takes more time, however, and hence is a more expensive system.
(2) Invoice checked with purchase order in office	
(3) Copy made for blind check	
(4) Quantities checked by checker and filled in	
(5) Copy sent to buyer (initialed by checker)	
(6) Three copies checked against each other in office	
b. Direct check: The comparison of an invoice with goods directly to determine whether quantity appearing on bill agrees with actual quantity received.	b. Put definition on board.
(1) Invoice is given to checker who counts quantities of each item received	
(2) If all colors and sizes are correct, checker signs on back or pastes an "apron" slip of paper to invoice.	(2) Explain that an "apron" is a form pasted to each invoice on which to record various facts concerning the merchandise. (Get samples and pass around to students).

Topical Outline	Teaching Suggestions
c. Dummy invoice: a form made out in business, from merchandise received, when actual invoice is delayed or missing.	
(1) Checker makes memorandum from actual merchandise count of goods received.	Point out that this system helps to get merchandise to selling floor quickly and provides a record in the office.
(2) Dummy invoice is held in office.	
(3) Goods are then cleared through to sales floor or stockroom.	
3. Irregularities in shipment to be noted	Draw examples from group.
a. Breakage or damage	a. Fragile merchandise broken due to incorrect wrapping. Rough handling may cause damage to merchandise.
b. Shortage	b. Invoice or packing slip may call for a smaller number than that received. How would shortage affect inventory, if not checked when received?
c. Overage	c. Point out that an "overage" would cause the book inventory not to balance.
d. Substitution	d. Explain that invoice or packing slip may call for a different style number, color, material, or size, than that received.
D. Marking Merchandise	
1. Kinds of price tickets and marking	1. Call to the attention of the students that not every piece of merchandise needs to be marked, provided personal selling rather than self-service is used. For small, low-priced, fast-selling staples found on counters, trays, in bins, etc. the prices are marked on container of goods.

Topical Outline	Teaching Suggestions
a. Gummed labels and pin tickets are cheap and quick.	
b. Tags are used on apparel, and large ticket items.	
c. Crayon may be used on some items.	
d. Bins, trays and containers may be marked with price of content.	
e. Manufacturers may premark merchandise by request.	Have students cite examples of merchandise which would use the different types of markers and what types.
2. Cost codes on tickets	
a. Definition: Cost code is a symbol placed on a price ticket to indicate the cost price of an item of goods	
b. Reason for cost codes - to keep the customer from knowing the difference in cost and retail price.	Point out that most customers are not aware of the business's heavy expenses of operation and would think only of the vast difference between cost and selling price.
c. Kinds of codes	
(1) Use of word or phrase as a code	(1) Cite example: MAKE PROFIT 1234 567890 Thus $19.50 = MIPT
(2) Symbol code	(2) Draw example on board: 1 2 3 4 5 6 X = 0 X 7 8 9 thus $19.50 is

Topical Outline	Teaching Suggestions
(3) Addition, subtraction, multiplication, or division of cost digits	(3) Cite examples: Place 3 in front of cost price $19.50 and 3 added to each digit dropping tens, then $19.50 would appear as 3 4 2 8 3.
(4) Placing of two meaningless figures in front of and one figure after cost ommitting the decimal	(4) $19.50 would be written as 36 1950 7
3. Other information on tickets	
a. Date merchandise received	Refer to Retail Merchandising, Fifth Edition, p. 293
b. Department number	
c. Size	Draw examples from class.
4. Machine, hand, and punch card marking	
a. Rubber stamp and machine marking aid in price control as exact number of tickets needed are made.	Point out the aid this counting gives to book inventory.
b. Handwritten figures should be legible.	
c. Punch cards make for easy classification later.	Show samples of each kind (obtain from some local business firm.) NOTE TO COORDINATOR: Plan a field trip to a department store receiving and marking room. Invite receiving room or traffic manager to talk on new developments in receiving, checking and marking.

III. STORAGE ACTIVITIES

Objectives

1. To point out the functions of storage
2. To show the results of storage.
3. To make students aware of storage standards
4. To point out the kinds of storage

Topical Outline	Teaching Suggestions
A. Importance of Storage to Businesses	
1. Definition: Storage is the marketing function that involves holding goods between the time of their production and their final sale.	Point out that most commodities require storage at some time during their distribution.
2. Functions of storage	
a. Creation of time utility -- A commodity has time utility when it is available when needed.	a. Example: Farm products, such as wheat, fruits, and vegetables, have a varying consumption rate throughout the year, but only certain seasons favor their growth. Therefore, it may be necessary to freeze, can, bin, etc. the surplus commodities until consumers demand them.
b. Creation of form utility -- A commodity has form utility when it is in the form or shape which makes it useful.	b. Ask group meaning of "form utility" Cite definition. Example: Crude petroleum as it comes out of an oil well has little use; after it is refined into several products, such as fuel oil, gasoline, kerosene, etc., it becomes very useful.
c. Creation of place utility -- A commodity has place utility when it is in the place where it is needed and can be used.	c. Point out that storage encourages standardization and grading by providing space and facilities. A principal function of storage is to make goods available to a buyer at his place of business or home when he needs it.

Topical Outline	Teaching Suggestions
	Example: A retailer who runs out of a particular item can simply telephone the sholesaler's warehouse and have the merchandise delivered within 24 to 48 hours.
B. Results of Storage	
1. Reduction of risks	Point our that certain risks are part of ownership; however, an owner can reduce his risks by storing merchandise with a reputable warehousing firm.
a. Warehouseman absorbs part of the risk.	
b. Producer's risk is reduced.	Explain that through the commodity exchange, which permits hedging (a transaction which often eliminates the risk caused by price fluctuations), the risk for producer is lessened.
2. Cutting of transportation costs	2. Discuss with class the fact that goods shipped C.L.C. (carload lots) cost less than partial carload lots; therefore, storage of goods until needed will save money for business; i.e., increased size of shipment helps to decrease transportation costs.
3. Encourages quantity buying	3. Storage enables the purchaser to increase the size of his purchases, which, in turn, cuts the price he pays for goods.
4. Facilitation of selling	4. Point out that storage makes selling more efficient through its effects upon the quantity and variety of available merchandise. Ask the class if such would make "hand-to-mouth" buying possible for small businesses.
5. Stabilization of pricing	5. Point out that storage of goods puts the law of supply and demand into effect, stablizing prices. Example: Eggs that cannot be sold immediately are kept fresh in cold storage.

Topical Outline	Teaching Suggestions
C. Storage Standards	
1. Proper conditions and handling	1. Bring to the attention of class that the care and handling of goods depends upon the kinds or types of goods.
a. Goods must be inspected	
b. Special storage equipment	Example: Glassware must be packed in excelsior. Wholesale houses must have refrigerated units for fresh vegetables and fruits.
2. Convenience of storage facilities	2. Point out that goods must be kept where the facilities for transportation and financing will be convenient for the producer, the middleman, and the consumer.
3. Control of storage	
a. Dependable	a. State that the storage facility must be prepared to supply requested merchandise and services.
b. Account of goods stored	b. Point out that the storage facility must be in a position to furnish proof of title of goods in storage.
D. Kinds of Storage: Classified by Ownership and Use	
1. Public warehouses--operated for the benefit of the public	1. Mention that public warehouses charge fees for storage; they are privately owned.
2. Private warehouses--operated for the sole use of owners.	2. Explain that private warehouses are owned and operated by an organization principally for its own use. Example: The storage facility of a retail store.
3. Field or custodial warehouses	3. Explain that in a field warehouse, space for storage is set aside on the premises of the owner of the merchandise. The space is leased to a public warehouseman, or custodian, who has physical and legal control of the goods, even though the goods remain on the owner's premises.

Topical Outline	Teaching Suggestions
	Purpose: The warehouse receipt may be used as collateral for loans.
4. Government warehouses — owned by the federal and municipal governments.	4. Explain that these warehouses may store government property or private property. Example of private property storage: Tobacco must be aged before it can be marketed; therefore, the government stores it for a fee and postpones the collection of internal revenue tax until the product is sold. NOTE TO COORDINATOR: This area will be covered in greater detail in Marketing II.

IV. WRAPPING AND PACKING ACTIVITIES

Objectives

1. To show how good wrapping and packing affects business.
2. To show how the development of prepacking has aided the retailer.
3. To consider the organization for wrapping and packing in both personalized and self-service stores.
4. To discuss selection of layout, equipment and supplies Needed in wrapping and packing activities and what salespeople can do to keep down costs.

Topical Outline	Teaching Suggestions
A. Importance of Wrapping and Packing Activities	
1. Definitions	
a. Wrapping: The preparation of merchandise for delivery not requiring special handling, unless so designated.	Explain that terms are frequently used interchangeably. State that gift wrapping is a special form of wrapping.
b. Packing: The preparation of bulky or breakable merchandise for delivery which requires special handling	Cite housewares and toilet goods as examples.
2. Purposes of wrapping and packing service	
a. To provide customer convenience and so increase sales	Have group suggest purposes.
b. To protect merchandise and cut down loss and damage	
c. To publicize the business	c. Comment on prestige value of a well wrapped package or a labeled bag.
3. Cost of wrapping and packing service	
a. Is an additional cost to business in supplies, etc.	a. Point out that salespeople can do much to conserve here.
b. May take up selling space	b. Ask where wrapping stands are located in various business in area.
c. May take up selling time	
d. May involve additional payroll expense	d. Special wrapping department

Topical Outline	Teaching Suggestions
4. When wrapping and packing is done	Draw examples from group.
a. Prepacking, in advance of sale	
b. Wrapping and packing on consummation of sale	
(1) At time of sale for "take" transactions	
(2) At later date for "send" transactions	Ask what will determine when this is done.
B. Development of Prepacking	
1. Definition--Prepacking: The packing of merchandise in advance of sale either in the store or by the manufacturer	
2. Purposes of prepacking in a business	2. Call for examples from group.
a. To speed up selling service	a. Note that packing is done at times when personnel are not busy with customers.
b. To simplify service for customers and encourage self-selection	b. Comment on growing practice in meat and produce departments.
3. Purposes of prepacking by manufacturer	Explain that this is sometimes referred to as unit packing.
a. To reduce damage and handling costs	
b. To eliminate packing activities	Explain that usually it is only necessary to attach an address label in delivering to customer. Cite use for housewares.
c. To encourage unit sales	Point out, however, that prepacking cost is added to cost of merchandise to retailer and shipping charge is likely to be higher than bulk packing. Note current use in dairy field and probable further development in selling of meats.

Topical Outline	Teaching Suggestions
C. Organization for Wrapping and Packing	
1. Methods used	
a. In personalized selling service stores or departments	
(1) Clerk wrap	Remind members that this refers to situation where salesperson takes initiative in getting items wrapped.
(2) Department wrap	
(3) Central wrap	Ask how many wrap packages themselves, and how many have a department station.
(4) Combination	Point out use of central wrap for send merchandise and bulky or fragile goods.
b. In self-selection and self-service stores or departments	
(1) Clerk wrap	Point out that customers in these stores take merchandise to station to be wrapped unless wrapped by clerk.
(2) Department wrap	
(3) Check-out stand at exit	Stress fact that exit stations are usually confined to one-level stores.
(4) Combination of 1 and 2	
2. Factors to be considered in determining methods used	
a. Type of merchandise sold	
(1) Clerk wrap for merchandise that requires simplicity of packing, minimum wrapping time and small possibility of damage	Call for examples from group
(2) Central and department wrap for bulky and fragile merchandise	(2) Cite house furnishings, luggage, toys.
(3) Check-out stands for merchandise requiring simple handling	(3) Note use in food and variety stores. Time element must be short to allow flow of traffic.

Topical Outline	Teaching Suggestions
b. Volume of transactions	b. Stress clerk wrap for small unit sales with high volume of transactions. Note large numbers of items per person in food stores where check-out stands are used.
c. Proportion of take and send transactions	c. Refer back to central wrap for send purchases.
d. Ease of transferring merchandise to wrapping desks	d. Ask where wrapping stations are placed in various departments. Mention carriers used, such as baskets, trucks, conveyor belts.
e. Available floor space	e. Refer back to cost.
f. Extent of packing involved	f. Note that some merchandise is sent prepacked from stockroom to warehouse.
3. Gift wrapping as a special service	
a. Purpose -- To provide customer with special service for wrapping gifts	a. Ask what businesses do this.
b. Kinds of service provided	
(1) Price removed, gift card enclosed, no special wrap	(1) Point out that this is the simplest.
(2) Special box provided	(2) Mention use at Christmas.
(3) Special wrapping provided	(3) Show sample.
c. Organization for wrapping	
(1) Gift wrapping by salesperson	
(2) Gift wrapping at special desk	

Topical Outline	Teaching Suggestions
(3) Gift pre-wrapping	(3) Mention fruit baskets as example.
d. Cost of wrapping and how handled	d. Emphasize expense involved.
(1) No charge	
(2) No charge for purchases over a certain amount	
(3) Small charge for all purchases	
(4) Charge according to type of wrapping provided	
D. Layout, Equipment and Supplies	
1. Points to consider in locating packing units	Note the necessity of considering all three.
a. Location in relation to stockrooms, selling and delivery departments	
b. Value of space	
c. Means of transferring merchandise	
2. Equipment to be considered	
a. Chutes and conveyor belts	a. Ask how many use these.
b. Hand trucks	b. Explain that these may be called wheelers or dollies.
c. Elevators	c. Ask where these are located and whether customers use them.
d. Check-out stand and wrapping desks	
(1) Proper arrangement of work space	

Topical Outline	Teaching Suggestions
(2) Provisions for supplies and equipment	Have students make comments about each point according to their stores.
(3) Adequate lighting	
3. Kinds of wrapping supplies in use	3. Put five main types on board
a. Containers	Note that some merchandise such as brooms, paints, garden tools, etc., are delivered without wrapping.
(1) Bags	(1) Note use for large ready-to-wear items, instead of boxes.
(2) Cardboard boxes	(2) Point out that these may be built up by wrapper.
(3) Cartons	(3) Ask what these are used for.
(4) Wood boxes or crates	(4) Note use in grocery stores.
(5) Pliofilm bags	(5) Explain that ready-to-wear departments sometimes use bags like those used by dry cleaning firms for delivery since it saves packing.
b. Paper	
(1) Plain	Stress importance of using correct size to save waste.
(2) Corrugated	
c. Fasteners	
(1) String	
(2) Sealing tape	
(3) Staples	
d. Miscellaneous	Illustrate proper and improper use of supplies by a demonstration to bring point home.
(1) Sealing and stapling machines	
(2) Stationery supplies	

Topical Outline	Teaching Suggestions
e. Shopping bags purchased by customers	e. Ask how these serve both the store and the customer.

V. DELIVERY ACTIVITIES

Objectives

1. To develop an appreciation of the part delivery service plays in promoting good public relations for the store.
2. To become aware of the different delivery services.
3. To understand the delivery system in both small and large businesses
4. To show the effect of the development of shopping centers and use of motor transportation on delivery service

Topical Outline	Teaching Suggestions
A. The Importance of Delivery Service in Building Customer Good Will	
1. Kinds of deliver service	
a. Delivery to home	Draw students into discussion of why there are two kinds of delivery service.
b. Delivery to car	
2. What the customer wants in delivery service	
a. To get exactly what was bought or ordered, in good condition	
b. To receive purchase when promised	Ask whether customers are ever annoyed by having to wait for boy to deliver groceries to a car. Call for examples of delayed home delivery.
3. What salespeople can do to improve delivery service	
a. Record transactions accurately and legibly	Cite example of poor saleschecks.
b. Be careful in promising delivery	
4. What deliveryman can do to improve service	
a. Make a pleasing appearance	
b. Carry out actions that build customer good will	Ask for things customers notice.

Topical Outline	Teaching Suggestions
B. Delivery Systems	
1. Methods of delivery	
a. Organized systems	
(1) Independently owned One that is owned and operated by an individual business.	
(2) Central system — One organized to serve a group of competing or non-competing stores in a specific area.	
b. Common carriers	Refer back to Topic II for meaning of term.
(1) Express	
(2) Parcel post	
c. Deliveryboys	c. Ask how many have done this. Mention use of bicycle and delivery on foot.
(1) Home delivery	
(2) Delivery to car	Call for use in business represented.
2. Comparison of different methods	
a. Organized systems	
b. Common carriers	
c. Delivery boys	
3. Factors to be considered in selection	
a. Size of business and number of deliveries to be made	
b. Type of business and clientele	
c. Size of area to be covered	

Topical Outline	Teaching Suggestions
d. Space in store building	
e. Facilities available	
f. Comparative cost	
C. Store Delivery Practices	
1. Charging for delivery service	1. Point out that stores vary in practice.
a. Included in cost of merchandise	
b. Additional charge made	b. Explain that it may be a flat rate or graduated according to size of order.
c. Discount on cash and carry purchases	c. Point out that customer is not charged for delivery and credit service.
2. Use of special delivery service	
a. Definition: Delivery to a customer not included in the regular delivery schedule.	
b. Points to consider	
(1) Additional cost in relation to customer satisfaction	(1) Ask what additional time and operating expense would be involved.
(2) Possible misuse of service	(2) Point out need for tact in refusing request.
c. Methods of delivery	
(1) Truck delivery for large order	
(2) Delivery boy on bicycle or motorcycle	
(3) Others	Note that in some cities Western Union will render this service; also some cab companies.

Topical Outline	Teaching Suggestions
3. Use of store carriers for publicity purposes	Refer back to independent delivery system.
a. Importance of store name being seen	a. Ask what effect these points have on the customer. Call for examples of good advertising in this respect.
b. Importance of appearance of carrier	
4. Points to consider in all delivery	
a. Effective scheduling to conserve time and effort	
b. Delivery routes that will save time and mileage	
c. Effective methods of sorting and loading merchandise	Draw points from group and show how consideration of points will reduce delivery costs and increase customer good will.
d. Checking merchandise against saleschecks before leaving store	
e. Check-up of delivery equipment	
D. Organization of Department Store Delivery System	
1. Within store functions	
a. Assembling packages	
(1) By chutes	
(2) By baskets	Draw examples from group.
(3) By hand trucks	
b. Sorting and routing	
(1) Conveyor used in larger stores	
(2) Individual route bins used for each driver	

Topical Outline	Teaching Suggestions
c. Recording packages	
(1) Sheetwriting	(1) Explain that this is used for paid and charge packages. C.O.D. packages recorded on from in assembly room.
(2) Stub system	(2) Explain that a duplicate sales check is used. Packages are numbered by dispatcher and checked by driver, then balanced on driver's return.
d. Taking care of returns	
(1) Use of return room for undelivered merchandise	
(2) Division of packages according to types	
(a) Send agains	
(b) Don't wants	
(c) Wrong address	
(d) C.O.D. charges -- to account and redelivered	(d) Ask why merchandise is returned and what salespeople can do to prevent it.
(e) Hold for future delivery	
2. Outside delivery functions	
a. Setting routes	
(1) Unit or section system	(1) Explain that these are assigned numbers and maintained all year.
(2) Area system	(2) Explain that average number of pieces may be made smaller or larger at different seasons.

Topical Outline	Teaching Suggestions
b. Using substations (large stores) (1) Saves space in store (2) May be sued as garage (3) Saves time (no heavy downtown traffic)	TIPS TO COORDINATOR: 1. Plan field trip to delivery department. 2. Have class members singly or in groups develop a simple shopping blank that could be used in evaluating delivery service. 3. Summarize Sales Supporting Activities by having class members put on a panel discussion covering the four topics studied.

III. SALESMANSHIP

SALESMANSHIP

MATERIALS AND EQUIPMENT NEEDED

1. Order from your local telephone company the following material:

   a. Teletrainer

   b. Film - "The Voice With A Smile"

   c. Tape - "Put Your Best Voice Forward"

   d. Tape recorder

   e. Flash cards

   f. Booklets for each student "The Voice With A Smile" (free)

   g. Film - "Ten Men and The Telephone

2. Pass out sheets at end of unit mimeographed for each student.

   a. Self-evaluation Test For Prospective Salespeople

   b. Voice Personality Rating Scale

   c. Types of Customers

   d. Know Your Merchandise

   e. Descriptive Words

   f. Shopping Report

   g. Objectiion Analysis Form

   h. Characteristics of Conversation

   i. Types of Oral Communications

I. PERSONAL SELLING

Objectives
1. To introduce the field of personal selling
2. To stress the buying motives of an individual

Topical Outline	Teaching Suggestions
A. Definitions of Selling:	
1. The exchange of a commodity for an agreed price	1. Draw from students several definitions and as a group select one definition.
2. Selling goods or services that will not come back to customers that will	2. Explain to the class how "nothing really happens until something is sold."
3. The power to persuade people to purchase to their personal profit	3. Explain that selling creates competition.
4. Helping customers buy	
B. Selling - A Marketing Function	
1. Buyer-seller function - How good selling performs a service to people	
a. Helps buyer make wise decision	
b. Brings buyer satisfaction as result of salesman's selling ideas	
2. Marketing-seller function - How selling raises the standard of living	
a. Creates mass markets, mass distribution	
b. Brings lower costs, higher wages as result of mass production	
C. Selling Appeals Buying Motives	C. Discuss buying motives with students and add the following: 1. Physical pleasure 2. Desire to feel important 3. Imitation 4. Curiosity 5. Pssession 6. Sex or romance 7. Altruism 8. Health 9. Beauty 10. Urge to Create 11. Security 12. Fear or caution
1. Price	
2. Quality	
3. Originality or variation of style or design of goods	

II. ORGANIZATION OF A SALES DEPARTMENT

Objectives

1. To discuss the organization of the sales department
2. To clarify the duties of a sales manager

Topical Outline	Teaching Suggestions
A. Types of Salesmen	
1. Manufacturer's salesman	1. Give an example of the Albert Pick Company where the same sales force may have different types of salesmen. Refer to Textbook of Salesmanship, Russell, Beach, and Buskirk, 7th edition, p. 37.
2. Wholesaler's salesman	
3. Retail salesman	
4. Speciality salesman	
5. Industrial salesman	a. Road salesmen b. House salesmen c. Servicemen d. Field operators e. Technical experts
B. Similarities and Differences	
1. Retail selling	
a. Easiest type of selling, as customer comes to salesman	
b. Mostly salary jobs	
c. Provides good background for future jobs in other sales fields	
2. Wholesale selling	
a. More difficult than retail selling	
(1) Requires more experience	
(2) Requires a prepared sales presentation	
(3) Involves selling many products of lines	
b. Usually on salary or salary plus commission basis	
c. Less turnover of salesmen than in retail selling	

Topical Outline	Teaching Suggestions
3. Specialty selling	
a. Hardest of all types of selling jobs	
(1) Involves seeking out customer	
(2) Requires prepared sales presentation	
(3) Requires determination	
b. Requires cash reserve	
c. Recommended for experienced salesmen only	
4. Service selling	Project:
a. Easier than specialty or wholesale selling	The following statements apply particularly to one or more of three types of salesmen: namely, retail, wholesale, and specialty. Identify the statements with one or more of the three types. a. He does not have to locate customers. b. He has irregular working hours. c. He must possess a sense of humor. d. His working condition are easier. e. His pay is usually on a commission basis. f. His sales operations require more time. g. He must be punctual. h. He may have a narrower range of experience. i. He should have a good knowledge of finance and general business. j. He meets with a larger proportion of "unpleasant prospects." k. He may become a star salesman, supervisor, or sales manager.
b. Easier to get than other types of selling jobs	
c. Easy way to gain sales experience	
d. Good probability of advancement	
e. Not "cut-out job" - is what salesman makes it	
C. Organization of Sales Department	
1. Departmental vice president	
a. Office manager	
b. Sales promotion manager	See organization chart pass out sheet prepared by individual coordinator. Taken from the chart in Business Principles, Organization and Management, Tonne, Simon and McGill, 2nd edition, p. 139.
c. Credit manager	
d. Traffic manager	

Topical Outline	Teaching Suggestions
2. Merchandising manager	
a. Product planning manager	
b. Sales force manager	
c. Sales training manager	
3. Sales force manager	
a. Wholesale salesman	
b. Retail salesman	
c. Institutional salesman	
D. Sales Training Manager - Functions and Responsibilities	Appoint a student committee to set up a bulletin board exhibit of the functional duties and responsibilities of the typical sales department.
1. Selection of salesmen	
2. Training and retraining of salesmen	
3. Compensation, planning and administration	Ask each student to select a business firm to which he will write for information about the firm's training program for salesmen. Oral reports to the class should be made by each student.
4. Motivation of the sales force	
5. Control and supervision of the selling function	
6. Preparation of sales quotas	
7. Responsibility for adequate sales coverage	
8. Responsibility for efficiency and completeness of sales activity	
9. Financial control of expenditures in areas of sales activity	Use the most recent census data and the U. S. Department of Labor data to determine the wage and salary level of workers in various jobs and in various parts of the county. Discuss reasons for differences.
10. Evaluation of selling efforts (over-all and by each sales control division established)	Have student present a debate on the question "Guaranteed Annual Wages Are Detrimental To American Industry." The debate should serve to bring out both sides of the issue and allow the class to form conclusions with an open mind.

III. SALES PERSONALITY - GETTING READY TO SELL

Objective
To stress the qualifications necessary for a salesperson

Topical Outline	Teaching Suggestions
A. Personality	Note to coordinator - Personality as related to careers will be covered in "Careers In Distribution" Unit V
1. Definitions	
a. Personality is the word used to describe the effect of one individual upon another.	
b. Character is defined as what you really are.	Stress that sensitivity to other people is the greatest asset to a selling personality.
c. Reputation is defined as what people think you are.	Self-control is the mark of emotional maturity.
2. How you look	
a. Grooming	
b. Posture	Have students check a personality chart to determine how they rate. Pass out sheet No. 8.
c. Facial experession	
d. Voice and speech	See sample of voice personality chart. Pass out sheet No. 9. (Salesmanship Fundamentals, Ernest & DaVall, p. 62-63.
	Bulletin board suggestion: Use "How Do you Measure Up?" Salesmanship Fundamentals, Ernest & DaVall, p. 78.
3. How you act	
a. Courtesy	
b. Consideration	
c. Cheerfulness	
d. Cooperation	
e. Enthusiasm	
f. Tact	
g. Interest	
h. Honesty	
i. Self-control	

Topical Outline	Teaching Suggestions
4. Steps in developing a selling personality	
a. Realize the need for improvement.	
b. Make a survey of your personality.	
c. Develop a systematic plan for improvement.	
B. Types of Customers	
1. Nervous	
2. Dependent	Discuss how to recognize each type of customer and also how to handle each type.
3. Disagreeable	
4. Trying	See pass out sheet on Types of Customers. Pass out sheet No. 10.
5. Common-sense	

IV. KNOW YOUR PRODUCT

Objective
To emphasize the importance and necessity of merchandise information

Topical Outline	Teaching Suggestions
A. Merchandise Knowledge	Use merchandise and store information check list, Store Salesmanship, Robinson, Blackler and Logan, p. 162-163.
1. Why you must know merchandise	
2. How you find it	
a. Store training programs	
b. Buyers, department heads, experienced sales personnel	Use pass out sheet No. 11, "Know Your Merchandise"
c. Tags, labels, package enclosures	
d. Catalogues, manuals and magazines	Use pass out sheet No. 12, "Descriptive Words"
e. Buyer's catalogues	
f. Price lists	
g. Trade magazines	
h. Professional salesmen	
i. Technical publications	
j. School and city libraries	
k. Store and national advertisements	
l. Research bureau studies	
m. Pamphlets, brochures, and publications	
3. What you use	
a. Brand names	
b. Local company policies	
c. Product history	
d. Materials	
e. Workmanship	

Topical Outline	Teaching Suggestions
f. Research and development	
g. Manufacturing processes	
h. Competitive products	
i. Care and use of product	
j. Prices, credit terms	
k. How knowledge of merchandise benefits the customer	

V. SALES PRESENTATION

Objectives
1. To discuss the types of presentation
2. To compare the mental and physical steps in a sale

Topical Outline	Teaching Suggestions
A. Essentials of A Good Demonstration	
1. Complete	
2. Eliminates competition	
3. Clear	
4. Wins the prospect's confidence	
B. Types of Presentation	
1. Memorized sales talk	
a. Advantages	Have a local demonstrator of some product demonstrate it to the class.
(1) Covers all the ground, leaving no gaps	
(2) Insures a logical order	
(3) Saves time for the salesman and prospect	
(4) Enables beginner to sell effectively	
(5) Gives the saleman more confidence	
b. Disadvantages	
(1) Sounds "canned"	
(2) Possibility of forgetting parts of it	
(3) May not sound sincere	
2. Organized sales talk -- On the Basis of Benefits	Benefits: Economy, safety, ease of operation
3. Perfect product comparison plan	
a. Paint a picture of the perfect product.	
b. Point out the similarity of the merchandise.	

Topical Outline	Teaching Suggestions
C. Methods of Presentation	
1. Use showmanship	
a. Pictures	
b. Films	
c. Sales portfolio	Dramatize by testing the product before group. Example: standing on a piece of luggage or throwing a plastic plate on the floor.
d. Tests	
2. Take pulse of the interview	
3. Use comparisons	
a. Simile	To clarify the sales story use the valuable tool of rhetoric. Figures of speech may be used very effectively.
b. Metaphor	
c. Analogy	Simile: "This electric hot water heater is well insulated. It is just like a big thermos bottle and is as safe as and electric light." (The words <u>like</u> and <u>as</u> are used for comparison between two familiar qualities of the thermos bottle and the electric light.)
	Metaphor: "Our quarterback is an important cog in our machine." (The word <u>like</u> or <u>as</u> is ommitted, but a comparison is made.)
	Analogy: Use a story to illustrate the points to be clarified in the sales story.
D. How to Win Confidence	
1. Apply the Golden Rule.	
2. Do not knock the boss.	Refer to cases in <u>Textbook of Salesmanship</u>, Russell, Beach, p. 354-356 7th edition on the following: The Absent Order, The Missing Order, Some Gossip, The Touchy Technician, The Perfect Presentation.
3. Use guarantees.	
4. Use testimonials.	

Topical Outline	Teaching Suggestions
5. Capitalize on the reputation of the seller.	(Here are five situations in which salesmen found themselves embarrassed. Analyze each, and tell where each man made his mistakes.
6. Show records.	
7. Plan plant tours.	
8. Give experiences of others.	
E. Mental Steps in a Sale	
1. Attract attention	
2. Arouse interest	
3. Create desire	Attention - Approach the customer. Interest - Overcome objections. Desire - Demonstrate the product.
4. Induce action	Action - Close the sale properly.
F. Physical Steps in a Sale	
1. Prospecting	
2. Preapproach	
3. Approach	Compare the mental steps and the physical steps of a sale.
4. Demonstration	More preparation has to be made for the physical steps in a sale in outside selling.
5. Meeting objections	Ask how the mental steps in a sale are similar to the physical steps.
6. Close the sale	Let students put on sales demonstration.
7. Suggestion selling	Role play or demonstrate - sloppy, disheveled appearance of a salesperson.

VI. FINDING PROSPECTS

Objectives

1. To emphasize the importance of proper selection of prospects
2. To discuss the prospecting systems
3. To illustrate the use of time schedules

Topical Outlines	Teaching Suggestions
A. Sources of Prospects	
1 Your immediate family	
2. Friends, acquaintances, relatives	Project:
3. Contacts with community organizations	Assume that you are a salesman for a retail floor-covering firm. Your chief products are linoleum and asphalt tile. Where would you get your prospects? List them in the order of their importance to you.
4. Present customers	
5. Tradesmen and merchants	
6. Classified directories	
7. Trade and professional membership lists	Prepare a chart for reporting the progress of ticket sales for some activity. Have students devise methods of approach and report to class on the success of the methods.
8. Service clubs and social organizations	
9. Building permits	Discuss the difference between a suspect and a prospect.
10. Tax lists	
11. Newspapers	Suspect - Needs and buying capacity are not known.
12. Advertising for prospects	Prospect - One who can benefit from buying the product and can afford to buy it.
13. Store and showroom contacts	
14. Commercial advertising lists	
B. Evaluating Prospects	Prospect Card
1. Need for the product	Name / Title / Date of Call / Follow Up Date
2. Ability to pay	Firm / Business
3. Authority to buy	Street City-State Salesman
4. Accessibility of the prospect	Remarks
5. Special qualifications	Additional space on reverse side

Topical Outline	Teaching Suggestions
C. Prospecting Systems	
1. Endless chain	1. Endless chain - referred lead. Example: Go and see Charlie, and tell him I sent you.
2. Center of influence	2. Center of Influence - important people in community or club.
3. Personal observations	3. Personal observations - observe models of merchandise, conversations at club meetings, social gatherings, business meetings.
4. Junior salesmen (spotter plan)	4. Junior salesmen - Sales Associates Key people who may help the salesman locate prospect by making surveys or through helpers not employed by the company.
5. Cold canvass	5. Cold canvass - know nothing about the prospect.
6. Direct mail and telephone	6. Direct mail and telephone - used by companies for initial contact. Use premiums or gifts, enclose return post card, ask for appointments for demonstrations.
D. Managing Time Schedules	
1. Secret of Good Planning	
a. Determine your objective	
b. Apportion your selling day	
c. Prepare a schedule	
d. Write your plan	
2. Scheduling calls	
a. Route your calls	
b. Determine suitable hours for calling	
c. Allow time between calls for traveling and holdovers	
d. Have a flexible schedule	
e. Eliminate needless calls	
3. Time wasters	

Topical Outline	Teaching Suggestions
a. China eggs	a. China egg - a person who appears to be a good prospect but who fails to hatch or materialize into a buyer.
b. Poorly planned presentation	
c. Late morning start	
4. Use of selling time	
a. Know here your time goes	The more calls that are made the more sales will be made.
b. Use the telephone.	Objective: Sales, not just calls or interview.
c. Use letters.	
d. Make good use of your waiting time.	
e. Have a schedule.	
f. Call only on bona fide prospects.	<u>Project</u>:
g. Have a planned presentation.	Design a time-saving system for yourself as a student that will enable you to make the most effective use of your day as a student. Use the full twenty-four hours a day.
h. Avoid departures from your daily plan.	
i. Leave each interview as soon as you can.	Example: (Insurance information) a. Daily reminders and age changes b. Prospects c. Policyholders d. Children
j. Keep a notebook and consult it often.	
5. Records to keep	
a. Set quotas	
b. Call quota	
c. Hour of work quota	Read chapter in <u>Textbook of Salesmanship</u>, Russell, Beach and Buskirk p. 518-521, 7th edition.
d. Dollars of sales quota	
e. Long range goals	Problem: Interview a successful salesman and find out -- a. What his employer or manager does to help him cultivate sound attitudes and methods. b. How he plans his schedule.

VII. GAINING ATTENTION (APPROACH)

Objective

To demonstrate proper methods and attitudes that lead to effective customer approaches

Topical Outline	Teaching Suggestions
A. Objectives of the Approach	
1. To make favorable impression	
2. To gain favorable attention of the prospect	
3. To develop this favorable attention into definite interest	
B. Elements of a Good Approach	
1. Be prompt.	Good operners: a. Question - consumer benefit approach b. Curiosity appeal c. Special interest appeal d. Gift (example, Fuller Brush) e. Survey claim to get in door f. Service g. Reference h. Anecdote i. Exhibit j. Product handed to customer without explanation k. Compliment paid to customer
2. Be enthusiastic.	
3. Be friendly.	
4. Have a strong opener.	
5. Appeal to the five senses.	
6. Discover the customer's needs.	
7. Get to the point.	
C. Other Essentials of a Good Approach	
1. Make appointments.	In obtaining an interview, it may work out more satisfactorily to ask for some odd times as 10:20, 2:50, 3:05 to flatter the executive at the recognition of the fact that his time is very precious.
2. Time the approach.	
3. Use business card.	
4. Give proper attention to your appearance.	
5. Avoid early dismissal by a planned approach.	
6. Never apologize for taking the customer's time.	
7. Win prospect's undivided attention.	

Topical Outline	Teaching Suggestions
8. Center the prospect's attention	Problem I: You are a salesman from IBM electric typewriters. Devise a product, a consumer benefit, a premium, and a survey approach you could use. Which do you feel would be best.
9. Relieve or remove sales tension quickly.	
10. The call-back approach	Problem II: You are a salesman for Merrill, Lynch, Pierce, Fenner and Smith who is trying to build up business with young middle-management executives on the way up. Devise some approaches you would use.
a. Make a return call on the customer.	
b. Approach him from a different angle.	Problem III: You are a sales manager who wants to sell the president on the idea that he needs five additional men to cover the area properly. Devise your approach.
D. Types of Approach	
1. Greeting	1. Greeting - "Good morning, Mrs. Jones."
2. Merchandise	2. Merchandise - "This is 100% wool."
3. Service	3. Service - "Is someone helping you?" or "May I help you?"
E. Shopping Report	
1. Definition: Survey of a sales situation	
2. Things to look for	Have students make a shopping report on a salesperson and bring to class for oral reports. Use pass out sheet No. 13.
a. Approach	
b. Selling points	
c. Use of suggestion selling	
d. Attitude of salesperson	

VIII. CONDUCTING THE DEMONSTRATION

Objective
To help students prepare a good demonstration

Topical Outline	Teaching Suggestions
A. Rules for a Successful Demonstration 1. Prepare your demonstration in advance. 2. Develop the prospect's need or desire. 3. Let the prospect participate or sell himself. 4. Make the picture clear; dramatize. 5. Be ready to close at any point.	Project: Make a list of the selling features that you might demonstrate for the following products, arranging the points in the order of importance: a. Electric range b. Electric refrigerator c. Quick-drying enamel d. House paint e. Tractor f. Set of fine dishes g. Insurance
B. Results of a Well Planned Demonstration 1. Arouses prospect's appreciation of product and desire for ownership by appealing to five senses 2. If lively, tends to prevent distraction and gives prospect something to do 3. Allows prospect to try out the product, selling himeself on its merits 4. Tends to reduce sales resistance by taking mind of prospect off idea of expenditures and focusing on idea of ownership 5. Helps salesman to secure confidence of propsect through skillful presentation of product	Prepare a list of the different ways in which the product selected for your term project may be demonstrated. Refer to your list of selling appeals or "sizzles," and plan a demonstration for each one. The following form is suggested for planning each demonstration: Product_____ Selling Feature_____ What to say What to do Use following questions in building each demonstration: a. How will you get customer to participate? b. What testimonials, facts, analogies, and so on, will you use? c. What visual materials will you use? d. What senses will you appeal to and how?

IX. HANDLING OBJECTION

Objectives

1. To explain difference between real objections and excuses
2. To discuss types of objections and how to handle them

Topical Outline	Teaching Suggestions
A. Real Objections and Excuses	
1. Definition	Examples of objections:
a. Objection: An honest point of difference between salesman and prospect.	"Your price is too high." "It does not fit my needs." "I do not like the color." "I am afraid it will not wear." "It takes too long to get delivery." "I would rather deal with a well-known firm."
b. Excuses: Smoke screens behind which a prospect hides to discourage salesman from making presentation.	Examples of excuses:
	"I have not the time to look at it right now." "I cannot afford it." "I would like to think it over." "I want to talk with my husband."
	Point out the difference between a real objection and an excuse.
	Discuss reasons for sales resistance, and ask group what makes some customers suspicious.
B. Types of Objections	
1. Need	
a. No call for the goods	
b. No room for a new line	
c. Likes the firm he is now buying from	
2. Product	
a. Handled without success by another dealer	
b. Friend bought product and was unhappy with it	
c. Prefers another brand	

Topical Outline	Teaching Suggestions
3. Service	
4. Price	
C. Handling Objections	Examples:
1. "Yes, but" method	1. <u>"Yes, but"</u> - Agree with the customer and then attack from another angle.
2. Superior point	2. <u>Superior point</u> - Admit objection is valid; then emphasize a superior point to offset it.
3. Boomerang	3. <u>Boomerang</u> (reverse-English method) Turn objection into reason for buying.
4. Exaplantion	4. <u>Explanation</u> - Ask prospect to explain his objections.
5. Question	5. <u>Question</u> - Ask question that when answered will overcome the objection.
6. Direct denial	6. <u>Direct denial</u> - Firmly deny statement without contradicting the prospect. (Use sparingly.)
7. Demonstration	7. <u>Demonstration</u> - Demonstrate article to disprove prospect's claim.
8. Third party	8. <u>Third party</u> - Shift the burden of proof to the neutral third party.
D. General Procedure in Answering Objections	
1. Listen to the objection.	<u>Project</u>: During the summer, you are going to sell door-to-door a line of quality bakery products priced slightly higher than store goods. You plan on covering the same territory twice a week. Prepare an Objection Analysis Form listing the possible objections that you may encounter and answer them.
2. Restate the objection.	
3. Concede a point.	
4. Answer briefly.	
5. Ask for the order.	See "Objective Analysis Form," pass our sheet No. 14.

X. SUGGESTION SELLING

Objectives

1. To assist students in their understanding of monetary aspects of increasing sales
2. To suggest techniques and ideas for increasing sales

Topical Outline	Teaching Suggestions
A. Suggestion Selling -- Definition:	
1. Suggestion selling is to increase the quantity of each sale by selling goods not definitely asked for.	
2. It is not high-pressure selling.	
3. It reminds him of items that he may ultimately need.	
B. What to Suggest	
1. Related items	Define the term "trading up."
2. Larger quantity	Prepare selling sentences using suggestion selling and have students identify what each suggests.
3. Higher priced, better quality merchandise	1. "We have the bracelet to go with that necklace. Let me show it to you." (related)
4. Newly arrived stock	2. "We have a light-weight wool blanket advertised today. Let me show you how very light it is." (special)
5. Specially advertised items	3. "We have just received some of the new Italian silk blouses. Fell this lustrous silk!" (new merchandise)
6. New or different use of merchandise	4. "We have a larger bottle of hand lotion which holds three times as much for just twice the price of the smaller bottle. Let me show it to you. It is a splendid value; it makes quite a saving for you." (quantity)
7. Merchandise for special occasions	
C. Rules to Follow in Making Suggestions	
1. Satisfy the customer's request first.	Ernest and DaVall, Salesmanship Fundamentals, Second Edition, 1959, p. 265-268.
2. Make the suggestion from the customer's point of view.	Haas and Perry, Sales Horizons, Prentice-Hall Inc., 1958, p. 320-321.
3. Make a specific suggestion.	
4. Make the suggestion positive, not negative.	
5. Demonstrate the suggested item	

Topical Outline	Teaching Suggestions
D. Call-Backs 1. Be prompt in "calling back" for repeat orders. 2. Sell the complete line. 3. Become acquainted with items in line (price, feactures, uses) 4. Concentrate on key items in line. 5. Prepare a sales demonstration on key item to customer.	<u>Project</u>: Using the principles learned in suggestion selling, write a related item suggestion for each of the following purchases: a. Cup of coffee in restaurant b. Bottle of mouthwash c. Umbrella d. New automobile e. Five gallons of gasoline f. Handbook on grammar in bookstore
E. When to Increase Sale 1. At close of first sale, but before sale is recorded 2. When customer is reluctant to leave 3. When "casual" shoppers are in the department 4. With customer who is "just looking"	How could you improve the following sales situations: a. A customer asks to see suits advertised at $35. The salesperson says "I can show you those suits, but I am sure that you would like these suits at $50 better. They are a real value." b. A customer asks for a certain brand of toothpaste. The salesman says, "we have that brand, but our private brand is a lot better."
F. Monetary Value of Plus Selling Cost and Profit <u>To Sell One Item</u> / <u>Two Items</u> 1.98 selling price / 3.96 s.p. 1.04 cost / 2.08 cost .85 expenses / .85 expenses .09 net profit / 1.03 n. profit 1.98 / 3.96	Explain the increase in profit by using suggestion selling to increase the sale.

XI. CLOSING THE SALE

Objective

To encourage prompt, effective closings before a sale is lost

Topical Outline	Teaching Suggestions
A. Buying Signals	
1. Agreement on part of customer	"The close is the most important step in the sale."
2. Individual attention from customer	(It requires more skill than any other step)
3. Questions from customer	
4. Action on part of customer	Cases and Problems Refer to Salesmanship Fundamentals, Ernest and DaVall, p. 224-231 and 236-239.
5. Certain types of objections	
B. Methods of Closing a Sale	
1. Review selling points.	
2. Contrast advantages and disadvantages.	
3. Assume a close.	
4. Offer a choice.	
5. Suggest ownership.	
6. Offer a premium.	
7. Caution on last chance to buy.	
8. Indicate "Standing Room Only."	
9. Tell story of satisfied customer.	
10. Narrow the choice.	
11. Use the conditional close.	
12. Ask for the direct order.	
C. Why Buying Action Fails Because of Salesman	Case: Analyze the following transaction, indicating what the salesperson did or failed to do in the process of helping the customer decide:
1. Hurring the customer.	
2. Failing to help customer decide	Two customers shopping together are looking at an upholstered living room chair. You have given them the selling points and

Topical Outline	Teaching Suggestions
3. Stumbling over sales obstacles 4. Stressing wrong selling points 5. Trying to force action 6. Being discourteous when customer fails to buy	advantages of the merchandise yet they are still undecided. The following conversation took place: Customer: I am not sure that this is exactly the chair we need. Salesperson: It is a wonderful piece of merchandise and you will find it exceptionally comfortable. Customer: Yes, it looks as if it is well constructed, but I am not quite sure about the style. Salesperson: This is a good modern style. Customer: Yes, I suppose it is, but still I cannot see it in my living room. Salesperson: We sell a lot of those chairs for homes of the type you folks have. Customer: Yes, I suppose you do, but I still do not believe it is what we want.
D. Do's and Do't's Closing a Sale 1. Do display a friendly manner at the close, even through there is disagreement between the prospect and the salesman. This helps to avoid arguments. 2. Do be sure to have all materials and equipment that will be needed. Misplaced order blanks, obsolete price lists, and dry fountain pens can lose sales. 3. Do realize that beggin for a sale makes the salesman and his offer look bad; it also disgusts the prospect. 4. Do ask the prospect to "OK" or approve the order rather than sign it. 5. Do make buying as easy and painless as possible.	

Topical Outline	Teaching Suggestions
6. Do try for privacy at the close. Phone calls and third parties distract.	
7. Do study each prospect as a basball pitcher studies each batter. Then pitch to his weakness.	
8. Do lead the prospect to think of himself as the owner of the product from the beginning of interview.	
9. Don't let the prospect know how much the sale means.	
10. Don't be apologetic, particularly in quoting price.	Mimeograph the Do's and Don't's in closing a sale and give to each student for his notebook.
11. Don't make written or even oral promises unless authorized to do so. Otherwise, there will be friction and expense.	
12. Don't make a ceremony out of closing, lest the prospect become frightened.	
13. Don't give the prospect an excuse or an opportunity to back away from the purchase.	
14. Don't ever ask the prospect for the buying decision in such a way that he can answer with a "yes" or a "no," for the latter closes the door.	
15. Don't make it difficult for the prospect to complete his purchase quickly if he cares to do so.	
16. Don't let the prospect miss seeing that the salesman expects the prospect to buy.	
17. Don't make it easier for the prospect to refuse than to buy.	

XII. SELLING IDEAS

Objectives

1. To create in the minds of students the vital role oral communications play in personal acceptance
2. To create a realization of the need for mechanics of speech

Topical Outline	Teaching Suggestions
A. Communication 1. Definitions a. Exchange of information b. Interchange of facts, thoughts, opinion, and emotions 2. Examples a. Oral b. Written	Project Prepare pantomime instructions for student to act out: Thumb a ride Wash clothes, wring them out and pin on line.
B. Necessity for Communications 1. To present material logically 2. To sell ideas by persuasion 3. To present ideas that appeal to traits, actions, feelings and attributes of the mind	Use flannel board presentation of two stock figure men in color. Have one figure assembled on the left side of the flannel board and the other broken down in pieces of the same colors and shapes of peices. Conceal completed man from view with poster board held in the center of the board. Let a student give directions to another student about how to construct the pieces into the complete man. Discuss success or failure of communications process.
C. Elements of Communication 1. Transmission and reception a. Sight b. Sound c. Touch d. Smell e. Taste 2. Rapport - agreement or harmony	Use poster for bulletin illustrating the per cent of learning through the five senses. The illustration could be a circle dividing the percentages by the use of lines from the center. Sight - 87% Sound - 7% Touch - 3% Smell - 2% Taste - 1%

Topical Outline	Teaching Suggestions
	Questions What three factors or elements are involved in communications? a. Transmission b. Reception c. Rapport Can you transmit ideas without someone receiving them? Explain.
D. Communicating Without Words	
1. Facial expression	
2. Action, demonstrations	
3. Display to reveal the dynamic	We remember: What we read - 10% What we hear - 20% What we see - 30%
4. Color	
5. Illustrations, charts, photos, drawings	Have an "obstacle period" in class. Let a student give a sales demonstration or tell a short story and try to keep the audience interested in spite of interruptions and unusual occurrences (which are planned with the teacher, while the storyteller is out of the room)
E. Methods of Communications	
1. May be oral, pictorial, written, and symbolic.	
2. Examples of method	
a. Face-to-face contacts	Illustrations: a. Is a tape recorder effective in presenting a product? Why?
b. Group meetings	b. Is a telephone effective in job application?
c. Motion pictures	c. What kind of messages are best for school and store broadcasts?
d. Telphone	d. How should posters convey messages?
e. Plant broadcasts	e. Would you agree that in most cases face-to-face communications is most effective? Why?
f. Tape recorders	
f. Poster, signs	
F. Approach to Good Communication	
1. Know what you are trying to sell - products, ideas, services.	Use role-playing - Have students handle the following: a. Complaint from customer by telephone. b. Face-to-face sale of product to customer. c. Extending credit to customer.

Topical Outline	Teaching Suggestions
2. Know purposes of selling - to get action, to change attitudes to gain knowledge.	
3. Know how to sell.	
a. Know the merchandise.	
b. Be honest about results.	
4. Know your audience.	
a. Watch audience closely.	
b. Analyze needs.	
5. Know yourself.	
a. What you will gain from this communication such as making a sale or acceptance of ideas	
b. What to avoid in communicating	
(1) Talking too much	
(2) Understating	
(3) Cutting in on others	
(4) Assuming too much knowledge	
6. Formulate a plan.	
a. Proper timing	
b. Location - surroundings	
c. Approach - a positive rather than negative approach	
d. Emphasis on key points	
7. Aim at lasting satisfaction.	
G. Ten Commandments for Good Communications	

Topical Outline	Teaching Suggestions
1. Seek to clarify ideas before communicating them.	
2. Examine the true purpose of each communication.	Use the ten commandments to good communications as a pass out sheet for the students.
3. Consider the total physical human setting when communicating.	Effective Communication On the Job, Dooker and Marquis, AMA, New York, New York, 1956.
4. Consult with others, where appropriate, in planning communications.	
5. Be mindful while communicating of overtones as well as the basic content of your message.	
6. Take the opportunity, when it arises, to convey something of help or value to the receiver.	
7. Follow up your communication promptly.	
8. Communicate for tomorrow as well as for today.	
9. Be sure that actions support communications.	
10. Seek not only to be understood, but to understand - be a good listener.	
H. Mechanics of Oral Communication	
1. Build a working vocabulary	Look up and remember words related to your work.
2. Pronunciation	
a. Say syllables and words according to correct dictionary usage.	Practice new or unfamiliar words until you can use them with ease.
b. Practice difficult words.	
3. Enunciation	
a. Pronounce distinctily.	
b. Speak clearly.	

Topical Outline	Teaching Suggestions
4. Volume	Illustrate volume control by showing how posture and diaphragm contribute.
5. Pitch	Vary pitch for emphasis. Pitch should be kept low for a pleasing voice.
6. Inflection - adds variety to the pitch	Have students recite "Mary had a little lamb" in the following voices: a. sad b. boredom c. laughing c. angry
7. Timbre-quality of tone in voice expresses happiness, interest, enthusiasm, optimism, eagerness)	
8. Gestures	Practice saying "Good morning Mrs. Brown" by varying the pitch.
a. Head	
b. Eye and eyebrow	Use a tape recorder to record each student's voice. Have students criticize each other's voice.
c. Mouth	
d. Arms and hands	Let students read the statements below changing the tone to agree with the thoughts in the sentences. a. The stream murmured, but the thunder roared. b. In childhood he was happy and carefree; as an adult he seemed to carry the burdens of the world upon his shoulder. c. They went hom; I should have told you. d. When I entered the house, the mother was sitting thinking; but the child was dashing wildly about.
9. Emphasis	
a. Emphasize key words	
b. Emphasize key points	
10. Pauses	
a. Make pauses count.	
b. Study effectiveness of pauses in holding interest	Hand out pass out sheet giving the characteristics of conversation. Pass out sheet No. 15.
	Communications in Distribution, Distributive Education Department, The University of Texas
	Fundamentals of Speech, McGraw Hill Book Company, Powers, David Guy, New York, 1951.
I. Gestures to Avoid - Mannerisms	
1. Blinking of eyes	
2. Twitching eyebrows	
3. Cracking knuckles	
4. Biting fingernails	

Topical Outline	Teaching Suggestions
5. Scratching head	Draw examples of mannerisms from group.
6. Shrugging shoulders	
7. Smacking lips	
8. Jerking head	
9. Pulling an ear	
10. Licking Lips	
11. Tapping floor with foot	
12. Swinging crossed leg	
13. Wrinkling brow	
14. Twiddling thumbs	
15. Tapping fingers	
16. Stroking chin	
17. Locking and unlocking fingers	
18. Tugging at clothes	
19. Swaying body	
20. Shutting eyes	
J. Telephone Selling	Show movie "Voice With A Smile" secured from Bell Telephone Co. or Carolina Telephone Co.
1. Characteristics	
a. No opportunities to display	Use teletrainer and tape recorder to demonstrate more effective telephone usage. The Southern Bell Telephone Co. will furnish the equipment. Use the series "Put Your Best Voice Forward" Time: 25 min.
b. Sale is based on SOUND only.	
c. Mental picutre is based on salesperson's voice.	
d. Voice reflects attitude.	
2. Principles of good telephone selling	
a. Answer promptly giving name and department	Order booklets for each student "The Voice With A Smile" and show movie also. Movie - "Ten Men and The Telphone

Topical Outline	Teaching Suggestions
b. Clear, pleasant voice	Southern bell Telephone Co. Carolina Telephone Company
c. Listening - giving full attention	
d. Getting essential information	
e. Taking notes	
f. Knowledge of merchandise and ability to talk convincingly about it	
g. Using assistance of another salesperson	
h. Answer questions carefully	
i. Explain absence from phone	
j. Thank customer	
k. Hang up receiver gently	
l. Follow through on telephone sale promptly	
K. Types of Oral Communications	
1. Conversation	Develop differences through class discussion. Use pass out sheet of comparison of the three types listed on the left of the outline. Pass out sheet No. 16.
2. Conference	
3. Public speaking	
L. Public Speaking	
1. Preparation of speech	Have students prepare a five-minute speech.
a. Select subject	
b. Limit scope	<u>Suggested Topics</u> How To Increase Sales By Making Suggestions How To Build A Customer Clientele How To Sell By Telephone Is The Customer Always Right? New Trends In Marketing What Private Enterprise Means To Me
c. Gather materials	
d. Narrow topic	
e. Use index cards for notes	
2. Present speech	
a. Practice in front of mirror	

Topical Outline	Teaching Suggestions
b. At home before audience	
c. Make improvements	
d. Make presentation	
M. Aims of Speeches	Illustrations
1. To inform	
2. To convince	
3. To gain action	
4. To impress	
5. To entertain	
N. Outlining Speech	
1. Lettering the outline I. A. 1. a. (1) (a)	Two to four major divisions. Concise topics, not sentences. Development of major divisions with details. Consistent lettering
2. State purpose	Assignment
3. List items	Outline a four-minute talk
4. Group items and arrange in logical order	Is the purpose clear? Do main divisions relate directly to purpose?
5. Plan introduction and conclusion	Is outline complete and well proportioned? Is outline accurate in form?
6. Add details, examples, and interest material	Does outline need new material and illustrations?
7. Check proportion	

Aim	Subject	Audience	Purpose
to inform	gold mining	chemistry club	explain
to convince	football	public speaking class	night vs. day games
to get action	school yearbook	student council	cost
to impress	Shakes-peare	English Class	his achievements
to enter-tain	greetings	school clubs	modes used

IV. SALES PROMOTION

SALES PROMOTION

MATERIALS AND EQUIPMENT NEEDED

1. Order from: National Cash Register
   Merchants Service
   Dayton 9, Ohio

   Sufficient copies for each student of the following pamphlets (free):
   a. "Display Selling"
   b. "Making Your Windows Work For You"
   c. "Advertise---To Promote Your Business To Sell Your Goods"

2. Order from: Small Business Administration
   Trade Street
   Charlotte, North Carolina

   Sufficient copies for each student of the following Small Marketers Aids (free):
   a. #56 "Advertise For Profit and Prestige", June 1960
   b. #60 "Sales Promotion Pointers for Small Retailers", December 1960
   c. #63 "Making the Most of Your Show Windows", March 1961
   d. #72 "Direct Mail Advertising For Small Retailers", September 1961

3. Sales promotion questionnaire form
4. Survey forms for advertising survey
5. Samples of ads
6. Samples of various types of media
7. Secure from local newspaper mats and mat book (free)
8. Survey forms for display survey
9. Window display judging forms
10. Materials suggested in the unit for display

I. SALES PROMOTION

Objectives

1. To give students a clear picture of sales promotion.
2. To acquaint students with various media.
3. To learn importance and necessity of sales promotion.
4. To teach the economic impact of sales promotion and its effects on sales volume and profit.
5. To help students understand the relationships of selling to sales promotion.

Topical Outline	Teaching Suggestions
A. Introduction To Sales Promotion	
1. Definition:	1. Ask group to define the term and write definition on the board.
a. Sales promotion includes every activity that contributes in any way, directly or indirectly, to the promotion of profitable sales.	
b. Sales promotion is the coordination of publicity, personal salesmanship and customer services in order to promote profitable sales.	
B. Purposes of Sales Promotion	B. Ask group why they think businesses engage in sales promotion activities and list these on the board.
1. To increase sales volume	
2. To create good will and prestige	
3. To coordinate business activities with the above aims	ASSIGNMENT: Have students read SBA Publication No. 60 - "Sales Promotion Pointers For Small Retailers"
C. Factors that contribute to successful sales promotion	C. Ask group what businesses do to attract customers. List these on the board.

Topical Outline	Teaching Suggestions
1. Good business location	1. Do businesses plan their location? Why?
2. Attractive surroundings	2. Why do businesses spend money fixing up their facilities? Why are most downtown areas going through "face liftings"?
3. Good reputation	3. If you have an unhappy experience with a business, do you tell your friends?
4. Advertising	4. Have you ever bought anything because you saw or heard it advertised?
5. Window and interior display	5. What was one item you bought because you saw it in the window?
6. Correct prices	6. State that prince ranges for various types of merchandise must be consistent.
7. Effective salesmanship	7. State that businesses have sales training programs.
8. Careful planning of sales events	8. State that plans for Christmas promotion are started in July.
9. Business services, such as:	
a. Parking facilities	a. Ask what is one advantage of shopping centers.
b. Credit	b. Do you and your family pay cash for everything you buy?
c. Delivery	c. Do you carry all of your purchases home?
d. Wrapping	d. Do you always wrap all of your gifts?
e. Adjusting and handling complaints	e. Have you ever returned merchandise and had your money refunded?
f. Adequate rest rooms	f. Are businesses required to have rest rooms?
g. Cashing checks	g. Have you or your family ever cashed a check for a purchase?
h. Personal shopping services	h. Name some local businesses which have personal shoppers.
i. Telephone selling	i. What is something you or your family have purchased over the telephone?
j. Care of children	j. Cite bowling alleys that have nurseries.
10. Publicity stunts	10. Cite shoe stores that sell one pair of shoes for the regular price and the second pair for 5¢.
11. Wage incentives for salespeople	11. Explain these terms.

Topical Outline	Teaching Suggestions
a. Bonuses and commissions	
b. Contests	
c. Premium money	
D. Types of Sales Promotional Events	D. Explain that certain customs, occasions, and seasons of the year provide natural promotional opportunities. Draw examples from the group and list on the board.
1. Natural "gift-giving" periods	
a. Christmas	
b. Valentine's Day	
c. Easter	
d. Mother's Day	
e. Gruaduation	
f. Father's Day	
2. Spring fashion	2. Ask group what types of merchandise and/or services are promoted in the spring.
3. Vacation items	3. What merchandise and/or services are promoted during vacation time?
4. School items	
5. Community-wide special events	
a. Dollar Day	
b. Green Tag	
c. George Washington's Birthday	
d. Fall Harvest Festival	
6. Individual business events	6. Point out that some businesses have special events.
a. Clearance sales	a. Sales held for purpose of selling merchandise that is going out of fashion or being discontinued

Topical Outline	Teaching Suggestions
b. Special purchase sales	b. Special lots offered to customers at reduced prices, post-season offerings made by manufacturers to retailers because of overproduction
c. Sales from stock	c. Temporary price reductions on regular goods.
d. Anniversary sales	d. One purpose is to commemorate the founding of the store, but the primary purpose is to obtain an increased volume by offering a large variety at special prices.
e. Fashion shows	e. Involve primarily women's fashions, but men's and children's fashion shows are also held.
	Assignment: Clear with local businesses to have sales promotion surveys done by students. Have each student survey one wholesale and one retail establishment. Use pass out sheet No. 17, "Sales Promotion".

II. ADVERTISING

Objectives

1. To help students understand responsibilities in advertising.
2. To provide instruction in advertising for those who may specialize in that field.

Topical Outline	Teaching Suggestions
A. Introduction to Advertising	
1. Definition: Any paid form of nonpersonal presentation of facts about goods, services, or ideas directed toward groups of people.	1. Ask how many have solicited ads for high school annual, junior and senior play programs. State that advertising differs from selling face-to-face. Explain nonpersonal as nondirect contact, that is, through medium such as newspapers, television and not in person. Point out that goods themselves are not presented directly, as in display, but that goods are presented by means of pictures or words. Point out that advertising addresses hundreds and millions of people at one time, while personal selling relies on individual contacts.
2. Comparison of selling and advertising methods	
Selling / Advertisement	
a. Approach / a. Attention	a. In selling, the salesperson tries to get the customer's attention through his approach, manner and dress. The advertisement attempts to secure favorable attention through its make-up, headline, color and type.
b. Determine need / b. Interest	b. In selling the salesperson tries to arouse interest and determine need of the goods or service by showing merchandise or telling about service.

Topical Outline		Teaching Suggestions
Selling	Advertising	
		b. The advertisement must secure the interest of the reader so that the copy will be read.
c. Presenting merchandise or service	c. Desire	c. In selling, the salesperson tries to create desire in the customer through appreciative handling of the merchandise, demonstrating it in use, and answering questions. The advertisement creates desire through using the basic appeals.
d. Close	d. Action	d. In selling, the salesperson gets the customer to make a decision by using convincing statesments, overcoming objections, and closing the sale. The advertisement implants the suggestion that the reader do something either now or in the future.
B. Aims of Advertising		Give out National Cash Register Booklet "ADVERTISE---TO PROMOTE YOUR BUSINESS TO SELL YOUR GOODS."
1. Ultimate aim is to sell merchandise or service		
2. To draw customers into the establishment		2. Compare with an invitation. Ask what else they might buy other than the advertised article or service.
3. To build a reputation for the establishment		3. Ask for examples of how different advertisements reflect the characters of the establishments. Show examples.
4. To stablize sales volume		4. Stress importance of leveling off peaks and depression. Draw simple rough graph on the board.

Topical Outline	Teaching Suggestions
5. To introduce new products	5. Ask whether new styles or products are always well-received at first. Call for examples of products that took some time to catch on.
C. Importance of Advertising	C. Draw these importances from group through questioning and list on the board.
1. To the salesperson	
a. Advertising builds a clientele.	
b. Advertising introduces and describes new merchandise.	
c. Advertising maintains customer interest.	
d. Advertising helps educate.	
e. Advertising helps direct and inform the customer.	
f. Advertising sells merchandise for the salesperson in some cases.	
2. To the customer	
a. Advertising improves standard of living.	
b. Advertising educates and helps people to buy more intelligently.	
c. Advertising makes possible more, better, and less expensive news and entertainment media, through financial support of those media (newspapers, radio, and television).	
3. To the business	

Topical Outline	Teaching Suggestions
a. Advertising increases sales volume.	
b. Advertising increases net profit.	
4. To the nation	
a. Advertising keeps economy stable	
b. Decreases cost of living.	
c. Advertising raises standard of living.	
d. Advertising improves public health.	
	ASSIGNMENTS: Assign each student at least 5 newspaper advertising surveys. Contact the Chamber of Commerce or the Retail Merchants Association and let them know what the class will be doing and that the results will be made available to them. Use "NEWSPAPER ADVERTISING SURVEY" Pass out No. 18. The instructor must give instructions as to how to shop. The student says to the salesperson, "I would like to see such-and-such item advertised in yesterday mornings paper."
D. Types of Media	
1. Definition--the means by which an advertising message is conveyed.	1. Put definition on board.
2. Types of media	2. List 3 types as discussed.
a. Periodicals--printed publications appearing periodically	a. Cite newspaper as example.
b. Mass media--addressed to public with little selection as to reader or hearer	b. Give as examples: radio, television, electrical signs. Call for a few others.

Topical Outline	Teaching Suggestions
c. Direct advertising--addressed to an individual	c. Cite direct mail as one form.
E. Use of Periodicals	
1. Types of periodicals	
a. Newspapers--read by a large public	a. Show examples of each and bring out the public appealed to.
b. Magazines and trade journals--appealing to special groups	
c. Directories--used for reference mainly	c. Ask how many ever used the classified telephone directory.
2. Reasons for frequent use of newspaper advertising	
a. Newspaper has large circulation and is localized.	a. Ask why newspaper advertising is used most frequently.
b. Newspaper is universally read by varied types of readers.	b. Bring out points not mentioned by group.
c. Quick results in sales are obtained.	
d. Appeal may be made timely.	
e. Copy may be changed daily.	e. Cite examples from sample advertisements.
f. Planning long in advance is not necessary.	
F. Use of Mass Media	F. Write three types on board.
1. Broadcasting	1. Comment on large audience reached
a. Radio and television	a. Point out that station breaks or spot announcements are usually utilized to advertise local store products.

Topical Outline	Teaching Suggestions
b. Public address system	b. Ask how many have heard businesses use this system of advertising both on the street and in the business.
2. Motion pictures and signs	
a. Films and slides	a. Ask for examples from local movie houses.
b. Electric and neon signs	b. Note attention value of motion.
c. Sky writing, airplane "trailers"	c. State that this may be used either for national or retail advertising.
3. Pictorial and printed messages	
a. Billboards and posters	a. Call for example in community.
b. Car and bus cards	b. Show copy, if possible.
c. Signs on truck	c. Ask what businesses advertise this way.
d. Point of sale signs	d. Cite as examples business sign; signs on window (painted or posted); signs and show cards in interior. Note frequent use in grocery and drug stores and service occupations, such as dry cleaning.
G. Use of Direct Advertising	
1. Direct mail	1. Ask what is meant by direct mail. Bring out fact that it includes all forms of material sent through the mail directly from the business to the individual potential customer.
a. Catalogs	a. Show mail order catalog as outstanding example of effective advertising.
b. Letters and post cards	b. Read a copy: show return postal.

Topical Outline	Teaching Suggestions
c. Pamphlets and folders	c. Show samples, ask for others.
d. Calendars	d. Note that these are used by food stores and meat markets. Also bring out value of constant reminder.
2. Peddled or handout material	
a. Circulars and handbills	a. Show samples.
b. Shopping news	b. Explain that this is published by a group of businesses. Show, if used in community.
3. Materials attached to merchandise	
a. Tags, labels and booklets	a. Show samples.
b. Package inserts wrapped with merchandise	b. Ask for examples.
c. Wrappers and containers	c. Compare with sign on delivery truck; while they advertise the business to indivicual customer, they also act as mass media.
H. Factors That Decide Selection of Media	
1. Clientele sought	1. Ask members how they decide where to buy a dress or suit.
a. Just looking--buy later	
b. Charge or cash customer	Point out that advertisers consider these points in selecting type of media.
c. Store-wide purchaser or patron of only one or few departments	
2. Type of organization	
a. Specialty shop	

Topical Outline	Teaching Suggestions
b. Department store	
c. Drug, grocery, etc.	Discuss briefly the media used most frequently by these different types.
d. Chain or independent	
e. Large or small	
3. Trading area or location	
a. Urban, suburban, rural	a. Ask for different media used in each instance.
b. Central, distant	
c. Principal and secondary shopping districts	c. Ask where these are located in the community.
4. Message to be sent	
a. Private--personal--"to whom-it-may concern"	a. Show samples.
b. Promotional--institutional	b. Explain difference: Promotional to sell merchandise, institutional to sell business or good will.
5. Cost of advertising media	
a. Relative cost	a. Point out fact that media vary greatly in production cost.
b. Amount business has to spend	b. Stress fact that amount sets limits, usually expressed in % of sales.
6. Competition to be met	6. State that while experience of other businesses provides a valuable lesson it is not always good simply to follow the leader.
I. Types of Advertising Copy	
1. Two types	1. Write on board.
a. Promotional	a. Tie up with term "merchandise."

Topical Outline	Teaching Suggestions
b. Institutional	b. State that this has to do with presenting ideals and services.
2. Use of two types of copy	
a. Use of one type only in an advertisement	a. Point out that occasionally an advertisement may be purely promotional or institutional. Show an example of each.
b. Combination of two types of copy in one advertisement	b. Explain that ordinarily both types appear in same advertisement. Show several examples.
J. Aims and Measurement of Each Type of Copy	
1. Promotional copy	1. State that this is the bread and butter advertising of the business. Upon it the business relies for its next day's business.
a. Intended to produce immediate sales	a. Stress importance of following through in selling.
b. Urges customers to buy specific merchandise on specific days	b. Read copy to bring out point.
c. Its results can be gauged by daily sales	c. Ask how this can be done.
2. Institutional copy	2. Point out that this type of advertising is concerned primarily with building good will, not with the immediate sale of merchandise or service.
a. Designed to sell the institution as a place to shop	a. Read slogan or service copy wich brings out this idea.
b. Seeks ultimate business	b. Ask why it may be beneficial in the long run.

Topical Outline	Teaching Suggestions
c. Its results can be gauged by study of over-all business	c. Comment on difficulty of gauging accurately the effectiveness of institutional copy.
K. What is Advertised in Each Type of Copy?	
1. Promotional copy	
a. Prestige merchandise or service to establish reputation as to progressiveness and alertness in buying	a. Explain that this might be merchandise of special brand, new item on the market, some special find, etc. Show advertisement illustrating prestige merchandise.
b. Regular priceline to create in public mind that there is a complete range of superior merchandise at these prices.	b. Point out that this type of promotional advertising seeks immediate sales of fashion or staple merchandise at price lines. Cite as example: A store carries regular price lines in dresses at $16.95, men's suits at $22.50, hats at $5.00, towels at 29¢, frying pans at $1.00 and spool of thread at 10¢. At these regular prices the store has complete assortments of fresh, timely and wanted merchandise. Show regular priceline advertisement.
c. Special promotion or sales advertising to produce immediate increase in sales volume at price concession, usually for shorttime only.	c. Point out that special promotions often follow special purchases of goods at great reduction in price, the business passing on the saving to the customer. Sometimes they come at end of a season when manufacturer wants to dispose of excess stock, sometimes before the season gets under way, as with summer fur sales. Markdowns may be taken also.

Topical Outline	Teaching Suggestions
	Show an advertisement emphasizing a special promotion.
d. Clearance promotion to enable each buyer to dispose of slow-selling merchandise, odd sizes, small lots of old merchandise	d. State that many businesses hold monthly sales which are clearance promotions designed to move slow-selling stock more often than is possible through semi-annual sales. Show an example of a clearance advertisement.
2. Institutional copy	
a. Institution as a whole	a. Mention inclusion of statements about bond drives, civic activities, parking facilities, etc., as well as observance of special holidays or season's greetings.
(1) Reputation in community	
(2) Part in community activity	
(3) Type of customer catered to	
(4) Convenience of location	Note that general tone of the advertisement conveys an institutional message. Show a strictly institutional advertisement of this nature.
b. Services of institution	b. Draw these points from the group briefly, first, then take advertisements and show where mention is made of each of these points.
(1) Credit and deferred payment plans	
(2) Delivery and mailing charge	
(3) Mail and telephone orders	

Topical Outline	Teaching Suggestions
(4) Store openings	
(5) Store directory	
(6) Special features, as gift wrap, tea room, etc.	
(7) Selling service	
(8) Merchandise policy as to completeness of stock, prices, guarantees, exchanges, etc.	Stress point that this advertising helps to make shopping easier for the customer and hence increases likelihood of sales.
L. Advangates of Each Type of Copy	
1. Promotional copy	1. Suggest members look back over aims and measurement, and what is advertised in promotional copy and then suggest its main advantages.
a. Results in immediate sales	
b. Informs customers on what is carried in various lines	
c. Allows customers to take advantage of special prices and savings	
d. Increases stock turnover by weeding out old merchandise	
e. Draws customers into organization for further purchases	
2. Institutional copy	
a. Attracts regular customers rather than one-time purchasers	a. Bring out point that institutional advertising aims to bring the customer back again and again.
b. Introduces the public to policies and services	

Topical Outline	Teaching Suggestions
c. Creates good will for the organization	c. Ask how these advantages will aid in making a permanent customer for the organization.
d. Impresses slogan on public	
e. Makes it easier for customer to shop	
M. How to Use Information About Each Type of Copy	
1. Promotional copy	
a. Use information given about merchandise as selling points	a. Point out the fact that the information in the advertisement has been prepared by experts after consultation with the buyer, and therefore is most valuable. Draw these main points from the group.
b. Answer customer's questions about advertised merchandise fully and accurately.	
c. Improve selling vocabulary by studying advertising copy.	
2. Institutional copy	
a. Refer to slogan or mention advertisement when appropriate.	a. Ask why this might be a good idea.
b. Answer questions about policies and services mentioned in copy.	b. Have group bring this out.
c. Reflect character of organization as indicated in advertisement is selling service	c. Stress importance of everyone's telling the same story.

Topical Outline	Teaching Suggestions
N. Steps in Advertising	N. Through group discussion, develop the importance of planning for effective advertising.
1. Planning the advertising program	
a. Determine objectives for a specific program.	
(1) Estimate expected sales.	
(2) Plan other objectives (increased good will, etc.)	
b. Outline dates for advertising program.	
c. Determine merchandise or services to be advertised.	
d. Decide on media to be employed.	
e. Estimate cost of advertising as to	e. Discuss ways of budgeting for advertising
(1) Dollars	
(2) Percentage of sales.	
2. Planning the specific advertisement	
a. Obtain needed information	
(1) Regarding merchandise or service to be advertised	
(a) Specific description of merchandise or service	
(b) Price	
(c) Quantity on hand and on order	
(d) Guarantee	

Topical Outline	Teaching Suggestions
(e) Services offered in connection with sale (credit, delivery, gift-wrapping, etc.)	
(2) Regarding medium to be used	
(a) Size of advertisement	
(b) Time and frequency of advertisement	
(c) Specific cost of advertisement	
b. List selling points of merchandise or services to be advertised.	
c. Write copy	
d. Prepare layout	d. Have students prepare an actual layout of an advertisement for merchandise or service in which they are interested.
(1) Principles of good layout	
(a) Attract favorable attention	
(b) Secure and maintain interest	
(c) Create desire	
(d) Induce action	
(2) Parts of the layout	
(a) Headline	
(b) Subheadline	
(c) Copy blocks	
(d) Illustration	
(e) Border	

Topical Outline	Teaching Suggestions
(f) Price	
(g) Logotype (Company signature)	
(h) White space	
3. Checking the results	3. Explain that this is sometimes called measuring the "pulling power" of advertising - the ability to draw in customers and to produce sales. Discuss methods of checking the results of an advertising program or a specific advertisement.
O. Using Professional Advertising Services	
1. Advertising agencies	
2. Local media representatives	
3. Mat services	3. Discuss services available to small businesses.
4. Publicity department of the individual business (large companies)	4. Outline typical publicity or advertising department in a large business.
a. Publicity or advertising manager	
b. Copywriters	
c. Layout artists	
d. Fashion artists	Refer to: Retailing Principles and Practices, 4th Edition, Chapters 43, 44, 45, and 46. Sales Horizons, 1958 copyright, Chaper 17. Business Principles, Organization and Management, Chapter 10.
	ASSIGNMENT: Give each student a newspaper advertisement and have each one answer the following:
	(1) What was the one outstanding idea in the ad?
	(2) Is the advertised merchandise appropriate to the time of year and season? Explain.

Topical Outline	Teaching Suggestions
	(3) List the important facts about the merchandise to a potential customer. (4) What is the major benefit the customer will receive if he purchases this item? (5) How is the reader urged to take action? (6) What is the major selling appeal?

III. DISPLAY

Objectives

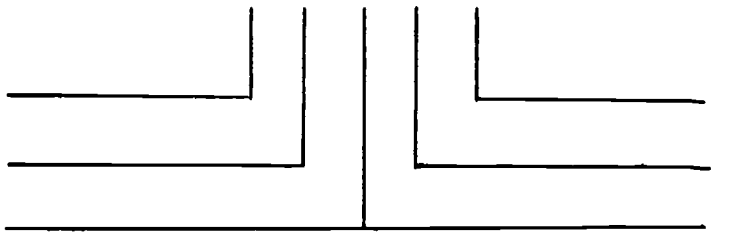
1. To help students understand display and its part in the sales promotion program.
2. To help develop ability in preparing displays as part of sales promotion programs.

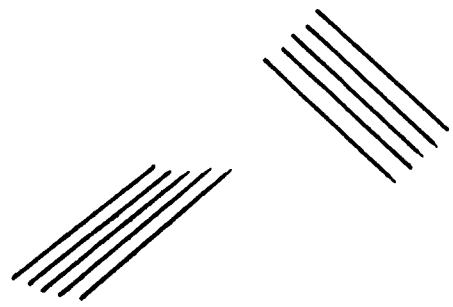
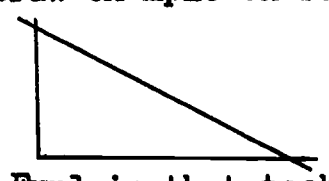
Topical Outline	Teaching Suggestions
A. Introduction to Display	A. Tie up display with advertising unit all through discussion.
1. Definition	1. Draw definitions from group and put on the board.
a. Any form of nonpersonal presentation of goods or an idea to a group	
b. A kind of advertising in which actual merchandise or services are presented visually	
2. Difference between display and other forms of promotion	2. Show group an article and an advertisement for the article. With these two draw differences from the group.
a. Different from direct selling -- person absent	
b. Different from advertising -- actual merchandise present	
c. Different from special event -- may be part of an event	
3. Functions of a display	3. Compare with functions of direct selling and advertising to show that all are methods of promoting sales.
a. To attract attention	
b. To arouse interest	
c. To create desire	
d. To induce action	
4. Importance of display	
a. Has a close correlation to relative strength of sense appeals	
b. Reflects personality of business	
c. Educates the public	

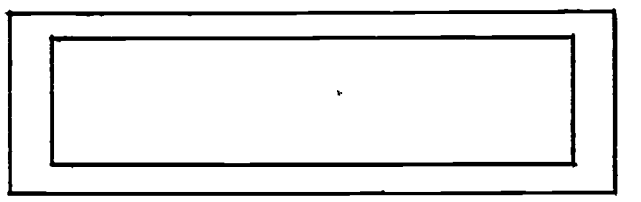
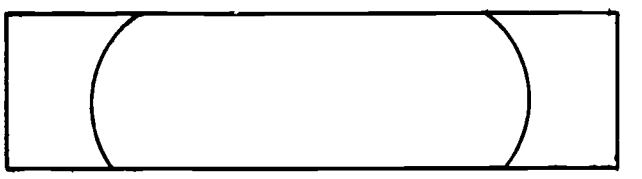
Topical Outline	Teaching Suggestions
d. Helps prepare the customer for the personal message of the salesperson by showing the actual merchandise or services, not just pictures of them	
e. Contributes to the pleasing environment of the business establishment	
f. Increases customer traffic	
g. Increases sales, thereby increasing net profits	
B. Classifications of Display	
1. Classifications of displays according to purpose	1. Point out that display, like other advertising, is classified primarily according to the two basic purposes. Ask students for examples of institutional displays which they have seen.
a. Institutional displays: those displays which have as their purpose to build customer good will, thereby increasing future sales	
b. Promotional displays: those displays which have as their purpose to achieve immediate sales	
2. Classifications of displays according to location	2. Discuss the three types of display, according to location.
a. Window displays	
(1) Types	
(a) Open	
(b) Closed	
(c) Semi-closed	
(2) Functions	
(a) Create first impression of business - serve as the "face" of the business	

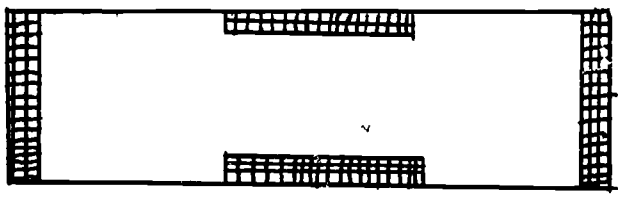
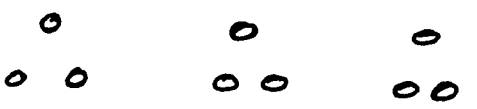
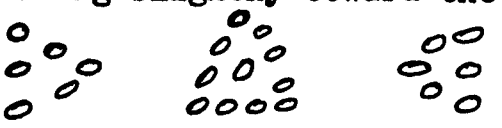
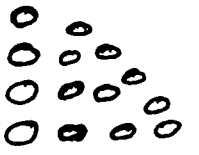
Topical Outline	Teaching Suggestions
(b) Strengthen and support other advertising of the business	
(c) Attract customers into the building	
b. Interior displays	
(1) Types	
(a) Open displays.	(a) Through group discussion, bring out various types of interior displays used in businesses represented by students;
i. Shelf	
ii. Counter top	
iii. Bin	
iv. Island	
v. Aisle table	
(b) Closed displays	
(c) Architectural displays	
(2) Functions	
(a) Enhance beauty of interior	
(b) Show items for sale at point of purchase	
(c) Support window displays and other advertising	
(d) Miscellaneous displays	
c. Outside displays (located at other than site of business building)	
(1) Fairs	
(2) Conventions and meetings	
(3) Other	

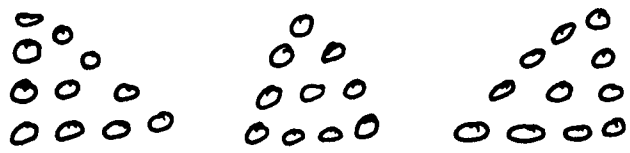
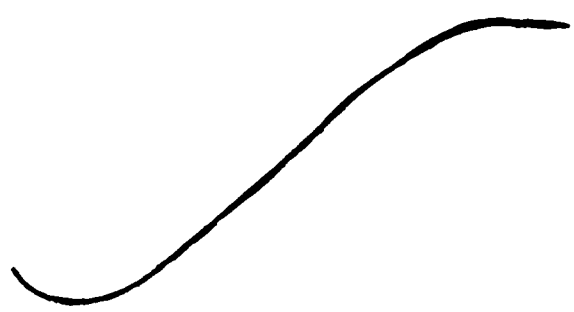
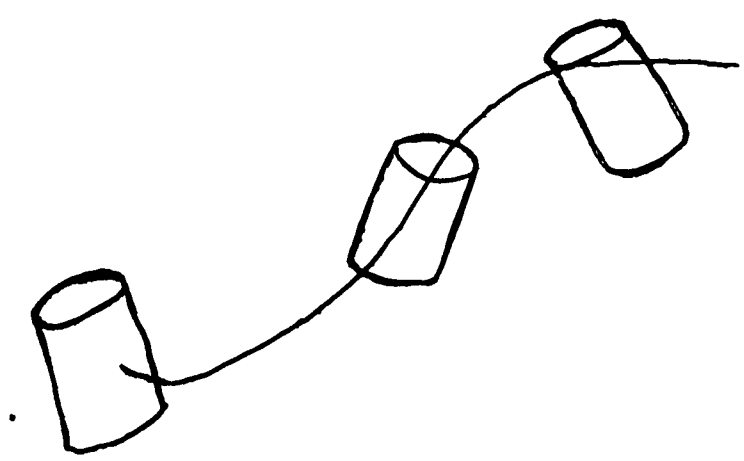
Topical Outline	Teaching Suggestions
	Give out display survey forms, pass out No. 19. Have each student complete at least five. Notify Chamber of Commerce and/or Retail Merchants about the project.
	Reference 8, Chapter 39.
C. Basic Principles Underlying all Display	C. State that effective displays are governed by basic principles.
1. Principles of design or arrangement	1. Write on board or present in poster form. Do not define at this point but explain that each will be discussed in detail later.
a. Harmony	
b. Proportion	
c. Emphasis	
d. Rhythm	
e. Balance	
2. Principles of color	2. Stress wide use of color in display and need for knowing how to use it wisely.
a. Color harmony	
b. Combining colors	
c. Emphasis	
d. Balance	
D. Facts About Design or Arrangement	
1. Definition of design or arrangement--the selecting and arranging of material in an orderly and neat fashion	1. Get ideas from group as to what design or arrangement means to them.
2. Advantages of good design	2. See following page for suggestions.
a. Merchandise catches the eye.	a. Demonstrate with two displays set up before class; one well arranged, the other hit or miss
b. Merchandise is more pleasing.	
c. Merchandise can be seen to better advantage.	c. Have group compare the two, thus bringing out the advantages of good arrangement.

Topical Outline	Teaching Suggestions
d. Merchandise takes on meaning.	
3. Five principles of design or arrangement	3. Write five principles on board. Explain that each principle will be discussed briefly and applied to display.
a. Harmony	
b. Proportion	
c. Emphasis	
d. Rhythm	
e. Balance	
E. Five Aspects of Harmony and Their Application	E. Start discussion by having group think of harmony in its musical sense (e.g. barbershop quartet harmony) as being pleasant to the ear. State that the same is true with objects if they are pleasing to the eye, they are said to be harmonious. Write definition of harmony on board: "That which produces an impression of unity through the selection and arrangement of consistent ideas and objects."
1. Line	1. Point out that lines fall into four classes.
a. Use opposition to express strength and stability	a. Draw illustration on board. 
b. Use repetition (simplest kind of harmony) for emphasis.	b. Draw the following examples on board point out reaction to each:
(1) Vertical lines are severe and display masculine quality.	

Topical Outline	Teaching Suggestions
(2) Diagonals from left to right induce action. The eye follows along this line of force.	
(3) Diagonals from right to left suggest a lack of stability.	
(4) Horizontal lines suggest relaxation and repose.	
c. Use contradiction for contrast and to make transition.	c. Draw example on board:  Explain that technically any line which cuts across from one opposing line to another is transitional. A straight line, as above, is so sudden and sharp that it cuts it sharply across corners: therefore, the term contradiction.
d. Use transitional to lead easily from one line to another.	d. Draw example on board: Point out that it is an easy, graceful line leading from one line to another. The sharpness is modified. State that line harmony is most important in display — especially for background treatments, and when you want to control eye movement.
2. Shape	2. State that a combination of lines results in a shape.

Topical Outline	Teaching Suggestions
a. For perfect harmony, use shapes which correspond to one another.	a. Draw as example: 
b. For contrast, use inharmonious shapes,	
3. Size	3. Cite as lack of harmony a lot of merchandise displayed in a small shadow box.
a. Keep size consistent.	
b. Keep sizes in proportion to each other.	
4. Texture	
a. Harmonize textures of materials.	a. Demonstrate with materials.
b. Harmonize skin and hair textures.	b. Explain that skin and hair texture of mannequins differ. Show, if possible.
5. Idea	
a. Let one fundamental idea dominate.	a. State that simplicity is the basis for good display.
b. See that details are consistent with the idea.	b. Ask whether details ever detract from a display because of lack of consistency.
	Sum up harmony by stating that it is the most important of design principles. It must consider both appearances and use.
F. Facts About Proportion as Used in Display	F. State that the principle of proportion as applied to design is called the "law of relationships." Put definition on board.
1. Facts about space relationships	
a. The Greek or golden oblong with a 3 to 2 relationship is	a. Draw oblong on board and then show how much more interesting

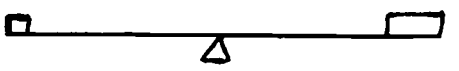
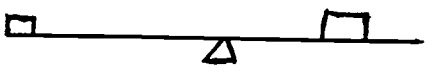
Topical Outline	Teaching Suggestions
the most pleasing area relationship.	and pleasing it is than a square.
b. Space intervals between objects govern the appearance of the whole	b. Illustrate by drawing rectangle on board and shading in squares.  Ask group if they see 4 small rectangles or an H.
2. Four commonly used space divisions or types of arrangement	2. Write four types on board.
a. Pyramid	
b. Step	Reference 8, Chapter 39.
c. Zig-zag	
d. Repetition	
G. Use of Four Arrangements in Display	G. Point out that the pyramid arrangement can be used with any type of merchandise, but it is most effective with hard merchandise.
1. Pyramid	1. Illustrate the pyramid arrangement by using cans or small boxes. 
a. Is commonly used	
b. May be used with any type merchandise	
c. Is stiff and formal	Show how emphasis can be secured by using a large pyramid in the center and two smaller ones on either side facing slightly toward the center. 
2. Step	2. Illustrate step arrangement by using cans or small boxes. 
a. Is effectively used as a side unit facing center of attraction	

Topical Outline	Teaching Suggestions
b. Is more informal than pyramid	
c. Is most effective when only three items are used	
(1) Difference in height should be equal	(1) Ask a member of the class to illustrate how the step arrangement could be used as side units.
(2) Items in each unit should face in the same direction	
d. Can be combined with pyramid	d. Point out how emphasis can be achieved by combining pyramid and step arrangement. 
3. Zig-zag	3. Draw example of double reverse curve on blackboard. 
a. Is based on principle of double reverse curve	
b. Is particularly adaptable to wearing apparel	
c. Requires equidistant spacing	
(1) Top items fact slightly outward	(1) Illustrate zig-zag arrangement by tin cans or boxes showing the gradual turning.
(2) Middle items fact slightly to right or left	
(3) Low items, opposite the middle items face inward	
d. May use small accessory items to eliminate vacant areas	

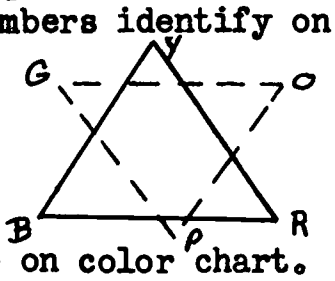
Topical Outline	Teaching Suggestions
4. Repetition (continental)	4. Explain that the continental type of arrangement originated in Europe and is based on the value of repetition.
a. Is simple in form	
b. Uses items of same general nature	Illustrate repetition by placing cans or small boxes in a straight line.
c. Aligns items in exactly the same manner as to height, spacing, and angle they face	
d. Requires deviations to break monotony	
(1) Use panels and elevated platforms.	(1) Ask how you can break the monotony.
(2) Display one item as a single unit.	
(3) Tilt formation at an angle.	
(4) Use box effect.	
H. Use of Emphasis in Display	H. State that emphasis is the creation of a center of interest.
	Point out that its purpose in display is to capture the customer's attention.
1. What to emphasize	
a. Decide what is most importance.	a. State that in a very simple display the show card may be the center of interest.
b. Subordinate other objects of importance.	b. Refer back to jumbled displays in which nothing stands out of the mass.
c. Have backgrounds less conspicuous than the objects which are to be seen against them.	c. Show good and poor examples.
	Demonstrate by having group pick out centers of interest in displays.
2. How to emphasize	
a. Create definite units by placement or grouping of objects.	a. Demonstrate with objects.

Topical Outline	Teaching Suggestions
b. Contrast light and dark colors.	b. Demonstrate by contrasting two objects, one pair alike in value, the other differing in this respect.
c. Use decoration.	c. Point out that too much elaboration may defeat the purpose.
d. Use plain space around object.	d. Compare with white space used in advertising to set off copy.
3. Where to place centers of interest	
a. If object on a horizontal plane is to be seen on all sides, place in center of space with equal borders on all sides.	a. Demonstrate with a bowl of flowers on mat in table center.
b. If object is to be seen from a vertical position, place center of interest above the mechanical center, and the lower margin wider than the others.	b. Explain that this is to overcome the optical illusion which makes objects in this position seem to drop in space. Show use in a show card.
4. Handling of area of visual shock, or emphasis	4. State that the shock area is the place of greatest emphasis or visual impact.
a. The exact size of the shock area varies.	a. State that there should be usually one point of emphasis, never more than three.
b. The area is usually 1/4 to 1/16 of the total display area.	
c. The shock area should be in contrast to the background.	c. Ask why.
d. Merchandise should be placed around the shock area.	d. Show examples.
I. Use of Rhythm to Hold Interest	I. State that after you have the customer's attention it is the art principle of rhythm that will hold the attention. Write definition on board: "Rhythm is related movement."
1. Through repetition of shapes	
a. Shapes are repeated at regular intervals.	a. Cite as examples button and tie displays.

Topical Outline	Teaching Suggestions
b. Separate units are not apparent.	b. Call for examples from group.
2. Through progression of sizes	
a. Eye is made to move rapidly over display	a. Cite as expamples mixing bowls (demonstrate) and Mother 'n Daughter dresses.
b. Sizes may increase or decrease	b. Call for suggestions.
3. Through continuous line movement	
a. Makes large use of curves	
b. Creates graceful, swinging movement	b. Cite draped fabric as example.
4. Through radiation	
a. Movement grows out of a center point.	a. Kation use in displaying silver flatware, kitchen gadgets, small articles like ties and handkerchiefs.
b. Movement outward may be restrained by an outer encircling band.	
	Summarize by pointing out that your eye should travel along an easy, graceful, connected path of any arrangement of lines, colors or objects. Through the use of rhythm, you draw the eye around the rest of the display, thereby tying your composition together, and, at the same time holding your customer's attention.
J. Use of Balance in Display	
1. Formal balance	1. Demonstrate with object.
a. Objects are alike or equally forceful.	
b. Objects have same power of attracting attention.	
c. Feeling of dignity, restraint and conservatism is given.	
2. Informal balance	

Topical Outline	Teaching Suggestions
a. Objects idffer in size, shape or color.	
b. Objects differ in their ability to attract.	Demonstrate with objects.
c. More subtle, imaginative arrangements can be achieved.	
3. Determining balance	
a. Draw an imaginary line down the center of whatever is to be balanced.	a. Have members experiment with changing from formal to informal balance and vice versa.
b. Bring together the articles to be balanced.	
c. For formal balance, place weight for weight on either side of imaginary line.	c. Compare with see-saw. 
d. For informal balance, place heavier object nearer the center, lighter or less attractive object farther from the center.	d. Compare with see-saw. 
e. Avoid topheaviness by placing the heavier looking object and colors close to the floor.	Summarize by stating that balance is nothing more than rest or repose. The restful effect is obtained by grouping shapes and colors around a center in such a way that there will be equal attractions on each side of that center.
K. Important Color Terms	K. Stress importance of a color vocabulary to an understanding of the subject.
1. Two kinds of color	
a. Chromatic colors, such as red, green, blue	a. Explain that word chroma means color.
b. Achromatic colors or neutrals, such as black, white, and grays	b. Explain that black is without color; white is a mixture of all colors; gray is intermediate; tans are sometimes considered neutral.

Topical Outline	Teaching Suggestions
	Refer to: Retailing Principles and Practices, 4th Edition, Chapters 39 and 40. Store Salesmanship, 5th Edition, Chaper 13. Business Principles, Organization and Management, Chapter 10.
2. Warm and cool colors	
a. Warm colors--those with red or yellow in them	a. Ask members what they would consider warm colors--then analyze.
b. Cool colors--those with blue or green in them	b. Contrast warm and cool colors to show the difference.
3. Tints and shades	
a. Tints--colors with white in them	a. Demonstrate with merchandise showing difference between tint and shade of same hue.
b. Shades--colors with black in them	
4. Properties of color	4. State that every color has three properties
a. Hue --the color itself	a. Cite as example, red, blue, green. Explain that in a restricted, popular sense, hue is used to describe intermediate colors, such as yellow-green, red-purple.
b. Value--the lightness or darkness of a color	b. Refer back to tint and shade.
c. Intensity or chroma--the brightness or dullness of a color	c. Demonstrate difference between value and intensity by showing a bright and dull tint and shade.
L. Facts About Hue	L. State that the Prang theory applies to pigments only, not to light.
1. Classification of hues	1. Demonstrate with use of 6-point star, on flannel board if possible.
a. Primary hues are red, yellow and blue.	a. Explain that they cannot be formed by mixing any colors. Show on triangle.
b. Secondary hues are formed by mixing primary hues.	b. Have members identify orange, purple and green on the chart, adding second triangle.
c. Tertiary hues are formed by mixing secondary hues.	c. Have members identify on chart: Green and orange -- citron Green and purple -- olive Purple and orange -- rust

Topical Outline	Teaching Suggestions
d. Six intermediate hues are formed by mixing primary hues with their neighboring secondary hues.	d. Have members identify on chart: Yellow-orange Orange-red Red-Purple Blue-purple Blue-green Yellow-green
e. Complementary hues are those opposite each other on the color chart, which when mixed in equal proportions, give gray	e. Have members identify on chart. Give out copies of chart as summary. 
2. Effects of warm hues	2. Demonstrate on color chart.
a. Make things look larger	a. Compare warm and cool hues to bring out differences.
b. Make things appear nearer	
c. Invigorate the observer	
d. Cheer the observer	
3. Effects of cool hues	3. Have members identify on chart.
a. Make things look smaller	
b. Make things appear farther away	
c. Calm the observer	
d. Depress the observer	
M. Facts About Value	
1. How to change values	1. Demonstrate with materials or articles.
a. Make a <u>tint</u> by adding white.	
b. Make a <u>shade</u> by adding black.	
2. Effects of tints or light values	2. Demonstrate with materials or articles.
a. Make things look larger	
b. Make things look farther away	
c. Make other colors stand out	

Topical Outline	Teaching Suggestions
3. Effects of shades or dark values	3. Compare with tints.
a. Make things look smaller	
b. Make things look nearer	
c. Absorb colors	
N. Facts About Intensity of Chroma	
1. Intense hues do not blend easily.	1. Demonstrate with shiny materials.
2. Intensity may be increased in three ways.	2. Select a colored object and show how intensity may be changed.
a. By using a neutral, black white or gray near it	
b. By using a color of low intensity	
c. By using the complement of of the color near it	
O. Use of Color Harmony in Display	
1. Definition of harmony--an agreeable combination of colors when used together	1. Draw idea from group and then define.
2. Related harmony	2. State that there are two kinds--related and contrasting.
a. Monochromatic--a combination of one hue of different values and intensity	a. Explain that this means one color. State that it is pleasing but not exciting. Show examples.
b. Analogous--a combination of colors next to each other on color chart	b. Use chart to demonstrate. Show examples.
3. Contrasting harmony	
a. Complementary--a combination of complementary colors	a. Demonstrate on chart and show examples. Ask group to compare different effect produced.
b. Double complementary--a combination of two neighboring colors with their complements	b. Have members identify on chart and try out effect.

Topical Outline	Teaching Suggestions
c. Triad--a combination of any 3 colors that form a triangle in the color star	c. Rotate triangle around center point of star to locate triads. Show samples.
P. Principles of Combining Colors	
1. Group colors	1. Show examples.
a. Use warm or cool colors.	a. Let class members select combinations.
b. Use colors of opposite groups only for contrast in small amounts.	
2. Have background bring colors together	
a. Use neutral background for colorful merchandise.	a. Demonstrate
b. Use strongly colored backgrounds to draw attention to neutral merchandise.	b. Stress need for contrast.
3. Key colors for harmony	
a. Add a trace of one color in all colors.	a. Show examples.
b. Place neutral colors between two colors that do not relate well.	b. Have members select and demonstrate.
c. Roughen texture to improve blend.	
Q. Principles of Balance and Emphasis	
1. How to balance colors	
a. Select one color for emphasis	a. Demonstrate with objects and materials.
b. Contrast hues, values and intensity	
R. Effect of Aritificial Light on Colors	

Topical Outline	Teaching Suggestions
1. Artificial light adds yellow to all colors	1. Demonstrate with merchandise.
2. Artificial light changes colors	
a. Warm colors are brightened	a. Demonstrate and ask what happens.
b. Blue becomes slightly greenish	
c. Purple may appear grayish	Ask why it is important to realize this fact in planning displays.
S. Steps in Creating a Display	S. If possible direct students in the creating of an actual display.
1. Plan the display	
a. Merchandise or service to be displayed	
b. Theme	Refer to: Sales Horizons, 1958 Copyright, Chapter 17. Retailing Principles and Practices, 4th Edition, Chapters 38, 39, 41, and 42. Store Salesmanship, 5th Edition, Chapter 13. Business Principles, Organization and Management, Chapter 10.
c. Arrangement	
d. Fixtures	
2. Prepare the display space and materials.	
3. Build the display in units.	
4. Make needed adjustments.	
5. Maintain cleanliness and lighting.	
T. Window Display Judging	T. Secure the approval of several establishments to have their windows prejudged by three adults experienced in display as these windows will be judged by students. Secure the three adult judges and train them in judging windows. Have the adult judges rate the windows and arrive at a composite score for each window. Then have students judge the windows and reach a composite score for each window to determine which student has scored nearest to adult judges.

V. BUSINESS ORGANIZATION

BUSINESS ORGANIZATION

MATERIALS AND EQUIPMENT NEEDED

1. Order from: National Association of Manufacturers
   2 East 48th Street
   New York 17, New York

   a. "Antitrust Laws" -- report of Attorney General's Committee, April, 1955.
   b. "Automation" -- study aid, April, 1960.

2. Current issues of "Stores, "Business Week", "Chain Store Age", "Department Store Economists", "U. S. News and World Report", and "The Journal of Retailing" and other periodicals concerning current activity and trends in marketing.

3. Mimeographed forms for each student:

   a. Organization chart of line, functional, and line and staff forms of internal organization.
   b. Organization chart of a small business and a large business
   c. The merchandising functions (Flash cards may be used instead.)
   d. Typical wholesale types of organization

4. Flash cards or flannel boards on:

   a. Legal forms of business organization
   b. Different types of stores
   c. The merchandising functions

I. BACKGROUND AND GROWTH OF MARKETING IN AMERICA

Objectives

1. To give an insight into the growth of marketing in America
2. To teach students that our system of business is primarily American in its concept and largely developed through economic, social, and political pressures.
3. To stress that poioneers in marketing and distribution were persons of vision and opportunity who had faith in their ideas
4. To show trends in marketing techniques and the evolution of today's business practices
5. To instill a sense of appreciation for distribution as a means of providing the United States with the highest standard of living in the world today

Topical Outline	Teaching Suggestions
A. The Growth of Retailing	A. Students may be selected to interview merchants to obtain brief histories of their stores and the plans for growth and make brief reports to class.
1. New types of retail outlets	Chapter 55, Richert, Meyer, and Haines, Retailing Principles, and Practices, 4th Edition.
a. Department stores	
b. Mail-order houses	
c. Variety stores	Assign reports on "merchant princes" such as John Wanamaker, Marshall Field, F. W. Woolworth, George H. Hartford, Aaron Montgomery Ward, Richard Sears, Isaac Gimbel, and others who were leaders in these stores.
d. Chain stores	Let student name local chains.
2. Changes in policies	
a. One price policy	a. One-price policy is in contrast to some systems where the policy is established by "haggling" or bargaining between shop owner and customer.
b. Better quality	b. Merchandising--"strategy to get the right product to the right place in the right quantity at the right price at the right time in the right light." Better quality merchandising refers to stocking known brands and quality goods.
c. Shortened credit periods	c. Show use of revolving charge plans, 30-day credit.

Topical Outline	Teaching Suggestions
d. Increased use of advertising	d. First newspaper ad appeared in 1704. Use of advertising is increasing as a key instrument in the great progress of America's standard of living.
e. Visual merchandising	e. Ask question, "What do we mean by visual merchandising?" (Display counters, interiors, counter displays, out-of-store displays)
f. Bargain merchandising	f. What is "bargain" merchandising? It is the policy of displaying an expensive item next to an inexpensive item which looks similar but is a price that most can afford.
g. Odd cent pricing	g. What is odd cent pricing, and why do you think it started? The practice of making an item 98¢ was to force the salesclerk to return change to the customer. Clerks were dishones; odd cent pricing made them register sales. Today, the odd cent pricing is retained for the psychological benefit. $4.98 appears more attractive than $5.00.
h. Honesty and integrity in merchandising	h. Merchants became more interested in repeat business as populated centers were established. This brought about change in philosophy from caveat emptor (let the buyer beware) to one of satisfying the customer by giving him quality merchandise at a good price and providing services.
	Summerize changes on chalkboard.
B. Twentieth Century Marketing Prior to World War II	
1. Rise of supermarkets	Lecture and discuss with group the growth of supermarkets in the local community. Supermarkets originally were "food store discounters." They drew the same criticism that general discount houses experience in their field.
a. Depression economy forced reduction of food distribution costs.	
b. Overhead was reduced by eliminating services.	

Topical Outline	Teaching Suggestions
c. These were located in lower income neighborhoods.	
d. Prestige gradually increased with better equipment and additional services.	
2. Growth of voluntary chains	2. Ask, "What is a voluntary chain?" It is a group of independent retailers who have been brought together for joint buying and other activities by some organization willing to serve the retailers as a wholesaler.
a. Price competition forced cooperative organization.	
b. Cooperative sales promotion reduced overhead.	
c. Ownership and operation remained completely independent.	
3. Government regulation	3. Have students give brief oral reports on government regulations prior to World War II concerning fair trade laws and anti-loss-leader legislation. Ask local store manager to discuss the advantages and disadvantages of these regulations.
a. Taxation	<u>Business Principles, Organization and Management</u>, Tonne, Simon, and McGill, Chapter 26, p. 421-444.
b. Safety	
c. Labor	Refer to pamphlet "Antitrust Laws," Report of Attorney General's Committee, from National Association of Manufacturers.
d. Price	
e. Merchandise	Develop a list of the effects on business resulting from government regulation through a "buzz" session.
f. Advertising	
C. Marketing Since World War II	
1. Status of wholesaling	
a. More highly specialized	
b. More services to retailers offered	
(1) Financial aid	

Topical Outline	Teaching Suggestions
(2) Assistance in location selection	
(3) Economic surveys	
(4) Other services	
2. New trends in retailing	Have students go into a "buzz" session on the topic, "Trends in Retailing."
a. Discount merchandising	
(1) Uniform price discounts	Have students read current articles in "Stores," Journal of Retailing," or any other references on the discount movement.
(2) Self-service	
(3) Curtailed services	
(4) Less expensive fixtures	
(5) Cash and credit basis	
(6) Mass display	
(7) Location in shopping centers	
b. Future of discounting	Here again, refer to current publications.
(1) Unlimited field	
(2) Reflects trends of consumer buying habits	
(3) Same origin and future as supermarkets	
c. Technology	
(1) New products	Example: (1) Teflon frying pans, which require no fat
(2) Automation	(2) Example: All types of vending operations Vending machines have been in use over 80 years. Also, refer to pamphlet, "Automation", Study Aid, National Association of Manufacturers.
	Discuss new products on the market today that were not there 10 years ago. Discuss effect of automation on retailing.
d. Suburban development	d. Example: shopping centers

Topical Outline	Teaching Suggestions
e. Urban redevelopment	<u>Retailing Principles and Practices</u>, Richert, Meyer, and Haines, Unit 1. <u>Retail Merchanding</u>, Wingate, et al. 5th Edition, Chapter 3. <u>Business Principles, Organization and Management</u>, Tonne, et al, Chapter 6.

II. TYPES OF LEGAL ORGANIZATION (According to Ownership)

Objectives

1. To give students an understanding of the legal forms of business organization
2. To point out advantages and disadvantages of different kinds of ownership and how authority is delegated through organizational structure
3. To give the student an appreciation of proper organization and established authority for efficient operation of any business

Topical Outline	Teaching Suggestions
A. Sole Proprietorship	
1. Definition: Individual ownership of a business, usually a small one, in which owner assumes all risks and receives all profits.	Define, explain, and discuss. Business Principles, Organization and Management, Tonne, et.al. Chapter 2.
2. Advantages	Draw from class and discuss. Ask students how many work for an individual proprietor. Give examples of sole proprietorship in your community. Ask students to summarize advantages of sole proprietorship:
a. Easy to organize	a. No "red tape" or complicated legal problems--easy to organize
b. Freedom of action	b. It is not necessary to consult others in order to reach a decision.
c. Profits not shared	c. Owner keeps all profits for himself.
d. Low taxes	d. Taxes are not levied against the type of ownership itself.
e. Personal pride of ownership	e. Owner has more incentive to work and gets more satisfaction from his work.
f. Personal and friendly relationship	f. Relationship between owner, employees, and customers is warm and firndly.
g. Profit taxes as personal income	g. Lower tax rate than partnership or corporation.
h. Room for creativity and ingenuity	h. Owner can use new ideas and experiment as he chooses.
3. Disadvantages	
a. Risk of loss	a. Owner stands alone in the risk of losing money; may also lose personal goods if business debts cannot be paid.

Topical Outline	Teaching Suggestions
b. Limitation of size	b. Capital needs are usually beyond the individual's ability to borrow.
c. Problems of management	c. Owner cannot be a specialist in all fields of business operation; must be a Jack-of-all-trades.
(1) Possible effects of lack of knowledge of all phases of management	
(2) Possible effects of death or disability of proprietor	If the proprietor dies or is otherwise unable to continue, the business may have to be terminated.
d. Limited capital	
B. Partnerships	
1. Definition: An organization owned by two or more individuals who have combined their money and talents.	Define, explain, and discuss.
2. Advantages	Comments:
a. More capital available than in sole proprietorship	a. Additional owners increase possibility of obtaining more money for expansion.
b. Improved credit position	b. Money may be borrowed on the basis of all partners' credit or assets rather than on one individual's.
c. Better management	c. Each partner will have much keener interest in the success of the business than if he were only an employee.
d. Pooling of skills and abilities	d. Combination of skills and ideas lead to better operating procedures.
e. Combines partners' good will	
f. Lower taxes than corporation	f. A partnership has tax advantages over a corporation. The form of ownership itself is not taxed as is a corporation.
g. Simple organization	g. Compared with the corporation, the partnership is relatively easy and inexpensive to organize - (few state regulations.)
h. Oral or written agreement	h. The agreement should be in writing, for this will prevent misunderstandings about the responsibilities of each partner.

Topical Outline	Teaching Suggestions
i. Profit sharing in proportion to capital invested	Discuss with the students the advantages and disadvantages of the partnership. Have students give examples of partnerships in their community.
3. Disadvantages	
a. Risk of dissolution	a. If a partner withdraws or is unable to continue because of illness or death, the partnership ends.
b. Possiblity of disagreement	b. Partners may not agree on how the business should be run, causing friction, drawn-out decisions, and general inefficiency.
c. Unlimited financial liability	c. Each partner is individually liable for all debts of the firm.
d. General agency	d. One partner's acts can bind all the others.
e. Limited size	e. Difficult to raise enough capital to become a large business
4. Types of partnership agreements	
a. Silent partner -- non-menagement for one partner but equal capital investment	a. Under this arrangement, partners may or may not share profits equally. This would be decided in the partnership agreement.
b. No capital investment for one partner in exchange for knowledge or ability	
c. Limited partner -- non-participation for one partner in exchange for capital investment	c. Under this arrangement, the liability of the limited partner does not exceed his investment.
	Ask students: If you could choose to go into the business of your desire, would you choose the proprietorship or the partnership form of organization. Why?

Topical Outline	Teaching Suggestions
C. Corporations	Business Principles, Organization and Management, Tonne, et. al, Chapter 3.
1. Definition: An organization made up of a group of people who pool their resources and operate the business under a state charter.	Federal government grants charters to national banks and organized the Federal Reserve Bank.
a. Stockholders own the business.	Assign individual reports on various corporations. They may write direct for information from Standard Oil of New Jersey, Jefferson Standard Life, Penney, etc. Instruction should be given as a review on proper letter writing techniques.
b. Stockholders elect directors.	
c. Stockholders have one vote per share owned.	
d. Board of Directors formulates general plans and policies and appoints officers.	
e. Officers have charge of active management.	
f. Business is incorporated for a fixed amount. Only that amount of shares may be sold.	f. Discuss formation of a corporation.
g. Stockholders may sell out at will.	

Topical Outline	Teaching Suggestions
h. Organization pattern allows for central, unified control.	
2. Advantages	Draw from group and discuss the advantages and disadvantages, giving examples of local corporations. Students may be divided into small "buzz" groups to list advantages and disadvantages. A secretary from the groups may list findings on chalkboard.
a. Limited financial liability of stockholder	a. Each stockholder is liable only to the extent of his original purchase of stock.
b. Contracts only bound by designated officer	b. No one owner can make a contract that will bind the company, as a partner can do.
c. Tremendous growth possibilities	c. The public corporation can grow large by selling securities to the general public.
d. Permanency of existence	d. The corporation life is not affected by death, disability, or disagreement of a stockholder.
e. Opportunity for expert management and large-scale economies	e. The large public corporation can afford to hire the most skilled personnel and can save money by large-scale purchases and integrated operation.
f. Ease of raising capital	f. New stocks or bonds can be issued as provided in the charter.
3. Disadvantages	Put on chalkboard a chart (or use flannel board or posters) showing comparison of definitions, advantages and disadvantages of legal forms of ownership business.
a. High taxes	a. The corporation pays many special kinds of taxes and its income is subject to double taxation.
b. Government regulations	b. The state and federal governments surround the corporation with many regulatory laws and supervisory bodies.
c. Dependence of credit on corporation's assets alone	c. A small corporation may find it difficult to borrow money or obtain credit, since no owner is liable for its debts.

Topical Outline	Teaching Suggestion
d. Separation of ownership and management	d. Proxy voting can give the control of the corporation to those not looking out for the best interest of the stockholders.
e. Charter restrictions	e. The corporation can operate only within the boundaries set forth in the charter.
f. Difficult to form	f. Complicated legal procedures are involved.
g. High operating expenses	
4. Types of corporations	
a. Closed or family-type -- stock owned by few, not open to general public for sale	a. Bing Crosby Enterprises is an example of a closed corporation. Ford Motor Company was until it was made a public corporation in 1955.
b. Public--stock open to general public and listed on exchanges for sale	b. General Motors, American Telephone and Telegraph, and Sears Roebuck are some examples of public corporations.
D. Cooperatives	Draw from group and discuss how a cooperative is like a corporation and how it is different.
1. Definition: A special corporate form of organization operated to supply goods or services to its members, who are its owners.	Give examples. Define, Explain. Many independent retailers or wholesalers have banded together in a cooperative movement to buy on a large scale and compete with the supermarkets. Independent Neighborhood Stores (INS) is an example of one cooperative. The FCX is also an example of a consumer's cooperative.
2. Characteristics	
a. Owners have only one vote regardless of number of shares owned.	
b. Members receive interest on investments.	Retailing Practices and Principles, Richert, et al. Chapter 59.
c. Merchandise is sold at market prices	Business Principles, Organization and Management, Tonne, et al, p. 41. Retail Merchandising, Wingate, et al, Chapter 4.
E. Mutual Companies	Definte and explain.
1. Definition: A special form of corporation owned by the people with whom they do business.	Examples: Insurance companies, mutual savings banks, mutual investment clubs.

Topical Outline	Teaching Suggestions
2. Characteristics	
a. Management is by a board of trustees appointed by company.	a. The board usually elects its own new members and is thus self-perpetuating.
b. Profits are divided among stockholders.	b. Profits are divided in the form of dividends.
	Invite a lawyer to speak to the class, summarizing the legal types of ownership.

III. INTERNAL ORGANIZATION OF A BUSINESS (Organizational structures)

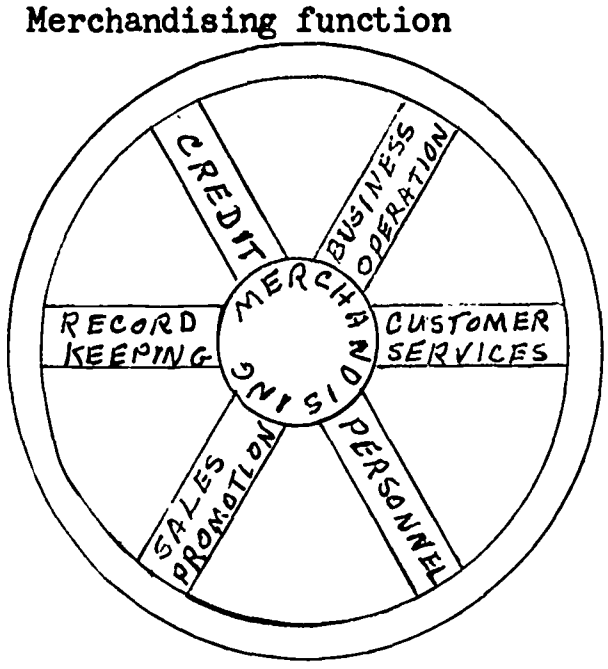
Objectives

1. To show students how authority is delegated through organizational structure
2. To enhance the student's understanding of the necessity of following established lines of authority and supervision
3. To show the principles of organization and the importance of organization in the successful business
4. To give the student an appreication of the need for proper organization and established authority for efficient operation of any business
5. To teach the difference between wholesale and retail organization and between independent and chain-store operation
6. To show students the importance of planning and organizing any type of enterprise.
7. To teach the major functional divisions of business

Topical Outline	Teaching Suggestions
A. Definition and Importance of Organization	The purpose of organization, then, is to make it possible for the objective of the business realized.
1. Definition: The dividing of a job into manageable units, assigning the units to people, so that they, together, can complete the job	Establish a good definition of organization through group discussion.
2. Importance	Through discussion, point out the effects of poor or good organization to these three groups.
a. From the viewpoint of management	
b. From the viewpoint of employees	Compare organization of D.E. Club to organization of business and relate importance of effective organization.
c. From the viewpoint of customers	
B. Types of Internal Organization Structures	
1. Line organization	State that this is the simplest form. Show an organization chart depicting line structure, or illustrate on chalkboard. Pass out sheet No. 21.
a. Characteristics	
(1) Direct line of authority from top management to lowest adminstrative unit	State that organization varies widely from company to company and even within a given company and often undergoes change to conform to changes in environment, objectives, and needs.
(2) Supervisors in direct control	

Topical Outline	Teaching Suggestions
(3) Simple in structure, easily understood	Ask how many students work for a business with this kind of organization. Most small, independent businesses use this type.
b. Advantages	Why do you think it is important to know how a business is organized?
(1) Functions smoothly	To know line of authority To know route of advancement
(2) Each employee responsible to only one supervisor	To learn responsibilities of job To know importance of organizing to get a job done efficiently
(3) Authority clearly defined	
c. Disadvantages	
(1) Makes little use of specialized skills	
(2) Too simple for complex organization	
2. Functional or staff organization	Draw from group and discuss. Refer to pass out sheet No. 21.
a. Characteristics	Ask how many students are employed by businesses using this organization.
(1) Each function of a business is supervised by a specialist	Show functional organization chart.
(2) Highly diversified control	Many wholesale establishments and some chains use this type of organizational structure.
(3) No direct line of authority	
b. Advantage-- makes use of a specialized skill for each service	
c. Disadvantage - too many bosses confuse responsibility	
3. Line and staff organization	Lecture and discuss. Refer to pass out sheet No. 21.
a. Characteristics	
(1) Combines best features of both line and functional types	Point out that this is the most common type of structure, especially in chain stores and department stores.

Topical Outline	Teaching Suggestions
(2) Military type of organization (3) Allows direct authority with assistance by specialists	Line and staff proportions must be designed to meet the reality of the specific situation.
b. Advantages (1) Includes direct lines of authority and communications channels of line type (2) Allows experts to supervise special functions	Show line and staff chart or illustrate on chalkboard, pointing out advantages and disadvantages. Pass out sheet No. 21. Summarize the three types of organizational structure. Ask students to give examples of this type of organizational structure. <u>Business Principles, Organization, and Management</u>, Tonne, et al, Chapter 4.
c. Disadvantages (1) Requires many supervisors (2) Overlap or conflict of authority between supervisor and advisor	<u>Retail Merchandising</u>, Wingate, et al, Chapter 5 Assign students to chart the organization of a fictitious business.
C. Principles of Good Organization 1. A business should have a clearly defined and specific objective, and the employees should know what the objective is. 2. There should be clear lines of authority so that each employee understands to whom he reports. 3. The responsibility and authority of each person should be clearly defined in writing. 4. Responsibility should always be covered with authority. 5. Authority should be delegated as far down the line as possible. 6. When possible, individuals and departments should specialize.	Discuss and state examples of good organization principles. Draw from group the effects of violation of good organization principles.

Topical Outline	Teaching Suggestions
7. Major decisions should be made by high level executives.	
8. Planning must be fitted to the job to be performed and to the individuals on the job.	
9. Organization should be flexible.	
10. Organization should maintain balance.	
D. Methods of Organization	
1. Make definite plan.	Discuss with group the problems that arise in setting up organizational pattern.
2. Designate authority and responsiblity.	
3. Have planned budget.	You cannot organize in a vacuum--you must organize <u>for</u> something.
4. Set definite wage scale.	
5. Make workable rules and regulations.	
E. Major Functional Divisions	Discuss and review all aspect of these functions as they relate to organization. Do not re-teach in subject content but teach only as functions.
1. Merchandising function 	Define merchandising (as review) -- The strategy of getting the right product to the right place in the right quantity at the right price at the right time in right light. Why is merchandising the central function of any distributive business? Show by blackboard, flannel board, or chart how merchandising is the hub and all other functions are the spokes which together turn the wheels of business.

Topical Outline	Teaching Suggestions
a. Buying to meet customer demand - functions of buyers	a. Who determines what kind, what price, what color, what size merchandise you will buy for your business" (Customers) List duties of buyers. Define the term: A buyer is one who selects and purchases merchandise to be redistributed. <u>Business Principles, Organization and Management</u>, Chapter 7. Tonne, et.al.
(1) Are guided by sound buying policies	
(2) Determine customer wants	
(3) Determine quantity to be purchased	
(4) Select sources of supply	
(5) Select proper price range	
(6) Negotiate terms of purchase	
(7) Exercise merchandise control	
(a) To meet demand	
(b) To improve profits	
(c) To provide information by inventory counts	
(d) To maintain sound investments in merchandise inventory	
(8) Conduct market research	(8) What is market research? It is gathering, recording, analyzing for a business all the data about problems relating to selling or promotion of sale of goods.
(9) Conduct comparison shopping	(9) Define comparison shopping. It is a system of visiting businesses for purposes of comparing or checking merchandise, prices, quality, store traffic, buying, etc.

Topical Outline	Teaching Suggestions
b. Selling merchandise to customers	b. Why is selling called the most important single function in American business? (It has been correctly stated that "in America nothing moves until something has been sold.") Business Principles, Organization and Management, Tonne, et al, Chapter 9.
(1) Essential functions	
(a) Caters to customer wants and needs	
(b) Determines who wants or needs the product	
(c) Secures orders from customers	
(2) Duties of sales personnel	(2) Show an organization chart how salespeople are the only producers of money in the entire business -- upon them rests the whole structure. Show how many non-selling personnel depend on salespeople for their jobs.
(a) Stockkeeping (optional)	
(b) Attaining merchandise knowledge	
(c) Using selling techniques and methods	
(d) Taking orders for merchandise	
(e) Cashiering (optional)	
(3) Duties of managing sales personnel	(3) Review briefly the major duties of a sales manager. Call in someone from your local Sales Marketing Executive Club to discuss sales management
(a) Providing sales training	
(b) Providing leadership	
(c) Encouraging sales effort	
(d) Promoting selling throughout organization	

Topical Outline	Teaching Suggestions
c. Receiving, checking, marking function	
(1) Receiving function	(1) Point out that most students will be familiar with this function from job experience. Why is this function important to learn before entering sales?
(a) Establishing point of arrival	
(b) Checking, maintaining, receiving records	
(c) Inspecting incoming merchandise	
(2) Checking procedure	
(a) Checking invoice against purchase order	
(b) Opening and sorting merchandise	
(c) Checking quantity, quality	
(3) Marking procedure	
(a) Attaching tags, tickets, labels	
(b) Printing merchandise information	
i. Price, size, color	
ii. Inventory codes	
iii. Merchandise dates	
(4) Distributing procedure	
(a) Maintaining reserve stockrooms, warehouses	
(b) Sorting, storing merchandise	

Topical Outline	Teaching Suggestions
(c) Moving merchandise to departmental stock	
(d) Moving merchandise to under-counter stock	
2. Sales promotion function	Business Principles, Organization and Management, Tonne, et al, Chapter 10.
	Review definition of sales promotion. Show its importance and relationship to merchandising. It is any method used by a business to stimulate sales on selected merchandise or for an entire business.
a. Advertising	Define advertising as a review. Discuss need, opportunities in advertising field. Advertising--to tell, praise, notify publicly by printed or spoken means.
(1) Definition: Any paid form of non-personal presentation of facts about goods, services, or ideas directed toward groups of people	
(2) Advertising department functions	
(a) Setting and maintaining a budget of expenditures	
(b) Planning methods of promotion	
(c) Planning timing of promotions and campaigns	
(d) Selecting merchandise to promote	
(e) Selecting proper media	
(d) Assisting in planning sales events and major promotions	

Topical Outline	Teaching Suggestions
(g) Making layouts, store mats, etc.	
(h) Writing copy	(h) Here is great need for copy writers, artists, illustrators.
(i) Drawing illustrations	
b. Display	Discuss need for display personnel. (Window trimmers, sign makers, show-card letterers, material construction for backgrounds, set designers, etc.)
(1) Definition: Any form of non-personal presentation of goods or an idea to a group.	
(2) Functions of display department	Discuss expense of display. Retail stores average 1½% to 2% of gross sales.
(a) Planning, designing, constructing, installing window and interior displays	Discuss the truth of the statement, "Goods well displayed are half-sold."
(b) Making store sets, mannequins, forms, materials	
(c) Assisting in selection of merchandise for display	
(d) Making uniform price cards	
(e) Assisting in planning sales promotion events	
3. Record-keeping functions	Record-keeping is not a separate division within an organization, but each department maintains its own records. As a function, however, its importance is extremely great.
a. Accounting department	
(1) Determines financial results	Discuss reasons for records, importance of accuracy, neatness, organization, etc.
(2) Provides information for planning	
(3) Supplies potential credit information	Which department is charged with accounting records?

Topical Outline	Teaching Suggestions
(4) Safeguards assets	Cite needs for bookkeepers, auditors, accountants.
b. Inventory functions	What division is charges with inventory records? (Merchandising--unit control)
(1) Charging merchandise to departments at both cost and retail prices	Business Principles, Organization and Management, Tonne, et al, p. 104-107; and Chapters 22, 23, 24, 25.
(2) Keeping complete data on reductions and additions to stock	
(3) Determining markup	
(4) Ascertaining amount of stock on hand	
(5) Maintaining accurate book inventory	
(6) Providing tax information	
c. Credit records	c. Cite need for legal personnel.
(1) Sales charge slips	
(2) Sales contracts	
(3) Installment contracts	
(4) Chattel Mortgages	(4) Define a chattel mortgage. A legal document which gives title to personal property items or items of non-real nature.
(5) Billing statements	Business Principles, Organization and Management, Tonne, et al, Chapter 12, 13, 14.
(6) Posting credit payments on accounts	
d. Insurance records	d. Who is charged with buying, maintaining insurance? (Executives, treasurer, ownership)
(1) Tangible property insurance	
(a) Fire, smoke damage	
(b) Cyclone, tornado, windstorm	

Topical Outline	Teaching Suggestions
(c) Water, hail, flood	
(d) Explosion, riot, civil uprising	
(e) Aircraft, motor vehicle damage	
(f) Theft, embezzlement	
(2) Business interruption or loss of use	
(3) Liability	(3) Define, discuss liability of business in relation to personnel, customers, population.
(4) Crime hazards	
(5) Surety bonds	
(6) Life, group, disability insurance	
(7) Unemployment insurance	
e. Sales records	Retailing Principles and Practices, Richert, et al, 4th Edition, part 15, p. 93-106; part 48, p. 320-3[illegible].
(1) Cash tickets	(1) Sales check a customer receives when she pays chash for merchandise
(2) Cash register tapes	(2) Cash register tape indicates amount of sale, date, department and other details of the sale.
(3) Charge plates, slips, cards, etc.	(3) An identification device used in charge sales. The plates give customers' name, address and other information
(4) Law-away records	(4) A sales check is made with a lay-away tag attached. Partial payment is made on the merchandise which remains in the store until balance is completely paid.

Topical Outline	Teaching Suggestions
(5) Discount slips	(5) A sales check is made out with discount subtracted from the regular price.
(6) Purchase orders	(6) Form used by buyers or department managers as requisitions for merchandise or supplies
(7) Invoices	(7) A list of items and prices of merchandise sent by the vendor to the purchaser
f. Tax records	
(1) State, local sales taxes	
(2) Federal, state excise taxes	(2) Define excise tax.
(3) Income tax (withholding tax)	
(4) Social security tax	
(5) Corporation (profits) tax	
(6) State, local property tax based on inventory records	Why do businessmen want as low an inventory figure as possible on January 1 and July 1 of each year? (Property taxes are based on on-hand stock.)
g. Payroll records - basis for	Lecture, Ask questions, Draw from group and list on chalkboard.
(1) Determining commissions, bonuses	
(2) Determining deductions from pay for insurance, bonds, taxes, credit payments, retirement, etc.	
(3) Determining individual sales performance records	

Topical Outline	Teaching Suggestions
(4) Determining wuotas for salespeople	
(5) Determining operating expenses	
(6) Maintaining employee attendance records	
4. Business operations functions	Show place and relation in total organization.
a. Traffic department	Cite need for trained traffic managers.
(1) Routes income shipments	
(2) Makes packing, shipping classification instructions	
(3) Specifies shipping procedures	
(4) Handles claims against carriers	
(5) Checks transportation charges	
(6) Handles customer claims for damages to c.o.d. and other mailable merchandise	
b. Customer services	b. Let students list all the customer services through "buzz" sessions or "brainstorming."
(1) Alterations	
(2) Parcel wrapping, checking	
(3) Gift wrapping	
(4) Delivery	
(5) Complaint or adjustment department	
(6) Returned goods	

Topical Outline	Teaching Suggestions
(7) Personal shopping service	
(8) Parts department	
(9) Service department	
(10) Customer information service	
c. Personnel department	c. Cite the need for personnel managers, employment managers, interviewers, testers, trainers.
(1) Receives, fills requisitions for staff help in all departments	Business Principles, Organization and Management, Chapters 18, 19, 20. Tonne, et.al.
(2) Contacts and develops sources of labor supply	
(3) Receives, reviews all job applicants	
(4) Selects, places personnel to fill job vacancies	
(5) Sets salaries, rates, hours, commissions	
(6) Maintains payroll, and time, production, attendance, performance records	
(7) Transfers, promotes, discharges employees	
(8) Establishes job evaluation, job analysis surveys	
(9) Establishes testing system, methods, techniques	
(10) Supervises employee training	
(11) Organizes, conducts business meetings	

Topical Outline	Teaching Suggestions
(12) Organizes, maintains employee activities (a) Medical, health, group life insurance plans (b) Social, education, athletic activities (c) Employee lounges, fountain, cafeteria, refreshment centers (d) Credit union, financial aid (13) Employer-employee relations	
d. Credit department	d. Discuss the increasing importance of credit to business. Emphasize impact credit has on American buying habits. Cite new credit installations in such stores as J. C. Penney, W. T. Grant, Sears, F. W. Woolworth. There is a great demand for trained credit personnel in all fields of business activity. Ask students to name the amount of tiems they would be able to buy if they were suddenly required to pay cash. (Home? Tires? Air conditioning? Boats? Motors?)
(1) Extending function (a) Interviewing (b) Completing credit applications (c) Approving credit risks (d) Using credit reporting agencies	

Topical Outline	Teaching Suggestions
i. Retail credit bureau	
ii. Retail merchants associations	
iii. Better business bureaus	
iv. Dun & Bradstreet	
(2) Collection function	
(a) Writing letters of collections on past-due, slow paying accounts	
(b) Using professional bill collectors	
(c) Using credit bureaus	
(d) Telephone	
(e) Personal visits	
e. Maintenance division function	e. Cite place, need, relationship of the physical upkeep of business plant, stock, equipment, etc.
(1) Protection of physical plant	
(a) Store detectives	
(b) Police protection	
(c) Outside investigative agencies	(c) Let students give examples of agencies who specialize in protection of property
(2) Protection of merchandise, equipment, supplies	
(a) Anti-shoplifting devices	

Topical Outline	Teaching Suggestions
(b) Detection of shortages	
(c) Employee's bag, parcel, package checking	
(d) Lost and found department	
(3) Physical plant maintenance	
(a) Resident engineer	
(b) Housekeeping staff (porters, charwomen, etc.)	
(c) Elevator operators	
(d) Building repair, maintenance staff	
(e) Boiler room operators	
(f) Electrical fixtures, supplies, storerooms	
(g) Garage, storage, service for delivery trucks	
F. Small Business Versus Large Business Store Organization	Draw information from group and discuss. Refer to small business organization chart, pass out sheet No. 22.
1. Small business	1. Point out why opportunities to learn are better in a small business setup.
a. Usually line organization	
b. Direct line of authority	
c. Owner or manager in complete charge	
d. Well-defined responsibilities for each person	

Topical Outline	Teaching Suggestions
e. Wide variety of duties for each person	
f. Little room for specialization	
g. Good opportunity to learn retailing methods and procedures	
h. Disadvantages: principally buying handicaps, growth limitations, little chance to innovate and a high failure rate potential	
2. Large business	Refer to large business organization chart. Lecture and discuss.
a. Usually line and staff type	a. Ask students to estimate the expense of operating a large business listing typical expenses.
b. Management has overall control	
c. Management concerned with business location, capital, ability, progress, research, legal interests	
d. Business operation under control of five functional divisions:	
(1) Merchandise division	
(2) Sales division	
(3) Operations division	
(4) Financing division	
e. Each division assisted by department specialists	
f. General trend is for fewer businesses doing an increasing amount of business	Many large companies are buying or merging with smaller businesses, i.e. Burlington Industries has added twelve companies; Foremost Dairies has added forty-eight; First Union National Bank has merged with The Scottish Banks. See pass out sheet No. 23.

IV. TYPES OF DISTRIBUTIVE BUSINESSES

Objectives

1. To show the students organizational structure of wholesale and retail business
2. To show students the differences in operation in large and small businesses
3. To point out to students the types of organization according to goods sold and methods of selling
4. To introduce and classify (according to Standard Industrial Classification) the types of jobs available in the various types of business organizations

Topical Outline	Teaching Suggestions
A. Wholesale Structure	
1. Characteristics	1. Draw information and discuss with group. Refer to organization chart of wholesale structure, pass out sheet No. 24.
a. Usually line and staff organization	
b. Warehousing, shipping are major departments	
c. Highly specialized	
d. Highly departmentalized	
e. Renders many services to retailers	
(1) Cooperative sales promotion	
(2) Store location, market research	(2) Explain that many wholesalers assist independent businesses in getting started in or choosing a new location
(3) Financial assistance	
(4) Merchandising assistance	
f. Breaks down bulk for retailers	
g. Assumes credit risks on new businesses	
h. Serves as a storehouse	
i. Absorbs loss on merchandise that cannot be sold in many cases	

Topical Outline	Teaching Suggestions
2. Types of wholesalers	
a. Full function	a. Renders all services normally expected of a wholesaler. Explain that most wholesalers are full function.
b. Limited function	b. Renders only a few services
c. Cash-carry	c. Offers no credit or delivery; usually self-service. Offers lower prices because of reduced overhead expenses
d. Truck wholesalers	d. Operates from a transportation conveyance which is used to transport merchandise around from outlet to outlet.
3. Job classifications (wholesale)	3. According to Standard Industrial Classification
a. Motor vehicles, automotive equipment	a. Draw as many examples from students as possible.
(1) Automobiles, other vehicles	
(2) Automotive equipment	
(3) Tires and tubes	
b. Drugs, chemicals, allied products	
(1) Drugs, drug proprietaries, druggists' sundries	
(2) Paints, varnishes	
(3) Other chemicals, allied products	
c. Dry goods, apparel	
(1) Dry goods, peice goods, notions	
(2) Apparel and accessories, hosiery, lingerie	
(3) Footwear	
d. Groceries and related products	

Topical Outline	Teaching Suggestions
(1) Groceries, general line	
(2) Dairy products	
(3) Poultry, poultry products	
(4) Confectionery	
(5) Fish, sea foods	
(6) Meat, meat products	
(7) Fresh fruits; vegetables	
(8) Other groceries and related products	
e. Farm products, raw materials	e. Those establishments primarily engaged in wholesale distribution of farm product raw materials, most of which are used in manufacturing industries.
f. Electrical goods	f. Here, again, let students list as many specific examples that they know of as possible.
(1) Electrical merchandise, general line	
(2) Electrical apparatus and equipment, wiring supplies, construction materials	
(3) Electrical appliances, television, radio sets	
(4) Electronic parts, equipment	
g. Hardware: plumbing and heating equipment and supplies	
(1) Hardware	
(2) Plumbing and heating equipment, supplies	
(3) Air conditioning, refrigeration equipment, supplies	

Topical Outline	Teaching Suggestions
h. Machinery, equipment, supplies	
(1) Commercial and industrial machinery, equipment, supplies	
(2) Farm machinery and equipment	
(3) Professional equipment, supplies	
(4) Service-establishment equipment, supplies	
(5) Transportation equipment, supplies (except motor vehicles)	
i. Miscellaneous	
(1) Metals, minerals	
(2) Petroleum bulk stations	
(3) Scrap and waste materials	
(4) Beer, wine, alcoholic beverages	
(5) Tobacco, tobacco products	
(6) Paper, paper products	
(7) Furniture, home furnishings	
(8) Lumber, construction materials	
(9) Other; e.g., farm supplies, jewelry, flowers, and nursery stock	
B. Retail Structure	<u>Retailing Principles, Practices</u>, Richert, et al, 4th edition, part 1, 2, and 55.
1. Types of organization	1. Show flashcards depicting the different types of stores.

Topical Outline	Teaching Suggestions
a. According to goods sold and methods of selling	a. Ask class for examples of each type in community.
(1) Department store	
(a) Definition: A business in which merchandise is offered for sale in a number of distinct departments	(a) Examples: Furniture, home furnishings, radio and TV sets, general line of apparel for the family, household linen, and dry goods.
(b) Characteristics	
i. Wide price range	Stress a broad market appeal to all kinds of people -- rich and poor.
ii. Broad assortment of goods	Have a large number of separate departments such as soft goods, women's apparel, accessories, home furnishings, men's wear, etc.
iii. Liberal credit	
iv. Customer service	Examples: Eating facilities, escalators, shopper guides, shopping by mail, etc.
v. Large purchasing power	Fierce rivalry going on between department stores and discount houses.
(2) Variety store	Examples: Woolworth's, Grants, Roses, McCellans
(a) Definition: A store that carries a large assortment of general, low-priced merchandise, highly departmentalized.	
(b) Characteristics	
i. Usually cash basis	
ii. Wide variety	
iii. Self-service	
iv. Open displays	

Topical Outline	Teaching Suggestions
(3) Specialty shop	
(a) Definition: a store which specializes in one type of merchandise and related items	(a) Organized along the same lines as department stores
(b) Characteristics	(b) Usually handle merchandise with a high profit margin--helps to reduce their considerable fashion risk of operation. Overhead costs are high due to use of specialized employees.
i. Usually has special clientele	
ii. Wide assortment of merchandise	
iii. Newest styles	
iv. Highly qualified sales personnel	
v. Personalized service	
(4) General store	
(a) Definition: a store which supplies a community with a wide variety of merchandise and is non-departmentalized	
(b) Characteristics	(b) Draw from group and discuss.
i. Wide variety of goods	
ii. Serves whole community	
iii. Personal contact	
iv. Limited buying power	

Topical Outline	Teaching Suggestions
v. Adjusts to local needs	
vi. Unorganized in buying and selling	
(5) Mail order	
(a) Definition: Selling goods to customers by mail instead of personal contact	
(b) Characteristics	(b) Sears, Roebuck, and Montgomery Ward, and Spiegel are leaders in the field.
i. Wide selling area	
ii. Large purchasing power	Trend in mail order retailing is the growth of direct selling stores to supplement mail-sales activity, order offices to speed up delivery, extension of customer credit, and a long term lendency to upgrade the offering of products.
iii. Centralized, well-organized	
iv. Price changes	
v. Time to deliver goods	
(6) House-to-house selling	
(a) Definition: Selling from door-to-door with no other specific retail outlet	
(b) Characteristics	Draw from group and discuss.
i. Good opportunities	
ii. Face-to-face contact	
iii. Customer resistance	
iv. Follow-up often necessary	

Topical Outline	Teaching Suggestions
(7) Automatic vending	
(a) Definition: Impersonal selling through the use of automatic machines	(a) Became an important influence first in vending cigarettes, soft drinks, and candy. Cuts down on pilferage losses.
(b) Characteristis	(b) Draw from group and discuss.
i. No selling cost after machine is paid for	i. Ask for examples. Machines can now make change in money over $1.
ii. Low advertising cost	
iii. No customer services demanded	
iv. Selling only on a cash basis	
(8) Discount houses	(8) Began as limited merchandise and service outlets, catering to special groups of people who were especially interested in bargain priced merchandise.
(a) Definition: Retail establishments that consistently offer all or most of their merchandise at list prices or lower	
(b) Characteristics	(b) Let students list names of discount houses that they know of and then discuss characteristics of them.
i. Give little or no service	
ii. Provide self-selection of merchandise	
iii. High sales turnover	
iv. Competitive pricing	

Topical Outline	Teaching Suggestions
v. Little advertising	
vi. Little, if any, window display	
b. According to operation	b. Show flashcards depicting the different types of stores according to operation.
(1) Chain	
(a) Definition: A group of stores, operated under the same ownership and centralized management, and carrying similar lines of merchandise in decentralized locations.	Ask for examples of each. Chain stores account for about 30% of all retail sales.
(b) Characteristics	Draw characteristics from student contributions.
i. Centralized management	
ii. Decentralized locations	Chain stores usually prefer to handle certain kinds of merchandise, fast selling products, widely known and heavily promoted-goods that will move with a minimum of time and with little or no push.
iii. Similar lines of merchandise	
iv. Closely controlled buying	
v. Effective visual display	
vi. Systematic bookkeeping	Chain store activity began with organizations such as the A & P and Woolworths.
vii. Aggressive sales promotion	

Topical Outlines	Teaching Suggestions
(c) Types of chain stores	Ask students to cite examples of each type.
i. Local	
ii. Sectional	
iii. National	
iv. Corporate	
v. Voluntary	
(2) Independent store	
(a) Definition: A store controlled by its own management	(a) Ask students to name independent forms of businesses in the community.
(b) Characteristics	
i. Individually owned and operated	
ii. Usually controlled locally	
iii. Predominant type of store in U.S.	
iv. Sometimes lacking in qualified personnel	
(3) Cooperative	
(a) Definition: A store which is owned and managed by its customers	(a) Affords superior planning, savings in buying, storage and transportation, more and better executed promotions, additional business advice and consultation available
(b) Characteristics	Draw from group and discuss.
i. All sales are generally for cash	

Topical Outline	Teaching Suggestions
ii. All merchandise is sold at prevailing market prices	
iii. Manager is hired by the investor customers	
(4) Branch store (see chain store)	
(a) Definition: A store operated under centralized management, that handles similar lines of merchandise	
(b) Characteristics	Draw from group and discuss.
i. Dominated by the parent store	
ii. Vary greatly in size	
iii. Less stock than main store	Retailing Principles and Practices, Richert, et al, 4 edition, Unit 15.
iv. Tremendous growth in last decade	Business Principles, Organization and Management, Tonne, et al, Chapter 6. Retail Merchandising, Wingate, et al, Chapters 3 and 5.
2. Job classification (retail)	(According to Standard Industrial Classification)
a. Lumber, building materials, hardware, farm equipment	Let students list as many examples as they can before discussion.
(1) Lumber yards	
(2) Building materials dealers	
(3) Heating, plumbing equipment dealers	
(4) Paint, glass, wallpaper stores	
(5) Electrical supply stores	

Topical Outline	Teaching Suggestions
(6) Hardware stores	
(7) Farm equipment dealers	
b. General merchandise	
(1) Department stores	
(2) Limited price variety stores	
(3) Dry goods and general merchandise stores	(3) Establishments which meet the requirements for department stores, but have fewer than 25 employees.
(4) General stores	
c. Food	
(1) Supermarkets, grocery stores, delicatessen stores	
(2) Meat markets	
(3) Fish markets	
(4) Fruit stores, vegetable markets	
(5) Candy, nut, confectionary stores	
(6) Dairy products stores	
(7) Retail bakeries--non-manufacturing	
(8) Egg and poultry dealers	
(9) Other--specialized lines, e.g., coffee, spice, health foods	
d. Automotive dealers and gasoline service stations	
(1) Passenger car dealers, franchised	
(2) Passenger car dealers, non-franchised	

Topical Outline	Teaching Suggestions
(3) Tire, battery, accessory dealers	
(4) Aircraft, boat, motorcycle dealers, others	
e. Gasoline service station	
f. Apparel and accessories	f. See Standard Industrial Classification for more detailed listing
(1) Men's, boys' wear	
(2) Women's wear	
(3) Children's wear	
g. Furniture, home furnishings, and equipment	
(1) Furniture stores	
(2) Floor covering	
(3) Drapery, curtain, upholstery	
(4) China, glassware, metalware stores	
(5) Household appliance stores	
(6) Radio and television stores	
(7) Record shops and musical equipment stores	
h. Eating and drinking places	h. See Standard Industrial Classification for more detailed listing
i. Other retail stores	
(1) Drug stores	
(2) Book and stationery stores	
(3) Sporting goods stores	

Topical Outline	Teaching Suggestions
(4) Farm and garden stores	
(5) Jewelry stores	
(6) Coal and wood stores	
(7) Fuel oil dealers, liquified petroleum gas dealers	
(8) Florists	
(9) Cigar and news stands	
(10) Camera, photographic supply stores	
(11) Optical goods	
(12) Typewriter, luggage, hobby, toys, and pet shops	
C. Services	
1. Definition: Business which market services rather than merchandise	1. These businesses may supply labor of a physical or mental nature or they may temporarily rent out or loan something.
2. Job classifications	(According to Standard Industrial Classification)
a. Hotels, camps, and other lodging places	
b. Personal services	
(1) Laundry and drycleaning	
(2) Photographic studios	
(3) Beauty shops	
(4) Barber shops	
(5) Shoe repair	
(6) Funeral services	
(7) Fur repair and storage	

Topical Outline	Teaching Suggestions
c. Business services	
(1) Advertising agencies	
(2) Consumer credit reporting agencies; adjustment and collection agencies	
(3) Duplicating, addressing mailing, mailing list, stenographic services	
(4) Blueprinting, photocopying services	
(5) Window cleaning	
(6) News syndicates	
(7) Private employment agencies	
(8) Business and management consulting services	
d. Automobile repair, automobile services, garage	
e. Miscellaneous repair services	<u>Business Principles, Organization and Management</u>, Tonne, et al, chart on page 8. Point out numbers of service businesses in U.S.
(1) Electrical repair shops	
(2) Watch, clock, and jewelry repair shop	
(3) Re-upholstery and furniture repair shops	Ask students to list in "buzz" sessions all the service organizations that they can. Discuss briefly.
f. Motion pictures	
g. Amusement and recreational services	
D. Special areas	

Topical Outline	Teaching Suggestions
1. Transportation --	1. Aids in expansion of markets, specialization, growth, and creates transporation centers, which become centers of industrial and commercial activity.
a. Definition: The creation of place utility by movement of goods to areas where need and desire is greatest	
b. Job classifications	
(1) Railroads	(1) Major form, which accounts for over 50% of all goods shipped annually.
(2) Local and suburban transit and interurban passenger transportation, including taxicabs	
(3) Motor freight and warehousing businesses	
i. Trucking, local and long distance	
ii. Public warehousing	
(4) Water transportation	(4) Accounts for approximately 15% of total volume each year. Major waterways in U. S. includes the Great Lakes, barge canal, inland rivers, coastal waterways.
(5) Airways	(5) Newest and fastest growing. Is expensive
(6) Pipelines	(6) An important and fast growing form for delivery of petroleum products.
(7) Transportation services	
i. Freight forwarding	Transportation specialists -- use skills to recommend and arrange the best forms of transportation.
ii. Arrangement of transportation, including tour services	
iii. Stockyards	
iv. Rental of railroad cars	

Topical Outline	Teaching Suggestions
2. Communication	
a. Definition: The process of conveying facts and information without which processed goods could not be moved	
b. Job classification	
(1) Telephone communication	
(2) Telegraph communication	
(3) Radio broadcasting and television	
3. Electric, gas, and sanitary services	
a. Electric companies and systems	
b. Gas companies and systems	
c. Combination companies and systems	
d. Water supply	
e. Sanitary services	
f. Steam companies and systems	
g. Irrigation systems	
E. Financing, Insurance and Real Estate	
1. Financing	
a. Definition: Process by which money is made available to produce goods, move goods, buy and sell goods, and acquire goods	
b. Job classification in financing	

Topical Outline	Teaching Suggestions
(1) Banking	
(a) Federal Reserve Banks	
(b) Commercial and stock savings banks	
(c) Mutual savings banks	
(d) Trust companies not engaged in deposit banking	
(e) Establishments performing functions closely related to banking	
(2) Credit agencies other than banks	
(a) Rediscount and financing institutions	
(b) Savings and loan associations	
(c) Agricultural credit institutions	
(d) Personal credit institutions	
(e) Business credit institutions	
(f) Loan correspondents and brokers	
(3) Security and commodity brokers, dealers, exchanges, and services	
2. Insurance	
a. Definition: Concerned with a pooling of risks which cannot be eliminated. One party undertakes to indemnify or guarantee another against loss by a certain specified risk for a stipulated consideration. The agreement or contract is drawn up in the form of a policy.	

Topical Outline	Teaching Suggestions
b. Job classifications in insurance	
(1) Insurance carriers	
(a) Life insurance	
(b) Accident and health insurance	
(c) Fire, marine, and casualty insurance	
(d) Surety insurance	
(e) Title insurance	
(2) Insurance agency, brokers, and service	
3. Real estate	
a. Definition: Property in houses and land. Real estate businesses are concerned with buying and selling of land and other real property.	
b. Job classification in real estate	
(1) Real estate operators and lessors	
(2) Agents, brokers, and managers	
(3) Title abstract companies	
(4) Subdividers and developers	
(5) Operative builders	
F. Manufacturing	Concentrate here <u>only</u> on the distribution function or occupations in manufacturing.

Topical Outline	Teaching Suggestions
1. Definition: Manufacturing is the process of formation of goods. Getting goods into the hands of users is also a concern of producation. 2. Job classifications a. Dairy products b. Bakery products c. Household appliances company sales representatives	

VI. CAREERS IN MARKETING

CAREERS IN MARKETING

MATERIALS AND EQUIPMENT NEEDED

1. City Directory (local Chamber of Commerce)

2. Standard Industrial Classification

3. Dictionary of Occupational Titles (Guidance Department)

4. Kuder Manual (Guidance Department)

5. "A Career - Planning Guide"
   Field Enterprises Inc.
   Merchandise Mart Plaza
   Chicago 54, Ill.
   (You may contact your World Book representative)

6. "Job Guide for Young Workers"
   Superintendent of Documents
   U.S. Government Printing Office
   Washington 25, D. C.

7. Career Kit (Guidance Department)

8. Chronicle Career File (Guidance Department)

9. Science Research Associates Career File (Guidance Department)

10. Career Opportunities
    Career Information Service
    N. Y. Life Insurance Company
    Box 51, Madison Square Station
    New York 10, N. Y.

11. The following pass-out sheets in sufficient number for each student to have one copy:

    a. Job Survey Sheet

    b. My Personal Interest Inventory

    c. Self Improvement Plan

    d. Personality Chart

    e. Personality Traits That Make Us Liked

    f. Job Interview Notes

I. INTORDUCTION TO CAREERS IN MARKETING

Objectives

1. To help students reach a realization of the many careers involved in marketing
2. To teach students how to conduct a job survey

Topical Outline	Teaching Suggestions
A. Entry Jobs in Marketing	
1. Review definition of marketing:	1. Use definition from Unit I, "Introduction to Marketing."
Marketing includes those business activities involved in the flow of goods and services from production to consumption	Ask questions to cause students to list all the marketing jobs they can think of.
	Have guidance counselor speak to class on the opportunities in marketing.
2. Types of entry jobs	
a. Advertising	Appoint committees to enumerate all related jobs in each category - "a" through "e".
b. Display	
c. Selling	
d. Stockkeeping	Have a committee member report to the class on their listing.
e. Merchandising (buying and selling)	
f. Personnel	
g. Market research	
B. Job Survey	B. Have class make a survey of local businesses and ascertain number of jobs available in the field of marketing.
1. Number of jobs	Appoint committees to survey certain sections of town.
	Classes in the larger cities may just do a survey of a shopping center.
	Use Pass Out Sheet #25.

Topical Outline	Teaching Suggestions
	Refer to the City Directory Yellow Pages in the telephone book also are helpful.
2. Type of jobs	Notify Chamber of Commerce, Merchants Association, etc. of this survey and secure their help.
3. Tally	Talley results of your survey and analyze them. Send results of your survey to Chamber of Commerce, Merchants Association, etc. Report results to local newspaper, if adviasble.
4. Analysis	Classify each job listed in the survey according to Standard Industrial Classification. This would be a good time to review Standard Industrial Classification introduced in Unit V.
C. Treatment of Guest Speaker	
1. Invitation	1. Instruct class in proper way to invite a guest - in person, by telephone, by letter. Make sure guest knows the topic you wish him to cover, how long you wish him to speak, and where he is to speak. Inquire as to any special equipment the speaker wishes to provide. Use role-playing to demonstrate to the students the proper way to invite a guest.
2. Introduction	2. Have all members of the class choose a businessman and write inviting him to speak to the group. (This may be ficticious, of course.)

Topical Outline	Teaching Suggestions
	As an assignment have individual members of the class make introductions.
3. "Thank You"	3. As a class assignment have each member of the class write a thank you note to a guest speaker.
D. Guest Speakers	Bring in local businessmen, whenever possible, to speak to the class about their marketing jobs. Have students make the invitations, introductions, and write the "thank-you" notes. Appoint a committee to greet the guest. Career Night in Marketing: This could be a club program. It could also include all students involved in the DE program. Have your counselor help plan and set this up. She will have information on how to do this. CDE II superior students could be invited to speak about their jobs in marketing.

II. PERSONALITY IN MARKETING

Objectives

1. To help students develop an understanding of their own personalities
2. To help students recognize their own abilities, interests, and limitations
3. To develop realizations of personality types who could expect to be successful in marketing

Topical Outline	Teaching Suggestions
A. Personality	
1. Definition	1. Through use of questioning help class develop a workable definition of personality
a. "That which constitutes distinction or person; distinctive personal character; individuality; magnetic quality" Webster	a. What is meant by personality? Dr. William Menniger, noted Psychologist once said, "Our personalities are the sum total of all we have been, are now, and hope to be; it's from our hairdo to the way we keep our temper. It's what other people think and say when they mean you."
	a. "Personality is the sum total of those habits a person has formed in adjusting himself to life situations." Psychology in Human Affairs J. Stanley Gray
	a. "Perhaps the most important quality needed by a salesperson is a suitable personality." The Retail Salesperson at Work--Beckley and Logan
	a. "Personality is what people see when they look at you, and what they hear when you speak, and what they feel when in your presence." So to Speak -- Elizabeth Von Hesse
	Pass Out Sheet #26

Topical Outline	Teaching Suggestions
b. Personal interest inventory	Have students fill our Pass Out Sheet #26. Explain the form before the class does it. Go over forms with students individually.
2. Marketing personality	2. What are personality characteristics that are helpful to a person in a marketing career?
a. Good traits	Assist class in drawing up a list of both good and bad traits.
(1) Gets along well with people	
(2) Makes friends easily	
(3) Tactful	
(4) Tolerant	
(5) Adaptable	
(6) Sincere	
(7) Loyal	
(8) Attractive appearance	
(9) Good manners	
(10) Even-tempered	
b. Bad traits	
(1) Envious	
(2) Greedy	
(3) Slandering	
(4) Jealous	
(5) Vulgar	
(6) Lazy	
(7) Conceited	
(8) Loud-mouthed	
(9) Bad tempered	
(10) Vain	

Topical Outline	Teaching Suggestions
c. Self-improvement plan	c. Have individual students draw up their own plan for self-improvement. Follow the plan throughout the Career Unit. Use Pass Out Sheet #27 Check with students individually and at intervals to see that the improvement plan is being followed.
3. Personality chart a. Personality characteristics b. Special abilities c. Ways of working	3. Use Pass Out Sheets # 28 and 29. Reproduce enough for each student. Have them fill in chart and graph it. Discuss these charts in class. Go over charts with students individually.
B. Student interests, abilities, and limitations for careers in marketing	
1. Abilities a. Intelligence b. Physical strength c. Manual desterity d. Social service e. Artistic skills f. Persuasive skills	Consult counselor about ability tests that have been administered in the past. Ask about the possibility of more tests being administered. Have guidance director review these tests with students. Ask Employment Security Commission in area to give General Aptitude Test Battery to Marketing students who have to be scheduled in advance of the date wanted and proper facilities will have to be provided. Check with counselor on this, as she might be planning to schedule the test.

Topical Outline	Teaching Suggestions
2. Interests a. Hobbies b. Likes and dislikes	Have guidance counselor revies Kuder Interest Inventory with students individually. Discuss the possiblity of some other interest inventory being given. Use Kuder Manual as a guide to a discussion of interests that lend themselves to a marketing career.
3. Limitations which handicap a. Poor health b. Physical disability c. Size d. Lack of education e. Lack of technical training f. Lack of experience g. Appearance	Through class discussion prepare a list of attitudes that keep people from getting ahead. If possible, secure "A Career - Planning Guide" By the World Book Encyclopedia Field Enterprises Inc. Merchandise Mart Plaza Chicago 54, Ill. This booklet provides many questions, lists, etc. that will aid in preparing lesson plans for this section of the Career Unit.

III. JOB ANALYSIS FOR MARKETING

Objectives

1. To teach students how to conduct a job interview
2. To teach students how to make a job analysis

Topical Outline	Teaching Suggestions
A. Job Interview	To learn more about an occupation of particular interest, arrange an interview with an employee in that occupation in your community. Project: Have each student make such an interview. Discuss with class the etiquette for making such an interview. Use "Job Interview Notes". Pass Out Sheet #30 Reproduce enough of these forms for each student. Explain the forms thoroughly to students before they make their interviews. Have each student give oral report on his interview.
B. Job Analysis 1. Factors a. Name of job b. Related jobs c. Nature of work d. Interest and aptitudes e. Educational requirements	B. A study of all factors involved in a job. (Factors listed in "a" through "k" below may be used later in preparing an outline for making individual job analyses.) c. What daily tasks are actually preformed? d. What things should you be able to do well? What things should you like to do? e. What subjects should you study? In high school? Is high school graduation

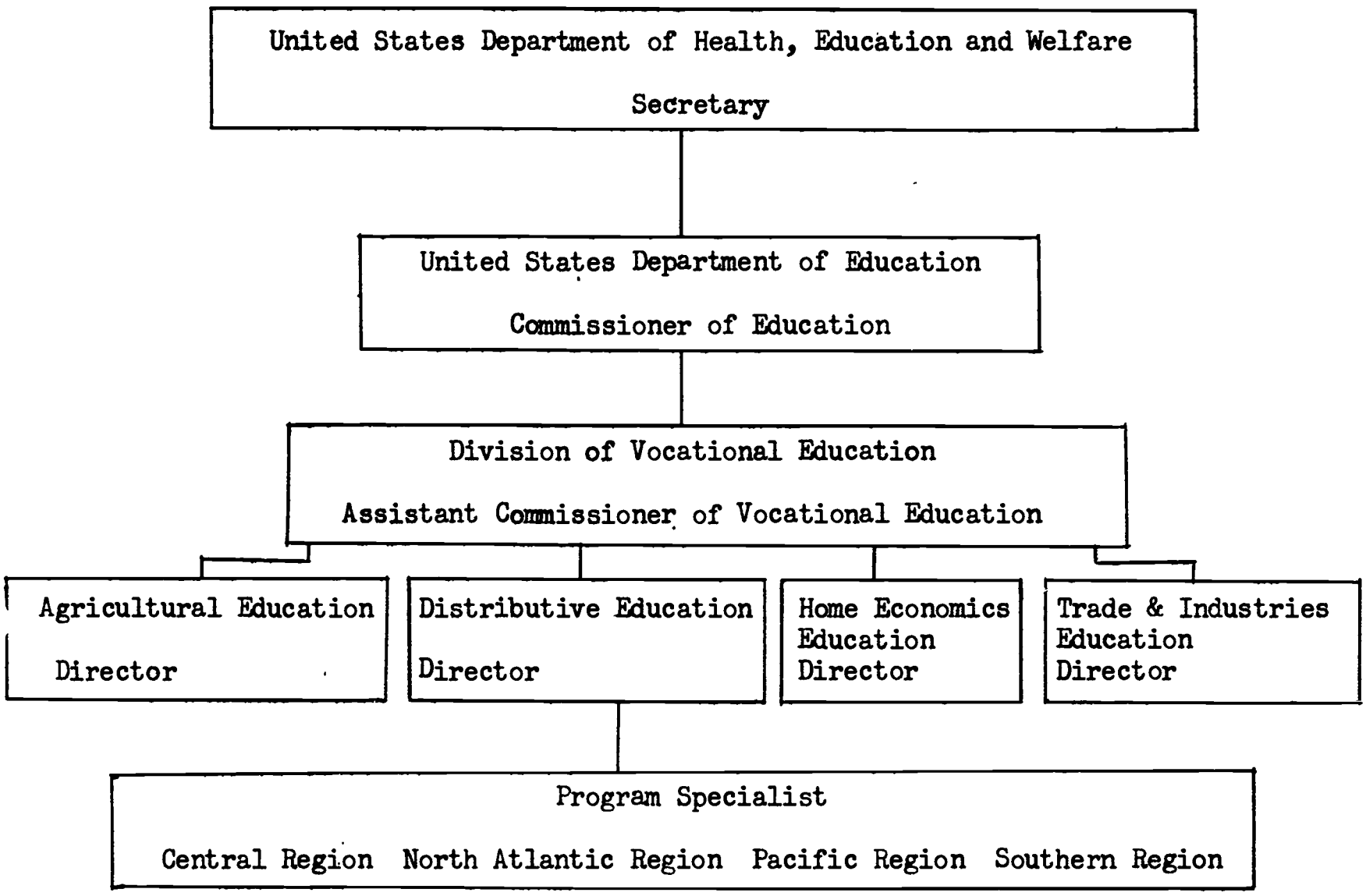
Topical Outline	Teaching Suggestions
	required? A college degree? Technical training?
f. Other requirements	f. Work experience? Union membership, special examination, licenses, etc.?
g. Working conditions	g. Is the work inside or outside, clean or dirty, heavy or light, etc.? Are there health or safety hazards?
h. Job location and employment trends	h. Where would the best job opportunities be? How many workers are employed in this occupation nationally? (Locally, if possible) What is the demand for workers? Is the demand increasing or decreasing?
i. Wages and opportunities for advancement	i. What is the starting wage? The top wage? What are chances for promotion? Are there benefits or compensations for illness, accidents, unemployment, old age?
j. Personal advantages	j. What do you like about this job?
k. Personal disadvantages	k. What don't you like about this job?
2. Outline for job analysis	2. Use factors "a" through "k" above and the teaching suggestions with each and you will have a workable outline for making a job analysis.
C. Making a Job Analysis	C. As a project, assign each student a job analysis of any job in the marketing field which he chooses. Secure the cooperation of your counselor and librarian. Have students become familiar with occupational information available to them.

Topical Outline	Teaching Suggestions
	Ask counselor to speak to them about the use of occupational information. Occupational information which may be used: Dictionary of Occupational Titles Standard Industrial Classification Job Guide for Young Workers Career Kit Largo, Florida Chronicle Career File Science Research Associates Career File Each school should have all or part of this material.
D. Special Report	D. Each student in addiditon to turning in his job analysis is to make an oral report. Before he gives his oral report, the class should be reviewed in the proper way to give an oral report.

ORGANIZATIONAL CHART

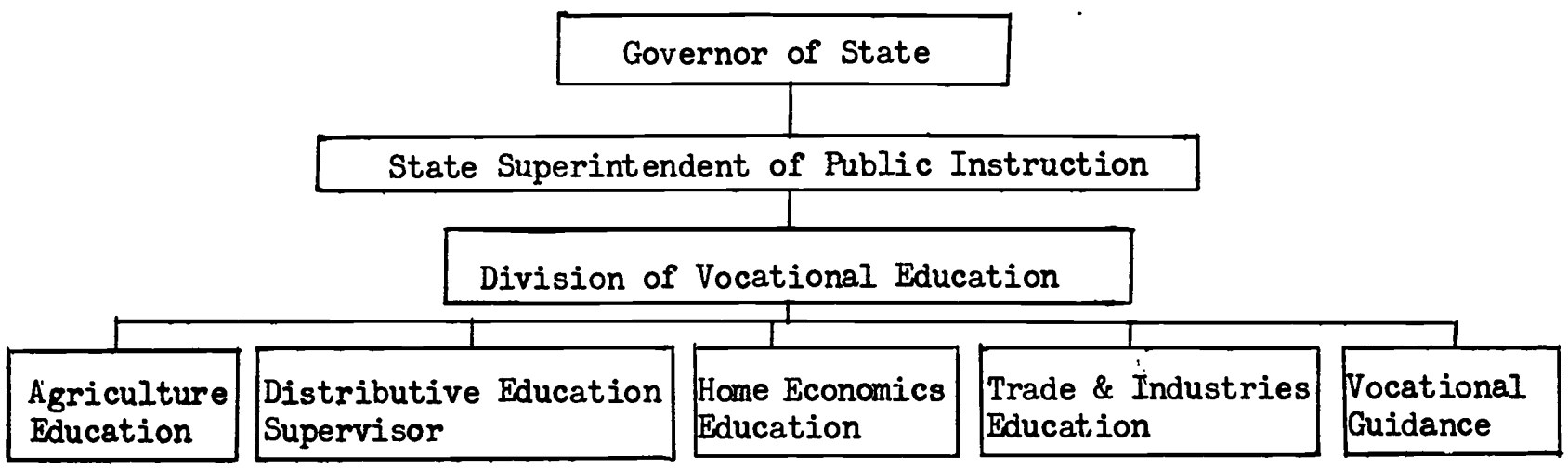
VOCATIONAL DIVISION OF THE UNITED STATED OFFICE

OF EDUCATION

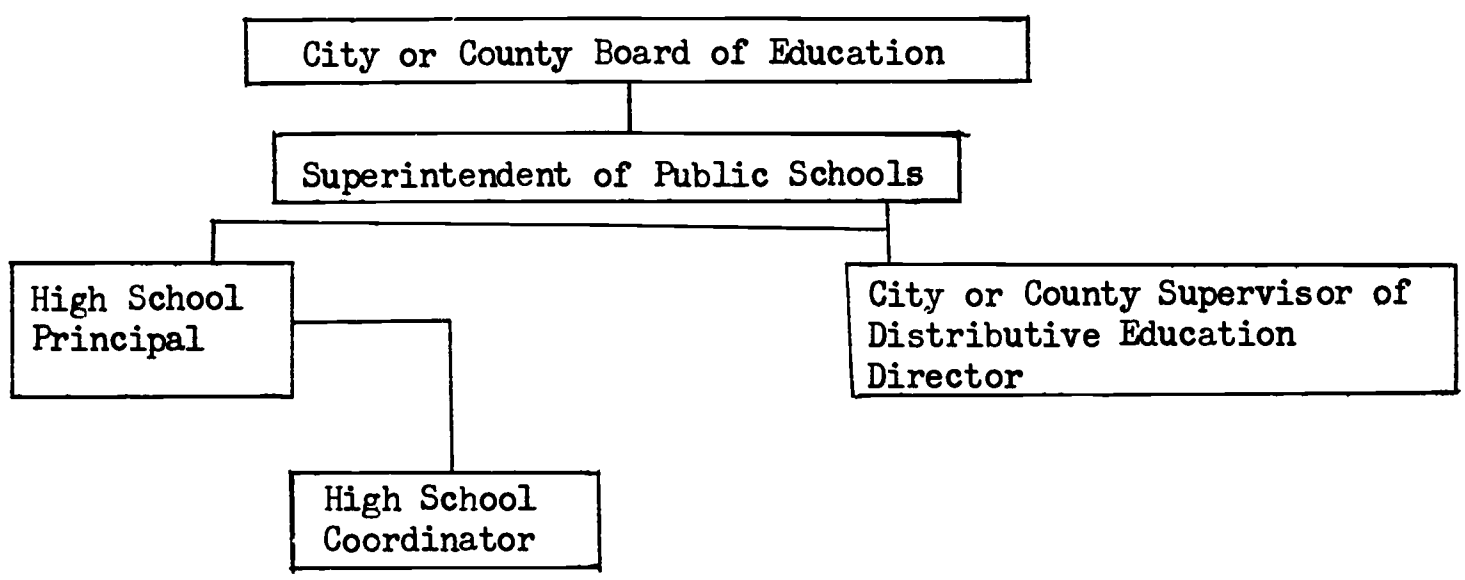


ORGANIZATIONAL CHART

VOCATIONAL EDUCATION DIVISION OF STATE DEPARTMENT OF EDUCATION



VOCATIONAL EDUCATION DIVISION OF LOCAL ADMINISTRATIVE UNITS



SELF-INVENTORY

FILL IN THE CORRECT ANSWER

1. Ismy hair clean?_____

2. Does my hair look neat, shiny, healthy?_____

3. Is my complexion clear and healthy looking?_____

4. Are my teeth clean and shiny?_____ Are they in good condition?_____ Have I had a dental checkup in the past year?_____

5. Are my fingernails clean, well shaped, free from bright polish that is chipped and from hangnails?_____

6. Are my hands clean?_____

7. Is my neck clean?_____

8. Are my ears clean?_____

9. Is my clothing appropriate?_____ Is it becoming?_____

10. Am I positive that my clothes and body are absolutely odorless?_____

11. Did I have a bath or shower this morning or at bedtime?_____

12. Are my shoes polished and the heels in good repair?_____

13. Are my shoes appropriate for business and for school?_____

14. Are my sholders free from dandruff and from stray hairs?_____

15. Are the clothes I am now wearing in good repair?_____

16. Do my clothes fit well?_____

17. Do I look fresh and wide awake?_____

18. Does my face look pleasant?_____ Do I smile most of the time?_____

19. Do I exercise to stay trim in size and in good physical condition?_____

20. Am I in good health, and do I give that appearance?_____

21. Do I try to look my best at all times, even when alone?_____

22. Would I be considered well-groomed?_____

23. Do I hang up my clothes every night?_____

24. Did I take the time this morning to make the most of my appearance?_____

Self-Inventory Cont'd.

GIRLS--CHECK UP!

Wearing hose?_____

Seams straight?_____

Free of runners?_____

Fashinable skirt length?_____

Hair trim and smart-looking?_____

Using moderate amount of make-up?_____

BOYS--CHECK UP!

Shave this morning?_____

Hair cut this week?_____

Shirt-tail inside?_____

Shirt buttoned up?_____

Trousers pressed and creased?_____

Tie, if required on job?_____

Date_____

EMPLOYMENT APPLICATION

Social Security Number_____

Store_____

Name_____ Male / Female
LAST FIRST MIDDLE INITIAL

Local address_____ Phone_____
STREET& NUMBER

Age_____ Height_____ Weight_____ Color hair_____ Color eyes____

Are you: Married
Single
Divorced
Separated
Engaged
Widowed

No. of dependents_____ Ages_____

Are you now in school?_____ if so, what grade?_____

Are you a high school graduate?_____ College?_____

Date of birth_____

What type work do you desire?_____ Salary expected?_____

When will you be available for work?_____

Former employer_____
NAME ADDRESS

Date hired_____ Date left_____ Reason_____

What was your position?_____ What was your salary?_____

Describe briefly experience or training in type of work you desire._____

_____

Do you have any physical defects?_____ If so, list _____

_____

Have you ever worked for any Jones Markets?_____ If so, list where, when, and reason for leaving_____

What hours can you work?_____

Will you work Saturdays or Sundays?_____

_____
APPLICANT'S SIGNATURE

This form will be filed for 30 days, then destroyed, unless you notify this store that you want this application to remain on file for an additional 30 days.

Marketing I - No. 4

PERSONAL DATA

Name _____

HOME ADDRESS: _____

TELEPHONE: _____

PERSONAL DATA: _____

Date of Birth: _____

Height: _____

Weight: _____

EDUCATIONAL RECORD:

High School: _____

College: _____

Degree: _____

Date of Graduation: _____

Entered: _____

Major: _____

Minor: _____

Scholastic Standing: _____

EXTRACURRICULAR ACTIVITIES:

_____

_____

PHOTO

PRACTICAL EXPERIENCE:

(Give company name, dates of employment, jobs held.)

_____ _____

_____ _____

_____ _____

MILITARY SERVICE:

_____

JOB REFERENCES:

_____

REFERENCES: _____

INTERVIEW

1. Greet personnel director by name. Do not take anyone with you. The employer wants to talk only to you.

2. Introduce yourself--"I am John Smith from _____High School." Present referral slip or card given to you by the coordinator.

3. Be able to state why you seek employment in this occupation and with this company.

4. Remain standing until requested to be seated.

5. Sit erect--do not sprawl.

6. Be pleasant, polite, courteous; smile and look at the person to whom you are speaking.

7. Do not smoke or chew gum, even though offered either one. Decline politely and thank person.

8. Speak distinctly and correctly--do not mumble. Speak with confidence and enthusiasm.

9. Be "at ease" -- avoid mannerisms such as snapping handbag, tapping pencil, popping knuckles, twisting hair, gigling, or covering face with hands.

10. Never talk about your personal, family, or financial troubles. Do not criticize former employers or associates.

11. If hired, ask a few questions--day and hour you are to report for work, and what you should wear on the job.

12. Leave when employer seems satisfied with the information given him.

13. Thank him for the interview--"Thank you for the interview, Mr. Jones; I appreciate your consideration."

Do not be discouraged during your first interview. Most employers understand teenagers and make some allowances. Study your presentation after each interview and try to improve. Call your distributive education coordinator after each interview and report your progress.

GOOD LUCK!

YOUR INTERVIEW

PERSONAL CLEANLINESS

1. Be sure your body is clean.
2. Clean and manicure your fingernails.
3. Comb your hair--it must be clean and well trimmed--no extremes.
4. Brush your teeth.

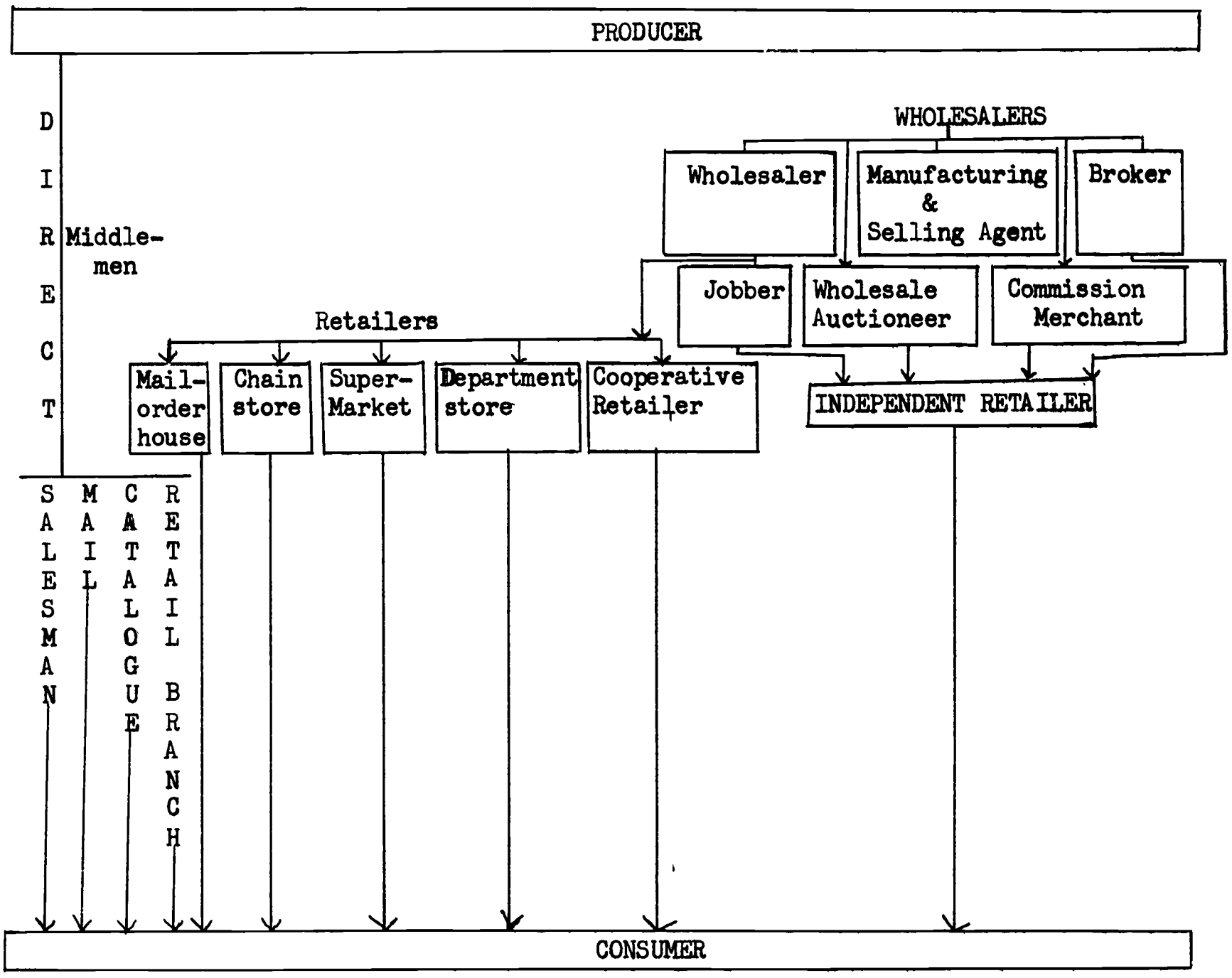
PERSONAL APPEARANCE

1. Shine your shoes.
2. Wear conservative business-like clothes.
3. Avoid loud colors and high school fads.
4. Girls--tailored dress, hose, suitable shoes.
   Avoid too much make-up or costume jewelry.
5. Boys--conservative trousers, shoes and shirt (coat and tie if job requires it).

APPLICATION BLANK

1. Read carefully the entire blank before starting to write.
2. Write or print neatly in ink.
3. Spell words correctly.
4. Fill out all blanks, including date. If question does not apply, write "no" or "none."
5. Write and take with you:
   a. Social Security number
   b. Names, addresses, and telephone numbers of three references
6. Answer all questions accurately, honestly, frankly and promptly.
7. Do not cross out mistakes or erase--rewrite application.
8. Give a continuous record of all your jobs:
   a. Dates of employment
   b. Wages received
   c. Nature of your work
   d. Reason you left

CHANNELS OF DISTRIBUTION CHART



Marketing I - No. 7

SELF-EVALUATION TEST FOR PROSPECTIVE SALESPEOPLE

Which of these statements describe you? Check "yes" or "no" for your answer. It is to your interest to be fair to yourself and as accurate in your opinion as possible.

		Yes	No
1.	I would rather deal with things than people.	____	____
2.	I think chemistry is a very interesting subject.	____	____
3.	I like talking to strangers.	____	____
4.	I would like to be a college teacher.	____	____
5.	People find it easy to approach me.	____	____
6.	I would like to do research in science.	____	____
7.	I enjoy raising money for a charity.	____	____
8.	I would like to teach in a school.	____	____
9.	I like fashionably dressed people.	____	____
10.	I would like to be a watchmaker.	____	____
11.	I like to attend conventions.	____	____
12.	I have more than average mechanical ingenuity.	____	____
13.	I dislike people who borrow things.	____	____
14.	I would like to be a mechanical engineer.	____	____
15.	I like blind people.	____	____
16.	I would like to have regular work hours.	____	____
17.	I would enjoy making speeches.	____	____
18.	I would like to be head of a research department.	____	____
19.	I like to keep meeting new people.	____	____
20.	I enjoy bargaining when I am buying something.	____	____
21.	I would like to develop some new scientific theories.	____	____
22.	I like to have a definite salary.	____	____

	Yes.	No.
23. I would rather have only a few really intimate friends.	_____	_____
24. I am better than average in judging values.	_____	_____
25. I like to play cards.	_____	_____

Self-Evaluation Test For Prospective Salespeople

Here are the answers that indicate interest or characteristics favorable to success in sales work. To obtain your score, add the number of your answers that agree with these. If your score is 16 or above, your chances of success in the selling field are favorable. A score below 16 indicates that you probably would have better chances of success in some other field.

1. No
2. No
3. Yes
4. No
5. Yes
6. No
7. Yes
8. No
9. Yes
10. No
11. Yes
12. No
13. Yes
14. No
15. Yes
16. No
17. Yes
18. No
19. Yes
20. Yes
21. No
22. No
23. No
24. Yes
25. Yes

Basic Selling, Distributive Education Department, University of Texas, Austin, Texas.

VOICE PERSONALITY RATING SCALE

Negative Voice Score

		Yes	Some-times	No
1.	Voice too high or shrill			
2.	Talks too loudly or too noisily			
3.	Tones are muffled and indistinct			
4.	Voice has a nasal twang			
5.	Speech is artificial and affected			
6.	Hesitates, stammers, or stutters			
7.	Has the "uh" habit			
8.	Has a whinning voice			
9.	Has a domineering, dictatorial tone of voice			
10.	Speech is jerky			
11.	Talks too fast			
12.	Has a tendency to choke off vowel sounds			
13.	Skips over consonants or fails to pronounce			
14.	Commonly mispronounces words			
15.	Runs words together			
16.	Has a monotonous voice			
17.	Has a breathy type of voice			
18.	Voice fades out badly at end of phrases or sentences			
19.	Voice is flat, dull, and colorless			
20.	Laugh is unpleasant			

Positive Voice Score

1.	Speaks fluently, words flow out evenly and clearly	
2.	Voice is pleasing to hear	
3.	Is easily understood	
4.	Has a cordial and friendly voice	
5.	Voice is free from monotone or dead-level speaking	
6.	Distinctly pronounces every work and syllable	
7.	Voice is resonant (has carrying power)	
8.	Has a melodious voice	
9.	Voice is natural and unaffected	
10.	Has a forceful delivery	
11.	Has a good level pitch in voice (high enough to be heard)	
12.	Tones are clear (free from a twang or muffled sound)	
13.	Voice rises and falls naturally	
14.	Maintains a normal rate of speed when talking	
15.	Correctly pronounces each word	
16.	Controls voice at all times (keeps it from booming or becoming too loud or noisy)	
17.	Emphasizes the thought rather than the words	
18.	Speech is free from colloquailisms or accent	
19.	Has a good vocabulary	
20.	Laugh is agreeable	

Total Score _____

Marketing I - No. 9

USE OF THE VOICE PERSONALITY RATING SCALE

The Voice Personality Rating Scales should be used in conjunction with the tape recorder for testing student's voices. Copies of this test (in mimeographed form) may be handed out to class members and recordings of students' voices played back. Class members will then rate the voice personalities on these forms and hand them to the instructor, who will note areas of agreement and will consult with each student as to his weakness or strength.

Key to Negative Voice Score

If the answer to a question is "yes," put down a minus five (-5). If the answer is "sometimes," put down minus two (-2). If the answer is "no," put down zero (0). Notice that the lower the numerical score, the fewer voice faults of the student.

0 to 10	Excellent
10 to 20	Good
20 to 30	Fair
Above 30	Unsatisfactory

Key to Positive Voice Score

If the answer to a question is "yes," put down a 5. If the answer is "sometimes," put down 2. If the answer is "no," put down a zero.

90 to 100	Excellent - a rare score
80 to 90	Good
70 to 80	Fair
Below 70	Unsatisfactory

TYPES OF CUSTOMERS

Classifying customers into types is helpful, but selling is not a science, and there are many exceptions to all selling. Remember that each customer is different and she may NOT be the same today as she was yesterday.

Nervous Customers

For customers who are:	You will need:
Tired and cross	Patience
Fussy and nervous	Consideration
Excitable	Quiet manner
Impatient	Dispatch
Unreasonable	Calmness

Dependent Customers

For customers who are:	You will need:
Timid and sensitive	Gentleness
Undecided	Decision
Old and deaf	Sympahty
Children	Power to think for them
Foreigners	Helpfulness

Disagreeable Customers

For customers who are:	You will need:
Skeptical	Candid manner
Inquisitive	Knowledge
Talkative	Courteous brevity
Insulting	Self-control

Trying Customers

For customers who are:	You will need:
Critical	Knowledge of goods
Indifferent	Tact
Silent	Perseverance
Bargain hunters	Convincing manner

Common Sense Customers

For customers who are:	You will need:
Pleasant	What they expect
Intelligent	Efficient service

In the final analysis all customers expect and should receive courteous treatment regardless of the situation or circumstance.

Distributive Education Department
The University of Texas

KNOW YOUR MERCHANDISE

(A check list)

WHAT A SALESPERSON SHOULD KNOW ABOUT THE MERCHANDISE	Use of the product	Primary and secondary uses Suitability Versatility
	How the product will perform	Durability Degree of color permanence Shrinkage or stretchage (in case of textiles) Breaking strength Resistance to water, wind, wear, etc. Cost of up-keep
	How the product is made (Construction)	Size Weight Weave (in case of textiles) Finish Handmade or machine made Pressed, molded, stamped, inlaid, etc. Conditions under which goods are made Packaging
	How to use the product	How to operate it, wear it, prepare it, eat it, apply it, arrange it, assemble it, display it, place it.
	How to care for the product	How to handle and adjust the product How to clean the product How to store the product How to repair the product How to oil and grease the product How to refrigerate the product
	Appearance of the product	Beauty Style Ensemble possibilities
	Background of the product	History of the article History of its manufacturer History of its uses History of competing articles Rarity Prestige
	Services available with the product	Credit terms Shipping terms Speed and cost of delivery Transportation methods

DESCRIPTIVE WORDS

Materials

Stainless steel
Chrome plated
White porcelain enamel
Heavy gauge steel
Galvanized
Insulated

Utility

Roomy
Handy
Portable
Reversible
Self-cleaning
Deluxe model

Economy

Easy to clean
Compactness
Economical
Stain resistant
Easy to install
Automatic
Maximum efficiency
Low maintenance cost
Trouble free service
Fireproof

Durability

Weather resistant
Substantial
Durable
Corrosion resistant
Heavy duty
Tough, long wearing
Die cast
All steel cabinet
Hand forged

Finish and Appearance

Streamlined appearance
Attractive

Comfort

Comfortable
Roomy
Healthful

Color

Colorful
Attractive
Gay
Appropriate
Tasteful
Striking
Lively looking
Richly colored

Workmanship

Sturdy
Graceful
Reinforced
No sag springs
Hand finished
Unexcelled
Dependable
Guaranteed
Molded frame
Skid proof
Precision built
Perfectly balanced
Careful
Well made
Well finished
Built to meet rigid specifications

The University of Texas
Industrial and Business Training
Texas Education Agency
Vocational Division
Distributive Education Service

Marketing I - No. 12

SHOPPING REPORT

Store Shopped_____Department_____

Date_____Day of Week_____Hour_____

When You Entered The Department

Were you approached promptly?_____If not, what would you say was the reason?_____

Circle one of the following words to describe the salesperson's greeting.

Friendly Courteous Indifferent Rude

What did the salesperson say to greet you?_____

_____

Did the salesperson smile?_____

What did the salesperson say that indicated she knew the good points of the merchandise?_____

Did the salesperson point out customer benefits?_____If so, tell what she said in this respect._____

_____

Did the salesperson suggest additional merchandise after the close of the sale?_____

Underline words which describe the salesperson's appearance.

Well-groomed Untidy Dirty Appropriately dressed

Name of person making report_____

Marketing I - No. 13

Objection Analysis Form

(Sample Form)

Product: Mahogany Kneehole Desk

1.	Type of Objection	Price
	Expression	But the price is so high.
	Suggested answer	It might appear that way, Mrs. Prospect, but actually it is not so high when you consider the lifetime use of this desk. You get lasting beauty for your home and the daily use of this desk.
2.	Type of Objection	Need
	Expression	I have no use for a desk right now.
	Suggested answer	I am glad you raised that point, Mrs. Prospect. I noticed a pile of mail on your table as I came in. No doubt there are personal letters to be answered and bills to be paid. These are reasons for using a desk of this type.
3.	Type of Objection	Service
	Expression	The last desk I had fell apart.
	Suggested answer	I am sorry to hear that, but not this desk. Notice the strong dovetail construction in the drawers. These drawers will not come apart at the corners. Moreover, we guarantee this item.
4.	Type of Objection	Product
	Expression	Mahogany will not blend with my other furniture.
	Suggested answer	That is an important fact, Mrs. Prospect, but this classical style will grace any room.

Objection Analysis Form (Continued)

5.	Type of Objection	Source
	Expression	Your company is very slow in making deliveries.
	Suggested answer	Naturally, you want that service. It just happens, Mrs. Prospect, that I have a letter with me which I received this morning from one of our customers in Oshkosh, Wisconsin. In it, they thank us for the prompt delivery of an order.
6.	Type of Objection	Company
	Expression	I would prefer to buy a desk from the XYZ Company.
	Suggested answer	Mrs. Prospect, I am sure that you are a very careful buyer and want to see several different makes. Our clients are friends who reorder year after year. I am sure you will like our work too.

Ernest and DaVall, Salesmanship Fundamentals, Gregg Publishing Division, McGraw-Hill Book Company, Inc. Second Edition, 1959, p. 203-4.

CHARACTERISTICS OF CONVERSATION

Term	What is it?	Varieties
Pitch	Highness or lowness of tone	High Medium Low
Volume	Loudness or softness of tone Power is in diaphragm Posture is important	Loud Medium Soft
Quality	Timbre or clang Emotional strain reflected Fatigue affects quality	Head Chest Avoid breathy, husky, harsh nasal, thin, flat, shrill
Inflection	Use of pitch change on a single syllable (reverse is monotone)	Rising Falling
Emphasis	Means used to draw attention (Search for meaning to be conveyed) Present meaning forcefully	Change in pitch, rate, force, quality, facial expression, gesture
Pronunciation	Uttering words or syllables	Standard-dictionary Local, solvenly, Precision-like
Enunciation	Clearness of speech according to an established pattern (Avoid "lazy lips" or "clinched teeth")	Clear, precise Slovenly
Stress	Force applied to a word (Amount of energy or intensity used)	Strong-Secondary
Gestures	Motion used to express an idea or to emphasize	Effective Ineffective

Powers, David Guy, Fundamentals of Speech, McGraw Hill Book Company, New York, 1951.

Marketing I - No. 15

TYPES OF ORAL COMMUNICATIONS

PUBLIC SPEAKING	CONVERSATION	CONFERENCE
Monologue	Dialogue	Dialogue
Subject matter developed	Subject matter flexible	Predetermined
Adapted to many people	Adapted to few persons	Few persons
Public surroundings	Intimate surroundings	Business area
Prepared in advance	No preparation	Partially prepared
No interruptions	Interruptions	Interruptions
No questions	Questions	Questions
No stops	Stops	Stops
No anecdotes	Anecdotes to listen to	Anecdotes to hear
Performs alone	Participation with others	Same
Presents in full	Talk and listen	Talk and listen
Standing	Sitting-generally	Sitting-standing
One man - show with applause	Give and take	Give and take

Marketing I, No. 16

SALES PROMOTION

1. Do you have a "set" number of sales every year? _____

   If so, what are they? _____

   _____

   _____

2. How far in advance is a promotion planned? _____

   _____

3. Describe one complete promotion.

4. What publicity media do you use? _____

   _____

5. Do you buy most of your materials used in display or do you make them? ___

   _____

   _____

NEWSPAPER ADVERTISING SURVEY

NAME OF ORGANIZATION _____

DEPARTMENT _____ ARTICLE _____

DATE OF AD & PAPER _____ DATE SHOPPED _____

Degree to which salesperson knew about advertisement. (Check one)

Knew about immediately _____

Hesitant . . . . . _____

Knew nothing . . . . . _____

_____
Shopper's Name

WINDOW DISPLAY SURVEY

NAME OF STORE _____ DATE OF DISPLAY _____

DEPARTMENT _____ DATE SHOPPED _____

ARTICLE _____

Degree to which salesperson knew about article displayed and asked for. (Check one).

Knew about immediately _____

Hesitant. . . . . _____

Knew nothing . . . . . _____

_____
Shopper's Name

WINDOW DISPLAY JUDGING

PURPOSE: To help the student develop a knowledge and understanding of the principles and techniques of display by giving him an opportunity to judge window displays

- -

DIRECTIONS: The questions under each main heading are to be used as a guide in determining actual points that heading should receive. Based on your judgment, enter the actual points for each heading.

- -

1. POWER TO ATTRACT ATTENTION (Value - 20 points) Actual points _____

   If there is something moving, is it used to good advantage?
   Is background appropriate?
   Is theme or idea clever?
   Is theme well executed?
   Are display props suitable and attractive?
   Is floor appropriate to display?

2. ARRANGEMENT (Value - 20 points) Actual points _____

   Does window reflect character of the business?
   Is there a proper amount of merchandise in window?
   Do props enhance, rather than detract from, the merchandise?
   Is related merchandise used?
   Are appropriate "dealer" helps or show cards used?
   Do major items within a unit point to the next?
   Does the window make use of several vantage points?

3. CLEANLINESS (Value - 10 points) Actual points _____

   Is window glass clean?
   Is clothing (if displayed) clean and well pressed?
   Are forms and fixtures clean and in good repair?
   Is floor clean?
   Is background clean and fresh?
   Are valances or frames clean?
   Are painted or colored surfaces fresh and clean?
   Is ceiling clean?

4. TIMELINESS (Value - 10 points) Actual points _____

   Is merchandise well chosen?
   Are colors appropriate for the season?
   Is the theme right for the season and merchandise?
   Are "dealer" helps or show cards related to the season?

WINDOW DISPLAY JUDGING

5. SELLING POWER (Value - 20 points) Actual points _____

Do display props focus attention on merchandise, but not detract from it?
Are merchandise features clearly shown?
Does special lighting emphasize most important merchandise?
Do show cards bring out important selling points of the merchandise?
Does the theme aid the feature of the merchandise?
Is it possible to find and concentrate on most important item?
Is merchandise displayed as it would be used?

6. LIGHTING (Value - 5 points) Actual points _____

Does lighting enhance the colors used in the window?
Is lighting equipment adequate?
Are lighting fixtures clean?
Does lighting focus attention on merchandise, rather than detract from it?

7. TECHNICAL EXCELLENCE (Value - 15 points) Actual points _____

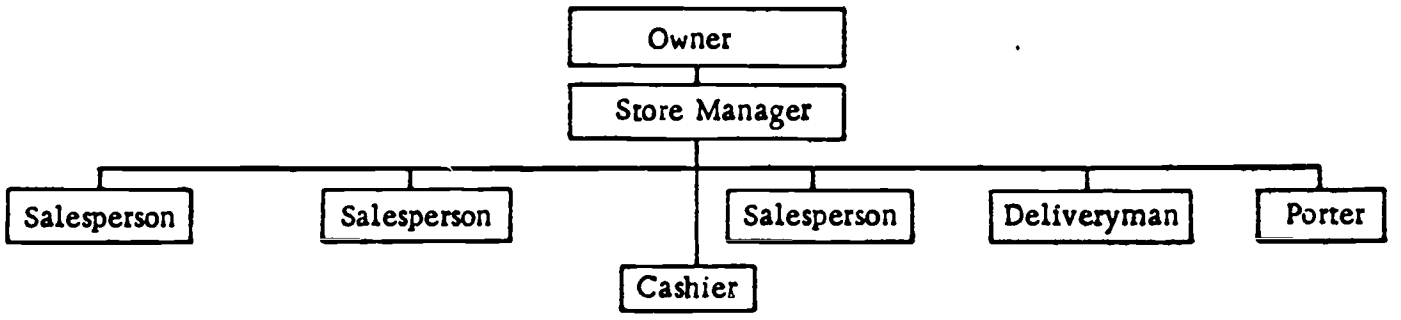
If there is a unique item such as chicken wire, pipe, string, etc. used, is it used effectively?
Does arrangement of merchandise add to appearance of the merchandise?
Is the merchandise well folded, draped, placed or suspended?
Do such draping, foldings, and placements add to the merchandise?

COMPREHENSIVE SCORE

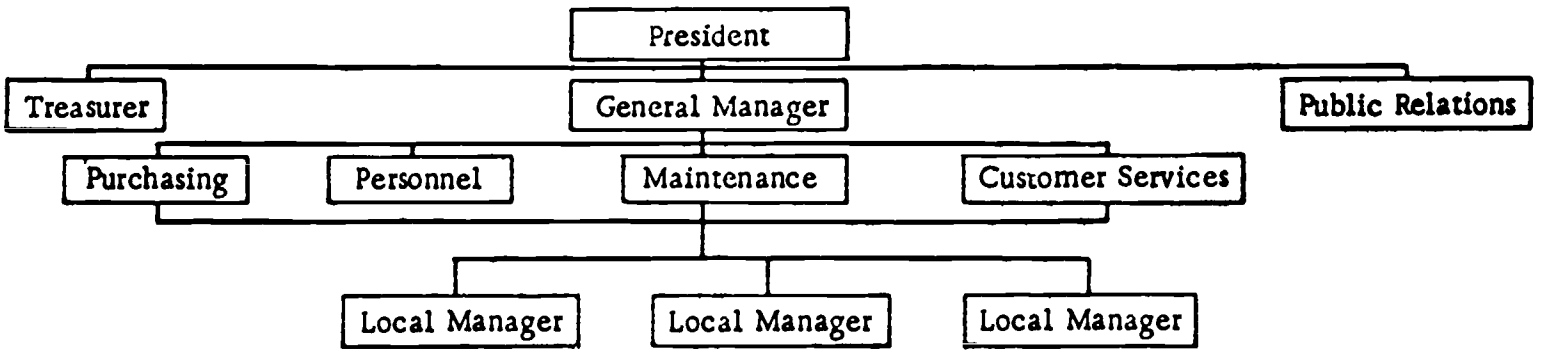
		Possible Points	Actual Points
1.	POWER TO ATTRACT ATTENTION	20	_____
2.	ARRANGEMENT	20	_____
3.	CLEANLINESS	10	_____
4.	TIMELINESS	10	_____
5.	SELLING POWER	20	_____
6.	LIGHTING	5	_____
7.	TECHNICAL EXCELLENCE	15	_____
		TOTAL	_____

THREE BASIC TYPES OF ORGANIZATION

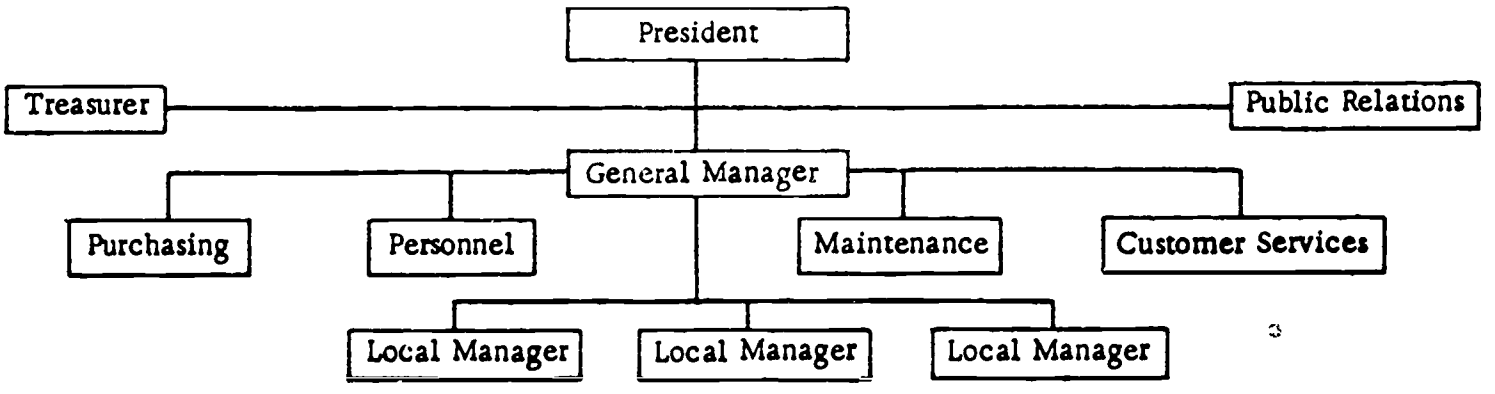
A LINE TYPE ORGANIZATION--Direct Authority



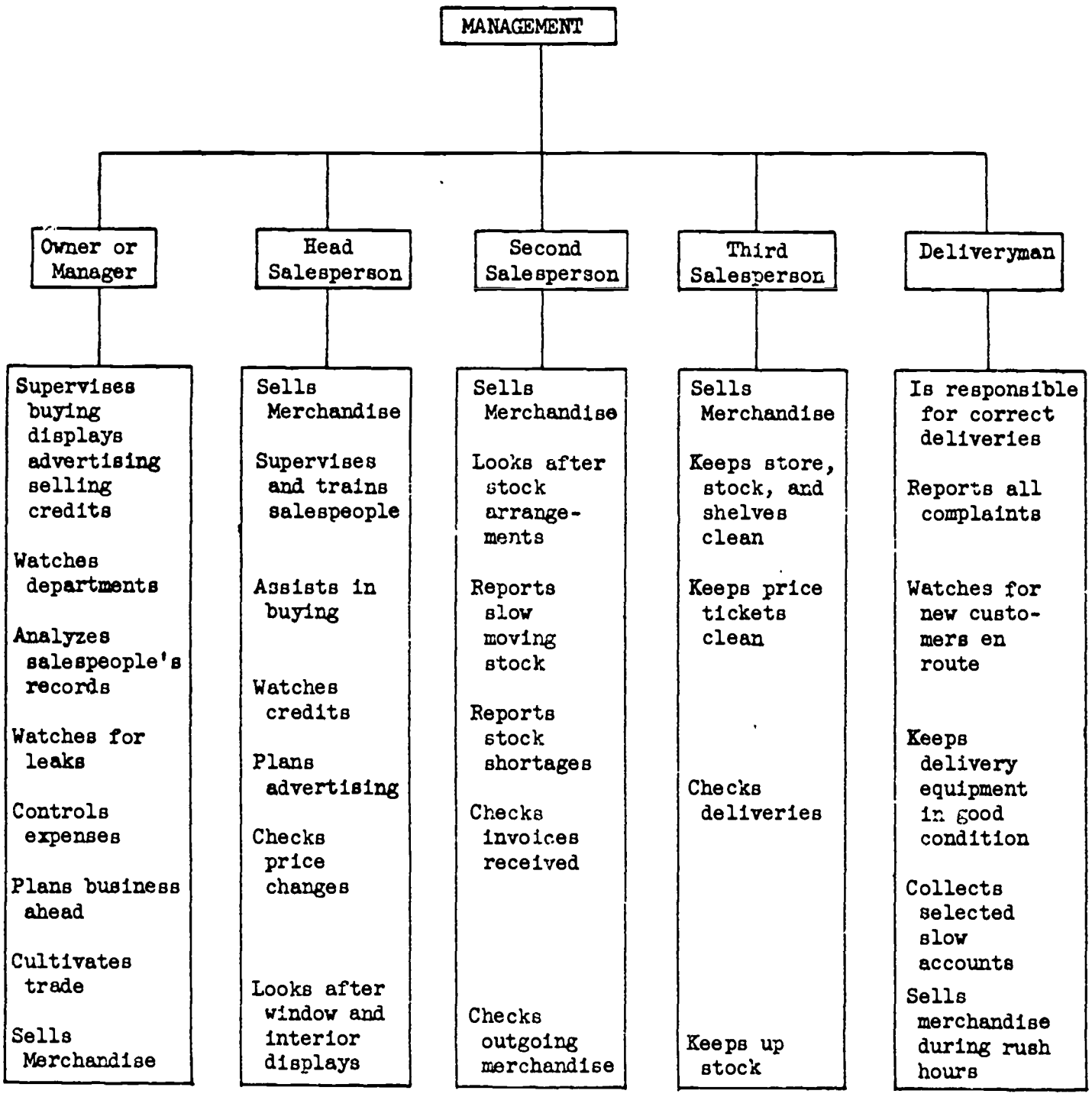
A FUNCTIONAL TYPE ORGANIZATION--Specialist-Centered, Diffused Authority



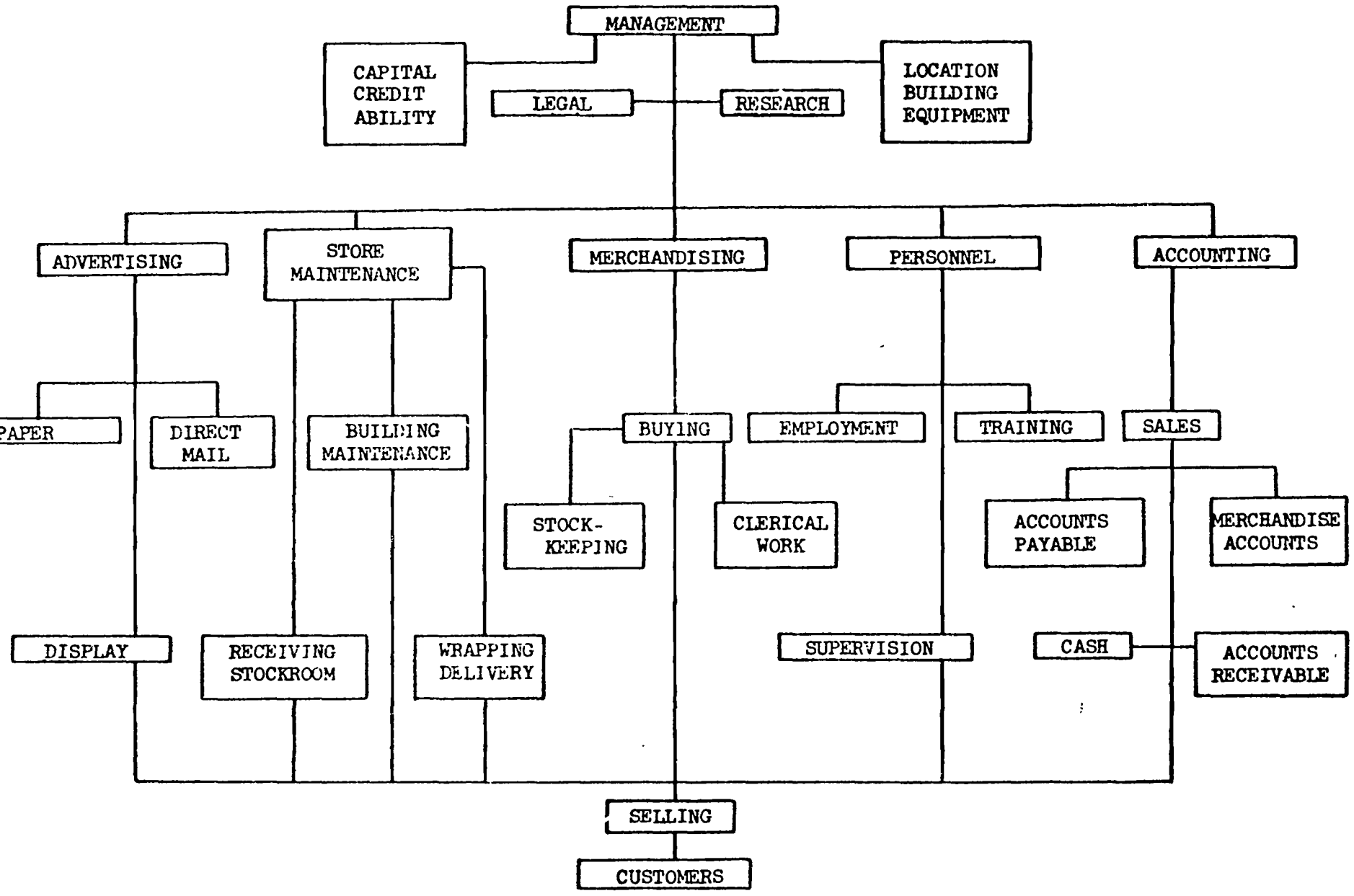
A LINE AND STAFF ORGANIZATION--Notice How Authority Is Direct, but Aided by Specialists



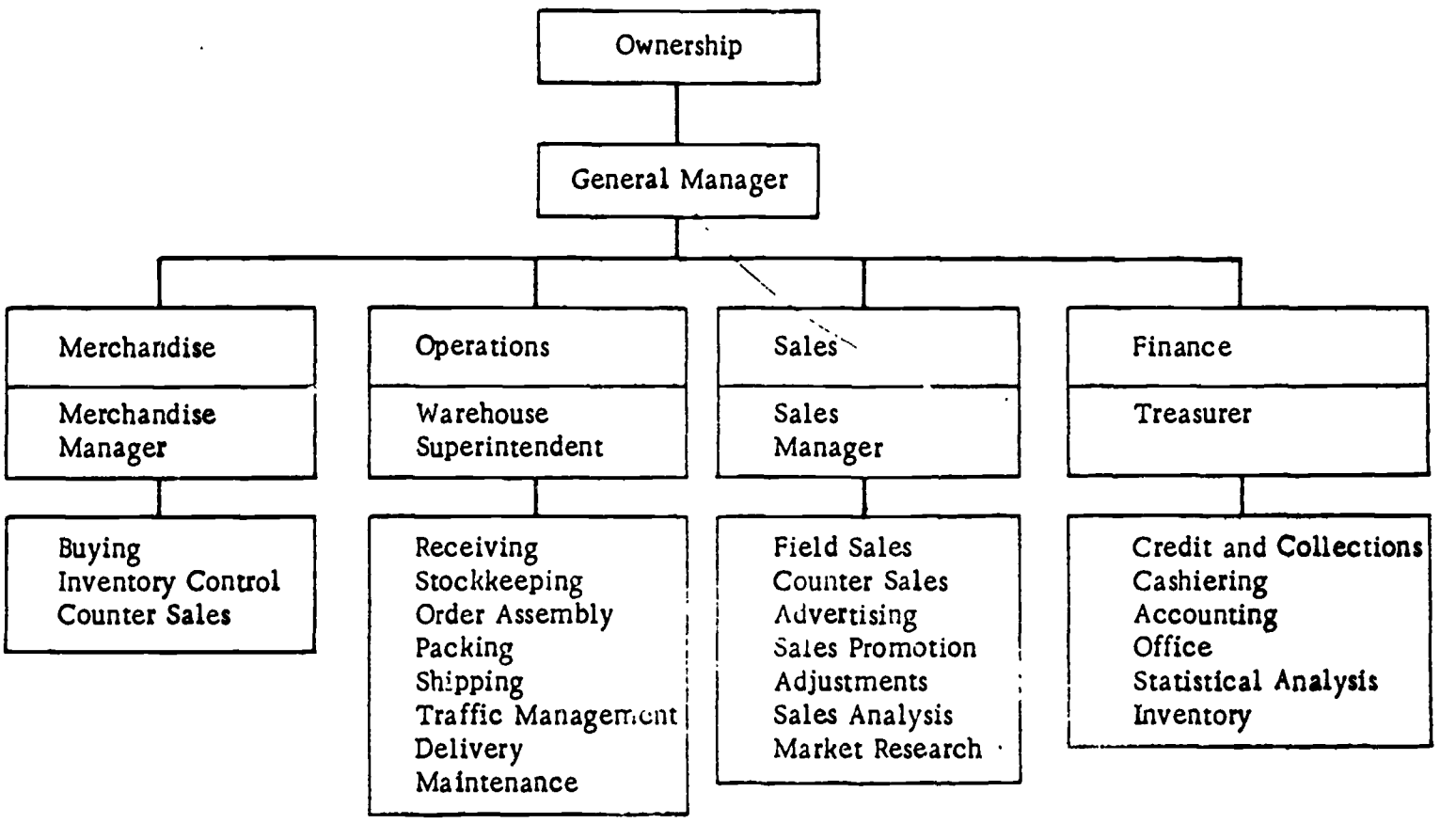
ORGANIZATION CHART -- SMALL STORES



ORGANIZATION CHART -- LARGE STORE



TYPICAL WHOLESALE ORGANIZATION PLAN



These are the major functional divisions in a wholesale setup for a full-function type line and staff organization.

JOB SURVEY SHEET

Name of Business _____

Address _____

Date _____

Person Interviewed _____

Number of Employees _____

Number of:

Supervisors _____

Sales Persons _____

Personnel _____

Clerical _____

Maintenance _____

Buyers _____

Advertising _____

Service _____

Other (specify) _____

_____

_____

_____

Total _____

Check Ownership as to:
(check only one)

Sole Proprietorship _____

Partnership _____

Corporation _____

Cooperative _____

Mutual Company _____

Check Type of Business as to:

Retail _____

Wholesale _____

Service _____

Comments: _____

_____

_____

_____

Marketing I - #25

PERSONAL INTEREST INVENTORY

Making an inventory of likes and dislikes involved in school and other activities may help you analyze your interests and see how several interests may be involved in one activity. Fill in the chart below, telling what you like and do not like about each activity named.

WORK EXPERIENCE

Job	Things I like about it	Things I dislike about it

EXTRACURRICULAR ACTIVITIES

Activity	Things I like about it	Things I dislike about it

SCHOOL SUBJECTS

Subject	Things I like about it	Things I dislike about it

SOCIAL LIFE

Activity	Things I like about it	Things I dislike about it

Marketing I - #26

HOBBIES

Hobby	Things I like about it	Things I dislike about it

Marketing I - #26 continued

SELF-IMPROVEMENT PLAN

SELF-ANALYSIS CHART

I. PHYSICAL CHARACTERISTICS:

Your physical characteristics may affect the kind of job you want. Some you can easily determine for yourself. To evaluate others, such as the health aspects, you may have to get help.

A. Height

B. Weight

C. Age

D. Personal appearance

E. Bearing and posture

F. Voice and manner of speaking

G. Physical defects or handicaps

H. General health, level of energy

II. PERSONAL ADJUSTMENTS:

A. Emotional and social characteristics

Although you probably won't be able to answer "yes" to all of the questions listed below, the more you can answer in the affirmative, the better adjusted person you are. Since personality is such an important factor in job success, you will want to consider your characteristics carefully.

1. Are you succeeding in your studies?

2. Do you feel that school is worthwhile?

3. Do you attend school regularly?

4. Do you manage not to worry about things?

5. Are you able to concentrate?

6. Do you usually feel optimistic and friendly?

7. Do you feel that people like you?

8. Do you get along fairly well with your family?

9. Do you like both boys and girls?

10. Are most things in your life satisfactory to you?

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ABSTRACT - Developed to aid school administrators in planning facilities for conducting trade preparatory classes in carpentry, this planning guide contains: (1) an introduction to carpentry, (2) course objectives, (3) course admission requirements, (4) laboratory and physical facilities, (5) suggested carpentry shop layout, (6) suggested course outline, (7) tool and equipment list, (8) recommended supply list, and (9) recommended texts and reference materials list. (GR)

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TRADE AND INDUSTRIAL EDUCATION

June, 1965

TIE Series No. 11

TRADE PREPARATORY TRAINING

PLANNING GUIDE

for

CARPENTRY

Trade and Industrial Education
Charles D. Bates, State Supervisor

ERIC

PREFACE

This planning guide has been developed to aid school administrators in planning facilities for conducting Trade Preparatory classes.

The recommendations and suggestions contained in this guide are a composite of the thinking and practices of the Trade Preparatory instructors who are now teaching in the secondary schools of North Carolina. The State Staff for Trade and Industrial Education has compiled this information and put it in its final form.

It is hoped that through its use adequate facilities will be provided wherein effective programs of Trade Preparatory Training can be conducted.

In suggesting a shop layout for the various areas of instruction, it is intended to show only the minimum space needs and not a specific arrangement.

Charles D. Bates

Charles D. Bates, State Supervisor
Trade and Industrial Education

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Suggested Floor Plan	4
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ADMISSION REQUIREMENTS

The applicants requesting admission to the course should have achieved a level of maturity expected of any beginning worker. He should show evidence of having satisfactorily completed eight high school units. It is desirable that at least two of the eight units shall be in mathematics; two shall be in English and one shall be in science.

The applicant shall be of average intelligence or above, and should show evidence that he has scored satisfactorily on a standardized intelligence quotient test or make a qualifying score on the General Aptitude Test Battery. For this field of work he should be mentally alert, physically fit and possess the interest and ability to profit by the experience he will receive. These factors will be determined by tests and interviews administered by the guidance center and/or administration.

The teacher in charge of the course shall conduct the final interview and upon the basis of this interview and the student's test profile, he will make whatever recommendations are necessary. If all of the above mentioned information leaves any doubt in the teachers's mind about the applicant's ability and intention, he may recommend that the applicant be admitted for a probationary period. This period is to be terminated at the teacher's request.

CARPENTRY

Introduction

Building is one of the largest and most important of our permanent industries. Each year thousands of homes, industrial and commercial establishments are either being constructed or repaired to meet the requirements of our society. The oldest art of working in wood to meet our building growth is that of carpentry. The carpenter must be skilled in the use of many hand and power tools. In addition, he must be able to read plans, interpret specifications and make accurate estimates of materials and labor costs. He must also enjoy outside work and be physically able to stand strenuous work.

Objectives

1. To develop the necessary skills, technical information and job judgment that is required for employment as an advanced learner in the carpentry trade.

2. To provide basic experience in such manner that their use may be applied to other closely allied woodcrafts.

3. To develop safe, orderly and reliable work habits.

4. To develop occupational competence and high standards of workmanship.

5. To develop an appreciation and understanding of the work done by other crafts and how this work fits into the total building process.

As new methods, materials, tools and labor saving devices are gradually being introduced into the building industry, it becomes increasingly important that yearly evaluations be made of the course content of our training programs in order that the type of craftsmen that can meet the demands of our society might be developed.

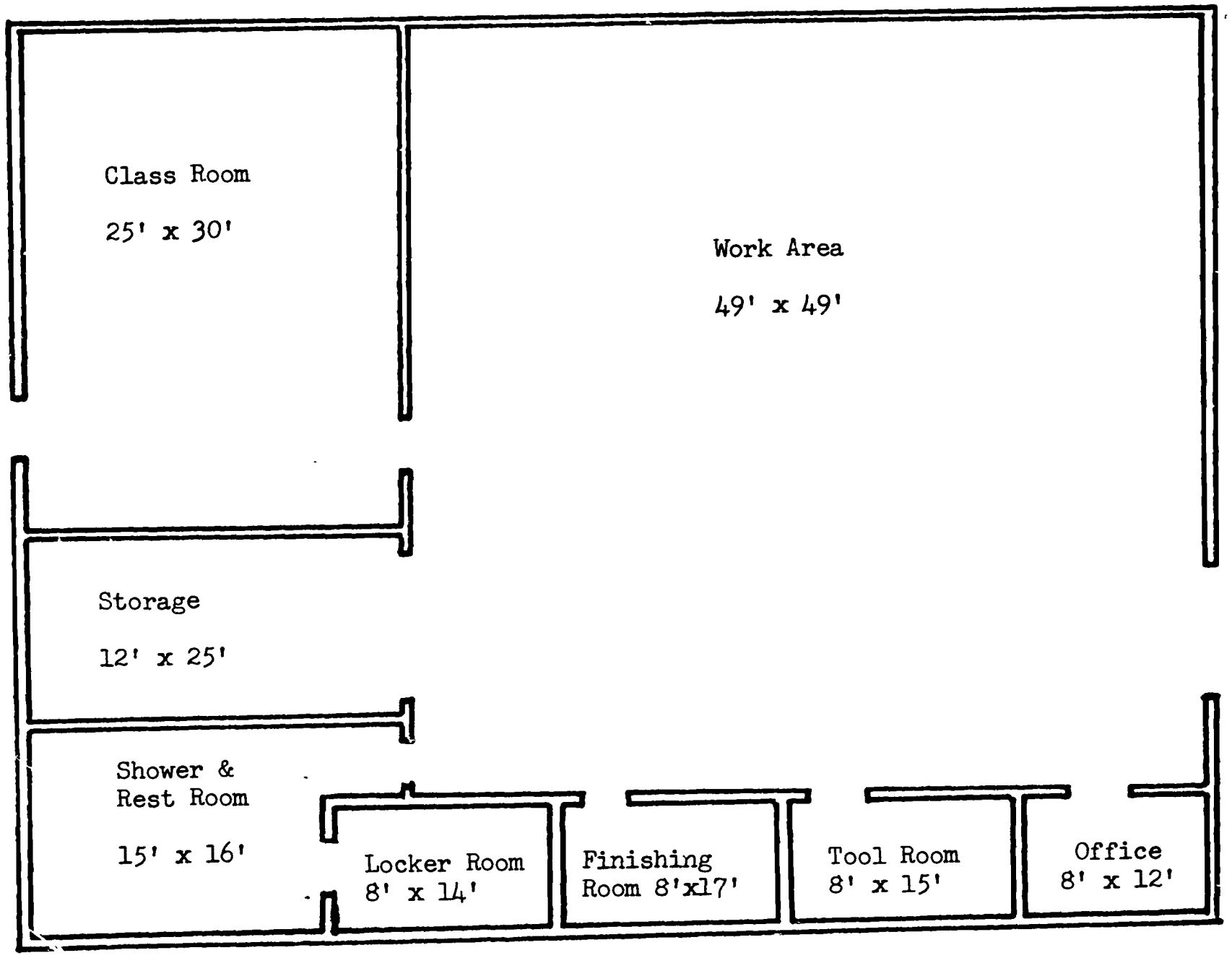
HOUSING AND PHYSICAL FACILITIES

Adequate space is a must in establishing a vocational training program. Inadequate space increases hazards and offsets the total instructional efficiency. The shop or laboratory should be a complete self-sustaining unit, free of inside obstruction. All partitions should be non-load bearing so as to achieve maximum flexibility. The floor plan on the following page should give some ideas of the space requirements and the necessary auxiliary rooms that are needed to sponsor a worthwhile program.

RECOMMENDED SPACE REQUIREMENTS FOR
MEDIUM-LARGE SHOP
CARPENTRY
(15 - 20 Students)

Work Area	2401 sq. ft.
Class Room	750 sq. ft.
Storage	300 sq. ft.
Shower - Rest Room	303 sq. ft.
Locker Room	112 sq. ft.
Finishing Room	136 sq. ft.
Tool Room	120 sq. ft.
Office	96 sq. ft.
Total Area	4,218 sq. ft.

MINIMUM SUGGESTED FLOOR SPACE
FOR A MEDIUM LARGE SHOP
CARPENTRY 4,218 sq. ft.
(15 - 20 Students)



COURSE OUTLINE FOR CARPENTRY

I. ORIENTATION

A. The Building Trades

B. The Carpenter and His Job

II. MATERIALS AND FASTENERS

A. Lumber

B. Hardware

C. Screws and Nails

III. CARE AND USE OF TOOLS

A. Planing

B. Sawing

C. Boring

D. Shaping

E. Measuring

F. Sharpening

IV. LAYING OUT THE FOUNDATION

V. CONSTRUCTING FOUNDATION FORMS

VI. FLOOR FRAMING

A. Sills

B. Joist

C. Girders

D. Bridging

VII. FRAMING FLOOR OPENINGS

A. Stairs

B. Chimney

C. Hearth

VIII. FLOOR COVERING AND LAYOUT

A. Subfloor

B. Subplate

IX. WALL FRAMING

A. Studs

B. Corners

C. Braces

D. Blocking

E. Plate

F. Ceiling Joist

X. FRAMING WALL OPENINGS

A. Windows

B. Doors

C. Arches

D. Cabinets

XI. EXTERIOR WALL COVERING

A. Sheathing

B. Felt

C. Insulations

D. Siding

XII. ROOF FRAMING

A. Ridges

B. Rafters

C. Bracing

D. Trusses

XIII. SCAFFOLDING

A. Single Pole

B. Double Pole

C. Portable Buck

XIV. SAFETY

XV. MAKING AND SETTING WINDOWS AND DOOR FRAMES

XVI. EXTERIOR WALL TRIM

A. Corner Boards

B. Facer Boards

C. Water Tables

XVII. FRAMING AND FINISHING THE CORNICE

A. Open

B. Box

C. Returns

XVIII. FRAMING AND FINISHING CANOPIES

XIX. FRAMING AND FINISHING LOUVERS

XX. FRAMING AND FINISHING DORMERS

XXI. MAKING AND FITTING SCREWS

XXII. INTERIOR COVERING

A. Sheetrock

B. Plywood

C. Panels

D. Flooring

XXIII. INTERIOR TRIM

A. Window

B. Door

C. Base

D. Molding

XXIV. INTERIOR CABINETS

A. Kitchen Wall

B. Kitchen Base

C. Bookcase

XXV. FITTING AND HANGING WINDOWS

XXVI. FITTING AND HANGING DOORS

XXVII. STAIR CONSTRUCTION

A. Straight

B. Dog Legs

CARPENTRY

TOOLS AND EQUIPMENT

Items	Quantity
Bars, Gooseneck Ripping	2
Bars, Straight Ripping	1
Bevels, Sliding	3
Bits, Auger 4/16" to 1" by 16ths	2 sets
Bits, Auger 1/2", 5/8", 3/4"	3 each
Bits, Auger, Doorlock	1
Bits, Extension	1
Bits, Expansive 7/8" to 1 1/2"	1
Bits, Expansive 7/8" to 3"	1
Bits, Countersink, square shank	2
Bits, Countersink, High speed	2
Bits, Machine 1/8" to 1/2 by 16ths	1 set
Bob, Plumb	2
Braces, Ratchet	6
Brushes, Paint 2"	6
Brushes, Paint 3"	6
Brushes, Bench 8"	6
Brushes, Wire , hand	1
Brushes, Wire with handles	2
Chisels, Cold 3/8", 1/2"	2 each
Chisels, Wood Bevel Edge, 1/4", 3/8", 1/2", 3/4"	6 each
Chisels, Ripping	1
Claw, Nail	1
Clamps, Bar, 3', 5', 7'	3 each
Clamps, "C", 6"	6

Items	Quantity
Chalk Line Reel	2
Dividers 6", 8"	3 each
Dividers, Angle	1
Doweling Jig	2
Drawing Sets, Complete	3
Drills, Push	2
Drill, Points	2 sets
Drills, Star 1/4", 1/2", 3/4", 12" Length	1 each
Drills, Hand	3
Files, Assorted	36
First Aid Kit, General	1
Gauges, Butt	2
Glass Cutters	3
Hammers, Tack	3
Hammers, Claw 16 oz.	15
Hammers, Claw 13 oz.	4
Hammers, Ball Pein	5
Hammers, Sledge 8, 12 lb., with handles	1 each
Hatchets	3
Knives, Utility	2
Levels, Transit	1
Levels, 24" Carpenter	4
Levels, 48" Mason	1
Miter Box	1
Miter Vise	1
Nail Sets	2 sets
Oilers	4

Items	Quantity
Oilstones, Crystolon Combination	2
Planes, Block	6
Planes, Jack, Smooth Bottoms	6
Planes, Smooth Bottoms	4
Planes, Jointer, Smooth Bottoms	1
Pliers	1/2 doz.
Protractor, Saw	1
Putty Knives	6
Picks	2
Picks	2
Rules, 6' Folding	1 doz.
Steel Tapes 50' and 100'	1 each
Scratch Awl	2
Saw Clamps	3
Saws Coping	2
Saws, Back	6
Saws, Keyhole	3
Saws, Hack	2
Saws, Hand 8 pts.	6
Saws, Hand, 11 pts.	4
Saw Sets	2
Scrapers, Cabinet	3
Shovels, Round point	2
Shovels, Square point	2
Screw Mates	1 set
Screw Drivers	21 astd.
Screw Driver, Ratchet	1

Items	Quantity
Soldering Iron, 100 Watts	1
Squares, Combination	1 doz.
Torch, Propane Kit	1
Square, Framing	6
Square, Try	6
Trammel Points	1 pr.
Vises, Machine	1
Wrenches, Adjustable	3
Wrenches, End	2 sets
Waste Cans, Oily	2
Wheel Barrows, 5 cu. ft.	1
Portable Power Tools	
Drill, Portable, Electric 1/4"	1
Drill, Portable, Electric 1/2"	1
Sander, Portable Electric Belt	1
Sander, Portable Electric Finishing	1
Saw, Portable Electric 6 1/2"	1
Saw, Portable Electric 7 1/4"	1
Saw, Sabre	1
Router Plane, Builders Kit	1
Stationary Equipment	
Work Benches, Double Faced, w/equipment (vises & bench stops)	4
Arbor Saw 10"	1
Band Saw 20"	1
Drill Press, floor model, 15"	1
Jointer 6"	1
Radial Saw, 10", 3 hp	1

Items	Quantity
Router with 1 doz. assorted bits	1
Grinder with blade sharpening attachment	1
Stationary Equipment Attachments	
Complete mortising attachments and equipment for drill press, sizes 1/4", 3/8", 1/2"	1 each
Dado Set, 8" dia., 5/8" bore	1
Moulder Set	1
Inserts	1 each

SUPPLIES

The supplies listed below are basic to this area of training. This list is incomplete and should be considered only as a beginning. The complete and appropriate list of supplies should be developed by the local administration, the local advisory committee and the instructor. Supplies should be purchased that conform with the instructional program.

Items	Quantity
Bolts and washers, assorted	24 bxs.
Brads, wire, assorted	15 lbs.
Cord, Extension, 25', 50', 100'	1 each
Glue, Powdered, Waterproof	25 lbs.
Hardware, (Locks, Hinges, Pulls, etc.)	Assorted Pieces
Lumber, Pine, assorted sizes	1000 ft.
Nails, assorted	200 lbs.
Oil, Machine	1 gal.
Plywood 4' x 8'	5 sheets assorted
Sand Paper, assorted sheets	12 doz.
Sand Paper Belts	4 doz.

Items	Quantity
Screws, assorted sizes	24 bxs.
Steel Wool, 1 lb pkgs.	1 doz.
Tacks, assorted	3 lbs.
Twine	6 balls

BUDGET NOTE: It is suggested that once the department is equipped with the above mentioned tools, equipment and supplies that a yearly operational budget of $600 be allowed for preparation in shop training. It is also expected that a minimum of $6,000 will be allowed for the outside live project training.

CARPENTRY

RECOMMENDED TEXTS AND REFERENCES

Textbooks

Durbahn, W. E: Fundamentals of Carpentry, Vols. I and II, American Technical Society, Chicago, Ill.

References

Mix, Floyd and Cirou, Ernest N.: Practical Carpentry, Goodheart-Wilcox Company Homewood, Ill.

Burbank, Nelson L: House Construction Details, Simmons-Boardman Publishing Corp., New York, New York, 1959

Townsend, Gilbert: Steel Square, American Technical Society, Chicago, Ill. 1950

Townsend, Gilbert and J. Ralph Dalzell: How To Estimate For the Building Trades, 2nd Ed., American Technical Society, Chicago, Ill.

Graham and Emery: Audels Carpentry and Builders Guides, Theo Audel and Company, New York, New York, 1961

Wilson and C. Rogers: Carpentry Mathematics, McGraw-Hill Pub. Co., New York

The Use of Hand Tools and Portable Machinery, Delmar Pub. Co., Albany, N. Y.

Ramsey and Sleeper: Architectural Graphic Standards, Simmon Boardman Co., N. Y.

McDonnell, Leo P: Hand Woodworking Tools, Delmar Pub. Co., N. Y.

Dalzell, V. Ralph: Building Trades Blue Print Reading, Part I and II, American Technical Society, Chicago, Ill.

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IDENTIFIERS - NORTH CAROLINA

ABSTRACT - Written by a professor of agricultural education, this manual is for use by vocational agriculture instructors teaching production agriculture in North Carolina. Contents include chapters on: (1) preparation for soil fertility programs, (2) lime and its uses, (3) sources of nitrogen, phosphorus, and potash, (4) secondary elements, (5) trace elements, (6) mixed and bulk blend fertilizers, (7) soil testing, (8) content of fertilizer nutrients in plants, (9) fertilizer application, (10) fertilization of tobacco, and (11) specific considerations for specific plants. Each chapter provides questions and exercises, and some are illustrated with tables, charts, diagrams, and line drawings. Reference materials and a subject index are appended. (AW)

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FERTILIZER
and
LIME

by

EMERSON R. COLLINS

VOCATIONAL EDUCATION
in
AGRICULTURE

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December 1966

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FOREWORD

Proper fertilization is one of the keystones in modern production agriculture. The modern farmer in America knows that plants, like animals, must have the proper plant food elements in the correct amount.

As technology in agriculture has advanced in all areas increased yields of crops are produced from the soil. All indications point toward the necessity for increased production of food, feed and fiber to support the ever-growing population. In order to maintain production, as well as to increase it, we must rely on the intelligent use of commercial fertilizers and limes to condition the soil and to provide necessary plant food elements.

Technology has enabled mankind to utilize the resources provided by nature in developing commercial fertilizers to replenish the soil. Even though a great variety of fertilizer materials are available there still remains the problem of understanding the proper utilization of plant foods for most efficient production. Toward this end Dr. Collins has developed this book as an aid to teachers of vocational agriculture and others in understanding and teaching about fertilizers in North Carolina.

V. B. Hairr

State Supervisor, Agricultural Education

FERTILIZER AND LIME

By Emerson R. Collins
Professor Emeritus North Carolina State University
Formerly In Charge, Extension Agronomy, 1942-65

1st Printing
1966

This material was written to give North Carolina farmers, homeowners, and fertilizer dealers a practical background for wise use of lime and fertilizers.

The material is the outgrowth of thirty years of varied experience in North Carolina. This included 6 years with the N. C. Expt. Sta., 5 years teaching the undergraduate course in fertilizers and 23 years in charge, Extension Agronomy, N. C. Extension Service.

The author wishes to salute the large number of research workers who have laid a sound foundation for increasing crop production in North Carolina; the county Extension workers who have shared many experiences in educational meetings and conducting demonstrations of new practices; the vocational teachers and their teaching of improved practices; and the large number of farmers who have unselfishly given their talents, land, labor, supplies, and counsel to try new and untried practices on their farms.

The fast spectacular increases in crop yields will continue with this irresistible force of teamwork.

Contact author for reproduction privileges.

Emerson R. Collins
2713 Rosedale Ave.
Raleigh, N. C.

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INTRODUCTION

WHY LIME AND FERTILIZE?

The requirements for plant growth are summarized in Figure 1. This included energy from the sun to manufacture starches and sugars; carbon dioxide to combine with water to form the carbohydrates and sugars; oxygen for respiration by the plant; and nitrogen for fixation by legumes.

The soil supplies, or stores from fertilizers, the three major elements (N, P, and K), the three secondary elements calcium, magnesium and sulfur, and the micronutrients or trace elements boron (b), manganese (Mn), zinc (Zn), iron (Fe), copper (Cu), molybdenum (Mo), and chlorine (Cl). The soil contains also a supply of water.

Some so-called "fertile" soils have all the necessary mineral requirements for plant growth and the plants grow vigorously. However, most soils are lacking in one or two ways; namely:

1. The soils are too acid or alkaline. Plants prefer a rather specific, and narrow range, of acidity for best growth.

2. Low Plant Nutrients or Elements. One or more of the essential plant nutrients is too low for best growth. In some cases high amounts can be toxic or interfere with the uptake of needed elements.

SOIL TEST SUMMARIES SHOW NEED IN NORTH CAROLINA

The soil tests made on soil samples sent to the Soil Testing Laboratory have been summarized by crops, areas and counties. These soil test summaries are available, free, by requesting for your county, a copy from the N. C. Soil Testing Laboratory, N. C. Department of Agriculture, Raleigh, N. C. 27601. Presently available summaries are for the year 1960. A more recent summary is anticipated soon.

MANY SOILS IN NORTH CAROLINA NEED LIME

Briefly, these soil test summaries show that many of the soils are too acid for the best growth of the crops grown. However, each field is an individual case and a few of the soils have too high a pH for the best growth of the crop to be grown.

MANY SOILS IN NORTH CAROLINA ARE LOW IN ORGANIC MATTER AND NITROGEN

The soil tests further show that many soils are low in organic matter and therefore have a low ability to supply nitrogen and some other nutrients to growing crops.

MANY SOILS IN NORTH CAROLINA ARE LOW IN PHOSPHORUS

Forty-seven percent of the soils of the Mountain area are low in phosphorus. This compares with 7% in the Coastal Plain area (1960 summary).

Figure 1. NUTRIENT REQUIREMENTS FOR PLANT GROWTH.

1. <u>The sun supplies</u>:

   Energy for the plants to manufacture carbohydrates (starch, sugar, etc.).

2. <u>The air supplies</u>:

   Carbon dioxide (CO_2)

   Oxygen (O_2)
   Nitrogen (N_2) particularly for legumes that fix nitrogen.

3. <u>The soil, fertilizer, and lime supply</u>:

   A. Three major elements

      Nitrogen (N), Phosphorus (P) and Potassium (K).

   B. Three secondary elements

      Calcium (Ca), Magnesium (Mg) and Sulphur (S)

   C. Micronutrients or trace elements:

      Boron (B), Manganese (Mn), Zinc (Zn), Iron (Fe), Copper (Cu) Molybdenum (Mo) and Chlorine (Cl)

   D. Water (H_2O)

Many soils used for tobacco, truck crops, etc. have been fertilized heavily for a period of years. These soils are frequently high or very high in phosphorus.

MANY SOILS IN NORTH CAROLINA ARE LOW IN POTASH

Many of the soils of the Piedmont area, and particularly those of the Coastal Plain area are low in potash. The same is generally true of magnesium.

SOME SOILS IN NORTH CAROLINA ARE LOW IN ONE OR MORE OF THE TRACE ELEMENTS

Soil samples from problem areas are low in magnesium, manganese, zinc, iron, copper, etc. However, no summary data is available. See Trace Element chapter for crop conditions and areas where specific trace elements are likely to be a problem.

LARGE AMOUNT OF FERTILIZER IS USED IN NORTH CAROLINA

A total of 1,715,343 tons of fertilizer was sold in North Carolina in the fiscal year 1965-66.

A tabulation of the fertilizers used by grades and counties is available from the Commissioner of Agriculture, N. C. Department of Agriculture, Raleigh, N. C. A similar list is available for fertilizer materials. Request the fiscal year tabulation as it will be more meaningful to you.

PLANTS DIFFER IN THEIR REQUIREMENTS

Studies with different crops show that they have different acidity level preferences and different levels of nutrient requirements for maximum economic growth. Therefore, it is necessary to keep in mind the plant and the soil in determining the lime and fertilizer needs. Table 21 gives the approximate amount of the fertilizer elements contained in designated crop yields.

CONSIDER LIME AND FERTILIZER AS ONE PROGRAM

A good lime program is planned to adjust the acidity to the preference of the plant. (Also to supply calcium and magnesium).

A good fertilizer program is planned to supply the kind and amount of nutrient elements needed for plant growth - those that cannot adequately be supplied by the soil in which the plants are to be grown.

Lime and fertilizer must both be adjusted for the particular plant and the soil. Therefore, we should consider lime and fertilizer as <u>one</u> program.

SUGGESTED MATERIALS FOR CLASS DISCUSSION

1. Have each one fill out the true-false questionnaire for future reference.

2. Soil test summary for the county. It would be well to put these on charts showing: (Request summary from Soil Testing Laboratory)

	% Low and Very Low	% Medium	% High and Very High
Acidity[1/]			
O. M.			
Phosphorus			
Potassium			

3. A tabulation of fertilizer grades (also materials) sold by counties. (Request from Commissioner of Agriculture - ask for fiscal year summary as it will be more meaningful).

4. Chart, slide, or diagram of Figure 1 that can be seen by the group.

5. Chart, slide, or actual bags showing front of lime and fertilizer bag.

6. Chart showing the amount of fertilizing elements contained in some common crops.

QUESTIONS AND EXERCISES

1. What is the purpose of liming?

2. What is the purpose of fertilizing?

3. Why is a soil test desirable?

4. Why should different plants receive different amounts of lime and fertilizer?

5. How much fertilizer is used in North Carolina each year?

1/ Express as those needing 1-2 tons, 0-1 ton and none (or other applicable terms meaningful to the county). Include designation for those over-limed.

TEST YOUR KNOWLEDGE OF LIME AND FERTILIZERS

(It is suggested that you take this test before you start the course and check your answers as you cover each one in the discussion)

1. pH determines the amount of acidity in the soil. true_____ false_____

2. Aluminum can be high enough in an acid soil to decrease plant growth (below pH 5.0). true_____ false_____

3. It is important to mix dolomitic limestone with the soil. true_____ false_____

4. Sidedressing corn on one side is as good as both sides. true_____ false_____

5. Sidedressing tobacco on one side is as good as both sides. true_____ false_____

6. Potash and nitrogen leach (wash out) out of the soil more than phosphate fertilizers. true_____ false_____

7. You should cover nitrate of soda and ammonium nitrate with soil when it is sidedressed. true_____ false_____

8. Nitrate nitrogen is more quickly available to plants than ammonia nitrogen. true_____ false_____

9. All plants prefer nitrate nitrogen to ammonia nitrogen. true_____ false_____

10. Eighty pounds of nitrogen applied as anhydrous ammonia will make the soil more acid than the same amount of nitrogen applied as ammonium nitrate. true_____ false_____

11. Lime is not needed when you use a basic source of nitrogen such as nitrate of soda. true_____ false_____

12. Sulfur is released in the air by burning coal, oil, etc. When this sulfur is brought down by rain, there is enough sulfur for crop growth. true_____ false_____

13. Phosphates added to the soil as a fertilizer are made less available to plants in an acid soil than in one properly limed. true_____ false_____

14. Cotton is most likely to show a boron deficiency on an acid soil. true_____ false_____

15. Tobacco fertilizers should have at least 50% nitrate nitrogen when the soil has been fumigated. true_____ false_____

16. Dolomitic limestone is preferred to calcitic limestone for most soils. true_____ false_____

17. Muriate of potash is cheaper than sulfate of potash. Therefore, it is just as good for:
    a. Corn true_____ false_____
    b. Cotton true_____ false_____
    c. tobacco true_____ false_____

18. Fertilizer placed too close to a seed or seedling can kill the plant. If the plant recovers and grows there is very little decreased yield. true_____ false_____

19. Plants can absorb fertilizers sprayed on the leaves (foliar sprays). Increased yields can generally be obtained by using foliar sprays. true_____ false_____

20. A fertilizer guaranteed as 5-10-10 means 5% total N, 10% available phosphoric acid (P_2O_5) and 10% available potash (K_2O). true_____ false_____

21. A nitrogen deficiency is shown in corn by firing around the edges with the midrib remaining green. true_____ false_____

22. The maximum chlorine content of all fertilizer is required in the guarantee. true_____ false_____

Chapter I

LAYING THE FOUNDATION FOR A SOIL FERTILITY PROGRAM

The ordinary thermometer helps us regulate our environment. This measuring device is conveniently marked in terms of degrees. Water freezes at 32° F. and water boils at 212°. We regulate our homes and schools around 68° for our physical comfort and to keep our minds alert. However, the polar bear prefers a temperature below zero and the tropical bird prefers a temperature around 100°.

If the tropical bird were transported to the polar region it would die. The best food known to science could not keep it alive because of the unfavorable environment.

PLANT LIFE IS REGULATED BY TEMPERATURE AND ACIDITY

The kind and amount of plant life is also regulated by temperature. Citrus fruit grows in Florida, and apples in the mountains of North Carolina. Plants have an additional factor of environment expressed as acid, neutral, or basic. This environment is measured in terms of the pH scale from 1 to 14. One is very acid and 14 is very basic. Seven is neutral.

Where the tropical bird requires a high temperature, alfalfa thrives at high pH values of 6.5 to 7.0. Corresponding to the low temperature requirements of the polar bear azaleas thrive at low pH values of 4.0 to 5.0. Our common agricultural crops do best between these two extremes of pH. See Table 2 for desirable pH range for some common crops.

SOIL ACIDITY CAN BE REGULATED OR ADJUSTED

Excess soil acidity (low pH) can be destroyed (neutralized) by applying basic materials such as lime. Soils that are basic (pH too high) can be made more acid (pH lowered). This can be done by the use of sulphur, acid forming fertilizers,

or deeper plowing to mix the acid sub soils with the overlimed surface soil. The latter is true in North Carolina because most of the soils have acid sub soils.

ACIDITY INFLUENCES AVAILABILITY OF FERTILIZERS

The acidity of the soil influences the availability of many fertilizer nutrients. The acid (sulfuric) from the storage battery of a car dissolves or rusts the iron frame. An aluminum kettle turns bright when the housewife uses it to cook an acid fruit such as a tomato. The acid dissolves the outer layer of the aluminum. Mineral acids, plant acids, and soil acids dissolve iron and aluminum in the mineral soils of North Carolina.

Soluble iron and aluminum present three problems for crop production.

First, aluminum is toxic to plant growth.

Second, the iron can accumulate in the nodes of corn, for example. This accumulation of iron can stop the movement of nutrients from the corn roots to the ear.

Third, iron and aluminum form insoluble soil phosphates that are unavailable to plants.

Iron and aluminum do not normally present a problem when the pH is above 5.5. Therefore, this should be the lowest level used for crop production except for specific acid loving or tolerant plants.

Other elements such as manganese, zinc, and iron become less soluble as the pH of the soil is raised around pH 6.2 to 6.5. The lowered solubility of these elements can decrease plant growth. For example, boron is usually included in the recommendation for alfalfa grown at the high pH range of 6.5 to 7.0.

Economical crop production requires adjusting the environment (pH) for most field crops between pH 5.8 and pH 6.2. Closer adjustment is beneficial for specific crop as shown in Table 2.

A RELIABLE SOIL TEST IS NECESSARY

Unfortunately, determining the pH is not a simple procedure. There are some quick colorimetric pH tests that work fairly satisfactorily in the hands of experienced persons. However, the dark colored soluble organic matter, and certain colored clays (red, yellow, etc.) can frequently give a misleading test. We should not jeopardize the production of an important crop by adjusting the pH on the basis of a colorimetric test. Send a representative sample to a reliable soil testing laboratroy such as the one maintained by the North Carolina Department of Agriculture, Raleigh, N. C. Free tests are made for North Carolina farmers. Most other states have similar soil testing laboratories.

OTHER FACTORS DETERMINING A FERTILIZER PROGRAM

A complete fertilizer program considers both the level of nutrients in the soil and the specific requirements of a crop. A person released from a prison camp may need a program of building the body in addition to the normal maintenance requirements. Similarily, some plant nutrients must be built up to reasonable levels in the soil before maximum yields can be expected. This is true for some crops even with high row applications of fertilizer.

1. Soils differ in their fertility level.

There are natural, or man-made, differences in soil fertility. Soils also differ in their ability to prevent applied fertilizers from leaching or being fixed in forms unavailable to plants.

New all-time high state average yields are being produced in practically every normal crop year. This results from the continued application of more fertilizers than the amount removed by the crop. This is very apparent in the phosphate levels built up on tobacco soils with high fertilization.

Fifteen hundred pounds of a 3% nitrogen, 9% phosphoric acid, and 9% potash fertilizer supplies 135 pounds of phosphoric acid (9% x 1500 lbs.). On the other hand, 2800 pounds of flue-cured tobacco leaves remove only 15 lbs. of phosphoric acid. Fields receiving high fertilization for tobacco, truck crops, etc., generally show very high soil levels of phosphoric acid (P_2O_5). The optimum levels of phosphorus and potash will be discussed later.

2. Crops differ in their fertilizer requirements.

Lespedeza and crotalaria, for example, can produce good crop growth on so-called poor soils. Poor soils generally mean that one or more of the plant requirements is low or lacking.

Soybeans and small grain are intermediate crops. They respond to fertilizer but give little response to phosphorus or potash when the level of these nutrients is high in the soil.

Irish potatoes and flue-cured tobacco are crops that give yield responses to phosphorus and potash even on soils that are high in these nutrients.

Legumes fix much of their nitrogen requirements from the air. Maximum nitrogen fixation usually takes place on well limed soils, and with at least medium levels of phosphorus and potash.

3. Crops differ in their feeding habits.

The use of radioactive phosphorus shows that plants have different feeding habits. The rate of root growth and the amount of feeding from each soil area was determined by systematically placing radioactive phosphorus at different distances from plants, and at different depths. The specific feeding pattern established for the different crops (corn, cotton, peanuts, and tobacco) is discussed under the fertilization of the specific crop.

4. Farmers have different cultural practices.

Rotations, level of weed control, plant spacing, level of production desired, anticipated moisture level, type of soil, drainage, variety, or hybrid, etc. should be evaluated by the farmer in addition to the soil test information.

The yield level desired by the farmer will determine the level of basic fertility he will want to build into his soil, in addition to the row and sidedressing applications.

It would not be economical to use average fertilizer rates on thickly spaced corn with adequate irrigation anticipated. Neither would it be economical to use high rates of fertilizer on soybeans to be grown on an acid soil. In other words, fertilization is only one of the important factors to consider in making plans for an economical yield. Familiarity with these factors places you in a good position to make the best judgment on fertilizer use and selection.

5. Secondary elements are necessary - (calcium, magnesium, and sulfur)

A good liming program with ground dolomitic limestone should normally supply the calcium and magnesium requirements of most plants. Peanuts, for example, require landplaster (calcium sulfate) to supply adequate calcium for good filling of the fruit.

Sulfur is normally supplied in adequate amounts by the use of super phosphate (contains calcium sulfate) and sulfate of ammonia in many conventional mixed fertilizers.

Sulfur may be low in high analysis fertilizers, bulk blended fertilizers, and liquid fertilizers.

6. Trace elements can limit growth and production.

It is recognized that plants have requirements for elements in addition to the primary nutrients; namely, nitrogen, phosphoric acid, and potash; and the secondary elements; namely, calcium, magnesium, and sulphur. These trace elements are designated as boron, manganese, zinc, iron, copper, molybdenum, and chlorine. Farmers continue to remove larger yields of crops from their land each year. Fertilizers are becoming more concentrated and therefore, contain less impurities such as these trace elements.

Most of these trace elements do not become problems on the crops grown in North Carolina with a sound program of liming and with the pH between 5.8 and 6.2.

Some crops are more likely to need trace elements than others. The specific requirements of alfalfa for boron, peaches for zinc, etc. are discussed in Chapter VI, Trace Elements. The relation of specific soil conditions to the likely need for trace elements is also discussed.

SUMMARY

A sound fertility program should consider the following factors:

1. A reliable soil test made on a representative sample from a uniform area.

2. Lime with dolomitic limestone to adjust the acidity (pH) within the optimum ranges of the crops to be grown in the rotation.(Table 2)

3. Build phosphorus and potash levels to medium or higher depending on the crop or crops to be grown.

4. Broadcast, apply in the row, or sidedress the nitrogen, phosphorus, and potash to maintain adequate levels throughout the growing season. Pay particular attention to nitrogen, potash and magnesium that are frequently leached from sandy type soils.

5. Note specific crop or soil requirements for secondary and trace elements.

6. Adapt the fertilizer program to the level of management anticipated and to the capabilities of the soil, with or without irrigation.

7. Remember that building a soil is a long time investment - not a crop season expense.

Exercises for Chapter I

1. List the factors that would affect the kind and amount of fertilizer that would be desirable.

2. Why is a soil test desirable?

3. How does acidity affect the availability of plant nutrients?

4. How do plants differ in their needs for fertilizer?

5. What are the three major fertilizer nutrients?

6. What are the three secondary fertilizer nutrients?

7. What are the seven trace elements?

8. What are the major points to consider in a sound fertilizer program?

9. Check list of factors to consider in selecting a fertilizer program.

   a. The requirements of the crop to be grown.

   b. The level of production desired.

   c. The level of moisture (or irrigation) anticipated.

   d. The level of lime, or plans for an adequate liming program. Will the soil acids be neutralized by any lime applied in time to benefit the present crop?

   e. The level of natural or man-made soil fertility.

   f. Plant spacing (plants per acre).

   g. The degree of weed control expected.

   h. Evaluation of disease probability.

   i. The degree of risk you are willing to take on the higher production costs of high yield efforts.

Chapter II

LIME

SPEAKING THE LANGUAGE

Considerable confusion exists relative to the terms used in connection with "lime".

"Lime", in dictionary terms, means burned limestone (calcium oxide-CaO)[1/]. This form of lime is also called quick lime, burnt lime, and caustic lime. In this discussion, we will use the conventional agricultural terms as follows:

1. Ground dolomitic limestone (42% calcium carbonate-$CaCO_3$ and 52% magnesium carbonate-$MgCO_3$).
2. Ground calcitic limestone (80-95% calcium carbonate-$CaCO_3$).
3. Baked oyster shells (85% calcium carbonate ($CaCO_3$), and impurities).
4. Marl (primarily shells and impurities, 60% calcium carbonate-$CaCO_3$).
5. Burned lime (85% calcium oxide-CaO).
6. Burned oyster shells (55% calcium oxide-CaO, magnesium when added, and impurities).
7. Hydrated lime (calcium hydroxide-$Ca(OH)_2$). (65% Calcium oxide CaO).
8. Basic slag (a byproduct of steel manufacture having a neutralizing value and containing many impurities).
9. Landplaster (calcium sulphate ($CaSO_4 \cdot 2H_2O$).

SOIL TESTING SUGGESTIONS ARE BASED ON GROUND DOLOMITIC LIMESTONE

With the relatively high rainfall in North Carolina, magnesium is readily leached from the soil. This is particularly true in the sandy Coastal Plain area.

1/ The chemical name - followed by the chemical symbols will help us to see the relationship between the forms of lime.

Therefore, all suggestions from the North Carolina Soil Testing Laboratory are in terms of ground dolomitic limestone that contains magnesium carbonate ($MgCO_3$) as well as calcium carbonate ($CaCO_3$). Calcitic limestone, oyster shells, and marl contain very little magnesium unless it is added.

RELATION BETWEEN pH AND LIME REQUIREMENT

The pH of a soil indicates the degree of acidity. However, the pH does not indicate the amount of acidity.

A 1000 gallon tank of water, 30 feet in the air, will show a certain pressure on the faucet at ground level. This will be the same pressure as that of a one inch pipe filled with water to the same height.

Pressure is like pH. It is not a measure of quantity.

Two sandy soils with the same pH and organic matter level will require about the same amount of lime to change the pH one unit. However, a clay soil will require more lime to change the pH one unit. A high organic soil will also require more lime than a sandy soil.

The amount of lime required will increase as the clay and/or organic matter increases. These factors are taken into account when the lime suggestions are made by the soil testing laboratory.

LIMING MATERIALS HAVE DIFFERENT NEUTRALIZING VALUES

Substitutions for the dolomitic limestone suggested must take into account the different neutralizing values on a weight basis.

TABLE 1. THE RELATIVELY NEUTRALIZING VALUES OF LIMING MATERIALS. (Expressed as a per cent of the neutralizing value of pure calcium carbonate as 100)

LIMING MATERIALS	RELATIVE NEUTRALIZING VALUE
1. Ground dolomitic limestone	95 - 108
2. Ground calcitic limestone	85 - 100
3. Baked oyster shell	80 - 90
4. Marl	50 - 90
5. Burned lime	150 - 175
6. Burned oyster shells	90 - 110
7. Hydrated lime	120 - 135
8. Basic slag	25 - 35
9. Landplaster	None

A suggestion of one ton of ground dolomitic limestone would be the equivalent in neutralizing value to approximately 1220 lbs. of burned oyster shells (2000 lbs. x 100 (average neutralizing value of dolomitic limestone) = 200,000 divided by 164 (average neutralizing value of burned oyster shells) = 1220).

LIMING MATERIALS DIFFER IN THEIR SPEED OF REACTION WITH THE SOIL

Hydrated lime ($Ca(OH)_2$) is a strong base. It is similar to household lye. It reacts quickly with the soil acids. Unfortunately it can also partially sterilize the soil. It also brings about other undesirable effects when applied too soon before a crop is planted. The high calcium level, for example, can bring about temporary potash deficiency symptoms. Retarded growth and some dying can result in extreme cases.

Burned lime (CaO) reacts with the soil moisture (water H_2O) to form hydrated lime ($Ca(OH)_2$). Also with the carbon dioxide (CO_2) of the soil to form calcium carbonate ($CaCO_3$). The effect can be the same as described above for hydrated lime.

Dolomitic limestone blocks are used for building purposes. It is very satisfactory because it is water insoluble and resists weathering. However, finely ground dolomitic limestone can neutralize soil acids by direct contact.

Ground dolomitic or calcitic limestone react more rapidly with the soil when they are finely ground. Limestone must be ground so that 100% passes through a 10 mesh screen, and 40% through a 100 mesh screen to be legally sold in North Carolina. The finer particles will react with the soil acids within a few months. The speed will depend on how thoroughly it is mixed with the soil, the season of the year, and the acidity of the soil. The particle sizes between 10 mesh and 100 mesh will react within a reasonable length of time.

Ground calcitic and dolomitic limestones are water insoluble. Their availability depends on the carbon dioxide content of the soil forming soluble bicarbonates.

$MgCO_3$ or $Ca\ CO_3^+$	H_2CO_3	=	$Mg(HCO_3)$ or $Ca(HCO_3)_2$
Magnesium carbonate or	Carbonic acid		Magnesium bicarbonate or
Calcium carbonate (insoluble)	Water (H_2O) and carbon dioxide (CO_2)		Calcium bicarbonate (soluble in water)

The carbon dioxide content of the soil is related to the biological activity (bacteria, molds, etc.) and the amount of root growth. Therefore, we get the fastest reaction of limestone with the soil during the warm summer months. This is the period when crops and soil micro organisms are growing vigorously and giving off carbon dioxide. This relative insolubility of ground calcitic and dolomitic limestones makes it desirable to spread them evenly and mix them thoroughly with the soil.

BULK LIMESTONE SUPPLIES THE CHEAPEST NEUTRALIZING VALUE

Bulk limestone can be delivered to the farm at the lowest cost for neutralizing value. The same minimum standards for grinding applies to both wet and dry ground limestones. When the material is wet, it is more difficult to spread uniformly than the same product in a dry form. This requires greater care with bulk wet limestone to get it thoroughly mixed with the soil for rapid reaction with the soil acids. This is not much of a problem when a liming program is designed to maintain a satisfactory pH. It may be very important where quick reaction is desirable on soils too acid for the crop to be grown this year.

OVERLIMING MAY CAUSE DEFICIENCY SYMPTOMS

Overliming can result from failing to recognize the need for mixing the ground limestone with the soil. Limestone applied on the surface and plowed down gets very little mixing with the soil. Since the limestone was not mixed with the soil, a later test may show that lime is still needed. Overliming occurs when the second application is made, and both applications are mixed with the soil by later tillage operations.

Overliming may develop recognizable symptoms on sensitive crops such as soybeans, peanuts, and small grain. Both manganese and magnesium deficiency result in the leaves turning light green, yellow, or white, with the veins remaining green. A soil test is helpful to distinguish between manganese and magnesium deficiency. The manganese deficiency is most common on light soils with pH values 6.2 or above. Foliar sprays, as suggested under "Trace Elements", will usually give quick plant recovery and help diagnose field problems.

HOW TO MIX LIMESTONE WITH THE SOIL

Work has been done to determine the efficiency of different tillage implements for mixing limestone with the soil. These results show that a special effort is needed to get good contact of the limestone with the soil acids.

Results show that tillage operations varied enormously in uniformity of mixing material with the surface six inches of soil.

The results can be summarized as follows:

1. Two operations with a rotary tiller were necessary to mix the soil uniformly to a 6 inch depth.
2. The spring tooth harrow and disk harrow did not mix the material with the lower part of the tilled section.
3. The disk harrow left a non-uniform horizontal distribution of the material.
4. Plowing left most of the material in the lower part of the tilled section. The results indicate that this irregular mixing could be avoided to a certain extent by applying half the material before disking and plowing, and the remainder before final harrowing. Also by applying the material through a fertilizer hopper at the time of plowing. (This refers to a 16 inch mold board plow with the material applied through a fertilizer hopper in two streams on the furrow wall of the plowed land.) Or (a 16 inch mold board plow with the material applied through a fertilizer hopper in two streams -- one on jointer, and the other on the furrow as it leaves the mold board).
5. The soil cross section patterns indicate the use of a deep springtooth harrow such as a field cultivator could give fairly good soil mixing in both top and bottom zones of a plow furrow.

Another suggestion would be to start with a brush drag or a spike tooth harrow to mix the limestone with the dry loose surface soil. Then follow with implements that mix this surface soil and limestone with lower depths of soil. On extremely acid soils, where rapid reaction is desirable, half the lime can be applied and mixed with the surface. This can be followed by plowing and mixing the other half of the limestone with the soil that is turned up.

Hydrated lime and burned oyster shells will react quicker than ground limestone. The drastic action of these strong bases, and the lack of magnesium, (unless added), makes this practice questionable. This is particularly true in the Coastal Plain. When a soil is adequately limed with a calcitic lime (hydrated or burned oyster shells without magnesium added) the magnesium may be low. This would require the use of relatively expensive water soluble magnesium sources. Further, the water soluble sources are frequently less effective than the magnesium in the dolomitic limestone. This is due to the fact that magnesium becomes available only as fast as the dolomitic limestone reacts with the soil acids. Therefore, it does not leach out as rapidly as the water soluble magnesium.

DOLOMITIC LIMESTONE MAY BE TOO HIGH IN MAGNESIUM FOR SOME CROPS

With crops such as peanuts, results would indicate that a dolomitic limestone containing 15% magnesium carbonate (conventional dolomitic limestone contain around 42% magnesium carbonate) may be preferred. Under these conditions, liming with a combination of calcitic limestone and ground dolomitic limestone would decrease the amount of magnesium. A combination of quick acting lime and dolomitic limestone would speed up the reaction with the soil and supply adequate magnesium for the growing crop.

CROPS HAVE SPECIFIC REQUIREMENTS FOR SOIL ACIDITY LEVELS

The North Carolina Experiment Station lists the approximate pH ranges desirable for the major crops grown in the state. These are shown in Table 2. The pH values are altered from the best pH for maximum growth where disease control is desirable. Irish potatoes, for example, are grown at a pH lower than optimum to help control scab. Lower than optimum pH levels on tobacco helps to control root rot. However, this may increase fixation of phosphates and the leaching of potash.

TABLE 2. APPROXIMATE pH RANGES DESIRABLE FOR SPECIFIC CROPS

pH 4.8 - 5.2 (Strong Acidity)	pH 5.8 - 6.2 (Slight Acidity)		pH 6.3-6.7* (Nearly Neutral)
Blueberries Irish Potatoes	Apples Beans, snap Crimson Clover Crotalaria Corn** Cotton Lettuce Pasture Maintenance	Peaches Peanuts Small Grain (Lesp)*** Soybeans Strawberries Sweet Potatoes Tobacco (5.2 - 6.0) Vetch	Alfalfa Cabbage Ladino-grass Red Clover Sweet Clover

* On highly organic soils it is not advisable to lime to a high pH. Good crop production may be obtained where the pH is around 5.5.

** In rotation with alfalfa, Ladino-grass, red clover, or sweet clover, the soil should be limed to about pH 6.5.

FIGURE 2. GUARANTEE ON THE LIME BAG OR TAG

All liming material shall have attached to or be accompanied by the information shown to be required by law. In the case of bulk material, the statement shall be delivered to the purchaser either with the material or with the invoice.

A. Ground limestone or mixtures of burned or unburned materials. (This includes ground oyster shells).

Example	Required by Law
100 pounds net	New weight when sold in packages.
JOHN DOE'S GROUND DOLOMITIC LIMESTONE	A brand or trade name truly descriptive of the product.
Guaranteed Analysis Calcium Carbonate ($CaCO_3$)..... 52% Magnesium Carbonate ($MgCO_3$)..... 42%	The minimum percent of calcium expressed as calcium carbonate ($CaCO_3$) and of magnesium expressed as magnesium carbonate ($MgCO_3$).
Neutralizing equivalent..... 95	Total neutralizing value expressed as "calcium carbonate equivalent" or "neutraling equivalent."
Screen Analysis 100% through 10 mesh 40% through 100 mesh	Fineness of the material as determined by screens complying with the specifications of the United States Bureau of Standards.
JOHN DOE CO., NORFOLK, VIRGINIA	The name and address of the manufacture or vendor guaranteeing the registration.

B. Burned materials. (The term "lime" can be used only with completely burned material).

Example	Required by Law
100 pounds net	Net weight when sold in packages.
JOHN DOE'S BURNED OYSTER SHELL LIME	A brand or trade name truly descriptive of the product.
Guaranteed Analysis Calcium Oxide (CaO)..... 55% Magnesium Oxide (MgO).....0.5%* Neutralizing equivalent.....100%	The minimum percent of calcium expressed as calcium oxide (CaO) and of magnesium as magnesium oxide (MgO). (or Calcium (Ca) and Magnesium (Mg). Total neutralizing value expressed as "calcium carbonate equivalent" or "Neutralizing equivalent".
JOHN DOE CO., NORFOLK, VIRGINIA	The name and address of the manufacture or vendor guaranteeing the registration.
* More magnesium is added to some burned limes sold in the state	The guarantee of screen analyses shall not be required for the products of completely burned limestones or shells. The name and address of the manufacturer or vendor guaranteeing the registration.

TREAT EACH PART OF THE FIELD ACCORDING TO ITS LIME NEEDS

More emphasis must be placed on differential liming in the same field. This becomes more important as fields get larger. Many fields have eroded areas, areas of darker soil, sandier soils, or other differences that affect the lime requirements.

When you include areas of different characteristics in your soil sample, you get an average lime suggestion that may not give you the best pH in any area of the field.

The lighter sandy areas may be overlimed while the darker or heavier areas may not have enough lime for best crop production.

A dairyman must feed each of his cows according to her potential for economical production. We must do the same thing when different parts of the field have different basic lime and fertilizer requirements.

TREAT OVERLIMED AREAS

Uniform lime applications to a nonuniform field,or indiscriminate liming in the past,may have brought about an overlimed area. This is most likely around old lime piles, sandy ridges or areas of marl use.

Take a soil sample from the area and describe the background of the problem area. The soil test will indicate the best treatment.

Manganese can be applied as a foliar spray or be added to the fertilizer. (See discussion in Chapter VI, "Trace Elements"). Sulfur will react with the extra lime and reduce the pH. One pound of sulfur is equivalent to about three pounds of dolomitic limestone. The sulfur is oxidized to form sulfuric acid that neutralizes the limestone. Applications of sulfur above 300 to 400 pounds per acre at one time may be detrimental to crop growth.

Deeper plowing will mix the overlimed surface soil with the more acid subsoil. It is desirable to gradually plow a little deeper (1 to 2 inches) each year.

HOW TO TAKE A SOIL SAMPLE

Directions for taking soil samples are on the information supplied with the soil sample boxes and containers supplied by the N. C. Soil Testing Laboratory, Raleigh, N. C. Field crops, lawns and pastures have different instructions. Be sure to follow the one that best applies to your conditions. See Chapter IX, "Soil Testing."

Directions and supplies can be obtained from most Agricultural Extension and Vocational Agriculture Offices.

SUMMARY

A sound liming program can be summarized as follows:

1. Take a representative soil sample from each area of each field that has different soil characteristics or shows a difference in crop growth. This should be done every three or four years.
2. Send the soil sample to a qualified laboratory where the tests have been standardized against crop response for your area.
3. Apply the suggested rate of ground dolomitic limestone 2/ uniformily over the area of the field represented by the soil samples. Give special consideration to sandy areas, dark soil areas, etc.
4. Mix the limestone thoroughly with the soil for faster neutralization of the soil acid.
5. Correct nutrient deficiencies in overlimed areas by adding the element or elements needed, using acid forming fertilizer, deeper plowing, etc.

2/ See section on "Dolomitic Limestone May be Too High in Magnesium for Some Crops".

QUESTIONS AND EXERCISES FOR CHAPTER II

1. Why is ground dolomitic limestone suggested as a source of lime?

2. How do liming materials vary in their ability to neutralize soil acids?

3. What effect does acidity have on the availability of plant nutrients?

4. Since dolomitic limestone is insoluble in water, how does it neutralize the soil acids?

5. Why does overliming result in deficiencies of plant nutrients?

6. Why is it necessary to mix dolomitic limestone thoroughly with the soil?

7. What appears to be the most practical methods to mix dolomitic limestone with the soil?

8. What are the optimum pH ranges for the crops you grow?

9. Why should more than one soil sample be taken from a field that has more than one soil type or crop response?

10. How would you treat an overlimed area on your farm?

11. Assume that the Soil Testing Laboratory results would suggest one ton of lime per acre. How much of the following sources of lime should you use to have the same neutralizing value?

    a. Burned oyster shell lime
    b. Landplaster
    c. Hydrated lime

12. What is the relation between pH and lime requirements for a soil?

13. Take a soil sample according to the directions of the N. C. Soil Testing Laboratory and send it to the laboratory in Raleigh, N. C. Farmers should take a sample from each area of each field that has different characteristics.

14. Study the results of your soil test and ask questions about anything you do not understand.

Chapter III

SELECTING YOUR SOURCE OF NITROGEN

Nitrogen fertilizers can be purchased in many combinations under many brand names. All of the nitrogen materials can be classified into about five groups. Each group has its own characteristics, advantages, and disadvantages. Allowing for special situations, a summary statement in North Carolina Experiment Station Technical Bulletin No. 96 appears applicable. "Results of field studies with cotton, corn, small grain, and vegetable crops has shown that one source of nitrogen is generally as efficient as any other source when the soils are adequately supplied with potassium and limed properly." Also, "The efficienty of nitrogen solution or anhydrous ammonia or corn or cotton compared favorably with that of solid sources of nitrogen."

NITROGEN SOURCES VARY IN THEIR EFFECT ON SOIL ACIDITY (See Table 5)

Sources of nitrogen can be grouped as to their effect on soil acidity.

1. Acid to the extentof 36 pounds of limestone* per 20 pounds of nitrogen.
   a. All ammonium nitrogen except sulfate of ammonia.
   b. All combinations of ammonium and nitrate nitrogen.
   c. Urea.
2. Acid to the extent of 107* pounds of limestone per 20 pounds of nitrogen.
   a. Sulfate of ammonia.
3. Basic to the extent of 36* pounds of limestone per 20 pounds of nitrogen.
   a. Sodium nitrate.
   b. Potassium nitrate.
   c. Calcium nitrate.

*This is officially expressed in terms of calcium carbonate equivalent - dolomitic limestone vary from 95 to 108 in terms of calcium carbonate equivalent.

Since dolomitic limestone supplies calcium and magnesium as well as neutralizing soil acidity, the basicity of sodium and potassium nitrate does not substitute for a sound liming program.

4. Neutral sources.

Ammonium nitrate mixed with enough limestone to neutralize the potential acidity is sold as a 20.5% N source.

Calculating limestone at $8 per ton applied, it would cost 15¢ to neutralize the 36 lbs. of acidity produced by 20 lbs. of nitrogen - 72¢ per acre where 100 pounds of nitrogen is sidedressed on corn.

DESCRIPTION OF NITROGEN SOURCES

Nitrogen sources can be classified as -

1. Organic or insoluble nitrogen (natural organics and urea-formaldehyde).
2. Ammonium nitrogen (NH_4^+).
3. Nitrate nitrogen (NO_3^-).
4. Urea ($CO(NH_2)_2$) (the nitrogen in liquid manure).
5. Other (cyanamides, etc.).
6. Combinations of the other five.

ORGANIC OR INSOLUBLE NITROGEN

A. Natural Organics - Most of the nitrogen in natural organics is in a water insoluble form. Plants cannot use this nitrogen until acted upon by the soil micro-organisms. The micro-organisms change the insoluble nitrogen to ammonium nitrogen (NH_4^+). Ammonia is the cheapest form to purchase on the market. This raises a question on the economics of organic sources of nitrogen. The five states tobacco workers group has stated "--natural organic forms were long considered superior in terms of the effect on crop yields. Under experimental conditions, however, many of the alleged advantages have not been found --".

Experiment station results in Figure 3 show the availability of insoluble nitrogen in 168 tobacco fertilizers from Florida, Georgia, South Carolina, North Carolina, and Virginia. Two important points were made. (1) Even with the so called "high grade organics", (cottonseed meal, soybean meal, etc.), the average amount of the total insoluble nitrogen converted to a usable form was only about 50%; only 20-25% for the lower grade organics. (2) 80 to 85% of the total nitrogen changed to water soluble nitrogen took place by the end of the third week. A leaching rain during the first three weeks would remove some of the nitrogen contributed by the natural organics the same as the water soluble nitrogen.

The biological activity built up in decomposing the organics such as cottonseed meal, cannot distinguish between the fertilizer organic and the germinating seeds or seedlings. Destruction of crop seeds is one of the reasons why cottonseed meal is not suggested for use on tobacco plant beds.

Soil fumigation destroys some of the micro-organisms in the soil and delays the change of water insoluble nitrogen (unavailable) to the available ammonium (NH_4^+) and nitrate (NO_3^-) nitrogen.

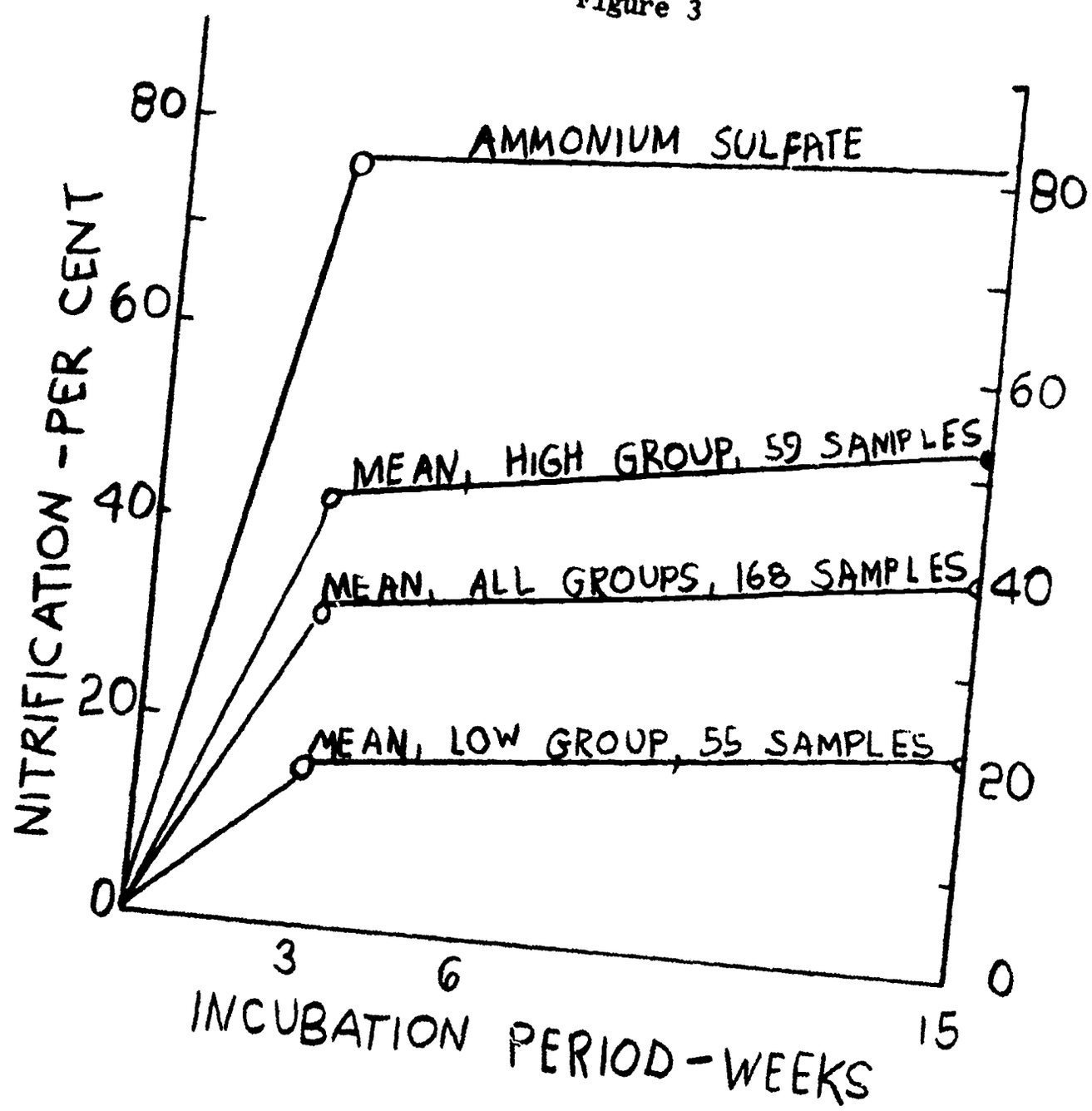
See table 3 for relative availability of different organic nitrogen sources.

B. Urea - formaldehyde - Urea ($CO(NH_2)_2$) and formaldehyde (CH_2O) mixed in the ratio used to make plastic steering wheels is not readily decomposed by soil organisms. Increasing the percentage of urea permits soil organisms to decompose this mixture (Figure 4). This slowly released nitrogen is first available to crops in the ammonium (NH_4^+) form, as in the case of natural organics. Mixtures are being made that contain some urea nitrogen and varying ratios of urea-formaldehydes. This combination should theoretically release designated amounts of nitrogen over a period of time. As in the case of the natural organics,

NITRIFICATION OF VARIOUS WATER INSOLUBLE NITROGEN FRACTIONS OF FERTILIZERS AND AMMONIUM SULFATE

(Slightly modified arrangement from Soil Science Society of North Carolina Summary of Seventh Annual Meeting, Vol. VII Proceedings - 1964 pp 2 & 3)

Figure 3



Very briefly, the organic or water-insoluble fraction of a number of mixed fertilizers was separated from the remainder of the fertilizer and subjected to nitrification tests under ideal environmental conditions. The organic material decomposed, and the released ammonium ion was converted to nitrate. Ammonium sulphate was included as a check. The total amount of nitrogen added was the same in all treatments.

There are three points illustrated in Figure 1. They are:

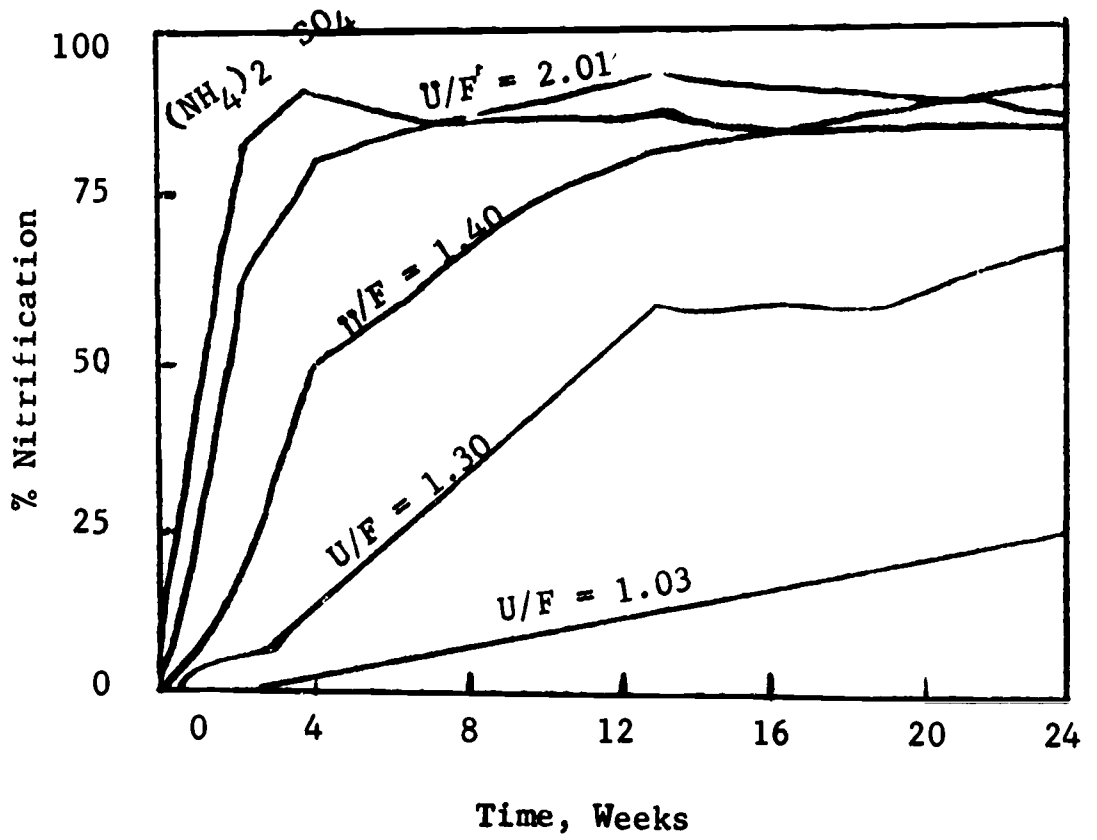
1. the initial conversion to NO_3 of the ammonium from the organic forms and the ammonium sulphate was rapid;
2. regardless of the form in which it was added, 80 to 85% of the conversion to the nitrate was completed at the end of the three week sampling period;
3. even in the best of the organic materials, only a little more than 50% of the total nitrogen was converted to the nitrate form at the end of 15 weeks. With the ammonium sulphate, about 83% of the nitrogen was converted to the nitrate form.

UREA FORMALDEHYDE NITROGEN SOURCES

(Slightly modified arrangement from Soil Science Society of North Carolina Summary of Seventh Annual Meeting Vol VII Proceedings. pp 7.)

Urea formaldehyde reaction products, or ureaform as they are more commonly called, are made by reacting formaldehyde and urea. When these materials are added to the soil, they hydrolyze releasing ammonia. The rate of hydrolysis is dependent upon the mole ratio of urea to formaldehyde in the reaction product as shown below. (2.01 ratio means a higher ratio of urea to formaldehyde than the 1.03 and therefore, is more quickly available - acts more like sulfate of ammonia.)

Figure 4



The idea behind the manufacture of these ureaform materials is controlled release of the nitrogen. That some degree of control is attained is apparent from the curves shown in the graph. These materials have shown some good responses by turf and other grasses and they are included as a substitute for natural organics in mixed fertilizers where a more slowly available source of nitrogen is desired. Additional cost should be evaluated against the cost and inconvenience of side-dressing additional nitrogen after a leaching rain.

Table 3

Relative availability of different organic nitrogen sources.
(Rubins and Bear, Soil Science 54, 411-423)

Availability in decreasing order as shown by sudan grass growth	Decreasing order of availability as shown by the average of four other methods: alkaline and neutral permanganate, vegetative test and nitrification test
1. Peruvian Guano	Cottonseed meal
2. Soybean meal	Peruvian Guano
3. Dried blood	Soybean meal
4. Cottonseed meal	Dried fish scrap
5. Castor pomace	Milorganito sewage tankage
6. Milorganite sewage tankage	Hynite tankage
7. Dried fish scrap	Castor pomace
8. Hoof meal	Dried blood
9. Nitrorganic sewage tankage	Animal tankage
10. Animal tankage	Processed tankage
11. Hynite tankage	Nitrorganic sewage tankage
12. Acid fish scrap	Acid fish scrap
13. Processed tankage	Agrinite process tankage
14. Agrinite process tankage	Smiro process tankage
15. Smiro process tankage	Bone meal
16. Bone meal	Sewage sludge
17. Sewage sludge	Alfalfa hay
18. Alfalfa hay	Peanut hull meal
19. Peanut hull meal	Ground cocoa cake
20. Ground cocoa cake	Tobacco stems
21. Tobacco stems	

It is recognized that there is a great variability in the availability of the nitrogen in the organic sources frequently used.

The guarantee on the fertilizer bag in North Carolina is given as insoluble nitrogen. This means that many organic materials, containing nitrogen in the organic form, can be used and guaranteed as water insoluble nitrogen.

both the urea and the urea formaldehyde mixture would be changed to ammonium nitrogen and then to nitrate nitrogen in the soil. Emphasis is placed on a relatively high percentage of nitrate nitrogen for tobacco on fumigated soils. The nitrogen from organics and urea-formaldehyde is released as the ammonium (NH_4^+) form and then changed to nitrate (NO_3^-).

Urea-formaldehyde fulfills the guarantee requirements of insoluble nitrogen in a mixed fertilizer. It is being used by some manufacturers, particularly for tobacco.

AMMONIUM NITROGEN

Ammonia (NH_3) is the first step in the manufacture of synthetic nitrogen fertilizers. The nitrogen is taken from the air (82% nitrogen) and the hydrogen is obtained from natural petroleum products, or coal. The ammonia is a gas containing 82% nitrogen. It is compressed to a liquid under pressure or held at very low temperature for handling.

Anhydrous ammonia is the cheapest source of nitrogen and this accounts for the widespread use of anhydrous ammonia in mixing complete fertilizers (solid or liquid) and for direct applications to the soil.

The ammonia (NH_3) reacts with the water of the soil to form ammonium (NH_4^+). This change is shown by - $NH_3 + HOH \rightarrow NH_4OH$. This positively charged (NH_4^+) ion is absorbed on the negatively charged(-) clay and organic matter particles of the soil. The anhydrous ammonia is normally applied about 5 inches deep. The rate per applicator blade should be limited to the absorption capacity of the soil (depends upon the amount of moisture, clay and organic matter). Also, the ability to seal the applicator blade tracks to prevent the loss of the ammonia gas before it is absorbed by the soil.

The ammonium (NH_4^+) nitrogen can be commercially oxidized to nitrate (NO_3^-). The ammonium (NH_4^+) can be combined with the nitrate (NO_3^-) to form ammonium

nitrate (NH_4NO_3). This product is sold in many ways including (1) ammonium nitrate solution (16-21%N); (2) as an ammonium nitrate solution in aqua ammonia (household ammonia) (37%N), (3) as an ammonium nitrate-urea solution - 30 to 32%, (4) as a solid fertilizer with the particles coated to prevent taking up moisture; (5) and as a solid ammonium nitrate limestone mixture (20.5% nitrogen).

NITRATE NITROGEN

Nitrate nitrogen is available as sodium nitrate. It is sold as a refined naturally occurring product and as a synthetic product produced from ammonia and soda ash ($NaNO_3$-16%N); as potassium nitrate (KNO_3, 14-0-44); as calcium nitrate ($CaNO_3$, 15%N); and in the ammonium nitrate mixtures discussed above. At least 50% nitrate nitrogen is now suggested for tobacco fertilizers, 50 to 100 % for tobacco topdressers. This is particularly necessary on fumigated soils. The soil micro-organisms that change (oxidize) ammonia nitrogen to nitrate nitrogen are decreased by the fumigant. This slows up the change from ammonia to nitrate nitrogen in the soil.

UREA

Most of the nitrogen in liquid manure is urea ($CO(NH_2)_2$). Urea combines with water (hydrolyzes) when it comes in contact with the urease enzymes of the plants or soils. This forms carbon dioxide, ammonia and water. Urea plus water gives carbon dioxide and ammonia gas ($CO(NH_2)_2 + H_2O \longrightarrow CO_2 + 2NH_3$). Normally, the changes to ammonia take place within 24 hours after application to the soil.

When urea is deposited on plant tissue, or on the surface of the soil, the ammonia gas released can be lost to the air. Results have been reported of considerable loss when applied to very sandy soils (soils low in clay and organic matter) or on dense sods such as Coastal Bermuda. In other experiments, urea has compared favorably with other sources of nitrogen even under these extreme conditions.

It is well to keep in mind that all sources of nitrogen are subject to loss from the soil under certain conditions. Nitrate nitrogen, for example, can change to nitrogen gas (N_2) or nitrous oxide (NO_2), and be lost to the air. Ammonium nitrogen can be absorbed on the inside of clay particles in such a manner that it is unavailable to plants. Organic nitrogen can be tied up in the protein of the micro-organisms that decompose the organic material. Field trials have never been consistently in favor of any one source under all conditions for all crops.

A solution of urea and ammonium nitrate (30-32% nitrogen) can be kept in solution at a much lower temperature than solutions of ammonium nitrate (16-21% nitrogen). This higher analysis has encouraged the use of urea-ammonium nitrate solutions. This is particularly true where the ammonium nitrate solution in aqua ammonia (37% nitrogen) cannot be used because it has to be placed in the soil. Experiment Station tests show that spraying ammonium nitrate and urea solutions on the soil surface with a herbicide have given comparable results with the ammonium nitrate solution and herbicide sprays.

OTHER NITROGEN SOURCES

Calcium cyanamid has been used in North Carolina as a nitrogen-chemical weed control combination on tobacco plant beds. It is basic to the extent of 32 lbs. of lime for each 20 lbs. of nitrogen. It is also used as a defoliant on cotton.

The North Carolina Agricultural Experiment Station Technical Bulletin No. 96 states in the summary - "Calcium cyanamid was found to be somewhat less effective than other sources of nitrogen in certain experiments. Cyanamid must be applied well in advance of planting for most effective use. In some instances mixed sources of nitrogen were more effective than single sources."

GENERAL CONSIDERATIONS FOR SELECTING YOUR NITROGEN SOURCE

The effectiveness of ammonia or nitrate nitrogen seems to depend upon the kind and age of the plant. Nitrogen can be taken into the plant as either

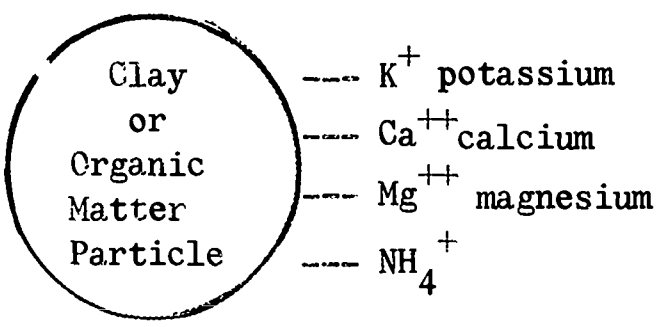
ammonium (NH_4^+) or nitrate (NO_3^-). Corn, cotton, as well as many other plants, have been reported to do equally well with either the nitrate or ammonium form.

NITRATE NITROGEN PREDOMINATES IN A WARM WELL AERATED SOIL

Regardless of the form applied or used by plants, the nitrate form will be present in the greatest amounts for summer crops in normal, well aerated soils. This is true because of the rapid change of ammonium to nitrate nitrogen in well drained, warm soils. Once the nitrogen is in the plant, conversion to protein begins. Formation of protein in the plant is done by stages. The first step is the amides ($C\text{-}NH_2$) which you will note is much closer to the ammonia (NH_4^+) form than the nitrate (NO_3^-) form. Therefore, it takes less energy on the part of the plant to convert ammonia nitrogen to protein synthesis than in the case of nitrate. This would raise some question regarding the statement that nitrate nitrogen is quick acting. Most foliar sprays (where fertilizers are applied on the leaf surface) are made from ammonium sources of nitrogen and these are more quickly used by the plants than soil applied nitrogen materials.

NITROGEN SOURCES VARY IN RESISTANCE TO LEACHING

The clay and organic part of a soil is negatively charged. These negatively charged particles attract positively charged plant nutrients and other positively charged ions.



Note that nitrate (NO_3^-) is negatively charged while (NH_4^+) is positively charged.

There is no attraction between the negatively charged nitrate (NO_3^-) and the negatively charged clay. Positively charged ammonia (NH_4^+) is attracted by the negatively charged clay particle. This accounts for some resistance to leaching

of ammonia in comparison to nitrate nitrogen.

USE CAUTION WITH ALL AMMONIA FOR COOL SEASON CROPS

Sources containing all ammonium nitrogen should be used with some caution for cool season crops unless the specific requirements of the crop are known. This suggestion is made because ammonium nitrogen will not be changed rapidly to nitrate nitrogen under cool season conditions. The same caution should be used on soils that have been recently fumigated because many of the soil organisms have been killed.

GUIDE FOR SELECTING YOUR NITROGEN SOURCE

Selection of nitrogen source then should be on the basis of cost including neutralizing any acidity formed; (2) convenience of application for your specific condition; and (3) the specific characteristic of the soil or crop that would favor one source over another.

The cost per pound of nitrogen for any material can be calculated by using the follwoing formula:

$$\frac{\text{Cost per ton}}{2000 \times \%\ N} = \frac{\$50 \text{ per ton}}{2000 \times 20.5\%\ N} = \frac{\$\ 50}{410 \text{ lbs. } N} = \frac{12.2¢ \text{ per}}{\text{pound of } N}$$

The price per pound of nitrogen + application cost + cost to neutralize acidity or - neutralizing value will give relative costs of availalbe sources for a specific situation.

See Table 5 - "Some Commonly Available Nitrogen Materials" for acidity or basicity produced at varying rates of nitrogen. Ammonium nitrate 33.5%N, nitrogen solutions (16, 19, 21, 30, and 32% N), and anhydrous ammonia 82% N applied at the rate of 100 pounds of nitrogen (N) per acre would require 190 pounds of dolomitic limestone to neutralize the acidity produced. This would cost 76 cents per acre with ground dolomitic limestone at $8 per ton applied.

See Table 6 for a convenient table to compare cost of nitrogen at different prices per ton of product.

Table 5

SOME COMMONLY AVAILABLE NITROGEN MATERIALS

Name of Nitrogen Source	%N	Kind of Nitrogen: Ammonia	Kind of Nitrogen: Nitrate	Pounds of Materials Required To Supply Rate of Nitrogen Needed: 15	30	45	60	80	100	Acidity or Basicity[5] Lbs. Nitrogen Used: 15	60	80
Ammonium Nitrate	33.5	50%	50%	45	90	135	180	240	300	28	114	152
Ammonium Sulfate	21	100%		71	143	214	286	380	476	85	340	450
Anhydrous Ammonia[1]	82	100%		18	37	55	73	98	122	28	114	152
Ammonium Nitrate & Lime	20.5	50%	50%	73	145	220	292	390	490	0	0	0
Calcium Cyanamid[2]	20.6	2	2	73	145	218	290	388	485	48B	190B	254B
Nitrate of Soda	16		100%	94	188	282	375	500	625	28B	114B	152B
Amm. Nitrate in Aqueous Ammonia	37	68%	32%	41	81	121	162	216	270	28	114	152
Amm. Nitrate Solution	21	50%	50%	71	143	214	286	382	476	28	114	152
½ Amm. Nitrate & ½ Urea in Solution[4]	30	75	25%	50	100	150	200	267	333	28	114	152
Urea[4]	45	100%[4]		33	67	100	133	178	222	28	114	152
Urea-formaldehyde[7]	36.8	100%		40	79	118	158	210	262	58	114	152

GALLONS OF MATERIAL REQUIRED						
Anhydrous Ammonia	3.5	7	11	14	19	24
Ammonium Nitrate in Aqueous Ammonia (37%N)	4.1	8	12	16	22	27
Ammonium Nitrate Solution (21%N)	6.6	13	20	27	35	44
½ Amm. Nitrate & ½ Urea in Solution (30% N)	4.6	9	14	18	25	31

1. Handled only in containers withstanding high pressure.
2. Goes through several changes including urea, ammonium and nitrate.
3. Precautions should be used below 47° to 48° as the salts will crystallize out of solution and settle to the bottom of the container.
4. Hydrolizes to ammonium soon after applying to the soil. Nitrogen losses have been reported when applied on bermuda sod.
5. Example-80 lbs. of nitrogen (N) applied as anhydrous ammonia would require 152 pounds of dolomitic limestone to neutralize the effect on soil acidity. B = basic to the extent shown in pounds of dolomitic limestone.
6. Part of the nitrogen is released slowly over a period of time.
7. Cannot burn vegetation. Nitrogen becomes available slowly. Cannot leach until nitrified.

Prepared by E. R. Collins from N. C. Extension Cir. No. 386 Rev.

Table 6

Cost of nitrogen at different market prices for nitrogen materials. Example: With a 20.5% material at $61.50 per ton, the nitrogen would cost 15 cents per pound. This would be the same cost as anhydrous ammonia at $246.00 per ton, urea at $135.00, ammonium nitrate at $100.46, nitrate of soda at $48.00, 41% solution at $123.00, 37% solution at $111.00, 32% solution at $96.00, 30% solution at $90.00, 21% solution at $63.00, 19% solution at $57.00, and 16% solution at $48.00.

COST PER TON (2000 POUNDS)												
					SOLUTIONS							Cents per 1 lb. of N
Anhydrous Ammonia 82%	Urea 45%	Ammonium Nitrate 33½%	Solid Forms With 20.5%	Nitrate Soda 16%	41%	37%	32%	30%	21%	19%	16%	
$164.00	$ 90.00	$ 67.00	$ 41.00	$32.00	$ 82.00	$ 74.00	$ 64.00	$60.00	$42.00	$38.00	$32.00	10.00
168.10	92.25	68.68	42.03	32.80	84.05	75.85	65.60	61.50	43.05	38.95	32.80	10.25
172.20	94.50	70.35	43.05	33.60	86.10	77.70	67.20	63.00	44.10	39.90	33.60	10.50
176.30	96.75	72.03	44.08	34.40	88.15	79.55	68.80	64.50	45.15	40.85	34.40	10.75
180.40	99.00	73.70	45.10	35.20	90.20	81.40	70.40	66.00	46.20	41.80	35.20	11.00
184.50	101.25	75.38	46.13	36.00	92.25	83.25	72.00	67.50	47.25	42.75	36.00	11.25
188.60	103.50	77.05	47.15	36.80	94.30	85.10	73.60	69.00	48.30	43.70	36.80	11.50
192.70	105.75	78.73	48.18	37.60	96.35	86.95	75.20	70.50	49.35	44.65	37.60	11.75
196.80	108.00	80.40	49.20	38.40	98.40	88.80	76.80	72.00	50.40	45.60	38.40	12.00
200.90	110.25	82.08	50.23	39.20	100.45	90.65	78.40	73.50	51.45	46.55	39.20	12.25
205.00	112.50	83.75	51.25	40.00	102.50	92.50	80.00	75.00	52.50	47.50	40.00	12.50
209.10	114.75	85.43	52.28	40.80	104.55	94.35	81.60	76.50	53.55	48.45	40.80	12.75
213.20	117.00	87.10	53.30	41.60	106.60	96.20	83.20	78.00	54.60	49.40	41.60	13.00
217.30	119.25	88.78	54.33	42.40	108.65	98.05	84.80	79.50	55.65	50.35	42.40	13.25
221.40	121.50	90.45	55.35	43.20	110.70	99.90	86.40	81.00	56.70	51.30	43.20	13.50
225.50	123.75	92.13	56.38	44.00	112.75	101.75	88.00	82.50	57.75	52.25	44.00	13.75
229.60	126.00	93.79	57.40	44.80	114.80	103.60	89.60	84.00	58.80	53.20	44.80	14.00
233.70	128.25	95.46	58.43	45.60	116.85	105.45	91.20	85.50	59.85	54.15	45.60	14.25
237.80	130.50	97.14	59.45	46.40	118.90	107.30	92.80	87.00	60.90	55.10	46.40	14.50
241.90	132.75	98.80	60.48	47.20	120.95	109.15	94.40	88.50	61.95	56.05	47.20	14.75
246.00	135.00	100.46	61.50	48.00	123.00	111.00	96.00	90.00	63.00	57.00	48.00	15.00
250.10	137.25	102.13	62.53	48.80	125.05	112.85	97.60	91.50	64.05	57.95	48.80	15.25
254.20	139.50	103.80	63.55	49.60	127.10	114.70	99.20	93.00	65.10	58.90	49.60	15.50
258.30	141.75	105.47	64.57	50.40	129.15	116.55	100.80	94.50	66.15	59.85	50.40	15.75
262.40	144.00	107.14	65.60	51.20	131.20	118.40	102.40	96.00	67.20	60.80	51.20	16.00

PLOW DOWN NITROGEN

Plow down nitrogen is a term used widely in the mid-west. It refers to applying nitrogen at the time of plowing, frequently in the fall of the year. The nitrogen is placed at or near the bottom of the plow furrow. This has an advantage for several reasons. The nitrogen can be applied with a conventional operation and thus save a separate trip. The nitrogen is placed where the roots can get it when the rainfall during the growing season is not sufficient to leach the nitrogen down to the root zone. Nitrogen placed near the surface is frequently out of reach of the deeper roots. There are few feeding roots in the dry surface soil with their limited rainfall during the growing season.

This practice can be used to advantage in the southeast when the subsoil is of such a nature that it prevents the ready movement of water. This would prevent nitrogen being carried by the water through the subsoil, and out with the drainage water. This usually means a clay subsoil, a hard pan, or a plow sole. It has a particular advantage in the Piedmont for small grain. Wet weather frequently prevents getting on the land at the time of normal topdressing in late February or early March. Also, it can save topdressing expense when it is not necessary to cultivate row crops because of good chemical weed control.

This type of application can also be used to advantage when a heavy growth of vegetation is turned under. The nitrogen speeds up the decomposition of the vegetation so that the soil will settle and result in a better seed bed. In this case 15 to 30 pounds of nitrogen can be broadcast on the surface, sprayed on the vegetation or applied at the time of the plowing or disking operation.

USE CAUTION WITH EARLY APPLICATION OF NITROGEN

There is a tendency to use early application of nitrogen in many cases where leaching rains will result in the loss of the nitrogen before the plant can use it. Efforts to extend the season for applying nitrogen has a tendency to push

the application ahead of the optimum date for minimum loss by leaching.

SUMMARY

All major sources of nitrogen supply either ammonium (NH_4^+) or nitrate (NO_3^-) nitrogen. Urea, insoluble and organic sources are broken down by micro-organisms to ammonia before they are used by the plants.

In a normal well aerated soil the ammonia normally changes to nitrate in less than three weeks. Therefore, nitrate nitrogen predominates in well aerated soils.

EXERCISES AND QUESTIONS

1. How do nitrogen sources differ relative to their effect on the acidity of the soil? (See Table 5)

2. Name the six classes of nitrogen materials?

3. What must happen to organic sources of nitrogen before the nitrogen can be used by plants.

4. What percentage of water insoluble nitrogen (organic) was found to be available in tobacco fertilizers?

5. How does the urea-formaldehyde fertilizer compare with organic (cottonseed meal, etc.) as a fertilizer?

6. Can ammonia nitrogen be utilized as well as nitrate nitrogen by plants?

7. What source of nitrogen predominates in warm well aerated soils regardless of the kind of nitrogen applied?

8. Compare the cost of nitrogen (cents per pound of N) using local costs per ton. (See Table 6)

9. How does the source of nitrogen in a liquid fertilizer differ from that in solid form?

10. Under what conditions would it be economically safe to apply all of the nitrogen to corn before planting?

11. Under what conditions would you prefer -

    Ammonia nitrogen to nitrate nitrogen?

    Nitrate nitrogen to ammonia nitrogen?

    A combination of nitrate and ammonia nitrogen?

    Other sources of nitrogen?

CHAPTER IV

SELECTING YOUR SOURCE OF PHOSPHORUS

TERMINOLOGY IN PHOSPHATE FERTILIZERS

The major source of phosphate fertilizers is rock phosphate. The manufacture of superphosphate, by adding sulfuric acid, can illustrate the terminology of phosphate fertilizers.

Rock phosphate $Ca_3(PO_4^{---})_2$	Called tricalcium phosphate because all <u>three</u> negative charges (PO_4^{---}) of the phosphate ion are neutralized by the positive charges of calcium (Ca^{++}).
Treatment with sulfuric acid gives dicalcium phosphate $Ca(HPO_4^{--})$	Called dicalcium phosphate because <u>two</u> of the three negative charges (PO_4^{---}) are taken up by the positive charges of the calcium.
Further treatment with sulfuric acid give monocalcium phosphate $Ca(H_2PO_4^{-})_2$	Called monocalcium phosphate because only one of the three negative charges of the phosphate (PO_4^{---}) are taken up by the positive charges of the calcium.

The same terminology applies to the ammonium phosphates -

$(NH_4)_2\ (HPO_4^{--})$	diammonium phosphate (2 ammonium)
$(NH_4)\ (H_2PO_4^{-})$	monoammonium phosphate (1 ammonium)

This becomes significant because it is generally considered that the plant uses the $H_2PO_4^{-}$ found in the monocalcium and monoammonium phosphates.

GUARANTEE OF PHOSPHORUS IN FERTILIZER

We speak of phosphorus to refer to the phosphates used by plants and guaranteed on the fertilizer bag as available P_2O_5. The term "available" includes water soluble phosphorus and citrate soluble phosphorus. The latter is a chemical method

calibrated to approach the availability of water insoluble phosphorus to plants. (See discussion of water soluble versus citrate soluble phosphorus.)

MAJOR SOURCES OF PHOSPHATES

The list of available sources can be viewed in the light of the terminology just discussed. (See Table 8 and 9 for phosphorus sources.)

Source	Composition	Solubility
1. Superphosphate	dicalcium phosphate monocalcium phosphate	Citrate soluble Water soluble
2. Ammonium phosphate	diammonium phosphate monoammonium phosphate	Water soluble Water soluble
3. Phosphoric acid	H_3PO_4	Water soluble
4. Nitric phosphates		31-48% water soluble

PHOSPHORUS DOES NOT MOVE MUCH IN THE SOIL

Phosphorus moves very little in the soil and therefore does not leach like many of the other plant nutrients. However, the soil and applied phosphates are frequently fixed in forms unavailable to plants. Phosphorus fixation increases as follows:

1. Increasing clay content of the soil.

2. The amounts of hydrated iron $Fe(OH)_3$ and hydrated aluminum $Al(OH)_3$ that are present in large amounts in acid soils. They absorb phosphates on their surfaces to make the phosphate relatively unavailable to plants.

$$\underset{\text{Aluminum hydroxide}}{Al(OH)_3} + \underset{\text{Phosphate}}{(H_2PO_4^-)} \text{ gives } \underset{\text{Aluminum hydroxide phosphate}}{Al(OH)_2 \cdot (H_2PO_4^-)}$$

3. The amount of aluminum held by the negative surface charges of the clay and organic matter. This aluminum is found in larger amounts in acid soils. The aluminum (Al^{+++}) combines with the phosphate (PO_4^{---}) to form insoluble aluminum phosphates ($Al\ PO_4$).

RELATIVE FIXING POWER OF DIFFERENT NORTH CAROLINA SOILS

The relative fixing power of North Carolina soils are as follows:

1. Low for Coastal Plain soils.

2. Medium for yellow Piedmont soils.

3. High for high organic matter soils with a high exchangeable aluminum (acid soils).

4. Very high on red Piedmont and Mountain soils high in clay.

The importance of this fixation of phosphorus by iron, aluminum, and calcium can be illustrated by the following results: The equivalent of 3.3 tons of 20% superphosphate (580 pounds phosphorus - P) was applied to a high organic matter soil (Portsmouth). Seven years later the analysis showed:

1. Seventeen percent as insoluble aluminum phosphate (unavailable Al PO_4).

2. One percent as insoluble iron phosphate (unavailable as Fe PO_4).

3. A trace of insoluble calcium phosphate (unavailable as $Ca_3(PO_4)_2$).

4. Thirty-five percent as organic phosphate.

5. Thirty-five percent unaccounted for in these four forms (assumed unavailable).

ACID SOILS REQUIRE MORE PHOSPHORUS

Larger amounts of phosphorus are required for plants growth on an acid soil. A Norfolk soil with pH 4.6 produced 1.58 grams of millet with a known amount of phosphorus in solution. One third as much phosphorus produced 28 percent more millet at pH 7.0. Liming acid soils to decrease the hydrated iron and aluminum, and the exchangeable aluminum will result in more efficient use of applied phosphates.

PHOSPHORUS AVAILABILITY TO PLANTS DEPENDS ON SEVERAL FACTORS

The amount of phosphorus available to the plant depends on:

1. The amount of phosphorus in the soil solution.

2. The ability of the soil to replenish the phosphorus in the soil solution.

3. The amount of phosphorus applied as a fertilizer.

4. The amount of the applied phosphorus that remains in the soil solution.

Sandy soils should have a higher available phosphorus level to keep supplying adequate phosphorus over a period of time than clay soils.

HOW PHOSPHORUS IS SUPPLIED IN NORTH CAROLINA

The major use of phosphorus in North Carolina is in the form of conventional analysis mixed fertilizers. All straight phosphatic materials sold in 1963-64 was about 1% of the mixed good sales. (15,343 tons vs 1,341,031)

Competition forces the manufacturers to make many fertilizers in the most economical way. This generally means using low priced anhydrous ammonia or solutions high in ammonia nitrogen. This is done by adding the anhydrous ammonia or nitrogen solution to superphosphate. This is called ammoniating superphosphate. It has the further advantages of improving the physical condition of the fertilizer, and neutralizing any free acid resulting from the acidulation of the rock phosphate. Ammoniation is also a necessary step in some processes to make the fertilizer in a granular form.

With all these advantages to all concerned, including the farmer, we should take a look at the fertilizers produced. Superphosphate supplies about 85% water soluble phosphorus. Ammoniation decreases the amount of water soluble phosphorus depending on the temperature, time of contact, rate of adding the ammonia, and the amount of ammonia added. Part of the mono-calcium phosphate (water soluble) of superphosphate is changed to di-calcium phosphate (citrate soluble, but not water soluble).

The water soluble phosphorus content of fertilizers sold in Alabama showed varying amounts of water soluble phosphorus. The 27 sample of 8-8-8 for example,

had two samples with 10% water soluble phosphorus, three with 10-20%, 10 with 20-40%, six with 40-60%, and six with over 60%. (Mississippi Chemical Farming, Spring Issue, 1961). Note that none were as high as the 85% water soluble phosphorus in superphosphate.

GUARANTEE OF PHOSPHORUS ON THE FERTILIZER BAG

Available phosphoric acid (P_2O_5) as guaranteed on the fertilizer bag is the sum of the water-soluble and the citrate-soluble phosphoric acid. The guarantee on the bag does not tell the consumer the degree, if any, of ammoniation of the superphosphate.

HIGH ANALYSIS FERTILIZER

High analysis fertilizers are available in some areas of North Carolina. Economics favors the use of the water soluble ammonium phosphates. Therefore, most of the phosphorus in high analysis fertilizers is water soluble. This is generally true of the bagged and bulk blended high analysis fertilizers. However, triple superphosphate, with a high percentage of water soluble phosphorus, can be used.

ADVANTAGES OF WATER SOLUBLE VS CITRATE SOLUBLE PHOSPHORUS

Water soluble phosphorus is desirable for short season and cool season crops. Differences in growth in favor of water soluble phosphorus are usually in the early periods of growth, where a large phosphorus response is observed. The differences may not be present at harvest of long season crops.

The effect of increasing amounts of ammoniation of superphosphate can be seen in table 7:

Table 7. Effect of Various Degrees of Ammoniation of [illegible] hosphate (0-20-0)

	Percentage Average Availability of Phosphorus in Sample		
	As Determined Chemically (Citric Acid Solubility) on Basis of 1-Gram Sample	As Determined by Yields in Pots* in Greenhouse. No Ammoniation Pot Yields Were Considered to Have a Value of 100.	
Degree of Ammoniation		All Crops	Short Season Crops
0%	95%	100%	95%
2%	94%	100%	93%
3%	94%	88%	80%
4%	94%	82%	72%
5%	93%	65%	50%

* Grain sorghum, millet, wheat, and sudan crops were grown in pots.

You will note that the citric acid solubility did not adequately evaluate the availability of the phosphorus in ammoniated superphosphate. This was particularly true with the short season crops.

COMPARING AVAILABLE SOURCES OF PHOSPHORUS

Water soluble phosphates may be excessively fixed on an acid soil high in clay, organic matter, iron, or aluminum. Under these conditions a fertilizer placed in large pellets or granules may permit the roots to get the phosphate with minimum cortac between the soil and the phosphate. The greater contact of liquid fertilizers, and finely divided fertilizers, would result in more fixation. A citrate soluble fertilizer such as basic slag, di-calcium phosphate, nitric phosphates, etc. would be less subject to fixation over a period of time. However, short season crops might not give maximum yields. A good liming program and a reasonably high water soluble source would be a good compromise under any situations.

The characteristics of some commonly available phosphorus sources are shown in Tables 8 and 9.

Table 8. Common Phosphorus Sources

WATER SOLUBLE SOURCES

Source	Analysis	Description
1. Ammonium Phosphate		
A. Di-Ammonium Phosphate	18-46-0	$(NH_4)_2 HPO_4$
	21-53-0	
B. Mono-Ammonium Phosphate	11-48-0	$(NH_4)H_2 PO_4$
C. Mixture of Mono-Ammonium and Di-Ammonium Phosphates	16-48-0 18-46-0	$(NH_4)H_2PO_4$ and $(NH_4)_2 HPO_4$
2. Ammonium Phosphate Nitrate	29-14-0	
3. Ammonium Phosphate Sulfate	16-20-0	
4. Phosphoric Acid		H_3PO_4
A. Wet Process		
B. Electric Furnace	75 to 85%	H_3PO_4
5. Superphosphate		
A. Ordinary	20%	Mono-calcium and di-calcium phosphates
B. Triple Superphosphate	46%	Mono-calcium and di-calcium phosphates
C. Ammoniated Superphosphate		Adding 1 pound of ammonia per 8.7 pounds of P_2O_5 changes the mono-calcium phosphate to mono-ammonium phosphate and di-calcium phosphate (note that the latter is not listed as water soluble). Increasing to 1 pound of ammonia to 3.3 pounds of P_2O_5 forms an insoluble tricalcium phosphate and may reduce availability of P_2O_5 by 50%.

PARTIALLY WATER SOLUBLE SOURCES

1. Nitric phosphates	14-14-0 20-20-0	31 to 48% water soluble (Di-calcium phosphates)
2. Ammoniated superphosphate		Depending on the degree of ammoniation. See above.

WATER INSOLUBLE SOURCES

Rock phosphate	30 to 36% total P_2O_5. Considered about 1/7 as efficient as superphosphate, varying with the acidity of the soil, fineness of division, and the crop. Sometimes sold as Colloidal phosphate.

Table 8 contd.

Calcium Meta Phosphate	60 to 65% P_2O_5	Citrate soluble
Basic Slag	9% P_2O_5	Availability by special method for this material.
Cotton and other oil seed crops	3% P_2O_5 mostly in an organic form.	
Animal Tankage	6 to 15% P_2O_5	

Table 9. Approximate Analysis of Common Phosphorus Materials

	TOTAL NITROGEN	WATER SOL. NITROGEN	AVAILABLE P_2O_5	WATER SOLUBLE	AVAILABLE K_2O	CHLORINE	MAGNESIUM	CALCIUM	SULFUR
Ammonium Phosphate (Mono)		11	48	98%	0.2	0.1	0.3	1.1	2.2
Ammonium Phosphate (di)		18	46						
Ammonium Phosphate Nitrate		3	10						
Ammoniated Superphosphate		3-6	18-20	3/				17.2	12
Basic Slag			9 2/				3.4	29	.3
Cotton Seed Meal	6		2.6		1.4	.06	.4	.2	.3
Nitric Phosphates		14-20	14-20	31%-48%		.1	0.1	8-10	.2-3.6
Peanut Meal	7.2		1.5		1.3				
Phosphoric Acid (liquid)			52						
Rock Phosphate 1/			1/			.1	.2	33.2	.3
Superphosphate			18-20	87%	.2	.3	0.2	20.4	11.9
Superphosphate, Concentrated			48	95%	.4		.3	13.6	1.4
Tankage, Animal	6-9		6-15		.4	.8	.2	8-11	.5

1/ 30-46% total P_2O_5 considered about 1/7 as efficient as superphosphate. Other nutrients reported also slowly available.
2/ Availability by special method for this material (citric acid method).
3/ Varies with degree of ammoniation.

PLANTS DO NOT GET ALL THEIR PHOSPHORUS FROM FERTILIZER APPLIED IN THE ROW

Studies with radio active phosphorus demonstrates that only a relatively small part of the total phosphorus in mature plants come from the fertilizer applied in the row. Only about 1/3 of the phosphorus in the corn plant came from the fertilizer when applied in the row in the conventional manner. Irish potatoes used a much higher percentage of the applied phosphate. Other crops are generally between these two extremes. Studies show that only 5 to 30% of the phosphorus applied to the crop was recovered by the plants. These studies point out that the phosphorus requirements of the crop cannot be entirely supplied by that applied to the row. Therefore, building reasonable soil fertility levels of phosphorus is essential for maximum economical yields.

It appears desirable to build the phosphorus level to medium as shown by North Carolina's soil testing laboratory tests. Higher levels may be desirable for high cash return crops such as tobacco and truck crops. Very high levels are not considered economical for lower income crops. The loss of availability of the phosphorus by fixation is too high at the high and very high levels.

Phosphorus levels can be raised through broadcast applications of phosphorus materials or the use of high rates of mixed fertilizers. Crops such as peanuts, soybeans, corn, and lespedeza give only a small response to row applied phosphorus on soils with high or very high phosphorus levels. A small amount of phosphorus in the row will frequently give an early vegetative response that may not be reflected in increased yields.

Some phosphates are fixed in the soil regardless of the pH. Therefore, it appears uneconomical to raise the soil level above that necessary for best yields when supplemented with conventional row applications.

Some farmers consider it economically undesirable to slow down the planting

operation by applying a high rate of fertilizer. Others have problems of obtaining a stand with a high level of fertilizer in the row. This prompts some farmers to establish higher soil fertility levels of phosphorus with broadcast applications. Row applications are then reduced to starter fertilizer levels or left off.

SUMMARY

Phosphorus is readily fixed in a form unavailable to plants on acid, clay and high organic soils. The following guide for phosphorus fertilization is suggested:

(1) Soils should be limed on the basis of a soil test to decrease fixation of phosphorus.

(2) The soil phosphorus should be built up and maintained at medium levels for most annual crops; high to very high for some high value crops.

(3) Water soluble phosphorus is desirable for short season and cool season crops.

(4) Select the degree of water solubility best suited to your conditions and crop.

EXERCISES AND QUESTIONS

1. What does the guarantee of 20% available P_2O_5 mean on the fertilizer bag?

2. How are phosphates fixed in the soil?

3. How can phosphate fixation be decreased?

4. What factors determine the availability of phosphorus to plants?

5. Under what conditions is water soluble phosphorus most important?

6. What effect does ammoniating superphosphate have on the water soluble phosphorus?

7. Why are high analysis, bulk blended and liquid fertilizers usually high in water soluble phosphorus?

8. Review conditions under which water soluble or citrate soluble phosphorus is advantageous.

9. What do you think is the best level of phosphorus for your crops as shown by a soil test?

Chapter V

SELECTING YOUR SOURCE OF POTASH

LEARNING THE LANGUAGE

Potassium (K^+) is the fertilizer nutrient. It is guaranteed on the fertilizer bag as available potash (K_2O). The term "available" is about the same as water soluble in most cases.

Potash is supplied as fertilizer materials, sidedressing mixtures of nitrogen and potash, and complete fertilizers containing nitrogen, phosphoric acid, and potash. Also as mixtures of lime and potash.

FUNCTIONS OF POTASH

The functions of potash in the plant are listed as:

1. Increased root growth and improves drought resistance.
2. Builds strong cell walls with cellulose and reduces lodging.
3. Aids and activates many enzyme actions.
4. Regulates respiration and thus reduces losses of carbohydrates.
5. Aids photosynthesis by developing chlorophyll (green coloring matter of plants)
6. Helps translocation of sugars and starch.
7. Gives high starch in grains.
8. Increases protein content due to the role in formation of proteins.
9. Maintains turgor of plants - reduces water loss and wilting.
10. Increases resistance to diseases.

POTASH IS SUPPLIED BY SEVERAL MATERIALS

Muriate of potash, (KCl) (60% K_2O), is the cheapest and most universally used potash material. It supplied about 94% of the potash deliveries in 1965 in North Carolina. Sulfate of potash (K_2SO_4) (48% K_2O), and sulfate of potash - magnesia, (K_2SO_4 - $MgSO_4$) (22% K_2O and 11.2% magnesium) make up most of the remainder. The sulfate of potash is used in tobacco and sweet potato fertilizers to keep the chlorine content low. The supply of potassium nitrate (KNO_3) (11-0-44) is increasing rapidly and gaining popularity. It is being used largely on tobacco where a high nitrate content and low salt effect is desirable. See Table 10 for the list of potash materials and their composition.

POTASH HAS BEEN DEPLETED ON MANY SOILS

There has been a long continued use of low potash fertilizers such as 3-8-3, 3-9-6, 4-8-4, etc., (the last figure is % K_2O). This has depleted the potash supply of many soils. Potash is water soluble and leaching has accounted for further loss. Plant removal of potash is high in many crops as shown in Figure 21. 2800 pounds of tobacco leaves, for example, removes 90 pounds of potash (K_2O); the stalks and leaves would contain about 190 pounds of K_2O. This removal by the plant is equivalent to the potash in about 900 pounds of 3-9-9 and 100 pounds of 8-0-24. This would allow no margin for loss by leaching or the 100 pounds of K_2O in the stalks.

The corn and stover in a 100 bushel corn crop would contain about 137 pounds of potash (K_2O). This amount is equivalent to the potash in 500 pounds of 5-10-10 fertilizer and 145 pounds of 60% muriate of potash.

TABLE 10. APPROXIMATE ANALYSIS OF POTASSIUM MATERIALS

	TOTAL NITROGEN	NITRATE NITROGEN	WATER SOLUBLE NITROGEN	AVAILABLE P_2O_5	AVAILABLE K_2O	CHLORINE	MAGNESIUM	CALCIUM	SULFUR
Potassium Chloride 1/					60	47	.1		.1
Potassium- Magnesium sulfate 2/					22	1.5	11.2		22.7
Potassium Nitrate			14		45	1.1	.2	.4	.3
Potassium Sulfate 3/					48	2.1	.7	.5	17.6
Tobacco Stems	2			.7	6.0	1.2	.4	3.6	.4
COMMON SECONDARY ELEMENT FERTILIZERS (Approximate Analysis)									
Dolomitic Limestone							12	14	
Oyster Shell Lime							34		
Gypsum (Land Plaster)					.5	.3	.4	22.5	16.8
Magnesium Oxide						.5	56	1.1	.2

1/ Muriate of potash 2/ Sulfate of potash - magnesia 3/ Sulfate of potash

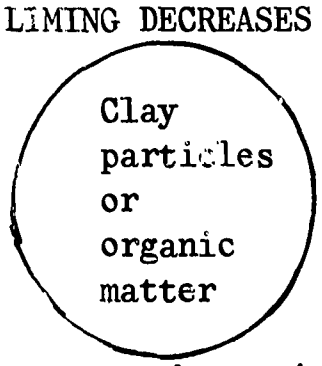
* Figures are not available for blank spaces under secondary and trace elements.

** B = Basic

POTASH CAN INJURE SEED GERMINATION

Potassium salts are injurious to the germinating seeds and seedling when placed too close to the seed or plant. High rates of fertilizers, containing potash, are best placed below and to the side of the seed. Broadcasting or side-dressing part of the potash can decrease the amount necessary in the row applied fertilizer. Potash is normally applied to the crop preceding peanuts, for example, rather than directly to the peanut crop.

LIMING DECREASES THE LEACHING OF POTASH



The surface of the extremely small clay particles, and organic matter particles, are covered with many negative (-) charges. These negatively charged particles attract the positively charged potash (K^{+}) element.

When a litter of pigs try to get to a small feed trough, some get crowded out. So it is with the fertilizer nutrients in their effort to stay on the negatively charged clay and organic matter particles. The elements differ in their ability to crowd out the others. Their ability to stay on the clay particle is in the decreasing order of aluminum (Al^{+++}), hydrogen (H^{+}), calcium (Ca^{++}), magnesium (Mg^{++}), potassium (K^{+}), ammonium (NH_4^{+}), and sodium (Na^{+}). The potash is like the runt pig and can get pushed out into the soil solution and go out in the drainage water. It is easier for potash to stay on the clay particle when it is competing with calcium (Ca^{++}) and magnesium (Mg^{++}), on a well limed soil, than when it is competing with aluminum (Al^{+++}) and the hydrogen (H^{+}). The latter are associated with acid soils. Decreased leaching of potash is one of the important reasons for adequate liming on the basis of a soil test.

QUESTIONS AND EXERCISES

1. How much potash (per acre) would be required by the plants in a two year rotation producing 100 bushels of grain (corn) and 40 bushels of soybeans per acre? (See Table 21.)
2. Figure the same thing for a rotation on your farm.
3. How would you apply this amount of potash, plus a reasonable amount to take care of leaching?
4. Why should high rates of high potash fertilizers be sideplaced, sidedressed, or broadcast?
5. What is the principle source of potash used in North Carolina? Why?
6. Why is sulfate of potash used in tobacco and sweet potato fertilizers? Also for tobacco sidedressing?

CHAPTER VI

SECONDARY ELEMENTS - CALCIUM, MAGNESIUM AND SULFUR

LEARNING THE LANGUAGE

"Secondary" elements refer to those usually required in smaller amounts by plants than the "primary" elements. Although secondary in amount, they are essential for plant growth.

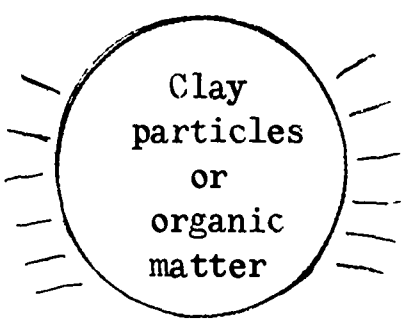
They include calcium (Ca^{++}), magnesium (Mg^{++}) and sulfur (S). Sulfur is generally considered to be absorbed by the plants as sulfates (SO_4^{--}). We are familiar with sulfur as SO_4 in landplaster ($CaSO_4$), ammonium sulfate $(NH_4)_2\ SO_4$) sulfate of potash-magnesia (K_2SO_4 - $MgSO_4$), etc.

The secondary elements are permitted as an optional guarantee on the fertilizer bag or tag. (See Figure 5). They can be guaranteed as the elements calcium (Ca), or the oxide, calcium oxide (CaO); magnesium (Mg) or magnesium oxide (MgO); and as sulfur (S).

EXCHANGE CAPACITY OF THE SOIL AFFECTS AVAILABILITY

The particles of clay and organic matter have many negative charges. The amount of these charges is called the "exchange capacity". (Base Exchange Capacity or Cation Exchange Capacity) In other words, the ability of a soil to hold positively charged calcium (Ca^{++}), magnesium (Mg^{++}), potassium (K^{+}), etc.

This ability to hold positively charged elements (exchange capacity) is normally illustrated by:



Note the negative (-) charges that can attract positively (+) charged calcium magnesium, hydrogen, aluminum, potassium, sodium, etc.

An acid soil has a large proportion of hydrogen (H^{+}) and aluminum (Al^{+++}) held by these negative charges.

An adequately limed soil has a large proportion of the negative charges holding calcium (Ca^{++}) and magnesium (Mg^{++}).

SANDY SOILS HAVE LOW EXCHANGE CAPACITY

The low clay and organic matter content of sandy soils supply relative few negative charges per volume of soil. Therefore, a sandy soil can never have a high amount of exchangeable calcium.

HOW CALCIUM IS SUPPLIED AS A FERTILIZER

Calcium is normally supplied as dolomitic limestone (14% Ca), landplaster (22.5% Ca) usually applied to peanuts, oyster shell lime (34% Ca), calcitic limestone (36% Ca), superphosphate (20.4% Ca), and in fertilizers made from superphosphate or ammoniated superphosphate.

THE CALCIUM ION IS ABSORBED BY PLANTS

The calcium ion (Ca^{++}) is absorbed by the plant. The calcium can come from the soil solution or by actual contact of the root with the clay particle holding the calcium.

AMOUNT OF CALCIUM NEEDED IN THE SOIL

The amount of calcium needed in the soil for plant growth is related to the ability of the clay and organic matter to hold bases (base exchange capacity). A few relative examples will help to illustrate this point.

Type of Soil	Base Exchange Capacity	% Calcium Needed to be Adequate	M E* of Calcium Necessary	Pounds Calcium Needed Per Acre
High Organic Soil	100 M E*	25 - 40	25 - 40	2,500 - 4,000
Kaolinitic Clay	8 M E	40 - 60	3 - 5	300 - 400
Montmorillonitic Clay	10 M E	60 - 80	6 - 8	600 - 800
Sandy C. P. Soil	2 M E	50%	1	400

*Relative measure of ability of a soil to hold bases.

The significant point from these figures is that it takes 2,500 to 4,000 pounds of calcium per acre on a high organic soil, and only 400 pounds per acre on a sandy coastal plain soil. The soil test had to be calibrated against actual field conditions to determine this information. This points out the need of having your soil tested by a laboratory using locally adapted tests for the crops to be grown in the area. It also emphasizes that pH is only one factor in determining an adequate liming program.

CALCIUM CONTENT OF PLANTS

Plants contain considerable calcium. Two thousand pounds of tobacco leaves contain 75 pounds of calcium; 100 bushels of corn 11 pounds; 20 tons of cabbage 20 pounds, etc.

MAGNESIUM AVAILABILITY RELATED TO CALCIUM LEVEL

Liming with calcitic limestone could result in a large percentage of the negative charges of the clay and organic matter to be taken up by calcium (Ca^{++}). Under these conditions it would be difficult for the plant to get much magnesium potash or other positively charged bases. A very general statement might be that there should be one magnesium ion for each six calcium ions for crop production.

Similarly high calcium can interfere with the availability of potash to the plant. Temporary potash deficiency can show up following the application of burned lime.

HOW MAGNESIUM IS SUPPLIED AS A FERTILIZER

Magnesium is normally supplied by dolomitic limestone (28%Mg), sulfate of potash-magnesia ($K_2SO_4 - MgSO_4$) (11.2% Mg), 20.5% ammonium nitrate-lime mixtures (NH_4NO_3 +lime) (0-5% Mg), Epsom salts ($MgSO_4 \cdot 7\ H_2O$) (10% Mg), magnesia (MgO) (50-56% Mg).

THE MAGNESIUM ION IS ABSORBED BY PLANTS

The magnesium is normally absorbed as the magnesium ion (Mg^{++}). It leaches similar to potash. It is the only mineral constituent of chlorophyll, the green color of plants. This chlorophyll is necessary for the plant to build starches and sugars. Magnesium is also found in seeds.

MAGNESIUM IS A MAJOR PROBLEM IN THE COASTAL PLAIN

Magnesium is particularly low in the Coastal Plain soils. The problem is made worse by the use of high calcitic lime resulting in an unfavorable calcium-magnesium balance. Magnesium is also released and subject to leaching when large amounts of fertilizer salts are added that are low in magnesium. The calcium and potash replace the magnesium on the negative charges of the clay. The addition of chlorides and sulfates in fertilizers also speeds up the removal of magnesium in the drainage water.

DOLOMITIC LIMESTONE IS GOOD WAY TO SUPPLY MAGNESIUM

Liming with a dolomitic limestone on the basis of a soil test is the most satisfactory way to take care of magnesium requirements. This should be supplemented by magnesium in the fertilizer on high value crops such as tobacco where magnesium deficiency (sand drown) is common. Tobacco fertilizer in North Carolina must contain a guaranteed percentage of magnesium oxide or magnesium. It is recommended that at least 50% of this be in the water soluble form. This guarantee, however, does not specify the water solubility - only the total magnesium or magnesium oxide.

HOW SULFUR IS SUPPLIED AS A FERTILIZER

Sulfur is normally supplied as the accompanying element or as impurities in fertilizer materials. The major source is the sulfur in superphosphate (11.9% S) used in the manufacture of most conventional analysis fertilizers.

Sulfate of potash contains 17.6% S and sulfate of potash-magnesia contains 22.7% S. The landplaster used on peanuts contains 16.8% sulfur. Sulfate of ammonia contains 17% sulfur. Some of the high analysis fertilizers contain sulfur while others may be low in sulfur.

Deficiencies of sulfur have occurred in the southeast on cotton and tobacco on the sandy Coastal Plain soils.

Sulfur is brought down in the rainfall, particularly in industrial areas using fuel containing sulfur. This varies from one pound per acre in rural areas to 100 pounds in industrial areas. Sulfur is also made available to plants through the decomposition of organic matter in the soil.

SULFUR CAN CORRECT OVERLIMING

One pound of sulfur will correct the liming effect of about three pounds of limestone. The soil organisms oxidize the sulfur, which then combines with water to form sulfuric acid.

Sulfur + Oxygen + Water → Sulfuric Acid

$$S + O_2 + H_2O \longrightarrow H_2SO_4$$

The sulfuric acid reacts with any excess limestone to form calcium sulfate. The SO_4^{--} can then be used by the plant.

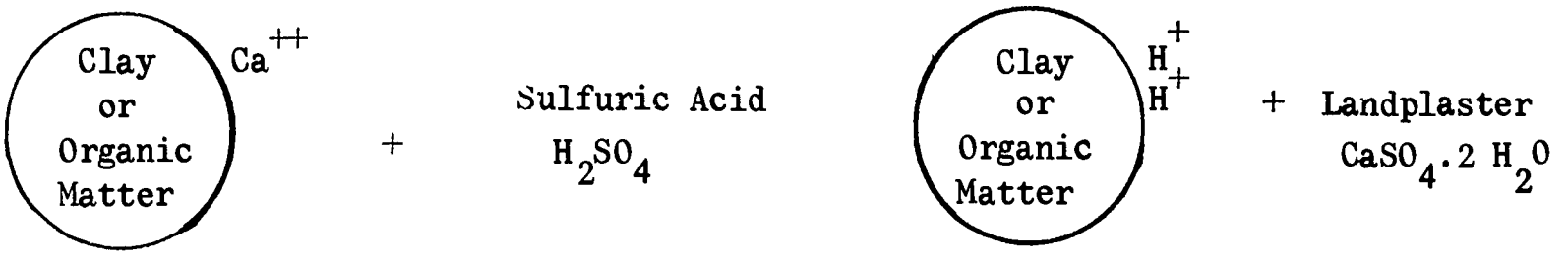
Sulfuric Acid + Limestone → Landplaster + Carbonic acid

$$H_2SO_4 + CaCO_3 \longrightarrow CaSO_4 \cdot 2\,H_2O + H_2CO_3$$

SULFUR IS TAKEN UP BY THE PLANT AS SO_4^{--}

We have been talking about the absorption of bases (Mg^{++}, Ca^{++}, K^{+}, NH_4^{+}, etc.). However, plants also take up acids such as phosphates ($H_2PO_4^{-}$), sulfates (SO_4^{--}), chlorides Cl^{-}, nitrates (NO_3^{-}), fluorides (Fl^{-}), etc. The bases taken up by plants must be accompanied by an equal amount of acids such as sulfate (SO_4^{--}) or organic acids.

The exchangeable calcium (Ca^{++}) on the clay and organic matter also reacts with the sulfuric acid to form landplaster ($CaSO_4 \cdot 2\ H_2O$). The hydrogen (H^+) goes on the clay or organic matter as exchangeable hydrogen.



CAUTION ON USE OF LOW SULFUR FERTILIZERS

Persons using high analysis fertilizers (conventional, liquid, or bulk blended) would need to watch for possible problems from sulphur deficiencies particularly on high producing crops on sandy type soils. This sulfur could be supplied by using sulfate of ammonia as a nitrogen top or sidedressing, using sulfate of potash instead of muriate of potash, using landplaster (calcium sulfate), etc.

QUESTIONS AND EXERCIES ON SECONDARY ELEMENTS

1. Why are calcium, magnesium and sulfur called secondary elements?
2. In what form does the plant take up calcium, magnesium and sulfur?
3. What is the importance of magnesium to the plant?
4. What is the best way to supply calcium and magnesium?
5. How can sulfur correct overliming?
6. Why should soluble magnesium be included in tobacco fertilizers?

Chapter VII

TRACE ELEMENTS ON MICRONUTRIENTS

LEARNING THE LANGUAGE

"Trace elements" or "micronutrients" are essential to plant growth. The name refers to the small amount needed by plants. The seven trace elements include boron (B), manganese (Mn), zinc (Zn), iron (Fe), copper (Cu), molybdenum (Mo), and chlorine (Cl).

All except boron and chlorine are positively charged bases. Boron appears as a borate in borax $Na_2(B_4O_7^{--})$ with two negative charges. Chlorine is part of table salt and muriate of potash as Cl^-, a negatively charged element.

SOME TRACE ELEMENTS ARE DEFICIENT FOR SOME CROPS

Trace elements, like primary and secondary elements, are low in some North Carolina soils. Further, some crops have higher requirements for trace elements than others.

We will look at the trace elements from the standpoint of most probable conditions for needed additions. We will look at both the soil conditions and at specific crops.

AVAILABILITY OF TRACE ELEMENTS REGULATED BY ACIDITY

We have pointed out that phosphorus is fixed in acid soils and that ammonium (NH_4^+), and potassium (K^+) are leached more readily on acid soils. Trace elements can create a problem of excess on an acid soil (iron) or a deficiency on a well limed soil (manganese, zinc, etc.).

The effect of pH on the solubility of trace elements is shown in Table 11.

I. <u>Availability of Trace Elements Below pH 5.0 or 5.5</u>

Iron is likely to be in excess. Iron can accumulate in the nodes of corn and block the translocation tissues of the plant.

Molybdenum is likely to be deficient and is frequently used as a seed treatment on peanuts and soybeans as an insurance factor.

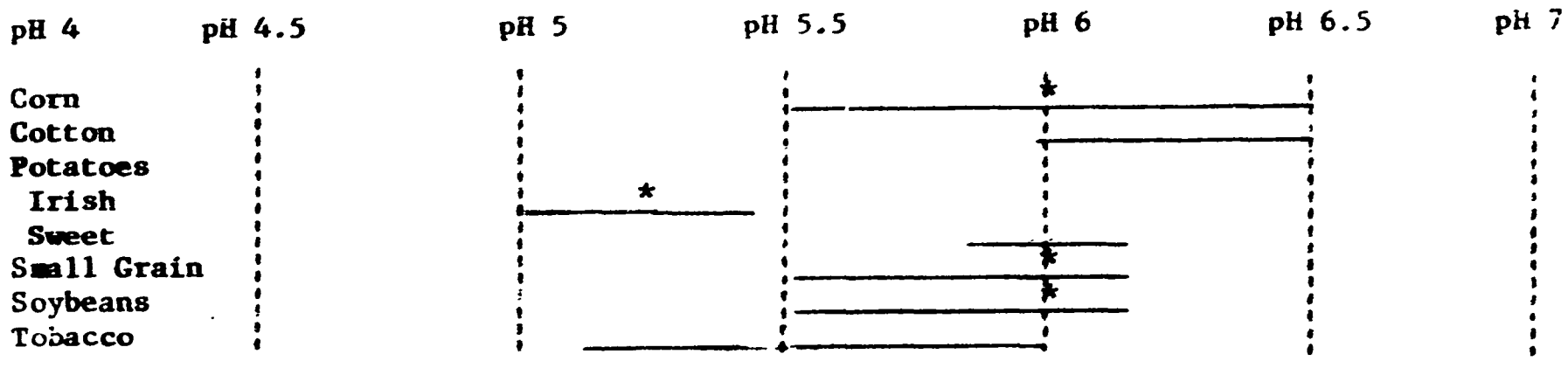
ACIDITY OF THE SOIL AS RELATED TO NUTRIENT AVAILABILITY AND CROP PREFERENCE FOR BEST GROWTH

Table 11

Below pH 5 or 5.5	pH 5.5 to pH 6.2	Above pH 6.2
TRACE ELEMENTS LIKELY TO BE IN EXCESS Iron Aluminum TRACE ELEMENTS LIKELY TO BE DEFICIENT Molybdenum	Deficiencies less likely in this range.	TRACE ELEMENTS LIKELY TO BE NEEDED ON SOME CROPS Manganese Zinc Boron Iron (? for field crops)
SECONDARY ELEMENTS LIKELY TO BE DEFICIENT Calcium Magnesium	SECONDARY ELEMENTS LIKELY TO BE DEFICIENT Magnesium if limed with a calcitic limestone such as burned oyster shell, lime, marl, etc.	
Added phosphates may be made unavailable to plants as insoluble iron and aluminum phosphates.		Added phosphates may be made unavailable to plants as insoluble calcium and magnesium phosphates.

Table 11A

RANGE OF pH CONSIDERED BEST SUITED FOR ECONOMICAL CROP PRODUCTION



* Considered most desirable.

Prepared by E. R. Collins

Note that aluminum is also likely to be in excess. It forms insoluble phosphates that are unavailable to plants.

II. Availability of Trace Elements at pH 5.5 - 6.2

Deficiencies are less likely in this range that corresponds to the best pH range for most crops as shown in Table 11A and Table 2.

III. Availability of Trace Elements Above pH 6.2

Manganese, zinc and boron (iron for shrubs) are likely to be needed on some crops, particularly at pH levels 6.5 to 7.0.

For example, manganese on soybeans, peanuts, oats, and cotton.

TRACE ELEMENTS ARE NEEDED UNDER CERTAIN SOIL CONDITIONS

Since alfalfa is usually grown on a soil limed to pH of 7.0, boron is usually included in the fertilizer recommendations. Boron should not be built up in the soil because it is very toxic to some crops such as beans.

Molybdenum is important in the formation of nodules on legumes on an acid soil. Therefore, it should probably be used where liming is not feasible or practical. However, it should be recognized that applying molybdenum for soybeans on an acid soil will probably not produce an economical yield. A sound liming program would help produce economical yields and generally overcomes the need for molybdenum. Molybdenum is sometimes being used as a seed treatment for peanuts and soybeans as an insurance factor.

Manganese, zinc, and iron frequently show up as deficiencies on overlimed soils. This is particularly true with crops sensitive to manganese deficiency such as soybeans and peanuts. Again, under a sound liming program these would not normally become problems unless the soil level is very low.

USE CAUTION IN APPLYING TRACE ELEMENTS NOT NEEDED

The phosphates of manganese, zinc, iron, copper, and molybdenum are insoluble.

Therefore, soil phosphates, and applied phosphates can be made unavailable to the plant by adding these elements. Continued applications of some trace elements such as copper and boron can easily result in toxicity to sensitive plants even with low rates. Molybdenum may be toxic to animals that eat plants with a high molybdenum content.

With a well adjusted soil acidity, refer to Table 12 for a list of the trace elements most likely to be deficient for a particular crop.

"Shotgun" or blanket mixtures of trace elements are not considered generally desirable because of detrimental effects as well as possible benefits. Trace element problems are specific with each set of soil conditions. For example, a sandy ridge may have a boron deficiency while a high organic, low area in the same field may have a copper deficiency.

The following approach is proposed as a sound program for the use of trace elements in N. C. Extension Circular No. 455, 1965.

1. Apply dolomitic lime on the basis of a soil test suggestion. This takes into account the specific soil conditions found in a field and the particular crops to be grown in the rotation. Liming increases the availability of molybdenum and generally insures that it is present in adequate amounts for the plants. Dolomitic lime supplies two secondary nutrients, calcium and magnesium. Also, increases the availability of phosphorus.
2. Check Table 12 for the probable situations and crops where deficiencies may be expected to occur.
3. Where a trace element is suspected or indicated, apply the trace element in question to several areas and leave several areas untreated for comparison. Apply only the trace element or elements in question and apply at the rate suggested for the crops.

Table 12. Trace elements most likely to be deficient for a particular crop*

Crop	Boron	Copper	Iron	Manganese	Molybdenum	Zinc
Alfalfa	X				X	
Apples	X					
Azaleas			X			
Barley		X				
Broccoli	X					
Cabbage	X					
Camellias			X			
Cantaloupes					X	
Cauliflower	X				X	
Crimson Clover	X					
Corn	X	X				X
Cotton	X			X		
Gladiolus	X					
Lettuce					X	
Oats		X		X		
Peaches						X
Peanuts	X			X	X	
Pecans						X
Soybeans		X		X	X	
Tobacco	X					
Wheat		X				

* Reproduced from N. C. Extension Circular No. 455, 1965.

4. Either excessive rates or continued applications of certain trace elements may create a toxic condition. So apply only those trace elements that are required when they are needed.

Specific requirements will be discussed further when individual crops are discussed.

QUESTIONS AND EXERCISES FOR TRACE ELEMENTS

1. At what pH range is a soil least likely to need trace elements added?
2. Under what conditions would added manganese most likely be profitable? On what crops? Answer the same question for boron, zinc, iron, aluminum and molybdenum.
3. Why is the indiscriminate adding of trace elements to fertilizers considered a questionable practice?
4. Check Table 12 for the crops you grow and make a list of likely needs for trace elements for your soil conditions.

Chapter VIII

MIXED FERTILIZERS

LEARNING THE LANGUAGE

I. Mixed Fertilizers

Mixed fertilizer is a mixture of two or more fertilizer materials. This can be a simple mixture such as 1000 pounds of nitrate of soda (16%N) and 1000 pounds of sulfate of potash (48% K_2O) to give one ton (2000) pounds of 8-0-24 - 8% nitrogen (N) and 24% available potash (K_2O). More complex mixtures of fertilizer materials are shown in Table 14 to make commonly used fertilizer grades for North Carolina.

The term mixed fertilizers applies to conventional, solid, pulverized or granular fertilizers as well as bulk blends, liquid fertilizers, etc.

Chemical materials such as potassium nitrate (14-0-44), ammonium phosphate (11-48-0), etc. are not considered mixed fertilizers by the North Carolina law.

II. A Complete Fertilizer

This generally means that the fertilizer contains the three essential elements: nitrogen (N), phosphoric acid (P_2O_5) and potash (K_2O). It does not mean that it contains all the nutrients required for plant growth.

The fertilizer is designated as an 8-8-8, 3-9-9 etc. with the first figure representing the percentage of nitrogen (N). The second figure gives the percentage of available phosphoric acid (P_2O_5). The third figure gives the percentage of available potash (K_2O). A 3-9-9 then means 3% N, 9% P_2O_5 and 9% K_2O; or 100 pounds contains three pounds of N, 9 pounds of P_2O_5 and 9 pounds of K_2O.

Some manufacturers guarantee the secondary elements (calcium, magnesium, and sulfur). Therefore, a 3-9-9-13-6-2 means 3% N, 9% P_2O_5, 9% K_2O, 13% total CaO, 6% total S, and 2% total MgO.

MANUFACTURER MUST STATE GUARANTEE ON BAG OR TAG

The North Carolina law requires that manufacturers place certain information on the bag or tag when fertilizer is offered for sale in the state. The information required is given in Figure 5. Additional guarantees for secondary and trace elements are discussed below.

GUARANTEES OF ADDITIONAL PLANT FOODS

Boron - guaranteed as pounds of ($Na_2B_4O_7 \cdot 10\ H_{20}$) per 100 pounds of fertilizer (maximum and minimum guaranteed).

Additional plant foods may be guaranteed by permission of the Commissioner of Agriculture and with the advice of the Director of the N. C. Experiment Station.

EVALUATION OF MIXED FERTILIZER OTHER THAN FOR TOBACCO

Evaluation of the fertilizer can be made on the guarantee of total nitrogen (optional, water insoluble nitrogen), available phosphoric acid, soluble or available potash, and potential basicity or acidity. (Consider nitrate N if needed)

Magnesium and calcium guarantees are not considered particularly important with a sound liming program with ground dolomitic limestone. Dolomitic limestone contains about 30% calcium oxide (CaO) and about 20% magnesium oxide (MgO). One thousand pounds of dolomitic limestone per acre would supply 300 pounds of CaO and 200 pounds of MgO. This amount of magnesium would be equivalent to the magnesium oxide in five tons of a fertilizer with a guarantee of 2% total MgO.

The sulphur guarantee. Sulphur may be needed on sandy soils for some crops. Therefore, it would be particularly desirable to know the sulphur content of high analysis and liquid fertilizers. Conventional analysis fertilizers made from superphosphate contains adequate sulfur. The use of sulphate of ammonia and/or sulphate of potash as all or part of the nitrogen and potash sidedressing material could supply adequate sulphur. The higher acidifying effect of sulphate ammonia

Figure 5. GUARANTEE ON THE FERTILIZER BAG

The following information is required by law.

A. General Crop Fertilizer

Example	Requirements by Law
100 lbs. net	Net weight of each package in pounds
5-10-10	Grade
FIELD CROP	Brand name
Guaranteed Analyses	
Total nitrogen.....(N).....5%	Total nitrogen, per cent (whole nos. only)
Nitrate nitrogen.....10% of total...	Optional
Water Insol. nitrogen 25% of total.....	Water insoluble nitrogen, per cent of total, in multiples of 5.
Available phos. acid..(P_2O_5).....10%	Available phos. acid, % (whole nos. only)
Available potash.....(K_2O).....10%	Available potash, % (whole nos. only)
Total calcium oxide..(CaO).....14%	OPTIONAL: Magnesium oxide (MgO) or Magnesium (Mg), Calcium Oxide (CaO) or Calcium (Ca), and sulfur (S) may be claimed as ingredients in all mixed fertilizers, but when so claimed the minimum percentages shall be guaranteed.
Total Sulfur.....(S).....5%	
Total magnesium oxide..(MgO).....2%	
Non-acid forming	Whether the fertilizer is acid forming or non-acid forming, the potential basicity or acidity expressed as equivalent of calcium carbonate in multiples of 5 per cent (or one hundred pounds per ton) only.
Potential basicity.....5%	
Manufactured by	
JOHN DOE CO.	
Norfolk, Va.	

B. Tobacco Fertilizer

Example	Requirements by Law
100 lbs. net	Net weight of each package in pounds.
3-9-9	Grade
Ripen Right	Brand name
TOBACCO	
Guaranteed Analyses	
Total Nitrogen.....(N).....3%	Total nitrogen, per cent (whole nos. only)
Nitrate nitrogen 25% of total (N as NO_3)	OPTIONAL: Nitrogen in the form of nitrates, per cent of total in multiples of 5. Water insoluble nitrogen, per cent of total in multiples of 5.
Water Insol. nitrogen 40% of total (N)	
Available phos. acid.....(P_2O_5).....9%	Available phos. acid, % (whole nos. only)
Available potash.....(K_2O).....9%	Available potash, % (whole nos. only)
Total calcium oxide.....(CaO).....14%	OPTIONAL: Magnesium oxide (MgO) or Magnesium (Mg), Calcium Oxide (CaO), and sulfur may be claimed, as ingredients in all mixed fertilizers, but when so claimed the minimum percentages (sulfur guaranteed shall be both maximum and minimum percentages) shall be guaranteed.
Total sulfur (S).....5%	
Total magnesium oxide (MgO)	
Chlorine (maximum).....2%	Maximum percentages of chloride expressed as chlorine, %. Whether the fertilizer is acid forming or non-acid forming.
Non-acid forming	
Potential acidity.....5%	The potential acidity or basicity expressed as equivalents of calcium carbonate in multiples of 5% (or one hundred pounds per ton) only.
Manufactured by	
JOHN DOE CO.	
Norfolk, Va.	

in comparison to anhydrous ammonia, ammonium nitrate and urea should be evaluated in the fertilizer and liming program. (See Table 5 for acidity of nitrogen sources.) The higher cost of sulfate of potash in comparison to muriate of potash should also be considered.

Trace elements are not considered a major problem on most soils and crops with a properly adjusted pH or acidity range. Review the previous discussion on trace elements, Chapter VII for trace elements most likely to be deficient for a particular crop and condition.

It is suggested that you lime on the basis of a soil test to prevent excess of some trace elements on acid soils; and to prevent making other trace elements insoluble or unavailable on over limed soils. Then check probable soil conditions and crops most likely to show certain deficiencies such as boron on alfalfa, zinc on peaches, manganese on soybeans on overlimed soil, etc. Then add the specific trace element or elements needed. Trace elements can be applied in the fertilizer, in insecticide sprays, other foliar sprays, in dusting material or as a seed treatment depending on the amount and the crop. General mixtures of trace elements in fertilizers are frequently not adequate where a deficiency exists. This plan also prevents the soluble trace elements from forming insoluble phosphate with the phosphates you have purchased in your fertilizer. Also preventstoxicity to particularly sensitive crops like beans to boron.

EVALUATION OF FERTILIZERS FOR TOBACCO

Since tobacco has more specific requirements, see the Chapter on Tobacco for evaluation of a tobacco fertilizer. Chapter XIII

HOW FERTILIZERS ARE FORMULATED

Mixed fertilizers are generally made by mixing one or more appropriate fertilizer materials. Special consideration must be given to compatability of material, physical condition, ease of sowing, etc. This is a story by itself. We will con-

sider only the material necessary to supply the plant nutrients in the following discussion.

AN ACID FORMING 14-0-14

An easy way to make a 14-0-14 topdresser would be to use sulfate of ammonia and muriate of potash.

100 pounds of 14-0-14 contains 14 pounds of nitrogen (100 lbs. x 14%) or (100 lbs. x 0.14).

This 14 pounds of nitrogen can be obtained from 68.2 lbs. of 20.5% sulfate of ammonia (14 lbs. N ÷ 20.5% N = 68.2 lbs.) (or 14 ÷ 0.205 = 68.2).

Similarly 100 pounds of 14-0-14 contains 14 pounds of potash (K_2O) (100 x 14%) or (100 x 0.14 = 14 lbs.).

This 14 pounds of potash can be obtained from 23.3 lbs. of 60% muriate of potash, (14 lbs. K_2O ÷ 60% K_2O) or (14 ÷ 0.60 = 23.3).

This can be shown as -

68.2 lbs. Sulfate of ammonia (20.5% N)

23.3 lbs. Muriate of Potash (60% K_2O)

8.5 lbs. Dolomitic limestone or filler
100.0 lbs. 14-0-14 fertilizer

Acid forming potential acidity 70%

From the table on nitrogen materials (Table 5) we see that sulfate of ammonia is acid forming to the extent of 80 pounds per 14 pounds of nitrogen supplied in the 14-0-14.

Eighty pounds less the 8.5 pounds of dolomitic limestone used as a filler = a net of 71.5 pounds (80 - 8.5) potential acidity per 100 pounds of 14-0-14. This would be 70% acid (71.5 ÷ 100) to the nearest 5%.

With limestone spread at $8 per ton (.004¢ per lb.), the 71.5 pounds of acidity would require 28 cents worth of limestone to neutralize the potential acidity in

this 100 pounds of fertilizer. This would be $5.60 for 2000 pounds of this 14-0-14.

Person buying 14-0-14 on the basis of price per ton may get this type of fertilizer.

A NON-ACID FORMING - BASIC 14-0-14

Fourteen pounds of nitrogen (N) could be obtained from 86.2 pounds of a neutral ammonium nitrate - lime mixture 20.5% N (14 lbs. N ÷ 20.5% N) or (14 ÷ .205 = 86.2).

The fourteen pounds of potash (K_2O) could be obtained from 23.3 pounds muriate of potash 60% K_2O, (14 lbs. N ÷ 60% K_2O) or (14 ÷ 0.60 = 23.3).

This can be shown as

68.2 lbs. ammonium nitrate lime (20.5% N)

23.3 lbs. muriate of potash (60% K_2O)

8.5 lbs. dolomitic limestone or filler

100 lbs. 14-0-14

Non acid forming Basic 5%

Both materials were neutral. Therefore, the basicity of 5% (nearest 5% to 8.5). This 8.5 pounds of lime would be worth .034 cents per 100 pounds or 68 cents per ton of 14-0-14.

The difference between the acid 14-0-14 and the basic 14-0-14 would be $5.60 + $0.64 or $6.24 per ton.

A BASIC 0-10-20

One hundred pounds of 0-10-20 contains 10 pounds of phosphoric acid (P_2O_5) and 20 pounds of potash (K_2O).

The 10 pounds of P_2O_5) can be supplied by 50 pounds of superphosphate (20% P_2O_5) (10 ÷ .20 = 50).

The 20 pounds of K_2O can be supplied by 33 pounds of muriate of potash (60% K_2O).

This can be shown as -

50 lbs. superphosphate (20% P_2O_5)

33 lbs. muriate of potash (60% K_2O)

17 lbs. dolomitic limestone or filler
100 lbs. 0-10-20

Non acid forming Basic 15%

FERTILIZER TABLE SIMPLIFIES FORMULATING FERTILIZER

Table 13 is helpful in showing the amount of a material that is required to produce a given analysis in a ton of fertilizer.

For example, use a 5-10-10 made from ammonium nitrate (33.5% N), superphosphate (20% P_2O_5) and muriate of potash (60% K_2O).

Look down the 5% column in Table 13 to the ammonium nitrate line. You will find 308.

Look down the 10% column to 20% superphosphate. You will find 1000.

Look down the 10% column to 60% muriate of potash. You will find 334.

Summarizing -

308 lbs. ammonium nitrate (33.5% N)

1000 lbs. superphosphate (20% P_2O_5)

334 lbs. muriate of potash (60% K_2O)

358 lbs. dolomitic limestone or filler
2000 lbs. 5-10-10

Non acid forming Basic 10%

Table 5 shows that ammonium nitrate is acid forming to the extent of 36 pounds of limestone for each 20 pounds of N (or 1% in a ton of fertilizer). In a 5% N fertilizer, made from ammonium nitrate, the fertilizer would be acid forming to the extent of 180 pounds of limestone (5 x 36 lbs. = 180 lbs.).

We used 358 pounds of dolomitic limestone in this 5-10-10. Therefore, it would be non-acid forming - Basic 10% (358 - 180 = 278 ÷ 2000 lbs. in a ton - 13.9% or 10% basic to the nearest lower 5%).

Table 13 POUNDS OF EACH MATERIAL REQUIRED TO GIVE THE ANALYSIS DESIRED IN ONE TON OF FERTILIZER

Materials	Analysis	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	14%	16%	18%	20%	22%	24%
Ammonium Nitrate	32.5	62	123	184	246	308	369	431	492	554	615	739	861	984	1107	1230	1353	1478
Cotton Seed Meal	5.7	351	702	1053	1404													
Muriate of Potash	60	34	67	100	134	167	200	234	267	300	334	400	467	534	600	668	733	800
Nitrate of Potash (N)	13																	
(P_2O_5)	44	46	91	137	182	228	273	319	364	410	455	546	637	728	820	910	1000	1092
Nitrate of Soda	16	125	250	375	500	625	750	875	1000	425	1200	1500	1750	2000				
Ammonium Nitrate-Lime and Sulfate of Ammonia	20.5	98	195	292	390	488	585	684	780	878	976	1170	1366	1560	1756	1952		
Ammonium Phosphate																		
Mono (N)	11	182	364	546	728	909	1092	1344	1456	1638	1818							
(P_2O_5)	48	42	84	125	167	209	250	292	334	375	417	500	584	668	750	834	917	1000
Di (N)	20.5	98	195	292	390	488	585	684	780	878	976	1170	1366	1560	1756	1952		
(P_2O_5)	50	40	80	120	160	200	240	280	320	360	400	480	560	640	720	800	880	960
Superphosphate	18	112	223	334	445	556	687	778	889	1000	1120	1334	1555	1778				
	20	100	200	300	400	500	600	700	800	900	1000	1200	1400	1600	1800			
	44	46	91	137	182	228	273	319	364	410	455	546	637	728	820	910	1000	1092
Ammoniated Super (N)	4																	
(P_2O_5)	16	125	250	375	500	625	750	875	1000	1125	1250	1500	1750					
Sulfate of Potash	48	42	84	125	167	209	250	292	334	375	417	500	584	668	750	834	917	1000
Sulfate of Potash Magnesia	22	91	182	273	364	455	546	637	728	819	910	1092	1274	1456	1638	1820		
Urea	45	44	89	132	178	220	266	311	355	399	444	533	622	710	799	888	977	1066

Example: To make one ton of 0-10-20 from 20% superphosphate and 60% muriate of potash, look in the 10% column on the 20% superphosphate lime for 1000 pounds of superphosphate. Look in the 20% column on the 60% muriate of potash lime for 668 pounds of muriate of potash. Then 1000 pounds of 20% superphosphate + 668 pounds of 60% muriate of potash + 332 pounds of filler will make 2000 pounds of 0-10-20 fertilizer.

Table 14 gives some examples of common fertilizers formulated in different ways. We should remember that these examples only supply the required nutrients for the analysis given. They do not take into account physical conditions, etc. No ammoniated superphosphate has been used in these fertilizers although it is one of the best ways to improve the physical condition of the fertilizer. It is also an economical source of nitrogen and phosphorus. Manufacturers normally formulate for a safety factor of around 5%. The analysis of samples taken by the North Carolina Department of Agriculture showed that the fertilizers sold in North Carolina had an excess plant food value of $1,920,379 (1964-65 fiscal year). No excess has been allowed in the examples of fertilizer given here.

See the discussion of fertilizers formulated for tobacco for a more complete discussion.

HIGHER ANALYSIS MATERIALS PERMIT HIGHER ANALYSIS FERTILIZERS

Example No. 4 in Table 14 shows that 986 pounds of filler was needed. A neutral 10-20-20 (high analysis or double strength) fertilizer is shown in Example No. 5, Table 14. This is made by leaving out the filler in Example No. 4. See the Chapter on "Bulk Blending" for a discussion of this relatively new development in the mixing and handling of fertilizer.

COMPARISON OF GRANULAR, LIQUID AND BULK BLEND FERTILIZERS

Table 15 gives a comparison of how conventional granular, liquid and bulk blend fertilizers might be formulated.

TABLE 14 SELECTED FERTILIZER ANALYSIS

	%	No. 1 2-12-12	No. 2 4-12-12	No. 3 5-10-10	No. 4 5-10-10	No. 5 10-20-20	No. 6 8-8-8	No. 7 8-8-8	No. 8 3/ 3-9-9	No. 9 3/ 3-9-9	No. 10 3/ 4-8-12
Ammonium Nitrate Sol.	40	80	125	100			100	100	40		
Ammonium Sulfate	20.5	40	155	295			590				
Ammonium Nitrate	32.5				65	130		585	65	180	240
Potassium Nitrate	13-14										
Cotton Seed Meal	2/								200		
Nitrate of Soda	16								70		
Superphosphate	20	1200	1200	1000			800	800	888	900	800
Triple Superphosphate	48										
Ammonium Phosphate	18-46				435	870					
or											
Potassium Chloride	60	440	400	334	668	335	267	267	40	40	84
Potassium Sulfate	48								270	270	300
Sulfate of Potash Magnesia 1/	22										
Calcium Sulfate									120	120	222
Dolomitic Limestone		106	120	271	180	332	243	248	307	108	354
Filler or Conditioner		134			986					382	
Acid, Basic, or Neutral		N	5%A	6%A	N	N	30%A	N	10%B	N	10%B

1/ 19% available MgO
2/ 5.75 N, 2.5 available P_2O_5, 1.5 K_2O
3/ Formulated for tobacco. 2% Chlorine; 1% water soluble magnesium; 50% of total as nitrate nitrogen.

Table 15 Comparison of Granular, Liquid, and Bulk Blend Fertilizers

Materials	12-12-12 Granular	8-8-8 Liquid	18-18-18 Bulk Blends
Ammonium sulfate 20.5% N	192 lbs.		
Di-ammonium phosphate 18-46-0		129 lbs.	769 lbs.
Nitrogen solutions 41%	494		
Anhydrous ammonia 82.3%		45	
Urea-ammonium nitrate soln. 32%		341	
Ammonium nitrate 33.5%			642
Superphosphate 20%	393		
Triple superphosphate 46%	350		
Phosphoric acid 54%		207	
Potassium Chloride 60%	400	258	589
Sulfuric acid 93%	171		
Water		1020	
Ammonium nitrogen	74%	84%	76%
Water soluble P_2O_5	80%	100%	100%
Potash source	muriate	muriate	muriate

The liquid fertilizer is usually the lowest analysis and bulk blend is the highest analysis. Each one uses characteristic materials best adapted to the kind of fertilizer. You will note from the materials used that secondary elements such as calcium, magnesium and sulfure are lower in the liquid and bulk blend fertilizers.

INSPECTION AND ANALYSIS OF FERTILIZERS

A primary function of the North Carolina Department of Agriculture is the control of commodities used directly in growing various crops. This includes fertilizers, liming materials and landplaster.

1. REGISTRATION

Fertilizers must be registered with the N. C. Department of Agriculture before they can be legally sold in the state. Applications for registration are examined and refused where the requirements of the law are not fully met.

2. FIELD INSPECTION AND SAMPLING

An inspection service is maintained for checking, labeling and general conditions. Also collection of official samples from farmers, dealers and other users. Anyone can request that a fertilizer be checked and a sample taken for analysis. These requests for inspection service are followed up as promptly as possible. Samples taken by other than officials are not generally analyzed.

3. REPORTS OF ANALYSES

The analyses are reported annually in a publication of the North Carolina Department of Agriculture entitled "North Carolina Fertilizer Report". The report for the last fiscal year will generally be available upon request from the Commissioner of Agriculture about February.

Table 16 gives examples of how the analyses are reported by manufacturer, brand and guaranteed analysis.

Dolomitic limestones are analyzed for calcium carbonate ($CaCO_3$) and magnesium carbonate ($Mg\ CO_3$) and also neutralizing value. Burned lime is analyzed for calcium oxide (CaO) and magnesium oxide (MgO). Also potash (K_2O) in potash-lime. Land-plaster is analyzed for calcium sulfate ($CaSO_4$).

4. PENALTIES ASSESSED

Deficiencies beyond reasonable operational tolerances are penalized. The manufacturer is required to reimburse the consumer. Where the consumer cannot be located the penalty is held for one year for further search for the consumer. It then goes for furtherance of the agricultural program of the state. Samples that received penalties are designated with a black hand ☞ in the report of the analysis. See Table 16 for an example of how the report is made.

Penalties are assessed on the average consumer cash price delivered at Raleigh,

Table 16 ANALYSES OF MIXED FERTILIZERS AND FERTILIZER MATERIALS - 1966-67

AVERAGE PERCENTAGE COMPOSITION

	G-Guaranteed F-Found	No. of Samples	Total Nitrogen	Nitrate Nitrogen	Water Insoluble Nitrogen	Water Soluble Nitrogen	Available Phosphoric Acid	Available Potash	Chlorine	Total Magnesium Oxide	Total Calcium	Sulphur	Other*	Pesticid Lbs. Per Ton	N-Neutral A-Acid Forming B-Basic	Rel. Value Per T. Guarantee + or -
Company X, General Crop 2-12-12	G					2.00									N	
	F	6	2.25			2.25	12.58	12.00							A8	+1.73
Company X, General Crop 3-9-18	G					3.00									N	
	F	2	3.04			3.04	9.41	18.14							A3	+ .98
Company X, Corn 3-9-18	G					3.00				2.50	11.00	7.00			N	
	F	1	3.02			3.02	9.00	19.50		2.42	12.65	6.76				+2.16
Company X, General Crop 4-8-12	G					4.00									N	
	F	1	4.12			4.12	8.00	11.40								- .46
Company X, General Crop 5-10-10	G					5.00									N	
	F	19	4.97			4.97	10.25	10.33							B24	+ .35
Company X, Sweet Potato 6-12-6	G			1.20	.60	4.20									A100	
	F	1	5.70	1.08	.48	4.14	12.20	6.20								-1.32
Company X, General Crop 8-8-8	G					8.00									A400	
	F	4	7.89			7.89	8.20	7.70								- .45
Company X, General Crop 14-0-14	G					14.00									A1300	
	F	2	14.28			14.28		12.95								- .57
Company X, Tobacco 3-9-9	G			1.05	.60	1.35			3.00	2.00					N	
	F	9	3.04	1.00	.66	1.38	9.19	8.95	2.64	2.77					B25	+ .80
Company X, Tobacco 3-9-9	G			1.05	.75	1.20			3.00	2.00					N	
	F	4	3.07	.97	.83	1.27	8.95	8.91	2.36	3.10						+ .59
Company X, Tobacco 3-9-9	G			.75	.60	1.65			3.00	2.00					N	
	F	3	3.01	.97	.67	1.37	8.95	8.92	2.52	2.72					B39	+ .40
Company X, Tobacco 3-9-9	G			.75	.45	1.80			3.00	2.00					B100	
	F	2	3.12	.81	.64	1.67	9.59	9.69	2.96	2.87					B120	+4.06
Company X, Tobacco 4-8-12	G			1.00		3.00			3.00	2.00					B100	
	F	1	3.98	1.02		2.96	8.75	12.50	2.56	3.96						+2.04

*These include Borax, pounds per ton, manganese, copper, iron, zinc, molybdenum, and pesticides per ton.

N. C. for the period covered by the report as follows:

For water soluble nitrogen.....	cents per pound
For nitrate nitrogen.....	cents per pound
For water insoluble nitrogen.....	cents per pound
For available phosphoric acid.....	cents per pound
For available potash (other than tobacco fertilizers)	cents per pound
For available potash in tobacco fertilizers.....	cents per pound

FERTILIZER SALES BY GRADES

Ninety percent of the mixed fertilizer sales in North Carolina are in 10 grades. 5-10-10 was 33.84% of all sales; 3-9-9 was 25.29%; 4-8-12 was 6%; 2-12-12 was 4.96%; 10-10-10 was 4.74%, 8-8-8 was 4.67%; 3-9-18 was 4.52%; 4-9-3 was 2.90%; 14-0-14 was 2.26% and 8-0-24 was 2.01%. All other approved grades were from .81% to 0% of the sales.

FERTILIZER GRADES ARE DESIGNATED EACH YEAR

Fertilizer grades are now based on the combinations of N, P_2O_5 and K_2O considered desirable to fill the needs for crop production in North Carolina.

For examples, a ratio of 0-1-1 means no nitrogen, and equal quantities of P_2O_5 and K_2O. A minimum grade (0-14-14) is specified for each ratio.

The annual grade list is available from the Commissioner of Agriculture. The list is prepared annually by the Board of Agriculture after a public hearing called by the Commissioner of Agriculture.

A few examples will illustrate the ratio and minimum grade. -

Ratio	Minimum Grade	Examples of Higher Grades
0-1-1	0-14-14	0-15-15, 0-16-16, etc.
0-1-2	0-10-20	0-12-24, 0-13-36, etc.
1-0-1	10-0-10	14-0-14, 16-0-16, etc.
1-1-1	8-8-8	10-10-10, 12-12-12, etc.
1-2-2	5-10-10	6-12-12, 7-14-14, etc.
2-1-1	16-8-8	18-9-9, 20-10-10, etc.

QUESTIONS AND EXERCISES FOR MIXED FERTILIZER

1. What is a mixed fertilizer?

2. What is generally considered as a complete fertilizer?

3. What does a fertilizer guaranteed 3-9-9-13-6-2 mean?

4. What must the manufacturer guarantee on the fertilizer bag for general crop fertilizer; for fertilizer branded for tobacco?

5. What other guarantees would you like to have? Are they permitted by law?

6. How would you evaluate a fertilizer for general crop use; for use on tobacco?

7. How important do you consider trace elements in your mixed fertilizer? Why?

Chapter IX

BULK BLENDED FERTILIZERS

LEARNING THE LANGUAGE

The term "bulk blending" is generally used in connection with mixing or blending granular high analysis fertilizer materials and handling in bulk. This is usually a relatively small plant, operating in a radius of 50 miles. Frequently, these fertilizers are blended and loaded directly on the truck for field spreading. They are also frequently mixed for specific field requirements as shown by a soil test.

BULK BLENDS BECAME PRACTICAL WHEN SUITABLE MATERIALS BECAME AVAILABLE

This relatively new process was made practical by the availability of granular fertilizer materials in different particle sizes, shapes, and density. This decreased the tendency for the heavier particles to settle to the bottom of the container as the fertilizer is transported or distributed in the field. It also permitted more even spreading of the fertilizer in the field by spinner type bulk spreaders now frequently used for spreading lime.

ADVANTAGES FOR BULK BLENDED FERTILIZERS

1. Specific conditions can be easily handled because the fertilizer is usually specifically mixed in relatively small lots at time of need.
2. Physical condition is not a major problem because the fertilizers are spread soon after mixing or blending. Conventional bagged fertilizers frequently require conditioning agents that increase the cost. This is in addition to the bagging cost.
3. The high analysis means fewer pounds of material to handle. This can mean less freight and handling costs.

4. Bulk blending is frequently a service oriented operation, particularly where soil testing, formulation for specific conditions, and custom application are part of the service. This service and custom spreading have considerable appeal to the farmer who can save both labor and time.

DISADVANTAGES OF BULK BLENDED FERTILIZERS

1. Materials may not stay uniformly mixed or be applied uniformly. Separation or segregation of the different fertilizer materials can take place when the mixture is being placed on the truck, while transportating over rough roads or fields, and during the actual spreading operation.

   This separation results from the slight differences in specific gravity and/or particle sizes of the different fertilizer materials. Distribution by spinner type spreaders results in the heavier particles being thrown farther from the truck than the lighter particles. Uneven distribution results in uneven crop growth and lower economic return from the fertilizer. Further work on particle size and density will further minimize this problem.

2. Calcium and sulfur may be low. Conventional fertilizers made from regular superphosphate contains calcium and sulfur. These and other secondary and trace elements may be lower in high analysis fertilizers. The problem of secondary elements can be largely overcome by a good liming program and selection of materials for sidedressing or top-dressing. See discussion on trace elements to evaluate the degree of trace element problem for specific conditions.

3. Injury to seed germination and seedlings may result. Many bulk blended fertilizers contain mono or di-ammonium phosphate. These salts are detrimental to germination when they come in contact with the seed. Side placement or broadcasting and mixing the fertilizer with the soil is very desirable to avoid fertilizer injury. This is especially necessary for sensitive crops such as cotton.

   It has been shown that soaking seeds in Epsom salts (magnesium sulfate) largely overcame the effect of di-ammonium phosphate on seed germination. They concluded that the injury appeared to be due to inactivation of the magnesium in the seed.*

4. The starter fertilizer effect is lost with broadcast fertilizer. The stimulating effect of fertilizers placed near the seedling and young plant will be lost with bulk blended or conventional fertilizers broadcast. This disadvantage is minimized with chemical weed control where early growth, to make cultivation easier, is less essential.

   Table 17 shows characteristic formula for granular conventional fertilizers, liquid fertilizers and bulk blended fertilizers. Note that the amount of plant food per ton generally increases from liquid fertilizers, conventional fertilizers to bulk blends. Note that muriate of potash is the only fertilizer material generally common to the three types of fertilizer.

QUESTIONS AND EXERCISES FOR BULK BLENDING

1. What is bulk blending?
2. How does it differ from conventional or liquid fertilizer?
3. If you were using a bulk blend, how would you like to have it formulated?

* Ensiminger, Hood and Willis. Soil Science Proceedings, 1965 pp 320-322.

TABLE 17. EXAMPLE FORMULATIONS OF GRANULAR, LIQUID, AND BULK BLENDS FERTILIZERS*

	Granulated 10-20-20	Liquid 5-10-10	Bulk Blend 12-24-24	Granulated 12-12-12	Liquid 8-8-8	Bulk Blend 18-18-18**	Granulated 6-18-18	Liquid 3-9-9	Bulk Blend*** 9-26-26	Source of Nitrogen
Nitrogen Solutions (44.8% N)	375									
Ammonium Sulfate				192						
Di-ammonium Phosphate (18-46-0)	240		1045			769			965	
Nitrogen Solutions (41% N)				494	129					
11-37-0 Solution		161						146		
Anhydrous Ammonia (82.3% N)		57			45		148	54		
Urea - Ammonium Nitrate Solution (32% N)		112			341					
Ammonium Nitrate (33.5% N)			154			642				
Superphosphate 20% P_2O_5				393			495			
Triple Superphosphate (46% P_2O_5)	678			350			576		167	
Wet Process Acid (54% P_2O_5)		260			207			233		
Potassium Chloride (60% K_2O)	667	323	801	400	258	589	600	290	868	
Sulfuric Acid (93% H_2SO_4)	106			171			214			
Water		1087			1020			1277		

* Douglas and Johnston, Farm Chemicals, April 1964
** Actually 17.65-17.65-17.65
*** Actually 8.7-26.1-26.1

Chapter X

SOIL TESTS

EVALUATING A SOIL TEST

A soil test is a chemical (sometimes biological or plant) means of estimating the ability of a particular soil to supply the nutrients required for the level of crop production desired. Some assumptions must be made. The lime and fertilizer use must be adjusted to any variation from the assumptions.

ASSUMPTIONS MADE IN SUGGESTING LIME AND FERTILIZER USE ON THE BASIS OF A SOIL TEST

1. The soil sample represents the area to be fertilized.

   A. Take small amounts of soil from 15 or 20 places uniformly spaced over a uniform area. (A one pound soil sample represents about 20,000,000 pounds for a 10 acre field 6 inches deep.)

   B. Take separate samples from areas with different slope, drainage, soil type, physical appearance, crop production level, and areas with different past lime fertilizer or crop treatment. Avoid small areas that differ widely from the average of the field or take separate samples.

   C. Avoid fertilizer bands where fertilizer was applied recently.

   D. Sample to the depths that the soil will be plowed.

   E. Sample three inches deep for lawns, and the maintenance of pastures, and hay fields.

   F. Soil must be dry enough not to ball up during mixing. Wet samples should be spread out on waxes paper and dried at room temperature before mixing to take portion for sample. Do not heat to dry.

2. Soil tests suggest liming and fertilization to supply adequate plant nutrients for acre yields, as indicated Table 18 (This information taken from the Soil Test Report Sheet.)

3. High level of management includes good varieties or hybrids, adequate plants, timely seeding, planting, side or topdressing, adequate weed, insect and disease control, etc.

4. Liming on time to correct acidity of soils too far out of the best range of production. Lime applied immediately preceding soybeans on a very acid soil may not change the pH quick enough to benefit the crop.

5. Nitrogen and potash leached by excessive rains must be replaced in line with approved practices.

INTERPRETING SOIL TEST RESULTS

1. Yield and Management Levels

Fertilizer suggestions of the Soil Testing Division of the N. C. State Department of Agriculture are based on the soil, weather and management factors given below - (Appropriate adjustments should be made for other conditions).

TABLE 18. YIELDS*, SOIL & MANAGEMENT CONDITIONS ASSUMED FOR "FERTILIZER SUGGESTIONS."

	(1) Adapted soils, good weather and high level of management			(2) Poorly adapted soils or bad weather		
Crop	COASTAL	PIEDMONT	MOUNTAIN	COASTAL	PIEDMONT	MOUNTAIN
Corn (bu)	85-125	80-110	85-125	60-85	50-80	60-85
Cotton (lbs.lint)	800-1250	700-1150		400-800	350-700	
Peanuts (lbs.)	3000-4000			1800-3000		
Soybeans (bu)	35-50	35-50	35-50	25-35	25-35	25-35
B.Tobacco(lbs.)			2000-2700			1600-2000
Tobacco (Flue-C)1/						
S. Potatoes(bu)	400-600	400-600	400-600	300-400	300-400	300-400
			All Areas			
Alfalfa(tons)		3.5-4.5				
Lad-grass (tons)		2-4				
C. Bermuda (tons)		3-6				
T. Fescue (tons)		3-4				
Wheat (bu)		35-50				
Oats (bu)		70-100				
Barley (bu)		60-80				

1/ Suggestions for fertilizing flue-cured tobacco are aimed at highest yields that are consistent with maximum quality for the soil and the weather conditions during the growing season.

*Yields below these values may be obtained on poorly adapted soil, or under conditions of limiting weather and management.

2. Levels of Phosphorus (P_2O_5) and Potash (K_2O) Represented by the Test Designations.

The following levels of phosphorus (P_2O_5) and potash (K_2O) are considered available for each soil test designation (VL, L, M. H, and VH).

TABLE 19. PHOSPHORUS & POTASH LEVELS FOR SOIL TEST DESIGNATIONS.

	Pounds per acre of Soil Test Phosphorus (P_2O_5)		Pounds per acre of Soil Test Potash (K_2O)
Soil Test Designation	Average Soil	Red Soil	All Soils
Very Low (VL)	0-32	0-32	0-47
Low (L)	37-100	37-65	48-93
Medium (M)	105-284	70-128	94-179
High (H)	288-500	133-238	180-276
Very High (VH)	Above 500	Above 238	Above 276

A medium (M) level test, for example, for P_2O_5 indicates around 105 to 284 pounds of available P_2O_5 per acre (525 to 1420 pounds of superphosphate, 20% of P_2O_5) for average soils; for potash, 94 to 179 pounds of available K_2O per acre (157 to 200 pounds of muriate of potash (60% K_2O).

Crops differ in their response to fertilization at any given level. With a medium level of phosphorus, no phosphorus is suggested for peanuts at planting. On the other hand, 40 pounds of P_2O_5 are suggested for soybeans, 50 pounds for cotton and 70-80 pounds for flue-cured tobacco.

Plant removal should be taken into consideration in order to maintain the levels of phosphorus and potash in the soil. 100 bushels of corn harvested for grain would remove only 27 pounds of potash (K_2O). If three tons of stover is removed there would be 4 times as much potash removed. (A total of 27 +110 = 137 lbs. K_2O). (See Table 21 for removal of phosphorus and potash by crops.

3. Nitrogen suggestions depend more on the crop than the soil test. One percent organic matter will release roughly 20 pounds of nitrogen for the average crop. See Table 21 page for removal of nitrogen by crops.

INTERPRETING THE SOIL TEST REPORT

Three examples on corn will indicate the type of fertilizer suggestions received.

Field No.	pH	Calcium	Phosphorus	Potassum	% O.M.	Amt. of Lime per acre
1	5.5	L	M	M	1.0	1,000 lbs.
2	5.5	L	M	L	1.0	1,000 lbs.
3	5.5	L	L	L	1.0	1,000 lbs.

The fertilizer suggestions for these three samples would be:

	Suggested lbs. per acre			Method applied
	N	P_2O_5	K_2O	
No. 1	20	40	40	at planting
No. 2	20	40	40	at planting
	0	0	60	topdressed
No. 3	0	100	0	broadcast
	20	40	40	at planting
	0	0	60	topdressed

Note that it is suggested that some of the potash be topdressed for sample No. 2 since a total of 100 pounds of K_2O is required. In sample No. 3, part of the phosphorus is broadcast before planting and part of the potash is topdressed. See page 99 for a further discussion on application.

Chapter XI

PLANT CONTENT OF FERTILIZER NUTRIENTS

Plant removal of fertilizer nutrients should be considered in planning a fertilizer program. Records of nutrients added in fertilizers, and that removed by crops, must be supplemented by figures on loss by leaching, fixation by the soil and the nutrients becoming available from the soil. Therefore such records should be used primarily as a guide to get a general picture of crop removal in comparison to application.

Plants frequently take up more of a nutrient than needed for growth. Luxurious consumption results in a much higher level of the nutrient in the plant than the level of the nutrient when grown on a deficient soil.

CROP REMOVAL VS CROP REQUIREMENTS

There is a difference between crop removal by 100 bushels of corn and the nutrients required or contained in the 100 bushels of corn and the stover. For example:

	N	P_2O_5	K_2O
Nutrients in 100 bushels of corn grain	90#	35#	27#
Nutrients in 100 bushel corn & forage	135	55	137

Four hundred pounds of a 5-10-10 (40 lbs. K_2O) might be considered adequate to take care of the 27 pounds of K_2O removed by 100 bushels of corn. However, it would be necessary for the soil to supply a minimum of 97 pounds of K_2O (137-40) to grow 100 bushels of corn with the forage.

NUTRIENTS REMOVED BY CROPS

References give the approximate pounds per acre of nutrients contained in portions of crops of the size shown. In a fertilizer program, we must consider the amount required to produce the crop and the amount removed by the harvested portion.

Figures are shown for selected North Carolina crops in Table 20. The figures are adapted to the better North Carolina yields by taking the appropriate percentage of given yields from available tables.

CROP REMOVAL RECORDS

We can work out a balance sheet of crop removal for a given rotation. Assume fertilization of a corn and soybean rotation as:

			N	P_2O_5	K_2O
Corn	500#	5-10-10	25	50	50
	120#	N & 60# K_2O	120		60
Soybeans	400#	0-10-20	0	40	80
		Total	145	90	190

Assume crop removal for 100 bushels of corn and 40 bushels of soybeans (see Table 20).

	Grain & Stover or Stalks			Grain Only		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
100 Bu. Corn	135	55	137	90	35	27
40 Bu. Soybeans	148	40	96	128	32	56
Total removed	283	95	233	218	67	83
Applied	145	90	190	145	90	190
	-138	- 5	-43	-73	+23	+107

We must consider that soybeans are a legume and therefore supply their own nitrogen when innoculated and grown on an adequately limed soil. Therefore, the need for more nitrogen than applied for both the grain and the total crop may not be out of line. The soybeans may even leave a residue of nitrogen for the corn crop.

Table 20 Approximate Plant Removal of Nutrients

(These figures will vary with season and soil fertility)

	Acre Yield	Nitrogen (N)	Phosphorus (P_2O_5)	Potassium (K_2O)
Corn	100 Bu.	90	35	27
	4500 lbs. stover	45	20	110
		135	55	137
Silage	20 %	130	50	160
Cotton	750 lbs. lint			
	1150 lbs. seed	45	18	24
	1500 lbs. stalks	30	10	30
		75	28	54
Peanuts	3000 lbs. nuts	110	15	20
	4800 lbs. vines	110	30	100
		220	45	120
Soybeans	40 Bu. beans	128	32	56
	1760 lbs. straw	20	8	40
		148	40	96
Sweet Potatoes	400 bu.	60	20	100
	Vines	32	80	40
		92	100	140
Tobacco	2800 lbs. leaves	60	15	90
	Stalks	35	10	100
		95	25	190

The shortage of phosphoric acid for the entire crop may be critical unless the phosphorus level is medium in the soil. The amount applied is less than the amount required. With phosphorus fixation this may be a minimum application.

The shortage of potassium for the entire crop (-43 lbs. K_2O) may be critical unless the soil level of potassium is around medium. The excess of 107 lbs. K_2O above removal by the grain would be adequate to permit some loss by leaching and still supply the crop. An exception might be on a sandy soil below the best pH level for the corn and soybean crop.

Chapter XII

APPLICATION OF FERTILIZER

Consumers are using higher rates of fertilization and using more of the essential nutrients for the production of increasingly higher yield. We should take a careful look at methods of fertilizer application in light of modern use. We will review the advantages of broadcast, row application, side or topdressing, and foliar sprays.

1. Broadcast Applications

Limestone and other liming materials are broadcast to raise the pH and supply calcium and magnesium.

Sulfur is broadcast to lower the pH in line with the crop needs (1 lb. S = 3 lbs. limestone).

Broadcast applications are made to raise the level of nutrients in the soil such as phosphorus and potash.

Larger crop residues interfere with land preparation and cultivation. Nitrogen applications can speed up the rate of decomposition of these crop residues. This also releases more of the nutrients in the vegetation for use by the next crop.

Building soil levels, bulk blends, and liquid fertilizer have encouraged the broadcasting of fertilizers to replace much or all of previously row applied fertilizers. Chemical weed control overcomes part of the need for rapid early growth to aid in early cultivations.

2. Row Applications

Row applications continue as a major method of applying fertilizer. Increasing injury from higher rates and higher analysis causes considerable stand and crop injury. Placing the fertilizer in two bands $2\frac{1}{2}$" to $3\frac{1}{2}$" to the side and 1 to 2 inches below the seed can reduce seed and seedling injury.

Starter solutions for transplanted plants have not been found too satisfactory for tobacco, the major transplanted crop.

Row application of fertilizer stimulates early growth and low rates (100 to 200 lbs. 8-8-8, 5-10-10, etc.) are frequently desirable even where the soil level of phosphorus and potash has been built up in the soil, or where the fertilizer has been broadcast.

A good compromise appears to be to build the soil level by broadcasting part of the fertilizer, then using side or topdressing to supplement the fertilizer applied in the row.

Questions are raised regarding the desirability of using fertilizer as a carrier of insecticides. The best placement for fertilizer response may be different from the best placement of the insecticide. Compromise in placement may not get the best response from either.

3. Side or Topdressing

Increasing rates of higher nitrogen and potash content fertilizers make it necessary to supplement the row application with side or topdressing. This decreases the salt effect of the fertilizer on the seed and seedlings.

More attention is being given to replacing leached nutrients following heavy rains on tobacco, corn, cotton, etc. Nitrogen and potash are the most commonly replaced nutrients.

Nutrients are applied just before the time of greatest need. This includes nitrogen and potash on tobacco, corn and cotton; calcium for peanuts. Also to correct observed nutrient deficiencies such as nitrogen, potash, magnesium, manganese, etc.

Nitrogen solutions are being topdressed as contact weed killers and as carriers of chemical weed control materials.

4. Foliar Sprays

Nutrients can be added to insect or disease sprays such as boron for cotton. Foliar application can be used where soil and applied nutrients are fixed and made unavailable to plants. Manganese on soybeans growing on overlimed soil for example.

Nutrients can be sprayed on the foliage to supplement the fertilizer program such as boron on cotton, zinc on peaches, iron on shrubs on overlimed soil, etc.

The concentration in foliar sprays is too low to replace a fertilizer program.

APPLICATION METHODS SUGGESTED BY SOIL TESTING LABORATORY

Methods of application suggested by the Soil Testing Laboratory can be illustrated with corn for a few different soil test level combinations.

Soil Test Levels		Broadcast	At Planting	Sidedressed*
P	K	$N - P_2O_5 - K_2O$	$N - P_2O_5 - K_2O$	$N - P_2O_5 - K_2O$
VH & H	VH	-	20-20-20	-
VH & H	L	-	20-20-40	0-0-60
VH & H	VL	0-0-120	20-20-40	-
VL & L	VH	0-100-0	20-40-20	-
VL & L	M	0-100-0	20-40-40	-
VL & L	L	0-100-0	20-40-40	0-0-60
VL & L	VL	0-100-120	20-40-40	-

* Plus 120-140 lbs. nitrogen sidedressed.

In the top part of the table, note that at the VH potassium level the potassium is applied in the row; with the low level of potassium, 60 pounds of K_2O is sidedressed; with the VL level of potassium 120 pounds of K_2O is broadcast.

In the bottom part of the table with VL & L phosphorus, 100 pounds of P_2O_5 is broadcast in all cases; with L potassium, 60 pounds of K_2O is sidedressed; with VL potassium 120 pounds of K_2O is broadcast.

Combination of broadcast, in the row, side or topdressed and/or as foliar sprays can be selected for each set of conditions and circumstances. Had this illustration been for cotton, there might have been a foliar spray of boron included in two insecticide sprays.

Chapter XIII

TOBACCO FERTILIZATION

Tobacco workers from the five flue-cured tobacco states meet annually, review the results of research, and make guidelines for the fertilization of flue-cured tobacco. North Carolina is well represented in this group. These concrete guidelines will be reviewed and then interpreted in terms of fertilizers that will supply the requirements.

1. Nitrogen

Nitrogen requirements are 30 to 60 pounds of nitrogen per acre. The rate is best determined by the depth of the soil to the B horizon (clay).

0 - 12" to B horizon (clay) use 30-40 lbs. nitrogen

12- 18" to B horizon (clay) use 40-50 lbs. nitrogen

18- 24" to B horizon (clay) use 50-60 lbs. nitrogen

Additional nitrogen should be applied to replace nitrogen lost by leaching.

At least 50% of the nitrogen at planting should be nitrate (NO_3) nitrogen (some authorities prefer more). Fifty to 100% of the nitrogen in the topdressing material should be nitrate (NO_3) nitrogen.

2. Phosphorus

Phosphorus requirements are in the range of 70 to 100 pounds of P_2O_5 per acre depending on the soil level of phosphorus.

It is important to note that phosphorus is most effective in preplant fertilizer to stimulate early growth of the plants.

3. Potassium

Potassium requirements are in the range of 120-170 pounds of potash (K_2O) per acre depending on the soil level of potassium.

Relatively high potassium content of the leaf is desirable for good quality. Potassium deficient plants are more subject to attack by leaf disease organisms. Higher rates should be applied as sidedressing to prevent excessive salt content in the fertilizer.

Additional potassium should be sidedressed to replace potassium lost by leaching. Apply three times as much potassium as nitrogen (see nitrogen section for estimating rate). This does not mean that potassium leaches three times as much as nitrogen. You will recall that tobacco requires 30 to 60 pounds of nitrogen applied and 120 to 170 pounds of potassium. Therefore, more potassium will be leached out than nitrogen.

4. Calcium

Calcium should be supplied in an available form to supply more than 60 pounds of CaO. This will be primarily in the form of calcium sulfate ($CaSO_4$) in superphosphate and the dolomitic limestone used to neutralize the fertilizer. The specification of "available" form would rule out coarsely ground dolomitic limestone used to neutralize the acid forming properties of a fertilizer. Later examples of fertilizers will assume finely ground dolomitic limestone use in manufacture of the fertilizer. Where coarsely ground dolomitic limestone is used, calcium sulfate ($CaSO_4$) may be used.

5. Magnesium

More than 30 pounds of magnesium (MgO) should be supplied for tobacco. They specify that at least one-half of this magnesium should be in a water soluble form. Additional magnesium should be supplied to replace excessive leaching losses.

The magnesium in finely ground dolomitic limestone becomes slowly available throughout the season. Therefore, it is not subject to loss by leaching as rapidly

as the water soluble magnesium. The coarsely ground dolomitic limestone should not be used as part of the magnesium supplied.

6. Sulfur

Sulfur (S) should be supplied to the extent of 75 to 100 pounds of sulfur (S) per acre. The amount of sulfur (S) should not exceed 200 pounds per acre.

The sulfur is usually supplied as the calcium sulfate in superphosphate, sulfate of ammonia, sulfate of potash, sulfate of potash magnesia, etc.

7. Chlorine

Twenty to 30 pounds of chlorine (Cl) per acre are suggested. Some authorities suggest that the lower amount of chlorine will improve the quality of the tobacco.

Excess chlorine in the plants results in thick brittle leaves. Also, the cured leaf has a poor burning quality.

8. Trace Elements

The need for trace elements has not been demonstrated in a sufficient number of cases to warrant general application of trace elements in fertilizers.

Boron deficiency has been observed in a few instances. 0.25 pounds of boron (B) per acre, (2.5 lbs. Borax) is considered sufficient to correct or prevent a deficiency of boron.

9. Foliar Sprays

The group feels that foliar sprays should be avoided because of ineffectiveness and the high cost. The probable reasons for poor response is given as the low rate of application in such a dilute solution. Also, the predominance of ammonium (NH_4) and urea ($CO(NH_2)_2$) in present commercial preparations.

10. Starter Fertilizers

Starter fertilizers have frequently stunted the growth of the tobacco and reduced the stand of plants.

SUMMARY

This can be summarized as follows:

N - 30 - 60# determined by depth to clay.

50% nitrate (NO_3) nitrogen at planting.

50-100% nitrate (NO_3) nitrogen in topdressing.

No superiority shown for natural organics.

Replace nitrogen lost by leaching -

P_2O_5	70 - 100#	Most effective in preplant fertilizers.
K_2O	120 - 170#	Topdress higher rates.
CaO	More than 60# in available form.	
MgO	More than 30# with at least 1/2 in a water soluble form.	
S	75 - 100#	Not more than 200#.
Cl	20 - 30#	

Table 21 shows one way of supplying the requirements of one acre of flue-cured tobacco by the use of 900 pounds of 4-8-12 and sidedressing with 100 pounds of 8-0-24. Nitrogen and potassium removed by leaching rains would be replaced according to the suggestions given in Table 21.

Note at the bottom of Table 22 that the requirements as summarized above are compared with the amount supplied by the use of these two fertilizers.

Table 14 shows examples of 3-9-9 that also meet the specified requirements for tobacco.

Table 21 Acre Requirements for Flue-Cured Tobacco

900 pounds 4-8-12 and 100 pounds 8-0-24

900# 4-8-12 for Tobacco (36-72-108)

	N	P_2O_5	K_2O	CaO	MgO	S	Cl
108# Ammonium Nitrate	36*						
360# Superphosphate		72		100		43	
100# Sulfate of Potash-Magnesia			22		18***	23	1.5
38# Muriate of Potash			22				18
135# Sulfate of Potash			64			24	2.8
159# Dolomitic Limestone****				37	39		
900# Totals	36	72	108	137	57	90	22

100# 8-0-24

	N	P_2O_5	K_2O	CaO	MgO	S	Cl
50# Nitrate of Soda	8**						
50# Sulfate of Potash			24			8.8	1.1
	8		24		35	8.8	1.1
Total 4-8-12 & 8-0-24	44	72	132	137	57	99	23
Needed for one acre Tobacco	30-60	70-100	120-170	60	30	75-100	20-30

* 50% Nitrate (NO_3) Nitrogen
** 100# Nitrate (NO_3) Nitrogen
*** At least 15# water soluble magnesium
**** Finely ground dolomitic limestone

TABLE 22 SELECTING YOUR SOURCES OF MATERIAL FOR A TOBACCO FERTILIZER

(Circle the number of your choice for each selection)

NITROGEN SOURCES

	1	2	3	4	5	6	7	Other
Nitrate Nitrogen[1/]	35%	50%	75%	35%	35%	50	50	
Ammonia Nitrogen	65%	50%	25%	35%	30	20	15	
Insoluble N[2/]	0	0	0	30%	35	30	35	

Comments:

Specify kind and amount of Insoluble N - Cotton seed meal_____; Urea-formaldehyde_____; Tankage_____; Other_____.

PHOSPHATE SOURCES[3/]

	1	2	3	4	Other
Superphosphate[4/]	100%	50%			
Triple superphoshate		50%	100	5/	
Ammonium phosphates				5/	
Other sources					

Comments:

POTASH SOURCE[6/]

	1	2	3	Other
Potassium Chloride[7/]				
Potassium Sulfate	50%	100%		
Sulfate of potash - Magnesia[8/]	50%		To supply 1% Mg	
Potassium Nitrate		9/		

Specify Maximum Chlorine guarantee_____%

Comments:

CALCIUM SOURCES[10/]

Calcium content desired - 2%_____; 3%_____; 4%_____; 5%_____; other_____%
(5% calcium would supply 50 pounds of calcium in 1000 pounds of fertilizer)
How should this calcium be supplied?
The calcium sulfate in superphosphate_____; dolomitic limestone_____; calcium sulfate (landplaster_____.

Comments:

MAGNESIUM SOURCE[11/]

Magnesium content - 1%_____; 2%_____; 3%_____; 4%_____; other_____%
(1% magnesium would supply 10 pounds of magnesium in 1000 pounds of fertilizer)
Percent of total water soluble - None_____; 25%_____; 50%_____; other_____%

Comments:

SULFUR SOURCE[12/]

Sulfur content - None_____; 5%_____; 10%_____; 15%_____; other_____%
(5% would supply 50 pounds of sulfur in 1000 pounds of fertilizer)

Comments:

(See over)

TRACE ELEMENTS[13/]

Boron	Trace_____	None added_____	Other_____
Copper	Trace_____	None added_____	Other_____
Manganese	Trace_____	None added_____	Other_____
Zinc	Trace_____	None added_____	Other_____

(Would you require trace elements to be guaranteed_____. If so, would you require a minimum amount before they could be guaranteed_____.

Comments:

ACIDITY OR BASICITY

30% acid_____; 20% acid_____; 10% acid; 5% acid_____; neutral_____%;

5% basic_____; 10% basic_____; 15% basic_____; other_____

(5% is equivalent to 100 pounds of lime per ton.)

SCREEN SIZE OF DOLOMITIC LIMESTONE

Coarse_____; medium_____; 50% through 100 mesh[15/]_____; other_____.

ANALYSIS PREFERRED[16/] - 2-10-8_____; 3-9-9_____; 4-8-12_____; 5-10-15_____; other_____.

PHYSICAL CONDITION REQUIREMENTS

Must be entirely free of lumps Yes_____ No_____

Must not take up moisture when the bag is left open. Yes_____ No_____

Must drill freely Yes_____ No_____

Physical condition is of minimum important_____; some importance_____; extreme importance_____.

Sign if desired _____

Prepared by E. R. Collins for a systematic evaluation of a tobacco fertilizer. This material is not considered desirable except in a course of study in which these choices are discussed.

CHAPTER XIV

SPECIAL CONSIDERATIONS FOR SPECIFIC CROPS OR PLANTS

Each year the N. C. Extension Service prepares an Extension leaflet entitled "Fertilizer Suggestions". This publication gives general recommendations for field crops, vegetable crops, apples and peaches, small fruits, lawn and ornamentals.

This publication gives general suggestions for nitrogen, phosphoric acid and potash for average conditions. Also for some special conditions related to rotations, soil level of nutritients, etc. This is not a good substitute for a soil test made by a laboratory using tests calibrated for your area. It can be used, however, to help understand the particular requirements of plants. For example, the high nitrogen requirements of corn are indicated by the suggested sidedressing of 80 to 120 pounds of nitrogen (N) for the Coastal Plain and Mountains. The equivalent of 400 pounds of 0-10-20 on soybeans shows that this legume can fix the nitrogen needed from the air. Also that the potassium requirements are higher than the phosphorus requirements. The 600 to 800 pounds of landplaster ($CaSO_4 \cdot 2H_2O$) on peanuts shows the need for extra calcium. Emphasis on lawns, shrubs, etc., can also be determined by the general suggestions for fertilization.

Some of these special situations will be reviewed for some of the more common crops. See Chapter XIII for a discussion on flue-cured tobacco.

CORN

Soil levels of medium should be maintained for phosphorus and potash. Low yield response is generally obtained from fertilization with phosphorus and potash on soils with high and very high phosphorus and potash levels. Starter amounts

of fertilizer in the row will give early vegetative response with high soil phosphorus and potash that may not be reflected in high yields.

Increased nitrogen and potash absorption starts around three weeks after planting. The major uptake is around the 4th to 7th week. Note that this leaves a long time for the nitrogen and potash to leach out when they are applied too early.

Nitrogen sidedressing applied on one side of the plant is as good as both sides with a normal root system. With restricted root growth from nematodes, or other causes, the nitrogen should be placed within reach of this restricted root growth.

Nitrogen leached by heavy rains should be replaced. Potash should also be replaced where the supply is limited in the soil.

Where very high yields are attempted, boron may reduce the number of barren stalks on thickly spaced corn.

Check the big difference between the amount of potassium required to produce a corn crop and the amount removed by the grain.

OPTIMUM SOIL FERTILITY LEVELS FOR SOYBEANS AND CORN*

A high organic Portsmouth soil was limed to pH 5.9. The initial low potassium level was raised to medium by the application of 100 pounds of K_2O per acre; to high by 200 pounds of K_2O per acre. The initial medium phosphorus level was raised to high by applying 330 pounds of P_2O_5 per acre; to very high by applying 660 pounds of P_2O_5 per acre. The seven year average yields are shown in Table 23 with varying annual rates of phosphorus and potash.

*E. J. Kamprath. Plant Food Review. Published by National Plant Food Institute.

Table 23. Seven Year Average Yields of Corn and Soybeans
(Varying fertilizer rates and soil levels of P_2O_5 and K_2O)

Annual Application K_2O lbs/A	Corn Yields Bu/A — Initial Soil K Level: Low	Medium	High	Soybean Yields Bu/A — Initial Soil K Level: Low	Medium	High
0	76	96	106	31	35	39
40	103	107	108	39	40	40
80	105	106	108	39	39	39

Annual Application P_2O_5 lbs/A	Corn Yields Bu/A — Initial Soil P Level: Medium	High	Very High	Soybeans Yields Bu/A — Initial Soil P Level: Medium	High	Very High
0	102	104	107	38	40	41
40	109	105	111	41	41	41
80	108	107	105	42	41	42

You will note that corn and soybean yields went up as the soil level of potassium increased from low to high. Similarly the yield went up with annual application on the soil with the low level of potassium. The increase was less marked on the soil medium in potash with little increase for row applied fertilizer on the soil high in potash.

The application of 40 pounds of K_2O per acre per year almost maintained the soil level of potash at medium. The 80 and 120 pounds annual application raised the medium level to high. It required 120 pounds of K_2O annually to maintain the soil at a high level - this would be uneconomical.

Note the smaller changes in yield from similar variations of the phosphorus levels. The high and very high soil levels produced about the same yield as annual applications.

COTTON

Best yields of cotton are generally obtained on the high side of the pH preference range usually given (5.8 - 6.2). Some authorities would prefer a pH of 6.5 to 7.0. Previously they had kept the pH below 6.2 to prevent the possibility of manganese deficiency. Now it appears practical to raise the pH and apply manganese in the probably response areas as shown by a soil test. Also, to use 1/2 pound of Boron (B) per acre in the fertilizer or 1 to $1\frac{1}{4}$ pounds of solubor (20.5% B) in each of two insecticide sprays - 10 days apart, in the early bloom stage.

Drought tolerance of cotton is related to the presence of a good tap root. Fertilizer placed directly under the seed may damage the tap root. Once the tap root is destroyed the root system approaches a fiberous root system nearer the surface of the soil.

Nitrogen distribution is important as low nitrogen levels are associated with excess shedding of squares and bolls. A good system is to apply 25 pounds of nitrogen (equivalent to 500# 5-10-10) at planting and sidedress 40 to 50 pounds of N at 4 to 6 weeks and again at 10 to 12 weeks.

Nitrogen replaced by leaching should be applied as soon as practical. If one inch of water moves through the root area, replace 1/5 of the total nitrogen used up to that time; with two inches, replace 1/3 of the nitrogen used; with three inches, replace 1/2 to 3/4 of the nitrogen used. Reduce the amount replaced as the plant uses the nitrogen that had been applied.

PEANUTS

One of the outstanding features of peanuts is the absorption of calcium through the root hairs on the peanut shells.

Peanuts can be planted with the roots in one pot and the peanuts pegging down in different pots on each side of the plant. This permits controlling the conditions in each of the pots as desired.

Assume that the peanuts are pegging down in low calcium soil on both sides of the plant. When a soluble source of calcium (landplaster or $CaSO_4.2H_2O$) is applied to the pot on the right side of the plant, norman peanuts develop. "Pops" or unfilled shells will be formed on the left side of the plant where the calcium level is low.

This points to the importance of placing landplaster uniformly over the area where peanuts are developing.

Further tests show that increasing the potash level in the pegging zone results in more unfilled nuts. This is the antagonism of ions we discussed previously. The high potash level decreases the absorption of calcium.

The high potash requirement of peanuts must be maintained with minimum amounts in the pegging zone. Applying potash to other crops in the rotation, or before land preparation, appears suitable to minimize the antagonism of potassium in the pegging zone.

It would appear that dolomitic limestone with 15% magnesium carbonate may be better suited to peanuts than the regular domomitic usually, with about 52% magnesium carbonate. Fulfilling the lime requirement with a combination of dolomitic limestone and calcitic limestone would accomplish the same purpose.

When calcitic lime is used, it should be supplemented with magnesium in some manner.

Molybdenum is required for proper innoculation of legumes. One-half ounce of molybdenum is sometimes used as a seed treatment as an insurance factor.

However, molybdenum is not considered necessary on adequately limed soils. One-half pound of boron per acre is used in the second or third copper-sulfur dust, to decrease internal damage under unfavorable growing conditions.

SMALL GRAIN

A major factor in small grain production is vigorous growth to encourage tillering or stooling to increase the number of seed heads.

A complete fertilizer, drilled at seeding, stimulates early growth and stooling. This early growth permits the plants to go through the winter better. The increased root growth reduces the amount of heaving out of the soil when the ground freezes.

Early topdressing with nitrogen stimulates tillering and suckering to produce more seed heads. Topdressing after March 15 or April 1 can only give slightly heavier grains - not a lot more seed heads and grains.

Applying the normally topdressed nitrogen before preparing the land for seeding would be satisfactory on clay soils or on soils with imperious subsoils. This assures the nitrogen being available on time in the spring. Wet soils frequently prevents application of the topdressing on time in the spring. Results show that nitrogen applied in the fall on sandy type soils is leached readily. Where leaching rains remove the topdressed nitrogen, it should be replaced.

SOYBEANS

Soybeans need a well limed soil (pH 5.8 to 6.2). Where limestone is needed, it should be applied three to six months before planting and mixed well with the soil. One-fourth to 1/2 ounce of molybdenum is sometimes used as a

seed treatment on soils below optimum pH levels. It can also be used as an insurance factor at optimum pH levels.

Use manganese on known and probable response areas as determined by the soil test and pH level. Deficiencies are most likely at pH levels above 6.2 and on soils low in manganese. Manganese deficiencies that appear on the established crop can be sprayed with a dilute manganese sulfate solution. This may permit the roots to extend below the overlimed surface soil where manganese may be available to the plants.

Soybeans are sensitive to fertilizer injury and the fertilizer can best be side placed. Part of rates above 400 to 500 pounds per acre should be broadcast.

FORAGE CROPS

Forage crops include grasses and legumes with varying characteristics.

Emphasis in the past was placed on a grass-legume economy for forage production. This consisted of a legume like white dutch clover growing with a compatible grass like blue grass. Both of these were shallow feeders and responded well to broadcast limestone and phosphorus applied on the surface. The idea here was for the lime and fertilizer to make conditions favorable to the legume. As the legume grew and fixed nitrogen the grass came in and flourished.

The grass responded to nitrogen applications, particularly in the spring, before the legume started to grow. The need for early grazing prompted the use of more nitrogen. This resulting in more grass growth with frequent crowding of the legume.

Higher acre production requirements led to higher producing combinations such as Ladino Clover and fescue or Ladino Clover and orchard grass. These plants were deeper feeding than the blue grass and fescue. They required mixing the lime

and phosphorus with the soil at lower depths and gave less response to surface applied lime and phosphorus.

These deeper feeding habits led to mixing the lime and fertilizer with the soil before seeding. Also plowing up, and mixing lime and fertilizer with the soil when it was necessary to renovate.

Problems of management to retain clover in the mixture prompted nitrogen applications to stimulate the grass. High nitrogen rates on straight grass seedings gained in favor. This includes warm season grasses like Coastal Bermuda that responds to previously unheard of rates of nitrogen application.

Forage legumes respond to lime, phosphorus and potash similar to soybeans. Forage grasses respond to lime, nitrogen, phosphorus and potash similar to corn with its high nitrogen requirements.

Fertilization of forage, therefore, depends on the goal of a grass-legume economy or a grass-nitrogen economy. Yield level and the period of year that the growth is needed influences the selection of the forage.

The specific requirements of the forage selected then can range from the surface applied phosphorus for blue grass and white dutch clover; through the lime, phosphorus plus potash for alfalfa; to the high nitrogen and lower phosphorus and potash requirements of Coastal Bermuda. These characteristics are shown in the annual "Fertilizer Suggestions" publication of the N. C. Extension Service.

Lespedeza flourished as a scavenger crop on eroded fields without lime and fertilizer. However, it responds to lime, phosphorus and potash where the level is low in the soil. The higher producing crop of alfalfa required higher pH levels and much higher levels of phosphorus, and particularly potash. Nematodes

took their toll of lespedeza and the alfalfa weevil wiped out much of the alfalfa. As new forages take their place the specific nutrient requirements of the plant will be established.

AZALEAS AND CAMELLIAS

Azaleas and Camellias can be fertilized when new growth starts and monthly through the first part of July. Use three pounds (3 pints) per 100 square feet. An acid forming fertilizer or special Azalea or Camellia fertilizer is desirable.

LAWNS

Lawn and shrubs grow best on soils medium or high in phosphorus and potassium. Broadcast phosphorus and potassium on soils below medium.

1. Cool season grasses like fescue and blue grass -

   20 pounds of 8-8-8 per 1000 square feet in early spring. Also, 1.5* pounds of nitrogen (N) per 1000 square feet in early fall.

2. Warm season grasses like bermuda -

   20 pounds 8-8-8 per 1000 square feet in early spring. Also 1.5* pounds of nitrogen (N) per 1000 square feet in June or July. Repeat the nitrogen application after leaching rains or when the grass does not have a good green color.

TREES AND SHRUBS

General suggestions are to use 1/2** pound of nitrogen in early spring for trees above 6 inches in diameter; 5 pounds or pints of 8-8-8 on soils low in phosphorus and potassium.

Use 1/2 the above rates for trees under 6 inches in diameter.

* About one pint of 16% N fertilizer; 3/4 pint of 20% N fertilizer.

** This would be about 1/3 or a pound or pint of 16% nitrogen material; 1/4 pound or pint for 20% nitrate nitrogen.

FLOWER GARDEN

At planting or in early spring, use about two pounds (2 pints) of 8-8-8 or 6-12-6 per 100 square feet.

Repeat the application in late spring or early summer.

Apply the fertilizer when the plants are dry. Wash off any fertilizer on the plants and wet the soil after application where practical.

PROBLEM AREAS AROUND THE HOME

Indiscriminate disposal of plaster and mortar around a new home can cause much grief as expensive shrubs later turn yellow with green veins, and bald spots show up in the lawn.

A soil test on the problem area can determine the degree of overliming. The soil can be replaced in small areas or sulfur can be applied to decrease the pH.

Foliar sprays of manganese, magnesium, boron, and zinc, (also iron on shrubs) can be helpful to determine the specific cause. A one percent solution of manganese, magnesium (Epsom salts), iron or zinc sulfates can be painted on the leaves of a branch for diagnosis. Boring a few holes (soil auger or soil tube) around the edge of the overhang of the foliage and filling with the designated material can overcome some of the problems for a longer period of time than foliar sprays.

APPENDIX

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ABSTRACT - Prepared by a team of junior and senior high school teachers during a workshop on education in family finance, this teaching unit in consumer buying includes the following color-coded sections: (1) Deciding What to Buy, (2) Deciding Quality to Buy, (3) Deciding Where to Buy, (4) Deciding When to Buy, (5) Deciding How to Use Advertising, and (6) Deciding How to Pay. Each section contains a broad generalization, followed by several related concepts. Desired behavior, main ideas, suggested learning experiences, and references and teaching aids accompany each concept. Charts, suggested sample test questions, and a bibliography of books, pamphlets, and films are appended. (SB)

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DOLLARS DEMAND DECISIONS!

A GENERALIZATION APPROACH TO A UNIT IN CONSUMER BUYING

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University of Denver
Dr. Roland Lanser, Director
1964

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PREFACE

The development of the ability to think is the central purpose to which education must be oriented today if it is to successfully accomplish its task.

To help students learn to think critically, the teacher will need to orient them with the problem-solving method which consists of the following steps:

- Find important facts
- Organize the facts into generalizations
- Use the generalizations in making decisions.

Generalizations and related concepts are information which will more likely transfer to new situations than facts learned in isolation. A generalization refers to a statement or proposition containing two or more concepts. A concept is a thought, an opinion, or an idea in general of what a thing should be. It is a mental image of the underlying structure of objects, events, and situations.

In order to learn to generalize, pupils must first be familiar with the concepts as presented and understand relationships among them. They must determine what each concept means before analyzing these interrelationships. Background facts and information give meaning and definition to concepts. Without known facts, concepts are shallow and build on limited experiences of the pupil or the teacher.

Basically, there are five steps in developing a teaching plan that will result in conceptual understanding and will help pupils to generalize.

- Identify the desired pupil behavior or desired outcome on the learning level of the majority of the pupils in the class.
- Identify and select the generalizations and concepts that will serve as the basic knowledge to bring the learner to the desired pupil behavior selected.
- List and document the background information necessary to help the learner understand the concepts and their relationships.
- Devise learning experiences which bring the pupil to recognize the relationships of the concepts, and which give meaning to the background facts and information.
- Bring the pupils to form generalizations in their own words.

To assure the wisest use of pupils' learning time, it is more beneficial to teach the skills of critical thinking and decision making which may be applied again and again, than to teach isolated specific facts which may become outdated and have no further meaning. Therefore, through teaching critical thinking processes, teachers may help students become more self-directive and discriminating people.

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INTRODUCTION

The purpose of the Denver Family Finance Workshop Team of 1964 was to prepare a Consumer Buying unit, emphasizing the formation of generalizations and concepts through the use of critical thinking rather than the learning of specific facts.

The ideas in this unit were based upon the following generalization: A knowledge and understanding of the principles of consumer buying increases an individual's purchasing power. The criteria for efficient buying of goods and services include deciding what, when, and where to buy; deciding the quality to buy; deciding how to make use of advertising and how to pay.

Each of the six areas—what, when, where, quality, consumer protections, and how to pay—was developed through the following steps:

- A generalization was formulated which encompassed the entire area.
- Several concepts were developed which related to the generalization.
- Each concept was developed through the following four steps:

  - Desired behavior—goals which the student should achieve
  - Main idea—facts or statements which relate to the concept
  - Learning experiences—suggested methods for presenting the main idea
  - References and teacher aids—activities, books, pamphlets, and films useful to the teacher.

Following the development of the four areas, sample test questions were prepared. These questions were designed to serve as a guide for the teacher in preparing his own tests.

CONSUMER BUYING

DECIDING WHAT TO BUY

GENERALIZATION: By defining our values as a consumer, we are more easily able to establish the goals that control behavior and direct spending to satisfy our needs and to achieve our wants.

CONCEPT:

- defining our values
- establish the goals
- satisfy our needs and wants
- direct spending
- control behavior

CONCEPT: Establish our goals

DESIRED BEHAVIOR	MAIN IDEA
Determine goals that involve spending.	Because consumers are interested in getting satisfaction for dollars spent, they need to set up goals as a basis for spending. Goals are the aims and objectives that direct the use of our resources, such as money, time, and ability.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AI
Motivation: Students have many desires and each person's may be very different from the others. As a stimulant, using pictures, magazines, and discussion, have students write down things they would like now and in the future.	Student pamphlet, A Date With Your Future. pp. 4-1C
Use "Shopper's Check List" to stimulate discussion and further study.	Money Management, Your Shopping Dollar. p. 34 (booklet), 1962 edition.
Give each student a certain amount of play money equal to their typical weekly allowance. Have pictures of articles or the actual articles they might purchase with the prices indicated. The students will spend their money as they please. Discuss or write an evaluation of their purchases. . Is there any money left? . What might they have done? . What other things should have been included in their spending?	
Discuss influences on our selection of goals: . money available . family situation . tastes and interests . any special conditions (illness, special talent) . location of residence	The Management of Family Resources. pp. 115-136 (book), pp. 342-350 Comparison charts of income, education, and occupations: Personal Finance. (book), pp. 17-25.
Reasons for using your goals: . easier to make decisions . better use of money . more satisfaction . impulse spending controlled . increased knowledge of money spent	
Bulletin board: Have a committee show typical goals of students their age.	
Speaker - discuss selection of realistic goals.	cf. bibliography

CONCEPT: Defining our values

DESIRED BEHAVIOR	MAIN IDEA
Analyze personal and/or family values.	Values are the ideals and principles by which we live that give meaning and purpose to our lives. The way we use money is an expression of our values.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Discussion: On what things do we spend money? . What things of value do not cost money? happiness, religion, friends, cleanliness, beauty, prestige, education, etc. . Which of these things do <u>you</u> think are important? List them in order of preference.	<u>Managing Personal Finances</u>. pp. 1-8. (book)
Clarify meaning of value. Point out that values.... are not easily defined . have influence on our behavior and attitudes.	<u>Personal Finance</u>, pp. 3-17. (book)
Each person choose an item from their list of goals. . What qualities or factors involved in this item are important to me? . What things should I consider in making this purchase? . Are these things values - which ones?	
Think of something you have purchased this week. What value does this reflect, if any?	
Discuss attitudes that are values. i.e. - sports car for prestige use of car reflects values of safety versus showing off i.e. - loyalty and dating a friend's boy or girl friend	cf. bibliography

CONCEPT: Our needs and wants

DESIRED BEHAVIOR	MAIN IDEA
Understand differences between needs and wants.	Needs are fairly stable and demand satisfaction first, but wants are unlimited and our ability to satisfy these wants is limited. If we know why we want to buy an article, we will be likely to get the item that best suits our needs.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Determine difference between needs and wants. Which should we consider first in spending? Write down things you need and things you want. Rearrange items in order of importance to you. Compare the list to money available. How can you use your money most effectively to buy these things ? Relate needs and wants to our individual standards of living. . type of home . area in which we live . presence or absence of luxuries . our level in society, etc. Divide class in small groups - each group select an item of common interest to buy. . Determine purpose and standards they want from item. . Determine why you want the article and ask yourself if it means sacrificing something else to get it. Is it worth it? Example: compare the purchase of a handbag for school and a purse for evening wear - or - stationery and scratch paper. . What differences would there be between these? . What happens if you bought the wrong type for each job?	Family Finance. (book), pp. 27-45. Understanding Our Economy. (pamphlet), pp. 13-17. cf. bibliography

CONCEPT: Direct our spending

DESIRED BEHAVIOR	MAIN IDEA
Realize the limitation of our money. Understand the importance of wise planning before purchasing.	Since we want more than we can buy with our incomes, we usually limit our spending and place priorities on goods and services needed or required. The more limited the resources, the more important becomes the decision of what to buy. When we plan for the use of our resources, we are more likely to make choices that result in satisfaction in place of confusion and frustration.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AII
Motivation: Use cartoons, articles from newspapers, or bulletin board that shows someone inheriting a million dollars. Have students tell what they would do with the money. Then discuss theories that show (1) people with lots of money aren't any happier than those with less (2) whether people have a lot or a little, they still worry a great deal about money (3) this shows it isn't how much money you have but it is knowing how to use the money you do have that counts.	Make Your Pennies Count. Money and You. A Miss and Her Money. (pamphlets).
Case Study: Give each student a copy of a situation typical of teenagers in the class. It gives a consumer's shopping dilemma. Class work on solutions to the problems included.	
Keep records of spending habits for two weeks, a month, etc. Analyze personal spending and determine if student needs to improve his use of money to reach his goals. . What expenses are necessary? . What expenses can be cut down?	
Refer to a unit "budgeting your money" to plan ahead for things you want. Class set up plan and record-keeping device. Know what you want and how much you can afford to pay for it.	Money Management, Your Budget. (pamphlet).
Discuss what is gained by planning your purchasing: . better use of money . more satisfaction . priorities first. "Do you plan your spending, or do you just go downtown shopping?"	Bulletin board idea - "Don't Fuss - Budget" to get what you want!
Determine the use of a family council in setting a framework for family and/or individual spending. . Decide which expenses are regular and necessary. . What decisions need to be made about the remaining money?	cf. bibliography

CONCEPT: Control our behavior

DESIRED BEHAVIOR	MAIN IDEA
Recognize current influences on choices.	Avoid buying on impulse or being influenced by pressured sales and exaggerated advertising by using our goals, wants and needs as our basis for spending.
	An inventory helps plan what to look for in buying wisely, helps distinguish between wants and needs, and contributes to elimination of unnecessary buying.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Have class develop list of shopping guides, such as: 1. Prepare a list of necessary purchases. Make list as detailed as needed for easy and quick understanding. Organize the list according to items needed and their location in store. (For extra credit a report on a related area: send student to department store or supermarket to discuss store arrangement with manager or have student prepare a report for class on his analysis of store.) 2. Know requirements necessary in each item. 3. Use information available. 4. Compare price and quality - make decision.	Money Management, Your Shopping Dollar. (pamphlet)
Have students bring items they have purchased on impulse which they think were good or poor buys. Show group and discuss reasons why they were good or bad. If dissatisfied, how could we prevent this or another unwise purchase again?	Effective Shopping. pp. 20-25, "Plan your shopping trip," (pamphlet).
Discussion: What is a fad? Name a common one at present. (They might bring some to class.) If you have limited money and you buy this item, does it give lasting satisfaction and good use? Does it fulfill some need or goal of yours?	
Determine what an inventory is and how to take one. . When would it be wise to take an inventory before planning your buying? household items clothing furniture sports equipment . How could it improve your purchasing skills? . Can an inventory reveal other uses for items?	A Date With Your Future. pp. 5-6, (pamphlet).
	cf. bibliography

CONSUMER BUYING

DECIDING QUALITY TO BUY

GENERALIZATION: A consumer's satisfaction with buying is achieved by understanding the meaning of quality which implies certain standards of performance, durability, usefulness, value and price, and consumer protections and its influence on purchases of goods and services.

CONCEPTS:

- usefulness
- performance
- durability
- consumer protections
- price and value
- quality

CONCEPT: Usefulness

DESIRED BEHAVIOR	MAIN IDEA
Be able to determine the usefulness of goods or services.	The usefulness of goods or services is the amount of profit or benefit an item will give.
	Every purchase has major and minor features that relate to the use of the item and one's purpose in buying it.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
List on the board goods and/or services which students feel could be used rarely, occasionally, often. Discuss how many persons would benefit from the goods or services. Discuss services that are beneficial in which students could and do engage. Bring pictures or examples of above items for class examination. Discuss the possibilities of changing an item slightly, in order for it to be utilized more effectively. Where and when possible, have groups of students actually change items and demonstrate what they did to make the change. . Jeans cut off for shorts. . Lamps made out of bottles. . Old cars that are modernized.	Dictionary: Webster's New World Assorted Magazines & Newspapers Samples or pictures of goods and services How to Buy a Used Car (film) cf. bibliography

CONCEPT: Performance

DESIRED BEHAVIOR	MAIN IDEA
Be able to analyze the performance of goods or services.	Performance is the operation or functioning of goods or services with regard to the effectiveness for which the item was planned.
	Some products have a changing rate of performance due to age and use.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Have students do research work from various consumer reports on the performance rating of items of their interest. Students give demonstrations or reports on their findings and include features to look for in an item to ensure the performance desired. The report should include such topics as: does the item do all you want it to do? does it do as much as another comparable product?	Dictionary: Webster's New World Consumer Research Bulletins Consumers Union Publications
Discuss and list standards of work habits desirable for a good service or serviceman. Include pride of workmanship and service.	
List on the board goods and services which have a diminishing rate of performance due to age and use, such as batteries, rubber goods, etc.	cf. bibliography

CONCEPT: Durability

DESIRED BEHAVIOR	MAIN IDEA
Be able to recognize the durability of goods or services from past experiences and/or research.	Durability of goods or services is the quality of continuing endurance or existence of goods under all conditions of use.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Have students define "durability" from the dictionary. Discuss terminology. Have students bring to class items or pictures of items which they know have endured much use. List conditions of use for each item: . Was it exposed to wind, rain, sun, heat, etc.? . Was the item used by adults only, children only, or both? . Under what conditions was the item used? . What was the necessary care of the item? . How much time was spent in using the item at any one interval? (An item with an electric switch that may be turned on for an hour or more in relation to some other switch that might be turned on and off again in just a few minutes or seconds. Analyze one of the above items and list on the board the construction features which have enabled the item to endure or not to endure. Have students do research from publications of Consumer Research and Consumers Union on specific items of their choice and report to the class their findings.	Dictionary: Webster's New World. Consumer Research Bulletins Consumers Union Publications Pictures and/or samples of specific items. cf. bibliography

CONCEPT: Consumer Protections

DESIRED BEHAVIOR	MAIN IDEA
Be aware of the types of consumer protections.	Labels give much factual information to the consumer. This information should not be false or misleading.
	Seals may identify tested products as "guaranteed," "certified," "approved," or "tested" by one of the various agencies established for that purpose. Consumer service bureaus prepare buying reports for a wide variety of products and services.
	There are government agencies which serve and protect the consumer.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
To be of value, a label should tell: • what materials are used in the product • how it is made • how it will perform • how to use and care for it • the name and address of the manufacturer. Have small groups of students go to various stores and record information about an item of their choice such as: brand name, labeling, price, weight, size, etc. Report back to the class and figure actual comparison costs per unit of measure of similar items. Students might use such items as: foods, clothing, sports equipment, car accessories, small appliances, and toys.	Consumer Research Bulletins Consumers Union Publications Sense Makes Dollars. (book) 1961 - p. 20 1962 - pp. 49-52. Money Management, Your Shopping Dollar. (pamphlet), pp. 10-17. Labels, tags, warranties, guarantees
To make intelligent use of seals and consumer service reports, one should know: • who approves the product • what tests were made • what were the test results • what does the certification include • what are the terms of guarantees and how long are they effective?. Students may contribute labels, tags, warranties, guarantees, etc., from their own purchases for bulletin boards or posters.	Reference to Chart No. 5 Consumer Protection. (film) Speaker from Better Business Bureau Read the Label. (pamphlet) Packaging and Labeling Practices. (pamphlet), pp. 983-987.
Discuss the reliability of various consumer protections as: • Food and Drug Administration • Federal Meat Inspection Division • Bureau of Standards • Post Office Department • Department of Public Health • Commerce Department - grocery scales & gasoline pumps • Securities and Exchange Commission.	cf. bibliography

CONCEPT: Value and Price

DESIRED BEHAVIOR	MAIN IDEA
Be able to analyze desires and needs in relation to costs in order to establish valuations of goods and services.	The consumer will get the most for his money if he relates the price of an item to its value to him. Price is not necessarily an indicator of quality. Attitudes toward spending and one's values are dependent upon one's present and past experiences.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Discuss the meaning of "Price and Value. . Price is the amount the seller hopes to receive in exchange for the goods or services. . Value is the worth of the goods or services to the buyer. The value of a certain item at a certain price may differ from one person to another because of job requirements, hobby and sports preferences, and familty needs. Relate past experiences in buying with regard to reasons for purchasing the article at that time.	Effective Shopping. (pamphlet), pp. 60-61. The Consumer Interest. (book), p. 221.

cf. bibliography

CONCEPT: Quality

DESIRED BEHAVIOR	MAIN IDEA
Show an awareness and understanding of quality of goods and services.	Quality is the degree of excellence which goods or services possess.
	How to judge quality is learned through careful observation and consideration of materials and construction of various items.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Discuss high quality, medium quality, low quality of goods and services with respect to performance, durability, usefulness, consumer protections, and value and price. . High quality merchandise may be the best buy if fine details are important. (sterling silver and fine china) . Medium quality merchandise may be the best buy if durability is important. (stainless steel and pottery) . Low quality merchandise may be the best buy if the item is to be of limited or short term use. (plastic utensils and paper plates)	Your Shopping Dollar.(pamphlet), p. 10. Pictures and samples of items Reference to Chart No. 4 How to Be a Better Shopper. (pamphlet)
Have students bring items or pictures of items to class. Judge quality of items brought.	
Create role-playing situations of purchasing a specific item with respect to quality desired.	

CONSUMER BUYING

DECIDING WHERE TO BUY

GENERALIZATION: The consumer is most likely to shop in the stores which offer the best chance of meeting his needs and wants involving the shopping facilities available, personal preference, price comparison, and the service of clerks.

CONCEPTS:

- shopping facilities available
- personal preference
- price comparison
- service of clerks

CONCEPT: Shopping facilities

DESIRED BEHAVIOR	MAIN IDEAS
Recognition that there are many shopping facilities available.	Decide which of the numerous shopping facilities would best fit one's needs and wants.
	Experience in shopping gives insight to wise buying.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Divide the class into small groups; have each group visit one of the following types of stores and make an oral report to the class on the advantages and disadvantages of shopping there. For teacher reference--including advantages and disadvantages Department - wide selection of goods in every price range/size of store may make it difficult to find what you want Specialty - greater variety/prices may be higher Discount - self service is speedy/return privileges are limited Supermarkets- large business means lower prices/no personal service Variety - merchandise is openly displayed/few services are provided Discuss advantages and disadvantages of non-store retailers using it as a supplement to retail store discussion. Direct door-to-door - home shopping is convenient/no price comparison Mail order - saves time and energy/cannot inspect merchandise Vending machines - offers 24-hour service/machines are impersonal Refer to Chart No. 1 Have class discussion on: . well-known communities . experience with certain sales clerks . reference of a store from friends . experiences with newspaper advertising of certain stores. Have a speaker, preferably a housewife, come in and relate her shopping experiences.	Money Management, Your Shopping Dollar. pp. 20-21. (pamphlet) Sense Makes Dollars. 1962. The Management of Family Resources. pp. 271-380. (book) cf. bibliography

CONCEPT: Personal preference

DESIRED BEHAVIOR	MAIN IDEAS
Recognize awareness of the types of services offered that will best suit his shopping tastes. Understand the influence stores can play on personal preference.	Certain trends in present day shopping may save time and money. Buying incentives such as trading stamps and coupons make a difference in personal preference. Learn how to select stores and what to look for according to your preferences.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Have students organize a debate team comparing stores that offer the following services versus stores that do not offer these services, keeping in mind that price may vary with these services. . delivery . mail or phone orders . parking . return privileges . nurseries . repair services . professional sales help Have students present a panel discussion on the importance of each of these buying incentives: . What is the cash value of the incentive? . Does the price differ from stores that do not have buying incentives? . Do these buying incentives limit your shopping to these places only, when you might find better buys elsewhere? . Do buying incentives motivate you to purchase items you do not need? The teacher may use these points as an outline for review. . Merchandise that meets your needs for quality and brand names . Services that could be time and/or money saving to your shopping, i.e., parking . Location that is convenient to you . Arrangement of merchandise in attractive displays, special sales offered, and types of sales people	Money Management, Your Shopping Dollar. pp. 17-19. (pamphlet) cf. bibliography

CONCEPT: Price comparison

DESIRED BEHAVIOR	MAIN IDEAS
Be aware that many factors influence price.	Comparative prices should be taken with a grain of salt unless all circumstances are considered.
	Some manufacturers may be guilty of phony pricing.
	Be aware of the bargains offered with the money-back guarantee angle which are those usually sent through the mail.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Discuss the following: Be suspicious of words such as— value worth manufacturers' list price not trustworthy since it is sometimes misleading regular price former price usual price trustworthy Collect newspaper advertisements to show the above examples. Have students compare prices of actual articles using the above examples. Have students discuss: . drastic price cuts . the avoidance of off-brand goods expecially when the list price has been dropped considerably . discount prices Discuss three common traits with regard to shopping by mail. . They could be of inferior quality. . Sometimes there is quality to the extent of just being legal. . Recognize the fine print in the guarantee. Have students bring in samples for bulletin board display entitling the display "The Sale by Mail Angle."	Kiplinger's Family Buying Guide. pp. 18-24. (book) Your Money's Worth in Shopping. (film) cf. bibliography

CONCEPT: Price comparison

DESIRED BEHAVIOR	MAIN IDEAS
same as before	Price varies by area. Price also varies with articles within any given store.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Discuss and give examples of the differences of quality demanded in the different areas as well as the difference of quality of products within one store. Have small groups of students take one store that might be located in several areas and bring back information to class for discussion and comparison. As a supplement to the above, have small groups of students price specific articles within a given store keeping in mind that quantity is a factor to be considered, i.e., whether to buy the large or small size in order to get the best buy.	Kiplinger's Family Buying Guide. pp. 18-24. (book) cf. bibliography

CONCEPT: Service of clerks

DESIRED BEHAVIOR	MAIN IDEAS
The salesclerk is one of the most important agents in the distribution of goods.	There are certain necessary services that consumers receive from salesclerks.
	The attitude of salesclerks often influences consumer purchases.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Discuss the necessity of the salesclerk-- . Salesclerks display goods for inspection. . Salesclerks give information about quality and price. . Salesclerks see that goods are wrapped. . Salesclerks can be an influence of purchase. Have students give classroom demonstration on how each of these points should be handled by the salesclerk. List on the chalkboard some of the reasons why each of these points may convince or not convince a consumer to buy. . reliance upon salesclerk by the consumer . high-pressure salesmanship . accuracy of information by salesclerk . nature of information divulged by salesclerk	The Consumer Buyer and the Market. pp. 379-386. (book) cf. bibliography

DECIDING WHEN TO BUY

GENERALIZATION: In deciding when to buy, the consumer should consider the best time to buy; the conditions in the community; the types of merchandise he is buying and the sales in the store where he shops.

CONCEPTS:

- the amount of time
- the conditions in the community
- the types of merchandise he is buying
- the sales in the stores where he shops

CONCEPT: Time

DESIRED BEHAVIOR	MAIN IDEAS
Show awareness of factors involved in timing buying.	Some people buy according to the season.
	Some people buy according to the hour of the day or the day of the week.
	Others time their buying over a period of years.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Invite reference person to speak on the busiest and slackest periods of the day, week, or year.	Consumer Protection. (film) Effective Shopping. p. 68. (pamphlet) Money Management. (pamphlet)
By means of class discussion find out what seems to be the best shopping times.	Kiplinger's Family Buying Guide. pp. 23-25. (book) The Consumer-Buyer and the Market. (book)
Have students bring in newspaper advertisements and make a bulletin board. Discuss whether or not these ads pertain to the season, the hour of the day or the day of the week, or over a period of years. Have students match these ads with the time.	cf. bibliography

CONCEPT: Conditions

DESIRED BEHAVIOR	MAIN IDEAS
Recognize the conditions influencing shopping habits.	Regardless of one's personal situation, a person will receive better service and selection if he will try to time his shopping to fit the store and community as well as his own behavior.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Discuss with students the following: . It is to your advantage to shop during slow traffic periods to avoid rush hours. . During these slack periods salespersons have more time to give you help, information, and services; therefore, you can make selection more carefully. . Rush hours vary in different communities. Traffic is usually heaviest during noon and late afternoon hours. . Weekly traffic is generally heaviest at the beginning and end of the week. . If it is possible for you to avoid these peak periods, shopping can be more satisfying. . If you find it necessary to shop during rush hours, you can cut down on confusion in stores by knowing exactly what you want and where to find it so that your decision can be accurate and speedy. . Night-time shopping is a trend in many communities. List the different types of consumers: working, housewife, etc. Have students find out what hours are best for these consumers to shop. List the different types of stores on the chalkboard and discuss the hours they are opened; list the convenience for shopping for each consumer: . downtown stores . shopping centers . discount houses . shops in outlying areas.	Effective Shopping, pp. 68-74. (pamphlet) Money Management—Your Shopping Dollar. pp. 22-25. (pamphlet) The Consumer-Buyer and the Market. (book) cf. bibliography

CONCEPT: Merchandise

DESIRED BEHAVIOR	MAIN IDEAS
The type of merchandise bought will often be a factor in deciding when to buy.	Season conscious shopping can help a person get good values for their money.
	Sometimes there are certain seasons which are best to buy certain goods.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Consider the seasons and discuss what seasons are best to buy certain merchandise. . clothing . food . furniture, etc. Refer to Chart No. 6. Have students make a chart of the seasons and what merchandise to buy in each season. Have students bring in newspaper ads on items being advertised; using the current season, compare these items with the shopping calendar listed in appendix. Discuss seasonal buying in relation to quantity and storage. Examples: (a) Fresh vegetables could be preserved, but this wouldn't be feasible if storage was limited. (b) Socks may be bought in quantity without creating storage problems.	Money Management—Your Shopping Dollar, p. 24. (pamphlet) Kiplinger's Family Guide, p. 23. (book) Effective Shopping, pp. 68-74. (pamphlet) How to Buy a Used Car. (film) cf. bibliography

CONCEPT: Sales

DESIRED BEHAVIOR	MAIN IDEAS
Be aware of a sale.	Stores have a habit of classifying sales according to whether they are one-day, spectaculars, private invitations, dollar-days, etc.
	Sales may also move you to buy foolishly; consider the advantage of knowing the original conditions of sale items.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Discuss the most common types of sales: . private . seasonal . special . anniversary . close-outs . one-day . penny . dollar-day	Money Management—Your Shopping Dollar. pp. 23-24. (pamphlet) Effective Shopping. p. 68. (pamphlet) The Better Business Story. (film) Consumer Protection. (film) Bulletin board of different types of advertisements pertaining to sales.
Discuss the following items: . Is it wise to compare prices to be sure of getting real reduction and bargains? . Should you check size, color, style, and condition of merchandise? . Try on items before buying - remember sale items are usually not returnable. . Price reduction may not be great enough to offset the cost of putting damaged items in useable condition. . Should you inspect seconds or irregulars? . Add expenses involved in shopping to sale prices; the cost of transportation; the cost of the babysitter as well as the value of your time and energy may offset cash savings and gain from sale shopping. . What is the disadvantage of stores not offering guarantees and services on sale merchandise? . The item may be a good buy if it is serviceable, but not if its flaws affect the useability of the article.	Newspaper advertisements on sales. cf. bibliography

CONCEPT: Sales

DESIRED BEHAVIOR	MAIN IDEAS
Same as before	Stores generally follow a time cycle in selling particular items at reduced prices. Refer to Chart No. 6.
	Sales may offer you an opportunity to buy items you want at reduced prices without sacrificing quality.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Become familiar with the months of the year and the items which can be bought during the different months on sale. Discuss advantages and disadvantages of using chart.	Newspapers Magazines Consumer Report. (magazine - monthly)
Collect newspaper advertisements showing weekly specials to show savings which come with planning to take care of special values. Those who monthly shop could not take advantage of the weekly specials.	Sense Makes Dollars, pp. 53-54. Denver Public Schools.
	Consumer Report, The Buying Guide Issue. (yearly)
Have students compare the "sale price" of a popular name brand appliance, at a store which continually has sales, with the price at a reputable store. Discuss the possible reasons why this can be done. Possible reasons may include lower overhead, difference in merchandise condition, not guaranteed by factory, used as a bait advertising, service repair. Divide the class into small groups; have each group draft a study outline regrading the problems of buying any one commodity in which they are interested. Check chart to see if this is the month to buy this particular item; if so, watch the newspapers for ads and bring them to class. If a buyer were to make a wise decision about this, what are important things he would need to know? From what sources could the information be obtained? Have students write a report.	cf. bibliography

DECIDING HOW TO USE ADVERTISING

GENERALIZATION: Advertising uses several media to present goods to the consumer; i.e., appeals, emotional buying, validity of brand names, trademarks and information; therefore, an understanding of these methods aids in more effective buying.

CONCEPTS:

- media of advertising
- appeals
- emotional buying
- information

CONCEPT: Media of advertising

DESIRED BEHAVIOR	MAIN IDEAS
Recognize different media of advertising.	There are various medias of advertising.
	Different media affect and influence consumer buying habits.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Bring advertisements from newspaper, radio, TV. Groups discuss number of people reached by different media and how their choices are affected by these media. Refer to business magazines on official data. Discuss door-to-door advertising as a media. How effective is this media? Discuss how telephone advertising affects the consumer. Is this an effective form of advertising?	The Consumer Interest - A Study In Consumer Economics. (book) Analysis of advertisements Class committee reports Better Business Bureau cf. bibliography

CONCEPT: Appeals

DESIRED BEHAVIOR	MAIN IDEAS
Become aware of emotional appeal involved in advertising. (psychological effects)	Advertising is "making known" to the consumer by: • showing how a product is desirable by making life simpler, happier, and easier • creating a want • explaining how one may gratify that want.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Have members of the class bring advertisements from newspapers, magazines, and handbills. Underline in blue parts of ad that give specific useful information (the parts that would aid you in comparison shopping). Mark in red the parts that serve to catch attention (parts which help sell goods and are pleasant to see but do not give any consumer help). If any statement in the ad is considered misleading or deceptive, indicate in third color. Organize a few select ads into an exhibit. Place side by side one or more of the most informative ads you can find. Conversely, one or more of the non-informative kind.	Effective Shopping. (pamphlet) Consumer Problems. pp. 117-118. (book) cf. bibliography

CONCEPT: Emotional buying

DESIRED BEHAVIOR	MAIN IDEAS
Realize difference between impulse buying and rational buying.	Advertising is often slanted toward emotional appeal rather than mental reasoning.
Show awareness of advertising gimmicks which influence purchasing.	Most advertising deals with popularity and social life. Advertising influences and deals with status and power.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Teacher leads discussion on the following: • Recognize "glittering generalities" in ads, adjectives that say nothing, i.e.,exquisite taste, colossal offer, very popular, current style. • Give examples of high pressure sales. • Note reactions to price by number, example: 4 for $1.00 suggests to buy 4 when perhaps there is no saving or when only one item is needed. • Analyze ads from newspapers and magazines that appeal to the consumer's emotions. • Arrange a bulletin board showing ads that use "glittering generalities."	The Consumer Interest - A Study in Consumer Economics. pp. 274-280. (book) cf. bibliography

CONCEPT: Information

DESIRED BEHAVIOR	MAIN IDEAS
Informative advertising benefits both the consumer and the advertiser.	Informative advertising gives pertinent and reliable information. Building confidence in a legitimate business and directing consumers away from shady operators is necessary to combat fraudulent practices.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Select advertisements and evaluate as to the amount of consumer information given and each advertisement considered. Analyze advertisement for factual and non-factual information. List data heard on radio or seen on TV commercials and analyze such data. Discuss the reliability of the informative ad: . company-run . integrity of manufacturer . Select labels and discuss as to "informative advertising." Analyze informative grade labels. What actual information do these give the consumer? Collect "trademarks" as found in ads. Evaluate how these protect the consumer. Analyze "seals" of some organizations who offer testing programs and recognize the meaning of the insignia. Refer to Chart No. 4. Question for thought or discussion: . Some people purchase goods according to known brand names rather than take a chance on unknown varieties. Is this reliable buying?	Kiplinger's Family Buying Guide, pp. 27-30. (book) The Consumer Interest - A Study In Consumer Economics, pp. 280-281. (book) cf. bibliography

CONSUMER BUYING

DECIDING HOW TO PAY

GENERALIZATION: In purchasing goods and services, a consumer may find it more advantageous to pay cash or to use some type of consumer credit such as service credit, charge account credit, installment credit, and personal loan credit.

CONCEPTS:

- pay cash
- consumer credit
- service credit
- charge account credit
- installment credit
- personal loan credit

CONCEPT: Pay cash

DESIRED BEHAVIOR	MAIN IDEAS
Understand the meaning of cash.	Cash or cash equivalents is an accepted medium of exchange which gives the power to buy now.
Recognize cash purchases.	Some form of cash is used for routine and repetitive everyday purchases. Cash may be used for major purchases if large amounts are available.
Show awareness of the source of cash.	Although there are many sources of cash, the receipt of cash for services rendered is the primary source.
Comprehend good business techniques in handling money.	It is wise to follow good business techniques in handling money when paying cash for goods and services.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
To illustrate the meaning of cash and cash equivalents bring to class and discuss some of the following: . currency and coins . certified check . personal check samples . cashiers check . money order samples	Personal Finance. p. 531. (book)
As an example, list the following items on the chalk board. Ask students to determine which items they may purchase for cash and why. Examples of everyday cash purchase: . movie ticket . rent or house payment . records . books . clothing . groceries Examples of major purchases: . automobile . motor scooter . home . ski equipment . hi-fi set . vacation	
To determine the source of cash, ask students where they get the money they spend. Some sources of cash are: . allowance . payment for work . savings bonds . gifts . life insurance . social security . inheritance . savings account	
Have role-playing activities to illustrate good business techniques in handling money when buying for cash: . Be sure that you receive the correct change. . Have enough money to pay for items you are going to buy. . Know how much money you have. . Keep receipts of payment for necessary adjustments, for tax purposes, and for a record of spending. . Avoid sending currency by mail.	Money Management, Your Shopping Dollar. p. 26. (pamphlet) cf. bibliography

CONCEPT: Pay cash

DESIRED BEHAVIOR	MAIN IDEAS
Recognize reasons for cash purchasing.	There are advantages in paying cash when purchasing goods and services.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Determine through discussion some of the reasons for paying cash for goods and services such as: . a feeling of independence . a greater selection of stores in which to buy . easier control of money . the opportunity to bargain for reduced prices . freer use of credit in an emergency . least expensive way to buy.	Money Management, Your Shopping Dollar. p. 26. (pamphlet) cf. bibliography

CONCEPT: Consumer credit

DESIRED BEHAVIOR	MAIN IDEAS
Understand the meaning of credit.	Credit permits an individual to obtain goods, services, or money which he may use now and pay for at a later date.
Recognize the value of establishing and maintaining a good credit rating and factors that make up a good credit rating.	Establishing and maintaining a good credit rating is a personal asset.
Comprehend the use of credit.	The function of credit is to provide convenience, to increase the standard of living, and to provide assistance in emergencies.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
To determine the meaning of credit, tell stories in which three facets of credit are used. For example , tell the story of: . the individual who purchases an article of clothing which he will wear now and pay for later (Charge account credit) . the individual who purchased an automobile which he will drive now and pay a certain amount of money each month for a period of time (Installment credit) . the individual who decides to accept another job with a company in another location and temporarily needs money to move his family (Personal loan credit).	
Use the examples above in discussing the value of establishing and maintaining a good credit rating. For instance, ask the students what would happen if the individual who purchased the automobile failed to make his monthly payment. Some factors which contribute to credit worthiness that may be emphasized in a discussion are: . character . capacity . collateral . capital . conditions . common sense.	How to Use Consumer Credit Wisely. pp. 11-12. (pamphlet)
Show the film, The Littlest Giant, to help illustrate that credit is earned and not given.	The Littlest Giant. (film)
Have students volunteer reports telling when his family has used credit. To help determine the function of credit, analyze the reports in relation to the following catagories: . convenience . increased standard of living . emergencies.	
	cf. bibliography

CONCEPT: Consumer credit

DESIRED BEHAVIOR	MAIN IDEAS
Show ability to recognize lending agencies and to understand the role of each in extending credit to the consumer.	Each of the various lending agencies performs a function in extending consumer credit.
Recognize factors which affect the cost of credit.	Establishments extending credit have to meet the expense of offering the service; therefore, a consumer using credit pays a portion of the expense.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Arrange field trips to some financial institutions, show films relating to financial institutions, and discuss other lending agencies to determine the function of each in extending credit to the consumer. . commercial banks . industrial banks . credit unions . pawnbrokers . loan sharks . consumer finance companies . savings and loan associations . retail establishments . insurance companies . personal sources	Personal Finance. pp. 17-47. (book) 'Til Debt Do Us Part. (film) How to Use Your Bank. (film)
Invite a guest speaker from the credit bureau to talk about the expenses incurred in extending credit such as: . investigation . bookkeeping . overhead . risk involved . collection of past-due accounts . credit losses . cost of money	How to Use Consumer Credit Wisely. (pamphlet)
	cf. bibliography

CONCEPT: Service credit

DESIRED BEHAVIOR	MAIN IDEAS
Understand the meaning of service credit.	Service credit is the extension of credit for services rendered to the consumer and paid for at the end of the month.
Recognize the use of service credit.	Service credit is used when services are consumed during a month and paid for at the end of the month.
Show awareness of the sources of service credit.	There are many establishments offering a variety of services that extend service credit.
Comprehend the basis for extend-service credit.	The past as well as the present performance of the consumer is important in the extension of service credit.
Develop an understanding of factors influencing the cost of service credit and how this expense is financed.	The charge for service credit is represented in the cost of the service and is paid by the consumer.
Understand how service credit affects the consumer.	The comfort and convenience of the consumer are greatly enhanced by the services obtained through credit.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
To develop the meaning of service credit, discuss, for example, what happens each time an individual flips a light switch, plays the radio or television, etc., and does not pay for the electricity until the end of the month. Have students volunteer examples of other services which are consumed during the month and paid for at the end of the month such as: . telephone . laundry and dry cleaning . meals in restaurants.	
Sort the above examples into the following categories: . utility companies . professional services . delivery services . credit card services.	How to Use Consumer Credit Wisely. pp. 20-21. (pamphlet)
Invite a guest speaker from a telephone company or credit card association to speak on the following topics, for example: . basis for extending service credit . how the service is obtained . what happens when there is a default in payment . who pays the expense incurred in extending the service. Select an establishment rendering a service such as the telephone company. Determine why there is a cost to rendering this service. Discuss who pays for this service. To help illustrate the affect of service credit, choose a company rendering a service and analyze the company as to: . why credit is extended . what would happen if credit was eliminated.	cf. bibliography

CONCEPT: Charge account credit

DESIRED BEHAVIOR	MAIN IDEAS
Understand the meaning of charge account credit.	Charge account credit is an arrangement between the consumer and a retail establishment which permits an individual to purchase goods to use now and pay for them at a later date.
Recognize the different types of charge account credit and understand the function of each.	The variety of charge account credit available enables the consumer to select one to meet his individual needs.
Recognize establishments that extend charge account credit and reasons for using this type of credit.	There are many retail establishments who extend charge account credit to the consumer. The consumer uses this type of credit to meet individual needs.
Demonstrate ability to recognize that credit costs may be represented in the price of goods or that it may be an extra charge, both of which the consumer pays.	The expense of charge account credit may be represented in the cost of goods purchased or in a service charge included in the transaction and the consumer pays this expense.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
To illustrate the meaning of charge account credit, give an example of a person walking into a local retail establishment, purchasing an item, signing a sales slip, and walking out with the item under his arm. Select students to visit retail establishments and report to the class the function of each of the following types of charge accounts: . open account . option charge account . revolving charge account . ninety-day charge account . teenage charge account. Choose other students to visit retail stores to observe people purchasing goods. Determine whether or not the consumer pays cash or charges the items purchased. Have student make a list of the articles that were purchased on charge account credit and analyze why the consumer may have charged those items. Some reasons for using this type of credit are: . cash is temporarily limited . establish credit . convenience . better service. Invite a guest speaker from a local retail store that extends different types of charge account credit to discuss: . the mechanics of opening a charge account . the age of the applicant . how credit applications are processed . what is expected of the applicant when his credit is accepted. Discuss the cost of extending charge account credit and who pays this expense.	Retail Credit Behind the Scenes. (film) cf. bibliography

CONCEPT: Charge account credit

DESIRED BEHAVIOR	MAIN IDEAS
Show ability to recognize factors affecting the wise use of charge account credit.	There are advantages and disadvantages in purchasing goods with charge account credit.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Determine through discussion and list on the chalkboard the advantages and disadvantages of charge account credit. Some advantages are: . enjoy merchandise before paying . unnecessary to carry large amounts of cash . convenient . returns and allowances are facilitated . may receive advance notice of special sales . take advantage of sales . statement provides a record of purchases. Some disadvantages are: . charge accounts may increase the cost of doing business . some consumers overbuy . careless buying is often the result of ease of return goods.	Personal Finance. (book) cf. bibliography

CONCEPT: Installment credit

DESIRED BEHAVIOR	MAIN IDEAS
Understand the meaning of installment credit.	Installment credit is an arrangement under which a consumer gets things now and promises to pay for them by making a series of partial payments.
Recognize installment purchases and when a consumer may use installment credit.	Installment credit is used to purchase durable goods of high-unit and long-lasting value--rather than by saving and paying cash.
Show awareness of the sources of installment credit.	The majority of installment credit is financed by sales finance companies, a minority is financed by commercial banks, and very little is financed by the seller of the goods.
Show an understanding of and an ability to compute the actual interest rate and dollar cost of installment credit.	Goods purchased on installment credit usually cost more than the cash price. A consumer should know the actual interest rate and dollar cost of installment credit.
Recognize factors which aid the consumer in decisions regarding installment credit.	A consumer should compare the cost of installment credit with the sources available, the services given in relation to the cost, and the possible benefits derived, to determine whether or not installment credit is worth its cost.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
To help determine the meaning of installment credit, give an example of an individual who buys a car and agrees to pay for the car in equal monthly payments for a period of three years.	Money Management, Your Shopping Dollar. p. 28. (pamphlet)
List on the chalkboard the following items. Ask students which of the articles might be purchased on the installment plan and why. . sweater . tennis racket . typewriter . sailboat . washing machine . lawn mower . home . sewing machine . radio	Using Consumer Credit. pp. 62-63. (pamphlet)
Discuss what actually happens when a consumer buys an automobile, for example, on installment credit. . The seller may furnish credit. . The seller extends credit and later sells the contract to a financial institution. . The consumer may obtain an installment loan from other lending agencies.	
Use the following problem to demonstrate how to compute the actual interest rate and the dollar cost of installment credit. Sam needs $150.00. The XYZ Finance Company is willing to lend $150.00 for six months with payments of $27.50.	Consumer Problems and Personal Finance. pp. 385-386. (book) (See sample problems.)
Discuss and list on the chalkboard the services available for the rate paid and the possible benefits derived. Some services are: . convenience in purchasing . usage of credit . repossession policies . insurance coverage, Some benefits are: . earlier enjoyment . reduction of expenses . raise standard of living . keep savings intact . meet emergencies.	Using Installment Credit. pp. 27-44. (pamphlet)
	cf. bibliography

CONCEPT: Personal loan credit

DESIRED BEHAVIOR	MAIN IDEAS
Understand the meaning of personal loan credit.	A cash sum, lent directly to an individual to help meet a personal expense often repaid on installment or demand, is personal loan credit.
Recognize situations when personal loan credit may be used.	Occasions arise where needs temporarily exceed income or savings and a personal loan may be necessary.
Recognize sources of personal loan credit.	Personal loan credit may be obtained from a variety of sources.
Demonstrate ability to understand and to compute the actual interest rate and dollar cost of personal loan credit.	The total cost of personal loan credit can be found by computing the actual interest rate and the dollar cost.
Show awareness of things to consider when shopping for a personal loan.	The reliability of the lender and the total cost of the loan are two important items to consider when a consumer shops for a loan.

LEARNING EXPERIENCES	REFERENCES AND TEACHING AIDS
Invite a guest speaker from a commercial bank or other lending institutions to explain personal installment and demand loans.	
State hypothetical cases when money is temporarily needed to meet the following situations to illustrate the use of personal loan credit. . unforeseen emergencies . consolidate and pay off past-due bills . moving expenses . household repairs . insurance . education . travel . taxes	Personal Finance. pp. 65-66. (book) (Good sample problems.)
Carry one of the cases a step further to show where a person may obtain a personal loan such as: . commercial banks . consumer finance companies . credit unions . insurance policies . pawnbrokers . loan sharks . personal sources.	Using Bank Credit. (film)
Use the following sample problem to show students how to find the dollar cost of a loan and the effective interest rate. Clark can borrow $200.00 from the local bank payable in 12 monthly payments of $19.00.	Using Consumer Credit. pp. 19-24. (pamphlet)
Give the students the following case: May has an expensive camera worth $150.00. She is out of a job and needs $100.00 desperately. In shopping for a loan what things should May consider? Some factors to consider are: . the reliability of the lender . the total cost of the loan . benefits received and services given in relation to the cost . capacity to pay.	cf. bibliography

APPENDIX

Charts

Suggested Test Questions

Bibliography

CENTRAL SHOPPING FACILITIES

Outlets	Descriptions
Retail Stores	DEPARTMENT -- chain or independent store merchandising a large variety of goods, divided into departments for purchasing, promoting and selling.
business establishments engaged in selling merchandise to consumers.	
CHAIN -- member of a group of stores with similar goods and policies.	SPECIALTY -- chain or independent store specializing in a limited type of merchandise, such as children's wear, shoes, clothing, books, furnishings or groceries.
True Chain -- owned and operated by one company.	
Voluntary Chain -- independent stores associated for common buying and promotional activities.	
INDEPENDENT -- operated by the owner.	VARIETY -- chain or independent store selling a variety of consumer goods usually in a low price range and with a high amount of self-service and open counter display.
	DISCOUNT -- chain or independent store selling some known lines of merchandise at consistently low prices.

ERIC
usehold Finance Corporation. "Money Management Your Shopping Dollar."

Advantages	Disadvantages
Many services are usually offered. One stop shopping is possible. A wide selection of goods is provided in every price range. Merchandise may be returned.	The size of the store and location of departments may make it difficult to find what you want. Department stores are often located in areas beyond your neighborhood.
There is greater variety within the area of specialty than in general stores. A wide range of prices is available in the specialty items. Salespersons are usually trained and their knowledge of the specialty results in good service and advice.	"One stop" shopping is not possible. Prices may be higher than in larger stores.
Merchandise is openly displayed. Self-service is speedy. The price range is low. Great variety is available.	Salespeople may not be well trained. Shopping traffic may be heavy. Few services are provided.
Parking is convenient. Self-service is speedy. Prices may be lower than other retailers. Stores are usually open for night shopping.	Usually little effort is made to display merchandise attractively. Service is limited. Return privileges are limited. Little or no home service on appliances or equipment is provided. Location may be inconvenient. There are usually few salespeople.

Chart No. 1

Outlets	Descriptions
Non-Store Retailers A business established to sell goods to consumers on non-store basis.	DIRECT DOOR TO DOOR -- selling in the consumer's home.
	MAIL ORDER -- selling through orders received and delivered by mail.
	VENDING MACHINES -- providing goods through a coin-operated machine on a self-service basis.
Cooperatives Associations created and jointly owned by their members, operated for their mutual benefit.	CONSUMERS' COOPERATIVES -- formed by private consumers to buy products and services jointly at favorable prices for selling to members.

Household Finance Corporation. "Money Management Your Shopping Dollar."

Advantages	Disadvantages
Shopping at home is convenient. Often the product is demonstrated for you. Offers the opportunity to see or use items in your home before purchasing them.	There is little opportunity for comparisons of products and price. Investigation of salesmen's qualifications is up to you. Salesmen may come at an inconvenient time. There is limited selection and price range.
Armchair shopping is convenient. Saves time and energy. Return privileges are offered. Prices are usually reasonable. Catalogue descriptions are usually accurate and helpful.	There is no opportunity to see and inspect merchandise before buying. You pay the cost of delivery. The time lapse between buying and delivery may be inconvenient.
It is quick and easy. It offers 24-hour service.	There is limited opportunity to inspect products. Machines are impersonal. No returns or services are possible.
Profit is divided among members. Prices compare with and are often lower than in retail stores.	The amount and variety of merchandise may be limited. There may be a lack of professional retailer know-how. Services may be limited. Location may be inconvenient.

Chart No. 1, cont.

RATES OF INTEREST CHARGED ON CONSUMERS' LOANS

Type of Institution	Common Charge (Percent)	Range of Charges (Percent)
Credit unions	12	6 to 12
Commercial banks	12	7 to 24
Industrial banks	15	12 to 24
Pawnbrokers	36	24 to 120
Remedial loan societies	18	9 to 36
Small loan companies (personal finance companies)	30	16 to 42
Unlicensed lenders	260	42 to 1,200

Donaldson, Elvin F. Personal Finance. New York: The Ronald Press Company, 1956, p. 58.

Chart No. 2

TRUE INTEREST RATES BASED ON ONE YEAR

HERE'S WHAT YOU PAY FOR CREDIT . . .

. . . If it is added to the purchase price and the total is repaid in 12 equal monthly payments:

When You Say	You Pay
4% per year:	7.3%
6% per year:	10.9%
8% per year:	14.5%
10% per year:	18.0%
1% per month:	21.5%

. . . If it is charged "only on the unpaid balance":

When You Say	You Pay
3/4 of 1% per month:	9%
5/6 of 1% per month:	10%
1% per month:	12%
1 1/4% per month:	15%
1 1/2% per month:	18%
2 1/2% per month:	30%

The Buying Guide Issue of Consumer Reports, New York: Consumers Union of U.S., Inc., 1963, p. 213.

TYPES OF QUALITY STANDARDS

Function	Example	Value to Consumer
Standard definitions define terms that describe the quantity, quality and performance of consumer goods.	Olive oil is "edible oil from the sound mature fruit of the olive tree." Silk is "the product of the cocoon of the silk worm."	helps consumers judge products and prevents misrepresentation.
Standard dimensions describe the size of consumer goods in terms of standard units of length.	Electric bulbs come in standard sizes to fit electrical sockets. Other examples are standard sizes for clothing, shoes, bedsteads, springs, mattresses, lumber and auto parts.	makes it possible to buy interchangeable products and parts and to be sure of sizes.
Standard specifications describe consumer goods in terms of standard definitions and units of measurement.	Sheets are described in terms of...length and width in inches...weight of a square yard in ounces...number of threads per inch...maximum percent of filling materials ...and maximum percent of shrinkage.	informs consumers about the quality, quantity and performance that can be expected from products.

ERIC

ley Management. "Your Shopping Dollar." Chicago: Household Finance Corporation, 1962.

Function	Example	Value to Consumer
Standards set requirements for test procedures.	Methods and equipment are standardized for testing flammability, resistance to wear, colorfastness and other textile qualities.	insures accurate testing and information on tested products.
Standards set requirements for safety in construction and operation of mechanical products.	The UL Seal of the Underwriters' Laboratories and the Canadian Standards Association Seal indicate that electric, automotive, gas and oil appliances meet certain safety requirements.	increases safe operation of appliances and provides a guide to consumers who want to buy appliances which have met the requirements.
Standards aid effective labeling.	American Standard L22 on labels of textiles means that the fabric meets performance requirements for its particular use.	insures consumers of accurate information on labels.

Chart No. 4

KINDS OF SEALS

The Seal	Where it is found	What it means
American Gas Association	on gas appliances, ranges, refrigerators, heaters, clothes dryers.	Products have been tested by AG. and are certified for conformit, to requirements of the American Standards Association, and are factory tested at least annuall, to insure continued conformity.
American Institute of Laundering	on labels attached to fabrics and ready made merchandise--clothing, bedding, draperies.	Products have passed AIL tests for shrinkage, color and sunfastness, fiber strength, resistance to perspiration, launderability of zippers, buttons and snaps and general appearance after laundering.
Canadian Standard Association	on electrical, gas or oil equipment and plumbing brass; on general products certified to show conformity with quality standards.	Products are certified by the manufacturers to conform to CSA Standards of safety and performance.

ey Management. "Your Shopping Dollar." Chicago: Household Finance Corporation, 1962.

The Seal	Where it is found	What it means
Underwriters' Laboratories, Inc.	on all appliances, equipment and materials which could possibly be fire or accident hazards or used to stop the spread of fire.	Products have passed original and periodical factory tests and examination in accordance with standards for safety.
United States Testing Company	on products continually tested and certified by the U.S. Testing Company.	Products have been tested and meet the requirements of the U.S. Testing Company and are qualified for materials, construction, use and performance as well as factory reinspected to insure continued quality.
CONSUMER MAGAZINES Parents Magazine Good Housekeeping Chatelaine McCalls	on any article or appliance tested and approved in the laboratories of one of these magazines.	Products have been tested and have met specific requirements set up by each magazine before receiving the *guaranteed, commended, investigated and approved, laboratory use-tested, or certified* seal. Refer to the magazine for an explanation of the policy and meaning behind statements made.

Chart No. 5

SHOPPING CALENDAR

JANUARY	FEBRUARY	MARCH
shoes, clothing, white goods--sheets, cases, blankets, towels--furs, small appliances and sports equipment, store-wide clearance, Christmas cards and decorations.	furniture, rugs, mattresses, china, glassware, housewares, curtains, women's coats and notions.	housewares, spring apparel, luggage.
APRIL	**MAY**	**JUNE**
women's dresses, millinery, men's and boys' clothing.	white goods, television, soaps and cleaning aids, lingerie, handbags.	women's dresses, television, refrigerators, fabrics, rug cleaning, lumber, storm windows and screens.
JULY	**AUGUST**	**SEPTEMBER**
shoes, clothing, hosiery, bathing suits, refrigerators, washing machines, toiletries, floor coverings, furniture, garden supplies, used cars.	furniture, tires, coats and furs, curtains, garden and lawn equipment, paint, hardware, cameras, camping equipment, white goods.	clothing, back-to-school specials, housewares, fabrics.
OCTOBER	**NOVEMBER**	**DECEMBER**
cars, coats and lingerie.	women's coats and dresses, blankets and fabrics.	toys and gift items after December 21, women's and girls' coats and men's and boys' winter suits and coats in late December.

Money Management. "Your Shopping Dollar." Chicago: Household Finance Corporation, 1962.

Chart No. 6

SUGGESTED SAMPLE TEST QUESTIONS

Evaluation is an essential part of teaching and learning. It not only is a process of determining the growth and development of the individual, but it also is a key factor in helping students gain concepts. A teacher's evaluation techniques and methods largely determine whether his students merely try to learn factual information or sincerely try to gain broad and deep understandings and concepts.

While facts and information must be presented and tested in any educational program, instruction should extend far beyond this level to include the acquiring of knowledge and understanding, the forming of concepts and attitudes, and the generation of a suitable "climate" for behavior change. Tests on each of these levels are discussed and illustrated below. The following sample test questions and other evaluation devices are correlated to the preceding subject areas of the unit.

FACTUAL LEVEL: Factual tests provide the teacher with signposts of student progress toward concept development. Here, objectively-scored test items are effective.

I. What to buy

True or False

__F__ It is wise to buy all of the current fads.
__F__ Impulse buying is the most intelligent method to make purchases.

II. Quality to buy

Completion

To be of value to the consumer, a label on a product should tell how it is made, how it will perform, how to use and care for it, what materials are used, name and address of the manufacturer.

II. Quality to buy (cont'd)

Name five agencies from which you may get protective service. Food and Drug Administration, Bureau of Standards, Post Office Department, Department of Public Health, Federal Meat Inspection Division.

III. Where to buy

Completion

Deciding where to buy depends upon the shopping facilities available, comparison of prices, personal preference, and the service of clerks.

IV. When to buy

Completion

The most common types of sales are: Private, Seasonal, Special, Anniversary, Close-out, One-day, Penny, Dollar-Day.

Discussion

List suggested articles which can be bought in each month taken from the shopping calendar. Discuss your answers.

V. How to use advertising

Completion with discussion

Four of the advertising media are newspaper, magazines, radio, and television. Give an example of how each type affects consumer practice in buying.

VI. How to pay

Completion

When a consumer purchases goods or services, he may pay for them with cash, or he may use some type of consumer credit, such as: service credit, charge account credit, installment credit, or personal loan credit.

KNOWLEDGE LEVEL: Objectively-scored test items may be useful in testing knowledge of factual relationships. Also, testing may involve the problem solving approach, in which students must perceive the proper relationships among numerous facts in order to arrive at appropriate solutions to problems.

I. What to buy

Problem solving

Mr. and Mrs. Jones, with a boy five years and a girl one year, want to buy a sofa for their living room. They have saved $185 for this purchase. They talked with salesmen in several stores and found a sofa in each store that appealed to them both in color and style.

Store A	Store B	Store C
Special: 5-piece set $189.50 including sofa, chair, coffee table, and lamp	Sofa $180 Stain and soil resistant No financing	Brocade sofa $250 Available on time payments

(other information should be listed)

Which of the following items should the Jones' consider as very important factors in their decision?

1. The brocade sofa will impress the Jones' neighbors and friends.
2. Store C is too expensive for them.
3. They can get a lot of furniture for their money at Store A.
4. Etc.

II. Quality to buy

Multiple choice

According to fabric performance, which of the following sports ensembles would be the best buy?

1. an inexpensive cotton knit labeled washable
2. a woven cotton check labeled Sanforized
3. a bold print cotton containing much sizing

True and false

__T__ The descriptive label is a guide to better buying.
__F__ An item with an unknown brand at a low price is usually a wise choice.
__F__ "Stamps of approval" are always the best shopping guide.

III. Where to buy

True and false

__F__ The best types of bargains can be found in articles in which prices have been drastically cut.

IV. When to buy

True and false

__T__ Some people buy according to the season, the hour of the day, or the day of the week, and others time their buying over a period of years.

Completion

List three conditions which you should consider when buying:

- community
- rush hours
- traffic
- type of store
- consumer
- and others

V. How to use advertising

Essay

How do trademarks, seals, and labels assist the consumer in making choices when buying? What is meant by "glittering generalities" in ads? How do these affect you when making a purchase?

VI. How to pay

Problem solving

Tom and May, newlyweds, are about to buy furniture for their apartment. They can make a substantial down payment, but in addition they need credit amounting to $360. They figure they can pay it in 12 months. The store where they plan to make their main purchases figures that the monthly payments will have to be $34. They consider the possibility of borrowing the money and paying cash. A small loan company in the neighborhood offers rates of 2 percent a month on the unpaid balance. A bank offers such loans at a rate of 6 percent per annum.

a. What is the dollar cost of interest charged by the bank? _____

Solution: I = Interest in dollars
R = Rate
P = Principal
T = Time

$I = P \times R \times T$

$I - 360 \times .06 \times 1 = \$21.60$

b. What is the dollar cost of the credit obtained from the loan company? _____

Solution: To calculate roughly, figure the use of the total sum of money for one-half the total time, or $360 x (6 months x .02) = $43.20. For a more accurate computation see Using Consumer Credit, p. 23.

c. What annual rate of interest is the store charging? _____

Solution: R = Rate of interest
C = Dollar cost of credit
M = No. of installment payments to pay off obligation
P = Principal or unpaid balance

$$R = \frac{24 \times C}{P \times (M+1)}$$

$$R = \frac{24 \times 48}{360 \times 13}$$

$$R = \frac{1152}{4680}$$

$$R = 25\%$$

d. Where should Tom and May obtain credit? bank

UNDERSTANDING LEVEL: In testing students' understandings, you may have them bring together certain factual relationships to explain or support points of view they have developed or you may have them respond to essay-type questions or oral tests. Test items should involve using significant elements or broad points of view to solve problems of immediate importance to students. Though objectively-scored tests have not often been used for testing understandings, a test like the following could be developed.

I. What to buy

Problem solving

Jean and Grace walked by Blacks Department Store on Saturday morning and discovered a store reduction sale of fur-blend sweaters. Grace wanted a bright pink sweater to wear with her plaid slacks and now she could get one for $10. She didn't have the money but thought she'd ask her Dad for a loan on her next few allowances to buy it.

Jean decided to get her sweater (marked "irregular" and no label attached) in the economy basement for $3.88 so she could get something else with the money she'd have left as she had saved $10. She needed a dark brown cardigan to replace the outgrown one that she wears with several skirts and dresses.

Do you agree with the decision made by: Grace _____ yes X no
Jean _____ yes X no

Explain your reasons for each answer.
State any assumptions you make.

Grace: Pink might not go with anything else in her wardrobe. In debt for a fad. Buy on impulse. A want. Should have gotten cheaper one or waited until had money.

Jean: A need for her and should make good purchase. Basic sweater should be of good quality. Not examined carefully. Information lacking.

II. Quality to buy

Matching

Match the columns by writing the correct letter from Column B in each blank in Column A.

	A	B
A	1. Article is expected to last a long time.	A. High quality
B	2. Durability is important.	B. Medium quality
C	3. Article has limited use.	C. Low quality
A	4. Fine details in construction.	

Discussion

Sue is shopping at the local dress shop and looks at the following hang tags. Which tag complies with the labeling law? Explain your answer.

A	B	C
Pique	Broadcloth	Rayon Taffeta
100% Cotton	60% Dacron	Preshrunk
Sanforized	40% Pima Cotton	Colorfast
Washable	Drip Dry	Dry Clean or Handwash
Dans Manufacturing Company	Handwashable	Spot Resistant
	Shrinkage 1%	Shores Manufacturing Company
	Colorfast	
	Crease Resistant	
	Mills Manufacturing Company	

III. Where to buy

Objectively-scored question

Mrs. Jones lives on a farm five miles from town A (pop. 800), seven miles from B, the county seat town (pop. 12,000), twenty miles from C (pop. 35,000), and one hundred miles from D (pop. 100,000). She has the following things to buy in the next two months: staple groceries, a living room rug, sturdy everyday shoes for herself, a washing machine, favors for a birthday party. Indicate the information which is correct by placing a (/) in front of the items. Indicate with a (-) the information which is incorrect.

_____ 1. A living room rug can best be bought in a retail department store in town A.
_____ 2. Sturdy everyday shoes can best be bought in town D in an exclusive shoe store.
_____ 3. Favors for a birthday party can best be bought in a variety store in town A.
_____ 4. Staple groceries can be bought in a supermarket in town B.
_____ 5. A washing machine can best be bought in an appliance store in town C.

IV. When to buy

Essay

Considering the different times to buy, (seasonally, weekly, monthly, hours, spring, fall) complete the following in essay form: To buy wisely one should plan their buying _____
_____.

V. How to use advertising

Essay

What would happen if all advertising stopped? How would this affect the consumer?

VI. How to pay

Discussion

Mr. Undecided needs $200 to pay off some past-due bills. He lives in a small town having only one commercial bank which is not interested in personal loans. He is told that the two local personal finance companies and the one industrial bank will probably lend the $200 that he needs. Mrs. Undecided has a diamond ring which originally cost $500. She suggested going to a pawnbroker to obtain the money by pawning the ring. Mr. Undecided belongs to a credit union and has used it to accumulate savings. Although he has never borrowed from the fund, he recently withdrew the amount of money he had accumulated. What principles of consumer credit should Mr. Undecided understand that will enable him to wisely choose a lending agency?

CONCEPT AND ATTITUDE LEVEL: One successful way of testing student concepts and attitudes is the inventory approach in which students respond to each question with "agree" or "disagree". These inventories are helpful as pre-tests, indicating areas of economics and business where instruction is most needed, and as post-tests, indicating the extent to which instruction has changed and improved the concepts and attitudes held. Teachers must guard against developing concepts in students and then merely testing their ability to memorize those concepts, for this would be no better than the rote-memorization-of-fact method which was used in the past.

Pre-test or Post-test idea: Below are several statements that involve planning your buying. Use the following letters to indicate how you feel about the statements.

SA - strongly agree
A - tend to agree
D - tend to disagree
SD - strongly disagree

I. What to buy

_____ If I decide that I want to save a certain amount of money each week from my allowance for summer camp, I will not waste so much of my money.
_____ If I have my own money to spend, I should be able to buy whatever I want and no one else should care.
_____ The only way to get what I want is to have a lot of money.
_____ I would be very happy if I just had more money.

II. Quality to buy

_____ A price tag on an item is a good indication of its true worth.
_____ Money-back guarantee articles are always good quality products.

III. Where to buy

_____ An individuals store preference may be based primarily on the giving of trading stamps.
_____ Experience in shopping gives insight to wise buying.
_____ The attitude of salesclerks often influences consumer purchases.

IV. When to buy

_____ Season-conscious shopping can help a person get good values for their money.

V. How to use advertising

_____ Advertising is a necessary commodity.
_____ Advertising raises the cost of goods and services.
_____ The increased price per article for advertising is not really an added cost but a tremendous reduction in cost.

VI. How to pay

_____ A business establishment that extends credit to the consumer may have to increase the price of the goods or services to cover the costs of extending credit.
_____ A consumer who purchases goods or services on credit pays for the use of credit.
_____ An individual may increase his standard of living by using consumer credit.

BEHAVOR CHANGE LEVEL: The ultimate test of successful teaching is behavior change. This test involves long-range evaluation and may be difficult to accomplish because many factors other than class instruction have an influence. For example, when a student sets up his own budget, is it because of what he learned in the classroom or because of something he saw and heard on television? Currently, numerous efforts are being made to measure behavioral change over various periods of time. Survey techniques are being used, and pencil and paper tests are being administered. However, control of all the factors affecting learning is almost impossible.

I. What to buy

Essay

Write a paragraph describing some unwise purchase you have made. Indicate what you should have done or could do in the future to make this purchase more satisfactory. USE IDEAS YOU'VE ACQUIRED IN OUR RECENT CLASS DISCUSSIONS.

II. Quality to buy

Essay

If cost of an item was of no concern to you, would you always buy the most expensive item? Explain your answer.

III. Where to buy

Role-Play

Divide the class into groups and have them show the right and wrong way to shop. Example:

A. Examination of merchandise
   - fresh fruits and vegetables
   - wearing apparel
   - books
   - etc.

B. Manners in check-out line
   - complete shopping before entering
   - wait your turn

C. Use the shopping care
   - observe safety rules in aisles
   - return cart to designated area

D. Return of merchandise
   - have sales receipt
   - article in its original condition
   - return article to proper location

IV. When to buy

Essay

Do you plan your buying on the basis of what you want from life, or do you buy impulsively or irrationally? Explain. What should you consider?

V. How to use advertising

Discussion

Provide an advertisement with much emotional appeal. During class discussion, teacher directs questions to discover how student might have reacted to such an advertisement previous to class study and how they react now.

VI. How to pay

Essay

Bob graduated from college last year. He has held three different jobs since that time, and at the moment is employed selling books door to door. He is three months behind in payments on his car, and owes $125 on his charge acccunt at a local men's shop. He is three weeks behind in rent on his room, and still owes a student loan he obtained in college. He is thinking of quitting his job, and wants to take a vacation to Florida. He feels the vacation will give him a better attitude and help him make a success of any new position he takes. He has no money to finance a vacation. What is your advice to Bob?

MY SHOPPING SCORE CARD

Date:								
(check)	Yes	No	Yes	No	Yes	No	Yes	No
Shopping at the Grocery Store								
Planned a market order.....								
Shopped by self.....								
Shopped with someone experienced.....								
Read labels on canned items before buying them.....								
Read lables on fresh fruits and vegetables before buying them.....								
Did not injure fruits and vegetables when handling them.....								
Was courteous to people in store.....								
Did not overspend..								
Shopping at other stores								
Planned before shopping.....								
Shopped by self.....								
Shopped with someone experienced.....								
Read labels on all items before buying them.....								
Was courteous to the sales people.....								
Avoided handling items more than necessary.....								
Hands were clean.....								
Considered the need, cost, quality, and use of item before purchasing.								

Shopping habits which need improvement:

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The Littlest Giant. National Consumer Finance Association, 1956, 14 minutes, sound, color, Loan: Modern Talking Picture Service. (User pays postage, seventh grade and up.)

'Til Debt Do Us Part. Credit Union National Association, 1958, 14½ minutes, sound, B & W Loan: Modern Talking Picture Service. (User pays postage, ninth grade and up.)

Using Bank Credit. American Bankers Association, sound, B & W Loan, 10 minutes. (Seventh grade and up)

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Your Money's Worth in Shopping. Household Finance Corporation, 20 minutes, color, free.

ERIC

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ABSTRACT - Developed in cooperation with the Ohio Trade and Industrial Education Service, this teaching guide prepared for improving teaching and evaluating techniques in trade and industrial education provides material to assist the instructor in the vocational education program. Contents include: (1) An Introduction to Trade and Industrial Teaching, (2) Planning Your Work as an Instructor, (3) The Teaching Steps, (4) Teaching and Working Relationships, (5) Planning for Your Teaching, (6) Planning for Your Classes in the Shop, (7) Planning for Your Classes in the Related Room, and (8) A Working Procedure Checklist. (GR)

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TRADE PREPARATORY TRAINING

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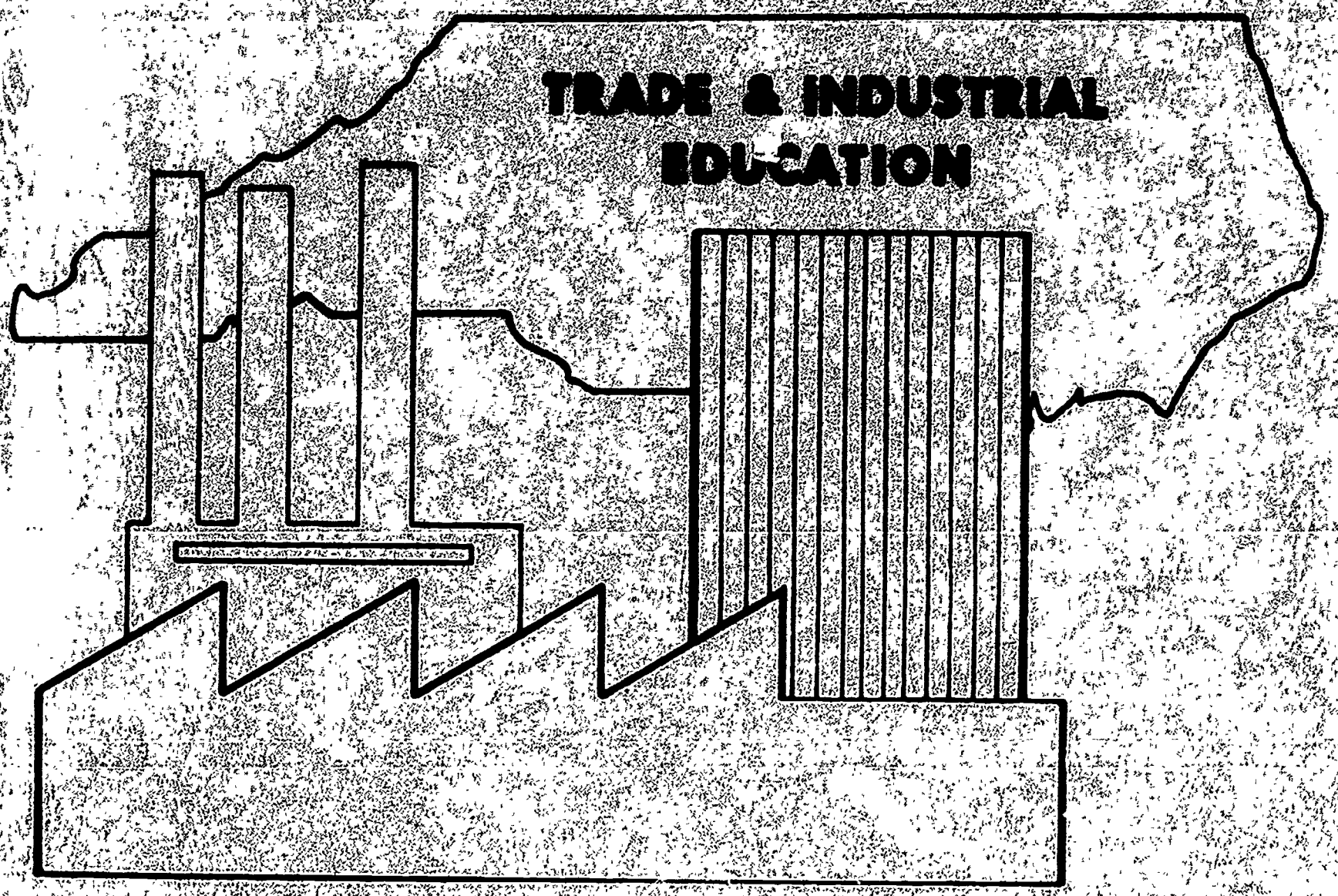

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HANDBOOK FOR TRADE AND INDUSTRIAL EDUCATION TEACHERS

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This handbook has been prepared with the idea of improving teaching and evaluation technique in Trade and Industrial Education. It provides material designed to assist the instructor in the vocational education program. This handbook is not intended to be an exhaustive treatment. It should be sufficiently comprehensive, however, to be really helpful to the vocational instructor during his early years of teaching.

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Charles D. Bates, State Supervisor
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AN INTRODUCTION TO TRADE AND INDUSTRIAL TEACHING

The Place and Purpose of Trade and Industrial Education in North Carolina's Vocational Education Program

Vocational Education and its desired outcomes: Vocational Education deals with the development of knowledge, skills, and attitudes that fit an individual, wholly or in part, for a definite occupation or vocation. The general objectives of vocational education are:

1. To contribute to the development and growth of the individual and, at the same time, to aid in the further development and growth of our society as a whole.

2. To promote person-group relationships with emphasis upon home and family life.

3. To make individuals and groups responsive to the needs of other individuals and groups, of communities, of governments, and of other desirable agencies.

4. To prepare prospective workers for proficiency in their respective fields.

Formal Divisions of Vocational Education:

1. Agricultural Education
2. Home Economics Education
3. Trade and Industrial Education
4. Distributive Education
5. Vocational Guidance

Trade and Industrial Education and Its Purposes: Trade and Industrial Education is formally concerned with education for any occupation which directly functions in the designing, producing, processing, assembling, maintaining, servicing or repairing of any manufactured product, and any public or other service trades or occupations which are not classified as agricultural, commercial, professional, or homemaking. This education is for pre-employment purposes.

The General Objective:

To fit the individual for effective employment in a trade or industrial occupation.

The Local School System

How is the local school system organized? - The local control of educational processes is an established procedure in our country. It is the obligation of the local community to determine the kind and amount of educational opportunities for the children of the area. In fairness, it must be pointed out that there are many factors which influence this decision. Conditions vary from one community to another.

The State Department of Public Instruction through the Division of Vocational Education serves the local school authorities in an advisory capacity. The department offers suggestions, makes recommendations, establishes standards, reports on existing conditions, and attempts in many ways to help improve the schools of the entire State.

The Board of Education - The local board of education is charged with the responsibility and authority of establishing and maintaining the educational program for the area. The board must have enough leeway to meet a variety of problems. It devotes its time and effort to long-term planning and policy formation for the schools.

The Superintendent of Schools - A professionally trained man is selected by the board to be the administrative head of the schools and is usually given the title of superintendent of schools. The superintendent is the executive head of the entire educational program for the community.

The High School Principal - The superintendent nominates and the Board elects a professionally prepared man to act as its representative in the administration of the high school. This man is know as the principal; he is responsible for the operation of the entire high school program:

The Director or Supervisor of Vocational Education - The administration of a vocational program requires specific preparing and experience. Accordingly, the superintendent may recommend the appointment of a director or supervisor to supervise the vocational program in the community. The local director or supervisor is the man who must operate the local program in conformance with the standards established by the State and policies of the local board of education. He is directly responsible for the supervision, direction, and development of vocational education in the local area. Wide experience in industry, a broad background in dealing with people, their plans and problems, are qualifications of the supervisor.

The Instructor of Trade and Industrial Education - The instructor must have a part in the supervision, direction, and development of vocational education. It is he who executes the plans and actually puts the theory of vocational education into practice. The instructor is the representative of vocational education who meets and works with the people of the community. A vocational program is as strong or as weak as individual instructors who make up that program.

Advisory Committees - In order to gear a vocational program to the needs of a community, the superintendent of schools, or his representative, appoints special committees composed of representatives of local employers and employees. The purpose of these groups or advisory committees is to represent the vocations in the area, and to advise the school on special problems.

The Program of Studies - The State Department of Public Instruction provides direction for the schools of North Carolina through the PROGRAM OF STUDIES, publication No. 381 of the Department of Public Instruction. This publication includes the total program of studies approved for grades 1 - 12 in the schools of the State. It further indicates courses by name, number, length in hours and credits recommended per course.

The local program of studies is a listing of all the subjects that are taught in a school. Usually these subjects are grouped together in a planned sequence to form a course of study leading toward pre-determined educational objectives. Almost all schools offer several courses of study which are designed to fit the needs of the various individuals who attend the school. The vocational program is only one area of the typical high school offering. It is possible that several distinct courses of study may be available <u>within</u> a particular vocational program.

It is essential that you have a clear understanding of the over-all picture of your school's total program and an appreciation of the place of the vocational program in relation to it.

CERTIFICATE REQUIREMENTS FOR TRADE AND INDUSTRIAL EDUCATION
TRADE PREPARATORY TRAINING - DAY TRADE TEACHERS

Requirements for Certificate	Period Valid	Renewal Requirements
Graduate Vocational (GV) - Master's degree and all requirements for Class A Vocational Certificate; three years of teaching experience.	5 years	6 semester hours of professional education credit, or 3 semester hours of professional education credit combined with 12 weeks work experience in their trade or an approved occupation.
Class A Vocational (VA) - College graduate and 12 semester hours' credit in professional courses in Industrial Education; and two or more years beyond the accepted learning period in the trade which the candidate prepares to teach, at least one year's experience within the past five years. Three years of trade experience shall be credited for engineering degree.	5 years	6 semester hours of professional Industrial Education credit, or 3 semester hours of professional Industrial Education credit combined with twelve weeks' work experience in their trade or approved occupation.
Provisional Class A Vocational (PAV) - College graduate; two or more years' experience beyond the accepted learning period in the trade which candidate proposes to teach; at least one year of the experience must have been within the past five years (presently employed trade teachers exempted from the recency clause); three years' trade experience shall be credited for an engineering degree.	1 year at a time	2 semester hours' credit in professional vocational Industrial Education annually. The certificate may not be renewed more than four times.
Provisional Vocational (PV) - High school graduate; two or more years beyond the accepted learning period in the trade which the candidate proposes to teach; at least one year of the experience must have been within the past five years. (Presently employed trade teachers exempted from the recency clause.)	1 year	Renewable for one year on completion of 2 semester hours credit in professional vocational Industrial Education and one year's teaching experience. One year certificates may not be renewed more than four times. May be converted into a five year certificate on 2 years of teaching experience and 12 semester hours of credit in professional vocational Industrial Education. The five year certificate renewed on 6 semester hours of professional Industrial Education, or 3 semester hours of professional Industrial Education combined with 12 weeks of work experience in their trade or an approved occupation.

Shop and Classroom Management

Good Housekeeping - When you walk into your shop or classroom for the first time, you may find it orderly, neat and clean, with all supplies and tools in their proper place, and with all the equipment in good repair. Then again, you may find the opposite condition. You will save yourself much time and trouble by straightening things out at the beginning and introducing a system that will keep them straight. The following are a few suggestions to aid you in putting the shop or classroom in smooth running order:

Storing Materials:

Advantages:

1. Protects from damage
2. Keeps shop orderly
3. Makes for convenience in use

Suggestions:

1. Keep everything in sight.
2. A special place should be provided for each tool.
3. Use racks, wall panels, shelves, and cabinets.
4. Provide space for unfinished work of students.
5. Have a place for everything, and keep everything in place.
6. Shop appearance is important.
7. Observe safety requirements in storing inflamable or dangerous material.

Maintenance of Equipment:

Responsibilities:

1. For the condition of all tools and machines
2. For accounting for all tools and machines

Suggestions:

1. Keep the shop clean by coordinating efforts of janitor, students, and instructor.
2. Use a checklist for routine checking and oiling of equipment.
3. Set up a tool accounting system - the requisition slip is recommended.
4. Basic tools may be assigned to a machine or work station. Panel mounting is recommended.
5. Tools and equipment are to be used, but not abused.

Inventory

One of the first duties of a new teacher is to take stock of all the material and equipment for which he is to be held responsible. An inventory made at the time you take charge will serve to acquaint you with your working equipment and its condition as well as providing a protection against possible future claims of lost or damaged materials.

Almost all schools will be able to put into the hands of a new instructor, an inventory of some kind. Whether it is new or badly out of date, it will serve as a guide in preparing one of your own In any event, it would be poor policy to accept without careful personal checking, any inventory for your shop or classroom.

The form for recording an inventory is not of great importance. However, certain kinds of information should be collected for an inventory to be of much value. If possible, an inventory should cover the following points:

1. Name of article and description
2. Quantity on hand
3. State of repair
4. Location in room
5. Name of manufacturer
6. Catalog number of item

For purpose of classification, it is common practice to divide school materials into two general groups: Supplies and Equipment. A supply may be any material which is used up in the instructional process and would include such items as: paper, stock, tool bits, welding rod, chemicals, etc. Equipment is considered to be any material which has a useful period of several years and include such items as: hand tools, machine tools, models, furniture, movie projectors, etc.

It is suggested that the new instructor secure immediately the latest inventory of the supplies and equipment for which he is to be responsible. If the school has a regular system already in operation, it will be wise to go along with it.

Ordering

School supplies, whether furnished by the school board or purchased by the students, are an item of considerable expense. The instructor should always keep this in mind. This does not preclude the use of any material that is essential to the instruction, but unnecessary frills should be avoided.

It is probably safe to say that no two school systems handle the problem of school supplies in the same manner. Some schools furnish their teachers and students with the supplies that they use. Others furnish almost nothing and require the student to purchase his own working materials. The trend is definitely toward the school purchasing and furnishing material that is essential for instructional purposes.

Of the supplies furnished by the board of education, there are two types: those which are stocked in quantity by the school and issued to individual teachers on request, and those which must be purchased by the school board through the Department of Purchase and Contract on the request of the individual teacher. Requests for purchases should be kept within an established annual budget for each program.

A written record of school purchases is essential in order to avoid the misuse or loss of school funds. Almost all schools have established forms to be used in ordering supplies. A new teacher should inquire immediately into the exact procedure to be followed in securing all kinds of supplies.

In the Shop	In the Classroom
Stock	Reference books
Small tools	Paper
Replacement parts	Models
Trade publications	Magazines

When ordering any material, certain basic information is always essential. The more completely you describe an article, the less chance there is on misunderstanding and delay. In order to insure the smooth operation of your program, it is imperative that the following information be furnished when ordering supplies:

Date of Order	Catalog Number of Item
Name and address of supplier	Title and page number of catalog
Quantity required	List price
Name of article and description	

Almost all schools prefer to place their orders in groups and at specific times during the year. It is essential that you discover the purchasing periods and policies of the school in which you work, if you want prompt action on your requests.

Safety

Safety instruction is one of the important parts of the teacher's job. It is an ever-present consideration and cannot be separated from the regular procedure of instruction. Safety cannot be taught in one or two easy lessons and then forgotten. Safety should be a part of an individual's way of living and working. It must penetrate into his thinking and working habits. To develop safety consciousness and safe working habits among a group, you must constantly emphasize safe practices in both shop and classwork.

Safety instruction should distinguish the dangers inherent in machines, materials, and processes as well as the human elements such as carelessness, ignorance, and physical and mental fatigue as they affect the individual in school, on the street, and in the home.

Responsibilities:

1. Illustrating through your own work a model of safety consciousness.
2. Acquainting the student with the established safety rules of the trade.
3. Insisting on the observation of shop safety precautions.

Suggestions:

1. You cannot over-emphasize the importance of safety rules and practices.
2. Use safety posters on your bulletin board. Unless changed frequently, they quickly lose their effectiveness.
3. Build and use written tests that will check on a student's understanding of safe practices.
4. Secure and use the many excellent printed safety materials available in your trade.
5. Remember that safety is mainly an attitude or frame of mind.

Attendance Reports

Attendance reports are written records of the individual student's attendance in your shop or classroom. They are required of every teacher as they serve as the basis for the payment of funds to the local school board.

You should have some system for recording the attendance, tardiness and absence of any individual in your class for every day or fraction thereof. There are many ways that this may be done. However, it is not the method but the information that is important. From such a record it is an easy matter to prepare any type of attendance report that may be requested.

Daily Attendance

Almost all high schools ask their teachers to submit daily a list of the names of students who are absent from their classes.

Monthly Attendance Figures

At the end of each month, a tabulation showing the number of absences and average attendance for the class group will be requested.

Annual Report

Each year the state office requires that every Trade and Industrial Education teacher submit a report on the students in his charge. Among other things, this report requires figures on attendance. A copy of this report should be kept in your file.

Become familiar with the attendance forms used in your school, and devise a system for recording the student's attendance which will make the necessary information easily accessible.

Progress Charts

In a vocational program, it is neither possible nor desirable to keep a whole class working together on the same job. There are many reasons why this is true. The shop equipment always very definitely limits the number of students who can perform a given operation at one time. The work stations are designed to provide learning experiences in the variety of skills that make up the particular trade. Usually more equipment is provided for the common operations than for the specialized ones. It is apparent then, that a schedule must be arranged and followed if all the students are to have an opportunity to use the items of limited equipment.

A group of students will be assigned to your shop for your instruction in the skills of your vocation. They will be as different as they are numerous. No two of them will be alike. The interest, desire, and ability that is found in one will be found in varying degrees in others. Some students learn rapidly and perform tasks quickly; others will learn slowly and require long periods of time to perform simple jobs. Individual students vary in all kinds of ways. The need for a planned procedure to meet this problem of individual differences should be obvious.

The work that comes to any vocational shop is varied in nature and irregular in arrival. This is desirable, but poses some perplexing problems in the division of the work. A very real danger exists that the pressure of outside jobs may overshadow the basic purpose of the program which is training. Thus it is necessary to know at all times the kind and amount of instruction that each student has had.

The progress chart is a device which is designed to assist the instructor in meeting the above problems. It is a very simple arrangement that portrays graphically the progress of each individual student in relation to the class as well as to the total experience he is expected to have in a particular school period. It is highly desirable that as a beginning instructor you devise and use a progress chart that will meet the requirements of your shop.

A Marking System

The idea of measuring an individual's accomplishment against a standard is as old as man. In all ages, men have compared their skills and abilities with those of their fellows. Schools have traditionally followed this custom in making records of a student's work and in reporting the student's progress to the parents. As an instructor, you will be expected to judge the work of your group and evaluate each student in terms of the standard marking procedure now in use in your particular school.

School marks are subjective even under the best system. In order to aid you in making your marking as objective as possible, a rating scale is provided for both manipulative and related work.

The following chart provides a key for transposing marks from the point system used in the attached rating scales to the other common forms of marking such as: (a) percentage; (b) letters; (c) word description.

Points	0	1	2	3	4
Percentage	Below 70	70-76	77-84	85-92	93-100
Letters	E	D	C	B	A
Word Description	Not Satisfactory	Below Average	Average	Above Average	Outstanding

RATING SCALE FOR MANIPULATIVE WORK

POINT SYSTEM	0	1	2	3	4
1 - Quantity of work - Speed	Always behind time on requirements	Sometimes meets time requirements	At least meets time requirements	Usually more than meets time requirements	Always more than meets time requirements
2 - Quality of work - Accuracy and precision	Always below quality requirements	Sometimes below quality requirements	At least meets quality requirements	Usually better than quality requirements	Always better than quality requirements
3 - Use and care of proper tools	Continually misplaces and breaks tools	Occasionally spoils a tool	Generally careful with tools	Always careful with tools and sometimes repairs,& replaces tool	Repairs, replaces and resharpens tools
4 - Use and care of proper materials and supplies	Wasteful of materials and supplies	Occasionally wasteful of materials	Generally careful with materials	Always careful with materials and supplies	Conserves materials and gets others to do the same
5 - Problem solving Ability to analyze Have systematic attack	Solves no problems No planning	Solves only an occasional easy problem	Solves those problems in which he is interested. Fair planning	Solves nearly all problems without help. Works systematically	Solves all problems. Planning excellent
6 - Safe work habits and procedures.	Dangerous worker Chance taker	Sometimes careless May take chances	Usually careful. Seldom takes chances	Careful worker. Takes few chances	Always careful. Protects others. Takes no chances.
7 - Extent to which person is well-liked by others and obtains cooperation	Cannot adapt himself to other workers, is not courteous, does not attract people	Adapts himself to other workers poorly, lacking in cooperation tact and courtesy	Adapts himself to others well, displays ordinary amount of cooperation, tact and courtesy	Adapts himself to others with ease. Successful in dealing with others	Is dynamic person. exceptionally successful in dealing with people, attracts others
8 - Degree to which worker controls his feelings and emotions	Unduly disturbed at times, shows strong feelings and emotions frequently, unwilling to accept blame	Becomes disturbed easily, great excitement, displays extremes of fear, anger and inferiority	Becomes disturbed less readily, fairly even-tempered, usually avoids extremes of feelings and emotions	Even-tempered, does not become unduly excited or disturbed, good control of feelings	Exceptionally good control of feelings and emotions, very even tempered even under trying circumstances

RATING SCALE FOR TRADE TECHNOLOGY

POINT SYSTEM	0	1	2	3	4
1. Preparation	Fails to prepare	Seldom prepares	Usually prepared Sometimes needs reminding	Always prepared and seldom needs urging	Always well prepared without warning
2. Outside preparation	Fails to turn in outside work consistently	Seldom completes outside work	Completes outside work most of the time	Always does outside assignments	Always turns in high grade outside assignments and does thorough work
3. Participation in class discussion	No participation	Seldom participates	Participates when called upon	Responds readily and gives worthwhile responses	Volunteers contributions. Intelligent, thoughtful participation
4. Industry - Application to class assignment	Wastes his time and bothers others	Wastes time and is lazy	Works without too much prodding and with supervision	Works with little supervision. Is a consistent worker	Always industrious, completes his work and asks for more
5. Method of attack on an assignment Has a system	No system	Little logic in attack	Usually a fair plan of attack	Usually has methodical and well planned attack	Analytical, logical plan
6. Organization of contributions and results	Disorganized, slipshod work	Poorly organized work	Some planning and organization	Usually well organized	Always well organized and effectively presented

PLANNING YOUR WORK AS AN INSTRUCTOR

Importance of Planning

One of the most common beliefs in regard to teaching is that anyone who is skilled in a particular operation can readily impart his knowledge and technique to others. However, understanding the job is just one part of teaching. Equally important is understanding the way in which people learn. Almost all new instructors are very anxious to aid the learner in every possible way. In an attempt to be of utmost assistance to the learner, an enthusiastic new instructor may do everything for the beginner. The rude awakening comes when the instructor discovers how very little the learner has gained from such a procedure. Long ago, effective instructors discovered that a teacher cannot teach a student anything; the student must learn for himself. Teaching thus becomes helping others to learn.

Teaching is an old and fascinating art, particularly for the individual who enjoys working intimately with people. A teacher's work must be evaluated in terms of the changes that he induces in the student. Frequently, some of these changes are difficult or impossible to measure as part of them involve reactions which both the student and teacher may fail to recognize or appreciate at that time. Fortunately, there are many other changes which an instructor can measure with considerable accuracy, and toward which he should plan and direct his every effort.

In a vocational program, these measurable changes are a part of the knowledge, skills and attitudes that fit the student, wholly or in part, for a definite vocation. The immediate problem that confronts the new instructor is to plan his activity toward the end that the learner will be actively engaged in a series of essential learning experiences.

Summary of the importance of Planning:

1. Insures covering the essential skills.
2. Permits scheduling of work in time units and in proper sequence.
3. Established definite goals for both teacher and pupil.
4. Provides a job for every student at all times.
5. Avoids unnecessary repetition.
6. Helps avoid problems of group discipline.

The Steps In Planning

It is highly probable that you have already started to plan your work as an instructor. Possibly, you have given considerable thought to your intended procedure without reducing anything to written form. Mental planning is the first step, but not the end of the line in planning for teaching. Your first day in the shop or laboratory will establish beyond the shadow of a doubt that written plans are essential in guiding the efforts of a group of students. A beginning instructor generally finds it necessary to make his plans in considerable detail. Later, as he acquires confidence and skill in teaching, the amount of written planning may be safely reduced.

The question of what to teach in a vocational program is fairly simple. The course of study should include instruction in the skills, knowledge, and attitudes of your vocation. For many years, previous instructors in your field have been analyzing your trade and have built up a catalog of the items which they agree are to be taught. With few exceptions, it will be possible to furnish each one of you an analysis of the trade you are to teach. It is intended to aid you in your planning and may be modified as your experience dictates. The trade analysis is the stockpile of what you are to teach.

Before the vocational instruction is completed, it is expected that the learner will master all or almost all of the items in the trade analysis. In almost all trades, from two to four years of instruction are necessary to accomplish this. It becomes desirable then, to divide the content of the course into sections for teaching purposes. This is usually done by grouping material of similar nature together. The next step involves the setting up of a desirable sequence in which the material may be introduced to the learners. The order in which items are taught is important because almost all of us learn more rapidly when we begin with an easy problem and then proceed to a more complex one.

Finally, it considered good practice to establish a time schedule for the entire course showing the amount of time to be devoted to any one phase of the work. Such procedure will assist in preventing the new instructor from giving too much time and attention to a particular area and neglecting others of equal importance.

From the overall planning described, it is necessary to provide a definite procedure for each day's work. The sucess of your teaching experience depends largely on how effectively you meet each day's needs as they arise. Accordingly, the daily plan for teaching is most important. There is no substitue for knowing in advance exactly what you intend to do and precisely what you expect of the student.

Summary - Steps in Planning

1. Select the course content
   a. Skills and knowledge required in the trade.

2. Divide the content into teaching units.
   a. Grouping of similar items for teaching purposes.

3. Establish the order in which units are to be taught.
   a. What should be taught first, second, and so on?

4. Set up a time schedule for the course.
   a. Number of days to be given to each unit.

5. Decide on a procedure for each day in advance.
   a. Exactly what the instructor will do.
   b. Exactly what the student will do.

6. Keep a daily record of work done in class.
   a. Instructor knows at all times what has been done and what remains to be done.

7. Plan your work; then work your plan.

THE TEACHING STEPS

From the analysis of your trade, it is possible to select the skills, knowledge, and attitudes that must be taught. In the preceding unit, a procedure for organizing, and arranging and subdividing this reservoir of teaching material was discussed. Having decided on what is to be taught and when it should be taught, you must then decide on how a lesson should be taught.

It is generally true that there is more than one good method of doing a job, Teaching is not an exception to this rule. There are many different procedures that have been used in teaching. The beginning instructor will be wise to try to master one tried and proven method of teaching before he becomes concerned with other suggestions.

Vocational teachers have for many years been using a pattern around which any lesson may be outlined and taught. This pattern is made up of the following four steps.

Step One — Preparation

The instructor assembles all materials, supplies, and equipment for the lesson. Then he must gain the attention of the student and arouse his interest in the lesson.

Step Two — Presentation

The instructor demonstrates and explains exactly what is to be learned.

Step Three — Application

The student performs, individually, the operations to be learned with the aid and assistance of the instructor.

Step Four — Testing

The student performs the operations by himself and is checked for efficiency and skill by the instructor.

A beginning instructor will find it desirable to plan each lesson around these four steps, and to follow them closely as he teaches the lesson. For the present, you will probably be very conscious of the form of the lesson, but with practice the steps will become second nature. It is essential that instruction in the shop be as informal as possible. Accordingly, the skillful instructor synchronizes these steps into a unified whole. The four steps will now be discussed more fully.

Preparation

Any demonstration to be interesting and effective must be smooth and run off like clock work. To accomplish this the instructor must have everything in readiness before he begins. Usually, it is desirable to run through the demonstration to be certain that it will click when the time comes. The demonstration should always be made with the same type of material and tools that the student will be expected to use. If possible, devise an instructional aid that will assist the student to more clearly understand the new aid. The instructor should make provision for the materials needed by the students, and clearly formulate in his mind, the standard of work that will be acceptable from the learner.

The preparation of the lesson is only half completed when the instructor is all ready. The next step is to prepare the student to receive the lesson. There are many ways of doing this, but basically the procedure is the same. It is first necessary to secure the attention of the student and arouse his curiosity and interest in the lesson. Once this is accomplished it will be relatively simple to connect the new lesson with the student's previous experiences. If the instructor has properly performed the preparation of the student, the time will quickly come when the student will ask for additional information. This is the mark of success in step one.

Presentation

The demonstration is now performed and explained. The methods and teaching aids used will depend on the lesson, and on the previous experience of the student group. The successful instructor usually goes through the lesson step by step, taking as much time as seems to be desirable. He may pause at various spots to point out details that might escape the attention of the learner or to indicate the common errors. The instructor should ask questions that will encourage the student to think about the job. He should emphasize the safety factors and explain the why of the established procedure for the job. Throughout the demonstration, the student should be encouraged to ask questions.

A common mistake is to try to do too much at one time. The presentation step should not be too long. It would be more desirable to have two shorter demonstrations than one long drawn out one. The chief concern of the instructor is to show the learner how to do the job and to do it safely and efficiently. When the instructor feels that the student understands the lesson and is ready and anxious to try to do the operation alone, step two has accomplished its purpose.

Application

This is the try-out step. The student is now ready to attempt the job by himself under the supervision and encouragement of the instructor. Everything that the instructor has done up to this time was intended to help bring the student to the place where he can strike out for himself. However, his first efforts are likely to be rough and clumsy and frequently wrong. The student should clearly understand that the instructor is anxious to help him overcome his difficulties in this stage. Equally important, the student and instructor should realize that the student will overcome his difficulties only when he knows how the operation is to be done and then is given the opportunity to do it. In many cases, it will be desirable for the instructor to repeat his demonstration, or some part of it, in order to clear up a point or two. It may be necessary for the learner to repeat the steps of the lesson several times before he acquires the desired skill. When the learner is able to perform the task efficiently and safely, step three has been successfully completed.

Testing

The only real proof of a good job of teaching is found in the ability of the student to perform the operation efficiently and safely on his own. Accordingly, in the testing step the learner is required to do his best without any assistance. The instructor is thus able to determine exactly the nature of the student's difficulties, if any. Also the learner may satisfy himself that he is really capable of carrying on without help. Thus, a test when used in this way assists both the instructor and student, and indicates whether or not the learner is ready to proceed further.

TEACHING AND WORKING RELATIONSHIPS

The Instructor

> A teacher affects eternity;
> He can never tell where his influence stops.
> -- Henry Adams

The new instructor should give some careful consideration to this quotation because it serves to focus his attention on the fact that he will influence his students in many ways in addition to his teaching. An instructor is an example, counselor, and friend to the students who attend his classes. This means that the instructor should always conduct himself as a gentleman and a scholar.

Some of the personal characteristics of an instructor which contribute to effective teaching are:

1. Appearance
   a. Be neat and clean.
   b. Clothes should be appropriate for the type of work to be done.
   c. Stand and walk erect.
   d. Act in a confident manner.

2. Speech
   a. Speak distinctly and clearly.
   b. Be concise and exact in your language.
   c. Cultivate a pleasing tone of voice.
   d. Slang expressions should not be encouraged.
   e. Profanity has no place in the school.

3. Attitude
   a. <u>Your</u> attitude determines the attitude of the class.
   b. Be pleasant and good natured, but firm.
   c. Expect only the best from everyone.
   d. Act as if accustomed to leading a group.
   e. Remember that familiarity breeds contempt.
   f. Be cooperative and expect cooperation.

The Student

As an instructor in a vocational high school program, you will be working with an entirely different kind of person than you have become accustomed to in industry. The obvious difference is in age, but there are many more fundamental differences.

Let us consider the youth who will attend your classes. In general, they will be between 16 and 18 years of age. They will come from every kind of home and will bring many of their home problems with them. Some will have a high degree of intelligence, others will not. Many will be friendly and easily approached, others will be cold and difficult to learn to know. Some will be eager to learn, others will go to extremes to avoid learning. In short, each one of them will be an individual and should be considered one.

What does all of this imply for the instructor?

That he should try to become familiar with the home conditions of each of his students.
That he should remember that all of a student's previous experience effect his actions.
That every student will progress at his own rate of learning.
That some students are not in school of their own free choice.
That each student is different from any other one.

Youth is a very interesting period of life, and it will be an advantage to an instructor to refresh his mind periodically on the real concerns of the average adolescent. Generally considered, these problems are:

1. Problems growing out of the body itself:
   How it works - how it looks, the fact that growth is out of proportion - personal appearance is very important.

2. New contacts with age mates of both sexes:
   Group conformity is almost demanded - acceptance by the group is most important to the individual.

3. Achieving independence from parents.
   Feels capable of handling himself - does not seem to want affection or advice, age becomes very important.

4. Acquiring confidence in relative values:
   Desire to have self-confidence - desire to demonstrate personal bravery - concern about meaning of life.

5. Achieving adult status:
   Wants to demonstrate that he has grown up - stays out late, smokes, etc.
   Desire to earn his own way - ability to get a job is evidence of success.
   Shows evidence of emotional instability, tendency to flightiness, and lack of dependability.

Student Conduct and the Learning Situation

In the shop or classroom you are confronted with the conflicting desires of the individual and the welfare of the group. Your decisions in matters of discipline will have to take into account the problems of the individual and the effects of the disciplinary action on the morale of the group. In addition, your decisions in matters of discipline will be more effective if you can succeed in recognizing whether your objective is to influence immediate surface behavior or to influence basic attitudes.

Discipline does not exist by itself. It is always connected with a goal. Goals for which discipline is required vary. Accordingly, conduct that is acceptable in one situation may be completely unacceptable in a different situation.

Securing satisfactory student conduct is a constant and ever changing problem. There is no series of ten easy lessons by which the new instructor may acquire the essential skills for securing the kind of discipline that is conducive to learning. Nevertheless, the new instructor may anticipate that he will develop his capacity for handling groups of adolescents if he will work with diligence toward that end. As a guide to your thinking, let us consider the following suggestions:

1. Attention of the learner must be secured.
   a. Work stations of students
   b. Instructor's teaching location
   c. Room conditions

2. The learner must have something specific to do.
   a. Be ready to start with a positive program of work the very first day.
   b. Plan a daily procedure.

3. Discuss student conduct with the group the first day.
   a. General regulations of the school
   b. The need for order in the shop
   c. Avoid making hard and fast rules or threats.

4. Students have always tried out a new teacher.
   a. Demonstrate clearly that you intend to be the leader.
   b. Meet the small tests the first day quickly and fairly.
   c. Many an instructor loses control of group during the first week.
   d. All students will try to bluff a new instructor.

5. Respect, confidence and cooperation of the group are essential.
   a. Be honest, fair, and firm - treat all alike.
   b. Build toward high group morale.
   c. Stay with student in trouble.
   d. Develop and keep a sense of humor.

Professional Growth

As a new instructor, you are probably experiencing all of the usual uneasiness that ordinarily accompanies the first contacts with a new job. You are also gradually becoming aware of the fact that teaching is a skill or trade in itself. Nevertheless, since you have undertaken the task you would like to become as good an instructor as is possible.

This handbook is intended to help you make the jump from the day to day work of your trade to the day to day work of the instructor. Perhaps you are wondering what else you may do to increase your effectiveness. Here are a few suggestions:

1. Improvement Courses:

   The teacher-trainer devotes part of his time to conducting teacher improvement courses. They are designed to assist you in becoming an effective vocational instructor. These courses are offered in the various locations during the school year with the time and place designed to fit your convenience. In addition, a regular summer school program is conducted each year at the State College of the University of North Carolina. You will be informed of the time, place, and type of work to be offered. It is hoped that you will enroll for course work according to your personal and certificate needs.

2. Teacher Contacts:

   As in any new job, you are of necessity in contact with a different group of people. As a beginning instructor, you will be working with a group that may be of great assistance to you in your new trade. As a group, classroom teachers are very friendly and cooperative. Like almost all professional people, they are proud of their work and loyal to their experience and training.

   As a tradesman you can easily appreciate the reverse situation - that a man who has been a teacher for many years and who is suddenly brought into your trade and placed on an equal footing with the established tradesman. If you will keep this comparison in mind as you begin your contacts with the teachers as individuals or as a group, you will make a much easier adjustment on the job.

   The problem of getting acquainted with a group is, of course, a very personal one. In any group, there will be certain individuals with whom you will find mutual interests. Although you may profit directly from the suggestions and assitance that other instructors can give you, it is well to remember that unless you enjoy the contacts and associations of any job you will not be satisfied with it. Accordingly, it is suggested that you go out of your way to become acquainted with people in your new profession. This should include the instructors in your area. Learn to know the people with whom you work. If you would make a friend, be one.

3. Trade Contacts:

   The begining Trade and Industrial Education instructor is usually well acquainted with many of the individuals in his trade. These contacts with the trade are most important and every effort should be made to

keep them functioning. For the part-time instructor, this presents no problem. But for a full-time instructor, the temptation to let your trade associations gradually die out is a very real thing. Unless the instructor is fully aware of the importance of keeping in close touch with his trade, the pressure of other affairs may in time break all of his former ties. Thus, it is highly desirable that the vocational instructor make a definite effort to maintain and improve his individual associations.

4. North Carolina Vocational Association:

The beginning vocational instructor should become familiar with the purposes and services of the NCVA Association. As an aid in his professional growth, it is recommended that he consider the advantages of becoming a member.

One of the main objectives of the Association is to assume and maintain active state leadership in the promotion of vocational education. There are many agencies that help to promote vocational education. The efforts of all should be directed toward the common goal. The Vocational Association in North Carolina assumes this responsibility.

The North Carolina Vocational Association is affiliated with the American Vocational Association which is the national organization. All of the state vocational associations, and many other groups, are actively working with the American Vocational Association.

Services Performed by the A.V.A.:

a. Professional leadership through research and publications, and the establishment of standards of service.

b. Economic security by insuring that adequate funds are available for the continuance of the program.

c. Information and inspiration through its conventions, publications and the field service of its officers.

d. Prestige for vocational education through the leadership exercised by the organization and the contact it maintains with various national agencies.

e. Opportunities to participate in committee activities for investigating problems and developing programs and methods which make for more effective service.

f. The dissemination of information regarding economic trends which are significant to vocational education.

g. The sponsoring of essential legislation and the exercise of its influence against movements which are inimical to the interests of vocational education.

PLANNING FOR YOUR TEACHING

In planning for your first days of teaching, it will be well to keep in mind the essential information you must have in order to satisfy the requirements set up for all teachers in the general school organization. Your principal or trade and industrial education supervisor can give you the information, which might include such items as:

	Your notes or comments
1. The exact time school opens and closes.	_____
2. The official length of the teacher's work day.	_____
3. Keys to be charged to you.	_____
4. Type of dress to be worn:	
a. Instructor's shop coat	_____
b. Special uniform for teachers	_____
c. Work clothes (for shop teachers)	_____
5. Method of reporting student absences	_____
6. Handling minor student misdemeanors	_____
7. Disposing of serious disciplinary problems	_____
8. Honoring requests for the loan of tools	_____
9. Date and method of paying salaries	_____
10. Vacations and holidays	_____
11. Method of grading students	_____
12. Length of grading period	_____
13. Lunch room periods and procedures	_____

Other points: (write in)

14. _____	_____
15. _____	_____
16. _____	_____

In addition there is certain information that has to be ascertained daily before taking up active teaching duties. The following chart may serve as a reminder of some of these activities until you become thoroughly familiar with them. Check them off for one week and add items not mentioned.

Preliminary Daily School Activities	CHECK					Remarks or Notations
	M	Tu	W	Th	F	
1. Did you sign the register?						
2. Have you checked your mail box for mail or announcements?						
3. Did you check the bulletin board?						
4. Any special announcement to be made?						
5. Is there an assembly today?						
6. Faculty meeting after school?						
7. Students to be excused for legitimate reasons?						
8. Assignment to assist with extra-curricular activities?						
9. Home contacts to be made?						
10. Assignment to special committee work?						
Others: Write in.						
11. _____						
12. _____						
13. _____						
14. _____						
15. _____						

PLANNING FOR YOUR CLASSES

In the Shop

It is imperative for an instructor to open his shop in a business-like manner. First impressions are lasting. The student will cooperate with and respect skill and efficiency on the part of the instructor. He is also quick to notice, and take advantage of, weaknesses such as lack of planning or organization.

As an aid in planning for your first week of teaching, the following outline is proposed. The suggestions for the shop instructor are intended to focus his attention on some of the things that should be covered in the opening days of the school term. The list is by no means inclusive. Each instructor should prepare a schedule of the shop activities to fit his particular needs and should feel free to ask his teacher-educator for assistance.

It will be noted that certain items under "Suggested Procedure: are identical and occur daily. They are identified by means of an asterisk which will indicate to you that details involving those particular procedures will not need to be repeated in your daily planning.

SUGGESTED PROCEDURE	INSTRUCTOR'S PLAN
The First Day	
Beginning and Advanced Groups 1. * The instructor should be in his shop well in advance of the time set for admitting students.	
2. * As the learners enter the shop, assemble them in a suitable spot preparatory to the opening of the class period.	
3. * Avoid opportunities for disorder through careful organization and supervision of details. Permit no wandering about.	
4. Secure the attention of the entire group by rising from your chair and writing your last name on the blackboard. Write plainly and use initials only for first and middle names. Explain how you and other faculty members are to be addressed.	

SUGGESTED PROCEDURE	INSTRUCTOR' PLAN
5. * Check attendance. Repeat names and verify pronunciation. Assign each student to a seat or work station.	
6. Make any special announcements.	
7. Give the class a brief summary of the background of your experiences to show them that you have "been around" and know your trade.	
8. Discuss your proposed shop program: Opportunities for employment in the trade Vocations that are based on an understanding of your trade The student completing the course is an advanced learner, not a craftsman Plan of the year's work in general terms Explain the organization of the shop Outline the factors to be considered in marking a student's work Explain the procedure for securing materials and tools	
9. Explain shop rules and regulations Behavior required in the shop Procedure for starting work, for stopping work, and for clean-up Dangers which may arise from carelessness and horseplay	

SUGGESTED PROCEDURE	INSTRUCTOR'S PLAN
Safety required in the shop General safety precautions that apply at all times Appropriate clothing to be worn First aid procedure Accident report forms Fire extinguishing equipment	
10. Conduct group on tour of the shop Stock or tool room Equipment Exits Washrooms Lockers Anything of interest in the room	
11. Summary and Question period	
12. Dismissal procedure * Check attendance by calling roll * Do not permit congregating around the door - supervise this closely * Dismiss group upon signal	
13. After School Look over your plans for the second day of school Make any changes that now seem advisable	

SUGGESTED PROCEDURE	INSTRUCTOR'S PLAN
The Second Day	
Beginners 1. * The instructor should be in his shop well in advance of the time set for admitting students	
2. * Avoid opportunities for disorder through careful organization and supervision of details	
3. * As learners enter the shop, assemble them in a suitable spot preparatory to the opening of class.	
4. * Secure the attention of the entire class.	
5. * Check attendance Repeat names and attempt to associate an individual with his name Use a pupil station chart if possible	
6. * Make any special announcements	
7. Demonstrate and explain how machines and equipment are to be closed.	
8. Appoint a tool room attendant to issue cleaning materials	
9. Supervise the process of issuing the cleaning materials.	
10. Assign learners to the machines and equipment which are to be cleaned. Divide the work among the group. Do not assign too many students to a small area.	

SUGGESTED PROCEDURE	INSTRUCTOR'S PLAN
11. Supervise and inspect the cleaning	
12. As individuals or small groups complete their assignments, get them started to work on elementary jobs.	
13. When the cleaning is completed, assemble group and discuss the lubrication of machines. Demonstrate and explain how to recognize points requiring lubrication	
14. Supervise the issuing of lubricating materials.	
15. Have students lubricate machines	
16. Supervise and inspect lubrication.	
17. As other individuals or small groups complete their assignments get them started to work on elementary jobs.	
18. Give signal for clean-up. Ten to fifteen minutes is usually sufficient.	
19. Dismissal procedure * Check attendance by calling roll * Do not permit congregating around the door - supervise this closely * Dismiss group upon signal	

SUGGESTED PROCEDURE	INSTRUCTOR'S PLAN
The Second Day	
Advanced Group 1. * The instructor should be in his shop well in advance of the time set for admitting students.	
2. * Avoid opportunities for disorder through careful organization and supervision of details.	
3. * As the learners enter the shop, assemble them in a suitable spot preparatory to the opening of class.	
4. * Secure the attention of the entire class	
5. * Check attendance Repeat names and attempt to associate an individual with his name Use a pupil station chart if possible	
6. * Make any special announcements	
7. Discuss with each student the details of his previous training Keep a record of this as a training guide	
8. Run machines and check efficiency	
9. Make a note of needed repairs	

SUGGESTED PROCEDURE	INSTRUCTOR'S PLAN
10. As individuals or small groups complete their assignments, get them started to work on suitable jobs	
11. Dismissal procedure * Check attendance by calling roll * Do not permit congregating around the door - supervise this closely * Dismiss group upon signal	
12. After school Look over your plans for the third day of school Make any changes that now seem advisable Review any demonstrations that you intend to present the next day Check on the readiness of all necessary materials	

SUGGESTED PROCEDURE	INSTRUCTOR'S PLAN
The Third Day	
Beginners 1. * The instructor should be in his shop well in advance of the time set for admitting students	
2. * Avoid opportunities for disorder through careful organization and supervision of details	
3. * As the learners enter the shop assemble them in a suitable spot preparatory to the opening of class	
4. * Secure the attention of the entire class	
5. * Check attendance Repeat names and attempt to associate an individual with his name Use a pupil station chart if possible	
6. * Make any special announcements	
7. Students with previous assignments continue their work	
8. Assemble the remainder of the group and present the demonstrations previously planned	
9. Assign learners to perform operations which have just been demonstrated Use operation sheets if available	

SUGGESTED PROCEDURE	INSTRUCTOR'S PLAN
10. Supervise work of learners Correct performances of such learners as may require it Provide such additional information as may be necessary Insist upon safe practices and techniques	
11. At the proper time, give the signal for clean-up	
12. Dismissal procedure * Check attendance by calling roll * Do not permit congregating around the door - supervise this closely * Dismiss group upon signal	

SUGGESTED PROCEDURE	INSTRUCTOR'S PLAN
The Third Day	
Advanced Group 1. * The instructor should be in his shop well in advance of the time set for admitting students	
2. * Avoid opportunities for disorder through careful organization and supervision of details	
3. * As the learners enter the shop, assemble them in a suitable spot preparatory to the opening of class	
4. * Secure the attention of the entire class	
5. * Check attendance Repeat names and attempt to associate the individual with his name Use a pupil station chart if possible	
6. * Make any special announcements	
7. Assign students to jobs in keeping with their recorded training record Use job sheets if available	
8. Supervise work of advanced group, correcting technique and giving such additional aid as may be necessary Insist upon safe practices	
9. As individuals complete their assignments, give demonstrations and	

SUGGESTED PROCEDURE	INSTRUCTOR'S PLAN
instructions that will permit the individual to progress as rapidly as possible	
10. At proper time give signal for clean-up	
11. Dismissal procedure * Check attendance by calling roll * Do not permit congregating around the door - supervise this closely * Dismiss group upon signal	
12. After school Look over your plans for the fourth day of school. Make any changes that now seem advisable Review any demonstrations that you intend to present the next day Check on the readiness of all necessary materials Work with the related instructor; make every effort to coordinate the shop and related work	

PLANNING FOR YOUR CLASSES

In the Related Room

It is imperative for an instructor to begin his related instruction in a business-like manner. First impressions are lasting. The student will cooperate and respect skill and efficiency on the part of the instructor. As an aid in planning for your first week of teaching, the following outline is proposed. The suggestions for the related instructor appearing below are intended to focus his attention on some of the things that should be covered in the opening days of the school term. The list is by no means inclusive. Each instructor will want to prepare a schedule of class activities with instructional units to be covered, to fit his particular needs.

SUGGESTED PROCEDURE	INSTRUCTOR'S PLAN
This material has not been arranged by days because of the varying conditions under which it will be taught. Beginning and Advanced Groups 1. The instructor should be in his laboratory or classroom well in advance of the time set for admitting students.	
2. Supervise the group entering the room. Get them seated immediately.	
3. Avoid opportunities for disorder through careful organization and supervision of details	
4. Secure the attention of the entire class	
5. Introduce yourself to the group. Place your name on the blackboard. Make clear the name of the course.	
6. Check attendance Repeat names and verify pronunciation Make a tentative seating assignment	

SUGGESTED PROCEDURE	INSTRUCTOR'S PLAN
Explain the rules relating to the time of starting, dismissal, etc.	
7. Make any special announcements	
8. Discuss your proposed class program Outline the relationship of the related work to the shop experience Point out the advantages of learning the related material with the manipulative Plan of the year's work in general terms Outline the factors to be included in marking a student's work	
9. Discuss and explain the following items: Work assignments in the related room Procedure to be followed when leaving room during class period Procedure for handling and issuing textbooks, reference books, magazines, and pamphlets Procedure for purchasing books Handling drawing equipment, or other special materials Safety in the classroom Care of washroom facilities	
10. Point out items of interest or curiosity in the room	
11. Evaluate the previous experience of the group	

SUGGESTED PROCEDURE	INSTRUCTOR'S PLAN
Give a review test covering the skills, operations, and information on which the related instruction will be based	
12. Analyze test results List basic skills, operations, and information when there is evidence that these are not adequately understood	
13. Plan instruction around test results Re-teach those elements in which there is evidence of weakness	
14. Present new lessons covering your planned work units	
15. After school Work with the shop instructor in outlining what and when new units are to be taught Look over your plans for the next day of school Make any changes that now seem advisable	

PLANNING FOR YOUR CLASSES

Getting Acquainted With Your Shop Or Laboratory

	Date Checked By Teacher	Date Discussed with Teacher-Trainer	Comments
1. Do you have a copy of your daily teaching schedule?			
2. Do you understand the time schedule of the building including the bell system used in the changing of classes?			
3. Have you secured and tried all necessary keys?			
4. Have you established a method of identifying keys?			
5. Do you have a list of the names of the students to be enrolled in your classes?			
6. Do you have the necessary forms, schedules and instructions for the homeroom group assigned to you?			
7. Are you in possession of a supply of all the school forms that you are expected to use such as: attendance forms, excuse slips, admit slips, accident reports, etc.?			
8. Have you made a list of the supplies that may be furnished to the student by the school?			
9. What fees does the student pay and how are they collected?			
10. Do you have the location, number, and condition of the lockers to be used by your students?			
11. What type and number of books will be available for use as reference materials?			
12. What type and number of textbooks will be available for use in your classes?			

	Date Checked By Teacher	Date Discussed With Teacher-Trainer	Comments
13. Do you have a plan to record the number of each book that is issued to a particular student?			
14. Do you know the number of hours you are officially employed each day?			
15. Do you know the conditions under which you are permitted to leave the school building or school grounds?			
16. Have you discovered the school policy of how you and other faculty members are to be addressed?			
17. Have you secured and examined a copy of your school calendar?			
18. Are you making an effort to become acquainted with the people with whom you will work?			
19. Are you familiar with the teacher training requirements?			
20. Have you located and checked the first aid supplies in your shop?			
21. How and where are you to obtain first aid supplies?			
22. Have you inquired about the emergency procedure in case of a serious accident to a student?			
23. Have you established a procedure to be followed in case of an accident?			
24. Where is the fire extinguisher equipment in your shop or adjacent area?			
25. Have you checked with the custodian to discover if the fire equipment is ready for use?			
26. What is the procedure for a fire drill?			

	Date Checked By Teacher	Date Discussed with Teacher-Trainer	Comments
27. Are all lights in working order?			
28. Have you located and checked all of the electrical circuits?			
29. Have you a supply of electrical fuses?			
30. Are the tools in safe and useable condition?			
31. What is your plan for enforcement of safety?			
32. Is the shop clean and in good order?			
33. Is the supply and storage room clean and neat?			
34. Is the tool room in good condition?			
35. Who is responsible for the washroom or washing facilities--you or the janitor?			
36. Have you prepared a clean-up system or routine for your shop?			
37. Do you have sufficient chairs in your related room?			
38. Have you organized a plan for the entrance and departure of the students?			
39. Have you checked on the material, stock, small tools, etc., that are available for use?			
40. Have you made an inventory of all exposed supplies and equipment?			
41. Are you familiar with your equipment, including such items as location, types, sizes, range or work, and safety factors?			
42. Is your procedure for issuing tools and equipment ready to place in operation?			

	Date Checked By Teacher	Date Discussed with Teacher-Trainer	Comments
43. What policy is in effect with respect to loaning tools to students, faculty members and outside persons?			
44. Do you have tentative plans to use <u>all</u> of the equipment?			
45. Have you at least one week's work planned in advance in writing?			
46. Have you prepared a work schedule showing the station assignments of each student?			
47. Have you formulated a set of standards to judge the work done in your shop?			
48. Have you thought of providing for individual differences?			
49. Have you planned for the delegation of authority--such as student foreman?			
50. Do you have a bulletin board?			
51. How do you plan on using it?			
52. Have you checked on visual aids materials and equipment available in your school?			
53. What is the method used to distribute visual aids equipment?			

WORKING PROCEDURE CHECKSHEET

HAVE THESE ITEMS BEEN EXPLAINED	YES NO	DISCUSSED WITH TEACHER-TRAINER
1. Working hours		
2. Rate of pay - pay days - salary schedule		
3. Smoking on or about the school premises		
4. Faculty room		
5. Lunch period - cafeteria policy		
6. Accident reports		
7. Nurse on duty - hours - office		
8. Use of school telephone		
9. Secretarial services available to an instructor		
10. Club sponsorship		
11. Procedure to follow in dealing with a student who "gets out of hand"		
12. Audiovisual services		
13. Assembly seating, policy, procedure		
14. Assignments to faculty committees		
15. Marking system in use		
16. Homeroom functions		
17. The person to whom to go for information and assistance		
18. Procedure to follow in reporting sickness or absence		
19. Procedure to follow when necessary to leave classroom		
20. Departmental organization and functions		

	YES NO	DISCUSSED WITH TEACHER-TRAINER
21. School supplies - chalk, pencils, paper, etc.		
22. Procedure to follow in purchasing emergency supplies		
23. Have you met every member of your school staff? (including administrators, teachers, secretaries, and custodians)		
24. Have you operated all the tools and machines in your shop?		
25. Can you demonstrate their operation to students confidently and efficiently?		
26. In-service teacher training		
27. Certification requirements		

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ABSTRACT - Developed by an associate professor of animal science in collaboration with curriculum laboratory personnel, this 20-hour course outline will serve as a guide in developing and teaching introductory adult courses in livestock feeds and feeding. Contents include suggestions for teachers, course objectives, a suggested course arrangement, and course outlines which cover the basic fundamentals of animal nutrition and include: (1) the digestive system, (2) classes and functions of nutrients, (3) feed analyses and digestibility, (4) nutrient distribution in feedstuffs and classification of feedstuffs, (5) types of nutrients, (6) additives, (7) feed processing and standards and balancing rations, and (8) feeding swine, beef cattle, dairy cattle, and poultry. References, resource materials, a topic planning form, and a student survey are appended. (AW)

VT 002 841

ED0 45856

A Guide For Course Planning

Livestock Feeds and Feeding

20 Hours

Adult Farmer Education

in

Vocational Agriculture

U.S. DEPARTMENT OF HEALTH, EDUCATION
& WELFARE
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Prepared by
Curriculum Laboratory
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State Board of Education
Raleigh, North Carolina

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PREFACE

This course outline is designed to be used as a guide in developing and teaching a course in Livestock Feeds and Feeding. Such a course should prove valuable to students, farmers, and feed merchants who produce livestock or handle livestock feeds.

The outline is designed to develop some understandings in basic fundamentals of animal nutrition. Many of the prospective students will have had little or no formal instruction in biological sciences. This course then might be considered a foundation course.

The last four chapters cover problems in feeding specific classes of livestock. This arrangement lends itself to adaptation to local areas and needs.

As agricultural research progresses, new knowledge in animal nutrition will emerge. This course should help the student to understand and apply more efficiently the findings of research in order to do a most profitable job of feeding.

Content of this outline was developed by Dr. Milton B. Wise, Associate Professor, Animal Science, North Carolina State, in collaboration with W. W. McClure, Curriculum Laboratory, Department of Community Colleges.

A. J. Bevacqua, Coordinator
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SUGGESTIONS TO TEACHERS

- This outline is presented to serve as a guide in developing and teaching an introductory course in animal nutrition. Many adult farmers and small feed dealers did not have the opportunity to study biological sciences and nutrition in high school. Even if they had these opportunities earlier, the science of nutrition has evolved so rapidly that their art and "know how" of feeding may be considerably altered in the face of new research and practices in feeding livestock.

- A course in animal nutrition should be regarded as a fundamental or foundation course in livestock production, upon which later experiences and learning may be built. Subsequent learnings in feeds and feeding should come easier and be more meaningful to one who has participated in this course.

- Before or during the first class session an attempt should be made to gain some information on education and experience of each prospective or actual enrollee. An instrument similar to the one included in the Appendix may be used for this purpose. Participants should be assured that the information they give as individuals will be held in confidence, but collectively the information will benefit both the instructor and the class.

- Attention should be given to objectives of the course during the first class session. One secret of a successful adult course is to have definite objectives and to drive toward them consistently. Involving class members in establishing objectives will lend purpose to the course.

- The course may vary in both time allocation and content to fit local needs, however, the first eight sections should be covered if basic understandings in animal nutrition are to be achieved. Special emphasis may be placed upon Sections 9 through 12, depending upon local needs. These latter sections may be treated as applied feeds and feeding for the type of livestock chosen.

- Most of the participants in this course will have had practical experience in feeding some type of livestock or in handling feeds. Thus, by using their experience as a basis, lead them to understand the "whys" in animal nutrition. They will learn principles and will develop concepts which will form a foundation for continued learning and intelligent application.

- Morrison's Feeds and Feeding is the most important reference for this course. The other titles will supplement this main reference. Bulletins in quantity for class members may be available through the County Extension Chairman. Several good bulletins and teaching aids are available from commercial sources. A good list of commercial sources, Free and Inexpensive Teaching Aids for Teachers of Agriculture, may be obtained from Interstate Printers and Publishers, Danville, Illinois for $1.00.

- This course may be made very interesting with adequate use of good visual aids. Drawings of digestive systems may be found in books, bulletins, and charts. These may be reproduced on chalkboard with colored chalk, on wrapping or chart paper with crayon, or on transparencies for overhead projection with acetate ink. Some prepared charts are available from commercial sources.

  Tables of feed analyses should be available to each class member. These may be reproduced locally, or may be found in References 23 and 24 which may be obtained in quantity for class use.

- Obtain a number of different feed tags for inspection and study by class members. These may be obtained from feed manufacturers or from actual feeds bought by class members.

  Other actual specimens for class study might be samples of good and poor hay, good and poor silage and various other feed stuffs. Most attention might be given to those feeds that are most frequently used locally.

- Efforts should be made early in preplanning for effective use of teaching resources. This will involve determining what resources are needed to do the job, identifying what is available already in the department, and procuring or otherwise making plans to use other resources. There may be special persons in the feed business, or in livestock feeding, available to help with certain portions of the course.

- This course should lend itself well to effective use of community resources. There can be effective supervised practice and follow-up since one of the objectives of the course should be to utilize the learnings attained in a more efficient job of feeding.

- Use the special form, "Resource Materials for Teaching Farmer Courses," as found in the Appendix to help organize and list the teaching resources. The

other forms, "Topic Planning for This Course," will be found helpful in planning for each class session or for each topic. These two forms will help provide "memory" for the teacher, will provide direction toward objectives of the course, and will help to make the most effective use of teaching resources. Each of these forms must be reproduced locally for additional copies.

ERIC

SUGGESTED OBJECTIVES OF THE COURSE

The following are some suggested educational objectives of the course. This list may serve as a guide in helping the class members establish learning goals for themselves. It is hoped that the attainment of these learnings will result in better understanding and more efficient feeding practices. Some suggested objectives of this course are to enable students:

- To develop appreciation for the importance of good nutrition in feeding animals.
- To acquire knowledge and develop understandings of the anatomy and physiology of the digestive systems of farm animals.
- To acquire an understanding of classes of nutrients, their function, and the values of feed additives.
- To become familiar with analysis of the more common feedstuffs and their digestibility in farm animals.
- To become familiar with feeding standards and requirements for various classes of livestock.
- To develop ability to apply principles and concepts of animal nutrition to their own situation and problems in feeding livestock.
- To utilize the learnings in this course as a basis for continued study of animal nutrition.

SUGGESTIONS FOR COURSE ARRANGEMENTS

Session No.		Topic	Time
1	I	Survey of Class Members, Objectives of the Course, Structure and Function of the Digestive System	2 hr.
2	II	The Classes of Nutrients and Their Function in the Body	2 hr.
3	III	Feed Analysis and Digestibility of Feeds	2 hr.
4	IV	Distribution of Nutrients in Feedstuffs and Classification of Feedstuffs	2 hr.
5	V	The Nutrients: Proteins, Carbohydrates, Fats	2 hr.
6	VI	The Nutrients: Minerals and Vitamins	2 hr.
7	VII	Feed Additives	2 hr.
8	VIII	Effect of Processing on Feed Value, Feeding Standards and Balancing Rations	2 hr.
9-10	IX	Feeding Swine	4 hr.
	X	Feeding Beef Cattle	
	XI	Feeding Dairy Cattle	
	XII	Feeding Poultry	

Note: The above is a suggested arrangement for this course. Topics I through VIII should be considered the "core" or basic part of this course. Sections IX through XII may be selected on basis of local needs and interest, both in topic and time. On the following page show the arrangements for the course as you have planned it.

I. Structure and function of the digestive system

A. Define digestion - All processes that take place in preparing food for absorption

B. Organs common to all domestic animals

1. Mouth

a. Gathering food

b. Mechanical breakdown

c. Moistening for swallowing

d. Start of chemical breakdown

2. Esophagus - transport of food

3. Stomach

a. Storage

b. Mechanical and chemical breakdown

4. Small intestine

a. Chemical digestion

b. Absorption

5. Large intestine

a. Storage

b. Bacterial action

c. Water absorption

C. Special organs

1. Rumen

a. First of 4 stomach compartments found in cow, sheep and goat

b. Large capacity

c. Special functions

(1) Regurgitation and rechewing

(2) Breakdown of coarse feeds-roughages

(3) Fermentation and synthesis of

(a) Certain vitamins

(b) Amino acids

2. Reticulum

a. Second compartment of ruminant stomach

b. Functions similar to rumen

3. Omasum

a. Third compartment of ruminant stomach
b. Absorbs water and bicarbonates

4. Abomasum
   a. Often called "true stomach"
   b. Secretes enzymes - chemical digestion
5. Caecum
   a. Enlarges sac between small and large intestine
   b. Important in pig and horse
   c. Storage and roughage digestion
6. Crop
   a. Present in poultry
   b. Storage and softening
7. Proventriculus or gizzard
   a. Present in poultry
   b. Grinding - heavy muscles and grit

D. Accessory organs
   1. Liver with gall bladder - bile - fat digestion
   2. Pancreas - digestive juices - enzymes

E. Specialized structures in organs
   1. Papillae
      a. In rumen
      b. Aid absorption
   2. Villi
      a. Fingerlike projections
      b. In small intestine
      c. Aid absorption
   3. Glands
      a. In mouth, stomach and small intestines
      b. Supply enzymes and HCl
      c. Secrete protective mucus
   4. Blood supply
      a. In wall of tract
      b. Also in villi and papillae

F. Enzymes and bacteria
   1. Enzymes

a. Called biological catalysts

b. Chemical breakdown of food into simpler substances

c. Special enzyme for each type of food constituent

2. Bacteria

a. Present in billions

b. Responsible for roughage digestion in rumen

c. Help to synthesize many substances needed by the animal body

References: 1 or 2

References that you will use: _____

_____

_____

Teaching procedures that you will use: _____

_____

_____

II. The classes of nutrients and their function in the body

A. Structure of both plants and animals based on element carbon

1. Hydrogen, oxygen and nitrogen also present

2. Living things referred to as organic (also substance that has lived)

3. Non-living things or things that have never lived called inorganic

B. Definition and explanation of the term nutrient

C. Nutrients usually divided into proteins, carbohydrates, fats, minerals, vitamins and water

1. Proteins

a. Contain about 16% nitrogen

b. Necessary for structure of body tissues

c. Made up of smaller units called amino acids

d. Found in high amounts in seed of plants such as

(1) Cotton (cottonseed meal)

(2) Soybean (soybean meal)

(3) Flax (linseed meal)

e. Also found in high amounts in animal by products such as

(1) Meat scraps

(2) Fish meal

(3) Tankage

(4) Blood meal

(5) Feather meal

f. Use of urea and other NPN sources with ruminants

2. Carbohydrates

a. The animals primary source of energy

b. Found in all feeds

(1) Roughages - primarily as cellulose

(2) Grains - primarily as starch

c. May be converted to fat by the animal

3. Fats or ether extract

a. Also a source of energy

b. About 2.25 times as much energy per pound as carbohydrate

c. Contains certain fatty acids essential to animal performance

d. Found in small amounts in almost all feeds

e. Available as crude animal and vegetable fats and oils for use in the feed industry

4. Minerals

a. Needed for structure of bones and teeth and in many reactions of body

b. Needed in relatively small amounts but very necessary for well being of animal

c. Major minerals

(1) Calcium

(2) Phosphorus

(3) Salt (Sodium and Chlorine)

(4) Sulfur

(5) Potassium

(6) Iron } May also be classified as trace minerals

(7) Magnesium }

d. Trace minerals

(1) Manganese

(2) Copper

(3) Zinc

(4) Cobalt

(5) Molybdenum

(6) Iodine

5. Vitamins

a. Fat solubles A, D, E, and K

b. Water solubles - B vitamins (many) and Vitamin C

6. Water

a. Very important in feeding of all animals

b. Should be clean and fresh at all times

References: 1, 2, 7, 11, 15 and 19

References that you will use: _____

_____

_____

Teaching procedures that you will use: _____

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III. Feed analyses and digestibility of feeds

A. Feed analysis not same as nutrient classification but includes the nutrients

B. Proximate analysis - General description

1. Dry matter

a. Remaining material after moisture is driven off

b. Oven with dry heat is generally used

2. Crude protein or total protein

a. Nitrogen in feed sample is determined

b. Protein = N x 6.25 since proteins have 16% nitrogen

3. Ether extract

a. All fatty substances are removed from sample by extracting with ether

b. Some other materials besides fats may be present in the extract

4. Crude fiber

a. Feed sample is boiled with hot acid and hot alkali

b. Material remaining is resistant carbohydrates such as lignin and a part of the cellulose

5. Minerals or ash
   a. Sample is burned in furnace at very high temperature
   b. Remaining material is mineral or ash
6. Nitrogen free extract (NFE)
   a. 100% minus the sum of all the other parts (subtraction)
   b. Consists of digestible carbohydrates such as sugars and starches

C. Digestibility of feeds
1. Definition - the part of the feed offered which is retained by the animal for use by the body
2. Determination of digestibility - based on analysis of feed and a digestion trial with animals
   a. Weigh and sample feed
   b. Analyze feed sample
   c. Collect all feces
   d. Weigh, sample and analyze feces
   e. The amount of the feed, as fed, not present in the feces is considered digestible
   f. Usually expressed as percentage figure and called a digestion coefficient
   g. May be determined for any constituent of feed by proper analysis

D. Digestible nutrients
1. Derived by multiplying the amount of a certain nutrient by the digestion coefficient for that nutrient
2. Total Digestible Nutrients (TDN)
   a. An estimation of the energy in the feed
   b. Calculated by adding together:

Digestible Protein
+ Digestible Fiber
+ Digestible NFE
+ Digestible fat x 2.25

TOTAL DIGESTIBLE NUTRIENTS

E. Feed control program, N. C. Department of Agriculture

1. Purpose of program

2. Manufacturer's responsibility

References: 1, 2, 21

References that you will use: _____

_____

_____

Teaching procedures that you will use: _____

_____

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IV. Distribution of nutrients in feedstuffs and classification of feedstuffs

A. Distribution of nutrients - general observations

1. Feedstuffs from plant sources

a. Effect of type of plant

Legumes usually higher in protein, minerals and vitamins than non-legumes

b. Effect of stage of maturity

(1) Older plant higher in fiber

(2) Younger plant higher in digestible carbohydrate and protein

(3) Yield must be considered

c. Effect of part of plant

(1) Leaf - high in protein, carbohydrate and vitamins

(2) Stem - high in fiber

(3) Root - high in carbohydrate

(4) Seed

(a) Coat - high in fiber, minerals and vitamins

(b) Endosperm - high in carbohydrate - low in fiber

(c) Germ - high in protein, fat and vitamins; low in fiber

2. Feedstuffs from animal sources

a. Bone - high in minerals

b. Muscle - high in protein

c. Fat - high in energy

d. Liver - high in protein and vitamins

e. Feathers - high in protein but of low quality; must be processed before use

f. Blood - high in protein

B. Classification of feedstuffs

1. Roughages

a. Dry forages

(1) Hays

(a) Legumes

Alfalfa

Lespedeza

Peanuts

Clovers

Soybean

Vetch

(b) Non-legumes

Orchard grass

Fescue

Coastal bermuda

(2) Straws

(a) Oat

(b) Wheat

(c) Rye

(d) Buckwheat

(e) Barley

(3) Other high fiber products

(a) Cottonseed hulls

(b) Corn cobs

(c) Corn shucks

(d) Cotton burrs

(e) Rice hulls

(f) Peanut hulls

(g) Dried beet pulp

(h) Citrus pulp

(i) Apple pomace

(j) Tomato pomace

(k) Corn fodder

(l) Corn stover

b. Succulent forages

(1) Silages

(a) Corn

(b) Sorghum

(c) Hay crop

Legumes

Grass

(2) Pasture

(a) Legume

(b) Grass

(c) Mixture

(3) Roots and tubers

(a) Potatoes

(b) Rutabagas

(c) Turnips

(d) Other roots

2. Concentrates

a. Energy

(1) Grains

(a) Corn

(b) Oats

(c) Wheat

(d) Rye

(e) Barley

(f) Buckwheat

(g) Milo

(2) Grain by-products

(3) Fats and oils

(a) Plant

(b) Animal

(4) Molasses

(a) Cane

(b) Beet

(c) Wood

b. Protein supplements or concentrates

(1) Animal products

(a) Tankage

(b) Meat scrap

(c) Poultry by-product meal

(d) Hydrolyzed poultry feathers

(e) Poultry hatchery by-product

(f) Blood meal

(g) Fish meal

(2) Plant products

(a) Oil meals

Cottonseed oil meal

Soybean oil meal

Linseed oil meal

Peanut meal

(b) Brewers and distillers dried grains and solubles

c. Mineral supplements or concentrates

(1) Bone meal (Ca + P)

(2) Phosphates (Ca + P)

(a) Rock, raw

Curacao Island

Florida and Tennessee Rock

Soft phosphate with colloidal clay

(b) Defluorinated

(c) Di-calcium

(3) Ground limestone (Ca)

(4) Calcium carbonate (Ca)

(5) Oyster shell (Ca)

(6) Salt(NaCl)

(7) Trace mineral concentrates (Mn, Mg, Zn, Cu, Fe, Co)

d. Vitamin concentrates

(1) Fat solubles

(a) Vitamin A

Alfalfa meal

Coastal Bermuda meal

Lespedeza meal

Fish liver oils

(b) Vitamin D

Fish liver oils and others

(c) Vitamin E

Tocopherols

(d) Vitamin K

(2) Water soluble

(a) B Vitamins (Thiamine, riboflavin, biotin, niacin, inositol, paraaminobenzoic acid, pyridoxine, folic acid, B_{12} (cyanocobalamin), choline)

Yeast products

Condensed fish solubles

Dehydrated alfalfa leaf meal

References: 1, 2, 3, 4, 5 and 6

References that you will use: _____

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Teaching procedures that you will use: _____

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V. The nutrients: proteins, carbohydrates, fats

A. Proteins

1. All animals must have protein in diet
2. Requirements are different for
   a. Growth
   b. Reproduction
   c. Lactation
   d. Maintenance
3. Requirements differ for various classes of livestock
4. Feeding standards present needs of classes of animals as determined by experience and research
5. Quality of protein is very important in simple stomach animals like chickens and swine
6. Quality is determined by the kinds and amounts of amino acids making up the protein
7. Ten of the amino acids are called "Essential Amino Acids" because they cannot be synthesized by the non-ruminant animal and therefore must be included in the diet. They are:

a. Lysine
b. Valine
c. Methionine
d. Arginine
e. Tryptophan
f. Threonine
g. Phenylalanine
h. Histidine
i. Isoleucine
j. Leucine
k. Glycine is considered essential for poultry but not for other classes of livestock

8. A part of the protein <u>in ruminant diets</u> may be furnished from synthetic nitrogen compounds called non-protein nitrogen
   a. Urea is the most widely used NPN source
   b. Use of NPN compounds should be in high energy rations - not high roughage rations
   c. Not more than 1/3 of total protein should come from Urea
   d. There is no energy in NPN sources
   e. One pound of urea + 6 pounds of corn equals 7 pounds of soybean meal in nutrient content for fattening cattle.

B. Carbohydrates
   1. Made up of simple sugars linked together like a chain to form molecules
   2. Some, like cellulose in roughages, can be broken down only by bacteria
   3. Starches in grain are more easily digested
   4. Carbohydrates make up about 75% of the dry matter in plants
   5. Chief source of heat and energy for livestock
   6. Carbohydrates are absorbed into the body as simple sugars - chiefly one called glucose

C. Fats
   1. A potent source of energy (2.25 times the energy of carbohydrates)
   2. Care must be taken in adding this ingredient so as to not add too much to the feed

3. May be used to limit feed intake of grazing animals

4. Most kinds of fat must be heated before adding it to the feed

5. Improves feed: gain ratio because of high energy value

References: 1, 2, and 22

References that you will use: _____

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_____

Teaching procedures that you will use: _____

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VI. The nutrients: Minerals and vitamins

A. Minerals

1. Common salt (sodium and chlorine; symbols Na & Cl)

a. Most likely to be deficient in livestock rations

b. More needed for cattle and sheep than for poultry and swine

c. A lack leads to general unthriftiness and poor production in farm livestock

d. Amounts needed

(1) Dairy cattle - 1% of ration

(2) Beef cattle - ½ to 1% of ration

(3) Swine - ½% of ration

(4) Poultry - ½% of ration

e. Beef cattle, dairy cattle and sheep should have salt offered free choice as blocks, lumps or loose salt

2. Calcium - (symbol - Ca)

a. Low in grains; medium in grass hays; high in legume hays

b. Especially low in corn - silage (Examples)

c. Lack of Ca leads to poor bone formation, slow growth and poor production

d. Large amounts needed by laying hens for egg shell formation

e. Cheapest sources are ground limestone and marine shells

f. A calcium to phosphorus ratio of 1:1 to 2:1 is necessary for poultry and hogs (wider with laying hens)

g. Wider ratios possible with ruminants - up to 6:1

3. Phosphorus (symbol - P)
   a. Ca & P together make up 90% of mineral matter in skeleton
   b. Hay is low in phosphorus (Examples)
   c. Grains are medium in phosphorus (Examples)
   d. Most protein supplements are high in phosphorus (Examples)
   e. Livestock fed mostly roughage must be supplemented with phosphorus
   f. Lack of phosphorus leads to rickets, other bone abnormalities and lowered growth and production
   g. Good sources of phosphorus are steamed bone meal, defluorinated rock phosphate and di-calcium phosphate.
   h. Fluorine content of rock phosphates should be low since fluorine is toxic at high levels
4. Sulfur (symbol - S)
   a. Essential for protein formation (amino acids cystine & methiomine)
   b. Needed in small amounts
   c. Must be supplied only where soils are very low in sulfur
   d. Sulfur should be checked closely when urea is fed to ruminants (cattle & sheep)
5. Potassium (symbol - K)
   a. Animals need fairly large amounts
   b. A ration consisting of natural feeds unlikely to be deficient in K
6. Iron (symbol - Fe)
   a. Necessary for red blood cell formation
   b. Lack results in anemia
   c. Sows milk may be deficient
   d. Pigs farrowed on concrete should have iron shots or iron solution swabbed on sows teats. Other methods.
7. Magnesium (symbol - Mg)
   a. Usually present in sufficient amounts in feeds
   b. Young spring grass may be low in Mg
   c. Milking cows and ewes grazing young spring grass may have low Mg intake resulting in grass tetany or grass staggers

d. Use of Mg supplement to prevent grass tetany

e. Treatment - Intravenous injection of calcium gluconate with added magnesium

8. Manganese (symbol - Mn)

a. Usually present in feeds so that no supplement is needed

b. Poultry have higher requirement than other farm livestock

c. Lack of manganese results in perosis or "slipped tendon" in poultry; also poor hatchability

9. Copper (symbol - Cu)

a. Needed along with iron for red blood cell formation

b. Seldom deficient in feeds except in highly organic soils such as peat and muck

c. May act like antibiotic when added to swine rations at levels of 125-150 parts per million

10. Zinc (symbol - Zn)

a. Usually present in adequate amounts in most feeds except swine rations

b. Should be added to corn-soy diets for swine

c. High zinc trace mineral salt is used in swine feeding

d. Lack of zinc causes parakeratosis (a skin disease) in swine

11. Cobalt (symbol - Co)

a. Needed for synthesis of Vitamin B_{12} by ruminants

b. Not likely to be deficient in feeds except in certain cobalt deficient areas

c. Can be supplied to ruminants with cobalt "bullet"

12. Molybdenum (symbol - Mo)

a. Needed in very minute amounts

b. Feeds not likely to be deficient

c. May be toxic in some areas. Takes very little to cause toxicity symptoms

13. Iodine (symbol - I)

a. Lack results in goiter and hairless pigs

b. Feeds usually have enough iodine except in iodine deficient areas

c. May be supplied in trace mineral or iodized salt

14. Use of trace mineral salt
    a. A good insurance measure in most sections of country
    b. High zinc TM salt should be used for hogs
    c. One part TM salt with two parts steamed bone meal fed along with plain salt in separate boxes makes a good free choice mineral program for ruminants

B. Vitamins
1. Vitamin A (fat soluble)
    a. Lack causes poor growth, poor vision, mummified pigs, night blindness and stiffness of joints
    b. Found in large amounts in green growing materials and good hay and silage
    c. Grains are usually low in vitamin A
    d. Purified sources are very reasonably priced
    e. Carotene in plants is converted to vitamin A
    f. Nitrates may interfere with conversion of Carotene to vitamin A
    g. Review conversion units (1 mg. carotene = 500 I. U. vitamin A)
    h. Vitamin A may be stored in liver for future use
2. Vitamin D (fat soluble)
    a. Best source is sunlight to irradiate carriers of vitamin D
    b. Present in sun-cured hay in large amounts
    c. Necessary for proper mineralization of bone and prevention of rickets
    d. Lack of vitamin D causes pregnant animals to produce weak offspring and also results in thin shelled eggs, decreased egg production, and lowered hatchability in poultry
    e. Two forms of vitamin D
        (1) D_2 effective for 4 footed animals, not very effective for poultry
        (2) D_3 effective for both 4 footed animals and poultry
    f. Care must be taken in winter when animals are housed to make sure that they receive vitamin D
3. Vitamin E (fat soluble)
    a. Necessary for reproduction in poultry

b. Reproduction in cattle, sheep and hogs not improved by addition of vitamin E

c. Stiff lamb disease is related to lack of vitamin E

d. Feeds usually contain enough vitamin E to meet needs of all livestock except perhaps poultry

e. Purified sources may be obtained commercially

4. Vitamin K (fat soluble)

a. Necessary for clotting of blood

b. Bacteria in rumen and large intestine can make vitamin K

c. Widely distributed in green forages

d. Feed usually meets requirements for K

5. Vitamin C (water soluble)

a. Farm animals can synthesize vitamin C

b. Not likely to be a problem in feeding of livestock

c. Lack causes scurvy in man

d. Found in abundant amounts in citrus fruits

6. B-complex vitamins (water soluble)

a. Synthesized by cattle and sheep

b. Almost all are found in forages (except perhaps B_{12})

c. Swine and poultry may need to be supplemented with the B vitamins

d. Yeast is a good source of almost all B vitamins

e. Following are some of the B vitamins:

(1) Vitamin B_1 or Thiamine

(a) Usually in sufficient amounts in livestock feeds

(b) Lack causes beri-beri in humans

(2) Vitamin B_2 or Riboflavin

(a) Poultry have high requirement for riboflavin and rations need to be supplemented

(b) Swine in dry lot may need supplemental riboflavin

(c) Ruminants are able to synthesize riboflavin

(d) Lack of riboflavin results in digestive disturbances, general weakness, poor condition of the eyes and skin and in chickens a condition called curled toe parabysis

(e) Dried skim milk and buttermilk are high in riboflavin

(f) Synthetic riboflavin is available commercially

(3) Niacin or nicotinic acid

(a) Ruminants synthesize niacin

(b) Most feeds high in niacin

(c) Lack causes diarrhea, skin disease and hind quarter paralysis in pigs also inflammation of mouth and poor growth and feathering in chicks

(d) Synthetic niacin is available commercially

(4) Pantothenic acid

(a) Rations generally furnish ample amounts

(b) Deficiency causes goose-stepping in pigs, ragged feather development in chicks, and skin diseases in both

(c) Large amounts in forage, wheat bran and dairy by-products

(5) Choline

(a) High requirement by poultry

(b) Feeds usually have needed amounts

(c) Available commercially

(6) Vitamin B_{12}

(a) Ruminant needs cobalt to synthesize B_{12}

(b) Plentiful in proteins of animal origin

(c) Should be supplied to pigs and chicks receiving a corn-soy ration

(7) Other B vitamins which are necessary but which are not likely to be deficient in feeds are

(a) Pyridoxine

(b) Biotin

(c) Betaine

(d) Inositol

(e) Para-aminobenzoic acid

(f) Folic acid

References: 1, 2, 20, and 22

References <u>that you will use</u>: _____

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Teaching procedures that you will use: _____

_____

_____

VII. Feed additives

A. Non-nutritive materials added to feeds to increase growth or feed conbersion are called additives

B. Care must be taken to follow rules and restrictions of F.D.A. governing the use of these materials

C. Types of materials which have been investigated:

1. Hormones and hormone-like substances

a. Diethylstilbestrol (a synthetic estrogenic compound)

(1) Should be used only with ruminants

(2) Not effective for pigs

(3) Can be implanted in ear of ruminant

(4) Most effective when animal is on a fattening diet

(5) Use is outlawed with poultry

(6) Should not be used with breeding animals

(7) Increase of 12-20% in gains

(8) Dosage level with fattening steers:

(a) Implant - 24 to 36 mg. in ear

(b) In feed - 10 mg/head/day

b. Hexestrol and dienestrol - about same as stilbestrol

c. Thyroxine

(1) Hormone from thyroid gland

(2) Use is not indicated at present

2. Antibiotics

a. Many available

b. Most widely used are the tetracycline - aureomycin and terramycin

c. Should be used under the following circumstances

(1) Pigs up to 100 lbs.

(2) Broilers

(3) Young calves

(4) Ruminants on a high roughage diet

(5) Special instances in which animals are under stress. Therapeutic levels may be indicated

3. Tranquilizers
   a. Many have been investigated
   b. None have been found to be generally effective in improving performance and feed conversion
4. Enzymes
   a. Still being investigated
   b. Usually compounds which will breakdown proteins, carbohydrates or gums
   c. May be useful in pig starters or for chicks
   d. Several have proven to be without real value as an additive to animal feeds
5. Nitrofurans
   a. Used with pigs and chicks
   b. Generally effective in preventing scours in pigs
   c. Not effective in ruminants
6. Arsenicals
   a. Used with pigs and chickens
   b. Dosage level should be watched carefully since overdoses may be dangerous
   c. A growth stimulant
7. Copper
   a. Used with young pigs (up to 100 lbs.)
   b. Acts like an antibiotic
   c. Care must be taken to avoid overdose
   d. Added at rate of 125 parts per million in pig rations
   e. Still being investigated

References: 1, 2, 8, 11, 16, 19, 20 and 22

References <u>that you will use</u>: _____

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Teaching procedures <u>that you will use</u>: _____

_____

_____

VIII. Effect of processing on feeding value, feeding standards and balancing rations

A. Processing methods

1. Hay

a. Pelleting

b. Grinding

c. Cubing

d. Wafering

2. Concentrates

a. Grinding

(1) Necessary for ruminants

(2) Effect of fineness of grind for hogs and sheep

b. Pelleting

c. Pelleting and regrinding

d. Crumbling

e. Rolling

f. Flaking

B. Feeding standards

1. Guides to livestock feeding

2. Present nutrients that are important to class of livestock in amounts necessary for

a. Maintenance

b. Growth

c. Fattening or finishing

d. Gestation

e. Lactation

3. Also given by weight of animals involved

4. Requirements - minimum needs

5. Allowances - requirements plus a safety factor

6. Easily obtainable feeding standard tables are:

a. Morrison's Feeds and Feeding

b. National Research Council (NRC) nutrient allowances for the various classes of livestock

C. Balancing rations

1. Definitions
   a. Ration - 24 hr. allowance of feed
   b. Balanced ration - a ration adequate to meet nutrient requirements of the animal in question for the situation specified
2. Rations usually balanced on basis of:
   a. TDN
   b. Digestible protein (Amino acids, in case of swine and poultry, must be considered)
   c. Calcium
   d. Phosphorus
   e. Vitamins and minor minerals are usually added from purified sources (commercial supplements) when lacking in the ration
3. Procedures for balancing rations
   a. Pearsons square useful in concentrates especially when grain and protein supplement are involved
   b. Steps in balancing a ration (general procedure)
      (1) Determine needs of animal (s) from feeding standard
      (2) Determine feed intake possible (from feeding standard)
      (3) Check most economical energy source to see how close maximum possible intake approaches feeding standard in terms of TDN (Feed Analysis Tables-Morrison)
      (4) If necessary substitute more concentrated energy source to balance TDN
      (5) Substitute high protein source to balance digestible protein
      (6) Check adequacy of minerals and vitamins and add as necessary
4. Examples - it is very important that the instructor use ample time in demonstrating the use of feeding standards, feed analysis tables and procedures for balancing rations. This would usually constitute the major portion of the laboratory work in a course in livestock feeding
5. On the next page is an analysis sheet for several common feeds. More extensive tables can be found in Morrison's Feeds and Feeding.

Average Composition of Feeds

Feedstuff	Total Dry Matter	Dig. Prot.	TDN	Ca.	P.	Carotene
DRY ROUGHAGES						
	%	%	%	gm/#	gm/#	mg/#
Alfalfa hay, all analyses	90.5	10.5	50.3	6.67	1.09	11.4
Alfalfa hay, 1/10 to 1/2 bloom	90.5	11.2	51.7	5.72	1.00	19.4
Alfalfa hay, past bloom	90.5	9.2	47.6	—	—	3.2
Alfalfa hay, dehydrated	92.0	11.3	55.4	6.72	1.14	43.4
Clover hay, Ladino	88.0	14.2	54.9	5.99	1.32	—
Clover & mixed grass hay, high in clover	89.7	5.5	52.2	4.09	0.86	—
Corn cobs, ground	90.4	0.0	45.7	—	0.09	—
Corn stover, medium, in water	80.3	2.0	45.5	1.18	0.23	—
Peanut hay, without nuts, good	90.6	5.4	47.3	1.12	0.13	8.0
Lespedeza hay, annual, in bloom	89.1	6.5	47.5	4.63	0.82	20.
Mixed hay, good, less than 30% legumes	88.0	4.4	49.8	2.77	0.82	—
Oat straw	89.7	0.7	44.7	0.86	0.45	—
Sorghum fodder, sweet, dry	88.8	3.3	52.4	1.54	0.54	1.1
Soybean hay, seed developing	88.0	9.8	48.5	6.13	1.14	13.6
Timothy hay, all analyses	89.0	2.9	48.9	1.04	0.91	5.3
SILAGES						
Alfalfa, not wilted, no preservative	25.0	2.7	13.7	1.59	0.36	21.1
Alfalfa-molasses, not wilted	26.8	2.7	15.4	1.86	0.30	14.5
Corn, dent, well-matured, all analyses	27.4	1.2	18.1	0.45	0.27	6.4
Corn, dent, immature, before dough stage	20.4	0.9	13.0	—	—	—
Grass silage, small proportion legumes wilted slightly, molasses added	29.0	1.6	18.0	—	0.32	—
CONCENTRATES						
Barley, excluding Pacific Coast	89.4	10.0	77.7	0.41	2.13	—
Brewers' grains, dried, 25% protein	92.9	22.1	67.1	1.14	2.22	—
Citrus pulp, dried	90.1	3.0	73.2	10.35	0.77	—
Corn & cob meal (corn ears, ground)	86.1	5.3	73.2	—	1.00	—
Corn, dent, yellow, No. 2	85.0	6.8	80.0	0.10	1.23	1.3
Corn gluten feed, 25% protein	91.1	22.9	76.5	1.82	3.72	—
Cottonseed meal, 36% protein	92.2	30.4	71.9	0.86	5.13	—
Cottonseed meal, 41% protein	92.2	34.2	73.6	0.82	5.18	—
Milk, cow's	12.8	3.3	16.2	0.54	0.41	—
Molasses, cane	74.0	0.	54.0	3.36	0.36	—
Oats, excluding Pacific Coast	90.2	9.4	70.1	0.41	1.95	—
Peanut oil meal, o.p., 43% protein	92.7	39.2	32.0	0.73	2.45	—
Sorghum, Kafir	89.5	9.1	80.7	0.18	1.50	—
Soybean oil meal, 41% protein	89.8	34.5	76.4	1.18	2.68	—
Soybean oil meal, 44% protein	90.8	37.1	78.6	1.36	3.00	—
Wheat bran	89.7	13.3	66.4	0.64	5.90	—
Wheat standard middlings	90.1	14.6	78.0	0.64	3.54	—

COMPOSITION OF CALCIUM AND PHOSPHORUS SUPPLEMENTS

Mineral Supplement	Calcium		Phosphorus	
	Per Cent	Grams/pound	Per Cent	Grams/pound
Bone meal steamed	30.0	136	13.9	63
Defluorinated rock phosphate	29.0	132	13.0	59
Dicalcium phosphate	26.5	120	20.5	93
Limestone (high calcium)	38.3	174	nil	nil
Oyster shell flour	36.9	167	nil	nil
Monosodium phosphate	—	—	22.4	102

References: 1, 2, 3, 4, 5, 6, 8, 11, 16 and 19

References that you will use: _____

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Teaching procedures that you will use: _____

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IX. Feeding swine

A. Feed - 80% of cost of pork production - a balanced ration is essential to efficient operation

B. Energy feeds

1. Make up about 80% of swine rations
2. Corn is usually cheapest source of energy
3. Rating of grains for hogs with corn as basis of comparison (complete substitution)

a.	Corn	— ground	100	
b.	Oats	— ground	85	(never substitute over 25%)
c.	Oats	— rolled	100	
d.	Wheat	— ground	95	
e.	Barley	— ground	86	
f.	Milo	— ground	94	
g.	Rye	— ground	90	(never substitute over 20%)

4. All commonly used grains should be ground for maximum utilization
5. There is still no evidence that cooking, soaking, or liquid feeding is of value when hogs are full-fed

C. Protein in swine rations

1. Amount depends on age and "work" of the hog
   a. Bred sow - 15%
   b. Sow and litter - 15%
   c. Creep feed - 16-18%
   d. Growing - fattening:
      (1) 75-125 lbs. 14%
      (2) 125-225 - 12%
2. Most widely used supplement is soybean meal

3. Corn-soy diets give excellent performance if fortified correctly
4. Particular attention must be paid to amino-acid balance in swine diets (Review 10 essential amino acids)
5. Fishmeal and meat and bone scrap do not contain enough tryptophan to adequately supplement corn
6. In the future, purified amino acids may be cheap enough to use as supplements
7. Cottonseed meal contains the toxic substance, gossypol. Therefore, it may be used in swine rations very sparingly

D. Minerals in swine rations

1. Salt - 0.5% is adequate in complete mixed rations
2. Calcium and phosphorus
   a. Breeder and grower rations based on corn and soybean meal are adequately supplemented with Ca and P by adding 1% limestone and 1% dicalcium phosphate, steamed bone meal or defluorinated rock phosphate
   b. The Ca:P ratio should be between 1:1 and 2:1 in the complete mixed ration
   c. Ca and P supplements must be adjusted downward when meat and bone meal or fish meal are used
3. Trace minerals - when salt is added at a level of .5 of the ration and is the carrier of the trace minerals, the salt should contain the following percentages of the trace minerals:

   Copper -- .06% of the salt
   Iron -- .5%
   Iodine -- .007%
   Manganese -- .75%
   Zinc -- .8%

E. Vitamins

1. Grower and breeder mixed ration consisting of 80% corn and 20% SBOM should have the following B vitamin fortification <u>per ton of ration</u>:
   a. Riboflavin - 1 gm.
   b. Pantothenic acid - 5 gm.
   c. Nicotinic acid - 15 gm.

d. Choline - 100 gm.

e. Vitamin B_{12} - 16 mg.

2. Finisher rations - 50% of above levels
3. Creep rations - double the above levels
4. Vitamin A - 3 million international units per ton
5. Vitamin D - 300,000 international units per ton
6. A protein supplement to be fed with shelled corn should have 4-5 times the vitamin levels recommended above

F. Additives for swine feed and levels recommended

	Antibiotic gm/ton	Arsanilic acid gm/ton	Copper PPM
Creep	40	90	125
Grower	10-20	90	125
Finisher	0	90	0
Breeder	0	0	0

G. Other special topics for discussion

1. Fineness of grind
2. Complete mixed vs grain and supplement
3. Liquid vs dry feeding
4. Limited vs full feeding
5. Frequency of feeding
6. Effect of temperature of water
7. Space at feeder
8. Pasture vs concrete
9. Addition of fat to swine rations
10. Hogging down corn - necessary supplementation

References: 1, 2, 3, 7, 8, 9, and 10

References <u>that you will use</u>: _____

_____

_____

Teaching procedures <u>that you will use</u>: _____

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X. Feeding beef cattle

A. Beef cattle can handle coarser feeds than hogs because of rumen which:

1. Digests roughage feeds
2. Synthesizes B vitamins
3. Synthesizes amino acids

B. Nutrients which the beef cattle producer must be concerned with

1. Energy

a. Amount needed depends on size of animal, what they are doing and what you expect from them

b. Energy may come from:

(1) Silages, corn and grass
(2) Hay
(3) Pasture
(4) Grains
(5) Field gleanings

c. The type of energy feeds used would depend on the type of cattle being fed

(1) Cattle being maintained such as herd cattle can get energy from coarser feeds
(2) Fattening cattle must have higher energy feeds

2. Protein

a. Any of the oil meals make good protein source

b. Synthetic nitrogen sources such as urea can furnish up to 1/3 of protein in fattening rations

c. Percent protein in ration should be:

(1) Pregnant cows - 4.5
(2) Nursing cows - 5.0
(3) Yearlings, wintering 5.0
(4) Calves, wintering 6.0
(5) Fattening calves 7-9
(6) Fattening yearlings 6.5-7.5

All of these are digestible, not total protein

d. Younger cattle need a higher percent of protein in their ration

e. Legume hay is good protein source

3. Vitamins A and D

a. Well cured hay is high in both

b. Purified sources are cheap

c. Forage meals such as alfalfa meal or coastal Bermuda meal is good source of A

4. Minerals

a. Complete mixed rations full fed should contain around .35% calcium for young cattle down to .20% calcium for older cattle

b. Phosphorus in complete mixed rations full fed should vary from .30% in young cattle to .15% in older cattle

c. A good free choice mineral program:

(1) 2 parts bone meal plus 1 part trace mineral salt in one box

(2) Plain salt in another box

C. Fattening cattle

1. Pasture

a. Good legume grass pasture can furnish all vitamins and most of protein plus a lot of energy

b. Energy supplement necessary such as corn

(1) Should be ground

(2) May be self fed with salt or fat

(3) If hand fed it should be limited to 1% of the body weight daily

c. Minerals free choice should be given as listed above

d. Pasture should be plentiful and not grazed closely

2. Dry-lot

a. Calves after weaning or steers after wintering fit in this category

b. Many systems possible

(1) Full feed silage + limited grain and supplement

(2) Hay limited + grain and supplement

(3) All-concentrate rations (Experimental)

c. Example fattening rations for beef cattle based on ground ear corn (on basis of pounds per ton)*

---

* Feed 3-5 pounds of hay per day with full feed of above.

	I	II	III	IV	V	VI
Ground ear corn	1480	1530	1580	1680	1630	1730
Soybean oil meal (44 or 50%)	---	250	250	250	250	200
Cottonseed meal (36%)	300	---	---	---	---	---
Alfalfa meal (17%)**	100	100	50	50	50	50
Molasses	100	100	100	---	---	---
Animal fat	---	---	---	---	---	---
Trace mineral salt	10	10	10	10	10	10
Limestone	10	10	10	10	10	10

d. Vitamin A should be fed at rate of 20,000 to 30,000 I.U. daily in fattening rations in dry lot unless good green hay is used.

D. Example rations for wintering cattle

1. Wintering calves and yearlings

a. Full feed corn silage + 1.5# oil meal daily + minerals free choice

b. Full feed grass hay + 1.5# oil meal daily + minerals free choice

c. Small grain pasture + 1.5# oil meal daily + minerals free choice

2. Wintering pregnant cows (example rations)

a. Alfalfa silage
Minerals free choice (see above for proper mixtures)

b. Oat silage or grass silage
1/2#/hd./day of soybean or cottonseed meal
1/10#/hd./day of limestone
Minerals free choice

c. Corn silage (good)
1/10#/hd./day of limestone
Minerals free choice

d. Oat or grass silage
4#/hd./day of alfalfa hay
Minerals free choice

e. Mixed hay (good)
Minerals free choice

** May be replaced with equal amount of Dehydrated Coastal Bermuda meal or Serecia Lespedeza Meal

f. Grass hay or grass silage

.5 daily of oil meal

Minerals free choice

E. Preparation of feed for cattle

1. All grains should be ground unless hogs follow the cattle to utilize undigested grains
2. Pelleting improves utilization of roughages
3. Pelleting does not improve high concentrate rations

F. Additives

1. Antibiotics
   a. Should be used with young calves
   b. Beneficial in high roughage rations
   c. May help prevent liver abscesses with high energy fattening
2. Stilbestrol - Do not use with breeding herd
   a. Fattening steer rations - 10 mg/hd.daily - improves gain 10-20%
   b. May be implanted in ear - 24-36 mg.

References: 1, 2, 4, 11, 12, 13 and 14

References <u>that you will use</u>: _____

_____

_____

Teaching procedures <u>that you will use</u>: _____

_____

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XI. Feeding dairy cattle

A. Also ruminants are able to:

1. Digest coarser feeds
2. Synthesize B vitamins
3. Synthesize amino acids

B. Need for energy

1. High producing cows need a large amount of energy
   a. Roughages that make good energy sources:
      (1) Corn silage
      (2) High quality hay

(3) Good pasture

(4) Green crop

b. Concentrates

(1) Cereal grains (corn, oats, barley, etc.)

(2) Animal and vegetable fats (up to about 4% of ration)

2. Energy usually expressed as total digestible nutrients (TDN)

C. Protein

1. Sources

a. Oil meals

b. Legume hays

2. Amount needed for milking cow depends on roughage as shown in following table

Kind of Roughage		Percentage of Protein in concentrate
High Protein	Green, leafy alfalfa hay, soybean hay, clover hay or excellent pasture (with corn or grass silage)	12%
Medium Protein	Coarse legume hay, good grass hay, lespedeza hay or very good pasture	14%
Low Protein	Coarse, stemy, poor quality hay or fair quality pasture (with corn or silage grass)	16%
Very Low	With corn silage as main forage	18-20%

D. Minerals

1. High requirement for calcium and phosphorus in lactating cow since milk is high in these minerals

a. 1% steamed bone meal should be added to concentrate mixture. Other calcium-phosphorus sources that may be used in place of steamed bone meal are decalcium phosphate and defluorinated rock phosphate

b. Bone meal should also be offered free choice

2. Salt should be available to the dairy cow as loose salt in a convenient place

3. There is little evidence that any trace mineral supplementation is needed in this state when good forage is fed. One part of

Trace mineral salt mixed with 2 parts Bone meal and fed free choice offers insurance

E. Vitamins

1. Vitamin A is necessary for growth and health and normal reproduction
   a. High quality hay is an excellent source
   b. Some found in grass and corn silage
   c. If most of energy comes from low quality hay and concentrate, then 3 million units of synthetic vitamin A should be added per ton of concentrate
2. Vitamin D
   a. From sun cured hay
   b. Direct sunlight is good source of irradiation
   c. Only in extreme cases would vitamin D be necessary as a ration additive
   d. Used experimentally in milk fever prevention

F. Water - an easily available source of fresh clean water is necessary for milking cows

G. Roughages and pasture

1. Sound feeding program should provide for ample, high quality roughage or pasture
2. Too small amounts of roughage will cause decrease in fat percentage in milk
3. Amount of roughage to feed

H. Economics of grain feeding

1. Substitution of grain
2. High level grain feeding
3. Comparison of various grains

I. Byproduct feeds and their use

1. Oil meals (cottonseed, soybean, linseed, peanut)
2. Molasses - usually high in price; make feed palatable
3. Citrus pulp or citrus meal
4. Beet pulp
5. Wheat bran

J. Commercially mixed feeds and supplements

1. Consider reputation of manufacturer
2. Low fiber and higher fat mean high TDN
3. Cost should determine whether you buy or mix your own concentrate

K. How much grain to feed depends on

1. Quality of hay or pasture
2. Amount of roughage consumed/100 lbs. body weight
3. Pounds of milk produced
4. Percent fat in milk
5. Tables are available to determine the amount of grain to feed under various conditions as outlined above. The dairyman should, by all means, have these tables available. See references.

L. Preparing feeds for dairy cows

1. Don't grind hay - too expensive
2. Grinding roughage may lower butterfat percentage
3. All grains should be ground

M. Feeding dry cows

1. Amount of energy feeds depend on condition of cow at end of lactation
2. Plenty of good forage and simple concentrate mix should be used
3. Extra bulk in concentrate is not necessary during the dry period

N. Other topics for discussion if time permits

1. Feeding of antibiotics
2. Feeding urea (not 3 lbs. or urea/100 lbs. ration)
3. Thyroprotein (experimental at present)
4. Use of animal fat (economics involved)
5. Feeding replacement heifers
6. Feeding bulls.

References: 1, 2, 5, 15, 16, 17 and 18

References <u>that you will use</u>: _____

_____

_____

Teaching procedures <u>that you will use</u>: _____

_____

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XII. Feeding poultry

A. Rations must be complete and well balanced to secure proper growth and egg production

B. Rations must be palatable in order to stimulate feed intake necessary for high production

C. Carbohydrates (energy)

1. From grains primarily - Relative worth of grains for poultry
2. Broken down into simple sugars for absorption
3. Feed intake is governed in chicken by energy concentration in diet
4. Ratio of calories to protein is important in poultry

D. Protein

1. General requirements (no safety factor added)
   a. Starting chicks (0-8 wks) - 20%
   b. Growing chickens (8-18 wks) - 16%
   c. Laying hens ---------- 15%
   d. Breeding hens---------- 15%
2. Balance of amino acids really more important than total protein level (referred to as protein quality)
   a. Amino acids not stored - must be fed in proper amounts each day
   b. Eleven amino acids are essential - see charts of requirements
   c. Combinations of protein sources may be necessary for balance of amino acids
   d. Purified amino acids are available - some at reasonable prices
   e. Methronine often deficient in corn-soy diets
3. Birds on high energy rations need a little higher percentage of protein
4. Hens fed mash and scratch grains in equal proportions - Mash should have 20-21% protein

E. Fat

1. Any practical poultry ration will supply necessary fatty acids
2. Fat often added to increase energy content of poultry rations
3. May be especially advantageous in broiler rations
4. Rations containing fat will improve feed efficiency because of high energy content (2.25 x carbohydrates)

5. May be added up to about 10% in broiler rations
6. May cut down dustiness and improve handling qualities

F. Minerals

1. Salt (NaCl)
   a. Should be added to all rations
   b. Requirement - .25 - .50%
   c. Too much salt will cause moist droppings
2. Calcium
   a. Requirements of poultry for Ca are higher than other farm animals
   b. Usually supplied to laying hens as:
      (1) About half in mash
      (2) Half in free choice Ca supplement such as oyster shells
   c. Ca:P ratio for chickens should be 1.5:1
3. Phosphorus
   a. Requirements
      (1) Laying hens and breeder hens - .75-.80%
      (2) Starting and growing chicks - .60%
   b. Phytin phosphorus (found in plants) not all available to poultry - .45% of the ration for layers should be inorganic phosphorus
4. Magnesium - Usually plenty in natural rations
5. Manganese
   a. Poultry is only farm animal in which Mn may be lacking in ration
   b. Requirements
      (1) Growing chicks - 25 mg/lb of feed
      (2) Laying hens - 20 mg/lb of feed
      (3) Common source of supplemental manganese is manganese sulfate ($\frac{1}{4}$ lb per ton of feed)
6. Iodine may be deficient in some areas - not North Carolina
7. Other minerals may be necessary as additions to the diet in trace mineral deficient areas
8. Grit - Aid in grinding of feed by gizzard - should be hard limestone or oyster shell and will also furnish Ca

G. Vitamins

1. Vitamin A

   a. Deficiency may result in slow growth, lowered egg production and hatchability and red, swollen eyes

   b. Requirement (no margins of safety)

      (1) Laying and breeding hens - 2000 USP units per lb of feed

      (2) Starting and growing chicks - 1200 units per lb of feed

   c. May be furnished in forms of carotene in forage meals

   d. Most widely used source is commercial preparation

2. Vitamin D

   a. Vitamin D_3 is more effective than D_2 in poultry rations

   b. Deficiency causes poor bone formation and poor egg shell formation

   c. Requirements of D_3

      (1) Laying and breeding hens - 225 international chick units/lb feed

      (2) Starting and growing chicks - 90 international chick units/lb feed

3. Vitamin E and K usually present in sufficient amount in natural rations

4. Vitamin B complex

   a. Riboflavin

      (1) Poultry have high requirement for riboflavin

         (a) Laying hens - 1.0 mg/lb ration

         (b) Breeding hens - 1.7 mg/lb ration

         (c) Starting chicks - 1.3 mg/lb ration

         (d) Growing chicks - 0.8 mg/lb ration

      (2) Pasture is good source of riboflavin

      (3) Alfalfa meal is good source

      (4) May be purchased commercially at reasonable prices

   b. Other B-complex vitamins including B_{12} may be purchased in correct quantities in commercial vitamin pre-mixes

H. Feed additives

1. Antibiotics - have a definite place in poultry feeding

   a. Effective types

   b. Levels in various types of rations

2. Arsenicals

3. Hormones

a. Stilbestrol - chemical caponization - no legal at present

b. Thyroprotein - not recommended

I. Unidentified growth factors

1. Many have been suggested including:

a. Fish solubles factor

b. Distillers solubles factor

c. Grass juice factor

d. Whey factor

e. Others

2. Should be given consideration in formulating rations if possible

J. Other subjects which should be discussed

1. Feed preparation for poultry and methods of feeding grain and mash

2. Pastures and green feed for poultry

3. Feed and water space necessary

4. Role of fiber in poultry rations

References: 1, 2, 6, 19 and 20

References that you will use: _____

_____

_____

Teaching procedures that you will use: _____

_____

_____

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20. Nutrition and Egg Production, Agradata Vol. 2, No. 1 Terre Hante, Indiana: Charles Pfizer and Co., Inc., Agri. Res. and Development Dept., January 1958.

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22. Animal and Poultry Nutrition, St. Louis 2, Missouri, Ralston Purina Company.

23. Feeding Practices, Memphis, Tenn., P. O. Box 12023, National Cottonseed Products Association.

24. Feedstuffs' Analysis Table for Feed Ingredients, Minneapolis 40, Minnesota, P. O. Box 67, The Miller Publishing Company.

RESOURCE MATERIALS FOR TEACHING FARMER COURSES

_____
Name of Course

Books	Kind	Date	File Code
Bulletins, Magazines, Etc.			
Slides, Filmstrips, Motion Pictures			
Magnetic, Flannel, and Bulletin Board			

(Continued)

RESOURCE MATERIALS FOR TEACHING FARMER COURSES

Name of Course

Charts, Maps, Posters	Kind	Date	Film Code
Transparencies			
Specimens, Models, Mounts			
Human and Community Resources			

*B-Books, B".-Bulletins, S-Slides, FS-Filmstrips, MP-Motion Pictures, C-Charts, M-Maps, P-Posters, T-Transparencies, Mg-Magnetic, Sp-Specimen, Fl-Flannel Board, A-Articles, BB-Bulletin Board, M-Models, AO-Actual Object, HR-Human Resources.

TOPIC PLANNING FOR THIS COURSE

Name of Course _____

Name of This Topic _____

Teaching Objectives: (Possible learning outcomes for those enrolled)

Major Phases of the Topic: (Problems, jobs, areas, skills, key points, understandings, etc.)

Learning Activities: (Field trips, completing summary forms, panel discussions, demonstrations, etc.)

Teaching Materials needed: (Book, bulletins, Visual Aids, etc.)

STUDENT SURVEY

(Livestock Feeds and Feeding)

Individual Reports Will Be Confidential

1. Name _____ Age _____

2. Address _____

3. Education (circle highest grade completed)

Elementary	High School	College
1 2 3 4 5 6 7 8	1 2 3 4	1 2 3 4

4. Previous livestock feeding schools, short courses, etc. attended.
Describe _____

_____

_____

5. Farm owner _____ Renter _____ Feed Merchant _____
(check one)

6. Type and No. head of livestock grown by you:

Beef cattle - No. head of breeding _____
No. head of market cattle _____

Dairy cows - No. _____

Hogs - No. purebred breeding hogs _____
No. grade breeding hogs _____
No. market hogs - annually _____

Chickens - Home flock - No. birds _____
Commercial eggs - No. birds _____
Hatching eggs - No. birds _____
Broiler production - No. _____

Other - _____ No. _____
_____ No. _____

7. Feed crops grown for use on farm; No. acres:

Corn (grain) _____ Other grain _____

Soybeans _____ Corn silage _____

Hay crops (kind) _____ Permanent pasture _____

Temporary pasture (kind) _____

8. Do you grind and mix feeds at home? _____ (yes) _____ (no)

For which livestock? _____

Do you bulk-feed? _____

Do you use mobile grinding and mixing service? _____ (yes) _____ (no)

9. In the past, what have been your main sources of information on new things in feeds and feeding? _____

_____

_____

_____

10. Check the areas below in which you are especially interested in this course.

A general knowledge of animal nutrition _____

Ability to formulate and calculate balanced rations _____

Feeding poultry _____ Feeding hogs _____

Feeding beef cattle _____ Feeding dairy cattle _____

Other livestock _____

11. List other special problems you wish covered in this course _____

_____

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ABSTRACT - This course outline is for teachers to use in planning an introductory course to vocational education in which students explore in some depth a small number of occupations. The five major units are: (1) Relating Our Economic System to Occupations and to Us, (2) Exploring Manual and Mechanical Occupations, (3) Exploring Clerical, Sales, and Service Occupations, (4) Exploring Professional, Technical, and Managerial Occupations, and (5) Evaluating and Planning Ahead. Each unit includes major learning outcomes, planned learning experiences, additional educational experiences for the unit, and materials and references. A bibliography and additional course material are appended. (GR)

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TENTATIVE DRAFT

INTRODUCTION TO VOCATIONAL EDUCATION

A Suggested Course Outline

July 1963

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For

Division of Vocational Education

State Department of Public Instruction

Raleigh, N. C.

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INTRODUCTION

The justification for a vocational education course at the early high school level is associated with the needs of this age group. Youth at the early high school age have rather specific characteristics which in turn suggest certain needs. For example, they lack first hand knowledge of the world of work; therefore, they need experiences which will supply this knowledge both directly and vicariously. They have not had opportunities to explore their capacities in various areas under a variety of situations; therefore they need opportunities to self appraise their emerging potentials. This age group also is characterized by a lack of self-confidence; a need then is for experiences which tend to build self-assurance into the developing personality.

There is considerable research which indicates that youth tend to make occupational choices in stages.[1] In other words, a person doesn't reach an ultimate vocational decision at a single moment in time, but through a series of decisions over a period of many years. Yet, youth are required to make a number of educational decisions at about the ninth grade level which have an important influence on their later occupational life. For instance, many of the high schools in this state are so organized that students must select one of several educational routes at the beginning of the ninth grade. Other decisions must be made such as whether or not to continue in school beyond the age of sixteen, change curricula, or even look forward to continuing formal education beyond the high

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[1]See, for example, a summary of the work of Super and others in Appendix A. Note also in Appendix A the contribution of Baer to the planning process, and the ideas of others on the need for new approaches in vocational education, as summarized by Porter.

school. The decisions students make at this point influence greatly their eventual vocational careers either by limiting or increasing their future educational and thus vocational choices.

There is currently a need in the public school curricula for a course designed to help students prepare to make the choices which are called for as they move through school toward an ultimate vocation. Instruction is greatly needed at the early high school level which will help students eventually to make vocational choices that are satisfying and productive for both themselves and to the society of which they are a part.

Course Objectives

The over-all objective of the course might be stated as follows: "to help students develop planfulness regarding their occupational futures." Planfulness as used here involves at least three logical dimensions. These are stated below in the form of major course objectives.

Teaching objectives:

1. To help students understand the basic processes of production, processing, and distribution in the American work economy and the importance of human relations and ingenuity in these processes.
2. To help students gain a first-hand knowledge, understanding, and appreciation of the changing employment patterns and opportunities in the North Carolina world of work.
3. To help students learn to appraise their own interests, aptitudes, personalities, and skills in relation to a variety of vocational opportunities.

Institutional objectives:

1. To explore and evaluate selected methods of orienting students regarding vocational opportunities.
2. To broaden the base for vocational education offerings in the public schools of North Carolina.

Major Learning Experience Areas

A course designed to introduce students to the world of work should include learning experiences in a number of areas. The needs of youth at this age level supply some implications for appropriate learning experiences. Then the skills, knowledges, and understandings which are needed by persons entering the world of work at various levels should be considered in selecting appropriate learning experiences for specific groups of students.

The needs of students at the early high school level which have been identified above provide the basis for the following major learning experiences for students in this introductory course to vocational education.

1. Discovering and understanding economic processes related to work.
2. Discovering occupational opportunities and requirements.
3. Exploring work opportunities and requirements, including performing work tasks.
4. Self-appraising vocational interests and aptitudes.

These four major learning experience areas are included as an essential part of each unit in the course outline. In fact, they serve somewhat as a sequence of experiences with the course content serving as the vehicle through which the desired learnings take place. This procedure is used to insure that the students are given first consideration. The content is

also very important because it identifies the what in the learning experience.

Overview of Course Outline

The outline presented here is designed to minimize teacher lectures on and dissemination of economic and occupational information to students. The primary emphasis is given to student planning and decision-making. The teacher's major function then is assisting with identifying sources of information suggesting appropriate methods for exploring interest areas, and aiding with interpretation during discussion sessions.

The suggested experiences included in this outline are designed to help students gain a more realistic look at themselves in relation to the world of work. It is assumed that students will receive some instruction in these areas prior to this course as well as in later school activities. Thus the range of experiences have been purposely restricted in order to give students an opportunity to explore in some depth a small number of occupations rather than studying about the many, many thousands of occupational opportunities which are available.[2]

Major units included in the outline. The outline is divided into the five major parts or units listed below:[3]

1. Relating Our Economic System to Occupations and to Us
2. Exploring Manual and Mechanical Occupations
3. Exploring Clerical, Sales, and Service Occupations
4. Exploring Professional, Technical and Managerial Occupations
5. Evaluating and Planning Ahead

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[2]The instructional approach suggested in this outline is based on the self concept theory of learning and ideas such as those expressed by writers of the papers presented as Appendix B.

[3]See Appendix C for illustrations of how certain census data on occupations are presented. Also note the number of people who are currently

Time needed for each unit. It is suggested that three weeks be used for the first unit, twelve weeks each for the second and third units, ten weeks for the fourth unit, and two weeks for the last unit.

The last portion of the outline deals with an additional period of approximately six weeks after school is out.

Headings for each unit in the outline. The headings below are used in each major unit. A brief explanation is given of what is included under each heading.

1. Major learning outcome. This is a concise statement of the major changes which this unit is designed to help the students make.
2. Planned learning experiences. This is a listing of more specific learning experiences which students should get during the unit, including activities and other experiences.
3. Suggestions for the teacher. Several suggestions are offered for teachers' consideration in providing meaningful learning experiences for students in each planned learning experience.
4. Materials and references. The last part of each unit is devoted to a list of materials and references which appear to be particularly appropriate for the unit.

UNIT I

RELATING OUR ECONOMIC SYSTEM TO OCCUPATIONS AND TO US

The first unit of this course is concerned with introducing students to the course and providing them with opportunities to become acquainted with the American economic system and its relationship to them as potential contributors to the further development of this economy. Approximately three weeks should be devoted to this unit.

Major Learning Outcome

In this unit students should learn the need for career planning, and they should learn the basic characteristics of the American economic system and how to plan most effectively for becoming a worthwhile contributor to the world of work, including how to appraise their own occupational interests and capabilities.

Planned Learning Experiences

1. Increasing understanding of the relationship between one's present activities and life plans.

   Activities:

   Class discussion centered around such questions as the following:

   a. What is your idea of success?

   b. Does luck have much to do with determining success?

   c. What is the value of planning for a career?

   d. Are your occupational opportunities much different from those open to your parents when they were your age? How are they different?

All students should interview one of their parents or another adult about the latter's career opportunities and plans when he was of high school age. Using the information collected in these interviews and other known examples, discuss career decision-making.

Suggestions for teacher consideration:

These activities should provide a framework within which students can see a wider range of career opportunities open to them. Students should begin to recognize that there is a relationship between their work plans and their life plans. For example, if they want to live in a rural area and be outside much of the time, this limits the occupational opportunities from which they will choose.

2. Gaining an understanding of how the specialized economic activities in our society relate to us individually, including such activities as extracting raw materials, manufacturing and processing, transporting and communicating, selling, financing, giving service and advice.

Activities:

Individual study and class discussion on what is meant when we say economics is a study of production and distribution of wealth. Also class agreement on the meaning of the above economic activity terms. Clarification of mis-concepts by teacher.

Class discussion and group listing of examples of the above economic activities along with in what economic institutions these activities are likely found - farms, stores, factories, banks, schools, etc.

Individual study and investigation to discover different kinds of jobs found in an institution which is engaged in one or more of the economic activities identified. For example, a mill engaged primarily in manufacturing may employ hundreds of workers to perform many different kinds of work. Some of these workers may be producing goods while others are transporting the goods, and still others selling, etc.

Select one of the institutions identified and devote special study to its financial activities in order to learn the importance and relationship of one activity to others in the institution.

Investigate through individual and small group work and class discussion the purposes for which a dollar spent for a gallon of milk (or some other commonly used product) is used. In this activity have students to determine the percentage of the dollar that goes for the numerous expense items, including profit.

Suggestions for teacher consideration:

Select an institution for special study which is sufficiently small to be within the mental grasp of the students and one for which the financial arrangements can be readily secured. Relate the financial arrangements of the institution selected to the students own finances - the income is either saved or spent.

Students should consider the following, among other factors in their special study of financial activities in the institution selected:

a. Major items of income and expense.

b. Does the firm have a budget to guide its spending?

c. Where did the funds come from to start this institution?

d. How much has it expanded? Where did the capital come from for expansion?

e. Who owns the institution? Are stocks involved?

f. What influence do the wages paid to employees have on the community? Other institutions in the community? You as an individual in the community?

g. Do workers in this institution receive more or less pay than employees in other firms in the community?

h. Who determines for what purposes income in the institution will be spent?

A special individual project to go along with this activity would perhaps make it more meaningful to some students. For example, students might be asked to plan a personal budget for an allowance of $50 per month for a year. Out of this allowance would come all personal expense items except room and board. This would include such items as clothes, books, recreation, entertainment, etc.

The activity involving the distribution of the milk dollar should provide an excellent opportunity to discuss with students and help them better understand such basic characteristics of the American economic system as: individual freedom, competition, private property, laws of contract, stable government by law, personal incentives, and profit motives. In this activity students may add to the list of occupations previously identified.

Through these activities, students should become more aware of the nature of work and its relationship to society. They should become more aware of the changing nature of work and requirements for employment, while a broader range of career possibilities are available.

3. Discovering occupational characteristics and requirements which seem to appeal to us individually and learning more about our personal interests and abilities.

Activities:

Each student should write a theme (average in length for 9th grade students in the school) on an occupation that he or she is interested in as a career. The theme should contain information about the occupation and why the student chose this kind of work.

Follow the written assignment by class reports and discussion on what should be known about an occupation before deciding "this is what I want to do."

Class study and discussion of individual differences among members of the class, including such traits as physical, personality characteristics, aptitudes, performance, etc. Relate these traits to occupational success.

Teacher-student individual conferences to discuss any test results and other data[4] available. Consideration should be given to personal interests and abilities as related to any tentative career plans.

Small group work followed by class reports and discussion to provide the class with an adequate list of techniques for securing information on making effective career plans for any of the occupations which have been identified.

Class, or small groups initially then the entire class, placement of the occupations which have been identified into the following broad categories:

[4]There are many forms for collecting data from students. Many school records are already available. A form such as the one in Appendix D should prove very helpful in individual conferences with students.

Manual and Mechanical

Clerical Sales and Service

Professional, Technical, and Managerial

Suggestions for teacher consideration:

In the discussion on what should be known about an occupation, students should identify and discuss such factors asthe following:

Description of the occupation

Nature of work

Working conditions

Size of the business or firm

Occupational outlook for this type of work

Income

Requirements

Personal, including mental ability, aptitudes and skills, physical, character and personality, age and sex.

Education and experience

Entrance certificate, license, or union membership.

Others

Note: See Appendix E for additional content which perhaps should be included in class discussions on this topic. Also see examples of evaluation forms which might be used by students in looking at themselves in relation to specific occupations, Appendix F.

The discussion of individual differences and the personal conferences should help students to understand themselves better and acquaint them with the kind of information tests can provide. Discussing such motives for success as money, power, fame, and service to mankind should help students to begin thinking about the relationship between self-concepts and career success.

In discovering techniques for securing information about career planning, students should arrive at such means as: identifying through study a variety of occupations from which to choose, preparing job descriptions, using an outline of specific things to look for in studying an occupation, listing advantages and disadvantages of an occupation, reading widely about occupations, interviewing persons in an occupation, and getting actual experience in the occupation.

There are a number of major occupational schemes. The three broad categories used in this outline were adapted from some of the more common classifications. These include:

a. U. S. Department of Commerce, Alphabetical Index of Occupations and Industries and Classified Index of Occupations and Industries, Bureau of the Census (Washington: Government Printing Office, 1950).

b. War Manpower Commission, Dictionary of Occupational Titles, Part IV: Entry Occupations, Division of Occupational Analysis (Washington: Government Printing Office, 1950).

c. Alba M. Edwards, Population: Comparative Occupational Statistics for the United States, 1870 to 1940. Bureau of Census (Washington: Government Printing Office, 1943).

d. U. S. Civil Service Commission, Handbook of Occupational Groups and Series of Classes Established under the Federal Position - Classification Plan (Washington: Government Printing Office, 1950).

e. Bureau of the Budget, Convertibility List of Occupations and Industrial Classification for Reports from Individuals. Division of Statistical Standards (Washington: Government Printing Office, 1940). Out of Print.

The three categories suggested above are somewhat arbitrary in nature for the purposes of this course. However, there are a number of common characteristics of the occupations which have been grouped together for study purposes.

a. Manual and mechanical: These occupations involve non-research type activities. Many of them are concerned with physical activities involved in the production, maintenance, and distribution of physical science products and plant and animal products.

Some specific occupations which might well be placed in this category are:

Forest ranger	Bricklayer	Lathe operator
Switchman	Concrete worker	Sheet metal worker
Park worker	Mechanic	Plumber
Miner	Machinest	Factory laborer
Farmer	Truck driver	Homemaker
Professional athlete	Electrician	

b. Clerical, sales, service. These occupations usually involve special skills in one or more areas, for example, attending to the needs of others, using persuasion to sell a product, or following directions of others. Judgment in dealing with others and following accepted procedures are important in many of these occupations, some of which may include the following:

Secretary	Mail clerk	Purchasing agent	Waiter
Salesperson	Porter	Receptionist	Houseworker
Stock clerk	Cashier	Policeman	
Timekeeper	Auctioneer	Sheriff	
Typist	Collector	Taxi driver	

c. Professional, technical, managerial. These occupations usually require a college education or considerable training and experience. They include research and experimentation know-how in many instances, and skill in planning ahead in others. A few occupations which might be placed in this category are:

Biologist	Jeweler	Union official	Nurse
Agronomist	Contractor	Doctor	
Physicist	Draftsman	Clergyman	
Teacher	Astronomer	Newspaper reporter	
Engineer	Aviator	Lawyer	
Architect	Factory manager	Librarian	

Classification of these occupations should serve as an introduction to the next three major course units where students will have an opportunity to study and appraise their own interests and abilities in one or more occupations in each of these broad occupational categories.

Note: At this point the class would be only interested in classifying the occupations which have been identified thus far. Numbers are not particularly important. A more exhaustive list can be developed in the next three topics if it is felt that more occupations are needed for instructional purposes.

Additional Educational Experiences for this Unit

It is suggested that teachers consider including the following additional learning experiences for students as a part of this unit. Most of these experiences have been mentioned previously but not emphasized in the outline.

1. Learning sources of occupational information.
2. Understanding the relationship of such personal factors as personality,

character, leadership, and followship to occupational opportunities.[5]

3. Learning to appreciate the importance of certain social and economic factors in career planning.

Materials and References

More detailed information is given on each reference in the Bibliography.

*1. Baer. Occupational Information. C. 1-3

2. Bryne. You and Your Abilities.

3. Chapman. Occupational Guidance. C. 1-2

4. Forrester. Occupational Literature.

5. Greenleaf. Occupations and Careers. p. 1 and 2

6. Knapp. North Carolina: An Economic Profile.

*7. National Task Force on Economic Education. Economic Education in the Schools.

*8. Report of the Materials Evaluation Committee. Study Materials for Economic Education in the Schools.

9. Senick. Your Personality and Your Job.

10. Smith. What Tests Can Tell You About You.

11. U. S. Department of Labor. Job Guide for Young Workers.

12. U. S. Department of Labor. Occupational Outlook Handbook.

13. U. S. Department of Labor. Dictionary of Occupational Titles, Volume I - II - PartIV.

14. Wolfbein. Our World of Work.

[5]See Appendix F for several examples of self-appraisal forms.

*These are for teacher preparation.

UNIT II

EXPLORING MANUAL AND MECHANICAL OCCUPATIONS

Manual and mechanical occupations furnish employment for more than 50 percent of the North Carolina work force. Included in these occupational areas are skilled, semi-skilled and unskilled workers in such occupations as manufacturing, construction, and farming. Most of these occupations involve non-research activities and many are concerned with physical activities of some sort.

Major Learning Outcomes

In this unit students should begin to look realistically at their own future occupational plans and develop a greater appreciation for the dignity of human labor.

The unit is designed to give all students an opportunity to explore manipulative skills, both for the purpose of self appraisal in relation to this type of work and to better understand the services persons in these occupations contribute to society. In doing this students should:

1. Gain a general understanding of manual and mechanical work and how it fits into our economic system.
2. Identify and explore specific requirements and skills needed for success in these occupations.
3. Learn of the changes which are taking place that affect the occupations in which students may be interested.
4. Evaluate personal, manual and mechanical occupational interests.

Planned Learning Experiences

1. Identifying a wide range of occupations which could be placed in this category.

Activity:

Individual and small group work to add to the list of manual and mechanical occupations previously identified in the first unit.

Suggestions for teacher consideration

This activity may not be necessary. The major reason for including it here is to give students an opportunity to grasp what kinds of occupations they will be dealing with during the next few weeks. It is important to see that they have identified a wide variety of occupations which should be included in this topic.

It should be emphasized also that students shouldn't get greatly concerned over whether or not a specific occupation should be placed in this category or one of the other two. The main point is that if individual students seem to have some interest in the occupation, it should be included in one of the three categories.

2. Studying the occupations which have been identified -- learning about the work they do, and learning some of the skills needed by persons to be successful in this kind of work.

Activities:

Individual and/or very small group work and visitation to observe and interview manual and mechanical workers, followed by short oral and/or written reports in class.[6]

Invite an employer of manual or mechanical workers to discuss what he looks for when employing people.

[6] See Appendix G for examples of forms for studying an occupation and information to collect in interviews.

Individual and class study of developments in industry and agriculture that have affected and continue to affect manual and mechanical occupations.

Suggestions for teacher consideration:

In helping students to prepare for studying the occupations they select, make use of the list of factors to consider in studying an occupation which the students identified in the previous unit. Perhaps it will be necessary to review this list and give students an opportunity to revise it and make additions.

This type of activity lends itself well to the development of leadership. Several committees might be used very effectively, and individual students must accept personal responsibility for carrying out their assignments.

In addition to the group work which would naturally accompany these activities, perhaps it would be well for a group of two or three students to keep a record of the reported kinds of machines workers in these occupations operate. Another committee should keep a list of all the reported tasks people in these occupations perform. (This information will be useful in a later activity.)

During class reports and study of these occupations explain to students how machines are used to replace labor and how the machines which are being listed in class affect kinds of work now available and the kinds of training needed by workers due to these machines.

It would be well to devote class time to briefly tracing with students developments in the manufacture of a machine. For example, trace the development of a car from 1900. Determine along with this the changes in jobs which were associated with the developments.[7]

[7] See Appendix H for examples of occupational changes which have taken place in two areas of work since 1900. Similar charts could be made for other areas.

During class discussions associated with these activities, teachers should better acquaint students with one aspect of our economic system - production. Include such factors of importance as: mass production and custom production; also requirements such as materials, financing, manpower, and equipment. At appropriate points in class discussions it would be well to include economic problems such as inflation and depressions and their influence on manual and mechanical occupations.

3. Identifying skills which are common to many manual and mechanical occupations.

Activities:

Reports from the committee responsible for keeping a list of all reported machines used in manual or mechanical occupations.

Report from the group responsible for keeping a list of the reported tasks that manual and mechanical workers perform.

Class discussion to make additions to these lists.

The teacher lists what he considers to be some of the basic skills needed by persons employed in these occupations.

Using the machines and task identified above, the class should add to or revise this list.

Visit with all vocational teachers in the school to determine what kinds of skills aretaught in the courses they teach.

Suggestions for teacher consideration:

This activity is designed to give students the opportunity to participate in selecting the skills they will be exploring. Their participation should help students to understand the need for

developing a wide variety of skills in most any occupation.

In visiting with other vocational teachers point out the relationship between these courses and others in the school. Also observe the machines used for teaching manual or mechanical skills by these teachers.

It should be emphasized that all occupations require skills of one kind or another. Some of those identified for special exploratory work here may or may not be important to success in other occupations.

Each teacher will perhaps have his own ideas as to what are basic skills in the manual and mechanical occupations. The following suggestive list was adapted from Curriculum Resource Materials for School Retention and Pre-Employment Needs:[8]

a. Household maintenance and repair.

(1) Simple electrical repairs: replacing wires on lamps, replacing switches, fuses, repairing plugs, bells.

(2) Puttying windows.

(3) Replacing washers on plumbing facilities.

(4) Elementary painting.

(5) Removing furniture and rug stains.

(6) Elementary plastering.

(7) Setting up an antenna.

(8) Replacing locks.

b. Woodworking

(1) Measuring and sawing.

(2) Using common handworking hand tools.

(3) Operating basic power machines.

(4) Preparing wood for joining.

(5) Assembling.

[8] Board of Education of the City of New York, pp. 207-208.

(6) Finishing and painting simple furniture projects.

(7) Reading and analyzing simple plans.

c. Metal work and light fabrication of plastics and metal.

(1) Repetitive operations.

(2) Grinding.

(3) Polishing.

(4) Filing.

(5) Drilling.

(6) Assembling and sorting.

(7) Fastening.

d. Service and mechanics' industries. (Building maintenance, restaurants, dry-cleaning plants, service stations including automobile and aircraft).

(1) Cleansing.

(2) Polishing.

(3) Stock taking.

(4) Pressing.

(5) Serving.

(6) Lubrication.

(7) Basic repair services for radio and TV, automobile, household appliances.

4. Exploring skills which are common to many manual and mechanical occupations.

Activities:

Individual and small group shop and classroom projects which involve as many as possible of the following elements which appear to be common to the skill areas listed above.

a. Measuring

b. Estimating

c. Care of tools

d. Care of supplies

e. Neatness

f. Safety precautions

g. Planning

h. Teamwork

i. Maintaining machines

j. Following directions

k. Trade or job vocabulary

l. Evaluating

(1) Checking

(2) Trauble shooting

m. Basic tools

n. Fitting one job into related jobs

o. Workshop assembly

(1) Counting and sorting

(2) Folding

(3) Weighing and sorting

(4) Packaging

(5) Assembling

Suggestions for teacher consideration:

Due to the variation in facilities available in schools throughout the state, and since different groups of students will be interested in different kinds of experiences, no effort is made here to suggest specific skill projects or activities, except to point out that the study of manual and mechanical occupations is perhaps the most appropriate time during the course to help some students develop certain skills which will be useful in many occupations.

Several of the skills identified above lend themselves to shop-type projects which are already common to many schools. In addition, the following are examples of other techniques teachers may wish to use in developing this learning area with students.

Plan with the students the organization of toolroom/office. What materials do we need? How much room do we have? Where should they be placed? This will involve measuring, observation, estimation, learning the principles of scale, and the importance of lighting and ventilation. Students might draw a rough plan of the room they work in.

Arrange for a visit to a place of business and ask one of the students to act as a guide. The class should plan in advance what to look for and the questions they want answered. This will give the

student guide an opportunity to prepare in advance and where necessary and convenient, to discuss the project with someone in the business. For example, in a scheduled visit to a stationery concern, some of the main questions might be:

a. What are the main items the company handles?

b. What is its source of supply?

c. How does it keep check on what has been sold? what is left?

d. How does it classify and arrange its stockroom for easy handling?

From time to time, the school will present simple repair problems within an area studied, requiring some form of trouble-shooting and solution. The class can be organized in the form of small rotating committees to observe how the problem was repaired and ,in some cases, participat~~ing~~e. A report of the work should be given to the class as a whole. Some of these tasks will require help or supervision from the teacher or other qualified person. Commendations and ratings are, of course, given. Examples of these repair problems and office problems might be:

a. Broken plasterboard wall.

b. Jammed stapling machine.

c. Tracing lost mail.

d. Broken roller map.

e. Puttying a window.

Make provision for an exhibit of meritorious work in a section of the shop, classroom, or school library. Some examples might be: stenciled work, wood projects, job analysis, sheet (with drawing) of a repair job.

Develop reading exercises based on printed matter directions, ingredients on labels of supplies in the particular area of saleable

skill. This will add to building up the skill or trade vocabulary.

Estimate the cost of a home repair job. How does one make sure he will not lose money? Factors to take into account are: source for buying materials, quantities of material, wastage, time to complete job, profit anticipated, cost of helpers.

Keep in mind that skill development by students in the activities selected is secondary. The primary concern is to help students relate the activities and work skills to their own interests and planning for the future in some occupation.

Other skills which appear to be appropriate for exploration by some students in this unit are: basic mechanical drawing, wood fitting, metal work, use of portable machinery, glass cutting, simple stenciling, soldering, pipe cutting and threading, simple installation of elementary electric circuits, heating and hardening metals, simple lathe work.

5. Appraising one's interests, aptitudes, and potentials in manual and mechanical occupations.

Activity:

All students select a manual or mechanical occupation which has some appeal to them personally. Evaluate this occupation using the factors which were previously identified by the class as useful in studying an occupation. A written report should be prepared of the findings of this study.

Suggestions for teacher consideration:

It may be advisable in this activity to provide students with a

suggested outline to follow, for example:[9]

a. Name of occupation.

b. Importance of the occupation to society.

c. Approximate number of people employed.

d. Duties and types of tasks involved, including types of equipment used.

e. Educational preparation and training needed.

f. Personal qualifications for the education and training needed.

g. Personal characteristics required - physical, mental, personality.

h. Method of entry, advancement opportunities, and possibilities of promotion to other occupations.

i. Earnings.

j. Working conditions and hours, including steady or seasonal, overtime, environment, etc.

k. Analysis by student of his personal characteristics in relation to the occupation.

l. Statement regarding any changes in appeal which the occupation has to the student.

Additional Educational Experiences for this Unit

Teachers should provide students with an opportunity to gain the following additional experiences at appropriate times during this unit.

1. Learning the opportunities in North Carolina for meeting educational requirements of manual and mechanical occupations.

2. Learning to more fully appreciate and understand the relationship

[9] See Appendix G for several examples of forms which have been used for this purpose.

between manual and mechanical occupations and other occupations in the world of work.

3. Becoming more aware of the importance of all parts of the school curriculum in occupational planning.

Materials and References

More detailed information is given for each reference in the Bibliography.

*1. Baer. Occupational Information. C. 5,6,7.

2. Chapman. Occupational Guidance. C. 4,5,6,21,22.

3. Gilles. Charting Your Job Future.

4. Greenleaf. Occupations and Careers. C. 19-22.

5. Hoards Dairyman. Choose Your Career in Agriculture.

*6. Hoppock. Occupational Information.

7. Humphreys. Choosing Your Career.

8. Knapp. North Carolina: An Economic Profile.

9. Packard. Do Your Dreams Match Your Talents.

10. Paulson. Discovering Your Real Interests.

11. U. S. Department of Labor. Dictionary of Occupational Titles.

12. U. S. Department of Labor. Manpower Report of the President.

13. U. S. Department of Labor. Occupational Outlook Handbook.

14. Wilkinson. The Sextant Series for Exploring Your Future in Manufacturing (Wage).

*These are for teacher preparation.

UNIT 3

EXPLORING CLERICAL, SALES, AND SERVICE OCCUPATIONS

More than 25 percent of the North Carolina labor force is employed in clerical, sales, and service occupations. Most women in the labor market are employed as clerical workers. Opportunities for employment in these occupational areas have increased during the 1950-1960 period in North Carolina.

Major Learning Outcome

The activities in this unit should afford students the opportunity to explore their own interests and capabilities in clerical, sales, and service type occupations. In addition, students should better understand how goods are processed and distributed in the American economy. In doing this students should:

1. Gain a better understanding of clerical, sales, and service work and how work in these occupations fits into our economic system.
2. Identify and explore opportunities and specific requirements and skills needed for success in these occupations.
3. Learn of changes taking place which affect occupational opportunities.
4. Evaluate personal clerical, sales, and service interests.

Planned Learning Experiences

1. Identifying the more common clerical, sales, and service occupations in North Carolina along with the possible job opportunities in these occupations.

Activities:

Class study and discussion on what are clerical, sales, or service occupations. Leading questions such as the following may be appropriate:

a. Do we have any clerical workers in our school? Sales? Service?

b. How did they get their job?

c. How many of you have parents, brothers, or sisters in clerical, sales, or service work?

Identify a wide range of clerical, sales, and service occupations through individual, small group then class procedures.

Through individual and group effort, determine approximately how many people are employed in these occupations in this county.

Collect want ads for a week from local newspapers to help determine the opportunities for work in these occupations in the county.

An individual interview by a student with the manager of the local Employment Security Office to determine availability of work in these occupations in the county - state.

Class discussion on questions similar to the following based on the information collected.

a. What are the most common occupations for women?

b. Why do a large proportion of girls enter clerical occupations?

c. Are there more men or women clerical workers? Why?

d. Do many of the boys who graduate from this school get jobs in sales or service occupations?

Organize a group project to show where clerical, sales, and/or service occupations are located in this county (town if of sufficient size). Center map on a large piece of wrapping paper and print the names of company at the side. Use different colored thread to connect

with map pin. Discuss the pros and cons of selecting a place to work near home.

Suggestions for teacher consideration:

In helping students to become acquainted with clerical sales and service occupations emphasize the wide variety of jobs included in this category. The aim is not to identify every occupation, yet enough that students will have a good understanding of the kinds of work they will be dealing with during the next few weeks.

Although emphasis is placed on occupational opportunities in this county, discuss with students the increasing rate at which people migrate from one part of this country to another. It is very likely that some of them will find employment in one of these occupations in another county, perhaps another state.

2. Gaining a better appreciation for and understanding of the work performed in clerical, sales, and service occupations.

Activities:

Plan a field trip to a nearby office to learn more about what kind of work is done in one specific occupation. If possible on this trip visit with persons engaged in clerical work, sales work, and service work.

Class visitation to commercial department in the high school or a nearby institution to learn more about the work people in clerical work perform and the education needed to prepare for this work.

Visit with all vocational teachers in the school to learn more about work performed in sales and service occupations.

Class study, reports, and debates on work in these occupations

and their importance to society.

Class member participation in producing posters indicating graphically the requirements and rewards of these occupations.

Class discussion on the importance of these occupations in processing and distribution in the American economy. Consider what would happen to our economic system if all these occupations were eliminated. Relate them to manual and mechanical occupations.

Written assignment on the growth and importance of clerical, sales, or service occupations to the American economy, including a statement concerning the appeal any of these occupations might have to the student personally for a future vocational career.

Students dramatize what might be a typical day as a secretary, salesperson, or a person in a service occupation.

Suggestions for teacher consideration:

Prepare students foreach field trip. They should understand clearly the purposes for which the visit is being made and the information which they will want to secure for themselves as well as what will be needed for class purposes. Some time in class prior to the trip should prove to be very beneficial.

In visiting with other vocational teachers and the commercial teachers take time to have these teachers help students see the relationship of these coursesto others in the total school program. Also during these visits call attention to the various types of machines which are used by workers in these occupations.

Use examples to illustrate the importance of clerical, sales, or service occupations. For instance, identify with the class all clerical and sales work associated with the cereal that students ate for breakfast.

Emphasize the importance of such forces as specialization and efficiency on opportunities for employment in clerical, sales and service occupations.

3. Exploring clerical, sales, and service skills.

Activities:

Small group work (divided into clerical, sales, and service occupational groups) to identify some of the more important skills which are needed by workers in these occupations.

Study educational and other requirements needed by workers in most of these occupational areas.

Secure actual experience in keeping records. This activity should be in cooperation with mathematics teacher and perhaps commercial teacher.

Written assignments to get experience in writing business letters, and relating this to the services performed by those who handle the letter until the student receives a reply.

Individual interviews by students to learn more about the work of specific occupations that appeal to them.

Class interview with one or more persons from each of these occupational areas.

Role playing in class to improve student skills in such areas as how to meet a customer, carrying out instructions, giving directions, etc.

Individual projects to help students explore their own interests and skills in these occupational areas (see note regarding skills under suggestions below).

Suggestions for teacher consideration:

As was learned in the previous unit, there are a number of skills which seem to be common to a large number of occupations. Use can be made here of many of the skills identified in the unit on exploring manual and mechanical occupations. The elements identified in that unit which seem to be common to many occupations may be used effectively here.

A wide variety of activities may be devised to give students the opportunity to explore fully such skills as the following:

Indexing and filing (folders, cross reference, alphabetical, numerical, geographical).

Handling mail and postal information.

Transporting messages and goods using forms and records: bank, stock, and personnel.

Using standard office procedures.

Using the telephone and taking messages.

Operating office machines and equipment: stencil; liquid duplicator; stapler; switchboard; sealing and stamping machines.

Wrapping.

Selling.

Investigating.

The following skills also should be appropriate for some students to explore during this unit: handling sales, cash receipts, purchases, and purchase returns; handling invoices, credit memos, requisitions; elementary selling; solving typical sales mathematical problems; simple baking - cup cakes, sweet rolls, etc.; analyzing changes in food; using kitchen tools and equipment; elementary catering; displaying materials; stitching, cutting, lining, padding, and pinning fabrics; basic hand and machine sewing skills.

4. Becoming familiar with opportunities in education and training for clerical, sales, and service occupations.

Activities:

Individual and group study and class discussion on opportunities for education and training for clerical, sales, and service occupations, including opportunities in high school, business or commercial courses, two-year college programs, four-year college programs, industrial education centers' programs, and on-the-job training programs.

Divide the class into buzz groups. Assign each group to discuss the educational opportunities in North Carolina for (1) clerical (2) sales, and (3) service jobs. Have secretary of each buzz group to make a report to the class.

5. Appraising one's interests, aptitudes, and potentials in clerical, sales, and service occupations.

Activity:

All students select a clerical, sales or service occupation which has some appeal to them personally. Evaluate this occupation using the factors which were identified earlier by the class. A written report should be made by each student on the findings of his study.

Suggestions for teacher consideration:

The outline used by students in evaluating manual and mechanical skills should be appropriate to use here.

Additional Educational Experiences for this Unit

Additional learning experiences which seem to be appropriate to include in this unit are:

1. Sharpening ones views relating to occupational considerations such as:

   a. Working inside vs working outside.

   b. Working in a small office or concern vs working in a large concern.

   c. Working for others vs working for oneself.

   d. Working on job with limited opportunity for advancement vs working in one where there is no limit to possible material return.

2. Learning more about determining their own interests through tests. For example, questionnaires similar to the one in Chapter 3 in Jobs in Clerical Work, Science Research Associates, 1959, or those on pp. 53-59 of Charting Your Job Future, Science Research Associates, 1959. Similar questionnaires may be developed for sales and service jobs.

3. Investigating the possibility of part-time work in one of these occupations.

Materials and References

Detailed information is given for each reference listed in the Bibliography.

*1. Baer. Occupational Information.

2. Bryne. You and Your Abilities.

3. Chapman. Occupational Guidance. C. 9,12,13,16,17.

*4. Division of Vocational Education (Ohio). Course Selection and Career Planning.

5. Greenleaf. Occupations and Careers. C. 14,15,16,17,18.

*6. Hoppock. Occupational Information. C. 14,15,16.

7. New York Life Insurance Company. Pamphlets on occupations.

8. Plummpr. Careers and You.

9. U. S. Department of Labor. Dictionary of Occupational Titles.

10. U. S. Department of Labor. Job Guide for Young Workers.

11. U. S. Department of Labor. Occupational Outlook Handbook.

12. Wolfbein. Our World of Work.

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*These are for teacher preparation.

UNIT 4

EXPLORING PROFESSIONAL, TECHNICAL AND MANAGERIAL OCCUPATIONS

Occupations which are classified as professional, technical or managerial attract the attention of many young people in the process of choosing careers. Yet, relatively few youth actually achieve this goal. Due to the education and other requirements necessary for entry into these occupations, students are forced to decide early that they must make educational and other plans which permit them to meet entry requirements, or that some other occupation would be a more realistic career choice.

Major Learning Outcomes

As a result of the activities and other learning experiences in this unit, students should be more appreciative of the contribution persons in professional, technical, and managerial occupations make to society, and they should have learned to be more realistic in their own occupational planning. These outcomes will be accomplished through individual and group activities dealing with:

1. What are professional, technical and managerial occupations?
2. Which of these occupations offer career opportunities for class members?
3. What kinds of work do persons in these occupations perform?
4. What educational and other preparation must be made by persons desiring to enter one of these occupations?
5. Where and under what conditions may this education and training be secured?
6. An evaluation of one's personal interest in professional, technical, or managerial work as a career.

Planned Learning Experiences

1. Identifying the more common professional, technical, or managerial occupations in North Carolina along with possible career opportunities for class members in these occupations.

Activities:

Class discussion on what are professional, technical, and managerial occupations. The discussion might be centered around such questions as the following:

a. Are there professional workers in our school? technical? managerial?

b. In which economic institutions in our community do we find these occupations?

c. How many of the class members have parents, brothers, or sisters employed in one of these occupations.

Small group investigation to identify professional, technical, and managerial occupations which are common to North Carolina. Determine which ones are increasing in numbers and which ones are declining. Secretaries should report the findings of their groups to the class. A list of the occupations identified should be reproduced so that each member of the class may have a personal copy. A part of the report should give the approximate number of people in the county employed in each occupation identified.

Class discussion on which occupations identified are open to women? men?

Class research project to determine the number of graduates from this school (or schools which consolidated to make this one) who have entered professional, technical and managerial occupations during the past ten years. Class discussion on why the percentage is so low.

Suggestions for teacher consideration:

Again, the concern in this activity should be to identify a range of occupations which will encompass the interests of class members. The total number identified is important only to the extent that it contributes to a better understanding of what are professional, technical and managerial occupations.

Emphasize in class discussions the necessity of moving outside the community to find employment in many of these occupations.

2. Gaining an appreciation for and a better understanding of work done by persons in professional, technical, or managerial occupations.

Activities:

Invite some person from a professional occupation to speak to the class concerning his own occupation and other professional occupations that are similar to his. The speaker should be furnished a list of questions by students which they want answered.

Individual and small group work followed by class reports to gain additional knowledge about the work of people in these occupations. Assignments would include activities such as the following:

a. Interviews with persons in these occupations.

b. A skit portraying a typical day for an effective worker, and ineffective worker in one of these occupations.

c. A bulletin board display.

d. Debate regarding the advantages and disadvantages of work in these occupations.

Class discussion describing the various kinds of professional jobs, noting the similarities and differences in the training, nature of work, and opportunities.

Select five common professional, technical, and managerial occupations and explain the educational requirements of each.

Individual student reports on subjects in the senior high school which are important for one of several common occupations in this group.

Each student select one occupation he or she is interested in and trace the education and training needed from the beginning of high school until employment.

Written assignment on the growth and importance of a professional, technical, or managerial occupation to the American economy, including a statement regarding the appeal this occupation may have to the student personally for a future vocational career.

Suggestions for teacher consideration:

As with previous activities involving field trips or visits by outsiders to classes and individual or small group investigations, students should be clear on what is to be done and the purposes for the activity. Each student should understand what information he is seeking and how it will be used.

Help students relate the work in these occupations to our economic system and more specifically to the students as members of our society. Give special attention to such economic factors as supply and demand, technological change, business cycles, and public policy as they relate to occupational opportunities.

3. Exploring skills in professional, technical, and managerial occupations.

Activities:

Individual visits with and observation of people working in one of these occupations. Participating in the work to the extent possible.

Make a list with class members of the more common skills which students have identified as being needed by persons in these occupations. Separate the skills according to whether they are primarily concerned with (1) science, (2) words, or (3) people. Class participation in devising techniques which might be used to help them explore more fully some of the skills identified.

Suggestions for teacher consideration:

Students should prepare a list of the activities they hope to observe and experiences they hope to secure prior to visiting with the person they select.

It may be more necessary to help students devise vicarious means of exploring skills in these occupations than in those previously explored. Role playing, hypothetical problems, and demonstrations should be explored fully.

The understandings and skills listed below are generally considered to be useful in many professional, technical, and managerial occupations:[10]

a. Mastery of the scientific method.

b. Understanding people and working with them effectively.

c. Skill in communication.

d. Organizational skill - the marshaling of scarce resources for given ends.

e. Wholehearted and persistent application to the task at hand.

[10] See Plummer. College, Careers and You. P. 9.

f. Memory and a judiciously selected knowledge of classified facts and relationships.

4. Becoming familiar with educational and training opportunities in North Carolina for professional technical, and managerial occupations.

Activities:

Small group work to plot on maps the location of educational and training opportunities for professional, technical, and managerial occupations in North Carolina.

Each student investigate the education and training he would need for a specific occupation and determine approximately how much this preparation would cost.

Relate educational requirements in the institutions identified in the activities above to courses offered in our high school.

Suggestions for consideration by teachers:

Make effective use of the school guidance counselor in these activities.

5. Appraising one's interests, aptitudes, and potentials in professional, technical, and managerial occupations.

Activities:

Class discussion on the most important points to be considered by students in evaluating a professional, technical, or managerial occupation.

Class discussion on why it is important to consider more than

one occupation in making career plans. Discuss what would be appropriate alternative choices to such occupations as a doctor, clergyman, scientist, banker, engineer, pilot, etc.

Student written reports on a professional, technical or managerial occupation of particular interest to them. This report should include information on the students' interest in this occupation prior to this unit, the new knowledge gained about the occupation during the unit, and any plans for furthering this occupational interest.

Suggestions for teacher consideration:

For the written report in this learning experience make use of the outline developed earlier for evaluating a manual and mechanical occupation.

Additional Educational Experiences for This Unit

Other educational experiences which might well be included in this unit include the following:

1. Relating professional, technical, and managerial occupations to other occupations - manual and mechanical, or clerical, sales, and service.
2. Gaining a better understanding of the importance of professional, technical, and managerial occupations in our American economy.

Materials and References

Detailed information is provided for each reference in the Bibliography.

*1. Baer. Occupational Information.

2. Chapman. Occupational Guidance. C. 14,18,19,20.

3. Greenleaf. Occupations and Careers. C. 11,12,13.

4. Groves. Education and Economic Growth.

5. Hoards Dairyman. Choose Your Career in Agriculture.

*6. National Task Force on Economic Education. Economic Education in the Schools.

7. New York Life Insurance Company. Pamphlets on various occupations.

*8. Norris. The Information Service in Guidance.

9. Paulson. Discovering Your Real Interests.

10. Plummer. College Careers and You.

*11. Super. The Psychology of Careers. C. 18-21.

12. U. S. Department of Health, Education and Welfare. Education forthe Professions.

13. U. S. Department of Labor. Job Guide for Young Workers.

14. U. S. Department of Labor. Occupational Outlook Handbook.

*These references are for teacher preparation.

UNIT 5

EVALUATING AND PLANNING AHEAD

This is the last major unit during the school year. It is designed for approximately two weeks of school.

Major Learning Outcomes

In this unit students should review their overall occupational interests and skills in relation to career opportunities in the American economic system. Students also should add to their knowledge of how to plan ahead vocationally in this unit.

Planned Learning Experiences

1. Evaluating and stablizing personal growth in occupational planning during this year.

Activities:

Review the activities of the course which have dealt with the American economic system and its relationship to students as potential workers in this system. This review should include discussions on such topics as those listed below:

a. Supply and demand of products as related to occupational opportunities and requirements.

b. Business cycles as related to occupational opportunities and requirements.

c. Technological change, automation, specialization, and bigness as related to occupational opportunities and

requirements.

d. Taste and style as related to occupational opportunities and requirements.

e. Public policy as related to occupational opportunities and requirements.

f. Socioeconomic status as related to occupational opportunities.

Review activities in the course which have dealt with discovering occupational opportunities and requirements. Students should select one or more occupations which appeal to them personally which they would like to explore more fully later.

Review activities in the course which have dealt with exploring work opportunities and requirements. Students should be able to use effectively by this time the instrument which has been used throughout the course in stuyding occupations. Discuss the procedure for studying an occupation and answer student questions concerning its use.

Review the activities which were concerned primarily with occupational skills. Students should list those skills which they have mastered best. Also list those which were most difficult for them to master. Select several skills from these lists which they would like to improve.

Review the activities in the course which dealt with appraising one's interests and aptitudes. Brief written reports from students should help to clarify what they want from the American economic system. For example, answer the following questions:

a. What is a useful job to you?

b. What is an acceptable standard of living to you?

c. What is a reasonable economic security to you?

d. What recognition do you want from fellow citizens?

e. What is personal freedom to you?

Suggestions for teacher consideration:

A minimum amount of time should be devoted to class discussion as a technique for review in this unit. It is anticipated that much of the time would be used for individual conferences dealing with problems and questions which the students have. Class time would be used for preparing the written reports suggested above.

2. Planning for additional learning experiences which students want and believe they need.

Activities:

Each student should study briefs on high school courses and state in writing which of these courses have most to offer in planning his or her occupational future. Indicate how the courses selected can make a contribution.

Students should indicate in writing the major changes which they think they must make in order to succeed in an occupation which is of interest to them at this time. Indicate changes needed in such areas as study habits, personality, use of time, skills, experience, etc. State in writing what will be done during the next six weeks to make the changes needed.

Suggestions for teacher consideration:

These activities should be effective pre-planning for teacher visits and follow-up of the course during the month after school

is out. It is suggested that special attention be given to helping students explore selected skills and activities in actual work situations after school is out.

Materials and References

More detailed information is given on each reference in the Bibliography.

*1. Baer. Occupational Information.

2. Chapman. Occupational Guidance. C. 23,24,25,27,28.

3. Gilles. Charting Your Job Future.

*4. Hoppock. Occupational Information. C. 18,25.

5. Humphreys. Choosing Your Career.

6. Knapp. North Carolina: An Economic Profile.

*7. Norris. Information Service in Guidance. C. 13.

8. Packard. Do Your Dreams Match Your Talents?

9. Paulson. Discovering Your Real Interests.

*10. Super. The Psychology of Careers. C. 18.

*These are for teacher preparation.

GETTING WORK EXPERIENCE

There is no way for a person to be certain that he has chosen the right occupation until he has actually worked in it long enough to find out for himself. For this reason, work experience has been included as a part of this course outline. Perhaps the minimum time recommended here for students is far short of that needed by them to make final judgments regarding an occupational choice. Final choice, however, is not the aim here. It is believed that work experience under actual conditions will help students to further evaluate tentative occupational interests, and help them in making appropriate educational plans as they progress through school.

As visualized here, work experience includes part-time work after school and on week ends or summer jobs and jobs around the home. Just any job will not prepare students for or better acquaint them with occupations of their choice. Thus, work experiences should be selected very carefully. In many instances this will involve parent-student-teacher planning. Special attention should be given to helping students get work experiences which they can relate to the occupational area that interests them.

At the same time, part-time work in many areas will be hard to find. It will be necessary for teachers to work through organizations and economic institutions in the community to help place students, especially for summer employment.

Students will naturally be interested in the monetary rewards from work. It may be necessary for teachers to use a variety of techniques to help students understand that there are more basic values to be derived from the work experiences which are planned as a part of this course.

The Work Experience Plan

It is suggested that all students secure a job and work for a minimum of one week during the first six weeks after school is out. In some instances the work may involve two or more jobs. Special care should be given to helping students select work which they can relate in several ways to their occupational interests.

Student planning. The activities in Unit 5 should serve as a basis for student planning for their work experiences. A number of jobs should be identified which relate to an occupation that is of interest to each student. For example:

baby sitting - homemaking, teaching, nursery, school work

care of lawn - landscape gardner

delivery boy - sales, business

newsboy, car hop - sales, business

farm hand - farming, agricultural occupations

All students should make specific plans for the work they will be doing. Each student should prepare a list of experiences he or she hopes to get while working. Each experience should be related in some way to the occupational interest of the student.

Students should become familar with appropriate ways to apply for a job. They should review and/or study how to get and hold a job.

Teacher planning. Teachers will need to locate all possible part-time work opportunities that are available through economic institutions in the community. In many instances it will be necessary for teachers to help place students, but where possible students should get the actual experience of applying for a job and making their own agreements.

The teacher should coordinate the work experiences so that no more

students are working in any one week than the teacher can visit and hold individual conferences with. Contacts should be made with the employers also.

Evaluation

The work experiences of each student should be evaluated and the results should become a part of the students permanent record in the school.

Student evaluation. Students should make a written evaluation of their own work experiences. In doing thisthey might use their list of planned experiences and the form used throughout the course for evaluating a job.

Employer and teacher evaluation. A written report should be made of the students' work by the employer and/or the teacher. Where possible an evaluation conference should be held with the student at the time his employment terminates.

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*10. Hoppock, Robert. Occupational Information. New York: McGraw Hill Book Company, Inc., 1957.

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APPENDIX A

ERIC

THE PLANNING PROCESS*

Beginning with Frank Parsons and continuing for many years, vocational guidance was described as a threefold process. An individual seeking assistance was encouraged to study himself, to investigate his vocational opportunities, and to match his attibutes with his opportunities. It was assumed that vocational planning was primarily the application of intellectural problem-solving abilities. Within the past decade there has been growing unrest over these descriptive steps. Likewise, there has been a growing search for a more dynamic rationale for career planning and vocational development. Statements by Ginzbert et.al.[1] and by Super,[2] as well as the summary of Darley and Hagenah,[3] are illustrations of this trend. These and other sources have supplied some of the following ideas around which the counselor or the teacher might build his rationale.

Individual planning. Within cultural and personal limits, each individual has the right to make his own career plans and to pursue such plans at his own pace and under conditions consistent with his own values and needs. Although our culture does not provide complete freedom in making or pursuing plans, the individual's right to self-determination, insofar as feasible, defines the counselor's and the teacher's role and makes it a democratic role, free from telling the individual what he must or must not do educationally and vocationally. It also suggests that all students are not equipped or ready to make and pursue plans at certain prescribed grade or age levels. They have a right to follow a natural, developmental pattern of career planning.

In his discussion of vocational adjustment, Super has provided one of the more meaningful descriptions of the over-all objectives of the career planning and development process. He[4] theorized that

> ..satisfaction in one'e work and one's job depends on the extent to which the work, the job, and the way of life that goes with them, enable one to play the kind of role that one wants to play. It is, again, the theory that vocationa development is the development of the self concept, that the process of vocational adjustment is the process of implementing a self concept, and that the degree of satisfaction attained is proportionate to the degree to which the self concept has been implemented...This leads to a final theory... work is a way of life, and ...adequate vocational and personal adjustment are most likely to result when both the nature of the work itself and the way of life that goes with it (that is, the kind of community, home, leisure-time activities, friends, etc.) are congenial to the aptitudes, interests, and values of the person in question.

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* Taken from Max F. Baer and E. C. Rober, Occupational Information (Chicago: Science Research Associates, 1958), pp.356-359.

[1] Ginzberg and others, op.cit., pp. 59-130.

[2] Donald E. Super, "Vocational Adjustment: Implementing a Self-Concept," Occupations, XXX (November, 1951), pp.88-92.

[3] Darley and Hagenah, op.cit., pp. 103-93.

[4] Donald E. Super, "A Theory of Vocational Development," The American Psychologist, 8 (May, 1953), p. 189.

In another article, Super[5] also redefined vocational guidance as "the process of helping a person to develop and accept an integrated and adequate picture of himself and of his role in the world of work, to test this concept of reality, and to concert it into a reality, with satisfaction to himself and to society."

Taking these two statements, the counselor ot the teachers can find several ideas which could influence his thinking about his function in the career planning and development process.

Self concept refers to a person's picture of himself, that is, how he sees himself-as he is and as he would like to be. Daily, each person plays roles at school, at home, and at work. What are these roles? He also has the desire to play certain roles at school, at home, and at work, roles which may well differ from reality. What are these desired roles? In any examination of self concepts and roles, the individual has to explore his aptitudes, interests, attitudes, values, and needs. If he discovers conflicts between how he sees himslef and how he would like to see himself, he ordinarily tries to find ways in which to resolve the differences. He attempts, as it were, to find a compromise[6] between his real self and his ideal self. Furthermore, these self-pictures may change significantly from time to time - they are a part of an ongoing, lifelong process. Both through group procedures and through counseling services, effective career planning activities are designed to aid in the development of these self-pictures. Strategically placed group procedures throughout all educational levels, augmented by counseling services as they are needed by individuals, increase the likelihood of adequate career planning.

Besides actually teaching information, group procedures are especially well adapted to orienting students to what is involved in making career plans, how they can use occupational and personal information in the process, and how they can collect many types of information. Counseling provides the nonevaluating environment in which pupils may safely carry on several types of explorations: consideration of personal attibutes and aspirations, attitudes toward occupational life, most advantageous compromises, possible testing experiences, and personal evaluations of any such testing experiences.

Implementing a self concept relates to an individual's efforts to explore the kinds of roles which best meet his needs. Such explorations are actual tryouts or testing experiences. They are a part of a lifelong process which is characterized by testing, re-examinating self-pictures, compromising inconsistencies, testing some more, ad infinitum. In attempting to find congenial roles in the families of occupations, a person is faced with the problem of finding economical methods by which to explore the ways of life associated with various occupations. Some types of career plans involved commitments in time and money that make it difficult to shift radically from one occupational family to another or, at times, even within one family of occupations.

Sometimes a person can find information, printed or otherwise, that will give him a "feeling for" the way of life associated with an occupation or occupational family. If he is able to project himself into the roles of various workers, he is able to make and evaluate tentative plans. In the final analysis, however, he has to test roles many times through educational preparation for, or actual work experience within, an occupational family.

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[5] Super, "Vocational Adjustment etc." op.cit., p. 92.

[6] Ginzberg and others, op. cit., pp. 185-98.

When searching for occupational pictures and testing situations, the counselor and the teacher are faced with extraordinary challenges. Trial and testing experience such as school subjects, extraclass activities, or work experience are always a necessary part of career planning and development. Individuals may need assistance in finding appropriate activities for testing purposes, and they may need help in evaluating the implications of such experiences. Professionally, the counselor and the teacher must accept responsibility for these kinds of assistance. The guidance services should also accumulate two types of data. First, they should provide survey data regarding testing experiences that are currently available in the school and in the community. Second, they should be able to demonstrate the need for any additional testing experiences.

November 12, 1962

THE NEED FOR NEW APPROACHES FOR VOCATIONAL AND PRACTICAL ARTS EDUCATION

Conditions Which Suggest the Need for New Approaches

1. Trend toward moving vocational education to the late high school and post-high school years.

There is evidence that vocational education is being moved and should be moved to higher maturity levels for most students. More basic education is now required than previously. Also, it seems that students need a broad foundation or preparation for strictly vocational education. This preparation seems to be needed because of two important factors (1) vocational maturity of students and (2) changing occupational opportunities.

2. Vocational Development and Maturity[1]

Much research in recent years has been devoted to guidance. Two phases of this research will be of special interest to anyone concerned with guiding students in choosing vocational careers and with determining who should be enrolled in certain school programs, particularly those with vocational emphasis. These two closely related phases of research are (1) vocational development, including occupational choice, and (2) vocational maturity.

a. Vocational Development and Occupational Choice.

Vocational development is the process of growth and learning which includes all instances of vocational behavior--the progressive increase and modification of a person's capacities and

[1]Adapted from findings reported in: Super, D. E., et al., The Vocational Maturity of Ninth Grade Boys, Teachers College, Columbia University, 1960.

dispositions (values, interests, attitudes, aspirations) for particular kinds of vocational behavior and of his repertoire of vocational behavior. In this sense vocational behavior encompasses all aspects of development which can be identified as related to work. The developmental nature of vocational orientation, choice, entry, adjustment, and retirement calls for a broad term, such as vocational development, which puts the emphasis on process over a period of time.

The following describes the periods and stages through which an individual progresses in making occupational choices.

Stage[2]	Age
1. Growth Stage	Birth-14
Fantasy	(4-10)
Interest	(11-12)
Capacity	(13-14)
2. Exploration Stage	15-24
Tentative	(15-17)
Transition	(18-21)
Trial	(22-24)
3. Establishment Stage	25-44
Trial	(25-30)
Stabilization	(31-44)

It is obvious from the above chart that the choice of an occupation is only tentative for any high school boy. This research would indicate that the occupational choice would still be only tentative for the boy even if his initial enrollment in a vocational course was moved up from the ninth grade (14 years of age) to the eleventh grade at 16 years of age. On the other

[2]Donald E. Super and Others, Vocational Development: A Framework for Research, New York, Teachers College, Columbia University, 1957, pp. 63-64. See also: Eli Ginzberg and Others, Occupational Choice: An Approach to a General Theory, New York, Columbia University Press, 1951.

hand, this research would indicate that the choice of an occupation would be just as "realistic" at an earlier age, even to the age of 11 years.

b. Vocational Maturity of Ninth Grade Boys.

Vocational maturity of ninth grade boys has been defined as behavior in preparation for vocational choice, as planning and looking ahead. Furthermore, in grade nine, vocational maturity is not characterizable as goal-attainment, as the having of consistent, realistic preferences, nor as having begun to make a place for oneself in the world of work. Thus, this vocational level of ninth grade boys restricts and also suggests the vocational development that should be fostered at this grade level.

3. Changes in Occupational Opportunities.

Increasingly, youth are confronted with a wide range of occupations from which to choose. This has been caused by the emergence of new occupations and by conditions favorable to a person's moving from one community to another to live and work.

The emergence of many new occupations is becoming characteristic of the economy. These new jobs will require people who can make the adjustment from one occupation to another. This adjustment would be facilitated by appropriate educational background and also by continuing education.

Shifts in occupational opportunities and population need to be facilitated by education which is appropriate. In some locations, strictly farming areas for instance, occupational opportunities for youth are limited. In other words, they usually

have to overcome two difficulties: (1) Learning about and exploring occupational opportunities which cannot be observed in the community; and (2) moving from their community to another to live and work.

These conditions suggest the need of youth for broad exploratory experiences which are common to several occupations.

4. The School Drop-Out Problem.

It is known that a large number of school drop-outs occur because the students lack the interest and abilities required for the school courses offered. Much remains to be done in developing specific courses and perhaps core curriculums in order to come nearer to meeting the needs of potential school drop-outs. Providing a broad prevocational course, beginning at an early grade, would seem to be a step in the right direction and perhaps would lower the drop-out rate. Even if the drop-out occurs, some exploratory experiences in the course should have guidance and vocational value to the student.

5. The Education Needed.

The following are educational needs as stated by Super, Emerson, and in a publication on junior high schools.

a. Super

Super and his associates* in their report of the study of vocational maturity of ninth grade boys discussed some implications for education and guidance. They posed this question: "The school may well ask what it is doing to

*Super and associates, Vocational Maturity of Ninth Grade Boys, Teachers College, Columbia University, New York, New York, 1960.

help seventh-, eighth-, and ninth-grade students to broaden their horizons, to explore potentially challenging but unfamiliar fields, and to experience the satisfactions they come with achievement, recognition, and mastery."

b. Junior High School Publication

The following statements were taken from The Junior High School We Need*

In discussing trends at the junior high school level, it was stated: "The able child interested and talented in music, art, homemaking, industrial arts, drama or other creative areas may find his program, even in the seventh or eighth grade, restricted to academic courses. At the same time, this child needs all the more urgently to understand his world and human behavior."

Discussing the crucial need for guidance and counsel during the junior high school years, it was stated: "Parents need all the information and aid that can be given by the junior high school teachers and counselors about the individual pupil's development and about his scholastic potential and needs."

c. Emerson

Industrial life has need for scientists, engineers, technicians, skilled craftsmen and semi-skilled workers. With the complexity of modern industry and the need for complicated and expensive equipment with which to provide training, it is becoming increasingly clear that the high

*Commission on Secondary Curriculum, The Junior High School We Need. Assoc. for Supervision and Curriculum Development, NEA, 1201 16th Street, N. W., Washington 6, D. C., 1961.

school of tomorrow will not be capable of providing the specialized training for any of these types of jobs.

What, then, should be the function of the high school with respect to the students who will eventually find jobs in industrial occupations? The needs of students in high school who will become technicians are somewhat different from those who will become skilled mechanics or semi-skilled workers. Programs are needed which will be of value to each of these groups. What might be the nature of such programs? Each program should provide foundation instruction which will lead naturally into the specialized training which, will be obtained later in specialized schools on the post-high school level, through apprenticeship, through plant training programs, or through on-the-job instruction. The programs will thus take the form of pre-vocational education, laying foundations on which the specialized programs can function effectively.

(1) Pre-vocational program for the technician occupations

This program would grow out of analysis of the basic skills and knowledges needed for a considerable variety of technician occupations in the industrial field. Such analysis would probably reveal the need for considerable mathematics taught with industrial applications; for physics and possibly chemistry; for drafting and drawing interpretation; for basic hand tool skills and possibly a minimum of machine tool skills; for understanding of the materials and processes of industry. Such a foundation would provide a basis for effective learning of

the specialized technician training programs which would follow on the post-high school level. This type of program would require students of reasonably high intellectual ability, and who have interests in and aptitudes for the technician occupations.

(2) Pre-vocational program for the skilled trades

This is a somewhat more difficult program to develop than the preceding one, for the skilled crafts vary greatly in their content and methods. Here, again, the program would grow out of analysis of the basic skills and knowledges needed for a variety of skilled crafts. The selection and use of hand tools; the principles of operation of machine tools, with emphasis on the development of understanding of how to handle such tools rather than the development of high degrees of skills in their use; materials and processes of industry, with special reference to the skilled crafts; basic principles of applied science, taught on a level somewhat lower than that of the program outlined above; interpretation of drawings; basic mathematics, with applications to skilled crafts work; these are some of the items which analysis might reveal as needed for this program. Students for this program would spend a reasonable amount of their time in shop work, not confined however to a specific type of skilled craft but sampling several areas. The quality of student with respect to intellectual ability

need not be as high as that required for the pre-technician program, but they should have interest in and aptitude for the skilled crafts field. One of the problems inherent in such a program is that of motivation of the student.

(3) Basic program for the semi-skilled occupations

Large numbers of high school youth will eventually find employment in the semi-skilled occupations, which usually require a narrower range of skills and understandings than is needed for the skilled crafts. Many of these youth now drop out of school before graduation, with little basic preparation for the work they enter. What might be done in the high school to give these youth some preparation for work life? The range of semi-skilled occupations in industry is great, and it is a difficult task to develop a curriculum to meet basic needs for a variety of such occupations. But it could be done if we really wanted to do it. The procedure would require at the onset an extensive research project to determine the basic skills, knowledge and understandings which are common to large numbers of semi-skilled jobs. Occupational analysis of hundreds of such jobs should reveal such items as selection and use of hand tools, principles of care and operation of power driven tools and machines, recognition and properties of materials used in industry, methods of assembly, safety practices, and others. Out of this analysis would grow the

Industrial education portion of the curriculum, rounded out with appropriate mathematics, elementary science, social science, English. Since the youth in such a program would be in the group with less than average intellectual ability the content would need to be geared to their capacities. A reasonable portion of the curriculum might well be given to shop work and elementary laboratory work which would grow out of the findings of the occupational analysis.

HOW WELL ARE WE MEETING THE NEED?

For the most part, industrial arts education and vocational education in agriculture are the only subjects offered at the early high school level which provide an appreciable amount of exploratory experiences related to occupations.

Some schools offer both of these subjects, others offer only one, and others offer neither.

Subjects Offered	Number of High Schools
Industrial Arts only	181
Agriculture only	477
Industrial Arts & Agriculture	67
Provide neither	145
Total No. high schools in N C.	870

The number of teachers employed and schools providing subjects are as follows.

Subjects	No. Schools	No. Teachers
Industrial Arts	248	304
Agriculture	544	638

-o-

By purpose and definition, agriculture and industrial arts subjects are limited to the occupational areas implied in the name.

1. Vocational Agriculture

In schools which offer only agriculture, a void exist for many students who need an opportunity to explore industrial and business work and occupational opportunities. Though many other factors have been responsible, this void appears to have affected many of the on-going vocational agriculture courses. For example, approximately 40 per cent of the schools offering vocational agriculture enroll all ninth grade boys in the subject.

The types of students enrolled and a knowledge of their future opportunities among other factors has lead to the development of a rather strong agricultural mechanics program. Though programs vary greatly, many have included instruction and student practice in (1) learning and using hand and power tools, (2) elementary drawing and blue print reading, (3) small electrical and combustion engines, (4) welding, (5) general shopwork construction and others.

Except on an individual basis, any instruction aimed at relating these shopwork experiences to occupational opportunities probably would be incidental.

2. Industrial Arts

With respect to the type of prevocational course envisioned as needed, industrial arts is limited in two ways.

(1) It is narrow in coverage--covering only the industrial area.

(2) Many of the programs appear to be planned around the students constructing projects.

Likely, much of the time and effort put into the projects go beyond the point of deminishing educational returns.

APPENDIX B

ERIC

A LEARNING THEORY FOR CURRICULAR CHANGE *

The curriculum development projects listed in this book are not just proposals for doing more of the kind of thing the schools are doing already. It is now apparent that the information explosion and the scientific developments which have triggered these projects require revolutionary changes in the goals and methods of instruction as well as changes in subject matter. Almost all of the projects listed have resulted from a general recognition that the social and technological changes now taking place throughout the world are moving so fast that almost any specific fact or procedure taught today will be uselessly obsolete long before the student who learns it has completed his career as a worker or a citizen.

These projects therefore, almost without exception, accept the fact that our task now is to teach people how to deal with problems which have not yet arisen, whose solutions are therefore still unknown. For example, the new curricula in the physical and social sciences specifically list as their objectives the student's discovery of concept snd generalizations and the development of "thinking processes," "independent learning skills," and creativity. The same type of objective is now essential in the field of vocational training. Within a very few years all routine tasks outside the home will be done by machines, and adults who have not been helped to attain the conceptual skills and the attitudes of initiative and responsibility required for technical, managerial or professional work will be economically dispossessed, unable to participate in productive work.

We do not know how many people can be brought to the level of intellect, initiative and responsibility that will be required; yet the fact that there is already a shortage of professional and technical workers while several million routine workers are unable to find jobs suggests that we shall have to devise new methods to accomplish this.

How? And what? At this point we come squarely up against the fact that conventional learning theory has almost nothing to offer a curricular planner or a teacher who wants to do more than teach the facts we already know and the solutions we have already worked out. Its most widely accepted form, reinforcement theory, simply attempts to explain why an act is repeated. This question, which was crucial when we were trying to teach children the answers to problems someone has already solved, or to keep on doing something they did not want to do the first time, has no relevance to a teacher or curricular planner who is trying to develop creativity, initiative and the ability to deal with new problems. It is impossible, by definition, to reinforce an act which has not yet been committed.

At this point it does no good to fall back on common sense. Contrary to common sense, repetition does not surely lead to learning. In some situations, repetition may make learning possible; but in others it causes inattention. More than 30 years ago Knight Dunlap demonstrated that one way to break habits is to practice them. Contrary to common sense, punishment sometimes "reinforces" an act and strong rewards can interfere with learning (1). If the folkfore which passes for common sense were an adequate guide for teaching, the concept of reinforcement would not have been proposed in the first place.

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* Taken from Donald Snygg, "A Learning Theory for Curricular Change," Using Current Curriculum Developments. A report of ASCD's Commission on Current Curricul Develop ents, 1963 pp. 109-115. HPB/6/63

A Perceptual Field Approach

There is, however, another possibility. While reinforcement theory has monopolized the attention of experimental psychologists, a completely different theory of learning, generally called cognitive field theory of perceptual field theory, has been found to be useful by psychologists in education, industry and other applied fields. A number of interesting implications for curricular development make it worth discussing.

The basic assumption of this perceptual field approach is that behavior is always appropriate to the situation as perceived by the behaver at that instant. That is, behavior is determined, not directly by reality, but by the behaver's perceptions of the situation. The hunter mistaken for a deer is shot at, the deer mistaken for a bush goes free. Learning is therefore the result of the learner's achieving a clearer, more realistic perception of the situation with which he is dealing. Learning takes place in the following steps:

1. The learner becomes aware of a need or goal the achievement of which will enable him to satisfy his purposes. (Goal)

2. The existence of an obstacle makes it necessary for him to perceive the situation. (Interpretation 1)

3. He attacks the problem (attempts to reach the goal) in a way which is appropriate to his perception of the situation. (Act 1)

4. This act has consequences. If the result is the achievement of the goal and the satisfaction of the need the process is complete, his perception of the situation remains unchanged and he has, therefore, learned little that is new. If, however, the result is not the one he sought and expected, (Result 1)

5. a reinterpretation of the situation takes place. (Interpretation 2)

6. The second attack (Act 2) is appropriate to this new interpretation.

7. The consequent result (Result 2), if it is the achievement of the goal, brings the search and reinterpretation to an end, or if it is not the result expected, causes a

8. reevaluation of the situation. (Interpretation 3).

The process continues until the learner reaches his goal or perceives another goal as a more practical means of satisfying his need. It will be noticed that this concept deposes both practice and reinforcement as "causes" of learning. Each repetition of the problem gives the pupil an opportunity to gain a clearer and more accurate perception of the situation but the only pupils who use this opportunity for discovery are those who are trying to discover something. The cause of learning, in this conceptual scheme, is the learner's desire to find his way to a desired goal. "Reinforcement" is not required to explain the stabilization of a successful act. Because he has found a satisfactory path to that goal the learner simply stops exploring the situation. With no more incentive to reexamine the situation, his perception of it and his response to it cease to improve. Once he has either reached or abandoned a goal, no amount of drill will cause him to find cues that he does not want to find.

This point of view assumes that education for the unforeseeable, an awkward problem for reinforcement systems, is indeed possible. Transfer of learning from one situation to another occurs when the learner perceives the two situations as similar, when he perceives a solution to one problem as applicable to part of another problem, and when he acquires new perceptions of himself or of the world at large which are applicable to both or all situations. Personality and character training, which by reinforcement theories would have to be achieved by the reinforcement of a vast number of separate and unrelated behavior acts, are achieved by helping the individual to perceive himself constructively as an accepted and responsible member of society, as an individual capable of creative insights, and by helping him master the knowledge and learn the skills needed for these roles.

This view of the learning process allows us to see the relation between motivation and course content in a new light. The question as to whether goals are determined by single or multiple needs (5) is still open. But as long as the pupils in our schools are reasonably well fed and comfortable it seems safe to assume that all students are mainly motivated by a desire for a greater feeling of personal worth and value (6) or a greater feeling of competence (7) and that they will seek these objectives in the areas where they see the greatest prospect of achieving them. A curriculum planner using this point of view will therefore try to provide opportunities for the learner to feel successful as a creative problem solver. To do this the student must have an opportunity to work at problems which are worthwhile to him and are real problems, whose answers are not unquestionably known. The cookbook science "experiment" whose results are known before the "experiment" is done can at least be modified by requiring the student to invent one step in the procedure, or when the student is more able, by requiring him to devise an alternate way of testing the result. The primary question in mathematics might be, "In what other way could this be solved?"

Implications for Curriculum

Assuming the validity of the steps of perceptual field learning theory as listed, teachers and curriculum planners can draw the following implications:

1. (Goals) The primary function of the teacher is to help the students to discover problems which demand their personal attention. Giving students answers to problems they do not have short circuits the whole process of learning by making exploration and reality testing by the students unnecessary and the problem they are intended to solve unimportant. Fundamentally, the curriculum aids the student, not by giving him the answers to problems he does not have, but by helping him to discover new and more fruitful objectives in his personal campaign for feelings of personal worth and value. Students must be protected from answers which make their own consideration of the problem unnecessary.

This requires a flexible curriculum in the sense that the goals it presents must be appropriate to the personal value system, the self-concept, and present understanding and skill of the student if he is to accept these as personal goals, to be pursued seriously and with persistence.

This requires that the teacher think of himself as a learner who needs to explore his students' perceptions of the subject and of themselves so that he can give special treatment to the individual. This requires a classroom setting in which the student is free to explore and express his own perception of the situation without fear of humiliation or reprisal so that the instructor can see the consequences of his own acts. Classroom discussions should be not testing situations but opportunities for exploration of the problem by the students and for exploration of the student's perceptions of the problem by the instructor.

2. (Interpretation 1.) The instructor uses this knowledge to arrange a situation in which the student will have a better opportunity to solve his problem without direct instruction. This may be done by providing the required tools, by providing necessary experiences and conceptual models, and sometimes by removing extraneous factors from the situation so that the essential aspects can be more easily differentiated.

A curriculum based upon perceptual field principles will have to assume that a teacher is a professional workers in the true sense and is equipped, as routine workers are not, with a background of professional theory which enables him to deal with unique cases and with situations which have never before arisen.

3. (Act 1.) It is essential that the curriculum and the school situation must give the student the opportunity to test his perceptions of reality by acting on them. Ideas not put to the test of action are, quite properly, perceived as doubtful, as play money for tender in examinations but not to be trusted in real life where we are playing for keeps. The failure of students to apply their verbal learnings from the classroom to their behavior outside the classroom is due, from the perceptual field point of view, to the fact that these "learnings" had never been successfully validated by use and thus remain merely something to talk about.

A curriculum based on perceptual field principles will provide many opportunities for the student to put his ideas to the test of action so that he will discover and correct his misconceptions as soon as possible and so that he will gain the confidence required to act on his perceptions and concepts that are confirmed and to make them the basis of his further thinking. In a modern physics curriculum the students do not just talk about gravity, they measure it by methods they understand.

4. (Result 1). Both perceptual field and reinforcement theories suggest that immediate knowledge of the results of an act is essential to learning. Field theory suggests that the essential factor is the learner's discovery of the relation between the act and the result. For this purpose a teacher's evaluation of the results cannot be an adequate substitute for the student's own inspection of the consequences since, strictly speaking, the teacher can tell the student only about the effect of the act on the teacher, and this may not be pertinent to the student's evaluation of the results when the teacher is not present. This brings back, in a new form, the distinction between intrinsic and extrinsic rewards and suggests that the distinction may be more important than we have thought.

5. (Interpretation 2.) Generally the change in the learner's perception of a situation due to experience is in the direction of increased awareness of details and in breaking the total problem into a number of subproblems and related steps. As long as the teacher does not take over and impose his own solution, based on his own perceptions, on the student, he may safely call the student's attention to some details in the situation as factors the student might want to consider.

It is essential, however, that the student not be led to feel that the teacher has taken over the problem or that his own work is unnecessary and valueless. Above all the student should not be led to become dependent on the teacher. The teacher should not interfere to prevent the student from making mistakes.

One of the most striking implications of perceptual field theory is the function which this theory assigns to error. From this point of view learning does not take place unless the learner finds that he has made a mistake or would have made a mistake, that is, unless an act enlarges his perception of the situation by giving rise to results he did not anticipate. The opimum situation for learning is not one in which the learner will make no mistakes, as in current reinforcement theory. Rather, optimum learning takes place in a situation which allows the learner to test his ideas under conditions in which their results are immediately apparent.

Level of Difficulty

One of the most unconventional implications of the perceptual field theory is the push it gives toward more difficult curricula. Contrary to general opinion among teachers, which postulates that all failure is detrimental because it causes frustration and thus either aggression or withdrawal, and contrary to the opinion of reinforcement theorists, which tends to assume that material should be so easy that all responses to it will be "correct," perceptual field theory suggests that the optimum level of difficulty is one which allows the student to win success after difficulty.

If our basic goal is indeed a greater feeling of personal worth and value, tasks which require little talent or effort are bound to be unrewarding and boring and to be as unproductive and harmful from an educational point of view as are problems which are completely beyond the current capacities of the student. Most teachers and educators are well aware of the latter danger; fewer seem to have considered the first.

The success or failure of the implementaion of current curricular developments into effective practice may well depend upon the degree to which both curriculum planners and learning theorists will translate the implications of the perceptual field theory into a rigorous upgrading and strengthening of the quality of the educational program throughout the entire school span.

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LEARNING EXPERIENCES*

> If curriculum is a plan for learning, and if objectives determine what learning is important, then it follows that adequate curriculum planning involves selecting and organizing both the content and learning experiences. - Taba

In discussing learning experiences in relation to curriculum, our major objective is to see how you, as a teacher, can make effective use of learning experiences. How the idea can be built-in to all teaching, as a part of every class. This is a problem no teacher can avoid. It faces me right now, just as it faces you every time you are teacher of a group, whether it be 9th grade class, an adult group or a Sunday School Class of teenagers. The question is, "What sort of learning experiences, <u>by the members of this group</u>, will most likely result in most effectively reaching the educational objectives of this class?" Put another way, you ask yourself, what experiences can I as a teacher cause these students to have so that the desired learning will take place.

So, in trying to "practice what we preach" let's take a close look at our own learning situation. In thinking about this and trying to help you make it an effective learning experience, I have built my approach (content) around three major areas, as follows:

I. THE IDEA

II. THE THEORY

III. THE IMPLEMENTATION

It is hoped (objective) that our discussion of these areas will result in more effective use of learning experiences in planning for and doing more effective teaching. Your participation (learning experiences) has already started, and, hopefully, will become deeper and more involved.

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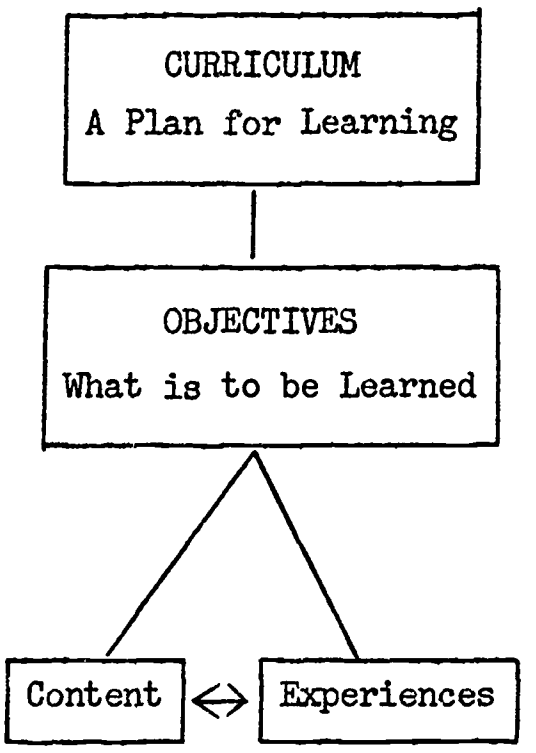
* Prepared by C. C. Scarborough, N. C. State College, June 1963.

I. THE IDEA

As indicated in the opening quotation of this paper, learning experiences have a key role in planning for effective teaching. A drawing of this idea might look like this:



The experience area could be labeled "How it is to be Learned." However, this label was not used to avoid the chance of seeing experience as synonymous with methods. It should be added that content and experiences should not, and cannot, be separated. They are examined separately for better understanding. One other related point should be mentioned, which is emphasized in the sketch. That is objectives are in terms of behavioral outcomes (what is to be learned) rather than simply saying the objective is to "learn the content."

It cannot be overemphasized that the type of objective to be reached by the learners is the key to determining the experiences needed by the learners. For example, learning objectives in one relatively small area of tractors might vary from recognizing the make, model and size (colored pictures cut from magazines might be the key experience), to a motor overhaul, where an entirely different set of learning experiences would be required. Lack of clarification of the major objective leads to fuzzy efforts to plan learning experiences.

Contributing to the difficulty just described is the realization that no experience occurs in isolation. That is, an experience must be related to some previous experience to have any meaning. This may seem to be strange relationship, easily overlooked by the teacher. The relationship seen by the student may be "wrong" (from the teacher's viewpoint) or negative, but for an experience to have meaning it is related to a previous experience. Therefore, learning how a person "sees" an experience before actually having the experience may give the teacher the clue needed to help make the experience meaningful to the student. In short, learning is an individual, personal matter. "The class" doesn't learn, the individuals do. "Now class," says the teacher, "do you understand what I have just explained?" The answer is no, unless each individual understands, and the chances are strong that not all would understand the explanation as the teacher saw it.

So, the basic idea of the learning experience is that it is the meaning seen by an individual as a result of his activity, or other type of experience. Now, to try to make this idea more meaningful to us as teachers let's turn to the theory of experience in education.

II. THE THEORY

EXPERIENCE IN EDUCATION

> Every experience affects the individual who has it ... Experience which is educative is not only a process of growth, it is a process of growth of a special kind: it is a reconstruction of experience - Wynne.

The Role of experience in education has been discussed (sometimes cussed) for many years, especially since John Dewey's emphasis of its importance. In fact, one of Dewey's major points in the "new education" he proposed was the effective use of experience. Not just any old, dull routine, but a lively, meaningful experience. The key word in Dewey's idea of meaningful experience was perhaps growth. More later on Professor Dewey.

Let's try to clarify our thinking on what we mean by experience, at least an educative experience. Some would say that all experience is educative. Even though this may be true, from an educational viewpoint we are more concerned about desirable experience, or experience which helps reach desirable educational objectives. The dictionary definitions vary from "the actual living through an event or events," to "the sum total of the conscious events which compose an individual life." Professor Wynne explains experience this way:

> Experience consists of interactions that are continuous in the life of individuals and in the social groups to which they belong. Interactivity and continuity thus constitute the fundamental features or dimensions of experience. When these features are defined, experience is defined ... Education is experience and the essential features of experience are interactivity and continuity.

Let's take a closer look at what is meant by these two features or dimensions.

Interactivity of Experience

This means an individual's reaction to a situation. Note the term "an individual reaction." This is a key point to remember in thinking of interactivity of experience This is why that too frequently a "good" experience as seen by the teacher is a "terrible" experience for the student. Such interactions involve thought, feeling or attitude, as well as action. It is not merely a mental process that takes place in the mind.

In recent years, much work has been done on the influence of the group on individual interaction. Also, in analyzing interaction of individuals within a group, much insight can be gained in one's own action and interaction, if he sees this as a learning experience. Likewise, instead of seeing group decisions as always being a compromise of individual decision (which is sometimes the case) they can be seen as different and better than any one individual's decision. This would frequently be the case if, we could all become effective members of the group faced with the job of making a decision. Even so, the "experiencing of experience" is an individual matter, and there seems to be no substitute.

It is suggested, therefore, that educational leaders might make much more effective use of an individual's reaction to an educative experience. In fact, recent research indicates that an individual's reaction to experience - even before he has the experience - is an important key to its educational value for that individual. Again, this is why that the same (?) experience has such different meaning for different individuals. This gets us into the area of self-concept.

Self-concept. This is not a new idea, but recognition of its importance in learning is now being established. Professor Robert Bills has an interesting way of looking at this idea.

> One very important aspect of the self concept is its relation to our beliefs about how other people see themselves. On this basis we can distinguish four groups of people: + + who like themselves and who believe that other people like themselves at least equally as much; - + who do not like themselves in varying degrees and who believe that other people like themselves more than they; + - who like themselves but who question if other people like themselves as much; and - - who do not like themselves and who believe that other people don't either. If this os confusing to you, just remember that the first of the two signs refers to feelings about self and the second sign refers to feelings about other people. In a high school or college population, we find about 30 percent + +, 30 percent - +, 30 percent + -, and somewhat less than 10 percent - -. The - - group is virtually absent in teachers and educational administrators. How we like or dislike ourselves is probably intimately related to our notions of our worth and the worth of other people.

The foregoing factors are probably primary in importance in determining perceptions. It seems as if the self concept acts as a set or a screen through which all other perceptions are formed. Let us illustrate, with research, the significance of some of these variables.

Suppose we were to ask you to introduce yourselves at "random" to the other members of a group. We know that those of you who are + + or + - will be among the first tovolunteer and those of you who are - + will be last.

Suppose we say to you, "All people at some time or other have been unhappy. This is not to mean that you are unhappy people but that you have experienced unhappiness." And suppose then we ask you to list the times you aan recall being unhappy. Following this we can ask, "Who or what was responsible for this unhappiness?" We can predict that the + + people will list relatively few instances of unhappiness for which they, other people, and circumstances were responsible. The - + people will list the greatest number of incidents, and they will believe it has been their own inadequacy or inferiority which was responsible. The + - people, though, list the smallest number of incidents and the blame is externalized - other people or situations were responsible.

The goals and ideals of a person are measurably influenced by perceptions of self and others. This is clear from the descriptions of self, ideal self, and the ordinary person. The + + person says in effect, "I am quite like I want to be. I am also quite like other people, and what I desire is to be like other people." The - +, though, says "I am not like I want to be. Neither am I like other people. But I would like to be like other people." The + - is quite different. He says, "I am very much like what I want to be. I am not like other people, nor do I want to be like other people."

These perceptinna also influence our evaluations of our performances. When the + + is asked to evaluate his performance, he is quite realistic in his estimate. The - + usually underestimates his performance while the + - overestimates.

The language of these three groups also shows the perceptual differences which are present. We can use comparative adjectives for purposes of illustratio The + + person uses few comparative adjectives. He seems content to accept to accept things as they seem to be. Both the - + and the + - use many comparative adjectives, although these are expressed in different directions. The - + is concerned with his present status in respect to his past or future status or the status of other people. The + - makes comparisions which do not involve himself. Instead he compares this person with that one or a person with what he should be.

This idea has strong implications for exploratory experiences. In fact, if an experience is really exploratory, we must be aware of the behaviors related to this act or experience.[1] The behaviors may be categorized as search, experimentation, investigation, and trial. Professor Jordaan adds hypothesis-testing to complete the essential elements of exploratory behavior. The reason he wants to add hypothesis-testing to the other more common elements is that he feels that it is extremely important to learn what ideas (hypothesis) a person may have about an experience before he has it, his expectations. Then the experience offers an opportunity to test the ideas (hypothesis). This self-concept related to an experience gives an important clue to the educational value of an experience.

Continuity of Experience

Now we examine the second fundamental feature of educative experience, as seen by Professor Wynne, that of continuity. This simply means that no experience is in isolation from other experience. Thus, any given experience follows previous experiences and will be followed by other experiences. Furthermore, there is linkage to previous experiences as well as those in the future. This may be compared to a link in a chain, although it must be admitted that the linkage may not be quite so certain and secure. So, in a sense, when a person says, "This is a new experience for me", he is not entirely correct.

Note that we are concerned here largely with educative experiences. Therefore, to be educative an experience would mean growth - of an educationally desired kind. How is such growth acquired? One theory is that it is a reconstruction of previous experiences in light of the present experience. "Oh Yes, I see," is often an expression indicating an reconstruction of experience. Such reconstruction of experience involves interactivity as well as continuity.

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1 Basic ideas here based upon Professor Jordaan's "Exploratory Behavior: The Formation of Self & Occupational Concept." Teachers College, Columbia University, 1962.

Brameld [1] and others believe that reconstruction of experience goes further than the individual and the same idea is and should be used in improving our society. Thus, reconstructionism is a philosophy of action toward remaking our society. In short, such a philosophy would attempt the task of interpreting our times and setting a future course - future - centered educational programs.

Features of Educative Experience

Professor Wynne suggests that there are six features of educative experiences which are important for educational leaders to recognize.

1. Relativity of experience. What is the relative importance of this experience
2. Sociality of experience. What sort of social experiences are important in our society?
3. Motivation of experience. What is the most desirable motivation?
4. Creativity of experience. To what extent does the experience promote creativity?
5. Selectivity of experience. What process will help select most desirable experiences?
6. Unity of experience. How can experiences be related and unified for best results?

In Educational Programs

How do we make effective use of the educative experience in educational programs? We can summarize several ideas in the one word, relatedness. This is a key word in effective teaching and learning. It works many ways, let's look at two. In acquiring new knowledge, understanding or ideas, clarification can often be rapidly made by relating the new idea to a previous experience. Likewise, plans for experiences can be made to clarify a theory. (The latter is more common, but the former has some psychological advantages, at least for some people. Perhaps both approaches should be used).

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[1] See his book Toward A Reconstructed Philosophy of Education.

One other way to make use of experiences is in planning an educational program. Enough flexibility is left to make some adaptation in the program to take advantage of experiences of members of the group. In other words, build in some flexibility rather than planning all things apart from the group involved. It would seem that this would be a good thing to do, regardless of your philosophy of education -- if you are interested in the maximum amount of learning.

Finally, back to the original question of what is experience? Is doing or physical activity essential? This is difficult to answer. Certainly much effort and money is put into laboratories and facilities to include physical activities as part of educational programs. Sometimes the doing seems necessary. However, more important to us as educational leaders is the reaction to experiences. It would seem, therefore, that such reactions (thinking, reconstructing experiences) may take place without the usual physical activity of the laboratory, field trip, shop, etc.

III. THE IMPLEMENTATION

How can we implement the idea and theory of experience in education? There are many possibilities, but again, trying to,"practice what we preach," let's try to concentrate on key points directly related to the problem at hand. Some essentials for the teacher are:

A. Clarify the role of experience in the learning process

B. Select appropriate learning experiences

C. Help the learning experiences "come alive" for the learner

D. Organize (and evaluate) the learning experience, in terms of the objectives

E. Guiding the learning experiences

These will be discussed briefly with some indication of direction for further study.

A. Clarifying the Role of Experience in the Learning Process

The theory section of this paper was devoted partly to clarifying the role of experience. If it is still not clear, further study should be concentrated in this area.* For example, the following statement should be clear, meaningful and used as a basis for planning appropriate learning experiences:

> All learning is based on the ability of the learner to, (a) associate the learnings of previous experiences with new situations in which they are pertinent, (b) create new responses or patterns of behavior to fit the new situation and (c) incorporate or build in the resulting values for future use. (Wood)

To implement these and other ideas suggested in this paper calls for understanding of the teaching-learning process. We seem to give more thought to the

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* Any book dealing with learning might be helpful. Two interesting ones directly related to curriculum are Taba, Curriculum Development and Wood, Foundations of Curriculum Planning and Development.

teaching process than to the learning process. Actually the learning process should be the indication of the direction of the teaching process.

B. Selecting Appropriate Learning Experiences

All learning experiences should be selected in terms of satisfying the needs of the students. However, this is only one step, because there may be many possibilities. Wood[1] has listed ten criteria or principles for selecting educational experiences. These, to be used as guides, are as follows:

1. A learning experience should satisfy a recognized need.
2. A learning experience should be appropriate to the maturity and understanding of the learner.
3. A learning experience should build toward consistent, continuing, and dynamic goals.
4. A learning experience should be based on social values.
5. A learning experience preferably should be positive.
6. A learning experience should be realistic.
7. A learning experience should be efficient.
8. A learning experience should not be limited by artificial barriers such as the four walls of the classroom, subject-matter lines, class bells, and other impedimentia.
9. A learning experience should involve total behavior.
10. A learning experience should be feasible of accomplishment.

The teacher has the responsibliity for selecting learning experiences, but this does <u>not</u> mean that he should do the job himself. In fact, a major aim should be to secure the increasing participation of the student in planning his own learning experiences.

C. Helping the Learning Experience "Come Alive" for the Learner.

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[1] <u>Ibid</u>. - Wood page 114 - 115

The learning experience must "live" if it is to be meaningful. It has a value to the learner, though it may not be the value desired by the teacher. There is considerable evidence that a major cause of drop-outs is sheer boredom. Here is the key to why a course is dull, monotonous and boring. In short it does not live, is not an important part of the student's life needs - as he sees it at that time. The learning experience must "come alive" now for the student regardless of how important it might be to the teacher, or even to the student "later."

D. Organizing and Evaluating the Learning Experiences in Terms of the Objectives.

Again, we turn to Wood for suggested steps on guides for organizing learning experiences into courses.

1. The scope of each broad area should be carefully and rather specifically defined in terms of educational needs.

2. Learning activities and materials should be allocated to maturity levels on the basis of needs, interests, learning readiness, sequence, and availability of materials.

3. If necessary, these experiences should be divided into sub-areas or grouped into larger areas on the basis of group interest, purposes served, teaching relationships, and teacher abilities.

4. Some attention should be given to methods of integrating these experiences within each subject or course.

5. All available pertinent curriculum planning aids should be utilized in organizing learning experiences.

6. Curriculum plans should be in written form and should be available to all concerned with their use.

The same basic idea, more specifically planned, would be followed in organizing learning experiences in a teaching unit.

Evaluating. As indicated earlier the learning experiences are planned to help reach the educational objectives. If this is done, it follows that the evaluation of the effectiveness of the learning experience will be in terms of the behavioral outcomes of the students.

E. Guiding the Learning Experiences

The area of guiding the learning experiences will be discussed briefly, because this gets into the teaching process more than curriculum development. However, it is closely related to curriculum planning in that plans for teaching are often directed by the curriculum. One aspect is of particular importance in relating curriculum and teaching. That is, the decision as to how much planning is done in advance and how much is delayed and developed with the members of the class or group. Perhaps the more common approach is to develop plans in advance. The other extreme is to develop no plans in advance. A combination of the two perhaps results in more effective teaching.

The major point of emphasis here is that the teacher has the responsibility for seeing that there are real learning experiences being realized by the students. This must be done whether the planning is done in advance or "on the spot." There is no magic in either. A teacher can waste time or be an effective teacher in either case. A complete, illustrated, day-by-day book of plans for teaching would still call for planning and guiding learning experiences. If this is not the case, the teacher is not as important as we think in the learning process.

SUMMARY

The idea is that experiences of students are the keys that unlock the doors to learning. The teacher can greatly increase and improve learning by students by understanding the theory of experience in education. The teacher needs to help the experiences "come alive" for the student by helping him see how the experiences fit into his life at that time. To help the teacher accomplish this requires deep understanding of the individuals expected to do the learning. To add all these things up to an effective teaching program requires developing a curriculum closely relating content and learning experiences with the educational objectives for the class period, the unit, the semester and the course.

THE LECTURE*

Are We Reviving Discredited Teaching Methods?

The growing flood of students and its accompanying competition for the education dollar has led educators to search for new ways to reduce educational costs. Because it is one of the few methods that can be used with large classes, increasing reliance has been placed upon the lecture. It has always been the major teaching method in our colleges and universities, but during the past few years its use has been extended into all levels of the educational system through team teaching and educational television. If fiscal success is not to become educational failure, it is imperative that educators carefully evaluate student learnings from the lecture.

To gain some perspective on its current usage, let us turn to the historical development of the lecture system. It is useful to remember that the lecture system evolved largely because of the scarcity of hand-copied books in medieval universities, prior to Gutenburg's invention of moveable type in the fifteenth century. The few books in existence were usually in possession of the masters and doctors who taught in those institutions. It was natural under such conditions for the teacher who controlled the source of knowledge to fall into the habit of lecturing to his students. These lectures often consisted of nothing more than the doctor reading from his book while his students took notes. The strength of this pattern of academic culture is reflected in the fact that the Latin word legere (past participle, lectus), meaning "to read," became synonymous with teaching.

As books gradually became available, the lecture was expanded to include comments on authors being studied, and a summary of their points of view. At a later date, the faculty at the University of Halle used the lecture for the presentation of a changing field of knowledge, rather than just an interpretation of accepted texts. This concept of the lecture as a teaching method became part of the culture of American higher education as it came more and more under the influence of German universities.

What is to be learned from this historical experience? While in some fields, especially the natural sciences, books become obsolete almost before they are published, the use of the lecture today may hardly be justified because of a scarcity of books. Perhaps a more signicant point is that, through the teacher-centered use of the lecture, the medieval university relegated the student to a secondary position. This cultural pattern was further reinforced by German universities in their primary emphasis on research and the advancement of knowledge, and it became a major pattern in American universities as the German experience became the model for American graduate education.

While failure to evaluate the teaching-learning process is a weakness of our entire educational system, there are two studies which lend valuable insights for our evaluation of the lecture.

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*Lloyd Pulliam, formerly chairman of the Department of Education at Knox College, is now engaged in research on learning theory at the University of Oregon, Eugene.

One group of studies is reported by Ralph G. Nichols and Leonard A. Stevens in their book Are You Listening? At the University of Minnesota, these researchers tested thousands of college students and members of adult education classes on their ability to understand and remember what they heard in short lectures by university faculty. As a result of these tests, it was concluded that "immediately after the average person has listened to someone talk, he remembers only about half of what he heard - no matter how carefully he thought he had listened." Even more significant was the finding on a retest after a two-month time lapse that "the average listener will remember only about 25 per cent of what was said." Even if learning is defined simply as the ability to comprehend and recall information, this study indicates that the lecture, as normally used, is not very effective as a learning method.

It is not content that is usually remembered from a lecture, but an "impression" of the speaker's personality, his speaking delivery, and the attitudes he voices about concerns important to the listener. If there is no clarifying interaction between listener and lecturer, the attitudes conveyed may be distorted from those actually intended. If the lecture does not move students to further activity, very little will be remembered. Let teachers who doubt this, if they feel courageous and secure, conduct their own experiments, using surprise tests to evaluate retentipn of subject matter from the lecture.

'Lecture Doesn't Change Behavior' - Lewin

A second group of studies bearing on the use of the lecture were conducted during World War II under the late Kurt Lewin, a prominent social psychologist. The results of these studies have been widely reported in a number of articles, one of which is entitled "Group Decision and Social Change." In these studies the lecture was compared with group discussion leading to group decision as means of inducing housewives to use organ meats instead of commonly used cuts, and to increase comsumption of both fresh and evaporated milk.

Every effort was made to give attractive and effective lectures. The nutritive values of these foods were stressed, as well as their low cost. The lecturer told of her experience in using these foods with her own family, and handed out recipes. Charts and other visual aids were used. Even the patriotism of the housewives was called into play with the suggestion that greater use of these foods would aid the war effort. The lectures would compare favorably with those given today via educational television.

The results indicated that only 3 per cent of the women who attended the lectures served one of the meats they had never served before. In the groups where group discussion led to group decision, 32 per cent of the housewives served the new meats. Results increasing the use of milk were similar: 15 per cent of the housewives who heard a lecture increased family usage, while almost 45 per cent made the change after being involved in group discussion and decision. If learning is defined as behavioral change, the lecture, in these studies, was relatively ineffective.

What is the difficulty with the lecture, and who does it appear to be directly responsible for so little learning? The most obvious limitation of the lecture, as it is commonly used, relates to the fact that it is teacher-centered rather than learner-centered. Whether the situation be the college and university classroom,

television or team teaching, the choice of the lecture does not rest primarily on the needs of students but is determined by the cultural situation of the teacher, the character of the medium, or the organization of the class. In these situations the lecture is largely a teaching method, in its focus, orientation, and lack of concern, in the deepest educational sense, with what is happening to the learner. The lecturer is occupied with the question of "What shall I say?" rather than the "what kinds of experience can I lead students into that will increase their positive learnings?" In order to prepare his lecture notes, the teacher does much reading and studying, and therefore, acquires most of the learning.

The student does not learn desired knowledge and skills just from listening, being told and exhorted. The student learns only as he makes knowledge, skills, and attitudes his own, in such a manner that he gains meaning from them for his own life, and is able to use them in a variety of contexts. His learning is accomplished through self-discovery and personal experience, in a socio-cultural context, where his discoveries and experiences are interpreted and evaluated, accepted or rejected, learned or not learned. This is an active process on the part of the learner, not something his teachers do for him. Emerson seems to have been subjectively aware of some of these human processes when he said, in his address on "The American Scholar," " Only so much do I know, as I have lived."

Individual Learns Through Interaction

Evidence from the behavioral sciences indicates that the individual learns as he interacts with other human beings. His teachers, many of whom are not conscious of their teaching role, may be his parents, siblings, peers, professional people, and leaders in the community. Even the experience which the individual acquires alone is ultimately social in the sense that it is evaluated against his background of socially acquired experience. Thoreau, for example, discovered that he could leave society behind physically by isolating himself at Walden Pond, but his socio-cultural experience went with him. It was this background which he used, because he had no other, to appraise his life among nature.

Since the individual leans through social interaction, the lack of such interaction in the lecture situation also contributes to its ineffectiveness. The lecture places the student in an isolated, often confusing and disorganized socio-cultural situation where the learning process has little chance to operate in a positive manner. Lewin points out that while the individual may, physically, be part of a group listening to a lecture, he is in a "psychologically isolated situation with himself and his own ideas." He has no chance to test ideas as he interacts with members of the group, nor does the teacher who is lecturing become aware of misconceptions and prejudices which he might then try to correct.

Moreover, all experiece does not result in positive learning conducive to normal development of the individual as a functioning member of society. The increase in number of delinquents indicates that some individuals acquire negative learnings harmful to themselves and to society.

Learning May Be Miseducative

Learning experience may also be negative and miseducative in the sense that it is incomplete. Whitehead had defined education as "the art of the utilization of knowledge." He explains that "the applications are part of the knowledge, for the very meaning of the things known is wrapped up in their relationships beyond themselves. Thus unapplied knowledge is knowledge shorn of its meaning."

It is evident, from Whitehead's explanation, that the mere acquisition of knowledge is only part of the learning process. The learner may, for example, acquire knowledge about biology, literature, or any other field, without any knowledge or understanding of its application. This is the character, unfortunately, of much that is called learning in the American educational system. The student acquires knowledge about a subject long enough to pass a test and get a desirable course grade, then promptly forgets it.

Most lectures are confined to giving information, without is accompanying application. Where this is the case the lecture is an incomplete learning experience which leads to verbalism rather than meaningful learning. Moreover, the inflexibility of the lecture limits its effectiveness when it is used with a class that has a wide range of interests and abilities. If the lecture is aimed at the median ability group, students of low ability may not understand what is said, while those of high ability may become bored because they are not challenged. While the lecturer is easily aware of the highly interested students who are following every word, and the ones who are dozing, there is a large group between these two extremes whose response he is unable to evaluate until he reads their examination papers.

It is common practice for the lecture system to be organized around a "master teacher" whose major task is to give lectures to large groups. In colleges and universities, quizzes and discussions are often organized in smaller groups under the direction of student assistants, or, at the high school level, under the guidance of other classroom teachers. With this type of educatinnal organization, there is no interaction between lecturer and students to clarify subject matter and attitudes or give the lecturer the feedback of student response which he needs to evaluate the effectiveness of his lectures. Most of the student learning in these situations occurs in the smaller groups, under the guidance of teachers who are usually less competent than the lecturer. For a variety of reasons, these teachers may not be able to interpret the lecturer's remarks satisfactorily. Where this is the case, it is the entering point for student confusion and negative learnings.

One of the arguments most often used in favor of lecturing to large classes, especially through team teaching or educational television, is that in this way influence of master teachers may be extended to a greater number of students. Recent communications research by sociologists, however, indicates that the success or failure of a master teacher lecturing to a large group (defining success as maximum positive student learning) is largely determined by the personal influence of students' primary-group leaders, who may either reinforce or negate the master teacher's efforts. If this be true, in those cases where the master teacher makes no effort to work effectively with student primary-group leaders, the influence of the master teacher may actually be diminished rather than extended.

Previous discussion has attempted to delineate the reasons why the lecture, as commonly used, is so often ineffective. But it may be a valuable part of the learning process if it is used properly. The effective use of the lecture relates to the self-education of the student. It begins with a student-centered orientation and emphasis on the part of the teacher. It will derive its value largely from what happens to the student after the lecture is over. If it does not stimulate a student into activity, it will largely fail as a learning method. This kind of outcome does not usually follow unless it is structured into the lecture itself.

Lectures may be designed to inspire new thoughts and action, to lead directly into new experience such as readings, a laboratory experiment to test ideas, field work to lend concreteness to verbalized theory, a thought-provoking and testing discussion, and so on. In the majority of cases, the lecturer should ask for student activity to follow his remarks, suggesting specific reading references and other work that will support, clarify, and make application of the ideas discussed in the lecture.

In addition to being designed for action by the student, the lecture is most effective when used in conjunction with other methods and is confined to a group of not more than thirty students. A class of this size enables the lecturer to shift to other methods with relative ease, using discussion, audio-visual aids, demonstrations, and other methods to clarify subject matter and attitudes that may otherwise be distorted if the lecture is used alone. Supplementing the lecture with other methods also gives it the flexibility needed to work effectively with the wide range of ability and interests found in most classes.

It is realized that lack of funds in some educational institutions will not permit any choice other than the organization of some large classes. However, if mass education is not carefully organized to obtain the maximum learning possible, its cost will be largely wasted. Since most of the learning in these situations will not come directly from the television or large class lectures but from student activities individually and in the smaller groups, the major focus should be on the latter. To support this approach, it is useful to conceive of the efforts of the small-group teachers and student primary-group leaders as an extension of the work of the master teacher.

If educational experience is organized in this way, the major role of the master teacher, instead of being largely focused on the presentation of lectures, would be that of the coordinator of a staff of associate teachers, the demonstration of effective teaching practices, and the suggestion of learning activities and resources. This does not eliminate the master teacher's lectures, but rather changes the emphasis of his role to stimulate, support, coordinate, and provide leadership for the activities of the smaller groups. If the experience of large classes is not organized and integrated in this way, it cannot be expected that there will be the continuity of teaching and the understanding and effort on the part of the student that results in maximum positive learning.

Learning To Learn *

In our schools and colleges we try to cram enough learning in the first third of life to last the next two-thirds. That it can't be done seems axiomatic, but we usually act as though it could. We do not prepare our students for life long education; we prepare them for graduation from high school and college. If we believe that life long learning is a necessity, we must accept self-education as a key goal of learning. We must learn how to learn and develop a zest for learning. What follows from this?

First, every learner must get his ignorance organized. He must at some point decide what he intends to learn and what he plans to remain relatively ignorant about. He must develop the motivation to learn - the want-to, and he must couple this with the methods and the materials of learning - the know-how and the know-why. Therefore, his curriculum will not only be the subject matter of a field but the associated learning processes as well. He must, in short, consciously learn how to process information, ideas, subject matter.

If we agree with this approach, we must conclude that the major job of the school is not to help the student cover the ground (this is impossible anyway) but rather to help him to experience in depth certain phases of subject matter and at the same time learn how to attack and process life experience in its many forms. And in this processing, we must master the habit of sustained attention, develop the power to resist distraction, learn to focus on a problem with full concentration. The residues of half-hearted, half-attentive learning are meager indeed.

If we learn to attack problems in depth, our usable memory of that subject will be greater and our ability to learn from it will be enhanced. Further, the enjoyment that comes from really knowing a subject will make it unnecessary to have someone around to keep winding us up. Instead we can be self-winding and self-sustaining in our intellectual activities. Success in learning will provide increasingly strong motivation.

In mastering any subject, in learning to learn, we must map the field, note its basic principles, its key ideas, its conceptual structure. For example, no sensible person studies the automobile by first trying to master the names of all its parts. Instead he thinks in terms of systems - ignition, fuel, transmission, braking, etc. In each of these classes there are meaningfully related concepts, e.g., spark plug, magneto, timer, carburetor.

The solution of problems requires that we quickly bring dissimilar ideas together. To do this, one's mental scanning system must operate at full efficiency. The crux of learning is to develop a conceptual scheme for skillful filing of experience. If you file an idea properly, you will be able to retrieve it. This means constant practice in school and college on idea filing and retrieving. This requires a shift from always asking, "What did the textbook say?" to asking, "What ideas do I already have that I can bring to bear in solving this problem?"

Further, when you try some of these ideas on for size they may not fit. New ideas from additional sources may be needed or you may have to rework some old but relevant ideas. We may have to reconceptualize the problem; the old filing system may not work. Learning, therefore, is always a process of relating and integrating.

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*Edgar Dale in The News Letter, Ohio State University, May 1963.

When we ask the student to take charge of his own learning we are asking him to grow up, to become a mature learner who has mastered his own learning processes. It is no simple task; it is uncomfortable. It is much easier to turn to a teacher or a book not only for the answers but for the questions as well.

If we are to learn - become skillful in meeting new learning situations, we must distinguish between training and education, between imitative reaction and creative interaction. When we train we put emphasis on drill, on imitative behavior, or unrelated specifics, on memorizing, on immediate results, on learning activities which have a low ceiling of growth. We rely only on teacher or outside evaluation. We learn how but do not ask why.

When we educate, however, we emphasize creative interaction, learning by discovery, developing usable generalizations from specifics, educational activities which are, in Whitehead's phrase, "suffused with suggestibility." We emphasize better planning of what is to be learned so that the student can begin to set up his own life curriculum. Critical self-evaluation looms large in the process of learning to learn. The student learns to ask both how and why.

A person who is learning to learn searches for regularities - for ways by which he can put experiences together more meaningfully. Let us apply this to vocabulary development. Nearly every college student has come into contact with such words as dystrophy, eugenic, dyspeptic, euphoria, euthanasia, eurhythmic, dysentery, eulogy, euphony. If he has learned a method of word attack which searches for meaningful similarities and differences in roots, suffixes and prefixes, he will note here the use of two prefixes eu and dys. He discovers that they apparently mean good and bad.

He will now test out his hypothesis. If eulogy means "good words," is there a word dyslogy which means "bad words?" There is such a word. One might experiment further and create such words as dysphoria, dysgenic, eupeptic, eutrophy, dysphony. When he meets the word eudemonic, he can check the context to see if it means a good demon. It is a little heard to work "eutrophy" into a dinner table conversation, but we ought to learn some things just for our own amazement. Most adults know such words as neuritis, appendicitis, anemia, toxemia, alcoholism, morphinism, claustrophobia, hydrophobia, psychosis, arteriosclerosis. But many have not learned through discovery the following meanings: itis-inflamation; emia-blood; ism-excess; phobia-fear; osis-diseased or abnormal condition.

In learning to learn it is often helpful to build outlines, models, paradigms as a way of classifying ideas. Thus one develops a ready system for filing, reclassifying, and re-trieving past experience. It also helps one to discover missing material. I have found it useful to think about the communication process using the following outline. It shows visually that communication involves both the producing and consuming of ideas and that three pairs of associated abilities are needed to do it: reading-writing, listening-speaking, and observing-visualizing. One can also see that, as the cells are filled in, there are many other possible combinations.

Producing Messages	Consuming Messages		
	Reading	Listening	Observing
Writing	*		
Speaking (including music)		*	
Visualizing (including plastic arts)			*

The typical curriculum in English or reading now emphasizes reading-writing and speaking-listening. But it rarely deals in depth with visualizing-observing as one of the key phases of communication. Thus teachers ignore the pervasive, mediated experiences of television, motion pictures, and photographs - major aspects of the communication process.

They may neglect, too, the producing of visual meaning, whether by drawing, painting, drama, 8mm motion pictures, photography, demonstrating, or the making of varied exhibits. They short-change the non-verbal phases of communication. They neglect the development of a verbal-visual approach to communication.

Schools have typically emphasized learning to learn through reading and writing, and neglected critical guidance in the listening process. Certainly in view of the importance of listening as a mode of learning we need to correct our weakness in this field.

We may well put more emphasis on the observing phase of the visualizing-observing process. Keen and critical observation is a necessity for professional competence. Charles Drawin once said in speaking of himself: "I have no quickness of apprehension or wit . . . My power to follow a long and purely abstract train of thought is very limited . . . My memory is extensive, yet hazy . . . On the favorable side of the balance, I think I am superior in noticing things which easily escape attention, and in observing them carefully."

The point I am making is that in learning to learn we need to use all the modes of producing and consuming ideas. They reinforce each other, provide additional rich associations which make the filing, reconstruction, and retrieval of ideas more effective. Further, they can uncover special abilities of pupils who may lack competence in one phase of communication but are especially adept in another.

I recently visited the Menlo Park School in California where I saw children learning (not memorizing) geography which was based on the mastery (not memorization) of fourteen physical science principles. These principles enabled pupils to forecast where bananas or wheat or coconuts could be grown - and indeed where they probably were grown. They checked the accuracy of their forecasts by referring to geography texts or other reference materials.

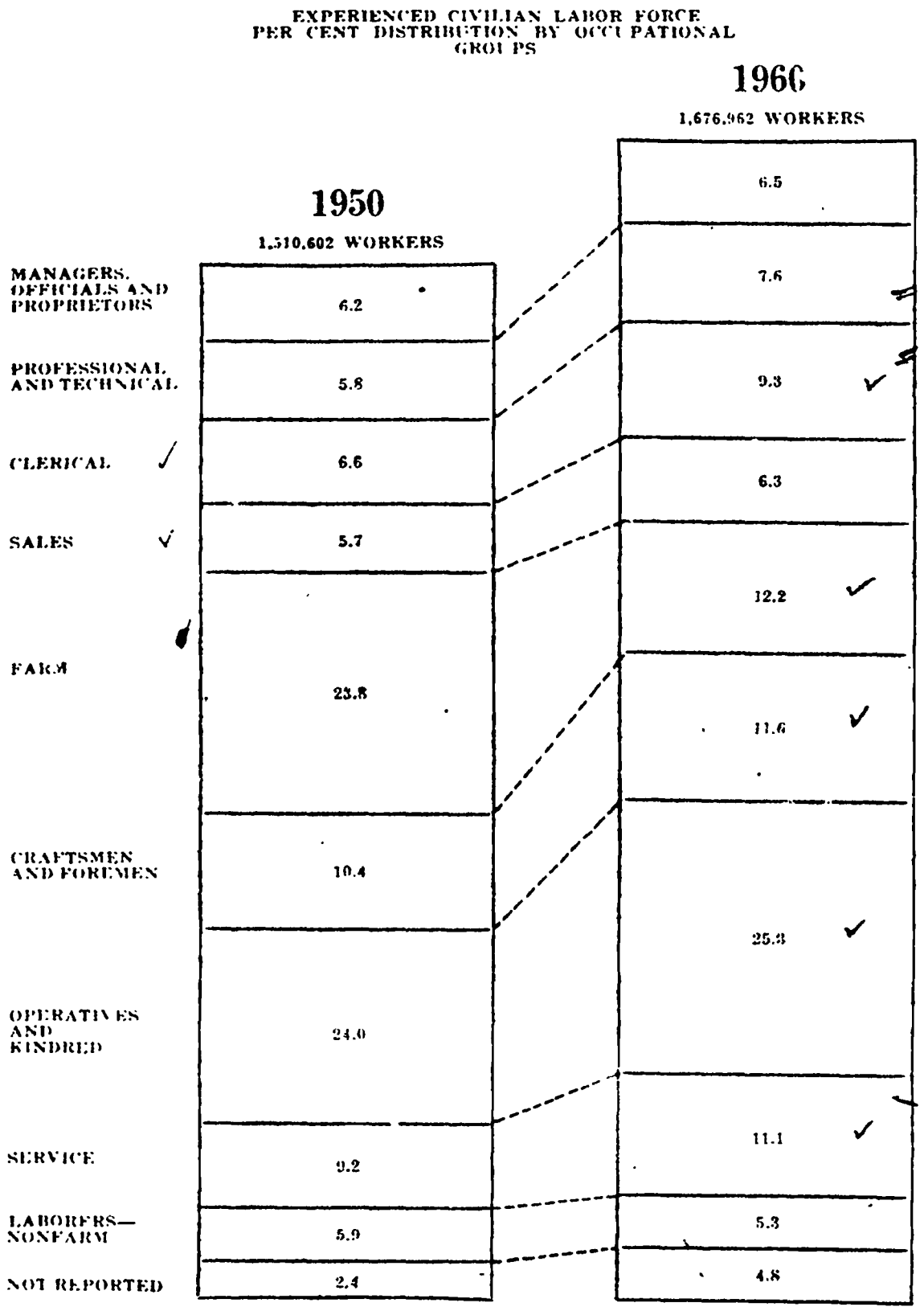
At Shaker Heights, Ohio, I saw an experimental program in two elementary schools which emphasized learning to learn through mastery of study skills. The terminal behaviors in these skills had been carefully formulated and allocated to grades 4, 5, and 6. The library had been reorganized to provide a rich repertoire of learning materials, many of which were studied individually. Listening skills were developed by such tape recordings as "Fact or Opinion." Large group presentation furnished some of the big ideas, and classroom and individualized work in the library gave practice in putting these skills to use. The pupils were learning to learn and were also mastering subject matter.

Some instructors when asked what they teach may say: "I teach English," or "I teach children." I suggest that there is another meaningful answer: "I teach learning." Clearly we do need to be sensitive to the subject matter and the person taught. But unless we learn to learn and develop a love for continuing learning we may well meet the fate predicted by the philosopher Alfred North Whitehead who said: "In the conditions of modern life the rule is absolute: The race which does not value trained intelligence is doomed. Not all your heroism, not all your social charm, not all your wit, not all your victories on land and sea, can move back the finger of fate."

APPENDIX C

ERIC

THE STATE'S OCCUPATIONAL PATTERN IS SHIFTING*



Experienced Civilian Labor Force
Workers 14 Years Old and Over

	Per Cent Change 1950 - 1960
All Workers	+ 11.0
Managers, Officials and Proprietors	+ 15.8
Professional, Technical & Kindred Workers	+ 46.6
Clerical Workers	+ 56.2
Sales Workers	+ 23.8
Service Workers	+ 33.4
Craftsmen, Foremen and Kindred Workers	+ 24.2
Operatives and Kindred Workers	+ 16.5
Laborers — Nonfarm	- 0.6
Farm Workers	- 42.9

Inevitably, significant industrial and occupational changes will continue in the decades to come as production methods are modernized, as outmoded machines and processes are discarded, and as workers are displaced. Industrial growth, automation and technological advances are creating many new and different job opportunities, but labor shortages exist in many of these occupations due to a lack of qualified, trained workers.

* N.C. Employment Security Commission, Digest of The North Carolina Study of Technical and Skilled Manpower.

APPENDIX D

ERIC

STUDENT PERSONAL DATA FORM FOR PILOT STUDY, 1961-62

Vocational Agriculture (Experimental)

To the Student:

The purpose of this form is to bring together essential information about you, so that your teacher will know you better. Answer the questions frankly and completely as possible. The forms are for confidential use only.

Date _____

Name _____ Age _____

Home address _____ Phone _____

Place of birth _____ Date of birth _____

Father's or Guardian's name _____

Father's Occupation _____ Highest grade completed _____

Mother's Occupation _____ Highest grade completed _____

Older brother and sisters:

Sex (M or F)	Approximate age	Highest grade completed	Occupation

Was your last year's scholastic standing high?____ above average?____ average?____ below average?____ low?____ (check one)

List the subject that:

You like best:	You dislike most:	Is easiest:	Is hardest:

Do you plan to graduate from high school? _____

If you do not plan to graduate from high school, encircle the last grade which you plan to complete. Grade 9, 10, 11, 12

State briefly the chief reason why you might have to leave school. _____

_____

_____

Note: This page should be completed by the teacher in conference with student.

What do you plan to do when you leave high school?

_____ go to college

_____ go to a technical school

_____ go to a trade school

_____ go to business school

_____ go to work

_____ military service

_____ other plans, what are they? _____

State the chief reasons for your plans indicated above. _____

_____

_____

If you have decided upon the particular school or college that you plan to enter after leaving school, name it. _____

What do you enjoy in life more than anything else? _____

_____

What achievements in school have given you greatest satisfaction? _____

_____

What occupations or fields of work have you considered for your life's work?

1st choice _____

2nd choice _____

3rd choice _____

Reason for first choice _____

When did you begin considering this choice? _____

If you could do just as you wished, what would you want to be doing when you are around 30 yrs. old? _____

How much schooling do your parents or guardians want you to complete? _____

What vocational career do your parents want you to follow? _____

_____ Why? _____

APPENDIX E

YOU AND SUCCESS ON THE JOB*

1. How can you plan for a successful future through wise choice of an occupation?
   a. Learn about the many types and levels of occupations at which people work - manual and service occupations, clerical, technical.
   b. Learn about your abilities and interests through your school records and tests.
   c. Learn about your physical limitations.
   d. Consult your parents, relatives, and counselors.
   e. Be prepared to start from the bottom.
2. How important is your schooling?
   a. Mastering the basic tools of learning.
   b. Learning how to assess yourself: limitations, abilities, goals.
   c. Getting advice on present or future employment.
   d. Achieving a good record and recommendation: grades, attendance, personality traits.
3. Where do you look for a job?
   a. Public agencies.
   b. Private agencies (including social and religious).
   c. School employment bureau.
   d. Newspapers (including Civil Service newspapers).
   e. Friends and relatives.
4. How do you apply for a job?
   a. Preparing a letter of application.
   b. Filling out an application form.
   c. Taking an examination.
   d. Being interviewed by the employer.

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*Taken from Board of Education of the City of New York, Curriculum Resource Materials for Meeting School Retention and Pre-Employment Needs (New York: Board of Education, 1961), pp. 98-99. HEP/7/63

5. What can you do to hold your job?

   a. Regular and punctual attendance.

   b. Showing courtesy.

   c. Willingness to accept criticism.

   d. Avoiding repeated errors.

   e. Ability to be tactful when necessary.

   f. Showing your cooperation by helping other workers and offering suggestions to your employer when requested.

   g. Dependability.

6. What are the personality traits important in getting and keeping a job?

   a. Good character traits.

   b. Good appearance.

   c. Good speech and manners.

   d. Pleasing voice.

   e. Self-confidence without conceit.

   f. Even temper.

7. How do you grow and develop on the job?

   a. Through doing your best job.

   b. Through patience. (Do not expect too rapid growth or advancement.)

   c. Through preparing, when possible or necessary, for the job immediately ahead.

8. When should you change your job?

   a. Possibilities of advancement.

   b. Chance to develop new interests.

   c. Appreciable difference in wage scales.

9. How do you measure success on the job?

   a. The position you occupy.

   b. The wages you make now and the chance for advancement.

   c. The pleasure of doing something you like.

   d. The surroundings you work in.

APPENDIX F

ERIC

STEP I: Read below and rate yourself on Items 1-50

S--SUPERIOR, OR "A" grades in school courses, OR you possess this ability to a greater degree than about 9 out of 10 people.

G--GOOD, OR "B" grades in school courses, OR you possess this ability or trait to a greater degree than about 6 out of 10 people.

F--FAIR, OR "C" grades in school courses, OR you possess this ability or trait to a greater degree than about 3 out of 10 people.

P/NR--POOR, "D", "F", OR "U" grades in school courses or at least 7 out of 10 people possess this ability or trait to a greater degree than you, or NO EXPERIENCE on which to base a rating in this area.

WHEN YOU HAVE COMPLETED ALL 70 ITEMS, TEAR OFF THE RATED SECTION AND FOLLOW THE INSTRUCTIONS ON THE REVERSE SIDE.

STEP II: Read below and rate yourself on Items 51-70

VS--Your interest in or need for this type of activity or situation is very strong.

M -- Your interest in or need for this type of activity or situation is moderate.

I -- You are indifferent to this type of activity or situation; you have no strong feelings one way or the other, or you do not have enough experience in this area on which to base a rating.

D -- You dislike this type of activity or situation.

NOTE: Additional copies of this profile form may be ordered from.

American Liberty Press
161 W. Wisconsin Avenue
Milwaukee 3, Wisconsin

		S	G	F	P/NR
A-SCHOLASTIC ABILITY – refers to your capacity for performing mental activities such as school work.	A-SCHOLASTIC				
1. What are your average science grades?	1.	O	O	O	O
2. What are your average English grades?	2.	O	O	O	O
3. What are your average social science grades?	3.	O	O	O	O
4. What are your average mathematics grades?	4.	O	O	O	O
5. What are your average foreign language grades?	5.	O	O	O	O
6. How does your homeroom teacher, counselor or advisor rate you according to scholastic aptitude (I.Q.) tests you haven taken?	6.	O	O	O	O
7. How do you rate your scholastic ability in comparison to the other students in your class?	7.	O	O	O	O
B-SOCIAL ABILITY — refers to your ability for working with other people.	B-SOCIAL				
8. How would you rate the extent to which you appreciate what others do for you?	8.	O	O	O	O
9. How tactful are you?	9.	O	O	O	O
10. How would you rate your ability to cooperate with others?	10.	O	O	O	O
11. How do you think adults would rate you in personal appearance and hygiene?	11.	O	O	O	O
12. How would you rate your ability to get your ideas across to other people?	12.	O	O	O	O
13. How would you rate your ability to make friends?	13.	O	O	O	O
14. How would you rate your genuine liking of people?	14.	O	O	O	O
C-MECHANICAL — refers to ability you posses for working with tools, mechanisms, materials, machines.	C-MECHANICAL				
15. What are your average grades in courses which are mechanical in nature — shop courses?	15.	O	O	O	O
16. What are your average mechanical drawing grades?	16.	O	O	O	O
17. What are your average typing grades?	17.	O	O	O	O
18. What are your average shorthand grades?	18.	O	O	O	O
19. What are your average homemaking arts course grades?	19.	O	O	O	O
20. How would you rate your mechanical dexterity as shown by hobbies, working with tools or sewing?	20.	O	O	O	O
21. How do mechanical aptitude or ability tests rate you?	21.	O	O	O	O
22. How do your parents rate you on mechanical know-how?	22.	O	O	O	O
D-AESTHETIC AND CREATIVE ABILITY — refers to your ability to imagine and express concretely your ideas concerning words, colors, tones, lines, forms and your creativity or resourcefulness.	D-AESTHETIC				
23. How would you rate your ability to play a musical instrument?	23.	O	O	O	O
24. How would you rate your ability to do original musical work such as arranging or composing?	24.	O	O	O	O
25. How would you rate your ability to sing?	25.	O	O	O	O
26. How would you rate your sense of rhythm?	26.	O	O	O	O
27. How do your teachers rate your written work such as compositions and themes?	27.	O	O	O	O
28. How would you rate your ability to put your thoughts into written words?	28.	O	O	O	O
29. How would you rate your ability to express your thoughts in speaking?	29.	O	O	O	O
30. How would you rate your ability to dramatize your speech through facial and body expression?	30.	O	O	O	O
31. How would you rate your creative imagination or resourcefulness?	31.	O	O	O	O
32. How would you rate your ability to sense the correctness of color schemes?	32.	O	O	O	O
33. How would you rate your ability to sense symmetry of lines and forms?	33.	O	O	O	O
E-PHYSICAL ABILITY	E-PHYSICAL				
34. Hearing—How would you rate your ability to hear?	34.	O	O	O	O
35. Eyesight—How would you rate your ability to see?	35.	O	O	O	O
36. How would you rate your ability to distinguish different colors?	36.	O	O	O	O
37. Speech—How would you rate the mechanics of your speech such as enunciation and pronounciation?	37.	O	O	O	O
38. Manual dexterity—How would you rate your ability to work with your hands?	38.	O	O	O	O
39. Finger dexterity—How would you rate your ability to do precision work with your hands?	39.	O	O	O	O
40. Endurance—How would you rate your ability to withstand continuous physical exertion?	40.	O	O	O	O
41. General health—How would you rate your general physical condition?	41.	O	O	O	O
42. Coordination—How would you rate your general physical coordination (as in athletics)?	42.	O	O	O	O
F-PERSONAL TRAITS	F-PERSONAL				
43. Initiative—How would you rate your ability to work without constant direction or prodding?	43.	O	O	O	O
44. Courage—How would you rate your ability to act according to what you believe is right?	44.	O	O	O	O
45. Perseverance—How would you rate your ability to stick to a project, job, plan or purpose?	45.	O	O	O	O
46. Reliability—How would you rate your ability to do what is expected of you even when unsupervised?	46.	O	O	O	O
47. Cooperation—How would you rate your ability to work or engage in recreational activities with others?	47.	O	O	O	O
48. Warmth—How would you rate your ability to reflect sincere interest in others?	48.	O	O	O	O
49. Neatness—How would you rate your ability to keep yourself and your surroundings neat and orderly?	49.	O	O	O	O
50. Courtesy—How would you rate your consideration for the feelings of others?	50.	O	O	O	O
G-INTERESTS	G-INTERESTS	VS	M	I	D
For questions 51-70, rate your desire to be in situations or activities—					
51. Involving outdoor work regardless of the weather (outdoor)?	51.	O	O	O	O
52. Involving tools, moving parts, drawing or mechanisms (mechanical)?	52.	O	O	O	O
53. Involving problems with numbers (numerical)?	53.	O	O	O	O
54. Which involve abstract or speculative problems which may involve numbers, ideas or things (theoretical)?	54.	O	O	O	O
55. Which involve satisfying your curiosity, relating particularly to physical, material or natural fields of knowledge (scientific)?	55.	O	O	O	O
56. Which involve the imagining and expressing of ideas concerning colors, lines, and forms (artistic)?	56.	O	O	O	O
57. Which involve the imagining and expressing in written form your ideas, feelings, thoughts and observations (literary)?	57.	O	O	O	O
58. Which involve the imagining and expressing of your ideas and feelings in musical activities (musical)?	58.	O	O	O	O
59. Which involve changing or influencing the ideas of others (persuasive)?	59.	O	O	O	O
60. Which involve helping people in the areas of their health, education and welfare (social service)?	60.	O	O	O	O
61. Which involve office work (clerical)?	61.	O	O	O	O
62. Which involve organizing the work of other people (supervisory)?	62.	O	O	O	O
63. Which involve considerable travel (travel)?	63.	O	O	O	O
H-NEEDS	H-NEEDS				
64. In which you are usually directed by others (dependence)?	64.	O	O	O	O
65. In which you direct the activities of others (dominance)?	65.	O	O	O	O
66. In which you can usually be certain of the future (security)?	66.	O	O	O	O
67. Which would result in respect to you because of your work, title or position (prestige)?	67.	O	O	O	O
68. In which you can originate ideas, methods, products or things (creativity)?	68.	O	O	O	O
69. Which result in the protection of the lives, health, property or rights of others (protectiveness)?	69.	O	O	O	O
70. In which you are usually able to work on your own and make your own decisions (independence)?	70.	O	O	O	O

SELF-RATING CHART *

Name_____ Grade _____ Date_____

Read each statement listed below & place an X in the column (1-5) that best describes you.

Col. # 1: Decidedly below average or Seldom; # 2: Below average or Sometimes, # 3: Average or Generally, # 4: Excellent or Usually, and # 5: Superior or Always.

	1	2	3	4	5
1. PHYSICAL TRAITS					
a. Do I exercise good health habits					
b. Do I possess vitality					
c. Do I exercise self-control					
d. Do I present a good appearance					
2. WORK HABITS					
a. Do I do only my own work, without talking					
b. Am I ready to start working as soon as I enter the room					
c. Do I listen to and follow directions					
d. Do I work until the job is finished					
3. MENTAL CHARACTERISTICS					
a. Do I think clearly and with an open mind					
c. Am I intellectually curious					
d. Am I mentally industrious, possessing the will to do					
e. Do I exercise constructive imagination					
f. Do I read the directions before asking questions.					
f. Do I do more work than is required					
g. Do I use the library regularly					
h. Do I bring things related to classwork to the class					
4. SOCIAL ATTRIBUTES					
a. Do I take a genuine interest in others, being responsive to them					
b. Do I work harmoniously as a member of a team					
c. Am I considered dependable by my classmates, teachers					
d. Am I able to express myself effectively					
e. Do I think of how my actions and speech will affect others before I act or speak					
f. Do I keep order in my section of the room by behaving					
g. Am I courteous to my fellow students & the teachers					
h. Do I show an active interest in every class activity					
5. MORAL AND SPIRITUAL BELIEFS					
a. Do I have high ideals					
b. Do I possess moral courage					
c. Do I have a true appreciation of worthwhile things					
d. Do I believe in the cultivation of one's higher nature					
6. RESPONSIBILITY					
a. Am I on time to class and with my work					
b. Do I behave myself in class during teachers absence					
c. Do I bring my materials to class everyday					
d. Do I take part in class discussions					
e. Must I be spoken to individually because I have not listened to class directions.					

STUDY OF OCCUPATIONS NAME_____

JOBS OR OCCUPATIONS INTERESTED IN	CHARACTERISTICS OF JOBS OR OCCUPATIONS	SPECIAL ABILITIES NEEDED THIS JOB

STUDY OF OCCUPATIONS NAME_____

JOBS OR OCCUPATIONS INTERESTED IN	CHARACTERISTICS OF JOBS OR OCCUPATIONS	SPECIAL ABILITIES NEEDED THIS JOB

INTERVIEW SHEET NAME _____

PERSON INTERVIEWED	OCCUPATION OF PERSON INTERVIEWED	NOTES

HIGH SCHOOL GRADES

NAME _____

SUBJECTS	ABOVE AVERAGE	AVERAGE	BELOW AVERAGE
FOREIGN LANGUAGE			
SOCIAL SCIENCES			
MATHEMATICS			
SCIENCES			
FINE ARTS			
ATHLETICS, PHYSICAL EDUCATION			
COMMERICAL & BUSINESS			
AGRICULTURE			

TEST INDICATIONS- SPECIAL AND GENERAL

GENERAL AND SPECIAL BACKGROUN

WHAT I AM LIKE

The outline below is to help you prepare oral reports about yourself. Cop. the headings which apply to you in some way and check those items which especially tell something about you.

WHAT AM I LIKE SOCIALLY?

____Enjoy being with people
____Like to be by myself
____Make friends easily
____Lose my temper frequently
____Assume responsibility
____Work well with others
____Accept criticism cheerfully

WHAT AM I LIKE MENTALLY?

____Speak and write well
____Like working with ideas
____Have intellectual curiosity
____Like to think out problems
____Take things as they come
____No failures in school subjects
____Some failures in school subjects
____Like to read
____Dislike reading
____Dislike writing

WHAT DO I LIKE TO DO?

____Have a definite occupational choice
____Am influenced in choices by friends
____Like working with things
____Like working with people
____Have hobbies
____Make good use of leisure time
____Do what my friends suggest
____Waste leisure time

WHAT DO I EXPECT FROM LIFE?

____Travel, adventure
____Stay in Worcester
____To make money
____To really work hard
____To be of service to people
____Recognition and prestige
____To impress people
____Like job which allows more leisure time

WHAT AM I LIKE PHYSICALLY? (UNDERLINE THE WORD WHICH APPLIES TO YOU)

____Weight: slight-medium-average-heavy-husky
____Strength: weak-average-strong-very strong
____Manual dexterity: excellent-good-fair-average-poor
____Coordination: excellent-good-fair-average-poor
____Skill: name your particular skill _____

WHAT AM I LIKE TEMPERAMENTALLY?

____Accurate
____Methodical
____Inaccurate
____Fairly accurate
____Easily tired
____Lose interest in a job quickly
____Like routine
____Dislike routine
____Like security
____Security unimportant
____Willing to work for long time goal

Taken from Occupational Relations Second Year Course Outline

APPENDIX G

ERIC

SUGGESTED FORM FOR PUPIL STUDY OF HIS JOB FIELD *

Name _____

Date _____

Complete the blanks or underline either yes or no.

I. Field

A. General _____

B. Specific branch _____

_____

C. Job or jobs you want

1. _____

2. _____

II. Duties on the Job (List a minimum of five.)

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

J. _____

III. Training or Preparation Needed for the Job

A. What skills do you need?

1. _____

2. _____

3. _____

4. _____

5. _____

*Cincinnati Public Schools. Economic Relations I

SUGGESTED FORM FOR PUPIL STUDY OF HIS JOB FIELD (Continued)

B. Where can you get the training needed for this job?

1. _____

2. _____

3. _____

C. What additional education is needed and recommended?

1. _____

2. _____

3. _____

D. Where can you get this additional training that is needed?

1. _____

2. _____

3. _____

IV. Personality Traits Needed for the Job (List a minimum of five.)

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

V. Need for Workers in This Field

A. Are new workers needed now in this occupation? Yes or No

B. Will new workers be needed in the future Yes or No

VI. Promotion

A. Will there be an opportunity for promotion? Yes or No

B. Name the steps of promotion.

1. _____

2. _____

3. _____

4. _____

SUGGESTED FORM FOR PUPIL STUDY OF HIS JOB FIELD (Continued)

C. Is additional training needed for promotion? Yes or No

1. Formal Yes or No

2. Informal Yes or No

3. Apprentice Training Yes or No

D. Are there related occupations to which this job may lead (either with or without more training)? Yes or No

VII. Earnings

How much would you earn as a

A. Beginning wage (Underline per hour, per day, or per week)

B. Wage earned by most of the workers _____

C. Highest wage _____

D. Is there usually a vacation with pay? Yes or No

VIII. Time Worked

A. How many hours on the average would you work?

1. Daily _____

2. Weekly _____

B. Is there usually additional pay for overtime work? Yes or No

C. Are there seasonal lay offs? Yes or No

IX. Health and Safety

A. Is there a danger to your health? Yes or No

B. Is the accident rate high on this job? Yes or No

C. What safety precautions would you have to take on this job?

1. Wear protective clothing Yes or No

2. Check guards on the machines and equipment? Yes or No

3. Obey safety rules of the firm? Yes or No

X. Employee Organizations of a Full-Time Worker

A. Would you be expected to join a union? Yes or No

B. Would you be expected to join an employee organization other than a union? Yes or No

SUGGESTED FORM FOR PUPIL STUDY OF HIS JOB FIELD (Continued)

XI. Service to the Community (List a minimum of three ways that workers in this job serve the community.)

A. _____

B. _____

C. _____

D. _____

E. _____

XII. Firms in Cincinnati Where This Type of Job Would be Available (List a minimum of three.)

A. _____

B. _____

C. _____

D. _____

E. _____

XIII. Sources of Information Used to Make This Study (List a minimum of three.)

A. Title _____

Publisher _____

Date Published _____

B. Title _____

Publisher _____

Date Published _____

C. Title _____

Publisher _____

Date Published _____

D. Co-ordinator's help

1. Speech to class Yes or No

2. Consultation with him Yes or No

E. Additional means

1. _____

2. _____

SELECTED FOR INTERVIEW AND STUDY _____
(Name of occupation)

Obtain the following information plus any other information you desire:

1. Does this job offer opportunities for the following: (Explain)

   a. Be of service to people? _____

   b. Work out of doors? _____

   c. Do things with your hands? _____

   d. Read? _____ Study? _____

   e. Write? _____

   f. Operate machinery? _____

   g. Travel? _____

   h. Do detailed work? _____

   i. Explore? _____ Investigate? _____ Discover? _____

   j. Work with people? _____

2. Job opportunities.

   a. How hard is it to find a job in such a career?
      (When you have the necessary qualifications.)

      Easy_____ Difficult_____ Very difficult_____

   b. In the future will the need for people in this job be greater? _____

      _____ Less? _____ The same? _____

   c. Are the opportunities good for advancing from this job to a better one? _____

3. What are the incomes people receive in this occupation per year?

   Highest $_____ Lowest $_____ Average $_____

4. Geographically, where are these jobs located? _____

Taken from N.C. Extension Service, Career Exploration

5. In this occupation would you work:
(check)

a. By the hour? _____ b. By piece work? _____ c. For a salary? _____

d. For commission? _____ e. For fees? _____ f. In business for yourself? _____

6. What are the hazards such as temporary unemployment, risk of financial loss, being killed, or disabled?

_____

7. Qualifications:

a. Type of education needed. _____

b. Amount of education needed. _____

c. Cost and place of this education. _____

d. How much will it cost to enter the occupation after completion of education? (For example, a farmer needs equipment and operating cash, a dentist needs dental and office equipment, a machinist needs tools.)

_____

e. What physical limitations would be handicaps in this job?

_____

_____

f. Personal traits needed (such as neatness, patience, etc.):

_____

_____

g. Other (special advantages or disadvantages):

_____

_____

_____

_____

_____

EVALUATING A JOB *

To find your life work, you need to study a number of jobs. This will be your first effort in doing some independent research. Research is important before you make any decision about a job. Give research a trial -- you might like it.

When you are considering a job, it is necessary to evaluate it in order to find out if you can meet its requirements and if the job can fulfill your requirements.

Below, select jobs which would meet the educational requirements listed.

1. _____ requires a high school education.

2. _____ requires a high school education.

3. _____ requires trade school training.

4. _____ requires trade school training.

5. _____ requires an apprenticeship.

6. _____ requires an apprenticeship.

7. _____ requires a college education.

8. _____ requires a college education.

On the following pages, you will find outlines to use which will illustrate what various jobs have to offer you. To get the greatest benefit from this exercise use only those jobs in which you think you might like to earn your living.

You may be surprised at some of the information you uncover.

EVALUATING A JOB

Job title _____

Education needed _____

* [illegible] (Continued)

1. Description of work _____

_____

_____

_____

2. Earnings _____

3. Working conditions _____

4. Hours of work _____

5. Ability required _____

_____

6. Temperament required _____

_____

7. Education and training required _____

_____

_____

8. Cost of this education and training _____

_____

9. Attractive features _____

_____

10. Disadvantages _____

_____

11. Outlook for future _____

_____

_____

(continued)

12. Licensing, unions, or profe . onal organizat . . . mu
join.

_____

_____

13. How would you g about getting this job? _____

_____

_____

14. Why does this job interest you? _____

_____

15. Rate this job as a lifetime job for you:

SUMMARY

Appealing _____

Disappointing _____

No interest _____

ANOTHER JOB EVALUATION

On the next page is another type of evaluation of a job. It is how you feel towards some of the conditions of the job. Answer with your own feelings. Again, use jobs in which you think you are interested. The summary will be interesting. The independent thinking will be a good experience.

Go over these pages as many times as you wish, using your own independent judgment in evaluating the different jobs and how they appeal to you. These exercises will also give you experience in learning how to "make up your mind."

JOB EVALUATION

Job title _____

	Interesting	No emotion
1. Salary	_____	_____
2. Short hours	_____	_____
3. Vacations	_____	_____
4. Work alone	_____	_____
5. Work in groups	_____	_____
6. Routine work	_____	_____
7. Early retirement	_____	_____
8. Easy work.	_____	_____
9. Outdoor work.	_____	_____
10. Good working conditions . . .	_____	_____
11. Variety of work	_____	_____
12. Security	_____	_____
13. Adventure	_____	_____
14. Socially acceptable	_____	_____
15. Co-workers desirable	_____	_____
16. Advancement	_____	_____
17. Working hazards	_____	_____

SUMMARY

By merely looking at the number of checks in the "interesting" columns, you can now tell at a glance the job or at least the area which you should consider seriously for your future.

REPORT ON YOUR OCCUPATIONAL CHOICE *

Copy the headings which apply to your occupational choice. Check any items which tell about your job choice. From the items checked prepare an oral report for class.

I. IN WHICH GENERAL AREA WILL YOU WORK?

____Prefessional
____Semi-professional
____Skilled
____Unskilled
____Clerical and sales
____Service

II. WHAT WILL BE THE NATURE OF YOUR WORK?

____Office work
____Working with people
____Selling service or goods
____Mechanical
____Manual
____Other

III. WHAT APTITUDES ARE MOST IMPORTANT FOR SUCCESS IN YOUR JOB CHOICE? EXPLAIN THE INDIVIDUAL REPORT FORM FOR THE DIFFERENTIAL APTITUDE TESTS.

____Verbal
____Numerical
____Clerical
____Spelling
____Mechanical
____Sentence-Language Usage

IV. WHAT ARE THE PHYSICAL REQUIREMENTS?

____Do you sit?
____Do you stand?
____Must you have finger dexterity?
____Do you use one hand?__both hands?
____Do you need leadership ability?
____Is good hearing necessary?
____Do you use the telephone?
____Is good vision important?
____Do you work indoors?
____Do you work outdoors?
____Do you move around?
____Do you stoop?
____Do you lift heavy loads?
____Is the work routine?
____Do you talk to outsiders?

V. WHAT KIND OF TEMPERAMENT DO YOU NEED?

____Must you be able to get along well with others?
____Must you be able to work alone?
____Should you be outgoing in personality?
____Must you be able to work under strict supervision?
____Must you be able to work under little or no supervision?

* Worcester, Mass. Public Schools. Occupational Relations. Second year course outline.

Report on your Occupational Choice (continued)

VI. WHAT OPPORTUNITIES DOES THE FUTURE HOLD FOR YOUR OCCUPATIONAL CHOICE? EXAMINE THE 1960 CENSUS OF WORCESTER AND THE OCCUPATIONAL OUTLOOK HANDBOOK.

1. Future Growth in Worcester
   ___Upward trend ___Staying the same ___Downward trend

2. What is the trend throughout our nation?
   ___Increasing ___Dying out ___Overcrowded

3. How are promotions granted?
   ___On merit ___Politics ___Seniority ___Tests or examinations

4. How long does it take to reach maximum pay?
   ___1 year ___5 years ___8 years ___10 years

VII. WHAT IS THE SALARY AND WHAT ARE THE FRINGE BENEFITS?

1. ___Starting salary

2. Will you be paid by:
   ___Check ___Weekly ___Monthly
   ___Cash ___Bi-weekly

3. Fringe benefits:
   ___Sick leave ___Bonuses
   ___Retirement ___Vacation
   ___Insurance ___Profit-sharing

VIII. WHAT PREPARATION IS REQUIRED?

___Training on the job ___High school ___Technical school
___Apprenticeship ___Trade school
___Evening high school ___Correspondence school

IX. PERSONAL INTERVIEW

Report the results of at least one personal interview with some person now actively engaged in the occupation. If possible, visit this person on the job so that you can see the actual work done.

X. Set up a general summary listing what you feel are the main advantages and main disadvantages as you see them and which you think are most important in deciding why you wish to select this occupation.

APPENDIX H

ERIC

GENERAL CHANGES OCCURRING OVER THE YEARS IN TYPES OF

OCCUPATIONS NEEDED FOR THE HOUSE BUILDING TYPE CONSTRUCTION

Periods of Time

Early American days

DESIGN, MATERIALS, BUILD
One Man Operation

Several years ago

DESIGN
Architect

MATERIALS
Bldg. Supply Co.

BUILD
Machine Operators
Carpenters
Brick and Stonemasons
Electricians
Painters
Plumbers

The present day

DESIGN
Architect
Draftsman

MATERIALS
Bldg. Supply Co.
Pre-Fabricating Firms

BUILD

STRUCTURAL

Carpenters
Bricklayers
Stonemasons
Cement or Concrete Masons
Structural Iron Workers
Reinforcing Iron Workers
Riggers
Boilermakers
Operating Engineers

FINISHING

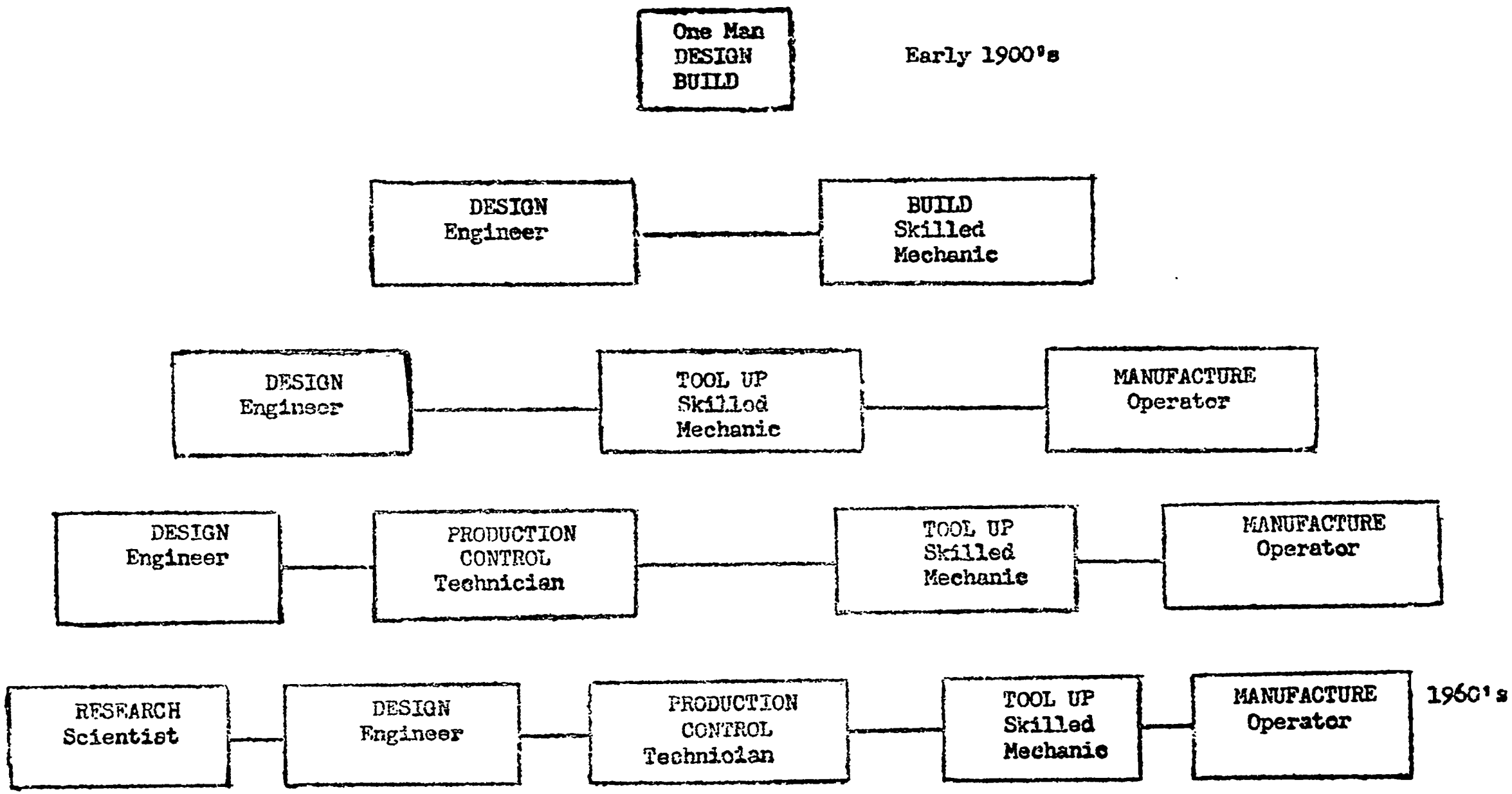
Lathers
Plasterers
Marble Setters
Tile Setters
Terrazzo Workers
Painters
Paperhangers
Soft-floor Layers
Glaziers
Roofers
Asbestos Workers

MECHANICAL

Plumbers
Pipefitters
Millwrights
Construction Electricians
Sheet Metal Workers
Elevator Constructors

CHANGES IN MANUFACTURING TEAMS, Which Build

Cars and Most other Products, Since Early in the 1900's - Henry Ford Days



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ABSTRACT - Developed by a curriculum coordinator, this resource guide was later tested in cooperating junior high schools. The materials may be used in a one-term course for teaching drafting skills, but suggestions are also given for correlating these materials with science, mathematics, language arts, social studies, art, health education, and other industrial areas. The aim, suggested activities, discussion topics, teacher demonstration, and assignments and homework are outlined for each of the 24 lesson plans. A section devoted to teacher suggestions covers: (1) resources and aids, (2) necessary equipment and materials, (3) visual aids, (4) classroom management, and (5) teaching techniques. (DM)

VT 003 553

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CURRICULUM BULLETIN • 1966-67 SERIES • NO. 9

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DRAFTING EXPERIENCES

for

INTERMEDIATE SCHOOL PUPILS

A Resource Bulletin for

Teachers of Industrial Arts

VT003553

BOARD OF EDUCATION OF THE CITY OF NEW YORK

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FOREWORD

The application of basic drafting skills to many areas of the curriculum can provide meaningful experiences for pupils in the intermediate schools. By providing guidelines for teaching the understanding and appreciation of problems related to this technological age through the medium of applied drafting techniques, this resource bulletin makes available to the subject teacher a valuable aid to lesson enrichment. Emphasis is placed on the correlation of drafting with science, mathematics, language arts, social studies, and the practical arts. Many areas of the curriculum can adapt the concepts and related lesson outlines in this bulletin to the topics under discussion. These lessons may serve as a means of individualizing instruction, and they may extend the horizons of young people in the subject disciplines.

This resource bulletin contains information which should be useful to teachers of many subjects in the intermediate school. The examples of lesson outlines, tests, and drafting procedures can serve the needs of students with different skills and interests. The ability to visualize three-dimensional objects and to apply these concepts to challenging problems will serve as a valuable means of making more meaningful the many aspects of the students' experience in the school, home and community.

Helene M. Lloyd
Acting Deputy Superintendent of Schools

January 1967

VT 003 55

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This curriculum bulletin, DRAFTING EXPERIENCE FOR INTERMEDIATE SCHOOL PUPILS, was developed under the direction of William H. Bristow, Assistant Superintendent, Bureau of Curriculum Development, and Herbert Seigel, Director of Industrial Arts. Harry E. Wolfson, Assistant Superintendent, Office of Curriculum, gave advice and support to the development of this material. Helene M. Lloyd, Acting Deputy Superintendent, Office of Curriculum and Instruction, provided overall supervision of the project.

Daniel A. Salmon, Curriculum Coordinator, Bureau of Curriculum Development, designed the program and developed the original drawings and text material.

During the years of 1964-65 an experimental course was distributed to cooperating junior high schools. This field experience and evaluation provided suggestions and modifications which were incorporated in the manual. The Standing Advisory Committee for Industrial Arts and the Association of Chairmen of Industrial Arts endorsed the proposed bulletin and recommended its implementation in the schools.

Under the direction of Joseph O. Loretan*, Deputy Superintendent of Schools, an advisory committee of industrial arts personnel from the junior and senior high schools reviewed the proposed bulletin and recommended its adoption. The committee included Sharony Berger, Morris Dickstein, Arthur E. Golomb, Morton E. Perlman, Harvey W. Schaffer, and Richard Wayler.

Aaron N. Slotkin, Editor, Lillian B. Amdur, and Edythe Kahn provided editorial and production assistance. Simon Shulman did the layout and prepared the manuscript and cover for printing. Drawings were inked by Robert Boily. Donald Pitkoff did the cover design. Daniel A. Salmon was coordinator and editor of the project.

* *Deceased*

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INTRODUCTION

The development of fundamental drafting skills at the intermediate school level provides the student with the opportunity to become acquainted with a variety of technological understandings that are related to many aspects of the curriculum. The ability to interpret and to visualize the products of industry and to relate these products to other curriculum areas enables the student to enrich his knowledge and appreciation of the many facets of the total school program.

This resource bulletin may be useful to teachers of all subjects as well as to those instructors who specialize in industrial arts. Adaptation of the materials contained in the bulletin may be as follows:

1. AS A RESOURCE BULLETIN for teachers and students this guide introduces the fundamentals of mechanical drafting that are applicable to a variety of curriculum areas. An examination of the plates and the related lesson topics illustrates how these basic concepts can be correlated with other school subjects. The typical unit provides related drafting experiences in two or more subject areas including mathematics, science, social studies, language arts, and practical arts.

2. AS SUPPLEMENTARY INSTRUCTIONAL MATERIAL this curriculum bulletin provides project ideas and related lesson outlines for teachers of industrial arts. The topic outlines may serve as models for teacher planning. These can be of special value to both the inexperienced and experienced teacher who is assigned to the intermediate school program.

   The teacher of subjects other than industrial arts may utilize the projects and lesson materials to enrich his presentation of a unit, to illustrate related ideas and problems, and to correlate the activities in the classroom with the skills application in the industrial arts program.

3. AS A MEANS OF INDIVIDUALIZING INSTRUCTION these materials may be used to stimulate students to do their own thinking, designing, and planning in related problems in all subject areas. Teachers may use this manual to provide basic instruction to pupils who may be developing reports, projects, presentations, or visual aids. Elementary drafting skills applicable to these problems can be developed with the aid of this resource bulletin.

   The drafting procedures outlined in this resource bulletin may be conducted in a regular classroom; little special material is required. By enabling the student to familiarize himself with some of the fundamental drafting concepts as they apply to a particular subject area, the teacher provides the opportunity for the development of an understanding of the interrelationships among all subject areas of the curriculum.

4. AS A CORRELATED COURSE OF STUDY these materials may be used to provide valuable and motivated instruction to students in an industrial arts sequence. Basic skills and concepts required in this technology

may be introduced, and students can learn fundamental procedures which will be developed further in articulated drafting programs in the comprehensive secondary school.

Objectives

The broad, general objectives of this resource bulletin may be described as follows:

1. To provide supplementary materials related to the understanding of basic drafting skills for correlated curriculum topics.

2. To assist in the interpretation of mechanical drawings and sketches in order to solve problems, both technical and nontechnical.

3. To develop visualization skills as they apply to the understanding and appreciation of the products and processes of man's growth and changing technology.

4. To serve the needs of students in all subject areas as a source of basic technical information relating to the development and preparation of problems and activities requiring fundamental drafting techniques.

5. To motivate the student who indicates an interest in drafting as an occupational opportunity and to provide him with a basis for evaluating these aspirations.

Correlated Instruction

1. The teacher is expected to correlate drafting experiences with other school subjects. Every opportunity to relate drafting skills and knowledge to other school and community experiences should be expanded. Drafting is a problem-solving activity which may be involved with other subjects in the school curriculum; no attempt should be made to isolate it or to limit the relationship to industrial arts only. The sciences, language arts, social studies, mathematics, and other subject areas may utilize drafting concepts through instruction, related materials, assignments, and student activity. An assignment, such as the drawing of laboratory equipment, a ball field, or flow chart or graph, would relate to the other curriculum areas and provide much information and knowledge to pupils participating in such an activity.

2. Instruction may be given as class or individual presentations. The teacher is urged to develop new concepts based on knowledge and understandings previously acquired by the pupils. Instruction related to school activities as well as those experiences in the home and community are primary sources of motivation.

3. Understanding should be developed through visualization, sketches, and mechanical drafting. Students should be encouraged to develop skills in freehand sketching as well as mechanical drawing. A procedure requiring each student to make a freehand sketch before using drafting instruments will do much to improve the technical sketching ability of each pupil.

4. Stress should be placed on the principle that drafting is a language used to express ideas. The technical details of form and style are merely devices which help others to understand this language, no matter who writes it. The skills involved in making the drawing are the results of practice. The understandings involved are the results of excellent instruction.

CORRELATING DRAFTING WITH SCIENCE

The visual interpretation of science concepts often involves the ability to design and draw apparatus, diagrams, and charts of a variety of laboratory experiences. The alliance of science and drafting activities is part of the work of the technician, and the close correlation of these subject areas can be an important part of the school program.

	Page
Airplane	22
Alloys	41
Animal Cage	45
Battery Operated Clock	47
Biology - Portable Display Case	57
Bird House	25
Bunsen Burner	64
Dry Cell	63
Electroplating	61
Flashlight	40
Geographic Pole and Magnetic North - Compass Rose	17
Hi-Fi Amplifier	17
Home Appliances	23, 44, 52
Ignition System	72
Inclined Plane - Screws and Threads	49
Laboratory Pump	29
Lever	63
Lighting	42
Living Plants - Planter	37
Magnetic Latch	39
Metric System	14
Opaque Projector	24
Overhead Projector	24, 44
Pantograph	24, 62
Periscope	64
Photo Enlarger	24
Print Reproduction	72
Properties of Materials: Metals, Woods, Plastics, Ceramics	31, 37, 44, 52
Proportion and Comparison	25
Pulley	39
Racing Car	29
Rocket	28, 42
Rock Sample Tray	57
Sectional Views - Dry Cell, Lever	63
Space Exploration - Nose Cone	37
Sun Dial	42
Symbols - Electronic Circuit Diagrams	71
Telephone	50, 60
Telescope	51
Television	48
Terrarium	37
Test Tube Rack	41
Transistor Radio	34
Transportation	70
Tuning Fork	41
Turbine	32

CORRELATING DRAFTING WITH MATHEMATICS

Skills and concepts acquired in mathematics can be transferred readily to the drafting class through the application of practical drafting problems. The following list indicates where mathematical topics may be directly related to lessons and assignments in the drafting course.

	Page
Circles: Circumference, Diameter, Radius, Chord	17, 27
Computing Costs: Cost per Unit, Number of Units	70
Constructions, Geometric: Circles, Squares, Angles	16, 17
Decimals	14
Degrees of an Angle	17
Direct Measurement	14, 15, 28
Dividing a Space into Equal Parts	16, 21
English System of Measurement	14
Enlarging by Squares	25, 33
Equations and Formulas: Perimeter, Area, Volume, Circumference	37, 66
Fractions	15, 28
Geometric Shapes - Polygons	16, 17
Graphs: Bar, Line, Circle	16, 18, 19
Indirect Measurement	25
Metric System of Measurement	14
Parallel Lines	13, 21
Percentage	19
Perpendicular	17, 21
Problem Solving: Centering Drawing	40
Proportion: Scale Drawing	24, 34
Protractor: Measuring Angles	23
Ratio	14, 21
Tangent	17
Whole Numbers	28, 45

CORRELATING DRAFTING WITH LANGUAGE ARTS

Drafting offers opportunities not only for learning drawing techniques, but also for improv-

ing communication skills. The execution of drafting problems requires that the student read and understand technical terms, interpret blueprint information, and write accurate notes and specifications.

	Page
Abbreviations	71
Bills of Materials	46
Descriptive and Expository Writing	9, 10
Developing Folders:	
Process, Products, Projects	10, 12
Dictation of a Verbal Problem	11
Dictionary of Technical Terms	9
Drafting as a Universal Language	
"Picture" Versus "Word"	12
Identifying Drafting Equipment	9
Interpreting and Folowing Instructions:	
Test No. 1	21
Test No. 2	33
Test No. 3	43
Test No. 4	53
Test No. 5	65
Test No. 6	74
Letter Writing - Request for Catalog	10
Occupational Reports	10, 72
Oral Presentation -	
Individual and Group Reports	10
Pronunciation of Technical Terms	19
Reading and Interpreting	
Graphic Materials	54, 55
Recording Information in a	
Systematic Manner - Charts	19, 28
Research Reports	10, 72
Specifications	70
Spelling of Technical Terms	19
Symbols in Drafting -	
Architectural, Electronic	71
Verbal Instruction of a Visual Problem	58

VOCABULARY- DEFINITIONS

	Page
Architecture	68, 69
Auxiliary View	60
Cabinet Drawing	48
Circumference	14
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Development	66
Diameter	16
Dimension	18, 27
Exploded View	55
Extension	18, 27
Horizontal	12, 13
Intersection	16
Isometric	50, 51
Lamination	22
Multiview	40
Oblique Drawing	48
Orthographic	44
Parallel	16
Pattern	24
Perimeter	16
Perpendicular	14
Perspective	48
Pictorial	48, 49
Projection	44
Radial	66
Scale	34
Sectional	62
Template	24
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CORRELATING DRAFTING WITH SOCIAL STUDIES

The growth and development of this nation has been closely allied with massive industrial expansion and improving technology. Almost everything that is designed and constructed requires mechanical drawings; the ability to interpret these drawings and visualize the product will help the student to appreciate the relationships of commerce and industry to the strength of the nation's economy.

Automation	58
Building Codes	70
Civilizations Contributing to	
Letters and Language	18
Charts - Organizations, Flow	19
Consumer Education	72
Elicit Word "House" in Many Languages	12
Establishment of New Industries	28, 37

	Page
History and Development of Modern Alphabet	18
Industrial Revolution	12
Interpretation of Graphs - Budgets, Population Growth	19
Inventions - Drawings and Models	12
Labor Organizations	70, 72
Maps - National, State, City, District	32
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Occupational Information:	
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Contractor	70
Draftsman	12, 72
Electrician	70
Electronics Technician	71
Engineer	12
Plumber	70
Scientist	12
Sheet Metal Worker	68
Technician	12
Professional Societies	16
Raw Materials - Geographical Location, Supply and Demand	32
Standardization in Industry	26
Trade Associations	26
Traffic Regulations	23
United States Patent Office	17

CORRELATING DRAFTING WITH ART

Art and design are an important part of draftsmanship. The mechanical interpretation of sketches and drawings is part of the work of the architect and the engineer. The art teacher may use these resource materials to reinforce interpretive concepts related to many areas of the school program including those discussions related to industrial and architectural design.

Architectural Styles	68
Block Prints	30
Design	72
Gothic Lettering	18
Illustrations - Magazines, Advertising	46
Perspective	50
Sketching	50
Stencils	31
Textile Patterns	30

CORRELATING DRAFTING WITH HEALTH EDUCATION

The layout and design of athletic activities and games can be related to many drafting concepts. The motivation of students can be tied in the drawings of playing fields and score charts for many athletic programs. The health education teacher can refer to this bulletin as an aid to improving drafting techniques in the preparation of related charts and diagrams used in the athletic program.

Baseball	19
Basketball	23, 34
Football	20, 34
Paddle Tennis	17

CORRELATING DRAFTING WITH OTHER INDUSTRIAL ARTS AREAS

Inherent in the designing, developing, and constructing of projects in the industrial arts shops is the ability to read and interpret working drawings, sketches, and blueprints. As part of each shop activity, the instructor will teach the fundamentals of drafting and design. The materials in this resource bulletin can serve as an aid in this area of instruction.

WOOD SHOP

Bench - Portable	57
Book Ends	64
Chisel	40
Clamps	34
Clock Case	49
Display Case - Portable	57
Hammer	34
Jack Plane	44
Jewelry Box	51
Mallet	38

CORRELATING DRAFTING WITH OTHER INDUSTRIAL ARTS AREAS (continued)

WOOD SHOP

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Marking Gauge	49
Punch	36
Rock Sample Tray	57
Screw Driver	40
Table Lamp	42
Try Square	28, 38

METAL SHOP

Bank - Sheet Metal	59
Bracelet Blank	23
Center Punch	36
Chromium Plating	61
Dies	66
Files	30
Funnel - Sheet Metal	66
Gauges	22
Hammer - Setting Down	52
Hollow Punch	64
Lathe	44
Machine Parts	34
Parallel Line Development	66, 67
Radial Line Development	66, 67
Templates	30
Tool Box - Sheet Metal	45

CERAMICS SHOP

Box	47
Lamp	52
Template	25
Tile	30

ELECTRICITY SHOP

Floor Plan	71
Hi-Fi Amplifier	71, 73
Ignition System	72
Transistor Radio	73

Basic Concepts and Scope

The organization of this resource bulletin provides for correlation with other school subjects within the framework of three major units. The concepts included in these units are introductory drafting topics, working drawing topics, and intermediate drafting topics.

The sequence of problems and discussion topics will permit the development of a range of basic drafting skills which can be of value to students in any subject area of the curriculum.

UNIT I

1. Introduction to drafting
2. Measurement and constructions
3. Drawing angles, circles, and arcs
4. Introduction to lettering
5. Making a one-view drawing
6. Patterns and templates
7. Introduction to dimensioning
8. Applications of one-view working drawings.

UNIT II

9. Scale drawings
10. Making a two-view drawing
11. Dimensioning the working drawing
12. Hidden edges
13. Making a three-view drawing
14. Shop drawings
15. Introduction to pictorial drawing
16. Isometric drawing and sketching

UNIT III

17. Pictorial drawings to working drawings
18. Shop drawing problems - sketching
19. Auxiliary views
20. Sections
21. Surface development
22. Architectural drawing
23. Electrical and plumbing drawings
24. The individual problem

Introductory Drafting Experience

The material in this manual may be adapted for use as related information in all school subjects. It may be presented as a unit or as a factor in topic areas including social studies, science, mathematics, or language arts. In addition, the material related to industrial arts activities may be adapted in any shop area as correlated drafting experiences.

It is practicable to use this resource bulletin as a one-term course of study for the teaching of drafting skills. This offering can be part of the industrial arts sequence for those schools where a program of this type may be integrated into the course of study.

Shop drawing and blueprint reading are taught regularly within the context of the individual shop programs. The materials in this bulletin supplement shop instruction and are designed to provide the student with a broader understanding of drafting problems. At the same time they can assist in developing certain basic skills used in the drafting room. The topics in this manual are representative problems found in the intermediate school program, and they can help to provide a broad overview of the industrial arts program.

This manual is designed to provide a carefully graded and logical sequence of correlated problems which will introduce drafting to the average student in the intermediate school program. Provision has been made to provide for the bright student through additional challenging and enrichment problems. The slower pupil will benefit from this material when the teacher adapts the selection of problems to his needs and ability.

Using This Material As A Unit Course

The material contained in this resource bulletin may be adapted for use as a one-term course of study, introduction to drafting. The sequence of problems and topic discussions provides for an understanding of basic concepts of drafting. A unit course offered as part of an industrial arts schedule can enrich the understanding and appreciation of industrial experiences which the student encounters in the intermediate school program. In addition, a unit course can provide valuable training for students who may be engaged in related problems and activities in science, mathematics, fine arts, and the humanities.

ORGANIZATION AND PLANNING

1. A calendar of scheduled lessons and tests is to be found on page 8. The teacher is urged to indicate the specific date for each activity early in the school term, and to make such adjustments which may be necessary to compensate for holidays or other changes in the school schedule.

2. Group instruction in new concepts is planned for every third period. Classes meeting on a double forty-five minute basis should also adhere to this schedule. Most lessons should be limited to twenty minutes of instruction, thus providing the students with adequate time to develop their drafting skills.

3. Regular tests, given at three-week intervals during the term, will enable the teacher to check the progress of the class and the effectiveness of his teaching. The manual includes six sample tests for the term's work. These tests are manipulative and are designed to cover the areas taught in the previous four units. They may serve as examples for the teacher who wishes to develop his own test, or they may be duplicated for pupil use.

4. This manual has been designed specifically for use by the teacher; drawings, tests, and related materials, however, are suitable for student use and may be duplicated for distribution by the instructor.

UNIT COURSE PLANNING CALENDAR

This program is planned for one semester of approximately 18 weeks. Classes are scheduled for 4 periods per week, 45 minutes per session.

WEEK 1	2	3	4	5	6
Lesson #1			Lesson #5		
		Lesson #4			Lesson #8
	Lesson #3			Lesson #7	
Lesson #2		Test #1	Lesson #6		Test #2
WEEK 7	**8**	**9**	**10**	**11**	**12**
Lesson #9			Lesson #13		
		Lesson #12			Lesson #16
	Lesson #11			Lesson #15	
Lesson #10		Test #3	Lesson #14		Test #4
WEEK 13	**14**	**15**	**16**	**17**	**18**
Lesson #17			Lesson #21		
		Lesson #20			Lesson #24
	Lesson #19			Lesson #23	
Lesson #18		Test #5	Lesson #22		Test #6

Resources and Aids

It may be useful for the teacher to select problems from the manual to be enlarged on index board or large sheets of heavy paper. Made with a felt-tip marking pen, they may be stored in envelopes for use when needed. When the need is is indicated, the instructor can fasten one of the problems on a bulletin board and discuss the concepts during the class period.

Transparencies for use with the overhead projector may be duplicated by the Thermofax or similar process. Selected problems may be projected on a screen for instructional purposes.

Each teacher should establish a resource library of appropriate materials in the classroom. This resource library is necessary so that the pupil may have access to pertinent information about the problem. In addition to books the following materials should be included:

Models	Globes
Trade publications	Charts
Hobby magazines	Photographs
Professional blueprints	Newspapers
Catalogues	Scrapbooks
Maps	Brochures

The teacher should be alert to the many valuable examples of reference ideas found in and near the school. Examples of these references which might be brought to the attention of the students include the following:

Construction in progress
School boiler room
Office machines
School shops
Appliances, automobiles, boats, etc.
Library displays
Museum tours
Science exhibits
Airports and railroad terminals

Materials

PUPIL MATERIALS

The following materials are suggested as minimum supplies:

Notebook - 1/8" squared paper, 8 1/2" x 11"
Twelve inch rule, 1/16" divisions
3H pencils, erasers, drafting tape
30° triangle, 45° triangle
Compass
Large manila envelope, 9" x 12"

TEACHER MATERIALS

The following materials are suggested for use by the instructor:

Chalkboard drawing instruments (G-1 list)
Classroom lettering charts, displays, models, samples, photographs
Index board (G-1 list) for making large drawings
Felt tip pens (G-1 list)
Visual instruction equipment - overhead projector, filmstrip projector, opaque projector, slide projector, film projector
Duplicating equipment - mimeograph duplicator, spirit duplicator

INSTRUCTIONAL MATERIALS

The following optional materials are useful for instruction:

Drawing boards (G-1 list)
T-squares (G-1 list)
Drafting tape (G-1 list)
Drawing pencils, 3H, 2H, HB (G-1 list)
Paper (G-1 list) - All drawings in this manual will fit on 8½" x 11" typewriting paper or 9" x 12" mechanical drawing paper. Squared graph paper and isometric sketching paper may be used for class work and/or homework assignments.

Visual Aids

Several kinds of visual aids will prove useful to the teacher. Most of them are instructive. They may be utilized as reference materials or as motivational devices.

1. CHARTS

   Lettering charts, decimal equivalent charts, tap drill size charts, machine parts diagrams, maps, scientific diagrams, solar systems charts

2. DRAWINGS

   Professional blueprints and whiteprints, student drawings, project plans, house plans, hobby prints, shop drawings, laboratory drawings.

3. BOOKLETS

   Many business and industries supply free literature which may prove to be of value to the teacher. Current issues of professional educational magazines will be useful.

4. SLIDES

   Motion pictures, strip films, and slides for use with the overhead projector are available. The teacher may use these devices for stimulating interest in related information or teaching a specific lesson. The overhead projector is one of the best devices for the teaching of related drafting topics. Prepared slides with overlays can be used to develop new principles and practices.

5. MODELS

   The drafting room should contain many models, dioramas, and three-dimensional aids. Pupils should be able to examine the objects they are drawing, thereby developing the ability to visualize the drafting problem. Working with solid objects helps to improve pupils' visualization skills.

Recordkeeping

Individual achievement of each pupil should be recorded in a manner which is useful and practical for the teacher. The SECONDARY SCHOOL RECORD BOOK #11 may be adapted for this purpose, or the teacher may wish to use some other system of grading and recording which he has found to be satisfactory. In any case a record should be made for each pupil of work completed, quality and quantity of projects, test and quiz results, class participation, assignments, and other notations which would enable the instructor to estimate the progress of the student during the semester.

Assignments

Homework and outside preparation assignments are to be given in keeping with the policies of the school. It is important that assignments be designed to enrich the drafting experiences of the pupils and not become a form of disciplinary control. Practice in sketching techniques, preplanning sketches, prelimary outlines, correlated research, related and technical drawings and investigations, notebook preparation, reports and surveys, models and samples, and mechanical drawings other than those in this manual are examples of the kinds of assignments which can be made and which will interest and motivate the student.

Classroom Organization

Inasmuch as most intermediate schools do not have drafting-room facilities, this activity may be conducted in a regular classroom. Provision is to be made for storing T-squares and drawing boards as well as other supplies necessary for instruction. Students should be required to store their work in manila envelopes to be carried with their other books and school supplies. Bulletin board space should be available for display purposes. Students should have individual drawing equipment (triangles, compass, rules, pencils) whenever possible.

Class Management

The student should be given the opportunity to become familiar with as many drafting concepts as possible during the term. The teacher should utilize available space to display blueprints, mechanical drawings, other pupils' work, pictures of construction and related blueprints, models of commercial and scientific products and the prints used when constructing them, magazine articles and the associated drawings, and any other related materials. Students should be urged to bring in models and samples of items which can be used for instructional and display purposes.

Whenever the opportunity permits, students should be urged to draw from three-dimensional objects rather than from sketches in this manual or a textbook. It is most important that the skills associated with visualization be stressed. Drafting techniques are secondary; the ability to visualize the drawing from the object and the object from the drawing becomes a primary purpose of the instruction during the course.

Students should be taken into the shops and laboratories to observe the need for the drawings. They should be encouraged to examine some of the things that they are drawing and sketching. The close correlation with other subjects will make this introduction to drafting of real value to all students, even those who will not pursue their education in the industrial or commercial programs.

Teaching Techniques

An excellent means of presenting the material in this manual is through the medium of the overhead projector. Transparencies can be made directly from the pages of the book, and notations and instruction can be written directly on the transparencies.

The chalkboard will be used constantly in lesson presentations and illustrating information. The teacher should make every effort to develop his drawing and lettering abilities so that they serve as examples of good drafting technique.

TOPIC I INTRODUCTION TO DRAFTING

Aim

1. To introduce the students to the drafting industry and its place in society
2. To provide information about the tools and materials used in the profession
3. To demonstrate and teach certain basic drafting techniques

Activity

1. Locate and set up paper on the drawing board.
2. Draw horizontal lines with the T-square.
3. Draw vertical lines with the T-square and triangle.
4. Draw slant lines with the T-square and triangle.

Class Discussion

1. Drafting is a universal language. Discuss the concept of picture versus word in many languages.
2. What is the place of the drawing in industry and science? How does the engineer, the scientist, the technician, the architect, the builder, and the man in the street utilize the technical drawing? What is required for a patent in the United States?
3. The tools of the drafting profession are both simple and complex. Illustrate the basic tools such as the pencil, compass, T-square, triangles, and curves. Discuss drafting sets, reproduction equipment, drafting machines, inking, and tracing.
4. Freehand drawing and mechanical drawing—what are the values of each?
5. Practice insures mastery and development of basic skills?

Teacher Demonstrations

1. Illustrate the universal concept of drafting. Draw a house on the chalkboard and elicit the word "house" in many languages.
2. Show how to align paper and T-square on the drawing board.
3. Utilize information sheets for student motivation.
4. Demonstrate how to draw horizontal lines.
5. Demonstrate how to draw vertical lines.
6. Demonstrate how to draw slant lines.
7. Demonstrate how to draw parallel slant lines, using a free T-square.

Assignments

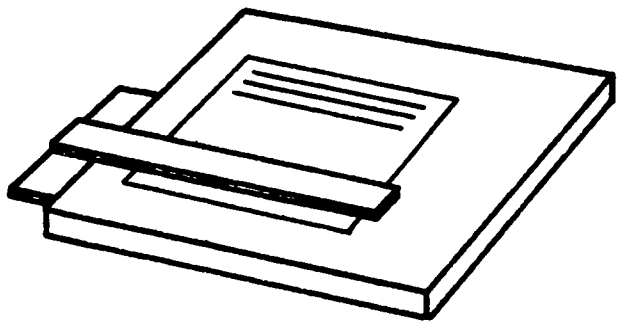
1. Set up paper on the drawing board, using the T-square and tape.
2. Sharpen a 3-H pencil and draw horizontal lines on the paper.
3. Draw vertical lines on the paper. Design flags, pennants, playing fields.
4. Fold a piece of paper into four parts and draw lines as illustrated.

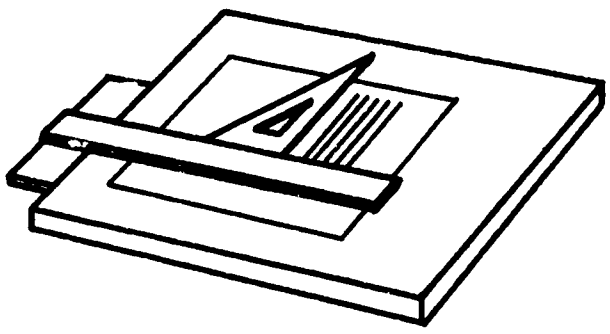
Homework

1. Using graph paper folded into four parts, practice drawing lines without the use of drafting instruments. Grip the pencil lightly, and concentrate on each stroke.
2. Letter your name between the 1/8" squares at the lower right hand corner.
3. Draw a problem related to science, mathematics, or social studies which uses horizontal or vertical lines as part of the design.

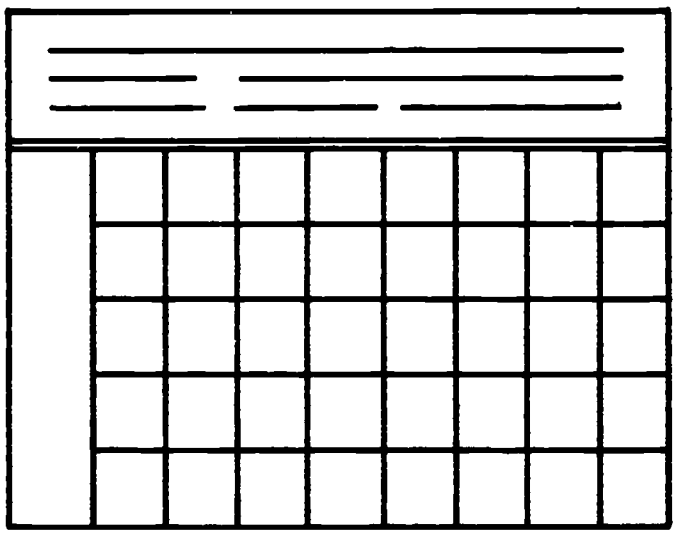
PLATE NO. 1

A



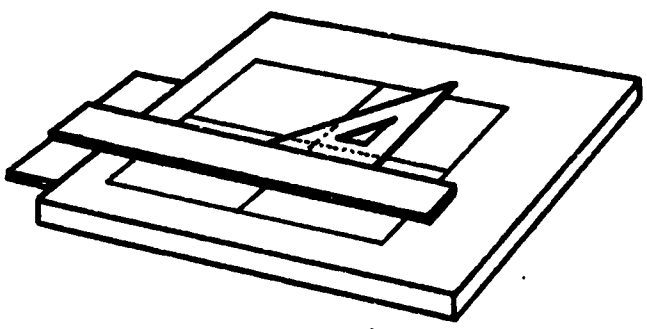


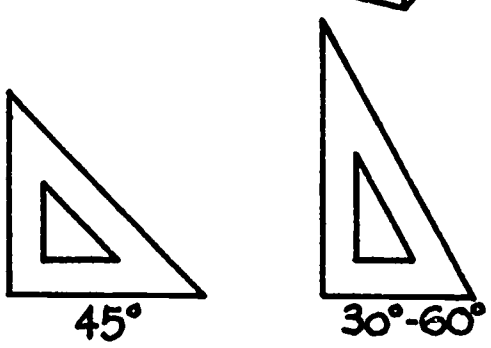
DRAW YOUR PROGRAM ON A 5 x 8 CARD



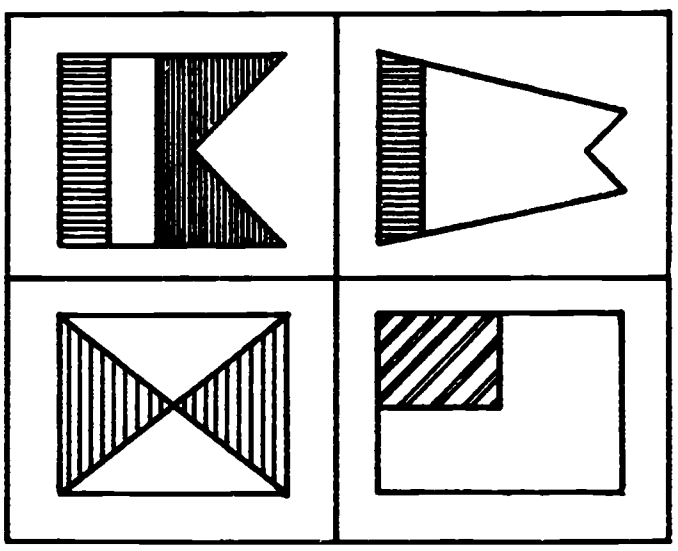
B

DESIGN A PENNANT FOR YOUR SCHOOL OR CLUB





DRAW THIS FULL SIZE ON 8½ x 11 PAPER



TOPIC 2 MEASUREMENT AND CONSTRUCTIONS

Aim

1. To demonstrate the use of a rule or scale in drafting
2. To utilize the rule as an instrument for layout
3. To apply principles of measurement to drafting constructions

Activity

1. Measure and dimension various lines and shapes used in drafting.
2. Locate various points and positions on a drawing by using a rule.
3. Divide areas into equal parts by using a rule.
4. Use a rule and compass (dividers) to measure and locate.

Class Discussion

1. How do we determine the height of this drafting room? Of the desk? What is the length and width of the drawing board?
2. All projects made in the shops and factories must be measured. Measurements may be in decimals or fractions. Discuss and campare the value of each method.
3. Compare the English and metric systems of measurement. Where are they used?
4. One inch represents a space between two points. How many 1/4" fractions are there in one inch? In three inches?
5. Measure the long edge of your drawing paper and write your answer along the edge. Measure the short edge and write your answer.

Teacher Demonstrations

1. Draw a "big inch" on the board and divide it into fractions, calling upon pupils to locate the positions.
2. Utilize a segmented block teaching-aid to demonstrate fractions.
3. Demonstrate how to transfer measurements from a scale to the paper, using a divider or compass.
4. Demonstrate how to divide a space into equal parts by tilting the scale.
5. Draw a number of shapes on the board, and have pupils measure them by using a yardstick.
6. Provide the students with practice measuring sheets, and demonstrate how to indicate the correct measurements.

Assignments

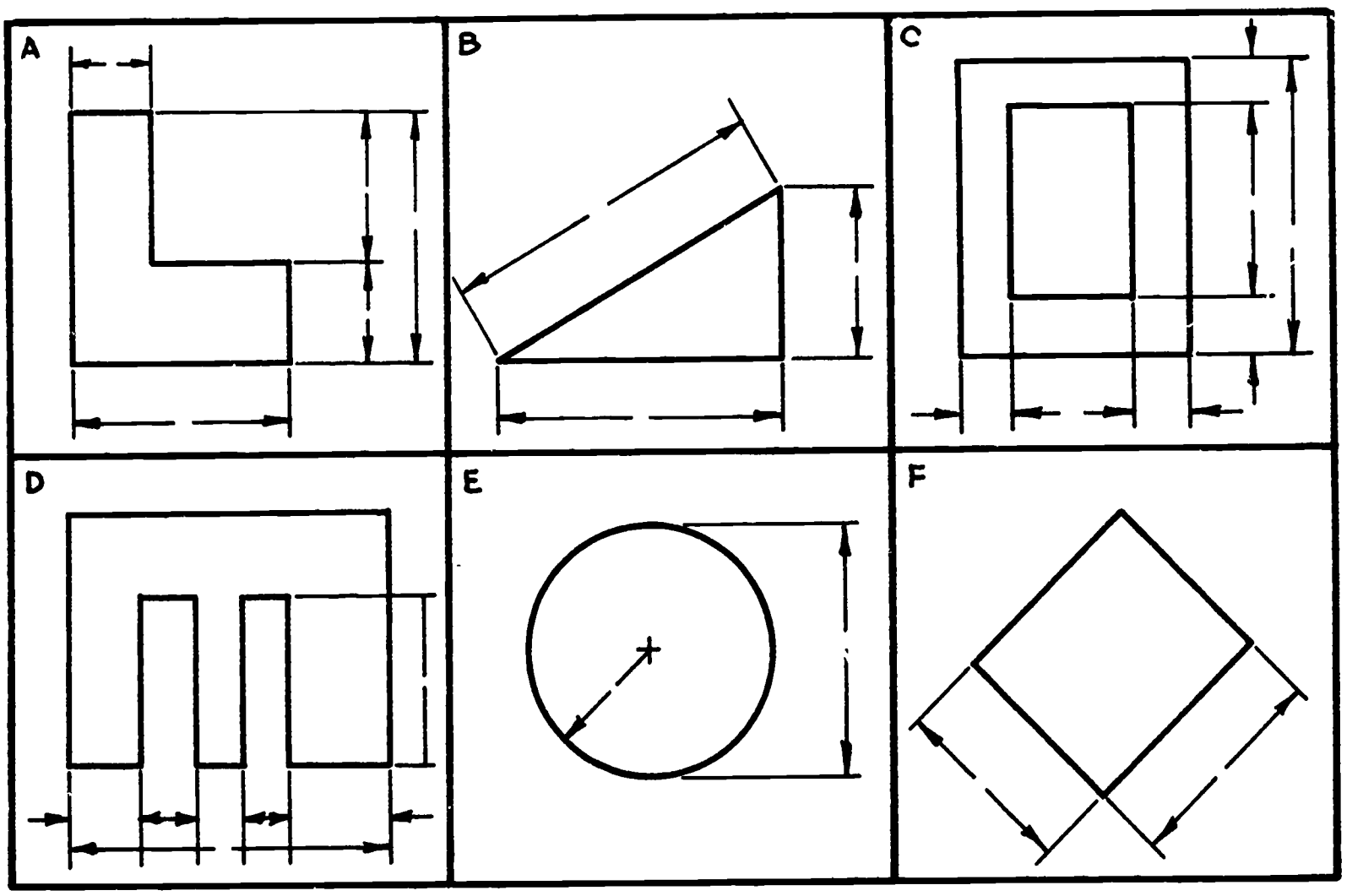
1. Measure the sample sheets and indicate the dimensions in the proper spaces.
2. Divide the paper into six equal parts, using the scale as a layout tool.
3. Draw the border and title block illustrated on the assignment sheet. Use the T-square and triangle.

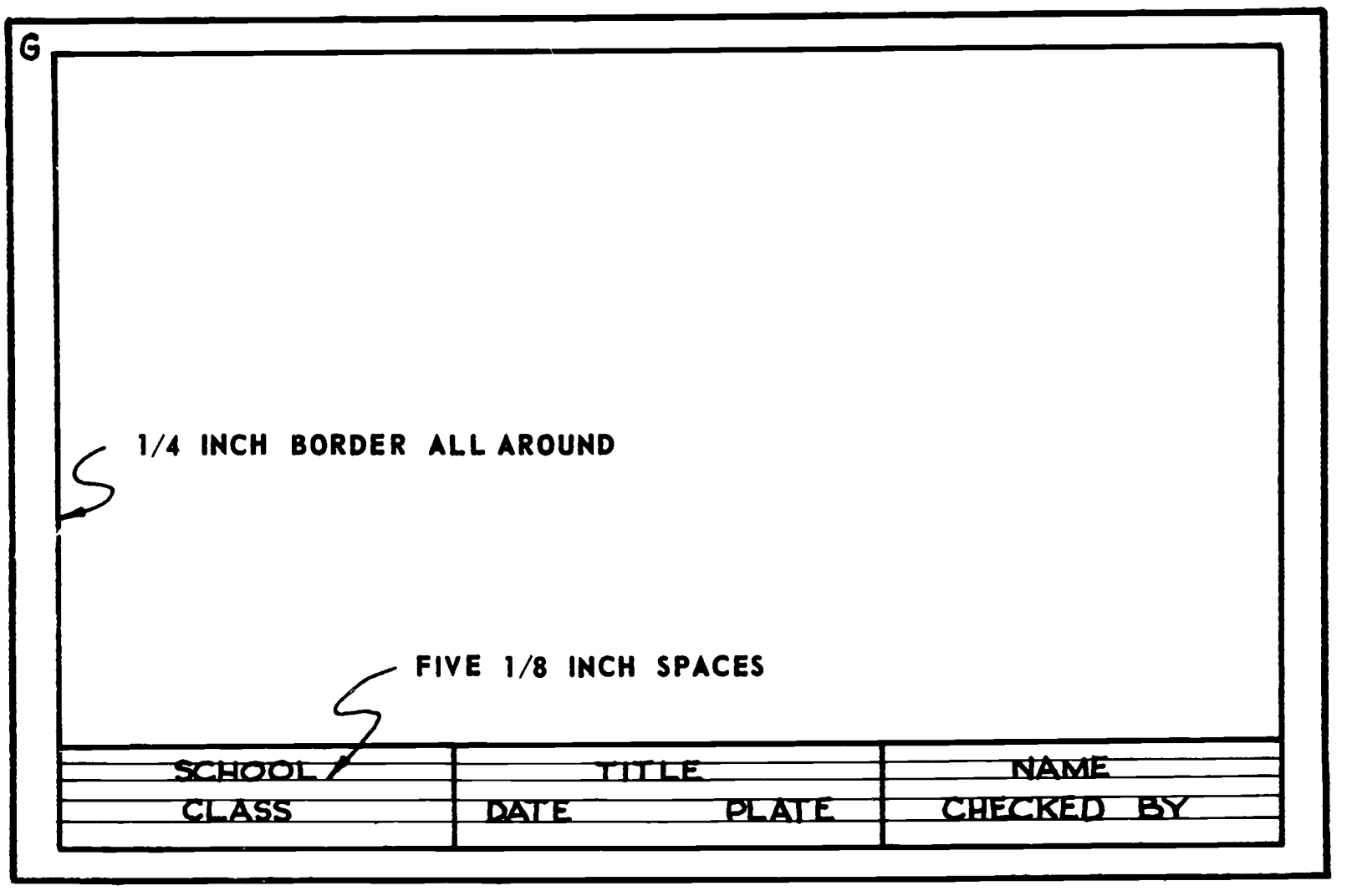
Homework

1. Practice measuring small objects found in the house. Items such as paper clips, matchfolders, spoons, spools, jars, switch plates, books, and pads will give you practice.
2. Using plain paper, divide the sheet into nine equal boxes. Practice dividing each box into various equal parts. Letter your name between 1/8" lines in the lower right hand corner.

MEASUREMENT

PLATE NO. 2





TOPIC 3 DRAWING ANGLES, CIRCLES AND ARCS

Aim

1. To demonstrate the use of triangles for drawing angles.
2. To demonstrate the use of the pencil compass for drawing circles and arcs.

Activity

1. Use the 30° and 45° triangles to draw a variety of angles.
2. Draw a pattern, using triangles with other drafting tools.
3. Use a compass to draw circles. Discuss graphs: bar, line, circle, picture.
4. Use a compass to step off the radius.
5. Lay out a hexagon, using a compass and triangles.
6. Divide a circle into a number of equal segments, using triangles.
7. Draw an arc at the intersection of two lines.

Class Discussion

1. Triangles have been used to draw vertical and parallel lines.
   What other uses do triangles have at the drawing board?
2. What are the angles of each triangle? How can other angles be drawn using the triangles? How many combinations of angles can be determined?
3. How is a compass used to draw a circle? How is the size of the circle determined?
4. What is a radius? What is the diameter of the circle? How is it determined? What is the relationship between radius and diameter?
5. What objects are used in the shop which are measured by diameter?
6. What things required accurate layout of a circle? (Clock, spoked wheel, etc.)

Teacher Demonstrations

1. Draw a variety of angles, using the T-square and triangles.
2. Utilize a combination of triangles to draw different angles.
3. Show how to locate a center of a circle and measure the radius.
4. Demonstrate how to draw an arc at an intersecting corner.
5. Show how to step off the radius on the perimeter of the circle to draw a hexagon. Use the 30° triangle to illustrate an alternate method.
6. Draw a square within a circle, using triangles.

Assignments

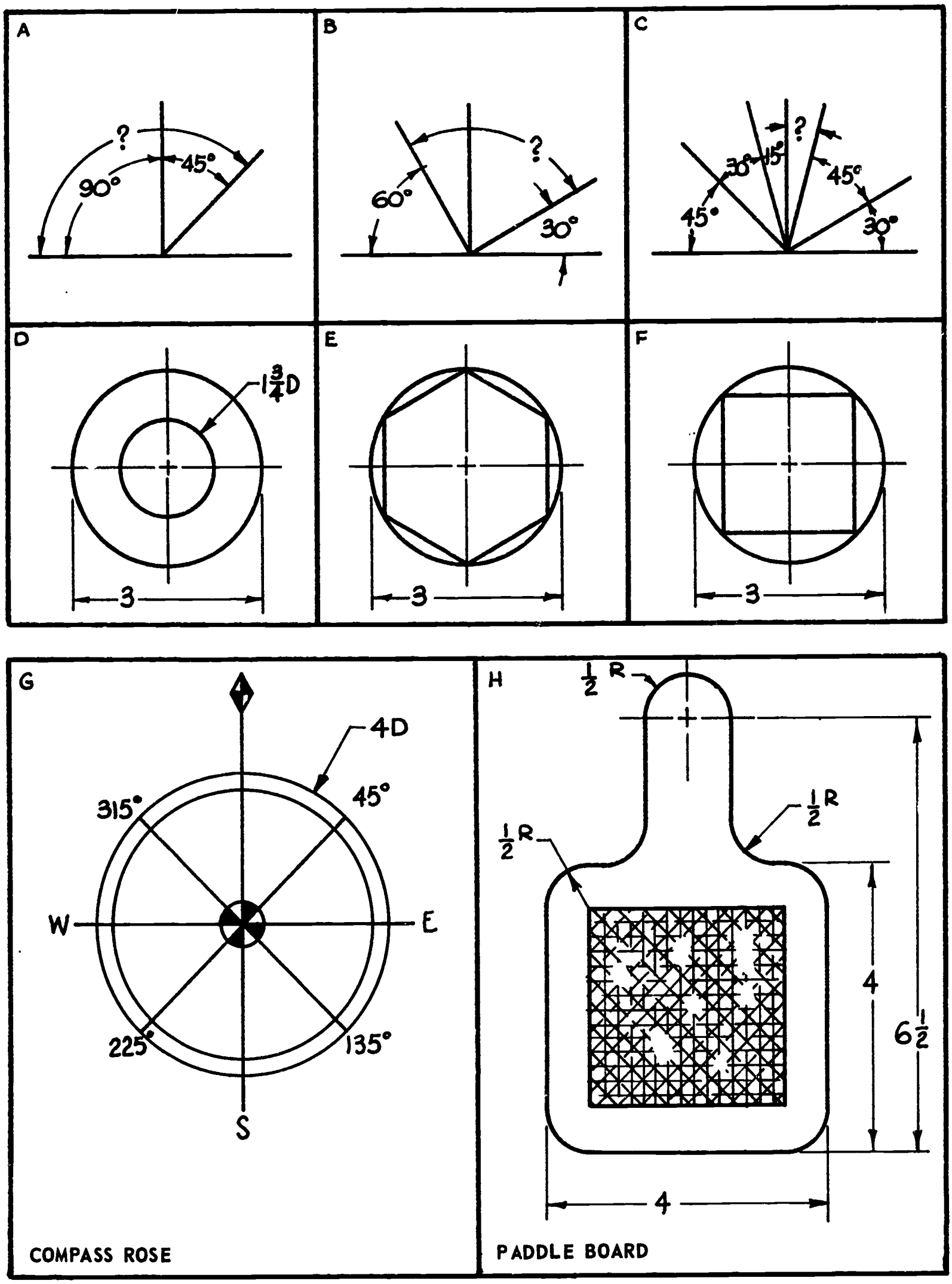
1. Draw the angles indicated on the sample sheets.
2. Draw the circles indicated on the sample sheets.
3. Complete the problems on plate number 3.
4. Draw a graph for current problems selected from a newspaper.

Homework

1. Using graph paper, draw a series of circles freehand. Lay out intersecting diameters and connect the ends.
2. Use a piece of paper to draw the arc of freehand circles.
3. Draw a variety of geometric forms, using the compass and triangles. Experiment by dividing a piece of paper into nine equal parts and by drawing a different form in each of the boxes.

ANGLES, CIRCLES, & ARCS

PLATE NO. 3



TOPIC 4 INTRODUCTION TO LETTERING

Aim

1. To introduce the proper lettering forms used in drafting
2. To demonstrate the application of letters and numbers to the working drawing

Activity

1. Letter words, phrases, dimensions, and notes, using proper form.
2. Letter the title of all plates.
3. Letter a project requiring numbers, words, or phrases.
4. Apply lettering techniques to forms, records, applications, and notebooks.

Class Discussion

1. What is the history of our modern alphabet? How were the lhe letters developed? What civilization contributed to our letters and languages?
2. What is the difference between lettering and printing? Which does the draftsman use on the drawing?
3. What are the general rules for spacing letters? Why does the space vary?
4. What is the value of guide lines? Why should these lines be very light?
5. What is the difference between inclined and vertical lettering? Which is easier to do? Why?
6. Are there any devices which can be used to letter a mechanical drawing?
7. Why is hand lettering important to a good drawing?
8. Of what value is good lettering technique to those who will not become draftsmen or engineers?

Teacher Demonstrations

1. Illustrate the correct method of doing vertical upper-case Gothic lettering. Utilize an overhead projector.
2. Demonstrate the lettering groups and the proper method of forming letters and numbers.
3. Stress proper letter spacing, use of guide lines, relaxed position, good posture, and practice and drill.

Assignments

1. Complete the lettering practice sheets.
2. Letter the title block of plates.
3. Letter the problems for instruction plate number 4.
4. Practice good lettering technique whenever time is available.
5. Complete a graph for a science or mathematics topic; letter the information neatly.

Homework

1. Practice lettering technique on 1/8 inch graph paper. Letter between the horizontal lines. Use the vertical lines for guides only.
2. Letter a variety of words used in drafting—vertical, horizontal, angle, compass, pencil, rule, scale, object, hidden edge, extension, dimension, etc.
3. Complete an application for a permit, a book, a contest, or a membership by letttering all the information necessary, utilizing upper-case Gothic letters to answer the questions.
4. Draw a graph of a current social studies problem. Letter all information with standard upper-case Gothic letters.

LETTERING

PLATE NO. 4

ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890 & %

HORIZONTAL VERTICAL PLATE CLASS NAME SCALE

RADIUS DIAMETER EXTENSION SECTION CENTER CURVE

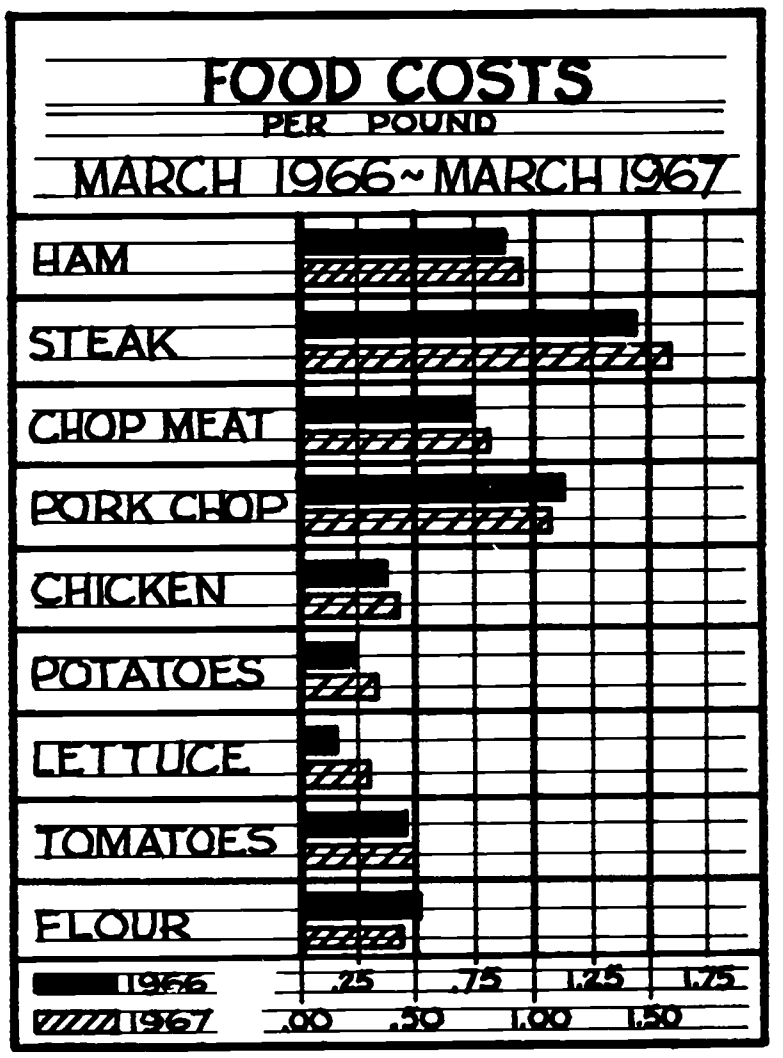
$1\frac{1}{2}$D $3\frac{3}{8}$R $4\frac{1}{2}$ $6\frac{1}{4}$ $9\frac{5}{8}$ $16\frac{3}{4}$ $7\frac{5}{16}$R $8\frac{1}{8}$ $2\frac{9}{16}$ $15\frac{15}{64}$ $1\frac{9}{32}$

ORTHOGRAPHIC ISOMETRIC CABINET SEGMENT ARC

DEVELOPMENT AUXILIARY VIEW ARCHITECTURAL RULE

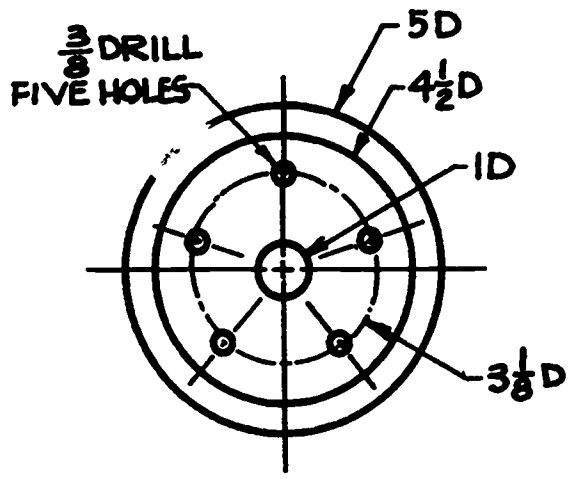
AMERICAN LEAGUE

TEAM	WON	LOST	PCT.	G.B.



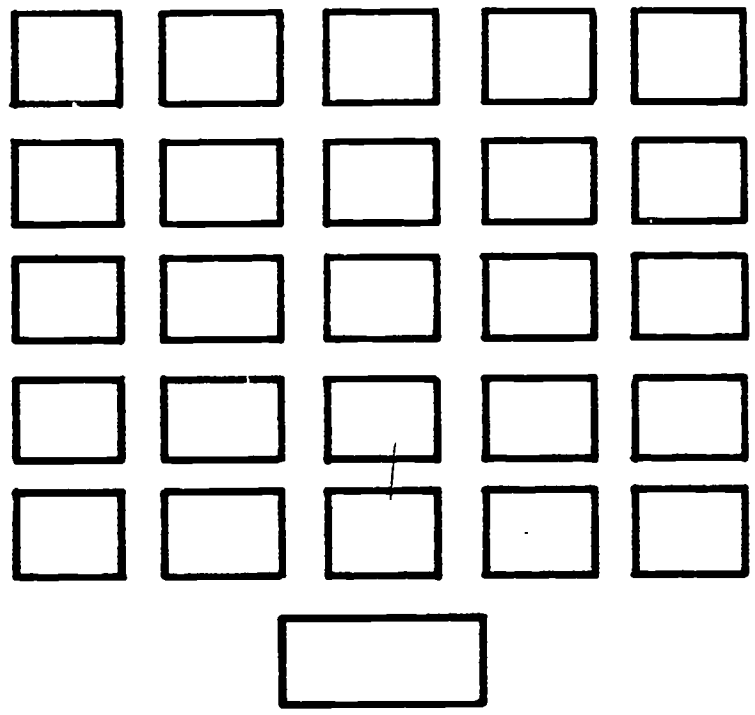
EXTRA CREDIT

E1



WHEEL HUB
DRAW FULL SIZE

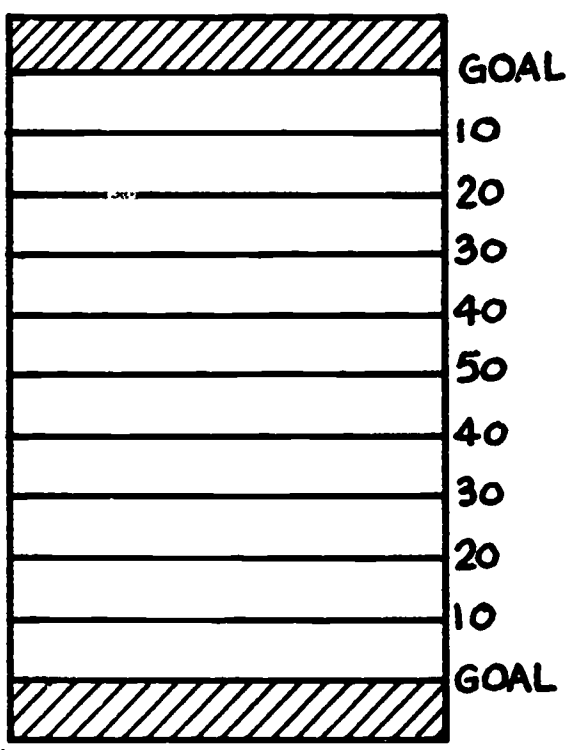
E2



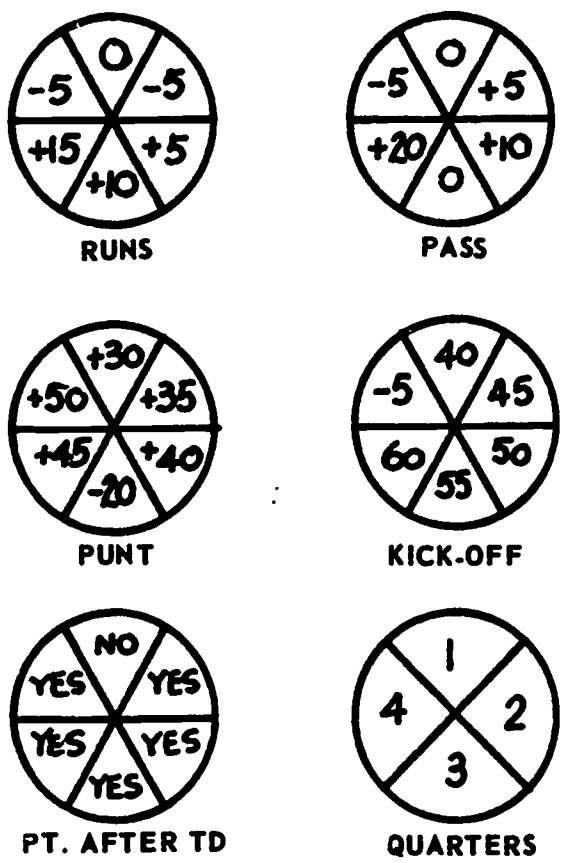
SEATING PLAN
DRAW YOUR DRAFTING ROOM

E3

FOOTBALL GAME



SCALE: 3/4" = 10 YDS.
TO BE DRAWN ON INDEX BOARD

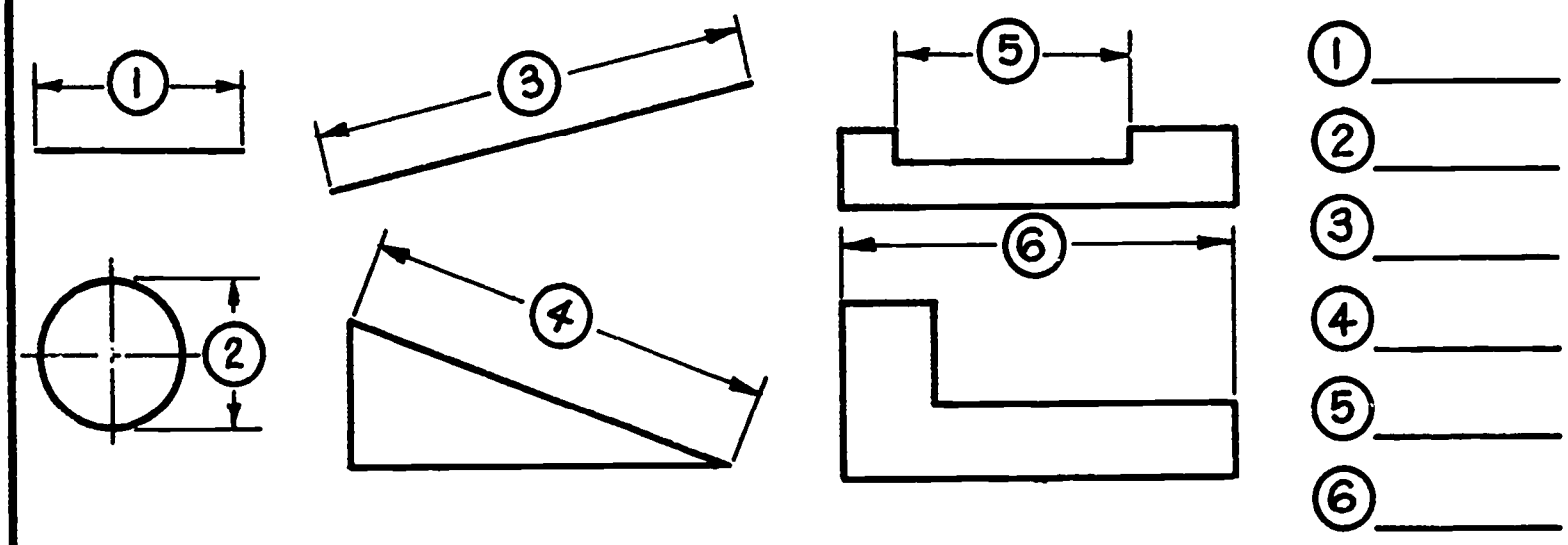


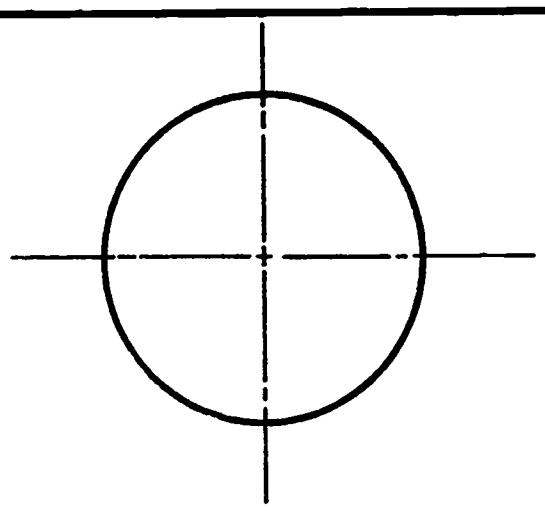
NOTE: SIX SPINNERS REQUIRED

TEST NO. 1

FASTEN THIS TEST TO YOUR DRAWING BOARD, USING THE T- SQUARE TO ALIGN THE PAPER.

MEASURE EACH LINE. PLACE YOUR ANSWER AT THE RIGHT.





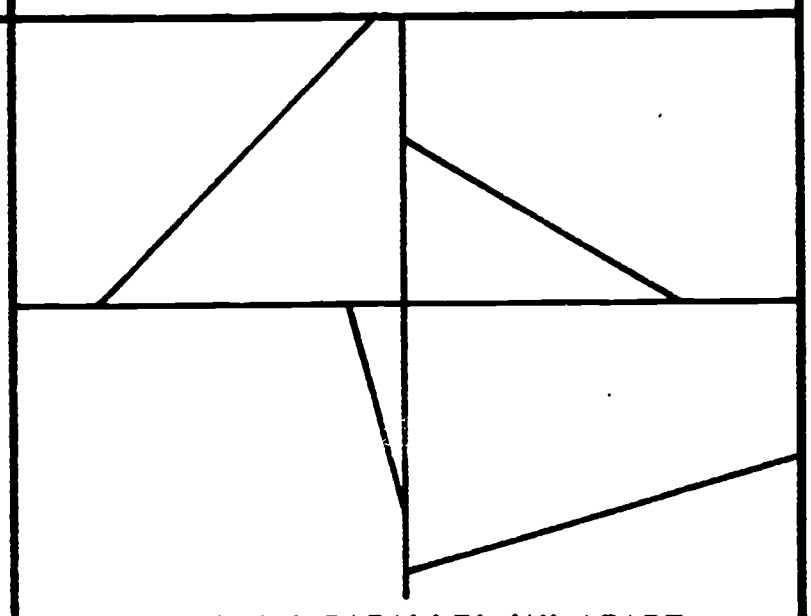
CONSTRUCT A HEXAGON WITHIN THE CIRCLE. USE TRIANGLE AND T- SQUARE FOR CONSTRUCTION

DIVIDE THE SPACE INTO SEVEN EQUAL VERTICAL STRIPS

NAME _____
ADDRESS _____
CITY & STATE _____
TELEPHONE _____
SCHOOL _____
TEACHER _____

AGE	HEIGHT

LETTER THE ABOVE INFORMATION



DRAW LINES PARALLEL ¼" APART

NAME _____ CLASS _____ DATE _____

TOPIC 5 MAKING THE ONE-VIEW DRAWING

Aim

1. To introduce the students to the fundamentals of drawing a single plane
2. To teach how to visualize and draw a single surface of an object
3. To teach how to center a one-view drawing on the paper

Activity

1. Make sketches of objects requiring a single-view drawing.
2. Locate and center drawings on paper.
3. Measure and draw a variety of objects requiring a single-view mechanical drawing.

Class Discussion

1. What kinds of objects could be drawn with only one surface or view?
2. How would you make a drawing of the 30° triangle?
3. How many views would be required to draw a metal pattern used in a shop?
4. Name and list a variety of items which can be drawn with one view.
   (Gaskets, templates, patterns, shims, brackets, gauges, laminations, etc.)
5. What are some of the basic shapes from which drawings are developed?
   (Rectangles, squares, circles, semicircles, triangles)
6. How is the drawing centered or located on the page? Horizontally? Vertically?
7. How is the drawing started? Why is it important to use very light lines?

Teacher Demonstrations

1. Show the class a variety of objects requiring drawings with one view. Items associated with the shop, home, or hobby will be self-explanatory.
2. Make a drawing on the board or overhead projector, illustrating the principles of single-plane drawing. Utilize some familiar object such as a template, lamination, or a model part such as an airplane wing rib.
3. Frame a drawing within a basic shape, and stress the value of the outline drawing before starting on details.
4. Demonstrate how to center a one-view drawing on the page.

Assignments

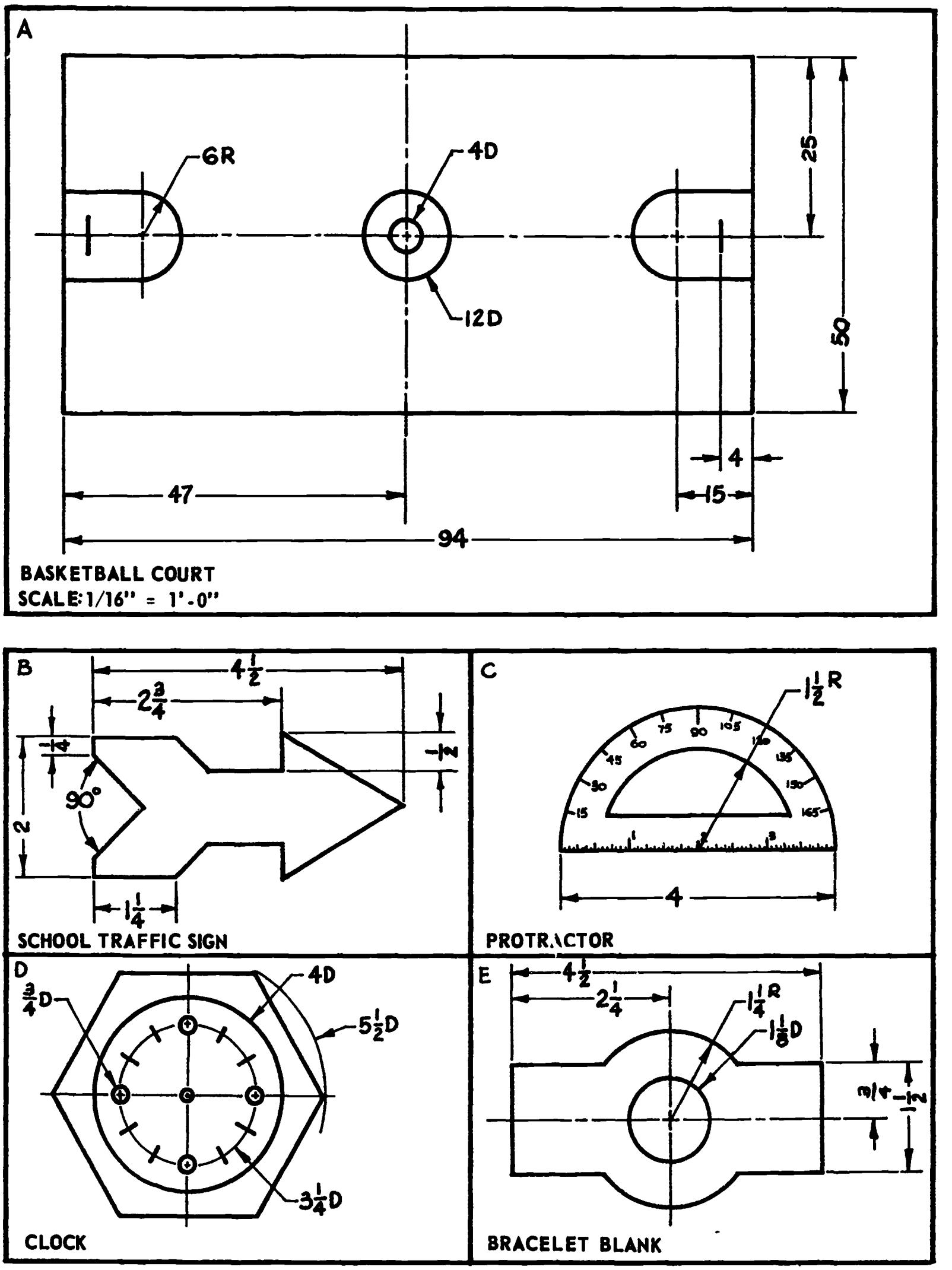
1. Make full-size drawings of each of the problems shown on the next page.
2. Complete the borders and title block of each drawing.
3. Make full-size drawings of the objects provided by the instructor.
   (Note: The teacher will distribute a variety of items requiring one-view drawings. Objects familiar to the students should be measured and drawn, NOT TRACED.)

Homework

1. Make freehand sketches on graph paper of objects which require one-view drawings. If the object is too large for the paper, reduce it proportionately. Try to keep all parts in scale.

ONE-VIEW DRAWING

PLATE NO. 5



TOPIC 6 TEMPLATES AND PATTERNS

Aim

1. To make one-view drawings which can be used for shop patterns or templates
2. To demonstrate the use of graph paper for enlarging patterns

Activity

1. Make one-view drawings of objects which can be used for templates.
2. Enlarge one-view templates by means of graph paper.

Class Discussion

1. What particular uses can be found for some of the one-view drawings which were made in this class?
2. What does the draftsman or technician do when he wants to make a pattern?
3. How can a full-size pattern be made from a small drawing? What mechanical devices can be used? (Pantograph, opaque projector, photoenlarger)
4. What methods can be used in the shop or home to enlarge (or reduce) a drawing?
5. How is the grid size selected for the drawing?
6. When can a half-pattern be made? Of what value is the half-pattern in the woodworking shop? In the ceramics shop?

Teacher Demonstrations

1. Show the class a variety of templates and patterns which can be utilized in the shop or home.
2. Show a drawing of an object such as a free-form table top. Discuss how a full-size pattern can be developed for this table from the small drawing.
3. Use the overhead projector with a grid to demonstrate the method of enlarging by squares. If the projector is not available, use a grid chart or pounce pattern on the chalkboard to illustrate the technique of enlarging by squares.
4. Show how to reduce a pattern (for jewelry, ceramics, finished drawings, etc.) .
5. Demonstrate how to use a half-pattern for drawing a symmetrical object.

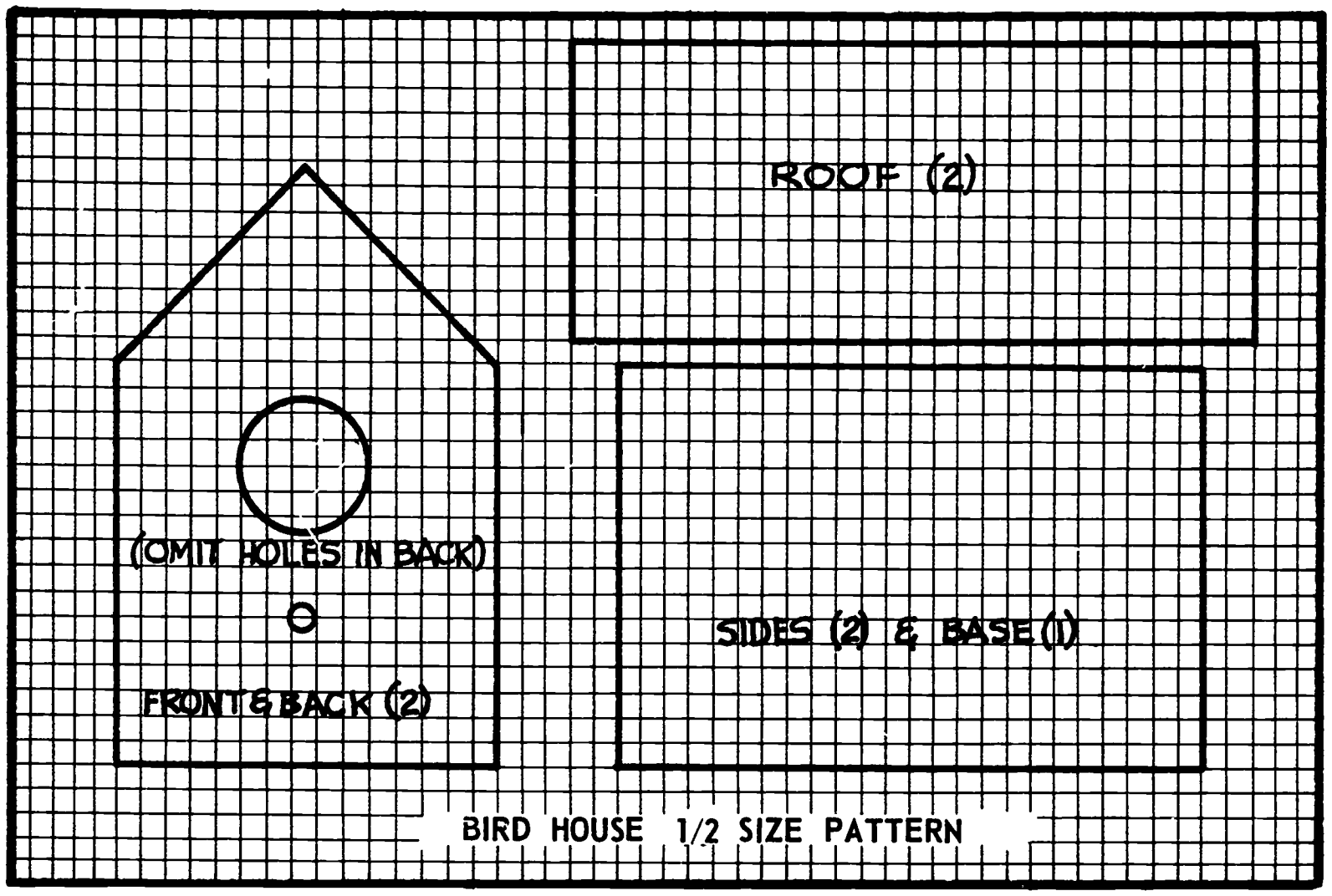
Assignments

1. Make full-size drawings of the plates shown at the right by using 1/4 inch squared paper. Locate the points and connect the necessary lines using the proper straight-edged or curved drafting tools.
2. Select a full-size pattern of a tool or machine part which requires one view, and reduce it by squares to fit the drawing paper.
3. Make a full-size pattern of a project requiring one view only. The problem should be selected from a magazine or book of projects which does not contain full-size patterns.

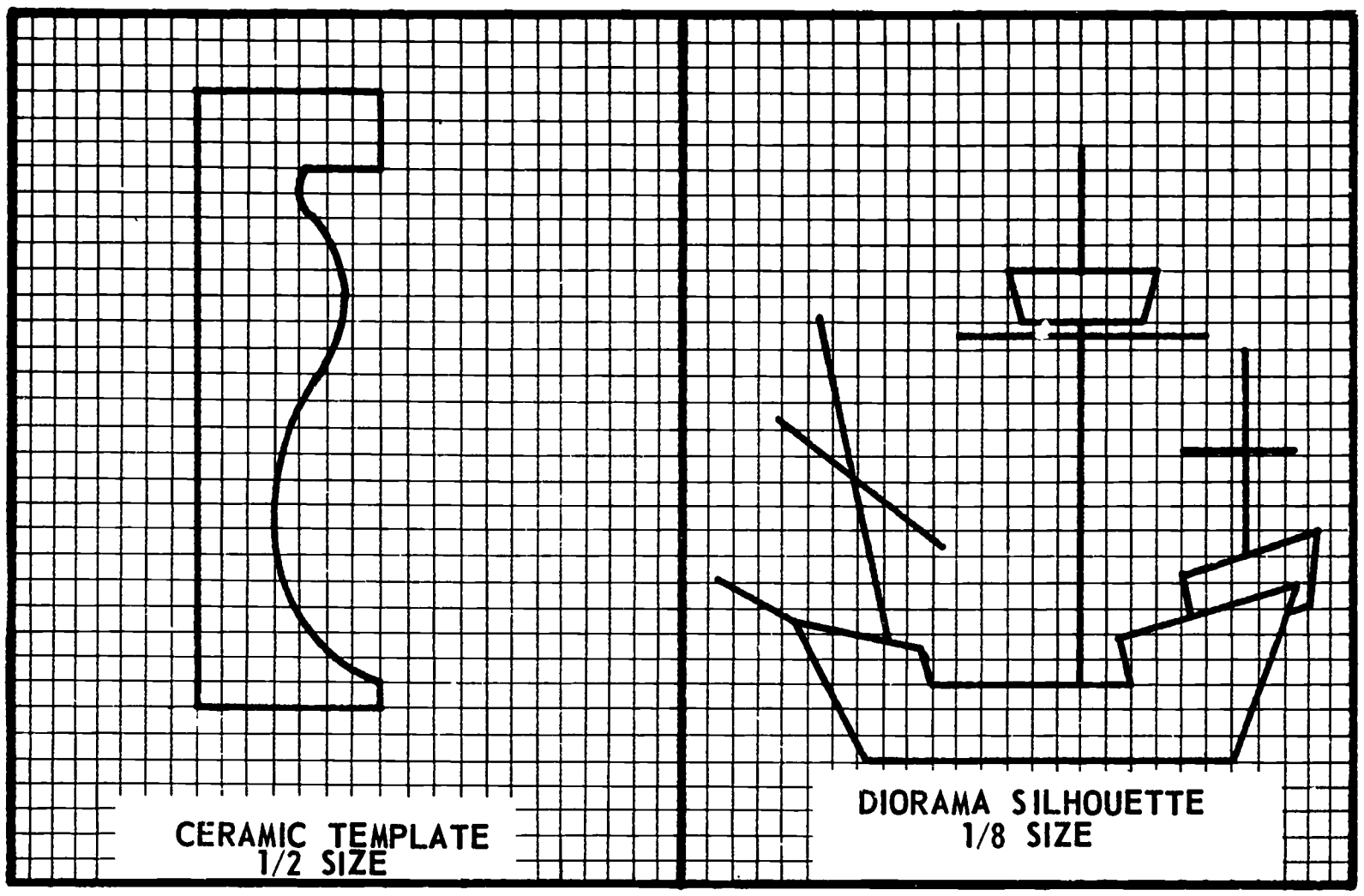
Homework

1. Make a freehand sketch, using squared paper,of each of the following items: switchplate, cake server, table top, television screen, clock face.
2. Draw each of the items above double size, using the squared paper method of making the drawing.

PLATE NO. 6



BIRD HOUSE 1/2 SIZE PATTERN



CERAMIC TEMPLATE
1/2 SIZE

DIORAMA SILHOUETTE
1/8 SIZE

TOPIC 7 INTRODUCTION TO DIMENSIONS

Aim

1. To teach the fundamentals of dimensioning
2. To establish a sense of line quality and value
3. To provide opportunity to measure and dimension various objects

Activity

1. Measure and dimension the drawings.
2. Measure three-dimensional objects and apply these measurements to the drawings.
3. Draw various kinds of lines used by draftsmen.
4. Make working drawings of single-plane objects.

Class Discussion

1. How can the size of patterns and templates be noted? How does the engineer and the architect "read" the dimensions of a drawing?
2. What are the purposes of dimensioning on a drawing? (Size and location).
3. Why is careful numbering and lettering so important when dimensioning a drawing?
4. Why is a fully dimensioned drawing which includes notes and instructions called a "working drawing"?
5. What grades of pencils may be used for dimensions What is meant by the "Alphabet of Lines"? Who decides what standard line weights should be? (ASA—American Standards Association, 10 East 40th Street, New York City, acts as a clearing house for information on standards for many trade associations and professional societies.)

Teacher Demonstrations

1. Use the chalkboard or overhead projector to illustrate the basic techniques of dimensioning a one-view drawing.
2. Demonstrate the proper method of drawing arrowheads.
3. Show the differences in line value, and emphasize the use of various lines.
4. Provide practice and experience problems for drawing and dimensioning.
5. Illustrate the various line conventions on drawings and show their relationships to three-dimensional models.

Assignments

1. Measure and dimension the practice sheets provided.
2. Measure and dimension several of the drawings made earlier in the term.
3. Study the information sheet at the right and learn the dimensioning techniques as you develop your drawing skills.

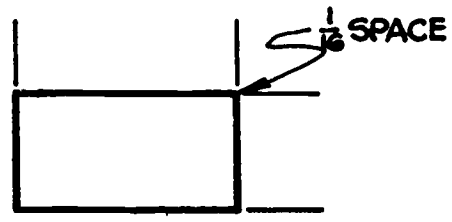
Homework

1. Make freehand sketches of the objects on the following pages.
2. Dimension each of the objects, using freehand technique.
3. Select a piece of flat hardware (door plate, hinge, receptacle plate, brace, bracket, gasket, washer, etc.), and make a fully dimensioned freehand drawing on graph paper.

INTRODUCTION TO DIMENSIONING

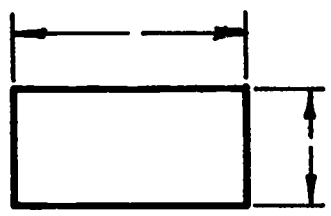
TOPIC 7

1



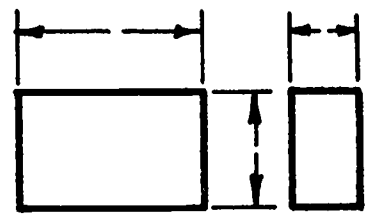
EXTENSION LINES MUST BE AT RIGHT ANGLES TO THE SURFACE.

2



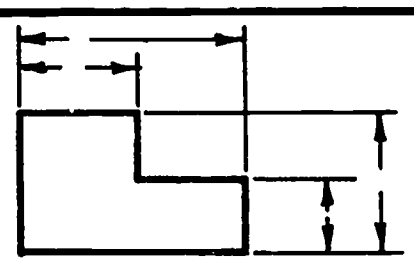
ARROW HEADS MUST TOUCH THE EXTENSION LINES.

3



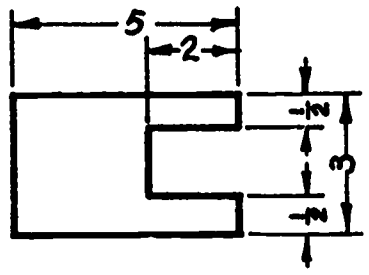
DIMENSION LINES SHOULD BE ALIGNED WHEN POSSIBLE.

4



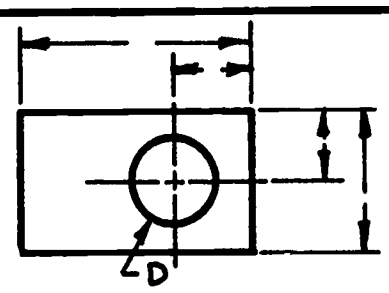
PLACE SMALLER DIMENSIONS NEARER TO THE DRAWING.

5



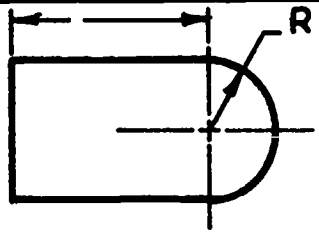
DIMENSIONS SHOULD BE READ FROM THE BOTTOM AND RIGHT.

6



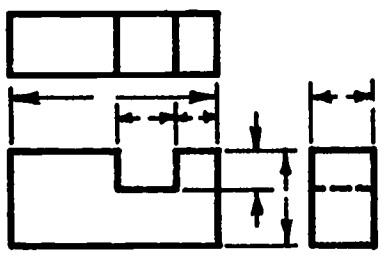
THE SIZE OF A CIRCLE IS INDICATED BY GIVING THE DIAMETER

7



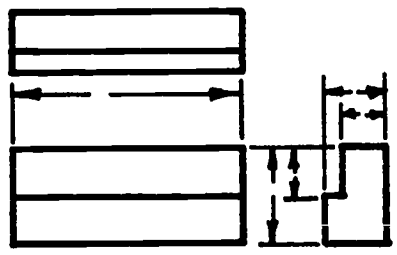
AN ARC IS DIMENSIONED BY INDICATING THE RADIUS.

8



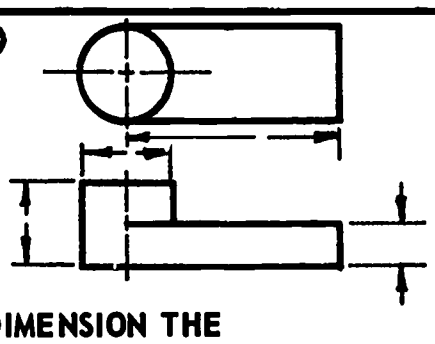
PLACE DIMENSIONS BETWEEN VIEWS (WHEN PRACTICAL).

9



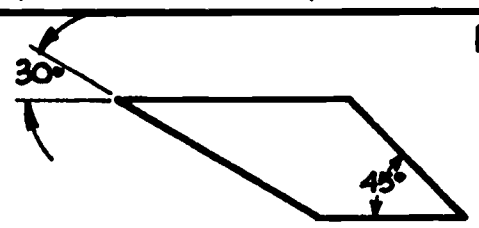
DIMENSION TO PROFILE WHENEVER POSSIBLE.

10



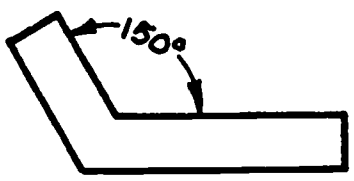
DIMENSION THE PROFILE VIEW OF CYLINDERS.

11



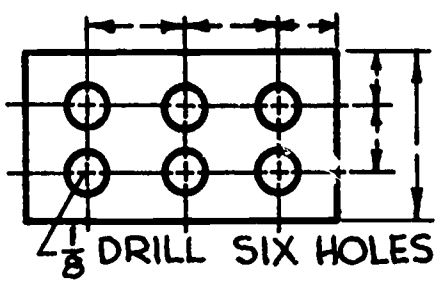
DIMENSION ANGLES OF 90° OR LESS BY PLACING THE NUMERALS IN A HORIZONTAL POSITION.

12



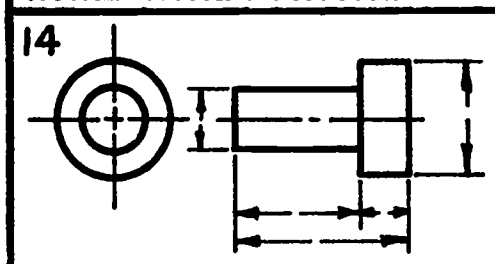
ANGLES OF MORE THAN 90° ARE DIMENSIONED BY FOLLOWING THE ARC.

13



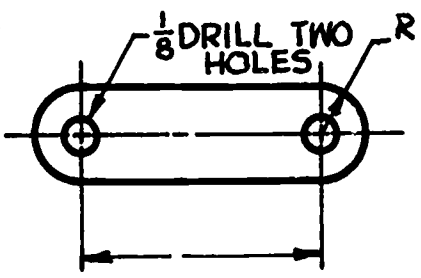
DIMENSION SIMILAR CIRCLES BY MEANS OF A NOTE.

14



GIVE OVERALL LENGTH OF CYLINDERS.

15

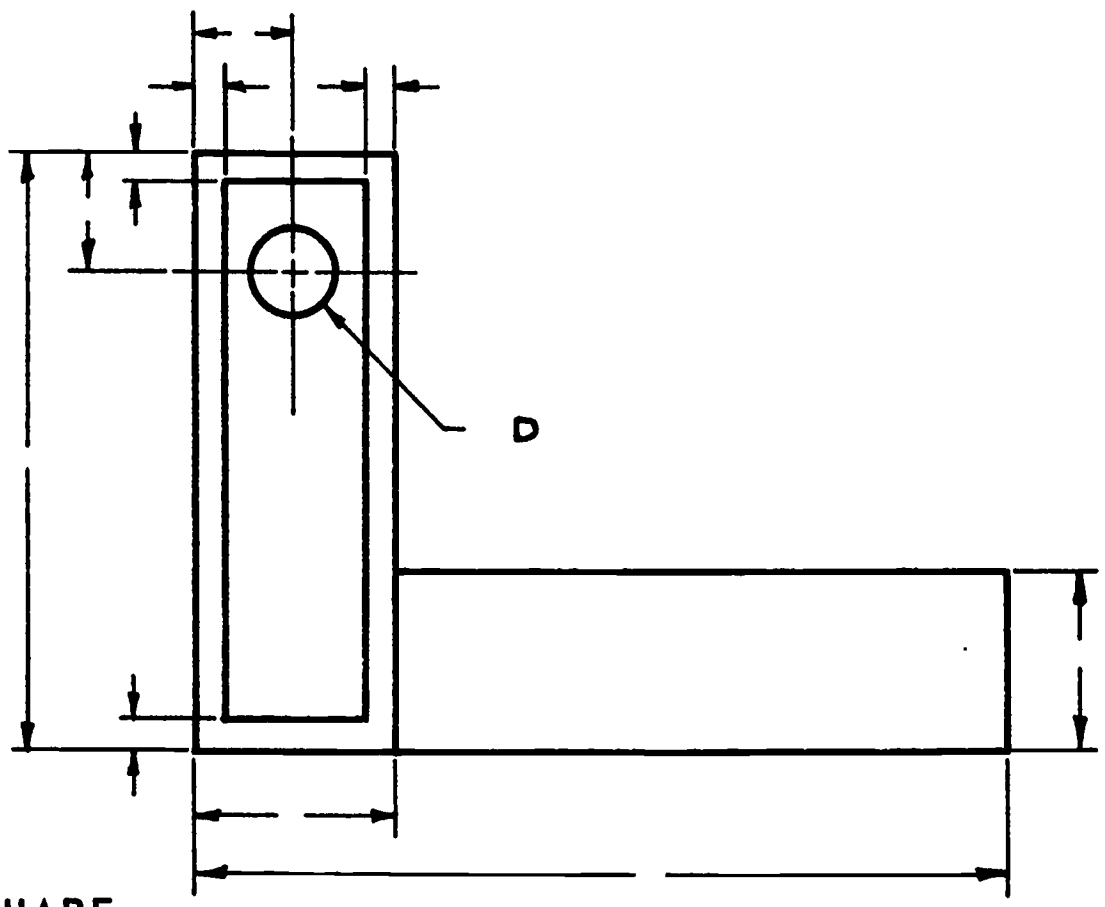


LOCATE THE CENTERS DO NOT GIVE OVERALL LENGTH.

DIMENSIONING

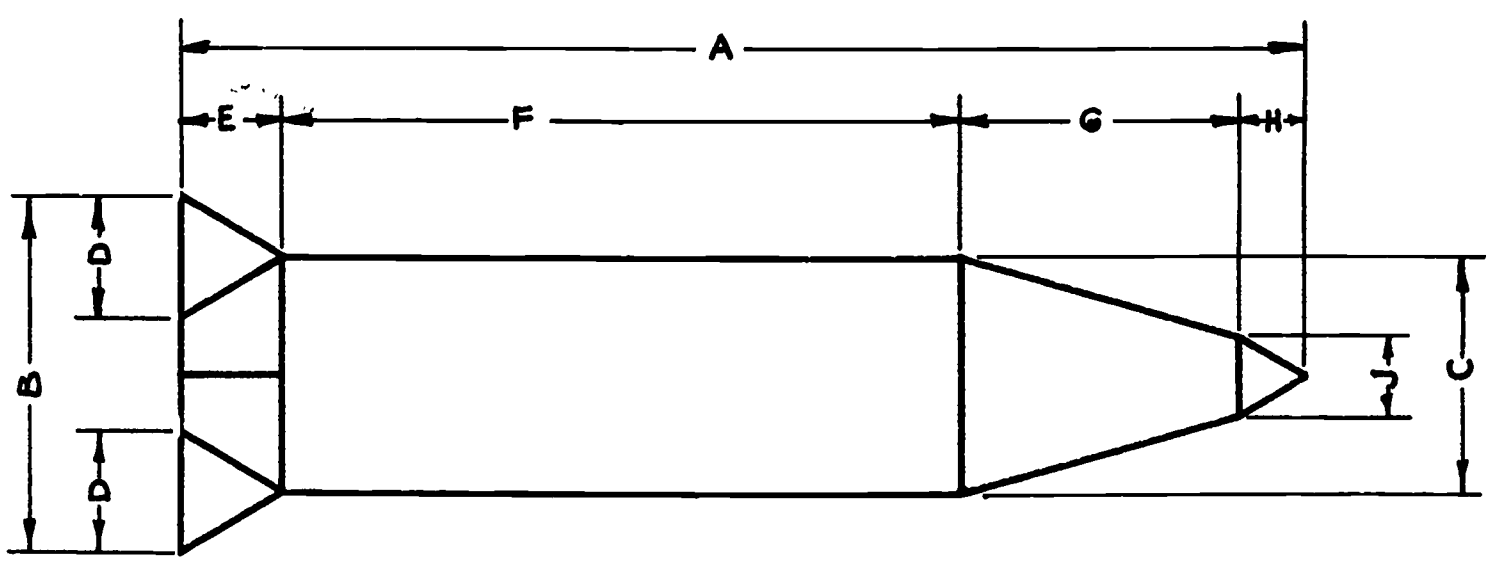
PLATE NO. 7

A



TRY SQUARE

B



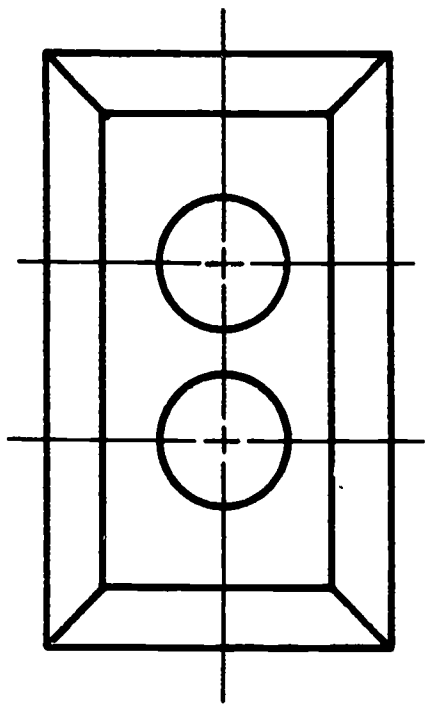
A	B	C	D	E	F	G	H	J

SATURN ROCKET
MEASURE AND DIMENSION

DIMENSIONING

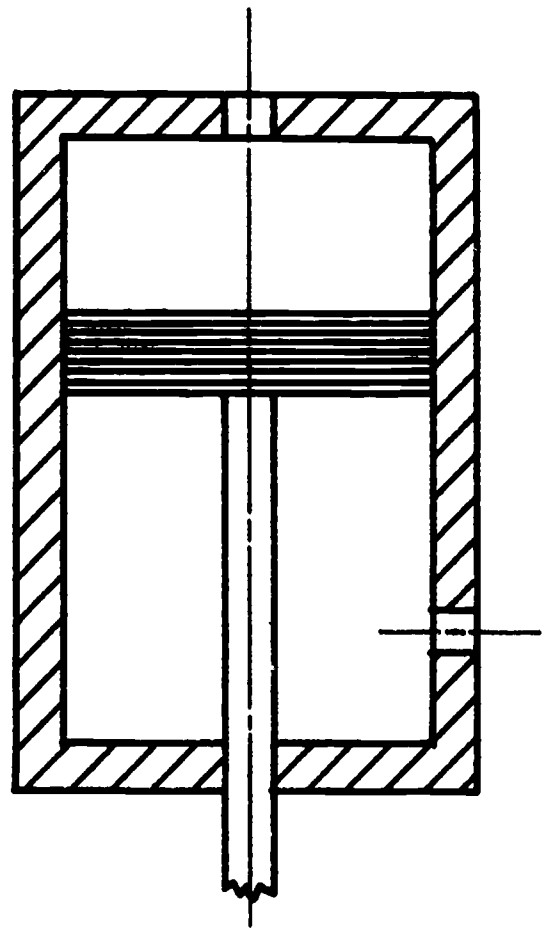
PLATE NO. 7

A



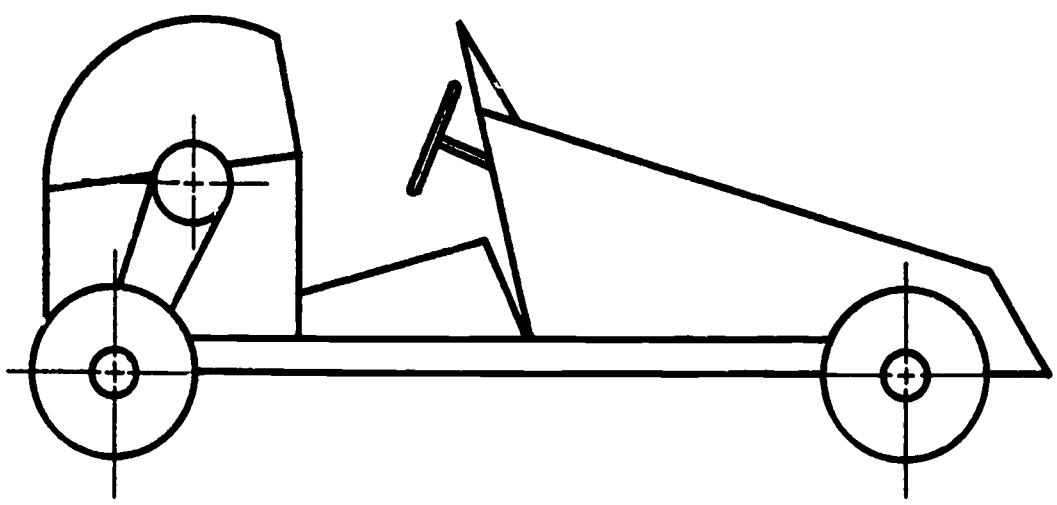
T.V. ANTENNA PLATE

B



LABORATORY PUMP

C



GO-CART PROFILE PLAN

TOPIC 8 ONE-VIEW WORKING DRAWINGS

Aim

1. To provide opportunities to visualize and interpret one-view drawings
2. To introduce one-view working drawings

Activity

1. Draw orthographic views of single-plane objects from sketches.
2. Make working drawings of objects from three-dimensional models.
3. Make shop sketches from models of various items.

Class Discussion

1. A drawing used in the shop for construction of a project is called a working drawing. What does this drawing include?
2. What is the difference between a one-view drawing and a working drawing?
   (A working drawing includes dimensions, notes, scale, and other instructions.)
3. What are the steps followed in the making of a working drawing from a sketch?
4. When are the dimensions placed on the drawings?
5. What are some items used in your shop classes that could be drawn as a one-view working drawing?

Teacher Demonstrations

1. Demonstrate the steps in making a single-plane working drawing of a familiar object Patterns, metal plates, templaes, notepads, flat metal files, ceramic tiles, textile patterns, block print designs are some of the items which might be used.
2. Emphasize the meaning of the term "working drawing." Point out the use of notes.
3. Introduce the term "scale," but do not elaborate on it at this time.
4. Have various students add dimension lines and figures to the basic drawing which has been placed on the chalkboard Have students measure the object. This will provide additional drill in measuring and dimensioning.

Assignments

1. Make full-size working drawings of the objects shown on the assignment sheets. All drawings are to be single view, and are to include all dimensions, notes, border, and title block.
2. Make a full-size working drawing of the items supplied by the teacher.
3. Make freehand sketches of the objects shown on the assignment sheets. Try to make an orthographic drawing and the pictorial sketch shown.

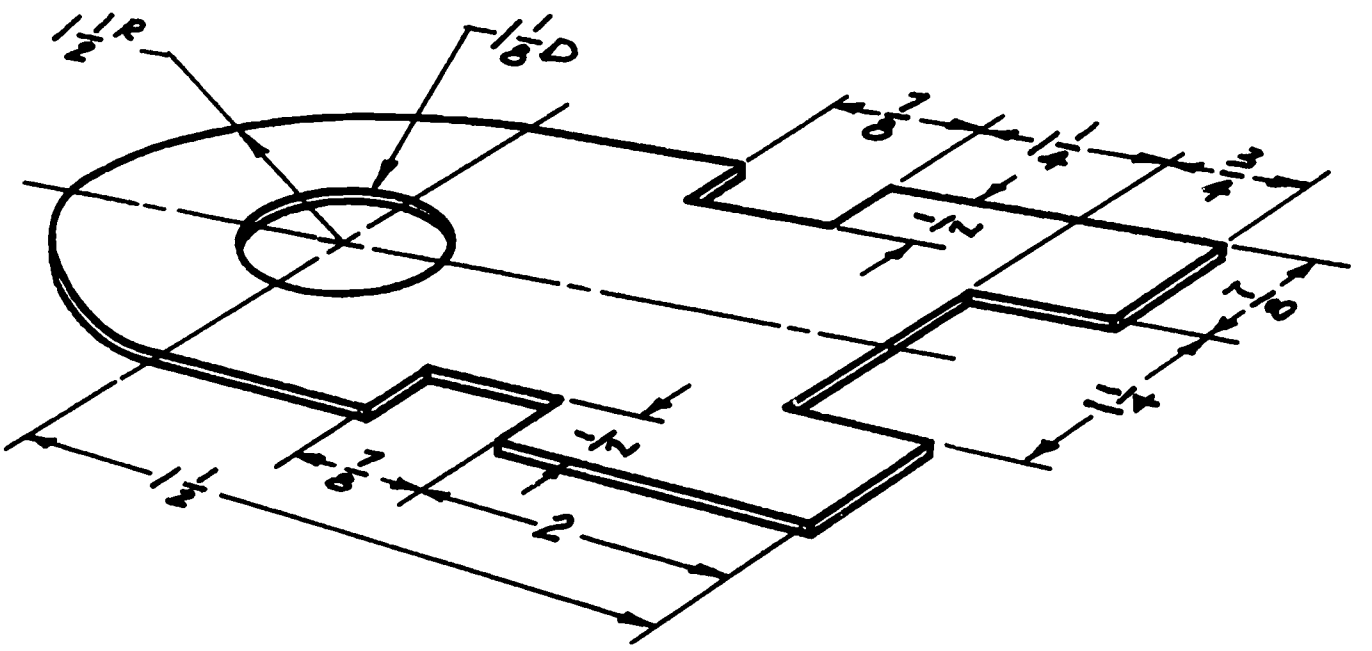
Homework

1. Make a one-view drawing on graph paper of a kitchen spatula. If the spatula is too large for the paper, make it half size, but indicate the true dimensions on your drawing.
2. Sketch the front of your television set or other cabinet. Try to draw all the parts in proportion. Indicate the dimensions of the major parts.

ONE-VIEW DRAWING

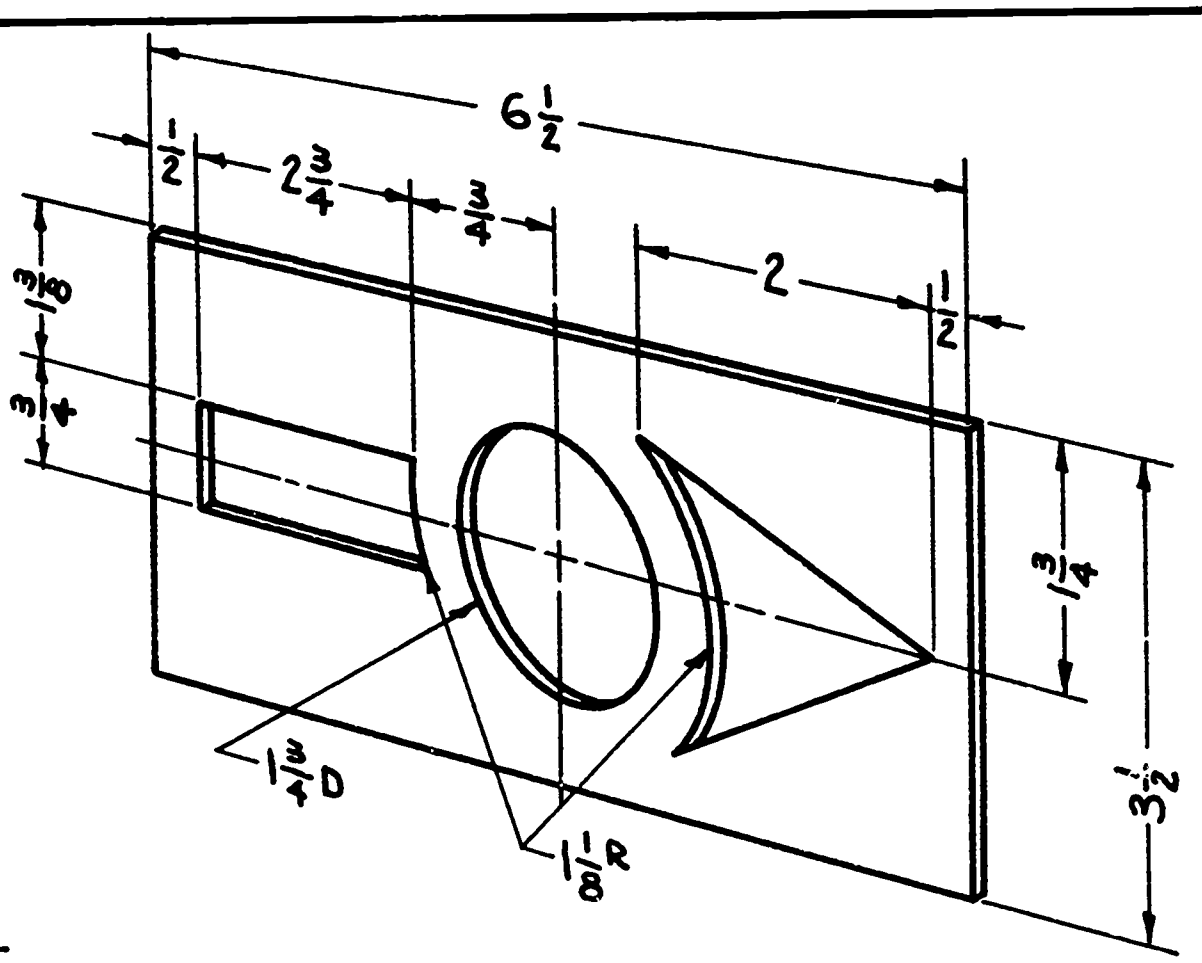
PLATE NO. 8

A



MASS PRODUCTION TEMPLATE
16 GA. STEEL
SCALE 1:1

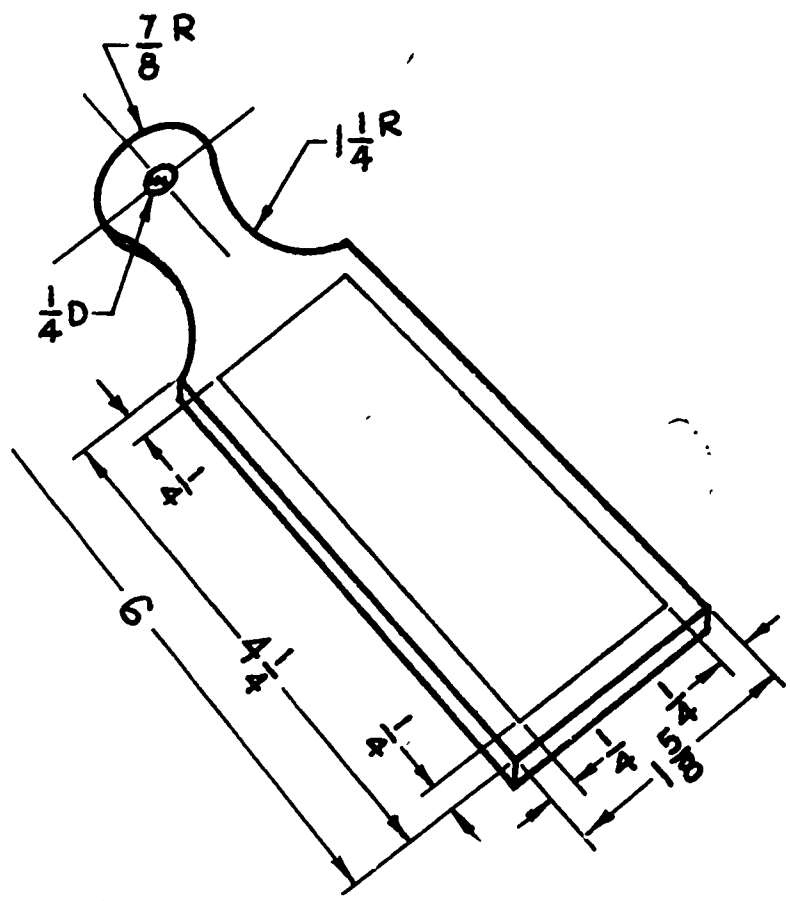
B



STENCIL
1/8" MASONITE
FULL SIZE

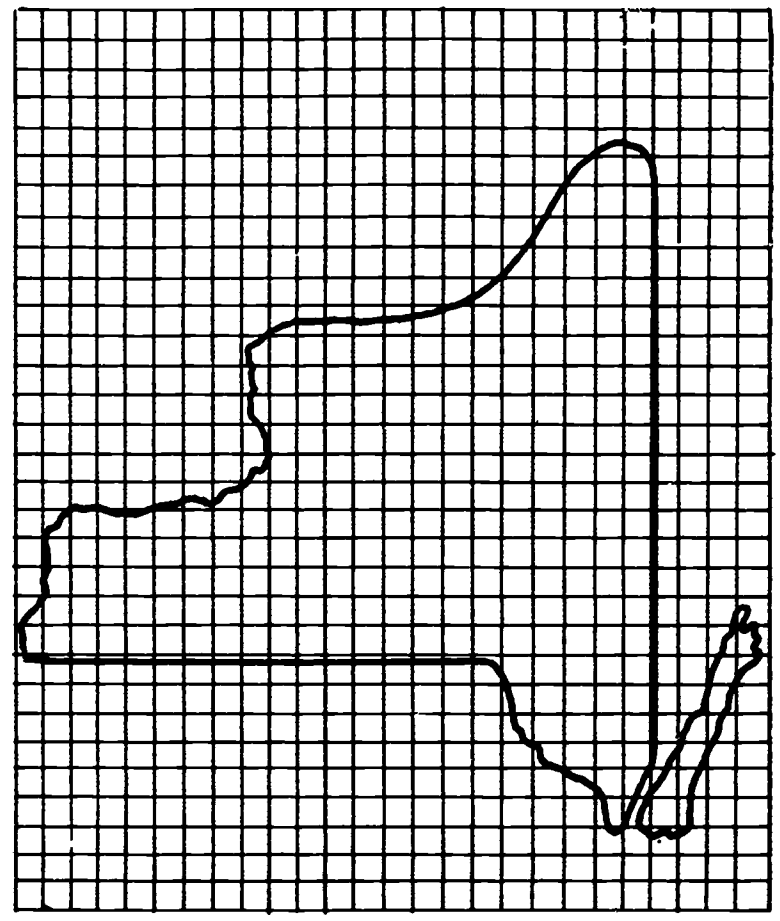
EXTRA CREDIT

E5



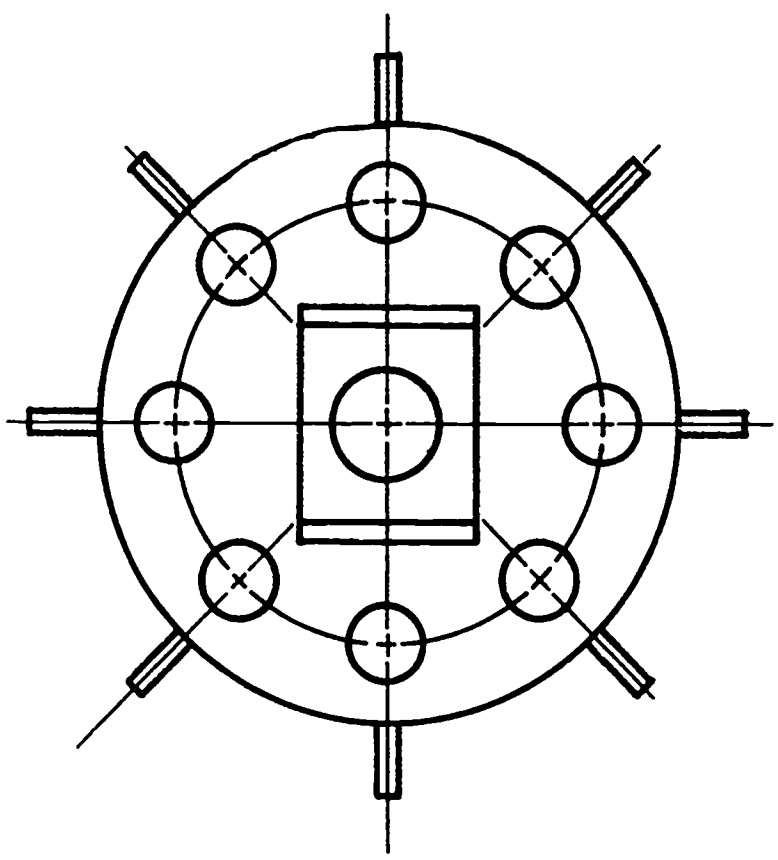
PENCIL POINTER
MAKE A WORKING DRAWING

E6



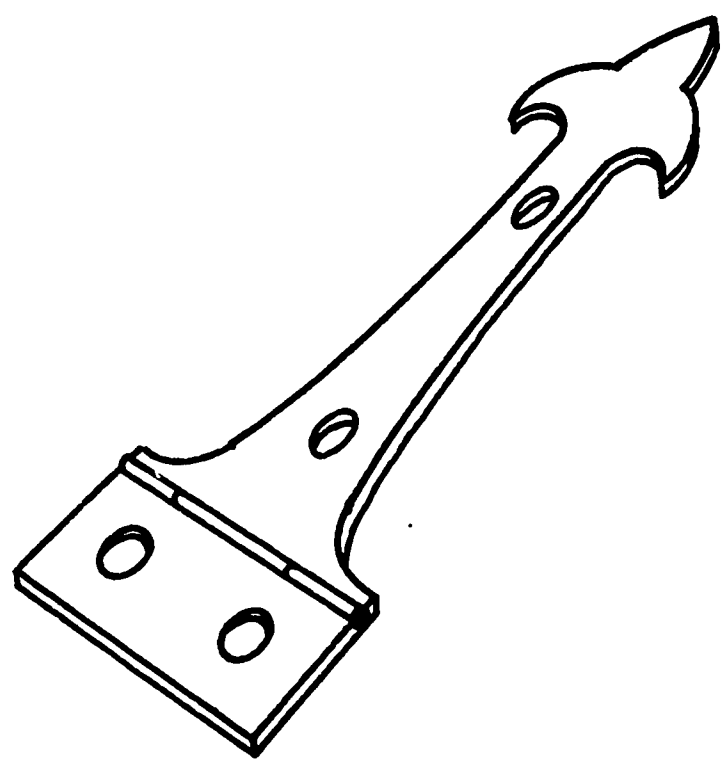
NEW YORK
ENLARGE DOUBLE SIZE

E7



TURBINE
MEASURE & DIMENSION

E8



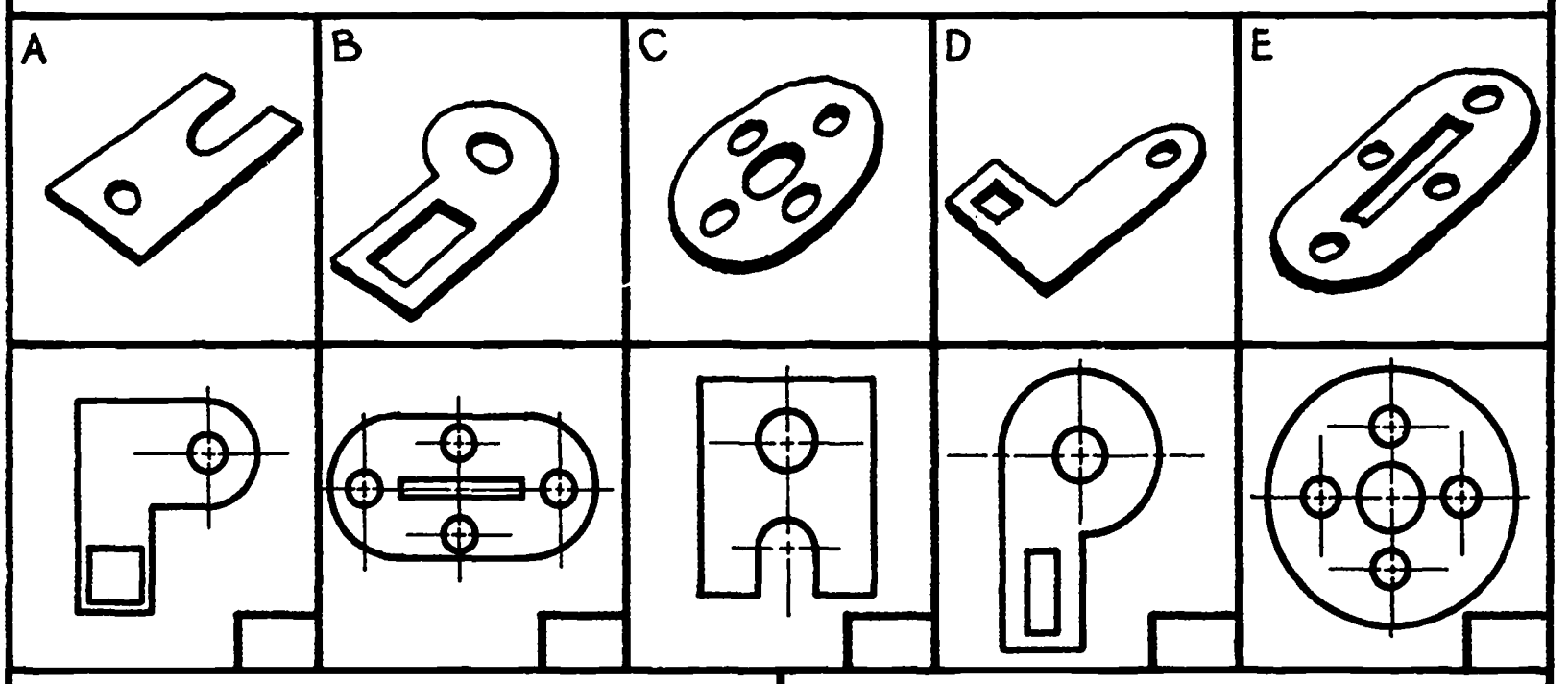
STRAP HINGE
MAKE A DIMENSIONED SKETCH

ONE VIEW DRAWING

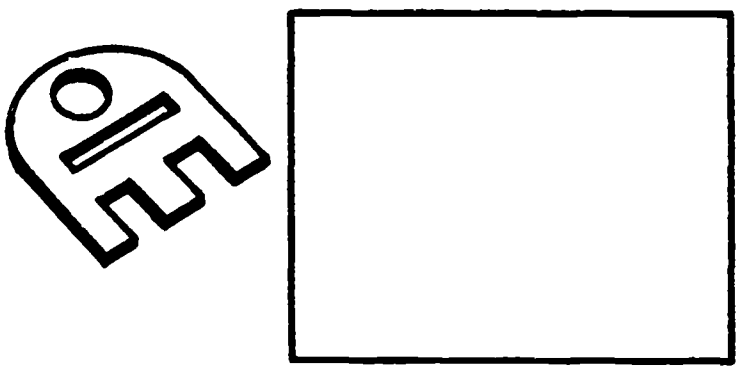
TEST NO. 2

FASTEN THIS TEST TO YOUR DRAWING BOARD USING THE T- SQUARE TO ALIGN THE PAPER.

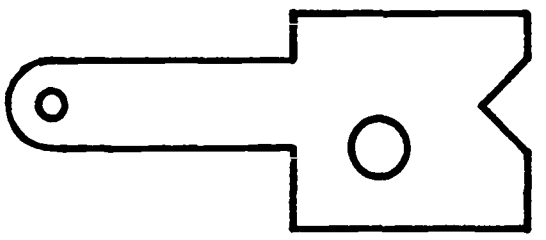
MATCH THE CORRECT SKETCH WITH THE ONE-VIEW DRAWING BY PLACING THE LETTER IN THE APPROPRIATE BOX BELOW.



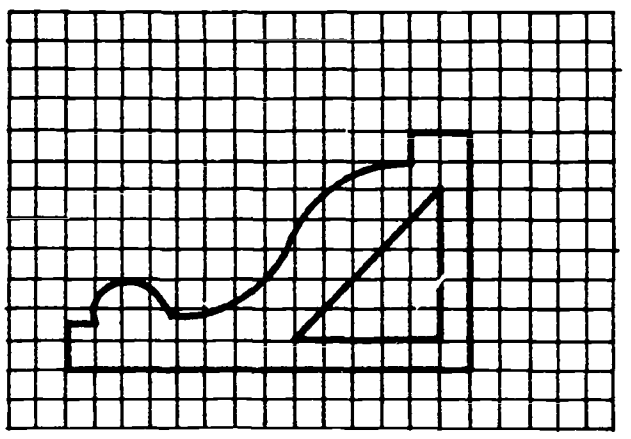
SKETCH THE SHIM IN THE BOX.

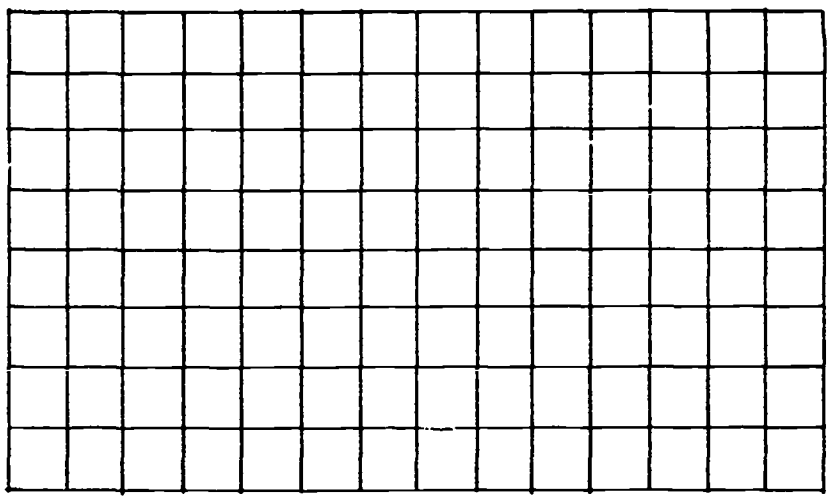


DIMENSION AND MEASURE THIS UNIT.



MAKE AN ENLARGED SKETCH OF THE OBJECT BELOW.





NAME _____ CLASS _____ DATE _____

TOPIC 9 SCALE DRAWING

Aim

1. To teach the use of scale in mechanical drawing and freehand sketching
2. To provide opportunity to visualize scale and proportion of objects

Activity

1. Draw and sketch large objects in reduced size to fit the drawing paper.
2. Draw and sketch small objects by scaling up practical size.
3. Increase and decrease drawings of objects proportionately.

Class Discussion

1. How would a drawing of a basketball court or football field be made on 8½" x 11" paper? How can all the lines and areas be reduced proportionately?
2. How can the rule be used to help make a drawing of this type?
3. How would a gear from an HO-scale locomotive be drawn on the paper? How large would a transistor be if it were drawn full size on the paper?
4. What are some objects that are found in the shop which might be drawn "half size?" (hammers, clamps, trays, machine parts, staplers, etc.)
5. What are some items which might be drawn double size? (watch parts, jewelry, model details, small screws, clips, etc.)
6. What large objects would have to be reduced to a scale of 1/4" = 1'—0"? (houses, maps, boats, airplanes, floor plans etc.)

Teacher Demonstrations

1. Show a large object such as a ceramic tray, and discuss methods of drawing this tray on paper. Demonstrate how it can be made half size.
2. Emphasize the term half size and half scale. Explain various methods of indicating scale on the drawing. (Scale: Half Size, Scale: ½" = 1", Scale: 1:2, Scale: 6" = 1'—0")
3. Review the fact that an indication of Scale: 1/4" = 1'—0" means that 1/4" on the drawing is equal to 1'—0" on the object being drawn.
4. Demonstrate how to use graph paper for sketching scaled drawings.

Assignments

1. Make a scale drawing on plain drawing paper of each of the problems.
2. Make a scale drawing of the front of the door to the drafting room.

Homework

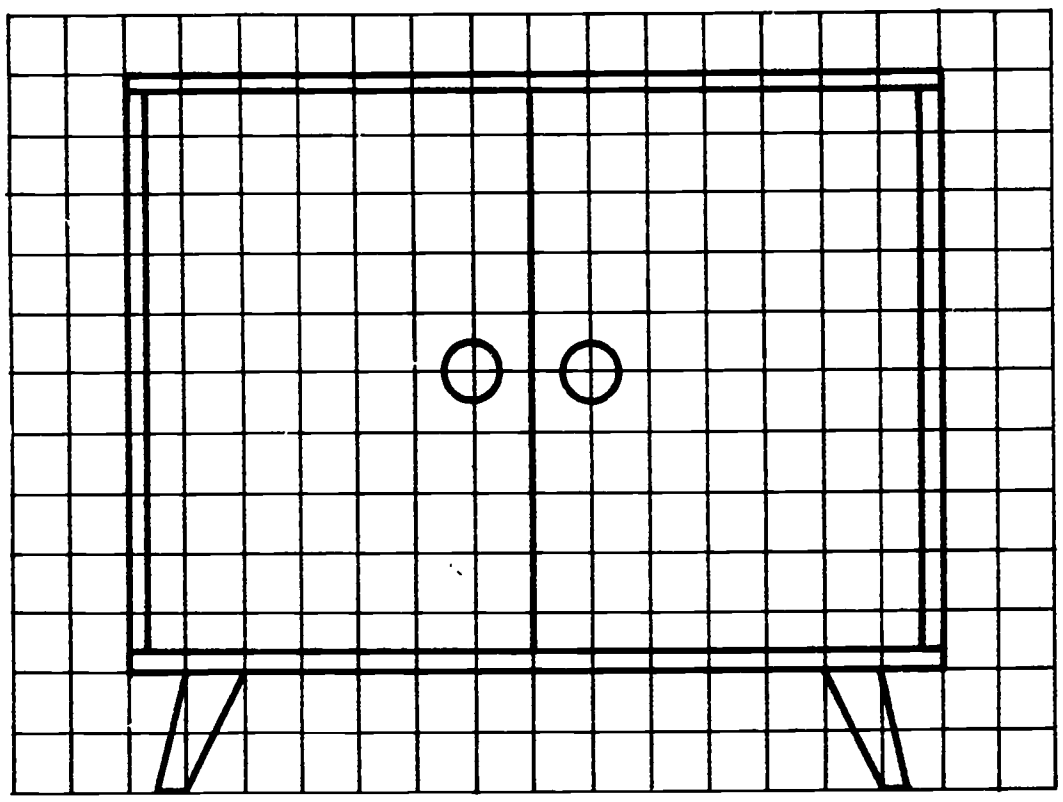
1. Sketch the floor plan of your kitchen at home. Scale the drawing so that it can fit on 8½" x 11" graph paper.
2. Make a scaled sketch of the front of a wrist watch. Scale: Double Size.
3. Make a scaled sketch or drawing of a model train layout or a model racing car track you would like to build. Dimension all parts correctly.

SCALE DRAWING

PLATE NO. 9

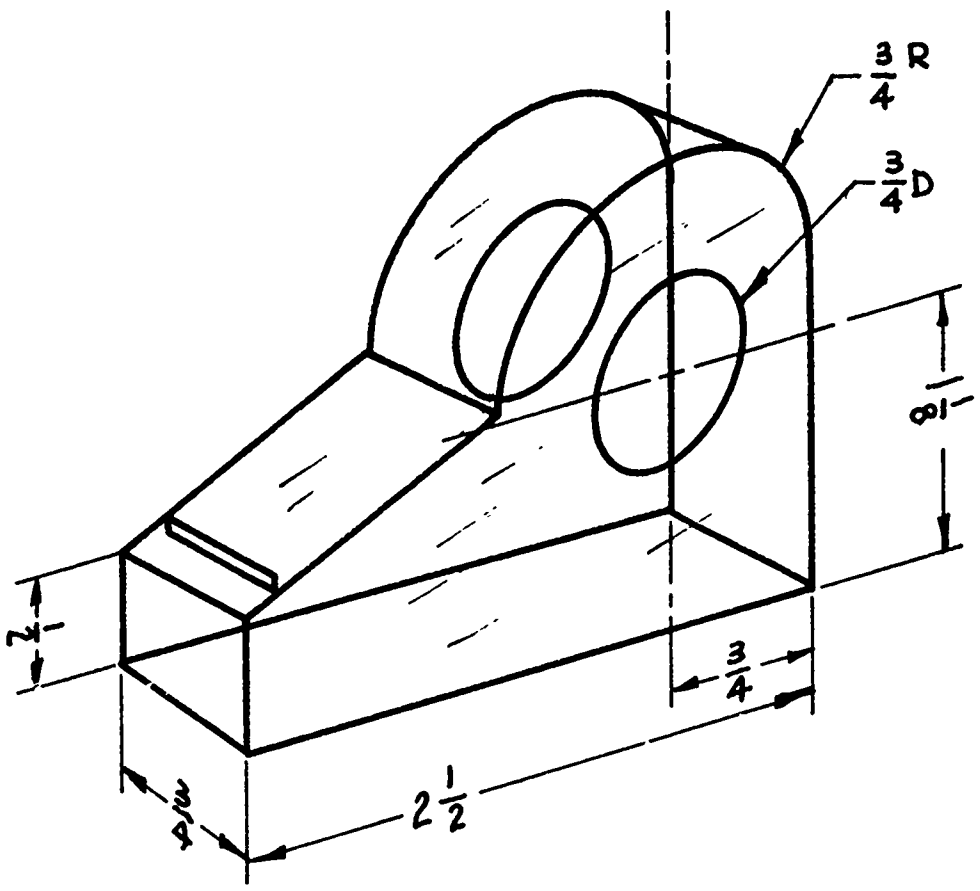
A

RECORD CABINET
DRAW ¼ SIZE



ONE BOX 2 INCHES

B



PLASTIC TAPE CASE
DRAW THE FRONT VIEW
DOUBLE SIZE

TOPIC 10 MAKING THE TWO-VIEW DRAWING

Aim

1. To provide opportunities to visualize and interpret two-view drawings
2. To teach how to project views

Activity

1. Draw and sketch objects requiring two views.
2. Make two-view drawings from three-dimensional models.
3. Make shop sketches of objects requiring two-view drawings.

Class Discussion

1. Most of the drawings that have been made thus far have been of flat single-plane objects. How would the draftsman indicate the shape of a small box? A jar? A pencil?
2. What is the relationship of the end view to the front view?
3. When is the top view selected for the second view?
4. What are the purposes of the extension lines?
5. Why is it necessary to examine both views when visualizing the surfaces of an object?

Teacher Demonstrations

1. Show the class several objects such as boxes, tools, plugs, jars, and other items which require two-view drawings.
2. Discuss methods of drawing each view. Show the relationship of the views by drawing light projection lines.
3. Demonstrate how to select the views for drawing.
4. Introduce methods of centering drawings on the paper.
5. Show the fundamentals of dimensioning between the views.

Assignments

1. Make two-view drawings of each of the objects shown on the assignment sheets.
2. Collect a number of small common objects which can be drawn with two views. Select one or two of these and make a two-view drawing of each.

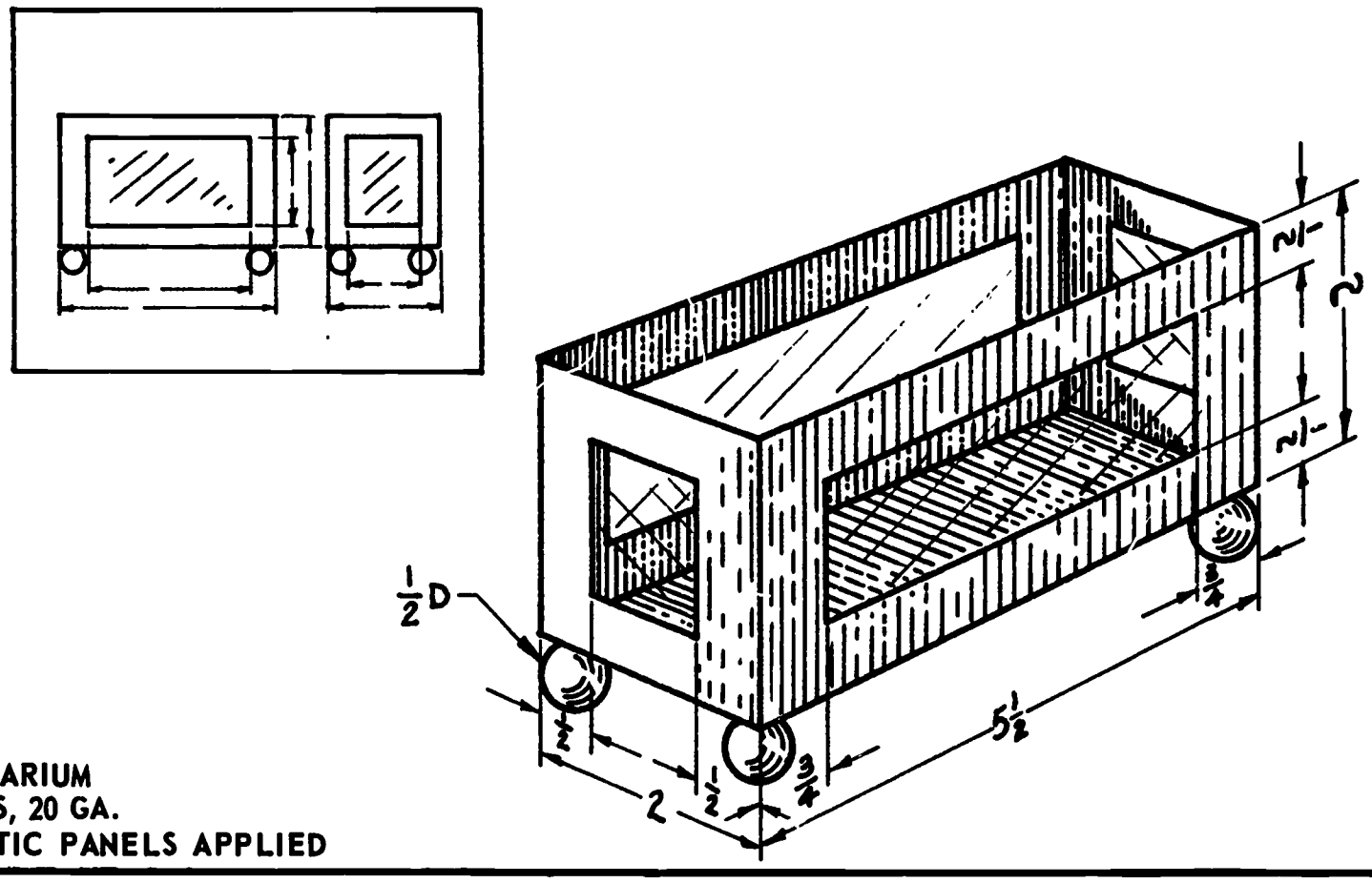
Homework

1. Make a two-view sketch of each of the following items. Use graph paper and draw the objects to scale if necessary: center punch, spool of thread, fry pan, ash tray, blackboard eraser.
2. Make a two-view sketch of the cabinet you selected to draw as a front view. Compare your skill in sketching now with your original sketch.

TWO-VIEW DRAWING

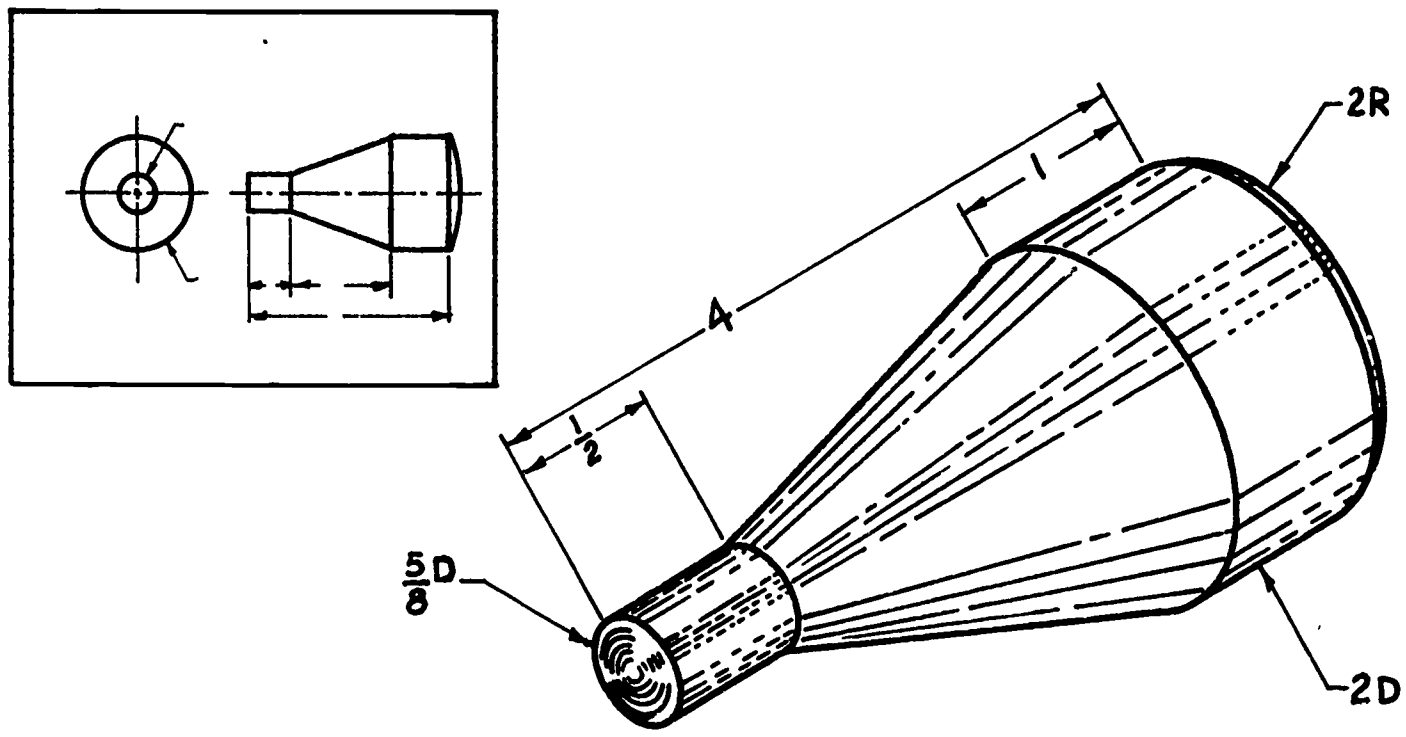
PLATE NO. 10

A



TERRARIUM
BRASS, 20 GA.
PLATE PANELS APPLIED

B



MODEL SPACE CAPSULE
NOTE: TO BE MASS PRODUCED
BY INJECTION MOLDING

TOPIC 11 HIDDEN EDGES

Aim

1. To teach how to draw hidden edges
2. To provide opportunities to visualize and interpret drawings with hidden edges
3. To establish procedures for dimensioning hidden-edge lines

Activity

1. Make two-view drawings of objects which will require hidden-edge lines.
2. Draw and sketch hidden-edge lines on a working drawing.
3. Dimension lines indicated by hidden edges.

Class Discussion

1. Show several objects which will require hidden-edge lines in at least one of the views. How are these lines indicated on the drawing?
2. When are hidden-edge lines required? When can they be omitted?
3. How are cylinders drawn with hidden edges?
4. What is the proper thickness of the hidden-edge line?
5. How is a hidden-edge line dimensioned?
6. How can the views of the object be shifted to eliminate some hidden-edge lines?
7. What is the purpose of the center line when drawing an internal cylinder?

Teacher Demonstrations

1. Show the class how many objects require hidden-edge lines on the drawing.
2. Demonstrate the proper technique of making hidden-edge lines.
3. Show how to eliminate hidden edges by revolving or shifting views.
4. Illustrate methods of dimensioning to a hidden-edge line. Emphasize the need for dimensioning to visible edges in most instances.
5. Show how hidden edges appear on many project plans.
6. Use the overhead projector to show how to project and draw hidden-edge lines.

Assignments

1. Complete each of the assignments by drawing any necessary hidden edges and by dimensioning the entire plate.
2. Make a working two-view drawing, including any necessary hidden edges of the assignment at the right.
3. Make a dimensioned two-view drawing of your mechanical drawing compass. Make the drawing to a scale of 1:1, and include all dimensions and hidden-edge lines.

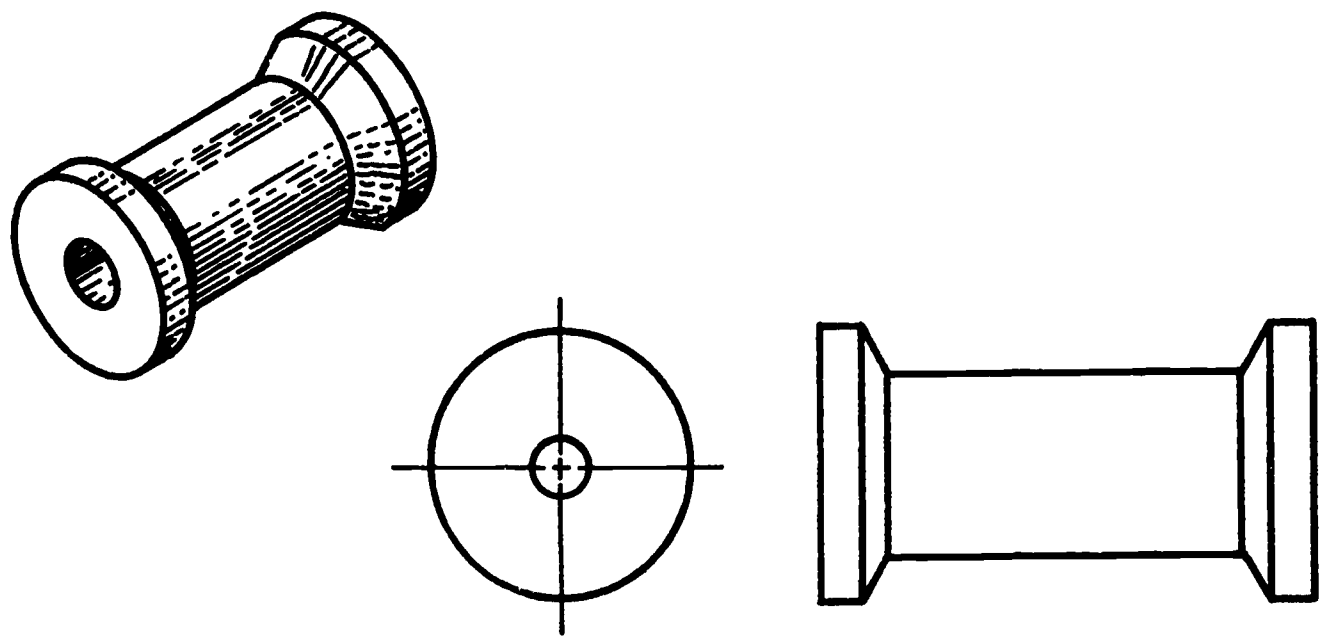
Homework

1. Make a freehand scale drawing of a trysquare. Include all necessary hidden edge lines and dimensions.
2. Make a mechanical drawing of a wood mallet, showing all necessary lines and dimensions.

HIDDEN EDGES

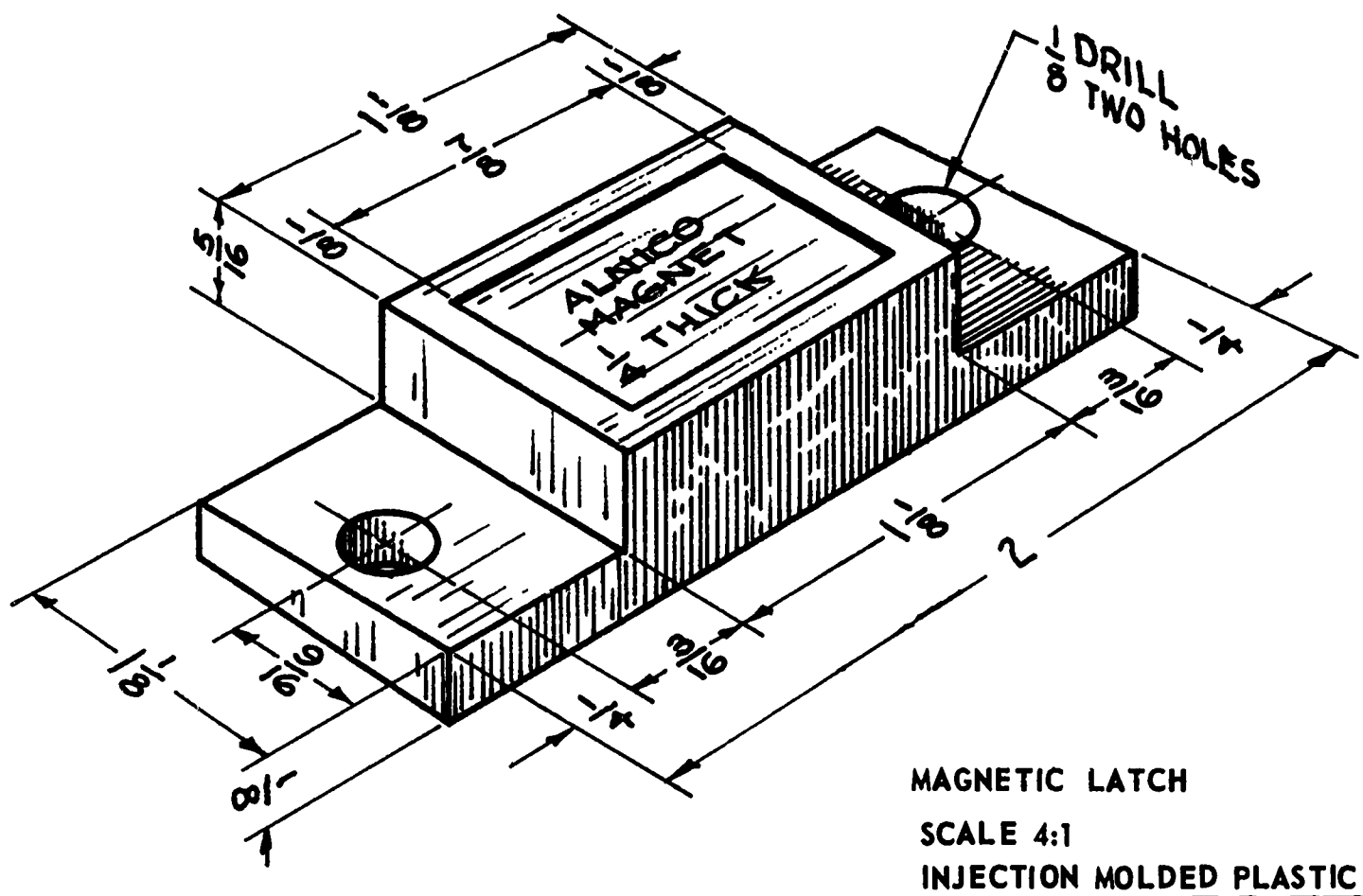
PLATE NO. 11

A



BELT PULLEY
SCALE 1:1
COMPLETE THIS PLATE BY
DRAWING ALL MISSING LINES.
MEASURE AND DIMENSION.

B



MAGNETIC LATCH
SCALE 4:1
INJECTION MOLDED PLASTIC

TOPIC 12 DIMENSIONING THE WORKING DRAWING

Aim

1. To reinforce knowledge and understanding of dimensioning techniques
2. To provide experience for dimensioning multiview drawings
3. To teach how to dimension a variety of two-view drawing situations

Activity

1. Make fully dimensioned two-view drawings.
2. Dimension freehand two-view sketches of various shop items.
3. Measure and dimension projects for several industrial arts areas.

Class Discussion

1. Review the purposes of dimensioning drawings.
2. What is the relative thickness of each of the lines used in drafting?
3. Why is dimensioning considered a descriptive means of indicating information?
4. Why are dimensions usually placed between the drawings?
5. How much room is usually left for dimension lines?

Teacher Demonstrations

1. Show the class how to dimension several simple two-view drawings.
2. Emphasize the differences of line weights for various conventions.
3. Demonstrate how to make rough calculations for allowance for space between the views of a drawing.
4. Show how to sketch freehand dimension lines.
5. Mention the problems involved with making drawings of invisible or hidden edges.

Assignments

1. Dimension each of the problems at the right.
2. Select a shop tool such as a punch, a screwdriver, or a chisel, and make a dimensioned two-view drawing of the item.

Homework

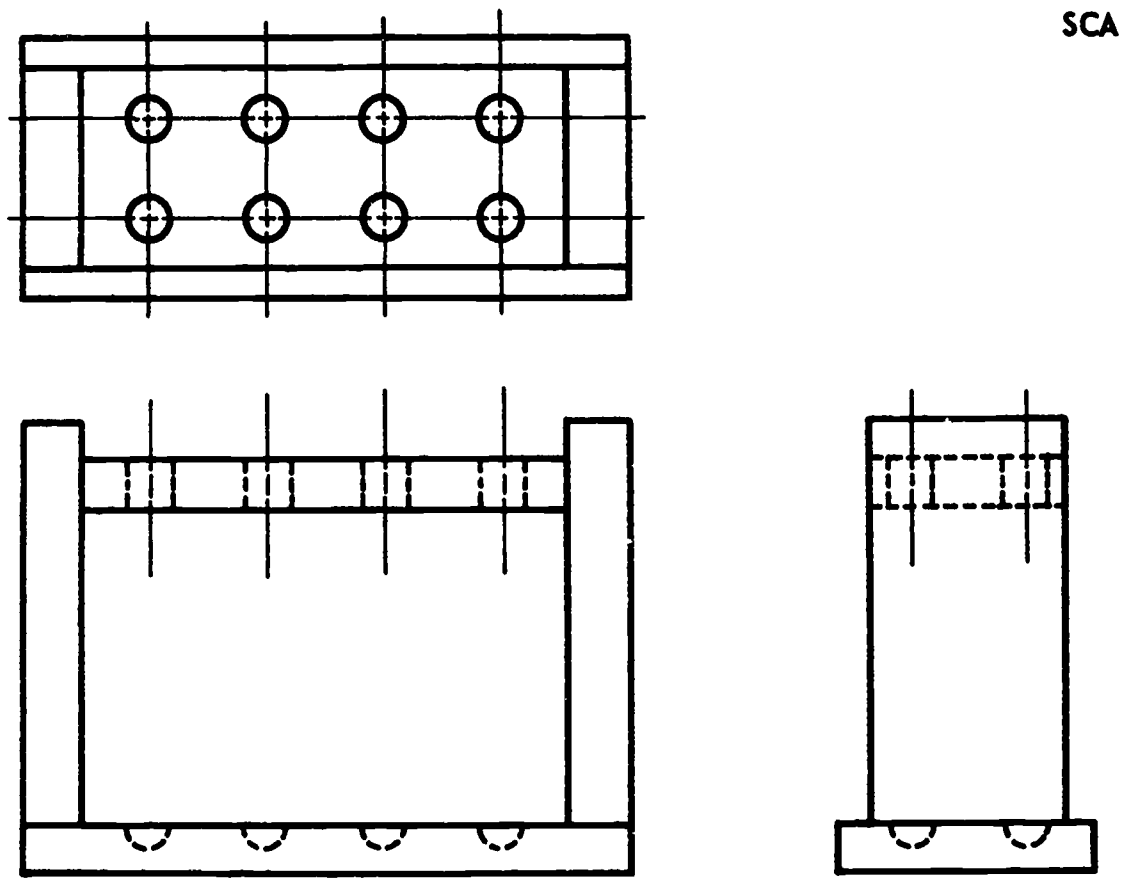
1. Make a dimensioned sketch of a table lamp or a flashlight. Indicate all major dimensions in the two-view sketch.
2. Select a small piece of hardware from the scrap box, and make a dimensioned two-view working drawing of the part.

DIMENSIONING PROBLEMS

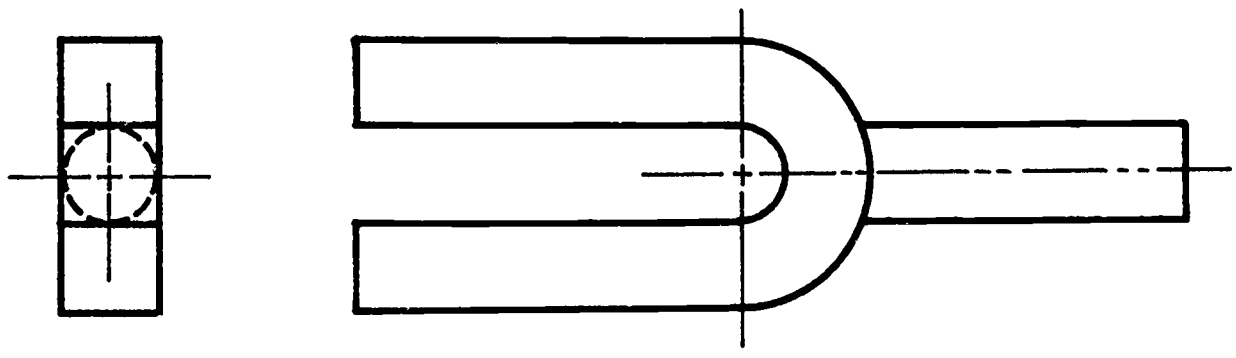
PLATE NO. 12

A

TEST TUBE RACK
SCALE: 1:2



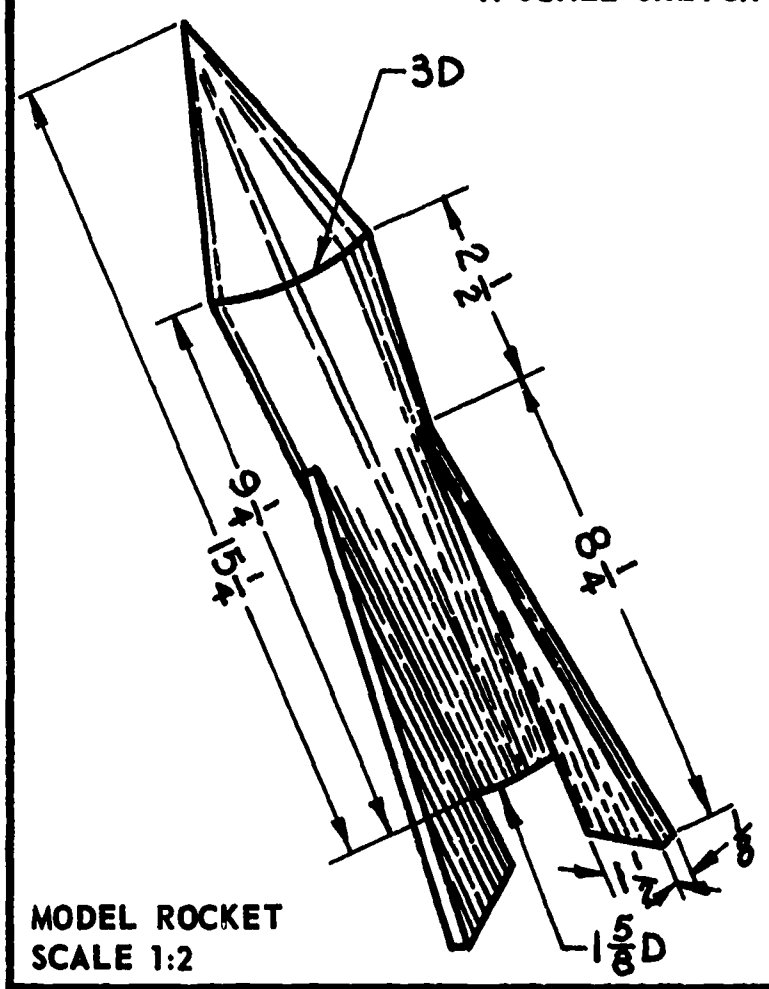
B



TUNING FORK
SCALE: HALF SIZE

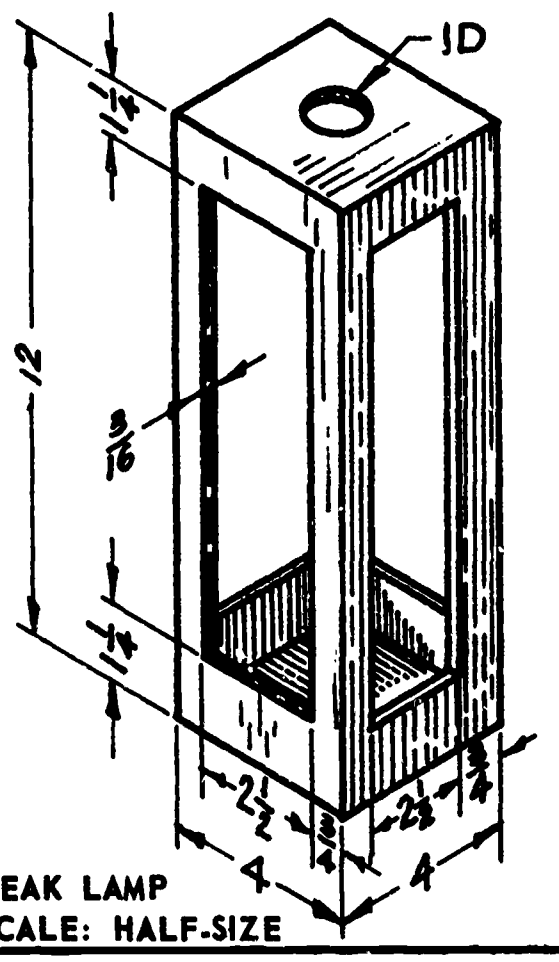
EXTRA CREDIT

E9 A SCALE SKETCH



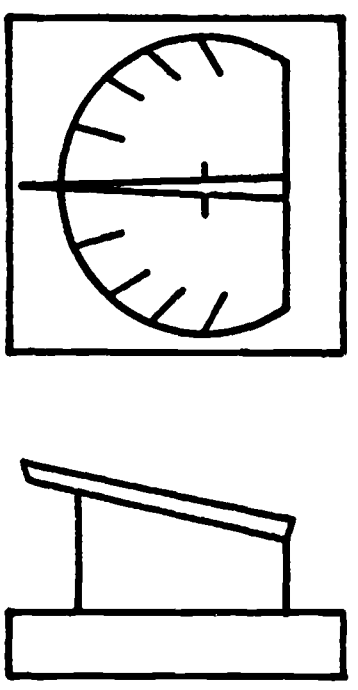
MODEL ROCKET
SCALE 1:2

E10 A WORKING DRAWING



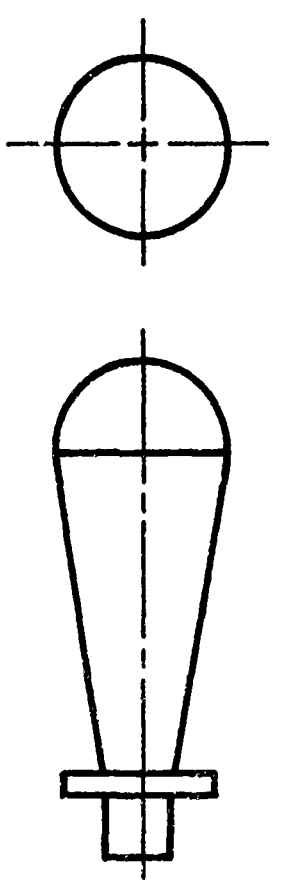
TEAK LAMP
SCALE: HALF-SIZE

E11 MEASURE & DIMENSION
DESIGN A PROBLEM



SUNDIAL
SCALE 1:8

E12 COMPLETE & DIMENSION



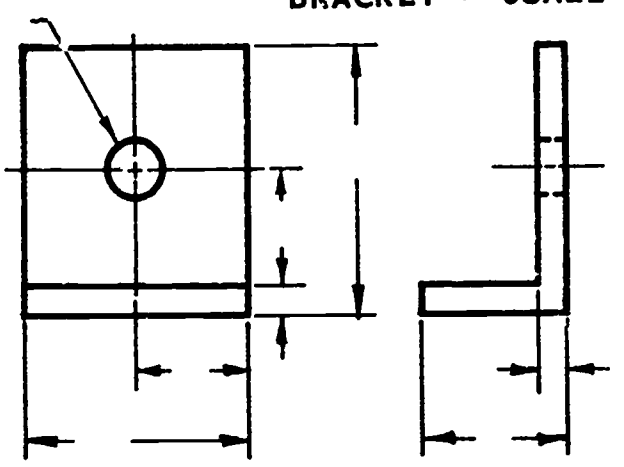
CONTROL KNOB
SCALE 1:1

TEST NO. 3

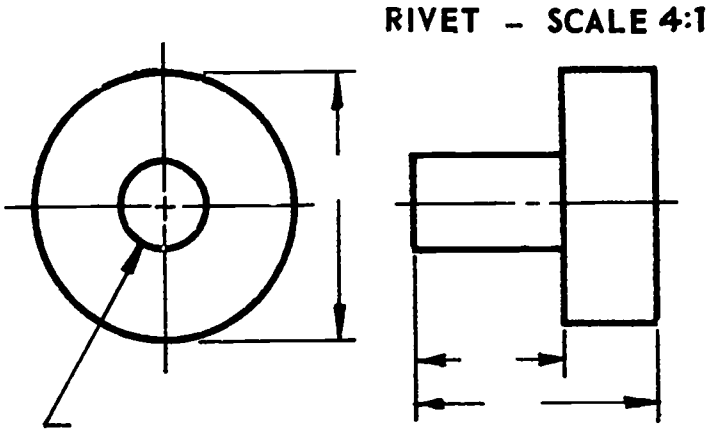
FASTEN THIS TEST TO YOUR DRAWING BOARD, USING THE T- SQUARE TO ALIGN THE PAPER.

DIMENSION THE DRAWINGS BELOW. INDICATE TRUE SIZE.

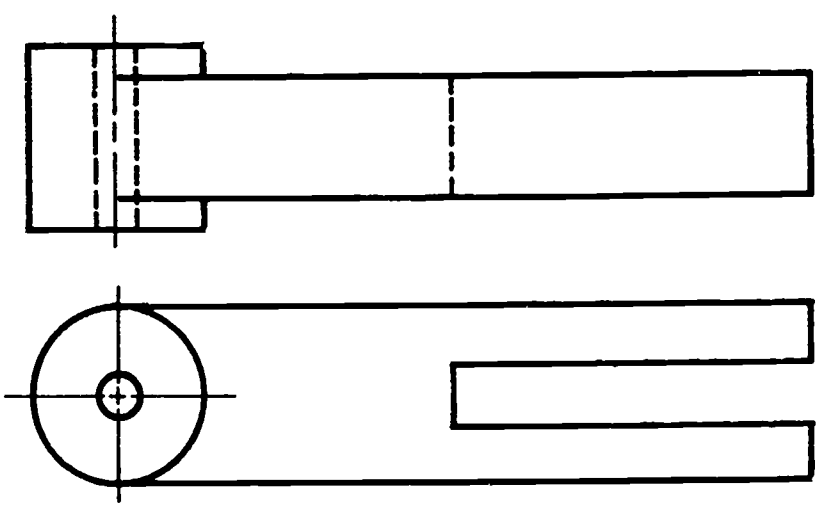
BRACKET - SCALE 1:2



RIVET - SCALE 4:1

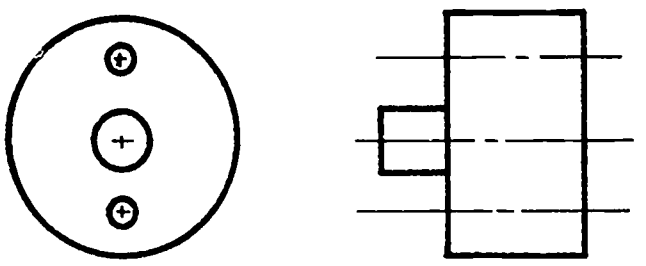


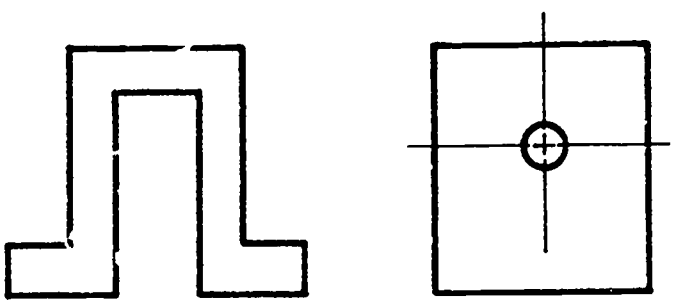
MEASURE AND DIMENSION THE ADJUSTABLE BEARING BELOW.



SCALE: FULL SIZE

FILL IN ALL MISSING LINES BELOW. DO NOT DIMENSION.





NAME _____ CLASS _____ DATE _____

TOPIC 13 MAKING THE THREE-VIEW DRAWING

Aim

1. To teach how to make a three-view orthographic projections
2. To provide opportunities to visualize and interpret three-view drawings
3. To establish procedures for making three-view drawings

Activity

1. Make three-view drawings of shop items.
2. Dimension orthographic projections and shop drawings.
3. Visualize three-dimensional objects as working drawings.
4. Locate and space each view properly when making the working drawing.

Class Discussion

1. Show the class an object requiring three views in the finished drawing. Items, such as tools, appliances, school furniture, pencil sharpeners, fixtures, equipment, toys, models, cabinets, etc., will serve as examples.
2. A two-view drawing will not be able to describe this object completely. Why is this so? What must be done to show all the details?
3. How is the third view developed on the drawing paper?
4. How does the draftsman start the drawing? Which view is made first? Why?
5. How is the end view developed from the front and top views?
6. What is the advantage of "making the turn" mechanically rather than by measuring with a rule or dividers?
7. Where are the dimensions usually placed? Why?
8. How is the drawing centered when three views are required?

Teacher Demonstrations

1. Show the class a common item requiring three views for complete description.
2. Develop each view, emphasizing the relationships between the views.
3. Use the overhead projector to demonstrate how to "make the turn" for the end view. Use one method only, preferably the 45° angle.
4. Provide opportunity for students to sketch three-view drawings at the chalkboard in order that other students may be able to visualize and discuss the procedures. Use simple objects or large model blocks.
5. Demonstrate how to center the drawing.

Assignments

1. Make a three-view working drawing of each of the objects at the right.
2. Select a sample block or small tool, and make a three-view working drawing of the object by measuring and dimensioning.

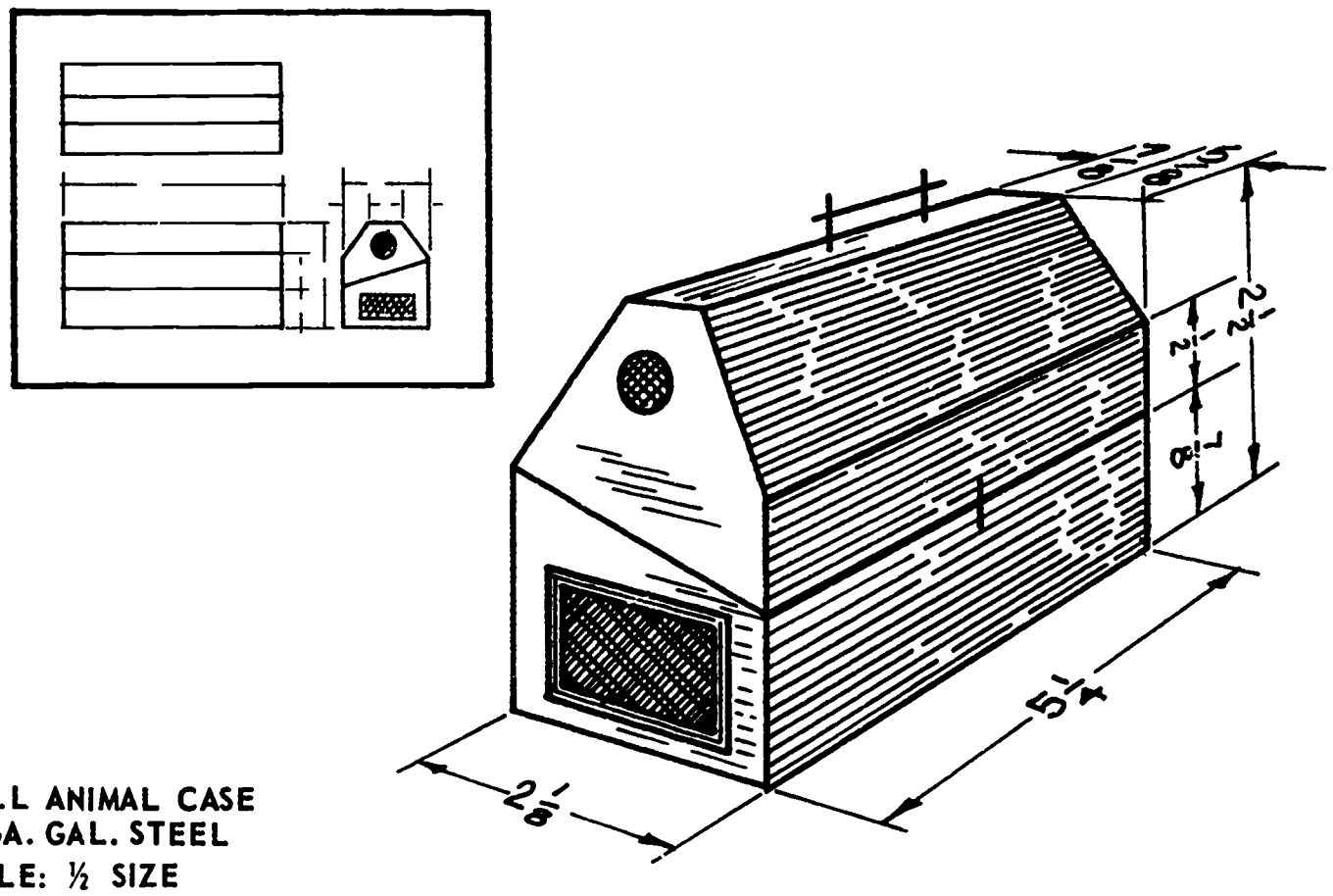
Homework

1. Sketch three-view orthographic projections of any of the following items: telephone, chest of drawers, desk chair, model train box car, desk lamp, jack plane, proof press, lathe, power pack, row boat, etc.
2. Make a three-view working drawing of the sketch of the item selected.

THREE-VIEW DRAWING

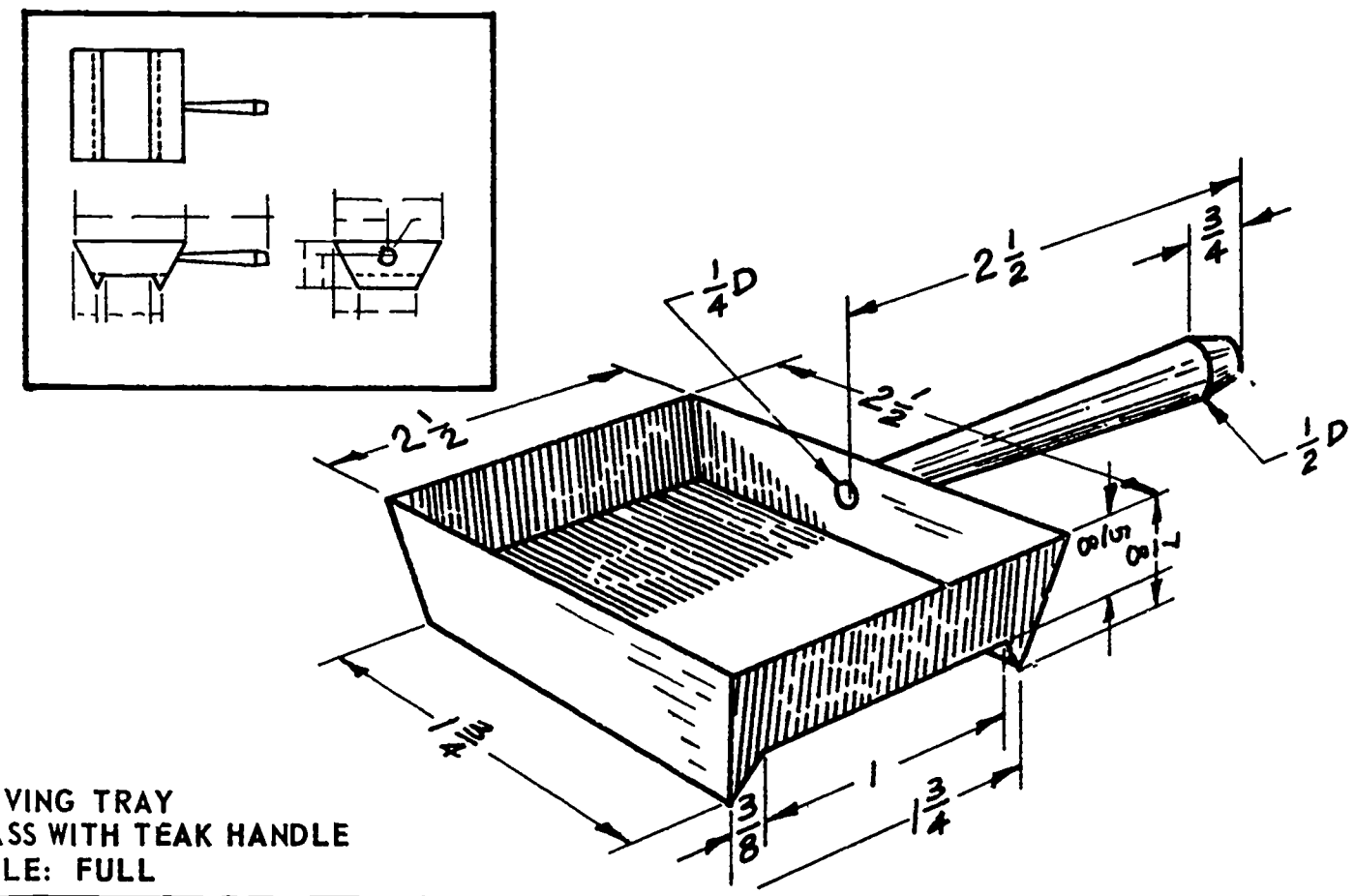
PLATE NO. 13

A



SMALL ANIMAL CASE
20 GA. GAL. STEEL
SCALE: ½ SIZE

B



SERVING TRAY
BRASS WITH TEAK HANDLE
SCALE: FULL

TOPIC 14 SHOP DRAWINGS

Aim

1. To provide additional experience in making three-view drawings
2. To teach how to read and interpret project plans and instructions
3. To apply previously learned knowledge to the drawing of shop plans

Activity

1. Examine and interpret a variety of project plans and designs.
2. Make orthographic working drawings of industrial arts shop projects.
3. Make freehand sketches of projects in various industrial arts areas.

Class Discussion

1. What is the value of being able to understand and draw plans?
2. What skills have you learned in the drafting class which can be useful in other class activities?
3. What is needed to make the three-view drawings into a working drawing?
4. How does the machinist or the carpenter use the drawings made by the draftsman? What must the draftsman know about craftsman's work?
5. What is the value of being able to make a clear freehand sketch?
6. How do you determine the number of views required for a drawing?
7. What is the advantage of the orthographic projection over the picture drawing?

Teacher Demonstrations

1. Display a variety of project plans used in the shops or industry. Have pupils discuss and describe the drawings.
2. Discuss the need for instructions and notes on the working drawing.
3. Demonstrate the procedures for making the working drawing of a project from the sketch or the three-dimensional object.
4. Mention the use of the pictorial drawing in magazine and advertising illustrations, but do not elaborate on the discussion at this time.
5. Provide opportunity to sketch three-view working drawings on graph paper and on plain drawing paper.

Assignments

1. Make a working drawing of each of the objects on the assignment sheets.
2. Select a project being made in any shop at this time and make a working drawing of this problem. Make an acceptable shop sketch before attempting the finished drawing. Draw up a bill of materials for the problem.

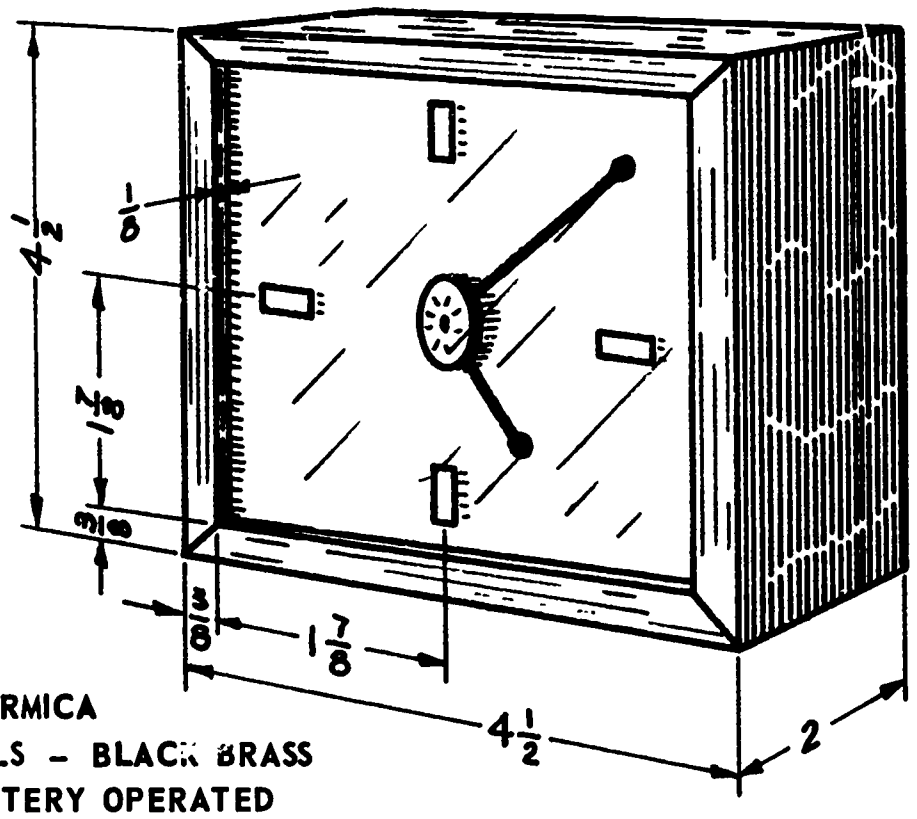
Homework

1. Select a small box or can found in the home, and make a working drawing of the object. The drawing should not include any advertising or lettering. All drawing must be to scale.
2. Make a working drawing of a project you would like to construct in an industrial arts shop.

SHOP DRAWING

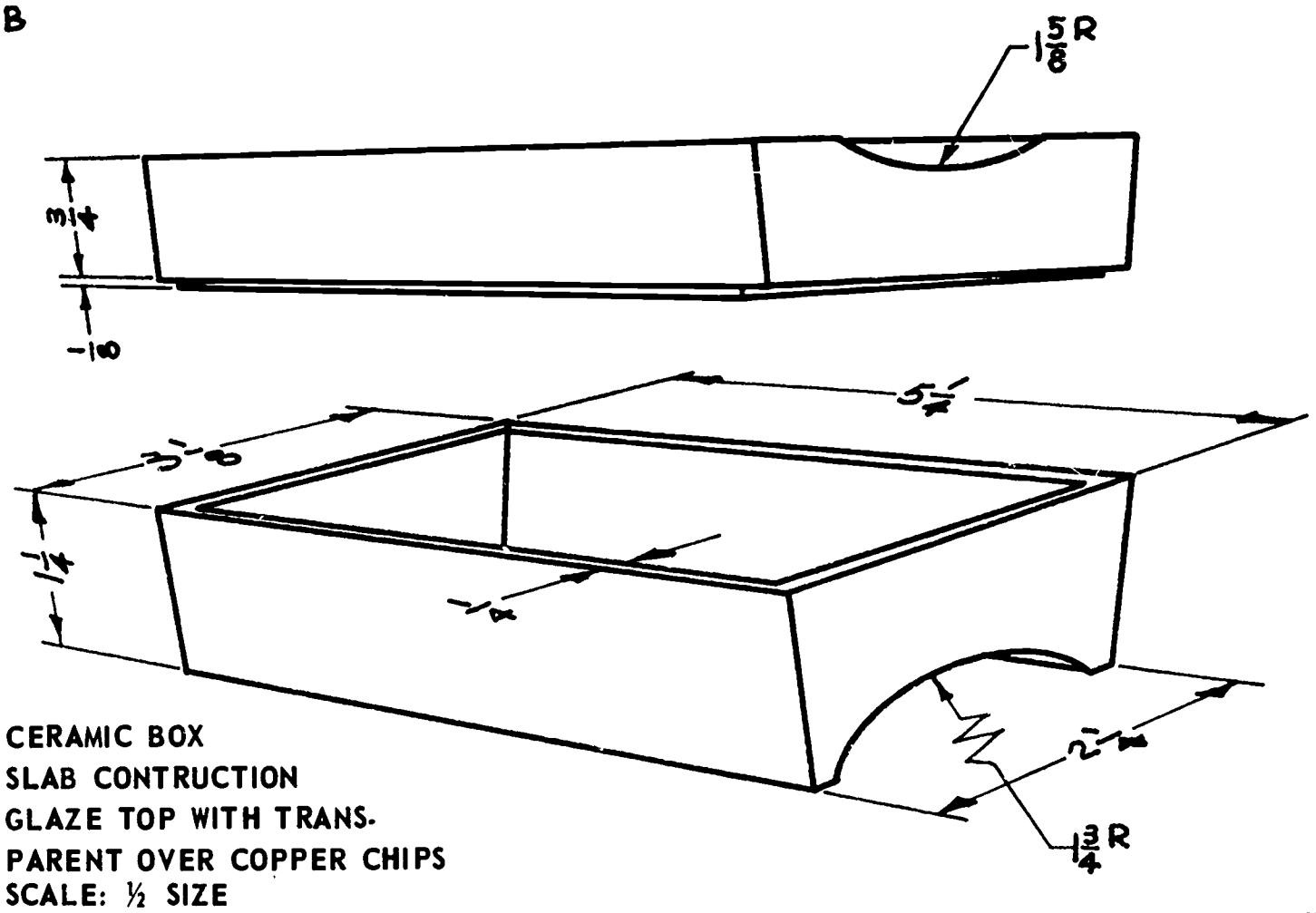
PLATE NO.14

A



CLOCK
CASE - WALNUT
FACE - WHITE FORMICA
HANDS & NUMERALS - BLACK BRASS
MECHANISM - BATTERY OPERATED
SCALE 1:1

B



CERAMIC BOX
SLAB CONTRUCTION
GLAZE TOP WITH TRANS-
PARENT OVER COPPER CHIPS
SCALE: ½ SIZE

TOPIC 15 INTRODUCTION TO PICTORIAL DRAWING

Aim

1. To teach how to make simple pictorial drawings
2. To provide opportunity to visualize and draw pictorially from orthographic projections.
3. To teach how to make mechanical cabinet and oblique drawings

Activity

1. Make a cabinet drawing of a shop project.
2. Make freehand cabinets sketches of various objects.
3. Dimension a cabinet drawing.

Class Discussion

1. Draw the front view of a trinket box on the chalkboard. How can a picture drawing of this project be made?
2. What are the advantages of picture drawings? The disadvantages?
3. At what angle are the receding lines drawn?
4. Why are cabinet drawings made with the receding lines half size?
5. What kind of drawing does the artist make when he sketches a picture?
6. What are the disadvantages of these drawings for the draftsman?

Teacher Demonstrations

1. Show how to change the front view of a drawing into a cabinet drawing.
2. Emphasize the use of half-length lines for better pictorial effect.
3. Show how to project forward and backward on the cabinet drawing.
4. Illustrate the technique of perspective development, but limit the discussion to one of understanding rather than one of developing technique.
5. Show how to dimension cabinet drawings. Emphasize the limitations of this kind of drawing, i.e., front view only, true size and shape, line and size distortion on receding lines (not useful for all kinds of problems).
6. Mention the isometric drawing as a method of overcoming most of these objections. Do not discuss the drawing technique at this time.

Assignments

1. Make a cabinet drawing of each of the problems at the right.
2. Select a project from an industrial arts shop, and make a suitable cabinet drawing of the problem.

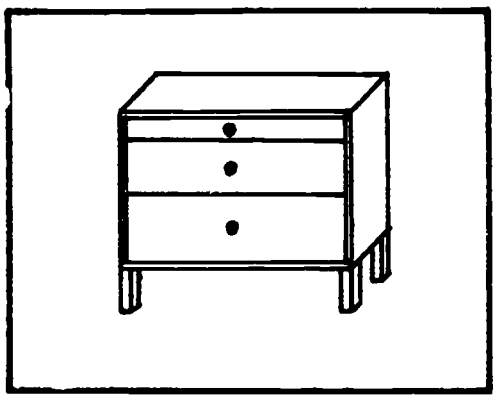
Homework

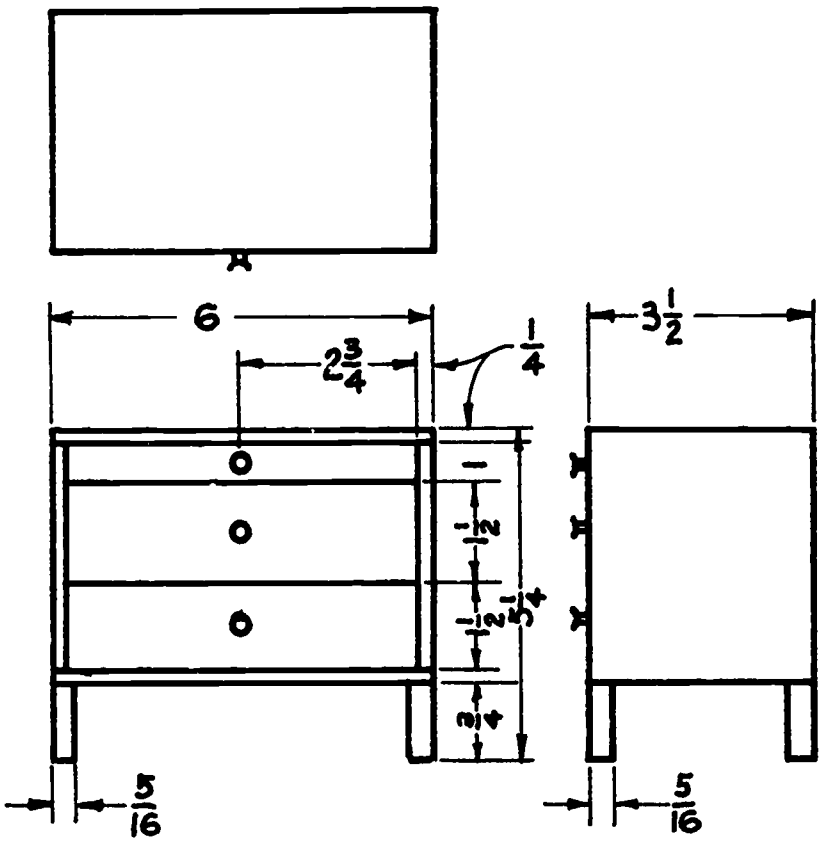
1. Make a cabinet sketch of a radio or television sset you have in your home.
2. Make a cabinet drawing, including all necessary dimensions, of a desk, table, or chest of drawers in your home.
3. Make a pictorial drawing of the shop project for which you have already made an acceptable working drawing.

PICTORIAL DRAWING

PLATE NO. 15

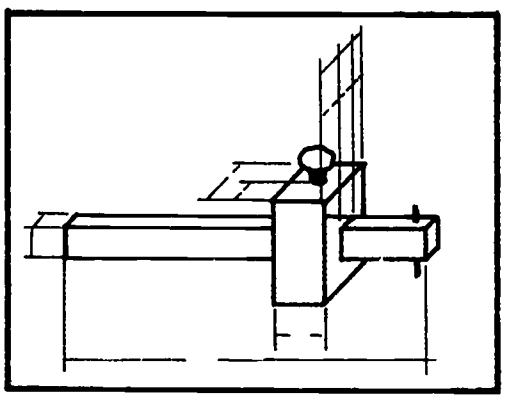
A

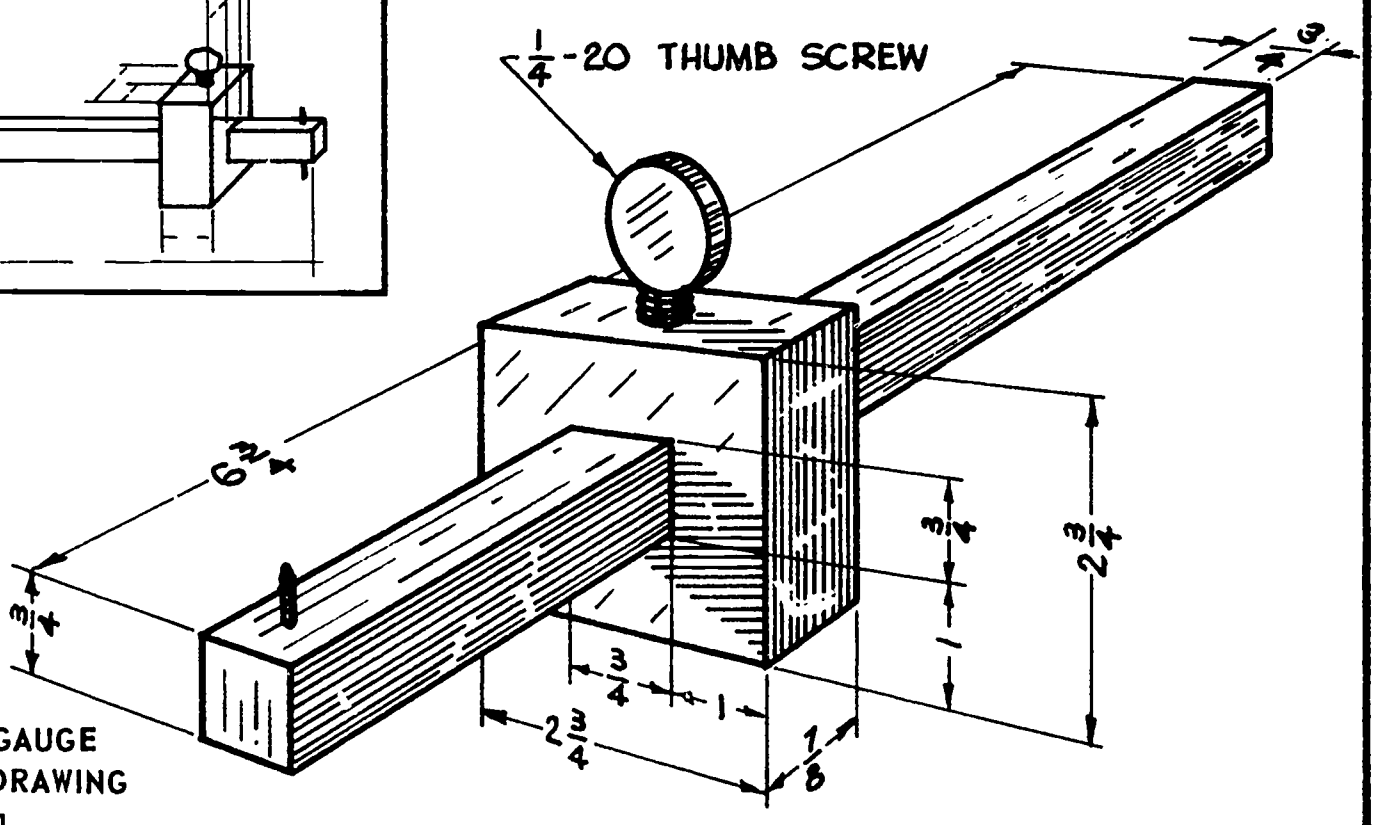




SMALL PARTS CHEST
CABINET DRAWING
SCALE: FULL SIZE

B





MARKING GAUGE
CABINET DRAWING
SCALE: 1:1

TOPIC 16 ISOMETRIC DRAWING AND SKETCHING

Aim

1. To teach how to make simple isometric drawings
2. To provide opportunity to visualize and draw objects in isometric form from three-dimensional objects
3. To make isometric sketches from working drawings and three-dimnsional objects

Activity

1. Discuss the limitations of cabinet and perspective drawings. Mention the problems of measuring and dimensioning.
2. Why can isometric drawings be of value in the shop? (All isometric lines are true length lines.)
3. Why are isometric drawings use in magazine illustrations and hobby construction plans?
4. Why are all isometric drawings made in a "basic framework"?
5. Why is it necessary to construct an isometric square before drawing an isometric circle?
6. What are the values of templates in isometric drawings?
7. Why is isometric sketching paper used?
8. How are the dimensions placed on an isometric drawing? (All dimensions are placed on the plane being dimensioned and are read from the center of the drawing. See ASA drafting standards.)

Teacher Demonstrations

1. Show how to draw a simple block or box by means of the isometric drawing.
2. Illustrate the use of isometric sketching paper.
3. Emphasize the true length line principle of all isometric lines.
4. Show how to draw a non-isometric line by locating the end points of the line.
5. Demonstrate how to draw an isometric circle. This technique will usually require a considerable amount of individual instruction. A teaching aid showing how to do this is useful if isometric circles are emphasized in a drawing. (Pages 96-98, Almon, VISUALIZED BASIC MECHANICAL DRAWING can be duplicated as instruction sheets using the thermal spirit master units for the Rexograph machine.)
6. Show how templates can be used for making isometric circles. Point out the commercial applications for such templates.

Assignments

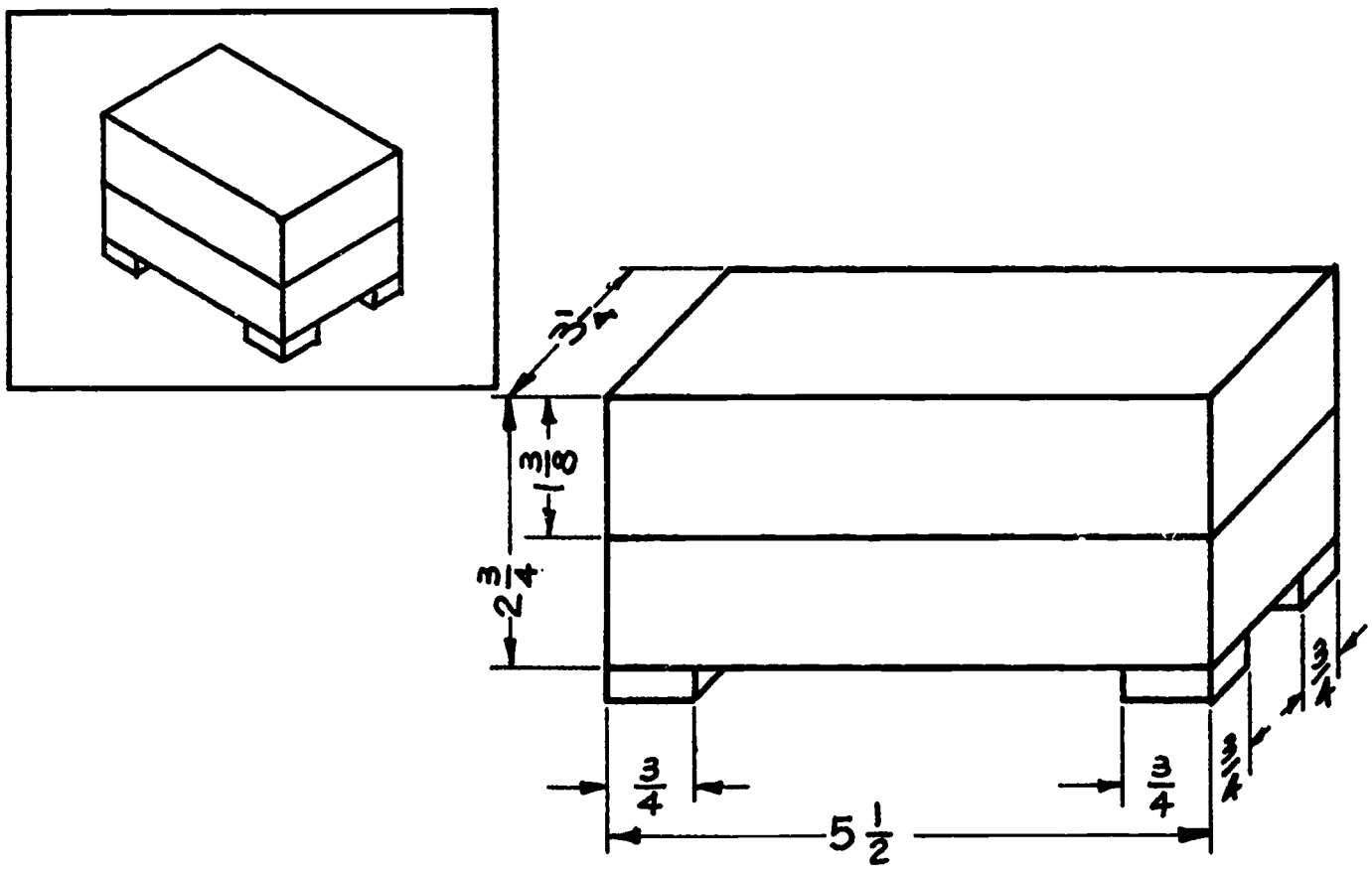
1. Make an isometric drawing of the object shown on the assignment sheet as cabinet and orthographic projections.
2. Make an isometric working drawing of a shop project.

Homework

1. Make an isometric sketch of the cabinet you drew as an orthographic working drawing or cabinet drawing. Compare the two drawing techniques.
2. Make an isometric drawing of the above sketch.

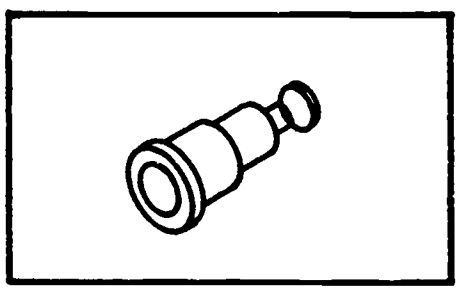
PLATE NO. 16

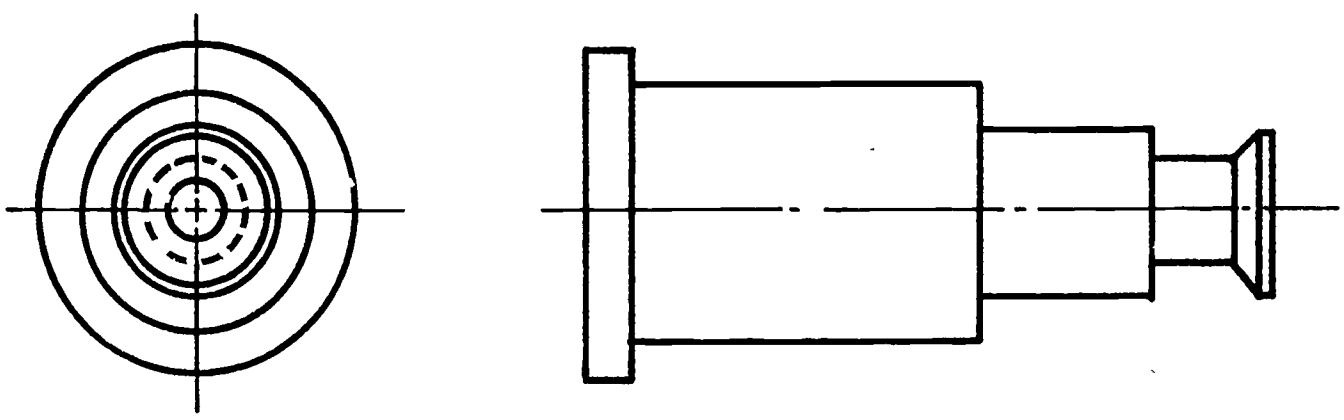
A



JEWELRY BOX
SCALE: FULL SIZE

B

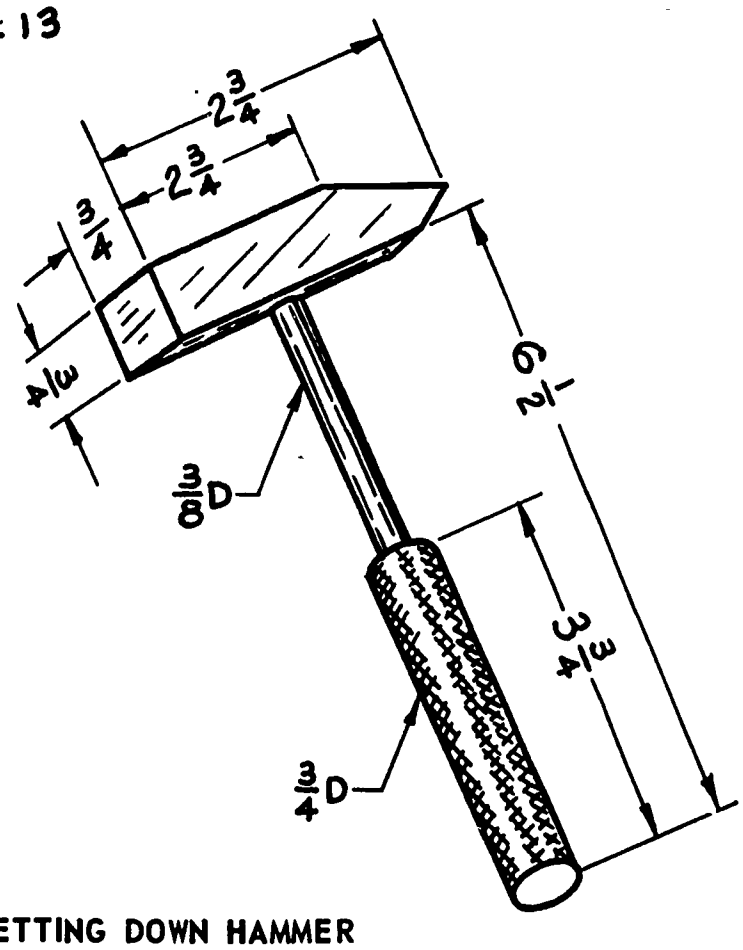




TELESCOPE
SCALE 1:1
MEASURE & DIMENSION
DRAW ISOMETRIC

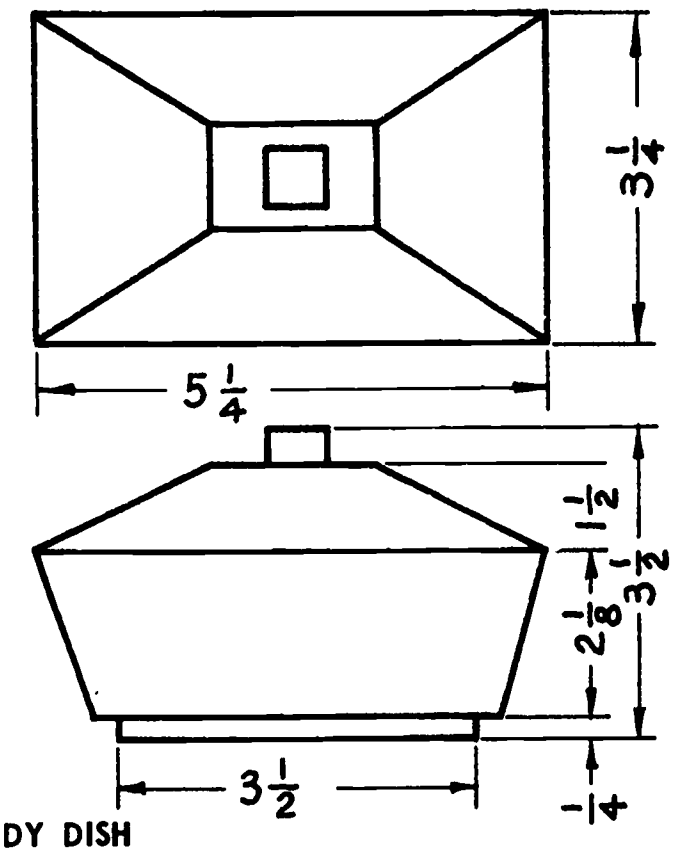
EXTRA CREDIT

E13



SETTING DOWN HAMMER
SCALE: FULL SIZE
MAKE A WORKING DRAWING

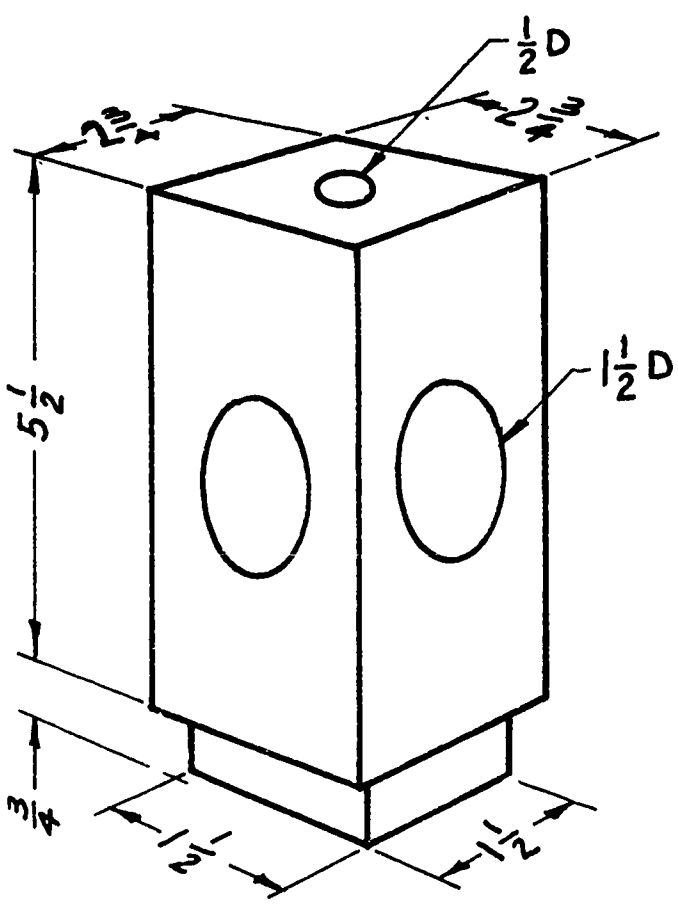
E14



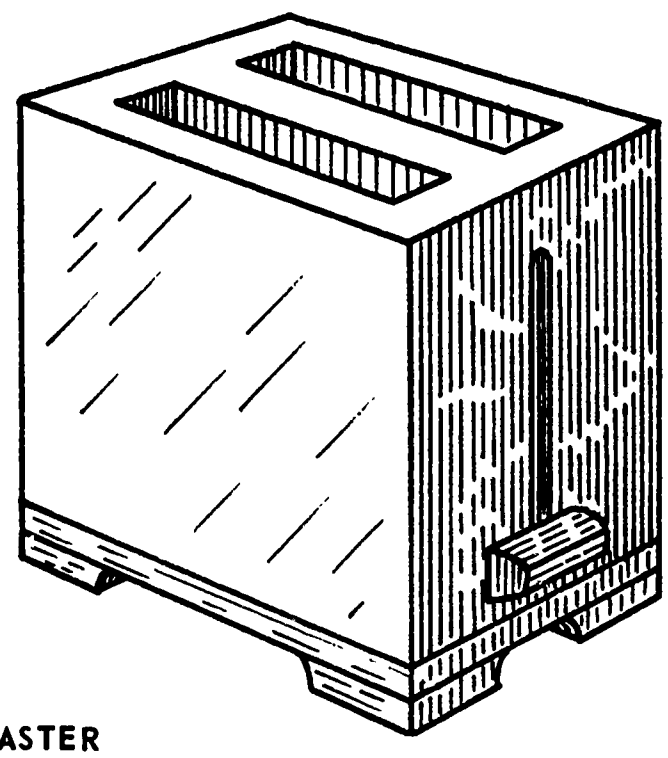
CANDY DISH
SCALE 1:1
MAKE AN ISOMETRIC DRAWING

MAKE A CABINET DRAWING
OF THIS CERAMIC LAMP

E15



E16

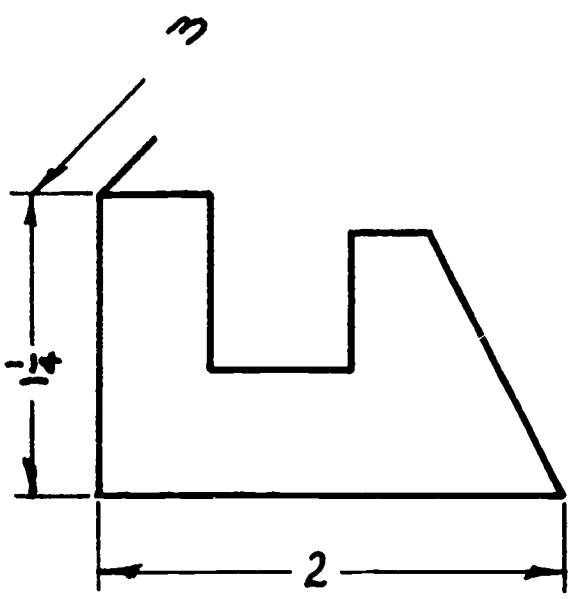


TOASTER
SCALE 1:4
MAKE A WORKING DRAWING
MEASURE AND DIMENSION

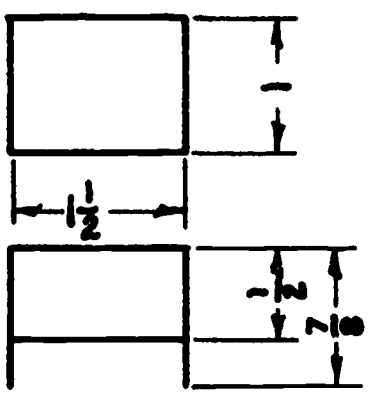
TEST NO. 4

FASTEN THIS TEST TO YOUR DRAWING BOARD, USING THE T-SQUARE TO ALIGN YOUR PAPER. DO ALL WORK ON THIS PAPER.

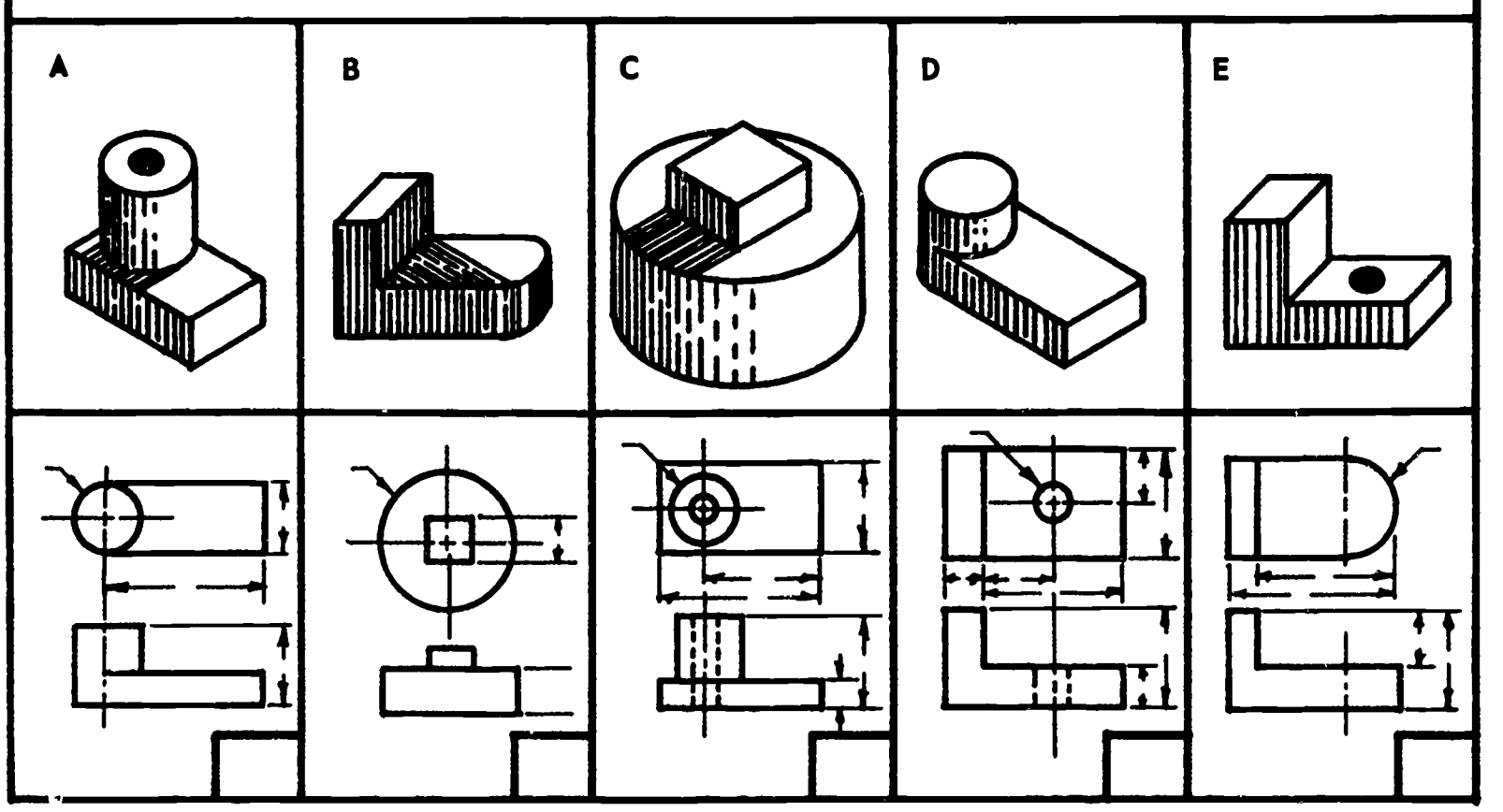
I. MAKE A CABINET DRAWING



II. MAKE AN ISOMETRIC DRAWING OF THIS STOOL

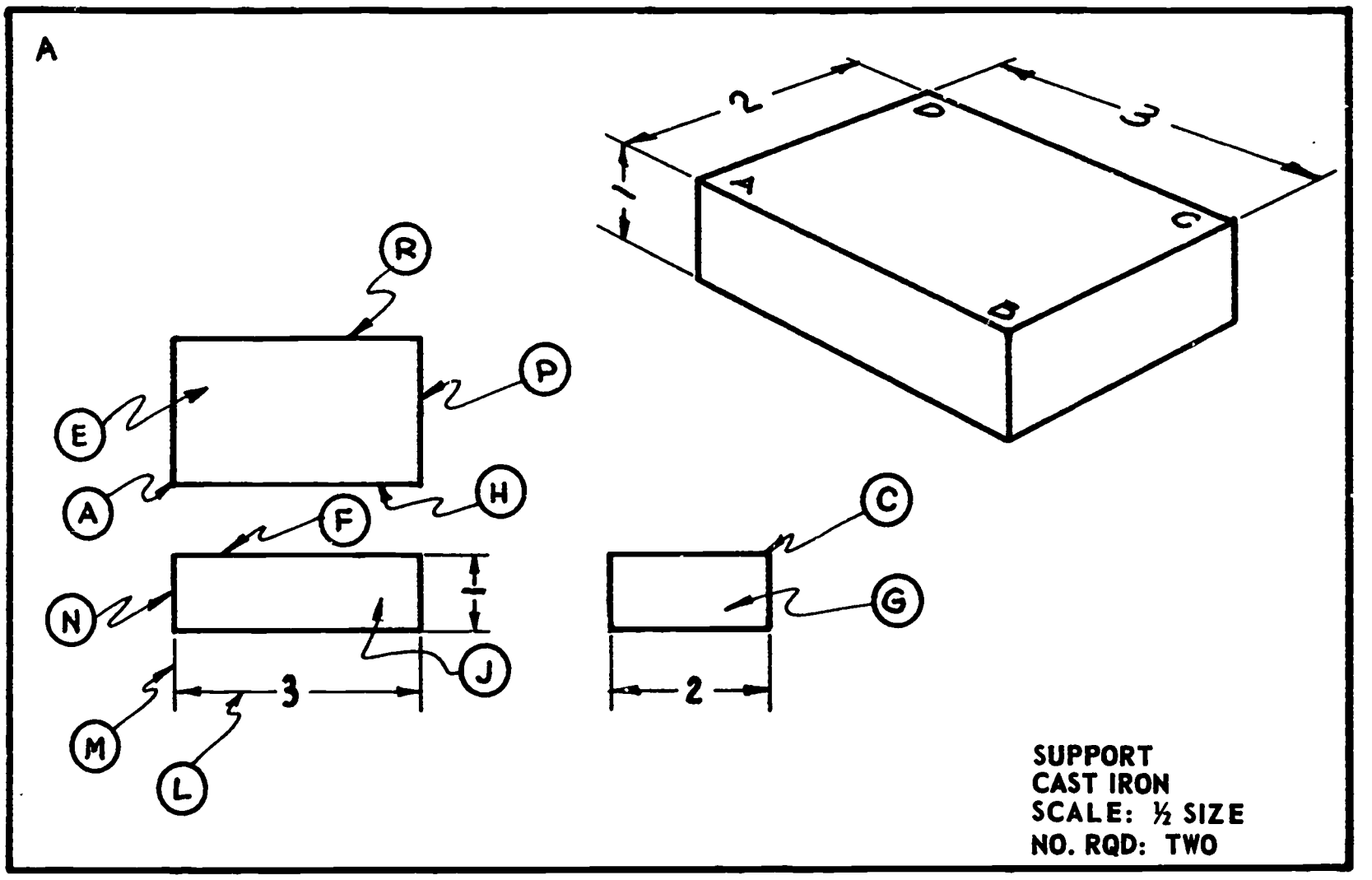


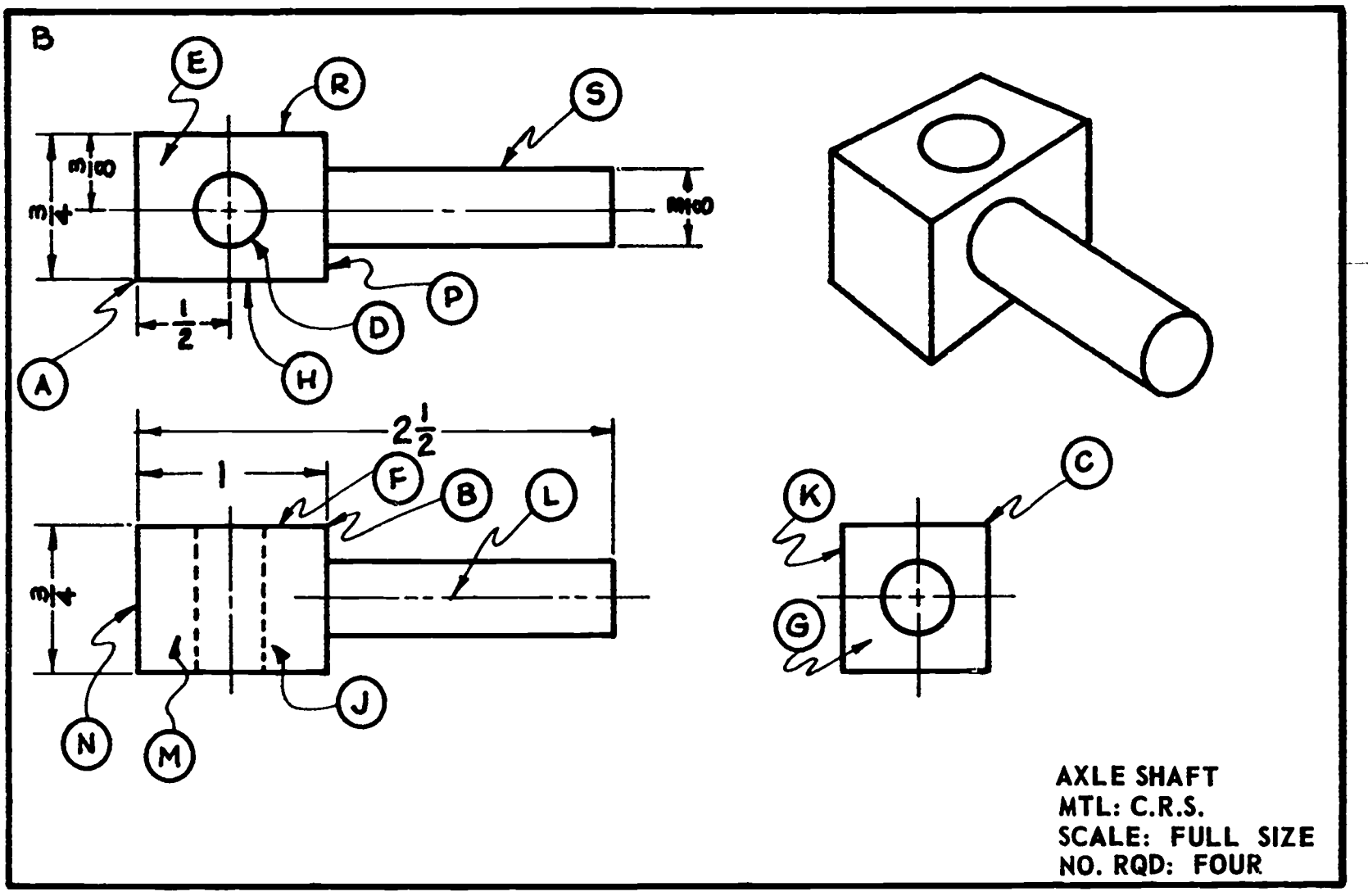
MATCH THE DRAWING WITH THE SKETCH BY PLACING THE LETTER IN THE PROPER BOX BELOW.



READING AND INTERPRETING GRAPHIC MATERIAL

Problem A or B	Answer
1. What is the name of the part?	_____
2. What material is to be used?	_____
3. What is the scale of the drawing?	_____
4. How many pieces are needed?	_____
5. What is the length of the unit?	_____
6. What is the width?	_____
7. What is the maximum height or thickness?	_____
8. In what two views is the length the same?	_____
9. In what two views is the width the same?	_____
10. In what two views is the height or thickness the same?	_____
11. If letter (E) in the top view represents the top surface, what in the front view represents the top of the object?	_____
12. If letter (G) in the side view represents the side surface, what line represents this surface in the top view?	_____
13. What line in the top view represents the surface (J) in the front view?	_____
14. What line in the side view represents the front surface of the front view?	_____
15. Point (B) represents what line of the top view?	_____
16. Point (C) represents what line of the top view?	_____
17. Point (A) represents what line of the front view?	_____
18. What type of line is (L)?	_____
19. What type of line is (M)?	_____
20. What type of line is (N)?	_____


A
2
3
1
D
A
C
B
R
P
E
A
H
F
C
N
G
J
3
2
M
L
SUPPORT
CAST IRON
SCALE: ½ SIZE
NO. RQD: TWO


B
E
R
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2½
1
F
B
L
C
K
G
J
N
M
AXLE SHAFT
MTL: C.R.S.
SCALE: FULL SIZE
NO. RQD: FOUR

TOPIC 17 PICTORIAL WORKING DRAWINGS

Aim

1. To teach how to make pictorial dimensioned drawings
2. To provide opportunities to examine and visualize exploded views
3. To make working drawings of various types from pictorial sketches

Activity

1. Make dimensioned isometric drawings of shop problems.
2. Dimension isometric, cabinet, and other pictorial drawings.
3. Draw orthographic working drawings from isometric sketches.
4. Draw isometric mechanical drawings and sketches from orthographic drawings.

Class Discussion

1. What are the advantages of the isometric drawing in the school shop? Are there any disadvantages? What are they?
2. How are isometric drawings dimensioned? How are cabinet drawings dimensioned?
3. How can an object with various parts be illustrated in the isometric drawing? What is an exploded view?
4. How can an orthographic drawing be made when an isometric drawing is shown on the plans for a project? What purpose would be served to make an orthographic drawing in this situation?
5. Of what value is the isometric sketching paper in planning projects?
6. What other kinds of pictorial drawings can be useful to illustrate shop projects? When would they be used?

Teacher Demonstrations

1. Show the class a variety of isometric drawings and plans. Discuss the advantages, such as ease in visualization, true measurement on isometric lines, dimensions easy to read, assembly, and details simple to understand, etc.
2. Demonstrate how to dimension isometric and cabinet drawings following ASA procedures.
3. Discuss the exploded-view drawing and explain how it is made.
4. Demonstrate how to utilize isometric sketching paper for shop sketches.

Assignments

1. Make an isometric working drawing of the object shown on the assignment sheet.
2. Make an isometric sketch of the shop problem shown at the right.

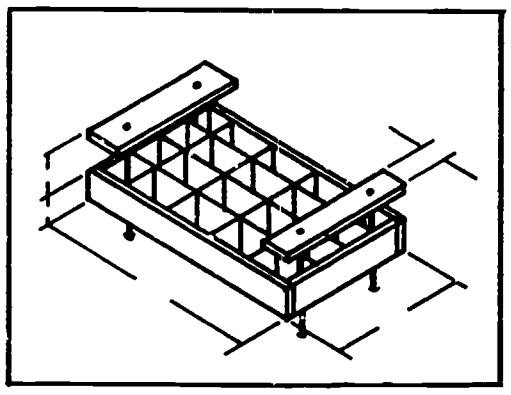
Homework

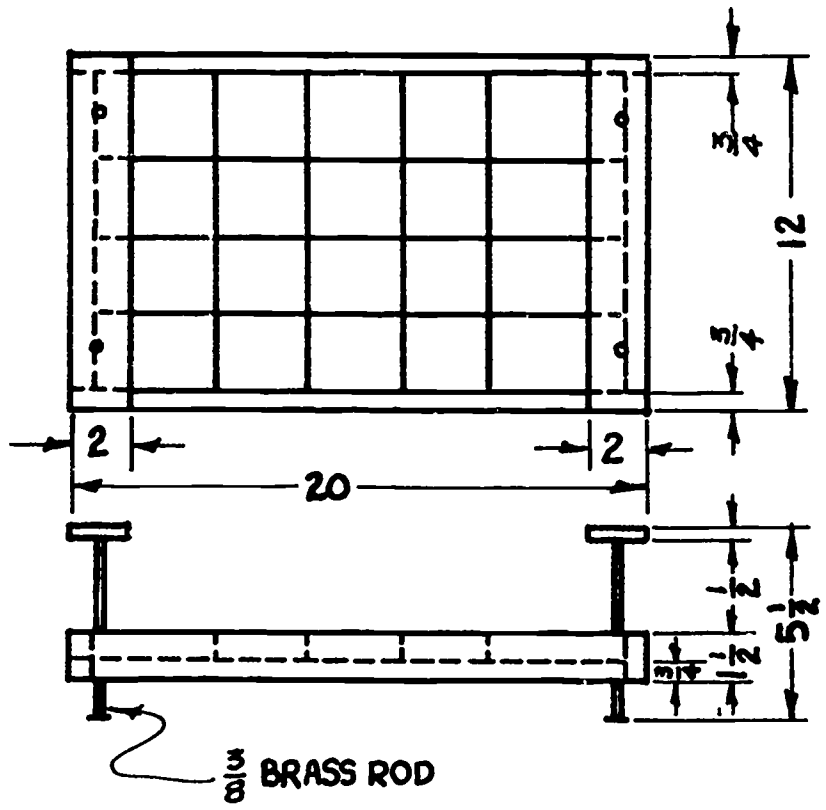
1. Make an isometric sketch of a small table in your home. Dimension the sketch, using correct isometric technique.
2. Make an exploded drawing of a small object such as a file handle, screwdriver, lipstick case, jar and screw cap.

PICTORIAL DRAWING

PLATE NO. 17

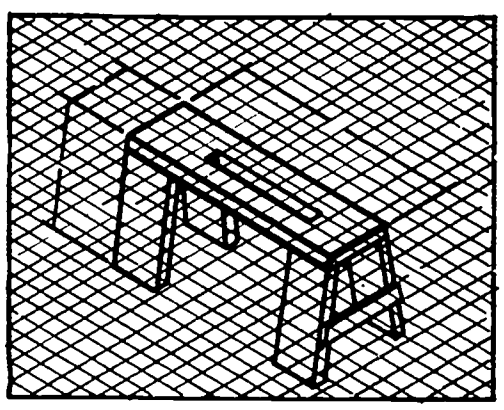
A

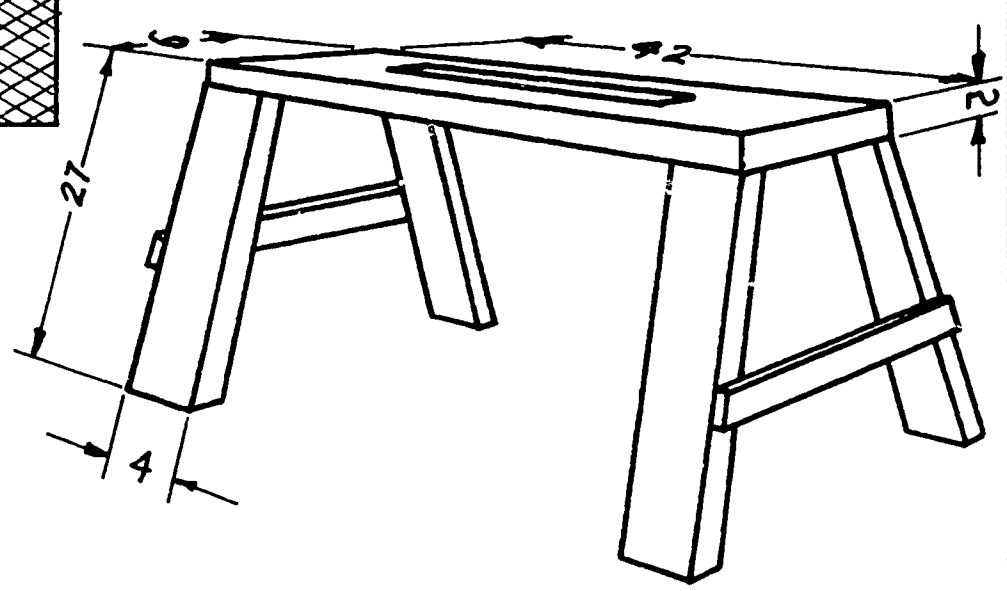




ROCK SAMPLE TRAY
REMOVABLE PLASTIC DIVIDER

B





PORTABLE BENCH SAW HORSE
ALL 2" STOCK
BRACES 1" x 4"

SCALE: 1:6

TOPIC 18 SHOP DRAWING AND SKETCHING PROBLEMS

Aim

1. To provide opportunities for students to make drawings of a variety of projects and problems found in the industrial arts shops
2. To teach how to plan and prepare a drawing of a shop problem
3. To make working drawings of typical shop problems

Activity

1. Make complete working drawings of items related to the industrial arts shop by measuring and dimensioning models and samples.
2. Draw various objects found in the home and the school as mechanical drawings and freehand shop sketches.
3. Plan and design a shop project by making sketches and mechanical drawings for use in the shop.

Class Discussion

1. Show the class a project from each of several industrial arts areas. What procedues were followed in the original design and development of this project?
2. Which comes first, the project or the plan? Why?
3. What is required to develop a suitable working plan for a project in the woodworking shop? In the graphic arts shop?
4. How would you go about planning and designing a serving tray made of wood and ceramic tile? How would you visualize the finished project.
5. What type of drawing would be most suitable for making templates and patterns for this project?
6. What type of drawing would you make to show an inexperienced student what the completed project would look like?
7. What does automation have to do with drawings? What additional requirements must the draftsman consider in industry?

Teacher Demonstrations

1. Show the procedures necessary to make a finished drawing from the completed project.
2. Make a working orthographic sketch and an isometric drawing of a single object, developing an idea into a useful plan of a completed project.
3. List the procedures for developing an idea into a finished product.

Assignments

1. Make an orthographic working drawing and an isometric sketch of the objects shown at the right.
2. Select a project or a tool found in the shop, and make a suitable working drawing and isometric drawing of the item.

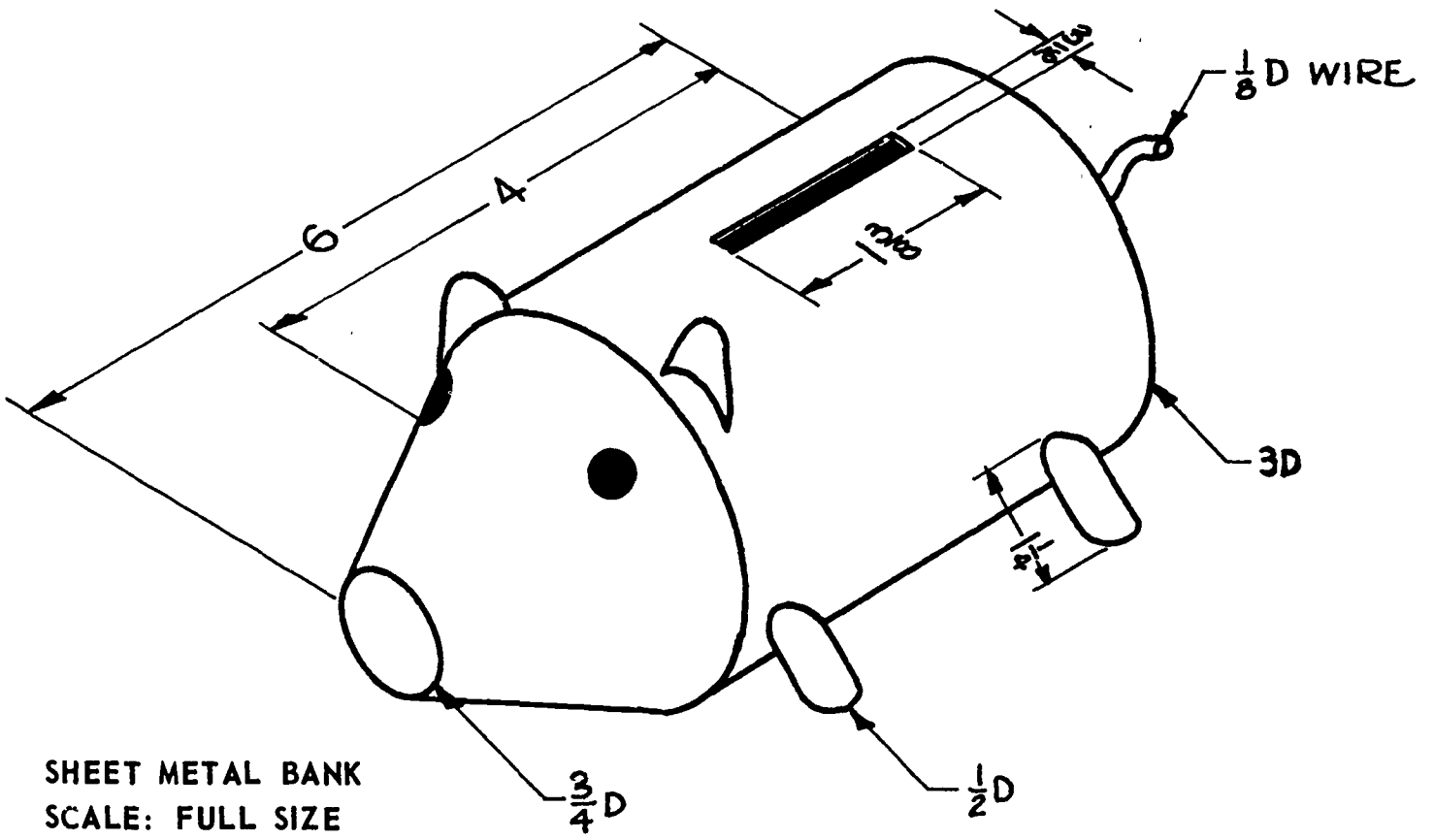
Homework

1. Design a project which could be used in your home, and make a sketch of this item. The sketch may be orthographic or isometric.
2. Make a working plan for production of this object.

SHOP DRAWING

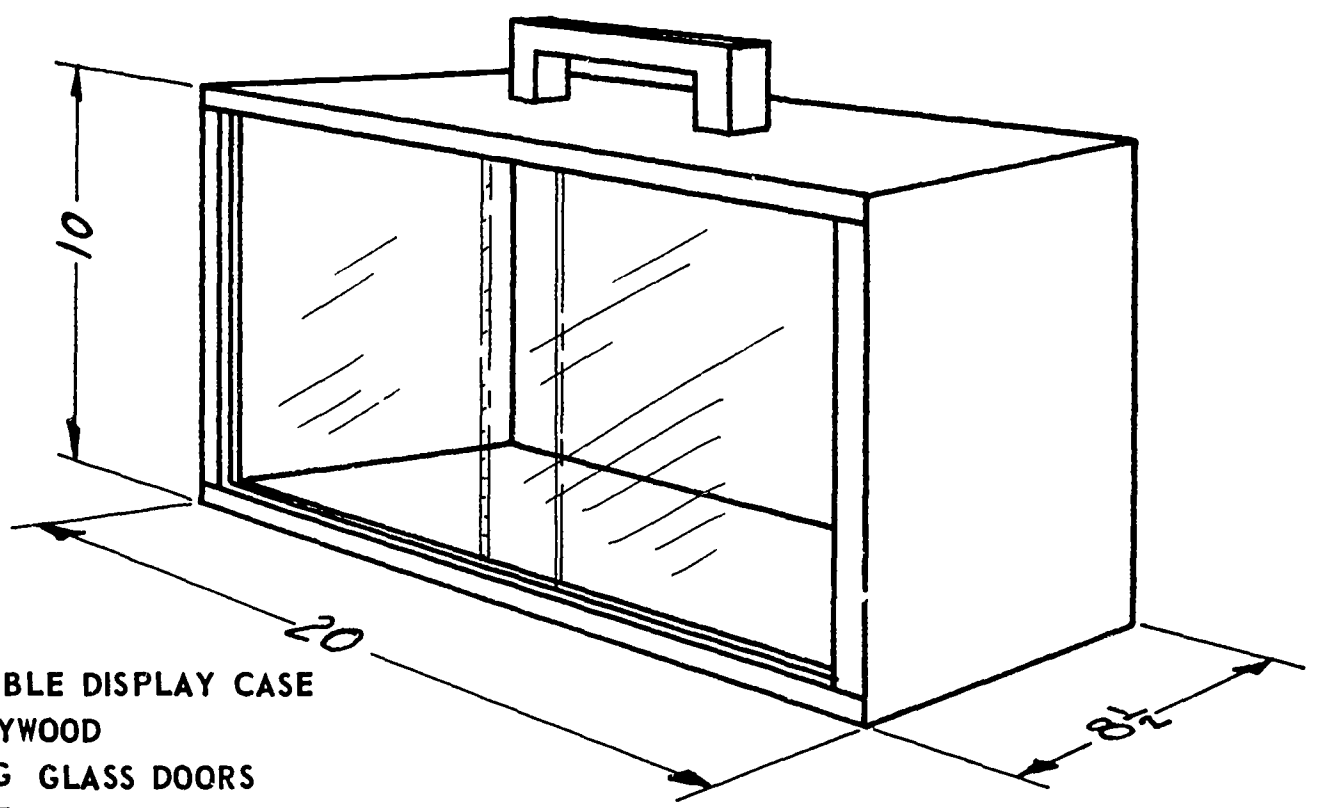
PLATE NO. 18

A



SHEET METAL BANK
SCALE: FULL SIZE

B



PORTABLE DISPLAY CASE
3/4 PLYWOOD
SLIDING GLASS DOORS
LUCITE HANDLE
SCALE: HALF-SIZE

TOPIC 19 AUXILIARY VIEWS

Aim

1. To teach how to develop auxiliary views
2. To make drawings of objects having slanted surfaces
3. To measure and dimension the auxiliary views

Activity

1. Make auxiliary views of objects with slanting surfaces.
2. Dimension auxiliary views.
3. Visualize the true shape of the auxiliary views of various objects.

Class Discussion

1. Most orthographic drawings require two or three views. When would an extra view be needed?
2. Why does the extra view have to be projected at right angles to the slanting surface?
3. How are the T-square and triangle used to project the auxiliary view?
4. When is a partial auxiliary view made on the drawing?
5. How is the paper arranged to provide room for the auxiliary view?

Teacher Demonstrations

1. Show the class several objects which have slanting surfaces. Items such as brackets, machine parts, clamps, plane handles, sharpening stones, and wrenches will require some auxiliary views.
2. Show how the slanted surfaces will not appear as a true shape on the orthographic drawing. Demonstrate how this surface must be viewed at right angles in order to see the true shape.
3. Demonstrate how to project at right angles using the T-square and triangle.
4. Using the overhead projector or chalkboard, demonstrate how to lay out and dimension the auxiliary view of the object.
5. Show various methods of rearranging the views on the drawing to provide room for the auxiliary view. Discuss the need for partial auxiliary views.

Assignments

1. Draw the required orthographic and auxiliary views of the objects on the assignment sheet.
2. Make a freehand sketch of a tool or machine part requiring an auxiliary view. Dimension the sketch.

Homework

1. Make a freehand sketch of a telephone showing the dial surface as the auxiliary view.
2. Make a mechanical drawing of a small object which requires an auxiliary view. Dimension the drawing completely.

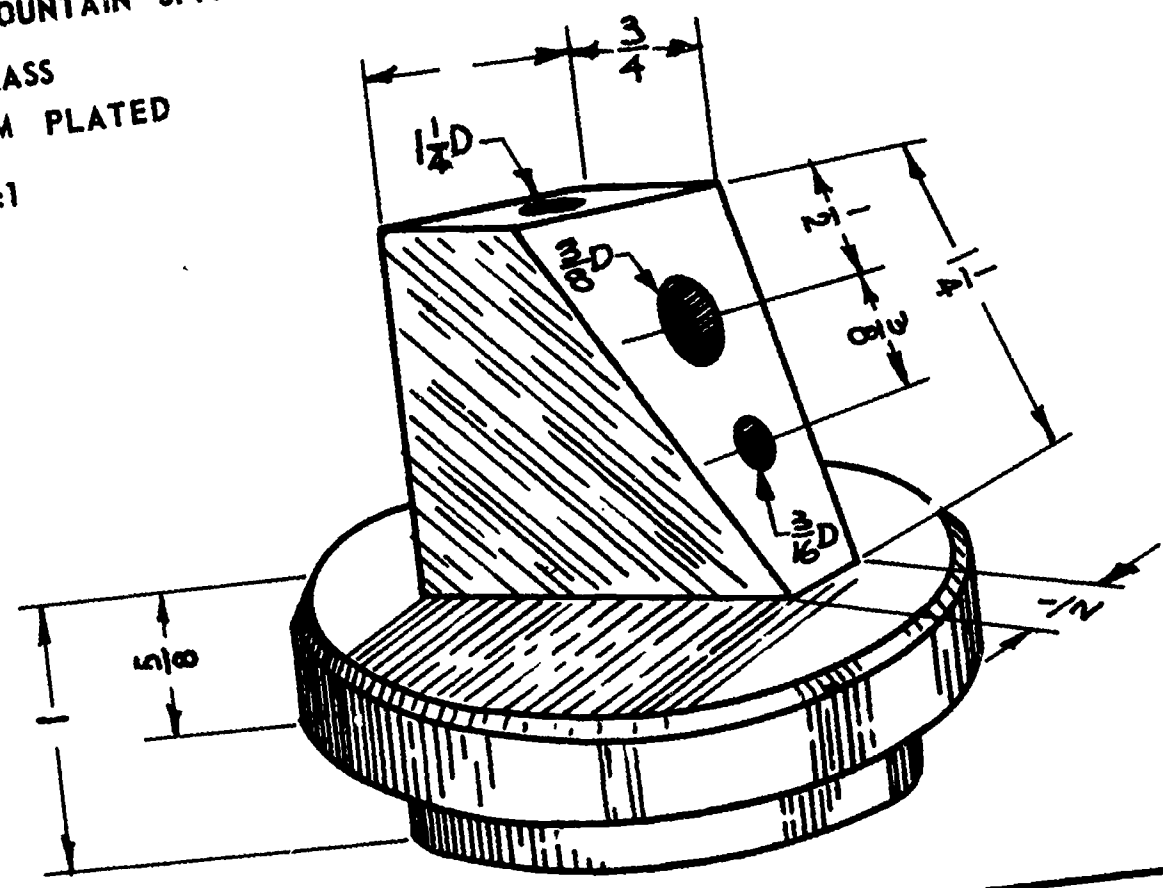
PLATE NO. 19

A

WATER FOUNTAIN SPIGOT

CAST BRASS
CHROMIUM PLATED

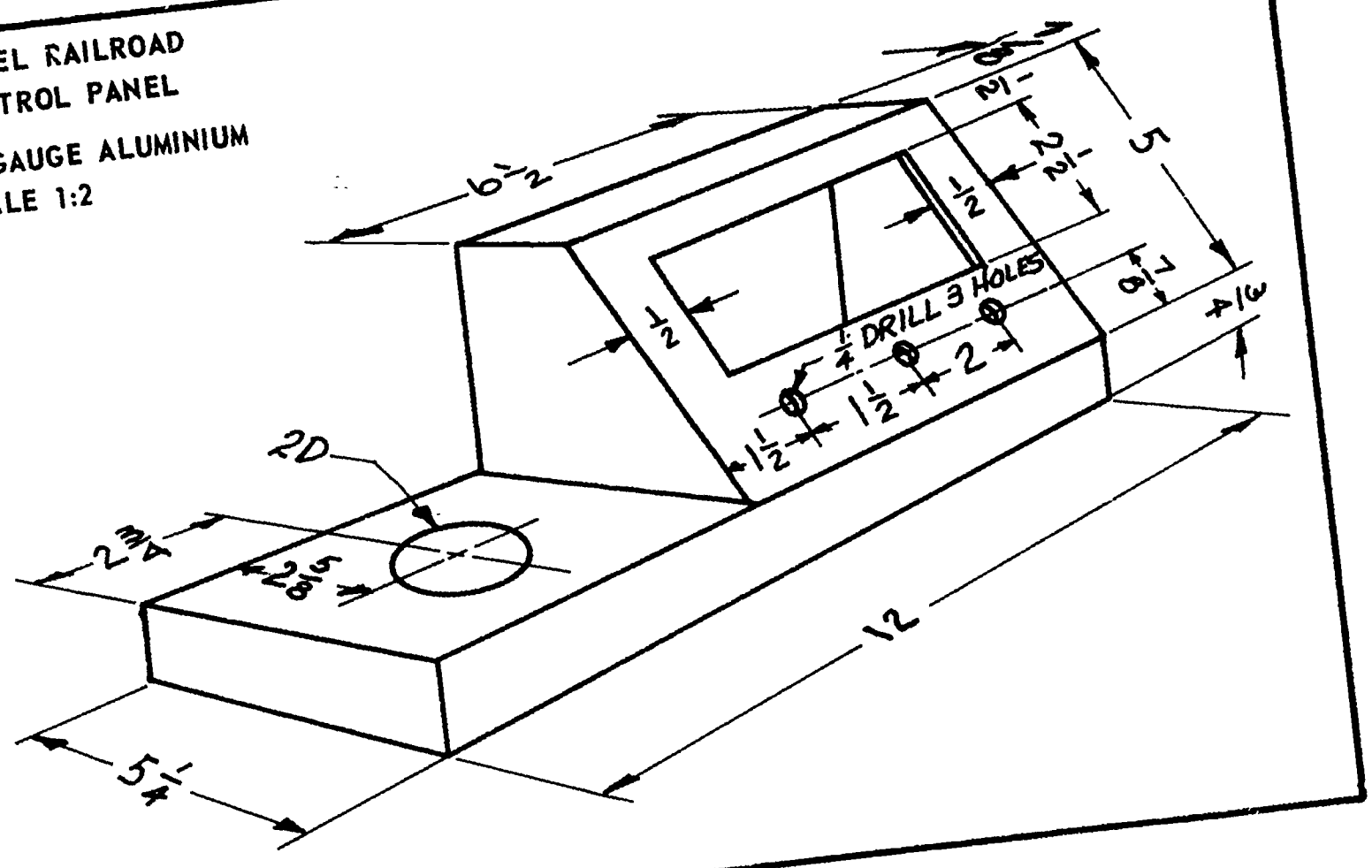
SCALE 1:1



B

MODEL RAILROAD
CONTROL PANEL

16 GAUGE ALUMINIUM
SCALE 1:2



TOPIC 20 SECTIONS

Aim

1. To teach how to visualize and interpret section drawings
2. To make drawings requiring simple sectional views
3. To provide opportunity for making sectional views of shop items

Activity

1. Determine the need for sectional views of various objects.
2. Make drawings of objects requiring full sections.
3. Use a section drawing to determine the final shape of an object. (A bowl turned on the lathe could require a section.)

Class Discussion

1. How is it possible to determine the inside shape of an object without cutting it apart?
2. What does the draftsman do to show the cross-section of an object?
3. What line indicates the theoretical surface to be cut? (the cutting-plane line.)
4. How is the direction of sight indicated on the cutting-plane line?
5. What is the purpose of cross-hatching or section-lining?
6. Some drawings do not require a full section. Mention other kinds of sections, but do not elaborate on them at this time.

Teacher Demonstrations

1. Use a three-dimensional model to show how a full-section appears on a drawing. Several wood blocks, loosely pinned, will serve to demonstrate the principle.
2. Show how the drawing is sectioned. Use the regular section-lining only.
3. Demonstrate how to locate and draw the cutting-plane line.
4. Discuss other kinds of sections, but do not teach these topics at this time. The overhead projector is useful for teaching the principles of sectioning, and commercially prepared slides such as the "DCA Drafting Series" illustrate the practices of section drawing.
5. Show how a section drawing is useful in the development of project designs. Apply these principles to various shop areas.

Assignments

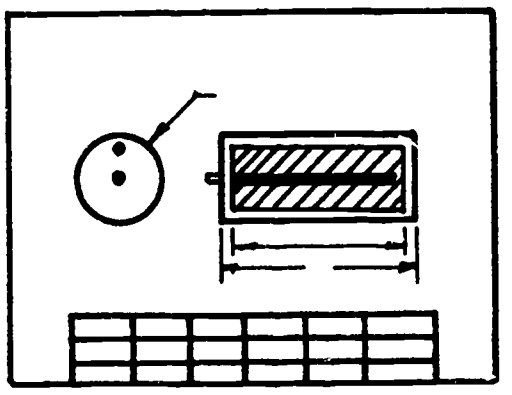
1. Make a section drawing of each of the objects shown at the right. All drawings should be fully dimensioned orthographic drawings.
2. Select a tool used in any shop, and make an orthographic working sketch and necessary sectional views of the tool.

Homework

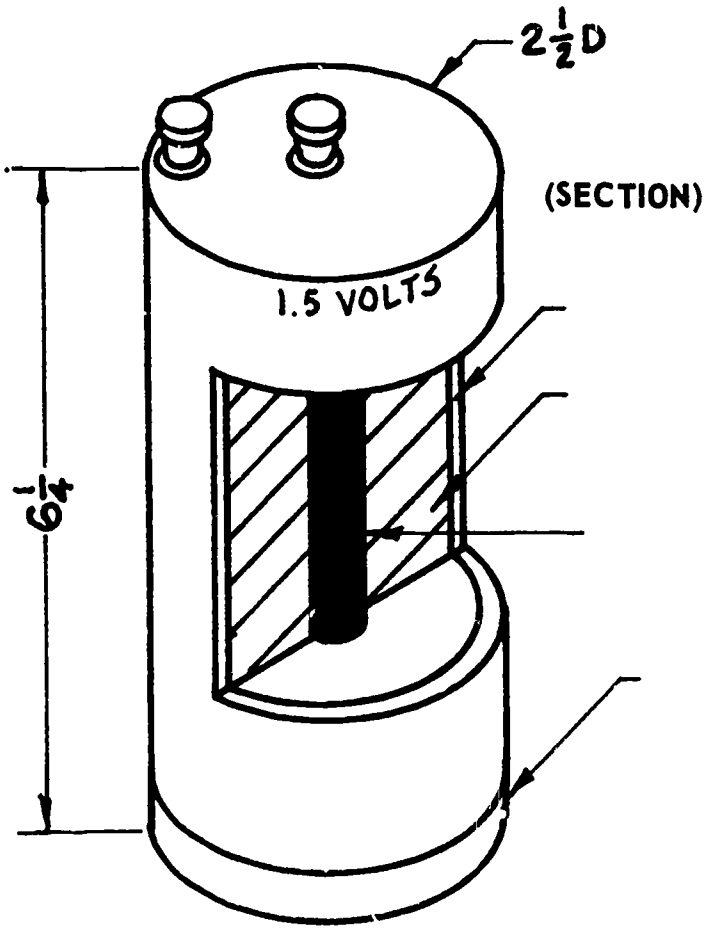
1. Make a shop sketch of a kitchen utensil, such as a spatula or ladle, showing a sectional view of the handle.
2. Draw all necessary views and a full-section of a lead pencil or ball point pen case. Dimension all necessary views.

PLATE NO. 20

A

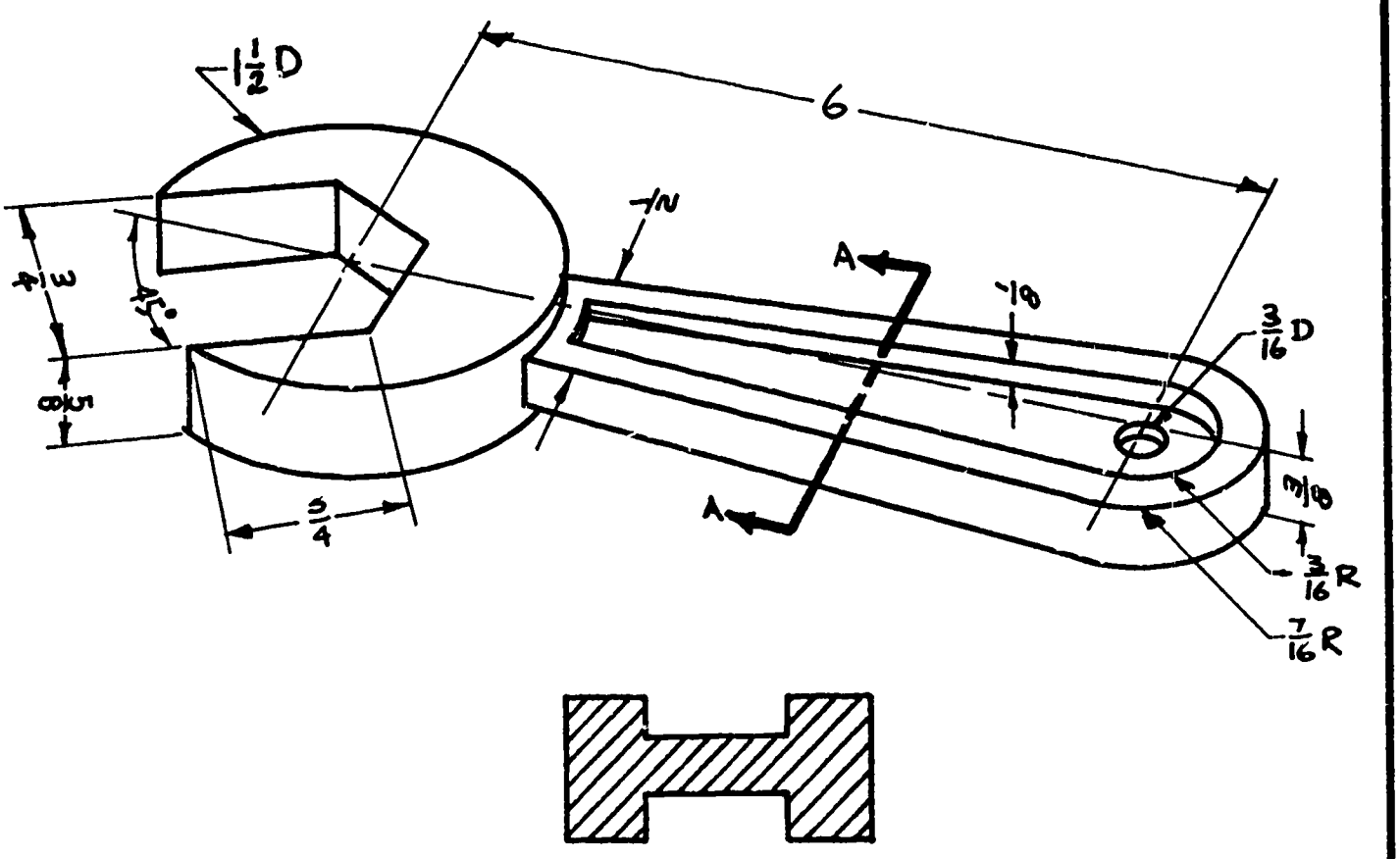


LABEL PARTS &
LIST MATERIALS



DRY CELL
SCALE: FULL SIZE

B

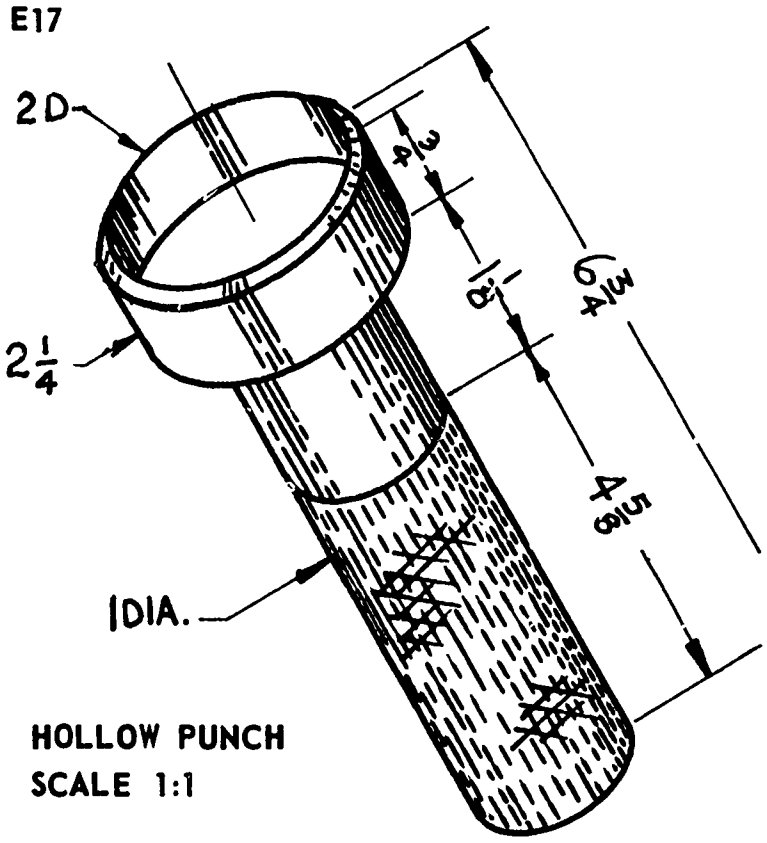


SECTION A-A

WRENCH
SCALE: FULL SIZE

EXTRA CREDIT

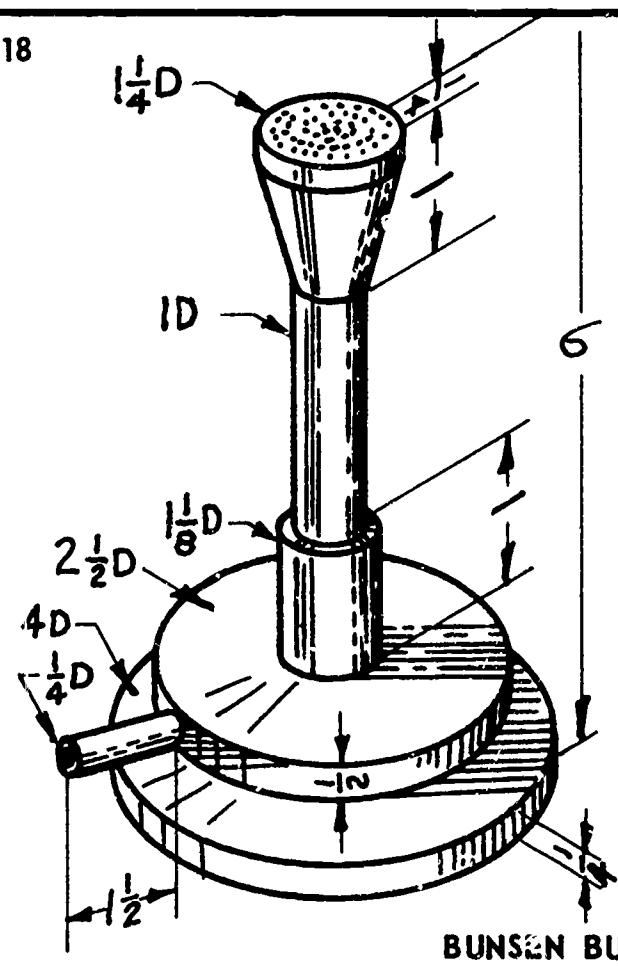
E17



HOLLOW PUNCH
SCALE 1:1

MAKE A WORKING DRAWING

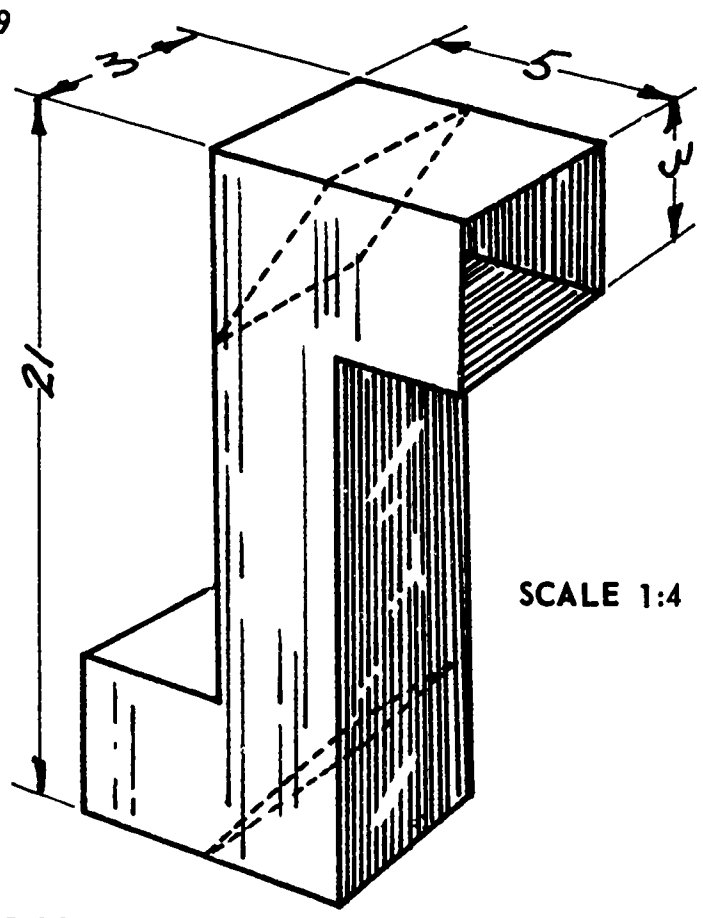
E18



BUNSEN BURNER
SCALE 1:2

MAKE AN ISOMETRIC DRAWING

E19

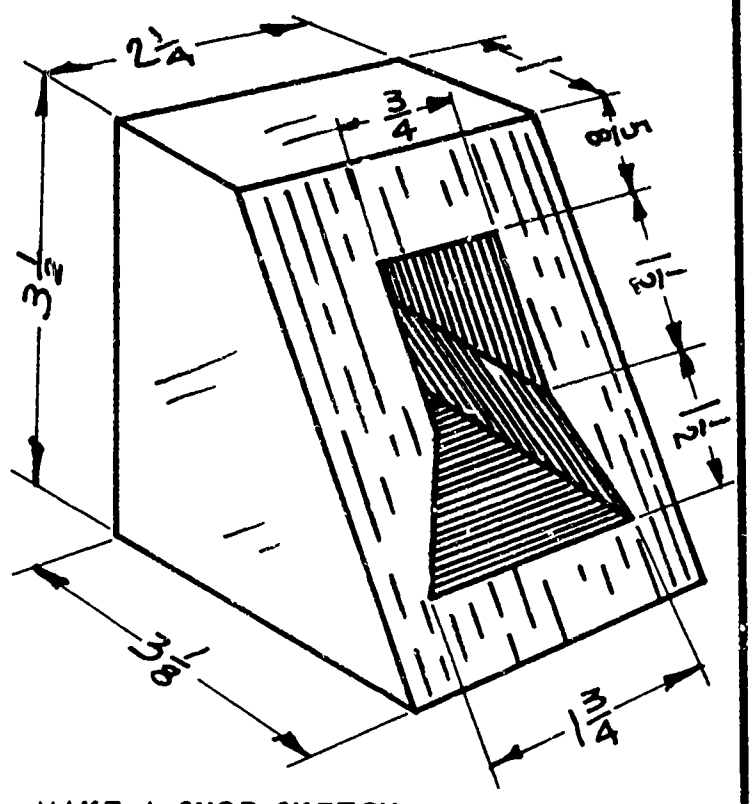


SCALE 1:4

PERISCOPE
MAKE A WORKING DRAWING &
FULL SIZE MODEL

BOOK END, TEAK
SCALE 1:2

E20

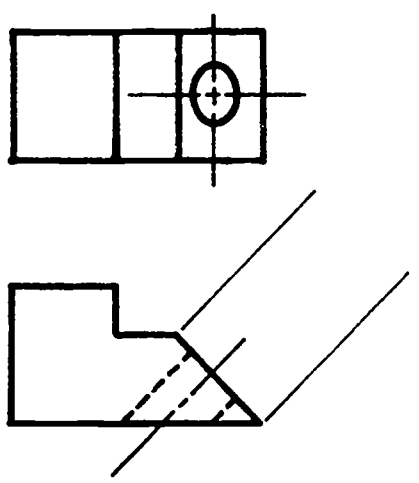


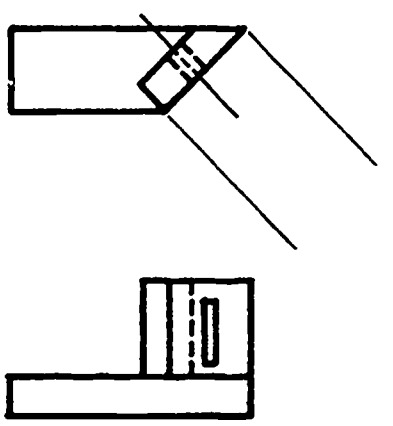
MAKE A SHOP SKETCH
AND AUXILIARY VIEW

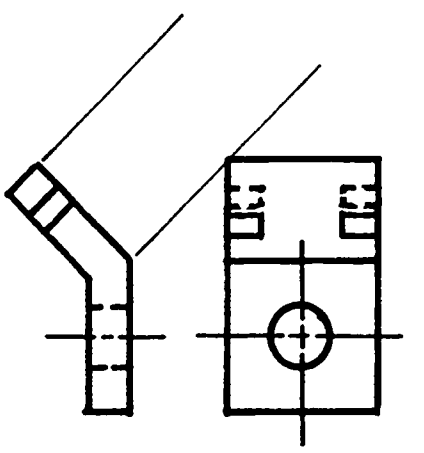
TEST NO. 5

FASTEN THIS TEST TO YOUR DRAWING BOARD, USING THE T- SQUARE TO ALIGN YOUR PAPER DO ALL WORK ON THIS PAPER

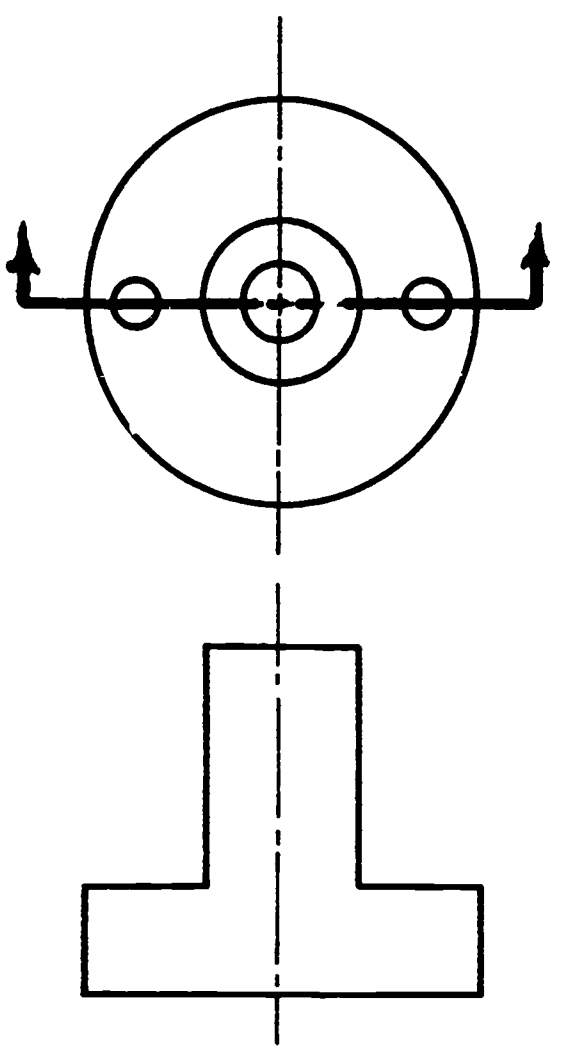
DRAW THE AUXILIARY VIEW OF EACH OF THE FOLLOWING.

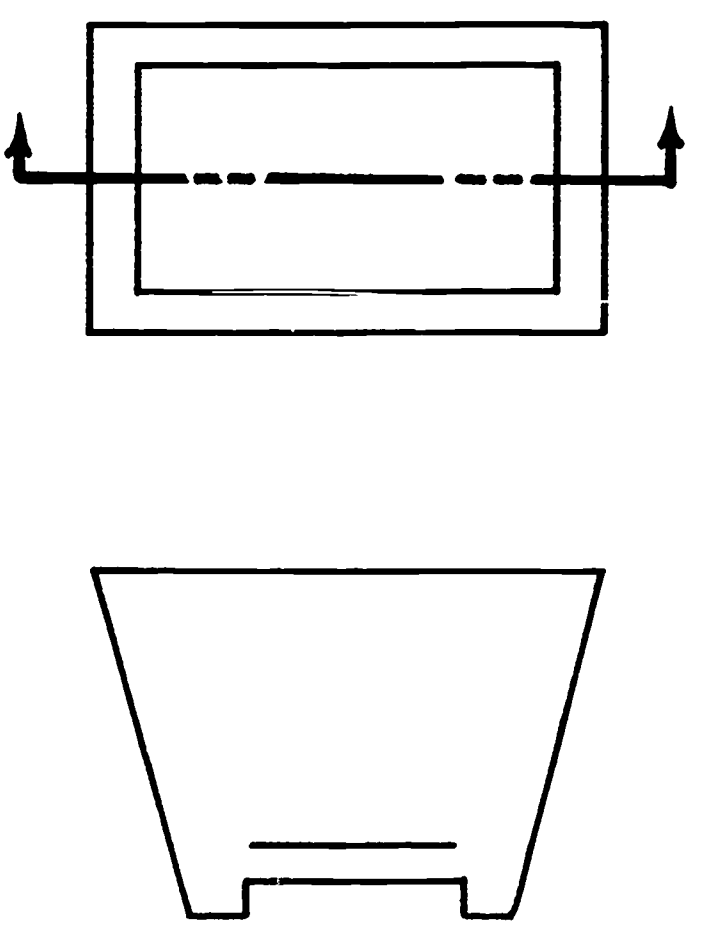






COMPLETE THE FOLLOWING BY MAKING A FULL SECTION





NAME _____ CLASS _____ DATE _____

TOPIC 21 SURFACE DEVELOPMENT

Aim

1. To teach how to make surface developments and patterns
2. To make drawings of simple parallel line development problems
3. To make drawings of simple radial line development problems

Activity

1. Make drawings of objects requiring parallel line development.
2. Make drawings of objects requiring radial line development.
3. Examine sheet metal and cardboard patterns of common objects.

Class Discussion

1. Show the class a cracker box. Have a pupil make an orthographic drawing of the box on the chalkboard.
2. How would the manufacturer of this box produce the dies which are used to make the flat pattern for this box? How would the shape of the dies be determined?
3. Show the class a conical object such as a funnel or a paper cone. How is the pattern for this object developed?
4. How is the pattern for a tin can measured and developed?
5. What other objects, using these principles of surface development, can be made?

Teacher Demonstrations

1. Have several cardboard models of blocks, boxes, and cylindrical objects.
2. Discuss the principles of parallel line development by unfolding the object and drawing each surface on the board.
3. Demonstrate the technique of parallel line development of a box.
4. Show the class how to develop a cylindrical object.
5. Discuss the radial line principle, and show how to make the development of a cone.
6. Mention other development techniques for items such as transition pieces, intersections, and truncations. Show various objects utilizing these principles, but do not go into detail at this time.

Assignments

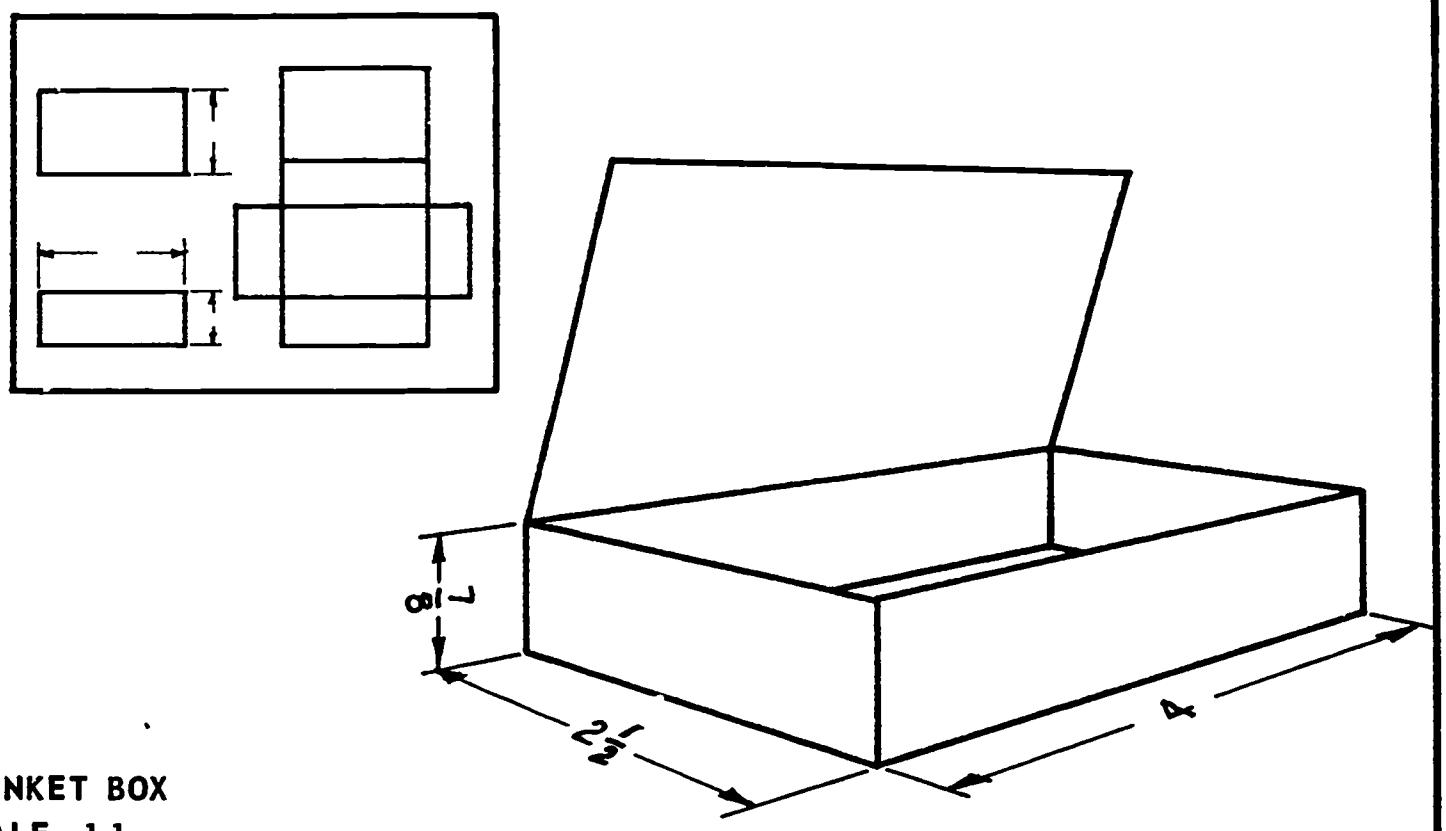
1. Make an orthographic drawing and development of the sheetmetal box shown at the right. Dimension the orthographic drawing only.
2. Make an orthographic drawing and development of the cardboard cone in the assignment sheet.

Homework

1. Select a cooky box or other folded cardboard container, and make an orthographic drawing and development of the box.
2. Make a radial line development of a tin funnel which might be made in the metalworking shop.

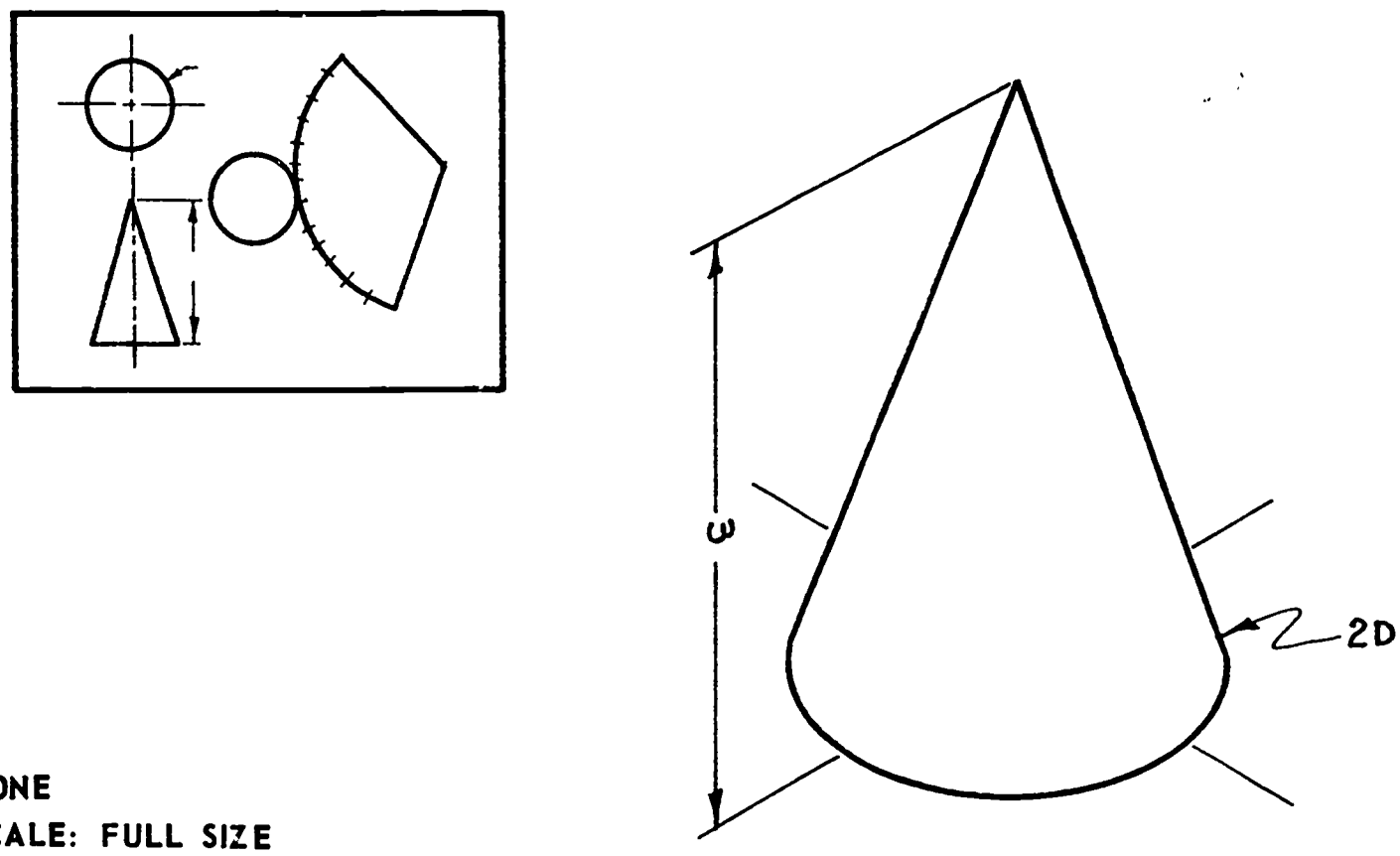
PLATE NO. 21

A



TRINKET BOX
SCALE: 1:1

B



CONE
SCALE: FULL SIZE

TOPIC 22 ARCHITECTURAL DRAWING

Aim

1. To teach how to draw the floor plan and elevations of a simple building
2. To teach some of the important symbols used in architectural drafting
3. To provide opportunity to examine drawings and prints of a variety of buildings and floor plans and to learn about the history of architectural styles

Activity

1. Make floor plans and elevations of simple buildings.
2. Utilize the various architectural symbols in making the drawings.

Class Discussion

1. Show the class blueprints and plans of various kinds of commericial and residential construction.
2. Distribute prints among the students and discuss the architectural symbols used for doors windows, chimneys, plumbing fixtures, etc.
3. Discuss the architectural method of dimensioning and indicating measurement.
4. Show the relationship between the floor plan and the front elevation.
5. How does the architect show the final appearance of the building? What kind of drawing is made to enable the client to visualize the building?
6. What are the relationships of the measurements of doors, walls, and windows to the sizes of construction lumber? Discuss scale measurement.

Teacher Demonstrations

1. Demonstration how the floor plan of a small building such as a garage or summer bungalow is developed. Calculate the available square foot space.
2. Show how the architect draws the dimensions for a building.
3. Illustrate the relationship of the elevations to the floor plan.
4. Show how to make a sketch of a floor plan. Discuss the sizes and proportion of rooms, doors, windows, etc.
5. Use a three-dimensional model made to 1/4" or 1/8" scale. Show how the plans and prints relate to the model. (Models can be constructed of illustration board, or scale model kits can be purchased from most shops that carry model railroad supplies.)

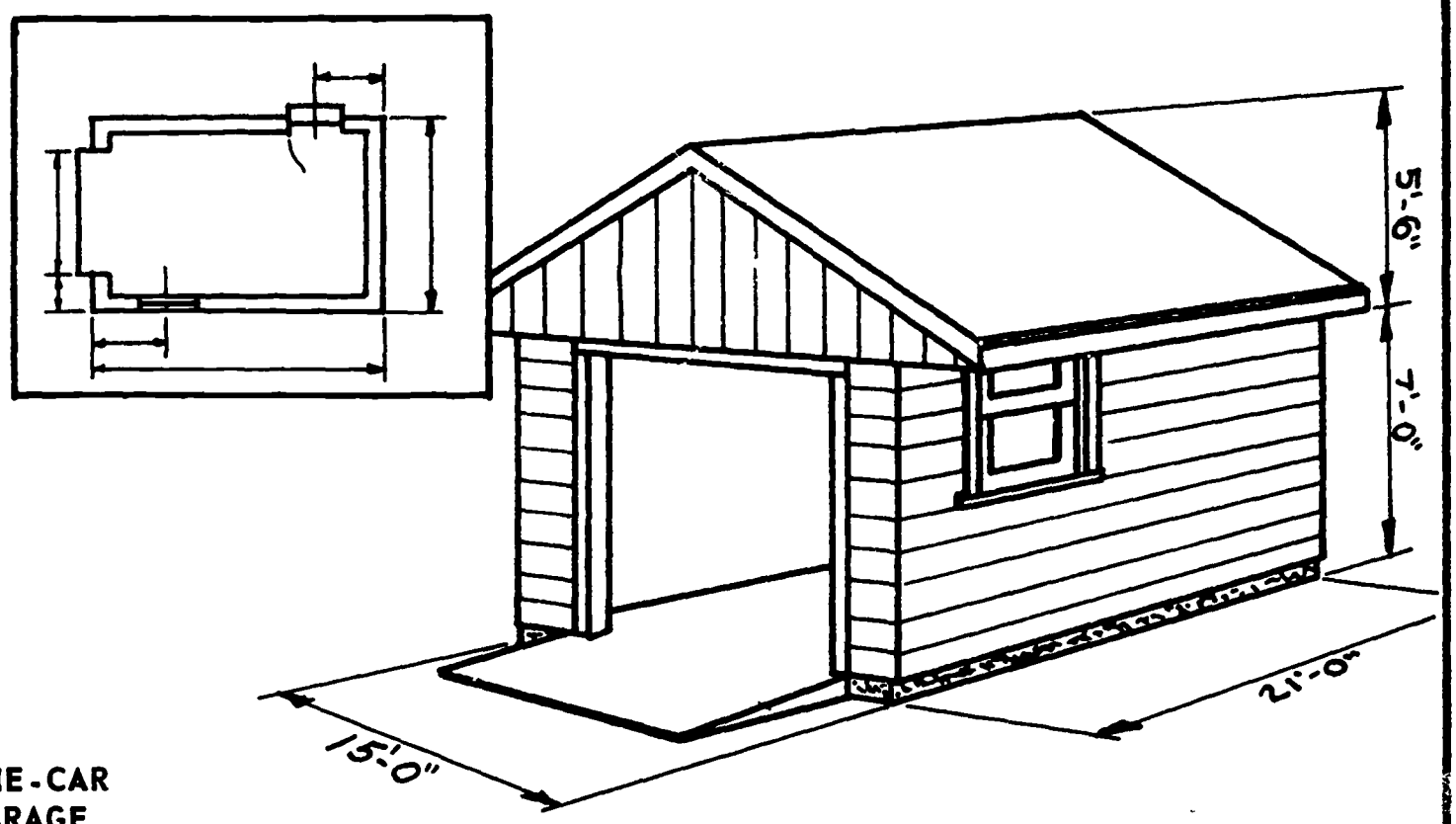
Assignments

1. Make a floor plan of the sketch of the building shown at the right. Use the proper architectural dimensioning system, and draw the proper symbols for the various parts of the building.
2. Make the front and side elevation of the building in the sketch. All drawings should be to the scale: 1/8" = 1'—0".

Homework

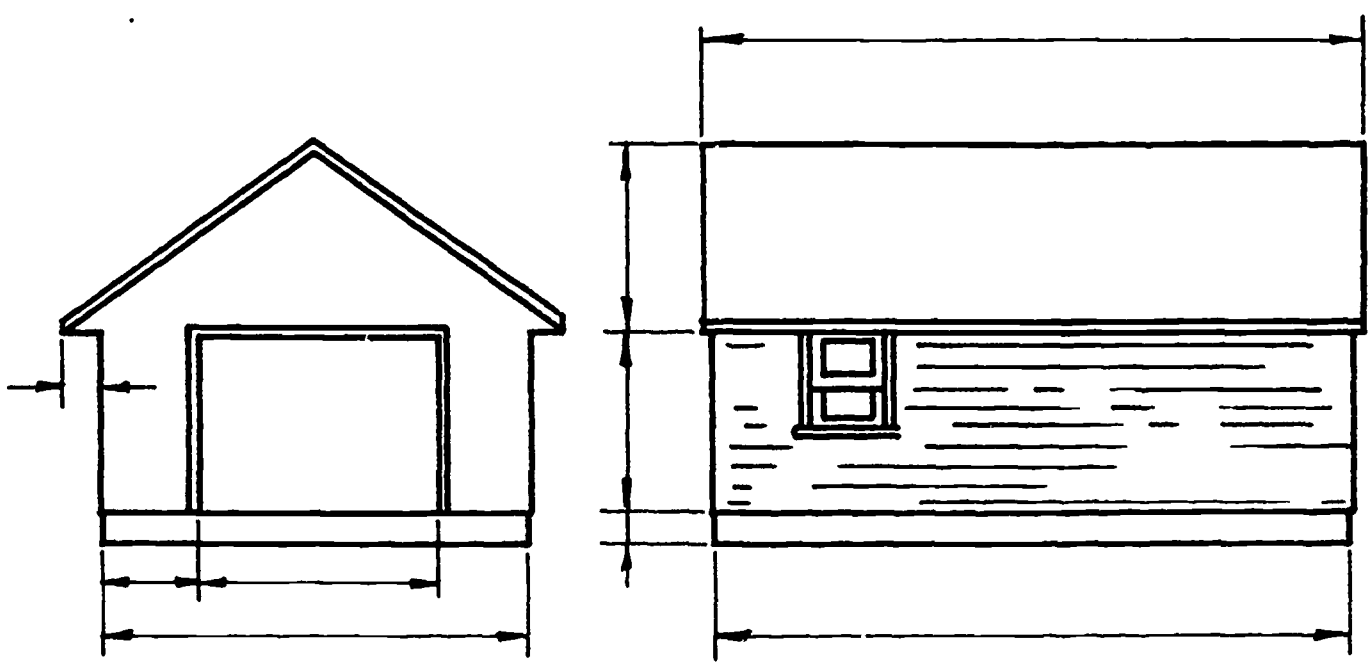
1. Make a floor plan of your house or apartment, indicating all the windows, doors, plumbing fixtures, etc. Draw the plan to scale: 1/4"= 1'—0".
2. Make a model of a house for an HO model railroad. The scale for this project is nominally 1/8".

PLATE NO. 22



ONE-CAR
GARAGE
SCALE: 1/8"=1'-0"

DRAW THE ELEVATIONS 1/4"=1'-0"



SCALE 1/8"=1'-0"

TOPIC 23 ELECTRICAL AND PLUMBING DRAWINGS

Aim

1. To teach how to draw the electrical and plumbing diagrams used in architectural drafting
2. To teach some of the important symbols used in these drawings
3. To learn the purpose of each of the fixtures and fittings
4. To teach how to draw diagrams for electronic equipment

Activity

1. Make drawings of architectural, electrical, and plumbing diagrams.
2. Make schematic drawings of simple electronic circuits.
3. Examine various fittings and electronic units to establish relationships between the objects and the drafting symbols.

Class Discussion

1. Distribute the house prints to the members of the class. Discuss the symbols used for the electrical and plumbing diagrams. What is the building code of NYC?
2. Show the class some of the parts and fixtures represented by the symbols. Items such as switches, unions, receptacles, elbows, soil lines, etc., will help the pupils to visualize the objects from the diagram.
3. Discuss the various symbols used for radios, television, and other electronic equipment.
4. How does the contractor determine the cost of installing wiring or plumbing in the house? What is the purpose of the architect's drawing?
5. What is the value of the schematic diagram found in the television repairman's manual? How does he read it?

Teacher Demonstrations

1. Show the class the relationship between the architect's symbols and the actual fittings and parts used in electrical and plumbing work.
2. Show how to make the schematic drawings of various electrical circuits.
3. Draw the necessary electrical and plumbing diagrams used for the problem in the previous lesson.
4. Discuss the electrical symbols used for electrical diagrams.

Assignments

1. Make a drawing of the electrical system and the plumbing schematic of the house or garage drawn in lesson 22.
2. Make a schematic drawing of the simple radio shown in the picture at the right.

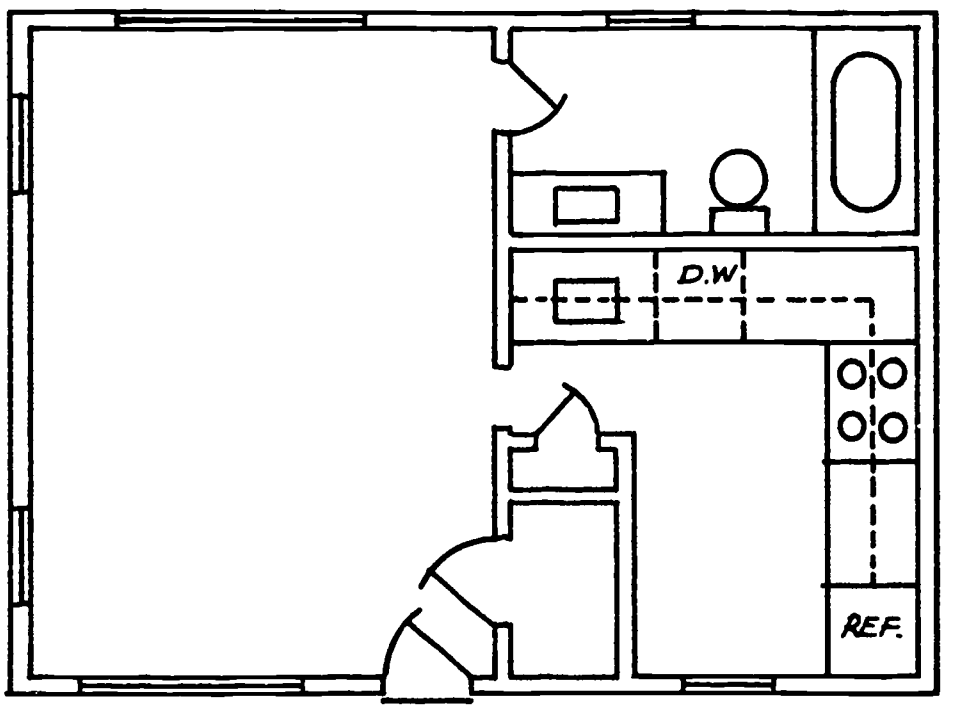
Homework

1. Draw the electric schematic of your house or apartment. Be sure to indicate the fuse box and electrical source.
2. Draw the plumbing schematic of your house or apartment.

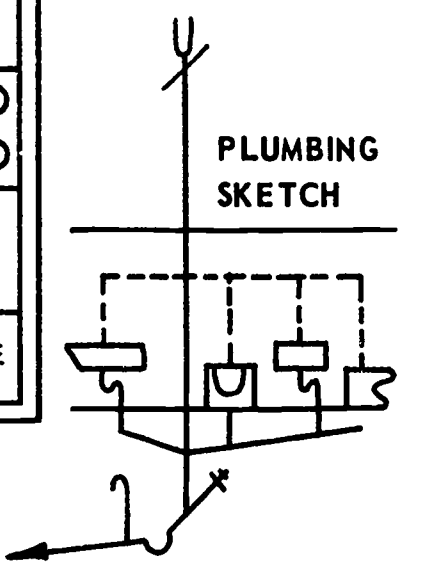
ELECTRICAL DRAWING

PLATE NO. 23

A

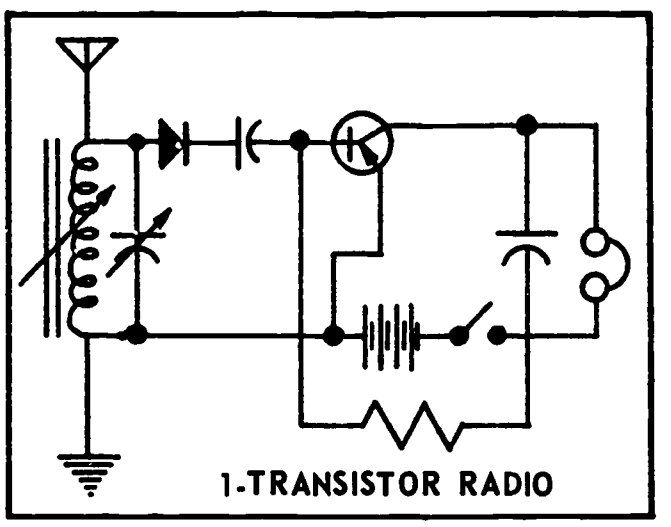


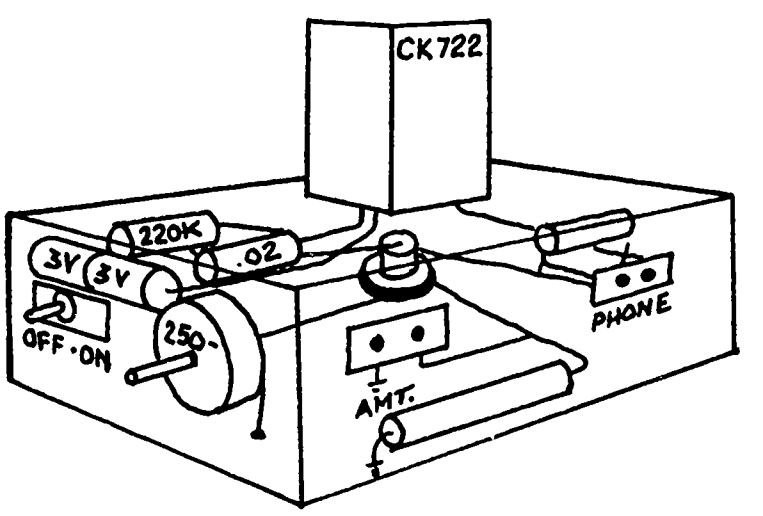
CEIL. FIX.
WALL OUT.
S SWITCH
APPLIANCE
RANGE
CLOCK
FAN



B

ONE-TRANSISTOR RADIO
SCHEMATIC & SKETCH





COMPLETE A SCHEMATIC DRAWING
OF AN ELECTRONIC DEVICE

TOPIC 24 INDIVIDUAL PROBLEMS

Aim

1. To provide opportunity to select, design, and draw individual projects
2. To make drawings of objects found in the home, school, and community
3. To do individual research in the various drafting and related fields

Activity

1. Make drawings of selected projects, items of furniture, electronic diagrams, and shop problems.
2. Make models of objects for which drawings have been made, or are available.
3. Read prints and diagrams of various objects.

Class Discussion

1. What is the place of the draftsman in industry?
2. Of what value is the ability to make and read drawings to the man in industry? In science? In technology?
3. What procedures are to be followed in order to make a working drawing of a shop product? What constitutes good project design?
4. What additional courses are available to the student who is interested in developing his drawing skills?
5. How are drawings duplicated and reproduced?

Teacher Demonstrations

1. Discuss the procedures for making a complete drawing from the object.
2. Show how the model is developed from the plans.
3. Indicate the employment and educational possibilities in the related drafting fields.
4. Discuss items such as inking, print reproduction, specifications.

Assignments

1. Make a complete drawing of one of the objects shown on the following page. Develop your own dimensions and specifications for the problem.
2. Make a drawing of a shop project.
3. Make an electrical wiring diagram of a piece of electronic equipment.

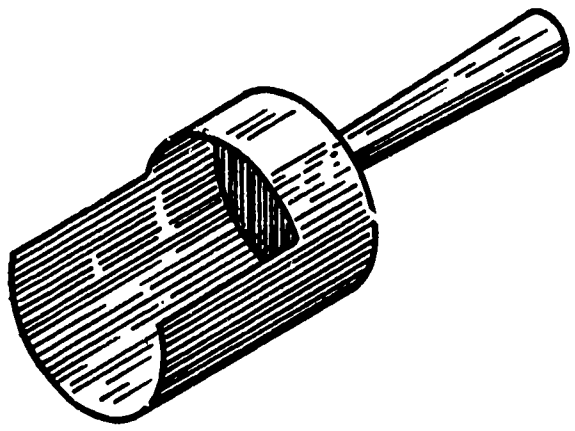
Homework

1. Make a working drawing of a piece of furniture in your home. Scale the drawing properly, and indicate all necessary notes and dimensions.
2. Develop a research folder for a related subject problem. Include all drawings, materials bills, bibliography, and other pertinent materials.
3. What should the consumer know about materials and construction?

INDIVIDUAL PROBLEMS

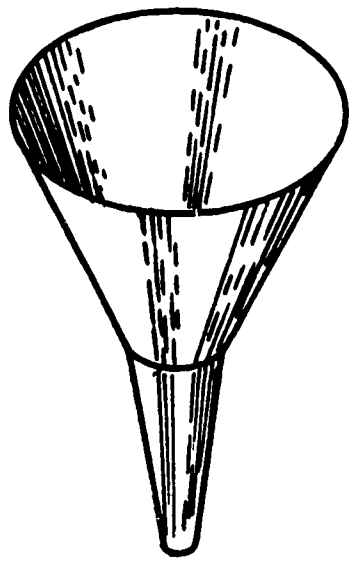
PLATE NO. 24

A



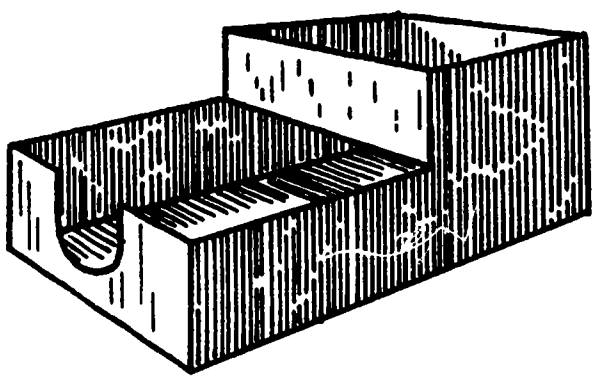
SCOOP DEVELOPMENT & MODEL

B



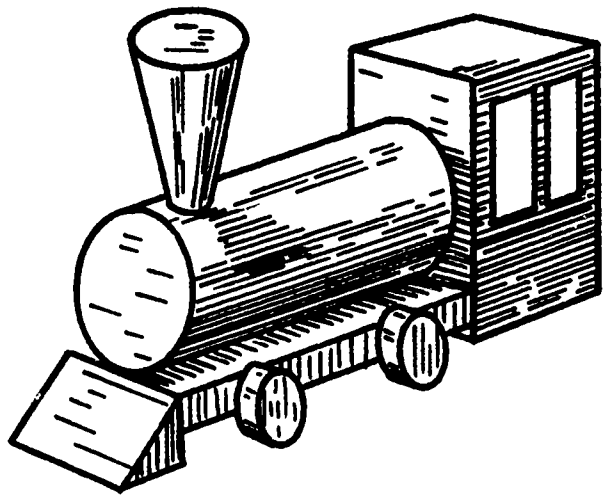
FUNNEL RADIAL LINE DEVELOPMENT

C



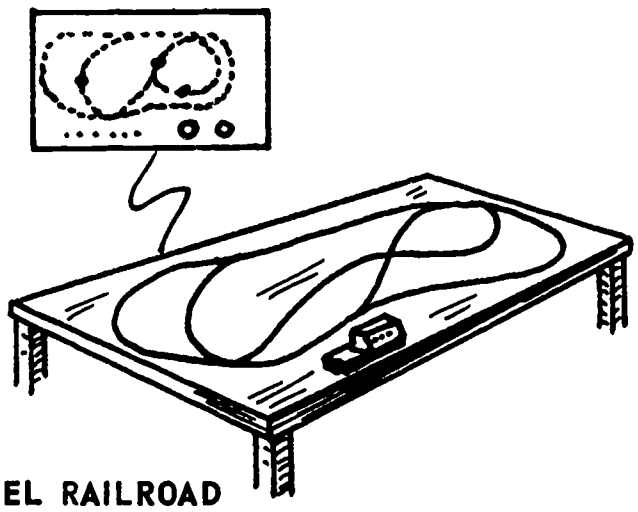
DESK TRAY WORKING DRAWING

D



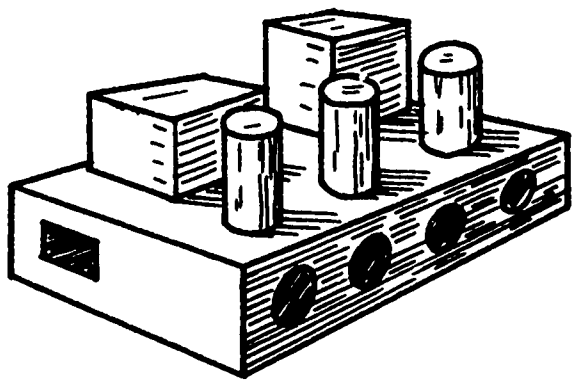
ENGINE DEVELOPMENT & MODEL

E



MODEL RAILROAD
SCHEMATIC WIRING DIAGRAM

F

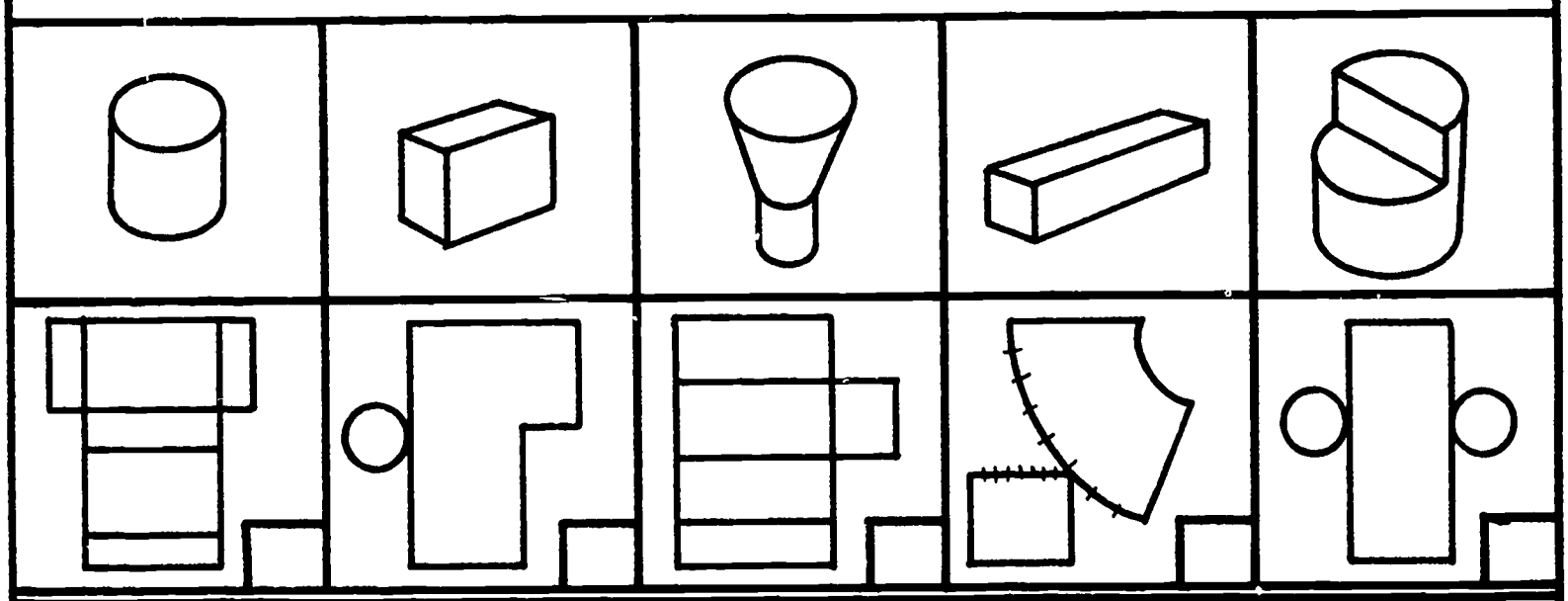


HI-FI AMPLIFIER
SCHEMATIC

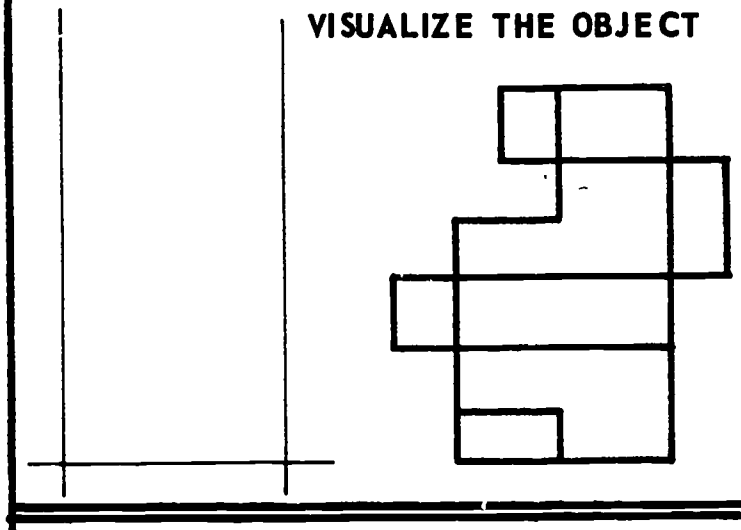
TEST NO. 6

FASTEN THIS TEST TO YOUR DRAWING BOARD, USING THE T-SQUARE TO ALIGN YOUR PAPER.

MATCH THE SKETCH AND DEVELOPMENT PLACE THE NUMBER IN THE BOX.

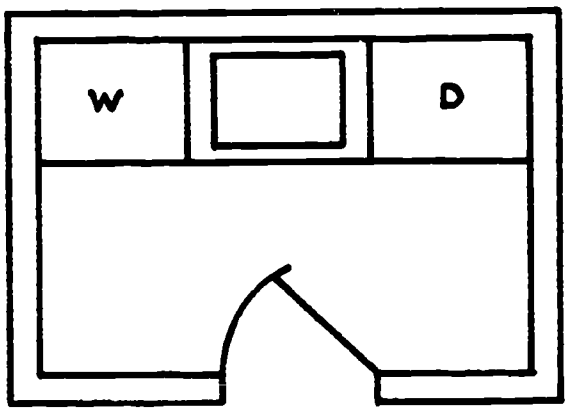


DRAW THE FRONT AND TOP ORTHOGRAPHIC VIEWS USING THE DEVELOPMENT TO VISUALIZE THE OBJECT



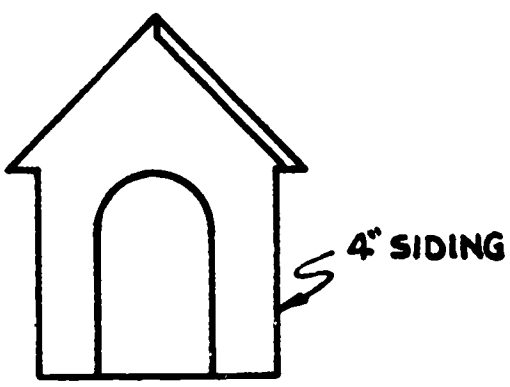
DRAW THE SYMBOLS INDICATED ON THE LAUNDRY ROOM PLAN:

1. Light Switch
2. Ceiling Light
3. Window
4. Appliance Outlet



COMPLETE THE DRAWING BELOW BY FILLING IN MISSING LINES AND DIMENSIONING

SCALE 1/4"=1'-0"



NAME _____ CLASS _____ DATE _____

SELECTED BIBLIOGRAPHY

The following books will provide technical drafting information for both the teacher and the student. The teacher is urged to acquire a library of these and related publications for both reference and research information. Those books which are starred will be useful as class textbooks and may be ordered as sets through the school principal under the regular textbook allotment.

* Almon, Joseph J. VISUALIZED BASIC MECHANICAL DRAWING. Milwaukee: Bruce Publishing Co., 1961

* Almon, Joseph J. VISUALIZED BASIC SHEET METAL DRAWING. Milwaukee: Bruce Publishing Co., 1962

Berg, Edward MECHANICAL DRAWING I AND II, 4th ED. REVISED. Milwaukee: Bruce Publishing Co., 1958

* Coover, Shriver L. INDUSTRIAL ARTS DRAWING AND BLUEPRINT READING. New York: McGraw-Hill Book Co., 1961

* Feirer, John L. DRAWING AND PLANNING FOR INDUSTRIAL ARTS. Peoria: Chas. A. Bennett Co., Inc., 1956

French, Thomas E. and Svensen, Carl L. MECHANICAL DRAWING, 6th ED. New York: McGraw-Hill Book Co., 1962

Giachino, Joseph W. and Buekema, Henry J. AMERICAN TECHNICAL SOCIETY'S DRAFTING, 2nd ED. Chicago: American Technical Society, 1961

Rotmans, Elmer A. DRAFTING SIMPLIFIED Albany: Delmar Publishing Co., 1959

* Zipprich, Anthony E. FREEHAND DRAFTING FOR TECHNICAL SKETCHING. Princeton: D. Van Nostrand Co., Inc., 1954

Additional textbooks and reference books will be found in the current editions of the "List of Textbooks for the Day and Evening Elementary and Junior High Schools" and the "List of Textbooks for the Day and Evening High Schools." Books are listed under the categories of both Mechanical Drawing and Industrial Arts.

In addition to the above-mentioned material, the teacher is urged to secure a set of "Drafting Standards" from the American Standards Association, 10 East 40th Street, New York City. Write to the Association for a listing of current standards, prices, and availability.

N-X
VT

FROM:

E[illegible]LITY

[illegible]301

1735 [illegible]E ST[illegible], N. W.

WASHINGTON, D. C. 20006

VT 003 726
Basic Machine Shop Training Course, Test Sheets. Unit V--Milling Machine.

Louisiana Vocational Curriculum Development and Research Center, Natchitoches
MF AVAILABLE IN VT-ERIC SET.
Vocational Curriculum Development and Research Center, P.O. Box 657, Natchitoches, Louisiana 71457.
PUB DATE - 67 16p.

DESCRIPTORS - *TESTS; *TRADE AND INDUSTRIAL EDUCATION; *MACHINISTS; *MACHINE TOOL OPERATORS; *MACHINE TOOLS; METAL WORKING OCCUPATIONS; POST SECONDARY EDUCATION; UNITS OF STUDY (SUBJECT FIELDS)

ABSTRACT - Part of a five-unit machinist training series, this test booklet is for use with the answer book available as VT 003 735 (also in this issue) and the related study guide, VT 003 727 (AIM Summer 1968). Other documents in the series are VT 003 728, VT 003 730, VT 003 732, and VT 003 733 (all appearing in this issue), and VT 003 729, VT 003 731, VT 003 734, and VT 003 736 (all in AIM Summer 1968). (AW)

VT 003 726

ED0 45856

STATE VOCATIONAL-TECHNICAL & TRADE SCHOOLS of LOUISIANA

MACHINE SHOP TRAINING COURSE

TEST SHEETS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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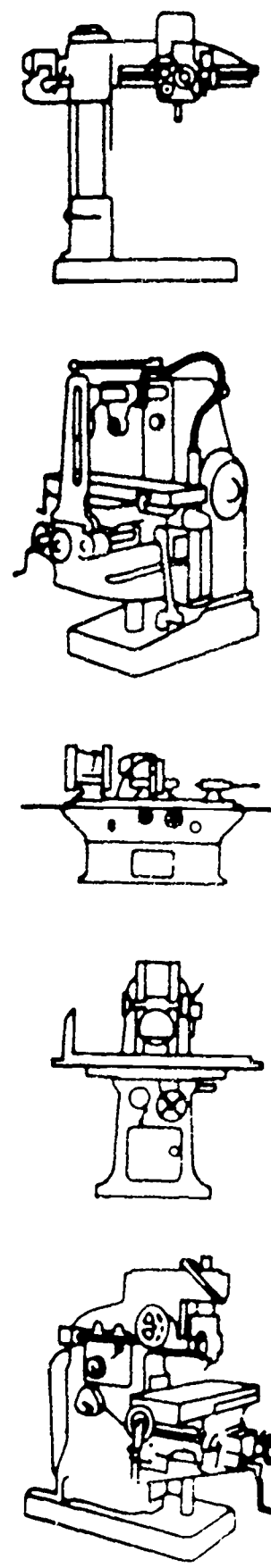

UNIT V

REVISED

BASIC MILLING MACHINE

1967

VT003726

BASIC MACHINE SHOP TRAINING COURSE

TEST SHEETS

UNIT V- MILLING MACHINE

Published by

STATE OF LOUISIANA
Vocational Curriculum Development and Research Center
NATCHITOCHES, LOUISIANA 71457

for the

State Vocational-Technical and Trade Schools of Louisiana

ERIC

M E M O R A N D U M

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Lloyd A. Ponder (Agency) Vocational Curriculum Development and Research Center

(Address) P. O. Box 657 Natchitoches, Louisiana, 71457

DATE: September 25, 1967

RE: (Author, Title, Publisher, Date) Research Center, BASIC MILLING MACHINE Vocational Curriculum Development and Research Center, 1967

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency Vocational Curriculum Development & Research Center
Address P. O. Box 657 Natchitoches, La. 71457
Limitation on Available Copies 1 Price/Unit $2.00
(quantity prices) No

(2) Means Used to Develop Material:
Development Group Committee of Trade School Instructors
Level of Group State
Method of Design, Testing, and Trial Experience of teachers. Some sections have been field tested on five schools.

(3) Utilization of Material:
Appropriate School Setting Area vocational-technical school
Type of Program Preparatory--preferably post secondary but not essential.
Occupational Focus Machine shop training
Geographic Adaptability No limitations
Uses of Material Student reading and using of job sheets.
Users of Material Student. Teacher may use as course of study.

(4) Requirements for Using Material:
Teacher Competency Must be qualified machine shop instructor
Student Selection Criteria male, with interest in machine shop training, age 16 or older, who plan to enter employment as beginning machinist.
Time Allotment 250 clock hours.

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe See attached page

Source (agency)
(address)

Required Textbooks

BOOK V

Unit V: Milling Machine

Title	Source
Burghardt, Axelrod and Anderson MACHINE TOOL OPERATION	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
MILLING MACHINE WORK	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
Ihne and Streeter MACHINE TRADES BLUEPRINT READING	American Technical Society 848 East Fifty-Eighth Street Chicago 37, Illinois
Olivo and Payne BASIC BLUEPRINT READING AND SKETCHING	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
Slade and Margolis MATHEMATICS FOR TECHNICAL AND VOCATIONAL SCHOOLS	John Wiley & Sons, Inc. 605 Third Avenue New York, New York
Oberg and Jones MACHINERY'S HANDBOOK	The Industrial Press 148 Lafayette Street New York 13, New York

Table Of Contents

TEST BOOK V

BASIC MACHINE SHOP TRAINING COURSE

Unit V - Milling Machine

R.S.A. 1 - Orientation . . . . . Test
R.S.A. 2 - Operation of the Milling Machine . Test
R.S.A. 3 - Work Holding Devices . . . . . Test
R.S.A. 4 - Mounting the Milling Cutter . . . . Test
R.S.A. 5 - Speeds and Feeds . . . . . Test
R.S.A. 6 - Straddle Milling . . . . . Test
R.S.A. 7 - Vertical Milling . . . . . Test
R.S.A. 8 - Milling Flat Surfaces . . . . . Test
R.S.A. 9 - Special Attachments . . . . . Test
R.S.A. 10 - The Index Head . . . . . Test

Machine Shop
Unit V
Milling Machine

R.S.A. 1

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. Give three ways for holding the milling cutter.
2. What other machine in the machine shop is comparable to the milling machine in adaptability?
3. Operation of the milling machine intelligently envelopes the knowledge of what? Name five things.
4. Name the two types of milling machines.
5. Give the type of milling machine used most in the manufacturing of duplicate parts.
6. What milling machine manufacturing company invented the first universal milling machine?
7. What is the most important attachment for the milling machine?
8. What attachment would be used for cutting keyseats on a milling machine?
9. Is the rack milling attachment mounted vertical or parallel to the T-slot of the table?

Machine Shop
Unit V
Milling Machine

R.S.A. 2

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. Of what purpose is the clutch on a milling machine?
2. Why should the spindle hole be cleaned before using on a milling machine?
3. Why are clamps provided for locking the table, knee, and saddle on the milling machine?
4. What are the three directions of movement of the milling machine table?
5. The number of graduations on the vertical feed handle collar is directly related to what?
6. What is meant by the term "backlash"?
7. Give two ways to eliminate backlash.
8. Do all makes of milling machines have dual control levers?

Machine Shop
Unit V
Milling Machine

R.S.A. 3

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. What is the most commonly used means of holding the milling cutter?

2. What is the taper per foot on the new type milling machine arbor?

3. Of what value are the T-slots in the milling machine table?

4. How do you adjust the table for depth of cut?

5. In clamping the work on the milling machine table, should the work or should the step block be closer to the T-bolt?

Machine Shop
Unit V
Milling Machine

R.S.A. 4

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. Name five holding devices used on the milling machine.

2. In face-milling cutters, why are two slots machined in the bore of the cutter?

3. What is the purpose of the keyway cut the whole length of the straight part of the arbor?

4. Do shell-mill arbors have more than one type taper? If so, name them.

5. What is the purpose of the collets or sleeves?

6. What is an adapter?

7. Name four types of clamps used in milling machine work.

8. T F Parallels are always hardened and ground.

Machine Shop
Unit V
Milling Machine

R.S.A. 5

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. Give a definition of cutting speeds.

2. Give the formula for finding the cutting speed of a cutter used in milling work.

3. Give formula for finding RPM of milling cutter.

4. What is the purpose of coolant on a milling machine?

5. Why are coarse tooth styles of milling machine cutters preferred to other styles?

6. T F It is always better to leave a few thousandths of an inch on the finish cut and file to size.

7. T F It is usually considered better practice to use climbing cut when slitting or parting.

8. What is the average cutting speed for (a) brass (b) tool steel?

Machine Shop
Unit V
Milling Machine

R.S.A. 6

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. In what type of work is straddle milling mostly used?

2. T F Brass cannot be milled by the method of straddle milling.

3. T F Only large diameter cutters may be used in straddle milling.

4. T F It is considered good practice to use slow speed and fine feed in straddle milling.

Machine Shop
Unit V
Milling Machine

R.S.A. 7

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. What is the most important part of the vertical milling machine?

2. T F Several operations may be performed without moving the part on the vertical milling machine.

3. Is it possible to drill angled holes on a vertical milling machine with the work fastened horizontally?

4. Can the same job be performed on a plain milling machine as on a vertical?

5. T F Spiral gears may be cut on a vertical milling machine.

6. What type of milling cutter is usually used for face-milling on a vertical machine?

Machine Shop
Unit V
Milling Machine

R.S.A. 8

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. T F No cutting lubricant is used when milling cast iron.

2. What is meant by the term "Setting Up" the milling machine?

3. In flat milling, how many cuts are usually taken?

4. What is the most important factor in setting up for flat milling?

5. T F Always use hard hammer in setting work in milling machine vise.

Machine Shop
Unit V
Milling Machine

R.S.A. 9

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. What is the most important attachment used on the milling machine?

2. T F Some type of attachment must be used on all milling jobs.

3. T F Much skill is required in the operation of milling attachments.

4. Give three types of attachments used in milling work.

5. Is it necessary to use the rack attachment for milling a rack?

ERIC

Machine Shop
Unit V
Milling Machine

R.S.A. 10

PART I

Technical Information

Test Sheet	Name: _____ _____ Date: _____	GRADE

1. Name six parts of the index head.
2. Describe the principle of the index head.
3. Where does the universal spiral dividing head get its power?
4. What is the ratio between the work and index plate on a Cincinnati index head?
5. What degree of taper does the dividing head center have?
6. What is the function of the milling machine dog?
7. What is the function of the tailstock or footstock?
8. What type of indexing is used for 50 divisions?
9. Give the formula for setting up the dividing head for simple indexing.

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STATE OF LOUISIANA

Vocational Curriculum Development and Research Center

NATCHITOCHES, LOUISIANA 71457

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VT 003 728
Basic Machine Shop Training Course, Test Sheets. Unit IV--Shaper .

Louisiana Vocational Curriculum Development and Research Center, Natchitoches
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PUB DATE - 67 19p.

DESCRIPTORS - *TESTS; *TRADE AND INDUSTRIAL EDUCATION; METAL WORKING OCCUPATIONS; *MACHINISTS; *MACHINE TOOL OPERATORS; POST SECONDARY EDUCATION; UNITS OF STUDY (SUBJECT FIELDS); *MACHINE TOOLS

ABSTRACT - This text booklet is for use with the answer book (VT 003 735, also in this issue) and the related study guide available as VT 003 729 (AIM Summer 1968). Other documents in this five-unit machinist training series are VT 003 726, VT 003 730, VT 003 732, and VT 003 733, which appear in this issue, and VT 003 727, VT 003 731, VT 003 734, and VT 003 736 (all in AIM Summer 1968). (AW)

VT 003 728

ED0 45856

STATE VOCATIONAL-TECHNICAL & TRADE SCHOOLS of LOUISIANA

MACHINE SHOP TRAINING COURSE

TEST SHEETS

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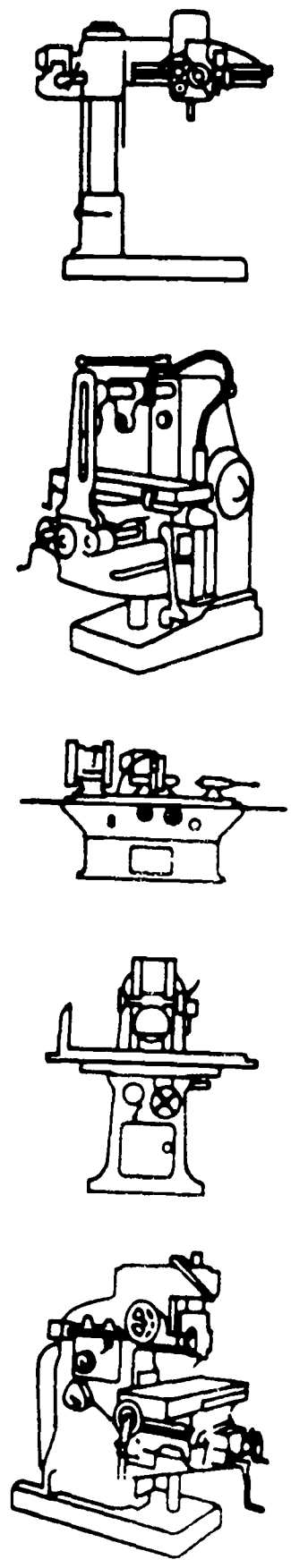

UNIT IV

REVISED

BASIC SHAPER

1967

VT003728

BASIC MACHINE SHOP TRAINING COURSE

TEST SHEETS

UNIT IV- SHAPER

Published by

STATE OF LOUISIANA
Vocational Curriculum Development and Research Center
NATCHITOCHES, LOUISIANA 71457

for the

State Vocational-Technical and Trade Schools of Louisiana

M E M O R A N D U M

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Lloyd A. Ponder (Agency) Vocational Curriculum Development and Research Center

(Address) P. O. Box 657 Natchitoches, Louisiana 71457

DATE: September 25, 1967

RE: (Author, Title, Publisher, Date) Research Center, BASIC DRILL PRESS, Vocational Curriculum Development and Research Center, 1967

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

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Agency Vocational Curriculum Development & Research Center
Address P. O. Box 657 Natchitoches, La. 71457
Limitation on Available Copies 1 Price/Unit $2.00
(quantity prices) No

(2) Means Used to Develop Material:
Development Group Committee of Trade School Instructors
Level of Group State
Method of Design, Testing, and Trial Experience of teachers. Some sections have been field tested on five schools.

(3) Utilization of Material:
Appropriate School Setting Area Vocational-technical school
Type of Program Preparatory--preferably post secondary but not essential
Occupational Focus Machine shop training
Geographic Adaptability No limitations
Uses of Material Student reading and using of job sheets.
Users of Material Student. Teacher may use as course of study.

(4) Requirements for Using Material:
Teacher Competency Must be qualified machine shop instructor
Student Selection Criteria male, with interest in machine shop training, age 16 or older, who plan to enter employment as beginning machinist.
Time Allotment 60 clock hours.

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe See attached page

Source (agency)
(address)

Required Textbooks

BOOK IV

Unit IV: Shaper

Title	Source
SHAPER WORK Machine Shop Series	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
Burghardt, Axelrod and Anderson MACHINE TOOL OPERATION	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
MACHINE SHOP MATHEMATICS Machine Shop Series	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York

Table Of Contents

TEST BOOK IV

BASIC MACHINE SHOP TRAINING COURSE

Unit IV - Shaper

R.S.A. 1 - Cutting Keyways . . . . . Test
R.S.A. 2 - Offset Key . . . . . Test
R.S.A. 3 - Chock Wedge . . . . . Test
R.S.A. 4 - Drill Press Vise Jaws . . . . . Test
R.S.A. 5 - Speeds and Feeds . . . . . Test
R.S.A. 6 - Angular Shaping . . . . . Test
R.S.A. 7 - Contour Shaping . . . . . Test
R.S.A. 8 - Shaping a Tongue and Groove . . . . . Test
R.S.A. 9 - Indexing--Simple and Direct . . . . . Test
R.S.A. 10 - Gear Tooth Parts . . . . . Test
R.S.A. 11 - Gear Segment . . . . . No Test
R.S.A. 12 - Drill Press Vise . . . . . No Test
R.S.A. 13 - Cutting Serrations . . . . . Test
R.S.A. 14 - Shaper Cutting Tools . . . . . Test
R.S.A. 15 - Holding the Work . . . . . Test

Machine Shop
Unit IV
Shaper

R.S.A. 1

PART I

Technical Information

Test Sheet	Name: _____	GRADE
	Date: _____	

1. The keyseat tool and the _____ tool have the same general appearance.

2. The stocky cut should be taken in the _____ of the layout.

3. For efficient shaping of keyseats, what is recommended as the maximum width of the cutting tool?

4. How many cuts would have to be taken to gain the proper width for a 1/2 key?

5. List 3 places where clearance is necessary on a slotting tool. _____, _____, and _____.

6. T F Keyseats cut on a shaper must stop in a hole.

7. T F In cutting a slot wider than the tool, the stocking cut should be taken to the full depth of the slot.

8. T F It's more efficient to feed the tool upward while cutting an internal keyseat.

Machine Shop
Unit IV
Shaper

R.S.A. 2

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. T F Always clean the table when mounting the vise.
2. T F The clapper box contains the clapper which raises the tool on the forward stroke.
3. T F Burrs should be removed from the work before it is placed in the vise.
4. The table may be moved either by _____ or by _____.
5. The automatic movement of the table is called _____.
6. The shaper feeds on the _____ stroke.
7. The shaper has _____ speeds.
8. The clapper box is mounted on the _____.
9. The length of stroke is indicated by _____.
10. The length of stroke is determined by _____.

Machine Shop
Unit IV
Shaper

R.S.A. 3

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. List 6 work holding-devices used on the shaper.

2. The _____ is most frequently used to hold the work.

3. _____ one used to hold thin work to the table.

4. Before a work holding device is mounted, the table must be _____.

5. Index centers are used most satisfactorily for _____ work.

6. T F Two types of vises are the independent and clamp ring hose.

7. T F Parallels are used to hold work down to the table.

8. T F Vises may be lined up by indicators.

9. T F The witness marks on a vise, when lined up, will exactly position a vise true.

Machine Shop
Unit IV
Shaper

R.S.A. 4

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. What is the position of the tool head when cutting off?
2. What is the position of the vise?
3. Where would the stock be held in the vise?
4. How much clearance is recommended between the cut off tool holder and the work?
5. Is the clapper box allowed to move during cut off?
6. What is over hang?
7. Could you use a right hand cut off tool holder?
8. Will the cut off be clean or will it leave a burr?

Machine Shop
Unit IV
Shaper

R.S.A. 5

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. Feed is the rate at which the _____ moves.

2. Three factors which determine cutting speed are: _____, _____, and _____.

3. What is the formula for determining strokes per minute using cutting speed as a factor?

4. It is usually customary for the beginner to run the shaper too _____; therefore, he should consider cutting speeds.

5. Calculate the number of strokes required for brass at 100 f.p.m. using an 11-inch stroke.

6. Calculate the number of strokes per minute required for steel at 80 f.p.m., using a 15-inch stroke.

7. The shaper is on the cutting stroke when the crank pin is moving _____.

Machine Shop
Unit IV
Shaper

R.S.A. 6

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. List 4 methods by which work may be held in a vise to machine an angular surface.

2. Which way is the clapper box set when machining an angle?

3. Cutting a slight angle on the edge of a piece is called _____.

4. T F Angles may be set with the tool head set perpendicular to the vise.

5. T F Angles may be cut with a tool ground at the appropriate angle and set in the tool post.

6. T F Angles may be cut with the tool head offset a given amount.

Machine Shop
Unit IV
Shaper

R.S.A. 7

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. When shaping a contour, start a cut at the _____point
2. A _____ tool should be used to cut contours.
3. The table may be moved by hand or _____.
4. The tool head is fed _____ to obtain the best results.
5. If a shallow curve is to be formed, the cut may be started at the _____edge.
6. Small curves may be cut with a _____ tool.
7. T F When feeding by hand both ways, the material is removed in steps.

Machine Shop
Unit IV
Shaper

R.S.A. 8

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. Which part is machined first?

2. Is it necessary to square the block?

3. Could a cut off type tool be used satisfactorily?

4. In making the tongue, a _____ shouldering tool is used.

   A. Right hand.
   B. Left hand.
   C. Both right and left hand.

5. Which is easier to machine? (A) Tongue (B) Groove

Machine Shop
Unit IV
Shaper

R.S.A. 9

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. Rapid indexing is also called _____ indexing.

2. What are the two methods of indexing?

3. Plain indexing is also called _____ indexing.

4. The habit of indexing to the _____ should be developed to avoid confusion.

5. How many turns and/or parts of a turn are necessary to index for the following number of divisions using a simple index head?

   (A) 12 _____
   (B) 6 _____
   (C) 3 _____
   (D) 20 _____
   (E) 9 _____

6. T F The index plate and the section arms are to aid in indexing parts of turns.

Machine Shop
Unit IV
Shaper

R.S.A. 10

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. The ratio of the number of teeth in the gear per inch of pitch diameter is called the _____pitch.

2. The distance from a point on one tooth to the same point on the next tooth is called_____pitch.

3. The distance from the pitch circle to the top of a gear tooth is the_____.

4. From the pitch circle to the clearance is the_____.

5. Working depth plus clearance is called_____ _____.

6. The angle at which the gear tooth is cut is called the _____angle.

Machine Shop
Unit IV
Shaper

R.S.A. 13

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. The tool is _____ in shape.

2. What two patterns may be produced by serrating?

3. May hand feed by used? Yes No

4. It is considered good practice to finish the serration to depth in _____ cuts.

   A. One
   B. Two
   C. Three
   D. Five

5. The depth of the cut is attained with the _____.

   A. Table
   B. Crossfeed
   C. Tool head

6. T F In cutting serrations, the work piece is usually clamped to the table.

Machine Shop
Unit IV
Shaper

R.S.A. 14

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. Name six parts of the cutting tool.

2. A cutting tool with a broad flat nose is used for finishing _____.

3. The Armstrong shaper tool holder may hold the cutting tool in any one of _____different positions.

4. What advantage has a forged tool over a small tool held in a tool holder?

5. What would happen to a tool ground with 30 degrees front clearance?

6. A tool used to cut a curved surface is called a_____ tool.

7. Carbide tools require a cutting speed of at least_____.

8. The main difference between the shaper cutting tool and the lathe tool is_____.

   A. Material
   B. Clearance
   C. Sharpness
   D. Weight

9. The shape of the tool is determined by the_____.

   A. Operation
   B. Vise
   C. Work
   D. Length of stroke

Machine Shop
Unit IV
Shaper

R.S.A. 15

PART I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. The methods used in vertical shaping are _____ and _____.

2. When vertical shaping with the tool head, the tool is fed down on the _____ stroke.

3. A block may be squared by combining a _____ and a horizontal cut.

4. A piece clamped in front of the work to hold it in position is a _____.

   A. Dog
   B. Stop
   C. Nut
   D. Button

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VT 003 730
Basic Machine Shop Training Course Test Sheets. Unit II--Drill Press.

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ABSTRACT - Part of a five-unit machinist training series, this test booklet is for use with the answer book available as VT 003 735 (also in this issue) and the related study guide, VT 003 731 (AIM Summer 1968). Other documents in the series are VT 003 726, VT 003 728, VT 003 732, and VT 003 733, which appear in this issue, and VT 003 727, VT 003 734, and VT 003 736, all in AIM Summer 1968. (AW)

VT 003 730

BASIC MACHINE SHOP TRAINING COURSE

TEST SHEETS

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UNIT II - DRILL PRESS

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for the

State Vocational-Technical and Trade Schools of Louisiana

VT 003 730

M E M O R A N D U M

TO: The ERIC Clearinghouse on Vocational and Technical Education
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(Address) P. O. Box 657 Natchitoches, Louisiana 71457

DATE: September 25, 1967

RE: (Author, Title, Publisher, Date) Research Center, BASIC DRILL PRESS, Vocational Curriculum Development and Research Center, 1967

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(2) Means Used to Develop Material:
Development Group Committee of Trade School Instructors
Level of Group State
Method of Design, Testing, and Trial Experience of teachers. Some sections have been field tested on five schools.

(3) Utilization of Material:
Appropriate School Setting Area Vocational-technical school
Type of Program Preparatory--preferably post secondary but not essentia
Occupational Focus Machine shop training
Geographic Adaptability No limitations
Uses of Material Student reading and using of job sheets.
Users of Material Student. Teacher may use as course of study.

(4) Requirements for Using Material:
Teacher Competency Must be qualified machine shop instructor
Student Selection Criteria male, with interest in machine shop training, age 16 or older, who plan to enter employment as beginning machinist.
Time Allotment 60 clock hours.

Supplemental Media --
Necessary x
Desirable ____ (Check Which)

Describe See attached page

Source (agency)
(address)

Required Textbooks

BOOK II

Unit II: Basic Drill Press

Title	Source
Burghardt, Axelrod and Anderson MACHINE TOOL OPERATION	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
Olivo and Payne BASIC BLUEPRINT READING AND SKETCHING	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
Oberg and Jones MACHINERY'S HANDBOOK	The Industrial Press 148 Lafayette Street New York 13, New York
Slade and Margolis MATHEMATICS FOR TECHNICAL AND VOCATIONAL SCHOOLS	John Wiley & Sons, Inc. 605 Third Avenue New York, New York
Axelrod, Aaron MACHINE SHOP MATHEMATICS	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York

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TEST BOOK II

BASIC MACHINE SHOP TRAINING COURSE

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R.S.A. 2 - Twist Drill . . . . . Test
R.S.A. 3 - Speeds and Feeds of a Drill Press . . Test
R.S.A. 4 - Using Trigonometric Tables . . . . . Test
R.S.A. 5 - Boring . . . . . Test
Unit II Test

Part I

Technical Information

Test Sheet	Name : _____ Date : _____	GRADE

Directions: The following are completion statements. In the statement you will find a number where the correct answer should be. Place the correct answer in the blank between the parentheses at the beginning of the statement.

1. (a._____) (b._____) In most drilling machines the (a) is vertical and a horizontal (b) supports the work.

2. (a._____) (b._____) (c._____) List three types of drill presses: (a), (b), and (c).

3. (a._____) (b._____) For light work we use the (a) drill press which is (b) driven.

4. (a._____) The spindle rotates in a (a) which may be moved up and down vertically.

5. (a._____) (b._____) Standard drill presses may have either (a) or (b) worktables.

6. (a._____) The length of the (a) of a radial drill determines its size.

7. (a._____) (b._____) (c._____) (d._____) (e._____) To prevent drilling into the table when drilling through holes, the work should be supported with (a) bars, placed in a (b) block, clamped in a (c), or put in a (d) or (e).

8. (a._____) Before drilling, the (a) should be adjusted so the drill will just go through the work.

9. (a._____) The bench type drill press usually has a capacity for drills up to (a) inches in diameter.

10. (a._____) The drill is fed into the work a few (a) of an inch for each revolution.

Part I (Continued)

11. (a._____) The approximate size of the upright drill press are judged by the (a) of the largest piece that can be centrally drilled.

12. (a._____) The (a) is the pressure used to make a drill cut into the metal.

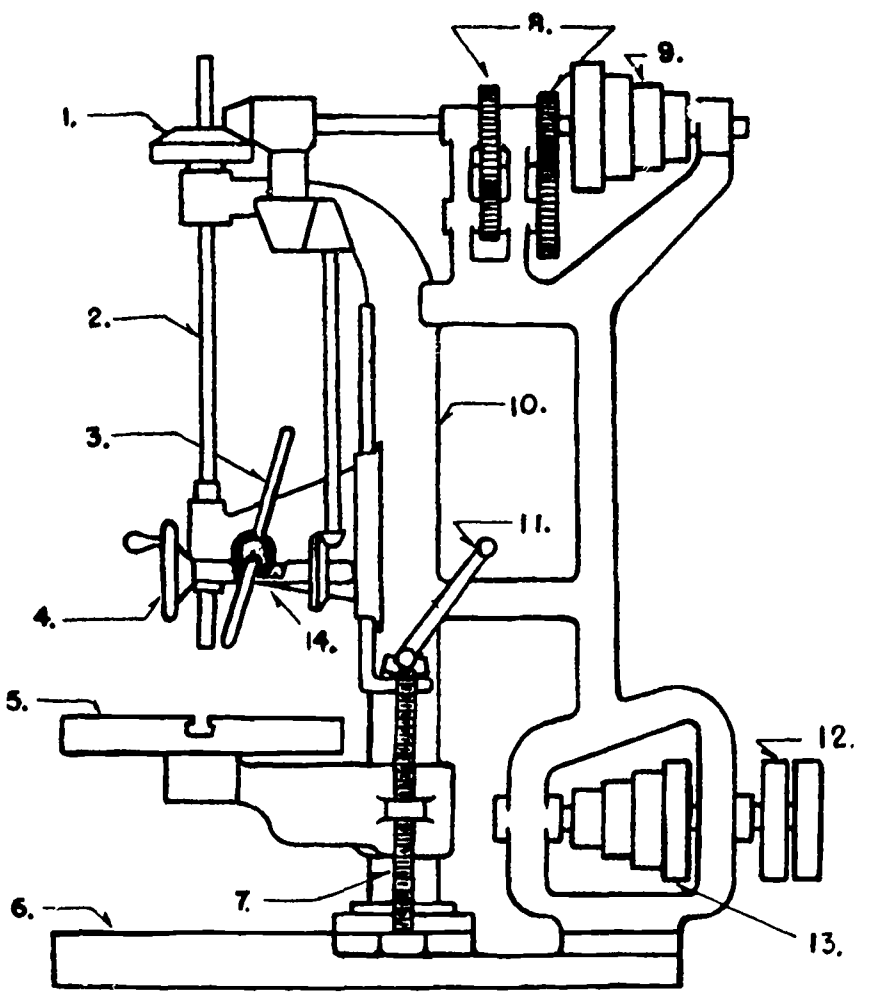
13. (a._____ b._____) The various speeds and feeds on the large drill presses may be obtained through (a) or (b).

14. (a._____) Drill presses having longitudinal and lateral movements are called (a) tables.

15. (a._____ b._____) Feed pressure is applied to the revolving spindle by (a) or (b).

Part I (Continued)

16. Write in the name of the indicated part in the correctly numbered blank at the bottom of the page.



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____

Part I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. (a._____ b._____ c._____) The parts which are common on all twist drills are the (a), (b), and (c).

2. (a._____) The (a) is that part of the drill that provides positive drive.

3. (a._____) The conical part of the drill is called the (a).

4. (a._____) The recommended angles of the cutting lips of a twist, in relation to the axis of the drill, is (a) degrees.

5. (a._____) So the drill will not bind in the hole, the diameter of the drill is slightly (a) from the point to the shank.

6. (a._____ b._____) The two most commonly used shanks are the (a) and the (b).

7. (a._____) The two spiral grooves running around the body of a twist drill are known as (a).

8. (a._____) Lip (a) is the "relief" which is given the cutting edges in order to allow them to enter the metal without interference.

9. (a._____ b._____) Safe work habits are developed by carefully (a) a job, and using good (b) to analyze the correct procedures to do a job.

10. (a._____) The operator has to be (a) in safety before he can wholeheartedly practice good work habits.

Part I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

Directions: The following are completion statements. In the statement you will find a number where the correct answer should be. Place the correct answer in the blank between the parentheses at the beginning of the statement.

1. (a._____ b._____) A machinist should use a slow speed for (a) drills and a fast speed for (b) drills.

2. (a._____) Too much drill (a) will cause the outer edges of the cutting lips to become dull.

3. (a._____) Since there are no hard and fast rules for drill speeds and feeds, the feed and speed will be determined by the operator's (a).

4. (a._____) The (a) of the drill is the amount of vertical travel of the spindle in one revolution.

5. (a._____ b._____) The formula to find the revolutions per minute of a drill is $\frac{(a)}{(b)}$.

6. (a._____ b._____) If a drill splits, it is an indication of too much (a) or not enough (b).

7. (a._____) In actual shop practice, the size of the drill, kind of metal being drilled, and kind of metal which the drill is made determines the (a).

8. (a._____) Too much drill (a) will cause the edges of the cutting lips to break off.

9. (a._____ b._____) Drills are made of (a) or (b) steel.

10. (a._____ b._____) A squeaking drill indicates a (a) or (b).

Part II

MATHEMATICS

1. In the following problems the diameter of the drills and the revolutions per minute are known. Find the cutting speed in feet per minute.

	Diameter of Drills	R.P.M.	Cutting Speed
a.	1"	380	
b.	1/4"	1260	
c.	1 1/2"	220	

2. In the following problems the diameter of the drill and the cutting speed are known. Find the revolutions per minute.

	Diameter of drill	R.P.M.	Cutting Speed
a.	1/8"		90
b.	1/2"		80
c.	3 1/2"		90

Part I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE:

1. (a._____) The (a) taper system uses the most sensible key to give all the dimensions of a tapered part.

2. (a._____) The (a) taper is used on drill shanks and other cutting tools.

3. (a._____) The (a) taper is used in milling machine spindles.

4. (a._____) The American Standard Taper Pins have a taper of (a) per foot.

5. (a._____) The diameter on the large end of a number 2 taper pin is (a) than that of a number 8 taper pin.

6. (a._____) The difference in diameter measured on each end of a tapered part is called the (a).

7. (a._____) (b._____) (c._____) (d._____) The four parts of a taper are (a), (b), (c), and (d).

8. (a._____) The diameter on the small end of a number 4 pin is .167 inch. If the pin is 4 inches long, what is the diameter at the large end?

9. (a._____) The diameter on the large end of a number 5 pin is .289 inches. What is the diameter of the pin 1 inch from the large end?

10. (a._____) (b._____) (c._____) The helical reamer is most efficient for production work because it is free(a), the (b) do not pack in the flutes, there is a minimum of (c).

Machine Shop
Unit II
Drill Press

Part I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE:

1. (a._____) A boring (a) is used in the drill press for boring operations.

2. (a._____ b._____) The difference between boring and counterboring is that in counterboring the hole is bored to a specific (a) and in the process of boring the hole is (b) through the stock.

3. (a._____) He who works safely will wear (a) when operating the drill press are any other machine tool.

4. (a._____ b._____) An operator is often injured by being (a) with the (b) being drilled.

5. (a._____) Flying chips can create serious (a) injury.

6. (a._____ b._____) The two distinct types of boring machines other than the drill press are the (a) and (b) boring mills.

Part II

Mathematics

1. A boring bar tool is adjusted to increase the size of a hole 7/16 inch in one cut, what is the depth of the cut?

2. If a hole is being bored to fit a shaft 5 inches in diameter for a press fit and the allowance is the diameter of the shaft minus 0.0005 inch for each inch of the shaft diameter, what will be the diameter of the bore?

3. A hole is drilled and counterbored 1 1/16 - 0.8125 inch, what is the difference between the diameters?

4. Two holes 15/16 inch diameter is drilled into a plate 3 inches center to center, how much metal is left between the two holes?

Unit Test II

Part I

Test Sheet Technical Information Mathematics Blueprint Reading	Name: _____ Date: _____	GRADE

Multiple Choice Items

Directions: Each of the incomplete statements below is followed by several phrases. From these phrases choose the one that when added to the statement makes it true. Place the letter of that phrase (A, B, C, or D) in the numbered blanks at the end of the statement.

1. Portable drills and drill presses equipped with a chuck use (_____)

   A. Morse taper shank drills
   B. Straight shank drills
   C. Jarno taper shank drills
   D. Any of these

2. The straight fluted drill is used to drill (_____)

   A. Babbitt
   B. Stainless steel
   C. Cast iron
   D. Monel metal

3. The approximate taper per foot of a Morse taper shank drill is (_____)

   A. 3/4"
   B. 1/2"
   C. 5/8"
   D. 12/16"

4. A round shaft is held best for drilling in a (_____)

   A. Vise
   B. Special clamp
   C. "V" block
   D. "C" clamp

Unit Test II

5. To remove a taper shank drill from the drill press spindle you use a (_____)

   A. Hammer
   B. Drift
   C. Chisel
   D. Bar

6. The operation of making a cone shaped enlargement at the end of a hole is called (_____)

   A. Counterboring
   B. Countersinking
   C. Reaming
   D. Off-setting

7. Drill point angles for average drilling is (_____)

   A. 75°
   B. 540°
   C. 59°
   D. 62°

8. When reaming a hole, the reamer should never be turned (_____)

   A. Fast
   B. Upside down
   C. By hand
   D. Backwards

9. When grinding the cutting lips on a drill the drill should be held at an angle of

   A. 30 degrees with the face of the grinding wheel
   B. 40 degrees with the face of the grinding wheel
   C. 59 degrees with the face of the grinding wheel
   D. 69 degrees with the face of the grinding wheel

10. After the flutes are cut on a twist drill the remaining portion of the surface of the body is relieved and a narrow (_____)

   A. Land is left
   B. Margin is left
   C. Web is left
   D. Tang is left

Unit Test II

11. The purpose of body clearance on a drill is to (_____)

    A. Increase the cutting speed
    B. Refuse the friction on the drill in the hole
    C. Increase the feed
    D. Make the drill lighter

12. The best drill to use for drilling soft metal is the (_____)

    A. Flat drill
    B. Twist drill
    C. Straight-fluted drill
    D. High speed drill

13. The cutting speed of a 1 inch drill revolving 320 r.p.m. is approximately (_____)

    A. 50 feet per minute
    B. 78 feet per minute
    C. 128 feet per minute
    D. 150 feet per minute

14. A $1\frac{1}{2}$ inch drill has a cutting speed of 120 feet per minute it is revolving (_____)

    A. 50 feet per minute
    B. 78 feet per minute
    C. 128 feet per minute
    D. 150 feet per minute

15. When a hole is tapped (_____)

    A. It is enlarged
    B. It is made smoother
    C. It is finished to size
    D. Threads are cut in the hole

16. The standard drill presses are classified as to size (_____)

    A. By the height of the drill press
    B. By the size of the column
    C. By the size of the table
    D. By the width of the base

17. The speeds on the drill press can be changed by (_____)

    A. Increasing the feed per minute
    B. Changing the job position
    C. Use of pulleys and gears
    D. Changing the feed gears

Unit Test II

18. Before starting a drilling operation (_____)

A. Check the elevating screw
B. Check the accuracy of the set up
C. Start the motor
D. Clean off the table

19. A drill with a worn margin will (_____)

A. Drill oversize
B. Drill an accurate hole
C. Drill undersize
D. Run off center

20. A squeaking drill indicates (_____)

A. That the drill is too soft
B. A dull drill
C. That the work is not set up right
D. That the speed is too slow

21. When drilling brass with a twist drill (_____)

A. Slow down the cutting speed
B. Increase the feed
C. Increase the heel clearance
D. Grind off some of the cutting lips rake

22. The drill commonly made in the shop for special sizes is called (_____)

A. A twist drill
B. A straight shank drill
C. A three fluted drill
D. A flat drill

23. Spot facing a hole is to (_____)

A. Enlarge the hole
B. Make the wall surface of the hole smooth
C. Smooth and square the surface around the hole
D. Make the hole taper

24. The average cutting speed for drilling machine steel is (_____)

A. 400 feet per minute
B. 60 feet per minute
C. 80 feet per minute
D. 100 feet per minute

25. Counter boring a hole is the process of (_____)

A. Enlarging the hole
B. Making the wall surface of the hole smooth
C. Boring the hole tapered
D. Enlarging the end of the hole cylindrically

26. Reaming is the operation of (_____)

A. Enlarging a hole with a cutting tool with one cutting edge
B. Making a hole where none exists
C. Sizing and finishing a hole smooth, straight, and accurate
D. Enlarging the end of the hole cone shape

27. The lip angle of a twist drill used for general purpose is (_____)

A. 56 degrees
B. 59 degrees
C. 62 degrees
D. 69 degrees

28. The purpose of a tang on a twist drill is to (_____)

A. Keep the drill from slipping in the sleeve
B. Fit the drill in a drill chuck
C. Give the drill better cutting action
D. Increase the speed of the drill

29. A drill with different lip lengths will (_____)

A. Drill correct sized holes
B. Drill undersized holes
C. Drill oversized holes
D. Drill crooked holes

30. The cutting speed of a drill is (_____)

A. The number of turns a drill revolves in one minute
B. The distance the outer corners of the cutting edges of the drill will travel in feet per minute
C. The distance the drill will advance into the metal for each spindle revolution
D. The number turns the drive spindle revolves in one minute

Unit Test II

Part II

Directions: The following are completion statements. In the statements you will find numbers where the correct answer should be. Place the correct answer in the parentheses at the end of the statement.

Example: A thread cutting die is used for cutting (X) threads. X. (External)

1. Drilling is the operation of producing a (1) hole by removing solid metal. 1. (_____)

2. Boring is the operation of (2) a hole by means of an adjustable cutting tool. 2. (_____)

3. Counter-boring is the operation of enlarging the end of a hole (3) as for a recess for a fillister-head screw. 3. (_____)

4. Counter-sinking is the operation of making a (4) enlargement of a hole, as for a recess for a flat head screw. 4. (_____)

5. The drill press spindle is provided with a (5) standard taper hole of a size in proportion to the size of the machine. 5. (_____)

6. A chuck is a gripping device with two or more adjustable (6) set radially. 6. (_____)

7. The drills most commonly used are (7) drills. 7. (_____)

8. Always examine a drill for (8) before using it. 8. (_____)

9. When a particularly accurate hole is required it is first drilled, bored, or machine rounded to about .005" undersize and then (9). 9. (_____)

10. Probably the most efficient kind of reamer for any purpose is the (10) reamer. 10. (_____)

Unit Test II

11. The approximate size of a drill press may be judged by the (11a) size or the distance from the center of the spindle to the (11b). — 11. (a. _____) (b. _____)

12. The "all around" drilling machine is the (12). — 12. (_____)

13. A squeaking drill indicates a (13a) or (13b). — 13. (a. _____) (b. _____)

14. List four parts of a drill: (14a), (14b), (14c), and (14d). — 14. (a. _____) (b. _____) (c. _____) (d. _____)

15. No lubricant is needed to drill (15a) and (15b). — 15. (a. _____) (b. _____)

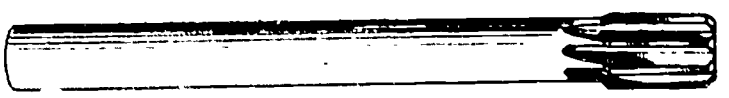
Unit Test II

PART III

Identification of Tools:

Directions: In the numbered blank below each illustration write the correct name of the tool.

1. _____



2. _____

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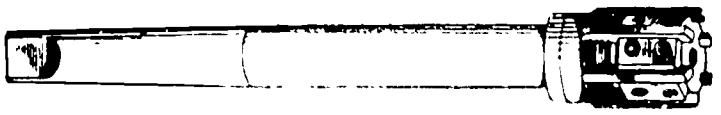

5. _____

6. _____

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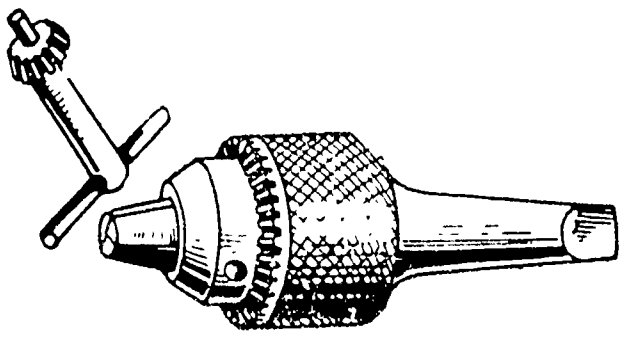

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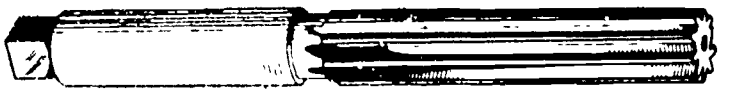

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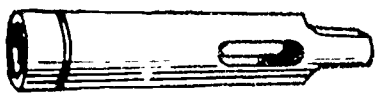

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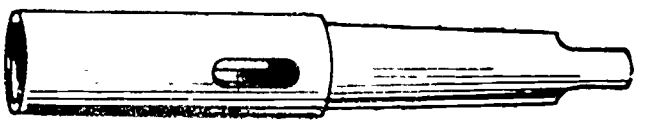

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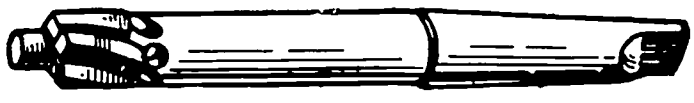
Unit Test 1I



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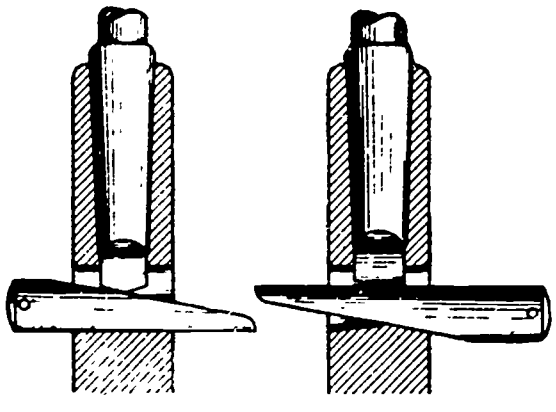

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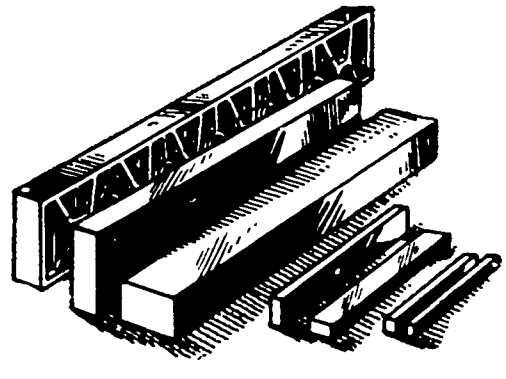

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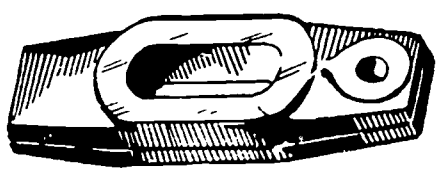

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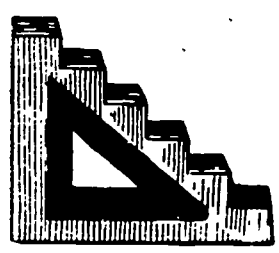

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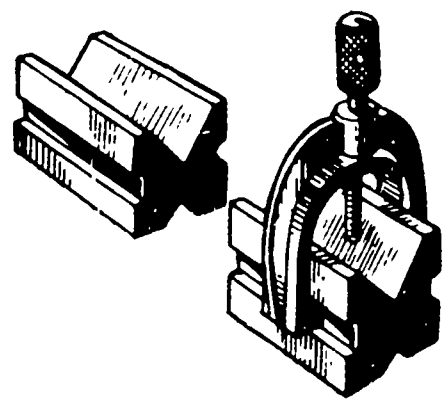
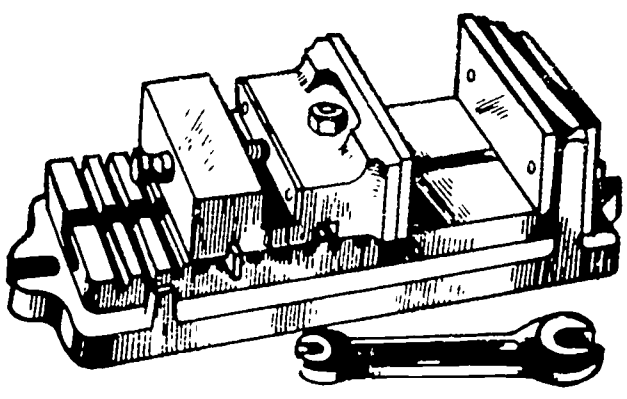


20. _____



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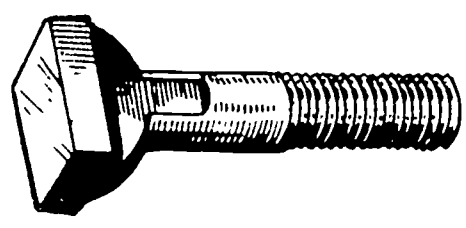
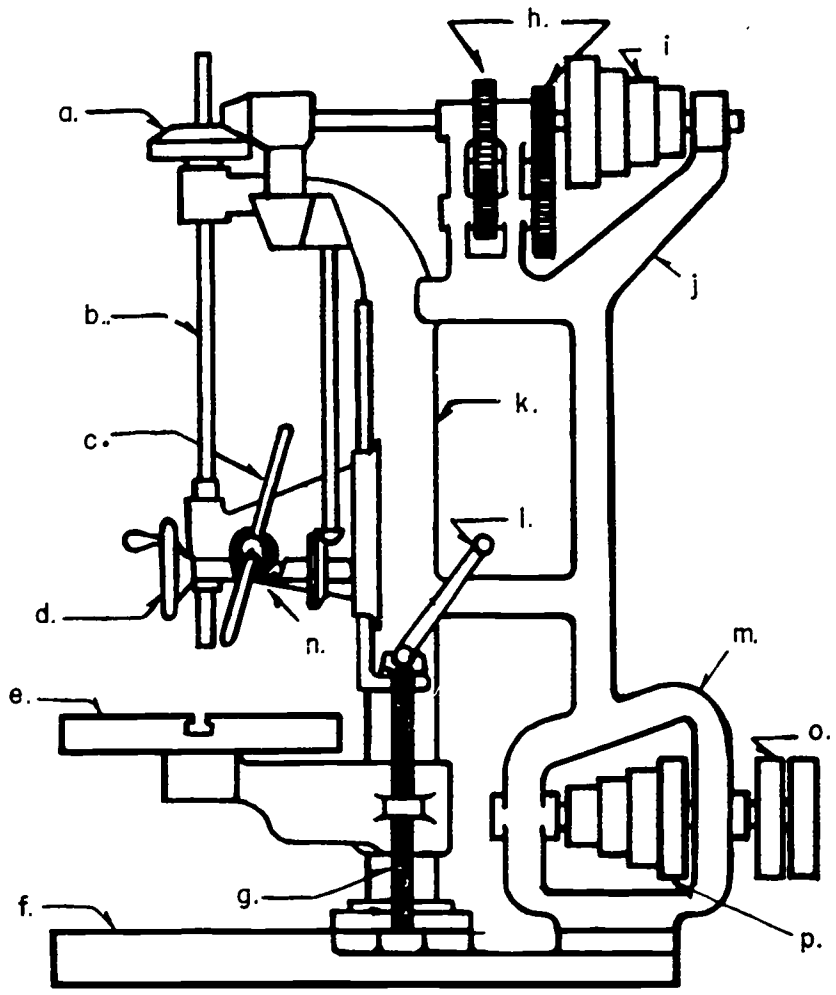


22. _____

Unit Test II

Part III

23. In the blanks provided, identify the following parts of the drill press.



a. _____ i. _____

b. _____ j. _____

c. _____ k. _____

d. _____ l. _____

e. _____ m. _____

f. _____ n. _____

g. _____ o. _____

h. _____ p. _____

Unit Test II

Part IV

Mathematics:

1. A drill press operator is paid $1.05 each for drilling frames. How much did he get for drilling 69 frames?

   _____.

2. A drill hand gets 1/2 cent for every hole he drills in bolts. If each bolt has two holes drilled in it and he drills 575 bolts, how much did he earn?_____

3. A machine uses lard-oil cutting compound at the rate of 1/2 quart every 20 minutes in cutting steel. How many gallons will be used in 5 days, 8 hrs. a day, if the same amount is used every 20 minutes?_____.

4. The over-all length of a piece of metal is 30". If 1/4" is allowed on each end, how many 1" holes can be bored leaving 1/2" between them?_____.

5. A 2 1/2" hole is being drilled into a piece of aluminum. At what R.P.M. should the drill-press operator set his machine if he assumes a cutting speed of 250 ft. per minute?_____.

6. Find the cutting speed of 7/8" drill rotation at 150 R.P.M. _____.

7. A drill press hand is drilling into cast iron with a 3/4" high-speed drill. He is running his press at 400 R.P.M. Does his cutting speed come within the safe speed for the metal being cut?_____.

8. Two drills 3/4" and 1" in diameter, are both cutting at the rate of 80 f.p.m. How fast is each revolving?

   _____.

9. At what R.P.M. would you set your drill press for the following? a._____, b._____, c._____

   a. Stainless steel @ 35 f.p.m., using a 2" drill.
   b. Soft cast iron @ 125 f.p.m., using a 7/8" drill.
   c. Monel metal at 45 f.p.m., using a 1 1/2" drill.

Unit Test II

Part V

Blueprint Reading:

Directions: Some of the statements are true, some are false. If a statement is true, encircle the (T) at the left. If the statement is false, encircle the (F) at the left.

1. T F Drawings of parts shown in section as though cut or sawed through are called full section drawings.

2. T F In sectional drawings, the same type of section lines are used to identify different materials.

3. T F In the internal part of a half section drawing hidden lines may be omitted.

4. T F All drawings must have detail sections.

5. T F Working drawings should contain all information necessary to complete the manufacturing stages indicated.

6. T F Solid objects which are cut by planes are usually not sectioned.

7. T F By use of standard symbols screw threads can be represented by simplified drawings.

8. T F In drawing thread symbols the conventional type is the easiest one to draw.

9. T F The drawing of a screw shows all information necessary for its manufacture.

10. T F Both conventional and simplified representation are used to indicate internal threads.

Unit Test II

Part VI

Directions: Some of the following statements are true and some are false. If the statement is true, place a circle around the letter (T). If it is false, place a circle around the letter (F).

1. T F The revolving spindle of the drill press carries the cutting tool.

2. T F Tapered key or "drift" is used to remove the tapered shank from the tapered hole of a spindle.

3. T F A drill chuck is a tool used to shim up work to be drilled.

4. T F The drills most commonly used are straight fluted drills.

5. T F Straight and tapered shank drills are perhaps the most common shank type.

6. T F Most tapered shank drills have the Morse standard taper.

7. T F The bottom or end faces of the cutting edges of the drill are at an angle of approximately 60 degrees with the axis.

8. T F If small drills are used and not marked, the size is found by the use of a drill gauge.

9. T F For drilling brass, copper, or other soft metals, a drill with rake is considered best.

10. T F In shops where considerable amounts of drilling is done, it is economical to sharpen drills by hand.

11. T F Clearance on drill at cutting edge should be 25 degrees.

12. T F Drill chucks are made in various sizes, and a series of three or four will hold drills from the smallest size up to 1 inch diameter.

13. T F The twist drill is probably the least used and the least efficient cutting tool in the shop.

14. T F To strengthen a drill the web is made thicker toward the shank.

15. T F There is a tendency for the beginner to give insufficient lip clearance toward the center of the drill.

Unit Test II

Part VI

16. T F When a drill squeaks, it is usually an indication of a cracked hole or a dull drill.

17. T F Cutting oils tend to dull the cutting edge of the drill.

18. T F Lard oil is the original cutting oil and is still highly recommended.

19. T F Sulphur added to lard oil has a disadvantage in drilling hard or tough metals.

20. T F A jig is a device made especially for holding the work and guiding the cutting tool while drilling.

21. T F Using a lubricant on the tang of a twist drill will keep it from getting hot.

22. T F Large drills are operated at fast speed and small drills are operated at slow speed.

23. T F The feed and speed of a drill is the same.

24. T F It requires more intelligence and skill to set up a job in a vise or on the drill press table, to lay out and drill the holes, than what is required to use a jig for drilling.

25. T F The success of any job that has to be clamped on the table of any machine such as, drill presses, shapers, milling machines, etc. depends almost entirely upon the manner in which it is clamped.

VT 003 732
Basic Machine Shop Training Course, Test Sheets. Unit III--Lathe.

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ABSTRACT - These test sheets are for use with the answer book available as VT 003 735 (also in this issue) and the related study guide, VT 003 736 (AIM Summer 1968). Other documents in this five-unit machinist training series are VT 003 726, VT 003 728, VT 003 730, and VT 003 733 (all in this issue), and VT 003 727, VT 003 729, VT 003 731, and VT 003 734 (all in AIM Summer 1968). (AW)

VT 003 732

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BASIC MACHINE SHOP TRAINING COURSE

TEST SHEETS

UNIT III- LATHE

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VT 003 732

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DATE: September 25, 1967

RE: (Author, Title, Publisher, Date) Research Center, BASIC LATHE

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Development Group Committee of Trade School Instructors
Level of Group State
Method of Design, Testing, and Trial Experience of teachers. Some sections have been field tested on five schools.

(3) Utilization of Material:
Appropriate School Setting Area vocational-technical school
Type of Program Preparatory--preferably post secondary but not essential.
Occupational Focus Machine shop training
Geographic Adaptability No limitations
Uses of Material Student reading and using of job sheets.
Users of Material Student. Teacher may use as course of study.

(4) Requirements for Using Material:
Teacher Competency Must be qualified machine shop instructor
Student Selection Criteria male, with interest in machine shop training, age 16 or older, who plan to enter employment as beginning machinist.
Time Allotment 330 Clock Hours.

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Geographic Adaptability -- the limitations of the material related to geographical regions. (e.g., Southeastern United States, Western United States, Minnesota, etc.)
Uses of Material -- the specific uses for which the material was designed. (e.g., course planning, lesson planning, student reading)
Users of Material -- the person for whom the material was designed. (e.g., teacher, student)

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(5) Please list other information on a separate sheet. This might include unique aspects of the material not provided for in other categories on the form.

Required Textbooks

BOOK III

Unit III: Lathe

Title	Source
C. A. Felker MACHINE SHOP TECHNOLOGY	Bruce Publishing Company 400 N. Broadway Milwaukee 1, Wisconsin
Burghardt, Axelrod and Anderson MACHINE TOOL OPERATION	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
LATHE WORK Machine Shop Series	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
Slade and Margolis MATHEMATICS FOR TECHNICAL AND VOCATIONAL SCHOOLS	John Wiley & Sons, Inc. 605 Third Avenue New York, New York
Olivo and Payne BASIC BLUEPRINT READING AND SKETCHING	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
Oberg and Jones MACHINERY'S HANDBOOK	The Industrial Press 148 Lafayette Street New York 13, New York
C. A. Felker SHOP MATHEMATICS	Bruce Publishing Company 400 N. Broadway Milwaukee 1, Wisconsin

Table Of Contents

TEST BOOK III

BASIC MACHINE SHOP TRAINING COURSE

Unit III - Lathe

R.S.A. 1 - Types of Lathes and Identification of Parts . . . . . Test
R.S.A. 2 - Cutting Tools . . . . . Test
R.S.A. 3 - Chucking Work . . . . . Test
R.S.A. 4 - The Compound Rest . . . . . Test
R.S.A. 5 - Drilling . . . . . Test
R.S.A. 6 - Filing and Polishing . . . . . No Test
R.S.A. 7 - Knurling . . . . . Test
R.S.A. 8 - Turning Tapers . . . . . Test
R.S.A. 9 - Turning Angles With the Compound Rest. . . . . Test
R.S.A. 10 - Interchangeable Manufacture - Mass Production - Fits and Tolerances . . Test
R.S.A. 11 - Screw Threads . . . . . Test
R.S.A. 12 - Boring . . . . . Test
R.S.A. 13 - Cutting a Left-Hand Thread . . . . . Test
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R.S.A. 15 - Square Threads . . . . . No Test
R.S.A. 16 - Pipe Threads . . . . . No Test
R.S.A. 17 - The Value of Sketching . . . . . No Test

Machine Shop
Unit III
Lathe

R.S.A. 1

Part I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. How are lathes classified according to headstock construction?
2. Name and locate five principal parts of a lathe.
3. When is a lathe in alignment? Out of alignment?
4. What are some advantages of a geared-head lathe?
5. What is the purpose of the feed rod? The lead screw?
6. What is a combination lead screw and feed rod?
7. How is the carriage moved longitudinally for thread cutting?
8. What is the purpose of change gears?

Part 1

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

Directions: Complete the following statements.

1. The action of a cutting tool depends primarily on three things:

   1. _____
   2. _____
   3. _____

2. The most common sizes of square bits are: _____, _____, and _____ square.

3. The _____ degree angle at the ends of the tool bit blank serves as a guide to give the proper amount of front clearance to the tool when placed in the tool holder.

4. The tool fits the holder at an angle of approximately _____ degrees.

5. What is the proper angle in degrees for side clearance, and side rake on a cutting tool? _____ _____ _____.

6. Does a right hand tool cut to the left or to the right? _____

7. Remove as much metal by _____ grinding as possible, then use_____ wheel for finishing.

8. The most commonly used off-hand dressers are: the _____ and the _____.

9. Oilstoning the edge of a tool bit serves to produce a better _____ on the work and prolongs the life of the _____.

Machine Shop
Unit III
Lathe

R.S.A. 3

Part 1

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. The farther the cutting edge of any tool projects from the tool post, the greater the_____and the more the_____of the tool. This causes_____ and often worse evils and should be avoided whenever possible.

2. The tool post should be located at the_____ _____ of the T slot in the tool rest.

3. If the dog hits the tool rest when the lathe is running, the point of the_____ _____ will be broken off and the _____ _____ in the work spoiled.

4. If the tool is set too high, the tool will_____. If set too low, the edge will be more quickly_____.

Rough and Finish Cuts

5. T F For roughing cut, the tool is set square or pointing a little to the right.

6. T F Leave about 1/64 inch for finishing cut.

7. T F To prevent undercutting your work, you should take caliper measurements while the machine is running.

8. T F The character of the material determines whether the finishing chip shall be 1/64 inch or more.

9. T F The feed for finishing is finer than for roughing, say 1/64 inch or less.

Types of Lathe Chucks and Truing Up Work

10. T F The three types of lathe chucks are, the independent four-jaw chuck, universal three-jaw chuck and the combination chuck.

11. T F The position of the chuck jaws may be reversed to accommodate work of large diameter.

12. T F For inside chucking, the work may be held in the steps of the jaws by exerting an inward pressure.

13. T F The purpose of the ring marks on the face of the chucks is to adjust the jaws to the approximate size of the job.

14. T F To make the work run more nearly true, you should adjust two opposite jaws to push the spot toward the center.

Calipers

15. How would you hold a caliper to read the measurement on a scale?

Shoulder Turning

16. What are the usual angles of chamfers?

Facing

17. Why is it necessary to drill a center hole in work when it is turned and held in a chuck?

Machine Shop
Unit III
Lathe

R.S.A. 4

Part I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. The complete compound rest unit consists of what three parts?
   1. _____
   2. _____
   3. _____

2. The swivel slide is usually graduated through an angle of _____ degrees.

3. The term " _____" denotes the number of degrees in the angle to one side of the center line or axis of the work.

4. Since the compound rest is set at an angle which corresponds to the angle with the center line, the angle produced is the _____ _____.

5. There are two kinds of cuts in machine shop work called, respectively, the _____ _____ and the _____.

6. The machinist's purpose is to remove the excess stock as _____ as he can without leaving a surface too torn and rough.

7. The finishing cut, to make the work smooth and accurate, is a _____ _____.

8. Cutting speed in any machine shop operation is expressed in _____.

9. The _____ in lathe work is the amount the tool advances for each revolution of the work.

10. By the term _____ in lathe work is meant the depth of cut.

11. The time it takes to produce a finished piece of work is called the _____.

12. In machine shop practice, when speaking of sizes, the _____ is expressed, not the circumference.

ERIC

Machine Shop
Unit III
Lathe

R.S.A. 5

Part I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. Why is work sometimes counter-drilled before it is drilled?

2. What is a drill holder? Why is it used with larger drills?

3. What factors determine the best cutting speed for drilling on a lathe?

4. What is the advantage of an offset cutting-off tool in chuck work?

5. When is the cutting-off tool set properly?

6. What is meant by chattering? How may it be prevented?

Machine Shop
Unit III
Lathe

R.S.A. 7

Part I

Technical Information

Test Sheet Name: _____ GRADE

Date: _____

1. What is knurling?
2. How is a knurling tool set in the tool post?
3. Why is the diameter increased when knurling?
4. What are the three grades of knurls?

ERIC

Machine Shop
Unit III
Lathe

R.S.A. 8

Part I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. What are three different methods which can be used to turn tapers on the lathe?

2. Which is the most preferred?

3. What terms are used to specify the taper of a tapered part?

4. Name the taper which is used on drill shanks.

5. How do you try a taper in a gauge? Why do you make 3 chalk marks?

ERIC

Machine Shop
Unit III
Lathe

R.S.A. 9

Part I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. How many degrees are there in a circle?
2. What instrument is used in the machine shop to measure angles?
3. What is meant by the term "angle with the center line"?
4. What lathe operations does the reaming follow?
5. Why are holes sometimes reamed on the lathe?
6. What size is a hole drilled or bored before reaming?
7. How is the small end of a mandrel identified?

Machine Shop
Unit III
Lathe

R.S.A. 10

Part I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. What are the requirements for mass production?

2. What factors contribute to the success of mass production?

3. What factors have contributed mostly to the possibility of machining parts in large quantities?

4. Name the four different kinds of cylindrical fits used in machine work?

5. Why should a shaft which is run in a bearing be turned smaller than the bore of the bearing?

Machine Shop
Unit III
Lathe

R.S.A. 11

Part I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. What is the pitch of a thread?
2. If a thread has 16 threads per inch, what is its pitch?
3. If a thread notation on a blueprint is 3/4-10-UNC-1A, is it an internal or external thread? Why?
4. What is the depth of a 5/8-11-UNC-1A thread?
5. What is tolerance? In what unit of measure is it given?
6. How far will a double thread, pitch 1/8", advance in one turn?
7. Find the number of threads per inch for the following: 5/16, UNC; ¼, UNF; No. 10 UNF.
8. What is the function of the quick-change gearbox on a lathe?
9. To what angle is the compound rest swiveled to cut a thread?
10. What does a screw-thread tool gauge measure that a center gauge is unable to measure when grinding a thread tool bit?
11. What is the advantage of top rake on a thread tool?
12. How is a thread-cutting tool mounted?
13. When cutting a thread, how is the depth of cut regulated?
14. What are the advantages of a thread dial for cutting a thread?
15. What is the use of a thread pitch gauge?
16. Why are threads rounded or chamfered at the beginning of the thread?
17. Why are the ends of threads sometimes undercut?

Machine Shop
Unit III
Lathe

R.S.A. 12

Part I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. Give 3 reasons why it is not safe to assume that a drill will run perfectly true through solid metal, even though it starts true?

2. Is the point of the tool set above or below center?

3. What tools are used to measure a hole accurately?

4. How much metal should be left for a finish cut?

5. When is a telescoping gauge used to measure the diameter of a bored hole?

6. What is a trial cut?

Machine Shop
Unit III
Lathe

R.S.A. 13

Part I

Technical Information

Test Sheet	Name: _____ Date: _____	GRADE

1. What three steps are involved in cutting a left-hand thread?

2. What side of the cutter bit does the cutting when cutting a left-hand thread?

3. In which direction is the compound rest swiveled to cut an internal left-hand thread?

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BASIC MACHINE SHOP TRAINING COURSE

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UNIT I - BENCH WORK

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(Address) P. O. Box 657 Natchitoches, Louisiana, 71457

DATE: September 25, 1967

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Required Textbooks

BOOK I

Unit I: Basic Bench Work

Title	Source
Krar and St. Amand MACHINE SHOP TRAINING	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
Burghardt, Axelrod and Anderson MACHINE TOOL OPERATION	McGraw-Hill Book Co., Inc. 330 West 42nd Street New York 36, New York
C. A. Felker MACHINE SHOP TECHNOLOGY	Bruce Publishing Company 400 N. Broadway Milwaukee 1, Wisconsin
Slade and Margolis MATHEMATICS FOR TECHNICAL AND VOCATIONAL SCHOOLS	John Wiley & Sons, Inc. 605 Third Avenue New York, New York
Oswald A. Ludwig METALWORK	McKnight and McKnight 109-111 West Market Street Bloomington, Illinois
Giachino and Feirer BASIC BENCH-METAL PRACTICE AND PRECISION MEASURING	Charles A. Bennett Co., Inc. 237 N. Monroe Street Peoria, Illinois
Olivo and Payne BASIC BLUEPRINT READING AND SKETCHING	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
BENCH WORK Machine Shop Series	Delmar Publishers, Inc. Mountainview Avenue Albany 5, New York
Oberg and Jones MACHINERY'S HANDBOOK	The Industrial Press 148 Lafayette Street New York 13, New York

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BASIC MACHINE SHOP TRAINING COURSE

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Machine Shop
Unit I
Bench Work

R.S.A. 2
6 Hours

Part I

Technical Information

Test Sheet	Name : _____ Date : _____	GRADE

1. What determines the pitch of a saw blade?
2. What is the average cutting speed, in strokes per minute, for saw blades?
3. What are the terms of a fraction?
4. What is a mixed number?
5. What is a pillar file?
6. How can you determine if your filing is being properly done?
7. What tools are used for measuring?
8. What is a vernier caliper?
9. Name the parts of a micrometer.
10. What is meant by layout?
11. What is blue vitriol?
12. What are "Trammel Points?"
13. Work the following problems.
    a. What is the price of an article marked $12.00, if the price has been reduced 12%
    b. Write as common fractions.
       20%, 331/3%, 25%, 10%, 5%.

c. Add these fractions

3/10 + 4/5 =

1/2 + 1/4 =

5/6 + 2/3 =

1/2 + 2/3 =

1/4 + 1/6 =

1/6 + 1/8 =

1/3 + 2/5 =

7/16 + 1/8 =

d. Express in lowest terms

1/4	1/2	1/4	1/3
1/6	3/8	3/6	11/16
3/5	1/8	1/4	3/12
5/10	1/3	5/6	5/6
1/4	5/7	7/10	3/16

e. Reduce to sixty-fourths

3/8

7/16

15/32

24/128

f. Subtract the following

2/3 - 1/3 =
2/3 - 1/6 =
10/15 - 1/5 =
7/12 - 1/2 =
13/25 - 4/20 =
63/64 - 21/32 =
9/10 - 7/8 =
3/4 - 3/16 =

g. Multiply the following

3/4	x	8/9	=
3/8	x	8	=
3/4	x	7/8	=
2/3	x	9/16	=
3/4	x	3/5	=
16/25	x	5/16	=
33	x	6/16	=
1/2	x	1/8	=

h. How long a piece of drill rod is required to make 20 drills 3 3/16" long if 1/8" waste is allowed for each cut?

i. How long a piece of stock will be required to cut 15 washers each 3/32" thick if 1/16" waste is allowed for each cut?

Machine Shop
Unit I
Bench Work

R.S.A. 3
6 Hours

Part I

Technical Information

Test Sheet	Name : _____ Date : _____	GRADE

1. Why do grinding wheels break?
2. What is a wet grinder?
3. What are the names of two artificial abrasions used to make grinding wheels?
4. Name the tool used to dress grinding wheels.
5. Name 5 safety precautions for replacing and using "emery wheels."
6. What is the lip clearance of a drill?
7. Where is the heel of a drill?
8. What is a drill guage and what is it used for?
9. What kind of coolants are used in drilling?
10. Why is grinding thin stock dangerous?
11. What is used for eye protection when grinding?
12. What happens when work is jammed against a grinding wheel?
13. Describe the sparks caused by grinding Carbon Tool Steel.
14. What is a decimal fraction?
15. Is 7/32 a decimal fraction?
16. What is different about a whole number seven and a decimal fraction seven.

17. Work the following problems.
    a. Add the following
       283.5 + 69.2

       384.73 + 63.14

       1738 + 0.0087 + 7.58

       .067 + 37.762 + 7.9

18. How many washers .3475 are needed to fill a space 1.7375?

19. A pipe with an outside diameter of 2" had .010 turned off of the outside to make it fit. What was the size of the part the pipe was going to fit if .02 was allowed for clearance?

20. A collar having a 2" outside diameter had .008 removed from the inside diameter. What was the final outside diameter of the pipe?

21. Work the following

    a. Subtract

       24.630
       18.205

    b. 423.201
       37.640

    c. .6473
       .1471

    d. 9.0000
       6.4136

    e. 1.624
       .012

    f. 8.324
       .606

    g. .473
       .213

    h. 627.12
       30.01

22. If a pipe has a wall thickness of .231" and is 1.50 inside diameter, what is the outside diameter?

23. Divide

.780 by .964 =

.12 by 15 =

.39 by .03 =

122 by .004 =

164.4 by .0436 =

840.6 by .0242 =

ERIC

Machine Shop
Unit I
Bench Work

R.S.A. 4
3 Hours

Part I

Technical Information

Test Sheet	Name : _____ Date : _____	GRADE

1. What does a blueprint tell a machinist?
2. Is a blueprint a standard method that can be understood by designers and engineers alike?
3. Why is training in blueprint reading important?
4. What is done with the original drawing or sketches?
5. Is the blueprint an exact copy of the original?
6. Name 3 ways of producing copies of drawing.
7. What are hidden lines and how are they used?
8. Draw an example of the following:
   a. Center lines
   b. Dimension lines
   c. Hidden lines
   d. Extension lines
   e. Cutting plane lines
   f. Break lines
9. Give the 2 systems in use by the machine shop to divide the inch.
10. What is the difference between a machinist's steel rule and a combination steel rule?
11. What can a steel rule be used for besides measuring?
12. What tools are most commonly used to transfer measurement?
13. How do we make measurements under hundredths of an inch?

14. Where is the anvil of a micrometer?

15. What is the difference between 1/3 and .33333?

16. Why is it important to open the micrometer before removing it from the work?

17. What is the increase in distance between the anvil and the end of the spindle when the thimble is turned one full turn?

18. How much does one division on the thimble of the micrometer represent?

19. Construct straight lines of the following lengths.

    2½ inches
    4 "
    4 3/8 "
    1 1/4 "
    2 3/8 "
    5 7/16 "
    2 7/8 "
    5 5/16 "
    4 1/32 "
    3 7/32 "
    2 9/64 "
    4 32/64 "
    1 1/10 "
    2 7/10 "
    3 50/100"

20. What is a trammel?

21. Find the distance the spindle advances when the thimble makes 9 full turns and 17 divisions on the thimble.

22. What is the measurement when the reading on the barrel is 7 graduations and on the thimble 11?

	Number of whole divisions showing on the barrel	Reading on thimble	Answers
23.	9	9	
24.	5	23	
25.	10	15	
26.	11	18	

	Number of whole divisions showing on the barrel	Reading on thimble	Answers
27.	0	20	
28.	12	3	
29.	25	21	
30.	22	7	

Make a sketch showing the following micrometer readings:
(refer to problems 36-50 for examples of sketches)

31. 0.456

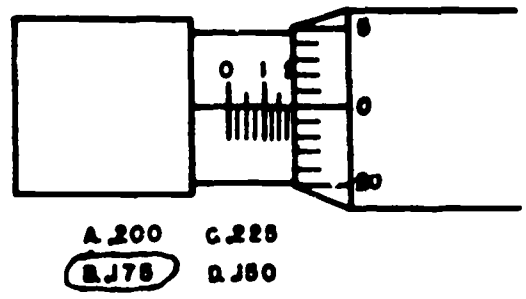
32. 0.875

33. 0.3125

34. 5/8

35. 1/4

Example:



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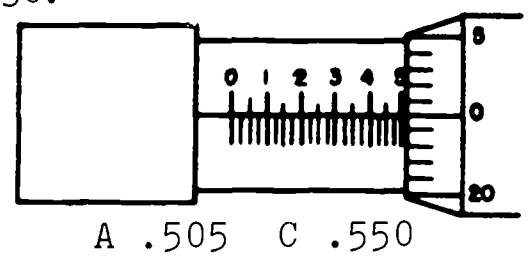
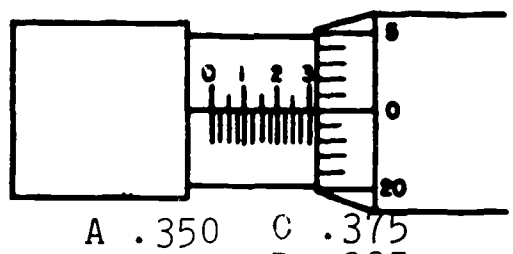


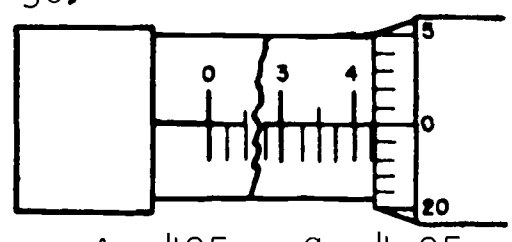
A .505 C .550
B .505 D .525

37.



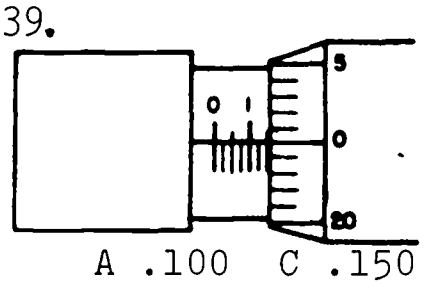
A .350 C .375
B .390 D .325

38.



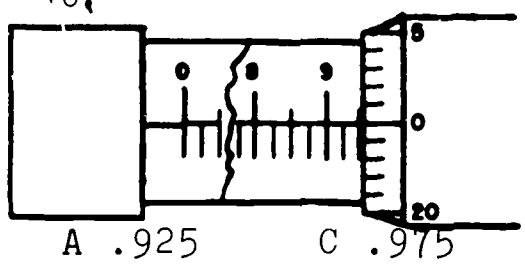
A .425 C .4.25
B .0425 D .0.425

39.



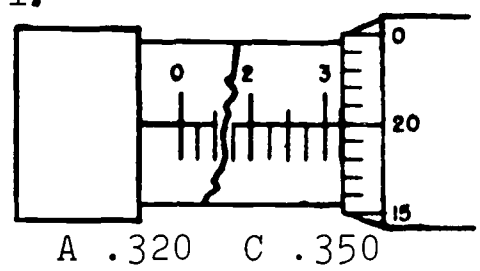
A .100 C .150
B .110 D .125

40.



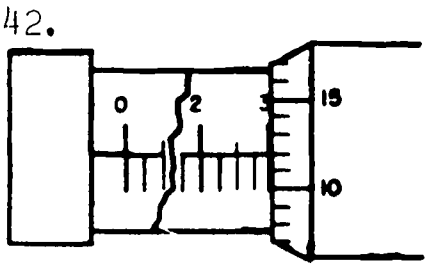
A .925 C .975
B .950 D .935

41.



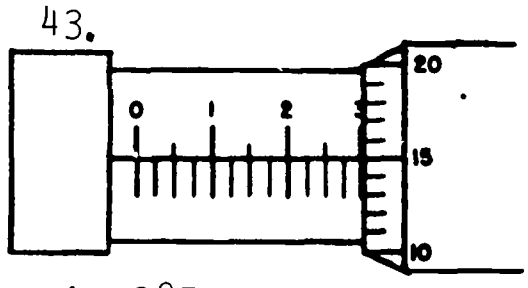
A .320 C .350
B .325 D .327

42.



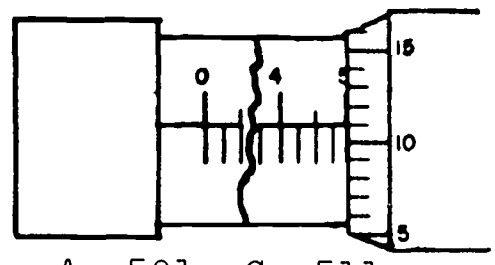
A .309 C .350
B .311 D .312

43.



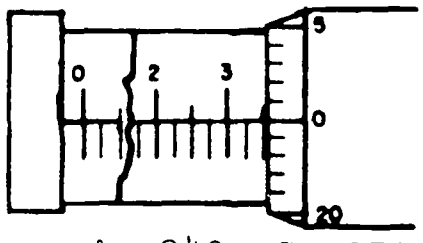
A .285 C .305
B .315 D .351

44.



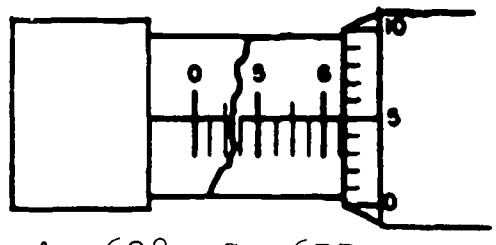
A .501 C .511
B .510 D .0511

45.



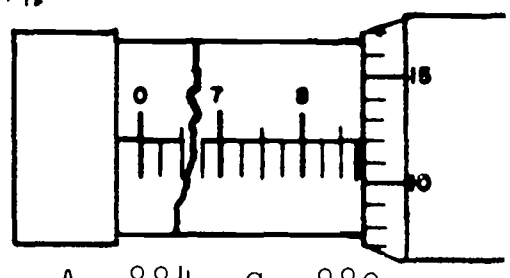
A .340 C .350
B .335 D .347

46.



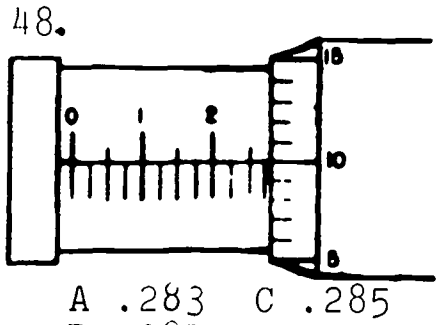
A .628 C .655
B .630 D .635

47.



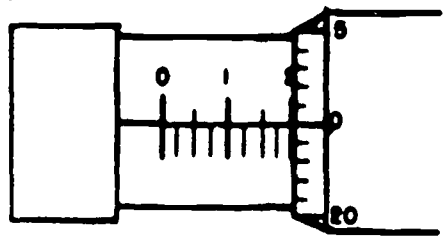
A .884 C .889
B .887 D .885

48.



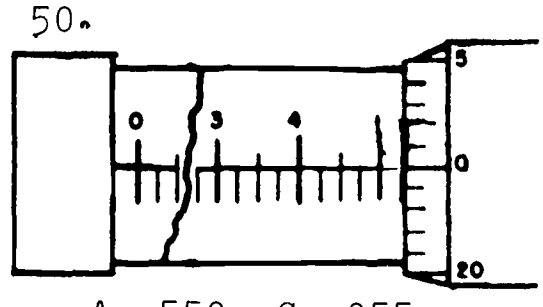
A .283 C .285
B .287 D .291

49.



A .200 C .100
B .110 D .205

50.



A .550 C .055
B .575 D .525

Machine Shop
Unit I
Bench Work

R.S.A. 5
3 Hours

Part I

Technical Information

Test Sheet	Name : _____ Date : _____	GRADE

1. What are chisels usually made of?
2. What types of cold chisels are there?
3. To what angle should the chisel cutting edge be ground?
4. What happens if too much pressure is used in grinding the chisel?
5. What is meant by "mushroom head" of a chisel?
6. What usually causes cracks and breaks in a chisel?
7. Give three safety rules to follow when using a chisel.
8. What kind of a chisel is used to cut key ways?
9. What is a burr?
10. Why is removal of burrs necessary?
11. What are the industrial standard notations used on blueprints requesting work to be finished?
12. What part of the chisel should be watched while chipping?
13. In what direction should the shearing and chipping be done?
14. Why are drawings of more than one view needed in the machine shop?
15. How do you determine how many views of a drawing are needed?
16. Which are the most common views?

17. How do you decide which is the front view?

18. Why is the view always in line with the front view and immediately above it?

19. Solve the following problems.

a. 4/5 + 3/10 =

b. 1/2 + 1/4 =

c. 7/8 + 3/4 =

d. 5/6 + 2/3 =

e. 1/3 + 1/4 =

f. 2/3 + 1/2 =

g. 1/8 + 1/6 =

h. 1/5 + 1/3 =

i. 1/3 + 3/4 =

j. 3/8 + 1/4 =

k. 1/5 + 3/10 =

l. 2/3 + 3/4 =

m. 2/5 + 1/3 =

n. 1/2 + 2/9 =

o. 3/4 + 1/2 =

p. 1/5 + 7/10 =

20. Add and express in lowest terms.

a) 1/4 1/6	b) 3/8 1/2	c) 5/8 2/5	d) 1/3 7/8
e) 3/8 7/12	d) 5/6 2/3	e) 7/10 4/5	

21. Subtract

a) 1/2 1/4	b) 1/3 1/5	c) 3/4 1/2	d) 3/4 3/5
e) 2/3 1/2	f) 3/4 3/8	g) 7/8 1/4	h) 5/6 1/3
i) 4/5 1/3	j) 7/9 2/3	k) 6/7 1/2	l) 7/12 3/16

22. Multiply

a) 2/3 x 2/3 =

b) 4/5 x 3/5 =

c) 7/8 x 4/7 =

d) 6/7 x 7/9 =

e) 2/5 x 15/22 =

f) 1/2 x 1/2 =

g) 4/9 x 6/11 =

h) 1/4 x 1/4 =

m - 394	t - 3649
n - 396	u - 6319
o - 493	v - 83524
p - 2146	w - 123456
q - 3179	x - 789
r - 234671	y - 302
s - 81088	z - 16

8. Check problems using excess of nines, mark R or W.

a. 642 x 32 = 19902

b. 832 x 42 = 34944

c. 1606 x 83 = 134904

d. 19 + 21 + 48 = 88

e. 32 + 9 + 8 = 49

f. 6 + 3 + 3 + 6 = 15

g. 82 x 91 = 7462

h. 198 - 83 = 105

i. 16 + 105 ÷ 2 = 60.5

j. 1098 + 3692 = 4790

k. 62 + 34 + 68 = 164

l. 841 + 3 = 843

m. 26 + 27 + 28 = 61

n. 13814 x 86345 = 1450236

o. 10653 x 812 - 16 = 1450220

p. 963 ÷ 18 = 53

Machine Shop
Unit I
Bench Work

R.S.A. 6
3 Hours

Part I

Technical Information

Test Sheet	Name : _____ Date : _____	GRADE

A. 1. When do we hand cut internal openings?

2. What makes cutting an internal opening a simple problem?

3. Why is it poor practice to use a flat cold chisel to cut out the internal section?

4. How do you make a single elongated slot?

5. Why must holes be drilled accurately?

B. 1. When are two view drawings used?

2. What are hidden lines used for?

3. Are the same two views always used?

4. What views are preferred?

5. What kind of a line do you use for a hidden circle?

6. Draw 2 views of some object in the room showing dimension lines, hidden lines, center lines and extension lines.

7. Give the excess of nine of the following numbers.

a - 343	g - 4262
b - 628	h - 3194
c - 421	i - 12
d - 762	j - 2692
e - 320	k - 4321
f - 333	l - 622

q. 962 ÷ 18 = 54

r. 483.000 ÷ 19 = 2542

s. 19 + 48 = 67

t. 10321 + 1 = 10232

u. 12 - 2 + 16 = 26

v. 16 + 2 - 12 = 6

w. 12 + 362 = 12

x. 3 x 3 x 3 x 3 = 81

y. 32 + 48 = 80

z. 2 + 2 - 2 + 2 = 16

Machine Shop
Unit I
Bench Work

R.S.A. 7
3 Hours

Part I

Technical Information

Test Sheet	Name : _____ Date : _____	GRADE

1. What information is needed when ordering rivets?
2. What is our most common rivet made out of?
3. What shape heads are available in rivets?
4. What shape does a wagon box rivet have?
5. What is a bolt?
6. What are bolts used for?
7. How many kinds of common bolts are there?
8. What is usually used to fasten metal together when a bolt and nut would interfere with the part function?
9. What kinds of screws are there?
10. What is a stud bolt and where is it used?
11. When do we use a one view drawing?
12. How do we designate a diameter dimension on a one view drawing?
13. Are notes permissible on a one view drawing if it is necessary to produce a clear drawing?
14. When do we use an auxillary view with a drawing?

Machine Shop
Unit I
Bench Work

R.S.A. 8
3 Hours

Part I

Technical Information

Test Sheet	Name : _____ Date : _____	GRADE

1. Why must a hammer handle be square with hammer head?
2. Why do we have soft-faced hammers?
3. What is a ball peen hammer used for?
4. What will happen if a screwdriver is ground with a chisel point?
5. What kind of a screw driver is fluted?
6. What are diagonal cutters?
7. What kind of pliers are used for placing and removing parts from small spaces?
8. What is an open end wrench?
9. What is the wrench called that has eight notches arranged in a circle inside a closed end?
10. What is a spanner wrench?
11. When do you make a three view drawing?
12. What is done to the top view to make it project on the drawing paper?
13. Which are the three views usually shown of a drawing?
14. When is an auxilliary view used?
15. Why are some lines solid in one view and short dashes in another?
16. What abreviation is used for auxilliary view?
17. Solve the following:
    a. How many square inches in a 6 inch square?
    b. How many square inches in an object 6 x 7 inches?

c. A one inch square rod is three feet and four inches long; how many square inches does it contain?
d. A man is building a machine shop 80 feet long and 63 feet wide. How many square feet of floor space has he?
e. How many 1/2 inch blocks will it take to fill a 2" hole 1/2 " deep?
f. If it takes six minutes to saw a log into three pieces, how long will it take to saw the same log into four pieces?
g. Find the area of a right triangle having a 10" side and a 5" side.
h. A box is 14" square and 10" deep. The lid has a capacity of 196 square inches but fits ½" down on the box. How much does the box and lid enclose?
i. What is the distance around a wheel 10" in diameter?
j. How many cubic feet in 1 cubic yard?
k. How many cubic inches in 1 cubic foot?
l. How many cubic inches in a block 3 x 12 x 18?
m. If steel weighs .2835 lbs. per cubic inch, how much does a rod weigh that is 3/4" in diameter and 4½' long?

Machine Shop
Unit I
Bench Work

R.S.A. 9
3 Hours

Part I

Technical Information

Test Sheet	Name : _____ Date : _____	GRADE

1. What does the accurate use of calipers depend on?
2. What two ways may a caliper be used?
3. Name three types of calipers.
4. At what angle should calipers be held toward center of work?
5. How much force is necessary when putting a caliper over the work for a measurement?
6. How close can a skilled worker measure with a caliper?
7. Is it correct to say that the legs of an inside caliper should touch the legs of an outside caliper center to center when transferring measurements?
8. What is an hermaphrodite caliper used for?
9. Is it permissible to use a center line for an extension line?
10. When would it be desirable to use center lines as extension lines?
11. When several holes are equally spaced on a circle, is it necessary to locate each hole?
12. Why?
13. When several unequally spaced holes are located on a circle, what information must be given?
14. In giving dimensions for holes not on a circle it is common practice to give the dimensions as related to each other. Is this true?

15. What is base line dimensioning?

16. What is meant by tolerances?

17. How is tolerance shown on a drawing?

18. Are tolerances ever used with angular dimensions?

19. What symbols are used with angular dimensions?

20. Write 20 degrees 14 minutes 3 seconds using symbols.

21. Answer all test questions in math.

Machine Shop
Unit I
Bench Work

R.S.A. 10
3 Hours

Part I

Technical Information

Test Sheet	Name : _____ Date : _____	GRADE

1. Why is a drill not reliable to finish a hole smooth and accurate.
2. Name the main parts of a reamer.
3. Define the two general types of hand reamers.
4. In what direction should a reamer always be turned?
5. What is the function of a pipe reamer?
6. What is the taper per foot of a dowel pin reamer?
7. What is the angle of a reamer which is used to fit flat head rivets and machine screws?
8. What type of tool is a reamer and what is its function?
9. What part of a solid hand reamer is tapered and how long is the taper?
10. Which of the reamers is considered the most efficient to use for general purposes?
11. What type reamer can be sharpened and easily adjusted?
12. Define five types of fits.
13. Which type fit is used when two parts are to remain indefinitely together?
14. What is meant by the term "limits?"
15. What is meant by the term "tolerance?"
16. What is the pitch of micrometer screw?

Machine Shop
Unit I
Bench Work

R.S.A. 11
3 Hours

Part I

Technical Information

Test Sheet	Name : _____ Date : _____	GRADE

1. Name the common type die which is fixed and has no adjustment.

2. Which die is used for chasing or recutting a damaged and burred thread?

3. What is the advantage of an adjustable die?

4. What other name is given a die holder?

5. How should the end of a rod be prepared for threading?

6. How is the size of a die determined to thread the end of a rod?

7. What tool is used to determine the threads per inch of a screw thread?

8. When is it necessary to reverse a die?

9. What size die is needed to thread a 5/8 inch rod to have 11 threads per inch?

10. What are the principal uses of screw threads?

11. Name the five American National screw thread system series.

12. What is meant by the obsolete term "U.S.S.?"

13. What is meant by the obsolete term "S.A.E.?"

14. What three sets of taps and dies are found in the average shop?

15. Define a screw thread.

16. Define depth of thread.

17. Define external thread.

18. Define internal threads.

19. Define major diameter.

20. Define minor diameter.

21. In what type of metal are studs usually used?

22. Why are studs used to assemble parts?

23. What kind of threads are usually used on the stud end on which the nut is screwed?

24. What is the term used for the smallest diameter of a tapped hole?

25. What is the function of a screw extractor?

ERIC

Machine Shop
Unit I
Bench Work

R.S.A. 12
1 Hour

Part I

Technical Information

Test Sheet	Name : _____ Date : _____	GRADE

1. What is meant by the term "ore?"
2. What is hematite?
3. Where is the greatest portion of hematite found?
4. Where are the greatest iron ores located?
5. Name the two methods of removing iron ore.
6. What is the function of the blast furnace?
7. Why is the product of the blast furnace called pig iron?
8. What is a grain?
9. Name five properties of metals. Define each.
10. What are ferrous metals?
11. Name four non-ferrous metals.
12. Is stainless steel a ferrous metal?
13. About how much iron ore, coke, limestone and air are required to produce one ton of pig iron?
14. What is the hottest temperature found in a blast furnace?
15. About how often do they tap the blast furnace to remove the pure iron?
16. Is a blast furnace run continuously?
17. Is the raw material controlled or are the weights for various materials approximate?

18. What does a stove do for a blast furnace?

19. What is the temperature of the hot-air blast?

20. Where is most of the pig iron used?

21. Work the following problems.
    a. Is it correct to say "seven and eleven are nineteen" or to say "seven and eleven is nineteen"?
    b. Divide. Give answers to 3 places.

    1) 42)150365
    2) 63)45089
    3) 23)165605
    4) 29)114842
    5) 18)172584
    6) 182)720565

    c. Divide. Give answers to four places.

    1) 51)641456
    2) 38)421222
    3) 36)720361
    4) 16)320486
    5) 72)845091
    6) 17)447101

    d. Subtract

    1) .87 / .44
    2) 7.6 / 3.6
    3) 5.1 / 2.7
    4) 26.85 / 18.80
    5) 7.871 / 1.793
    6) 33.000 / 9.175
    7) 7.0 / .1
    8) 18.000 / .018
    9) 24.10 / 9.27
    10) 1.00 / .39

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Vocational Curriculum Development and Research Center

NATCHITOCHES, LOUISIANA 71457

ERIC

VT 003 735
Basic Machine Shop Training Course, Basic Bench Work, Answer Book.

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ABSTRACT - This answer book is for use with the following related test booklets: VT 003 726, VT 003 728, VT 003 730, VT 003 732, and VT 003 733 (all in this issue). Other documents in this five-unit machinist training series are study guides available as VT 003 727, VT 003 729, VT 003 731, VT 003 734, and VT 003 736 (all in AIM Summer 1968). (AW)

VT 003 735

ED0 45856

1. A tap is an accurately threaded and fluted tool for cutting internal threads.
2. The fluting produces the cutting edges of the tap.
3. A tapered tap is one that has a smaller diameter at the starting end.
4. This varies with the type. It is given in the machinist handbooks and is usually some figure such as 0.6495 x pitch.
5. Use formula--outside diameter--(.75 x 1.299/no. of threads per inch)
6. Because it requires different threads for the various types of metal.
7. To permit adjustment.
8. Cutting oil.

1. Solid block die.
2. Solid block die.
3. Adjustments may be made for wear and fit desired.
4. Die stock.
5. Grind or file a chamfer or bevel on the end of the rod to be threaded.
6. By measuring the diameter of the rod.
7. Thread gauge.
8. When thread must be cut against a shoulder.
9. 5/8" die with 11 NC.
10. Holding parts together and transmitting motion.
11. National course, National fine, National extra fine, National 8 pitch series, National 12 pitch series.
12. United States Standard.
13. Society of Automotive Engineers.
14. National Course, National Fine, National Pipe.
15. A spiral groove cut on the outside of a rod or the inside of a nut.
16. Distance between the root and crest of a thread measured normal to the axis.
17. A thread on the outside of a part.
18. A thread on the inside of a part.
19. The largest diameter of a screw thread.
20. The smallest diameter of a screw thread.
21. Cast iron.
22. When it would be impractical to run a bolt through the part.
23. National Coarse.
24. Root diameter.
25. To remove broken off screws and bolts.

A. 1. Burns out impurities of iron ore.

2. Receiving Hopper

Distributor	Stock line	Bustle pipe
Small bell	In wall	Tuyeres
Large bell	Slagnotch	Bosch
Bleeder valve	Hearth	Inwall
Gas uptake	Iron notch	

3. Mixes with ashes of burned coke and rock and earth of the iron ore making slag.

4. A furnace, called a blast furnace because of the very hot air that is forced into it from the bottom, is charged with iron ore, coke and limestone. The hot air and burning coke melts the iron. The heating and burning process melts the iron ore and the iron, being heavy drops to the bottom and flows out through an iron notch. The impurities mix with the limestone to form slag which floats on top of the melted iron. The slag is drawn off through a special outlet hole.

5. Slag is a mixture of iron impurities and limestone.

6. Pig iron is the iron ore with the impurities removed.

B. 1. Melting and refining of metal is considered chemical metallurgy. Behavior of metals during shaping and treating is physical metallurgy.

2. Metallurgy deals with the study and control of metals.

3. A grain is a small particle of metal made up of atoms.

4.

Tensil strength	Fatigue
Ductility	Toughness
Brittleness	Hardness
Elasticity	Corrosion resistance
Compression strength	Weldability

5. Ductility, brittleness, toughness.

6. 1375 degrees.

7. Increases strength--decreases grain size.

8. To determine how much stock is needed to make required bend. Lay out pattern to scale, measure each leg of bend. Add the length of the legs, reduce by 1/2 the diameter for each leg. The result will equal the length of the center line of the material needed.

Answers to Mathematics
on page 3 of 6 of R.S.A. 12

1. 13.5°
2. 3 3/4°
3. 1 8/15° or 1.533°
4. 3/4°
5. 28°
6. 2 5/6° or 2.833°
7. 1/4°
8. 16 1/2°
9. Acute
10. 360°; 360°; 360°
11. 180°; 90°
12. 90° 40'
13. 60; 3600
14. 33° 20'
15. No
16. Acute
17. 360°
18. 1/360 of a circle
19. 159° 45'
20. 3600

Answers to Mathematics
on pages 4 and 5 of 6 of R.S.A. 12

1. Acute
2. Obtuse
3. Supplementary
4. 90°
5. 60
6. 60
7. 3600
8. 330
9. 64° 46' 54"; Acute
10. Supplementary
11. 360°; 360°; 180°
12. No
13. Yes
14. 39° 40' 5"
15. 25°; 35°; 20°
16. 109° 5'; 65° 20'
17. 36°; 180°; 84°; 32°; 96°; 44°

Answers to Mathematics
on page 6 of 6 of R.S.A. 12

A. 90°
B. 180°
C. 270°
D. 104°
E. 148°
F. 109°

G. 64°

H. 104°

I. 171°

J. 22°

K. 257°

L. 103°

M. 352°

N. 8°

1. A mineral bearing rock.
2. An iron ore.
3. Lake Superior District.
4. Lake Superior District.
5. Open pit and underground mining.
6. To purify the iron.
7. Because the trenches originally made to receive the molten iron looked like a litter of suckling pigs.
8. A small particle of metal made up of atoms.
9. Ductility - ability to stretch, bend, or twist.
   Tensile strength - resistance to pulling apart.
   Brittleness - opposite to ductility.
   Hardness - resistance to penetration.
   Corrosion resistance - ability to resist chemical action.
10. A metal alloy that contains iron in some quanity.
11. Copper - brass - bronze - aluminum.
12. Yes.
13. 2 tons ore, 1 ton coke, ½ ton limestone, 3½ tons of hot air blast.
14. Almost 3000 degrees F.
15. Every 6 hours.
16. Yes.
17. Very rigid control
18. Heats the blast air.
19. 1000 degrees F.
20. In making steel.
21. a. Seven plus eleven <u>is</u> <u>18</u>.

b.
1) 358
2) 715
3) 720
4) 396
5) 958
6) 395

c.
1) 1257
2) 1108
3) 2001
4) 2003
5) 1173
6) 2630

d.
1) .43
2) 4.0
3) 2.4
4) 8.05
5) 6.078
6) 23.825
7) 6.9
8) 17.982
9) 14.83
10) .61

STATE VOCATIONAL-TECHNICAL & TRADE SCHOOLS
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LOUISIANA

REVISED

BASIC BENCH WORK

1967

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Answer Book

VT 003 735

BASIC MACHINE SHOP TRAINING COURSE

NOTE:

The answers to Math Assignments 1 through 9 are in the front of the Answer Book. These assignments should be given as a final math examination at the end of the unit. This is optional with the instructor.

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Machine Shop
Unit I
Bench Work

Answers for Math 1

Mathematics 1

1. 101
2. 5
3. 92
4. 25
5. 169
6. 1109
7. 3304
8. 14
9. 524
10. 23401
11. 121,646,865
12. 14,688
13. 22,848
14. 45,648
15. 383,760
16. 38,376
17. 277,576
18. 98,901
19. 912,000
20. 84,800
21. 16,411,572
22. 170.5
23. 25
24. 101
25. 215
26. 6300
27. 1669.5
28. 2596
29. 1001
30. 202

Unit I
Bench Work

1. $\frac{67}{16}$; $\frac{4}{3}$; $\frac{237}{14}$; $\frac{120}{11}$

2. 12; 8; 146; 18

3. 5 1/3; 9 1/7; 9; 11 1/9

4. 1 27/50

5. 7/16

6. 13 11/16

7. 86 1/16

8. 60 13/16

9. 63 43/48

10. 34 47/60

11. 12 1/24

12. 41 41/64

13. 34 1/2

14. 1/6

15. 18 37/63

16. 6 11/48

17. 61/168

18. 54 31/32

19. 9

20. 15 2/15

Machine Shop
Unit I
Bench Work

Answers for Math 3

Mathematics 3

1. 1/48
2. 4
3. 4 2/3
4. 1 25/128
5. 1 13/32
6. 10 2/3
7. 1/18
8. 1/21
9. 27/32
10. 1 10/27
11. 3/32
12. 20
13. 3/16
14. 3/16
15. 55 5/6
16. 2 2/7
17. 303
18. 2
19. 55/576
20. 10

1. 13.56
2. 16.64
3. .03864
4. .07904
5. .000358
6. 23.04
7. .9801
8. .12420
9. 3388.128
10. .057375
11. 1.06
12. 16.111
13. 303,603.33
14. .028
15. 6,000
16. 222,000
17. 2,400
18. .2400
19. 41.09
20. 24610

Unit I
Bench Work

1. 594; 3 1/12 yd.;
   83 1/3'; 8 1/3

2. 5; 16; 24; 4

3. 100; 75; 30; 18

4. 112; 660

5. 848; 60

6. 36

7. 16

8. 27

9. 6

10. 14

11. 72

12. 2

13. 75

14. 250

15. 10

16. 64

17. 7

18. 10

19. 2437.5

20. 7 39/110 or 7.35

Unit I
Bench Work

1. 386" or 32' - 2"
2. 19' - 7 15/16"
3. 8 3/4"
4. 85.97" or 7' - 1 63/64"
5. 18
6. 17
7. 55.56" or 4' - 7 9/16"
8. 109 or 115
9. 1' - 1 7/16" or 1' - 1.43"
10. 2999 mm. or 2.99 m.

Machine Shop Answers for Math 7 Mathematics 7
Unit I
Bench Work

1. Measuring device
2. Changing size - keep prop.
3. Mark indicating quantity
4. Partition
5. Definite quantity as stand
6. 5 1/2 yds; 16.5 ft.
7. 12 inch; 1/3 yd.
8. 1/12 of ft.
9. 5280 ft.
10. 3.281 ft.; 39.376"
11. 1/10 metrr; 3.9376:
12. Figure - intersection lines
13. 1000
14. 1 million
15. 1/1000
16. 1/360 of circle
17. 12
18. 3
19. 1000
20. 16
21. 108
22. 24

Unit I
Bench Work

1. (parallelogram) rhomboid
2. trapezoid
3. hexagon
4. square
5. equilateral triangle
6. octagon
7. isosceles triangle
8. trapezium
9. pentagon
10. (parallelogram) rhomboid
11. rectangle
12. right triangle
13. ellipse
14. cube
15. (rectangular) right prism
16. (triangular) right prism
17. (parallelogram) right prism
18. right triangle
19. cone
20. frustum of a cone
21. right regular cylinder
22. pentagon pyramid
23. sector of a circle
24. square pyramid
25. circle

Machine Shop Answers for Math 9 Mathematics 9
Unit I
Bench Work

1. 6.928" or 6 59/64"

2. 41.568 sq. in.

3. 20.772 sq. in.

4. 87.75 sq. in.

5. 7.07" or 7 1/16" $\pm$

6. 11.088 or 11 3/32

7. 15.554" or 1' - 3 9/16"

8. 1.465 or 1 15/32"

9. 4.33" or 4 21/64"

10. 3.465 or 3 15/32

Machine Shop
Unit I
Bench Work

Answers for R.S.A. 1
Mathematics on R.S.A. 1

1. 21
2. 24
3. 63
4. 30
5. 54
6. 32
7. 18
8. 28
9. 45
10. 56
11. 49
12. 48
13. 36
14. 42
15. 81
16. 100
17. 64
18. 24
19. 72
20. 36
21. 40
22. 27
23. 35
24. 28
25. 18
26. 144
27. 14
28. 24
29. 20
30. 25

Machine Shop
Unit I
Bench Work

Answers to R.S.A. Questions

R.S.A. 2
6 Hours

A. 1. (a) Calipers, Micrometer, Vernier Calipers.
(b) Steel tape, rule, divider, trammel.
(c) Bend protractor.
2. Micrometer.
3. Because of damage to accuracy--also rusting.
4. It is generally used to measure larger objects than can be measured with an ordinary micrometer.
5. The accuracy of any measuring tool depends on its condition and the care of the user.
6. Gages used by machinists for a "go" or "no go" on rough turning.
7. A tool for measuring angles.
8. Dial indicators are measuring tools used to align machine tools, or aligning objects in leather, etc.
9. Hold the thimble between the thumb and forefinger with the frame resting on base of thumb.
10. Frame, anvil, spindle, sleeve and thimble.

B. 1. Layout is the scribing on the metal surface for the guidance to the worker.
2. Because it is confusing.
3. To make the scribe marks stand out clearly.
4. Copper sulfate disolved in water plus a few drops of Nitric acid.
5. A beam compass.
6. Bench plate, hammer, center punch, prick punch, scriber, divider, vernier caliper, morphy Caliper scale, bend protractor, square, parallels angle plate, height gage, surface gage trammel points.
7. Blue vitrol.

C. 1. Distance from Point on one tooth to corresponding point on next tooth.
2. Blades are hardened throughout.
3. ½" wide 14 to 32 teeth 8 - 16 inches long.
4. Adjustable and solid.
5. None.
6. Make a starting nick with a file.
7. Manner in which teeth are bent.
8. 14 to 32.
9. 50 strokes per minute.
10. 4.
11. High speed, Tungsten, other alloy steel.
12. Clamp the metal between two pieces of board.
13. Numerator and denominator.
14. A whole number and a fraction.
15. A fraction whose value is 1 unit.
16. A proper fraction with the numerator smaller than the denominator.

Machine Shop
Unit I
Bench Work

Answers to R.S.A. Questions

R.S.A. 2
6 Hours

D. 1. Because each is designed for a specific type of work.
2. A narrow hand file.
3. Two courses of cuts crossing each other.
4. To remove chips and "pinning."
5. If the work is square and smooth.
6. Emery cloth.
7. An abrasive cloth.

Answers for
Mathematics on R.S.A. 2

1.	2	11.	16
2.	2	12.	8
3.	2	13.	16
4.	4	14.	2
5.	4	15.	4
6.	2	16.	12
7.	6	17.	18
8.	8	18.	6
9.	10	19.	13
10.	24	20.	8

Machine Shop — Answers To Test Questions — R.S.A. 2
Unit I — 6 Hours
Bench Work

1. Pitch of a hack saw blade is the distance to a point on one tooth to the correspondent point on the next tooth.
2. 50 strokes per minute.
3. Denominator and the numerator.
4. A mixed number is composed of an integer and a fraction.
5. A file used to cut key ways and slots, one edge is not cut. File is double cut.
6. Using a straight edge and square.
7. Rule, tape, calipers, sheet stock measuring guage, micrometer, square, divider, trammel, protractor.
8. A measuring tool used in machine shops for fine and exacting work. Divisions are 1/40 in graduation.
9. Frame, anvil, spindle, lock nut, hub, sleeve, screw, ratchet stop.
10. Transferring of information from a working drawing to the metal surface.
11. A copper sulfate solution used in laying-out.
12. A beam compass for drawing arcs or circles with a large radius.
13. a. 13.60
    b. 1/5, 1/3, 1/4, 1/10, 1/20
    c. 1-1/10, 3/4, 1½, 1-1/6, 5/12, 7/24, 11/15, 9/16
    d. 5/12, 7/8, 3/4, 1-1/48, 1-7/20, 21/24, 1-47/60, 61/48
    e. 24/64, 28/64, 30/64, 12/64
    f. 1/3, 3/6, 7/15, 1/12, 8/25, 21/32, 13/30, 9/16
    g. 2/3, 3, 21/32, 9/24, 9/20, 1/5, 231/16, 1/16
    h. 20 drills x 3-3/16 + 18 x 1/8

       20 x 3-3/16 = 20 x 51/16 = 1020/16= 63.75

       18 x 1/8 = 18/8 = 2.25

       63.75 + 2.25 = 66" needed

    i. 15 washer x 3/32" + 13 x 1/16

       15 x 3/32 = 45/32 = 1.4625
       13 x 1/16 = 13/16 = .8125
       1.4625 + .8125 = 2.2750

Machine Shop | Answers to R.S.A. Questions | R.S.A. 3
Unit I | | 6 Hours
Bench Work

A. 1. A machine either hand or electrically operated used to sharpen tools or remove roughness from metal object.
2. A grinder that can be taken from job to job.
3. A grinder that uses a flow of water as a coolant.
4. Flaws in wheel, too much speed, improper mounting and work being caught in wheel.
5. What the term says--precision.
6. Do not stand in front of grinder.
7. Carborundum, (silicon carbide), (aluminum oxide) and crystolon (silicon carbide).
8. Vitrified, silicate, shellor, resinoid, and rubber.
9. Shellor wheels.
10. By the strength of the Bond.
11. Allow 1/16 to 1/8" clearance.
12. Grinding wheel Dressor Tool.
13. Spoils shape of grinding wheel.
14. Page 40 of reference.

B. 1. The clearance behind the cutting edge of a drill.
2. The angle of lip clearance should be from 12 to 15 degrees.
3. The trailing edge of the lip.
4. High speed steel or carbon steel.
5. By the discoloration of the drill tip.
6. To permit cutting edge to enter the metal to be drilled.
7. When sharpening a drill watch for lip clearance, angle of lip clearance, length of lips.
8. A drill gauge measures the points mentioned in answer 7.
9. No answer.
10. Wearing of the corners.
11. Yes.
12. Oil, cutting oil, turpentine, lard oil and others.

1. Improper mounting, flaws, excess speed, work getting caught.
2. A wet grinder has a constant flow of coolant supplied to the wheel during grinding.
3. Alundum, carborundum, crystolon and axolite.
4. Grinding wheel dresser.
5. a. Always use a face shield.
   b. Never use a grinding wheel that is loose on the shaft.
   c. Test wheel for cracks.
   d. Feed work slowly and gradually.
   e. Stand out of the line of grinder when starting it up.
6. Clearance made by grinding away the metal behind the cutting edge.
7. The heel is the trailing edge of the drill behind the cutting edge.
8. A drill guage is used when sharpening drills to secure the correct length and cutting angle.
9. Lard oil, turpentine, soluble oil, kerosene.
10. Because thin material can be caught in the grinder.
11. Goggles
12. Wheel breakage, breaking of part, injury, etc.
13. Carbon Tool Steel sparks are white and explode immediately into bright stars and disappear. Sparks often follow around the wheel.
14. A decimal fraction has a denominator of 10 or a power of 10.
15. No
16. The decimal point.
17.

283.5	384.73	1738.0000	.067
69.2	63.14	0.0087	37.762
352.7	447.87	7.5800	7.900
		1745.5887	45.729

18. $.3475\overline{)1.7375}$ = 5

19. 1.970 inches
20. 2 inches
21.

a) 24.630	b) 423.201	c) .6473	d) 9.0000
18.205	37.640	.1471	6.4136
6.425	385.561	.5002	2.5864
e) 1.624	f) 8.324	g) .473	h) 627.12
.012	.606	.213	30.01
1.612	7.718	.260	597.11

22.
$$\begin{array}{r} 1.500 \\ .231 \\ \hline 1.731 \end{array}$$

23.
$$\begin{array}{r} .809 \\ .8 \\ .13 \\ 30.5 \\ 37706.32 \\ 34735.772 \end{array}$$

Machine Shop | Answers to R.S.A. Questions | R.S.A. 4
Unit I | | 3 Hours
Bench Work

A. 1. Blueprints provide a language by which simple and complex parts can be completely described.
2. A blueprint is a copy of a drawing made on tracing paper. As many copies as are needed can be made from one tracing.
3. Blueprint, photostats, ammonia process, and other new processes such as Xerox.
4. A copy made by photographic equipment.
5. Views, section, dimension, notes.
6. Object lines - give an outline of the object.
Hidden lines - Lines that indicate parts of the object not visible to the observer.
Center lines - Lines that indicate the center of the object or part of the object such as holes.
Extension lines - Light solid lines that extend away from the object and indicate what area is included in the dimension.
Dimension lines - The lines that have arrows on their ends and indicate the size of a part.
Projection line - Lines that show the relationship between two parts.

B. 1. A simple form of expression indicating what part of a unit is being expressed.
2. The yard as a unit of length.
3. None.
4. Measurement and drawing a straight line.
5. Calipers are used for measuring and transferring measurements.
6. No.
7. 0.025
8. 25
9. Because rough handling can destroy their accuracy.
10. Checking the squareness of objects.
11. Takes care of his tools.
12. To avoid damage to instrument.
13. A burr can hold the square away from the object and give a false reading.
14. To explain the use "laying-out" as it applies to Machine Shop practice.
15. On the surface of the job.
16. An adjustable hand tool used to scribe parallel lines, inspect parts, align jobs, etc.

Answers to Mathematics
on page 3 of 7 of R.S.A. 4

1. 5/16
2. 15/16
3. 1 5/16
4. 5/8
5. 4 5/16
6. 1 1/8
7. 2 11/16
8. 1 15/16
9. 3 1/2
10. 1
11. 1 11/16
12. 1 13/16
13. 5 5/16
14. 3 13/16
15. 3 1/4
16. 2 5/8
17. 2 1/4
18. 5 11/16
19. 1/2
20. 2 5/16
21. 3 7/16
22. 13/16
23. 1 3/4
24. 2
25. 2 15/16
26. 3 13/16
27. 4 7/16
28. 4 15/16
29. 5 1/2
30. 2 11/16

Answers to Mathematics
on page 4 of 7 of R.S.A. 4

1. 4 1/2
2. 5/8
3. 1
4. 3 1/4
5. 1 7/16
6. 9/16
7. 1/4
8. 1 5/8
9. 1 13/16
10. 13/16
11. 3 13/16
12. 4 3/16
13. 3
14. 1 1/4
15. 2 3/16
16. 1 1/2
17. 3 7/16
18. 3 1/2

Answers to Mathematics on page 4 of 7 of R.S.A. 4 (cont'd)

19. 5/8
20. 7/16
21. 15/16
22. 6 1/8
23. 3/4
24 5 11/16
25. 2 15/16
26. 4 15/16
27. 1 1/4
28. 1 1/8
29. 5/16
30. 4

Answers to Mathematics on page 5 of 7 of R.S.A. 4

1. 3/8
2. 7/8
3. 2 11/16
4. 1 3/4
5. 2 1/16
6. 1 5/16
7. 4 3/16
8. 3 7/16
9. 5 1/8
10. 2 7/16
11. 2 15/16
12. 4 3/4
13. 4 7/16
14. 5 9/16
15. 3 13/16
16. 5 15/16
17. 1 1/8
18. 2 5/8
19. 4 1/4
20. 5 3/8
21. 3 1/8
22. 4 5/8
23. 3 3/8
24. 3/8
25. 1 7/8
26. 3 5/8
27. 3/4
28. 5 7/8
29. 5
30. 2 3/8
31. 1 1/2
32. 5 15/32
33. 5 1/4
34. 5 25/32
35. 4 31/32
36. 5 31/32

Answers to Mathematics on page 5 of 7 of R.S.A.

37. 5 9/16
38. 5 1/16
39. 4 13/16
40. 5 5/16
41. 5 7/8
42. 4 23/32
43. 5 5/32
44. 5 21/32
45. 4 7/8
46. 5 13/32
47. 5 23/32
48. 4 43/64
49. 5 13/64
50. 5 53/64
51. 5 25/64
52. 4 59/64
53. 5 7/64
54. 5 31/64
55. 5 59/64
56. 5 9/32
57. 4 49/64
58. 5 35/64
59. 5 47/64
60. 4 55/64

Answers to Mathematics on page 6 of 7 of R.S.A. 4

1. .242
2. .186
3. .234
4. .148
5. .265
6. .293
7. .020
8. .303
9. .646
10. .557
11.
12.
13.
14.
15.

On Problems 11-15 the instructor should check student's sketches for student understanding.

Answers to Mathematics
on page 7 of 7 of R.S.A. 4

16. D
17. D
18. A
19. C
20. B
21. A
22. D
23. B
24. C
25. C
26. B
27. B
28. C
29. A
30. D

1. A blueprint describes an object to the machinist in detail and in a very precise manner.
2. Yes.
3. Because it gives a person the ability to visualize various manufacturing processes and how to describe his ideas so that others will understand them.
4. The original drawings are usually kept on file and copies are used in the shop.
5. Yes, except that the blueprint will be somewhat smaller because of shrinkage during drying process.
6. Blueprint, ammonia process, photostats.
7. Hidden lines are a continuous series of medium weight short dashes used to show lines and edges hidden from the observer.
8. a.

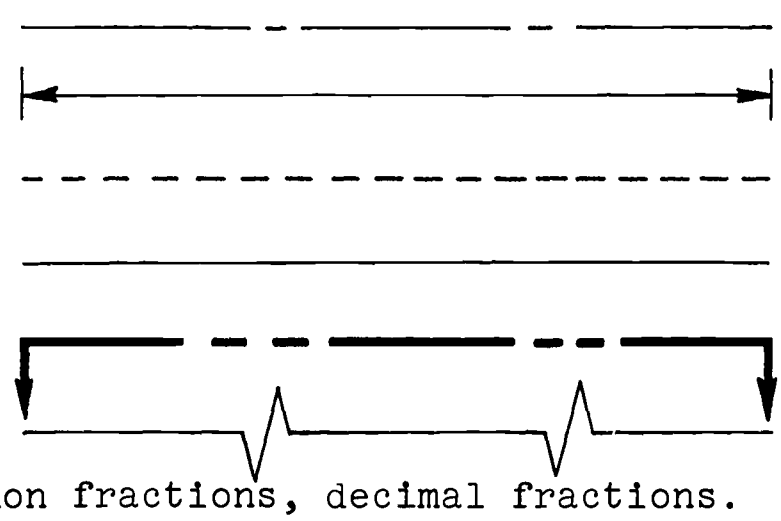
   b.

   c.

   d.

   e.

   f.



9. Common fractions, decimal fractions.
10. A machinist's rule has graduation of 1/8" on one edge and 1/16" on the other edge. On the other side of the rule are graduations of 1/32" and 1/64". A combination rule has graduation of 1/64" on the top edge and .010 on the bottom edge.
11. As a straight edge.
12. Inside and outside calipers.
13. By using a micrometer.
14. It is the stationary point of the micrometer where the work is placed for measurement.
15. None.
16. To avoid damage to micrometer and destroy its accuracy.
17. If a micrometer is opened one full turn the distance between the anvil and the end of the spindle is increased .025".
18. 0.001"
19. No answer--must be measured.
20. A beam divider used for scribing large circles.

Answers To Test Questions

21.	.242	36.	D
22.	.186	37.	D
23.	.234	38.	A
24.	.148	39.	C
25.	.265	40.	B
26.	.293	41.	A
27.	.020	42.	D
28.	.303	43.	B
29.	.646	44.	C
30.	.557	45.	C
31.	Instructor checks this.	46.	B
32.	" " "	47.	B
33.	" " "	48.	C
34.	" " "	49.	A
35.	" " "	50.	D

Machine Shop — Answers To R.S.A. Questions — R.S.A. 5
Unit I — 3 Hours
Bench Work

A. 1. The head of a chisel that has been flattened with rough ragged edges.
2. The stationary jaw.
3. Yes.
4. Flat, cape, diamond point, round nose.
5. a. Flat - general, chipping, cutting off.
b. Cape chisel - cutting keyway, narrow groove.
c. Diamond point - V grooves.
d. Round nose - round corners and beads.
6. At an angle of about 30°
7. The metal left on a part by the drill press, shaper.
8. With a cold chisel.
9. To avoid spoiling the part to misalignment on further processing.
10. To make the object look trim and neat.
11.

grind	machine smooth	rough machined finish	old symbol denoting machine surface

12. The blade.
13. Hold loosely in a position that any chips will fly away at an angle of approximately 50 degrees.
14. 1/16"
15. The cutting edge.
16. The edge when chipping steel.
17. Makes chisel easier to drive and cut faster.
18. Hold the hammer free and easy well back on the handle.
19. Flat chisel.
20. Caping chisel.

B. 1. Because one view will not always give the necessary details.
2. Drawings usually having a front, top and right side view.
3. The one the observer sees directly.
4. The full dimension of the view such as greatest width or greatest height.
5. The copy of the tracing given to the machinist to make the part.

Answers to Mathematics
on page 4 of 6 of R.S.A. 5

1.	.125	11.	.0769
2.	1/4	12.	.4500
3.	5/8	13.	.3333
4.	.03125	14.	2/25
5.	.609375	15.	.6000
6.	13/16	16.	.0010
7.	.1875	17.	13/16
8.	9/16	18.	.0240
9.	5/16	19.	.3000
10.	.34375	20.	57/64

Answers to Mathematics
on page 5 of 6 of R.S.A. 5

1.	.875; .4285; 9; 1.44	11.	11.235
2.	$\frac{7}{8}$; $\frac{13}{16}$; $1\frac{9}{40}$; $\frac{15}{16}$	12.	2.545
3.	1.7066	13.	.000 000 5
4.	2.0884	14.	10.066
5.	277.519	15.	2.9125
6.	9.96	16.	.094
7.	2.7	17.	.0312
8.	.00214	18.	2.37667
9.	54,965	19.	9.0625
10.	10.02	20.	42.7964

Answers to Mathematics
on page 6 of 6 of R.S.A. 5

1.	2.564	3.	.0078125
2.	.630	4.	1.667

Answers to Mathematics on page 6 of 6 of R.S.A. 5 (cont'd)

5. 19.9835
6. 6.229
7. 52.1142
8. 71.92
9. 12.4875
10. 1.6509
11. 7.59375
12. 9.485
13. 2.54475
14. 3.766
15. 89.281
16. 1.49
17. .0002
18. 5.088
19. 5.5544
20. 11.757

1. Octagonal tool steel.
2. Flat, cape, diamond point, round nose and gouge.
3. 70 degrees included angle.
4. The generated heat may destroy temper of chisel.
5. The head of the chisel flattens out and hangs over the side of the chisel body.
6. Improper fogging or heat treating.
7. a. Never use a chisel without wearing goggles.
   b. Never use a chisel with a mushroom head.
   c. Use a proper size hammer. Be sure it's heavy enough.
8. Cape chisel.
9. A burr is the turned up or projecting edge of metal left by sawing, drilling, punching and cutting.
10. To avoid misalignment when clamping in a machine. Also to avoid sharp corners for safety.
11.

G	S	R	
grind	machine smooth	rough machined finish	old symbol denoting machine surface

12. The cutting edge.
13. Toward the solid jaws of the vise and the direction of a blank wall.
14. Because one view may not be enough to describe the part clearly.
15. Always use the minimum number to completely describe the part.
16. Front Top and Right side views.
17. The way the observer looks at the part.
18. Because the part is in the same position as it was for the front view. What the observer sees when looking at the top of the part is rotated into the same plane as the front view for projection to the flat surface of the paper.
19.

a - 1 1/10	e - 7/12	i - 1/12	m - 11/15
b - 3/4	f - 1/6	j - 5/8	n - 13/18
c - 1 5/8	g - 7/24	k - 1/2	o - 1 1/4
d - 1 1/2	h - 8/15	l - 1 5/12	p - 9/16

20.

a - 5/12	d - 1 5/24
b - 7/8	e - 23/24
c - 1 1/40	f - 1 1/2
	g - 1 1/2

Answers To Test Questions

21.

a - 1/4	e - 1/6	i - 7/15
b - 2/15	f - 3/8	j - 1/9
c - 1/4	g - 5/8	k - 5/14
d - 3/20	h - 1/2	l - 19/48

22.

a - 4/9
b - 12/25
c - 1/2
d - 2/3
e - 3/11
f - 1/4
g - 8/33
h - 1/6

Machine Shop — Answers To R.S.A. Questions — R.S.A. 6
Unit I — 3 Hours
Bench Work

A. 1. Because parts must fit properly.
2. The holes may be drilled close together if accurately drilled.
3. Shearing chisel.
4. When it is a small job that would require lengthy machine operation.
5. A drift punch is narrow.

B. 1. When one will not give complete information.
2. By using hidden lines or cutaway section.
3. By using two center lines crossing at the exact center of cylinder.
4. In text.

Answers to Mathematics
on page 5 of 6 of R.S.A. 6

1.	6	18.	5
2.	7	19.	8
3.	0	20.	7
4.	8	21.	R
5.	4	22.	R
6.	5	23.	R
7.	7	24.	W
8.	3	25.	R
9.	5	26.	R
10.	1	27.	W
11.	0	28.	R
12.	4	29.	R
13.	7	30.	W
14.	1	31.	R
15.	4	32.	W
16.	6	33.	W
17.	7	34.	W
		35.	R

Answers to Mathematics
on page 6 of 6 of R.S.A. 6

1. R
2. W
3. R
4. R
5. R
6. W
7. R
8. R
9. R
10. R
11. W
12. R
13. W
14. W
15. R
16. R
17. R
18. W
19. W
20. W
21. R
22. W
23. W
24. W
25. W
26. R
27. R
28. W
29. R
30. R

Machine Shop — Answers To Test Questions — R.S.A. 6
Unit I — 3 Hours
Bench Work

A. 1. When the work is small and would require a lengthy machine operation.
2. When laying out, drilling, chiseling and filing are carefully done.
3. A flat cold chisel will distort the work by wedging the metal apart.
4. Drilling a single series of holes and using a shift punch. Finish with a file.
5. Holes drilled at an angle may make the opposite side opening too large.

B. 1. On sleeves, shafts, rods, and parts where complete detail cannot be given in a one view drawing.
2. To show parts that are hidden.
3. No.
4. Front and Top views.
5. Hidden lines.
6. Check drawing.

7.

a - 1	n - 0
b - 7	o - 7
c - 7	p - 4
d - 6	q - 2
e - 5	r - 5
f - 0	s - 7
g - 5	t - 4
h - 8	u - 1
i - 3	v - 4
j - 1	w - 3
k - 1	x - 6
l - 1	y - 5
m - 7	z - 7

8.

a - W	n - W
b - R	o - R
c - W	p - R
d - R	q - W
e - R	r - W
f - R	s - R
g - R	t - W
h - W	u - R
i - R	v - R
j - R	w - W
k - R	x - R
l - W	y - R
m - R	z - W

Answers To R.S.A. Questions

A. 1. Ease of assembly, strength of joint, permanent or removable.
2. Round head, oval, flat, countersunk, wagon box, truss.
3. No.
4. Round, flat.
5. A nut slotted for cotter pins.
6. Because head section imbeds in wood to prevent turning.
7. Headless bolts with thread on both ends.
8. To hold objects on shafts.
9. Steel, copper, brass, aluminum.
10. (a) Drill proper size hole.
(b) Select correct rivet.
(c) Rest rivet in riveting block.
(d) Strike center of rivet with peen of a ball peen hammer until rivet is spread out and rounded.
(e) Use rivet set to smooth off and round newly formed rivet head.
11. Cap screws are used when it is difficult to get at both sides of the work.
12. Thumb screws are used when a part is removed frequently and finger tightening is sufficient.
13. To prevent nuts from coming loose.
14. The same size as the bolt.

B. 1. One.
2. Three.
3. When it gives all the details.
4. An extra drawing needed to give complete information.
5. Only once on one view.

Answers to Mathematics
on page 4 of 6 of R.S.A. 7

1. Measuring device
2. Changing size - Keep proportion
3. Mark indicating quantity
4. Partition
5. Definite quantity as standard
6. 5 1/2 yds; 16.5 ft.
7. 12 inches; 1/3 yd.
8. 1/12 of ft.
9. 5280 ft.
10. 3.281 ft.; 39.376"
11. 1/10 meter; 3.9376"
12. Figure-intersection lines
13. 1000
14. 1 million
15. 1/1000
16. 1/360 of a circle
17. 12
18. 3
19. 1000
20. 16
21. 108

Answers to Mathematics
on page 5 of 6 of R.S.A. 7

1. 117' - 2 1/4"
2. 10
3. 78' - 7 47/64"
4. 9 59/64 or 9.915'
5. 3' - 1 15/16"
6. 88 pcs.
7. 41' - 9 9/16"
8. 4' - 3 5/16"
9. 62' - 6"
10. 1' - 6 11/16"

Answers to Mathematics
on page 6 of 6 of R.S.A. 7

1. $42.59
2. $4.00
3. $ .2289
4. $ .3930
5. $287.50

Machine Shop | Answers To Test Questions | R.S.A. 7
Unit I | | 3 Hours
Bench Work

1. Diameter, length, shape, kind of metal.
2. Soft iron.
3. Roundhead, oval head, flat head, countersunk head, wagon box head, truss head.
4. The wagon box head has a very thin round head.
5. A piece of rod having a head on one end and a threader section on the other.
6. To hold pieces of metal or metal and wood together when the protruding bolt does not interfere with the function of the part.
7. Machine, stove, carriage, stud.
8. Screws.
9. Round, flat, fillister, oval, set, log and cap screws.
10. A stud bolt is a headless bolt with thread at both ends used particularly for fastening cylinder heads on engines.
11. When the part is uniform and all information can be shown in one view.
12. By using the letter "D" and a center line.
13. Yes.
14. When one of the surfaces is at a slant and a regular view will not show true shape.

Machine Shop — Answers to R.S.A. Questions — R.S.A. 8
Unit I — 3 Hours
Bench Work

A. 1. Metal finishing is the last operation that is given to metal to make it look nice, to protect the surface from rusting and to make it wear longer.
2. Yes.
3. Painting, enameling, lacquering, spraying, bronzing, hammering, copper coloring, smoke finish, use of heat, burnishing, electroplating and others.
4. Copper coloring.
5. Red lead.

B. 1. How they are taken care of.
2. A torque wrench is used to determine how much tension is put on a nut as it is being tightened.

Answers to Mathematics
on pages 3 and 4 of 10 of R.S.A. 8

1. 144
2. 9
3. 1296
4. 1,000,000
5. 576
6. 2' - 6 55/64" or 2' - 6.857"
7. 266.6 yds.
8. 53101.7' or 53101' - 8.5"
9. 681,120 sq. ft. or 75,680 sq. yd.
10. 511.5 sq. ft.
11. 47.1489 sq. in. or 47 9/64"
12. 323 sq. ft.
13. 53.625 sq. in.
14. 2.697 sq. in.
15. 14.28 sq. in.

Answers to Mathematics
on pages 5 and 6 of 10 of R.S.A. 8

1. 140.625 sq. ft.
2. 66.6' or 66' - 7 13/64"
3. 64 sq. cm.
4. 80 mm.
5. $9.60
6. .6909 sq. ft.
7. 72 sq. in.
8. 25 sq. in.
9. 1.319 sq. ft.
10. 80.527 sq. in.
11. 1.57 sq. ft.
12. 6.57 sq. ft.
13. 5.585 sq. ft.
14. 16'
15. 8.944 or 8 15/16"

Machine Shop Answers to Mathematics R.S.A. 8
Unit I on pages 7 and 8 of 10 of R.S.A. 8
Bench Work

1. 27 cu. ft.
2. 1728 cu. in.
3. 46,656 cu. in.
4. 339.29 cu. in.
5. 648 cu. in.
6. .375 cu. ft.
7. 3.375 cu. ft.
8. 5.48 liters
9. 4.4156 cu. in.
10. 6.7597 lbs.
11. 807.84 gals.
12. 6750 to 6866.6 lbs.
13. 41.866
14. 267.95 cu. in.
15. 2.49 cu. in.

Answers to Mathematics
on pages 9 and 10 of 10 of R.S.A. 8

1. 156.1 sq. ft.
2. 223.7 sq. ft.
3. 2.759 sq. ft.
4. 110.2 sq. ft.
5. 24 sq. ft.
6. 74.76 cu. ft.
7. 6.59 cu. ft.
8. 222 gals.
9. 26.18 gals.
10. 1572.12 lbs.
11. 5.66" or 5 21/32"
12. 28.02"
13. 35.854 cu. in.
14. 11' - 7 21/64"
15. 4.96" or 4 31/32"

Machine Shop | Answers To Test Questions | R.S.A. 8
Unit I | | 3 Hours
Bench Work

1. To place the tool in probe balance and to enable the user to hit the object squarely.
2. To use on finished surfaces without marring them.
3. This is the common hammer of a machinist. The flat face is used for general work and the peen head is used for riveting or swaging.
4. Will slip out of the slot and cause ragged edges to the screw.
5. Phillips
6. Cutting pliers with cutting edges set at an angle.
7. Needle-nose pliers.
8. A wrench with a slotted opening made to fit one size nut.
9. An eight point box wrench.
10. A spanner wrench is made to fit around the nut hook into a slot or hole.
11. When necessary to provide worker with enough information to make the part.
12. Rotated to a vertical plane.
13. Front, top and right side.
14. When necessary to make a clearly understood drawing.
15. Because they are hidden in the second view.
16. Aux. V
17. a. 36
    b. 42
    c. 40
    d. 5040
    e. 16
    f. 9 minutes
    g. 25 sq. in.
    h. 2058 sq. in.
    i. 56.55 in.
    j. 27 cubic feet
    k. 1728 cubic in.
    l. 648 cub. in.
    m. 6.7597 lbs.

Machine Shop — Answers to R.S.A. Questions — R.S.A. 9
Unit I — 3 Hours
Bench Work

A. 1. Unit 26 in Basic Bench Metal Practices
(1) To maintain the bending moment at the correct point.
(2) The circular bend desired.
(3) Serves as an anchor point.
(4) Serves as a quick way of advancing bending points
(5) No difference except circle is closed.

Unit 27 in Basic Bench Metal Practices
(1) A scroll is a continuous curve.
(2) Because it acts as an actual pattern.
(3) Lay soft wire over scroll and mark amount needed to cover scroll pattern. Straighten wire and measure.
(4) When necessary to make small sharp curve at beginning of scroll.
(5) Scroll would not be flat.
(6) By placing it over the pattern and being certain it fits perfectly.

n 2. The inside is compressed and the outside stretched.
3. To avoid over-stressing resulting in cracks or breaking.
4. By using patterns or bending devices.
5. 1/4"
6. U clamp and pin block.

Answers to Mathematics
on page 4 of 7 of R.S.A. 9

1. 312.5 lbs.
2. 41.75 or 42.5 lbs.
3. 1242.5 lbs.
4. .6 oz.
5. 1.55 tons
6. 76.7 lbs.
7. 344.625 or 350.625 lbs.
8. 210.3808 lbs.
9. 295.3 lbs.

Answers to Mathematics
on page 5 of 7 of R.S.A. 9

1. .21
2. .0625
3. .00075
4. .001
5. .339
6. .00025
7. .0015
8. .095
9. 1.45
10. 2.38

Answers to Mathematics on page 5 of 7 of R.S.A. 9 (cont'd)

11. 15.64
12. 29.34
13. .01
14. .5
15. 25%
16. 41.66%
17. 1.3%
18. 11.2%
19. 6.25%
20. .25%

Answers to Mathematics on page 6 of 7 of R.S.A. 9

1. 25.6246
2. 87.5%
3. .394¢
4. $175 or $185
5. 52.63
6. 46.5
7. 40%
8. 216.6%
9. 20
10. 61.5
11. 145
12. 50%
13. 6153.8
14. 200%
15. 5.3

Answers to Mathematics on page 7 of 7 of R.S.A. 9

1. 75
2. 240 r.p.m.
3. 31/64
4. 26.04
5. 50 hrs.
6. 2 hrs.
7. 20 lbs.
8. 15.708
9. 160 hrs.
10. $13,225.

Machine Shop | Answers To Test Questions | R.S.A. 9
Unit I | | 3 Hours
Bench Work

1. The accurate use of calipers depends on the "feel" developed through use.
2. Set directly over the object.
3. Outside, inside, hermaphrodite.
4. Right angles.
5. None.
6. .002 to .005"
7. Yes.
8. Used to scribe lines parallel to the edge of metal.
9. Yes, when it gives clearer details.
10. When locating a circle or an arc.
11. No.
12. It is necessary only to locate one hole exactly and then show diameter of holes, the number of holes and the term "equally spaced."
13. Diameter of circle, size of each hole and its position.
14. Yes.
15. All measurements are made from a common finished surface.
16. This is the allowable variation from the actual dimension.
17. By notation on drawing such as Tolerances $\pm$ 1/64"
18. Yes.
19. Degrees ($^{\circ}$), minutes ('), seconds (")
20. $20^{\circ}14'3"$

Machine Shop | Answers To R.S.A. Questions | R.S.A. 10
Unit I | | 3 Hours
Bench Work

A. 1. To make round, smooth holes of an exact size.
2. Angle of chamfer, body and shank.
3. Destroys the cutting edge.
4. No, sometimes used to prevent friction.
5. Hand reamer, machine reamer.
6. Shank-body, angle of chamfer.
7. Preserve reamer life--produce straight holes.
8. Cutting blades can be moved up or down tapered slots.
9. By unevenly spacing of teeth, spiral cut teeth.
10. Making hole large enough for a film of oil between hole and shaft.
11. A shrink fit is metal that has been heated before assembly; as the metal cools it shrinks.

B. 1. A tool for measuring sizes accurately.
2. An accurate screw device is mounted in a fixed nut to permit variation of an open space between two measuring surfaces. One of these surfaces is called an anvil and the other is called a spindle. The spindle is attached to the screw device.
3. Frame, anvil, spindle, barrel, thimble, ratchet.
4. Decimal.
5. For greater accuracy.
6. The vernier scale has 25 divisions numbered 0 - 25.
25 on vernier = 24 on the beam
Graduations on beam are 1/40" or 0.025"
Therefore, 24 x .025 = 0.600"
One division on vernier = 1/25 of 0.600"
One division, therefore, on the beam and one on the vernier equal 0.025 minus 0.024 or 0.001
7. Burrs, micrometer out of alignment.
8. Work Test Math Problems.

Machine Shop | Answers To Test Questions | R.S.A. 10
Unit I | | 3 Hours
Bench Work

1. Because a drilled hole is always larger than the drill diameter.
2. Body, shank, angle of chamfer, blades land.
3. Straight reamers and adjustable reamers.
4. Clockwise.
5. A reamer used to ream pipe that is to be threaded.
6. 0.250
7. 82°
8. A cutting tool used as a finishing tool.
9. A hand reamer is slightly tapered near the end for about the distance of its diameter.
10. The adjustable.
11. The adjustable.
12. Running, driving, force, shrink, sliding.
13. Drive fit.
14. The extreme permissible dimensions of a part.
15. The amount of variation permitted in a part.
16. 1/40 of an inch.
17. a) .043
    b) .991
    c) .289
    d) .387
    e) .143
    f) .381
    g) .202
    h) .362
    i) .229
    j) .633
18. Ruler.
19. A flexible steel tape used for measuring long distance.
20. A micrometer designed to measure internal sizes.

17. What is the micrometer reading under each of the following settings?

		Exposure of Barrel	Coinciding Line on Thimble
Between	1)	.025+	18
	2)	.975+	16
	3)	.275+	14
	4)	.375+	12
	5)	.125+	10
	6)	.375+	6
	7)	.200	2
	8)	.350	12
	9)	.225	4
	10)	.625	8

18. What measuring tool is best for measuring length?

19. What is a steel tape?

20. What is an inside micrometer?

Machine Shop
Unit II
Drill Press

Answer Book

R.S.A. 1

1. a. Spindle
   b. Table

2. a. Sensitive
   b. Radial
   c. Multiple

3. a. Sensitive
   b. Belt

4. a. Sleeve

5. a. Round
   b. Rectangular

6. a. Arm

7. a. Parallel
   b. V-Block
   c. Vise
   d. Jig
   e. Fixture

8. a. Stop

9. a. 1/2

10. a. Thousandths

11. a. Diameter

12. a. Feed

13. a. Cone pulleys
    b. Gears

14. a. Compound

15. a. Hand
    b. Power

16. 1. Bevel driving gears
    2. Spindle
    3. Quick return lever
    4. Hand feed
    5. Work table
    6. Base
    7. Table elevating screw
    8. Back Gears
    9. Upper cone pulley
    10. Column
    11. Elevating screw gear handle
    12. Tight and loose pulleys
    13. Lower cone pulley
    14. Feed mechanism

ANSWERS TO MATHEMATICS QUESTIONS

1. 1.545085 inches
2. 5.87785 inches
3. 2.472136 inches
4. 3.465 inches

ANSWERS TO RATIO AND PROPORTION

1. 75
2. 240 r.p.m.
3. 31/64
4. 26.04
5. 50 hrs.
6. 2 hrs.
7. 20 lbs.
8. Not possible to use proportion
9. 160 hrs.
10. $13,225

BLUEPRINT READING ANSWER SHEET

Section II, Page 21.

(1) 4

(2) Cast Iron

(3) 4 - 57

(4) 2 3/4

(5) 1 1/2

(6) 1 5/8

(7) 1 1/4

(8) 3/8

(9) H

(10) Front - Top - Right Side

(11) G

(12) P

(13) K

(14) N

(15) E

(16) C

(17) Object

(18) Dimension

(19) Q

(20) E

Machine Shop
Unit II
Drill Press

Answer Book

R.S.A. 2

1. a. Body
   b. Shank
   c. Point
2. a. Tang
3. a. Point
4. a. 59
5. a. Tapered
6. a. Straight
   b. Tapered
7. a. Flutes
8. a. Clearance
9. a. Planning
   b. Judgment
10. a. Interested

R.S.A. 3

1. a. Large
   b. Small
2. a. Speed
3. a. Judgment
4. a. Feed
5. a. 4 C.S.
   b. 4
6. a. Feed
   b. Clearance
7. a. Cutting
   b. Speed
8. a. Clearance
9. a. Carbon
   b. High-speed
10. a. Crooked hole
    b. Dull drill

ANSWERS TO DRILL PRESS - CUTTING SPEEDS

1. 128 r.p.m.
2. 18.75 f.p.m.
3. 4.35 f.p.m.
4. 1120 r.p.m.
5. 39.06 f.p.m.
6. 365.71 r.p.m.
7. 172.3 r.p.m.
8. 800 r.p.m.
9. 3.906 f.p.m.
10. 640 r.p.m.
11. 19.92 f.p.m.
12. 71.25 f.p.m.
13. 4800 r.p.m.
14. 23.4375 f.p.m.
15. .7964"

Part II

1. a. 95
   b. 78
   c. 82
2. a. 2880
   b. 640
   c. 102

BLUEPRINT READING ANSWER SHEET

Section II, Page 23

(1) Gray Cast Iron

(2) 6

(3) 4 1/2

(4) 76-42

(5) 1 7/8

(6) Hidden

(7) 1/2" holes

(8) B - R

(9) M

(10) G

(11) H

(12) F

(13) P

(14) 1/2 D

(15) 1 1/4

(16) 5/8"

(17) Yes

(18) 3"

(19) 1/2"

(20) 2 1/2

(21) 1 3/4

(22) 1/2"

(23) Hidden

(24) Object

Section II, Page 29

(1) Front - Top

(2) F

(3) E

(4) G

(5) C

(6) Center

(7) Object

(8) Extension

(9) Hidden

(10) N

(11) D - C - B - A - L

(12) I - O

(13) 1 1/4

(14) 7/8

(15) 1 1/8

(16) 1 5/8

(17) 1 1/2 x 2 x 1 5/8

(18) 3 1/2

(19) 76 - 32 - 05

(20) Cold drawn steel

BLUEPRINT READING ANSWER SHEET

Section II, Page 31

(1) Flanged Sleeve

(2) 45 - 21

(3) 12

(4) Cold drawn steel

(5) Front - Top

(6) a. Hidden
b. Center
c. Object
d. Center
e. Extension
f. Dimension
g. Hidden

(7) 3 1/4

(8) 1/2"

(9) 1"

(10) Yes

(11) 2 1/2

(12) 3 3/4

Section II, Page 33

(1) Cast Brass

(2) Front - Top

(3) e. Center
f. Object
g. Dimension
h. Extension
i. Hidden

(4) 3 7/8

(5) 4 3/4

(6) 3

(7) 5/16

(8) 1/2

(9) 1 3/4

(10) 3 1/2

(11) 5/8

(12) 3/4

(13) Center

(14) 1/4

(15) 3/8

BLUEPRINT READING ANSWER SHEET

Section II, Page 35

(1) Front

(2) Round

(3) 4

(4) 2 1/4

(5) 1/2 D

(6) 4 1/2

(7) 1 1/16

(8) 1 1/2

(9) A - C - F

(10) Hiaden

(11) E

(12) They are concentric

(13) 3/8

(14) 245 - A - 12

(15) Tool Steel

ANSWERS TO LATERAL AND TOTAL AREA

1. 51.868 sq. in.; 61.999 sq. in.
2. 58.240 sq. in.; 74.240 sq. in.
3. 144.6 sq. in.; 183.85 sq. in.
4. 46.23 sq. in.; 62.73 sq. in.
5. 25.95 sq. in.; 33.754 sq. in.

Machine Shop
Unit II
Drill Press

Answer Book

R.S.A. 4

1. a. Jarno

2. a. Morse

3. a. Brown and Sharpe

4. a. 1/4 inch

5. a. Smaller

6. a. Taper

7. a. T.P.F. or T.P.I.
   b. Large Diameter
   c. Small Diameter
   d. Length of Taper

8. a. .250

9. a. .268

10. a. Cutting
    b. Chips
    c. Breakage

R.S.A. 5

1. a. Bar

2. a. Depth
   b. Bored

3. a. Goggles

4. a. Struck
   b. Material

5. a. Eye

6. a. Horizontal
   b. Vertical

Part II: Mathematics

1. 7/32

2. .49975

3. .250

4. 2 1/16"

ANSWERS TO USING TRIGONOMETRIC TABLES

1.	.25038	11.	.16189	21.	45° 1'
2.	.71325	12.	.99647	22.	45°
3.	1.0403	13.	1.01025	23.	89° 3'
4.	1.7320	14.	.84186	24.	64° 15'
5.	.37953	15.	.03951	25.	38° 44'
6.	1.1215	16.	9° 21'	26.	43° 8' 30"
7.	.70711	17.	9° 28'	27.	31° 9' 30"
8.	.40911	18.	51° 41'	28.	20° 30'
9.	1.0003	19.	87° 29'	29.	48° 1'
10.	.5604	20.	48° 44'	30.	16° 5'

Machine Shop
Unit II
Drill Press

Answer Book

BLUEPRINT READING ANSWER SHEET

Section II, Page 39

(1) Malleable Cast Iron

(2) 20

(3) 71 - 24

(4) Front - Top - Auxiliary

(5) Hidden

(6) Object

(7) .625

(8) 13/16

(9) 1 1/4

(10) H

(11) 2

(12) 1 1/4

(13) N

(14) M

(15) L

(16) P

(17) .625 Hole

(18) Q

(19) 7/8

(20) 3/8

ANSWERS FOR (TRIGONOMETRY)
RIGHT TRIANGLES

1. 60° - 0' - 30"
2. 4' - 0"
3. 52° 7' 5"; 37° 52' 55"
4. 5° 43' 30"
5. 22° 37' 5"
6. 39° 48' 17"; 50° 11' 43"; 62.484"
7. 35° 32' 15"; 54° 27' 45"; 34.408"
8. 36° 52' 12.5"; 53° 7' 47.5"; 19.999' or 20'
9. 37° 40' 10"; 52° 19' 50"; 18.523"
10. 38° 59' 56"; 51° 0' 4"; 81.039"

Machine Shop
Unit II
Drill Press

Answer Book

UNIT TEST
ANSWER SHEET

1. B
2. A
3. C
4. C
5. B
6. B
7. C
8. D
9. C
10. B
11. B
12. C
13. B
14. C
15. D
16. C
17. C
18. B
19. C
20. B
21. D
22. D
23. C
24. C
25. D
26. C
27. B
28. B
29. C
30. B

Part II Filling in blanks

1. Circular
2. Enlarging
3. Cylindrically
4. Cone-shaped
5. Morse
6. Jaws
7. Twist
8. Size
9. Hand reamed
10. Adjustable
11. a. Table
    b. Column
12. Radial
13. a. Crooked hole
    b. Dull drill
14. a. Web
    b. Flute
    c. Land
    d. Shank
    e. Tang
15. a. Brass
    b. Cast iron

Machine Shop
Unit II
Drill Press

Answer Book

UNIT TEST
ANSWER SHEET

Part III Identification of Tools

1. Straight fluted reamer
2. Straight shank reamer
3. Oil tube drill
4. Air hole drill
5. Adjustable reamer
6. Straight shank drill
7. 4-fluted drill
8. Tapered shank drill
9. Drill chuck
10. Countersink
11. Drill sleeve
12. Hand reamer
13. Drill socket
14. Counterbore
15. Deep hole drill
16. Drift
17. Parallels
18. Strap Clamp
19. Step blocks
20. V-blocks
21. Drill press vise
22. T-bolt
23. a. Bevel driving gear
    b. Spindle
    c. Quick return lever
    d. Hand feed wheel
    e. Table
    f. Base
    g. Table elevating screw
    h. Back gears
    i. Upper cone pulley
    j. Yoke
    k. Column
    l. Elevating screw gear handle
    m. Pulley stand
    n. Feed mechanism
    o. Tight and loose pulleys
    p. Lower cone pulley

Part IV Mathematics

1. $72.45
2. $5.75
3. 15 gallons
4. 20 holes
5. 400 RPM
6. 32.81 FPM
7. 75 FPM
8. 427 RPM 320 RPM
9. a. 70 rpm b. 572 c. 120

Part V Blueprint Reading

1. T 2. T
3. F 4. F
5. T 6. F
7. T 8. F
9. T 10. F

Machine Shop
Unit II
Drill Press

UNIT TEST
ANSWER SHEET

Answer Book

Part VI True or False

1. T
2. T
3. F
4. F
5. T
6. T
7. F
8. T
9. F
10. F
11. F
12. T
13. F
14. T
15. T
16. T
17. F
18. T
19. F
20. T
21. F
22. F
23. F
24. T
25. T

1. Cone-pulley back-gear drive lathes and geared-head lathes.
2. (1) bed, (2) headstock, (3) feed and thread-cutting mechanisms, (4) tailstock, (5) carriage.
3. The two inner ways align the headstock and tailstock and guide for tailstock when moved longitudinally. Outer ways align carriage and guide it longitudinally.
4. (a) When locking pin is engaged the cone-pulley, the face gear, and the spindle all turn as one unit.
5. (b) When the locking pin is disengaged and the back gear is moved toward the operator, back gears will mesh with gears and power is transmitted on indirect speeds.
5. To change the speeds of feed or lead screw for turning or threading.
6. When the center lines of the tailstock and headstock spindle meet and form a straight center line. If the tailstock is set over, it will be out of alignment.
7. (1) apron (2) saddle (3) compound rest (4) tool post.
8. By set over screws to turn a tape.
9. Because it is driven by a cone-pulley.
10. Six speeds.
11. Different spindle speeds are obtained by simply moving levers on the headstock.
12. To produce longitudinal and crossfeeds. A lead screw for thread-cutting.
13. Feed rod is splined. Lead screw is acme threaded for thread-cutting.
14. The splined shaft and acme thread is all on same shaft and may be used for feed and threading.
15. Longitudinal feed is the amount the carriage is moved either from left to right for one complete revolution of the work or spindle, cross-feed is the amount of cross slide movement, either in or out, that is, away or toward the operator for one complete revolution of the work or spindle.
16. When the feed knob is in center position, threads may be cut by clamping the half nut on the lead screws.
17. Three different positions, out of mesh or neutral, and change the stud gear rotation.
18. This outside stud gear is commonly called a change gear, perhaps, not only because it may be changed, but also because a gear with a different number of teeth on this shaft will change the rate of rotation of the remaining gears in the feed and thread-cutting mechanisms.
19. Longitudinal feed of the carriage also can be obtained by turning the carriage hand wheel; and cross-feed, by turning the cross-slide knob. These feeds are called hand feeds.

20. (a) Lathes contain two centers, one called the live center mounted in the headstock spindle. (b) The other called the dead center mounted in the tailstock spindle.

NOTE: There are also ball bearing centers that fit in the tailstock, called live centers.

Machine Shop Answers to Test Questions R.S.A. 1
Unit III
Lathe

1. Cone-pulley back-gear drive lathes and geared-head lathes.
2. (1) bed, (2) headstock, (3) feed and thread-cutting mechanisms, (4) tailstock, (5) carriage.
3. (a) When the center lines of the tailstock and headstock spindle meet and form a straight center line. (b) If the tailstock is set over it will be out of alignment.
4. Different spindle speeds are obtained by simply moving levers on the headstock.
5. To produce longitudinal and cross-feeds. The lead screw for thread-cutting.
6. The splined shaft and acme thread is all on the same shaft and may be used for feed and threading.
7. When the feed knob is in center position, threads may be cut by clamping the half nut on the lead screw.
8. This outside stud gear is commonly called a change gear, perhaps, not only because it may be changed, but also because a gear with a different number of teeth on this shaft will change the rate of rotation of the remaining gears in the feed and thread-cutting mechanisms.

Answers to Math for R.S.A. No. 1

1-	R	11-	R
2-	R	12-	W
3-	R	13-	R
4-	R	14-	W
5-	R	15-	W
6-	W	16-	W
7-	W	17-	R
8-	W	18-	W
9-	W	19-	W
10-	R	20-	R

Machine Shop Answers to R.S.A. Questions R.S.A. 2
Unit III
Lathe

1. (a) The rigidity of the work, that is, of the piece itself, and the manner in which it is held in the machine; (b) the rigidity of the tool--its size and the way in which it is held; and (c) the shape of the cutting tool as it is ground, and as it is presented to the work.
2. Point, straight edge, and shaped edge.
3. Forming tools.
4. Left.
5. Their operations.
6. High speed steel.
7. 6 degrees, 10 degrees, 14 degrees.
8. Peel off the chip.
9. A tool blank when properly ground is a tool bit.
10. Because method is clumsy and inefficient, and second, because one is liable to grind the holder.
11. Emery and corundum, silicon carbide and aluminum oxide.
12. Hard grade.
13. Resinoid bonded.
14. Grinding is the process of removing material by the cutting action of hard and sharp abrasive particles of a revolving grinding wheel as they come in contact with the surface to be ground.
15. Snug.
16. Blotting paper washers.
17. Dressing is the process of restoring the sharpness of the grinding wheel by breaking away the dulled abrasive crystals or by removing the glazed or loaded surface of the wheel, thus presenting new sharp cutting edges of the abrasive grains.
18. Finishing tools which have been stoned to a keen edge will produce a surface that is smooth, practically free of tool marks, and within close limits of the required size. The work may then be polished with abrasive cloth without filing.
19. (a) Examine the grinder to make sure that the guards are in place, that the safety glass shields are properly set, and the tool rest is adjusted for the job.
(b) Check face of grinding wheel to determine whether it is straight and also whether it requires truing or dressing.

Machine Shop Answers to Test Questions R.S.A. 2
Unit III
Lathe

1. (a) Rigidity of the work.
   (b) The rigidity of the tool.
   (c) Shape of the cutting tool.
2. One quarter inch, five-sixteenths, and three-eighths.
3. Ten.
4. Twenty.
5. Side clearance six degrees, front clearance ten degrees, side rake fourteen degrees.
6. To the left.
7. Rough, fine.
8. Star type, abrasive stick.
9. Finish, tool.

Answers to Math for R.S.A. No. 2

1. PcN/π
2. OD Pd - 2
3. Ee
4. bF/W
5. $d_1 d_2 r / D_1 R$
6. $12V/\pi(D^2 + d^2 + Dd)$
7. $\pi D - 2P/P$
8. 2 C + M
9. 2b + 2r or 2(b + r)
10. 6.5 - .02N/N

Machine Shop Answers to R.S.A. Questions R.S.A. 3
Unit III
Lathe

Lathe Chucks:

1. Toward the center, because the high spot is away from the center and one must loosen the center. Loosen the opposite jaws and tighten the jaw with the chalk mark on it to center it.
2. Loosen the 2 opposite jaws of the high side and tighten the 2 jaws on the high side.
3. Helps true work by setting all jaws on approximate size of work and all on same ring.
4. By reversing the jaws, by chucking the work on the inside.
5. Jaws that can be turned around or upside down to hold work.

Calipers:

1. Hold rule in left hand, calipers in right hand, place one end of calipers on bottom end of rule held vertically, adjust caliper with thumb and finger.
2. Held the same way, but must be adjusted by rapping it against some solid object.
3. Should be held lightly and not with a "Grab Grip" if the calipers bearly hang from the work without falling off they are set right, do not force calipers over or into work.
4. Considerable practice and sense of touch.

Turning:

1. Greater the leverage and the more the spring of tool, causes chattering, may break compound.
2. If too low the edge will become dull fast, if too high less clearance, check with tailstock center and set tool.
3. The point of the live center will be broken off and the center hole in the work will be spoiled, always set the tool post at the left-hand end of the "T" slot.
4. The amount of material to be removed, condition of lathe.
5. The type of finish.
6. Less than of 1/64" does not give the tool point a chance to get under the chip.
7. With calipers, at the beginning of the cut.
8. The character of the roughing cut.

Shoulder Turning:

1. To improve the appearance of the work, remove burrs.
2. 30 degrees and 45 degrees.
3. Filleted corner, square corner, rounded edge, chamfered edge.

Facing:

1. 60 degrees.
2. To provide a bearing surface for center or pilot hole for a drill.

Machine Shop .nswers to Test Questions R.S.A. 3
Unit III
Lathe

1. Leverage, spring, chattering.
2. Left hand end.
3. Live center, center hole.
4. Burn, drilled.
5. T
6. F
7. F
8. T
9. T
10. T
11. T
12. T
13. T
14. T
15. Hold rule in left hand, calipers in right hand, place one end of calipers on bottom end of rule held vertical, adjust calipers with thumb and finger.
16. 30 and 45 degrees.
17. To provide a bearing surface for center, or pilot hole for a drill.

Answers to Math for R.S.A. No. 3

1. 20.7846"
2. 17.83
3. 45'
4. 33 bales
5. $7.05
6. $17.78
7. 9.093" or 9 3/32"
8. 175 days or 25 weeks
9. 129.125 sq. ft.
10. $7.11

Machine Shop Answers to R.S.A. Questions R.S.A. 4
Unit III
Lathe

1. In degrees.
2. 60 degrees.
3. May strike the chuck.
4. The time it takes to produce a finished piece of work.
5. Shape of the tool, the way in which the tool is held, kind of material being cut, nature of cut being cut (rough and finish).
6. Cutting speed is the rate at which a point on the circumference travels. R.P.M. is the speed the material turns.

1. (1) Compound rest slide stop.
   (2) Compound rest swivel slide.
   (3) Lower slide.
2. 180 degrees.
3. Angle with center line.
4. Included angle.
5. Roughing cut, finishing.
6. Fast.
7. Finer cut.
8. Feet per minute.
9. Feed.
10. Cut.
11. Time element.
12. Diameter.

Answers to Math Problems

1. 123 3/4 ft./min.
2. 35 ft./min.
3. 50 ft./min.
5. 55 ft./min.
8. 43 ft./min.
15. 42 2/3 r.p.m.

Cutting Feed Answers

1. 12.6 min.
2. 13.1 min.
3. 50 min.
4. 11.1 min.
5. 0.4 min.
6. 0.8 min.
7. 0.3 min.
8. 288.5

Answers to Math for R.S.A. No. 4

1. 47,124 lbs.

2. 2.436" or 2 7/16"

3. .8" or 51/64"

4. 83.33 lbs. per sq. in.

5. 44

Unit III
Lathe

1. (1) With the drill in the tailstock, and (2) with the drill in the headstock.
2. (a) Small hole drill before the finish drill size.
   (b) Because the gripping action on larger drills may slip.
3. Makes it easier to start the drill.
4. Large holder with a taper inside to fit drill shanks, handle to keep it from turning while drilling, it is used to hold large taper shank drills too large for the tailstock.
5. Piece fits into tailstock with "V" slot to hold work while drill is held into headstock of lathe.
6. Condition of lathe, amount of coolant reaching the drill point, condition of the drill, the amount of feed.
7. The drill is fed into the work by turning the tailstock handwheel.

Cutting Off:

1. To permit working close to the chuck.
2. (1) Front clearance, (2) clearance on both sides.
3. When it is on center.
4. It is a sure way of spoiling the work and breaking the tool.
5. Rapid vibration of the tool and work. Tighten the work, keep from springing, set tool on center, tighten cross slide, tighten the spindle bearings.

Math:
Page 211

1. 235 r.p.m.
2. 185 r.p.m.
3. 380 r.p.m.
4. 380 r.p.m.
5. 1000 r.p.m.
6. 485 r.p.m.
7. 790 r.p.m.
8. 300 r.p.m.
9. 615 r.p.m.

Machine Shop Answers to Test Questions R.S.A. 5
Unit III
Lathe

1. Makes it easier to start the drill.
2. Large holder with a taper inside to fit drill shanks, handle to keep it from turning while drilling, it is used to hold large taper shank drills too large for the tailstock.
3. Condition of the lathe, amount of coolant reaching the drill point, condition of the drill, the amount of feed.
4. To permit working close to the chuck.
5. When it is on center.
6. Rapid vibration of the tool and work. Tighten the work, keep from springing, set tool on center, tighten cross slide, tighten the spindle bearings.

Blueprint Reading Answers:

1. Front view, top view.
2. F
3. E
4. Circle G
5. Line C
6. Center line.
7. Object line.
8. Extension line.
9. Hidden line.
10. Circle N
11. A, B, C, D, L
12. I, O
13. 1¼" diameter.
14. 7/8 " diameter.
15. 1¼" inches long.
16. 2" long.
17. 2" long, 1½" wide, 1 5/8" height.
18. 3½" overall height.
19. 76 - 32 - 05
20. Cold-drawn steel.

Answers to Math for R.S.A. No. 5

1.	5.05 Horsepower	6.	24.74
2.	21.6	7.	32.04 Amperes
3.	1000 ft. lbs.	8.	12 Horsepower
4.	1.136 Horsepower	9.	396 Watts
5.	4.24	10.	1.837 Horsepower

Answers to Questions on Page 185:

1. To protect the cutter bit and the work.
2. Thread depth plus .015 inch or 1/64"
3. 1/8" inch.
4. The bit is ground square on end 1/8" wide, or the cutter bit may be ground with a rounded end.
5. Undercutting is external and recessing is internal.
6. To protect the work.
7. His chief purpose is to feed deeper than the exact depth.
8. ~~To protect~~ tools.
9. Lathe has a 1 to 2 ratio.

Answers to Study Questions:

1. Much safer.
2. Prevents the steel filings from clogging the file teeth.
3. 12" mill file.
4. Tang can stick into you if hit by lathe dog.
5. Tang, heel, face, edge, and point.
6. Fine grain.
7. Bearing too hard on the file.
8. .002
9. Anvil, spindle frame, hub, and thimble.
10. 25 equal parts.
11. .025
12. Finish all over.
13.

G	S	R	f
GRIND	MACHINE SMOOTH	ROUGH MACHINE FINISH	OLD SYMBOL DENOTING MACHINED SURFACE

Math Answers:

1. 3½
2. 4
3. 3
4. 1
5. 7
6. 4
7. 4½
8. 5½
9. 0.000
10. ½
11. 9
12. 2
13. 8
14. 3
15. 2.928
16. 3.6094
17. Chip depth 0.016-----finish diameter 2.093
18. .017 on a 1 to 1 ratio and .0085 on a 1 to 2 ratio.

Math Answers (Continued)

19. .140625
20. .03125
21. 1 9/32--.0625 1 11/32--.125 1 15/64--.015625
1 17/64--.046875 1 5/16--.09375 1 3/8--.15625

22. 10

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(a) 0.146
(b) 0.116
(c) 0.110
(d) 0.079
(e) 0.032
(f) 0.277
(g) 0.225
(h) 0.158
(i) 0.438
(j) 0.246
(k) 0.877

Page 182 1-8

1. 17/32
2. 13/16
3. 1.0938
4. 1.2188
5. 31 graduations on a 125
6. graduations and 62
7. graduations on a 250
8. graduations.
6. .032
7. 31
8. 128

Answers to Math for R.S.A. No. 6

1. 1963 lbs.

2. 13 rivets

6136 lbs.

11,250 lbs.

5,889 lbs.

Machine Shop Answers to R.S.A. Questions R.S.A. 7
Unit III
Lathe

1. Knurling is a forming instead of a cutting operation. The work is indented by pressing it into the serrated surfaces of the knurling rolls, thus forming a diamond-shaped pattern on the surface of the work.
2. These opposed teeth form a diamond-shaped pattern on the work.
3. They must be harder than the work to be knurled to press back the work.
4. On center the top roll must be set the same distance above the center line as the bottom roll.
5. The rolls will be in poor condition.
6. Because of the tremendous pressure on the center.
7. The rolls press the metal art.
8. (1) fine knurl (2) medium knurl (3) coarse knurl.

Math
Problem 1 and 2 pp. 189-190:

1. A. 58

   B. 38

   C. 24

   D. 38

   E. 38

   F. 24

   G. 24

   H. 24

   I. 58

   J. 58

2. (a) 31 graduations on a dial with 250 graduations.

   (b) 15 graduations on a dial with 125 graduations.

Machine Shop Answers to Test Questions R.S.A. 7
Unit III
Lathe

1. Knurling is a forming instead of a cutting operation. The work is indented by pressing it into the serrated surfaces of the knurling rolls, thus forming a diamond-shaped pattern on the surface of the work.
2. These opposed teeth form a diamond-shaped pattern on the work.
3. The rolls press the metal out.
4. (1) Fine knurl (2) Medium knurl (3) Coarse knurl.

Blueprint Reading Answers:

1. Flanged sleeve.
2. 45-21
3. 12 required.
4. Cold drawn steel.
5. Front and top view.
6. A. Hidden line
   B. Center line
   C. Object line
   D. Center line
   E. Extension line
   F. Dimension line
   G. Hidden line

7. 3 1/4" outside diameter.
8. 1/2" thick
9. 1"
10. Yes.
11. 1" diameter.
12. 3 3/4" overall length.

Answers to Math for R.S.A. No. 7

1. .6"
2. .04995
3. 9
4. .05262"
5. .01041"
6. 3"
7. .09"
8. .367"
9. 3.2"
10. 1.2385"
11. 5.49528"
12. 6.009"
13. .0161"
14. 1.5012"
15. .4"

Machine Shop Answers to R.S.A. Questions R.S.A. 8
Unit III
Lathe

1. (a) Offsetting the tailstock.
   (b) Using the compound.
   (c) By using the taper attachment.
2. Taper attachment.
3. It is inaccurate and too much trouble to align centers after offsetting tailstock.
4. (a) The taper per inch or taper per foot.
   (b) The length of the tapered part.
   (c) The large diameter.
   (d) The small diameter.
5. Morse, Brown and Sharp, the Jarno, and the tapered pin.
6. Brown and Sharp.
7. The Jarno system.
8. Morse taper.
9. By wringing it to the left and it will not stick. To find the high spot and check for accuracy.

Machine Shop Answers to Test Questions R.S.A. 8
Unit III
Lathe

1. (a) Offsetting the tailstock.
   (b) Using the compound.
   (c) By using the taper attachment.
2. Taper attachment.
3. (a) The taper per inch or taper per foot.
   (b) The length of the tapered part.
   (c) The large diameter.
   (d) The small diameter.
4. Morse taper.
5. By wringing it to the left and it will not stick, to find the high spot and check for accuracy.

Answers to Math for R.S.A. No. 8

1.	.7528"	9.	.4509"
2.	.7528"	10.	.286"
3.	.2245"	11.	.0945"
4.	.45"	12.	.2496"
5.	.51"	13.	.75"
6.	.0312"	14.	.2625"
7.	.082"	15.	1.955"
8.	1.6"		

Machine Shop Answers to R.S.A. Questions R.S.A. 9
Unit III
Lathe

1. An angle is the amount of the divergence between two straight lines that either meet in a common point, or would meet if sufficiently prolonged.
2. The straight lines are called the sides of the angle and the meeting point is called the vertex of the angle.
3. The circumference is divided into 360 parts of degrees and the number of degrees between the sides of the angle is the measure of the angle.
4. 360 degrees.
5. 30 degrees.
6. Is less than 90 degrees.
7. When their sum is equal to two right angles (180 degrees).
8. Taper per foot.
9. The bevel protractor.
10. Center line of the lathe.
11. Either a drilling or a boring operation.
12. To produce holes that are smoother and more accurate than a drill produces.
13. 1/64" less than 1/2" and 1/64" or 1/32" for over 1/2" reamer.
14. If work will not fit a standard mandrel an expansion mandrel is used. The size of this mandrel can be adjusted to vary over a limited range.
15. The size of the mandrel is stamped on the large end, the small end enters the hole in the work.

Machine Shop Answers to Test Questions R.S.A. 9
Unit III
Lathe

1. 360 degrees.
2. The bevel protractor.
3. Center line of the lathe.
4. Either a drilling or boring operation.
5. To produce holes smoother and more accurate than a drill produces.
6. 1/64" less than 1/2" reamer and 1/64" or 1/32" less for over 1/2" reamer.
7. The size of the mandrel is stamped on the large end, the small end enters the hold in the work.

Answers to Math for R.S.A. No. 9

1. 88° 34'
2. 50°
3. 49°
4. 58° 30'
5. 62° 30'
6. 67° 30'
7. 30° 30'
8. 56° 30'
9. 71° 22.5'
10. 60°

Machine Shop Answers to R.S.A. Qustions R.S.A. 10
Unit III
Lathe

1. Requires that 11 mating parts be made to rigid specifications so that after the parts have been made, as individual units they will fit together and function properly.
2. The accuracy that can be maintained and the innumerable mechanical apparatus that are in existence today.
3. Interchangeable manufacture requires that similar parts be made uniform in size and shape.
4. The unique machine tools, precision by use of measuring tools.
5. Allowance for running fit.
6. Allowance for press fit.
7. The amount of variation which, can either be below or above the basic diminsions, is called tolerance.
8. The American Standards Association approved fits.
9. (1) The running (and sliding)
   (2) Drive fit.
   (3) Force fit.
   (4) Shrink fit.
10. To allow for grease to get into the bearing.

Machine Shop Answers to Test Questions R.S.A. 10
Unit III
Lathe

1. Requires that all mating parts be made to rigid specifications.
2. The accuracy that can be maintained and the innumerable machanical apparatus that are in existence today.
3. The unique machine tools, precision by use of measuring tools.
4. (1) The running (and sliding)
   (2) Drive fit.
   (3) Force fit.
   (4) Shrink fit.
5. To allow for grease to get into the bearing.

Blueprint Reading and Sketching:
Assignment BP-21

1. (a) angular dimension ≠ 1 degree
   (b) decimal dimension ≠ .002
   (c) fractional dimensions ≠ 1/64"
2. 1.50 tapers per foot
3. .125 tapers per inch
4. $\frac{1.250}{1.249}$ = diameter
5. 1.4375
6. .625 tapers per foot.
7. .0520
8. .875
9. .9531
10. 2-16N-2
11. L. H. means that the thread is left-handed.
12. Class 2 fit.
13. This portion is knurled.
14. 14P diamond knurl.
15. .875" diameter
16. 82 degrees C' S' K. to 17/64 after knurling.
17. Chamfer 1/16" x 45 degrees.
18. 30 degree
19. Chamfer to thread depth.
20. 3.375"
21. C is approximately 4.750" long.
22. Grind.
23. D is 3.625
24. 1/4" x 1/8" overall length.
25. 6 3/4" overall length.

Answers to Math for R.S.A. No. 10

1. 18 r.p.m.
2. 16
3. 6:8 or 9:12 or 12:16, etc.
4. 12
5. 2720 r.p.m.
6. 16/28, 8/16; 24/42, 24/48
7. 236.8 r.p.m. clockwise
8. 50
9. 1
10. 8.33 r.p.m. counter-clockwise

1. The American National form thread angle is 60 degrees, but the top and bottom are intentionally flattened to P/8. The Whitworth form of thread is the British form. Its thread angle is 55 degrees, and its top and bottom are rounded to a specified radius.
2. Pitch diameter is the diameter of an imaginary cylinder whose surface would pass through the thread at certain points where the width of the thread and the grooves cut by the cylinder are equal.
3. Pitch is the distance of a point on a thread to the point on the next thread measured along a line parallel to the axis.
4. One sixteenth.
5. External thread, quick and easy to assemble.
6. 0.5135
7. Tolerance is the difference between the maximum and minimum limits of size. In thousandths of an inch or decimal.
8. ¼ inch.
9. 5/16-18-UNC, ¼-28-UNF, 12-24-UNC, 10-32-UNF.
10. Makes it possible to cut a wide range of threads.
11. 29 degrees.
12. American National form screw thread is 60 degrees with a flat on top and bottom of the thread.
13. The center gauge does not provide for gauging the flat on the end of the bit.
14. Makes it easier for steel chips to slide out over the top of the bit.
15. Mounted in the tool post, on center line, set at right angles to the surface using a center gauge.
16. To keep from cutting a taper.
17. Turning the compound rest handle.
18. The thread dial shows the exact point at which the half nuts must be engaged with the lead screw so that the cutting tool will cut in the original thread groove.
19. It is difficult to count the threads on fine pitches.
20. A coarse pitch thread is a thread with a greater pitch than for a finer thread with less pitch.
21. Used to measure the threads per inch.
22. Improve the appearance of the thread, to remove burrs, protect the beginning of the thread, and to facilitate starting the screw.
23. The undercut is used because it is difficult to withdraw the cutting tool from the thread groove at the end of the thread without breaking the tool point.

Machine Shop Answers to Test Questions R.S.A. 11
Unit III
Lathe

1. Pitch is the distance of a point on a thread to the point on the next thread measured along a line parallel to the axis.
2. one-sixteenth.
3. External thread, quick and easy to assemble.
4. 0.5135.
5. Tolerance is the difference between the maximum and minimum limits of size. In thousandths of an inch or decimal.
6. ¼ inch.
7. 5/16-18-UNC; ¼-28-UNF; 12-24-UNC; 10-32-UNF.
8. Makes it possible to cut a wide range of threads.
9. 29 degrees.
10. The center gauge does not provide for gauging the flat on the end of the bit.
11. Makes it easier for steel chips to slide out over the top of the bit.
12. Mounted in the tool post on center line, set at right angles to the surface using a center gauge.
13. Turning the compound rest handle.
14. The thread dial shows the exact point at which the half nuts must be engaged with the lead screw so that the cutting tool will cut in the original thread per inch.
15. Used to measure the threads per inch.
16. Improve the appearance of the thread, to remove burrs, protect the beginning of the thread, and to facilitate starting the screw.
17. The undercut is used because it is difficult to withdraw the cutting tool from the thread groove at the end of the thread without breaking the tool point.

Answers to Math for R.S.A. No. 11

1.	.06495	11.	1.4902
2.	.07216	12.	.20361
3.	.08118	13.	.6201
4.	.10825	14.	.78222
5.	.18557	15.	2.92525
6.	.09278	16.	.314115
7.	.09992	17.	.45128
8.	.11809	18.	.76675
9.	.28866	19.	1.11082
10.	.14433	20.	3.75643

Answers to Math Questions
(Page 270)
1 to 9

1) 0.8376 or 53/64

2) 0.7306 or 23/32

3) 0.4350 or 27/64

4) 0.6688 or 21/32

5) 0.1850 or 11/64

6) 1.9711 or 1 31/32

7) 0.1348 or 1/8

8) 0.1406 or 9/64

9) 1.4902 or 31/64

Machine Shop Answers to R.S.A. Questions R.S.A. 12
Unit III
Lathe

1. The drill used for drilling does not leave sufficient metal for reaming or because a reamer of proper size is not available.
2. (1) It might strike a blowhole (2) or a hard spot in the work, (3) or it may become dull. These conditions will cause a drill to wobble.
3. To obtain a hole that is correct size and is true.
4. 20 degrees.
5. Exactly on the center of the job.
6. Spring in the boring bar.
7. Inside micrometers and telescoping gauges.
8. 0.010 or 0.020 inch.
9. The material to be bored, the size of the hole.
10. When taking a roughing cut.
11. When a hole is to be bored with close tolerance.
12. The first cut.

Machine Shop Answers to Test Questions R.S.A. 12
Unit III
Lathe

1. (1) It might strike a blowhole, (2) or a hard spot in the work, (3) or it may become dull. These conditions will cause a drill to wobble.
2. Exactly on the center of the job.
3. Telescoping gauges and inside micrometers.
4. 0.010 or 0.020 inch.
5. When a hole is to be bored with close tolerances.
6. The first cut.

Answers to Math for R.S.A. No. 12

1. 80 r.p.m.
2. 2"
3. 112.5 f.p.m.
4. 36.57 r.p.m.
5. 2"
6. 12.173 r.p.m.
7. 468.75 f.p.m.
8. 4.235"
9. 28.07 r.p.m.
10. 161.875 f.p.m.
11. 3 mi. 4 sec.
12. 1 mi. 6 sec.
13. 7 mi. 42 sec.
14. 3 mi. 18 sec.
15. 3 mi. 12 sec.
16. 8.7 sec.
17. 12 mi.
18. 2 mi. 54 sec.

(42 sec., 38 sec.
35 sec., 31 sec.
28 sec.)

1. (1) The lathe carriage must move towards the tailstock.
   (2) The cutter bit must be ground on the top surface with side rake or slope from the right side of the cutter to the left.
   (3) The compound rest must be swiveled 29 degrees clockwise.
2. On the right-hand side of the 60 degree angle on the cutter.
3. 29 degrees to the right.

1. (1) The lathe carriage must move towards the tailstock.
   (2) The cutter bit must be ground on the top surface with side rake or slope from the right side of the cutter to the left.
   (3) The compound rest must be swiveled 29 degrees clockwise.
2. On the right-hand side of the 60-degree angle on the cutter.
3. 29 degrees to the right.

Answers to Math for R.S.A. No. 13

1. 44' - 4 25/64"

2. 19' - 1 1/32"

3. 398.56 lbs.

4. 56.548 sq. in.

5. 2.77 cu. in.

1. A steady rest is used to support long work in a lathe for facing, drilling, boring, etc.
2. It is used to prevent long slender shafts from springing away from the cutting tool.
3. The follower rest is clamped to the lathe saddle and moves with it.

Answers to Math for R.S.A. No. 14

1. .6786; .0357
2. .0914; .4286
3. .27464
4. 3.48; 3.5
5. 1.125; .0625
6. .27; 3.23
7. .13732
8. .1666; .0833
9. 5.615; .25
10. .1311; .8889
11. .3433
12. .730; .75
13. .21; .1
14. .7917; .04165
15. .3533; .9167

Machine Shop
Unit III
Lathe

Answers to Math for R.S.A. No. 15

1. 131.56
2. 13,500 r.p.m.
3. 10.915" or 10 59/64"
4. 14.82 lbs.
5. 11.258
6. 15' - 6 5/8"
7. 1250
8. .23968"
9. 2° 51' 44"
10. 210

Answers to Math for R.S.A. No. 16

1. 3.78%
2. 1.992'
3. 3.4176 cu. in.
4. .02209
5. 73.5 sq. in.
6. 6912 board feet
7. 18° 54'
8. 27.7" or 27 45/64"
9. 400 r.p.m.
10. 19' - 3 41/64" ±

Answers to Math for R.S.A. No. 17

1.	1° 26'	6.	.7125	11.	2° 23'	16.	3.83537"
2.	1° 14'	7.	3° 34'	12.	9.54875"	17.	2.702"
3.	3.3114	8.	5° 42'	13.	1.476"	18.	1.677"
4.	.0519"	9.	15.01"	14.	2.5969	19.	22° 38'
5.	18.02"	10.	3.3002"	15.	1° 46'	20.	7.6387"

STATE VOCATIONAL-TECHNICAL & TRADE SCHOOLS
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BASIC SHAPER

1967

Answer Book

BASIC MACHINE SHOP TRAINING COURSE

ERIC

Machine Shop Answers to Test Questions R.S.A. 1
Unit IV
Shaper

1. Cut off.
2. Middle.
3. A little smaller than the complete keyway.
4. Two.
5. Right side, left side, and front.
6. T
7. F
8. T

ERIC

Machine Shop Answers to Test Questions R.S.A. 2
Unit IV
Shaper

1. T
2. F
3. T
4. Hand.
   Power.
5. Power feed.
6. Return.
7. 8
8. Tool slide.
9. A dial or a scale.
10. The size of the work.

Machine Shop Answers to Test Questions R.S.A. 3
Unit IV
Shaper

1. Vise, clamps, square T-head bolts, hold downs, aligning strips, toe dogs.
2. Vise.
3. Hold downs.
4. Clean.
5. Round.
6. F
7. F
8. T
9. F

Machine Shop Answers to Test Questions R.S.A. 4
Unit IV
Shaper

1. Straight up and down.
2. Square.
3. Hanging out.
4. 1/8" to 1/4".
5. Yes.
6. Letting the tool slide hang down.
7. No.
8. It will leave a burr.

ERIC

Machine Shop Answers to Test Questions R.S.A. 5
Unit IV
Shaper

1. Table.
2. Type of metal being cut, type of cutting tool used, and shape of machine.
3. $N = \frac{CS \times 7}{L}$
4. Slow.
5. 63.
6. 37.
7. Down.

ERIC

1. Turn the table, grind a tool the required angle, turn the clapper box, and turn the tool head.
2. At an angle.
3. Beveling.
4. T
5. T
6. T

1. Highest.
2. Round nose.
3. Automatic.
4. Down.
5. Lowest.
6. Round nose.
7. T

ERIC

1. Groove.
2. Yes.
3. No.
4. C
5. Groove.

ERIC

1. Direct.
2. Simple and rapid.
3. Simple.
4. Right.

5. (A) 3 1/3
   (B) 6 2/3
   (C) 13 1/3
   (D) 2
   (E) 4 4/9

6. T

1. Circular pitch.
2. Linear.
3. Addendum.
4. Dedendum.
5. Full depth.
6. Involute angle.

ERIC

Answers to Test Questions

NO TEST

ERIC

Answers to Test Questions

NO TEST

ERIC

1. "V" shape.
2. Diamond and square.
3. Yes.
4. One.
5. Tool head.
6. T

1. Point, shank, face, cutting edge, lip angle, back-rake angle.
2. Cast iron.
3. Five.
4. It has more strength.
5. Break off.
6. Radius.
7. D
8. B
9. C

1. Feeding down with the tool head and feeding up with the table.
2. Return.
3. Vertical.
4. B

ERIC

Machine Shop Answers to R.S.A. Questions R.S.A. 1
Unit IV
Shaper

1. Upside down.
2. To have a place for the chip to end.
3. To have a place for the tool to start cutting and a place for it to stop.
4. Wider and not as long.
5. A tool used to remove large amounts of metal, often called a roughing tool.

ERIC

1. Universal and standard.
2. To let the tool swing back.
3. To stop the ram.
4. Automatic and hand.
5. A dial and a scale.

ERIC

Machine Shop Answers to R.S.A. Questions R.S.A. 3
Unit IV
Shaper

1. Spindle, anvil, frame.
2. (1) By moving the table, (2) by setting the tool at an angle, (3) by setting the tool head at an angle.
3. The ram ways.
4. To cut angles.

ERIC

1. A rectangle is a quadrilateral that has four right angles and whose adjacent sides are not equal.
2. Pentagon.
3. When the base of a prism is a circle, the figure is called a cylinder.
4. For a safety reason. The material could come out of the vise, and the operator could be injured.

ERIC

Machine Shop Answers to R.S.A. Questions R.S.A. 5
Unit IV
Shaper

1. To produce smooth surfaces and to make a certain part.
2. (1) Type of metal being cut, (2) type of cutting tool used, (3) shape the machine is in.
3. $0.14NL = CS.$ $N = \frac{CS \times 7}{L}$
4. Because soft metal cuts better.
5. The faster the feed, the faster the tool moves across the work.

Machine Shop Answers to R.S.A. Questions R.S.A. 6
Unit IV
Shaper

1. In order to have the tool cutting on its point.
2. The tool wouldn't cut on the point.
3. Grind the tool the shape of the angle, turn the tool head, turn the clapper box, and turn the table.
4. Not square.
5. (1) Setting the tool at an angle, and (2) setting the tool slide at an angle.

ERIC

Machine Shop Answers to R.S.A. Questions R.S.A. 7
Unit IV
Shaper

1. The angle being cut.
2. Round nose.
3. By feeding down by hand and feeding across automatic.
4. At the high side.
5. Round nose.

ERIC

1. Round nose.
2. Inside calipers.
3. No. Because layout may be wrong.

1. Rapid travel.
2. Saves time--time element is important.
3. Plain indexing.
4. 40 to 1.
5. $\frac{24}{N}$

ERIC

1. Top of gear.
2. Bottom of gear.
3. Circular pitch.
4. The length of the chord subtended by the circular thickness.
5. The distance between similar sides of adjacent teeth measured on the pitch line.

ERIC

Answers to R.S.A Questions

NONE

ERIC

Answers to R.S.A. Questions

NONE

ERIC

1. "V" shape.
2. To produce a flat groove in the bottom of the serrations.
3. In order to have them all the same size.
4. Square.

ERIC

1. Right hand, left hand, and straight.
2. Point, shank, face, cutting edge, lip angle, back-rake angle.
3. Flat nose.
4. A round nose tool cut to a certain radius.

ERIC

1. Vise.
2. Because there is a large amount of force against it.
3. To make metal level.
4. Plain clamp, U clamp, finger clamp, goose neck clamp, double finger clamp.

ERIC

STATE VOCATIONAL-TECHNICAL & TRADE SCHOOLS
of
LOUISIANA

REVISED

BASIC MILLING MACHINE

1967

Answer Book

BASIC MACHINE SHOP TRAINING COURSE

ERIC

1. Bolted directly to spindle, mounted on arbor, or held in collet.
2. Lathe.
3. a. Safety around revolving milling cutter.
   b. The names of the cutters and how they are used.
   c. The correct feeds and speeds for various metals.
   d. The setup that is mechanically right.
   e. Always use a brush to remove chips.
4. The bed type and the column and knee.
5. Bed type.
6. The Brown and Sharpe Manufacturing Co.
7. Dividing head.
8. Slotting attachment.
9. Parallel.

ANSWERS TO AREAS

1. 384 sq. in.
2. 26.507 sq. in.
3. 10.635 sq. in.
4. 73.33 sq. ft.
5. 183.687 sq. in.
6. 56.974 sq. in.
7. 45.43 sq. in.
8. 118 sq. in.
9. 241.48 sq. ft.
10. 72 sq. in.
11. 104 sq. in.
12. 119 sq. in.
13. 83.088 sq. in.
14. 134 sq. in.
15. 93.6 sq. in.

1. To control the starting and stopping of the machine.
2. To prevent scoring of the arbor and to maintain accuracy.
3. Prevents wear and contributes to accuracy.
4. Lengthwise, Crosswise, and Vertical.
5. Lead (the distance a screw advances in one revolution).
6. The distance a lead screw turns in the nut without moving the machine part.
7. Turn the handle about one-half turn in the opposite direction of the proposed adjustment.
8. No.

ANSWERS FOR LAYOUT CALCULATIONS

1. 3.351" or 3 11/32"

2. 2.8094" or 2 13/16"

3. 2.52" or 2 33/64"

4. 1.1547" or 1 5/32"

5. 3.544" or 3 35/64"

1. The arbor.
2. Three and one-half inches per foot.
3. For fastening vises, jogs and fixtures, and work to the milling table.
4. By turning the vertical handle clockwise the required amount for cut.
5. Work.

ANSWERS FOR VOLUME AND WEIGHT

1. 14.13 cu. ft.; 4.005 lbs.

2. 50.66 cu. ft.; 7801.64 lbs. or 3.9 tons

3. 104.534 cu. in.; 27.1789 lbs.

4. 16.429 cu. ft.; 2530.06 lbs. or 1.265 tons

5. 40" dia. or 3' - 4"

1. Vise, angle plate, fixture, V-block, and C-clamp.
2. They provide a positive drive and also prevent the cutter from slipping.
3. To drive and support the cutters.
4. Yes, Brown and Sharpe and Standard milling machine tapers.
5. To take up the space between the tapered hole in the spindle and the tapered shank of the tool.
6. A device which makes possible the use in the milling machine of a larger variety of tools.
7. U-clamp, flat clamp, adjustable clamp, and finger clamp.
8. False.

ANSWERS FOR SOLVING EQUATIONS

1. s/.707
2. $\sqrt{\text{Area}/.650}$
3. $\sqrt{\text{Area}/\pi}$
4. $\sqrt{p^2 - b^2/2}$
5. 1/8c + 5x
6. b/Sin B
7. tang. Ab
8. a Sin B/Sin A
9. 180 - C - b
10. DP/2t
11. E/R
12. DXR.P.M./r.p.m.
13. 1/P
14. PcN/π
15. π D/N
16. π/Pc
17. O.D. - 2/P
18. BP-2
19. D (N + 2)/N
20. L - 2c - 3.25r/3.25

1. The rate of travel of the work past the cutter.
2. Pi x O.D. x RPM.
3. RPM = $\frac{cs \times 12}{pi \times d}$
4. As a lubricant and it helps carry away the heat generated by friction.
5. They are stronger and have a freer cutting action.
6. False.
7. True.
8. (a) 200 feet per minute, (b) 70 feet per minute.

ANSWERS FOR CHECKING OPERATIONS

1. W
2. R
3. R
4. R
5. R
6. W
7. W
8. W
9. R
10. W
11. R
12. W
13. R
14. W
15. R
16. W
17. W
18. W
19. R
20. R

1. Production manufacturing
2. False.
3. False.
4. False.

ANSWERS FOR MISCELLANEOUS MEASUREMENT

1. 159" or 13' - 3"
2. 10 5/16"
3. 10 5/8"
4. 5.035 or 1/32"
5. 131 pins
6. 5' - 5 1/4"
7. 5; 23 17/32"
8. 16
9. 31 7/8" or 2'-7 7/8"
10. 7' - 3 1/4"

1. The head.
2. True.
3. Yes.
4. No.
5. True.
6. A shell end mill.

ANSWERS FOR LATERAL AND TOTAL AREA

1. 51.868 sq. in.; 61.999 sq. in.

2. 58.240 sq. in.; 74.240 sq. in.

3. 144.6 sq. in.; 183.85 sq. in.

4. 46.23 sq. in.; 62.73 sq. in.

5. 25.95 sq. in.; 33.754 sq. in.

1. True.
2. This includes clamping the work, mounting the cutter and adjusting the speed and feed.
3. Two, rough and finish.
4. Rigidity in work and cutter assembly.
5. False. Use soft hammer.

ANSWERS FOR MISCELLANEOUS PROBLEMS

1. .286"
2. 67' - 9 19/64 ± 3"
3. 14' - 10 37/64 ±
4. 42
5. 6
6. 69.742' or 69' - 8 23/32"
7. 14.779 sq. ft.
8. 1.17 cu. ft.
9. 384 cu. in.
10. 226.18 cu. in.

1. The index head.
2. False.
3. False.
4. Index head, vise and jigs.
5. No.

ANSWERS FOR MISCELLANEOUS PROBLEMS

1. 131.56
2. 13,500 r.p.m.
3. 10.915" or 10 59/64"
4. 14.82 lbs.
5. 11.258
6. 15' - 6 5/8"
7. 1250
8. .23968"
9. 2° 51' 44"
10. 210

1. Base, swivel block, spindle housing, worm assembly, index plate and spindle assembly.
2. The index head allows the work to be rotated on its axis and at the same time provides a means of accurately dividing the circular movement of the work into any number of divisions.
3. Through a series of gears attached to the table lead screw.
4. 40 to 1.
5. 60 degrees.
6. It is to prevent or control the movement of the work on its axis.
7. It is used to support the outer end of work on a center.
8. Simple indexing.
9. $N = \frac{40}{D}$

ANSWERS FOR MISCELLANEOUS PROBLEMS

1. 2.257'
2. .0185" per inch
3. 52.44 sq. yd.
4. 23.91"
5. .4188"
6. $125
7. 36.125 sq. in.
8. 12.808" or 12 13/16"
9. .4506
10. 22.406 sq. in.

VT 007 073
A Handbook for Student Teachers and Supervising Teachers in Vocational Agriculture.

Minnesota Univ., St. Paul. Coll. of Education
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DESCRIPTORS - *STUDENT TEACHING; *MANUALS; *GUIDELINES; *AGRICULTURAL EDUCATION; SCHOOL ACTIVITIES; TEACHER RESPONSIBILITY; *TEACHER EDUCATION; COOPERATING TEACHERS; STUDENT TEACHERS; EDUCATIONAL POLICY; TEACHER ORIENTATION; TEACHER EVALUATION
IDENTIFIERS - MINNESOTA

ABSTRACT - To answer questions of supervising and student teachers and to encourage genuine learning as a part of the student teaching experience, this manual was developed as a guide for student teaching activities. Section I, addressed to the student teacher, contains: (1) An Introduction to Student Teaching, (2) Your Entrance into the Teaching Profession, (3) Planning and Observing, (4) Your Work in the Classroom Before You Begin Your Unit, (5) Planning and Teaching Your Unit, (6) Evaluation of Your Work in Student Teaching, and (7) Report Forms. Section II, related to student teaching activities, contains: (1) getting established, (2) developing a community program, (3) teaching high school students, (4) advising youth organizations, (5) teaching adult farmer classes, (6) counseling pupils, (7) managing a department, and (8) improving professionally. Section III for the supervising teacher includes: (1) sharing of responsibility, (2) knowledge of class procedure, (3) careful planning, (4) the student teacher and the community, (5) evaluation, and (6) suggested references. (DM)

VT 007 073

ED0 45856

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95 p*

A HANDBOOK FOR STUDENT TEACHERS AND SUPERVISING TEACHERS IN VOCATIONAL AGRICULTURE

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COLLEGE OF EDUCATION
UNIVERSITY OF MINNESOTA

VT007073

STUDENT TEACHING DEPARTMENT

DEPARTMENT OF AGRICULTURAL EDUCATION

ED0 45856

A HANDBOOK FOR STUDENT TEACHERS AND SUPERVISING TEACHERS IN THE FIELD OF AGRICULTURAL EDUCATION

ERIC

MY CREED

oOo

I am a teacher of vocational agriculture by choice and not by chance.

I believe in rural America; I dedicate my life to its development and the advancement of its people.

I will strive to set before my students by my deeds and actions the highest standards of citizenship for the community, state and nation.

I will endeavor to develop professionally through study, travel, and exploration.

I will not knowingly wrong my fellow teacher. I will defend him as far as honesty will permit.

I will work for the advancement of vocational agriculture and I will defend it in my community, state and nation.

I realize that I am a part of the public school system. I will work in harmony with school authorities and other teachers of the school.

My love for rural people will spur me on to impart something from my life that will help make for each of my students a full and happy future.

oo

NATIONAL VOCATIONAL AGRICULTURAL TEACHERS ASSOCIATION, INC.

PREFACE

This handbook should prove helpful to you as you work in our student teaching program. An attempt has been made to build its contents around questions that supervising teachers and student teachers have frequently asked to have clarified.

It often happens that one clarification leads to several questions. Please do not hesitate to call the Department of Agricultural Education, the University supervisor working with you, or the Student Teaching Department when questions arise.

We welcome suggestions that you may have about the program of agricultural education and student teaching in this field.

Gordon M. A. Mork
Director of Student Teaching
373-2244

Harry W. Kitts
Supervisor of Student Teaching in Agricultural Education
647-3460

December 1965

To the Student Teacher:

We welcome you to the challenging and interesting role of Student Teacher! You will find it to be among the most stimulating and rewarding experiences of your college years.

Student teaching is one of the most important phases of the education of a teacher. Provision for actual experience in teaching and leadership roles is a basic and fundamental portion of the curriculum. In no other way can one quite so effectively develop the competence needed by teachers of vocational agriculture. You have the opportunity to test yourself, your ideas and your personality in a practical setting. You have the added opportunity to bring to your pupils a fresh contact with a college-age man with whom they should be able to identify in a wholesome and inspiring manner. Your example can be a splendid experience for them.

We hope that you will give serious thought to the long-range professional aspects of teaching. These extend far beyond your immediate field into your broader responsibilities as an educator, and challenge you to recognize that you are a member of a teaching staff in your own school, and in the state, the nation and the world. Perhaps this is best expressed by the creed for teachers of vocational agriculture on the preceding page.

When we can help you to make your student teaching experience more helpful and successful, please call upon us. At all times, too, your constructive suggestions will be welcomed and given every consideration.

Gordon M. A. Mork
Professor
Director of Student Teaching

FOREWORD

Student teaching is not just practice teaching. It is a genuine experience in teaching under competent supervision which gives the student the opportunity to participate in a functional cross-section of the work of a teacher of vocational agriculture in a well-organized department in a community setting. The full time of the student is required and, in most cases, residence in the community is necessary.

It is hoped that this manual will help supervising teachers and student teachers to organize their activities so this important phase of the teacher education program will be a genuine learning experience.

Student teaching centers are selected on the basis of the training and experience of the teacher, a co-operative administration, adequate facilities, and a complete program for the beginning farmer, adult and high school student, including work in the Minnesota Farm Management Service. The number of training centers used varies each year depending upon the number of seniors registered. Even though there are no permanent training centers, many of the same schools are used every year. The selection of supervising teachers is done by the staff of the Department of Agricultural Education of the University of Minnesota in co-operation with the State Supervisor of Vocational Agriculture.

Harry W. Kitts

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PART ONE

THE STUDENT TEACHER

I. An Introduction to Student Teaching

Admission to the College of Education

Students wishing to prepare themselves for teaching vocational agriculture in secondary schools make application for admission to the College of Education during the third quarter of their sophomore year in the College of Agriculture, Forestry, and Home Economics.

Admission requirements include the following:

1. A minimum of 2.3 GPA in all course taken in Agricultural Economics, Agronomy, Animal Husbandry, Dairy, Entomology, Forestry, Horticulture, Mechanized Agriculture (except MeAg 23), Plant Pathology, Poultry and Soils.

2. A minimum overall average of C (2.0) or better in all work taken to date.

3. A medical examination and clearance by the University Health Service.

4. An examination and clearance by the Speech and Hearing Clinic.

5. Completion of a battery of standardized tests which include the Miller Analogies, Co-op Reading Test, Minnesota Teacher Attitude Inventory, Minnesota Multiphasic Personality Inventory.

6. An interview by a trained counselor in the Student Personnel Office.

7. Have satisfactory agricultural background and experience.

Admission to Student Teaching

The student's record is reviewed before he is admitted to student teaching in his senior year. He must have maintained a 2.3 (C+) or better average in all technical agriculture courses taken to date. In addition, favorable recommendations are required from his counselor in Student Personnel, his major adviser, and those who worked with him in the course, "Introduction to Secondary School Teaching." His record and the recommendations are reviewed by the Director of Student Teaching. If it is believed that the student will continue to make satisfactory progress, he is approved for student teaching.

College of Education Course Requirements

Ed 55B, Introduction to Secondary School Teaching (5 credits), consists of three hours of lecture and two hours of lab each week.

All students are required to observe classes at University High School both directly and by closed circuit television. Students also work with a youth group in the community for a total of approximately 20 hours. The lectures and lab deal with individual differences and educational measurement, statistics, standardized tests, teacher-made tests, marking and promotion, educational research, psychology of learning and human development. Satisfactory completion of this course is a prerequisite for admission to student teaching.

Objectives of Student Teaching in Vocational Agriculture

The major objectives of student teaching are:

To aid in the development of the attitude, understanding and ability which will lead to proficiency in teaching vocational agriculture

To develop an appreciation of the total educational program

To develop an understanding of the contribution the vocational agriculture program makes to the community school

To develop an appreciation of community activities of an agricultural teacher

To develop techniques of using community resources in the teaching program

To develop the ability to evaluate a vocational agriculture program in terms of the objectives.

University-School Relationship

The proper relationship between the University and the local department of vocational agriculture is necessary for successful student teaching. The teacher of vocational agriculture is employed primarily to serve the school and people of his community by training present and prospective farmers and assisting them to become established in farming or related occupations. The University's Department of Agricultural Education has a responsibility to train prospective teachers of vocational agriculture. The placing of student teachers in departments of vocational agriculture over the state tends to bring about an integration of teacher education and local department responsibilities.

Student Teaching in Agricultural Education

Assignment to a Teaching Center - Student teachers in Agricultural Education will reside off campus in their assigned teaching center during the six weeks period in the winter quarter of their Senior year. Six credits will be granted

for the course. Students will be assigned to a teaching center while enrolled in AgEd 81 or during the orientation period.

Group Meetings Off-Campus - Supervisors will schedule late afternoon and evening conferences in the geographic area during the student teaching period. Student teachers and supervising teachers from several departments will attend these conferences. Where possible, each session will be held in a different school to provide opportunity to observe other physical facilities.

Experience has shown that many teaching problems are common to all beginners. You will feel more secure when you share your experiences with others and discuss the ways they have tried to solve these problems. This opportunity, along with the guidance of your supervisor, will help you gain perspective more rapidly. These meetings can emphasize teaching problems appropriate for the particular group. Problems are frequently quite different from those experienced by other individuals.

These meetings are sometimes used as a workshop for unit construction. Frequently they may be devoted to a particular topic or technique. Your supervisor may require that you do some special reading or preparation. Special resource people are occasionally utilized. Do not hesitate to make suggestions concerning things that you would like to have considered.

Orientation for Off-Campus Student Teaching - During the first five weeks of the winter quarter, students will report to the St. Paul campus for intensified daily instruction in: AgEd 56 - Rural Education Through Extension Methods; AgEd 103 - Adult Education in Agriculture; MeAg 130 - Instructional Methods in Farm Mechanics; and Orientation for AgEd 91 - Student Teaching. You will then report to the assigned teaching center for a six week residence period. During the final week you will return to the campus for a workshop to exchange ideas on your teaching experiences.

II. Your Entrance into the Teaching Profession

First Impressions

First impressions are important. Be genuinely courteous, cooperative, and sincere in your dealing with students, supervising teachers, administrators, other faculty members, school employees, parents, and residents in the community. The ability to work well with other people and to maintain desirable relationships is one which every beginning teacher should cultivate.

Your Supervising Teacher

Your supervising teacher and the high school pupils are looking forward to meeting you and working with you. They are prepared to like you. If you keep this in mind as you approach the classroom, it will make it mucheasier for you. Other members of the faculty will also be interested in you. This will be one of your first experiences in building professional relationships. It is an opportunity to learn to work effectively in a public school and, at the same time, be unassuming. This requires knowledge, sensitivity, tact and poise.

Your supervising teacher is working with you because he considers this a professional responsibility. The University pays a token honorarium which cannot be construed as adequate remuneration. His work with you is added to an already heavy schedule. Watching your progress is what makes this work rewarding. It is your responsibility to be courteous and appreciative. If your supervisor feels that he has helped you, he will feel that his work has been worthwhile.

It should be realized that the coming and going of student teachers causes some interruption of the regular school program. At the same time, you are added personnel in the school and as such, you should have additional ideas to present for consideration which can be of value to the educational program. Endeavor to make some permanent tangible contributions to the department and the regular school program during the period.

Administrative Relationships

Always remember the well-defined, but invisible channels. Think no more of bypassing your supervising teacher than you would of going directly to the school board without first going through your administrator. The supervising teacher is your immediate superior officer.

It should be understood that as soon as you step inside a public school, you are responsible to the principal of the school as well as to your supervising teacher. You are also responsible to your University supervisor. The administration expects you to become one of the teaching staff. Every teacher has certain obligations in the total program and you must be willing to do your share in this respect. At the same time, you are not assigned to the school to do "odd jobs" which are not required or expected of other teachers.

Public relations are of great importance to the University off-campus program, and all students are judged by those who go out. Your school has relatively few student teachers each year, so the conduct of each individual is important. The University has reason

to be proud of those who have preceded you. The welcome that you receive is a result of their work. The acceptance of the next student teacher will depend on you.

Ethics and Professional Relationships

You will be regarded as a teacher by both parents and pupils. It is necessary that you act as a professional person. All information concerning pupils, parents, or school must be kept in strict confidence. You must exercise care in discussions with other student teachers. When you study the files on your pupils, copy down test scores, but use a code in place of names. Do not copy any personal or family information of an anecdotal nature. This can be remembered. If there is no confidential information in your papers which can be identified, there will be no crisis should you mislay these papers.

All professional people learn a great deal that must never be revealed. Think of the role of the doctor or the lawyer. Yours is similar. When you are in doubt about the professional ethics involved in a particular situation, be most conservative in your speech and then discuss the problem with your supervising teacher or the University supervisor.

If you are successful in your professional relationships, you will be welcomed into other classrooms and at school functions. When you are included in activities where cost is involved, be sure to contribute your share.

Students usually express concern about "drawing the line" between themselves and the class. They want to be friendly, but they don't want things to get out-of-hand. Being well-dressed ("sharp" in a mature way) will help pupils to regard you as a teacher. If you look like a teacher and act like a teacher, you will very likely be accepted as a teacher. Some specific suggestions are listed below:

1. You probably will not find all situations as perfect as you think desirable; few of us do. This will call for discretion in everything you do.

2. Do not become involved socially with your students. This includes all high school girls.

3. You should never criticize one student to another, nor should you criticize your class, your supervising teacher, your administrator, or your school to others.

4. Do not hesitate to ask for assistance from the supervising teacher. If you do not know how to do a particular job, be sure to say so. Don't put yourself in an embarrassing predicament by claiming to "know it all."

5. Do not be afraid to suggest new ideas, but strive for tact when doing so. If the idea is not adopted or some idea is being used that may be contrary to your past teaching, ask why. Usually there is a very good reason.

6. Do not wait to be told what to do. After general instructions have been given you, or certain activities planned, proceed to get the job done. Use initiative, but be sure to keep your supervising teacher informed.

7. Personal appearance is important. Every student teacher is expected to be well-groomed at all times. Above all, this means cleanliness. Care of the hair and nails should be stressed. You should shave each morning. Dress for whatever the occasion requires. It is not necessary to have a large wardrobe, but clothing should be neat and pressed. Shoes should be shined. It is advised that you wear dress shirts and ties with suits or sport coats. Dress-type shoes should be worn.

Personality and Attitude

Student teachers are concerned about the impression they will make on the class. This concern sometimes makes them insecure and vulnerable. It is likely to make their behavior excessively "strict" or "easy." As long as a student teacher is mainly concerned with how he is doing, little progress can be made toward understanding pupil needs. Insecurity is a phase that most student teachers must go through. Your supervisors understand this and will try to help. However, it is important that you go through this phase of self-concern and not bog down at this performance level.

Tell yourself consciously to concentrate on your pupils as individuals and as a group. During each period, plan to observe something in particular. This is quite easy before you take over the teaching of the class. It becomes more difficult when you are before the class. As you grow in the power to observe the results of your classroom methods while they are in progress, you will become less concerned about yourself and more concerned with what your class is learning. You will develop sensitivity to the success of your methods and ideas.

As a professional person, you must grow in objectivity. This means that you look at problems, whether they be learning problems or behavior problems, as something to be solved. You do not look upon them as personal affronts and challenges to your authority. If you refuse to regard pupil behavior as a personal affront, even when you know that this was the intent, and yet deal firmly with the pupil, you take the fun out of aggravating behavior.

When a pupil learns slowly, or not at all, you should look upon this as a learning problem and keep trying different materials and approaches. The pupil should be helped as much as possible without taking time from the rest of the class and making him a constant center of attention. If you were to regard poor learning as a reflection on your teaching or on the pupil's effort, your action would likely be punitive. This would accomplish nothing constructive.

Obligations

In teaching, your first obligation is to have something interesting and worthwhile for pupils to learn during each class period. As a result pupils will expect to go to work when they enter your classroom. Even review time should reveal some new information and establish some new relationships.

Your second obligation is to study your pupils to see how they learn. This will enable you to plan for more challenging and effective learning situations. This is what is meant by on-going evaluation. To use this technique, you must know where it is that you want the class to go. Tests are only one phase of this kind of evaluation.

Your third obligation is to provide a pleasant, stimulating classroom atmosphere where pupils are free to work and learn. They must know that they need not worry about flying paper clips or other disturbing or destructive objects. To learn, they must be able to see and hear what is going on. They must also be able to participate in developing ideas as they reflect on what is presented to the class.

If you use these three obligations as points of reference as you decide how to deal with classroom problems, your decision is likely to be appropriate and to be recognized as such by the pupils. If the class becomes restless and you know it has been kept too long at one kind of activity, the solution is to change the activity rather than to reprimand the pupils. If you have planned a discussion and find that the class is too restless to proceed (for whatever reason), you should be able to teach for the same understanding through another activity more suited to the temper of the class. Perhaps the alternate activity should require more individual work. If your pupils are not learning what you had hoped, you may have to redesign a major portion of your unit.

If a particular pupil interferes with the progress of the rest of the class, it might be prudent not to take the most extreme action first. If a conference is ineffective, the pupil's seat might be changed. Thus far he is still a class member. The next step might be to place him in a chair removed from other class members. However if you begin to evaluate the disturbing element in a situation

when it first arises, it is rarely necessary to exclude a pupil. You should confer with your supervisors at the first signs of trouble. There may be alternatives you haven't considered.

Learning problems are never found in the same combination in any two classes. Each needs a little different approach. The sooner you can focus your attention on these problems, the sooner you will be able to develop appropriate methods for each group.

A sense of humor is always a great asset to a teacher. Reprimands which raise pupil resentment make learning impossible. You might as well accept your pupils as they are and then decide in which direction your efforts can most effectively be placed. Change in behavior will come as a result of pupil learning experiences. Undoubtedly you understand this approach in an academic way, but the sooner you put it into practice, the sooner you will be able to accept your pupils with genuine good will and good humor. Anything short of this is rejection, and pupils will sense it. Your pupils are the nicest people -- when you accept them, they will accept you. You take them where you find them, but <u>you do not leave them there</u>.

Your teaching will be enjoyable if you become alert to what students laugh at and think is funny. You and they might laugh as a result of the same incident, but they might not be laughing at the same thing that you are.

<u>Absence</u>

If you are ever absent from your assignment due to illness, <u>notify the school before classes begin in the morning</u>. If possible, talk with your supervising teacher. State the reason for your absence and when you expect to return.

Under no circumstances should you ask your supervising teacher for permission to be absent from student teaching. Your attendance is a University requirement. Even if your classes are not meeting, the assembly or field day that the pupils are attending is part of your experience in the school. You will be responsible for supervising pupils at such events in the future and this is your opportunity to get some understanding of what is required. Attend all school-wide events that occur during your time in the building. Do not use such time for study or planning.

The University takes this attendance requirement seriously. If it is necessary to be absent for any reason other than unexpected illness, you should notify your University supervisor and make arrangements with your supervising teacher so that the pupils' work will not be interrupted. All of this is to be done before the absence occurs.

Out-of-School Activities

You are to attend the out-of-school activities during your off-campus assignment. It should be interesting to attend plays, concerts, or athletic events. You may find that adolescents behave quite differently in each of these situations.

You might find these activities more interesting if you have some duty to perform such as taking tickets or working with pupils in a refreshment stand. You might offer your services to your supervising teacher. If he refers you to the teacher in charge of the event, offer your help to him. However, if you take on a responsibility, be sure that you know exactly what is expected of you.

Suggestions for the Student Teacher

Classroom, Agricultural Mechanics Laboratory and Field Work

1. First contacts are important. Your supervising teacher will introduce you to each class. Be friendly and sincere but reserved.

2. Learn the name of each boy and as much as possible about his farming program, or plans for a work experience program, and home conditions before starting your teaching.

3. Prepare your lesson plans carefully, have them checked by the supervising teacher far enough in advance so you can make any recommended changes. Avoid eleventh hour preparation. This also applies to tests, field trips, panel discussions, committee meetings, use of audio-visual materials and the like. Regular systematic planning will help produce a better learning atmosphere.

4. Maintain an orderly, business-like classroom atmosphere. You must maintain proper control of your classes. Secure the cooperation of your class but do not try to do this by being too "easy" or overly friendly. You must first gain their respect. As you gain experience, you can more easily direct and supervise class work which allows greater and more desirable student activity and freedom.

5. Endeavor to improve such things as your handwriting, board work, use of English and spelling.

6. Do not talk down to the students, neither go above their heads. Take into consideration their age and experience. Check often to see that the whole class is following you. Study the work of the supervising teacher, always trying to determine why he did what he did.

7. Shop instruction will require as careful planning and organization as the classroom. Have in mind your methods and approach. Secure your material and equipment in advance.

8. On field trips definitely plan what you want the students to observe or do. Follow this up later in class by means of discussion, the administration of a quiz, further explanation, or other appropriate activities.

9. Be prompt in meeting all your classes and appointments. It is better to arrive ahead of time than to rush into a room out of breath a split-second ahead of the bell. Be consistent in your methods and relationships. Develop patience and self-control.

10. Demonstrate a professional attitude in all your contacts in the school and community.

General Instructions

1. Student teachers in vocational agriculture are expected to devote their entire time to work and activities in the agriculture department and the school during their student teaching period.

2. Keep the required records and reports and submit them on time. See the instructions on the first page in the Records and Reports section of this manual.

3. Keep all required or desirable records such as mileage, meals, and hotel expenses.

4. Put things back in their proper place when you finish with them.

5. Do not ransack department files and take some of everything.

6. Be sure that everything you do is done to the best of your ability.

7. Do not feel hurt if the supervising teacher does not have time to visit with you at times. Make a definite later appointment.

8. The local school authorities have granted permission for you to observe and to do student teaching in their school. The continuance of this privilege to those who will follow you depends upon how well you do your work and the manner in which you conduct yourself.

9. Develop an understanding of the ethics of the profession. As an example, you must recognize the confidential nature of personal data and treat it as such.

10. Make arrangements in advance of arrival in the community for board and room.

III. Planning and Observing

Inform Yourself about the Pupils in Your Classes

Check the records of the pupils to find test scores that will help you in planning appropriate work. I.Q. scores can be helpful. Note the particular tests that pupils have taken and then check back into your Ed 55 notes to recall the characteristics of the test. Record the results of any achievement or aptitude tests which provide information helpful in planning work in your field. As you record these scores, use code instead of pupils' names. Make only mental notes of other personal information. Student teachers have indicated that the better they know their pupils, the more effectively they are able to work with them.

Knowing the Building

Acquaint yourself with the building. Go over the fire drill route from your classroom. Find where pupils should be taken for first aid when the nurse is in and when she is not. Make a record of the nurse's hours in the building. Find out where the audio-visual office is located. Check the route of your classes to the auditorium. Learn where the custodian's office is in the building. He can be a valuable friend to any teacher. The library will be a place where you spend a great deal of time. It is also of interest to know the location of gymnasiums, shops, art rooms and music rooms.

Following Administrative Procedures

It is necessary that you find out about school policies and regulations. Try to schedule a conference with a counselor and the principal. Find out what happens when a pupil is sent out of class. In some schools this might result in suspension. This will also be an opportunity to find out what responsibilities teachers have for pupil behavior in assemblies, lunch rooms, rest rooms and halls. If you ever should feel the necessity to discipline pupils in these places, be sure that you know what is expected of you.

It is important to find out what responsibilities teachers have in addition to regular classes. Many work with special activities or have guidance or administrative responsibilities.

Using School Facilities

As soon as possible you should acquaint yourself with the services of the school library, audio-visual office, and the procedure for duplicating teaching materials. For example, you might want to know how many books the librarian will allow you to keep in the classroom and for how long. You might want to have pupils check these books out directly from the library once selections have been made from the room library. This would require a special procedure. You should find out the circumstances under which small groups or entire classes may come to the library. Your getting to know the librarian is most important to the success of many units.

You should also gain knowledge of the materials in the library which will be useful in your unit.

In some schools movies are scheduled a year in advance. You should consult with your supervising teacher about whether pupils should see these movies if they do not directly relate to what is being taught. If they must be shown, you should recognize that these are days not spent on your unit.

Some schools have stringent regulations concerning the use of duplicating facilities. However, if your work is planned well in advance, provision is usually made for running off teaching materials.

Observing

One of the most important uses for extra time in the school is to observe other classes. You should try to make at least one observation each week. It is a good idea to observe a particular class for several days, if possible. You will find it interesting to observe other teachers. Special classes such as hearing and sight saving have aroused enthusiasm in many student teachers. If there is any special school program in reading or academic enrichment, be sure to gain an understanding of it.

You would find it most helpful to observe how teachers in the academic fields, in physical education, shop, home economics, art and music handle their classes. Pupils move about a great deal. Also, there are many materials to keep in order. These teachers have developed special techniques to keep both pupils and materials in order -- if they did not, their classes would be chaos. The student teacher can learn a great deal by studying their approach.

You should work through your supervising teacher to make arrangements to observe other classes. If your teacher indicates that such arrangements should be made in another way, you should follow whatever procedure is recommended. Setting up observations may sometimes be a delicate matter and will require tact and good will on your part. Teachers must feel that you are there to learn, not to criticize. They must feel that you will not look for some method

that you disapprove of to report back to a University class. Teachers know that many false impressions can result from one or two observations and it makes them hesitant to invite you into their rooms. You will be welcome when they are convinced of your good will and discretion. Your University supervisor is as much concerned with your experience and with public relations as you are. He can guide you in the professional ethics involved in any situation in which you might find yourself.

IV. Your Work in the Classroom Before You Begin Your Unit

Accepting Responsibility for Routine Matters

You will want your supervising teacher to feel that you have initiative, and yet will not want to be thought presumptuous. This requires tact. If you have not been delegated any responsibilities by the end of three or four days, you might suggest that you take over the attendance. This will help you to get to know the pupils and give you an opportunity to move about the room.

It will help you when you begin to teach if you already know the procedure for sending pupils to the library, office, nurse, rest room, or special activity. It is also necessary to know the conditions under which pupils may be requested from other rooms and the procedure for doing this. Complete familiarity with routine matters will make you more at ease when you take over responsibility for the class.

Read the school bulletin each day. Make notes of schedule changes and special events which will occur in the near future. If the teacher customarily reads the bulletin to the class, you might suggest that you could do this. Try to develop an awareness of pupil comfort. This should become automatic with teachers. You might offer to regulate ventilation, temperature, and lighting.

Learning Pupils' Names

Try to make seating charts on your first day in class and begin to learn the pupils' names immediately. You should have mastered their names before your unit begins.

Offering to Help Individuals and Small Groups

When the pupils have a study period during class, offer to go about the room. Give pupils any help that you can. Be sure you know the name of each pupil to whom you speak. You might suggest you take individuals or small groups to the library for study or to a special place to practice for a presentation to the class. The more you participate, the more you will "see" as you observe.

If you are to help pupils, you must keep up with what is going on in class. Read all assignments given to the pupils and know what other work they are doing. You might try answering the questions on any test they take -- just to check on yourself.

Handling Materials in the Classroom and Shop

It will prove helpful to note how materials are distributed and collected. When this is done can also be important. It is during times when materials are being passed about that a beginning teacher frequently loses control. If papers are sorted so that they can be handed down each row, they can be distributed before the bell rings. If materials are to be distributed, pupils can frequently pick them up as they enter the room.

Another restless time occurs at the end of a test -- or any written assignment. Some pupils finish more quickly than others. If they have already been provided with something interesting to do and directions have been properly given, you can pick up papers as you see them transfer to the new activity.

Giving Attention to the Interest Span of Pupils

Study the timing of the teacher. How long does the class stay with different kinds of activities before becoming restless? This will be valuable knowledge as you plan your units.

Identifying Elements of Good Classroom Discussion

If you are like most student teachers, you will experience some difficulty when you first begin to lead classroom discussions. As you observe, note the kinds of questions that elicit the best pupil response. Study ways to build on pupil responses toward a particular objective or generalization. This is much better than breaking the train of thought with a new question after each response. It makes pupils feel that they are contributing to something important rather than "telling you."

Refrain from such phrases as "tell me." "I want you to . . ." "Tommorrow I want you to . . . for me." There is no reason at all why pupils should spend their time studying for you. When you take this approach, learning tends to remain at a superficial level; implicit in each of your questions or directions should be what the pupils can gain from answering or complying. Phrase your questions so that pupils will understand this. Then build toward your objectives with pupil responses.

As you observe, you should be mentally phrasing questions and planning ways to build toward your objectives with pupil responses. This intellectual exercise will net large dividends. It is part of acquiring a mind-set which will precipitate a true learning situation.

Administering Assignments, Worksheets and Tests

Note the kinds of assignments that the supervising teacher gives. Find out how much homework pupils are accustomed to. If homework is given, pupils should understand what they are to do. It is frequently best to get them started in class so questions may be answered. Parents resent poorly defined homework assignments. Also, homework should not be busywork -- more of exactly the same kind of thing that has already been learned. There should be something worthwhile that the pupil is to find out or create, and you should be able to state this clearly.

Worksheets or study guides are used in many forms by teachers. They can be very useful to the beginning teacher when he sets up situations where pupils will use many different sources. The questions should be thought questions with real purpose. They should not be question and answer games keyed to a particular text.

It is preferred that you make up and administer your own tests. Note the kinds of tests to which pupils are accustomed. If yours differ, you will need to explain them.

Working with the Entire Class

Your supervising teacher will provide opportunities for you to work with the entire group for portions of a period at the beginning. When you take over the class, you should do so as smoothly as possible. Pupils will feel a little insecure with you at first. One manifestation of this may be restlessness and a tendency to "try you out." If you look upon this behavior as their attempts to establish their relationship with you, you will come through this period with greater understanding. Pupils need reassurance thatthings will not be too different, after all. When they feel secure with you, you may feel more sure of the success of any innovations that you might want to try. The pupils will probably enjoy them. Everyone likes a change of pace -- if his security is retained.

Whenever you assume responsibility for the class, you are required to make written plans. Before you begin to teach your unit, your entire unit plan must be complete.

V. Planning and Teaching Your Unit

A Statement of Purpose

When your supervising teacher and you have agreed about what you will teach, it is necessary to decide when you will begin and how long your unit is to take. If you are unfamiliar with the

topic, the first thing to do is to begin to inform yourself. For a quick overview, it is recommended that you use several school texts and reference works.

It is more likely, however, that you will know a good bit about the topic already. If you do, the next step is to ask yourself, "What is my major purpose in teaching this topic to my pupils?" Ideally, you should be able to break this major purpose into objectives which fall into the categories of understandings, attitudes and skills. However, this has been found to be difficult for student teachers. If you find it so, state your major purpose or objective carefully in writing. At this point a conference with your supervising teacher might prove helpful.

The Outline of Content

It is suggested that you next work on your outline of content. Duplication of effort can be avoided if you make up your bibliography and list of materials at the same time. This is the time when you organize all of the information that you can find that is related to your topic. Usually the outline will contain much more than you will be able to use in the classroom. This should not be an outline of your pupils' textbook. It should integrate materials found in the text, in other reference works, in current magazines and newspapers, and in books. This is the supporting evidence that builds toward your objectives. It is the data that will help support concepts. When you find materials you plan to have students read or you plan to use in class, it is helpful to indicate the reference in the right margin of your outline. Then, when you make daily lesson plans you need not search out materials all over again you "know are there."

Teacher Reference Materials

As you plan your unit, you should be looking for any materials that will help pupils to form concepts. Films, pictures, graphs, charts, maps, mechanical devices, and demonstrations are examples of teaching aids. These should be referred to in the right margin of your outline of content at a point where they might be appropriate. It should be noted that the use of such teaching aids frequently requires advance arrangements and preparations. This is the place where you might list selections that you might read to the class or that you might use to refresh your mind before a classroom presentation.

Bibliography for Class Use

As you work on your unit you should be compiling a bibliography of readings for your pupils. This should be found in your unit in proper bibliographic form. Do not include things that you have read for your own background work but do not expect pupils to read.

More Specific Definition of Objectives

When you have gathered and outlined all of the material applicable to your topic you should ask yourself, "What kinds of classroom experiences can I provide so that my pupils will gain the desired learnings?" When you ask this question you are beginning to think about developmental classroom activities. As you think in terms of pupil learning, you should be able to state your objectives in terms of understandings, attitudes and skills. These objectives should be stated in terms of pupil behavior. If you have difficulty with this, ask your University supervisor for help.

You have seen units which have long lists of objectives. Many of these were resource units where every possible objective was indicated with the idea that the teacher would choose those appropriate for his class. You should select only objectives which are appropriate for your class and your topic. If you teach the same topic to two classes, you may find your objectives different for each class.

As you decide on objectives, you should find out what has already been stressed with the pupils. Your observations of the class may have revealed areas where special work is needed. Chose objectives which are appropriate to your topic and which will emphasize areas where the class needs to work. For each stated objective, you should be prepared to show at least three different learning experiences in your unit which should help pupils to gain this goal.

Seldom is there a unit taught in Vocational Agriculture Class that does not adapt itself to carrying activities to the point of pupil application. Objectives should include this provision, "How can I adapt these practices to my home farm conditions?"

It is your job to maintain skills and attitudes already learned. New understandings should be related to those already established. However, the stated objectives for your unit are the focal points, the points for emphasis.

Developmental Activities

Developmental activities are the experiences you have devised for your pupils so they might gain the desired learnings. They should be described in detail. It should be clear not only what you hope to accomplish, but also how you plan to go about it. Each activity should warrant at least one paragraph. An effort should be made to plan for a variety of learning situations. This will make the work more interesting for the pupils. It will also give you many different experiences rather than one experience repeated many times.

The Evaluation of Pupil Progress

Evaluation should be continuous throughout your unit. Each time you set a goal, be it major or minor, you should determine how satisfactorily it was reached. As you plan your developmental activities, try to plan how you will evaluate their effectiveness. When you select a graph or a movie, think how you will determine its usefulness. Whenever pupils spend time in a learning activity, evaluate the resultant learning in terms of your objectives and the time spent. Many "old favorite" activities might disappear from the schools if such evaluation became prevalent.

At this time write an overview of how you plan to evaluate pupil learning. Indicate when you plan to give tests, and what kind, but do not make up the tests. Review your objectives and state how you will evaluate progress toward them during the course of your unit -- while there is still time to adjust your teaching to what you find out.

The Complete Unit

When your unit is complete it should be assembled as follows:

- Specific Objectives
  - Understandings
  - Attitudes
  - Skills
- Outline of Content (with references indicated)
- Developmental Activities
- Bibliography for Class Use
- Teacher Reference Materials
- Plan for Evaluation

Any dittoed materials that you prepare before your unit begins should be attached to the unit. Other materials should be handed to your supervising teacher with your daily lesson plans.

You should make a separate unit plan for each unit that you teach. Daily lesson plans should be approved not later than Friday for the entire following week. You should turn them in to your supervising teacher at the school as soon as possible so he can review them and schedule a conference with you to discuss your plans.

It is difficult for beginning teachers to know how much work to plan. Your supervising teacher will help you to see what might be added or cut should the need arise. He will also point out alternative methods for teaching the same thing. You may need help to meet individual differences. Pupils who learn rapidly must have purposeful work to do which is in line with your stated objectives, not busywork. Pupils who work more slowly also need special consideration.

Your daily lesson plan should also have a reminder section. Announcements and assignments may be listed here. Materials needed for the class period should also be indicated so that you can be sure to have them at hand.

Tests, worksheets, charts and diagrams or similar materials to be used in the classroom should be checked with your supervising teacher several days before you plan to use them, and before they are duplicated. If you work closely with your supervising teacher as you plan your unit, you will probably be given more freedom because the teacher will be assured that you are working hard to prepare worthwhile class activities.

You have been given a form for your daily lesson plan in your methods class: use it. You can easily make any additions to satisfy the preceding requirements.

Enterprise: Class_____

Job: Month_____

Objectives: No. of periods___

Discussion questions or factors: Information References:

Test Construction

It is preferred that you construct your own tests. When you do so, consult Stecklein's Bulletins on Classroom Testing for item construction. If you did not purchase these in Ed 55, do so now. Your items should be such that they reveal whether or not your objectives are being achieved. The test should be a teaching instrument at the same time it evaluates pupil achievement. It should be worthwhile to spend class time going over the test when it is handed back. When you do so, if your class begins to sound like a "rehearsal," then you should improve the quality of your next test.

A test which is a teaching device should make pupils reason as they take it. It will then become fun to discuss how they figured out an answer. It should also spark curiosity so pupils will be motivated to look up items and be eager to report what they have found.

To make the most of this learning experience, the test should be graded and ready for discussion at the next class period. The sooner papers of any kind are handed back, the better the learning experience.

Adjusting the Unit

No matter how carefully plans are constructed, changes must be made. This is not bad luck; it is to be expected. All of your planning has prepared you to do a good job. Thorough planning gives you confidence so that you can be sensitive to classroom interests and develop them whether or not they are exactly what you had planned. Your plans should free you rather than become your prison.

VI. Evaluation of your Work in Student Teaching

Conferences

It is essential that you make time available for conferences with both your supervising teacher at his convenience, and with the University supervisor. Since your period of student teaching is relatively short, early conferences are of great value because they can help you to improve during the quarter.

Feel free to ask for a conference with your supervising teacher at any time. Several points are indicated in the handbook where such conferences might prove helpful. However, several conferences are necessary:

After your unit is complete, but before you begin to teach
After each observation
At the end of the student teaching period.

It is your responsibility to arrange for these conferences. You will usually know when your University supervisor plans to visit you. If, for some reason, you do not teach that day, be sure to notify him so that he can make another observation instead.

Your final conference should be an analysis of your professional growth during the quarter. You might include such things as the effect of your personality on your classes and on the faculty, your professional relationships, the effectiveness of your planning, your classroom management, pupil guidance in the classroom, evaluative techniques, or any other area particularly significant for you.

Grading and Recommendations

You are evaluated throughout the period. You are evaluated on all the phases of your work discussed in this handbook. Conferences with your supervisors indicate how well you are doing as the quarter progresses.

You are graded on the basis of your level of achievement near the end. Your supervising teacher fills out an evaluation form. After conferences with the supervising teacher, study of the written evaluation, and review of his own experiences with you, the University supervisor assigns your grade. He will discuss it with you during your final conference, if you wish. The supervising teacher also submits a statement for your credentials for the Bureau of Recommendations.

VII. Report Forms

A. Before Going to the Teaching Center

1. Information on Student Teacher for the Supervising Teacher

B. Weekly Student Teaching Reports Submitted While at the Teaching Center

1. Weekly Student Teaching Report

2. Log of Other Activities

Keep a record of your activities on these forms. Three copies are to be made. Mail the original copy to the University supervisor each week; the supervising teacher should receive a copy; the third is for your own files as a permanent record and so you will be able to enter the "total to date" on the next week's report.

3. Weekly Calendar for Advance Planning

Six sheets are needed, one for each week of your student teaching period. These are to be used for recording planned and scheduled activities. Time passes swiftly -- this is especially true of the time available in the training center. You will reap big dividends if you carefully plan your work before the beginning of each week.

C. Immediately Upon Completion of Student Teaching

1. Information Pertaining to Student Teaching Center

2. All lesson plans, tests and other materials used should be accumulated and kept on file for personal use and for review by the University supervisor or supervising teacher on request.

3. Check list of participating experiences for student teachers (leave bound in this handbook).

STUDENT TEACHING REPORT

Student Teacher_____ Teaching Center_____ For the Week _____ to _____ 19 ___

	No. classes Observed or Taught (Count each period as a class)						Topics of Lessons Observed	Farming Programs Visited			School Business Mileage	Activities
	High School		Begin-ing Farmer		Adult Farmer							Meetings, Interviews, Trips, Contacts, Etc.
	Observed	Taught	Observed	Taught	Observed	Taught		High School	Beginning Farmer	Adult Farmer		
Total to date												
Mon.												
Tues.												
Wed.												
Thurs.												
Fri.												
Sat. & Sun.												
Total												

LOG OF OTHER ACTIVITIES

Student Teacher _____ Week of _____ to _____ 19____

and

Problems, Questions or Comments for Supervising Teacher and University Supervisor

Day of Week
Monday:
Tuesday:
Wednesday:
Thursday:
Friday:
Saturday and Sunday:

WEEKLY CALENDAR
FOR ADVANCE PLANNING

Student Teacher _____ Week of _____ to _____

Teaching Center _____

Hour of Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday

UNIVERSITY OF MINNESOTA AGRICULTURAL EDUCATION DEPARTMENT

INFORMATION PERTAINING TO STUDENT TEACHING CENTER

Student teachers are assigned the activity of putting together a folder containing the information in the form below, and filed in the Ag. Ed. office. Each subsequent student teacher will be responsible for bringing the folder up-to-date for those who follow. The folder is to be on file in the Agricultural Education office at all times and be available to student teachers so they may have advance information on the school.

_____ _____

Name of School Post Office

Name of Supervising Teacher _____

Names of other agriculture teachers in the department _____

Name of school superintendent _____ Principal _____

I. Community Information

A. Topography _____

B. Predominant soil types _____

C. Average growing season _____ Average rainfall _____

D. Major types of farming in area _____

_____

E. Average size of farm _____ Range in size of farms represented by members served by the department _____ to _____ acres.

F. Farm organizations in the community _____

_____

G. A paragraph describing the people of the community, covering ethnic background, religious denominations and standard of living.

_____

_____

_____

_____

II. The School

A. Total number of teachers in the Jr.-Sr. high school_____

B. Statement concerning physical facilities of the school such as: sanitary facilities, auditorium, cafeteria, gymnasium, lighting, seating, heating, audio-visual aids, faculty lounge rooms, etc.

III. The Vocational Agriculture Program

A. Include a diagram of the floor plan of the classroom and shop.

B. High school enrollment: _____ Agricultural enrollment:

9th grade_____ 10th grade _____ 11th grade _____ 12th grade _____

C. Enrollment in organizations:

	Total	No. of meetings per year	Average attendance
F.F.A.	_____	_____	_____
Beginning Farmers	_____	_____	_____
Adult Farmers	_____	_____	_____
Farm Management	_____	_____	_____

D. List the vocational agriculture classes taught by the supervising teacher _____

_____

E. School duties of supervising teacher other than vo-ag program

_____

F. Community activities of instructor (Service Club, Farm Organizations, etc.)_____

_____

_____

G. Other _____

IV. Other items to include:

A. School calendar, schedule and regulations

B. Written program of work for vocational agriculture department

C. Written program of work for F.F.A.

D. Summary of productive enterprise projects for previous year

INFORMATION ON STUDENT TEACHER FOR THE SUPERVISING TEACHER

Student Teacher _____ Teaching Center _____

Dates for Observation and Teaching: From _____ to _____

I. Occupational Experience

A. Farming

1. Type of farming _____ Number of years _____

2. Size and location of home farm _____

_____

B. Non-farm occupational experiences

1. Teaching _____

2. Salesmanship _____

3. Military _____

4. Other _____

II. Social Background

A. Activities prior to college

1. F.F.A. _____

2. 4-H _____

3. Judging Teams _____

4. Athletics _____

5. Church _____

6. Others _____

B. Participation in extra-curricular organizations in college _____

_____

_____

1. Offices held _____

2. Honors received _____

C. Membership in civic and fraternal organizations _____

_____

D. Hobbies (music, athletics, photography, etc.) _____

_____

E. Church affiliation _____

F. Married or single _____ No. of children _____

III. Financial Background

A. Percentage of money earned while in college _____

1. What kind of work

a. During School year _____

b. Summer _____

B. Percentage of college money borrowed _____

IV. Education Background

A. High school attended _____

B. Size of student body, grades 9-12 _____

C. I ranked _____ from top in class of _____ graduating seniors in high school.

D. Did you take vocational agriculture in high school?_____

No. of years _____ Teacher _____

$_____ invested in farming program at graduation.

Scope of farming program at graduation _____

_____

Highest degree in F.F.A._____

E. _____ years at _____ College prior to coming to U. of M.

V. Personal Data

A. Age _____ Height_____ Weight _____

B. Do you have any physical limitations? _____

_____

C. Professional attitude

1. Reasons for choosing vocational agriculture teaching _____

_____

_____

_____

2. What special experiences would you like to get during your student teaching experience? _____

_____

_____

St. Paul Mailing Address _____

Telephone Number _____

ERIC

PART TWO

STUDENT TEACHING ACTIVITIES

PARTICIPATING EXPERIENCES FOR STUDENT TEACHERS

IN

VOCATIONAL AGRICULTURE

This section of the Student Teaching Handbook consists of a number of participating experiences for student teachers in vocational agriculture. Those listed are believed to be important and strategic, but no claim is made that it is an all-inclusive list.

It is urged that the student teacher familiarize himself with the contents of this section and refer to them, not only one time but many times. Use this section as a check list and develop a program for yourself to cover as many of these activities as possible during your training period.

It is intended that this check list be used in both group and individual conferences. This list of participating experiences should be checked with the supervising teacher to assure that important aspects of the student teaching experience are not being overlooked.

The number of activities listed is rather imposing. However, no student teacher is expected to complete every item. The items which are preceded with an asterisk require a written report to be submitted to the University supervisor at the close of the student teaching period.

Review the complete list:

a. When you receive the handbook prior to student teaching.
   Date accomplished:_____

b. With the supervising teacher when you first arrive at the center.
   Date accomplished:_____

c. With the supervising teacher midway while student teaching.
   Date accomplished:_____

d. With the supervising teacher at the completion of student teaching. Date accomplished:_____

INSTRUCTIONS FOR MARKING AND USING CHECK LIST

Opposite each sub-heading (marked with a letter) and each activity (arabic numeral), will be found two spaces. As experience and proficiency are gained in each activity place a check in either column a or b.

These activities are grouped under the following major headings:

I. Getting established in the school and the community.

II. Discovering community needs and developing a community program of Agricultural Education.

III. Teaching high school classes and on-farm instructions.

IV. Advising an FFA Chapter

V. Teaching Young Farmer and Adult Farmer classes.

VI. Selecting, counseling, guiding and placing pupils.

VII. Organizing, administering and maintaining a department.

VIII. Improving professionally and personally.

PARTICIPATING EXPERIENCES FOR STUDENT TEACHERS

IN

VOCATIONAL AGRICULTURE

a - Satisfactory

b - Need more

	Evaluation a	Evaluation b	Remarks
I. GETTING ESTABLISHED IN THE SCHOOL AND COMMUNITY			
A. Get acquainted with "key" personnel			
1. Principal and/or superintendent			
2. Department advisory group members			
3. Outstanding farmers			
4. Parents of pupils			
5. Businessmen: (bankers, implement and lumber dealers, feed salesmen)			
6. Editor of local paper			
7. County agent and assistants			
8. FFA and Young Farmer officers			
9. School faculty members			
10. School guidance counselors			
B. Become informed on school and department policies			
Confer with supervising teacher and other appropriate school officials regarding:			
1. School and class schedules			
2. Department budget, ordering supplies and equipment, provision for school travel, insurance carried, handling funds			
3. Community, school and department standards as to dress and conduct			

	Evaluation a	Evaluation b	Remarks
4. Requirements for driver's license for operating school vehicles			
5. Provisions for liability insurance			
C. Become a citizen of the community. Confer with supervising teacher and participate as recommended and desired:			
1. Church activities			
2. Farm organizations			
3. Community organizations			
II. DISCOVERING COMMUNITY NEEDS AND DEVELOPING A COMMUNITY PROGRAM OF AGRICULTURAL EDUCATION			
A. Study and discuss with supervising teacher			
1. The long-time written program of work for the department			
2. Department records -- course of study, farm survey records, follow-up records of students, supervised farming reports, FFA program of work			
3. Reports and program of summer work			
B. Become familiar with types of farming in community:			
1. Collect additional data for the department farm survey			
2. Analyze census data			
C. Check records of past and present farming programs			

	Evaluation a	Evaluation b	Remarks
III. TEACHING HIGH SCHOOL CLASSES AND ON-FARM INSTRUCTION			
A. Develop an understanding of individual pupils in your classes:			
1. Learn pupils' names			
2. Visit homes of pupils in your classes			
3. Study personal records and data			
B. Observe teaching of classes:			
1. Obtain and study teaching programs and plans used by supervising and other teachers			
2. Observe and analyze methods used in:			
a. teaching skills jobs			
b. teaching managerial and mental jobs			
c. teaching farm mechanics jobs			
d. class management and discipline			
e. using and locating books, bulletins, tools and other materials			
f. carrying out school policies and rules with respect to classroom work, grading, discipline			
3. Take notes on classes observed and discuss with supervising teacher			
C. Observe and assist with initiation and supervision of farming programs:			
1. Observe supervising teacher on three or more visits to students enrolled in Agriculture 1 while he:			
a. Explains purposes of farming programs to the parents and their son			

	Evaluation a	Evaluation b	Remarks
b. Assists in determining the pupil's interest			
c. Studies available home facilities for conducting a farming program			
d. Assists pupil and his parents in planning his farming program including productive projects, improvement projects, and supplementary farm practice			
e. Assists pupil and his parents in making and recording business agreements, budgets, objectives, and plans in the Planning and Summary Book			
2. Study forms maintained by supervising teacher -- map of school area -- record of travel -- record of home visits, notes made, recommendations, follow-up			
3. Discuss with supervising teacher -- methods of scheduling visits -- factors used to determine whom to visit, when to visit and what to discuss			
4. Help plan and supervise a tour of farming programs for prospective students, for enrolled students and for parents			
5. Accompany supervising teacher on three or more supervisory visits to students with established programs			
6. Make 2 or more supervisory visits to students without the supervising teacher			
7. Check record books of students			

	Evaluation a	Evaluation b	Remarks
D. Plan for teaching:			
1. Obtain copy of teaching program of classes you are to teach and discuss with supervising teacher			
*2. Make and check with supervising teacher a calendar for period you are in the teaching center			
3. Select units to be taught, prepare teaching plans and obtain approval of supervising teacher			
E. Teach classes in agriculture and farm mechanics:			
1. *a. Prepare a written plan for each lesson to be taught, to include:			
-- title of lesson			
-- teaching objectives			
-- analysis and organization of content			
-- statement of procedures including student activities			
-- list of instructional materials			
b. "Tie in" Minnesota Planning and Summary Book in terms of pupil's needs			
c. Plan and conduct a demonstration			
d. Organize a panel discussion			
e. Develop and use at least 2 question and answer tests			
f. Plan and conduct a field trip			
g. Prepare and use at least 3 visual aids			
h. Arrange for a resource person to assist with a class			

* Written report to be submitted

	Evaluation a	Evaluation b	Remarks
i. Develop plans for application of class instruction in home farm situation			
j. Visit 3 or more pupils to observe the extent to which approved practices are being applied in terms of their plans			
k. Check safety conditions of equipment used and teach safe operation and use of tools and equipment			
l. Provide farm jobs for additional experience			
m. Develop in pupils orderly and efficient habits with respect to obtaining and returning tools and materials, cleaning up after work.			
n. Plan with pupils and use orderly procedures for opening and closing classes, for field trips, during class sessions			
F. Build a course of study:			
1. Study the course of study for the department noting basis for selection of units and core material			
2. Study the course calendar for the year and note sequence of teaching activities both as to seasonal jobs and to distribution over the 4 years of instruction			
3. Observe the supervising teacher as he works with his pupils and selects the materials to be taught and problems to be solved during period of student teaching			

	Evaluation a	Evaluation b	Remarks
4. Develop a list of units of instruction based upon the farming programs of the pupils and appropriate to the operation and management of farming in the area to include production phases, marketing phases, farm mechanics, family living, etc. Estimate the teaching time, seasonal sequence and year to include in the curriculum.			
IV. ADVISING AN FFA CHAPTER			
A. Assist in planning the program of activities for the chapter:			
1. Study and discuss with the chapter adviser and officers the previous year's program of activities and plans for the current year's program, and assist committees with their program of activities			
2. Obtain a copy for your files; obtain copies of programs from other student teachers in your area			
B. Serve as adviser of local FFA chapter:			
1. Advise at least 2 officers and 2 committees			
2. Analyze procedure for preparation of chapter budget, managing finances and collecting dues			
3. Act as adviser at a regular meeting			
4. Advise executive committee planning chapter meetings			
5. Elect officers within your class and set up class FFA organization where practical			
6. Provide instruction and practice in parliamentary procedure			

	Evaluation a	Evaluation b	Remarks
7. Assist in preparing (or reviewing) applications for State and/or American Farmer Degrees			
8. Assist in preparing applications for proficiency awards, foundation award, chapter award			
9. Participate in initiation and/or degree ceremony			
10. Assist in preparing state and local reports			
11. Participate in planning and conducting an FFA banquet			
12. Assist secretary and treasurer with records			
13. Participate in preparing for and competing in a field day, judging contest, or fair			
14. Participate in a leadership training conference			
15. Assist reporter in preparing articles for local paper			
16. Assist in planning and conducting cooperative and community service activities of the chapter			
17. Photograph events and keep scrapbook			
18. Advise student committee in planning and preparation of			
a. display board in school or local business			
b. booth for county or state fair			
C. Evaluate the effectiveness of a chapter with assistance of supervising teacher and executive committee:			

	Evaluation a	Evaluation b	Remarks
1. Evaluate progress made towards goals in program of activities			
2. Determine per cent of chapter members actively participating in program of chapter			
3. Evaluate extent of member responsibility and initiative in chapter activities			
4. Determine the contribution of FFA to supervised farming, class instruction, and accomplishing objectives of department			
V. TEACHING BEGINNING FARMER AND ADULT FARMER CLASSES			
A. Familiarize yourself with the Beginning Farmer and Adult Farmer Programs:			
Beginning Farmers			
1. Visit 2 individuals at their homes			
2. Check survey of young farmers in area completed by supervising teacher and assist him to continue this survey			
3. Acquire a copy of the survey form used			
4. Study methods of compiling, analyzing and using data			
5. Help publicize program and encourage participation			
6. Meet with the steering committee to plan for yearly program			
7. Plan and lead discussion at a meeting			
8. Meet with committee and plan recreation for a meeting			

	Evaluation a	Evaluation b	Remarks
9. Work with a class member in securing outside resource personnel for a meeting			
10. Write a news article publicizing the program			
11. Study forms and reports of progress maintained in department and/or submitted to state department - IV-C-75; IV-C-1b; IV-C-14			
12. Observe supervising teacher assisting one or more young men in establishing effective relationships toward progressive establishment in farming			
13. Assist with one or more leadership, cooperative or community service activities sponsored by the group			
14. Study organization and activities of young farmer organization if one in the school			
Adult Farmer			
1. Visit 2 adult farmers at their homes			
2. Study records of adult farmer programs conducted			
3. Help publicize program and encourage participation			
4. Meet with steering committee to plan yearly program			
5. Plan and lead discussion at a meeting			
6. Work with a class member in securing outside resource personnel for a meeting			
7. Write a news article publicizing the program			

	Evaluation a	Evaluation b	Remarks
8. Study forms and reports of progress maintained in department and/or submitted to state department - IV-C-1b; IV-C-14			
9. Study procedure for organizing adult program based on Minnesota Cooperative Farm Management concept			
10. Supervise and analyze at least one Minnesota Farm Account Book			
11. Compare summaries of 2 or more farms			
12. Discuss with supervising teacher the procedures he uses to secure understanding and support for a continuing program of agricultural instruction to serve young farmers and adults			
VI. SELECTING, COUNSELING, GUIDING AND PLACING PUPILS			
A. Discuss and obtain from supervising teacher standards and procedures for accepting pupils			
B. Determine methods used to locate and interest prospective pupils			
C. Provide guidance and counseling for individual pupils:			
1. Confer with guidance director regarding the services and policies of the school and the guidance responsibilities of the teacher of vocational agriculture			
a. Determine records maintained on each pupil including personal data and long-time farming program			

	Evaluation a	Evaluation b	Remarks
b. Determine the factors considered when counseling student into or away from the agricultural curriculum			
c. Analyze cumulative records of:			
-- a beginning student in vocational agriculture			
-- an upper classman			
2. Provide or observe individual guidance and counseling for the following situations, with consent of supervising teacher:			
a. personal problems not involving school			
b. school problems (disciplinary, attendance)			
c. on finishing school or quitting in order to work			
d. planning high school course			
e. planning post high school education			
D. Assist in placement and follow-up of pupils:			
1. Study and assist in bringing up to date follow-up records for department			
2. Assist supervising teacher in surveying placement opportunities in community			
3. Observe and assist supervising teacher in placement of pupils			
4. Assist in developing father-son (or other) partnership agreements			

	Evaluation a	Evaluation b	Remarks
5. Study cooperation with other agencies in aiding establishment in farming			
E. Select with the aid of the supervising teacher one pupil from each high school class			
1. Analyze the file of essential information on each individual regarding his personal information, home situation, farming program, community participation			
2. Observe the teacher conduct a teacher-student conference at school; conduct a conference on the home farm			
3. Note the results of such conferences and their implications for teaching situations			
4. Confer with a senior concerning his vocational future			
VII. ORGANIZING, ADMINISTERING AND MAINTAINING A DEPARTMENT			
A. Follow the organizational and administrative procedures of the local department. Learn and use local department procedures in:			
1. ordering and purchasing equipment			
2. purchasing consumable supplies			
3. preparing department budget			
4. keeping and reporting mileage and travel			
5. submitting travel claims			
6. requesting leave or vacation			
7. securing and using secretarial assistance			

	Evaluation a	Evaluation b	Remarks
8. keeping student records, grades, etc.			
9. reporting absences, disciplinary action			
10. handling funds			
B. Keep records and prepare reports:			
1. Study the reports to State Department:			
a. preliminary enrollment and class schedule (IV-C-3) - due Oct. 1			
b. follow-up of vocational agriculture graduates (IV-C-75) due Oct. 1			
c. quarterly report of on-farm supervision and instruction (IV-C-10) due Oct. 10, Jan. 10, Apr. 10			
d. preliminary report of S.F.P. for high school students (IV-C-13) due Jan. 1			
e. final report of S.F.P. for high school students (IV-C-12) due April 1			
f. annual agreement (IV-C-20) due May 15			
g. supplementary report: farming programs of high school students (IV-C-72) due June 1			
h. final report of Adult Farmer and Beginning Farmer activities (IV-C-14) due July 1			
i. travel reports (IV-C-1f) due July 5			
j. agriculture department annual report (IV-C-1) due July 5			

	Evaluation a	Evaluation b	Remarks
2. Study and discuss with supervising teacher last year's reports			
3. Study and analyze department inventory; obtain copy or list of books, bulletins, teaching aids, tools and equipment, apparatus, audio-visual equipment			
4. Study department method of filing and storage of teaching materials			
5. Study file of correspondence (with permission of supervising teacher)			
C. Secure and maintain instructional facilities:			
1. Secure and study lists of equipment, tools and supplies			
2. Visit at least two other departments and analyze instructional facilities			
3. Study plans and arrangements of agricultural and shop rooms and buildings (draw floor plan of these facilities)			
4. Get assignments and approval from supervising teacher and make improvements in arrangements and facilities in local department			
5. Assist in collecting and preserving teaching materials			
6. File bulletins and periodical references, according to Agdex or suitable filing and reference system			
7. Assist in keeping rooms and offices clean and orderly			
8. Operate:			
a. slide projector			
b. movie projector			
c. tape recorder			

	Evaluation a	Evaluation b	Remarks
d. duplicating machine			
e. overhead projector			
f. opaque projector			
D. Budget your time; plan daily and weekly schedules:			
1. Use calendar or schedule form			
E. Have complete charge of the department in the absence of the supervising teacher on two different days, preferably one early, the other late in the student teaching period			
VIII. IMPROVING PROFESSIONALLY AND PERSONALLY			
A. Maintain satisfactory school relationships			
1. Attend faculty meetings			
2. Get acquainted and cooperate with other teachers and school employees			
3. Attend and participate in faculty social functions			
4. Visit elementary classes in the school one-half day			
5. Visit classes at secondary level one-half day			
6. Make appointment and discuss with principal or superintendent the relation of the agricultural department and teachers with the total school program			
7. Confer with the principal or superintendent regarding procedure for applying for a position in this system			
8. Cooperate and assist with all-school functions as directed by supervising teacher			

	Evaluation a	Evaluation b	Remarks
B. Develop effective relationships with the staff of the State Supervisor and MVAIA:			
1. Become acquainted with the staff member of the State Supervisor's office assigned to your geographical area			
2. Learn names and responsibilities of staff of the State Supervisor of Agricultural Education			
3. Attend and participate in district meetings with supervisory teacher			
4. Attend and participate in district field days, leadership training workshops			
5. Check the agricultural magazines available to the supervising teacher			
6. Discuss the professional organizations in which the supervising teacher has membership as to cost, services, participation, value:			
a. MVAIA			
b. MVA			
c. AVA			
d. NVATA			
e. MEA			
f. AFT			
g. NEA			
h. Other			
7. Discuss with supervising teacher the arrangements for attendance at professional conferences and summer school			
C. Acquire and develop professional and technical skills and abilities:			
1. Acquire by study and practice as many farming abilities as possible			

	Evaluation a	Evaluation b	Remarks
2. Study and develop your ability to give an impromptu talk			
3. Write "thank you" letters, when appropriate, for favors done			
4. Develop your ability to preside over, conduct and participate in a meeting using correct parliamentary procedures			
D. Develop ability to publicize and promote a program in vocational agriculture:			
1. Prepare suitable news articles for local paper. Check school policy on press releases or feature articles			
2. Prepare a feature article with pictures for state or national magazine			
3. Assist in preparing and presenting radio program			
4. Assist in preparing an exhibit for public display			
5. Assist in presenting assembly programs and/or programs before community groups publicizing the local departmental program			
6. Plan and arrange displays on departmental bulletin board			
E. Acquire and develop social abilities and abilities in dealing effectively with individuals:			
1. Practice and improve yourself in making introductions			
2. Develop your ability to learn names of people you meet and to <u>use</u> their names in conversation			
3. Learn to initiate and carry on a conversation with strangers			

	Evaluation		
	a	b	Remarks
4. Develop the habits of effective personal relationships			
a. Let people know in advance of any plans or changes which affect them			
b. Give credit when due by letters, phone calls, or by telling them personally			

PART THREE

THE SUPERVISING TEACHER

To the supervising teacher:

On behalf of the College of Education of the University of Minnesota I welcome you as an indispensable member of our teacher education faculty. Numerous studies have shown that student teaching is the most important single aspect of college preparation for teaching and that the public school supervising teacher is the most influential person in determining the quality of the student teaching experience. Hence, the importance of the contribution that you can make to the education of future teachers is obvious.

Your colleagues on the staff of the College of Education stand ready to provide full support and assistance to you in this important undertaking.

Robert J. Keller
Dean of the College of Education

I. Responsibility for Successful Student Teaching is Shared

Responsibilities of the College of Education

The College of Education and the Department of Agricultural Education assume the first responsibility as they try to identify and prepare able candidates for the profession. Before a student is assigned to a teaching center, many people have tried to ascertain his potential. However, student teaching is still the major test of teaching ability. No student is graduated with a recommendation for certification who has not completed student teaching satisfactorily. The student teacher's success rests primarily on his own efforts and ability. However, he is a learner and the assistance of the supervising teacher and the University supervisor are vital to his success.

The Student Teacher's Responsibilities

The student teacher has the following responsibilities:

To conduct himself in a professional manner
To inform himself with regard to school policies
To become familiar with the total operation of the school, including, for example, the library, health services, attendance procedures, faculty meetings, parent-teacher activities, guidance services, extra-curricular activities, audio-visual resources, use of duplicating materials and programs in special education
To inform himself about the classes he will teach
To plan thoroughly and in writing for all teaching responsibilities
To make time available for conferences with the supervising teacher and the University supervisor
To be on time
To attend regularly whether he is teaching or not
To call the school before classes begin in the morning if he is ill
To be dressed appropriately and to be well-groomed at all times
To be responsible to the administrative officer of the public school to which he is assigned for the proper conduct of all activities delegated to him as though he were a regularly employed teacher in the school
To live off-campus in the community where he is assigned for student teaching

The University Supervisor's Responsibilities

The University supervisor will supply a personal data sheet which your student teacher has filled out. This is designed to give information about his personal history.

The University supervisor will observe the student teacher during the quarter. When he comes to the building, he will want to talk with the supervising teacher to determine what progress the student is making. If possible, it is well to include the student teacher in part of these discussions.

Because of their inexperience, student teachers frequently get the idea that the University is demanding one thing and the supervising teacher another. They need help to see that the supervising teacher is asking for an application of a theory that has been learned at the University. One of the major functions of both the University supervisor and the supervising teacher is that of helping the student to relate theory to teaching practice. For example, the student may be able to speak convincingly about making provisions for individual differences without having any real notion about how these theories are applied in planning and teaching. Or, he may believe that pupils should use many sources as they gather information and try to solve problems. However, the student teacher may not have a clear idea of how to handle multiple readings in a classroom situation. If he is not given help, he is likely to decide that his theories do not work in actual practice. Many of the problems that student teachers meet are common to all beginners. The University supervisor may identify those which can profitably be taken up with the group and those which are unique to your student teacher. If problems arise that you as supervising teacher would rather not handle yourself, refer them to the University supervisor.

The University supervisor will also help the student with his planning. However, he does not know conditions in each school. The appropriateness of the plans for a specific school and class will have to be checked by the supervising teacher. The University supervisor can only offer assistance with the application of method and theory to the class.

The University supervisor conducts group meetings for his student teachers. Supervising teachers are expected to attend these meetings. The University supervisor will schedule the time and place.

Evaluation is another area in which the University supervisor will offer suggestions. To be most effective, evaluation should continue throughout the quarter. When the supervisor comes, he would prefer to be as inconspicuous as possible, and to have no change in plans or special consideration of any kind. Any situation

changes a little when a new person enters the room -- this is expected. However, it remains more normal if pupils have not been warned to behave or informed that this person is there to observe the student teacher.

The Supervising Teacher's Responsibilities

The supervising teacher offers continuous professional and personal guidance to the student teacher. He is closest to the student teacher and his work and thus becomes the greatest single force in shaping the latter's professional development. All that has gone before has been preparation for the moment when the student teacher steps into the classroom.

Despite requirements and screening procedures, student teachers come in all dimensions. One thing that they have in common is an intense desire to do well. Many are really anxious. They want to make a good impression on their supervising teacher and the pupils. They have great difficulty in deciding between what might seem too forward or too retiring. You can do a great deal to help your student teacher if you accept him as a colleague and present him to your classes as such. It is helpful if you introduce him to the class on the first day of his assignment. The way that you work with him as you give him initial responsibility will do much to set the level of his acceptance by the pupils.

Student teachers will sometimes need help in gaining access to the pupils' records. They will also need help in finding out about procedures for the use of duplicating facilities, audio-visual materials and the library. They should be informed of emergency procedures, fire drill regulations and rules for conduct in assemblies. Students should attend most school functions that occur during their time in the building. It would be desirable if they could attend faculty or department meetings; participate in at least one parent-teacher meeting; and student activities such as a class play, an athletic event, or an FFA meeting.

If a student teacher is given specific responsibility gradually, he can usually handle it well. This builds up his confidence in himself and the pupils' confidence in him. If he does well, you will feel no need to break in on him as he teaches. This is usually most damaging to the student teacher's relationship with the pupils.

A student will usually do much better if he waits a week or two before taking over total responsibility for the classes that he will teach. During this time he might work with individuals or small groups or assist in many other ways as he observes your work with the classes. He might take over the entire class for portions of a period until, gradually, he is able to assume full responsibility for each of the classes for an extended period of time.

Many supervising teachers have followed a practice of having the student teacher work with different age levels. They may start the student teacher with Ag I and III classes, then switch him to Ag II and IV.

There is no best way to work with student teachers. It is necessary that you be satisfied that your pupils are being as well-taught as possible. However, it is suggested that you confer with the student to decide how much you will remain in the room during his first few days of teaching. After this, it is preferred that you observe him regularly and frequently so that you can help him to increase his effectiveness. Your pupils are reliable to evaluate his personality impact on the group, but they can offer little help toward better teaching methods. He may also need your help to understand the reactions of particular class members.

When a student teacher is thought of as a learner in the profession, his errors don't seem quite so irritating. Helping him progress then becomes a rewarding experience where you are witness to audible and visible evidence of your contribution to teacher education.

Some additional specific suggestions that may be helpful:

First Contacts

1. Be sure that your student teacher is introduced to the administrator(s), to other faculty members, and to employees as soon as possible.

2. At the first opportunity, the supervising teacher and the student teacher should co-operatively determine the policy on such matters as: (a) daily working hours, (b) weekends in the community, (c) responsibilities, (d) dress, (e) mileage and other expenses, and (f) personal conduct.

3. Acquaint the student teacher with the school and agriculture department plant and facilities, and with the activities and procedures of the school and department. This undoubtedly will be a progressive undertaking, but each student teacher should be familiar with such items if he is to benefit most from his experience in the training center and if he is to be most useful as an assistant to the supervising teacher.

Assignments

1. Allow the student teacher maximum freedom in arranging a schedule which will include the majority of the desired activities -- a self-active process.

2. Co-ordinate lesson plan assignments with your course outline but start the student teacher with a teaching job in the field in which he is well qualified.

3. Check lesson plans with the student teacher before he teaches the class, but let him handle the class when he does his teaching -- give him opportunity to develop confidence in himself.

4. Plan ahead and set up a long-time schedule of teaching assignments and responsibilities for FFA and other activities which will allow the student teacher to plan his work and schedule his time.

5. Arrange for the student teacher to visit pupils' farming programs with you early in the period he is in your department.

Supervision of Student Teachers

1. Check lesson plans.

2. Supervise and check their activities in supervising the farming programs of pupils.

3. See that student teachers regularly complete their Weekly Student Teaching Report. It is recommended that you request the student teacher to furnish you a copy of this report each week.

4. Each student teacher should have his own class responsibilities and his performance with that class should not be interfered with by a second student teacher, if there is one in the center. Likewise, the supervising teacher should not "take away" the control and direction of the class when a student teacher is functioning, except in an emergency.

5. Observe the ability of each student teacher to work with other people in the school and community. The development of the ability to follow proper professional procedures and to get along well with people is as important for the student teacher as is the development of skill in classroom teaching.

6. Submit the required reports on each student teacher within a week after he leaves. Discuss these reports with him personally before he leaves.

The purpose of all supervision is to help the student teacher to become more effective. In order to do this, both the supervising

teacher and the University supervisor must have some knowledge of what the student's special needs and problems are. It is always difficult to decide how much to help a student. It is safe, however, to set him on the path of self-evaluation and experimentation in the sense that the supervisors know both that there is no "one right way" and that effective teaching depends on initiative and flexibility as well as knowledge. Many students are looking for a "best way" and must be encouraged to try alternatives.

Teaching is regarded as the primary responsibility of student teachers. However, individuals are sometimes under many pressures at the University and in their private lives. They feel the strain of completing college, becoming independent of their families and beginning a career. Many are concerned about whether they have chosen the right profession. Some are married and have dependents. Many others become engaged. These are all major life decisions and compete with student teaching and college work for time and attention. Many students have the added burden of working in order to sustain themselves in college.

Student teachers need guidance in order to gain perspective. Sometimes they need help to see that one responsibility does not excuse an adult from another. If a student is not doing well because of complex responsibilities, the University supervisor can see that he seeks appropriate assistance. He may need to visit the Bureau of Loans and Scholarships if his problem is a financial one. If he has communication difficulties or physical problems, clinicians, therapists, and medical personnel are available. As long as a student is at the University, there are many services to help him, free of charge, to attain his potential effectiveness.

Student teachers should know what is expected of them in the halls and other places where pupils congregate. If they help to chaperone a school function, they will need careful instruction. They are concerned about undefined responsibilities and need instructions to clarify them.

Professional conduct often must be spelled out as it relates to particular incidents. Professional ethics are stressed in the orientation sessions for student teachers which are held on campus before they go out to the public schools. However, the student teacher may not understand how to apply what he knows. Student teachers have had little or no experience in handling confidential materials. The student teacher needs to develop discrimination about what things are confidential.

Legal Responsibility

1. Your legal responsibility as a teacher of agriculture is the instructional program you provide and any other responsibilities your school authorities may assign. The student teacher is your assistant. The complete, final and legal responsibility for pupils rests with you even though a student teacher may be present.

II. Student Teachers Learn to Know Classes as They Assume Responsiblity

Early in the quarter each student teacher should learn pupils' names and familiarize himself with the records of pupils in the classes that he will teach. Wherever possible, he should be assigned to teach two classes at different levels. It would be better if he did not take over full responsibility for both classes at the same time. However, the teaching should overlap for the major portion of his teaching time.

As soon as possible it is well to confer with the student teacher to decide what he will teach, when he will begin, and about how long he is to teach. He can then start his planning.

From the beginning, your student teacher can take over responsibility for routine matters customarily handled by you. He should observe carefully to see how materials can be distributed with the least disturbance. He will learn how assignments are made and will become able to identify the purpose of these assignments. He should find out what kind of study guides or worksheets the pupils are accustomed to. He should study test construction so that he can anticipate difficulties when he constructs his own. He should note how pupils' papers are graded.

Student teachers are encouraged to make the transition from your teaching to theirs as smoothly as possible. If they want to try some novel idea, it is suggested that they first let the class adjust to them as the new teacher. If they have been before the classes for short periods of time before they begin a major unit, the transition will be easier for the classes.

Student teachers frequently have a great deal of difficulty with leading class discussions. Your student teacher should observe the kinds of questions which elicit the best pupil responses. He should have an early opportunity to try to initiate a discussion and carry it through. After this experience, his powers of observation will be keener.

What the student teacher does in the time before he assumes full responsibility for teaching his classes will be a major factor in his success. When he is successful, the pupils profit.

III. Careful Planning Prepares the Way for Successful Teaching-Learning Experiences.

During the first few weeks when your student teacher is becoming acquainted with his new situation, he will also be preparing for his more extensive period of teaching.

When you and the student teacher decide what he is to teach, it is well to make clear to him any points that you want emphasized. If there are special concepts that are to be stressed, these should be pointed out at the beginning. This makes it possible for him to organize the unit himself and still be sure to include the things that you believe to be important for your pupils. If your pupils understand that no two teachers do things exactly the same way, they will not be disturbed if the activities and sequence are a little different in the classes taught by the student teacher.

This is the time, too, to help the student teacher to clarify the reasons for studying his particular area or topic. He should be able to determine the central purpose of a unit or a lesson. He may need help to identify the more specific objectives from the standpoint of pupil learning.

When purposes have been clarified, the way is prepared to work on method. He should be encouraged to ask, "Through what classroom experiences will my pupils arrive at the stated understandings, attitudes and skills?" The student teacher has no background from which to predict the success of learning. He often doesn't know what pupils are enthusiastic about. He frequently doesn't know much about alternative methods and is inclined to believe that you favor the few methods that he has had an opportunity to see you use. Consequently, he is likely to try to apply them whether they are appropriate or not. Sometimes he is unsure how to apply learning theory. For example, he knows that certain kinds of learning can result from repetition spaced over a period of time. This is likely to mean exact repetition to the inexperienced teacher. He needs help to plan ways to build major concepts in diverse learning situations.

Technically and reasonably, the student teachers' purposes in teaching should be identified before another step is taken. However, since they sometimes have great difficulty in identifying specific attitudes and understandings that are pervasive and have real meaning, it is occasionally advisable to start them on the outline of content as soon as they can state the general purpose of the unit or a single lesson. Sometimes having them write a brief overview clarifies the major objectives.

The outline of content is to include all information relevant to the major objectives. The student teacher should consult textbooks, room references, the library and audio-visual aids. If laboratory work is involved, he should become thoroughly familiar with the equipment and supplies available and the range of experimental work that is possible in the particular situation.

The unit or lesson plan should include the following items:

Objectives: Understandings, Attitudes and Skills
Outline of Content (with references cited)
Developmental Activities
Bibliography

It is stressed with the student teacher that no matter how good a plan is or how experienced the teacher, it must change. If it did not, it would mean that he was insensitive to the class. "Why, then, all this planning?" It is to insure that the classroom experiences are at least as good as the plans. It should be assumed that any changes will be in line with class interest and should, therefore, be an improvement over the initial plan. If he has prepared much more than is really needed, he is ready to develop work along many lines. He need not limit the class. An analysis of the kinds of changes that he has made gives the student teacher more insight into pupil interests.

When student teachers give a test, it should be planned well in advance. Questions should reveal whether or not the objectives of the unit are being achieved. Items should be constructed so that the test is a teaching device. It should be worth class time to discuss them -- and it should provide the basis for a discussion rather than a rehearsal. Students are asked to consult Stecklein's Bulletins on Classroom Testing for guidance in item construction. These Bulletins are available at Nicholson Hall Bookstore. Any test should be shown to the supervising teacher before it is duplicated and at least two days before it is administered. Since student teachers should construct their own tests for units taught, this provides the supervising teacher an opportunity to make sure that it is a good test.

IV. The Student Teacher in the Community

Student teachers are expected to reside in the community. This provides an opportunity to gain some understanding of the total operation of a school and the responsibilities of a teacher outside the classroom.

Your help will be necessary if student teachers are to make the best use of their time. They are asked to work through you to make arrangements for experiences which will give them additional knowledge of the total school program. It is desirable that your student have the opportunity to:

spend a few periods in the guidance office
visit with the nurse
talk with the principal
learn the operation of the audio-visual department

gain a knowledge of the resources of the library and of its services
learn about any special services provided by the school such as special reading or enrichment classes, sight-saving classes or vocational classes
observe teachers in other kinds of classes such as home economics, shop, physical education or an academic field
attend faculty and departmental meetings
attend adult and young farmer classes
attend functions where parents are present
attend extra-curricular events
participate in parent conferences
participate in community activities, as appropriate.

If some of these things necessitate the student's returning to the school in the evening, it is expected that he will do so.

V. Evaluation of the Student Teaching Experience

Evaluation of the student teaching experience should be an on-going part of the quarter's work. There should be frequent conferences between the student and the supervising teacher.

The only really valuable evaluation is that which improves the student's performance during the quarter. There is very little time in which to make progress, so early help is best. Your student teacher wants and needs specific suggestions and criticisms just as much as he wants and needs occasional praise and encouragement. You will need to help him answer the question, "How am I doing?" He needs help in developing the skill of self-evaluation. You can help lead him to an objective assessment of his own strengths and weaknesses. He can learn to build upon his strengths. Those weaknesses that he cannot overcome, he can minimize when he recognizes them.

At the end of the student teaching experience, the University supervisor must assign a letter grade appropriate for the student teacher's level of achievement. To do this, he needs your help. He will keep a record of all conferences with you, but he will want your written evaluation submitted. This evaluation will be filed in the Agricultural Education office.

The following sample forms are for your personal use in evaluating daily activities of your student teachers. They need not be forwarded to the University.

A GUIDE FOR EVALUATING A DEMONSTRATION

Subject of Demonstration _____

Student Teacher _____ Date _____

Objectives _____

DIRECTIONS: Draw a circle around one of the five numbers following the item to indicate your evaluation. No. 1 is the lowest rating and No. 5 the highest. In every demonstration there will be certain unique behaviors which you will wish to comment on in the space provided between items or at the bottom of the sheet

		Low High
1.	Proper materials, equipment and supplies were ready and correctly arranged.	1 2 3 4 5
2.	Equipment was in good condition (tools were sharp).	1 2 3 4 5
3.	Students were oriented to the need for the instruction.	1 2 3 4 5
4.	Appropriate objectives were developed with the students.	1 2 3 4 5
5.	Devices for arousing and sustaining interest were evident.	1 2 3 4 5
6.	Group was arranged so all could see and hear.	1 2 3 4 5
7.	Questions were used to good advantage.	1 2 3 4 5
8.	Safety precautions were stressed.	1 2 3 4 5
9.	Essential details were emphasized.	1 2 3 4 5
10.	Proper use and care of equipment were emphasized.	1 2 3 4 5
11.	Appropriate standards of accuracy were emphasized.	1 2 3 4 5
12.	Operations were performed skillfully.	1 2 3 4 5
13.	Principles basic to important steps were brought out.	1 2 3 4 5
14.	Student participation added to the effectiveness of the demonstration.	1 2 3 4 5
15.	Key procedures were effectively summarized.	1 2 3 4 5

Specific suggestions for improvement or other comments: _____

_____

If you would make demonstrations interesting, make difficult skills look easy; keep every observer participating; overlook no opportunity to introduce out-of-ordinary facts and methods and time and labor-saving devices.

_____
Observer

A GUIDE FOR EVALUATING CLASSROOM TEACHING

Student Teacher _____ Title of Lesson _____ Date _____

1. Was the teacher prepared? No Yes Fairly Well

2. Did he know his subject? No Yes Fairly Well

3. Did he introduce his subject quickly and well? No Yes Fairly Well

4. Were subject and material adapted to ability and interest of class? No Yes Fairly Well

5. Was his purpose clear and did he accomplish it? No Yes Fairly Well

6. Were his pupils interested? No Yes Fairly Well

7. Did he try to interest them? No Yes

8. Which of the following methods did he use to do so? (Underline) Telling appropriate story: getting pupils to give illustrations and experiences; convincing them of importance of problem; use of suspense; appealing to impulses (activity, curiosity, ownership, competition, creativeness, imitation, gregariousness, etc.) Other _____

_____

9. Who did most of the talking? Instructor Class 50-50

10. Was participation spread throughout the class? No Yes Fairly Well

11. Did he lead the discussion? No Yes Fairly Well

12. Did he get good thinking by the class? No Yes Fairly Well

13. Did he bring them to a definite conclusion? No Yes None needed

14. Was the problem used a practical, true-to-life situation? No Yes To most

15. Was effective use made of illustrative material? No Yes Not adapted

16. Was effective use made of blackboard? No Yes Fairly Well

How may this teacher best improve his teaching? _____

_____

_____

_____
Observer

A GUIDE FOR EVALUATING CLASSROOM TEACHING

Title of Lesson _____

Student Teacher _____ Date _____

Objectives _____

Activity	Good	Fair	Poor	Comments
The Teacher:				
1. Appearance				
2. Speech (voice, language, etc.)				
3. Animation or enthusiasm				
4. Tact and poise				
5. Sense of humor				
6. Initiative				
7. Interest				
Management:				
1. Discipline				
2. Neatness of room				
3. Care of light, heat, ventilation				
4. Adequacy of materials				
Techniques of Teaching:				
1. Preparation for the class				
2. Clearness of objectives				
3. Skill in arousing interest				
4. Skill in questioning				
5. Skill in stimulating thought				
6. Skill in teaching how to study				
7. Skill in getting pupils to work				
8. Ability to make clear explanations				
9. Proper timing in teaching a lesson				
10. Blackboard management				
11. Ability to select best methods and techniques				
12. Ability to use materials				
Results:				
1. Pupil response and appreciation				
2. Good statements by pupils				
3. Pupil leadership				
4. Habits of attention				
5. Habits of neatness				
6. Quality of pupils' work				
7. Evidence of practical application				

_____
Observer

A GUIDE FOR EVALUATING CLASSROOM TEACHING

Title of Lesson _____

Student Teacher _____ Date _____

I. Strong Points of Lesson

II. Suggestions for Improvements

III. Summary (general statement as to effectiveness of the lesson)

_____
Observer

A GUIDE FOR EVALUATING CLASSROOM TEACHING

Title of Lesson _____

Student Teacher _____ Date _____

TEACHING PROCEDURES

	Good	Fair	Poor	Comments and Suggestions
Introduction of unit				
Create interest				
Identify problem				
Develop objectives				
Lesson plans and assignments				
Pupil participation				
Skill of questioning				
Handling pupil questions				
Directing group discussion				
Variety of approaches				
Use of illustrations				
Review				
Emphasis of important points				
Plans for individual application				
Evaluation				
Attainment of objective				
Teaching at pupil level				
Handling discipline				
PERSONAL				
Voice				
Dress				
Language				
Attitude				

	Good	Fair	Poor	Comments and Suggestions
Rapport with students				
Writing on blackboard				
Use of teaching aids				
Knowledge of subject				
FACILITIES				
Seating arrangement				
Ventilation				
Lights				
Heat				
Distribution of materials				
Collection of materials				

A GUIDE FOR EVALUATING FIELD TRIPS

Place Visited _____ Date _____

Purpose of Trip _____

Student Teacher _____

	Yes	No
A. Planning prior to the trip		
Teacher		
1. Determined that the trip was essential to contribute to the classwork in progress or to follow.		
2. Made arrangements with the farm or place to be visited.		
3. Received clearance with school administration.		
4. Arranged for transportation.		
5. Developed specific directions to cover all phases of the trip.		
6. Purpose of trip and plans clearly explained to students.		
7. Definite assignments of student responsibilities.		
8. Trip scheduled at an appropriate time to contribute to the learning experiences of the student.		
Student		
1. Students arranged in advance of trip to make up work in classes missed.		
2. Members of class assisted in developing questions to be asked and observations to be made.		
3. Understood the responsibilities for behavior.		
4. Received instruction in proper clothing and equipment.		
5. Completed necessary reading or study assignment for advanced preparation.		
B. During the Trip		
1. Students were under the direction and control of the teacher at all times.		
2. A high degree of student interest was evident.		

	Yes	No
3. Students made the necessary observations and notations.		
4. Proper courtesies were shown the persons at the place visited.		
5. Trip concluded within the allotted time.		
6. No wasted time during the trip.		
7. If travel by bus, driver instructed as to time and place for pick-up.		
8. Safety rules and precautions observed.		
C. After the Trip		
1. Students participated in an evaluation of the trip.		
2. Students summarized the trip and made appropriate conclusions.		
3. Proper acknowledgment or "thank you" notes sent by students to individuals concerned.		
4. If travel by bus, before release of vehicle, check made for articles left behind.		
General Summary or comments:		

A GUIDE FOR EVALUATING ON-THE-FARM INSTRUCTION

Student Teacher _____ Date _____

	Yes	No
A. Prior to visit		
1. Conferred with student and scheduled visit.		
2. Reviewed with the supervising teacher the student's home farm situation, farming program, items to check and instructions given on previous visit.		
B. During the visit		
1. Checked student procedure against written plans.		
2. Observed all farming activities of the student.		
3. Noted progress made since previous visit.		
4. Discussed the student's farming activities with at least one of the parents.		
5. Discussed possible changes in or additions to the student's program with the student and at least one of the parents.		
6. Assisted the student in developing a skill.		
7. Checked program records for completeness and accuracy.		
8. Checked program for efficiency of feeding, rate of growth, control of disease, insects, erosion.		
9. Checked program for application of safety rules and principles.		
10. Discussed the student's participation in school and community activities with student and at least one parent.		
11. Developed a better understanding of the student and his environment.		
12. Arranged for use of materials for teaching aids.		
13. Checked possibility of assisting parents or other members of the family.		

	Yes	No
C. After the visit		
1. Recorded information needed regarding visit:		
a. Mileage and purpose of trip.		
b. Instructions given student.		
c. Promises to secure information or material or follow-up dates.		
2. Listed problems for use in classroom teaching or conference.		
3. Listed potential members for young or adult farmer classes.		

UNIVERSITY OF MINNESOTA -- AGRICULTURAL EDUCATION DEPARTMENT
Student Teaching Report

Due on final day of student teaching

Name of Student Teacher _____ School _____ Date _____

To the supervising teacher: Check each question at some point on the scale according to the student's performance. Remember the descriptive phrases are only suggestive and indicate extremes at either end. The position you check is an indication of your rating of the individual on the characteristics in the left column on the basis of these individual descriptions. It is the University supervisor's responsibility to assign a grade. This judgment is understood to indicate: Excellent, superior - an "A" student teacher; strong, above average but not outstanding - a "B" student teacher; satisfactory, average ability - a "C" student teacher; weak, questionable - a "D" student teacher; or unsatisfactory, not recommended - an "F" student teacher.

	Weak	Satisfactory	Outstanding
How does his personal appearance impress you?	Makes poor impression	Makes satisfactory appearance	Well groomed, excellent appearance
How does his personality affect other people?	Antagonizes and irritates others	Gets along reasonably well	Especially harmonious relations with others
How do pupils react toward him?	Pupils dislike him and show little interest in work	Pupil response shows reasonable interest	Pupils are eager, alert, interested

Student Teaching Report (continued)

	Weak	Satisfactory	Outstanding
Is he emotionally well poised?	Easily moved to anger or depression. Unresponsive, apathetic	Responsive, well controlled	Appears at ease even in difficult situations
Does he express himself clearly?	Makes frequent errors in speech; expression poor	Communicates reasonably well. English usually correct	Excellent English; conveys ideas effectively
What is his attitude toward pupils in school activities?	Dominates, decides all activities	Encourages pupil participation to some extent	Encourages pupil initiative; careful guidance evident
What is the atmosphere in the classroom?	Depressing, dull	Comfortable; pupils feel at home	Lively, good humor present
How does he control unexpected situations?	Baffled; poor decision, loses control	Meets emergencies fairly well	Anticipates emergencies; handles problems well
Are the lessons well planned and executed?	Confused about where to begin and what to do	Lesson well planned and executed	Careful planning results in purposeful pupil activity

Student Teaching Report (continued)

	Weak	Satisfactory	Outstanding
What use does he make of materials of instruction?	Uses textbook only	Supplements textbook to some extent	Uses wide variety of source materials
Does he show initiative and ambition?	Requires prodding; shirks responsibility	Works cheerfully but requires occasional help	Finds things to do without supervision
How does he react to suggestions?	Is offended by suggestions; defensive	Accepts suggestions and criticisms; performs assigned duties	Cooperates cheerfully, seeks help when needed
How does he provide for equipment?	Neglects equipment; room disorderly	Keeps equipment in order	Excellent care of equipment
Will he be likely to grow in effectiveness?	Seldom seeks new methods or materials	Modifies practices to some extent	Constantly seeking better methods and materials
Agricultural knowledge?	May not know answers to questions	Good general knowledge	Generally has right answer

Student Teaching Report (continued)

	Weak	Satisfactory	Outstanding
Skills in Agriculture?	Can demonstrate a limited number of simple skills	Can make common demonstrations	Give good demonstrations of most agricultural skills
Attitude toward teaching?	Indifferent, cares little about teaching	Interested in becoming a Vo-Ag teacher	Strong ambition to become a superior Vo-Ag teacher
Attitude toward administration and total school?	Indifferent to rest of school; Ag. Dept. is "whole show."	Tries to cooperate	Goes out of way to improve relationship within school
Comprehension of modern program of Agricultural Education?	Vague	Understands what constitutes a good program	Clear and complete concept of philosophy of Minnesota program
General impressions of student?	Does not indicate development into a good Vo-Ag teacher	Indications of a satisfactory teacher	Prospects for developing into superior Vo-Ag teacher

Please comment on the following:

1. What are the strengths of this individual?

2. What are the areas for improvement in teaching procedures for the individual?

3. What suggestions should be made to this student about his habits or his personality traits?

Signed _____
Supervising Teacher

ERIC

In the space provided please give a statement suitable for enclosure in the papers of this student.

Relate incidents or occasions in which you have observed the student teacher behaving in a manner typical of him which you believe show his possible effectiveness as a vocational agriculture teacher. For example, describe situations revealing knowledge of agriculture, social attitudes, success in relations with students, fellow workers and the community and outstanding characteristics and abilities. Consider whether what you write would be helpful to you if you were thinking of employing this person. Be cautious in the matter of prediction. School administrators often make their judgment on the basis of information available in this reference and from personal interviews.

* * * * * * *

STATEMENT FOR CREDENTIALS

_____

First name Middle Initial Last Name

Signed _____ Date _____
Supervising Teacher

_____ High School

AN ALTERNATE FORM FOR EVALUATION OF STUDENT TEACHING

Student Teacher _____ Date _____

School _____ Supervising Teacher _____

Due on final day of student teaching

While all factors are considered in rating the student teacher, items marked with an asterisk (*) should receive special emphasis. Your comments and ratings will be discussed with the student teacher unless you request that they be kept confidential. Draw a line through the rating space after any item on which you are unable to make a judgment during the student teaching period.

KEY: 1 - Possesses traits of outstanding teacher; 2 - Indications of a good teacher; 3 - A satisfactory teacher; 4 - Needs additional emphasis in this area; 5 - Definite weakness.

	1	2	3	4	5
PERSONAL TRAITS					
1. Cooperation with supervising teacher*					
2. Personal appearance					
3. Punctuality					
4. Honesty, fairness					
5. Accuracy, reliability					
6. Enthusiasm and interest*					
7. Confidence and self-control					
8. Adaptability to new or unexpected situations					
9. Housekeeping ability*					
SKILL IN INSTRUCTION					
10. Control of students*					
11. Accomplish objectives*					
12. Challenge students' thinking					
13. Encourage students' initiative					
14. Arouse & maintain interest					
15. Use of variety of materials					
16. Use of illustrative materials					
17. Use of tests or evaluative measures					
18. Care of equipment					

	1	2	3	4	5
SCHOLARSHIP					
19. Knowledge of subject matter*					
20. Breadth of general information					
21. Correct use of English*					
22. Correct spelling*					
ATTITUDE TOWARD STUDENTS					
23. Secure cooperation*					
24. Recognize students' point of view					
25. Recognize students' ability and efforts					
26. Personal interest in students					
27. Absence of favoritism					
ATTITUDE TOWARD WORK					
28. Lessons well planned*					
29. Lessons well executed*					
30. Definite, logical assignments					
31. Readiness to profit from suggestions					
32. Attempts to improve relationship within school & community					
33. Works cheerfully without supervision					
34. Clear concept of complete program of ag instructor*					

I would rate this individual 1 2 3 4 5 as a potential vocational agriculture instructor because:

Areas where improvement might be made are:

VI. Suggested References for Supervising Teachers

A. Books written especially for supervising teachers

Biddle, Bruce J. and Ellena, William J. Contemporary Research on Teacher Effectiveness. New York: Holt, Rinehart and Winston, 1964.

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American Society of Radiologic Technologists, 537 South Main Street, Fond du Lac, Wisconsin 54935 ($1.15).
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ABSTRACT - This resource unit is for teacher use in planning and conducting common experiments and demonstrations of electricity to enable students to better understand some of the fundamentals of electricity. The experiments have been taken from standard treatices on electricity, and a list of apparatus needed, where it can be obtained, and, in some cases, approximate costs are included for each experiment. The document is illustrated with line drawings. A list of references is appended. (GR)

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TEACHING AIDS IN ELECTRICITY

WORK SHOP

by

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VT007363

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PREFACE

This manual is written in an attempt to describe some of the more common experiments and demonstrations of electricity. It is hoped that by so doing electricity will be made more interesting, and it should enable students to better understand some of the fundamentals. This in turn should make it easier for them to read the standard text books listed in the Curriculum and Teacher's Syllabus. These experiments have been taken from standard treatices on electricity, yet not those commonly found in radiologists offices. An attempt has been made to list the apparatus needed; and, for the most part, where it can be obtained. Some cost figures are given; but, are only approximate.

It is well to remember that old discarded X-ray machines contain parts which make great aids to teaching. Many of these parts need not be connected to a machine for full operation, but only used as visual aids.

I wish to take this opportunity to thank The American Society of Radiologic Technologists for their foresight in trying at all times to improve the teaching of students in this field.

THE ATOM AND THE ELECTRON

The story of the atom has been done by Life magazine. The pictures in the magazine article are available from Life in film strip with a small manual explaining each picture. This was written by physicists for lay reading.

Another story on the atom for lay audiences is "A is for Atom" produced by the General Electric Company. This can well be used for our purpose especially the first half of the movie.

There is another color sound motion picture entitled "Principles of Electricity" produced by the General Electric Company. It breaks down the structure of matter into atoms, using conventional symbols to show the action of electrons within an atom. Individual treatment of the volt, ampere and ohm establishes these respective units of pressure, electric current and resistance as the principles involved in the flow of electricity. The film also explains the essence of magnetism and magnetic fields and illustrates why some materials can be magnetized while others cannot. Animated electrons show how magnetic fields function in the generation and application of electricity.

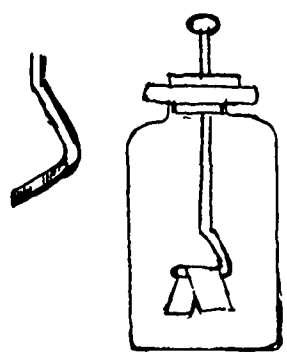
The films produced by General Electric can be obtained from their district offices. There are several visual aid films on electricity that can possibly be obtained from the U. S. Navy through local U. S. Naval Reserve training centers. The titles of a few are: "What is Electricity"; "Electricity and Magnetism", 2 parts; "Electromagnetism"; "Static Electricity"; "Current Electricity and Basic Principles".

STATIC ELECTRICITY AND THE ELECTRIC FIELD

The materials needed for these experiments are: a glass stirring rod, a rod of hard rubber, an electroscope, pith balls, silk or nylon and a piece of fur or wool.

The glass rod may be obtained from the chemistry department of the hospital laboratory, or may be a broken centigrade thermometer. It should be about 8 or 12 inches long. The hard rubber rod may be cut from some types of dark room tanks, or may be a hair comb with the teeth removed.

You can make an electroscope from a six ounce wide mouth bottle and a metal rod put through a rubber cork. Bend the lower one inch of the rod at right angles; then file both sides of this short piece to form a knife edge. Now cut with scissors a strip of aluminum foil about $1\frac{1}{4}$ inches long and $\frac{1}{4}$ inch wide. Hang the foil over the knife edge of the rod and place the assemble into the bottle.

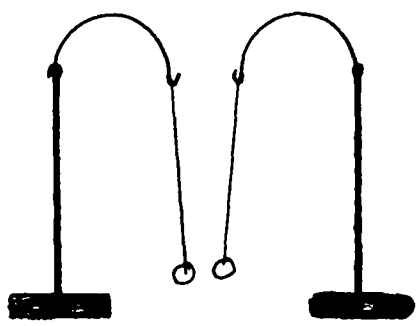


Cut two pith balls from a piece of cork so that they are small balls about $\frac{1}{4}$ inch in diameter. With a needle and thread draw a thread through each ball with the loose end about 8 inches long. Now cover each ball with foil from a cigarette package, and hang it from a piece of wire that has been secured in a piece of plywood about four inches square. Bend the wire supports at the top so the balls will hang free. Two will be needed.

The above articles are all that are necessary to demonstrate

that there are two kinds of electricity. You can show that like kinds of electricity repel like magnetic poles; and that unlike kinds of electricity attract.

Suspend the two prepared pith balls from the wire bracket.



Rub a glass rod with silk or nylon and a hard rubber rod or hair comb with wool. The glass will receive a positive charge and the wool a negative charge. If each is then brought close to the pith balls, both will attract the balls.

Now, if the glass rod touches one of the balls and the hard rubber the other ball, both balls will be repelled because they have received the same charge that is on the two rods.

If the glass rod is brought close to the ball that was touched by the hard rubber rod, the ball will be attracted.

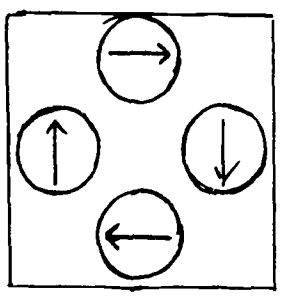
Again, if the pith ball is touched by the rod, the ball will be repelled.

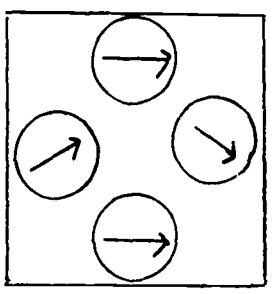
The electric field about a charged body can be demonstrated with the electroscope. If the charged rod is brought in contact with the top of the electroscope, the aluminum leaves fly apart by becoming electrified by conduction. If the electrified rod is brought close to, but not touching, the knob, the leaves again fly apart but this time by induction. Remember that when the leaves hang limp, they are neutral, or no charge. Also, there are two charges, positive and negative, always induced on the object. Thus, they attract and repel the same as poles of a

magnet. There are lines of force between a negative and positive charged body the same as like and unlike poles of a magnet. This electric field can be demonstrated by dusting fine oxalic acid crystals on a glass plate covering the charged bodies.

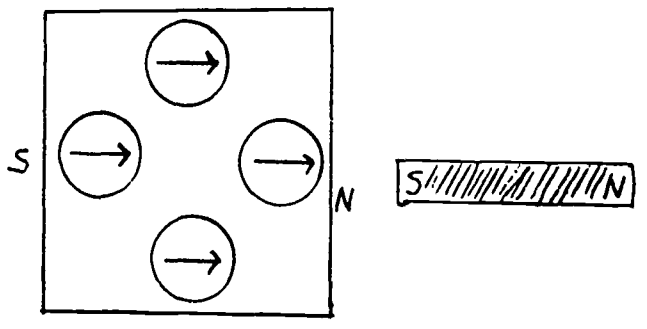
THE THEORY OF MAGNETISM

The theory of magnetism is probably best demonstrated by using four small compasses. Arrange them so that one is at 12:00, one at 3:00, one at 6:00 and the fourth at 9:00. This arrangement represents a molecule of metal, unmagnetized. Note that the pointed end of the needle at 12:00 points to the right, the one at 3:00 downward, the one at 6:00 to the left and the one at 9:00 upward.

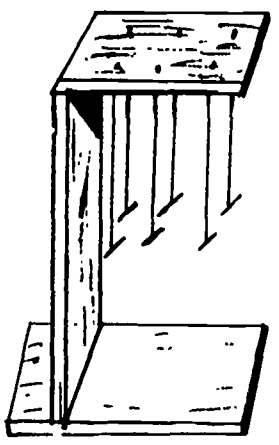




This represents as closely as possible a closed magnetic circuit. Now bring up, from a distance, a bar magnet and notice that the needles will turn somewhat in the direction of the magnet. As the magnet is placed nearest to the compasses, the needle that was pointing in the opposite direction from the magnet will swing into alignment with the others. If the magnet is brought close to the compasses, the needles will be arranged in more perfect line. This can be called the stage of saturation and represents the stages of magnetism corresponding to the experimental facts.

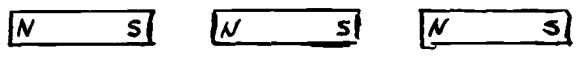


If the magnet is removed and the compasses are tapped with a pencil, the needles will return to the original position. This is what happenes when soft iron is magnetized. The same experiment can be performed by magnetizing four or six sewing needles about one inch long. Suspend them from an upright wooden frame about 8 inches above your table by tying a piece of thread in the center of each needle.



Be sure that they are suspended equidistant from each other. Then by placing the bar magnet at various distances to them, the same phenomena can be demonstrated as with the compasses.

Another experiment to demonstrate the principle of magnetism can be performed by placing coarse iron filings in a piece of plastic or glass drinking tube about 2 inches long. If the tubing is shaken hard and then tested with a compass, no magnetic effect will be observed. Now stroke the tubing with a bar magnet and test the tube with a compass. The tube will now have a north and a south pole, and the small particles will tend to line up parallel to each other. Each small piece of metal could be assumed to represent a molecule that has been lined up in orderly fashion. Each molecule has a north and south pole.



To demonstrate that a magnet has two poles, magnetize a hair pin; then test it for magnetism with a compass or iron filings. Now cut the pin in two pieces and test for magnetism. This cutting can then proceed; and it will be found that each piece of the pin, regardless of length, still has magnetism and will also have a north and a south pole.

MAGNETISM

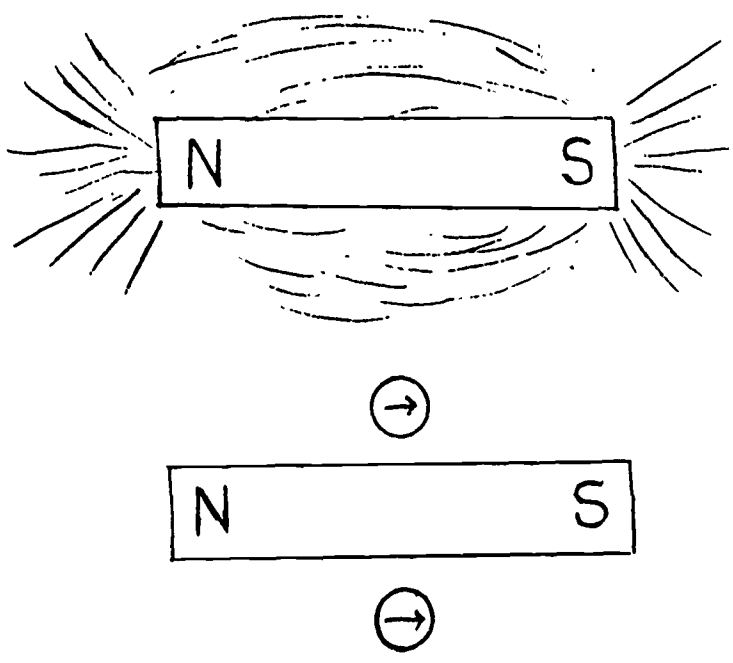
The equipment used to explain and demonstrate magnetism need not be expensive. It is as follows: a small piece of lodestone, 2 x 3 cm. in size; two bar magnets, 5 cm. in length; four small compasses, 1 inch in diameter; one horseshoe magnet, about 3 inches in length; several pieces of soft iron; one piece of glass or lucite, 8 x 10 inches in size; iron filings; and a small package of 2 3/4 inch hair pins.

A piece of lodestone of the size mentioned costs about 15 cents; the bar magnets, 55 cents a pair; the compasses, about $1.00 apiece; and the hair pins, about 5 cents.

The lodestone and bar magnets can be purchased from one of the scientific instrument companies, and the horseshoe magnet can be secured from any electric company supplying electricity. These horseshoe magnets come out of old or defective meters. Perhaps you could find an old magnet which may be made up from one to 20 horseshoe magnets (Model T Ford Magnets). The iron filings can be obtained from the work table beneath an emery

wheel and should be placed in a 2 ounce bottle with a wide mouth screw metal cap. The compasses can be the type found in sporting goods, hardware or novelty stores. Several sheets of soft iron can be obtained from the core of an old burned-out radio transformer. Always place a piece of the soft iron over the poles of a horseshoe magnet and keep the two bar magnets together so that a closed magnetic circuit is produced. This will make the magnets hold their magnetism much longer.

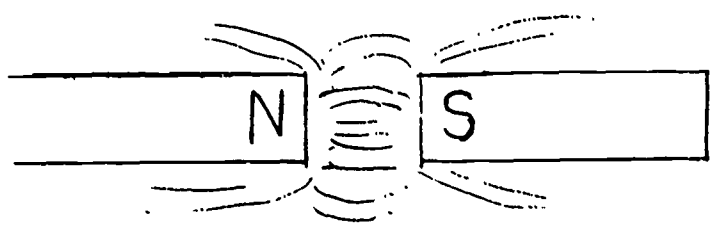
This simple outlay will make it possible to demonstrate the magnetic field and magnetic induction. The magnetic field is demonstrated by first placing a piece of glass on four corks or blocks of wood. Then place a bar magnet beneath the glass and dust some iron filings on the glass over the magnet. The arrangement of the filings shows the lines of force and their pattern around the poles and the center of the magnet.



Now remove the iron filings and place two small compasses on either side of the middle of the bar. Notice that the north of both compasses will point toward the south pole. This shows that the magnetic force outside the magnet travels from north to south.

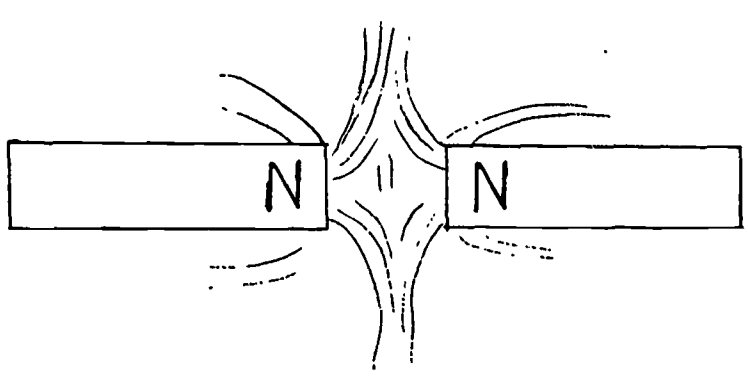
To demonstrate the internal path of the magnetic field, place one of the compasses directly over the center of the

magnet and point out that the north of the compass points to the north. Both of these experiments demonstrate that the two poles are of equal strength.



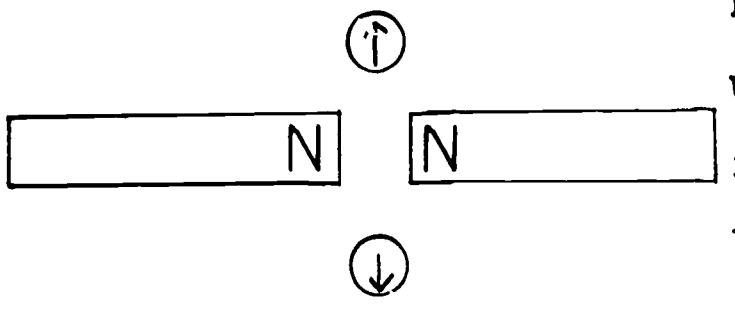
The next experiment is to illustrate the character of the poles of two bar magnets.

Place the two magnets end to end beneath the glass plate with a small gap between them. Now sprinkle iron filings on the glass above the ends of the two magnets. If you have a north and a south pole toward each other, the filings will arrange themselves between the poles parallel to the long axis of the bars. This shows that the lines of force are going between the poles, and that unlike poles attract each other.



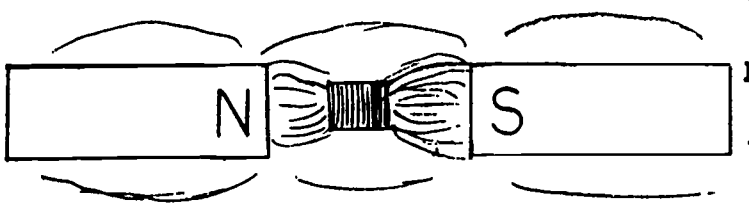
Next, remove one of the magnets and reverse its end. Sprinkle some new iron filings over the gap. Notice that they collect about the poles of the magnet, but that the space between the poles contains very few filings. In other words, the filings are being forced from the center of the gap; and the magnetic fields do not join; therefore, the two poles that are together are repelling. Again, by removing the filings and placing two com-

passes between poles above and below, it will be noted that the north needles point away from the poles at right angles; and that they point the same direction that the iron filings placed themselves.



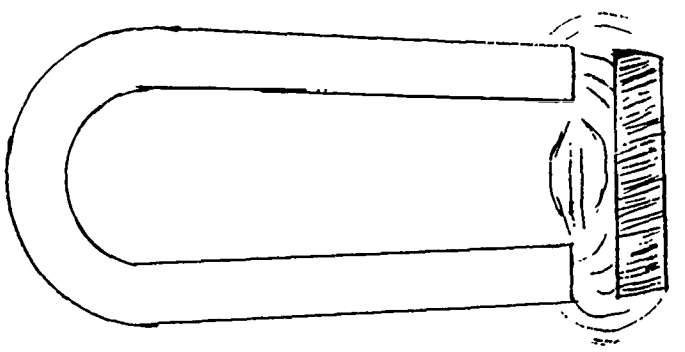
Most technicians are familiar with magnetic induction. That is, when a screw driver is brought in contact with a magnet, it becomes magnetized and will pick up small iron screws. Likewise, the hair spring on your watch may become magnetized by coming in contact with a magnet.

Magnetic induction can be demonstrated by placing a small piece of soft iron in the middle of, and to one side of, a bar magnet; and then placing a piece of glass over them. If iron filings are sprinkled over the soft iron, you will note that the filings are mostly gathered in by the pieces of soft iron thus showing a different pattern than without the soft iron. If a piece of soft iron is placed in the gap between the north and the south poles of two bar magnets, the filings will group themselves closely around the soft iron and less in the air gap. In both cases, the filings prefer to pass through the soft iron instead of air.



This proves that soft iron is more permeable than air; and that there is such a phenomena as a magnetic circuit. This perhaps is best illustrated with a horseshoe magnet and its

keeper, the soft iron bar: Place a piece of iron over the two poles of a horseshoe magnet and under the piece of glass. Sprinkle iron filings over the poles on the glass and notice that the lines of force are confined to the poles and the soft iron.



This indicates that the lines of force travel from one pole to another through the soft iron. This illustrates a closed magnetic circuit with the lines of force going from north to south through the soft iron bar.

Further experiments to illustrate magnetic induction can be performed.

A nail or a steel knitting needle may be magnetized by induction simply by being placed close to one of the bar magnets, and even better, if the needle or nail is stroked over the long axis of the magnet. The induced magnetism can then be either checked with a compass or by dipping the tip of the object in the bottle of iron filings. Similarily, the object may be rubbed over the lodestone and magnetized.

Magnetism may be induced in a large steel needle or an annealed iron bar by the earth's induction. Hold the object to be magnetized in a north-south direction with the north end dipping downward so that it forms an angle of about 70 degrees with the horizontal. Strike the end of the object a sharp blow with a hammer. Now test the object with a compass or iron filings. If the iron bar or needle is placed on the table in a

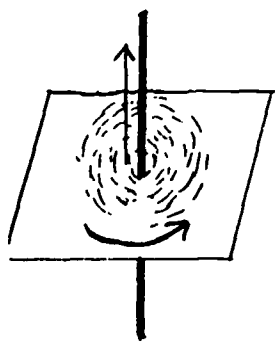
east-west position and hammered vigorously, the magnetism will disappear.

ELECTROMAGNETISM

The apparatus needed to demonstrate electromagnetism can be quite simple: an ordinary 1½ volt dry cell (No. 6), several feet of No. 24 insulated wire, compasses, iron filings, a sheet of lucite or cardboard and several strips of soft iron from the core of an old radio transformer.

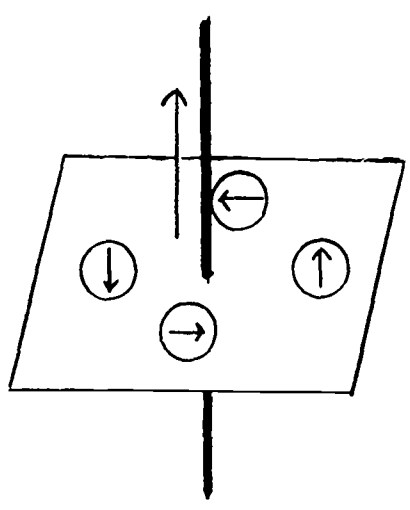
The No. 6 dry cell can be obtained from hardward and electrical shops at a very small cost. It is well to have 3 or 4 connected in series to obtain some of the better patterns with iron filings to be described later. The insulated wire need not be the exact No. 24, but any single strand wire of about this size. Most hospital work shops have scraps of wire that will be suitable; so, im most cases, it will not have to be purchased from commercial sources.

Current electricity always produces a magnetic field, and the character of the magnetic field can be studied with these experiments. Connect about two feet of the wire to the terminals of two 1½ volt dry cells. Be sure and remove the insulation from about one inch of the center of the wire. Sprinkle some iron filings on a piece of paper; then dip the center of the non-insulated portion of the wire into the filings. Note that the filings are attracted to the wire.



If the current is passing upwards through the wire, then the filings will arrange themselves in concentric circles around the wire in a counterclockwise fashion. If you reverse the ends of the wire on the batteries and tap the cardboard, it will be found that the filings now arrange themselves in a clockwise fashion around the wire.

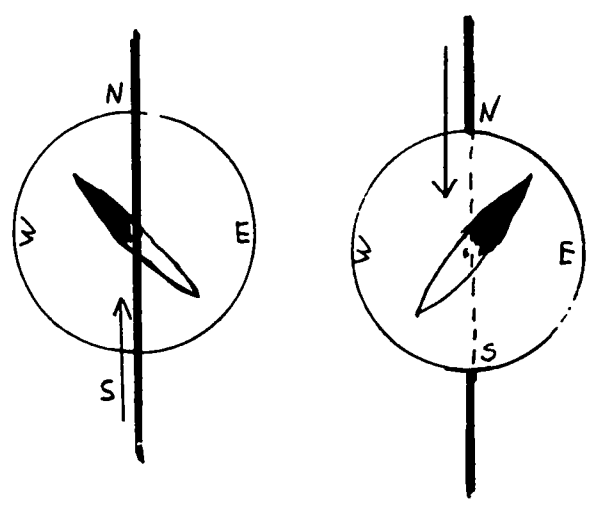
For the next demonstration, the same set up can be used; but instead of using iron filings, we will use the four small compasses Place the compasses about $1\frac{1}{2}$ inches away from the wire so that they are opposite each other. Now connect both ends of the wire to one dry cell. If the current is passing upwards in the wire, then the north needle of the compass at 3:00 will be pointing away; the north needle of the compass at 12:00 will be pointing to the left; the north needle of the compass at 9:00 will be pointing towards you; and the north needle of the compass at 6:00 will be pointing to the right.



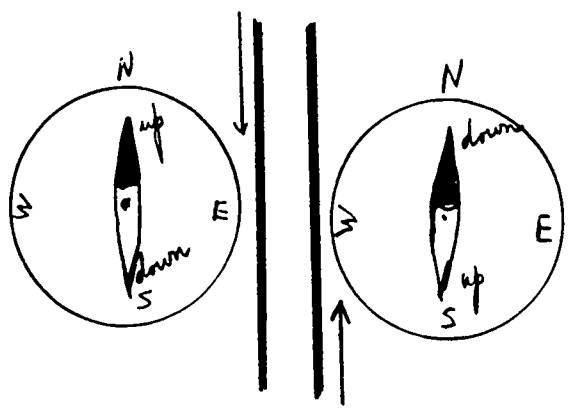
In other words, the north needle of the compasses are all pointed in a counterclockwise direction. If the wire to the battery is reversed at the terminals so that the current passes down through the wire, then the north needles of the compasses will reverse themselves and point in a clockwise direction around the wire.

The behavior of the magnetic effect is one of deflection and not attraction or repulsion.

Connect a single piece of wire to the terminal on one battery; then hold the wire above, and parallel to, a compass needle. If the current is flowing south to north, the needle of the compass will be thrust to the left, or west.



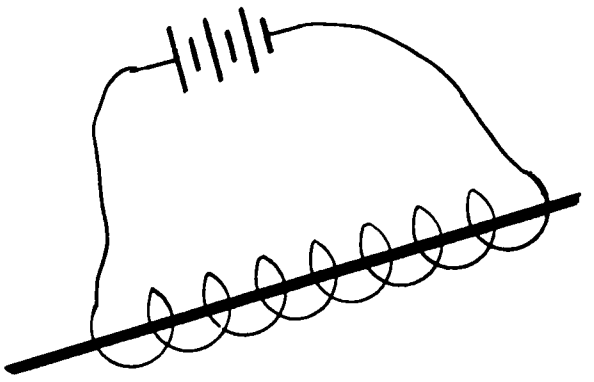
If the wire is placed under the needle, then the needle will be deflected to the right. Now, if the current is reversed, the opposite in both cases will be observed. Also, notice that a current north to south under the compass is in the same direction as a current south to north over the needle.



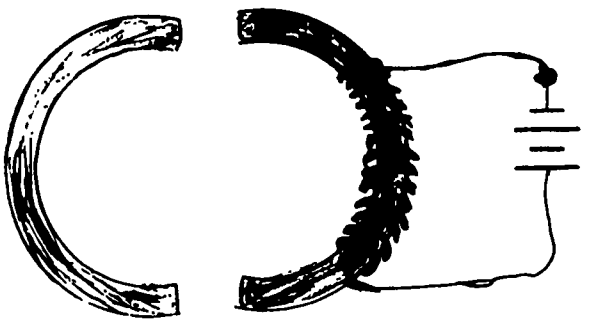
Lay the wire on the table to the right of the compass, and parallel to the needle; and notice that the north end of the needle will rise in the case and the south end dip. Now lay the wire in the same position to the left of the compass and notice that the south end of the needle will rise and the north end dip. Notice in placing the wire to the right, left, above and below that the north end of needle has made a complete circle. You have demonstrated the clockwise or counterclockwise character of the magnetic field depending upon which way the current was flowing through the wire, and that these lines of force are at right angles to the

wire and form circles about the wire. The north-seeking end of the needle of a compass will point in the direction of the magnetic field.

Now, if the wire is wound into a coil, the lines of force will be concentrated into the space inside the coil. With this in mind, wind a number of turns of wire around a pencil; and after removing the pencil, connect the ends of the wire to the terminals of a dry cell. Now insert a steel knitting needle into the coil.



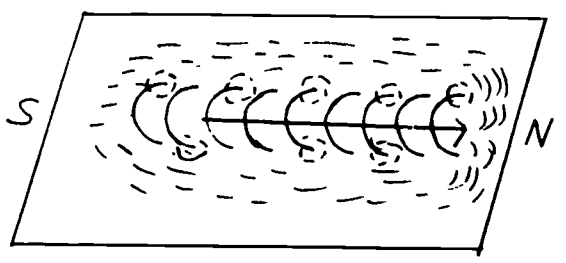
In a few minutes, remove the needle and test its magnetism with a compass or iron filings. This is another method of making a magnet, but is not permanent. A coil carrying a current is a magnet: Where the lines of force come out is the north pole, and where they enter is the south pole. Obtain a piece of iron pipe one or two inches in diameter. Saw off about one inch; then saw that piece in 2 pieces. Wind some insulated wire around one of the pieces of pipe and connect the wires to the terminal of a dry cell.



Now bring the loose piece of pipe up to the cut edges of the piece that has been wound with wire. Notice the strong magnetic attraction of the two pieces of pipe.

If several turns of heavy

copper wire are wound through holes in a sheet of lucite to form a coil, it is possible to demonstrate the magnetic lines of force around each coil of wire by sprinkling iron filings about the wires as they come through the plastic. Little ringlets of filings will group around each wire; and, if the current is strong enough, the ringlets will join, stacking one after the other.



Thus, there will be a magnetic field passing straight through the coil and return by a path outside the coil. The greatest concentration will be inside the coil. Test this phenomena with compasses, also.

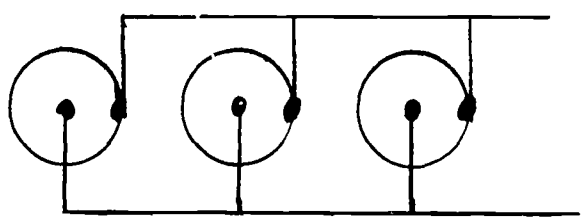
The strength of the magnetic force will be greatly increased by putting a core of soft iron into the coil. This core can be made from an old carriage bolt after removing its head.

ELECTRICAL CIRCUITS

There are two types of circuits used in nearly all electrical circuits; namely, series and parallel.

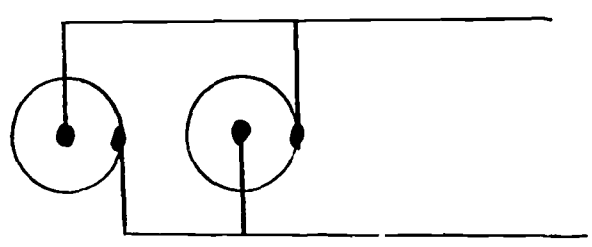
The materials needed to demonstrate these circuits are two or three No. 6 dry cell batteries; two sets of Christmas tree lights that use 110 volt lamps; a few pieces of insulated wire; and a small direct current voltmeter; and if possible, a small direct current ammeter. The latter can usually be obtained from an old radio or a second-hand electrical store.

If the batteries are connected by the pieces of wire from center tap to center tap and the marginal tap to marginal tap, you have connected them in parallel.



The negative terminals have been connected to each other and the positive terminals to each other. When this is done, the current is the sum of the current through each unit; yet the voltage is the same across each unit. Plug into an 110 volt outlet a set of Christmas tree lights. Notice that the brilliance of each bulb is as great in each bulb, regardless if only one burns or they are all turned on. Any one bulb may be removed, yet it does not affect the others. Therefore, the resistance of any given unit does not affect the other units. This is the way voltmeters are connected in electrical circuits.

If batteries are connected by pieces of wire from the center tap of one cell to the marginal tap of another cell, you have connected them in series.



When this is done, the voltage is the sum of the voltage of each cell; yet the current is the same as if only one cell is used. Both the voltage and the amperage can be measured in one cell. Measure the voltage when two or more are connected in this manner.

Using the second set of Christmas tree lights, cut the

greenwire (or the same wire) off as close as possible from each socket. Substitute another piece of wire the same size, but this time completely free from the socket. One end of this wire will have to be spliced and soldered to the cut end that comes out the male socket. The other end of this wire will have to be connected and soldered to the opposite end that comes out of the female socket. This will make a complete circuit. Substitute clear non-frosted bulbs; otherwise, it will be impossible to see the dimly lighted filaments. The reason that the filaments glow red is because each lamp is a resistance in the circuit. The resistance of a series combination is the sum of the resistances. In this experiment, it may be better to use about ½ of the sockets; otherwise, the filaments may be too dim to visualize in a lighted room.

It will be noted that in the series circuit if one bulb is removed, the other bulbs will not light. If an ammeter is placed in one of the lines in place of one of the bulbs, it will be noted that this instrument has no effect upon the glow of the lamps. If a voltmeter is placed in the line, the lights may not even glow. The reason will be explained later. Remember not to use D. C. voltmeters or ammeters with either set up when using alternating current.

ELECTRICAL CURRENTS

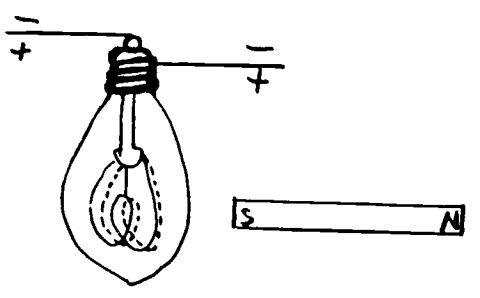
It is necessary for our students to have some understanding of electrical currents, especially alternating current. Direct current has not much use in our present apparatus. The apparatus needed to demonstrate alternating

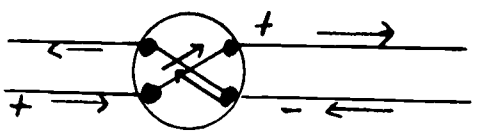
current is a permanent bar magnet; a coil of wire such as the primary windings of an old radio transformer, or you may wind your own from No. 24 or even smaller insulated wire. Wind about 25 or 30 turns around a cardboard tube about one inch in diameter and one inch long. An instrument for measuring current either a galvanometer or a compass around which are wound one turn of heavy insulated wire. You may obtain an exposure meter of the old type from a second-hand camera shop. If the back is removed, you will find two small wires connected to the selium cell. Disconnect these wires from the cell and bring the loose ends out through holes in the side of the case. This will serve as a galvanometer, except the needle will deflect mostly to the right and very little to the left. Since galvanometers are expensive, the above meter will serve the purpose. Also, you may be able to secure from a second-hand electric shop an ammeter, calibrated in one-tenth of an ampere or one ampere over the entire scale. This will perform the same as the meter of the exposure meter. Another simple piece of apparatus is a large carbon filament lamp bulb and a base type screw in socket. A few ounces of potassium iodide, some laundry starch and a tin pie pan or one of the metal pans now used with frozen pies are a few more pieces of apparatus. The only real expense connected with this outlay is the galvanometer which should cost about 25 or 30 dollars.

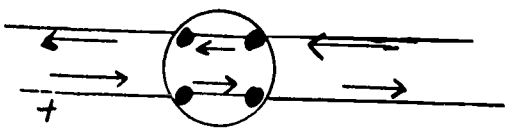
Connect the two ends of your coil to the galvanometer. Thrust one end of a permanent magnet into the coil. Notice that there is a deflection of the needle to the right or left depending upon which pole of the magnet enters the coil.

Reverse the pole of the magnet and thrust the other end into the coil. The needle will deflect in the opposite direction. If the magnet is pushed straight through the coil, the needle of the galvanometer first will go in one direction; but when the center passes through the coil, the needle will be deflected in the opposite direction. If the magnet is grasped in the center and twirled over the coil like a baton, the needle of the galvanometer will swing first in one direction; then, in the opposite direction. By rotating the magnet over the coil, the north and south poles of the magnet have been reversed in relation to the coil; and you have produced alternating current. If you rotate the coil between the north and south poles of permanent magnets, the same results on the galvanometer will be observed. If you have available an oscilloscope, you can connect the terminals of the coil to the vertical amplification terminal and the other to ground and observe the same phenomena.

A simple demonstration of the character of alternating current can be shown by placing a large carbon filament lamp in a base type socket and connected to a 110 volt alternating current supply. If a bar magnet is brought near the filament, the later will vibrate since the current has negative and positive values.

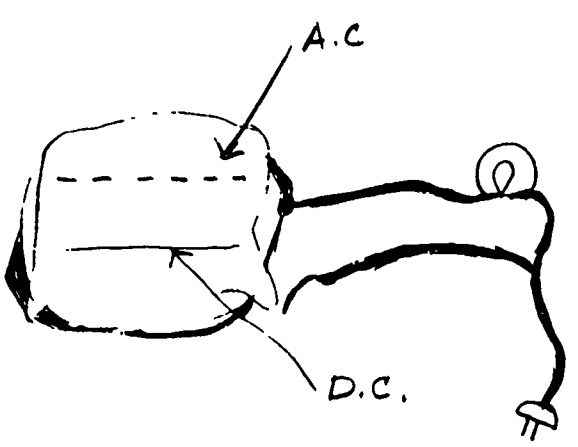






If you can obtain a reversing switch, four-way snap, or flush switch, it can be connected through a battery to the carbon lamp. This will demonstrate that the current flows through the lamp first in one direction; then, in the opposite direction by holding a bar magnet next to the lamp. You will notice repulsion and attraction of the filament is slower and more graphic than with the above experiment.

Another simple experiment to demonstrate the character of alternating current can be used by dissolving potassium iodide in a solution of ordinary laundry starch. Soak a piece of white cloth in the solution and wring out the excess liquid. Place the cloth over a tin plate and connect one wire to the plate through a 40 watt bulb to a 110 volt outlet. The free end of the other wire should have about $\frac{1}{4}$ inch of the insulation removed from its end. Then draw this free end over the wet cloth. Brown dots will appear on the cloth only when the wire is positive or when iodine is liberated from the potassium by electrolysis. No dots will appear when the current is in the negative phase.



Another apparatus that can be used to demonstrate alternating current is the magneto-generator. This is the type of generator that is found in the old type telephone where a crank was turned to produce the ring of the bells. Some of

these generators can be secured from the local telephone companies, especially in rural areas. In larger areas it may be necessary to purchase this equipment from one of the companies dealing with scientific apparatus.

Mount the generator on a piece of plywood about 6 by 12 inches in size. At the other end of the board, mount a base-type standard light socket to two terminals of the generator. When the crank is turned slowly, one plate of the lamp will glow and then the other; while, if this lamp was connected to a direct current supply, only one plate would glow. If the crank is turned fast enough both plates will glow at the same time. Use caution with this generator since rather high voltages can be generated.

MEASURING INSTRUMENTS

The voltmeter and ammeter are the two instruments used to measure voltage and amperage in x-ray circuits. These may be obtained from discarded x-ray machines. The voltage range on these types of voltmeters is a little high. Since all these experiments should be performed with not more than 10 or at the most 15 volts, it will be necessary to remove some of the inherent resistance. Most electrical generating plants have trained instrument men who will be glad to do this for you. It is advisable to also have a milliammeter so that the difference between it and an ammeter can be demonstrated.

Students should be taught the difference between a voltmeter and an ammeter and also how they are connected in an electrical circuit. The best way to teach the difference is to

cover the faces of both instruments; then have them measure the resistance across their terminals. In the case of a voltmeter, it can be connected in a series circuit. If connected in a series circuit, it can replace one of the light bulbs. In this case, it will be noted that the meter contains so much resistance that the light bulb may not even glow. If the voltmeter is connected in a parallel circuit, it again can replace one of the light bulbs. In this case, it will be noted that the meter has no effect on the brilliance of the other light bulbs. The actual resistance in a voltmeter can be measured in ohms by placing a voltmeter and ammeter in series with a suitable source of electricity depending upon whether the meter is D. C. or A. C. The resistance in the voltmeter can then be obtained by dividing the voltmeter reading by the ammeter reading.

If possible, try to obtain an old type ammeter or milliameter such as formerly used on non-shockproof overhead equipment. Cut away as much as possible of the surrounding case so that students can see and appreciate its delicate mechanism.

The ballistic meter is much more difficult to obtain so it is best that its operation be explained on present-day equipment. Most controls operate the ballistic meter out of the circuit so students may never be told of its use and value.

A voltmeter can be made from a fair-sized compass. Wind around it in the north-south direction as indicated on the dial a considerable number of turns of fine insulated copper wire; No. 30 Magnet wire is good.

You can make an ammeter from a compass by winding a single turn of coarse wire in the same manner as described above.

TRANSFORMERS

Before setting up experiments to demonstrate transformer action, the student should be familiar with the principle of mutual induction.

For these studies a very useful set of coils is the Gilley induction coils or the complete Gilley induction study kit. The price is about six or seven dollars. The wire in these coils will stand from 6 to 10 volts with A. C. or D. C. If you wish to make your own coils, they can be made from the wire that you have obtained from dismantling an old radio transformer; but remember it must be insulated. The primary winding is perhaps the best size, and it should be wound around a cardboard tube about one inch in diameter and one inch long. Plastic tubing makes excellent material upon which you can wind these coils. Another source of coils can be found in an old radio.

Connect one of these coils to a small door bell transformer and test the coil for magnetic flux with a compass. Connect the terminals of another coil to a small 6 volt Christmas tree lamp.

If the current from the door bell transformer is great enough, you will notice that the small bulb will begin to glow and get brighter the closer the second coil is brought up to the first coil. The small lamp may be substituted by a low range voltmeter or even the terminals of the wire of the second coil can be layed around a compass. The latter will demonstrate the magnetic flux around the wires coming from the second coil.

If a piece of soft iron is now placed in the opening of the two coils, it will be noted that the light glows brighter or the voltmeter reads a higher value. A good soft iron core can be made by straightening several paper clips then ty ing them together by thread. Greater values can be obtained on the second coil if the iron core is made in the form of a U; then another piece of soft metal is placed across the open limbs of the U. This will produce a closed magnetic circuit.

These same experiments can be done with several dry cells in series. In this case you must provide for making and breaking the circuit of the first coil that is connected to the batteries.

These experiments explain the principles of transformers; however, further demonstrations should be done to at least explain the principles of step-up and step-down transformers.

For this purpose it is desirable to remove the cores from several types of small old transformers so students can see the laminations and the various types of lamination patterns. Also, a partially dismantled transformer can be used to show the methods of winding the primary and secondary coils.

To demonstrate a step-down transformer bolt together about two-thirds of the laminations of an E pattern core with one side of the core open. Wrap a large number of coils of insulated wire around one of the limbs. Connect the terminals of this wire to 6 or 10 volts of alternating current. Around the other outside limb of the E pattern wind another insulated wire but about one half the number of turns as the other limb. Now bolt together several sheets of the laminations and place

over the top of the open E to close the magnetic circuit. If a voltmeter is connected in series with the larger coil and another is connected across the terminals of the second coil, it will be noted that the voltage across the second coil is lower than in the first coil.

Now reverse the coils to the source of the alternating current and measure the voltages. It will be noted that you have a higher voltage on the second coil or a step-up transformer.

These same experiments can be performed with the top of the E open to show the effect of the closed magnetic circuit or the secondary voltage.

Anyone who has suitable insulated wire can wind these various coils around small cardboard centers made in the form of a square. Large calibre of wire should be used to illustrate the primary coil. These simple windings can then be slipped over the square limbs of the laminated core.

Since an autotransformer utilizes the principle of self-induction, a simple experiment will suffice. Secure a coil from any commercial electro-magnet; for example, one of the coils of an old telephone, or one of the coils from an electric bell or buzzer. Connect one terminal of this coil through a socket containing a 10 or 15 watt electric light; then, to a convenient 110 volt alternating current. Of course, the other wire of the coil is also connected to the same supply. Make up a bundle of soft wire and place it in a coil for a core. When the circuit is completed, the lamp will light very dim; but if the core is pulled out, it will be more brilliant.

In effect you have made a choke coil which is the regulator of the filament current in most x-ray machines.

The autotransformer uses the same principle except that the laminated core is stationary and the single coil of insulated wire is wound around this core. At regular intervals, a wire is taken off the coil to metal taps or buttons. In this apparatus, it is possible then to utilize the effect of induction on anything from a few turns of the wire to a large number of turns.

An old autotransformer should be secured from a discarded x-ray machine so the students can see the connections of these taps to the metal buttons and the method in which the metal contactor moves from button to button.

RESISTANCE

The following apparatus will be needed to teach the four principles of resistance: about 25 feet of No. 11 insulated copper wire, that can be wound around a small wooden spool; about 5 feet of No. 22 insulated wire; about 25 feet of No. 30 insulated wire; 25 feet of malleable iron wire, the coil of wire out of a hot plate, or even the coil of wire from a common door bell.

If you have an ohmeter, it will be very simple to demonstrate the difference in resistance between the two pieces of copper wire that are the same length but of different diameters. This demonstrates one of the laws of resistance; namely, the resistance of a wire depends upon its diameter. Now measure the resistance between 25 feet of copper wire against 5 feet of copper wire of the same diameter. This demonstrates the

influence of the length of the wire on the resistance.

Now make measurements of resistance on wire of different metals but of the same size and length. This will demonstrate the next law of resistance; namely, that it depends also on the material in the wire. The next measurement should be made on the wire in an old heater plate. Next connect the heater to a suitable outlet and heat until the unit is red hot. Disconnect from the electrical outlet and quickly measure the resistance again. This equipment will demonstrate the effect of the temperature of the wire on resistance in the wire.

The effect of resistance in an electrical circuit is best demonstrated with variable and fixed resistance. For variable resistance secure the coil type of resistor that can be taken out of a radio or from the panel of an old x-ray machine, The sliding variable resistor may be more difficult to secure, yet they can be found in many electrical devices where it is used as fixed resistor. Another type of variable resistor is the button type found on many x-ray therapy machines, but also used on the foot switch of sewing machines. The best source of fixed resistors is found in radios where one can find ones of variable resistance.

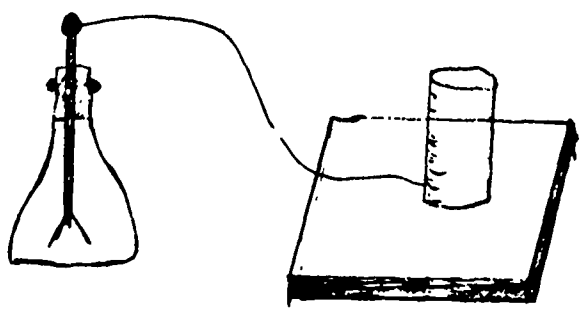
The best way to demonstrate their effect in an electrical circuit is to connect any one of them in series with a circuit that contains an ammeter and a light bulb. In this experiment the students can observe the effect on the ammeter reading as well as the brilliance of the light.

If no ohmeter is available, then Ohm's law can be used to compute resistance by using the formula-resistance equals

voltage divided by amperage.

RECTIFICATION

We are primarily interested in rectification of alternation currents using the principle of thermonic emission. This can be demonstrated with a very simple apparatus. Place a small tin can on a small block of parafin so the can will be insulated from the table. Solder a wire to the top of the can and secure the other end of the wire to the knob of the electroscope.



Now rub a glass rod with silk or nylon; then, touch the rod to the tin can. The leaves of the electroscope will fly apart with a positive charge. Now heat an old screw driver until it is nearly red hot and bring it close to the tin can but do not touch it. This will cause the electroscope to be discharged or the leaves will hang limp. The heated metal contains a negative charge, thus attracts the positive charge off the electroscope.

If you wish to demonstrate the wave form characteristics of a sine-wave, half-wave, and full-wave rectification of alternating current, it will be necessary to obtain an oscilloscope and a power supply apparatus capable of procuding both half-wave and full-wave rectification.

The oscilloscope need not be expensive since at least two companies sell complete kits for building and assembling a good scope. These kits can be obtained for about $40.00 and anyone

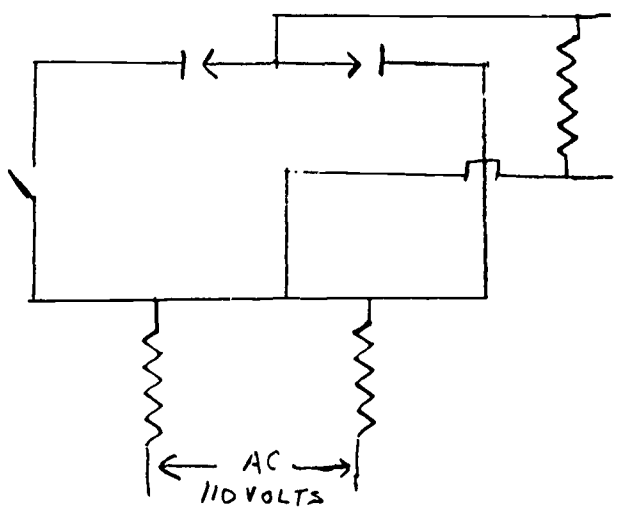
who has the ability to follow instructions can assemble one. The equipment needed is a small soldering iron, rosin solder, small screw driver, pliers, old knife for stripping insulation of wire and an old pair of scissors to cut wire. If you are not familiar with the common parts in the kit, any radio repair man will tell you their names as well as show you how to read the color strips on fixed resistances. The assembly instructions use actual drawings of the parts during various phases of the construction that are well labeled where R stands for resistance, C for condensor, V for tube base, S for switch and so on. The following description will give you an idea of how these instructions are written with S meaning solder and C meaning connect but not solder. Step 2-4, R24, 3.3 M ohm res(s) from 2 C to (C) 3C or step 1-2 C 5, .002 mfd cond (C) from RC to (C) 5X. If these are followed step by step as the assembly instructions are written, you will be amazed at the complicated intricate wiring you have done yet when completed to putting it in the case, you will have an excellent oscilloscope.

Incidentally, these same companies make kits for combination, ohmeters and voltmeters which are excellent aids for teaching. These kits cost in the neighborhood of $25.00.

Power supply units will be necessary as previously stated to connect to the scope to demonstrate half-wave and full-wave rectifications. These units can be purchased commercially and will supply 10 to 12 volts A. C. or 5 volts D. C. with about 3 to 5 amperes. Most of these units, however, rectify only full wave; however, they can be revamped with a simple toggle switch to rectify either half or full-wave rectification. These power

supply units usually use a dry disc type of rectification. The price is about 18 to 20 dollars.

These dry disc type of rectifiers can be made by securing two selenium type rectifiers, 5 plate stack and two screw-type resistors of 600 watts each. The rectifiers can be obtained at a radio supply store; and the resistors and their sockets at any hardware store since they are the type used in floor reflector heaters. This set up can be made into both half and full-wave rectification simply by putting in a simple toggle switch to cut out one of the rectifiers.



If you do not have two resistors, a small door bell transformer can be used to supply the desired low voltage to the selenium rectifiers.

If a vacuum-tube type of rectifier is desired, then any number of wiring diagrams may be followed. The one described in this treatise is taken from the Manual ABC of Radio, Electronics Department, General Electric Company. These rectifiers are made with radio parts that can be obtained from an old radio or can be purchased from a radio store. The diagram on page 29 of the above manual is that of a half-wave rectifier and on page 30 is the diagram of a full-wave rectifier using a single tube. In the latter, two half-wave rectifier tubes may be used. To select the type of tubes you must refer to the Radio ameteur Handbook which lists many half and full-wave rectifier tubes. By referring to the tube data the capacity of each tube is listed together

with the type of tube socket needed. A radio supply store will tell you the size of transformer needed with the amount of resistance on the load. If a one tube full rectifier is desired, a suitable tube is 5 U 4 and a tube base 5T. A suitable transformer is a small power transformer or receiver transformer. The load resistance should be fixed about 25000 ohms. These tubes take about 5 volts and 3 amperes on the cathode or filament and about 300 volts on the plate or anode. For those not familiar with these small transformers, the two black wires are from the primary windings and are connected to the 110 volt A. C. supply. The two yellow wires are connected to the filament of the tube. A white wire connected with one yellow wire usually supplies one half of the voltage to the filament. The white wire is not connected to the filament but to the output of the power unit. The red wires are connected to the plates or anodes of the tube. For additional wire, use single strand insulated wire. The whole set up can be mounted on a piece of lucite, masonite, or bakelite.

A complete rectifier apparatus using the vacuum tube principle can be purchased that can be connected to an oscilloscope or the neon glow lamps furnished with the apparatus can be used to illustrate half and full-wave rectification. (Central Scientific Co., Chicago)

It is operated on 115 volt A. C. and 115 volt D. C.; the former current connected through a No. 80 radio-rectifier tube.

X-RAY TUBES AND VALVE TUBES

At least two x-ray tubes should be available in which the filaments are intact so they can be connected to a small door bell transformer. One tube should be single filament and the other, two filaments or double focus. A small ammeter can be connected in series with a variable resistance to the tubes so students can be taught what happens when the tube current is changed on the instrument panel. Instead of a resistance in series, a choke coil can be used. The choke coil can be made from the coil of an old loud speaker, and its core can be made from a bundle of soft iron wire.

Several broken x-ray tubes should also be on hand to demonstrate the effect of high millamperage and high voltage, on the tungsten button of the target.

At least one rotating anode tube should be available not only to show the shape and construction of the anode but to spin the anode. In order to spin the anode it will be necessary to obtain a stator or field coil from an old motor. The startor can be found in a motor repair shop; the only requirement being that the opening in the stator will be large enough to insert the anode of the tube. It is not necessary to mount the tube on a frame; just connect the stator to a convenient 110 A. C. outlet and while holding the tube in both hands insert the anode end into the stator until it starts to turn. The anode will spin for several minutes.

At least one valve tube should be on hand to show the difference of construction with that of an x-ray tube. If an ohmmeter is available, then the difference in the resistances of the filaments can be shown.

Some schools are fortunate enough to have cut away sections of x-ray tubes and valve tubes to teach construction.

CONDUCTORS AND INSULATORS

A collection of various conductors and non-conductors of electricity should be available.

They can be obtained in various forms but an electrical circuit should be made in which various conductors are used as well as various insulators to demonstrate their effectiveness. This can be done using an electric lamp in the circuit or an ammeter. The articles listed below are conductors and insulators arranged in order of their relative effectiveness.

CONDUCTORS	INSULATORS
Silver	Slate
Copper	Oil
Aluminum	Porcelain
Zinc	Paper
Brass	Wool
Platinum	Sealing Wax
Iron	Sulphur
Nickel	Shellac
Tin	Mica
Lead	Paraffin
Antimony	Glass
Mercury	Plastics
Carbon	Dry Air
Acid solutions	
Salt water	
Moist earth	
The body	

FUSES

Various types of fuses should be made available so students can see their construction and have explained why they are or should be placed in all electrical circuits. These fuses should be everything from the small ones used in automobiles, household

types, and the various types of large cartridge fuses used in the switch boxes and panels of x-ray machines. In this connection they should then be taught how to test blown-out fuses and how to remove them from the circuit. Also, the importance of replacing fuses of the same amperage and not short circuiting fuses either with pennies or short pieces of copper wire.

SUMMARY

The materials listed in this manual are those used by the author. Most of this apparatus can be purchased if the teacher does not want to collect it as has been suggested in this manual.

Glass stirring rod or old centigrade thermometer

Rod of hard rubber or an old hair comb

Pith balls

Silk or nylon size of a handkerchief and a piece of wool the same size

Four small compasses (one inch in diameter)

Two compasses (two inches in diameter-optional)

Lodestone about 2x3 inches in diameter

Two bar magnets about 5 cm. in length

One horshoe magnet

Several pieces of soft iron (Laminations from an old transformer)

Iron filings

One piece of lucite or glass 8x10 inches

One package of hair pins 2 3/4 inches

Four dry cell batteries No. 6

One piece of $1\frac{1}{2}$ inch pipe, one inch wide then sawed in two pieces

Carriage bolt about 4 inches long

Paper clips

Two sets of Christmas tree lights (parallel)

D. C. Voltmeter (optional)

D. C. Ammeter

A. C. Voltmeter (optional)

A. C. Ammeter

Galvanometer (optional)

Large Carbon filament light bulb

Potassium iodide

Starch

Pie tin

Neon glow lamp bulb

Gilley induction set (optional)

Primary or secondary coil from a small transformer or coil from a radio choke coil

Small autotransformer from a discarded x-ray machine

Ohmmeter (optional)

Various fixed resistances (radio)

Variable resistances, coil and sliding

Oscilloscope (optional)

Wire

- Several feet of No. 20 or 24 insulated copper wire
- No. 30 magnet wire
- 25 feet of No. 11 insulated copper wire
- 5 feet of No. 22 insulated copper wire

25 feet of malleable iron wire

Coil from a hot plate

Small door bell transformer or toy train transformer

Various parts of broken x-ray tubes

One rotating anode tube (filament may be burned out)

Stator

Various conductors and insulators

Fuses of all types

REFERENCES

1. A. B. C.'s of Radio-Electronics Division, General Electric Co.
2. Mott-Smith M.; Fundamentals of Electricity, Washington Infantry, January, 1943, Westinghouse Electric and Manufacturing Co., and Science Service Inc.
3. Life Filmstrips
   9 Rockefeller Plaze, New York 20, N.Y.
4. Experimental Electricity for the Beginner
   Universal Scientific Co., Vincennes, Indiana
5. Practical Electricity, Croft, Terrell., McGraw-Hill Book Co.
   239 W. 39th St. New York, N.Y.

Note: Since this manual was prepared the author has had the opportunity to see demonstrations of electrical kits made by the Universal Instrument Co. of Vincennes, Indiana, for teaching purposes. Mr. Crow is in the process of making a kit adapted to the teaching of electricity to X-Ray technicians. These kits are excellent and highly recommended.

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ABSTRACT - This curriculum guide was developed by school personnel to prepare high school students as nursery assistants. The manual has sample instruction sheets and tests as well as suggestions for the organization of the class and methods of instruction. Outlined blocks of time cover the manipulative skills and technical knowledge related to (1) orientation, (2) the physical development of the pre-school child, (3) the social development of the child, (4) the intellectual development of the child, and (5) the organization of the nursery school. Total hours of shop work are estimated at 1,620 hours. Text and reference books are included. (JS)

VT 008 419

Public Schools of the District of Columbia

CARL F. HANSEN, Superintendent of Schools

Curriculum Guides in Trade and Industrial Education

NURSERY ASSISTANTS,

TRADE AND INDUSTRIAL EDUCATION

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1964 Reprint

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FOREWORD

General Statement of the Nursery Assistants Trade

Nursery education provides for the greatest development of children during the pre-school years. As far back as 2000 years ago, a Greek philosopher, Plato, mentioned community schools for young children. Through the influence of such persons as Comenius, Locke, Rousseau, Pestalozzi, Owen, Herbert, Froebel, and others, schools for young children have been developing into places where faith is expressed in the natural growth of children, where the environmental factors are studied and materials provided and methods used for the physical, intellectual, emotional, and social development of pre-school children.

Nursery schools have developed rapidly in communities where women are gainfully employed during the day and desire wholesome and adequate training for their young children. Instituted in the United States in 1920, the nursery school movement had enrolled, by 1947, about 58,000 children under the age of six years. Broadly used, "nursery" refers to more than one kind of pre-school education.

1. Day Nursery -- custodial care of children 2 to 4 years.

2. Nursery School -- an approved or government-licensed school promoting educational objectives through use of well-planned materials and equipment and supervised by adequately trained personnel.

The Nursery School Assistant is trained to provide experiences in relation to the child's basic needs. Some experiences emphasize physical growth, other experiences provide for intellectual growth. All experiences, however, are accompanied by emotional reactions and critically affect social relationships.

Persons trained as Nursery Assistants may find employment in accordance with their special aptitudes, abilities and interests in various areas and on such occupational levels of the trade where opportunities may exist. Included in such areas are:

1. baby sitters
2. mothers' helpers
3. day nursery assistants
4. nurses' aides in the Pediatrics Ward of hospitals
5. nursery assistants

The student is also qualified in purchasing, planning, and preparing meals.

Prerequisites For Entrance Into The Trade

Applicants for this course must have completed the 9th grade and should have passed the Vocational High School Entrance Examination. The minimum age requirement for admittance is fifteen years, except by special permission of the principal.

The physical development and general health must be such as to assure success in developing the ability to do effectively the required manipulative skills in the various occupational levels of the trade, since endurance and much physical energy is needed. A certificate of health including a chest x-ray is essential. The Nursery School Assistant should be free from any physical peculiarities and speech defects noticeable to children and her voice should be pitched low and of a pleasent tone.

The educational requirements will vary according to the occupational level of the trade. However, a high school education or its equivalent is necessary to understand the technical knowledge and the social-industrial relationships which condition the efficient manipulative achievement of the trade. Skill in human relations and a love for small children are essential. Special skills in story telling, music, drawing, nature study and handicrafts are also of great value.

Time Required To Complete The Course

The requirement for a high school diploma and a certificate in the Nursery Assistants course is three (3) years. Laboratory practice or shop work is scheduled for three (3) clock hours daily, 15 hours per week. One and one-half hours per day are spent in related subjects--science, mathematics and/or art. One and one-half hours are spent in academic subjects. Five hundred and forty (540) hours are spent in shop work per year--a total of 1620 hours for the three year course. Students, who have completed high school may take a post-graduate course and receive a certificate in the trade in one year.

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I. OBJECTIVES

Note: It should be kept in mind that vocational industrial education, as it is known today, is not designed to develop skilled craftsmen as such. It is intended, through preparatory programs in basic fundamentals, to bring students to the entrance point of wage earning ability at advanced apprenticeship level. Rapid advancement thereafter (toward thorough understanding and skilled craftsmanship levels) is accomplished through actual work on the job and night supplementary trade extension courses.

General

The general objectives of the courses of study in Trade and Industrial Education are to develop in the students the abilities to:

Do the various manipulative skills that will permit their initial employment in the industry, rapidly increase their efficiency, and promote their advancemeny in the salary scale.

Understand the application of basic principles of the sciences, mathematics, and related technical knowledge that condition the manipulative skills.

Appreciate the social and industrial relationships in connection with the contribution which a worker can make in the areas of health, effective services, and general social-industrial and public relations.

Specific

The specific objectives of the course of study in Nursery Assistants are:

To develop skills and related knowledge in regard to standard practices and procedures in pre-school programs.

To develop a wholesome philosophy of child guidance on the pre-school level.

To develop the ability on the part of the student to work harmoniously and cooperatively with others and gain self understanding.

To develop the ability to understand and appreciate standards of health, safety and sanitation.

To develop a sympathetic understanding and enjoyment of children and a desire to help them grow and a willingness to assume a greater responsibility in guiding them.

To develop an understanding of the standards--governmental and others governing the operation of nursery schools.

To develop high standards of work and encourage initiative.

II. GENERAL ORGANIZATION

General Statement of Methods of Instruction

To teach best the variety of skills, the related technical knowledge and the social-industrial relationships needed to equip students entering this trade, many methods of teaching are necessary. Each method has distinctive features that causes its use to be best suited for the teaching of a specific type of skill or knowledge.

In teaching shopwork, the following methods are used:

Demonstration	Questioning	Directed Technique Study
Explanation	Instruction Sheets	Group Projects
Visual Aids	Individual Projects	Problem-Solving Activities
		Field Trips

In teaching the related technical knowledge and social-industrial relationships, the following methods are used:

Discussion	Questioning	Written Reports
Directed Study	Individual Reports	Visual Aids
		Field Trips

Time Schedule Allotment

Block	Number of Hours Shop Work
I. Orientation	15
II. Physical Development of the Pre-School Child	405
III. Social Development of the Child	575
IV. Providing for intellectual Development of the Child	465
V. Organizing the Nursery School	55
VI. Interim Licensing at Nursery Schools in the City	105
Total Hours	1620

Type of Testing Program Used

More than one instrument is used to determine the effectiveness of teaching and to evaluate the achievement of students in the areas of manipulative skills, related technical knowledge, and social-industrial relationships. These are under the general knowledge of performance and written tests. One sure way to determine whether a student can do something is to have him actually try to do it. Hence, manipulative skills are tested continually in connection with every job. These tests are referred to as performance. In evaluating total performance, consideration is given to the various elements that are significant in the trade areainvolved. For example:

Safety	Finished Product
Techniques	Time and Effort Expended
	Use and Care of Tools, Equipment, Materials

The rate of progress in the assimilation of related information is revealed in the ability of the student to apply such knowledge to pertinent jobs and in his achievement on written tests which are given at regular intervals. Written tests may be Objective or Essay in form or a combination of both. Sample tests are included in this course of study in a separate section.

Evaluation of Student Progress

Students progress in the manipulative skills according to their demonstrated ability to meet minimum trade standards. They are required to repeat a job until minimum proficiency is reached before they are permitted to advance to the next job. Their rate of progress and the evaluation of it are recorded on a progress chart. Performance and written test achievement are interpreted as follows:

A	Outstanding	95 - 100
B	Above Average	85 - 94
C	Average	75 - 84
D	Below Average	70 - 74
F	Unsatisfactory	Below 70

Text and Reference Books

Text Books

Care and Guidance of Children, Goodspeed, Helen C. and Johnson, Anna J. B. Lippincott Co., N. Y., 1938

Child Care and Guidance, Goodspeed, Helen C., Mason, Esther R. and Woods, Elizabeth L. J. B. Lippincott Co., N. Y., 1953

Understanding Childrens' Play, Hartley, Ruth E. and Frank, Lawrence L. Columbia University Press, N. Y., 1951

Reference Books

A Nursery Handbook, Green, Marjorie and Woods, Elizabeth; Sierra Madre Community Nursery School Association, Sierra Madre, California, 1954

Nursery School Guide, Kellogg, Rhoda; Houghton Mifflin Co., Boston, 1949

Education of the Young Child, Landreth, Catherine; John Wiley and Sons, Inc., N. Y., 1943

The Nursery School, Read, Katherine H.; W. B. Saunders Co., Philadelphia, Pennsylvania, 1950

Child Growth and Development, Hurlock, Elizabeth B.; McGraw Hill Book Company, Inc., New York, 1956

III. OUTLINE OF INSTRUCTION

Block I - Orientation

Unit 1 - Survey of the Field of Nursery Education

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
	Objectives and aims of the course
	History of Nursery Schools
	Agencies, conferences, committees which benefit child welfare
	Introduction to and use of child-care library

Unit 2 - Heredity and Environment

	Life cycle
	Reproduction
	Environment (pre-natal and post-natal)

Block II - Physical Development of the Pre-School Child

Unit 1 - Nutrition

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Planning meals	"Basic Seven"
Marketing	Food needs from two to five years
Preparing meals	Methods of preparing foods for pre-school child
Serving	
Cleaning kitchen	Good food habits for the two to five year old
Handling food refusals and other problems	Calculation of meal costs
Recording food consumption	Techniques for encouraging good eating habits

Block II - Physical Development of the Pre-School Child (Continued)

Unit 2 - Bathing and Dressing Routines

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Assembling bath materials and equipment	Proper equipment and environment for the bath
Testing temperatures (room and water)	Methods of bathing and dressing child
Giving bath	Proper care and cleaning of bath facilities
Combing hair	
Dressing	
Cleaning the bathroom	
Unit 3 - Toileting Routines	
Providing sanitary toileting procedures	Techniques used in developing independence at toileting time
	Elimination control
	Dealing with problems of elimination
Unit 4 - Providing for Sleeping Routines	
Arranging cots according to health regulations	Pre-school sleeping health regulations
Making beds	Bedmaking
Arranging rooms	Techniques used to encourage sleep
Encouraging sleep and rest	
Unit 5 - Play Routines	
Preparing indoor play room	Study of play as a means of physical development (as of age and small muscles)
Directing indoor play	
Preparing for outdoor play on the playground	Types of and use of play equipment and playground safety
Directing outdoor play	

Block III - Social Development of the Child

Unit 1 - Guiding the Child in Group Contacts

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Handling behavior problems	Sharing responsibilities and privileges Following directions Developing independence Aggressiveness and being the center of attraction Negativism Dawdling Assuming responsibility for one's acts
Unit 2 - Providing the Child With Constructive Group Play	
Arranging play areas Indoor Outdoor	A study of areas of play as a socializing influence: Doll corner Woodworking area Pictures Sound experiences Music Books
Unit 3 - Directing Child's Interest in Objects of Nature	
	Plants and flowers Animals, birds Seeds Aquarium
Unit 4 - Acquainting Child with Civic Features of His Environment	
Providing accessory equipment for dramatic play Providing for field trips to see community helpers at work	People we know: Police, Clergyman Firemen, Doctor Grocer, Dentist Milkman Book corner Area for quiet games Area for art media Rearranging of outdoor play equipment with an eye to socialization

Block IV - Providing for Intellectual Development of the Child

Unit 1 - Guiding the Child in Sensory Experiences

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Supervising play in art media	Clay modeling
	Finger painting
	Cutting and pasting
	Story telling

Block V - Organizing the Nursery School

Unit 1 - Planning the Nursery School Day

Providing for nursery routines	Schedule or program
	Staff duties
	Housing or plant
	Equipment
	Materials
	Records
	Inventory

At the completion of the above, senior students are required to affiliate with nursery schools in the city for six weeks of interim training.

OUTLINE OF SOCIAL-INDUSTRIAL RELATIONSHIPS

INDUSTRIAL RELATIONSHIPS

Note: The industrial relations, for which every skilled worker must have an understanding and appreciation form a definite part of the instructional program in all of the areas previously outlined.

Some of these are:

Materials of the Trade -- Source, manufacture, distribution, specifications, costs, etc.

Tools -- Operations and processes in this trade that affect the worker and his relationships with other workers.

Working Conditions -- Hours, pay, seasonal employment, health, recreation, morale; workers' responsibility for these conditions.

Health -- Personal and social hygiene; vital facts every worker should know about well-being.

Industrial Development -- Growth of the industry, its scope and trends; other industries that support it; its relationship to other industries; how organized; how supported; importance of time and costs records.

Industrial Organizations -- Trade, labor, and employer; what their functions are on the job; how these affect happiness of the worker.

Shop Relationships -- Those which concern fellow-workers and the "boss" on or off the job; how these affect efficiency and happiness of the worker.

Laws and Ordinances -- City, county, or state that affect the worker, his job, trade, and industry; worker's compensation, unemployment, Social Security, safety

Public Relations -- Those factors having to do with consumer interests, confidence, honest work, fairness in dealings, loyalty to job.

Personality Characteristics -- Attitudes and habits that should be developed to make a successful craftsman; responsibility as a craftsman and citizen to join with others in promoting better working conditions for all and the civic and social welfare of the community.

Related Occupational Opportunities -- The extent to which this trade opens employment opportunities in related occupations.

SOCIAL RELATIONSHIPS

Note: The skilled worker also appreciates the contribution which his work can make in the areas of health, effective services, and general social and public relations. Such development forms a definite part of the instructional program.

Some of this instruction is along the following lines:

The individual in relation to special observances and current events

The individual -- a member of varying social groups (home, social, club, church, etc.)

The individual in his leisure time

The indivudual in his inner life and development of character

The individual worker in a trade or occupation presenting distinctive opportunities

The individual worker in relation to specific jobs, economic issues, and problems

The individual in relation to major civic and social issues

The individual in occasions of special personal government services

The individual in a legally constituted state

The individual worker in relation to specific jobs involving the lives of others

The individual worker in relation to specific jobs involving the safety of fellow workmen

The individual worker in relation to specific jobs involving the happiness and contentment of others

IV. SAMPLES OF INSTRUCTION SHEETS

JOB SHEET

Job Title #2 -- Feeding The Pre-School Child - Preparing Meals

Job Objectives:

To develop skill in preparing meals to adequately nourish the pre-school child.

To develop the ability to conserve time and energy in preparing a meal.

To develop an understanding of orderly working habits when preparing meals.

Work Standards and Specifications:

Orderliness and cleanliness of work and person.

Thorough knowledge of methods used to prepare food.

Tools, Equipment, and Materials:

Selected according to special dishes being prepared

Procedure By Operations:

Read recipes carefully.

Collect all materials, tools and equipment needed to perform the job.

Select the best tools for each job and place them conveniently.

Select the easiest motions and use the fewest in accomplishing a task.

Keep on with one kind of motion and complete as many jobs possible requiring that motion.

Use orderly working habits so that the task of cleaning will be relatively small.

Calculate either in your mind or on paper the various food preparations involved in the meal, and then classify them according to the length of time it takes to prepare them.

Organize your job so that all foods will be ready for serving at the correct time.

General Vocational Information:

Why is it necessary to assemble all tools, equipment, and materials before beginning work?
Explain "use the easiest motions" and "keep on with one kind of motion", etc.
Do you think it wise to classify jobs accrding to the time it takes for preparation? Explain. Give an example.
Make out a menu and explain how you would organize your jobs to get the best results.

INFORMATION SHEET

Trade: Nursery Assistants

Project: Serving the Nursery School Meal

This concerns techniques for encouraging good food habits in the preschool child. It should be noted that good food habits for the five year old do not include so many as would be required of an adult. At this age we might reasonably expect the child to have:

Mouthfuls of suitable size
Food thoroughly chewed
Food eaten in an unhurried, businesslike manner
Mouth empty of food before taking a drink
All food eaten that is served
Food eaten only at meal time
No food refusals

Previously we have considered what the daily diet requires at this age level and have listed the nutrients and the foods we give. The equipment and table setting used at meal time has also been considered. Later, we shall see what cooking methods are and are not used in the preparation of foods for the young child. Appetizing, nutritious, and attractive meals are prepared each day in the nursery. From this point, we hope to move on to pleasant mealtime procedures.

A few of the techniques known to be helpful follow. Observe these in regard to serving meals in the nursery:

To be hungry, the child must have one to three hours active exercise in the open air, depending upon the weather.

Giving the child enough time to leave his play, washing hands and having at least ten minutes rest before lunch is desirable. A tired, sleepy, angry or worried child usually has no appetite. Under these conditions, digestion is greatly hampered.

It is likewise desirable that the adult who serves the meal should also lend his cheerful attitude.

Remember that the attitude of the adult is more important than the techniques used. She should avoid any punitive attitude. She must be helpful and patient with such a small child who has so much to learn. Often the adult's tone of voice is more important than words.

Questions:

What ill effects result from allowing the young child to eat between meals?

Why should the mouth be empty of food before taking a drink?

What is wrong with the feeling that one eats regularly because one eats three times per day?

V. SAMPLES OF TESTS USED

BLOCK I - ORIENTATION

Survey of the Field

True or False — Part I

Place a plus sign before the statement which is true and a minus sign before the statement which is false.

_____ 1. The Nursery Assistant Course is designed to train students to the point of initial employability.
_____ 2. To train students in the manipulative skills in the various occupational areas and give them the technical knowledge that conditions these skills are the two specific objectives of this course.
_____ 3. As far back as 2000 years ago, Plato, a Greek philosopher, mentioned community nursery schools.
_____ 4. Nursery schools flourished in England in 1918.
_____ 5. America began to see the need of nursery schools at the same time as Russia.
_____ 6. Nursery schools were established to "keep" children.
_____ 7. There is no difference between a "Day Nursery" and a "Nursery School."
_____ 8. Nursery schools as research centers were established during the 1920's from financial grants to universities from the Laura Spellmen Rockefeller Foundation.
_____ 9. The University pf California at Los Angeles and the University of Minnesota, Columbia University and Merrill Palmer School of Detroit,Michigan were among the first schools to establish nursery schools.
_____10. The W.P.A. program and the Lanham Act had nothing to do with the establishment of nursery schools during World War II.
_____11. Nursery schools may be opened up without license by anyone who loves children.
_____12. The Children's Bureau is a government agency dedicated to the understanding of children's problems in the United States and all its possessions.
_____13. White House conferences on Child Welfare are called every year.
_____14. All persons interested in nursery education should become familiar with all local clinics in the city and their facilities and work.
_____15. Nursery Assistants in their desire to be successful and competent should keep informed with new developments in this field through educational courses, travel, and recent books publications.

KEY -- True and False

1. +	6. -	11. -
2. -	7. -	12. +
3. +	8. +	13. -
4. +	9. +	14. +
5. -	10. -	15. +

BLOCK I - ORIENTATION

Survey of the Field

True or False

Part II

Place a plus sign before the statement which is true and a minus sign before the statement which is false.

____ 1. The biological function of the family has to do with the procreation and rearing of children
____ 2. The character of the parents and remote ancestors has nothing to do with the character of the offspring.
____ 3. The term environment includes all that surrounds and influences the individual.
____ 4. Environment alone determines what a person shall do or be.
____ 5. Inherited traits or characteristics cannot be changed.
____ 6. Characteristics which we acquire after birth are not inherited by our descendants.
____ 7. Our inheritance cannot be changed but we can control the heredity of our children.
____ 8. Our inheritance can be modified to a certain extent by our environment.
____ 9. Heredity means the resemblance of one person to another based on ancestry and occurs in successive generations.
____ 10. Ill health, malnutrition and venereal disease are environmental factors which affect the child before birth.
____ 11. The marriage of two people is not such a serious matter and need not be given much thought.
____ 12. No one should marry without understanding the added obligation and responsibility.
____ 13. By reproduction, the world is kept inhabited.
____ 14. Puberty is synonymous with biological maturity.
____ 15. Birth registration is a means of protecting the community.
____ 16. Infant mortality is a problem of society.
____ 17. Children are marked by their parents before birth.
____ 18. The new-born infant is born with the ability to see, hear, feel and taste at birth.
____ 19. Babies are born with two fears--that of falling and a fear of loud noises.
____ 20. The placenta has nothing to do with the growth of the fetus.

KEY -- True and False

1.	+	11.	-
2.	-	12.	+
3.	+	13.	+
4.	-	14.	+
5.	+	15.	+
6.	+	16.	+
7.	+	17.	-
8.	+	18.	-
9.	+	19.	+
10.	+	20.	-

BLOCK I - ORIENTATION

Survey of the Field

Matching Test — Part I

Place the figure of column 2 in front of the matching figure in column 1.

____	1. Goodspeed and Johnson	____	1. Nursery School Guide
____	2. Day Nursery	____	2. One who deals with diagnosis and treatment of mental afflictions.
____	3. Rhoda Kellog	____	3. Education of the Young Child
____	4. Psychologist	____	4. One versed in the science of the mind
____	5. Laboratory Nursery School	____	5. Early Greek Philosopher
____	6. 1920	____	6. Custodial care of children
____	7. Catherine Landreth	____	7. Care and Guidance of Children
____	8. Nursery School	____	8. Research center for teacher training and child study
____	9. Psychiatrist	____	9. Establishment of nursery schools in the United States
____	10. Plato	____	10. Government licensed with planned educational program

KEY to the Above Statements

1 - - - - 7	6 - - - - 9
2 - - - - 6	7 - - - - 3
3 - - - - 1	8 - - - 10
4 - - - - 4	9 - - - - 2
5 - - - - 8	10 - - - - 5

BLOCK I - ORIENTATION

Survey of the Field

Completion Test — Part I

1. A good nursery school according to government standards is judged by the _____, and the _____, and the _____.

2. The nursery school movement in the United States by 1947 has enrolled _____ children under the age of six years.

3. Persons trained as Nursery Assistants may find jobs in the following areas; _____, _____, _____ and _____.

4. The Children's Bureau is located in Washington, D. C. at _____ _____.

5. The White House Conferences were started by President _____ in the year _____.

(Fill in the above blank spaces.)

KEY to the Above Statements

1. Plant and equipment, staff, program

2. 58,000

3. Baby sitters, mother's helpers, Day Nursery Assistant, Nursery School Assistant, Nurse's Aides in Hospitals, General Nursery School Helpers

4. 330 Independence Avenue, S. W.

5. Theodore Roosevelt, 1910

BLOCK I - ORGANIZATION

Survey of the Field

Trade Terms and Meanings

1. Nursery Assistant
2. Psychologist
3. Psychiatrist
4. Day Nursery
5. Nursery School
6. Private Nursery School
7. All Day Nursery School
8. Laboratory Nursery School
9. Cooperative Nursery School
10. Church Nursery School

KEY to the Above Terms

1. Nursery Assistant -- one who is trained to provide experience in relation to the child's basic need. Some experiences emphasize physical growth, others provide intellectual growth. All experiences, however, are accompanied by emotional reactions and critically affect social relationships.

2. Psychologist -- one versed in the science of the mind, its nature and functions.

3. Psychiatrist -- one who deals with the diagnoses and treatment of mental difficulties.

4. Day Nursery -- a nursery dealing with the custodial care of children, 2 to 5 years of age.

5. Nursery School -- an approved or government-licensed school promoting educational objectives through the use of well-planned materials and equipment and supervision by adequately trained teachers.

6. Private Nursery School -- a school owned and operated by individuals in the community. Some are non-provit, but most are commercial

7. All Day Nursery School -- a center caring for children from 10 to 12 hours a day, five or six days a week.

8. Laboratory Nursery School -- a nursery school used for the purpose of training teachers and also as a research center for the study of child growth and behavior.

9. Cooperative Nursery School -- organized by parents to provide housing, furnishings, equipment, financing, and employment of teachers to supervise the children.

10. Church Nursery School -- a nursery school organized by the church as a part of their religious education.

NURSERY ASSISTANT

Semester Test

1. Make out a program for the nursery school for one day. Use the regular time schedule.

2. Make out a menu for the nursery school lunch hour and justify its appropriateness according to food values and combinations.

Shop Test

1 The pupils will be given a copy of the day's program. (Nursery school-laboratory and kitchen routines.)

2. Pupils will be given their assignments and groupings.

3. Let the various groups begin their respective jobs.

4. Ratings will be based on:

    1. Knowledge of group duties
    2. Scientific handling of children
    3. Attitude toward work
    4. Attitude toward the children
    5. Group cooperation
    6. Personal grooming
    7. Time observance
    8. Deportment
    9. Job Morale
    10. Manipulative skill

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ABSTRACT - This curriculum guide was developed by school personnel to prepare high school students for entry positions in the labor market as hairdressers, manicurists, facial operators, and assistant managers. The manual has sample instruction sheets and tests as well as suggestions for the organization of the class. Outlined blocks of time cover the manipulative skills and technical knowledge required for (1) Sterilization, (2) Care of the Hair and Scalp, (3) Care of the Hands and Arms, (4) Care of the Skin, and (5) Management and Supervision. Total hours of shop work are estimated at 1,620 hours. (JS)

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COSMETOLOGY

CURRICULUM GUIDES
In Trade and Industrial Education

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Public Schools of the District of Columbia

ED0 45856

Public Schools of the District of Columbia

CARL F. HANSEN, Superintendent of Schools

Curriculum Guides in Trade and Industrial Education

COSMETOLOGY

TRADE AND INDUSTRIAL EDUCATION

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FOREWORD

General Statement of The Trade

Cosmetology is that branch of applied science which deals with the external embellishment of the person through the use of cosmetic products and treatments. The regions of the body which may be treated in beauty shops under existing laws are: the head, neck, upper chest and back, arms and hands.

---Florence Wall

Areas of Employment

The majority of the workers are all-around operators who give a variety of services such as shampoos, hair cuts, face and scalp treatments and manicures. There are some operators who are licensed to do manicuring only. In the larger shops, some operators may specialize in such services as hair styling, hair dyeing, permanent waving, manicuring, or facial treatments. In addition, a person trained as a cosmetologist may work as a demonstrator or manager. The men in this occupation are mainly stylists who specialize in hair cutting, setting, and styling.

Prerequisites for Entrance Into The Trade

Students must have completed the ninth grade.
Students must successfully pass an aptitude test.
Students must be physically sound and have normal vision.
Students should have full use of both hands, steady nerves, dextrous fingers, and be able to stand throughout an eight-hour day.
Students should have a pleasing personality.
Students should be free from any major disfigurements.

Time Required To Complete The Course

In order to obtain a license in Cosmetology, a student must meet the requirements of the D. C. Board of Cosmetology. The law requires that all applicants must complete a minimum of 1500 hours of training and the schedule of training must include the outline and time schedule prescribed by the D. C. Board of Cosmetology.

In addition to satisfying the requirements of the D. C. Board of Cosmetology, a student must complete the requirements for high school graduation. As the result of this, she receives a high school diploma as well as a certificate in cosmetology.

The course is a three year course. Every student must be a high school graduate before being recommended to take the D. C. Board of Cosmetology Examination.

NOTE: High school graduates are also allowed to enroll. The time required to complete the course is three semesters.

I. OBJECTIVES

Note: It should be kept in mind that vocational industrial education, as it is known today, is not designed to develop skilled craftsmen as such. It is intended, through preparatory programs in basic fundamentals, to bring students to the entrance point of wage earning ability at advanced apprenticeship level. Rapid advancement thereafter (toward thorough understanding and skilled craftsmanship levels) is accomplished through actual work on the job and night supplementary trade extension courses.

General

The general objectives of the courses of study in Trade and Industrial Education are to develop in the students the abilities to:

Do the various manipulative skills that will permit their initial employment in the industry, rapidly increase their efficiency, and promote their advancement in the salary scale.

Understand the application of basic principles of the sciences, mathematics, and related technical knowledge that condition the manipulative skills.

Appreciate the social and industrial relationships in connection with the contribution which a worker can make in the areas of health, effective services, and general social-industrial and public relations.

Specific

The specific objectives of the course of study in Cosmetology are:

To develop the ability to perform definite jobs specifically required in the trade of cosmetology so that students will be able to obtain employment.

To develop an understanding of the basic scientific information which will help students reach a greater understanding in their field of work.

To develop an understanding of social and economic problems in order to enable students to successfully adjust to the environment in which they live.

To develop the ability to correlate some elements of science with practical work so that students will develop judgment in the use of tools, equipment, and materials.

To develop understandings and appreciations that will safeguard the health of workers and patrons.

To develop an appreciation of the importance of observing safety precautions in all phases of shop and home life.

To stimulate interest in experimentation, originality, post graduate training, and advancement.

II. GENERAL ORGANIZATION

General Statement of Methods of Instruction

To best teach the variety of skills, the related technical knowledge and the social-industrial relationships needed to equip students entering this trade, many methods of teaching are necessary. Each method has distinctive features that causes its use to be best suited for the teaching of a specific type of skill or knowledge.

In teaching shopwork, the following methods are used:

Demonstrations	Individual Projects
Explanation	Directed Technique Study
Visual Aids	Group Projects
Questioning	Problem-Solving Activities
Instruction Sheets	Field Trips

In teaching the related technical knowledge and social-industrial relationships, the following methods are used:

Discussion	Written Reports
Directed Study	Visual Aids
Questioning	Field Trips
Individual Reports	

Time Schedule Allotment

	Block	Occupational Area	No. Hours Shop Work
I.	Sterilization		125
II.	Care of the Hair and Scalp	Hairdresser	800
III.	Care of the Hands and Arms	Manicurist	200
IV.	Care of the Skin	Facial Operator	375
V.	Management and Supervision	Assistant Manager	120
		Total Hours	1620

Type of Testing Program Used

More than one instrument is used to determine the effectiveness of teaching and to evaluate the achievement of students in the areas of manipulative skills, related technical knowledge, and social-industrial relationships. These are under the general headings of performance and written tests. One sure way to determine whether a student can do something is to have him actually try to do it. Hence, manipulative skills are tested continually in connection with every job. These tests are referred to as performance. In evaluating total performance, consideration is given to the various elements that are significant in the trade area involved. For example:

Safety
Techniques
Finished Product
Time and Effort Expended
Use and Care of Tools, Equipment, and Materials

The rate of progress in the assimilation of related information is revealed in the ability of the student to apply such knowledge to pertinent jobs and in his achievement on written tests which are given at regular intervals. Written tests may be Objective or Essay in form or a combination of both. Sample tests are included in this course of study in a separate section.

Evaluation of Student Progress

Students progress in the manipulative skills according to their demonstrated ability to meet minimum trade standards. They are required to repeat a job until minimum proficiency is reached before they are permitted to advance to the next job. Their rate of progress and the evaluation of it are recorded on a progress chart.

Performance and written test achievement are interpreted as follows:

A	Outstanding	95 - 100
B	Above Average	85 - 94
C	Average	75 - 84
D	Below Average	70 - 74
F	Unsatisfactory	Below 70

Test and Reference Books

Text Books (used and/or recommended)

Standard Textbook of Cosmetology by Constance Kibbee

Reference Books

Gould, George M., Medical Dictionary

Cherioli, Josephine, Beauty Culture, Its a Science and Practice

Kimber, D. C., Gray, C. E., and Stockpole, C. E., Textbook of Anatomy and Physiology

Van Dean Staff, The Van Dean System of Beauty Culture

Stingley, Glendora, Electricity Manual for Beauty Culture

Hall, Florence W., Principles and Practice of Beauty Culture

Wilson, Katheryn, Successful Hair Dresser

Rockwood, Reuben, Modern Cosmetology

III. OUTLINE OF INSTRUCTION

Block I - Sterilization

Unit 1

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Preparation of Sterilizers	Bacteriology
Preparation of Sterilizing Solutions	The Relationship of Bacteriology to Beauty Culture
Sterilization of:	The Occurrence of Bacteria
Combs and brushes Instruments Equipment	Definition Habitat Size and shape Reproduction Parasites Saprophytes Forms
	Active Spare formation
	Types of Bacteria
	Non-Pathogenic Pathogenic
	Number Character
	Effect on Human Body
	Forms of Pathogenic Bacteria
	Method of classification Forms
	Cocci Bacilli Spirilla
	The Nature of Infection
	Conditions favoring entrance of bacteria Methods of entering the body Kinds of infection The spread of infections

Block I - Sterilization

Unit 1 (Continued)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
	The Transmission of Diseases
	Resistance to Disease
	Degrees of Susceptibility Immunity
	Sanitation
	Definition of Terms
	Sterilization
	Methods of Sterilizing Accepted Germicides and their formulas
	Sanitary Regulations Governing Beauty Shops
	Personal Hygiene
	The General Plan of the Body
	Basic Structure
	Cells Tissues Organs Systems
	General Structure
	Ventral cavity Dorsal cavity Appendages of the body
	The Care of the Body
	The Digestive System
	The body's need for food The function of the digestive system The organs of digestion The digestive process Storage of food in the body Hygiene of the digestive system

Block I - Sterilization

Unit 1 (Continued)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
	The Respiratory System The body's need for oxygen The function of the respiratory system The organs of the respiratory system The breathing process Hygiene of the respiratory system The Excretory System The creation of waste material in the body The function of the excretory system The organs of excretion The urinary system Hygiene of the kidneys and other excretory organs The Circulatory System The need for a transportation system in the body The function of the circulatory system The organs of circulatory system The organs of circulation The blood Composition Function Properties The circulation of the blood Pulmonary General Hygiene of the circulatory system The Skeletal System The four types of body tissue Description and function of connective tissues associated with the skeleton

Block I - Sterilization

Unit 1 (Continued)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
	Ligaments Tendons Fascia Cartilage Description and function of bone Kinds of bony tissue Construction of bone Classification of joints Function of the skeleton Recognition of bones Cranial bones Facial bones Bones of the hand and arm Other bones (Scapula, Sternum, Ribs, etc.)
	Muscles
	The function of muscles Attachment of muscles Origin Insertion Classification of muscles according to: Cranial muscles Facial muscles Neck muscles Muscles of the hand and arm
	The Nervous System
	Definition and function of nerves The organs of the nervous system The brain-divisions, location, and function The spinal cord -- location and function Nerves Divisions of the nervous system Central nervous system Sympathetic nervous system Characteristics of nerves Location and function of the superficial Cranial nerves Facial nerves Nerves of hand and arm

Block II - Care of the Hair and Scalp

Unit 1

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Shampooing	Shampooing and Rinsing the Hair
Soap and water	Purpose of a Shampoo
Detergent	
Oil	Cleansing Agents and The Relative Merits
Soapless oil	
Lathering oil	
Egg	The Purpose of Hair Rinses
Dry	
Liquid	Kinds of Rinses
Powder	
	Cleansing
Treatments	Brightening
Massage	
Conditioning treatments for hair and/or scalp	Cranial Anatomy
	Bones of the Cranium
Rinses	
	Muscles of the Head
Cleansing	
Color	Nerves of the Head
Corrective	
Blue	Blood Supply of the Head
Creme	
Dandruff	The Hair
Pressing the Hair	Definition and Description
Hard	Composition
Light	
Medium	Function
Curling	Structure
With heat	Growth and Regeneration
With fluids	
	Typical Forms
Waving	
	Texture
Permanent waving	
Heat	Color
Cold	
Marcel waving	Abnormal Conditions and Diseases of the Hair and Scalp -- Causes, Description, and Treatment
Croquignole waving	
Finger waving	

Block II - Care of the Hair and Scalp

Unit 1 (Continued)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Hair Cutting	Hypertrichosis
Singeing Clipping Bobbing	Canities Alopecia
Hair Coloring	Brittleness
Bleaching Dyeing Vegetable dyes Synthetic organic dyes	Parasitic Conditions Seborrhea
Hairstyling	Eczema Psoriasis Favus
	Hair Coloring
	Purpose of Haircoloring
	Standards for Judging Hair Dyes
	Classification of Dyes
	Characteristics of Various Types of Haircolorings
	Preparation and Application of Various Kinds of Haircolorings
	Preparation and Application of Bleaches
	Keeping Records of Haircoloring Jobs

Block III - Care of the Arms and Hands

Unit 1

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Preparation of Manicuring Table	Anatomy of the Hand and Arm
Plain Manicure	Bones of the hand and arm Muscles of the hand and arm Location Function
Oil Manicure	Nerve supply of the hand and arm Blood supply of the hand and arm
Hand Massage	
Arm Massage	Definition and Composition of Nails
	Function of Nails
	Histology of the Nails
	Growth of Nails
	Abnormal Conditions and Diseases of the Nails
	Composition and Effects of Preparations Used in the Care of the Hands and Nails
	Sterilization and Care of Manicuring Tools
	Related Art Shapes of Nails Color Harmony

Block IV - The Care of the Skin

Unit 1

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Preparation of Patron	Nature, Structure, and Function of the Skin
Plain Facial	Abnormal Conditions and Diseases of the Skin
Corrective Facial	Anatomy of the Face
Make-Up	Bones Muscles Nerves
Hair Removal	Purpose of a Facial
Eyebrow arching Removing superfluous hair	Types of Massage Movements
	Composition and Effects of Preparations Used in Care of the Skin
	Principles of Artistic Make-Up
	Effects of Electricity, Heat, Cold, and Mechanical Devices on the Skin

Block V - Management and Supervision

Unit 1

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Planning Physical Layout	Capital
Control of Supplies and Equipment	Amount Available
Personnel Management	Amount Required
Merchandising	Selection of Location
Advertising	Urban
Record Keeping	Suburban
	Commercial
	Residential
	Transportation
	Clientele
	Interior Layout
	Booth Plan
	Functional Plan
	Floor Plan Space Requirements Reception Room Working Areas Lavatory Plumbing, Heating, and Lighting
	Furniture, Equipment and Supplies
	Selection
	Durability
	Utility
	Cost
	Color
	Upkeep

Block V - Management and Supervision

Unit 1 (Continued)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
	Quality
	Quantity
	Personnel
	Educational Standards
	Appearance and Personality
	Professional Ethics
	All-Around Operators
	Specialists
	Buying and Selling Commodities
	Brands
	Manufacturers
	Cost
	Seasonal Merchandise
	Overstocking
	Advertising Methods
	Laws-Taxes-Insurance
	Local Regulations
	Federal
	Community Obligations
	Trade Associations
	Trade Suppliers
	Trade Publications
	Civic Associations

Block V - Management and Supervision

Unit 1 (Continued)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
	Record Keeping
	Appointments
	Service Records
	Other Types of Records
	Business Law
	Individual Ownership
	Partnership
	Corporation
	Lease
	Protection Against Fire, Theft and Lawsuits
	Ignorance of the Law is no Protection

OUTLINE OF SOCIAL-INDUSTRIAL RELATIONSHIPS

INDUSTRIAL RELATIONSHIPS

Note: The industrial relations, for which every skilled worker must have an understanding and appreciation form a definite part of the instructional program in all of the areas previously outlined.

Some of these are:

Materials of the Trade -- Source, manufacture, distribution, specifications, costs, etc.

Tools -- Operations and processes in this trade that affect the worker and his relationships with other workers.

Working Conditions -- Hours, pay, seasonal employment, health, recreation, morale; workers' responsibility for these conditions.

Health -- Personal and social hygiene; vital facts every worker should know about well-being.

Industrial Development -- Growth of the industry, its scope and trends; other industries that support it; its relationship to other industries; how organized; how supported; importance of time and costs records.

Industrial Organizations -- Trade, labor, and employer; what their functions are on the job; how these affect efficiency and happiness.

Shop Relationships -- Those which concern fellow-workers and the "boss" on or off the job; how these affect efficiency and happiness of the worker.

Law and Ordinances -- City, county, or state that affect the worker, his job, trade, and industry; worker's compensation, unemployment, social security, safety.

Public Relations -- Those factors having to do with consumer interests, confidence, honest work, fairness in dealings, loyalty to job.

Personality Characteristics -- Attitudes and habits that should be developed to make a successful craftsman; responsibility as a craftsman and citizen to join with others in promoting better working conditions for all and the civic and social welfare of the community.

Related Occupational Opportunities -- The extent to which this trade opens employment opportunities in related occupations.

SOCIAL RELATIONSHIPS

Note: The skilled worker also appreciates the contribution which his work can make in the areas of health, effective services, and general social and public relations. Such development forms a definite part of the instructional program.

Some of this instruction is along the following lines:

The individual in relation to special observances and current events

The individual -- a member of varying social groups (home, social, club, church, etc.)

The individual in his leisure time

The individual in his inner life and development of character

The individual worker in a trade or occupation presenting distinctive opportunities

The individual worker in relation to specific jobs, economic issues, and problems

The individual in relation to major civic and social issues

The individual in occasions of special personal government services

The individual in a legally constituted state

The individual worker in relation to specific jobs involving the lives of others

The individual worker in relation to specific jobs involving the safety of fellow workmen

The individual worker in relation to specific jobs involving the happiness and contentment of others

IV. SAMPLES OF INSTRUCTION SHEETS

Job
Operation
Information
Assignment

JOB SHEET

Block IV Care of the Skin

Job Title: Plain Facial

Objective: To give a plain facial

Trade Time: 45 to 60 minutes

Tools	Equipment	Materials
Spatula	Facial Chair	Cleansing Cream
Supply Tray	Operator's Chair	Tissue Cream
Towels	Basin	Foundation Cream
Hair Gown		Astringent Lotion
		Cleansing Tissue
		Absorbent Cotton

Safety Precautions:

Operator's nails should not be long.

All manipulations must be given from the origin toward the insertion of the muscles.

Use wooden spatulas to remove cream from jars.

Steady chair before seating patron.

Follow all sanitary regulations.

Procedure:

Seat patron.

Assemble all necessary tools and materials.

Wash hands.

Prepare patron and place her in a reclining position.

Apply cleansing cream.

Remove cleansing cream.

Apply warm towels.

Apply tissue cream.

Apply eye pads.

Give finger manipulations.

Remove all cream.

Apply astringent (cold towels and/or astringent lotion).

Apply make-up.

Raise patron to sitting position.

Questions:

After giving a facial, determine a reasonable charge for this service. List the items considered in arriving at this price.

Make a diagram of the face showing the important muscles, nerves, bones, and blood vessels involved in a facial.

Why should the skin be cleansed before giving the facial manipulations?

Name several kinds of facial creams and the purpose of each.

In what direction should all facial manipulations be made? Why?

What sanitary measures should be observed in giving a facial?

OPERATION SHEET

Block IV Care of the Skin

Operation: Finger Manipulations for Plain Facial

Manipulations on the Neck

Place facial fingers of both hands on spine between shoulder blades and rotate to hair line. Repeat 6 times.

Place fingers of both hands on shoulder blades and rotate to seventh nerve. Repeat 6 times.

Place fingers of both hands on chest and rotate to chin. Repeat 6 times.

Manipulations on Face

Place facial fingers on point of chin and draw out and up to frown lines; draw fingers over frown lines 3 times, out over forehead, rest on temporal nerve. Repeat 3 times.

Tapping movement from chin to facial nerve, 6 times.

Tapping movement from corner of mouth to auricular nerve, 6 times.

Tapping movement from corner of nose to temporal nerve, 6 times.

Rotate up the sides of the nose, over frown lines, out to temple; rest on temporal nerve with slight pressure, 6 times.

Slide first two fingers of each hand to inner corner of eyebrows and slide gently around eyes to infratrochlear nerve. Repeat 3 times.

Same movement gently over eyelids. Repeat 3 times.

Slide to forehead and stroke gently over lines from eyebrows to hair line, temple to temple, 7 times.

Slide to 7th nerve. Alternating with right and left hand, slide down to chin, and lightly out to 7th nerve. Repeat 6 times.

Slide both hands to chin and rotate out from chin to 7th nerve; mouth to auricular nerve; and nose to temporal nerve. Repeat 6 times.

Flipping on the lines of the face. Chin to the 7th nerve, mouth to auricular nerve, and nose to temporal nerve. Repeat 6 times.

Slide to the chin, make cupid's bow lifting corners of mouth; place index finger in cupid's bow and flip with thumb and 3rd finger. Repeat 6 times.

Slide to chest and palm upward to chin, out to 7th nerve, back and forth 3 times.

Slide to 7th nerve to the auricular nerve, to the temporal nerve over frown lines, and back to temporal nerve. Slide down and off at the chin.

INFORMATION SHEET

Unit I: Maintaining Healthful Relationships

Topic: The Musculatory System

Definitions:

Myology is the science of the nature, structure, function, and diseases of the muscles. Muscles are contractile organs, compound of fibrous tissue by which movements of every part of the body are effected.

Function of Muscles:

The function of muscles is to cause motion. Motion, in this sense, includes not only conscious movements of the body, or part of the body, but unconscious movements of the visceral organs.

Characteristics of Muscular Tissue:

Special characteristics of muscle tissue are irritability (excitability), contractility, extensibility, and elasticity. Irritability is the property of receiving and responding to stimuli. The response is contraction.

Contractility is the property which enables muscles to change their shape and become shorter and thicker. Extensibility is a characteristic of muscular tissue by which it can be stretched beyond its original length.

Elasticity is the property of muscular tissue which enables it to return to its original form after being contracted or extended.

Muscle Tone:

In all healthy muscular tissue, there is a constant tendency to contraction which is called muscle tone. It gives a certain firmness to muscles and both the rapidity and smoothness of movement are dependent upon it. Lack of proper tone is shown in flabbiness and in the extra time, or effort, required to stimulate a muscle to its normal reactions.

Types of Muscle Tissue:

Muscles may be classified according to structure, location, or types of activity.

Structure	Location
Striated	Skeletal
Non-Striated	Visceral
Indistinctly Striated	Cardiac

Striated muscles are so called because of the appearance of cross stripes. They are called skeletal muscles because they are attached to the skeleton and they are called voluntary muscles because the movement accomplished by them may be under the conscious will.

The ends of the skeletal muscles are attached to bones, to bone and another muscle, or to bone and skin. The move fixed attachment of the end of a muscle is called its origin. The more movable attachment is called its insertion. Tendons serve to attach muscles to bones or to one another.

The function of skeletal muscles is to produce motion by operating the bones of the body and to give form to the body.

Non-striated, or smooth musclar tissue, is so called because of its unstriped appearance. It is called visceral because it forms the muscular part of the internal organs; involuntary because the motions caused by it are involuntary.

The function of non-striated muscles is to cause motion.

Cardiac muscle is peculiar to the heart. It is indistinctly striated, but not under the control of the will.

Stimulation of Muscles:

Muscle activity may be effected by means of the following forms of stimuli:

Chemical - changes in nutrition
Mechanical - exercise or massage
Nervous - nerve impulses
Electrical - applications of electricity
Thermal - application of heat. Chemical, mechanical and physical stimuli means of producing muscular activity artificial because all muscular activity is a direct result of nerve impulse.

ASSIGNMENT SHEET

Block IV: Care of the Skin

Assignments:

Review the following sheets:

1. Job Sheets IV: 1, 2, 3
2. Information Sheets IV: 7, 8, 9
3. Operation Sheet IV: 1

Answer the following questions:

1. What muscles are involved in each facial manipulation?
2. What are the purposes of a facial?
3. What is meant by origin and insertion of muscles?
4. Make a list of the sanitary rules which should be observed while giving a facial.
5. Give the purposes of the following creams:
   a. cleansing
   b. tissue
   c. foundation
   d. bleach
6. How often would you recommend a facial for normal skin?

V. SAMPLES OF TESTS

Block III - Care of the Arms and Hands

COSMETOLOGY

TEST I - NAILS (PART I)

1. What are the characteristics of healthy nails?

2. The nail is composed of a chemical substance called _____.

3. The nails are horny _____, serving to _____the _____ and _____.

4. The rate of growth of the nail is about _____inch per month about _____per year.

5. _____is a set of cells which produce the nail.

6. Nails (do) (do not) contain nerves and blood vessels.

7. Where is the nail root found?

8. Where is the nail body found?

9. Where is the free edge located?

10. Where are nails located?

TEST - (PART II)

1. Name the nail parts which correspond to the following descriptions:

   a. Overlapping part of skin of finger around the nail.
   b. An extension of the skin at the base of the nail.
   c. A portion of the epidermis under the free edge.
   d. A deep fold of skin in which the nail root is lodged.
   e. Visible half-moon area at the base of the nail body.
   f. The depression formed by the nail plate and the mantle.
   g. The portion of the epidermis upon which the nail body rests.
   h. The nail root originates from an active growing layer known as _____.
   i. The matrix of the nail is very vascular and sensitive due to the presence of _____and _____vessels.

TEST I - (SPELLING)

1. appendage
2. keratin
3. outgrowth
4. matrix
5. cuticle
6. eponychium
7. hyponychium
8. mantle
9. epidermis
10. Lunula
11. translucent
12. convex
13. conclave
14. groove
15. terminal
16. phalanx

KEY TO

TEST I - NAILS (PART I)

<u>Key</u>

1. A firm, flexible, pink color, smooth, curved or convex.
2. Keratin
3. Plates; protect; fingers; toes.
4. 1/8 and 1½
5. Matrix
6. do not
7. underneath the skin
8. visible part of nail extends from hair root to free edge
9. the part of nail reaching over the finger tips
10. ½ of upper surface of the terminal phalanx

(PART II)

a. cuticle
b. eponychium
c. hyponychium
d. mantle
e. lunula
f. nail groove
g. nail bed
h. matrix
i. nerves, blood

TEST II - (PART I)

1. Name four abnormal conditions of the nails that the beauticians can improve.

2. Name three conditions of the nails that can be benefited by the use of oil treatments.

3. What is recommended for bruised nails?

4. How should the manicurist care for hangnails?

5. If a small cut occurs during a manicure, how should it be treated?

6. Which step of a manicure should be omitted for an injured finger?

7. What should the manicurist do for an infected finger?

8. What are the signs of a nail infection?

9. What do blue nails usually denote?

10. Match the following definitions: a. _____ wasting away of nails; b. _____ white spots in the nail; c. _____ overgrowth of the nail; d. _____ brittle nails; e. _____ inflammation of matrix.

TEST II - (PART II)

1. List all equipment used for a manicure.

2. List all tools used for a manicure.

3. List all materials used for manicuring.

TEST II - (PART III)

1. Trichophytosis Unguem is _____.

2. Onychorrhexis (can, cannot) be treated by a manicurist.

3. Artificial nails help overcome the habit of nail _____.

4. Callous growth at the finger tips can be removed by rubbing the surface with the coarse side of an emery board or with _____.

5. Strongly alkaline soaps or chemicals may be responsible for _____ nails.

6. White spots in the nail can be prevented by avoiding injury to the nail _____.

7. Nail of an injured finger should not be _____.

8. Court _____ or adhesive tape may be used to mend broken nails.

9. Ingrown nails may affect the _____ or toe.

10. Hangnails are treated by softening cuticle with warm _____.

11. Redness, pain, swelling or pus are the signs of _____ or inflammation of the nail.

12. A bruised nail will be kept from discoloring by placing it alternately in bowls of hot and _____ water, immediately after the accident.

13. To prevent the formation of white spots, the manicurist should avoid injury to the nail _____.

14. Corrugations are caused by an uneven growth of the nails, usually resulting from _____.

15. Paroncyhia is an infection and inflammatory condition of the _____ surrounding the nails.

16. Improper sterilization of nail instruments and bacterial infection may cause _____.

17. In case of an infected finger, an _____ dressing should be applied and the patron should then be referred to a _____.

18. Blue nails may be attributed to _____ blood circulation or a cardiac disorder.

19. Ringworm of the nails is an infectuous disease caused by a _____ parasite.

20. A condition in which the cuticle splits around the nail is known as _____.

KEY TO

TEST II - (PART I)

Key

1. brittle nails, hangnails, split nails, egg shell nails
2. hangnails, brittle nails, egg shell nails
3. imersion in hot and cold water
4. soften cuticle and trim it carefully
5. apply iodine and let it dry
6. buffing
7. suggest medical treatment
8. redness, pain, swelling and pus
9. poor circulation or elimination
10. a. atrophy; b. leuconychia; c. hypertrophy; d. onychorrhexis; e. onychia

(PART III)

1. ringworm
2. can
3. biting
4. pumice
5. brittle
6. root or matrix
7. manicured or buffed
8. plaster
9. finger
10. oil
11. infection
12. cold
13. root
14. illness
15. nail wall
16. paronychia or onychia
17. antiseptic
18. poor
19. parasite or tinea
20. hangnails

TEST III - NAILS (PART I)

RULES OF SANITATION, STERILIZATION, AND SAFETY

1. What responsibility does the manicurist have regarding sterilization?
2. What sanitary rules should be followed by the manicurist?
3. How should the manicure instruments be prepared for actual sterilization?
4. How are files and nippers prepared for sterilization?
5. Name two methods of sterilizing manicure instruments.
6. How should manicure instruments be handled after sterilization?
7. What is the safe way to keep containers?
8. What precaution should be used in handling containers?
9. What is the first aid care for an accidental cut?
10. How should a sharp nail edge be dulled?
11. What is a safe way to use a nail buffer?
12. What is a safe way to use a cuticle pusher?

TEST III - (PART II)

1. What is the purpose of manicuring?
2. What is the origin of the word manicuring?
3. Is manicuring now considered as a luxury or a necessity?
4. What is your opinion of a person whose nails are not well manicured?
5. (The manicurist should keep her hands and nails perfectly groomed at all times). What impression will this make on patrons?
6. What structures of the body should be studied by the manicurist?
7. Which abilities help the manicurist establish a good reputation?
8. Why should the manicurist strive to please her patrons?

TEST III - (PART III)

9. What are four recognized nail types? Name them.
10. What determines the choice of nail shape?
11. Which nail shape is best for a short, stumpy finger?
12. Which shape is best for a long tapering finger?

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ABSTRACT - This curriculum guide was developed by school personnel to prepare high school students for entry into the garment industry as assistant seamstresses, seamstresses, sewing machine operators, alteration hands, dress makers, and pattern makers or designers. The manual has sample instruction sheets and tests as well as suggestions for the organization of the class. Blocks of time cover the manipulative skills and technical knowledge required for each occupation, allotting 270 shop hours to each for a total of 1,620 hours for the entire course. A list of texts and reference books is included. (JS)

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DRESSMAKING

CURRICULUM GUIDES
In Trade and Industrial Education

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Public Schools of the District of Columbia

CARL F. HANSEN, Superintendent of Schools

Curriculum Guides in Trade and Industrial Education

DRESSMAKING

TRADE AND INDUSTRIAL EDUCATION

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FOREWORD

A General Statement of The Trade

The ready-to-wear garment industry is one of the leading industries of the country.

This occupation includes the making and creating of all types and kinds of women's garments in accordance with the requirements of the three major employment areas: dressmaking establishments, custom made shops, and clothing manufacturing establishments.

Washington offers vocational training to the pupils of the city through the facilities of specialized vocational programs. The purpose of these programs is to prepare youth for self-respecting and self-supporting citizenship by equipping each individual to enter advantageously the field of skilled occupations.

Boys and girls are trained for entrance into gainful employment through the development of the basic skills and judgment necessary in a given vocation. In addition, the program makes provision for imparting such related technical information and trade or industrial practices as may make the student an intelligent, efficient workman. Finally, through its promotion of social and economic understandings, the school aids the pupil in the development of the knowledges and attitudes which are necessary in producing a successful, well-adjusted, and happy worker.

Prerequisites For Entrance Into The Trade

Individuals proposing to enter this occupation must meet the specifications set up by employers and the school. Students should:

have completed the 9th grade.
have good eyesight, hearing, and normal hands and feet.
posess normal intelligence.
be well balanced with no sign of a nervous disorder.
possess a certain degree of mechanical aptitude and manual skill.
be able to sit for long hours, and work under pressure.
pass test required by Vocational Department.

Time Required To Complete The Course

The course offered in the vocational high schools requires three (3) years for a high school diploma and a certificate in Dressmaking. Laboratory practice or shop work is scheduled for three (3) clock hours daily, 15 hours per week. One and one-half hours per day are spent in related subjects--science, mathematics and/or art. One and one-half hours are spent in academic subjects. Five hundred and forty (540) hours are spent in shop work per year--a total of 1620 hours per the three year course. High school graduates entering the trade as beginners spend six semesters for certification.

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I. OBJECTIVES

Note: It should be kept in mind that vocational industrial education, as it is known today, is not designed to develop skilled craftsmen as such. It is intended, through preparatory programs in basic fundamentals, to bring students to the entrance point of wage earning ability as advanced apprenticeship level. Rapid advancement thereafter (toward thorough understanding and skilled craftsmanship levels) is accomplished through actual work on the job and night supplementary trade extension courses.

General

The general objectives of the courses of study in Trade and Industrial Education are to develop in the students the abilities to:

Do the various manipulative skills that will permit their initial employment in the industry, rapidly increase their efficiency, and promote their advancement in the salary scale.

Understand the application of basic principles of the sciences, mathematics, and related technical knowledge that condition the manipulative skills.

Appreciate the social and industrial relationships in connection with the contribution which a worker can make in the areas of health, effective services, and general social-industrial and public relations.

Specific

The specific objectives of the course of study in Dressmaking are to:

develop the ability to perform the fundamental skills of Dressmaking as they exist in industry today and those that are in the process of being developed.

develop self expression, initiative, resourcefulness, and creative ability.

master the basic skills and techniques required for successful employment in Dressmaking, through extensive varied experiences.

recognize the appearance of professional workmanship and to achieve the same standards.

prepare for vocational life as a wage earner, and homemaker.

acquire proficiency in the skills involved in making, remodeling, and altering garments.

appreciate the beauty of color, line, and form in fashion design. Learn instructruction techniques used in custon establishments.

develop a sensitivity to fundamental democratic ideals and an appreciation of desirable attitudes toward work.

understand the significance of the technological changes and the meaning of organized labor.

understand the basic scientific information which is fundamental to success and advancement in the field of dressmaking.

understand the initial safety procedures that are necessary in the operation of sewing machines.

II. GENERAL ORGANIZATION

General Statement of Methods of Instruction

To teach best the variety of skills, the related technical knowledge and the social-industrial relationships needed to equip students entering this trade, many methods of teaching are necessary. Each method has distinctive features that causes its use to be best suited for the teaching of a specific type of skill or knowledge.

In teaching shopwork, the following methods are used:

Demonstration	Individual Projects
Explanation	Director Technique Study
Visual Aids	Group Projects
Questioning	Problem-Solving Activities
Instruction Sheets	Field Trips

In teaching the related technical knowledge and social-industrial relationships, the following methods are used:

Discussion	Written Reports
Directed Study	Visual Aids
Questioning	Field Trips
Individual Reports	

Time Schedule Allotment

Blocks	Occupational Areas	No. Hours Shop Work
I. Fundamental Hand and Machine Processes	Assistant Seamstress	270
II. Intermediate Garment Construction	Seanstress	270
III. Power Machine Sewing	Power Sewing Machine Operators	270
IV. Advanced Garment Construction	Dressmaker	270
V. Garment Alterations and Repair	Alteration Hand	270
VI. Pattern Draping and Design	Pattern Maker and/or Dress Designer	270
	Total Hours	1620

Type of Testing Program Used

More than one instrument is used to determine the effectiveness of teaching and to evaluate the achievement of students in the areas of manipulative skills, related technical knowledge, and social-industrial relationships. These are under the general headings of performance and written tests. One sure way to determine whether a student can do something is to have him actually try to do it. Hence, manipulative skills are tested continually in connection with every job. These tests are referred to as performance. In evaluating total performance, consideration is given to the various elements that are significant in the trade area involved. For example:

Safety
Techniques
Finished Product
Time and Effort Expended
Use and Care of Tools, Equipment, and Materials

The rate of progress in the assimilation of related information is revealed in the ability of the student to apply such knowledge to pertinent jobs and in his achievement on written tests which are given at regular intervals. Written tests may be Objective or Essay in form or a combination of both. Sample tests are included in this course of study in a separate section.

Evaluation of Student Progress

Students progress in the manipulative skills according to their demonstrated ability to meet minimum trade standards. They are required to repeat a job until minimum proficiency is reached before they are permitted to advance to the next job. Their rate of progress and the evaluation of it are recorded on a progress chart.

Performance and written test achievement are interpreted as follows:

A	Outstanding	95 - 100
B	Above Average	85 - 94
C	Average	75 - 84
D	Below Average	70 - 74
F	Unsatisfactory	Below 70

Test and Reference Books

Text Books

Power Machine Sewing by Julia E. Silverman, New York: Peter Smith, 1942

Reference Books

Baxter, Laura & Latyke, Alpha. Modern Clothing, New York: J. B. Lippincott Co., 1938

Bendure, Zelma and Pfeifer, Gladys. America's Fabrics, New York; The Macmillan Co., 1946

Byers, Margarette. Designing Women, New York; Simon and Schuster, 1944

Burhaus, Edna M. Slonim, Molly M. Sew and Save Work Book, New York; College Entrance Book Co., 1944

Chambers, Bernice. Fashion Fundamentals, New York; Prentice Hall, 1947

Cain, Gertrude. The American Way of Designing, New York; Simon and Schuster, 1941

Cotton Enni. Clothes Make Magic, New York; E. P. Dutton & Co., 1949

Consalus, Frances Hamilton; Tighe, A. G.; Dooley, W. H.; and Roher; Mayer. Distinctive Clothes, New York; Ronald Press Co., 1940

Crawford, Morris D. Ways of Fashion, New York; G. P. Putnam's Sons, 1941

Curtis, Irving and Diffate Phillip. Technological Problems in Pattern Making, New York; McCall Co., 1948

Disher, M. L. American Factory Production of Women's Clothing, London; Deveherux Publications, 1947

Fashion, Group Committee. Keys to a Fashion Career, New York; McGraw-Hill Book Co., 1946

Goldsteine, Harriet. Art in Everyday Life, New York; The Macmillan Co., 1937

Hardy, J. The Clothing Workers, New York; International Publishers Co., 1935

Hardy K. Costume Design, New York; McGraw-Hill Book Co., 1948

Hamstead, Lawrence. Color and Line in Dress, New York; New York; Prentice-Hall, 1938

Irwin, Mahel. Practical Dress Design, New York; The Macmillan Co., 1941

Kettunen, Marietta. Fundamentals of Dress, New York; McGraw-Hill Book Co., 1941

Kirschner, Jack. Simplified Pattern Making, New York; Fairchild Publications, 1949

Kramer, Rose A. and Nicotri, Marie. Fundamentals in Barment Machine Operating, New York; New York State Vocational and Practical Arts Association, 1940

Levine, Louis. The Women's Garment Workers, New York; B. W. Huebsch, 1924

Link, Nellie Weymouth. Precision Draping, New York; Funk and Wagnall's Co., 1942

Linton, George E., and Pizzuts, Joseph J. Applied Textiles, New York; Lifetime Editions, 1948

Mauch, Francis F. Modern Tailoring for Women, New York; The Macmillan Co., 1948

Maueraberger, Herbert B., and Mathews, J. M. Textile Fibers, New York; John Wiley and Sons, 1947

Nystrom, Paul H. Textiles, New York; Appleton-Century Crafts, 1933

Picken, Mary Brooks. The Language of Fashion, New York; Funk and Wagnall's Co., 1939

Picken, Mary Brooks. The Singer Sewing Book, New York; Singer Sewing Machine Co., 1949

Pivnick, Esther Beatrice. How to Design Beautiful Clothing, New York; William Wise, 1949

Spears, Ruth Wyeth. Better Dressmaking, New York; M. Barrows and Co.,1943

Stevenson, Margarita. How the Fashion World Works, New York; Harper and Brothers, 1938

Strickland, Gertrude. A Tailoring Manual, New York; Burgess Pub. Co.,1947

Talbot, Constance, The Complete Book of Sewing, New York; Book Presentations, 1943

Vocational and Practical Arts Association. Fundamentals of Trade Dressmaking, Delmar Publishers Inc., Albany, New York

Vogue Book of Practical Dressmaking, Greenwick, Conn., Conde Uast, 1951

The Butterick Co., Butterick Dressmaking Book, New York; The Butterick Co., 1949

The McCall Corporation. Dressmaking Made Easy, New York; The McCall Corporation, 1948

The Simplicity Pattern Company. Simplicity Sewing Book, New York; The Simplicity Pattern Co., 1949

FASHION PERIODICALS

American Fashion Magazines

Charm	Harper's Bazaar	Seventeen	Modern Miss
Glamour	Vogue	Town & Country	Madamoiselle

French Fashion Magazines

Le Jardin des Modes	Silhouette
Modes Documents	La Fenime Chic
L' art el la Mode	L'Official de la Coutere et de la Mode

PATTERN BOOKS

Advance	Originator	Modes Royale
Butterick	Vogue	American Designer
McCalls	Simplicity	International Designer

DRESSMAKING I

In Dressmaking I, simple cotton garments are made in order to include the basic processes of garment construction. Problems cover the fundamentals of hand and machine sewing.

Suggested Projects:	Suggested Cotton Materials:	
Kitchen apron	Muslin	Chambray
Student's smock	Percale	Flannel
Childs sunsuit, pinafore	Indian head	
Cotton lingerie	Batiste	
Pajamas	Broadcloth	

III. OUTLINE OF INSTRUCTION

Block I - Fundamental Hand and Machine Sewing Processes

Unit 1 - Basic Hand Skills

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Basting Even Uneven	Occupational Information
Running	Introductory information and practices
Shirring	Lockstitch Machines
Backstitching Combination	Safety
Hemming	Safety Pledge
Overcasting	Safety Rules
Overhanding	Safety Lessons
Buttonholes	Posture
Embroidery stitches Outline Blanket Wheat	Related Art Designing commercial wrappers and containers for household articles The packaging of garments and accessories Display for store windows and counters and stage sets for fashion shows

Block I - Fundamental Hand and Machine Sewing Processes

Unit 2 - Basic Sewing Machine Skills (Family Type)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Stitching on the lockstitch machine	Mathematics
Parts of the machine Location Function Cleaning and oiling	Review of fundamental mathematical processes; practice in their application to the women's-apparel trades
Control of power (operation of machine without thread)	Addition and subtraction: Inventory of storage space and trade terms Stock-room orders Multiplication: estimation of quantities of material needed for projects Division: distribution of materials in stock
Use of the presser foot Use of stitching charts Stitching straight lines Stitching square corners Stitching diagonal lines	
Threading the machine	Measurements, including the manipulation of fractions
Machine-stitching exercises with thread Use of the presser foot Use of plain cotton material Stitching straight lines Stitching square corners Stitching diagonal lines	Reading and writing statistics related to needle trades Newspaper items Graphs of production and business trends Estimating stock on hand
Unit 3 - Fundamental Operations	Measurements used by the trade Linear measurements checking stock for yardage, including fractional parts Unit measurements: pair, dozen, gross Surface (with reference to fabrics and trimmings) Liquid (with reference to purchasing machine oil and filling a steam iron with water)
Seams Plain Straight French Hems Straight Mitered corners Squared corners Bias Folding for a true bias Measuring the width of the bias Cutting strips Joining strips Application to straight edges as in binding, facing Application to inward and outward curve as in binding, facing	Reading and use of the tape measure and ruler Measuring lengths Estimating stock on hand Applying additions of fractions

Block I - Fundamental Hand and Machine Sewing Processes

Unit 3 - Fundamental Operations (Continued)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Plackets Straight, continuous in a slit opening Straight, continous in a seam Facings Straight Shaped Pockets Patch Darts Shoulder Underarm Buttonholes Hand-worked Shirring Hand Assembling processes Yoke Collar and cuffs Waist Shirt Sleeves Trimming Hand and machine finishing Hems Hand hemming Fastenings Buttons Pressing Underpressing section during construction Finished garment	Measuring and cutting given lengths from stock Distributing stock to workers Applying subtraction of fractions Perpetual inventory cards Short cuts to inventory applying multiplication of fractions Estimating production from stock; applying division of fractions Review Textiles - Science Fundamentals Importance of textiles Textile vocabulary Use of the pick glass with different materials Basic structure of principal types of weaves Relationship to the characteristics of finished fabrics Sample - analysis to the basic types of weaves Variations of plain weave Names and definitions of the constituents of woven fabric Primitive and modern methods of spinning Types of looms Main parts of loom Primitive and modern methods of weaving Comparison of fabrics made by weaving, knitting, plaiting, felting Structural analysis of samples of woven, knitted, plaited and felted cloths Characteristics, uses, advantages and disadvantages

Block I - Fundamental Hand and Machine Sewing Processes

Unit 3 - Fundamental Operations (Continued)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
	Types of yarn Comparison of fabrics made with a plain, a crepe, and a novelty yarn Sample - analysis of the three types of yarn Classification of natural and synthetic fivers and filaments; examination of swatches

DRESSMAKING II

In Dressmaking II, simple cotton garments are made in order to include the basic processes of garment construction. Problems cover the fundamentals of hand and machine sewing.

Suggested Projects:	Suggested Cotton Materials
Girl's blouse	Gingham
Playsuits	Pique
Overalls	Gabardine
Plain skirt	Dimity
Simple sports dress	Dotted Swiss
	Organdy
	Lawn
	Linen

Block II - Intermediate Garment Construction

Unit 1 - Fundamental Hand and Machine Sewing Operations

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Basting Tailor	**Occupational Information**
French Gathering	History of the sewing machine
Sewing on snap-fasteners	The sewing machine in Europe
Sewing on hooks and eyes	The sewing machine in America
Thread loops	Pooling the sewing machine patents
Embroidery stitches Fagoting Smocking	Development of the stitching industry The sewing machine and factory
Basic sewing machine skills Edge -stitching Joining and fastening ends Tacking	Safety precautions **Related Art** Expressing personality through consumer goods Development of awareness through choices of consumer goods Emphasis on independence of taste

Unit 2 - Fundamental Operations

Seams Plain Bias Shaped Flat fell Plain Tailored	**Related Mathematics** Application of fractions
Hems Shaped Scalloped	Furnishings Measurement of room sizes Simple scale drawings: work in ratio and fractions
Bias Application to straight edges as in trimming and piping Application to inward and outward curves as in trimming and piping	Billing Work in percentage and decimals Composing bills for material and labor Terms of discount Banking and loans Work in percentage and decimals Banking Deposits and withdrawals Interest Checking Account

Block II - Intermediate Garment Construction

Unit 2 - Fundamental Operations (Continued)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Plackets Modified L-shaped Bound Slit-opening Facings Bias Pockets Bound Pleats Side Inverted Box Darts Waistline Tucks Pin tucks Tucks of various widths Buttonholes Machine worked Tailored Loops Thread Braid Shirring Machine	Loans Savings Bank Finance Company Mortgage Government Bonds Consumer mathematics. Application of percentage and the decimal system Budgets Necessity for budget Typical allotment for family living Basic expenses Recreation Savings Simple personal budget Discounts Percentage rate Monetary value: work in decimals Newspaper advertisements as sources of data Installment buying: work in per-percentage and decimals Advantages and disadvantages Comparison with cash buying Newspaper advertisement as sources of data

Unit 3 - Assembling Processes

Assembling Processes		Science Textiles
Yoke	Skirt	Cotton
Collars	Sleeves	Properties and characteristics of cotton
Waist	Trimming details	
Hand and machine finishing Hems Slipstitching Blind-stitch machine hemming Fastenings Snap fasteners Hooks and eyes Slide fasteners Pressing Underpressing sections during construction Finished garment		Flax and Linen Characteristics of flax and linen Comparison of linen and cotton Processing from flax to linen Standard linen fabrics

DRESSMAKING III

The problems of Dressmaking III involve the more complex assembling skills in ga. ent construction, both custom and ready-to-wear. Emphasis is placed on fine finishes and decorative details and on the significance of color, line, and style.

Suggested Projects:

- Lingerie
- Housecoat
- Dress
- Playsuit

Suggested Materials:

- Cottons
  - Corduroy
  - Broadcloth
  - Balloon Cloth
- Woolens
  - Challis
  - Flannel
- Laces
  - Valenciennes
- Silks
  - Crepe
  - Taffeta
- Nylons
  - Crepe
- Blends
  - Mixtures of fibers

Block III - Power Machine Sewing

Unit I - How to Operate the Power Sewing Machine

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Control of factory-type, power-driven machine	**Occupational Information**
Stitching on paper charts	Plant management and operation
Threading the Singer lock-stitch machine	Dressmaking establishments Custom shops Factories
Regulating length of stitch	Labor Organizations and labor conditions that condition the workers
Selecting needles for lock-stitch factory-type machines	Safety precautions
Regulation tension on the Singer machine	**Related Art**
How the stitch is formed	Sketching
Setting the needle	Figure Head, hands, feet Necklines and collars Pleats and tucks Pleated, flared and draped skirts Shirrings and ruffles Child's dress showing the application of shirrings and ruffles
Adjusting the belt	
Determining the causes of common machine stitching difficulties	
Selecting appropriate sizes of needles and thread	

Block III - Power Machine Sewing

Unit I - How to Operate the Power Sewing Machine (Continued)

Manipulative Skills Jobs or Experiements by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Cleaning the machine	Blouses Sleeves
Oiling the machine	Sport dresses Collars and bows
Special machines	Shoes Coats trimmed and untrimmed on forms
Zig-Zag Button-hole Shirring Two-needle lockstitch Hemstitch	Information Fashion sketching in the trade Types of costumes and occasion for which they are worn Psychology of line: horizontal, vertical, diagonal, curved Principles of design: balance, rhythm, harmony, proportion, center of interest Future trends New York as a style center Wholesale district Retail district American and foreign designers Museum exhibitions and field trips Terminology of style, fashion, mode, vogue
	Publications: trade journals, magazines, newspapers

Block III - Power Machine Sewing

Unit 2 - Fundamental Operations

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Seams Plain Top stitched	Mathematics Measurements: Review
Seam finishings (hand and machine) Pinking Edge stitched	Reading and the use of the tape measure and rule: Fraction of the inch Inch-yard conversions Practice in measuring
Edge finishings (hand and machine) Rolled hem Seam binding Shell stitched Bias binding	Using gauges for measurements Review of fractions of the inch Making gauges
Decorative details Satin stitch Slip-stitching of motifs Piping Wheat stitch	Applications of measurement in the trade Measuring materials Patterns Seam allowance
Plackets - Self turned	
Pockets - Self welt - Separate welt	
Construction of added finishings Covered weights Belts	

Unit 3 - Techniques in Custom Garment Construction

Techniques in custom garment construction Taking individual measurements Comparison with standard dress-form measurements Use of more complex commercial patterns (such as Vogue, Modes Royale, etc.) Laying of pattern and cutting out garment Tracing with the use of: Chalk, Carbon Assembling Fitting Stitching Finishing Pressing	Science - Textiles Wool Types of wool bearing sheep Classification of wool fabrics; sample-analysis; counts Properties and characteristics of wool stock Staple and novelty wool fabrics Comparison of wool and worsted fabrics Silk Manufacture of silk yarn Characteristics of silk Sericulture Grades of silk; sample analysis of grades

DRESSMAKING IV

The problems of Dressmaking IV involve the more complex assembling skills in garment construction, both custom and ready-to-wear. Emphasis is placed on fine finishes and decorative skills and on the significance of color, line, and style.

Suggested Projects:

- Negligee
- Silk blouse
- Circular skirt
- Bathing suit

Suggested Materials:

- Cottons
  - Velveteen
  - Gabardine
  - Gingham
- Woolens
  - Gabardine
  - Cashmere
  - Serge
- Silks
  - Satin
  - Net
  - Chiffon
  - Faille
- Nylons
  - Jersey
- Laces
  - Alencon
  - Footing
- Blends
  - Mixtures of Fibers

Block IV - Advanced Garment Construction

Unit 1 - Fundamental Operations

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Seams	Occupational Information
Welt	Dressmaking as an occupation
Slot	Branches of the needle trade industry
Seam Finishings (hand and machine)	Occupations in a dress manufacturing plant as a power sewing operator
Overcasting	General characteristics of the work
Seambinding	Production standards
Edge finishings (hand and machine)	The operators responsibility
Cording	Trade legislation
Scalloped facings	
Rolling and whipping of lace	
Appliqueing of lace	
Plackets	
Faced (two piece)	
Pocket construction	
Tailored	
Flap	

Block IV - Advanced Garment Construction

Unit 2 - Decorative Details

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Decorative Details	Related Art
Hemstitching Novelty fagoting Featherstitching Bias-turned loops Quilting	Rendering Garments on fashion figures in water color and flat washes Garment details in water color Blouses and skirts in tempera Accessories in pastels Costumes on a fashion figure in water color Original fashion design in tempera or pastel Information Color theory Psychology of color Color trends Color selection for individual types Appreciation of color through the study of paintings Color in accessories

Unit 3 - Techniques in Custom Garment Construction

Padding a dress form	Related Mathematics
Draping a muslin pattern	Trade formulas and application Taking inventory Itemizing production Dozen-gross conversions Piece goods: yardage Computation of costs
Sponging, shrinking, and pressing woolen fabrics	Estimating for tucks Formula for the allowance Calculations for various widths
Tracings with use of Thread Tracing wheel	Estimating fullness for smocking, ruffling, and shirring Formula for the allowance Calculation for less fullness Allowance for the weight of the material
Techniques in ready-to-wear garment construction	Estimating for pleating Formula for the allowance Calculations for various sizes Side pleat Box pleat Inverted pleat
Examining the sample garment to study style, lines, construction and finishing processes	
Assembling procedures and techniques Identifying sections of the garment Correcting inaccuracies of cut section Assembling the garment in such sequence as will save time and motion	

Block IV - Advanced Garment Construction

Unit 3 - Techniques in Custom Garment Construction (Continued)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Hard finishing Pressing Inspecting the finished garment	Standard dress measurements Measuring for standard size Estimating yardage for various sizes
	Science Textiles
	Synthetic Fabrics
	Rayon Four methods of manufacture acetate, cupramonium, nitrocellulose, and viscose Trade names of four types Sample-analysis of the types Properties of the types Standard rayon fabrics
	Nylon Manufacture, characteristics and uses Vinyon, fiberglass and other new synthetics
	Review

DRESSMAKING V

Garment Alteration and Repair

The garment Alteration and Repair Unit is designed to train workers for employment in the alteration departments of stores and ready-to-wear shops.

Instruction and practice in fitting and altering are given on dresses, coats and suits. The instruction consists of training recommended by the alteration supervisor of local shops and stores.

Block V - Garment Alteration and Repair

Unit 1 - Hems

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Hems Garment too long Garment too short Types of skirts altered Gored skirt Circular skirt Straight skirt Pleated skirt	Occupational Information Qualifications of the Dressmaker Education Training Wholesome working conditions Ventilation Heating, lighting Sanitation Seating equipment The workers responsibility Health, happiness and labor Related Art Rendering Garment on a fashion figure Original textile design for cotton, rayon, silk, or nylon Children's, teen-age and/or misses outfits in cotton on textiles by the student Children's, teen-age and/or misses outfits in water color and other media Front and three-quarter views of an action figure

Unit 2 - Hips

Hips Garment too large Garment too small Types of garments altered Skirts Dresses	Information Discussion of line and design in children's, teen-age and misses outfits Fabric selection for children's, teen-age and misses outfits Style trends Discussion of period costumes Sketching three-quartered action figure

Block V - Garment Alteration and Repair

Unit 3 - Waist Line

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Waist line Garment too large Garment too small Types of garments altered Skirts Dresses Jackets Slacks Blouse	**Mathematics** Personal accounts Computation of time Reading the time card Work day Work week Overtime Wages Computation on an hourly basis Weekly, monthly on annual salary Overtime Double time Time and a helf Piece work Computation of social security Federal withholding tax: reading tables Sales and luxry tax Newspaper advertisement Sales slip Review **Science Textiles** Some elementary concepts of chemistry Matter Physical and chemical changes Elements, compounds and mixtures Oxidation and combustion referred to burning-tests Solutions, suspensions and emulsions Acids, bases, salts and neutralization Chemical tests for the identifications of fibers Alkali, acid, sulfuric, fumes, litmus, acetate, paper Burning tests

Block V - Garment Alteration and Repair

Unit 4 - Bust

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Bust Garment too large Garment too small Types of garments altered Blouse Dress Coat Jacket	Science Textiles (Continued) Microscopic study of major fibers Bleaching: Chlorine, hydrogen peroxide, sulfurous acid Dyeing Printing, stock and yarn dyeing Fabric dyeing Direct dyeing: wool, silk, and cotton Indirect dyeing: mordant, vat and azO Color fastness: resistance to laundering, ironing, perspiration, washing, etc.
Unit 5 - Shoulders Shoulders Garment too large Types of garments altered Blouse Dress Coat Jacket	
Unit 6 - Necks Neck Too large Too small Types of garments altered Garments with collar Garments without collar	
Unit 7 - Sleeves Sleeves Too long Too short Too large Too small	Unit 9 - Remodeling and Restyling Remodeling and restyling Types of garments remodeled and restyled Blouse Skirt Dress Suit Coat Vest Jumper
Unit 8 - Coats Coats Too long Too short Types of coats altered Lined coat Unlined coat Interlined coat	

DRESSMAKING VI

In the 12th year emphasis is placed on custom garment making. The problems are made complex; opportunities are provided to develop self-reliance, initiative, creative ability, speed in the manipulation of fabrics, furnishings, and special details.

Suggested Projects:	Suggested Materials:	
Short ensemble	Laces	Satins
Afternoon dress	Nets	Velvets
Dinner dress	Brocades	Sheers
Two-piece dress	Synthetics	Blends
Evening gown	Crepes	Trimmings and novelty belts of various kinds
	Metallic Cloths	

Block VI - Pattern Draping and Design

Unit 1 - Fundamental Operations

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Seams Corded Whipped Bias-piped Bias-bound Decorative details Beading Frogs Braids Bias self-cording Soutache Corded ornaments Arrow-heads Tailoring processes Interfacing Staying Taping edges Sponging Pressing	**Related Art** Rendering in color Original design for self Original design on a fashion figure for a prom or graduation dress Original design on an action fashion figure using a period costume as a source of inspiration Information Discussion of influences in fashion Interpretation of fashions from historical sources Wholesale designing Discussion of trade periodicals, newspapers Custom designing Field trips to museums and style centers Address by speakers from industry Opportunities in costume design

Block VI - Pattern Draping and Design

Unit 2 - Garment Design

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Garment Design Current trends Historical background Fabrics, trimmings, findings Figure proportions Line Color Interpreting the sketch Draping muslin Designing in favrics Adjusting style lines Estimating yardage and cost	Mathematics Job cost Labor Whole job Parts of the job Time card as recording work at various machines Materials Estimate of the amount needed for particular jobs Costs Overhead Machinery Utilities Spoilage
Unit 3 - Pattern Draping Foundation pattern standard size Shirtwaist dress Circular skirt Gored skirt Pleated skirt Princess-line dress Draped dress: current style, original design, or from an illustration Afternoon dress with the use of the block pattern	Science Textiles Care of fabrics Stain removal from various fabrics Dry cleaning for various fabrics Demothing Fireproofing Finishes: cotton, silk, wool Mercerizing Sizing and weighting Calendering Special finishes to make fabrics crease and crush resistant, waterproof, water-repellent, shrinkage-proof, mothproof, fire-resistant, odor-resistant, stainproof Consumer information Wool-labeling art Tensile-strength testing Abrasion testing Review

IV. SAMPLES OF INSTRUCTION SHEETS

OPERATION SHEET

Trade: Dressmaking (Power Sewing) Code IV-1

Operation: How to make a Plain Seam

Procedure:

Place the two right sides of the material facing each other. Keep edges evenly one-quarter to one-half inch from the raw edges. Guide in a straight even line while stitching, holding the under material firmly with the right hand as it is guided, and ease the upper material with the left hand. This will prevent one layer of material from being fuller or tighter than the other. Tack or back stitch both edges.

To stay or fasten a seam, raise the presser foot slightly and retrace the last $\frac{1}{4}$ inch of the stitching. Use this method to make the stitching secure at the beginning lines of stitching.

Pull the thread with the fingers, first on one side, then on the other, when ripping stitches made on the lockstitch machine. Ripping is important in sewing. Sewing mistakes cannot be corrected unless you know how to rip properly.

CAUTION: Do not tear the machine stitching apart or attempt to cut the stitches with a scissors.

Hold the larger part of the garment to the left of the presser foot. This gives better support for the garment on the machine table and more room beneath the machine arm for manipulating the work.

Always test the machine stitch on a double thickness of the material to be stitched to ascertain if the stitch is the desired length, if the tension is properly regulated, and if the thread is correct size and color. Always inquire about the seam allowance before assembling a garment. Guide the work easily and do not pull it from the presser foot. Seams that are too narrow will result in an inaccurately sized garment. Seams joined on the lengthwise grain are less visible than on any other grain.

Operation: How to Make a French and Flat Fell Seams Code IV-2

Procedure: French Seam

Place the two edges together, the wrong sides of the material facing each other. Stitch 1/8 inch from the edge. Trim, crease and fold back so that the two right sides of the cloth are together. Make sure the seam is directly on the folded edge and stitch $\frac{1}{4}$ inch from folded edge.

Procedure: Flat Fell Seam

Place the two pieces of material so that the edge of the under piece will extend $\frac{1}{4}$ inch beyond the edge of the upper piece and stitch 1/8 inch from the edge of the upper piece of material.

Fold the edge of the wider seam allowance back towards the 1/8 inch allowance. Turn this folded edge flat over the narrow seam allowance and stitch on the very edge. This edge can be stitched at the right or left of the first depending on the greater bulk of the garment.

(continued)

Flat Fell Seam (continued)

CAUTION: Hold the under piece firmly while you are sewing. Do not pull the folded edge while you are stitching it down. Hold the under material firmly and ease the upper edge or the seam will have a twisted appearance.

Operation: How to Make Standing Flat Fell and Hemmed Seams Code IV-3

Procedure:

Place the two pieces of material together with the right sides facing each other. Extend the under piece 1/8 inch beyond the edge of the upper piece. Fold the edge of the under piece over the upper piece. Fold again the desired width of seam, and stitch in place flat, close to the edge of the first fold.

Procedure: Lapped Seam

Fold the edge of one piece of material back 1/8 inch. Place this folded edge, with the raw edge downward, lapping another piece of material 3/8 inch in from the raw edge. Stitch in place on folded edge.

CAUTION: Hold the underpiece of material firmly and the upper piece loosely while stitching.

Remove material from machine and fold back 1/8 inch of the remaining raw edge and stitch flat.

CAUTION: The warp grain of material will give best results for making this seam on a single needle lockstitch machine.

JOB SHEET

Unit I - Fundamental Hand and Machine Sewing
Job 6 - Apron With Bib

Aim: To learn to make and assemble an apron with a bib and to follow the procedure step by step.

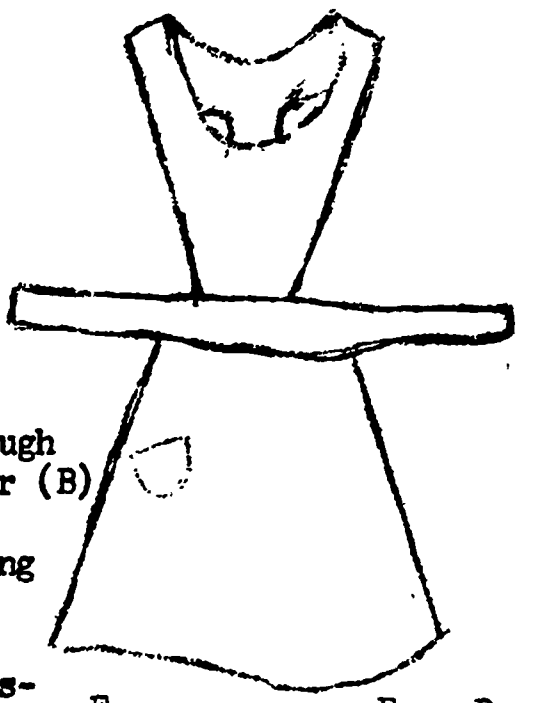
Tools and Equipment: Standard set-up

Materials: Ready-cut apron consisting of an aprom skirt, an apron bib, belt, back strap, and patch pocket.

General Information: Study the diagram of the aprom as you read the steps under procedure and be sure you understand the steps before proceeding on the job. It takes 1-1/3 yards of cloth for one apron. By making two of the same material, it takes two yards.

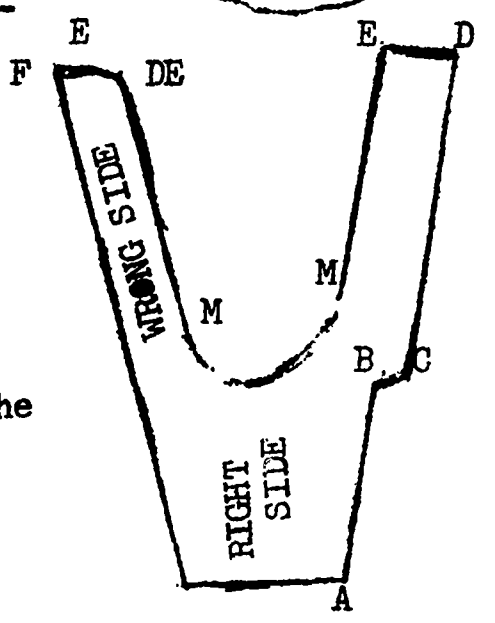
Procedure: Skirt of Apron

Make $\frac{1}{4}$" hem around three sides of apron skirt.
Finish corners by hand.
Make patch pocket and place upper left corner $3\frac{1}{2}$" in from the side of the apron and 5" down from top of apron. Baste in place. Stitch close to edge, stitching twice, depth of hem, 1/8" apart.



Procedure: Bib

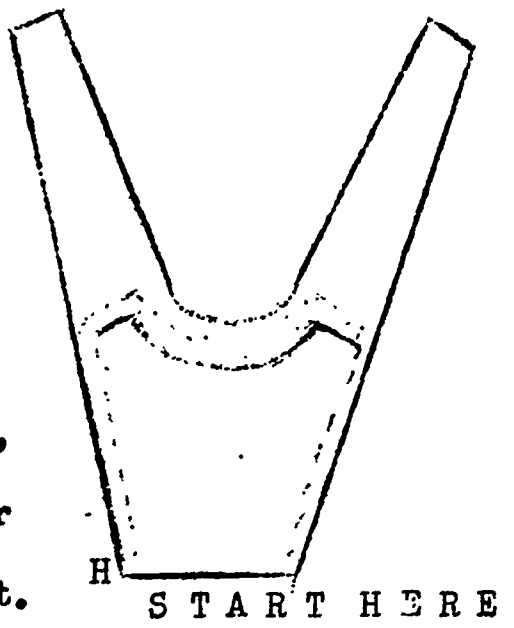
Baste, but DO NOT stitch, a $\frac{1}{4}$" hem from bottom (A) of bib up to cut-out (B). Clip corner (B) just enough to allow for smooth work. Turn under $\frac{1}{4}$" from corner (B) to outside of edge (C) on cut-out.
Fold ends of bib together like a couble belt, starting from (F) baste a $\frac{1}{4}$" plain seam.
Baste in place a bias facing along the curved neck edge from M to M, having crease of bias the same distance from the edge as the depth of the seam on bib ends. Lap ends of bias over bib ends. Stitch bib ends and bias facing in continuous stitching from F to F.
Turn ends of bib right side out. BE SURE to make a neat finish at the ends of the facing by allowing facing ends to slip under ends of bib. Baste facing in place onto bib.
Starting at (H) stitch the $\frac{1}{4}$" hem on side of bib and the bias facing in a continuous stitching. Finish the unstitched edges by hand. Lap ends of bib making a square. Make strap like a double belt.
Lap bib ends over end of strap and stitch around four sides, close to edge.
Turn up a 2" hem on end of strap, stitch twice, $\frac{1}{4}$" apart, leaving ends open to be used as casing for apron belt.

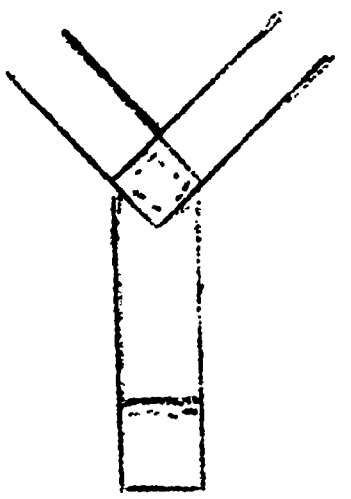


Job 6 - Apron With Bib (Continued)

Procedure: Joining Apron Skirt and Bib

Baste lower edge of bib to top of skirt, wrong sides together, notching center fronts.
Baste top of skirt and bib to belt, with right sides of bib and belt together, matching center fronts.
Stitch 3/8" plain seam.
Turn under seam allowance at unstitched edges of belt, then fold through the center lengthwise. Pin over seam just made, matching centers of belt. Baste near edge.
Fold bib up to top of belt and baste along top of belt.
Stitch ALL AROUND belt twice, close to edge and 1/8" in from edge.





JOB SHEET

Unit V: Making Seams Code IV-1

Job Title: Making Seams

Objective: To develop ability to make various seams in terms of material and purpose.

Trade Time: 3 hours, 45 minutes

Tools	Equipment	Materials
Pins	Standard	10 pieces of cotton material 4" by 8"

Safety Precautions:

1. Be sure to tack seams at the beginning and ending lines of stitching.
2. Always inquire about the seam allowance before assembling the seam.

Procedure:

1. Make plain seam.
2. Make french seam.
3. Make flat fell seam.
4. Make standing flat fell seam.
5. Make lapped seam.

Questions:

1. What are the functions of a seam?
2. Name a particular seam that serves a two fold purpose.
3. What causes a seam to have a twisted appearance?
4. What determines the particular type of seam to be used?
5. What type of seam is best adapted to very fine transparent material?

JOB SHEET

Unit

Job - A Four-Gored Skirt

Aim - To Make a Four-Gored Skirt

Tools and Equipment:

Standard setup

Materials:

Pattern - Zipper - Fabric - Findings

General Information:

Study your pattern and instruction sheet carefully before starting to work on your skirt.

Procedure:

1. Take customer's measurements.
2. Prepare fabric for cutting.
3. Prepare pattern for class use.
4. Check measurements of pattern with customer's measurements.
5. Make needed alterations.
6. Select "layout" for style, size, and material you are using.
7. Mark the perforations, notches, and other symbols and prepare the pieces of skirt for construction.
8. Follow instruction sheet and stitch all darts and seams not needed for fitting.
9. Pin baste other seams.
10. Fit garment to customer.
11. Make any necessary adjustments.
12. Stitch remaining seams.
13. Apply waistband.
14. Try on skirt for final fitting and hem adjustment.
15. Finish hem and all seams.
16. Check skirt carefully to see that all ends of stitching and hand work are fastened securely.
17. Give skirt final pressing.

INFORMATION SHEET

Trade: Dressmaking (Power Sewing) Code IV-1

Unit IV: Making Seams

Topic: Making Plain Seams

Seams are the means by which two edges of materials are sewed together.

The particular seam to use is determined by the weight, texture and fiber of the material and the functional or decoration use.

In machine sewing, unlike hand sewing, the operator in the trade must learn how to hold two or more pieces of cloth together without basting or pinning and how to guide the work so as to produce a seam that is stitched evenly and is neither stretched nor puckered.

A Plain Seam is used on nearly all kinds of fabrics and in the construction of nearly every type of garment. It makes an inconspicuous joining on material that is non-transparent. This particular seam is often used to join straight, bias or curved edges of material. The width of the seam depends on the fraying quality of the material and the type of seam finish to be used. Most frequently it is stitched one-half to five-eighths inch from the raw edge. Then used on cotton material the raw edge may be turned back and stitched on the folded edge independent of the garment. It can also be finished with binding or pinked as may be required by the weight of the material or purpose. It can also be folded back, both edges together and stitched on the outer or under-side of the garment for a decorative finish and greater strength.

Keep the stitching connected while sewing work from one seam to another and clip the thread to separate the parts after they are stitched. This saves time and thread and enhances the appearance of the work.

Bias seams can be handled best by stitching with the grain of the bias rather than against it. In sewing a straight edge to a bias or shaped edge, place the straight edge next to the feed, hold firmly, and control the upper edge as required.

At certain places where it is necessary to ease fullness into a seam, this can be done by placing the part to be eased next to the feed.

References:

Silverman, Julia E., Power Machine Sewing. New York: Richard E. Wright Co., 1942, pp. 152-162.

Simplicity Sewing Book, Diagram 4, p. 28.

Fundamentals of Garment Machine Operating.

Spears, Wyatt Ruth, Better Dressmaking. New York: Silver Burdett Co., 1943, pp. 94-104.

INFORMATION SHEET

Trade: Power Machine Sewing Code IV-2

Unit IV: Making Seams

Topic: Making a French and Flat Fell Seam

A French Seam is used on transparent, very fine, or soft fabrics. It is used in the construction of undergarments, infants slips, dresses and other articles, which require frequent laundering. It is adaptable to loose garments where a flat finish is not essential. It is frequently used in the manufacture of sheer garments. The finish of a french seam varies with the weight and texture of the material.

A Flat Fell Seam is used on firm medium weight material. It is very strong; gives a flat, decorative, tailored appearance; is easily laundered; and requires no other finish. For a decorative finish such as the shoulder yoke, or setting the sleeves in shirts, blouses, smocks, etc., the parts of the garment should be placed with the wrong sides of the cloth facing each other.

For construction seams, the material may be placed either with the right sides facing each other or with the wrong sides facing each other.

A special machine known as a double-needle seaming machine makes a seam very much like the flat fell but has two rows of stitching visible on both sides of the finished seam.

References:

Silverman, Julia E., Power Machine Sewing; New York, Richard E. Smith Co., 1942, pp. 152-162.

Simplicity Sewing Book, Diagram 4, p. 28.

Sample Book in the Fundamentals of Garment Machine Operating.

Spears, Wyatt Ruth, Better Dressmaking. New York; Silver Burdett Company, 1943, pp. 94-104.

INFORMATION SHEET

Trade: Power Machine Sewing Code IV-3

Unit IV: Making Seams

Topic: Making Lapped or Standing Flat Fell Seams and Lapped Seams

A Standing Fell or Hemmed Seam is used on underwear and other garments made of firm light-weight material.

This seam is thicker and heavier than the French seam and is used for construction lines only. It is made in a single operation and forms a self-finish. Straight grain edges can be managed by this method with less difficulty than bias or shaped edges. The machine hammer also is used to produce the standing fell seam.

A Lapped Seam. Like the flat fell seam, is often used on firm, medium weight material. It is strong, flat and decorative, and produces a self-finish. The effect in appearance (showing two rows of stitching) is the same on both sides of the material when it is made on the lock stitch machine. Because of this reversible feature, not found in other seams, it is readily adaptable to such articles as flags or where there is no definite right or wrong side. There are a number of special machines in use on such operations as setting sleeves, joining shoulders, stitching yokes, felling side seams, felling bibseams, felling inseams and outseams, etc. where there is definitely a wrong side to the garment.

Machines of the lockstitch and chainstitch types which are used in making this seam are manufactured by all the major companies such as: Singer, Union Special and Wilcot and Gibbs.

Although it is possible to form the lapped seam with a single needle lock-stitch machine, in actual production practice economy makes it necessary to employ a special machine.

The warp grain of material will give best results for making this seam on a single needle lockstitch machine.

References:

Silverman, Julia E., Power Machine Sewing. New York; Richard E. Wright Co., 1942, pp. 152-162

Simplicity Sewing Book, Diagram 5, p. 28

Sample book in Fundamentals of Garment Machine Operating

Spears, Wyatt Ruth, Better Dressmaking. New York; Silver Burdett Co., pp. 94-104

ASSIGNMENT SHEET

Block:

Unit:

Subject: Seams (Straight and Bias)

Objective: To develop the ability to make a plain seam on a straight and bias edge.

Materials: 6 straight strips of material 2"x 6" for each student
6 bias strips of material 2"x 6" for each student

Application: Make plain seams on straight and bias material 3/8 in. from edge.

Testing:
1. Inspect seams in progress.
2. Criticize work and handling.
3. Check individual and common errors with sample.
4. Continue to make 2 more sets until a fair degree of skill is attained.
5. Apply plain seam to project involved.

Summary:
1. What is the definition of a seam? Plain seam?
2. Where may a plain seam be used?
3. What is the average width of a plain seam?
4. What precaution must be taken when stitching a bias seam?
5. What two ways will prevent stretching when stitching a bias seam?

V. SAMPLES OF TESTS

COMPLETION TEST

On the line at the right of each statement write the letter of the word or phrase that best completes the statement.

1. It is always best to buy a _____ pattern for your first garment.
2. When cording, the cotton fibers are _____ and _____.
3. Twill weave makes a very _____ and rather _____ material.
4. If one is well dressed our clothing is suited to _____ and to _____.
5. Materials that are not alike on both sides should _____, _____ or _____ together to avoid cutting two pieces for one side.
6. Bleaching of the fibers removes all the _____ coloring.
7. The thimble is worn on the _____ finger of the hand.
8. The presser foot is an important factor in _____ and _____.
9. When placing the bobbin in the machine the needle should be _____.
10. To keep an even width making a hem the student should use a _____.

COMPLETION BY ENUMERATION (Sample)

On the lines write the items needed to complete each statement. Each item must be distinct from the other item of its group.

1. Name six common fabrics used in dressmaking.

   (a) _____ (c) _____ (e) _____
   (b) _____ (d) _____ (f) _____

2. Four most commonly used seams are:

   (a) _____ (c) _____
   (b) _____ (d) _____

3. Five important steps that must be followed before assembling a cut garment are:

   (a) _____ (c) _____ (e) _____
   (b) _____ (d) _____

4. Four most common attachments used in dressmaking are:

   (a) _____ (c) _____
   (b) _____ (d) _____

5. Three very popular pockets are:

   (a) _____
   (b) _____
   (c) _____

6. Three ways to prevent seams from raveling are:

   (a) _____
   (b) _____
   (c) _____

7. Four different kinds of plackets are:

   (a) _____ (c) _____
   (b) _____ (d) _____

8. Four most widely used hems are:

   (a) _____ (c) _____
   (b) _____ (d) _____

MULTIPLE CHOICE

On the line at the right of each statement write the letter of the word or phrase that best completes the statement.

1. The first lockstitch machine was invented by:

   a. Eli Whitney
   b. Thomas Edison
   c. Elias Howe _____

2. When the stitch regulator is raised to its highest point, a machine will produce:

   a. 16 stitches to the inch
   b. 10 stitches to the inch
   c. 22 stitches to the inch _____

3. The size of the needle to be used should be determined by:

   a. size of the thread
   b. the class of work
   c. the size of the machine _____

4. The most commonly-used decorative stitches are:

   a. the running stitches
   b. hold back
   c. the blanket stitch _____

5. Having all equipment at hand when needed will:

   a. enhance the beauty of your garment
   b. make you an outstanding worker
   c. increase one's speed _____

MATCHING

Select the item in the answer column, which is most closely related to it. Write the letter of the answer on the line at right.

Answer Column	Phrase
A. Thread-take up-lever	1. A means of shortening or lengthening a machine stitch. ____
B. Tacking	2. The parts of a machine which regulates the pull on the thread. ____
C. Back stitch	3. A double-needle sewing machine. ____
D. Mittering	4. Size of a needle for 80/3 cord. ____
E. Size 18	5. The part of a machine which holds the sewing in place. ____
F. Stitch regulator	6. To begin and finish the stitching of a seam. ____
G. Flat-fell	7. The size of a needle for 40/6 cord thread. ____
H. Size 14	8. A method of notching corners ____
I. Presser foot	9. A hand stitch that resembles a machine stitch. ____

SAMPLE PROCEDURE SEQUENCE-TYPE TEST

1. If you were asked to construct a simple cotton dress, place number 1 after the thing you would do first, number 2 after the thing you would do second, and so on.

Join side seams	( )
Make sleeve placket	( )
Stitch sleeves in armhole	( )
Make collar	( )
Hem skirt bottom	( )
Make dress placket	( )
Shoulder seams	( )
Finish neckline	( )
Apply cuffs to sleeves	( )
Apply pockets	( )

2. If you were asked to oil the sewing machine, place number 1 after the thing you would do first, number 2 after the thing you would do second, and so on.

Unscrew the throat plate and open bed slide	( )
Remove upper thread	( )
Replace throat plate	( )
Oil base of machine	( )
Remove bobbin case	( )
Remove all dust, oil, and lint	( )
Remove face plate and clean	( )
Oil head of machine	( )

TRUE FALSE TEST

Some of the following statements are true and some are false. Read each statement carefully and decide whether it is true or false. After each of the numbers to the right of the statement write the word "true" or "false."

1. (T) Stitches in the handsewing are a single pass of a needle or the loop or turn of the thread, twine or like, thus made and left in the fabric. _____
2. (T) The purpose of the electric light to the left of the needle is to avoid glare in the eyes. _____
3. (T) A perfect stitch is obtained only when the thread is selected to suit the fabric and the needle is the correct size for the thread _____
4. (F) Pulling the fabric when stitching is a good practice as it produces greater speed. _____
5. (F) A running hand stitch resembles a lockstitch made on the power machine. _____
6. (F) A lockstitch can only be produced by the interlocking of thread from the spool pin with that from the bobbin case. _____
7. (T) The thimble is worn on the third finger of the hand and should be large enough to cover the finger nearly to the first joint. _____
8. (T) Shears are used for heavy cutting and are distinguished by the length, which is always over six inches. _____
9. (T) Test the pattern for size and make the necessary alterations before cutting the garment. _____
10. (F) The sewing machine must be oiled every day after use. _____
11. (T) The average width of a seam is 3/8". _____
12. (T) An emery is a small ball filled with fine black dust of a polishing substance called emery. _____
13. (F) There is no duplication of a hand stitched hem by machine sewing. _____
14. (T) All garments were made in the factories during the Civil War. _____
15. (F) Careful selection of a tape measure is of no importance. _____
16. (T) The back stitch and the sewing machine stitch have a strong resemblance. _____
17. (F) A plain pinked seam is the only finish correct for woolen garments. _____
18. (F) Basting stitches are used most of the time as decorative stitches. _____
19. (F) The material is never placed on the table while basting the parts together. _____
20. (F) Straight stitching of a seam is assured by using the needle as a guide. _____
21. (T) A true bias is made by folding the material so that the selvage or warp threads lay paralleled to the woof or filling threads. _____
22. (F) Cotton fabrics are usually made in forty-five inch widths. _____

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ABSTRACT - This curriculum guide was developed by school personnel to prepare students for entry into the food trades. To qualify for the 3-year program a student must be at least 14 years of age, have reached the 10th grade with a knowledge of basic math, and meet the requirements for vocational aptitude tests and the Food Handlers Permit. An outline for instruction, suggestions for organizing the class, a sample work sheet and tests are provided in the guide. The instructional material outlines the manipulative skills and technical knowledge for each of the 11 units which include care and operation of kitchen equipment and preparation of specific types of food. A total of 1,620 shop hours is estimated for the total program. (JS)

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FOOD TRADES

CURRICULUM GUIDES
In Trade and Industrial Education

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Public Schools of the District of Columbia

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Public Schools of the District of Columbia

CARL F. HANSEN, Superintendent of Schools

Curriculum Guides in Trade and Industrial Education

FOOD TRADES

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OFFICE OF EDUCATION
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TRADE AND INDUSTRIAL EDUCATION

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FOREWORD

A General Statement of the Trade

The importance of the Restaurant Business is shown by the following statistics compiled by the National Restaurant Association in 1955:

The restaurant business ranks fourth in retail sales in the United States.

The restaurant industry ranks first in the nation in the number of people employed.

One out of every six persons, employed in retail trades, is employed in the restaurant business.

The course in Food Trades is designed to meet the needs of the student who wishes to enter the field of commercial foods.

Prerequisites for Entrance Into the Trade

The student shall have reached the 10th grade.

The student shall meet the requirements for the vocational aptitude tests.

The student shall have a knowledge of basic math.

The student shall meet the requirements for the Food Handlers Permit given by the Health Department.

The student should be at least 14 years of age.

Time Required to Complete the Course

The requirement for a high school diploma and a certificate in the Food Trades course is three (3) years. Laboratory practice or shop work is scheduled for three (3) clock hours daily, 15 hours per week. One and one-half hours per day are spent in related subjects--science, mathematics and/or art. One and one-half hours are spent in academic subjects. Five hundred and forty (540) hours are spent in shop work per year--a total of 1620 hours for the three-year course. Students, who have completed high school may take a post-graduate course and receive a certificate in the trade in one year.

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I. OBJECTIVES

Note: It should be kept in mind that vocational industrial education, as it is known today, is not designed to develop skilled craftsmen as such. It is intended, through preparatory programs in basic fundamentals, to bring students to the entrance point of wage earning ability at advanced apprenticeship level. Rapid advancement thereafter (toward thorough understanding and skilled craftsmanship levels) is accomplished through actual work on the job and night supplementary trade extension courses.

General

The general objectives of the courses of study in Trade and Industrial Education are to develop in the students the abilities to:

Do the various manipulative skills that will permit their initial employment in the industry, rapidly increase their efficiency, and promote their advancement in the salary scale.

Understand the application of basic principles of the science, mathematics, and related technical knowledge that condition the manipulative skills.

Appreciate the social and industrial relationships in connection with the contribution which a worker can make in the areas of health, effective services, and general social-industrial and public relations.

Specific

The specific objectives of the course of study in Food Trades are:

To train the student for employment in the Food and Restaurant Business.

To develop the ability to master the basic skills required of workers in the Food and Restaurant Business.

To develop an understanding of the science that conditions the performance of the skills required of workers in the Food and Restaurant Business.

To develop an understanding and an appreciation for safety, good work habits, health laws, and sanitation as they apply to his trade.

To develop an appreciation for the artistic principles that are basic in food preparation and service.

To develop an appreciation for originality and experimentation in the field of Food and Restaurant Service.

To develop an understanding of the social and economic problems that affect him as a worker and a worthy citizen.

To stimulate interest in further training and advancement on the job.

To develop the ability to work harmoniously and cooperatively with others and to gain self understanding.

To develop an appreciation for occupational competency and high standards of workmanship.

II. GENERAL ORGANIZATION

General Statement of Methods of Instruction

To teach best the variety of skills, the related technical knowledge and the social-industrial relationships needed to equip students entering this trade, many methods of teaching are necessary. Each method has distinctive features that causes its use to be best suited for the teaching of a specific type of skill or knowledge.

In teaching shopwork, the following methods are used:

Demonstrations	Individual Projects
Explanation	Directed Technique Study
Visual Aids	Group Projects
Questioning	Problem-Solving Activities
Instruction Sheets	Field Trips

In teaching the related technical knowledge and social-industrial relationships, the following methods are used:

Discussion	Written Reports
Directed Study	Visual Aids
Questioning	Field Trips
Individual Reports	

Time Schedule Allotment

Block	No. Hours Shop Work
I. Care and Operation of Kitchen Equipment	95
II. Eggs and Breakfast Foods	125
III. Meat Cutting - Boning or Preparation	125
IV. Meat and Poultry Cooking	285
V. Sauces and Gravies	70
VI. Fish and Shellfish Cooking	120
VII. Soups - Appetizers and Beverages	150
VIII. Vegetable Cooking	170
IX. Salads and Sandwiches	100
X. Breads - Pastries - Cakes and Cookies	280
XI. Desserts	100
Total	1620

Type of Testing Program Used

More than one instrument is used to determine the effectiveness of teaching and to evaluate the achievement of students in the areas of manipulative skills, related technical knowledge, and social-industrial relationships. These are under the general headings of performance and written tests. One sure way to determine whether a student can do something is to have him actually try to do it. Hence, manipulative skills are tested continually in connection with every job. These tests are referred to as performance. In evaluating total performance, consideration is given to the various elements that are significant in the trade area involved. For example:

Safety
Techniques
Finished Product
Time and Effort Expended
Use and Care of Tools, Equipment, and Materials.

The rate of progress in the assimilation of related information is revealed in the ability of the student to apply such knowledge to pertinent jobs and in his achievement on written tests which are given at regular intervals. Written tests may be Objective or Essay in form or a combination of both. Sample tests are included in this course of study in a separate section.

Evaluation of Student Progress

Students progress in the manipulative skills according to their demonstrated ability to meet minimum trade standards. They are required to repeat a job until minimum proficiency is reached before they are permitted to advance to the next job. Their rate of progress and the evaluation of it are recorded on a progress chart.

Performance and written test achievement are interpreted as follows:

A	Outstanding	95 - 100
B	Above Average	85 - 94
C	Average	75 - 84
D	Below Average	70 - 74
F	Unsatisfactory	Below 70

Text and Reference Materials

Bryan, The School Cafeteria

Dahl, Restaurant Management

Livingstone, Food Service

Strause, Pie Marches On

West and Wood, Food Service in Institutions

III. OUTLINE OF INSTRUCTION

Block I - Care and Operation of Kitchen Equipment

Unit 1 - Use of Kitchen Equipment, Utensils and Tools

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Operation and use of: Dish machines Glass machines Electric mixers Silver washers Food choppers Others	Layout of kitchen equipment Cost Initial Operating Good work habits Safe Productive

Unit 2 - Mechanical Equipment

Use of all types of mechanical kitchen equipment Gas ranges Electric ranges Broilers Steam tables Steam-jacket kettles and steamers Refrigerators Cleaning and care of all types of mechanical kitchen equipment	Sanitation and cleaning methods Steam cleaning Cleaning supplies Safety and work precautions

Block I - Care and Operation of Kitchen Equipment

Unit 3 - Electrical Equipment

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Manipulating all types of electrical equipment Peelers Vegetable cutters Buffalo choppers Ovens Ranges Deep fat fryers	Safety and work precautions
Cleaning and care of all types of electrical equipment	

Unit 4 - Gas Fired Equipment

Lighting gas-fired equipment Ranges Broilers Ovens	Safety precautions Thermometers Thermostats Cost operation
Cleaning of all types of gas-fired equipment	

Unit 5 - Steam Pressure Cooking

Operating steam pressure-cooking equipment Steam-jacket kettles Radar range	Pressure gauge Relief valves
Cleaning and care of steam pressure-cooking equipment	

Block II - Eggs and Breakfast Foods

Unit 1 - Cooking Eggs

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Boiling eggs	**Related Science**
Frying eggs	Nutrition as a science
Poaching eggs	Nutrition as related to food preparation and service
Scrambling eggs	Function of food
Making omelettes	Importance of food and diet to health
Shirring eggs	Carbohydrates Composition and sources Classification Effect of deficiency or excess Effect of cooking Digestibility
Preparing eggs for salads	Fats Nature and composition Sources Digestibility Effect of cooking
Using eggs for garnishes	Proteins Composition Sources Function Effects of deficiency or excess Effect of cooking on digestibility acceptability
Using eggs in other foods	Minerals Sources Functions Dietary requirements Effect of a shortage of minerals
Serving eggs	

Block II - Eggs and Breakfast Foods

Unit 2 - Batters and Toast

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Making pancakes or griddle cakes	Water
	A nutrient agent
Plain	Food sources
Fruited	Body functions
Buckwheat	Vitamins
Cornmeal	Compositions
	Functions
Making waffles	Food sources
	Vitamins in the diet
Plain	Effect of deficiency
Fruited	Effect of cooking
Flavored	Effect of freezing
	Loss of vitamins in cooking and preparation
Making toast	Prevention
Plain	
Cinnamon	Energy requirements of individuals
Melba	
French	Physical activity
	Age
	Sex
	Body structure
	Weight and size
	Importance of well-balanced food combinations
	Necessary nutrients
	Caloric content of foods
	Percentage retention after cooking

Block II - Eggs and Breakfast Foods

Unit 3 - Meats for Breakfast

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Cooking bacon	Digestive system
Cooking ham	Digestive juices Enzymes in digestive juices Types and functions Absorption Digestion and health habits Proper eliminations
Cooking sausage	
Various ways of serving meats for breakfast	
	Basic food chemistry
	Changes in food due to
	Cooking Freezing Curing Dehydrating
	Composition of foods
	Elements Compounds
	Identification of foods and detection of adulterants
	Food spoilage
	Causes Prevention Chemistry involved
	Food preservation
	Chemical and physical changes

Block II - Eggs and Breakfast Foods

Unit 4 - Cooked Cereals

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Cooking and serving cream of wheat	
Cooking and serving farina	
Cooking and serving oatmeal	
Cooking other varieties of cereals	

Unit 5 - Fruits

Preparing fresh fruit for breakfast and serving	
Preparing dried fruit for breakfast and serving	

Block III - Meat Cutting - Boning or Preparation

Unit 1 - Beef

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
How to cut beef	Grades and classification
General procedure Various cuts found in carcass Identification of cuts Bone structure Processing hind quarter Processing fore quarter Cutting, boning and trimming	Inspection Size Shape Location Use
	Tools and equipment
	Safety and work precautions
	Sanitation
	Calculation of costs

Unit 2 - Veal

How to cut veal	
General procedure Various cuts found in carcass Processing whole or side of veal Cutting, boning and trimming veal	

Block III - Meat Cutting - Boning or Preparation

Unit 3 - Pork

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
How to cut pork General procedure Various cuts found in the carcass Identification of cuts Bone structure Processing of hog carcass Cutting, boning and trimming	

Unit 4 - Lamb

How to cut lamb General procedure Various cuts found in the carcass Identification of cuts Processing of lamb carcass Cutting, boning and trimming	

Block IV - Meat and Poultry Cooking

Unit 1 - Roasting Meats and Poultry

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Roasting (beef, pork, veal, and lamb	Characteristics of grades and cuts suitable for roasting
Roasting meets Care and storage before roasting Preparation of fresh meats Preparation of frozen meats Seasoning Roasting procedures Carving	Equipment Roast pans Meat thermometers Oven Other equipment
	Shrinkage Cause Effect Control Cost
Roasting poultry (turkey, chicken, duck, capon and goose	Use of drippings, fat, and trimmings
Preparation Seasoning Stuffings and dressings Roasting procedures Testing Carving	Classification of poultry Characteristics of poultry suitable for roasting

BLOCK IV - Meat and Poultry Cooking

Unit 2 - Broiling Meat and Poultry

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Broiling meats (beef, veal, lamb, and pork) Preparation of fresh and frozen meats Procedures for broiling meats Seasoning Searing Testing for temperature Timing Fresh meats Frozen meats Testing for doneness Methods of serving Sauces Gravies Butters Garnishes	Purpose and effect of broiling Cuts of meat suitable for broiling Fuel used for broiling Characteristics of poultry suitable for broiling
Broiling poultry Preparation Procedure Seasoning Searing Basting Care while broiling Timing Testing for doneness Methods of serving	

Unit 3 - Braising Meats

Braising meats Preparation Marinating Larding Procedure Seasoning Precooking or frying Basting Timing Finishing process Testing for doneness Methods of serving	Cuts and grades of meat used for braising Equipment Purpose of Marinating Larding

BLOCK IV - Meat and Poultry Cooking

Unit 4 - Sautéeing (Pan Fry) Meats and Poultry

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Sautéeing meat	Cuts suitable for sautéeing
Preparation Procedure Seasoning Browning Timing Finishing Testing for doneness Preparation of sauces used with sautés Methods of serving Garnishes Sauces Gravies	Selection of butter, vegetable shortening, lard, or oil Equipment and utensils Variations in finishing process in oven
Sautéeing poultry	
Preparation Procedure Seasoning Browning Timing Finishing Testing Preparation of sauces Methods of serving	

Unit 5 - Frying Meat and Poultry

Frying meats and poultry	Cuts and grades suitable for frying
Preparation Fresh meats and poultry Frozen meats and poultry Cured meats	Equipment Fats used
Procedure Seasoning Dredging Timing Testing for doneness Preparation of sauce or gravy	Amount Temperature

Block IV - Meat and Poultry Cooking

Unit 6 - Frying in Deep Fat

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Frying meats and poultry in deep fat	Cuts of meat and poultry suitable for deep fat frying
Preparation of meats and poultry Procedure Seasoning Dredging Coating Timing Draining Testing for doneness	Fats used Temperature for frying Care and storage Breakdown or oxidation Equipment

Unit 7 - Simmering Meats and Poultry

Various ways to boil meats and poultry

Parboiling
Steaming
Pressure cooking
Blanching
Stewing
Poaching

Preparation of meats and poultry

Fresh meats
Corned beef
Smoked meats

Procedure for simmering

Seasoning
Care in cooking
Timing
Testing for doneness
Carving

Block IV - Meat and Poultry Cooking

Unit 8 - Cooking Stews

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Various kinds of stews Irish Fricassees (curry, goulash) Brown stews - Ragout	Selection of meats for stews Equipment Calculation of costs
Preparation for stewing	
Procedure Seasoning Care during cooking Timing Finishing (thickening)	
Various methods of serving	

Unit 9 - Cooking Ground and Variety Meats

Cooking ground and chopped meats	Economy factors
Preparation of ground and chopped meats	Use of left-overs Use of meat trimmings Storage and care
Raw Preparation Seasoning Cooking Serving and garnishing	Bacteriology and sanitation Equipment and tools
Cooked Preparation Seasoning Cooking Serving and garnishing	Sauces, gravies, and stocks Various kinds of glandular meats Care in storage
Preparation of hashes Preparation Seasoning Cooking Serving and garnishing	Nutritive value, cost factor Variety of uses

Block IV - Meat and Poultry Cooking

Unit 9 - Cooking Ground and Variety Meats (Cont'd.)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Cooking variety meats	
Preparation of variety meats	
Liver Kidney Sweetbreads Tongue Brains Tripe Heart	
Seasoning of each of the variety meats Cooking each type of the variety meats Serving and garnishing of each type of variety meat	

Block V - Sauces and Gravies

Unit 1 - Sauces

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Preparation of basic sauces	Hygiene and Sanitation
Preparation Seasoning Care during cooking Timing Care after cooking	Basic principles of hygiene and their application to health
	Bacteria
	How bacteria may enter food Conditions needed for growth
Preparation of cream sauce (Bechamel)	Health habits
Preparation Seasoning Care during cooking Timing Care after cooking	Rest Exercise Posture Recreation

Block V - Sauces and Gravies

Unit 1 - Sauces (Cont'd.)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Preparation of fricassee sauce (Velante)	Grooming
	Hair care
Preparation	Teeth
Seasoning	Skin
Timing	Hands
Care after cooking	Feet
	Bathing
Preparation of hollandaise	Clothing
Preparation	State and local sanitation laws
Seasoning	
Care during cooking	Storage of food
Timing	
Care after cooking	Raw
	Cooked
Preparation of tomato sauce	Storage of dry materials
Preparation	Flour
Seasoning	Meal
Cooking	Sugar
	Disposal of garbage and refuse material
	Cleaning and care of all types of kitchen equipment
	Cleaning and maintenance of floors and work areas
	Preventing rodents and insects
	Detecting presence of rodents and insects
	Controlling rodents and insects
	Diseases
	Parasitic infections
	Carriers
	Prevention of disease
	Characteristics of bacteria
	Hair nets, caps
	Nails, nail polish

Block V - Sauces and Gravies

Unit 2 - Gravies

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Preparation of natural gravy	Shoes, hose
Procedure Seasoning	Uniforms
	Types of refrigeration
Preparation of thickened gravy	Temperature Control
Procedure Seasoning Thickening Cooking	Bins, shelves, racks, containers
	Equipment
Preparation of cream gravy	Detergents
Procedure Seasoning Thickening	Sanitizing agents
	Purification agents
	Insecticides
	Safety
	Other precautions

Block VI - Fish and Shellfish Cooking

Unit 1 - Boiling and Steaming Fish and Shellfish

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Boiling and steaming fish and shellfish	Related Mathematics
	Fundamental mathematical process
Preparation	
Cleaning fish	Addition
Preparing shellfish	Subtraction
Filleting fish	Multiplication
Steaking fish	Division
Procedure	Fractions
Seasoning	Decimals
Temperature	Percentages
Timing	Weights
Testing for doneness	Measures
Methods of serving	Liquid
	Dry
	Degrees
	Calculation of raw food costs
	Calculation of portion costs or cost per serving. (Ready to serve cost)
	Maintenance of records necessary for adequate control cost within the kitchen
	Weights and measures
	Use of scales
	Use of oven and meat thermometers
	Recipe calculation
	Steam and other pressure
	Standard of accepted weights or measures of various servings
	Food cost
	Labor cost
	Overhead cost

Block VI - Fish and Shellfish Cooking

Unit 2 - Baking Fish (Cont'd.)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
	Safety
	Basic principles of safety as related to all phases of food preparation
	Correct attitude towards accidents
	Unsafe acts
	Failure to follow instructions Improper use of equipment Failure to control temper
	Unsafe conditions
	Allowing floors to remain wet Obstructed work aisles Badly located equipment Exposed hot pipes or electric wires
	Methods of eliminating accident hazards
Unit 3 - Broiling Fish	
Broiling fish	Personnel training
Preparation Small fish Fresh and frozen Large fish Fresh and frozen	Preinstruction Instructions Motivation Discipline
Procedure Seasoning Temperature Timing	Engineering provision
Testing for doneness Serving (various methods)	Guards on slicing machines Definite traffic lanes Isolation of hazardous equipment

Block VI - Fish and Shellfish Cooking

Unit 3 - Broiling Fish (Cont'd.)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
	First aid procedures Minor cuts Bruises Burns Heat exhaustion and shock Artificial respiration Bleeding Arteries Veins

Unit 4 - Sauteeing and Frying Fish

Sauteeing and pan-frying fish

Preparation
Procedure
Seasoning
Dredging
Breading
Temperature
Timing
Testing for doneness
Serving
Sauces
Garnishes

Deep-frying fish

Preparation
Procedure
Cutting
Breading
Seasoning
Temperature
Timing
Draining
Care in frying
Testing for doneness
Serving (various methods)

Block VI - Fish and Shellfish Cooking

Unit 5 - Cooking Other Types of Seafood

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Cooking clams, crabs, lobsters, oysters and shrimp	
Preparation of the above seafoods	
Care and storage before cooking	
Fresh	
Frozen	
Shelling	
Methods of cooking each type of seafood	
Seasoning	
Testing for doneness	
Serving	
Variation in seafood dishes	
Preparing newburg	
Preparing stew	
Preparing chowder	
Preparing cocktail	
Preparing casserole	

Block VII - Soups - Appetizers and Beverages

Unit 1 - Soups

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Preparing soup stock (white and brown)	Utensils
Seasoning	Uses of stock
Cooking	
Timing	Storage of stock
Various uses of stock	
	Curdling
Preparing gumbos	
	Cause
Preparing chowders	Effect
	How to prevent
Preparing vegetable soups	

Block VII - Soups - Appetizers and Beverages

Unit 1 - Soups (Cont'd.)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Preparing purees	
Green pea Yellow pea Lentil Kidney bean	
Preparing cream soups	
Chicken Potato Corn Tomato Mushroom	
Serving soups (various methods)	

Unit 2 - Appetizers

Preparing fruit-juice cocktails

Preparing vegetable-juice cocktails

Preparing seafood appetizers

Preparing fresh-fruit appetizers

Preparing accompaniments for appetizers

Serving various types of appetizers

Block VII - Soups - Appetizers and Beverages

Unit 3 - Beverages

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Preparation of coffee	
Hot Iced	
Preparation of tea	
Hot Iced	
Preparation of cocoa and chocolate	
Preparation of orange and other fruit juices	
Preparation of punch	
Various types of punch	
Methods of serving the various kinds of beverages	

Block VIII - Vegetable Cooking

Unit 1 - Cooking Fresh Vegetables

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Preparing fresh vegetables for cooking Leafy Stalk Flower Root Fruit Seed	Nutritive value of vegetables Effect of cooking Preservation of food value, color, flavor, and texture Temporary storage in cold water Equipment and utensils used in cleaning and preparing vegetables
Steaming fresh vegetables	Principles involved in
Boiling fresh vegetables	Steaming Boiling Blanching Creaming Sauteeing
Pressure cooking fresh vegetables	
Sauteeing fresh vegetables	
Braising fresh vegetables	
Frying fresh vegetables	Variations
Seasoning fresh vegetables	Related science
Preparing various types of sauces used with vegetables	Cost factors
Serving vegetables	

Unit 2 - Cooking Frozen, Dehydrated and Canned Vegetables

Cooking frozen vegetables

Leafy
Stalk
Flower
Root
Fruit
Seed

Cooking dehydrated vegetables

Cooking canned vegetables

Block IX - Salads and Sanwiches

Unit 1 - Preparing Salads

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Preparing of vegetable salads	Nutritive value of salads
Cooked vegetables Raw vegetables Gelatin salads with vegetables	Types of dressings Cost factors
Preparing of fruit salads	Variations
Cooked fruits Raw fruits Gelatin fruits	Equipment Cause of curdling or breaking
Preparing seafood salads	How to restore curdled mayonnaise
Shrimp salad Crab salad Tuna salad Salmon salad	Storage Selection of oils Variety dressings
Preparing poultry salads	
Preparing salad dressing	
Mayonnaise French dressing Cooked salad dressing Other dressing	

Block IX - Salads and Sandwiches

Unit 2 - Preparation of Sandwiches and Sandwich Filling

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Preparation of various types of sandwiches	Sanitation
Open face Club Toasted Finger Rolled Hot Grilled	Handling precautions Variety breads Bread storage Equipment and tools
Preparation of fillings	Type Care Safety precautions
Salads Spreads Sliced products	Kinds of fillings
Seasonings for sandwiches	Salads Spreads Sliced products
Arrangement on plate	Storage of sandwich fillings
Variety of cuts for sandwiches	Cost factors
Garnishes for sandwiches	
Care after preparation	
Storage of	

Block X - Breads, Pastries, Cakes and Cookies

Unit 1 - Bread and Rolls

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Making dough for bread, rolls, and sweet rolls	Food values of breads
	Weights and measures
Preparation of dough Proofing Shaping Timing Baking	Fermentation
	Yeast
	Care and operation of equipment
	Types of bread
	Types of rolls
	Fuels Gas Electricity
	Composition of flours
	Sanitary factors
	Sugars
	Glazes and crust
	Cost factors
	Types of baking powder
	Related chemistry

Block X - Breads, Pastries, Cakes and Cookies

Unit 2 - Baking Powder Bread

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Making biscuits	Equipment
Measuring Mixing Timing Baking	Varieties Biscuits Muffins Corn bread
Making muffins (various kinds)	Regional preferences
Measuring Mixing Timing Baking	Cost factors Types of shortening
Making corn bread	Eggs
Measuring Mixing Timing Baking	Fresh, powdered, frozen Milk Fresh liquid, evaporated, powdered Storage Varieties and use

Block X - Bread, Pastries, Cakes and Cookies

Unit 3 - Cake Making

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Making various types of cake dough	
Plain	
Sponge	
Pound	
Angel	
Baking cakes	
Loaf cake	
Layer cake	
Cupcakes	
Making frostings and icings for cakes	
Decorating cakes	

Unit 4 - Pastries and Other Dessert Doughs

Making pastries and tortes	
Making pies	
Various types of pies	
Fillings for pies	
Making cookies	
Various types of cookies	
Making cream puffs	
Making eclairs	
Making doughnuts	
Various types	
Making gingerbread	

Block XI - Desserts

Unit 1 - Gelatin Desserts

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Making gelatin desserts	Storage of fruit
Whipped Molded Fruited	Fresh Dehydrated Frozen
Serving gelatin desserts	Equipment, utensils, tools
	Kinds

Unit 2 - Puddings

Making various kinds of puddings	Equipment, utensils, tools
Cream puddings Fruit puddings Custards	Kinds
	Whipped Molded Fruited
Flavoring puddings	
Various methods of cooking	Storage
Serving	
Garnishes for puddings	

Block XI - Desserts

Unit 3 - Sauces for Desserts

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Making cooked sauces	
Various kinds	
Making uncooked sauces	
Various kinds	
Cooking sauces	
Serving sauces	
Storage of hard sauces	

Unit 4 - Fruits

Preparing fresh fruits for dessert	Storage of fruit
Preparing dried fruits for dessert	Fresh Dehydrated Frozen

Unit 5 - Frozen Desserts

Making Sherbert

Mixing
Freezing
Serving

Making ice cream

Mixing
Freezing
Serving

OUTLINE OF SOCIAL-INDUSTRIAL RELATIONSHIPS

INDUSTRIAL RELATIONSHIPS

Note: The industrial relations, for which every skilled worker must have an understanding and appreciation form a definite part of the instructional program in all of the areas previously outlined.

Some of these are:

Materials of the Trade -- Source, manufacture, distribution, specifications, costs, etc.

Tools -- Operations and processes in this trade that affect the worker and his relationships with other workers.

Working Conditions -- Hours, pay, seasonal employment, health, recreation, morale; workers' responsibility for these conditions.

Health -- Personal and social hygiene; vital facts every worker should know about well-being.

Industrial Development -- Growth of the industry, its scope and trends; other industries that support it; its relationship to other industries; how organized; how supported; importance of time and costs records.

Industrial Organizations -- Trade, labor, and employer; what their functions are on the job; how these affect happiness of the worker.

Shop Relationships -- Those which concern fellow-workers and the "boss" on or off the job; how these affect efficiency and happiness of the worker.

Laws and Ordinances -- City, county, or state that affect the worker, his job, trade, and industry; worker's compensation, unemployment, social security, safety.

Public Relations -- Those factors having to do with consumer interests, confidence, honest work, fairness in dealings, loyalty to job.

Personality Characteristics -- Attitudes and habits that should be developed to make a successful craftsman; responsibility as a craftsman and citizen to join with others in promoting better working conditions for all and the civic and social welfare of the community.

Related Occupational Opportunities -- The extent to which this trade opens employment opportunities in related occupations.

SOCIAL RELATIONSHIPS

Note: The skilled worker also appreciates the contribution which his work can make in the areas of health, effective services, and general social and public relations. Such development forms a definite part of the instructional program.

Some of this instruction is along the following lines:

1. The individual in relation to special observances and current events

2. The individual -- a member of varying social groups (home, social, club, church, etc.)

3. The individual in his leisure time

4. The individual in his inner life and development of character

5. The individual worker in a trade or occupation presenting distinctive opportunities

6. The individual worker in relation to specific jobs, economic issues, and problems

7. The individual in relation to major civic and social issues

8. The individual in occasions of special personal government services

9. The individual in a legally constituted state

10. The individual worker in relation to specific jobs involving the lives of others

11. The individual worker in relation to specific jobs involving the safety of fellow workmen

12. The individual worker in relation to specific jobs involving the happiness and contentment of others

IV. SAMPLES OF INSTRUCTION SHEETS

JOB SHEET

Block IX - Salads

Job 5 - Salad Dressings (French Dressing)

Aim: To make a sweet French dressing that does not separate, using the electric mixer.

Utensils: Tray, bowl, mixer-electric, measuring spoon, measuring cup, quart jar to store it in.

Materials	Quantity Required for 3 Cups	Cost
Salad Oil	2 C.	
Mustard	1 Tsp.	
Salt	2 Tsp.	
Sugar	1 C.	
Celery Seed	1 Tsp.	
Vinegar or Lemon-Juice	½ C.	
Paprika	1 Tsp.	

Procedure

1. Assemble materials and utensils.
2. Mix the dry ingredients.
3. Add 2 Tbs. oil and beat slowly for 1 minute.
4. Add 1 Tb. vinegar and beat for 1 minute.
5. Add 4 Tbs. oil and beat for 1 minute.
6. Add 1 Tb. vinegar and beat for 1 minute.
7. Continue adding and beating until all oil and vinegar has been used.
8. Give the mixture a final 2 minute beating.
9. Store in a quart jar.
10. Clean well around the machine.
11. Figure cost.

INFORMATION SHEET

AIM: To Establish Good Work Habits

RULES RELATED TO GOOD HOUSEKEEPING

1. To cut vegetables, cut down on a wooden surface. (Use a chopping knife.)
2. If you spill food particles or liquids, wipe the floor at once.
3. Turn off the oven or burner when you have finished using it.
4. Keep fingers away from the cutting edge of slicer. (Disconnect the electric outlet before cleaning.)
5. Stop the beater while adding ingredients in the power mixers.
6. Keep all paper towels and pot holders away from the flame when removing hot foods.
7. Place trays on a flat surface while loading or unloading.
8. Be careful to follow printed instructions when turning the steam table off or on.
9. Follow rules of hygiene and sanitation. (Wash hands before beginning to work with food and after touching hair, face or handkerchief.)
10. Hair nets must be worn in the cafeteria.
11. All cuts and burns, however small, must be given first aid treatment.
12. Keep all garbage on trays while working at the tables.
13. Separate garbage, waste paper and cans. Place in the correct container.
14. Keep a clean damp dish cloth at your working space in order to keep the surface clean as you work.
15. Scrape and rinse all utensils used.
16. Wrap or cover all foods placed in the refrigerator.

V. SAMPLES OF TESTS USED

FOOD TRADES
Test

True and False

Directions: Draw a circle around the F if the statement is false.
Draw a circle around the T if the statement is true.

1. T F Disease germs may be present on cafeteria dishes that have been carelessly washed, wiped or stored.

2. T F Germs grow rapidly on food which is cooled quickly and stored in a good refrigerator.

3. T F You cannot taste harmful germs if they are present in cream pie.

4. T F Soap is a good germ killer.

5. T F Germs are the size of a pin head.

6. T F It is possible to wash cafeteria dishes correctly without a mechanical dish washer.

7. T F The water in which cafeteria dishes are to be washed may be tested for correct temperature by using the hand.

8. T F When putting dishes into a rack, for washing in a dish machine, all the cups, bowls and glasses should be turned upside down.

9. T F Stack all the plates you can get in the rack, for the dish washing machine, in order to get the best results in dish washing.

10. T F Scrape dishes, for washing, after a preliminary rinsing.

11. T F If cafeteria dishes are washed and rinsed properly they do not have to be dried by using a towel.

12. T F Water should be 170 degrees (Farenheit) for washing dishes.

13. T F If hot food is not to be served at once, it should be put immediately into the refrigerator.

14. T F 55 degrees (Farenheit) is a good temperature for the refrigerator.

15. T F Warm foods may stand uncovered on the kitchen table for eight hours without increasing the danger of its being safe to eat.

16. T F (A fry kettle in which you are preparing french fried potatoes has dripped over and caught fire.) The best way to put out the fire is to throw a large pail of water on it.

17. T F To cut raw vegetables for soup, place the vegetables on a wooden surface and cut down with a long straight knife.

18. T F A wet floor may be the cause of a serious fall.

19. T F If you spill food or water on the floor, complete whatever job you are doing and then return to wipe up the floor.

20. T F A kitchen chair is a good thing to stand on when you need to reach up high.

21. T F When cleaning the electric slicing machine, be sure that it is disconnected from the wall switch.

22. T F If you break the skin with a small cut, it is not necessary to use any first aid treatment.

23. T F When storing knives, the sharp edge of the blade should be placed into the groove of the rack.

24. T F You can starve roaches to the point of extinction by being sure that no food scraps are available to them.

25. T F A five percent D. D. T. solution is an effective spray to use in the control of roaches.

FOOD TRADES

Test

1. Name 4 kinds of rice.

2. Name 3 rules for cooking rice.

3. What food elements does rice contain?

4. Which of these food elements is present in the largest amounts in rice?

5. Tell the difference between the food value of converted, brown, and polished rice.

FOOD TRADES
Test

Performance - Evaluation

For All Employees

How did I look and how did I work today?

Place an X in the column which describes how you looked and how you worked today.

	YES	NO
1. Was my uniform clean and pressed?	___	___
2. Did I wear my hairnet?	___	___
3. Were my nails clean and well trimmed?	___	___
4. Did I wash my hands before starting to work?	___	___
5. Did I remove any bracelets, earrings, or necklaces?	___	___
6. Did I have all the buttons on my uniform?	___	___
7. Did I take off my blouse, sweater, skirt, or dress?	___	___
8. Did I work quietly with equipment?	___	___
9. Did I keep my voice low and not talk oftener than necessary?	___	___
10. Was I ready for work on time?	___	___
11. Did I plan my work so that I finished on time?	___	___
12. Did I follow directions?	___	___
13. Did I refrain from interrupting the teacher (or classmate) when someone was talking to her?	___	___
14. Did I leave equipment clean and in its place?	___	___
15. Did I cooperate with others?	___	___
16. Did I do my work cheerfully?	___	___
17. When I finished my work, did I help someone else?	___	___
18. Was I courteous to guests and to classmates?	___	___
19. Did I do my finish-up work properly?	___	___
20. Did I get permission to go to the lavatory?	___	___
Total Score (5 points for each Yes)		

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ABSTRACT - This curriculum guide was developed by school personnel to prepare students for occupations in painting and decorating. Students for this 3-year program must have color sense, muscular coordination, and good health. The manual includes sample instruction sheets, tests, and suggestions for the organization of the course. Blocks of time cover the manipulative skills and technical knowledge for (1) interior and exterior painting, (2) wall covering, (3) color and color harmony, (4) woodfinishing, (5) special wall finishes, and (6) estimating. A total of 1,620 shop hours is estimated for the program. (JS)

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PAINTING AND DECORATING

CURRICULUM GUIDES
in Trade and Industrial Education

Public Schools of the District of Columbia

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Public Schools of the District of Columbia

CARL F. HANSEN, Superintendent

Curriculum Guides in Trade and Industrial Education

PAINTING AND DECORATING

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VT 008 499

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FOREWORD

General Statement of the Trade

Paint has been used by man almost from the beginning of his culture. No one knows the exact date but the Bible tells us that Noah used "pitch" on the Ark. Its value as a beautifier and preservative is so universally recognized as to assure a continuing demand for craftsmen skilled in its use.

Today's student or journeyman painter must acquire and retain a much larger body of knowledge than ever before. This is due to the revolutionary changes that have taken place in recent years in the manufacture of new materials pertaining to painting.

A knowledge of painting materials and the development of skills in their application are basic requirements for the painter. He then may properly select and apply paints which most satisfactorily meet specific needs. He will be able to follow specifications and discuss intelligently present-day paints and painting materials.

Prerequisites of Entrance into the Trade

The individual who desires to enter the painting and decorating trade must be in good health and possess good muscular coordination. He must be able to climb and to work at various heights and angles. He must have good eyesight and possess a color sense. His respiratory system ust be able to withstand the accompanying odors and fumes which are by-products of the trade. Usually, the painter is in close contact with the public and it is necessary that he be able to employ tact and self control. A high school diploma is desirable.

Time Required to Complete the Course

The time requirement for a high school diploma and a certificate in the Painting and Decorating course is three (3) years. Laboratory practice or shop work is scheduled for three (3) clock hours daily, 15 hours per week. One and one-half hours per day are spent in related subject-science, mathematics and/or drafting. One and one-half hours are spent in academic subjects. Five hundred and forty (540) hours are spent in shop work per year - a total of 1620 hours for the three year course.

OBJECTIVES

The objective of vocational trade training is to prepare selected students for employment through the development of occupational skills required for doing satisfactory work under actual employment conditions; the acquisition of technical information definitely related to the specific vocation; the formation of desirable attitudes and habits in terms of craft practice; and the cultivation of an appreciation of work and an attitude toward it that will contribute to civic and social efficiency.

General

The general objectives of the courses of study in Trade and Industrial Education are to develop in the students the ability to:

1. Perform various manipulative skills that will permit the student to enter employment (initial) in the field of painting and decorating and to advance rapidly in efficiency and in the salary scale.

2. Understand the application of basic principles of the science, mathematics, and related technical knowledge that condition the manipulative skills.

3. Appreciate the social and industrial relationships in connection with the contribution which a worker can make in the areas of health, effective services, and general social-industrial and public relations.

Specific

The specific objectives of the course of study in Painting and Decorating are to:

1. Provide instruction and develop skills in the basic fundamentals of painting and decorating necessary for successful entrance into the trade, or as an addition to the training of the paperhanger.

2. Work neatly and cleanly with consideration for the environment in which he is performing his job, bearing in mind that the painter and decorator sometimes performs his tasks in completely and lavishly furnished homes.

3. Familiarize the student with the best sources of materials and to estimate economically the amount of materials necessary.

4. Develop manipulative skill in mixing and blending paints and stains, and to develop a routine which can be repeated with machine-like precision.

GENERAL ORGANIZATION

General Statement of Methods of Instruction

To best teach the variety of skills, the related technical knowledge, and the social-industrial relationships needed to equip students entering this trade, many methods of teaching are necessary. Each method has distinctive features that cause its use to be best suited for the teaching of a special type of skill or knowledge.

In teaching shopwork, the following methods are used:

1. Demonstrations
2. Explanation
3. Visual Aids
4. Questioning
5. Instruction Sheets
6. Individual Projects
7. Directed Technique Study
8. Group Projects
9. Problem-Solving Activities
10. Field Trips

In teaching the related technical knowledge and social-industrial relationships, the following methods are used:

1. Discussion
2. Directed Study
3. Questioning
4. Individual Reports
5. Written Reports
6. Visual Aids
7. Field Trips
8. Weekly Critiques

Time Schedule Allotment

BLOCK I	Painting: Interior; Exterior	1080 hrs.
BLOCK II	Woodfinishing	270 hrs.
BLOCK III	Color and Color Harmony	65 hrs.
BLOCK IV	Estimating	65 hrs.
BLOCK V	Special Wall Finishes	65 hrs.
BLOCK VI	Wall Covering	75 hrs.
		1620 hrs.

Type of Testing Program Used

More than one instrument is used to determine the effectiveness of teaching and to evaluate the achievement of students in the areas of manipulative skills, related technical knowledge, and social-industrial relationships. These are under the general headings of performance and written tests. One sure way to determine whether a student can do something is to have him actually try to do it. Hence, manipulative skills are tested continually in connection with every job.

These tests are referred to as performance. In evaluating total performance, consideration is given to the various elements that are significant in the trade areas involved. For example:

1. Safety
2. Techniques
3. Finished Product
4. Time and Effort Expended
5. Use and Care of Tools, Equipment, and Materials

The rate of progress in the assimilation of related information is revealed in the ability of the student to apply such knowledge to pertinent jobs, and in his achievement on written tests which are given at regular intervals. Written tests may be objective or essay in form or a combination of both. Sample tests are included in this course of study in a separate section.

Evaluation of Student Progress

Students progress in the manipulative skills according to their demonstrated ability to meet trade standards. They are required to repeat a job until proficiency is reached before they are permitted to advance to the next job. Their rate of progress and the evaluation of it are recorded on a progress chart.

Performance and written test achievement are interpreted as follows:

A	Outstanding	95 - 100
B	Above Average	85 - 94
C	Average	75 - 84
D	Below Average	70 - 74
F	Unsatisfactory	Below 70

Text and Reference Books

1. Audel, Theodore. New York. Painting and Decorating Working Methods.
2. Ewing and Harris, Chicago, Illinois. Practical Instruction in Paperhanging.
3. Goodheart-Wilcox Co., Inc., Chicago, Illinois. Painting and Decorating Encyclopedia.
4. Kent, Donore. National Paint, Varnish & Lacquer Association, Inc. Paint Power and How to Sell It. Latest Edition.
5. Kinney, Ralph P. Charles Scribner's Sons, New York. The Complete Book of Furniture Repair and Refinishing.
6. Painting and Decorating Contractors Association, Inc., Brotherhood of Painters and Decorators and Paperhangers of America, Washington, D. C. Painting and Decorating Apprentice Training Course; first year, second year.
7. Painting and Decorating Contractors of America, Inc., Chicago, Illinois. Painting and Decorating Craftsman Manual and Textbook. Revised Edition.

OUTLINE OF INSTRUCTION

BLOCK I - Painting: Interior, Exterior

UNIT I - Stock Room Work

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 1	
Cleaning pots and brushes	Shop orientation Shop rules Shop safety Health precautions Description of the paint trade Opportunities in the trade Study of the materials and procedures used in cleaning used pots and brushes Special precautions necessary Study of the need for properly prepared pots and brushes Study of the history, kinds, and manufacture of brushes
Job 2	
Using pigments and vehicles	Study of opaque coating materials Comparison of pigments and dyes and where they are employed Study of basic whites for hiding power and as extenders Study of exterior influences such as: rain, sun, heat, light, abrasion, scuffing and wear - also, corrosion, rotting and smoke Study of the chemistry of white pigments - Titanium dioxide White lead Zinc oxide Study of extender pigments Study of vehicles: Linseed oil Other oils Resins Turpentine Mineral spirits Lacquer solvents Alcohol

OUTLINE OF INSTRUCTION

BLOCK I - Painting: Interior; Exterior

UNIT I - Stock Room Work - continued

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 3	
Mixing colors to apply on mock-up wall	Study of color pigments to tint white for yellow, red, purple, blue, and green points Study of the physics of color pigments Study of common groups of color pigments -- Earth colors Precipitation pigments Fire process Fume process Black pigments Metalic pigments
Job 4	
Puttying mock-up wood surfaces Making Swedish putty	Study of putty, caulking compounds, and fillers and their use Types of putty: White lead Whiting Linseed oil Home-made putty mixtures: Linseed oil and whiting Sawdust and glue Plaster of Paris Spackling putty Use of the putty knife stop.

OUTLINE OF INSTRUCTION

BLOCK I - Painting: Interior; Exterior

UNIT II - Interior Painting and Decorating (New Wood)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 1	
Applying paint to a small object	How to select the proper brush, paint, color, finish, position of object for best handling, ventilation, light, clothing and safety Study of the properties of the object for the purpose of preparing the surface to receive the paint
Job 2	
Preparing and applying paint to a plastered surface on a mock-up wall	Study of the needs for the primary coat of paint - how it is applied to larger objects Study of nomenclature and terms of the trade to describe tools used and objective to be reached
Job 3	
Preparing and applying paint to a wood surface on a mock-up wall with openings	Study of the use of driers to hasten oxidation: Kinds to use Care in use Study of the selection and use of proper brushes: Types and use of paint rollers
Job 4	
Applying additional coats of paint to surface on mock-up wall	Study of the effects of multiple coats of paint: Proper preparation Drying period Treatment of knots and resin streaks in wood

OUTLINE OF INSTRUCTION

BLOCK I - Painting: Interior; Exterior

UNIT II - Interior Painting and Decorating (New Wood)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 5	
Setting up and using a ladder indoors	Study of the kinds and construction of ladders: The single or straight ladder The extension ladder The trestle ladder - With extension The step ladder Study of ladder safety Use of paint bucket books
Job 6	
Protecting surfaces with drop cloths	

BLOCK I - Painting: Interior; Exterior

UNIT III - Painting (Old Work)

Job 1	
Preparing and applying paint on a previously painted plastered surface	Study of the effects of applying paint over unclean surfaces: How to clean off - Grease Dust and dirt Wax Gloss Chalked paint Scaled and chipped paint Review of related information in previous unit
Job 2	
Preparing and applying paint on a previously painted wood surface	

OUTLINE OF INSTRUCTION

BLOCK I - Painting: Interior; Exterior

UNIT IV - Exterior Painting

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 1	
Applying paint to a mock-up exterior surface (new work)	Study of the methods used in puttying, caulking, and treatment of knots and resin streaks Study of the effects of moisture on exterior wood surfaces Study of the effects of using a priming coat of paint and additional coats
Job 2	
Applying paint to a mock-up surface previously painted	Review of previous unit Study of treatment of surface: Check and loose paint Blistering Cracking Alligatoring
Job 3	
Replacing loose putty in window sash	Review of puttying
Job 4	
Replacing broken window glass	How to remove broken glass Sizes of new glass Review of puttying Inserting new glass Sealing with putty How and when to remove the sash Safe handling of glass
Job 5	
Preparing and painting a metal surface	Study of types of paint for metal surfaces Cleaning: Mechanically Chemically How to prepare for painting: galvanized iron; zinc; copper; tin plate; aluminum

OUTLINE OF INSTRUCTION

BLOCK I - Painting: Interior; Exterior

UNIT IV - Exterior Painting - continued

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 6	
Preparing and painting a masonry surface	Study of the reason for painting masonry: Decorative Protecting Keeping out moisture How to remove loose mortar How to refill joints and cracks
Job 7	
Setting up and using ladders and scaffolds out-of-doors	

BLOCK I - Painting: Interior; Exterior

UNIT V - Spray Painting

Job 1	
Spray painting a mock-up wall section	Study of equipment used: Spray gun Paint container Cup Pressure tank Air compressor Air regulating and purifying device Air and fluid hose Study of materials used: Lacquers Multi-colored spatter type of paint House paints Enamels Masking materials Study of the air regulation and the proper air pressure to use with spray gun Study of the proper techinque for handling the spray gun:

OUTLINE OF INSTRUCTION

BLOCK I - Painting: Interior; Exterior

UNIT V - Spray Painting - continued

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 1 - continued	
Spray painting a mock-up wall section	a. Getting the feel of the spray gun b. Proper pattern to use c. Stroke d. Distance e. Position
Job 2	
Cleaning the spray gun	Study of the proper procedure in cleaning the spray gun Study of safety precautions

OUTLINE OF INSTRUCTION

BLOCK II - Woodfinishing

UNIT I - Preparing and Applying Finish to New Wood

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 1	
Applying finish to small object: - Box or chest (small) Table (small) Chair - Other objects	Study of the preparation of the surface for finishing: a. Proper order - Sanding Bleaching Staining Applying filler Sealing Applying top coats
Job 2	
Finishing large objects: (new) Table Chest Cabinet Other	Study of woods used in furniture manufacture: Hardwood Softwood - Open-grained Close-grained Study of manufacture and use of abrasives and power sanders: Use of sanding block Use of sack rag
Job 3	
Finishing additional pieces of furniture and cabinets	Study of types and safe use of bleaches Study of kinds, mixing, and applying stains: Water stain Oil stain Spirit stain Acid stain Application of filler Application of sealer Study of the sources and manufacture of shellac and varnish Application of shellac Application of varnish: Brushing technique Number of coats Rubbing and polishing Rubbing machines Application of wax Study of the process of floor finishing

OUTLINE OF INSTRUCTION

BLOCK II - Woodfinishing

UNIT II - Refinishing Previously Finished Objects

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 1	
Removing old finish from small object: Chest Chair Small table Other	Study of application and safe use of paint and varnish removers: Vessel to use Tools Housekeeping practices Safe use of materials Review of Unit I information for proper procedure of finishing after removal of old finish
Job 2	
Refinishing Job 1	

BLOCK II - Woodfinishing

UNIT III - Repair and Touch-up of Finishes

Job 1	
Repairing and/or touching up a small furniture piece: With minor scratches With severe scratches, blemishes, or burns	Study of patching and repairing furniture finishes: Technique Study of method used to: Remove burns Remove alcohol marks Other blemishes
Job 2	
Filling the damaged area of a piece of furniture with stick shellac	Use of stick shellac: Source of material Selection Technique Tools used

OUTLINE OF INSTRUCTION

BLOCK II - Woodfinishing

UNIT III - Repair and Touch-up of Finishes - continued

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 2 - continued	
Filling the damaged area of a piece of furniture with stick shellac	Study of the matching of the old finish on replaced parts of furniture
Job 3	
Removing water marks and white spots from a piece of furniture	Types of materials used to remove water marks and/or alcohol spots Technique and various methods used
Job 4	
Removing alcohol spots from a piece of furniture	

BLOCK II - Woodfinishing

UNIT IV - Special Finishes

Job 1	
Applying an antique finish to a piece of furniture, a cabinet, or picture frame	Study of materials and method of application of special finishes: Antique Shellac French polish Lined Glazed
Job 2a	
Applying a shellac finish to a piece of furniture, a cabinet or picture frame	
Job 2b	
Applying a shellac finish to a piece of furniture or other object	

OUTLINE OF INSTRUCTION

BLOCK II - Woodfinishing

UNIT IV - Special Finishes - continued

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 3	
Applying a French polish finish to a piece of furniture or other object	Special techniques Source of materials Tools used Precautions
Job 4	Fumed Blond
Applying a limed oak or mahogany finish to a piece of furniture or other object	
Job 5	
Applying a glazed finish to a piece of furniture or other object	

BLOCK II - Woodfinishing

UNIT V - Enameling Furniture

Job 1	
Applying an enamel finish to a piece of furniture or other object	Review of surface preparation: a. Applying the undercoat b. Applying the enamel - Composition of enamel Technique of application Effects of temperature Cleanliness Types of brushes to use Review of varnish finish techniques

OUTLINE OF INSTRUCTION

BLOCK III - Color and Color Harmony

UNIT I - How We See Color

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 1	
Drawing a diagram of the eye to show how we see color	Study of the psychology of color Study of color dynamics: Tinting Shading Toning Study of the effect of color and the human reaction to color: Colors that give a "warming" effect Colors that give a "cooling" effect

BLOCK III - Color and Color Harmony

UNIT II - The Color Wheel

Job 1	
Making a color wheel and showing the primary and secondary colors	Study of the primary colors in the color wheel Study of the secondary colors in the color wheel: Complementary colors Harmonious colors Colors that clash Hue Monochromatic harmony Color harmony pattern Study of the effect of light on color: White light The prism The spectrum Color which is absorbed Reflected color

OUTLINE OF INSTRUCTION

BLOCK III - Color and Color Harmony

UNIT III - Mixing Color

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 1	
Mixing a color in oil paint	Use of four pigments to make the desired color Study of the effects of mixing color complements: Use of red Change in drying Floating The colors-in-oil Use in tinting
Job 2	
Mixing a color in latex paint	Review of information in Job 1 Study of dry or powdered pigments for coloring Study of modern discoveries in new paint materials: Cost Ease of application Quick drying qualities Chemical composition Study of the use of water color pigments
Job 3	
Mixing a color to match an old paint	Study of the problems in matching old paint: Determining color Determining hue Allowing for drying Dry lighter Dry darker Feathering the old paint Building the surface Other techniques Tools used

OUTLINE OF INSTRUCTION

BLOCK IV - Estimating

UNIT I - Materials and Labor

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 1	
Estimating the cost of materials and labor for a small paint or finishing job.	Review of basic arithmetic Finding areas Decimals Reading the rule Study of procedure for determining: Area to be painted Cost of materials to be used Time consumed to complete the job
Job 2	
Estimating the cost of material and labor for a large paint or finishing job	Study of short cuts in estimating large jobs: From blueprints Two kinds of estimates

OUTLINE OF INSTRUCTION

BLOCK V - Special Wall Finishes

UNIT I - Stipple Finish

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 1	
Applying a stipple finish on a mock-up wall	Study of the preparation of the surface to receive the stipple finish Review of wall preparation for paint: Plaster Wood Study of the type of paints to use and application: Technique Tools Review of housekeeping Use of texture paints

BLOCK V - Special Wall Finishes

UNIT II - Glazed or Wiped Finish

Job 1	
Applying a glazed or wiped finish to a section of mock-up wall	Review of Job 1, previous unit - Surface Preparation Study of techniques employed in producing the glazed or wiped finish: Materials used Tools used Use of tinting colors-in-oil

BLOCK V - Special Wall Finishes

UNIT III - Sponge Transfer

Job 1	
Applying a sponge-transfer paint finish to a section of mock-up wall	Review of surface preparation Study of effects of the ground cost How the second coat is applied: Technique Materials used Tools used Housekeeping practices Review of safety in use of ladders and scaffolds

OUTLINE OF INSTRUCTION

BLOCK V - Special Wall Finishes

UNIT IV - Lining

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 1	
Producing painted lines on mock-up brick surface	Study of techniques used Study of tools and materials used Review of housekeeping and safety practices

BLOCK V - Special Wall Finishes

UNIT V - Marbling and Graining

Job 1	
Applying a marble effect on a section of a mock-up wall	Study of composition of marble: White Colored Serpentine marble Fossiliferous marble Use of sample marbles as desirable guides
Job 2	
Applying a grained effect on a mock-up panel	Study of wood grains and colors Use of sample wood pieces as a guide for reproducing various wood imitations Study of materials and tools used in marbling and graining: Triangular rubber graining comb Steel combs Badger blender Check roller Piped over grainer Bristle mottler Liners Study of techniques employed in using the tools of the trade to produce simulated marble and wood grain finishes

OUTLINE OF INSTRUCTION

BLOCK VI - Wall Covering

UNIT I - Wall Preparation

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 1	
Removing old paper from a mock-up wall	Safety precautions Review unit on ladders Care of tools Starting steamer Storing steamer Protection of floor and articles in the room
Job 2	
Washing wall just cleaned of old paper	Use of sponge and warm water: Where to start Where to stop How to clean up Protection of floors
Job 3	
Patching ordinary cracks and holes	Study of the result of untreated faults in a plastered wall Study of various kinds of patching materials Review of unit on puttying
Job 4	
Sizing the wall	Study of new plaster effect on paper covering: Without sizing With sizing Study of kinds of sizing used: Zinc sulphate solution Glue sizing

OUTLINE OF INSTRUCTION

BLOCK VI - Wall Covering

UNIT II - Laying Off The Wall for Wall Covering

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 1	
Laying out mock-up wall	Study of the use of plumb bob and chalking plumb line

BLOCK VI - Wall Covering

UNIT III - Paste Table Work

Job 1	
Setting up a paste table	Use of drop cloth Importance of proper light Location of paste table to job
Job 2	
Preparing paste	Kinds: Prepared Homemade Pails to use
Job 3	
Measuring and cutting strips of wallpaper	Study of kinds of wallpaper Study of matching strips How to remove curl

OUTLINE OF INSTRUCTION

BLOCK VI - Wall Covering

UNIT IV - Pasting

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 1	
Applying paste to wallpaper strips	Study of: Positioning of strips for pasting Proper amount of paste The paste brush Proper technique
Job 2	
Folding the strip of wallpaper	Study of folding methods
Job 3	
Trimming the strip of wallpaper	Study use of: Straight edge Trimming knife or razor Ready-trimmed edges Safety precautions

BLOCK VI - Wall Covering

UNIT V - Hanging Wall Coverings

Job 1	
Hanging short strips of wallpaper	Study of types of seams: The butt joint The wire-edge joint The lapped joint Study of smoothing the wallpaper strip: Techniques in the use of smoothing brush Study of the method and technique of trimming the wallpaper after applying it to the wall: Shears Trimming knife Trimming wheel At ceiling At baseboard Around openings Problems in matching the pattern in applying additional wallpaper strips

OUTLINE OF INSTRUCTION

BLOCK VI - Wall Covering

UNIT V - Hanging Wall Coverings - continued

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 2	
Hanging long strips of wallpaper	Review of previous job information
Job 3	
Hanging a 30" width wallpaper	Tools used Review of unit on ladders and scaffolds Safety precautions
Job 4	
Hanging a block-pattern wallpaper	
Job 5	
Hanging a border	
Job 6	
Hanging wallpaper over a doorway	
Job 7	
Hanging wallpaper around a window	
Job 8	
Hanging wallpaper in a stairway	

OUTLINE OF INSTRUCTION

BLOCK VI - Wall Covering

UNIT VI - Hanging the Ceiling Paper

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 1	
Hanging ceiling strips	Review of unit on ladders and scaffolds Review of safety precautions Review of paste table work Study of techniques used in hanging ceiling papers

BLOCK VI - Wall Covering

UNIT VII - Hanging Wall Coverings in Panels

Job 1	
Laying out a panel on a mock-up wall	Study of use of measuring tools Locating centers and wall divisions Review of use of plumb bob and plumb line
Job 2	
Applying a panel paper on a mock-up wall	Review of paste table work Review of units on hanging wall covering Study of technique used Review of safety precautions

OUTLINE OF INSTRUCTION

BLOCK VI - Wall Covering

UNIT VIII - Estimating Wall Covering Cost

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Job 1	
Estimating the materials and cost of applying wallpaper to a selected-size room.	Study of the standard of measurement for American-made wallpaper: Single roll Bolts Widths Lengths Allowance for openings Study of labor constants: Travel time Transportation Hours to be worked Degree of perfection Help needed Study of elements that constitute total cost: Overhead Depreciation Use of tools Waste (necessary) Profit

OUTLINE OF SOCIAL-INDUSTRIAL RELATIONSHIPS

INDUSTRIAL RELATIONSHIPS

The industrial relations, for which every skilled worker must have an understanding and appreciation, form a definite part of the instructional program in all of the areas previously outlined.

Some of these are:

Materials of the Trade -- Source, manufacture, distribution, specifications, costs, etc.

Tools -- Operations and processes in this trade that affect the worker and his relationships with other workers.

Working Conditions -- Hours, pay, seasonal employment, health, recreation, morale; worker's responsibility for these conditions.

Health -- Personal and social hygiene; vital facts every worker should know about well-being.

Industrial Development -- Growth of the industry, its scope and trends; other industries that support it; its relationship to other industries; how organized; how supported; importance of time and costs records.

Industrial Organizations -- Trade, labor, employer; what their functions are on the job; how these affect happiness of the worker.

Shop Relationships -- Those which concern fellow-workers and the "boss" on or off the job; how these affect efficiency and happiness of the worker.

Laws and Ordinances -- City, county, or state that affect the worker, his job, trade, and industry; worker's compensation, unemployment, social security, safety.

Public Relations -- Those factors having to do with consumer interests; confidence; honest work; fairness in dealings; loyalty to job.

Personality Characteristics -- Attitudes and habits that should be developed to make a successful craftsman; responsibility as a craftsman and citizen to join with others in promoting better working conditions for all and the civic and social welfare of the community.

Related Occupational Opportunities -- The extent to which this trade opens employment opportunities in related occupations.

SOCIAL RELATIONSHIPS

The skilled worker appreciates the contribution which his work can make in the areas of health, effective services, and general social and public relations. Such development forms a definite part of the instructional program.

Some of this instruction is along the following lines:

The individual in relation to special observances and current events

The individual -- a member of varying social groups: home; social; club; church; etc.

The individual in his leisure time

The individual in his inner life and development of character

The individual worker in a trade or occupation presenting distinctive opportunities

The individual worker in relation to specific jobs, economic issues, and problems

The individual in relation to major civic and social issues

The individual in occasions of special personal government services

The individual in a legally constituted state

The individual worker in relation to specific jobs involving the lives of others

The individual worker in relation to specific jobs involving the safety of fellow workmen

The individual worker in relation to specific jobs involving the happiness and contentment of others

SAMPLES OF INSTRUCTION SHEETS:

1. JOB
2. INFORMATION

PAINTING AND DECORATING

JOB SHEET

BLOCK II - Woodfinishing

UNIT II - Refinishing Previously Finished Objects

Job 1 - Removing old finish from a small chest

Objectives: To learn how to remove the old finish from a piece of furniture quickly, safely, and without damage to the object.

Reference: Kinney, Ralph P. The Complete Book of Furniture Repair and Refinishing.

Tools and Materials:

Bucket	Small painted chest	Paint remover
Scraper, putty knife	#2 Steel wool; burlap squares	Sand paper 6/0
Old brush	Old newspapers	Alcohol

Safety Precaution:

The use of paint remover requires a well-ventilated place and protective covering for the user's hands and eyes. Fumes and splashes dangerous or injurious to a person may result from careless handling.

Procedure:

1. Protect the surrounding area of work with a drop cloth or old newspapers.

2. Use a convenient height work table to hold the object from which the old finish is to be removed.

3. Carefully pour a small amount of the paint remover from its container into the bucket.

4. Use a brush to apply the remover to all of the parts from which the old finish is to be removed.

   Note: Follow the safety precautions described above.

5. Allow the time specified in the manufacturer's directions on the container for the action of the remover to take place. Do not allow it to dry.

6. Scrub or work with #2 steel wool. Use the paint scraper to remove difficult spots that remain.

   Note: It may be necessary to make a second application of paint remover to complete the job.

   Wipe off as much of the remaining finish as possible, using burlap squares, or crumpled paper.

7. Wash the entire job with alcohol on a piece of cloth and wipe dry. This not only cleans traces of the remover from the surface but neutralizes its further action.

8. Clean up work area and use special caution to prevent fire by placing used waste in a metal container.

9. Wash hands well with plenty of soap and water.

10. After the chest is entirely dry (24 hrs.), use five-grain sand paper to restore a smooth finish to all surfaces.

<u>Assignment Questions:</u>

1. What safety precautions should be taken when attempting to remove the old finish with paint remover?

2. Why is alcohol recommended as a wash after using paint remover?

3. Why is it necessary to dispose of waste from a paint-removing job immediately?

4. Is it of any consequence to protect skin and eyes while using paint remover? Why?

5. When does it become necessary to reapply fresh paint remover?

PAINTING and DECORATING

INFORMATION SHEET

BLOCK II - Woodfinishing

UNIT II - Refinishing Previously Finished Object

Job 1 - Removing Old Finish from a Small Chest

Topic: Paint and Varnish Removers

Paint and varnish removers are made of chemical solvents which, when spread over old finishes, soften the finish and permit it to be removed with a steel scraper, putty knife, and steel wool.

There are various liquids which may be used to remove paint and varnish such as caustic soda, wood alcohol, acetone, ammonia and others, but as a general rule it is advisable to purchase ready-made removers.

Paint and varnish removers fall into two principal catogories: 1. those with a wax or paraffin base, and 2. removers that are wax free. They are again classified as inflammable and non-inflammable types.

In the wax-base remover, wax forms a floating film over the solvent to prevent rapid evaporation. The wax (or paraffin) must be carefully removed with a cleaning agent such as naphtha, denatured alcohol, turpentine, or benzine before proceeding with the refinishing, otherwise its presence will cause non-drying of future coats and lack of bond. Alcohol is usually best because it does not dissolve the wax. Solvents which dissolve the wax sometimes cause them to penetrate into porous surface should also be washed with some alkaline material such as a trisodium phosphate solution in hot water to remove wax traces remaining. This should be followed by many rinsings and drying to render the surfaces for repainting.

Special removers are made for lacquer finishes and produce better results than the ordinary removers.

Removers that are wax-free usually work slower than the wax-base removers, but have the advantage of eliminating the need for a wax solvent.

The painter should exercise great care in handling removers, since they can burn the skin, eyes, and clothing. They can damage other surfaces with which they come in contact. Because of the highly flammable nature of many removers, special precautions should be taken to prevent fire. The manufacturer's instruction and directions should be followed carefully. Neutralizing solution should be at hand to counteract the effects of the remover in case of an accident. Read the labels carefully and follow the advice given.

SAMPLES OF TESTS USED

PAINTING AND DECORATING

SAMPLES OF TESTS

BLOCK I

UNIT IV

Job 2

Test 1

Word Selection Test

Answer the following statements by writing, in the space provided, the letter preceding the correct answer.

1. _____ Prevailing practice provides that a coat of filler should be applied before varnishing (a) cross-grained woods (b) open-grained woods (c) close-grained woods.

2. _____ A typical close-grained wood is (a) oak (b) ash (c) yellow pine (d) chestnut.

3. _____ Before additional coats are applied, dry undercoats of varnish (a) should have their gloss increased by polishing with wax (b) should have their gloss removed by rubbing with sandpaper (c) should have their gloss dulled by dusting powder.

4. _____ Shellac is recommended as (a) an interior varnish (b) an exterior varnish (c) either an interior or exterior varnish if alcohol is added to it.

5. _____ Standard practice permits the use of a filler before varnishing on (a) interior surfaces only (b) exterior surfaces only (c) either interior or exterior surfaces.

6. _____ The word most commonly used to describe an exterior varnish is (a) tar (b) spar (c) dammar.

7. _____ The most durable exterior-varnish coating is that having (a) a rubbed finish (b) a natural-gloss finish (c) a shellacked finish.

8. _____ The most permanent kind of wood dye is (a) an oil stain (b) an acid stain (c) a spirit stain.

9. _____ A good material to spot-coat knots and sappy streaks that might show through a prime coat of exterior paint is (a) shellac (b) creosote (c) pitch.

10. _____ Flat paint generally dries (a) slower than gloss paint (b) faster than gloss paint (c) at about the same speed as gloss paint.

PAINTING AND DECORATING

SAMPLES OF TESTS

BLOCK IV

UNIT I

Job 3

Test 1

True or False Test

Directions: The following statements are either True or False. Draw a circle around the T if the statement is True, or around the F if it is False.

1. T F Although some painting jobs are done on a time-and-material basis, many are performed under contract after an estimate of all costs has been made.

2. T F An estimate is a tabulation of expected labor and material costs for a proposed job.

3. T F A cost analysis is an itemized record of actual labor and material costs for a completed job.

4. T F Check lists are used to reduce estimating omissions.

5. T F Estimates should properly include miscellaneous costs such as those for insurance, permits, transportation, and replacement of equipment.

6. T F About one gallon of paint is required to single-coat the sash and frames of ten window openings of a brick building.

7. T F Generally, $1\frac{1}{2}$ pounds of calcimine will cover 100 square feet of surface.

8. T F Most contractors assume that one gallon of floor varnish will cover about 350 square feet of surface.

9. T F Generally, one gallon of gloss enamel will cover about 900 square feet.

10. T F A labor time of about 30 minutes should be allowed to apply a prime coat to 10 window sash and frames.

CURRICULUM UNITS IN TRADE AND INDUSTRIAL EDUCATION

1. Advertising Art
2. Automobile Body Rebuilding and Refinishing
3. Automobile Repair and Service
4. Baking
5. Barbering
6. Brick and Masonry Work
7. Cabinet Making
8. Carpentry and Millwork
9. Cosmetology
10. Costume Designing
11. Drafting (Architectural)
12. Drafting (Engineering)
13. Diesel Engine Repair and Service
14. Dressmaking
15. Dyeing and Cleaning
16. Electrical Construction, Maintenance and Repair
17. Electrical Wiring
18. Food Trades
19. Gasoline Powered Equipment
20. Household Operations
21. Industrial Electronics
22. Landscaping
23. Machine Shop Practice
24. Nursery Assistants
25. Oil Burner Repair and Service
26. Painting and Decorating
27. Photography
28. Photo-Lithography
29. Plumbing
30. Practical Nursing
31. Printing
32. Radio and Television
33. Refrigeration Service
34. Sheet Metal Work
35. Shoe and Leather Work
36. Tailoring
37. Typewriter Repair and Service
38. Upholstering
39. Wall Covering
40. Watch Repairing
41. Welding (Arc and Acetylene)

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ABSTRACT - This curriculum guide was developed by school personnel to prepare high school students for entry level positions as household cleaners, home launderers, personal maids, nurse maids, home caterers, and cooks. The manual has sample instruction sheets and tests as well as suggestions for the organization of the class. Blocks of time covering manipulative skills and technical knowledge are outlined for each occupation. Total shop hours were estimated at 1,620 hours. (JS)

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HOUSEHOLD OPERATIONS

CURRICULUM GUIDES
In Trade and Industrial Education

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Public Schools of the District of Columbia

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Public Schools of the District of Columbia
CARL F. HANSEN, Superintendent of Schools

Curriculum Guides in Trade and Industrial Education

HOUSEHOLD OPERATIONS

TRADE AND INDUSTRIAL EDUCATION

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Curriculum Unit on Household Operations

Prepared by

Rhetta W. Prudhomme

FOREWORD

A General Statement of the Trade

Household Operations claims the largest number of women workers in the nation. Almost every home is a potential place of business using one or more of the skills taught in this type of training. Many men are also going into this field and are becoming quite successful. It is believed that trained workers will become outstanding in their workmanship and be recognized and given a standard wage-earning occupation.

Prerequisites for Entrance Intc the Trade

General interest in the trade.

Have completed the ninth grade.

Pass the general entrance test given by the school.

Average intelligence.

Good health (including blood test and smear).

Aptitude in manual skills.

Ability to get along with people.

Time Required to Complete the Course

The requirement for a high school diploma and a certificate in the Household Operations course is three (3) years. Laboratory practice or shop work is scheduled for three (3) clock hours daily, 15 hours per week. One and one-half hours per day are spent in related subjects--science, mathematics and/or art. One and one-half hours are spent in academic subjects. Five hundred and forty (540) hours are spent in shop work per year--a total of 1620 hours for the three year course.

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I. OBJECTIVES

Note: It should be kept in mind that vocational industrial education, as it is known today, is not designed to develop skilled craftsmen as such. It is intended, through preparatory programs in basic fundamentals, to bring students to the entrance point of wage earning ability at advanced apprenticeship level. Rapid advancement thereafter (toward thorough understanding and skilled craftsmanship levels) is accomplished through actual work on the job and night supplementary trade extension courses.

General

The general objectives of the courses of study in Trade and Industrial Education are to develop in the students the abilities to:

Do the various manipulative skills that will permit their initial employment in the industry, rapidly increase their efficiency, and promote their advancement in the salary scale.

Understand the application of basic principles of the science, mathematics, and related technical knowledge that condition the manipulative skills.

Appreciate the social and industrial relationships in connection with the contribution which a worker can make in the areas of health, effective services, and general social-industrial and public relations.

Specific

The specific objectives of the course of study in Household Operations are:

To develop skills in regard to standard practices and procedures in household operations.

To develop an understanding of the related knowledge that condition the successful performance of the procedures in household operations.

To develop the ability on the part of the students to work harmoniously and cooperatively with others.

To develop the ability to understand and appreciate standards of health, safety, and sanitation.

To develop high standards of workmanship and to encourage initiative.

To develop an appreciation for artistic workmanship in the performance of jobs in household operations.

II. GENERAL ORGANIZATION

General Statement of Methods of Instruction

To teach best the variety of skills, the related technical knowledge and the social-industrial relationships needed to equip students entering this trade, many methods of teaching are necessary. Each method has distinctive features that causes its use to be best suited for the teaching of a specific type of skill or knowledge.

In teaching shopwork, the following methods are used:

Demonstrations	Individual Projects
Explanation	Directed Technique Study
Visual Aids	Group Projects
Questioning	Problem-Solving Activities
Instruction Sheets	Field Trips

In teaching the related technical knowledge and social-industrial relationships, the following methods are used:

Discussion	Written Reports
Directed Study	Visual Aids
Questioning	Field Trips
Individual Reports	

Time Schedule Allotment

Blocks	Occupational Areas	No. Hrs. Shop Work
I. Household Cleaning	Household Cleaner	400
II. Home Laundering	Home Launderer	150
III. Food Services	Preparing and Serving Meals	350
IV. Maid and Personal Services	Personal Maid	300
V. Caretaking Service	Nurse Maid	245
VI. Home Catering	Home Caterer--Preparing and Serving Special Meals, Parties, Etc.	175
	Total Hours	1,620

Type of Testing Program Used

More than one instrument is used to determine the effectiveness of teaching and to evaluate the achievement of students in the areas of

manipulative skills, related technical knowledge, and social-industrial relationships. These are under the general headings of performance and written tests. One sure way to determine whether a student can do something is to have him actually try to do it. Hence, manipulative skills are tested continually in connection with every job. These tests are referred to as performance. In evaluating total performance, consideration is given to the various elements that are significant in the trade area involved. For example:

Safety
Techniques
Finished Product
Time and Effort Expended
Use and Care of Tools, Equipment, and Materials

The rate of progress in the assimilation of related information is revealed in the ability of the student to apply such knowledge to pertinent jobs and in his achievement on written tests which are given at regular intervals. Written tests may be Objective or Essay in form or a combination of both. Sample tests are included in this course of study in a separate section.

Evaluation of Student Progress

Students progress in the manipulative skills according to their demonstrated ability to meet minimum trade standards. They are required to repeat a job until minimum proficiency is reached before they are permitted to advance to the next job. Their rate of progress and the evaluation of it are recorded on a progress chart.

Performance and written test achievement are interpreted as follows:

A	Outstanding	95 - 100
B	Above Average	85 - 94
C	Average	75 - 84
D	Below Average	70 - 74
F	Unsatisfactory	Below 70

Text and Reference Materials

Text Books (used and/or recommended)

Housekeeping Work Book - How TO DO IT, by Balderson
Americas Housekeeping Book - New York Herald Tribune Home Inst.
At Work in the Kitchen, by Wieland

Reference Books

Household Workers - Harper and Brothers
Training for Household Service Occupations in the American Home, by Helen Livingstone
A.B.C's of House Cleaning - U. S. Office of Education
Setting Your Table, by Sprackling
Table Service, by Lucy G. Allen

Magazines

Good Housekeeping	Home Living	Practical Home Economics
American Home	Co-Ed	What's New

III. OUTLINE OF INSTRUCTION

Block I - Household Cleaning

Unit 1 - Cleaning Walls and Ceilings

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Cleaning Walls and Ceilings	Related Information (Misc.)
Painted	Purpose of the course
Papered Washable Non-washable	Employment future (employment chart)
Paneled	Qualifications of Household Operations Workers
Water base finish paint	Personality traits Good grooming Health habits
Sanitas and Walltex	Attitudes Knowledge and skill needed
Tile	Applying for a position as "Selling Yourself"
	How to make and keep appointments How to write a letter and answer one How to apply for a job through the daily papers How to dress for an interview How to conduct yourself during an interview Employer-employee relationships
	Trade Terms and Their Meaning

Block I - Household Cleaning

Unit 2 - Cleaning Woodwork

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Cleaning Woodwork Painted Varnished Waxed Stained Special problems	Work Plans, Daily, Weekly, Seasonal Parts and Operation of Tools and Equipment Used in Household Cleaning Care in use Care not in use Related Science Study of Cleaning Supplies Used in Household Cleaning Composition Effects Safety precautions Electrical Appliances Used in Household Cleaning Definition of common electrical terms Identification of parts of electrical appliances Safety in use of electrical appliances Metals Used in Household Cleaning Composition Effects of certain chemicals on metals Safety precautions in using various metals

Block I - Household Cleaning

Unit 3 - Cleaning Windows and Windows and Window Fittings

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Cleaning Windows and Window Fittings	Gas Appliances
Glass	Etc.
Shades	Related Mathematics
Venetian blinds	Review of Fundamental Mathematical Processes
Bamboo	Addition Subtraction Multiplication Division Fractions Decimals Percentage Weights Measures (liquid & dry)
Valences or cornice boards	
Screens	
Draperies and hanging	
	Application of Mathematical Principles in Calculating
	Cost of materials used for a job Preparing solutions from directions on labels Costs of jobs Etc.

Block I - Household Cleaning

Unit 4 - Special Cleaning Problems

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Special Cleaning Problems	
Mirrors	
Pictures	
Lighting fixtures	
Lamp bases and shades	
Telephones	
Pianos	
Books	
Fireplaces	
Radiators	
Refrigerators	
Stoves	

Unit 5 - Care of Metals

Care of Metals

Brass
Aluminum
Bronze
Chromium
Copper
Iron
Nickel
Pewter
Silver
Zinc

Unit 6 - Care of Furniture

Care of Furniture

Finished wood
Upholstered
Leather
Wicker
Willow
Other types

Block I - Household Cleaning

Unit 7 - Care of Floors

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Care of Floors	
Finished wood	
Unfinished wood	
Linoleum	
Composition	
Clay tile	
Marble	
Cement	
Other types	

Unit 8 - Rugs and Carpets

Pile rugs
Oriental rugs
Stair carpeting
Scatter rugs
Nylon and acrilan carpets
Pads
Etc.

Unit 9 - Dishwashing

China
Glass
Plastic
Silver
Cooking utensils

Note: This may be by hand or machine

Block II - Home Laundering

Unit 1 - Operating Home Laundering Equipment

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Operating Home Laundering Equipment	Related Science
Washing machines (various kinds)	Science of Materials
Dryers (various kinds)	Cottons Woolens Silk Nylon Dacron Other materials
Home mangles (various kinds)	
Steam and dry irons	Chemical Effects of Soaps and Detergents Used in Washing Various Materials
	Study of Machines Used in Home Laundering
	Washers (various types) Irons Mangles Dryers
	Chemistry of Stain Removers Used on Various Materials
	Related Mathematics
	Calculating Service Charges for This Type of Work
	Measurements
	Calculating Amount of Materials to be Used in
	Removing stains Washing clothes

Block II - Home Laundering

Unit 2 - Washing the Family Clothes

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Washing the Family Clothes	Related Art
Cottons Silks Woolens Nylons Other new fabrics	Artistic Folding of Garments and Linens Blocking Sweaters

Unit 3 - Washing the Household Linens

Washing the Household Linens

Sheets
Pillow cases
Towels
Napkins
Table cloths
Spreads
Blankets

Unit 4 - Ironing the Family Clothes Using Steam and Dry Irons

Ironing the Family Clothes Using Steam and Dry Irons

Cottons
Silks
Woolens
Nylons
Other new fabrics

Block II - Home Laundering

Unit 5 - Ironing the Household Linens Using Man

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Ironing the Household Linens Using Mangles or Steam and Dry Irons	
Sheets	
Pillow cases	
Towels	
Napkins	
Table cloths	
Spreads	

Unit 6 - Removing Common Stains

Removing Common Stains	
Fruit	
Tea	
Coffee	
Chocolate and cocoa	
Blood	
Ink	
Iron rust	
Etc.	

Unit 7 - Additional Procedures in Home Laundering

Additional Procedures in Home Laundering	
Starting family laundry	
Rinsing, if not included in washing machine process	
Bluing	
Starching	
Drying	
Folding of washed articles	
Sprinkling	

Block III - Food Services

Unit 1 - Food Services for Breakfast

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Setting table for breakfast Family breakfast Special occasion breakfast Etc. Preparing and serving of breakfast foods Fruits Fresh uncooked fruits Fresh cooked fruits Dried cooked fruits Beverages for breakfast Tea - different methods Coffee - different methods Milk drinks Fruit drinks Etc. Cereals for breakfast Hot cereals Cold cereals Breads for breakfast Popovers Biscuits Muffins - different kinds Cornbread Waffles Griddle cakes Etc.	Related Science Source of All Common Foods Used in the Course Composition and Values of Foods in the Diet Classification of Foods as to Content, Source and Value The Effect of Heat and Cold on Foods The Meaning of Trade Terms and in Preparing and Serving Foods Study of Tools and Equipment Used for Food Services in the Home Sanitation Food Spoilage Causes Prevention Chemistry involved Digestion and Health Habits Nutrition as Related to Food Preparation Energy Requirements for Individuals

Block III - Food Services

Unit 1 - Food Services for Breakfast (Cont'd.)

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Main dishes for breakfast Creamed eggs on toast Creamed salmon on toast Creamed chipped beef on toast Codfish cakes Salmon patties Broiled bacon Eggs fixed in different ways Etc.	Dietary Balance and Analysis Basic Food Chemistry Related Mathematics Fundamental Mathematical Processes Calculating Costs Cost Control Record Keeping Recipe Calculations Related Art Table Setting Artistic Arrangement of Food Color Harmony Decorating Food Dishes to Make Them Attractive Table Decorating Holiday Decorating of Tables

Block III - Food Services

Unit 2 - Food Services for Luncheons

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Setting Table for Luncheons	Related Information
Family luncheons Special luncheons for guests Bridge luncheons Picnic lunches Etc.	Basic Principles of Menu Planning and Making
	Marketing
	Terminology for Food Services
Preparing and Serving Luncheons	
	Tricks of the Trade
Cocktails Soups and Bouillons Salads Vegetable Fruit Fish Meat Meats or Fish Dishes Baking Roasting Braising Sautéing Creamed and escalloped dishes Hot breads Cakes and desserts Sandwiches and cookies Beverages - variations Garnishes for various dishes	Time Savers and Short Cuts
	How to Use a Cook Book
	Marketing and Making Grocery Lists
	Economy in Food Preparation

Block III - Food Services

Unit 3 - Food Services for Dinner

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Setting Table for Dinner	
Family dinner	
Dinner for guests	
Holiday dinners	
Preparing and Serving Dinner	
Appetizers	
Soups	
Salads	
Meats	
Poultry	
Fish	
Vegetables	
Dressings	
Gravies and sauces	
Desserts	
Bread (various kinds)	
Beverages	
Hot	
Cold	

Block IV - Maid and Personal Services Work

Unit 1 - Personal Maid's Work

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Personal Services to the Household	Related Information
Answering door summons Answering the telephone Errands Taking care of deliveries and agents Assisting guests Mending Pressing clothes Taking and delivering messages Assisting hostess with dressing Assisting children with dressing Preparing the bedroom for night Preparing the house for evening, adjusting lights, heat, and windows	Essentials for Success in Being a Personal Maid in a Household Code of Ethics for the Personal Maid

Block V - Caretaking Services

Unit 1 - Caring for Children

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Preparation of Children's Food	Related Information (Misc.)
Serving of Children's Meals	Planning Schedule
Bathing and Dressing of Small Children	Management of Children and Elderly Persons
Giving First Aid	Emotional Problems of Children
Recreational Activities	Essentials for Success in Caretaking Services
Etc.	Personality Honesty Reliability Kindness Accuracy
	Fundamental Principles and Rules of Oral and Written Expression
	Related Science
	Knowledge of First Aid
	Nutrition
	Basic Food Chemistry

Unit 2 - Baby Sitting

Entertaining Children

Telling stories
Playing games
Singing
Reading

Preparing Children for Bed

Block V - Caretaking Services

Unit 3 - Care of Elderly Persons

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Preparing and Serving Meals	
Grooming the Person	
Hair Skin Nails Teeth Feet	
Making Person Comfortable	
Entertaining Elderly Persons	
Reading to elderly persons Writing letters Taking elderly person out for a walk or ride	
Cleaning and Care of the Room	
Preparing room daily Arranging flowers Regulating heat, ventilation, and light General cleaning of room	

Unit 4 - Care of Pets

Feeding Pets
Bathing Pets
Walking Dogs

Unit 5 - Care of Plants and Flowers

Care of Plants
Care of Flowers
Arranging Flowers

Block VI - Home Catering

Unit 1 - Preparing Fancy Sandwiches

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Making Canapes and Hors d'oeuvres	Related Science
Making Fancy Sandwiches	Same as Block III on Food Services
Making Sandwich Puffs	Related Art
Etc.	Food Decorating
	Artistic Arrangement of Foods
	Artistic Services of Foods
	Artistic Design and Color Combination
	Related Mathematics
	Calculating Cost of Food
	Calculating Cost for Services
	Recipe Calculating
	Record Keeping
	Budgeting and Marketing

Block VI - Home Catering

Unit 2 - Preparing and Serving for Special Entertainment

Manipulative Skills Jobs or Experiments by Students	Related Technical Knowledge Instruction Sheets or Information Topics
Formal Breakfasts	
Weddings	
Formal Luncheons	
Formal Dinners	
Formal Suppers	
Bridge Parties	
Out-door Parties	
Teas	
Receptions	
Cocktail Parties	
Buffet Service for Special occasions	

Unit 3 - Food and Table Decorating

Decorating Various Types of Foods

- Beverages
  - Alcoholic
  - Non-alcoholic
- Vegetables
- Salads
- Meats, fish and fowl
- Desserts

Decorating the Table for Various Occasions

OUTLINE OF SOCIAL-INDUSTRIAL RELATIONSHIPS

INDUSTRIAL RELATIONSHIPS

Note: The industrial relations, for which every skilled worker must have an understanding and appreciation form a definite part of the instructional program in all of the areas previously outlined.

Some of these are:

Materials of the Trade -- Source, manufacture, distribution, specifications, costs, etc.

Tools -- Operations and processes in this trade that affect the worker and his relationships with other workers.

Working Conditions -- Hours, pay, seasonal employment, health, recreation, morale; workers' responsibility for these conditions.

Health -- Personal and social hygiene; vital facts every worker should know about well-being.

Industrial Development -- Growth of the industry, its scope and trends; other industries that support it; its relationship to other industries; how organized; how supported; importance of time and costs records.

Industrial Organizations -- Trade, labor, and employer; what their functions are on the job; how these affect happiness of the worker.

Shop Relationships -- Those which concern fellow-workers and the "boss" on or off the job; how these affect efficiency and happiness of the worker.

Laws and Ordinances -- City, county, or state that affect the worker, his job, trade, and industry; worker's compensation, unemployment, social security, safety.

Public Relations -- Those factors having to do with consumer interests, confidence, honest work, fairness in dealings, loyalty to job.

Personality Characteristics -- Attitudes and habits that should be developed to make a successful craftsman; responsibility as a craftsman and citizen to join with others in promoting better working conditions for all and the civic and social welfare of the community.

Related Occupational Opportunities -- The extent to which this trade opens employment opportunities in related occupations.

SOCIAL RELATIONSHIPS

Note: The skilled worker also appreciates the contribution which his work can make in the areas of health, effective services, and general social and public relations. Such development forms a definite part of the instructional program.

Some of this instruction is along the following lines:

The individual in relation to special observances and current events

The individual -- a member of varying social groups (home, social, club, church, etc.)

The individual in his leisure time

The individual in his inner life and development of character

The individual worker in a trade or occupation presenting distinctive opportunities

The individual worker in relation to specific jobs, economic issues, and problems

The individual in relation to major civic and social issues

The individual in occasions of special personal government services

The individual in a legally constituted state

The individual worker in relation to specific jobs involving the lives of others

The individual worker in relation to specific jobs involving the safety of fellow workmen

The individual worker in relation to specific jobs involving the happiness and contentment of others

IV. SAMPLES OF INSTRUCTION SHEETS USED IN TEACHING

HOUSEHOLD OPERATIONS

JOB SHEET

Block II - Home Laundering

Unit 3 - Hand Laundering

Job Title: Laundering Napkins and Doilies by Hand

Objective: To wash and iron napkins by hand using correct procedure

Trade Time: 45 minutes

Tools	Equipment	Materials
Electric Iron	Adjustable Ironing Board	Mild Soap or Powder
Sprinkler	Dryer	Stain Remover Agent
Wooden spoon	Iron Stand	Bleaching Agent
	Tub or Basin	Absorbent Cotton
	Tray	White Blotting Paper
	Saucepan	
	Bowl	

Safety Precautions

1. Always place iron on stand or up end.
2. Heat iron to temperature required for articles to be ironed.
3. Be sure to use the right agents when removing stains.
4. Attach iron cord to outlet and then to iron.
5. Disconnect electric iron immediately after using it.
6. Do not touch electrical outlets or plugs and switches with wet hands.
7. See that ironing board is securely adjusted.

Procedure

1. Remove stains using directions for that particular stain.
2. Soak articles in lukewarm soapy water for from 10 to 15 minutes.
3. Wring articles from water used for soaking - and wash in fresh hot suds.
4. Wash each piece one at a time until clean.
5. If boiling is necessary use enough soap in the water and boil from three to five minutes, tossing articles around with a wooden spoon.
6. Remove clothes from container in which they have been boiling.
7. Rinse thoroughly in plenty of hot, clean, soft water.
8. Follow the hot rinse with a lukewarm rinse.
9. Wring out all water.
10. Hang out doors if possible being sure that the clothesline and clothes pins are clean or put in the electric dryer.
11. Sprinkle articles evenly and thoroughly with warm water.
12. Pull articles into shape - fold and roll snugly. Place on a tray or in a laundry basket.
13. Iron linens on the wrong side making sure to get the corners even.
14. Iron in straight strokes with the thread of the material.
15. Fold evenly in desired shape.

HOUSEHOLD OPERATIONS

INFORMATION SHEET

Block II - Home Laundering

Unit 3 - Hand Laundering

Topic -- Laundering Napkins and Doilies by Hand

1. Always remove stains from articles before washing them or as soon after becoming stained as possible. Always follow the right directions for each particular stain.

2. Linens can be soaked as long as you like even over night.

3. Any all purpose soap can be used for linens.

4. Table napkins should always be soaked separately from other clothes.

5. Cotton and linens need not be boiled each time if they are rinsed well in hot water. Use enough soap when boiling -- too little soap causes scum to form on top.

6. Do not rinse clothes in cold water. It hardens the soap and makes it hard to remove.

7. Thorough rinsing is important because soap and washing powders, if allowed to remain in the fabric, weakens and yellows them.

8. Dry clothes out of doors if possible. Sunlight whitens clothes. Sunlight and wind helps to get rid of disease germs.

9. A home-made sprinkler can be made by punching holes in a jar lid and screwing it on to the jar.

10. Linens should always be ironed on the wrong side.

11. Care should be used in folding napkins so that they will look as attractive as possible.

12. Permit the iron to cool before storing.

ERIC

V. SAMPLES OF TESTS USED

HOUSEHOLD OPERATIONS

Block III - Food Services

Unit 2 - Serving Meals

TEST

Check the Correct Statement

1. Proper table service is desirable because:

   a. It indicates the amount of money one has
   b. It requires less time to eat
   c. Indicates the social set one belongs
   d. The comfort, cheerfulness and refinement of the family depends on it

2. The custom of placing silver has been determined:

   a. By history
   b. By convenience and order
   c. By a few authorities

3. After the spoon is used:

   a. It should be left in the coffee cup
   b. On the dinner plate
   c. On the saucer
   d. The handle should rest on the table

4. After the knife is used:

   a. It should be placed on the table
   b. The handle should rest on the table cloth
   c. It should be placed on the side of the place
   d. It should be placed on the salad plate

Check a Plus or Minus Behind the Following Statements

1. Always fill the glass to the top when serving beverages.

2. Serve men and women alternately when waiting on the table.

3. Everything is passed to the left when serving.

4. The buffet service is not very popular.

5. The hand farthest away from the person is used by the waitress in placing things on the table.

HOUSEHOLD OPERATIONS

TEST

Block I - Household Cleaning

1. What is the meaning of the word ethics?

2. Give at least five rules from the "Code of Ethics" of a Household Worker.

3. What is a work plan and give three reasons why you should use one.

4. Make a daily work plan for the following home:

   Problem -- The home consists of
   Two employed adults
   Two bedrooms
   Living room
   Dining room
   Kitchen and Bathroom

   Duties --- Preparation of breakfast served at 8 a.m. and dinner 5:30 p.m.
   Marketing
   Cleaning entire house, dish washing, etc.
   Laundry
   Answering door, phone, etc.
   (Thursday afternoon and all day off on Sunday)

5. List the jobs carried on in cleaning a room in the order in which they should be carried on.

6. In cleaning a house where do you clean first and why?

True and False: If true put a plus in front of the question, if false put a minus.

_____ 1. All of the heavy cleaning should be done at one time.

_____ 2. When airing a room in cold weather never shut it off from other rooms.

_____ 3. Once a month is enough for cleaning a refrigerator.

_____ 4. Put your mop away in the closet to dry after washing it.

HOUSEHOLD OPERATIONS

TEST

Block I - Household Cleaning

Multiple Choice

Directions: Put a circle around the letter indicating the correct statement

1. If the kitchen sink becomes slightly clogged, one should first:

   a. Call the plumber immediately
   b. Dip out the water
   c. Turn off the water supply
   d. Pour solution of washing soda down drain

2. In cooking it is convenient to know that I. C. of butter equals:

   a. One-half pound
   b. One-fourth pound
   c. One pound
   d. Three-fourths pound

3. Before washing greasy cooking utensils, the most desirable thing to do:

   a. Turn the hot water from the faucet on them
   b. Wipe out with a soft piece of paper
   c. Scrape them with a knife
   d. Sprinkle Dutch Cleanser on them

4. In selecting cooking utensils one should:

   a. Select the cheapest
   b. Buy only aluminum
   c. Consider the use and wearing quality
   d. Select the most expensive

5. The cleanest fuel to use is:

   a. Kerosene
   b. Wood
   c. Gas
   d. Electricity

HOUSEHOLD OPERATIONS

TEST

Block I - Household Cleaning

Directions: Underscore the correct statement with a red pencil.

1. An employer should be neat and clean and suitably dressed when:
   a. company is around; b. at all times

2. Mattress pads should be changed every: a. month; b. week; c. year

3. Sheets should be changed on the bed every: a. week; b. every other week

4. Work plans are good when you are: a. in a hurry; b. at all times

5. Water is boiling when: a. large bubbles come to the top and burst;
   b. small bubbles form around sides and bottom of pan;
   c. steam comes out

6. Always strike a match: a. away from you; b. towards you

7. When lifting hot pans use: a. tea towel; b. pot holder; c. tail of apron;
   d. wet cloth

8. Wipe up spilled water or grease: a. when you have time; b. at once

9. Dish towels and cloths should be washed: a. after every meal;
   b. every week

10. Pots containing carbohydrates and protein should be soaked in:
    a. cold water; b. hot water

HOUSEHOLD OPERATIONS

TEST

Block II - Home Laundering

Unit 6 - Removing Common Stains

Completion

Directions: On the blank lines, write the word or words that correctly complete the following statements.

1. Treat stains _____.
2. Try _____ _____ first.
3. When sponging stains always use a _____ of _____ _____ underneath.
4. Let the _____ remain on the fabric for a _____ time.
5. Never let a _____ dry on the fabric.
6. Always test for _____ _____ on a sample of the fabric.
7. Absorbents are _____, _____ _____, _____ _____, _____ _____.
8. Turpentine is used for removing _____ stains.
9. Lemon juice is used for removing _____ stains.
10. Magnesia, cornmeal, salt or talcum powder is used for _____ stains.

VI. PROGRESS CHART

HOUSEHOLD OPERATIONS

We Rate Ourselves

How Do I Rate on Table Setting?

Place an X in the column which most nearly describes the way you set the table.

	YES	NO
1. Is the table cloth on straight and even, with the center fold down the center of the table? Are the place mats on straight? The hot pads?		
2. Are the covers including those of the host and hostess, opposite each other so that the table appears balanced?		
3. Is the center-piece (if there is one) low and placed in the center of the table?		
4. Is there so much silverware and china on the table that it appears crowded?		
5. Is each individual cover set properly?		
6. Are the serving dishes arranged for the convenience of the host and hostess?		
7. Does each person have about 18 inches for his or her cover?		
8. Are the chairs placed so that they will not have to be pulled out from under the table when each guest sits down?		
9. Have you forgotten anything that should be on the table?		
10. Are any of the dishes finger-marked?		
11. Is all of the serving silver on the table and in place?		
TOTAL SCORE		

HOUSEHOLD OPERATIONS

We Rate Ourselves

How Did I Work Today?

Rating on Food Services.

Place an X in the column which most nearly describes the way you worked today.

	YES	NO	SOMETIMES
1. Did I wash my hands and put my apron on before starting to work?			
2. Did I get all of the utensils and supplies out before starting to work?			
3. Did I measure accurately?			
4. Did I spill any of the supplies?			
5. Did I take more than my share of the supplies?			
6. Did I sift the flour before measuring it?			
7. Did I burn or scorch the product that I made?			
8. Did I follow the directions given in the recipe?			
9. Did I scrape the bowl clean and empty the measuring cups so as not to waste food?			
10. Did I cook or bake the product I made at the correct temperature?			
11. Did I work quietly with equipment?			
12. Did I keep my table top neat as I worked?			
13. Did I leave all equipment clean and in place?			
14. Did I eat and enjoy the product I made?			
TOTAL SCORE			

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ABSTRACT - This teacher-developed curriculum guide is for use by high school or junior high students studying agricultural chemical sales and services as part of a cooperative program. Contents include units on: (1) agricultural sales, (2) agricultural business procedures, (3) agricultural chemicals and safety, (4) dilution charts and formulas, (5) equipment for chemical application, (6) insects, (7) use of agricultural chemicals as insecticides, (8) agricultural chemicals with regard to livestock and poultry, (9) use of agricultural chemicals as soil additives, (10) uses of chemicals as herbicides, fungicides, bactericides, and nematocides, (11) use of agricultural chemicals for control of rodents and predators, and (12) use of agricultural chemicals as plant regulators. Color coded for ease in using, this guide is divided into four sections, with the first providing assignment and information sheets, the second comprised of answer sheets keyed to the assignment sheets, the third containing topic tests, and the fourth consisting of answer sheets for the topic tests. A course outline and lists of required and supplemental references are included. (AW)

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VOCATIONAL AGRICULTURE

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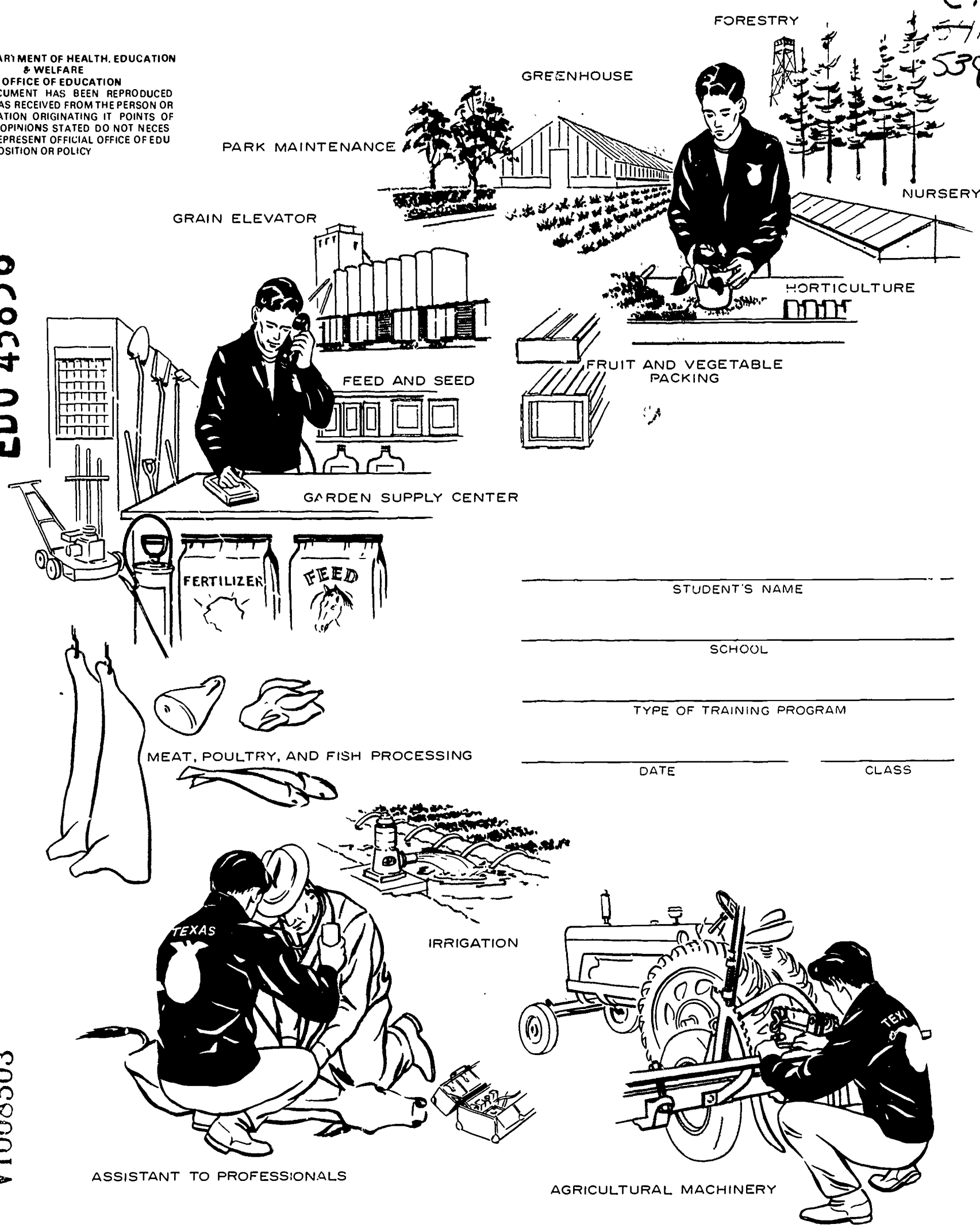

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Agricultural Chemical Sales and Serviceman

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M E M O R A N D U M

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(Address) Texas A&M University, College Station, Texas

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These materials, designed for the student enrolled in the Cooperative Part-time Training in Agriculture course, were developed by James B. Jones, Vocational Agriculture Teacher, Pattonville, and Lewis J. Rosprim, Vocational Agriculture Teacher, Eagle Lake. Because of their sincere interest and dedication to the vocational agriculture program in Texas, they devoted three weeks at the Teaching Materials Center during the summer of 1968 in preparing these instructional materials.

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John Holcomb, Coordinator
Teaching Materials Center

COURSE OUTLINE FOR
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

Unit I	Introduction	1. Opportunities in the Chemical Industry 2. Importance of Agricultural Chemicals 3. Federal and State Laws Pertaining to Agricultural Chemicals
Unit II	Agricultural Salesmanship	1. Agricultural Sales, General (Product and Label Knowledge) 2. Meeting Customers (Apprenticeship) 3. Presenting Supplies and Services 4. Overcoming Sales Resistance 5. Closing the Sale 6. Fundamentals for Successful Selling 7. Evaluating the Salesman
Unit III	Business Procedures	1. Business Records 2. Sales Tickets (Making Change) 3. Credit and Collection Policies 4. Determining Selling Price 5. Business Forms, Purchase Orders, and Ordering Merchandise 6. Inventory 7. Stocking, Receiving, and Storing Merchandise 8. Stock and Merchandise Planning
Unit IV	Agricultural Chemicals Safety	1. Chemical First Aid 2. Storing Agricultural Chemicals 3. Mixing Agricultural Chemicals 4. Application of Agricultural Chemicals 5. Agricultural Chemicals Container Disposal 6. Personnel and Equipment Clean-Up 7. Chemical Residue and Tolerances (Cross Contamination)
Unit V	Formulas and Dilution Charts	1. Calibrating Sprayers 2. Weights and Measures 3. Compatibility Charts
Unit VI	Chemical Application Equipment	1. Spraying Equipment 2. Dusting Equipment 3. Fogging Equipment 4. Fumigating Equipment

Agricultural Chemical Sales and Serviceman
(Course Outline continued)

Unit VII	Insects	1. Classes of Insects 2. Body Parts 3. Life Cycles 4. Host Plants or Animals 5. Insect Resistance to Chemicals 6. Losses Caused by Insects 7. Methods of Control
Unit VIII	Agricultural Chemicals Used as Insecticides	1. Introduction to Insecticides 2. Insecticide Terminology 3. Properties and Characteristics of Insecticides 4. The Chemistry and Mode of Action of Organic Insecticides 5. The Chemistry and Mode of Action of Inorganic Insecticides 6. The Use of Insecticides as Fumigants 7. Use of Insecticides on Household Pests
Unit IX	Agricultural Chemicals Used as Insecticides on Plants	1. Field Crops 2. Orchards 3. Ornamental Plants and Shrubs 4. Forest Plants 5. Vegetables 6. Grasses (Pastures) 7. Lawns 8. Stored Grains
Unit X	Agricultural Chemicals	1. Livestock 2. Poultry
Unit XI	Agricultural Chemicals Used as Soil Additives	1. Soil Additives and Deficiency and Deficiency Symptoms 2. Determining When to Use Soil Additives

Agricultural Chemical Sales and Serviceman
(Course Outline continued)

Unit XII	The Use of Chemicals as Herbicides	1. Introduction to Weed and Brush Control (Cost Comparisons) 2. Opportunities and Trends in the Use of Herbicides 3. Herbicide Terminology 4. Plant Nutrition and Physiology Principles of Weed and Brush Control 5. Identification of Weeds 6. Seed Laws Pertaining to Weeds 7. Classification, Properties, and Characteristics of Herbicides in Weed and Brush Control 8. Factors Affecting Weed and Brush Control With Herbicides 9. Herbicide Selection 10. Preparing Herbicides for Use (Compatibility) 11. Determining Method of Treatment 12. Application of Herbicides 13. Aquatic Weed Control with Herbicides
Unit XIII	Agricultural Chemicals as Fungicides	1. Fungicides, Their Development and Uses 2. Pathological Agents 3. Plant Diseases 4. Application of Fungicides
Unit XIV	Agricultural Chemicals Used as Bactericides	1. Bacteria 2. Bactericides
Unit XV	Agricultural Chemicals Used as Nematocides	1. Nematocide 2. Nematodes Infesting Soils 3. Types of Nematocides 4. Application of Nematocides
Unit XVI	Agricultural Chemicals Used in the Control of Rodents	1. Introduction to the Chemical Control of Rodents 2. Types of Rodenticides 3. Application of Rodenticides

Agricultural Chemical Sales and Serviceman
(Course Outline continued)

Unit XVII	Agricultural Chemicals Used in the Control of Predators	1. Control of Predators 2. Types of Chemical Control and Application of Chemicals
Unit XVIII	Agricultural Chemicals Used as Plant Regulators	1. Introduction to the Use of Chemicals as Plant Regulators 2. Terminology 3. Plant Physiology and Nutrition 4. Method of Application

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for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

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8. "Suggested Guide for Use of Insecticides," Agricultural Handbook No. 331, U.S.D.A. (Available from Teaching Materials Center)

9. "Power Sprayers and Dusters," U.S.D.A., B-2223 (Available from Teaching Materials Center)

10. "Insecticidal Spraying of Field Crops with Ground Machinery," Texas Agricultural Extension Service, L-486 (Available from Teaching Materials Center)

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Agricultural Chemical Sales and Serviceman
(Required References continued)

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15. "Texas Guide for Controlling External Parasites of Livestock and Poultry," Texas Agricultural Extension Service, MP-691 (Available from Teaching Materials Center)

16. "What You Should Know About Plant Diseases," Texas Agricultural Extension Service, B-995 (Available from Teaching Materials Center)

17. "How to Use Your Bank," Texas Agricultural Extension Service, L-389 (Available from Teaching Materials Center)

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22. "Herbicide Regulations 1-E," Texas Department of Agriculture, TDA-Q105(Available from Teaching Materials Center)

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31. Plant Diseases, 1953 Yearbook of Agriculture, Superintendent of Documents, Washington, D. C. (Usually available from your Congressman)

32. Insects, 1952 Yearbook of Agriculture, Superintendent of Documents, Washington, D. C. (Usually available from your congressman)

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Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Introduction

TOPIC: Opportunities in and the importance of the Agricultural Chemical Industry

OBJECTIVE To become familiar with the opportunities in and the importance of the agricultural chemical industry

REFERENCES:
Required
1. Information Sheet, "Opportunities in and the Importance of the Agricultural Chemical Industry"

QUESTIONS OR ACTIVITIES

1. List chemicals that are included as pesticides by the agricultural chemical industry
2. List employment opportunities available to students training in the agricultural chemical field
3. How has the application of chemicals kept the cost of food down?
4. According to the USDA, what is the most effective tool in fighting insect pests?
5. What has been responsible for a spectacular advance in American agricultural efficiency?
6. The use of chemicals to fight pests dates back to _____ _____
7. The Greeks used _____ (_____) as a pesticide
8. If pesticides were withdrawn from use, what percent decrease would we have in livestock and crop production?
9. Why are insects on the increase?
10. What will help us maintain or improve our present standard of living?
11.
12.

Information Sheet
on
OPPORTUNITIES AND IMPORTANCE OF THE
AGRICULTURAL CHEMICAL INDUSTRY

The agricultural chemical industry is one of the nation's fastest growing industries. Pesticide sales in 1966 in the U.S. amounted to $600,000,000, compared to $262,000,000 in 1960. Sales increased 18% over 1965. The use of pesticides--including fungicides, herbicides, rodenticides, nematocides, insecticides, fumigants, defoliants, desiccants, and plant regulators--continues to increase annually. As the industry expands, the need for trained people within the industry expands.

Employment opportunities are available for chemical salesmen, chemical warehouse employees, pest control operators, crop dusters, and positions in related businesses such as feed stores, nurseries, and pet shops. Also, governmental, private research, and manufacturing organizations offer employment opportunities to the person knowledgeable in agricultural chemicals. According to the members of the Agricultural Chemicals State Advisory Committee, they are unable to employ enough competent workers in their chemical businesses. Career opportunities in the chemical industry should be permanent.

Have you noticed the large number of new agricultural chemical businesses in the last few years? At one time the major part of the chemical business was part of a general business serving agriculture in many areas. Today, there are a large number of businesses with agricultural chemicals as their only business.

U.S. authorities tell us that the population of the world will double in the next thirty-five years. The land area needed to support a person, estimated at 2-1/2 acres, will decrease to 1-1/2 acres by the year 2000.

The importance of agricultural chemicals can not be overemphasized if we are to maintain our present standard of living. The use of chemicals to control insects has been responsible for increasing the production of many of our crops. The following statement appears in "The War That Never Ends," a USDA publication: "Pesticides are generally the most effective and, in many instances, the only weapon available to fight pests that damage or destroy crops, livestock, and forests or endanger human health and our natural resources. The development since 1945 of modern pesticides, together with other technical advances has made possible a spectacular advance in American agricultural efficiency."

The use of chemicals to fight pests dates back to ancient times. The Greeks employed brimstone (sulfur) as an insecticide. Salt was probably used in ancient times as the first chemical weed killer. The use of chemicals to control insects and pests helps

Opportunities and Importance of the Agricultural Chemical Industry
(Information Sheet continued)

keep food costs down and quality high. The USDA estimates that if pesticides alone were withdrawn from use, crop and livestock production could increase prices of agricultural products by 50 to 75 percent.

As our world population increases, we have a corresponding increase of insects. There are approximately 7,000 insect species that attack crops, livestock, and humans in the U.S. The number of insects is on the increase because of increases in production, the planting of improved varieties--without regards to developing varieties that are insect resistant--and our world-wide scope of transportation. Over 36,000 interceptions of dangerous insects and diseases were made at importation points in this country last year. The use of chemicals to control insects and diseases at these points made many shipments acceptable that otherwise would have been destroyed. The use of chemicals will help us meet the challenge to maintain or improve the standard of living in the U.S. and the world.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Introduction

TOPIC: Importance of Agricultural Chemicals

OBJECTIVE: To become informed of the importance of chemicals in agricultural production and the importance of the industry to the nation.

REFERENCES:
Required:
1. Information Sheet, "Importance of Chemicals in Agriculture"

QUESTIONS OR ACTIVITIES:

1. How can higher yields of crops be brought about by the use of agricultural chemicals?
2. What part can agricultural chemicals play in improving our daily diet?
3. What is the outlook for improving farm efficiency by use of agricultural chemicals?
4. What has the use of agricultural chemicals meant to our national health program?
5. How do agricultural chemicals affect our daily lives?
6. How are agricultural chemicals grouped?
7.
8.

Information Sheet
on
IMPORTANCE OF CHEMICALS IN AGRICULTURE

The importance of agricultural chemicals cannot be overemphasized today. Correct and proper use is necessary to sustain our present standard of living and to improve this same standard in the future. Higher yields are obtained when pesticides are used to control insect damage to fruits, crops, and vegetables. Farm output per man-hour is now more than twice as great as it was after World War II.

The results of improved food production on the farm are showing up in two important ways: (1) Deficiency diseases such as pellagra, scurvy, rickets, and others are seldom seen today and (2) American children are growing larger and healthier than their parents. They are breaking athletic records and are in a position to live fuller, more active lives.

Every 11 seconds there is a new mouth to feed in the United States. By 1975, we expect a population in excess of 220,000,000, about 30,000,000 more than we have today. Nearly 30 percent greater production of most foods will be needed to feed our population adequately in 1975. Land being removed from cultivation for various reasons amounts to about 1,000,000 acres per year.

Pesticide chemicals, fertilizers, farm equipment, new and better crop and cultural practices are keys to increased farm efficiency and productivity.

Pests have aptly been called our "rival world." They attack our food supplies, our natural fibers, and our forests. They damage our health and our buildings. Control of pests has given man a new power to improve his environment in many ways.

Malaria, typhus, Rocky Mountain spotted fever, plague, yellow fever, dengue, sleeping sickness, and others are among human ills carried or caused by pests. Malaria was eliminated from the Southern United States through spraying programs of the U.S. Public Health Service in 1947. Similar public health programs are being pushed forward to control or eradicate a number of human diseases by eradicating the pests which carry them.

Home gardening, indoor living, outdoor living, sports events, and wildlife have all benefited from the use of agricultural chemicals. The eradication of the screwworm in Texas has greatly increased Texas' deer population. Fogging of insects has resulted in more enjoyment and participation in sporting events. Improved highway beauty and safety is also evident because of the use of brush and weed control.

This unit on agricultural chemicals is designed to present the basis for a general understanding of the role of agricultural chemicals in the protection of our foods, our property, and our health today. To have a better understanding of these agricultural

Importance of Chemicals in Agriculture
(Information Sheet continued)

chemicals, the following breakdown by groups is given and includes the following:

Insecticides - used to protect growing and stored crops from insect damage and destruction and to protect people and animals from disease-carrying insects
Fungicides - used to protect stored products against fungi and to control bacterial and fungicidal infestation and infection of plants
Herbicides - used to control unwanted vegetation, either selectively or generally
Rodenticides - used to control rats, mice, and other rodent pests
Antibiotics - used to cure virus and bacteria-caused plant diseases
Nematocides - used to control nematodes, a type of worm
Molluscicides - used to control snails and slugs
Plant regulators - used to control plant growth by making plants grow faster or slower, or in some way beneficial to man, and to stimulate the growth of root cuttings
Defoliants and Desiccants - used to speed the drying of plant tissue or cause leaves and foliage to drop from plants to facilitate harvesting

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Introduction

TOPIC: Federal and State Laws Pertaining to Agricultural Chemicals

OBJECTIVE: To learn the federal and state laws and regulations governing the use of chemicals in agriculture.

REFERENCES:
Required:
1. "Safe Use of Chemicals in Agriculture," Texas Agricultural Extension Service, MP-437, pp. 1-12.
2. "Herbicide Regulation No. 1-E," Texas Department of Agriculture, TDA-Q 105.

QUESTIONS OR ACTIVITIES:

1. When was the first Federal Food and Drug Act enacted?
2. List one stipulation of the 1938 Act.
3. Give a brief discussion of the Miller Amendment, Public Law 518.
4. What were the general regulations provided for in the Federal Insecticide, Fungicide, and Rodenticide Act, passed in 1947?
5. Explain the term "tolerance."
6. What does an exemption from tolerance mean?
7. Give the general provisions of the Food Additive Amendment of 1958.
8. Are the state laws pertaining to the use of herbicides uniform in all states? Explain.
9. Dealers selling herbicides must make and retain a record of all herbicide sales for a two-year period. List information contained in this record.
10.
11.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Salesmanship

TOPIC: Introduction, Agricultural Salesmanship

OBJECTIVE: To develop an understanding of the importance of salesmanship in agricultural business.

REFERENCES:

Required:

1. Information Sheet, "Agricultural Salesmanship"

Supplemental:

1. Feed and Farm Supplies, The University of Texas, Division of Extension, Distributive Education Division, Austin, Texas
2. Salesmanship Fundamentals, Ernest and Davall, 2nd Edition, McGraw-Hill Book Co., New York, N. Y.
3. Let's Analyze and Sell, The University of Texas, Division of Extension, Distributive Education Division, Austin, Texas

QUESTIONS OR ACTIVITIES:

1. Name and give an example from your experience of four reasons customers fail to buy.
2. What are the main differences between need and desire for a product?
3. What six things must the agricultural salesman know to be successful?
4. Give five principal advantages of agricultural sales as a career.
5. What is one of the best forms of advertising?
6. Who benefits from efficient selling?
7. Good selling does two things connected with human wants. What are the two?
8. What five basic decisions are made by a customer before purchasing an item?
9. What product should be sold to a customer?
10. Give two things that help to make permanent customers.
11. Give a good short definition of "selling."
12.
13.

Information Sheet
on
AGRICULTURAL SALESMANSHIP

Selling is the key function of all business activity. This is as true in agriculture as in other areas. Selling is the act of assisting and persuading individuals or groups to make a buying decision which is to the mutual advantage of both the buyer and the seller.

Selling is really explaining to, persuading, and reminding the public of a particular business concern and of the opportunities and values to be gained from doing business with this concern.

The retailer's function is that of selling goods and services to the ultimate consumer. This is the final step in the distribution of agricultural goods and services.

Efficient salesmen realize that customers are lost because of:

1. Poor service rendered
2. Discourteous treatment received
3. Indifferent attitude exhibited on the part of the salesman
4. Lack of product information on the part of the salesman

The salesman must know the psychology of selling if he is to become a successful salesman. In other words, he knows that a customer buys primarily because of need and desire. These are influenced by reason, by emotion, or by a combination of these. A person may need something, but does not buy until he desires it, i.e., he feels the need.

In summary, to be successful, the agricultural salesman must know the selling process, the merchandise itself, and the firm, as well as understand himself, his relations to the customer, and the customer.

Here is an opportunity for a salesman to (a) deal directly with the public, (b) help other people make decisions, (c) face something new everyday, (d) know that his worth is quickly recognized in terms of advancement, and (e) enjoy the prestige of big business. This big business is made up of over 1,700,000 retail stores where Americans spend 70 percent of the family income each year.

Good selling does not happen incidentally, but is the result of sound training.

Successful selling produces a satisfied customer who in turn becomes the best form of advertising.

Agricultural Salesmanship
(Information Sheet continued)

The good salesman must realize that everyone benefits from efficient selling. High sales volume not only insures the salesman's position, but also lowers the price of products or services to the customer.

Good selling awakens and satisfies human wants. Selling is a challenge and every customer is an opportunity for a salesman to get positive reaction from the customer on five basic buying decisions, namely: the need, the thing, the source, the price, and the time. Selling is helping the customer to buy intelligently.

The customer will gain the most personal satisfaction from his purchase if the salesman makes sure that the product will best fit the customer's need. When the salesman demonstrates courtesy and a sincere interest to be of service, the result is a permanent customer.

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Material for this Information Sheet was taken from Module 4, Agricultural Supply Sales and Service Occupations, The Center for Research and Leadership Development in Vocational and Technical Education, Columbus, Ohio.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Salesmanship

TOPIC: Meeting the Customer

OBJECTIVE: To develop an understanding of the importance and techniques in making a good impression with customers.

REFERENCES:

Required:

1. Information Sheet, "Meeting the Customer"

Supplemental:

1. Let's Analyze and Sell, The University of Texas, Division of Extension, Distributive Education, Division, Austin, Texas
2. Feed and Farm Supplies, The University of Texas, Division of Extension, Distributive Education Division, Austin, Texas

QUESTIONS OR ACTIVITIES:

1. Why is the first contact with a customer very important?
2. Why should a salesman be well-groomed?
3. Why should a salesman like his work?
4. Give three "earmarks" of good salesmanship.
5. Give a short description of the proper way to treat a customer.
6. Select one of your classmates that you know well and fill out the "information needed about a customer" given in part 1-a of the information sheet.
7. How could you secure the information you gave in question 6 if you did not know the person well, and if he were an adult?
8. Pick a store (not the one in which you work) in which you purchased something recently and give your impressions about these characteristics of the store:
   a. Was the store neat and attractive? What made it appear that way?
   b. Was the store well-lighted?
   c. Did the equipment (not the merchandise) look good to you? Why or why not?
   d. Was the merchandise arranged in a manner you understood, or was it confusing to you? Why?
   e. Did the person who "waited upon you" have a pleasing appearance? Briefly describe him as he appeared that day.

UNIT: Agricultural Salesmanship
TOPIC: Meeting the Customer
(Assignment Sheet continued)

9. Pick an item from the store in which you work or plan to work and give from memory these characteristics of the product:
   a. Why is it designed as it is?
   b. The trade name
   c. How it is constructed or manufactured
   d. Its special features
   e. In what other forms it is available
   f. What help the store can give if something "goes wrong" with the product
10. Now pick an item your family purchased recently from another store and give the same information as you gave in No. 9 from memory about it.
11. List the preparation a salesman needs to make before he is ready to make a sale.
12. What may cause a salesman to fail to be prompt in greeting a customer?
13. How does the salesman find out about a customer's problem?
14. Give three examples of proper methods of greeting a customer.
15. Give the elements of a good salutation to a customer.
16. Name 11 physical and physiological factors that cause a customer to want to buy a product.
17. Give eight good attitudes for salesmen.
18.
19.

Information Sheet
on
MEETING THE CUSTOMER

The impression of the agricultural business that the customer carries away often results from his first contact with the salesman. Appearance and actions play an important part in forming this impression.

A well-groomed salesman attracts customers and inspires their confidence. Undivided attention on the job is essential to good salesmanship.

A good approach presupposes a proper attitude toward the job. Love for one's work is expressed in the enthusiasm with which it is carried out. Enthusiasm is shown through words, actions, and expression.

Salesmanship is demonstrated through promptness, alertness, and interest in the customer and his problems.

Treat the customer like a guest. This means that good manners and courtesy are practiced at all times; that the house is in order, neat and clean; that the merchandise is conveniently located; and that the salesman is trained in the fundamentals of selling to maximize the opportunity of being of service to customers.

Points to be considered when meeting the customer:

1. The preapproach Preparation
   a. Information needed about the customer
      (1) Name - Address
      (2) Personal characteristics
      (3) Mental make-up
      (4) Hobbies and interests
      (5) Common interests
      (6) Buying habits or policies
   b. Sources of this information
      (1) Participation in community activities and events
      (2) Chamber of Commerce information
      (3) Comments made by other members of civic clubs
      (4) A personal notebook on customers
      (5) Past sale records, credit department records
      (6) Interview with people in the community
      (7) Local newspaper
   c. Check of facilities and surroundings
      (1) General appearance of the store
      (2) Lighting
      (3) Equipment
      (4) Merchandise arrangement
      (5) Personnel

Meeting the Customer
(Information Sheet continued)

d. Knowledge of benefits the customer will receive from merchandise sold
   (1) Design or appearance
   (2) Quality of the source - trade name
   (3) Composition and construction
   (4) Special features
   (5) Assortment of sizes, colors, and styles available
   (6) Service available
e. Preparation by the salesman
   (1) Neatness of appearance
   (2) Preparation of an appealing display arrangement
   (3) Knowledge of contents of the merchandise in stock
   (4) Knowledge of the contents of newspaper advertising being circulated
   (5) Knowledge of names, background, and interests of customers
   (6) Knowledge of the competitors product
   (7) Preparation of a few selling sentences
   (8) Preparation of a record of common customer objections and development of methods of meeting them

2. Timing the Approach
   a. Importance of the impression created by the salesman's appearance and actions
   b. Suggestions for:
      (1) Promptness - clues for failure in being prompt:
         (a) Involved group conversations of salesmen
         (b) Stock duties
         (c) Timidity in approaching customers
         (d) Indifference to the needs of the customers
      (2) Alertness - based on accurate and careful observation; look for clues on:
         (a) How and when to greet the customer
         (b) When to present the merchandise
         (c) How to talk about merchandise
      (3) Interest in customer's problem
         (a) Take all the time necessary to understand his problem.
         (b) Probe to determine if problem is what customer first says it is.
         (c) Determine the procedure to be followed to assist the customer with his problem.

3. The Proper Approach - Greeting the Customer
   a. Type of salutations
      (1) Conventional
      (2) Question
      (3) Stating a fact about the merchandise

Meeting the Customer
(Information Sheet continued)

b. Elements of a salutation
   (1) Courteous
   (2) Short
   (3) Requires no decision
   (4) Affirmative
   (5) Emphasizes the desire to serve
c. Tone of voice - pleasant, enthusiastic, distinct, articulate, ordinary
d. Facial expressions
   (1) A pleasant smile
   (2) Cheerful expression

Different physical and psychological factors, operating alone or together, motivate a customer to buy a product. Among them are comfort, pleasure, appetite, possession, fear, devotion, curiosity, ornamentation, imitation, construction, and loyalty.

Developing the proper attitudes necessary for success in meeting a customer is important if the student is to develop effective sales abilities. Among them are:

1. Developing professional feeling toward selling
2. Constant courtesy
3. Enthusiasm for selling
4. Interest in customer and his problems
5. Willingness to develop self-confidence
6. Developing sincere attitude of service
7. Developing integrity
8. Appreciating proper psychology such as gaining the customer's attention and interest, creating a desire, and ending with deaction on the part of the customer

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Material for this Information Sheet was taken from Module 4, Agricultural Supply, Sales and Service Occupations, The Center for Research and Leadership Development in Vocational and Technical Education, Columbus, Ohio.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICE

UNIT: Agricultural Salesmanship

TOPIC: Presenting Supplies and Services to Customers

OBJECTIVE: To develop an understanding of the steps necessary to a successful sale.

REFERENCES:

Required:

1. Information Sheet, "Presenting Supplies and Services to Customers"

Supplemental:

1. Let's Analyze and Sell, Division of Extension, The University of Texas, Austin, Texas

QUESTIONS OR ACTIVITIES:

1. Give the four steps in a sale.
2. How does step 1 differ from step 2?
3. What brings about step 3?
4. What are some examples of motivating factors for farmers?
5. Name 4 ways attention is directed to a supply or service.
6. Tell how a potential customer may move from attention to interest to desire.
7. To conclude the sale, what does the salesman need to be able to do to secure action?
8.
9.

Presenting Suuplies and Services to Customers
(Information Sheet continued)

Desire for a product may be obtained by relating it to a need of the customer.

Explain how this feed will increase net income by improving an animal's rate of gain.
Show him, with proof from variety trials, how the new oat variety will stand, thereby reducing all those combining problems.
Show him that the chemical weed spray will reduce cultivation, allowing time to get the hay harvested, go fishing, etc.
Sell the merits of the tractor seat, not its cost.
Provide appointments for the customer to try the product on a trial basis.

To be able to present items effectively, you will need to:

Know the features of the item.
Be able to answer all questions about the item.
Demonstrate its use, operation, value, and advantages.

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Material for this Information Sheet was taken from Agricultural Supply, Sales and Service Occupations, Module 4, The Center for Research and Leadership Development in Vocational and Technical Education, Columbus, Ohio.

Information Sheet
on
PRESENTING SUPPLIES AND SERVICES TO CUSTOMERS

Successful selling requires a careful presentation by the seller. A salesman must recognize the importance of each of the psychological steps in a sale. He must gain the attention, develop interest, kindle desire, and induce action on the part of the customer.

Attracting attention is one thing, developing interest is quite another thing. Attention is more or less involuntary. Almost anything can attract attention; interest is the result of voluntary reaction on the part of the customer. Interest comes only when attention is prolonged voluntarily and is accomplished by concentration.

Next, one must combine the merits of the article with the needs or wants of the customer to kindle desire. Then, by demonstrating a complete understanding of the interest, needs, desires, and motivating factors that cause a customer to buy, the salesman will be able to make a successful sale. Sales are made by showing the farmer how to increase yields, make more profit, or reduce the labor required, etc.

The attention of customers to a supply or service may be secured in many ways.

Reading an advertisement about a beef concentrate
Seeing a new herbicide on a TV commercial
Talking to a neighbor about his new 5-plow tractor
Mailing a circular on early fertilizer purchase discount
Meeting a new petroleum delivery truck on the road
Hearing from a friend about the good service on baler repairs.
Reading in the newspaper about a new bulb shipment received at the garden center
Viewing an attractive display of seed at the supply center

Developing interest in a product can be initiated by the customer, the salesman, or serviceman.

Customers can move from the attention, interest, and desire steps very rapidly at times with little or no encouragement. Example - the customer sees a new field sprayer just the size and kind for which he has a preference -- the desire is developed. Often, however, the customer's interest in a product needs to be kindled. This can be done by:

Talking to him about the new features on this planter
Inviting him to a field day where the effectiveness of newly developed herbicides will be shown
Showing him the results of this product in test trials
Demonstrating how simple it is to mount this new corn picker
Pointing out to the customer the number of people in the community who are already using this feed, lawn seed, or grease

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Salesmanship

TOPIC: Overcoming Customer Resistance

OBJECTIVE: To develop an understanding of the reasons for customer resistance and effective methods of overcoming them.

REFERENCES:

Required:

1. Information Sheet, "Overcoming Customer Resistance"

Supplemental:

1. Let's Analyze and Sell, Division of Extension, The University of Texas, Austin, Texas
2. Feed and Farm Supplies, Division of Extension, The University of Texas, Austin, Texas

QUESTIONS OR ACTIVITIES:

1. Give the "two sides" to every sale.
2. The customer must be convinced that the salesman's product is his best choice, based upon one or more of three factors. What are the three?
3. Give statements that will help overcome customer objection for a product:
   a. Need:
   b. Quality:
   c. Source:
   d. Price:
   e. Time:
   f. Thing:
4.
5.

Information Sheet
on
OVERCOMING CUSTOMER RESISTANCE

It is natural for people to have sales resistance. Most of them did not come by the money in their possession easily. It is perfectly natural for people to want to get all they can for the money spent.

Each sale has two sides. The customer must sacrifice something in order to get something else. Since one cannot have everything, each sale means a choice between one product and another product or one product and another form of pleasure.

The customer must decide which of the choices will give the most satisfaction or pleasure.

It is the salesman's job to convince the customer that his product or service will provide this pleasure, satisfaction, or need. If this cannot honestly be done, perhaps he should not make the sale at all. Anything else is high pressure selling that is unethical and cannot be classified as salesmanship. It will invariably lead to ill will and dissatisfaction.

There are several reasons why customers are resistant to purchasing. The first objection is rarely the actual objection. Identify the real reason for such resistance and try to explain away the objection. To do this you are going to need to be well informed on the supply or service. Types of objections are:

1. Need - Objections to <u>need</u> are overcome by stressing the usefulness and benefits of the product.
2. Quality - Objections to <u>quality</u> are overcome by:
   a. Showing a better quality
   b. Pointing out a specific feature
3. Source - Objections to the <u>source</u> are met by:
   a. Providing names and experiences of satisfied customers
   b. Providing information about the company or by reference to national advertising
   c. Courteously straightening out misunderstandings
   d. Asking for a fair trial of this new firm or by offering something another firm does not carry
   e. Others correcting the shortcomings of the salesman if he is at fault
4. Price - Objections to <u>price</u> are overcome by:
   a. Revealing hidden values - building up values
   b. Emphasizing the quality or usefulness
   c. Providing an article that is not as expensive and doesn't have as many selling points
   d. Knowing competitors product so that any question or different values can be explained

Overcoming Customer Resistance
(Information Sheet continued)

5. Time - Objections to time are overcome by:
   a. Making a future appointment
   b. Inviting the customer to look at additional merchandise
   c. Continuing to show a positive interest in the customer whether the salesman is busy or not
   d. Trying to handle objections promptly as they arise
   e. Not trying to close a sale until all bonafide objections have been satisfied. Make feelers during the sales presentation to preclude objections to a reasonable closing of the sale because of the time.
6. Thing - Objections to the thing are overcome by:
   a. Showing more suitable goods
   b. Admitting the validity of objection but showing another feature to offset the objection
   c. Admitting that the objection is reasonable but showing that it does not really apply
   d. Changing the objection into a selling point in favor of the article
   e. Avoiding:
      Generalizations which mean nothing
      Contradiction of a customer's statement
      Display of a negative or discouraging attitude

Again, do not pressure customers to purchase; they are not likely to return if pressured.

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Material for this Information Sheet was taken from Agricultural Supply, Sales and Service Occupations, Module 4, The Center for Research and Leadership Development in Vocational and Technical Education, Columbus, Ohio.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Salesmanship

TOPIC: Closing the Sale

OBJECTIVE: To develop the ability to secure the final step in the selling process; that of closing the sale.

REFERENCES:

Required:

1. Information Sheet, "Closing the Sale"

Supplemental:

1. Let's Analyze and Sell, Division of Extension, The University of Texas, Austin, Texas
2. Feed and Farm Supplies, Division of Extension, The University of Texas, Austin, Texas

QUESTIONS OR ACTIVITIES:

1. When is closing a sale easy and almost automatic?
2. What must be the attitude of the salesman toward his function in closing a sale?
3. When is the salesman justified in making concrete suggestions during the "closing" process?
4. When is the right time to close a sale?
5. What conditions precede sale closing?
6. What is the "choice method" in beginning to close a sale?
7. Give seven errors that often lead to failure to buy.
8. Give four good general points for recording sales.
9.
10.

Information Sheet
on
CLOSING THE SALE

Obviously, closing the sale is the most important of all the steps in the selling process. Everything that has been done so far comes to naught, if the customer leaves without making a purchase. Closing starts at the beginning of the sales presentation and "trial" closes are appropriate as it proceeds.

Customers resent being hurried into making a purchase. The salesman must take an active part in inducing a favorable action on the part of the customer, but his attitude must be one of helping the customer in making a wise decision.

Sales are lost because the salesman fails to tailor the sales presentation to the individual needs and requirements of the customer.

A salesman is performing a useful service by offering suggestions to customers who are not aware of their needs or to customers who rely upon displays to remind them of what they came to purchase.

Anybody can sell a customer something he wants. It takes a salesman to sell the customer needed items of which he was unaware.

Closing the sale will be more or less automatic if the need for the article has been definitely established. One of the salesman's functions is to help the customer decide by making "trial" closures.

Don't trip on the last step. The time to close the sale is just after the customer has decided to buy.

Indications that the customer is making up his mind occur when the customer asks the salesman to repeat the advantages of each item and when he wants unwanted goods removed. This is when the salesman should repeat the advantages of the item in which the greatest interest was shown by the potential customer.

The decision to buy occurs after the following conditions have been met:

1. The customer has exhibited attention, interest, and desire in the product.
2. A relationship between need and the merchandise has been established.
3. All important objections have been overcome.
4. The price is low in comparison with value.
5. The product meets the customer's approval.
6. The customer has the power to make the purchase.

Closing the Sale
(Information Sheet continued)

The previous decision is reached by taking steps during the presentation to make buying "action" easy. Such steps include leading the customer to make a number of small favorable decisions himself, making these decisions progressively more forceful, seeking agreement more frequently as the presentation progresses, and narrowing the selection. This is done by concentrating upon items in which the customer is interested, by removing merchandise in which the customer is not interested, by repeating demonstrations in more detail, and by soliciting the opinion of others. Always ask for the order. Use the "choice" method in beginning the closing phase, i.e., 2 or 3 dozen.

Failure to close the sale may be due to:

1. Assuming that the customer is not going to buy
2. Hurrying the customer
3. Failing to help the customer decide
4. Stumbling over sales obstacles
5. Stressing the wrong selling points
6. Trying to force action
7. Being discourteous at any point in the process

When engaged in suggestion selling, the salesman must:

1. Make definite suggestions to the potential customer.
2. Give an acceptable justification for the suggestion made.
3. Demonstrate the merchandise thoroughly and unhurriedly.
4. Not overwhelming the customer with more facts, decisions, etc., than he can face comfortably

Sales are often increased by displaying related merchandise, handling larger quantities, comparing with higher priced merchandise, introducing new merchandise, developing "special" sales, demonstrating new uses for merchandise, and specializing in merchandise for special occasions.

When recording the sale, the salesman, in preparing the sales check, should:

1. Write legibly.
2. Be accurate with items, amounts, and price.
3. List the complete name and address if needed for files or for delivery.
4. Write down any special directions needed to help the customer.

Closing the Sale
(Information Sheet continued)

When operating a cash register, make change accurately. Never put a bill away until the customer is satisfied that he has received the correct change. Use the right compartment for paper money and change. Also, learn to count out change properly.

Just because the register bangs shut does not mean that the sale is completed. A proper, courteous farewell often means repeat visits by the customer.

Give the customer a friendly farewell whether or not he makes a purchase and invite him back soon.

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Material for this Information Sheet was taken from Module 4, Agricultural Supply, Sales and Service Occupations, The Center for Research and Leadership Development in Vocational and Technical Education, Columbus, Ohio.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Salesmanship

TOPIC: Fundamentals for Successful Selling

OBJECTIVE: To summarize and reinforce the steps in successful selling.

REFERENCES:
Required:
1. Information Sheet, "Fundamentals for Successful Selling"

QUESTIONS OR ACTIVITIES:

1. If you are to be a successful salesman,
   a. What must you have?
   b. What must you understand?
   c. What must you know?
   d. What must you use?
2. Select the three items at the right of the page in which you feel you are strongest. Write a short paragraph on each explaining your strengths.
3. Select three items at the right of the assignment sheet in which you feel you need improvement. Write a paragraph on each, including how you think you can improve.
4.
5.

Information Sheet
for
FUNDAMENTALS FOR SUCCESSFUL SELLING

To Help Customers Buy Wisely — You Must

HAVE A Wholesome Attitude — This Means

1. Keep your personal appearance neat and attractive.
2. Keep enthusiastic about your job.
3. Watch your health.
4. Be helpful to your customers.
5. Be loyal to your store.

Understand And Like People — This Means

1. Get your customers point of view.
2. Serve people as you like to be served.
3. Be courteous, considerate and attentive.
4. Be friendly, but not familiar.
5. Find out what your customer wants.
6. Treat customers as invited guests.

Know Your Merchandise — This Means

1. Know what your store carries in stock.
2. Know the location of each item carried.
3. Know the facts about the merchandise you sell.
   a. Facts about material
   b. Facts about construction
   c. Special features and qualities
   d. How to care for and use the merchandise
   e. Store's own brands

Use Good Selling Methods — This Means

1. Meet customers promptly and courteously.
2. Present your merchandise with respect and appreciation.
3. Give honest convincing facts about your merchandise.
4. Answer questions and objections fully -- help your customers decide.

Courtesy of Fairchild Publishing Company

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Salesmanship

TOPIC: Evaluating Salesmen

OBJECTIVE: To develop an understanding of the methods employed in evaluating sales personnel and to encourage self-evaluation.

REFERENCES:
Required:
1. Information Sheet, "Evaluating Salesmen"

QUESTIONS OR ACTIVITIES:

In the information sheet accompanying this topic are four check sheets.

Your assignment is to fill out each check sheet, making two marks in each item.

The first mark, a small "x", is your evaluation of a salesman from whom you recently made a purchase. If you wish, use a different salesman for each sheet.

The second mark, a small "o", is your own performance in the place in which you work. Use any customer contact during the past two weeks, and use a different one for each sheet, if you wish, but make an honest appraisal of your performance.

Information Sheet
on
EVALUATING SALESMEN

	Did so effectively	Did so partially	Did not	Could have
1. APPROACHED CUSTOMER PROMPTLY				
a. Was on the lookout for customers				
b. Stopped what he was doing				
c. Approached the customer mentally and physically				
2. WELCOMED THE CUSTOMER				
a. Smiled				
b. Used appropriate approach				
c. Treated the customer as a guest				
3. HELPED TO START CONVERSATION				
a. Adapted himself to situation				
b. Made comment about merchandise				
c. Anticipated customer's interest				

COMMENTS:

Information Sheet
on
EVALUATING SALESMEN

	Did so effectively	Did so partially	Did not	Could have
1. APPROACHED CUSTOMER PROMPTLY				
a. Was on the lookout for customers				
b. Stopped what he was doing				
c. Approached the customer mentally and physically				
2. WELCOMED THE CUSTOMER				
a. Smiled				
b. Used appropriate approach				
c. Treated the customer as a guest				
3. HELPED THE START CONVERSATION				
a. Adapted himself to situation				
b. Made comment about merchandise				
c. Anticipated customer's interest				

COMMENTS:

Information Sheet
on
EVALUATING SALESMEN

	Did so effectively	Did so partially	Did not	Could have
1. APPROACHED CUSTOMER PROMPTLY				
a. Was on the lookout for customers				
b. Stopped what he was doing				
c. Approached the customer mentally and physically				
2. WELCOMED THE CUSTOMER				
a. Smiled				
b. Used appropriate approach				
c. Treated the customer as a guest				
3. HELPED TO START CONVERSATION				
a. Adapted himself to situation				
b. Made comment about merchandise				
c. Anticipated customer's interest				

COMMENTS:

Information Sheet
on
EVALUATING SALESMEN

	Did so effectively	Did so partially	Did not	Could have
1. APPROACHED CUSTOMER PROMPTLY				
a. Was on the lookout for customers				
b. Stopped what he was doing				
c. Approached the customer mentally and physically				
2. WELCOMED THE CUSTOMER				
a. Smiled				
b. Used appropriate approach				
c. Treated the customer as a guest				
3. HELPED TO START CONVERSATION				
a. Adapted himself to situation				
b. Made comment about merchandise				
c. Anticipated customer's interest				

COMMENTS:

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Business Procedures

TOPIC: Importance of Accurate Records

OBJECTIVE: To develop an understanding of the necessity for accurate business records.

REFERENCES:

Required:

1. Information Sheet, "Importance of Accurate Records"

Supplemental:

2. Merchandising Products Used in the Farm Business, Ohio State University, Columbus, Ohio, 43210

QUESTIONS OR ACTIVITIES:

1. a. Give five reasons why management must have records.
   b. Which of the five is most important? Why?
2. What does an "operating statement" show?
3. How does a "balance sheet" differ from an "operating statement"?
4. Where does management get the "figure" for the operating statement and balance sheet?
5. Why are cash registers balanced daily?
6. Why are "merchandise purchases" not the total cost of the merchandise sold?
7. What are two good reasons for having periodic records of "stocks and inventories"?
8. If the firm in the "statement of operations" had received $1000 less during this year for storage and handling (with all entries being the same), what would have been the gross margin?
9. Where, in the "statement of operations" do you think these items are included?
   a. Wages paid a Co-Op Vocational Agriculture Student?
   b. The electricity bills?
   c. A radio "commercial" for the firm?
   d. The sacks for small items of merchandise?
   e. The decrease in value of a delivery pick-up?
10. In the "sample balance sheet" why is there no entry under "accumulated depreciation" for land?
11. If on December 30, 1968, this firm had paid an additional $5000 of its "accounts payable", how would these four numbers have been changed?
    a. Cash on hand and in bank?
    b. Total assets?
    c. Accounts payable?
    d. Total liabilities?
12.
13.

Information Sheet
on
IMPORTANCE OF ACCURATE RECORDS

Most people are familiar with the sales ticket and some of the other ordinary papers used in conducting business. These papers and procedures are so important in helping to make an operation successful that they need considerable attention.

To understand the importance of these items, an overview of the entire records of a business is necessary. Management of a business, to be successful, needs records of the business as a whole, and of each department, in order to:

1. Know the financial picture of the business at any given time.
2. Give proper information to board of directors, stockholders, and others involved.
3. Satisfy legal requirements.
4. Plan desirable changes in management and procedures.
5. Prepare state and federal tax returns.

One record needed by management is an "operating statement." It is sometimes called a "statement of operations" or a "profit and loss statement." These are prepared either annually, biannually, quarterly, or monthly, whichever is desired. The operating statement summarizes the receipts and expenses for a given period of time and shows the profit or loss for that period. Many businesses have this statement broken down by departments to ascertain the profit or loss of each department.

The other standard overall record used by businesses is the "balance sheet". The balance shows the financial condition of the business at a given time, but generally on the last day of the period covered by the operating statement. The balance sheet lists the assets, liabilities, and net worth of the business. The liabilities and net worth show the methods of obtaining capital for the business. The sum of the liabilities and net worth must "balance" with the assets of the business at any given time.

The balance sheet and the operating statement make up the financial report for a business. (Note attached sample forms.)

The daily, weekly and monthly records all help contribute to the final make-up of the "balance sheet" and "operating statement".

A record of "cash sales" for the period desired (day, week, month, or quarter) must be secured. In addition, the cash register must be balanced daily to be sure that all cash is accounted for and that all records are correct.

"Charge sales" must be correctly made and entered in appropriate ledgers, according to the policies of the particular business.

Importance of Accurate Records
(Information Sheet continued)

Records must be made of all "merchandise purchases", including the cost of transportation and other incidental expenses.

Periodic records of "stocks and inventories" must be made, both for knowing the business' financial condition, and also for determining stock needs and sales.

In addition to those items directly concerned with sales, the costs of payroll, property expense taxes, supplies, services, advertising, interest, depreciation, losses and legal costs must be paid before any profit is returned to the business.

SAMPLE STATEMENT OF OPERATIONS
FOR YEAR ENDED DECEMBER 31, 1968

SALES		$1,562,702.44
Less Cost of Commodities Sold		1,478,914 33
Gross Selling Margin		$ 83,788.41
OTHER REVENUE		
Grinding, Cleaning, etc.	$ 8,701.31	
Storage and Handling	10,893.03	
Dividends, Patronage Refunds, etc	665.41	
Total		$ 20,259.74
GROSS MARGIN		$ 104,048.16
EXPENCES		
Salaries and Wages	$40,247.18	
Heat, Power and Water	4,597.79	
Plant Repairs and Maintenance	3,737.88	
Insurance	3,942.74	
Interest	31 70	
Telephone	728 43	
Taxes	7,417 40	
Advertising	1,787 00	
Depreciation	12,116.40	
All Other Expenses.	3,710.15	
Total		$ 78,316 67
NET MARGIN		$ 25,731 49

Importance of Accurate Records
(Information Sheet continued)

LISTRIBUTION OF NET MARGIN

Provision for Dividend on Capital Stock-- $ 4%	2,272.00
Patronage Refund to Stockholders-- 2 and 1-1/2%	21,680.17
Provision for Federal Income Tax	254.64
Balance of Net Margin Retained	1,524.68
Total	$25,731.49

SAMPLE BALANCE SHEET, DECEMBER 31, 1968
ASSETS

CURRENT ASSETS:			
Cash on hand and in bank		$ 28,173.70	
Accounts Receivable-- Patrons	$ 26,060.54		
Less Allowance for Doubtful Accounts	2,302.20	23,758.34	
Accounts Receivable-- Grain Firms		3,787.41	
Inventories		42,016.76	
Prepaid Items		6,319.38	
Total Current Assets			$104,055.59
INVESTMENTS:			
Stocks, Bonds, and Credits in Other Companies			$ 10,667 15

	Cost	Accumulated Depreciation	Net
PLANT AND EQUIPMENT:			
Land	$ 2,326.39	$.....	$ 2,326.39
Buildings	245,749.02	87,007.97	158,741.05
Machinery and Equipment	73,488.70	39,452.33	34,036 37
Furniture and Fixtures	4,538.78	3,921.09	617 69
Total	$326,102.89	$130,381.39	$195,721.50
Total Plant and Equipment-- Net			$195,721 50
TOTAL ASSETS			$310,444.24

Importance of Accurate Records
(Information Sheet continued)

LIABILITIES

CURRENT LIABILITIES:		
Accounts Payable--Trade and Others	$ 15,649.42	
Federal Income Tax Payable	254.64	
Dividends Payable on Capital Stock	2,272.00	
Patronage Refunds Payable for Year 1967	21,624.51	
Employee's Taxes Withheld	554.72	
Accrued Salaries, Property and Payroll Taxes	8,522.75	
Total Current Liabilities		$ 48,878.04
STOCKHOLDERS' EQUITY:		
Capital Stock Authorized, 750 shares Par Value $100.00, 641 1/2 Shares Issued Including 73 1/2 Shares of Treasury Stock Outstanding, 568 Shares	$ 56,800.00	
Additional Paid-In Capital	4,132.00	
Retained Earnings	200,634.20	
Total Stockholders' Equity		$261,566.20
TOTAL LIABILITIES AND STOCKHOLDERS'EQUITY		$310,444.24

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Material for this Information Sheet was taken from: "Business Procedures", Module 6, Agricultural Supply, Sales and Service Occupations. The Center for Research and Leadership Development in Vocational and Technical Education, 980 Kennear Road, Columbus, Ohio 43212.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Business Procedures

TOPIC: Sales Tickets

OBJECTIVE: To develop an understanding of the necessity for completeness and accuracy in sales tickets and skill in their completion.

REFERENCES:
Required:
1. Information Sheet, "Sales Tickets"

QUESTIONS OR ACTIVITIES:

1. Secure 10 sales tickets of the type or types used in the place of business in which you are employed.
   Attach the first to a sheet of paper, and letter each part of the ticket in a manner similar to the sample in Information Sheet. Letter the parts in the order in which you would fill out the ticket. Then, on another sheet of paper, give the reason or the use for each part represented by a letter.
2. In making change, the salesman uses the _____ denomination of bills and coins possible.
3. A numerical file accounts for _____ sales tickets.
4. A record of the customers' business is provided by sales tickets in the _____ file.
5. Completely make out 9 sales tickets with at least 5 items each without repeating the same item.
6.
7.

Sales Tickets
(Information Sheet continued)

a. Enter the correct date.
b. Write the customer's correct name and address. If a partnership, it should be noted. The name and address becomes absolutely necessary if the purchase is charged.
c. Give a complete description of each article sold. Quantity and unit should be thought of as one item (for example, 100 lbs. of fertilizer or 10 gals of insecticide).
The description should clearly designate the type of merchandise being sold, and not merely be a commodity classification. For example, 100# Stocktox, not 100# dust. (On sales tickets, pounds are usually indicated by #.) This is necessary for checking price and for inventory controls. Show the price per unit for all merchandise. (Some sales tickets will have a column heading marked "price".) Bill all merchandise at the retail price. If the customer is entitled to a discount because of volume, damage, etc., this amount is deducted from the retail price. Extensions must be mathematically accurate and legibly written.
d. Make a sub-total of the extension.
e. Calculate the sales tax on all taxable items, and enter under the first total. (Sales tax policies will vary according to state laws.)
f. Next, calculate any delivery, mixing, blending or spraying costs.
g. Add the extension column to obtain the grand total of charges for the sale.
h. Check the block on the ticket to indicate the method of payment (cash, check, charge, returned, account).
i. If settlement is to be made by a check larger than the ticket total, it is necessary to note both the amount of the check on the face of the sales ticket, and the change to be given. A similar calculation is recommended when a large bill is given in payment.
j. Get the signature of the person receiving the merchandise when the settlement is other than cash.
k. When a customer pays on account, make out a sales ticket and mark the items for which he is paying (for example, fertilizer, feed, balance on note, etc.)
l. In all cases where an employee ruins a ticket for any reason, the word "void" should be written across the front of the ticket, and the original placed with the other tickets. Sales tickets must be numbered consecutively Each ticket must be accounted for at the end of the day's business.
m. The salesman initials the ticket in the appropriate block.

Properly prepared sales tickets giving full information about the transaction provide the manager with the information he needs in conducting the business. Sales tickets may prevent many misunderstandings with customers when a transaction is questioned.

Information Sheet
on
SALES TICKETS

The heart of the accounting system is the billing of merchandise to customers. This is necessary to provide accurate records of transactions. Many businesses have triplicate sales tickets, one for the customer and two for the office files. Sales tickets need to be numbered consecutively in advance for filing and checking purposes and to avoid loss of merchandise through carelessness. Sales tickets will provide the company with the following:

1. Information necessary to make an analysis of the day's business.
   a. Amount of cash taken in. This also serves as a check on the cash that should be in the cash register at the close of the day's business.
   b. The amount of merchandise sold
   c. The amount of sales tax collected

2. Information needed for the accounts receivable ledger for the customers who charged their purchases.

3. A record of each transaction for future reference. After the information contained on the sales ticket has been recorded in the proper journals, the two copies should be filed as follows:
   a. One in a numberical file. Since all sales tickets are accounted for in this file, a sales person cannot accept cash from a customer, prepare a sales ticket, give the customer his copy, destroy the office copies and keep the money.
   b. One in a client file. This will serve as a record of the customers' business.

Many factors are important in the preparation of the sales ticket:

1. In spite of the importance of sales tickets, many mistakes are made in their use. Some common mistakes are as follows:
   (Use examples to show how important common mistakes are to the net profit of a business, e.g., how much more is needed in sales to make up for an order for a ton of feed not billed.)
   a. The ticket cannot be read
   b. Some merchandise is not billed when sold
   c. Price list and discount policies are not followed
   d. Mistakes in arithmetic
   e. Employees do not keep all of their sales tickets.

2. Although each business will have its own procedure for completing sales tickets, the following shows one procedure to follow in making out a sales ticket correctly: (A sample sales ticket is included.)

Sales Tickets
(Information Sheet continued)

SAMPLE AGRICULTURE CHEMICAL AND FARM SUPPLY
Farmerton, Texas

June 10 19 68 a

Sold To Bill Jones & Son b

Address Farmerton, Texas

Quantity	Description	Price	Amount
100 gal	Treflon	$20.00 gal	$2000.00 c
c	Less 5% qty disc.		100.00
c			$ 1900.00 d
3 tons	Ammonium Nitrate	$57.00	171.00
3 tons	Spreading Nitrate	$3 ton	9.00 f
1	5 gal. Hudson		
	Hand Sprayer	$4.95	4.95
	Sales Tax	$ .15	.15 e
	Check $2100.10		
	Purch. 2085.10		$ 2085.10
	Change $15.00		

____ Eligible ____ Ineligible _____ Patronage Volume

j Received By: Trent Jones Salesman: Brown m

Cash	Check	Charge	Returned	Account	
	✓				No. 44891

h

Sales Tickets
(Information Sheet continued)

Making change following a purchase can be done accurately by using the following procedure:

1. Count from the cost of the purchase to the total amount of payment. For example, if the cost is $2.98 and a $5 bill is tendered, count "$2.99, $3.00, $4.00, $5.00."
2. Use the largest denomination of coins and bills possible in making change.
3. Positively identify the amount (e.g. $5, $10, etc.) of a bill or check and lay it on top of the cash drawer until after the change is given in order to avoid mistakes.
4. If in doubt as to the correct change, or if payment is by check, the computation should be made with pencil and paper.
5. Use a flannel board and proportionately enlarged coins and bills to bring the class into a discussion and demonstration on the change-making process.

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Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Business Procedures

TOPIC: Credit

OBJECTIVE: To develop an understanding of the need for and function of agricultural credit and the function of the agricultural business in supplying credit.

REFERENCES:
Required:
1. Information Sheet, "Credit"
2. "How to Use Your Bank, L-389, Texas Agricultural Extension Service
3. Profitable Farm Management, Hamilton, J. E. and W. R. Bryant, Prentice-Hall Inc., Englewood, Cliffs, N. J., pp. 99-115, (State Adopted Text)

QUESTIONS OR ACTIVITIES:

1. Give 7 sources of credit for farmers.
2. What is the difference between "Productive Credit" and "Consumptive Credit"?
3. What does the business extending credit need to know about a credit customer? The business firm is the "lender"; the customer, the "borrower".)
4. What are three advantages of the use of checks in paying bills?
5. Give 5 good rules in check writing.
6. Assume that a customer has requested that you write a check for his signature in the amount of his bill, $127.65. Obtain a blank check and write it out, leaving the signature space blank. Attach it to the sheet you are using to answer these questions.
7. How does a draft differ from a check?
8. What is a "note"?
9. What is a "mortgage"?
10. If your firm has a written credit policy, secure a copy and attach it in your notes.
11.
12.

Information Sheet
on
CREDIT

The capital required to finance modern farming operations is so great that most farmers must either borrow money to pay for their purchases, or charge their purchases, making use of credit plans made available by businesses.

Credit is a very useful tool in conducting business. A vast majority of business done anywhere in the world proceeds with little transfer of actual cash. The retailer buys from the wholesaler or the distributor on credit just as the farmer buys on credit from the farm supply store.

Credit may be extended for only a short time (30 days or less, the same as cash) in which case the business establishment may do the financing. Credit may be extended for several months or longer, in which case a credit institution such as a bank or loan association will usually finance the purchase. Large amounts are secured by credit instruments such as commodity notes and mortgages.

Each business will establish credit policies. These policies will state the conditions under which credit will be extended, the maximum credit to be allowed, and the payment plans and penalties.

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Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Business Procedures

TOPIC: Determining Selling Price

OBJECTIVE: To develop an understanding of the factors that enter into the determination of the selling price of merchandise.

REFERENCES:
Required:
1. Information Sheet, "Determining Selling Price"

QUESTIONS OR ACTIVITIES:

1. What must the selling price of an article include besides the original cost?
2. Which 5 of the "Overhead" cost items listed in the information sheet will remain almost the same from year to year?
3. Which three of the overhead items will fluctuate most widely?
4. When overhead costs vary little or not at all, what are they called?
5. Why is an increase in volume of business usually advantageous to the firm?
6. What is "markup"?
7. A merchant buys an item delivered to his store for $10.00. He prices it at $13.00.
   a. What is the markup?
   b. What is the percent markup?
8. What is gross margin? How does it differ from markup?
9. An item costing $10.00 is marked up to $13.00 and sold. What is the gross margin?
10. Give a "rule of thumb" for determining a necessary gross margin.
11. What are feed "turn over" goals higher than hardware?
12.
13.

Information Sheet
on
DETERMINING SELLING PRICE

The original cost of merchandise is the actual purchase price, including the cost of transportation The selling price must include the original cost plus merchandising costs, overhead costs, and a reasonable profit

The overhead costs may reflect some, or all, of the following conditions:

1 Merchandise ma become obsolete before sold
2 Merchandise becomes shop-worn
3 Some merchandise will be overstocked and will not sell
4 The price of merchandise may drop before the stock is sold
5 Interest on investment in inventory items
6 Insurance on inventory items
7 The cost of warehousing the merchandise
8 Delivery costs (to the customer)
9 Taxes on the merchandise carried in inventory
10 Theft of merchandise
11 Shrinkage of merchandise
12 Damage to merchandise in stock
13 Wages and salaries
14 Office and accounting expenses

Overhead costs may be grouped into areas of fixed costs (insurance, interest, taxes, etc) which will be constant per $1,000 of inventory, and variable costs (raw materials, product containers, packaging materials, etc) which change according to volume of business done, and the expenses of doing this business

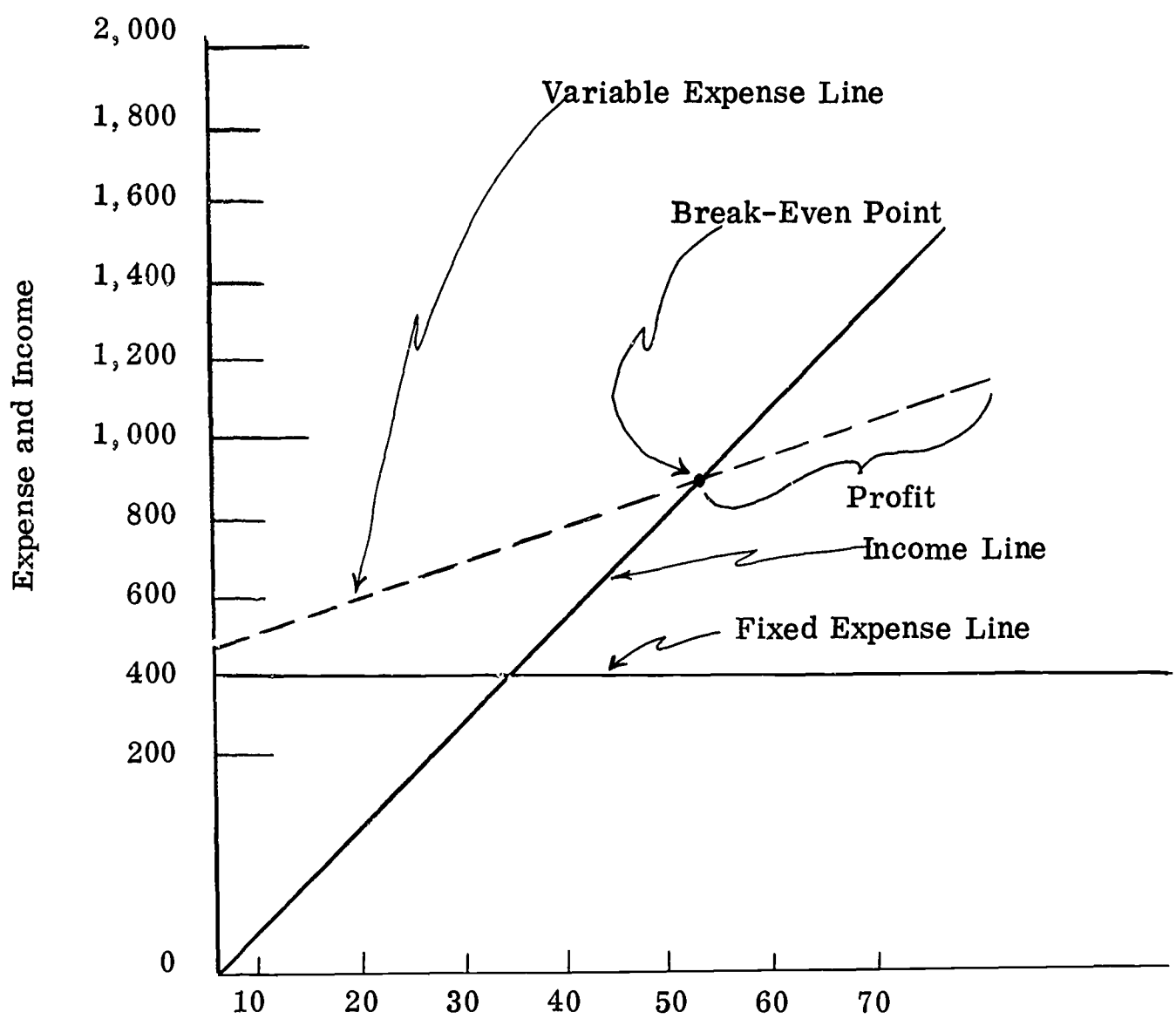
Some companies may find the annual cost of keeping items in stock as low as 10% of value while other companies may need an increase in cost of 15% or more in order to pay the expense of just keeping stock on hand

In addition to overhead costs, some companies may provide free services to their customers Services like mixing or spreading fertilizers will also increase the costs of doing business

Determining Selling Price
(Information Sheet continued)

A graph may help explain the need for increasing the volume of business in order to cover both fixed and variable expenses and make a profit:

BREAK-EVEN CHART



Determining Selling Price
(Information Sheet continued)

The merchant must determine a selling price for his products that is high enough to cover the cost of the item, overhead expenses, service costs, and allow a reasonable profit.

There are two terms used to describe the difference between the merchant's cost of an item and his selling price.

1. "Markup" - The amount added to the cost to make the selling price. As a percentage, it is the relation of the amount of markup to the cost. For example:

Cost	+	Markup	=	Selling Price
20	+	5	=	$25

The markup is 25% of the cost.

Example:		
	Merchant purchases vegetable dust	$1.00
	Merchant prices begetable dust at	1.25
	Cash markup	.25
	Percent markup	

$$\frac{\text{Cash markup}}{\text{Purchase price}} = \frac{.25}{1.25} = 25\%$$

2. "Gross margin: - Is determined by dividing the markup by the selling price.

Example:		
	Merchant purchase vegetable dust from wholesaler for	$1.00
	Merchant prices vegetable dust at	1.25
	Cash markup	.25
	Percent gross margin	

$$\frac{\text{Cash markup}}{\text{Selling price}} = \frac{.25}{1.25} = 20\%$$

Markup and gross margin are often confused. They are always the same in dollars and cents; but never the same in percentage because markup is figured on cost and margin on selling price.

Examples of the gross margins and markups used by one farm supply business to cover their expenses and to secure a reasonable profit is as follows:

Determining Selling Price
(Information Sheet continued)

	Percent Gross Margin	Percent Markup
Fertilizer	12.0%	13.6%
Grain	6.0%	6.4%
Hardware	33.3%	50.0%
Commercial Feed	18.0%	22.0%

A rule of thumb that may be used to determine gross margin is as follows: In order to make a large enough profit to remain in business, the number of times an item turns over in stock during the year times the gross margin should equal 100.

Example: Refer to the vegetable dust used in the illustration for markup and gross margin.

Vegetable dust turns over 5 times in stock during the year.

5 x X (gross margin) = 100
5X = 100
X = 20% gross margin

The suggested turnover goals for one business are as follows:

Feed.....	15	Seed	8-10	Farm equipment	3
Fence.....	4	Oil and Grease.....	4	Building Material	4
Paint.....	4	Tires and Tubes.....	4	Electrical merchandise...	4
Hardware .	3	Miscellaneous merchandise	4	Farm supplies, general	4
Machinery.	4				

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Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Business Procedures

TOPIC: Business Records: Ordering and Receiving Merchandise

OBJECTIVE: To secure an understanding of business forms used in ordering and receiving merchandise.

REFERENCES:

Required:

1. Information Sheet, "Business Records: Ordering and Receiving Merchandise"

Supplemental:

2. Stockkeeping, Division of Extension, The University of Texas, Austin, Texas

QUESTIONS OR ACTIVITIES:

1. Explain to the best of your knowledge who makes the decisions regarding what merchandise and how much to purchase in the business in which you work.
2. Secure a "purchase order" if one is available where you work and write up a sample order.
3. Why is it necessary to keep copies of purchase orders?
4. What is usually included in a "receiving record"?
5. Give two ways freight charges are handled.
6. What is a "bill of lading"?
7. What is an "invoice"?
8. How are invoices checked by business firms?
9. Explain the forms used for ordering and receiving goods in the business in which you work.
10.
11.

Information Sheet
on
BUSINESS RECORDS: ORDERING AND RECEIVING MERCHANDISE

In purchasing and receiving merchandise in a business, the following are typical procedures and business forms used:

1. A decision is made on the type, amount, and cost of merchandise to be ordered, and the company from which it is to be ordered.
2. A purchase order is completed.
3. Company policy usually assigns the responsibility in ordering merchandise to specific employees. Duplicate records or purchase orders are kept in order to check them against the materials, the invoice, and bill of lading when merchandise is received. Note specifically on the sample purchase order the complete items, including the company's order number.
4. When the shipment is received, a "receiving record" or "receiving report" are typical forms used to record the receipt of merchandise. Other similar records may be used.
5. The receiving record must be a complete record of the merchandise received, including its condition when received. The primary use of a receiving record is to check incoming merchandise against invoices and bills of lading.
6. Commercial carriers, such as railroads and trucking companies, will charge for hauling the products from the originating point to the delivery point. Prior to placing the order, an agreement should be made on who pays the delivery charges, the shipper or the receiver. Freight may be prepaid or sent C. O. D.
7. Forms used by the carriers are called "bills of lading" or "shipping records". An employee should know how to receive merchandise. He should understand the forms used.
8. The final business form to be considered in the ordering and receipt of merchandise is the "invoice". An invoice is a bill or statement due a company for merchandise delivered. Since the payment for goods is made from the invoice, it must be accurate. The invoice should be checked against all previous papers--the purchase order, the receiving record, and the bill of lading. All businesses have an established policy as to the checking of invoices for payment. The discount terms must appear on the invoice and be used in computing the amount to be paid.

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Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Business Procedures

TOPIC: Inventories

OBJECTIVE: To develop an understanding of principles and practices used in maintaining and utilizing inventories.

REFERENCES:

Required:

1. Information Sheet, "Inventories"

Supplemental:

2. Stockkeeping, Division of Extension, University of Texas, Austin, Texas

QUESTIONS OR ACTIVITIES:

1. What is an inventory?
2. Why are inventories necessary?
3. What is meant by "inventory control"?
4. What is a perpetual inventory?
5. When are "physical inventories" made?
6. In addition to counting the items, what purposes are met by a physical inventory?
7. What four items of additional information will most inventories secure?
8. If a form (or forms) is used for making inventories in the business in which you work, secure a form, study it and attach it with your answers.
9.
10.

Information Sheet
on
INVENTORIES

An inventory is a correct count of a concern's merchandise, including its value. An inventory is necessary for several reasons:

1. An accurate account of value is necessary for year-end or periodic analysis of the business.
2. Periodic merchandise counts enable the business to determine the freshness of its stocks, and to decide whether some items are obsolete.
3. Inventory counts will show the extent to which items are moving. They will show whether items are overstocked or understocked.
4. Physical count inventories are necessary to determine possible losses. (These are different than book inventories.)

Businesses will use inventories in additional ways. "Inventory control" is a system of keeping on hand adequate amounts of any given merchandise. A business needs to be sure that the customers' needs are met, but does not want to have surplus, outdated merchandise on hand which frequently may be in poor condition.

There are several types of inventories:

1. Perpetual inventories
   Many businesses have some or all of their stock listed so that they know at any given time the number of items of merchandise on hand. This is done by systematically adding the purchases to the inventory, and by subtracting the sales taken from the daily sales slips or totals which are then subtracted from these inventories. This results in maintaining a "book" inventory level as purchases and sales are made. To be sure it is correct, periodic physical counts must be made and checked against the perpetual inventory.
2. Physical inventory
   The physical inventory is an actual count of all merchandise on hand at a given time. This must be done at the end of the fiscal year, and is of considerable value at other times during the year. Procedures in making the count will vary but will include many or all of the following procedures:
   a. Arrange stock in an orderly fashion.
   b. Check stock for condition; count only that which is salable.
   c. Count and record every item, listing the cost price unless the particular business prefers that the selling price be used.
   d. Keep inventories separate for different departments and types of goods.
   e. Compute totals.

Inventories
(Information Sheet continued)

Businesses will have special forms used for taking the inventory. These forms may include:

1. Location of merchandise
2. Department to which merchandise is charged
3. Names of persons taking the inventory
4. Information concerning the age and/or quality of merchandise

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Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Business Procedures

TOPIC: Receiving and Storing Merchandise

OBJECTIVE: To develop an understanding of the steps involved in receiving and storing merchandise.

REFERENCES:

Required:

1. Information Sheet, "Receiving and Storing Merchandise"

Supplemental:

2. Stockkeeping, The Division of Extension, The University of Texas, Austin, Texas

QUESTIONS OR ACTIVITIES:

1. When should damage be noted when unloading merchandise upon its receipt?
2. How should damage be noted?
3. How are "shortages" checked?
4. When should the quality of merchandise be checked?
5. Secure one of the receiving forms used in the firm in which you work and attach it to this assignment.
6.
7.

Information Sheet
on
RECEIVING AND STORING MERCHANDISE

One of the important functions of any agricultural business is the receipt and storing of merchandise. To properly receive merchandise, whether it be feed, fertilizer, chemicals or miscellaneous merchandise, several steps must be followed:

1. A definite plan must be used in unloading, moving, and storing items. This involves consideration of who does the work, how various types of merchandise must be handled (by hand, fork lift, etc.), and how and where it is to be stored.
2. Damage or breakage must be determined as the unloading proceeds. Both damage and breakage must be noted on the receiving form. Damaged merchandise must be destroyed, returned, or kept and sold at a reduced price. The person in charge should determine, at the time of unloading, whether there is any shortage.
3. The possibility of shortage must always be checked by exact count or weight at the time of receiving the merchandise. The quantity of goods received must always agree with the goods signed for on the bill of lading, or other shipment records.
4. Policies vary on checking goods against the invoice to check against substitutions. Invoices may be with the goods or they may arrive before the goods. The person checking the shipment should be sure that the merchandise received is in accord with the purchase order before signing the delivery slip. Many businesses will use a duplicate copy of their purchase order to check against merchandise received.
5. The quality of the merchandise, insofar as it can be determined by visual examination or by approved testing procedures, should be checked at the time of arrival. Quality must be checked against what was ordered to be sure it meets the standards specified in the order.
6. The employee who receives the merchandise will usually sign for it. He will also complete a receiving report for his business. Note on the receiving report form the fact that accurate count, condition of merchandise, description of merchandise as well as other pertinent facts, are listed.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Business Procedures

TOPIC: Stocking and Merchandise Planning

OBJECTIVE: To develop an understanding of the importance of and methods used in properly stocking and in merchandise planning.

REFERENCES:
Required:
1. Information Sheet, "Stocking and Merchandise Planning"

QUESTIONS OR ACTIVITIES:

1. In your opinion, how should a merchant determine how much of a particular product to stock?
2. What are the penalties for a merchant ordering merchandise (a) too early? (b) too late?
3. Who should call attention to low stocks in a firm?
4. Name three items in the store or place of business where you work that have slow "turnover".
5. Name three items in the store in which you work that have rapid "turnover".
6. What is the reason for the difference in Nos. 4 and 5 above?
7. Draw a diagram of the place of business in which you work, drawing in the location of classes of merchandise.
8.
9.

Information Sheet
on
STOCKING AND MERCHANDISE PLANNING

Businesses have numerous decisions to make in determining the quantity of any certain item to order. The quality of stock and time to order are also important. Some factors which businesses must keep in mind in ordering supplies are:

1. Will this merchandise have a slow or fast turnover?
2. Will it keep if some remains unsold?
3. What will be the probable demand for this product this year or this season?
4. When will the demand come?
5. How long will it take to get replacement merchandise?
6. How much money may we have tied up in inventory stock?
7. Where can we secure quality merchandise at the lowest cost?

Although only certain employees will have the responsibility of ordering stock, all employees must be responsible for calling attention to low stocks and for keeping the stock neat and orderly.

An employee should know the exact location of merchandise. He should have a good working knowledge of the amount of a product on hand at a given time in relation to the probable demand.

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Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Safety

TOPIC: Chemical First Aid

OBJECTIVE: To learn the first aid treatments for individuals who have been poisoned by agricultural chemicals.

REFERENCES:
Required:
1. Information Sheet, "Chemical First Aid"

QUESTIONS OR ACTIVITIES:

1. Name four types of agricultural chemical poisons that you may have to render first aid for.
2. What is usually the first thing you would do for a victim of any of the chemical poisons in order to help him and protect yourself?
3. How can an organic phosphate be removed from a victim's eye?
4. What are two ways to induce vomiting in a victim poisoned by chlorinated hydrocarbons?
5. Name five of the earliest indications that a person is being poisoned by organic phosphate.
6. When do symptoms of methyl bromide poisoning appear as related to exposure?
7. What would you do for a person who had just spilled a concentrated organic phosphate solution on himself?
8.
9.

Information Sheet on CHEMICAL FIRST AID

Wherever chemicals are stored or used there is always the possibility of individuals being poisoned by accident. In order to increase a poisoned individual's chances for survival, it is most important that you know what to do in advance of the incident.

A knowledge of the symptoms produced by the various types of agricultural chemicals will help you in assisting the victim. These symptoms by chemical type are as follows:

Organic Phosphates

Early Symptoms

1. Headache
2. Giddiness
3. Nervousness
4. Blurred vision
5. Constricted pupils
6. Weakness
7. Nausea
8. Cramps
9. Diarrhea
10. Discomfort in the chest
11. Sweating
12. Watering of the eyes
13. Slobbering
14. Vomiting

Late Symptoms

1. Foaming at the mouth
2. Convulsions
3. Unconsciousness (Coma)
4. Loss of urinary and bowel control

Immediately after recognizing these symptoms in a victim you should remove him from the source of contamination. The sequence of events, following the removal of the victim from contamination, will vary with the severity of poisoning, the assistance available, etc.; and you will have to remain calm and use good judgment. Listed below are the steps to follow in giving first aid.

1. Administer mouth to mouth resuscitation if the victim has stopped breathing or is having difficulty breathing.
2. Remove the contaminant from the victim's body.
   a. Remove clothes if they are contaminated.
   b. Wash chemical from exposed skin with soap and water very quickly, flushing with plenty of water.
   c. Flush eyes with clear water for ten minutes if chemical is in eyes.
   d. Induce vomiting by sticking finger down victim's throat if chemical has been swallowed.
3. Get a doctor immediately.
4. Be sure to have copy of chemical label for doctor.

Poisoning from organic phosphates is acute.

Carbamates

Similar symptoms occur here as with organic phosphates, and the first aid rendered will also apply.

Chemical First Aid
(Information Sheet continued)

Chlorinated Hydrocarbons

Early Symptoms

1. Nausea
2. Tingling of tongue, lips, and parts of face
3. Apprehension
4. Dizziness
5. Confusion
6. Trembling
7. Headache
8. Fatigue

Late Symptoms

1. Tingling of body extremities
2. Convulsions

As with other types of poisons, remove victim from the source of contamination. Then, as good judgment dictates, administer aid as follows:

1. Give mouth to mouth resuscitation if victim has stopped breathing.
2. Give warm salt water to induce vomiting, also run finger down victim's throat to induce vomiting.
3. Tea or coffee may be given if victim is conscious (no alcohol).
4. Get a doctor immediately.
5. Be sure to have copy of poison label for doctor.

The hazard of acute poisoning from chlorinated hydrocarbons is not usually so high as for the organic phosphates, but they can kill.

Methyl Bromide

These symptoms do not occur until one to four hours following exposure.

Symptoms

1. Nausea
2. Vomiting
3. Weakness
4. Drowsiness
5. Convulsions
6. Unconsciousness
7. Fluid in lungs

These victims should be removed from further exposure and taken to a doctor immediately.

Anyone who is exposed to agricultural chemicals should check with his physician, telling him what kind or kinds of chemicals that he may come in contact with. The doctor must know what poison he is dealing with in order to treat the patient. It is very important that treatment be started immediately.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Safety

TOPIC: Storing Agricultural Chemicals

OBJECTIVE: To learn to store agricultural chemicals successfully and safely.

REFERENCES:
Required:
1. Information Sheet, "Storing Agricultural Chemicals"

QUESTIONS OR ACTIVITIES:

1. Why should chemicals be stored in the original containers?
2. Why should chemicals be stored in locked closets?
3. Why should chemicals not be stored near livestock feed?
4. List the two reasons why you should not lend a portion of a chemical to another person in an unlabeled container.
5. Why should herbicides and insecticides not be stored in the same room?
6. Where should heavy drums of chemicals be stored?
7. How can you protect labels on chemical containers to be stored for a long period?
8.
9.

Information Sheet
on
STORING AGRICULTURAL CHEMICALS

Always store chemicals in the original containers, with the label attached, and the lid closed tightly. Using soda pop bottles, fruit jars, or other types of containers can have serious consequences (Fig. 1). Small children associate various shaped containers with their original contents and may be injured or killed by careless use of containers. Never leave excess pesticide mixtures in unmarked containers. You will have no one to blame but yourself if you are responsible for someone's injury or death because you left poisons in unmarked containers.

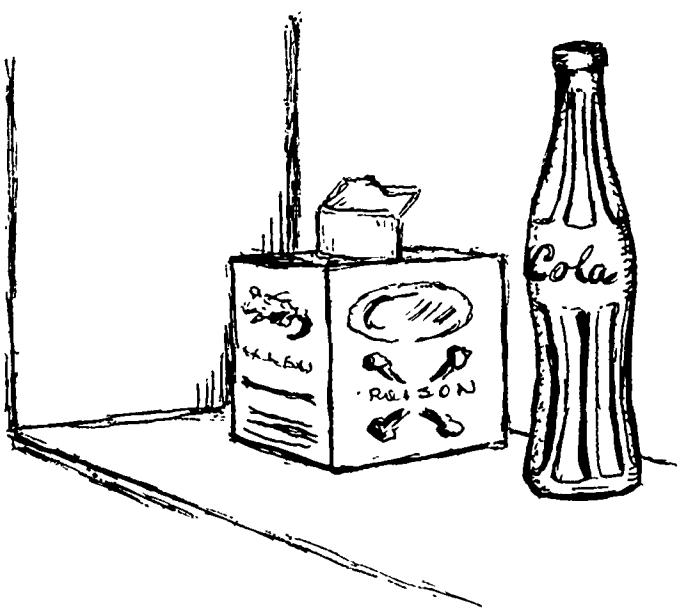


Fig. 1. This coke bottle to a child should contain coke. If it contains a toxic chemical, a death could result.

Keep all chemicals out of the reach of children, pets, and irresponsible people. Do not store them in your home near food. This will help reduce the exposure hazard and also prevent possible contamination of food. Lock all chemicals in a building or cabinet (Fig. 2). The lock should keep everyone out of the chemicals except those who are qualified to use them properly. Children are always curious. Remember, anything they can get their hands on may be put in their mouths (Fig. 3).

Storing Agricultural Chemicals
(Information Sheet continued)

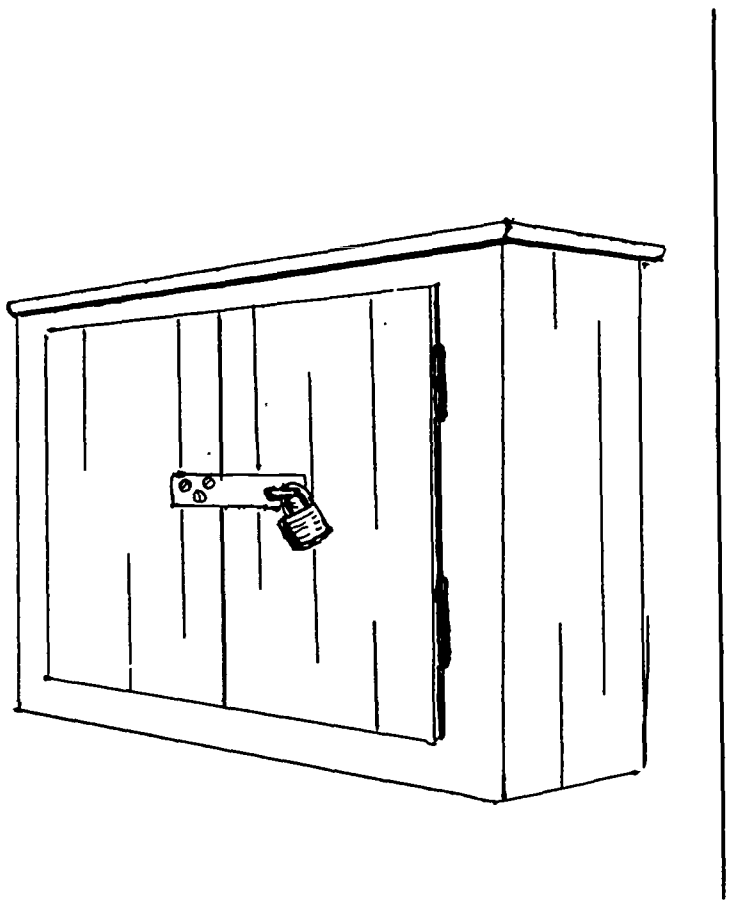


Fig. 2. Always store chemicals in a locked building or cabinet.

Fig. 3. You have no one to blame but yourself if this situation develops around your home.

Keep chemicals away from livestock feeds to prevent possible contamination. Livestock are frequently killed in this manner. Crop seeds should not be contaminated with chemicals because it may prevent germination.

Never lend a portion of a chemical to another person in an unmarked or unlabeled container. This is very dangerous. First, someone other than the person to whom you gave the chemical may use it by mistake and injure himself or others. Secondly, the person who uses it does not have the label giving directions for its proper and safe use. It is a poor practice to rely on verbal directions only.

Chemicals in large containers, which are heavy to handle, should be stored on or near the floor to prevent falling. Extremely heavy containers should be on the floor to prevent breaking down a shelf. Placing heavy containers on the floor also eliminates lifting and may prevent a back injury. Containers should not extend beyond shelving or cabinets where they may be bumped and knocked off the shelf where they may break open and spill.

Storing Agricultural Chemicals
(Information Sheet continued)

Special care must be taken to see that corrosive materials are stored and handled in containers designed for such materials. A corrosive material in the wrong kind of container may eat through the container and be wasted or cause serious damage. (Fig. 4).

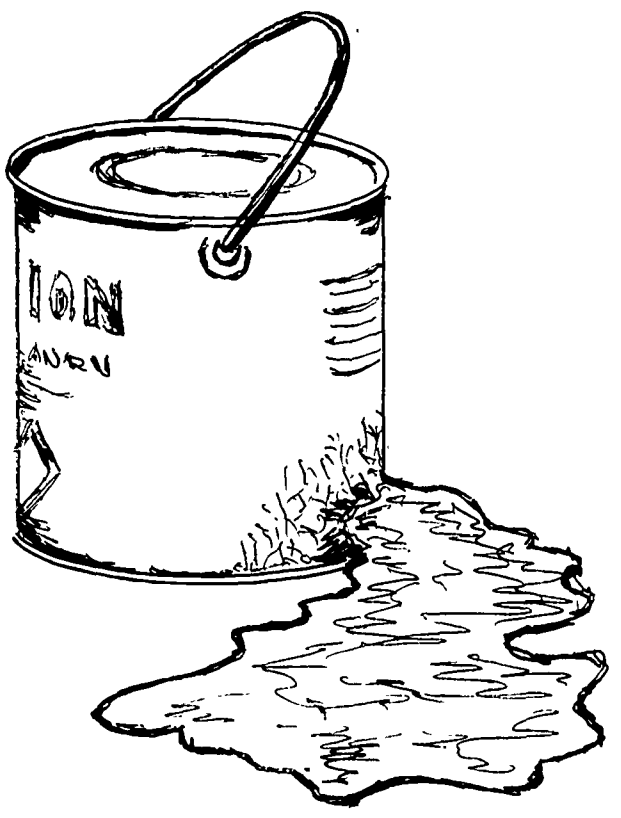


Fig. 4. All corosive materials should be stored in safe containers.

Chemicals in glass bottles should not be stored near heat. Since many chemicals must be stored in glass containers, it is necessary to be especially careful. Glass containers can break or explode, spreading the chemical over a large area Store materials in glass containers in dry, cool areas (Fig. 5). However, it is necessary to protect some of them from freezing, so check the label carefully for proper storage information.

Storing Agricultural Chemicals
(Information Sheet continued)

Fig. 5. Proper storage prevents accidental breakage or spilling.

To be sure that the label remains on the container and in readable condition, protect it with transparent tape or lacquer if the chemical is to be stored for a long period. Remember, the label is the most important safety factor in the use of agricultural chemicals. Do not let it become damaged or destroyed. (Fig. 6).

Storing Agricultural Chemicals
(Information Sheet continued)

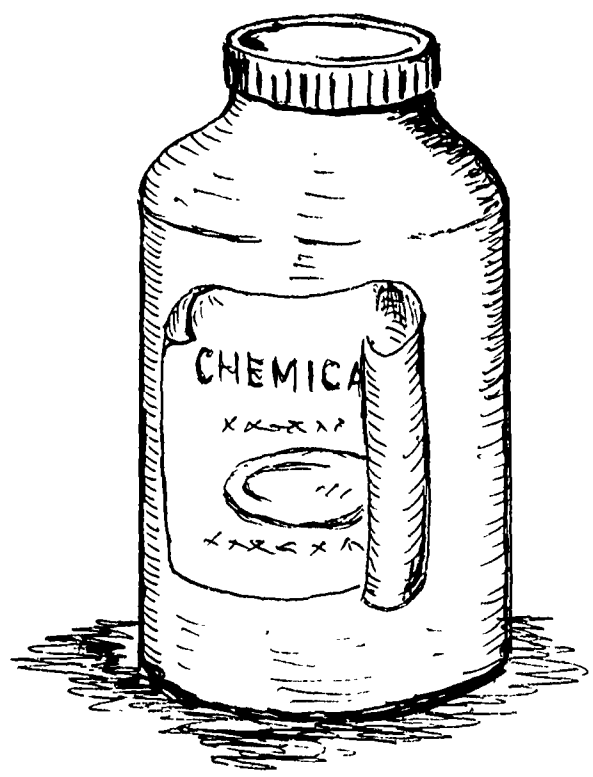


Fig. 6. Be sure all labels are securely attached and protected.

(CAUTION: Do not store weed killers, herbicides or defoliants in the same room with insecticides. Volatile materials such as 2,4-D and its derivatives can contaminate other pesticides. Chlorate salts can create a fire or explosion hazard.)

Summary

The best way to avoid the hazards from agricultural chemicals is to know what you are using and how to use it. The only way you can be sure of this is to read the label. Most pesticides are safe. In fact, a person almost has to go out of his way to cause injury or harm with them.

Storing Agricultural Chemicals
(Information Sheet continued)

The attitude of the user is one factor that is often overlooked. Perhaps he thinks he knows exactly how to use the pesticide he will apply. Or he may not care what precautions should be taken to prevent injury to persons, animals or plants. In either case, he is quite likely to cause injury or crop damage at some time in the future. If this group of people could realize the legal obligation from using pesticides, they would be more apt to read the label and follow the instructions closely.

Reading the label will not insure safety -- the instructions must be followed. A person has to use a little common sense in handling and storing chemicals. By combining all these factors, plus good management with safety in mind, there should be few accidents with the use of agricultural chemicals.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Safety

TOPIC: Mixing Agricultural Chemicals

OBJECTIVE: To learn to mix agricultural chemicals successfully and safely.

REFERENCES:
Required:
1. Information Sheet, "Mixing Agricultural Chemicals"

QUESTIONS OR ACTIVITIES:

1. Why should you use the amounts of chemicals directed by the manufacturer on the label when mixing chemicals?
2. What kind of gloves should be worn when working with chemicals?
3. When pouring chemicals from a can which has a spout, how should the spout be positioned?
4. Before pouring chemicals into spray, what should you use to test sprayer to be sure it is working?
5. What should you do after mixing chemicals before eating or smoking?
6. Why should the end of a water pipe or hose being used to fill a sprayer tank be supported above the full water level of the tank?
7.
8.

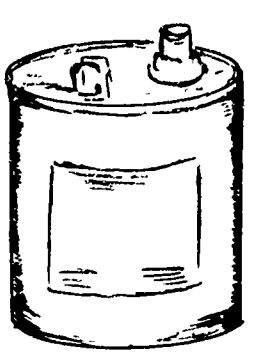
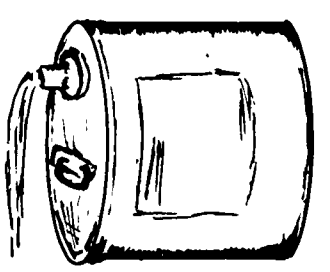
Information Sheet
on
MIXING AGRICULTURAL CHEMICALS

Do not permit an irresponsible employee or any careless person to handle, mix, or apply any agricultural chemicals. Some workers cannot read the instructions on the labels; others may not care. Ability and attitude are of equal importance in the safe, effective use of chemicals.

Measure ingredients accurately and mix thoroughly. Use only the exact amounts as directed on the label. It is often unsafe, as well as uneconomical, to use more than the manufacturer directs. This may actually reduce the ability of the chemical to do its intended job. When using agricultural chemicals, the old saying "I'll use a little extra to make sure I get the job done" does not hold true. It may work in reverse. When the mixture is too concentrated, the exposure to humans or animals is greatly increased during mixing and handling.

Mix only the amount of pesticide that you need for immediate use. This eliminates having mixtures setting around in your sprayer, duster, or even in open containers. Leaving pesticides around like this creates special hazards to small children, livestock, or pets. If you should have material remaining, store it in a safe container or dispose of it in any safe manner.

When cutting out the plastic seal in the pouring spout or removing the bung or other outlet cover on a pesticide container, always wear protective clothing. This includes natural rubber gloves and goggles. Never place any portion of the body directly over the seal or the pouring spout. The release of pressure may cause the liquid to spew from the container. Use a respirator if called for on the label. When pouring from a can with a spout, always keep the spout positioned at the top of the can to prevent an uneven flow of liquid, thus avoiding splashing.

Mixing Agricultural Chemicals
(Information Sheet continued)

Use care in mixing materials. Avoid spilling on skin and clothing and inhalation of fumes. Use paddles for mixing chemicals thoroughly. Don't breath fumes, dust or spray mist.

Check equipment before use. Test with clean water before adding chemicals.

Do not smoke or eat during or after mixing the chemicals without thoroughly washing hands and face with soap and water. The chemicals may be poisonous or flammable.

The end of a water pipe or hose being used to fill a sprayer tank should be supported above the full water level of the tank to prevent back-siphoning of water and chemicals. Never leave a sprayer unattended while it is being filled. Wasted chemicals or rinse water from the sprayer tank should not be spread near a well.

DO'S AND DONT'S
Storing and Mixing Chemicals Safely

Be Sure To --
--Obtain required permits from Ag Commissioner.
--Read the label twice (every time you use it).
--Use proper protective clothing.
--Pour dusts and powders slowly.
--Remove screen on spray tank before putting in concentrate.
--Clean out your measurers after use.
--Store chemicals under lock and key in a dry room.
--Keep chemicals out of reach of children.
--Handle empty containers as carefully as those that are full.

Do Not mix chemicals that are incompatible.
Do Not mix chemicals in an enclosed room.
Do Not allow liquid to splash or spill.
Do Not allow anyone to sleep in room where chemicals are stored.
Do Not think of emptied containers as being empty or harmless.
Do Not permit delivery of pesticides unless a responsible representative or employee is on hand to receive and properly store them.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Safety

TOPIC: Application of Agricultural Chemicals

OBJECTIVE: To develop an understanding of the precautions necessary for the safe application of chemicals.

REFERENCES:
Required:
1. Information Sheet, "Application of Agricultural Chemicals"

QUESTIONS OR ACTIVITIES:

1. When chemicals are used according to label directions, name two things they do for family living today that people a generation ago did not enjoy.
2. Why should the label be read before a chemical is used in or around the house?
3. How can you tell when a pesticide is highly toxic?
4. Give two reasons why the manufacturer gives so much information on the label.
5. Name eight things that will influence the distance spray material will drift when applied with an airplane.
6. Why do dusts drift farther than sprays?
7. Why do oil-spray droplets tend to drift farther than water-spray droplets?
8. Approximately how far will a 50-micron droplet of water drift while falling 50 feet in a 3-mile-per-hour wind?
9. Why should the boom length on spray planes be limited to three-fourths of the wing span?
10.
11.

Information Sheet
on
APPLICATION OF AGRICULTURAL CHEMICALS

Householders, apartment dwellers, and home gardeners have been using more pesticide chemicals every year. These materials, available in spray cans, bottles and packages, are performing a thousand and one needed tasks.

They help to keep homes free of ants, roaches, silverfish and other insect pests. They protect flowers, trees and businesses from damage by insects and plant diseases. They keep out destructive rodents. They clean lawns of unwanted weeds.

Where these chemicals have been used according to label directions, they have achieved striking success. They are among the new developments which help to make living today healthier, more comfortable and in many ways better than it was a generation ago.

Just as pesticides help keep homes and home gardens free of unwanted pests, they protect our food and fiber crops from damage. They are widely used in the United States Public Health Service and state and local health agencies to wipe out disease-carrying insects and rodents. In this way they help protect our nation from diseases.

Pesticides must be handled with care. Directions and cautions on containers must be read and followed to the letter.

Those pesticides which are highly toxic are required to be labeled with the skull and crossbones, the word "POISON" in red on a contrasting background, and a suitable antidote statement. They will also be labeled with the precautions to be observed when using them. Many times people become so accustomed to seeing the skull and crossbones with the word POISON on the labels that they become careless and are killed or injured because they did not follow the directions.

The manufacturer puts much information on labels on pesticide containers for two good reasons.

The first is that when he sells the product as suitable for a given use, he gives you the directions for using the product effectively and safely. This, you might say, is his moral obligation.

Application of Agricultural Chemicals
(Information Sheet continued)

The second reason is that federal and state laws back up his moral obligation. These laws require that the label must bear adequate directions for effective use and warning against hazards of misuse. Every label must be approved by government experts and registered with the U. S. Department of Agriculture under the provisions of the Federal Insecticide, Fungicide and Rodenticide Act. The manufacturer must supply scientific research data to prove his claims and show that his directions and warnings are accurate.

Pesticide Safety Check List

Yes	No	
		Do you always read the label before using sprays and dusts and follow the directions?
		Do you store sprays and dusts in original, labeled containers?
		Do you avoid smoking while spraying or dusting, when this is directed?
		Do you avoid inhaling sprays or dusts, and wear protective clothing and masks when directed to do this?
		Do you avoid spilling materials on your skin, and wash immediately when they are spilled accidentally?
		Do you wash hands thoroughly after spraying or dusting and before eating or smoking?
		Do you cover food and water containers when treating around livestock or pet areas?
		Do you always dispose of empty containers so they pose no hazards to humans, animals, or valuable plants?
		Do you wash contaminated clothing before reuse, when this is directed?
		Do you always observe label direction to keep residues on edible portions of plants within limits permitted by law?

(All answers should be yes.)

Application of Agricultural Chemicals
(Information Sheet continued)

Methods of Application: There are many methods of applying agricultural chemicals - all the way from hand application to aerial application. Regardless of how the chemical is applied you should apply the correct amount of the chemical in a safe manner.

Drift is the movement of released material from a path of vertical decent caused by air movement.

You cannot completely eliminate drift when you apply dusts or sprays by aircraft. You can, however, reduce the quantity and extent of drift.

The necessity for controlling drift depends on the circumstances prevailing at the time and place of application. Special precautions will be needed if the material being applied is hazardous to adjacent or nearby areas - susceptible crops, crops for which a residue tolerance is in effect, reservoirs, streams, human beings, livestock, pastures, and buildings.

The main factors that influence the distance the material will drift are particle size, specific gravity, evaporation rate, height of release, horizontal air movement, vertical air movement, temperature, humidity, and aerodynamic forces created by the aircraft.

The rate of fall of particles through the air is affected by their size and specific gravity. Small, lightweight particles fall very slowly. For example, a 5-micron (1 micron = 0.001 inch) drop of water would require 5-1/2 hours to fall 50 feet in still air as compared to only 55 seconds for a 100-micron drop under the same conditions (disregarding evaportation).

The average size of dusts is considerably smaller than that of sprays. Dusts, therefore, tend to drift farther than sprays. If there is a choice between dusts and sprays, always use sprays to reduce drift hazards. This will not always be possible, since there are situations where dusts may provide more effective plant coverage than sprays for control of certain plant diseases. Also, some sprays may be phytoxic (poisonous to plants).

Oil-spray droplets tend to drift farther than water-spray droplets because they usually are lighter and thus remain airborne for a longer period. The rate of evaporation of water-base sprays is higher than that of oil-base sprays unless anti-evaporant materials are added to the formulation.

Application of Agricultural Chemicals
(Information Sheet continued)

With present commercial spray equipment and spray formulations now available, all small particles cannot be eliminated. A coarse spray has a wider range of sizes (a higher maximum) than a fine spray. Although a coarse spray will drift less than a fine spray, the coarse spray results in narrower swaths with fewer drops per unit of area. When the average drop size is doubled, the number of drops in a gallon will be reduced to one-eighth the original number.

If thorough coverage is required for control of a specific pest, coarse sprays may not be economical or effective. For some herbicides, however, coverage may not be critical, and moderately coarse sprays can be effective. To reduce drift, the atomization should be no finer than is necessary to do the effective job.

The main factors affecting the distance a particle may drift while it is falling are height of release and horizontal and vertical air movement. For example, a 50-micron droplet of water will drift about 890 feet while falling 50 feet in a 3-mile-per-hour wind. Doubling either the height or the windspeed should double the distance.

One danger from drift is that unpredictable changes in air movement may occur to move the drift in an unexpected direction.

During early-morning and late-evening hours, the air temperature differential between ground and 10 to 20 feet above ground is considerably less than during the middle of the day. As the ground warms up, ground air temperatures increase above that of the air at 10 to 20 feet. This warmer air rises and sets up convection and thermal air currents to lift small particles, which may be carried to some distant point before they settle out. Avoid application when this condition exists.

Calm conditions with a high inversion (ground air 2° to 5° cooler than air above) may cause the smallest spray drops or dust particles to remain suspended in this layer of cold undisturbed air and eventually move out of the area before coming to rest. Avoid application under this condition.

Because of the aerodynamic forces set up by the aircraft moving through the air, spray or dust released within 3 to 5 feet of the wingtips of fixed-wing aircraft may be moved outward and upward by the wingtip vortices (swirling motion of air current) and be moved out of the treated area by the wind.

Application of Agricultural Chemicals
(Information Sheet continued)

On spray planes, limit the boom length to three-fourths of the wing-span so that the spray will not be emitted near the wing tips. Use leakproof on-off spray valves and dusttight hopper feed gate to eliminate dribbling in turns or ferry flights.

The states regulate the application of herbicides and pesticides and if in doubt about the conditions governing their use, you should check with the proper authority. Special permits are required for some herbicides and pesticides.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemical Safety

TOPIC: Agricultural Chemicals Container Disposal

OBJECTIVE: To learn to safely dispose of chemical containers.

REFERENCES:
Required:
1. Information Sheet, "Agricultural Chemicals Container Disposal"

QUESTIONS OR ACTIVITIES:

1. What should you do with any pesticide remaining in the container before destroying it?
2. What should be done with empty containers until they are disposed of?
3. What is the best and easiest way to dispose of large metal drums?
4. Why should holes be chopped in empty drums that are hauled to the public dump grounds?
5. Why is level ground better than hillsides for a chemical disposal area?
6. Name two dangers of chemicals being carried away by run-off water.
7. How can noncombustible containers be decontaminated by burning?
8. Why should you not burn weed killer containers that have contained 2-4-D?
9. How deep should weed killer containers be buried?
10. What should be done with glass containers after herbicides are used?
11.
12.

Information Sheet
on
AGRICULTURAL CHEMICALS CONTAINER DISPOSAL

Disposal methods for chemical containers and necessary precautions to take while disposing of them will depend upon the type of container and facilities available. Regardless of the disposal plan you follow, you can lessen the amount of hazard by:

1. Draining any pesticide remaining in the container into a pit dug in sandy soil.
2. Rinsing glass and smaller metal containers several times with the diluent being used and including the rinse in your spray.
3. Keeping lids and bungs tightened at all times when containers are not being used.
4. Keeping all empty containers in a secure storage area until they can be disposed of safely.

Large metal drums can be disposed of most safely and easily by returning them to the supplier or selling them to a firm equipped to handle toxic materials. Pesticide containers also can be safely disposed of locally at public dumps, incinerators, or private disposal sites.

Public Dump or Incinerator

Notify the operator of the dump or incinerator of the nature of the material so that he will be able to take any necessary precautions. Before leaving the disposal site, remove lids and bungs, break glass containers, and chop holes in the top, bottom, and sides of metal containers with a sharpened pickax. Breaking and puncturing containers will make it less likely that an unauthorized person will remove them.

Agricultural Chemicals Container Disposal
(Information Sheet continued)

from the dump and attempt to convert them to other uses. Containers should be buried at the public dumps.

Private Disposal Sites

If suitable public disposal facilities are not available and containers cannot be returned to a supplier or sold to a cooperage firm, select a disposal site that will be used only for surplus pesticide and pesticide containers. It should not be an area that might later be returned to cropland or some other use. It should be away from homes, wells, streams, crops, and livestock. Level ground is best because it will let the residue be absorbed through the soil and lessen the chance that it will be carried away in water runoff. Do not locate the site on the watershed of a public water supply or where livestock have access to it.

A family near Honey Grove, Texas, was almost killed when their well became contaminated with runoff water where the man had washed his spray tank.

A farmer in the Clardy Community near Paris, Texas, lost twenty cows that ate poisoned grass in his own pasture. His neighbors were cotton farmers and had dumped their poison cans in a small creek near his pasture. The spring rains backed water from the creek up in his pasture and poisoned the grass.

Burn empty containers away from buildings and avoid breathing any smoke from the fire.

Agricultural Chemicals Container Disposal
(Information Sheet continued)

Combustible Containers: Paper bags, cardboard boxes, and plastic containers should be burned after making sure that smoke will not drift over nearby homes, people, livestock, and the person doing the burning. Pouring used crankcase oil over the containers before lighting them will aid combustion.

(CAUTION: Some muncipalities have restrictions against burning. Consult local authorities before burning containers.)

Noncombustible Containers: Where economical sources of fuel are available, metal and glass containers can also be decontaminated by burning. After removing lids, use a sharpened pickax to chop holes in the top, bottom, and sides of metal containers. Build a heap of scrap wood, dry brush, old automobile tires, or anything else that will make a hot fire. Then place containers on the pile and start the fire.

Heat containers until they are red hot and hold them at that temperature (800° to 1200° F.) for at least five minutes.

You can construct your own incinerator for burning small containers from a 55-gallon drum. Remove one end from the drum and punch holes in the sides, leaving room at the bottom of drum to hold the fuel. Fuel oil or used crankcase oil will provide complete combustion yet is safe to use if handled carefully.

But Don't Burn Weedkiller Containers

Do not burn containers which have held weedkillers such as 2, 4-D and its derivatives. When these herbicides volatilize, the resulting vapor may damage nearby plants, crops, and shrubbery. Also, herbicides or defoliants containing chlorates may explode when heated.

Dispose of these containers in this manner:

1. Break glass containers and chop holes in the top, bottom, and sides of metal containers so they cannot be re-used or collect water. A sharpened pickax is best for this purpose.
2. Bury all weedkiller containers to a depth of 18 inches at a safe disposal site or take them to a dump where they will be covered with soil.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Safety

TOPIC: Personnel and Equipment Clean-Up

OBJECTIVE: To learn how to safely clean up personnel and equipment after using agricultural chemicals.

REFERENCES:
Required:
1. Information Sheet, "Personnel and Equipment Clean-Up"

QUESTIONS OR ACTIVITIES:

1. After you have finished applying chemicals, when should you bathe?
2. Make a table showing the amounts of water and detergents to use with three different sizes of containers for clean-up.
3. Why should the sprayer be cleaned after each use?
4. What should you use in washing the nozzles, strainers, and screens?
5. After 2, 4-D has been in a sprayer, how should the sprayer be cleaned?
6.
7.

Information Sheet
on
PERSONNEL AND EQUIPMENT CLEAN-UP

1. Remove clothing that has been contaminated with insecticides and then bathe immediately.

2. Wash hands and face after dusting or spraying before eating.

3. Carefully rinse empty containers with water and detergent (see table below). Allow water and detergent to remain in the container for 15 minutes with intermittent agitation. Pour rinsing into a pit dug in sandy soil.

4. Re-rinse container for another 15 minutes with the same amount of water and detergent. Again pour rinse solution into the pit.

Container Size	Water	Detergent
5 gallons	2 quarts	2 tablespoons
30 gallons	3 gallons	1/2 cup
55 gallons	5 gallons	1 cup

Cleaning the Sprayer

Clean the sprayer after each use. Many chemicals are corrosive; some are in suspension and will settle out and harden if left standing. Drain and flush the tank with clear water. Disassemble the nozzles, strainers, and screens. Wash with gasoline or kerosene using an old toothbrush or other soft-bristled brush or compressed air. Coat the threads with cup grease or pipe compound to prevent joints from "freezing." Before reassembling, pump clear water through until sprayer is clean. Sprayer requires special cleaning after spraying weed control chemicals.

Procedure to follow in cleaning the sprayer after using 2, 4-D and related chemicals:

1. Clean out spray material.

2. Soak all pieces of spray equipment in a 1 percent solution of household ammonia. (1 gallon of ammonia to 100 gallons of water or 2 teaspoons per quart of water) Rinse sprayer several times with clear water.

CAUTION: Even after this thorough cleaning, the sprayer should not be used to spray plants such as tomatoes or grapes which are susceptible to chemicals.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Safety

TOPIC: Chemical Residue and Tolerances

OBJECTIVE: To be able to determine the amount of agricultural chemicals that may be applied without injury to the crop, animal, or consumer.

REFERENCES:
Required:
1. Information Sheet, "Chemical Residue and Tolerances"
2. Agricultural Chemicals, Books I, II, and III, Thomson

QUESTIONS OR ACTIVITIES:

1. What is meant by residue?
2. What is meant by tolerance?
3. Are instruments available that can easily detect the presence of small amounts of pesticide residues in foods?
4. What authority does the Food and Drug Administration have over raw agricultural products?
5. Are the chances of a consumer being poisoned very great if the pesticide has been applied to the product according to the label directions?
6. Where can you get up-to-date information giving tolerances for specific crops and chemicals?
7.
8.

Information Sheet
on
CHEMICAL RESIDUE AND TOLERANCES

Res ue is the amount of pesticide in or on a product when it enters commerce (leaves the farm).

The "tolerance" is simply the amount of a pesticide which scientists have determined may safely remain as a residue on the food crop without injury to the consumer. The tolerance is specific for the pesticide and the crop. It is set by regulation.

Chemical residue is measured in parts per million. The Food and Drug Administration first considers evidence of safety and the amount of residue which will remain if the product is used according to directions on the label. FDA then sets a tolerance which will be safe and which can be met if the directions are followed. If a tolerance is not necessary for protection of the consumer, FDA may exempt a particular use from requirements for a tolerance.

A limited number of pesticide chemicals have been officially declared safe and do not require either a tolerance or exemption. Except for these products, no amount of residue of a particular chemical on a specified crop is permitted if (1) there is no tolerance or exemption or (2) the tolerance is zero. However, the absence of a published tolerance or exemption does not necessarily imply that a pesticide chemical may not be used. Some pesticide uses--for example, certain dormant sprays and soil treatments--do not result in residues of the chemical on the harvested crop. Uses which do not leave residues do not require tolerances or exemptions and do not have to be passed upon by the Food and Drug Administration.

The FDA now has instruments which can measure one part per trillion (.000001 ppm) of a residue. This refinement in the checking instrument has caused quite a furor in the agriculture industry because detection of such minute quantities of a chemical makes the existence of a zero tolerance nearly impossible. In fact, now the authorities cannot decide exactly what is meant by zero. Zero, an absolute nothing in quantity, for practical purposes of analysis cannot be obtained. A committee of leading agricultural chemical people throughout the country met in Washington, D.C. during 1964 for the purpose of deciding exactly what is meant by zero in the term zero tolerance.

Dr. Robert Rollins, Chief of the Division of Chemistry, California Department of Agriculture, said the following recently to indicate the unreasonableness of zero tolerance in the face of such detection refinement:

> If you put one cupful of DDT in the ocean and mixed it uniformly throughout all the ocean waters of the world, then every cupful of ocean water dipped up anywhere in the world would contain 80 molecules of DDT.

Chemical Residue and Tolerances
(Information Sheet continued)

As an example of the great sensitivity of analytical methods now available, Dr. Rollins further stated:

> If you divide one teaspoonful of DDT equally among all the 2,800,000,000 people in the world, each person would have 2 nanograms of DDT; and with the analytical methods being used in routine pesticide residue work, each chemist could readily measure his portion.

Thus we can readily see that our machines for detecting residue are much more refined than our ability to apply and use materials with that precision.

When the Food and Drug Administration established these tolerances, it built in safety factors, much as an engineer designs a bridge with many times the strength it will ever be expected to need. The FDA scientists may be quite sure that a certain chemical will be safe for man at 500 parts per million--because larger doses begin to adversely affect small test animals such as rats or rabbits. However, these scientists, knowing that animal experiments do not always indicate similar reactions in man, to be on the safe side will set the tolerance at one one-hundredth (.01) of that figure--five parts per million. The desirability of this approach is apparent when you consider they are establishing these tolerances for a wide range of conditions and individual differences, many of which cannot be foreseen or predicted. Other safety factors include the determining of degradation rates and human detoxification capabilities and the FDA's authority to inspect raw agricultural crops wherever located plus the right to confiscate and destroy products that carry illegal residues.

Because of these safety factors, the chance of poisoning a consumer is very remote if you follow the label and apply the pesticide in the manner, amounts, and timing prescribed. <u>There has never been a proven case of a person being killed by foodstuffs that had been treated by a pesticide applied according to label instructions.</u>

The tolerances for a specific insecticide used on a particular crop can be found in the Agriculture Handbook No. 331 published in 1967 by the USDA. As new tolerances for insecticides are established or changes made, the USDA will review these suggestions and modify them as needed to insure that residues do not exceed the new tolerances. Since new materials and new uses for older materials are registered throughout the year, we suggest you keep in contact with the USDA for up-to-date information.

Chemical Residue and Tolerances
(Information Sheet continued)

What Is One Part Per Million?

Most lay people have no conception of what constitutes one part per million residue on crops. The following examples may help you make this interpretation for them:

1. One inch is one part per million in 16 miles.
2. A postage stamp is one part per million of the weight of a person.
3. A one gram needle in a one ton haystack is one part per million.
4. One part per million is one minute in two years.
5. Lay your hand on the ground and it covers five parts per million of an acre.
6. If one pound of a chemical lands on an acre of alfalfa, the hay has 500 ppm. One ounce of a chemical would impart 31 ppm.
7. A teaspoon of material on an acre would impart five ppm.
8. One teaspoon of DDT drifting onto five acres of alfalfa puts one ppm in the hay and the federal law says that the hay must contain none.

(Source - Western Crops and Farm Management)

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Formulas and Dilution Charts

TOPIC: Calibrating Sprayers

OBJECTIVES: To learn to calibrate agricultural chemical distribution equipment accurately.

REFERENCES:
Required:
1. Agricultural Chemicals, Book III, Thomson, W. T., pp. 153-157

QUESTIONS OR ACTIVITIES:

1. What is probably the most important step in a spraying operation? Why?
2. What are four ways you can get a higher rate of spray from your sprayer?
3. How many gallons per acre would you apply if it took 5 gallons to refill your tank after spraying a 20 foot swath for 660 feet?
4. (Based on the situation above) How many pounds of active material would you put in your tank to spray 5 acres if the required dosage is 2 pounds actual per acre? How many gallons of water would this take?
5.
6.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Formulas and Dilution Charts

TOPIC: Weights and Measures, Charts and Conversion Tables

OBJECTIVE: To become familiar with weights, measures, charts, and conversion tables, and to learn their use in determining amounts of chemicals that should be used.

REFERENCES:
Required:
1. Information sheet, "Weights and Measures, Charts and Conversion Tables"
2. Agricultural Chemicals, Book III, Thomson, W. T., pp. 159-169

QUESTIONS OR ACTIVITIES:

1. Read both references, becoming familiar with the location and use of the tables and charts. The test over this area will not require you to memorize the charts and tables or formulas, but you must know how to use them.
2. How many pounds of 50% wettable DDT powder are needed to make 50 gallons of 0.5% DDT spray?
3. What % spray would you have if 2 gallons of 25% emulsifiable concentrate were mixed with 150 gallons of water?
4. How many pounds of talc, and how much 50% DDT would have to be mixed to have 30 pounds of dust which contained 5% D.D.T.?
5. How many acres are in one square mile?
6. How many gallons are in one cubic foot?
7. How many feet square is one acre?
8. How many square feet are in one acre?
9. 4 milligrams per liter is equal to how many parts per million?
10. .01 percent is equal to how many parts per million?
11. How many 40 inch rows make an acre if they are 594 feet long?
12.
13.

Information Sheet
on
WEIGHTS AND MEASURES, CHARTS
AND CONVERSION TABLES

1. To figure the number of pounds of wettable concentrate to use in preparing sprays and dips:

$$\frac{\text{\% spray desired x gallons of spray x 8.4}}{\text{\% of concentrate}} = \text{lbs. of concentrate.}$$

Example: You desire to make 100 gallons of 0.5% DDT spray from 50% wettable DDT powder.

$$\frac{0.5 \times 100 \times 8.4}{50} = 8 \text{ pounds of 50\% wettable DDT per 100 gallons of water.}$$

2. To figure the % of active ingredient in a spray mixture:

$$\frac{\text{lbs. of insecticide used* x \% strength of concentrate}}{\text{gallons of spray x 8}} = \text{\% strength of spray}$$

Example: 2 gallons of 25% DDT emulsifiable concentrate were mixed with 100 gallons of water. What % DDT was in spray?

$$\frac{16 \times 25}{100 \times 8} = 0.5\%$$

3. To figure the pounds of insecticide needed to mix a dust containing a given % of active ingredient:

$$\frac{\text{\% active ingredient wanted x pounds of mixed dust wanted}}{\text{\% active ingredient in insecticide used}}$$

Example: 5 pounds of 3% DDT dust are wanted: How much inert ingredient (talc, clay, etc.) and how much 50% DDT dust should be used?

$$\frac{3 \times 5}{50} = 0.3 \text{ lb. 50\% DDT}$$

5 lb. - 0.3 lb. = 4.7 lb. talc

* This formula works for both wettable powders and emulsifiable concentrates, but weigh each emulsifiable concentrate before converting pounds to gallons.

Weights and Measures, Charts and Conversion Tables
(Information Sheet continued)

CAPACITY MEASURE (LIQUID)

One cup = 16 tablespoonfuls = 8 fluid ounces
One pint = 2 cupfulls = 16 fluid ounces
One quart = 2 pints = 32 fluid ounces
One gallon = 4 quarts = 128 fluid ounces

Water is considered to weigh 8.4 pounds per gallon in this chart.

Weights and Measures, Charts and Conversion Tables
(Information Sheet continued)

3) Recommendations are also made to use a certain percentage concentration of the toxicant in 100 gallons. The following table tabulates certain of these concentrations.

Insecticide Formulation	Amount of Formulation Needed Per 100 Gallons of Water to Obtain the Following Percentages of Actual Chemical				
	0.25%	0.5%	1%	2%	5%
25% wettable powder	8 lb.	16 lb.	32 lb.	64 lb.	160 lb.
50% wettable powder	4 lb.	8 lb.	16 lb.	32 lb.	80 lb.
75% wettable powder	2-2/3 lb.	5-1/3 lb.	10-2/3 lb.	21-1/3 lb.	53-1/3 lb.
12% emulsion concentrate, 1 lb. active ingredient per gal.	2-1/12 gal.	4-1/6 gal.	8-1/3 gal.	16-2/3 gal.	41-2/3 gal.
20% emulsion concentrate, 1-1/2 lb. active ingredient per gal.	1-1/4 gal.	2-1/2 gal.	5 gal.	10 gal.	25 gal.
25% emulsion concentrate, 2 lb. active ingredient per gal.	1 gal.	2 gal.	4 gal.	8 gal.	20 gal.
45% emulsion concentrate, 4 lb. active ingredient per gal.	1/2 gal.	1-1/8 gal.	2-1/4 gal.	4-1/2 gal.	11-1/4 gal.
75% emulsion concentrate, 8 lb. active ingredient per gal.	1/3 gal.	2/3 gal.	1-1/3 gal.	2-2/3 gal.	6-2/3 gal.

Weights and Measures, Charts and Conversion Tables
(Information Sheet continued)

b) The quantity of insecticide to give specific amounts of active ingredient per acre for selected chemicals is tabulated in the following table.

Insecticide Formulation	Amount of Formulation Needed Per Acre to Obtain the Following Amounts of Active Chemical Per Acre				
	1/8 lb.	1/4 lb.	1/2 lb.	3/4 lb.	1 lb.
1 % dust	12-1/2 lb.	25 lb.	50 lb.	75 lb.	100 lb.
5% dust	2-1/2 lb.	5 lb.	10 lb.	15 lb.	20 lb.
10% dust	1-1/4 lb.	2-1/2 lb.	5 lb.	7-1/2 lb.	10 lb.
25% wettable powder	1/2 lb.	1 lb.	2 lb.	3 lb.	4 lb.
40% wettable powder	1/3 lb.	2/3 lb.	1-1/4 lb.	7/8 lb.	2-1/2 lb.
50% wettable powder	1/4 lb.	1/2 lb.	1 lb.	1-1/2 lb.	2 lb.
75% wettable powder	1/6 lb.	1/3 lb.	2/3 lb.	1 lb.	1-1/3 lb.
10-12% emulsion concentrate, 1b. active ingredient per gal.	1 pt.	1 qt.	2 qt.	3 qt.	1 gal.
15-20% emulsion concentrate, 1-1/2 lb. active ingredient per gal.	1/3 qt.	2/3 qt.	1-1/3 qt.	2 qt.	2-2/3 qt.
25% emulsion concentrate, 2 lb. active ingredient per gal.	1/2 pt.	1 pt.	1 qt.	3 pt.	2 qt.
40-50% emulsion concentrate, 4 lb. active ingredient per gal.	1/4 pt.	1/2 pt.	1 pt.	1-1/2 pt.	1 qt.
60-65% emulsion concentrate, 6 lb. active ingredient per gal.	1/6 pt.	1/3 pt.	2/3 pt.	1 pt.	1-1/3 pt.
70-75% emulsion concentrate, 8 lb. active ingredient per gal.	1/8 pt.	1/4 pt.	1/2 pt.	3/4 pt.	1 pt.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Formulas and Dilution Charts

TOPIC: Compatibility Charts

OBJECTIVE: To be able to determine from charts those chemicals that are compatible.

REFERENCES:
Required:
1. Information Sheet,"Compatability of Insecticides"
2. Spray Compatibility Chart 1967, Meister Pub. Co.

QUESTIONS OR ACTIVITIES:

1. Can two or more insecticides always be mixed together successfully? Why?
2. Is it possible to mix insecticides with Herbicides? Explain.
3. Can herbicides be readily mixed together? Explain.
4. Why are fertilizers often mixed with herbicides?
5. Should one use a liquid and powder or granular form together?
6. Why should herbicide fertilizers be applied by experienced operators as a general rule?
7.
8.

Information Sheet
for
COMPATIBILITY OF INSECTICIDES

Certain solvents and other mixing agents may change the compability of other chemicals. (Compatibility means - capable of existing together in harmony) (capable of forming a homogeneous mixture that neither separates nor is altered by chemical interaction). Therefore care must be exercised when mixing insecticides, with other types of farm chemicals to insure (1) safety to the operator, (2) unchanged chemical and physical compatibility of the chemicals used, (3) that residue and tolerance levels are not changed by the mixing of two or more farm chemicals.

Labels of any chemicals you plan to mix should be read carefully and information from these labels may answer questions regarding compatibility of such chemicals. If the labels do not contain such information, the manufacturer or his representative should be contacted to supply reliable information regarding the mixing of other farm chemicals with his particular product.

Research is continually being conducted regarding the mixing of chemicals. Some cannot be mixed and still retain their original chemical composition and safety when used for their original purpose.

An example: Malathion is compatibile with most all insecticides used today, and will mix readily with fungicides except the following: Bordeaux, Lime sulfur, Zinc sulphate + lime, and Lime.

Aldrin, Dieldrin, Endrin, Chlordane, and Heptachlor will mix readily with most insecticides and fungicides without chemical changes of either. The compatibility chart, a part of this unit, should be consulted for more complete information.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Chemical Application Equipment

TOPIC: Spraying Equipment

OBJECTIVE: To become familiar with spraying equipment, its uses, and operation.

REFERENCES:

Required:

1. Information sheet, "Spraying Equipment"
2. "Power Sprayers and Dusters," F.B. 2223, pp. 1-16
3. "Insecticidal Spraying of Field Crops with Ground Machinery," Texas Agricultural Extension Service, L-486.

QUESTIONS OR ACTIVITIES:

1. What are the five major types of spraying equipment?
2. What factors are common to all sprayers?
3. Should spray parts be kept on hand?
4. Should sprayer be checked out prior to use?
5. Name the component parts of a tractor-mounted spray rig.
6. What are the advantages of spraying over dusting?
7. Study Farmers Bulletin 2223.
8.
9.

Information Sheet
on
SPRAYING EQUIPMENT

The farm sprayer has become as common as the plow. This makes it important to learn the jobs that different types of sprayers will do.

Spraying livestock for insect control, field crops for insects and weed control, and spray application of fertilizers require different pressures, different amounts of materials, and different types of coverage.

For these varied uses, a versatile general-purpose sprayer is needed. Both home-made and commercially manufactured sprayers work satisfactorily.

Some spray jobs are done best with low pressure and high volumes. Other jobs require high pressure and high volume. Some can be done with low pressure and low volume.

Spraying fields and row crops represents the largest new use of spraying equipment. The equipment must be versatile and adjustable to the requirements of the spray job and the material being sprayed.

It is estimated that insects nullify the productive effort of over 10 percent of our agriculture labor force, causing losses in excess of $4,000,000,000 annually.

Points to consider before buying or building a farm sprayer:

1. What do I need to spray?
   (a) Livestock, (b) Orchards, (c) Row crops, (d) Weeds, (e) Hay crops, (f) Others
2. How much am I justified in spending for a sprayer? Labor vs. cash outlay determines whether to buy or build.
3. Maximum pressure determined by use
4. Maximum gallonage determined by use
5. Type and size of pump determined by pressure and gallonage
6. Is power take-off or separate engine best source of power?
7. What size tank and type of agitator will I need?
8. Do I need a boom or just a hand gun?
9. How adjustable should it be?
10. Do I want it tractor-mounted, or do I want a unit I can slip into the pickup truck?

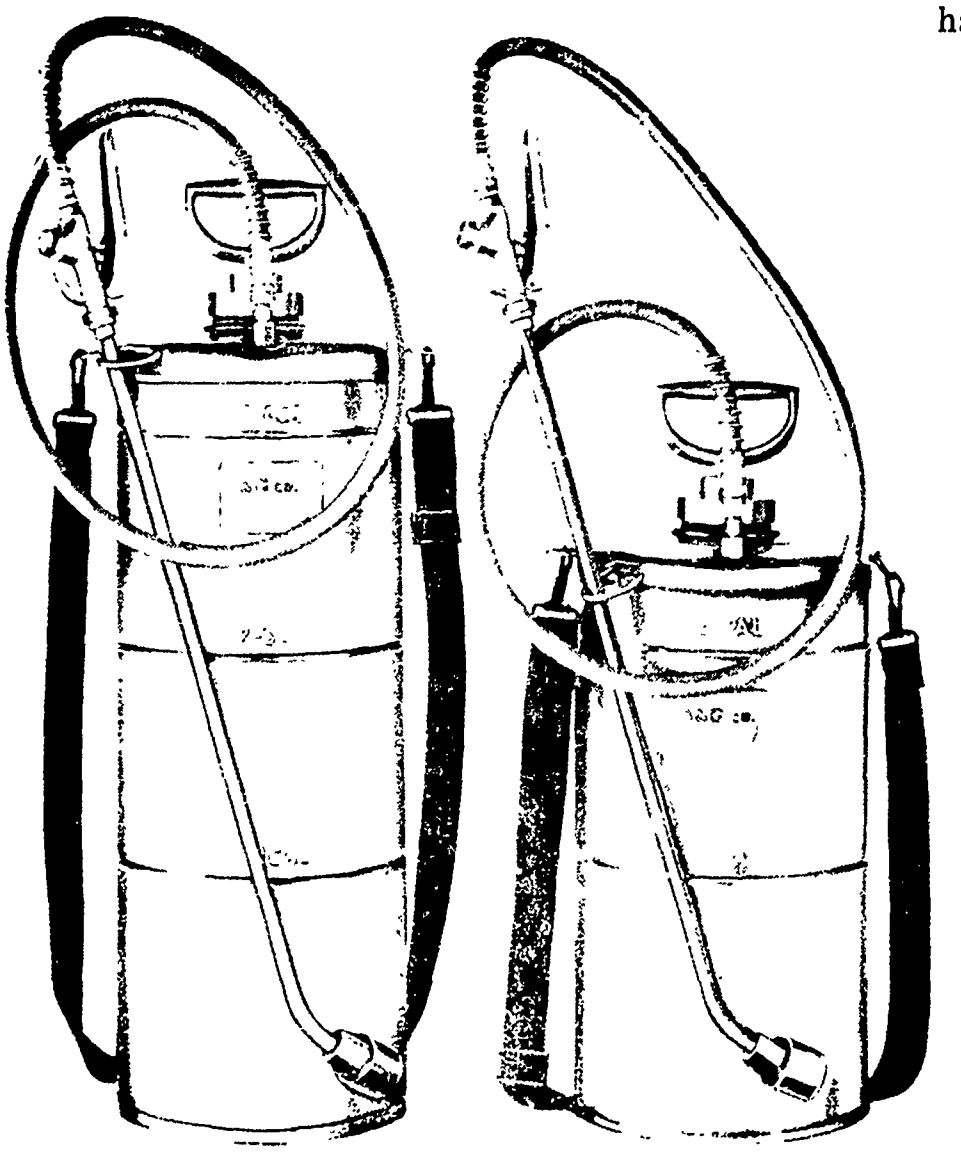
Spraying Equipment
(Information Sheet continued)

Pressure - Capacity Information for Various Spray Jobs

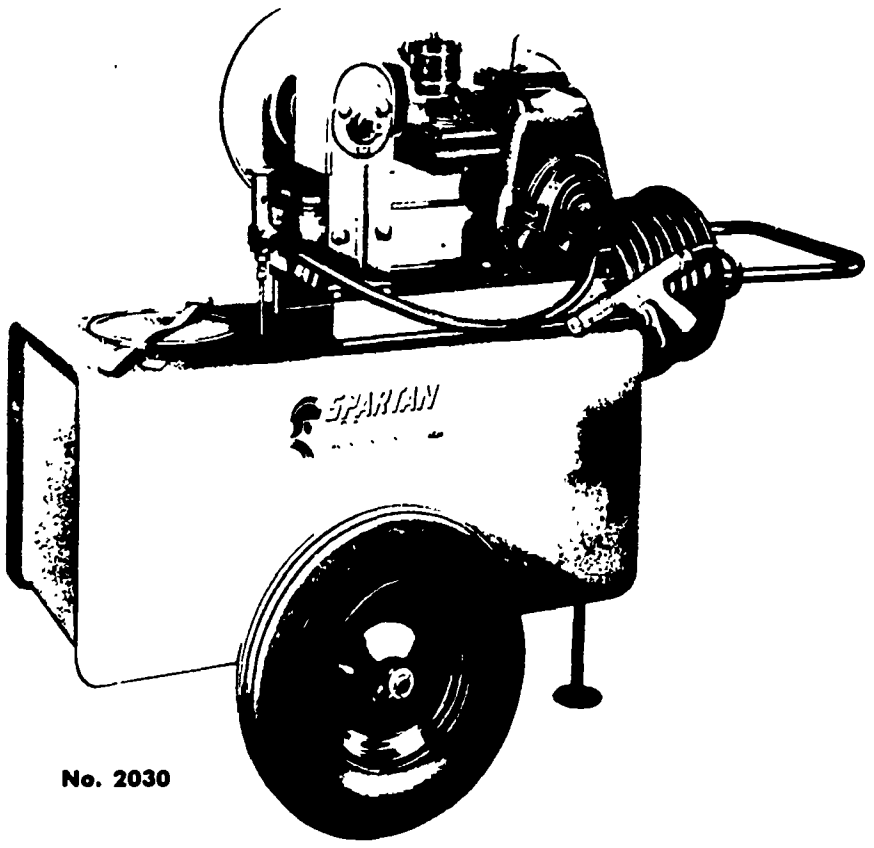
Spray Job	Pressure PSI	Gallonage
Livestock	350 to 400	9-12 gal. per minute
Trees	300 to 400	9-12 gal. per minute
Alfalfa Weevil	100 to 200	30-50 gal. per acre
Row crop	30 to 50	30-50 gal. per acre
Weed control	30 to 50	30-60 gal. per acre

Types of Spraying Equipment

1. Knapsack (hand sprayers). Used on small areas for a variety of purposes. This includes the small 1-3 gallon pressure hand carried sprayers.



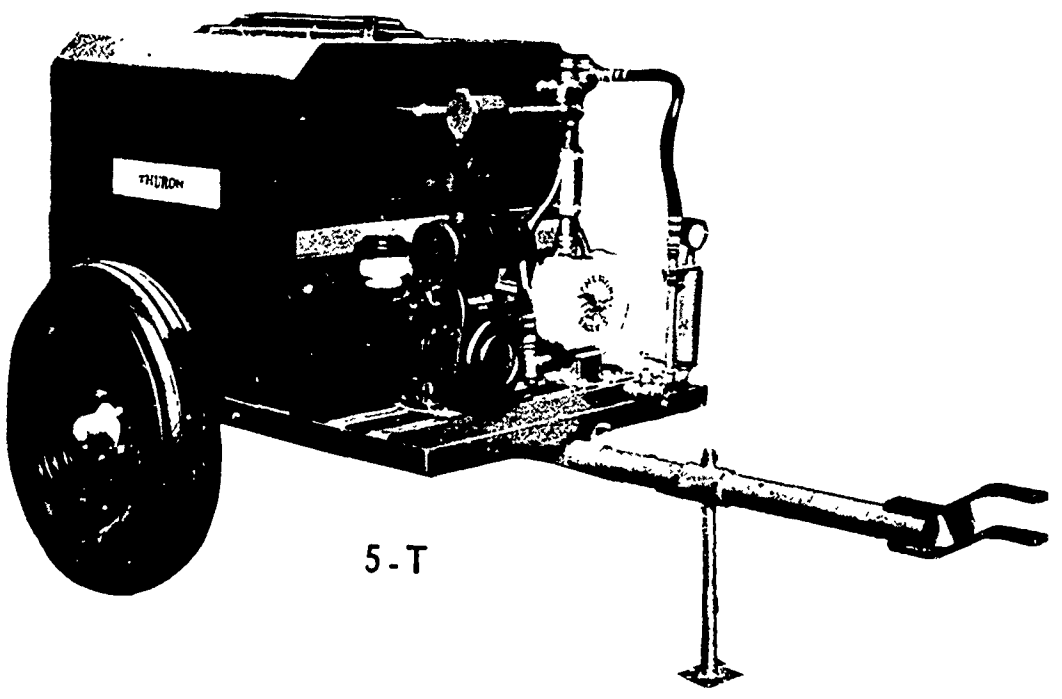
Spraying Equipment
(Information Sheet continued)



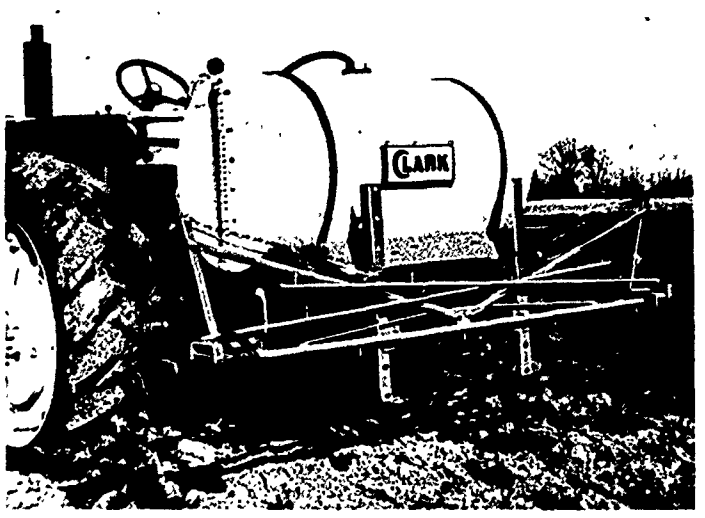
30 GALLON MODELS

2. Hand propelled equipment. Used on small areas for a variety of purposes. This is often referred to as a general use sprayer. These sprayers include the power wheelbarrow, the estate or small wheel-mounted and skid-mounted sprayer unit. These sprayers are designed to handle spraying jobs that are too large for hand equipment. Jobs for which they are used include garden spraying and small tree and nursery spraying.

3. Multiple purpose farm sprayer. These sprayers are designed to handle all or most of the spraying needs on general farms, from low-pressure weed or row crop spraying (30-50 lbs.) to high-pressure fruit tree, field crop, and livestock spraying (200-400 lbs. or more).



Spraying Equipment
(Information Sheet continued)



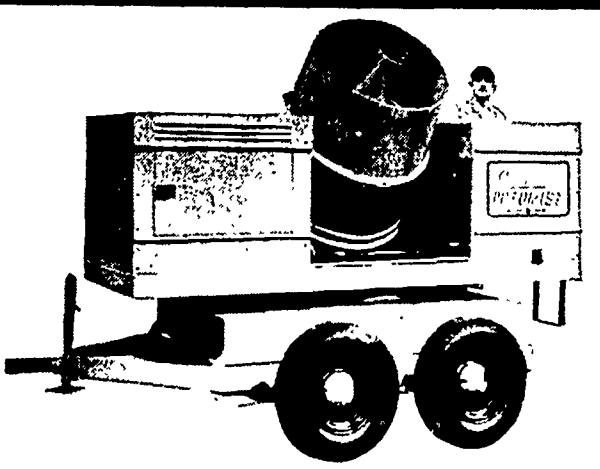
Easily Mounted or Dismounted

4. Tractor-mounted.
   a. High pressure, high volume. These sprayers are used primarily by commercial growers of fruit and truck crops. They provide the high pressure, high volume spray delivery required for complete coverage of fruit trees in full foliage and dense growth of vine and truck crops.

   b. Low pressure, low volume. These sprayers are designed primarily for low pressure, low volume spraying--less than 100 pounds pressure and 3 to 50 gallons per acre application recommended for insect, disease, and weed control in crops.

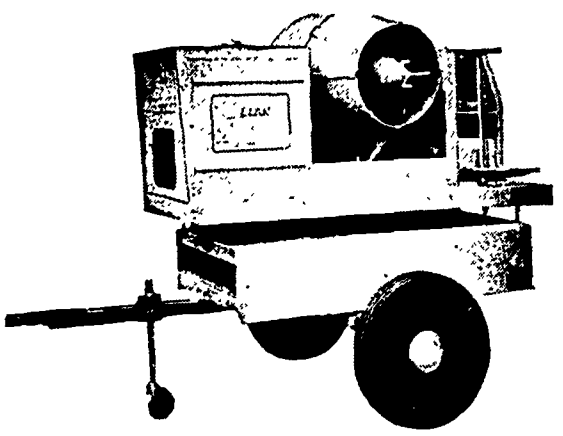
   c. Self-propelled, high clearance. These special purpose machines are designed for spraying field and row crops that are too tall for conventional sprayers.

5. Airblast machines. Air sprayers are used for spraying orchards and large shade trees. Units are also available for spraying field and row crops.



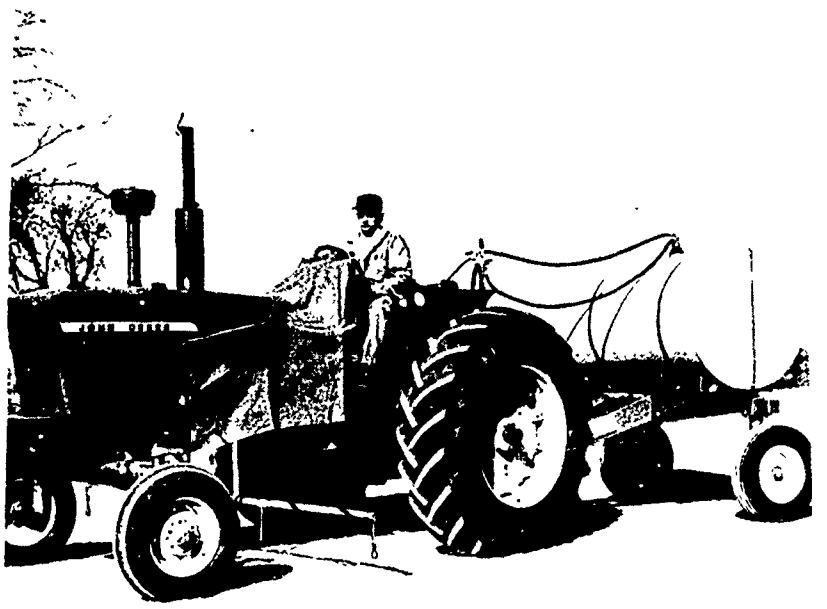
302 ROTOMIST

Spraying Equipment
(Information Sheet continued)



6. Fog applicators.
Fog applicators or aerosol generators are not used much in agriculture because of the type of spray produced. They are used mostly for temporary control of mosquitoes, flies, and other insects in buildings and restricted outdoor areas. The fog must contact the insects to be effective since there is little or no residual action.

7. Band sprayer and band applicator.
These are used primarily for applying herbicides for control of grasses and weeds in row crop farming. Generally, low volume, low pressure sprayers are modified for this purpose.



8. Aircraft sprayers.
Aircraft spraying is usually done by commercial concerns either by contract on an annual basis or on a per acre basis. This may include all costs or the farmer may supply all the materials and pay the pilot or concern the cost per acre for application of the materials used.

9. Concentrate sprayers, ultra-low volume.
Recent advances in the ultra-low volume application of aerial sprays have led to the introduction of Malathion LV* Concentrate. (*Trademark of American Cyanamid Co.) This highly concentrated form of malathion containing 95% active ingredient has inherent chemical and physical properties that make possible its direct use without additives.

Spraying Equipment
(Information Sheet continued)

10. Fumigant injectors.
    a. Plow application
    These deliver the fumigant into the furrow as the soil is turned. The soil must be sealed immediately after the fumigant is used to prevent loss of the fumigant.

    b. Tooth or chisel method
    These applicators are attached to the tractor-mounted cultivators or mounted on trailer-type cultivators. The chisels or teeth are usually spaced 10 to 12 inches apart. The chisels place the fumigant 6 to 8 inches into the ground by means of tubes attached to the chisels. When this is used, the chisel furrows must be filled and sealed immediately behind the applicator.

11. Subsurfacing applicators.
    Similar to fumigant injectors except furrows need not be sealed after application of insecticides.

12. Soil incorporators.
    This equipment thoroughly mixes agricultural chemicals into the soil in such a way that the chemical actually becomes part of the soil itself.

13. Fertilizer injectors.
    Liquid and gaseous fertilizer equipment
    a. Anhydrous ammonia
    b. Low pressure solutions
    c. Nonpressure solutions
    d Foliar sprays

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Chemical Application Equipment

TOPIC: Dusting Equipment

OBJECTIVE: To become familiar with dusting equipment, its use, and operation.

REFERENCES:

Required:

1. Information Sheet, "Dusting Equipment"
2. "Power Sprayers and Dusters," F.B. 2223, pp. 16-18

QUESTIONS OR ACTIVITIES:

1. What is the difference between dusting and spraying?
2. What are the component parts of a duster?
3. What type fan is commonly used on power dusters?
4. At what speed do fans generally operate?
5. These fans deliver _____ to _____ c.f.m. of air at velocities of _____ to _____ m.p.h.
6. Name the four types of dusters that may be found on farms today.
7. What type would one use for small areas or for spot dusting in large fields?
8.
9.

Information Sheet
on
DUSTING EQUIPMENT

Granular applicators

This equipment puts out larger particles of insecticides, instead of using powder or dust forms of these materials. These involve little or no drift hazards.

Soil incorporators

Places dust or granules and mixes into the soil thoroughly and gives complete coverage. Hand-operated dusters are used on single plants or small areas around the home and garden.

Tractor-mounted dusters

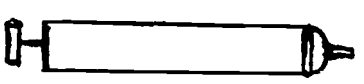
Power dusters are usually classified by the method of powering--engine or tractor power take-off. They may also be divided into two general types--single outlet units (one hose and nozzle) designed for orchard dusting and multiple outlet units designed for field and row crop work.

Aircraft

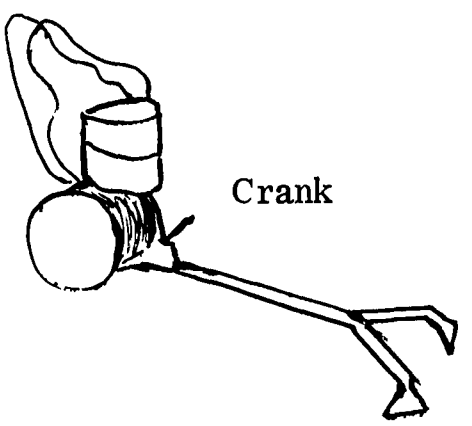
This service is usually performed by aerial spraying and/or dusting contractors.

Types of dusters found in the home and on the farm are as follows:

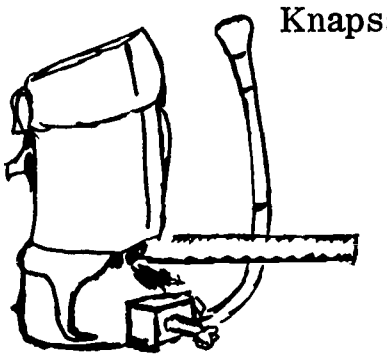
1. Plunger--The smaller household dusters are especially convenient for placing insecticidal dusts in kitchens, pantries, basements, and around small individual plants for control of ants and other crawling insects. The larger garden-size duster is ideal for applying dusts for the control of insects and plant diseases in the home garden.



Plunger



Crank



Knapsack

Dusting Equipment
(Information Sheet continued)

The principal parts of the duster consist of the chamber for holding the dust, the air pump for supplying the air blast, and the delivery tube and nozzle. The dust chamber may be of glass or metal construction.

2. Crank and knapsack--These dusters are designed for use on estates, in large gardens, on small acreages of truck crops, and on field crops such as cotton or tobacco. They are also useful for controlling spot infestations in larger fields. The crank and knapsack dusters will hold from 5 to 25 pounds of dust, an agitator to prevent the dust from packing, and a mechanism to feed the dust uniformly into the outlet. The crank duster is operated by a manually operated rotary fan or blower, which provides a continuous discharge of dust.

   The knapsack duster develops an air blast by means of a bellows rather than a fan or blower. The dust is, therefore, discharged intermittently and is best suited for treating crops planted in hills or for spot dusting of crops in which the plants are widely spaced in the row.

3. Wheelbarrow or traction dusters--These dusters are intermediate between hand and power equipment. They are used on small acreages of row crops. Because of their light weight and mobility, they often supplement power dusters when fields are soft or rough. The hoppers hold 15 to 50 pounds of dust and the discharge rate may be varied from about 5 to 45 pounds per acre. A clutch is provided for intermittent use in the field. Some may have a hitch in front to be used in attaching to a horse, mule, or small tractor when larger fields are to be dusted.

4. Tractor-mounted dusters--These are dusters powered by PTO or powered by a separate engine unit.

Dusters can be used only when there is little air movement. Dusting is popular in places where water supplies are limited.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Chemical Application Equipment

TOPIC: Fogging Equipment

OBJECTIVE: To become familiar with fogging equipment, its uses, and operation.

REFERENCES:
Required:
1. Information Sheet, "Fogging Equipment"

QUESTIONS OR ACTIVITIES:

1. Where is fogging equipment used?
2. Fogging mist is a contact insecticide. (True _____ or False _____)
3. Can fogging be used effectively during high winds?
4. Why is fogging generally used at night?
5. How is an insecticide used in fogging machines?
6. Are foggers used very extensively in agriculture?

Information Sheet
on
FOGGING EQUIPMENT

Fog applicators, or aerosol generators, are not used much in agriculture because of the type of spray produced. They are used mostly for temporary control of mosquitoes, flies, and other insects in buildings and restricted outdoor areas.

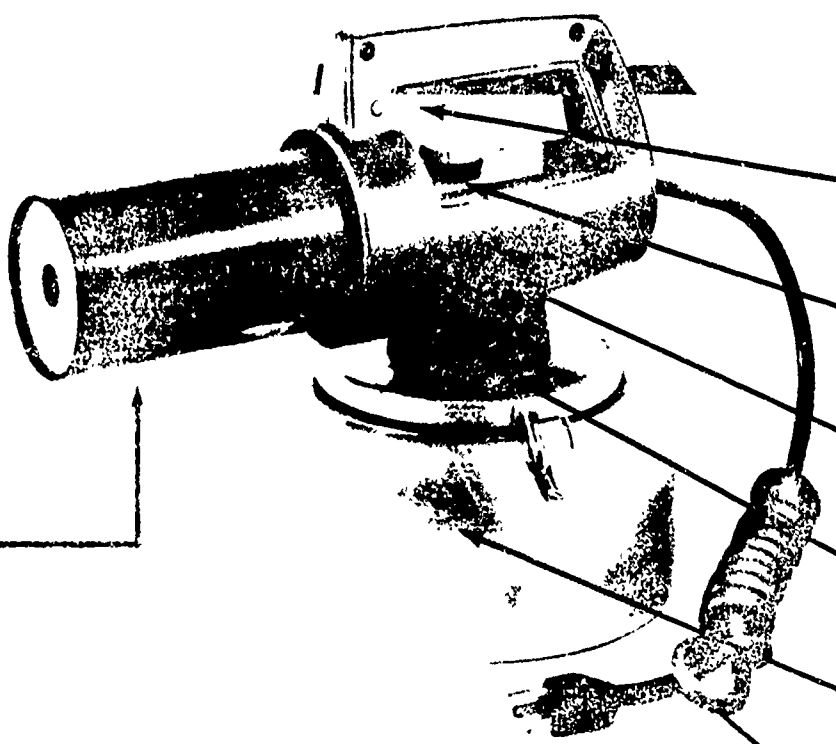
The sprayers produce a fog or mist that remains in the air for a considerable time. The fog must contact the insects to be effective since there is little or no residual action.

Outdoor applications are usually made at night when temperature, humidity, and wind conditions are most favorable. An application cannot be made under excessive wind conditions, but some air movement is required to disperse the spray over the area to be treated.

Fog applicators were developed during the Second World War primarily for spraying enclosed space. Some have been used to control flies and mosquitoes in buildings and outdoor areas. Few are used by farmers; they are generally considered unsatisfactory for providing adequate residual deposits and coverage because they rely on air drift to carry the insecticide.

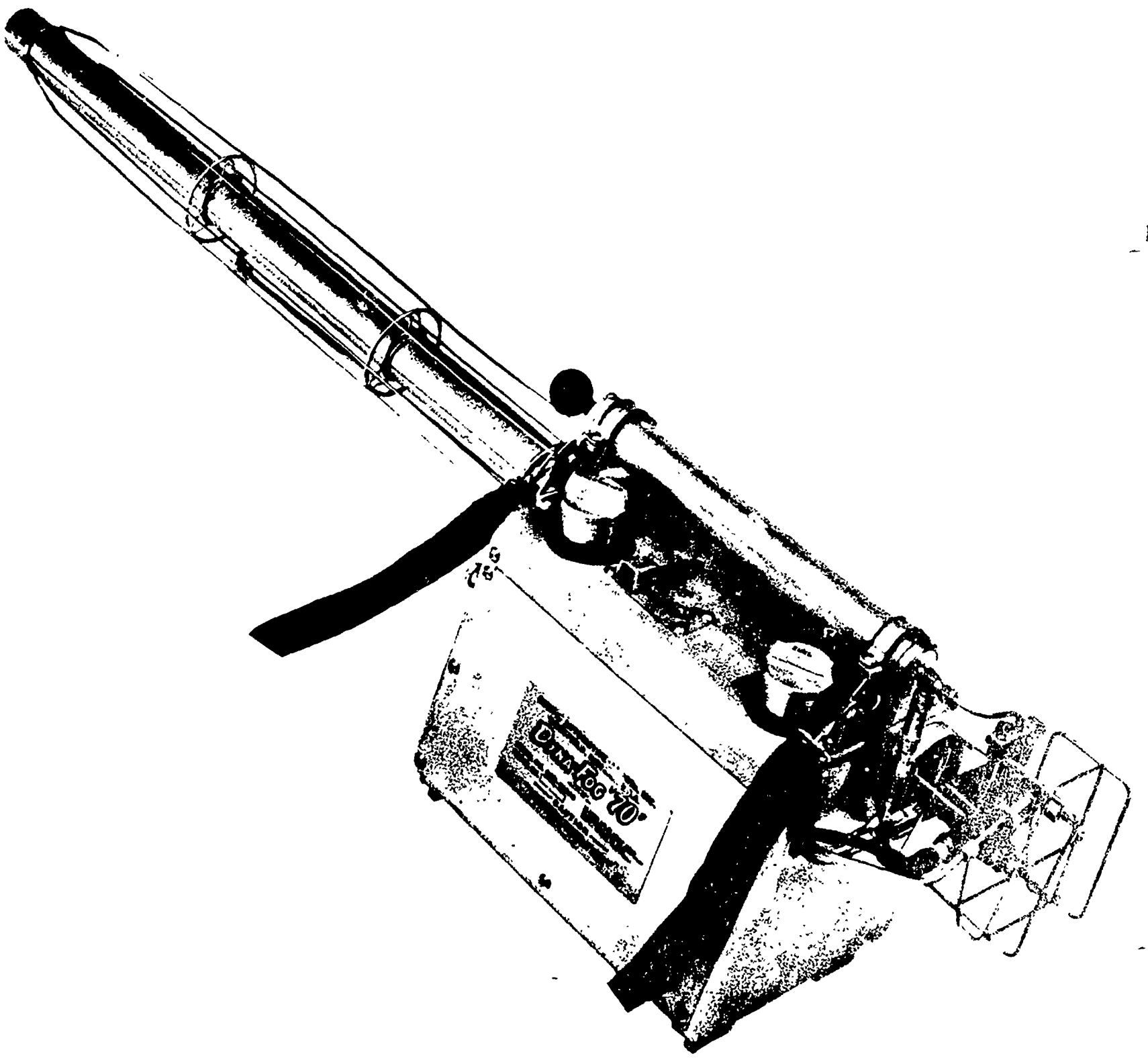
Types of foggers are as follows:

1. Portable, electric hand type--This model used to fog small outdoor areas and enclosed space to control flies and mosquitoes primarily.



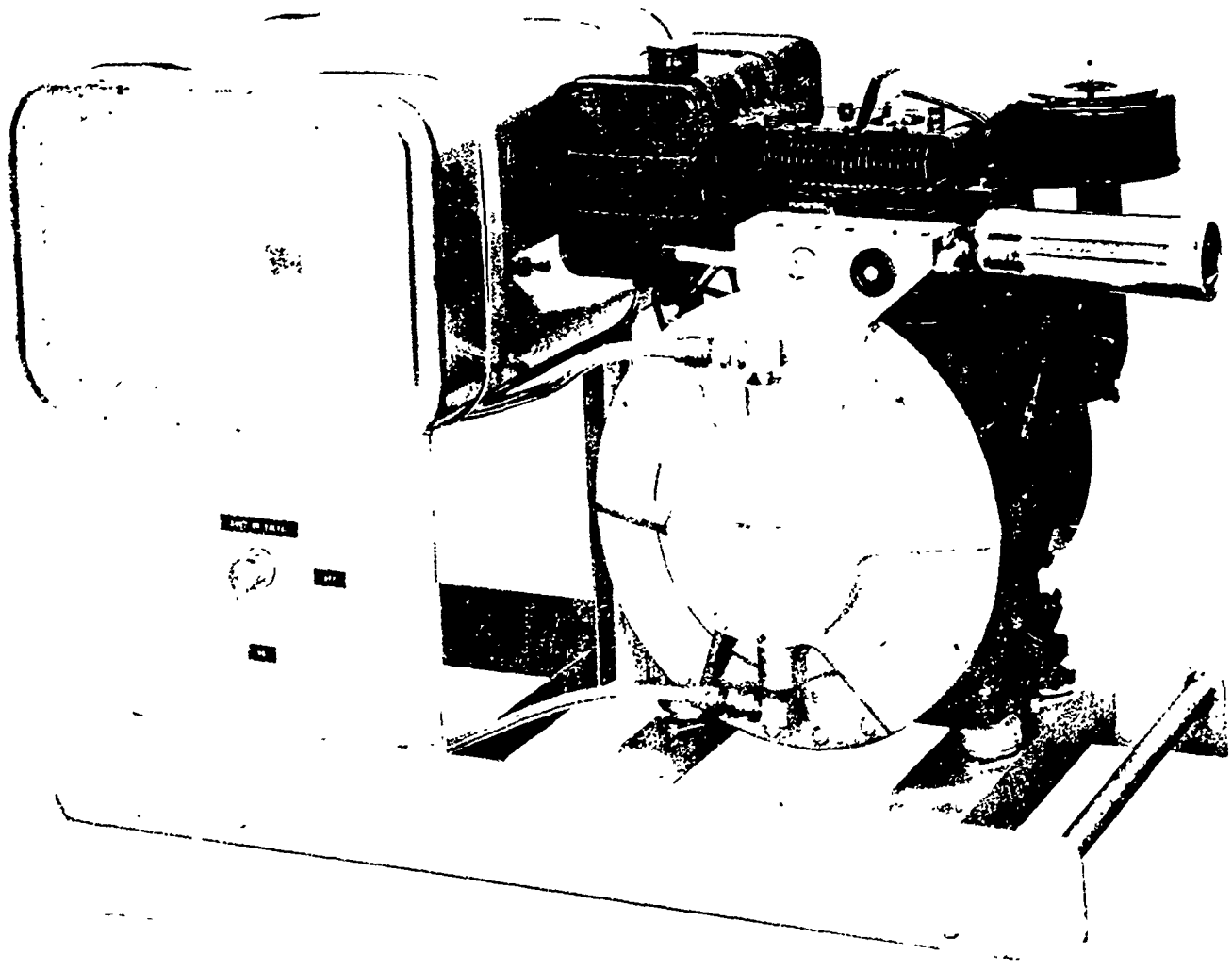
Fogging Equipment
(Information Sheet continued)

2. Small gasoline engine models--Primarily used to fog around homes and restricted areas for control of flies and mosquitoes. Some have converter kits attached directly to the exhaust system of lawn mowers and edgers.



Fogging Equipment
(Information Sheet continued)

3. Mounted foggers, separate gasoline engine driven--Used primarily by cities and mosquito control districts to control flies and mosquitoes in larger areas.



Most foggers require a source of heat to vaporize the insecticide being used.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Chemical Application Equipment

TOPIC: Fumigating Equipment

OBJECTIVE: To become familiar with fumigating equipment, its uses, and operation.

REFERENCES:
Required:
1. Information Sheet, "Fumigating Equipment"

QUESTIONS OR ACTIVITIES:

1. How do soil fumigants work?
2. What is the primary purpose of soil fumigants?
3. What else may be controlled by soil fumigants?
4. What are three methods of using soil fumigants?
5. What precautions must be taken with these chemicals?
6.
7.

ERIC

Information Sheet
on
FUMIGATING EQUIPMENT

Soil fumigants are the modern means of controlling nematodes, and many of them also control diseases and other soil insects. Fumigants generally do an excellent job of controlling weeds while sterilizing the soil.

Plant roots are the general target of nematodes--elongated, cylindrical, parasitic worms. Several thousands of species of nematodes have been described; and out of these, several hundred are known to be plant parasites. Some of these nematodes burrow through root tissues while others feed on the root surface. Though their habits vary, the end result is usually the same--the damage to the crop has been done before it is noticed. Injured roots are not able to make the most of the moisture and fertility in the soil. They become more susceptible to disease; and by the time the damage is detected above ground by dwarfed and stunted plants, it may be too late. Nematodes have already eaten up the profits. You have probably already seen symptoms of nematode damage on crops. Roots are galled, knotted, or "whiskered." Plants often look wilted. Leaves may be discolored or spotted; usually the entire plant is dwarfed and so is its yield. Soil fumigants are used to control these parasites.

Methods of Soil Fumigation

1. Plow application
   Plow applicators deliver the fumigant into the furrow as the soil is turned. The soil must be sealed immediately after the fumigant is applied to prevent loss of the fumigant. To seal in the fumigant, any of the various implements may be used such as spike-toothed harrows, cultipackers, drags, floats, or rollers. When applied by plow-sole applicators, the fumigant may be introduced into the furrow either under pressure or by gravity flow equipment.

2. Tooth or chisel application
   These applicators are attached to the tractor-mounted cultivators or mounted on trailer-type cultivators. The chisels are usually spaced from 10 to 12 inches apart. The chisels place the fumigant 6 to 8 inches into the ground by means of tubes attached to the chisels. When fumigating in this manner, the chisel furrows must be filled and sealed immediately behind the applicator.

3. Confinement method (covered area)
   Plastic, gasproof covers may be used to confine gasses to the soil for a longer period of time. Treatment in this manner will control nematodes, soil insects, most fungi, weed and grass seeds, roots, stolons, and bulbs. Once released beneath the cover, the fumigant penetrates at least to the depth the soil has been worked. CAUTION: EXTREME CARE MUST BE USED WITH THIS METHOD AS THE GASSES USED ARE POISONOUS AND ARE DANGEROUS IF NOT PROPERLY HANDLED.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES & SERVICEMAN

UNIT: Insects

TOPIC: Classes of Insects

OBJECTIVE: To learn the classes and orders of insects.

REFERENCES:
Required:
1. Information Sheet, "Classes of Insects"
2. Insects, 1952 Yearbook of Agriculture, USDA, pp. 43-60

QUESTIONS OR ACTIVITIES:

1. List five of the major divisions or phyla of the animal kingdom.
2. What is the largest division, based on the number of animals in the division?
3. List five of the arthropoda classes.
4. Explain why the scientific names of animals are in Latin.
5. Why does the name of each species consists of two words?
6. Why can't the generic name of insects be duplicated?
7. List the characteristics of each of the five classes of insects.
8. What is the basis for classifying insects?
9.
10.

Information Sheet
on
CLASSES OF INSECTS

The animal kingdom is composed of a number of major divisions, referred to as a phyla; some are the Chordata, Protozoa, Echinodermata, Annelida, Platyhelminthes, Nemathelminthes, Mollusca, and Arthropoda.

The phylum Arthropoda, comprising approximately eighty percent of all known animals, is the largest division. This phylum includes the invertebrate, backboneless animals, which have a segmented body, jointed appendages, and a hard outer covering, or exoskeleton. There are thirteen classes of Arthropoda, but only five will be listed here. They are the Arachnida, Chilopoda, Crustacea, Diplopoda, and Hexapoda.

A class of insects is divided into a number of orders. Members of certain orders are more closely related to one another than to members of other orders.

Within each order of insects is a number of families. The word "family" therefore shows a closer relationship than the word "order." Families, in turn, have been divided into genera ("genera" is the plural of "genus"). All members of the same genus are quite closely related. Within each genus is one or more species or special kind of animal.

A particular kind or specie of an insect or other animal is referred to scientifically by the name of its genus, which comes first and is capitalized; then the specific name is next and is not capitalized. Also it may be followed by the initials or name of the person who originally proposed the scientific name and described the species.

Order	Family	Genus	Specific Name	Common Name
Diptera	Muscidae	Musca	domestica	Housefly

The scientific name of the common housefly is thus musca domestica.

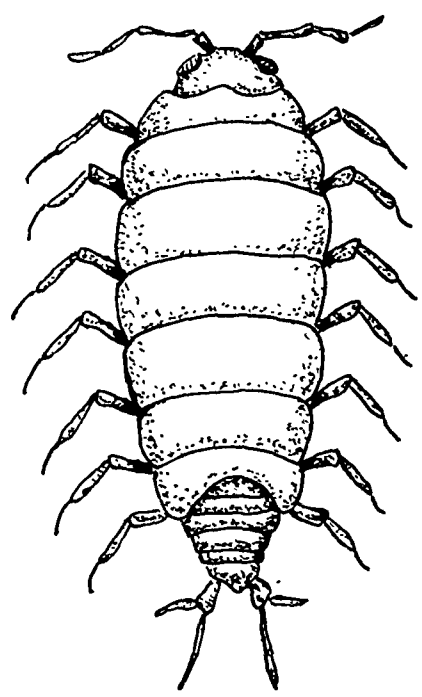
Since common names of insects differ from country to country and may vary from one locality to another, the scientific names are very important in identifying them. The mouth parts are another important aid in identifying an insect.

Three characteristics--the type of mouth parts, the type of metamorphosis, and the presence or absence of wings are the basis for classifying insects.

Classes of Insects
(Information Sheet continued)

The classes of Arthropodas and a brief description of class members are as follows:

Class Crustacea

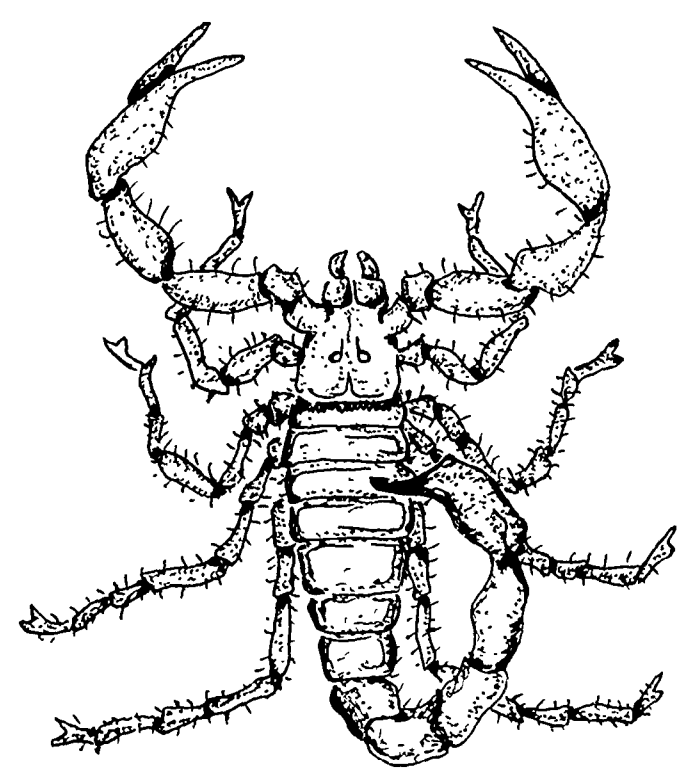


Crayfish, lobsters, pill bugs, sow bugs, crabs, and shrimp are members of this class. Most of these class members breathe with gills; however, a few breathe through their body walls. They generally have two pairs of antennae, several pairs of legs and are aquatic. The head is merged with the thorax. Most of the Crustacea class are beneficial; but some, such as the sow bugs, pill bugs, and barnacles, are not.

Class Arachnida

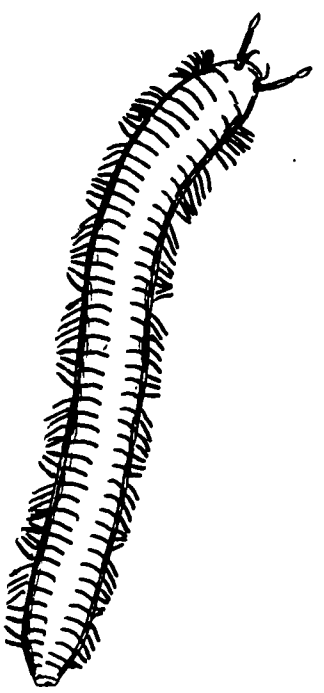
Members of this class are spiders, scorpions, ticks, and mites. Their bodies are generally divided into two parts, the cephalothorax and abdomen. They have four pairs of jointed legs and an absence of wings and antennae. Noticeable characteristics are simple eyes and an absence of antennae. They breathe with air tubes and lungs.

The Arachnida class is divided into a number of orders. Some of these are Araneida, spiders --Black Widows and Tarantulas; Scorpionida, scorpions; Pedipalpida, whip scorpions; Phalangida, Daddy-Longlegs; Acarina, mites, ticks, and red bugs.



Classes of Insects
(Information Sheet Continued)

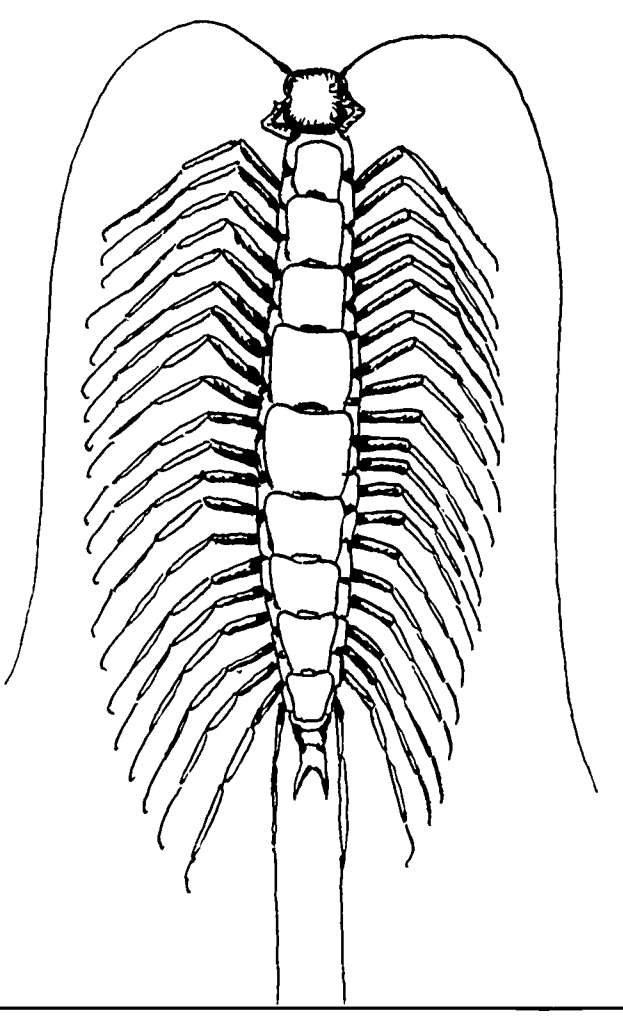
Class Diplopoda



The millipedes are members of this class. They have a large number of legs, a pair of antennae on their head, and breathe by means of air tubes. Their bodies are segmented, with two pairs of legs on each segment.

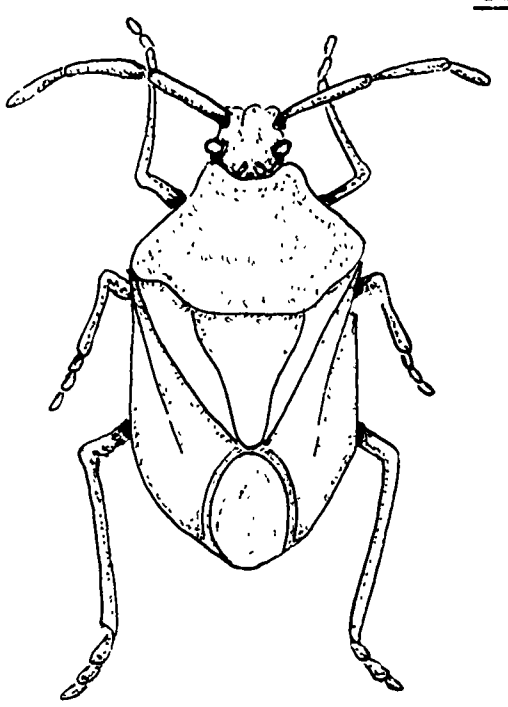
Class Chilopeda

Centipedes are members of this class. They have a pair of legs on each segmented part of their body, a pair of antennae on their head; and breathe by air tubes. Also, they have a pair of poison claws behind their head, used to paralize insects, which they use for food.



Classes of Insects
(Information Sheet continued)

Class Hexapoda



The true insects are members of the Hexapoda class Their body is divided into three distinct regions: head, thorax, and abdomen The thorax has three pairs of legs and two pairs of wings, usually These insects breathe through air tubes, and one pair of antennae are always present. The wings will help identify members of this class; however, there are a few insects in this class that do not have wings None of the other class members have wings There are two sub-classes in this class, the Apterygota--those insects without wings, and the Pterysota--those insects with wings.

Since one of the most important classes is the Hexapoda, the student should become familiar with the orders of their class The orders and an example of each order are as follows.

Anaplura - bloodsucking lice
Coleoptera - beetles, weevils
Collembola - springtails
Corrodentia - book lice
Dermaptera - earwigs
Diptera - flies, gnats, mosquitoes
Ephemeroptera - Mayflies
Hemiptera - bedbugs, leaf bugs
Homoptera - aphids, scale insects
Hymenoptera - ants, bees, wasps
Isoptera - termites
Lepidoptera - butterflies, moths
Mallophaga - Chewing lice
Mesoptera - scorpion-flies
Neuroptera - ant-lions, aphid-lions
Odonata - dragon flies
Orthoptera - grasshoppers, locusts, roaches

Classes of Insects
(Information Sheet continued)

Plecoptera - salmon-flies
Siphonoptera - fleas
Strepsiptera - twisted-wing parasites
Thysanoptera - thrips
Thysanura - silverfish
Trichoptera - caddice-flies or worms

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Insects

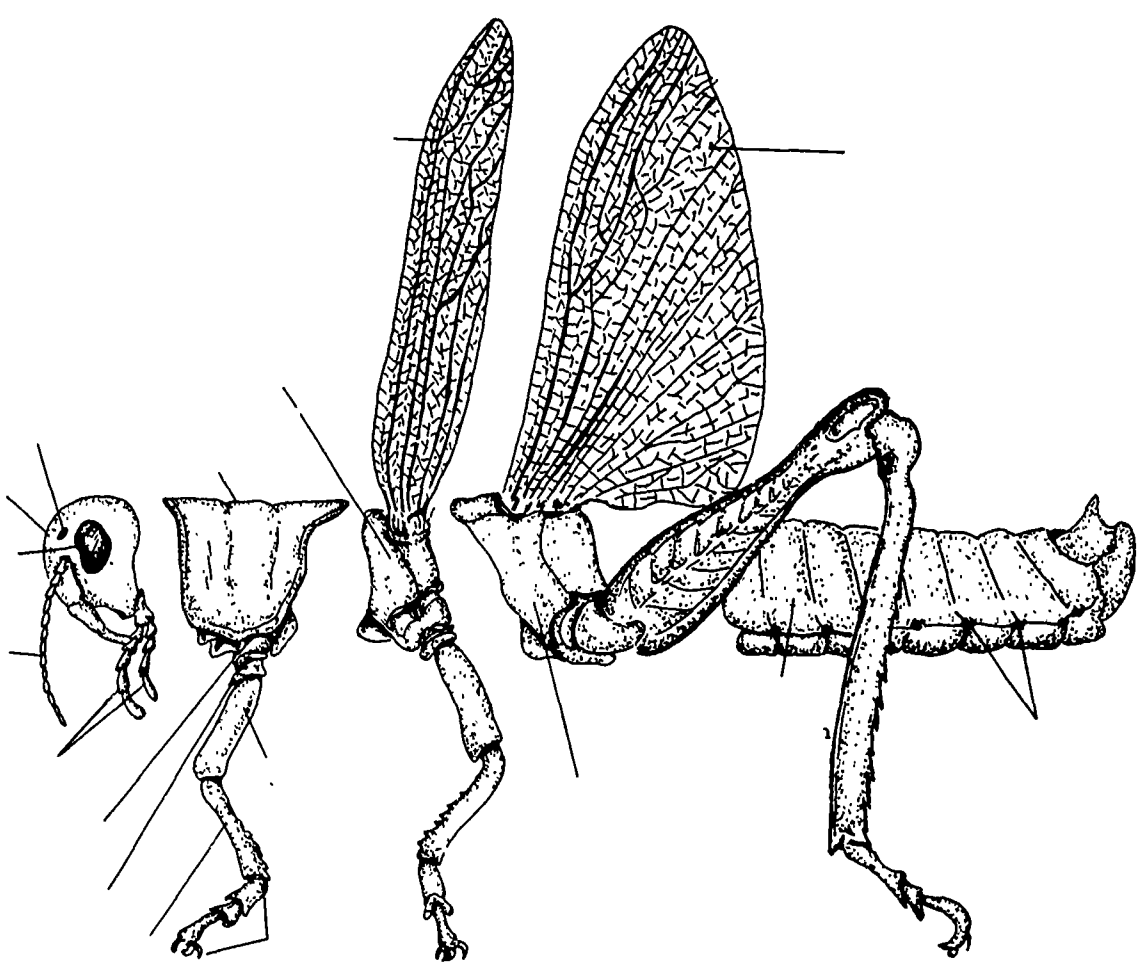
TOPIC: Body Parts

OBJECTIVE: To learn the body parts of insects.

REFERENCES:
Required:
1. Information Sheet, "Body Parts"
2. Insects, 1952 Yearbook of Agriculture, USDA, pp. 43-60

QUESTIONS OR ACTIVITIES:

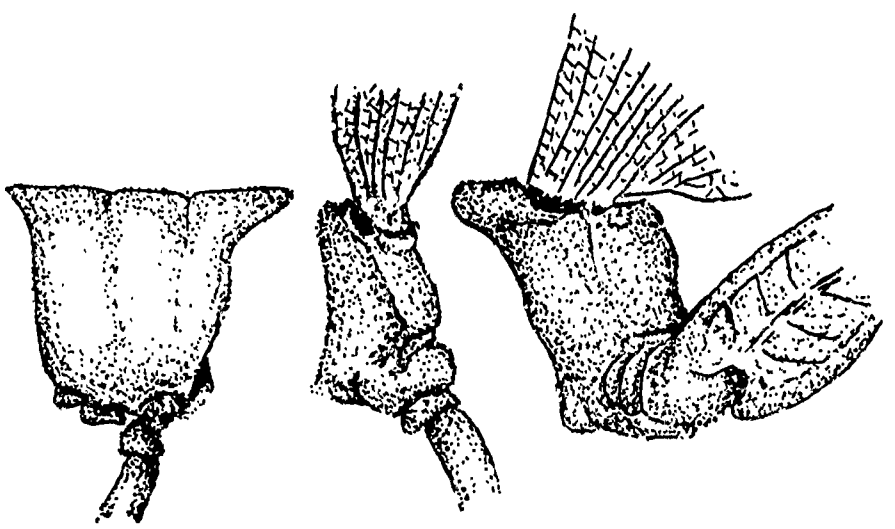
1. Label the parts of the grasshopper illustrated below.



2. Why is the knowledge of the anatomy of an insect important?

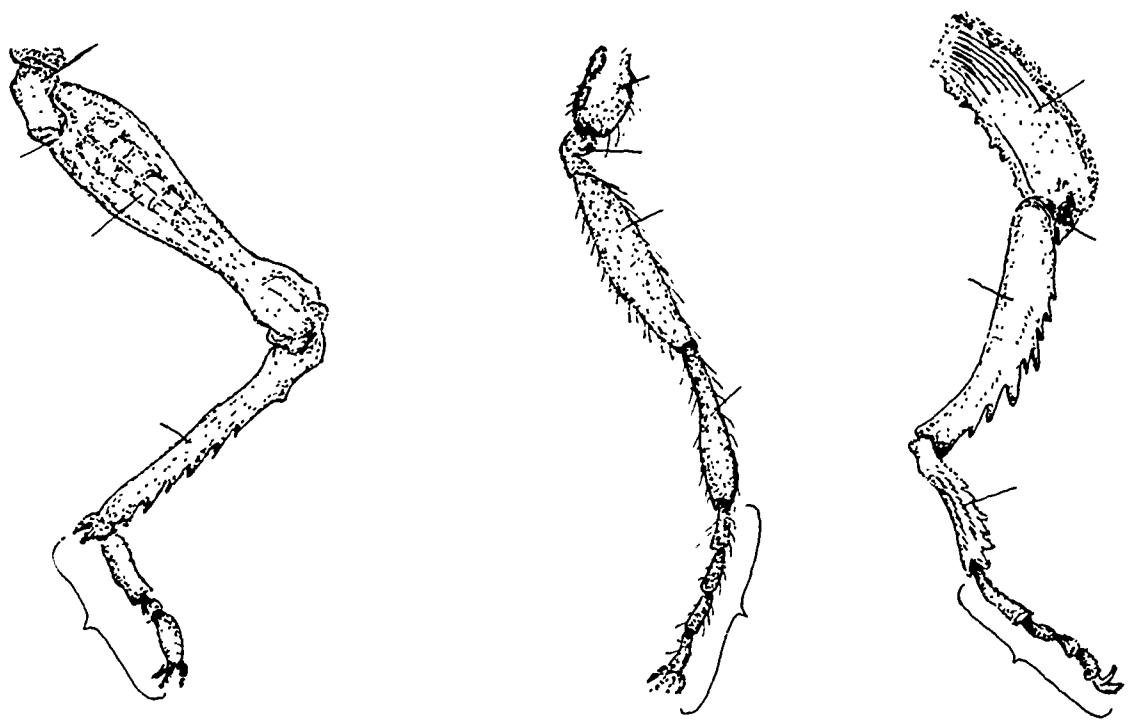
UNIT: Insects
TOPIC: Body Parts
(Assignment Sheet continued)

3. What is the exoskeleton and list its parts.
4. What is the material that makes up the exoskeleton called, and how does this material protect the insects?
5. Where are the breathing tube openings located on insects?
6. What is the function of the insect's antennae?
7. List the kinds of mouth parts found on insects.
8. Why is the knowledge of the mouth parts important?
9. Label the parts of the thorax illustrated below.

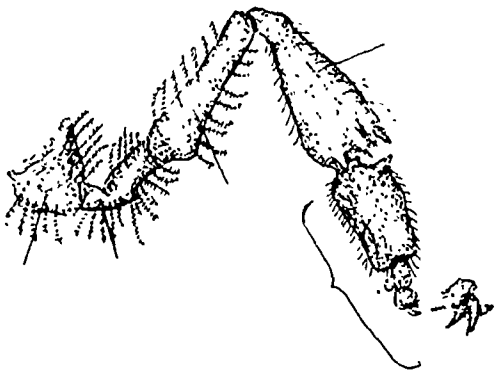


UNIT: Insects
TOPIC: Body Parts
(Assignment Sheet continued)

10. Label the parts of the leg of an insect illustrated below.

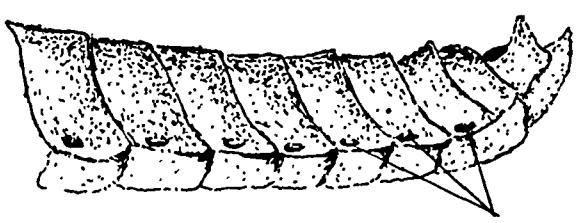


C ----- Coxa
Tr----- Trochanter
F ----- Femur
T ----- Tibia
Ts ---- Tarsus



UNIT: Insects
TOPIC: Body Parts
(Assignment Sheet continued)

11. Label the parts of the abdomen illustrated below.

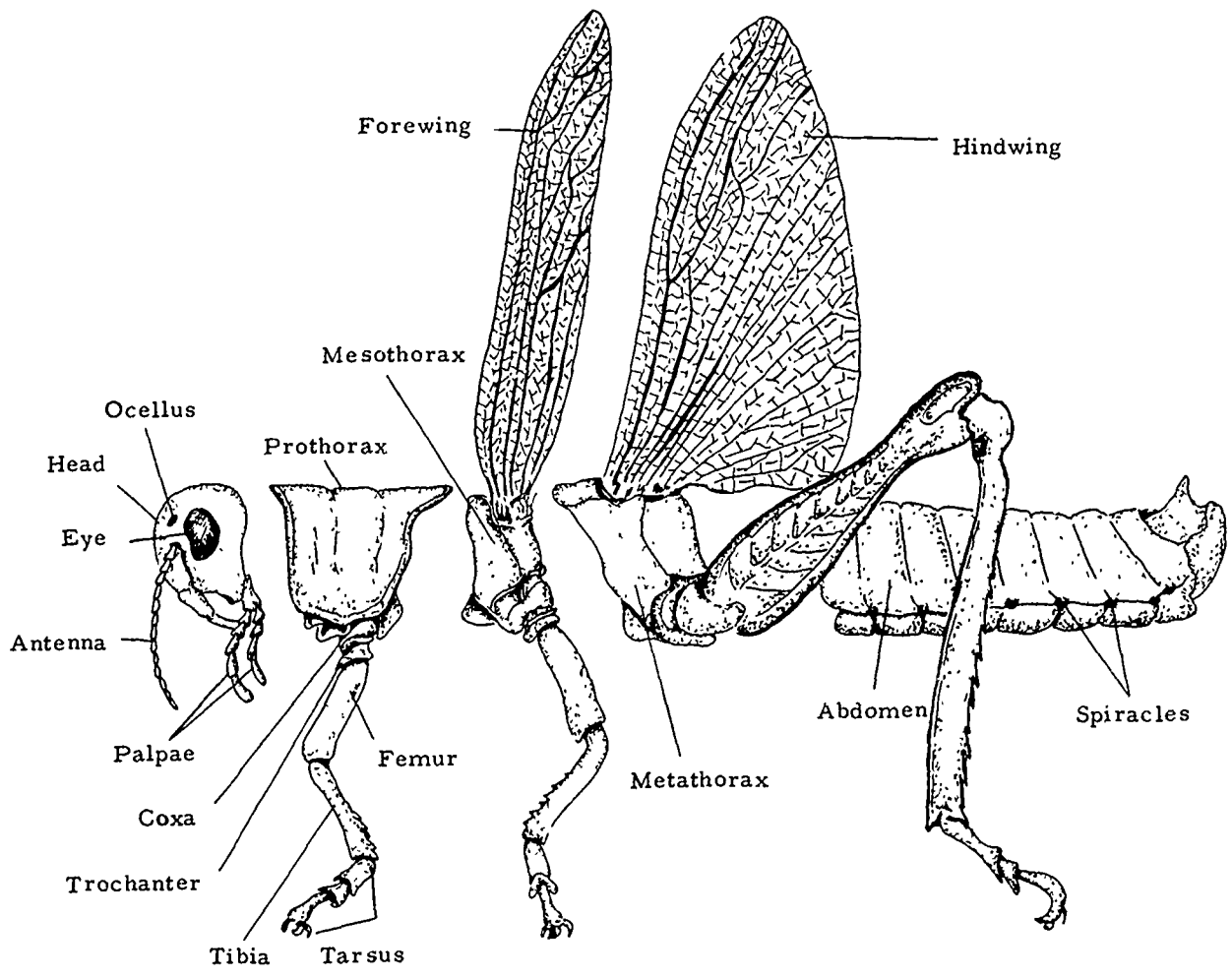


12. List the characterisitics of the insect's wing that may aid in identifying the insect
13.
14.

Information Sheet
on
BODY PARTS

In order to distinguish the class, order, or species of insects, a knowledge of insect anatomy is necessary. Insects are covered with a suit of armor, called an exoskeleton. This protective covering is the reason that insects can withstand varied conditions. Also, the exoskeleton gives the insect leverage and explains the reason for its remarkable strength.

The three parts of the exoskeleton are the cuticula, hypodermis, and basement membrane. The cuticula has two distinct layers, the exocuticula--the outer layer; and the endocuticula, an inner layer. The material making up the exoskeleton is called chitin. The chitin is resistant to water, alcohol, and alkalis. In addition, the chitin protects the insect from disease and extremities of environmental conditions, which enables them to live under varied conditions. The wings and breathing tubes are formed from extensions of the body covering. The breathing tubes open through the air openings, or spiracles, which are arranged along the sides of the abdomen.



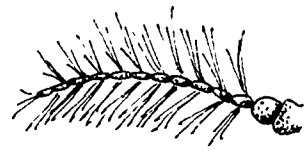
Body Parts
(Information Sheet continued)

The function of the parts of an insect are as follows:

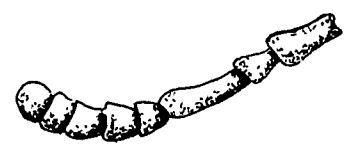
Head

Antennae - The antennae perform a sensory function. The sense of touch is located in the antennae, and in some insects the sense of smell and hearing is located in the antennae. There are a number of different types of antennae.

ARISTATE



PLUMOSE



CALVATE

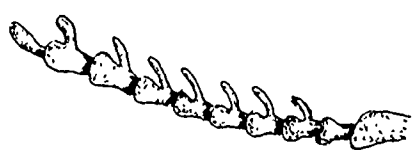
LAMELLATE

SERRATE

MONILIFORM

FILIFORM

SATACEOUS



PECTINATE

Body Parts
(Information Sheet continued)

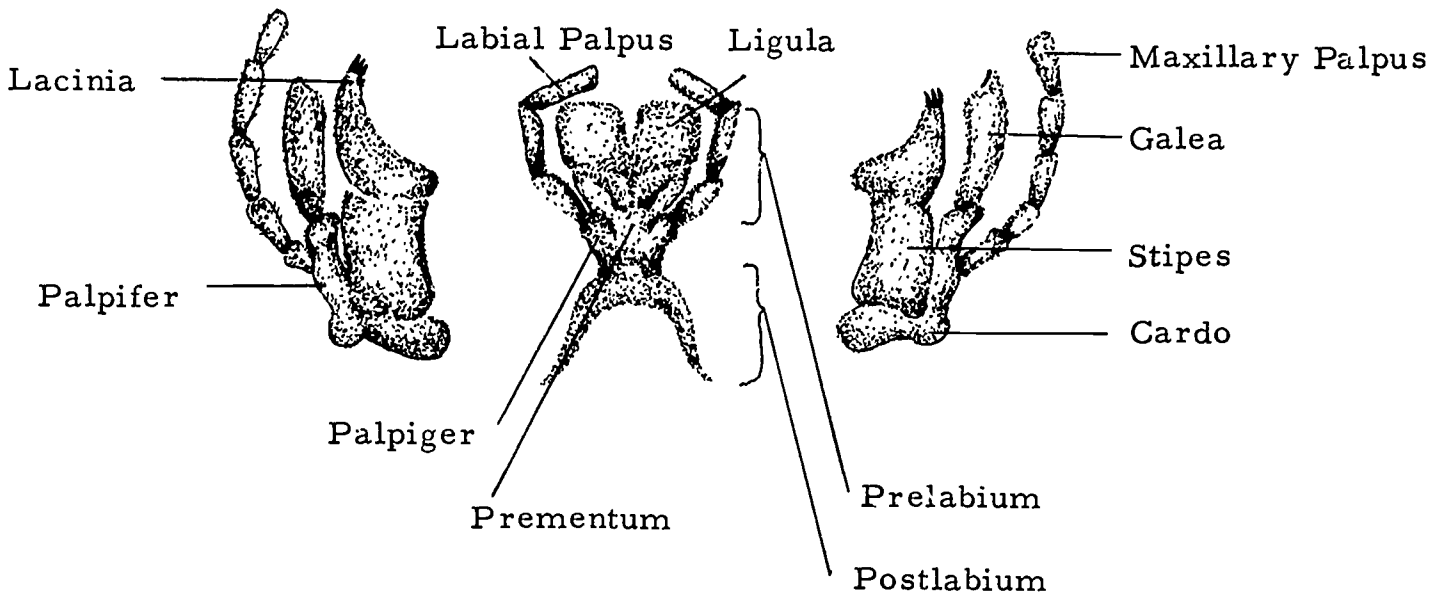
Mouth Parts - As was stated in a previous topic, the mouth part is an aid to the identification of insects and their control. The most common kinds of mouth parts are chewing - (grasshoppers, beetles, caterpillars); piercing-sucking - (fleas, bugs, certain flies, bees); chewing-lapping - (bees, wasps); sponging - (houseflies); siphoning - (butterflies, moths); and rasping-sucking - (thrips).

LABRUM

RIGHT MANDIBLE

HYPOPHARYNX

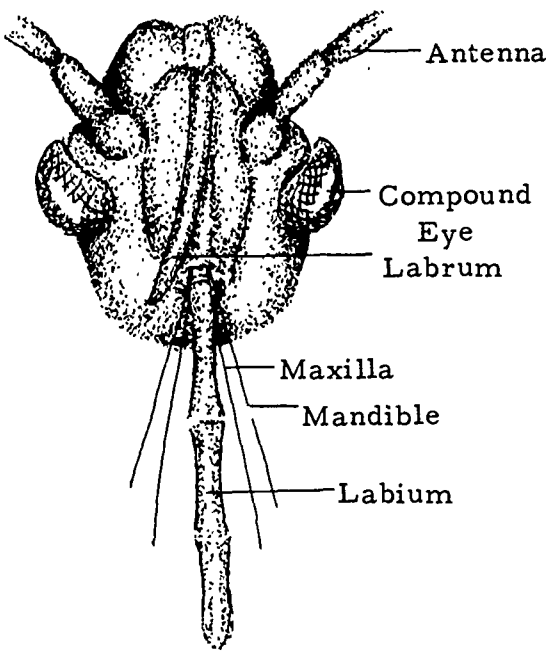
LEFT MANDIBLE

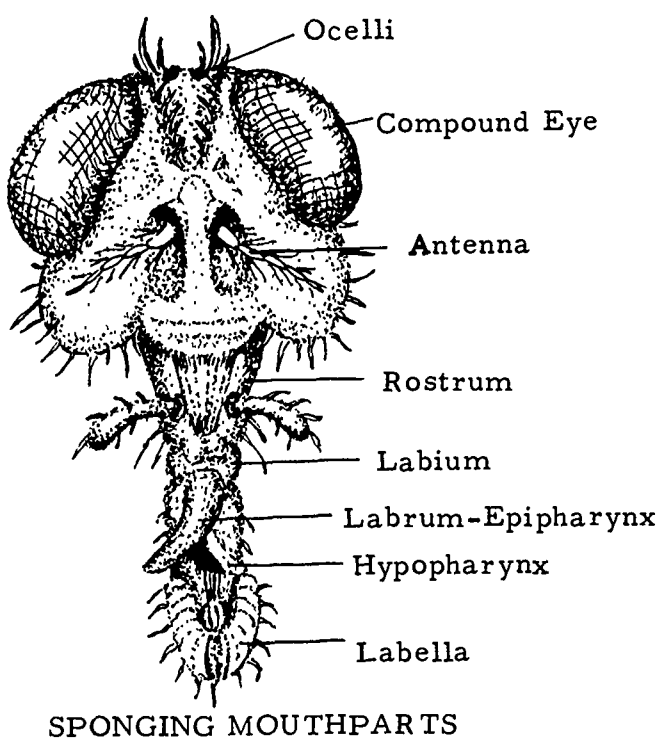


CHEWING MOUTHPARTS

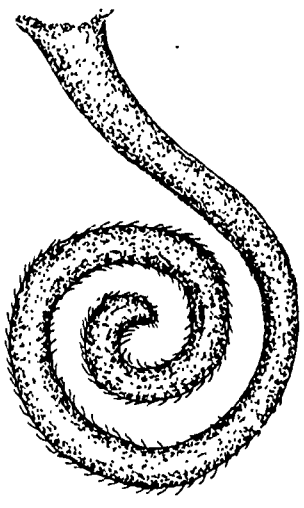
Body Parts
(Information Sheet continued)

Mouth Parts continued

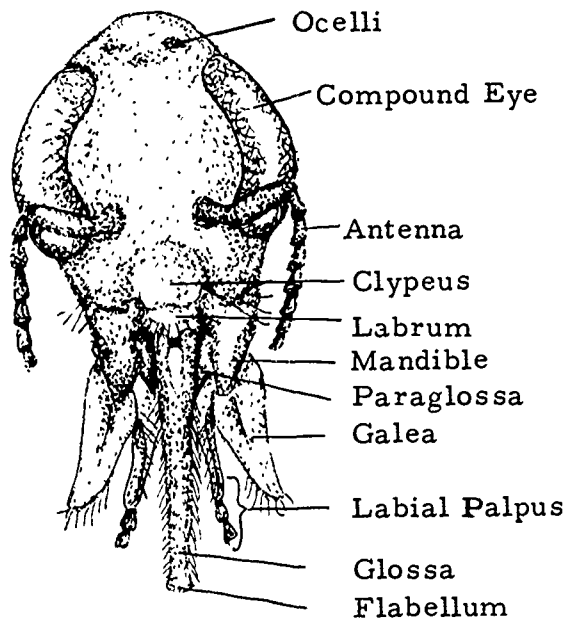




SPONGING MOUTHPARTS



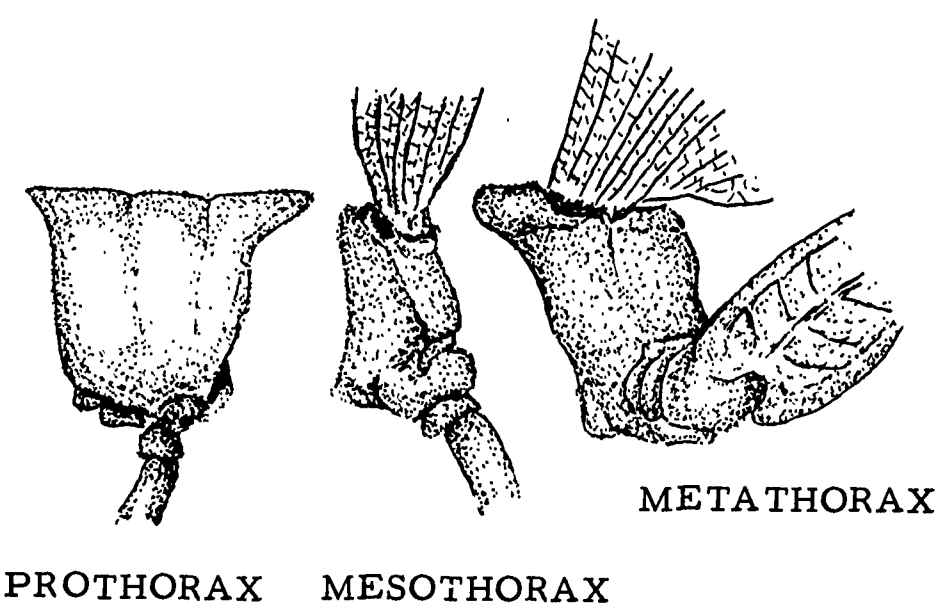
SIPHONING MOUTHPARTS



CHEWING-LAPPING
MOUTHPARTS

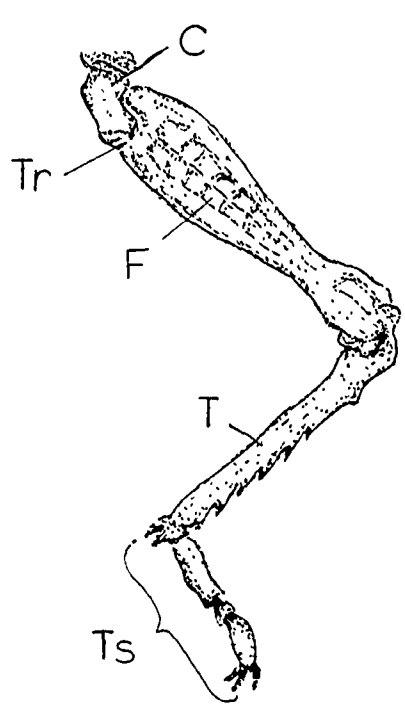
Body Parts
(Information Sheet continued)

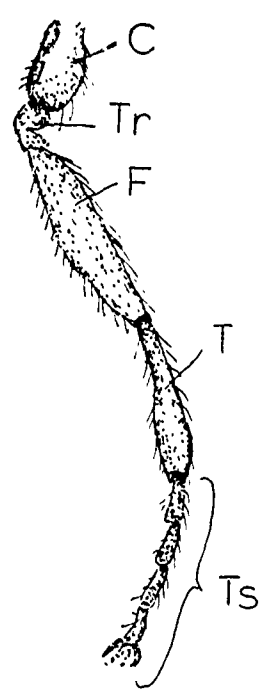
Thorax - The thorax consists of three parts: the prothorax, mesothorax, and metathorax. Each part has a pair of legs. The first pair of wings are attached to the mesothorax, and the second pair of wings are attached to the metathorax.

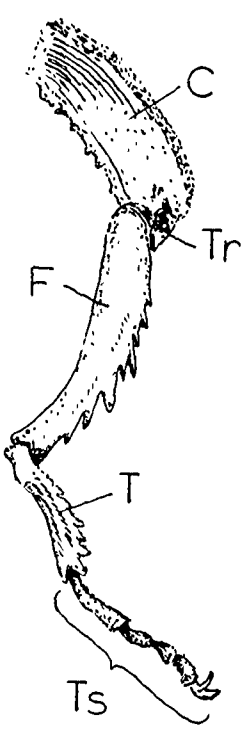


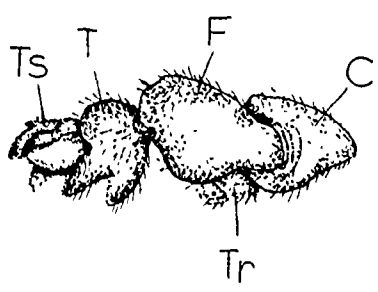
Body Parts
(Information Sheet continued)

Legs - The legs of an insect vary in shape and size and one pair of legs is attached to each part of the thorax.









C ----- Coxa
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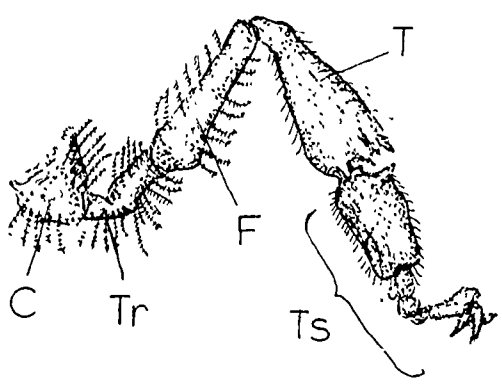
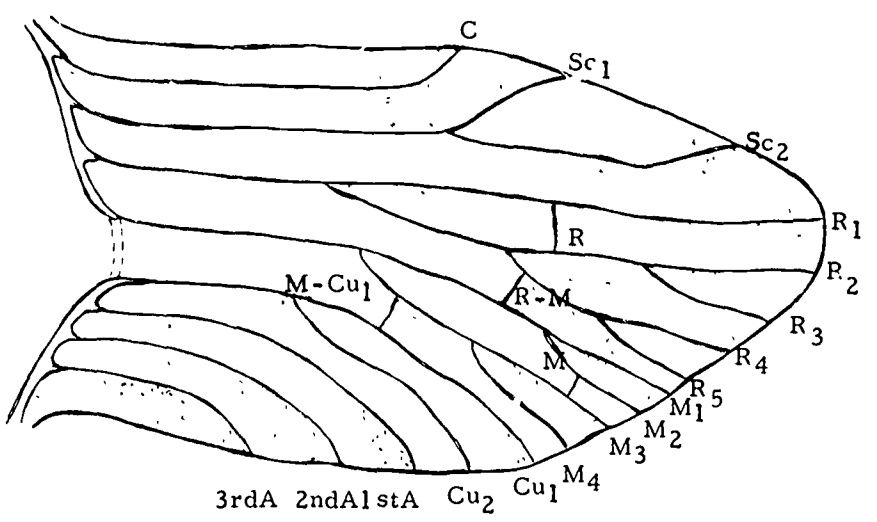


Body Parts
(Information Sheet continued)

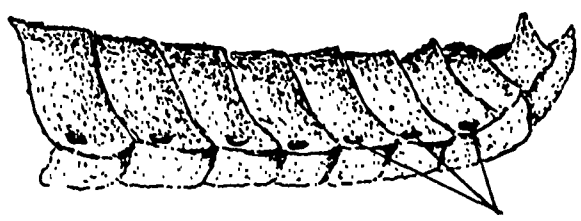
Wings - Insects are the only animals that have wings, and the number varies. Some insects have two pairs and some insects, such as the silverfish and springtails, have none. Some insects have wings but lose them. The orders of insects are based on the wing characteristics. The identifying characteristics of the wing are the shape, size, and texture.



NAME OF VEINS	ABBREVIATION
Costa	C
Subcosta	SC
Radius	R
Media	M
Cubitus	Cu
First Anal	1st A
Second Anal	2nd A
Third Anal	3rd A

Body Parts
(Information Sheet continued)

Abdomen - The abdomen of an insect may have as many as ten or eleven segments; however, they may have as few as five or six.



SPIRACLES

ABDOMEN

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Insects

TOPIC: Life Cycles

OBJECTIVE: To become familiar with the life cycle of insects.

REFERENCES:

Required:

1. Information Sheet, "Life Cycle of Insects"

Supplemental:

2. Insects, 1952 Yearbook of Agriculture, USDA
3. Little, V. A., General and Applied Entomology, Harper and Row, Publishers, New York, 1963.

QUESTIONS OR ACTIVITIES:

1. What is the average number of eggs laid by insects?
2. Why is it important to be able to identify the eggs of an insect?
3. List five factors that will aid in identifying insects.
4. When does the fertilization of the egg take place?
5. How long does it take for insect eggs to hatch?
6. List the four types of metamorphosis.
7.
8.

Information Sheet
on
LIFE CYCLE OF INSECTS

Insects develop from eggs, with the number of eggs laid by the female varying from a few to several hundred. The honey bee lays 1500 to 2000 eggs daily for several weeks, but the average number of eggs laid by most insects will average from 100 to 200.

The number of eggs laid by an insect will aid in determining the number of insects one can expect during the next season, and when the insect should be poisoned. In trying to identify eggs of insects, in order to estimate numbers, the student should note the size, shape, color, host, and the location where the egg was laid. The insect will usually lay its eggs in a favorable place for the young to hatch.

The fertilization of the egg takes place at the time the egg is being laid. The spermatozoa, which has been stored by the female insect, enters the egg on the proximal end. The length of time it takes for the egg to hatch varies from several hours to several months, depending upon conditions. The embryonic development occurs in some insect eggs without fertilization, and the eggs of some insects hatch in the insect's body and are deposited as young insects by the female.

After an insect hatches, it grows rapidly; but its growth is restricted by the exoskeleton, which was discussed in the previous topic in this unit. To continue its growth, the insect must shed its outer skin. This is called molting. Before molting, the insect discontinues eating, and a fluid, called molting fluid, collects between the old and the new cuticula. A slit in the old cuticula allows the insect to work itself out of the old exoskeleton. Within a few hours, the new exoskeleton becomes hard. It isn't uncommon for an insect to molt five or six times, growing in size each time it molts.

The life history of insects is complicated and not completely understood, but it is known that all insects do not develop into an adult by the same series of stages. The metamorphosis, the period during which the insect changes from an immature stage to an adult, is of four different types; and they are as follows:

Ametabola or Primitive Development

The insects of this type have the same appearance from the time they hatch until they reach maturity. They live in the environment and have the same type of mouth parts and feeding habits. The stages of development are egg, young, and adult. Some insects of this type are silverfish, bristletails, springtails.

Paurometabola - Small or Slight Change

The insects within this type have a gradual or direct metamorphosis, in which anatomically the various stages look alike; but there are usually marked changes in color and size and often in the acquisition of wings. With each change, and there are several, the insect looks more like the adult. The stages of development are egg,

Life Cycle of Insects
(Information Sheet continued)

nymph, and adult. Some insects within this type are earwigs, grasshoppers, katydids, crickets, and cockroaches.

Hemimetabola - Incomplete Change

The insects within this type have an incomplete metamorphosis, with the changes being pronounced; but the changes are not as great as those insects having a complete change. The immature stages of these insects are spent in water, and they breathe with gills; they go through a series of molts and have chewing mouth parts. The adults of these insects have wings. The stages of development are egg, nymph, and adult. Some of this type are mayflies, dragonflies, damselflies, stoneflies, and salmonflies.

Holometabola - Complete Change

The insects within this group have a complete change, with the stage of the life cycle being egg, larvae, pupa, and adult. These insects have different kinds of mouth parts.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Insects

TOPIC: Host Plants or Animals

OBJECTIVE: To learn how insects choose their food, and the host plants of some insects.

REFERENCES:
Required:
1. Insects, 1952 Yearbook of Agriculture, USDA, pp. 37-42

QUESTIONS OR ACTIVITIES:

1. Where do animals get their food?
2. What is an entomophagous parasite?
3. What kind of an insect is an omnivorous insect?
4. Where do entomophagous insects usually lay their eggs?
5. What is a predatory insect?
6. Why are parasitic and predatory insects considered beneficial?
7. List the three groups of insects based on their selection of food and define each group.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Insects

TOPIC: Insect Resistance to Chemicals

OBJECTIVE: To become familiar with the resistance to chemicals by insects.

REFERENCES:
Required:
1. Information Sheet, "Insect Resistance to Chemicals"
2. Insects, 1952 Yearbook of Agriculture, USDA, pp. 317-330

QUESTIONS OR ACTIVITIES:

1. What is meant by insect resistance to chemicals?
2. How do insects develop resistance to insecticides?
3. When is resistance to a chemical most likely to develop?
4. When was the resistance to insects first noticed?
5. How will insect resistance to chemicals affect the farmer?
6. List four factors that affect insect resistance to chemicals.
7. Is there a possibility that insects will lose their resistance to a chemical?
8.
9.

Information Sheet
on
INSECT RESISTANCE TO CHEMICALS

The observation that houseflies and mosquitos were resistant to DDT caused entomologists to recognize that many insects could become tolerant to chemicals. The experts are not in agreement as to exactly what happens when insects become resistant to chemicals; but it is known that insects must be exposed to high levels of chemicals to develop resistance. The insect develops resistance in two ways: (1) physiological resistance, and (2) genetic differences present within the insect which are influenced by the insecticide and cause resistance.

Insect resistance to chemicals, which does not develop at the same rate for all chemicals, is influenced by several factors. Factors affecting resistance are environmental conditions, heritable factors, insecticide dosages, and frequency of applications. Since some of the factors affecting resistance are known, the control of insects may be accomplished by eliminating one or several of these factors. The frequency of application, being one of the factors affecting resistance, can be eliminated by using a different insecticide at regular intervals when attempting to control insects.

It has been determined that insects resistant to DDT are either resistant or will develop a resistance to other chemicals, such as chlordane, dieldrin, lindane, methoxychlor, and toxaphene; however, some insects have been found susceptible to closely related chemicals. Generally insects resistant to DDT and other organochlorine compounds are susceptible to organophosphorus, such as pyrethrum.

The possibility that insects will lose their resistance to a chemical is remote, even if the insecticide is not used for a long period of time. An insect population that has been or is resistant to a chemical will usually increase its resistance very rapidly when the resistance insecticide is applied again. According to long time records, insects that were resistant to chemicals forty years ago still maintain this resistance. This is an extreme example, but it indicates the possibility of resistance to certain chemicals by insects.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Insects

TOPIC: Losses Caused by Insects

OBJECTIVE: To learn of the losses caused by insects.

REFERENCES:
Required:
1. Insects, 1952 Yearbook of Agriculture, USDA, pp. 141-160.

QUESTIONS OR ACTIVITIES:

1. How do insects affect crop production?
2. Give an estimate of the amount of damage caused by insects in 1938.
3. What is the estimated losses of the livestock industry caused by insects? Give the 1940-44 estimate.
4. How do insects transmit diseases?
5. List some of the disease organisms carried by insects.
6. What order of insects are probably more responsible for human illnesses and deaths?
7.
8.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Insects

TOPIC: Methods of Control

OBJECTIVE: To become knowledgeable in the methods of controlling insects.

REFERENCES:

Required:

1. Information Sheet, "Methods of Controlling Insects"

QUESTIONS OR ACTIVITIES:

1. Is it possible to have a true balance of nature, thus controlling insects by this balance?
2. List two kinds of insect control.
3. How can climate control insects?
4. Explain how large bodies of water can limit the spread of insects.
5. Explain one method of biological insect control.
6. How can insects be controlled by laws?
7. List five ways of controlling insects by cultural means.
8. When chemically controlling insects, list five factors that should be considered.
9.
10.

Information Sheet
for
METHODS OF CONTROLLING INSECTS

Controlling insects has been a constant battle for man since the beginning of time. Because of man's need for large quantities of food and the insect's ability to multiply in equally huge quantities, the battle seems to be a never ending one. If unchecked, a pair of flies starting in April can produce 191,010,000,000,000,000,000 offspring by August.

Today some people think that if the balance of nature had not been disturbed, insects would not be a problem. Because of man's way of life, a true balance of nature cannot exist. All through the years man has bent nature to serve him and he has utilized plants and animals for his own benefit. He will have to continue to fight the elements of nature and insects for his food, and fiber.

Insect control is the killing, repelling, and interferring with the feeding and propagation of insects. There are two kinds of insect control, natural and artificial. Natural control includes the following: (1) Climate - temperature, rainfall, and sunshine; and (2) physical factors - mountain ranges, seas and other barriers, and dominant plant and animal types; (3) predators and parasites - birds, mammals, reptiles, and fish; and (4) diseases - bacteria, viruses, and fungi.

Climate is probably the most important natural control of insects. As has been stated previously, insects usually multiply under warm, moist weather conditions. Insects are usually destroyed when there is a sudden change of temperature from warm to cold.

Large bodies of water and other physical factors play an important role in controlling insects. A good example of this type of insect control is the screwworm eradication program conducted on an island off the coast of Florida. As you probably know, the Southwest Animal Health Research Foundation was established in Texas because of the experiments conducted in Florida with screwworms. If the screwworm fly hadn't been restricted by the body of water surrounding the island off the coast of Florida, the S.A.H.R.F. would have never been a reality.

Artificial control of insects is the most important method of insect control; but unfortuately this type of control isn't always successful. The five methods of artificial control are mechanical and physical, chemical, cultural, legal, and biological.

The most common method of physical control is the screening of houses to eliminate flies, mosquitoes, and other insects. Another type of physical control would be the placing of aluminum foil around plants to protect them from insects, such as is sometimes used to control cutworms. To mechanically control insects; temperature, either hot or cold, is used.

Methods of Controlling Insects
(Information Sheet continued)

Some methods of cultural control of insects that can be applied are plowing under crop residue, rotating crops, using fertilizer, applying sanitary measures, and planting at the proper time.

One of the most recent control measures to be applied is that of legal control. For many years agricultural products could be moved freely from one state to another and from nation to nation. Because of this, many insects were scattered and distributed. Recent state and federal laws, enacted since 1900, prohibit this movement of products without authorization. The first quarantine law was passed in 1905. Since this time, many similar laws to control insects have been passed.

The male sterile screwworm fly that is being dropped over a large area of the Southwest is a biological method of controlling insects. The control of insects by biological methods has been practiced many times.

The controlling of insects by using chemicals has become one of the most often used. A wide variety of insecticides have been developed to solve specific insect problems. Several factors should be considered to get adequate chemical control of insects. Some of these are as follows:

1. Identify the specific insect or insects you want controlled. If in doubt as to the identification of the insect, the Insect Identification sheet on the next page can be used to secure positive identification. Be sure to provide all the information requested on the Insect Identification sheet.

2. Select an insecticide effective against the insect.

3. Follow carefully the directions for mixing, applying, and safe handling of the insecticide.

4 Apply the insecticide at the right time, in the right amount, and in the right form to gain maximum effectiveness.

5. Generally, the earlier the applications are made, the less damage the crops will suffer. Preventive spraying assures you of the best crop protection.

D-543 (Revised)

INSECT IDENTIFICATION

Submit *three copies* of this form with the insect specimens. One copy will be returned to you with the identification and remarks, one will be sent to your county agent or district agent (whichever is applicable), and one copy will be retained for our files.

Collecting and Mailing Specimens

1. Place undamaged specimens and a paper label with your name and address into a vial of rubbing alcohol. The label should be typed or written in *pencil* because the alcohol will dissolve ink.

2. Pack the vial carefully to prevent breakage enroute.

3. Pack plants and plant parts to prevent crushing.

4. Mail the specimens and identification forms to EXTENSION ENTOMOLOGISTS, AGRICULTURAL EXTENSION SERVICE, COLLEGE STATION, TEXAS.

Information

The following information is helpful in identification and is needed for our records:

Host_____ nearest town_____ county_____

Degree of infestation: light_____ moderate_____ heavy_____

Distribution of infestation: local_____ widespread over county_____

General remarks: (Insects per leaf, per plant, per animal; stage of plant growth, etc.).

Submitted by _____ Date _____

Occupation_____

Mailing address_____

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides

TOPIC: Introduction to Insecticides

OBJECTIVE: To become familiar with the use of chemicals in insect control.

REFERENCES:
Required:
1. Information Sheet, "Introduction to Insecticides"

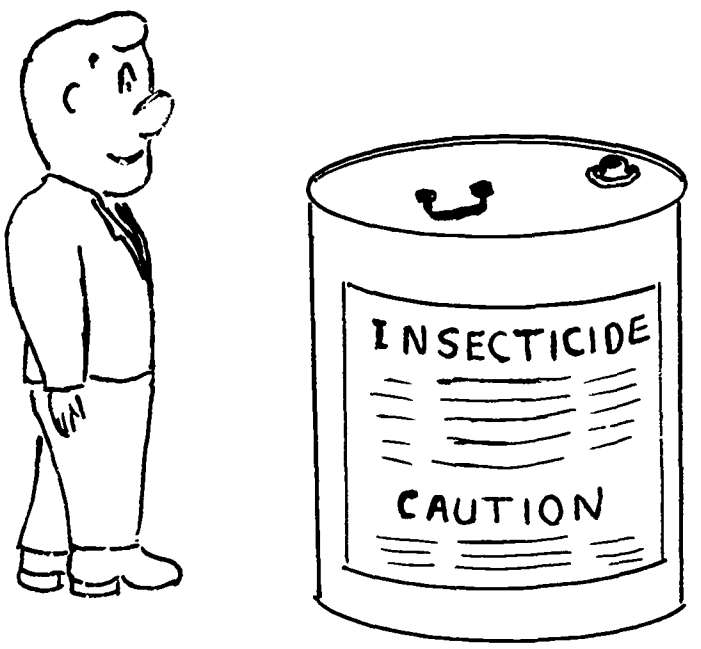
QUESTIONS OR ACTIVITIES:

1. What must people who are applying chemicals to crops do to insure the safety of those who will come in contact with the crops?
2. Are the occasional accidents with pesticides, accidents which result in killing people, grounds for banning use of all pesticides?
3. According to the USDA, if production of food in the United States was discontinued, how long would the stored food in the U.S. feed our population?
4. Give four reasons why pests are more of a problem in modern agriculture than they were 30 years ago.
5. Are pesticides necessary?

Information Sheet
on
INTRODUCTION TO INSECTICIDES

Agriculture is the basic industry of all modern civilization, the industry producing food and plant fiber in sufficient quantities and in acceptable quality to support all other activities of man. The key phrase here is "sufficient quantities and acceptable quality " Sufficient quantities provide the food and fiber to the consumer at a reasonable price. Acceptable quality requires that a food be safe for human beings to eat as well as nutritive, good tasting, and attractive enough as offered in the market, to sell. The grower is responsible to the consuming public as well as to his own business to see that the food crop he sells is safe, nutritious, and of good quality. Legislation is in force to protect food purity, and the American consumer will not buy an off-grade product in today's competitive market.

Many pesticides are used on today's crops to attain the quantity, quality, and consequent value-for-reasonable-price inherent in the mass production and consumption of America's astounding food economy. When pesticides (poisons) are applied to food crops, even in small quantities to kill pests, the public is rightfully wary of the dangers of over-application. Persons who handle, mix, store, and apply these chemicals--as well as those who harvest the crops--must for their own safety and the safety of others follow all of the directions and observe all of the cautions on each pesticide label.

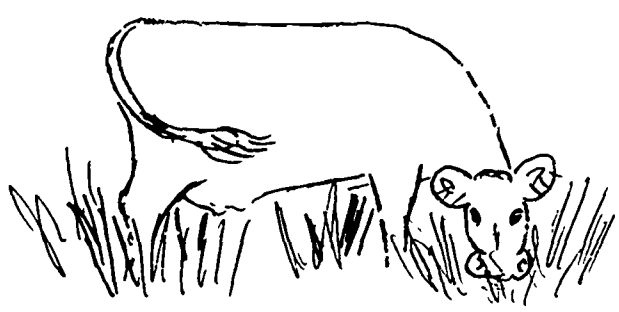


Besides handling these dangerous chemicals safely, agriculture today must aid in the education of the communities and the nation in the dangers as well as the incredible benefits of modern pesticides. Malaria and sleeping sickness, for example, may be wiped from the face of the earth through pesticides, as yellow fever largely has been

Introduction to Insecticides
(Information Sheet continued)

before them. Apple production, for another example, would drop 40 to 80 percent without pesticide assistance to agriculture--with a consequent unnecessary scarcity and high price on apples. Yet occasional pesticide poisoning of children, farm workers, livestock, or food consumers make shocking headlines and awaken public fears.

Some thoughtful and sincere nature devotees, not seeing the whole picture, join alarmists and sensation-writers to cast doubt on the rightness of any pesticide use. Although pesticide use and control is admittedly a fast-developing field, with new products and new test results becoming available daily, and great areas of frontier knowledge yet to be explored, the plain facts of pest control and food purity justify the continued careful use of many types of pesticides. In fact, we must not abandon these great aids to production if we are to continue the fruitful abundance and overall food purity of American agricultural products.



The plain facts of pest control and food purity are: (1) If properly applied according to label directions on food crops, these chemicals are not poisonous or in any way injurious to human beings or livestock; and (2) To produce food crops profitably in the qualities and quantities required by today's mass market, growers must use many kinds of pesticides. In the process of profitably producing food crops with the aid of pesticides, some accidental deaths or illness and some damage to wildlife or fish has occurred in the past and will probably occur from time to time in the future--because of simple probability and the inherently hazardous nature of pesticides.

Introduction to Insecticides
(Information Sheet continued)

These unfortunate occurrences are not to be condoned nor excused in any way, but they are really industrial accidents brought about by the new technology. We will continue to have accidents with airplanes, automobiles, and tractors; but the American people will not give up using--and on the whole benefiting from--these vehicles. Pesticide accidents, however, possibly due to their sensational nature, seem to attract widespread emotion-evoking press coverage with little corresponding coverage of the overall benefits of pesticides made by agriculture or research scientists.

Crop Losses Without the Use of Pesticides

According to estimates by the USDA, if all production of food in the United States were discontinued completely, all of the food stored in warehouses and government surplus storage would feed our population for only ninety days. This may seem impossible in light of our tremendous surpluses, but one only has to think of the potato famine in Ireland in the 1840's (caused by potato blight) to realize how close we live to starvation. At a recent meeting in Texas, Dr. N. C. Brady, Director of Science and Education, USDA, stated: "In this intensely developed man-made society of ours, it would not take much to tip the scales from plenty to scarcity. Scarcity, after all, has been a normal condition of man throughout all history and it is, even now, the accepted way of life for the greater part of the world's three billion people."

Without the use of pesticides, it is safe to say that we could not commercially produce apples, peaches, potatoes, citrus fruits, nor tomatoes on the scale needed by society, to mention only a few desirable foods. To illustrate: In 1946, without the use of fungicides, blight destroyed over 50% of the tomato crop in ten eastern states. In the period between 1940 and 1945, before suitable and effective chemical controls were developed, millions of acres of corn in the United States were attacked by the European corn borer. The USDA estimates that 40 to 80% of the commercial apple crop would be lost to the coddling moth, and cotton yields would be reduced by 25 to 42% without the use of effective insecticides. Mr. C. O. Barnard, Executive Secretary of the Western Agricultural Chemical Association, estimates that the coddling moth would, within two or three years, destroy commercial apple production in the United States if no insecticides were used.

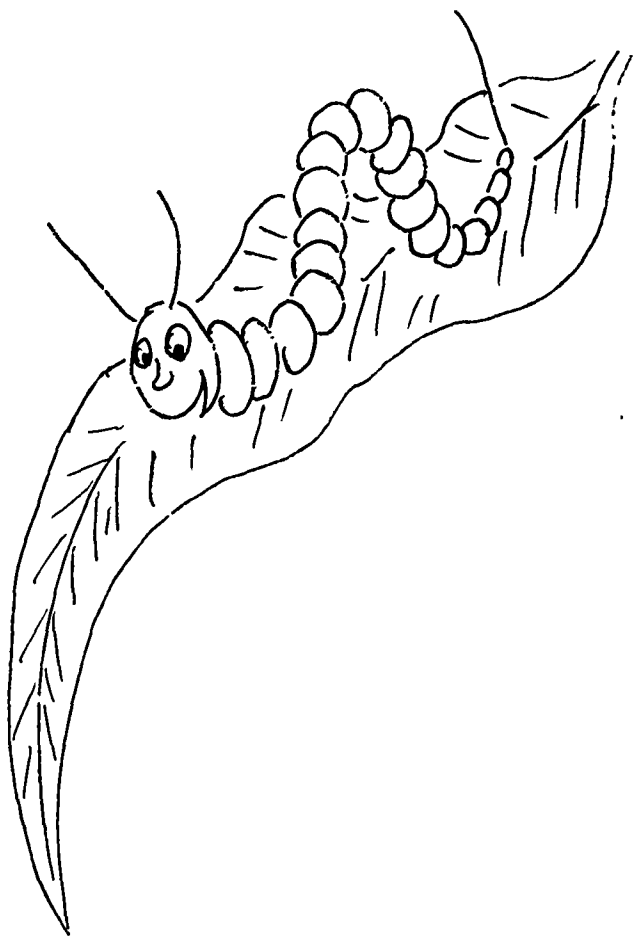
Why are pests more of a problem in modern agriculture than they were thirty years ago? There are several reasons. First, a grower must use modern technology and achieve high production to be competitive. This heavy production furnishes a very ready food supply for many insects and other pests--far more than the species wou'd readily find in nature. A pest will reproduce and thrive in direct proportion to its food supply. Modern mass production of food and fiber furnishes a ready food

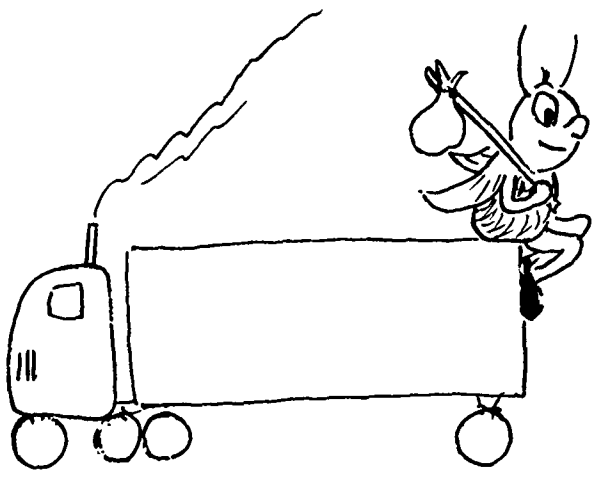
Introduction to Insecticides
(Information Sheet continued)

supply for more millions of pests than the less productive agriculture of former days supplied.

Second, many insects that normally would not feed on cultivated crops have become adapted to living on these crops.

Third, modern crop varieties are bred and selected for many characteristics: yield, quality, size, earliness of ripening, color, and so forth.



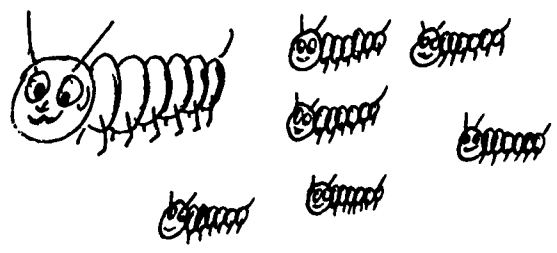


In the selection for desirable characteristics, resistance to insects and disease is often neglected. These more susceptible varieties only add to the pest problem.

Fourth, with modern mass transportation systems, there is more widespread distribution of insects, parasites, and diseases than when world and national travel was less common and much slower.

Introduction to Insecticides
(Information Sheet continued)

Fifth, quite often an introduced insect or disease will live and reproduce more successfully in its new location than it did in its native habitat because it does not have to contend with natural enemies. Obviously, modern agricultural methods have created a situation which would give pests the advantage if we did not use chemical controls systematically and effectively.



The Farmer's Responsibility

The farmers must use pesticides to feed the human population. In fact, it is really a question of "Who is going to eat the crops we raise--insects or human beings?" What can the farmer do to convince the consuming public of this? He must educate himself on the safe use of these chemicals and avoid mistakes. He must see to it that all the pesticides he uses are applied safely and properly. He must use the less toxic or less residual pesticides when they will do the job.

Are pesticides necessary? Yes, if we wish to continue an adequate supply of wholesome and high-quality food in face of continuing rising populations.

Are pesticides poisoning our food supply? No, if they are used safely in accordance with the directions on the label.

Introduction to Insecticides
(Information Sheet continued)

New pesticides are being discovered and tested each year and with our continuing rising population, more chemicals will be used by farmers each year in the foreseeable future.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides

TOPIC: Insecticide Terminology

OBJECTIVE: To develop the use of insecticide terminology used by the chemical industry.

REFERENCES:

Required:

1. Information Sheet, "Insecticide Terminology"
2. Agricultural Chemicals, Book I, by Thomson, pp. 328-333

QUESTIONS OR ACTIVITIES:

1. Name eight common types of insecticide formulations.
2. Tell how stomach poisons kill.
3. Tell how contact poisons kill.
4. Tell how fumigant poisons kill.
5. What has largely replaced inorganic insecticides?
6. What is the primary use of oils in insecticides?
7. Name four botanical toxicants.
8. Name five synthetic organic insecticides that are chlorinated hydrocarbons.
9. Name five fumigants.
10. Name four attractants.
11. What year was DDT introduced?
12. What year were systemic insecticides introduced?

Information Sheet
on
INSECTICIDE TERMINOLOGY

The use of chemicals in recent decades to control insects which infest plants has progressed through three distinct phases. Less than 100 years ago extensive use was made of various concoctions as could be prepared. Arsenic compounds were most often used although preparations of tobacco, pyrethrum, and sulphur were not uncommon. The successful use of arsenic compounds against the Colorado potato beetle ushered in an era of widespread use of inorganic insecticides. These were primarily compounds of antimony, arsenic, mercury, selenium, sulphur, thallium, zinc, and fluorine. Under the stimulus of World War II, wide introduction and immediate acceptance of so-called synthetic organic compounds was experienced. DDT was introduced in 1942, organophosphorus compounds in 1946, and systemic insecticide in 1950. The field is now crowded with proven and candidate materials against practically all kinds of insect pests of practically all agricultural plants. The technician in the field must have a working knowledge of these chemical resources common to the field.

1. Common types of insecticide formulation

   a. Dusts--
   Mixed with or impregnated on walnut shell flour, talc, pryophyllite, bentonite or attapulgite. Ground to 1 to 40 microns in size (pass through a 325 mesh screen) and active materials may make up from 0.1 to 25% of the dust.

   b. Granular formulations--
   20/40 size means most of the granules pass through a standard 20 mesh screen and only a negligible quantity will pass through a standard 60 mesh sieve. These formulations are much like dusts except for size.

   c. Insecticide - fertilizer mixtures--
   Granular insecticide added to commercial fertilizers or insecticide is sprayed directly onto fertilizer.

   d. Wettable powders--
   Appearance like dusts but they are meant to be diluted and suspended in water and used as sprays. May contain as high as 75% toxicant.

   e. Solutions--
   Materials which go into true solution. Water is used for some but most organic insecticides must be di olved in organic solvents.

Insecticide Terminology
(Information Sheet continued)

f. Emulsifiable concentrates--
Consists of insecticide, solvent, and an emulsifying agent. Oil-in-water type possible. Serves many purposes.

g. Aerosols--
Minute particles suspended in air as fog or mist. Particle size range from 0.1 to 50 microns. The dispersion accomplished in various ways.

h. Fumigants--
Insecticide used in the gaseous form most often formulated as a liquid and held in a container under pressure. Upon release to the air, it changes to a gas.

i. Miscellaneous--

(1) Pills

(2) Shampoo

(3) Waxes

(4) Baits

2. Classification of insecticides
Several ways are used to classify insecticides. The student should be familiar with the basis of these classifications as well as with some of the more common insecticides in each of the categories of the classification used.

a. Based on the mode of entry into the insect

(1) Stomach poisons--
Materials are ingested and lethal action is primarily through absorption into the digestive system (lead arsenate, calcium arsenate, sodium fluoride).

(2) Contact poisons--
Materials are absorbed through the body wall. Insect must come into direct contact (chlorinated hydrocarbons, rotenone, organic phosphate).

(3) Fumigant poisons--
Enter the tracheal system in the form of a gas (methyl bromide,

Insecticide Terminology
(Information Sheet continued)

b. Based on the chemical nature of the insecticide

(1) Inorganics--
A few inorganic insecticides are still used in agriculture even though most have been replaced by organic compounds.

(a) Acid lead arsenate

(b) Basic lead arsenate

(c) Sodium fluoride

(d) Cryolite

(e) Sulfur

(f) Sodium selenate

(2) Oils--
Oils are phytotoxic but may be used on plants in emulsions.

(a) Quality of oil is according to viscosity, boiling range, and degree of refinement.

(b) Used primarily as solvents or carriers for insecticides.

(c) Oils are insecticidal and used as--

summer sprays, applied to trees in foliage

dormant sprays, applied when no foliage is present

(3) Botanicals (derived from plants)--

(a) Attractants

(b) Repellents

(c) Solvents and extenders

Insecticide Terminology
(Information Sheet continued)

(d) Toxicants

--Nicotine
--Pyrethrum
--Rotenone
--Sabadilla

(4) Synthetic organic insecticides--

(a) Chlorinated hydrocarbons

--DDT
--Methoxychlor
--Toxaphene
--Benzene hexachloride (BHC)
--Lindane
--Aldrin
--Dieldrin
--Chlordane
--Heptachlor
--Endrin

(b) Organic phosphates

--Parathion
--TEPP
--Malathion
--Diazinon
--Demeton
--Di-syston

(c) Fumigants

--Hydrogen cyanide
--Carbon disulfide
--Methyl bromide
--Ethylene dichloride
--Carbon tetrachloride
--Paradichlorobenzene
--Naphthalene
--Dichloropropane

Insecticide Terminology
(Information Sheet continued)

(d) Specific miticides

--Ovex
--Genite
--Fenson
--Dinitrophenols
--Mitox
--Kelthane
--Aramite

(e) Insect repellents - plants

--Bordeaux mixture

(f) Attractants

--Geraniol
--Eugenal
--Q-Lure
--Medlure

Insecticide Terminology
(Information Sheet continued)

GLOSSARY OF AGRICULTURAL CHEMICAL WORDS

Acid Soil--A soil with a pH reaction of less than 7.0. It has a preponderance of hydrogen ions over hydroxyl ions. Litmus paper turns red in contact with moist acid soil.

Aerosols--Suspensions of solids and liquids in air. They partake in some measure the properties of a gas, and the particles remain in suspension in the air for considerable periods of time.

Alkali Soil--A soil, usually above pH 8.5, containing alkali salts in quantities that usually are harmful to crop production.

Alkaline Soil--A soil with a pH above 7.0.

Ammonification--Formation of ammonium compounds, or ammonia in soils by action of soil bacteria.

Annual--A plant that lives only one year.

Antibiotics--Active chemical substances produced by organisms which are antagonistic to other organisms--have the capacity of inhibiting the growth of/or destroying other micro-organisms.

Aquatic--A plant that grows in water.

Aromatics--Compounds derived from the hydrocarbon, benzene (C_6H_6)

Attractants--Substances used in poisoned baits, sprays, or dusts to induce insects to eat the poisoned material, or to lure insects into traps.

Band Application--An application of spray or dust to a continuous restricted area such as in or along a crop row rather than over the entire field area.

Basal Treatment--A basal treatment is an application to the stems of plants at and just above the ground line.

Biennial--A plant that completes its growth in two years. The first year it produces leaves and stores food. The second year it produces fruits and seeds

Insecticide Terminology
(Information Sheet continued)

Blanket Application--An application of spray or dust over an entire area rather than only on rows, beds, or middles.

Brush Control--Control of low-growing herbaceous and woody plants.

Carrier--The liquid or solid material added to a chemical compound to facilitate its preparation, storage, shipment, or use in the field by means of increasing the bulk. (See also "diluent.")

Chlorosis--A yellowing of plant foliage which results from the halting of the development of the green coloring matter

Compatible--Two compounds are said to be compatible when they can be mixed without affecting each other's properties.

Concentration--Refers to amounts of active material in a given volume of diluent. Recommendations and specifications for concentration of agricultural chemicals are frequently given on the basis of pounds per unit volume of diluent.

Contact Herbicide--A herbicide that kills primarily by contact with plant tissue rather than as a result of translocation.

Contact Insecticides--Sprays, dusts, or dips that kill the insect by direct contact on the body without being swallowed May be used to kill any insect that can be reached with a spray or dust, regardless of the type of mouth part.

Deciduous--Indicates plants which lose their leaves during the winter.

Defoliant--A material used to remove the leaves from plants. As an example, a defoliant spray used to remove leaves from cotton plants just prior to harvesting the cotton.

Denitrification--The reduction of nitrates to nitrites ammonia and free nitrogen in the soil.

Desiccant. Crop--A crop drying agent.

Dicot (dicotyledon)--A plant that has two seed leaves or cotyledons. Generally includes the broad-leaved plants Leaves are not veined.

Insecticide Terminology
(Information Sheet continued)

Diluent--Any liquid or solid material serving to dilute or carry an active ingredient.

Directed Application--An application of spray or dust to a restricted area such as a row, or bed at base of plants.

Dormant Spray--Chemical applied in winter or before the plants have started active growth.

Emergence--The time when the first leaves of the crop plant come through the ground.

Emulsifying Agent--A material which facilitates the suspending of one liquid in another.

Emulsion--A mixture in which one liquid is suspended in minute globules in another liquid; for example, milk.

Eradicant Fungicides--Materials used to destroy fungus organisms already established in a given location.

Fibrous Root System--One composed of profusely branched roots with many lateral rootlets with no main or tap root development.

Flocculate--To collect individual particles into small groups or granules.

Fumigant--Chemical used in the form of a volatile liquid or a gas to kill insects, nematodes, fungi, bacteria, or plants; usually applied in an enclosure of some kind or in the soil.

Fungicide--A chemical substance used as a spray, dust, or solution to kill fungi.

Fungus--A group of the lower plants that cause many plant diseases. The group includes the molds. Fungi reproduce by spores instead of seeds, contain no chlorophyll, and thus live on dead or living organic matter.

Insecticide Terminology
(Information Sheet continued)

Growth Stages of Cereals

1. Tillering stage--when a plant produces additional shoots from a single crown, as in wheat.
2. Jointing stage--when the internodes of the stem are elongating.
3. Boot stage--when the seed head of a plant begins to emerge from the sheath--usually applied to the grain crops.

Hard Water--Water which contains certain minerals, usually calcium and magnesium sulfates, chlorides, or carbonates, in solution to the extent of causing a curd, or precipitate, rather than a lather when the soap is added.

Herbaceous--A more or less soft or succulent plant that does not develop wood tissue

Herbicide--A chemical used for killing or inhibiting the growth of plants.

Hormone--A chemical growth-regulating substance.

Hydroponics--The growing of plants in aqueous chemical solutions.

Insecticide--A chemical used to kill insects.

Insects--Bees, beetles, bugs, flies, etc., having three pairs of legs with three body segments: Head, thorax, and abdomen.

Larvicide--Chemical that kills the larvae of insects.

Leach--To remove materials by solution.

Leaf Blade--The expanding flat portion of a leaf.

Lethal--Fatal or deadly.

Miscible--Liquids capable of being mixed.

Mites--Small spider-like pests with eight legs that have their body in two segments

Monocot (monocotyledon)--Any seed plant having a single cotyledon or seed leaf Includes corn and grass-type plants. Leaves are mostly parallel veined

Insecticide Terminology
(Information Sheet continued)

Necrosis--The death of all or a part of the plant.

Neutral Soil--A soil neither acid nor alkaline.

Nitrification--Formation of nitrates from ammonia.

Nonselective Herbicides--Chemical formulations which destroy plant life in general without regard to species.

Nutrient (plant)--A chemical element taken into a plant that is essential to its growth, development, or reproduction.

Oils--Certain petroleum oils used for insecticidal purposes.

Ovicide--A toxicant that kills eggs.

pH--The designation for degree of acidity or hydrogen ion concentration.

Perennial--A plant that continues to live from year to year. In many cases, in cold climates, the stem dies down, but the root persists.

Pesticide--Any substance or mixture of substances intended for controlling insects, rodents, fungi, weeds, and other forms of plant or animal life that may be declared as a pest

Phytotoxic--Poisonous to plants.

Postemergence Treatment--Any treatment made after the crop plants emerge.

Pre-Emergence Treatment--Any treatment made after a crop is planted but before it emerges.

1. Contact pre-emergence--an application made after weed emergence.
2. Residual pre-emergence--an application which kills weeds as the seed germinates or as they emerge either before or after the crop has emerged.

Preplanting Treatment--Any treatment made before the crop is planted. It may remain on the surface or be mixed with the soil.

Protective Fungicides--Materials applied in anticipation of a fungus attack.

Insecticide Terminology
(Information Sheet continued)

Pubescent--Hairy stems or leaves.

Rate or Dosage--These terms are synonymous. "Rate" is the preferred term. Rate usually refers to the amount of active ingredient material (such as 2,4-D acid equivalent) applied to a unit area (such as one acre) regardless of percentage of chemical in the carrier.

Residual--To have a continued killing effect over a period of time.

Rhizome--Underground root-like stem that sends out roots and leafy shoots.

Selective Herbicide--One which has more toxic action on weeds than on the crop in which the former are found By this means weeds may oftentimes be controlled without damage to the crop.

Soft Water--Water which does not contain those minerals that prevent free lathering when soap is added.

Soil Sterilant--A material which, when present in soil, prevents the growth of plants. Sterilization may be temporary or relatively permanent.

Spray Drift--The movement of air-borne spray particles from the spray nozzle outside the intended contact area.

Spreading Agent--A substance used to improve the wetting, spreading, and adhesive properties of an insecticide, fungicide, or herbicide spray solution.

Stem--That part of the plant above the ground which supports leaves, flowers, and fruit.

Stolon--Above-ground runners or slender stems that develop roots and shoots at the tip or nodes as in the strawberry plant.

Stomach Poisons--Sprays, dusts, or dips that kill the insect when they are swallowed.

Surfactant--A material used in pesticide formulations to impart emulsifiability, spreading, wetting, dispersibility, or other surface-modifying properties.

Suspension--A liquid or gas in which very fine solid particles are dispersed, but not dissolved.

Insecticide Terminology
(Information Sheet continued)

Systemics--Toxicants introduced into living organisms in such a way as to produce resistance to insect or disease attack or, as in the way of certain herbicides, to have a killing effect throughout the entire plant.

Tap-Root System--One characterized by a primary or main root which grows vertically downward with few lateral fibrous rootlets.

Toxic--Poisonous

Translocation--Transfer of food or other materials from one part to another in plants.

Vapor Drift--The movement of herbicidal vapors from the area of application to adjacent areas.

Virus--Ultramicroscopic protein bodies, the presence of certain types of which in plant tissues cause mosaic and other diseases. They reproduce in plant tissues.

Volatile--A compound is said to be volatile when it evaporates or vaporizes (changes from a liquid to a gas) at ordinary temperatures on exposure to the air.

Weed--Any plant that grows where it is not wanted.

Wettable Powder--A powder that will form a suspension in water.

Wetting Agent--A compound which when added to a spray solution reduces the surface tension of water and causes it to spread over and wet plant surfaces more thoroughly.

Winter Annual--A plant that starts from seed germination in the fall, lives over winter and completes its growth, including seed production, the following season.

Woody Plants--Plants that ~~develop~~ woody tissue.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides

TOPIC: Properties and Characteristics of Insecticides

OBJECTIVE: To become familiar with the names, composition, toxicity, and intended use of insecticides and to learn how to secure the above information on a specific insecticide.

REFERENCES:

Required:

1. Agricultural Chemicals, Book I, by Thomson, pp. 1-307
2. Information Sheet, "Properties and Characteristics of Insecticides"

QUESTIONS OR ACTIVITIES:

1. Prepare a kit of samples representative of the insecticides in common usage in the local regional area. Classify and assemble according to the guides presented in the information sheet.

Information Sheet
on
PROPERTIES AND CHARACTERISTICS OF INSECTICIDES

1. Properties and characteristics of insecticides

   a. Names

      (1) Common name(s)

      (2) Trade name(s)

      (3) Technical name

   b. Composition

      (1) Chemical structure

      (2) Industrial preparation

      (3) Formulation of the insecticides

      (4) Analysis of mixtures - percentages of components

      (5) Physical state

         (a) Gas

         (b) Liquid

         (c) Solid

   c. Intended use as an insecticide (type)

      (1) Stomach poison

      (2) Contact poison

      (3) Fumigant

      (4) Combination

Properties and Characteristics of Insecticides
(Information Sheet continued)

d. Toxicity

(1) LD ratings
LD_{50}--the rating usually given as the designation for the dose lethal to 50 percent of the test animals. Ratings may be expressed as acute oral or acute dermal.

(2) LC ratings
LC_{50}--the rating often used to express the lethal concentration of inhalation toxicity.

(3) ppm--parts per million of the daily diet for a specified number of days is sometimes used to express chronic toxicities.

e. Compatibility with other chemicals

f. Special additives used

(1) Carriers

(2) Solvents

(3) Spreaders

(4) Stickers

(5) Extenders

g. Effectiveness as an insecticide

h. Problems

(1) Application

(2) Residue

(3) Safety hazards

Properties and Characteristics of Insecticides
(Information Sheet continued)

i. Synergists

(1) Some chemicals have the property of greatly increasing toxicity of certain insecticides.

(a) Most synergists have been used with pyrethrum or allethrin.

(2) Sesamine

(3) Piperonyl

(4) Cyclonene

(5) Sulfoxide

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Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides

TOPIC: The Chemistry and Mode of Action of Organic Insecticides

OBJECTIVE: To become familiar with the mode of action of organic insecticides.

REFERENCES:
Required:
1. Information Sheet, "The Chemistry and Mode of Action of Organic Insecticides"
2. Agricultural Chemicals, Book I, by Thomson, pp. 137-269

QUESTIONS OR ACTIVITIES:

1. What is the most common cause of organic phosphate insecticide accidents?
2. Why are organic phosphates more hazardous than chlorinated hydrocarbons when handling?
3. Before a person works with organic phosphates, why should he have a physician check his blood for its normal cholinesterase?
4. If the cholinesterase level is too low, what should a pesticide worker do?
5. Why can a person that weighs more than another person take a larger dose of a given chemical with less harm than the smaller person?
6. Why do chlorinated hydrocarbons present more hazard in causing illegal residues than organic phosphates?
7. Name five commonly used chlorinated hydrocarbons.
8. How do chlorinated hydrocarbons kill?
9. Why is Sevin being used as a substitute for DDT in many instances?

Information Sheet
on
THE CHEMISTRY AND MODE OF ACTION OF ORGANIC INSECTICIDES

Organic Phosphates

Many of the organic phosphates are very toxic as evidenced by their low LD_{50} ratings. Each one used offers a hazard to the person handling it if its fumes are breathed, if the chemical is ingested, or if the chemical is spilled on the skin. (The latter is the most common cause of pesticide accidents among agriculture workers.) Since most organic phosphates break down into harmless by-products much faster than chlorinated hydrocarbons, the hazard from illegal residue is low. Most of them are also more quickly detoxified (broken down into harmless chemicals within the body) than the chlorinated hydrocarbons. However, organic phosphates offer a greater hazard to the careless individual handling them because many of them are as toxic when absorbed through the skin as when taken orally, and skin exposure is far more likely than swallowing. Some of the most widely used and highly toxic members of this group are: Parathion, TEPP (tetraethyl pryophosphate), EPN (ethyl p-nitrophenyl thionobenzene phosphorate), Demeton or Systox, Di-Syston, Soradan, Phosdrin, Phorate (Thimet), and Methyl Parathion. These are the most potentially dangerous to the user and the accidentally exposed. The ease with which they are absorbed through the skin emphasizes the need for protective clothing and adequate respirators while working with them.

Much less toxic are Malathion, Chlorthion, Ronnel (Korlan), Diazinon, Dicapthon, and Trichlorofon--even though they apparently act in the same manner as the other organic phosphorous compounds. This lower toxicity may be due to slower absorption and other complex factors involved in detoxification within the body.

Organic phosphates cause injury to animals by inhibiting the action of an enzyme called cholinesterase (pronounced coaleen-ESTER-aze). In the process of nerve impulse transmission, very small electrical impulses are transmitted from nerve cell to nerve cell by the organic chemical acetylcholine (asa-TEEL-coaleen). This gap between the cells is called the synapse (pronounced sin-APS). As soon as the nerve impulse passes the synapse, this chemical is broken down chemically to non-conductors by the enzyme, cholinesterase, resulting in a single nerve impulse. When there is an organic phosphate present, there is not enough cholinesterase present to "break the circuit," resulting in continuing nerve impulses that are detrimental to normal body processes.

Before a person works with organic phosphates, he should have a physician check his blood for its normal level of cholinesterase. This is the base against which to compare later blood tests. When working with organic phosphates, the worker should have a blood sample taken periodically (often once per week) to determine the cholinesterase level. When this level goes down to a critical level, it is an

The Chemistry and Mode of Action of Organic Insecticides
(Information Sheet continued)

indication that the worker has had dangerous exposure to organic phosphates and should avoid any further exposure until his body has had time to regenerate cholinesterase to its normal level. Usually a commercial applicator will do some other work until a blood sample tests normal. Experience in the field indicates that some individuals are less affected by exposure to organic phosphates than others, although clinical data cannot confirm or explain this difference among individuals. Also, when two people have a similar body chemistry, the person who weighs more will be able to take a larger dose of a given chemical without harm than the smaller person. This is because, as with most chemicals, toxic dosage is proportional to body weight.

Chlorinated Hydrocarbons

Chlorinated hydrocarbons are more dangerous chronically (through their long-lasting stability and their tendency to accumulate in body fat) than they are acutely poisonous. Chlorinated hydrocarbons are long-lived chemicals generally and present more hazard in causing illegal residue on food crops than personal injury to the person handling the concentrate or spray. However, they can cause death from acute poisoning if a person is exposed to enough of the chemical.

Chlorinated hydrocarbons commonly used as insecticides are: Aldrin, dieldrin, chlordane, DDT, DDD, toxaphene, lindane, heptochlor, methoxychlor, endrin, thiodan, TDE, and perthane. These chemicals act upon the central nervous system and neuromotor apparatus. The exact mechanism of this action, either in man or in animals, has not been explained. Yet it is clear that large doses induce nausea and/or diarrhea. On repeated dosage, the compounds produce microscopic changes in the liver and kidneys in some experimental animals. Somewhat different damage may result from a single fatal dose.

Chlorinated hydrocarbons (and/or certain of their degradation products) getting into the body are stored in fat. Such storage results either from a single large dose or from repeated small doses. The materials stored in the fat appear to be largely inactive since the total amount stored in an experimental animal often may be greater than a lethal dose given at one time. Most of these compounds are absorbed through the skin as well as the respiratory system and digestive tract. DDT is not absorbed through the skin unless in solution. Others, such as chlordane and dieldrin, are readily absorbed through the skin.

The Chemistry and Mode of Action of Organic Insecticides
(Information Sheet continued)

Carbamates

The carbamate group has come into the pest control picture in the last few years, and many experts believe that carbamates will be more important in the future because of their relatively low toxicity and faster breakdown into harmless by-products on food crops. A common carbamate insecticide now being used as a substitute for DDT in areas where residue is a problem is Sevin.

Sevin is considered to be one of the less hazardous pesticides, yet it too can be dangerous if it is absorbed in large enough amounts through the skin or the respiratory or digestive tracts. Like the organic phosphate compounds, it affects the enzyme cholinesterase; but this action is rapidly reversible.

NOTE: Additional review may be made of the toxicity of insecticides on pp. 131-142 of the USDA Yearbook of Agriculture 1956, Animal Diseases.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides

TOPIC: The Chemistry and Mode of Action of Inorganic Insecticides

OBJECTIVE: To become familiar with the mode of action of inorganic insecticides.

REFERENCES:
Required:
1. Insects, Yearbook of Agriculture, 1952, USDA, pp. 218-222
2. Agricultural Chemicals, Book I, by Thomson, pp. 273-307

QUESTIONS OR ACTIVITIES:

1. Name ten inorganic insecticides.
2. With what chemical is zinc arsenate incompatible?
3. Of what origin are inorganic insecticides?
4. Is sodium fluoride a contact or stomach poison?
5. Is lime-sulfur a contact or stomach poison?
6. Is sodium selenate a contact, stomach, or systemic insecticide?
7. What tolerance has been set by the the Food and Drug Administration for sodium selenate on food and feed crops?
8. How much lead arsenate is a lethal dose for a man?

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides

TOPIC: The Use of Insecticides as Fumigants

OBJECTIVE: To learn the use of fumigants in the control of insects on stored grain and for household insect control.

REFERENCES:

Required:

1. Information Sheet, "The Use of Insecticides as Fumigants"
2. Insects, Yearbook of Agriculture, 1952, pp. 331-339.
3. Agricultural Chemicals, Book III, by Thomson, pp. 1-60.

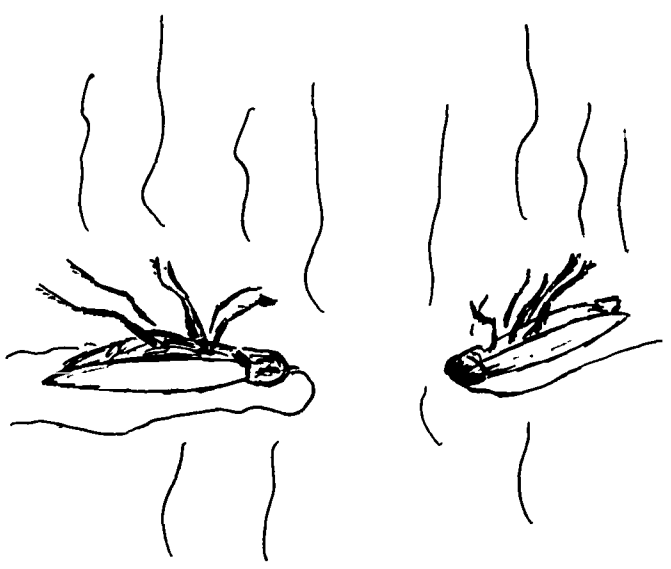
QUESTIONS OR ACTIVITIES:

1. According to the 1952 Yearbook of Agriculture, how long have fumigants been used?
2. What was one of the first fumigants used?
3. Why can small grain be successfully fumigated in buildings that are not tightly sealed?
4. What kind of foodstuffs may retain obnoxious odors from certain fumigants?
5. How many pounds of methyl bromide are needed to treat 1000 bushels of grain sorghum against insects?
6. What has been found effective for fumigating warehouses filled with grain, feed, flour, or other dried foodstuffs?
7. What is meant by fumigation by vacuum?
8. Give two advantages of vacuum fumigation over leaving all the air in the storage room.
9. What two soil conditions need to be right for good soil fumigation?
10. Why should water never be used to clean soil fumigation equipment?
11. According to estimates, what percent of stored grain do insects destroy each month?
12. Why should carbon disulfide (Hi-Life) not be used alone?

Information Sheet
on
THE USE OF INSECTICIDES AS FUMIGANTS

The distinguishing feature of a fumigant is that it is a chemical or combination of chemicals which is transmitted to the insect in the gaseous or vapor state. All known fumigants are toxic to man and animals.

The selection of a fumigant for a suitable purpose depends on combinations of many properties besides toxicity to the insect or mite pest, illustrated below.



Some of these properties are:

1. It must be non-injurious to the commodity.
2. Its vapor tension must be adequately high under the contemplated conditions.
3. Its vapors must penetrate the interstices among the units of the commodity and possibly within those units.
4. It must be chemically stable during the fumigation period.
5. It must not be excessively dangerous to handle.
6. It must not leave hazardous or disagreeable residues if the commodity is a foodstuff.
7. At an effective concentration, its vapors should not form explosive mixtures with air.

Soil Fumigation: Soil fumigation is important in many areas of the United States. Nematode damage to cultivated crops in the United States has been conservatively estimated at half a billion dollars per year.

There is no cheap way to fumigate soil due to the cost of the chemicals and the labor required in applying the chemicals to the soil. Soil fumigants work best in soils that have been worked thoroughly. Proper preparation of the soil is the most important first step in your over-all fumigation job. Make sure that trash is well buried, that crop refuse is well decayed, and that soil is free of clods. Remember, land should be in a well fitted planting condition.

Soil Moisture and Temperature: Here are two more important factors in successful soil fumigation. Fumigants may be applied at any time the soil can be worked providing there is good soil moisture and the soil temperature is at or above the minimum recommended for the particular fumigant at the depth at which it is to be

The Use of Insecticides as Fumigants
(Information Sheet continued)

applied. In general, the soil moisture should be high and yet not so high that the soil structure will be destroyed when it is worked. When treating sandy soils, best results are obtained when moisture is near field capacity. When soils on the dry side are to be fumigated, a product like Telone Soil Fumigant (a product of Dow Chemical Co.) is suggested as the best type product because its performance is less dependent on favorable soil moisture.

Control of Insects in Farm-Stored Grain: Grain producers suffer enormous losses annually from stored-grain insects. Insects destroy an estimated two percent of the nation's farm-stored grain each month. Losses are due primarily to conditions existing in storage structures which have not been properly cleaned or to conditions of high temperature and high moisture.

Insects that attack stored grain are classified as primary (those that attack whole kernels and complete their development inside the kernel) and secondary (those that feed primarily on cracked or broken kernels).

Three species of primary pests--rice or corn weevil, lesser grain borer, and Angoumois grain moth--are considered the most destructive stored-grain insects in Texas. The granary weevil also is a primary pest, but it rarely occurs in damaging numbers in Texas. In the immature stages these insects feed within the kernel, unseen and usually unsuspected. These immature stages cannot be removed by ordinary cleaning machinery, and in most cases must be controlled by fumigation.

Some of the more common species of secondary stored-grain insects are the rice moth, Indian meal moth, flat grain beetle, confused flour beetle, cadelle and saw-toothed grain beetle. These insects feed primarily on cracked grain or grain that has been damaged by primary insects.

Psocids, or book lice, and grain mites are two other pests which are of secondary nature. They are found occasionally in large numbers in grain and grain products.

Residual Bin Spray: After the bin has been cleaned thoroughly, spray the inside surfaces with one of the following formulations at the rate of about two gallons per 1,000 square feet of surface area. Larger volumes of the spray mixture will be needed for spraying external areas.

Methoxychlor	2 1/2 percent
Malathion (premium grade)	2 1/2 percent

The Use of Insecticides as Fumigants
(Information Sheet continued)

Fumigants: Several liquid fumigants are effective in killing stored grain insects. They are formulated as various combinations and are sold by companies under different trade names. The dosages vary according to the ingredients used. Directions on the label should be followed. Some of the more common liquid fumigants are ethylene dibromide, ethylene dichloride, carbon tetrachloride and carbon disulphide. Carbon disulphide (Hi-Life) should not be used alone because of the fire hazard. Two gaseous fumigants, methyl bromide and hydrogen cyanide, also are very effective in killing stored grain insects but they require recirculation systems in storage structures. These two fumigants should be used only by people experienced in the application of these materials.

Tolerance Chart
(Residue tolerances have been established for certain fumigants under federal regulations.)

Allowable Parts per Million of Some Chemicals on or in Stored Grain

Chemicals	Corn	Oats	Wheat	Rice	Barley	Rye	Sorghum (milo)
Carbon tetrachloride	*	*	*	*	*	*	*
Ethylene dichloride	*	*	*	*	*	*	*
Carbon disulphide	*	*	*	*	*	*	*
Chloropicrin	*	*	*	*	*	*	*
Methyl bromide	50	50	50	50	50	50	50
Ethylene dibromide (as inorganic bromides)	50	50	50	50	50	50	50
Hydrogen cyanide	100	100	100	100	100	100	100
Malathion	8	8	8	8	8	8	8
Methoxychlor	2	2	2	2	2	2	2
Piperonyl butoxide	20	20	20	20	20	20	20
Pyrethrins	3	3	3	3	3	3	3

*Exempt from tolerance and can be used repeatedly.

In many instances, grain is infested in the field and should be fumigated as soon as it is stored. After grain has been stored, make inspections at about 2-week intervals. Probe samples should be taken at various areas and depths throughout the grain.

The Use of Insecticides as Fumigants
(Information Sheet continued)

Sift the samples through a 10- to 12-mesh screen and examine them for insects. Fumigants should be applied if one granary weevil, one rice weevil, or one lesser grain borer or as many as five insects of other species, such as bran beetles, cadelle, or grain moths are found per quart sample of grain. Before fumigation, spray the outside of the bin with a residual spray to kill insects that may be forced out of the building by the fumigant. Also, all waste grain outside of the bin should be destroyed to prevent carryover of insect pests. Fumigants are most effective when the grain temperature is 70 to 85 degrees F. and the air is calm.

How to Fumigate: Make a special effort to make the grain bin as tight as possible before fumigation. The grain surface should be level to insure even penetration. The liquid fumigants should be applied to the entire surface of the grain as a coarse spray. A 3- to 5-gallon capacity hand-type compressed air sprayer may be used to obtain a coarse spray; remove the spray nozzle and flatten the tip of the spray rod with pliers, or remove the disc from the spray nozzle.

Use some form of power equipment when fumigating a large volume of grain. Compressed air tanks or diaphragm or brass gear pumps may be used. These pumps may be operated by a small motor or from the power take-off of a tractor. Select or construct a discharge nozzle that disperses the liquid in an even pattern as a coarse spray. Close the bin immediately after applying the fumigant and do not open it for at least 24 hours--preferably 4 or 5 days. Air the bin at least overnight before entering. Fumigated grain may be fed to livestock as soon as no fumigant odor is present.

Fumigants, when applied properly, will penetrate grain and in most cases kill all stages of insects to a depth of 10 to 12 feet. Grain may be fumigated effectively at greater depths when bins are equipped with proper aeration facilities. Even when fumigation is carried out in structures that are airtight or nearly so, the movement of outside air influences the efficiency of fumigation. Consequently, best results are obtained if fumigants are applied when the air is calm.

Cautions: Fumigants are dangerous. Carefully follow the cautions listed on the manufacturer's label. Persons applying fumigants inside bins should wear gas masks with a full facepiece and proper canister approved by the U.S. Bureau of Mines. Gas masks of this type will not protect the wearer against heavy concentrations in bins where oxygen has been replaced by fumigants. The effective life of a gas mask canister is limited. Keep an accurate account of the time that a canister is used and replace it after 30 minutes of continuous or intermittent exposure to grain fumigants. Avoid spilling the fumigant on the skin, clothing, or shoes.

The Use of Insecticides as Fumigants
(Information Sheet continued)

Clothing wet with fumigant should be removed at once and the skin washed thoroughly with soap and water. Grain that has been fumigated should not be used or fed to livestock until aeration has eliminated the odor of the fumigant.

When applying fumigants always work with someone who can assist you in case of an accident or excessive exposure.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides

TOPIC: The Use of Insecticides on Household Pests

OBJECTIVE: To learn the control and method of application to control household pests.

REFERENCES:
Required:
1. Insects, Yearbook of Agriculture, 1952, 11. 469-475
2. Guide for the Use of Insecticides, Agricultural Handbook No. 331, pp. 187-189

QUESTIONS OR ACTIVITIES:

Using the Suggested Guide for the Use of Insecticides to Control Insects Affecting Crops, Livestock, Households, Stored Products, Forests, and Forest Products, make a chart as follows for eight common household insects:

Insects	Insecticide	Strength		Where & How to Apply	Remarks & Precautions
		Spray	Dust		

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Plants

TOPIC: Field Crops

OBJECTIVE: To become familiar with the insects that attack field crops and the control of these insects

REFERENCES:
Required:
1. Information Sheet, "Field Crops"
2. "Texas Guide for Controlling Insects on Grain and Forage Crops," MP339, all
3. "Official 1968 Cotton Pest Control Guide," 1968, pp 1-6 and 24-35
4. "Suggested Guide for the Use of Insecticides," Ag. Handbook # 331

QUESTIONS OR ACTIVITIES:

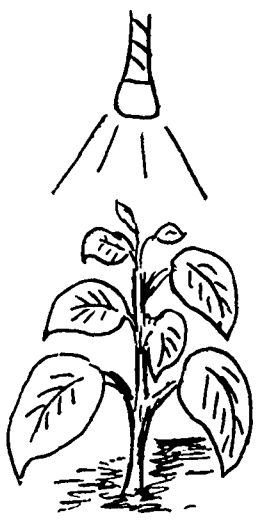
1. When do insects affect field crops?
2. What methods of control are generally used for insect control on field crops?
3. When spraying and dusting, how does wind affect applications of insecticides?
4. What is the pump pressure recommended for spraying field crops?
5. When should one, two, and three nozzles per row be used?
6. What is meant by an insect being resistant to a certain insecticide?
7. How many species of cotton insects are known to be resistant to certain chemicals?
8. What may happen as a result of excessive use of insecticides?
9. Should natural parasites and predators be encouraged to control insects?
10. What should be done when insecticides are washed off or plants develop new growth?
11.
12.

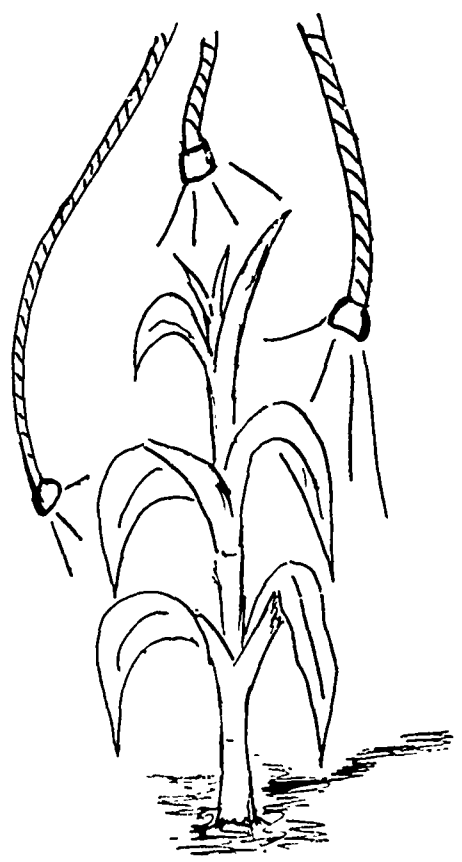
Information Sheet
on
FIELD CROPS

Field crops are subject to insect attacks throughout the growing period. Some insects are difficult to control, but proper treatment will usually give effective results.

Ground machines or airplanes may be used for applying insecticides, either sprays or dusts. For best results with airplanes, flag the swaths so that they meet, or overlap.

Do not make spray applications when winds exceed 15 miles per hour and spray when plants are dry; when dusting, winds should not exceed 5 mph. For broadcast-planted crops, No. 3 cone nozzles, set 20 inches apart on a rear-mounted boom of a tractor sprayer are satisfactory. A pump pressure of 60 pounds per square inch is recommended. Nozzle size, number of nozzles, ground speed, and pressure influence the rate of output per acre, so the sprayer should be calibrated carefully to insure the application of recommended amounts of insecticides. One nozzle per row usually is adequate for young or small row crops, but the use of two or three nozzles per row may be desirable on large plants to obtain adequate coverage.





Field Crops
(Information Sheet continued)

The development of resistance to insecticides, deposits of harmful residues in the soil or on neighboring crops, and the destruction of beneficial insect parasites and predators dictate the judicious use of insecticides. If possible, their use should be restricted to actual need based on inspections.

At least 10 species of cotton insects and mites have shown some degree of resistance to chemicals that once were effective. There is good evidence that the more extensively a material is used, the more rapidly resistance develops.

Fruits, vegetables and animal feed have been contaminated by insecticidal drift, sometimes resulting in harmful residues. Continued excessive use of certain insecticides results in soil residues which makes the growing of root crops in these soils hazardous.

Natural populations of parasites and predators play an important role in cotton insect control and should be maintained by avoiding use of chemicals unless harmful numbers of injurious insects are present.

Cotton insects can be controlled economically by using recommended insecticides at the correct time. Insecticides must cover the plant for effective control. Plants, however, usually are not protected when insects attack new growth or when chemicals are washed off.

The control of cotton insects should include the following steps:

1. Early season control (insures early fruiting and maturity)
2. Late season control (insures continued fruiting and protects fruit)
3. Early stalk destruction and farm cleanup (reduces overwintering populations of boll weevils, pink bollworms, cotton bollworms and tobacco budworm.)

The following list of insects are of economic importance to growers of field crops in Texas. All of these do not attack all crops.

Wireworms	Grasshopper
Cutworms	White grubs
Army worms	Sorghum webworm
Greenbug	Corn earworm
Aphids	Corn leaf aphid
Winter grain mite	Sorghum midge
Chinch bug	Southern corn rootworm
Flea beetle	Seed corn maggot
Southern corn borer	Lesser corn borer

Field Crops
(Information Sheet continued)

Water weevil	Thrip
Spotted alfalfa aphid	Mexican bean beetle
Pea aphid	Bean leaf beetle
Webworms	Velvet bean caterpillar
Leaf miners	Blister beetle
Fleahoppers	Spider mites
Bollworms	Boll weevils
Leaf worms	Cotton aphids
Pink bollworm	Cabbage loopers

Specific areas may have other insect infestations other than those listed.

Check required references for recommended control measures for each insect and the crop that is infested.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Plants

TOPIC: Orchards

OBJECTIVE: To become familiar with the insects that attack orchards and to be able to select an insecticide that will give the proper control

REFERENCES:

Required:

1 Information Sheet, "Orchards
2 Suggested Guide for Use of Insecticides - Agri Handbook # 331, USDA, Washington D. C
3 Insects, Yearbook of Ag 1952, pp 297-301

QUESTIONS OR ACTIVITIES:

1 Why are chemical control measures so important in fruit production?
2 Would fruit harvested be of equal value without the use of farm chemicals?
3 What is being done to keep fruits free of dangerous contamination?
4 When fruit is sprayed according to recommendation, do we find much residue?
5 List three ways residue is reduced?
6 What is the outlook for residue on fruits.
7
8

Information Sheet
on
ORCHARDS

A proper way to use chemicals to control insects on fruits and vegetables without harming the person who eats them remains a serious problem for the grower. This problem is a concern for the chemists who develop insecticides, the growers who use them, food officials of state and federal agencies, and home gardeners who might not always treat the poisons with the respect due them. Many scientists, who realize that worm and insect debris in fruits and vegetables would lower their value to grower and consumer, have carried on a tremendous amount of research to develop ways to keep foods free of dangerous contamination with insecticides.

But the problem still exists. Our cropping areas have become more concentrated; insects have become more abundant and hard to control; and spray and dust programs have included more and heavier applications. The investigations concluded that only small amounts of spray residue remained on fruits and vegetables that had been sprayed according to standard recommendations. They reported, however, that excessive residues remained on fruits or vegetables that had been oversprayed or sprayed too close to harvest time.

Many insects that affect tree fruits can be controlled without leaving excessive spray residue. The determination of dosages that are fatal or that cause obvious distress is the simplest part of the job. The potential danger of taking in very small quantities of an insecticide day after day must also be determined. Any effect on consumers of spray residue would come about by repeated consumption of small quantities. The quantities found on marketed fruits and vegetables are rarely, if ever, great enough to have immediate effect. To secure information on cumulative effects, experiments must extend over many months, some as long as two years.

The investigations have created some problems for the chemists. The amounts to be measured are so small that they are expressed as parts per million. During the interval between the last insecticide application and harvest, the residue may be reduced in three ways -- by crop growth, by physical weathering, and by chemical breakdown of the insecticide, so that the residue at harvest, expressed in parts per million, is lower than it was immediately after application of the spray or dust.

Although the establishment of tolerances as a result of hearings conducted by various federal agencies may have a stabilizing influence, the situation will never be a static one. Insect control problems are changing continually. New insecticides are appearing continuously and are creating new problems. The residue factor will always be an important consideration. We are confident that steady progress will be made, and the public will be insured of a safe, adequate and continuous supply of fruits and vegetables of high quality.

Orchards
(Information Sheet continued)

Insects of economic importance to fruit and nut growers include the following:

Japanese Beetle	Oriental Fruit Moth
Apple Maggot	Codling Moth
Plum Curculio	San Jose Scale
Mediterranean Fruit Fly	Peach Twig Borer
Stink Bugs	Aphids
Pecan Nut Casebearer	Mites
Pecan Weevil	Pecan Leaf Casebearer
Fall Webworm	Hickory Shuckworm
Sowflies	May Beetles
Pecan Bud Moth	Pecan Spittlebug
Shot Hole Borer	Flatheaded Borer
Obscure Scale	Walnut Caterpillar
Pecan Twig Girdler	Cottony Cushion Scale
Citrus Aphids	Apricot Mealybugs
Citrus Thrips	

Specific areas may have other insect infestations other than those listed.

Check required references for recommended control measures for each insect and fruit or nut concerned.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Plants

TOPIC: Ornamental Plants and Shrubs

OBJECTIVE: To recognize insects that attack ornamental plants and shrubs and to be able to determine the insecticide that will control the insects.

REFERENCES:

Required:

1. Information Sheet, "Ornamental Plants and Shrubs"
2. "Suggested Guide for the Use of Insecticides," Ag. Handbook 331, USDA, Washington D. C.
3. Insects, Yearbook of Agriculture, 1952, pp. 640-651

QUESTIONS OR ACTIVITIES:

1. What type of an insecticide is generally used in greenhouses?
2. List the six groups of insects attacking plants and shrubs.
3. How are insecticides applied for controlling outdoor insects?
4. A severe attack by insects may result in seriously _____, _____, or _____ them.
5. When is insect damage most likely to occur?
6. Why can fumigants be used effectively in greenhouse operations?
7. How do leaf-chewing insects damage plants?
8. How do sucking insects draw the sap from the plant?
9. Why is the tip and stem infesting insect damage difficult to see?
10. What two types of soil and root infesting insects do we find?
11.
12.

Information Sheet
on
ORNAMENTAL PLANTS AND SHRUBS

Many kinds of insects beset flowers and shrubs about the home and in greenhouses. The injury they cause depends on their feeding and egg laying habits. Some insects feed on the seed as soon as it is planted, while others attack the young seedling as it breaks through the ground. Still others infest the flowers, leaves, stems and roots.

Injury to the leaves may consist of mining the interior, skeletonizing the surface, and eating part or all of the foliage. Injury to the terminal shoot may be caused by external feeding, by chewing of holes through the surface, and by tunneling extensive mines in shrubs between the bark and wood, or even in the wood itself. Such injury may cause the stunting or death of the terminal growth beyond the point of attack. Certain insects also hollow out the interior of terminal buds and shoots of hardy shrubs. A few make pits in the surface of the bark of the main stem after sitting there and feeding for a while. One other type of injury consists of the removal of the cell sap by the feeding of certain insects or mites on the stem, foliage, or other parts of the plant. Injury to the roots may consist of feeding on the young roots, and on shrubs, by chewing through the bark surface or boring directly into the wood. Further injury consists of the formation of galls, which may occur on any part of the plant.

The effect of the various kinds of injury depends largely upon the intensity of insect infestation and the vigor of the plants. It may range all the way from making the plants only slightly less attractive in appearance to seriously weakening, stunting, or killing them. This is often more noticeable following periods of drought or transplanting operations when it is difficult for the plants to get adequate moisture and food.

Because insect enemies of flowers and shrubs are of many kinds, it would be difficult for the average person to identify them without first knowing the different groups involved. We therefore group them as leaf-chewing insects, sucking insects, leaf-mining insects, gall forming insects, tip and stem-infesting insects, and soil and root infesting insects.

To control insects outdoors, insecticides are usually applied as sprays, dusts or baits. In the greenhouses they may be used as sprays, dusts, baits, fumigants, and aerosols. Aerosols have now been made so effective that they have nearly replaced other methods in greenhouses.

Some insects in each of the groups are as follows:

Leaf-chewing insects bite off the foliage and chew and swallow the plant tissue. These are usually controlled by a stomach poison. Chief among this group are caterpillars, sowflies, beetles, bagworms, cutworms, fall webworms, eastern tent caterpillars, blister beetles, cucumber beetles and the Japanese beetles.

Ornamental Plants and Shrubs
(Information Sheet continued)

Sucking insects get their food by inserting their mouth parts through the surface of the plant and drawing sap into their bodies. They are usually controlled by contact poisons. This group includes aphids, leafhoppers, tree hoppers, scale insects, thrips, mealybugs, lace bugs, plant bugs, and spider mites.

Leaf-mining insects feed on the plant tissue between the upper and lower leaf surfaces and cause the formation of blotchlike or irregular serpentine mines. Typical of these insects are the boxwood, burdock and arborvitae leaf miners.

Gall forming insects sting the plant cells. This sting stimulates growth and causes formation of gall like structures of various sizes and shapes near the point of attack. Among these are the spruce gall aphids, the beaked willow gall midge, and chrysanthemum gall midge.

Tip and stem infesting insects include the larvae of certain beetles, moths and flies. Their activity is more or less concealed, and often not detected until considerable damage has been done. It consists mostly of hollowing out or tunneling the terminal buds, shoots, or main stems of flowers and shrubs. Examples are pine tip, and shoot moths, stalk borers, dogwood twig borer, rose stem borer and the flat headed apple tree borer.

Soil and root infesting insects crawl on the surface of the soil or work through it to reach the underground portions of the plants such as the roots, bulbs, corns and tubers. They feed on the exterior surfaces or bore into and tunnel the parts they infest. Examples of the surface infesting forms include ants, millipedes, slugs, and snails. Boring types include wireworms, white grubs, block vine weevil, strawberry root weevil, and the narcissus bulb fly.

The insects we have mentioned here are examples of a large number that infest flowers and shrubs. The measures recommended against a specific insect often are effective against others of the same group. That they be controlled is of growing importance, just as the plants they infest are of increasing importance to home owners, gardeners, commercial florists and nurserymen throughout the United States.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Plants

TOPIC: Forest Plants

OBJECTIVE: To become familiar with insects that attack forest plants and to be able to select an insecticide that will control these insects.

REFERENCES:
Required:
1. Information Sheet, "Forest Plants"
2. Insects, Yearbook of Agriculture, 1952, pp. 677-682
3. "Suggested Guide for the Use of Insecticides," Agriculture Handbook No. 331

QUESTIONS OR ACTIVITIES:

1. What has modern civilization done to the forest industry?
2. What are two methods of controlling forest insects?
3. What uses have caused an increase of forest products?
4. How do insects reduce the trees in our forests?
5. What effect do termites and tree borers have on forest products?
6. What is meant by using repressive measures in controlling insect populations?
7. What is meant by using an indirect method of control?
8. How does modern science help in controlling insects?
9.
10.

Information Sheet
on
FOREST PLANTS

Nature has always used insects for her own purposes in forests. Some insects are house keepers, while some are only incidental parts of the forest environment. Some merely prune trees; others kill living trees, but even they do not destroy the capacity of the forest to restock and produce new stands of trees. Primitive man could not have been greatly worried by the insects that killed forests where he got shelter and meat. Wood was plentiful for all, and there was ample time for young trees to grow up and replace those that were used or destroyed.

In modern civilization these things are changing. Now the activity of destructive insects upon the trees and in the forests does matter. Great areas have been cleared of forest growth for agriculture and increasing populations have increased the use and need of wood. Now, in search for timber stands to meet the need for saw logs, pulp, and box shooks, the lumberman finds some areas where insects got there first and harvested the pick of the crop. For the forest resources and commercial and aesthetic values involved, we are joined in battle --insects versus man--and man, for all his science and machines, is not yet the winner.

The kind of insects that attack forest trees include many species that vary widely in their habits and in the character and amount of damage they do. Some insects attack only the flowers, while others attack the cones and the seeds. Sucking insects, such as scales and aphids, attack foliage and stems. The most effective tree killers are the defoliators and bark beetles, whose activities destroy vital plant organs and bring about an immediate and often fatal effect upon the growth functions of the tree. Other insects that cause great damage are termites and some wood borers, which feed only on the wood after the tree is dying, or dead, and destroy material that otherwise could be put to use. The insects that attack flowers, cones and seeds may destroy the seed crop and thereby destroy the ability of the forests to reproduce.

Prevention is the starting point. If he is sufficiently interested and acts in time, man can save for his own use much of the timber that insects will otherwise destroy. There are two ways of doing this.

One approach is to initiate repressive measures against the insect populations that are causing the losses. In the case of the defoliators, this usually involves spraying the trees with chemicals which will either kill the insects on contact or poison them through their food. These methods are termed direct control.

The second approach is to prevent the buildup of destructive insect populations by preventing conditions in the forest that are favorable to their increase Healthy, rapidly growing stands of timber are less susceptible to insect infestations Logging out the more susceptible tree species in a mixed forest, selective logging in pure stands to remove the most susceptible trees, thinning to encourage more rapid growth and regulation of slash conditions to remove favorable breeding grounds for insect populations reduce the chances that insect populations will build up and become

Forest Plants
(Information Sheet continued)

destructive. These are measures that can be attained through forest management. These measures are termed indirect control.

The direct methods of insect control are not always entirely satisfactory for several reasons. They are expensive, they are not always as effective as desired, and they do not alter the underlying causes of insect outbreaks.

Mechanical devices and versatile power units have taken the hand labor out of insect control and marvelous insecticides are spread quickly by airplane at costs that are a mere fraction per acre of the values at stake.

Insects of economic importances to the forest industry include the following:

Gypsy moth	Elm leaf beetle
Subterranean termite	Carpenter ants
Red-headed pine sowfly	Bark beetle
Spruce bud worm	Cankerworm
Great basin tent caterpillar	Southern pine beetle
Black turpentine beetle	European pine sowfly
Pine scale	Texas leaf cutting ant
Loblolly pine sowfly	Pine tortoise scale
Western pine beetle	Flat headed tree borer
Lodgepole needle miner	Pine tip moth
European pine shook moth	Boxelder bug
Black-headed budworm	Pine bark aphid
Juniper scale	White pine weevil

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Plants

TOPIC: Vegetables

OBJECTIVE: To acquire the ability to recognize and identify vegetable insects and to determine the insecticide to use for their control.

REFERENCES:

Required:

1. Information Sheet, "Vegetables"
2. "Texas Guide for Controlling Insects", MP-675, Texas Agricultural Experiment Station

Supplemental:

3. "Suggested Guide for the Use of Insecticides", Agriculture Handbook #331.
4. Insects - Yearbook of Agriculture, 1952, United States Department of Agriculture

QUESTIONS OR ACTIVITIES:

1. Vegetable insects are placed in three major groups. Name them.
2. Why is control of vegetable insects so important?
3. Why should commercial growers be familiar with vegetable insects?
4. Can beneficial insects control injurious insects?
5. How can a magnifying glass help a vegetable grower?
6. What may be the cause of damage when no insects are seen?
7. Why are scale insects hard to find?
8. What type of damage do scale insects inflict?
9. How does a leaf roller hide?
10. Why should you use ONLY recommended dosages of chemicals for insect control of vegetables?
11. Are sucking insects often carriers of fungus diseases?
12.
13.

Information Sheet on VEGETABLES

The control of insects attacking vegetables assumes more importance than the control with most other crops because even minor damage may lower the crop's value or render it unfit for sale. Commercial vegetable growers should recognize the different insects in their various stages in order to begin control measures before damage occurs. Some insects attack more and different vegetable crops than others. New or uncommon insects may occur on various crops and information from a trained entomologist may be desirable on these new insects.

Beneficial insects often are found on vegetables, but seldom are they abundant enough to keep destructive insects below damaging levels.

Here are a few tips to help you: A plant that does not appear healthy may be suffering from a lack of water. Nearby trees or shrubs may be robbing the plant of the fertilizer you put out. The plant may need more sun, or maybe more shade. Are the roots in good soil? All of these factors can influence the plant's growth, vigor and resistance to attacks by diseases and insects.

One should have a small hand magnifying glass powerful enough to see mites, scale insects, insect eggs, and lesions of diseases which are often hard to see with the naked eye.

Shaking a twig or leaf on a piece of white paper or your hand may help you see these tiny insect pests more readily. If thrips are present they fly quickly, so look closely. This type of examination may tell you if insects are causing the condition or if it is a disease that is causing your leaves to change color. Plants showing signs of damage may be visited by night insects that hide in the soil or soil trash during the daytime. Snails move slow, but their rasping mouth parts can shred a leaf for a succulent meal. The scale may resemble the twig, but a colony can sap the juice from a valuable shrub until it is killed. They are sap suckers and can be seen easily if you turn the scale covering over exposing the scale underneath. Aphids may cause leaves to pucker or curl. Leaf rollers tie leaves together with silk. The leaf roller is a small green worm that has built himself a hide out.

Leaf miners, tiny maggots, leave small brownish or white spots, or snake tracks on the leaves. These tiny maggots eat out or tunnel between the leaf covers causing the leaf to have a lacy appearance.

Plants that wilt or die should be removed carefully, being inspected for borers, maggots or grubs. Feel the roots; are they firm or soft? Do you find any sign of fungus growth? Avoid over-watering or piling up excess soil around the tree or plant.

Vegetables
(Information Sheet continued)

Burn any diseased plants to prevent infection the following year. Do not add these to a compost pile; this only spreads the disease.

When using chemicals for insect or disease control, use only the recommended dosages. Do Not Add For Good Measures because of the danger of excess residue on your vegetables.

Remember that sucking insects such as aphids and leaf hoppers can spread virus diseases from an infected plant to a healthy one. Control of these insects may also eliminate some of the disease problems you may be confronted with.

Fumigate after the growing season to prevent insect and disease build-ups during the dormant season. This will be beneficial during the next growing season.

Some of the insects attacking vegetables by groups are chewing, sucking and root or stem feeders and are lised as follows: (This is not a complete list.)

Chewing Insects

Armyworm	Grasshopper
Blister beetle	Mexican bean beetle
Cabbage looper	Salt marsh caterpiller
Colorado potato beetle	Spotted cucumber beetle
Corn earworm	Texas harvester ant
Cutworm	Tomato hornworm
Fall Army worm	Vegetable weevil

Root or Stem Feeders

Cut worms	Squash vine borer
Wireworms	White grubs
Sweet potato weevil	Southern corn root worm

Sucking Insects

Aphids	Spider mites
False cinch bug	Squash bug
Garden fleahopper	Stink bug
Harlequin bug	Thrips
Leaf hoppers	White flies

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Plants

TOPIC: Grasses

OBJECTIVE: To learn the insects that attack grasses and be able to select insecticides that will give the proper control.

REFERENCES:
Required:
1. Information Sheet, "Grasses"
2. "Suggested Guide for the Use of Insecticides", Agriculture Handbook #331
3. "Texas Guide for Controlling Insects on Grain and Forage Crops", MP-339, Texas Agricultural Experiment Station

QUESTIONS OR ACTIVITIES:

1. What is the most prevalent insect pest of grasses?
2. What kind of damage do insects cause?
3. Why is insect control also important in disease control?
4. What other methods of control do we have besides insecticides?
5. What is a peculiar habit of spittle bugs?
6. What is the name of the shield-shaped bugs found in forage crops?
7. What damage do stink bugs do?
8.
9.

Information Sheet for GRASSES

An incredible number and variety of insects live on grasses and legumes. Under favorable conditions many species compete successfully with domestic animals as co .ɔumers of these crops. Any farmer who has seen an outbreak of grasshoppers or army worms ruin a good stand of grass or grain almost overnight or alfalfa aphids destroy a whole cutting of alfalfa can verify the seriousness of insect competition.

Often the number of insects run into many millions to an acre and their large appetites more than make up for their small size. Hundreds of species are pests of grasses, legumes, and other forage plants.

Grasshoppers are among the most prevalent pests of pasture and hay crops. Some species favor the uncultivated ranges, while others like the cultivated grasses and legumes. In both environments their abundance and control may mean the success or failure of a year's farming operations.

Insects sometimes cause heavy damage; all commonly grown forages are susceptible. Insects may injure or kill forage grasses and legumes in several ways, the most important of which are a result of sucking the sap, chewing and boring into the vegetative and floral parts, attacking and destroying the underground roots and stems, laying eggs on various parts of the plant, and transporting disease organisms to plants and implanting them there.

Practical controls have not been developed for some of the insects, but there are practical controls for almost all of the most destructive species. Among them are the use of selective insecticides, crop rotations, escape crops, tillage, variation in time of planting or harvesting, clean culture, and destruction of residues and weeds.

White grubs, cutworms, army worms, and grasshoppers are probably the most important among those injuring the grasses. The sweet clover weevil, clover root curculio, potato leafhopper, and the grasshopper are among insects that cause the most injury to legumes.

Spittle bugs are little sucking insects with the queer habit of living in small masses of white froth or spittle which they excrete around themselves during the immature stages as a protection against their natural enemies. These insects look like fleahoppers and cause a withering of the infested stems and bloating of the seed heads. Suggested methods of control are early mowing, burning the dead grass in the infested fields during the dormant season, and frequent rotation from grass and clovers to some other crop.

Grasses
(Information Sheet continued)

Several species of sucking insects more or less resembling lygus bugs in habits, if not in appearance, attack grass and legume crops in various parts of the country. Among these are certain shield-shaped green or brown stink bugs, and the long, narrow green or brown plant-bugs that are somewhat larger than lygus bugs. These insects often seriously reduce the yield of grasses and legumes grown for seed and undoubtedly reduce the hay yields as well. Methods for their control have received comparatively little attention. In general, the cultural and insecticidal measures in use are doing a good job of controlling lygus and spittle bugs.

Some of the more important insect pests of grasses and legumes are as follows:

Spotted alfalfa aphid	Grasshoppers
Pea aphid	White grubs
Cutworms	Sweetclover weevil
Army worms	Potato leafhopper
Web worms	Blister beetles
Sod web worms	Green clover worm

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Plants

TOPIC: Lawns

OBJECTIVE: To acquire a knowledge of lawn insects and their control.

REFERENCES:

Required:

1. Information Sheet, "Lawns"
2. "Lawn Insects", B-53, USDA, Washington, D.C.
3. "Suggested Guide for the Use of Insecticides", Agriculture Handbook #331

QUESTIONS OR ACTIVITIES:

1. What four groups do lawn insects come under?
2. What damage do lawn insects cause?
3. What, besides lawns, may these insecticides be used for?
4. What precaution should be used with lawn insecticides?
5. Where can you buy these insecticides?
6. What forms of insecticides are used?
7. What is a natural control for the Japanese beetle?
8. How long can an application of insecticides for soil and root insects be effective?
9.
10.

Information Sheet
for
LAWNS

Many insects and insect-like pests damage lawns and other turf. They cause the grass to turn brown and die, or they build unsightly mounds that may smother the grass.

Some of the pests infest the soil and attack the plant roots; some feed on the plant leaves and stems, while others suck juice from the plants.

Other insects and insect-like pests inhabit lawns but do not damage them. They are annoying, and some of them attack people.

These pests can be controlled by insecticides. The recommendations are applicable not only to lawns but also to such places as parks, roadsides, golf courses, athletic fields, cemeteries, and to the areas around airport landing strips. However, these are not intended for the control of insects on turf areas that might be grazed by livestock.

Insecticides are sold under various trade names by garden supply houses, and hardware, seed and drug stores.

Dusts and granules are ready-made formulations that are used dry. You can apply them directly from the container, but it is usually better to mix the amount recommended for 1,000 square feet with 10 to 15 pounds of dry sand or fertilizer. Apply them with a hand or power duster, or with a lawn fertilizer spreader.

Wettable powders and emulsifiable concentrates are used in sprays. Mix the purchased produce with water, and apply the spray with a sprinkler can, a garden type compressed air sprayer or a knapsack sprayer. The quantity of water to use depends on the type sprayer you have. Usually you will need 2 or more gallons of water. If a wettable powder is used, frequent mixture is necessary.

NOTE: You can use a tablespoon or cup to measure emulsifiable concentrates.
1 fluid ounce = 2 tablespoons
8 fluid ounces = 1 cup
1 pint = 2 cups
Dry formulations vary in weight.

A quart jar attachment for a garden hose will provide good distribution of an insecticide on a lawn. Use an attachment that delivers a coarse spray and large volume of water. Usually a quart jar full of an insecticide mixture will cover about 500 square feet of lawn.

Lawns
(Information Sheet continued)

Baits are usually purchased ready-mixed, but a bait for controlling slugs and snails may be prepared.

Apply insecticides at any time except when the ground is frozen. Spring or fall is the best time to control grubs.

To control underground lawn pests, apply an insecticide and, immediately afterward, sprinkle the lawn thoroughly. On application may control the pests for several years. Control of soil insects is slow, and it may be a month or more before the insecticide becomes fully effective.

To control above ground lawn pests, apply an insecticide to the grass. Sprinkle lightly with water to wash the insecticide down around the crowns of the plants. Do not water again for a few days; then sprinkle thoroughly to wash off the insecticide. One application may control the pests for several weeks. Repeat the application if they become numerous.

Grubs of the Japanese beetle can be controlled by applying a dust containing spores of milky disease. However, the disease may require several years to spread and reduce beetle populations appreciably.

In general, the spore dust should not be applied to soil that has been treated with an insecticide. Although the insecticide does not harm the disease spores, it reduces the grub population and thereby greatly lowers the chance of establishment and spread of the disease.

Spore dust powder can be purchased. Apply it when the ground is not frozen. Follow the directions on the label.

Lawn insects are placed in four groups.

(1) Those that infest soils and roots.

Grubs	Ants
Mole Crickets	Wireworms
Wild Bees	Bill Bugs
Desert Termite	Earthworm
Cicada-Killer Wasp	Periodical Cicada

Lawns
(Information Sheet continued)

(2) Those that feed on leaves and stems.

Sod Webworm	Armyworms
Cut Worms	Bill Bugs
Fiery Skipper	Lucrene Moth
Grasshoppers	Leaf Bug
Fruit Fly	

(3) Those that suck plant juices.

Chinch Bug	False Chinch Bug
Scale Insects	Leafhoppers
Mites	Meadow Spittlebug

(4) Those that inhabit but do not damage lawns.

Earwigs	Ticks
Chiggers	Thrips
Slugs and Snails	Millipedes and Centipedes
Sowbugs and Pillbugs	Spiders and Scorpions
Fleas	Mosquitoes

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Plants

TOPIC: Stored Grain Insects

OBJECTIVE: To become familiar with insects of stored grains and methods of their control.

REFERENCES:

Required:

1. Information Sheet, "Stored Grain Insects"
2. Insects, Yearbook of Agriculture, 1952, USDA, pp. 629-639
3. "Suggested Guide for Use of Insecticides", Agriculture Handbook #331, USDA, pp. 190-259

QUESTIONS OR ACTIVITIES:

1. What percent of our stored grain is lost because of insects?
2. Why is the loss greater in the south?
3. What is the estimate of stored grain in number of bushels lost to insects annually?
4. What happens if a housewife finds a package contaminated by insects?
5. How much loss would be sustained if each family in the United States discarded 50¢ worth of infested food annually?
6. Total estimated losses caused by all insects in the United States amounts to _____ dollars.
7. What three species of insects comprise the largest proportion of insects affecting shelled corn?
8. What insect causes the most damage to stored grains in the south?
9. Larvae of grain insects destroy many times their own weight in the _____ to _____ weeks of their development?
10. Grain insects cannot reproduce if grain moisture is _____ percent or below.
11.
12.

Information Sheet
for
STORED GRAIN INSECTS

Insects cause an average annual loss of at least 5 percent of the rice, corn, wheat, barley, oats, grain sorghums and similar crops after they are harvested and while in storage on the farm, in elevators or in warehouses. Much of this loss comes right on the farm and is even more severe in the southern parts of our country where in the warmer temperatures the weevils, beetles, and moths breed and feed throughout most of the year. The actual amount of grain lost annually because of these pests has been estimated at 300 million bushels, worth more than 500 million dollars.

Processed foods and packaged goods of various kinds get their share of insect damage, although such contamination is far less today than it was in our grandparents' time. Today, if the housewife finds a sign of an insect in a package, it goes back to the dealer. Our food and drug administration laws insist that our food be free from insect contamination.

Every now and then a housekeeper has to discard a partly used package of cereal, meal, nuts, dried fruit, or other food which, forgotten on the shelf, has become infested by moths, worms, or weevils - the pantry pests. Suppose each family in the United States discarded only 50¢ worth of infested products a year; the loss would be over 20 million dollars.

Such figures should give us pause to think. They are figures for fewer than 100 of the 600 or more injurious species of insects of primary importance that are known to occur in North America. They emphasize that everyone is affected in many ways by many insects, even though he might go for months without seeing or noticing an insect or any sign of insect damage. Losses caused by all insects in the United States add up to a staggering amount, whether we regard it in terms of dollars, lost food and fiber, or time and material used in combatting them. That amount, in the opinion of entomologists, is at least 4 billion dollars for an average year.

Insects are one of the most important hazards to the safe storage of grain, but the investigations have demonstrated time and again the basic truth that the factors favorable for preserving the keeping quality of grain are unfavorable for the development of insects.

The insects that attack stored grain are rather general feeders, but some of them definitely prefer certain grains. The six species most commonly found in stored shelled corn and constituting more than 98 percent of the insect population were the saw-toothed grain beetle, flat grain beetle, red flour beetle, foreign grain beetle, larger block flour beetle and the hairy fungus beetle. The first three comprised the greater portion of the insect population. In the south, where field infestation is common, the rice weevil is by far the most abundant species and constitutes the largest proportion of the insect population of stored corn.

Stored Grain Insects
(Information Sheet continued)

Weevils, flour beetles, and many other beetles devour at least their own weight of food each week. Their larvae destroy many times their own weight of food during the 3 or 4 weeks they are developing.

Many species feed almost entirely on the germ of the grain, so that its viability is reduced and much larger amounts of infested than uninfested grain must be used for seed. They frequently cause grain to heat. A lowering of grade may be caused by off-odors or insect damage. Finally, the milling quality of infested grain is reduced by the presence in the kernels of immature stages of weevils, which are hard to detect and cannot easily be removed during the milling process.

The insect pests of stored grain and seed depend on their food supply for water. Seed or grain that is low in moisture is unfavorable for their development. The true grain weevil cannot breed in grain that has a moisture content below 9 percent, and their breeding is restricted in grain unless the moisture content is above 11 percent. Moisture and temperature requirements of stored grain insects are closely related, up to certain levels their rate of development rises with the increase in temperature and the moisture content of the food.

To preserve grain from insect damage, one must think first of prevention of destructive outbreaks.

Most of the insect pests of stored grain and seed have short generations, a high rate of reproduction, and are long lived individuals, characteristics that cause great fluctuation in numbers. Under favorable conditions, outbreaks are apt to occur suddenly.

The immediate causes of such outbreaks are the factors that affect the rate of egg laying, the rate of development, the death rate, or the longevity of the insects. The more important factors are moisture, temperature, food supply and human acitivites.

We cannot,in the foreseeable future, expect research concerned with the control of insects in stored grain to be completed, but on the other hand we are more than holding our own against these pests. As we learn more and more about sprays, fumigants, control of grain moisture, and the habits and weaknesses of the insects themselves, we are better able to meet their threats.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Animals

TOPIC: Livestock

OBJECTIVE: To acquire the knowledge of controlling insects of livestock.

REFERENCES:

1. "Texas Guide for Controlling External Parasites of Livestock and Poultry" MP 691. Texas Agriculture Experiment Station
2. "Suggested Guide for Use of Insecticides" Agriculture Handbook 331, United States Department of Agriculture.
3. Dairy Production, Bundy & Diggins, pp. 254-260

QUESTIONS OR ACTIVITIES:

1. List the insecticides that have been used for many years to control external parasites.
2. Name some newer insecticides.
3. What is a major concern in developing effective insecticides?
4. What two factors are considered in determining the safety of an insecticide?
5. Name two common insecticides derived from plants.
6. What are two main disadvantages of DDT?
7. Methoxychlor has what advantages over DDT?
8. What insecticide is used in the screwworm control preparation.
9. Why does chlordane have limited use on livestock?
10. Name other new insecticide materials.
11. What is the oldest and most practical method of internal parasite control?
12. How are chemical agents used most profitably in a control program?
13. Why is phenothiazine ranked as outstanding antihelmintis?
14. Sodium fluoride is a chemical used to control what parasite?
15. What is the main disadvantage of sodium fluoride?
16. Name two compounds that are used in place of sodium fluoride.
17. Sulfonamides are known to aid in controlling what disease?
18. What should all dairymen do to help control flies?
19. Since the Pure Food and Drug Administration forbids the use of many sprays, name one that can be used directly on lactating dairy cows.
20. Name two good sprays to use on fly resting places such as buildings, board fences and shrubs and trees.
21. Explain the life cycle of the heel fly.
22. When dusting cattle for grubs, use _____ to _____ percent retenone dust.

UNIT: Agricultural Chemicals Used as Insecticides on Animals
TOPIC: Livestock
(Assignment Sheet continued)

23. What symptoms are noticeable when an animal becomes infested with lice?
24. Name the insecticide used to treat for ticks and mites.
25.
26.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Animals

TOPIC: Poultry

OBJECTIVE: To acquire the ability to select insecticides that will control poultry parasites.

REFERENCES:

Required:

1. Profitable Poultry Production, by Parnell, pp. 217-222
2. "Texas Guide for Controlling External Parasites of Livestock and Poultry," MP-691, Texas Agricultural Extension Service.
3. Suggested Guide for use of Insecticides, Agriculture Handbook 331, USDA

QUESTIONS OR ACTIVITIES:

1. What control is advisable for the control of round worms in poultry?
2. What is the treatment recommended for the control of cecal worms?
3. What treatment can be used for tapeworms in poultry?
4. How do flies and mosquitoes affect poultry?
5. What conditions can a poultry farm aid in breeding flies and mosquitoes?
6. How can one secure additional control measures for flies and mosquitoes?
7. How many species of lice are known to affect poultry?
8. What can one use to control lice on the poultry farm?
9. How do mites affect chickens?
10. How can mites be controlled?
11. How can fowl ticks be controlled?
12. Where do fleas breed?
13. How can fleas be controlled?
14. What can be done to assist in eliminating breeding places for flies and mosquitoes?
15. What is a major safety precaution one should use in spraying buildings?
16.
17.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Soil Additives

TOPIC: Soil Additives - Trends and Deficiency Symptoms

OBJECTIVE: To become informed of the trends and deficiency symptoms of soil elements.

REFERENCES:

Required:

1. Information Sheet, "Soil Additives - Trends and Deficiency Symptoms"
2. Soil, 1957 Yearbook of Agriculture, United States Department of Agriculture, pp. 172-183.

QUESTIONS OR ACTIVITIES:

1. What are soil additives?
2. What is the trend in the use of soil additives?
3. List three ways of determining the additives needed.
4. List the possible symptoms that one might observe in plants grown in soils deficient in lime.
5. List some factors that affect plant growth other than soil deficiencies.
6. List the three steps necessary to determine the nutrients needed in the soil.
7.
8.

Information Sheet
on
SOIL ADDITIVES - TRENDS AND DEFICIENCY SYMPTOMS

A soil additive is considered to be any chemical that is added to the soil to increase plant growth and yields. The use of fertilizers and other soil additives has tripled in the last fifteen years; and it is expected that there will be a continuing increase in their use as our knowledge of the soil increases.

Plants need thirteen elements, excluding the elements provided by the atmosphere, for growth. Seven of the thirteen elements are available in the form of salts; these are calcium, magnesium, sulfur, nitrogen, potassium, phosphorus, and iron. Other elements necessary for plant growth are manganese, boron, zinc, copper, molybdeum, and chlorine.

To determine the amounts and kinds of soil additives needed by a given soil, one must become familiar with the health and productiveness of plants. Plants in poor health are usually stunted or show signs of sickness of the leaves, stems, or fruit. These symptoms are a useful guide; however, to make an accurate diagnosis, chemical tests of plant tissues and a soil analysis should be made.

There are several laboratories in the state that will analyze your soil for a nominal fee.

To assist you in recognizing plant deficiencies, a list of plant deficiency symptoms follows:

Nitrogen Deficiency Symptoms

1. A sick yellow green color.
2. A distinct slow and dwarfed growth.
3. Drying up or firing of the leaves which starts at the bottom of the plant and proceeds upward. The firing starts at the top of the bottom leaves and proceeds down the center along the mid-rib.

Phosphorus Deficiency Symptoms

1. Slow growth and maturity.
2. Purplish leaves, stems, and branches.

Potassium Deficiency Symptoms

1. Mottling, spotting, streaking or curling of leaves.
2. Leaves become scorched, or burned on margins and tips.
3. Firing starts at tip of leaf and proceeds downward.

Soil Additives - Trends and Deficiency Symptoms
(Information Sheet continued)

Calcium Deficiency Symptoms

1. Young leaves in terminal bud become hooked in appearance and then die at the tips and along the margin.
2. Roots are short and branch out.
3. Leaves have a wrinkled appearance.
4. Plants could exhibit deficiency symptoms of other nutrients, since the proper balance of calcium influences intake of other nutrients.

Magnesium Deficiency Symptoms

1. Loss of green color starting in the bottom leaves and later moving up the stalk. The veins of the leaf remain green.
2. The plant stem is slender and weak.
3. Leaves are mottled.
4. Leaf tips are turned or cupped upward.

Sulfur Deficiency Symptoms

1. The young leaves are light green in color and have even lighter veins.
2. The stalks are short and slender.
3. Plant growth is slow and stunted.

Boron Deficiency Symptoms

1. Young leaves of terminal buds become light green at the base.
2. In later growth the leaves become twisted and the stalk finally dries back to the terminal bud.

Iron Deficiency Symptoms

1. The young leaves are mottled with the principal veins remaining green.
2. The stalks are short and slender.

Copper Deficiency Symptoms

1. Young leaves permanently wilt without spotting or mottling.
2. The twig or stalk just below tip and seedhead is often unable to stand erect in later stages of an acute shortage.

Zinc Deficiency Symptoms

1. Leaves spot, which involves the areas between veins.
2. Leaves are thick.
3. The internodes are short.

Soil Additives - Trends and Deficiency Symptoms
(Information Sheet continued)

Manganese Deficiency Symptoms

1. Spots of dead tissue are scattered over the leaf.
2. The smallest veins tend to remain green, producing a checked effect.

Molybdenum is essential to plant development and reproduction does not take place in the absence of micronutrients.

Assignment Sheet
on
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Soil Additives

TOPIC: Determining When to Use Soil Additives

OBJECTIVE: To develop the knowledge to determine when to use soil additives.

REFERENCES:
Required:
1. Soils, 1957 Yearbook of Agriculture, United States Department of Agriculture, pp. 67-72; 282-290; 184-193.

QUESTIONS OR ACTIVITIES:

1. What is meant by soil pH?
2. What is the range of the pH scale?
3. How can an acid soil be neutralized?
4. What is the difference between active acidity and potential acidity?
5. How do soils become acid?
6. What are saline and alkaline soils?
7. List reasons why saline soils are sometimes developed.
8. List some advantages of liming.
9.
10.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals As Herbicides

TOPIC: Introduction to Weed and Brush Control

OBJECTIVE: To become familiar with the cost, damage to animals, and the damage to humans.

REFERENCES

Required:

1. Information Sheet, "Weed and Brush Control"
2. Weed and Brush Control, W. T. Thomason, Agricultural Chemicals Book II; Thomason Publications; Davis, California.

QUESTIONS OR ACTIVITIES:

1. Make a chart of the herbicides where you work; showing the weeds they control and the recommendations of the manufacturer in applying them. Show cost per acre where possible.

2. Make a chart of the herbicides to control brush and trees and show the recommended application along with cost per acre where possible.

3. According to estimates, how much economic loss do weedy plants cause in the United States annually?

4. How much more water do weedy plants require to produce a pound of dry matter than range and pasture grasses?

5. What percent of forage, for livestock grazing on Texas rangelands, should the ranges produce?

6. About what percent of the forage for livestock grazing on Texas rangelands are the ranges producing?

7. List five ways weeds cause losses to farmers.

8. Why are weeds more economically controlled with chemicals than mechanically?

UNIT: The Use of Chemicals As Herbicides
TOPIC: Introduction to Weed and Brush Control
(Assignment Sheet continued)

9. Why does the cost of clearing brush and trees vary so greatly?

10. About what percent root kill can you expect on post oak and black jack oaks when two applications of 2, 4, 5-T are applied at two year intervals?

Information Sheet
on
WEED AND BRUSH CONTROL

Weed plants in the United States cause an estimated economic loss of up to 5 billion dollars annually. Ranchmen certainly lose their share on Texas' 100 million acres of rangeland. These weedy plants require four to eleven times more water to produce a pound of dry matter than do range and pasture grasses. Therefore, weeds may retard range improvement more than brush.

Texas rangelands should produce about 90 percent of the forage required for livestock grazing. They are now producing about 50 percent because of improper grazing management and heavy investation of undesirable weeds.

There are many ways in which they cause losses. While these losses cannot be entirely eliminated, an understanding of their causes and the application of this knowledge to improved farming practices will go a long way toward reducing them to a minimum.

The presence of weed seeds in agricultural seed and in grain, and weedy material in hay, greatly reduce the value of these products. The grazing or feeding of dairy animals upon such weeds as wild garlic, wild onion, mustard, fanweed, yarrow, chicory, ragweed, or giant marshelder impart undesirable odors or flavors to dairy products. In the production of vegetable or crop seeds, the presence of related weed species in the vicinity of the seed plots may seriously impair the quality of the seed as a result of cross-pollination.

Control of weeds requires operations for preparation of the soil, caring for the growing crop, and in harvesting. The presence of weeds increases wear and tear on machinery used in growing and harvesting crops, while certain pieces of equipment are designed and must be maintained for the express purpose of controlling weeds. Serious infestations of noxious perennial weeds may bring about modification of the entire farming program.

Irrigation costs are increased by weeds growing in and along the banks of irrigation ditches, not only because of the expense involved in removing the growth and the accumulated sediment, but also as a result of water loss through the weeds and reduced efficiency of the water carriers.

Chemical control of range weeds, where there are no susceptible crops, is more economical and practical than mowing or shredding. One properly timed spraying usually gives near complete control for a growing season. Weeds controlled with herbicides allow forage grasses to take advantage of all soil moisture and make fast growth before the dry summer period. Other advantages of chemical weed control are that no forage plants are disturbed and any terrain can be sprayed with ground or aerial methods. Herbicides cost $1.50 to $3.00 per acre for one application (1968 prices). If weeds are controlled mechanically it usually takes three or four mowings each growing season. Each mowing will cost from $1.50 and up per acre at 1968 prices.

Weed and Brush Control
(Information Sheet continued)

There are many methods of clearing brush and trees, but there is no cheap method known to date. The mechanical methods are slower, as a rule, and more expensive than chemical methods in most instances.. However, with some of the mechanical methods the land can be cleared of timber and put into crop production immediately.

The cost of bulldozing is from $10 to $75 or more per acre varying with the density of tree and brush cover and intensity of treatment.

Large areas of brush and timber are most effectively and economically treated by aerial spraying.

For relatively pure stands of post and blackjack oaks, as in the CrossTimbers, Central Basin and western portion of the East Texas Post Oak Belt, initial application of 1.25 pounds per acre of silvex or 1.5 pounds per acre of 2,4. 5-T should be followed by a repeat application one or two years later consisting of 0.75 pound per acre of silvex or 1.0 pound per acre of 2,4, 5-T. Rootkills of 65 to 75 percent on post oak and 35 to 60 percent of blackjack oak are obtained with this two year program at a total cost of $15 to $20 per acre.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Opportunities and Trends in the Use of Herbicides

OBJECTIVE: To become acquainted with the opportunities and trends in the use of herbicides.

REFERENCES:
Required:
1. Information Sheet, "Opportunities and Trends in the Use of Herbicides"

QUESTIONS OR ACTIVITIES:

1. Why have farmers been slow to turn to herbicides?
2. What is forcing farmers to use herbicides?
3. Why did some sections of Texas begin using herbicides on a large scale before other sections?
4. When will farmers use more herbicides?
5. How has increased use of fertilizer caused a greater need for herbicides?
6. What will bring about a natural growth in the use of herbicides?
7. What will bring about a greater need for technically trained personnel in the use of herbicides?
8.
9.

Information Sheet
on
OPPORTUNITIES AND TRENDS IN THE USE OF HERBICIDES

Opportunities in the use of herbicides in farming are probably limited more by farmers' knowledge and ability to use them than any other factor. Even though herbicides have been in use for many years the labor shortage becoming acute in different sections of the country at different times forced farmers to use herbicides. Today farmers are forced to use herbicides if they are to continue farming for a profit, in most every section of the United States.

At this time there is a shortage of technically trained personnel to train the farmers in the use of herbicides. At the same time, many farmers throughout the United States are just now beginning to look to the use of herbicides as a way out of the labor shortage and the cost price squeeze of labor.

In some sections of Texas 100% of the weeds that are controlled are controlled with chemical herbicides and this has taken place in the past ten years. This shows the trend and there is certainly no sign of a let-up in the use of herbicides until 100% of the weeds and grasses are controlled with chemicals in all areas of the United States.

As farmers increase their knowledge of herbicides through study and experience they will be using more and more herbicides. Present-day agriculture, with its specialized crops and methods of production, its increased use of fertilizers, its rapid mechanization, and its efficient handling of fungus and insect pests, demands adequate weed control.

As the population continues to increase and the demand for agricultural products continues to increase there will be a natural growth in the use of herbicides. As this growth comes about there will be a greater need for technically trained personnel in the use of herbicides. The opportunities for young men trained in this field is limited only by their initative and ability.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Herbicide Terminology

OBJECTIVE: To learn and be able to apply the terminology used in the herbicide industry.

REFERENCES:
Required:
1. Agricultural Chemicals - Book II, W. T. Thomson, pp. 265-286.

QUESTIONS OR ACTIVITIES:

1. In the book, Agricultural Chemicals - Book II by W. T. Thomson, study the tables, charts and terms found on pages 265 through page 286.
2. Pages 281 to 286 contain a glossary of terms. Look up the following terms:
   a. Additive -

   b. Adhesive -

   c. Aerosol -

   d. Biological control -

   e. Antidote -

   f. Biennial -

   g. Boot stage -

   h. Compatability -

UNIT: The Use of Chemicals as Herbicides
TOPIC: Herbicide Terminology
(Assignment Sheet continued)

i. Concentration -

j. Contact Herbicide -

k. Fumigant -

l. Herbicide -

m. Deteregent -

n. Drift -

o. Percent Concentration -

p. Post-emergence Herbicide -

q. Pre-emergence Herbicide -

r. Toxicity -

s. Synergism -

t. Systemic -

UNIT: The Use of Chemicals as Herbicides
TOPIC: Herbicide Terminology
(Assignment Sheet continued)

u. Winter annual -

v. Tolerance -

w. Weed -

x. Growth Regulator -

y. Eradication -

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Plant Nutrition and Physiology Principles of Weed and Brush Control

OBJECTIVE: To learn the characteristics particular to weed nutrition and the physiological principles of weed and brush control.

REFERENCES:
Required:
1. "Weeds of Colorado", B-514, Colorado State, pp. 12-22.
2. Weed Control, by Crafts & Robbins, pp. 120-139.

QUESTIONS OR ACTIVITIES:

1. What are the principal characteristics that enable plants to behave as weeds under certain conditions.
2. List the mechanical methods for controlling weeds.
3. What is the difference between selective and non-selective herbicides?
4. When should mowing be done to prevent seed formation?
5. When is the best time to control weeds?
6.
7.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Identification of Weeds

OBJECTIVE: To learn the classification of weeds, how to identify weeds, and the preparation of weeds for identification.

REFERENCES:

Required:

1. "Weeds of Colorado, B-514-S, Colorado State University, pp. 8-11; 24-25.
2. "Weeds of the North Central States", Pub. #36, University of Illinois, pp. 195-199; 217-219.
3. Grasses, Yearbook of Agriculture 1948, United States Department of Agriculture, pp. 727-729.

QUESTIONS OR ACTIVITIES:

1. What is a weed?
2. On the basis of habits of growth weeds are classified as: a) _____, b) _____, and c) _____.
3. List seven examples of a true annual.
4. List six examples of a winter annual.
5. List six examples of biennuals.
6. List four examples of simple perennials.
7. List four examples of creeping perennials.
8. Weeds have been classified in seed and weed laws as _____ and _____.
9. List five plants that can cause mechanical injury to livestock.
10. What is a Bey?
11. How are weeds prepared for identification?
12. Where are these specimens sent for identification?
13. The first step in reducing the number of weeds on a farm should include _____ the introduction and _____ of weeds and weed seeds from outside sources.
14. Effective and efficient control of weeds is founded upon two basic principles. These are: a) _____
    b) _____.
15. Select two plants. Using a key for identifying weeds, trace the plants until you have them properly named and identified.
16.
17.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Seed Laws Pertaining to Weeds

OBJECTIVE: To become familiar with the state seed laws pertaining to weed seeds.

REFERENCES:
Required:
1. Information Sheet, "Weed Control Laws of Texas".

QUESTIONS OR ACTIVITIES:

1. What are noxious weeds?
2. What are the two classes of noxious weeds?
3. What is the difference between the classes of noxious weeds?
4. What is required to be on the label of any seed sold within the state pertaining to weeds?
5.
6.

ERIC

Information Sheet
on
WEED CONTROL LAWS OF TEXAS

You have already seen that weed seed have various ways of being transplanted from one farm to another. Impure seed, E.E., seed of one species that contains a large quanity of seed of another species, is one of the ways that weed seed are spread. In order to control the selling of impure seed, as much as possible, the State of Texas has passed a Texas Seed Law to furnish the purchaser with information to evaluate a given lot of seed.

Study the following terms as set forth in the Texas Seed Law and Regulations.

1. "Weed Seeds" - shall include the seeds of all plants generally recognized as weeds within the state.
2. Noxious weeds - those weeds that are harmful and destructive to any given crop. Noxious weeds shall be divided into two classes: a) primary noxious weeds and b) secondary noxious weeds.
3. "Primary noxious weeds" are the seeds of weeds such that they not only reproduce by seed, but also may spread by underground roots or stems, and which, when establishe are highly destructive and difficult to control in this State by ordinary good cultural practices. Examples are: Nutgrass, Johnson grass, Wild onion, etc.
4. "Secondary noxious weeds" are weeds that are objectionable in fields, lawns, or gardens of this State, but can be controlled by good cultural practices. Examples are: Bermuda grass, Blueweed, Pock, Goat grass, etc.

The "Texas Seed Law" requires that any seed offered for sale in the state must have a label with the following information pertaining to weeds.

1. Percentage by weight of all weed seeds.
2. Primary and secondary noxious weed seed will be shown at the rate per pound.
   A. Nutgrass, Field Bindweed, and Hedge Bindweed are prohibited from sale if present in any amount.
   B. Dodder, Curled Dock, Blueweed, Canada Thistle, and Johnson grass in excess of 100 weed seed per pound are prohibited from sale, except that crops containing Johnson grass in excess of 100 weed seed per pound may be labeled "PASTURE MIXTURE" if sold.

There is nothing the "Texas Seed Law" to prevent one farmer from selling seed to another farmer provided that the seed were grown on his farm, not advertised outside the seller's home county by the press, and not shipped by common carrier.

Information Sheet
on
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Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Classification, Properties, and Characteristics of Herbicides in Weed and Brush Control

OBJECTIVE: To develop the ability to secure the classification, the properties, and characteristics of herbicides used in weed and brush control.

REFERENCES:

Required:

1. Weed Control, by Crafts and Robbins, pp. 186-260.
2. "Weeds of Colorado", B-514-S, Colorado State University, pp. 14-22.

QUESTIONS OR ACTIVITIES:

1. How are herbicides classified as to methods of application?
2. What is meant by a non-selective herbicide?
3. What is meant by a selective herbicide?
4. What is the difference between pre-emergence and post-emergence?
5. Explain the following:
   a. Temporary effect
   b. Extended effect
   c. Prolonged effect.
6. What does contact effect mean in weed control?
7. How does translocated effect kill weeds?
8. How are most non-selective soil herbicides used?
9. What is the action of herbicides when used in soil applications?
10. Why are selective herbicides becoming increasingly important in control of weeds in row crops?
11. What is meant by preharvest applications?
12.
13.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Factors Affecting Weed and Brush Control with Herbicides

OBJECTIVE: To become familiar with the factors that affect weed and brush control and to be able to control selected weeds.

REFERENCES:

Required:

1. Information Sheet, "Factors Affecting Weed and Brush Control with Herbicides"
2. Weed Control, by Crafts and Robbins, pp. 120-153.
3. "Weeds of Colorado", B-514-S, Colorado State University, pp. 20-23.

QUESTIONS OR ACTIVITIES:

1. Chemical weed control involves the use of _____ methods.
2. Why is timing important in chemical weed control?
3. As plants approach _____ the efficiency of the herbicide usually_____.
4. What five factors should one consider in chemical weed control?
5. Soils should be _____ and _____ when herbicides are applied.
6. Rain immediately after contact spray is applied may result in _____.
7. Light rain after application of pre-emergence herbicide is applied is usually _____.
8. _____ temperatures speed up herbicidal action.
9. Lower temperatures may require_____ amounts of herbicide being applied.
10. What part does humidity play in the application of herbicides?
11.
12.

Information Sheet
on
FACTORS AFFECTING WEED AND BRUSH CONTROL WITH HERBICIDES

Treatment of weeds with chemicals involves use of more or less technical methods and the observance of certain specific details. A certain degree of risk may also be entailed. For these reasons and because chemicals and methods for their use are constantly changing, anyone contemplating chemical weed control, will need to obtain full information on the subject from the proper source or sources before undertaking the operation. Also, the manufacturer's instructions must be followed closely.

Timing is important in weed control. Generally, you can get more effective weed control faster and with a smaller amount of chemical when conditions are right. Here are some factors to watch for:

1. Stage of weed growth - Generally weeds are easier to control when they are young and actively growing. As plants approach maturity the efficiency of herbicidal action decreases. On the other hand, with perennial weeds, applications made at certain later stages of development may be more effective than earlier treatments due in part to a large amount of leaf absorbing surface and also to the fact that a considerable amount of root reserve energy has been expended just prior to blooming.

2. Soil conditions - Warm moist soil that favors rapid growth of seedlings is conducive to high effectiveness of applied herbicides. Drought conditions make it more difficult to get good control. The type of soils also influences herbicidal retention from pre-emergence treatments. There is more leaching in light, sandy soil than in soils containing higher amounts of organic matter and clay. For best results from applications of Dowfume MC-2 as a seedicide or Premerge as a pre-emergence herbicide, soil should be well worked, moist, and free of trash before application.

3. Rainfall - Rain immediately following application of a foliage herbicide may reduce its effects by washing it from weed leaves before it has been absorbed. Later, rain may actually help herbicidal action by improving growth action of weeds. Too much rainfall after application may prove detrimental to some crops however, since it can cause some herbicides to leach into the crop root zone and cause injury. Light rain after application of a pre-emergence herbicide is beneficial.

4. Temperature - Air temperature is important to the proper action of some herbicides. Higher temperatures, generally speed up herbicidal action. Lower temperatures retard it. Therefore, it usually is necessary to use higher application rates under low temperature conditions.

Factors Affecting Weed and Brush Control with Herbicides
(Information Sheet continued)

5. Humidity - Humidity can also play a part. Usually under very dry conditions a given amount of herbicide may be less effective than under average humidity conditions found in the humid areas of the country..

Chemicals - Teammates of Tillage

The important thing to remember when you decide to make use of modern farm chemicals is this: herbicides are not meant to replace tillage; they're designed to reduce it.

Chemicals are a profitable supplement to good cultural practices. For example, the availability of weed killers does not make it any less important to select good, clean seed. Clean seed is one way to stop weed problems before they start.

Thorough tillage and seedbed preparation is important in the control of weeds as well as in assuring a hearty start for crop plants. Often, it may be advisable to plow land early, allow weed seed to germinate, then kill them with a shallow cultivation or with a contact spray. This gets rid of at least one phase of weed growth.

Even chemical control of early weeds in row crops with a herbicide such as Premerge does not necessarily eliminate the need for later cultivation to control weeds that got a late start.

Chemicals for weed control can be used most profitably when they become a part of sound farm management - management that calls for wise seed selection, proper tillage practices, and good fertilization programs.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Herbicide Selection

OBJECTIVE: To acquire the knowledge necessary to select herbicides in the control of weeds and brush.

REFERENCES:

Required:

1. "Weeds of Colorado", B-514-S, Colorado State University, pp. 20-22.
2. Weed Control, by Crafts and Robbins, pp. 265-292.

QUESTIONS OR ACTIVITIES:

1. What is meant by the term selective herbicides?
2. What advantage is there in using a selective herbicide?
3. Where would you use a non-selective herbicide?
4. Under what conditions would it be necessary to use foliage application of herbicides?
5. How would herbicides be applied to roots of plants?
6.
7.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Preparing Herbicides for Use

OBJECTIVE: To acquire the knowledge necessary to mix, prepare, and use herbicides safely.

REFERENCES:

Required:

1. Information Sheet, "Preparing Herbicides for Use".
2. Weed Control, by Crafts and Robbins, pp. 204-229.
3. Compatibility Chart, Meister Publishing Company.

QUESTIONS OR ACTIVITIES:

1. Herbicides are an excellent aid to the farmer for _____ _____.
2. Explain what is meant by selective herbicides.
3. How are herbicides sold?
4. Herbicides labels carry plant killing ingredients as _____ or _____.
5. A spray should be used up the _____ it is made up.
6. _____ and _____ definitely should not be mixed.
7. Many _____ and _____ can be readily mixed.
8. What is meant by the term "carrier" in spray solutions?
9. What is a wetting agent?
10. What is a herbicide?
11.
12.

Information Sheet
for
PREPARING HERBICIDES FOR USE

Herbicides are available for killing most of the weeds in our farming program. If properly used, they do not damage desirable plants.

Don't depend solely on herbicides. Use them only when necessary and as a part of your management practices to include fertilization, disease and insect control, and irrigation if necessary.

Herbicides differ in ease of application and in effectiveness. They also differ in selectivity. (For example, one herbicide may remove weeds without injury to others, another herbicide may temporarily, or even permanently injure others.)

Herbicides are sold in liquid, powder and granular forms. Most of them have common names that are derived from their chemical names.

The plant killing strength of some are stated on labels either as pounds per gallon acid equivalent or as percent of active ingredient. The plant killing strength of others is stated on the label as percent of active ingredient. The active chemical ingredient is always included on the label.

Questions frequently arise concerning the compatibility of various spray chemicals. Incompatibility can occur in several forms. Sometimes the toxicity or length of residual effectiveness of a pesticide is reduced in a mixture. Sometimes incompatibility means a mixture will cause injury to plants, but that either material used alone is safe. Often, incompatibility means that mixures left standing in a tank for more than a few hours lose effectiveness, but if sprayed out quickly lose no strength. It is a good practice to apply any spray the day it is made up.

Commercial spray operators should obtain a spray compatibility chart. An excellent one is available from American Fruit Grower, Willoughby, Ohio. In general, the recently developed synthetic organic pesticides are compatible in mixtures. Modern insecticides and miticides, as DDT, chlordane, aldrin, BHC, toxaphene, malathion, parathion, Kelthane, and others, are compatible with each other and with modern fungicides, captan, thiram, ferbam, maneb and ziram. Many of these should not be used in highly alkaline sprays and should not be mixed with lime or lime-sulfur. Check a compatibility chart carefully before mixing summer oils or wettable sulfur with other pesticides. Oil and sulfur definitely should not be combined.

Preparing Herbicides for Use
(Information Sheet continued)

There are many compounds that perform several functions in the spray solution.

1. Carrier - Many sprays have a carrier or diluent. This extends the active ingredient so it will cover entire plant surfaces. Water is the most common carrier. Oil is another carrier.

2. Filming agent - Used with oil sprays to cause a thin film of oil to spread over the plants enabling the contact herbicide to penetrate the surface of the plant.

3. Wetting agent - Water generally used as an aid in spreading material over the waxy surface of the plant.

4. Emulsion stabilizer - A stabilizer is used to reduce or lower interfacial tension between oil and water.

5. Solvent or coupling agent - Where the solubility of the toxic agent is not suited to the carrier or filming agent, a coupling agent is used.

6. Toxicant - Many of the new organic herbicides are extremely toxic. In many mixtures they are only a fraction of one percent of the total mix. Toxicants originally used in many oils are so low in effectiveness, they are not economically feasible. They are fortified with highly toxic-organic compounds, now a common practice.

Oil may serve as a filming agent and as a dual agent. It may also serve as a solvent for the toxicant.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Determining Method of Treatment

OBJECTIVE: To acquire the knowledge necessary to determine the method of treatment to use in controlling weeds and brush.

REFERENCES:
Required:
1. Information Sheet, "Methods of Treatment"
2. Weed Control, Crafts and Robbins, pp. 205-?

QUESTIONS OR ACTIVITIES:

1. What is meant by selective foliage contact herbicides?
2. What is meant by non-selective foliage contact herbicides?
3. What is meant by translocated herbicides?
4. Why can pre-emergence treatments of corn, sorghum, and sugar cane kill the grasses and not harm these crops?
5. What is meant by broadcast spraying?
6. What advantages are there to row spraying?
7. What grasses are often spot treated?
8. What conditions usually affect action of herbicides?
9.
10.

Information Sheet
for
METHODS OF TREATMENT

The methods of treatment for chemical control of weeds will differ with the weed to be controlled and the chemical used. There are four times that chemicals can be applied to the soil for weed control.

1. Soil fumigation is the practice of applying a chemical to the soils before planting to kill weed and grass seeds before they can germinate and grow.

2. Pre-emergence treatment is the application of chemicals after a crop is planted but before crop plants emerge. Contact pre-emergence treatment is one which is made after the weeds emerge but before the crop plants come up. Residual pre-emergence is one which kills weeds as the seeds germinate or emerge. This can take place either before or after crop emergence even though application is made before crop emergence.

3. Emergence treatment is the application at the stage when the crop plant seedlings are breaking through the soil.

4. Post-emergence treatment is the application after the crop plants have grown above the crop surface

After the time of application has been decided upon, the type of action the chemical has upon the weed should be considered.

1. Contact weed killers kill by contact rather than being translocated within the plant.

2. Systemic weed killers are translocated from the point of contact to other parts of the plant by the plant's system.

3. Selective weed killers are herbicides that have more effect on some plants than on others. This type of herbicide often offers the possibility of controlling weeds without damage to the crop.

4. Non-selective weed killers kill all plants without regard to species.

5. Some chemicals have delayed action that causes a delayed response. They may cause the plant to stop developing. then gradually die from the treament.

Methods of Treatment
(Information Sheet continued)

The factors that will affect chemicals are as follows:

1. Stage of weed growth
2. Soil conditions
3. Rainfall
4. Temperature
5. Humidity

In order to get the best effect from chemical weed control, treatment should be when the weeds are young and actively growing. Warm, moist soil is best for favoring rapid growth of seedlings and will increase the effectiveness of a herbicide. Rain falling after an application of a herbicide may decrease its effectiveness by washing it from the leaves. Later, rainfall may help by improving growth action.

Higher temperatures help the action of chemicals in weed control.

Average humidity conditions are best for optimum control.

The methods of application for farm treatment of chemicals are varied. A few are as follows:

1. Field Spraying - This is done with a boom and offers complete coverage of a field.

2. Row Treatment with Drop Nozzles - This type of application is used when crop is large enough that the drop nozzles can serve as extensions to the boom and direct the spray to the base of the plant without spraying the foliage.

3. Spot Treatment - By using hand operated sprayers or hose extensions from power equipment; weeds such as Johnson grass or Bermuda can be treated in the field.

4. Row Treatment - Row treatment is placing the chemical only on the row where the crop is growing. Time and chemical cost can be saved by using this method.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals As Herbicides

TOPIC: Application of Herbicides

OBJECTIVE: To become familiar with the methods used to apply herbicides and to acquire the knowledge to select the methods of application at a given time.

REFERENCES:
Required:
1. Information Sheet, "Application of Herbicides"
2. Weed Control, Crafts and Robbins, pp. 479-511.

QUESTIONS OR ACTIVITIES:

1. In field spraying why is complete coverage essential?
2. Why are drop nozzles used in row crops?
3. How is spot treatment used in weed control?
4. When is row treatment used in weed control?
5. What kind of equipment may be used for applying herbicides?
6. How are herbicides applied for weed control?
7. What are three prime requirements of any machine used for applying pest control materials?
8. Name three special purpose sprayers and spray booms.
9. Why is spraying for pasture weeds usually cheaper, faster and more effective than mowing?
10. Compare the cost of mowing and spraying.
11. Competition of weeds and grasses in pastures for moisture, plant nutrients, light and space reduce grass yields by _____ percent.
12. How can nonselective herbicides be used to advantage on the farm?
13.
14.

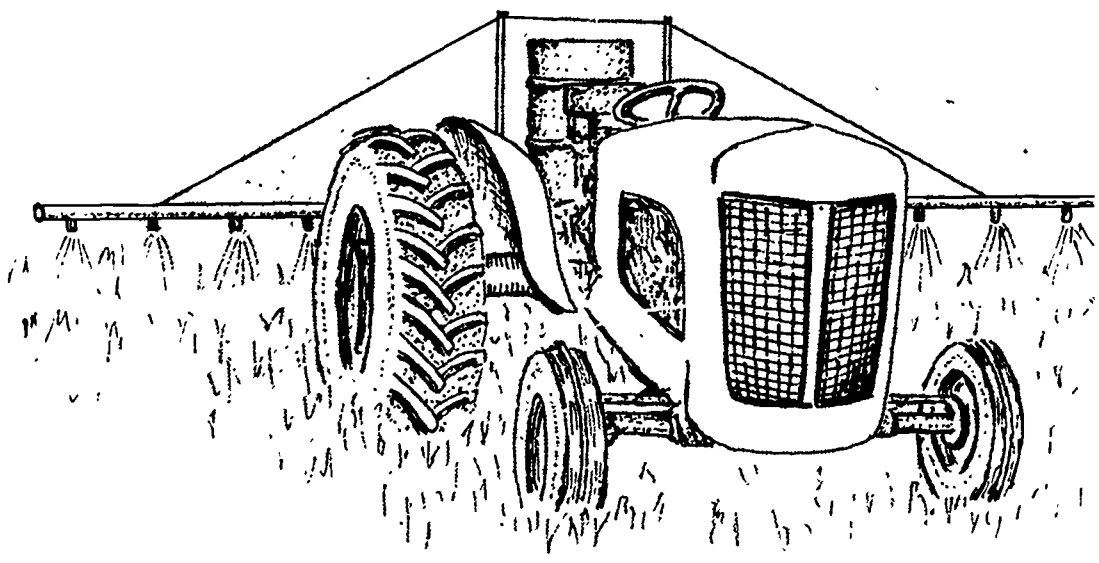
Information Sheet
on
APPLICATION OF HERBICIDES

HOW TO USE CHEMICAL TOOLS FOR FARMING

There is nothing difficult or complicated about the application of herbicides. Spraying equipment is generally simple in design and easy to operate. Methods of application differ, according to the type and severity of the weed problem, the crop to be treated and, sometimes, the area to be covered.

FIELD SPRAYING

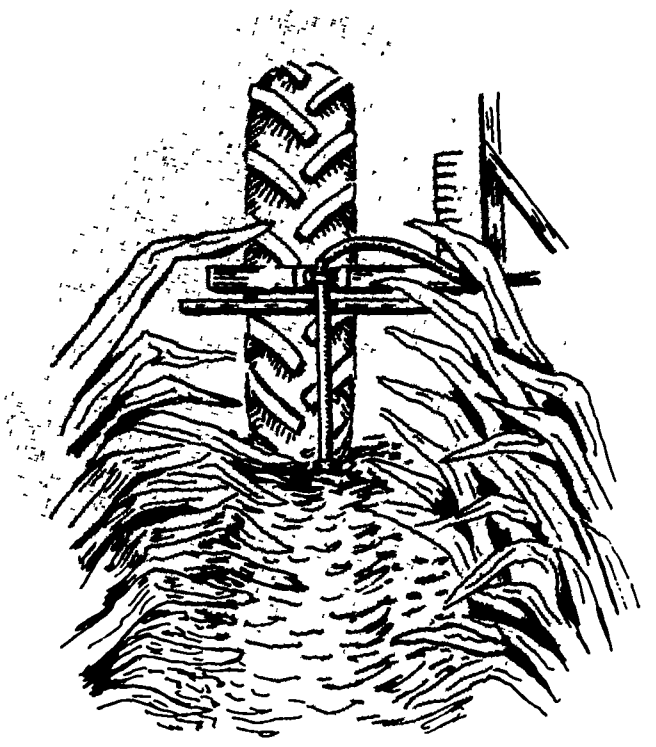
Over-all field spraying is done with a boom sprayer (see illustration) which can be either tractor or trailer mounted. On a boom-type sprayer, nozzles are spaced so that the spray patterns from each nozzle give complete coverage of the area to be treated.



Application of Herbicides
(Information Sheet continued)

ROW TREATMENT WITH DROP NOZZLES

By using drop nozzles (see illustration), weeds in row crops such as corn may be sprayed when the corn is fairly well developed. The drop nozzles serve as extensions of the boom, allowing the spray to be directed to the base of the plant, thus avoiding spraying the foliage which may be susceptible to damage from the spray.



Application of Herbicides
(Information Sheet continued)

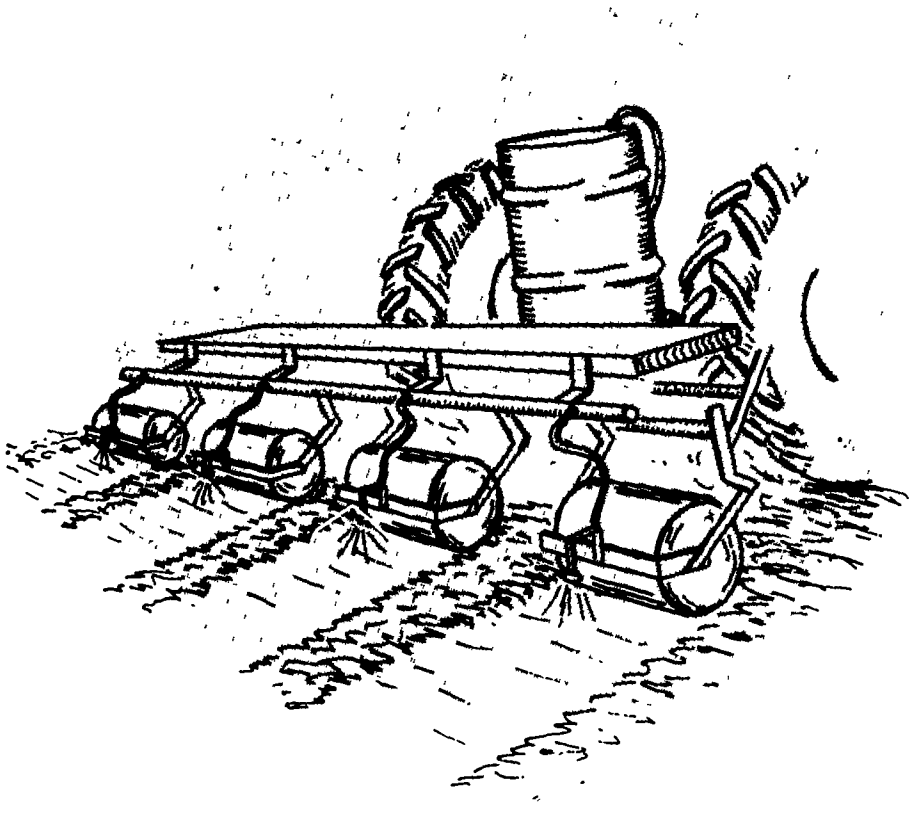
SPOT TREATMENT

By using either knapsack sprayers or hose extensions from power equipment, weeds may be spot-treated in the field. Johnson grass and Bermuda grass growing in cotton are often treated in this manner.

Application of Herbicides
(Information Sheet continued)

ROW TREATMENT (Band Treatment)

A saving in time and chemical cost can be realized by treating only the row area where the crop is planted. Row treatment is often used in the application of Premerge, and may be done at the time of planting or afterward. If spray is applied at planting time, the srpayer nozzles are mounted behind the press wheels or slide (see illustration). A band of 12 to 16 inches is usually treated. Results of row treatment in a peanut field are shown in the accompanying illustration.



HOW TO SELECT SPRAYING EQUIPMENT

Spraying equipment differs depending upon how it is to be used. Many farmers choose to construct their own equipment from component parts, tailoring it to their own specific needs. Tractor-mounted equipment is comparatively low in cost, and is practical for most farm uses. However, sprayers mounted on trailers, trucks, or self-propelled high-clearance units are in wide use in many areas. Whether you plan to buy or build a sprayer, however, these notes on proper equipment will serve as a guide in the selection of equipment.

Application of Herbicides
(Information Sheet continued)

PUMPS

Any good pump that will deliver the required volume of spray under the desired spraying pressure is suitable. Pumps differ in operating principle. Gear pumps and reciprocating piston pumps are positive action type pumps. Impeller pumps and centrifugal pumps usually are not. Self priming is an asset in a pump, but is not a necessity if the pump is to be mounted below the level of the supply tank. The pump should be able to deliver from 3 to 10 gallons per minute. It should always be operated at the correct speed. Pump life will be prolonged by proper care. After each day's use, pumps should be thoroughly cleaned and at the end of the season filled with a rust preventative.

SUPPLY TANK

Pick a durable container with enough capacity. It should be easy to clean. The tank need not withstand pressure if a pump is to provide the liquid pressure. Many farmers use clean oil drums for tanks. A rusty one may cause continuous trouble by plugging nozzles. A paddle-type agitator, or hydraulic agitation from excess pump capacity, will be necessary if the spray solution requires agitation in use.

PRESSURE REGULATORS

By-pass regulators are used with positive action type pumps. Diaphragm pressure regulators may be used with nonpositive action pumps. The regulators permit excess liquid to flow back to the supply tank. Adjustment of the regulator thereby maintains the proper amount of constant pressure at the nozzle.

VALVES

In addition to the several gate or globe valves on a weed sprayer, the sprayer should have a fast acting shut-off valve that will start or stop the flow of spray to the boom.

PRESSURE GAUGE

An accurate pressure gauge is important to precision spraying. It should be mounted so the operator can see it easily.

STRAINERS

Proper strainers will save time and trouble in spraying. A field sprayer should have an 80-100 mesh suction strainer or a 100-150 mesh strainer on the pressure line as well as strainers in each nozzle. The mesh in a nozzle strainer will depend on the size of the nozzle orifice.

Application of Herbicides
(Information Sheet continued)

SPRAY BOOMS

Booms should be made of corrosion-resistant metal. Galvanized steel pipe is widely used and is satisfactory.

HOSES AND FITTINGS

Hoses and fittings should be strong enough to withstand the pump pressure used, and should be of material that is not deteriorated by spray solutions including oil. Pipe fittings should be of a corrosion resistant metal such as brass.

NOZZLES

Two general types of nozzles are available for applying weed sprays: the single broadcast nozzle and the smaller fan nozzle mounted on a boom. The broadcast nozzle is constructed in such a manner as to produce a spray pattern of considerable width. The higher the nozzle is held above the ground the greater the swath width. Such nozzles are used singly or in clusters to cover widths up to sixty feet. Uniform spray patterns from such nozzles are difficult to obtain when there is any wind.

Fan type nozzles are usually preferred to cone type nozzles. Such nozzles are attached to booms of varying lengths by eyelet fittings. Fan nozzles are available in several spray angle types. Narrow angle spray nozzles (65°) are useful for certain types of spraying. The usual nozzle spacing on the boom is 20". If the narrow angle nozzles are used it is necessary to maintain greater boom height than with the wider angle nozzles. The higher the boom is from the ground the greater will be the spray interference caused by wind.

A representative chart showing the delivery in gallons per acre from various size orifices at pressures ranging from 20 to 100 psi and traveling at speeds of 2 to 5 miles per hour is shown. More complete data may be obtained from nozzle manufacturers. The chart included here gives approximate orifice sizes, speeds and pressures for the more common application rates. The first two digits (80) in the code numbers in the nozzle column refer to the fan spray angle - i.e., 80 degrees. These are Spraying Systems Company nozzles but other suitable makes may be available. Other special nozzles delivering uniform spray over the entire pattern are available for precision pre-emergence applications. Under certain circumstances, a spray pattern that delivers more spray to one side of the orifice is desirable for directed sprays. These are available from nozzle manufacturers.

Application of Herbicides
(Information Sheet continued)

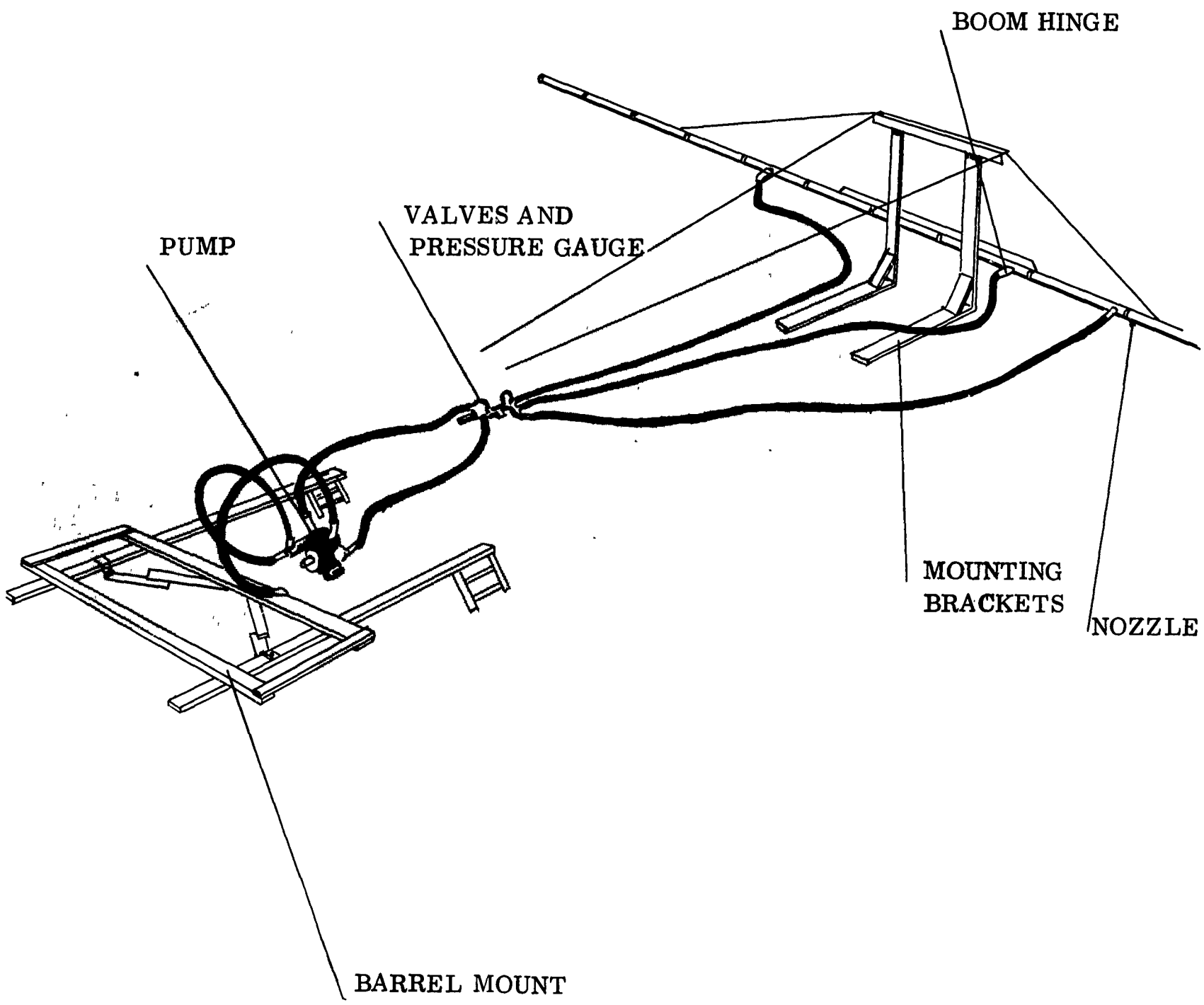
SPRAY NOZZLE CHART*

Nozzle	Spray Pressure in PSI	Capacity 1 Nozzle in GPM	Gallons Per Acre 2 MPH	3 MPH	4 MPH	5 MPH
800067	20	.05	7.0	4.7	3.5	2.8
	25	.055	7.8	5.2	3.9	3.1
	30	.06	8.6	5.7	4.3	3.4
	40	.067	9.8	6.6	4.9	4.0
100 Mesh	50	.07	11.0	7.4	5.5	4.4
	60	.08	12.0	8.1	6.0	4.9
	80	.09	14.0	9.3	7.0	5.6
	100	.11	15.6	10.4	7.8	6.3
8001	20	.07	10.5	7.1	5.3	4.3
	25	.08	11.8	7.8	5.9	4.7
	30	.09	12.9	8.6	6.4	5.1
	40	.10	14.9	10.0	7.4	6.0
100 Mesh	50	.11	16.7	11.2	8.3	6.7
Screen	60	.12	18.2	12.2	9.1	7.4
	80	.14	21	14.1	10.5	8.5
	100	.16	24	15.8	11.7	9.5
80015	20	.11	15.7	10.5	7.8	6.3
	25	.12	17.5	11.7	8.8	7.1
	30	.13	19.2	12.9	9.7	7.7
	40	.15	22	14.9	11.1	8.9
100 Mesh	50	.17	25	16.7	12.4	10.0
Screen	60	.18	27	18.2	13.6	10.9
	80	.21	31	21	15.7	12.6
	100	.24	35	24	17.6	14.1
8002	20	.14	21	14.0	10.5	8.4
	25	.16	23	15.7	11.8	9.4
	30	.17	26	17.2	12.9	10.3
	40	.20	30	20	14.8	11.8
50 Mesh	50	.23	33	22	16.5	13.2
Screen	60	.25	36	24	18.1	14.4
	80	.28	42	28	21	16.7
	100	.32	47	31	23	18.7
8003	20	.21	32	21	15.7	12.6
	25	.24	35	23	17.6	14.1
	30	.26	38	26	19.3	15.4
	40	.30	45	30	22	17.8
50 Mesh	50	.34	50	33	25	20
Screen	60	.37	55	36	27	22
	80	.42	63	42	31	25
	100	.47	70	47	35	28
8004	20	.28	43	28	21	16.8
	25	.32	47	31	24	18.7
	30	.35	51	34	26	21
	40	.40	59	40	30	24
50 Mesh	50	.45	66	44	33	27
Screen	60	.49	73	49	36	29
	80	.57	84	56	42	34
	100	.63	94	63	47	38

* This chart is based on 20 inch spray nozzle spacing and 17 to 19 inch boom height.

Application of Herbicides
(Information Sheet continued)

TYPICAL BOOM-TYPE SPRAY RIG FOR FIELD SPRAYING



Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Aquatic Weed Control with Herbicides

OBJECTIVE: To become knowledgeable in the control of aquatic plants.

REFERENCES:
Required:
1. "Common Aquatic Plants," B-1018, Texas Agricultural Extension Service, pp. 3-15.

2. Weed Control, Crafts and Robbins, pp. 594-606.

QUESTIONS OR ACTIVITIES:

1. Why is algae a problem in irrigation ditches?
2. What compounds have been successfully used to destroy algae?
3. How are chemicals applied to kill algae?
4. Where do the roots of floating plants feed?
5. Under what circumstances do duck weeds cover a pond?
6. How can you control duck weeds with ducks?
7. What are submersed waterweeds?
8. How can you prevent submersed waterweeds in a pond?
9. Give two ways to prevent rooted plants with floating leaves such as waterlilies.
10. How much fertilizer do you need to apply to get rid of waterlilies?
11. Complete this chart:

COMMON WATERWEEDS AND THEIR CONTROL

Name Common & Scientific	Type of Waterweed	How to Prevent	How to Control
1. Algae, flamentous, branches, Pithophora			
2. Arrow-arum, Peltandra virginica			
3. Cowlily, Nuphar advera			
4. Eelgrass, Zostra marina			
5. Waterchestnut, Trapa natans			

12.
13.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Fungicides

TOPIC: Fungicides, Their Development and Uses

OBJECTIVE: To become familiar with the development and uses of fungicides.

REFERENCES:

Required:

1. Plant Diseases, 1953 Yearbook of Agriculture, United States Department of Agriculture, pp. 115-120; 134-135.
2. Information Sheet, "Fungicides"

QUESTIONS OR ACTIVITIES:

1. Where did the term fungicide derive from?
2. What is a fungicide?
3. What is the purpose of using fungicides?
4. Fungicides are classified according to the location of the organisms to be controlled; list these classifications.
5. Fungicides are also classified as to composition; list these classifications.
6. How can fungicides be applied to seeds?
7. Classify fungicides according to their uses.
8. List the forms of fungicides.
9.
10.

Information Sheet on FUNGICIDES

Fungicides have been used for a long time, with the first recorded use being in 1821. Since that time, improvements have been made in the uses and numbers of fungicides. Today, fungicides are classified according to their use; and it is necessary that the student become familiar with this classification.

The classification of fungicides according to their use is as follows:

Seed Protectants

Fungicides used as seed protectants are applied as dusts or "slurries" to prevent blight, damping off, and root rot. Chemicals that may be used are Spergon, Orthocide 75, Panogen, Arasan, and Ceresan "M".

Foliage and Blossom Protectants

Chemicals applied as dusts or sprays to prevent blossom blight and leaf spot diseases. Some recommended chemicals are Captan, Ferbam, Karathane, and Maride "M".

Fruit Protectants

Chemicals in this group would be applied to prevent harvest rots and blemishes. Dithane M 22, Thylate, Manzate, and Captan may be used as fruit protectants.

Eradicants

There are only a few fungicides that can eradicate a disease once it is present. Chemicals that may be used to eradicate diseases are Phix, Tag, Panogen, Puratized, and liquid lime-sulfur.

Antibiotics

This chemical is recognized as being related to penicillin and other so-called "wonder drugs." Antibiotics are recommended for the control of fire blight. Recommended chemicals to control blight are Phytomycin, Agrimycin, and Acti-Spray and Agri-Strep.

Soil Fumigants

These are used to eradicate soil borne disease fungi in gardens, greenhouses, and plant beds. These chemicals are used in the form of gas or water soluble materials and are Methyl bromide, MC_2, Picfume, Vapam, VPM, and Bedrench.

General Purpose Sprays and Dust Formulations

These are chemicals applied as sprays and dusts and commercial products that contain the proper mixtures for the control of fungus around the home.

Fungicides
(Information Sheet continued)

Fungicides are used in several forms, with some of these being: wettable powders, dusts, emulsifiable concentrates, granules, solutions, and suspensions.

Familiarize yourself with the above terms; a definition of each can be found in the Agricultural Chemicals, Book I by W. T. Thomson.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Fungicides

TOPIC: Pathological Agents

OBJECTIVE: To become familiar with the pathological agents and reproduction of fungi.

REFERENCES:

Required:

1. Plant Diseases, 1953 Yearbook of Agriculture, United State Department of Agriculture, pp. 27-36.
2. "What You Should Know About Plant Diseases", Texas Agriculture Extension Service, B-995, pp. 7-8.

QUESTIONS OR ACTIVITIES:

1. What is a pathogenic fungi?
2. Can fungi be readily seen?
3. Are fungi living and do they require a source of energy?
4. Define:
   a. Hyphae

   b. Mycelium

   c. Obligated parasite

   d. Facultative parasite

   e. Pathogenic disease

   f. Inoculation

   g. Invasion

   h. Establishment

UNIT: Agricultural Chemicals Used as Fungicides
TOPIC: Pathological Agents
(Assignment Sheet continued)

i. Incubation

5. List the four groups of fungi.
6. How are fungi distributed?
7. How are leaf, stem, and fruit diseases usually caused?
8.
9.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Fungicides

TOPIC: Plant Diseases

OBJECTIVE: To become familiar with the causes, symptoms, and control of plant diseases.

REFERENCES:

Required:

1. "What You Should Know About Plant Diseases" Texas Agricultural Extension Bulletin, B-995, pp. 3-18.
2. Plant Diseases, 1953 Yearbook of Agriculture, United States Department of Agriculture, pp. 27-31.
3. "Identifying Plant Diseases", Texas Agricultural Extenstion Service, MP-512, pp. 3-7.

QUESTIONS OR ACTIVITIES:

1. What is a plant disease?
2. What causes plant diseases?
3. Why is it necessary that we understand how diseases develop in plants?
4. What are fungi?
5. Are fungi living organisms and do they require a source of energy?
6. How do fungi reproduce?
7. Describe fungi spores.
8. What is a parasitic disease?
9. What is a nonparasitic disease?
10. Why is it necessary for students to understand the structure of plants?
11. Explain how the roots, stems, and leaves serve a plant.
12. Define the following terms:
    a. Blight

    b. Canker

    c. Chlorosis

    d. Curl

UNIT: Agricultural Chemicals Used as Fungicides
TOPIC: Plant Diseases
(Assignment Sheet continued)

e. Damping-off

f. Dieback

g. Dwarfing

h. Gall

i. Host

j. Infection

k. Lesion

l. Mildew

m. Mosaic

n. Mummy

o. Pustule

p. Resistance

q. Ring spots

r. Rosette

UNIT: Agricultural Chemicals Used as Fungicides
TOPIC: Plant Diseases
(Assignment Sheet continued)

s. Rot

t. Russet

u. Scab

v. Spore

w. Vector

x. Wilt

13. What is the key to the best control of plant diseases?
14. List four factors that would lead the student to suspect that plants were diseased.
15. Explain how you would begin to identify a disease.
16. List the steps in collecting and packaging small plant disease specimens.
17. Explain how you would collect, package, and ship specimens of the following:
    a. Crops

    b. Vegetables or flower plants

    c. Lawn grass and other small plants

    d. Shrubs and trees

    e. Fleshy fruit, vegetables, bulbs, nuts, or tubers

    f. Plant parasitic nematodes

18. Prepare form D-418, Plant Disease Diagnostic Laboratory, for a plant disease specimen.
19.
20.

D-418 (Revised)

PLANT DISEASE DIAGNOSTIC LABORATORY

Obtain a copy of MP-512, Identifying Plant Diseases, from your county Extension agent before collecting, packing and shipping a plant disease specimen. *Please read and follow instructions in the publication on how to identify a plant disease and how to collect, package and ship sick plants.*

Fill out the following Plant Disease Specimen Record as completely as possible. Mail a copy of this sheet with the plant disease specimen. Address the package to Plant Disease Diagnostic Laboratory, Texas Agricultural Extension Service, College Station, Texas. Persons living near Lubbock or Weslaco may send their specimens to the area Extension plant pathologist at one of these Research and Extension centers.

Plant Disease Specimen Record

Date_____ Grower_____

Box and R.F.D._____ City_____ County_____

Crop or plant_____ Variety_____ Acreage_____

Plants affected (%)_____ Yield loss (%)_____ Soil type_____

Occurrence (underline appropriate phrase):

Occasional Scattered Small areas Large areas Whole fields

Other crops or plants grown on area during last 5 years: 19____ _____,

19____ _____, 19____ _____, 19____ _____, 19____ _____

Age of shade tree or shrub:_____ years. Soil pH:_____

Describe symptoms of disease specimen at time of collecting. (See list of words that describe plant diseases in MP-512.)

_____

_____

_____

When did plants first get sick?_____

Fertilizer program_____

_____

Disease and insect control practices_____

_____

Weed killer practices_____

Source of seed or transplants_____

(over)

Date of planting_____ Date of last rain_____

Irrigation program_____

_____

Neighboring crops_____

Insect situation now and during last month_____

_____

Other information that might help in diagnosis_____

_____

Sent in by_____ Date_____

Address_____ Occupation_____

Do not fill in below

Diagnosis_____

Cause_____

Treatment_____

Reply by_____ Date_____

Title_____

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Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Fungicides

TOPIC: Application of Fungicides

OBJECTIVE: To become knowledgeable in the methods of applying fungicides.

REFERENCES:

Required:

1. Information Sheet, " Application of Fungicides"

Supplemental:

2. Sharvelle, Eric G., The Nature and Uses of Modern Fungicides, Burgess Publishing Company, Minneapolis, 1961.

QUESTIONS OR ACTIVITIES:

1. In order to protect plants from disease, one must consider three important factors. List these.
2. Why are most of our fungicides classified as protectants?
3. List the decisions that must be made after a positive identification of the fungus disease has been accomplished.
4. List factors important in making a wise choice of the fungicides to apply.
5. List the kinds of applications that are available for applying fungicides.
6. List the methods of applying fungicides.
7.
8.

Information Sheet
on
APPLICATION OF FUNGICIDES

The use of fungicides in many instances has been declared a failure when in reality its chances of success were doubtful because of the ignorance of the user. In order for the application of fungicides to protect plants from disease, it must be applied at the proper time, at the recommended rate; and the mixture must cover the entire foliage or fruit of the plant.

Most of the fungicides in use today are classified as protectants; that is, they protect the plant from the fungus rather than kill the fungus. If the fungicide was applied at the rate required to kill the fungus, it would injure the plant.

There are more than 250 trade names of fungicides suggested for the control of fungi. This is too many for the average person to remember. Also, the individual may become confused by the use of the two names, trade name and common name, given a fungicide. Because chemical companies sell fungicides with the same ingredients under different names and because the trade name and common name of fungicides are both used, the following chart is given to assist the student in identifying fungicides.

Common Name	Chemical	Manufactor's Trade Name
Captan	N-trichloro-methylthiotet-rahydrophthal-inide	Orthocide 50 Wettable, Orthocide 75 Seed protectant, etc.
Chloranil	Tetrachloropara-benzoquinone	Spergon, Spergon-SL, Spergon Wettable, etc.
Dichlone	2, 3 dichloro, 1, 4-naphthoquinone	Corona Phygon-XL, Phygon XL, Phygon Navgets, etc.
Dodine	Dodecylquanidine acetate	Cyprex
Ferbam	Ferric Dimethyl dithiocarbamate	Fermate, Ferberk, Karbam Black, Ferradow, etc.
Glyodin	2-Heptadecyl glyoxalidine	Crag 341-C, Crag Glyodin solution
Maneb	Ethylene Bisdithiocar-bamate	Manzate, Dithane-M22
Nabam	Disodium Ethylene Bisdithiocarbamate	Dithane D-14, Parzate liquid, etc.

Application of Fungicides
(Information Sheet continued)

Common Name	Chemical	Manufactor's Trade Name
Thiram	Tetramethyl Thiuram Disulfide	Arasan, Panoram, Thylate, etc.
Zineb	Ethylene Bisdithio-carbamate	DuPont Fungicide"A", etc.
Ziram	Zinc Dimethyl Dithiocarbamate	Corozate, Karbam White, Niagara Z-C, etc.

Assuming a positive identification of the fungus or disease has been made, several important decisions must be considered before applying the fungicide. Some of the decisions are the selection of the fungicide to use, kind of auxiliary agent to use - if any - kind of application, method application, and time of application.

In order to make a wise choice of fungicides, the student must possess knowledge of the compatibility of the fungicide to other fungicides and chemicals, the susceptibility - high, low, or medium - of the fungus to the fungicide, point of infection, and the habitat - growth stages and soil conditions - of the fungus.

Several auxiliary agents are available, and their use usually increases the effectiveness of the fungicide. These agents and an explanation of each are as follows:

1. Wetting Agent - A material used with the fungicide to reduce the surface tension of particles and to eliminate air between a solid and a liquid.

2. Spreader - A material used to facilitate creeping or spreading over a surface so that the area covered is increasingly greater.

3. Adhesives - Material used to increase the adhesion of fungicides.

4. Deflocculating Agents - Materials which keep particles from each other to prevent flocculation and to assure dispersion and to retard settling of a solid within a liquid.

5. Emulsifier - A material used to facilitate formation or increase dispersion of one liquid within another.

6. Safeners - A material used to counteract the chemical characteristics of a material which may normally cause phytotoxic effects.

Application of Fungicides
(Information Sheet continued)

The kinds of applications available are complete sprays, mist sprays, dusts, aerosol fog, and fumigants. In controlling fungus, one must decide the kind of fungicide application he is going to use.

As was stated in a previous paragraph, the method of applying the fungicide is important. Methods that may be used are seed treatment, spraying, dusting, drenching, furrow treatment, planter treatment, soil fumigation, dips and paints.

Possibly, one of the most important decisions in controlling fungus is to determine the time to apply the fungicide. To make this decision, one must understand the stages of fungus growth, the condition of plants, moisture conditions, temperature, humidity, and equipment available.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Bactericides

TOPIC: Bacteria

OBJECTIVE: To become familiar with the role of bacteria in the world.

REFERENCES:
Required:
1. Information Sheet, "General Characters of Bacteria"
2. Plant Diseases, Yearbook of Agriculture - 1953, pp. 10-14.

QUESTIONS OR ACTIVITIES:

1. Give three reasons why bacteria are significant.
2. If all the descendants of one bacteria cell lived, how many individual cells would be present in 24 hours?
3. Name the three general shapes of bacteria.
4. What do all bacteria require in order to grow?
5. List and briefly explain the four groups of bacteria in regard to their need for oxygen.
6. Briefly discuss the difference between aerobic and anaerobic.
7. Upon what two items should a student base his identity of animal or plant diseases?
8. Name three ways in which bacteria can gain entrance to plants.
9. List the 13 ways that plants can respond to invasion by bacteria.
10.
11.

Information Sheet
on
GENERAL CHARACTERS OF BACTERIA

Man has known for several years that fungus diseases cause tremendous economic losses to crops, but not until more recent years has he recognized that bacteria diseases also cause losses.

Bacteria, being some of the smallest organisms known to man, require the microscope to be seen. They are significant in our society because of their small size, their ability to multiply rapidly, and their various biochemical activities.

Bacteria cells multiply by division (fission) into two cells. This division of each cell may occur every hour so that if all of the descendants of one cell lived, in 24 hours there would be about 17,000,000 individual cells. It is easy to see that when we provide the right conditions for bacteria to grow and reproduce, their influence or damage can appear "overnight."

The three general shapes of bacteria are spherical (cocci), cylindrical (called rods or bacilli), and spiral, with loops or just a small section of a spiral (vibrio). Their ends may be pointed or blunt. Some form spores, some are motile, and some are capable of both.

Bacteria, like plants, obtain nutrients for growth and reproduction by absorbing food materials in solutions through their cell walls. Some forms are able to manufacture all of their food requirements, while others must have these factors supplied in various forms.

Although all bacteria require a definite, but small, concentration of carbon dioxide (CO_2) to grow, they can be divided into four groups in regard to their need for oxygen from the air. These include:

1. Facultative anaerobes - Can grow and reproduce in either the presence or absence of air.

2. Obligate anaerobes - Remain dormant or die in the presence of air.

3. Microaerophylic - Can tolerate only a small amount of oxygen.

4. Obligate aerobes - must have a full supply of air in order to grow.

General Characters of Bacteria
(Information Sheet continued)

The terms aerobic and anaerobic are easily remembered if the student will realize that the first three letters of aerobic could be spelled air, which would mean air is present. The prefix an in anaerobic comes from the work anti, which means against or opposite. The opposite of air being present is air being absent, so anaerobic means in the absence of air.

Bacteria produce an interesting effect when present in the bloodstream of an animal (man included). The student is probably familiar with the general theory behind vaccinating animals, so we will attempt to support this theory with a general example.

> Blackleg in cattle is caused by an infection of certain species of bacteria. We inject a certain amount of dead bacteria of these species into the bloodstream of a healthy calf. These bacteria cause substances, known as antibodies, to form in the animal's bloodstream. Since these bacteria were dead, they can't reproduce; but, the calf now has these antibodies in his body ready to devour any bacteria of this type. So, if the calf gets into an infected area and some of these bacteria invade his bloodstream, the antibodies present eat them and they never get the chance to reproduce and build up. Thus, we say that the calf is vaccinated against Blackleg.

Just as we have learned to identify diseases of animals in the field, so must we do for plant diseases. If the student plans to pursue a course of study in college as a pathologist, then he will learn to identify different fungi, viruses and bacteria. For our purpose in this course of study, the student should learn to identify plant and animal diseases based upon symptoms and experiences (both his and those of others), and use the chemicals that are available for controlling them based upon these symptoms.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Bactericides

TOPIC: Bactericides

OBJECTIVE: To help the student understand the broad nature of bactericides and become familiar with the names of bactericides being used.

REFERENCES:

Required:

1. Information Sheet, "Bactericides"
2. Plant Diseases, Yearbook of Agriculture, 1953, pp. 313 & 314.

QUESTIONS OR ACTIVITIES:

1. What are the three classifications for animal bactericides?
2. Why has the use of bactericides on plants been limited?
3. Obtain at least three leaflets on bactericides from your employment station and bring them to class.
4. From one of the leaflets in Number 3, list the diseases that can be treated, the plants that can be treated, and the special instructions on use.
5.
6.

Information Sheet
on
BACTERICIDES

Bactericides are rather common for control of bacterial diseases in animals. These bactericides can be classified as:

a. Antibiotics
b. Sulfa drugs
c. Furazolidone

There is more limited use of bactericides in controlling bacterial infection in plants. Generally, the treatments have been of limited success and costly. The antibiotic, streptomycin, has provided some control of fireblight in apples and pears and walnut blight.

The student would get a current outlook on bactericides if he could obtain leaflets on specific bactericides where he is employed and study them.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Nematocides

TOPIC: Nematocide Uses and Terminology

OBJECTIVE: To develop an understanding of nematocide uses and to become familiar with the terminology as it relates to the subject of nematodes and nematocides.

REFERENCES:

Required:

1. Information Sheet, "Nematocide Uses and Terminology"

Supplemental:

2. "What You Should Know About Plants," B-995, Texas Extension Service pp. 13-14
3. Protecting Our Food, 1966 Yearbook of Agriculture, U. S. D. A. pp. 40-42.

QUESTIONS OR ACTIVITIES:

1. Name five nematocides commonly used to control nematodes. Use Chemical name.
2. Why should different specialized fumigants be used?
3. When should a nematocide be used?
4. List the trade name of soil fumigants that should be used to control nematodes in the following areas:
   a. Potting soils and seed-beds.
   b. Tree and shrub areas
   c. Soils planted to vegetable crops.
   d. Soils planted to cotton and peanuts.
   e. Soil areas for ornamentals.
5. What is a soil fumigant and why is it used?
6.
7.

Information Sheet
on
NEMATOCIDE USES AND TERMINOLOGY

Nematodes are resistant to most chemicals due to the protective covering. The nematode egg is also resistant to most chemicals due to a waxy material that prevents penetration of the chemical into the egg.

As early as 1881 attempts were made to chemically control nematodes. Since World War II scientists have developed fumigants that have helped control nematodes, thereby increasing yields of crops on soils that were once heavily infested with the organisms. Chemicals have brought back into production many acres of fertile land that were abandoned by farmers because there soils just wouldn't produce.

The most commonly used nematocides are:

1. Dichloropropene - Dichloropropane - This nematocide is used primarily for field crops, and against all major species of nematodes.
2. Ethylene dibromide - This nematocide is used primarily for field treatment but it is ineffective against cyst and root-lesion nematodes.
3. Methyl bromide - This material is packaged in small cylinders and is recommended for use against many types of nematodes in small areas.
4. Trichloronitromethane (Chloropicrin) The tear gas is an excellent soil fumigant, but it is also expensive. It is used primarily for seed beds and potting.
5. Debromochloropropane (trade name nemagon) - This nematocide is used primarily for seedbed treatment for preplant, at the time of planting and post-plant application. It can be mixed and used in a water solution.

Different soil fumigants are used due to various types of soils, different types of soil-borne nematodes, and the variation of crops that are attacked by the pests. Some species of plants are highly sensitive to some types of chemicals, while label restrictions limit the use of others on certain crops. The formulation of fumigants differs in regard to their activity against specific organisms.

Hardly any area of crop land is free of nematodes or some other type of root disease. A nematocide should be used when nematode plant injury and soil infestation have been identified. The presence of plant-parasitic nematodes does not always indicate a need for control, however, nematodes may be present, but in numbers small enough not to cause sufficient damage to require special control measures, especially on crops of low value per acre. Symtoms of nematode infestation can be seen above and below-ground. Plants may show dead buds, seed and leaf galls, crimped stems and foliage, discoloration, root galls, rot, lesions, and leaf spots. The plant laboratory can detect and identify the nematodes by microscopic examination.

D-D soil fumigant is used as a general nematocide. It is less effective against sting and potato rot than the bromides. Ethylene bromide, under the trade name of Dowfume W-85, has been used effectively on cotton, peanut, strawberry, and tree and shrub

Nematocide Uses and Terminology
(Information Sheet continued)

planting sites.

Fumazone 86 and Nemagon are trade names for 1,2-dibromo-3-Chloropropane, and are useful in controlling nematodes in peanuts, cotton, strawberries, certain vegetables, and ornamentals.

Chloropicrin is useful for fumigating potting soils and plant seed beds. The fumes are toxic to plants, especially if the plants are wet. Larvacide or Picfume, the trade names of Chloropicrin, may be used on strawberry, floral crop, and vegetable areas.

Methyl bromide, when mixed with other fumigants, may be found under the trade names of Dowfume, Bonzone, Pestmaster, Bed-Fume, and Trizone. These fumigants can be used on soil areas for trees and shrubs, ornamental nurseries, fruit trees, and vegetables.

Definitions:

Nematocide - a chemical that kills nematodes.
Nematode - a microscopic worm (often called eelworm and roundworm) that seldom exceeds one-eighth of an inch in length.
Fumigant - a solid or liquid that forms vapors which destroy pathogens, insects, fungi, and many other forms of animal and plant life.
Soil sterilization - freeing the soil of microorganisms.
Pathogen - any organism capable of causing disease.
Gall - a pronounced swelling; an outgrowth, consisting of unorganized cells.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Nematocides

TOPIC: Nematodes Infesting Soils

OBJECTIVE: To learn about some of the most common types of nematodes that infest the soils.

REFERENCES:

Required:

1. Information Sheet, "Nematodes Infesting Soils"

Supplemental:

2. Plant Disease Handbook, Westcott, D. Van Nostrand Company, Inc., New York, 1950, pp. 241-242
3. Plunder Underground, A Handbook; The Dow Chemical Company, Midland, Michigan, 1966, pp. 24-25.

QUESTIONS OR ACTIVITIES:

1. What type of host is preferred by the nematode?
2. List three groups of nematodes that inhabit the soil.
3. What are the five most common types of nematodes?
4. Are all nematodes termed parasites by all writers?
5. What is the most common method used in controlling the nematode by use of chemicals?
6. Can nematodes be completely eliminated from the soil by fumigation?
7. What approved practices are effective in controlling nematodes?
8.
9.

Information Sheet
on
NEMATODES INFESTING SOILS

The soil nematodes live in a small soil area; they may not move more than thirty inches in a year. They are usually spread by water movement (irrigation), transfer of infested plants, soil on machinery, hoofs of animals, and shoes of workers. The bud, leaf, and steam nematode may hatch and live in the plant, but may get into the soil and live from one season to the next.

Nematodes live in moist soil, in plant tissue and other organisms, as well as in decaying matter. The predacious species live on small animal life and other organisms. The saprophagous species live on decaying plant matter and a third species feed on plants.

There are several genera of soil nematodes. The most common types are as follows:

1. Root-knot, genus meloidogne
2. Cyst, genus Heterodera
3. Burrowing, genus Radopholus
4. Lesion, genus Pratylenchus
5. Sting and owl, genera Belovolaimus and Dolichodorus
6. Citrus, genera Nacobbus and Meloidodera
7. Bud and leaf, genus Aphelenchoides
8. Stem, genus Ditylenchus
9. Seed-gull, genus Anguina
10. Stubby-root, dagger, and needle, genera Xiphinema and Longidorus
11. Lance, genus Hoplolaimus

Nematodes are known as thread worms, roundworms and eelworms. They are generally thought of as plant and animal parasites, but some writers class certain nematodes (root surface feeders) as grazers and browsers.

Due to the resistance of nematodes to most chemicals it has been necessary to develop fumigants from volatile and other similar chemicals. There are many treatments effective against nematodes, but there is no treatment that has a permanent lasting effect against this particular soil parasite.

The practices that have been approved in controlling the nematode are as follows:

Sanitation - Soils have been cleaned of materials that provide a natural habitat. Sterlization by steam and heat have proved to be successful in cleaning soils.

Crop rotation - Plants that do not serve as a host to the nematode have been planted in infested soils.

Fumigation - Chemical control methods have been used with success since 1945. The cost may vary from $40 to $500 per acre.

Flooding - Areas remaining under water for periods of time have been freed of nematodes.

Nematodes Infesting Soils
(Information Sheet continued)

Selection of Planting Stock - Planting stock should be inspected for nematode symptoms before it is transferred to a soil free of nematodes.
Fallowing - Land is allowed to be idle for a growing season. The land is usually cultivated to destroy weed growth and conserve moisture.

TYPES OF NEMATODES

Cyst formers

Cabbage Cyst Nematode, *Heterodera cruciferae*	Cabbage
Carrot Cyst Nematode, H. *carotae*	Carrots
Clover Cyst Nematode, H. *trigolii*	Clover and other legumes
Golden Nematode, H. *rostochiensis*	Irish potato, Tomato, Eggplant
Grass Cyst Nematode, H. *punctata*	Small grains, such as wheat
Hop Cyst Nematode, H. *humuli*	Hop, Hemp
Oat Cyst Nematode, H. *avenae*	Small grains, Corn, Grass
Pea Cyst Nematode, H. *goettingiana*	Peas
Soybean Cyst Nematode, H. *glycines*	Soybeans
Sugar Beet Nematode, H. *schachtii*	Celery, Sugar Beets, Cress, Turnips, Spinach, Radishes
Tobacco Cyst Nematode, H. *tabacum*	Tobacco, Tomato

Root penetrating nematodes (endoparasitic)

Potato Rot Nematode, *Ditylenchus destructor*	Potato, Dandelion

Root-knot nematodes, *Meloidogyne* spp.

(Several species and varieties)	Found in more than 1,700 host plants including small grains, grasses, fruits, vegetables, nursery crops and field crops.

Root lesion or meadow nematodes

Smooth-headed nematode. *Pratylenchus brachyurus*	Potato, Corn, Peanuts, Cotton, Tobacco
Coffee Nematode, P. *coffeae*	Coffee, Tea, Abaca, Cane, Banana, Tobacco, Wheat, Corn, Olive

Nematodes Infesting Soils
(Information Sheet continued)

Root lesion or meadow nematodes (continued)

Schribner's Meadow Nematode, P. scribneri	Potato, Strawberry
Thorne's Meadow Nematode, P. thornei	Wheat, Grains, Grass
Lesion Nematode, Pratylenchus sp.	Fruits, Citrus, Walnut, Grape, Raspberry, Rose
Corn Nematode, P. Zeae	Corn, Wheat
Rice Nematode, Aphelenchoides oryzae	Rice
Burrowing Nematodes, Radopholus similis	Citrus, Ornamentals, Avocado
Kidney-shaped or Reniform Nematode, Rotylenchulus reniformis	Turf, Cotton, Peanut, Tomato, Ornamentals
Citrue Nematode, Tylenchulus semi-penetrans	Citrus trees, Olive

Nematodes that feed on root surfaces (ectoparasitic)

Sting Nematode, Belonolaimus spp.	Corn, Cotton, Ornamentals, Celery, Vegetables, Peanut, Pine
Ring Nematode, Criconemoides spp. and Criconema spp.	Cotton, Peanut, Citrus, Decidious Fruit
True Spiral Nematode, Helicotylenchus spp.	Peanut, Tobacco, Tomato, Clover
Lance Nematode, Hoplolaimus spp.	Nursery Crops, Cane, Alfalfa, Red Clover, Peppermint
Pin Nematodes, Paratylenchus spp.	Many Vegetable Crops
Spiral Nematodes, Rotylenchus spp.	Ornamentals
Stubby Root Nematodes, Trichodorus spp.	Corn, Celery, Beans, Peas, Tomato, Cotton, Beets, Pepper
Stylet Nematode, Tylenchorhynchus sp.	Tobacco, Corn, Cotton, Strawberry, Milo, Peanut, Beans, Ornamentals
Dagger Nematode, Xiphinema sp.	Cotton, Strawberry, Oats, Tobacco, Peaches, Nursery Stock

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Nematocides

TOPIC: Types of Nematocides

OBJECTIVE: To become familiar with the most common types of nematocides and their chemical formulations.

REFERENCES:

Required:

1. Information Sheet, "Types of Nematocides"

Supplemental:

2. Plunder Underground, a Handbook, The Dow Chemical Company, Midland, Michigan, 1966, pp. 26-27.
3. Plant Nematodes, Their Bionomics and Control, Christie, Hand W. B. Drew Company, Jacksonville, Florida, 1959, pp. 36-40.
4. "1966 Nematode Recommendations", Agricultural Extension Service, Virginia Polytechnic Institute, Blacksburg, Virginia, Circular 998.

QUESTIONS OR ACTIVITIES:

1. What type of hydrocarbons are considered the most effective nematocides?
2. List the trade name of the following chemical compounds:
   a. Ethylene dibromide - _____
   b. Dichloropropene - _____
   c. Dibromochloropropane - _____
   d. Methyl bromide + Chloropicrin - _____
   e. Chloropicrin - _____
3. What compounds are used in the following fumigants:
   a. Vidden - _____
   b. Bromogas - _____
   c. Dorlone - _____
   d. Nemagon - _____
   e. Larvacide - _____
4. Is there an effective method for controlling nematodes with any type of nematocide in established trees and shrubs?
5.
6.

Information Sheet
on
TYPES OF NEMATOCIDES

The halogenated hydrocarbons are considered the most effective nematocides since nematodes are senstivie to the halogens. As mentioned in the topic, "Nematocide Uses and Terminology", there are five compounds that are considered most effective against the nematode. The compounds are:

1. Methyl bromide
2. Ethylene bromide
3. Dichloropropene
4. Chloropicrin
5. Dibromochloropropane

Each of the compounds has certain characteristics that distinguish them from other compounds that are used for the same purpose.

The five most common types of nematocides used to control nematodes are:

1. Dichloropropene known as 1,3-dichloropropene and 1,2-dichloropropane is a brown volatile liquid soil fumigate. The soil fumigate made up of 1,3-dichloropropene and related C_3 hydrocarbons is sold under the trade name TELONE.
2. Ethylene dibromide is a clear liquid fumigate. Formulations containing a certain percent of the chemical are sold under the trade names of DOWFUME W-85, SOILFUME 85, BROMOFUME 85, and NEMEX 85.
3. Nemagon soil fumigate is a chemical compound 1,2-dibromo-3-Chloropropane. It is a heavy, straw-colored liquid. The compound formulation is also sold under the trade name FUMAZONE.
4. Methyl bromide is one of the better known soil fumigants; it is a gas. When 1.4 percent of chloropicrin and 68.6 percent methyl bromide are mixed as a soil fumigant it is sold as BROZONE. Different percentage mixtures of the same two fumigants are sold as DOWFUME MC-2 and MC-3, and TRIZONE.
5. Chloropicrin is a yellowish volatile liquid sold under the trade name PICFUME and LARVACIDE. It is known as tear gas.

Fumigant trade names and their compound formulations are:

1. DD, Vidden D (dichloropropene - dichloropropane)
2. Telone (dichloropropene)
3. Dowfume - W85 Soilfume-85 (ethylene bromide, called EDB)
4. Trizone (methyl bromide + chloropicrin + propargyl bromide)
5. Bromethane, Bromogas, Dowfume MC-3 (methyl bromide)
6. Fumazone, Nemagon (dibromochloropropane)
7. Dorlone, Fieldfume (dichloropropene + ethylene dibromide)
8. Vapam (sodium methyl dithocarbamate)

Types of Nematocides
(Information Sheet continued)

No nematocide is ideal for all purposes. Most of the nematocides are toxic to plant life and must be used with caution. Also it is necessary that most fumigants leave the soil quickly, so that the soil can be used for seeding purposes. If the fumigant leaves the soil too quickly the residual nematode population has the opportunity to rapidly build up again.

There is a need for an effective non-phytotoxic nematocide (nematocide non-injurious to plants) to use around the roots of living plants. Established trees, shrubs, and other perennials suffer from nematode infestation due to a lack of effective method for controlling the pest.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Nematocides

TOPIC: Application of Nematocides

OBJECTIVE: To develop an understanding of methods used in applying fumigants in soils.

REFERENCES:

Required:

1. Information Sheet, "Application of Nematocides"

Supplemental:

2. Plunder Underground, a Handbook; The Dow Chemical Company, Midland, Michigan, 1966, pp. 4-13.
3. "1966 Nematode Recommendations", Agricultural Extension Service, Virginia Polytechnic Institute, Blacksburg, Virginia, Circular 998.

QUESTIONS OR ACTIVITIES:

1. What are the three methods used to fumigate a soil?
2. What methods are used to put the fumigant in the soil?
3. What are factors to consider in applying a fumigant?
4. How is the fumigant injected into the soil?
5. List the eight conditions to observe in applying nematocides.
6.
7.

Information Sheet
on
APPLICATION OF NEMATOCIDES

Most of the plant nematodes are inhabitants of the soil. The chemical method used to control nematodes is difficult due to the possiblity of injuring the soil for plant growth. The task of destroying the organism is also difficult due to it being soil-borne.

The three methods used to bring a chemical in contact with the organism are as follows:

1. Use of a chemical - by diffusion through the soil as a gas.
2. By dissolving the fumigant (chemical) in water and then dispersing it through the soil by water.
3. Mechanically mix the chemical in the soil.

Soil conditions must be right for fumigation. First, the soil should be fitted in a condition for planting. It should be well plowed, free of clods, crop refuse should be well decayed, and all trash should be buried. Second, the soil should contain the proper moisture and temperature recommended for the particular fumigant. Third, the fumigant must be properly sealed in the soil to prevent its escape into the air.

Fumigants are applied to the soils by various types of applicators. Applicator kits can be mounted on tractor equipment to include plows, harrows and cultivators. Custom applicators mounted or pulled behind the tractor make the furrows for the fumigant, deposit the fumigant, cover it, and then apply a broad cover of polyethylene all in one operation.

If a large area is to be treated, a tooth or chisel method can be used successfully. The chisels are spaced 10 to 12 inches apart behind the tractor. The chisels place the fumigant six to eight inches into the ground by means of tubes attached to the chisels. The furrow is immediately sealed. Row treatment is similar to broadcast or field treatment. The fumigant is applied only in narrow strips. This type of treatment is less expensive to apply.

The irrigation application method is one of the safest. The volatile fumigants are mixed in water at a certain number of parts per million. The water should be applied to the area within four to six hours if possible.

Sidedressing established plants can be practiced if Fumazone 70E and Fumazone 86 are used. Power equipment is used for a large area and hand injectors are used for small areas.

Application of Nematocides
(Information Sheet continued)

Conditions to observe in applying nematocides are:

1. Dichloropropene - dichloropropane
   a. Plow under crop residues and let decay.
   b. Soil should be moist with temperature between 40 and 80 degrees F.
   c. Soil should be in seedbed condition.
   d. A chisel applicator should have chisels spaced 12 inches apart. The chemical should be applied 6 to 8 inches below the surface.
   e. Apply chemical at rate of 20 gallons per acre.
   f. For row application use two chisels spaced 12 inches apart. On 3 foot rows it takes 13.3 gallons per acre.
   g. Immediately after application compact the soil with a float, roller, cultipack or similar sealing device to prevent rapid escape of gas.
   h. Do not disturb soil for 14 days.
   i. Plow soil to aerate.
   j. Use a 30% nitrate solution to protect soil against nitrogen deficiency.

2. Telone
   a. Apply at the rate of 16 gallons per acre, chiseled 12 inches apart.
   b. 3-foot rows require 10.6 gallons.
   c. Use procedures that are given in No. 1 above.

3. Ethylene dibromide
   a. Applied at 4.5 gallons per acre. Chiseled 12 inches apart.
   b. 3-foot rows use 3 gallons per acre.
   c. Other application procedures are the same as No. 1 above.

4. Trizone
   a. Apply chemical at the rate of 140 to 200 pounds per acre.
   b. Use 12 inch chisels as in 1, 2, 3 above.
   c. Leave soil covered (tarp) at least two full days and up to five days.
   d. Planting can follow 4 days after cover is removed. And transplanting can begin two to three weeks after cover is removed.

5. Vorlex
   a. Chisels should be set 6 to 8 inches apart. Apply at a rate of 10 to 60 gallons per acre.
   b. Follow steps in No. 1 above.

Application of Nematocides
(Information Sheet continued)

6. Methyl bromide
   a. Apply 2 pounds per 100 square feet under gas tight plastic cover.
   b. Cover should remain in place two days.
   c. Use a nitrate fertilizer as in No. 1.
   d. Methyl bromide should be preheated before using. The container should be heated at 160 to 170 degrees.

7. Nemagon
   a. Apply at the rate of four gallons per acre.
   b. Use other procedures as listed in No. 1.

SAFETY PRECAUTIONS OF NEMATOCIDES

1. Do not breathe vapors.
2. Keep chemical away from skin and clothing.
3. Do not wear contaminated clothing until it is free of chemical odor.
4. If chemical gets in eyes flush for several minutes with flowing water and get medical attention.
5. Do not use chemicals in closed areas.
6. Wash skin thoroughly with soap and water after handling chemical.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used in the Control of Rodents

TOPIC: Chemical Control of Rodents

OBJECTIVE: To lead the student to understand the importance of chemical control of rodents.

REFERENCES:

Required:

1. Information sheet "Chemical Control of Rodents"

Supplemental:

2. "Rodent Eradication and Poisoning Programs," Training Guide - Rodent Control Series, 1964 U. S. Department of Health, Education and Welfare pp. 1-4.

QUESTIONS OR ACTIVITIES:

1. How expensive are rodents?
2. List the ways that rodents can cause expensive damage.
3. List some ways of controlling rodents other than chemical control.
4. What type of rodent damage are farmers most concerned with?
5.
6.

Information Sheet
on
CHEMICAL CONTROL OF RODENTS

Rodents cause farmers and other residents losses amounting to millions of dollars each year. Cities, towns, and farms, residences and commercial establishments all provide food and shelter for rodents, and suffer the inevitable consequences. The greatest damage is to foods and feedstuffs. Not only is a large amount of food eaten, but several times this amount is contaminated and spoiled. It has been conservatively estimated that one adult rat will have caused twenty dollars damage. It is further estimated that for each rat seen about the farm premises there are at least twenty other rats in hiding.

Rats and mice deposit their droppings and urine on food while they are feeding. They are constantly shedding their hair, and filth is carried by them in their travels. Food exposed to rodents quickly becomes unfit for human consumption.

Rodents create further damage by continually gnawing materials and packages. Their burrows undermine foundations and footings. They carry many diseases and parasites, and will even bite humans. All these damages are unnecessary and can be controlled.

There are various means of controlling rodents, and poisoning is the method most often used in community programs.

For the best results, rat poisoning activities must be coordinated with the other rodent and ectoparasite control measures. A combination of rat poisoning (with DDT dusting if necessary), good general house keeping, and rat proofing, can be very effective and long lasting.

Poisoning operations are best scheduled to follow DDT treatment, but they should precede or accompany the clean-up of garbage and rubbish, proper food storage, the removal of harborage and ratproofing.

Rat poisoning operations should be extended over large areas, treating every infestation, both inside and outside of buildings.

Because the center of activity is widely separated, reinfestation takes longer in rural areas and the individual farmer gets longer lasting results from rat killing than does the city dweller.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used in the Control of Rodents

TOPIC: Types of Rodenticides

OBJECTIVE: To develop an understanding of the types of rodenticides available and the effectiveness of each.

REFERENCES:
Required:
1. "Rodent Eradication and Poisoning Programs," U. S. Department of Health, Education, and Welfare, 1964. pp. 23, 29-47

QUESTIONS OR ACTIVITIES:

1. What are the two rodenticides which should be the only ones used by the public when there is no supervision by trained personnel?
2. What are the chief disadvantages of the rodenticide called 1080?
3. Name five anticoagulant type rodenticides.
4. Name the two single dose rodenticides which are natural poisons.
5. How long does it generally take for Red Squill to kill a rat?
6. How long does it generally take for ANTU to kill a rat?
7. What type of rat will ANTU kill?
8. Can 1080 cause secondary poisoning?
9. What type of rodent will DDT kill?
10. Would you recommend any of the inorganic rodenticides? Why?
11. Explain how the anticoagulant rodenticides kill.
12. How long does it take to kill rodents with anticoagulants?
13. How long will you have to bait with an anticoagulant to get rodent control?
14.
15.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used in the Control of Rodents

TOPIC: Application of Rodenticides

OBJECTIVE: To develop an understanding of the methods used for application of rodenticides.

REFERENCES:
Required:
1. "Rodent Eradication and Poisoning Programs," U. S. Department of Health, Education, and Welfare, 1964, pp. 25-59

QUESTIONS OR ACTIVITIES:

1. Study those parts of the reference which are concerned with bait formulation and their application, placing particular emphasis on red squill and the anti-coagulants.
2. What are four ingredients commonly incorporated into a rat bait?
3. Why is it important that only the amount of poison recommended be mixed in a bait?
4. What is a major requirement which must be met to give good results with water baits?
5. What is the purpose of pre-baiting?
6. What proportions by weight of red squill, food, and binder should be used to make a bait?
7. Name the first anticoagulant rodenticide discovered.
8. What mixture by weight of corn meal and warfarin would you need for killing roof rats? For Norway rats and mice?
9. How would you mix a bait of warfarin for mice which do not accept the above mixture?
10. How much charcoal can be added to 20 lbs. of bait to discolor it so it will not be mistaken for food?
11. How may proportions of watersoluble anticoagulant would you mix with water and sugar for a water bait?
12. Study different types of containers and positioning of containers to get effective poisoning safety. Pages: 50-54 "Rodent Eradication and Poisoning Programs."
13.
14.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used in the Control of Predators

TOPIC: Control of Predators

OBJECTIVE: To develop an understanding of the need for and the terminology used in controlling predators with chemicals.

REFERENCES:
Required:
1. Information Sheet, "Chemical Control of Predators"

QUESTIONS OR ACTIVITIES:

1. Name six predators which are of economic importance.
2. What are three kinds of birds which may be predators?
3. How can chemicals for control of predators be classified?
4. Can a landowner use any kind of chemical authorized for predator control? Explain.
5. Would you recommend to anyone having a pest control problem to use chemical control? Explain.
6.
7.

Information Sheet
on
CHEMICAL CONTROL OF PREDATORS

A predator can be defined generally as an animal that lives by killing or consuming animals, or eating crops in such a way that the predation causes much waste of the crop along with that which is eaten.

The predators of economic importance in Texas are gophers, coyotes, fox, prairie dogs, rabbits, moles, and others, to a limited extent in some areas, which can be controlled chemically. Chemicals normally used are of a type which kill these animals. There are repellents on the market today however, which can be used against some of these animals as well as for crows, pigeons, gulls, and others.

The damage done collectively, or even individually, for some species can be disastrous. A coyote, for example, can kill or cripple many sheep and goats in a very short time. Crows, can eat and destroy large amounts of crops in a short period also.

There are laws governing control of some species of predators. Anyone being molested should check with the local game warden before taking action, to determine what can legally be done. The land owner however, normally, can protect his property from predators.

The chemical control of predators is sometimes limited to only those who are licensed pest control operators while other types of chemicals can be purchased and used by land owners. It is extremely important that anyone using chemicals for predator control realize the full capabilities of the chemical he is using. Some of these chemicals, applied incorrectly, may be dangerous or even kill domestic animals, pets, and children.

Anyone who has a problem with predators should keep in mind that chemical control is only one method available. It may be more practical to control predators with other methods thereby eliminating the dangers involved with chemical control. Regardless of the method used it is of great economic importance that they be controlled.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used in the Control of Predators

TOPIC: Types of Chemical control and application of chemicals.

OBJECTIVE: To learn the different chemicals which are used for predator control and the correct application of these chemicals.

REFERENCES:
Required:
1. Agricultural Chemicals Book III, Thomson, W. T. pp. 134-137, 140-141, 147-149, 107-109, 112-116

QUESTIONS OR ACTIVITIES:

1. Explain how to prepare baits using strychnine.
2. How can grain treated with strychnine be prepared so as not to harm birds?
3. What is the toxicity of strychnine?
4. Who can use Compound 1080?
5. Can Boyer 38819 be sold?
6. In what proportions do you mix Thallium Sulfate and baiting materials?
7. What type of compound is Zinc Phosphoride?
8. Name three animals that Tetramethylthiram Disulfide will repel.
9. ZIP will repel what animals?
10. Name the four repellents of birds.
11.
12.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Plant Regulators

TOPIC: Introduction to the Use of Chemicals as Plant Regulators

OBJECTIVE: To understand the type of chemicals used for the purpose of controlling or regulating plant growth.

REFERENCES:
Required:
1. Seeds, The Yearbook of Agriculture 1961, U.S.D.A., Washington, D.C., pp. 51-57.

QUESTIONS OR ACTIVITIES:

1. List several chemicals which control plant growth.
2. How does Amo-1618 affect the growth of some plants?
3. In what ways may plant growth be regulated?
4. What is a common use of 2,4-D?
5.
6.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Plant Regulators

TOPIC: Terminology

OBJECTIVE: To assist the student in understanding terms pertinent to plant growth regulators.

REFERENCES:
Required:
1. Seeds; The Yearbook of Agriculture, 1961, U.S.D.A., Washington, D.C. pp. 561-578.

QUESTIONS OR ACTIVITIES:

1. Compare a glossary of the following terms pertinent to growth regulators.
   a. Defoliant
   b. F_1
   c. Gibberellins
   d. Herbicide
   e. Hormone
   f. Inhibit
   g. Inhibitor
   h. Inhibitory
   i. Partheno carpic
   j. P.P.M.
   k. Plant regulators
   l. Synthetic growth substances
   m. Systemic
   n. Weed
   o. 2,4-D
   p. 2,4,5-T
   q. Amo-1618
2.
3.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Plant Regulators

TOPIC: Plant Physiology and Nutrition

OBJECTIVE: To develop an understanding of the life processes of plants and how they are affected by available nutrients.

REFERENCES:
Required:
1. Crop Production In the South, Klingman, Glenn C., pp. 13-35.

QUESTIONS OR ACTIVITIES:

1. What are the three classifications of substances used by both plants and animals for energy and growth?
2. What is meant by the term "photosynthesis?"
3. Name the fifteen elements essential for growth of plants.
4. Generally, what is the difference between photosynthesis and respiration in plants?
5. How does the respiration rate of plants affect the rate of nutrient uptake?
6.
7.

Assignment Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Plant Regulators

TOPIC: Method of Application

OBJECTIVE: To develop an understanding of the method of application for each of the growth regulator chemicals.

REFERENCES:
Required:
1. Agricultural Chemicals, Book III, Thomson, W. T., pp. 61-106.

QUESTIONS OR ACTIVITIES:

1. Explain the application of G.A. on the Thompson Seedless variety of grape.
2. Explain the use of Fusarex to prevent potatoes from sprouting.
3. What four fruit types can be thinned with DNBP?
4. What fruit will sevin thin?
5. What effect will 3-CP have on Duarte Plum and French Prune beside chemical thinning?
6. Which is safer for thinning peaches, 3-CP or 3-CPA?
7. What are four uses of TIBA?
8. How many applications of MH are usually needed to stop runner growth?
9. When should Nip-A-Thin be applied to fruit trees?
10. When and why would you apply Duraset the first time on greenhouse tomatoes?
11.
12.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Introduction

TOPIC: Opportunities in the Agricultural Chemical Industry

1. Fungicides, herbicides, rodenticides, nematocides, insecticides, fumigants, defoliants, desiccants, and plant regulators
2. Salesmen, warehouse employees, pest control operators, crop dusters, related businesses, governmental organizations, and private manufacturing organizations.
3. By maintaining production. A decrease in production could increase food costs from fifty to seventy-five percent.
4. Pesticides
5. The development of modern pesticides with technical advances
6. Ancient times
7. Brimstone (sulfur)
8. Twenty-five to thirty percent
9. Increases in production, improved varieties, world-wide transportation system
10. Chemicals
11.
12.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Introduction

TOPIC: Importance of Agricultural Chemicals

1. Control of insects, grasses, and weeds increasing output per man-hour and yield per acre

2. a. Lower food prices because of increased efficiency
   b. Better quality products and more yield per acre
   c. Nutritional deficiencies are reduced.

3. Excellent

4. a. Elimination of diseases carried by pests
   b. Eradication of human and some animal diseases
   c. Preventing diseases

5. a. Improve enjoyment of outdoor activities
   b. Control of weeds and brush along highways
   c. Increases participation in sports events
   d. Provides increased wildlife supply for hunting activities

6. a. Insecticides
   b. Fungicides
   c. Herbicides
   d. Rodenticides
   e. Antibiotics
   f. Nematocides
   g. Molluscicides
   h. Plant regulators
   i. Desiccants and defoliants

7.

8.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Introduction

TOPIC: Federal and State Laws Pertaining to Agricultural Chemicals

1. 1906

2. Under the 1938 Federal Food, Drug, and Cosmetic Act, the Food and Drug Administration could not bar the use of a chemical unless it could prove in court that the chemical was poisonous or harmful to man.

3. The Miller Amendment placed the responsibility for clearing each chemical with the USDA and FDA on the manufacturer. It also requires that the product, when sold, carry on its label full and specific instructions for its use so as to leave no residue above the legal limit set by the FDA. It further stipulated that the responsibility for using the chemical lies with the user, and his crop could be confiscated if it contained more than the legal residue.

4. The Act placed the responsibility for registration of the product with the manufacturer. It also provided for the establishment of safety precautions in applying and handling agricultural chemicals.

5. Tolerance is the amount of a chemical that has been determined to be safe to remain on crops.

6. Exemption means that certain crops have been exempted from the requirement of a tolerance.

7. The Food Additive Amendment prohibited the use of substances in food until they have been tested to determine if they are safe.

8. No. In order to determine the laws regulating the use of herbicides in a county, one must use the latest Herbicide Regulation. These are available from the office of the State Commissioner of Agriculture.

9. a. Name of the purchaser
   b. Mailing address of purchaser
   c. The date of the sale or delivery
   d. Amount and kind of herbicide sold
   e. Area to which the herbicide is to be applied

10.

11.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Salesmanship

TOPIC: Introduction, Agricultural Salesmanship

1. a. Poor service rendered
   b. Discourteous treatment received
   c. Indifference on the part of the salesman
   d. Lack of product information on part of salesman
   (Personal experiences may be varied)

2. Need - may or may not be recognized by the customer. It is based upon reason.
   Desire - is a feeling of need. It may not be based upon reason.

3. a. The selling process
   b. The merchandise
   c. The firm
   d. Himself
   e. His relation to the customer
   f. The customer

4. a. Deals directly with the public
   b. Helps others make decisions
   c. Something "new" everyday
   d. Success is quickly recognized
   e. Enjoys high prestige

5. A satisfied customer

6. Everyone; the salesman, the firm, the customer and the public

7. a. Awakens human wants
   b. Satisfies human wants

8. a. His need
   b. The price
   c. The product needed
   d. The source (firm or store)
   e. The time

9. The product that best fits his needs

10. a. Courtesy
    b. Sincere interest

11. Helping the customer to buy intelligently

12.

13.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Salesmanship

TOPIC: Meeting the Customer

1. The first contact gives the customer a lasting impression of the salesman and the business.

2. A well-groomed salesman: (a) attracts customers, (b) inspires customer confidence.

3. Enthusiasm is difficult if the job is unpleasant.

4. a. Promptness
   b. Alertness
   c. Interest in the customer and his problems

5. The customer should be treated as a guest.

6. Exercise in recognition of personal characteristics

7. a. Participation in community activities
   b. Chamber of Commerce information
   c. A personal notebook on customers
   d. Comments made by others
   e. Past sales records
   f. Questions asked others
   g. Newspapers

8. Exercise in customer impressions. Depends upon the student's observations.

9. Exercise in product knowledge. Check for extent of knowledge.

10. Exercise in product knowledge, designed to make student aware of customer knowledge of product.

11. a. Good appearance
    b. Stock displayed attractively
    c. Knowledge of merchandise
    d. Knowledge of customer
    e. Knowledge of firms advertising
    f. Selling sentences
    g. Knowledge of competitor's product
    h. Possible customer objections and methods of meeting them

12. a. Discussions with other employees
    b. Stock duties
    c. Timidity in approaching customers
    d. Indifference to customer needs

UNIT: Agricultural Salesmanship
TOPIC: Meeting the Customer
(Answer Sheet continued)

13. a. By taking the time to let the customer express the problem
    b. By asking questions to determine if the customer understands the problem
    c. By suggesting a procedure that will assist with the problem

14. Examples of:
    a. Conventional - "May I help you, Mr. Jones (or sir)?"
    b. Questions - "Is this cold weather affecting your milk production, Mr. Brown?"
    c. Stating a fact about merchandise - "We've surely been selling a lot of that feed, Mr. Smith."

15. Courteous Requires no decision Emphasizes the desire to serve
    Short Affirmative

16. a. Comfort
    b. Pleasure
    c. Appetite
    d. Possession
    e. Fear
    f. Devotion
    g. Cur osity
    h. Ornamentation
    i. Construction
    j. Imitation
    k. Loyalty

17. a. Professional feeling toward selling
    b. Courtesy
    c. Enthusiasm
    d. Interest in the customer and his problems
    e. Willingness to develop self-confidence
    f. Integrity
    g. Desire to be of service
    h. Appreciation of psychology

18.

19.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Salesmanship

TOPIC: Presenting Supplies and Services to Customers

1. a. Attention
   b. Interest
   c. Desire
   d. Action

2. Attention may be involuntary. Interest is a voluntary reaction.

3. A combination of the needs or wants of the customer with the merits of the merchandise.

4. a. Desire for increased yields
   b. Desire for more profits
   c. Desire for less difficult work
   Others acceptable

5. a. Newspaper advertising
   b. TV or radio advertising
   c. Talk with a neighbor
   d. Direct mail circulars
   Others acceptable

6. Student activity. He should include: a. Attention step
   b. Interest step
   c. Desire step

7. a. Know the features of the product.
   b. Be able to answer questions about the product.
   c. Be able to demonstrate the product, including its advantages.

8.

9.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Salesmanship

TOPIC: Overcoming Customer Resistance

1. The seller and the buyer must "give up" something to secure something. The seller "gives up" merchandise; the buyer, money. Each sale represents a choice.

2. The customer's: (a) pleasure, (b) satisfaction, and/or (c) need

3. a. Need - Stress usefulness of a product
   b. Quality - Point out good features
   c. Source - Name satisfied customers; provide company information or reliability
   d. Price - Revealing values of product
   e. Time - Show positive interest; counter all objectives
   f. Thing - Showing suitability of the product

4.

5.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Salesmanship

TOPIC: Closing the Sale

1. When the need for the merchandise has been definitely established

2. That of helping the customer make a wise decision

3. When the customer is not aware of his needs or not well aware of product choices

4. Immediately after the customer decides to buy

5. a. The customer has exhibited attention, interest, and desire for the product.
   b. The relationship between the need and the product has been established.
   c. Objections have been overcome.
   d. The price is acceptable.
   e. The product is approved by the customer.
   f. The customer has the "power" (ability) to make the purchase.

6. Giving the customer a small decision to make, based upon the major decision to buy. Example: "Do you prefer the red or the green?", or "Would you prefer sacks or paper bags?"

7. a. Assuming failure in the beginning
   b. Hurrying the customer
   c. Failing to help the customer decide
   d. Failing to overcome obstacles
   e. Stressing the wrong selling points
   f. Trying to force the customer
   g. Discourtesy at any point

8. a. Write legibly
   b. Accuracy
   c. Name and address completed
   d. Special directions noted

9.

10.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICE

UNIT: Agricultural Salesmanship

TOPIC: Fundamentals for Successful Selling

1. a. A wholesome attitude
   b. People
   c. Merchandise
   d. Good selling methods

2. Student activity, written

3. Student activity, written

4.

5.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Business Procedures

TOPIC: Importance of Accurate Records

1. a. (1) To know the financial status of the business
   (2) To give proper information to company officers and stockholders
   (3) To satisfy legal requirements
   (4) To plan for desirable change in management and procedures
   (5) To prepare tax returns
   b. To plan for desirable change in the business

2. Profit or loss for a stated period of time

3. A balance sheet shows all assets and liabilities. The two always are equal.

4. All daily records of the firm, including sales tickets, invoices of purchases, and other records

5. To be sure that this part of the firm's records are correct for the day

6. Because transportation and many other items of expense are involved in the true "cost" of the merchandise to the firm.

7. a. To assist in determining the firm's financial condition
   b. To plan for purchases of stock

8. $103,048.16

9. a. Salaries and wages
   b. Heat, power, and water
   c. Advertising
   d. All other expenses
   e. Depreciation

10. Because the land did not become less valuable.

11. a. $23,173.70
    b. $305,444.24
    c. $10,649.42
    d. $305,444.24

12.

13.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Business Procedures

TOPIC: Sales Tickets

1. Activity

2. Largest

3. All

4. Client

5. Activity

6.

7.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Business Procedures

TOPIC: Credit

1. a. Merchants or dealers
   b. Individuals
   c. Commercial banks
   d. Insurance companies
   e. Production credit associations
   f. Federal Land Banks

2. Productive credit is used to make more money. Consumptive credit is used in a manner that is not designed to produce extra income.

3. a. The moral responsibility of the customer
   b. History of debt
   c. The financial status of the customer (his repayment capacity)

4. a. Large amounts of cash are unnecessary.
   b. A cancelled check serves as a receipt.
   c. Risk of theft is small.

5. a. Write plainly, in ink.
   b. Completely fill in the space for the amount of the check that is written.
   c. Numbers following the "dollar sign" should be placed as close as possible.
   d. Never erase on a check.
   e. The purpose should be placed on the check.

6. (Activity) (Examine check for proper execution)

7. The amount shown is paid by a third party, previously arranged and shown on the draft.

8. A written promise to pay a specific amount at a specific future date.

9. A written claim against property, guaranteeing the payment of a debt.

10. Activity

11.

12.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Business Procedures

TOPIC: Determining Selling Price

1. a. Merchandising costs b. Overhead c. Profit

2. a. Interest on investment
   b. Insurance
   c. Warehousing
   d. Taxes
   e. Office and accounting expenses

3. a. Drop in price b. Theft c. Damage

4. Fixed costs

5. Fixed expenses will increase little with increased volume; variable costs will increase more, but opportunities for total profits become greater.

6. The amount that is added to the cost to arrive at the selling price

7. a. $3.00 b. 30% (3.00 ÷ 10.00 = 30%)

8. The gross margin is obtained by dividing the markup by the selling price (not the cost).

9. $3.00 ÷ $13.00 - 23 + %

10. Number of times an item "turns over" per year times gross margin should equal 100.

11. Feed is consumed, requiring more frequent purchase.

12.

13.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Business Procedures

TOPIC: Business Records: Ordering and Receiving Merchandise

1. Activity

2. Activity

3. To check against invoice, bills of lading and goods delivered

4. a. Merchandise received
   b. Condition of merchandise

5. a. The shipper "prepays" the freight.
   b. Goods arrive "C. O. D. ", with the merchant paying the freight upon delivery.

6. A form used by the carrier (railway, etc.) enumerating items being shipped.

7. A statement (bill) due a company for merchandise delivered

8. Invoices are checked for accuracy and compared to purchase orders, receiving records and bills of lading.

9. Activity

10.

11.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Business Procedures

TOPIC: Inventories

1. An accurate listing of the firm's merchandise on hand with its value

2. a. For periodic analysis of the business
   b. To determine age of stock on hand
   c. To indicate volume of business by items
   d. For location of losses

3. A system for making sure that adequate, but not excessive amounts of merchandise is on hand

4. An inventory kept up-to-date constantly by addition of purchases and deletion of sales

5. At the end of the firm's fiscal year and often at other times

6. a. Arranging stock
   b. Checking condition of stock
   c. Separation into departments or categories
   d. Listing values of the stock

7. a. Location of the merchandise
   b. Department to which merchandise is charged
   c. Names of persons preparing the inventory
   d. Information on age and quality of the merchandise

8. Activity

9.

10.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Business Procedures

TOPIC: Receiving and Storing Merchandise

1. As unloading proceeds

2. On the receiving form and in other ways used by the firm

3. By exact count or by weight

4. As soon as possible after its arrival

5. Activity

6.

7.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Business Procedures

TOPIC: Stocking and Merchandise Planning

1. (Opinion question) May include past experience; weather conditions affecting farmer needs, etc.

2. a. Capital utilized unproductively; store or warehouse space tied up.
   b. Loss of sales; undesirable customer relations.

3. Any employee

4. Activity

5. Activity

6. Activity-thought question

7. Activity

8.

9.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemical Safety

TOPIC: Chemical First Aid

1. Organic Phosphate, Carbamates, Chlorinated Hydrocarbons, and Methyl Bromide

2. Remove the victim from the source of contamination.

3. Flushing with clear water for ten minutes

4. Giving warm salt water and running finger down throat

5. Headache, giddiness, nervousness, blurred vision, and constricted pupils

6. One to four hours after exposure

7. a. Remove clothing immediately
   b. Wash exposed area with soap and water, followed by thorough flushing
   c. Get a doctor
   d. Have chemical label for doctor to read

8.

9.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Safety

TOPIC: Storing Agricultural Chemicals

1. Small children associate various shaped containers with their original contents and may be injured or killed by careless use of containers.

2. To prevent children and inexperienced people from being injured or killed.

3. Livestock feed could become contaminated and the livestock killed.

4. a. Someone other than the person to whom you gave the chemical may use it by mistake and injure himself or others.
   b. The person using it does not have the label giving directions for its proper use.

5. Can create fire or explosion hazard.

6. On floor if possible to prevent falling on other chemicals.

7. With transparent tape or lacquer

8.

9.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Safety

TOPIC: Mixing Agricultural Chemicals

1. It is often unsafe as well as uneconomical to use more than the manufacturer's directions.

2. Natural rubber

3. Always keep the spout positioned at the top of the can.

4. Clear water

5. Thoroughly wash hands and face with soap and water.

6. To prevent back-siphoning of water and chemicals

7.

8.

ERIC

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Safety

TOPIC: Application of Agricultural Chemicals

1. Healthier and more comfortable

2. The spray may be too poisonous to use in the house. The label will also remind you to remove pets, fish bowls, and the like from the room before spraying.

3. Label will have skull and crossbones, the word "POISON" in red ink.

4. (a) Moral obligation and (b) required by federal and state laws.

5. (a) Particle size, (b) specific gravity, (c) evaporation rate, (d) height of release, (e) horizontal air movement, (f) vertical air movement, (g) temperature, (h) humidity and aerodynamic forces caused by the aircraft.

6. Dusts have smaller particle size than sprays.

7. They are lighter.

8. 890 feet

9. Spray or dust released within 3 to 5 feet of the wing tips of fixed-wing aircraft may be moved outward and upward by the wingtip vortices (swirling motion of air current) and be moved out of the treated area by the wind.

10.

11.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Safety

TOPIC: Agricultural Chemicals Container Disposal

1. Drain into sandy pit.

2. Kept in a secure storage place

3. Return them to the manufacturer.

4. To prevent unauthorized people from removing them from the dump and using them for other purposes

5. It will have more opportunity to be absorbed through the soil and lessen the chance that it will be carried away in water runoff.

6. People and livestock can be killed by water and grass becoming contaminated.

7. Heat them to 800° to 1200° F. for five minutes.

8. Nearby plants, crops, and shrubbery may be killed.

9. At least 18 inches

10. They should be broken.

11.

12.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Safety

TOPIC: Personnel and Equipment Clean-Up

1. Immediately

2.

Container Size	Water	Detergent
5 gallons	2 quarts	2 tablespoons
30 gallons	3 gallons	1/2 cup
55 gallons	5 gallons	1 cup

3. This prevents corrosion and is a safety measure.

4. Gasoline or kerosene

5. a. Clean out spray material.
   b. Soak all pieces of spray equipment in a 1 percent solution of household ammonia (1 gallon of ammonia to 100 gallons of water or 2 teaspoons per quart of water). Rinse sprayer several times with water.

6.

7.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Safety

TOPIC: Chemical Residue and Tolerances

1. Amount of pesticide in or on a product when it enters commerce

2. The amount of pesticide which scientists have determined may safely remain as a residue on food and crop

3. Yes, down to one part per trillion

4. Authority to inspect, confiscate, and destroy products that carry illegal residues

5. No, never a proven case

6. USDA

7.

8.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Formulas and Dilution Charts

TOPIC: Calibrating Sprayers

1. Calibration, applying incorrect amounts may do much more damage than good.

2. a. Reducing the speed
   b. Increasing the pressure
   c. Changing to a larger nozzle
   d. A combination of any two or three of the above

3. 16-1/2 gallons = $\frac{5 \times 66}{20}$

4. Two pounds active/16-1/2 gallons/ acre times 5 acres = 10 pounds of active material and 82-1/2 gallons of water

5.

6.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Formulas and Dilution Charts

TOPIC: Weights and Measures, Charts and Conversion Tables

1. Student activity

2. $\frac{0.5 \times 50 \times 8.4}{50} = 4.20 = 4$ pounds

3. $\frac{16 \times 25}{150 \times 8} = 3.3\%$

4. $\frac{5 \times 30}{50} = 3.0$ pounds of 50% D.D.T.
30 lbs. - 3 obs. = 27 pound of tale

5. 640 acres

6. 7.5 gallons

7. 209 feet square

8. 43,560 square feet

9. 4 p.p.m.

10. 100 p.p.m.

11. 22

12.

13.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Formulas and Dilution Charts

TOPIC: Compatibility Charts

1. No, some may have adverse reaction when mixed together.

2. This practice can be used, but care must be used to prevent possible chemical reaction of mixture concerned.

3. Yes, mixtures are often. Often modern herbicide formulations involve combinations of toxicants.

4. To reduce cost of application, one trip does both instead of one trip for each.

5. Liquids will readily combine using a liquid and powder together has proven unsatisfactory in the past.

6. Inexperienced operators are sometimes careless in handling these mixture which could result in considerable damage to plants and humans.

7.

8.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Chemical Application Equipment

TOPIC: Spraying Equipment

1. (a) Hand sprayer
   (b) Hand-propelled
   (c) Tractor-mounted
   (d) Airblast
   (e) Aircraft

2. It should be kept clean, properly adjusted, and stored after use to prevent rust and corrosion.

3. Yes, especially those sprayers that have multiple units having common parts

4. Yes, to be sure everything is in proper working order and in proper adjustment

5. Pump, tank with agitator, pressure gauge, pressure regulator, strainers and screens, control valves, distribution system including nozzles and power source

6. Drift problem reduced. Can be used when wind velocity is higher. Damage of being washed off by rain is less.

7.

8.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Chemical Application Equipment

TOPIC: Dusting Equipment

1. Dusting uses dry materials while spraying uses liquid materials, often mixing dry materials with a liquid to make a solution.

2. Dust hopper, fan, distribution system (including hoses and nozzles)

3. Centrifugal-type

4. 2,200 to 3,400 r.p.m.

5. 500 to 1,000 c.f.m.; 50 to 100 m.p.h.

6. Plunger, crank, knapsack, and tractor-mounted units

7. Crank type or knapsack could be used.

8.

9.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Chemical Application Equipment

TOPIC: Fogging Equipment

1. Used mostly to control mosquitoes and flies

2. True, the mist must make direct contact with the insect.

3. No. Some wind is required, but excessive wind will disperse the mist too rapidly.

4. Temperature, humidity, and wind conditions are most favorable at night.

5. A source of heat is necessary to vaporize the insecticide.

6. No. They are considered unsatisfactory because they leave little or no residual deposits.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Chemical Application Equipment

TOPIC: Fumigating Equipment

1. They sterilize the soil by use of chemicals.

2. Control of nematodes

3. Diseases, soil insects, weed and grass seeds

4. Plow application, chisel application, and covered (confinement) method

5. Read label carefully and follow directions as listed on the label.

6.

7.

ERIC

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Insects

TOPIC: Classes of Insects

1. Chordota, Protozoa, Echinodermata, Annelida, Platyhelminthes, Nemathelminthes, Mollusca, and Arthropoda

2. Arthropoda - Eighty percent of all known animals are in this division.

3. Arachnida, Chilopoda, Crustacea, Diplopoda, and Hexapoda

4. The system of naming animals was established about 200 years ago; since Latin is a dead language, and will never be changed, it was decided that this would serve well for classification purposes.

5. The name of each species consists of two words, the name of the genus to which the species belongs and a word, often an adjective, that stands for the species. The first name gives the genus and the second name usually describes the species.

6. The generic name can not be duplicated because of the International Rules of Zoological Nomenclature.

7. Crustacea - Most members of this class breathe will gills; however, a few breathe through body walls. They have two pairs of antennae, a number of legs, and are aquatic.

   Arachnida - Their bodies are composed of two parts; they have four pairs of jointed legs, and an absence of wings and antennae. They breathe with air tubes lungs.

   Chilopoda - Each body segment has a pair of legs, and each member of this class has a pair of poison claws behind its head.

   Diplopoda - The members of this class have two pairs of legs on each body segment, a pair of antennae, and breathe by means of air tubes.

   Hexapoda - The bodies of the true insect are divided into three distinct regions: head thorax, and abdomen, The thorax has three pairs of legs and two pairs of wings, usually. This insect breathes through air tubes.

UNIT: Insects
TOPIC: Classes of Insects
(Answer Sheet continued)

8. Three characteristics are the basis for classifying insects. They are the type of mouth parts, the type of metamorphosis, and the presence or absence of wings.

9.

10.

ERIC

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Insects

TOPIC: Body Parts

1. See information sheet.

2. In order to distinguish the class, order, or species of insects

3. The exoskeleton is the protective covering on an insect's body. The parts are the cuticula, hypodermis, and basement membrane.

4. Chitin. The chitin is resistant to water, alcohol, and alkalis thus protecting the insect. Also, the chitin protects the insect from disease and environmental extremities.

5. The breathing tubes open through the air openings or the spiracles, which are located on the sides of the abdomen.

6. The antennae perform a sensory function. The sense of touch is located in the antennae; and in some insects, the sense of smell and hearing are also located in the antennae.

7. Chewing, piercing-sucking, sponging, siphoning, and rasping-sucking

8. The mouth parts aid in identifying the insect.

9. See information sheet.

10. See information sheet.

11. See information sheet.

12. Size, shape, and texture

13.

14.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Insects

TOPIC: Life Cycles

1. 100 to 200 eggs

2. To be able to estimate the number of insects that one can expect during the next season.

3. The size, shape, color, host, and the location where the egg is laid.

4. At the same time the egg is laid.

5. The time varies from a few hours to several months.

6. Ametabola, Paurometabola, Hemimetabola, and Holometabola

7.

8.

ERIC

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Insects

TOPIC: Host Plants or Animals

1. On living, dead or decaying plants; or living or dead animals

2. An entomophagous parasite is one that is very specific in the selection of a host. They usually lay their eggs on or directly within the body of the host insect.

3. An omnivorous insect feeds on many kinds of plant and animal materials.

4. On the host

5. A predatory insect catches living prey, usually animals less active and smaller.

6. Because they subsist on other insects

7. Polyphagous - insects that eat many varieties of plants.
Oligophagous - They eat specialized foods, generally eating foods having common characteristics.
monophagous - These insects feed upon a single species of food plant.

8.

9.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Insects

TOPIC: Insect Resistance to Chemicals

1. Insect resistance means that the insect can thrive and survive in the presence of a chemical that is supposed to kill it.

2. The development of resistance to chemicals by insects is not fully understood, but it is known that the insects must be exposed to high levels of chemicals. They develop resistance physiologically and their genetic differences, present within the insect and influenced by the insecticide, cause resistance.

3. Resistance is most likely to develop when all insects in a given situation are exposed to the insecticide and there is little reinfestation by insects not exposed.

4. Possibly, it was recognized for more than a half century. As early as 1897, John B. Smith, entomologist of the New Jersey Agricultural Experiment Station, mentioned variations in results in the control of San Jose Scale and other insects.

5. Insect resistance to chemicals will influence the farmer in his selection of an insecticide and the frequency of application of insecticide.

6. Environmental conditions, heritability factors, insecticide dosages, and frequency of applications

7. This is a remote possibility. Usually, insect resistance to a chemical will increase.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Insects

TOPIC: Losses Caused by Insects

1. Insects reduce the yields, lower the quality, increase the cost of production and harvesting, and require outlays for materials and equipment to apply control measures.

2. According to J. A. Hyslop, of the Department of Agriculture, the damage and cost of controlling insects is $1,601,527,000 annually. This estimate was made in 1938. The cost today will exceed the 1938 estimate several times.

3. $396,500,000

4. Insects transmit diseases in many ways. Some of these are by contaminating food, insect bites, transferring germs by their presence, and by stinging.

5. Microscopic viruses, bacteria, and protozoa

6. Diptera

7.

8.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Insects

TOPIC: Methods of Control

1. No. Man's way of life will prevent this.

2. Natural and artificial

3. Climate is probably the most important natural control of insects. A sudden change in the temperature from warm to cold destroys many insects.

4. A large body of water prohibits insects from flying across the water and prevents their spread.

5. The most recent and one of the most publicized biological methods of controlling insects was the releasing of sterile male screwworm flies to control screwworms.

6. The quarantine laws prohibit the transporting of certain products, and this controls insects by preventing their spreading to new areas.

7. Plowing under crop residue, rotating crops, using fertilizer, applying sanitary measures, and planting at the proper time.

8. (1) Identify the insect; (2) select an effective insecticide; (3) follow directions for mixing, applying, and handling; (4) apply the insecticide at the right time; (5) apply insecticide early, preventative spraying is the best crop protection.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides

TOPIC: Introduction to Insecticides

1. Follow all the directions and observe all of the directions and cautions on each pesticide label.

2. No. People are killed in automobiles and tractors, but we do not stop using them.

3. Ninety days

4. (1) A grower must achieve higher production just to stay in business. This mass production furnishes a ready food supply for more insects.
   (2) Insects have become adapted to feeding on a wider variety of crops.
   (3) In selecting crops for desirable characteristics, resistance to insects and disease is often neglected.
   (4) With modern mass transportation systems, there is more widespread distribution of insects.

5. Yes, if we wish to continue an adequate supply of wholesome and high-quality food for our rising population.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides

TOPIC: Insecticide Terminology

1. a. Dusts
   b. Granular formations
   c. Insecticide - fertilizer mixtures
   d. Wettable powders
   e. Solutions
   f. Emulsifiable concentrates
   g. Aerosols
   h. Fumigants

2. Absorption into digestive system

3. Absorption through body wall

4. Enter the tracheal system in the form of a gas

5. Organic compounds

6. Solvents or carriers for insecticides

7. (a) Nicotine, (b) pyrethrum, (c) Rotenone, (d) Sabadilla

8. (any five of the following) (a) DDT, (b) methoxychlor, (c) toxaphene, (d) BHC, (e) lindane, (f) aldrin, (g) dieldrin, (h) chlordane

9. (a) Hydrogen cyanide, (b) carbon disulfide, (c) methyl bromide, (d) ethylene dichloride, (e) carbon tetrachloride

10. a. Geraniol
    b. Eugenal
    c. Q-Lure
    d. Medlure

11. 1942

12. 1950

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemical Sales and Serviceman

TOPIC: Properties and Characteristics of Insecticides

(Sample of information you should get for the chemicals commonly used in your area)

1. Aldrin

   a. Names

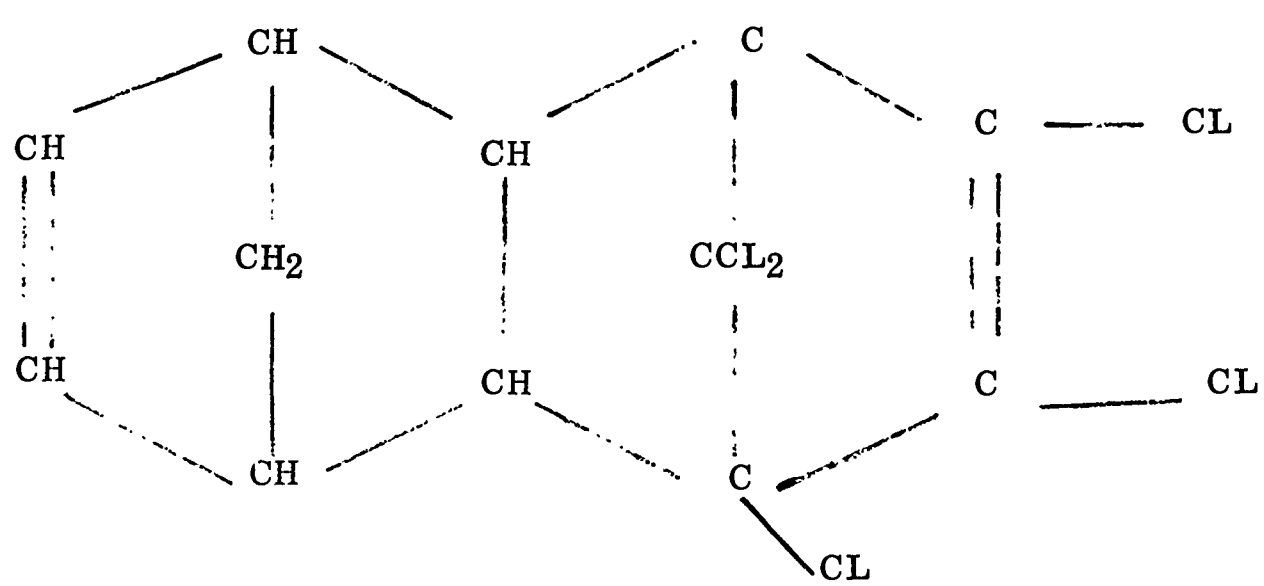
      (1) Common name: Aldrin

      (2) Trade names: Aldrin, HHDN, Octalene, Aldrec, Algran, Mersect, Soildrin

      (3) Technical name: 1, 2, 3, 4, 10, 10-Hexachloro-1, 4, 4a-5, 8, 8a-hexahydro-endo-1, 4-exo-5, 8-dimethano naphthalene

   b. Composition

      (1) Chemical structure



      (2) Industrial preparation
      Shell Chemical Company, 1948

UNIT: Agricultural Chemical Sales and Serviceman
TOPIC: Properties and Characteristics of Insecticides
(Answer Sheet continued)

(3) Formulations of the insecticide
WP 20-50%, dusts 1-25%, granules 2-25%, EC 2 and 4 lbs. active/gal., baits and a 75% WP for seed treatment. Also sold mixed with DDT, dieldrin, TDE, captan, heptachlor, chlordane, malathion, parathion, sulfur, lindane, fertilizers, and others.

(4) Get this information from labels or books published by the company manufacturing the chemical.

(5) Physical state

(a) Gas (no)

(b) Liquid--emulsifiable concentrate 2 and 4 lbs. active/gallon

(c) Solid--wettable powder, dusts, and granules, baits

c. Intended use as an insecticide

(1) Stomach poison

(2) Contact poison

(3) Fumigant--some fumigant action

d. Toxicity--LD_{50}, 38 mg./kg. Absorbed through the skin.

e. Compatibility with other chemicals--Aldrin is compatible with other chemicals.

f. Special additives used

(1) Carriers

(2) Solvents
Solubility is moderate in aromatics, esters, halogenated solvents, ketones, and paraffins, sparingly in alcohols. Insoluble in water.

(3) Spreaders

UNIT: Agricultural Chemical Sales and Serviceman
TOPIC: Properties and Characteristics of Insecticides
(Answer Sheet continued)

(4) Stickers

(5) Extenders

(NOTE: This information can be obtained from chemical book published by chemical company.)

g. Effectiveness as an insecticide
Number one insecticide in U. S. for use on grasshoppers. Controls ants, cutworms, armyworms, boll weevils, crickets, Diabrotica, wireworms, flea hoppers, grasshoppers, Japanese beetles, chinch bugs, leaf miners, slugs, snails, sowbugs, spittlebugs, thrips, and many others.

h. Problems

(1) Application

(a) Foliage--apply at a uniform rate with common application equipment.

(b) Soil--increase dosage 100% on peat and mulch soils. Apply broadcast, band or furrow.

(c) Transplants--drench soil around each plant at time of transplanting.

(d) Seed treatment--used to protect germinating seeds from insects. Use in a slurry treater, dry seed treater, or mix directly in the planter box.

(2) Residue--Long residual effects, nonsystemic, can be applied within five days of harvest to some crops.

(3) Safety hazards--Don't use on animals. Don't contaminate lakes, streams, or ponds. Don't let livestock graze on treated crops. Soil applications should no longer be made to root crops. Soil carryover from previous seasons may contaminate carrots.

i. Synergists

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides

TOPIC: The Chemistry and Mode of Action of Organic Insecticides

1. Chemicals spilled on skin

2. Many organic phosphates are as toxic when absorbed through the skin as when taken orally.

3. This is the base against which to compare later blood tests.

4. Avoid any further exposure until his body has had time to regenerate cholinesterase to its normal level

5. Toxic dosage is proportioned to body weight.

6. Through their long-lasting stability and their tendency to accumulate in body fat

7. Aldrin, dieldrin, chlordane, DDT, toxaphane

8. Act upon central nervous system and neuromotor apparatus

9. Because it leaves a lower residue

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides

TOPIC: The Chemistry and Mode of Action of Inorganic Insecticides

1. a. Calcium arsenate
   b. Copper arsenite
   c. Lead arsenate
   d. Magnesium arsenate
   e. Sodium arsenite
   f. Zinc meta arsenite
   g. Zinc arsenate
   h. Barium carbonate
   i. Sodium fluoride
   j. Mercuric chloride (many others)

2. Sulfur

3. Mineral

4. Stomach

5. Contact

6. Systemic

7. Zero

8. .1 of a gram

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides

TOPIC: The Use of Insecticides as Fumigants

1. 200 B. C.

2. Fumes from sulphur and asphalt

3. The grain has ability to absorb and hold the vapors for considerable periods.

4. Those high in oils

5. Three pounds

6. Methyl bromide or mixtures of methyl bromide with chloropicrin or ethylene dibromide

7. Placing the commodity in a gas-tight steel chamber, removing the air, and replacing it with gas lethal to the insects

8. (1) Insects are killed faster.
   (2) Length of exposure cut from 10 to 24 hours to 1 to 3 hours

9. Moisture and temperature

10. Water will increase the corrosive action of soil fumigants.

11. Two percent

12. Because of fire hazard

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides

TOPIC: The Use of Insecticides on Household Pests

Example

Insects	Insecticide	Strength		Where & How to Apply	Remarks & Precautions
		Spray	Dust		
Ants	Chlordane	2-3%	5or6%	Paint or spray on base-boards and in out-of-sight areas.	Use on limited areas only. Do not contaminate food, water, dishes, or utensils with insecticides. Do not allow children or pets near treated surfaces until spray has dried.
	Diazinon	0.5%	--		
	Dichlorvos	0.5%	--		
	Dieldrin	0.5%	1%		
	Heptachlor	0.5%	--		
	Lindane	0.5%	1%		
	Malathion	2-3%	4or5%		
	Kepone	--	0.125% Bait		

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Plants

TOPIC: Field Crops

1. Field crops are subject to insect attack throughout the growing season.

2. Spraying, either ground or aerial, and dusting.

3. Dusting, winds should not be over 5 mph.

4. Sixty pounds pressure per square inch

5. One nozzle, small plants, two and three nozzles to give enough volume to completely cover the entire plant.

6. Insects that will survive applications that previously were effective in controlling the insect.

7. At least ten insects

8. Other crops, fruits, vegetables and soils may be injured due to harmful residues.

9. Yes, but natural parasites and predators are destroyed also, when chemical insecticides are used.

10. Insecticides must be reapplied, as new plant growth is not protected, nor is it protected if the insecticide has been washed off.

11.

12.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Plants

TOPIC: Orchards

1. Without chemicals, fruit production would be reduced approximately 50 per cent.

2. No, insect damage would reduce the value of the fruit that is harvested.

3. Continued research by scientists and research people is done to reduce or eliminate contamination.

4. No, unless fruits have been oversprayed or sprayed too close to harvest time.

5. Crop growth, physical weathering, and by chemical breakdown

6. With all the research by state and federal agencies control of residue has been fairly stable.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Plants

TOPIC: Ornamental Plants and Shrubs

1. Aerosol sprays

2. Leaf-chewing, sucking, leaf-mining, gall forming, tip and stem infesting, and soil and root infesting

3. As sprays, dusts or baits

4. Weakening, stunting or killing

5. During periods of droughts or transplanting operations

6. Greenhouses contain restricted areas and can be closed for fumigation.

7. Chew and swallow the plant tissues

8. Inserting mouth parts into plant to remove sap

9. The damage is more or less concealed and hard to detect because of this.

10. Surface crawlers, and boring insects that work underground

11.

12.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides

TOPIC: Forest Plants

1. Forest stands have been cleared, and there is more need of forest products for the increased population.

2. Direct and indirect

3. Sow logs and pulp wood production

4. Destroy flowers, cones and seeds, attack foliage and stems reducing reproduction ability

5. Destroy wood before man can make use of it

6. Spraying trees so chemicals will kill insects by contact or by stomach poison through the food they eat.

7. Prevent build-up of destructive insects by preventing conditions favorable to their increase

8. Mechanical devices, versatile power units, new chemicals, and airplane spraying of forests

9.

10.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Plants

TOPIC: Vegetables

1. Chewing, sucking and root and stem feeders.

2. Even minor damage lowers crop value or renders it unfit for sale.

3. Being able to recognize the insects in their various stages, will enable the grower to begin control measures before damage occurs.

4. Generally, no. They are not abundant enough to completely control insects below damaging levels.

5. It will help him to identify very small insects.

6. This may be caused by insects feeding at night and hiding during the daytime or disease.

7. They resemble parts of the twig, because they are well camouflaged.

8. They suck the sap from the plants.

9. The leafroller builds a hide out by rolling or curling the leaf and tieing it with silk strands.

10. Because danger of excessive residue on the vegetable

11. Yes, they can transmit fungus disease to healthy plants.

12.

13.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Plants

TOPIC: Grasses

1. Grasshopper

2. Suck sap, chew and bore into vegetative parts, destroy underground roots and stems

3. Many insects spread diseases from infected plants to healthy plants.

4. Crop rotations, escape crops, tillage, clean culture destruction of residue and weeds and variation in time of planting and harvesting

5. They secrete froth or spittle around themselves for protection against natural enemies.

6. Stink bugs

7. Reduce yields of grasses and legumes grown for seed; also reduce yield of forage produced

8.

9.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Plants

TOPIC: Lawns

1. Those that infest soil and roots, those feeding on plant leaves, those that suck juices from plants and those that are annoying.

2. They cause the grass to turn brown and die, or build mounds that smothers the grass.

3. Parks, roadsides, golf courses, athletic fields, cemeteries, and airports

4. They should not be used on areas that might be grazed by livestock.

5. Garden supply houses, hardware, seed and drug stores

6. Dusts, granules, wettable powders, emulsified concentrates and baits

7. Use of milky disease spores

8. One application can last for a year or more.

9.

10.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Plants

TOPIC: Stored Grain Insects

1. 5 percent

2. Warmer temperatures, insects breed and feed throughout most of the year.

3. 300 million bushels

4. It goes back to the dealer and is made good.

5. 20 million dollars

6. 4 billion dollars

7. Saw-toothed grain beetle, flat grain beetle, red flour beetle

8. The rice weevil

9. Three to four weeks

10. Nine percent, greatly restricted even at 11 percent

11.

12.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Animals

TOPIC: Livestock

1. a. Arsenicals
   b. Nicotine
   c. Sulfur
   d. Cresole
   e. Rotenone
   f. Pyrethrum

2. a. DDT
   b. Methoxchlor
   c. Toxaphene
   d. BHC
   e. Lindane
   f. Chlordane

3. That they be safe

4. a. Will not harm the animal
   b. Will not leave harmful residues in animal products

5. a. Rotenone (cube or derris)
   b. Pyrethrum

6. a. Residue buildup
   b. Flies become resistant

7. It has little tendency to build up residues.

8. Lindane

9. Because of chronic toxicity to livestock

10. a. Dieldrin
    b. Aldrin
    c. Heptachlor
    d. Perthane
    e. Strobane
    f. Malathion

11. Chemicals (Chemather apentic agents)

12. Systematic prevention programs rather than treatments

13. a. Range of application
    b. High degree of efficiency
    c. Unusual margin of safety
    d. Easy and versatile administration
    e. Variation and range of antiparasitic actions

14. Round arms in [illegible] ine

UNIT: Agricultural Chemicals Used as Insecticides on Animals
TOPIC: Livestock
(Answer Sheet continued)

15. Poisonous if not properly administered

16. Cadmium salts
    Piperazine

17. Coccidiosis

18. Keep barns, pens, and lots well drained and free from manure.

19. Pyrethrin with synergist

20. a. 1-2 percent malathion spray
    b. 1 percent diazinon spray

21. a. Heel fly lays its egg on the lower part of the animal during spring and early summer.
    b. Eggs hatch, the tiny grubs bore through the skin and migrate through the animal's body.
    c. Feed on tissues for about nine months.
    d. They appear as lumps along the back from early winter until spring.
    e. Mature grubs perforate the skin, and come out through the openings in the hide.
    f. Grubs drop to ground and pupate
    g. Pupae develop into flies.

22. 1 to 2 percent

23. a. Rub along fences and feed banks
    b. Hair appears dry and dead
    c. Bare places on the shoulder, neck, top line and flanks from rubbing and scratching
    d. Milk production drops
    e. Young animals slow up in development

24. Lindane

25.

26.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Insecticides on Animals

TOPIC: Poultry

1. A nicotine compound prepared in feed or a piperazine compound prepared in drinking water.

2. The treatment that is recommended for cecal worm control it to feed one pound of phenothiazine in 100 pounds of mash.

3. A number of tin compounds are effective in removing tapeworms from poultry.

4. They cause considerable annoyance to poultry. They also spread disease and eggs of internal parasites.

5. Conditions such as stagnant water and manure

6. One can use recommended chemicals for spraying the house and places where parasites breed.

7. There are seven known species of lice that will affect chickens.

8. One can control lice by using drugs such as sodium fluoride, B.H.C., DDT, and nicotine sulfate.

9. By sucking blood from them, usually at night

10. Mites can be controlled thoroughly cleaning the poultry house and equipment and spraying with a mixture of equal parts of kerosene oil and anthracene oil.

11. Fowl ticks can be controlled by using kerosene oil and anthracene oil; DDT is also effective.

12. Fleas breed in loose dry dirt or litter.

13. Fleas can be controlled by spraying with creosote oil and anthracene - Kerosene oil mixture. Carbolized vaseline and derry powder are effective for destroying fleas already on the heads of poultry.

14. Drainage of stagnant water and spreading manure thinly so that eggs and larvae will be killed by drying and heat.

UNIT: Agricultural Chemicals Used as Inseciticides on Animals
TOPIC: Poultry
(Answer Sheet continued)

15. Do not contaminate feed and drinking water. Do not use baits in poultry houses.

16.

17.

ERIC

Answer Sheet
on
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Soil Additives

TOPIC: Developments and Trends in the Use of Soil Additives

1. Any chemical added to the soil to increase growth and yields.

2. The use of fertilizers and soil additives has tripled in the last fifteen years.

3. Plant tissue test, soil test, and plant symptoms

4. Young leaves in terminal bud become hooked in appearance and then die along the tips and along the margins, roots are short and branch out, leaves have a wrinkled appearance, and plants may exhibit deficiency symptoms of other nutrients.

5. Climate, poor drainage, overliming, applying fertilizer too close to the plant, and improper cultivation

6. The problem must be diagnosed. The degree of deficiency must be determined. The amount of fertilizer needed for the desired yields must be determined.

7.

8.

Answer Sheet
on
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Soil Additives

TOPIC: Determining When to Use Soil Additives

1. The pH is the degree of acidity or alkalinity of the soil.

2. 0-14

3. By adding lime

4. Active acid is the acid that is measured in the soil when a pH reading is made. The potential acid is the acid that is held on the surface of the soil by soil particles. This acid may or may not go into the soil.

5. The leaching of calcium out of the soil be the downward percolation of water

6. These are soils that have been harmed by soluble salts.

7. Restricted drainage, using irrigation water high in salt, and using too much irrigation water bringing the water table too near the surface.

8. The plant nutrients, calcium and magnesium are supplied by liming; neutralizes soil acidity, producing better crops; phosphates are utilized more readily; and increases the micro-organisms in the soil.

9.

10.

Answer Sheet
on
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Introduction to Weed and Brush Control

1. Student activity

2. Student activity

3. 5 billion dollars

4. 4 to 11 times as much

5. 90%

6. 50%

7. Weed seed in agricultural seeds
   Weed seed in grain
   Weeds in hay
   Off flavor in milk products
   Increased wear and tear on machinery

8. One chemical application per year usually is sufficient while it usually takes three or four mowings.

9. Cost varies with density of tree and brush cover.

10. Post oaks 65 to 75%; blackjack oaks 35 to 60%

11.

12.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Opportunities and Trends in the Use of Herbicides

1. Lack of knowledge in how to use them

2. Labor shortage

3. The labor shortage occurred in some sections before it did in others.

4. As their knowledge and experience in the use of herbicides increases.

5. Weeds grow faster and larger

6. Increase in the population

7. Increase in use and need of herbicides

8.

9.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Herbicide Terminology

1. Student activity

2. a. Additive - Any material that is added to the spray solution and is not necessarily a wetting agent or surfactant.

   b. Adhesive - A substance that will cause a spray material to stick to the sprayed surface.

   c. Aerosol - A colloidal suspension of solids or liquids in the air.

   d. Biological Control - The finding and introduction of beneficial parasites not native to a particular location, and their growth and distribution. Controlling a pest by its natural or introduced enemies.

   e. Antidote - A practical immediate treatment including first aid in case of poisoning.

   f. Biennial - A plant that completes its life cycle in two years. The first year it produces leaves and stores food while the second year it produces seed.

   g. Boot stage - When the seed head of a grass plant begins to emerge from the sheath.

   h. Compatability - Refers to chemical materials that can be mixed together without adversely changing their effects on pests or plants.

   i. Concentration - The amount of active material in a given amount of substance. The rest is made up of diluent or carrier.

   j. Contact Herbicide - A weed killer that affects only the parts of the plant it falls upon

   k. Fumigant - Any material that destroys organisms when it is in the gas or vapor form.

UNIT: The Use of Chemicals as Herbicides
TOPIC: Herbicide Terminology
(Answer Sheet continued)

l. Herbicide - Any compound used to kill or inhibit the growth of a plant.

m. Detergent - Any cleaning agent or solvent such as water or soap.

n. Drift - The movement of material outside the intended target area.

o. Percent Concentration - Similar to parts per million, but expressed as a percentage.

p. Post-emergence Herbicide - A chemical applied to the foliage of weeds after the crop has emerged from the soil.

q. Pre-emergence Herbicide - A chemical applied after planting or at time of seeding, but before the emergence of the crop.

r. Toxicity - Degree to which something is poisonous.

s. Synergism - Two compounds, whose effects, when mixed together are greater than the sum of the two working separately.

t. Systemic - A compound, which when taken in by the plant, is made effective throughout its whole system. Usually refers to insecticides that kill insects which eat the juices of treated plants.

u. Winter annual - A plant that germinates in the fall or winter, matures seed and dies in the spring or early summer.

v. Tolerance - The amount of chemical that can legally be on or in the crop at the time it is offered for sale.

w. Weed - A plant growing where it is not desired.

x. Growth Regulator - Compounds that upset an organism's growth and metabolic processes.

y. Eradication - Complete elimination of a living organism from a specified area.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Plant Nutrition and Physiology Principles of Weed and Brush Control

1. a) Production of numerous seeds
   b) Adaptations that provide effective dispersal
   c) Dormancy of seeds
   d) Longevity of buried seeds
   e) Ability to survive adverse conditions
   f) Adaptations that repel grazing animals
   g) Ability to propagate vegetatively
   h) Ability to spread vegetatively
   i) Resistance to chemicals

2. a) Hand pulling
   b) Hoeing and spudding
   c) Tillage
   d) Mowing
   e) Flooding
   f) Burning
   g) Smothering

3. Selective Herbicides kill only certain species with little or no damage to the rest. Non-selective herbicides kill all species.

4. Prior to flowering or formation of a seed head

5. When they are young

6.

7.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Identification of Weeds

1. a. A plant out of place, especially if it is herbaceous, aggressive, and pestiferous or,
   b. A plant that does more harm than good and has the habit of intruding where not wanted.

2. a. Annuals
      True annuals
      Winter annuals
   b. Biennials
   c. Perennials
      Simple perennials
      Creeping perennials

3. a. Lambs quarter
   b. Pigweed
   c. Russian thistle
   d. Cockleburr
   e. Crabgrass
   f. Buffaloburr
   g. Purslane

4. a. Shepherdspurse
   b. Peppergrass
   c. Prickly lettuce
   d. Wild Barley
   e. Fanweed
   f. Tumbling mustard

5. a. Parsnip
   b. Houndstongue
   c. Mallow
   d. Mullein
   e. Bull thistle
   f. Burdock

UNIT: The Use of Chemicals as Herbicides
TOPIC: Identification of Weeds
(Answer Sheet continued)

6. a. Chicory
   b. Dock
   c. Dandelion
   d. Plantain

7. a. Bent grass
   b. Bermuda grass
   c. Healall
   d. Wedge-leaf fogfruit

8. Common and noxious weeds

9. a. Sandburr
   b. Three awned grass
   c. Needlegrass
   d. Wild oats
   e. Cockleburr
   f. Russian thistle

10. A key is a device for identifying plants.

11. a. Select an average or representative plant.
    b. Obtain as complete a specimen as possible, including the underground parts, the foliage portion, and the flowering or fruit bearing parts. Obtain mature seed if at all possible.
    c. Allow plant to dry. Pack in a box of sufficient rigidity to prevent shattering. Drying in a flattened position is desirable.

12. Crop plants - to Extension Agronomist, Weed Control, Soil & Crop Sciences Department
    Pasture and Range plants - to Extension Range Specialists - Range Sciences Department, Texas Agriculture Experiment Station, College Station, Texas.

13. a. Preventing
    b. Distribution

UNIT: True Use of Chemicals as Herbicides
TOPIC: Identification of Weeds
(Answer Sheet continued)

14. a. The elimination, so far as possible, of the source of weed seed
    b. The elimination or control of seedlings and weeds already established, including those creeping perennials which are not dependent upon seeds for their spread.

15. Student activity

16.

17.

ERIC

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Seed Laws Pertaining to Weeds

1. Weeds that are harmful and destructive to any given crop

2. "Primary noxious weeds" and "secondary noxious weeds"

3. Primary noxious weeds are difficult to control by ordinary cultural practices while secondary noxious weeds can be controlled by good cultural practices.

4. a. Percentage by weight of all weed seed
   b. Rate per pound of all primary and secondary noxious weed seeds
   c. Labeled "Pasture Mixture" if Johnson grass seed is in excess of 100 weed seed per pound

5.

6.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Classification, Properties, and Characteristics of Herbicides in Weed and Brush Control

1. I. Soil Treatment
   A. Non-selective
      1. Temporary effect
      2. Extended effect
      3. Prolonged effect
   B. Selective
      1. Extended effect
         a. Preplanting
         b. Pre-emergence
         c. Post-emergence
   II. Foliage Application
      A. Non-selective
         1. Contact effect
         2. Translocated

2. Kills <u>all</u> plant growth

3. Differential effect on weeds as compared to crop plants

4. Pre-emergence - application before crop is planted.
   Post-emergence - application after crop is up.

5. a. Temporary effect - few days to 2 to 3 weeks
   b. Extended effect - several months to even a year
   c. Prolonged effect - several years

6. Contact effect - kills part of plant actually hit by spray. Action usually rapid, complete coverage essential.

7. Translocated effect - carried from points of contact to other parts of plant, both upward and downward. Action usually slow. May involve several weeks; complete coverage generally not essential.

UNIT: The Use of Chemicals as Herbicides
TOPIC: Classification, Properties, and Characteristics of Herbicides in Weed and Brush Control
(Answer Sheet continued)

8. They are used to control deep-rooted creeping perennials.

9. The plants absorb the chemical through the root system; some may be toxic to the top if applied in spray form.

10. Selective herbicides generally affect a specific weed or grass. These are used because of scarcity and high cost of hand labor formerly used.

11. It is used to promote uniform ripening or drying of the crop and reduce trash and green leaf stain at harvest time (cotton defoliation as an example)

12.

13.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Factors Affecting Weed and Brush Control with Herbicides

1. Technical

2. Generally faster control with smaller amounts of chemicals occurs when plants are young and growing.

3. Maturity, decreases

4. a. Stage of weed growth
   b. Soil conditions
   c. Rainfall
   d. Temperature
   e. Humidity

5. Warm, moist

6. Reduced effectiveness

7. Beneficial

8. Higher

9. Larger

10. The lower the humidity the less effective herbicides may be.

11.

12.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Herbicide Selection

1. The herbicide kills only certain plants while it does not affect others.

2. You can kill broadleaf plants out of small grains. You can kill grasses out of broadleaf crops.

3. Where you wanted to kill all plants that were growing (ex.: around buildings).

4. Once a weed population has become established.

5. Mixed with the soil before or at time of planting

6.

7.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Preparing Herbicides for Use

1. Weed control

2. Selective herbicides destroy a specific weed without injury to desirable plants.

3. Liquid, powder and granular form

4. Pounds per gallon acid equivalent or percent of active ingredient

5. Day

6. Oil and sulfur

7. Herbicides and insecticides

8. A carrier is a liquid or solid material added to a chemical to dilute its concentration.

9. A material which when added to a spray solution causes the spray to spread over and wet the entire plant surface.

10. A chemical used for killing or inhibiting the growth of plants.

11.

12.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Determining Method of Treatment

1. Sprays that kill some plants on contact, but do not harm other plants.

2. Sprays that kill all plants on contact

3. Herbicides that are to kill roots at a distace from point of application by mowing through the stems and roots.

4. Due to their high tolerace of the chemicals used

5. The entire field or pasture is sprayed with boom-type sprayer or high pressure broadcast nozzle.

6. Saves herbicides and herbicide can be applied on lower parts of crop plants avoiding injury to the crop.

7. Johnson grass and bermuda grass

8. Soil conditions
   Rainfall
   Stage of weed growth
   Temperature
   Humidity

9.

10.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Application of Herbicides

1. To get complete control of weeds in field spraying complete coverage is very important.

2. Drop nozzles are used to spray crops after the plants are fairly well developed. These drop nozzles direct sprays to the base of the plants.

3. Spot treatment is often used on Johnson grass and Bermuda grass in cotton fields.

4. Used in applying pre-emergence sprays. Usually applied as bands at time of planting.

5. Sprayers, dusters, chemical applicators, and fumigant injectors are available in both power driven and hand-operated models.

6. Herbicides are applied to weeds via the foliage and/or via the roots.

7. a. The machine dispenses material at a uniform controllable rate.
   b. It distributes the material uniformly over area being treated.
   c. That it be easily calibrated to apply a pre-determined dosage.

8. High clearance sprayers, special booms, hand booms

9. Weeds often resprout after mowing, but proper spraying frequently gives near complete control for one season.

10. When all expenses are considered, one spraying costs about the same as one mowing, but it often is more effective than three mowings.

11. 50 percent

12. Nonselective herbicides kill all plants and can be used effectively around buildings, fences, or other places where all vegetation is to be controlled. Care should be used in following recommedations on the label as pertains to grazing by livestock of these treated areas.

13.

14.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: The Use of Chemicals as Herbicides

TOPIC: Aquatic Weed Control with Herbicides

1. Retards flow of water

2. Copper sulfate (blue vitriol) and rosin D acetate (RADA)

3. Place several pounds in a gunny sack and suspend the sack in the water.

4. From the water rather than the soil

5. When the wind is blocked from blowing across water

6. Keep 6 or 8 tame ducks per acre.

7. Grow chiefly below the surface of the water though their flowers and a few leaves may extend above it.

8. Shade them out or winter fertilization

9. Deepen the edges and fertilize

10. Enough to color the water

11.

Name Common & Scientific	Type of Waterweed	How to Prevent	How To Control
1. Algae, filamentous, branched, Pithophora	Algae...	Unknown	Algae-eating fish
2. Arrow-arum, Peltandra virginica	Marsh plant...	Deepen[4]	2, 4-D
3. Cowlily, Nuphar advera	Rooted plant with floating leaves	Deepen[4], shade[5]	Silvex; 2, 4-D granuales
4. Eelgrass, Zostera marina	Submersed plant	Shade[5]	Uncertain
5. Waterchestnut, Tropa natans	Floating plant	Do not plant	2, 4-D[2]

2. Esters of 2, 4-D and 2, 4, 5-T are mixed in diesel oil or used crankcase oil
4. Deepen edges and fill to eliminate marshy conditions
5. Shade the bottom against sunlight by fertilizing

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Fungicides

TOPIC: Fungicides, Their Development and Uses

1. The word "fungicide" is derived from the Latin word "fungus", a microscopic plant", and the word "caedo", "I kill."

2. A fungicide is a chemical used as a spray, dust, or solution to kill fungi.

3. To prevent infection

4. Seed disinfectants, disinfectants or protectants

5. Organic, inorganic, mercurial, nonmercurial, metallic, and nonmetallic

6. May be applied as a dust or as a wet treatment.

7. Seed protectants, foliage and blossom protectants, fruit protectants, eradicants, antibiotics, soil fumigants and general purpose sprays and dust formulations

8. Wettable powders, dusts, emulsifiable concentrates, granules, solutions, and suspensions

9.

10.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Fungicides

TOPIC: Pathological Agents

1. A pathogenic fungus is one that must live, grow, and reproduce. It is a living organism that requires a source of energy.

2. Yes, most can be readily seen.

3. Yes; yes

4. a. Hyphae - individual filaments of fungi.

   b. Mycelium - the fungi in aggregate.

   c. Obligated parasite - fungi that live only on living host plants.

   d. Facultative parasites - fungi that are capable of living on living and nonliving hosts.

   e. Pathogenic disease - a condition caused by the interaction of at least two living organisms.

   f. Inoculation - the pathogen and the host coming into contact.

   g. Invasion - the entry of the pathogen into the host.

   h. Establishment - the developing of successful assocation between the host tissue and the fungus.

   i. Incubation - development of the pathogen prior to its visual appearance of recognized symptoms.

5. Phycomycetes, Ascomycetes, Basidiomycetes, and Fungi Imperfecti

6. They are distributed by wind, water, birds, animals, and insects.

7. Leaf, stem, and fruit diseases are caused by airborne or insect-carried fungi.

8.

9.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Fungicides

TOPIC: Plant Diseases

1. A plant disease is a condition in which any part of a living plant is abnormal, or which interfers with the normal activity of the plant's cells or organs.

2. Plant diseases are caused by fungi, bacteria, viruses, and nematodes.

3. Through an understanding of disease development in plants, we can combat and control most of them successfully.

4. Fungi are living organisms that require energy to live; and most of them are composed of microscopic filaments, which may be colorless or variously colored.

5. Yes

6. Fungi reproduce by the formation of microscopic bodies called spores.

7. The fungi spores vary in size, measuring several hundred or even thousands to the inch. Some are one-celled, and some are two-celled. Some fungi spores are colorless; others are lightly tinted; and still others are coal black.

8. A parasitic disease is an organism that gets its food from living plants or animals.

9. A nonparasitic disease is a disease that is caused by a deficiency. Lack of water, nutritive deficiency, and unfavorable temperature are factors that could cause a nonparasitic disease in plants.

10. To identify and control plant diseases.

11. Roots serve the plant by absorbing water and the necessary minerals from the soil. The stem serves the plant by transporting food and minerals and supports the leaves. Leaves contain chlorophyll, a green pigment, that gives the leaf its color. Chlorophyll particles take energy from the sun's rays and change it into energy used by the plant in manufacturing food.

UNIT: Agricultural Chemicals Used as Fungicides
TOPIC: Plant Diseases
(Answer Sheet continued)

12. a. Blight - The rapid discoloration and death of tissue over certain portions of the plants. This usually results in the general killing of leaves, flowers and stems. Examples of this are the bacterial disease, fire blight, on pears and bacterial blight of cotton.

b. Canker - A dead area on a stem surrounded by living tissue. Brown canker on the stems of roses is an example of this condition.

c. Chlorosis - Yellowing of normally green tissues due to partial failure of chlorophyll to develop. Iron deficiency often produces this effect in areas where available iron is lacking in the soil.

d. Curl - A puff-like distortion on a leaf resulting from the unequal development of its two sides. Peach leaf curl is a common example of this condition.

e. Damping - off - A disease of seedling plants usually caused by fungi. Early planted cotton often is affected by this disease and the disease sometimes is blamed on cool weather.

f. Dieback - Progresseive death of branches, shoots and roots beginning at the tips. This type of condition is characteristic of unhealthy trees or shrubs.

g. Dwarfing - The failure of any part of the plant or the entire plant to develop properly. With the exception of dwarf varieties, this condition usually is produced by nutritional deficiencies or a disease organism.

h. Gall - A pronounced localized swelling occurring on roots, stems and branches. The stimulation for development may be caused by a disease organism, insect or a wound.

i. Host - The plant on, or in which, the parasite is living and obtaining its food.

j. Infection - The establishment of a disease-producing organism on or within a host.

k. Lesion - A localized spot of diseased tissue. Spots, blisters and scabs are examples.

UNIT: Agricultural Chemicals Used as Fungicides
TOPIC: Plant Diseases
(Answer Sheet continued)

l. Mildew - A plant disease caused by a fungal organism which forms a whitish or grayish coating over the surface of leaves.

m. Mosaic - Symptom of a virus disease appearing as dark green, light green, white or yellowish irregular spots on the leaves of affected plants.

n. Mummy - A dried, shriveled fruit resulting from certain fungal disease. Old mummified fruits may be found under peach trees. They serve as a means of infection for the next year's crop.

o. Pustule - Small raised blister-like areas on the surface of leaves or other plant tissue. They usually burst to free a spore mass which starts new infections.

p. Resistance - The inherited ability of the plant to retard growth of certain disease organisms.

q. Ring Spots - Yellowish rings on the leaves with green tissue inside the ring. This usually is associated with virus diseases.

r. Rosette - A disease symptom in which stems are shortened, producing a bunchy growth habit. This symptom may be observed where there is a zinc deficiency in pecans.

s. Rot - A state of decomposition produced by a micro-organism.

t. Russet - Brownish roughened areas on the suface of fruits caused by diseases, insects or spray injury.

u. Scab - A crust-like disease lesion, produced as a result of disease infection. Pecan scab is an example.

v. Spore - A reproductive unit of a fungus that functions much like seed of green plants.

w. Vector - An agent that transmits disease producing organisms. Insects are common vectors of plant disease organisms.

x. Wilt - Loss of freshness due to inadequate moisture. This condition usually is caused by a disease condition stopping up the water transporting vessels of a plant.

UNIT: Agricultural Chemicals Used as Fungicides
TOPIC: Plant Diseases
(Answer Sheet continued)

13. Proper identification

14. a. When all or any part of a plant dies
    b. When roots, stems, leaves or other plant parts grow wrong
    c. When the use of plant food nutrients, watering and control of weeds and grass or insects fail to give expected yields
    d. When a certain kind of plant or seed gradually yields less or "runs out" over several years

15. See Page 3 - MP-512

16. See Page 4 & 5 - MP-512

17. See Page 6 & 6 - MP -512

18. Student Activity

19.

20.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Fungicides

TOPIC: Application of Fungicides

1. a. The time to apply the fungicide
   b. The rate of application
   c. Efficiency of application
   The application must cover the entire foliage or fruit of the plant.

2. They protect the plant from fungus rather than killing the fungus. If the fungicide was applied at the rate required to kill most fungi, the plants would be injured.

3. Selection of the fungicide, kind of auxiliary agent to use - if any - kind of application, method of application, and time of application

4. A knowledge of the compatibility of the fungicide, the susceptibility of the fungicide, the susceptibility of the fungus to the fungicide, and habitat of the fungus

5. Complete sprays, mist sprays, dusts, aerosol fog, and fumigants

6. Seed treatment, spraying, dusting, drenching, furrow treatment, planter treatment, soil fumigation, dips, and paints

7.

8.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Bactericides

TOPIC: Bacteria

1. a. Small size
   b. Ability to multiply rapidly
   c. Various biochemical activities

2. 17,000,000

3. a. Spherical (cocci)
   b. Cylindrical (bacilli)
   c. Spiral (vibrio)

4. Carbon dioxide (CO_2)

5. a. Facultative anaerobes - Can grow and reproduce in either the presence or absence of air.
   b. Obligate anaerobes - Remain dormant or die in the presence of air.
   c. Microaerophylic - Can tolerate only a small amount of oxygen.
   d. Obligate aerobes - Must have a full supply of air in order to grow.

6. Aerobic means in the presence of air while anaerobic means in the absence of air.

7. Symptoms and experiences

8. a. Uninjured tissue
   b. Natural openings
   c. Wounds

9. a. Galls
   b. Wilts
   c. Slow growth
   d. Dwarfing
   e. Imperfect fruit or ears
   f. Rots
   g. Color changes of various plant parts
   h. Retarded ripening

UNIT: Agricultural Chemicals Used as Bactericides
TOPIC: Bacteria
(Answer Sheet continued)

i. Distortion of leaves
j. Cankers
k. Brooming
l. Fasciation (malformation of stems)
m. Leaf spots

10.

11.

ERIC

Answer Sheet
for

AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Bactericides

TOPIC: Bactericides

1. a. Antibiotics
   b. Sulfa Drugs
   c. Furazolidone

2. The treatments have been of limited success and costly.

3. Student activity

4. Student activity

5.

6.

ERIC

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Nematocides

TOPIC: Nematocide Uses and Terminology

1. a. Dichloropropene (Dichloropropane)
   b. Dibromethane (ethylene dibromide)
   c. Trichloronitromethane (Chloropicrin)
   d. Bromomethane (Methyl bromide)
   e. Dibromochloropropane

2. Different soil fumigants are used due to the difference in soil, types of nematodes, and types of crops

3. A nematocide should be used when nematode plant injury and soil infestation has been indentified.

4. a. Larvacide or Picfume
   b. Dowfume W-85, Pestmaster, and Brozone
   c. Larvacide and Picfume
   d. Fumazone and Nemagon
   e. Dowfume, Bonzone, Pestmaster, Bed-Fume, and Trizone

5. A soil fumigant is a solid or liquid that forms vapors which destroy pathogens, insects, fungi, and many other forms of animal and plant life.

6.

7.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Nematocides

TOPIC: Nematodes Infesting Soils

1. Nematodes live in moist soil, tissues of other living organisms, and decaying organic matter.

2. The three groups that inhabit the soil are as follows:
   a. The predaceous species that live on small animal life and other nematodes.
   b. The saprophagous species that feed on microorganisms and decaying plant matter.
   c. The species that feed on plants.

3. a. Root-knot nematodes
   b. Cyst nematodes
   c. Burrowing nematodes
   d. Lesion nematodes
   e. Nematodes that feed on root surfaces

4. No. Some writers refer to the nematodes that feed on roots as grazers or browsers.

5. Fumigation

6. No. It is virtually impossible to achieve a 100 percent kill.

7. Effective control can be realized by using the following approved practices:
   a. Sanitation
   b. Crop rotation
   c. Fumigation
   d. Fallowing
   e. Flooding
   f. Selection of planting stock

8.

9.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Nematocides

TOPIC: Types of Nematocides

1. Halogenated hydrocarbons

2. a. Dowfume W-85 or Soilfume 85
   b. Telone
   c. Fumazone or Nemagon
   d. Brozone, Dowfume MC-2 or Trizone
   e. Larvacide or Picfume

3. a. Dichloropropene - dichloropropane
   b. Methyl bromide
   c. Dichloropropene + ethylene dibromide
   d. Dibromochloropropane
   e. Chloropicrin

4. No. No method has been proven successful in controlling nematodes in established trees and shrubs without removing the plant.

5.

6.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Nematocides

TOPIC: Application of Nematocides

1. a. By diffusion through the soil as a gas.
   b. By dispersing the chemical in water.
   c. By mechanically mixing the chemical in the soil.

2. a. An applicator kit to mount on the tractor equipment. Both pump and gravity types are used.
   b. Custom equipment that does all jobs in one trip over the soil.
   c. Hand injector for seedbeds.
   d. Added to irrigation water.

3. a. The land should be prepared in good seedbed form.
   b. The soil temperature should be between 40 and 80 degrees F.
   c. The soil should be moist enough to sprout a seed.
   d. The fumigant should be covered to prevent its escape.
   e. The land should not be disturbed until the fumigant has had time to kill the organism.

4. By a hose attached to plow feet or by hand injectors.

5. a. Crop residue should be plowed under.
   b. Soil should be in seedbed condition.
   c. The range of temperature is between 40° and 80° F.
   d. Soil should contain enough moisture to germinate seed.
   e. Chisels should be set about 12 inches apart and plow from 6 to 8 inches deep.
   f. Apply amount of chemical per acre as recommended for each brand name.
   g. Compact soil over fumigant
   h. Plow to aerate between 2 and 14 days, depending on type of chemical used.

6.

7.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used in the Control of Rodents

TOPIC: Chemical Control of Rodents

1. Rodents do damage running into millions of dollars.

2. Rodents cause expensive damage by eating, gnawing, contaminating food and spreading diseases.

3. Good general housekeeping, rat proofing and, removal of harborage

4. Crop damage

5.

6.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used in the Control of Rodents

TOPIC: Types of Rodenticides

1. Red squill and the anticoagulant rodenticides

2. Extreme toxicity and lack of an antidote

3. Warfarin, Pival, Fumarin, PMP, and diphacinone (Diphacin)

4. Red Squill and Strychnine

5. Most will die within 12 hours.

6. Within 48 hours

7. Norway rat

8. Yes

9. Mice

10. No, they are too dangerous

11. They act to reduce the clotting ability of the blood, resulting in internal and external hemorrhage and eventual death.

12. Usually maximum kill between fourth and ninth day if bait is consumed by rodents regularily.

13. Two weeks or longer

14.

15.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used in the Control of Rodents

TOPIC: Application of Rodenticides

1. Student activity

2. Rodenticide, a food, a filler or binder, and sometimes an emetic

3. More poison than recommended will decrease acceptance by rats and it increases the danger to man and animals.

4. The normal source of drinking water must be eliminated or reduced.

5. To entice rats into eating enough of certain foods at certain locations regularly

6. 1 # of red squill, (500 mg. 1 kg. strength) 8 2/3 of food, 1/3 # of binder

7. Warfarin

8. Roof rats - 19 lbs. of corn meal to 1 lb. of warfarin.
   Norway rats and mice - 99 lbs. of cornmeal to 1 lb. of warfarin

9. Replace 7 parts of cornmeal with 5 parts of rolled oats, 1 part of granulated or powdered sugar, and 1 part of corn oil.

10. 1/2 ounce

11. Water - soluable anticoagulant - contents of package
    Water - 1 quart usually
    Sugar - 5% by weight

12. Student activity

13.

14.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used in the Control of Predators

TOPIC: Control of Predators

1. a. Coyotes
   b. Gophers
   c. Rabbits
   d. Moles
   e. Prairie Dogs
   f. Fox

2. a. Crows
   b. Pigeons
   c. Gulls

3. Those that kill - those that repel

4. No, some chemicals for predator control can only be used by licensed pest control operators.

5. No, it would depend on factors of safety, economy, and practicality of other methods of control.

6.

7.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used in the Control of Predators

TOPIC: Types of Chemical control and application of chemicals.

1. Usually applied with grain, vegetables, fruits, etc. at a rate of .5 - .6% concentration for the alkaloid and at .5 - 1% concentration for the sulfate.

2. Color grain

3. LD-100, 1-30 mg. 1 kg.

4. Available only under a licensed grant.

5. No, it is not marketed yet.

6. 1 part thallium sulfate and 99 parts baiting material.

7. Inorganic compound

8. Rabbits, mice,and deer

9. Deer and rabbits

10. Avitrol 200, Avitrol 100, Tribromoethanol and Anthroquinone

11.

12.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Plant Regulators

TOPIC: Introduction to the Use of Chemicals as Plant Regulators

1. Naphthalene acetic acid (NAA); 2,4-D; N-meta-Tolylphthalamic acid; Gibberellins; Malerichydrozide; alpha-orthochlorophenoxyacetic acid, 3-chloro-isopropyl N-phenyl carbamate (Chloro IPC); beta-naphthoxyacetic acid; 2,4,5-trichlorophenoxy acetic (2,4,5-T); indoleacetic acid; sodium-gamma, beta-dichlorosobutyrate; Amo-1618

2. Amo-1618 suppresses the growth of some kinds of plants and causes them to grow as dwarfs; Amo 1618 is unusual in its ability to get into seed resulting in the first generation plants being semi-dwarf.

3. It may be sped up or retarded, cause fruit to produce no seed or fewer seed, and can delay blooming or make blooming earlier.

4. To control unwanted broadleaf plants.

5.

6.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Plant Regulators

TOPIC: Terminology

1. Glossary for Plant Growth Regulators:

   a. Defolia - A chemical or method of treatment that causes only the leaves of a plant to fall off.

   b. F_1 - Denotes the first generation offspring coming from the mating of two parents.

   c. Gibberellins - Plant growth - stimulating chemicals produced by a fungus, Gibberella fujikuroi.

   d. Herbicide - A chemical or mixture of chemicals for killing plants by applications.

   e. Hormone - A chemical substance that is produced in one part of a plant and induces a growth response in another part.

   f. Inhibit - To prevent or restrain.

   g. Inhibitor - A chemical substance that acts to prevent a process from occurring.

   h. Inhibitory - Property of blocking or checking a process or reaction.

   i. Parthenocorpic - The production of fruit or a fruiting body without seeds.

   j. P.P.M. - Parts per million

   k. Plant Regulators - (Growth regulators) Synthetic compounds prepared in the laboratory that induces growth responses in plants.

   l. Synthetic Growth Substances - Chemically synthesized compounds which affect the growth of a plant.

   m. Systemic - Absorbed into the sap stream and passed to other parts of the plant.

   n. Weed - Any plant growing out of place.

UNIT: Agricultural Chemicals Used as Plant Regulators
TOPIC: Terminology
(Answer Sheet continued)

o. 2,4-D - Para-chlorophenoxyacetic acid - Used to regulate growth and seeding ability of a plant.

p. 2,4,5-T - Trichlorophenoxyacetic acid - Used to increase size of some fruits (ex. - the apricot increased as much as 40%)

q. Amo-1618 - (2-isopropyl-4-dimethylamino-5-methylphenyl 1-piperidinecarboxylate methyl chloride) Suppresses the growth of some plants causing them to be dwarfed.

2.

3.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Plant Regulators

TOPIC: Plant Physiology and Nutrition

1. Carbohydrates, fats, and proteins

2. The combining of carbon dioxide and water by the chlorophyll of living plants in the presence of light.

3.

a. Carbon	f. Nitrogen	k. Manganese
b. Hydrogen	g. Sulfur	l. Magnesium
c. Oxygen	h. Calcium	m. Copper
d. Phosphorus	i. Iron	n. Boron
e. Potassium	j. Molybdenum	o. Zinc

4. Photosynthesis is a building process, while respiration is a decomposition process.

5. The higher the respiration rate the faster the rate of nutrient uptake.

6.

7.

Answer Sheet
for
AGRICULTURAL CHEMICAL SALES AND SERVICEMAN

UNIT: Agricultural Chemicals Used as Plant Regulators

TOPIC: Method of Application

1. Apply 20-40 ppm at berry shatter or normal girdling time. This is 7-10 days after bloom, but before berries are 3/16 inch in diameter. For cluster loosening apply when shoots are 15-21 inches in length and cluster forms are 1-3 inches long, about 2-3 weeks before bloom.

2. Apply as potatoes are going into storage any time before sprouting begins. Application can be made by a mechanical feeder over the conveyor belt, blown in through the ventilating ducts, top dressed on the stored potatoes or applied to the top of barrels before dumping. For best results temperatures should be held between 45 and 55°F.

3. Apricots, peaches, plums, and prunes

4. Apples

5. Increases fruit size, reduces die-back of terminals and prevents excessive limb breakage. It also induces more annual bearing.

6. 3-CPA

7. a. To increase the branch angle on apple trees.
   b. Promotion of apple tree bearing
   c. Fruit thinning
   d. Increase soybean yields

8. 2-3 applications

9. 1-5 days after full bloom.

10. When the first true leaves are 1 1/2 - 2 inches long to increase flower numbers on the first cluster.

11.

12.

Topic Test
on
OPPORTUNITIES IN THE AGRICULTURAL CHEMICAL INDUSTRY

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true, and False beside the statements that are false.

_____ 1. The agricultural chemical industry is one of the nation's fastest growing industries.

_____ 2. In 1964, the volume of pesticide sales amounted to 425 million dollars.

_____ 3. The availability and use of chemicals have decreased the world's food supply.

_____ 4. An expanding industry generally increases the number of employees needed by that industry.

_____ 5. There are many businesses in the U. S. today with agricultural chemicals as their only business.

_____ 6. The use of chemicals to control pests dates back to the beginning of World War II.

_____ 7. Without chemicals our food supply would probably be reduced twenty-five to thirty percent.

_____ 8.

_____ 9.

Topic Test
on
IMPORTANCE OF AGRICULTURAL CHEMICALS

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. Name nine groups of agricultural chemicals other than fertilizers.

A. _____ E. _____

B. _____ F. _____

C. _____ G. _____

D. _____ H. _____

I. _____

2. How has Texas increased wildlife population through the use of chemicals?

_____

3. How has our nation been benefited in our eating habits?

A. _____

B. _____

C. _____

4. Crop yields can be increased by up to _____ percent by use of agricultural chemicals.

5. What disease has been eliminated from the Southern United States by use of chemicals?

_____

6.

7.

Topic Test
on
FEDERAL AND STATE LAWS PERTAINING TO AGRICULTURAL CHEMICALS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. The Miller Amendment was passed in 1953.

_____ 2. The first Pure Food Act was passed in 1906.

_____ 3. The Food Additive Amendment provides the use of a chemical substance after it has been tested.

_____ 4. All herbicide dealers must have a license.

_____ 5. The dealer's license expires on January 1 of each year.

_____ 6. It is against the law to spray herbicides when the wind velocity is greater than five miles per hour.

_____ 7. The maximum pressure at the outlet on a piece of ground equipment is 30 pounds per square inch.

_____ 8. Dealers must keep an annual record of herbicides sold.

_____ 9. All ground equipment must be inspected prior to the issuing of a license for the equipment.

_____ 10. An inspection fee of $10 may be charged for inspecting equipment.

_____ 11.

_____ 12.

Topic Test
on
IMPORTANCE OF ACCURATE RECORDS

Student: _____ School: _____

Date: _____ Score: _____

Complete the following statements by filling in the correct word or words:

1. An "operating statement" summarizes the _____ and _____ for a given period of time and shows the _____ or _____ for the period.

2. A "balance sheet" shows the _____ of the company at a given time.

3. Records of stocks and inventories are needed for determining the financial condition of the firm and for _____.

4. Total _____ and total _____ are always the same on a balance sheet.

5. On a balance sheet each item below would be either an "asset" or a "liability". Which in each case?
   a. Land _____
   b. Taxes Payable _____
   c. Inventory _____
   d. Cash on hand _____
   e. Accounts Payable _____

6.

7.

Topic Test
on
SALES TICKETS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Sales tickets need to be numbered consecutively.

_____ 2. Once the cash register is balanced, sales tickets are no longer needed.

_____ 3. This entry would be sufficient for a sale ticket under description: "1 gal. insect poison".

_____ 4. The customer should sign "charge" tickets.

_____ 5. The best change for a $1.66 purchase when the customer presents a $10 bill would be three pennies, one 5¢ piece, one 25¢ piece and eight $1 bills.

_____ 6.

_____ 7.

Topic Test
on
CREDIT

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Productive credit is utilized to earn profits.

_____ 2. One source of farm credit is the Soil Conservation Service.

_____ 3. Checks should not be written in pencil.

_____ 4. A written claim against property is called a "note".

_____ 5. A cancelled check serves as a receipt.

_____ 6.

_____ 7.

Topic Test
on
DETERMINING SELLING PRICE

Student: _____ School: _____

Date: _____ Score: _____

Multiple Choice:

_____ 1. Costs that vary little or not at all are called (a) fixed, (b) standard (c) recommended, (d) fair-trade costs.

_____ 2. The amount added to the cost of an article to secure the selling price is called (a) margin, (b) gross margin, (c) net profit, (d) markup.

_____ 3. If an item costs a merchant $1.00 and retails for $1.25, the markup is what percent?
(a) 125%
(b) 20%
(c) 25%
(d) 50%

_____ 4. Markup and gross margin are (a) the same in dollars and cents, (b) different in dollars and cents, (c) the same in percentage, (d) always 25%.

_____ 5. "Turnover" is an expression used in business for (a) the number of times per year an item is sold and replaced, (b) the practice of moving stock to keep it fresh, (c) the moving of feed to keep it from hardening, (d) the total merchandise ordered at any one time.

_____ 6.

_____ 7.

Topic Test
on
BUSINESS RECORDS: ORDERING AND RECEIVING MERCHANDISE

Student: _____ School: _____

Date: _____ Score: _____

Multiple Choice:

_____ 1. A receiving record will include
a. Instructions for storage
b. Condition of merchandise
c. A catalog for future orders

_____ 2. Freight charges are
a. Always paid by the seller.
b. Never paid by the seller.
c. Sometimes paid by the seller.

_____ 3. A bill of lading will list the
a. Number of packages in the shipment
b. Cost of each article
c. Suggested selling prices

_____ 4. Statements of amounts due enumerating goods delivered are called:
a. Price lists
b. Bills of lading
c. Invoices

_____ 5.

_____ 6.

Topic Test
on
INVENTORIES

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. An inventory is an accurate record of merchandise on hand with its value.

_____ 2. Physical inventories are unnecessary if perpetual inventories are kept.

_____ 3. Inventory control helps to insure that enough goods are in the store.

_____ 4. Physical inventories are made at the end of a firm's fiscal year.

_____ 5. Physical inventory time is a good time to rearrange stock.

_____ 6.

_____ 7.

Topic Test
on
RECEIVING AND STORING MERCHANDISE

Student: _____ School: _____

Date: _____ Score: _____

Multiple Choice:

_____ 1. Damage to a shipment should be noted (a) before unloading (b) as unloading proceeds (c) in the warehouse.

_____ 2. Notes on damage in shipment should be (a) phoned to the supplier (b) disregarded (c) noted on the receiving form.

_____ 3. "Shortages" often may be checked by (a) weight (b) asking the driver (c) comparing with last shipment.

_____ 4. Merchandise delivered usually will be "signed for" by (a) the owner (b) the cashier (c) the employee receiving merchandise.

_____ 5. Checks for substitutions may be made by (a) phoning the company (b) comparing to order (c) comparing to bill of lading.

_____ 6.

_____ 7.

Topic Test
on
STOCKING AND MERCHANDISE PLANNING

Student: _____ School: _____

Date: _____ Score: _____

Complete the following statements by filling in the correct word or words:

1. Merchandise ordered too early results in poor use of _____.

2. Merchandise ordered too late results in loss of _____.

3. Who should call to the attention of the owner or manager to stock getting low? _____.

4. Who should know the location of merchandise in the store? _____.

5. Which should be sold first, old stock or new stock? _____.

6.

7.

Topic Test
on
CHEMICAL FIRST AID

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are False:

_____ 1. A person poisoned by agricultural chemicals should always be moved immediately from the source of contamination.

_____ 2. One of the earliest signs of poisoning by the organic phosphates is a headache.

_____ 3. Convulsions usually occur as one of the first symptoms when a person is poisoned by the organic phosphates.

_____ 4. The first aid for a victim of poisoning by the carbamates is about the same as for the organic phosphates.

_____ 5. The first aid for a victim of poisoning by the chlorinated hydrocarbons is about the same as for methyl bromide.

_____ 6. Coffee or tea can be given to a poison victim of the chlorinated hydrocarbons.

_____ 7. The doctor must know what is on the label of an agricultural chemical container in order to treat a victim of that chemical.

_____ 8. The two symptoms of chlorinated hydrocarbon poisoning which occur late are tingling of the body extremities and convulsions.

_____ 9. Symptoms of methyl bromide poisoning usually occur from one to four hours following exposure.

_____ 10. A victim of agricultural chemical poison must be treated quickly after becoming contaminated.

_____ 11.

_____ 12.

Topic Test
on
STORING AGRICULTURAL CHEMICALS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Left-over chemicals should be stored in tightly closed fruit jars in the garage closet or somewhere near the house.

_____ 2. Chemical closets should never be locked because they could explode.

_____ 3. The livestock feedroom is a good place to store chemicals because it is handy.

_____ 4. Herbicides and insecticides should not be stored in the same room.

_____ 5. Heavy drums should be stored on the floor so they will not fall and break other containers.

_____ 6. Special care must be taken to see that corrosive materials are stored and handled in containers designed for such materials.

_____ 7. Chemicals in glass containers should not be stored near heat.

_____ 8. Labels do not contain storage information.

_____ 9. Chlorate salts can create a fire or explosion hazard.

_____10.

_____11.

Topic Test
on
MIXING AGRICULTURAL CHEMICALS

Student: _____ School: _____

Date: _____ Score: _____

Complete the following statements by filling in the correct word or words:

1. When mixing chemicals you should use the amounts of chemicals directed by the _____ on the label.

2. _____ _____ gloves should be worn when working with agricultural chemicals.

3. When pouring chemicals from a can, the spout should always be positioned in an _____ positioned.

4. Before pouring chemicals into the sprayer tank you should test the sprayer with _____ _____ to be sure it is working properly.

5. After mixing chemicals you should wash your face and hands with _____ and _____ before eating or smoking.

6. The end of a water pipe or hose being used to fill a sprayer tank should be supported above the _____ _____ level of the tank.

7.

8.

Topic Test
on
APPLICATION OF AGRICULTURAL CHEMICALS

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. Tell how chemicals aid family living.

2. Why should you read the label before spraying a chemical in your house?

3. Why do dusts drift farther than sprays?

4. Why do oil-spray droplets tend to drift farther than water-droplets?

5. What does the skull and crossbones on the label indicate?

6.

7.

Topic Test
on
AGRICULTURAL CHEMICALS CONTAINER DISPOSAL

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. What determines the method used in disposing of a chemical container?

_____

2. What is the easiest way to dispose of large metal drums?

_____

3. Why is level ground a better disposal site for chemicals than a hill?

_____

_____

4. What danger is there in throwing used chemical containers in a ditch or creek?

_____

_____

5. Why would you need to chop holes in drums carried to the public dump grounds?

_____

6. What is the best method to dispose of paper bags, cardboard boxes, and plastic containers?

_____

_____

7.

8.

Topic Test
on
PERSONNEL AND EQUIPMENT CLEAN-UP

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. After you finish applying chemicals, there is no need to bathe.

_____ 2. After using 2, 4-D in a sprayer, all that is necessary for clean-up is to rinse it out with clear water.

_____ 3. Water and detergent should remain in empty containers for 15 minutes.

_____ 4. The sprayer need not be cleaned until the end of the spraying season.

_____ 5. Many chemicals are corrosive and will clog a sprayer if they are not cleaned out after spraying.

_____ 6.

_____ 7.

Topic Test
on
CHEMICAL RESIDUE AND TOLERANCES

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. Define residue. _____

_____

2. Define tolerance.

_____

_____

3. In what units of measure does the Food and Drug Administration list the residues in products?

_____

4. Can the Food and Drug Administration confiscate and destroy a product that has illegal pesticide residue? _____

5. How many known cases of people being killed by pesticide residues when the product was treated according to the label on the pesticide are there?

_____

6.

7.

Topic Test
on
CALIBRATING SPRAYERS

Student:_____ School:_____

Date:_____ Score:_____

Complete the following statements by filling in the correct word or words:

1. Calibration of your sprayer should be done at least every _____ of operation.

2. Reducing speed of travel when spraying will give a _____ spray rate.

3. Reducing the spraying pressure will give a _____ spray rate.

4. Increasing the speed of travel and changing to a smaller nozzle when spraying will _____ spray rate.

5. In order to calibrate by any method you must be able to determine the number of _____ used as well as know the swath length and width.

6. How many gallons/acre will you spray if you used 20 gallons on a 660 swath which was 20 feet wide? _____

7. One formula for calibration is gallons/acre = $\frac{(_____) \text{ X gallons delivered}}{\text{swath length (ft.) X swath width (ft)}}$

8.

9.

Topic Test
on
WEIGHTS AND MEASURES, CHARTS AND CONVERSION TABLES

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

Answer questions 1 and 2 using the following formula:

$$\frac{\text{\% spray desired X gallons of spray X 8.4}}{\text{\% of Concentrate}} = \text{pounds of concentrate}$$

1. How many pounds of 25 % wettable D. D. T. powder will need to be mixed with 100 gallons of water in order to have a 5% spray? _____ pounds

2. How many pounds of 25% wettable Co-Ral powder will have to be mixed with 50 gallons of water to make a .2% spray? _____ pounds

Answer question 3 using the following formula:

$$\frac{\text{lbs. of insecticide used X \% strength of conc.}}{\text{gallons of spray X 8}} = \text{\% strength of spray}$$

3. What % D. D. T. is in a spray mixture which has 1 gallon of 50% emulsifiable concentrate mixed with 50 gallons of water? _____% spray.

Answer question 4 using the following formula:

$$\frac{\text{\% active ingredient wanted X pounds of mixed dust wanted}}{\text{\% active ingredient in insecticide used}} = \text{pounds of insecticide needed for mixture}$$

UNIT: Formulas and Dilution Charts
TOPIC: Weights and Measures, Charts and Conversion Tables
(Topic Test continued)

4. How much clay and how much 50% D. D. T. dust will it take to make 100 pounds of 5% D. D. T. dust?

_____ pounds of D. D. T. dust
_____ pounds of clay

5.

6.

ERIC

Topic Test
on
COMPATIBILITY CHARTS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Caution should be used when mixing calcuim arsenate with other insecticides.

_____ 2. Bordeaux is the least compatible insecticide listed on the compatibility chart.

_____ 3. Zinc Sulphate + Lime will mix effectively with any other insecticide.

_____ 4. Malathion will mix easily with most other insecticides.

_____ 5. Malathion and Sevin mixture may cause injury to cotton.

_____ 6. Labels on containers will not have information concerning compatibility of insecticides.

_____ 7.

_____ 8.

Topic Test
on
SPRAYING EQUIPMENT

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. Name the five general classes of hydraulic sprayers commercially available.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

2. What determines the spraying pressure of a sprayer?

   _____

3. What factors determine size and type of pump needed?

   a. _____

   b. _____

   c. _____

4. Spray patterns are usually found in what three types?

   a. _____

   b. _____

   c. _____

Spraying Equipment
(Topic Test continued)

5. Name four types of spray distribution units.

a. _____

b. _____

c. _____

d. _____

6. What are the two methods of agitating the spray material in the tank?

a. _____

b. _____

7

8.

ERIC

Topic Test
on
DUSTING EQUIPMENT

Student: _____ School: _____

Date: _____ Score: _____

Complete the following statements by filling in the correct word or words:

1. The hopper capacity of most power dusters ranges from _____ to _____ pounds.

2. Fruit tree dusters usually have _____ discharge hose and nozzle.

3. Vineyard units have _____ hoses and nozzles.

4. Field and row crop dusters may have _____, _____, or _____ hoses and nozzles.

5. _____ _____ fans are generally found on power dusters.

6. The feed regulators are adjustable to deliver dust at rates between _____ and _____ pounds per acre.

7.

8.

Topic Test
on
FOGGING EQUIPMENT

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. The best time to use fogging equipment is at night.

_____ 2. The mist produced by fogging is a contact insecticide.

_____ 3. There should be no air movement when fogging equipment is used.

_____ 4. Fogging equipment is used extensively in agriculture.

_____ 5. Fogging mist has little or no residual effect.

_____ 6. Foggers are used extensively in field crop production.

_____ 7.

_____ 8.

Topic Test
on
FUMIGATING EQUIPMENT

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. What are nematodes?

2. Where may nematodes be found?

3. How large are nematodes?

4. What crops are damaged by nematodes?

5. How many different species of nematodes are known?

6. What are three methods used for fumigating?

7. Why must the soil be packed immediately after the fumigant is applied?

8.

9.

Topic Test
on
CLASSES OF INSECTS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

1. True insects are members of the Arachnida class.

_____ 2. The Arthropoda phyla is composed of eighty percent of all known animals.

_____ 3. The classification of insects began about 200 years ago.

_____ 4. The scientific names of animals are in Greek, the dead language.

_____ 5. The name of each species consists of two words.

_____ 6. A scientific name of an animal may be duplicated if they are members of the class.

_____ 7. A true insect has three distinct body parts.

_____ 8. A true insect always has antennae.

_____ 9. A true insect has three pairs of legs.

_____ 10. A true insect usually has wings.

_____ 11. All members of a genus are closely related.

_____ 12. Each order of insects has a number of families.

Topic Test
on
BODY PARTS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. There are three main body parts to all members of the animal kingdom.

_____ 2. The exoskeleton is one of the three main parts of an insect.

_____ 3. The knowledge of insect anatomy is important.

_____ 4. The exoskeleton is made from a material called chitin.

_____ 5. Most insects breathe through lungs.

_____ 6. There are four parts to the exoskeleton.

_____ 7. The chitin, covering of an insect, protects the insect from changing environmental conditions.

_____ 8. In some insects the sense of hearing as well as the sense of touch is located in the antennae.

_____ 9. There are four kinds of insect mouth parts.

_____ 10. The thorax consists of three parts.

_____ 11. Each part of the thorax has a pair of legs.

_____ 12. Insects are the only animals that have wings.

_____ 13.

_____ 14.

Topic Test
on
LIFE CYCLES

Student: _____ School: _____

Date: _____ Score: _____

PART I:
Complete the following statements by filling in the correct word or words:

1. A honey bee lays _____ to _____ eggs daily for several weeks.

2. The _____ is stored by the insect and fertilizes the insect's eggs as they are being laid.

3. The sperm enters the egg on the _____ end.

4. The embryonic development occurs in some insects without _____.

5. The insect _____ or sheds its skin to grow.

PART II:
Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Being able to recognize the eggs of insects will help in determining the number of insects one could expect the next season.

_____ 2. Recognizing insect eggs will also help in determining when to poison.

_____ 3. An insect usually lays its eggs in a favorable place for them to hatch.

_____ 4. Insect eggs hatch within a few hours.

_____ 5. The growth of an insect is restricted by the exoskeleton.

_____ 6. A molting fluid collects between the old and new cuticula prior to an insect's molting.

_____ 7. It isn't uncommon for an insect to molt five or six times.

_____ 8. The life cycle is not completely understood.

_____ 9.

Topic Test
on
HOST PLANTS OR ANIMALS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Many insects have a mixed diet, eating both plants and animal materials.

_____ 2. Predatory insects frequently are selective in capturing their living prey.

_____ 3. Parasitic insects help increase the number of plant eating insects.

_____ 4. Many insects refuse to eat more than one host plant.

_____ 5. The sense of smell in insects is much more acute than in humans.

_____ 6. Insects can be grouped according to their feeding habits.

_____ 7. The selective appetite of an insect is purely instinct as far as entomologists can determine.

_____ 8. Some insects induce abnormal growth on some plants.

_____ 9.

_____ 10.

Topic Test
on
INSECT RESISTANCE TO CHEMICALS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Insects resistant to chemicals can not be killed by an application of the chemical to which they are resistant.

_____ 2. Insects are said to be resistant to a chemical when a sizeable proportion can survive the application of the chemical at the recommended strength.

_____ 3. Insect resistance to chemicals can not be fully explained.

_____ 4. After the continued application of a chemical, it may be necessary to use another unrelated chemical to secure insect control.

_____ 5. The possibility that insects may develop resistance to some chemicals has been known for a long time, maybe half a century.

_____ 6. When planning his insect control program, the farmer should eliminate some of the factors affecting chemical resistance by insects.

_____ 7. The observation that ticks were tolerant to DDT caused entomologists to recognize that other insects may become resistant to chemicals.

_____ 8. A. L. Melander, Professor at Washington State University, pointed out in 1914 the possibility of insect resistance to chemicals.

_____ 9. All insects develop a resistance to chemicals at the same rate.

_____ 10. Insects resistant to one chemical will develop a resistance to other chemicals.

_____ 11. Insects will not generally become susceptible to a chemical after they have once developed a resistance to the chemical.

_____ 12. Some insects have maintained resistance to a chemical for as long as forty years.

_____ 13.

Topic Test
on
LOSSES CAUSED BY INSECTS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Insects are constantly damaging food and fiber.

_____ 2. Insect damage to crops increases the cost of production.

_____ 3. Probably 10,000 kinds of mites, ticks, and other insects infect man directly or indirectly.

_____ 4. Insects may transmit a disease merely by their presence.

_____ 5. Some insects carry disease organisms and viruses.

_____ 6. Most disease cycles can be broken by breaking the insect cycle.

_____ 7. In order for houseflies to reproduce, they must breed in filth, animal matter, or fermenting vegetable matter.

_____ 8. Insects have the ability to travel long distances.

_____ 9. A common housefly may travel 100 miles.

_____ 10. Caterpillars also carry human diseases.

_____ 11.

_____ 12.

Topic Test
on
METHODS OF CONTROL

Student: _____ School: _____

Date: _____ Score: _____

PART I:
Complete the following statements by filling in the correct word or words.

1. If allowed to multiply, a pair of flies starting in April can produce _____ _____ offspring by August.

2. Man will always have to fight nature for his _____ and _____.

3. Insect control is the _____, _____, and interferring with the _____ and _____ of insects.

4. Natural insect control includes such factors as _____, _____ and _____.

5. _____ is probably the most important natural control of insects.

6. A large body of _____ can play an important role in _____ insects.

7. The most common method of the physical control of insects is the _____ of houses.

PART II:
Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Some insects are controlled by artificially controlling the temperature.

_____ 2. Warm, moist weather is ideal for insect reproduction.

_____ 3. The first quarantine law was passed in 1900.

_____ 4. The controlling of insects by chemical means is a method most often used.

_____ 5. There are a limited number of insecticides available for controlling insects.

_____ 6.

_____ 7.

Topic Test
on
INTRODUCTION TO INSECTICIDES

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. What should you always do before applying a pesticide?

_____

2. How long would the stored food supply in the U.S. feed our population if all production ceased?

_____

3. Are pesticides necessary? Why?

_____

_____

4. Are pesticides poisoning our food supply? Explain.

_____

_____

5.

6.

Topic Test
on
INSECTICIDE TERMINOLOGY

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. Name four different types of insecticide formulations.

   a. _____ c. _____

   b. _____ d. _____

2. How do stomach poisons kill? _____

   _____

3. How do contact poisons kill? _____

4. How do fumigant poisons kill? _____

   _____

5. What has largely replaced inorganic insecticides? _____

6. What is the primary use of oils in insecticides? _____

7. What is meant by botanical? _____

8. Name two synthetic organic insecticides that are chlorinated hydrocarbons.

   a. _____

   b. _____

9.

10.

Topic Test
on
PROPERTIES AND CHARACTERISTICS OF INSECTICIDES

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. Why should chemical salesmen have a sample kit of insecticides common to their area?

_____

_____

2. Why should the sales kit include technical information regarding the properties and characteristics of insecticides, herbicides, fumigants, growth regulators, repellents, and rodenticides?

_____

_____

3. What are four ways poisons kill?

a. _____

b. _____

c. _____

d. _____

4. What are three physical states of chemicals?

a. _____ b. _____ c. _____

5.

6.

Topic Test
on
THE CHEMISTRY AND MODE OF ACTION OF ORGANIC INSECTICIDES

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. What causes the most accidents with organic phosphate insecticides?

   _____

2. Why do you need to be more careful with organic phosphate poisons than chlorinated hydrocarbons?

   _____

3. Why should you see a physician before working with organic phosphates?

   _____

4. How often should a person working closely with organic phosphates have his blood checked?

   _____

5. If the blood test indicates danger from the organic phosphates, what should the worker do?

   _____

   _____

6. How do chlorinated hydrocarbons kill? _____

   _____

7. Why is Sevin being used as a substitute for DDT in many instances?

   _____

The Chemistry and Mode of Action of Organic Insecticides
(Topic Test continued)

8. Why is a little skinny person more subject to being poisoned than a big fat person?

_____

9.

10.

Topic Test
for
THE CHEMISTRY AND MODE OF ACTION OF INORGANIC INSECTICIDES

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. Name five inorganic insecticides.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

2. Of what origin are inorganic insecticides? _____

3. Is sodium fluoride a stomach or contact poison? _____

4. Is lime-sulfur a contact or stomach poison? _____

5. Is sodium selenate a contact, stomach, or systemic poison? _____

6.

7.

Topic Test
on
THE USE OF INSECTICIDES AS FUMIGANTS

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. What two men are mentioned in Roman and Greek history as using sulphur as a fumigant? a. _____ b. _____

2. What characteristic do small grains possess that makes it possible to fumigate them in open buildings? _____

3. What kind of foodstuffs may retain obnoxious odors from certain fumigants?

   _____

4. How do you fumigate by vacuum? _____

   _____

5. What are two advantages of vacuum fumigation?

   a. _____ b. _____

6. What two soil conditions need to be right for soil fumigation?

   a. _____ b. _____

7. Why should water never be used to clean soil fumigation equipment?

   _____

8. According to estimates, what percentage of stored grain is destroyed by insects each month? _____

The Use of Insecticides as Fumigants
(Topic Test continued)

9. Why should carbon disulfide (Hi-Life) not be used alone?

_____

10. When you are fumigating, why should someone else always be present?

_____

11.

12.

Topic Test
on
THE USE OF INSECTICIDES ON HOUSEHOLD PESTS

Student: _____ School: _____

Date: _____ Score: _____

1. Name an insecticide and the strength which can be used for control of each of the following household insects:

   Ants _____

   Bedbugs _____

   Cockroaches _____

   Fleas _____

   Silverfish _____

   Spiders _____

   Ticks _____

   Wasps _____

Topic Test
on
FIELD CROPS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Insects affect field crops at certain stages of growth only.

_____ 2. Dusting is not used for control of insects on field crops.

_____ 3. Spraying should be done when plants are dry and wind is under 15 miles per hour.

_____ 4. Pump pressure should not generally exceed 60 pounds per square inch.

_____ 5. No more than one nozzle per row should be used when spraying row crops.

_____ 6. Insects never develop resistance to insecticides.

_____ 7. Excessive use of insecticide may be harmful to other crops.

_____ 8. If possible, natural parasites and predators should be used to control harmful insect populations.

_____ 9. Cotton insect control should include early season, late season, and early stalk destruction steps.

_____ 10.

_____ 11.

Topic Test
on
ORCHARDS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Farm chemicals increase the value of fruit harvested.

_____ 2. Residue of chemicals on fruits is constantly checked.

_____ 3. Crop growth does not affect residue.

_____ 4. Residue is reduced by physical weathering.

_____ 5. Stink bugs do not affect fruits.

_____ 6. Most tree borers are hard to control.

_____ 7. Most scale insects of fruits can be treated at anytime.

_____ 8. Pecan twig girdler attacks foliage of pecans.

_____ 9. Aphids and mites attack foliage of trees.

_____10. Fall webworms encase entire limbs in white webs.

_____11.

_____12.

Topic Test
on
ORNAMENTAL PLANTS AND SHRUBS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Aerosol sprays are very effective in greenhouses.

_____ 2. We have six groups of insects attacking plants and shrubs.

_____ 3. Leaf chewing insects are usually controlled by contact poisons.

_____ 4. Insect damage may occur from the time the seed is planted, and through all stages of growth.

_____ 5. Insecticides may be used as sprays, dusts, baits and fumigants.

_____ 6. Gall forming insects sting the plant cells causing the gall to form.

_____ 7. Tip and stem damage is done mostly by adult beetles and moths.

_____ 8. Ants are a type of surface infesting insects.

_____ 9. Wireworms are boring type soil insects.

_____ 10. Leaf-miners eat the entire leaf.

_____ 11.

_____ 12.

Topic Test
on
FOREST PLANTS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Some insects act as tree pruners.

_____ 2. Some insects reduce the ability of trees to produce seed for restocking.

_____ 3. Man has always been able to control forest insects.

_____ 4. Direct methods and indirect methods are often used to control forest insects.

_____ 5. The increase of our population has no bearing on forest production.

_____ 6. Modern science has made it easier and cheaper to control forest insects.

_____ 7. Primitive man was not worried by forest insects.

_____ 8. Termites and borers are responsible for great damage to forest products.

_____ 9. Stomach poisons kill defoliator type insects.

_____10. Keeping trees healthy is a good way to keep down insect population.

_____11.

_____12.

Topic Test
on
VEGETABLES

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Vegetable insects are generally placed in three groups.

_____ 2. Aphids and leafhoppers are sap suckers.

_____ 3. Cutworms are both surface and underground feeders.

_____ 4. Grasshoppers are classed as sucking insects.

_____ 5. There are several kinds of blister beetles.

_____ 6. Care must be taken to prevent excessive chemical residue on vegetables.

_____ 7. Squash bugs are sucking insects, while the squash borer is a chewing insect.

_____ 8. The sweet potato weevil is a serious pest in sweet potato growing areas.

_____ 9. Control of sucking insects may also help in the control of some plant diseases.

_____10. Snails do not feed on plants.

_____11.

_____12.

Topic Test
on
GRASSES

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Grasshoppers are serious pests of grasses.

_____ 2. Insects often spread plant diseases.

_____ 3. Destruction of weeds and residues does not help control insects.

_____ 4. Immature spittle bugs can provide protection against natural enemies.

_____ 5. One type of damage caused by insects is the eating of leaves and stems.

_____ 6. Stink bugs are chewing insects.

_____ 7. Stink bugs are generally shield-shaped insects.

_____ 8. Grubs and cut worms do not harm grasses.

_____ 9. Generally, cultural and insecticidal measures do a good job of controlling spittle bugs.

_____10. Weevils are generally not a serious pest of grasses.

_____11.

_____12.

Topic Test
on
LAWNS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Lawn insects are grouped into three damaging groups.

_____ 2. The fourth group of lawn insects is annoying.

_____ 3. Soil and root feeding insects are difficult to control.

_____ 4. Livestock should be permitted to graze areas treated for lawn insects.

_____ 5. Use of milky diseases spores help control the Japanese beetles.

_____ 6. Applications of insecticide for soil and root insects need to be repeated often.

_____ 7. Leaf and stem feeding insects can be controlled by using DDT.

_____ 8. Baits are often used to control lawn insects.

_____ 9. The annoying group of insects does not bother man.

_____10.

_____11.

Topic Test
on
STORED GRAIN INSECTS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Ten percent of our stored grains are lost because of insects.

_____ 2. Total value of products lost to insects annually amounts to 4 billion dollars.

_____ 3. Temperature and moisture are important in insect reproduction cycles.

_____ 4. Losses from insects are the same in the southern and nothern United States.

_____ 5. The rice weevil does most of the damage in the south.

_____ 6. Insects of stored grains devour their own weight in food each week.

_____ 7. The immature stages of grain insects can easily be removed during the milling process.

_____ 8. Prevention of destructive outbreaks plays a big part in control of grain insects.

_____ 9. Stored grain insects have a low rate of reproduction.

_____10. Modern science is keeping up with grain insect control.

_____11.

_____12.

Topic Test
on
LIVESTOCK

Student: _____ School: _____

Date: _____ Score: _____

Fill in blanks with correct word or words.

1. Many newer insecticides materials are synthetic _____ chemicals.

2. Rotenone is still used to control _____ _____ _____.

3. _____ has a rapid parolytic effect on insects.

4. DDT has a low _____ to animals.

5. _____ and _____ are two chemicals containing the gamma isomer benzene hexachloride.

6. _____ insecticides are the newest approach to controlling external parasites.

7. A good insecticide might be described as being _____, _____, and _____.

8. Two disadvantages of phenothiazine are:
   a. _____
   b. _____

9. Five other chemical used to control internal parasites are:
   a. _____ c. _____ e. _____
   b. _____ d. _____

10. Even though you send screw worm specimens to the state laboratory, what other precautions should you take to treat screw worms? _____
_____

11. Cattle lice are most abundant during the _____ months.

12. Only two sprays from _____ to _____ days apart are generally required to free cattle from lice.

13.

Topic Test
on
POULTRY

Student: _____ School: _____

Date: _____ Score: _____

PART I: Complete the following statements by filling in the correct word or words:

1. More emphasis should be placed on _____ and less on medication for removal of roundworms in poultry.

2. Heavy roundworm infestations sometimes _____ young birds.

3. Phenothiazine is an _____ drug for the _____ of cecal worms in poultry.

4. Mature tapeworms consist of several hundred_____.

5. Poultry manure may be treated with _____ percent lindane _____ spray for fly larval control.

6. Flies may spread _____ and _____ of internal parasites.

7. For adequate control of parasites, _____ must be supplemented with the prevention of fly breeding.

8. _____ and _____ lice do most harm to poultry.

9. Mites leave their hiding places at _____to suck _____ from poultry.

10. The life _____ of the fowl _____ is very similar to that of mites.

11.

12.

PART II: Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Roundworms can be prevented by using proper sanitation practices.

_____ 2. Roundworms are usually found in the liver of baby chicks.

UNIT: Agricultural Chemicals Used as Insecticides on Animals
TOPIC: Poultry
(Topic Test continued)

_____ 3. Cecal worms do little harm to chickens but are a danger to turkeys.

_____ 4. Tapeworms do not have very many intermediate hosts.

_____ 5. Flies do not bite poultry.

_____ 6. Care should be exercised in using all insecticides for the control of flies and mosquitoes.

_____ 7. Nicotine sulfate is recommended for the control of mites.

_____ 8. Few drugs are strong enough to destroy lice eggs.

_____ 9. The fowl tick sucks the blood of poultry.

_____10. Fleas can be controlled the same as lice.

_____11.

_____12.

Topic Test
on
DEVELOPMENTS AND TRENDS IN THE USE OF SOIL ADDITIVES

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Plants need thirteen elements in addition to the natural elements in order to grow.

_____ 2. The plant tissue test and soil test are the most accurate methods of determining soil deficiencies.

_____ 3. Plants grown on deficient soil usually will show signs of the soil deficiency.

_____ 4. The soil sample taken for the purpose of determining soil deficiencies may represent the soil from several area.

_____ 5. The soil profile will influence the diagnosis of a soil deficiency.

_____ 6. A chemical analysis of unfertilized plants will help in determining deficiency of soils.

_____ 7. The fertilizer application can affect the appearance of the plant.

_____ 8. One or two soil sample, taken in an area, is adequate for getting an accurate soil test.

_____ 9.

_____ 10.

Topic Test
on
DETERMINING WHEN TO USE SOIL ADDITIVES

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. A neutral soil would have a pH of 6.5.

_____ 2. A measurement of soil acidity of alkalinity is like a doctor's measurement of a patient's tempertaure.

_____ 3. There are three different types of soil acidity.

_____ 4. Calcium and magnesium are the basic materials used to treat acid soils.

_____ 5. Alkali soils contain excessive amounts of adsorbed sodium.

_____ 6. Poor drainage may affect the salinity of the soil.

_____ 7. The effects of salinity on growth is negligible.

_____ 8. Soils can be leached by applying water to the surface.

_____ 9. Salt affected soils occur mostly in arid or semi-arid climates.

_____ 10. Alkali soils contain excessive amounts of sulfur.

_____ 11.

_____ 12.

Topic Test
on
INTRODUCTION TO WEED AND BRUSH CONTROL

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. According to estimates, how much economic loss do weedy plants cause in the United States annually?

2. How much more water do weedy plants require to produce a pound of dry matter than range and pasture grasses?

3. What percent of the forage produced by Texas ranges should be utilized by livestock?

4. What percent of the forages being produced by Texas ranges can be utilized by the livestock grazing on them?

5. List 4 ways weeds cause losses to farmers.

6. Why are weeds more economically controlled chemically than mechanically?

7. Why does the cost of clearing brush and trees vary so much?

8. About what percent root kill can you expect on post oak when two applications of 2, 4, 5-T are applied?

9.

10.

Topic Test
on
OPPORTUNITIES AND TRENDS IN THE USE OF HERBICIDES

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. Why have farmers been slow to turn to herbicides?

2. What is forcing farmers to use herbicides?

3. Why did some sections of Texas begin using herbicides on a large scale before other sections?

4. When will farmers use more herbicides?

5. How has increased use of fertilizers caused greater need for herbicides?

6. What will bring about a natural growth in the use of herbicides?

7. What will bring about a greater need for technically trained personnel in the use of herbicides?

8.

9.

Topic Test
on
HERBICIDE TERMINOLOGY

Student: _____ School: _____

Date: _____ Score: _____

Complete for following statements by filling in the correct word or words:

1. Biennial - A plant that completes its life cycle in _____ years.

2. Blanket or Broadcast Application - Placing the chemical over the _____ area.

3. Adhesive - A substance that will cause a spray material to _____ to the sprayed surface.

4. Antidote - A practical immediate _____ including _____ aid in case of poisoning.

5. Boot stage - When the seed head of a grass plant begins to emerge from the _____.

6. Compatability - Refers to chemical materials that can be _____ together without adversely changing their affects on pests or plants.

7. Fumigant - Any material that destroys organisms when it is in the _____ or _____ form.

8. Herbicide - Any compound used to _____ or inhibit the growth of a plant.

9. High Volume Spray - Spray application of more than _____ gallons/acre.

10. Percent Concentration - Similar to parts per million but expressed as a _____.

11. Post-emergence Herbicide - A chemical applied to the foliage of weeds _____ the crop has emerged from the soil.

12. Pre-emergence Herbicide (Residual) - A chemical applied at _____ of seeding or just _____ to drop emergence to kill weed seeds and germinating seedlings.

13. Toxicity - Degree to which something is _____.

14. Synergism - Two compounds, whose effects, when mixed together are _____ than the sum of the two working separately.

15. Winter Annual - A plant that germinates in the fall or winter, matures seed and dies in the _____ or early _____.

Topic Test
on
PLANT NUTRITION AND PHYSIOLOGY PRINCIPLES
OF WEED AND BRUSH CONTROL

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. What is meant by "Adaptations that repel grazing animals"?

2. What is meant by "Ability to propagate vegetatively"?

3. How does "Something" control weeds?

4. What are the two problems involved in controlling perennial weeds?

5. What is meant by "biological" methods of weed control?

6.

7.

Topic Test
on
IDENTIFICATION OF WEEDS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. A weed is a plant out of place.

_____ 2. Annuals are classed as true annuals and winter annuals.

_____ 3. Crabgrass is classed as a perennial.

_____ 4. Bermudagrass is classed as a perennial.

_____ 5. Weeds, according to seed laws, are classed as common and noxious weeds.

_____ 6. Sandburrs can cause mechanical injury to livestock.

_____ 7. A key is a device for identifying plants.

_____ 8. To identify plants properly, one should have a complete plant if at all possible.

_____ 9. Weeds' seeds may be introduced in crop seed at planting time.

_____10. A perennial requires seeds to keep growing year after year.

_____11.

_____12.

Topic Test
on
SEED LAWS PERTAINING TO WEEDS

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. Farmer Brown is selling his neighbor farmer Jones seed that has not been advertised and is not labeled. Is this legal? Yes or No.

2. Farmer Jones has seed that contain more than 100 Johnson grass seed per pound. What must be on the label in order to market this seed?

3. Farmer Brown has seed that contain 50 nutgrass seed per pound. Is it legal to market this seed?

4. When purchasing seed what should one do to insure that the seed is pure?

5.

6.

Topic Test
on
CLASSIFICATION, PROPERTIES, AND CHARACTERISTICS
OF HERBICIDES IN WEED AND BRUSH CONTROL

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Preplanting application of herbicides can be done during winter months.

_____ 2. Nonselective herbicides kill all plant growth.

_____ 3. Extended effect of herbicides last 2 to 3 weeks.

_____ 4. Selective herbicides will kill all weeds.

_____ 5. Systemic weed killers are affecting parts of the plants other than those directly contacted.

_____ 6. Nonselective herbicides are used to kill deep-rooted perennial plants.

_____ 7. Post-emergence herbicides are used on crops to kill weeds or grasses after the crop is up.

_____ 8. Annuals propagate only by seed,therefore herbicides can control these to prevent seed production.

_____ 9. Care must be used when herbicides are applied.

_____10. Use of 2,4-D, and 2,4,5-T, as herbicides are restricted by the Texas Department of Agriculture.

_____11.

_____12.

Topic Test
on
FACTORS AFFECTING WEED AND BRUSH CONTROL WITH HERBICIDES

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Use of chemicals for weed control does not require technical knowledge.

_____ 2. Time of application is not important in the application of herbicides.

_____ 3. Young growing plants are easier to control with herbicides.

_____ 4. Soil should be well tilled, warm and moist for herbicides to be most effective.

_____ 5. Low temperatures require more herbicides to do the job.

_____ 6. Non-selective herbicides kill all plants.

_____ 7. Contact herbicides generally require complete coverage of the plant.

_____ 8. Pre-emergence treatement is one which kills weeds as the seeds germinate.

_____ 9. Systemic weed killers are not used.

_____ 10. Selective weed killers are more toxic to some species of plants than others.

_____ 11.

_____ 12.

Topic Test
on
HERBICIDE SELECTION

Student: _____ School: _____

Date: _____ Score: _____

Complete the following statements by filling in the correct word or words:

1. A selective herbicide kills certain plants, while others that the herbicide comes in contact with are _____ affected.

2. Selective herbicides can be used to kill _____ leaf plants out of small grain.

3. Non-selective herbicides can be used to spray anywhere you want _____ plants killed.

4. Once the weed population is established, you would use a _____ herbicide.

5. Root herbicides can be applied by mixing the herbicide in the top layer of the _____ before or during planting.

6.

7.

ERIC

Topic Test
on
PREPARING HERBICIDES FOR USE

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Herbicides are sold only in liquid form.

_____ 2. Non-selective herbicides kill all plants.

_____ 3. Herbicide spray should be used the day it is mixed.

_____ 4. Lime and and lime-sulfur are incompatibile with other herbicides.

_____ 5. Labels of herbicides should always be read carefully.

_____ 6. The active ingredients are always listed on the labels.

_____ 7. All herbicides can be mixed with insecticides or fungicides.

_____ 8. A carrier is a filler agent in the spray solution.

_____ 9. Herbicides alone should be depended upon for weed control.

_____10. Toxic means poisonous materials are present in the mixture.

_____11.

_____12.

Topic Test
on
DETERMINING METHOD OF TREATMENT

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. What is meant by selective foliage contact herbicide?

2. What is meant by non-selective foliage contact herbicide?

3. What is meant by translocated herbicides?

4. Why can pre-emergence treatment of corn , sorghum and sugar cane kill the grasses in these crops and not harm the crops?

5. What is meant by broadcast spraying?

6. What advantages are there to row spraying?

7. What grasses are often spot treated?

8. What conditions usually affect action of herbicides?

9.

10.

Topic Test
on
APPLICATION OF HERBICIDES

Student:_____ School: _____

Date:_____ Score: _____

Write True beside the statement that are true and False beside the statements that are false:

_____ 1. Herbicides kill weeds through root systems only.

_____ 2. Herbicides may be obtained in liquid, powder or granules.

_____ 3. In field spraying complete coverage is not necessary.

_____ 4. Spraying weeds in pastures is usually cheaper than mowing.

_____ 5. Drop nozzles allow spraying of growing crops.

_____ 6. Row treatment generally means band application.

_____ 7. High clearance power sprayers are used on growing crops.

_____ 8. High clearance equipment can not be used for complete field coverage.

_____ 9. Grass in competition with weeds have yeilds reduced as much as one-half of potential yield.

_____10. Selective herbicides kill all plants.

_____11.

_____12.

Topic Test
on
AQUATIC WEED CONTROL WITH HERBICIDES

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Algae speeds the flow of water in irrigation ditches.

_____ 2. Copper sulfate and RADA are used to control algae.

_____ 3. A common practice in getting chemicals in the water of irrigation ditches to kill algae is to pour in liquid concentrates.

_____ 4. The roots of floating plants feed from the bottom of ponds.

_____ 5. Duckweeds grow better when the flow of air is blocked from a pond.

_____ 6. The flowers of submersed waterweeds grow under the water.

_____ 7. Fertilizing a pond helps prevent water lilies.

_____ 8. If you fertilize to get rid of waterlilies you should apply enough fertilizer to color the water.

_____ 9.

_____ 10.

Topic Test
on
FUNGICIDES, THEIR DEVELOPMENT AND USES

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Fungicides are also used as insecticides.

_____ 2. A fungicide is a chemical substance used as a spray, dust or solution to kill fungi.

_____ 3. In treating seeds, fungicides are used as disinfectants and protectants.

_____ 4. Fungicides can only be used in powder form.

_____ 5. Protectants are used against organisms found in the soil.

_____ 6. Systemic fungicides show promise for future use.

_____ 7. Soil fumigants may be liquid, powder, or gas.

_____ 8. Only organic substances are used as fungicides.

_____ 9. Extreme care must be taken when applying fungicides to avoid harm to the operator.

_____10. When applying fungicides to seeds in slurry formulations, seeds need not be dried.

_____11.

_____12.

Topic Test
on
PATHOLOGICAL AGENTS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. The pathogen agents for fungi are other living hosts.

_____ 2. Fungi reproduce by the formation of microscopic bodies called spores.

_____ 3. Fungi depend on living plants for their food source.

_____ 4. There are three groups of fungi.

_____ 5. Fungi are classified according to the manner in which spores are produced.

_____ 6. Fungi are carried by natural elements and other means.

_____ 7. Inoculation is when the pathogen and host come in contact.

_____ 8. Diseases are caused by insects carrying fungi.

_____ 9. Some fungi reproduce by nonsexual spore formations.

_____10. The rust and smut fungi are members of the Basidiomycetes group.

_____11.

_____12.

Topic Test
for
PLANT DISEASES

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. A plant disease is a condition in which any part of a living plant is abnormal.

_____ 2. A fungus is a living organism that requires sunlight to live.

_____ 3. Fungi reproduce by the formation of microscopic bodies called spores.

_____ 4. Some of the fungi spores are one-celled and some are two-celled.

_____ 5. All fungi spores are the same size.

_____ 6. A nonparasite disease is a disease caused by a parasite.

_____ 7. Roots serve the plant by absorbing water and the necessary minerals from the soil.

_____ 8. Chlorophyll takes energy from the sun and changes it into energy used by the plant.

_____ 9. The stem is part of the plant's transportation system.

_____ 10. The symptoms of soft rot are similar in all vegetables.

_____ 11.

_____ 12.

Topic Test
for
APPLICATION OF FUNGICIDES

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Fungicides classified as plant protectants kill fungus on contact.

_____ 2. Many applications of fungicides have been successful without regards to time of application.

_____ 3. Most fungicides can be applied at very high rates before plant injury is noticeable.

_____ 4. Fungicides containing the same ingredients are sold under different names.

_____ 5. Trade names and common names of fungicides are usually the same.

_____ 6. A wetting agent is used to increase the amount of air in the liquid.

_____ 7. The use of auxiliary agents usually increase the effectiveness of the fungicide.

_____ 8. An adhesive wetting agent increases the adhesion of the fungicide or causes it to adhere to the plant.

_____ 9. An emulsifier counteracts the chemical characteristics of a material.

_____10. Seed may be treated by drenching with a fungicide.

_____11.

_____12.

Topic Test
on
BACTERIA

Student: _____ School: _____

Date: _____ Score: _____

Complete the following statements by filling in the correct word or words:

1. Bacteria are significant because of their _____ size, their ability to _____ rapidly, and various _____ activities.

2. The three general shapes of bacteria are _____, _____ and _____.

3. All bacteria require a definite, but small, amount of _____ in order to grow.

4. _____ means in the presence of air, while _____ means the absence of air.

5. Two of the three ways that bacteria can gain entrance to plants are:
   a. _____
   b. _____

6. Five of the ways that plants can respond to invasion by bacteria are:
   a. _____
   b. _____
   c. _____
   d. _____
   e. _____

7.

8.

Topic Test
on
BACTERICIDES

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Antibiotics are classified as bactericides.

_____ 2. Sulfuric acid can be used to delint cotton seed.

_____ 3. The use of bactericides for controlling plant disease has been very successful so far.

_____ 4. Streptomycin has been used to control walnut blight.

_____ 5. Bactericides for plant diseases are plentiful on the market today.

_____ 6.

_____ 7.

Topic Test
on
NEMATOCIDE USES AND TERMINOLOGY

Student: _____ School: _____

Date: _____ Score: _____

Part I: Define the following terms:

1. Nematode

2. Nematocide

3. Pathogen

4.

5.

Part II: Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Nematodes are resistant to most chemicals.

_____ 2. Treating soils with fumigants does not necessarily increase the yield.

_____ 3. Most of the fumigants are considered nonvolatile.

_____ 4. Methyl bromide is one of the best recognized soil fumigants.

_____ 5. Chloropicrin is known as tear gas.

_____ 6. Control measures by use of fumigants are recommended even though nematodes are found in the soil in small numbers.

_____ 7. Most all crop land is infested with either nematodes or some other type of root disease.

_____ 8.

Topic Test
on
NEMATODES INFESTING SOILS

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. Nematodes are spread by:

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

2. List one type of nematode opposite the host plant, use the common name. (Example root-knot)

   a. Tomato _____

   b. Grasses _____

   c. Ornamentals _____

   d. Citrus trees _____

   e. Pepper _____

   f. Oats _____

   g. Nursery stock _____

   h. Pine _____

   i. Soybeans _____

   j. Irish Potato _____

UNIT: Agricultural Chemicals Used as Nematocides
TOPIC: Nematodes Infesting Soils
(Topic Test continued)

3. Give five ways soil nematodes are controlled.

a. _____

b. _____

c. _____

d. _____

e. _____

4.

5.

ERIC

Topic Test
on
TYPES OF NEMATOCIDES

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Generally speaking all compounds have the same characteristics.

_____ 2. Ethylene bromide is used as tear gas.

_____ 3. Methyl bromide is used on the soil in gas form.

_____ 4. A trade name for Chloropicrin is Picfume.

_____ 5. A trade name for dichloropropene is Trizone.

_____ 6. Certain types of nematocides are developed to use on the roots of established trees.

_____ 7. There is no single nematocide developed to serve all purposes.

_____ 8. Most nematocides are injurious to plants.

_____ 9. Nematocides remain in the soil more than 30 days after treatment.

_____10. There are nine very effective compounds used as nematocides.

_____11.

_____12.

List the most effective types of compounds used to control nematodes.

1. _____
2. _____
3. _____
4. _____
5. _____

Topic Test
on
APPLICATION OF NEMATOCIDES

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. Are plant nematodes found in stems and leaves of plants? _____

2. Can all fumigants be used in areas where there are established plants? _____

3. Can a fumigant be added to irrigation water before the crop is planted? _____

4. Are most fumigants liquid or solids? _____

5. Are fumigant applicators a complicated piece of equipment? _____

6. What type of material is used as a tarp to cover the fumigated area?
_____

7. What is the trade name of a fumigant that can be used for sidedressing?
_____ _____

8. Should the soil be dry or moist when applying a fumigant? _____

9. Are nematodes easy to destroy in the soil? _____

10. Are the vapors of most fumigants harmless? _____

11. There are _____ methods for bringing a chemical in contact with a nematode.

12. The furrow is immediately _____ after the nematocide is applied.

13. The fumigant should be applied from _____ to _____ inches below the soil surface.

14. The two nematocides requiring a 30% nitrate application following their use are:
(a) _____ (b) _____ _____.

15. Chisels should be spaced about _____ inches apart for applying fumigants.

UNIT: Agricultural Chemicals Used as Nematocides
TOPIC: Application of Nematocides
(Topic Test continued)

16. Tri-one is applied at the rate of _____ to _____ pounds per acre.

17. Methyl bromide is applied at the rate of _____ pounds per 100 square feet.

18. It is less _____ to apply fumigants in rows.

19. A person should use _____ _____ when handling nematocides because the vapors are dangerous if breathed.

20. A _____ _____ is used to apply a fumigant in a small area.

21.

22.

Topic Test
on
CHEMICAL CONTROL OF RODENTS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. One adult rat may cause twenty dollars in damages.

_____ 2. Poisoning is the most often used measure for rat removal.

_____ 3. There are local, state, and national laws governing poisoning programs.

_____ 4. Dusting premises with DDT should follow poisoning of rats.

_____ 5. Clean-up of garbage and rubbish should be done before rats are poisoned.

_____ 6. Each tracking patch must be smoothed carefully with a trowel or other straight edged tool.

_____ 7. Buildings can be assumed free of rats if tracking patches do not show rodent tracks the first day.

_____ 8. Reinfestation takes longer around farm building than in cities.

_____ 9.

_____ 10.

Topic Test
on
TYPES OF RODENTICIDES

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Red squill is a single dose poison.

_____ 2. Red squill kills by causing heart paralysis.

_____ 3. The most desirable characteristic of red squill is that it has a natural emetic action which causes vomiting in most animals other than rats.

_____ 4. Red squill is effective as a poison for all rodents.

_____ 5. Strychnine is moderately hazardous where there is a possibility of children and animals around.

_____ 6. ANTU is highly toxic to dogs, cats, and pigs.

_____ 7. ANTU is effective for control of roof rats and common house mice.

_____ 8. Children have been killed by chewing empty cups which have contained 1080.

_____ 9. Anticoagulants must be injested in small amounts for several days before they become effective.

_____ 10. Anticoagulants are painful to rodents and cause bait shyness.

_____ 11.

_____ 12.

Topic Test
on
APPLICATION OF RODENTICIDES

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Rodent baits need not be kept fresh.

_____ 2. Too much poison in a bait may give a strong taste or odor.

_____ 3. Mice may depend on food as their major source of water.

_____ 4. Red squill can be purchased in a commercial or fortified grade.

_____ 5. The major disadvantage of red squill as a rat poison is its bitter taste.

_____ 6. For effective control of house mice, placement of any poisoned baits should be at intervals of 20 feet or more.

_____ 7. Ready to use dry bait mixes containing 0.025 percent Warfarin are available on the market.

_____ 8. A mixture replacing 7 parts of yellow cornmeal with 5 parts of rolled oats, 1 part granulated or powdered sugar, and 1 part of corn oil is usually more readily acceptable to mice than a mixture of 19 parts yellow cornmeal and 1 part Warfarin.

_____ 9. One-half pound of charcoal can be added per 20 lbs. of Warfarin bait to make it distinguishable from edible food.

_____ 10. Rodents may be wary and avoid bait boxes.

_____ 11.

_____ 12.

Topic Test
on
CONTROL OF PREDATORS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Chemicals which kill and those which repel could be used against some predators.

_____ 2. Anyone wishing to use chemical control for predators should check with the local game warden.

_____ 3. Chemicals used for control of predators may be harmful to children, domestic animals, and pets.

_____ 4. Chemical control of predators is always the best method of control.

_____ 5. The land owner can use any type of chemical authorized for control of predators.

_____ 6.

_____ 7.

Topic Test
on
TYPES OF CHEMICAL CONTROL AND APPLICATION OF CHEMICALS

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Avitrol 100 will repel birds.

_____ 2. Grain colored yellow will not prevent it being eaten by birds.

_____ 3. Thiram and ZIP can be used to repel rabbits.

_____ 4. Most repellents cannot be used on plants used for foods.

_____ 5. Some repellents are available only to licensed pest control people.

_____ 6. Strychnine is a botanical compound.

_____ 7. Strychnine will kill both birds and animals.

_____ 8. There is a certain antidote for compound 1080.

_____ 9.

_____ 10.

Topic Test
on
INTRODUCTION TO THE USE OF CHEMICALS AS PLANT REGULATORS

Student: _____ School: _____

Date: _____ Score: _____

Answer the following questions:

1. Two common plant regulators used for broadleaf weed control are _____ _____.

2. An exciting new development in plant research is the possibility of using chemicals as an aid in securing _____ _____.

3. Sprays, containing controlled amounts of 2, 4-D, applied to tomatoes will produce _____.

4. _____ suppresses the growth of some kinds of plants and causes them to grow as dwarfs.

5.

6.

Topic Test
on
TERMINOLOGY

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Terminology isn't important in studying plant growth regulators.

_____ 2. 2,4-D is used only to kill broadleaf plants.

_____ 3. Amo - 1618 causes some plants to be dwarfed.

_____ 4. The application of 2,4,5-T in proper amounts will cause an apricot to increase in size to 40%.

_____ 5. Gibberellins are produced by a fungus called Gibberelia fujikuroi.

_____ 6. A harmone is a chemical which causes just the leaves to fall off the plant.

_____ 7. To inhibit means to prevent or restrain.

_____ 8. Systemic means to be absorbed into the sap system and passed to other parts of the plant.

_____ 9.

_____ 10.

Topic Test
on
PLANT PHYSIOLOGY AND NUTRITION

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. Plants differ from animals in that plants can manufacture food from carbon dioxide and water.

_____ 2. In plants Carbon + Water + Light in the presence of chlorophyll will give Sugar + Water + Oxygen.

_____ 3. CO_2 which was dissolved in the water film of plants, moves through the water film, through the cell wall, and into the cell by the process of diffusion.

_____ 4. The excess oxygen produced by photosynthesis moves out of the plant by diffusion.

_____ 5. Living old cells are higher in protein than young cells.

_____ 6. Carbon, hydrogen, oxygen, and nitrogen usually make up 97% or more of the dry weight of plants.

_____ 7. There are 15 essential elements.

_____ 8.

_____ 9.

Topic Test
on
METHOD OF APPLICATION

Student: _____ School: _____

Date: _____ Score: _____

Write True beside the statements that are true and False beside the statements that are false:

_____ 1. There are growth regulators which inhibit the sprouting of potatoes.

_____ 2. There are many growth regulators for chemically thinning fruit trees.

_____ 3. Growth inhibitors allow plants to be grown out of season.

_____ 4. The growth regulators must be used on only the plants recommended at the specific rate of application.

_____ 5. Some growth regulators are herbicides also.

_____ 6. There is a growth regulator for inhibiting runner growth of strawberries.

_____ 7. There are growth regulators which are used for sterility of male plants.

_____ 8.

_____ 9.

Answer Sheet to Test
on
OPPORTUNITIES IN THE AGRICULTURAL CHEMICAL INDUSTRY

1. True
2. True
3. False
4. True
5. True
6. False
7. True
8.
9.

Answer Sheet to Test
on
IMPORTANCE OF AGRICULTURAL CHEMICALS

1. A. Insecticides
   B. Fungicides
   C. Herbicides
   D. Rodenticides
   E. Antibiotics
   F. Nematocides
   G. Molluscicides
   H. Plant regulators
   I. Desiccants and Defoliants
2. Eradication of screwworm flies
3. A. Reduced nutritional deficiency
   B. Increased production of food and fiber
   C. Healthier population
4. 50%
5. Malaria
6.
7.

Answer Sheet to Test
on
FEDERAL AND STATE LAWS PERTAINING TO AGRICULTURAL CHEMICALS

1. False
2. True
3. False
4. True
5. True
6. False
7. False
8. False
9. True
10. False
11.
12.

ERIC

Answer Sheet to Test
on
IMPORTANCE OF ACCURATE RECORDS

1. Receipts Expenses Profit Loss
2. Financial condition
3. Planning purchases
4. Assets Liabilities
5. a. Asset
   b. Liability
   c. Asset
   d. Asset
   e. Liability
6.
7.

Answer Sheet to Test
on
SALES TICKETS

1. True
2. False
3. False
4. True
5. False
6.
7.

Answer Sheet to Test
on
CREDIT

1. True
2. False
3. True
4. False
5. True
6.
7.

Answer Sheet to Test
on
DETERMINING SELLING PRICE

a 1.
d 2.
c 3.
a 4.
a 5.
____ 6.
____ 7.

Answer Sheet to Test
on
BUSINESS RECORDS: ORDERING AND RECEIVING MERCHANDISE

1. b
2. c
3. a
4. c
5.
6.

Answer Sheet to Test
on
INVENTORIES

1. True
2. False
3. True
4. True
5. True
6.
7.

Answer Sheet to Test
on
RECEIVING AND STORING MERCHANDISE

1. b.
2. c
3. a
4. c
5. b
6.
7.

Answer Sheet to Test
on
STOCKING AND MERCHANDISE PLANNING

1. Capital (shelf space: o.k.)
2. Business
3. Every employee
4. Every employee
5. Old
6.
7.

Answer Sheet to Test
on
CHEMICAL FIRST AID

1. True
2. True
3. False
4. True
5. False
6. True
7. True
8. True
9. True
10. True
11.
12.

Answer Sheet to Test
on
STORING AGRICULTURAL CHEMICALS

1. False
2. False
3. False
4. False
5. True
6. True
7. True
8. False
9. True
10.
11.

Answer Sheet to Test
on
MIXING AGRICULTURAL CHEMICALS

1. Manufacturer
2. Natural rubber
3. Upward
4. Clear water
5. Soap and water
6. Full water
7.
8.

Answer Sheet to Test
on
APPLICATION OF AGRICULTURAL CHEMICALS

1. People are healthier and more comfortable.
2. It may be too poisonous.
3. Smaller particle size
4. Lighter
5. Poison
6.
7.

Answer Sheet for Test
on
AGRICULTURAL CHEMICALS CONTAINER DISPOSAL

1. The kind of chemical
2. Return them to the chemical company.
3. The soil has a better opportunity to absorb the chemicals that otherwise might be carried off in water.
4. Livestock and people can be killed from the runoff water.
5. To discourage people from using them again
6. Burn them unless they have contained weed killers. Weed killer containers should be buried.
7.
8.

Answer Sheet to Test
on
PERSONNEL AND EQUIPMENT CLEAN-UP

1. False
2. False
3. True
4. False
5. True
6.
7.

Answer Sheet to Test
on
CHEMICAL RESIDUE AND TOLERANCES

1. Amount of pesticide in or on a product when it enters commerce
2. Amount of pesticide which is safe to remain in a product as a residue
3. Parts per million (ppm)
4. Yes
5. None
6.
7.

Answer Sheet to Test
on
CALIBRATING SPRAYERS

1. Day
2. Higher
3. Lower
4. Lower
5. Gallons
6. 660
7. 43,560
8.
9.

Answer Sheet to Test
on
WEIGHTS AND MEASURES, CHARTS
AND CONVERSION TABLES

1. $\frac{.5\% \times 100 \text{ gallons} \times 8.4}{25} = 16.8$ pounds
2. $\frac{.2\% \times 50 \text{ gallons} \times 8.4}{25} = 3.4$ pounds
3. $\frac{8 \times 50}{100 \times 8} = .5\%$
4. $\frac{5\% \times 100}{50} =$ 10 pounds of 50% D. D. T.
   100 lbs. - 10 lbs. = 90 lbs. of clay
5.
6.

Answer Sheet for Test
on
COMPATIBILITY CHARTS

1. True
2. True
3. False
4. True
5. True
6. False
7.
8.

Answer Sheet to Test
on
SPRAYING EQUIPMENT

1. a. Small general use sprayer
   b. Multiple purpose farm sprayer
   c. High pressure, high volume sprayers
   d. Low pressure, low volume sprayers
   e. Self-propelled, high clearance sprayers
2. The pump along with other components
3. a. Size of the job; b. Number of acres; c. Plants or trees to be sprayed
4. a. Flat fan; b. Hollow cone; c. Solid cone
5. a. Hand guns
   b. Automatic spray heads
   c. Spray booms
   d. Boomless sprays
6. a. Mechanical
   b. Hydraulic
7.
8.

Answer Sheet to Test
on
DUSTING EQUIPMENT

1. 60 to 200 pounds
2. One
3. Two
4. Four, six, or eight
5. Centrifugal-type
6. 5 and 50 pounds
7.
8.

Answer Sheet to Test
on
FOGGING EQUIPMENT

1. True
2. True
3. False
4. False
5. True
6. False
7.
8.

Answer Sheet to Test
on
FUMIGATING EQUIPMENT

1. Nematodes are elongated, cylindrical, parasitic worms not closely related to any other form of animal life.
2. In all parts of the world in soils, fresh water, sea water, and in plants and animals
3. Usually range from 1/64 to 1/4 of an inch in length
4. All crops are subject to attack by nematodes of one kind or another.
5. Several thousands of species of nematodes have been described. Of these, several hundred are known to be plant parasites.
6. Plow, tooth or chisel, and confinement
7. To prevent loss of the fumigant
8.
9.

Answer Sheet to Test
on
CLASSES OF INSECTS

1. False
2. True
3. True
4. False
5. True
6. False
7. True
8. True
9. True
10. True
11. True
12. True
13.
14.

Answer Sheet to Test
on
BODY PARTS

1. False
2. False
3. True
4. True
5. False
6. False
7. True
8. True
9. False
10. True
11. True
12. True
13.
14.

Answer Sheet to Test
on
LIFE CYCLES

PART I:
1. 1500 to 2000
2. Spermatozoa
3. Proximal end
4. Fertilization
5. Molts

PART II:
1. True
2. True
3. True
4. False
5. True
6. True
7. True
8. True
9.
10.

Answer Sheet to Test
on
HOST PLANTS OR ANIMALS

1. True
2. True
3. False
4. True
5. True
6. True
7. True
8. True
9.
10.

Answer Sheet to Test
on
INSECT RESISTANCE TO CHEMICALS

1. False
2. True
3. True
4. True
5. True
6. True
7. False
8. True
9. False
10. True
11. True
12. True
13.
14.

Answer Sheet for Test
on
LOSSES CAUSED BY INSECTS

1. True
2. True
3. True
4. True
5. True
6. True
7. True
8. True
9. False
10. False
11.
12.

Answer Sheet to Test
on
METHODS OF CONTROL

PART I:
1. 191,010,000,000,000,000,000
2. Food and fiber
3. Killing, repelling; feeding and propagation
4. Climate, temperature, and rainfall
5. Climate
6. Water, controlling
7. Screening

PART II:
1. True
2. True
3. False
4. True
5. False
6.
7.

Answer Sheet to Test
on
INTRODUCTION TO INSECTICIDES

1. Read the label and follow instructions.
2. Ninety days
3. Yes, if we are going to provide food for all our population.
4. No, if they are used safely in accordance with the directions on the label.
5.
6.

Answer Sheet to Test
on
INSECTICIDE TERMINOLOGY

1. Any four of these: Dusts, Granular formations, Wettable powders, Solutions, Insecticide-fertilizer mixture, Aerosols, Fumigants
2. Absorption into digestive system
3. Absorption through body wall
4. Through tracheal system in form of a gas
5. Organic compounds
6. Solvents or carriers
7. Derived from plants
8. DDT and BHC (many others)
9.
10.

Answer Sheet to Test
on
PROPERTIES AND CHARACTERISTICS OF INSECTICIDES

1. Many potential customers will not be acquainted with the chemicals.
2. Aid in sales and to prevent costly mistakes regarding chemicals
3. a. Stomach poison
   b. Contact poison
   c. Fumigant
   d. Combination
4. a. Gas
   b. Liquid
   c. Solid

Answer Sheet to Test
on
THE CHEMISTRY AND MODE OF ACTION OF ORGANIC INSECTICIDES

1. Spilling on skin
2. Toxic if absorbed through the skin
3. To have your blood checked
4. Once per week
5. Avoid contact with organic phosphates until his blood test is back to normal
6. Act upon central nervous system and neuromotor apparatus
7. Lower residue
8. Toxic dosage proportioned to body weight
9.
10.

Answer Sheet to Test
on
THE CHEMISTRY AND MODE OF ACTION OF INORGANIC INSECTICIDES

1. a. Lead arsenate
   b. Calcium arsenate
   c. Copper arsenite
   d. Magnesium arsenate
   e. Zinc arsenate
2. Mineral
3. Stomach
4. Contact
5. Systemic
6.
7.

Answer Sheet to Test
on
THE USE OF INSECTICIDES AS FUMIGANTS

1. a. Cato b. Homer
2. They absorb the fumigants.
3. Those high in oils
4. In an airtight building, draw air out before fumigant is administered.
5. a. Quicker kill b. Saves exposure time
6. a. Moisture b. Temperature
7. Increases corrosion
8. Two percent
9. Because of fire hazard
10. In case of accident or excessive exposure
11.
12.

Answer Sheet to Test
on
THE USE OF INSECTICIDES ON HOUSEHOLD PESTS

1.	Ants	Chlordane 2-3%
	Bedbugs	Malathion 1%
	Cockroaches	Chlordane 2-3%
	Fleas	Malathion 2%
	Silverfish	Chlordane 2-3%
	Spiders	Chlordane 2-3%
	Ticks	Chlordane 2-3%
	Wasps	DDT 5%

Answer Sheet to Test
on
FIELD CROPS

1. False
2. False
3. True
4. True
5. False
6. False
7. True
8. True
9. True
10.
11.

Answer Sheet to Test
on
ORCHARDS

1. True
2. True
3. False
4. True
5. False
6. True
7. False - Treat during dormant season
8. False
9. True
10.
11.

Answer Sheet to Test
on
ORNAMENTAL PLANTS AND SHRUBS

1. True
2. True
3. False
4. True
5. True
6. True
7. False
8. True
9. True
10. False
11.
12.

Answer Sheet to Test
on
FOREST PLANTS

1. True
2. True
3. False
4. True
5. False
6. True
7. True
8. True
9. True
10. True
11.
12.

Answer Sheet to Test
on
VEGETABLES

1. True
2. True
3. True
4. False
5. True
6. True
7. True
8. True
9. True
10. False
11.
12.

Answer Sheet to Test
on
GRASSES

1. True
2. True
3. False
4. True
5. True
6. False
7. True
8. False
9. True
10. True
11.
12.

Answer Sheet to Test
on
LAWNS

1. True
2. True
3. False
4. False
5. True
6. False
7. False
8. True
9. True
10.
11.

Answer Sheet to Test
on
STORED GRAIN INSECTS

1. False
2. True
3. True
4. False
5. True
6. True
7. False
8. True
9. False
10. True
11.
12.

Answer Sheet to Test
on
LIVESTOCK

1. Organic
2. Cattle grubs
3. Pyrethrum
4. Toxicity
5. a. BHC
   b. Lindane
6. Systemic
7. a. Safe
   b. Economical
   c. Effective
8. a. Expensive
   b. Doses are bulky
   c. Some animals susceptible to intoxication
   d. Animals eliminate red dye
   e. Not effective on some parasites
9. a. Piperazine
   b. Cadmium salts
   c. Toluene
   d. Metallic arsenates
   e. Solfanomides
   f. Antibiotics
10. Apply smear E Q 335
11. Winter
12. 16 to 18 days
13.
14.

Answer Sheet to Test
on
POULTRY

PART I:

1. Prevention
2. Kills
3. Effective
   Removal
4. Segments
5. 0.5
   Emulsion
6. Diseases
   Eggs
7. Chemicals
8. Head
   Body
9. Night
   Blood
10. Cycle
    Tick
11.
12.

Part II:

1. True
2. False
3. True
4. False
5. True
6. True
7. False
8. True
9. True
10. False
11.
12.

Answer Sheet to Test
on
DEVELOPMENTS AND TRENDS IN THE USE OF SOIL ADDITIVES

1. True
2. True
3. True
4. False
5. True
6. True
7. True
8. False
9.
10.

Answer Sheet to Test
on
DETERMINING WHEN TO USE SOIL ADDITIVES

1. False
2. True
3. False
4. True
5. True
6. True
7. False
8. True
9. True
10. False
11.
12.

Answer Sheet to Test
on
INTRODUCTION TO WEED AND BRUSH CONTROL

1. 5 billion dollars
2. 4 to 11 times as much
3. 90%
4. 50%
5. Weed seed in planting seed
   Weed seed in grain
   Weeds in hay
   Increased wear and tear on machinery
6. One chemical application per year is usually sufficient, while it usually takes three or four mowings.
7. The density of the brush and trees vary.
8. 65-75%
9.
10.

Answer Sheet to Test
on
OPPORTUNITIES AND TRENDS IN THE USE OF HERBICIDES

1. Lack of knowledge in how to use them
2. Labor shortage
3. The labor shortage hit in some sections before it did in others.
4. As their knowledge and experience in the use of herbicides increases
5. Weeds grow faster and bigger.
6. Increase in our population
7. Increase in use and need of herbicides
8.
9.

Answer Sheet to Test
on
HERBICIDE TERMINOLOGY

1. Two
2. Entire
3. Stick
4. Treatment, first
5. Sheath
6. Mixed
7. Gas, vapor
8. Kill
9. 60
10. Percentage
11. After
12. Time, prior
13. Poisonous
14. Greater
15. Spring, summer

Answer Sheet to Test
on
PLANT NUTRITION AND PHYSIOLOGY PRINCIPLES
OF WEED AND BRUSH CONTROL

1. Some weeds have a disagreeable odor or flavor; others are equipped with thorns or spines.
2. Many weeds will propagate themselves from small pieces of roots or stems as well as from seed.
3. By excluding the light and thus preventing all top growth
4. 1) Preventing the old plants from ripening seeds and eradicating seeds already present in the soil
   2) Eradicating the old existing plants
5. Using insects or fungus organisms that live on specific weeds
6.
7.

Answer Sheet to Test
on
IDENTIFICATION OF WEEDS

1. True
2. True
3. False
4. False
5. True
6. True
7. True
8. True
9. True
10. False
11.
12.

Answer Sheet to Test
on
SEED LAWS PERTAINING TO WEEDS

1. Yes
2. Pasture Mixtures
3. No
5. Read the label

Answer Sheet to Test
on
CLASSIFICATION, PROPERTIES, AND CHARACTERISTICS
OF HERBICIDES IN WEED AND BRUSH CONTROL

1. True
2. True
3. False
4. False
5. True
6. True
7. True
8. True
9. True
10. True
11.
12.

Answer Sheet to Test
on
FACTORS AFFECTING WEED AND BRUSH CONTROL WITH HERBICIDES

1. False
2. False
3. True
4. True
5. True
6. True
7. True
8. True
9. False
10. True
11.
12.

Answer Sheet to Test
on
HERBICIDE SELECTION

1. Not
2. Broad
3. All
4. Foliage
5. Soil
6.
7.

Answer Sheet to Test
on
PREPARING HERBICIDES FOR USE

1. False
2. True
3. True
4. True
5. True
6. True
7. False
8. True
9. False
10. True
11.
12.

Answer Sheet to Test
on
DETERMINING METHOD OF TREATMENT

1. Sprays that kill some plants on contact but do not harm other plants
2. Sprays that kill all plants on contact
3. Herbicides that are to kill roots at a distance from application by mowing through the stems and roots
4. Due to their high tolerance of the chemicals used
5. The entire field or pasture is sprayed with boom-type sprayer or high pressure broadcast nozzle.
6. Saves herbicides and herbicide can be applied to lower parts of the crop plants avoiding injury to the crop.
7. Johnson grass and bermuda grass
8. a) Soil conditions, b) Rainfall, c) Stage of weed growth, d) Temperature, d) Humidity
9.
10.

Answer Sheet to Test
on
APPLICATION OF HERBICIDES

1. False
2. True
3. False
4. True
5. True
6. True
7. True
8. False
9. True
10. False
11.
12.

Answer Sheet to Test
on
AQUATIC WEED CONTROL WITH HERBICIDES

1. False
2. True
3. False
4. False
5. True
6. False
7. True
8. True
9.
10.

Answer Sheet to Test
on
FUNGICIDES, THEIR DEVELOPMENT AND USES

1. True
2. True
3. True
4. False
5. True
6. True
7. True
8. False
9. True
10. True
11.
12.

Answer Sheet to Test
on
PATHOLOGICAL AGENTS

1. True
2. True
3. False
4. False
5. True
6. True
7. True
8. True
9. True
10. True
11.
12.

Answer Sheet for Test
on
PLANT DISEASES

1. True
2. False
3. True
4. True
5. False
6. False
7. True
8. True
9. True
10. True
11.
12.

Answer Sheet for Test
on
APPLICATION OF FUNGICIDES

1. False
2. False
3. False
4. True
5. False
6. False
7. True
8. True
9. False
10. True
11.
12.

Answer Sheet for Test
on
BACTERIA

1. Small, multiply, biochemical
2. Spherical, cylindrical, spiral
3. CO_2
4. Aerobic, anaerobic
5. Uninjured tissue, natural openings, wounds
6. See list of 13 ways on Answer Sheet to 926-XIV-1.
7.
8.

Answer Sheet for Test
on
BACTERICIDES

1. True
2. True
3. False
4. True
5. False
6.
7.

Answer Sheet to Test
on
NEMATOCIDE USES AND TERMINOLOGY

Part I:
1. A nematode is a microscopic worm that seldom exceeds one-eighth inch in length.
2. Nematocide is a chemical that kills nematodes.
3. Pathogen is any organism capable of causing disease.

Part II:
1. True
2. False
3. False
4. True
5. True
6. False
7. True
8.
9.

Answer Sheet to Test
on
NEMATODES INFESTING SOILS

1. a. Water
   b. Transfer of infested plants
   c. Soil on machinery
   d. Hoofs of animals
   e. Shoes of workers
2. a. Cyst
   b. Root-knot
   c. Nematodes that feed on root surfaces
   d. Root lesion
   e. Nematodes that feed on root surfaces
   f. Root-knot
   g. Nematodes that feed on root surfaces
   h. Nematodes that feed on root surfaces
   i. Cyst
   j. Cyst
3. a. Sanitation
   b. Crop rotation
   c. Fumigation
   d. Fallowing
   e. Flooding or stock selection
4.
5.

Answer Sheet to Test
on
TYPES OF NEMATOCIDES

1. False
2. False
3. True
4. True
5. False
6. False
7. True
8. True
9. False
10. False
11.
12.

The most effective types of compounds to use against nematodes are:

1. Methyl bromide
2. Ethylene bromide
3. Dichloropropene
4. Chloropicrin
5. Dibromochloropropane

Answer Sheet to Test
on
APPLICATION OF NEMATOCIDES

1. Yes
2. No
3. Yes
4. Liquid
5. No
6. Polyethylene
7. Fumazone 70E
8. Moist
9. No
10. No
11. Three
12. Sealed
13. 6 to 8 inches
14. DD and Methyl bromide
15. 12 inches
16. 140 to 200 pounds
17. 2 pounds
18. Expensive
19. Safety precautions
20. Hand injector
21.
22.

Answer Sheet to Test
on
CHEMICAL CONTROL OF RODENTS

1. True
2. True
3. True
4. False
5. False
6. True
7. False
8. True
9.
10.

Answer Sheet to Test
on
TYPES OF RODENTICIDES

1. True
2. True
3. True
4. False
5. True
6. True
7. False
8. True
9. True
10. False
11.
12.

Answer Sheet to Test
on
APPLICATION OF RODENTICIDES

1. False
2. True
3. True
4. True
5. True
6. False
7. True
8. True
9. False
10. True
11.
12.

ERIC

Answer Sheet to Test
on
CONTROL OF PREDATORS

1. True
2. True
3. True
4. False
5. False
6.
7.

Answer Sheet to Test
on
TYPES OF CHEMICAL CONTROL AND APPLICATION OF CHEMICALS

1. True
2. False
3. True
4. True
5. True
6. True
7. True
8. False
9.
10.

Answer Sheet to Test
on
INTRODUCTION TO THE USE OF CHEMICALS AS PLANT REGULATORS

1. 2,4-D
   2,4,5-T
2. Hybrid vigor
3. Seedless fruit
4. Amo-1618
5.
6.

Answer Sheet to Test
on
TERMINOLOGY

1. False
2. False
3. True
4. True
5. True
6. False
7. True
8. True
9.
10.

Answer Sheet to Test
on
PLANT PHYSIOLOGY AND NUTRITION

1. True
2. True
3. True
4. True
5. False
6. True
7. True
8.
9.

Answer Sheet to Test
on
METHOD OF APPLICATION

1. True
2. True
3. False
4. True
5. True
6. True
7. True
8.
9.

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ABSTRACT - This report of a correlation study of the teaching of mathematics and physics in the 2-year technical institutes covers some of the basic logic needed in establishing these courses and concludes with examples of the math-physics programs at Wentworth Institute. A survey was made of 135 accredited curriculums from 36 technical institutes or community colleges. The diversity of the programs studied led to tl conclusion that no particular method of teaching would be suitable in every school, but this report might be used as a guide in setting up programs and in correlating the basic math and physics courses. (GR)

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Math-Physics Correlation Study

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An attempt has been made to correlate the teaching of mathematics and physics in the two-year technical institutes.

In order to get a clear picture of the methods being used now, a study has been made of all of the E.C.P.D. accredited programs in the United States. This study has revealed many differences in admissions requirements, time devoted to the study of mathematics and physics and contents of the programs. From this, I concluded that it would be impossible to devise a method of teaching mathematics and physics that would be suitable for all the schools across the country.

The report covers some of the basic logic needed in establishing these courses and concludes with examples of how the math-physics programs have been set up at Wentworth Institute. These could be used as a guide to anyone interested in setting up programs and correlating the basic math and physics courses, which are the backbone of all engineering technology curricula.

A study made of 135 E.C.P.D. accredited curricula from thirty six technical institutes or community colleges has revealed the following data that could be used as a guide when upgrading existing programs, or inaugurating new ones. The areas studied are the following:

1. Admission requirements.

   a. Algebra
   b. Geometry
   c. Trigonometry
   d. Physics

2. Time devoted to the study of mathematics.

3. Time devoted to the study of physics.

4. Time devoted to theory vs. laboratory and shops.

This study was made on the E.C.P.D. accredited programs offered in the school year 1966-1967.

1. Admission requirements:

Of the 135 curricula studied, ninety one had a specific requirement for algebra, which ranged from a minimum of one unit to a maximum of two and one-half units. The average for all the curricula studied is 0.99 units.

Seventy one of the 135 had specific requirements for geometry. All of the curricula, that had a requirement, only required one unit. The average amount of geometry required comes out to be 0.52 units.

Trigonometry was listed as a specific requirement by only twenty six of the curricula studied. The minimum required was one half of a unit to a maximum of one unit. This averaged out to 0.16 units of trigonometry as a specific requirement.

Thirteen percent of the curricula required at least one unit of algebra, geometry and trigonometry, and twelve percent required at least one unit each of algebra, geometry, trigonometry and physics.

Thirty eight percent of the curricula required at least one unit of physics, seven percent required one unit of chemistry, thirteen percent required one unit of a science, and twelve percent required one unit of either physics or chemistry.

2. A study was made of the total contact hours of each curriculum that was devoted to the study of mathematics. This included in some cases a course called computer mathematics.

The average time devoted to the study of mathematics for the 135 E.C.P.D. accredited curricula was 10.1%. Sixty-one curricula devoted more than 10.1% of the time, sixty curricula devoted less than 10.1% of the time, while fourteen devoted 10.1% of the time to mathematics. The highest was twenty five percent, while the low was four percent. About fifty percent of the curricula included courses in calculus or higher mathematics, while approximately fifty percent had an introduction to calculus as the final math course.

The range of the number of mathematics courses offered runs from two to ten. This includes all of the curricula on a semester, quarter and term basis.

3. A compilation of the time devoted to physics courses also shows a great variance. This again covers the 135 accredited curricula.

The average amount of time allocated for physics courses, lecture time only, was approximately five percent. The time devoted to laboratory work was approximately four percent.

A look at the theory aspect of physics shows that the time devoted ranges from 0% to 14%. This is quite a wide range. Using 5% as the

average, there were twenty eight programs at this percentage. Forty nine curricula devoted more than 5% of the time, while fifty eight curricula devoted less than 5% of the total time of the program.

The percentage of the total time devoted to physics laboratory also had a wide range. This range ran from zero percent to nine percent. With an average of approximately four percent, thirty three curricula fell on the average, thrity one offered more than the average, and seventy one offered less than the average.

The percentage of the total time allocated for physics lecture and laboratory together has a range from 0% to 18%, with the average at 8.5%. Seventy one curricula devoted more than the average time, while sixty four devoted less than the average time.

4. Another interesting aspect of the study was the time devoted to theory vs. time devoted to laboratories and shops (including in some cases, physical education).

The average for 135 E.C.P.D. accredited programs was fifty eight percent theory to forty two percent laboratories and shops (including in some cases, physical education).

A very wide range exists in this area. The range is from thirty five percent theory and sixty five percent laboratories and shops, to eighty percent theory and twenty percent laboratory and shops (including in some cases, physical education).

Sixty two were above the average with more emphasis on the theory, sixty five were below the average with emphasis on the laboratories and shops, and eight were at the average.

The 135 accredited curricula studied consists mainly of the following areas. Listed below are the curricula which are included as being offered by three or more schools:

Mechanical	28
Electronics	21
Electrical	17
Civil	13
Construction	6
Air Conditioning	6
Chemical	5
Architectural	3
Aircraft	3
Aerospace	3
Industrial	3
Electrical & Electronics	3
Drafting & Design	3

Table #1 is a breakdown of the above areas listing the percentage of the total time devoted to theory and laboratories and shops, the number of programs offered in a given area, the range of the percentage of the time devoted to theory and the number of curricula at, above or below the average.

Table #2 is a breakdown of the above areas listing the total time devoted to mathematics, physics, physics laboratory and the number of programs offered in the given area.

TABLE #1

Name of Curriculum	Number of Programs	Average % Theory	Avg. % Lab.	% Range of Theory	Number of Curricula At the Average	Number of Curricula Above the Average	Number of Curricula Below the Average
All Programs	135	58	42	35-80	8	62	65
Mechanical Eng.	28	57	43	46-68	2	14	12
Electronic	21	61	39	37-80	2	9	10
Electrical	17	60	40	48-68	0	8	9
Civil	13	57	43	43-73	0	6	7
Construction	6	55	45	42-66	0	3	3
Air Conditioning	6	60	40	49-72	0	3	3
Chemical	5	59	41	54-65	0	2	3
Architectural	3	52	48	50-53	1	1	1
Aircraft	3	50	50	35-61	0	2	1
Aerospace	3	60	40	54-68	0	1	2
Industrial	3	68	32	61-71	0	2	1
Electrical & Electronics	3	64	36	60-67	0	2	1
Drafting & Design	3	42	58	38-44	0	2	1

TABLE #2

Name of Curriculum	Number of Programs	Average % Math	Average % Physics	Average % Physics Lab
All Programs	135	10.1	4.8	3.8
Mechanical Eng.	28	9.6	4.7	3.8
Electronics	21	12.0	5.1	3.2
Electrical	17	9.7	4.9	3.8
Civil	13	9.8	5.5	4.2
Construction	6	7.5	2.5	3.2
Air Conditioning	6	8.8	4.5	3.3
Chemical	5	10.0	6.2	4.2
Architectural	3	8.0	4.0	4.0
Aircraft	3	9.3	5.0	2.3
Aerospace	3	13.3	4.3	3.0
Industrial	3	9.0	6.3	5.3
Electrical & Electronics	3	11.0	6.7	3.3
Drafting & Design	3	6.7	1.7	4.0

TABLE #3

Name of Institution	Private or Public	Regional Accrediting Area	Number of Accredited Programs
Academy of Aeronautics	Private	MS	3
Alfred, State University of New York	Public	MS	5
Arlington State College	Public	SA	4
Bronx Community College	Public	MS	2
Broome Technical Community College	Public	MS	4
Canton, State University of New York	Public	MS	4
Capitol Institute of Technology	Private	MS	1
Central Technical Institute	Private	NC	2
City College of San Francisco	Public	WA	8
Cogswell Polytechnical Institute	Private	WA	3
University of Dayton	Private	NC	3
DeVry Technical Institute	Private	NC	1
Embry-Riddle Aeronatuical Institute	Private	SA	1
Erie County Technical Institute	Public	MS	4
Farmingdale, State University of New York	Public	MS	7
Franklin Institute of Boston	Private	NE	3
Gaston College	Public	SA	4
Hartford State Technical Institute	Public	NE	3
Houston, University of	Public	SA	6
Iowa State University	Public	NC	3
Milwaukee School of Engineering	Private	NC	8
Mohawk Valley Community College	Public	MS	2
Norwalk State Technical Institute	Public	NE	5
Ohio College of Applied Science	Private	NC	5
			91

TABLE #3

-2-

Name of Institution	Private or Public	Regional Accrediting Area	Number of Accredited Programs
Ohio Technical College	Private	NC	1
Oklahoma State University	Public	NC	5
Oregon Technical Institute	Public	NW	6
Pennsylvania State University	Public	MS	2
Queensborough Community College	Public	MS	1
RCA Institute	Private	MS	1
St. Petersburg Jr. College	Public	SA	1
Sinclair Community College	Public	NC	1
Southern Technical Institute	Public	SA	8
Spring Garden Institute	Private	MS	2
Vermont Technical College	Public	NE	1
Wentworth Institute	Private	NE	15
			44

TABLE #4

Regional Accrediting Area	Number of Private Schools	Number of Public Schools	Total	Number of Accredited Programs	Number in Private Schools	Number in Public Schools
NE	2	3	5	27	18	9
MS	4	9	13	38	7	31
WA	1	1	2	11	3	8
SA	1	5	6	24	1	23
NC	6	3	9	29	20	9
NW	0	1	1	6	0	6
	14	22	36	135	49	86

TABLE #5

Admission Requirements

Regional Accrediting Area	Number of Schools	Number of Accredited Programs	Units of Algebra	Units of Geometry	Units of Trig.	Units of Physics	Units of Science
New England	5	27	1.7	0.89	0.48	0.37	0.63
Middle States	13	38	1.17	0.39	0.21	0.45	0.24
Western Assoc.	2	11	1.0	1.0	0.73	0.73	0
Southern Assoc.	6	24	0.33	0	0	0	0
North Central	9	29	1.3	0.76	0.14	0.28	0.58
North Western	1	6	*	*	*	*	*

* Due to insufficient number of schools, averages could not be obtained.

TABLE #6

	Number of Programs	Algebra	Trig.	Geometry	Physics	Science
Private (Total)	49	1.6	.37	.71	.57	.61
Public (Total)	86	.82	.19	.54	.24	.17
N. E. Section						
Private	18	2.00	.72	.83	.55	.44
Public	9	1.1	0	1.0	0	1.00
M.S.						
Private	7	1.6	0	.57	1.00	.57
Public	31	1.1	.26	.39	.42	.39
W. A.						
Private	3	1.0	0.0	1.0	0.0	0.0
Public	8	1.0	1.0	1.0	1.0	0.0
S. A.						
Private	1	*	*	*	*	*
State	23	.35	0	.35	0.0	0.0
N. C.						
Private	20	1.4	.25	.65	.55	.85
State	9	1.2	0	1.0	*	*
N. W.						
Private	0	*	*	*	*	*
Public	6	*	*	*	*	*

* Due to insufficient number of schools, averages could not be obtained.

If an attempt was made to design a math-science interrelationship for all two-year technical institutes awarding an associate degree, it would be impossible to come up with a plan that would be applicable to all technical institutes.

A survey made of most of the presently E.C.P.D. accredited programs in the United States shows that many factors are influential in the variations that appear in the survey.

A study of the survey points out many variations that would be difficult to overcome at the technical school level. Some of the factors that must be considered are the following:

1. The background or preparation of the students in the area that the school mainly attracts its enrollment from. This is evident in the admission requirements of the school. The requirements cannot be too far out of line with what the students are offered in the high schools. This varies from the New England area where the requirements on the whole are much more rigorous than other parts of the country. As we move south and west of New England, we find the admission requirements less rigorous to a point where basic mathematics must be taught in the technical institute.

2. Another factor which must be taken into consideration is the number of curricula offered by the institute. A school that offers only one curriculum may, because of its single purpose, delve deeper into the specialty area than other schools with many curricula. This would necessitate, in some cases, more mathematics than is usually offered, and also a different

approach to the sciences. Some of these programs are very narrow in scope, and this would necessitate drastic changes in the approach to teaching.

From the results shown in Tables 1 through 6, one can see that the variation of admissions requirements, course content, and course design varies not only from one section of the country to another, but also varies greatly between private and public schools in the same section of the country. Whether or not technical school educators are aware of this situation, I do not know. This does create the misunderstanding, held by many guidance counselors and employers as to just what qualifications a technical school graduate should have. This is one of the reasons why the term engineering technician is used in many various capacities other than what it should be.

Much of the confusion in this regard is the product of the technical institutes themselves. If this great variation can exist, and yet all of the curricula studied are E.C.P.D. accredited, then what is an "Engineering Technician"?

This question does not need to be answered now. What must be considered now is the programs themselves. Engineering is built on a solid math-science interrelationship. It is my contention, that the backbone of all engineering technology programs should be a solid math and science core, physics being the primary science. Not only should these be substantial, but they should be taught simultaneously, keeping in mind that the mathematics required to solve the physics problems, should be covered first in the mathematics courses.

The major areas of physics are:

1. Mechanics
2. Electricity & Magnetism
3. Heat
4. Light
5. Sound
6. Optics

Looking at these general topics, one must decide what level of mathematics is needed in problem solving to best illustrate the material covered. All of the topics listed above can be taught based on simple algebra, or based on calculus. If all of the physics is to be calculus based, then it would not be possible to offer physics the first semester of the first year. This would then create the problem of not having the physics covered before the students concentrate on their technical specialties. In most cases, the physics is the background material for the specialty courses. If the physics is calculus based and is offered the first semester of the first year, then too much time will need to be devoted to the teaching of calculus and less time to the teaching of physics.

If all of the physics is algebra based, then when the students enter into their technical specialties, which in many cases are calculus based, they will have to either make the adjustment on their own, or some of the time in these courses would have to be devoted to teaching the mathematics.

Both of these problems can be eliminated if some serious thought is given to the teaching of mathematics and physics from the start.

The mathematics should start with a review of high school mathematics and then proceed on up to and including basic calculus. It is impossible for a two-year school to delve very deeply into calculus in the short time available. At what point to start, and how soon calculus is introduced is something that will have to be decided by each school. As you study

Table #6, one can see that the admissions requirements for mathematics vary, not only from one section of the country to another, but also between private and public schools in the same regional accrediting area. From Table #6, it is easy to see that the average mathematics requirements vary for algebra from 2.00 units to 0.35 units, trigonometry from 1.00 units to 0.00 units, and geometry from 1.00 units to 0.25 units. This shows that the beginning level of mathematics will differ considerably from school to school, and likewise the time it takes to introduce calculus will vary somewhat.

Generally, most schools offer physics the first and second semesters of the first year. This is in keeping with my way of thinking. With the physics completed in the first year, then the specialty courses that rely on the physics background can be better presented to and better understood by the students. I am not ruling out a minimal of time needed for a rapid review, but I am trying to eliminate valuable course time needed to teach the physics principles.

All schools are facing or have faced this problem. Wentworth Institute is no exception. We faced this problem, and came up with a math-physics interrelationship, that we feel is a big assist in better preparing the students for their second-year subjects.

Our math and physics courses have been tailored so that the physics topics, which can be taught effectively are covered at the beginning of the school year, which is the same time that the high school mathematics is being reviewed. As the level of the mathematics increases, the physics topic that can best be taught with this level of mathematics is introduced. This continues until the calculus is introduced at which time, the physics of mechanics is taught, based on the calculus. The physics of mechanics is

a sound background for such courses as Strength of Materials, Analysis & Design of Structures, Bridge Design, Kinematics & Design to mention only a few.

With the calculus being introduced in the first semester, and being taught in the second semester of the first year, paves the way so that the more advanced specialty topics of the second year can be taught using more advanced, calculus based textbooks.

With this in mind, it appears that it would be necessary to propose six different levels of math-science interrelationship. This would be a time consuming project, and in the long run would probably have to be altered to meet the particular goal of the institute. At this point, I would like to show how this problem has been worked out at Wentworth Institute. It is possible that from our programs, one may be able to adapt it to suit their own needs.

The physics courses are offered to the students the first and second semester of the first year. Both semesters consist of three hours of theory and a two-hour laboratory period per week. The laboratory experience is designed to reinforce the theory being offered at the time. Also taken into consideration is the level of mathematics that the students have attained at the time, and the physics topic covered are those that can be taught most intelligently at the given math level.

The mathematics that is being taught at the same time as the physics is a review and continuation of the mathematics required for admission to Wentworth Institute. The admission requirements are not the same for our Engineering Technology and Industrial Technology programs.

For admission to an Engineering Technology program, two years of algebra, one year of trigonometry and one unit of geometry are required.

Two years of algebra and one year of geometry are required for admission to the Industrial Technology programs. Consequently, both the mathematics and the physics offered to the two types of programs are presented differently and at a different rate.

To help clarify the procedure used at Wentworth Institute to keep the mathematics and physics on an even level, a breakdown of both subjects is as follows.

Engineering Technology

First Semester

Mathematics	Physics
1. Fundamental Processes of Algebra 2. Solutions of Linear Equations 3. Solutions of Quadratic Equations in One Unknown	1. Fluids
2 weeks	
4. Exponentials & Radicals 5. Variation 6. Binomial Theorem & Natural Exponential Base 7. Algebra of Logarithms 8. Logarithmic Computations	2. Heat
5 weeks	
9. Trigonometry of Right & Oblique Triangles 10. Trigonometric Identities & Equations 11. Graphs of Trigonometric Functions 12. Computations with Vectors and Complex Numbers 13. Analytical Geometry of the Straight Line 14. Linear Empirical Equations 15. Functional Relationships	3. Wave Motion 4. Sound 5. Light
5 weeks	
16. Curve Sketching 17. Graphical Methods of Calculus 18. Delta Process 19. Limits	6. Scientific Method & Measurements 7. Scalars, Vectors & Manipulation 8. Kinematics of Translation
2 weeks	

Engineering Technology

First Semester

-2-

Mathematics	Physics
20. Differentiation of Polynomials	9. Force, Mass & Dynamics of Translation
21. Differentiation of Power Functions, Products & Quotients	10. Application of Newtons 2nd Law
22. Iterated Differentiation	11. Work, Energy & Power
23. Applications of Derivitives	12. Statics of Particles & Rigid Bodies
24. Differentials	

3 weeks

Engineering Technology

Second Semester

Mathematics	Physics
1. Chain Rule for Differentiation 2. Problems of Maxima & Minima 3. Implicit Differentiation 4. Problems of Related Rates 5. Mean Value Theorem 6. Newtons Method of Approximating Roots	1. Sound 2. Mechanical Properties 3. Angular Quantities 4. Circular Motion
4 weeks	
7. Differentiation of Transcendental Functions & Logarithmic Differentiation 8. Integration of Algebraic Functions 9. Integration of Transcendental Functions	5. Dynamics of Rotation 6. Work Done in Rotation, Impulse and Momemtum 7. Simple Harmonic Motion 8. Gravitation 9. Dynamics of Fluids
5 weeks	
10. Definite Integral 11. Areas by Integration & by Simpon's Rule 12. Volumes of Revolution, First Moments, & Moments of Inertia	10. Centroids & Mass Moments of Inertia 11. Friction
3 weeks	
13. Theorems of Pappus & Parallel Axis Theorem 14. Work & Force by Integration 15. Basic Differential Equations	12. Electro static (Forces) 13. Electro dynamic (Forces) 14. Electro Magnetic (Forces) 15. Magnetic Pole (Forces) 16. Interference & Diffraction 17. Spectra & Quantum Theory 18. Nuclear Phenomena
5 weeks	

Industrial Technology

First Semester

Mathematics	Physics
1. Fundamentals of Algebra	1. Fluids
1 week	
2. Linear Equations in One Unknown 3. Simultaneous Linear Equations & Determinants	2. Heat
3 weeks	
4. Exponents, Radicals & Imaginary Numbers	3. Wave Motion 4. Sound
2 weeks	
5. Quadratic Equations in One Unknown	5. Light
2 weeks	
6. Trigonometry of the Right Triangle 7. Trigonometry of the Oblique Triangle	6. Measurement 7. Scalar & Vector Quantities 8. Kinematics of Translation
2 weeks	
8. Vectors & Trigonometry 9. Vectors & Analytical Trigonometry	9. Force & Motion 10. Work, Energy & Power
1½ weeks	

Industrial Technology

First Semester

-2-

Mathematics	Physics
10. Common Logarithms 11. The Binomial Theorem	11. Forces - Composition, Resolution Moment, Transmissibility 12. Resultant of Force Systems 13. Equilibrium Force Systems 14. Distributed Force Systems
$2\frac{1}{2}$ weeks	
12. Compound Interest Law - Natural Logarithms 13. Ratio, Proportion & Variation	15. Nuclear Physics
2 weeks	

Industrial Technology

Second Semester

Mathematics	Physics
1. Arithmetic & Geometric Progressions	1. Mechanical Properties
1 week	
2. Complex Numbers & Position Vectors	2. Rotation of Rigid Bodies 3. Momentum
1 week	
3. Trigonometric Formulas, Identities & Equations	4. Uniform Circular Motion 5. Simple Harmonic Motion
1 week	
4. Radian Measure 5. Graphs of the Trigonometric Functions	6. Dynamics of Fluids 7. Friction
1 week	
6. Analytical Geometry of the Straight Line	8. Center of Gravity
1 week	
7. Linear Empirical Equations 8. Non Linear Empirical Equations	9. Electro Statics (Forces) 10. Electro Statics (Distributed) 11. Electro Dynamics (Forces) 12. Electro Magnetic (Forces)
2 weeks	
9. Translation of Axes 10. Graphical Differentiation	13. Magnetic (Forces & Moment) 14. Magnetic (Unit Forces)
1 week	

Industrial Technology

Second Semester

-2-

Mathematics	Physics
11. The Delta Process 12. Explicit Differentiation of Algebraic Functions	15. Dispersion, Spectra 16. Color 17. Interference & Diffraction 18. Polarization of Light
3 weeks	
13. Maximum & Minimum Applications 14. Curve Sketching	19. Relativity 20. Photon (Quantum Theory) 21. Atomic Physics 22. Particles & Waves
3 weeks	
15. Related Rates	23. Nuclear Physics
1 week	

The intent of this report is not to say that this is the manner in which all schools should teach their mathematics and physics. It has been written mainly to emphasize the need of all departments working as a team, when setting up their courses. In the case of the math-physics programs, it is essential that both departments work together in setting up their respective courses. Since it is agreed by many that the math and physics are the solid background needed for all engineering technologies, these departments must also keep in mind the needs of all the areas that they service.

If all factors are taken into consideration, admissions requirements, math level to be attained, the needs of the areas serviced, then a sound math-physics program could be taught, which would be beneficial to all.

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Jefferson, Ted B.
Welding and Flame-Cutting Processes and Practices. Technical Aids No. 90 for Small Manufacturers.

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ABSTRACT - One of a series of Technical Aids for Small Manufacturers, this bulletin presents information on basic welding processes and their production and maintenance uses. The pamphlet was written by a welding engineer to aid small manufacturers and small plant owners in deciding which welding processes will be most practical for use in their own operations. The content discusses the 11 basic processes, concentrating on the three most widely used: arc welding, gas welding, and resistance welding. Each type is covered in terms of the equipment required, the cost, a brief history and description of the process, uses and applications for which each type is suitable, and advantages and disadvantages. The other eight processes, described briefly, are: (1) brazing, (2) stud, (3) friction, (4) explosive, (5) electron beam, (6) ultrasonic, (7) laser, and (8) forge. A list of selected references is included. (AW)

VT 008 757

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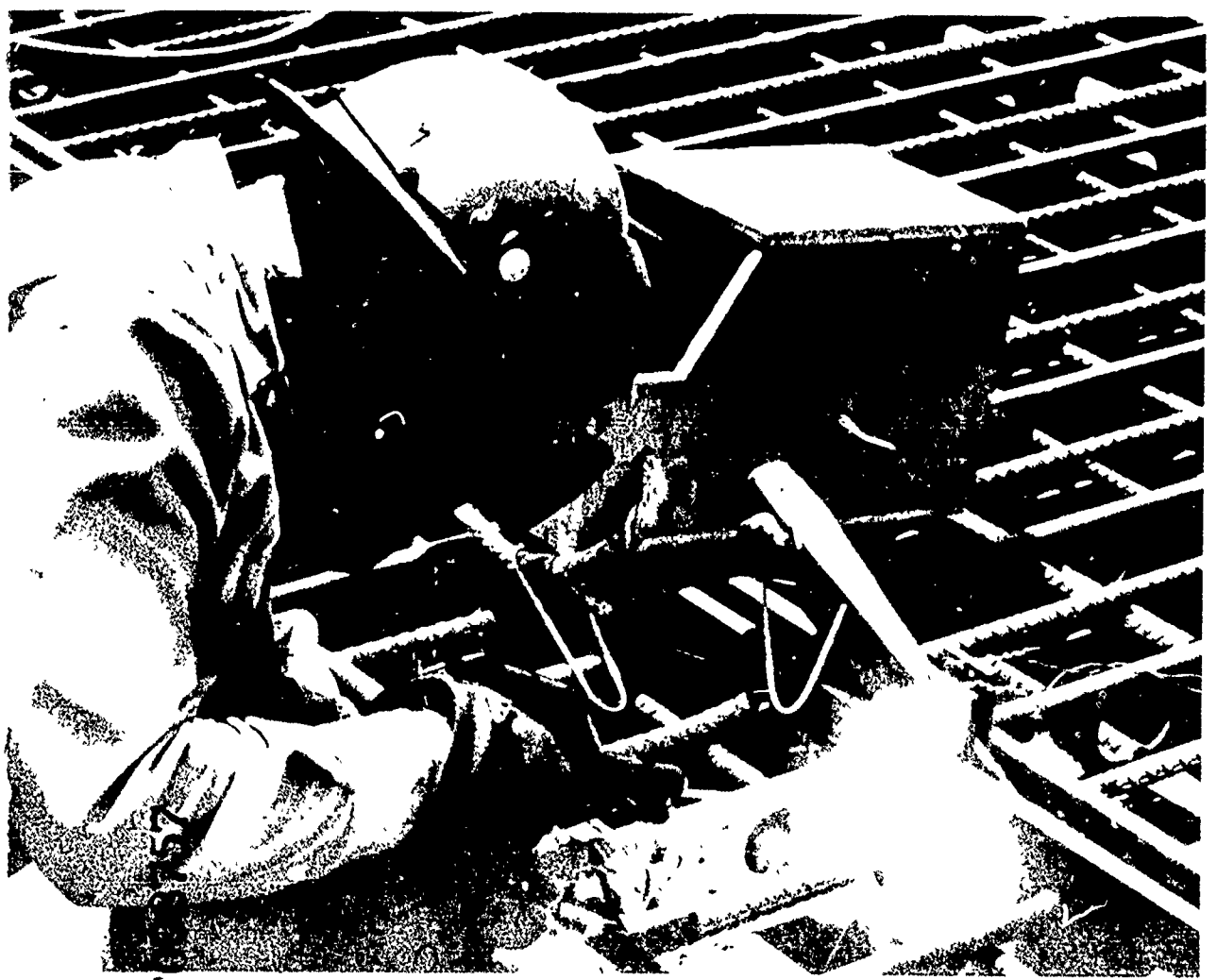
Welding and Flame-Cutting Processes and Practices



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SUMMARY

Welding is to metalworking as adhesives are to woodworking. It allows the assembly of components and the construction of products which would be inconceivable without the economical fusion of metals.

Eleven basic welding processes and their variations—approximately 50—are available for industrial production and maintenance. This *Aid* discusses the 11, concentrating on the three most widely used processes—arc welding, gas welding, and resistance welding.

Welding is used for production or maintenance. Many plants use it for both, and some industries would be hard put to manufacture their products without it and its related processes. Examples of such industries are aerospace, pressure vessel manufacturing, and, to some extent, automotive, home-appliance, and power-generation manufacturing.

Basic Processes. In welding, there are 11 basic processes, and some 50 variations of the 11. The three basic processes that are most widely used in metalworking are arc welding, gas welding, and resistance welding. The other 8 processes are brazing, stud, friction, explosive, electron beam, ultrasonic, laser welding, and forge welding.

Production Uses. Welding finds a variety of production applications. To use it economically, the product to be welded should be designed for welding. Welding costs can also be reduced by using composite weldments. These weldments may be made up of castings or forgings welded to plates, shapes, or tubing. In this manner, complicated weldments may be developed without difficult and time-consuming welding operations.

Improved fabricated tools have come about as a result of the increased service life which welding can provide. An example is a cutting tool with a tungsten carbide tip—a brazing operation that materially lengthens the tool's life. Similarly, the deposition of hardfacing materials on tools increases their service life. A hard metal overlay or buildup on the softer base metal results in a tool with the characteristics of a harder material at a cost only slightly above that of the least expensive carbon steel tool in the shop.

Maintenance Uses. Depending on the type of maintenance operation, several welding methods are available. The most common maintenance jobs are carried on with arc or gas welding.

Maintenance on sheet metal parts, such as screens and machinery guards, can be done with resistance welding. Sheet metal parts may be joined faster and more permanently by this type of welding than by riveting or bolting.

Welding is excellent for repairing heavy metal parts. Usually, it is cheaper to weld a worn or broken part than to buy a new replacement. Often the welded part will give better service than a new one.

ARC WELDING

Arc welding came into its own around 1930 with the development of the coated electrode. This improvement assured the deposition of weld metal which could match or surpass the quality of the base metal. Following are the various arc welding processes in order of their acceptance and use: metal arc, Tig, Mig, CO_2 Mig, and submerged arc.

Metal Arc Welding

Metal arc welding done *manually* is the most popular process. It requires a fairly small investment for welding equipment. Aside from protective clothing for the weldor, all that is needed is relatively inexpensive equipment and accessories.

The equipment can be a DC rotary-type machine or a transformer type which converts to AC-DC or rectified-DC current. The accessories include an electrode holder, cables, ground clamp, and a supply of electrodes. A shop can be set up for $600 to $1,000, depending on the volume of welding.

If a plant uses welding on a variety of materials—both ferrous and nonferrous—and on a production schedule, (in the fabrication of products), the owner-manager should consider a semi-automatic arc welding method, such as Mig (metal inert gas) welding. Mig insures greater production than manual welding, and in some instances, requires less skill from the weldor.

Automatic welding can be used when high production is desired. In such case the welds are either long or of such a nature that they can be made with a machine following a template. Automatic welding equipment costs considerably more than manual welding equipment. However, the extra cost can often be offset by lower labor costs.

The cost of automatic welding equipment starts at about $2,000. The exact cost depends on the welding process and on whether the application is semi- or fully-automatic. On the lower end of the price range is the simple, semi-automatic submerged arc or Mig welding equipment. At the upper end—$50,000, $60,000, or more—is the numerical-controlled, automatic equipment which is capable of performing highly sophisticated jobs.

Tig Welding

In electric arc welding *Tig* (tungsten inert gas) is the oldest of the inert gas welding processes. Developed about 1942 as a process for welding light metals, such as magnesium, its use includes all ferrous and nonferrous metals.

The Tig process uses a nonconsumable tungsten electrode shielded by an inert gas for extremely high quality welding of nonferrous materials. It is especially suited to the welding of aluminum and for working in a vacuum chamber with exotic materials, such as titanium, molybdenum, and columbium.

Mig Welding

Mig (metal inert gas) welding is an offshoot of the original Tig process, having been developed around 1948. In Mig welding, the electrode is a consumable one which usually matches the metal being welded. Mig is generally semi-automatic, and it develops fantastic

weld disposition speeds. It can also be fully automated.

A disadvantage of Mig welding is the high cost of argon and helium—the gases which are used for shielding. However, substitute gases can be used, for example, nitrogen for welding copper and copper alloys. As already mentioned, another example is carbon dioxide for welding steel. Various mixtures of helium, argon, carbon dioxide, and oxygen also produce satisfactory results.

In nonferrous Mig welding, an inert gas—usually argon or helium—is used for shielding purposes. In the welding of mild steel, argon or helium may be used, but carbon dioxide (CO_2) will produce equally satisfactory results and is much cheaper.

CO_2 Mig Welding

CO_2 (carbon dioxide) Mig welding is widely used for steel fabrication because CO_2 is a low-cost shielding gas, and the process is capable of high deposition rates.

Conventional CO_2 Mig welding employs a large wire ($\frac{1}{16}''$ diameter or larger) to make possible welding at very high speed and at low cost. However, it sometimes produces a problem with weld spatter. In another CO_2 Mig application, small wires (0.045″ diameter or less) are used. Although this application is slower, it produces a higher quality weld than does the large wire. The small wire permits out-of-position welding with relatively low current (maximum 250 amps) and results in low spatter weld.

Argon can be added in CO_2 Mig to soften the arc. And sometimes pure CO_2 is replaced by pure argon or a mixture, such as argon-CO_2 or argon-oxygen.

The relatively low heat of CO_2 Mig makes it excellent for joining thin gauge carbon steel sheets. This type of welding is fast, tolerant of poor fit-up, and produces little distortion. And, very important, it is easy to use.

These advantages—along with smooth operation and easily controlled weld puddles—have led to CO_2 Mig applications on low alloy materials and stainless steels. It is used extensively to fabricate plate and pipe in all positions. Recent applications on heavy thicknesses of quenched and tempered steels of 100,000 psi yield strength have produced good results.

CO_2 Mig welding is a process that should be investigated by owners of metalworking shops that do production welding.

Submerged Arc Welding

In electric welding *submerged arc welding* lends itself particularly well to automatic and semi-automatic welding of ferrous materials, 18 gauge or more in thickness. In this process, a layer of granular flux thick enough to cover the entire weld is automatically deposited in advance of the moving arc. A bare wire electrode is automatically fed into the flux blanket with direct or alternating current producing an arc between the electrode and the joint. The flux in the weld area is melted and floats to the surface of the weld. There it solidifies as slag. Because the arc and the molten metal are protected from the atmosphere high quality welds are assured.

High travel speed and extremely high weld deposition rates are possible by submerged arc welding. Thus, it is economical in semi-automatic or automatic applications.

GAS WELDING AND FLAME CUTTING

Gas welding is used primarily for welding light gauge metals. At one time, it was the most popular process because of its slowness and high heat input. Generally, it has been replaced by arc welding. It is principally used for cutting metals.

The equipment needed for gas welding and flame cutting is relatively inexpensive. The necessary equipment for gas welding and/or manual flame cutting operations can be bought for $200.

The oxy-acetylene flame is used mainly for cutting ferrous materials. With it, steel up to thicknesses of 8 feet or more can be cut quickly. However, long straight cuts of comparatively thin gauge steel can be made quicker with a shear. But even so, oxy-acetylene cutting is cheaper if a plant uses only a small volume of thin gauge steel.

On routine, one-of-a-kind cutting jobs, usually a manually held flame-cutting torch is sufficient. On high-quality repetitive work, machine-controlled flame cutting can be more economical. A small, simple flame-cutting machine for straight line cutting costs only a few hundred dollars. On the other end of the price scale, the cost may be as much as $50,000 for an electronically controlled flame-cutting machine with a photo-electric eye and capable of magnifying templates from 10 to 100 times.

Flame straightening is another use for the oxy-acetylene flame. Here, controlled heating and cooling—to expand and contract the metal involved—corrects distortion that may be caused during welding or service conditions.

The oxy-acetylene flame is also used in flame hardening. In this application, the surface of metal is hardened by heating and quenching.

RESISTANCE WELDING

The third commonly used process—resistance welding—is the oldest of the processes, having been invented in 1877. It is used primarily for welding thin gauge materials on a repetitive basis. A large volume of production is needed because resistance welding equipment is costly.

A spot welding machine costs less than $1,000, but that's not the whole story. With any type of resistance equipment, proper control equipment is needed to produce satisfactory welds. Preferably the control equipment should be electronic. Proper control equipment insures the flow of effective welding current for the correct period of time.

A highly complicated welder that can produce several hundred welds at one time may cost as much as $1 million. Consistently uniform welds of good quality and a relatively low cost per weld on a large production volume could pay for such an investment.

OTHER PROCESSES

The owner of a small plant should be aware of the other welding processes even though he may have no immediate use for them. They are brazing, stud, friction, explosive, electron beam, ultrasonic, laser welding and forge welding.

Brazing

There are eight basic brazing processes, but metalworking plants use only five of them. All five do the same work, and the only difference is in the source of heat.

1. ***TORCH.*** The most popular of the brazing processes gets its heat from a torch. Usually, it is a gas welding torch or a special piece of oxy-acetylene equipment designed to do a job.

2. ***FURNACE BRAZING.*** In this method, the brazing is done in a protective atmosphere, such as hydrogen. Furnace brazing speeds up brazing time and improves uniformity.

3. ***INDUCTION HEATING BRAZING.*** This process is also done in a protective atmosphere, such as hydrogen. Or a protective flux may be used. Like furnace brazing, this method speeds up brazing time and improves uniformity.

4. ***RADIANT GAS.*** When radiant gas heating is used, a jig or fixture set is usually needed to produce a fast, accurate brazing job.

5. ***CHEMICAL SALT BATH.*** Chemical salt bath brazing, or salt bath brazing, as it is also called, uses an external heat source. Usually, the flame is a gas or an oil. Heating may be done also with electrical resistors in the bath. Controls must be provided to maintain the molten salt bath within the required brazing temperature range. Likewise, the bath must be of sufficient size to maintain the desired brazing temperature even when the cold parts to be brazed are immersed in it.

Because it allows the simultaneous brazing of multiple joints and intricate assemblies, salt bath brazing is used primarily for volume production. Salt bath brazing allows for controlling the warpage of parts which require uniform heating.

Stud Welding

Stud welding is a modification of the arc welding process. The modification is designed to make joints between the ends of rods and bars and a metal surface, such as a plate, tube, or structural section. One method for making this type of joint is to draw an arc between the rod (stud) and the surface and then bring the molten surfaces in contact. In this simple type of joint, the process replaces the stud which is drilled and tapped into the surface. Hence the name stud welding. No elaborate preparation is necessary for stud welding.

More consistent results are obtained if the surface to which the stud is to be welded is cleaned by a grinding or wire brushing before welding. With this process, it is possible to make welds from $\frac{1}{8}''$ to $1''$ in diameter (or equivalent cross sectional areas) in steel, stainless steel, brass, or aluminum.

Friction Welding

Friction welding is used for joining materials from $\frac{3}{16}''$ to several inches in diameter. At least one or preferably both of the work pieces should be of a circular cross section, either a bar or tube. Within these limits, the process competes with flash welding. It has two advantages over flash welding: cleanliness and a balanced steady load on the power source. Power requirements, of course, are greatly reduced as compared with flash welding.

Friction welding is generally carried out between a stationary and a rotating part. Two work pieces are brought together under

pressure, and one part is revolved against the other so that friction heat is generated on the inner face. When the increased temperature has made the joint area sufficiently plastic, the rotation is halted and the ends forced together to forge and form the joint.

Explosive Welding

Explosive welding is a specialized process in which two pieces are compacted together to provide a weld on the inner face when certain conditions are met. It can be applied only to variations of a lap joint.

However, an advantage is that explosive welding can be used: (1) to make welds in places inaccessible to conventional processes or (2) for field welding where the power and skill for fusion welding are difficult to obtain. Basically, it is used for cladding applications, ranging from heavy plates down to foil gauges.

Electron Beam Welding

Electron beam welding is a highly sophisticated and costly process. Usually, it is done in a vacuum. The energy for melting the metal is supplied by the impact of a focused beam of electrons. This highly intense heat source results in a deep narrow penetration as well as a narrow heat-affected zone.

This process results in reduced distortion and improved mechanical properties in joints when compared with other welding processes. Its disadvantage is that all satisfactory welds must be produced in a vacuum chamber. This requirement limits the size of the part to be welded and the welding speed.

Ultrasonic Welding

In ultrasonic welding, a vibrating probe produces lateral vibration and slip between the faying surfaces (surfaces to be welded). The surface film is disrupted and the temperature is raised to form a sort of friction weld. Although metals about $1/10''$ in thickness have been welded ultrasonically, this process is used chiefly for welding parts of foil thickness. Aluminum and a variety of metals, including refractory metals, are ultrasonically welded.

The temperature rise in an ultrasonic weld is localized, and the process can be used on temperature-sensitive materials and for delicate components. It is also an ideal process for joining thin to thick materials. Because there's no fusion, dissimilar metals can be welded with good results.

Laser Welding

"Laser" comes from the initial letters of the type of radiation which makes this welding process possible—Light Amplification by Simulated Emission of Radiation. This process is used for micro-spot welding, and a vacuum chamber is not required for the generation and delivery of the beam. It appears to be the most promising application, particularly where minimum spread of heat is required. While laser welding is basically a single spot process, a seam weld may be made by overlapping individual spots.

Forge Welding

Forge welding is the earliest known welding process and has been

used by blacksmiths for joining iron and steel for centuries. With the disappearance of the blacksmith and forge shop. this process is seeing lesser use than in earlier years. It is also slower and dirtier than conventional welding methods.

In forge welding, the parts to be joined are usually heated to 1800 or 1900 degrees Fahrenheit so they are plastic and then joined by hammering the pieces together. At this temperature, the oxide and scale are fluid. and the hammering is done in such a way as to squeeze these impurities out of the joint and permit metal-to-metal contact.

It is not unusual now for workpieces to be rolled, drawn, or squeezed together rather than being hammered together. Generally, the pieces to be joined are shapped so as to assist the process of squeezing out the oxide. Often mechanical interlocking is provided as well.

Wrought iron, which contains layers of readily fused slag, is easy to forge weld. Carbon steels require more precise temperature control, and silica sand or borax is sprinkled on the weld face to make the oxide more fluid. Alloy steels which often contain elements giving off refractory oxides cannot be satisfactorily forge welded.

FOR FURTHER INFORMATION

Readers who wish to explore further the subject of the uses of welding and welding processes may be interested in the following references. This list is brief and selective. However, no slight is intended toward authors whose works are not mentioned.

The Welding Encyclopedia. 16th ed. Edited by T. B. Jefferson. $10. Monticello Books, Inc., Morton Grove, Ill. 60053

The Welding Encyclopedia Study Guide and Workbook by T. B. Jefferson. $3.50. Monticello Books. Inc., Morton Grove, Ill. 60053

Welding Handbook. 6th ed. Edited by Arthur Phillips. $10. American Welding Society, 345 E. 17th St., New York, N. Y. 10017

Jefferson Gas Welding Manual by T. B. Jefferson. $2. Monticello Books, Inc., Morton Grove. Ill. 60053

Metals and How to Weld Them by T. B. Jefferson and Gorham Woods. $2. James F. Lincoln Arc Welding Foundation, Cleveland, Ohio 44117

Periodicals:

The Welding Engineer. $3 per year. P .O. Box 128, Morton Grove, Ill. 60053

The Welding Distributor. $3 per year. P. O. Box 128, Morton Grove, Ill. 60053

The Welding Journal. $8 per year. 345 E. 47th St., New York, N. Y. 10017

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A Technical Drawing Course for College-Preparatory Students.

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Industrial Arts Education, Maine State Department of Education, Education Building, Augusta, Maine 04330 (no charge).
PUB DATE - ND 18p.

DESCRIPTORS - *INDUSTRIAL ARTS; *DRAFTING; *COLLEGE BOUND STUDENTS; CURRICULUM GUIDES; COURSE OBJECTIVES; SENIOR HIGH SCHOOLS; SECONDARY SCHOOL STUDENTS; *TEACHING GUIDES
IDENTIFIERS - MAINE STATE DEPARTMENT OF EDUCATION; AUGUSTA

ABSTRACT - A state-level committee of teachers developed this guide for teacher use in planning a technical drawing course for college preparatory students in industrial arts, grades 11 and 12, so that these students would be equipped to successfully complete engineering college work. The contents are organized as follows: (1) Objectives, (2) Freehand Sketching, (3) Orthographic Projection, (4) Working Drawings, (5) Pictorial, (6) Development and Intersections, and (7) Suggested Texts. Each unit lists the operations a pupil should learn and the information he should know. The course is designed for approximately 5 hours per week for 72 weeks (2 school years). (GR)

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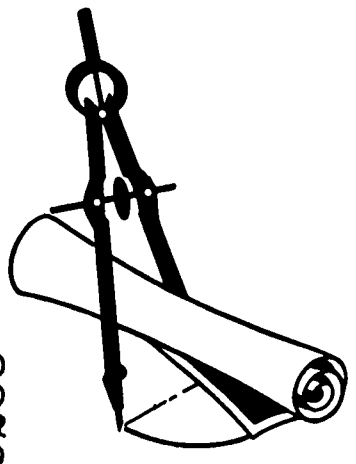
A Technical Drawing Course for College-Preparatory Students



VT009288

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MEMORANDUM

Revised 5/69

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
1900 Kenny Road
Columbus, Ohio 43210

FROM: (Person) Carl W. Butler, Consultant (Agency) State Department of Education
Education Building
(Address) Augusta, Maine 04330

DATE: August 19, 1969

RE: (Author, Title, Publisher, Date) Albert Brown and others. A Technical Drawing Course for College-Preparatory Students.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency Carl W. Butler, Consultant, Industrial Arts Education
Address Education Building, Augusta, Maine 04330
Limitation on Available Copies As requested on official letterhead stationary. Price/Unit NO COST (quantity prices)

(2) Means Used to Develop Material:
Development Group Teacher Workshop
Level of Group Teachers - State-wide
Method of Design, Testing, and Trial Classroom - State-wide

(3) Utilization of Material:
Appropriate Educational Setting Secondary Industrial Arts program (College preparatory)
Type of Program High School (College preparatory)
Occupational Focus Technical Drafting
Geographic Adaptability Designed for Maine - could be used nationwide.
Uses of Material Course planning - College-preparatory
Users of Material Teachers

(4) Requirements for Using Material:
Teacher Competency A good background in Drafting.
Student or Trainee Selection Criteria Age 15 to 21, male or female, Grades 11 & 12, college-preparatory students.
Time Allotment Approximately 200 minutes per week for 72 weeks (two school years).

Supplemental Media --
Necessary X
Desirable ____ (Check Which)

Describe Any good college drafting test (suggested texts are listed in the bibliography of the publication).
Source (agency)
(address)

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Foreword

This technical drawing course was made possible by the efforts of the following people:

Albert Brown, Head of Department, Stephens High School, Rumford

G. Vincent Cuozzo, Head of Department, Bangor High School

John Greer, Associate Professor, Gorham State College

Gerald Hallett, Assistant Principal and Head of Department, Scarborough High School

Richard Langlois, Teacher, Portland High School

Elmer Lyons, Jr., Teacher, Deering High School, Portland

Norbert Young, Head of Department, Maine Central Institute, Pittsfield

Elwood A. Padham, State Director of Industrial Arts Education

Title of Course: Pre-engineering Technical Drawing

Introduction:

This basic technical drawing course is designed to help pre-engineering college students learn the fundamentals of drawing. They will develop basic skills of drawing and an understanding of the technical processes related to this subject area.

When high school students pursue a well-taught technical drawing course, they will be better equipped to enter and successfully complete engineering college work.

Scope:

a. 11th or 12th grade

b. 36 weeks (4 or 5 periods a week)

c. 200-275 min. per week

Objectives

1. To develop in each pupil the ability to read and interpret technical drawings.

2. To develop in each pupil the techniques of making technical drawings.

3. To develop in each pupil the power of visualization and constructive imagination.

4. To develop in each pupil habits of neatness and exactness of thought.

Pre-engineering Technical Drawing

The Pupil Should Learn These Operations	The Pupil Should Know This Information	TIME
Orientation	Historical background of drawing A. Present need B. Present use (objectives) C. Projected developments Class Organization A. Tools & equipment B. Supplies C. Seating D. Textbook E. Notebook F. Rental plan G. Personnel H. Evaluation I. Tardiness Overview of course Major units A. Freehand sketching B. Orthographic projection C. Working drawings D. Pictorial drawings E. Development & Intersections	
Freehand sketching		10%
How to select materials A. Pencils B. Paper--unlined and graph C. Erasers	Why sketching has value as a skill	
How to hold pencil for sketching	Sketching techniques A. Use of pencil B. Understanding proportion	
Sketchlines A. Straight B. Curved C. Circles and arcs D. Ellipses		
Estimate A. Lengths B. Proportion		

The Pupil Should Learn These Operations	The Pupil Should Know This Information	TIME
Freehand sketching (Cont.) How to sketch: A. Isometric axis B. Oblique axis C. One point perspective D. Two point perspective E. Objects with straight sides F. Circles in isometric G. Curves in isometric	Angles of axis lines A. Isometric B. Oblique C. Perspective-one point two point Differences between and uses of: A. Isometric drawing B. Oblique drawing C. Perspective drawing and its uses	
Orthographic Projection 1. Lettering		35%
	Communicative Language A. History-Pictures B. Signs & Symbols	
	Styles of Letters Drafting Standards A. Single stroke B. Commercial gothic C. Vertical D. Inclined Widths & Heights	
How to position pencils	Guidelines for: A. Upper case B. Lower case C. Fractions D. Figures	
How to make and use guidelines A. Upper case B. Lower case C. Numerals D. Fractions	Types of pencils for lettering	
How to develop letters single stroke method	Composition A. Arrangement B. Spacing C. Style D. Size	
How to arrange and space lettering	Lettering Guideline aids A. Ames lettering guide B. Braddock-Rowe triangle C. T-Square	
	Special lettering devices A. Drawlet B. Payzant C. Leroy D. Edco E. Wrico	

The Pupil Should Learn These Operations	The Pupil Should Know This Information	TIME
Orthographic Projection (Cont.) 1. Lettering (Cont.) How to sketch the various lines	That each line has definite meaning That each line is drawn in definite way That there are varying thicknesses of lines A. Thick lines 1. Border lines 2. Visible lines 3. Cutting plane line 4. Short break line B. Medium lines 1. Hidden lines C. Thin lines 1. Long break lines 2. Section lines 3. Center lines 4. Dimension lines 5. Extension lines arrowhead-ledger lines 6. Phantom lines 7. Construction lines Where these lines are used	
2. Use and care of instruments How to point a pencil A. Regular B. Mechanical	Pencils: A. Selection grades mechanical pencils	
How to attach paper A. Methods B. T-Square for positioning paper C. Drawing horizontal lines	T-Square - Position on board A. Positioning paper B. Fastening paper C. Horizontal lines D. Parallel lines	
How to use triangle and T-square in combination to draw vertical lines, inclined lines T-square & triangles in combination to obtain angles in multiples of 15°	Triangles - 45°, 30°, 60° A. Their use with T-square B. Horizontal lines C. Inclined lines D. Irregular curves	
How to read architect's scale	Scales - Measurement)Eng.)Metric A. Mechanical Engineer's Scale B. Architect's Scale C. Civil Engineer's Scale	

The Pupil Should Learn These Operations	The Pupil Should Know This Information	TIME
Orthographic Projections (Cont.) 2. Use and care of instruments (Cont.)		
How to transfer distances	Dividers A. Proportional divider and uses B. Conventional C. Bow	
How to divide a line		
How to draw a circle How to sharpen lead for compasses How to set a bow compass	Compasses A. Compass & extension bow B. Bow C. Beam	
How to use the erasing shield	Erasers A. Types B. Shields	
How to use lettering guide	Lettering guides A. Braddock B. Rowe C. Ames	
How to use templates	Types of templates Drafting machines	

The Pupil Should Learn These Operations	The Pupil Should Know This Information	TIME
Orthographic Projections (Cont.) 3. Dimensioning		
How to draw arrowheads, leaders & other lines peculiar to dimensioning How to dimension drawings according to standards & rules How to interpret dimensions and blueprints How to perform the mathematics involved in dimensioning How to use tools and equipment necessary to dimensioning How to interpret charts of tolerances and standards	The standard symbols used in drafting A. Inch (") B. Foot (') C. Surface finishes General dimension arrangements A. Over-all dimensions B. Location on views C. Principal view D. Dimensions from datum E. Reference dimensions F. Indicating symmetry G. Hidden lines (not points of origin or termination) H. Broken outlines Dimensioning cylindrical or spherical surfaces A. Diameters of concentric elements B. Radii of arcs C. Distances along curved surfaces D. Parts with rounded ends E. Round holes F. Counterbored holes G. Countersunk holes H. Shaft centers Limits and tolerances A. Unilateral and bilateral systems B. Standard fits: running & sliding, locational, drive, force The need for considering shop processes when dimensioning a drawing A. Drilling B. Boring C. Reaming D. Counter-boring and counter-sinking E. Spot-facing F. Milling G. Casting H. Finishes I. Grinding J. Tapering K. Knurling	

The Pupil Should Learn These Operations	The Pupil Should Know This Information	TIME
Orthographic Projections (Cont.) 3. Dimensioning (Cont.)	The use of notes on drawings A. Materials B. Scale C. Finishes D. Number of pieces The use of various lines when dimensioning A. Dimension lines B. Extension lines C. Centerlines D. Leaders E. Arrows Tools associated with dimensions A. Calipers B. Micrometers C. Architect scale, engineer scale, decimal scale D. Templates The breakdown of an object into geometric parts A. Cylinders and holes B. Prisms C. Rectangles D. Cones	
4. Geometrics (as needed) A. How to divide a line into equal parts B. How to bisect vertical & horizontal lines C. How to bisect an angle D. How to construct a triangle from given sides E. How to construct a square F. How to construct a pentagon G. How to construct a hexagon H. How to construct an octagon I. How to construct a circle through 3 given points J. How to draw a circle tan. to a line K. How to draw a line tan. to a circle L. How to draw arcs tan. to straight lines M. How to draw arcs tan. to arcs N. How to construct an ellipse O. How to locate center of circle of arc	Reason for studying engineering geometry Common geometric shapes A. Planes parts of the circle B. Solids Terminology A. Vertical line B. Horizontal line C. Bisector D. Tangent E. Perpendicular F. Hypotenuse Symbols A. ℄ Centerline B. ⊥ Perpendicular C. ∠ Angle D. ∠s Angles	

The Pupil Should Learn These Operations	The Pupil Should Know This Information	TIME
Orthographic Projections (Cont.) 5. Manufacturing Processes*		
How to identify and indicate on drawings, appropriate manufacturing processes	Scheduling of machine production An understanding and knowledge of the various processes The functions, operations and limitations of the various machines and processes A. Rough forming 1. Casting 2. Forging 3. Welding B. Finishing 1. Lathe work 2. Boring 3. Reaming 4. Drilling 5. Shaping 6. Milling 7. Grinding 8. Broaching 9. Heat treatment C. Assembling	
6. Auxiliary views		
How to draw the auxiliary views (primary & secondary) How to apply auxiliary views to determine true size of dihederal angles How to plot true shape of inclined surface of any shape	Definition of auxiliary views Purpose of auxiliary views The auxiliary plane Use of the reference plane Classification of auxiliary views A. Depth auxiliary view B. Height auxiliary view C. Width auxiliary view Uses of auxiliary views A. Dihedral angle B. Plotted curves C. True length lines	

*Formerly known as shop processes. If facility lends itself to this procedure, this could be carried out.

The Pupil Should Learn These Operations	The Pupil Should Know This Information	TIME
Working Drawings 1. Sections		20%
How to indicate a cutting plane How to draw: A. Full sections B. Half sections C. Offset sections D. Assembled sections E. Special sections	Purposes & definition of cutting plane Types of sections A. Full section B. Half section C. Offset section Sections of assembled pieces Special sections A. Shaft, bolts, nuts, screws, keys B. Revolved section C. Ribs D. Phantom section E. Outline section F. Blacked-in section G. Shaded section H. Aligned section Section lining A. Line weight B. Assembled pieces 1. Angle 2. Size C. Single object 1. Angle 2. Size D. Conventional symbols used when sectioning materials	
2. Threads and fasteners	The helix Threads A. External B. Internal Thread forms A. American Standard & Unified B. Square C. Acme D. V E. Worm F. Knuckle G. Buttress Thread pitch Threads per inch Thread conventions	

The Pupil Should Learn These Operations	The Pupil Should Know This Information	TIME
Working Drawings (Cont.) 2. Threads and fasteners (Cont.)		
How to draw semi-conventional sharp, V., Unified and American Standard threads	Principles of drawing A. Conventions B. Simplified conventions	
How to draw semi-conventional square threads	Screw thread annotation	
	Use of screw thread tables	
How to draw conventional threads A. Internal B. External	ASA - Organization	
How to use thread notes	About American Standard Bolts & Nuts A. Square head B. Hexagonal head	
How to draw bolts and nuts A. Square B. Hexagonal	Typical Cap Screws A. Hexagon head B. Flat head C. Round head D. Fillister head E. Hexagon socket	
	Typical machine screws A. Round head B. Flat head C. Oval head D. Fillister head	
	Wood screws	
	Set screws	
	Key and keyways	
	Rivets	
3. Tracing and making prints How to trace How to reproduce drawings	Methods and procedures used for reproduction of drawings (Tracing papers & cloths)	

The Pupil Should Learn These Operations	The Pupil Should Know This Information	TIME
<u>Pictorial</u> 1. <u>Isometric</u> How to draw isometric axis with instruments How to draw non-isometric lines How to draw angles in isometric How to draw circles and arcs in isometric How to draw ellipses with instruments How to draw curves in isometric		20%
2. <u>Oblique</u> How to draw oblique axis at 30°, 45°, 60°	The scale of depth in: A. General oblique drawings B. Cabinet drawings How to select axis for objects to be drawn	
How to: A. Draw angles in oblique B. Draw circles and arcs in oblique C. Draw sections in isometric and oblique D. Dimension in isometric & oblique	Principles of dimensioning	
3. <u>Perspective</u> A. Draw one point perspective B. Draw two point perspective		

The Pupil Should Learn These Operations	The Pupil Should Know This Information	TIME
Development & Intersections		15%
1. Parallel line development		
How to develop A. Truncated prism B. Oblique prism C. Cylinder D. Truncated cylinder	Development defined A. Pattern B. Stretch out C. Parallel-line development D. Radial-line development Methods of bending metal Edges and Seams Circumference Elements	
2. Radial line development (Parallel line development)		
How to develop a: A. Pyramid B. Truncated pyramid C. Cone D. Truncated cone E. Oblique cone		
3. Intersections		
How to layout an intersection of 2 square prisms	Intersection Line of intersection Figure of intersection	
How to layout an intersection of a cylinder		
How to layout an oblique intersection of a cylinder	Cutting plane	
How to layout intersection of prism and pyramid		
How to layout intersection of cone and cylinder		
How to layout intersection & development of cone and cylinder		

Suggested Texts:

French and Svenson. Mechanical Drawing. New York, N.Y: McGraw-Hill Pub. Co., 1966 7th ed.

Spencer, Henry C. Basic Technical Drawing. New York, N.Y: The MacMillan Co., 1962

Zozzora, Frank. Engineering Drawing. New York, N.Y: McGraw-Hill Pub. Co., 1965

VT 009 359

Nursing Home and Extended Care Administration, A Certificate Program. Curriculum.

Portland State Coll., Ore.
Oregon State System of Higher Education, Corvallis. Div. of Continuing Education

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PUB DATE - ND 246p.

DESCRIPTORS - *CURRICULUM GUIDES; *HEALTH OCCUPATIONS EDUCATION; *INSTRUCTIONAL ADMINISTRATION; *NURSING HOMES; ADULT VOCATIONAL EDUCATION; STATE COLLEGES; BIBLIOGRAPHIES

ABSTRACT - A syllabus is given for the 90-week certificate program in nursing home administration held on a weekly evening schedule on the campus of Portland State College and having as its aim the preparation of nursing home and extended care facility administrators for responsible, creative, and skilled leadership. The overall planning and administration of the program was directed by a faculty member in the School of Social Work with a faculty member in the sociology department as curriculum consultant. Specialists in various areas serve on the faculty. Content is presented in narrative and outline form. Teaching methods, techniques, and resources are suggested; bibliographies and handouts are included. The major content areas are: (1) Administrative Process, (2) Chronic Illness, (3) Medical Care Administration, (4) Rehabilitation Therapies, (5) Recreation, Socialization, (6) Environmental Health Control, (7) Nutrition and Food Planning, (8) Fiscal Administration, and (9) Community Relationships. (JK)

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NURSING HOME and EXTENDED CARE ADMINISTRATION

A Certificate Program

CURRICULUM

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Continuing Education for Social Work
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Curriculum Consultant
Gary D. Hansen, M.A.
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A Project
Sponsored by Portland State University in
Cooperation with the Division of Continuing Education
Oregon State System of Higher Education

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Goals and Strategy for Training
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INTRODUCTION

INTRODUCTION

Portland State College, the urban college for Oregon, in cooperation with the Division of Continuing Education and the Oregon State System of Higher Education, has formally committed its resources to the development of training and research programs in the field of gerontology. An interdepartmental committee on gerontology has been established at Portland State College for comprehensive planning of curricula, practicum and research. Committee activities include the current updating curriculum project in Nursing Home Administration, continuing education programs for other administrative and professional personnel in extended care facilities and other programs for the aging, and the eventual development of a degree level curriculum in extended care administration. (See Appendix on Gerontology Program Plans--Proposed Courses and Descriptions.)

Need for a Certificate Program on Nursing Home Administration

Oregon is a national leader in pioneering the development of health, education and welfare programs for its citizens. Certain professional personnel felt that further delays were intolerable in the establishment of a qualitative education and training program for administrators of nursing homes and other types of extended care facilities. The nursing home industry of Oregon, with a bed complement of 9,074 beds and an annual budget of over twenty-three million dollars requires--above all other considerations, competent, well-trained, professional administrative leadership. To bring Nursing Homes into the mainstream of health care today, where they belong and where they can serve important functions, demands professional leadership. Nursing Homes are major community health enterprises and require effective administration to deliver the services needed by chronically ill, disabled and aged patients.

It is axiomatic to state that Nursing Homes require more than just nursing services. They actually require coordination by the Administrator of more than twenty-five professions and allied work groups; physicians, nurses, para-medical personnel, laboratory technicians, social workers, physical, occupational and speech therapists, dietitians, nurses aides and other personnel. To recruit and develop such a team of workers within a Nursing Home requires competent administration.

The convergence of many factors, notably an accelerated increase in the percentage of those over sixty-five, sweeping changes in the array and organization of community health services, much of it stemming from recently enacted federal-state legislation and revolutionary changes in the biological, physical and social sciences, has spurred the demand for qualified personnel to administer the rapidly expanding network of extended care facilities for the chronically ill and aged.

Education Plan for Certificate Program on Nursing Home Administration

Institutions of Higher Education, throughout the nation, responding to the need for education and training of nursing home administrators, have sponsored within recent years a variety of educational programs. To identify a few of these institutions, the University of California at Los Angeles, University of Oklahoma, George Washington University, Columbia University, University of Southern California, University of Pittsburgh and the State University of Iowa have developed programs ranging from a one-week intensive training workshop to certificate- and degree-granting programs in institutional management.

Following intensive conferencing and consultation with representatives of the Oregon Nursing Home Association and the Nursing Home Licensing staff of the Oregon State Board of Public Health, a program design was developed that met the desired educational criteria of comprehensive continuity and integration. The education program described in this report extends over a nine-month period and provides for a total of ninety class hours of instruction. The classes are held weekly from 7:00 to 9:30 p. m. on the campus of Portland State College.

Course Purpose and Objectives

1. General Objective: To prepare administrators of nursing homes and other types of extended care facilities for responsible, creative and skilled leadership in the management of their institutions.
2. Specific Objectives:
   a. To develop an understanding of administration as a process, including the nature of authority and leadership, and the essential elements of human behavior in organizations.
   b. To develop knowledge and skill in personnel administration, including the allocation of tasks, effective utilization of time, and staff development and training.
   c. To develop an awareness of the specific mission of the nursing home in the spectrum of community health services.
   d. To examine criteria for selection and admission of residents to nursing homes, including social and medical evaluation and required records.
   e. To develop new insights and gain greater knowledge into the nature of illness and disability in the aging process, including the dynamic factors influencing physical, social, and emotional needs of individuals in nursing homes.
   f. To develop knowledge in the factors governing environmental health conditions of the nursing home.
   g. To develop knowledge of the design, equipment, utilization, and maintenance of the physical structure of the nursing home.

h. To examine the philosophy and goals in the rehabilitation process, including the range of therapeutic approaches, physical therapy, occupational therapy, social service, and rehabilitation nursing.
i. To gain greater knowledge of the nutritional needs of the aged, including knowledge of special diets, food preparation and distribution and administration of food services.
j. To gain greater understanding of the role of the nursing profession, including consideration of the role and function of the licensed practical nurse and nurse's aid.
k. To gain greater knowledge of relationships with the medical profession required for effective medical care of residents of the nursing home.
l. To gain greater knowledge of the fiscal management procedures and legal factors in the sound operation of the nursing home.

Overview of Course Content

Administrative Process.....
Human behavior and organization / Styles of administrative leadership / Work groups in organization / Personnel administration

Chronic Illness.....
Major chronic illnesses / Mental illness / Dental problems and treatment / Management of terminal illness problems

Medical Care Administration.....
Physician relationships with the nursing home / Medical ethics and relationships / Administration of nursing services / Medical records

Rehabilitation Therapies.....
Rehabilitation as a philosophy and a process / Physical-occupational-speech therapies / Role of the family and social services in rehabilitation

Recreation and Socialization.....
Social work and recreation therapy in long-term care facilities / Individual and group concepts / Therapeutic uses / Volunteer resources

Environmental Health Control.....
Sanitation in the physical plant / Food storage, processing, distribution / Epidemiological approaches to institutional health care problems / Safety

Nutrition, Food Planning.....
Nutrition for the aging / Standards for judging food quality, cost factors, food laws / Working with a dietitian and food service supervisor

Fiscal Administration.....
Income determination, cost analysis, cash flow, analytical reports / Sources of revenue / Third party payments / Fiscal intermediaries

Community Relationships.....
Health facilities and services in the community / Extension of services to outresidents / Public welfare, Social Security, Medicare, Title XIX

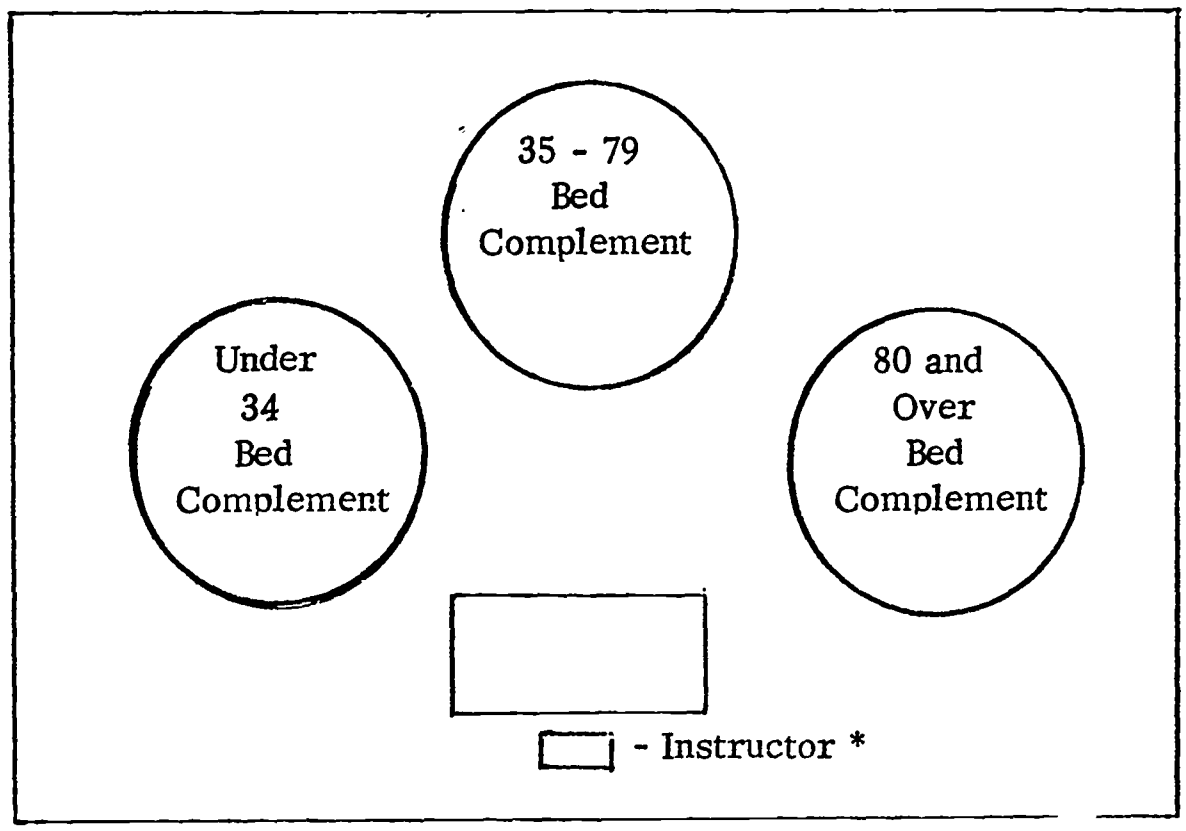
Faculty and Teaching Methods for Certificate Program

The overall planning and administration of the Certificate Program in Nursing Home Administration was directed by Dr. Oscar Kurren, Associate Professor, School of Social Work, Portland State College. Curriculum consultant for the Certificate Program was Gary D. Hansen, Associate Professor, Sociology Department, Portland State College. Specialists in each substantive area of instruction were invited to serve on the faculty.

A series of faculty orientation seminars was held prior to the start of the Certificate Program. The objective of the orientation seminars was to assure that the participating faculty were fully informed about the general and specific educational goals of the Program. Teaching methods were reviewed with the faculty and arrangements completed for the use of textbooks, periodicals, case studies, films and other visual aids.

A variety of teaching methods have been employed to date throughout the program. The initial class of thirty-six administrators and senior nursing home staff members admitted to the Certificate Program was organized into three small groups. The size of the bed complement of their nursing home served as the criterion for the formation of the three groups. The three groups consisted of large, medium and small nursing homes. The seating arrangement used in the classroom facilitated the small group process.

Diagram of Seating Arrangement



*Faculty Listed on following page

NURSING HOME and EXTENDED CARE ADMINISTRATION
A Certificate Program

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Program Director

Gary Hansen, M. A.
Curriculum Consultant

FACULTY

Administrative Process

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Nutrition, Food Planning

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Dietetic Consultant
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Fiscal and Legal Administration

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Arthur Young & Co.
Portland, Oregon

John W. Danner, L.L.B.
Colombo, Danner and Boston
Attorneys-at-Law
Portland, Oregon

Community Relationships

Samuel Lissitz, M.A.
Executive Director
Robison Jewish Home
Portland, Oregon

Secretary - Certificate Program, Nursing Home and Extended Care Administration

Mrs. Sherrie Perrin, B.A.
Continuing Education for Social Work

STUDENT PROFILE AND ORGANIZATIONAL CHARACTERISTICS
First Certificate Program Class

EDUCATION	%
High School Graduate	28
Undergraduate Experience	61
Bachelor's Degree	6
Graduate Work	5
Total	100%
Proportion with R.N. License serving as Administrator	8%

LENGTH OF TIME IN PRESENT POSITION	%
Less than one year	22
One but less than two years	14
Two but less than three years	14
Three but less than five years	31
Six but less than ten years	8
Ten but less than twenty years	6
Over twenty years	5
Total	100%

LICENSING AND CERTIFICATION STATUS	%
Licensed as a Nursing Home	81
Licensed as a Convalescent Hospital	10
Licensed as a Hospital	6
Licensed as a Home for the Aged	3
Total	100%
Certified Medicare	55
No Medicare	45
Total	100%
Profit	81
Non-Profit	19
Total	100%

Acknowledgements

Robert E. Ackenhausen, Executive Director of the Oregon State Nursing Home Association, along with the officers and members of his association, provided the encouragement and essential support that is so crucial to a pioneering educational program.

Professor Gary D. Hansen, who served as curriculum consultant to the Certificate Program, brought to bear his extensive knowledge and experience of gerontology and long-term care administration in helping to shape a comprehensive and innovative curriculum design, and in assisting with recruitment of a distinguished faculty.

We are much indebted to the faculty of the Certificate Program for their extensive commitment of time and effort in developing the curriculum and serving so ably as educators.

The Oregon State Board of Health, primarily through the assistance and encouragement provided by Dr. Robert M. Heilman, Director of Licensing of Care Facilities, helped make the Certificate Program possible.

The Division of Continuing Education, particularly through the office of Dr. LeRoy Pierson, Head of Portland Center of Continuing Education, provided the essential supportive services in space, material, and public relations.

Much credit is due to the efficient and skillful secretarial and coordinative services provided by Mrs. Sherrie Perrin in facilitating the operational aspects of the Certificate Program.

ADMINISTRATIVE PROCESS

Presentation I

Understanding the Behavior of People in Organizations

Presentation II

Authority, Programmed Responsibility

Presentation III

The Integrative Role of the Administrator

OSCAR KURREN, Ph. D.

Presentation I

Education, Training and Staff Development

Administrative Personnel and Support of Directors and Investors

Goals and Strategy for Training

Barriers to Participation in Nursing Home Training Programs

Presentation II

Supervisors in the Training Program

The Administrators' Relationship to Department Heads and Supervisors

Presentation III

Personnel Development

GARY D. HANSEN, M.A.

ERIC

ADMINISTRATIVE PROCESS SEQUENCE

Instructor: Oscar Kurren, Ph. D.

General Purpose

To develop awareness of the confluence of forces and relationships which determine behavior of people in organizations.

Specific Objective

To develop awareness of the interaction between behavior and environment and relate this to a social system analysis of administrative practice.

PRESENTATION I

Understanding the Behavior of People in Organizations

1. Dynamics of change process in organizations
   a. Principle of constancy of change in patient population, staff turnover, and change in resources, materials available to the institution.
   b. Range and scope of behavior variants of staff: absenteeism, tardiness, theft, disloyalty, resistance, turnover, drug and alcohol addiction.
   c. Rationales adopted for explanation of behavior variants of staff: economic determinism model - staff turnover and dissatisfaction is primarily related to low salaries; situational determinism - it is in the nature of our business to expect this kind of behavior; human nature model - human nature is unpredictable and often capricious.
2. An interactional conceptual framework for understanding behavior
   Key Concept: The behavior of the person is the function of the person in interaction with his environment. The formula developed by Kurt Lewin[1] in explanation of this concept is as follows:

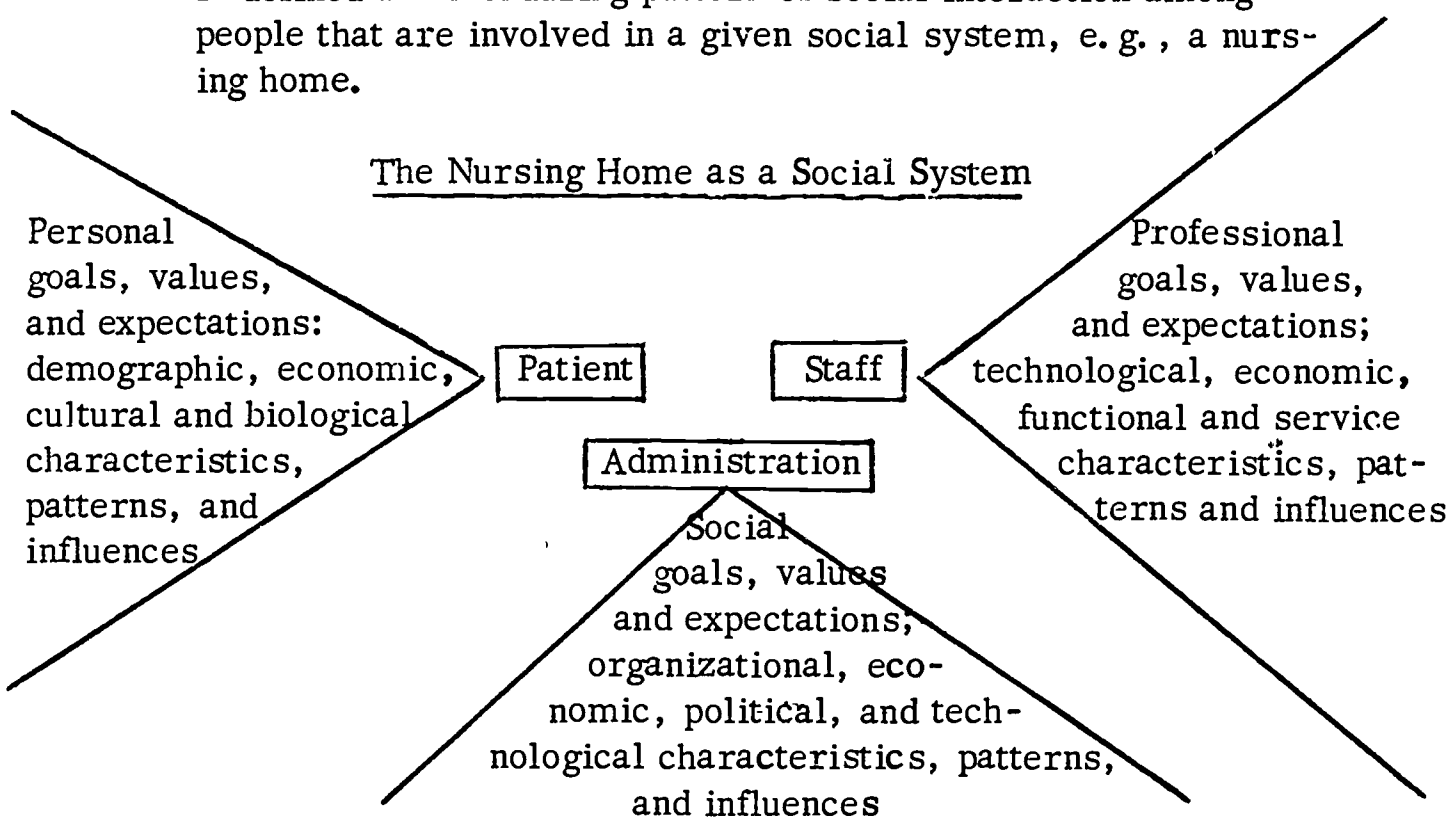
   $B = f(P, E)$ B=behavior
   f=function
   P=person
   E=environment

   The person and his environment are not independent of each other. How an aged person sees a given situation, such as the nursing home, depends on his state of being, i.e., his state of illness or health, his personality, his intelligence, his present life circumstances,

[1] Lewin, Kurt, "Reselling Social Conflicts," Harper & Brothers, New York, 1945.

his prior life experiences, his education. It is also true that how a person sees or perceives a given situation depends on the nature of the presenting situation. In essence the state of the person after encouragement is different than after discouragement. In an atmosphere of security and sympathy, the situation is different for the individual as compared to an atmosphere that is full of conflict, insecurity, and indifference.

3. A social systems model for studying the interplay of all the elements or parts that constitute a nursing home. A social system is defined as an enduring pattern of social interaction among people that are involved in a given social system, e.g., a nursing home.



Teaching Notes Amplifying a Social Systems Approach

To best illustrate the applicability of a social systems approach for problem solving in nursing home administration, the model of the family was utilized. The family was chosen since this is the most familiar and oldest of the social systems. A circle was drawn to designate the boundary for the family or the social system under analysis. The concept boundary for a social system was defined as the range of interactions that are greater within the boundary as contrasted to actions that take place outside the boundary. It was stressed in the discussion that in reality all social systems are in essence open systems. To survive, a social system must maintain an active interchange with its environment. The nursing home, if it is to survive, must maintain a constant exchange with its environment in terms of inputs and outputs of patients, and resources (money, material, and equipment), and staff. An active, positive interchange must take place between the nursing home and the community to obtain all three factors necessary for its survival. (The nature of community relationships is the subject of a separate section in the Certificate Program.)

The concepts of tension, stress, strain, and conflict, were identified as dynamic qualities or manifestations of social system interaction. These concepts were discussed using the family as the case in point. The following ideas illustrate the dynamics of a social system.

> "We expect certain behavior from the members of the family - mother, father, and children. The fact that there are age and sex differences along with culturally defined role expectations for each of the members, produce tension in the family system. This tension inevitably leads to stress in relationships. If not checked, it can produce strain and eventual conflict. The example was used of the father who sustains a serious disability and can no longer work. The father has sustained what behavioral scientists term 'role discontinuity.' In essence he can no longer play the role of wage earner. This function may have to be assumed by the wife or the children. We can therefore understand the stress, the strain, and potential conflict that can occur in the family unit.

> "The development of 'family therapy' was mentioned as a manifestation of the growing awareness and importance of a social systems approach to treatment of individual problems. Psychiatrists, social workers, and psychologists have reached the understanding that there is little point in treating the individual per se, if the family is sick. They have accepted the reality that the source of much mental illness in the individual stems from the interaction of the individual with the family. To a great extent, the family can be the source of mental illness manifested by the individual."

The following passage from an article titled, "Prejudice and Scapegoating in the Family," was read to the class:

> "In examining the relations of family and individual we have observed that the family inflicts emtional damage on the patient and the patient in his turn injures the family. Each defends against the other's urge to blame and punish. We have learned something of the means by which the family may harm the individual. Thus far, however, we have learned little of the other side of the question, the ways in which the patient may harm the family. Now and then we get the dramatic impact of a patient's destructive invasions upon the life of the family and even see the instances of a schizophrenic killing a parent. We have not yet systematically studied a family's defenses against the threat. And though we have discovered something of the family's destructive potential,we know much less of the family's role in promoting healing and recovery. Nor do we know much about what happens when a patient tries to make over a pair of parents to heal what ails their relationship so that he may recover a livable place in the family.

"Since people make one another sick they also make one another well again. We may then formulate a broad question. What is the balance of forces in the relations of family and individual as between a circular process of prejudicial scapegoating and a circular process of healing?"

The concepts of family therapy, identified by Dr. Ackerman were then linked with the dynamics of patient-staff interaction in the nursing home, particularly stressing the interdependence of all of the members comprising a given social system.

Core Concepts Undergirding a Social Systems Approach

1. Human behavior is purposeful; it is motivated. It is not random activity without meaning or purpose.

2. Regular patterns of human interaction are associated with certain basic values and goals held by the individual and by the group.

3. Shared values lead to expectations of how people are supposed to behave in organizations.

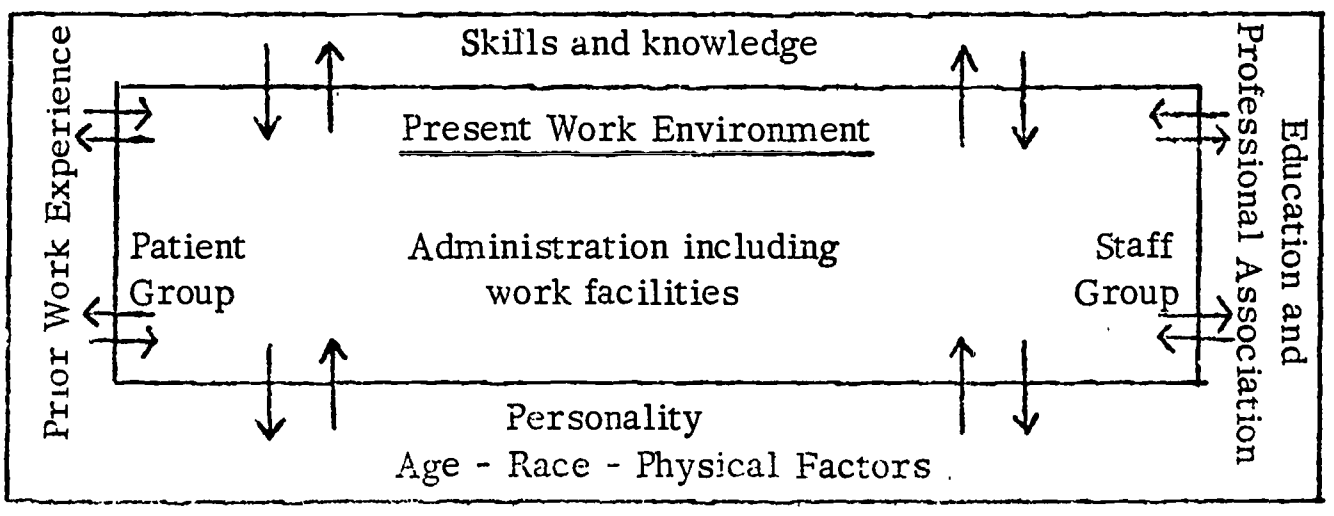
4. Specific values that govern behavior in a social system are called norms or standards of behavior. When these are violated, certain actions or sanctions are brought to bear on the individual to bring his behavior back to an acceptable range of variations.

5. Within a social system the various members play certain roles. How an individual actually performs in a given position, as distinct from how he is supposed to perform, is considered his role. In essence, role is the behavior of people occupying given positions in the organization. It is important to distinguish between role and position. To use the example of the registered nurse, her position may be officially designated as "Charge Nurse." The role she assumes, that is her actual behavior on the job, depends on a host of factors that frequently extend beyond the officially designated position.

Teaching Note

The life space chart was presented depicting the many elements and forces that determine the role behavior of a position incumbent.

Life Space Chart



In the case vignettes distributed to the class for discussion in the small group sessions, the following questions were presented for analysis: (See Exhibit I)

1. How does the position incumbent perceive her role?
2. How does the administrator perceive her role?
3. What skills and knowledge have contributed to the role perception of the individual worker?
4. What has been the effect of prior work experiences on role behavior?
5. What is the effect of age on role behavior?
6. What are the effects of professional associations on role behavior?
7. What has the presenting work situation contributed to shaping role demands for staff, patients, and administrator?

Exhibit I

Administrative Responsibility

Mr. C. W., aged 45, had purchased the Ocean View Nursing Home, a 75-bed facility that had been in operation for eight years. Mr. C. W. decided to serve as the administrator of the Home. Prior to his present position, Mr. C. W. had worked in the central office of a large drug firm, as one of their accountants. He has had limited experience in supervision and administration.

Mr. C. W. was known to be a very precise and hard worker. He was a man who was determined to meet all expectations held for him no matter how difficult or arduous the task. He had to show his merit.

After the first few weeks at the Ocean View Nursing Home, it became evident that he was a "lone" operations administrator. He kept a constant personal check on practically every phase of the nursing home's operation. His office soon became the central point for all decision making in the Home.

He found fault with the way the Nursing Department was handling supplies, including requisitioning. He demanded that he be kept completely posted on all changes in work routines.

He found fault with the way the kitchen services were run, and decided with a flare of great annoyance that the only way he could be sure that supplies were properly ordered was to do it himself. He then organized his own job so that he could personally check all the problems of the daily routine in the various departments.

Whenever a regulation that he had established was not followed, such as for example an aide not wearing a cap, he would bypass the nurse supervisor and directly criticize the aide on the floor.

One day after a particularly bitter argument with his chief nurse that led to her resignation, Mr. C. W. was visited by a friend of his who was a personnel director for a large firm. In discussing the personnel problems of the Home, the friend suggested that perhaps Mr. C.W. should ease up on his tight central controls on all phases of the Home's operations. At that Mr. C. W. became quite angry and demanded, "How can I be responsible for what goes on in the Home unless I know everything that is happening?" He also stated that he was not going to be just a figurehead to be pushed around by the staff. Mr. C. W. explained that only by personally being involved in all aspects of the Home's operations could he maintain the power necessary to meet the responsibility placed on him, and only by keeping a check personally could he be assured that the Home's work would be done.

Discussion Points

1. Discuss this director's concept of responsibility.
2. Suggest ways to delegate responsibility and yet maintain control.
3. Discuss the need of the director in relation to the manner in which he perceived his job.
4. Discuss the implications for the staff of this type of administration.
5. What solutions can be offered?

PRESENTATION II

Authority, Programmed Responsibility and the Integrative Role of the Administrator

1. The meaning of authority
   a. Legal definition of authority - defined in terms of legal rights and duties. Examples cited - the military, the police.
   b. Traditional concept of authority - based on the absolute or autocratic concept of authority invested in monarchies.
   c. Human relations - definition of authority.
      1). Based on the nature of the relationship or more specifically the transaction between two or more persons. Under certain circumstances, employees do obey commands and decisions of employers rather than the fact that a legal system or organization imposes upon them the duty to do so.
      2). Acceptance of authority in a human relations definition centers on the willingness of the individual to accept the proposal for action. The core concept emphasized is that until a proposal is accepted it is not authoritative. Authority implies acceptance of a decision by the person who is expected to implement the decision.

d. Limits of authority

1). Concept of Area of Acceptance.

Within a certain range of circumstances, an employee will obey orders and accept other proposals for action. Outside of this Area of Acceptance, the employee will forget to carry out or will carry it out in such a way as to actually sabotage it, will refuse to obey it, or will resign rather than carry it out.

2). Boundaries of Area of Acceptance.

A serious limitation to organizational authority is the difficulty of properly communicating proposals. The essential principle for accepting authority is that the person must be able to understand an order given to him. This principle is predicated on the clear delineation and communication of the order by the employee. Secondly, authoritative communications that conflict with the basic ideas and values of the worker as to organizational purpose will meet with employee resistance. Thirdly, proposals are often made which cannot be implemented because the employee lacks the mental, physical or technical capability to carry them out.

e. The use of authority

The chief function of authority is to permit flexibility in the assignment and division of work and the making of decisions. Specifically, the functions of authority are to make available the expertise needed for decision making, planning and programming, to ensure that responsibility for the job assigned has been fulfilled, and to coordinate the work efforts of the staff.

f. The concept of programmed responsibility

Programmed responsibility is described as the process of administrative activity concerned with securing positive control of the organization through direction, guidance, supervision, and regulation.

1). Methods for maintaining programmed responsibility.

a). Administrative policy guide: the formulated policy guides for the nursing home serve as a yardstick for measuring the performance of the staff member. The following can be determined: how well policies are being carried out; conformity or deviance from established policy.

b). Objective standards for personnel: objective standards for selection and retention of staff.

g. The integrative role of the administrator

1). Integrative leadership is defined as the ability to coordinate and integrate staff efforts for the purpose of

accomplishing objectives of the organization. Integrative leadership is the force that gives purpose and direction to the contributions of the nursing home staff. In this concept of integrative leadership the administrator functions as the leader of the professional team. This reponsibility cannot be abrogated.

2). Principles for implementing the integrative role of the administrator
   a). Thoroughly understanding the nature of individual contributions, including strengths and limitations, of the different professional disciplines - medicine, social work, nursing nutrition, physical and occupational therapy, etc.
   b). Seeks to achieve a balance in contribution from all of the disciplines and services involved in patient care.

Case Illustrations Submitted by Class and Utilized for Small Group Discussion and Role Playing

Problem 1

In October of 1963, I came to X Convalescent Hospital as administrator. I was immediately aware that the air was full of electricity and that the first time I stepped the wrong way we would have problems. One morning about six weeks later at the close of morning report the LPN on duty acted as spokesman for the group, saying they felt we needed more help. I went briefly over the work schedule with them pointing out reasons why the staffing pattern was as it was--apparently the reasons were not to their satisfaction and at 8:45 a.m. three aides walked off the floor.

Problem 2

One of the problems which I will describe is one we have had with one of our R. N. 's, who at one time was the head nurse. She has a habit we have tried to break of upsetting the family and the friends of the patients. She does not do it on purpose but she is a very outspoken person, repeatedly saying things before she thinks. This has resulted in the loss of some patients and some of the hired help. I feel that the families of the patients should be spared all the possible grief. The family should know the patient's condition. A little tact should be used in telling them about the condition to avoid upsetting them.

Problem 3

A major problem was experienced at our Nursing Home when an R. N. administrator was authorized to purchase all nursing and drug supplies. She had previously served as Head Nurse in a large department of a hospital. Whenever

drugs or nursing supplies were needed, she simply requisitioned the purchasing department for a 6 or 12-month supply of the needed item.

The problems were anticipating supply needs on a 4 to 6-week basis, and overcoming the inducement of the salesman to purchase a few more cases in order to save another one or two percent.

Problem 4

I think the main reason for many of our problems is the head cook who is not a born leader or boss. However, she can cook a very good meal. She is a very pleasant person to work with and gets along well with other people. I wonder if some problems with the other cooks are the result of jealousness and not liking to take orders from anyone else.

Problem 5

We have one lounge to serve all personnel. It would be adequate if they would each take a certain time and each department a different time. Instead, all come at the same time. The nursing personnel started waiting fifteen to twenty minutes later than the usual but then some of the other departments started coming later.

I set two one-half hour periods for our lunch time, one at 11:30 a. m. and one at 12:30 p. m., to pass lunch trays and feed the patients. The first period works out very well but the later one is the problem. The cleaning crew is supposed to go to lunch from 12:00 to 12:30. They wo uld still be out when we went to lunch so we waited until 12:40, but they would still be there. If we waited any later, the kitchen crew would come for their lunch period. We talked about it at staff meetings. The administrator and the assistant administrator would tell them to take their lunch time from 12:00 to 12:30 but they didn't follow through to see that it was done. The head of the cleaning department should see to it that her help follows these instructions; the administration should follow up to see that she carries out her instructions.

Problem 6

We have a nurse's aide who has been with us for several years and is doing a fine job. However, lately she has started drinking to the point that, at times, it affects her alertness on the job. Since such help is hard to find, we hesitate to dismiss her. We have pointed out the dangers of such actions, but she still has not given up this practice. The cause for her problem seems to be due to boredom, since she lives alone in a room provided by our institution.

Problem 7

Our kitchen aides are often finished with their specified responsibilities before their eight-hour schedule is over. Should we tell them to leave after seven or seven-and-a-half hours or ask them to do something else even though it is outside of their job description?

Problem 8

In our institution we are given a maximum wage scale by the board of directors. Is it proper to pay a higher wage to those who do more efficient work than others? The same problem is in regard to those who have been with the organization for several years. The friction comes when they compare their checks and notice a difference.

Problem 9

One of the biggest problems was an R. N. who was a drug addict. Our drugs were missing all the time. Even medications from the patients' trays were taken. This was a case of long standing and a very difficult situation. The habit was acquired through a long illness.

Problem 10

One of our aides exaggerates everything she says about everyone and everything. No one can believe her. The results are: resentment, misunderstanding, trouble, annoyance, and laughter. The habit was formed in childhood and was not corrected during that time. This situation is difficult to cope with. Your suggestions would be most appreciated.

PRESENTATION III

The third session in administrative process was in the nature of a review of the concepts introduced in the first two sessions. The elements in a social systems approach for analysis of organizational process were reviewed. Particular stress was placed on assessment of the three major variables, goals, values, and expectations that influence the behavior of patients, staff, and administrators. These variables were considered in the context of actual problematic situation, submitted by the class.

Situational Vignettes

The J Situation

The administrator had spent hours preparing menus and later discovered that the cook was refusing to accept his recommendations for food preparation. It also appeared that the kitchen crew was apprehensive and tended to side with the head cook in the conflict with the administrator.

> Teaching Notes: Using a social systems form of analysis, what is the nature of this conflict? Identify the nature of role conflict in terms of values and work expectations. What is the effect of the work group in the kitchen in reinforcing the head cook's resistance to the administrator?

The H Situation

One administrator felt that the most appropriate role model for the administrator was that of "benevolent dictator." He believed that the administrator must be dictatorial but at the same time must demonstrate to the staff that he likes elderly people and seeks to demonstrate through his behavior a concern and understanding for the residents of the home.

> Teaching Notes: Does one have to be authoritarian to be an effective administrator? By demonstrating a concern for patients what principle does he demonstrate in enhancing his position of authority?

The D Situation

The administrator had gone on vacation. When she returned, she discovered that the charge nurse had changed the routine for dispensing medications. Medication to facilitate sleeping had been discontinued and the result was an angry staff. The administrator punished the charge nurse by assigning a "string of patients" for bedside nursing care. This angered the charge nurse and she resigned.

> Teaching Notes: What are your observations regarding the strategy of the administrator in punishing the charge nurse for her seeming defiance of authority? Is there a basic conflict in organizational goals and values among the contending parties?

The L Situation

The administrator noted that by being on friendly terms rather than being "professional" he suffered loss of authority. He observed that the more he "favored" a subordinate in terms of money, days off, etc., the less he could trust the employee in times of emergency.

> Teaching Notes: What is the administrator attempting to accomplish by being on friendly terms? Is this the most effective way of securing compliance with authority? Why is this failing? Why the failure to achieve a cohesive work group? What other factors should be considered in securing acceptance of authority - leadership, work conditions, participation of staff in decision making, relating the work groups?

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ADMINISTRATIVE PROCESS SEQUENCE

Instructor: Gary D. Hansen, M. A.

PRESENTATION I

Education, Training and Staff Development

The primary responsibilities of administrators in long-term care institutions are to secure, develop and retain competent personnel who provide quality care and comprehensive services to the resident patients.

Care and services provided in "total institutions" are necessarily diversified and complex to sustain daily life, treat illness, disability and dependency, and to provide supportive services to a heterogeneous patient population and their families.

Administrative Personnel and Support of Your Directors and Investors

The administrator should be a catalyst, provide leadership, give support to the coordinator of training, and make resources available for training opportunities.

Since training programs require people, space, money and other resources, the board of directors and investors must be convinced that training is necessary and costs are reasonable withing the overall budget.

Training programs are continued when they demonstrate that the training results in personnel development and better or more efficient patient care.

Training opportunities need to be considered for all personnel; the top echelons of the administrative staff need training and time to think creatively about future patients, staff, services, facilities, and resources.

The administration, directors and investors need to recognize that some of the rewards of training and other personnel development programs will be realized in the future.

Goals and Strategy for Training

Training should be geared to the achievement of professional standards of job performance in direct patient care and supportive services which transcend legal requirements.

Training helps the staff and program keep up with changes in: the patients and their expectations; new specialty and resource personnel; equipment and techniques; family and social pressures and the competition.

Training programs should emphasize knowledge, skill and experience that is job centered and related to advancements in pay and position.

The best time for training is when the person is new on the job.

Personnel development opportunities can be provided through group education or training but each individual proceeds at his or her own pace.

Barriers to Participation in Nursing Home Training Programs

--lack of motivation and dislike for the work
--family and household responsibilities
--"locked in" positions
--inadequate financial incentives for advancement
--attitudes of "knowing all" and "experience is the only teacher"
--fear of poor performance in the group
--fear of exposing mental incompetence of other limitations

PRESENTATION II

Supervisors in the Training Program

The coordinator of training needs to be aware of how the goals and expectations of supervisors will affect the trainees.

Supervisors need special orientation to their role in training since they are in charge of the daily work activities of those being trained.

The supervisor's role in training involves:

- helping the nurses' aides and other staff recognize their need to improve
- providing regular evaluations of performance and guidance on improving knowledge and skill
- providing psychosocial support to help adjust to the new job, staff, and institution
- providing release time for special training, private study and in-service education
- making the training realistic, in line with work objectives, and close to the individual's capabilities
- working regularly on improving her (the supervisor's) ability to teach

The Administrator's Relationship to Department Heads and Supervisors

The administrator of a long-term care institution is responsible for the operation of several major departments and normally delegates the responsibility to department heads.

An administrator should plan to spend time regularly with each department head or supervisor.

A department head or major supervisor should be aware of what the administrator is doing and planning. The administrator has the responsibility to share the perspective that comes from his knowledge of the whole institution.

The administrator should delegate enough authority to allow the department heads and supervisors to fully carry out their responsibilities.

The administrator should establish high goals for the institution. Each department head should be informed about the general goals of the institution and help plan specific objectives for his department which complement the overall pattern.

The administrator should publicize the joint achievements of the group of department heads in order to develop more team work and a common identity.

The administrator should also give recognition to department heads and supervisors for their individual accomplishments.

The administrator should provide full support to department heads and supervisors. This involves avoiding situations where some subordinates get between the administrator and department head.

The administrator should help the department head develop individuality rather than encouraging uniformity or duplication.

The administrator should utilize potentials for learning in every situation with department heads and supervisors.

PRESENTATION III

Personnel Development

Management has allowed two conditions to prevail which severely undermine the capacity of individual members and the staff team to function at optimal levels: (1) job expectations have not been clearly and completely outlined; interrelationships between staff members have not been defined; and objective performance evaluations over time have been neglected or completely absent; and (2) we have failed to plan, organize, and carry out comprehensive and continuous personnel development programs.

What are the essential components of a personnel development program?

We must start with a thorough knowledge of where each staff member is when employed, which requires education, work experience, medical, and personality data.

Secondly, an inservice orientation program is fundamental to an understanding of all components of the new job, institution, staff, patients, facilities, equipment and rules.

Regular staff conferences are necessary for the purposes of: discussing problems, developing team approaches, reviewing philosophy and goals, honoring achievement and personalizing the work, providing supportive services, and utilizing various types of decisions and strategies.

The next step involves a series of educational and professional contacts and experiences with competent people from other health care institutions, colleges, and the community.

Discuss and outline an individual development program with each staff member which involves: (a) participation in the appropriate activities available; (b) reachable technical and professional goals; (c) incentives for service and development; (d) promotional opportunities and pay raises.

A counseling service should be organized and available as needed.

Psychiatric, psychological, social work, marriage and family counseling services can be made available on a consultant, part-time, or referral basis.

All of these activities in a personnel development program should flow from a new philosophy about staff care and development, which is directly and systematically related to the philosophy, values and specific goals of the institution.

The expected results of comprehensive and continuous personnel development programs are:

--better patient-resident care
--more loyalty and less conflict
--increased knowledge, new techniques, professional status and responsibility
--a stimulating and rewarding place to work
--reduced absenteeism and turnover
--better public relations
--higher morale, status, and enthusiasm
--motivated and resourceful staff members
--increased team work and interpersonal skills
--personnel whose basic needs are met
--life career attraction, orientation, and subsequent retaining power

The following outline was prepared to facilitate thinking and action in the area of personnel development. Each administrator in the course completed this evaluation and planning form. Administrators were encouraged to share their goals with their employers or directors and obtain commitments of resources to help achieve these goals. The administrators were also encouraged to select their key personnel, who had potential for development and planned to stay with the institution, and work with them on an individual, comprehensive development program using the outline provided.

HANDOUTS

INDIVIDUAL PERSONNEL DEVELOPMENT PROGRAM

Name	Position

Employer	Supervisor	Date

A. SPECIAL INTERESTS AND HOBBIES:

B. PERSONALITY:

1. Identify your attitudes and characteristics that help you in various aspects of your work and relationships.

2. Identify your attitudes and characteristics that hinder your work and relationships.

C. FORMAL EDUCATION

Name of School or College	No. of years completed	Certificates or degrees	Yr.

D. OTHER TRAINING: (Include on-the-job training)

Course	Duration	Recognition or Certificate	Yr.

E. HISTORY OF WORK EXPERIENCE:

Type of Job	Duration

F. RATING OF PRESENT PERFORMANCE ON CURRENT JOB DESCRIPTION

List all responsibilities and rate yourself A, B, C, or D on each one.

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

NOW RATE YOURSELF ON THE FOLLOWING CRITERIA*

(Examples of criteria for administrators of long-term residential and care facilities)

	A	B	C	D
A. Personal Qualities				
Physical and mental health				
Intelligence				
Character and integrity				
B. Social Competency				
Leadership ability				
Interpersonal skills				
Public confidence and trust				
Community relationships				
C. Knowledge				
Specialized training in administration				
Knowledge of technical standards				
Progressive philosophy of care				
Knowledge of gerontology				
Related services and activities				
D. Experience				
Career orientation				
Organization and co-ordination				

* A=Superior B=Good C=Fair D=Poor

G. FUTURE CAREER GOALS: (List all you can think of)

Now go back and group them and set priorities 1 - 5:

H. CAREER STRATEGY: (Outline in sequence the major steps for advancement in your career. Put your ultimate desired position or goal at the top and work down to your present situation.)

I. KNOWLEDGE YOU WOULD LIKE TO OR SHOULD OBTAIN: (Identify areas of content.)

APPROPRIATE METHODS TO OBTAIN KNOWLEDGE:

J. SKILLS YOU WANT TO OR SHOULD DEVELOP: (Be specific)

APPROPRIATE METHODS TO DEVELOP SKILLS:

K. EDUCATIONAL INSTITUTIONS OR PROGRAMS AVAILABLE to obtain knowledge and develop skills and list alternatives:

L. COMMITMENT OF RESOURCES: (financial, time, material, etc.)

Individual:

Employer:

M. PLAN OF ACTION:

1968 1969 1970

N. EVALUATION OF PROGRESS WITH SUPERVISOR

1968

March _____

June _____

September _____

December _____

1969

March _____

June _____

September _____

December _____

ERIC

EDUCATIONAL METHODS FOR PERSONNEL DEVELOPMENT PROGRAMS

Educational methods are a means toward ends, and there are many of them. None are sacred or mandatory; some are closely related and serve multiple functions. You are free to pick and choose the best ones to serve your objectives. An educational consultant would help you explore goals and select appropriate methods.

A. INDIVIDUAL EFFORTS

1. PERSONAL STUDY - All other methods are secondary. There is no substitute for concentrated, regular disciplined study and reflection.
2. RESEARCH AND DOCUMENTATION - Require thoroughness, methodical analysis, systematic outlines, and scholarly reporting.
3. DAILY REACTION LOG - Requires introspection, assessment of personal feelings, beliefs, and skills.
4. VISITS AND OBSERVATIONS - Broaden perspectives and encourage innovation.

B. GROUP ACTIVITIES

5. GROUP DISCUSSION - is important for sharing ideas, clarifying concepts and exchanging feelings, beliefs and practices.
6. LECTURE - works best to impart facts and details.
7. STAFF CONFERENCE - Contributes to the status and identification of the staff with the institution, encourages cooperation and promotes resourcefulness.
8. DEMONSTRATIONS - Bring all elements together in one situation avoiding the abstract.
9. PROFESSIONAL SEMINARS - Can be used to bring in experts and colleagues on any theoretical or applied subject.
10. CONFRONTATIONS - Encourage realistic responses to problem situations and controversial issues.
11. ROLE PLAYING - Is useful in the development of empathy, perception and appropriate psycho-social support and responses.
12. VERBAL REPORTING - Develops communication and public relation skills, explanatory abilities and self-confidence.
13. EXAMINATIONS - Should test the student, teacher, and program providing definite measures of progress and defining future work.

C. SUPERVISOR-TRAINEE METHODS

14. SUPERVISED PRACTICE - Is valuable in the teaching and refinement ment of specific tasks and skills.

15. EVALUATION INTERVIEWS - Are directional, focusing on past performance, current growth and progress expected in the future, including ways and means for achievement.

PERSONALITY FACTORS TO CONSIDER IN PERSONNEL SELECTION AND DEVELOPMENT

Characteristics Related to Degree of Risk*

Low Risk	High Risk
(These persons are usually successful in caring for the aging)	(These persons are usually unsuccessful in caring for the aging)
1. Relationship to Self	
Those who accept the aging process. Those who do not feel that they have lost out in life. Those who are generally satisfied with their position (status and role).	Those who do not accept the aging process. Those who are overly concerned about themselves, believing that they have lost out in life. Those who are generally dissatisfied with their position (status and role).
Those who do not conceal their own age and who are not overly concerned with their appearance.	Those who must conceal their age and who are overly concerned about their appearance.
Those who do not require of themselves perfection, complete understanding, and immediate results.	Those who require of themselves perfection, complete understanding, and immediate results.
Those who are patient.	Those who are very impatient, losing patience easily and early.
2. Relationship to Parents and/or Grandparents	
Those who are accepting of parents and/or grandparents, seeing them as reasonable and nonrestricting.	Those who are nonaccepting of parents and/or grandparents, seeing them as unreasonable and restricting.
Those who believe that parents and grandparents lived productive lives and did not unduly sacrifice themselves.	Those who believe that parents and grandparents lived unproductive lives and unduly sacrificed themselves.
Those who feel free and satisfied, although separated from parents and/or grandparents.	Those who feel harassed and guilty at being separated from parents and/or grandparents.

* From Hugh Mullan, M.D., "The Personality of Those Who Care for the Aging," Leeds and Shore, Geriatric Institutional Management, G. P. Putnams Sons, New York, 1964.

3. Relationship to the Cosmos

Those who view sickness and death as another experience in life, neither denying it nor ignoring it.	Those who have marked difficulty in experiencing sickness and the thought of death and who avoid it in all possible ways.
Those whose religious beliefs include a conviction that there is a hereafter and that life is but an aspect of the total experience.	Those who are without religious conviction and who tenaciously (neurotically) hold on to this world.

ADMINISTRATORS' CHECKLIST FOR PERSONNEL MANAGEMENT in NURSING AND RETIREMENT HOMES

A. PREPARED DOCUMENTS:

Have you prepared documents as follows:

Yes	No	
____	____	1. Clear and Comprehensive Personnel Policies
____	____	2. Precise and Complete Job Descriptions
____	____	3. Organization Chart Showing Relationships and Lines of Authority Between Personnel and Departments
____	____	4. Operational Expectations and Developmental Goals of the Institution
____	____	5. Personnel Development Program Which Relates Institutional Goals to Expectations for Individual Staff Development

B. ADMINISTRATIVE ACUITY:

Do you provide:

Yes	No	
____	____	1. Exemplary Leadership and Administrative Conduct
____	____	2. Support for Staff Decisions
____	____	3. Open Channels for and Free Flowing Reciprocal Communications
____	____	4. Regular and Spontaneous Social Rewards Including Recognition, Status and Fellowship
____	____	5. Comfortable, Adequate and Aesthetic Offices, Working and Social Areas for the Staff

Are you:

____	____	1. Sensitive to Common and Unique Psychological Needs of Each Person on the Team
____	____	2. Aware of Changes and Causes of Change in Morale, Enthusiasm and Work Satisfaction

C. CONTINUING PROCESSES:

Do you have these continuing processes in your home:

Yes	No	
____	____	1. Uniform Education and Fair Enforcement of all Policies
____	____	2. Definite Work Expectations, Methods to Evaluate Performance and Quality Control
____	____	3. Wage and Salary Reviews, Comparisons and Adjustments of Fringe Benefits
____	____	4. Development of Opportunities for Various Types of Advancement and Promotion
____	____	5. Sharing Ideas for Improvement and Demonstration of Superior Methods
____	____	6. Means to Identify and Resolve Conflicts and Operational Problems
____	____	7. Establishment of Patterns of Cooperation and Coordination
____	____	8. Personnel Development and Planning by Staff and Administrator

D. OTHERS KNOWN ON THE BASIS OF EXPERIENCE OF PREVIOUS TRAINING
(Write in)

Yes	No	
____	____	1.
____	____	2.
____	____	3.
____	____	4.
____	____	5.
____	____	6.
____	____	7.

PERSONNEL DEVELOPMENT BENEFITS YOUR CLIENTS: BETTER AND MORE COMPREHENSIVE PATIENT CARE AND SERVICE

A comprehensive and continuous personnel development program will better enable your staff to effectively meet the following needs of the patients in your home.

Needs of Chronically Ill, Disabled, and Geriatric Patients

1. Provision of the basic essentials of food, clothing, room accommodations, and central facilities for daily human sustenance, safety, comfort, privacy and security within the physical environment.

2. Balanced programs of daily and weekly activities which maintain social, physical, mental and spiritual well being and competencies at optimal, reasonable levels and which provide stability through regular, familiar activities and adventure in spontaneous experiences.

3. Stimulative and supportive social milieu of diversified intergenerational communication, interaction, sharing and helping. Consideration of the needs for companionship, love, status, prestige, recognition, position, influence and power. (Staff, patients, family, friends, clergy, etc.)

4. Psychological climate of acceptance, trust, empathy, nurturance, freedom and flexibility which fosters individuality, independence, identity, expressiveness, dignity, worth and pride.

5. Administrative management policies and practices which encourage and support individual initiative and family responsibility in decision making and problem solving on the basis of competency and reliability.

6. Periodic, professional interdisciplinary study and evaluation of physical, psychological and social conditions, changes, relationships and responses to treatment and care.

7. Comprehensive professional and technical care and service based upon high standards, current findings of research and experimentation, and confirmed clinical experience and practice.

8. Philosophic and ethical, or religious and spiritual, focus and orientation in the goals and activities of the staff of the care facility and patient participation in worship services and other religious experiences.

9. Identification with and participation in a small group of peers and a sense of brotherhood, family and community with other resident-patients, staff and significant others outside the home.

10. Knowledge of one's general condition and specific potentials, with access to therapeutic, restorative, and rehabilitative services and the hope and willingness to work on and cooperate in reasonable rehabilitation efforts.

11. Capacity to accept the unchangeable limitations imposed by chronic disease, disability and aging and awareness of and adaptation to changes.

12. The integration of personality and ego as achieved through: the continuity of self through family, profession and institutions; examination of conscience and the final life review; acceptance of the process of dying and death as a transitional stage with faith in an immortal life.

RATING ADMINISTRATORS OF NURSING HOMES

General Criteria and Brief Descriptions

A. PERSONAL QUALITIES

1. PHYSICAL AND MENTAL HEALTH:
Good physical and mental health which provides stamina, stability, patience and frustration tolerance.

2. INTELLIGENCE:
Above average intellectual ability as shown by academic transcripts, intelligence tests, and mental alertness.

3. CHARACTER AND INTEGRITY:
Personal ideals, values and ethics which contribute to reliability, trustworthiness, careful judgment, and predictability; and a sense of purpose which motivates and sustains individual productivity, thrift, and charity; civic mindedness, family background and present stability; and church affiliation.

B. SOCIAL COMPETENCY

4. LEADERSHIP ABILITY:
Dynamic and continuous leadership ability which provides the example for personnel and residents and,particularly, motivates personnel to their highest levels of dedication, loyalty, competency and service.

5. INTER-PERSONAL SKILLS:
Ability to be concerned about, empathize with, and accept the feelings and thoughts of various individuals objectively, thus maintaining the capacity to share, inform, guide and counsel.

6. PUBLIC CONFIDENCE AND TRUST:
Ability to meet with, develop and maintain the good will, cooperation, and support of many different types of individuals, families and organizations.

7. COMMUNITY RELATIONSHIPS:
Knowledge about and ability to maintain close working relationships, informational exchanges, and referrals with various public and private agencies, institutions, and organizations in the community, county, state and nation.

C. KNOWLEDGE

8. SPECIALIZED TRAINING:
Specialized training in all major aspects of institutional management and general business administration.

9. TECHNICAL STANDARDS:
General knowledge of standards and regulations which govern health care, safety, sanitation, and the physical plant, including usage of equipment. Awareness of services and training programs to meet total environmental needs.

10. PROGRESSIVE PHILOSOPHY OF CARE:
Positive philosophy and set of values about retirement living and resident care,including modern concepts of medical, nursing and rehabilitation potentials and procedures.

11. KNOWLEDGE OF GERONTOLOGY:
Knowledge and understanding of gerontology, retirement living and the processes of aging.

12. RELATED SERVICES AND ACTIVITIES:
Familiarity with the social, psychological, spiritual, recreational, and educational opportunities and problems of group housing and living arrangements.

D. EXPERIENCE

13. CAREER ORIENTATION:
Primary career interest and successful experience in institutional management or other business.

14. ORGANIZATION AND COORDINATION:
Organization and coordination of staff, materials, and all available resources to establish a home-like environment where people can live together in harmony, security, comfort and a well-balanced, meaningful life.

IV. RATING GUIDE FOR INDIVIDUALS

	RATINGS							
	Poor	Fair	Good	Excellent	Superior	MULTIPLY RATINGS BY	EQUALS	SUB GROUP TOTAL
A. PERSONAL QUALITIES:	Check the No.							
1. Physical and Mental Health	1	2	3	4	5	0		
2. Intelligence	1	2	3	4	5	0		
3. Character and Integrity	1	2	3	4	5	0		
SUBTOTAL A								
B. SOCIAL COMPETENCY:								
4. Leadership Ability	1	2	3	4	5	5		
5. Inter-Personal Skills	1	2	3	4	5	5		
6. Public Confidence and Trust	1	2	3	4	5	3		
7. Community Relationships	1	2	3	4	5	3		
SUBTOTAL B								
C. KNOWLEDGE:								
8. Specialized Training	1	2	3	4	5	6		
9. Technical Standards	1	2	3	4	5	2		
10. Progressive Philosophy of Care	1	2	3	4	5	4		
11. Knowledge of Gerontology	1	2	3	4	5	4		
12. Related Services and Activities	1	2	3	4	5	2		
SUBTOTAL C								
D. EXPERIENCE:								
13. Career Orientation	1	2	3	4	5	6		
14. Organization and Coordination	1	2	3	4	5	5		
SUBTOTAL D								
						GRAND TOTAL		

Prepared by Gary D. Hansen, Associate Professor of Sociology, Portland State College. Curriculum Consultant and instructor of course on Nursing Home Administration, January, 1968.

NURSING HOME ADMINISTRATION

In your responsibilities and activities at the nursing home, how do you rate yourself on the following: (Use a numerical scale from 5 to 1 with 5 as the highest, 3 as the middle or average, and 1 as the lowest rating.)

1.	Thinking about and planning for the future	5 4 3 2 1
2.	Effective completion of routine tasks and regular work	5 4 3 2 1
3.	Being aware of and accepting the skills and limitations of others	5 4 3 2 1
4.	Deciding on what is most and least important, first or last, and establishing priorities	5 4 3 2 1
5.	Obtaining, studying and applying facts and other objective information from professional, educational or scientific sources	5 4 3 2 1
6.	Getting jobs done through organized effort, by bringing people, resources and tasks together	5 4 3 2 1
7.	Changing plans, methods or resources when you or others find them unsatisfactory or unworkable	5 4 3 2 1
8.	Being alert and responsive to the interests, needs and problems of others	5 4 3 2 1
9.	Maintaining time schedules, sequences of work and other activities that are satisfactory to you and others	5 4 3 2 1
10.	Encouraging and stimulating creative thinking and productiveness in others	5 4 3 2 1
11.	Making appropriate and rewarding decisions	5 4 3 2 1
12.	Obtaining, evaluating and using ideas and suggestions of your spouse or friends	5 4 3 2 1
13.	Setting standards and guidelines for work and conditions of the nursing home, such as cleanliness, quality of food	5 4 3 2 1
14.	Assigning, authorizing and sharing the work	5 4 3 2 1
15.	Budgeting money, defined as the planned distribution and use of financial resources	5 4 3 2 1
16.	Providing leadership and guidance to the staff	5 4 3 2 1
17.	Flexibility to change or adapt to the unexpected or unusual (such as financial crisis, sickness or unanticipated help)	5 4 3 2 1
18.	Identifying alternative choices or approaches to decisions or problems	5 4 3 2 1
19.	Using special techniques or equipment to simplify work, reducing the time or energy it requires	5 4 3 2 1
20.	Establishing immediate objectives and long-range goals	5 4 3 2 1
21.	Evaluating how well tasks are accomplished	5 4 3 2 1
22.	Awareness of and providing recognition for the efforts and supportiveness of others	5 4 3 2 1
23.	Recognizing problems that exist, identifying the real issues and analyzing the different aspects of problems and issues	5 4 3 2 1
24.	Carrying special plans out, accomplishing non-routine tasks and activities	5 4 3 2 1
25.	Obtaining and making the best use of the knowledge and skills of others	5 4 3 2 1

OUTLINE TO ESTABLISH AND REVIEW TOTAL EMPLOYEE BENEFITS AND SERVICES

A. FINANCIAL

1. Wages or Salary: _____ current _____ In one year _____ 2 yrs. _____ 3 yrs. _____ ultimately or present schedule

Annual Employer Contributions to:

2. Social Security
3. Retirement Pension
4. Unemployment Insurance
5. Life Insurance
6. Health Insurance
7. Malpractice Insurance
8. Other

Expense Account Privileges:

9. Travel
10. Room
11. Meals
12. Other

Regular Performance Evaluations:

13. Merit Pay Raises
14. Cost of living pay increases

B. OTHER MATERIAL RESOURCES

15. Office space
16. Desk and furniture
17. Special equipment
18. Published resource materials (personal use)
19. Staff library
20. Furnished uniforms or other apparel
21. Dining privileges (value of meals per year)
22. Transportation provided
23. Lounge available
24. Private rest room facilities for staff
25. Locker

C. TIME AND RELATED BENEFITS

26. Paid vacation
27. Paid sick leave
28. Breaks allowed, net work time per shift
    Value of refreshments per year

29. Paid time allowed for professional meetings
30. Paid time allowed for education and training
31. Time allowed for voluntary community service activities
32. Shift to be worked
33. Weekend duty
34. Leave of absence

D. HUMAN AND OTHER RESOURCES

35. Volunteers
36. Paid assistants or aides
37. Health services at the institution
    - TB test
    - X-ray
    - Shots (allergies, etc.)
    - Medications through pharmacy
    - Other
38. Job description
39. Table of organization
40. Procedural guidelines
41. Philosophy and goals of the institution

E. EMPLOYEE DEVELOPMENT

42. Time allowed for professional meetings
43. Time allowed for education and training
44. Time allocated and value of supervision per year
45. Time allocated and value of in-service education
46. Special awards for merit, loyalty and long-term service
    - Certificate
    - Pin
    - Banquet
    - Ceremony
    - Publicity
47. Time allocated and value of staff development conferences
48. Time allowed for voluntary community service activities
49. Regular performance evaluations
50. Higher level positions for advancement
51. Employee information and referral program
52. Employee counseling or group therapy program
53. Employee council and committees
54. Access to supervisor and administration
55. Research or consultant evaluation to assess quality and quantity of services and total program
56. Planning and development program for patients, staff and the institution

CRITIQUE OF HANDOUTS ON PERSONNEL DEVELOPMENT

Please evaluate the handouts received during the sessions on personnel development in terms of their usefulness and value to you, your staff and/or your institution. Complete these evaluations only after you have carefully studied each handout.

	Excellent	Good	Fair	Poor
1. Personnel Development Benefits Your Clients: Better and More Comprehensive Patient Care and Service Comments: _____				
2. Rating Administrators of Nursing Homes General Criteria and Brief Descriptions Comments: _____				
3. Administrators' Checklist for Personnel Management in Nursing and Retirement Homes Comments: _____				
4. Individual Personnel Development Program Comments: _____				
5. Personality Factors to Consider in Personnel Selection and Development Comments: _____				

	Excellent	Good	Fair	Poor
6. Educational Methods for Personnel Development Programs Comments: _____				
7. Outline to Establish and Review Total Employee Benefits and Services Comments: _____				

Other general comments, reactions, criticism, etc.:

_____

_____

_____

_____

CHRONIC ILLNESS

Definition
Health Services for the Chronically Ill
Role of the Health Department
Kinds of Services
Chronic Disease or Conditions by System

WILLIAM L. WRIGHT, M.D.

Development of Condition
Types of Mental Disturbances Dealt With in Nursing Homes
Types of Nursing Homes
Therapy

WENDELL H. HUTCHENS, M.D.

Dentistry and Nursing Home Administration

JAMES BENNETT, D.M.D.

Care of the Terminal Patient

SISTER M. LOYOLA SCHWAB,
O.S.B., R.N., B.S.

ERIC

CHRONIC ILLNESS SEQUENCE

Instructor: William L. Wright, M. D.

I. Definition

Chronic illnesses include all impairments or deviations from normal which have one or more of the following characteristics:

A. Presumably permanent
B. Leave residual impairment
C. Caused by a non-reversible pathological alteration
D. Require special measures for rehabilitation
E. Usually require long period of supervision, observation or care

II. Health Services for the Chronically Ill

A. Official agencies (hospitals, clinics, health departments, etc.)
B. Voluntary health groups (Heart Association, Cancer Society, etc.)
C. Professional organizations (American Medical Association, American Dental Association, and others)
D. Private practitioners (doctors, nurses, druggists, dentists, therapists, etc.)
E. Special interest groups (American Gerontological Society, Home Health Agencies, Nursing Home Association, etc.)
F. Civic clubs
G. General public

III. Role of the Health Department

A. Health officer
B. Public Health Nurse
C. Medical social worker
D. Therapists (P. T., O. T., Speech Therapists, etc.)
E. Health educator
F. Nutritionist

IV. Kinds of Services

A. Preventive.
   1. primary prevention (good nutrition, physical fitness, adequate housing, sufficient rest, recreation, protection against hazards, etc.)
   2. secondary prevention (case finding surveys, multiphasic screening, selective examinations, early diagnosis, etc.)
   3. tertiary prevention (adequate treatment to arrest the condition, prevent complications and sequelae, limit disabilities, prevent death and rehabilitate patient)

B. Identification of problems
   1. statistical studies
   2. data collection and analysis (age, sex, geographical distribution, disabilities, costs and so forth)

C. Education of:
   1. professionals
   2. para medical and other staff
   3. patients and families
   4. special groups (legislators, appropriating bodies, governing boards, opinion molders, news media and others)
   5. general public

D. Treatment
   1. out-patient (ambulatory)
   2. hospitalization
   3. specialized clinics
   4. nursing homes
   5. home health services (bedside nursing, home health aides, homemakers, loan closets, friendly visitors, physical, speech and occupational therapists, etc.)

E. Rehabilitation
   1. individualized plan and goals
   2. group therapy
   3. hospital, clinic or home facilities
   4. devices, appliances and modifications of standard equipment
   5. psychological aspects and motivations - family role
   6. staffs
   7. costs

F. Research
   1. causation and natural history
   2. epidemiology
   3. treatment and delivery of service
   4. evaluation

V. Chronic Disease or Conditions by System

A. General considerations
   1. Chronic disease may occur at any age but prevalence increases with age.
   2. While basic pathology may remain same or get worse the symptoms or handicap may show acute exacerbations.
   3. Chronic disease usually is multiple--that is, there are often two or more such conditions present in the same person--while major effect may be in one body system usually other systems are involved to some extent.
   4. Many chronic diseases are usually not thought of as such example: obesity, smoking, dental caries, deafness, alcoholism and others.

B. Sensory system
   1. vision
      a. Infectious diseases and injuries are now second to chronic disease conditions as a cause of blindness
      b. "Legal blindness" is vision of 20/200 or poorer in the better eye (with correction).
      c. 400,000 "legally blind" in U. S. A. now and probably 30,000 new each year .
      d. Many not "legally blind" still have visual handicaps .
      e. Principal chronic disease visual conditions
         1). refractive error - inability of eye (lens) to focus image on the retina; hyperopia, myopia, presbyopia, astigmatism
         2). cataract - opacity of lens due to degenerative changes of protein content due to advancing age, frequent after age 60, accounts for 20% of "legal blindness," is not preventable at present, treated by surgical removal of lens and glasses
         3). corneal opacity - sometimes transitory but usually permanent, caused by injury or chemicals or infections; if located in center of cornea then there is impairment of vision, accounts for 10% of "legal blindness " only treatment is surgical removal of the scar tissue and corneal transplant
         4). glaucoma - increased pressure of fluid inside the eyeball due to blocked drainage, may be acute or chronic, sudden onset with pain or insidious with no pain, pressure causes irreversible destruction of the retina (starting at outer edge), vision becomes "tunneled" (loss of side vision), about equal in both sexes , onset usually after 30 but more common as age increases, 2% of persons over age 40 have some increased pressure, accounts for 15% of "legal blindness," chronic glaucoma is irreversible but can be treated (further retinal damage prevented) by drops and/or surgery
   2. hearing loss
      a. about 4% of adults have a hearing loss and about 2% of this group have no functional hearing
      b. hearing loss may be due to:
         1). nerve impairment due to infections, tumors, loud traumatic noise or brain damage, usually incurable, loss may not be total or necessarily bilateral,

more males affected than females and hearing aids may help, lip reading will sometimes suitably aid person with social activities

2). conduction loss is usually due to chronic middle ear infection with destruction or injury to ear drum and/or bones of middle ear, treatment of the infection and surgical repair of ear drum may restore hearing and hearing aids can help

3. speech impairment (dysphasia)
   a. in older persons is most often due to: Parkinson's Disease, Multiple Sclerosis, Huntington's Chorea, toxic states, surgery of neck and throat, brain tumors, head (brain) injuries and stroke
   b. most frequent causes are: stroke and head injury
   c. improvement in speech after stroke and head injury may be slow; patient needs motivation; family and care staff need patience, knowledge of do's and don'ts understanding of patient's physical and psychological problems; patient should be evaluated by speech therapist and those who work with the patient should be guided and supervised by the therapist
   d. impairment of speech may be due to:
      1). poor muscle control of throat, tongue and lips
      2). impaired audio interpretation of heard sounds or speech
      3). faulty memory of previously learned words
      4). impaired reading ability or interpretation of what is seen
   e. speech practice should have practical application to daily living, patient not to be treated or spoken to as if he were a child, voice should not be raised but enunciations must be good and while his speech may be impaired, his hearing and understanding may well be normal (so be careful of your comments in his presence)

C. Bronchopulmonary system
   1. asthma
      a. usually a chronic condition with acute episodes in which there is wheezing (more pronounced on expiration), shortness of breath and cough with thick mucoid sputum; attacks last from 1/2 to several hours.
      b. may be due to allergy, chronic sinus or bronchial infections
      c. attack may be precipitated by emotional stress, infections or endocrine upsets

d. affects about 2% to 3% of people with about 10% of those affected being physically limited in their activities, no apparent race or sex difference in incidence.
e. treatment in acute attacks is usually with the use of broncho-dialators (epinephrine, ephedrine or aminophyllin) given as an injection or inhaled from a nebulizer, sedatives are sometimes useful as are iodides to loosen the tenacious mucous in the throat
f. asthma tends to be chronic in older persons with attacks becoming more frequent, asthma seldom causes death but can be serious in the elderly, the obese and those with heart disease

2. chronic bronchitis
   a. a chronic, progressive, infectious disease of the bronchial tree, usually with an insidious onset
   b. cough with production of excessive amounts of sputum is the most usual symptom, attacks occur daily for periods of as long as three months
   c. gradually other symptoms develop - such as wheezing or progressive shortness of breath on exertion
   d. obstruction to the bronchial air flow and chronic infection may lead to pulmonary emphysema, the patient may develop broncho-pneumonia or right-sided heart failure
   e. about 15% to 20% of persons in U. S. A. over age 40 have some chronic bronchitis and the incidence is higher for men than women and for city dwellers than rural persons, it appears to be very common among heavy smokers
   f. treatment is usually with broncho-dialators and iodide expectorants. Avoidance of smoking, air pollution, dust and fumes will help hold down acute attacks.
   g. disease does not progress rapidly but without proper treatment the prognosis is poor and periods of disability become prolonged
3. pulmonary emphysema
   a. a chronic non-reversible progressive disease in which the air sacs are distended and/or destroyed and there is a trapping of air in the lungs with a resultant impairment of ventilation, circulation and oxygenation of the blood
   b. the chief symptom is an initial shortness of breath on exertion. Later this is severe enough to interfere with the patient's work. Cough, expectoration, dyspnea, blueness of lips and ears and progressive heart failure follow later. Disability becomes more apparent and death is usually slow in coming.

c. most emphysema patients are heavy smokers and must give up the habit to get any relief
d. treatment is often anti-microbial drugs to control the infection-usually present, broncho-dialators and iodide expectorants
e. rehabilitation can help arrest or slow down the disease and perhaps add 3 to 8 years more to the patient's life as well as decrease his physical disability

D. Cardiovascular system
1. atherosclerosis and arteriosclerotic heart disease
a. atherosclerosis is the process of focal deposits of various substances on the lining of the heart and larger arteries forming plaques which may become so numerous or thick as to restrict the vessel lumen and thereby reduce the blood flow. This may occur in any part of the body or be fairly generalized and may predispose to thrombosis with complete occlusion of the vessel.
b. symptoms vary with the organ or part involved:
1). legs - cramps, lowered skin temperature, sensory disturbances, ulceration and/or gangrene
2). brain - stroke and/or cerebral deterioration
3). coronary arteries - coronary insufficiency, angina pectoris, myocardial infarction, thrombosis or embolism (all of these exhibit pain in chest which varies from intermittent in angina to constant pain in myocardial infarction)
c. a clear picture of the cause of this condition has not yet evolved but the risk appears to be related somewhat to obesity, high blood pressure, hypothyroidism, elevated serum cholesterol, lack of exercise, chronic cigarette smoking and chronic psychological stress
d. disease is very common in U. S. A. and onset of plaque formation is at early age (20 years) though the clinical symptoms may not be apparent until middle age and later. Prevalence is somewhat higher in whites than Negroes and higher in men than women. In 1960 arteriosclerotic heart disease accounted for 30% of all deaths.
e. prevention - not possible to prevent until we know the exact cause or causes but we can reduce the "risk" factors such as obesity, lack of exercise, cigarette smoking and others
f. detection is usually not possible until there are changes in the electrocardiogram although symptoms, family history, obesity and so forth may indicate one is in the "high risk" group

g. treatment of atherosclerosis (plaque formation) is not established. Angina responds readily to rest, nitroglycerine, vasodilators and in some special instances to tranquillizers. Treatment of the acute myocardial infarction commonly includes rest, narcotics for relief of pain, anticoagulants, oxygen and sedatives. Special "care" units in hospitals with special equipment and well-trained staff (nurses and others) have reduced the mortality greatly. Stroke, if it occurs, is treated much like myocardial infarction but differs greatly in the resultant rehabilitation.

2. hypertension and hypertensive heart disease
   a. hypertension is a condition in which the arterial blood pressure is chronically elevated, usually arbitrarily set at 160/90 or higher. Hypertensive heart disease is the enlargement of the heart due to the strain of working against the elevated blood pressure.
   b. the cause of hypertension is usually not known (in about 90% of cases) but in the other 10% may be due to kidney disease, toxemia of pregnancy, hypersecretion of the adrenal glands, hyperthyroidism and others
   c. both hypertension and hypertensive heart disease may develop rapidly (malignant hypertension) but usually they develop slowly over a period of months or years
   d. the rate of these two conditions is about twice as high in non-whites as in whites. They are major causes of death in the U. S., causing about 5% of all deaths. It is estimated that 15% of the adult population of this country have one or both conditions.
   e. prevention is not yet possible since the cause of 90% of the hypertension is not known
   f. treatment is usually with some of the newer antihypertensive drugs, salt-free diet, sedatives and, in selective cases, surgery (sympathectomy)
3. stroke
   a. stroke is a process resulting in varying degrees of brain damage by either ischemia (insufficient blood supply due to restriction of blood vessels) or pressure from thrombosis, hemorrhage and/or embolism. The damage is usually focal - that is, the damage is usually located in one small area and leads to a complexity of impairments
   b. the evidence of stroke is variable and may include transient vertigo (dizziness), visual disturbances, confusion, temporary weakness, partial paralysis of one side of body, impairment of speech or word recognition, sensory losses, or sudden death

c. transient ischemic attacks, "little strokes" and "progressive strokes" may occur in which the symptoms are not severe enough to bring the individual to a physician for treatment
d. the causes of stroke are:
    1). hemorrhage from ruptured artery in brain, usually due to hypertension and arteriosclerosis
    2). congenital aneurysms when they rupture may also cause brain hemorrhage
    3). reduced blood flow due to restricted lumen of arteries may lead to clot formation
    4). cerebral embolism due to a blood clot from somewhere else in the body
    5). air or fat embolism in brain artery as the result of an injury to lungs or long bones
e. the destroyed brain tissue resulting from the reduced blood supply cannot be replaced but sometimes the ischemia can be overcome and the brain tissue returned to normal
f. stroke is the third leading cause of death in the U. S., accounting for 12% of all deaths. Stroke is about twice as frequent in non-whites as in whites and a little higher among males than females.
g. prevention by:
    1). control of other chronic diseases such as hypertension, obesity, diabetes and rheumatic heart disease
    2). surgical intervention for aneurysm or restricted arteries
h. treatment during the acute phase is usually:
    1). supportive
    2). attention to complications of immobility
    3). sedation (but not narcotics)
    4). anticoagulant drugs (with careful laboratory control)
    5). thrombolytic drugs are being studies
    6). surgery is mostly in the research stage - for removal of atherosclerotic plaques, thrombi, and aneurysms
i. rehabilitation
    1). should be started early and pushed vigorously
    2). rehabilitation should be carried on over a long period of time
    3). delay in initiation of rehabilitation may result in:
        a). muscle contractures and general immobility
        b). infections

c). kidney stones
d). decubitus ulcers (bed sores)
e). invalidism, dependency, depression and loss of motivation

4). family and friends must be included
5). 85% of stroke patients who survive their first attack can achieve recovery all the way from self-care to near-normal activity

j. prognosis
1). about 80% of patients whose stroke is due to thrombosis survive the initial attack and about half this number will survive for four or more years
2). stroke due to hemorrhage is more deadly and the chance of survival goes down as the patient's age at the time of the attack goes up (survival is inversely related to patient's age)
3). 75% of those who survive and receive early care and rehabilitation can be discharged from the hospital to their home, the remainder need nursing home or chronic disease hospital care
4). about 25% of stroke patients eventually reach a point at which they are employable but due to their age, only about 5% actually return to work

E. Cancer
1. general considerations
a. cancer is a term used for the malignant, uncontrolled proliferation of body cells, can occur at any age and in any body tissue. The word malignant indicates "harm" or "danger" as contrasted with the term benign. Cancers, unlike tumors (benign growths) may metastasize or spread to other parts of the body.
b. cancer is second only to heart disease as a cause of death and deaths from cancer are about twice as common among females as among males
c. the cause of most cancers is unknown but we do know that some substances to which persons are exposed for a long period can cause cancer (sunlight causes skin cancer in farmers, chromate dust causes lung cancer in some industrial paint manufacturers, chimney soot used to cause cancer of the scrotum in chimneysweeps in England, etc.)
d. there is as yet no overall screening test that will detect cancer (no blood test, skin test, or other)

e. in general cancers on the surfaces or orifaces of the body are more easily seen, diagnosed and treated than those within the body (skin, lip and mouth as contrasted with lung, ovary, breast or colon)

f. treatment is usually one or more of these:

1). surgical removal

2). X-ray and/or radium treatment

3). specific drugs for specific types (only a few cancers are so treatable at present)

2. nursing home considerations

a. post surgical recovery - for the most part these patients need a great deal of nursing care but very little medical care so hospitalization is not required. Some rehabilitation may be undertaken while patient is in nursing home. Patient usually needs a good deal of psychological support from the staff.

b. terminal cases - those for whom nothing more can be done medically or surgically but who do need more nursing care than they can get at their own home. They do not require costly hospitalization. Again, these people need continuing psychological support (whether they are aware of their impending death or not).

CHRONIC ILLNESS SEQUENCE

Instructor: Wendell H. Hutchens, M. D.

MENTAL DISTURBANCES

I. Development of Condition
   A. Placement in home because of mental or behavior disturbance
      1. Therapeutic measure
      2. Relief of family
   B. Development of mental abnormality while resident in hospital
   C. Importance of viewing patients as individuals in which mental disturbance is usually only a small part of personality to be dealt with

II. Types of Mental Disturbances Dealt With in Nursing Homes
   A. Organic brain syndrome
      1. Arteriosclerosis and degenerative diseases, including alcoholism
      2. Character of memory defects
      3. Importance of maintaining motivation
      4. Companionship
      5. Supportive nutritional care
   B. Post-Cerebrovascular accidents
      1. Paralysis
      2. Special sensory defects such as aphasia, blindness, vestibular imbalance
   C. Depressions
      1. Part of pre-existing personality pattern
      2. Cyclic type
      3. Situational
         a. home environment
         b. nursing home environment
      4. Place of electro-convulsive therapy
   D. Paranoid personality patterns
      1. As pre-existing personality
      2. As part of depression
      3. Situational
      4. How to deal with paranoid individuals
   E. Chronic Schizophrenia
      1. Nursing home as therapeutic procedure
      2. Milieu therapy, discussion
      3. Custodial as primary purpose
   F. Condition secondary to other medical problems

III. Types of Nursing Homes
- A. "Senior citizen" homes
- B. Average convalescent
- C. More geriatric
- D. Specializer
  1. Psychiatric
  2. Arthritic

IV. Therapy
- A. Special nursing procedures
  1. Records and relaying information
  2. Working with doctors
  3. Attitude and personality of nurse
- B. Drugs and medication
  1. Sedative, type--use and abuse
  2. Motivators
  3. Nutritional support
  4. Specific medication
- C. Psychotherapy, attitude and group organization
- D. Dealing with relatives

V. Summary and General Philosophy

CHRONIC ILLNESS SEQUENCE

Instructor: James Bennett, D. M. D.

DENTISTRY AND NURSING HOME ADMINISTRATION

Objectives

1. To develop a generalized concept of modern dentistry
2. To develop a generalized concept of dental disease
3. To review the major dental problems of aging persons
4. To develop concepts of the emerging role of geriatric dentistry

I. The Dental Profession in the Community
   - A. The general nature of dentistry
     1. Training and background of the dentist
     2. Legal basis of the dental profession
     3. Governing bodies of the dental profession
     4. Current trends of change in the dental profession
   - B. Professional relations in dentistry
     1. Relationship to the medical profession
     2. Relationship to hospitals and other clinics; relationship to other paramedical and paradental services
   - C. Dental community relations
     1. Community service organizations
     2. Comprehensive health planning groups

II. Dental Disease and Chronic Illness
   - A. The healthy dental patient
     1. Chronic dental disease in the healthy individual
     2. Prognostication and the aging process
   - B. The sick dental patient
     1. Definition of the sick dental patient
     2. Management of the sick dental patient
     3. Prognostication and the aging process
   - C. The institutionalized dental patient
     1. Home-bound patient
     2. Hospitalized patient
     3. Patient in the convalescent and nursing home situation

III. Major Dental Problems of Aging Persons and Modalities of Management
   - A. Dental problems detected in local nursing homes
     1. Oral hygiene problems
     2. Periodontal disease
     3. Dental caries
     4. Prosthetics problems
     5. Emergency situations in the oral cavity

B. Concepts of preventive dentistry
   1. Preventive dentistry at the community level
   2. Preventive dentistry in the private dental office
   3. Preventive dentistry in the home
C. Concepts of restorative dentistry
   1. Operative dentistry
   2. Crown and bridge dentistry
   3. Endodontics
   4. Other related fields
D. Prosthetics - denture problems
E. Soft tissue problems
   1. Abuse of the oral cavity by environmental factors
   2. Oral cancer
   3. Non-malignant soft tissue problems needing attention
   4. Tissue changes with aging

IV. Geriatric Dentistry: An Emerging Concept
A. Should geriatric dentistry become a new dental specialty?
   1. The pros and cons of dental specialties
   2. Emerging fields of community dentistry, social dentistry, and ecological dentistry
B. Biologic realities in geriatric dentistry
   1. Limitations derived from concomitant health problems
   2. Prognostication and treatment planning
C. Psychosocial realities in geriatric dentistry
   1. Attitudes of population groups towards the dental profession and dental care
   2. The influence of government upon the dental profession
   3. The influence of community groups upon the dental profession

--Demonstration of aids and adjuncts for maintenance of oral hygiene.

CHRONIC ILLNESS SEQUENCE

Instructor: Sister M. Loyola Schwab, O. S. B., R. N., B. S.

CARE OF THE TERMINAL PATIENT

Objectives

1. To present a positive approach to the care of the dying based on a philosophy of the innate dignity of the individual human person
2. To teach standards and methods of providing quality care to dying patients
3. To point out attitudes and conflicts of staff and families of dying geriatric patients
4. To relate some of the psychological and physical needs of the dying patient

I. Introduction to the subject of dying
   - A. Distinction between the subject of "death" as philosophical
   - B. Religious issue and "dying" as a nursing and medical problem of support and care with psycho-social implications
   - C. Death and dying identified as "taboo" topic in our society--therefore rarely discussed or investigated objectively by professional therapists, who function largely intuitively
   - D. Problem of who is defined as dying and who does the defining

II. Philosophy of approach to the dying - rights and dignity of person as PERSON

III. Attitudes
   - A. Of the patient
     1. fear of the unknown
     2. fear of loneliness, loss of family and friends
     3. fear of loss of body
     4. fear of loss of self-control and regression
     5. feeling of being cut off from others when no one is willing to talk to him about his dying
   - B. Of the staff
     1. involvement vs. detachment (emotionalism vs. professionalism)
     2. rejection (backward concept)
     3. feelings of failure
   - C. Of the families
     1. grieving as a process --importance of staff recognizing stages and complexities of grieving reactions when family finishes grieving before patient dies
     2. conflicts concerning prolongation of life

IV. Ways to help dying patient *
   A. Share responsibility for facing problem that can be solved
   B. Continue human contact
   C. Assist in any way appropriate in the grieving process of the patient
   D. Assume responsibility for functions which person can no longer perform while maintaining his self-respect
   E. Assist with gradual regression

V. Consideration of ethical issues surrounding prolongation of life by artificial means

* Ways to help patient taken from lecture by Mansil Pattison, M. D., University of Washington, Seattle, Washington

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MEDICAL CARE ADMINISTRATION

Professional Relationships between Nursing Home Administrators and the Physicians
The Administrator, Physician and Medicare

MORTON J. GOODMAN, M.D.

Medical Care Standards
Physician Relationships with the Nursing Homes

ALLEN L. MUNDAL, M.D.

An Historical-Sociological Overview of Nursing Services Administration
Administrative Devices
Group Conference

HELEN DONOVAN, R.N., M.A.

Overview
The Patient Record
Indexes and Statistics
The Utilization Plan

VIRGINIA PETTENGIL, R.N., R.R.L.

ERIC

MEDICAL CARE ADMINISTRATION SEQUENCE

Instructor: Morton J. Goodman, M. D.

Professional Relationships between Nursing Home Administrators and the Physicians

Nursing Home Administrator should be aware of the basic principles of Medical Ethics--especially as they affect doctor-patient-nurse relationships.

Need for close communication between physician, nursing personnel, and administrator. This involves more than simply the area of medical care. Personal and psychological support, rehabilitation efforts, family problems are all involved.

Personal courtesies and amenities involved in physicians' visits to Nursing Homes. Methods of saving doctors' time, attending to his convenience, etc.

Need for clearest understanding of doctors' orders, written and verbal. Prompt reporting to physician regarding changes in patients' condition, complications, etc. When to phone the doctor.

The Administrator, Physician and Medicare

Need for strict attention to Medicare regulations on part of all members of health team. Importance of Utilization Committee, properly structured, fully operative, to determine the patients' stays on ECF status no longer than medically necessary.

Importance of careful records.

Growing criticism of abuses on part of some Nursing Home operators, (and of some physicans). Importance of clear definition of ECF status of patients as compared with Nursing Home or domiciliary categories.

Likelihood of more strict government controls of rates, standards, etc.

Problems involved in transferring of patients and his records to extended care facilities and back to the hospital.

Probable changes in Medicare law and regulations.

MEDICAL CARE ADMINISTRATION SEQUENCE

Instructor: Allen L. Mundal, M. D.

I. Medical Care Standards: Who sets them? How are they established?
   A. Owner--builder--location
   B. Board of Directors
   C. Administrator
   D. State Board of Health
   E. Medicare Planners
   F. Patients
   G. Doctors
   H. Nurses and aides

II. Physician Relationships with the Nursing Home
   A. Location of the nursing home
   B. Location of the doctor, hospital, office and home
   C. Location of other extended care facility where he has patients

To discuss the relationship of the nursing home or Extended Care Facility and physicians, comments were made on the framework of the booklet, "Standards for Accreditation of Extended Care Facilities, Nursing Care Facilities and Resident Care Facilities,"--Chapter 2, Professional Services.

This discussion attempts to bring out the practical ways of meeting the requirements in a satisfactory manner even though requirements are seemingly out of focus with practices in vogue today.

MEDICAL CARE ADMINISTRATION SEQUENCE

Instructor: Helen Donovan, R. N., M. A.

NURSING SERVICE ADMINISTRATION

Objectives

1. To become more familiar with the administrative process, especially as it relates to the nursing service.
2. To develop a more concrete and comprehensive view of nursing.
3. To appreciate the interpenetration of the human relation and communication factors in both administration and nursing.
4. To increase understanding of and skill in the conference technique as it relates to administration and nursing.

PRESENTATION I

An Historical-Sociological Overview of Nursing Service Administration

- Newness of nursing service administration
- Newness of hospital administration
- Changes in nursing education
- Impact of other disciplines
  - sociology
  - psychology
  - industrial relations
  - medical sciences
- Impact of a changing society
  - increased knowledge and ability
  - increased affluence
  - third party influences
  - cultural changes
- Administration
- Definition - "the marshaling of resources to accomplish a purpose." (Finer)
- Management by objective vs. by crisis
- Goal selection - long-and/or short-range
- The process
  - attuning
  - planning
  - organizing
  - staffing
  - directing
  - coordinating
  - reporting
  - budgeting

Evaluation - methods to be selected in the planning stage
Principles - unity of command; span of supervision
Problem Solving - development of a group selected problem
See: "Enrollee Perceived Examples of Good and Bad Nursing Behavior in Use of Initiative and/or Judgment."
Nursing Care
What it is: provision for and giving of continuous coordinated care for the physical, mental, emotional, spiritual and social needs of patients.
What it is becoming: selected facets of patient care in transition within the health team.
What it is not: those duties lying clearly within another work category.
Conservation of Professional Time

PRESENTATION II

Administrative Devices

Assignments
Nursing Care Plans
Nursing Care Conferences
Reports - oral; written
Rounds
Procedure Manuals
Policy Manuals
Staff Organization
Nursing Audit
Evaluation Guides

PRESENTATION III

Group Conference (using)

Case Study - "Mrs. Johnson"
Incident List drawing on:
each enrollee's experience and background
material presented in previous sessions
data provided in case and incidents

Methods to be Used:

Lecture
Discussion
Written Assignments
Group conference--case study and incident techniques
Reading materials--available for interim use by students

READING LIST

Books and Pamphlets

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Books

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Federal Aviation Agency, Management for Supervisors, 1961

Isler, C., The Nurses' Aide in the Hospital, Springer Co., N. Y., 1968.

Leadership Resources, Inc., Monographs
- Learning Climate
- Ethics
- Leadership Dilemma
- Authority and Hierarchy
- Group Effectiveness
- Self-Development
- Process of Change
- Decision-Making
- Communication
- Individual Motivation
- Creativity
- Consultative Process
- Staff-Line Relations
- Appraisal of Personnel

Communicating Within the Organization
Delegating and Sharing Work
Planning for Achieving Goals
Understanding the Management Function

National Advisory Commission on Health Manpower, Report, 1967.

National League for Nursing, Self-Evaluation Guide for Nursing Services in Hospitals and Related Institutions, 1967.

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JOB DESCRIPTION

Director of Nursing - Extended Care Facility

Requirements: Registered Nurse
Preferably with additional preparation in clinical nursing and/or administration.
Interested in her own professional growth
Interested in staff development
Membership in American Nurses Association, National League for Nursing and American Nursing Home Association

Accountable directly to the administrator of the facility - for the conduct of the nursing service.

Responsibilities: Direct

1. Makes final selection on all nursing personnel
2. Plans, directs and supervises all nursing care
3. Delegates appropriate authority to supervisors, lead nurses and charge nurses.
4. Schedules nursing staff for optimal coverage with adequate advance notice
5. Engages in a continuing exploration with staff of comprehensive nursing care - physical, mental, emotional, spiritual and social, especially as it relates to the care of patients with long-term illness
6. Provides a comprehensive recording system - charts, assignment, time and work sheets, nursing care plans, narcotic sheets etc.
7. Provides staff with both procedures and policy manuals.
8. Assumes responsibility for drugs - stock, prescriptions, emergency and narcotics. (where a commercial pharmacy is used.)
9. Assumes responsibility - for inventory and maintenance of material and equipment employed in nursing service
10. Maintains regular contact with individual doctors and medical staff.
11. Arranges for orientation and training of nursing personnel
12. Arranges for staff development programs
13. Arranges for staff organization - regular meetings of staff by level and/or shift, standing committees e.g. procedure policy, nursing audit etc.
14. Provides regular systematic evaluation of nursing care
15. Provides for annual nursing personnel evaluations
16. Arranges for flu vaccine clinics, mobile chest x-ray program etc. for patients and staff

17. Assumes limited and delegated responsibility for special services to patients e.g. physiotherapy (between appointments)
18. Submits an annual written report to the administrator

Responsibilities: Participatory

1. Assists in recruitment of nursing personnel
2. May or may not act for administrator in his absence
3. Serves on or appoints a nursing representative to
   patient care committee
   executive committee
   utilization committee
   personnel committee
   interdepartmental meetings
4. Helps in selection and purchase of material and equipment for the nursing service
5. Assists in public relations program.

Accepts responsibility only until replacement can be made and with full awareness that these are not nursing responsibilities for the following:

Dietary department including special diets
Housekeeping department
Laundry and Linen storage
Purchasing

GOAL: IMPROVEMENT IN STAFF COOPERATION, TEAM-WORK AND GENEROSITY

1. Better understanding of behavior.
2. Greater appreciation of potential in interpersonal relationships and communication for cooperation instead of friction.
3. More fruitful staff - patient relationships.

Administrative Process	Parts of Organization	Steps
Planning		1. Select person(s) to carry forward the project. Establish time-table and schedule with them.
Delegation Staffing Coordination		2. Select steering committee (representative) and sub-committees e.g. library, films, arrangements.
		3. Refine time-table and schedule.
	Staff Development	4. Select and procure library materials.
	↓	5. Determine content of sessions a. Outside speakers e.g. social workers, psychologists, counselors etc. b. Use of written material as base for discussion e.g. case of Mrs. Johnson. Looking Into Leadership Series. Leadership Resources, Inc. (1750 Pennsylvania Ave.N.W., Washin on D.C., 20006) Communication in Nursing, Kron, W.B. Saunders, 1967. c. Films (see list P.75) also Training Film Index, Learning About Leadersh Series (address above)
	↓	6. Role playing.

Administrative Process	Parts of Organization	Steps
	↓	7. Panel Discussions.
		8. Staff Conferences - to reinforce and explore presentations, findings, etc.
	Executive Development	
Staffing	"	10. Occasional rotation of shift by all personnel
Reporting	Reports	1. Schedule reports - oral, written periodic, final
Budgeting	Budget	1. Number of man hours - assigned personnel - committee - staff conferences - sessions -outside experiences
		2. Money - expenses for outside experiences - library materials - film rentals - outside speakers
Evaluation	Supervision	1. Are staff members more knowledgeable? - more aware of pitfalls - More careful of speech? - more solicitous of feeling and opinions of others?
	Gathering of Evidence	2. Are there fewer complaints of lack of cooperation?
		3. Is there any reduction in absenteeism and turnover?
		4. Review of written and oral solicited opinions and findings of staff.

LIST OF FILMS FOR COOPERATION AND TEAM WORK

Division of Continuing Education, Oregon State System of Higher Education
Corvallis, Oregon

"All I Need Is A Conference" 28 min.
Rental $5.00

"Person To Person Communication" 14 min.
Rental $4.50

"How Good Is A Good Guy" 21 min.
Rental $4.50

"Individual Motivation and Behavior" 30 min.
Rental $5.00

"Supervisor As A Leader," Part I -- 14 min.
Rental $4.50

"Supervisor As A Leader", Part II - 13 min.
Rental $4.50

ANA - NLN Film Library
267 West 25th St., New York, N.Y. 10001

"Inner Man Steps Out" 30 min.
Rental $5.00

"Meeting In Session" 20 min.
Rental $5.50

For Nursing Care

"Mrs. Reynolds Needs A Nures" 38 min.
Free

"Cerebral Vascular Disease: The Challenge of Management" 38 1/2 min. Rental $6.00

EXAMPLES OF GOOD AND BAD NURSING BEHAVIOR IN USE OF INITIATIVE AND/OR JUDGMENT

* Denotes medication involved

17 examples of good behavior
20 examples of bad behavior
3 incidents involving medication in good behavior
7 incidents involving medication in bad behavior

List to serve as a base for staff discussions designed to improve initiative and/or judgment.

List suggests:

1. Need for careful review of all medication orders and policy governing medication administration without Drs.' orders
2. Need for review of obligations to families
3. Need for review of admission policies
4. Need for review of policies governing internal transfers
5. Need for review of orientation program

Good Behavior	Bad Behavior
RN encouraged patient to help roommate to eat--occupied her time	*RN giving medication without Dr's orders
Aide encourages and wheels patient in wheel chair through halls	Aide giving enema without Dr's orders
*Staff gave fluids, aspirin & sponged patient for T. 101°, fever brought down. Dr. told later	*Staff called M. D. instead of trying Kaopectate for diarrhea
RN moved quarreling patient to another room	*Aide treated rash without order. Patient allergic to medication, serious reaction
RN moved disturbing patient into different area	*Called M. D. in middle of night when there was a previous order
Good work load for LPN so RN can give personal attention to each patient	Not informing family of sudden change for the worse - patient died
RN had patient's wrist x-rayed on Sunday afternoon after accident in yard when she could not get M. D.	Telling patient's family "there is no hope" without knowing background or what M. D. has told them

Good Behavior	Bad Behavior
Aide took care of arrangements re patient's death by using procedure manual	Good looking nurses'notes and shabby looking patients
*Plan made for H. S. Sedation for patient who complained of hard mattress as well as mattress change. (Patient wanted previous mattress back. There had not been one.)	RN refused to make exception for family visiting at unscheduled times
Alerting all personnel quietly and efficiently in case of fire, so patients are not alarmed	Aide was not able to take care of arrangements re patient's death without supervision
Aide gave resuscitation to patient who had stopped breathing and revived him	RN sent aide to check on diabetic patient who was having a feeding problem instead of going herself. (Another aide had reported problem to RN)
RN refused to admit patient until checked by M. D. as telephone information not an accurate description of patient's condition	Discussing illness of a patient with other patients, also discussing personal affairs with them
RN used her judgment re death of patient regardless of rule book	DNS took back aide Adm. had discharged (with her knowledge and consent) during Administrator's absence
Organizing food cart so trays, patients and rooms are in order	*RN negative about investigating patient's request for "her green pills" (patient in iron lung)
RN refused to admit patient until Dr. checked patient, M. D. sent patient then directly to State Hospital	RN follows book in all cases not considering human factors
RN drew Dr's attention to breast abnormality of new patient. Patient had mastectomy shortly	RN keeps moving incompatible roommates without trying to resolve differences. There is repetition of behavior
*Secures order for all medications - laxative, aspirin, antacids, etc. Notifies family when patient turns worse, gets family's written consent for patient to be taken for rides	Doing only what you are told, washing patients without soap because you thought or were told to do so

Good Behavior	Bad Behavior
	*Patient had previous order for demarol. RN gave placebo 2 hrs. after injection for extreme discomfort without Dr's orders. (Patient required these injections infrequently)
	Dryer breaks down. RN keeps washing things but not drying, instead of separating items and doing those most needed
	*RN withheld 4 p.m. tranquilizer. Patient very agitated in evening - difficulty in giving medication then, patient awake and noisy all night.

PROGRAM FOR INDIVIDUALIZED RESTORATION OF WALKING

Can be introduced by:
- Doctor's order
- Nursing diagnosis

1. Appraisal of Patient
   - Physically - strength - general, in legs
     - Number of steps at which to begin
     - Estimate of long-range goal
   - Mentally - state of patient's motivation
     - Estimate of long-range goal

2. Selection of beginning position in program continuum
   - Dangling
   - Standing
   - Few steps
   - B. i. d. or Q2H or Q4H
   - To and from chair
     - bathroom
     - washbasin
   - Extending distance
     - in corridor
     - to recreation room
     - ad lib
   - Frequently in each phase

   Tentative Schedule:

First day:	Dangle 4-6 times
Second day:	Stand 4-6 times; few steps 3-6 times
Third day:	To and from chair 1-3 times
Fourth day:	To and from bathroom 1-3 times

3. Determination of amount of Assistance and/or Supervision
   - Full
   - Partial - for appraisal; for assistance to toilet
   - Estimated amount
   - Periodic evaluation

4. Equipment needed and available
   - Walker with seat/without seat
   - Wheelchair (for emergency)
   - Canes with tips for replacement

5. Procedure includes
   - Instruction and direction of patient
     - in goal of posture
     - in goal of movement
   - Use of collateral materials, eg., trapeze to strengthen arms; exercises to strengthen legs: passive, kinetic isometric, active; foot wear: firm, comfortable non-skid shoes
   - Safety
     - Avoid proximity: to doors; use and location to rails, furniture; to cleaning personnel

HOW THE NURSE CAN HELP THE EMPHYSEMATOUS PATIENT:

By listening to him to learn about his apprehensions.

By being sympathetic with his struggles and efforts.

By visualizing his fright and panic.

By trying to place herself in his situation.

By calming his fears and frustrations through a dedicated program for the alleviation of air hunger.

By explaining to him the basic physiology of the breathing problem.

By teaching him and his family how to live with respiratory disease.

By encouraging him to pursue his personal interests within the limitations of his disability.

By relieiving him of physical tensions, especially with massage of the upper back and shoulders.

By teaching him how to achieve physical comfort through posture and relaxation techniques.

By knowing exactly what to do and how to do it when intermittent positive pressure breathing is prescribed.

By having a positive and reassuring personality, knowledge, ability and sympathetic understanding.

From: Nursing Outlook, September, 1967. Pg. 53-55. Jones, W., "Living with Emphysema."

MRS. JOHNSON - Patient

Mrs. Johnson called her neighbor and friend who was a nurse to come and see her.

When Mary Brown arrived she found Mrs. Johnson agitated and anxious. Mrs. Johnson told her that she had not had a bath since she had come into the home on Monday. (This was Thursday.) Moreover they brought her into the TV room in the walker and just left her. Everyone said they were too busy to "walk" her and she must get used to the fact that this was a nursing home not a hospital. She added that the therapist had worked with her legs and got some padding to make a pillow to elevate her legs. She explained to Mrs. Brown that she was not sure enough of herself in the walker and needed supervision and help with it. She wondered what she could do to get the care she needed so she could get strong enough to go home.

Mrs. Brown suggested that she ask to see the Director of Nursing, who was a Mrs. Baldwin. Mrs. Johnson wondered how she'd get through to her. Mrs. Brown offered to call Mrs. Baldwin as she had met her at a nursing meeting. Mrs. Brown also offered to call the nurse at Doctor Smith's office. Mrs. Johnson seemed most grateful.

The next morning Mary Brown called Mrs. Baldwin, identified herself and asked if she would check into Mrs. Johnson's care as she was upset and dissatisfied.

Mrs. Brown also called Dr. Smith's office and told the story to the nurse, adding that Mrs. Johnson was not asking Dr. Smith to see her but just wanted him to know.

A week later, after the family vacation, Mrs. Brown went to see Mrs. Johnson. She was anxious to know if things had improved for her.

Mrs. Johnson was resting but was glad to see Mrs. Brown. She had many things to tell her. First of all she had five stitches and a bruise over one eye. She had fallen getting into the bathtub. The nurse assisting her had said she did not need another person helping when Mrs. Johnson had asked if she (the nurse) could get her into the tub by herself. They had taken her to the Doctor's office to have the stitches put in and she was to go back the next day to have them removed. She also told her that she was fearful in the toilet, as the seat was low and she had great difficulty pulling herself up and that the hand bars were out of reach. However, her roommate, who had a broken arm, was helpful about keeping an eye on her and calling the nurses.

Mrs. Brown asked if Mrs. Baldwin had been in. "Oh yes, she had," replied Mrs. Johnson. She went on to tell Mrs. Brown that she had come in, asking if Mrs. Johnson were trying to make trouble between the Home and the Doctor as his

office had been deluged with calls about Mrs. Johnson's care at the Home. Mrs. Johnson said there had been only two calls--one from her daughter-in-law and one from her neighbor, a nurse Mrs. Brown.

Some time later Mrs. Brown again visited Mrs. Johnson and found her alone with the door closed. She was crying. It was a gray day and neither her son nor any of her family had been in. She was worried about him as he had had what was thought to be a slight stroke and was having tests done. Her other son and family had moved away only recently and had not been in since the move. Mrs. Brown asked if she'd like to play solitaire as Mrs. Johnson had been a daily player prior to her accident. Mrs. Johnson replied that she might. Mrs. Brown asked at the desk about cards but the reply was vague. Mrs. Johnson said that she would have her grandson bring some from home when he went up for the mail sometime. Two workers came in and inquired how she was, praised the piece of apple pie Mrs. Brown had brought for her supper and left.

Some days later Mrs. Brown again visited Mrs. Johnson. She was fully dressed even to stockings and looked better. She was walking without a walker and Dr. Smith had been to see her. As she was nervous and her hands shaking, he had prescribed medicine and suggested she do some of the things she used to do. She said she'd be going home in a week or two but her family and the Doctor had said not to hurry since she had Medicare. She had gotten a housekeeper to stay with her when she would go home and seemed quite relieved about finding someone.

She told her she had had another bad experience in the bathtub. The nurse had forgotten her and an hour had elapsed when her roommate made inquiries to the nurse about her. The nurse hurried in but Mrs. Johnson was quite upset by then. She was also cold but had managed to reach a towel and put it around her shoulders. She said that she had tried to put hot water into the tub but it was very difficult to reach and as she got cold water, she was afraid she might get burned if she fooled with it.

Mrs. Brown suggested that she drive to Mrs. Johnson's home so that she could get some of the knitting she was doing for the Fall Bazaar. Mrs. Johnson enjoyed the ride and visiting and got the sweater she had been knitting, as well as wool and needles for the Bazaar bedroom slippers. They returned then to the home.

Mrs. Johnson, upon return to the room, said how glad she was to be by the window now as her roommate was gone. She explained how she pulled one curtain right across the room and her own part way and left the door open at night. She hoped the other bed would remain empty. As she reached for something in her drawer she pulled out a little flower made from a flattened pill cup and bearing the signatures of the nurses at the hospital.

She told Mrs. Brown how they had brought it into her on an individual cake the day she had left the hospital to go to the Home. She seemed pleased to remember their kindness. Mrs. Johnson and Mrs. Brown walked to the nurses' station with the cane Mrs. Johnson had brought back from home. The rubber tip was worn through. The nurse took adhesive and put it over the end. Mrs. Johnson said it no longer slid on the floor. She smiled as she told Mrs. Brown how Dr. Smith had said that three legs are better than two.

As she walked with Mrs. Brown to the door, they passed a cart of cleaning materials; a maid was mopping nearby. Mrs. Johnson remarked how they were always cleaning somewhere.

A few days later Mrs. Johnson was moved back to her first room and as her roommate seemed odd and she was walking so well, she called the Doctor and asked to go home. She observed that a flashily dressed woman with lots of make-up had been given the room by herself which she had vacated.

She was happy to get home and liked her housekeeper so much.

Nursing Home Incident List

1. Mrs. Lamphier thanked Mrs. Ogden as she finished filing her nails and applying cream to her hands. She asked if Mrs. Ogden would trim her toe nails. She replied that she'd be glad to and went to the nurses' station to get a pair of scissors.

The nurse told her that no one cut toe nails there. The podiatrist came regularly and did the toe nails.

Mrs. Lamphier died not long after. Mrs. Ogden wondered if her toe nails had ever gotten trimmed.

2. "Mrs. Knapp was very annoyed that I had Doris take everything off her table and clean it. She said she was going to have her children take her out of this home," said Mrs. Allen, the relief R. N. "I must phone Mrs. Camp so she'll be ready for the complaints when she comes back," she continued.

"They sure do hate to have anything touched," replied the aide.

3. "The odor hits you as you come in the door, but soon you don't notice it," the volunteer said to the volunteer group at their meeting.

"I wish we could spray a deodorant around without offending Mrs. Green," added another volunteer. (Mrs. Green was the R. N. in the home.)

4. "The 3-11 shift leaves things for us to do! Why don't they do them themselves. Just the other day they left a note asking us to cut Mr. Yaeger's toe nails. They could do it as well as us."

Mrs. White was complaining about the 3-11 shift at lunch time to another RN.

5. "Couldn't someone have phoned for absentee ballots?," asked the volunteer.

"I can't, I'm so busy giving the medicines and 'shots' and checking all the medicine supply," replied Mrs. Gould, the R. N.

"How about an aide then?," continued the volunteer.

"They can't either, there are only two of them today and we've got fifty patients," Mrs. Gould replied.

Note: T e volunteer had previously arranged for getting four of the patients registered for voting. This nursing home does not have bedridden or seriously ill patients.

6. "Mrs. Hill says quite often that she hasn't been 'walked' since the last time I did it," reported one volunteer to another as they were talking over their activities.

"I wish they'd set up a craft corner so the people could work with things in between our visits," replied the other volunteer. "You just can't do it and get the things put away in two hours."

7. Mr. Jones said, "I'm so glad to be home again," as he stood with his newly shortened cane and a lady's apron protecting his shirt and trousers talking to the volunteer. "My cane was too long," he continued, "and I fell."

Mr. Jones is an 84-year old who had had periodic strokes over the last ten years. He had fallen, been taken to the hospital, then a more acute care nursing home and finally back to the Home.

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MEDICAL CARE ADMINISTRATION SEQUENCE

Instructor: Virginia Pettengill, R.N., R.R.L.

HEALTH RECORD SYSTEMS IN EXTENDED CARE FACILITIES

I. Overview
   Introduction and Objectives of Session

II. The Patient Record*
   1. Minimum Standards and Basic Content
   2. Forms
   3. Ownership and Responsibility
   4. Filing
   5. Retention and Legal Aspects

III. Indexes and Statistics
   1. Patient Index; Disease Index
   2. Statistics Reporting

IV. The Utilization Plan
   Function of the Administrator in the Utilization Review

*Additional material shown to students -- Medical Records for Nursing Homes, Physicians Record Company, Berwy, Ill. Catalog No. 1624.

PRESENTATION I

I. Overview

The medical record in the nursing home is fundamentally the same as that in the hospital, the primary purpose being to improve care of the patient. Properly written and maintained medical records safeguard the institution giving the care and provide a basis for the evaluation of care. What are the special aspects of a nursing home which have a bearing upon its medical record system?

Nearly all the special aspects stem from the type of patient. The patient in the nursing home is not acutely ill and there is less need for recording in the nursing home than in the hospital, and no need for a multiplicity of forms. The patient at this level of care stays for a long time with the result that the simplest forms pile up and a storage problem develops. He may be acutely ill for brief periods, and variations in the level of care are needed. The problems of medical record-keeping during this intervening illness come to the fore. The

patient's illness may require admission to a hospital and later return to the nursing home. Quality care requires a continuing record. The development of a system of medical records in a nursing home must take into consideration all these areas.[1]

The Standards for Accreditation of Extended Care Facilities supplement by the Joint Commission on Accreditation of Hospitals states: "A separate medical record shall be maintained for each patient with all entries dated and signed. This record is an important tool in the medical and nursing care of the patient. It serves as a basis for planning patient care and also provides a means of communication between all members of the health team. It also furnishes a document for evidence of the patient's course of illness and treatment and serves as a basis for review, study and evaluation of the medical and nursing care rendered to the patient."[2]

Three of the main areas of medical records to be considered here are: 1) the basic content and minimum standards for health records, 2) systems used to keep the records well organized, and 3) statistical reporting and indexing.

II. The Patient Record

A. Minimum Standards and Basic Content

1. Identification data
   This information is necessary so the patient may be properly identified, and should become the summary sheet of the patient's individual record with a space left for the physician to record the diagnosis and sign this portion of the sheet. (Some forms are called Admission-Discharge sheets.)
2. Referral or Transfer Statement
   This information should be obtained from the hospital or the physician so duplication of examinations, tests and treatments are avoided and patient care can be instituted smoothly. There should be a statement of patient abilities, recent medication, activities and treatment. This information should be sent with the patient when he is referred to a hospital or to another nursing home.
3. Reason for Admission and Diagnosis
   This information should be recorded for understanding of the patient and his problems.
4. Admitting Evaluation and Treatment Plan
   Medical and social history, physical examination and aims of treatment, written by the physician, should be part of each record so that he or any physician who follows will proceed intelligently in the treatment. The reason for admission and diagnosis may be included on this form.

5. Orders
   Treatments, tests, activities and medication should be ordered in writing and signed by the physician. They should be reviewed by him at least every 30 days.

   Automatic stop orders should be in effect on medications such as narcotics, sedatives, stimulants, antibiotics, tranquilizers and anticoagulants and be discontinued after seven days unless reordered for a specific period by the physician.

   Restraints should require a written order and automatic stop orders should be a routine procedure. A discharge order should be signed by the physician before discharge of the patient unless a release is signed by the patient or his authorized agent. If a patient or his family wishes the patient to leave against the advice of the physician, a release from responsibility should be signed to protect the home legally.
6. Progress Notes
   Notes by the physician and other members of the health team are essential at regular intervals depending on the individual case. These notes should include statements about reaction to treatment, general attitudes affecting treatment, and notations of any change in treatment.

   Progress notes give a chronological picture of the patient during his stay. Each note should be identified by the signature and title of the person writing. Notes should be limited to meaningful observations. The reaction to a drug, any apparent change in the condition of the patient and any accident should be recorded. The date and time of occurrence, the findings of the nurse and physician, along with the treatment should be recorded on the progress record and on a special accident report for administrative purposes.

   The nurse should always record the general condition of the patient at the time of admission, whether ambulatory or bedfast, whether there are scars, bruises or bed sores. At discharge, the condition of the patient and the means by which he left are necessary. All medication administered should be recorded as to the time, amount and by whom given. Restrictions should be recorded with reason, time of starting and ending and regular observations during restriction.

   Notes on critically ill, terminal or acutely ill patients should be made daily on each shift. Observations on all other patients may be summarized and recorded periodically or according to state regulations.

7. Special Reports
   Reports from x-ray, laboratory, physical therapy, occupational therapy, activities, psychology and social service (in the nursing home or from the community) may be recorded on separate forms, on a combined form or on the progress notes, if properly identified.
8. Diagnoses
   At admission and as the patient develops other diseases, they should be recorded on the summary sheet in acceptable terminology by the physician.
9. Miscellaneous
   Such items as legal papers, admission agreement, consent to care, health aids and valuables list, release from responsibility, release for information, insurance reports, copy of death certificate, body receipt and autopsy report ;may become part of the record. Some may be retained as administrative forms by the administrator during the patient's stay and be placed with the record at discharge. It is advisable not to include these items on the record itself, but file them with the record.[3]

These standards, if properly maintained, will make the record meaningful and functional. The record should reflect the care given the patient for evaluation by the Utilization Committee, for reporting to the fiscal intermediary, federal and state agencies, as well as the patient's future needs. It is the duty of the administrator of the nursing home to see that the medical record is simple, accurate and factual. Recording should be in relation to the specific patient with a well-defined purpose in mind. Finally, the record should be properly maintained for legal protection of the patient, the institution and the employees of the institution.

B. Forms

The definite format for the medical record is the prerogative of the nursing home administrator and shall be dictated by the re-requirements of admitted patients. Forms which combine two or more of the parts before-mentioned are acceptable. It is important that the material be organized to facilitate ready access and chronological documentation of events for a clear clinical picture.

Many companies design and print record forms ready for use, or they will help the home develop simple, logical easy-to-use forms of uniform size, quality and weight of paper, and space for entries.

Forms may have identification at either the top or bottom of the page, may be in several colors and have side or tip binding.

Folders or holders made of metal or other materials may be used while the patient is in the home, and manila folders may be used for the discharged record.

C. Ownership and Responsibility

The medical or health record is the property of the governing board of the facility or its owner. These persons are responsible for seeing that the individual record is maintained. He may elect to delegate his responsibility to medical and administrative staffs. The medical record is a legal document and subject to court subpoena and orders. Information about a patient, which is recorded in the health record as part of the physician-patient relationship, is confidential. The administrator is responsible for making sure that no unauthorized person takes records out of the files or nursing home or reads or copies or otherwise tampers with them. Release of information from the health record varies from state to state, but in general is done only with the written authorization of the patient or his legally authorized agent. (This phase will be dealt with more in depth in another part of this outline.)

D. Filing

A filing system for the health record should enable the user to 1) identify the patient's record, 2) find the record in the filing system and 3) locate the record when it has been taken out of the filing system. A good system will protect the record when not in use and make it easier to find again whenever it is needed. The nursing home should use the system and methods that do this job best. No matter what the system, the individual record should be kept in one place as one unit. A misfiled record is a lost record. The health records of patients who have been discharged may be filed in alphabetical or numerical order.

Should the home elect to use the numerical or alphabetical system of filing? The answer would seem to lie in the size of the nursing home. While even the smallest hospital using the alphabetical filing system finds this system to very soon become a nuisance due to the duplication of common names and the necessity of interfiling to maintain alphabetical sequences, the nursing home is often smaller than the hospital and here there is less rapid turnover, making duplication of names but a remote possibility.

While numerical filing is free of these two disadvantages, it requires a card file of patients' names cross-referenced to

case number. This name file, referred to in the hospital as the "patient index," need not be a one-purpose file. Business ledger cards will serve the purpose, provided each carries the patient's case number. In the long run, to keep documents filed in numeric sequence is generally more efficient and accurate than to maintain them in correct alphabetic order.

From a long-range view, a combination of alphabetical and numerical filing seems most feasible to meet the needs of nursing homes from both maintenance of records of current patients and for accessibility to records of patients who have left. An alphabetical index file of records at the nurses' desk for patients now under care is simple to maintain and is readily accessible. Upon discharge or death of a patient, the record can take its place in numeric sequence in a permanent file, the key to which will be an alphabetical card file. When the numerical system is used, the unit or serial unit system is the system of choice.

Should storage of records be by shelf or file? In filing current records, speed of reference, efficiency in charting and confidentiality are the deciding factors. The standard aluminum chart holder usually found in the hospital also has its place in the nursing home. One file drawer in the nurses' or record clerk's desk will house such records for as many as 50 patients. For the records of discharged patients, safe-keeping and confidentiality are again deciding factors. Drawers in a file that can be locked may be entirely adequate in the smaller nursing home for many years. Larger nursing homes will certainly consider the greater capacity provided by shelving, but charts on shelves are not as easily protected unless they are in a room which can be kept locked.[4]

E. Retention and Legal Aspects

The health record should be kept in the nursing home as long as required under the statute of limitations or the regulations of the state in which the institution is located. (See attached statutes.) The statute of limitations is the factor which sets the time limit on bringing law suits involving patients and their treatment in the health facility. The time limit varies in states and in different types of law suits.

In the nursing home, with the pattern of care being routine, it would appear that old records are far less valuable. To answer inquiries by relatives, etc., a summary card might be of value. Microfilming should be considered only when there are a large number of records to be retained and the filing space is not adequate to retain the original record.

A confidential communication is one which contains certain private information given by a patient to his physician, by a client to his attorney, or by a person to his religious advisor. Even though a state may not have a specific statute regarding confidential communications, practice has grown from usage in states not having such statutes.

The physician-patient relationship is observed and the patient is protected from unauthorized release of information from his medical record in these instances.

Insofar as the character of the medical record as a confidential communication is concerned, the record may have the same relative standing as the oral statements of the physicians or nurse; hence, unless the patient waived the claim of privilege of the medical record by a written authorization for release of information, it can be brought to court only on subpoena or court order. Types of cases using evidence from the medical record are insurance cases, workman's compensation, personal injury suits, malpractice suits, will cases and criminal cases.[5]

III. Indexes and Statistics

A. The Patient Index

The patient index is an alphabetical index of names filed on every patient who has ever been admitted to the nursing home. It is usually kept in card form with a separate standard size card for each patient.

Many homes use the patient index as a quick check on whether a person has been or is a patient in the facility. Cards are filed alphabetically by the patient's last name and lists dates of admission, discharge and the number(s) assigned to him on admission.

These cards should be maintained as a perpetual patient index. In the numerical filing system, these cards are the source of finding the patient's health record. These cards should be maintained permanently after having been made at the time of the first admission of the patient and kept in a file of patients who are currently in the facility. When the patients are discharged or die, the card is transferred to the perpetual patient index file. The date of discharge or death should be entered on the card before it it is filed. The same card should be used if the discharged patient is admitted again.[6]

B. The Disease Index

A disease index is a listing of patient records by the disease or condition for which the patient is treated. These diseases or

conditions are listed according to the diagnosis given by the physician, and they are listed in uniform terminology. A disease index, however, should be necessary only in health facilities where the following conditions are found:

1. a facility which must report its patients by a diagnostic or disease code number to Medical Assistance for the Aged (MAA), Old Age Assistance (OAA) or other central agency.
2. in a facility where research is being conducted.

When a disease index is used, it becomes not only the key to the location of records of patients with certain diseases for the purpose of study and research, but it is also useful in compiling certain statistics about medical care given in the facility. It also gives the facility a good means of counting individuals treated for a certain disease during the year.[7]

The two systems used most widely in coding diseases are the International Classification of Disease, Adapted, and the Standard Nomenclature of Diseases and Operations. The former system (ICDA), is the system of choice and will no doubt be used internationally for reporting statistics within a few years.

C. Statistics

Facts in the form of figures are collected in the nursing homes and homes for the aged for various purposes; evaluating the service given, decisions for operation and expansion of facilities and meeting requirements of standard-setting agencies. These statistics should be gathered in a uniform way according to standard definitions. There should be a definite reason for using all information recorded, and it should be recorded in a systematic way. The following definitions will be helpful in compiling statistics:

1. A patient discharge is the termination of lodging and the final release of a patient from the facility.
2. The patient census is the number of patients occupying beds in the facility at a given time. The census-taking hour is often specified as midnight or any one time during the 24-hour period, provided the time is the same daily.
3. A patient day is the unit of measure denoting lodging provided and services rendered to one patient between the census-taking hours on two consecutive days.
4. Patient days of care given during any period consist of the daily totals of the patient census for this period of time.

5. Discharge patient days are the total number of days each discharged patient spent in the facility. (See attached formulas for additional information.)

All admissions, discharges, temporary hospital transfers, temporary leaves and deaths should be reported on a daily census report. Each day the patient is on temporary leave, temporary hospital transfer or on a transfer to a skilled care unit, his name must appear on the report. This daily census report should also include the number of patients present each day. From this daily a worksheet should be developed to record these items by number each day. These figures should be tabulated monthly. From these totals the statistical data can be computed for the year.

There are numerous questions that may be asked of nursing homes and homes for the aged. More questions will be asked as these facilities move into the Medicare program.

IV. The Utilization Review

The Function of the Administrator in the Utilization Review Program

The administration of the Extended Care Facility plays a most essential role in the Utilization Review process. It is the administrator who coordinates the original efforts in formulating the Utilization Review Committee and who obtains approval of the governing board and/or medical staff where these exist. It is the administrator who selects the various personnel in the institution to handle the charts and forms and other materials which are so necessary for the procedure. The administrative group in an ECF will be in close contact with its Utilization Review Committee and at times be represented at regular meetings. They will be responsible for the maintenance of the various required records, reports and recommendations from the Utilization Review Committee and for implementing changes suggested by this Committee. The administration, of course, is also responsible for reporting the decisions of the Utilization Committee to the fiscal intermediary, especially in those cases in which the decision is made that a given patient has received maximum benefits from the level of care under consideration.

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6. "How to Organize a Health Record System," Washington, D. C., U. S. Dept. Health, Education, and Welfare, Supt. of Documents, 1966.

7. Legal Handbook for Oregon Hospitals, Oregon Association of Hospital, 1964.

8. "The Utilization Committee for the Extended Care Facilities," Regional Utilization and Medical Review Project, Rochester, N. Y., 1967.

Temporary Medical Records:	Minimum Retention Period:
1. Case records or charts (either original or microfilm) (Note: Original files may be replaced with microfilm copies with the approval of the State Board of Health. If filmed, the original case records shall be held two years beyond the date of last discharge.)	25 years from date of last discharge
Exceptions for which microfilming is not recommended:	
Cases ending in death unless kept for research purposes	5 years
Nurses' notes	5 years
2. X-ray reports on out-patients, if filed separately from case records	25 years or 2 years if microfilmed, or 5 years after death

Temporary Medical Records:	Minimum Retention Period:
3. X-rays.	7 years, except: most recent positive chest examinations which show pathology for living individuals, and examples as long as they are retained for teaching purposes.
4. Electrocardiograms	5 years
5. Out-patient sheets or cards	7 years
6. Out-patient family files, except for admission documents and agreements preserved under permanent records program.	5 years
7. Laboratory copy of reports (original should be filed in case files)	1 year
8. Daily hospital census or statistical reports	2 months, if cumulated in monthly report or ledger
9. Monthly hospital census or statistical reports or ledger	1 year, if cumulated in annual report or ledger
10. Nursing records from floors or wards, such as bed books, and records of daily events and responsibilities, used basically to guide work	2 months, if posted to medical case 5 years if supplementary to medical records
11. Copies of birth and death certificates forwarded to the State Board of Health and any record of births and deaths	7 years
12. Narcotics sheets or records of distribution of drugs	2 years

If any institution desires to microfilm any of these records and then destroy the original records prior to limitations stipulated, the written permission must be obtained from the Board (ORS 441.055).

SITUATION I

A 50-bed nursing home is being opened. The administrator is preparing to set up a medical record or health record system. This nursing home is to be licensed and is to qualify as an extended care facility. The following questions must be answered by the administrator:

1. Who is to be responsible for the health records?
2. Where shall he be located?
3. What equipment is needed?
4. What shall the record contain?
5. What forms should be used?
6. Who shall admit the patient and secure pre-admission information?
7. How often shall the record of inpatients be checked for deficiencies?
8. What numbering system shall be used?
9. What filing system shall be used?
10. What indexes shall be maintained? What items shall be contained?
11. Should there be a number control book or a patient register? What shall it contain?
12. How long shall the record be kept?
13. What are the policies for release of information?
14. What is the system for transfer of information between the hospital and the nursing home and vice versa?
15. What is the system for Utilization Review?

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Oregon State Board of Health, 1500 S. W. Sixth, Portland, Oregon.

Guide to Utilization Review for Extended Care Facilities, Blue Cross Assoc., Chicago, Ill., 1967.

Standards for Accreditation of Extended Care Facilities, Joint Commission on Accreditation of Hospitals, Chicago, 1967.

"The Utilization Committee for the Extended Care Facility," Regional Utilization and Medical Review Project, Rochester, N. Y., 1967.

An Administrative Manual for Medical Record Librarians, Sister Mary Yvonne, SS, MM, CRL; Catholic Hospital Association, St. Louis, 1958.

Legal Aspects of Medical Records, Hayt and Hayt, Physicians' Record Co., 1964.

Conditions for Participation of Extended Care Facilities, U. S. Department of Health, Education, and Welfare, Supt. of Documents, U. S. Government Printing Office, Washington, D. C., 1966.

Nursing Home Records, a reprint, Sister Mary Loretta, OBS, RRL, College of St. Scholastica, Duluth, Minn.

REHABILITATION THERAPIES

Who is a Candidate for Rehabilitation?
Physical Statement and Function Assessment
Nursing Care
Physical Therapy
Occupational Therapy
Psychology
Speech Pathology

LELAND L. CROSS, MD., M.P.H.
CAROL AYLES, O.T.R.
HAZEL MUNRO, R.P.T.

REHABILITATION THERAPIES SEQUENCE

Instructors: Leland L. Cross, M. D., M. P. H.
Carol Ayles, O. T. R.
Hazel Munro, R. P. T.

Place: Rehabilitation Institute of Oregon

Goal: To promote better patient care in nursing homes by provision of information through lecture, seminar discussion, visual aids and on the premises demonstration of psychology, nursing, occupational, physical and speech therapy parameters.

I. Who is a Candidate for Rehabilitation?
   A. Diagnosis of disability
   B. Physical statement
   C. Communication statement
   D. Social statement (detail left to another time and person)
   E. Psychological statement
   F. Vocational or avocational statement

II. Physical Statement and Function Assessment
   A. Activities of daily living spectrum: Eating, dressing, personal hygiene, transfer and ambulation.
   B. Degrees of independence in each area.
   C. History and physical key areas
      1. Premorbid function level
      2. Coexistent diseases affecting function: Amputations, fractured hips, vision, hearing, etc.
      3. Family availability and a home.
      4. Cardio-respiratory reserve.
      5. Any additional unnecessary disability, dependency, depression.
      6. Ability to learn and retain new skills and knowledge: Sitting and standing balance, strength.

III. Nursing Care, Visual Aides - Slides
   A. Bed positioning in hemiplegia.
   B. Skin care - prevention of decutibi - Kosiak's pressure time graph.
   C. Bowel and bladder care, toileting.
   D. Attitude emphasizing remaining assets, using them and becoming independent as possible.

IV. Physical Therapy, Visual Aids and Demonstration
   A. Range of motion and self-assistive exercises.
   B. Transfers--wheelchair, tub, toilet.

C. Ambulation--with and without aids.
D. Group activities--mat classes.
E. Individual exercises for strength and endurance.
F. Assistive devices--braces, slings, walker, canes, wheelchair, etc.

V. Occupational Therapy, Visual Aids and Demonstration
A. Activities of daily living, visual aids, dressing, eating, grooming, bathing.
B. Disturbances of vision and affect upon activity, hemianopsia, verticality difficulty, vision-motor impairments.
C. Assistive devices--self-care and homemaking.
D. Diversional supportive and recreational activities.

VI. Psychology, Lecture and Material Handouts
A. Group activities--patients interact to benefit each other, recreation in lounges, two meals daily together, O. T. and P. T. group classes.
B. Learning experience for patients to adjust to disability behavior--use what remains to become as independent as possible. What patients do more important than what they say they can or will do.
C. Brain damage deficits: symbolic; perceptual; memory. Quality control of functions; Affective lability.
D. Intellectual, personality and interest evaluation frequently very helpful in understanding and optimally working with patients.
E. Methods: WAIS, MMPI, Strong Vocational Interest.

VII. Speech Pathology
A. Areas of Disfunction:
1. auditory perception and recall
2. reading
3. speaking
4. writing
B. Testing methods--Eisenson's test for aphasia. Family counseling for management of communication disorder and need for treatment.

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Fordyce, Wilbert E. and Jones, Robert H. "The Efficacy of Oral and Pantomime Instructions for Hemiplegic Patients," in Archives of Physical Medicine and Rehabilitation. Vol. 47, October, 1966.

Resource materials listed or given out in class.
Articles--copies for students.
Reference--booklets--AR Foundation, available at book store.
Individuals--for programs and resources.

THE STROKE PATIENT WITH A COMMUNICATION PROBLEM

Evaluating Language Disorders

Auditory Disturbances
- Impaired auditory perception
- Reduced retention span

Reading Disturbances
- Perceptual and visual defects
- Reduced retention span

Speech Disturbances
- Dysarthria
- Apraxia
- Anomia
- Defects in structure and organization of language

Writing Disturbances
- Failure to recall previously learned visual symbols
- Spelling errors
- Anomia
- Defects in structure and organization of language

Prognosis Based on Performance

Simple aphasia - general reduction of language with no complicating perceptual or motor defects. Prognosis: excellent.

Aphasia with sensorimotor involvement - severe reduction of language with difficulty discriminating, producing, and sequencing phonemes. Prognosis: good.

Aphasia with scattered findings - severe reduction of language with evidence of visual and sensorimotor involvement. Prognosis: fair.

Irreversible aphasic syndrome - almost complete loss of functional language in all modalities. Prognosis: poor.

SUGGESTIONS REGARDING REFERRAL OF A STROKE PATIENT TO AN OCCUPATIONAL THERAPIST OR A PHYSICAL THERAPIST

I. Information needed by physical therapist and occupational therapist from physician regarding treatment of patient with stroke.
   - A. Current diagnosis and onset of disability.
   - B. Current medical status including any precautions or symptoms to be reported back to physician immediately.
   - C. Any information from previous medical history that may affect treatment - e. g., allergies, arthritis, peripheral vascular disease, surgical metallic implants, cardiac pacemaker, old fractures with limited motion, visual or hearing deficits, etc.
   - D. Any information from social history that may affect treatment - e. g., family cooperation, home program.

II. What the physician can expect of physical therapy treatment.
   - A. In recent stroke -
     1. Teach family and/or nursing staff proper bed positioning.
     2. Teach family and/or nursing staff passive or assistive ROM to avoid contractures.
   - B. In later stroke -
     1. Assist patient and/or family in maintaining joint mobility through passive or assistive exercises.
     2. Assist patient and/or family in strengthening exercises for muscles which show return of function as well as those not affected by CVA.
     3. Teach patient and/or family safest and most efficient methods of transfer and use of wheelchair (to and from bed, toilet or commode, car - with or without assistance).
     4. Teach patient and/or family highest level of safe and efficient ambulation of which patient is capable - with or without appliances or apparatus (brace, cane, walkerette).

III. What the physician can expect of occupational therapy treatment.
   - A. In recent stroke -
     1. Assist patient, family and/or nursing staff in early self-care - e. g., eating.
     2. Provide temporary static splinting to avoid contractures.
   - B. In later stroke -
     1. Assist patient and/or family in planning and achieving maximum physical independence in the following areas:
        - a. self-care - eating, dressing, grooming
        - b. communication - evaluate devices and equipment in writing, typing
     2. Assist patient and/or family with purposeful activities in maintaining or regaining ROM, strength, endurance, and coordination.
     3. Construct or assist family in assistive devices needed to carry through physical independence.

EVALUATING A COMMUNICATION DISORDER

I. Understanding Speech

A. Point to the following objects:

Pencil Nickel Cigarette Comb Band-aid ERRORS____

B. Answer the following questions with yes or no .

Does milk come from cows? (yes)
Should children disobey their parents? (no)
Does the sun rise in the west? (no)
Can anyone get a license to fly an airplane? (no)
Is it possible for a good swimmer to be drowned? (yes)

ERRORS____

C. Repeat after the examiner. Score as an error if the patient asks for repetition.

6 1 2
7 3 8 4
1 8 3 6 2
8 3 7 5 6 2
6 8 5 3 7 4 1

ERRORS____

II. Speaking

A. Naming. If mis-naming occurs, record the response.

Pencil Nickel Cigarette Comb Band-aid ERRORS____

B. Simple questions. Record response.

What do you do with a fork?
What do you do with a razor?
What is a knife for?
What is a pencil for?
What is a stove for?

ERRORS____

C. Biographical information. Record response.

Name
Address
Age
Date
Where born
Occupation

ERRORS____

D. Use the following words in a sentence.

Cup Give Pretty Many ERRORS____

E. Define the following words.

Robin Island Bargain ERRORS____

F. Explain the following proverbs.

Don't put all your eggs in one basket.
Don't change horses in the middle of the stream. ERRORS____

III. Reading

A. Match words to objects.

Pencil Nickel Cigarette Comb Band-aid ERRORS____

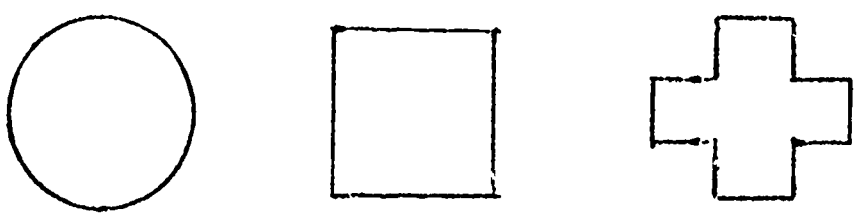
B. Mark the following questions yes or no .

1. Are there seven days in a week? __Yes __No
2. Does milk come from cows? __Yes __No
3. Does the sun rise in the east? __Yes __No
4. Do you tell time with a match? __Yes __No
5. Are bicycles faster than trains? __Yes __No

ERRORS____

IV. Writing

A. Copy the following forms



ERRORS____

B. Write the numbers from 1 to 20.

ERRORS____

C. Write the following words. If unable to write, can the patient spell out loud correctly?

Man Has Watch Yellow ERRORS____

D. Write the following sentences.

The grass is green.
We have a new car.
Do you think it will rain today?

ERRORS____

WHO IS A CANDIDATE FOR REHABILITATION?

I. Diagnosis of Disability and Residual Ability

A. Each Patient's Personal Disability Includes a:
1. physical statement
2. communication statement
3. social statement
4. vocational statement
5. avocational statement
6. psychological statement

B. Rehabilitation - A Remover of Disability

C. The Patient - Environment Interaction

II. The Basic Physical Functions

A. Activities of Daily Living
1. eating spectrum
2. dressing spectrum
3. personal hygiene spectrum
4. transfer spectrum
5. ambulation spectrum

B. The Environment Again

C. Degrees of Independence
1. total independence
2. needs standby assistance but not physical assistance
3. needs partial physical assistance to complete the task
4. can't participate in completion of the task--needs total physical assistance

III. Key Features of History and Physical Examination for Planning Physical Restoration Goals

A. Pre-Morbid Performance in Basic Physical Functions
B. Coexistent Disease that Posed no Function Problem Prior to Stroke but Plus Stroke may Multiply Disability
C. Physical Requirements of Home and Availability of Family Personnel
D. Cardiac and Respiratory Reserve for Retraining
E. Presence of Unnecessary Additional Secondary Disability
F. Ability to Learn and Retain Newly Learned Motor Acts Consistently
G. Sitting and Standing Balance
H. Muscle Strength of Hemiparetic Arm and Leg

PSYCHOLOGICAL ASPECTS OF STROKE

I. Evaluation

A. Introduction

There are not many emotional problems peculiar to the problem of stroke per se. Most of the emotional problems of stroke patients are those one would expect from anyone who has had a significant physical disability or from the disruptions in the emotional functioning peculiar to brain damage. Those will be commented on briefly below.

B. Symbolic or language deficit

1. Refers to intellectual tasks involving the use of symbol systems such as language and numbers. Aphasia, in its various forms, is one but not the only form of this kind of deficit. It also includes such things as numerical reasoning and calculations, the ability to form abstract concepts, and the ability to carry out language reasoning tasks.
2. Symbolic deficit may occur when the cerebral damage is in the left hemisphere, particularly the parietal and temporal lobe areas. It may also occur when damage is to the right parietal temporal lobe areas in a left-handed person. Mostly, then, we would expect it in right hemiplegics and not in left hemiplegics.
3. Symbolic deficit may occur even when there are no significant signs of aphasia. It is important, however, that the evaluation of symbolic deficit be coordinated and integrated closely with a speech and language evaluation.
4. Assuming aphasia is minimal, this kind of deficit is most directly assessed by the verbal sub-tests of the Weschler Adult Intelligence Scale (WAIS). Interpretation of the findings must, however, be done by a person skilled and experienced in working with brain damaged people. If there is a significant language deficit, evaluation becomes much more difficult. One of the more useful testing devices is the Object Sorting Test, a kind of verbal concept formation test in which subjects can produce responses by sorting objects and not with the requirement of writing or speaking.

C. Perceptual Deficit

1. The general term "perceptual" is used here to refer to intellectual operations sometimes labeled by such terms as constructional apraxia, spatial-motor and visual-motor

functions. It refers to such cognitive operations as the appreciation of space, distance, movement and form. Deficits are manifested by such things as difficulty in appreciating the vertical, difficulty in discriminating between widely differing geometric forms, difficulty in reproducing geometric forms, a tendency to bump into things by showing an inability to appreciate relative distance and movement, etc.

2. These perceptual difficulties are usually associated with damage to the right cerebral hemisphere, particularly the temporal and parietal lobe areas. This is essentially true whether we are dealing with left or right-handed people. It is therefore to be expected in left hemiplegics. Significant perceptual difficulties are frequently overlooked because the patient shows no impairment in the use of language and many of the other parameters of the conventional medical mental status exam.
3. Evaluation of perceptual deficits can be carried out by performance sub-tests of the WAIS, and a variety of perceptual tests such as the Bender-Gestalt, and many others. Adequate interpretation of findings will again require the experience of one trained in working with brain-damaged patients.

D. Memory Deficit

1. Memory deficits seem to show a moderate relationship to symbolic and perceptual deficits. That is, the stroke patient with significant symbolic deficit is more likely to show memory difficulties in symbolic media and less likely to show memory difficulties in perceptual media. Conversly the stroke patient with perceptual deficit is more likely to show memory difficulties in perceptual media and not in symbolic, etc. This is not always true. Memory problems seem a little more likely to occur than other forms of intellectual deficit. Frequently, one will find patients who seem quite intact intellectually except for memory problems.
2. We suggest distinguishing three general types of memory functioning.
    a. Auditory attention span: This refers to the number of units in a given signal a patient can handle. Many patients with language problems will be able to assimilate and retain a three-word signal, for example, but not a five- or six-word message. An effective speech and language evaluation will comment to that dimension.

b. Pre-morbid learning: This refers to the recall of material learned prior to the brain damage. Assuming adequate available language, many stroke patients may reveal quite intact recall of things they knew before, even when they show other kinds of memory difficulties. However, when they show significant difficulties in this kind of recall task, they generally show quite severe memory problems in other respects.

c. Post-morbid learning: This refers to the ability to assimilate, retain, and reproduce material not previously acquired. It is this memory functioning which seems most vulnerable to brain damage. It can play a critically important role in treatment and vocational planning because it influences significantly the degree to which, and the methods by which, a patient might learn a new way of doing things or kind of work, as may be dictated by his disability.

3. Memory functioning can be evaluated by such devices as the Weschler Memory Scale, a recall portion of the Bender-Gestalt, the Benton Memory for Visual Designs Test, etc. There are no simple quantitative expressions of memory loss and therefore test interpretation must be in the hands of an appropriately skilled examiner.

E. Quality Control

1. Many patients with stroke will show difficulties in monitoring their own behavior, thereby failing to detect errors or being unaware of mistakes until the mistakes are critically severe. It is not easy to discriminate this sort of phenomena from mistakes which derive from sheer carelessness of an essentially careless person, from apathy relating to depression, and from the diffident efforts of someone who is simply not interested in rehabilitation. It may be observed, however, in a person who pre-morbidly was quite careful and meticulous. Frequently, it gets misidentified by the unsophisticated observer, professional or family member, as carelessness, laziness, etc.
2. These difficulties seem more likely to occur where there is frontal lobe involvement, bilateral involvement, or brain stem involvement.
3. Its presence is best detected by careful observations in a variety of settings. One place to look is to observe the strategies the patient employs in trying to solve intellectual tasks in such things as the WAIS.

F. Affective Lability of an Organic Nature

1. It is not uncommon for stroke patients to show an ease of emotional expression. Most commonly, this is in the form of an ease and frequency of crying, though it may also be in laughter or in outbursts of anger and frustration. Many times, such expressions are simply the straight-forward emotional expressions of an upset person. Sometimes, however, there has been sufficient disinhibition of emotional controls that the person may almost spontaneously, or at any rate, with very little external provocation, burst into tears, or laughter, etc.
2. These difficulties seem more likely to occur where there is brain stem involvement.
3. There seems to be some usefulness in discriminating between this kind of "organic" affective lability and straight-forward emotional lability by assessing the degree to which it can be interrupted. For example, if the patient suddenly bursts into tears, interruption by such things as snapping one's fingers or vigorously changing the subject may break up the pattern. If it does, one is probably observing "organic" affective lability.

II. Treatment

A. Communicating and Instructing in the Presence of Symbolic and/or Perceptual Deficits

1. Right hemiplegics tend to have more difficulty handling language and oral instruction, even when they have little if any aphasia. It is frequently helpful to rely on pantomime instruction and communication in a variety of situations.
2. Conversely, the left hemiplegic, with perceptual difficulties, frequently finds it difficult to assimilate instructions where there is a generous use of gesture and pantomime. That kind of input may only confuse him. Frequently, one can better instruct and communicate with him by relying almost exclusively on oral expression. At this point in time, it is not yet clear whether the mixture of pantomime and oral instruction work better, but our evidence suggests that it does not.
3. Where there is language and symbolic deficit, but where circumstances require the use of some oral instruction, it is important to make a particular effort to keep the oral signals brief, simple and couched in concrete terms.
4. It is obvious from the above, that vocational planning for right hemiplegics with symbolic deficits should weigh very

carefully the language and symbolic-manipulating demands of the work situations. The more the job requires the patient to think up or generate new ideas, the less likely he will be to handle it. The more abstract the language tasks involve, the less likely he will be able to handle it. The more extensive the demands on him to retain abstract language instructions and methods, the less likely he will be able to handle it.

B. Memory Difficulties

1. The left hemiplegic will find his greater difficulties in tasks requiring fine form, distance, and position discriminations. Drafting, blueprint reading, and design work would be illustrative of intellectual operations at which he would be disadvantaged.
2. Memory difficulties can frequently be overcome either by excessive drill and training to produce overlearning, or by manipulating the environment in such a way as to build in feedback or cue producing systems. For example, a patient with memory difficulties may not be able to remember how to do a job, but you may be able to teach him to rely on printed instructions which he can read each time he carries out the job.

C. Quality Control Deficit

1. As with memory problems, planning in the presence of significant quality control difficulties should proceed along the lines of seeking situations in which there are built-in feedback systems on which the patient can draw to cue himself as to whether he is making a mistake or not. For example, in some kind of simple assembly task, one should keep a finished product model available against which the subject can check himself.

D. "Organic" Affective Lability

1. This kind of brain damage induced emotional expression is not problem solving. It should not be permitted to continue if one can interrupt it. Therefore, one should instruct those around the patient to try to divert his attention in order to interrupt the emotional expressions.

E. General Considerations

1. The loss of a previously intact component of intellectual functioning is an extremely frightening and confusing experience. Many patients will, therefore, try to mask the

loss by bluffing their way through intellectual operations they can't really handle very well. In trying to cover it up, they will convey the impression many times that they are more committed to identifying themselves as not having sustained that loss than is really the case. That is, they may convince those around them that they are less able to recognize and acknowledge the impairment in intellectual functioning than is truly the case. To illustrate, a certified public accountant who has had a stroke, a right hemiplegia and resulting symbolic difficulties in numerical calculations, may behave as if he is unaware of his difficulties and is absolutely determined to return to his accounting work. Many times, what he is really expressing with that kind of posture is that he is afraid others will judge him harshly for his deficiencies. One may be very helpful to the patient by calmly and maturely pointing out that he recognizes the difficulties in numerical calculations. Many times, the patient will breathe a sigh of relief at not having to bluff any more.

2. Regardless of the pattern of intellectual deficits which a given brain-damaged patient may show, it is wise in the initial contacts with that patient to be particularly careful to speak slowly and clearly. By doing this, you may find you can elicit far more ability from the patient.

REFERENCES FOR INFORMATION ON SELF-CARE INCLUDING BATHROOM ADAPTATIONS AND HAND SPLINTING MATERIALS

ADAPTED DEVICES:

Rehabilitation Products
Department of American Hospital Supply
Division of AHSC
General Offices
2020 Ridge Avenue
Evanston, Illinois 60201

Equipment for Physical Medicine and Rehabilitation (Catalog 1072)
J.A. Preston Corporation
71 Fifth Avenue
New York, N.Y. 10003

Hospital Supplies
Abbey Rents
1500 N.E. Sandy Blvd.
Portland, Oregon 97204

HEMIPLEGIA:

Facts About Strokes
Oregon Heart Association
1133 S.W. Morrison St.
Portland, Oregon 97205

Strokes (A Guide for the Family)
American Heart Association
44 East 23rd Street
New York, N.Y. 10010

Cerebral Vascular Disease and Strokes
Superintendent of Documents
U.S. Government Printing Office
Washington D.C., 20402

Understanding Aphasia (A Guide for Family and Friends)
The Institute of Physical Medicine and Rehabilitation
New York University - Bellevue Medical Center
400 East 34th Street
New York, N.Y. 10016

Home Program for the Recent Stroke Patient
Physical Medicine and Rehab. Service
Occupational Therapy Section
G.M & S. Hospital
V.A. Center
Los Angeles, California

Strike Back at Stroke
American Heart Association
44 East 23rd Street
New York, N.Y. 10010

Bed Positioning and Transfer Procedures for the Hemiplegic
Minnesota Department of Health
Kenny Rehabilitation Institute
1800 Chicago Avenue
Minneapolis, Minnesota 55404

A Stroke Needn't Strike You Out
National Society for Crippled Children and Adults, Inc.
2023 West Ogden Avenue
Chicago, Illinois 60612

HEMIPLEGIA (Continued)

Rehabilitative Nursing Techniques - 2
(Selected Equipment Useful in the Hospital, Home or Nursing Home)
Kenny Rehabilitation Institute
1800 Chicago Avenue
Minneapolis, Minnesota 55404

Rehabilitative Nursing Techniques - 3
(A Procedure for Passive Range of Motion and Self-Assertive Exercises)
Kenny Rehabilitation Institution
1800 Chicago Avenue
Minneapolis, Minnesota 55404

Rehabilitative Nursing Techniques - 4
(Self-care and Homemaking for the Hemiplegic)'
Kenny Rehabilitation Institute
1800 Chicago Avenue
Minneapolis, Minnesota 55404

Ambulation: A Manual for Nurses
(Rehab. Publication No. 707)
American Rehabilitation Foundation
1800 Chicago Avenue
Minneapolis, Minnesota 55404

Splinting Materials used at the Rehabilitation Institute of Oregon:

1. "Prenyl" (plastic)
   Ortho Industries, Inc.
   49 Lawton Street
   New Rochelle, N. Y. 10801

2. "Bioplastics" (plastic)
   Smalley and Bates, Inc.
   450 Park Avenue South
   New York, N. Y. 10016

3. "Nyloplex" (plastic, extremely sturdy)
   Fillauer Surgical Supplies, Inc.
   936 East Third Street
   Chattanooga, Tenn. 37401

4. "Velcro" (fastening for straps)
   Smalley and Bates, Inc.
   450 Park Avenue South
   New York, N. Y. 10016

Reprinted Materials Distributed to Class

Asher, R. A. J., M. D., MRCP, "The Dangers of Going to Bed," British Medical Journal, 1947. pp. 967.

Dock, William, M. D., "The Evil Sequelae of Complete Bed Rest," from University of Southern California Department of Medicine. June 15, 1944.

Fussell, Mary R., R. N., "To Help Patients Adjust, Treat Them Like Friends," Modern Nursing Home, Vol. 22, No.1. January/February, 1968.

Jebsen, Robert H., M. D., "Therapeutic Exercise in Motion Problems," Northwest Medicine, Vol. 65, Pp. 742-747, 834-838, 952-953

Jebsen, robert h., M.D., "Use and Abuse of Ambulation Aids," The Journal of the American Medical Association, Vol. 199, No 1. January 2, 1967.

McQuillan, Florence L., R. N., "If Nursing Schedules Don't Fit Patient Needs, Change the Schedules," Modern Nursing Home, Vol. 22, No. 1, Jan./Feb., 1968.

Siebenthal, Bernice, R. N., and Schecter, George O., "Bedsores are the Result of Bad Nursing," Modern Nursing Home, Vol. 22, No. 1, Jan./Feb., 1968.

Wiseman, Eleanor P., "Rehab Center Reaches Out to Homes," Modern Nursing Home, Vol. 22, No. 1, Jan./Feb., 1968.

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RECREATION AND SOCIALIZATION

Attitude Toward Rehabilitation, Recreation and Socialization
as a Tool
Preparation and Pre-Planning

VIRGINIA L. CROWTHERS, M.S.W.

RECREATION AND SOCIALIZATION SEQUENCE

Instructor: Virginia L. Crowthers, M. S. W.

Basic Concept

Activities (individual and group) can be a means to achieve recreation and socialization goals in a rehabilitation program, within a concept of rehabilitation as spelled out by Dr. Baumgartner (text p. 139), "The rehabilitation program for a nursing home involves much more than the installation of a physical therapy or an occupational therapy unit; it is every activity of employees dealing with patients. Rehabilitation can be effective only when motivation and stimulation are a 'way of life' in the nursing home. Administrative understanding of the demands of a rehabilitation program as well as active and enthusiastic participation in fostering it will be the foundations of an effective program."

In this concept the process by which the goals are determined, planned for, and achieved, involving staff, patients, families and community is therefore as important to consider as the goals themselves.

Objectives of Sessions on Recreation and Socialization

To afford students the opportunity to:

- Clarify ideas and concepts regarding activities, recreation, socialization as part of rehabilitation
- Try themselves out in planning and carrying out some sample activities which might be used with patients
- Exchange ideas and experiences
- Become more knowledgeable about local, state and national resources of potential help to administrators and the program of recreation and socialization in a nursing home

Organization and Approach

Materials and Resources

- General Assignment Sheet
- Bibliography
- Case History from Harlow, Minnie, "Content of the Group Experience in a Psychiatric Hospital," Social Group Work with Older People, NASW, 1963
- Workbook, prepared by V. L. Crowthers, adapted from several sources
- Paper by Dr. William C. Menninger, "Our Reactions to the Physically Handicapped," Working with the Handicapped, Girl Scouts of America
- Paper by Jean Maxwell, "Group Service"
- Vignettes for Role Play and Discussion

Assignments

Assignment was designed mainly to stimulate reading of text, Baumgartner, Unit V. Emphasis on Chapter 16 was achieved through asking members of class to write out a statement from Chapter 16 with which they strongly agreed or disagreed for the first session. Other assignments were of an informal nature.

Doing and Experiencing in Class

Class experience was approached by instructor throughout as an opportunity for class members to be involved in sample activities and to discuss from these experiences the application to the nursing home setting.

To this end, class was involved in several games, some limited role play, some use of simple puzzles, decision making as to direction of class content, and encouragement of sharing experiences.

For example, the use of large name cards was discussed in relation to their own emotional reaction to focusing on names in class and the application to identity problems among patients.

Discussion

Opportunity for discussion of shared experiences (such as the game "just played") and reactions to material contained in vignettes, workbook, and other materials was included both as a means to facilitate active participation in the class but also as a demonstration of the meaningfulness of being included in such an approach. This latter was pointed out at the conclusion of the sessions. Instructor maintained "control" throughout the discussion so that sheer sharing of ignorances and venting of feelings did not waste class time unnecessarily.

Lecture

Instructor did a minimum of formal lecture, instead leading discussion in relation to specific materials and endeavoring to include considerable "oblique" teaching through handling of content as it arose from the group in reaction to materials and comments. Collaboration of the material in the workbook as a base was thus possible.

Major Content

Attitude toward rehabilitation, recreation and socialization as a tool

Basic concepts on developmental tools of the aged and physically handicapped role theory as applied to nursing home setting

principle of planning program, principle of work with staff (paid and volunteer) in activities current status of professional preparations for work with activities programs

Resources to use:

Books and reading
Organizations
Community Resources

Gap in resources and training personnel

PRESENTATION I

Preparation and Pre-Planning

Large name cards for each class member prepared and placed in front of each. (Cardboard, 4 x 6, folded back, name with Magic Marker, large enough to be seen across the room.)

Materials for "Who Am I" game, and small prizes (candies). Introduction of game: "Who Am I?"

Discussion of reaction to name tages, use of game, and application to activities in a nursing home; i.e., identity, resistance, manner of encouraging participation, pre-planning and preparation, possibile resources to use (books, etc., people), meaning of involvement of the individual.

Discussion by Instructor of Conceptual Framework, recognition of limitations of their practical situations, plan for course.

Group discussion of their choice as to whether to use remaining sessions to plan and carry out a special activity as a sample experience or to leave to instructor to devise a plan for them to experience some activities along the way, such as, the game above and the use of puzzles. Group voted for latter.

PRESENTATION II

Preparation and Pre-Planning

Use of Name Cards

Planning for games and discussion as to application

Games

Follow-up to encourage class members who had volunteered to take home one puzzle and present it to class

Hot and Cold (singing in regard to finding object)

Find the Leader (motion game)

Chal' :ges and Tricks (one introduced by instructor then spontaneous sharing from within class).

Discussion of resources and factors to consider in adapting activities to aged and handicapped.

Discussion of content from Workbook related to Leadership and Goals
pp. 8 and 9, Qualities of Leadership for Activity Programs
p. 13, Goals in Regard to Respect for Individuals

Discussion of status of professional training for furnishing personnel for leadership of activities. (Based on Workbook, pp. 6 and 7)

Use of Vignette for stimulation of role play and discussion of volunteers, role of aides, and planning. (Three prepared, class chose which to focus on.)

Vignette #2:
"Two aides have been told by their administrator that the patients were to be helped to be more active. They have just learned that at 4 o'clock that afternoon five teen-age girls will arrive to do volunteer work--will the aides see that they are helped to be useful?"

PRESENTATION III

Explanation by some class members of sample arts and crafts materials made by patients.

Review by instructor of material in Workbook, particularly focusing on brief review of material regarding developmental needs and role changes as outlines in Workbook, pp. 4-7; and on specific resources, pp. 13-26, with members of class supplementing regarding local and specific resources.

By choice of class, total class participation in sample activity, p. 20, "The King with the Terrible Temper."

Brief highlighting of gaps in resources and potential cooperative planning between nursing homes for training programs and/or sharing specialists.

WORKBOOK

ON

RECREATION AND SOCIALIZATION

IN REHABILITATION

NURSING HOME ADMINISTRATION

"... the board arranged a lovely party, but it would have been so much fun to arrange the flowers."... from a resident of a home.

ERIC

SOME THOUGHTS ON.....WHAT WE MEAN BY RECREATION AND SOCIALIZATION IN REHABILITATION

In the foreward to Toni Merrill's Activities for the Aged and Infirm, Dr. Lois J. Hardt Says:

"The modern concept of dynamic rehabilitation of the ill and impaired has validity and application in caring for the aged and infirm. The "team approach" of coordinated, inter-disciplinary procedure is being put into practice in ever-increasing numbers of institutions and programs for the elderly and chronically disable. Today the "poor farms" and "asylums' which offered static custodial care are being replaced by institutions of the highest calibre, which give not only care, but which actively endeavor to at least maintain and often to regain the highest level of function for the individual residents.

Unfortunately , the paramedical services which accompany the medical aspects of modern rehabilitation are very costly, and whenthe administrator must work with limited financial resources he is forced to either forego or diminish those services which appear to have the least tangible and measurable results.

The service called "recreation" is one of these, and although the detrimental effects of social isolation and idleness have been fully recognized, the values of recreational experiences as combatants of this deterioration have not been fully recognized.

Perhaps the values have never been fully perceived because the potential of recreation and socialization has never been fully exploited and realized. For too long a time, the adjunctive therapy of recreation and socialization was relegated to an existence dependent upon the "Lady Bountifuls" who allied themselves with the institution. Untrained, given no leadership, no equipment, no budget and no meaningful time in the daily schedule, the well-meaning and dedicated volunteers evolved the only program they knew -- they did for rather than with-- and for many years, the passive entertainment type of recreation and socialization which these volunteers provided were the only bright spots in the long days of the institution residents.

Just as we have come to recognize that maximum rehabilitation or the maximum maintenance of habitation can only be achieved through a process of combined efforts of medical and paramedical disciplines, we also realize that each contributing discipline must be equally dynamic and aggressive. The socio-recreational phase of the procedure, therefore, cannot be static or passive and still make its contribution to the process. But even as we recognize this, we lack sufficient trained professional recreation personnel to direct the socialization aspect, and we probably never will have adequate personnel to do all that could be done.

We have needed, therefore, and we shall always need, the volunteers, the untrained but dedicated people who fill the personnel and program void by giving long hours of untiring effort; and we, the professionals, must aid and enhance their efforts by providing them with the tools to carry out our programs.

This book is a tool. Written by a professional for the volunteer, it tells why, how, what, when and where. It shows the way to do with rather than merely for. In using this book, the reader will not only find step-by-step directions and methods, but will also read of the creativity of other volunteers and hopefully be encouraged to create anew."

From Baumgartner, Concepts of Nursing Home Administration,

Rehabilitation: A total program of patient care and motivation and includes virtually every activity of employees dealing with patients. Rehabilitation can be effective only when motivation and stimulation are a "way of life" in the nursing home.

Some Questions a Nursing Home Administrator Needs to Ask:

1. What can the Nursing Home Administrator do to help develop this "way of life" in the nursing home?
2. What do we mean by rehabilitation "needs," recreation, socialization?
3. What guidelines can be helpful?
4. What resources are available?

THE BASIC NEEDS OF PATIENTS....

The Institute of Gerontology of the State University of Oiwa lists the following needs and drives of the older person, based on the thinking of Clark Tibbitts:*

1. To render some socially useful service
2. To be considered a part of the community
3. To occupy increased leisure time in satisfying ways
4. To enjoy normal companionships
5. For recognition as an individual
6. For opportunity for self-expression
7. For health protection and care
8. For suitable mental stimulation
9. For living arrangements and family relationships
10. For spiritual satisfactions

Louis Lowy, in "Meeting the Needs of Older People on a Differential Basis," states:

"Aging is a developmental process with its own developmental tasks."

*Tibbitts, Clark, ed., Handbook of Social Gerontology, Chicago, University of Chicago Press, 1060, p. 467.

....The concept of common human needs (biological, physiological, emotional, social, or spiritual) for people of all ages is a familiar one.... According to a sociological-anthropological notion, a universal biological restlessness or tension becomes a "need," and at the level of consciousness this "need" becomes socially shaped and defined. "The need is the manifestation in the individual of a group's functional prerequisite to survival, as shaped by that group and brought to consciousness through group experience. Needs, in this sense, change with changes in the fate, orientation and technology of the social group."

Viewed in this way, older adults (and handicapped adults who live in nursing homes) may be seen as a group who live in a "sub-culture" in our society and therefore, have certain common needs that have developed out of their shared "fate," their ascribed status or position in our culture, which in turn have modified their particular needs as individuals. Each individual adapts in different ways to the "subcultural aspects" of the aged (or handicapped group). These differential modes of adaptation are inherent in the particular personality of the individual; his ego structure, his "life history" in evolescence, his idiosyncratic responses prior to senescence (or being handicapped), his self-image, his reactions to stress situations, his position in the social structure--in short, the totality of an individual's life pattern--shaped by biological and environmental forces and his psychological repertoire of responses to new situations, new expectations and new demands.

Problems

Because of the conditions imposed by society on the aging (and the handicapped), many have greater difficulty satisfying and fulfilling their needs than persons of younger age. Some of these particular problems are:

Gradual isolation and aloneness
Loss of social identity (work identity, identity reversal in family roles, sexual identity)
Physical and mental loss
Fear of death and lack of future

"Problems" viewed as Developmental Tasks...

Viewed as part of the total process of living, the problems may be seen as developmental tasks of the particular developmental process known as aging (or the tasks confronted by the handicapped):

1. To redefine social identity through development of "new" social roles in associational contexts
2. To link past and present to future as related to family, peers, associations, services and community

3. To redefine the individual's value system
4. To adjust to physical and mental changes
5. To develop a new self-image "challenging" the societal-stereotyped expectations of behavior of older (and handicapped) people
6. To develop a sense of integrity which can lead to a profound concern for system, order and meaning in human existence

Adapted from Lowy, Louis, "Meeting the Needs of Older People on a Differential Basis," Social Group Work with Older People, National Association of Social Workers, New York, N. Y., 1963.

SOME GUIDELINES FOR . . . . PLANNING FOR AND CARRYING OUT EFFECTIVE ACTIVITIES THROUGH RECREATION AND SOCIALIZATION TO MEET REHABILITATION GOALS

Most important features of rehabilitation in a nursing home should include total staff participation, patients as motivators, volunteers, family as co-planners, physical and occupational therapists as consultants, and wherever possible, a psychiatrist as a consultant, and cooperative relationships between nursing home and hospital. The success of any rehabilitation program revolves around attitudes of staff. Consequently, they must be involved in the decision-making process when rehabilitation is being introduced. In addition, a continuous inservice training program should be set up so that they can develop applied skills necessary to make a contribution to the whole process. Not to means: risking disinterest, resistance, and failure. *

Some Guidelines Regarding Personnel for Recreation and Socialization Activities . . .

Possibly the only agreement we might get among the various professions which have developed approaches to rehabilitation through recreation and socialization activities would be that no one profession at the present time either has the "perfect" training program or produces enough personnel to begin to begin to fill the need.

Many factors bear on the present situation of there being much more demand for staff, including professional, paraprofessional and volunteer, to meet the growing need for well-planned, well-run, effective activities programs in work with the aged and the handicapped.

Some of these factors briefly are:

1. The Protestant-Puritanical ethic of society in the U. S. which has until recently tended to see recreation as "play," idleness, wastefulness, etc.
2. The fairly recent emergence of strong support within the medical profession for sound use of recreation and socialization activities on an individual and group basis as part of effective rehabilitation of the handicapped.
3. Fairly recent recognition that some of the "on the shelf" attitude toward the older citizen and the handicapped citizen was falsely based and that restoration of functioning, if not to maximum previous level, to a more satisfying level to the individual is frequently possible.

*Text. Baumgarten, p. 141 (Margolin and Hurwitz).

4. Recent development of professional training programs: 1) recreation, 2) occupational therapy, 3) physical therapy, 4) rehabilitation as professional development itself, 5) social work especially social group work, 6) special education, 7) new nursing education, 8) many "para-professional" developments related to all of these specialties such as aides, attendants, etc.

The following guidelines are generic, and not related to any one professional discipline as preparation for rehabilitation.

SOME GUIDELINES REGARDING PERSONNEL IN RECREATION AND SOCIALIZATION ACTIVITIES

Personal Qualities of Recreation Leaders:

George Butler*, a long-time worker in recreation - an expert, cites personal qualities of recreation leaders as follows:

Leaders must have the same personal qualities expected of all professional persons dealing with human personalities. Among these qualities essential for recreation leaders are:

1. Belief in the worth and dignity of every human being.
2. An understanding of the interests and needs of people.
3. Concern with the growth of individuals through creative expression.
4. Sense of service above personal ambition.
5. Personal realization of the joy of life and the art of living.
6. Good sense of humor.
7. A pleasing, friendly personality.
8. Appreciation of leadership as an art.
9. Organizing ability.
10. Belief in democracy in recreation, as in government.
11. Productive energy and contagious enthusiasm.
12. Ability to get along with people, to accept others' opinions and personalities.
13. Sterling character and personal and professional integrity.
14. Good physical and mental health.

*Butler, George D., Introduction to Community Recreation, McGraw-Hill, New York, N. Y., 1959, pp. 109-110.

Personal Qualities in Work with the Handicapped:

Janet Pomeroy* elaborates on Mr. Butler's listing in discussing qualities essential for good leadership in work with the handicapped as follows:

The leader should:

1. Accept the handicapped person first as an individual who has the same basic needs, desires, and problems as other people.
2. Maintain a sympathetic understanding of each person's handicap, but not indulge in pity.
3. Demonstrate a capacity for patience, imagination, and ingenuity.
4. Recognize and be able to meet the specific and immediate social and recreational needs of the individual.
5. Help the handicapped to help themselves.
6. Be willing to do menial tasks such as feeding and lifting the handicapped, toileting and handling wheel chairs and portable beds.

In summary, Mrs. Pomeroy states:

1. Emotional stability
2. Self-confidence and security
3. Patience, tolerance and understanding
4. Stamina and physical energy
5. Ingenuity and imagination
6. Selflessness
7. Responsibility
8. Mature judgment
9. Enthusiasm and a sense of humor

SOME GUIDELINES FOR EVALUATING EFFECTIVENESS OF RECREATION AND SOCIALIZATION ACTIVITIES AS PART OF REHABILITATION**

A. Evaluating in relation to the individual patient....

It is necessary to know the patient as well as possible - attendants on the wards giving baths and working closely with them are often helpful.

* Pomeroy, Janet. Recreation for the Physically Handicapped, MacMillan and Co., New York, 1964, pp. 52-54.

** Adapted from Merrill, Toni, Activities for the Aged and Infirm. A Handbook for the Untrained Worker, Charles C. Thomas, Publisher, Springfield, Ill, 1967.

1. Does the patient have a chance to take part in planning specific activities in the Home?
2. Are the patient's needs studied carefully and adapted to the program?
3. Can the patient evaluate the program through questionnaires, a patient council or other specific requests on what he'd like in a program?
4. Are individual special interests, talents, physical abilities, sex, religious, and cultural backgrounds considered?
5. Is there a chance for the patient to see improvement, accomplishment and success in a program planned to help him achieve as much as he's able?
6. Does encouragement, recognition and approval go with his taking part?
7. Does the program give him a sense of belonging and having some importance in the Home?
8. Is the patient learning new interests and developing helpful skills?
9. Is patient helped to develop and learn through new activities?
10. Is effort made to determine improved change in his attitude, behavior, social and physical?

B. Evaluating the Leader. . .

1. Does the activity staff closely cooperate in working with the rest of the Home personnel, attending daily staff meetings, informing them of the program and receiving individual referrals of patients with whom to work?
2. Are the leader's responsibilities related to his training?
3. Does the leader have a chance to develop skills by attending schools or institutes, workshops and professional meetings?
4. Do the leaders at every level have supervision and direction?
5. Is every resource - equipment and manpower - in the Home utilized to expand the program?
6. Does each leader have his duties as well as the goals of the program stated in writing?
7. Does the leader give thought to the future in budgets, facilities and equipment as well as program?
8. Does the budget planning correspond with the achievements to be reached in the program, a budget which contributes directly to the needs of the program?
9. Is equipment adequate and are areas attractive?
10. Are reports and records kept for permanent use in the Home?
11. Is there good communication among activity staff members and among other departments?

12. Can the leader evoke good response with his staff, directing and inspiring them rather than dictating?
13. Does the leader keep in mind definite needs and individual differences among residents?

C. Evaluating in Relation to the Activities Staff (Professional and Volunteer)...

1. Does the activity staff closely cooperate in working with the rest of the Home personnel? Is their work related to staff meetings, directly or indirectly?
2. Is there provision for an individualized referral process to and from activities in relation to each patient?
3. Are the leader's responsibilities related to his training? And vice versa?
4. Does activities staff have opportunity to develop skills by attending schools or institutes, workshops, and professional meetings?
5. Is supervision and direction provided at all levels?
6. Is every resource - equipment and manpower - in the Home utilized to develop program?
7. Does each activities leader have his duties as well as the goals of the program stated in writing?
8. Is there a direct means for needs and experience of the activities program to be related to current and future budgeting?
9. Is equipment adequate and are areas attractive?
10. Are reports and records kept for permanent use in the Home?
11. Is there good communication among activity staff members and among other staff?
12. Can the activities director evoke good response with staff directing and inspiring them rather than dictating?
13. Does the leader keep in mind definite needs and individual differences among residents?

D. Evaluating in Relation to the Activities Program as a Whole....

1. Do activities offer the greatest active participation by the greatest number of residents?
2. Are activities centered around a stated goal for the program?
3. Is there a balance of social and physical activities, crafts, games?
4. Is there appropriate balance between individual and group activities?
5. Do activities provide for the resident making some contribution to the community, in some way taking part in community life?

6. Is the program judged by only the number of participants or by their interest, enthusiasm and satisfaction?
7. Are activities judged not only on their number and variety but also on their effectiveness?
8. Does the program teach skills and other materials for continued activity during evenings and weekends?
9. Does programming allow for working with individuals?
10. Do all activities agree with the nursing goals of the Home?
11. Is the program broad enough to provide for a wide range of interests for individuals?
12. Does the program change as the needs of the residents change?
13. Does the program kindle group consciousness and residents responsibility to one another?
14. Can the program scheduled be continued over a length of time?

SOME SAMPLES OF ACTIVITIES

"If there is interest in rehabilitation, a good maxim is to "begin to begin". Start with the premise that rehabilitation is an all-embracing concept and includes many diverse facets. It is the author's contention that although trained rehabilitation therapists and elaborate facilities or equipment are nice to have, they are not absolutely necessary to begin a program. In fact, with a little ingenuity, it would be possible for the administrator to establish a program without adding a penny to the nursing home's operating costs."

But remember, also... "The success of any rehabilitation program revolves around attitudes of staff."

The activities listed in the following pages are drawn from actual experiences of staff (professional, para-professional and volunteer) in working successfully with older and handicapped patients, and generally low in cost.

Adapted from Merrill, pages 102-104.

Activities for Senescent Patients. . .

Cautions regarding need for medical prescription or approval for activities for these patients in particular.

Beachball

..... Senescent, senile residents or the mentally infirm, seated in a circle, will catch a beachball when bounced to them and begin to laugh, perhaps

learning to call another by name they throw the ball. And whether or not the game is explained to them, they'll catch the ball in a reflex action. If the ball is bounced on the floor instead of thrown directly at them, eye glasses won't be knocked off.

Other

.....Other seated exercises using arms, legs and head motions are given by an activity aide demonstrating in the center of the circle with music. .....This type of geriatric patient can be reached sitting in a circle just clapping to music.

Rhythm Band

.....Senescent patients tied in wheel chairs to prevent their falling out, often completely disoriented, are difficult to reach; but party hat on their heads and a pie tin and wooden spoon in their hands make them feel a light-hearted gaiety which brings smiles. If a record player or a pianist begins some old familiar tune such as a march with a regular beat, heads will nod in time and wooden spoon and pie tin become rhythm beater. Triangles or bells, hummers and other conventional rhythm band instruments will add to the tone.

Discussion

.....An aide reports on leading a group discussion with senescent patients who seemed lucid about early periods of their lives; discussing some research on the common cold, they remembered treatments for their childrens' illnesses and could talk about them. They discussed shopping and remembered the marketing of a generation ago. The aide meeting them regularly on the ward starts the discussion by beginning "way back" leading the discussion toward more recent times.

Adapted from Merrill, pp. 107-119.

Activities for Bed Care Patients

1. Physically Restrained or Disoriented Patients
   a. Tear rags for rugs
   b. Fold diapers, napkins, etc.
   c. Knit
   d. Play with a doll
   e. Play maracas, tin pans and spoon, triangles
   f. Color books

2. Blind Bed Patients
   a. Make shaggy rugs
   b. Play coverall

c. Sand Breadboards
d. Refinish or whittle small pieces of wood
e. Guess what's in the box, quizzes
f. Cut stockings for stuffing animals and dolls

3. Deaf Bed Patients
   a. Read
   b. Sew, crochet, handiwork
   c. Arrange dried flowers
   d. Write for the home newspaper or city paper
   e. Do jigsaw puzzles
   f. Play bedside games
   g. Paint
   h. Do quizzes (deaf patient cited 119 words from the words "Summer Vacation.")
   i. Mend for staff and other patients
   j. Assemble puppets and other model kits
   k. Make link belts, leather lacing

4. Aphasic Patient
   a. Read or someone read to him (if he can understand)
   b. Do crafts
   c. Play games
   d. Have someone give him a manicure, brush his hair; personal grooming
   e. Study nature
   f. Watch movies, slides, viewer

5. Bed Patient with One Hand
   a. Make pot holders
   b. Make huck toweling, embroider
   c. Make link belts
   d. Make macaroni crafts
   e. Make gravel mosaics

Other ideas for bed patients discussed by Merrill:

Simple crafts
Staff "springing" puzzles, guessing games
Throwing suction darts--or styrofoam ball from bed
Bingo--carefully organized so all can hear, help given to watch cards if needed

Hobbies:

Birds--watching feeders, using the Bird Call records
Gardening--chemical gardening, planting lemon or grapefruit seeds, beans, in small jar or dish; carrot or beet tops in water on small

stones. A carrot with a well dug in the top filled with water and hung in the window will begin to sprout and become interesting to watch if cared for by a bed- or wheel-chair patient.

Collections

Keeping Diaries

Writing to Pen Pals

Discussion

Staff, professional and volunteer, can be found or trained to give leadership to effective group discussion. Look for teachers, former teachers, college students....who can listen!

Some hints: Keep the group small so every one gets a chance to talk. Focus on topics which give a chance for using memories or relating to an immediate experience which the group has all shared such as an item from current news or a poem. The leader needs to practice being skilled in using open-ended questions which lead to more discussion.

Some ideas:

When I went to school
Work I did as a young person
What travel used to be like
My most unforgettable teacher
The worst winter I ever remember

Some suggestions for instance: What was the first school you remember? Anyone remember a sod-building, adobe or log? What color was it? What was the floor like? Heating? How did it keep going? How far did you have to walk? Ever get a ride? What happened on your first day at school? What was lunch like? Recess? etc.

A specific remotivation program based on Discussion is described in Baumgarten, pp. 177-181, by Dr. Granville L. Jones. He says: "The basic theory of remotivation is that while the patient is sick, not all his personality is affected by his illness. We know well that the general illness of the brain and nervous system affects first the things that have been learned and experienced more recently. Simple, normal everyday things, things which the person has been meeting and experiencing all of his life will remain less impaired. It is these things about which the discussion in the remotivation sessions are carried on. The patient is able to use and exercise that part of him which is reasonably well and health, even if it is somewhat atrophic from neglect. The method facilitates the exchange of consideration and respect which helps the patient to feel that he belongs, to feel that his opinions are listened to and respected, and that he is still part of the world about him."

Service Projects - Some Possibilities

Making layettes for babies whose mothers need such a boost.

Making simple dresses or coveralls for older children who are served by local welfare agencies.

Making holiday tray favors, table decorations.

Stitching up mosquito-net Christmas stockings to be filled by a church group or local service club.

Stuff animals for children's hospitals, nursery schools, clinics, etc. (Lots are needed--so kids can take their "friends" home with them.)

Make puzzles and toys for children's hospitals, Head-start programs, nursery schools, waiting rooms at social agencies and clinics--paste large pictures of animals, people, scenes from large magazines, calendars, etc. on cardboard--cut into large pieces.

Make special teaching devices needed for teaching handicapped children--how to tie laces, button buttons, etc. Check with teacher as to what is needed--don't decide for them!

Making bandages and pads for Cancer Society and other medical settings.

Make quilts to have available for Red Cross or other community welfare resources when families suffer fire or other disaster.

Stuffing envelopes, etc. for local agencies such as United Good Neighbors, Red Cross, Mental Health Society, other similar organizations.

Finding Things to do to Keep the Home Running Smoothly

Can the tasks to keep the nursing home running be organized and shared so as to give patients a chance to share in their own living situation?

- Mending--sheets, clothes, making aprons and tie-strings for gowns and aprons
- Sorting linen
- Making foam rubber cushions for wheel-chairs
- Lawn work, raking leaves
- Working in stock room
- Overseeing library
- Keeping games and activities equipment in good order
- Acting as receptionist

Caring for plants
Cleaning silver
Preparing posters and bulletin boards
Helping with office work
Distributing newspapers

Music

Music is the most subjective of all the arts, existing only as it is made. It is probably the most primitive of the arts, since our earliest cultural form was the ritual ceremony containing music. Music is probably the earliest form of artistic expression of emotion.

With the older and handicapped individual, music may have a special place because it is so basic to human experience and because capacity for participation in some form or other may remain when other impairments have impinged on previously enjoyed arts and past-times.

In general, there are four kinds of musical activities: 1) singing, or making sounds with the human voice, 2) moving parts or all of the body to rhythms, 3) listening to music, and 4) creating tone mechanically on various instruments.

A nursing home patient may be able to participate in all four ways.

Many resources are available through books and people to help to adapt such activities creatively to work with the aging and the handicapped.

For example:

Rhythm Instruments (Combine low cost, craft activity, and ease in leading.)

Dramatics, Choral Speech

Formal play-acting and dramatics are not so easy or successful with older and handicapped citizens. Many simple adaptations of the fun to pretend can be made however.

Paper Bag Dramatics: Place four or five objects in a paper bag, give a small troup some time to make up a skit.

Charades

Pantomime: milking a cow; breaking eggs; baking a cake; popping corn; catching a fish; bathing baby (dog); picking a chicken; receiving unexpected callers; starting an old-time car; starting the wood stove.

Group Story Game

The King with the Terrible Temper

Lion Hunt

Reading a play out loud--one person or different persons

Choral Speech or Reading Aloud Together

Easy for all in group to take part in at their pace. Older people likely memorized considerable poetry in their school days--McGuffey's Readers (available in libraries and stores) would provide old familiar poems. Snow-bound, Longfellow's poems, probably some of Shakespeare, and Bible stories might be of interest to some groups.

Resource: Heltman, Harry J. and Brown, Helen J., Choral Reading for Fun and Recreation, Westminster Press, Philadelphia.

Games, Special Events, Parties

So much is available in excellent books that examples are not given here. (See the Bibliography.)

Some other hints:

1. Watch newspapers and magazines for new ideas--and often articles on useful activities can be adapted. For example, Woman's Day, July 1960--101 Tricks and Treats, designed for harried mothers of kids home from school, had many good ideas of possible use to adapt to patients.

2. Adapting current TV and radio programs or old favorites...can be a good involvement of some patients to make the plans and excellent activity. For example, What's My Line, Twenty Questions, The Price is Right.

3. Mock Tournaments (as well as regular ladder tournaments in checkers, chess, etc.) are fun for patients to help plan and easy to carry out, with care in adapting, i.e., Basketball (into a waste-basket), clothes pins into a can.

Many other possibilities

Gardening (indoors and out)
Patients newspaper
Hobbies and collections

SOME RESOURCES

Film Sources

For catalogues:

Audio-Visual Aids
Library
Pennsylvania State University
University Park, Pennsylvania 16802

Metropolitan Life Insurance Company
1 Madison Avenue
New York, New York 10010

Educators' Guide to Free Films
Educators' Progress Service
Randolph, Wisconsin 53956

Film Catalogue on Free Films
The Sterling Movies, Inc.
6 East 39th Street
New York, N. Y. 10016

Arts Activities Almanac:
(Excellent compilation of widely varied activities; arranged for easy use.)

Complete Art Activities Almanac
Art Education Alumni
Wayne University
100 West Kirby Avenue
Detroit, Michigan 49202 ($3.50)

Special Games Supplies

Candler's Bingo King
P. O. Box 1178
Englewood, Colorado 80100
(#400 type card at 43¢ each for bingo with "seethru" plastic shutters)

Mansfield-Zesiger Mfg. Co.
Cuyahoga Falls, Ohio
(Portable bowling game, pins hang on a rod and flip over, very popular game; $9.95 postpaid)

Masenfield Bros., Inc.
Central Falls, R.I. 02863
(Bull's eye target game, styrofoam ball is thrown at plastic pointed pins on target. For bed patients.)

J. B. Birchall
2520 Glenwood
Rockford, Illinois 61103
(Egyptian checkers in combination of checkers and Chinese checkers with small blocks; $13.90 a dozen.)

World Wide Games
Box 450
Delaware, Ohio 43015
(Excellent collection of sturdy well-made games and puzzl es.)

Excellent Handbook (one of the best - cost $1.00)

Recreation Handbook
U. S. Department of Health, Education and Welfare
Government Printing Office
Washington, D. C. 20402

Pen Pals, etc.

Federation of Aged People's Clubs in Japan would like to exchange correspondence with senior groups in the U. S.

The Federation of Aged People's Clubs
Hyogo Prefecture
c/o Shakei Jigyo Kaikan
Nakayamate - dor 2 chome
Ikata-Ku, Japan

Grandmother's Clubs of America
National Headquarters
203 N. Wabash Avenue
Chicago, Illinois 60601

What about local church contacts with departments of work overseas? People who travel to find such contacts?

CASE HISTORY

C, now in her 60's, had been hospitalized for 45 years--since she was 15! In every respect she was the "typical back-ward patient" of a state hospital--the straight hair, the soup-bowl haircut, the sack dress which hung from her shoulders; disgruntled and suspicious that others wanted to get rid of her. Yet there were evidences of health thinly covering her illness. She worked in the hospital bakery. She was not a management problem, so well adapted she was to institutional living.

She had always lived on a woman's ward, but when she was included in the research project she was moved to a ward where both sexes lived. This alone could have been traumatic for her, but her preparation began early with the group worker gently telling her about the goals of the project. C was determined that she would never leave the hospital and attempted in many ways to prove this until one day, when she was with a group of patients baking a cake, preparing for a birthday party.

A cake mix deliberately had been chosen by the group worker since many of the patients in the group did not know about such "newfangled ideas." C was adamant in her disbelief as to the eventual success of the cake, and as it was baking she kept peeking into the oven. However, the cake was beautiful and tasted good. The following morning C confronted the group worker with a severe charge that she and the others had been "holding" her in the hospital, and were not letting her know what was going on in town. C had not been off the hospital grounds for more than twenty years; each time such a trip had been planned she had been shrewd enough to avoid it. After this backhanded bid for more "tastes of the outside world," the group worker suggested that C gather a group of her friends and that together they would go to town to visit the local market where they could find some other things to cook.

C at first refused to go to town. "Looking like I do, those folks will know that you have been mistreating me all these years. I've got to have some new clothes." Some new clothes, and even a new hairdo followed. This trip and others finally took place. The local merchant became so interested in the project for these patients that he shared with them his order book and ordered their choices of specialties for them.

Case History: From Harlow, Minnie, "Content of the Group Experience in a Psychiatric Hospital," Social Group Work with Older People, NASW, 1963.

B came to the hospital because he felt that he was "slipping." He was anxious, tense, and fearful. His wife, five years his senior, had always depended on him. However, she had helped him feel needed and adequate. Throughout

his life B had overcompensated for his feelings of inadequacy not only by being important to his wife, but by being an aggressive farmer-rancher. Now, these previous methods of adaptation were no longer available. He was retired andthe needs of his wife were becoming too heavy a load to bear. The problem was, how could the hospital help him find new methods of adaptation?

When B entered the hospital, his loneliness and his feelings of desertion initially increased his anxieties and made him question his decision to explore his problems. His feelings of inadequacy were intensified by the necessary hospital admission procedures. For example, he no longer carried the keys to his car, his wallet, and other personal identifications. The hospital, too, was imposing additional losses upon him.

At B's first floor meeting he heard some of the younger, and very vocal, patients complain vociferously about the lack of parties, the fact that "it was very dull here," and about how deeply they resented the hospital policies. In the meeting, B indicated by his reactions that he felt some empathy with these younger patients who could express their feelings of deprivation. After the meeting, however, like a "grouchy old man," he said that he did not see "any sense to such a meeting--and listen to those kids gripe--they should know what real problems are!" He also complained, "Those youngsters do not even know how to conduct a meeting or how to conduct themselves in a meeting." The group worker agreed that it must have been very uncomfortable for him but wondered if there were not specific areas in which he could help these younger patients so that they could present their questions, complaints, and concerns in a more orderly and adult manner. He thought they would "scoff" at him. In further discussions he recognized that they were just as unhappy in the hospital as he was, but "they show it in a different way."

The following week one of these young patients told the group worker that he had been visiting with "our older man" and "my, but he has done a lot of living. All the things he did during the dust bowl; that homestead he had...." This younger patient suggested that the group worker should get to know the patient because "he talks some real sense. He has some good ideas about how we could do more for ourselves and not ask for so much." While they were talking in this way another patient joined in and said that things on the floor in the evening were somewhat different since B came. Several of them had learned to play "pitch." He was teaching them some of the things he knew, and they were also teaching him some of the games they liked to play.

B was no longer "the grumbling old man who complained about the youngsters." His early destructive attitude and behavior toward the patient group dissolved as he found he had something of adult value to contribute to the hospital life of the younger patients. His experiences in the unit meetings also helped him use what the hospital could offer him. He felt some return of the sense of mastery in this therapeutic community.

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Situation #1

The Nursing Home Administrator has been taking a course in which he has become convinced that it's important that the patients have more activities. The president of the local Garden Club has convinced her garden club members that they could do a good service by helping the Nursing Home (their ideas are to come and plant flowers--take care of them--bring bouquets of their flowers, etc.). A patient who formerly had an extensive garden can get around but has some handicap with one arm. The nurse's aide has been doing a good job looking after patients, seeing that all their physical needs are well taken care of, and the administrator told her the day before to organize more activities.

The scene is in the Administrator's office:

All have come in at one time . . . .

--the Garden Club president to make their pitch

--the patient to make his pitch (he'd be glad to look after the grounds but he doesn't have any money to buy plants and he can't do it all alone)

--the aide to complain she has too much to do

Situation #2

Two aides have been told by their administrator that the patients were to be helped to be more active. They have just learned that at 4 o'clock that afternoon five teenage girls will arrive to do volunteer work--will the aides see that they are helped to feel useful?

Situation #3

The Nursing Home Administrator has decided that the patients need to be more active. He learned that layettes were needed by the Salvation Army Home for Unwed Mothers. He gets the materials and has the nurse in charge tell patients (who can take part) that this is here for them to do.

He gets word back that the patients refuse to take part--just encourage those good for nothing girls to be worse to reward them with nice clothes for the baby.

OUR REACTIONS TO THE PHYSICALLY HANDICAPPED

by William C. Menninger, M. D.

If we are going to understand adequately the reactions of the physically handicapped individual, we must start with a clear understanding of ourselves. Whatever his reaction may be depends very largely on our reactions to his problem. Therefore, intentionally or unintentionally, we can add to or lighten his burden materially. We can well afford first to scrutinize our own feelings, their origin, and our behavior associated with those feelings.

Most, if not all, people have specific feelings about and therefore react either positively or negatively towards handicapped persons. Many of these reactions are definitely negative and as such inflict an additional burden on the handicapped person. How, and perhaps more importantly, why do we feel as we do towards the crippled, the paralyzed, the deformed?

No two of us feel just alike towards any particular person whether he is handicapped or not. There are many variable factors that determine the interpersonal relations between people. Most vividly influencing one's attitude is the relationship to and the investment of emotion in the person concerned; if this person is one's own child, or even any member of the family, the attitude is very different from that felt towards a stranger. Our feeling depends also on whether the crippling may have been present from birth or was the result of disease or accident after a period of normal development. All of us are influenced in some degree by the extent and the nature of the crippling, perhaps most importantly by the external appearance and the extent of the functional handicap in ordinary living. We have different reactions to the crippled child as compared to the crippled adult. Our personal knowledge about and contact with such individuals and our technical information about the psychological and physical rehabilitation also affect our attitude and behavior.

Emotional feelings are expressed not only by word of mouth, but more importantly by facial expression and behavior. One of the basic facts we have learned in the study of personality is that we may be influenced more by another person's attitudes or feelings than by his words or actions. In a close relationship to a specific person, our real feelings are communicated automatically in many other ways than by what we say. Our immediate reaction towards handicapped persons whose physical difficulty is apparent is that he is "different." Our feelings are sometimes such that we would not want to admit them; very often they are beyond our own under standing.

What are the common emotional feelings about physically handicapped persons, with their resulting reactions?

1. Curiosity: This is perhaps the most common reaction of people towards the physically handicapped. It is somewhat similar to the interest of some persons in viewing the freaks in a sideshow. Frequently one is so intrigued that he feels inclined to call the attention of someone else to the sights to be seen as if to share his guilt in peeping at the forbidden. The cultured person feels embarrassed at his own desire to stare. The less mature person makes little effort to hide his curiosity in the morbid.

2. Pity: This is also a common response. One cannot say that this is an ignoble feeling but most frequently it is felt when there is recognition but no understanding of a condition. Often it is an admission of the knowledge of a sorry state of affairs but with no responsibility or intent to change the situation. Sometimes it represents a kind of hands-off policy. Because the status of a handicapped person may be no business of the observer, it creates a feeling of helplessness to change or relieve the stress caused by the handicap.

3. Over-solicitousness: This is frequently expressed by many people towards the handicapped, particularly so when he is a member of the family. However, this reaction is by no means limited to the members of the immediate family. In the majority of instances it is a compensatory attitude. It is an excessive striving to aid someone as a disguise for the unadmitted feelings, at a deeper level of the personality, which are totally unacceptable consciously. In many instances it represents a strong effort to deny an unconscious rejection. It is a way of banishing from conscious recognition the hostile feelings towards the person involved. The hostility of one part of the personality is held in check by another part which assumes the opposite attitude. Such behavior is not infrequently shown in the way some people determine the amount they give to charity--enough to appease their conscience and thus get it off their mind, regardless of the need.

4. Mild dislike for personal contact with a handicapped person is expressed by many people. In their intimate circle they frankly admit this unacceptable although unexplainable attitude. Rarely do they have any understanding of why they feel as they do, only being aware of feeling uncomfortable or ill at ease with such persons. This is a mild form of rejection.

5. Repugnance and complete rejection are occasionally acknowledged by some people but one must assume that this attitude is far more common than the very few who admit having it. One may recognize such an attitude as unreasonable and, even though sympathetic, cannot change this more basic response.

6. Fear as an emotional reaction may be expressed in either of two directions. Some people feel anoth r's handicap as some vague threat to themselves. All of us feel uncertain about the unknown. Because the physically handicapped

individual appears as a strange and unknown kind of person, contact produces a feeling of uneasiness or anxiety. Some people fear their contacts with the physically handicapped because they are painfully aware of being so ill at ease with them. They are afraid that they may say or do something out of place or even offensive. They do not want to be over-solicitous or patronizing. Many people simply do not have sufficient contact with handicapped persons to know what they should say, how they should behave, or how much acknowledgment they should make of the handicap that exists.

7. Sympathetic understanding: This is fortunately an increasingly common emotional reaction to the physically handicapped. It is the only rational attitude. However, while most human beings can be sympathetic, understanding only comes with information. One cannot completely understand a complicated problem in human relationships on the basis of "common sense." It requires very uncommon sense. Therefore, it becomes the responsibility of all of us to provide a basis for understanding to the handicapped, to their friends and relatives and the public.

In addition to these general attitudes, there are some special ones in very occasional circumstances. The physician and therapists who work with handicapped patients must keep foremost a scientific attitude towards the problem. Insofar as it is scientific, it is unemotional. All of us who work with handicapped people modify our initial attitudes with increasing experience. The change, varying in the personal relationships with each person with whom we come in contact, often leads to admiration and respect.

1. Describe briefly the main features of your social and recreational program for your residents.

2. Do you have a staff member who has specific responsibility for the social, recreational program? Yes_____ No_____

3. If yes, how much time is devoted to the program ?
   Full time_____ Half time_____ Other (specify)_____
   Also describe the experience of this staff member in recreation.

4. What are the problems your staff is experiencing in securing resident participation in the social and recreation program?

5. How much help in terms of volunteers and services are you able to secure from the community for your social and recreational program.

6. Do you have a resident committee help in planning activities in the social and recreation program?

7. Do you have space specifically provided for large group activities? Describe. If not, what provisions are made for social and recreational activities?

8. What are the main items of equipment and supplies that are used in the social and recreational program?

ADDITIONAL MATERIAL DISTRIBUTED TO STUDENTS:

"Games for Adults of all Ages," World Wide Games, Box 450, Delaware, Ohio.

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ENVIRONMENTAL HEALTH CONTROL

Presentation I
- Epidemiological Approaches to Health Problems

Presentation II
- Water Supply
- Sewage Disposal
- Sanitary Plumbing
- Food Sanitation
- Vector Control
- Solid Wastes

Presentation III
- Laundry and Linen Service
- Housekeeping
- Summary

VERNE C. REIERSON, M.P.H.

ENVIRONMENTAL HEALTH CONTROL SEQUENCE*

Instructor: Verne C. Reierson, M.P.H.

PRESENTATION I

Epidemiological Approaches to Health Problems

Human factors peculiar to nursing home environments:
- Water borne diseases
- Food borne diseases
- Air borne diseases
- Vector borne diseases
- Chemical and toxicity problems
- Injuries and accidents
- Environmental stress: noise, heat, light, odors

The physical plant and the premises must provide, protect and promote the physical, biological and social well being for the patients and personnel of our nursing homes in Oregon.

During development of construction plans particular attention should be given to the following factors influencing the environment of the structure and premises:
- Water supply
- Sewage disposal
- Solid waste disposal
- Plumbing system
- Food service
- Lighting (electrical) systems
- Heating and ventilation
- Laundry service areas
- Accoustics
- Safety factors - fire safety
- Exclusion insects and rodents
- Choice of materials to enable satisfactory maintenance and housekeeping

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Your key reference for outside study is:

*"Nursing Homes Environmental Health Factors," U.S. Dept. of Health, Education and Welfare, Public Health Service Pub. No. 1009, Supt. of Documents, U.S. Govt. Printing Office, Washington, D.C.20402, 1967. $1.00 per copy.
Ordered for the students by the Division of Continuing Education.

The location for a care facility should be so selected that it will be accessible, ample in size, safe, well drained, convenient for connection to public water supply lines, and a community sewer, and remote from sources of air pollution, loud noise and heavy traffic. Work with your planning and zoning officials before you purchase any property. Before any construction or remodeling of a nursing home is begun, complete plans should be drawn showing exact location of all buildings, and complete details of their construction. These plans should be submitted to:

Official Health Agency - OSBH
Oregon Bureau of Labor
Oregon Fire Marshals Office
Local Building Department

for their review and approval prior to construction.

The preparation and review of construction plans are next in importance to site selection in determining a healthful nursing home environment.

It is recommended that an architect or registered engineer be retained to do this work.

The following topic areas will be discussed within this framework as applicable from construction to the vital phases of operation and maintenance.

Water supply
Liquid wastes
Sanitary plumbing
Food sanitation
Vector control
Solid wastes - air sanitation
Laundry services
Furniture and bedding
Fire safety
Environmental stresses (noise - heat - light)
Injury control
Detergents, disinfectants, sterilization
Housekeeping and sanitation procedures

PRESENTATION II

Water Supply

Each building within the nursing home complex must be provided with an adequate supply of potable water.

Water Supply (continued)

Water for nursing home use must conform to the chemical and bacteriological quality requirements of the Oregon State Board of Health.

It is recommended that the home be located where it will be served by a community water system.

A major factor that must be considered is the determination of the average daily water consumption and the peak rate demand, i.e. 200 gallons of water per day per bed. The peak demand rates must be estimated in order to determine plumbing and pipe sizing, pressure losses, and storage requirements.

After a water supply has been provided, whether it be from a public or individual source, and particularly in the case of the latter, it is the responsbility of the nursing home administrator to insure that the biological quality of the supply is maintained at a high level.

Technical resources:
- Water supply engineer
- Consulting engineer
- Health Department Sanitarian or Engineer

Sewage Disposal

Every nursing home building must be provided with an adequate, satisfactory method for the disposal of body and other domestic wastes.

Wherever possible this end point should be a public sewerage system.

Where it is not possible to connect to a community sewer system, a method of disposal on the premises must be provided which will be satisfactory to the public health authorities having jurisdiction. No matter what the method the system must be of adequate capacity and proper design.

In planning the nursing home site for buildings, the site should be so selected and the buildings so laid out that, wherever possible, connection can be made to a public sewer system.

Technical resources:
- Public Works Engineer
- Consulting Engineer
- Health Department Sanitarian or Engineer

Sanitary Plumbing

There is a relationship between plumbing and health. It has been demonstrated many times that enteric disease can be directly correlated to the presence, absence, and the degree in which plumbing is provided.

Nursing home buildings shall be provided with a properly designed and installed plumbing system. Oregon requires an approved plan review. The details of installing should be assigned to licensed journeyman plumber or plumbing contractor.

Inadequate flow from fixtures at times of high demand is not merely a matter of inconvenience. It can affect the health of the nursing home personnel and patients, as well as the people of the community.

Important considerations are: sizing of the building water supply system, demands of fixture units, pressure ranges, thereby providing for adequate supply to every fixture.

We must prevent direct cross connections in the system, sewer gas, and access for rodents and insects.

Technical resources:

Bonded and licensed plumbing contractor
Health Department plumbing personnel

Food Sanitation

Food service operations in nursing homes must insure the use of safe wholesome foods, suitable equipment, physical facilities and well-trained personnel. The preparation and serving of food must be conducted in a sanitary manner, i. the occurrence of food borne illnesses is to be minimized.

Many foods are futile media for the growth of micro-organisms. When such foods become contaminated with certain types of bacteria, they become potential vehicles in the spread of disease. Foods may also become contaminated with poisonous and toxic substances, if carelessly handled during storage, preparation and service.

Food sanitation in the nursing home is of major importance, since generally the food is prepared for service to most of the patients at one time, all of whom would be subject to illness if the foods were not safe.

Review and discuss item by item the public health significance of the Oregon State Board of Health Food Sanitation laws and standards.

Food Sanitation (continued)

Personnel responsible for the food service operation should work with the local health department sanitarians. The function of the official health agencies is not only to control or administer public health but also to furnish consultation on food sanitation problems. Their services should be utilized to the fullest possible extent by nursing home administrators.

I would recall for your consideration that more cases of food borne diseases are reported as having occurred in hospitals and institutions than in any other kind of food serving establishment.

Food is essential in promoting and maintaining the health and morale of the aged and the infirmed. Food must not be a vehicle for conveying pathogenic organisms (germs) bacterial toxins (germs) or poisonous chemicals to nursing home residents.

Technical resources:

Health Department sanitarians and nutritionists

Vector Control

The nursing home grounds and buildings must be kept free from insects and rodents.

A number of insects along with mice and rats are vectors or carriers of communicable diseases. They are indicators of filth. When they are controlled a link in the chain of disease transmission may be broken.

The basic means of preventing an infestation of insects (flies, cockroaches, mosquitoes, fleas, bedbugs, lice) and rodents is to maintain good sanitary standards throughout the buildings and premises.

Insecticides and rodenticides are to be used only as an auxiliary aid to the control of insects and rodents. In applying these agents, it must be remembered that they are harmful and lethal to human beings. It is, therefore, of major importance that the use and storage of chemical agents be such that protection of the patients and nursing home staff is insured.

Technical resources:

Health Department Sanitarian
Vector Control Specialists
Pest Control Operators

Solid Wastes (Air Sanitation - Vector Control)

A method shall be provided for the prompt removal from the care facility premises of solid waste materials. These include all wastes other than body wastes.

Accumulations of waste materials provide harborage and breeding places for insects and domestic rodents. Also good fire safety demands that such accumulations not be permitted.

There are four components: storage, collection routes for removal, an ultimate place of disposal.

Care must be taken to see that garbage and refuse cans are covered at all times to prevent fly and rodent attraction. Garbage cans are a source of fly breeding if not properly maintained.

Community services (public or private) when available, should be used for all solid wastes except infected dressings, surgical dressings, and other infectious agents. These latter wastes should be incinerated on the premises if approved under special procedures of the air pollution authority. In most communities special types of incinerators are necessary to meet air pollution control requirements. In general, burial on the premises often proves to be an unsatisfactory means of waste disposal.

Metal and plastic waste containers must routinely be washed and sanitized. Lining of all transfer cans will reduce depreciation, noise and cleaning requirements.

Burning in open drums, fireplaces, etc. should never be used for the disposal of wastes from a nursing home.

Technical resources:
- Health Department Sanitarian
- Public Works officials
- Air Pollution authorities

PRESENTATION III

Laundry and Linen Service

The laundering operation is an important factor in controlling the nursing home environment--it is a bulwark in the preventive program that is aimed at preventing the spread of infection.

Laundry and Linen Service (continued)

An improperly operated laundry spreads contamination rather than eliminating it.

Improper handling of contaminated linen exposes employees to infective agents.

All homes collect and sort soiled articles and they store and distribute clean articles.

Processing procedures at the laundry:
- Sorting
- Washing
  - Wash formula
  - Temperatures
- Materials used in washing process
- Extracting
- Presswork
- Supply and storage room
- Transportation

Sanitation Problems
- Dust and dirt
- Partial processing
- Slip hazards
- Airborne recontamination
- Insects and rodents

Disinfection and Sterilization
- Sterilization
- Germicide
- Bactericide
- Disinfectant
- Antiseptic
- Sanitizer

Housekeeping

Systems and methods in housekeeping
- Maintenance
- Work schedules
- Tasks
- Rating forms and check lists

Final Summary and Question Session

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IT'S A FACT

Germs are responsible for many diseases. It would take 25,000 of these microbes laid end to end to make one inch.

Some germs or "Bacteria" are useful; others are harmless; but a great many are dangerous arch-criminals responsible for much suffering. Different diseases are caused by different bacteria with different likes and dislikes, different habits.

Bacteria live everywhere. You carry more of these germs on your person than there are people on the earth. They are alive, just as we are; take in food, give off wastes, grow, and multiply. What they lack in size they make up for in number. A single germ in 24 hours will under favorable conditions produce 281,000,000,000,000 other germs, each one capable of doing the same.

Fortunately a great many bacteria die off by themselves and a great many do no harm. Otherwise we would all be sick all the time. What we are concerned about are those that do bring on sickness.

Most disease germs grow best at body temperature. High temperatures usually kill them. Freezing does not hurt them any, though it does keep them from multiplying. They are not lovers of the light. They like to breed in the dark. Direct sunlight kills them. Most bacteria need air; some grow only in the absence of air; others can get along with or without it. They need moisture to grow. Their favorite homes are milk, eggs, meats, shellfish, poultry and water.

THE HUMAN ELEMENT AND THE PRINCIPAL CAUSES OF FOOD-BORNE DISEASE OUTBREAKS

Failure to refrigerate perishable foods
Diseased employees
Poor personal hygiene
Failure to thoroughly cook contaminated foods
Obtaining food from unsafe sources
Failure to clean and disinfect kitchen utensils and equipment
Poor food storage practices leading to contamination by rodents, sewage, customers, and admixture with toxic materials

PRINCIPLES OF FOOD-BORNE DISEASE CONTROL

Wholesomeness and Safety of Food and Drink
- Source - production
- Transportation
- Manufacturing
- Warehousing - storage
- Delivery
- Preparation
- Service

Human Element
- Disease Control
- Personal Hygiene - Sanitary Food Handling
- Education
- Supervision

Time - Temperature Factors
- Thorough Cooking
- Adequate Refrigeration - Cold Storage
- Proper Holding

Protection from Contamination
- Protection from: Customers, Workers, Insects and Rodents, Dust and Dirt, and Backflow

Sanitary Design and Construction

Equipment
- Non-toxic
- Smooth
- Impervious
- Not easily Corrodible
- Easy to Clean
- Accessible

Building
- Efficient Layout
- Proper Utilities and Fixtures
- Serviceable
- Easy to Clean
- Impervious
- Insect and Rodent Stoppages

Clean-Up

Proper Use of Detergents and Disinfectants
Equipment and Utensil Cleaning - Dishwashing
Sanitary Maintenance

ADDITIONAL MATERIALS DISTRIBUTED TO THE STUDENTS:

"Your Personal Check List," Oregon State Board of Health pamphlet.

"Fly Control in Food Service," Oregon State Board of Health pamphlet.

"Sanitary Restaurant Operation, "Dishwasher's Edition," Board of Health pamphlet.

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NUTRITION, FOOD PLANNING

Presentation I
- Psychology of Food Service in Nursing Home
- Nutritional Needs
- Menu Planning
- Therapeutic Diets

Presentation II
- Food Buying
- Food Storage
- Food Preparation
- Food Service

Presentation III
- Forms and Records
- Personnel
- Sanitation and Safety

WYNNE SPIEGEL, B.S.

ERIC

NUTRITION, FOOD PLANNING SEQUENCE

Instructor: Wynne Spiegel, B. S.

PRESENTATION I

A. Psychology of Food Service in Nursing Home
   1. Importance to elderly
      They understand it
      Satisfies more than nutritional needs
      High spots in patients' day
      New environment upsetting
   2. Importance to Administrator
      Financial
      Reputation
      Personal satisfaction
      Administrator sets tone of employees
      Desire to cater or satisfy
      Helpful publications

B. Nutritional Needs
   1. Patient Eating Habits
      75-year old
         male - 2,000 calories
         female - 1,700 calories
      Laymans view of nutrition
      Foods - meat, vegetable, bread
   2. "Menu Planners Guide," N.Y. State Extension
      Nutrients and Calories
      a. Protein - complete (animal)
                incomplete (beans, nuts)
         Purpose - growth and repair of body tissues
                prevent decubitous ulcers
      b. CHO - sugars and starches
         Energy
      c. Fats - muscle tone - energy
         Margarine, mayonnaise, meat
      d. Minerals
         1. Calcium - milk, cheese
            Bones, teeth, muscles, blood
         2. Iron - meat, vegetable, eggs
            Red blood cells
      e. Vitamins
         A - Skin and mucous membrane
            Eyesight - Respiratory - Liver - Yellow and green vegetables

Thiamine - appetite - heart function
Pork, liver, whole grain cereals
Riboflavin - eyesight, skin and mouth tissue
Milk, meat, eggs
Niacin - skin, tongue, digestion
Meat and eggs
Vitamin C - blood vessels
Bones - teeth
Resist infection
Healing of wounds
Sources: citrus fruits, broccoli, cabbage, potato skins

C. Menu Planning
1. Procedures
Establish meal pattern
Start with breakfast
Meat
Vegetable
Dessert
Avoid own likes and dislikes
2. Variety
Consult patients
Patient turnover
Avoid too many starches
3. Color - Texture - Flavor Combinations
Importance of good combinations of food
Roast Pork, mashed potatoes, sauerkraut, wax beans, angel cake - color?
Poached tuna, escalloped potatoes, creamed cauliflower au gratin, custard - texture?
Italian spaghetti, Harvard beets, rhubarb cobbler - flavors?
4. Menu Planning and Assignment of Class
Three day menu of own home.
5. Cycle Menu
At least two cycles a year needed
Summer - Fall: May, June through October or November
Winter - Spring: November through April, May
Double cycle makes one menu a year possible.
a. Strawberry shortcake or pumpkin pie
b. Fresh or frozen squash
c. Tuna casserole or tuna salad
6. Selective Menu
Naturally selective because of diet foods.
Degree of catering desired.
7. Holidays and birthdays

D. Therapeutic Diets
   1. Take from general menu where possible.
      Daily diet menu.
   2. Identify - tray cards (colors)
   3. Diet manual
      Types - Soft, Bland, Salt-free, Reduction, Diabetic
      Doctors orders
      Establish what each diet provides at your home or use an est. manual
      a. Soft - three categories:
         1). Whole but soft food
         2). Ground meat
         3). All osterized
      b. Bland - no raw foods (Hemorrhoids, ulcer, diverticulosis, gastritis)
         Soup and beverage
         Hot bread
      c. Low salt - 500 Mgm. (edema, heart failure, kidney disease, hypertension)
         1 gm.
         No salt on tray
         Salt substitutes
      d. Reduction diets (obesity)
         800 to 1,000 to 1,200 calorie
         Depends on activity and metabolism
      e. Diabetic
         General diabetic
         Calculated diabetic (CHO - Pro-fat figures)
      f. Liquid diets
         Full liquid
         Rest. liquid
      g. Low fat - Low cholesterol
      h. Allergy diets
      i. Ulcer diets - various stages
         Sippy - milk and cream

PRESENTATION II

A. Food Buying
   1. Quantity buying - 50% of budget
   2. Establish set time for buying for week
   3. Storage space for quantities make buying economical
   4. Check lists
      Groceries - size of cans #10 - 25-30 servings, #2 1/2 - 7 servings
      Vegetables, frozen foods (amount of storage), bread (standing "build to" order), milk and ice cream, fish (filets or whole), poultry (50% bone), and meat (3 oz. portion - 4 oz. with bone shrinkage).

5. Use purchase book as record - do not trust memory
6. Establish suppliers
   Delivery days each week
7. Comparative buying
   Specifications
   Time consuming
8. Inventories
   Physical
      Mimeo sheets
      Hand written item by item
      Value in buying
   Perpetual
      Time consuming

B. Food Storage
   1. Receiving food
   2. Refrigeration
   3. Freezing
   4. Dry storage
   5. Cleaning supplies and non-food
   6. Left overs

C. Food Preparation
   1. Recipes
      Books
      Files
      Standardize serving size
         #12 dipper 1/3 cup
         #16 dipper 1/4 cup
         #24 dipper 2 2/3 cup
   2. Terms
      Braise
      Blanch
      Blend
      Breaded
      Fricassee
      Poach
      Buttered
      Steamed
      Rare
      Garnish
   3. Meat Cookery
      Low - Moderate temperature
      Suitable to cut
      Moist heat
      Dry heat

4. Egg, milk, cheese cookery
5. Vegetable cookery
   Juice from vegetable
   Under cook most vegetables

D. Food Service
1. Trays
   Hot foods hot, cold foods cold
2. Dining room
3. Meal schedules

PRESENTATION III

A. Forms and records
1. Meal Census
   Patients
   Employees
   Guests
   Total
2. Inventories and Cost Control

May 1, beginning inventory	$200.00
Add cost of all food for May	400.00
	$600.00
Subtract ending inventory June 1	180.00
Cost of May food	$420.00

Divide cost by total meals served to get cost per meal times three equals cost per day
Controls of budget
Personnel to do job - no more
Use leftovers, careful preparation
Purchase wisely

B. Personnel
1. Policies posted
   Vacation
   Meals
   Sick time
   Fire rules
2. Job description
   Name of job
   Education required
   Hours
   Wages
   Experience

3. Work descriptions
   Hours for meals
   10:00 a.m. to 10:30 a.m.
4. Daily work schedules
   10 days in advance
5. Health cards
   Work permits

C. Sanitation and Safety
1. Equipment (types and uses)
2. Dishwashing regulations
3. Hand washing facilities
4. Protect food from dust, flies and vermin
5. Use convenient utensils and containers

- -

Please fill in and bring to class next week.

1. Who is responsible for the food service at your institution?
   a. Food contractor (Saga, Mannings, Canteen)
   b. Dietitian
   c. Food Manager or Supervisor
   d. Nursing Department
   e. Cook and Administrator
   f. Other

2. Is the above satisfactory?

3. How many patients or residents do you serve?
   How many employees?

4. Is the largest meal served at noon or at night?

5. What % of your budget for dietary is spent on
   Raw food_____
   Labor_____
   Equipment, supplies, garbage_____

6. What do you consider your biggest worry or problem in this department?

Need not be signed.

NAME OF HOME _____

Date:	MONDAY	TUESDAY	WED.
Breakfast			
Dinner			
Supper			
Between Mean Nourishment and Time			
Bedtime Snack			

List foods and beverages actually served on these three consecutive days. You will use this as a worksheet on the Wednesday class.

FISCAL AND LEGAL ADMINISTRATION

Presentation I
Organization for Fiscal Administration
Presentation II
Cost Finding in Long-Term Care Institutions
Presentation III
Rate Setting and "Profit Planning"
Presentation IV
Management Control Procedures

STANLEY D. RASMUSSEN, C.P.A.

General Observations as to Liability
Responsibility to Public, Employees and Patients
Foreseeability

JOHN W. DANNER, L.L.B.

ERIC

FISCAL AND LEGAL ADMINISTRATION SEQUENCE

Instructor: Stanley D. Rasmussen, C.P.A.

PRESENTATION I

Organization

In order to produce the most useful financial data for management, it is necessary to provide an adequate fiscal administrative organization. This organization will vary depending upon size and nature of service, but should contain certain basic elements including:

1. Personnel who are adequate both in training and number and who receive the support and cooperation of management.

2. An adequate accounting and reporting system designed to fit the needs and operations of the organization.

The presentation will include a discussion of:

1. Selection of accounting personnel
2. System development
3. Chart of accounts
4. Establishment of basic controls
5. Financial and statistical reports

PRESENTATION II

Cost Finding

Cost finding has been practiced in a small percentage of health care institutions for many years but it has only been since the advent of Medicare that it has become a byword. The understanding and application of cost finding is still in a very basic stage in many institutions.

We will discuss the nature of cost finding and its beneficial applications. This will include:

1. Accounting system and data requirements to perform meaningful cost finding
2. Methods of cost finding
3. An example of cost finding
4. Analysis of certain elements of cost
5. Uses of cost finding

PRESENTATION .II

Rate Setting and "Profit Planning"

There are many organizations that leave their financial success or failure too much to chance. This is just as applicable to nonprofit institutions as it is to proprietary ones. Definite recognition must be given to the necessity of producing an excess of revenues over expenses in order to survive and progress since the services and equipment of today cannot be purchased with yesterday's dollar. Accepting this, it follows that a definite, organized plan should be developed and followed to assist in producing favorable financial results.

We will discuss the nature and purpose of a financial operation plan as well as the manner in which it can be formulated and utilized. The roles of cost finding, rate setting and financial reporting will be correlated with this plan.

PRESENTATION IV

Management Control Procedures

Management is obviously in a position and has the responsibility to influence the financial success of their institutions by providing general guidance and leadership. One of the most basic tools provided to accomplish this is a clear and timely financial reporting system upon which management can base plans and act.

This leadership should be extended by providing definite operating procedures and controls in specific areas. There is a never-ending opportunity to increase revenues and/or reduce costs so we will discuss some specific areas for illustration as follows:

1. Variance review
2. Management of cash
3. Control and collection of receivables
4. Inventory control
5. Property and equipment management use
6. Insurance coverage
7. Non-patient revenues

FISCAL AND LEGAL ADMINISTRATION SEQUENCE

Instructor: John W. Danner, L.L.B.

Liability of Nursing Home Operators and Administrators

I. General Observations as to Liability
   A. Duty of care in general
   B. Duty of care in specific situations
   C. "Exercise of due care"
      1. To whom is duty of care owed?
      2. Standards
      3. Negligence defined

II. Responsibility to Public at Large
   A. By facility itself
      1. Buildings and equipment, etc.
      2. Owned or leased autos
   B. Employees' negligence
      1. "Respondeat Superior" - liability for acts of employees
      2. "Qui Fait" - "who acts through another acts for himself"
   C. Responsibility to Public for Acts of Patients
      1. Confused
      2. Dangerous

III. Responsibility to Employees
   A. Common Law - in general
   B. Statutory - Workmans' compensation

IV. Responsibility to Patients
   A. Status of patient affecting responsibility of those charged with no care
      1. Ill
      2. Infirm
      3. Confused
      4. Dangerous
   B. Knowledge
   C. Pay - or - charity (no difference)
   D. Standard of care in community
   E. Employer negligence - direction
      1. Malpractice
      2. Misfeasance and malfeasance

V. Comments re Foreseeability
   A. Known or should have known
   B. Foreseeable vs. unforeseeable result

VI. Questions and Answers

COMMUNITY RELATIONSHIPS

Presentation I

- Concept of the Community Today
- Concepts of Health and Disease
- Rise of Health Services and Citizenship Rights
- Sociology of Health Care
- Institutionalization and Institutions of Health Care
- Community Health Pattern

Presentation II

- Emergence of the Nursing Home in the Health Care Pattern
- Issue of Self-Policing and/or Public Community Intervention
- New and Increased Governmental Role of Social Security
- Medicare and Related Challenges
- The Demand for Community Health Planning
- Balancing of Community Services
- Medical and Health Care Economics

Presentation III

- Objectives
- Self-Improvement of Nursing Homes and Community Relationships
- Nursing Homes and Relationships with Government and the Public
- Family Relationships
- Senility
- Relationships with General Hospitals
- New Challenges of the Health Pattern

SAMUEL LISSITZ, M.A.

ERIC

COMMUNITY RELATIONSHIPS SEQUENCE

Instructor: Samuel Lissitz, M.A.

The objectives of these three sessions and of this area of the subject:

A. To discuss the interrelationships of the community and health services and facilities.
B. To develop concepts of community and changes in that concept(s).
C. To examine the concepts of health and changes therein, in outlook and emphasis, and in the light of social changes.
D. To review major sociological concepts of health care and society.
E. To present the pattern of health care developed in American society, and how it differs in societies and reflects society.
F. To deal with medical economics and the financing of health care, with some attention to the new challenges of prepayment.
G. To deal with the new roles of government, the example of Medicare.

Methods

1. Important articles on above will be printed in advance and circulated.
2. Members of class will be asked to bring in material on their experiences with Medicare and their problems.
3. Controversial aspects of Medicare, the Welfare State, the urban crisis, and medical care today will be examined.
4. Searching questions to elicit discussion will be given prior to sessions.

Readings

A full list of readings and selected readings mimeographed will go out to class well in advance of the sessions. Members of the class will be required to do some reading and some writing of their problems in this area.

PRESENTATION I

Objective

Review objectives as outlined above; community interrelationships will make or break nursing homes today; changed values and new priorities given by society to health will be highlighted; the community as complicated totality with special interests and pressures - what the community pressures and demands seem to be today; health care system and pattern of services and facilities elaborated; Anselm Strauss - work on the poor and medical care is important here.

A. The Concept of the Community Today
   1. Short history of different approaches to community
      a. Tonnies - the switch from rural to urban
      b. Cooley - shift from primary groups
      c. Simmel - conflict exists in community
      d. Parsons - the structural-functional school
      e. MacIver - community and associations and institutions
      f. Galbraith - the changed industrial state and role of government
   2. Rise of bureaucracies and Weber's ideas in this field

B. The Concept of Health and Disease
   1. World Health Organization concept of health - positive force, not just absence of disease
   2. Siegerist - history of medicine - excerpts
   3. Malinowski - magic, science, and religion
   4. Health - cultural component - Parsons
      a. The applied professions and place in society and in health care
      b. Important relationships of health and dependency, and of health and poverty
      c. Rise of chronic illness and changing nature of disease creates demands for extended care facilities
      d. Population growth and social morphology influence health care pattern.
      e. Social challenges of longevity - work of Rucker and Wolfbein

C. The Rise of Health Services and Their Availability Becomes a Citizenship Right
   1. Lenski on rise of citizenship rights and new values
   2. Beveridge and American social security thinkers
   3. Supreme Court decision on collective bargaining and health fringe benefits
   4. Rise of labor in financing of health care
   5. Rise of single standard of medical care today - and Public Welfare health care policies

D. The Sociology of Health Care
   1. Interrelationships of society, community and health.
   2. The contrasting two approaches:
      a. The structural-functional school
      b. The conflict school
   3. The rise of medical and health care from magic and religion - Malinowski
   4. The medical revolution link with the basic scientific revolution
   5. Urbanism as a factor in new health care pattern

E. The Institutionalization and Institutions of Health Care
   1. Health care facilities reflect rise of bureaucracies and large organizations

2. The changes in the community values and emphasis and the rise of health care patterns
3. The entrance of government as purchaser of health care, and its new role in standards and research - National Institutes of Health.
4. The large purchasers of health care - prepayment and government

F. The Community Health Pattern
1. The various institutions
   a. General hospitals
   b. The American Medical Association and physicians
      1). Private practice - fee for solo
      2). Rise of group practice and problems and challenges
   c. Mental hospitals
   d. Nursing homes and extended care facilities (intermediate) - hospital care
   e. Homes for the aged, and changes in them
   f. Home health care
   g. Out-patient care
   h. Rise of para-medical services
2. The concentration upon hospitals and the historical reasons for them
3. The rise of chronic illness and effect upon above

Review

How shall we view the community? What does the community expect? Special Interests and Nursing Homes? Government?

What is the dependency and interdependency of the extended care facility and the community?

What are the social changes today affecting nursing homes and health care?

What is the aged picture and its relationships to community?

Why are effective community relationships essential today?

PRESENTATION II

Major Topics

More elaboration and discussion of the new roles of government.

The new partnership of private and public facilities and services.

The challenge to the private sector.

The rise in demand for non-institutional health care.

Objectives

To understand how in the community of today, the government assumes new roles.

To seek understanding of the power of nursing homes today, and their public accountability.

Consumer programs for health care and participation in them, with higher level of health education, are on the increase today.

A. The Emergence of the Nursing Home in the Health Care Pattern.
   1. Power and responsibilities to the community.
   2. Services will determine quality and depth of community relationships.
   3. The profit factor and its place in the picture of community relationships.
   4. The aged and political power and public issue today.
   5. Increased competition for the health dollar.
   6. The rising costs as public factor.

B. The Issue of Self-policing and/or Public Community Intervention.
   1. Rise of the social welfare concepts today, the war against poverty, and the crisis of Public Welfare.
   2. Attitudes today toward nursing homes - on trial.
   3. Nursing homes' level and general hospitals' level
   4. Balancing the health care spectrum and pattern today.
   5. Rise of need for community planning of health.
   6. The emerging role of the extended care facilities.

C. The New and Increased Governmental Role of Social Security, Medicare. Health Legislation, Government Purchasing of Health Care.
   1. Medicare, decisive turning point in government role.
   2. New intervention and roles of community and of government at work.
   3. Contrast our attitudes toward government here, with that of Canada, Great Britain, Scandinavian countries, etc.
   4. Complex issues of government and public intervention and health care.

D. Medicare
   1. Review the major provisions.
   2. Review title 19 and title 18.
   3. 1967 Social Security amendments.
   4. Significance and effects thus far - trends thus far appearing and facing nursing homes.

5. Government
   a. Set standards.
   b. Exacting changes in private sector.
   c. Pushing of integration and planning
   d. Changing Public Welfare approach.

E. Challenges in Working with Medicare.
   1. Special problem of small nursing homes.
   2. Principles of reimbursement, problems of.
   3. The profit factor issue and government financing.
   4. Growth of personnel and staffing needs.
   5. Financing of long-term care.
   6. Precedents of Medicare.
   7. Effect upon the prepayment agencies and plans.

F. The Rise in the Demand for Community Health Planning, and the Demand for the Balancing of Institutional and Non-institutional Community Services.
   1. The Special Senate Committee on Aging, April 1, 1968 Report.
   2. Gaps and weaknesses of community health resources.
   3. Changing the emphasis and concentration upon institutionalization.
   4. Out-patient services.
   5. Home health care services and continuity of care.

G. Medical and Health Care Economics
   1. Rising costs.
   2. Personal service industry.
   3. Dual chain of command, problem of.
   4. New methods of financing - Blue Cross, Kaiser Plan, public financing.
   5. Cost of training and research.
   6. Professionalization and role of associations.

Review

How does Medicare relate to the sociology of medicine and health in light of social changes?

What are major challenges facing nursing homes today and tomorrow?

How shall administrators of nursing homes and owners participate in community relationships?

PRESENTATION III

A. Review and Tie Together the First Two Sessions.
   1. Have group discussion.
   2. How do you view Medicare? Shall nursing homes work with it? How? What trends now appear? How does it affect community relationships?

B. Objectives of the Third Session
   1. Draw conclusions on the interrelationships of nursing homes and communities.
   2. The administrator's role in community relationships.
   3. The future of nursing homes will be decided by the services, their quality, and the community relationships that are evolved through more effective leadership.
   4. Business as usual to be changed.

C. The Self-improvement of Nursing Homes and Community Relationships.
   1. Services within nursing homes come first and above all - public relations only come if services are there.
   2. The role of the administrator as community leader and worker in the nursing home for self-improvement.
      a. Methods improvement and creativity.
      b. How to relate to community?
      c. How to reduce isolation?
      d. How to become part of the mainstream of community health resources and community agency?
   3. What are the special problems of the long-term extended care facility? Special issues:
      a. Staff relationships.
      b. Family and aged relationships - understanding of aged, realistic and more effective.
      c. With professional programs and associations.

D. Nursing Homes and Relationships with Government and Public.
   1. With Public Welfare - what changes now face us?
   2. Legislative relationships - state and federal.
   3. With the field of aging.
   4. With community welfare and health council.
   5. Role of the Oregon Health Care Association.

E. Family Relationships - Further Elaboration and Discussion.
   1. Attitudes toward families.
   2. Using the families constructively.
   3. Problems in working with and in understanding role of dependency and change of roles of parent.

F. Senility.
   1. Effect upon community relationships.
   2. Effect within the nursing homes.
   3. Staffing and architectural challenges.

G. Relationships with General Hospitals.
   1. Key role of the medical profession.
   2. Cooperative arrangements.
   3. Medical staffing.

H. New Challenges of the Health Pattern
   1. Forecasts and trends.
   2. Group prepayment.

3. Expansion of government financing and new programs.
4. Health maintenance of the aged, rising demand for.
5. Where will and how shall nursing homes fit into this larger picture?

MATERIAL DISTRIBUTED TO STUDENTS

Ball, Robert M., "An Interview with Robert M. Ball," Hospitals, J.A.H.A. January 1, 1967, Vol. 41. pp. 46-52.

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Lissitz, Samuel, "Patient - Family Interrelationships in a Geriatric Hospital," The Gerontologist, September 1962.

Lissitz, Samuel, "Motivating Geriatric Hospital Patients," Reprinted in Professor Harold Baumgartner's textbook, Long-Term Care, MacMillan, 1963.

Lissitz, Samuel, "Food Symbolization within a Geriatric Hospital," Journal of Rehabilitation, Vol. XXIX, No. 1, January - February, 1963.

Lissitz, Samuel, "The Challenge of the Senile Aged," Paper for presentation to the Nineteenth Annual Scientific Meeting of the Gerontological Society, Waldorf-Astoria, New York,November 3-5, 1966.

Lissitz, Samuel, "Occupational Therapy Gives Meaning to Patients' Lives," Nursing Homes, , June 1967.

Mattison, Berwyn F., M.D., M.P.H., F.A.P.H.A., "Community Health Planning and the Health Professions," American Journal of Public Health, June 1968, Vol. 58, No. 6, pp.1015-1021.

McNerney, Walter J., "An Interview with Walter J. McNerney," Hospitals, J.A.H.A., July 1, 1967, Vol. 41, pp. 49-54.

Shore, Herbert, "Let's Not Forget the Patient!" Professional Nursing Home, July 1968, pp. 9-14.

Your Medicare Handbook, Department of Health, Education, and Welfare, Social Security Administration, Baltimore, Maryland 21235.

APPENDICES

ERIC

APPENDIX A
OVERVIEW

CERTIFICATE PROGRAM - NURSING HOME ADMINISTRATION
Units of Instruction - 90 Class Hours

Administrative Process	Chronic Illness	Medical Care Adm.	Rehabilitation Therapies	Recreation Socialization	Environmental Health	Nutrition Food Pln.	Fiscal Adm.	Community Relationships

TIME SCHEDULE - Weekly, Wednesdays, 7:00 - 9:45 P.M., Portland Center for Continuing Education

1. Administrative Process	January 3, 10, 17, 24, 31; February 7
2. Chronic Illness	February 14, 21, 28; March 6
3. Medical Care Administration	March 13, 20, 27; April 3
4. Rehabilitation Therapies	April 10, 17, 24; May 1
5. Recreation and Socialization	May 8, 15, 22, 29
6. Environmental Health Control	June 5, 12, 19
7. Nutrition, Food Planning	June 26; July 3, 10
8. Fiscal Administration	July 17, 24, 31; August 7
9. Community Relationships	August 14, 21, 28

CREDITS - Non-Degree, Professional Inservice Transcript - Certificate Awarded Upon Completion of all Units of Instruction - 90 Class Hours

PROJECT DIRECTOR - Oscar Kurren, Ph.D., Associate Professor, Portland State College, School of Social Work

CURRICULUM CONSULTANT - Gary D. Hansen, Associate Professor, Portland State College, Department of Sociology

ADMISSION CRITERIA - Administrators and Senior Professional and Administrative Personnel of Nursing Homes and other Extended Care Facilities Serving the Chronically Ill, Disabled, and Aged
Minimum Education Requirement - High School Diploma

SPONSORING AGENCY - School of Social Work, Portland State College, in cooperation with the Division of Continuing Education, Oregon State System of Higher Education

APPENDIX B

THE PROFESSIONAL SOCIAL WORKER IN THE EXTENDED CARE FACILITY UNDER MEDICARE

What is a Professional Social Worker?

A person who, after graduation from college, has completed the professional training in an accredited school of social work and who has earned a Master's Degree in Social Work.

What is the Role of the Professional Social Worker in an Extended Care Facility?

(1) The primary function of the medical social worker is to contribute understanding of the patient's social and emotional problems, as they relate to the patient's medical condition and to provide corrective assistance through the use of casework techniques where appropriate. Through casework services the patient can be helped to understand and accept his condition and to work with the medical team for his own improvement.

(2) Because of his special training in psychodynamics and psycho-social development, the social worker is equipped to offer consultation in solving the patient's social and emotional problems as they relate to the patient's illness. This might be in helping the other members of the team better understand the patient with his problem, or it might be helping the staff find the best possible community resource to solve a special problem of the patient. Also, the medical social worker can help an agency to plan programs so that the patient's social and emotional health, as well as his physical health, are supported.

(3) The professional social worker can make a unique contribution to in-service training and other educational programs carried on within an extended care facility. Through the supervision of social work assistants (baccalaureate degree social workers), the trained social worker can help them to be more effective on their jobs.

APPENDIX C

The Contribution of the Professional Social Worker in the Home Health Agency, under Medicare

The trained social worker is a specialist who uses specific professional skills to help people with social and emotional problems relating to illness or disability. In so doing the social worker collaborates with other medical and allied personnel in providing care for the individual patient.

In the home health agency, professional social work services are provided within the context of the home care team. The basic home care team usually consists of the physician, nurse and medical social worker. The team members, when the need arises, call upon the services of other health workers, such as, home health aides, physical therapists, occupational therapists, speech therapists, etc.

The medical social worker makes his contribution to the welfare of the home health agency patient by:

(1) Direct contact with the patient and his family: An evaluative visit to the home is usually made when home care is being planned; this enables the social worker to assess the emotional climate of the home and to learn of some of the familial and social factors that might have a bearing on the illness, the recovery and the case planning in general. Following the evaluative contact, social work services are provided as needed on an ongoing basis to assist the patient and his family to make the best possible use of the help which is available.

For instance, it is necessary to discover the meaning of the illness to the patient and to his relatives. How does it affect his feelings about his social role and his occupational adequacy? What pressures are being exerted on the patient by the family and how does he deal with this? What economic problems does the family face and how does this affect their ability to follow through on necessary planning?

On the basis of the understanding which is thus gained, the social worker is in a position to assist the patient and his family to carry out the medical recommendations.

(2) Consultation to the other members of the team and the maintenance of appropriate files and case records: The social worker shares his thinking with the rest of the professional team and participates actively in the organized case-planning discussions. He outlines the problems which he has identified and elaborates by pointing out how specific factors, as, for instance, emotional instability in one of the family members might make one approach to case-planning more practicable than another.

He makes note of the strengths of the patient and the family, and he shares with the team his prognosis, his impression of the ability of the family to make significant social changes.

(3) Knowledge of the community and of the resources available in it which might be utilized in the rehabilitation of the patient and the enhancement of his social functioning: The social worker has a good working knowledge of other social agencies, knows what they can and what they can't do. He utilizes this knowledge in his planning and in his work with the patient and family. Since human problems cannot be fitted neatly into pigeon-holes, this task demands a considerable amount of resourcefulness and originality. As someone has commented, "The social worker must be able to use what is there (in the community), adapt it for his use, and create what is lacking."

(4) Supervision of the work of social work personnel who do not possess full professional qualifications: The Medicare guidelines provide for the employment of social work assistants, persons with baccalaureate college degrees but without graduate social work training. The professional social worker provides on-going supervision, consultation, and appropriate in-service training for the social work assistants who may be employed by the home health agency.

APPENDIX D

Excerpts from the Guide for Social Service in Nursing Homes *

Social Services for Residents of Nursing Homes

Social Service staff may be obtained from the following sources:

1. Employment of full- or part-time social workers by a nursing home, the number dependent upon its size; or sharing of these staff persons by two or more homes (again based on their size);

2. Contractual arrangements for the services of social work staff employed by hospitals, family service or other social agencies, on a regular hourly or daily basis;

3. Assignment of personnel to specific nursing home(s) full-time by hospitals or qualified social agencies (including welfare departments) who have been given intensive inservice training and are supervised by or have available as a consultant a professionally trained social worker.

In general, the social workers will carry out some or all of the following activities:

1. Participation in the assessment of the appropriateness of referrals for nursing home care, identification of the patients' particular needs and evaluation of the prospective home (in regard to suitability and adequacy of services), with due consideration of alternative possibilities, in conjunction with members of the family and other professions involved.

2. Development of social histories on residents prior to or immediately after admission through information obtained from referral sources, appropriate social agencies, patients and family members, which data will be made available to nursing home personnel (as appropriate in line with principles of confidentiality) to facilitate their dealings with the residents.

3. Assistance with adjustment of persons admitted to nursing homes, with support at critical periods, such as transfer to other facilities or discharge from the home back to the community, and provision of individualized social casework services in appropriate situations.

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*The material in this Guide was developed by ten social workers, representing as many settings; it is being up-dated and revised for publication.

4. Assistance in the development, with other professional personnel within and outside the facility, of supportive services for the residents during their stay in nursing homes, including group activities, recreation, volunteer and protective services, and pastoral counseling, in line with patients' interests and needs.

5. Consultation to nursing home personnel on social problems they encounter among patients and on preventive approaches by means of enhancing a home-like atmosphere, which activity may involve help on individual situations or collective orientation to increase staffs' understanding of social needs and ways in meeting these.

6. Consultation to staff of other health and social agencies who share responsibility for the residents, and development of a cooperative working relationship between social workers involved with patients in nursing homes.

7. Involvement of needed community resources in the patients' care, interpreting to them the problem and encouraging them (if necessary) to liberalize their policies in order to provide the required service.

8. Documentation, for ready reference for the nursing home administrator, of information on agencies to which referrals may appropriately be made for different types of social problems, including the name of the individual "intake" worker whom they should call.

9. Sustained contact with family members, whether nearby or far away, involving them in the residents' situations and progress. Such activity may include help also in dealing with the family's feelings, financial responsibilities, and other problems related to patient care (necessitating, on occasion, referral to community agencies as indicated). In this way relatives can be helped to make a contribution to the patients' successful adjustment to the nursing home, while simultaneously some of their own difficulties will be alleviated.

10. Assistance in arranging for transfer of patients to another facility if the need arises because the nursing home cannot provide the required care or the patients' dissatisfaction cannot be resolved even with sustained efforts on the part of all persons involved.

11. Participation in the evaluation of the residents' need for continued care within a group facility (through periodic review) and of the feasibility of return to the community. Help will be given in evaluating the environment to which patients plan to return, in effecting the discharge, and in arranging for continued support thereafter to ensure a satisfactory subsequent arrangement.

Nursing home administrators will enable social workers to provide necessary service by:

1. Arranging space for office work and private interviews with patients and their relatives.

2. Providing full access to patients unless contraindicated by medical orders.

3. Including social history summaries in the medical chart.

4. Participating, and facilitating the attendance of other personnel, in case conferences which concern plans for any of their patients, or in educational programs designed to enhance staff understanding of social components in nursing home care.

5. Sharing pertinent information and making referrals to the social worker of situations in which problems of a social nature have arisen.

6. Providing the social worker opportunities to contribute suggestions which will assist in the adjustment of individual patients or the total patient population of the home.

7. Facilitating the involvement of other consultants, as indicated, such as psychiatrists, by communicating with the attending physicians.

8. Providing information on patients' progress which can be transmitted directly or by the social worker to family members or to staff in social agencies which have some responsibility; and encouraging the sustained involvement of these other persons and their interest in the patients' welfare.

The social worker will:

1. Become thoroughly familiar with the policies and personnel of the nursing home and develop a cooperative working relationship with the various members, intruding as little as possible upon their time and responsibilities.

2. Provide services, as requested by the administrator or other personnel or on self-referral, regardless of patients' economic status and involvement with an agency; however, information on the services provided will be communicated to that agency's social worker.

3. Communicate with the attending physician on any patient for whom direct services are requested, for his approval and periodically for the purpose of assessing the need for continuing nursing home care.

4. Discontinue direct casework services when a critical situation has been resolved but maintain surveillance, by observation and continuing contact, to determine that no recurrence arises; and to provide continuing support to the patient.

5. Work in close collaboration with other personnel in the nursing home in developing group activities.

6. Interpret to nursing home personnel attitudes or obstacles to acceptance of appropriate care and jointly with them effectuate resolutions, if possible.

7. Continually build on his basic professional training additional knowledge needed to enhance his skill in working with this special population, through reading, attendance at institutes or courses dealing with the aged and chronically ill; or by seeking consultation from appropriate sources.

8. Accept that he is administratively responsible to the administrator of the nursing home, if employed by that facility.

APPENDIX E

PORTLAND STATE COLLEGE GERONTOLOGY PROGRAM PLANS

PROPOSED COURSES AND DESCRIPTIONS

Social Gerontology

History of social gerontology in the United States and the world; comparison of the roles, status and security of the aging and aged in preliterate, pre-industrial, and industrial societies; cross cultural and comparative national perspectives and differences; present and projected characteristics of the aging population; demographic facts, life expectancy, mortality rates and migration of the aging and aged in the United States.

The impact of aging on social and governmental structure and policy in public voluntary institutions; consideration of major social systems and institutions which are affected by aging, retirement and older people.

Sociology of Adult Development and Aging

Social aspects of development and aging during adult stages of the life cycle; normative data about and consequences of participation in various social, institutional and community systems; consideration of educational and socialization processes and activities which facilitate adjustment to, satisfaction with, and productivity during middle age and retirement; major social problems and disorganization related to aging, leisure and retirement, i.e. role preparation, allocation, change, rolelessness and role reversals; differences in life style, resource availability and allocation related to social and economic stratification; subculture of aging, minority group consciousness and collective behavior.

Protective and Family Services for the Aging

Philosophy and purposes of public and private social, protective and family services for the aging, aged, chronically ill and disabled; review of categorical programs of social and economic assistance; prevention and amelioration of poverty, dependency and social isolation; availability, adequacy and utilization of protective services; such as, police, legal, guardianship, conservators, safety and accident control; telephone assurance; reduction and prevention of frauds and quackery; financial advisors in various financial institutions; individual and family counseling

services in public and private social welfare and mental health agencies; organization and administration of family services to middle aged and older clients.

Psychology of Maturity and Old Age

Developmental changes in man from the early twenties to and including the last stages of life; psychological effects of physical development and decremental changes; impact of differing cultural expectations upon behavior; changes in self-concept and self-esteem throughout maturity and old age.

Psychological Assessment of the Elderly

Psychological problems in assessing the elderly with regard to vocational skills, intelligence and personality; review of normative data and comparison of various theories of psychological adjustment in the aged; incidence, trends and types of mental illness as related to age, sex, socio-economic and other demographic characteristics; suicide rates and modes, neuroses, psycho-neurotic behavior, psychosomatic problems and psychoses; uses and limitations of standard psychological tests in evaluating the aged.

Biological and Physiological Aspects of Aging

Overview of normal healthy aging, decremental changes and adaptive responses; comparative longevity of higher vertebrates; gross anatomical changes in stature, weight and configuration; changes of appearance, skin texture, hair distribution and color; water, fat and mineral composition and the aging process; equilibrium change, deterioration and adaptation in selected tissue, organs and organic systems; influence of genetic and environmental factors; experimental studies on radiation, temperature, altitude and longevity.

Health Care Facilities and Services for the Aging

Description of various types of health care facilities and care programs for the chronically ill, disabled and aged. Services provided in general, chronic disease and mental hospitals, convalescent and rehabilitation centers, nursing homes, infirmaries and outpatient departments, day care centers and sheltered workshops.

Community programs to coordinate health and supportive services; continuity of patient care through referral systems between public and private agencies and institutions. Home care nursing, medical, dental, paramedical, social, psychological and other supportive services.

Economics of Aging and the Aged

A survey of income and asset positions of the aging and aged and their impact on economic systems; income maintenance through public and private pension programs, savings, investments and securities; standards and the cost of living; sources, amounts and adequacy of income for different age groups, individuals and couples; concepts of poverty and the aged as a low income group; economic aspects of medical care, housing, social and protective services; consumer motivation and spending patterns of the aged; age related trends in labor force participation; occupational distribution of and employment policies affecting older workers; employment and retirement in the life career; impact of technology and automation.

Governmental and Political Aspects of Aging

Governmental and private responsibility for dependent segments of the population; philosophy and relationships between federal, state and local government; major laws and enabling legislation affecting middle aged and older people; policy making and administration of specialized services for the aging and aged.

The aging and aged as a political pressure group and power bloc; analysis of the forms of political assertion and activity including; voting, lobbying and party support; participation in legislative, legal, diplomatic and administrative positions of government; comparison of age groups on attitudes toward politics, government and related activities; research and theories on the politics of age; political implications of organizations for the elderly; current political party approaches to aging; political significance of the response to existing and proposed governmental services for the aging and aged.

Housing for Middle Aged and Older People

Analysis of basic and variable individual and family needs for shelter; social, economic, and psychological aspects of housing; location and spatial arrangements of housing and patterns of communication and interaction; review of factors related to safety, comfort, psychological security, easy maintenance and cost; discussion of independent, congregate, and institutional dwellings; age segregated vs. integrated environments; senior housing supply by type, numbers, and locations; sponsorship and financing; federal, state, local and private resources and developments.

Counseling and Psychotherapy of the Aged

Various forms of individual and group psychotherapy with the aged; techniques of behavioral modification and other innovative approaches to helping the aged by psychological means; demonstrations of interviewing and counseling the aged in various facilities in the metropolitan area.

Theories of Aging

The nature of theory in the study of aging: Process and problems of theory development in gerontology; characteristics of useful theories.

Biological: Internal conditions, changes and adaptive systems; loss of homeostasis, cumulated stress and aging hits, insults and injuries; changes in cell structure and function; aging as a breakdown in integration at the nervous system level, neural and transmission losses, cessation of growth; bio-time clock, involution and progeria, metabolic toxins, loss of systems control, cortical control, auto immunization and mutation, cellular reproduction and replicatory mechanisms, cross link immobilization of protein.

Sociological: The impact of societal expectations and cultural values on the behavior of older people; understanding aging as a change in roles or rolelessness in relation to the structure and functions of society; aging as "disengagement" and reciprocal withdrawal; the aged as a subculture and minority group engaged in collective behavior; symbolic interaction analysis in the formation and continuity of self-concepts, self-imagery and social behavior.

Psychological: Learning theory as it relates to memory, assimilation, adaptive behavior, transfer, motivation, and neurological change; personality theory and human development in middle and old age; external adaptive systems, crises, developmental functions and tasks, general outcomes and emotional precipitates.

Research Seminar in Gerontology and Thesis

Review of scientific approaches to the study of aging and relevant research monographs including: cross-sectional surveys, longitudinal and panel programs; developmental and life cycle research; historical, biographical and case studies; and cross-cultural comparative studies. Application of research and statistical methods to a project within the student's major field; utilization of appropriate techniques of research design, sampling, data collection, and processing, statistical analysis, interpretation and generalization.

Administration of Long-Term Residential and Care Facilities (2 qtrs.)

Application of administrative theory and techniques to long-term residential and care facilities; functions of the administrator and relationships with staff, residents, patients, directors, and the community; communications, decision making, establishment of policy and other processes of management; organizational structure, patterns of service and operational procedures; planning, implementation and evaluation of social, recreational, psychological, educational, spiritual, medical, nursing,

pharmaceutical, nutritional, special rehabitative, and other services for the resident-patient; fiscal and legal resources and problems; standards and quality control on services to patients, environmental sanitation, operation of physical plant, safety and accident prevention; special staff problems, inservice education and personnel development programs; relationships with governmental agencies, business establishments, voluntary institutions and professional associations.

Gerontology Practicum

1. Field observation of and orientation to selected agencies, institutions and programs in the student's field of interest.

2. Internship of 3 to 6 months' duration in an approved program, under the supervision of administrative and/or professional personnel and the college faculty advisor.

Major Types of Agencies, Institutions and Programs for Internships

State and local commissions on aging
Retirement homes and communities
Public housing projects
Extended care facilities, convalescent hospitals, nursing homes
Multi-purpose senior citizen centers
Co-ordinated home care programs
Adult and retirement education programs

Municipal, County or State Departments of:

1. Mental Health
2. Public Welfare
3. Public Health
4. Employment Services
5. Parks and Recreation
6. Veterans' Administration
7. Social Security
8. Vocational Rehabilitation

APPENDIX F

SPECIAL HOUSING AND HEALTH CARE FACILITIES FOR THE ELDERLY

In Portland and Multnomah County*

		Institutions	Resident Capacity
1.	Extended Care Facilities	24	1,879
2.	Homes for the Aged	39	1,261
3.	Hospitals (Large General with Capacity of 200+)	8	2,676
4.	Nursing Homes	29	1,872
5.	Public Housing Projects	9	436**
	Rent Supplement Program	500+	370**
6.	About 1/2 of 1% (.55) are in Mental Hospitals (estimated)	1	359

Metropolitan TriCounty Area

7.	Retirement Homes and Campuses (Major)	
	a. Calaroga Terrace (Portland)	305
	b. Holladay Park Plaza (Portland)	250
	c. King City (Tigard)	1,000+
	d. Rose Villa (Milwaukie)	315
	e. Terwilliger Plaza (Portland)	400
	f. The Village (Gresham)	200
	g. Westmoreland's Union Manor (Westmoreland)	340
	h. Willamette View Manor (Milwaukie)	560
		3,770

NUMBER OF MEN AND WOMEN 65 AND OVER IN MULTNOMAH COUNTY

	Men	Women	Total	%
1965	29,853	39,474	64,327	12.51
1970	30,791	42,514	73,305	12.34
	42%	58%	(approximately)	

*Summary compiled by Gary D. Hansen, Associate Professor of Sociology, Portland State College.

**Actual number of elderly and disabled residents as of January, 1968.

APPENDIX G

SURVEY OF EDUCATION AND TRAINING INTERESTS IN GERONTOLOGY, GERIATRICS AND ADMINISTRATION AMONG SELECTED NURSING HOME AND RETIREMENT HOME PERSONNEL IN OREGON

February, 1967

Gary D. Hansen - Director
Oregon Gerontology Study and Training Center
Mt. Angel College, Mt. Angel, Oregon

This project has been conducted in co-operation with the: Health Manpower Project of the Board of Health, State of Oregon; the Oregon State Nursing Home Association and the Oregon Association of Retirement Services.

Background

In the fall of 1966, the staff of the Oregon Gerontology Study and Training Center at Mt. Angel College decided to review the interests in and needs perceived for education and training in gerontology, geriatrics and administration among the administrators and supervisory nursing personnel in nursing homes and retirement homes of Oregon.

Such data were deemed essential as the foundation for the development of responsible education and training programs in these fields. The ten-year plan of the Oregon Gerontology Study and Training Center recognizes the need for considerable short-term training opportunities for the personnel in various departments of long-term care facilities. This study and report provides some documentation for short-term training and for the regular degree programs at the undergraduate and proposed graduate levels.

Other institutions of higher education and officials of the best clinical facilities and programs should consider this report in terms of the qualitative contributions they could make to the development of higher levels of staff competence, excellence of service and care.

This report is based on data obtained from 66 questionnaires filled out by administrators and nurses either at the 1966 Oregon State Nursing Home Convention or in their facilities and returned by mail. It seems appropriate to assume that those who completed the questionnaires and returned them are not representative of all nursing and retirement home personnel in Oregon, but instead are the most active, professionally involved and are from the more progressive institutions. Thus, the findings of this sample cannot be generalized on a direct proportional basis to the respective personnel of all nursing and retirement homes in Oregon. The respondents appear to be those most interested and willing to involve themselves in education and training programs for professional development, improvement of facilities, services and care and to enhance financial security.

It should be noted that three other groups of personnel could be considered as an integral part of the education and training market potential in this field: 1) those employed in government or public agencies at state, county and local levels in the fields of health, welfare and social services; 2) personnel from Long Term Residential and Care Facilities in the Southwestern section of the State of Washington; and 3) others working in various hospitals which have chronic or long-term care divisions and patients. The participants in the Geriatric Nursing Series and other conferences held under various auspices have represented all of these interest groups and employers. It should also be noted that 54 of the respondents were from nursing homes and 12 were from retirement homes or homes for the aged.

Development, Utilization and Administration of Geriatric Services

The respondents were asked what priority they would assign to various topics which could be included in a continuing seminar or intensive short-term training program for the administrative and professional staff of care facilities.

The rank ordering of topics based on a combined percentage of high and average priorities as opposed to a low priority was as follows:

			Percent (N=66)
Group A	1.	General Administration	62.0
	2.	Nursing	57.5
		Occupational Therapy	57.5
		Recreation	57.5
	3.	Physical Therapy	55.9
	4.	Business Management	54.4
		Public Relations	54.4
	5.	General Medical Care	51.4
		Psychiatry	51.4
		Psychology	51.4
Group B	6.	Gerontology	49.9
		Speech Therapy	49.9
		Nutrition	49.9
	7.	Safety and Accident Prevention	48.4
	8.	Social Work	46.9
	9.	Physical Medicine	45.3
		Human Development	45.3
	10.	Volunteer Programs	43.9
		Law and Legal Services	43.9
	11.	Pharmacy	42.3
		Religious Services	42.3
Group C	12.	Accounting	40.9
		Public and Volunteer Agencies	40.9
		Podiatry	40.9
		Sociology	40.9
	13.	Bookkeeping	39.3
		Education	39.3
	14.	Library Resources	36.3
	15.	Audiology	34.7
	16.	Ophthalmology	31.2
	17.	Dentistry	28.7
	18.	Home Care Services	24.1

When asked if they or some other staff member from their institution would participate, the combined proportions were reduced by an average of 10% under the priority assessment on most topics. The ranges were from 17% to 52% on participation and 24% to 62% on priorities, respectively. The choices and discriminations were very consistent on topics most and least preferred, but there was some shifting on the topic in the middle range. For example, topics of psychology and psychiatry were placed in the A group on the priority rankings but ended up at the end of the B group when rated for participation by the respondent or another staff member. The two topics which replaced them in the A group were Safety and Accident Prevention and Volunteer Programs. Likewise, three topics were shifted forward from the C group to the B group --education, public and voluntary agencies and accounting replaced speech therapy, human development and religious services.

Short-Term Training on Nursing Services Administration

What are the combined high-average priorities on major content areas in the field of administration of nursing services? The rank ordering was as follows:

			Percent (N=66)
Group A	1.	Inservice Education	57.5
	2.	Training and Staff Development	52.9
	3.	Staffing Patterns	51.5
		Personnel Policies	51.5
	4.	Personnel Functions and Qualifications	49.4
	5.	New Patient Care Programs	48.4
Group B	6.	Standards of Nursing Practice	46.9
	7.	Planning and Decision Making	45.4
		Evaluation Techniques	45.4
	8.	Organizational Plan	43.9
	9.	Philosophy and Objectives	39.3
		Interdepartmental and Inter-Disciplinary Coordination	39.3
		Disaster and Emergency Planning	39.3
Group C	10.	Budgeting	37.8
		Nursing Research	37.8
	11.	Supplies and Equipment	33.2
	12.	Physical Facilities	31.8

As in the previous analysis, the respondents were generally consistent between assessment of priority and statements of desired participation in training programs that could be developed around various content areas. Twelve of the seventeen topics remained within the same group designated above. Topics of Budgeting and

As in the previous analysis, the respondents were generally consistent between assessment of priority and statements of desired participation in training programs that could be developed around various content areas. Twelve of the seventeen topics remained within the same group designated above. Topics of Budgeting and the Functions and Qualification of Personnel were downgraded from priority group A to group B. Standards of Nursing Practice went up from B to A and Supplies and Equipment went up from C to B, while interdisciplinary and Interdepartmental Co-ordination dropped from B to C. The implications of these shifts should be considered by planners staff and co-ordinators of short term training programs in the administration of nursing services for long term residential and care facilities.

Courses and Seminars in Gerontology, Geriatrics and Administration

The following questions were asked of the respondents about 30 different courses and seminars that could be made available.

1. What priorities would you assign to the following courses and seminars for administrative and key professionals in long-term care facilities?

2. Do you think that you or someone else in your program would enroll in such a course if available?

The following tabulation shows the rank ordering of priorities, enrollment interest and the difference between these factors. The most unusual priority and enrollment potential which departs from the pattern of all other responses is on Chronic Disease and Disabilities - Adaptation and Adjustment.

		1 High-Average Priority (N = 66)	2 Enrollment Interest (N = 66)	3 Percent Difference Between 1 & 2
	GROUP A			
1.	Development, Utilization and Administration of Therapies: Rehabilitation, Physical, Occupational, Recreational, Nursing and Speech	68	59	9
2.	Administration of Nursing Services	62	52	10
	Recreation, Leisure and Mental Health	62	44	22
	Personnel Management and Development	62	47	15
3.	Principles of Administration and Management	60	44	16
	Medical and Psychiatric Management	60	42	22
	Personality Adjustment and Disorganization	60	36	24
4.	Biological Aging, Personal and Preventive Health	59	35	24
5.	Social Gerontology	58	33	25
	GROUP B			
6.	Health Care Facilities and Care Program	53	35	18
	Fiscal Management and Accounting	53	33	20
	Food Planning, Purchasing, Services and Nutrition	53	41	12
7.	Aging in Community and Society	51	29	22
8.	Preparation for Retirement Education	50	32	18
9.	Chronic Disease and Disabilities: Adaptation and Adjustment	48	52	4
	Welfare, Protective and Family Services	48	24	24
	Counseling, Guidance and Casework, Middle Aged and Older Clients	48	35	13
	Program Development and Evaluation	48	33	15
	GROUP C			
10.	Developmental Psychology II	45	29	16
	Research in Gerontology	45	20	25
	Religion, the Churches and Aging	45	26	19
11.	Housing Middle Aged and Older People	44	24	20
	Theories of Aging	44	27	17
	Economics of Aging and Income Maintenance	44	20	24

	1 High-Average Priority (N = 66)	2 Enrollment Interest (N = 66)	3 Percent Difference Between 1 & 2
(Group C continued)			
12. Cultural Aspects of Aging	41	24	17
13. Environmental Health in Residential and Care Facilities	39	24	15
14. Architecture, Location and Design	38	18	20
15. Economic, Political and Legal Factors	33	18	15
16. Political Gerontology	26	11	15

Preferred Locations for Training

Portland was the first choice of a location for training by half of the respondents. Other individual communities did not compete favorably with Oregon's major metropolitan center for the location of training programs. Salem ranked second, Mt. Angel was third and Eugene was the fourth choice of location for training programs. The combined percentages for first, second and third choices were as follows:

Portland	54.5
Salem	24.6
Mt. Angel	15.1
Eugene	9.1

Locations in eastern and southern Oregon were mentioned by only three respondents.

APPENDIX H

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American Journal of Nursing. Monthly. American Association, 10 Columbus Circle, New York, N. Y. 10019. $5/yr., 60¢ a single copy.

Chronic Illness Newsletter. Bimonthly. Council on Medical Service, American Medical Association, 535 N. Dearborn St., Chicago, Ill., 60610.

Geriatric Focus. Monthly. Knoll Pharmaceutical Co., Orange, N. J. 07050. Free on request.

Geriatrics. Monthly. Lancet Publications, Inc., 65th at Valley View Road, Minneapolis, Minn. 55424. $6/yr., $1 a single copy.

The Gerontologist. Quarterly. Gerontological Society, Inc., 660 S. Euclid, St. Louis, Mo. 63110. $5/yr., $1.25 a single copy.

Harvest Years. 681 Market St., San Francisco, Calif. 94105. $4.50/yr., 50¢ a single copy.

Journal of Gerontology. Quarterly. Gerontological Society, Inc., 660 S. Euclid Ave., St. Louis, Mo. 63110. $15/yr., $3.75 a single copy.

Journal of Rehabilitation. Bimonthly. National Rehabilitation Association, 1522 K. Street, N. W., Washington, D. C. 20005. $1 a single copy. Subscription included with membership in the Association.

Journal of the American Geriatrics Society. Monthly. Williams and Wilkins Co., 428 E. Preston St., Baltimore, Md. 21202. $10/yr., $1.50 a single copy.

Modern Maturity. Bimonthly. American Association of Retired Persons. Du Pont Circle Bldg., 1346 Connecticut Ave., N. W., Washington, D. C. 20036. $2/yr., includes membership and subscription to "Newsletter" and magazine.

Modern Nursing Home Administrator. Bimonthly. McGraw-Hill Publications. 1050 Merchandise Mart, Chicago, Ill. 60654. $5/yr., $1 a single copy.

Nursing Homes. Monthly. Professional Publications, Inc., 65th at Valley View Rd., Southdale Park, Minneapolis, Minn. 55424. $5/yr.

Professional Nursing Home. Monthly. Miller Publishing Co., 2501 Wayzata Blvd., Minneapolis, Minn. 55440. $10/yr., $1 a single copy.

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Senior Citizen. Monthly. Senior Citizens of America. 1424 16th St., N. W., Washington, D. C. 20036. $5/yr., $1 a single copy.

Social Security Bulletin. Monthly. Social Security Administration, U. S. Department of Health, Education and Welfare. $2.75/yr., 25¢ a single copy from the Superintendent of Documents, Washington D.C. 20402.

Trends. 1965 ed. U. S. Department of Health, Education and Welfare. 1966. Part I, $1.25; Part II, 55¢ from the Superintendent of Documents, Washington, D. C. 20402.

APPENDIX I

NURSING HOME ADMINISTRATION
Staff Curriculum Vitae

James S. Bennett, D.M.D.

Education:	Reed College, B.A.	1952
	U. of Oregon Dental School, D.M.D.	1958
	U. of Oregon Dental School, M.S.(Oral Pathology)	1961
Experience:	U.S. Marine Corps	1946-48, 1952-54
	U. of Oregon Dental School · Dept. of Pathology	1961-65
	Acting Head, Dept. of Gerondontology	
	Associate Professor, Univ. of Ore. Dental School	1965-present
Memberships:	American Dental Society	
	Oregon State Dental Society	
	Multnomah County Dental Society	
	American Academy of Oral Pathology	
	American Society for Geriatric Dentistry	
	Interagency Commission on Aging	
	Interagency Association for Dental Research	
	Psi Omega Fraternity	
	Omicron Kappa Upsilon	
Publications:	Three scientific articles	
	"Retrocuspid Papillae"	
	"Pulp Polyps in Miniature Swine"	
	"Liquid Nitrogen Storage of Tissue Sections"	

Virginia L. Crowthers , M.S.W.

Education:	Allegheny College, Meadville, Pa., A.B.	1941
	University of Pittsburgh, Pittsburgh, P.A., M.S.W.	1948
	Workshop on Human Relations, N.Y.U.	Summer 1951
	Methods of Field Instruction, U. of Pittsburgh	1949
	Advanced Supervision, U. of Pittsburgh	1950
	Psychiatric Casework, Wayne State U.	1959
	Theories of Interpersonal Relationships, U. ofMich.	1965-66
	Casework III, U. of Michigan	1965-66
	Human Behavior, U. of Michigan	1965-66
Experience:	Teacher, Mt. Lebanon Pub. Schools, Pittsburgh	1941-44
	Director, various community agencies	1948-59
	Group Work experience in clinics & hospitals	1959-62

NIMH Grant - develop project of group services in community agencies - focus on mental health 1964-65
Coordinator, Indirect Services, Children's Center of Detroit 1966 ----

Memberships: National Association of Social Workers, Chairman, Group Work Section of NASW of metropolitan Detroit
National Conference on Social Welfare
Council on Social Work Education
Member, National Committee on Group Work in the school setting, NASW
Member, Committee on Mental Health of Department of Parks and Recreation, City of Detroit

Publications: "The School as a Group Setting," Social Work Practice, 1963, National Conference on Social Welfare, pp, 70-83, New York: London: Columbia University Press.
"Techniques to Motivate Patients," Recreation for the Ill and the Handicapped, 6:2, April 1962.

Leland L. Cross, M.D.

Education: San Jose Community High School San Jose, Ill 1942-44
University of Illinois, B.S. 1944-48
Northwestern University Medical School, M.D. 1948-52
Iowa Methodist Hospital, Raymond Blank Memorial Hospital for Children, Des Moines, Iowa, Rotating Internship 1952-53
U.C.L.A., Center for Health Sciences Graduate School of Public Health, Medical Care Administration, M.P.H. 1963-65

Experience: U.S. Navy - Hospital Corpsman 1945-46
Private practice - solo. General practice Mt. Pulaski, Illinois 1953-60
Private practice - partnership. General practice Mt. Pulaski, Illinois 1960-63
Regular staff, Abraham Lincoln Memorial Hospital, Lincoln, Illinois 1954-63
Courtesy Staff, Springfield Memorial Hospital, Sprinfield, Illinois 1954-63
Courtesy Staff, Macon County Hospital, Decatur, Ill 1954-63
Resident in Physical Medicine & Rehabilitation, UCLA Medical Center, Los Angeles 1963-64
Senior Resident in Physical Medicine and Rehabilitation UCLA Medical Center 1964-65
Assistant Professor in Residence, UCLA Medical School, Dept. of Physical Medicine and Rehabilitation 1965-67

Director of Physical Medicine and Rehabilitation, Los Angeles County Harbor General, Torrance, Cal. 1965-67
Director, Portland Rehabilitation Institute, Portland 1967-present

Memberships: Illinois State Medical Society
Logan County Medical Society (Pres. 1957-59)
Community Consolidated Board of Education, Mt. Pulaski, Illinois - 1958-63 (Pres. 1963)
Church Board of Trustees - 1957-62
American Medical Association
American Public Health Association
American Congress of Rehabilitation Medicine
Southern California Society of Physical Medicine and Rehabilitation
California Society of Physical Medicine and Rehabilitation
Los Angeles County Harbor General Hospital Attending Staff Association
UCLA Medical Society
Cancer Committee -- UCLA School of Medicine
Coordinator, Training Program. L.A. County Harbor General Hospital
Coordinator, Occupational Medicine, Resident's Curriculum UCLA Medical School

Publications: Co-author - research project - "Experimental Studies on Irradiated Peripheral Nerve Homografts" Jan. 1965.
Co-author - "Axon Growth through Irradiated Peripheral Nerve Homografts' paper, Jan. 1966.
Paper -"Evaluation of Primate Nerve Grafts Using EMG, Nerve Conduction and Microscopic Studies"
Paper - "Evaluation of Quality Care in Rehabilitation"

John W. Danner, Attorney at Law

Education: Wisconsin State University at Eau Claire 1936
University of Portland, A.B. 1939
Northwestern College of Law, LL.B. 1948

Experience: Admitted to practice before United States District Court and all Courts in Oregon, 1948.
Partner: Colombo, Danner and Boston, Attorneys at Law, Portland, Oregon

Member: American Bar Association
Oregon State Bar
Multnomah County Bar
American Trial Lawyers Association
National Assn. Defense Lawyers and Criminal Calls

Mrs. Helen M. Donovan, M.A.

Education: Royal Victoria Hospital School of Nursing, Montreal, Canada, RN
Wayne State U., Detroit, Nursing Education, B.S.
U. of Chicago, Nursing Service Administrator, M.A.
Experience: Staff nurse, head nurse, Royal Victoria Hospital, Montreal
Supervisor, Ass't. Director, Medical & Surgical Nursing.
Grace Hospital, Detroit
Nursing Consultant - Germany. UN Relief and Rehabilitation Administration (UNRRA)
Instructor, Nursing Education, U. of Chicago
Free lance consultant and instructor in Nursing Service Administration
Non-credit instruction - U. of North Carolina and Wisconsin, three Northwest V.A. Hospitals
Credit instruction - U. of Oregon and DePaul University (Chicago)
Publications: 25 published articles.

Morton J. Goodman, M.D.

Education: University of Oregon, B.A.	1926
University of Oregon, Medical School, M.D.	1929
San Francisco Hospital -- Internship	1929-30
Experience: House officer in Medicine- Johns Hopkins Hospital	1930-31
Resident Physician, John Hopkins Hospital	1931-32
Fellow and instructor in Medicine, John Hopkins Medical School and Hospital	1932-34
Private Practice of Internal Medicine, Portland	1934-present
Instructor of Anatomy, Associate in Medicine, Division of Chest Diseases and Ass't Clinical Professor of Medicine, U. of Oregon Medical School	
Staff of Good Samaritan Hospital, Portland	
Memberships: Diplomate - National Board of Medical Examiners	
Diplomate - American Board of Internal Medicine	
Oregon State Medical Society	
American Medical Association	
North Pacific Society of Internal Medicine	
American College of Chest Physicians	
American Heart Association	
American Federation for Clinical Research	
Western Society for Clinical Research	
Oregon State Welfare Commission	1956-60
President's Committee on Aging	1961
Medical Advisory Committee to Surgeon General on Tuberculosis Control	

Advisory Committee to President Kennedy on Medical Care for Aged through Social Security
Medical Advisory Committee, Disability Division of Social Security
Publications: Author of many papers and articles on topics in Internal Medicine

Gary Hansen, M.A. (Ph.D. Candidate)

Education: Firth High School, Firth, Idaho 1954
Utah State University, B.S. Sociology 1958
University of Minnesota, M.A. Sociology 1960
University of Minnesota, Ph.D. coursework 1960-62
Oregon State University, Ph.D. coursework completed. Home Management. Family Economics, Housing and Family Relations 1965-66
Graduate - L.D.S. Institute of Religion, Longan, Utah
Experience: Research Assistant - Utah State and U. of Minnesota
Research Fellow, Midwest Council for Social Research on Aging, at U. of Minnesota
KSTP Radio and Television Research Consultant, Minneapolis and St. Paul
Consultant, Morrison County Project on Chronic Illness and Disability Aging - Minnesota
Nursing Home and Senior Residence Requirements Project - Consultant, Marshall, Minnesota
Home Managerial Behavior of Retired Couple - Corvallis, Consultant
Research Consultant - Division of Research and Development Administration on Aging, Dept. of H.E.W., U.S. Gov. Fall, 1966
Executive Director - Commission on Aging, State of Michigan, Lansing 1962-63
Instructor and/or Assistant Professor, College teaching in Family Relations at U. of Minnesota, Michigan State, Oregon State U. and Mt. Angel College
Director, Oregon Gerontology Study and Training Center Mt. Angel College 1963-67
Acting Administrator, Benedictine Nursing Home, Extended Care Facility (100 patients), Mt. Angel, Oregon 1967
(Now serving as Gerontology Specialist on consultation basis)
Associate Professor, Department of Sociology, Portland State College Current
Memberships: American Gerontological Society
Oregon Public Health Association
Chairman of Research and Development, Oregon Governors Committee on Aging

Consultant, Bureau of Health Services, Division of Hospital and Medical Facilities, Research and Demonstration, Grants Branch, U.S. Public Health Service
Oregon Regional Medical Program, U. of Oregon Medical School, Evaluation Team and Advisory Group Member
Awards: Directed and/or planned numerous conferences and seminars on aging
Publications: Numerous books, monographs and articles.

Wendell H. Hutchens, M.D.

Education: Washington High School, Portland, Oregon	1924
Pacific College (George Fox) Newberg - AB	1928
University of Oregon, B.S.	1929
U. of Oregon Medical School, M.D.	1932
Special Psychiatric Work - Colorado Psychopathic Hospital U. of Colorado	1935
Commonwealth Fellowship - Psychiatry - Phipps Psychiatric Clinic, John Hopkins	1935-36
Experience: Private Practice - neuro-psychiatry, Portland	1936-65
Faculty of U. of Oregon Medical School	1934-59
U. S. Naval Reserve - Commander - active	1942-46
Morningside Hospital - medical director	1965-present
Holladay Park Hospital - active staff	
Good Samaritan Hospital - courtesy staff	
Providence Hospital - courtesy staff	
Memberships: Diplomate, American Board of Psychiatry	1938
Fellow, American Psychiatric Association	
American Medical Association	
Member, State Board of Health	1938-42 1959-60
North Pacific Society of Neurology and Psychiatry (Past Pres.)	
North Pacific District Branch, American Psychiatric Assn. (Past Pres.)	
Oregon Neuropsychiatric Society (Past Pres.)	
Portland Psychiatrists in Private Practice (Past Pres.)	
Oregon State Medical Association	
Multnomah County Medical Association	
Portland Academy of Medicine	
Medical Advisory Committee - Vice Pres., U.S. Veterans Administration Hospital, Roseburg, Oregon	
Salvation Army Hospital Advisory Council Member	
Mental Health Association of Oregon	
White Shield Home (Past Pres.)	
Phi Beta Pi (Medical Fraternity)	

Oscar Kurren, Ph.D.

Education: U. of Pittsburgh, B.A., Education	1943
U. of Pittsburgh, Graduate School of Social Work, MSW	1948
Florence Heller Graduate School for Advance Studies in Social Welfare, Brandeis University, Ph.D.	1967
Experience: Medical Administrative Corps, Army, Captain	1943-46
Medical Social Worker, Veteran's Administration Hospital, Aspenwall, Pennsylvania	1948-50
State Rehabilitation Supervisor, Pennsylvania State Council for the Blind	1951-54
Executive Director, Harmarville Rehabilitation Center	1954-58
Consultant on Rehabilitation Facilities, National Society for Crippled Children and Adults, Chicago, Illinois	1958-63
Institute Director, National Institute for Handicapped Children and Youth	1962-63
Institute Director, National Institute on Public Health and Rehabilitation	1963-65
Associate Professor, School of Social Work, Portland State College, Director, Continuing Education in Social Work	1965-present
Memberships: Fellow, American Public Health Association	
Association of Rehabilitation Centers	
National Association of Social Workers (Academy of Certified Social Workers)	
National Rehabilitation Association	
Publications: "Inter-Agency Joint Planning and Collaboration -- Fact and Fiction" article, 1962.	
"Social Work in Rehabilitation," article, 1959,	
"Services to Handicapped Children and Youth," report - 1964.	
"Planning Rehabilitation Center Services," article, 1957.	

Samuel Lissitz, M.S.

Education: U. of Chicago, B.S.	1933
American U., Washington D.C. - graduate work in sociology	
Brooklyn College, Summer, M.S., Sociology	1967
Experience: Operated general merchandise and credit business	1933-43
U.S. Army, Infantryman	1943-45
Administrator, Kabat-Kaiser Rehabilitation Hospital Washington D.C.	1946-54
Administrator, Central Nassau Medical Plan, Hempstead, Long Island	1954-55
Executive Director - Sheltering Oaks Hospital, Cincinnati, Ohio	1955-64

Assistant Director - 550 bed nursing infirmary section of Brooklyn Hebrew Home and Hospital for the Aged 1964-65
Executive Director of Robison Jewish Home, Portland 1965-present
Memberships: Fellow, Gerontological Society
Fellow, American Public Health Association
American College of Hospital Administrators
International Association of Gerontology, Social Welfare Research Committee 1963
Washington D.C., Chapter of National Rehabilitation Association (first Pres.)
President's Committee to Employ the Physically Handicapped
National Advisory Committee on the Employment of the Adult Cerebral Palsy.
Awards: First winner of Greater Cincinnati Hospital Council Monsignor Wagner Award to person making the outstanding contribution of the year to the hospitals and to the community
Publications: Papers and articles on geriatrics

Allen L. Mundal, M.D.

Education: Washington State College, B.S., Pharmacy and Pre-med. 1940
University of Oregon Medical School, M.D. 1943
Good Samaritan Hospital - Internship
Experience: Army Air Force
Resident - U.S. Veterans Hospital, Portland in Internal Medicine
Physician - Internal Medicine

Virginia D. Pettengill, R.N., R.R.L.

Education: Port Angeles General Hospital affiliated with University of Washington. Diploma in nursing 1940
Registration for Record Librarian 1964
Experience: Hospital nursing and office nursing 1948-58
Dept. Head - Medical Record Dept., Lebanon Community Hospital 1959-present
Memberships: Member - Board of Directors - Oregon Association of Medical Record Librarians
Chairman - Library Committee - Oregon Association of Medical Record Librarians
Workshop Coordinator for Oregon Association of Medical Record Librarians 1967

Stanley D. Rasmussen, C.P.A.

Education: University of Oregon - B.S.	1956
Experience: U.S. Army	1956-57
Haskins & Sells	1957-58
Arthur Young & Company, Audit Manager	1958- present
Memberships: CPA of Oregon	
Member of Oregon Society of CPA's	
Member of American Institute of CPA's	
Member of American Association of Hospital Accountants	
Member of Budget Executives Institute	
President, Portland Chapter, Institute of Internal Auditors	

Verne C. Reierson, M.P.H.

Education: Willamette University, Salem, Ore. - B.A.	1938
U. of California - M.P.H.	1949
University of Minnesota, Graduate School of Public Health-Research Associate	
Experience: Director, Health Education Bureau, Ministry of Health Burma	1950-53
Director, Environmental Sanitation, Oregon State Board of Health	1954-64
Director, Center of Public Health Studies, Portland State College	1965-present
Memberships: National Association of Sanitarians	
American Public Health Association (Past Pres.)	
Confederation of Western Affiliates - American Public Health Association	
Oregon Public Health Association	
Oregon Sanitarians Association	
Diplomate - American Intersociety Academy for the Certification of Sanitarians, Inc.	
Awards: Mangold Award - Outstanding Sanitarian in the United States	1959
Oregon Public Health Association Award for the Outstanding Leadership to Public Health	1962
Presidential Citation, National Association of Sanitarians	1966
Consultant to the National Sanitation Foundation	
Associate Editor, Journal of Environmental Health	1965, 66, 67

Sister M. Loyola Schwab, O.S.B.

Education: St. Benedict's Hospital School of Nursing, Ogden, Utah (Registered in State of Oregon)	1961
Mt. Angel College, Mt. Ang. , Oregon, B.S.-Sociology	1965
Experience: Nursing Supervisor, Benedictine Nursing Home, Mt. Angel, Oregon	1961-65
Training Coordinator, Oregon Gerontology Center, Mt. Angel College	1963-64
Director of Nursing, Benedictine Nursing Home, Mt. Angel Oregon	1965-present

Mrs. Wynne Spiegel, B.S.

Education: Kansas State University, B.S. - Dietetics and Institution Management	1939
Cincinnati General Hospital, Dietetic Hospital Internship	1940
Experience: William Woods College, Fulton, Mo., Residence Hall Food Manager and Instructor in Nutrition	1941
Medical Department - U.S. Army, Head Dietitian 110th General Hospital in European Theater	1942-45
Teacher - Home Economics - Portland Public Schools	1955-63
Dietitian - West Hills Convalescent Hospital, Portland	1963-present
Robison Jewish Home - Dietetic Consultant	
Baptist Home for the Aged - Dietetic consultant	
Columbia Manor Nursing Home - Dietetic Consultant	
Crestview Convalescent Hospital - Dietetic Consultant	

William L. Wright, B.S., M.D., M.P.H.

Education: University of Louisville, Louisville, Kentucky B.S.	1932
University of Louisville, Louisville, Kentucky M.D.	1936
Johns Hopkins University M.P.H.	1952
Yale University Summer School of Alcoholic Studies - Certificate	1955
Experience: County Health Officer, Morgan County, Kentucky	1939-40
United States Army	1940-45
County Health Officer, Bell County, Kentucky	1945-46
County Health Officer, Sarasota County, Florida	1946-61
Director Bureau of Local Health Services, Florida State Health Department	1961-63
Director Chronic Disease Section, Oregon State Board of Health	1963-present

VT 009 527
Office Education Association Handbook.

National Youth Group for Vocational Office Education Students, Madison, Wis.
MF AVAILABLE IN VT-ERIC SET.
PUB DATE - 69 64p.

DESCRIPTORS - *MANUALS; *ORGANIZATIONS (GROUPS); *OFFICE OCCUPATIONS EDUCATION; ACTIVITIES; LEADERSHIP QUALITIES; GUIDELINES

ABSTRACT - Information intended to assist state associations and local chapters of the Office Education Association is provided in this handbook. Types of information are: (1) an organizational chart, (2) names and addresses of national officers, (3) national constitution, (4) forms for state and local associations, (5) requirements for national, state, and chapter officers, (6) publicity suggestions, and (7) possible chapter activities. (SB)

VT 009 527

ED0 45856

OFFICE EDUCATION ASSOCIATION

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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HANDBOOK

VT 009 527

O.E.A. -- National Youth Group for Vocational Office Education Students
P.O. Box 4287, Madison, Wisconsin 53711

1968-69

PURPOSE OF OEA HANDBOOK

This OEA Handbook has a three-fold purpose:

1. To clarify OEA operation and procedures.

2. To outline procedures for local chapters involvement, improvement and development.

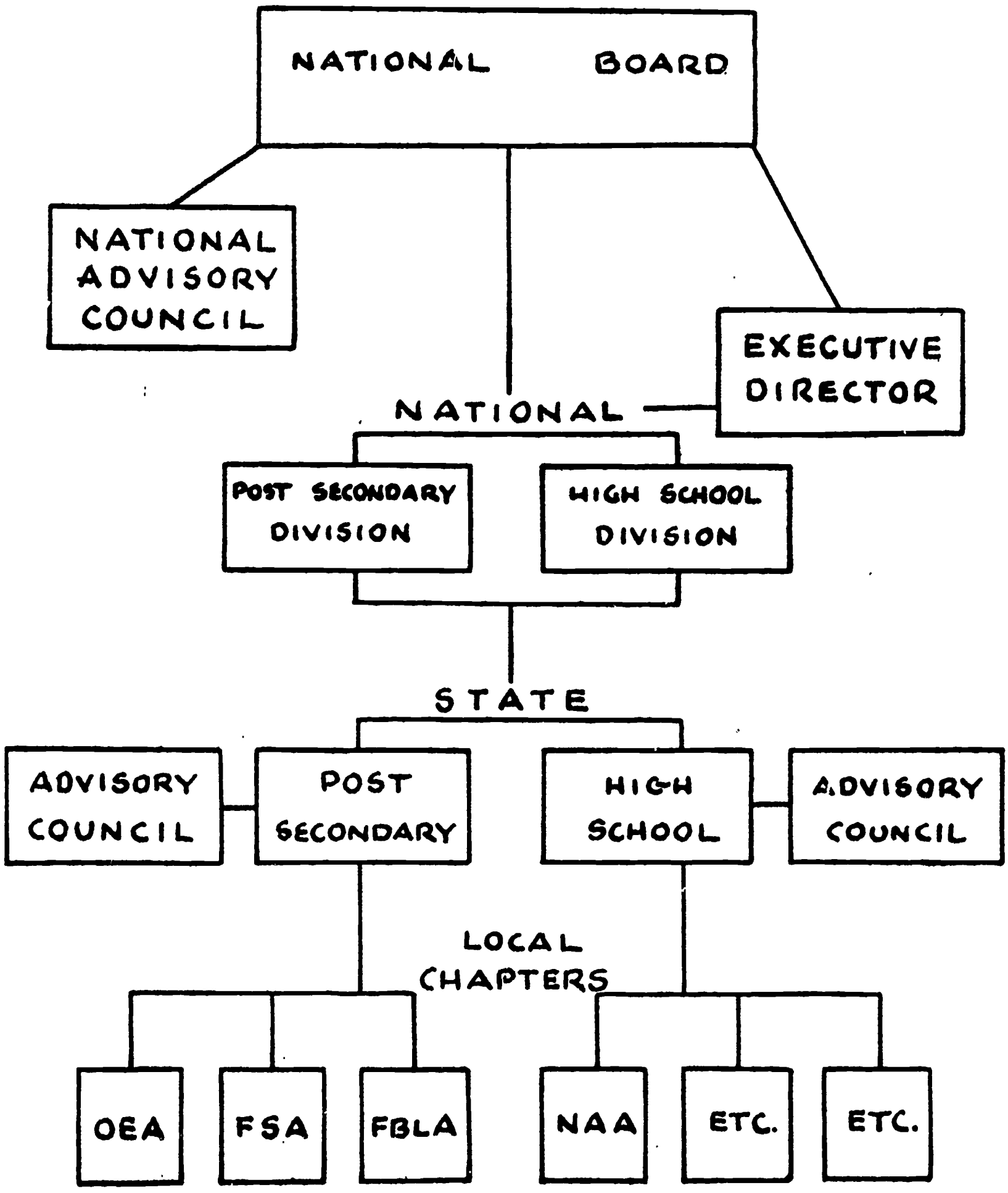
3. To help the State Associations and their local chapters function best in their role of supplementing Office Education Programs.

The National Office hopes that the information enclosed will assist State associations and their local chapters in their operations. Its aim is to motivate and direct rather than to dictate any specific function of a state association or local chapter. Frequent requests have indicated the need for this handbook and the guidance which it seeks to give.

We in the National Office hope it will serve the purpose well.

A competitive events manual is also available to assist you.

OFFICE EDUCATION ASSOCIATION



1968-69

NATIONAL OFFICERS

OFFICE EDUCATION ASSOCIATION

	High School	Post Secondary
President:	Linda Jones St. Louis Park H.S. St. Louis Park, Minn.	Carol Holtcamp S.E. Iowa Area Comm. Coll. Burlington, Iowa
Vice President:	Jeanne Anderson Sentinel H.S. Missoula, Mont.	"Pat" Martin III Delaware Tech. & Comm. Coll. Georgetown, Delaware
Eastern Reg. V.P.	Gloria Cavanaugh Camden-Rockport H.S. Camden, Maine	
Western Reg. V.P.	Linda Hughes Sherman H.S. Sherman, Texas	Kay Malone Eastern New Mexico University Portales, New Mexico
Central Reg. V.P.	Kathy Witt Naperville Comm. H.S. Naperville, Illinois	Cynthia DeGroot Racine Technical Inst. Racine, Wisconsin
Secretary:	Rose Marie Schmidt Wichita West H.S. Wichita, Kansas	Beverly Schroeder Faribault Area Voc. School Faribault, Minn.
Treasurer:	Jack Graeber St. Louis Park H.S. St. Louis Park, Minn.	Catherine Hale Manitowoc Tech. Inst. Manitowoc, Wis.
Historian:	Connie Baechtel Cleburne H.S. Cleburne, Texas	Loretta Hajenga Lakeshore Tech. Inst. Sheboygan, Wis.
Parliamentarian:	Trudy Gilbert Hopkins H.S. Hopkins, Minn.	Dottie Lueck North Central Tech. Inst. Wausau, Wis.

The national board has officially approved the Cherrydale Farms Confections fund raising program. Those chapters interested in a "no risk-no investment" candy sales program may contact Cherrydale Farms Confections, 5230 Baltimore Ave., Philadelphia, Penna., 19143; attention, Mr. Joseph Sataloff. More information on this program will be forthcoming.

The OEA national education advisory council has elected Mrs. Lucille Wright of the University of Northern Iowa as its chairman. As new vice-chairman, Dr. Walter Jacoby, American Institute of Cooperation, Washington, D.C. and as its secretary, Mr. James Urness, North Central Technical Institute, Wausau, Wisconsin. Dr. Fred Cook, past chairman is to be commended for his efforts in behalf of OEA.

The national office solicits and requests suggestions from chapter advisors on the past national conference. National board director, H. D. Shotwell of Kansas has been appointed 1969 national conference chairman.

Balfour Supply Service now can supply advertised OEA items. Suggestions on other supply items that should be available are welcome. Write national office.

OEA national board meeting at Atlanta, Georgia on May 5, 1968 reappointed Walter A. Chojnowski as executive director with annual salary of $1.00, July 1, 1968-June 30, 1969.

Please send reports and pictures of local chapter activities for OEA newsletter. Deadline for September issue is August 1, 1968. Your cooperation will make the newsletter more interesting and helpful!

Several OEA national student officers will be busy this summer; on schedule are appearance at the national conferences of F.H.A. at Miami, Florida; V.I.C.A. at Oklahoma City, Oklahoma and American Institute of Cooperation in Virginia. Other appearances are to be scheduled.

1968-69

NATIONAL BOARD

OFFICE EDUCATIONAL ASSOCIATION

Chairman
Mr. James Houstmann, State Supervisor
State Department of Education
Harvey Building, Suite F
Santa Fe, New Mexico

Secretary
Mr. James Bowling
State Department of Public Instruction
P. O. Box 697
Dover, Delaware 19901

Treasurer
Mr. Weldon Else, State Consultant
Business Education
542 State Office Building
Des Moines, Iowa

Mr. Everett Fuller, State Supervisor
Texas Education Agency
Capitol Station
Austin, Texas

Mrs. Louise Taylor, State Supervisor
Room 1807
160 N. La Salle
Chicago, Illinois 60601

NATIONAL SECRETARIES ASSOCIATION
Mrs. Lenore S. Forti, CPS-International
President
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St. Clair Shores, Michigan 48080

Dr. Fred Cook
Wayne State University
Detroit, Michigan

Mrs. Lucille Polk
Wormley Administration
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3331 Prospect Street, N. W.
Washington, D. C. 20007

Mr. H. D. Shotwell, State Supervisor
Distributive Education
State Office Building
Topeka, Kansas 66612

Mr. Charles H. Boterf, Jr.
State Department of Education
State Office Building
Augusta, Maine 04301

Mrs. Lucille Wright
Department of Business Education
University of Northern Iowa
Cedar Falls, Iowa 50613

Mr. Earl Halvas, State Supervisor
Box 928
Lansing, Michigan

Mr. John D. Lee, State Supervisor
600 Old Trails Building
309 W. Washington
Indianapolis, Indiana

NATIONAL ADVISOR:
Dr. Bruce Blackstone, Specialist
Division of Vocational, and Technical Educ.
U.S. Office of Education
Department of Health, Education & Welfare
Washington, D. C. 20202

EXECUTIVE DIRECTOR
Mr. Walter A. Chojnowski, State Supervisor
Office and Distributive Education
Board of Vocational, Technical
and Adult Education
137 East Wilson Street
Madison, Wisconsin 53703

NATIONAL EDUCATIONAL ADVISORY COUNCIL

OFFICE EDUCATION ASSOCIATION

1968-69

Chairman
Mrs. Lucille Wright
Department of Business Education
University of Northern Iowa
Cedar Falls, Iowa 50613

Vice Chairman
Dr. Walter Jacoby
Director of Youth Education
American Institute of Cooperation
1200 - 17th Street
Washington, D.C. 20036

Secretary
Mr. James Urness, President
Wisconsin Vocational-
Business Education Association
North Central Technical Institute
River Drive
Wausau, Wisconsin 54402

Mr. Bernard Shilt
Supervisor of Business Education
Board of Education
City Hall
Buffalo, New York 14202 (Pres. of A.V.A.)

Dr. John Rowe
Teacher Educator
University of North Dakota
Grand Forks, North Dakota 58201

Mr. Donald Strait
Teacher Educator
Emporia State Teachers College
Emporia, Kansas 66802

Mrs. Rosemary Shanus
Executive Secretary
Office Education Clubs
St. Louis Park High School
6425 West 33rd Street
St. Louis Park, Minnesota 55426

Miss Patricia Goldman
Chamber of Commerce of the United States
1615 H Street, N.W.
Washington, D.C. 20006

Dr. Fred Cook
Department of Bus. & Dist. Ed.
Wayne State University
Detroit, Michigan 48202

Dr. George Wagoner
Head, Business & Dist. Ed.
University of Tennessee
Knoxville, Tennessee 37916

Mr. John Caserta
Washoe County Public Schools
Reno, Nevada

Mrs. Lillian Martino
National Secretaries Association
1103 Grand Avenue
Kansas City, Missouri

Mrs. Alice I. Ross
Teacher-Coordinator
Coeur d'Alene High School
Coeur d'Alene, Idaho

Mr. E. Calvin Elliott
Data Processing Management Association
524 Busse Highway
Park Ridge, Illinois

Mr. William Blake
International Consumer Credit Association
375 Jackson Avenue
St. Louis, Missouri

Mr. Jolen Adams
Supervisor of Office Education
Chicago Public Schools
Chicago, Illinois

Mrs. Elaine Pitts, Manager
Sperry and Hutchinson Company
330 Madison Avenue
New York, New York

OEA - A TOOL TO SHAPE THE FUTURE

The businessman wants a socially efficient and occupationally competent worker at the desk in his office. The office is becoming increasingly important in the lives of the businessmen themselves. Relationships which weren't even known to exist a few years ago are now considered as essential to decision making. Who supplies the data upon which decisions are made? The office worker!

Office workers must be able to record and retrieve data and to communicate it to others. They analyze, synthesize and report so that the businessman can make his "guesstimate" of what action should be taken. No decision is better than the information upon which it is based, and this is the reason why the businessman looks for more and better office workers. There will be more information about more things needed in the future and the office worker will record it, classify it, summarize it, and predict the future as a recommendation for action to his employer.

The office worker has another set of demands placed upon him to meet the needs of his employer--he must be able to adequately represent the firm or organization which employs him. The voice on the telephone is the business to the person on the other end of the line. Poor judgment, poor social skills or inaccurate information on the part of one junior office worker can destroy the good image the businessman has developed through years of good work!

The businessman wants people WHO CAN DO SOMETHING WELL. They must be able to pull their weight from the first day, get along with others, give and take instructions, cooperate in achieving group goals, and all of the other items which make up office life.

The office worker is generally a "staffman" who must know how to run a meeting, get a consensus, recognize and solve problems with minimal direction. Because he works with people more than "things," the businessman recognizes the need for office workers to work closely together, working "with" not "for" the boss.

As the basic source of information, and probably the first contact point for persons with the firm, the office worker needs to know "what will go" with people and "what will not!" The office worker should respect individual differences among his fellow workers, his subordinates, and his superiors.

The business community has a real interest in having office personnel who can communicate ideas both upward and downward in the line and staff organization. Each of the employees should, of course, be occupationally competent in such areas of employment as:

Accounting and Computing Occupations
Business Data Processing Occupations
General Clerical Occupations
Information Communication Occupations
Materials Support Occupations: Transporting, Storing, Recording
Personnel, Training and Related Occupations
Stenographic, Secretarial and Related Occupations
Supervisory and Administrative Management Occupations
Typing and Related Occupations
Miscellaneous Office Occupations

These major areas of instruction make up the basis of education for office occupations. Office Occupations Education serves the needs of the nation's economy and defense needs by providing occupational education in the major classifications found in the Dictionary of Occupational Titles which apply to office work. The content of this instruction is based upon an analysis of "what is done" on the job and "what social skills are necessary" to put the occupational skills into operation.

The businessman desperately needs persons who can lead and arbitrate discussions and who have the abilities to ask intelligent questions which stimulate and encourage thinking on the part of their fellow workers, subordinates and superiors. The ability to coordinate the activities of others is essential as offices grow larger and more complex. Awareness of the desirability of giving credit to individuals for their achievements, as well as credit for group work well done, is a rare commodity in office workers.

To accomplish coordinated leadership by suggestion and command is a learned skill that is certainly desired in the modern business office. The ability to criticize, direct, and redirect actions of subordinates, peers, and superiors all call for a high degree of social as well as occupational skill.

Each organization with an office, and what organization does not have one, needs persons with skill in developing enthusiasm, those who can make this feeling contagious and form a "team." The enthusiasm and confidence developed by past success has much to do with the abilities of individuals to lead and to be flexible enough to be molded by the organization, and, at the same time, to help mold the organization itself.

In other words, what the businessman wants in the future, and wishes he had today, is a well rounded, socially-effective, occupationally-effective individual who is a "leader type," but also knows the "follower" role--a person who is experienced enough to know how to produce a day's work (and generally a little more) for a day's wage at acceptable achievement levels; a person who has a balanced outlook and experience; a person who can be an Ambassador of Good Will for the firm; and a person who can represent the finest in the firm.

WHERE IS THE PARAGON OF EXCELLENCE?

Strangely enough, all of the "future demands" of businessmen are learned skills which may be developed and expanded through programs of vocational education and their supporting youth organizations. Students in the schools of the nation today who are part of the program of education for office occupations are learning to meet all of these demands, both in and out of school, in the realistic job situation and through the national youth organization specifically designed to support the vocational education efforts fostered by the Vocational Education Act of 1963. This Act made education for office occupations a part of the vocational education team, which this year has celebrated its 50th anniversary of

service to the nation's economic and defense needs for initial, refresher, and upgrading of all levels of occupational education in all communities of the nation.

A new youth group has been founded to expand opportunities for education in office occupations. Here, the students, both secondary and post-secondary, have an opportunity to learn leadership and followership by doing both in their club activities. The Office Education Association is a voluntary association of State youth groups supporting the office education program within the framework of vocational education. It is part of the education program which is designed to develop leadership abilities, interest in the American business system, and competency in office occupations.

Individual membership in OEA is recognized through membership in State authorized and supervised OEA clubs. Any existing or emerging youth group which demonstrates how it will meet the State developed requirements may participate in the OEA program as part of the State Association.

The OEA is an independent organization not associated with a professional or other groups. Its development has been at the grass roots level, reflected by the independent action of several States to combine their efforts, to improve education for office occupations through the inclusion of youth group activities. It is a national youth organization dedicated to serve students enrolled in vocational office occupations education, developing student leadership abilities, interest in the American business system, and knowledge of vocational competencies. Membership is without regard to race, creed, or national origin. It conducts educational, professional, and civic activities.

Learning by living their roles as leaders and followers, members of the local OEA club develop both a sense of leadership and responsibility. The club program provides an opportunity to be with those who are "on the job" in an individual's personal career-objective area, and this experience can help the student decide

if "Accounting and Computing" (or any of the other classifications) "is for me!" The students participate in a group concerned with their career objective field and have a chance to associate with recognized leaders in the community. They secure prestige and recognition by participating in a variety of a challenging projects and pursue excellence in a peer approved set of activities. They face the problems of communication and coordination in a "real" situation. The interaction of students, teachers, community leaders, and local leaders in the student's career objective area helps the student learn to be socially effective as well as occupationally competent. Through planning and conducting meetings and working on mutual problems, opportunities for giving and receiving instruction are provided.

As a result of opportunities to appear before the group as a program leader or project leader of a special project, the student learns how to represent his group well, particularly this is true when he has the chance to compete in State and national contest activities.

Cooperative efforts are needed to achieve local club awards such as Chapter of the Year in the city, State or national competitions. Here is an opportunity for youth to learn the essential elements of "getting along with others" that make our society possible.

Once a student has been to a State or national OEA meeting he is filled with enthusiasm for his club program. As he represents his local club, he helps develop the skills of stimulation and encouragement of others. Each member of the club will have an opportunity to "sell" an idea, to learn by doing--developing competency which will aid him all his life.

Those who are charged with responsibility for the educational programs find that the OEA activity motivates students by providing a chance to develop, through practice, democratic principles which are the essential elements of citizenship and effective office work. The field of free enterprise and its importance is

"lived" through the club competitive and cooperative programs. It is also true that OEA activities provide satisfaction to some youth who would otherwise be passed by in terms of recognition and self-expression.

The OEA program provides a greater depth and scope to the office occupations program than can be provided in the classroom alone. This program is designed to support the formal education program, to involve the business community in a realistic situation, and to expose students to learning challenges and successes.

OEA provides a chance for development of the ethics of competition and of teamwork as members work together. It also provides a chance for competition and its enthusiasm as the club and individuals compete in their occupationally-oriented activities. The social values of working with others is especially important in a society which is changing as rapidly as that of the United States.

The Office Education Association provides a means of helping the businessman solve his immediate and future problems concerning office workers by providing students with opportunities to develop the skills, knowledges and understandings desired by those in the business community.

WHAT CAN THE BUSINESSMAN DO ABOUT ALL THIS?

Obviously, the first thing that can be done is to be aware of the program! Make your friends and compatriots aware of it and see if YOU can help out in some way. Further information about the Office Education Association can be obtained from:

Mr. Walter A. Chojnowski, Executive Director
Office Education Association
P. O. Box 4287
Madison, Wisconsin 53711

or

Your Local Office Occupations Education Teacher.

1. Can YOU attend an Employer-Employee Banquet with an OEA student who has worked in your office (at the employees expense) to receive the thanks of all the office students for your support of OEA?
2. Can YOU help the school establish more adequate performance standards for instruction by sharing your knowledge of office work as a member of the Office Occupations Consultative Committee?
3. Can YOU provide a work station where students can come as part of the cooperative education phase of their experience? This is the time when the student "goes into the business world" and works part-time and goes to school part-time in a planned educational experience. Perhaps, YOU could provide this "realistic" experience for students on a visitation basis.
4. Can YOU provide a past graduate of the school program to go back to the school and tell students "about the real world?" Could YOU do it yourself?
5. Can YOU help judge contests and provide support for the participations of OEA representatives from your school or State?
6. Can YOU provide realistic dictation or filing, or similar occupational information to the schools so that they can bring reality to the classroom and to the club program?
7. Can YOU listen to and advise office occupations education students about their careers?
8. Can YOU do the same thing for their teachers?
9. Can YOU help assure that the equipment, housing, and other educational facilities available to your town's students are up to date, effective and efficient?
10. Can YOU help assure that your students have a chance for the best in teacher-coordinators who know how to make use of the OEA?

CONSTITUTION

PREAMBLE

With the identification of office occupations as an area of vocational education it has become necessary to provide youth group experiences for enrollees in business and office education programs.

Leadership development through youth groups can be effective in strengthening vocational education for office occupations. It is deemed essential that:

1. There be established a vocationally oriented youth group to serve the needs of those receiving initial, refresher or upgrading office education.

2. This organization be an identifiable part of the vocational education curriculum preparing students for office occupations.

3. The organizational pattern facilitates the use of existing youth groups as in integral part of the educational pattern for office occupations as established in law and regulation.

4. This organization provide a means for individual states to organize their youth groups and to participate as members of a national youth group serving the educational needs of office occupations education enrollees.

ARTICLE I -- NAME

The name of this organization shall be "Office Education Association."

ARTICLE II -- PURPOSES

The purposes of this organization are:

To assist local club members in the growth and development of their purposes.

To unite in a common bond without regard to race, creed, or national origin of students enrolled in classes with office employment as their objectives.

To develop leadership abilities through participation in vocational education, civic, recreational, and social activities.

To assist students in establishing realistic training and employment objectives.

To create enthusiasm for learning.

To promote high standards in ethics, workmanship, and scholarship.

To develop the ability of students to plan together, organize and carry out worthy activities and projects through the use of the democratic processes.

To foster an understanding of the functions of labor and management organizations.

To develop competent, aggressive business and office education leadership.

To develop and strengthen confidence in themselves and their work.

To develop and participate in a cooperative effort.

To provide satisfactory social and recreational activities.

To foster practical application of business and office education through competition.

ARTICLE III -- ORGANIZATION

Section 1. The Office Education Association is an organization of State Associations, each operating in accordance with a charter granted by OEA, Incorporated. Each State Association chartered at the National Conference of OEA shall be considered a charter member.

Section 2. The administration of OEA will be vested in the Board of Directors of OEA, Incorporated.

Section 3. The OEA will be composed of two divisions: a high school division and a post secondary division. Each division will have an Executive Council of officers who will be elected annually by the voting delegates of that division, who in turn will make recommendations to the Board of Directors with respect to the welfare of that division.

Section 4. The Office Education Association, Incorporated, is a non-profit, educational corporation consisting of those persons who are officially designated by the states to serve as Chief State Supervisors of Business and Office Education in each state and territory chartered by this corporation, and organized to serve as the sponsoring agency for the youth organization bearing the name, Office Education Association.

Section 5. The Board of directors who are to manage the affairs of this Corporation shall number fifteen persons. One of the fifteen will be a head member of the Office Education staff of the U. S. Office of Education. One will be the immediate past-chairman of the Board, one will be the chairman of the Office Education Advisory Council, one chairman of the Business Advisory Council and one a National Affiliated Association representative from the Education Advisory Council. One will be the Treasurer of the Association and the remaining nine will be elected three each year by and from the membership for three year terms at the Board's annual meeting. The Board will elect its own officers from the elected nine, who will also serve as officers of the Association. The Board will appoint an administrative officer for its national headquarters and may make other special appointments as may be necessary. Any Board vacancy occurring other than by expiration of the term of a Director shall be filled by the Board of Directors. The Board will be responsible for recommending alteration, repeal, or additions to these by-laws, and will meet as deemed necessary by the Board Chairman. A quorum will consist of seven members.

Section 6. The Chairman of the Board of Directors will be elected annually by the Board of Directors. He will preside over all meetings of the Board of Directors, will serve as special counsel for the Board as the occasion may demand, and otherwise represent the Association as may be necessary.

Section 7. The Vice Chairman will be elected annually by the Board of Directors, will serve in the absence of the Chairman and will perform such duties as the Chairman may direct.

Section 8. The Secretary of the Board will be elected annually by the Board of Directors. He will issue notices of all official meetings, distribute copies of such records to members, and perform such other duties as the Chairman may direct.

Section 9. The Treasurer of the Board will be appointed annually as an ex-officio member by the Board of Directors. He will serve as financial advisor to the national student organization. He will oversee the receiving, depositing, investing and disbursing of funds by the executive director in accordance with the budget approved by the Board of Directors, and will be bonded the amount to be fixed by the Board. He will arrange for an annual audit by an independent accountant and make this audit available to all members and other interested persons as may be designated by the Board of Directors.

Section 10. The Executive Director is employed by and directly responsible to the National Advisor and to the Board of Directors. He will serve as the administrative representative and will be responsible for the supervision of all other employees. He will assist the Treasurer of the Association by receiving, depositing, investing and disbursing funds in accordance with the budget approved by the Board of Directors. He will be bonded with the amount fixed by the Board, and perform such other duties as may be directed by the National Advisor and the Board of Directors.

Section 11. Annual meeting of the Association will be held at a designated time and place. All members will receive written notice of this meeting at least two months prior, along with a tentative agenda. In the event a member is unable to attend, he shall designate, in writing, his representative for purpose of representing him during said meeting.

Section 12. Voting privileges shall be exercised by each member or his appointed representative, each member having one vote. A quorum shall consist of one-third of the membership.

ARTICLE IV -- MEMBERSHIP

Section 1. The association of any state or territory of the United States may be chartered as a member of OEA upon approval of the Board of Directors of OEA, Incorporated.

Section 2. The members of OEA shall be the chartered state associations. A state association will consist of the chapters located within a state, and each chapter will consist of student members.

Section 3. OEA will recognize individual memberships only through a state association. Individual memberships of state associations' local chapters will be recognized as active members or professional members.

Active Members shall be students enrolled in a high school or post secondary program of office education as approved by that state. An active member must pay dues as established by OEA, and will be eligible to hold national office, participate in national award programs, serve as a voting delegate, or to otherwise represent his state in national OEA affairs.

Professional Members may be persons associated with or participating in the professional development of OEA as approved by a state association. Such members may include teacher-coordinators, teacher-educators, and OE Supervisors; persons enrolled in OE pre-service teacher-education programs; employers and/or training station sponsors of OE students; advisory committee members, and others willing to contribute to OEA growth and development. Professional members will pay dues as established by OEA, but will be ineligible to serve as a national voting delegate, hold national office or otherwise represent his state association in national OEA.

Honorary Life Members may be individuals approved by the Executive Council of each division and the Board of Directors of OEA, Incorporated.

Section 4. Application for Membership. Any chief state officer in Business and Office Education may apply for membership through the Board of Directors by submitting a letter requesting the issuance of a charter for that State Association of OE Clubs, and including: a copy of the constitution and by-laws, a list of local chapters, a list of state officers, a remittance to cover national dues for each chapter member and a remittance of $10.00 for the charter fee. The Board of Directors will notify the person making application of its findings.

Section 5. States in Good Standing. All State Associations will be considered in good standing if they meet the following requirements each school year: have active local chapters of OEA, pay national dues as required, and file reports and records as the Board of Directors may set.

ARTICLE V -- VOTING

State associations who are members of OEA shall exercise their voting privilege through national voting delegates at the national conference. The allocation of the voting delegates will be decided each year by the Board of Directors.

ARTICLE VI -- OFFICERS

Section 1. Officers for each high school and post high school division shall be elected by majority vote of the voting delegates of that division at the National Conference of OEA, and shall consist of a president, vice president, secretary, treasurer, historian, parliamentarian, and regional vice presidents, the collective group to be known as the Executive Council for that division.

Section 2. Officers elected at one annual meeting will continue to hold office until the close of the next annual meeting.

ARTICLE VII -- MEETINGS

Section 1. A National Conference shall be held each year, with the time and place to be selected by the Board of Directors of OEA, Incorporated. This National Conference shall be the official annual meeting of OEA.

Section 2. Parliamentary procedure of all meetings will be governed by Robert's Rules of Order, Revised.

ARTICLE VIII -- ADVISORS

Section 1. The head state supervisor of vocational office education of any state affiliated with OEA, Incorporated, will be responsible for that state association as described in the Articles of Incorporation. Each teacher and/or teacher-coordinator of vocational office education will serve as advisor of his OEA chapter.

Section 2. The National Advisor will be the Office Education Specialist of the U. S. Office of Education.

Section 3. Advisory committees to assist national OEA growth and development may be appointed as deemed necessary by the Board of Directors of OEA, Incorporated.

ARTICLE IX -- FINANCES

Section 1. State associations will be responsible for national dues according to the number of individual members claimed in each membership classification, times the amount established for that classification.

Section 2. The Board of Directors will control all OEA finances and will furnish an annual audit to each association according to Article 6, Section 6.

ARTICLE X -- EMBLEMS AND COLORS

Section 1. Colors are hunter green and gold.

Section 2. (Yet to be established)

ARTICLE XI -- AMENDMENTS

Section 1. To amend this constitution, the proposed amendment must be presented in writing by a state association, through its voting delegates, to the Constitution and By-Laws Committee of each division. These committees have the responsibility to correct the proposed amendment but must not alter its purpose. The committee chairman will present the amendment to the Executive Council of his division where it must be approved by three-fourths majority vote. The amendment will then be published in the minutes of the annual conference. It then must be presented for vote during the first scheduled business meeting of each division at the next annual conference, and may be adopted by a three-fourths majority approval of the voting delegates of each division.

ARTICLE XII -- RULES, REGULATIONS, AND BY-LAWS

Section 1. Each division of OEA will adopt such rules, regulations, and by-laws as are deemed necessary by the voting delegates and the Board of Directors to operate the division.

BY ---- LAWS

ARTICLE I -- QUALIFICATIONS FOR STUDENT NATIONAL OFFICE

Section 1. Only active members will be eligible for office in either division.

Section 2. To be eligible for office in either division candidates must meet the qualifications as established by the Board, but must be holding or have held elective state association or local chapter office in his division; and must submit the approved application for candidates for national office. The official nominating committee will review and determine the eligibility of the candidates. This slate will consist of not more than two candidates for each office. Other candidates determined eligible by the nominating committee may be nominated from the floor of the delegate assembly and shall be allowed time to address the assembly equivalent to the time allowed any other candidate for that office.

Section 3. Upon gaining approval of the nominating committee of his division to campaign for an office, any candidate will be automatically disqualified from candidacy for violation of any rule adopted.

ARTICLE II -- DUTIES OF NATIONAL STUDENT OFFICERS

Section 1. President. It shall be the duty of the president of each division to preside at all business meetings of that division; to preside over the Executive Council meetings of that division; to make all necessary committee appointments including the designation of committee chairmen; to develop with his Executive Council a program of work for his term of office; and to make himself available, as necessary, in promoting the general welfare of OEA.

Section 2. Vice President. It shall be the duty of the vice president of each division to serve in any capacity as directed by his president; to serve as chairman of the Student Committees of that division; to accept the responsibilities of his president as occasions may demand; and to make himself available, as necessary, in promoting the general welfare of OEA.

Section 3. Secretary. It shall be the duty of the secretary of each division to serve in any capacity as directed by his president; to record the proceedings of all business and Executive Council meetings of his division; to accumulate the minutes and/or proceedings of all committee meetings of his division; and to make himself available, as necessary, in promoting the general welfare of OEA.

Section 4. Treasurer. It shall be the duty of the treasurer of each division to serve in any capacity as directed by his president; to present any financial and membership reports necessary for his division; and to make himself available, as necessary, in promoting the general welfare of OEA.

Section 5. Historian. It shall be the duty of the historian to maintain the OEA Activity Manual, and to accumulate information and material which will be of value in recording the history of OEA.

Section 6. Parliamentarian. It shall be the duty of the parliamentarian to be responsible for the general conduct at the National Conference by formulating and distributing rules of conduct. He shall review constitutions of new chapters and issue charters to those new chapters during the National Conference. He shall rule on rules of order, should the occasion arise, during the business meetings of OEA.

Section 7. Regional Vice President. It shall be the duty of each regional vice president to serve his division in any capacity as directed by his president, to promote the growth and development of OEA within his region in accordance with the program of work during his term of office; and to make himself available, as necessary, in promoting the general welfare of OEA.

ARTICLE III -- THE STUDENT EXECUTIVE COUNCIL

The Executive Council of each division of OEA will be composed of the president, vice president, secretary, treasurer, historian, parliamentarian, and regional vice presidents, and shall meet upon the call of its president. It shall be the duty of the Executive Council of each division to plan for the welfare of that division, to represent that division, and to act for that division as occasions may demand.

ARTICLE IV -- DUES

The membership year shall be July to June 30 and/or February 1 to January 31 inclusive. Annual dues for each membership classification shall be one dollar, with the exception of honorary life members who shall be exempt from payment of dues or as established by the Executive Board.

ARTICLE V -- AMENDMENTS

To amend these by-laws, the proposed amendment must be presented in writing by the state association proposing the amendment to all state associations of OEA and each division president at least thirty days prior to the national conference. The Executive Secretary and the President of each division is responsible for making the proposed amendment known immediately to his Executive Council and must consider the proposed amendment during its next meeting. The president must then present the proposed amendment, together with the actions recommended by his Executive Council, to the Board of Directors of OEA, Incorporated. If approved by the Board of Directors, the proposed amendment will be presented at the next scheduled meeting of OEA, and may be adopted by majority approval of the voting delegates of each division.

OPERATING PROCEDURE

VOTING - The Board of Directors shall allocate each year after the first national conference the number of voting delegates in each division to each member state. The number of voting delegates in each division shall not exceed 200.

OFFICE EDUCATION ASSOCIATION

DATES OF CONCERN

August 12-13-14, 1968	National Officer's Leadership Training Clinic and Board Meeting - Chicago, Illinois
September 1, 1968	Membership Rosters accepted by National Office
October 15, 1968	News Deadline - Fall Issue (Send copy, pictures to Weldon Else, Dept. of Public Instruction, Des Moines, Iowa)
December 8-13, 1968	American Vocational Association Conference, Dallas, Texas
	OEA National Board Meeting
	OEA National Educational Advisory Council Meeting
	Joint Meeting of Board and Council
December 15, 1968	News Deadline - Winter Issue
February 1, 1969	News Deadline - National Conference Issue
March 1, 1969	State membership of this date to be used in determining voting allotment of National Conference
	Application deadline for State Association for charter at National Conference
March 14, 1969	Nomination forms for National Student Officer's candidates submitted to National Office
	Registration forms and fees for OEA conference sent to national office
	Send directly to hotel for accommodations
	Contestants names submitted to national office
March 21, 1969	National Officer's candidate test date
March 31-April 1-2, 1969	National Conference - Kansas City, Missouri
April 2, 1969	News Deadline - Post Conference Issue
June 7-8-9, 1969	National Officer's Leadership Clinic and Board Meeting - site to be selected

GENERAL INFORMATION FOR STUDENTS ATTENDING OEA CONFERENCE

1. Atendance Criteria

   A. Be an active member of OEA

   B. Have approval of school administration

   C. Have approval of chapter advisor

   D. Have the approval of parents (or guardian(s)) unless student is more than 21 years of age.

II. What to bring

   A. Luggage - A small, easily handled piece of hand luggage packed with everything you need.

   B. Clothing Recommendations -

      Girls - Wrinkle-resistant suits or one-piece dress for traveling; light-weight wool for most conference occasions. Appropriate dress for the Friday night buffet and Saturday banquet.

      Boys - Comfortable, conservative sportswear for traveling; coats and ties required for all sessions. A dark suit and white shirt for any conference activity.

   A business-like appearance is appropriate for delegates at all times.

III. Registration - Housing

   (This information to be released at a later date.)

IV. Transportation and Insurance

   A. The National Office would like to recommend that all chapters consider commercial transportation for their delegates to the National Conference. Be sure that students under 21 years of age have received their parents' permission and that you are fully covered by insurance for this trip.

V. Non-Conference Activities and Entertainment

   A. Activities have been planned for all delegates during the conference dates. Do not plan non-conference activities and entertainment during this period. You will have a full schedule of activities. Before and after the conference, activities are up to you and your chapter advisor.

OEA Form 8
12/66

OFFICE EDUCATION ASSOCIATION
P.O. Box 4287
Madison, Wisconsin 53711

STATE ASSOCIATION MEMBERSHIP REPORT

Report Number _____

Date _____

State Association _____

Number of Clubs
(OEA Form 10 is attached for each club)

	High School	Post Secondary
This Report	_____	_____
Previous	_____	_____
Total	_____	_____

Number of Members

	This Report	Previous Report(s)	Total
H.S. Active			
H.S. Associate			
P.S. Active			
P.S. Associate			
Professional			
Total			

Request for Cards and Charters

High School Active _____ Post Secondary Active _____

High School Associate _____ Post Secondary Associate _____

Professional _____

High School Charters _____ Post Secondary Charters _____

Attached are copies of OEA Form 10 for each club and members reported above, and remittance for national dues in the amount of $ _____.

_____
(Signature of State Advisor)

OEA Form 9
1/67

OFFICE EDUCATION ASSOCIATION

APPLICATION FOR CLUB CHARTER

_____ASSOCIATION

The _____ Office Education Club hereby applies for
(school)

charter by the _____ Association of the Office Education Association.
(state)

We certify that students supporting this charter are enrolled in bona fide Office Education classes meeting the requirements of the State Plan for Vocational Education. It is requested that a certificate of charter evidencing affiliation be issued to the above named club. As required by the Office Education Association, we hereby submit the following:

_____ Constitution and By-laws

_____ OEA Form #10, Application for Membership

_____ Remittance of $ _____ to cover state and national dues for _____ members

_____
(Signature Club President)

_____
(Signature Club Advisor)

_____
(Date of Application)

_____
(Signature School Principal)

Mail to State OEA Advisor

OFFICERS

NATIONAL

The National Officers of the High School and Post Secondary Division of OEA are elected at the National Leadership Conference and serve for one year. Their term begins at the end of the Conference at which they are elected and concludes at the end of the next year's annual Conference. Election to office must be made by majority vote of the Voting Delegates. Each division of each State Association is entitled to one Voting Delegate plus a major fraction thereof.

To be eligible for candidacy, a student must be an active member of his division, have a scholastic average of 2.5 (an "A" letter grade equivalent to 4.0) for the two previous completed semesters prior to the National Leadership Conference and must be holding or have held an elective State Association or Chapter office in his division. In addition a prospective candidate must pass the written Parliamentary Procedure and OEA Information Test prior to the National Conference.

Any OEA member who desires to run for National office should consult with his Chapter and State Advisor. The tests are sent to the school's guidance director, principal or dean of students, who administers the test. Chapter and/or State Advisors will not have access to the tests. Separate tests will be given candidates in the High School and Post Secondary Divisions.

The test together with official nomination forms, will be sent to the school guidance official, principal or dean designated by the State Supervisor or State Advisor, who has the only authority to initiate the testing procedure. The time schedule for testing will be announced to State Associations shortly after the beginning of the calendar year. Test results will be mailed to each candidate, his Chapter and State Advisor before the National Leadership Conference.

All candidates who have met all requirements and passed the test will be interviewed by the nominating committee of their respective divisions during the National Leadership Conference. Each division's nominating committee will select two candidates for each office and if they choose, declare additional qualified candidates eligible for nomination from the floor. Passing the test does not guarantee nomination or declaration of eligibility by the nominating committee.

Each division has eleven officers. The officers and the duties of each are:

PRESIDENT: It shall be the duty of the President of each division to preside over the Executive Council meetings of that division; to preside at all business meetings of that division; to make all necessary committee appointments including the designation of committee chairman; to develop with his Executive Council a program of work for his term of

office; and to make himself available, as necessary, in promoting the general welfare of OEA.

VICE PRESIDENT: It shall be the duty of the Vice President of each division to serve in any capacity as directed by his President; to serve as Chairman of the Student Government Committee of that division; to accept the responsibilities of the President as occasions may demand; and to make himself available as necessary in promoting the general welfare of OEA.

SECRETARY: It shall be the duty of the Secretary to serve in any capacity as directed by his President; to record the proceedings of all business and Executive Council meetings; to accumulate the minutes and/or proceedings of all committee meetings; and to make himself available, as necessary, in promoting the general welfare of OEA.

TREASURER: It shall be the duty of the Treasurer to serve in capacity as directed by his President; to present any financial and membership reports necessary; and to make himself available, as necessary, in promoting the general welfare of OEA.

PARLIAMENTARIAN: It shall be the duty of the Parliamentarian to serve in any capacity as directed by his President; and to make himself available, as necessary, in promoting the general welfare of OEA.

HISTORIAN: It shall be the duty of the Historian to work closely with the President and State Association Advisor to encourage maximum publicity by all Chapters. He will maintain a file of all published releases and prepare materials for use during conferences. He will keep National OEA informed of the activities of his State Association.

REGIONAL VICE PRESIDENTS: (Southern, North Atlantic, Central and Western.) It shall be the duty of each Regional Vice President to serve his division in any capacity as directed by his President; to promote growth and development of OEA within his region in accordance with the Program of Work during his term of office; to make himself available, as necessary, in promoting the general welfare of OEA.

NOMINATION FORM

Name of candidate _____

Name of School _____ State _____
( ) High School ( ) Post Secondary

Parents' Name _____ Address _____
_____

Advisor's Name _____ Address _____
_____

Principal's Name _____

Hometown Newspaper _____

Attach Photo If Convenient

Office sought - Please Check:

	President	____	Vice President	____
Regional	Vice-President	____	Treasurer	____
	Secretary	____	Historian	____
	Parliamentarian	____		

Evidence of leadership ability in school or outside organization

Name of Organization	From-To	Office Held
_____	_____	_____
_____	_____	_____
_____	_____	_____

If employed

Place of employment _____ Type of business _____
Position held _____ Length of employment _____

Attach school transcript of first semester grades and certified copy of grades to date for second semester.

The above candidate is a member in good standing of the _____ Chapter of the Office Education Association. To the best of my knowledge all information submitted on, with or attached to this nomination for is factual and exists as presented.

_____ State Advisor

_____ Chapter Advisor

If elected, I will make every effort to attend next year's National leadership conference and to actively serve in office to the best of my ability and abide by the Constitution of the Office Education Association.

_____ Office Candidate

OFFICERS

STATE

It is evident that the success of a State Association's program will depend, to a large extent, upon the strength of its student officers. An intelligent selection of officers can be made only if the qualifications of the candidates are carefully examined. An accepted practice in many states, therefore, is for the nominating committee to receive nominations from local Chapters. More and more State Associations are using a written test similar to that used by National OEA.

In order to make the work of the nominating committee truly effective, the local Chapters should consider qualifications such as the following when making suggestions: must be an active member of local, state and national OEA; must have a thorough knowledge of parliamentary procedure and be poised enough to conduct a meeting; should be able to express opinions and make decisions; should be able to meet people easily and have an outgoing personality; should be available for state and national meetings; and should have a true desire to serve OEA.

The recommended officers and duties of each are:

PRESIDENT: It shall be the duty of the President to preside at all meetings; to preside over the Executive Council meetings; to make all necessary committee appointments; including the designation of committee chairmen; to develop with his Executive Council a program of work for his term of office; and to make himself available as necessary, in promoting the general welfare of OEA.

VICE PRESIDENT: It shall be the duty of the Vice President to serve in any capacity as directed by his President; to serve as Chairman of the Student Government Committee; to accept the responsibilities of his President as occasions may demand; and to make himself available, as necessary, in promoting the general welfare of OEA.

SECRETARY: It shall be the duty of the Secretary to serve in any capacity as directed by his President; to record the proceedings of all business and Executive Council meetings; to accumulate the minutes and/or proceedings of all committee meetings; and to make himself available, as necessary, in promoting the general welfare of OEA.

TREASURER: It shall be the duty of the Treasurer to serve in capacity as directed by his President; to present any financial and membership reports necessary; and to make himself available, as necessary, in promoting the general welfare of OEA.

PARLIAMENTARIAN: It shall be the duty of the Parliamentarian to serve in any capacity as directed by his President; and to make himself available, as necessary, in promoting the general welfare of OEA.

HISTORIAN: It shall be the duty of the Historian to work closely with the President and State Association Advisor to encourage maximum publicity by all Chapters. He will maintain a file of all published releases and prepare materials for use during conferences. He will keep National OEA informed of the activities of his State Association.

OFFICERS

CHAPTER

It is important for the growth of each Chapter to have a well-qualified and dependable group of officers. With capable officers, the business of the Chapter will be conducted in the proper parliamentary fashion, an effective program of work which includes all members will be maintained, records and minutes will be up-to-date and complete, good publicity will be forthcoming, and all members will grow professionally.

Every consideration should be given by the membership in electing officers. It is a mistake to look only for the most popular members. Qualifications for the positions to which the individual will be elected should be the prime consideration. Don't expect every officer to be familiar with his duties and responsibilities just as soon as he is elected, but be sure you have chosen a person who is willing to work hard to prepare himself to perform his duties well. All Chapter members should have a general understanding of the duties and responsibilities of each office as well as a knowledge of the qualities of leadership to look for, since only with this understanding and knowledge can a good slate of officers be elected.

A leader is one who can communicate his ideas and feelings and yet is willing to listen and understand the need for democratic procedures. He respects the rights, the ability, and dignity of every member. He is able to convey enthusiasm and inspire confidence. He has the courage of his convictions, but he is open-minded. He is vitally interested in everything that concerns the Chapter and the community and is willing to put the good of the Chapter before his personal desires.

Each officer should be familiar with the Chapter constitution and by-laws and with the annual program of work. He should own an OEA Handbook, know his part in all ceremonies, and be familiar with parliamentary procedure. He should, of course, cooperate with other officers and all members at all times.

Chapters may want to consider electing a slate of officers each semester to allow maximum opportunity for leadership development.

Suggested officers and duties:

PRESIDENT: Preside over and conduct meetings according to accepted parliamentary procedure; keep members on the subject and the discussion within a time limit; appoint committees and serve as ex-officio member on them; call other officers to the chair as necessary and desirable; represent the Chapter at special school events and before out-of-school organizations; coordinate Chapter activities by keeping in close touch with the other officers, the membership and the Advisor; keep Chapter work moving in a satisfactory manner by following up on progress being made on all activities; and call special meetings.

VICE PRESIDENT: Assist the President in the discharge of his duties; preside at meetings in the absence of the President; be prepared to assume the duties and responsibilities of the President should the need arise; and, serve as ex-officio member on Chapter committees.

SECRETARY: Prepare and read the minutes of meetings; have available for the President the agenda for each meeting; attend to official correspondence; send out and post meeting notices; count and record rising vote when taken; prepare Chapter reports; keep permanent records of the Chapter; cooperate with the Treasurer in keeping an accurate membership roll and issue membership cards; read communications at meetings; and, have on hand for each meeting secretary's book, minutes of previous meeting, lists of committees and committee reports, copies of local, state and national programs of work, copies of the constitution and by-laws, and a copy of the Handbook.

TREASURER: Receive and act as custodian of Chapter funds; collect all state and national dues and be responsible for their disbursement to the state treasurer; keep financial records neat and up-to-date; devise, with the assistance of the membership and the Advisor, appropriate fund-raising activities; pay out Chapter funds as authorized; encourage systematic saving - individual and Chapter thrift; assist in preparing an annual statement of estimated receipts and expenditures; and, protect the financial reputation of the Chapter by seeing that its obligations are met promptly.

HISTORIAN: Gather and classify Chapter news; prepare news and articles for publication in school and local newspaper(s); acquaint local newspaper editors with aims and purposes of Office Education and OEA; file clippings and pictures of Chapter activities and keep a Chapter scrapbook; assist in maintaining a Chapter bulletin board; assist with planning and arranging Chapter exhibits; and, prepare and collect news and feature stories of Chapter activities for the state newsletter or magazine.

PARLIAMENTARIAN: Assist Chapter members in understanding the fundamental purposes of parliamentary procedure; be prepared to advise the presiding officer and other Chapter members on points of parliamentary procedure; have reference material pertaining to parliamentary procedure available for each meeting; watch for significant irregularities in parliamentary procedure and call them to the attention of the Chair; and, be prepared to explain any irregularity and its effect on the rights of all Chapter members.

CHAPTER ADVISOR: Although the Chapter Advisor is not an elected officer, his duties should include: responsibility for starting a Chapter; become familiar with the history, principles, constitutional provisions, ceremonies, State and National activities, parliamentary procedure, and other aspects of OEA; assist with plan for obtaining an efficient group of officers; instruct newly-elected officers in their duties and provide leadership training for all members; assist members in setting up practical and worth while programs of work and guide them to completion; see that programs are adequately financed and Chapter

funds properly protected; see that Chapter meetings are held regularly throughout the year and conducted in a business-like manner; help new members to get into the activities of the Chapter and see that each member has a part in Chapter work; help set up a system of adequate Chapter records and accounts; counsel individual members and committees on problems; see that all ceremonies, public performances, and displays are carefully planned and creditably carried out; keep school authorities and the public in touch with activities and developments; keep informed of new developments in OEA and pass information on to the members; encourage membership participation in state and national contests and on committees; explain the significance and proper use of Chapter insignia; and keep the purposes of OEA in mind regarding all OEA activities.

OATHS OF OFFICE

The following are the oaths of office which are read by the outgoing officer and repeated by the incoming officer. This ceremony takes place at the beginning of the last general meeting.

PRESIDENT

"Mr. President-elect, you have been selected by your fellow members to be the leader of our state association for the coming year. Your past record of accomplishment has marked you as possessing those qualities of leadership which all future business leaders should possess. Hence, you now become responsible for leading our state association in all its worthy undertakings. May you work intelligently and seriously to ably discharge the responsibilities of your office."

If you agree to assume these responsibilities will you repeat after me.

I ___(your name)___, do hereby state that I will fulfill my responsibilities as President of the _____Office Education Association.

VICE-PRESIDENT

"Mr. Vice-President-elect, you have shown your leadership ability by being elected to this station. You are to assist the President at all times in directing the work of our state association, preside over meetings in his absence, and help him to keep all committees working efficiently."

If you agree to assume these responsibilities, will you repeat after me."

I ___(your name)___, hereby state that I will fulfill my responsibilities as Vice-President of the _____ Office Education Association.

SECRETARY

"Mr. Secretary-elect, you have been chosen by your fellow members to keep accurate minutes of all meetings, carry on all correspondence of our state association, and preside over meetings in the absence of both President and Vice-President, or until a temporary chairman has been chosen. You must be responsible for state association reports. The Secretary has custody of the constitution, by-laws, and other reports of the state association. You will keep an accurate list of members and the Degrees awarded and furnish membership cards. You should provide the chairman with a statement of all business to be transacted at each meeting along with a list of all committees."

If you agree to assume these responsibilities, will you repeat after me.

I ___(your name)___, do hereby state that I will fulfill my responsibilities as Secretary of the _____ Office Education Association.

TREASURER

"Mr. Treasurer-elect, being selected for this office means our state association has placed high honor and trust upon you. Your duties require you to keep accurate records of all receipts and disbursements and be ready at all times to give a report of the financial condition of our state association."

If you agree to assume these responsibilities will you repeat after me.

I ___(your name)___, do hereby state that I will fulfill my responsibilities as Treasurer of the _____ Office Education Association.

PARLIAMENTARIAN

"Mr. Parliamentarian-elect, your duty will be to insure that this state association is run according to good parliamentarian procedures. You will assist the local chapter by providing guidance and information on parliamentary procedures of conducting local chapter meetings. You will also supervise the election of state officers at next years leadership conference."

If you agree to assume these responsibilities, will you repeat after me. I ___(your name)___, hereby state that I will fulfill my responsibilities as Parliamentarian of the _____ Office Education Association.

HISTORIAN

"Mr. Historian-elect, your duty is to strive to supply public information. This can be accomplished in part by gathering and submitting all interesting news from local chapters. All outstanding news should be reported to you by the local chapters. You will assist the secretary in making association reports by keeping a scrapbook of pictures and articles published concerning the state association and its members, and help in compiling our state association history."

If you agree to assume these responsibilities will you repeat after me. I ___(your name)___, hereby state that I will fulfill my responsibilities as Historian of the _____ Office Education Association.

VOCATIONAL AND TECHNICAL EDUCATION FOR THE OFFICE OCCUPATIONS

Office occupations education is a combination of courses and practical experiences, organized into programs of instruction to provide opportunities for persons to prepare for and achieve career objectives in office occupations.

This program is designed to serve the needs of society through initial, refresher and upgrading education. It leads to employment and advancement of individuals in occupations in public enterprises or organizations related to the facilitating function of the office which includes such activities as: Recording and retrieval of data, supervision and coordination of office activities, internal and external communication and the reporting of information.

Office occupations education serves the entire spectrum of individual abilities from the very low to the very high. High school students, those who have completed or left high school, those who have entered the labor market and need training and retraining, persons with special educational disadvantages and teachers of office occupations are the major groups which can expect service from office education programs.

PURPOSE

The overall purpose of education for office occupations is to provide individuals with skills and abilities to meet local, State and national needs for office workers. It is for all citizens who want, need and can profit from this instruction. Realistic consideration is given to the needs and opportunitites of the employment market, projected development and to provide a balanced program of office education in support of the economic and defense needs of the nation for office workers.

The office as the facilitating factor in our society makes possible the achievement of the goals of the production and distribution factors in our economy. Office work gets the right thing to the right place at the right time, and it provides management with the data upon which to base decisions.

Office Occupations education is making important strides in breaking away from traditional subject-oriented curricula. The curricula are sequences of educational experiences related to occupational objectives which have been formulated through an analysis of behavioral requirements (duties, skills, abilities and attitudes) of office occupations. The instructional sequence is a balance of business principles from which the student learns about the environment he will face in office work; occupational specialization to acquire skills necessary to succeed in an office career; realistic "in school" and "in office" experiences with necessary supervision, direction and coordination; and, coordinated youth group activities based upon the enrollees career objective are an integral part of the curriculum.

Education for office occupations is a vocationally-oriented program stressing the career objective of the individual student. It is not a terminal program in a conventional sense of the word because the individual determines the level of training he wishes to obtain through a program which extends from routine office activities to complicated administrative positions.

The wide scope of office occupations education is indicated by the major categories of instruction:

Accounting and Computing Occupations
Business Data Processing Systems Occupations
Filing, Office Machines and General Office Clerical Occupations
Information Communication Occupations
Materials Support Occupations
Personnel, Training and Related Occupations
Stenographic, Secretarial and Related Occupations
Supervisory and Administrative Management Occupations
Typing and Related Occupations
Miscellaneous Office Occupations
Other Office Occupations not elsewhere classified

Office occupations education programs are offered in many settings. The major groupings include:

HIGH SCHOOL

The major purpose of the high school level office occupations programs is to provide entry level office workers. Office education is based upon the general education required of all students of the school and the basic business education offerings available as part of the academic program, plus business principles, occupational specialization, and realistic office experiences provided in the office education program. The office occupations portion of the students education is specifically related to the career objective of the student. Major career objectives are indicated above. A high school program must be in conformity with State plan requirements and may extend over a two or three year period for those with career objectives in office occupations. Adequate coordination, direction and supervision of the realistic work experience phase of the program must be provided.

POST SECONDARY

The major purpose of the post secondary office occupations education program is to provide initial, refresher and upgrading education to help individuals enter and advance in an office career. At this level of the educational system, students may be trained as entry office workers and to be upgraded to skilled office worker positions. Education may also be provided for entry office technician positions with upgrading to specialized office occupations. Entry office administrative positions as well as upgrading training leading to administrative management positions is also provided.

Normally, the activities at this level include the three types of learning experiences related to the career objective of each student in a full "day school" environment.

ADULT

There are two major types of adult education offered in the office occupations program. First, that which is supplemental to employment, and second, that which is preparatory, entry, or refresher education. Normally, the adult program is on a "part-time basis" in the evenings or late afternoons. It involves the same major classifications of learning experiences, the need for a career objective, and behavioral analysis as the basic element in the curriculum structure.

YOUTH AND ADULTS WITH SPECIAL EDUCATIONAL PROBLEMS

Office occupations education is based upon "need to knows", both social and the skills and knowledges necessary to help a person get and advance in office work. To enter the regular program of office occupations education requires certain prerequisites without which a satisfactory completion of the program is improbable. The term "special needs" implies in office occupations education, a person who needs to be raised to prerequisite levels, for whatever reason.

There are many areas of office occupations where persons with physical, mental, emotional or academic handicaps can satisfactorily perform. In this program, there is an emphasis upon preparation for gainful employment as well as preparing persons to enter the regular office occupations program.

OFFICE EDUCATION ASSOCIATION

The OEA is an independent national youth organization for students enrolled in high school and post secondary office occupations education programs. Local chapters function as an integral part of the instructional program. Specific provision is made for other vocational office oriented and specialized youth groups to participate in State level and national level activities. Through its varied program of planned youth activities, members have an opportunity to develop individual and group activities as they serve as leaders and followers in office related activities.

SOURCES OF FURTHER INFORMATION

Office occupations education is largely supported from State appropriations and local school budgets. Federal funds serve to stimulate and support State and local efforts on a matching basis. In each State there is a person charged with responsibility for office occupations education who may be reached by writing the State Supervisor of Office Occupations Education, State Board of Vocational Education, in the State Capitol.

Requests for information about the national vocational youth organization in support of office occupations education may be sent to the Executive Director, Office Education Association, P. O. Box 4287, Madison, Wisconsin 53711.

Additional information about the office occupations education program is available from the Office Occupations Education Unit, Division of Vocational and Technical Education, U. S. Office of Education, Washington, D. C. 20202.

WHAT IS THE SIZE AND POTENTIAL OF OFFICE OCCUPATIONS

There is every reason to believe that the office occupations will continue to grow as more data about more things are required for making decisions. The office occupations education program is the second largest of the vocational education programs after only four years. There are approximately two million persons in office occupations education in the nation today.

The future of office work is very bright. Between 1966 and 1980, it is expected that the office work force will jump from 14.7 million to about 30.7 million. While some 20 million new jobs will be created during this period, some 8.2 million of them will be "teenage" jobs.

Major work opportunities will be found in the Stenographic and Secretarial Occupations, General Clerical Occupations, Accounting and Computing Occupations, and Typing and Related Occupations for entry jobs. Data Processing Occupations, Supervisory and Administrative Management, Personnel Administration, and Information Communication Occupations offer many advancement possibilities.

BUILDING THE EMBLEM CEREMONY

OFFICE EDUCATION ASSOCIATION

Equipment Needed:

One easel

A board covered with black cloth or painted black

A gold shield

Parts of the OEA emblem

A small spotlight

After the introduction by the president, the officers will build the emblem. Each officer participating will walk to the emblem, place his portion of the emblem on the shield, turn and speak before the microphone. He will than return to his seat. Each officer should be seated before the next speaker rises.

President:

The Office Education Association has an attractive emblem composed of significant parts which represent the aims and objectives of our organization. Will the officers please assist me in building the OEA emblem.

Vice President:

Our emblem is a golden shield, signifying honor, dignity, and the importance of office occupations.

Treasurer:

The stripes represent education, citizenship, loyalty, patriotism, dependability and competency, essential characteristics of every successful office worker.

Historian:

The green bar represents the service provided by those engaged in office occupations, to themselves, to their employers, and to their nation.

Secretary:

The quill and inkwell represent those early leaders who developed American independence, our free enterprise system, our democratic system of government, and our codes of social behavior which have brought this nation to a position of world leadership. The quill signifies leadership, scholarship, character, and courage.

Parliamentarian:

The letters OEA show the national character of the organization which is composed of State associations and local chapters.

President:

Honor and dignity, purposeful education, dependable service, leadership and good character, courage and patriotism -- these parts of the national emblem are symbolic of the goals and purposes of our Office Education Association.

Office Education Association

Ceremoney for Opening a Meeting

The president should be seated on the platform or in the front of the room. The other officers should be seated in a semi-circle around the delegates at national and state conventions and around the room at local chapter meetings. The vice president should be seated immediately back of the delegates and should face the president.

President: (Stands and raps the gavel for attention)

The meeting will come to order. We are now holding a meeting of the _____(chapter, State association or national organization). Mr. Vice President, what are the major purposes of our organization?

Vice President:

We recognize the importance of office occupations and understand the contributions that have been made to our country by workers in this expanding field. We are preparing to take our place in these challenging occupations. We work together in the OEA to develop essential competencies in leadership, scholarship, character and citizenship so that we may share in the improvement of our economy and the advancement of our nation.

President:

May we accomplish these objectives. Mr. Vice President, will you please present the other officers.

Vice President:

With pleasure, I introduce:

(Introduce in order the historian, secretary, treasurer, parliamentarian, and regional vice presidents. Pronounce the name of each individual and the office held. As each officer is introduced he should stand and remain standing until seated by the president).

Mr. President, all officers are at their stations.

President:

Will the members and friends please rise and join me in stating why we are here.

(Raps three times with gavel. The audience should rise on the third rap of the gavel.)

Everyone:

We are met in a spirit of friendship and goodwill as we prepare for lives of service in office occupations. We work together to attain the goals of OEA and pledge our loyalty to our nation.

President:

Please be seated.

Ceremony for Closing a Meeting

President:

Mr. Secretary, do you know of any further business which should be transacted at this time?

Secretary: (Rises, replies and sits down)

I have none, Mr. President.

President:

We are about to adjourn this meeting of the _____ of the Office Education Association. As we associate together, let us be dedicated, courteous and honest.

Fellow members, and guests, join me in a salute to our flag.

(Taps three times with the gavel to call the members to stand. All members face the flag and with their hands over their hearts, repeat the following pledge:)

Everyone:

"I pledge allegiance to the Flag of the United States of America and to the Republic for which it stands, one Nation under God, indivisible, with liberty and justice for all."

President:

I now declare this meeting adjourned.

(Taps once with the gavel and the meeting is adjourned.)

STOP AND EVALUATE YOUR OEA CHAPTER

	Points		
ACTIVE COOPERATION	3	2	1
Are our members interested, active, cooperative and informed?	___	___	___
Are our advisors referred to for advice?	___	___	___
Does each member appear or assist with a chapter activity during the year?	___	___	___
Is a real effort made to find the abilities of each member?	___	___	___
PROGRAM OF WORK			
Are our activities based on OEA purposes?	___	___	___
Does our chapter program of work make use of the State and National Program of Work?	___	___	___
Is our program of work organized so that it is easily understood by all members?	___	___	___
Is our Program of Work planned early in the year and are later activities carried out according to this plan?	___	___	___
Is OEA part of the Office Education Program?	___	___	___
GOOD ADVERTISING AND PUBLICITY			
How have we interpreted our OEA program to the community and school?	___	___	___
Have we completed chapter activities which help strengthen the school in our community?	___	___	___
OEA ACTIVITIES			
Is our chapter promoting training of students for the business world?	___	___	___
Have our activities helped our members grow in social graces?	___	___	___
Are our money making projects educational and related to the OEA goals?	___	___	___
DEMOCRATIC COOPERATION AND UNDERSTANDING			
Have we promoted democracy and the development of creative leadership in school and community life?	___	___	___
Are opportunities provided by the chapter for all members to learn to participate in group work?	___	___	___
Are our chapter meetings orderly, well-planned meetings?	___	___	___
Do the members clearly understand OEA goals, objectives and values?	___	___	___
Do our members recognize the opportunity for personal growth through OEA?	___	___	___

OPPORTUNITY TO LEARN

	Points 3	2	1
Is effective use made of the Chapter Handbook, and other releases from the State Offices?	___	___	___
Do Chapter experiences provide opportunities for all members to develop leadership abilities?	___	___	___

COMPLETION OF WORK - A SUCCESSFUL CHAPTER?

Are accurate reports kept on file?	___	___	___
Are necessary reports and dues sent promptly to the State Advisor?	___	___	___
Do we participate and assume our responsibilities in the State Organization?	___	___	___
Did the projects of our Chapter help us achieve the goals we set?	___	___	___
Do we use what we learn from our evaluation for future plans?	___	___	___

Excellent	65-79 points
Average	41-64 points
Below Average	Below 40 points

Publicity

The public judges an enterprise by what it does and by what it says. If its purpose is sound, its services good, its people aggressive and successful individually, and its program beneficial, your community and perhaps the nation should be told about it. This combination of sound policies and good practices, multiplied by effective publicity, is what produces good public relations. This means simply winning the friendship and support of the public.

Good publicity for OO and OEA activities will perform several functions:

--Keep students informed and interested
--Attract additional students to the OO program
--Maintain pride among students and stimulate further progress
--Create interest on the part of the general public
--Create and sustain public support of the OO and OEA program

Publicity covering projects and programs which have a state or regional appeal should be handled by the State OEA Advisor. These will include such things as the State Conference, guest speakers of national prominence, competitions, outstanding or unique accomplishments of individual members or Chapters, etc.

If the news is of broad interest--of interest to people outside the immediate state or region--the item should be forwarded to the OEA State Office to be included in a news release or the OEA Newsletter. News which appears benefits the state organization and builds prestige and support at a national level.

Tools

Effective publicity is easier when you have good tools for the job. Many news media people will supply you with guides to follow in preparing copy for them. Tools for use by people charged with publicity responsibilities have been developed and are available through industry.

Assemble a scrapbook of publicity as it appears. Keep notes on radio and television publicity and other media used. Send one clipping of every printed article to your National OEA Headquarters. In many cases, this will rate you national publicity not otherwise possible.

What Is News?

Learn to recognize and use for publicity only those things that interest others. News media want to capture the attention of their audience and hold it. Many OEA accomplishments will do this. You stand a good chance of having these stories used.

Some things worthy of mention are:

--State Conferences
--Outstanding speakers (These can form not only the basis for printed news stories, but you may be able to arrange an interview on the local radio or TV station.)
--Tours and competitions
--Election of OEA officers
--Accomplishments of individual OEA members, promotions and winners of competitions
--OEA awards won or awards given
--Events honoring major industry supporters--or longtime industry supporters
--Other events of interest as they occur
--Scholarship Awards

Writing a News Release

Five points are important to a good news release: WHO, WHAT, WHEN, WHERE, and WHY. If possible, a sixth, HOW, should be included. It is important to get all these points in the first sentence or two, whether you're writing for a printed publicity or broadcasting. These first sentences are called the "lead". A good lead captures the attention of a reader or listener and makes him want to know more.

Now go into the details of your story. Each succeeding paragraph should be of declining importance. If an editor cannot use the whole release, he can then cut from the bottom--where the least important details are given. Use short words. Write short sentences, short paragraphs. Two sentences make a good paragraph in a news release. Be brief.

If possible, have a standard letterhead type format for your news release. This should carry the name of the OEA contact, address and telephone number--probably the name of your OEA advisor. (Many a story has failed to appear because the newspaper or magazine did not have a contact to call to verify a fact or name.) Always give exact dates in a news release: June 10 rather than "next Thursday" or "tomorrow". Specify "October", not "next month". Eliminate adjectives when you write a news release. Be sure to check every point of your story for accuracy. Never guess on names, places, dates or times.

Mechanics of Preparing a Release

News releases should always be typewritten on 8 1/2 x 11" plain white paper--unless you have a standard letterhead type format. Use a quality paper that can be handled without tearing. Never use onionskin or tissue weight paper. Never send carbon copies. Carbons smear easily, causing possible errors in spelling of names or dates. If you need many copies, mimeograph them. Then let the editor know others are getting the same release, and he'll rewrite it a little for individuality.

When identical, individually typed releases are sent out, be sure to list at the top of the release just which newspaper and broadcast outlets are getting identical stories. Be sure to keep a copy of every release you send out. Leave ample margins (1 1/2 inches) on each side of paper. In the upper left hand corner of the first page, type the name of the OEA contact, address and telephone number. Next type the release date in the upper right hand corner. "FOR IMMEDIATE RELEASE" means the editor or broadcaster can use it at once. If at all possible, your release should carry this notation.

If you MUST ask for a specific publication date, it should read, "RELEASE AFTER 4:00 p.m., THURSDAY, APRIL 10, 1964." Such releases complicate an editor's job, so should be avoided whenever possible. Always start typing your copy one third of the way down the first page. The editor needs this space left open so he can write a headline for your story and give other instructions. (Most editors prefer to write the headline for your story, but a few may ask you to provide one). Check each one and follow his wishes. Type double-space or triple-space on one side of the paper only. Indent each paragraph at least five typewritten spaces. If your story must run more than one page, write "More" at the bottom of each page except the last. Always end each page with a complete sentence and paragraph.

When your release runs more than one page, type the OEA name at the top of each succeeding page. Drop a few ##### under the final paragraph of the news release. Many newspapers and magazines supply a style sheet on request, telling how they capitalize, abbreviate, spell and punctuate their copy. Follow the editorial style of each paper carefully.

Check your news release for absolute accuracy in typing. Make sure all names, dates, hours and places are correct. If there are unusual names, put a small check over each one to let the editor know you have checked them for accuracy. Never staple the pages of a news release. They must be separated in the news room and may be torn in the process.

DELIVER or MAIL every release so it arrives WELL IN ADVANCE of whatever deadline you must meet. Whenever possible, include a photograph with your release.

Pictures

Picture requirements are indefinite, paper by paper, magazine by magazine, varying greatly depending upon the make-up and budget of each one. Check with each editor to determine his needs and requirements. Note carefully what each will supply and what you are expected to provide for the kind of picture publicity you need. Some newspapers will send a photographer to cover a story, as will some magazines. Others will be glad to use photographs if they are furnished to them in proper form. Be sure--if you send pictures--to follow the editor's directions for picture arrangement size and finish of prints.

When you contact the editor, find out just how far in advance it will be necessary to get in touch with him to schedule a picture story. Contact him when you have such a story in mind. All pictures require advance planning. You should have no more than two or three persons in a picture and THEY SHOULD BE DOING SOMETHING. Work out action plans in advance, developing props to create interest. Follow your photographer's suggestions for picture composition. A good photographer has this special knowledge; he may also have definite orders from his editor if he is representing a newspaper or magazine.

Have everything ready so that the photographer can get to work quickly on arrival. Someone should be designated to work with him, to answer questions and identify by name and title the people whom he photographs. A typewritten list made up in advance is most helpful to the photographer. Editors will tell you how to prepare and attach captions to any photographs which you submit. As a general rule, the caption (identification of people in picture) is typed on a piece of plain white paper. Be sure to leave space above the typing to be used as a "paste-up space". Apply paste to approximately 1" of space immediately above typing. Attach it to bottom of the back of the picture, with typing and picture facing up. Fold the caption up over the face of the picture.

Never use a paper clip--and never write on the back of a picture. Either of these may damage the photo and spoil it for reproduction. Be accurate with spelling of names in picture captions. Verify them carefully before pasting the caption to the photograph. At one of your OEA Chapter meetings, invite a professional news photographer as a speaker. At your request, he will bring examples of good and poor photos--and explain why they are good or poor.

Radio and Television

Millions of dollars worth of air time is given by the broadcast industry every year for public service. Your OO and OEA activities, have a broad enough appeal to merit a share of this time. Broadcast time is limited by the clock. Radio and television stations are limited to the hours they are licensed to be on the air.

Study the program of your local stations before you make your first station contacts. (Do not forget the educational television channels that operate in many sections of the country.)

A few possibilities of shows which might be available to you are: (1) Interview Shows (If you have an important out-of-town speaker, here's a good place to try to arrange publicity) and (2) Panel or group discussions.

Educational channels might offer the opportunity for a show to explain OO and OEA. Such a show would help attract students to the program. Contact director or the news editor. They coordinate the public service time.

Meeting deadlines and prompt appearance for live or taped shows cannot be stressed too much in your work with the broadcast industry. It is extremely important to arrive well in advance of the time set. Choose people to represent your program who are not given to nervousness and who have a pleasant speaking voice.

When you write releases for radio and television, the same basic rules apply as in newspaper copy. Be brief, accurate and neat. Always submit on 8 1/2 x 11" plain white paper, typed double-spaced. The guide to radio and television publicity, "If You Want Air Time," published by the Public Relations Service, National Association of Broadcasters, Washington, D.C. 20006 will be helpful.

Courtesy to the Press

It is a good idea to extend an open invitation to the press to attend any events conducted by you. A special invitation should be extended to particularly important events. When they do attend introduce them. If a reporter or a photographer attends any function, they should do so as your guest.

At the end of the year, write thank you notes to the papers, magazines, radio and television stations who have given you publicity throughout the year.

Provide each reporter or photographer who attends your event a typed list of the "important people" expected to be in attendance. Make certain each has a copy of the program. Try to provide copies of any OO or OEA brochures which may help him understand your program and its purpose.

Chapter Activities

Chapter activities and projects may be classified in major areas.

Professional
Financial
Civic
Service
Social

In planning activities for the Chapter's Program of Youth Activity, every effort should be made to incorporate the state and national programs into the calendar. Wherever possible, other youth organizations such as DECA, FFA and FHA may be helpful in promoting activities and projects.

PROFESSIONAL

Professional activities are those that contribute to the professional improvement of the students. Chapters should plan for meetings at least once a month at which guest speakers, demonstrations, panel discussions, films and similar presentations relating to business are featured. Field trips are frequently conducted in connection with topics studied in class.

Possibly the most universally accepted professional activity is the annual Employer-Employee Banquet which brings together those closely associated with the Office Education Program. Participation of students, school officials and business leaders in the banquet program demonstrates the community-wide nature of the plan of instruction in business.

Contests and the Studies in Business Programs are also considered professional activities. Designed primarily to stimulate student interest in improving career-related knowledge and skill, these activities emphasize the importance of learning through preparation and participation. Individual achievement is recognized in a sequence of local, district, state and national eliminations.

FINANCIAL

Financial activities involve raising funds to support the financial obligations of the Chapter. These obligations often include expenses for items such as travel funds for delegates and committee members, field trips, professional and social meetings and communications. Individual Chapters determine the number and types of financial activities in which they wish to participate. Many Chapters assess nominal membership dues, but a major proportion of local revenue comes from financial activities and projects.

CIVIC

Civic activities are conducted by Chapters to serve the school and the community. Projects range from campus improvement campaigns to participation in fairs, trade shows, and other community-wide events. The activities are frequently conducted in cooperation with local business organizations, school organizations and civic groups.

SERVICE

Service activities emphasize the need for sharing with others. Frequently, projects are designed to coincide with Thanksgiving and Christmas. Many of the projects are so conceived that they involve student participation as well as gifts and contributions.

SOCIAL

Social activities are a major requisite of the OEA program. There is a tendency to de-emphasize social activities per se by enriching professional activities with social elements. For example, many social connotations are connected with the annual Employer-Employee Banquet although the primary purpose of it is professional in nature. Social activities also become an important finishing touch to professional meetings, particularly when community leaders are invited to participate in the Chapter program.

Suggested Chapter Activities

Films	Contest Program	Election of Officers
Field Trips	Boss Breakfast	Needy Family Project
TV Programs	Assembly Program	Professional Meetings
Fund Raising	Regular Meetings	Installation of Officers
Fair Exhibit	Alumni Activities	Local Publicity Releases
Fashion Show	Social Activities	Initiation of New Members
Parents' Night	Civic Appearances	Employer-Employee Banquet
Guest Speakers	Panel Discussions	"Good Citizenship" Project
Chapter Newsletter	Homecoming Parade	"Get-Out-The-Vote" Project
State Conference	Sponsor "Clean-Up" Project	National Conference
"Careers in Business"	Articles for OEA Newsletter	
Executive Council Meeting		
"Student in Office Education"		
Reception for Prospective Business Students		
Follow-Up Survey of Former Business Students		

Guidelines for Chapter Activities

The variety and number of Chapter activities and projects depend to a large extent on the ingenuity and vision of the members and the Chapter Advisor. In determining projects or activities, however, fundamental consideration should be given to the value that the project or activity will

give for each individual student. The Chapter program of activities should lend itself to the needs of the individual. Thus, he is afforded an opportunity to participate. As the program is extended to area, state, and national levels, the opportunity for individual student participation becomes proportionately less. While many projects or activities will be of a group nature, every effort should be made, even in group activities, to allow for individual activities that are in keeping with the individual student's interests and abilities.

The chapter activities or projects should provide an opportunity for:

The development of a spirit of cooperation
A recognition of social values
An understanding of competition
An ability to communicate
Individual recognition
Realization of the responsibilities of leadership and followership

COOPERATION

Cooperation enables students to work with each other. Planning and programming Chapter activities emphasizes the importance of individual contributions to successful group accomplishments. By learning to work well with one another in Chapter activities, students develop a sense of human relations necessary for success in business careers.

COMPETITION

Competition is a basic element of free enterprise. Students preparing for careers in office occupations must learn to win and to lose. Chapter awards give students an opportunity to develop a competitive spirit. Competition encourages initiative and vision. The true essence of competition may not necessarily be in winning or losing, but it may be the motivating device that enables one to make a greater contribution to the society in which he lives.

SOCIAL VALUES

Social values should be apparent in the activities conducted by local Chapters and should provide the students with an opportunity to know others engaged in office occupations. The ability to meet with other people easily and freely is a basic requisite of personal communication which is fundamental to success.

COMMUNICATION

Communications must be effective in any organization. Opportunities to learn the importance of good communications exist in almost every activity of the OEA program. Planning local activities requires a closely knit system of conveying information and ideas to individuals and groups

involved. Reporting activities in state and national publications gives students practice in disseminating ideas through a central exchange.

RECOGNITION

Recognition builds individual morale. Chapter activities provide abundant opportunities for recognition and student participation. The most obvious recognition is that given to student officers, committee chairmen and contest winners. Less evident contributions to individual and Chapter growth are frequently recognized. For example, recognition for important tasks performed in the background, such as addressing envelopes for a Chapter survey or creating table settings for a banquet can strengthen student appreciation for their part in the success of OEA activities.

LEADERSHIP AND FOLLOWERSHIP

Leadership and followership are essential to the success of a business enterprise. Students must learn the principles of sound leadership and how to use them if they are to be fully prepared for future responsibilities to business and society. They must learn that good leadership and good followership are closely interwoven. A leader in one function will be a follower in another.

The Chapter program is patterned to provide students the opportunity to develop leadership qualities through participation in projects and activities. Elected officers are in a position to develop leadership ability, but the Chapter that stands out is the one that offers such advantages to the entire membership. The chapter which serves its members best, however, is the one that emphasizes leadership through individual responsibilities and committee activities.

Suggested Order of Business for Chapter Meetings

1. The meeting is called to order by the president - two raps of gavel.

2. Three raps of gavel for members to stand, one rap to sit down.

3. Minutes of the preceding meeting should be read by the secretary. These may be approved as read or may be approved with additions or corrections.

4. Treasurer's report is read and "received as read and filed for audit (Chair so states)."

5. Reports of committees are called for by the president.

6. Unfinished business is taken up at the call of the chair or of the meeting.

7. New business.

8. The program, if any, may be held at this point. This is considered part of the meeting and the president presides throughout with the assistance of the program chairman.

9. Adjournment. This may be followed by refreshments and entertainment.

After the meeting, evaluate:

1. Was the meeting well-planned in advance?
2. Did we achieve our purpose, objective, or goal?
3. Did every member have an opportunity to participate--individually or through group activities?
4. Have many members had opportunities to serve in leadership roles?
5. Are persons participating in meetings adequately prepared?
6. Did the meeting challenge members to greater efforts toward objectives?
7. Did meeting start on time? Stop on Time? Move along smoothly?
8. Was there a "cooperative' atmosphere?---A "friendly" atmosphere?
9. Was the time used wisely?

Remember: Keep your school administrators and your community informed!

Planning Your Employer--Employee Banquet

The key to the success of any Employer-Employee Banquet, like any other OEA activity, is pre-planning. Inasmuch as this event involves everyone who participates in a Office Education program, it is important that every effort be made to assure a 100% successful activity. Probably at no other time during the school year is your OE program on exhibit as it is during your annual Employer-Employee Banquet.

The best time to start planning for your Employer-Employee Banquet is the day after the previous year's banquet, if possible. A complete written report indicating items needing improvement should be made to assist in planning for the next banquet. Planning for the current school year's banquet should continue shortly after school begins. Necessary committees should be appointed, and there must be close coordination between the Chapter Advisor and all committees.

The Chapter President or a qualified individual should be appointed general chairman for your banquet. A time table is a MUST and should be closely adhered to throughout the entire year. Remember, during the Employer-Employee Banquet you are selling a product--you're selling Office Education.

The matter of obtaining a speaker for your banquet generally causes quite a bit of concern. It is, of course, not necessary to have a speaker. There are other alternatives--members can present skits, plays, talent shows, etc. You may have two or three successful graduates each talk a minute or so on how OE helped them. The best source from which you can secure a speaker for your program would be from your local civic clubs--Lions, Optimists, Rotary, etc. The entertainment or program chairman of these local civic clubs can be of great help in securing an able speaker. Many companies furnish speakers and, quite often, they can be obtained. Your Advisory Board members will undoubtedly be able to help you in selecting the type of speaker you want for your banquet. State Representatives and State Senators should certainly be considered as potential banquet speakers. As to the length of the speech, thirty minutes should be the absolute maximum, and, as a rule of thumb, you might remember that nobody ever heard a bad short speech. If possible, select a speaker who will entertain your audience and also bring a short, serious message woven into his remarks.

Since you are not going to pay the speaker, there are other ways to thank him. Meet his train, his plane, or his bus; see to his hotel reservation; be sure to arrange for his transportation to your meeting place; do those things which make anyone feel welcome and wanted. In introducing the speaker, be sure the master of ceremonies does it well and that it is neither too lengthy or too short. Pick out the important things from his biographical sketch which he will furnish you. After the speaker has finished, be sure that something nice is said about his remarks. It would be well if you could clue your students to come up after the program, shake hands with the speaker and again thank him for being with your group.

In all cases, the student giving the invocation should read the invocation. The welcome given by a student and the response given by one of the employers should not be lengthy. Two to three minutes should be ample for each. Your entire program will be keyed on your master of ceremonies. If at all possible, a microphone should be used with a table rostrum. The master of ceremonies should practive a great deal before the banquet in the use of the microphone. Great care should be exercised in the length of your program. Remember no one appreciates sitting through a lengthy program.

The question of whether or not students should be introduced and they, in turn, introduce their employer comes up many times in planning Employer-Employee Banquets. This is time consuming, and, if your Chapter has fifteen or more members, it might be well to dispense with this formality. Remember, the names of the students and their employers appears in the printed program--a must for any Employer-Employee Banquet. Consider the guest list carefully. Other than your employers, for whom the banquet is being held, you should always invite your State Senator and Representative. Members of your School Board and your School Administrators should be invited, if at all possible.

With respect to publicity, you should always handle this matter through the business editor of your local newspaper. If your newspaper does not have a business editor, then it should be handled with the regular editor, who will assign this story to one of his reporters. The Chapter Advisor should always go out of his way to cultivate the business editor of the local newspaper for, if he understands the OO program, he should be one of your greatest disciples. When the Chapter Advisor is interested in publicity for his program, he should go to the newspaper in person--never call or send material by mail.

Regarding dress for your Employer-Employee Banquet, boys should wear OEA blazers, white shirts, plain dark ties, and matching trousers. Shoes, of course, should be highly polished and dark socks worn. For the girls, the OEA blazer with a white blouse and either a dark or white skirt, heels and hose, is most appropriate.

Certificate of Appreciation should be given to all employers for their participation in the OO program. In addition, you will probably want to give a few Outstanding Service Awards to individuals who have gone out of their way to support your program during the year. The highlight of any presentation that a Chapter might make during the year will, of course, be the presentation of an Honorary Life Membership to an individual or individuals, who have over the past years, contributed a great deal to the support of your OO program. All certificates are available from the Balfour Supply Service.

Remember, your Employer-Employee Banquet will be only as successful as the planning and effort that you put forth to make it a success.

CHAPTER AFFILIATION

WHY JOIN OEA

OEA is the only national organization working full time to create good public relations attitudes toward all Chapters.

OEA makes national organizations aware of OO as an important field of study for careers in Office Occupations.

OEA promotes *prestige* and *recognition* of Chapters all over the nation, and is recognized by leaders in education and business as being a vital part of the total OE program.

OEA encourages individual and group initiative and competition, thus helping to *Develop Future Leaders for Office Occupations*.

OEA has *potential* of becoming one of the largest youth movements in our nation's history.

OEA provides each individual member with *opportunities* to become aware of America's system of free enterprise.

OEA is YOUR professional organization. Materials are available to all members, Chapters, and State Associations of OEA.

OEA Chapters and State Associations have opportunity for *national recognition* via the National Leadership Conference and other member service activities.

OEA is the ONLY national organization operating through public schools attempting to build status for careers in Office Occupations.

OEA desires and needs the support of every Chapter and State Association if its efforts to *serve* OO are to be successful.

OEA is the *only* national organization designed exclusively for OO students.

CHAPTER OFFICERS AND STANDING COMMITTEES

President

Vice President

Secretary

Treasurer

Historian

Parliamentarian

Program of Work

1.
2.
3.
4.
5.

Finance(Fund Raising)

1.
2.
3.
4.
5.

Social

1.
2.
3.
4.
5.

Membership

1.
2.
3.
4.
5.

Publicity

1.
2.
3.
4.
5.

Civic-Professional Activities

1.
2.
3.
4.
5.

State Convention

1.
2.
3.
4.
5.

GUIDING PRINCIPLES FOR WORKING WITH

YOUTH ORGANIZATIONS IN VOCATIONAL EDUCATION

1. The teacher is responsible for having a good chapter or club.

2. The teacher is responsible for guiding the chapter (or club) in setting up a program of activities and carrying it out. The aim and purpose of the organization are attained through the chapter activities. The success of any program of activities depends largely upon the guidance of the advisor.

3. A chapter (or club) activity is a group activity, selected, planned, and carried out, and evaluated by the chapter members as a group.

4. The program of activities should make a significant contribution to attaining the aim and objectives of instructional program in vocational education.

5. Most chapter activities should be based on the needs of the students as recognized in the course of study. The activities should help to motivate students in the study of the subject(s) to be taught.

6. The teacher must be primarily concerned with the chapter program of activities as a teaching device--a device to help him attain his teaching objectives.

7. The purpose of an activity must be clear to the advisor, and steps must be taken to accomplish it. The purpose is not likely to be achieved unless it is clearly seen and without assiduous and intelligent efforts to accomplish it.

8. Contests and awards should be set up in the program of activities to encourage proficiency in skills and abilities being dealt with in the course of study. The supervised occupational experience programs should be used as a basis for determining what contests to have and what awards to make.

9. Contests and awards should be so designed as to recognize all of those who excel; the best should not be recognized when it is poor.

10. The occupational experience programs of the chapter members should determine what displays, shows, contests, and sales the chapter should sponsor and what the members should enter. The displays, demonstrations, shows, and sales should be the "show window" of the organization; in them should be seen good performance or products resulting from good supervised occupational experience programs. A chapter member should never dispaly a poor product just to win a ribbon and some prize money.

11. Much teaching should be done in working with members in getting ready for contests. The contest is the teacher's golden opportunity to do further teaching and to guide the boys and girls to evaluate their products or performance.

12. The program of activities should be broad enough to offer every member of the chapter a chance to excel - to find his place in the sun.

13. The building of a chapter program of activities should be a continuous affair. As activities are carried out and reports made to the chapter, the chapter should decide at that time whether or not to include the activity in next year's program of activities. (Of course, activities may be added or deleted at any time.) The program should not remain the same from year to year.

14. The number and types of activities to be developed in any chapter should be determined by the number of students in the chapter, their age and development, and the need for activities to motivate the teaching of the vocational area.

15. Chapter activities should encourage members to strive for advanced degrees through good supervised occupational programs and leadership activities.

16. Chapter activities should motivate members in becoming established in vocations.

17. The chapter should keep the public informed of its activities and accomplishments.

18. Adequate money-raising activities should be set up to enable the chapter to finance its program of activities.

19. Chapter activities should provide good leadership training for <u>all</u> the members.

20. All activities should be supervised by the school (the advisor) and should be under school control and discipline. Before an activity is launched, it should be approved by the principal or other school executive. Since the principal is responsible for his school, he should have the power to veto any school organization.

21. All activities should be scheduled, to avoid conflicts in dates and to secure better administration in general.

22. There should be close supervision of the chapter funds and accounts. Perhaps handling the chapter account through the central accounting system of the school is best.

23. Good year-round records should be kept of the chapter meeting in an official secretary's book.

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Safety Handbook; A Guide for Industrial Arts Programs, and Transparency Masters.

Clemson Univ., S.C.
South Carolina State Dept. of Education, Columbia. Industrial Arts Section
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ABSTRACT - This guide on safety, developed by a materials specialist, is for teacher use in planning a safety unit for junior and senior high school industrial arts. The first section is devoted to safety information for the teacher covering: (1) safety responsibilities of the school administrator, the teacher, and the student, (2) Recommendations for shop and lab safety, (3) first aid hints, and (4) teacher liability. The second section is a unit on general safety education covering approximately 40 minutes when used with the 31 transparencies included with the document. Appended are: (1) The South Carolina Eye Protection Law, (2) Suggested Reference Books, (3) Film List, (4) Filmstrip List, (5) National Standard School Shop Safety Inspection Check List, and (6) Transparency List. (GR)

VT009 867

ERIC

SAFETY HANDBOOK

A GUIDE FOR

INDUSTRIAL ARTS PROGRAMS

Prepared and published by:

STATE DEPARTMENT OF EDUCATION
Office of Vocational Education
Industrial Arts Section
Columbia, South Carolina

In Cooperation With

CLEMSON UNIVERSITY
Department of Industrial Education
and
Vocational Education Media Center
Clemson, South Carolina

1969

VT009867

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FOREWORD

This publication has been prepared to serve as a guide for teachers of Industrial Arts programs in conducting an effective program of safety instruction and contains the basic information needed for teaching safety in all general shop programs. However, it does not contain specific safety instruction for each of the different subject areas that might be included in the industrial arts laboratory. Instructors will find it necessary to prepare specific instruction for each of these areas. Teachers can easily prepare lesson plans, overhead transparencies, tests, and other materials for this purpose.

ACKNOWLEDGMENTS

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Appreciation is also extended to the American National Red Cross for providing the artificial respiration illustrations, to Dr. Alfred F. Newton for reviewing the manuscript and offering his suggestions, and to the National Safety Council for granting permission to reproduce posters as transparencies.

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HOW TO USE THIS MANUAL

This manual is divided into two sections, as follows:

Section I: Safety Information for the Teacher

Section I is intended for the teacher's use as reference material or as a short review in safety education.

Section II: General Safety Education

Section II, together with its set of transparencies, is a complete lesson plan for a class in general safety.

SECTION I

SAFETY INFORMATION FOR THE TEACHER

A. INTRODUCTION

A major objective of every instructor must be to prepare his students to work safely in their chosen vocations. Mastery of the skills, techniques, and theory of a trade is important, but not any more important than becoming safety conscious and learning the safe way to do things.

Instruction in safety must be practical--not just preparing students to pass a course or an examination. The results of safety instruction cannot be effectively measured by the number of correct answers on a safety test. The results can only be measured by the proper application of safety practices in the laboratory.

Safety instruction helps the students work and play safely in all activities in their homes, on their jobs, and on our highways. Students must be safety conscious and alert to dangerous situations. They must know how to prevent accidents, but be able to apply basic fundamentals of first aid if an accident occurs.

Safety instruction must not be taken lightly. An organized safety unit should be taught early in the school year. Safety practices should be followed in the laboratory at all times and reviewed as the necessity arises.

B. SAFETY RESPONSIBILITIES

1. The School Administrator

The administrator's safetv responsibilities include:

a. Promotion of a safety-conscious attitude in all phases of his school's operations.
b. Establishing a safety education program in all departments of his school.
c. The maintenance of safe working conditions, the safeguarding of equipment, and the elimination of health hazards in his school.
d. Insuring compliance with all local and state regulations pertaining to safety in school shops and laboratories.
e. Maintaining contact with the local, state, and national agencies which provide safety services.

2. The Teacher

The teacher's basic safety responsibilities include:

a. Maintaining safe working conditions and practices in his class or laboratory.
b. Providing safety education for his students and encouraging student cooperation in all phases of safety.
c. Recommending needed safety improvements to the school's administrator.
d. Following the recommendations of administrators for the promotion of safe practices and safety education.
e. Keeping up to date on the latest safety practices in education and in industry.
f. Setting a good example for his students by personally observing all safety rules and practices.

3. The Students

All students have safety responsibilities, including:

a. Rendering the proper attention to safety instruction.
b. Obeying safety rules and observing safety practices at all times--at home, at school, and at work.
c. Being watchful of fellow students in order to prevent their injury through unsafe actions.
d. Notifying the teacher of any unsafe conditions observed so that corrective action may be taken.

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) A. K. Jensen (Agency) Vocational Education Media Center

(Address) Clemson University, Clemson, S. C. 29631

DATE: November 12, 1969

RE: (Author, Title, Publisher, Date) SAFETY HANDBOOK--A GUIDE FOR INDUSTRIAL ARTS PROGRAMS, Vocational Education Media Center, Clemson University, Office of Vocational Education, State Department of Education, 1969.

Supplementary Information on Instructional Material

Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

(1) Source of Available Copies:
Agency Industrial Education Department
Address Clemson University, Clemson, S. C. 29631
Limitation on Available Copies 1 per state Price/Unit not sold by unit (quantity prices) Contact Industrial Education Dept., Clemson University

(2) Means Used to Develop Material:
Development Group Materials Sepcialist
Level of Group college
Method of Design, Testing, and Trial Designed primarily for use in S. C. Industrial arts programs, not tested prior to publication, now being tested.

(3) Utilization of Material:
Appropriate School Setting junior and senior high school
Type of Program industrial arts program
Occupational Focus cluster
Geographic Adaptability not limited
Uses of Material course planning, lesson planning, teaching
Users of Material teachers

(4) Requirements for Using Material:
Teacher Competency certified industrial arts instructor
Student Selection Criteria NA

Time Allotment NA

Supplemental Media --
Necessary ____)
Desirable ____) (Check Which)

Describe

Source (agency)
(address)

C. SHOP AND LAB SAFETY

1. General Recommendations

a. Never leave a class unsupervised.
b. Power equipment not in use should be disconnected from the power source.
c. Students should secure approval of instructor before operating power machinery.
d. Comply with the "eye safety" law.
e. Insure that students know the fundamentals of first aid and procedures to follow in case of fire.
f. Promote safety at all times.
g. Require active student participation in safety activities.
h. Use color coding on machines and hazard stripes on floors. Teach students the meaning and importance of such codes.
i. Insure that all machinery is properly mounted and that all power connectors are properly and safely installed.
j. Keep the classroom and shop orderly and clean with all tools and materials in the proper place.

2. Industrial Color Coding

The safety color codes developed by the American Standards Association for industrial use should be taught and used in schools teaching vocational or industrial arts subjects. Standard color codes are as follows:

a. RED
   (1) identifies FIRE PROTECTION equipment.
   (2) indicates EMERGENCY STOPS on equipment.

b. ALERT ORANGE
   designates hazards that might cut, crush, or shock.
   Examples: switch box interiors, gears and pulleys, cutting edges, presses and transmission cases

c. HIGH VISIBILITY YELLOW
   (1) indicates CAUTION.
   (2) designates hazards from stumbling, falling, tripping, bumping, or collision.
   Examples: aisles, handrails, barricades, protruding parts, stair approaches, and floor areas near pits

d. SAFETY GREEN
   identifies first aid and safety equipment.
   Examples: first aid kits, stretchers, and personal protective equipment storage

e. PRECAUTION BLUE
marks equipment controls as a reminder to use caution.
Examples: electrical controls, valves, brakes, and signs indicating that equipment is not to be used

f. BLACK AND WHITE
indicates HOUSEKEEPING areas.
Examples: locations of waste containers, stair risers, and food dispensing equipment

3. Protective Clothing and Equipment

Protective clothing and equipment will not prevent accidents and injuries; but when properly used, such items may serve to lessen the resulting degree of damage or injury.

The wise and proper use of protective clothing and equipment by students will be the result of good personal safety habits inspired by the teacher. The student must be taught to prepare himself to enter the school shop or lab safely so that, in future years, he will be a safety-conscious worker.

The teache might start out by "checking" the personal appearance of class members before beginning lab work. This checking should consist of reminding everyone to have his sleeves rolled up, rings and watches placed in pockets, and ties tucked in or removed. As soon as students know the routine, develop class participation through the use of a "safety inspector" or a "buddy system."

a. Eye protection

The requirements for eye protection and the minimum quality standards of safety glasses are specified by the South Carolina Eye Protection Act, reproduced in its entirety in the appendix of this publication. Of special importance to administrators and teachers is the requirement to provide visitors to the shop with eye protection. All areas requiring eye protection should be marked by signs, such as "Eye Protection Required Beyond This Point." Mounting the storage rack for both students' and visitors' safety glasses near the shop entrance is recommended.

Eye protection equipment may be disinfected by thorough cleaning with soap and warm water or by a complete immersion in a "Lysol" solution. Commercially available storage cabinets include one type which has ultra-violet lamps that come on when the cabinet doors are closed, for the purpose of sanitizing safety glasses.

b. Head and ear protection

Although head and ear injuries are not very common in school shops, "hard" hats are highly recommended for programs such as building construction where there is a possibility of being struck by a falling object. Again, providing

for the safety and protection of visitors is recommended.

c. Hand, foot and leg protection

The majority of all disabling injuries occur to hands, legs, and feet. Finger injuries are the most frequent.

(1) Gloves and Hand Leathers. Canvas or heavy cotton work gloves should be worn to provide protection from blisters due to friction. Asbestos gloves should be used when heat is present. Leather gloves which extend well past the wrist are recommended for use in welding. Rubber gloves should be worn when handling acids, solvents, and petroleum. When working around machinery, a decision must be made as to whether or not the use of gloves presents a greater hazard if caught in the machinery.

(2) Foot Protection. Safety shoes with steel toe inserts are used in industry to protect feet from heavy objects dropped or lowered on the feet. Metal inner soles protect feet from the hazards of protruding nails. Even though the school situation may not require such extensive foot protection, the teacher should advise his students of the availability and use of safety shoes. Future employment situations may require the use of safety shoes.

(3) Leg Protection. Leggings provide protection against sparks, acid, and metal splashes.

d. Respiratory equipment

Filter respirators are available for protection against various types of dust, mists, and fumes. Extreme care must be exercised when selecting filters, as a false sense of security can be generated by a filter not appropriate to the hazard present. Before selecting filters, carefully evaluate the hazards present, the exposure conditions, and the characteristics of available filters. An additional factor will be the need for periodically cleaning and sanitizing the filters. A very important point for the teacher to emphasize is that a filter may remove dust and some fumes, but may not be capable of protecting the user from carbon monoxide or carbon tetrachloride fumes at all.

(Additional point: Carbon Tetrachloride, formerly used as a cleaning agent and as a filler for fire extinguishers, should never be used for anything! Less toxic agents are available. Carbon tetrachloride is no longer recommended as a cleaning agent.)

e. Body protection

Shop coats, aprons, and coveralls should be used, as appropriate, in shops and labs. Aprons should be tied securely to prevent getting caught in machinery.

4. Fire Safety and Fire Extinguishers

Knowledge of the classes of fires, and the correct types of extinguishers for a given class of fire is extremely important. Using an incorrect type of extinguisher may only create a greater hazard.

a. Classes of fires

Class	Flammable Material	Type of Extinguisher
A	Wood, Hay, Paper, Textiles	(1) Soda-Acid (2) Water Pump (3) Water from Hose or Bucket (4) Smother with Blanket
B	Oil, Grease, Gasoline	(1) Pressurized Dry Chemical (2) Carbon Dioxide (CO_2)
C	Live Electrical Equipment	(1) Carbon Dioxide (CO_2) (2) Pressurized Dry Chemical

b. Characteristics of fire extinguishers

(1) Soda-Acid (Figure 1) - One of the most common types. This extinguisher contains water, soda, and a bottle of acid. When turned upside down, the acid mixes with the soda water and generates pressure for the stream. Use on Class A fires only. **Caution:** Once turned upside down, this extinguisher cannot be stopped until it is completely discharged. The solution may cause skin burns and is harmful to fabrics. This extinguisher should be pressure tested and recharged by qualified personnel once a year. Dangerous if used on electrical or oil fires.

(2) Water Pump (Figure 2) - The water pump extinguisher is simply a tank with a hose and a hand-operated pump. Use only on Class A fires. Anyone can inspect this extinguisher for correct water level, pump operation, and hose condition. Dangerous if used on electrical or oil fires.

(3) Pressurized Dry Chemical (Figure 3) - The active ingredient in this extinguisher is ordinary baking soda and is not harmful to humans or fabrics. This type of extinguisher can be used intermittently if necessary. Use on Class B or C fires. A pressure gauge indicates the condition of the extinguisher. Use of this extinguisher leaves a residue of baking soda which, in some instances, may be difficult to remove. This extinguisher must be recharged by a qualified person.

(4) Carbon Dioxide (CO_2) (Figure 4) - Use on Class B and C fires. Extinguishers containing carbon dioxide leave no residue. **Cautions:** Only effective at close range. Released carbon dioxide gas (which puts out the fires)

could injure a person because of the resulting low temperatures (far below 0°). A leaky valve may result in an extinguisher being empty when needed. An experienced serviceman must determine (by weighing) when the extinguisher needs a recharge. Refilling must be done by a qualified person.

(5) Carbon Tetrachloride - Extinguishers containing carbon tetrachloride are no longer approved for use. Phosgene, a dangerous gas, results when the carbon tetrachloride strikes a hot surface.

The various types of extinguishers are recognizable by their shapes. Everyone should make a habit of knowing where fire extinguishers are located in the school or at work. Never allow a soda-acid or water type extinguisher to be placed in a shop area where there is a possibility of electrical or oil fires. Students should know classes of fires, types of extinguishers and their characteristics. Periodic inspections of buildings and all fire protection equipment should be conducted by qualified personnel.

c. Fire safety practices

(1) Flammable liquids, such as gasoline and paint thinner, should be kept in approved cabinets or storerooms.

(2) Large quantities of flammable liquids should be stored in an area away from the main building.

(3) Store flammable liquids only in approved safety containers.

(4) Do not use highly flammable liquids for cleaning purposes.

(5) Inspect all paint and chemical cabinets periodically for fire hazards.

(6) Provide instruction on fire prevention in the school shop.

(7) Have fire extinguishers inspected regularly by qualified personnel.

(8) Provide periodic instruction and practice in the proper procedure for evacuating the shop in case of fire or other emergency situations.

d. If your clothing should catch on fire, don't panic. Smother the flames by wrapping in a blanket, a coat, or by rolling on the ground.

5. Electrical Safety

Electrical equipment is found in nearly every vocational subject area. Students should be taught the dangers present in electrical equipment and wiring and how to protect themselves and others from injury.

a. General electrical safety

(1) Install all electrical wiring in compliance with the National Electrical Code.

TYPES OF FIRE EXTINGUISHERS

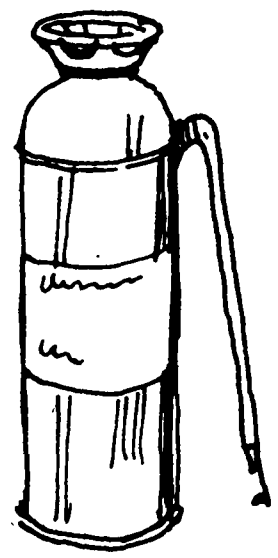
TYPES OF EXTINGUISHERS CAN BE RECOGNIZED BY THEIR SHAPES.

FOR CLASS A FIRES (WOOD, HAY, PAPER AND TEXTILES)

1. SODA-ACID—

TO OPERATE:

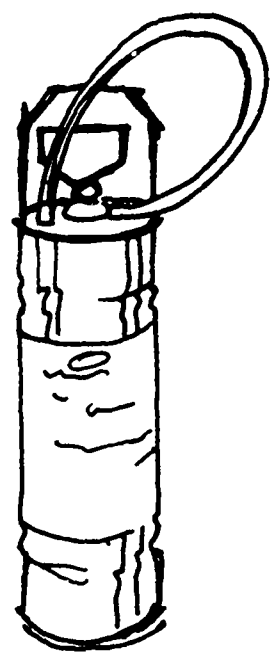
AIM NOZZLE AT FIRE
TURN EXTINGUISHER UPSIDE DOWN



2. WATER PUMP

TO OPERATE:

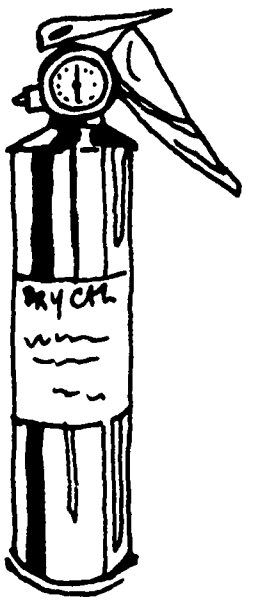
AIM NOZZLE AT FIRE
OPERATE HAND PUMP



FOR CLASS B AND C FIRES

(OIL, GREASE, GASOLINE, PAINT, ELECTRICAL FIRES)

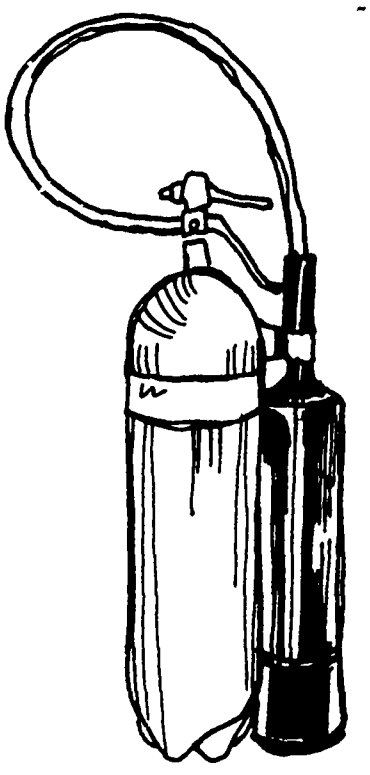
3. PRESSURIZED DRY CHEMICAL



TO OPERATE:

PULL SAFETY PIN
AIM EXTINGUISHER AT FIRE
SQUEEZE HANDLE

4. CARBON DIOXIDE (CO_2)



TO OPERATE:

PULL SAFETY PIN
AIM NOZZLE AT FIRE
SQUEEZE HANDLE

(2) Never use temporary wiring. All extension cords for tools and appliances should be 3-wire parallel ground with grounding lug plugs.

(3) Teach students to assume that all electrical equipment and wiring is "alive" and must be treated as such.

(4) Students should be taught the importance of safety interlocks and the dangers of by-passing electrical safety devices such as circuit breakers.

(5) Never work on electrical equipment alone--always have someone else nearby.

(6) While working on electrical equipment, stand on rubber mats or wooden floors.

b. Rescue from electrical shock

A person may receive an electric shock by touching a bare wire, an exposed socket, or a faulty electrical tool or appliance. Shock hazards also exist inside various types of electronic equipment and around power lines. The possibility of shock is greatly increased if the person is also in contact with a grounded surface, or if the floor or his body is wet.

(1) If possible, shut off the current quickly.

(2) If the current cannot be shut off promptly, attempt to move the victim away from the conductor, using some sort of insulated material.

(3) Do not touch the victim until electrical contact is broken. Use a wooden pole, such as a broom handle, to separate the victim and the conductor. A large cloth, such as a coat, may also be used.

(4) A live conductor may cling to the victim, making it necessary to pull him (or the conductor) quite a distance away.

(5) If the victim is not breathing after he has been removed from contact with the conductor, give him artificial respiration.

D. FIRST AID

First aid is the immediate care given to an injured or sick person until the service of a physician can be obtained.

Teachers of vocational subjects should be qualified to administer first aid. The shop should be equipped with a good general first aid kit containing bandages, gauze, cotton, tape, gauze pads, band-aids, eye pads, triangular bandages, tourniquets, ammonia, cotton buds, splints, measuring cups, scissors, tweezers, antiseptic cream, and a first aid guide booklet.

The first aid program of the American National Red Cross provides for the training and certification of both instructors and students in first aid procedures. The Red Cross also publishes instructors' and students' handbooks. For additional information on first aid training and certification, contact your local Red Cross chapter.

A complete coverage of all first aid procedures is not possible in this brief publication. The following summary of recommended first aid procedures covers those situations most likely to be encountered in vocational school activities.

1. Shock

Any serious injury may cause shock. Bad burns, loss of blood, cuts, and broken bones are often followed by shock.

a. Signs of shock: The victim's skin feels cool and is whiter than usual. Perspiration may appear, especially on the forehead or chin or over the mouth. The victim may vomit.

b. First aid for shock: Always treat for shock when giving first aid. Shock may result in a loss of blood to the brain and may be more serious than the visible injury.

(1) Make the victim lie down so his head is level with, or lower than, the rest of his body.

(2) Cover the victim, placing a blanket beneath him and a coat or blanket over him. However, don't make him sweat.

(3) The patient may drink warm water if an hour or more will pass before the doctor arrives. Don't give water if the person is unconscious or has an injury in the stomach region. Stimulants, such as ammonia, have no value in shock.

(4) Don't disturb the patient unnecessarily. Try to avoid measures that would cause more pain. Don't feed him.

2. Wounds in Which Bleeding is Not Severe

Do not touch the wound or the skin near it with fingers, clothing, or any other object. Do not breathe directly on the wound.

a. Apply a sterile gauze dressing.

b. Apply a bandage over the dressing.

c. Send the victim to a doctor.

Do not apply such things as lard, butter, or oils to wounds. Do not put adhesive tape directly on a wound, and do not use cotton as a dressing.

3. First Aid for Serious Bleeding

A victim bleeding seriously requires immediate first aid attention. If someone is available to call the doctor, have them do so while you attempt to stop the bleeding. If there is no one available, attempt to stop the bleeding before you call the doctor. Locate a physician as soon as possible.

In most cases, bleeding can be stopped by applying pressure with a cloth wad placed directly on the wound. Bandage this wad tightly against the wound and do not remove it.

a. Keep the victim quiet.

b. Do not handle him roughly, transport him carelessly, or talk to him unnecessarily.

c. Treat him for shock.

d. Do not give him any stimulants.

e. A bleeding limb should be raised slightly above the rest of the body by placing blankets or some other object under the limb.

f. For severe bleeding of the upper or lower extremities, the use of a tourniquet or finger pressure may be helpful.

g. Locate a physician.

4. Wounds that May Result in Tetanus (Lockjaw)

Germs which cause tetanus are found around horses, on farms, or where land has been fertilized with horse manure. Powder burns, such as those caused by fireworks, may also result in tetanus. Tetanus germs grow best in puncture wounds, such as those caused by nails, sharp sticks, splinters or other sharp objects. Even though the wound might not seem serious it should be treated by a physician, since a tetanus injection may be necessary.

5. Eye Injuries

Follow these procedures if a small object is on the eye surface:

a. Do not rub the eye.

b. Do not attempt to remove the object with any sort of instrument.

(1) If you can gently pull the eyelid away from the eye and see the object under the lid, you may be able to remove it by touching it with a corner of a sterile cloth.

(2) If the foreign object has entered the eyeball, do not try to remove it. Place the injured person flat on a stretcher and get a doctor.

c. Send the injured person to the school nurse or to a doctor.

6. Artificial Respiration

The mouth-to-mouth (or mouth-to-nose) method is now believed to be the most practical method for emergency ventilation of a person who has stopped breathing when medical breathing equipment is not available. When a person stops breathing, artificial respiration should be started as soon as possible.

See the artificial respiration instructions on page 16.

ARTIFICIAL RESPIRATION

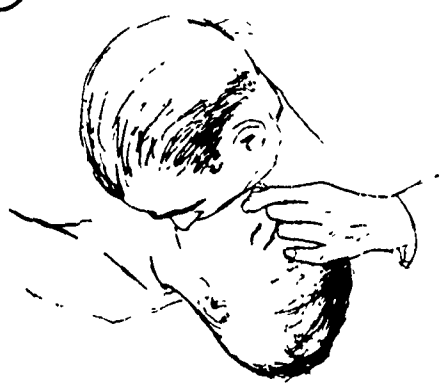
MOUTH-TO-MOUTH (MOUTH-TO-NOSE) METHOD

(1) If there is foreign matter visible in the mouth, wipe it out quickly with your fingers or a cloth wrapped around your fingers.

Tilt the head back so the chin is pointing upward.

(2) ⬆ Pull or push ⬇ the jaw into a jutting-out position.

(3)

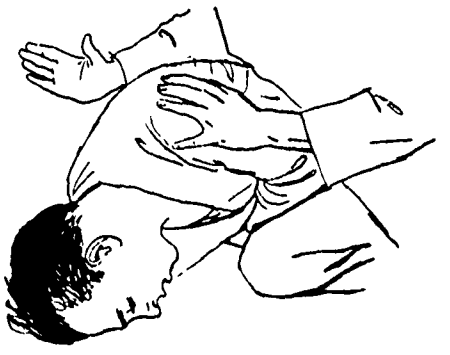


(4) Open your mouth wide and place it tightly over victim's mouth. At same time pinch victim's nostrils shut.

(5) Or close the nostrils with your cheek.

(6) Or close the victim's mouth and place your mouth over the nose.

Blow into the victim's mouth or nose. If you are not getting air exchange, recheck the head and jaw position (see drawings above at left).



(7) If you still do not get air exchange, quickly turn the victim on his side and administer several sharp blows between the shoulder blades in the hope of dislodging foreign matter.

Resume breathing procedure.

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E. TEACHER LIABILITY

This section contains information for the teacher and should not be included as part of the safety instruction program for the students.

1. Introduction

Complete coverage of all aspects of teacher liability for student injury is not possible in this brief publication. The infinite number of ways for students to sustain injuries, and the varied conditions and situations possible in each case preclude a quick and easy textbook establishment of responsibility for a given type of injury or circumstance.

This section does describe, in general terms, the liability of teachers for pupil injuries and the elements of proof for negligence which may lead to a teacher's being held liable.

In preparation for the performance of his profession, the vocational teacher should familiarize himself with the legal aspects of school accidents and the manner in which he may be held liable.

2. The School is Immune

School districts and school boards in South Carolina claim "Common Law," or governmental immunity. Common law immunity, originating in England during the Middle Ages, is based on the principle that "The king can do no wrong." Today, this legal tradition is interpreted to mean a sovereign state can do no wrong and cannot be sued without its own consent. Following this principle, the school district, a division of the government, and the school board, an agency of the state, are immune to tort action. (Tort: "A wrongful act, not including a breach of contract or trust, which results in injury to another's person, property, reputation, or the like, and for which the injured party is entitled to compensation," Random House Dictionary of the English Language, 1966)

While the school district and the school board are immune to suit for damages, the teacher is not. In the case of an accident resulting from negligence, the individual directly responsible (perhaps the teacher) may be held personally liable. The fact that the teacher is employed by a governmental (state) agency does not provide him immunity.

The teacher's actions are governed by the common law principle that charges every individual to act, or use things under his control, so as not to injure anyone else. A teacher is expected to practice the same degree of care and prudence that any other reasonable person would have practiced in the same or similar situation.

Legally, the teacher's relationship with his students is described by the Latin phrase, "in loco parentis" (in place of parents). In situations related to the education

of his students, society expects the teacher to exercise some of the rights and duties of the parents. The teacher is expected to use reasonable care in the performance of these duties, since students have been entrusted to him.

3. Types of Accidents

An accident generally results from an unsafe act or a physical or mechanical hazard. An accident which was unforeseeable, unavoidable, and for which no one was to blame is called a "pure accident," and no damages are recoverable. On the other hand, proof of negligence on the part of the person directly responsible for the conditions under which the accident occurred may result in that person having to pay damages.

4. Negligence

Negligence, defined as "the failure to exercise due care," is the basic problem in establishing liability.

One may be judged liable if it can be shown that the injuries to another were the direct results of improper actions on the part of the defendant. The teacher cannot be held at fault in cases where his own actions had no reasonable connection with the injury. Conscientious, continuous safety education and safe practices by the teacher, along with student cooperation and participation, are the keys to the avoidance of liability cases.

Specific areas in which the teacher must definitely assume and accept responsibility, thereby reducing the possibility of being negligent, include the following:

a. Supervision - A teacher who leaves a class unsupervised might be judged negligent if a student's injury results from lack of supervision. If called away from the shop, the teacher must stop and lock all power machinery.

b. Machine Guards - The school must provide adequate guards, and the teacher must insure they are used. The teacher allowing the use of unguarded machinery is negligent.

c. Eye Protection - The public schools of South Carolina are required by law to furnish protective eye devices to students and teachers participating in specified vocational and industrial arts laboratories. The teacher is responsible for having his students wear these protective devices.

d. Physical Facilities - The teacher must insure that the working area is safe and that tools and equipment are handled safely. Included in this category are housekeeping and the use of safety clothing.

e. First Aid - Teachers may be negligent in their actions, or failure to act, in the case of an accidental injury. The teacher is expected to do the best he can for the student in case of injury. Teachers should not attempt to go beyond

normally accepted first aid procedures. First aid is the care rendered until a physician is obtained. The teacher should have a knowledge of first aid, and first aid equipment should be readily available in the shop. Know your local regulations concerning application of first aid.

f. Permission Slips - Parental releases, or permission slips may be useful to inform parents of the activities in which their children will participate. These same slips may have a degree of value in causing the students to be more conscious of their actions. The teacher must keep in mind that permission slips do not, in any way, relieve him of his "in loco parentis" responsibility for the safety of a student.

g. Liability Insurance - The wise vocational teacher will investigate and select some form of liability insurance, either on an individual or a group basis. Group liability insurance is usually sponsored by educational or professional associations. Such coverage is available to members of the American Industrial Arts Association and to members of the American Vocational Association. Additional information may be obtained from:

American Industrial Arts Association, Inc. Members' Group Insurance 403 Davis Building 1629 K Street, N. W. Washington, D. C. 20006	or	American Vocational Association, Inc. 1025 Fifteenth Street, N. W. Washington, D. C. 20005

5. Additional Information

The following publications are highly recommended for additional information on teacher liability:

Kigin, Denis J., Teacher Liability in School Shop Accidents. Ann Arbor, Michigan: Prakken Publications, Inc., 1963.

Williams, William A., Accident Prevention Manual for Shop Teachers. Chicago: American Technical Society, 1963.

APPENDIX

THE SOUTH CAROLINA EYE PROTECTION LAW

The following is a copy of the eye protection law:

(R545, H1314)

An Act To F : .ire The Public Schools Of The State To Supply Plano Protective Eye Devices To Pupils And Teachers Participating In Certain Courses And To Require Pupils And Teachers Desiring Protective-Corrective Eye Devices To Secure Such Devices At Their Own Expense.

Be it enacted by the General Assembly of the State of South Carolina:

Section 1. Every pupil and teacher in any public school participating in any of the following courses:

(a) Vocational or industrial art shops or laboratories involving use of or exposure to:

(1) Hot molten metals

(2) Milling, sawing, turning, shaping, cutting, or stamping of any solid materials

(3) Heat treatment, tempering, or kiln firing of any metal or other materials

(4) Gas or electric arc welding

(5) Repair or servicing of any vehicle

(6) Caustic or explosive materials

(b) Chemical or combined chemical-physical laboratories involving caustic or explosive chemical or hot liquids or solids; is required to wear industrial quality eye protective devices at all times while participating in such courses or laboratories. The trustees of each school district shall purchase and cause such plano protective eye devices to be placed in such public schools for the eye protection of pupils, teachers, and visitors to such classrooms or laboratories.

(c) Any person desiring protective-corrective lenses instead of plano protective devices supplied by the school trustees shall at his own expense procure and equip himself with industrial quality eye protective devices secured from legally authorized dispensers.

The phrase "industrial quality eye protective devices", as used in this section, means devices meeting the standards of the American Standard Safety Code for Head, Eye, and Respiratory Protection, Z2.1-1959, promulgated by the American Standards Association, Incorporated.

Section 2. This act shall take effect upon approval by the Governor.

In the Senate House the 4th day of June

In the Year of Our Lord One Thousand Nine Hundred and Sixty-Five.

Edgar A. Brown,
President Pro Tempore of the Senate

Solomon Blatt,
Speaker of the House of Representatives.

Approved the 8th day of June, 1965.

Robert E. McNair
Governor.

SUGGESTED REFERENCE BOOKS

Williams, William A., Accident Prevention Manual for Shop Teachers. Chicago: American Technical Society, 1963.

Silvius, G. Harold and Curry, H. Estell, Teaching Successfully in Industrial Education. Bloomington, Illinois: McKnight and McKnight Publishing Company, 1967.

FILMS AVAILABLE

1. Challenge, The (1959) 16mm. Sound Color 10 min.
   Concerns prevention of fires. Available from The Travelers Insurance Companies, Travelers Film Library, 52 Prospect Street, Hartford, Connecticut 06115.

2. Days of Our Years (1956) 16 mm. Sound Color 20 min.
   Emphasizes need for safety on the job. Available from Union Pacific Railroad, Motion Picture Bureau.

3. Don't Drop Your Guard 16 mm. Sound Color 15 min.
   Shows importance of machine guards. Available from Aetna Life and Casualty Company, Public Relations and Advertising Department Film Library, 151 Farmington Avenue, Hartford, Connecticut.

4. Home Sweet Home (1962) 16 mm. Sound Color 24 min.
   Emphasizes need for home safety. Available from The Travelers Insurance Companies. (See address above.)

5. Knowing Not Enough (1957) 16 mm. Sound Color 28 min.
   The title explains itself. You must not only know safety practices, but must follow them. The Travelers Insurance Companies. (See address above.)

6. Lifting, Man's Age Old Problems (1964) 16 mm. Sound Color 14 min.
   Discusses how to avoid back injuries from lifting. Available from Aetna Life and Casualty Company. (See address above.)

7. Safety at Work (1963) 16 mm. Sound Color 18 min.
   Shows how safety programs can reduce deaths and injuries in industry. Available from Aetna Life and Casualty Company. (See address above.)

8. Safety Makes Sense (1966) 16 mm. Sound Color 20 min.
   Discusses safety and accident prevention. Clark Equipment Company, Industrial Truck Division, Battle Creek, Michigan 49016.

9. Slips and Falls (1965) 16 mm. Sound Color 10½ min.
   Compares hazards of steel workers on skyscrapers to hazards of homes, offices and shops. Available from Bell Systems Telephone Office. (Call manager of your local Bell System Business Office.)

FILMSTRIPS AVAILABLE

Safety filmstrips available from the Department of Industrial Education, Clemson University, Clemson, South Carolina 29631.

FT-20	—	Organization
FT-21	—	Machines
FT-22	—	Handling
FT-23	—	Falls
FT-24	—	Factory Safety
FT-25	—	A Safe Day
FT-26	—	As Others See Us
FT-27	—	Paradise Valley
FT-SS5	—	Safety for Sale
FT-SS6	—	Twenty-Hour Safety Course (9 strips)
FT-SS9	—	Rules for Tools
FT-SS10	—	Grime Doesn't Pay
FT-SS11	—	Open for Infection
FT-SS12	—	Women and Machines
FT-SS13	—	The Eyes Have It
FT-SS14	—	Nothing Upstairs
FT-SS15	—	Double Trouble
FT-SS16	—	Woven in Safety
FT-S1	—	Safe Only in Smart Hands
FT-KIT I	—	Personal Side of Safety (5 strips)

NATIONAL STANDARD SCHOOL SHOP SAFETY INSPECTION CHECK LIST

Prepared by the Joint Safety Committee of the
AMERICAN VOCATIONAL ASSOCIATION — NATIONAL SAFETY COUNCIL

_____ Date_____

INTRODUCTION

A safe environment is an essential part of the school shop safety education program. The safe environment will exist only if hazards are discovered and corrected through *regular* and *frequent* inspections by school personnel—administrators, teachers and students. Safety inspections are to determine if everything is satisfactory.

Inspections may be made at the request of the board of education, the school administration or upon the initiative of the teacher. Some communities have drawn upon the cooperative service of professional safety engineers, inspectors of state labor departments, insurance companies and local safety councils to supplement and confirm inspections by school personnel.

The National Standard School Shop Safety Inspection Check List, recommended by the President's Conference on Industrial Safety is an objective inspection procedure for the school shop.

DIRECTIONS

WHO INSPECTS?

This will depend upon local policies. It is recommended, however, that shop teachers, and students—the student safety engineer and/or student safety committee—participate in making regular inspections. This not only tends to share responsibility but stimulates a broader interest in the maintenance of a safe school shop.

WHEN TO INSPECT?

As a minimum, a safety inspection should be made at the beginning of every school term or semester. More frequent inspections may be advisable.

HOW TO INSPECT?

Inspections should be well planned in advance.

Inspections should be systematic and thorough. No location that may contain a hazard should be overlooked.

Inspection reports should be clear and concise, but with sufficient explanation to make each recommendation for improvement understandable.

FOLLOW-UP

The current report should be compared with previous records to determine progress. The report should be studied in terms of the accident situation so that special attention can be given to those conditions and locations which are accident producers.

Each unsafe condition should be corrected as soon as possible in accordance with accepted local procedures.

A definite policy should be established in regard to taking materials and equipment out of service because of unsafe conditions.

The inspection report can be used to advantage as the subject for staff and class discussion.

CHECKING PROCEDURE

Draw a circle around the appropriate letter, using the following letter scheme:

S — Satisfactory (needs no attention)
A — Acceptable (needs some attention)
U — Unsatisfactory (needs immediate attention)

Recommendations should be made in all cases where a "U" is circled. Space is provided at the end of the form for such comments. Designate the items covered by the recommendations, using the code number applicable (as B-2).

In most categories, space is provided for listing of standards, requirements or regulations which have local application only.

A. GENERAL PHYSICAL CONDITION

1. Machines, benches, and other equipment are arranged so as to conform to good safety practices..... S A U
2. Condition of stairways..... S A U
3. Condition of aisles..... S A U
4. Condition of floors..... S A U
5. Condition of walls, windows, and ceiling..... S A U
6. Illumination is safe, sufficient, and well placed..... S A U
7. Ventilation is adequate and proper for conditions..... S A U
8. Temperature control..... S A U
9. Fire extinguishers are of proper type, adequately supplied, properly located and maintained..... S A U
10. Teacher and pupils know location of and how to use proper type for various fires..... S A U
11. Number and location of exits is adequate and properly identified..... S A U
12. Proper procedures have been formulated for emptying the room of pupils and taking adequate precautions in case of emergencies S A U
13. Lockers are inspected regularly for cleanliness and fire hazards. S A U
14. Locker doors are kept closed..... S A U
15. Walls are clear of objects that might fall..... S A U
16. Utility lines are properly identified..... S A U
17. Teachers know the procedure in the event of fire including notification of the fire department and the evacuation of the building. S A U
18. Air in shop is free from excessive dust, smoke, etc.... S A U
19. _____ S A U
20. _____ S A U
21. _____ S A U
22. _____ S A U
23. Evaluation for the total rating of A. GENERAL PHYSICAL CONDITION..... S A U

B. HOUSEKEEPING

1. General appearance as to orderliness..... S A U
2. Adequate and proper storage space for tools and materials. S A U
3. Benches are kept orderly..... S A U
4. Corners are clean and clear..... S A U
5. Special tool racks, in orderly condition, and provided at benches and machines ..... S A U
6. Tool, supply, and/or material room is orderly..... S A U
7. Sufficient scrap boxes are provided..... S A U
8. Scrap stock is put in scrap boxes promptly..... S A U
9. Materials are stored in an orderly and safe condition.. S A U
10. A spring lid metal container is provided for waste and oily rags. S A U
11. All waste materials and oily rags are promptly placed in the containers ..... S A U
12. Containers for oily rags and waste materials are frequently and regularly emptied ..... S A U
13. Dangerous materials are stored in metal cabinets..... S A U
14. Machines have been color conditioned..... S A U
15. Safety cans are provided for flammable liquids..... S A U
16. Bulk storage of dangerous materials is provided outside of the building ..... S A U
17. A toe-board or railing around a mezzanine used for storage or washing facilities ..... S A U
18. Materials are stored in an orderly and safe condition on this mezzanine ..... S A U
19. Flammable liquids are not used for cleaning purposes S A U
20. Floors are free of oil, water and foreign material..... S A U
21. Floors, walls, windows, and ceilings are cleaned periodically. S A U
22. _____ S A U
23. _____ S A U
24. _____ S A U
25. _____ S A U
26. Evaluation for the total rating for B. HOUSEKEEPING S A U

C. EQUIPMENT

1. Machines are arranged so that workers are protected from hazards of other machines, passing students, etc..... S A U
2. Danger zones are properly indicated and guarded..... S A U
3. All gears, moving belts, etc., are protected by permanent enclosure guards ..... S A U
4. All guards are used as much as possible..... S A U

C. EQUIPMENT (continued)

5. All equipment control switches are easily available to operator. S A U
6. All machines are "locked off" when instructor is out of the room. S A U
7. Brushes are used for cleaning equipment..... S A U
8. Nonskid areas are provided around machines..... S A U
9. Machines are in safe working condition..... S A U
10. Machines are guarded to comply with American Standards Association and local state code..... S A U
11. Adequate supervision is maintained when students are using machines and dangerous tools..... S A U
12. Tools are kept sharp, clean and in safe working order S A U
13. All hoisting devices are in safe operating condition... S A U
14. Machines are shut off while unattended..... S A U
15. Adequate storage facilities for tools, equipment, etc., not in immediate use ..... S A U
16. _____ S A U
17. _____ S A U
18. _____ S A U
19. _____ S A U
20. Evaluation for the total rating for C. EQUIPMENT.. S A U

D. ELECTRICAL INSTALLATION

1. All switches are enclosed..... S A U
2. There is a master control switch for all of the electrical installations ..... S A U
3. Electrical outlets and circuits are properly identified.. S A U
4. All electrical extension cords are in safe condition and are not carrying excessive loads..... S A U
5. All machine switches are within easy reach of the operators. S A U
6. Electrical motors and equipment are wired to comply with the National Electric Code..... S A U
7. Individual cut-off switches are provided for each machine. S A U
8. Machines are provided with overload and underload controls by magnetic pushbutton controls..... S A U
9. No temporary wiring in evidence..... S A U
10. _____ S A U
11. _____ S A U
12. _____ S A U
13. _____ S A U
14. Evaluation for the total rating for D. ELECTRICAL INSTALLATION .....S A U

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E. GAS

1. Gas flow to appliances is regulated, so that when appliance valve is turned on full, the flames are not too high..... S A U

2. Gas appliances are properly insulated with asbestos or other in-ating material from tables, benches, adjacent walls, or other flammable materials ..... S A U

3. No gas hose is used where pipe connections could be made. S A U

4. Gas appliances have been adjusted so that they may be lighted without undue hazard..... S A U

5. Students have been instructed when lighting gas appliances to light the match first before turning on the gas..... S A U

6. There are no gas leaks, nor is any odor of gas detectable in any part of the shop..... S A U

7. Shop instruction has been given concerning the lighting of gas furnaces operating with both air and gas under pressure.. S A U

8. When lighting the gas forge, goggles are worn..... S A U

9. When lighting the gas furnace, the following procedure is used: (a) light the match; (b) turn on the gas; (c) drop the match in the hole in top of the furnace..... S A U

10. In shutting down the gas furnace, the gas valve is closed before the air valve..... S A U

11. _____ S A U

12. _____ S A U

13. _____ S A U

14. _____ S A U

15. Evaluation for the total rating for E. GAS..... S A U

F. PERSONAL PROTECTION

1. Goggles or protective shields are provided and required for all work where eye hazards exist..... S A U

2. If individual goggles are not provided, hoods and goggles are properly disinfected before use..... S A U

3. Shields and goggles are provided for electric welding.. S A U

4. Rings and other jewelry are removed by pupils when working in the shop..... S A U

5. Proper kind of wearing apparel is worn and worn properly for the job being done..... S A U

6. Leggings, safety shoes, etc., are worn in special classes such as foundry, etc., when needed..... S A U

7. Respirators are provided for dusty or toxic atmospheric conditions such as when spraying in the finishing room..... S A U

8. Provisions are made for cleaning and sterilizing respirators. S A U

9. Students are examined for safety knowledge ability.. S A U

10. Sleeves are rolled above elbows when operating machines. S A U

11. Clothing of students is free from loose sleeves, flopping ties, loose coats, etc. ..... S A U

12. _____ S A U

F. PERSONAL PROTECTION (continued)

13. _____ S A U

14. _____ S A U

15. _____ S A U

16. Evaluation for the total rating for F. PERSONAL PROTECTION. S A U

G. INSTRUCTION

1. Shop Safety is taught as an integral part of each teaching unit. S A U

2. Safety rules are posted particularly at each danger station. S A U

3. Printed safety rules are given each student..... S A U

4. Pupils take a safety pledge..... S A U

5. Use of a safety inspector..... S A U

6. Use of a student shop safety committee..... S A U

7. Use of safety contests..... S A U

8. Motion and/or slide films on safety are used in the instruction. S A U

9. Use of suggestion box..... S A U

10. Use of safety tests..... S A U

11. Use of safety posters..... S A U

12. Talks on safety are given to the classes by industrial men. S A U

13. Tours are taken of industrial plants as a means of studying safety practices ..... S A U

14. Periodic safety inspections of the shop are made by a student committee ..... S A U

15. Men from industry make safety inspections of the shop S A U

16. Student shop safety committee investigates all accidents S A U

17. A proper record is kept of safety instructions which are given, preferably showing the signature of student on tests given in this area ..... S A U

18. Rotate students on the Shop Safety Committee so that as many students as possible have an opportunity to participate... S A U

19. _____ S A U

20. _____ S A U

21. _____ S A U

22. _____ S A U

23. Evaluation for the total rating of G. INSTRUCTION S A U

H. ACCIDENT RECORDS

1. There is a written statement outlining the proper procedure when and if a student is seriously hurt..... S A U

2. Adequate accident statistics are kept..... S A U

3. Accidents are reported to the proper admini trative authority by the instructor ..... S A U

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H. ACCIDENT RECORD (continued)

4. A copy of each accident report is filed with the State Department of Education ..... S A U

5. Accident reports are analyzed for instructional purposes and to [illegible]sh the basis for elimination of hazards..... S A U

6. _____ S A U

7. _____ S A U

8. _____ S A U

9. _____ S A U

10. Evaluation for the total rating of H. ACCIDENT RECORDS. S A U

I. FIRST AID

1. An adequately stocked first aid cabinet is provided... S A U

2. The first aid is administered by a qualified individual S A U

3. The school has individuals qualified to administer first aid. S A U

4. _____ S A U

5. _____ S A U

6. _____ S A U

7. _____ S A U

8. Evaluation for the total rating of I. FIRST AID.... S A U

RECOMMENDATIONS

Code No.	

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SECTION II

GENERAL SAFETY EDUCATION

Section 2

GENERAL SAFETY EDUCATION

Note: This unit is a guide for the presentation of a block of instruction emphasizing general safety. This section, when used with the provided overhead transparencies, requires approximately 40 minutes for the presentation. Cues for transparencies are in the left margin. An index for the transparencies is on page 39.

A. INTRODUCTORY COMMENTS ON SAFETY

Safety/01 Everyone, including students, parents, teachers, and those at work, must develop and practice safety consciousness. The most important reason why safety consciousness is necessary is that it may protect us from personal injury. Let's spend a few minutes discussing why it is absolutely essential that we protect ourselves from personal injury:

02 1. Personal injury may take away the use of a finger, an eye, an arm, a leg, or may cripple an individual.

2. Personal injury may cause a person to have to stop working--either for a short period of time or permanently.

The person out of work because of injury cannot properly support his family. He loses income and then he may not be able to afford his wants and needs.

He cannot participate in activities with his friends and neighbors. He may become a burden upon the rest of society.

3. The ultimate personal injury might be death.

03 Most of us know others who have suffered because of injuries. Perhaps even some of you have had this undesirable experience. Daily, most of us are around or work with equipment, machinery and vehicles that can hurt us in many different ways. Keep in mind, however, that a machine, a vehicle, an electric wire, or a brick wall isn't going to wait just for you to walk by so it can jump out and grab you, hit you, or fall on you. Accidents are caused by us--people. The purpose of this program is to acquaint you with safety practices for your use in the shops and laboratories while you are learning.

Constant practice of safety awareness will help you in learning the proper way to use your skills and will help keep you free from accidents and injury so that you can enjoy your future. Your own safety awareness should help protect your family, your fellow students, and your fellow workers from injury. Make safety serve you in all you do at home, at school, or at work.

B. THE PREVENTABLE ACCIDENT

04 Just what causes an accident? Do all accidents contain some similar factors? If certain factors are present in all accidents, can the elimination of these factors lead to possible prevention of future accidents?

In his book, Industrial Accident Prevention, H. W. Heinrich says that:

> A preventable accident is one of the five factors in a sequence that results in an injury. The injury is invariably caused by an accident and the accident in turn is always the result of the factor which immediately preceded it. In accident prevention, the bull's eye of the target is in the middle of the sequence--an unsafe act of a person or a mechanical or physical hazard. The several factors in the accident-occurrence series are given in chronological order in the following list:
>
> 1. Ancestry and Social Environment
> 2. Fault of Persons
> 3. Unsafe Acts and/or Mechanical or Physical Hazards
> 4. The Accident
> 5. The Injury
>
> The occurrence of a preventable injury is the natural culmination of a series of events or circumstances which invariably occur in a fixed and logical order. One is dependent on the other and one follows because of another, thus making a sequence that may be compared to a row of dominoes placed on end and in such alignment in relation to one another that the fall of the first domino causes the fall of the entire row. An accident is merely one factor in the sequence.
>
> (Herbert W. Heinrich, Industrial Accident Prevention, New York: McGraw-Hill Book Company, 1959, pp. 14-15.)

Let's briefly discuss and identify the factors in the accident sequence.

04A 1. **Ancestry and Social Environment.** We all have probably inherited some personal characteristics that may contribute to an accident. These characteristics might include such things as poor eyesight, bad hearing, or a tendency to be nervous.

Our environment may have caused us to develop habits or behavior patterns that may contribute to accidents. Examples of these might be

our tendencies to make and accept dares, show off, and take chances.

We must keep in mind that each of us are products of our heredity and environment and that these traits may play a part in an accident.

04B 2. **Fault of Persons.** Personal faults or shortcomings that may contribute to accidents include:

a. A lack of knowledge or skill related to what you're trying to do.

b. Being physically unsuited for the job, such as having poor hearing or vision, being the improper age or height, having allergies, faulty reaction time, an illness, or a physical handicap.

c. Improper attitudes, such as willfully disregarding danger, resenting authority, not following instructions properly, being over-confident, getting angry, being over-tired, participating in horseplay, being distracted, or hurrying unnecessarily. Personal faults may also result from improper instruction and supervision.

04C 3. **Unsafe Acts.** An "unsafe act," according to the National Safety Council, is "a violation of a commonly accepted safe practice." Examples of such unsafe acts include:

a. Operating equipment without permission

b. Operating or working at unsafe speeds (too slow or too fast)

c. Removing or disconnecting safety devices and guards

d. Using unsafe equipment

e. Working on moving or dangerous equipment

f. Horseplay

g. Failure to use safety clothing or personal protective devices, ~~such as respirators,~~ goggles, hel~~mets, and gloves~~

Mechanical or Physical Hazards

A hazard is a condition which could have been guarded, corrected, or eliminated. Hazardous conditions are present in machines, vehicles, electrical equipment, hand tools, dusts, radiation, and on working surfaces, such as floors, ramps, roads, shelves, and stairs. Specific examples of hazards include unguarded or poorly guarded machinery, insufficient light or ventilation, and unsafe clothing.

The combination of an unsafe act and a mechanical or physical hazard results in an accident.

04D 4. **The Accident.** An accident is an unplanned and uncontrolled event in which an action or reaction of either an object, a person, or a substance results in personal injury, or the probability of personal injury. Many accidents do not cause injury, but the probability of injury is always

present. We don't want to have accidents just so we can see how close we can come to being injured!

04E 5. **The Injury.** The injury is the damage, hurt, or suffering resulting from the accident. Injury may not always be personal, physical pain. Injury can also occur as a loss in pay for being out of work, the loss in damaged equipment or material spoiled, or the loss of time needed to meet a schedule.

Now we have analyzed the accident sequence:

a. Ancestry and Social Environment
b. Fault of Person
c. Unsafe Acts and Hazards
d. The Accident
e. The Injury

05 These events occur in a chain reaction--like a row of falling dominoes.

Notice that the removal of the third domino, the unsafe act or hazard, prevents the occurrence of the accident and the injury. The major objectives of safety education are:

1. To teach you to recognize and respect unsafe acts and hazards.
2. To teach you how to avoid injury to yourself and to others by knowing what to do about unsafe acts and hazards.

C. CATEGORIES OF SAFETY RULES

In vocational education courses, there are three categories of general safety rules. These categories are:

1. Good personal habits that will prevent accidents.
2. General activities in working conditions and materials handling.
3. Safety precautions applying to all tools, including hand tools, appliances, and machines.

Now, let's discuss the safety rules that fall into each of these three categories. (**Note:** The teacher should be prepared to elaborate on these points if necessary.)

06 **Good Personal Habits:**

07 1. Remove outer garments, such as coats and sweaters, prior to beginning your lab work.
2. Wear a well-fitting lab coat or shop apron.
3. Keep sleeves rolled up above your elbow except in classes such as welding.

08 4. Tuck neckties inside shirts, or remove them while working around machinery.
5. Keep your hands clean.
6. Keep long hair in place by using a cap or visor.

09 7. Remove personal jewelry, such as rings and watches when working on machinery.
8. Always move carefully, at a walk, when in a shop.

10 9. No horseplay or "fooling around" is ever permitted in a lab or shop.

11 10. Always give warning any time you observe an unsafe act or condition.

12 11. Report all injuries immediately, even if you think they might be insignificant. A small cut that becomes infected may develop into a major injury.

13 **General Activities:**

14 1. Long pieces of material should be carried by two persons.

15 2. Always wear gloves while handling large sheets of metal.

16 3. Secure the permission of the teacher prior to moving large or heavy objects.

17 4. Cloths containing oils or paints should be deposited in the proper safety containers.

18 5. Clean up spills and splashes immediately.

19 6. Always keep aisles and walkways clear.

20 7. Never leave a board with a protruding nail on the floor.

21 **Tool Safety:**

There are several safety rules that apply generally to all tools, appliances, or machinery. These safety rules are:

22 1. Never use tools with mushroomed ends.

23 2. Do not carry tools with sharp edges or points in your pockets.

24 3. Do not use a tool having a broken handle or a loose head.

25 4. Before connecting an electrical appliance, be sure your hands are dry, the switch is off, the cord is in good condition, and the grounding lug is in use.

26 5. Don't attempt to clean or oil a machine while it is in motion.

27 6. Only the operator is allowed in the operator's zone while the machine is in operation.

D. SPECIFIC SHOP RULES

28 Each shop and laboratory area has its own characteristics. Prior to learning the operation of a particular piece of equipment, everyone must know the layout of the lab and how to turn the power on and off. We shall now cover some specific topics and their use in this lab. (**Note:** The teacher must be prepared to discuss specific rules as applicable to his own school and shop or lab area.)

1. How and when to turn on the main power switch.
2. The use of the emergency stop switch.
3. The purpose of the "operator's zone."
4. The use of safety glasses, goggles and eye shields. (Explain the South Carolina Eye Protection Law.)
5. The personal conduct expected of machine operators and all class members.
6. The conditions under which each machine may be operated. (Operator's training and qualifications.)
7. When to oil and clean the machines.
8. The purpose and use of guards.
9. What to do in case an accident occurs in this shop.
10. The location of first aid and emergency equipment, and the use of these materials.
11. The safety color code used in industry and school shops.

E. SUMMARY

29 During this class, we have studied why safety consciousness is important to us. The main reason we must practice safety in everything we do is so that we, members of our families, our friends, or our fellow workers will not become injured by accidents.

Remember that an injury may be both physical and economic. Losing your job because of injury can also ruin your future plans through a lack of income.

The accident-occurrence sequence shows that all injuries have five basic factors. These factors are:

1. Ancestry and Social Environment
2. Fault of Persons
3. Unsafe Acts and/or Mechanical or Physical Hazards
4. The Accident
5. The Injury

These events occur in a chain reaction just like a row of falling dominoes. We saw that the removal of the third factor, the unsafe act and/or mechanical or physical hazard, could prevent the occurrence of an accident and the resulting injury. The purpose of safety education is to learn how to prevent or remove unsafe acts and hazards.

In this session, we have covered the three categories of general safety rules that apply to shop and laboratory courses. These categories of safety rules are:

1. Good personal habits that will prevent accidents.
2. General activities in working conditions and materials handling
3. Safety precautions applying to all tools, including hand tools, appliances, and machines.

We also studied the specific shop rules that apply to this class, including locations of power switches, personal conduct requirements, what to do in case of accidents, and first aid procedures.

Note to Teacher: End presentation by answering any questions students may have.

TRANSPARENCY LIST

Safety File Number	Identification
01	Safety in Industrial Arts
02	Why Avoid Personal Injury?
03	Make Every Day a Safe Day!
*04	The Preventable Accident
04A	Ancestry and Social Environment
04B	Fault of Person
04C	Unsafe Act or Hazard
04D	An Accident
04E	An Injury
05	Dominoes
06	Good Personal Habits
07	Loose Clothing is Dangerous
08	Don't Hang Around Moving Machinery
09	A Ring is Nice
10	One Joker on the Job Endangers Everybody
11	When You See Anything Unsafe - Report It!
12	Don't Duck It
13	General Activities
14	Think When Handling Material!
15	Be Sharp - Handle Sharp Material With Care
16	Get Help
17	Eliminate a Hazard - Prevent an Accident
18	Big Crash from Small Splash
19	Keep Walkways Clear
20	A Point to Remember
21	Safety Precautions for All Tools, Appliances and Machines
22	Friends or Foes
23	A Pocket is No Place for Tools
24	Faulty Tools Cause Injuries
25	All Shook Up?
26	Stop - Start
27	Tools Don't Cause Accidents
28	Safety in Our Shop
29	Stay Alert for Safety
30 and 31	Types of Fire Extinguishers

*NOTE: 04A–04E are overlays to be used with Safety/04.

M E M O R A N D U M

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980 Kinnear Road
Columbus, Ohio 43212

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(Address) Clemson University, Clemson, S. C. 29631

DATE: November 12, 1969

RE: (Author, Title, Publisher, Date) SAFETY HANDBOOK--A GUIDE FOR INDUSTRIAL ARTS PROGRAMS, Vocational Education Media Center, Clemson University, Office of Vocational Education, State Department of Education, 1969.

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(2) Means Used to Develop Material:
Development Group Materials Sepcialist
Level of Group college
Method of Design, Testing, and Trial Designed primarily for use in S. C. Industrial arts programs, not tested prior to publication, now being tested.

(3) Utilization of Material:
Appropriate School Setting junior and senior high school
Type of Program industrial arts program
Occupational Focus cluster
Geographic Adaptability not limited
Uses of Material course planning, lesson planning, teaching
Users of Material teachers

(4) Requirements for Using Material:
Teacher Competency certified industrial arts instructor
Student Selection Criteria NA

Time Allotment NA

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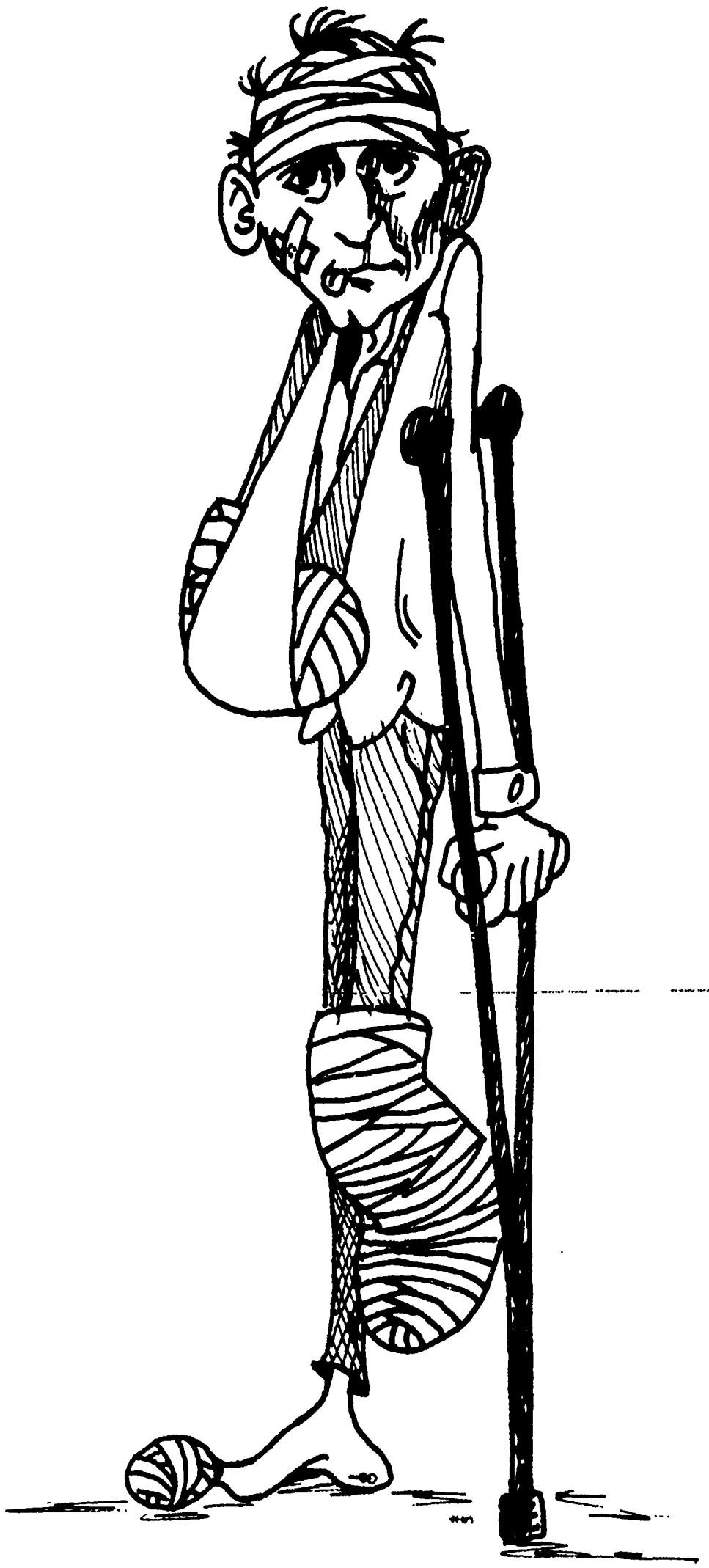
SAFETY IN INDUSTRIAL ARTS EDUCATION

WHY AVOID PERSONAL INJURY?



ERIC

THE PREVENTABLE ACCIDENT

ANCESTRY AND SOCIAL ENVIRONMENT

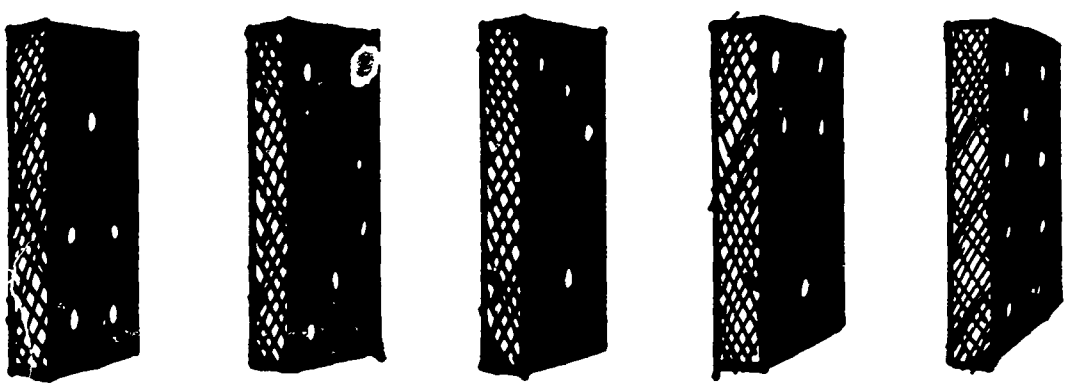
FAULT OF PERSON

UNSAFE ACT OR HAZARD

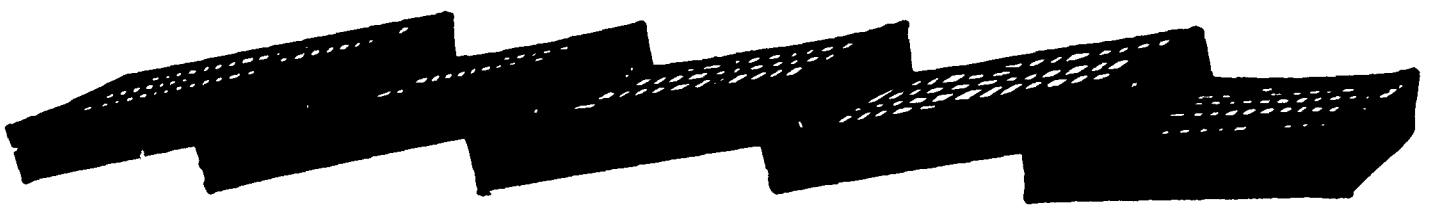
AN ACCIDENT

AN INJURY

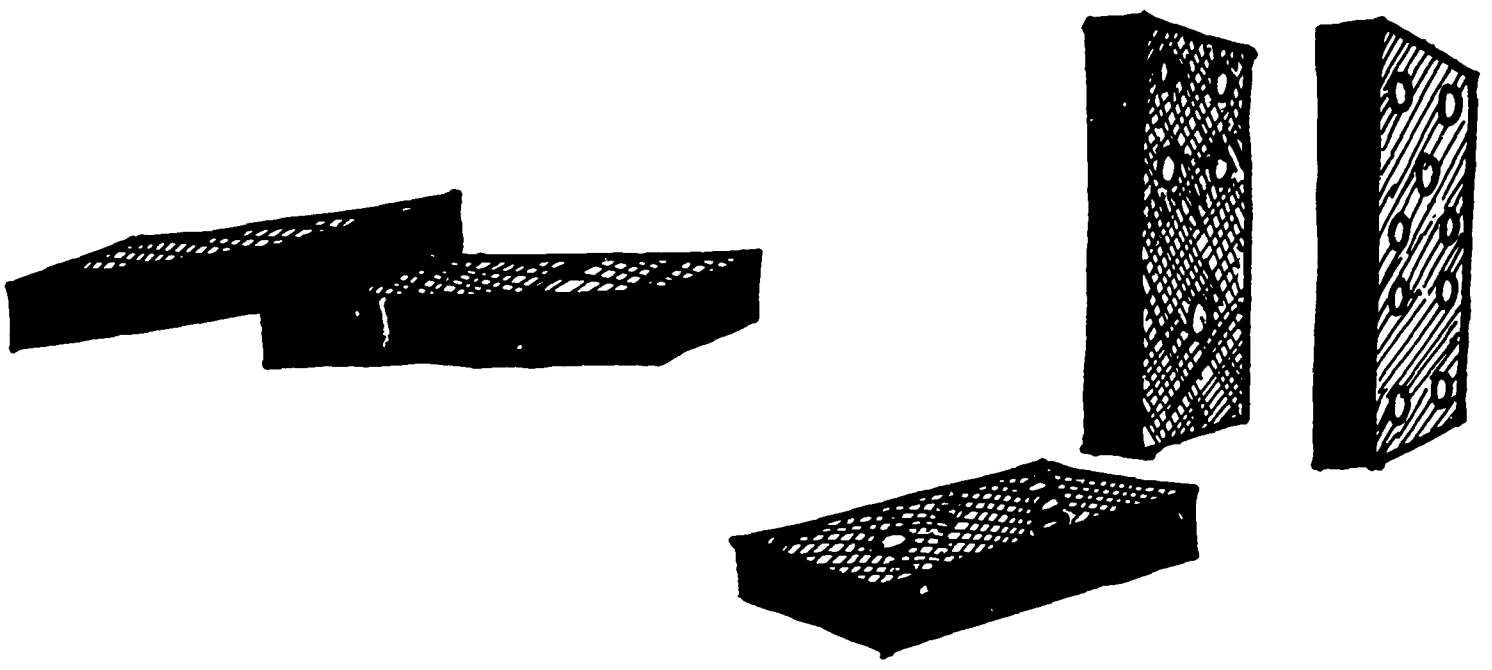
A ROW OF DOMINOS



FALLS BY CHAIN REACTION



UNLESS ONE IS REMOVED



1. GOOD PERSONAL HABITS

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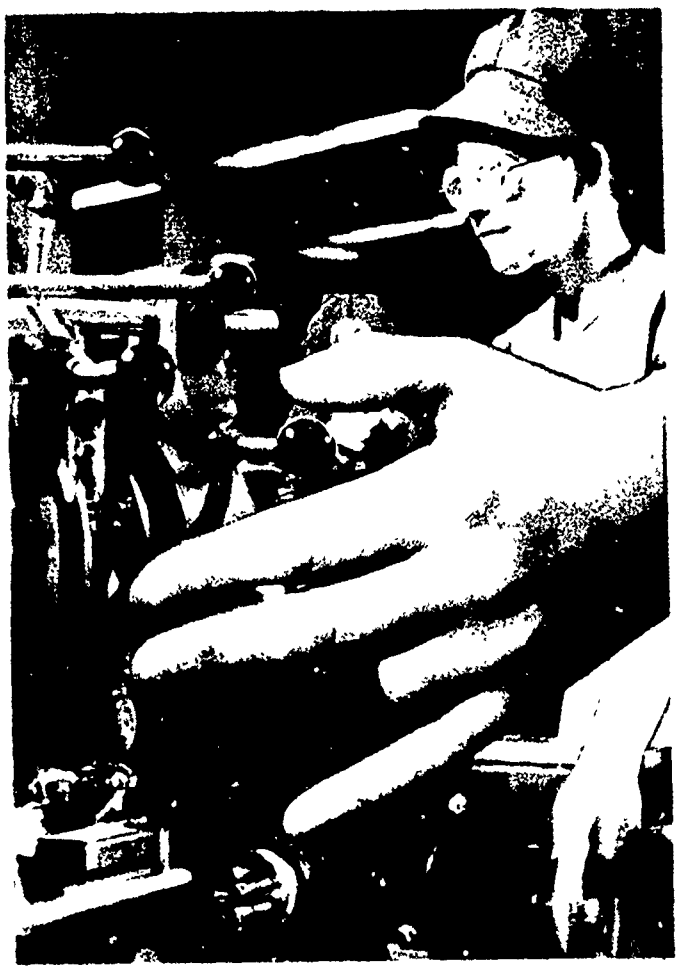
National Safety Council

Don't hang around moving machinery with loose clothing!

Reprinted Courtesy
National Safety Council

A RING IS NICE

BUT *not around machinery*



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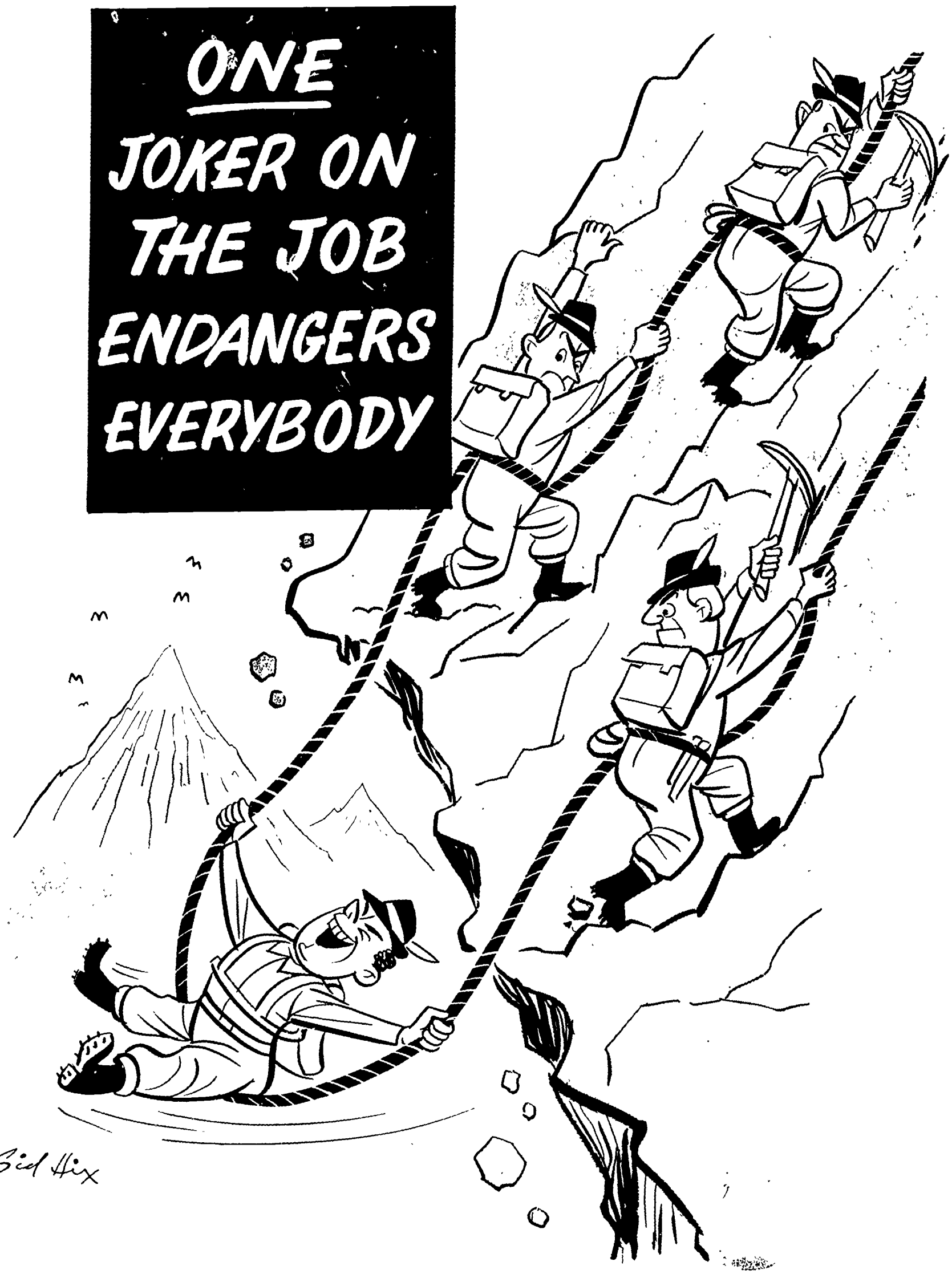

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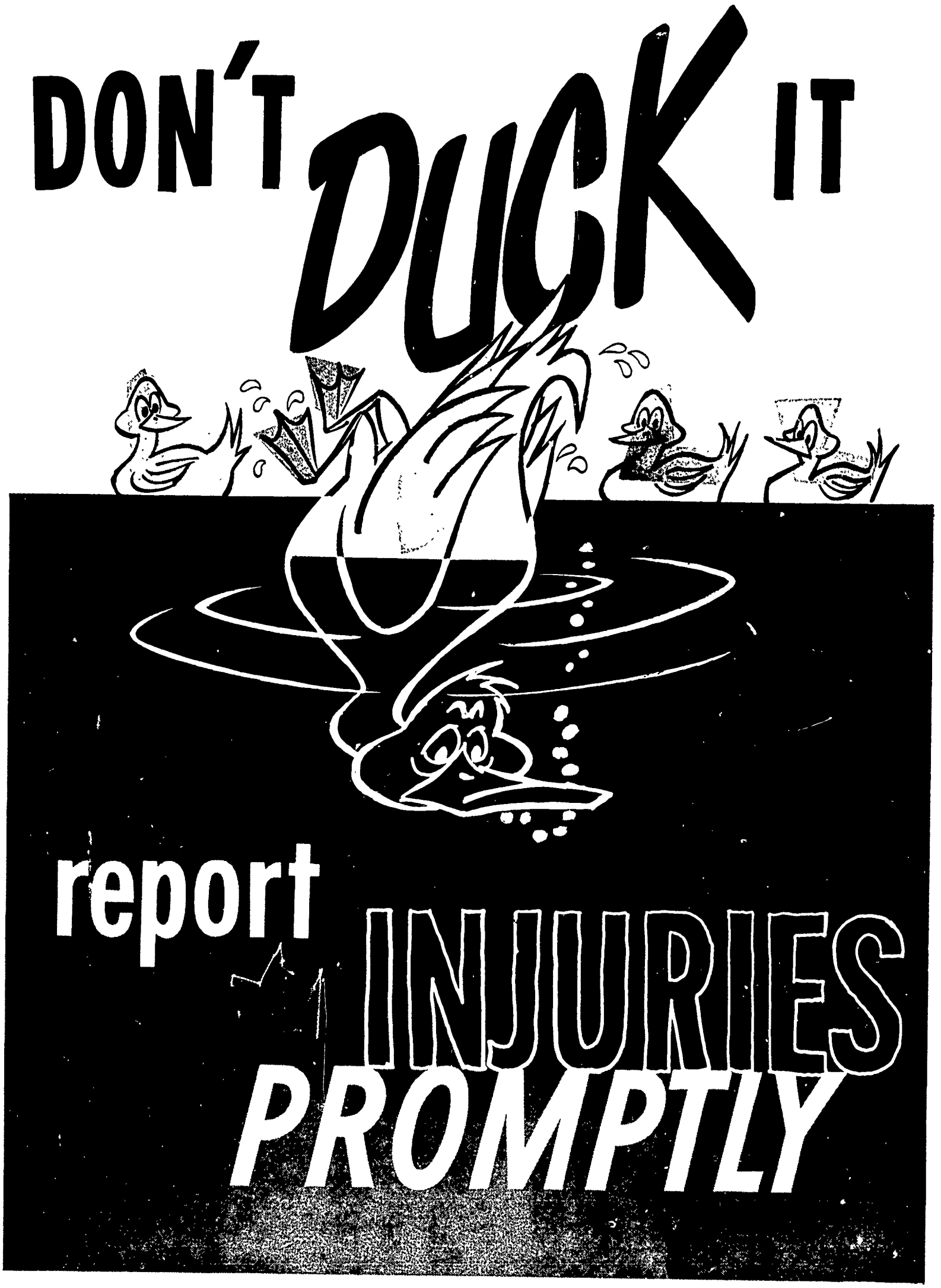

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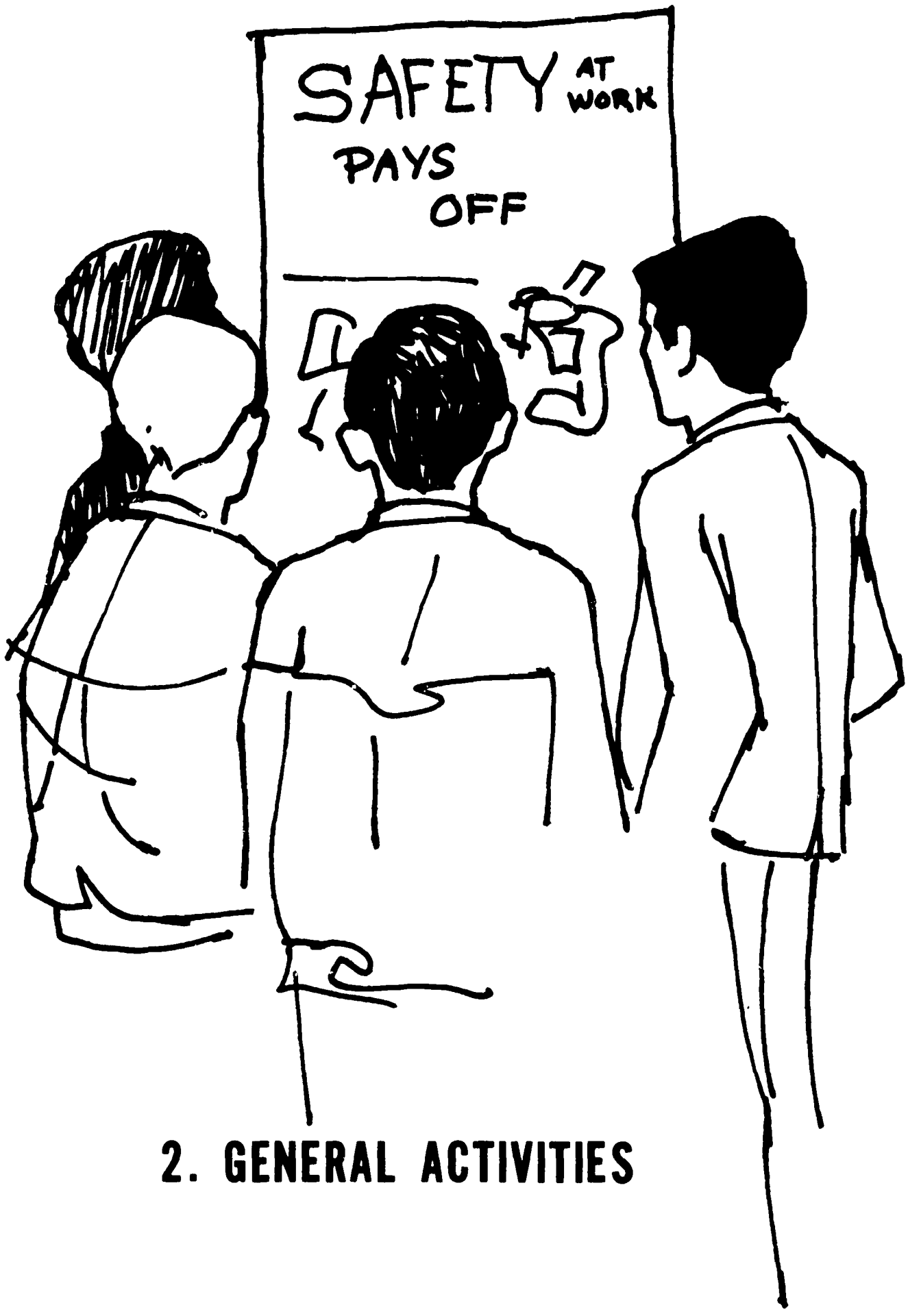
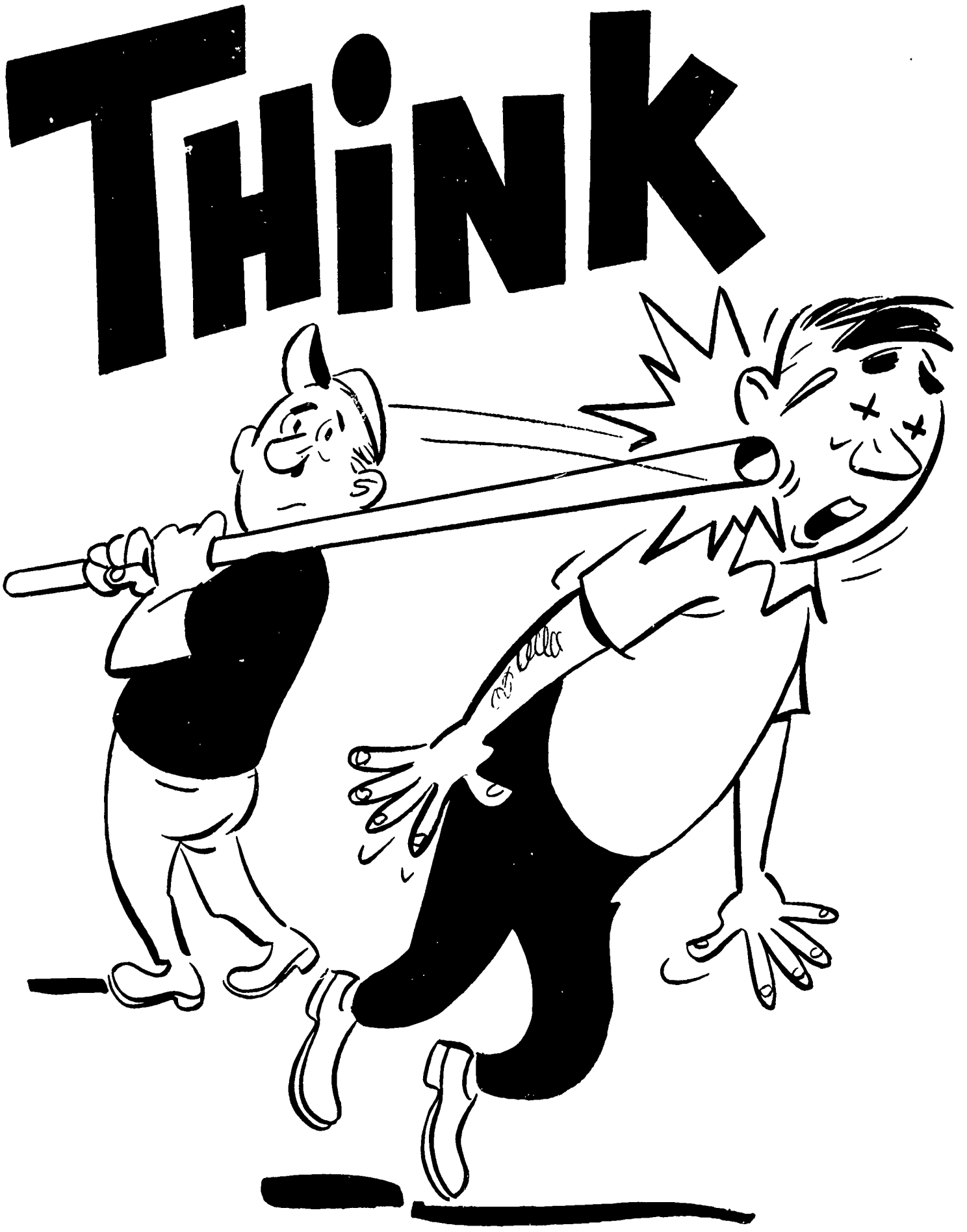


2. GENERAL ACTIVITIES



When Handling Material!

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GET HELP

79

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ELIMINATE A HAZARD-
PREVENT AN ACCIDENT

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BIG CRASH FROM SMALL SPLASH

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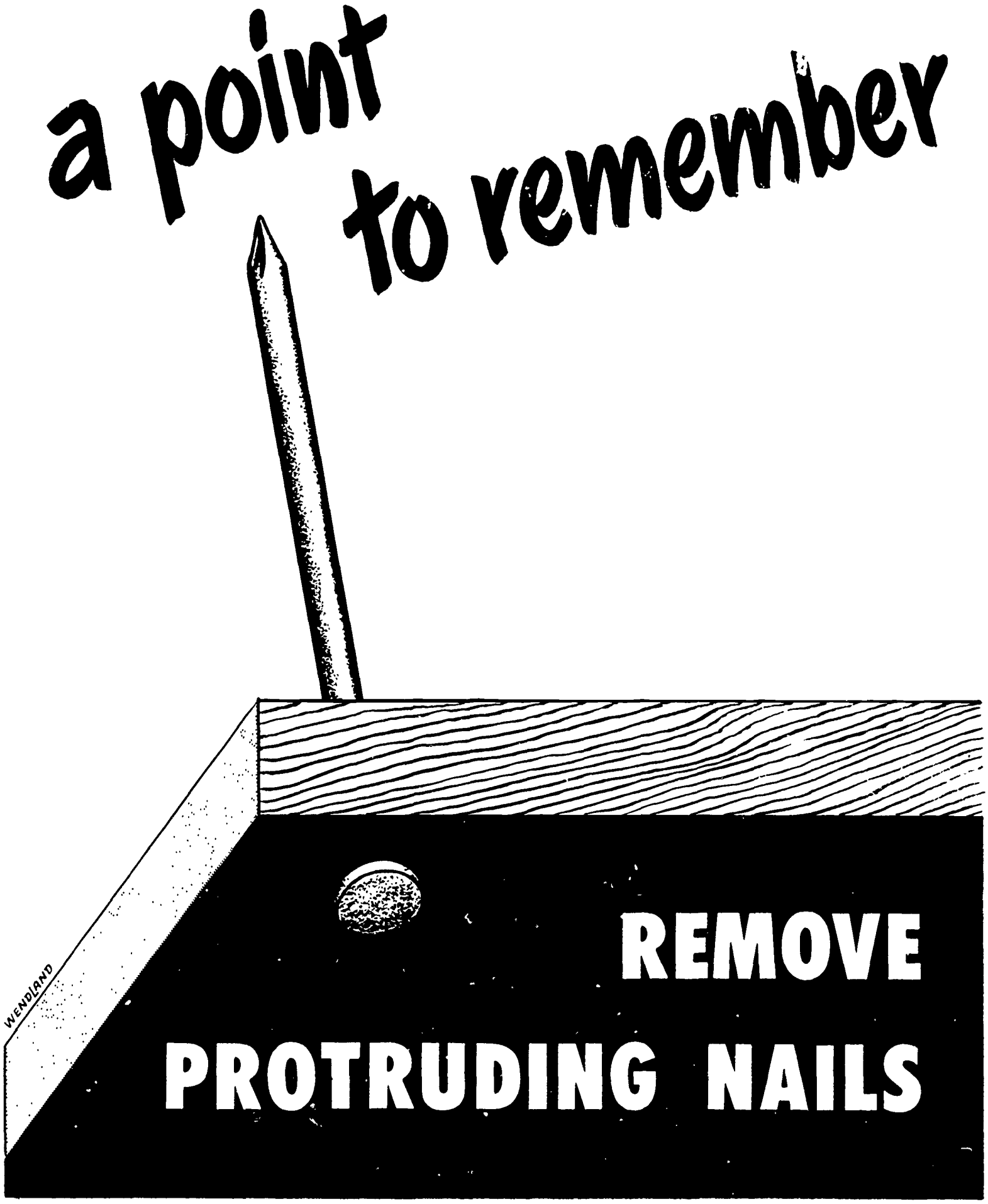

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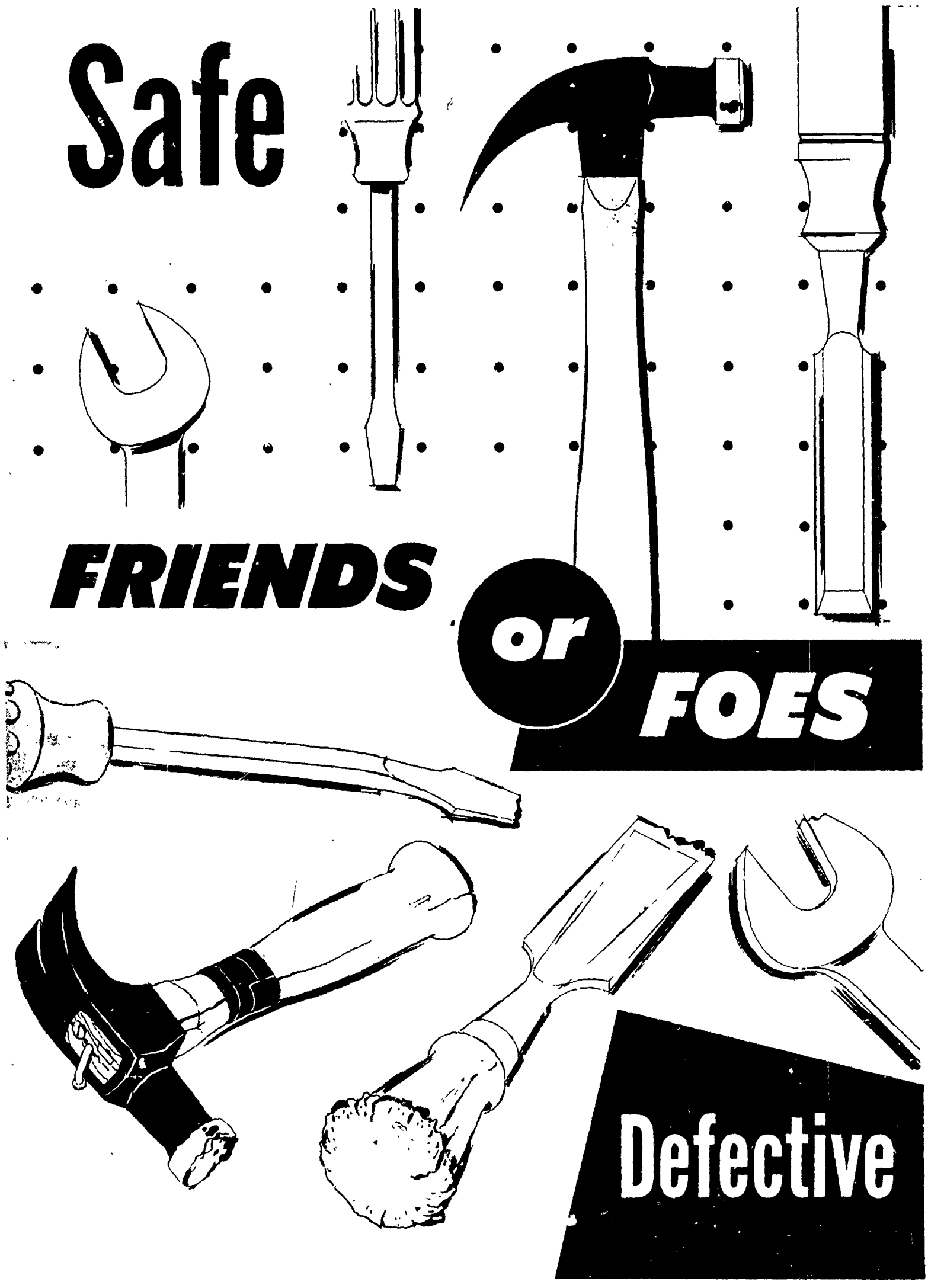
3. SAFETY PRECAUTIONS FOR ALL TOOLS, APPLIANCES, AND MACHINES



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Pete Jones Forgot the Safety Rules- A Pocket is No Place for Tools

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National Safety Council

Check Em!
FAULTY TOOLS CAUSE INJURIES

ALL SHOOK UP?

GROUND IT BEFORE IT GROUNDS YOU!

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SAFETY IN OUR SHOP

ERIC

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TYPES OF FIRE EXTINGUISHERS

TYPES OF EXTINGUISHERS CAN BE RECOGNIZED BY THEIR SHAPES.

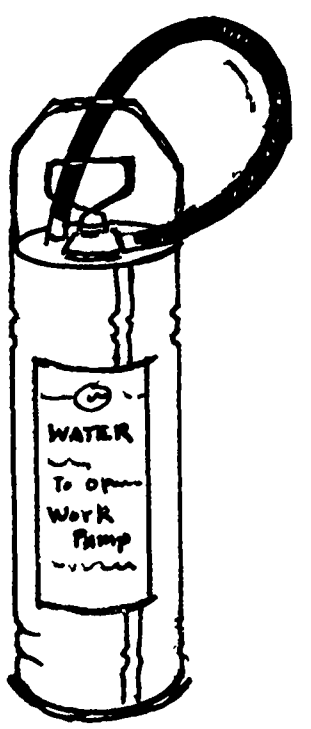
FOR CLASS A FIRES
(WOOD, HAY, PAPER AND TEXTILES)

1. SODA-ACID—

TO OPERATE: AIM NOZZLE AT FIRE
TURN EXTINGUISHER
UPSIDE DOWN

2. WATER PUMP

TO OPERATE: AIM NOZZLE AT FIRE
OPERATE HAND PUMP



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FOR CLASS B AND C FIRES

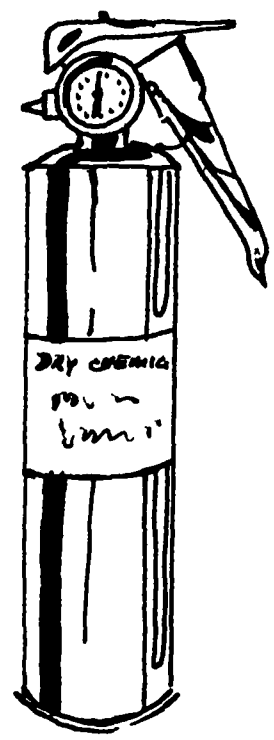
(OIL, GREASE, GASOLINE, PAINT, ELECTRICAL FIRES)

3. PRESSURIZED DRY CHEMICAL

TO OPERATE: PULL SAFETY PIN

AIM EXTINGUISHER AT FIRE

SQUEEZE HANDLE

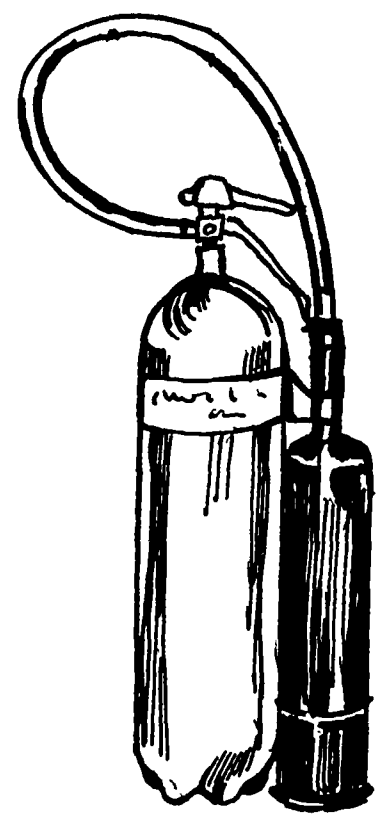


4. CARBON DIOXIDE (CO_2)

TO OPERATE: PULL SAFETY PIN

AIM NOZZLE AT FIRE

SQUEEZE HANDLE



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DESCRIPTORS - *HOMEMAKING EDUCATION; *TEACHING GUIDES; *EVALUATION TECHNIQUES; STUDENT EVALUATION; COURSE EVALUATION; PROGRAM EVALUATION; SECONDARY GRADES; *TESTS

ABSTRACT - Developed and tested by six committees of high school teachers, this manual is for teacher and administrator use in evaluating high school home economics courses and students. Major sections are: (1) Evaluating at Various Levels of Learning, (2) Evaluating the Total Home Economics Program, (3) Evaluating Areas of the Home Economics Program, (4) Evaluating Phases of the Home Economics Program, (5) Evaluating Teaching Resources, and (6) Improving Teacher-Made Tests. Each section contains suggested evaluation techniques and examples of evaluation devices, which include pretests and posttests, motivational techniques, interest and attitude surveys, rating scales, scorecards, checklists, progress checks, and item analysis of tests. Use of behavioral objectives is stressed. (SB)

VT 009 884

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118

TOWARD BETTER EVALUATION IN HOME ECONOMICS

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(Address) Clemson University, Clemson, S. C. 29631

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(2) Means Used to Develop Material:
Development Group six committees
Level of Group high school teachers
Method of Design, Testing, and Trial committee testing

(3) Utilization of Material:
Appropriate School Setting high school
Type of Program home economics
Occupational Focus home economics
Geographic Adaptability universal
Uses of Material evaluationa of home economics students
Users of Material teachers and administrators

(4) Requirements for Using Material:
Teacher Competency professional teachers
Student Selection Criteria

Time Allotment

Supplemental Media --
Necessary ____)
Desirable ____) (Check Which)

Describe

Source (agency)
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FOREWORD

Evaluation is often described as the most difficult task in teaching. In an effort to make the task less difficult, this publication, Toward Better Evaluation in Home Economics, has been compiled. The purposes of the publication are twofold:

1. To provide an increased understanding of evaluation and its integral role in the home economics program.

2. To provide a source for ideas when evaluating the subject matter areas of home economics, the phases of the home economics program and some of the techniques used in teaching home economics.

The first meeting of the evaluation committee was held in August, 1968. Small, independent group meetings were held throughout the State in the early part of 1969 to work on evaluation of specific areas and phases of the home economics program. A regional workshop on evaluation in home economics, sponsored by Region 5, under Title III of the Elementary and Secondary Education Act, provided valuable assistance in the preparation of this publication. Dr. Rebecca Smith of the University of North Carolina at Greensboro directed the work of the regional workshop.

The following persons deserve special thanks for their contributions to this publication:

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OUR PHILOSOPHY

EVALUATION IN HOME ECONOMICS	
What We Believe	What We Will Do
Evaluation is a means for determining the progress made toward reaching specific goals.	Devise ways for evaluating the progress made toward short and long term goals.
Evaluation is a continuous process.	Include a variety of well-planned evaluations throughout each unit.
	View evaluation in terms of daily goals, overall objectives of the unit and the objectives for the total home economics program.
Evaluation of pupil progress is a cooperative enterprise.	Allow students to participate in setting goals and determining how their progress toward goals will be measured.
Evaluation is a means for improving instruction.	Determine new methods for reaching goals when evaluation shows that adequate progress is not being made.
	Examine and evaluate goals; if evaluation shows that goals are unrealistic, teachers and pupils reestablish goals that are obtainable.
Each individual and each class is unique; therefore, the methods of evaluation used must also be unique.	Consider the characteristics of the students and the classroom in the development and use of evaluation techniques.
	Use evaluation devices developed commercially or by fellow-teachers to gain ideas; adapt the ideas to own particular circumstances.

Self-appraisal by the teacher is a necessary part of the evaluation process.	Assess teaching methods and techniques used for their effectiveness. Be willing to change methods and techniques as needed.
Students may help teachers to evaluate themselves and their teaching.	Be alert to student criticisms and comments.
	Ask for or devise measures to obtain students' opinions on teaching methods and techniques used in class.
Evaluation is less complicated when objectives are stated behaviorally.	State objectives realistically to include behaviors expected of students when objectives have been reached.
	Use devices and techniques which evaluate whether or not the student behavior is in accord with the behavior set forth in the objectives.
Evaluation can be a teaching device.	Help students understand objectives so they will know the behaviors expected of them.
	Discuss the evaluation after its use so students will see their mistakes and learn from them or will reinforce their learning when mistakes are not made.
Before specific goals are set, one needs to determine where the student is in the learning process.	Give pre-tests.
	Become familiar with students' background and capabilities.

Evaluation is based on observable evidence that student behavior has changed.	Use realistic evaluation techniques which will give evidence that the students' behavior have changed.
There are many methods and techniques of evaluation.	Use various procedures and instruments in evaluating--both formal and informal.
Evaluation encompasses not only assessment of knowledge; assessment of comprehension, attitudes, interest, and ability to apply are also integral parts of the evaluation process.	Use evaluation techniques which will give evidence of change in knowledge, comprehension, attitudes, interests and ability to apply.

EVALUATING AT VARIOUS LEVELS OF LEARNING

Goal-setting occupies a major role in teaching-learning activities. Whether the goals are determined by teachers, students, administrators, or combinations of these, evaluation is inherently a part of the goal-setting process. If one accepts the notion that an objective is a statement of desired outcome, then one must also accept the fact that the evaluation procedures and techniques used should give evidence of the degree to which such outcomes have occurred.

There are various levels at which learning occurs; thus, the objective needs to make clear the level of learning which is desired. The Taxomony of Educational Objectives, Handbooks I and II* have provided a valuable service in helping to clarify the various levels of objectives. Evaluation techniques must take into consideration the level of learning desired and measure for a particular kind or level of learning as specified in the objective. For example, suppose the following is an instructional objective: "When given a list of basic colors, the student will be able to identify which colors are primary hues, which colors are secondary hues and which colors are intermediate hues." One cannot then, when evaluating, ask the student to draw a color wheel and place primary, secondary and intermediate colors in the proper positions so as to form a color chart. Again, the inherent relationship between objectives and evaluation is seen.

The evaluation task becomes less complicated when instructional

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*Bloom, Benjamin S., ed. Taxonomy of Educational Objectives, Handbook I: Cognitive Domain. New York: David McKay Company, Inc., 1956.

Krathwohl, David R; Bloom, Benjamin S.; and Masia, Bertram B. Taxonomy of Educational Objectives, Handbook II. Affective Domain New York: David McKay Company, Inc., 1956.

objectives are stated behaviorally in terms of specific pupil behaviors expected. Classroom objectives need to be stated specifically enough for students to know what behavior will be expected of them. Words such as "know," "appreciate" and "understand" are ambiguous in the sense that there is no agreement upon what behavior will be exhibited when one knows, appreciates or understands. For example, suppose an objective is stated as follows: "The student will appreciate the use of color in interior design." There would be numerous varying ideas on what learnings the student must have in order to "appreciate." However, suppose we break the objective down and state a single specific goal: "When given a list of basic colors, the student will be able to identify which colors are primary hues, which colors are secondary hues and which colors are intermediate hues." The specific behavior defined in the latter objective has given clarity to the objective. Little room has been left for disagreement on what behavior the student should exhibit when the objective has been accomplished. Specificity in behavioral objectives also provides valuable guidelines in choosing evaluation techniques which will give evidence of whether or not the behavior, as set forth in the objective, has occurred. One of the most satisfying methods is to outline the evaluation techniques to be used as the objectives are set up.

The following outline, using two objectives from the state curriculum guide in the area of Health, First Aid, and Home Nursing, Home Economics I, illustrates this method.

HEALTH, FIRST AID, HOME NURSING

HOME ECONOMICS I

OBJECTIVE III: To understand the relationships between good habits and safety in the home.

SPECIFIC BEHAVIORAL GOALS:

1. Students will be able to compile a list of safety hazards at home and school and resulting accidents that could occur at their homes and school.

2. Students will be able to identify the most common hazards and accidents at home and school.

3. Students will be able to recognize the causes of accidents and suggest or demonstrate why to eliminate them.

EVALUATION:

1. Students make a survey, in report form, of safety hazards and accidents that have happened or could happen at home or school by collecting news clippings, magazine articles, viewing safety films, and observing behavior and conditions present at home and school.

2. When given a list students can choose the most commonly occuring hazards and accidents at home and school.

3a. Make up situations in which accidents have occured. Have students write suggestions as to what happened and why and how it could have been avoided.

3b. Either draw on paper or stage a scene in the home economics room in which a number of safety hazards are included. Have students to observe, find and record the hazards, then suggest or demonstrate how the hazard could be eliminated.

HEALTH, FIRST AID, HOME NURSING

HOME ECONOMICS I

OBJECTIVE IV: To develop some understanding and ability in simple first aid measures.

SPECIFIC BEHAVIORAL GOALS:

1. When given a list of minor accidents, the student is able to write or tell orally the proper treatment for each accident.

2. When given a list of accidents, the student is able to determine which ones are minor accidents and which ones are major accidents.

3. The student is able to demonstrate simple treatment given for a specific accident.

4. The student is able to choose basic first aid supplies, assemble a first aid kit, and know how to care for and store first aid supplies.

5. The student is able to write or tell orally what first aid treatment needs to be given in case of accidents, how to seek medical help if needed and the necessary information one gives in seeking medical help.

EVALUATION:

1. Make a list of minor accidents; have students to write the proper treatment for each accident on the list.

2. Make a list of accidents--major and minor. Beside each accident, have student write whether the accident is a major or minor accident.

3. Write on slips of paper various types of accidents. Let each student draw on and demonstrate the treatment for the accident on the slip of paper she has drawn.

4. Have students make and assemble a basic first aid kit to be placed and used in their own homes after class evaluation.

5. Make up specific situations in which an accident has occurred and medical help is needed. Have student write the first aid treatment she would administer, how medical help is sought and what information she would have to give to the doctor.

SIX LEVELS OF LEARNING*

1. KNOWLEDGE

Emphasizes remembering by recognition or recall. Requires something more than rote memory, but should not be too different from the way in which the knowledge was originally learned.

Words related to knowledge level:

Define Recall List

2. COMPREHENSION

Emphasizes grasping meaning and intent of the material.
Deals with content of material.
Ability to translate from abstract to more simple phraseology.
Is able to interpret material.

Words related to comprehension level:

State in your own words . . . . . .
Give an example . . . . . or This is an example of . . . . .
Illustrate . . . . . or The idea illustrated by the cartoon is . . .
Describe . . . . .

3. APPLICATION

Ability to apply what he remembers and comprehends.
Applies what he has learned to problem situations in real life.

Words related to application level:

How will this affect? . . . . Choose . . . . What would you do? . . .

4. ANALYSIS

Emphasizes the breakdown of the material into its constituent parts and detection of the relationships of the parts.

Aid to fuller comprehension. Ability to: distinguish fact from hypothesis, to identify conclusions and supporting statements, to distinguish relevant from non-essential material, and to note how one idea relates to another.

Deals with both content and form.

Words related to analysis level:

Which . . . . The main . . . . Analyze . . . .

*Bloom, Benjamin S. and D. R. Krathwohl, editors. Taxonomy of Educational Objectives. Longmans Green and Company, 55 Fifth Ave., N. Y. $1.50 (Paperback)

5. SYNTHESIS

Provides for creative behavior on part of the learner.

More complete than comprehension, application and analysis.
Emphasizes uniqueness and originality - draws upon elements from many sources and puts these together into a structure or pattern not clearly there before.
Organizes ideas into new patterns.
The learner functions as a producer of ideas, rather than a consumer.
Takes time (to become familiar with task, explore different approaches, interpret, analyze and try out various organizational approaches.)
Needs freedom from tension and from pressures to conform.

(A democratic society thrives best when its citizens are able to arrive at their own decisions rather than when someone in authority does the thinking for them.)

Requires a novel product - something that the student cannot produce as a whole from memory.
Relates a number of ideas to explain something.

Examples of synthesis level:

1. Ability to plan a unit of instruction for a particular teaching situation
2. Ability to develop a personal philosophy of child rearing

Words related to synthesis:

Write a paper . . . . Think . . . . Make up a story . . . .
Develop a plan . . . .

6. EVALUATION

Makes a judgement about the value of some ideas, principles, solutions, methods, etc.
Involves the use of criteria
Not necessarily the last step in thinking or problem solving - may come before acquisition of new knowledge
Judging - appraising
NOT opinions (not egocentric)
Must be based on some criterion
Purpose to broaden the student's foundations on which he make judgements

Words related to evaluation;

Compare . . . . Determine the best possible . . . . Judge...and support

EVALUATING THE TOTAL HOME ECONOMICS PROGRAM

Home economics teachers concerned with the progress of students will want to evaluate programs in terms of their effectiveness in helping students progress toward their education objectives. The following principles should serve as a guide to the formulation of meaningful objectives:

- A statement of objectives should describe not only the kind of behavior expected but also the content or the context to which the behavior applies.
- Objectives need to be clearly and unequivocally stated so that there is no doubt as to the kind of behavior expected.
- Objectives should be realistic and should include only what can be translated into curriculum.
- The scope of objectives should be broad enough to incorporate the outcomes envisioned in a home economics curriculum.

Determination of the objectives of the curriculum is the basic and the first step in a comprehensive evaluation program. It is in terms of these objectives that the evaluation program is to be developed.

Evaluation has been described by Taba* as an intricate and complex continuous process which begins with the stating of objectives and involves decisions about the means of securing evidence on the achievement of these objectives; processes of interpretation to get at the meaning of this evidence; judgments about the strengths and weaknesses of the students; and ends in decisions about the needed changes, improvements in curriculum and teaching, and evidence of changed behavior.

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*Taba, Hilda. Curriculum Development--Theory and Practice. New York: Harcourt, Brace and World, Inc., 1962.

Evaluation must satisfy several basic criteria, which are as follows:

- Facilitate self-evaluation.
- Encompass every objective valued by the school.
- Facilitate learning and teaching.
- Produce records appropriate to the purpose for which records are essential.
- Provide continuing feedback into the larger questions of curriculum development and educational policy.

Not all behavioral outcomes can be evaluated by the same technique. Teachers need to know and understand a variety of means and methods available to them for securing evidences of learning. These may include pencil and paper tests, tape recorder techniques, attitude scales, interest inventories, check lists, sociograms, questionnaires, interviews, observations, performance tests, anecdotal records, etc. Taba suggests that the method of evaluating what is learned dictates the way in which learning takes place.

Some questions which the home economics teacher might consider in evaluating her program are:

1. Are the program objectives stated in terms of behavioral outcomes?
2. Has the program been successful in achieving the instructional intent?
3. Has interpretation of behavioral outcomes suggested hypotheses regarding strengths and weaknesses in the program?
4. To what extent have various methods of evaluation been used to analyze the effectiveness of teaching?
5. To what extent are persons of all ages being served?
   a. Persons in high school
   b. Persons in the post-high school
   c. Persons who are employed but who need training or retraining in order to succeed or to advance
   d. Persons who have special needs
6. To what extent do students indicate an interest in home economics careers?

EVALUATING THE TOTAL HOME ECONOMICS PROGRAM

SUGGESTED TECHNIQUES:

1. Conferences with administrators.

2. Listen to parents' comments as home visits are made.

3. Ask parents for written statement of ways to improve program and things they feel are important to include in the program.

4. Students' comments.

5. Ask students to evaluate parts of program after they have been involved with the program--get students' ideas on things they feel need to be changed to make the program more valuable to them.

6. Discuss program with other teachers in the school. Find out what the other teachers think about the program.

7. Discuss program with other home economics teachers to evaluate program and exchange ideas for improvement of program.

8. Conferences with district supervisor.

9. Read up-to-date professional periodicals and books to determine whether or not current concepts of home economics are integrated in the program.

10. Check records for program enrollment data.

11. Talk with persons in community businesses and organizations to see if they feel that needs of the community are being met in the home economics program.

12. Observe changes in behavior of persons involved in the program.

EVALUATING AREAS OF THE HOME ECONOMICS PROGRAM

CHILD CARE AND DEVELOPMENT

TEXTILES AND CLOTHING

HOUSING AND HOME FURNISHINGS

FOOD AND NUTRITION

HEALTH, SAFETY, FIRST AID, HOME NURSING

MANAGEMENT

FAMILY LIVING

CHILD CARE AND DEVELOPMENT

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CHILD CARE AND DEVELOPMENT

Pre-test and Post-test

Pre-tests are given to help the teacher discover how much her pupils already know about the subject matter she wishes to teach. It also helps her in planning her objectives and curriculum around the needs, interest and abilities of the students. The post-test helps the teacher to evaluate her established objectives and teaching methods by testing the students' progress after the curriculum material has been presented.

There are two methods which may be used in giving pre-test and post-test: the formal and the informal. The formal method is more thorough than the informal and requires a correct answer. The informal does not require a correct answer but test the attitudes of the students toward certain areas.

In the following formal test all questions lettered A make up the pre-test and those lettered B make up the post-test. In the informal test the same questions are used for the pre-test and post-test.

MULTIPLE CHOICE

Directions--In the blank to the left of the question, place the letter of the best possible answer.

Behavioral objective: The student will identify the ways of coping with sleeping problems.

A. A You have just put Salley to bed. As you leave the room, she begins to cry and continues to do so. You should:
   a. Go back and tell her a story
   b. Make sure all her needs are cared for and cheerfully say good night.
   c. Ignore her.
   d. Go get her and allow her to stay up until she becomes sleepy.

B. C If a child has difficulty getting to sleep should you:
   a. Insist that he go to sleep in the dark immediately without toys
   b. Let him play in bed with any toys he wants until he tires and falls asleep.
   c. Leave a light in the hall and let him take a soft teddy bear or other soft toy to bed with him.
   d. Insist that he go to sleep immediately with his favorite toys.

Behavioral objective: The student will identify the right way to keep a child from running away.

A. D What would you do to keep Jimmy playing contentedly in the yard without running away?
   a. Spank him every time he runs away.
   b. Promise him an ice cream if he would stay in the yard.
   c. Watch him every moment to make sure he doesn't run away.
   d. Create a desire in Jimmy to stay in the yard.

B. B If a child runs away from home you should
a. Whip him
b. Find out why he ran away.
c. Tell him the policeman will get him.
d. Take his toys away from him for a time.

3. Behavioral objective: The student will identify reasons for a child to get along with other children.

A. D Mrs. Smith wants Jane to learn to share her toys with other children. When Jane is selfish, she should
a. Take her toys away from her for a time.
b. Give some of her toys to her friends to play with.
c. Send her to bed without her supper.
d. Suggest how she and her friends can use the toys together.

B. B If a child has trouble getting along with other children should you
a. Remove him because the other children have been unkind to him.
b. Try to discover and treat the causes of the difficulty.
c. Give him more toys to play with so he will have something to do.
d. Tell him he has to learn to fight for his rights.

4. Behavioral objective: The student will identify ways of choosing proper toys for children.

A. C In buying toys for children you should select
a. Toys that you like.
b. Expensive toys.
c. Toys which suit the age of the child.
d. Anything the child wants.

B. A You are buying a toy for a one-year old. Which would be the most suitable one?
a. A wagon.
b. An electric train.
c. A wind-up automobile.
d. A paper story book.

5. Behavioral objective: The student will identify the correct way to guide a child in the formation of good eating habits.

A. C If a child refuses to drink his milk
a. Tell the child to hurry.
b. Scold the child
c. Wait quietly and drink your own milk
d. Stop giving the child milk

B. B Dorothy did not like to eat new foods, but her mother thought she should learn to eat beets. She offered Dorothy a small spoonful which she refused. What should she do?
a. She should force Dorothy to eat the beets, so she will know what they taste like.
b. She should offer the beets to Dorothy again a few days later.
c. She should say, "Well, I don't like them either."
d. She should make facial expressions indicating that she doesn't like them.

6. Behavioral objective: The student will define the correct way of dealing with a child who is fearful.

A. A Fearful children can be helped by:
   a. Example of children their age or of older people.
   b. Forcing them to take part in the activity, thus teaching there is nothing to fear.
   c. Reasoning with him when he becomes frightened.
   d. None of the above.

B. B Ruling the child by fear makes a
   a. Law-abiding citizen later.
   b. a timid child.
   c. a bold child.
   d. a selfish child.

7. Behavioral objective: The student will identify the importance of vitamins.

A. C The baby's chief source of Vitamin D is
   a. Cereal
   b. Egg
   c. Cod-liver oil
   d. Orange juice

B. A A baby should be given tomato juice or orange juice because
   a. It is rich in vitamin C.
   b. It is colorful.
   c. It taste good.
   d. It is rich in vitamin D.

8. Behavioral objective: The student will describe undesirable habits of children.

A. D If a five year old takes something that does not belong to him, should you
   a. Whip him.
   b. Punish him by depriving him of something he enjoys.
   c. Tell him the police will get him.
   d. Give him more loving attention.

B. C If a child destroys something you treasure, should you
   a. Whip him and tell him he is bad.
   b. Show no signs of anger but patiently tell him to be more careful.
   c. Show him your annoyance but explain to him that you love him even when he makes mistakes.
   d. Ignore the whole situation.

9. Behavioral objective: The student will describe important characteristics in discipline problems of children.

A. B Most important in disciplining youngsters is
   a. Leniency
   b. Consistency
   c. Strictness
   d. Flexibility

B. A When Jimmy's mother calls him to come in he is usually too busy playing to mind her. The best thing for his mother to do is
a. Give him a five minute warning, then go and bring him in.
b. Call him, and then go inside and pay no attention to him.
c. Tell him how badly she feels when he is naughty.
d. Go out and bring him in; then make him stay in the rest of the afternoon.

10. Behavioral objective: The student will identify the responsibilities of caring for children.

A. D You are baby sitting with John and he wants to go next door and play. He tells you that his mother always lets him go. His mother has left no directions with you concerning the fact of whether he may go next door or not. You should
a. Let him go.
b. Let him go, but say to him, you'll "tell mother" when she comes home.
c. Call his mother at the P.T.A. meeting and ask her.
d. Use your own judgement and decide if he should be allowed to go.

B. A The babysitter's primary job is
a. To help the child accept the absence of his parents without being worried.
b. To improve the child's behavior.
c. To have a good time and invite her friends over.
d. To exercise strict authority with the child and to make him over in one night.

CHILD CARE AND DEVELOPMENT

The following device may be given at the beginning of a child care and development unit as a motivational device to stimulate interest and discussion in the area of child care and development. Further use of the device may include using it as a pre-test to help the teacher discover the knowledge and attitudes held by the students. At the end of the unit the device may be used as a post-test to determine the level of retention and application of child development principles taught during the unit. For more effectiveness, the teacher may put the situations on a tape recorder and play them back to the students, allowing time after each situation for the student to write her response.

OBJECTIVES: To become acquainted with the various areas of child care and development.

To become acquainted with some behavioral problems which arise in caring for children and desirable solutions to the problems.

1. Mary Ann, a three-year-old: "I have to go to the bathroom."

   Nursery School Teacher: "All right, Here, I'll help you take off your slack outfit. Now. . .sit down."

   Mary Ann: "I don't want to sit down. I want to stand up like Jimmy does when he goes to the bathroom."

   Nursery School Teacher: "But, Mary Ann, _____."

2. Willard (father): "Mary, I took Tommy to the barber shop with me today, and guess what happened again!"

   Mary: "Oh, no!"

   Willard: "Yes, he wet his pants again and then told me about it afterwards. . .He's two and one-half years old, Mary! What are we going to do with him to get him trained?"

   Mary: "Let's see. . .I remember in our Home Economics Classes in high school that we talked about special problems in toilet training. And, in cases like Tommy's we learned that you should _____."

3. (Telephone conversation between two Mothers.)
   Betsey: "Hello, Bonnie, is Johnnie over at your house?"

   Bonnie: "No, I don't think so, but I'll look. Hold on just a minute. . .Betsey, no; I don't see Johnnie anywhere. He hasn't run away again, has he?"

Betsey: "I'm afraid so. He ran away Monday, yesterday, and now he's gone again. Bonnie, you had three children. Tell me, what am I going to do? ? ? I've spanked him, scolded him, sent him to bed. . .Why is he running away? What am I going to do?"

Bonnie: "I can remember this happening to me when my children were younger, and I _____."

4. Little Bill: "It's mine!! It is! Give it to me!"

Little Marty: "It's mine!! It's mine! I want it!"

Both Bill and Marty: "Wah..Wah..I want my ball. It's mine! Mine!

Sue, the baby-sitter: "Boys, boys. Here. . .let's _____."

5. (Three-year-old Jeanie and Mother on a shopping trip)
Jeanie: "Mommy, I want some of the red candy."

Mother: "Not today, Jeanie. We're going to eat supper as soon as we get home."

Jeanie: "No, Mommy. . .I want some candy right now."

(Jeanie begins hitting the candy counter, junping up and down, and yelling.)

Mother: "Jeanie! Listen, I'm _____."

CHILD CARE AND DEVELOPMENT

BEHAVIORAL OBJECTIVE: The student will be able to identify principles in guiding children's play experiences

DIRECTIONS: Draw a circle around the letter of the phrase that best completes the sentence.

	Answers
1. In telling or reading a story to a child a. express action with the voice. b. keep the voice low. c. talk in baby talk.	a.
2. Whey buying toys for children select a. according to the child's age. b. according to the child's wants. c. according to the child's needs.	c.
3. An example of an improvised toy is a. a doll carriage. b. a newspaper hat. c. a stuffed animal.	b.
4. Cutting things out of paper helps develop a. skill. b. coordination c. rhythm.	b.
5. If you were buying a toy for a one-year-old, the most suitable toy would be a a. wagon. b. wind-up automobile. c. electric train.	a.
6. Jimmy, age five, is selfish with his toys when playing with others. To teach Jimmy to be unselfish a. take away his toys for a time. b. don't allow him to play with the other children. c. suggest how he and friends can use the toys together.	c.
7. When a child is using a toy a. let him use it in his own way. b. show him the proper use. c. tell him how to use it.	a.

8. The decision of what a child is to play

   a. is guided by the adult
   b. is made by the adult. a.
   c. is made by the child.

9. "Attention span" refers to

   a. types of playthings to which a child will pay attention.
   b. the length of time that a child is capable of participating in one activity. a.
   c. the degree to which a child pays attention to an order or request.

10. If a child is misusing a piece of play equipment

   a. take it away from him.
   b. ignore it. c.
   c. show him how to use it.

BEHAVIORAL OBJECTIVE: The student will be able to identify the games and activities of children according to (a) the type of play or activity and (b) the type of development the game or activity promotes.

DIRECTIONS: Listed below are games and activities that children often enjoy. In the space to the left of the game or activity, write
A, if it is active play
B, if it is dramatic play
C, if it is creative play, and
D, if it is social play
There may be more than one answer to each. In the space on the right, write down one type of development this type of play would promote (physical, emotional, intellectual, social).

_____1. building with blocks_____

_____2. singing_____

_____3. watching TV cartoons_____

_____4. finger painting_____

_____5. riding a tricycle_____

_____6. dressing dolls_____

_____7. listening to a story_____

_____8. seesawing_____

_____9. dress-up_____

_____10. hide and seek_____

CHILD DEVELOPMENT

OBJECTIVE:

To identify attitudes students have toward children.

INSTRUMENT:

A Sentence Completion Sheet

BEHAVIORAL OBJECTIVE:

The student will complete sentences in relation to their attitude toward children.

DIRECTIONS:

Complete each sentence with the first thing that comes to your mind. You will have 5 minutes to complete the sentences and your paper will be collected as soon as you have completed the sentences.

1. I think children
2. When children are unhappy
3. The most likeable thing about children
4. It is important for parents
5. Children should
6. The most unlikeable thing about children
7. The background of a child
8. Each child
9. The future of a child
10. The most puzzling thing about children

11. When children misbehave

12. I wish children

13. The hardest thing about growing up

14. Children need

15. I wish parents

ERIC

EVALUATION IN TEXTILES AND CLOTHING

The scope of home economics in the area of clothing and textiles has broadened. Increased emphasis is being placed on textiles and the consumer education aspects of clothing and textiles. What behaviors are desired of home economics students in the area of clothing and textiles? The following broad objectives, stated in terms of pupil behaviors expected, are believed to be worthwhile for the secondary home economics program in the clothing and textiles area.

1. Recognize textiles and identify their characteristics.

2. Become familiar with and demonstrate ability to use textile terminology as found on the labels of clothing and other textile products.

3. Select and purchase appropriate and satisfying clothing and clothing accessories.

4. Use acceptable techniques in all phases of clothing construction.

5. Demonstrate techniques for the proper care of clothing.

6. Become acquainted with job opportunities in clothing, textiles and related fields.

7. Work satisfactorily with others.

These broad, over-all objectives should be broken down into specific behavioral goals for each level of homemaking in the high school program. Hopefully, the following devices will help in evaluating student behavioral change as stated in the specific behavioral goals.

TEXTILES AND CLOTHING

TO THE TEACHER:

The following evaluation device requires prepared samples. The samples needed for each item are given with the item.

Identification Test on Clothing for Beginning Sewing

BEHAVIORAL OBJECTIVE:

The student will identify correct tension, length of stitch and methods of securing stitches on cotton fabric.

A. Samples showing correct and incorrect tension.
(Two samples: poor and good)

B. Samples showing correct and incorrent length stitch.
(Three samples: too long, too short and correct)

C. Samples showing method of securing thread.
(Three samples: tie, backstitch and lock)

BEHAVIORAL OBJECTIVE:

The student will identify the accepted form of dart construction.

A. Samples showing bust darts.
(Four samples of darts: excellent, good, poor, and unsatisfactory)

B. Samples of fitted waistline darts.
(Three samples of darts: good, fair and unsatisfactory)

TEXTILES AND CLOTHING*

OBJECTIVE:

The student will cut a garment bodice and facing and will attach the facing to the bodice.

MATERIALS PROVIDED BY TEACHER:

Half-size patterns for: bodice (neckline and shoulders)
neck facing

1/2 yard of fabric for each student

Large envelope to be used for returning finished product to the teacher

MATERIALS PROVIDED BY STUDENT (On the day before the test is given, ask the student to bring these supplies):

Thread
Bobbin (if not provided by school)
Tape measure
Pins
Scissors
Needle

DIRECTIONS: You have been given a half-size bodice and facing pattern. With the fabric provided, cut the bodice and facing and apply the facing to the neckline of the bodice. Return the finished product in the envelope provided. Your product will be graded on the following factors:

Placing the pattern
Cutting the bodice and facing
Staystitching
Clean finishing
Applying facing to curved edge
Understitching
Tacking the facing

*This test is used to best advantage with small classes in which each student has her own sewing machine and sufficient cutting space. Adapting this evaluation device to larger groups with a limited number of sewing machines is possible if sufficient time is given.

TEXTILES AND CLOTHING

The following questions may be used for several purposes. Students may be given all of these questions, along with others, to study and use during classroom learning experiences. Questions could be given to individual students to study and report findings to the class. Various types of evaluation devices could be developed from these questions, depending upon the behavioral goals of the class.

1. What is the difference between the terms "fiber" and "yarn?"
2. How does fiber length affect yarn strength?
3. What does fiber elasticity mean in regard to wrinkling?
4. What does mercerization do to the appearance of cotton fabric?
5. If fabric is sanforized so that shrinkage is kept to 1% or less, how much could you expect a yard of cloth to skrink?
6. How are wash and wear and permanent press cottons different from ordinary cotton fabrics?
7. What is the purpose and value of a crush-resistant finish on cotton?
8. How can you identify cotton from other fabrics?
9. What quality about linen makes it excellent for kitchen towels?
10. What quality about linen makes it an excellent summer dress fabric?
11. How are these rated in ability to take on dye and resist fading-- Cotton? Linen? Silk? Synthetics?
12. Why does linen not soil as easily as cotton?
13. Give the identification tests for linen.
14. From what raw materials is rayon made?
15. What is the difference between rayon and acetate?
16. What advantage has rayon over silk as far as yellowing is concerned?
17. What quality of wool makes it excellent for cold weather wear?
18. What are the differences between worsteds and woolens?
19. Which become shiny more easily, the worsteds or woolens? Why?

20. What is meant by napping in relation to fabrics?

21. What care must be observed in laundering wool fabrics?

22. What is a disadvantage of wool in regard to its retention of odors?

23. How can we protect wool against moth damage?

24. What are the differences between virgin, reprocessed, and reused wool?

25. Two similar types of virgin wool sweaters have the same quality of construction but have a large difference in price. What is the most likely explanation for this difference?

26. How can you identify a woolen fabric?

27. How does fiber strength of silk compare with that of cotton?

28. Does silk wrinkle easily? Why or why not?

29. What care must be observed in washing, pressing, and storing silk?

30. Name the most commonly used synthetic fibers.

31. What is a synthetic fiber by definition?

32. What is the difference between a trade name and a generic name of a fiber?

33. What is the big advantage of synthetic fabrics from the standpoint of ironing?

34. What happens to synthetic fabrics if considerable heat is applied?

35. What are the differences between filament and spun yarns?

36. Spun synthetic fibers have a tendency to form small balls on the surface as a garment is worn. What is this tendency called?

37. Why do some garments made of synthetic fibers make us feel sticky on a hot day?

38. What resistance do synthetic fibers have to moth and mildew damage?

39. How do synthetic fibers compare to natural ones in resistance to shrinking?

40. What is meant by a fabric blend? Why are they made?

41. What are some of the trade names of acrylic fibers?

42. What are some of the trade names of polyester fibers?

43. What are the distinct characteristics of the acrylic fiber?

44. What are the distinct characteristics of the polyester fiber?

45. What does ply mean in reference to yarn?

46. Explain the weaving process.

47. What are the most common fabric weaves?

48. How does fabric weave affect the wearing qualities of fabric?

49. What is the difference between knitting and weaving?

50. How is felt made and what uses do we commonly find for it?

51. How do wool felts compare in quality with fur felts?

52. What methods are used for applying color to fabrics? What are the advantages and disadvantages of each method?

53. What is the purpose of sizing and weighting fabrics?

54. Why is it important for us to know the fiber content of the clothes we wear?

TEXTILES AND CLOTHING

TO THE TEACHER:

The following score sheet has been adapted from the "Clothing Construction Score Sheet" used by the Future Homemakers of America in South Carolina.

GARMENT SCORE SHEET

STUDENT _____ AGE _____ YEAR OF HOME ECONOMICS _____

TEACHER _____ NAME OF SCHOOL _____

DIRECTIONS:

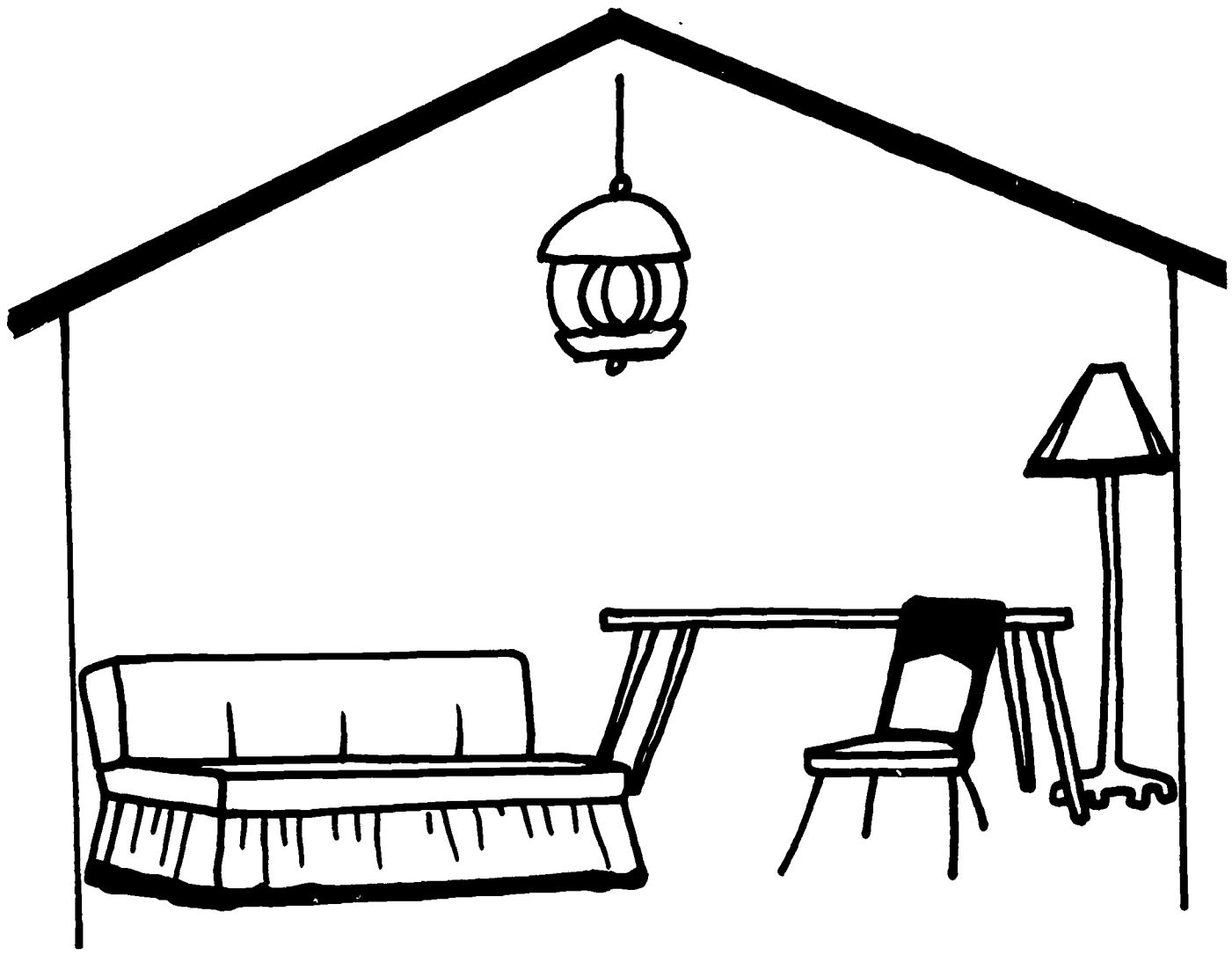
Using the following scale, rate yourself on each of the characteristics listed. Give yourself five points when the characteristic does not apply.

5 - excellent	2 - fair
4 - good	1 - poor
3 - satisfactory	0 - unacceptable

Total the points for each section and for the three sections combined.

	Possible Score	Score: Pupil	Score: Teacher
A. GENERAL APPEARANCE	55		
1. Suitability of pattern lines to girl	5		
2. Suitability of fabric type to pattern and girl	5		
3. Suitability of trim or other visible details	5		
4. Suitability of color and fabric design to girl	5		
5. Suitability of accessories to girl and garment	5		
6. Fit and neatness of dress	5		
7. Level hem line	5		
8. Length becoming to girl	5		
9. Appropriateness for occasions to be worn	5		
10. Appropriateness for age of girl	5		
11. Garment has style and individuality	5		
TOTAL SECTION A			
B. WARDROBE PLANNING AND UPKEEP	15		
1. Addition of garment to wardrobe reflected by need	5		
2. Cost of garment justified in quality and appearance	5		
3. Probability of success in laundering or cleaning	5		
TOTAL SECTION B			

	Possible Score	Score: Pupil	Score: Teacher
C. WORKMANSHIP	75		
1. Fabric on grain	5	____	____
2. Stitching (evenness, length)	5	____	____
3. Seam (construction, width, pressing, grading finish)	5	____	____
4. Fullness--darts, tucks, pleats, gathers (tapering, pressing, stitching, spacing, etc.)	5	____	____
5. Neckline finish--collars, facings (suitability, construction, understitching)	5	____	____
6. Armseye finish--facings, bindings, sleeves, cuffs (ease adjustment, pressing, understitching)	5	____	____
7. Waistline finish--belts, waistbands, reinforcements (construction, width, interfacing)	5	____	____
8. Interfacings (use, on grain, application)	5	____	____
9. Placket--zipper (construction, weight, conspicuousness)	5	____	____
10. Hem (evenness, suitability to fabric and style, construction)	5	____	____
11. Fastenings--buttonholes, button, snaps, hooks, loops (choice, spacing construction, application)	5	____	____
12. Visible details--top stitching, outside tucks, trims, (stitch length, evenness, application)	5	____	____
13. Linings and underlinings (fabric choice, construction)	5	____	____
14. Special fabric treatment--plaids, directional designs, napped surfaces, finishes (matching, cutting, stitch length, thread tension)	5	____	____
15. Thread choice--(color, fiber, weight, size)	5	____	____
TOTAL SECTION C		____	____
TOTAL SECTIONS A, B AND C		____	____



HOUSING AND HOME FURNISHINGS

HOUSING AND HOME FURNISHINGS

BEHAVIORAL OBJECTIVE:

The student will be able to evaluate specific features of a house plan according to its adequacy or inadequacy for her family.

MATERIALS NEEDED:

Before administering the following evaluation device, each student needs a copy of a house plan.

DIRECTIONS:

Your family is planning to build a house. The attached floor plan is presented to the family for consideration.

1. Describe your family--number of members, ages, occupations, sex, hobbies and interests of each.

2. Discuss the adequacy or inadequacy of the attached floor plan for your family in respect to

   a. Room locations
   b. Traffic patterns
   c. Storage space
   d. Sleeping areas
   e. Living areas (all areas other than sleeping areas)
   f. Wall space
   g. Privacy provisions
   h. Room exposures
   i. Expansion possibilities

HOUSING AND HOME FURNISHINGS

BEHAVIORAL OBJECTIVE:

The student will be able to make and support decisions on housing problems, as stated in case studies.

PROBLEM I:

Setting:
Bill and Mary Jones
Married one year (just after both graduated from high school)
Live in one-bedroom apartment furnished with items given to them by parents, other relatives and friends, along with some small accessory items they have purchased themselves.
Both Bill and Mary work and have a combined take-home pay of $450 per month. Basic expenses: Rent (not including utilities) $85 per month.
Car payment (1½ years left to make payments) $90 per month.

Problem:
Mary wants to buy a home. Bill feels they should rent for a year or so longer before buying a home. With which person do you agree--Mary or Bill? Support your point of view.

Setting:
Mary Jones, single
Take-home pay of $325 per month
Presently living in furnished two-bedroom apartment with a roommate, Karen. Apartment rents for $120 per month. Karen will be married in two months.

Problem:
Mary has to make different housing arrangements. She has looked at various apartments and feel she has three choices:

1. Stay in her present apartment and try to find another girl to move in with her.
2. Rent an unfurnished one-bedroom apartment for $75 per month (not including utilities) and start buying some furniture.
3. Rent a furnished one-bedroom apartment for $85.

If you were Mary, which of these solutions would you choose? Support your choice.

HOUSING AND HOME FURNISHINGS

TO THE TEACHER:

The following evaluation device was designed as a motivational technique and/or pretest. Used as a motivational technique, a discussion of the functions of a home could follow the use of the device. As a pretest, the teacher could ascertain what the student knew about the functions of a home.

OBJECTIVE:

The student will be able to relate some of the functions of a home by analyzing what her own home provides for her.

DIRECTIONS:

In the space provided, write the answer to the following question:

What does your home provide for you?

There are no right or wrong answers. (Do not confuse home with house and/or the people in the house. Both of these make a home.)

CHECKING THE DEVICE:

Device may be checked using the following functions of a home as criteria.

social needs	safety	work
privacy	comfort	family headquarters
security	shelter	self-expression

OBJECTIVE:

To develop an understanding of basic art principles that apply to home furnishings and housing.

SPECIFIC GOALS:

1. The student will identify the hues that compose the classifications of color (primary, secondary, and intermediate) and place them in proper sequence so as to form a color chart.

2. The student will identify the standard color harmonies from examples of color schemes.

3. The student will find pictures of interior designs which illustrate the principles of proportion, balance, rhythm and emphasis in the arrangement of furniture.

4. The student will analyze the relationship between the principles of design and color.

HOUSING AND HOME FURNISHINGS

TO THE TEACHER:

The following evaluation device was designed to be used after there have been classroom learning experiences on color and design principles as related to interior design.

For the first two items of the evaluation device, cut-out sections of hues which constitute a basic color wheel are needed. For the final three items, the following illustrations are needed:

For Item 10, a room in which the use of color gives the room an appearance of spaciousness;

For Item 11, a room with an adjacent, complementary or triad color scheme which would appear more spacious if colors were changed.

For Item 12, a room with a monochromatic color scheme which would appear more spacious if colors were changed.

These pictures may be shown to the total class by use of an opaque projector. Some filmstrips and slides contain illustrations which could be used.

BEHAVIORAL OBJECTIVE:

The student will identify the hues that compose the classifications of color (primary, secondary, and intermediate) and place them in proper sequence so as to form a color chart.

Item 1. Directions: From the collection on the table, choose a primary hue and place it in the proper position on the color chart.

Item 2. Directions: From the same collection, choose a secondary hue and place it in the proper position on the color chart.

Item 3. Directions: Identify the intermediate hue that should be placed in the position designated by the teacher.

BEHAVIORAL OBJECTIVE:

The student will identify the standard color harmonies from examples of color schemes.

Item 4. I have selected the hues yellow, blue, and red for my den.
Which standard color harmony have I used?

Item 5. Mary recently redecorated her bedroom. The walls in her room are rose. She chose a geometric print of rose and green for her bedspread and draperies.
Which standard color harmony did Mary use?

Item 6. The Smiths have chosen to use blue draperies in their living room which has green walls and blue and green floral upholstry.
What color harmony did the Smiths use?

BEHAVIORAL OBJECTIVE:

The student will analyze the relationship between the principles of design and color.

Item 7. I have decided to derive the color scheme for my room from the hues that appear in my draperies, gold and green on a white background.
How can I achieve rhythm within my room through the use of color?

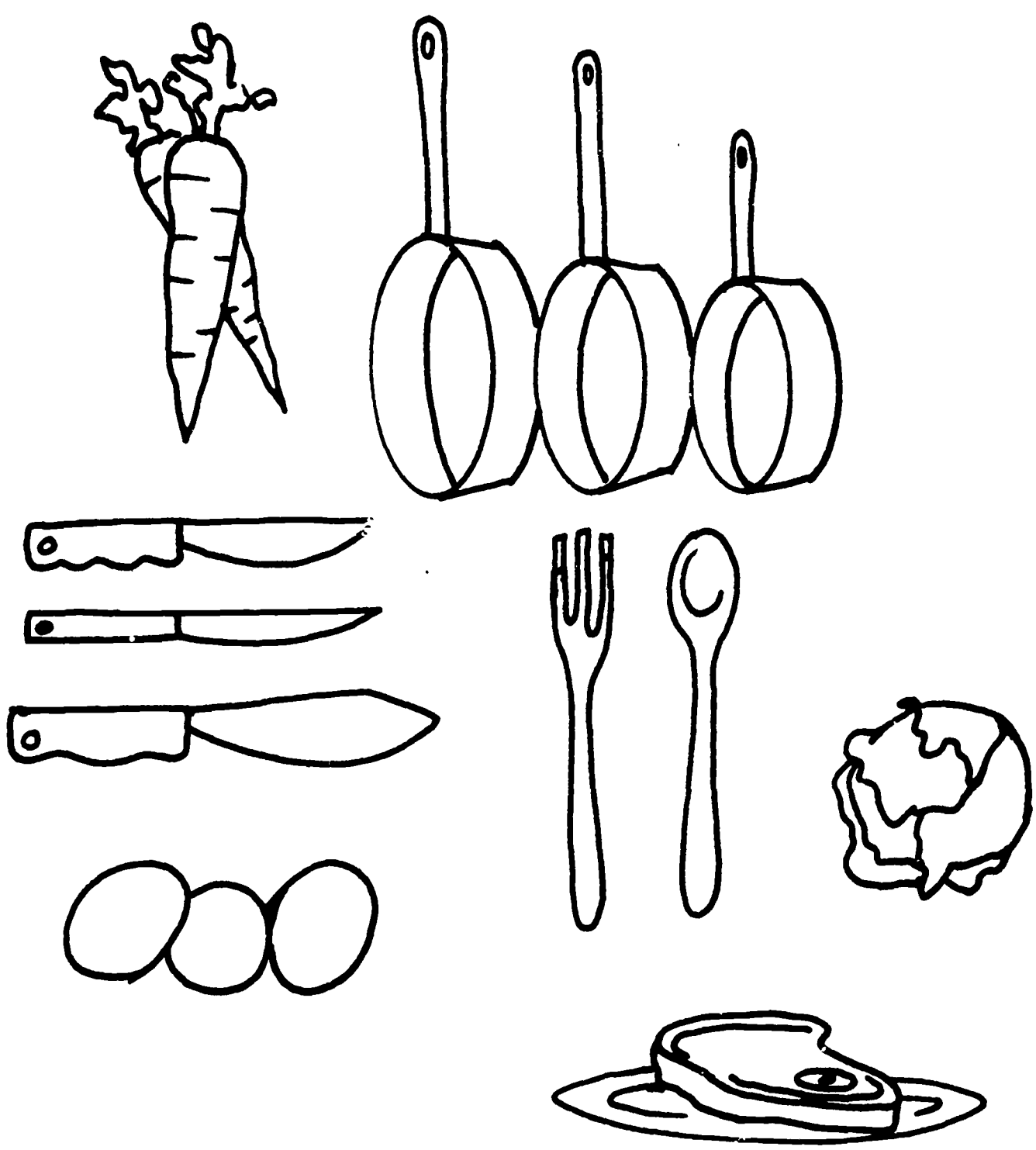
Item 8. How may the principle of emphasis be applied through the use of color in a room in which the larger areas, such as the walls and floor covering, are light and dull green?

Item 9. The living area in my home has varying shades of brown with one chair upholstered in orange. How can I achieve balance through the use of color?

Item 10. Analyze the color elements in this picture which make it appear spacious.

Item 11. In this picture tell what could be done with color to make the room appear more spacious.

Item 12. This picture has a monochromatic scheme. What could be done to make the room appear more spacious?



FOOD AND NUTRITION

ERIC

FOOD AND NUTRITION

BEHAVIORAL OBJECTIVE:

When given statements of etiquette rules for meals, the student will be able to:

(a) determine if the statement is true or false.
(b) change false statements to make them true.

DIRECTIONS:

Determine whether each of the following statements is true or false. If the statement is true, write true in the blank preceding the statement. If the statement is false, write the word or words that, when substituted for the underlined word or words, will make the statement true. Write the correction over the underlined portion of the statement.

_____1. The basis of good manners is consideration for <u>others</u>.

_____2. The <u>host or hostess</u> is responsible for conversation at the table.

_____3. The <u>invited guest</u> decides where he or she will sit at the table.

_____4. <u>Special guests</u> and <u>younger</u> members of the group enter the dining area first.

_____5. When not in use, the hands are <u>rested on the edge of the table</u>.

_____6. Keep feet <u>on the floor</u> while seated at the table.

_____7. Begin eating <u>as soon as you are served</u>.

_____8. Unfold the napkin and place it in your lap <u>after</u> the hostess has placed her napkin in her lap.

_____9. After the meal, the napkin is placed casually to the <u>right</u> of the cover.

_____10. The napkin <u>is not</u> refolded before being placed at the end of the meal.

_____11. When passing serving dishes, the handle is toward the person who is passing the dish.

_____12. Dip the spoon away from you when eating soup.

_____13. If there is no under plate for soups, salads, etc., place the utensils on the table after they have been used.

_____14. Bread, nuts and celery are eaten with the fingers.

_____15. When refusing a second serving of food, say "I'm full."

_____16. The mouth is closed when chewing.

_____17. If a food or beverage is too hot to eat, wait until it cools.

_____18. When eating, lower your head to the food.

_____19. When using glasses, grasp them at the base.

_____20. Break bread into small portions for eating.

FOOD AND NUTRITION

OBJECTIVE:

Plan economically and nutritionally for the purchase of family food.

SPECIFIC GOALS:

The student will:

A. Identify the forms in which the food being studied is available.

B. Compare the cost of the different forms of each food.

C. Identify the basic food group to which each food belongs.

D. List qualities to look for when buying each food.

E. List the methods for caring and storing for each food.

TO THE TEACHER:

The following evaluation device can be adapted for all levels of homemaking and family living. The teacher should supply a list of foods--fresh, frozen, canned, dried--from the foods which have been studied. If used as a take-home device, the student will be able to look for prices of food to determine cost per serving; otherwise, a price list needs to be supplied or the cost column needs to be eliminated.

GUIDE FOR STUDYING FOODS

Name of Food	Forms in Which Food is Available	Cost of Food in Each Form Per Serving	Basic Food Group	What to Look for When Buying the Food	Ways to Care for and Store the Food in the Home

FOOD AND NUTRITION

BEHAVIORAL OBJECTIVE:

The student will prepare specified vegetables using procedures which help to retain the most nutritive value.

TYPE OF EVALUATION:

Performance Test

DIRECTIONS:

On the supply table are two different vegetables, potatoes and carrots. Prepare and serve each of them using procedures which will result in the vegetables retaining the greatest amount of nutritive value. Prepare the carrots once for serving raw and once for serving cooked. (Total number of preparations for carrots and potatoes is three.)

SCORE CARD

SCORING:

The foregoing test can be scored using this score card. For example, if the potato is cooked whole and unpeeled with no water, 10 points are given; if the potato is cooked whole and unpeeled with a small amount of water, 9 points are given.

Points	10 9	8 7	6 5	4 3	2 1
POTATO	cooked whole, unpeeled	cooked whole, peeled	peeled, out in quarters	peeled, sliced	peeled, cubed
water added	none / small amt.	none / small amt.	small amt. / large amt.	small amt. / large amt.	small amt. / large amt.
CARROTS (raw)	unpeeled sticks	peeled sticks	unpeeled, thin strips	peeled, thin strips	carrot curls
air exposure	protected from air / not protected	protected from air / not protected	not protected from air / protected	not protected from air / protected	protected / not protected
CARROTS (cooked)	whole, unpeeled	whole, peeled	large pieces, unpeeled	large pieces, peeled or 1 small piece unpeeled	peeled, small pieces of cubes
added while cooking	no fat / fat	no fat / fat	no fat / fat	no fat / fat	no fat / fat

	Yes	No
Were potatoes covered (lid on) during cooking?	____	____
Were carrots covered during cooking?	____	____
Were carrots cooked in small amount of water?	____	____

FOOD AND NUTRITION

BEHAVIORAL OBJECTIVE:

The student will evaluate herself on the planning, preparation and service of a meal.

DIRECTIONS:

Place a check in the appropriate column. The sections for comments are for any further explanation you feel is needed.

	YES	NO	TO SOME EXTENT
I. Plans			
a. Plans complete and checked.			
b. Workable time schedule for each member.			
c. Plans neat, readable, usable.			
d. Recipes studied ahead of time			
Comments:			
II. Personal Appearance			
a. Apron clean and well pressed.			
b. No sweaters or jackets worn during lab.			
c. Hands and nails clean			
d. Good posture.			
e. Hair net worn or hair back out of face.			
Comments:			
III. Preparation of Meal			
a. Equipment and supplies ready.			
b. Followed individual time schedule			

	YES	NO	TO SOME EXTENT
c. Worked quietly and did not visit other kitchens.			
d. Kept kitchen clean and orderly.			
e. Used good working habits: 1. Measured accurately			
2. Used pot holders at the range			
3. Used suitable utensils.			
4. Used time wisely.			
5. Worked cheerfully			
f. Conservative with supplies--did not use too much.			
g. Able to readjust when unforeseen problems arose			
Comments:			
IV. Serving the Meal a. Table correctly set			
b. Attractive flowers or decoration used for centerpiece			
c. Meal served correctly			
d. Good table manners practiced.			
e. Meal served on time			
f. Taste of food was pleasing.			
g. Variety in color, texture and flavor of food. .			
h. Finished on time.			

Comments:

	YES	NO	TO SOME EXTENT
V. Cleaning			
a. Floor clean, swept.			
b. Garbage can empty, cleaned and relined.			
c. Range clean			
d. Cabinets clean, inside and out.			
e. Sink scrubbed with cleanser			
f. Dishes in proper place in cabinets.			
g. Dish towels clean, rinsed and hung up			
h. Table and chairs in order			
i. Kitchen checked by the hostess and checked out with teacher.			

Comments:

FOOD AND NUTRITION

BEHAVIORAL OBJECTIVE:

The student will analyze her eating habits as they relate to everyday life.

TO THE TEACHER:

The following evaluation device was designed as a motivational technique. After the case study has been read, the questions given below should be discussed. The questions listed are only suggestions. Discussion of these questions may lead to analyzing other food and nutrition problems. As study in the area of nutrition proceeds, the students should be better able to analyze other habits such as choice of snacks and likes and dislikes of various foods and food combinations.

PROBLEMS:

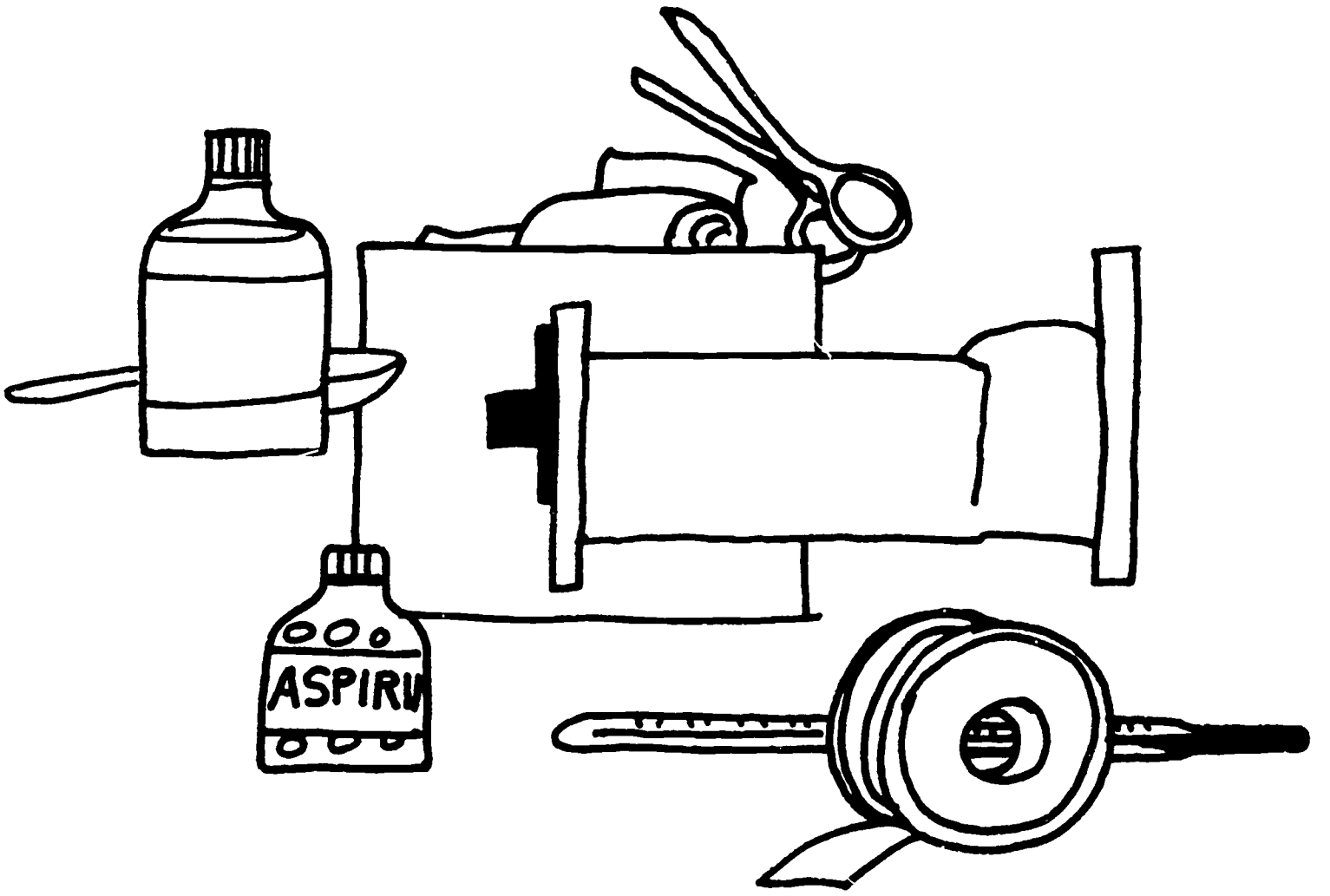
Skipping breakfast

CASE STUDY:

Beth is a ninth grade girl who is slightly overweight. She is well-liked by her classmates. She is always well groomed and attractively dressed. However, she is often so tired and hungry by 4th period (period before lunch) that she isn't as interested and doesn't listen as well as she does in her other classes. Her mother prepares a breakfast of tomato juice, cereal, and coffee or milk and encourages her family to eat it. Beth says she has time only for a cup of coffee and "besides," she says, "it makes me sick to eat more."

SUGGESTED QUESTIONS FOR DISCUSSION:

1. Why does Beth skip breakfast?
2. Are there other reasons that she might have that are not expressed?
3. Is Beth wise to go to school without breakfast?
4. Is skipping breakfast a good way to reduce weight?
5. Do you think there is any relationship between going without breakfast and feeling tired and not interested?
6. Have you ever skipped breakfast?
7. Let's think about your reasons. Are they different from Beth's?
8. Have you always not eaten breakfast?
9. Why do you think you stopped eating breakfast?



HEALTH, SAFETY,

FIRST AID, HOME NURSING

HEALTH, SAFETY, FIRST AID, HOME NURSING

OBJECTIVE:[1] To gain a better understanding of mental health problems and services available.

BEHAVIORAL GOALS:

1. Student will identify symptoms of mental illness.
2. Student will identify fallacies about mental illness.
3. Student will be able to list causes of mental illness.
4. Student will be able to list ways of dealing with mental illness.

CASE STUDY:[2]

Mary Humphrey had long been feeling out of sorts. For some weeks past she had been getting deeper "in the dumps." Then, recently, she had become irritable and on edge. She complained constantly about conditions at the office: the girls she worked with were mean to her; the boss was very unfair. On Sunday she refused to go to church with the family and when they came home, she kept to herself and was inclined to be tearful.

Next morning she did not come down to breakfast. Her mother called her repeatedly. Nothing happened. Finally she went to Mary's room and found her still in bed. When her mother scolded her, Mary began to sob. She said she was sick, but couldn't seem to explain where she felt worse. When Mrs. Humphrey took Mary's temperature and found it normal, she went downstairs completely baffled.

Mary was the chief topic of conversation at breakfast, as you would expect. Mrs. Humphrey announced that she tried to "bring the girl to her senses"--she had even tried slapping her face, but Mary just buried her head under the covers and refused to reply to anything said to her.

Brother Bill had an idea that Mary's boy friend was the cause of trouble. "He's just gotton notice to report for his army physical! And she's worried about all those dames he'll meet in camp."

Mary's sister sniffed. "She's just spoiled," she said. "Mary ought to snap out of it. After what happened to Aunt Hattie at the asylum and

[1]Objective taken from state curriculum guide, Health, First Aid, Home Nursing, Home Economics III, Objective II.

[2]Story taken from "The Mind," Mutual Life Insurance Company, Boston, Mass., 1954.

Uncle Bill with his wild sprees, people might begin to wonder what's wrong with the whole family."

Mary's father knew the cause of her trouble. "She has anemia. She must eat more, especially apples and raw carrots. Apples and carrots will keep anyone healthy."

Grandma then added her opinion. "A million girls have similar problems," she argued. "Mary is just the one in a million who can't take it. If you ask my advice (though nobody had) Mary needs a good talking to!" Grandma would be glad to oblige.

Mother Humphrey's sister, Martha, phoned right after breakfast. She also had a theory: Mary was over-worked and should get away. Aunt Martha was going to Florida and offered to take Mary with her for a couple of weeks. To Mary's mother this seemed like an act of Providence; all their problems would then be solved.

But Mary's difficulties were not solved, for she refused to consider Florida. Neither was her sister, her brother, her father, nor her grandmother on the right track. None of the homemade remedies they suggested could cure Mary. For Mary was sick!

BEHAVIORAL GOAL:

1. Student will identify symptoms of mental illness.

List the symptoms of mental illness which Mary has displayed.

BEHAVIORAL GOAL:

2. Student will identify fallacies about mental illness.

List three fallacies in the family's discussion of Mary's illness and how it may be cured. Beside each fallacy listed, list the fact that makes it fallacy.

BEHAVIORAL GOAL:

3. Student will be able to list causes of mental illness.

What are 3 possible causes of Mary's illness?

BEHAVIORAL OBJECTIVE:

4. Student will be able to list ways of dealing with mental illness.

What procedures should Mary's mother follow in helping Mary overcome her illness?

ERIC

HEALTH, SAFETY, FIRST AID, HOME NURSING

OBJECTIVE: To realize that safety is the responsibility of all family members.

BEHAVIORAL GOALS:

1. The student is able to recognize, in a role playing situation, accident prone situations.
2. The student is able to identify, in a role playing situation, family members who did not accept responsibility for keeping their home accident free.

ROLE PLAYING

SITUATION: Many accidents occur in homes because of carelessness. These could, in many instances, be prevented by family members accepting their responsibilities.

CHARACTERS: Dad, Mother, Bob (age 15), Ann (age 13), Baby (age 2½). Place labels on each character and use simple props.

SPECIFIC PROBLEM SETTING: (each student will have a copy)

The time is 5:30 in the afternoon. Mother comes from the grocery store and places the supplies on the cabinet. Dad calls mother to bring the gasoline that goes in the lawn mower. Ann quits sewing to begin preparation on dinner. The telephone rings, Ann answers, it's for Bob who is out burning trash. Baby is having a "ball" doing as she pleases.

DIRECTIONS TO PARTICIPANTS: Pretend and carefully act out as many accidents as you think might occur in this situation.

DIRECTIONS TO OBSERVERS: Make a list of all the accidents you see happen in the role playing. (Teacher make a list, too.)

DIRECTIONS TO TEACHER: At the end of the drama compare the students' lists and teacher's list--use as a summary and make a list on the board. To obtain evidence that the students realize the responsibility of the whole family for making the home a safe place for everyone, give them the following five questions. (Use the check list below to evaluate their answers.)

Questions for Participants and Observers.

DIRECTIONS: Answer the following questions as best you can.

1. If the baby was accidentally burned, who might have been responsible? Why? Would there be more than one person responsible?

2. What accidents could happen if the grocery supplies were not put away immediately? Who do you think should have put the supplies away?

3. Omitting the accidents we have already mentioned, can you think of any others which might have occured because someone was careless? Who could have prevented these accidents?

4. Can you think of accidents that have happened in your home that could have been prevented? Name them. Who might have prevented them? (This question may be used as a pre-test before the drama. It may prove interesting to compare the answers obtained before and after the role playing.)

5. What are you going to do as a family member to make it safer at home and at school?

CHECK LIST

NAME	WAS AWARE OF ACCIDENT PRONE SITUATIONS			RECOGNIZED RESPONSIBILITIES OF VARIOUS FAMILY MEMBERS TO PREVENT ACCIDENTS			
	Many	Some	None	In most instances	In some instances	In few instances	Not at all

HEALTH, SAFETY, FIRST AID, HOME NURSING

UNIT: HEALTH AND HOME NURSING*

BEHAVIORAL OBJECTIVE: The student will demonstrate her ability to perform home nursing skills.

DIRECTIONS: Today we will have a practical test. Draw a slip of paper and follow the instructions given with no help from anyone. If your task requires a patient, you may choose any class member to assist you as your patient. As you perform the task, tell orally what you are doing.

HOME NURSING SKILLS:

Wash the hands (as you would before and after giving care to a patient.)

Take an oral temperature.

Cleanse a thermometer (as you would before and after taking a patient's temperature.)

Take a pulse.

Count respiration.

Make a bed (without a patient in it.)

Make a bed with a patient in it.

Assist a patient into a chair.

DIRECTIONS TO TEACHER: Have students evaluate themselves after the task is completed. Teacher may use same device or other more specific evaluative devices.

EVALUATING YOURSELF ON THE TASK PERFORMED

DIRECTIONS: Score yourself on each of the following items after you have completed your home nursing skill. Score in the following way:

4 = excellent (Did this throughout the task)
3 = good (Did this during most of the task)
2 = fair (Did this during part of the task)
1 = poor (Did not do this at all)

		MY SCORE
1.	Showed confidence in self	
2.	Used correct procedures	
3.	Procedure was carried out using good time and energy management	
4.	Correct supplies used	
5.	Gave adequate oral account of task	
6.	Completed all parts of task	
	Total	
	Average Score	

*Same type of test could be used with first aid procedures.

HEALTH, SAFETY, FIRST AID, HOME NURSING

BEHAVIORAL OBJECTIVE:

The student will give her ideas on what home nursing involves.

DIRECTIONS TO TEACHER:

This device could be used as a pre-test and post-test. Standards need to be set for grading when used as post-test.

DIRECTIONS:

Answer the following questions.

CASE PROBLEM ONE:

You are in bed with the flu. List all the things your family could do to make you as comfortable as possible.

CASE PROBLEM TWO:

Someone in your family has been in the hospital for a few days for an operation and is now recuperating at home. Complete bed rest is prescribed for three days. What help can you give this person while in bed and after he is allowed to get up for short periods of time?

HEALTH, SAFETY, FIRST AID, HOME NURSING

BEHAVIORAL OBJECTIVE:

The student will give suggestions for solving health problems.

DIRECTIONS:

Answer the questions in the spaces provided.

A. Sue is having a problem with her complexion. Although she cleans her face regularly, she still has many blemishes. What other health practices would you advise for Sue?

If Sue's condition persists after she has followed the health practices you recommend, what should she do?

B. Mary could be a very attractive girl--she is always well groomed; but Mary has sloping shoulders. What do you think has caused Mary's shoulders to slope?

Can the situation be remedied? If so, how? If not, why?

C. Tom is a high school sophomore, 5 feet 6 inches tall and has an average weight. Because Tom always seems to be tired and listless, his friend Joe suggested that Tom participate in the school athletic program. Tom wants to know how the athletic program will help him. How would you answer Tom's question?

HEALTH, SAFETY, FIRST AID, HOME NURSING

*OBJECTIVE:

To gain some understanding of job opportunities in the area of health.

SPECIFIC BEHAVIORAL GOALS:

1. The student is able to write generalizations relating personal characteristics needed by persons in health careers to the value of having the characteristics.

2. The student will be able to relate orally some of the rewarding features and some of the disadvantages of health careers.

3. The student will be able to tell what opportunities exist for employment in health and health related careers in the community.

4. The student will be able to identify the educational requirements of selected health and health-related jobs.

5. When given a list of jobs in the area of health, the student will be able to supply job descriptions for the job.

EVALUATION DEVICE FOR SPECIFIC BEHAVIORAL GOAL I.

DIRECTIONS:

Listed below are some characteristics which would be desirable for persons to have who choose a career in health. Write five generalizations, using one or more of these characteristics for each generalization, stating why these characteristics would be valuable to persons in health careers.

Example: Characteristics: Calm, composed
Generalization: A calm and composed worker helps patients to feel relaxed and confident in the care they are receiving.

CHARACTERISTICS:

1. Calm, composed
2. Alert
3. Close observer
4. Concerned with personal advancement
5. Well groomed
6. Genuine interest in people
7. Cheerful
8. Enjoys good physical and mental health
9. Keeps informed on current events in his area of work
10. Accepts responsibility

*Objective taken from state curriculum guide, Health, First Aid, Home Nursing, Homemaking III, Objective IV.

11. A pleasant speaking voice
12. Is confident and able to work well with others
13. Loyal
14. Discharges duties promptly

GENERALIZATIONS:

1.

2.

3.

4.

5.

ERIC

HEALTH, SAFETY, FIRST AID, HOME NURSING

*OBJECTIVE:

To develop some understanding of the importance of making some preparation for disaster.

SPECIFIC BEHAVIORAL GOALS:

1. The student is able to list and describe types of disasters families need to prepare for at home.

2. The student is able to identify service agencies and the services they render in time of disasters.

3. The student is able to tell orally or write the safety measures to take in case of floods, hurricanes, fires, fall-out and electrical storms.

4. The student is able to list the supplies needed for his family in case of disasters.

5. The student can list places in his community that have been designated as civil defense shelters.

EVALUATION DEVICE FOR SPECIFIC BEHAVIORAL GOAL 4

DIRECTIONS:

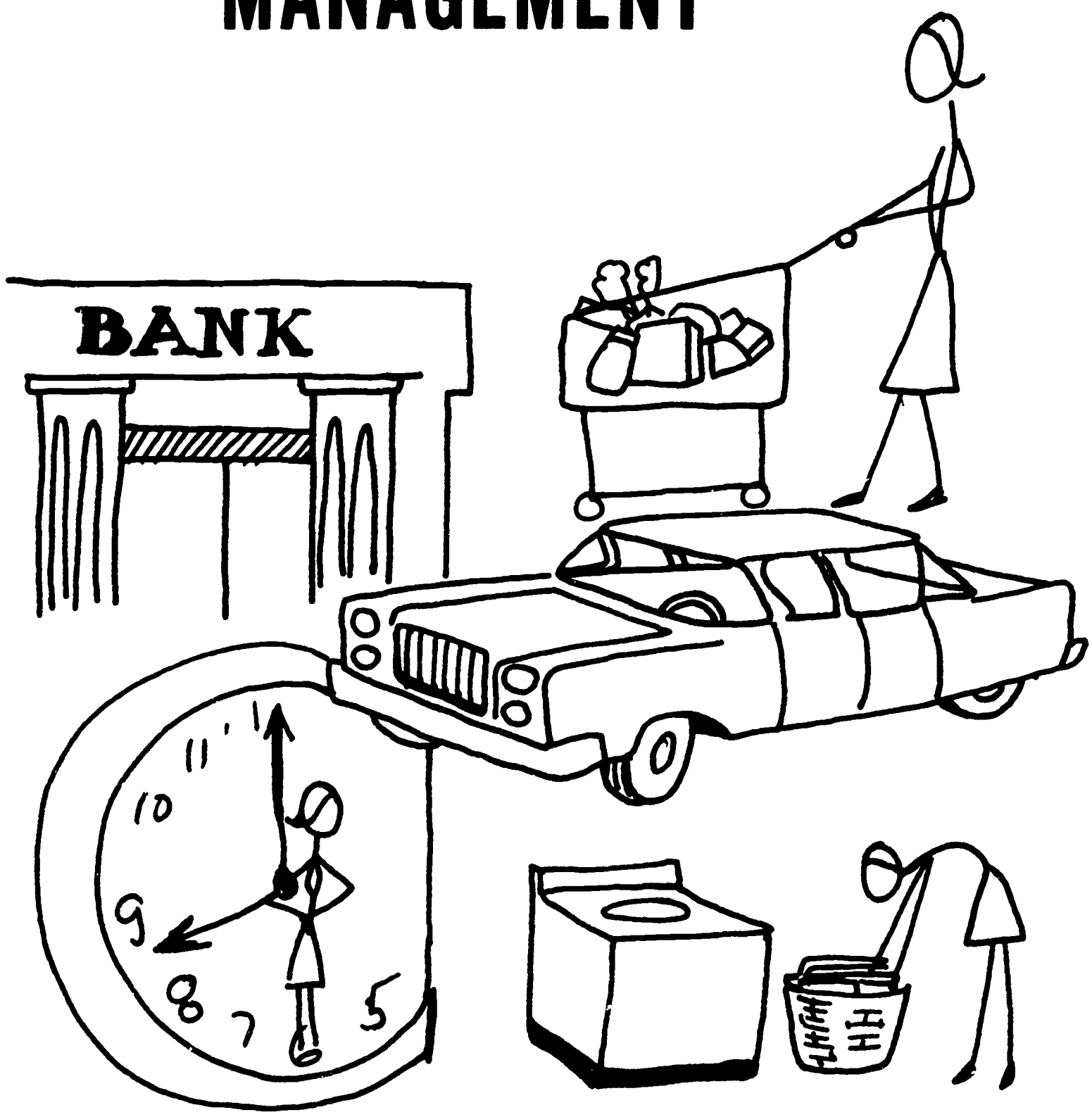
In the space provided, answer the questions about your family. Then, complete the chart below with the necessary items that would be needed by your family in case of a disaster in which your family would need to stay in a storm shelter for a week. Items should be specified as to type and amount.
Example: Water--Drinking, 6 gallons
Personal needs, 20 gallons

Number of family members _____
Ages of family members _____
Special needs of any family members:

*Objective taken from state curriculum guide, Health, First Aid, Home Nursing, Home Economics III, Objective III.

WATER	FOOD AND COOKING EQUIPMENT	FUEL	CLOTHING	SANITATION	RECREATION	MEDICAL SUPPLIES

MANAGEMENT



MANAGEMENT

BEHAVIORAL OBJECTIVE:

The student will identify, in a case study, decision-making activities and the alternatives considered in making the decision.

TO THE TEACHER:

This test was designed to be given after discussion of management as a decision-making activity.

DIRECTIONS:

In the following episode draw a line under any situation which shows that a decision-making activity has taken place. Beside each situation underlined, write in the space on the right two alternatives that were considered before making the decision.

Mr. Smith, approaching the kitchen, could smell the aromas of the breakfast his wife has prepared. He hoped that the meal included his favorite cheese omelet, with which Mrs. Smith sometimes surprised him, rather than the usual scrambled egg. However, as he opened the door he saw that a scrambled egg had been placed on his plate. As he sat down he wondered if he should wait on the children before

beginning to eat. Since he was rather hungry, he lifted his fork and began his meal. Picking up the newspaper beside his plate, he noticed the headlines, but turned then to the section containing the business reports. Seeing that his stocks had risen three points he remarked to Mrs. Smith that he thought it would be profitable to buy another two shares, an idea with which she agreed. The children had arrived now. Jim, the older, had hardly begun to eat before he began telling his father that he simply must have fifty cents to buy a new notebook. Mr. Smith reminded Jim of the allowance they had both agreed upon for him and that it included school supplies. Jim shrugged his shoulders and mumbled something about not knowing whether his notebook would last another week or not. Mr. Smith glanced at his watch, and seeing that he had a couple of minutes before time to leave for work,

turned to the sports page. After everyone was gone, Mrs. Smith looked at the untidy kitchen and started to stack the dishes. Looking through the window she saw that Mrs. Andrews, her neighbor, was hanging out clothes. Leaving the dishes until later in the morning, Mrs. Smith walked outside to chat with Mrs. Andrews.

CHECKING THE TEST:

There are seven situations which should be underlined in the test:

1. . .a scrambled egg had been placed on his plate.
2. . .he lifted his fork and began his meal.
3. . .turned then to the section containing the business reports.
4. . .an idea with which she agreed.
5. . .reminded Jim of the allowance they had both agreed upon for him and that it included school supplies.
6. . .turned to the sports page.
7. . .walked outside to chat with Mrs. Andrews.

MAMAGEMENT

OBJECTIVE:

To identify methods for saving motion and/or time in housekeeping.

DIRECTIONS:

Each of the following statements saves motion, time, both motion and time or neither motion nor time. Determine what the statement implies. Using this list below, find the letter corresponding to your choice and write it in the blank to the left of the sentence.

A. Saves motion
B. Saves time
C. Saves both motion and time
D, Saves neither motion nor time

_____1. Two hands are better than one for washing windows and dusting.

_____2. Have a place to keep all cleaning tools and supplies.

_____3. Wash dishes after each meal.

_____4. Work out a routine for frequently performed jobs.

_____5. The time allowed for any task should provide for doing it at a normal rate of speed.

_____6. Develop standardized procedures for making various food products.

_____7. Continuous curved movements are more economical than straight-line movements in changing directions.

_____8. Work should proceed in a straight line; retracing steps back and forth should be reduced.

_____9. Set a standard for the appearance of the inside of a house.

____10. Use easy-to-clean fabrics where it is possible.

Key: 1. B; 2. C; 3. D; 4. C; 5. A; 6. C; 7. A; 8. C; 9. C; 10. C.

MANAGEMENT

I. BEHAVIORAL OBJECTIVE:

The student will answer questions identifying activities which contribute to the effective use of time and energy.

DIRECTIONS TO THE STUDENT:

In the blank to the right of each question, write yes or no.

1. Do we use energy when we rest or sleep? _____
2. Do all people have an equal amount of energy? _____
3. Do emotional problems cause fatigue? _____
4. Is feeling tired a sign of fatigue? _____
5. Is height of working surface related to fatigue? _____
6. Is it unnatural to become tired? _____
7. Are tiredness and fatigue the same thing? _____
8. Is feeling short of time an unusual experience? _____
9. Does a time plan need to be flexible? _____
10. Are elaborate time plans more workable than simple ones? _____
11. Does posture affect your energy supply? _____
12. Does walking require more energy than running? _____
13. If you divide a load in two parts, is it harder to carry? _____
14. In stacking, are items stacked from the bottom? _____
15. Are opposite items stacked together? _____
16. Does the use of drawer dividers save time? _____
17. Are functional homes and home with conveniences the same? _____
18. Is leisure time included in a time plan? _____
19. Are leisure and loafing the same? _____
20. Is overmanagement of time and energy possible? _____

II. BEHAVIORAL GOAL:

The student will be able to analyze a stiuation involving use or lack of use of management principles and identify the principle which was used or should have been used.

DIRECTIONS:

Read carefully the incident below. In the blanks beside each sentence write the number of the principle of management listed below which Jane used or which she should have used.

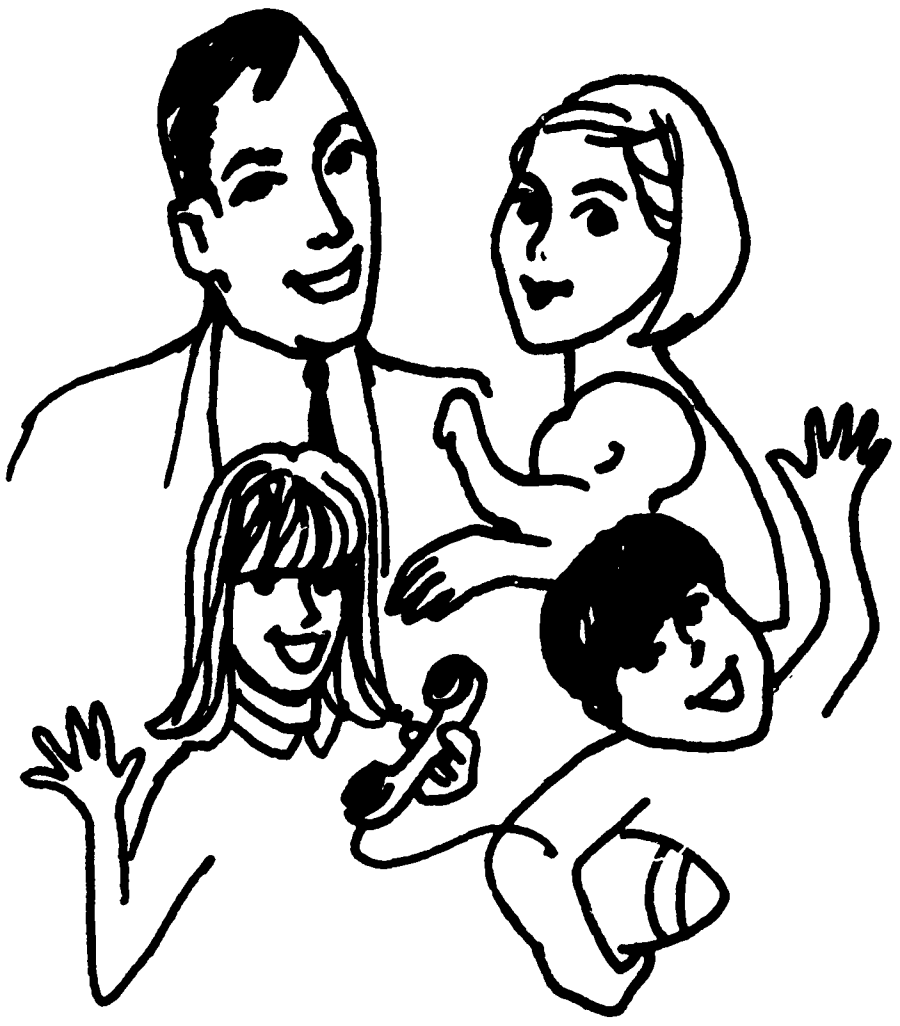
_____Jane rushed into her home economics class just as the bell rang.

_____She dropped her books on a table and rushed to get her sewing box. _____Then she took her supplies to the table, put them down, gathered her books and took them to the shelf near the door where she came in. _____Going back to the table, she laid her various blouse pieces on the table, looked for her guide sheet and finally found it in the pattern envelope. _____Looking around to see what the other pupils were doing and seeing everyone busy, she raised her hand to ask the teacher what she should do now but the teacher was busy. _____Jane searched in her guide sheet for help. _____Sue, her partner reminded her of their decision the day before to let Jane use the sewing machine the first half of the period. _____Jane gathered up her blouse pieces, guide sheet, and thread and went to the machine. _____She returned to the table and picked up her bobbin and pin cushion. _____After picking out the two pieces of her blouse that she needed, she sewed a seam. _____Then she returned to her table to get her scissors. _____Sue reminded Jane that she has used her share of the time at the machine and that she was ready to use it for the rest of the period.*

*Story above adapted from Evaluation in Home Economics, The Indiana Home Economics Association, 1964, p. 57.

1. Make one trip do for two or more.
2. Do one thing at a time.
3. Use both hands.
4. Place items together that are used together.
5. Plan ahead the procedures you will use.
6. Avoid a last minute rush.

ERIC



FAMILY LIVING

ERIC

FAMILY LIVING

BEHAVIORAL OBJECTIVE:

The student will identify factors important in making and keeping friends.

DRAMATIZATION (on tape or acted out by class members):

Helen bursts into a group congregated in the hall.

"Girls! Have you heard the latest?"

Without waiting for a reply, she went on.

"Did you know that the new girl in our Latin class has oodles of money and has always gone to private schools? She won't want to go around with us. They say she's an awful snob, but she's coming to our high school because her parents are divorced and her father won't give her mother any alimony."

After Helen left, one of the girls said, "That Helen! What a cat!. I'm afraid to tell her anything--the way she repeats and exaggerates. I though that new girl seemed very friendly."

ITEMS:

1. What factor of friendship is Helen ignoring?
2. Do others really like people who gossip? Why?
3. One of the reasons people gossip is that it makes them feel important. What are ways that a person can feel important without having to gossip?
4. Other than feeling important, what are other reasons that make people gossip?

Other factors relating to making and keeping friends which could be dramatized are:

1. Being a good sport.
2. Accepting people for what they are, not who they are.
3. Good manners.
4. Snobbery
5. Moodiness

FAMILY LIVING

BEHAVIORAL OBJECTIVE:

The student will identify psychological, biological or economic factors which affect older persons in choosing housing facilities.

DIRECTIONS:

Listed below are characteristics which many older people look for in selecting housing facilities. Under each characteristic, list one biological, psychological or economic factor which explains why older persons would desire that characteristic.

1. Quietness

2. Privacy

3. Nearness to relatives, friends

4. Near community facilities (churches, stores, etc.)

5. Inexpensive

6. Single-level

7. Warm climate

ERIC

FAMILY LIVING

OBJECTIVE:

To help students gain an understanding of themselves in relation to their friends, acquaintances and family.*

BEHAVIORAL GOALS:

1. The student will identify from case studies, family members who have not accepted their responsibilities and the effects of the failure to accept responsibility on other family members.

2. The student will analyze family responsibilities and suggest ways in which the responsibilities can be fairly divided among family members.

3. The student will be able to list reasons why the responsibilities of family members may vary from one family to another.

4. The student will write a report on a person he or she admires, giving reasons for admiring that person.

5. The student will analyze relationships with friends and list the responsibilities one accepts in friendships.

*Objective taken from state curriculum guide, Family Living, Understanding Ourselves and Others, Objective I.

BEHAVIORAL GOAL:

The student will analyze family responsibilities and suggest ways in which the responsibilities can be fairly divided among family members.

SITUATION:

John and Sue Smith are a married couple living in a small town. They have four children--Bill, 16; Mary, 13; Jimmy, 11; and Susan, 5. Both John and Sue work outside the home.

DIRECTIONS:

The Smiths are trying to work out a plan in which everyone will share in carrying out the regularly occuring household tasks. Beneath each of the tasks listed below write the name of the person or persons you feel should assume responsibility for that task.

1. Plan family meals
2. Prepare family meals
3. Wash dishes
4. Empty garbage
5. Make up beds
6. Feed the dog
7. Wash the family car
8. Mow the lawn
9. Clean the bathroom
10. Clean the floors
11. Dust furniture
12. Pick up magazines, newspapers, etc.
13. Wash clothes
14. Hand out clothes
15. Sweep the porch

If Bill is on the school baseball team, do you feel there should be any changes in the responsibilities he assumes?

What changes, if any, do you feel should be made if Sue Smith stopped working outside the home and became a full-time homemaker?

Jimmy has just gotten a job delivering papers. Should he be relieved of his responsibilities? Why or why not?

When Mr. and Mrs. Smith go out in the evening, who do you feel should assume responsibility for the care of the younger children?

EVALUATING PHASES OF THE HOME ECONOMICS PROGRAM

HOME EXPERIENCES

THE ADULT PROGRAM

THE SUMMER PROGRAM

THE DAY SCHOOL PROGRAM

HOME EXPERIENCES

Home experiences are an integral part of home economics through which classroom learnings are supplemented. Home experiences have three phases--planning the experience, carrying out the experience and evaluating the experience. Although the focus of the experience is on the student, parents and teachers need to participate in all phases. Evaluation needs to be a part of the home experience from beginning to end.

HOME EXPERIENCES

The following evaluative device was designed for a "progress check" on the home experience. Either parents, student, or teacher could use the device. A progress check can be made at any time during the project. If the student appears to be having difficulty, a progress check in the early phases of the project is recommended. If the device shows that the student is having problems with the project, a conference should be scheduled to discuss how the problems may be solved.

NAME OF STUDENT _____

TITLE OR BRIEF DESCRIPTION OF PROJECT _____

_____

_____

DIRECTIONS: Answer the following questions concerning the home experience on which work is being done at the present time.

1. Is there continuing interest in the project? _____ YES
   _____ NO

2. Have problems arisen? _____ YES
   _____ NO

3. Have parents' and/or teacher's help been sought in helping to solve problems? _____ YES
   _____ NO

4. Have the plans been workable? _____ YES
   _____ NO

5. At this time is the project costing what it should according to plans? _____ YES
   _____ NO

6. Does the project appear to be too easy or too difficult? _____ YES
   _____ NO

7. Have the time plans been realistic? _____ YES
   _____ NO

8. Have there been any complaints about the project? _____ YES
   _____ NO

9. Do you feel that any changes need to be made on the project? _____ YES
   _____ NO

HOME EXPERIENCES

The following evaluative device was designed for use by the student upon completion of her home experience.

NAME _____

HOME EXPERIENCE (brief description or title) _____

_____

_____

DIRECTIONS: Answer the following questions which are related to the home experience you have completed.

1. Why did you choose the project?

2. Did you make a plan for

   _____ all of your work?
   _____ part of your work?
   _____ none of your work?

3. Did you follow the plans?

   _____ all the time
   _____ sometimes
   _____ not at all

4. Was your plan written or mental?

5. Did you finish all of your work? Were you satisfied with the work done? If not, why?

6. What is one idea or skill you learned that you did not know before working on the project?

7. Do you feel you can use what you learned from the home experience? If so, how will you use it?

8. (a) Do you feel the home experience was valuable to members of your family? If so, how?

   (b) Did the members of your family feel the home experience was beneficial to you and them? How do you know how they felt about the project?

9. What changes would you make in the home experience if you were to repeat it?

10. (a) What was the total cost of the project? (Write down the items purchased and cost of each as best you can remember.)

    (b) Did you or your parents feel the project was too expensive?

11. Which of the following statements best describes your feeling about the quality of work you did on the project?

    _____ I am satisfied with the quality of my work.
    _____ I could have done better quality work on some parts of the project.
    _____ I am not satisfied with the quality of work I did on the project.

EVALUATING HOME EXPERIENCES

The following evaluation device was designed for use by the teacher in evaluating each student's home experience.

TEACHER EVALUATION

NAME OF STUDENT _____

BRIEF DESCRIPTION OF PROJECT _____

_____

_____

DIRECTIONS: Circle the number over the phrase or between the phrases which best describes the home experience. Numbers circled between the phrases (2 or 4) indicate that the project is not described totally by one description buy by a combination of two descriptions.

I. Choice of Home Experience

A.

1	2	3	4	5
Directly related to a personal concern or need.		Little need for the project.		Chosen for ease or convenience--not because of need.

B.

1	2	3	4	5
Included opportunities for gaining new learnings and experiences.		Gave little opportunity for gaining new knowledge and experience.		Gave no opportunity for gaining new knowledge and/or experience.

II. Plans for Home Experience

A.

1	2	3	4	5
Planned in relation to ability and experience.		Plans for home experience not wholly realistic in terms of ability and experience.		Plans showed that student did not consider her abilities and past experiences.

B. 1 2 3 4 5

Plans were made cooperatively with parents and teacher.	Student consulted with teacher and parents only briefly concerning her plans.	Student consulted with neither parents or teacher in making her plans.

C. 1 2 3 4 5

All aspects of experience planned before project was begun.	Some aspects of project were not carefully planned.	Plans were not clear or definite and were unorganized.

D. 1 2 3 4 5

Objectives of home experience were clear.	Student was not sure what she wanted to accomplish through the home experience.	Objectives of home experience were not clear.

III. Working on the Home Experience

A. 1 2 3 4 5

Work was carried out according to plan.	Failed to use plan as guide in all phases of her work.	Plans not used at all and project finished late.

B. 1 2 3 4 5

Able to readjust plans when obstacles arose.	"Panicked" when obstacles arose but sought help in readjusting.	"Gave up" when obstacles arose and made no effort to readjust plans.

C. 1 2 3 4 5

Parents and teacher were consulted concerning progress of project.	Parents and teacher were not wholly aware of progress of project.	No progress was reported to parents or teacher during project.

D. 1 2 3 4 5

Work on project provided a challenge to student.	Some of work was challenging.	Student did not appear do be challenged.

E. 1 2 3 4 5

Maintained an interest in her project.	Sometimes seemed bored with project.	Showed no interest in her project or expressed boredom with the project.

F. 1 2 3 4 5

Quality of work was good.	Quality of work was fair.	Quality of work was poor.

G. 1 2 3 4 5

Quality of work was in keeping with student's ability and experience.	Student's background experience and abilities were not used to best or full advantage.	Project was too easy or difficult in consideration of student's background and ability.

H. 1 2 3 4 5

Finished on time and work was done according to time plan.	Finished on time but time plans were not followed.	Not finished on time.

I. 1 2 3 4 5

Cost plans realistic--cost of project was as planned.	Costs not well planned--cost of project was slightly different than had been planned.	Costs not well planned--cost of project totally different from planned cost.

IV. Evaluation of the Project

A. 1 2 3 4 5

Student felt satisfied with the experience chosen and carried out.	Satisfaction appeared to be gained from some areas of work.	Student did not appear to feel any satisfaction from her project.

B. 1 2 3 4 5

Was able to relate written or orally the new experiences gained from the project.	Was able to see only some of the new experiences gained from the project.	Was not able to tell or write any new experiences gained from project.

C. 1 2 3 4 5

Was able to point out mistakes and weaknesses of project and how she could improve.	Realized she made mistakes but hesitated to point them out herself.	Could see no mistakes or weaknesses in plans or work even though there were mistakes or weaknesses.

D. 1 2 3 4 5

Sought opinions of parents and teacher on her project--wanted to know the strengths and weaknesses of her project as seen by them.	Rationalized some of her mistakes and errors when pointed out by others.	Made excuses for errors or mistakes and resented parents or teacher pointing out how project might have been improved.

CRITERIA FOR A GOOD ADULT PROGRAM

	Yes	No	To Some Extent	Does Not Apply
Planning				
A. The Teacher				
1. Finds out the needs and desires of the adults in her community in all areas of home and family living.				
2. Plans classes based on the needs and/or desires of the adults in the community.				
3. Acquaints the public with the class (or with what adult classes are).				
4. Uses an advisory council to help plan her program				
5. Encourages the participation of adults of all ages and all socio-economics levels within the community.				
6. Prepares materials or prepares outline of resources and instructional materials to be used in class				
7. Plans meetings for a time convenient to the adults				
8. Abides by the planning standards set up by home economics supervisors				
9. Sets up lesson topics and methods she will use to carry out the topics.				
10. Has plans approved by school superintendent and district supervisor.				
11. Tries to include all areas of homemaking in planning for adult work.				

	Yes	No	To Some Extent	Does Not Apply
B. The Adult				
1. Lets the teacher know her needs.				
2. Lets the teacher know if she will attend the class (may vary, especially in introductory classes)				
Teaching				
A. The Teacher				
1. Presents the material in an interesting way.				
2. Has "good" teaching materials (clear, interesting, up-to-date and varying types)				
3. Is enthusiastic.				
4. Sees that surroundings and equipment are conducive to good teaching and learning (comfortable physical condition, properly operating equipment, etc.)				
5. Is prepared for each class and has materials and equipment ready for use at class time.				
6. Uses a variety of techniques . .				
7. Uses informal techniques and methods to help adults feel comfortable.				
8. Uses the experiences and abilities of the adults in helping to teach the class and encourages the adults to participate.				
9. Individualizes instruction according to the varying abilities of the class members .				
10. Maintains a good working relationship with adults				

	Yes	No	To Some Extent	Does Not Apply
11. Starts and ends class on time. .				
12. Changes plans as needed according to her group				
B. The Adult 1. Participates in the class discussions.				
2. Attends regularly.				
Follow-up and Evaluation A. The Teacher 1. Lets the public know what has taken place.				
2. Observes level of accomplishment as a basis on which to plan further work and correlating work				
3. Maintains individual contact with adults to observe carry-over in home				
4. Talks with the adults individually to evaluate accomplishments and further needs.				
5. Seeks the adults' opinions on how the class can be improved. .				
6. Observes the reaction of adults to see if new interest is stimulated				

SUMMER PROGRAM

PURPOSE: The following device was designed as a self-evaluation check sheet by teachers who carry out summer programs. All of the activities stated would not be carried out in each community as the types of communities differ along with the needs of community members. Each teacher's main purpose should be to fulfill the particular needs of persons in her community.

OBJECTIVES:

1. To instruct and visit new students and those previously enrolled in home economics.
2. To contribute to the growth of the individual adult and the community.
3. To improve the program of instruction, the department, and teaching aids.
4. To develop and carry out well-planned programs and recreational activities with the F.H.A.
5. To survey the community for job opportunities, individual interest and needs and resource persons.
6. To work with local agencies and faculty members in planning meetings and activities for the men and women of the community.

OBJECTIVE 1: To instruct and visit new students and those previously enrolled in home economics.

_____1. Helped each girl plan home experience.

_____2. Filed complete plans for each girl's home experience.

_____3. Scheduled dates to assist girls with home experience.

_____4. Worked with school guidance counselor to obtain list of girls who signed up to take first year home economics.

_____5. Scheduled dates to visit girls who signed up for first year home economics.

_____6. Encouraged and conducted instructional programs for teenagers.

_____7. Made plans for play school and prepared observation sheets.

_____8. Secured equipment and supplies needed for play schools.

_____9. Prepared sheets giving responsibilities of girls and parents.

OBJECTIVE 2: To contribute to the growth of the individual adult and community.

_____1. Scheduled definite day and hour for adult classes during each week in the summer.

_____2. Announced units to be taught and dates of meetings.

_____3. Prepared and mimeographed materials for adult classes.

_____4. Ordered films for fall and spring adult classes.

_____5. Worked with agriculture teacher and set up schedule for canning in cannery, department or homes.

_____6. Posted canning policies in cannery, school and various places in the community.

_____7. Mailed out letters to school patrons and others giving plans for summer canning.

_____8. Gave students letters to take home to parents giving plans for summer activities.

_____9. Organized meetings in communities served by school and sent patrons purposes, date, time and place of meetings.

____10. Visited in homes of families who haven't participated in the program and informed them of services school has to offer.

____11. Worked out plans with agriculture teacher for summer meetings to be held for both men and women.

____12. Visited homes in community for purpose of studying individual family needs and for organization for groups for next school terms.

____13. Visited families who have been enrolled in adult classes for evaluating and planning additional instruction.

OBJECTIVE 3: To improve the program of instruction, the department, and teaching aids.

_____1. Unit plans for the past year were evaluated.

_____2. Suggestions for home economics offerings were secured from talks with pupils _____ mothers_____ principals _____ superintendent ____.

_____3. Curriculum bulletins were received.

_____4. All out of date illustrative materials was destroyed.

_____5. All advertising material was evaluated and poor material was destroyed.

_____6. All old books were removed from the shelves and destroyed.

_____7. Books ____, films____, slides____, other audio visuals ____ were ordered for day school classes.

_____8. Mimeographed materials that would fit in with the tentatively planned program were prepared.

_____9. Pre-tests were prepared and mimeographed in some areas.

____10. Home experience record sheets were prepared and mimeographed.

____11. Record sheets for each student were prepared.

____12. Files were brought up to date.

____13. Equipment was prepared.

____14. Equipment was replaced where necessary.

____15. Some improvements were made in the department.

____16. Some real teaching materials were prepared or obtained.

____17. Attended and participated in summer conferences and workshops designed for professional improvement of home economics teachers.

____18. The superintendent and the principal were kept informed of all activities of the teacher and the department.

____19. Information as to content of courses in Home Economics and family living was prepared for the Guidance Counselor.

____20. A study was made of graduates and drop outs of the past 5 years to determine their use of the Home Economics courses.

____21. A list of home economics references was made and given to and discussed with the librarian.

____22. Some personal improvement was made through reading, professional organizations, workshops, and conferences.

OBJECTIVE 4: To develop and carry out well-planned programs and recreational activities with the F.H.A.

____1. Monthly program meetings were held. Yes ____ No _____

____2. Monthly meetings were planned before school closed. Yes ____ No ____.

____3. Monthly recreational meetings were held. Yes ____ No ____.

____4. Monthly recreation was planned before school closed. Yes ____ No ____.

____5. One recreational activitiy for the community was sponsored by F.H.A.

____6. Committee projects and activities were carried on during the summer.

____7. Business meetings were held by officers and members.

____8. Each committee met and set up goals and activities for the year.

____9. The year book committee completed part of the yearbook during the summer.

____10. A leadership training workshop was held for the officers.

____11. The degree program was supervised during the summer.

____12. A play school for small children was held or some practical experience in understanding children was provided.

____13. Planned summer recreational activities for children in the community.

OBJECTIVE 5: To survey the community for resource people, job opportunities and individual interests and needs.

_____ 1. Surveyed employment opportunities within the geographic area and need for organizing home economics occupational classes.

_____2. Surveyed opportunities for job observation and work experience.

_____3. Surveyed pupils for interest in courses and aptitude for training.

_____4. Contacted and listed resource persons available in the area.

_____5. Surveyed the community to determine if there were people with special homemaking needs (persons on food stamp program, living in low-rent housing developments, with physical handicaps, with low educational attainment, low income, etc.)

OBJECTIVE 6: To work with local agencies and faculty members in planning meetings and activities for the men and women of the community.

_____1. Planned community meetings of men and women with the agriculture teacher.

_____2. Carried out plans made with the agriculture teacher.

_____3. Held conference with O.E.O.workers to obtain cooperation and suggestions for persons needing instruction.

_____4. Planned and carried out programs using suggestions from O.E.O.

_____5. Contacted Welfare Department for suggested list of persons that need instruction.

_____6. Worked with the County Health Department to obtain list of persons needing instruction.

_____7. Held programs on health using county nurse or doctor as resource person.

_____8. Taught medical self-help courses. (Find out if this can be done.)

_____9. Worked with Health Department in supplying volunteer help by girls in homemaking classes on clinic days.

_____10. Presented public relations programs to local clubs and civic organizations to obtain suggestions and cooperation.

THE DAY-SCHOOL PROGRAM

DIRECTIONS:

Place a check in the column that most nearly describes you as a home economics teacher.

	Always	Some-times	Never
1. Are you and your students prompt?			
2. Are you prepared by having complete			
annual plans?			
unit plans?			
daily plans?			
3. Do you present objectives for the day in each class?			
4. Do students have a part in planning?			
5. Do you know your subject matter thoroughly?			
6. Do you use a wide variety of teaching methods?			
7. Do you use a wide variety of teaching aids?			

6. Approximately how often do you use

	Once a Week	Once a Month	Once a Year	Never Use It
Discussion				
Lecture				
Field trip				
Demonstrations				
Buzz groups				
Committees				
Individual projects				
Panels				
Symposiums				
Laboratories				
Resource persons				
Brainstorming				
Role playing				
Questioning				
Skits or plays				

7. Approximately how often do you use

	Once a Week	Once a Month	Once a Year	Never Use It
Films				
Filmstrips				
Posters				
Bulletin boards				
Records				
Supplementary books				
Booklets and pamphlets				
Constructed tests				
Opaque projection				
Exhibits				
Transparencies				

	Always	Some-times	Never
8. Do you set an example for your students in your personal grooming?- - - - - - - - - - - - - - - - - -			
personality consistency?- - - - - - - - - - - - - -			
tolerant attitude--self control?- - - - - - - - -			
sense of humor? - - - - - - - - - - - - - - - - - -			
example of femininity - - - - - - - - - - - - - - -			
enthusiasm- -			
9. Do you possess the leadership ability to maintain classroom order without being dominant?- - - - - - - - - - - - -			
10. Do you help each individual student feel his sense of worth?			
11. Do you conclude each class period with a summary? - - - - -			
12. Do you help students summarize and make generalizations of important ideas? -			

THE DAY SCHOOL PROGRAM

The following evaluation device is applicable to teachers in all subject matter areas. The device was contributed by Union High School and has been used successfully in the school.

DIRECTIONS:

Rate yourself on the following characteristics. Five (5) indicates an excellent rating; one (1) indicates a poor rating.

I. Routine

1. I arrive at school on time and make necessary preparations for the day's work.	5	4	3	2	1
2. I am prompt in beginning and ending classes, assignments, and other activities.	5	4	3	2	1
3. I am prompt, neat, and accurate in all forms, records, and reports.	5	4	3	2	1
4. I accept and execute all responsibilities promptly.	5	4	3	2	1
5. I check the teachers' bulletin board and other sources of official information daily.	5	4	3	2	1
6. I exercise proper discretion in the care and use of school equipment and materials.	5	4	3	2	1
7. My students and I keep our classroom neat, orderly, and properly ventilated.	5	4	3	2	1

II. Personal Qualities

8. I am physically able to perform my duties without frequent absences or illnesses.	5	4	3	2	1
9. I am emotionally stable to perform my duties with wholesome attitudes toward life and my work.	5	4	3	2	1
10. I am consistently well-groomed and appropriately dressed.	5	4	3	2	1
11. I speak clearly, using good English, in a well-modulated voice.	5	4	3	2	1
12. I avoid conduct that will bring criticism upon me as a member of the teaching profession.	5	4	3	2	1
13. I maintain good relationships with parents and others. I interpret the school's program properly to them.	5	4	3	2	1

III. Teaching Performance

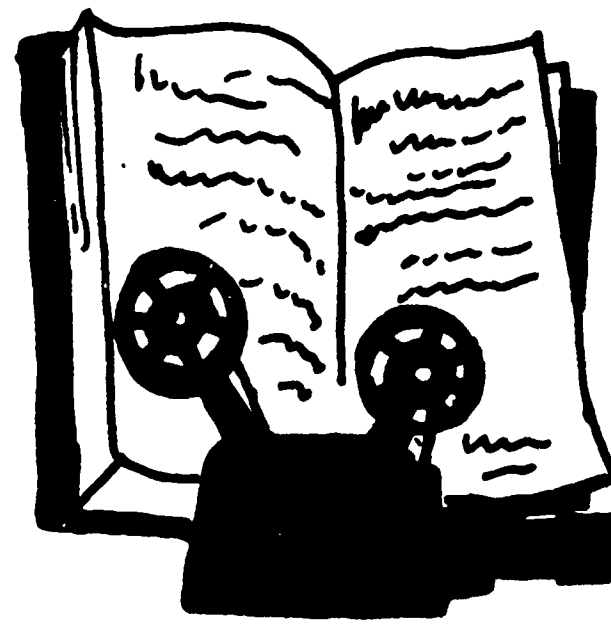
14. I possess a sympathetic understanding of all types of children and I employ it in dealing with them.	5	4	3	2	1
15. I have adequate knowledge of my subject matter area and I employ the skills for the assigned job.	5	4	3	2	1
16. I am familiar with the objectives and the curriculum of my school.	5	4	3	2	1
17. I employ standards commensurate with the abilities and progress of individual pupils.	5	4	3	2	1
18. I study individual students who present problems such as behavior or under-achievement and call in additional help, if necessary.	5	4	3	2	1
19. I make adequate plans and preparation for my classes.	5	4	3	2	1
20. I use a variety of materials and methods to motivate interest, and challenge students.	5	4	3	2	1
21. My students make measurable progress in study habits, skills, knowledge, and appreciations.	5	4	3	2	1
22. I make clear and reasonable classroom and homework assignments.	5	4	3	2	1
23. I consistently evaluate the progress of my students through tests and other means.	5	4	3	2	1
24. I am firm with my students but maintain a positive attitude of praise and encouragement.	5	4	3	2	1

IV. Professional Growth and Performance

25. I am a member of my professional organizations--local, state, and national.	5	4	3	2	1
26. I attend and participate actively in all available professional meetings affecting me and my work.	5	4	3	2	1
27. I regard scheduled non-teaching days as work days for which I am paid. On these days, I am prompt in attending meetings. I listen courteously to proceedings. I participate when necessary and I make professional use of information and materials suggested.	5	4	3	2	1
28. I serve willingly on school and systemwide committees.	5	4	3	2	1

29. I am a member of and I attend PTA meetings in my school as a regular part of my school day.	5	4	3	2	1
30. I have met state professional certification requirements.	5	4	3	2	1
31. I do systematic reading of professional literature and I keep abreast of new developments in my field through additional study.	5	4	3	2	1
32. I am discreet in discussing school problems, school personnel and my students at any time.	5	4	3	2	1
33. I use sick leave and other privileges granted to me as a member of the teaching profession without abuse at any time.	5	4	3	2	1
34. I adhere to the established policies, procedures, and standards of my county school system.	5	4	3	2	1
35. I am proud of my profession and promote respect for it.	5	4	3	2	1

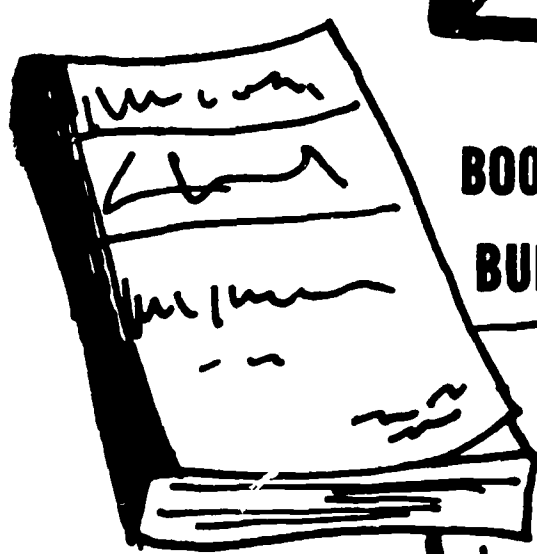
EVALUATING TEACHING RESOURCES

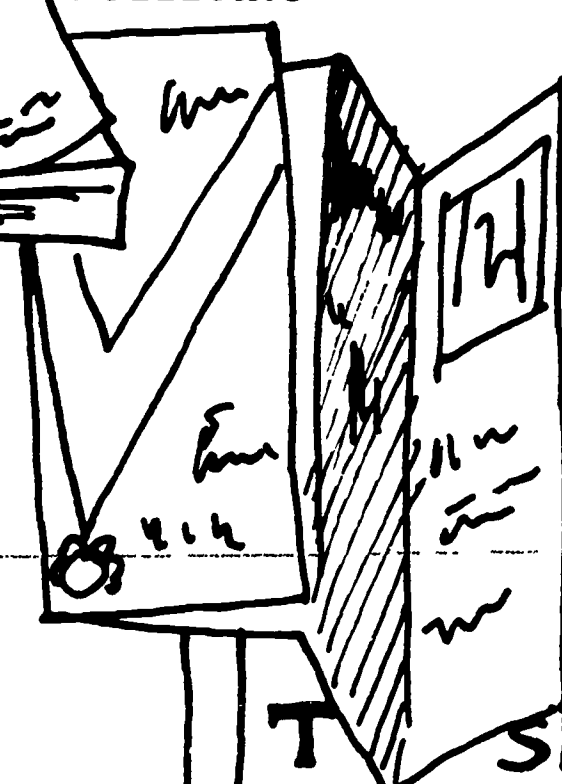


TEXTBOOKS

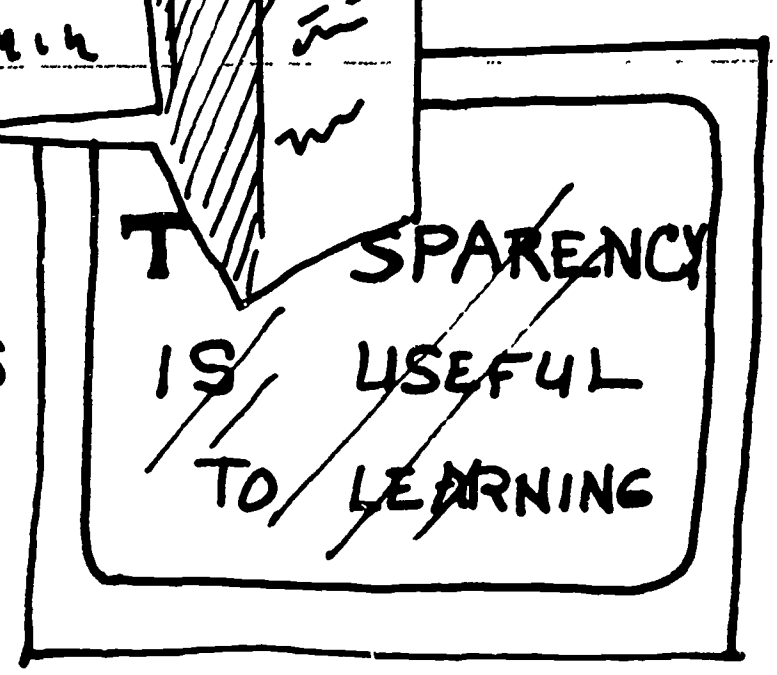
FILMS AND FILMSTRIPS

BOOKLETS, PAMPHLETS, BULLETINS





TRANSPARENCIES



EVALUATING BOOKLETS, PAMPHLETS AND BULLETINS FOR CLASSROOM USE

An overflowing file of booklets, bulletins and pamphlets is not necessarily an indication that a teacher has a wealth of quality instructional materials. In the area of booklets, bulletins and pamphlets, teachers need to be especially discriminating in their choices. Vast quantities of such items are often "free for the asking." Many commercial concerns insert coupons in educational periodicals which enable teachers to conveniently order materials, often free of charge. Many of these bulletins, booklets and pamphlets have little or no value as instructional materials. Consider, for example, a commercial producer who illustrates various ways in which his product can be used. Such information may be "nice to look at," but at the same time, the publisher is "pushing" his product and thereby lessening the quality of his publication for instructional purposes. Also, the generality of the information is limited as a single product only is considered.

However, one needs to realize that without many of the pamphlets, bulletins and leaflets that are used today, teachers would be at a great loss. Many excellent materials are published in these forms by reputable organizations, institutions and business organizations. Textbooks, in an effort to cover broad subject areas, are not always sufficient in depth or breadth to be considered adequate instructional resources. Pamphlets, booklets and bulletins serve as valuable supplementary instructional resources. Quality, not quantity, is the key to the selection of useful instructional material. Affirmative answers to the following questions would indicate that a bulletin, booklet or pamphlet has qualities which would make it useful as instructional material.

1. Does it point out an objective for a course, or can it be used to help fulfill an objective?
2. Is the information accurate, up to date and non-biased?
3. Is the information adaptable to a classroom learning situation?
4. Does it provide additional information rather than duplicating material already on hand?
5. Is the information suitable for the level of students with which it will be used or is it useful as a teacher reference?

EVALUATING FILMS AND FILMSTRIPS

Numerous films and filmstrips on a multitude of topics are readily available to teachers. Various groups such as industry, business, education and government have produced these media. Teachers can now well afford to be selective in their use of films and filmstrips.

Although many film and filmstrip catalogs give brief descriptions of the film content, such information may be insufficient or misleading. In almost all instances, selective use of films and filmstrips requires an actual previewing. Previewing a film or filmstrip for possible use necessitates two showings. The first showing gives one a general look at the content, photography, up-to-dateness, etc. During the second showing, the film or filmstrip should be viewed in terms of how it contributes to the classroom objectives. Teachers may take notes or make a brief outline of the film. Printed evaluation forms may be helpful. The film or filmstrip can be stopped or reversed for examination of specific parts. Such evaluations should be filed for future reference to eliminate repetition in previewing.

Evaluation of a film or filmstrip is not only necessary before the film is shown--evaluation after a showing is also a necessity. The real value of a film or filmstrip lies in its ability to stimulate or help students accomplish learning objectives. Several methods have been used successfully by many teachers to evaluate the effectiveness of films or filmstrips. The method of evaluation should probably be varied according to type of film or content. Generally, taking notes during a showing of films or filmstrips is not desirable. Students become interested in taking written notes and do not give full attention to the total film, thereby missing important points.

SUGGESTED CHECKLIST FOR USE IN PREVIEWING FILMS AND FILMSTRIPS*

TITLE: _____

AVAILABLE FROM: _____

_____

_____

RECOMMENDED PURCHASE OR RE-USE? _____YES _____NO

GRADE LEVELS _____

IS FILM OR FILMSTRIP RELEVANT TO THE LEARNING OBJECTIVES OF THE CLASS?

_____YES _____NO

IS THIS FILM OR FILMSTRIP THE MOST EFFECTIVE MEANS AT MY DISPOSAL FOR HELPING TO ACCOMPLISH THE LEARNING OBJECTIVE? _____YES _____NO

	YES	PARTIALLY	NO
SUBJECT MATTER ACCURATE AND UNBIASED			
UP-TO-DATE.			
SOUND EFFECTS SATISFACTORY.			
PHOTOGRAPHY SATISFACTORY.			
OBVIOUS ADVERTISING OMITTED			
PRESENTS DESIRABLE ATTITUDES. . . .			
OBJECTIVE OF PRESENTATION IS CLEAR.			
INTERESTING			
TOPIC ADEQUATELY COVERED.			

COMMENTS: _____

_____

_____

_____

_____

*SOME ITEMS PERTAIN ONLY TO FILMS HAVING SOUND EFFECTS.

SUGGESTED METHODS FOR EVALUATING FILMS AND FILMSTRIPS

1. Discussion
   Used alone or with other techniques, discussion is a valuable method for film or filmstrip evaluation.

2. Have the students write a short summary of the film or filmstrip, pointing out the main points. Follow the written summaries with a discussion.

3. Before classroom viewing, prepare key questions on the content of film or filmstrip. After classroom viewing, have the students answer the questions and discuss their answers.

4. Have the students criticize the action in the film or filmstrip--verbally or written. Ask the students what changes they would make and why.

5. If a problem is presented, ask the students to tell how they would solve the problem. (Even though the problem may be solved within the film or filmstrip, new solutions may be explored.)

6. Ask the students to describe events which might possibly precede or follow the action in the film or filmstrip.

7. Allow the class members to carry out projects which are sometimes suggested in films or filmstrips.

TEXTBOOKS

Although numerous types of instructional materials have been and continue to be developed, the textbook continues to retain its position as a major instructional resource. Over the years, authors and publishers have been continuous in their efforts to improve textbooks.

Traditionally, home economics has employed many textbooks, rather than adopting a single text for a class. Basically, there are two reasons why the multi-reference approach has been taken:

1. Home economics covers a wide range of subject matter, and one specific text could not suffice for all the needs.
2. Using a number of textbook references gives a wider perspective to the subject matter--gives more ideas and viewpoints. Using one text tends to limit the material covered in class and the depth to which it is covered.

Whether a single text book is adopted as the basic classroom text of the multi-textbook approach is taken, the matter of choosing textbooks for classroom use deserves special consideration. The mere existence of the textbook in a certain area is no insurance that the textbook is a valuable piece of instructional material. Choosing textbooks is a matter which concerns pupils and teachers, as well as administrators.

Many times lists, with specific texts recommended by administrative personnel who take the responsibility for reviewing them, are given to teachers. Still, the teacher herself must decide what importance will be attached to that text in her classroom. When evaluating a text, the following points may need to be considered:

1. Author(s) - Are the authors qualified to write the text?
2. Is the content accurate?
3. Is the content useful to the teacher and her students?
4. Is the content up-to-date?
5. Level of text - Is the text written on a level that makes it readable and usable by the students?
6. If illustrations or photographs are used, are they up to date?
7. Are the illustrations or photographs useful? Do they help in gaining an understanding of the content or make the content more interesting?
8. Are supplementary aids provided? Lists of additional references, generalizations about content, laboratory ideas or questions on the content are very useful to teachers and students.

USING TRANSPARENCIES

In the past decade there have been numerous developments in the area of instructional audio-visuals. Of these, overhead projection has, perhaps, been the most outstanding. The versatility and relative simplicity of overhead projection has contributed to its wide acceptance and use by classroom teachers. Transparencies are available commercially in numerous subject matter areas; and, in addition, many teachers have or are becoming skilled in developing their own transparencies. Whether purchased commercially or hand-made, there are some standards which need to be followed if transparencies are to be effective as classroom teaching aides.

1. Lettering - Make sure the printing can be seen by all students. For the average classroom, 3/16 inch letters are minimum. The larger the classroom, the larger the lettering needs to be. Typical book print or typewriter copy is generally not acceptable for transparencies which will be used in a classroom setting. Spacing of print should enhance easy reading. Lettering which has been squeezed together makes reading difficult.

2. Simplicity - A transparency needs to be kept simple. Students experience difficulty in trying to understand one idea or concept when numerous other ideas are presented simultaneously. For more complex ideas, two or more transparencies may be needed. Over-simplifying is practically impossible.

3. Color - Color generally adds interest, but too much color adds confusion. Color is valuable in emphasizing, differentiating and focusing attention. Lettering, illustrations or background may be colored. Use color wisely for color generally adds cost.

4. Information - Make sure the information and illustrations on the transparency are correct.

5. General appearance - Whether hand made or commercially purchased, a transparency needs to be kept neat and professional looking.

IMPROVING TEACHER MADE TESTS

PREPARING A TEST

ITEM ANALYSIS—A PROCEDURE FOR EVALUATING TEST ITEMS

PREPARING A TEST

Paper and pencil tests are the most often used method for determining student achievement. These tests are generally prepared by the classroom teacher. The following five steps are recommended as procedures for preparing a paper and pencil test: (An illustration showing how these steps were followed for a test on credit is given after the steps.)

Step One: List the major topics covered in the unit or subunit on which you are giving the test and the number of items to be devoted to each. The number of items for each topic is assigned with consideration of the importance given to the topic in the classroom.

Step Two: Under each topic list the information the students will be expected to know, comprehend, apply, analyze, synthesize or evaluate.

Step Three: Based on the behavioral objectives of the class, decide on the type of items you will need. Did the objective state that the student must identify, define, lists, differentiate, judge or construct? Were the learning experiences designed to enable the student to know, comprehend, apply, analyze, synthesize or evaluate? Test items must take into consideration the level of learning which is desired, as stated in the objective and test for learning on that level. (In the illustration given, checks are made under the type of learning to be tested by the items on a specific topic.)

Step Four: Assemble all the materials used for instruction of the unit or subunit. Consider the visuals and audio-visuals used. Notes from class discussions or other class activities should also be part of the information upon which classroom tests are based.

Step Five: Using all of the information from the previous four steps, construct the test.

Test Unit of Subunit: Credit

Class: Family Living

Date of Test: October 15, 1969

No. of Items: 50

TOPICS	NO. OF ITEMS	RECALL	UNDER-STAND	APPLY
Obtaining Credit	15			
Where credit is given		✓		
What can be purchased through credit		✓		
Bases on which credit is given			✓	
Cost of credit				✓
Credit application forms			✓	✓
Types of Credit	20			
Installment credit		✓	✓	✓
Sales credit				
Cash credit				
Noninstallment Credit		✓	✓	✓
Utility bills				
Fees				
Credit cards				
Charge accounts				
Credit Oblications	15			
Payment obligations		✓	✓	
Credit rating			✓	
Garnishment of wages		✓	✓	
Repossession of merchandise		✓	✓	
Claims on personal property		✓		
Bankruptcy		✓		

Step One: List major topics and number of questions for each.

Step Two: List basic information students have studied.

Step Three: Decide on type of items needed.

Step 4: Assemble Materials

Step 5: Construct test

ITEM ANALYSIS - A PROCEDURE FOR EVALUATING TEST ITEMS

The value of a test lies in its ability to do two things:

1. Sample the learnings upon which classroom objectives were based.

2. Distinguish between persons who have and have not changed their ability to know, comprehend, apply, analyze, synthesize or evaluate.

One cannot devise a test and know that it is a valuable instrument. Quite often test results differ from what was expected when the test was constructed. Objective tests, the most often used type of testing device, have a great advantage in their ability to be analyzed. One can determine through relatively simple procedures the value of objective test items. By using item analysis, two pieces of information can be discovered:

1. The index of difficulty - whether the test item was too hard or too easy.

2. The index of discrimination - if the test item distinguished between those who have and have not changed their abilities.

The following initial steps are required for finding either the index of difficulty or the index of discrimination:

1. Score the papers.

2. Rank papers high to low.

3. Divide papers (if small classes, can divide in half, if large classes, take a percentage of the top and bottom group, such as 25%. If there is an uneven number of scores, take out the middle score--for example, if there are 19 students take out the score ranking 10.)

4. Record responses for high scoring and low scoring group (see table).

5. Tally the responses (see table).

The following item analysis is the result of a test of ten objective items to 20 students (10 in each group).

ITEM NUMBER	RECORD OF HIGH GROUP RESPONSES	RECORD OF LOW GROUP RESPONSES	NUMBER OF PERSONS HAVING CORRECT RESPONSE IN HIGH SCORING GROUP	NUMBER OF PERSONS HAVING CORRECT RESPONSE IN LOW SCORING GROUP	HIGH AND LOW	HIGH MINUS LOW	INDEX OF DIFFI-CULTY	INDEX OF DISCRIM-INATION
1			10	10	20	0	1.00	0
2			9	6	15	3	.75	.3
3			7	6	13	1	.65	.1
4			2	1	3	1	.15	.1
5			10	0	10	10	.50	1.0
6			3	9	12	-6	.60	-.6
7			9	7	16	2	.80	.2
8			2	4	6	-2	.30	-.20
9			6	3	9	3	.45	.3
10			8	1	9	7	.45	.7

To determine the index of discrimination:

Divide $\frac{\text{upper-lower}}{\text{number in one group}}$

Examples: Item 1. $\frac{0}{10} = 0$

Item 2. $\frac{3}{10} = .3$

Item 5. $\frac{10}{10} = 1$

Item 8. $\frac{2}{10} = -.20$

Reading results:

Items which have a +.20 value and above are considered to be discriminating. The higher the index, the more discriminating the item. In this test then, the items which discriminate are 2, 7, 9

and 10. Item 5 is the most discriminating item with a discrimination index of 1.0.

A negative value means that the item discriminates but in the wrong direction. This is called negative discrimination and means that more persons in the low scoring group answered the item correctly than in the high scoring group. This means the items are unsatisfactory. For this test, items 6 and 8 discriminate negatively.

To determine the index of difficulty:

Divide $\frac{\text{total number correct (high and low)}}{\text{total number in both groups}}$

Examples: Item 1. $\frac{20}{20} = 1$

Item 2. $\frac{15}{20} = .75$

Item 4. $\frac{3}{20} = .15$

Item 6. $\frac{12}{20} = .60$

Reading results:

If the value obtained is between .20 and .80, the item is considered to have an acceptable level of difficulty. If the value is under .20, the item is too hard; if above .80, the item is too easy.

For this test then, the items which are neither too difficult or too easy are items 2, 3, 5, 6, 7, 8, 9 and 10. Item 1 is too easy; item 4 is too hard.

The same type of analysis is more often used to assess the value of each option of a test item. Suppose, for example, there is a multiple choice item having four options. The analysis data would be recorded for each option and would allow observation of the results obtained for each item. Options not chosen by anyone would probably need to be replaced as well as incorrect options chosen by a larger number.

USING ITEM ANALYSIS TO IMPROVE TESTING

Assuming that an item analysis has been made on a test, how can the teacher use the information?

1. The teacher can identify the students who are having difficulty or areas of difficulty the class as a whole is having,

thereby seeing individuals who need help or areas in which instruction needs to be improved.

2. The teacher can build better tests on the basis of information gained from item analysis.

One procedure for improving testing is the building of a card file of test items. Items found to be adequately discriminating and difficult can be filed for future use. A large number of cards can be prepared for card file use by mimeographing or duplicating methods. These cards contain the test item and the information discovered about that item. Typical cards from such a file might look like the following ones.

ITEM: When buying by the installment plan, the goods purchased are not legally yours until all payments have been made.

(TRUE) FALSE

Date:	2/7/69		
Class:	Home Economics I		
Total Number of Students	30		
Number of Students in Each Analysis Group	10		
Lower (Answering correctly)	10		
Upper (Answering correctly)	5		
Index of Difficulty	.50		
Index of Discrimination	.75		

When analyzing each option, a card from the file might look like this: (The numbers in the upper and lower columns indicate the number of students in each group responding to that option.)

Date	10/12/68					
Class	Home Economics II					
Item No.	18					
Total Number of Students	21					
Number of Students in Each Analysis Group	10					
OPTIONS	UPPER	LOWER	UPPER	LOWER	UPPER	LOWER
A	8	2				
B	9	5				
C	0	0				
D	4	8				
Index of Difficulty	.70					
Index of Discrimination	.40					

ITEM:

The most important factor in disciplining children is

A Leniency
(B) Consistency
C Strictness
D Flexibility

VT 009 973
Phipps, D. Bart
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ABSTRACT - Prepared by a subject matter specialist, this workbook provides basic instruction on refrigeration for use in apprentice training in the plumbing and pipe fitting industry. Contents include information sheets and student assignments for 17 instructional units, including: (1) Basic Principles of Refrigeration, (2) Evaporators, (3) Condensers and Cooling Systems, (4) Motors and Controls, (5) Accessories and Equipment for Refrigeration Systems, (6) Calculating and Installing Refrigeration Piping, (7) Water and Drain Lines, (8) Seasonal Operation and Trouble Analysis, and (9) Common Service Operations. Student progress report sheets are provided for both student and instructor use. The reference to be used with this workbook is "Refrigeration Manual," available from the Trane Company, LaCrosse, Wisconsin, for $2.00. (AW)

VT 009 973

ED0 45856

BASIC REFRIGERATION

for

APPRENTICE TRAINING
in the
PLUMBING AND PIPE FITTING INDUSTRY

Workbook No. 11

Prepared by

D. Bart Phipps, Specialist
Apprentice Training
Plumbing and Pipe Fitting

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for the Plumbing and Pipe Fitting Industry

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The reference for this Packet is Trane - "Refrigeration Manual". This reference must be ordered from The Trane Company, La Crosse, Wiconsin, at the list price of $2.00. In some cases, it may be obtained from local Trane representatives. Other educational material is listed in this Trane manual which will aid in teaching more advanced work.

ERIC

Name_____

BASIC REFRIGERATION

Packet No. 11

STUDENT PROGRESS RECORD
in
BASIC REFRIGERATION FOR APPRENTICE TRAINING
for the
PLUMBING AND PIPE FITTING INDUSTRY

	Information Sheets	Student Assignments	Date Completed
1. Basic Principles of Refrigeration	6 pages	3 pages	
2. Refrigerants	4 pages	4 pages	
3. The Refrigeration Cycle	2 pages	5 pages	
4. Evaporators	none	5 pages	
5. The Compressor	none	3 pages	
6. Condensers and Cooling Systems	none	7 pages	
7. Expansion Valves	none	7 pages	
8. Refrigeration System Control Equipment	none	6 pages	
9. Motors and Controls	none	4 pages	
10. Refrigeration System Control	none	3 pages	
11. Accessories and Equipment for Refrigeration Systems	none	3 pages	
12. Refrigeration Piping Systems	none	11 pages	
13. Calculating and Installing Refrigeration Piping	none	4 pages	
14. Water and Drain Lines	none	6 pages	

(over)

BASIC REFRIGERATION

Packet No. 11

STUDENT PROGRESS RECORD
(continued)

	Information Sheets	Student Assignments	Date Completed
15. Testing, Charging, and Checking the Refrigeration System	none	5 pages	
16. Seasonal Operation and Trouble Analysis	none	4 pages	
17. Common Service Operations	none	4 pages	

NOTE: Green sheet for student's notebook
Gold sheet for instructor's file

Name_____

BASIC REFRIGERATION

Packet No. 11

STUDENT PROGRESS RECORD
in
BASIC REFRIGERATION FOR APPRENTICE TRAINING
for the
PLUMBING AND PIPE FITTING INDUSTRY

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9. Motors and Controls	none	4 pages	
10. Refrigeration System Control	none	3 pages	
11. Accessories and Equipment for Refrigeration Systems	none	3 pages	
12. Refrigeration Piping Systems	none	11 pages	
13. Calculating and Installing Refrigeration Piping	none	4 pages	
14. Water and Drain Lines	none	6 pages	

(over)

BASIC REFRIGERATION

Packet No. 11

STUDENT PROGRESS RECORD
(continued)

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NOTE: Green sheet for student's notebook
Gold sheet for instructor's file

Information Sheet
in
Plumbing and Pipe Fitting

Subject: BASIC PRINCIPLES OF REFRIGERATION

Refrigeration is a process of transferring or removing heat. The removal of heat is accompanied by a reduction of temperature below that of its surrounding environment. To maintain an object at a lower temperature requires the continual removal of heat.

It now becomes necessary to more thoroughly understand what heat is, how heat is measured, how heat is transferred and what heat may be expected to do under definite conditions. It will be helpful for the serviceman to understand these general fundamentals of refrigeration principles.

Heat and Cold

Heat is a form of molecular energy and its intensity is indicated by temperature measurement. Cold is the absence of heat, just as darkness is the absence of light.

Cold is a relative term and hence is not a quantity at all. The quantity of heat present in a given body is determined by the rapidity of movement of molecules in the matter which constitutes the body. Movement of the molecules does not cease until all heat has been removed, and this does not happen until the body has been cooled to 460°F below zero (absolute). On the other hand, if heat is transferred from one body to another, the molecular motion increases. This is indicated by a rise in temperature. When heat is removed from a body, the molecular motion decreases. This is indicated by a drop in temperature. Heat, being a form of energy, can be moved from one place to another but cannot be destroyed.

Heat Transfer

Heat flows from bodies of higher temperature to bodies of lower temperature. When two bodies come into thermal contact, the heat starts to flow until both bodies are the same temperature, and the greater the difference in temperature, the faster the flow of heat. When the temperature is equal there is no heat transfer. Heat can be transferred in one of three different ways, or a combination of the three ways, which are Radiation, Convection, and Conduction.

Radiation is the process of transferring heat through space from one body to another, as from the sun, where no material substance acts as a carrier. Radiant heat passes through transparent substances without heating them, while opaque or dark objects absorb it. Radiant heat travels only in a straight line just as light does and may be reflected from a polished or light colored object. This explains the reason that summer clothes are light and gasoline tanks, metal buildings, etc., are often painted aluminum. For the same reason, aluminum sheets or foil is used for insulation.

Convection is the transfer of heat through fluids, either liquid or gas. For example, the movement of air through a duct is the transfer of heat by convection. The air may be forced by a fan or flow freely due to variations in density caused by difference in temperature.

Convection is the most common operating method of refrigeration evaporators. The heat is transferred by the movement of air or a liquid, such as brine, as it comes in contact with the warmer objects and the colder evaporator. The difference in temperature of the two bodies causes a difference in density which in turn causes the movement of the carrier.

In this method of heat transfer consideration must be given to the flow of the carrier such as cooling air in air conditioning duct or brine in cooling coils. The best heat transfer from one to the other is obtained when the carrier fluid has a free flow with little restriction or resistance to flow.

Conduction is the flow of heat from one part of a body to another part of the same body, or to another body in direct contact -- for example, heat flowing through an iron bar when one end has been heated. Another example would be the flow of heat through the metal of a cooling coil or evaporator. Some materials conduct heat better than others. Conduction is used where rapid heat transfer is desirable, as in a cooling coil or a heat exchanger.

Types of Heat

There are three types of heat that are of interest to the refrigeration man. They are:

1. Sensible heat
2. Latent heat
3. Specific heat

Sensible heat is heat that effects a change in temperature of a body. It may be indicated by a temperature change on a thermometer. Thus the heat required to change one pound of water from 60°F to 70°F is sensible heat.

Latent heat is heat that must be added or removed from a body to cause its change of state without changing its temperature. It cannot be indicated on a thermometer. The heat required to change a pound of ice from 0°F to 32°F is sensible heat. If this pound of ice at 0°F were placed in a room with a temperature slightly higher than 32°F, the ice would melt, thereby changing its state. This change of state takes place at 32°F. The heat required to change its state from 32° ice to 32° water is called its latent heat.

Specific heat is defined as the number of British Thermal Units (abbreviated BTU) that must be removed from, or added to, one pound of a substance to change its temperature one degree Fahrenheit. From the definition of a BTU given above, it can be seen that the specific heat of water is approximately one. It can also be seen that all substances do not have the same specific heat. The specific heat of products or any substance must be known to determine how much heat must be removed to refrigerate various products ranging from eggs, to meat, as well as many other commercial and industrial products.

British Thermal Unit

By definition, the amount of heat required to raise one pound of water 1°F is one British Thermal Unit. As an example, when a pound of water absorbs enough heat to raise its temperature 10°F, it has absorbed 10 BTU of heat. In a like manner, if 10 pounds of water absorbs sufficient heat to raise it 1°F it has absorbed 10 BTU. As water is cooled, the amount of heat released is exactly the same as was required to heat it over the same temperature range. In refrigeration work, one British Thermal Unit has been adopted as a standard of measurement to express the capacity of a given weight of any material to absorb and retain heat under a given temperature increase.

Refrigeration units are sometimes rated according to their capacity for extracting heat units in British Thermal Units. The rating of one ton of refrigeration for a compressor corresponds to the horse power of an engine. This unit (ton) is determined from the heat absorbed during the melting of one ton of ice.

When one pound of ice at 32°F is melted into water at 32°F, 144 BTU of heat is absorbed (latent heat of fusion).

2000 pounds X 144 BTU = 288,000 BTU absorbed per ton of ice in 24 hours

REFRIGERATION

Key: B I - P 11 - 1I
Page 4 of 6

Temperature

Temperature is a measurement of heat intensity. It is not a measure of quantity. Sometimes the two may be confused. This is best illustrated by two bodies having the same temperature, yet due to their volume and specific heat, their heat content in BTU may vary widely. Thus one cubic foot of iron will contain more heat units than one cubic foot of copper, even if both are of the same temperature.

Thermometers

Thermometers are based upon the contraction or expansion of a liquid, with a corresponding decrease or increase in temperature. Mercury has been found the most reliable, since the relation of its rate of expansion and contraction to the intensity of heat is constant over a very wide range.

Two temperature scales are used in modern refrigeration--the Fahrenheit and the Centigrade scales. The Fahrenheit scale is used extensively in the United States and Great Britain, and the Centigrade in other countries. On the Fahrenheit scales, the temperature at which water freezes has been indicated at 32 degrees above zero, and the temperature at which water boils is 212 degrees above zero. Thus 180 degrees represent the difference between the freezing and boiling points of water. On the Centigrade scale the freezing point of water has been indicated at zero degrees and the boiling point of water at 100 degrees above zero, or a difference in temperature of 100 degrees.

It is often necessary to convert Fahrenheit temperatures to Centigrade and vice versa. Formulas have been developed for this purpose based on the fact that the freezing point on the Fahrenheit scale is 32° and on the Centigrade scale is 0° and boiling points are $212^{o}F$ and $100^{o}C$, respectively. There are 180° difference between freezing point and boiling point on the Fahrenheit scale and 100° difference on the Centigrade scale. Therefore, Fahrenheit is 180/100; 1.8 or 9/5 of Centigrade + 32.

Remember that to convert Fahrenheit to Centigrade, 32° must be subtracted in order to begin the calculation at zero on both scales.

In converting to Centigrade, the same 32° must be added after the calculations are made to bring the difference up to the Fahrenheit scale.

For example:

Convert 40° Fahrenheit to Centigrade

$$C = 5/9\ (F-32) = 5/9\ (40-32)$$
$$= 5/9 \times 8 = 4\text{-}4/9^{\circ}C$$

Or $C = \frac{(F-32)}{1.8} = \frac{8}{1.8} = 4.44^{\circ}C$

Convert 40°C to Fahrenheit

$$F = 9/5C + 32 = 9/5 \times 40 + 32$$
$$= 72 + 32 = 104^{\circ}F$$

Or $F = 1.8C + 32 = 1.8 \times 40 + 32$
$= 72 + 32 = 104^{\circ}F$

Latent Heat of Fusion

Fusion designates the process of changing a body from a solid to a liquid state, or vice versa. To accomplish this process, a definite amount of heat must be applied to or dissipated from the solid body. This specified amount of heat is known as the latent heat of fusion.

From a carefully conducted physical experiment, it is known that the latent heat of fusion of ice is 144 BTU's. This means that to change one pound of water at 32° Fahrenheit to one pound of ice at 32° Fahrenheit, 144 BTU's are absorbed or dissipated in the process.

Latent Heat of Vaporization

As stated before, the amount of heat required to change the state of a liquid to vapor without changing its temperature is called the latent heat of vaporization of a substance. By careful experiment, it has been found that to change one pound of water at 212° Fahrenheit to vapor or steam at 212° Fahrenheit, it takes 970 BTU's. This is called the latent heat of vaporization. At sea level, if the pressure is greater than atmospheric, a greater amount of heat will be needed to turn water into vapor. Therefore, increasing the pressure on a liquid raises its boiling point and decreasing the pressure on a liquid lowers its boiling point.

Saturation Temperature

Boiling or vaporization temperature of a liquid is usually referred to as the saturation temperature. This temperature is also the condensing temperature.

Subcooling

A liquid with a temperature lower than the saturation temperature corresponding to its pressure is subcooled. For example, water at atmospheric pressure at a temperature less than 212°F is subcooled. Ice at a temperature less than 32°F is subcooled.

Saturated Vapor

A vapor may be wet or dry saturated vapor. Saturated in this sense means that the vapor is saturated with heat. When a vapor contains all the heat it will hold at that temperature it is considered a dry vapor because it contains no entrained liquid.

A mixture of vapor and entrained liquid at the saturation temperature is considered a wet saturated vapor. This happens in a boiler or evaporator. When the vapor leaves the surface of the liquid, small droplets of liquid are carried along with it and are said to be entrained in the vapor.

Superheated Vapor

A vapor which has a temperature higher than that which corresponds to its pressure is said to be superheated. A vapor cannot be superheated until all the liquid in the mixture is evaporated. For this reason a vapor to become superheated cannot be in contact with its liquid.

Condensation

Condensation is the changing of a vapor from a gaseous state to a liquid state. In order to condense a vapor it first must be reduced to the saturation temperature. The cooling medium must be at a lower temperature so the heat will flow from the vapor and cause it to condense. The saturation temperature of a vapor may be increased by raising its pressure. That is the function of a compressor in a refrigeration system. The gas or vapor in the system is compressed to raise the pressure, thereby raising the temperature above that of the cooling medium, either water or air.

Student's Name_____ REFRIGERATION THEORY

Date_____ Key: B I - P 11 - 1A

Page 1 of 3

Approved by_____

STUDENT ASSIGNMENT
in
PLUMBING AND PIPE FITTING

Subject: Refrigeration Theory

Purpose: To promote an understanding of basic science and theory upon which is based the movement of heat by refrigeration.

References: Information Sheet
Trane Refrigeration Manual - Chap. I, page 1.

Introductory Information: Refrigeration is basically simple. It requires a knowledge or study of theory upon which it is based. Practical work is necessary under the supervision of an instructor to learn certain techniques of installation and maintenance of a refrigeration system. A knowledge of these fundamentals will provide a basis for solving problems encountered in refrigeration.

Directions: After studying the references, answer the following questions and solve the problems.

1. Refrigeration deals with the transfer of _____.

2. Heat travels from a _____ to a _____ body.

3. As temperature is increased the movement of molecules in a substance is

_____.

4. Heat, being a form of energy, cannot be _____.

5. The three types of heat of interest to the refrigeration man are:

a. _____

b. _____

c. _____

REFRIGERATION THEORY

Key: B I - P 11 - 1A
Page 2 of 3

6. A thermometer indicates the _____ of _____.

7. BTU is a measure of the _____ of _____.

8. A British Thermal Unit is the amount of heat required to raise the _____ of water _____.

9. _____BTU of heat are required to change 32° ice to 32° water. That heat is known as _____heat.

10. How many BTU's of heat are removed when 150 pounds of water at $60^{o}F$ is reduced to $32^{o}F$?_____

11. How much heat is absorbed when 150 pounds of ice is melted and raised to a temperature of $60^{o}F$?_____

12. How many pounds of water may be cooled in a given time from 150° to 70° if the cooling unit is capable of absorbing 6000 BTU's?

_____

13. The capacity of the containers of a block ice machine totals 3000 lbs. Starting with water at 70°, how much time is required to freeze the water with a refrigeration unit capable of moving 36,000 BTU's per hour?

_____

14. If the specific heat of a substance is .75, how many BTU's are required to raise 30 pounds of the substance from $60^{o}F$ to $100^{o}F$? (The specific heat of water is 1).

_____

15. What is the total heat transfer when 10 pounds of water is heated from $20^{o}C$ to steam at $100^{o}C$?

_____

16. The three methods of heat transfer are:

    a. _____

    b. _____

    c. _____

17. A system using brine as a secondary coolant is a combination of the following methods of heat transfer:

    _____ and _____

18. Opaque objects will _____ heat particularly when transmitted by _____.

19. How is specific heat used in refrigeration? _____

    _____

    _____

20. The specific heat of milk is .90. If it is necessary to move 1000 BTU's of heat to reduce a given amount of water 20°F, how much heat must be moved to reduce an equal amount of milk 20°F?

    _____

Information Sheet
in
Plumbing and Pipe Fitting

Subject: REFRIGERANTS

Refrigeration has been in use in this country for many years, but until late in the nineteenth century most refrigeration was done by "natural ice" which was cut and packed in sawdust in the winter for use in warmer seasons.

As early as 1683 a Dutchman named Anton Van Leeuwenhock, while experimenting with a microscope, discovered that water and food contained millions of tiny organisms. These organisms, some good and some harmful, were found to become dormant and stopped growing or spreading when subjected to temperatures below 50°F. This was the beginning of the realization of the value of refrigeration to the preservation of food.

Machines for making "artificial ice" were experimented with, but probably the first successful ice making machine of value commercially was built in 1834 in England.

Sometime after 1890 the American doctors began prescribing the use of artificial ice for the sick as well as for preserving food.

Demand for ice to be used commercially and in the home brought refrigeration forward as a means of supplying that demand. For many years commercial icemaking was the primary use for refrigeration equipment. A great many improvements and developments have been made, however, and have been expanded to the present standard of use as household refrigeration, commercial refrigeration, air conditioning, comfort cooling, dehumidifying, food freezing, and many critical manufacturing processes.

In the process of advancement and development a number of fluids have been used as refrigerants in the experimental stages. Today several refrigerants are in use. Because of the difference in characteristics the application of each one varies somewhat. Fluids easily changed from a liquid to a gas and from a gas to a liquid are used as refrigerants since the changing process always is accompanied by a change in heat content.

Refrigerants for practical use should offer the following desirable characteristics:

REFRIGERANTS

Key: B I - P 11 - 2I
Page 2 of 4

1. They should have a low boiling temperature. When the boiling temperature is not low it is necessary to operate the system under a high vacuum which lowers the efficiency and capacity of the system.

2. The pressure at which the refrigerant vapor condenses at ordinary air or water temperatures should be low, otherwise heavier materials, coils and more power will be necessary to operate.

3. Specific volume - The refrigerant vapor should have a low volume per pound. This affects compressor efficiency as well as the size of equipment.

(Note: Specific volume of a substance is defined as the number of cubic feet occupied by one pound of liquids and gases at a given temperature and pressure. The specific volume of a liquid is affected by temperature, but since a liquid is practically incompressible it is not affected by pressure. The volume of a gas is affected considerably by both temperature and pressure. The specific volume of refrigerant gases a major consideration in the selection of equipment and materials.)

4. High latent heat is desirable. It is necessary to circulate less refrigerant with high latent heat per ton of refrigeration. Equal results can be accomplished with refrigerants of low latent heat by increasing the speed or size of the cylinders of the compressor, thereby moving a larger volume of gas.

5. A refrigerant must be stable. It must not break down under ordinary temperatures causing it to deposit sludge and incondensable gases.

6. There should be no harmful reaction with oil. Most refrigerants are miscible with oil. This is not usually considered undesirable.

7. Refrigerants should be:

   a. Nonpoisonous
   b. Nontoxic
   c. Noncorrosive
   d. Nonexplosive
   e. Nonflammable

8. Leaks should be easy to detect and locate either by mechanical or chemical means.

Some refrigerants most commonly used at present are ammonia, sulfur dioxide, methyl chloride, "Freon 12" and "Freon 22".

Ammonia is one of the oldest refrigerants. It has a boiling point of -28°F which makes it desirable for use in ice plants, skating rinks and other large installations. Since it has a low boiling point, it is possible to operate below zero without operating below atmospheric pressure in the evaporator. It will corrode copper and brass in the presence of moisture, but it does not affect iron or steel. The condensing pressure is from 150 to 190 psig.

Sulfur Dioxide (SO_2) is a refrigerant used in automatic systems for many years. It is being replaced in many older units with other refrigerants, however. The boiling point of SO_2 is +14°F. This will allow ordinary systems to operate at slightly lower than atmospheric pressure. SO_2 in its pure form is noncorrosive, but in the presence of moisture forms sulfurous acid which is corrosive to steel. It is doubly important to avoid moisture in the system when installing or servicing. It is nonexplosive and nonflammable. It gives off a very irritating odor and is very harmful to vegetation. However, it does not harm food and is not considered toxic. Leaks in an SO_2 system can be detected by holding a swab near the suspected leak dipped in a 28 per cent ammonia solution. If there is a leak a white smoke will appear.

Methyl Chloride has a boiling point at atmospheric pressure of -10.65°F and a condensing pressure of 75-100 pounds. It is corrosive only in the presence of moisture. It is moderately flammable and explosive. Only at concentrations of from 8.1 to 17.2 per cent is it explosive.

Methyl chloride is considered nontoxic and harmless to food or vegetation, but in large concentrations it is an anesthetic akin to chloroform. Leaks can be detected only by soap suds. A Halide leak detector may be used as for Freon refrigerants but is not recommended because of its flammability.

Freon 12 is used extensively as a refrigerant for comfort air conditioning because of its favorable characteristics. It is nontoxic even in high concentrations. It breaks down only in the presence of an open flame or hot metal into very toxic gas. The boiling point of Freon 12 is -21.7°F with a condensing pressure of 100 to 130 psig. These characteristics will

permit its operation for most application above atmospheric pressure and with comparatively lightweight equipment.

Since Freon 12 is so miscible with oil some provision must be made to allow the oil to return to the compressor. The Halide torch and/or soap suds are used to test for leaks in Freon 12. The Halide torch is very sensitive and will indicate the slightest trace of Freon in the air. The torch consists of an alcohol or acetylene torch with an intake tube which is passed over the suspected leak. Escaping gas will flow through the pick-up tube into the burner which contains a copper screen heated by the flame of the burner. As the Freon gas comes in contact with the copper screen the flame turns a bright blue. Methods of testing and equipment for testing will be illustrated and discussed in detail later in this series of assignments.

Freon 22 has been developed in recent years for use in low temperature refrigeration. The boiling point is -41.4°F at atmospheric pressure and the condensing pressure is normally from 160 to 200 psig. This is higher than the more common refrigerants. It has a latent heat of 93.6 at 5°F.

Freon 22 must be kept free of moisture since it is much more soluble in water than the other common refrigerants. Only a wax free oil refined for low temperature operation should be used with Freon 22. Although it is miscible with oil at higher temperatures such as that in the condenser, the oil will float on top of Freon 22 in a flooded evaporator, and at extremely low temperature the wax will be separated from the oil. Consequently, special provisions must be made under certain conditions.

In this series of assignments on basic refrigeration, Freon 12 and Freon 22 will be dealt with primarily. These will be the refrigerants most commonly used in commercial refrigeration and air conditioning.

In the reference provided, "Refrigeration Manual" - Trane, other characteristics of these refrigerants are illustrated by charts. It is very important for the serviceman or installer to be familiar with refrigerants.

Student's Name_____

Date_____

Approved by_____

REFRIGERANTS

Key: BI - P 11 - 2A

STUDENT ASSIGNMENT
IN
PLUMBING AND PIPE FITTING

Subject: Refrigerants

Purpose: To become familiar with the characteristics of refrigerants

Reference: Information sheet; Refrigeration Manual - Trane, Chap. I.

Introductory Information: Refrigerants which are available today vary in characteristics and physical properties. The demands on refrigeration also vary considerably; consequently, a broad knowledge of refrigerants is a necessity for anyone operating, maintaining or installing any type of refrigeration equipment.

Directions: Study the references and answer the following questions:

1. The important factors to be considered in the selection of a refrigerant are:

   a. _____

   b. _____

   c. _____

2. What characteristic of a refrigerant determines the size of the compressor or type of materials necessary to handle it?

   _____

3. Give five reasons why Freon 12 is a desirable refrigerant for comfort cooling.

   a. _____ d. _____

   b. _____ e. _____

   c. _____

REFRIGERANTS

Key: BI - P 11 - 2A
Page 2 of 4

4. What is the boiling point of Freon 12?_____; of Freon 22?

_____.

5. What is the advantage of a low boiling point for refrigerants?_____

_____

6. Name one possible hazard common to both Freon 12 and Freon 22._____

_____

7. Why is it even more important that Freon 22 systems be kept free of moisture than other refrigerants?

_____

8. Why is the Halide torch <u>not</u> recommended for use as a leak detector with Methyl Chloride?

_____

9. What provisions should be made pertaining to the oil in a Freon 12 system?

_____

10. Why is it desirable for a refrigerant to have high latent heat?_____

_____

11. On the chart, pages 3 & 4, are shown some of the characteristics of Freon 12 (CCl_2F_2) and Freon 22 ($CHClF_2$). Give the gage pressure of the two refrigerants corresponding to the given temperature.

Freon 12		Freon 22
_____	$-40^{o}F$	_____
_____	$0^{o}F$	_____
_____	$20^{o}F$	_____
_____	$32^{o}F$	_____
_____	$70^{o}F$	_____
_____	$90^{o}F$	_____

12. Why are the pressures shown in column three 14.7 lbs. psig less than in column two?

_____

_____

13. What is the latent heat of vaporization of Freon 12 and Freon 22 at the temperatures given below:

Freon 12		Freon 22
_____	-40°F	_____
_____	0°F	_____
_____	10°F	_____
_____	20°F	_____
_____	32°F	_____
_____	70°F	_____

14. From the figures compiled in number 13 above, what advantage is indicated for Freon 22 over Freon 12?

_____

_____

15. For what chief purpose has ammonia been used as a refrigerant for many years in the United States?

_____

16. What one particular incident in history emphasized the value of cooling foods for preservation?

_____

17. When was the first successful ice making machine built?_____

18. Name one important use of manufactured ice in the United States in the early days of ice making.

_____

REFRIGERANTS

Key: BI - P 11 - 2 A
Page 4 of 4

19. Name 6 uses of refrigeration in the United States today.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

20. List every type of job that you have worked on where refrigeration was used.

_____

_____

_____

_____

_____

ERIC

Information Sheet
in
Plumbing and Pipe Fitting

Subject: THE REFRIGERATION CYCLE:

The discussion of the "Elementary Refrigeration Cycle" in Chapter II of the "Trane Refrigeration Manual" very aptly illustrates the theory behind the basic refrigeration cycle.

Figures 2-3 on page 6 of the reference show a refrigeration unit, naming all of the component parts of a system as well as accessories. A perfect understanding of the refrigeration cycle is necessary for the maintenance or serviceman and construction journeyman. It is the foundation for the analysis of trouble as well as for proper installation and operation of any type of compression system, regardless of size or application.

The cycle of refrigerant in a cooling system is a closed cycle because the refrigerant starting in a given condition passes through a series of pressure and temperature changes and returns to the starting condition with no deterioration, under normal conditions, ready for another cycle.

Refer to figures 2-3, page 6 of the reference. Consider that the liquid refrigerant starts at the liquid line shut off valve from the bottom of the condenser receiver Unit C under pressure, flowing through the liquid line to the expansion valve D, where a controlled amount of liquid refrigerant flows into the cooling coils or evaporator A where the pressure is much lower. The liquid has a temperature much higher than the boiling point corresponding to the lower pressure in the evaporator. As a result, it boils or changes to gas as heat is picked up from material surrounding the evaporator. Thus, each pound of liquid that is changed into gas absorbs an amount of heat equal to the latent heat of vaporization of the refrigerant at the pressure in the evaporator. This cooler gas is drawn out of the evaporator by the compressor B. The gas is subjected to a higher pressure by the compressor, thereby increasing the pressure and corresponding temperature. For each pressure there is a definite boiling point for the refrigerant and the boiling point increases or becomes hotter as the pressure is increased. As a result, air or water is cooler, making it possible to cool and condense the high pressure high temperature gas in the condenser, Unit C by ordinary tap water and on other types of systems by air at room temperature.

THE REFRIGERATION CYCLE

Key: B I - P 11 - 3I
Page 2 of 2

Briefly, the cycle consists of moving the refrigerant through a closed system as follows:

1. Receiver. . . . . liquid high pressure
2. Expansion Valve . . . . . liquid high pressure
3. Evaporator. . . . . low pressure liquid and gas
4. Compressor. . . . . high pressure gas
5. Condenser . . . . . high pressure liquid

The accessories and conditions existing in a refrigeration system as illustrated here will be discussed later in this series of assignments. The important step at this stage is to be entirely familiar with the refrigeration cycle.

Student's Name_____

Date_____

Approved by_____

THE REFRIGERATION CYCLE

Key: B I - P 11 - 3A

STUDENT ASSIGNMENT
IN
PLUMBING AND PIPE FITTING

Subject: The Refrigeration Cycle

Purpose: To familiarize the apprentice, as far as possible with the cycle of refrigeration.

References: Information sheet
"Refrigeration Manual" - Trane, Chapter II.

Introductory Information: The cycle of refrigeration is the foundation for the operation of a refrigeration system. Know it well before going further into these assignments.

Directions: Study the references, then answer the questions and work the problems.

1. What is meant by the cycle of refrigeration?_____

_____

_____

_____

2. List the three things in the basic refrigeration cycle, the proper use of which makes a refrigeration system work.

a. _____

b. _____

c. _____

3. What purpose does the compressor serve in the refrigeration cycle?

_____

_____

THE REFRIGERATION CYCLE

Key: B I - P 11 - 3A
Page 2 of 5

4. The pressure and temperature of the gas is raised by the compressor. What is the next step that occurs in the cycle as a result? What makes it possible?

_____

_____

_____

5. List the five principal parts of a refrigeration system:

a. _____

b. _____

c. _____

d. _____

e. _____

6. Make a neat sketch of a refrigeration system showing the five component parts. Label the following:

a. Liquid line shutoff valve
b. Liquid line
c. Expansion valve
d. Evaporator
e. Suction line
f. Compressor
g. Condenser
h. Receiver

State the condition of the refrigerant in each stage of the cycle and in each connecting line.

(Note: Make sketch on following page.)

7. The example in the reference gives the pressure as 136.00 as discharged from the compressor. This pressure is maintained from the compressor to what point in the cycle before changing?

_____

(Note: By solving the following problems, the purpose and value of a knowledge of refrigerants, as provided in the tables, and familiarity with the operating cycle will be better understood and appreciated. This information can be used to a greater advantage if it is remembered in its logical sequence of purpose and operation rather than by memory alone.)

8. In the reference, Freon 12, under certain definite conditions, is said to absorb 49.06 BTU's. Why is this figure important and how is it determined?

a. _____

b. _____

_____

THE REFRIGERATION CYCLE

Key: B I - P 11 - 3A
Page 4 of 5

9. How is the "refrigerating effect" used to determine the amount of Freon 12 necessary to be circulated through a system?

_____

_____

10. The absolute pressure of Freon 12 is given as 150.7 psia. What is the gage pressure if the temperature of the liquid as it leaves the condenser is 110°F?

_____

11. How is the compression ratio of a compressor determined from the pressure of the refrigerant?

_____

12. Why is the compression ratio of the compressor of importance in the design of a refrigeration system?

_____

13. The density of vapor and liquid Freon 12 is shown in columns 4 and 5 of the chart 1-1. The density of the vapor at 40°F is 1.263. How is the number of cubic feet per minute of gas that a compressor must pump through a system calculated to satisfy a certain condition?

_____

_____

14. The load of a system is calculated to be 144,000 BTU's. What is its rating in tons of refrigeration?

_____

15. The evaporator temperature of the 12 ton system is 20°F. The condensing temperature is 120°F. Calculate the following:

a. The refrigerating effect per pound of refrigerant _____

b. The amount of refrigerant needed to be circulated in the system:

(1) per hour _____

(2) per minute _____

c. The compression ratio of the compressor _____

d. Amount of vapor per minute that must be pumped by the compressor to supply the required amount of refrigerant for this system when the compressor is 75% efficient.

_____

Student's Name_____

Date_____

Approved by_____

EVAPORATORS

Key: B I - P 11 - 4A

STUDENT ASSIGNMENT
IN
PLUMBING AND PIPE FITTING

Subject: Evaporators

Purpose: To introduce the first of the component parts of the refrigeration system and describe its function in the system.

References: Trane Refrigeration Manual - Chapter III

Introductory Information: The refrigeration system is made up of the several component parts and accessories. A working knowledge of each part, its function and how it affects the balancing of the system is an absolute necessity. Study the reference well and form a mental picture of the operation so the information may be more easily retained.

Directions: Answer the following questions as a guide to study the reference.

1. Describe very briefly the process by which an evaporator cools the materials surrounding it.

_____

_____

2. Name the two general types of evaporators.

a. _____

b. _____

3. Explain the difference between the two types of evaporators:

a. _____

_____

EVAPORATORS

Key: B I - P 11 - 4A
Page 2 of 5

b. _____

_____

4. How is the refrigerant controlled in each type?

a. _____

b. _____

5. Give a practical example of each type of evaporator.

a. _____

b. _____

6. What does the abbreviation D.E. mean and to what does it refer?

_____

7. As a serviceman or construction journeyman, to what extent should you be concerned with the type or selection of the evaporator?

_____

_____

8. What is meant by a balanced refrigeration system?_____

_____

9. List three conditions or items which affect the capacity of a direct expansion coil in an air conditioning system.

a. _____

b. _____

c. _____

10. List two conditions that will increase the capacity of the D.E. coil.

a. _____

b. _____

11. How is the capacity of the compressor affected when capacity of the coil is increased or decreased?

_____

12. Why is the capacity of the compressor increased as suction pressure increases?

_____

_____

13. Explain why the capacity of the evaporator is decreased when suction pressure is increased.

_____

_____

14. For what purpose is the "Balance Chart" particularly recommended?

_____

_____

15. On chart 3-1, page 9 of the reference, the rating of what part of the refrigerating system is indicated by the curves X, Y, and Z?

_____

16. What is indicated by the curves A and B on the same chart? _____

_____

EVAPORATORS

Key: B I - P 11 - 4A
Page 4 of 5

17. The curves intersect at points 1, 2, 3, 4, 5, and 6. What information is indicated about the system by these points?

_____

18. What capacities are indicated by the six points of intersection of the curves?

1. _____ 4. _____

2. _____ 5. _____

3. _____ 6. _____

19. List the three primary conditions for coils which are considered in setting up curves to determine the point of balance in a system.

a. _____

b. _____

c. _____

20. As shown by curve X the coil represented shows a reduced capacity. From the specifications why is this true?

_____

_____

21. Why is the velocity of the refrigerant in the cooling coil important?

a. _____

b. _____

c. _____

d. _____

22. What is the recommended minimum and maximum pressure drop for a Direct Expansion Coil?

a. _____

b. _____

Student's Name_____

Date_____

Approved by_____

THE COMPRESSOR

Key: B I - P 11 - 5A
Page 1 of 3

STUDENT ASSIGNMENT
IN
PLUMBING AND PIPE FITTING

Subject: The Compressor

Purpose: To point out the purpose and function of the compressor as related to other component parts of the refrigeration system.

References: Trane Refrigeration Manual - chapters 4, 5, and 6.

Introductory Information: This assignment and reference is a continuation of information pertaining to the component parts of a system. It is not an attempt to cram engineering data or unnecessary information into the apprentice's instructional materials; rather it is an attempt to provide a thorough foundation of knowledge from which problems may be solved or work more efficiently accomplished, whether for service or installation.

Directions: Study the reference and answer the questions.

1. Distinguish between a compressor unit and a condensing unit. _____

_____

_____

2. The purpose of a compressor is to raise the pressure of the refrigerant gas from evaporator pressure to condensing pressure. What is the function of the compressor?

_____

_____

3. The refrigerant is in what physical state as it passes through the compressor?

_____

THE COMPRESSOR

Key: B I - P 11 - 5A
Page 2 of 3

4. In one sentence, explain how the refrigerant is moved through the compressor.

_____

_____

5. How is the capacity of the compressor affected by the compression ratio?

_____

6. Define volumetric efficiency. _____

_____

7. Solve the following problem involving volumetric efficiency:

A system requires 20 pounds of Freon 12 per minute to be circulated. What would be the volumetric efficiency under the following conditions: Suction temperature - 20°F.
Condensing temperature - 110°F.

_____

8. From the information in problem #7, determine the amount of gas (cfm) required to be pumped at the volumetric efficiency calculated in problem.

_____

9. From the table on page 13, the capacity of the Trane Model 10C+ unit when the operating pressures are as follows: 20°F suction temperature, 115°F condensing temperature.

_____

What size motor will be necessary to operate the unit in brake horse power?

_____

10. Why is the capacity of the compressor increased as the speed in RPM is increased?

_____

11. List three methods of controlling the capacity of compressors.

a. _____

b. _____

c. _____

12. Explain the difference between a "cylinder cutoff" system and a cylinder unloader system.

_____

_____

_____

13. Why is the cylinder cutoff system not generally recommended? _____

_____

14. What are three forces which cause the pressure sensing device to operate?

a. _____

b. _____

c. _____

15. List five important considerations when installing a condensing unit.

a. _____

b. _____

c. _____

d. _____

e. _____

Student's Name_____

Date_____

Approved by_____

CONDENSERS AND
COOLING SYSTEMS

Key: B I - P 11 - 6A
Page 1 of 7

STUDENT ASSIGNMENT
IN
PLUMBING AND PIPE FITTING

Subject: Condensers and Cooling Systems

Purpose: To understand the purpose and advantages of various types of condensers for refrigeration units.

Reference: Trane Refrigeration Manual, Chapter 7 and 8.

Introductory Information: Many factors affect the proper operation or application of the condenser in a refrigeration system. Although a journeyman is not expected to design and select the condenser for a particular system, he should be familiar with the many factors which affect the capacity of a condenser. A knowledge of the operation, capacities, charts and other information pertaining to ratings and applications is a necessity for the serviceman, operator, or installer.

Directions: Study the reference carefully before attempting to answer the following questions:

1. As the gas leaves the compressor, heat is removed in the condenser. Why does the gas condense when a sufficient amount of heat is removed?

_____

_____

_____

2. For what purpose is the refrigerant changed from a hot gas to a liquid by the condenser?

_____

_____

CONDENSERS AND
COOLING SYSTEMS

Key: B I - P 11 - 6A
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3. Explain "heat of compression". _____

_____

4. What heat other than "heat of compression" must be removed by the condenser?

_____

5. What is "subcooling"? _____

_____

6. On page 22 of the reference, the functions of a condenser are illustrated. List the functions illustrated in the removal of heat by a condenser and the heat content at the various stages.
Example: 89.03 = heat content of gas at condensing temperature.

7. In one sentence describe what the process illustrated above represents.

_____

_____

8. In the shell and tube type condenser-receiver, how much liquid usually is maintained and why must there be some liquid in the receiver?

_____

_____

9. List the three factors affecting the capacity of a water cooled condenser.

a. _____

b. _____

c. _____

10. How is it possible to use less cooling water in the condenser of a system by increasing the condensing pressure?

_____

_____

_____

(Note: You have learned from the previous assignments and problems that refrigeration tables and formulas provide information which eliminates a great deal of calculation necessary in determining capacities of various components of a refrigerating system under given conditions as well as other pertinent information. It is important, then, that you become as familiar as possible with the various factors and constants in order to know where or how to find information concerning any phase of a system where operation or installation is concerned. It must be emphasized again that it is not necessary to memorize this information; rather by study and

experience you should develop a mental picture of the operation of the basic refrigeration system. Know what must happen in each phase and know where and how to find necessary information and data to determine possible "trouble" when operating, servicing, or installing a unit. With this thought in mind study information provided in the reference on pages 22 and 23 pertaining to the capacity of a water cooled condenser, with the idea of using it as a tool as you advance in knowledge and experience in the field of refrigeration and air conditioning.)

11. Although manufacturers usually provide information pertaining to quantities of water for certain condensers, what two factors primarily cause water requirements to vary?

    a. _____

    b. _____

12. The "Z" factor is determined by the formula $Z = \frac{NT}{D}$. When "Z" is determined (as given in the example Z = 0.392), what information then may be obtained from Table 7-2, page 23, for that particular type condenser?

    a. _____

    b. _____

13. From what rating table can the factor "T" be determined? _____

    _____

14. Why is it important to consider the "fouling factor" in a cooling system?

    _____

    _____

    _____

15. What is set forth in the Plumbing Ordinance in your city pertaining to disposal of condenser water?

_____

_____

16. Upon what does the air cooled condenser depend? _____

_____

17. Why does evaporation have such a cooling effect? _____

_____

_____

18. Trace the water through each step of a refrigeration system where a cooling tower is used. Begin at the cooling tower tank.

a. _____

b. _____

c. _____

d. _____

19. What are the advantages of a forced draft cooling tower over a natural draft tower?

a. _____

_____

b. _____

_____

c. _____

_____

CONDENSERS AND
COOLING SYSTEMS

Key: B I - P 11 - 6A
Page 6 of 7

20. How is the water cooled condenser eliminated in the system illustrated in Figure 8-2, page 27, of the reference?

21. Why is the cooling process speeded up in the evaporative condenser?

22. Why is it considered a simple matter to select the proper size evaporative condenser?

23. In using the table 8-1, why is the heat of compression disregarded?

24. How is the capacity of an evaporative cooler affected when the wet bulb temperature increases?

25. As a practice problem select the proper size evaporative condenser, using the table 8-1 and the example as a guide.

The compressor is required to pump 250,000 BTU's per hour at 40° suction temperature and 115° condensing temperature. The average maximum set bulb temperature is 72°.

26. In order of importance, list two advantages of subcooling the liquid refrigerant.

a. _____

b. _____

27. What is the advantage of discharging exhaust air from conditioned areas through the evaporative condenser?

_____

_____

28. What is the purpose of a purge valve in a system and where should it be located?

_____

_____

29. Under what conditions is the use of a hot gas check valve recommended?

_____

_____

30. Why is condensation of gas at the compressor considered dangerous?

_____

_____

_____

Student's Name_____

Date_____

Approved by_____

EXPANSION VALVES

Key: B I - P 11 - 7A

STUDENT ASSIGNMENT
IN
PLUMBING AND PIPE FITTING

Subject: Expansion Valves

Purpose: To explain the types, use and purpose of expansion valves in the refrigeration system.

Reference: Refrigeration Manual - Trane, Chapter IX.

Introductory Information: Certain phases of the refrigeration system are considered, by many people, to be very complex in construction and operation. A thorough understanding of the purpose of each component part and a good knowledge of what takes place in the process of moving heat by refrigeration will discount such an idea. Many small details will be invaluable in the installation of expansion valves. Study the reference carefully and absorb all information possible to complete the picture of the operation of the refrigeration system.

Directions: Study the reference and answer the following questions:

1. List two important reasons why refrigerant is metered into the evaporator. Explain the results of improper metering.

   a. _____

   _____

   b. _____

   _____

   _____

EXPANSION VALVES

Key: B I - P 11 - 7A
Page 2 of 7

2. Name the two types of systems resulting from the method of metering employed:

   a. _____

   b. _____

3. List three methods commonly used to control the flow of refrigerant to the evaporator.

   a. _____

   b. _____

   c. _____

4. The "remote bulb" of the thermostatic expansion valve is connected to the diaphragm, which in turn is in contact with the "valve pin" which opens or closes the valve. (See illustration Fig. 9-3, page 31.)

   a. How is the diaphragm actuated to open or close the valve?_____

   _____

   _____

   b. How is the degree of opening of the valve controlled?_____

   _____

   _____

5. What is the purpose of the adjustment on the spring tension in the valve?

   _____

   _____

6. Why is the valve adjusted so that gas passing the remote bulb will be heated approximately 10° above the temperature corresponding to the suction pressure (superheat)?

_____

_____

7. How is the expansion valve affected when the load on the evaporator increases (meaning that it picks up more heat)?

_____

_____

8. How is sufficient space or section of the evaporator (identified by point "X" in the reference) controlled or adjusted to maintain the proper superheat?

_____

9. What temperatures determine how much of the evaporator coils will be used to superheat the refrigerant?

_____

_____

10. a. At what superheat setting are direct expansion coils usually rated under normal load?

_____

b. What setting is recommended for variable loads?

_____

11. On page 32 of the reference, under the heading of "Pressure Drop", it is shown that since Freon 12 is used to charge the remote bulb and Freon 12 is used in the system, pressure will be equalized on top and below the diaphragm. The temperatures being the same, the absolute pressures are equal. What force, then, is holding the expansion valve closed?

_____

EXPANSION VALVES

Key: B I - P 11 - 7A
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12. As stated, the expansion valve spring is set for 10° superheat, the valve will open at 50° since the evaporating temperature is given at 40° (40° + 10° superheat = 50°); from the Table 1-1, page 3, what is the absolute pressure of Freon 12 at 50°?

_____

13. In the example given, the evaporator will have a pressure drop of 6 pounds. With an evaporating temperature of 40° and 5.68 lbs., plus a spring pressure of 9.71 plus 6 lbs., there will be a total of 67.39 psia at the expansion valve and under the diaphragm. Approximately what will the gas temperature be at the expansion valve (see Table 1-1)?

_____

14. With a 6 lb. pressure drop across the evaporator, how much must the total superheat be to overcome the pressure at the diaphragm of the expansion valve?

_____

15. Why is excessive superheat objectionable?_____

_____

16. How is the pressure drop in the evaporator compensated for in the expansion valve to avoid the necessity of excessive superheat?

_____

17. What two factors determine pressure drop in the liquid line to the evaporator?

a. _____

b. _____

18. Give two reasons why "flash gas" is objectionable in the liquid line ahead of the expansion valve.

a. _____

b. _____

_____

19. What causes flash gas in the liquid line ahead of the expansion valve?

_____

20. List two methods of subcooling the liquid to avoid flash gas.

a. _____

b. _____

21. List four recommendations for the installation of thermostatic expansion valves.

a. _____

b. _____

c. _____

d. _____

_____

22. List five recommendations for attaching the remote bulb.

a. _____

_____

b. _____

_____

c. _____

d. _____

e. _____

23. Why does liquid in the suction line near the remote bulb cause false valve response?

_____

_____

24. Different remote bulb charges are used to satisfy varying applications. How are they usually charged?

_____

_____

25. Give one advantage, one disadvantage, and one typical application of an expansion valve with a gas charged remote bulb.

a. _____

_____

b. _____

_____

c. _____

_____

26. For what application is the "cross charge" remote bulb recommended?

_____

27. Under what conditions is use of the "Bulb in a Well" recommended?

_____

_____

_____

28. Explain how external equalizers must be installed from expansion valves where a coil has two or more valves.

_____

_____

Student's Name_____

Date_____

Approved by_____

REFRIGERATION CONTROL EQUIPMENT

Key: B I - P 11 - 8A

STUDENT ASSIGNMENT
IN
PLUMBING AND PIPE FITTING

Subject: Refrigeration System Control Equipment

Purpose: To become familiar with types, purpose, and operation of controls for the refrigeration system.

Reference: Refrigeration Manual - Trane, Chapter X.

Introductory Information: Due to the many variations in the demands and applications of a refrigeration system a variety of controls are necessary.

This assignment is presented strictly for the purpose as stated above. As your experience is broadened in refrigeration both in the shop and on the job, you will learn your own limitations as well as that of the controls insofar as operation and maintenance is concerned.

Directions: Study the reference and answer the following questions:

1. What condition primarily makes it so important for a refrigeration system to be automatically controlled?

_____

2. What source of information is available to provide complete and current information on controls?

_____

3. List three types of thermostats:

a. _____

b. _____

c. _____

4. Why is it necessary to use a relay on certain types of thermostats?

_____

_____

_____

5. How is it possible to use one thermostat for both cooling and heating?

_____

_____

6. Describe the difference in designs of thermostats for cold storage rooms and ordinary room thermostats.

_____

_____

7. Explain the difference in operation of a modulating thermostat and the typical room thermostat.

_____

_____

_____

_____

8. Name two types of equipment that may be used in conjunction with a modulating thermostat.

a. _____

b. _____

9. What physical characteristic of a material makes it suitable for use as a power element for a humidity controller?

_____

10. Define a pressure controller. _____

_____

11. Why is the pressure switch with the two bellows generally used on a refrigeration system?

_____

_____

12. What is the normal position of the switch on the pressure controller when system is in normal operation?

_____

13. Does the large bellows control the low pressure or high pressure?

_____

14. The cutout setting on the low pressure bellows is 20 lbs.; cutout pressure on the high pressure bellows is set at 180 lbs.; the compressor has stopped with gages showing 18 lbs. low pressure and 175 lbs. high pressure; which bellows has opened the pressure switch to stop the compressor?

_____

15. How is the compressor started again after suction pressure drops below cutout pressure setting?

_____

_____

16. On what types of compressors are the "oil pressure failure control" used?

_____

17. How is the "oil pressure failure control" designed to allow the compressor to start, even though there is no oil pressure, when it is stopped on the normal "off" cycle?

_____

_____

_____

_____

18. How is the "heater" circuit for the timer switch de-energized during the 120 second time delay to allow the condensing unit to remain in normal operation?

_____

_____

_____

19. Why is it necessary to have a differential setting for temperature and pressure controls?

_____

_____

20. List the primary parts of a solenoid valve.

a. _____

b. _____

c. _____

21. Why is a solenoid valve referred to as a "two position control"?

_____

22. When the electrical solenoid coil is energized, in what position is the valve--open or closed?

_____

23. What type of valve is the evaporator pressure regulator?_____

_____

24. Why must the evaporator pressure regulator be installed between the evaporator and the compressor?

_____

_____

_____

25. Give two reasons why suction pressure must not be allowed to drop below a predetermined level in certain types of systems.

a. _____

b. _____

26. What is the difference in the operation of the "suction pressure hold back valve" and "evaporator pressure regulator"?

_____

27. What is the purpose of a modulating control for a thermostatic expansion valve?

_____

_____

28. Is the capillary control line of the water regulating valve connected to the high side or low side of the refrigeration system?

_____

29. Is the water valve closed by spring pressure or by pressure from the system?

_____

30. How does the valve maintain a set condensing pressure?_____

_____

31. Name another method used to supply cooling water for a refrigerating system?

_____

Student's Name_____

Date_____

Approved by_____

MOTORS & CONTROLS

Key: B I - P 11 - 9A

STUDENT ASSIGNMENT
IN
PLUMBING AND PIPE FITTING

Subject: Motors and Controls

Purpose: To present information about motors and controls which a refrigeration man should know to install, maintain, or operate a refrigeration system.

Reference: Refrigeration Manual - Trane, Chapter XI.

Introductory Information: A good knowledge of motors and controls is a must for the refrigeration and air conditioning serviceman and installer. It would be almost impossible to diagnose trouble in a system without knowing the functions of all the component parts.

Although the serviceman will not be required in most cases to make electrical repairs, he must know where the trouble originates by having a knowledge of the operation of the motors and controls.

Directions: Study the reference and answer the following questions:

1. Define ambient temperature_____

_____

2. What is generally the operating temperature of an "open" motor operating with an ambient temperature of 80°F?

_____

3. Explain the term "open" motor._____

_____

MOTORS & CONTROLS

Key: B I - P 11 - 9A
Page 2 of 4

4. List seven types of motors classified as to their construction.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

g. _____

5. What type motor is recommended for cooling tower water pumps located out of doors?

_____

6. What is the chief advantage of a ball-bearing motor over a sleeve-bearing motor?

_____

7. What is the purpose of a starting winding or a starting mechanism in an electrical motor?

_____

_____

8. List two types of motors whose starting winding are disconnected by a centrifugal switch or mechanism.

a. _____

b. _____

9. How does the squirrel cage motor differ from most other motors?

_____

_____

10. What are the advantages in the design of "Refrigeration Duty Motors"?

_____

_____

11. Define a motor starter._____

_____

12. Define a magnetic starter._____

_____

13. What is meant by "across-the-line" starter?_____

_____

14. How is it possible to use pressure controllers or thermostats that have relatively light contacts with a starter which contains heavy contacts and voltage?

_____

_____

15. In figure 11-4, page 51, what does T1 - T2 - T3 represent?_____

_____

16. How are the main contacts closed on the three wire control switch when the starter button is pushed?

_____

MOTORS & CONTROLS

Key: B I - P 11 - 9A
Page 4 of 4

17. When too great a current is drawn on the line, how is the power cut off by the magnetic control for protection?

_____

_____

18. How is the motor started after the overload relay has tripped the switch?

_____

19. When low voltage causes the main contacts to open on the two-wire control system, how is the motor restarted?

_____

_____

20. How should the disconnect switch be located for a motor?_____

_____

_____

Student's Name_____

Date_____

Approved by_____

REFRIGERATION SYSTEM CONTROL

Key: B I - P 11 - 10A

STUDENT ASSIGNMENT
IN
PLUMBING AND PIPE FITTING

Subject: Refrigeration System Control

Purpose: To become familiar with the various methods and extent to which a refrigeration system can be controlled.

Reference: Refrigeration Manual - Trane, Chapter XII.

Introductory Information: In a refrigeration system many causes of trouble in starting or in shutdowns can be traced either through or to the control system. The refrigeration serviceman or installer must be familiar with the various control systems in order to know their functions under all conditions.

Directions: Study the reference. Do not attempt to memorize each control circuit illustrated. Know the circuit by the function of each of its component parts.

1. In the simple control system illustrated in Figure 12-1, page 53, how can the thermostat control the compressor motor when there is no electrical connection from it to the magnetic starter?

_____

_____

_____

2. What is the chief objection to use of the simple system illustrated in Figure 12-1?

_____

_____

REFRIGERATION SYSTEM CONTROL

Key: B I - P 11 - 10A
Page 2 of 3

3. In Figure 12-2, how is the control system modified to cause the compressor to start only when there is a demand on the evaporator?

_____

_____

_____

4. With control circuit as illustrated in Figure 12-2, page 53, how is "short cycling" prevented when leaky valves cause suction pressure to close the pressure switch?

_____

_____

5. What additional control is shown in the control circuit illustrated in Figure 12-6 over that in Figure 12-5?

_____

6. What is the purpose of the control mentioned above? _____

_____

7. What type of condenser is used on the system using the control circuit illustrated in Figure 12-6?

_____

8. Figure 12-6 illustrates the compressor control circuit. Which of the figures illustrates the circuit which will combine with this figure to serve a direct expansion air conditioning unit using a circulating fan, Figure 12-5, Figure 12-4, Figure 12-2, or Figure 12-1?

_____

_____

9. Which figure illustrates the circuits necessary to combine with the circuit in Figure 12-4 to make up an air conditioning system using a cooling tower and pressure lubricating system?

_____

_____

10. In an interlocking system what precaution is taken to avoid feeding refrigerant to the evaporator unless the fan is running or a load demands it?

_____

_____

Student's Name_____ ACCESSORIES & EQUIPMENT

Date_____ Key: B I - P 11 - 11A

Page 1 of 3

Approved by_____

STUDENT ASSIGNMENT
IN
PLUMBING AND PIPE FITTING

Subject: Accessories and Equipment for Refrigeration Systems.

Purpose: To become familiar with equipment used for various purposes in refrigeration systems.

Reference: Refrigeration Manual - Trane, Chapter XIII.

Introductory Information: For various applications of refrigeration systems, different types of accessories must be installed in the system to cause it to maintain desired conditions.

Directions: Answer the following questions:

1. Briefly state the purpose of the following equipment or accessories.

   a. Hot gas muffler: _____

   _____

   b. Heat exchanger: _____

   _____

   c. Dehydrator: _____

   _____

   d. Strainers: _____

   _____

   e. Sight Glasses: _____

   _____

ACCESSORIES & EQUIPMENT

Key: B I - P 11 - 11A
Page 2 of 3

2. Sight glasses may be located near either the receiver or the expansion valve. Why is the sight glass located near the expansion valve when it is some distance from the receiver?

_____

_____

3. How is the heat exchanger installed in the refrigeration system?

_____

_____

4. How is operation of an expansion valve affected by installation of a heat exchanger?

_____

_____

5. Of what advantage is addition of heat to the suction gas?_____

_____

6. What is meant by a compound gage?_____

_____

7. What common purpose does the diaphragm and packing serve in manual shutoff valves?

_____

8. What is "back seating" in refrigeration valves?_____

_____

9. What is the most common purpose of the "back seat port" on a compressor shutoff valve?

_____

10. What additional feature is incorporated in the design of refrigeration valves to give additional damage and leakage protection not ordinarily found on valves?

_____

11. Why is it necessary that receiver valves be fitted with "liquid tubes" when mounted on top of the receiver?

_____

12. List two safety devices that may be used to relieve high pressure in a refrigeration receiver or condenser:

a. _____

b. _____

13. Under what conditions is it necessary to install a refrigerant receiver in a system in addition to the condenser?

_____

_____

14. To what maximum per cent of total volume should a receiver be filled?

_____

15. Why is the receiver not filled completely?_____

_____

Student's Name _____

Date _____

Approved by _____

REFRIGERATION PIPING SYSTEMS

Key: B I - P 11 - 12A

STUDENT ASSIGNMENT
IN
PLUMBING AND PIPE FITTING

Subject: Refrigeration Piping Systems

Purpose: To understand the value of properly designed and installed piping systems.

Reference: Refrigeration Manual - Trane, Chapter XIV and XV.

Introductory Information: A refrigeration system with well balanced equipment can be so installed that it will give continuous trouble. Improperly installed or poorly designed piping systems will cause poor operation of the system and create conditions which can cause serious damage. Much of this type of knowledge is left up to the journeyman installing the pipe.

Directions: Study the reference above before answering questions below:

1. What factor in the refrigeration system primarily complicates the design of the piping system?

_____

2. What causes the oil to leave the crank case of the compressor?_____

_____

_____

3. In which state, liquid or gaseous, does oil mix with Freon 12 or 22?

_____

4. List four purposes which a trap serves in a refrigeration system:

   a. _____

   b. _____

   c. _____

   d. _____

5. To make it possible to start oil in a vertical line, which two considerations must be given to pipe size and trap construction?

   a. _____

   b. _____

6. What is the "basic function" of the hot gas discharge line? _____

   _____

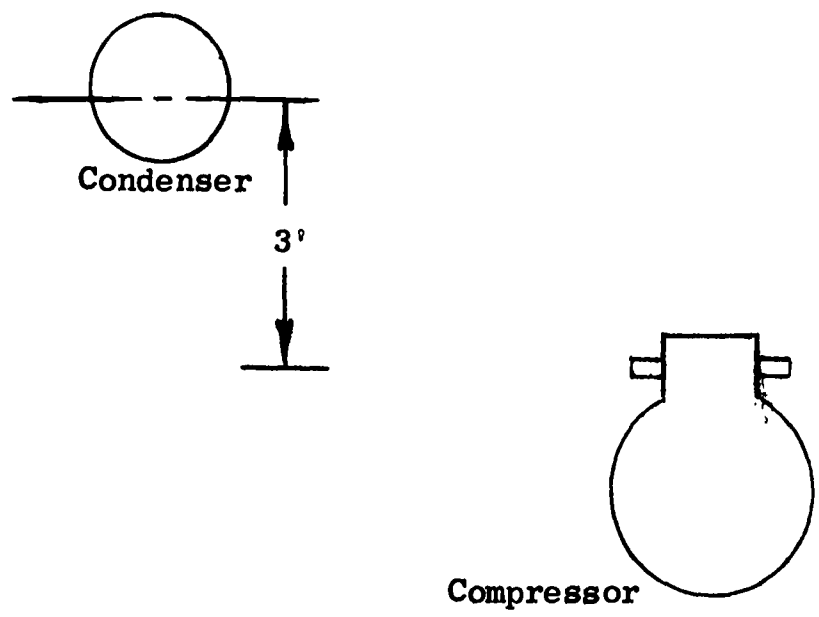
7. In what direction and how much should the horizontal hot gas line be "pitched"?

   _____

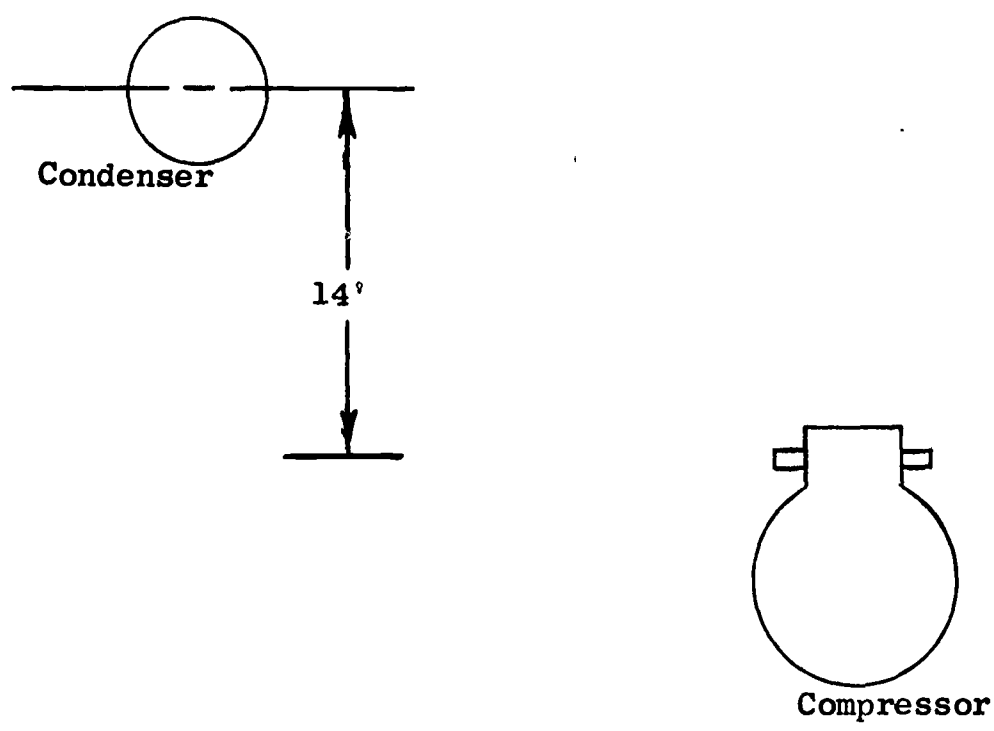
   _____

Show the hot gas discharge piping in the systems as indicated below by single line drawings. Indicate the pitch of the lines and the necessary traps.

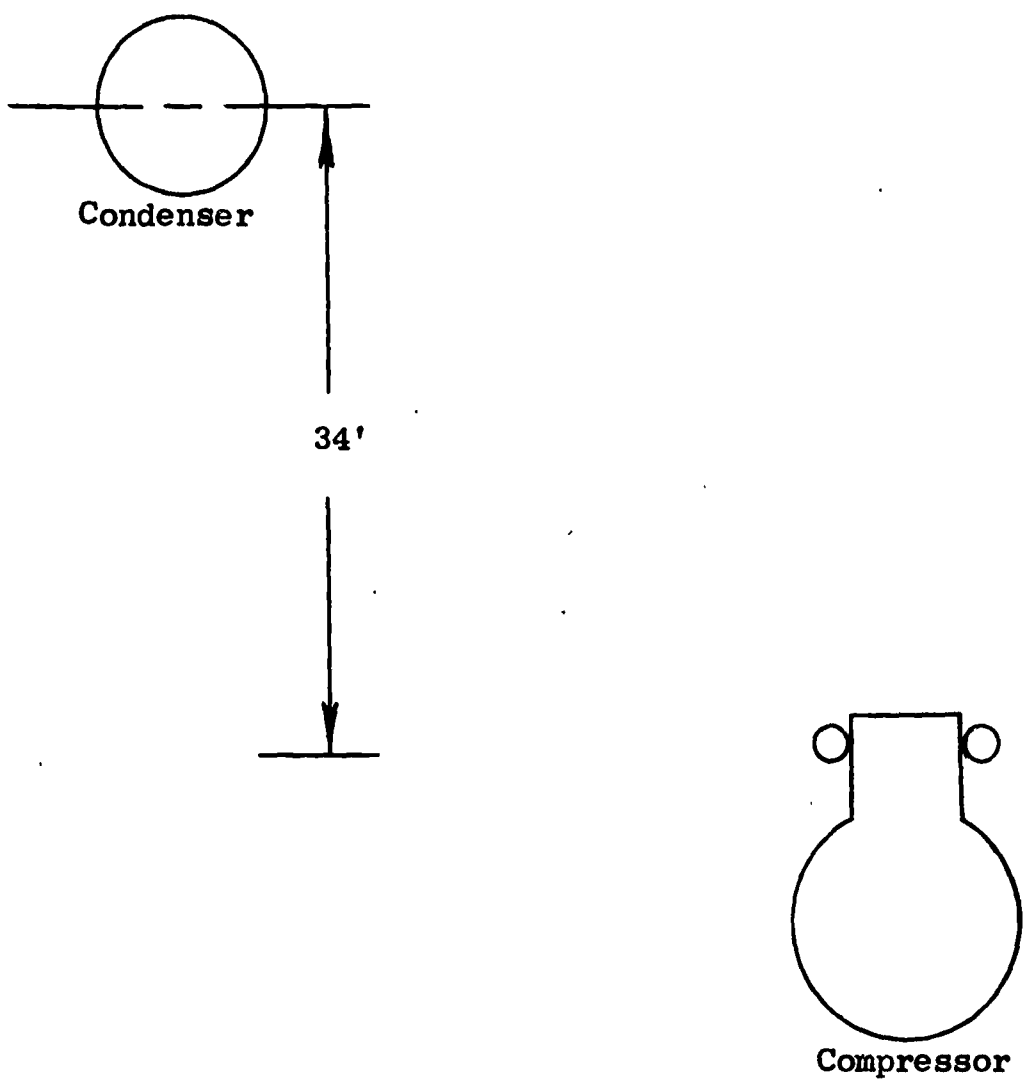
8. Show the hot gas discharge piping in the system indicated below in which the condenser is three feet above the compressor.



9. Draw in the hot gas lines of the system shown below in which the condenser is 14 feet above the compressor.

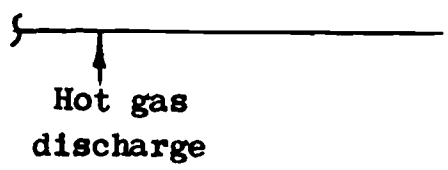


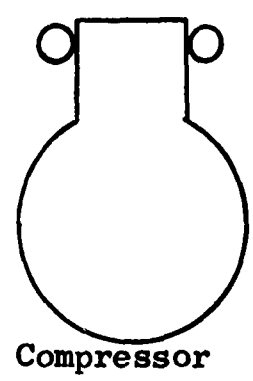
10. Show the hot gas discharge line in a system as indicated below in which the condenser is 34 feet above the compressor.



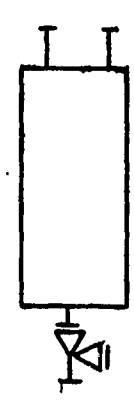
11. By sketching in the hot gas discharge lines, show two methods of piping the hot gas in a system which operates at varying loads. These methods will also apply with a compressor equipped with some form of capacity modulation.

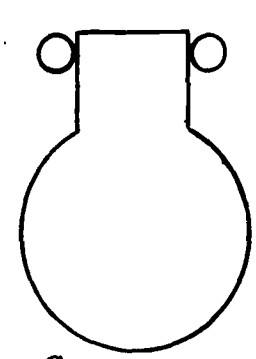
a.





b.





12. Name two conditions or factors that can cause the liquid refrigerant to flash into gas.

a. _____

b. _____

13. What is the pressure per square inch exerted by a column of liquid Freon 12 one foot high?

_____ Of Freon 22? _____

14. Liquid Freon 12 is forced upward in a vertical liquid line 30 feet. The pressure at the bottom of the line where it leaves the condenser is 150 psia. What is the total drop in pressure at the top of the 30 feet column if the total friction loss is 2 psi?

_____

15. Under the same conditions, what would be the total pressure drop for Freon 22?

_____

16. Why is it so important that only gas and entrained oil be delivered by the suction line to the compressor?

_____

_____

17. Why is the pipe size of suction lines and the velocity of gas in a suction line so important in the design of suction piping?

_____

_____

_____

18. Why are traps and "dead ends" in suction lines hazardous? _____

_____

19. When should a trap be installed in a suction line and where should it be located?

_____

_____

20. Give two reasons why it is recommended that suction and liquid lines be run together where the compressor and the evaporator are installed at approximately the same level?

a. _____

b. _____

21. Give two reasons why it might be necessary to parallel compressors in a system.

a. _____

b. _____

22. List two precautions that must be taken in installing refrigerant piping or parallel piping.

a. _____

b. _____

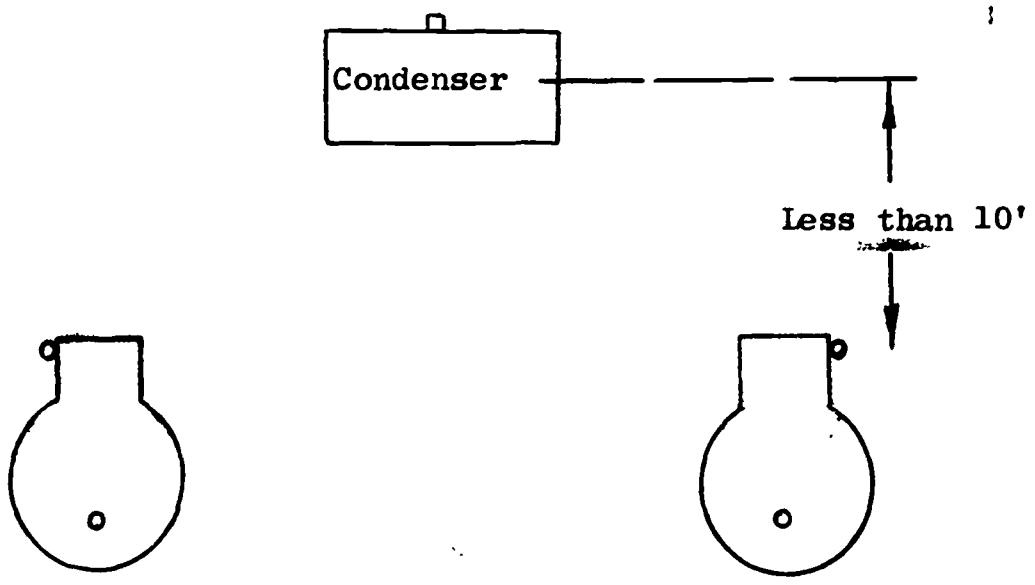
23. Give two reasons for using a "Y" connection for the "hot gas" lines from parallel compressors to the condenser.

a. _____

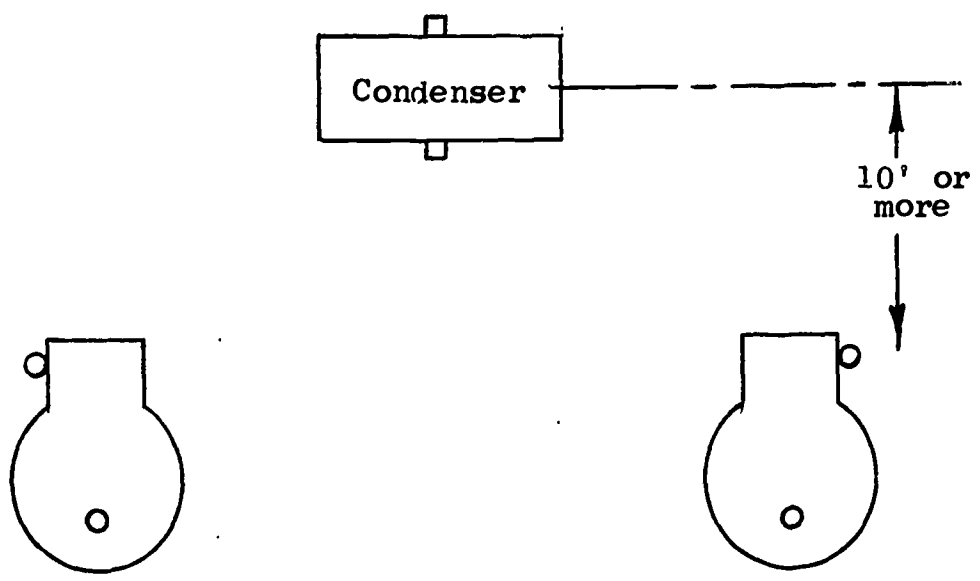
b. _____

(Note: Show hot gas piping on the following systems under the conditions specified. Show the piping by single line sketches. Indicate necessary equalizer lines in all sketches.)

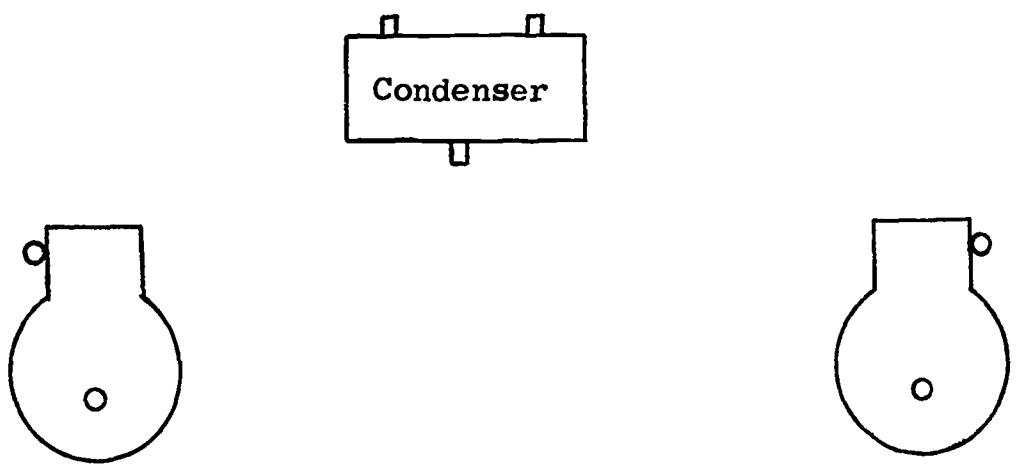
24. Parallel compressors with a common condenser less than 10 feet above the compressors. Show the necessary equalizer lines and indicate the pitch of the lines.



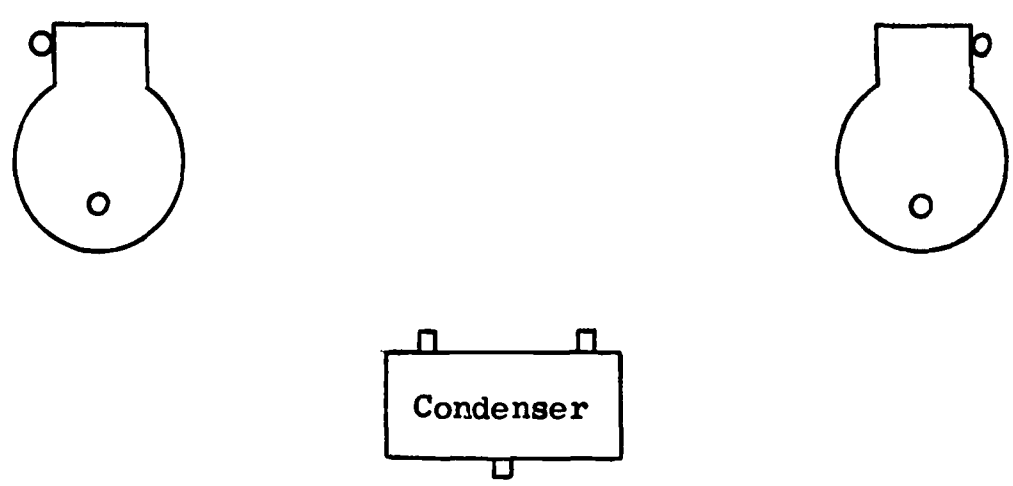
25. Show piping for a system with the condenser more than 10 feet above parallel compressors. Indicate the pitch.



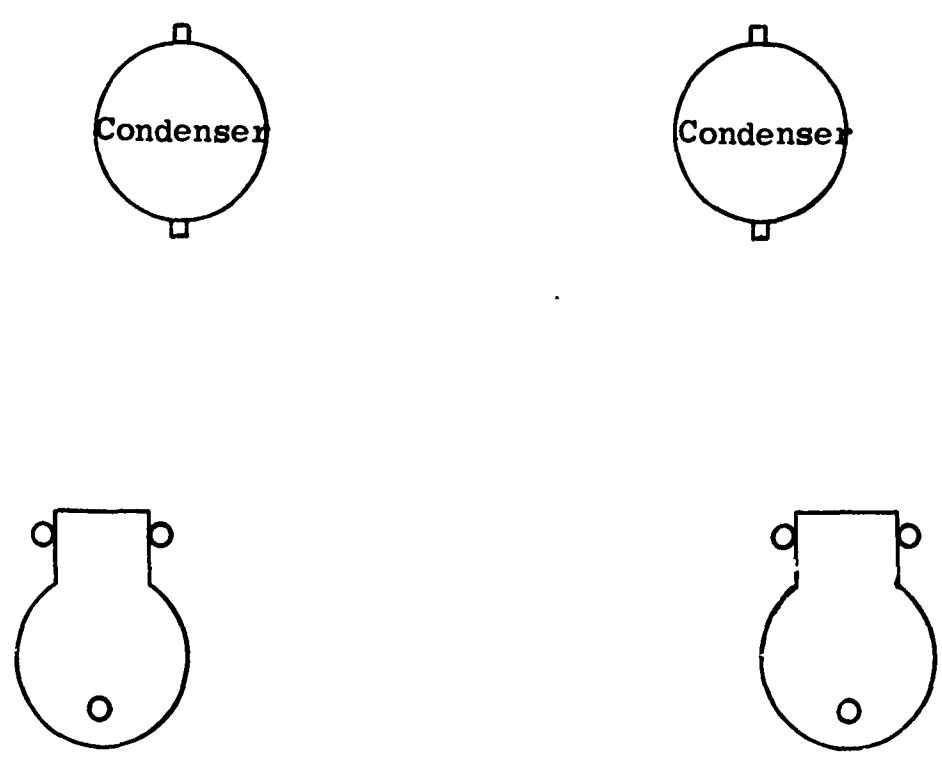
26. Show piping for a system as indicated by the sketch.



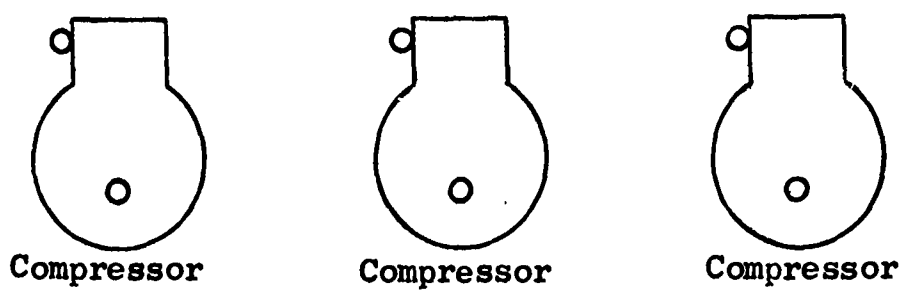
27. Show piping for a system with condenser below the compressors.



28. Show both the hot gas discharge and suction piping for a system with parallel compressors and separate condensers.



29. Show the suction lines for a system where three compressors are hooked up in parallel. Show necessary equalizer lines as in previous sketches.



Student's Name_____

Date_____

Approved by_____

CALCULATING & INSTALLING REFRIGERATION PIPING

Key: B I - P 11 - 13A

STUDENT ASSIGNMENT
IN
PLUMBING AND PIPE FITTING

Subject: Calculating and Installing Refrigeration Piping

Purpose: To understand the necessity of maintaining proper velocities of the refrigerant in the piping system.

Reference: Refrigeration Manual - Trane, Chapter XVI.

Introductory Information: Piping size in a refrigeration system must be properly calculated and installed. A pipe that is too large affects the velocity of the refrigerant which in turn affects the efficiency of the system. Too many fittings, trapped lines, or too small pipe size also will seriously affect the system. It is true that a journeyman seldom designs a system, but a good knowledge of pipe sizing and installation is necessary to properly operate a system as well as being an aid to the serviceman in diagnosing trouble.

Directions: Study the reference and provide the following information.

1. Show the proper size pipe for the conditions specified below for Freon 12 for the hot gas line:

   a. 30 ton capacity; 50 ft. from compressor to condenser; 3 pound pressure drop:

   _____

   b. 100 ton capacity; 10 ft. from compressor to condenser; 3 pound pressure drop:

   _____

2. Show the proper size suction line piping for a system in which the compressor and evaporator are at the same level. Specifications are as follows:

   a. 50 ton capacity; suction temperature 40°; 20 feet from compressor to evaporator; pressure drop of 1 psi:

   _____

   b. 50 ton capacity; 20° suction temperature; 50 ft. suction line; 2 lbs. per square inch pressure drop:

   _____

   c. 75 ton capacity; 20 foot suction line; 45° suction temperature; 2 psi pressure drop:

   _____

3. Show the proper size liquid line for the systems as specified below, with condenser and evaporator on the same level.

   a. 150 ton capacity; 50 ft. liquid line; 3 lbs. psi pressure drop:

   _____

   b. 200 tons capacity; 20 ft. liquid line; 3 lbs. pressure per square inch drop:

   _____

   c. 150 ton capacity; 10 ft. liquid line; 5 lbs. psi:

   _____

4. Calculate the proper pipe sizes for hot gas, suction, and liquid line for the system as specified below. All component parts are on the same level. 75 ton capacity with 40° suction temperature, and 105° condensing temperature.

a. 10 ft. of hot gas line with an allowable pressure drop of 3 lbs.:

_____

b. Suction line 20 ft. long; 2 psi allowable pressure drop:

_____

c. Liquid line 30 ft. long; 3 psi allowable pressure drop:

_____

5. Using the velocity charts check the velocity of the system used in problem 4 above.

   75 ton capacity; 40° suction temperature; 105° condensing temperature; 2-5/8" hot gas line; 3-5/8" suction line; 1-5/8" liquid line:

   _____

6. What types of copper pipes are recommended for refrigeration systems?

   _____

7. Why are cast fittings <u>not</u> recommended for refrigeration lines?

   _____

8. Why is it more difficult to sufficiently clean copper or steel pipe when using F-12 or F-22 as a refrigerant?

   _____

   _____

   _____

9. List the four necessary steps in sweating or brazing copper pipe:

a. _____

b. _____

c. _____

d. _____

_____

10. What type of soft solder is recommended for use by some codes in a refrigeration system?

_____

11. What precautions must be taken when brazing solenoid valves or sight glasses?

a. _____

b. _____

Student's Name_____

Date_____

Approved by_____

WATER & DRAIN LINES

Key: B I - P 11 - 14A

STUDENT ASSIGNMENT
IN
PLUMBING AND PIPE FITTING

Subject: Water and Drain Lines, Support and Insulation

Purpose: To understand the importance of piping other than actual refrigeration lines and necessity for proper installation.

Reference: Refrigeration Manual - Trane, chapters XVII and XVIII.

Introductory Information: The flow of water in a refrigeration system is affected by the same basic laws as any other installation. Certain sizes and types of systems require a definite amount of water for cooling. Several factors affect the flow of water so the journeyman should know what they are and know the characteristics of water as well.

Water lines as well as refrigerant lines must be well supported and properly insulated to properly maintain operation of the system.

Directions: Study the reference and answer the following questions:

1. What causes water to flow through piping?_____

_____

_____

2. When there is a choice between a long refrigerant line or long water line, which should be kept as short as possible?

_____

3. List two causes for pressure drop in a water line.

a. _____

b. _____

WATER & DRAIN LINES

Key: B I - P 11 - 14A
Page 2 of 6

4. A line of 1" steel pipe 150 ft. long is installed to provide water for cooling. With a flow of 20 gallons per minute, water pressure at the service is 50 lbs. psi. What is pressure at the end of the 150 ft. length of pipe? (Disregard fittings.)

_____

5. The 1" water line continues to the condenser using 12 additional feet of pipe and four 90° standard elbows, one union, and one gate valve. Using pressures determined above in problem #4, determine pressure of the water entering the condenser.

_____Answer

6. According to the predetermined requirement for the Trane 10 CT "typical system", will the system set up in problem 5 above provide sufficient cooling water?

_____

7. If water line is installed 8 feet above the condenser, how much will be subtracted from friction loss of the pipe as calculated?

_____

8. Why is it necessary to have a "fool proof" connection such as a swing joint when either river or well water is used for cooling and city water may be used as a stand by?

_____

9. List three precautions that must be taken when condenser water is wasted into sewer.

a. _____

_____

b. _____

_____

c. _____

_____

10. Give two reasons why proper pipe supports are important in refrigeration.

a. _____

b. _____

_____

11. List three important points that must be considered to select the proper hanger for refrigeration piping.

a. _____

b. _____

c. _____

12. Name two types of hangers that may be used on long runs of pipe to permit expansion and contraction.

a. _____

b. _____

WATER & DRAIN LINES

Key: B I - P 11 - 14A
Page 4 of 6

13. List three methods of absorbing expansion and contraction.

a. _____

b. _____

c. _____

14. How can transmission of vibration be eliminated before reaching the piping?

_____

_____

15. What is largest size pipe that may be supported by 1/16" x 3/4" perforated metal strips?

_____

16. When supporting vertical piping, for what purpose are spring hangers used?

_____

_____

17. What part of horizontal run of pipe may be supported by vertical pipe?

_____

18. What is the purpose of pipe insulation? _____

_____

_____

19. Give requirements for the insulation of a 5" cold line at following temperature ranges?

    a. Temperature range 50°F to 75°F: _____

    _____

    b. Temperature range 32°F to 50°F: _____

    _____

20. What is maximum distance that hangers should be spaced for 5" pipe and what size hanger rods should be used?

    a. Maximum spacing: _____

    b. Hanger rod size: _____

21. What thickness of cork insulation should be used on 5" pipe with a temperature range of -25°F to 0°F?

    _____

22. Why is it recommended that liquid line and suction line be insulated as a unit when they are conveniently run close together?

    _____

    _____

    _____

23. Give two reasons why a leak in insulation of a cold line is more serious than one in a hot line?

    a. _____

    _____

    _____

WATER & DRAIN LINES

Key: B I - P 11 - 14A
Page 6 of 6

b. _____

_____

24. It is recommended that fittings be insulated because of the extensive heat transfer. What is heat transfer surface of $1\frac{1}{4}$" pipe tee?

_____

25. How should insulation be protected from damage by movable rollers on hangers?

_____

Student's Name_____

Date_____

Approved by_____

TESTING, CHARGING & CHECKING

Key: B I - P 11 - 15A

STUDENT ASSIGNMENT
IN
PLUMBING AND PIPE FITTING

Subject: Testing, Charging, and Checking the Refrigeration System.

Purpose: To become familiar with proper steps in testing and charging and to provide a suggested check list.

Reference: Refrigeration Manual - Trane, Chapters XX and XXI.

Introductory Information: Testing, charging and checking a refrigeration system not only requires skill and knowledge but also a planned procedure in order to thoroughly and systematically test and check a system.

The reference at this point suggests procedures for testing and checking to avoid damage and unnecessary interruptions in operation of the system.

Directions: Study this reference carefully before answering these questions. Pay particular attention to procedure and the sequence of each operation.

1. What is the first step in preparation for a pressure test of a refrigeration system?

_____

_____

2. Why is the expansion valve plugged for the test?_____

_____

_____

3. From the dictionary or other source, what is the meaning of the word 'anhydrous'?

_____

TESTING, CHARGING
& CHECKING

Key: B I - P 11 - 15A
Page 2 of 5

4. Why is it necessary to use a regulator on a CO_2 drum when used for testing?

_____

_____

5. What pressures are recommended for testing provided it is according to local codes?

   a. High side: _____

   b. Low side: _____

6. List four suggested steps for thoroughly testing refrigeration piping:

   a. _____

   b. _____

   c. _____

   d. _____

7. How much pressure fluctuation can be expected in a system setting for a 24-hour test according to the ambient temperature?

_____

_____

8. Why should the compressor never be used to evacuate a system? _____

_____

_____

9. What is the purpose of a vacuum dehydration indicator? _____

_____

10. In the process of evacuating the system, where should the vacuum dehydration indicator be connected into the system?

_____

_____

11. Name two hazards caused by leaving moisture in a system.

a. _____

b. _____

12. List four possible causes for failure to reach a sufficiently low vacuum.

a. _____

b. _____

c. _____

d. _____

13. List equipment that must be checked systematically before charging.

_____

_____

14. Why is the refrigerant drum inverted when charging from the high side?

_____

_____

15. Why must there be at least two men in the operation of charging the system?

_____

_____

16. After the estimated amount of refrigerant has been pumped into the system, what does the presence of bubbles in the liquid line sight glass indicate?

_____

_____

17. How is the charging line from refrigerant drum purged?_____

_____

_____

18. How is the superheat setting of a thermostatic expansion valve checked after system is put into operation?

_____

_____

_____

19. Over what period of time is the recommended final check made?_____

_____

20. List 10 check points for final check period.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

g. _____

h. _____

i. _____

j. _____

21. What specifications govern the type of oil used in a compressor?

_____

_____

Student's Name_____

Date_____

Approved by_____

SEASONAL OPERATION AND TROUBLE ANALYSIS

Key: B I - P 11 - 16A

STUDENT ASSIGNMENT
IN
PLUMBING AND PIPE FITTING

Subject: Seasonal Operation and Trouble Analysis

Purpose: To emphasize the importance of proper maintenance and service.

References: Refrigeration Manual - Trane, Chapter XXII and XXIII.

Introductory Information: The life of a system and satisfactory operation depends upon maintenance and service after the equipment is installed. A schedule for seasonal operation and maintenance should be set up and strictly followed to assure nothing is missed that may cause a shut down, damage, or inefficient operation of the system.

Directions: Study the reference with the idea of becoming familiar with the steps and schedule to follow in properly maintaining a refrigeration system.

Answer the following questions:

1. List the three most essential steps in the weekly check:

   a. _____

   b. _____

   c. _____

2. List five mechanical or physical checks that should be made once a month other than the actual refrigeration or compressor system.

   a. _____

   b. _____

c. _____

d. _____

e. _____

3. When the cooling tower is checked, what will indicate that water treatment is necessary?

_____

4. At what intervals should the condensing water system be checked and scale removed and all exposed parts painted?

_____

5. Why is it advisable to pump down a system that will be idle for several months?

_____

_____

_____

_____

6. What is the first valve that should be closed when pumping down a system?

_____

7. The system should be pumped down to what pressure or vacuum?

_____

8. What precaution should be taken to avoid damage to condenser and pipe due to freezing?

_____

9. After a complete inspection, list steps necessary to start a refrigeration system after a seasonal shutdown:

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

g. _____

The maintenance or serviceman must be able to diagnose trouble by symptoms of a refrigeration system. A chart is given listing symptoms, possible causes, and the remedy. Do not overlook the reference notes.

Identify the symptoms given below and give the probable cause:

10. The compressor short cycles and there is excessively cool water leaving condenser. Discharge pressure is too high.

_____

11. Bubbles showing in sight glass._____

_____

12. Excessively cold suction line.

a. _____

b. _____

SEASONAL OPERATION AND
TROUBLE ANALYSIS

Key: B I - P 11 - 16A
Page 4 of 4

13. Oil level in compressor drops gradually.

a. _____

b. _____

c. _____

14. How can it usually be determined that a strainer or filter is clogged?

_____

_____

15. Expansion valve hisses._____

_____

16. Compressor is noisy and suction pressure is too high. _____

_____

17. Describe one simple test for broken valves in the compressor.

_____

_____

18. It also is possible for suction pressure to rise higher than normal if expansion valve is open. Describe the test for a faulty power element of a thermal expansion valve.

_____

_____

_____

_____

Student's Name_____

Date_____

Approved by_____

COMMON SERVICE OPERATIONS

Key: B I - P 11 - 17A

STUDENT ASSIGNMENT
IN
PLUMBING AND PIPE FITTING

Subject: Common Service Operations

Purpose: To understand the standard and safe practices in the performance of the most common service operations.

Reference: Refrigeration Manual - Trane, Chapter XXIV.

Introductory Information: Maintenance and service operations require a great deal of experience. The serviceman must be able to "diagnose" the trouble, as well as be able to remedy it in the most economical and efficient manner. The information provided in the reference is the result of much experience and knowledge. Follow the text carefully and make a habit of following these procedures and deviate only when authorized by responsible people.

Directions: Study the reference carefully and answer the following questions:

1. Describe the basic procedure for pumping down a refrigeration system.

a. _____

_____

b. _____

_____

c. _____

_____

d. _____

_____

COMMON SERVICE OPERATIONS

Key: B I - P 11 - 17A
Page 2 of 4

2. Why is it advisable to let the refrigerant lines warm up to the temperature of the surrounding air before disconnecting and exposing to the atmosphere?

_____

_____

3. Describe the procedure for the replacement of a new part after the old one has been removed.

_____

_____

_____

4. How should the manual valves be manipulated when starting up after repair part has been installed and the machine is ready to start?

a. _____

b. _____

c. _____

5. In low side charging, where is the charging line connected?

_____

6. How is the charging line purged? _____

_____

_____

7. What should be the position of the refrigerant drum when charging from the low side and why?

_____

_____

8. How is it recommended that a drum should be warmed when necessary for the refrigerant to flow into the system?

_____

9. Upon inspection of the compressor seal the surface is found to be free of scratches or grooves. How is it prepared for replacement?

_____

_____

10. How is it possible to remove the head of the compressor without pumping down the entire system?

_____

_____

11. When removing the head of the compressor, why is it advisable to leave two bolts with which to remove the head cautiously?

_____

_____

12. List two methods of removing air from the compressor when only the compressor has been pumped down.

a. _____

_____

b. _____

_____

13. Define a non-condensible gas. _____

_____

COMMON SERVICE OPERATIONS

Key: B I - P 11 - 17A
Page 4 of 4

14. What is the most common non-condensible gas which is a hazard to the refrigeration system?

_____

15. In a system with a water cooled condenser, why is it advisable to keep the condenser water running for a time after the compressor is stopped?

_____

_____

16. What is the proper procedure for the actual purging of the air from the system?

_____

_____

VT 009 974
Piping Specification for Plan No. 3615, The Girdler Corporation, Gas Processes Division for the Construction of Liquid Hydrocarbon Desulfurization Plant.

Texas A and M Univ., College Station. Engineering Extension Service
Texas Education Agency, Austin. Vocational Industrial Education
Texas State Joint Apprenticeship Committee for Plumbing and Pipe Fitting
MF AVAILABLE IN VT-ERIC SET.
Instructional Materials Production, Engineering Extension Service, Texas A and M University, F.E. Drawer K, College Station, Texas 77843.
PUB DATE - ND 29p.; Reference for Workbook No. 25 of Instructional Material for Apprentice Training in the Plumbing and Pipe Fitting Industry of Texas.

DESCRIPTORS - *RESOURCE MATERIALS; *TRADE AND INDUSTRIAL EDUCATION; *APPRENTICESHIPS; *PLUMBING; *SPECIFICATIONS

ABSTRACT - These specifications are for use with the related workbook, VT 010 012 (also in this issue), as part of an apprenticeship program for plumbers and pipe fitters. Following general information, the bulletin provides specifications and plans for construction of a hypothetical liquid hydrocarbon desulfurization plant. (AF)

VT 009 974

ED0 45856

PIPING SPECIFICATIONS
for
PLAN NO. 3615
THE GIRDLER CORPORATION
GAS PROCESSES DIVISION

For the Construction of
LIQUID HYDROCARBON DESULFURIZATION PLANT

U.S. DEPARTMENT OF HEALTH, EDUCATION
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Reference for
WORKBOOK NO. 25
of
INSTRUCTIONAL MATERIAL
for
APPRENTICE TRAINING
in
THE PLUMBING & PIPE FITTING
INDUSTRY OF TEXAS

ENGINEERING EXTENSION SERVICE
Texas A&M University System
cooperating with
VOCATIONAL INDUSTRIAL EDUCATION
Texas Education Agency

and

Texas State Joint Apprenticeship Committee
for Plumbing & Pipe Fitting

VT009 974

3-68-200

GENERAL NOTES

1. Thickness of lines larger than 18" will be specified on P & ID.

2. All pipe shall be of thickness shown except where design to the A.S.A. Code stresses requires heavier weight pipe. All welding fittings shall be of thickness at least equal to pipe.

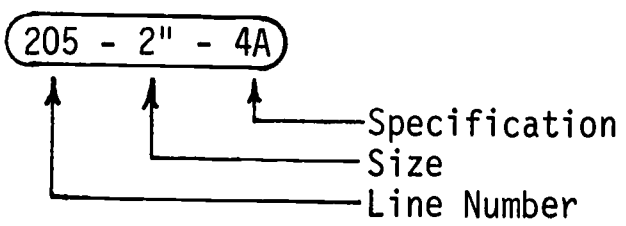
3. Five (5) diameter or greater radius bends will be used where pressure drops are critical, otherwise use weld ells or miters.

4. Water drain lines which may handle water containing caustic or ammonia are under Specification 3; other drains should be specified according to service.

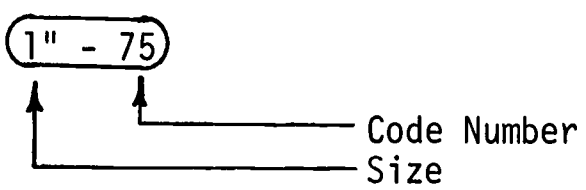
5. Item No's. shown on W.N. flanges (regular or orifice) only apply for bores to match standard range of pipe schedules (1 1/2" & smaller - Sch. 80, 2" - 6" Sch. 40, 8" - 12", Sch. 30, 14" & larger, Sch. 20). Other bores require special numbers.

6. Drains from process vessels should be Specification 4A, 4B, 5A, 5B, 8A, or 8B to&including the first valve.

7. Line numbers will be coded thus:



8. Pipe, valves, fittings will be coded thus:



9. When purchasing valves, fittings, etc., order shall read - Catalog number shown or equal. Where no substitute is permissible, drawings, bills of material and orders should so state.

10. Plug Valves should be ordered complete with wrenches and capscrews or studs where these are required.

11. Orifice flanges should be ordered in pairs, tagged with instrument number.

12. These specifications are a guide to general piping practice. Special fittings required for unusual cases not indicated.

13. Pipe schedule numbers and specs shown are minimum standards. If substitutions are required because of availability, equal or better grades will be purchased. These substitutions are apparent from piping list of material and they will not be indicated on layout drawing.

14. Swaged nipple (73) (t.b.e.) may be substituted for (75) (t.s.e.) by cutting off threads.

15. Substitute items (600) (700) and (800) for (691) (791) and (891) respectively for water lines above the frost line.

16. Seal weld all threaded connections except meter manifolds for L.P.G. butane propane 150# steam and hydrocarbons over 100 psig 350°F.

17. Minimum size process piping 3/4 except instrument leads may be 1/2".

* ⚠ 18. Bessemer steel is not acceptable.

⚠ 19. Stress relieve caustic lines operating over 150°F.

⚠ 20. Orifice flanges used on sizes 4" and smaller, throat taps used on lines 6" and larger with slip on flanges. (W.N. Flgs. for 6" - 300# only.)

* Revision number 1

SPECIFICATION - 1

SERVICE

Standard Service Piping
Use for:
Cooling water
Condensate

Air
Raw Water
Instrument leads for the above * See Note (4)

PIPE

2" to 18"
Seamless steel pipe conforming to ASTM A-53 or A-106 or API 5-L Grade A or B

2" - 6" Schedule 40 (4) See
8" - 12" Schedule 30 (3) Notes
Over 12" Schedule 20 (2) (1) (2)

1 1/2" & Smaller
Seamless steel pressure tubing pipe size, conforming to ASTM A-83
Schedule 80 (15) See Note (2) See Note (13) & (18)⚠

Underground Piping
Seamless steel pipe. (Same as above) Somastic coated.
2" - 6" Schedule 40 - (95)
8" - 12" Schedule 30 - (94)
Over 12" Schedule 20 - (93)

VALVES

Plug Valves
None

Gate Valves
1/2" to 2" (201) 150# screwed brass gate valve, solid wedge, rising stem. Crane 431.
3" & larger (691) 125# IBBT flanged, o. s. & y. gate valve, solid wedge, bolted bonnet F & D, ASA, FF. Crane 465

Globe Valves

1/2" to 2" (222) 150# screwed brass globe valve, rising stem, renewable composition disc. Crane 7

(Substitute) (231) 150# IBBT globe valve, inside screw renewable seat & disc, union bonnet, Crane 350 1/2

3" & larger (791) 125# IBBT flange glove valve, rising stem bolted bonnet, F&D, ASA, FF. Crane 351. See Note (15)

Check Valves

1/2" to 2" (242) 150# screwed brass horizontal check valve, union cap, renewable composition disc. Crane 27.

3" & larger (891) 125# IBBT flanged swing check valve, bolted cap, F&D, ASA, FF metal disc. Crane 373

FLANGES

6" & smaller - Weld Neck

8" & larger - Normally Slip-on

(500) ASA 150# forged steel blind flange, F & D, ASA 1/16" RF.

(400) ASA 150# forged steel slip-on flange, F & D, ASA 1/16" RF (use only where required by layout)

(300) ASA 150# forged steel welding neck flange, F & D, ASA 1/16" RF.

(380) ASA 300 # forged steel WN orifice flanges, complete with studs, Jackscrews & gaskets, F & D, ASA 1/16" RF. (Order in Pairs) See Note (11), (20)⚠

BOLTS

1" & smaller

Carbon Stl. Machine bolts with ASTM A - 194. Class 2H nuts

1 1/8" & larger

Material Spec. 9 B-7 Allow studs with ASTM A - 194 Class 2H nuts

GASKETS

1/16" asbestos composition ring gasket

FITTINGS

2" & smaller

300 # malleable iron screwed fittings

⚠(101) 90° elbow

⚠(121) tee

⚠(111) 45° elbow

(180) bar stock plug (steel)

(73) XH swaged nipple, t.b.e. See Note (14)

2" or larger

Seamless steel welding fittings, standard weight

(1040) long radius 90° weld ell
(1041) short radius 90° weld ell
(1042) 45° weld ell

(1048) concentric reducer
(1049) eccentric reducer
(75) XH swaged nipple TSE
(1046) reducing welding tee
(1080) reducing weld ell

See Notes (2) & (3)

UNIONS

2" & smaller (165)

300# malleable iron union, brass to iron seat.

2 1/2" & larger

Use flanges

COUPLINGS

3000# forged steel couplings (133)

NIPPLES

Extra heavy (sched. 80) pipe nipples (71) t.b.e. (72) t.o.e.

JOINTS

1 1/2" & smaller

Screwed or welded depending on field conditions.

2 1/2" & larger

All welded or flanged

2" all welded except scd. fittings may be used in the piping at valve or in valve & steam trap manifolds.

SPECIFICATION - 1A

SERVICE

Drinking Water

Instrument air in control house

PIPE

Standard weight galvanized welded steel pipe, conforming with ASTM A-120. 2" Max. line size (91). See Note (13)

VALVES

Same as Specification 1 except No Flanged Valves 2" screwed valves may be used.

FLANGES

None

BOLTS

None

GASKETS

None

FITTINGS

150# banded malleable iron galvanized.
(100G) 90° elbow
(110G) 45° elbow
(120G) tee
(150G) cap
(140G) reducer

UNIONS

(165G) 300# malleable iron ground joint union, brass to iron seat, galvanized.

COUPLINGS

300# F. S. Galvanized (133G)

NIPPLES

Extra heavy galvanized pipe nipples. (71G) t.b.e.

JOINTS

Screwed

SPECIFICATION - 1B

SERVICE

Standard Service Piping
40# Process steam (Not including header isolating block valves which must be steel.)

PIPE

Same as Spec. 1

VALVES

Gate Valves
1/2" to 2" (204) 300# screwed brass gate valve, rising stem. Crane 622E 3" & larger, Same as Spec. 1

Globe Valves
1/2" to 2" (224) 300# screwed brass globe valve rising stem. Regrinding type Disc. Crane 362E
3" & larger, Same as Spec. 1

Check Valves
1/2" to 2" (244) 300# scd. brass horiz. check valve un. cap regrinding type disc. Crane 74E
3" & larger, Same as Spec. 1

FLANGES

Same as Spec. 1

BOLTS

Same as Spec. 1

GASKETS

Same as Spec. 1

FITTINGS

Same as Spec. 1

UNIONS

Same as Spec. 1

NIPPLES

Same as Spec. 1

JOINTS

Same as Spec. 1

SPECIFICATION - 3

SERVICE

Special Service Piping

Use for:

Drain lines which may handle water containing caustic or ammonia. See Notes (4) & (6)

PIPE

Same as Spec. 1

VALVES

Gate Valves

1/2" to 1 1/2" (214) 600# forged steel, screwed gate valve, union bonnet, 12% chrome trim. Chapman 960.

2" & larger (690) 125# all iron, flanged o.s. & y., gate valve, solid wedge, bolted bonnet, F & D ASA, FF. Crane 475 1/2

Globe Valves

1/2" to 1 1/2" (230) 150# all iron screwed plug globe valve, inside screw, rising stem, renewable seat, & disc, union bonnet, iron seat & disc. Crane 355 1/2

2" & larger (790) 125# all iron flanged globe valve bolted bonnet, F & D ASA, FF. Crane 351 1/4

Check Valves

1/2" to 1 1/2" (252) 250# W.O.G. all iron screwed swing check valve Regrinding Type Disc. Walworth 904

2" & larger (890) 125# all iron flanged swing check valve, bolted cap, F & D, ASA, FF. Crane 373 1/2

FLANGES

Same as Spec. 1

BOLTS

Same as Spec. 1

GASKETS

Same as Spec. 1

FITTINGS

1 1/2" & smaller

300# M.I. scd. fittings. Same as Spec. 1

2" & larger

Smls. stl. welding fittings Std. wt. Same as Spec. 1

UNIONS

(161) 300# all iron screwed union

COUPLINGS

Same as Spec. 1

NIPPLES

Same as Spec. 1

JOINTS

1 1/2" & smaller
Scd. or welded depending on field conditions.
2" & larger
All welded or flanged.

SPECIFICATION - 4A

SERVICE

ASA 150# Carbon Steel Piping
Use for:
Process lines within ASA 150# rating & below 450° F.

Fuel oil
Fuel gas

Instrument leads for the above

40# superheated steam

Hot Treated Water

PIPE

2" to 18"
Seamless steel pipe conforming to ASTM A-53 or A-106 or API 5-L Grade A or B

2" - 6" schedule 40	4	See Notes (1) (2)
8" - 12" schedule 30	3	
Over 12" schedule 20	2	

1 1/2" & smaller
Seamless steel pressure tubing, pipe size, conforming to ASTM A-83 Schedule 80 (15)

See Notes (13) (16) (17) (18)⚠

VALVES

Plug Valves

(Hypreseal Type) are required in place of Gate Valves in L.P.G. See Note (10)

1/2" to 1 1/2" (276) 300# C.S. Scrd. Lubr. Plug Valve - wrench operated - Nordstrom 2024.

1/2" to 1 1/2" (277) 1500# C.S. (hypreseal) Scrd. Lubr. Plug Valve - wrench operated - Nordstrom 3044.

2" to 4" (900) 150# C.S. Flgd. Lubr. plug valve-wrench operated - ASA - 1/16" R.F. Nordstrom 2025.

6" (973) 150# C.S. Flgd. Lubr. plug valve-wrench operated - ASA - 1/16" R.F. Nordstrom 1965.

2" to 6" (977) 150# C.S. (Hypreseal) Flgd. Lubr. plug valve-wr. operated - ASA - 1/16" R.F. Nordstrom 1945.

8" to 12" (970) 150# C.S. Flgd. Lubr. Plug valve - Gear Operated - ASA - 1/16" R.F. Nordstrom 1989.

8" to 12" (980) 150# C.S. (Hypreseal) Flgd. Lubr. Plug Valve-Gear Oper. - ASA - 1/16" R. F. - Nordstrom 1949.

Gate Valves

Are required for block valves on superheated steam and process lines.

1/2" to 1 1/2" (214) 600# f.s. screwed gate valve, solid wedge union bonnet, 12% chrome trim. Chapman 960.

2" & larger (600) 150# C.S. flanged o.s. & y., solid wedge gate valve, bolted bonnet, 12% chrome trim, F. & D. ASA 1/16" R.F. Crane 47x

Globe Valves

Should be used for throttling, as in control valve by passes or for split flow.

1/2" to 1 1/2" (234) 600# f.s. screwed plug globe valve, union bonnet, 12% chrome trim, Chapman 660.

2" & larger (700) 150# C.S. flgd. globe valve bolted bonnet, 12% chrome trim, F. & D. ASA 1/16" R.F. Crane 143x.

Check Valves

Should be used for protection against reversal of flow.

1/2" to 1 1/2" (254) 600# f.s. screwed horizontal lift check valve. Chapman 680.

2" & larger (800) 150# C.S. flanged swing check valve, bolted cap, 12% chrome trim, T & D ASA 1/16" R.F. Crane 147x

FLANGES

(300) ASA 150# forged steel welding neck flange, F & D ASA 1/16" R.F.
(400) ASA 150# forged steel slip-on flange, F & D ASA 1/16" R.F. (Use only where required by layout)
(500) ASA 150# forged steel blind flange, F & D ASA 1/16" R.F.
(380) ASA 300# forged steel WN orifice flanges, completed with studs, Jackscrews, & gaskets, F & D ASA 1/16" R.F. (order in pairs)

See Note (11) (20)

6" & smaller - Weld Neck
8" & larger - normally Slip-On ⚠

BOLTS

Same as Spec. 1

GASKETS

1/16" asbestos composition ring gaskets.

FITTINGS

1 1/2" & smaller
2000# forged steel screwed fittings or socket welding (102) 90° elbow (122) tee, (112) 45° elbow, (180) bar stock plug, (73) XH swaged nipple, t.b.e.

2" & larger
Seamless steel welding fittings standard weight, (1040) long radius 90° weld ell
(1041) short radius 90° weld ell, (1042) 45° weld ell, (1048) concentric reducer (1049) eccentric reducer, (75) XH swaged nipple, TSE See Note (14). (1046) reducing welding tee, (1080) reducing weld ell. See Notes (2) & (3).

UNIONS

1 1/2" & smaller
2000# forged steel union, steel to steel seat, (162) 2" & larger, use flanges.

COUPLINGS

3000# F.S. (133) Use only as welding bosses.

NIPPLES

Extra heavy (sched. 80) pipe nippled (71) t.b.e. (72) t.o.e.

JOINTS

1 1/2" & smaller, screwed or welded depending on field conditions.
2" & larger, all welded or flanged.

SPECIFICATION - 4B

SERVICE

ASA 150# Carbon Steel Piping
Use for:
Process lines within ASA 150# rating & above 450° F.

PIPE

Same as Spec. 4A

VALVES

Plug Valves
In place of Gate Valves are required for LPG. See Note (10)

1/2" to 1 1/2" (277) 1500# C.S. Screwed lubr. plug valve, wrench operated. (Hypreseal Type) Nordstrom 3044.

2" to 6" (978) 150# C.S. flanged lubr. plug valve wrench operated, ASA small T facing. (Hypreseal Type) Nordstrom 1945.

8" to 12" (982) 150# C.S. Flanged lubr. plug valve, gear operated, ASA small T facing. (Hypreseal Type) Nordstrom 1949.

Gate Valves

Are required for block valves on superheated steam and process lines.

1/2" to 1 1/2" (214) 600# f.s. screwed gate valve, solid wedge, union bonnet, 12% chrome trim. Chapman 960.

2" & larger (601) 150# C.S. Flanged, o.s. & y., solid wedge gate valve bolted bonnet, 12% chrome trim, ASA small T facing. Crane 47x.

Globe Valves

Should be used for throttling as in control valve by passes or for split flow.

1/2" to 1 1/2" (234) 600# f.s. screwed plug globe valve, union bonnet, 12% Chrome trim, Chapman 660.

2" & larger (701) 150# C.S. flanged globe valve, bolted bonnet, 12% chrome trim ASA small T Facing. Crane 143x.

Check Valves

Should be used for protection against reversal of flow.

1/2" to 1 1/2" (254) 600# f.s.s screwed horizontal lift check valve. Chapman 680.

2" & larger (801) 150# C.S. flanged swing check valve, bolted cap, 12% chrome trim, ASA small T facing. Crane 147x.

FLANGES

T (301) ASA 150# forged steel welding neck flange, ASA small T & G facing G (302)

T (401) ASA 150# forged steel slip-on flange, ASA small T & G facing to 750° F. G (402) (Use only where required by layout)

T (501) ASA 150# forged steel blind flange, ASA small T & G facing. G (502)

(381) ASA 300# forged steel WN orifice flanges, complete with studs, jack-screws, & gaskets, ASA small T & G facing (order in pairs).

See Note (11) (20) ⚠

6" & smaller - Weld Neck

8" & larger - Normally Slip on

BOLTS

Mat'l. Spec. 9. B-7 Alloy studs with ASTMA-194 Class 2H nuts.

GASKETS

Steel jacketed asbestos for flanges & gate valve bonnet.

FITTINGS

Same as Spec. 4A

UNIONS

Same as Spec. 4A

COUPLINGS

Same as Spec. 4A

NIPPLES

Same as Spec. 4A

JOINTS

Same as Spec. 4A

SPECIFICATION - 4C

SERVICE

ASA 150# Carbon Steel Piping
Use for:
150# Steam to 500° F.

PIPE

Same as Spec. 4A

VALVES

Same as Spec. 4A

FLANGES

Same as Spec. 4A

BOLTS

Same as Spec. 4B

GASKETS

Same as Spec. 4A

FITTINGS

Same as Spec. 4A

UNIONS

Same as Spec. 4A

COUPLINGS

Same as Spec. 4A

NIPPLES

Same as Spec. 4A

JOINTS

Same as Spec. 4A

SPECIFICATION - 5A

SERVICE

ASA 300# Carbon Steel Piping
Use for:
Process lines within ASA 300# rating, & below 450° F, including instruments leads, except for LPG.

PIPE

Same as Spec. 4A

VALVES

Plug Valves None

Gate Valves
Are required for block valves except on Propane & Butane lines.

1/2" to 1 1/2" (214) 600# f.s. screwed gate valve, solid wedge, union bonnet, 12% chrome trim. Chapman 960.

2" & larger (610) 300# C.S. flanged o.s. & y., solid wedge gate valve, bolted bonnet, 12% chrome trim, ASA 1/16" R.F. Crane 33x.

Globe Valves
For throttling.

1/2" to 1 1/2" (234) 600# f.s. screwed plug globe valve, union bonnet, 12% chrome trim. Chapman 660.

2" & larger (710) 300# C.S. flanged globe valve, bolted bonnet, 12% chrome trim, F & D, ASA 1/16" R.F. Crane 151x.

Check Valves
For Non-reversal of flow.
1/2" to 1 1/2" (254) 600# f.s. screwed horizontal lift check valve. Chapman 680.
2" & larger (810) 300# C.S. flanged swing check valve, bolted bonnet, 12% chrome trim. F & D, ASA 1/16" R.F. Crane 159x.

FLANGES

(310) ASA 300# forged steel welding neck flange, F & D, 1/16" R.F.
(410) ASA 300# forged steel slip-on flange, F & D, 1/16" R.F. (Use only where required by layout)
(380) ASA 300# forged steel orifice flanges, complete with studs, jack-screws & gaskets, F & D, ASA 1/16" R.F. (order in pairs)

See Note (11) (20) ⚠

6" & smaller - Weld Neck
8" & larger - Normally Slip-On

BOLTS

Same as Spec. 1

GASKETS

1/16" asbestos composition ring gaskets

FITTINGS

Same as Spec. 4A

UNIONS

Same as Spec. 4A

COUPLINGS

Same as Spec. 4A

NIPPLES

Same as Spec. 4A

JOINTS

Same as Spec. 4A

SPECIFICATION - 5B

SERVICE

ASA 300# Carbon Steel Piping

Use for:
Process lines with ASA 300# rating & above 450° F.

PIPE

Same as Spec. 4A

VALVES

Plug Valves
In place of Gate Valves are required for LPG, See Note (10)

1/2" to 1 1/2" (277) 1500# C.S. screwed, lubr. plug valve, wrench operated. (Hypreseal Type) Nordstrom 3044.

2" to 6" (979) 300# C.S. flanged, lubr. plug valve, wrench operated, ASA small T facing, (Hyperseal Type) Nordstrom 2045.

Gate Valves
Are required for block valves except on LPG lines.

1/2" to 1 1/2" (214) 600# f.s. screwed gate valve, solid wedge, union bonnet, 12% chrome trim. Chapman 960.

2" & larger (611) 300# C.S. flanged o.s. & y., solid wedge gate valve, bolted bonnet, 12% chrome trim, ASA small T facing. Crane 33x.

Globe Valves
For throttling.

1/2" to 1 1/2" (34) 600# f.s. screwed plug globe valve, union bonnet, 12% chrome trim. Chapman 660.

2" & larger (711) 300# C.S. Flanged globe valve, bolted bonnet, 12% chrome trim, ASA small T facing. Crane 151x.

Check Valves
For non-reversal of flow.

1/2" to 1 1/2" (254) 600# f.s. screwed horizontal lift check valve. Chapman 680.

2" & larger (811) 300# C.S. flanged swing check valve, bolted bonnet, 12% chrome trim, ASA small T facing. Crane 159x.

FLANGES

T (311) ASA 300# forged steel welding neck flange, ASA small T & G facing. G(312)

T (411) ASA 300# forged steel slip-on flange, ASA small T & G facing (slip-on limited to 750) G(412)

(381) ASA 300# forged steel orifice flanges, complete with studs, jack-screws & gaskets. ASA small T & G facing. (order in pairs)

See Note (11) (20) ⚠

6" & smaller - Weld Neck
8" & larger - Normally Slip-On (to 750°)

BOLTS

Same as Spec. 4B

GASKETS

Steel jacketed asbestos

FITTINGS

Same as Spec. 4A

UNIONS

Same as Spec. 4A

COUPLINGS

Same as Spec. 4A

NIPPLES

Same as Spec. 4A

JOINTS

Same as Spec. 4A

SPECIFICATION - 8A

SERVICE

ASA 150# Alloy Steel Piping

Use for:

Process lines within ASA 150# rating, including instrument leads.

For corrosive services.

PIPE

All Sizes

Alloy steel pipe conforming to AISI #347
1 1/2" & smaller, schedule 80 (45)
2" - 4" schedule 40 (44)
6" & larger - 1/4" Wall (42)

See Notes (13) (16) (17)

VALVES

Plug Valves None

Gate Valves

For block valves.

1/2" to 1 1/2" (215) 600# f.s. screwed gate valve. solid wedge, union bonnet, meeting ASTM A-182 Grade F-5. Chapman 960.

2" & larger (671) 150# cast alloy steel flanged gate valve o.s. & y., solid wedge, bolted bonnet, body & trim 5 chrome-moly. ASA small T facing, ASTM A-157 Grade C-5a. Chapman 150.

Globe Valves

For throttling

1/2" to 1 1/2" (235) 600# f.s. screwed plug globe valve, union bonnet, ASTM A-182 Grade F-5. Chapman 660.

2" & larger (771) 150# cast alloy steel flanged globe valve, bolted bonnet, body & trim, 5 chrome-moly, ASA small T facing, ASTM A-157 grade C-5a. Chapman 153.

Check Valves

For non-reversal of flow.

1/2" to 1 1/2" (255) 600# f.s. screwed horizontal lift check valve. ASTM A-182, Grade F-5. Chapman 680.

2" & larger (871) 150# cast alloy steel flanged check valve, bolted cap, body & trim 5 chrome-moly, ASA small T facing. ASTM A-157, Grade C-5a. Chapman 151A.

FLANGES

A. S. A. Forged Carbon Moly Van Stone Flange (ASTM A-182, Gr. F-1) with Cr.-Ni., (A.I.S.I., Type 347) Van Stone Lap Nipples.

(587) 150# flange
(1096) nipple-sm. Tg. facing
(1097) nipple-sm. Gr. facing

BOLTS

Material Spec. 9
B-7 to 850°
B-14 over 850°

GASKETS

Steel jacketed asbestos

FITTINGS

Seamless alloy steel, AISI # 347 fittings, standard weight.
(1090) long radius 90° weld ell
(1091) 45° weld ell
(1092) conc. weld reducer
(1098) weld tee

See Notes (2) & (3)

1 1/2" & smaller 2000# F.S. Allow scrd. AISI Type 3471
(105) 90° elbow
(115) 45° elbow
(125) Tee
(155) Cap
(145) Reducer

UNIONS

1 1/2" & smaller 2000# forged steel, AISI type 347, ground joint union (167)

2" & larger, use flanges

COUPLINGS

3000# forged Alloy Steel - A.I.S.I. Type 347 (136)
Use only as Weld Bosses

NIPPLES

Make from pipe in field

JOINTS

Same as Spec. 4A

SPECIFICATION - 8B

SERVICE

ASA 300# Alloy Steel Piping
Use for:
Process lines within ASA 300# rating, including instrument leads.

For Corrosive services.

PIPE

Same as Spec. 8A.

VALVES

Plug Valves None

Gate Valves

For block valves.

1/2" to 1 1/2" (215) 600# f.s. screwed gate valve, solid wedge, union bonnet, ASTM A-182 Grade F-5. Chapman 960.

2" & larger (681) 300# cast alloy steel flanged gate valve, o.s. & y., solid wedge bolted bonnet, body & trim 5 chrome-moly, ASA small T facing, ASTM A-157 Grade C-5a. Chapman 300.

Globe Valves

For Throttling.

1/2" to 1 1/2" (235) 600# f.s. screwed plug globe valve union bonnet, 12% chrome trim, ASTM A-182 Grade F-5. Chapman 660.

2" & larger (781) 300# cast alloy steel flanged globe valve, bolted bonnet, body & trim 5 chrome-moly, ASA small T facing, ASTM A-157 Grade C-5a. Chapman 303.

Check Valves

For non-reversal of flow

1/2" to 1 1/2" (255) 600# f.s. Screwed horizontal lift check valve. Chapman 680.

2" & larger (881) 300# cast alloy steel flanged check valve, bolted cap, body & trim 5 chrome-moly, ASA small T facing, ASTM A-157 Grade C-5a. Chapman 301A.

FLANGES

ASA Forged Carbon Moly Van Stone flange (ASTM A-182, Gr. F-1) with Cr. - Ni., (A.I.S.I. Type 347) Van Stone Lap Nipples.

(588) 300# Flange
(1096) Nipple-Sm. Tg. Facing
(1097) Nipple-Sm. Gr. Facing

BOLTS

Same as Spec. 8A

GASKETS

Same as Spec. 8A

FITTINGS

Same as Spec. 8A

UNIONS

Same as Spec. 8A

COUPLINGS

Same as Spec. 8A

NIPPLES

Same as Spec. 8A

JOINTS

Same as Spec. 4A

SPECIFICATION - 11

SERVICE

Ammonia Caustic
Inaccessible lines where screwed fittings are undesirable.

PIPE

1/2" & smaller
Seamless steel pressure tubing, pipe size conforming with ASTM A-83. Sched. 80. (15)

2" - 6" Sched. 80 (5) Seamless steel pipe.

See Note (13) (18) & (19) ⚠

VALVES

Gate Valves

1/2" to 1 1/2" (216) 600# f.s. socket welding gate valve, solid wedge, union bonnet, 12% chrome trim. Chapman 960.

2" & larger, Same as Spec. 4A.

Globe Valves

(236) 600# f.s. socket welding plug globe valve, union bonnet, 12% Chrome trim. Chapman 660.

2" & larger, same as Spec. 4A

Check Valves

(256) 600# f.s. socket welding horizontal lift check valve, Chapman 680.

FLANGES

Same as Spec. 4A

BOLTS

Same as Spec. 4A

GASKETS

Same as Spec. 4A

FITTINGS

3000# forged carbon steel socket welding fittings bored for sched. 80 pipe.

(1070) 90° elbow Crane 1380
(1072) Tee Crane 1381
(1071) 45° Elbow Crane 1382
(1074) Reducer Crane 1387
(1073) Cape Crane 1389
(81) XH Swaged nipple-plain end both ends.

UNIONS

2000# forged carbon steel socket welding union, bored for sched. 80 pipe.
(1076) Vogt. B2220 Series.

COUPLINGS

3000# forged carbon steel socket welding coupling (1075) Crane 1386

NIPPLES

Plain end nipples cut in field

JOINTS

1 1/2" & Smaller - Socket Welded
2" & Larger - all welded or flanged

ERIC

VT 009 975
Pulaski, Richard E.
Theory and Practice of Natural Gas Installation for Apprentice Training in the Plumbing and Pipe Fitting Industry. Workbook No. 9.

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ABSTRACT - This manual on the theory and practice of natural gas installation was prepared by a subject matter specialist for use in plumbing and pipe fitting apprentice training. Contents include information sheets and student assignments covering the topics of natural gas as a fuel, gas piping installation, design and adjustment of gas burners, and venting gas equipment. The manual is illustrated with numerous drawings, diagrams, figures, and photographs, and also includes student progress reports for both student and instructor use. (AW)

VT 009 975

ERIC

ED0 45856

THEORY AND PRACTICE
of
NATURAL GAS INSTALLATION

for

APPRENTICE TRAINING
in the
PLUMBING AND PIPE FITTING INDUSTRY

Workbook No. 9

U.S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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Prepared by

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Plumbing and Pipe Fitting

ENGINEERING EXTENSION SERVICE
Texas A&M University
cooperating with
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1. Vent Installation Handbook, Metalbestos Division, William Wallace Company

2. Transite Flue Pipe
   Johns-Manville

Name:_____

BASIC INSTRUCTION

Apprentice Workbook No. 9

STUDENT PROGRESS RECORD
in
BASIC INSTRUCTION FOR APPRENTICE TRAINING
for the
PLUMBING AND PIPE FITTING INDUSTRY

	Information Sheets	Student Assignments	Date Completed
1. Natural Gas as Fuel	10 pages	4 pages	
2. Gas Piping Installation	19 pages	5 pages	
3. Design and Adjustment of Gas Burners	9 pages	6 pages	
4. Venting Gas Equipment	78 pages	7 pages	

NOTE: Green Sheet for student's notebook
Gold Sheet for instructor's file

Name: _____

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ERIC

Name:_____ Natural Gas as Fuel

Approved:_____ Key: BI - WB9 - 1I

Date:_____

Information Sheet
in
Plumbing and Pipe Fitting

Subject: Natural Gas as Fuel

Fuels are classified generally according to their physical state as solid, liquid or gaseous. Fuels used principally for domestic heating are coal, oil and gas. Other materials such as coke, wood, and kerosene are still used to some extent and in varying applications.

Gas is the most widely used of all types of fuels. In some areas, the availability of gas causes the cost to be such that it cannot compete favorably with other fuels. Very often, however, the advantage of using gas for fuel offsets the higher cost. Some of these advantages are:

1. Availability of gas in almost any quantity upon immediate demand.
2. The absence of firing problems.
3. Simplicity of design of equipment.
4. Longer equipment life.
5. Elimination of smoke, soot and ashes.
6. More accurate automatic temperature control.
7. Ease of combustion control to produce oxidizing, neutral or reducing flame as desired.
8. No necessity of storage.
9. Very little variation in cost.
10. Ease of checking the rate of consumption and cost.
11. Absence of sulphur compounds present in coal and oil, making gas ideal for direct firing in some industries.

Very often gas is compared unfairly with other fuels. It is used in converted and sometimes crude appliances that are not designed to efficiently utilize the available heat. Of great importance in the design and use of gas burning equipment is: Perfect combustion, good insulation and elimination of leakage loss.

Natural gas is the richest of the gases. It contains from 80 to 95 per cent methane, plus other hydrocarbons and traces of carbon dioxide, carbon monoxide and oxygen.

Hydrocarbons are compounds containing only hydrogen and carbon. The various hydrocarbons are made by changing the proportions of hydrogen and carbon. Some of the hydrocarbons are as follows:

Compound	Chemical Formula
Methane	CH_4
Ethane	C_2H_6
Propane	C_3H_8
Butane	C_4H_{10}
Pentane	C_5H_{12}
Hexane	C_6H_{14}
Heptane	C_7H_{16}
Octane	C_8H_{18}

Notice the different combinations of hydrogen and carbon as signified by the formula. Anything in natural gas other than hydrocarbons are regarded as impurities.

Definition of natural gas is a substance occuring in nature in a gaseous form which may be used as fuel. This means that it was not manufactured, but may have been modified slightly.

The heat value of gas is measured in B.T.U. and the unit of gas is the cubic foot.

The average heating value of natural gas is 1000 BTU per cubic foot and specific gravity of approximately 0.60.

The standard cubic foot of gas is one cubic foot of gas saturated with water vapor at a base temperature of 60 degrees Fahrenheit at an absolute pressure of 14.735 pounds per square inch (atmospheric pressure).

The following information will be useful in installations, operation, or maintenance of any natural gas system.

1. In order to be able to use certain charts pertaining to natural gas, it will be necessary to know the specific gravity of natural gas and understand the meaning of Specific Gravity. The definition of Specific Gravity of any substance is a number which tells how many times heavier the given substance is than any equal volume of some standard substance.

Solids and liquids are usually compared to water as a standard while gases are usually compared to air.

The specific gravity of air is taken as 1 (air = 1). The specific gravity of hydrogen is 0.0696, or approximately 7 per cent as heavy as air.

2. Density is referred to as both weight density and mass density. The most commonly used and probably the easiest to understand is the weight density which is defined as: weight per unit volume of any substance.

3. Specific Heat is that amount of heat required to raise the temperature of one pound of any substance one degree Fahrenheit.
Example:

> .214 BTU is required to raise one pound of aluminum 1 degree Fahrenheit; therefore, the specific heat of aluminum is said to be .214.
>
> From this and the definition of BTU, it may be seen that the specific heat of water is one (1).

4. Gas input as the name implies, is the amount of gas in BTU per hour permitted to flow in to an appliance or equipment through a controlling device, as a valve or orifice.

5. Vent sizes are governed by the input of BTU per hour.

Input	Diameter of Vent
75,000	5 inch
100,000	6 inch
200,000	7 inch
300,000	8 inch

6. Minimum requirements for venting of household appliances are as follows: Appliances with an input rating of more than 5,000 BTU must be vented if it is automatically controlled and over 50,000 if manually controlled.

   Any appliance must be vented if the input exceeds 30 BTU per cubic foot of space in the room in which the appliance is installed.

   Example: A room 10' x 10' x 8' contains 800 cubic feet. 800 x 30 = 24,000 (800 cu. ft.) x (30 BTU) = 24,000 BTU input = maximum input allowed for a room 10' x 10' x 8' without a vent.

7. Natural gas consumes an appreciable amount of air when used as fuel in gas heaters. Gas with a heating rate of 1000 BTU per hour uses approximately 9.4 cubic feet of air.

There are certain laws of gases that must be considered when dealing with the various gases. These are natural laws which derive the name from the fact that natural events occur in a certain way, hence the laws of nature.

In making calculations in which the gas laws are used, absolute pressures and temperatures must be used, in other words, to obtain absolute pressure 14.65 must be added to gage pressure and to obtain absolute temperature 460 must be added to degrees Fahrenheit while 273 must be added to degrees Centigrade. (Fahrenheit and Centigrade are the most commonly used temperature scales.) To convert from one to the other, the following formulas must be used: C = 4/9 (F-32), F = 4/9C plus 32, the writer has found it much simpler to remember the one formula 9C = 5F - 160.

Example: What is $43^{o}F$ in ^{o}C?

$$9C = 5F - 160$$
$$9C = (5)(43) - 160$$
$$9C = 215 - 160$$
$$9C = 55$$
$$^{o}C = 55/9 = \underline{6.1}$$

Example: What is 100°C in °F?
9C = 5F - 160 or 5F = 9C plus 160
(9) (100) = 5F - 160
5F = (9) (100) plus 160
5F = 900 plus 160
5F = 1060
°F = 212

Always keep in mind that the freezing point of water is approximately 32°F and 0°C; the boiling point of water is approximately 212°F and 100°C. Therefore, in making temperature conversions, take care to note the correct relation of the temperatures, i.e., the degrees Centigrade will be less than the degrees Fahrenheit.

Charles' Law states that the volume of a gas varies directly with the absolute temperature if the pressure remains constant. This means that the volume of any definite weight of gas under constant. This means that the volume of any definite weight of gas under constant pressure increases or decreases in proportion to the absolute temperature.

Example: If the temperature of a gas is cooled from 1000° to 500°, the volume is decreased one half.

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Boyle's Law: The volume of any given weight of gas at constant temperature is inversely proportional to the absolute pressure.

Example: Double the pressure of a confined gas with the temperature remaining constant and the volume is decreased one half.

Practically, it is almost impossible to compress a gas to one half the original volume without increasing the temperature. By increasing the temperature and maintaining a constant volume, pressures can be increased to dangerous proportions very quickly.

$$P_1V_1 = P_2V_2$$

It would be well to keep this in mind when working with gases in the field. Ordinances and specifications should always be observed when installing gas lines or equipment.

Name:_____

Approved:_____

Date:_____

Information Sheet
in
Plumbing and Pipe Fitting

Subject: Natural Gas as Fuel

*Definitions:

Absolute temperature, zero degrees Kelvin or minus 273.1° Centigrade.

Change of state. Latent heat is the additional heat required to transform a substance from one form to another. The temperature of the substance is not increased during this transformation. The heat required to change a substance from solid to liquid is called the latent heat of fusion. The heat required to change a substance from a liquid to a vapor is called the latent heat of vaporization. For water this amount is 970.4 Btu.

Combustion is a chemical change known as rapid oxidation, or the rapid combining of oxygen with the combustible elements of the fuel employed.

Conduction of Heat. A process by which heat is transferred from a hotter to a cooler portion of a medium without visible motion of the medium.

Convection of Heat. The transfer of heat from one part of a fluid to another by motion of the fluid from the hotter part to the colder. The motion is usually due to the hot, less dense, fluid rising through the colder, denser regions, and thus causing convection currents.

Heat Quantity. Heat quantity is measured by the change of temperature produced. The British Thermal Unit (Btu) is the heat required to raise the temperature of one pound of water at its maximum density one degree Fahrenheit.

Radiation. Radiant heat is of the same nature as light. It can pass through a vacuum.

Specific Heat is the ratio heat to be applied to any substance to raise it one degree Fahrenheit as compared with water. Specific heat is not a constant factor but increases with rise in temperature.

Temperature. Temperature may be defined as the condition of a body which determines the transfer of heat to or from other bodies. There are several units in use. The Fahrenheit unit divides the difference between the melting point of ice and the boiling point of water under ordinary atmospheric pressure in 180 degrees; the first point being 32 and the latter 212° F. The Centigrade unit divides the difference between the melting point of water under ordinary atmospheric pressure in 100 degrees; the first being 0 and the latter 100° C.

Transfer of heat, can be by convection, conduction or radiation.

Conversions:

1 Btu -- Quantity of heat required to raise 1 lb. of water 1°F.
970 Btu required to evaporate 1 lb. of water at 212°F at atmospheric pressure.
1 Boiler hp -- Evaporation of 34.5 lb. per hour at 212°F steam at atmospheric perssure.
1 Boiler hp -- 33,479 Btu.
1 Boiler hp -- 139 sq. ft. of steam radiation
1 Boiler hp -- 222 sq. ft. of hot-water radiation.

FUELS

Fuel oils may be any oil used as a fuel. The U. S. Commercial Standard Specifications for fuel oils classify them for oil burners according to Table 9.

Gas Fuels. Manufactured gases are produced in many ways, the ordinary city gas being carbureted-water gas or retort gas. In some localities, it is mixed with natural gas.

Other gases are blast-furnace gas, a product of blast-furnace operation and low in heat value; blue-water gas, made by forcing steam through a bed of glowing coke or anthracite; carbureted-water gas, a blue-water gas with additional hydrocarbon from vaporized oil; coke-oven gas, a product of distillation of coals at high temperature; oil gas, vaporized oils; producer gas, same process as blue-water gas; and retort gas, sometimes called coal gas, manufactured by distillation of bituminous coal.

Mixed gas is any mixture of natural and manufactured gas.

Natural gas is a mixture of hydrocarbon gases, chiefly methane and ethane. Generally it is colorless and odorless. It has a higher ignition temperature than manufactured gas and requires approximately one cubic foot of air for each 100 Btu. of gas burned. Being so much lighter than air it does not mix readily and, if sufficient turbulence is not provided to insure intimate mixture of gas and air, there is a considerable loss through unburned fuel escaping up the flue.

Fuel Units. The unit for heat measurement with solid or liquid fuels is the pound (avoirdupois), and for gases the cubic foot.

The merchandising units for these fuels are usually the ton for solid fuels, the barrel (42 gallons) for oil, and 1000 cubic feet (mcf) for gas or a therm (100,000 Btu.).

HEAT CONTENT OF FUELS

Gross heat content of coal may vary from 10,000 Btu. per lb. to 14,500 Btu. per lb.

Heating Value of Gas. (Standards for Gas Service, Circular 405 of the National Bureau of Standards). Probably without exception at the present time, all city gas supplies consist of mixtures of a number of individual chemical substances. Natural gas is usually mainly methane with some ethane, propane, butane, etc., all of which are fuels, and some nitrogen, and at times other constituents which are not fuels. Manufactured gas usually contains as important combustible constituents. hydrogen and carbon monoxide, methane, ethylene, and minor amounts of other hydrocarbons (compounds of the elements of hydrogen and carbon). Inert nitrogen and carbon dioxide are also present. Given quantities of each of the combustible constituents produce perfectly definite, but very different, amounts of heat when burned, and any mixture of them produces an amount of heat equal to the sum of the heat available from the individual constituents of the mixture. Consequently, a measured quantity of gas may have any heating value within a wide range, depending upon the proportions in which the various constituents of the mixture are present.

The heating value of a gas is the amount of heat which is given off when a unit quantity of the gas is burned. The heat quantity is expressed in Btu. The unit quantity of gas used is the cubic foot. The heating value is expressed in Btu. per cubic foot.

The total heating value of a gas is the number of Btu. produced by the combustion, at constant pressure, of 1 cu. ft. of gas at 60° F, if saturated with water vapor when the products of combustion are cooled to the initial temperature of gas and air, and when the water formed by combustion is condensed to the liquid state.

The net heating value of a gas differs from the total heating value in that the water formed during combustion remains in the state of vapor. Roughly, the net heating value is usually about 90 per cent of the total.

For the sake of comparison with solid fuels, which are classified by their total heating value, commercial standards for gas are expressed in the same manner.

Observed heating value is an experimental term used to express the actual measured heat. Somewhat less than the actual total heating value.

Most of the gas companies distributing butane and air are sending out a mixture having a heating value of from 500 to 550 Btu. per cu. ft.

Gas Heat Transfer. (Relation between heating value of gas and its usefulness to the consumer, by E. R. Weaver, Technological Papers of the Bureau of Standards, No. 290). The key to the problem lies in the fact that when any of the commercial combustible gases is burned with air under favorable conditions the hottest part of the flame has about the same temperature for each gas. In a few applications all the heat of the gas is directly utilized. In all others, there is an incomplete transfer of the heat of combustion from the flame to some object to be heated, and the efficiency of the transfer depends upon bringing the zone of maximum flame temperature into the most favorable position with respect to the object. When this is done, that is, when the appliance is correctly adjusted, the rate of heat transfer from the flame to the object will remain the same provided the total amount of heat supplied to the region of transfer is the same.

There are in the literature several discussions of this subject based upon more or less theoretical grounds involving the relations between flame velocities, specific heats, the potential heat per unit volume of the gas-air mixtures in correct proportion for complete reaction, dissociation at high temperature, etc. Few, if any, of these discussions are complete, and in view of the uncertain accuracy of some of the important data, such as the specific heats of gases at high temperature, we are justified in avoiding the complication and the uncertainty of a theorectical discussion by considering only directly observed facts.

*Plumbing, Practice and Design, Vol. II, By Svend Plum, 1950, New York, John Wiley & Sons, Inc., pp. 27-30. Reproduced by permission of the publisher.

Name: _____ Natural Gas as Fuel

Approved by: _____ Key: BI - WB9 - 1A

Date: _____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Natural Gas as Fuel

Purpose: To give you a better understanding of the theory of gases and conditions affecting it.

References: Information Sheet BI - WB9 - 1I

Introductory Information: In order to understand the characteristics of gases and the conditions affecting it, you should be familiar with gas laws and other related theory. This will give you a basis for solving problems and help you to understand why gases react as they do under varying conditions. This knowledge plus the experience you will gain on the job will equip you to handle many situations which will be encountered working as a journeyman in Plumbing and Pipe Fitting Industry. Your instructor will give you the benefit of his experience if you are interested.

Directions: Study the reference listed and answer the questions and work the problems. Be sure you understand the theory behind these problems.

Study Questions and/or Problems:

1. What is the definition of natural gas in your own words?

2. How are fuels normally classified?

3. List 5 advantages of natural gas as a fuel.

4. List 5 advantages of natural gas most important to industrial users.

5. List the three factors governing the most efficient and economical use of gas.

6. Define hydrocarbons.

7. How are the various hydrocarbons formed or how do they differ?

8. What hydrocarbon makes up the greater part of natural gas?

   What per cent is usually present in natural gas?

9. List three hydrocarbons with which you are familiar?

   a.

   b.

   c.

10. What is the source of natural gas?

11. Define B.T.U.

12. What is meant by the term "Heating Value of gas"?

13. Define Specific Heat.

14. What is the specific heat of water?

15. In your own words, define gas input.

16. What is the minimum size of a flu that must be used for a heater with a 150,000 BTU rating?

17. What is given as the normal average specific gravity of natural gas?

18. How does the specific gravity of natural gas compare with that of air?

19. What is the maximum input generally allowed for an unvented appliance in a room 12' x 14' with a 9 foot ceiling?

20. An appliance has a rated input of 36,000 BTU. What is the minimum allowance in cu. ft. of a room in which the appliance may be installed without a vent?

21. At a rated 36,000 BTU approximately how much air will be consumed per hour by the appliance?

22. What is meant by gas law?

23. The temperature of a certain weight of gas under constant pressure is reduced from 1200° to 600°. How is the volume affected?

24. The pressure of a confined gas is doubled at a constant temperature, how is the volume affected?

25. If a 3 cu. ft. cylinder with a moveable piston is heated from $90^{o}F$ to $140^{o}F$, what is the new volume of the cylinder, if the pressure is held constant?

26. If the volume of a gas is 1000 cubic feet at 29.3 pounds per square inch absolute, what will the volume be at 14.65 pounds per square inch?

27. If the pressure of a gas is 20 pounds per sq. in. absolute at 50 degrees F., what will the pressure be at 80 degrees F.?

Name: _____

Approved by: _____

Date: _____

Gas Piping Installation

Key: BI - WB9 - 2I

Information Sheet
in
Plumbing and Pipe Fitting

Subject: Meters and Regulators

The accurate measurement of natural gas is made possible by the reaction of gas to standard conditions. In the review of gas laws in a previous assignment, we learned that gases reacted a certain way under certain conditions without variation.

From these Gas Laws we know that the weight of one cubic foot of gas at a certain temperature and pressure will remain the same until one factor is changed. This being true, gas may be measured by specifying the temperature and pressure at which the cubic foot is considered standard. The standard basis for measurement is defined: "The standard cubic foot of gas is the quantity which occupies a volume of one cubic foot at a pressure of 14.65 pounds absolute at a temperature of 60°F". The line pressure and temperature is determined and the gas is metered accordingly. The specific gravity and heat value is also considered when measuring gas at a "base temperature" and "base pressure".

Gas meters are tested to register the volume of gas in cubic feet at a certain pressure. The positive displacement meter commonly used in this country operates on the principle of a series of cylinders to give uniform flow through the meter. As each cylinder is filled, that amount of gas is registered on the dial and discharged to the consumer's line, while other cylinders are at various stages as stated above to insure continuous flow and pressure.

The positive displacement meter is the most familiar type of "iron body or iron cased meter" named thus because of the cast iron case.

The tin case meter as shown in Plumbing Apprentice Training, Fig. 835, page 60 of Vol. VII, is known as a "positive" meter. The action of this meter is motivated by the difference in pressure of the inlet and outlet sides of the meter.

In other words, when a cock on an appliance is opened, the slight pressure drop on that side of the meter causes it to operate and register the amount of gas used.

Positive displacement meters are used for domestic consumers as well as industrial users up to 15,000 to 17,000 cubic feet consumption per hour. These meters may be set side by side in the line where more capacity or flow is needed. This is called a parallel connection.

On high pressure lines, it is often necessary to use a recording pressure gauge in conjunction with the meter. After 24 hours, the average pressure is determined and the amount of gas consumed is calculated accordingly.

Although the journeyman plumber or pipe fitter does not consider himself a meter reader, the meter serves very useful purposes other than the actual determination of overall consumption. It may be said here that the gas meter is considered one of the best known measuring devices so far as continuous accuracy over a long period of time is concerned.

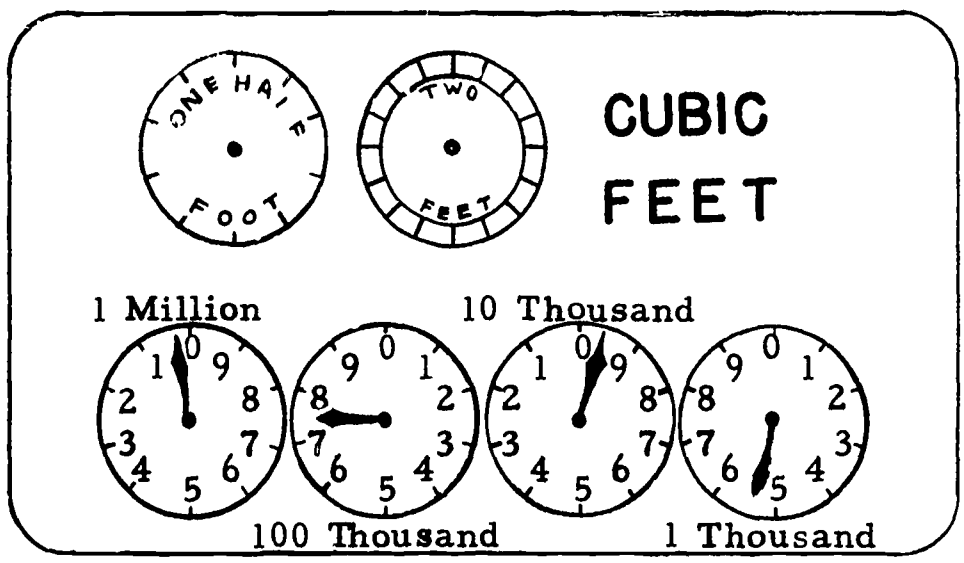

Fig. 1

The dial of a common type of meter is shown in Fig. 1 and Fig. 2. These dials are used by the journeymen for preliminary checks on leaks in a system. The small dials represent two feet or five feet, as the case may be, with each revolution of the hand. These dials may also be used

to check the amount of gas consumed by an appliance or equipment.

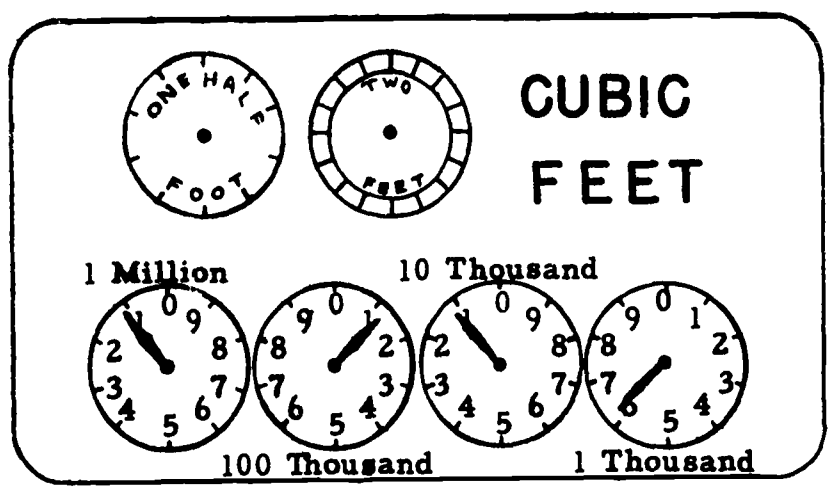

Fig. 2

Example:

A heater rated at 50,000 BTU per hour should use gas at the rate of approximately 50 cubic feet per hour. These figures apply to natural gas with a specific gravity of 0.60 and an average heating valve of 1,000 BTU per cubic feet.

In installations wherein large volumes of gas are to be consumed, the input should be carefully checked. A visual adjustment of a number of burners can cause a waste of gas while on the other hand, the efficiency of the equipment may be greatly reduced because of an insufficient input of gas.

It is possible for a faulty or damaged meter or regulator to cut off or greatly reduce the flow of gas, but this is seldom true. The meter is often blamed for low pressure or pressure drop when the system is actually over-loaded or the building lines are improperly installed.

As stated above, the small dials are used as a preliminary check for leaks in the system and to check the input or consumption of gas. These dials are generally referred to as test dials or hands. They are not considered when taking a reading of the meter.

In Vol. VII of "Plumbing Apprentice Training", meter indexes are illustrated on page 60, Fig. 386. Notice that the first dial to the right is one thousand cubic feet on all of the indexes. The other dials are marked 10 thousand, 100 thousand and one million, except the smaller index which has only 3 dials.

The reading of the index in Figure 2 of this information sheet is read as follows:

"1,000 dial"	500
"10,000 dial"	9,000
"100,000 dial"	70,000
"1,000,000 dial"	-0-
Complete reading	79,500

Start reading from the right to the left. If the smallest dial marked 1 thousand, then add two zeros to the resulting figure. For example, in Figure 2, the dial on the right shows 5, then two zeros will be added, i.e., 500 to complete the reading above. On the ten thousand dial, the hand has passed 9 but has not yet reached zero, then the reading is 9. On the one hundred thousand dial, the hand appears to be approaching 8 but could possibly be just past. To be accurate, check the preceeding or 10 thousand dial and we find that the hand has not reached zero and has not completed a turn. We know then that the hand has not reached eight and will be read as 7. The complete reading being 79,500 since the hand on the one million dial has not reached the number one.

INFORMATION LETTER NO. 48

SUGGESTIONS PERTAINING TO ABOVE GROUND GAS PIPING WITHIN INDUSTRIAL AND COMMERCIAL PREMISES

Issued by
INDUSTRIAL GAS PRACTICES COMMITTEE
Charles C. Eeles*, Chairman

Prepared by

A. D. Frydendall**

To assure satisfactory, efficient, and safe operation of gas equipment, proper gas piping is of utmost importance. The following suggestions regarding piping installation may be of assistance to the engineer faced with the problem of recommending, installing, or supervising gas lines within industrial and commercial premises.

Importance of Rules

All gas piping and the installation thereof should conform to the local ordinances and any regulations established by the Gas Company. Gas should not be turned on unless and until these ordinances and regulations are complied with.

Work Reserved for Authorized Agencies

All gas piping should be approved by the local authority having jurisdiction over such matters. Only authorized employees of the Gas Company should be permitted to install, connect, or disconnect meters, break seals, remove locks, or turn on gas to the premises. Close contact with the Gas Company will facilitate prompt attention to these matters and reduce delays.

Pipe and Fittings

All pipe for building services, risers and fuel lines should be of standard weight (ASA Schedule 40) for pressures up to 125 psig. For higher pressures, piping should be in accordance with the ASA code for Pressure Piping B 31.1.

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*District Industrial Sales Manager, The Ohio Fuel Gas Company, Toledo, Ohio

**The People Gas Light and Coke Company, Chicago, Illinois

Welded joints are preferable, but screwed and flanged joints may be used. Plain end pipe with gland type couplings may be used if the pipe is suitably braced to take care of end thrust. Fittings should be of steel or malleable iron in pipe sizes under 4-inch. For sizes 4-inch and over, fittings of malleable iron, cast iron, steel or welded fittings, either shop and field fabricated, may be used.

Flange gaskets may be either of the full face or ring type and should be made from a standard grade asbestos composition sheet packing. Packing for gland type joints used with plain end pipe shall be of an oil-resistant first grade compounded rubber or approved equal and should have all surfaces clean and free of rust or dirt when installed.

Shut-Off Valves

Shut-off valves should be of either the lubricated plug cock or gate valve type. Cocks other than the lubricated plug type are not recommended in sizes larger than 2-inch.

Emergency Shut-Off Valves

Manual shut-offs, consisting of lubricated plug cocks or gate valves, should be provided in large industrial piping systems and located so as to permit cutting off the gas supply to buildings, ovens, furnaces, etc., in an emergency. These emergency shut-offs should be accessible in event of an accident, and their locations should be posted on building walls or columns.

Unions and Bushings

Unions or bushings should not be used in piping that is to be concealed. Unions should be placed on the burner or appliance side of shut-off valves. Reducing couplings are to be preferred to bushings. Bushings under 2-inch pipe size on the male side should not be used. When bushings are used, they should reduce no less than two pipe sizes, otherwise their wall thickness is inadequate.

Expansion Fittings

When cast iron fittings of either the screwed or flanged type are used on pipe 6-inches and over, suitable expansion bends or gland type couplings should be used to compensate for expansion and contraction. When expansion bends are used, they should conform to good practice in regard to radius, uniformity of curvature, and uniformity of wall thickness. Where gland type couplings are used, they should be located where they can be readily inspected and maintained, and under no circumstances should they be installed in a confined area. Packing designed for gas should be used with gland type couplings.

Supporting Pipe

All piping should be securely fastened and supported with proper hangers at intervals to prevent sagging and trapping. A building service, riser or fuel run should not be hung, strapped or supported from a water, steam, sewer, or other pipe or electric conduit. The practice of supporting pipe on outside building walls should be avoided wherever possible since building settlement may cause sagging or rupture of the line.

Workmanship

All piping should be installed in a neat workman-like manner, free from traps and properly graded down (no less than one inch in twenty-five feet) to risers, drops or to a suitable connection at the appliance.

Where expedient for removal of foreign matter, a tee with a nipple in its bottom opening properly capped may be used in the low point of the line.

After the pipe has been cut and threaded, the ends should be reamed to remove cutter burrs and the entire length of pipe thoroughly swabbed internally to remove chips, oil, scale and dirt before putting in place. Gas piping with threaded joints should be made up with standard tapered pipe threads with an approved pipe joint compound applied to the male thread only.

On welded construction, each length of pipe should be thoroughly swabbed internally before being welded into place and precautions should be taken to prevent welding beads or other projections from remaining inside the pipe.

Test Pipe

A test connection of not less than 3/8 inch pipe size should be installed on a riser or fuel run and a pipe extended so that pressure tests can be made when standing on the floor.

Final Testing and Inspection

Before the piping is finally approved and appliances connected, a test for tightness should be made by the contractor and observed by a qualified representative of the authority responsible for final approval. To test for tightness, the system should be subjected to a test pressure of at least 1.5 times the maximum working pressure, but should hold this bottled up pressure for a period of time depending upon the size of the system but no less than ten minutes without showing any drop in pressure after the test gas in the pipe has been given time to arrive at room temperature.

For test purposes, air or an inert gas such as carbon dioxide, nitrogen or products of combusion (but not oxygen) should be used as a pressure medium. The use of water for testing is not recommended.

After appliances are connected, the piping should stand a pressure of 1.5 times the working pressure but not less than one inch mercury column or 1/2 psig. without showing any drop for a period of at least 10 minutes after room temperature in test gas has been reached.

Piping in Unsatisfactory Locations

Gas piping should not be exposed to varied or sudden changes of temperature, as might be obtained by running through hot air furnaces, cold air ducts, refrigeration room, ice boxes or to any outside exposures where freeze-ups might occur.

Gas piping should not be buried in or under floors of buildings or in places where proper ventilation cannot be provided.

Gas Piping used as Electrical Grounds

Gas piping should not be used as a ground for electrical equipment.

Painting

It is recommended that all gas piping be painted an identifying color in accordance with the approved specifications of the American Standards Association, copies of which are obtainable from the Association at 70 East 45th Street, New York, N. Y.

Subject: Gas Piping and Appliances*

Definitions:

Mains and Service Pipes. Any pipes laid in public highways, private ways, or on rights-of-way owned or leased by the utility, for the purpose of conveying gas in the direction of such highways or rights-of-way, shall be considered as mains.

Any pipes used to convey gas from the mains to the premises of, or to, the piping owned by any customer shall be considered as service pipes.

MINIMUM PRESSURE IN MAINS

Two inches of water column is the traditional minimum limit of pressure for the distribution of manufactured gas in this country. It is the pressure specified in almost all the regulatory ordinances and requirements in effect. No such general agreement appears in relation to natural gas, the pressure of which is usually expressed in ounces per square inch rather than in inches of water column. Two ounces is probably the figure most frequently employed.

One ounce per square inch is equivalent to 1.73 inches of water column. There is a tendency to abandon the expression of gas pressure in ounces.

The great majority of present-day appliances are built to meet the approval requirements of the American Gas Association (also adopted generally as "American Standards" by the American Standards Association). These requirements specify that the appliances be adjusted for test to give their normal ratings at a pressure at the appliance of 3.5 inches of water column with manufactured gas and 7 inches with natural gas. The difference results from the fact that much smaller orifices must be used with natural gas to permit the injection of the percentage of air needed.

The requirements of the AGA for house piping and appliances installation recommend the design of house piping for a pressure drop of 0.5 inches. This must, of course, be added to the pressure at the orifice, making the minimum pressure 4.0 inches for manufactured and 7.5 inches for natural gas.

The problem of selecting suitable minimum pressures for mixed gases of compositions intermediate between those of the usual manufactured and natural gases is most simply solved by making the minimum pressure at the appliance proportional to the heating value. Of course, the minimum pressure is related to the "air requirement" of the gas and not directly to the heating value, but the substantial proportionality between these two properties permits the one to be substituted for the other, as a matter of convenience, in an approximate computation of this kind.

The formula reduced to its simplest terms, is

$$0.4\ H + 0.3$$

where H represents the heating value of the gas in hundreds of Btu. per cu. ft.

Permissible variations in pressure are:

Minimum pressure in inches	Greatest variation permissible, in inches
2 to 3	2
3 to 4	2½
Over 4	3

This schedule has been adopted in several states.

INSTALLATION, MAINTENANCE, AND OWNERSHIP OF SERVICE PIPES

Rules relating to the installation and ownership of service pipes are in as confused a state as those relating to mains. In some cases, the customer pays for the entire cost of the service connection but this is relatively rare. In other cases, the utility pays for and owns the entire service connection. Various rules exist as to the length of service pipe installed without charge to the customers; the most common provisions specify 50 or 100 ft. A large number of companies, possibly a majority, install the entire service pipe, but pay for and own only the portion from the main to the curb, or to the property line. A few companies will install the service pipe only to the property line and require the remainder of the connection to be made by the customer. There is a similar discrepancy in the rules relating to maintenance. In many cases, the utilities specifically provide that they will maintain and repair

only the portion of the service pipe which they own, but the majority will maintain the entire service pipe by whomever it is installed or owned.

The recommended practice is to have the utilities install, own, and maintain all services except those of unusual length.

METERS

B type meters up to 100 lights are used for all domestic, institution and small industrial purposes.

C type meters are used on large installations and whenever the customer receives gas service at an hourly demand rate, so in each case, it is essential to meter all consumption through one meter in order to register on a special indicator the maximum demand during any one hour.

Rotary positive displacement gas meters are used mainly for industrial gas measurements. Because of their unusually wide range of accurate operation they are especially applicable to industrial loads, where such a condition is usually encountered. They are also widely used as station meters and might be considered the standard method of measuring the output of gas plants.

Capacities vary from 4,000 cubic feet per hour to over 1,000,000 cubic feet per hour meter displacement. They are available in cases of different strengths to withstand 25 or 50 and 125 pounds of static pressure. Special meters can be furnished for much higher pressures.

This type of meter has an extremely high capacity with low pressure drop as compared to other types of meters. Thus a single rotary displacement meter occupying less space and having less piping may do the work of a whole bank of the diaphragm type of meters. The rotary displacement meter requires no internal seals of any kind or electric current for its operation. The register furnished with the meter reads rent for its operation. The register furnished with the meter reads directly in cubic feet units at line conditions. If so required, indicating or recording, or integrating, instruments can be attached to the meter which will give a reading correcting to the desired pressure and temperature base.**

**Information furnished by Roots-Connersville Blower Corporation, Connersville, Indiana.

Installation. Gas meters are usually set at the front basement wall where the service pipe enters the building. It should be placed in an easily accessible location. In apartment buildings where there are separate meters to the individual apartments, a separate room should be provided. Such a meter room should be ventilated to the outside, located conveniently to the gas service, and be accessible without passing through any leased portions of the building.

Gas meters must be protected from extreme temperatures. They should not be installed in unprotected or unheated buildings or be placed near furnaces, boilers, or heating pipes that are not properly covered or insulated.

DESIGNING GAS-PIPING SYSTEMS

Without proper adequate house piping, the use of gas is restricted and the selection of the best appliances for a particular installation interfered with. Architects and builders should insist on complete piping for gas in all new buildings. Some may not be aware of the desirability of using gas for all fuel purposes. Future occupants of the same building, however, may wish to install gas appliances, and the expense of subsequent piping of the house will be excessive; thus the lack of adequate house piping in a building may prevent its future lease or sale.

Municipal Regulations Regarding Gas Piping. The installation of gas piping is usually governed by local ordinances and all requirements of the community should be complied with.

General Specifications for Gas Piping. All house piping must be installed so as to grade back toward the inlet, provided, however, that in cases where such grading is impracticable, and it is necessary to grade the house piping away from the inlet, drip pipes of adequate capacity be installed at all points where the house piping is trapped by such changes in grade. Drip pipes must be so located as to be readily accessible at all times. Drip pipes shall not be used as outlets for the attachment of any fixture or gas appliance. Drip pipes at least 6 in. in length must also be placed at the bottom of all vertical pipes which rise from and are connected at the end of a horizontal pipe.

All house piping must be securely fastened in place in such a manner as to maintain the grading and shall not be used for supporting any weight other than lighting fixtures which may be attached thereto.

Pipe ends must be thoroughly reamed after threading before making up.

Piping installed underground, or in places exposed to sudden changes or wide ranges of temperature, must be protected from corrosion with an asphaltic coating or with suitable insulation, as the conditions may require.

All branch outlet pipes shall be taken from the top or sides of running horizontal lines and not from the bottom. No crosses shall be installed on horizontal lines.

Above the basement, pipe shall not be run under beams or floor joists where it will be covered with lath and plastering but shall be run along the top of the beams or joists, so that it will be accessible by removing one or two boards from the floor. Where it is necessary to notch beams or joists, piping shall not be more than 24 in. from the wall or supports below the beam.

No unions, gas cocks, or valves shall be used in concealed work. Every gas cock or valve should be readily accessible for inspection and repair.

Outlets shall extend one inch through finished ceiling, floors, or walls, and either the outlet fitting or the pipe should be securely fastened to the wall or partition. In the case of masonry walls, the walls shall be plugged, either with a wooden plug or with a metal expansion plug. Ceiling drops shall be supported between joists or beams to prevent fixtures from swinging.

After all house piping has been installed and concealed, and before any fixtures or appliances have been attached, a test shall be made, at which time the house piping shall stand an air pressure equal to not less than 6 in. of mercury and the house piping shall hold this air pressure for not less than 10 minutes without a perceptible drop in pressure. When tests are made by official inspector, plumbing contractor shall present certificate certifying that piping complies with all municipal requirements.

Useful Suggestions. The inlet for every house gas-piping system should be located within 30 in. of and above the proposed location for the gas company's gas meter or service gas-piping outlet.

Where two or more systems of house gas piping are installed in the same building, the inlets should be not less than 18 in. apart in a horizontal plane nor more than 24 in. apart in a vertical plane. Each should be plainly and permanently marked with metal tags die-marked to designate the systems.

No house piping should be less than 3/4 in., except ceiling, wall, or floor outlets. If imbedded in concrete no house line should be less than 1 in.

Outlets for cooking appliances should be not less than 3/4 in. and for gas water heaters not less than 1 in. In no instance should the house supply line to the appliance be less in diameter than the inlet on the appliance.

Water heaters and furnaces, or boilers, should have a separate house supply line to each from the meter location, except that water heaters of less than 50,000 Btu. input (i.e., using less than 50,000 Btu.'s per hour) do not require a separate house line.

Sizing of Pipes.***The correct size of gas piping is determined by three factors: the length of the pipe, the allowable pressure drop, and the flow through the pipe.

Step A: Length of Pipe. The length of the pipe may be measured directly, or may be obtained from plans of the building.

Step B: Allowable Pressure Drop. In designing a system of piping, a pressure drop of 0.5 in. water column may be allowed from the meter to the appliance. If the piping includes vertical risers, the tendency of the gas to rise will help it to flow through the pipe. An allowance for this may be added to the 0.5 in. allowable pressure drop. Table 71 shows the increased pressure available due to a vertical rise. (If the gas flows down through a vertical

***This method does not mention friction losses for valves and fittings. The sizing procedure is, however, liberal enough to cover the ordinary number of fittings.

pipe, this pressure should be deducted from the allowable pressure drop.)

Step C: Flow through Pipe. The input to a domestic gas range with a four-burner top may be taken as 62,500 Btu. per hr., and to one with a six-burner top and dual ovens as 107,500 Btu. per hr. The input ratings of other appliances will be found on the nameplates. The input rating of each appliance in Btu. per hour is divided by the heating value of the gas in Btu. per cubic feet to get the input to each appliance in cubic feet per hour. This figure should then be multiplied by the proper factor from Table 72 to allow for the specific gravity of the gas. The pipe sizing table is based on a gas of 0.60 specific gravity. A lighter gas will flow more easily, hence, it is equivalent to a smaller amount of 0.60 gravity gas when it comes to sizing the gas piping. This gives the corrected flow in cubic feet per hour of 0.60 gravity gas.

Step D: Determining Pipe Size. Determine the length of the longest run from the meter to the appliance. Enter Table 73 at the left in the column headed "Length of Pipe Feet" with the next largest figure. Follow to the right along this horizontal line until you come to a pressure drop just less than that obtained in paragraph B. Go down this vertical column to the first flow figure larger than the corrected flow required for each section of this longest run. Go to the left along each horizontal line to get the size of pipe.

Step E: Branches. After determining the sizes of pipe to be used in the longest run, the size of each branch may be determined by entering the table with the length of the branch from the meter to the appliance. Go to the right to the pressure drop next lower than that determined for the branch in paragraph B. Go down to the flow figure next larger than the corrected flow for the branch. Go to the left for the size of pipe for this branch. This process is repeated until the pipe size has been selected for all the branches.

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*Plumbing Practice and Design, Vol. II, By Svend Plum, New York, John Wiley & Sons, Inc. Reprinted with permission of publisher.

Table 69

APPROXIMATE SIZES AND CAPACITIES OF GAS METERS

B TYPE METERS

Size	Size Conn. Iron Pipe	Cap. ½ In.	Width	Depth	Height
3/100	3/8 in.	100	11 3/16 in.	8 1/4 in.	14 1/2 in.
5/150	1/2 in.	150	12 5/16 in.	9 9/16 in.	16 1/4 in.
10/300	3/4 in.	300	14 3/4 in.	11 1/4 in.	18 1/2 in.
20/450	1 in.	450	17 1/4 in.	12 15/16 in.	21 1/2 in.
30/600	1 1/4 in.	600	20 1/4 in.	14 15/16 in.	26 1/8 in.
60/1250	1 1/2 in.	1250	26 5/16 in.	20 3/4 in.	31 3/8 in.
100/1850	2 in.	1850	30 in.	23 1/4 in.	36 3/8 in.
200/3200	2 1/2 in.	3200	37 3/16 in.	30 3/8 in.	42 3/8 in.
500	6 in.	9000	60 3/4 in.	47 in.	66 3/8 in.

TABLE 70

C TYPE METER

Size	Size Conn. Iron Pipe	Cap. ½ In.	Width	Depth	Height
6	1 1/4 in.	600	16 in.	13 in.	19 3/4 in.
11	2 in.	1,100	22 1/4 in.	16 7/8 in.	27 3/4 in.
25	2 1/2 in.	2,500	28 in.	24 1/2 in.	34 in.
40	3 in.	4,000	32 3/4 in.	29 1/2 in.	38 1/2 in.
60	4 in.	6,000	41 in.	35 3/8 in.	45 in.
170	8 in.	17,000	67 in.	60 in.	69 1/2 in.

TABLE 71

INCREASE OF PRESSURE WITH ALTITUDE (AT SEA LEVEL)

Specific Gravity of Gas	Gain in Pressure per Hundred Feet of Vertical Pipe, Inches of Water
0.35	0.96
0.40	0.89
0.45	0.81
0.50	0.74
0.55	0.66
0.60	0.59
0.65	0.52
0.70	0.44

TABLE 72

SPECIFIC-GRAVITY FACTOR

Specific Gravity of the Gas	Factor
0.35	0.77
0.40	0.82
0.45	0.87
0.50	0.91
0.55	0.96
0.60	1.0
0.65	1.04
0.70	1.08

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Gas Piping Installation

Purpose: To point out materials used and necessary precautions in the proper and safe installations of Gas Piping.

References:

1. Information Sheets BI - WB9 - 11 and 2I
2. Any Standard Piping Catalog (Crane or equal)
3. Gas Utilities Docket No. 1, Railroad Commission of Texas, Gas Utilities Division
4. Local City Ordinance
5. Installation of Gas Piping and Gas Appliances in Buildings, American Gas Association, Inc.

Introductory Information: The installation of gas piping is strictly governed by the City ordinances and rules set up by gas companies and company engineers. This is necessary because the improper installation of gas can be very hazardous to the occupants of a house or building as well as the man installing it. Certain simple rules should be followed and the mechanic must have a good knowledge of the characteristics of natural gas.

Procedure: Study the references and become familiar with the information covered before attempting to answer the question.

I. Answer all of the questions in Volume No. VII of "Plumbing Apprentice Training", Chapter 42, pages 58-72.

II. Answer the following questions after studying the information sheets and other references.

A.

1. What is the standard basis for measuring gas?

2. How is this temperature and pressure referred to usually?

3. What factors effect the selection and setting of the meter that is installed in a particular line?

4. What type of meter is referred to as the "iron case" meter?

5. What is the principle of the operation of the meter mentioned in No. 4 above?

6. Approximately what is the capacity of a positive displacement meter in cu. ft. per hr.?

7. What arrangement may be made to take care of volumes of gas over 15,000 to 17,000 cu. ft. per hr.?

8. How is it possible to accurately determine the volume of gas used when there is a great variation in line pressure?

9. What type of meter is the "tin case" meter?

10. What conditions cause the positive meter to operate?

11. Who is responsible for the installations, connection, breaking seals, etc. of a gas meter?

12. What are the specifications for pipe used for gas with pressures up to 125 pounds?

13. What type of fittings are recommended for gas piping under 4"?

14. What allowances are made for fittings for gas piping of sizes 4" and over?

15. How do the recommendations from the American Gas Association compare to your local city ordinance or specifications with which you are familiar?

16. What general type of shut-off valves are used for gas?

17. If it is necessary to use a bushing, what are the limitations?

18. How should a union be locked to prevent unscrewing by vibration?

19. Why is it so important to have hangers properly spaced on a gas line?

20. How much should a gas line be graded?

21. List 5 precautions that should be taken to guarantee or reflect good workmanship in the installation of a gas line.

22. Describe a test procedure when a gas system is installed before appliances are connected.

23. Why is it recommended to avoid exposing gas lines to severe changes of temperature?

24. List two conditions from which underground piping should be protected.

ERIC

The gas that is completely burned liberates all of its available heat but does not necessarily mean that the greatest possible benefit is being derived from the gas. The heat may be dissipated into the air of the room or may escape up a flue causing loss of efficiency as well as increasing the cost of operation.

The most common type of burner used is the Bunsen or blue-flame burner. In this type burner, the gas is introduced into the burner through a small opening known as an orifice. At this point, some air mixes with the gas before it reaches the flame. This is called primary air as noted in Figure 1. The remainder of the air required to complete the combustion is taken from the atmosphere around the flame as it leaves the burner. This is known as secondary air. Gas enters the mixing chamber with relatively high velocity which creates a suction and draws air into the mixture. The amount of air that goes into the mixture must be adjusted to create perfect combustion. The orifice and the natural gas valves may be adjusted either by screwing spud in or out with a wrench, or in case of a fixed orifice, it may be removed and replaced with an orifice with a larger or smaller hole as the case requires.

A properly adjusted flame burns with a steady blue flame which has two distinct parts. It has a pale blue innerpart and an outer part of a darker shade. With the holes in the burners round, these 2 parts are seen as 2 cones, one within the other. A yellow flame from the burner of the blue flame type indicates that the supply of primary air is insufficient. Such a flame not only deposits soot but is very wasteful. This condition can be corrected by opening the air shutter as shown in Figure 1 to permit more air to enter the chamber causing a proper mixture for combustion.

Flames that lift or move away from the burner are usually caused by too much gas pressure or too much primary air. This can be corrected by closing the air shutter or by closing down the gas by adjusting the orifice spud. Lint or dirty burners, particularly in the mixing chamber, will cause the same conditions to exist. This condition can be corrected by cleaning the ports in the burners and in the mixing chamber. Particular attention should be given in the adjusting of Bunsen type burners, particularly of the air. Excess air will dilute the products of combustion and will reduce their temperature and decrease efficiency. An insufficient amount of air will cause poor combustion and undesirable and poisonous gases.

Information Sheet
in
Plumbing and Pipe Fitting

Subject: Design and Adjustment of Gas Burners

When a mixture of gas and air is ignited, the gas burns by uniting chemically with oxygen from the air and this chemical action liberates heat. If the gas is completely burned, all of the available heat is liberated and only water vapor and gas called a carbon dioxide is formed. Carbon dioxide is a non-poisonous gas. It is the same gas that is exhaled from the lungs. If gas flame does not have a sufficient quantity of fresh air or the mixture of gas and air is chilled by coming in contact with a cool surface before all of it has an opportunity to ignite, the gas is not completely burned. As a result, the combustion is incomplete resulting in the loss of available heat. Part of the gas escapes unburned, soot and carbon are deposited and the very poisonous gas, carbon monoxide, is produced.

There are other disagreeable gases that are produced due to poor combustion but are not poisonous, only irritating to the eyes and nostrils. The poisonous carbon monoxide gas has no odor, but as this gas and the other accompanying disagreeable gases are produced under a similar circumstance or condition by appliances that give off bad odors Carbon monoxide is most likely to be present when the gases given off from appliances have bad odors or are irritating to the eyes and nostrils.

Although small quantities of carbon dioxide and water vapor produced by complete combustion are not particularly objectionable, air containing considerable quantity of carbon dioxide cannot be breathed. Also, the water vapor sometimes causes trouble in making the air too moist or by condensing to water form. Condensation of water vapor causes walls to sweat and is injurous to furniture and appliances. It is considered safe to use many gas appliances without flue connection in any well ventilated room. It is always advisable, however, where it is possible, to use a vent on gas appliances. This supplies an outlet for undesirable unburned gases, poisonous gases, or for pure gas that would be liberated into the room in case the heater goes out, and will eliminate much of the moisture that would normally condense on the furniture, walls or windows in the room.

Burners of various appliances and equipment vary in design. It is very important that a burner properly designed for equipment be used. The variation in line pressure may affect the adjustment of the burner. The appliance burns less gas at a low pressure than a normal pressure. This reduces efficiency and produces less heat. In many homes, however, the house piping is too small for adequate service. If the line is over loaded, the pressure will be low in various parts of the house caused by a large appliance robbing another of gas. This is often confused for a low line pressure or improperly operating gas meter. It is the responsibility of the journeymen to know the proper size of a pipe that should be used in a particular house, a commercial building or whatever the installation may be.

The atmospheric or Bunsen type burner consists of the following parts: primary air inlet, a mixing tube, a burner head with a series of gas ports as well as the orifice as mentioned previously. The primary air as described previously is drawn into the mixing tube due to the high velocity of the gas leaving the orifice. These parts are shown in Figure 1. The design and application of a burner has much to do with the efficient use. A knowledge of the design and application of a burner will help the journeyman in the installation of gas burning equipment.

For example, conditions limiting the size of parts for various type burners are governed by the following:

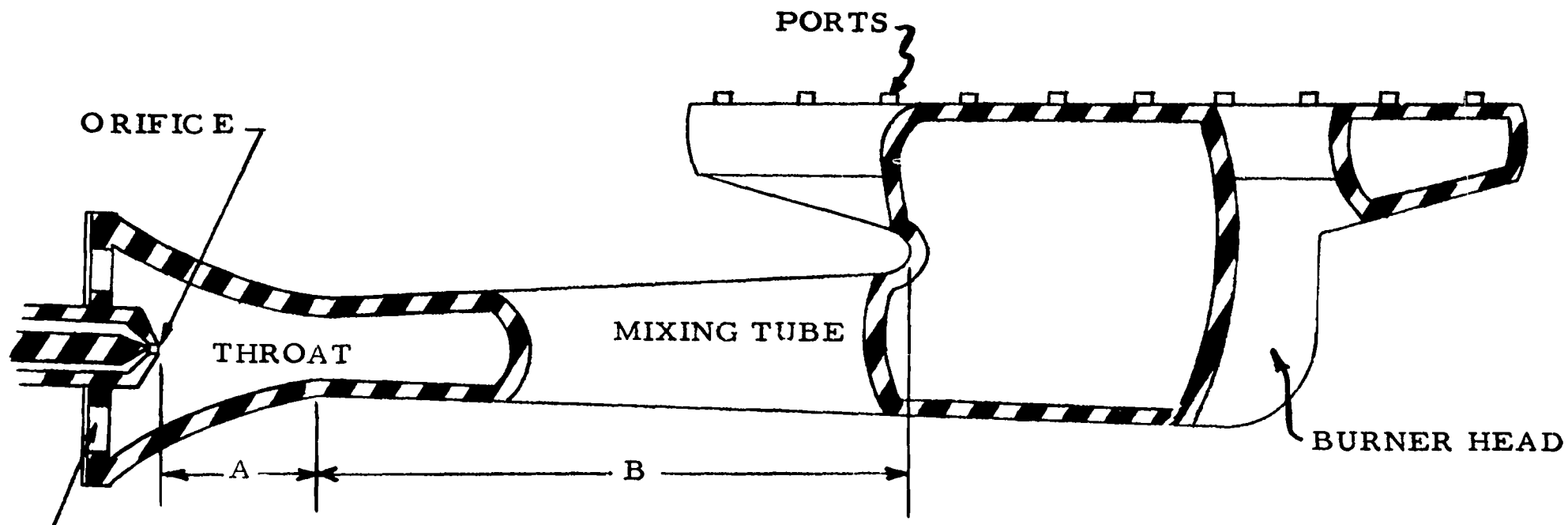
1. Burner must not flash back
2 Burner should not lift from the ports
3. The flames should not have yellow tips

Normally these conditions can be corrected by adjustment. However, it is entirely possible for a burner that has not been designed for a particular application to cause such conditions to exist and would be very difficult to correct by adjustment. Flash back, for example, may be caused by large ports used with low gas pressure or high primary air injection. A condition of blowing or lifting may result from a port size that is too small for given air gas mixture leaving the ports although stable flames might result in larger ports at the same primary injection rate per sq. in. of total area. Also, if the individual ports are too large, yellow tips may be obtained at rates that would be satisfactory to smaller ports thereby lowering the efficiency of the burners.

Primary air as mentioned before, is the air just introduced into the burners, and mixes with the gas before it reaches the burner port. This air is drawn through the primary air opening into the burner mixer head by the flow of gas from the orifice. Controlled primary air is necessary for Bunsen or atmospheric type burners to insure satisfactory flame characteristics. It has been shown by experiment and application that primary air openings of an area of 1/4 to 1/2 times the total burner port area must be provided when designing an atmospheric burner. If insufficient primary air is supplied, free carbon is liberated and a smoking flame is produced. This is corrected very simply usually by supplying the adequate amount of primary air. In the event that too much primary air is supplied to the burner, the flames will tend to lift and blow from the burner ports or flash back. This occurrence must be avoided since it will, in most cases, result in carbon monoxide production and in cases of slight changes of pressure or chemical composition of your gas may cause the flame to lift entirely from the burner ports and be extinguished.

The variations of fuel gases make it necessary to provide a means of primary air adjustment. The varying conditions under which the gas is used causes the amount of primary air to become necessary to be controlled. The more general method of regulating the primary air supply is to employ an adjustable air shutter to the mixer head, shown in Figures 2 and 3. When this method is employed, it is necessary to have the shutter so designed that it may be securely held in any desired position to avoid air leakage between the air mixer and face, and the orifice fitting must be reduced to a minimum. The design of the primary air opening should be such as to reduce stoppage of dust, lint and grease. A near circular primary air opening port has the greatest resistance to grease, lint or dust. The primary air control shown in Figure 2, is satisfactory for most applications but it is not recommended for burners requiring a small amount of primary air injection due to the air slot which will clog with dust, grease, and lint when the shutter is nearly closed. The screw type shutter, shown in Figure 3, is generally used on burners requiring a small amount of primary air injection when approaching a closed position.

The mixing tube should be constructed in the shape of a venturi with a throat area of 40 - 45% of the total port area. That is, the area in which the primary air is introduced, as shown in Figure 2 and 3. The throat should be located approximately 2 times the throat diameter from the gas orifice for good inspiration and mixing.



PRIMARY AIR OPENING
1-1/4 TO 1-1/2 TIMES PORT AREA

A. Approx. 1 1/2 to 2 Throat Diameter
B. At least 6 Throat Diameters
Throat Area - 0.35 to 0.45 Times Port Area

FIGURE NO. I

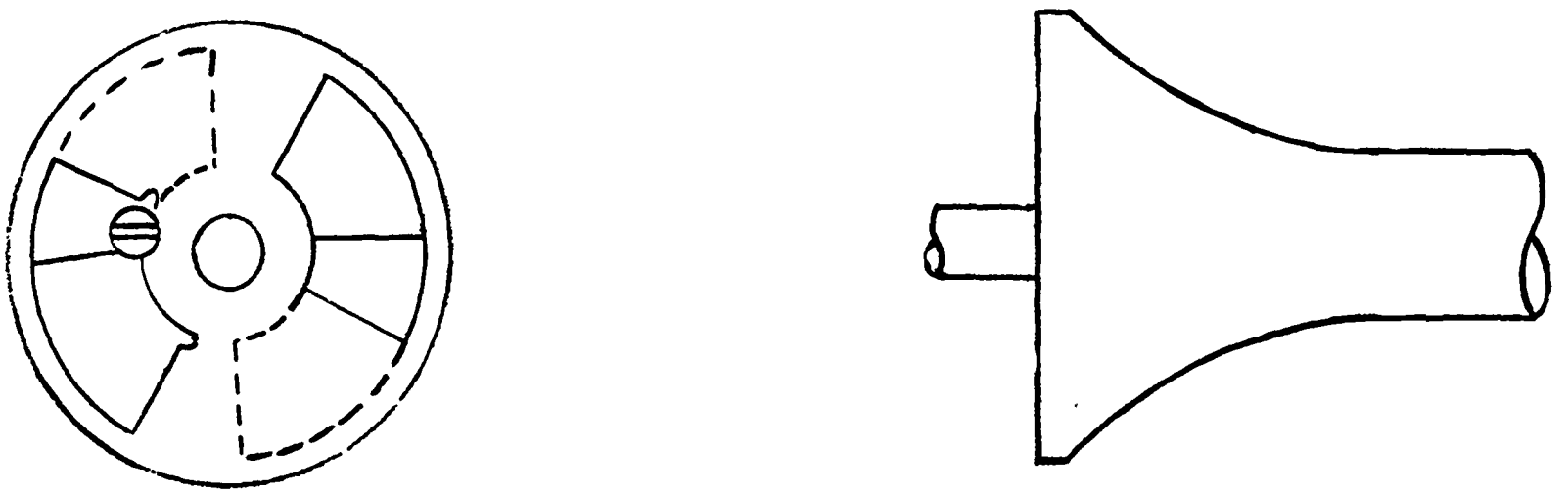


FIGURE NO. 2

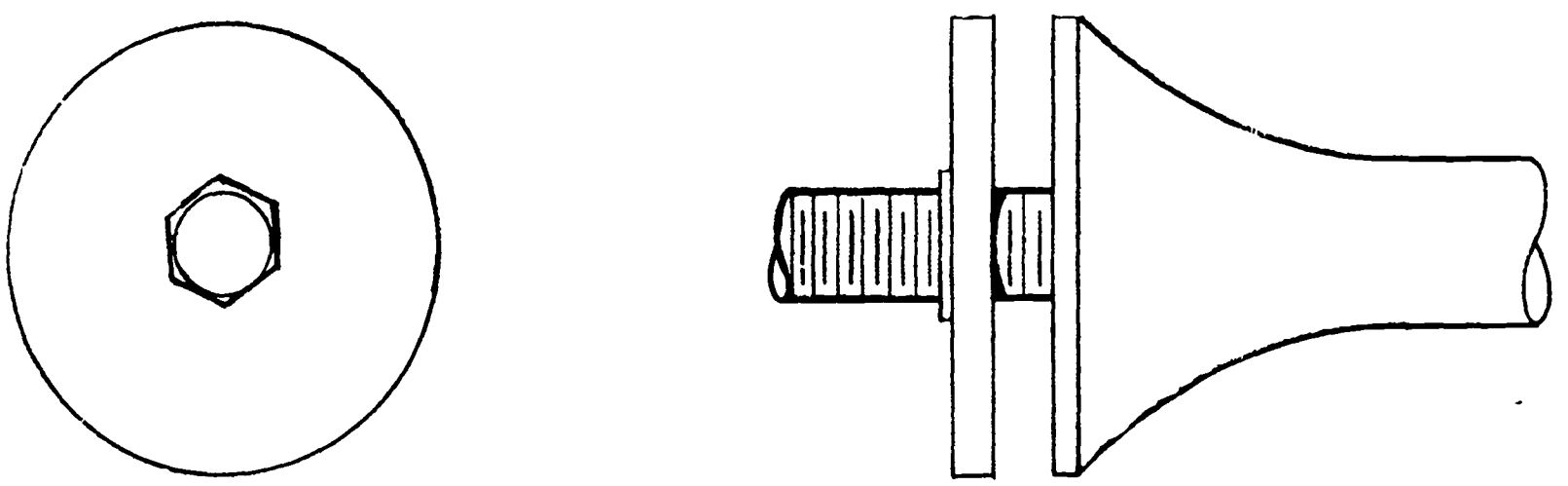


FIGURE NO. 3

This information is worthwhile to a mechanic in the proper application of a burner since a poorly designed burner will affect the efficiency of the equipment.

When gas and air enter a burner, eddycurrents are sometimes set up within the burner. This turbulence slows down the gas and cuts down energy; therefore, the mixing tubes are sometimes set in the mixing chamber to avoid the eddy and cause the gas to go directly into the burner. The length and taper of the mixer beyond the throat should be such that the air-gas stream expands gradually without too much turbulence or abrupt change of directions. This information will show why a particular gas burner cannot be changed or should not be redesigned in the field without sufficient knowledge of the equipment or the burner. A length of 6 throat diameters from throat to burner head assures good mixing of gas and air.

The purpose of the burner orifice is to direct the flow and control the amount of gas to be injected into the burner within a given period of time. The orifice, sometimes known as the spud, is drilled in the end of the hood of the cap. The hood is in turn, screwed onto the outlet of a burner control valve or a nipple fitting. The size of the orifice is determined by the amount of gas required to flow through it in order to meet the BTU per hour input rating of the burner. The test for which we will discuss later.

There are 2 basic types of orifice. The adjustable orifice, as the name implies, is one in which the gas can be regulated by turning the spud on the control valve which will increase or decrease the size of the orifice. The fixed orifice is one having a drilled hole, a given size and cannot be regulated. Many pieces of equipment or appliances are manufactured and designed to operate at a certain BTU input. This is controlled by a set orifice as mentioned above when the orifice size cannot be regulated. It should not be changed without proper authorization by a mechanic or journeyman. Factors affecting the size of an orifice are as follows and it is well for a journeyman to be familiar with them although he should not be expected to be able to design:

1. The rate of input of the burner in BTU per hr.
2. The heating value BTU per cu. ft. of gas being used.
3. The available gas pressure.
4. The specific gravity of the gas.

This information, normally, can be obtained from a local gas company or other authority.

Efficiency tests may be run by a mechanic or journeyman on the job if it is necessary to determine the efficiency or the proper adjustment of the various equipment and it is often wise to do so. The following is a description of a test that may be run by a journeyman on a water heater:

1. Determine the capacity of a water heater, as to the number of gallons of water.
2. Measure the temperature of the water by means of a thermometer having a range from 0° to 212°F.
3. Check the dial readings of the gas meter to make sure that no other appliance is on the test line during the test.
4. Light the gas burner and operate it with the valve full on or full capacity.
5. Operate at full capacity until a temperature of 120°F. is reached. Shut off the gas burner and read the meter.

This test can be performed very simply with the equipment which a journeyman may normally either have in the shop or obtain. The results of the test may be determined by using the following formula:

$$\text{Thermal Eff.} = \frac{(8.34 \text{ lb.})\ (C)\ (140^{o} - IT)}{(FMR - IMR)\ \ (H.V.)}$$

Where
IT = Initial Temperature
C = Capacity of Heater in Gallons
FMR = Final Meter Reading
IMR = Initial Meter Reading
HV = Heat Value of Gas in BTU per cu. ft.
8.34#/gal = Weight of 1 Gal. of Water
BTU = The amount of heat required to raise the temperature of one pound of water 1°F.

After running a test of this kind, a journeyman can appreciate the value of a properly adjusted burner, or the value of thermal efficiency of a gas or of a situation installation.

Thermal efficiency as proven by the formula above is a per cent of available heat in BTU's that has been used under certain conditions.

This information will show the factors concerned in the efficient use of natural gas.

A burner adjusted for safe consumption of gas is not necessarily the most efficient adjustment. Although safety is the primary responsibility of the journeyman pipefitter or plumber, the efficiency in which the installation operates is also partially his responsibility.

Some knowledge of the design and operation of gas burners is essential in the training of the plumbing and pipe fitting apprentices to cause him to realize the importance of the design of equipment. Changes should not be attempted without proper authority or information. For example, the position of a burner has much to do with the safety and efficient consumption of gas.

The foregoing information should point the possibilities as well as some of the limitations as to the installation of gas burning equipment.

Name: _____ Design and Adjustment of Gas Burners

Approved by: _____ Key: BI - WB9 - 3A

Date: _____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Design and Adjustment of Gas Burners

Purpose: To help you realize the value of the knowledge of the composition and characteristics of natural gas and to familiarize you with the various factors concerned in the design and adjustment of gas burning equipment.

References: Information Sheet.

Introductory Information: The installation and adjustment of gas fired equipment requires a certain amount of knowledge as well as experience. The characteristic of natural gas, the factors involved in the design of equipment, the proper adjustment and methods of testing for efficient consumption forms a foundation of information. It will enable you as a journeyman to install, adjust and test equipment and determine the efficiency with which the equipment should operate and run tests which will accurately verify your knowledge of the installation.

Procedure: Answer the following questions and work the problems as instructed below. The instructor will assist you in giving the information practical application.

1. Explain the reaction which causes heat to be generated when a mixture of gas and air is ignited.

2. What gases are formed when a proper mixture of air and gas is ignited?

3. What will likely be the result when the burner of a boiler or water heater is raised high enough for the flame to come in contact with the surface of the tank?

4. How can carbon monoxide be identified or recognized?

5. When obnoxious gases are liberated what is generally the source?

6. What should be done in the installation of gas fired equipment to eliminate excess water vapor, undesirable unburned gases and poisonous gases?

7. How is it possible for a flue or vent to effect the efficiency of an appliance?

8. How is the gas controlled as it enters a Bunson or Blue Flame type burner?

9. Define primary air.

10. What causes the primary air to be sucked into the mixing chamber?

11. How is the flow of gas into a burner with a fixed orifice adjusted?

12. Describe a properly adjusted flame.

13. What is the effect of a yellow flame?

14. How is the efficiency of equipment effected by the use of yellow flame?

15. What can be done to correct the condition causing the yellow flame?

16. List two reasons why the flame may lift or move away from the burner.

    a.

    b.

17. What is the effect of lent or grease in the mixing chamber?

18. List the five essential parts of a Bunsen type burner.

19. List three conditions that govern the design of a burner for a particular application.

    a.

    b.

    c.

20. Under what condition would it be difficult to eliminate flash back in an appliance?

21. List three conditions that may exist when improperly designed burner is substituted in gas burning equipment.

22. What is the proportion of a primary air opening to the total port area of a properly designed burner?

23. In the adjustment of a burner, describe how the following conditions can be corrected?

    a. A smoking flame

    b. Flash back

24. Describe the method of adjusting primary air.

25. What type of primary air opening is found to be more resistant to grease, lint or dust?

26. What type or class of burner generally uses the screw type primary air shutter?

27. What is the approximate throat area of a burner containing 2.5 inches of total port area?

28. In a properly designed burner, what is the distance from the gas orifice to the throat of a burner when the throat diameter is 3/4"?

29. What should be the total distance from the gas port of the same burner to the burner head?

30. How is the BTU per hour input of a burner controlled?

31. Explain the difference between an adjustable orifice and a fixed orifice.

32. What is the purpose of a fixed orifice?

33. List four factors effecting the size of an orifice for a gas burner?

34. What are two factors with which the journeyman is primarily concerned when adjusting a gas burner?

PURPOSE OF VENTING

The purpose of venting a gas appliance is to completely and safely remove all the products of combustion and vent gases to the outside air, without condensation in the vent or spillage at the draft hood.

The chief products of theoretically perfect combustion are nitrogen, water vapor and carbon dioxide, which are produced when a mixture of gas and air is completely burned. The table (Fig. 1) shows the air requirements and combustion characteristics for natural and liquefied petroleum gases. Approximately 240 lbs. of vent gases must be floated out for each 100,000 Btu. of gas burned. Good venting technique enables this to be done completely and safely.

COMBUSTION CHARACTERISTICS OF THE MOST COMMONLY USED GASEOUS FUELS

Type of Gas	Natural Gas Methane (CH_4)	Liquefied Petroleum Propane (C_3H_8)	Liquefied Petroleum Butane (C_4H_{10})
Heat content per cu. ft. (Btu)	1000	2522	3259
Cu. ft. per 100,000 Btu	100	39.65	30.67
Cu. ft. of air required to burn 100,000 Btu			
— perfect combustion only	952.4	944	940
— for combustion plus 50% excess air	1428.6	1416	1410
Cu. ft. of oxygen required for combustion per 100,000 Btu	200	197	199
Products of combustion per 100,000 Btu in cu. ft.			
Carbon dioxide (CO_2) +	100	118.95	122.68
Water vapor (H_2O) +	200	158.6	153.35
Nitrogen (N_2)	752.4	745.76	750
Lbs of H_2O per 100,000 Btu	9.5	7.5	7.2
Gals. of H_2O per 100,000 Btu	1.13	0.898	0.862

Fig. 1 Note: The above table assumes perfect combustion at standard conditions - no excess or dilution air.

PRINCIPLES OF VENT INSTALLATION

To assure correct venting, use a strong, gastight, insulated pipe of sufficient cross-sectional area and net vertical height. This pipe should be capable of quickly establishing and continuously maintaining an upward draft that will safely float all products of combustion up from a gas appliance to the outside air. Avoid the use of any pipe which absorbs within itself a large quantity of heat, or which transmits excessive heat to surrounding surfaces or combustible material.

WHAT GAS EQUIPMENT SHOULD BE VENTED

In general, every appliance that is provided with a fine collar or draft hood should be vented. Conversely, every vented appliance should be provided with a draft hood. The draft hood permits introduction of dilution air and allows for temporary spillage of flue gases in case of back or blocking of the vent.

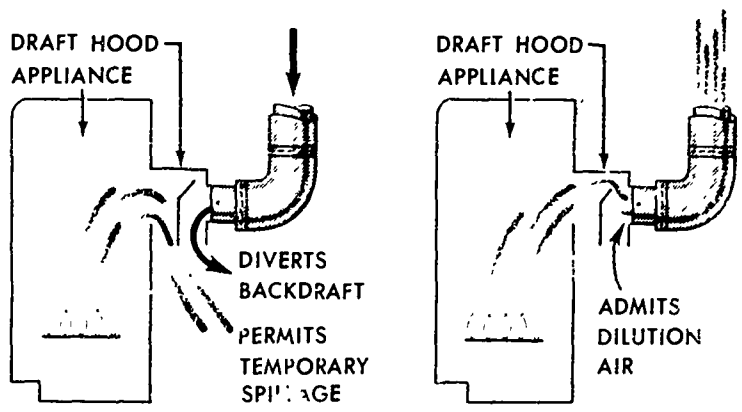


Fig. 2

HOW A GAS VENT OPERATES

The operation of a gravity type vent depends on having the vent gases inside the vent hotter (and therefore lighter) than the surrounding air. This is because the heat content of the vent gases represents the power available to operate the vent. The hotter the vent gases, the lighter they are and the greater is the force that expels them up through the vent. Therefore, the first requirement of a vent is to keep the vent gases hot (Fig. 3).

How well a vent meets this requirement depends on two important factors:

(1) the average temperature of the vent gases inside the vent.

(2) the amount of heat loss through the walls of the vent.

As stated previously, the average temperature inside the vent is significant because it represents the power available to operate the vent. Keeping heat loss to a minimum is important because the lower the heat loss the greater will be the "power" left for venting.

Single-wall, uninsulated vents reduce venting efficiency because they allow excessive heat loss to the surrounding air. Vents made of heavy materials such as cement asbestos or terra cotta also lower inside vent temperatures because they absorb so much heat within themselves. Extensive research and thousands of field installations have proven that Metalbestos - an insulated, double-wall, all-metal vent, assures maximum venting efficiency because it prevents excessive heat loss and maintains higher temperatures inside the vent.

OPERATION OF A GAS VENT

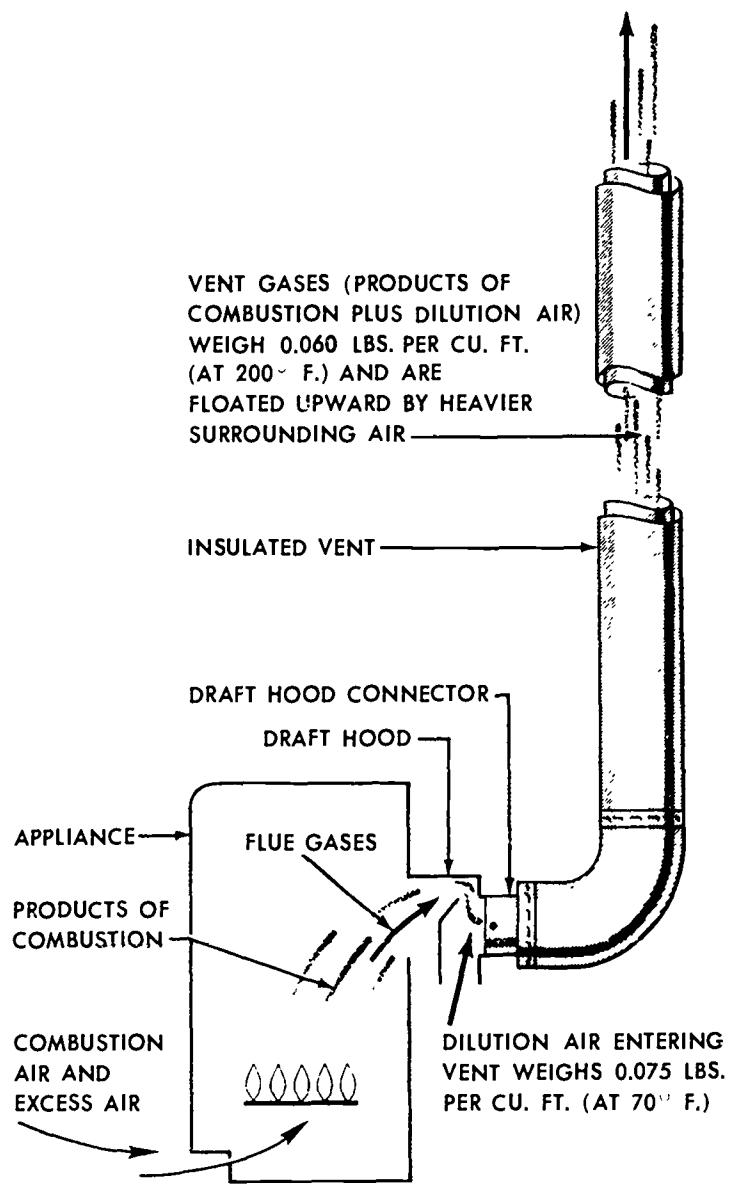


Fig. 3

GENERAL PRECUATIONS

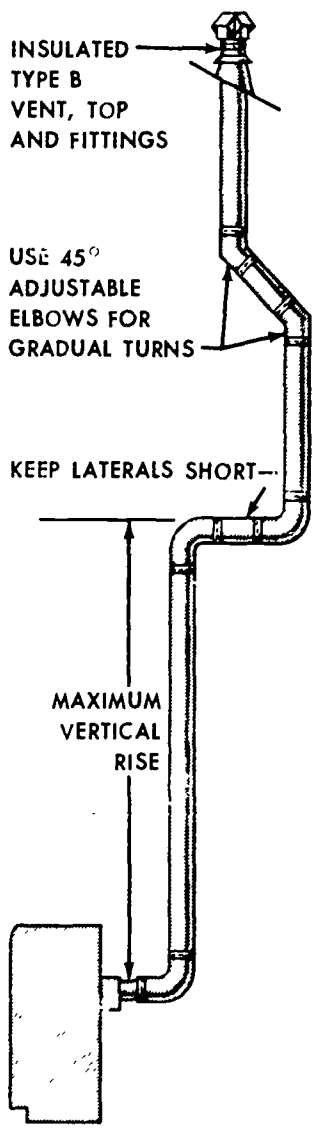


Fig. 4

DO THIS:

Use insulated Type B vent pipe and fittings from the draft hood all the way to the outside. Make as few changes of directions as possible, and when they are necessary, make them gradual.

Install the maximum possible vertical rise right from the draft hood.

When joining two or more vents, use a larger common vent of the proper size (see Page 29). Provide the maximum possible vertical rise for each vent before joining into common vent.

Be sure that the final installation provides a safe, rigid and self-contained venting system from start to finish.

Maintain required clearance from combustible materials at all times.

Comply with local building code requirements.

DON'T DO THIS:

Don't use galvanized or black iron pipe or fittings, or any other substitute for Underwriters' Laboratories approved Type B vents for any part of the installation.

Don't use an unlined masonry chimney for venting gas appliances. Line the chimney with an insulated and approved Type B vent.

Don't connect two or more vents into a common vent without providing the maximum vertical rise possible below the point of connection.

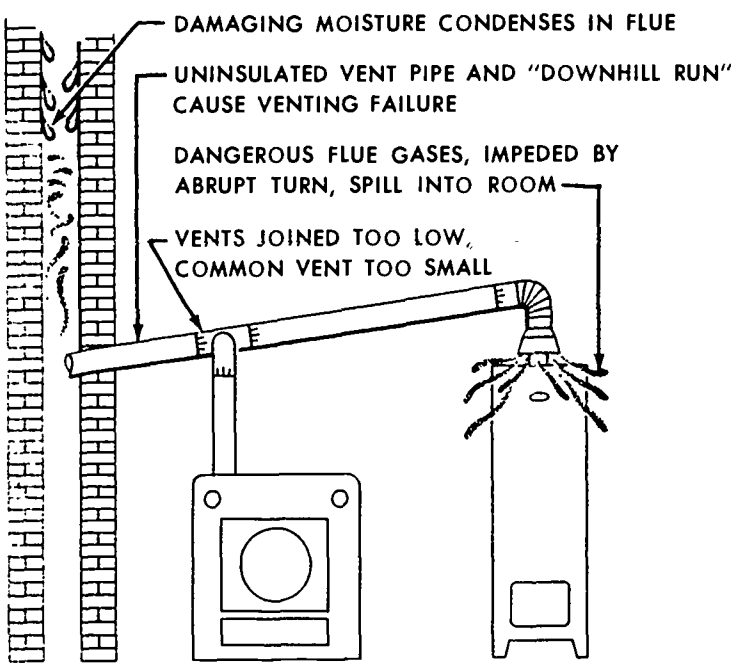


Fig. 5

CORRECT VENT SIZES

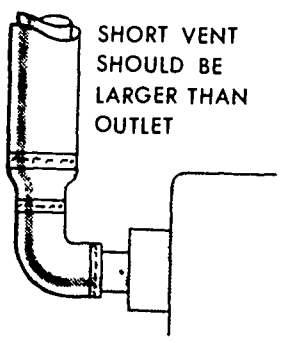


Fig. 6

It is commonly believed that a vent should have a cross-sectional area equal to that of the flue collar or draft hood outlet. However, this is not necessarily true. This commonly accepted rule usually applies only to vents of medium height. In general, vents of very short height should be larger in cross-sectional area than in the area of the flue collar or draft hood outlet, while vents of long vertical height may be of smaller cross-sectional area.

See explanation of vent capacity on pages 8 through 11.

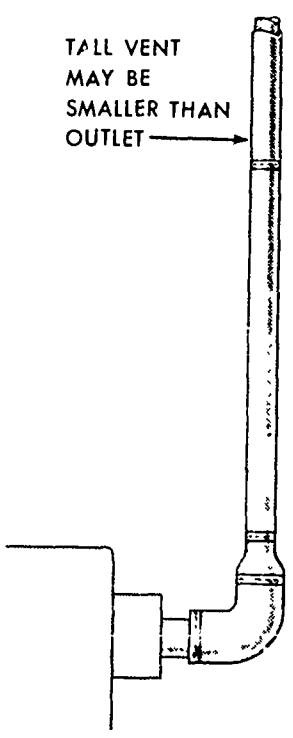


Fig. 7

VENT CAPACITIES

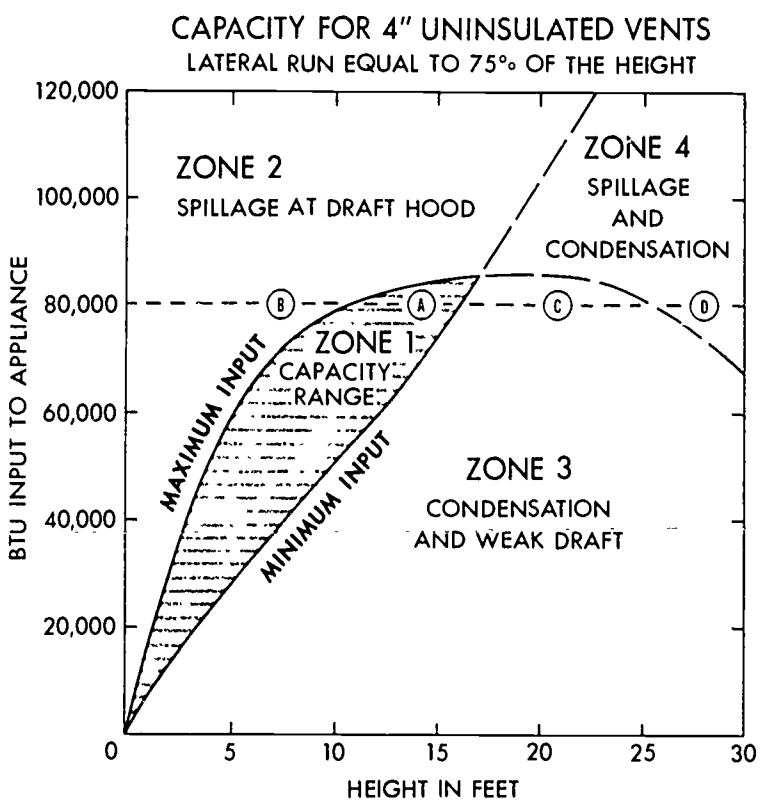
The purpose of a gas vent is to remove all of the products of combustion to the outside air. To accomplish this there cannot be spillage of the flue gases at the draft hood or condensation of the gases in the vent. If the vent allowed one or both of these conditions to exist, it would not be removing the products of combustion to the outside air and would not have the required "Vent Capacity."

The volume of flue gases produced in a gas appliance is approximately proportional to the Btu. input. If you were to install a gas vent and then progressively connect larger and larger appliances to it, you would finally reach a point when the input to the appliance produced more flue gases than the vent could carry off. At this point, some of the flue gases would spill out of the draft hood into the room. The greatest Btu. input that can be used without causing spillage may be called the "Maximum Input" for this particular vent.

Now let us assume that you connect a gas appliance of fixed input to a vent. As the gases flow through the vent, they lose heat through its walls and become cooler. If the vent gases become too cool, the draft will be weak and spillage may result, especially if there happens to be a slight negative pressure in the building or a positive pressure on the roof due to wind conditions. If the vent is made long enough or high enough, the gases in the vent will be cooled to a temperature below their dew point and condensation will result. When this occurs, the condensate runs back down the pipe and all the vent gases do not reach the outside air. This corrosive condensate may cause serious damage to the vent and the building in which it is installed. In this case, there is not enough energy (Btu. input) to vent the appliance. The vent did not function at its required capacity because there was too little input into the appliance in relation to the size and length of the vent. This Btu. input (just before condensation occurs) may be called the "Minimum Input" for this vent. If the input were less than this minimum, condensation, spillage, or both could occur.

This shows that to operate properly, a gas vent is limited to a "Maximum Input" and a "Minimum Input " The vent will carry off all the flue gases only if the input is between this maximun and minimum This range may be called the "Vent Capacity."

For example, if we assume a Btu. input of 80,000 and a maximum possible temperature leaving the draft hood of 460°F, and that to prevent condensation we keep the minimum temperature in the vent 180°F, then maximum and minimum input curves can be plotted by use of the equation given on Page 14. These are shown in the Chart, Fig 8, for a vent having a lateral run which is equal to 75% of the height. In this case, the vent material is assumed to be uninsulated 4" diameter single wall pipe such as sheet metal, cement-asbestos or terra cotta.



Note: Chart assumes that 15% of the Btu. input is being delivered to the draft hood.

Fig. 8

From these curves it can be seen that there are four conditions which may exist in gas venting.

(1) If the operating condition of the vent (as determined by the intersection of the Btu. input and height) falls in Zone 1 (the "Vent Capacity"), the appliance will be properly vented. (Point A, 80,000 Btu. input and 15 Ft. High).

(2) If the operating condition occurs above both the maximum input and minimum input curves, Zone 2, there will be spillage at the draft hood. (Point B, 80,000 Btu. input and 8 Ft. High).

(3) If the operating condition lies under both the minimum and maximum, Zone 3, condensation is likely and the draft will be weak. (Point C, 80,000 Btu. input and 22 Ft. High.)

(4) If the operating condition is above the maximum and below the minimum, Zone 4, there will be both spillage at the draft hood and condensation in the vent. This zone probably represents the worst possible venting condition and the one most likely to cause serious troubles. (Point D, 80,000 Btu. input and 28 Ft. High).

It is common practice to vent 80,000 Btu. appliances with 4" uninsulated vents with lateral runs 75% of the height. However, Fig. 8 shows that except between the narrow range of heights from approximately 10 to 17 feet improper venting will result.

Heat loss through the walls of the vent has a most important effect on capacity, because an insulated vent retains the heat in the gases, and allows longer runs of vent pipe to be used without danger of condensation. The curves in Fig. 9 show this clearly. The solid lines are the input curves for Metalbestos, an insulated double-wall aluminum vent, and the dotted lines are for uninsulated vents such as single-wall sheet metal, cement-asbestos and terra cotta.

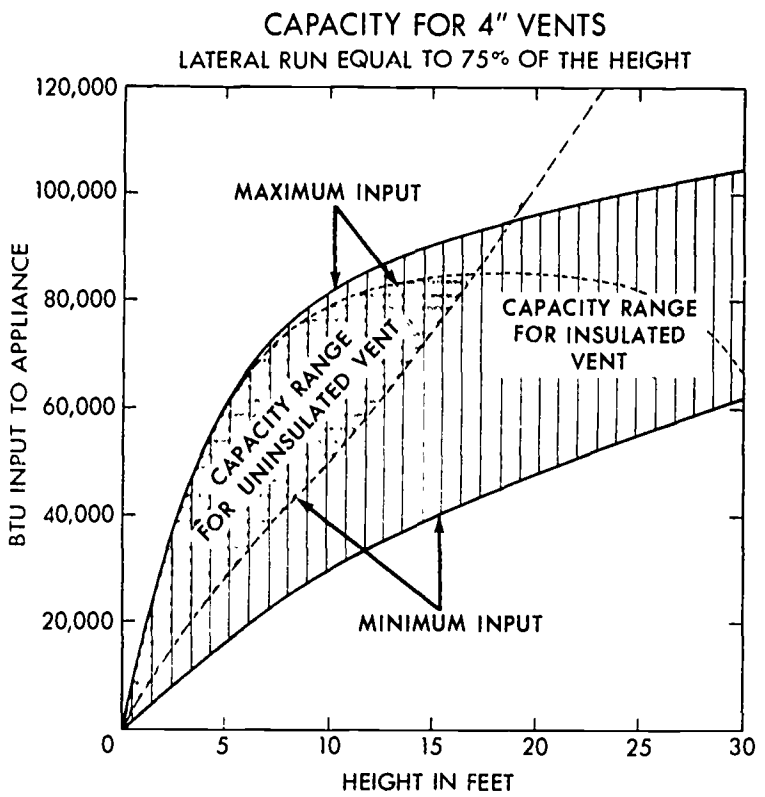


Fig. 9

It can be seen from these curves that the "Vent Capacity" of the insulated vent, Metalbestos, is many times that of the uninsulated vent. A good part of the dangerous "Zone 4" of the uninsulated vent falls within the safe "Vent Capacity" of the insulated vent. The "Vent Capacity" of the insulated vent also safely covers a part of the "Spillage Zone" and a large part of the "Condensation Zone" of the uninsulated vent.

From the Fig. 9, it can be seen that for the insulated vent and the 80,000 Btu. appliance the safe height is increased to 38 feet (off chart). In this case, the safe range of heights is 10 to 38 feet as compared to the range for the uninsulated vent of 10 to 17 feet. The range for the uninsulated vent of 10 to 17 feet. The range of the insulated is therefore 4 times that of the uninsulated vent.

The equation below is a simplified version of Kinkead's Equation* which was used to develop the capacity charts shown in Figs. 8 and 9 as well as the Metalbestos Vent Capacity Tables published separately**. Combining fundamental venting theory with experimental analysis, Kinkead's Equation establishes, for the first time, a scientific means by which the correct vent capacity for any given installation can be determined. Extensive tests with both laboratory and actual field installations have proved conclusively the validity of this equation.

KINKEAD'S EQUATION (SIMPLIFIED VERSION)

$$B = cA \frac{\sqrt{H}}{\sqrt{R}} (Ta - k) + b$$

where B = the heat content of the flue gases in Btu's.
A = the area of the vent in square inches
H = the height of the vent in feet
R = the resistance of the vent in velocity heads
Ta = the average temperature of the vent gases in the vertical portion of the vent in degrees Fahrenheit.
b = the heat loss through the walls of the vent up to the midpoint of the vertical vent in Btu's.
and c and k are constants related to the ambient temperature and altitude.

*As reported in the Proceedings of the Pacific Coast Gas Association, Volume 43, 1952, p. 89, "Operating Characteristics of a Gas Vent," by Alan Kinkead.

FUNDAMENTAL RULES OF VENTING

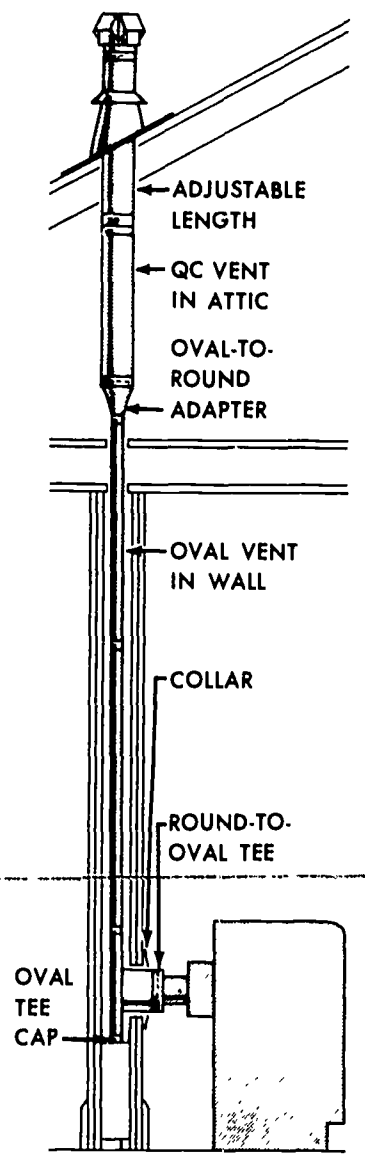


Fig. 10

1. Locating the Appliance

   Learn and observe requirements of the American Gas Association, Inc., National Board of Fire Underwriters', the vent manufacturer and local codes pertaining to the location and clearance for a given appliance.

   In general, locate an appliance for best heat distribution, remembering that is should be as close as practicable to a point from which a vertical vent can be run up through the roof.

   When locating an appliance in a basement, consideration should be given to where the vertical vent can be installed. Whenever possible, provide space for a vertical rise of the vent connecter as high as possible immediately after leaving the draft hood. Keep vent connectors as short as possible, preferable no longer than 75% of the height of the vertical vent.

1. Locating the Appliance (Continued)

In every case, so far as venting is concerned, the best location for a gas appliance is where no vent connector is needed and the appliance can be vented straight upward from the draft hood.

Fig. 11

2. Connecting Vent to Appliance

Connect vent to appliance with a draft hood connector of the same size as the flue collar or outlet of the draft hood. (However, there can be exceptions to this rule - Page 7)

The best type of draft hood connector is a circular one which has a flexible shank that can be easily shaped to fit either a round or oval flue collar or draft hood outlet. The end of this type of draft hood connector farthest from the appliance is provided with a coupling for attachment to a length or fitting of Type B vent.

Fig. 12

Note: A proper draft hood connector fits either round or oval outlets

3. Choosing the Location of Vertical Vents

There are five general locations for vertical vents. The selection of any given location is often dictated by conditions at the job.

These five locations are:

a. Inside furred out space in walls or closets
b. Inside interior walls or partitions
c. Inside exterior walls
d. Outside exterior walls or exposed in rooms
e. Inside masonry chimney.

3(a). INSTALLING VENTS WITHIN FURRED OUT SPACES

When it is unnecessary or impractical to run a vent up inside a partition or wall, yet desirable to have the vent concealed, it can be enclosed in a furred out space. Usual practice is to install and support the vent with 1" clearance from combustible construction, but local codes should always be observed. After installation, the vent is concealed within a furred out pilaster or corner cover, no combustible portion of which is closer than 1" to the outside of the vent. If furred space permits, use round double-wall vent pipe to eliminate transitions.

3(a). VENTS WITHIN FURRED OUT SPACES (CONT'D.)

With a circular vent, however, furred out installations sometimes require such extensive projection of pilasters into the room that they would be unsightly. To overcome this difficulty, a double-wall Type B vent having an oval cross-section should be used within the furred out space. This type of vent is efficient and requires considerably less space than round vents.

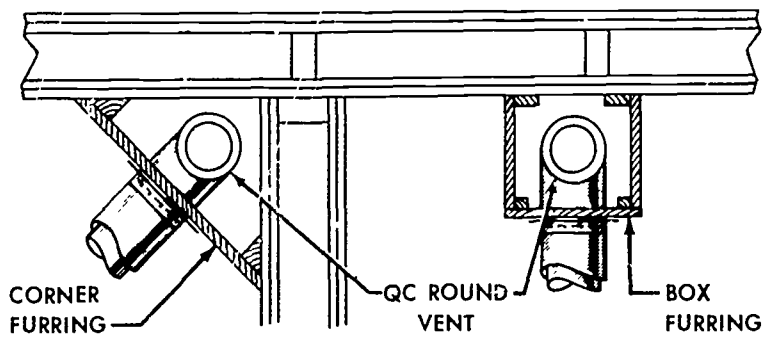


Fig. 13

If furred out space is large enough, use round double-wall vent pipe to eliminate transitions.

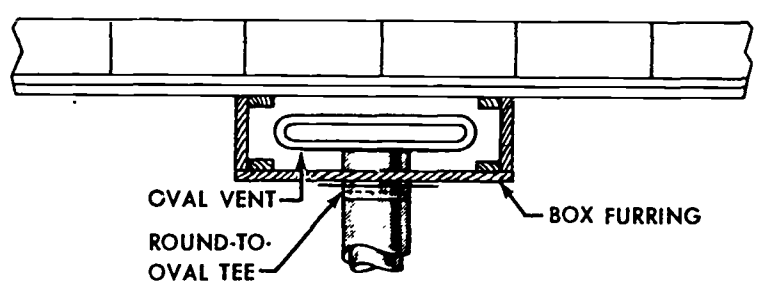


Fig. 14

Use oval double-wall vent pipe where furred projections must be kept small.

3(b). INSTALLING VENTS INSIDE INTERIOR WALLS

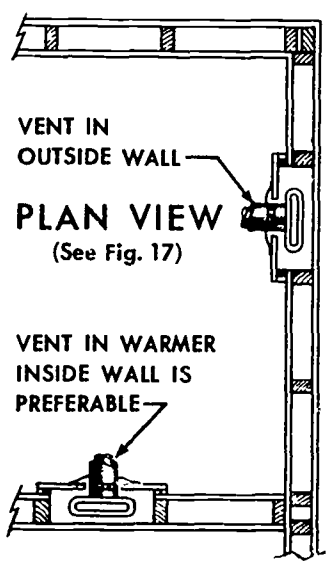


Fig. 15

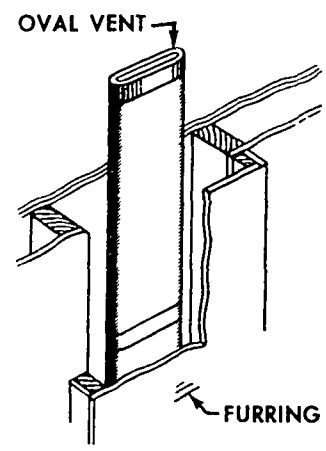


Fig. 16

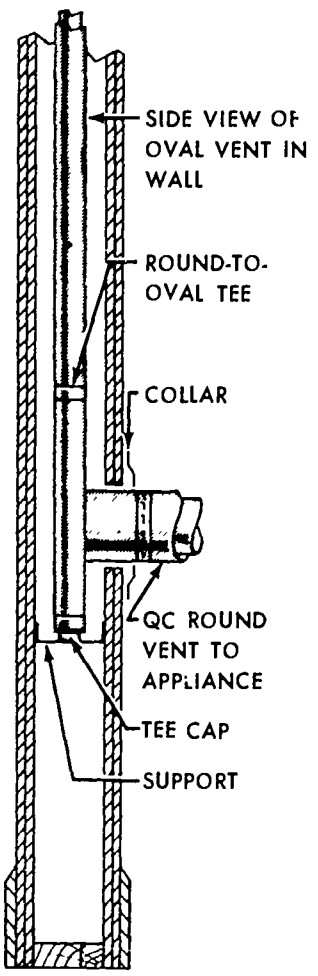
Double-wall oval vents require only slight furring out of 2" x 4" stud walls and partitions.

Whenever possible, it is desirable to conceal vents inside interior walls or partitions.

When interior walls or partitions are built with 2" x 4" studs, round Type B vents cannot be concealed inside them, as the space is too small. Oval vent pipe, however, is designed for this purpose and can be installed without difficulty in existing or new interior walls and partitions.

The procedure for installing oval vents is simple, but will vary somewhat depending upon regional and local building requirements. For this reason, the exact installation procedure should be determined by the contractor on the job after reference to proper authorities.

3(b). VENTS INSIDE INTERIOR WALLS (CONT'D)



In general, if the appliance is within the room it is most convenient to start the run of oval vent pipe with a tee at the bottom. A short section of pipe, or vent connector, should be used to connect the appliance to the oval tee within the wall. For appliances located elsewhere, such as a basement, the vent should have the maximum possible vertical rise direct from the draft hood before it is connected to the vent inside the wall.

Ceiling and floor plates should be cut out to allow required clearance for the oval vent and then reinforced with metal plates or by some other approved means.

Use oval pipe inside the wall until the vent emerges into the attic space. At this point attach an oval to round adapter fitting and complete the vent run with round, double-wall pipe.

Metal or other non-combustible fire stops should be placed over the cut ceiling plates. (For venting of recessed wall heaters, see Page 41).

3(c). INSTALLING VENTS INSIDE EXTERIOR WALLS

Concealing vents within exterior walls is done in the same manner as previously described for interior walls and partitions. There is, however, greater heat loss through exterior walls in cold weather than through interior walls and partitions. Therefore, it is better venting practice to install vents inside interior walls.

3(d). INSTALLING OUTSIDE VENTS

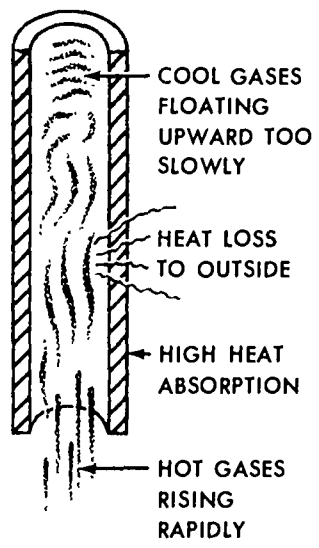


Fig. 18

Material with high heat absorption cools vent gases, causes faulty venting

It is, of course, possible to vent a gas appliance with a vent that runs through an exterior wall and then up along the wall, terminating above the roof. However, this method of venting, although occasionally necessary, is not as efficient as interior venting. The reason is because the vent gases contained in an exposed uninsulated vent lose their heat content rapidly and often do not float upward fast enough to vent the appliance properly. If an exposed vent must be used, it is far better to install Metalbestos, a Type B double-wall aluminum pipe, than one made of heavy material that absorbs a large quantity of heat.

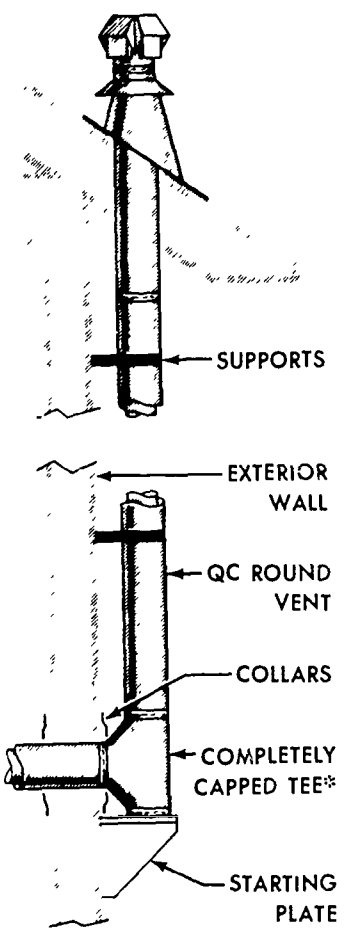
3(d). INSTALLING OUTSIDE VENTS (CONT'D)

Any material that absorbs large amounts of heat from the hot gases inside it will also give off this heat from its outside surface, thus creating a constant flow of heat from vent gases to vent pipe to outside air. A double-wall aluminum vent, however, is an insulated vent and transmits heat very slowly. The inner wall stays hot, conserving the heat of the vent gases, while the outer wall remains relatively cool because it is insulated from the inner wall by an air space.

Install an adjustable length in the vent connector unless a regular length will terminate the vent connector at the desired exterior position where it connects with the vertical vent.

Install a 90° ell or a tee from vent connector to bottom of vertical vent to provide a transition. If a tee is used, completely close the bottom of the tee with a tee cap and support the tee on a starting plate.

Above the elbow or tee, install Type B double-wall aluminum vent pipe up the outside wall, maintaining at least 1" clearance from combustibles. The vent must be adequately supported against wind pressure, using wall brackets where possible.



The recommendations of the American Standards Association and the American Gas Association, Inc., for the installation of gas appliances in buildings, as well as many codes, state that "natural draft vents extending through and terminating adjacent to outside walls are prohibited." When necessary to install an outside vent, terminate it at least 18" above the eaves or parapet of the roof.

The termination should be made with a vent top that is efficient for all wind directions, even at minimum height above the roof.

*Use of 90° elbow is recommended where building codes permit.

Fig. 19 Use a double-wall metal vent pipe if vent must be run up outside a building.

3(d). INSTALLING OUTSIDE VENTS (CONT'D)

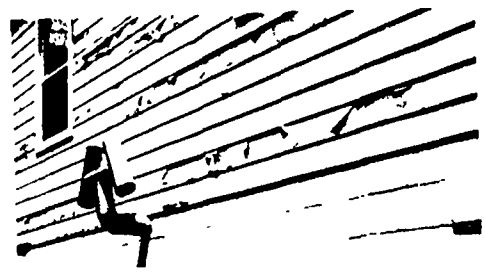


Fig. 20 Never terminate an outside vent pipe next to the wall. Run it up 18" above the eaves or parapet of the roof (see Fig. 19) to prevent condensation damage.

Where vents are exposed inside rooms, the installation should conform to building code requirements with proper clearance maintained from adjacent wall surfaces. Care should be given to proper bracing and when any vent passes through a wall, ceiling or floor, a collar should be inserted on both sides, or if desired, a ventilated thimble may be used.

3(e). INSTALLING VENTS INSIDE MASONRY CHIMNEYS

A prior statement (see page 6) in this booklet was: "Don't use an unlined masonry chimney for venting gas appliances. Line the chimney with an insulated and approved Type B vent." A masonry chimney is apt to absorb so much heat from the vent gases emitted by gas appliances that the temperature inside the chimney often falls below the dew point. Hot vent gases would cause little if any damage to a masonry chimney, but when they are cooled below the dew point, considerable damage may occur as a result of the condensed vent gas products.

Masonry chimneys that have been subject to the damaging action of condensate from vent gas products frequently look like the chimney shown in Fig. 21. Damage of this sort usually is caused by the mixture of condensed vent gas products with an exceedingly small amount of sulphur products, forming a sulphurous or sulphuric acid.

Fig. 21

This is how the room side of a chimney looks when vent gases have condensed and moisture has seeped through damaged mortar joints.

3(e). VENTS INSIDE MASONRY CHIMNEYS (CONT'D)

This acid attacks the binder of the mortar, leaching it out and creating leaks. The high vapor content of the vent gases within the cold chimney provides a continuous source of moisture which passes through the disintegrated mortar. On the room side of a chimney so damaged, the seepage shows up as water stains. Damage is from the inside to the outside. When evidence appears on the outside of the flue, the chimney has been damaged throughout.

A satisfactory way to prevent such a condition, or to stop further damage, is to insert a Metalbestos Type B double-wall aluminum vent within the chimney, using an otherwise unused flue as a passageway. An insulated vent like this within the chimney will act as an independent vent, separate and apart from the chimney itself. The vent gases from a gas appliance will then float up and out safely, for the insulated vent keeps them warm.

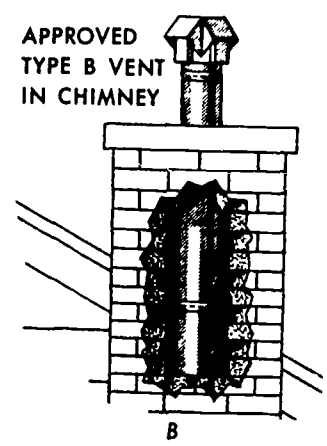


Fig. 21

NOTE: Type B gas vents should not be installed in chimneys being used for other fuels.

Using a chimney flue as a passageway for a Type B double-wall aluminum vent not only vents flue gases successfully to the outside air, but by leaving the chimney open at the top, and removing the clean-out door at the bottom, an open circuit of free-flowing air will move through the masonry flue around the vent to dry out a moisture soaked chimney.

Interior plaster, damaged by water stain, should be completely dried our before replastering is done.

The following steps should be taken in using a masonry chimney as a passageway for a vent:

1. Inspect the chimney for offsets or obstructions in the flue to determine the feasibility of using it as a passageway for a Type B vent.

2. Clean out soot, debris and projecting pieces of mortar; take off clean-out door or make a permanent opening by removing several bricks at base of the flue.

3. Determine and select proper size of vent.

4. Break out the brick at the base of the chimney as high as possible, allowing for maximum vertical rise from the appliance. Provide a 1" clearance between vent connector and combustibles.

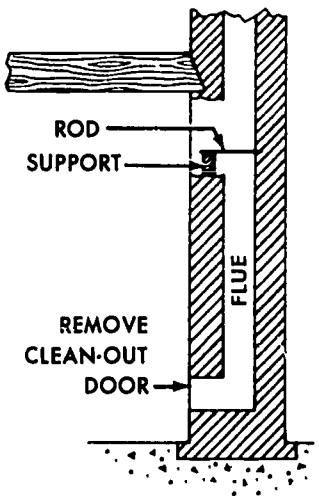


Fig. 23

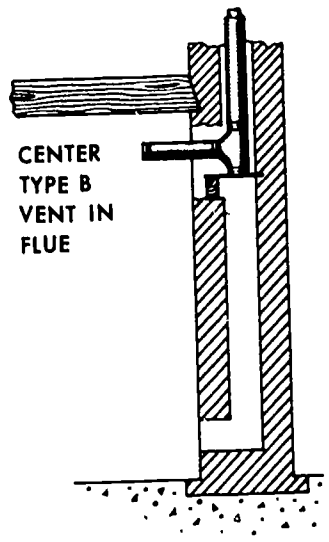


Fig. 24

5. Drive a steel rod into a mortar joint of the chimney at the base of the opening so the rod extends across the opening from front to back.

6. Level the steel rod and support it with a piece of wood.

7. Fit tee cap tightly into base of tee; set tee on steel rod inside the chimney.

8. Lower lengths of vent down the chimney after securely fastening each joint with a minimum of three screws. Join lower end of vent with top of tee at knockout opening. Then fasten vent and tee securely together with two or three screws.

9. Center tee and vent on steel rod at bottom; center vent at top with a spacer ring.

10. Attach an approved top to top of vent.

11. Clean out refuse and soot which may have fallen into base of chimney during installation. Remove through clean-out door.

12. Attach straight stub length into horizontal opening of tee to extend tee beyond chimney face. Fasten stub to tee with three screws.

13. Close break-out opening by replacing brick, but leave the clean-out door off.

14. Complete installation by extending vent connector from chimney liner to draft hood.

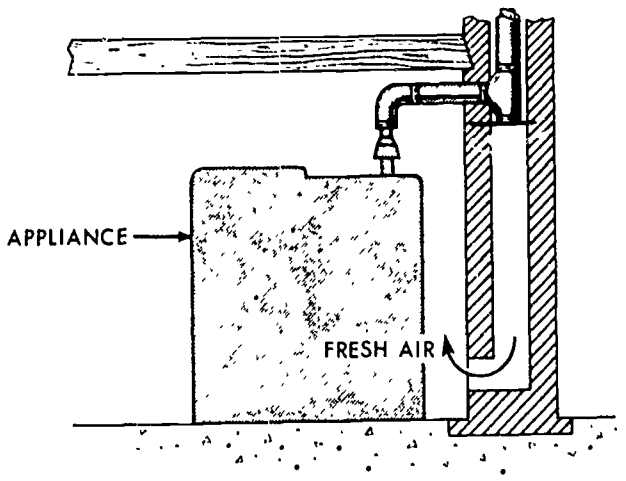


Fig. 25

4. RUNNING VENTS THROUGH ATTIC SPACES

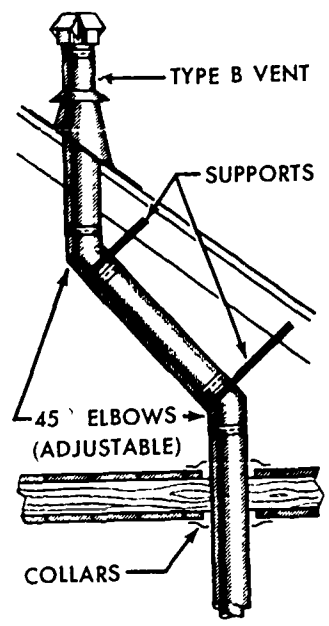


Fig. 26

The best way to run a vent through an attic space is vertically. If laterals are necessary, slope upward as steeply as possible, following the line of the roof, in order to make the venting most efficient. Make the transition from the vertical to the lateral (and from the lateral to vertical) with 45° adjustable elbows.

In attic spaces, it is desirable to use round, double-wall aluminum vent pipe. Support laterals firmly, using metal straps and observe proper clearance from combustibles. When there is more than one vent through the attic, vents may be combined into a properly sized common vent so as to have a single outlet through the roof.

14. Complete installation by extending vent connector from chimney liner to draft hood.

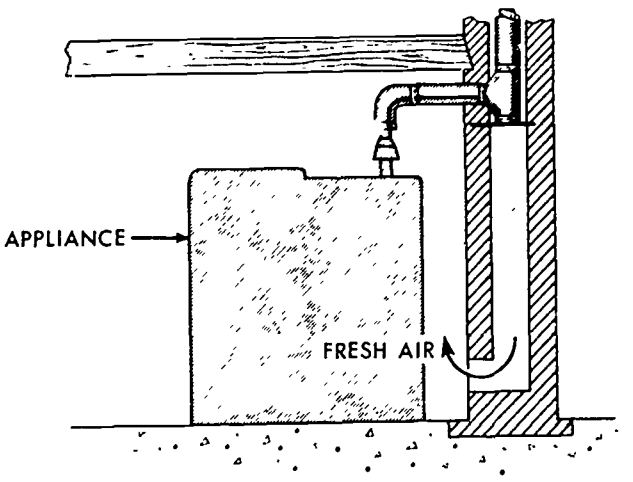


Fig. 25

5. RUNNING VENTS THROUGH ROOFS

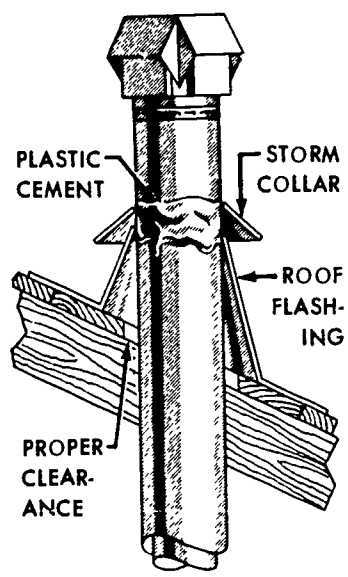


Fig. 27

Install an adjustable round roof flashing where a vent pipe passes through a roof. This flashing fits flat on pitched roofs and will adjust up to a 6/12 pitch. It should be located so the hole through its upper part is centered over the hole made in the roof boards for the vent pipe. Roofs of steeper pitch requires a locally manufactured flashing. Caulk joint where vent pipe passes through upper hole of roof flashing, using plastic cement.

Apply plastic roof cement and a storm collar above adjustable roof flashing. The roof cement should be directly above the flashing and the storm collar should be drawn into the cement. The collar acts as a counterflashing keeping out rain and snow.

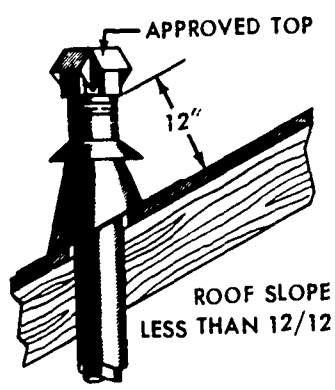


Fig. 28

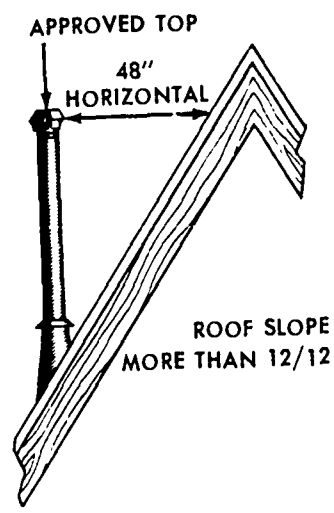


Fig. 29

Many codes call for vents to be 2 feet higher than any obstruction within a 15-foot radius. Where codes call for heights that would require excessively high vent projections above the roof, or excessively long laterals in the attic space, it is advisable to submit facts on an approved top to the authorities. This top provides high venting efficiency without excessive height. Such an approved top should be positioned so that: (a) for roof slopes less than 12/12 pitch (45°) a 12" clearance is maintained between the roof or other obstructions and the lower portion of the top and (b) for roof slopes greater than 12/12 pitch, a 4-foot clearance is maintained between the roof or other obstruction and the lower portion of the top.

This recommendation is based on the "Rules and Regulations for the Installation of Gas Appliance Vents" adopted by the Board of Building and Safety Commissioners of the City of Los Angeles, dated March 23, 1945. It also meets the requirements of the Uniform Code of the Pacific Coast Building Officials Conference (see Chapter 37, 1952 edition) which is currently in use by approximately 700 cities.

6. VENTING TWO OR MORE APPLIANCES

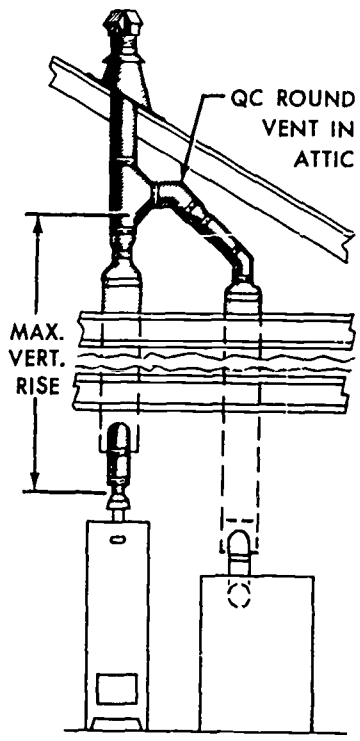


Fig. 30

While the equation shown on page can be used to determine the correct venting of two or more appliances through a common vent for any given set of conditions, it is not practical at present to formulate an exact rule covering all such installations. Generally speaking, however, the following factors should be considered when venting two or more appliances.

1. If possible, it is desirable to run a separate vent from each appliance straight up through the roof.

2. If separate vents are not practical or desirable, allow as much initial rise as possible for each vent before joining into a common vent.

3. Use a common vent which is larger than the separate vents connecting it.

4. Determine size of the common vent in accordance with most recent recommendations of recognized authorities.

If installation conditions permit, it is advisable for each vent to have as great an initial rise as possible, e.g., up into the attic space, before it is connected to a common vent. Otherwise, improper venting could result if one or more of the appliances is turned off because the heat of the flue gases emitted from the appliance still in operation may be insufficient to heat the dilution air entering the several draft hoods. By providing a sufficient initial rise before joining two vents, the vent gases usually obtain enough velocity to float up to the outside air.

For assistance with special problems concerning common vents, you are invited to write to William Wallace Company, Belmont, California.

7. PROVIDING FOR COMBUSTION AND DILUTION AIR

All gas appliances need a constant supply of fresh air for correct combustion while in operation. Vented appliances also need an additional supply of air for dilution at the draft hood. (See Fig. 2) Venting action cannot continue unless there is plenty of fresh air exerting pressure at the draft hood.

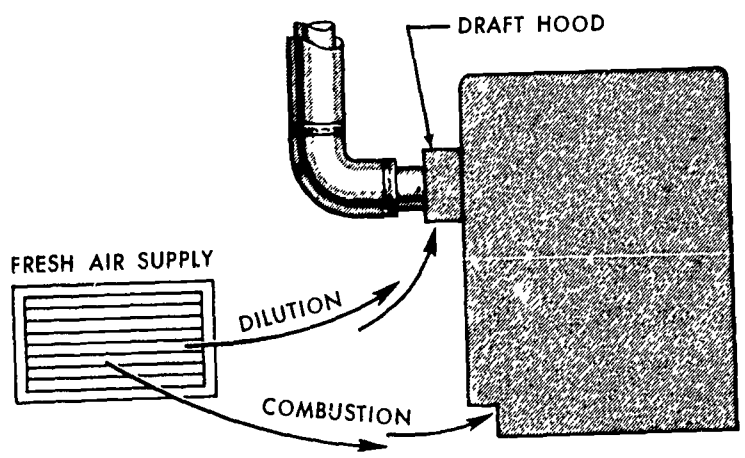


Fig. 31

Install grills or fresh air pipes where necessary.

The air needed for combustion and venting is normally taken from the interior of the room or building. In most cases, installers expect natural "in-leakage" through cracks around doors and windows to provide this fresh air. Often this natural "in-leakage" is sufficient, but frequently it is not enough.

7. COMBUSTION AND DILUTION AIR (CONT'D)

When tight construction and weather stripping are used, they reduce "in-leakage" materially. When exhaust fans have been installed, they can easily cause down drafts .... a downward instead of an upward flow through the vent, which means that the flue gases are escaping into the room or building and not up the vent. Consider all factors that combine to remove fresh air from a room or building .... combustion, dilution at the draft hood for venting, exhaust fan, unvented gas appliances, etc. and, if necessary, provide grills in floors, walls, or doors, or pipe fresh air into the room or building. If air for combustion and dilution is taken from attic space, attic louvres should be left open.

Venting in Utility Rooms and Garages

Utility rooms are often kept closed, hence ample provision should be made to admit fresh air for combustion and dilution at the draft hood, as mentioned in the preceding paragraphs. Put a grill in a door, the floor or the ceiling to admit fresh air from permanently open spaces. The free opening of such a grill should be equal to, and preferable greater than, the combined cross-sectional areas of the flue collars of all appliances in the room.

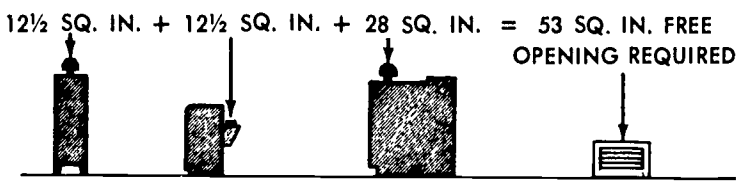


Fig. 32

If a gas appliance is installed in a garage, observe local code provisions, as gasoline vapors could present a hazard.

CHECK LIST FOR VENTING GAS APPLIANCES

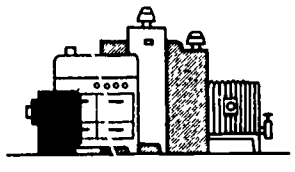


Fig. 33

1. Vent every gas appliance that is provided with a flue collar or draft hood.

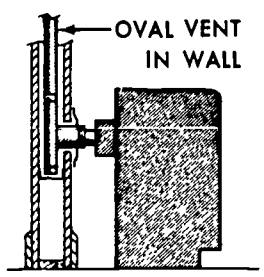


Fig. 34

2. Locate a gas appliance as close as practicable to a point from which a vertical vent can be run through the roof and where, possible, no lateral vent connector will be needed.

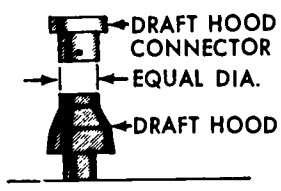


Fig. 35

3. Connect vent to appliance with a draft hood connector of the same size as the flue collar or draft hood outlet.

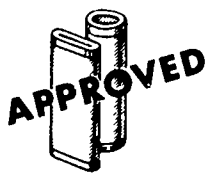


Fig. 36

4. For venting, use a strong, gastight, insulated Type B vent of the proper cross-sectional area and net vertical height.

CHECK LIST FOR VENTING GAS APPLIANCES (CONT'D)

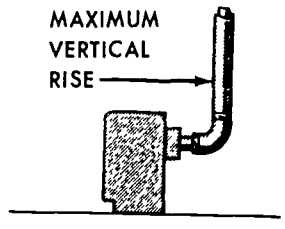


Fig. 37

5. When installing a vent, allow for maximum possible vertical rise directly from the flue collar or draft hood outlet.

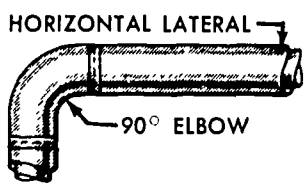


Fig. 38

6. Although codes frequently require a rise of 1/4" per running foot for laterals, this requirement is unnecessary provided there is sufficient initial rise and an insulated vent is used. When so installed, a horizontal lateral does not interfere with proper venting.

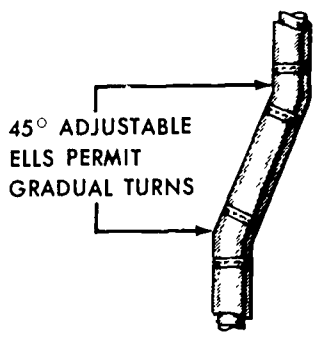


Fig. 39

7. Make changes of direction of a vent as gradual as possible.

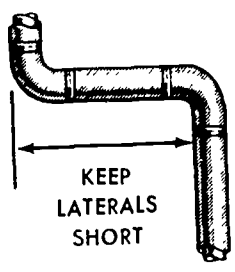


Fig. 40

8. Keep vent connectors as short as possible, preferably not more than 75% of the vertical height of the vent.

CHECK LIST FOR VENTING GAS APPLICANCES (CONT'D)

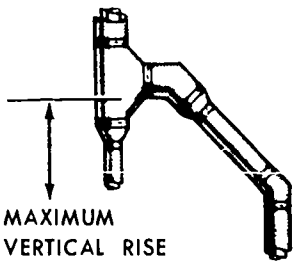


Fig. 41

9. Provide the maximum possible vertical rise for a vent before connecting it into a common vent with any other vent. Increase size of common vent (see Page 29).

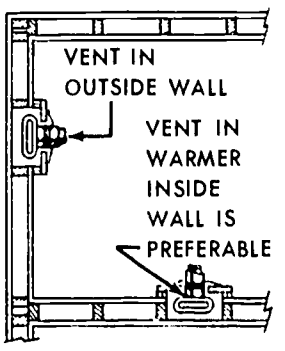


Fig. 42

10. Run vents up through interior walls, partitions or furred out spaces rather than up through exterior walls.

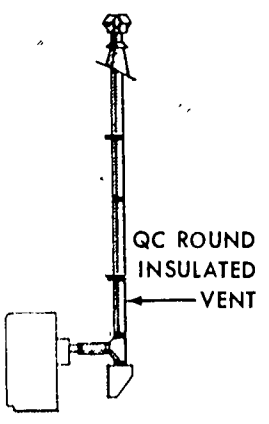


Fig. 43

11. Try to avoid running a vent up outside an exterior wall of a building; when it is absolutely necessary, run an insulated vent through the roof, not around eave.

CHECK LIST FOR VENTING GAS APPLIANCES (CONT'D)

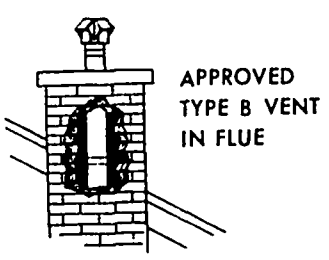


Fig. 44

12. Use the flue of a masonry chimney only as a passageway for an approved Type B vent.

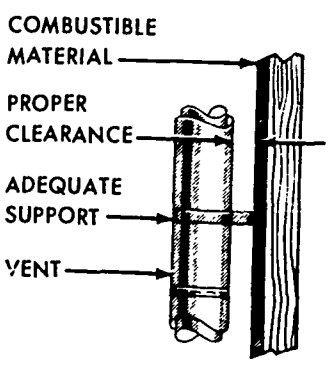


Fig. 45

13. Observe clearances of vents from combustibles and fasten securely in place so these clearances will be maintained.

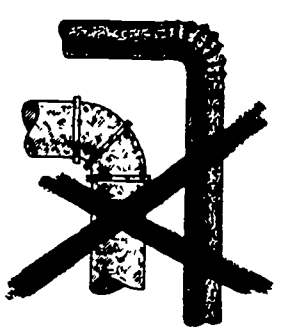


Fig. 46

14. Do not use galvanized or black iron vents or fittings, or any other substitutes for Underwriters' Laboratories approved Type B vents in any part of the installation including the vent connector

CHECK LIST FOR VENTING GAS APPLIANCES (CONT'D)

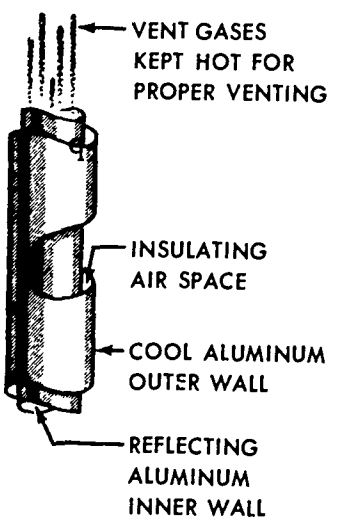


Fig. 47

15. Use only an insulated Type B vent which cannot absorb within itself a large quantity of heat and which cannot transmit excessive heat to surrounding combustibles.

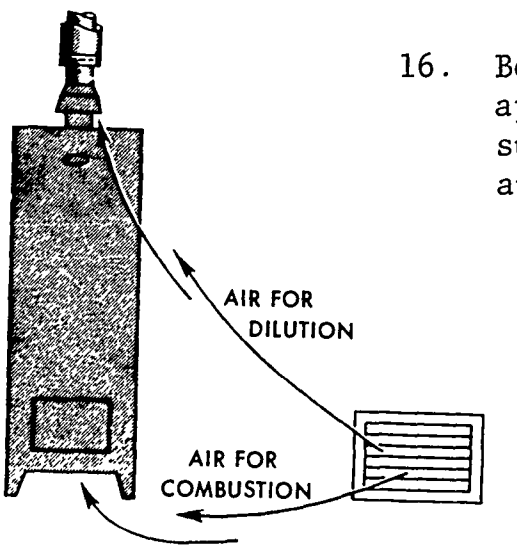
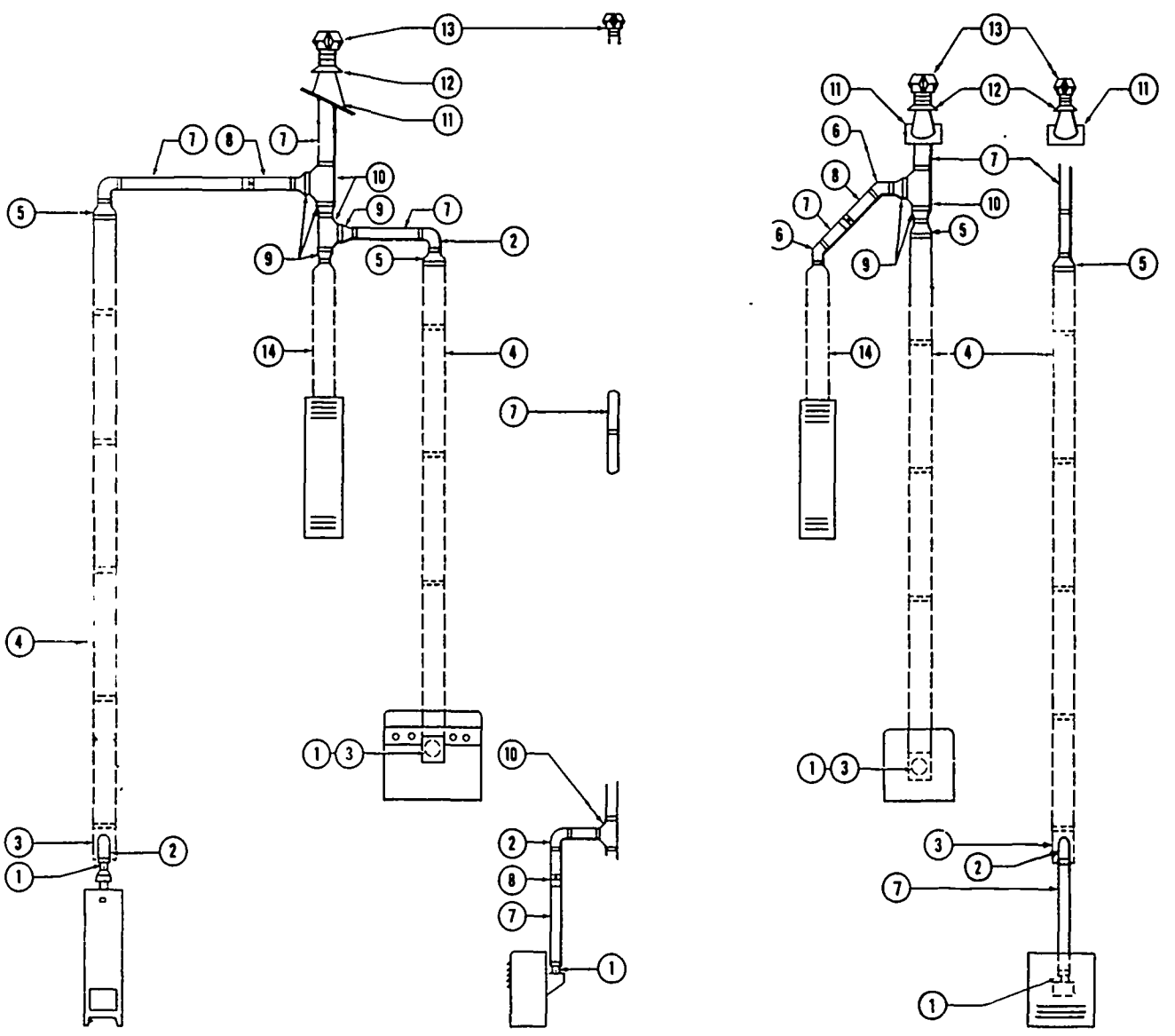


Fig. 48

16. Be sure the space in which a gas appliance is located has a constant supply of fresh air for combustion and dilution.

SPECIAL VENTING RULES FOR GAS APPLIANCES



1. QC DRAFT HOOD CONNECTOR
2. QC 90° ELBOW
3. ROUND-TO-OVAL TEE
4. OVAL PIPE
5. OVAL-TO-ROUND ADAPTER
6. QC 45° ADJUSTABLE ELBOW
7. QC ROUND PIPE
8. QC ADJUSTABLE LENGTH
9. QC INCREASER
10. QC TEE
11. ADJUSTABLE ROUND ROOF FLASHING
12. STORM COLLAR
13. QC BELMONT TOP
14. TYPE B-W WALL VENT

Fig. 49

Note versatility and ease of installation possible with combined use of Round and Oval Metalbestos gas vent pipe and fittings.

SPECIAL VENTING RULES FOR GAS APPLIANCES

Each of the general types of gas appliances for which venting is needed has certain requirements in connection with venting for which provision should be made. Special venting rules for the more common gas appliances follow.

Central Heating Units

Central heating units, such as boilers, warm air furnaces and duct furnaces, should be installed strictly in accordance with manufacturers' instructions. Observe clearances, accessibility requirements and protection of combustible construction as called for by codes.

The flue collar or draft hood must be located outside any duct and must be able to obtain dilution air from the same source as that which supplies conbustion air. Naturally, a constant supply of fresh air for combustion and dilution must be able to reach the appliance from a non-habitable space. No circulating air, however, may be taken from any enclosure in which the appliance is located. "All air circulated to and from central heating unit must be handled by ducts which are sealed to furnace casing and are entirely separate from means provided for supplying combustion and ventilation air." (From page 24 A.S.A. standards Z21.30, 1950, "Installation of Gas Piping and Gas Appliances in Buildings.")

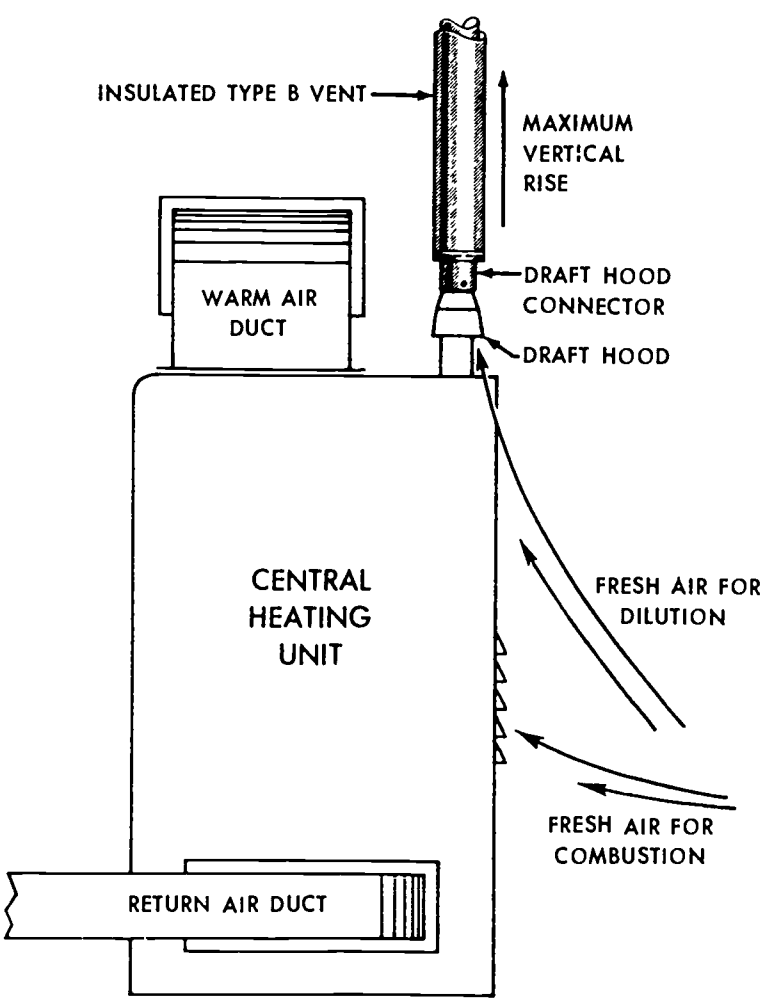


Fig. 50

FLOOR FURNACES

Locate a floor furnace as required by local codes with adequate provision for access and servicing. Make sure that adequate air for combustion and draft hood dilution can reach a floor furnace from some permanently ventilated, uninhabited space. Provide proper clearance of vent connector and vent from combustibles.

An approved floor furnace may be installed in an upper floor provided that the furnace assembly is completely enclosed and that this enclosure projects below into a non-habitable space. The enclosure must be of fire resisting material and the floor furnace must be provided with a proper air intake and means of access for servicing. For the most satisfactory results from a floor furnace, follow all the directions of the manufacturer.

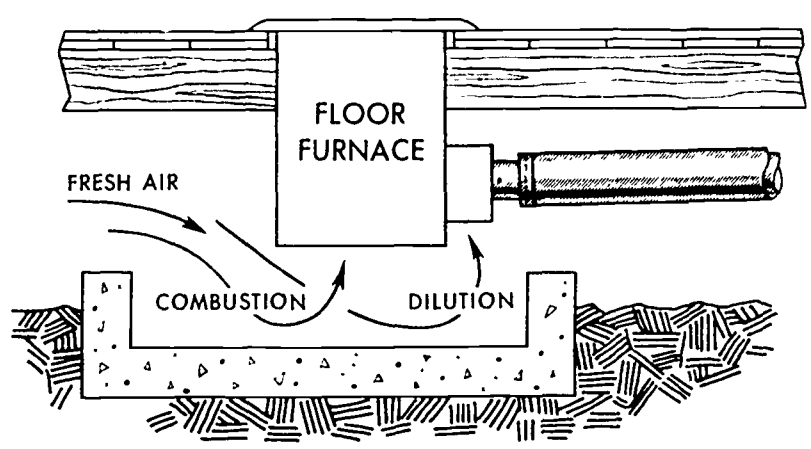


Fig. 51

RADIANT HEATERS, WARM AIR CIRCULATORS AND GAS-STEAM RADIATORS

When radiant heaters, warm air circulators and gas-steam radiators are provided with flue collars or draft hoods, they should be vented. Attach a draft hood connector to the flue collar or draft hood outlet. Join into oval vent through a tee. Continue this voal vent pipe to a point above the ceiling joists, where it should be connected to round vent pipe and carried up through the roof.

Gas heating appliances installed in rooms used for sleeping purposes require special care in venting. If the appliances in such rooms are not adequately vented, there is a strong probability that sleeping occupants will not be aware of dangerous conditions. During waking hours, people are more likely to notice the warning signals of inadequate venting.

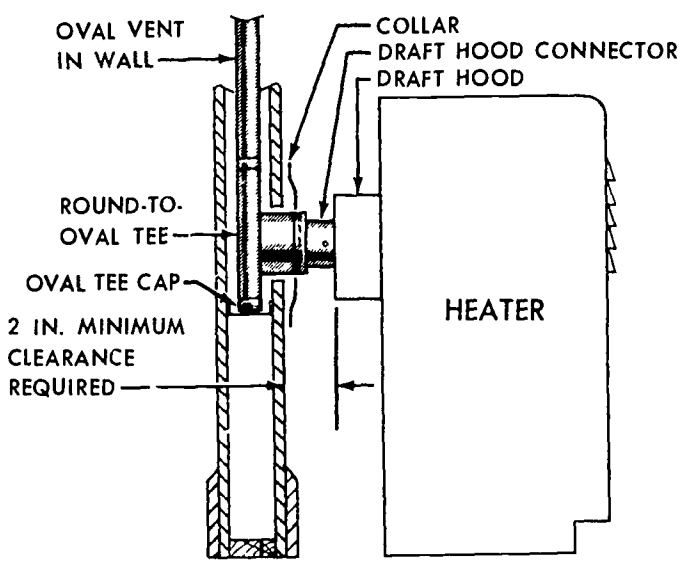


Fig. 52

Venting a space heater.

VENTED RECESSED HEATERS

Listed recessed wall heaters should always be installed in strict accordance with manufacturers' instructions and national and local codes. For venting recessed wall heaters inside 2" x 4" stud partitions a special package is available. This package includes a 3-foot, 4-foot or 5-foot length of rectangular, double-wall vent pipe with an integral rectangular-to-round adapter, a base plate and two ceiling plate angles which position and fasten the vent as well as retain the structural strength of the top plate.

The rectangular vent pipe fits down over the projecting flue collar of the recessed wall heater; the rectangular-to-round adapter extends above the ceiling joists where it connects with round vent pipe to carry flue gases through the attic space and up through the roof.

Special attention should be given to the rulings of the American Gas Association which require appliance manufacturers to specify the type of vent to be used. Since Underwriters' Laboratories requires that a Type B-W Wall-Vent be used unless 1" clearance to combustible construction is maintained, this ruling has the effect of requiring use of a Type B-W vent if furring out is to be avoided.

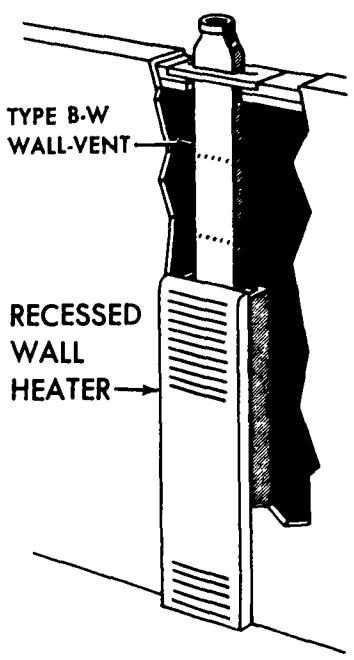


Fig 53

Venting a recessed wall heater

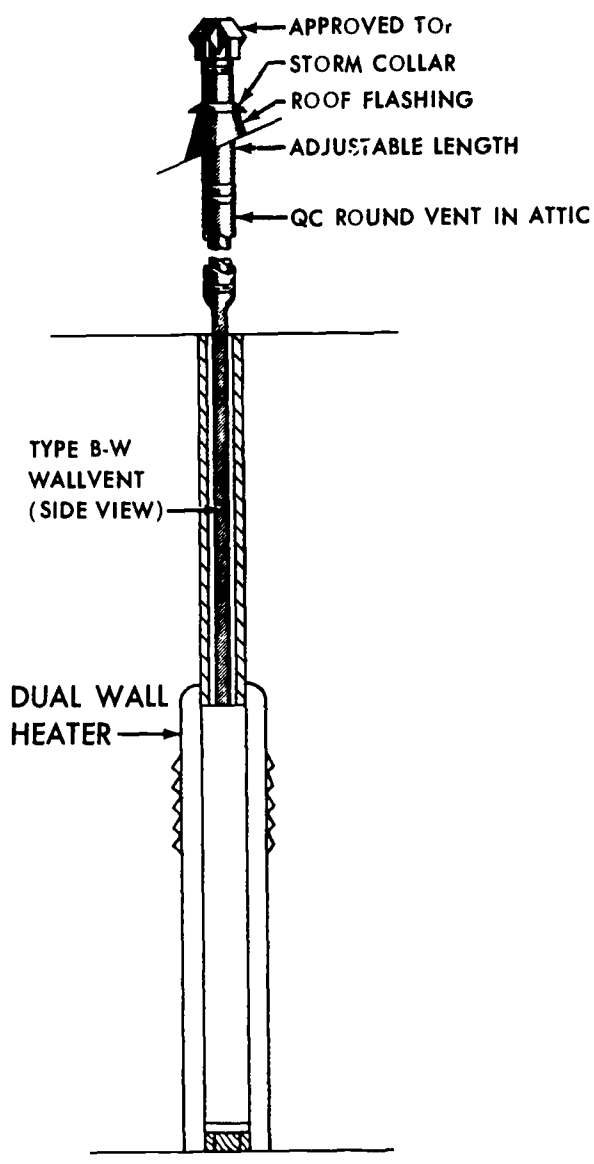


Fig. 54

Venting a recessed dual wall heater.

The rectangular portion of this vent requires only 3/8" clearance from combustible construction for a single-story structure, thus eliminating the expense of furring out the wall. Above the ceiling plate 1" clearance must be maintained from combustible construction. The assembled contents of this special package for venting recessed wall heaters within 2" x 4" stud walls are known as Type B-W Wall-Vent.

WATER HEATERS

It is especially important that water heaters be well vented. This is because of the peculiar conditions which are apt to exist when a water heater is operating. The water inside the heater is always far colder than the flue gases. This means that the metal tank holding the water is also much colder than the flue gases.

The reason the water becomes hot is because the metal and the water surrounded by it absorb heat from the flue gases. This absorption of heat from the flue gases in an efficient water heater may be so complete that there is not much heat left in them when they reach the flue collar.

Since the action of a gravity vent depends entirely on the heat energy of the flue gases entering it, the small amount of heat energy emerging from a water heater must be conserved as much as possible. The temperature of the flue gases will be considerably lowered by the dilution air entering at the draft hood. Then if the vent pipe absorbs large quantities of heat, the vent gases become so cool that the difference between their temperature and that of the surrounding air may not be enough to float them up to the outside air. In such case, the water heater is only partially vented or is not vented at all. The use of Metalbestos double-wall aluminum vent pipe conserves the best of vent gases and the low thermal capacity of this insulated Type B vent also eliminates further temperatures drops that can easily cause condensation damage.

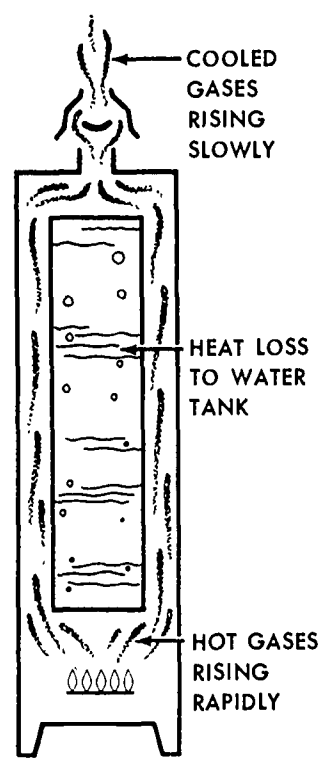


Fig. 55 Flue gases from efficient water heaters contain very little heat.

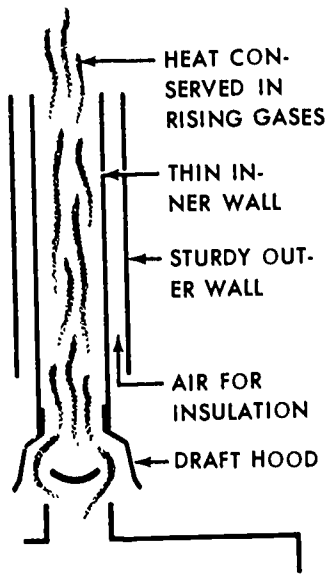


Fig. 56

A double-wall vent conserves the heat energy best.

CLOTHES DRYERS

Clothes dryers release large quantities of water vapor which are frequently vented separately from the vent gases. Some dryers are provided with fans to force this water vapor out through a collar. Others have no fans, but do have a water vapor exhaust collar.

If there is no fan, and gravity venting of water vapor must be done, the vent should terminate in a location so that it is not subject to wind pressures. Because of this, many gas companies require that clothes dryers be equipped with power blowers capable of overcoming the velocity pressure of a 15 mph wind.

Most clothes dryers limit the maximum temperature of vent gases to 200° F and hence may be vented with a single pipe (wall), preferably aluminum, in accordance with the National Board of Fire Underwriters Bulletin 90. An insulated vent is not necessary, and under no circumstances should Metalbestos be used to vent a clothes dryer.

Always follow the manufacturer's instructions for installing and venting clothes dryers.

DOMESTIC GAS RANGES

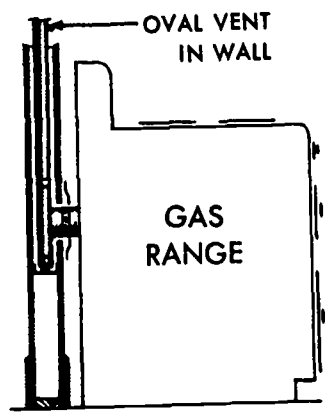


Fig. 57

If local codes require the venting of the ovens of domestic ovens of domestic gas ranges, such venting can be done most satisfactorily with double-wall aluminum vents. After attaching a draft-hood connector to the flue collar or draft hood outlet of the range, connect to an oval vent inside the wall by means of a round to oval tee.

GAS-FIRED UNIT HEATERS

Approved gas-fired unit heaters must have a minumum of 6" clearance between the appliance, projecting flue collar or draft hood and combustible construction. The control side must be at least 18" from any wall or partition. A constant supply of fresh air for combustion and dilution must be provided and the location of the heater must be such that a negative pressure will not be created in the room or space.

Vents from unit heaters usually consist of a draft hood connector attached to the flue collar or draft hood outlet, with the vent gases passing thence into a 90° ell or tee (through a short stub from the draft hood connector if necessary) and upward through a vertical run of vent pipe to the outside air. If a tee is used, the bottom should be completely closed off with a tee cap.

The clearance recommendations above are based on paragraph 4.10.2 A.S.A. standards Z21.30, 1950, "Installation of Gas Piping and Gas Appliances in Buildings".

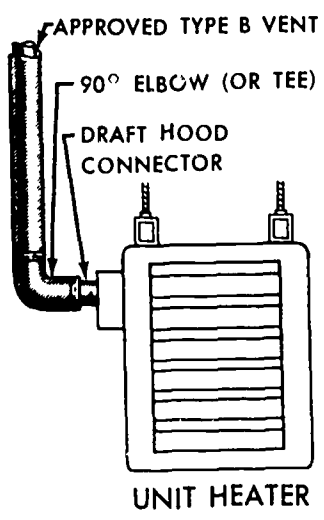


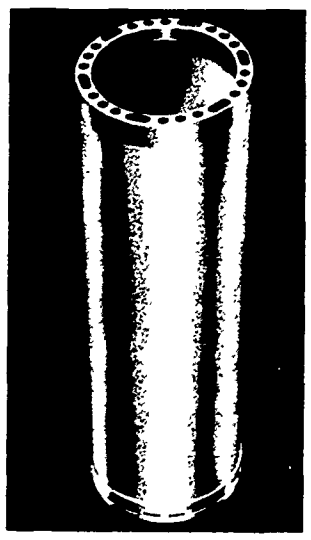
Fig. 58

QC METALBESTOS VENT PIPE AND FITTINGS

Fig. 59

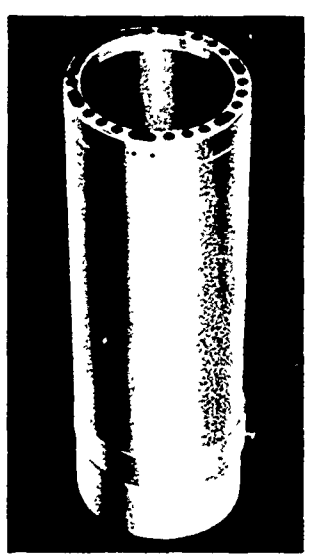
Cutaway illustration showing two joined sections of QC Metalbestos round vent.

There are many sizes, lengths and types of double-wall aluminum vent pipe and fittings produced by the Metalbestos Divison of the William Wallace Company. This insulated venting material provides a strong, gastight system capable of quickly establishing and continuously maintaining a strong upward draft for vent gases. The insulating air space between inner and outer walls serves a double purpose. It minimizes loss of heat from the vent gases and it keeps the outer wall temperature at a minimum. Hot vent gases are removed faster and will not condense. Cool outer walls are safer. A description of Metalbestos products follows:



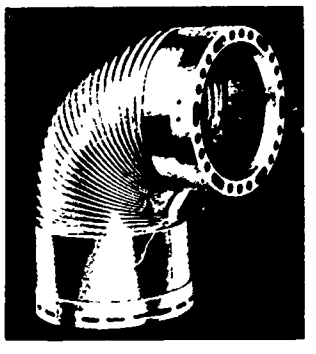
QC ROUND PIPE

A round, double-wall aluminum vent pipe with die-formed, quick coupling ends.



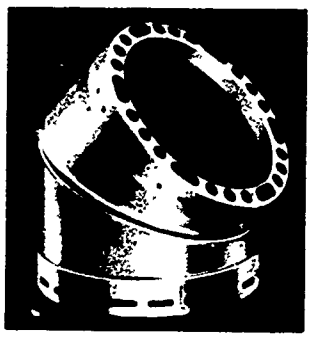
QC ADJUSTABLE LENGTH

A telescoping round, double-wall vent pipe with one die-formed, quick coupling end. When used in conjunction with a length of equal diameter QC round Metalbestos vent pipe, it permits variable extension of from 3" to 17" without cutting.



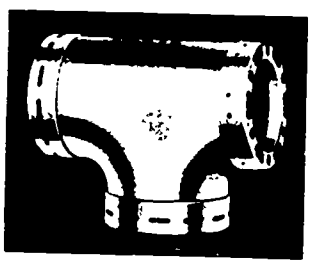
QC 90° ELBOW

A round, double-wall aluminum 90° elbow with die-formed, quick coupling ends for quick, easy, rigid installation.



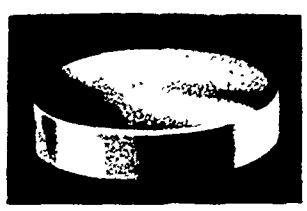
QC 45° ADJUSTABLE ELBOW

A round, double-wall aluminum elbow which speedily forms smooth changes of direction from 0° to 45° by a simple twisting of a swivel joint. When used with quick coupling vent pipe, adjustable lengths or fittings of the same size, a vent system can be fitted into any available space with ease and without cutting.



QC TEE

A round, double-wall aluminum tee with three quick coupling ends. Can be used at the base of vertical vents and for joining two vents into a common vent. Smooth curves reduce resistance to flow of vent gases.

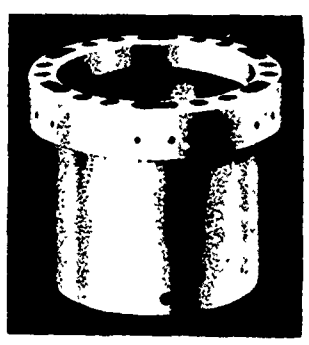


QC TEE CAP

A round, aluminum tee cap which completely closes the lower end of a quick coupling round tee and makes a strong corrosion resistant bottom.

ADJUSTABLE VENTILATED WALL THIMBLE

This device provides additional insulation from combustible construction where vents pass through walls, floors or ceilings. However, wall thimbles are not necessary when Metalbestos is installed, since pipe collars on each surface are entirely adequate.

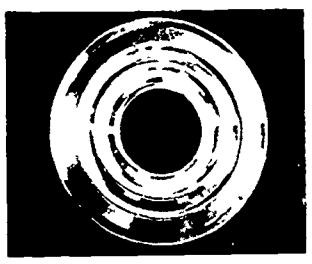


QC DRAFT HOOD CONNECTOR

A round, aluminum draft hood connector, the lower end of which slips over the flue collar or draft hood outlet of the gas appliance. The upper end is provided with a die-formed quick coupling for easy attachment to a length or fitting of QC round, double-wall aluminum vent pipe. When appliances have a female draft hood outlet, crimp the skirt of the draft hood connector to fit inside.

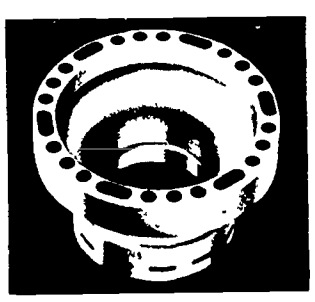
QC DRAFT HOOD CONNECTOR (CONT'D)

The lower end or shank of this draft hood connector can be shaped by the fingers to fit an oval flue collar or draft hood outlet. Three sheet metal screws fasten the draft hood connector tightly to the flue collar or draft hood outlet.



PIPE COLLAR

A protective flange which is placed on each surface where a vent pipe passes through a wall, ceiling or floor.



QC INCREASER

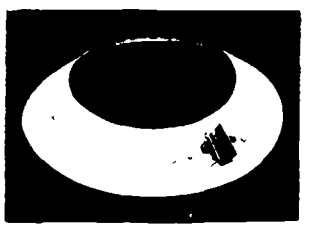
A round, double-wall aluminum fitting which permits the increasing of the size of pipe in a vent line.

QC REDUCER

A round, double-wall aluminum fitting which makes possible the proper sizing of vents in accordance with the Metalbestos Vent Capacity Tables referred to in the Preface of this handbook.

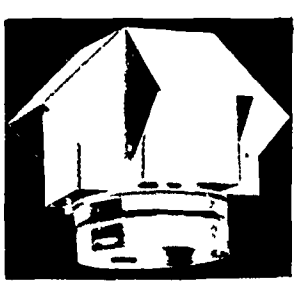
ADJUSTABLE ROUND ROOF FLASHING

An aluminum, corrosion-resistant roof flashing or collar to provide a watertight seal where a round vent pipe passes through a roof. Can be used on flat or pitched roofs. Asphalt plastic cement should be used at the junction of the vent and the roof flashing to provide a water tight seal.



ROUND STORM COLLAR

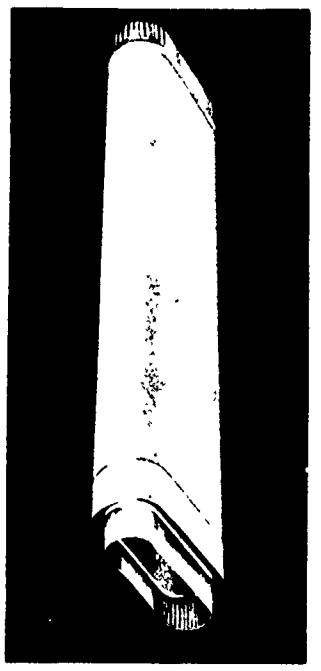
An aluminum collar which fastens about a round, double-wall vent pipe immediately above the roof flashing to act as a conter-flashing.



QC BELMONT TOP

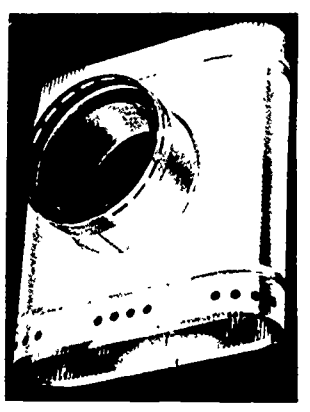
This round all-aluminum vent top is one of the most efficient ever produced. It provides adequate protection against the entry of rain and snow. Its "ejector" action helps create an upward draft and eliminates wind-created back drafts. (No top will eliminate back drafts caused by static pressure). The QC round Belmont top has a die-formed, quick coupling bottom for easy, rapid connection to a QC round, double-wall aluminum vent pipe.

METALBESTOS OVAL VENT PIPE AND FITTINGS



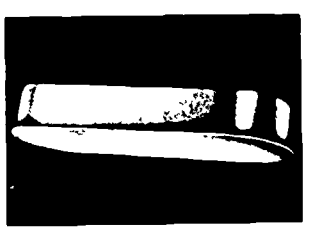
OVAL PIPE

Metalbestos oval vent pipe and fittings are available in several commonly used sizes. Furnished with crimp joint ends, it features the same aluminum double-wall design as round Metalbestos. Oval vent is designed primarily for running a vent within a wall or other narrow space after which conversion should be made to round vent for the remainder of the vent system. Due to its thin cross-section, it can be installed inside 2" x 4" stud walls with only minimum furring out required.



OVAL TEE

An oval, double-wall aluminum tee, the side opening of which has a die-formed quick coupling for easy attachment to a length or fitting of QC round vent pipe. Commonly used as a starter fitting for an oval vent within a wall.

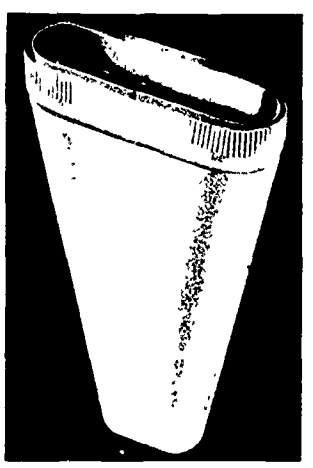


OVAL TEE CAP

An oval aluminum tee cap which completely closes the lower end of an oval tee and makes a strong, corrosion-resistant bottom.

ADAPTER - OVAL TO ROUND

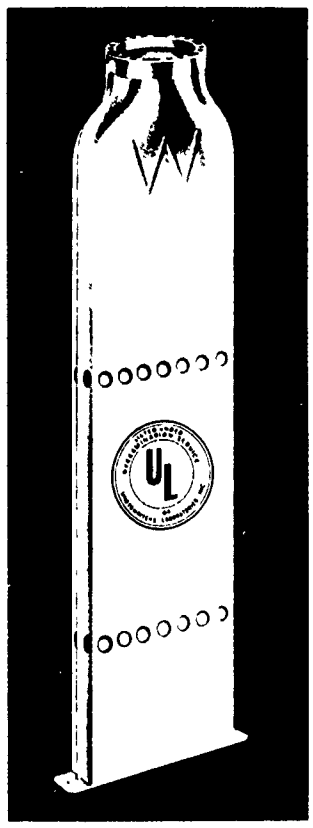
A double-wall, aluminum adapter, one end of which has a die-formed quick coupling to change vent from oval to QC round pipe.



OVAL INCREASER

An oval, double-wall aluminum fitting which permits an increase in the size of pipe in an oval vent line.

METALBESTOS VENT PIPE AND FITTINGS



WHV WALL-VENT

Recessed wall heaters can be safely vented inside 2" x 4" stud walls. The Metalbestos WHV Wall-Vent is designed specifically for this purpose and can be installed without furring out or other special construction.

It is a packaged unit of double-wall aluminum pipe rectangular in cross-section and equipped with an adapter from rectangular to round, with a die-formed quick coupling at the top to fit QC round pipe. A base plate and ceiling plate angles are included to enable correct spacing of the Wall-Vent.

The Metalbestos WHV Wall-Vent is listed by Underwriters' Laboratories as a fully approved Type B gas vent (Type B-W Wall-Vent), with the added permission to use it with a clearance of only 3/8" from combustible construction in single-story structures.

METALBESTOS INSTALLATION TIPS

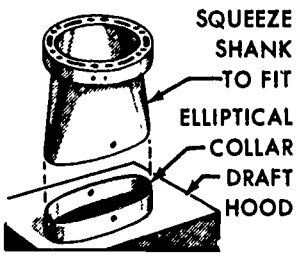


Fig. 60

Assembly and installation of QC round double-wall aluminum vent pipe and fittings is simplicity itself. Starting at the gas appliance draft hood outlet or flue collar, attach the proper size draft hood connector. If the flue collar or draft hood outlet is elliptical, squeeze the shank end of the draft hood connector between your fingers and it becomes an elliptical shape which will slip over the elliptical collar. Align holes in draft hood connector and flue collar or draft hood outlet and fasten permanently with sheet metal screws. When no collar is furnished, crimp end to fit inside opening.

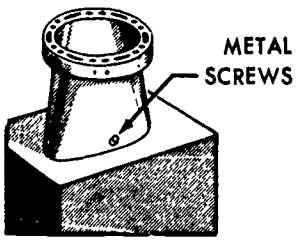


Fig. 61

After installing the draft hood connector, only the die-formed, slotted coupling end of the next section can fit onto it. The arrows on the slotted coupling will then point away from the appliance in the direction of the flow of flue gases. Subsequent lengths or fittings are assembled in the same manner.

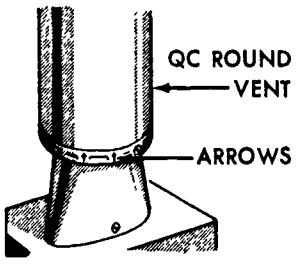


Fig. 62

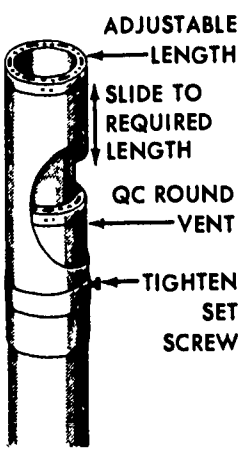


Fig. 63

Use 5-foot lengths of Metalbestos wherever possible. Use 3-foot and 18-inch lengths only to piece out. Keep on hand a supply of QC adjustable lengths. This enables you to make more efficient installations at lower cost because you eliminate the waste of time and material formerly required for cutting and discarding odd lengths of vent pipe.

Metalbestos vents are light. They do not require expensive footings for support. If support is desired, use metal straps.

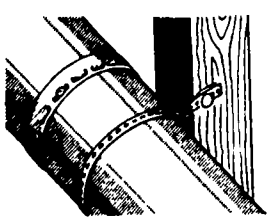


Fig. 64

CHECKING THE DRAFT

After the vent has been installed, the appliance should be lighted and the main burner checked and adjusted for proper combustion.

When it has been determined that the main burner is properly adjusted, the draft hood should be checked while the main burner is lighted to make sure that the products of combustion are being properly removed. One method is to pass a lighted match, a piece of burning paper, a taper or candle around the edge of the opening at the bottom of the draft hood.

If the vent is drawing properly, the test flame will be drawn into the draft hood. If the vent is not drawing properly, the products of combustion will tend to put out the test flame or blow it away from the bottom edge of the draft hood.

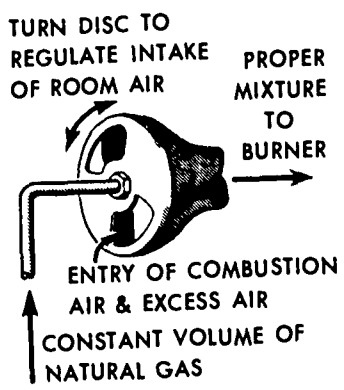


Fig. 65

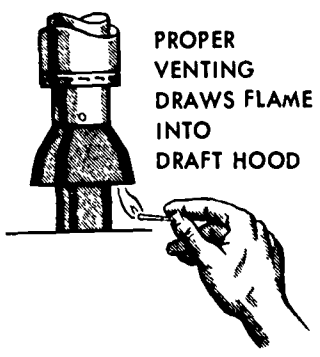


Fig. 66

CUATION! BEFORE USING THIS TEST, MAKE CERTAIN THAT THE MAIN BURNER OF THE APPLIANCE IS LIGHTED AND THAT NO UNBURNED GAS IS BEING RELEASED INTO THE APPLIANCE OR INTO THE ROOM. DO NOT PERMIT USE OF AN APPLIANCE UNTIL YOUR TESTS SHOW THAT THE APPLIANCE IS OPERATING PROPERLY AND THAT THE PRODUCTS OF COMBUSTION ARE BEING COMPLETELY REMOVED THROUGH THE VENT.

PAINTING METALBESTOS ALUMINUM VENT PIPE

Metalbestos aluminum gas vent pipe can be painted if desired.

The following condensed painting instructions include brand names of products generally available throughout the United States. The brand names are supplied for examples only and preference of manufacturer is not intended or implied.

Painting procedure is as follows:

1. CLEANING

Oil, grease, dirt and finger prints must be removed from the surface by washing down with one of the following products:

(a) Kelite Cleaner KDL #1, Manufactured by Kelite Products, Inc., Los Angeles, California.

(b) Oakite Aviation Cleaner or Oakite Composition #61, manufactured by Oakite Products, Inc., 22 Thames St., New York 6, New York.

(c) Sprey Aviation Cleaner, Manufactured by Dubois Company, Cincinnati, Ohio.

(d) D. C. #36, made by the Diversey Corporation, 53 West Jackson Boulevard, Chicago, Illinois.

(e) Clepo #86 P, made by Fred Gumm Chemical Company, 538 Forest Street, Kearney, New Jersey.

(f) Alumiprep #20, Manufactured by Neilson Chemical Company, available through Sherwin-Williams Branches.

Note: These products usually require dilution with water, and normally are high alkaline. (Use rubber gloves and protect skin and clothing as a safety measure.)

Follow instructions of the manufacturer regarding application, drying time and removal.

Application may be by brush or damp cloth. Remove by rinsing with clear water and wipe dry with clean cloth. If none of the products listed are available, plain naphtha may be used. Use liberally, wipe off and repeat once again. (Naphtha is highly inflammable, so take precautions against fire.)

2. SURFACE TREATMENT

After the surface is free of oil, dirt and grease, it is necessary to apply one of the following solutions usually containing phosphoric acid to phosphatize the surface in order to achieve good paint adhesion.

The manufacturers' recommendations should be followed regarding the time allowed for the solution to act, proper removal, etc. Protect skin and clothing when using these chemicals; rubber gloves are advisable.

(a) Alumiprep #1, Manufactured by Neilson Chemical Company, available through Sherwin-Williams Branches.

(b) Diversey #3, Manufactured by Diversey Company, 53 West Jackson Boulevard, Chicago, Illinois.

(c) Deoxidine or Alodine, Manufactured by American Chemical Paint Company, Ambler, Pennsylvania.

(d) Oakite Compound #36, Oakite Products, Inc., 22 Thames Street, New York 6, New York.

If none of these are available, buy from your local druggist and mix the following solution:

Solution: 40% by vol. Butyl Alcohol
30% Isopropyl Alcohol
20% Water
10% Phosphoric Acid

Apply solution and rinse off with water when etching becomes uniformly visible.

3. PRIMING

Priming should be done immediately following the surface treatment, after allowing the surface to dry.

Lead base primers must not be used.

Metal primers are recommended and preferably those for aluminum:

(a) Zinc Chromate is one of the most effective primers. However, due to its bright yellow color, it is difficult to hide with a single finish coat. Three coats are normally required with this primer. (Interior work or exterior)

(b) Zinc Chromate type primers, (Interior or Exterior.)

44-D 72
44-Y 76
RGL 15435-A
GL-50320-C
GL-52976
Glidden Paint Company
Cleveland, Ohio

(c) Zinc Chromate Primer for Aluminum 17-12, Pittsburgh Plate Glass Company, Pittsburgh, Pennsylvania.

(d) Interior Work. Flat Rite Primer, Sherwin-Williams Company.

(e) Exterior Work. Sherwin-Williams Kromik Metal Primer #74 dried overnight followed by one coat SWP Undercoater #450 dried overnight. (Finish with house paint.)

(f) Metalcote Zinc Chromate Primer #255, Manufactured by Lowe Brothers, Dayton, Ohio.

(g) Noxide 96 "One Day Primer"
House paint 305 Exterior Primer
Effecto The Outdoor Enamel Primer
Vitralite Transportation Primer Dark #100
Vitralite Transportation Primer-Sealer
White #1034, Gray #1035, Pink #1036
Manufactured by Pratt and Lambert, Inc.,
Buffalo, New York

4. FINISH

Any standard finish may be used over the primers and good results will be obtained if proper attention was given to the CLEANING, SURFACE PREPARATION AND PRIME COAT.

TECHNICAL TERMS EXPLAINED

APPLIANCE - Any device using gas fuel to produce light, heat or power.

BTU - Abbreviation for British thermal unit, is the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit.

BURNER - A device for the final conveyance of gas, or a mixture of gas and air, to the combustion zone.

CENTRAL HEATING UNIT - A gas appliance normally used as the primary means of heating premises. Ordinarily this includes gas boilers, warm air furnaces and floor furnaces, but does not include unit heaters, room or space heaters, or industrial gas boilers.

CHIMNEY - A vertical masonry or reinforced concrete shaft containing one or more flues.

COMBUSTION - Combustion, as used herein, refers to the rapid oxidation of fuel gases accompanied by the production of heat, or light and heat. Complete combustion of fuel is possible only in the presence of an adequate supply of oxygen.

COMBUSTION AIR - The air theoretically required to mix with gas in order to insure complete combustion.

COMBUSTION CHAMBER - That part of a gas appliance in which a mixture of gas and air is burned. Sometimes called the COMBUSTION ZONE.

COMMON VENT - A vent into which the vents from two or more gas appliances are connected and which is designed to float the vent gases from two or more gas appliances to the outside air.

CONDENSATE (CONDENSATION) - The liquid which separates from a cooled vent gas.

CROSS-SECTIONAL AREA - The area (usually in sq. in.) of the inside of a vent pipe in a plane perpendicular to its length.

DILUTION AIR - Air joining the products of combustion in the vent at the draft hood and which has not passed through the combustion chamber of the gas appliance.

DRAFT HOOD (DRAFT DIVERTER) - A device built into a gas appliance or made a part of the vent or vent connector from a gas appliance, which is designed to (1) insure the ready escape of the products of combustion in the event of no draft, or stoppage in the vent;

(2) prevent a back draft from entering the appliance (which might extinguish the flame and pilot permitting raw gas to escape, into the room); (3) prevent excessive stack action (upward suction) through the vent from affecting the operation of the gas appliance; and (4) to provide entry for the dilution air.

DRAFT HOOD CONNECTOR - A fitting with a shank at one end for attaching to the flue collar or draft hood of an appliance and with a die-formed coupling at the other end for easy connection with a vent pipe length or fitting.

EXCESS AIR - The amount of air which must be admitted to and passed through the combustion chamber and appliance flues in excess of that amount of air which is theoretically required for complete combustion.

FLUE - The passageways within the appliance through which the products of combustion.

FLUE COLLAR - That portion of a gas appliance designed for the attachment of the draft hood or draft hood connector.

FLUE GASES - The products of combustion plus excess air within the flues of an appliance prior to the draft hood.

HEAT ABSORPTION - The ability of a substance to absorb heat. It usually is combined with the ability to radiate heat to surrounding substances.

LATERAL - In gas appliance venting, any portion of a vent system that is not vertical.

MAIN BURNER - A device or group of devices essentially forming an integral unit for the final conveyance of gas or a mixture of gas and air to the combustion zone and on which combustion takes place to accomplish the function for which the gas appliance is designed.

PILOT - A small, continuously burning flame, which is utilized to ignite the gas at the main burner or burners.

PRODUCTS OF COMBUSTION - The mixture of hot nitrogen, carbon dioxide and water vapor resulting from the complete burning of gas in a gas appliance.

ROOF FLASHING (ROOF COLLAR) - A device, usually of metal, through which a vent pipe passes through a roof without coming into contact with combustible material and which prevents leakage through the roof at this point. It also sometimes is called a roof jack.

STORM COLLAR - A device fastened around a vent pipe immediately above a roof flashing to prevent the entry of rain or snow between vent pipe and top of roof flashing.

THERMAL CAPACITY - The amount of heat required to raise the temperature of a substance by any given amount. Aluminum has low thermal capacity; requires much less heat to raise its temperature than is needed to raise the temperature of asbestos-cement, brick or tile. Aluminum does not absorb nearly as much heat from vent gases as do these other materials.

TOP - A device placed on top of a vent pipe above roof level to prevent wind from hampering the escape of vent gases and to keep out rain and snow.

TRANSITION - A change of size, shape or direction of a vent system.

TYPE B VENT - Vent piping of non-combustible, corrosion-resistant material of sufficient thickness, cross-sectional area, and heat insulating quality to avoid excess temperature on adjacent combustible material and certified by a nationally recognized testing agency. (From Pamphlet No. 54, National Board of Fire Underwriters.)

TYPE B-W VENT - A vent designed exclusively for use with vented recessed heaters when installed strictly in accordance with the listings of a nationally recognized testing laboratory.

VENT - A pipe or tube through which vent gases are floated up to the outside air.

VENT CONNECTOR - The vent pipe between an appliance and the main vertical vent.

VENT GASES - The products of combustion plus excess air plus dilution air within the vent shows the draft hood.

VENTING - The complete and safe removal of all the products of combustion and vent gases to the outside air without condensation in the vent or spillage at the draft hood.

INSTRUCTIONS FOR INSTALLING
ASBESTOS-CEMENT GAS VENT PIPE

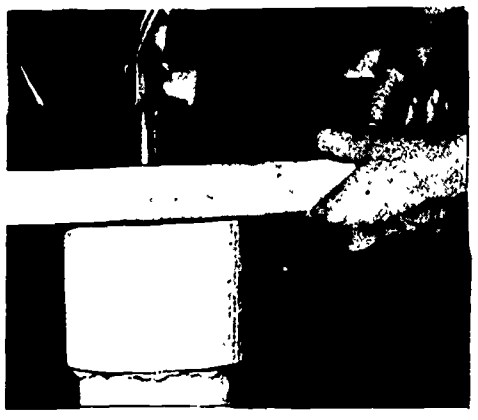
Asbestos-Cement Gas Vent Pipe is listed by the Underwriters' Laboratories, Inc. for use as a Type B gas vent. Type B gas vents are intended for venting listed appliances equipped to burn only gas. Type B gas vents are not permitted for use with incinerators, conversion burners or recessed heaters or with appliances requiring chimneys, whether factory built, masonry or metal. These instructions cover round and oval asbestos-cement gas vents.

These instructions include:

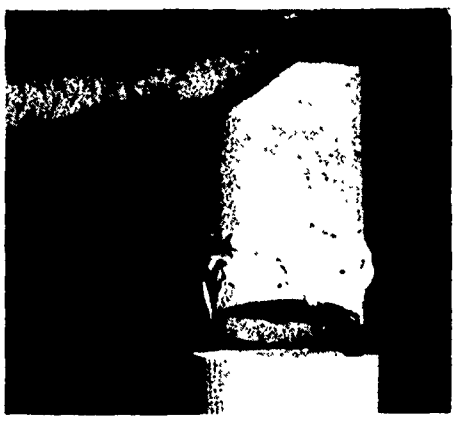
- A—Assembly of Pipe and Fittings
- B—Minimum Clearances
- C—Firestopping and Maintenance of Clearances
- D—Typical Methods of Supporting Pipe
- E—Flashing Vent Through Roof
- F—Vent Termination

(A) ASSEMBLY OF PIPE & FITTINGS

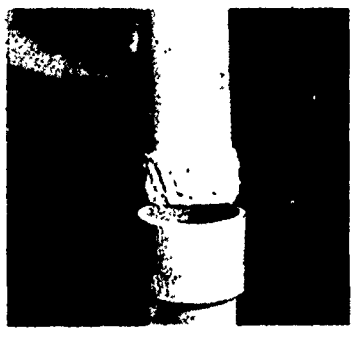
1. A special cement, after being mixed with water, is applied to the end of the asbestos-cement Gas Vent Pipe with trowel or putty knife.



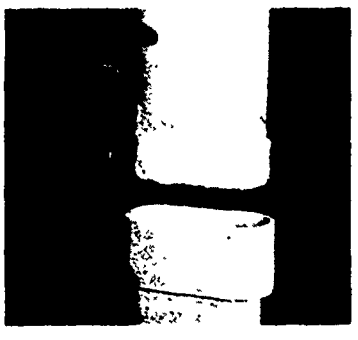
2. Then the tapered coupling is placed over the cemented pipe end, and may be driven home easily by a light hammer tap on a wood block.



3. After it is spread with cement, a second length of pipe is placed within the coupling and driven home. Joints are tight, positive, permanent-do not pull apart easily.



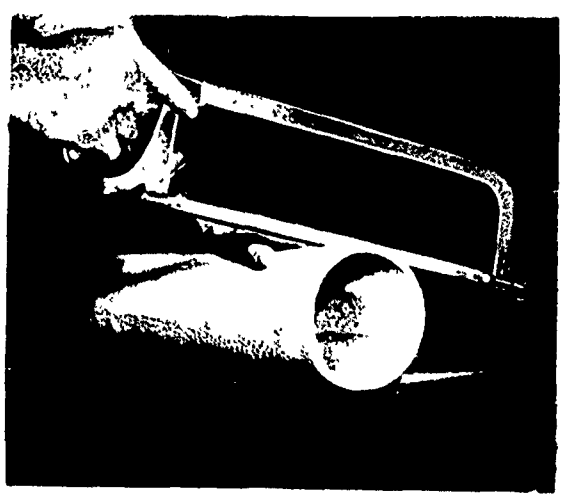
4. Field-cut ends of pipe receive sufficient cement to fill bell end of Duplex coupling



5. Asbestos-cement Oval Gas Vent Pipe is spread with cement in the same manner as field-cut round pipe, before placing in oval coupling

6. The finished joint, whether oval or round, is "pointed up"-all excess cement removed.

FITTINGS: Asbestos-Cement Gas Vent Pipe fittings are assembled in the same manner as pipe and coupling.



EASY TO CUT AND TO MACHINE.....Asbestos-cement Gas Vent Pipe is readily cut, using a standard hacksaw. A 10 or 14 point blade should be used for best results. A 6 point carpenter's saw or a standard asbestos-cement pipe cutter may also be used. Field cut ends of asbestos-cement Gas Vent Pipe may be machined to receive the tapered coupling. A standard asbestos-cement machining tool is available, or field cut ends may be installed directly into Duplex Coupling.

(B) MINIMUM CLEARANCES

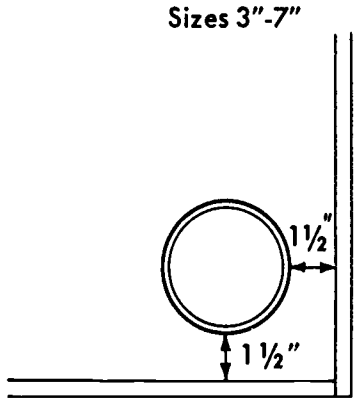
Minimum clearances for Transite Type B Gas Vent Pipe are:

SHAPE	SIZES	CLEARANCE
Round	3"-7"	1 ½ inches
Round	8"-12"	3 inches
Oval	No. 3 & No. 4	In 2x6 studding; or 1 ½ inches
Oval	No. 5 & No. 6	3 inches

Suitable precautions should be taken to prevent building insulation from coming in contact with any part of vent pipe, if necessary wire mesh may be employed for this purpose.

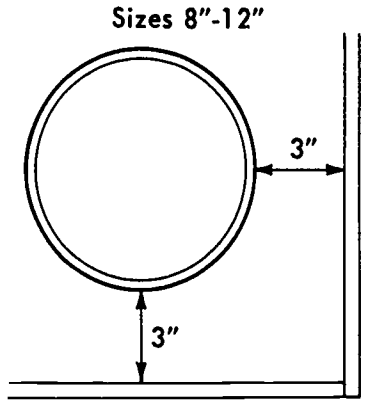
ROUND

Sizes 3"-7"



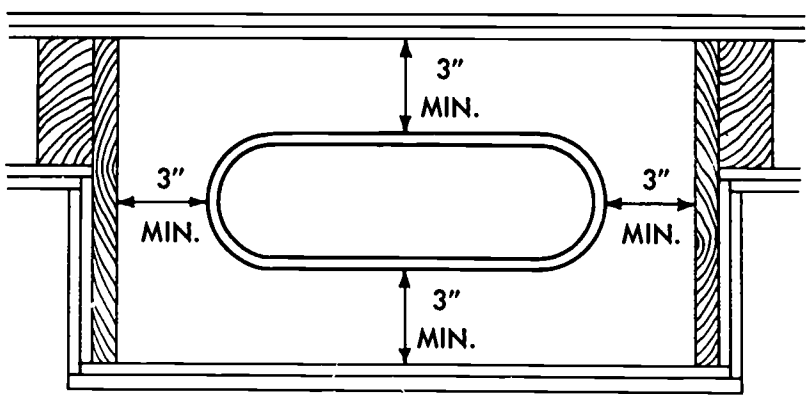
Minimum Clearances: 1 ½ Inches

Sizes 8"-12"



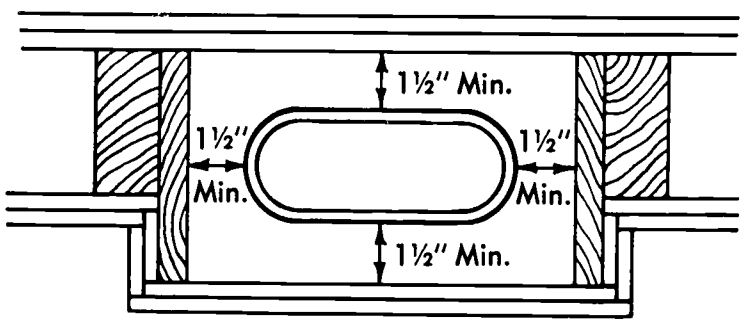
Minimum Clearances: 3 Inches

OVAL SIZES NO. 5 & NO. 6



Minimum Clearances: 3 Inches

OVAL SIZES NO. 3 & NO. 4



Minimum Clearances: 1½ Inches

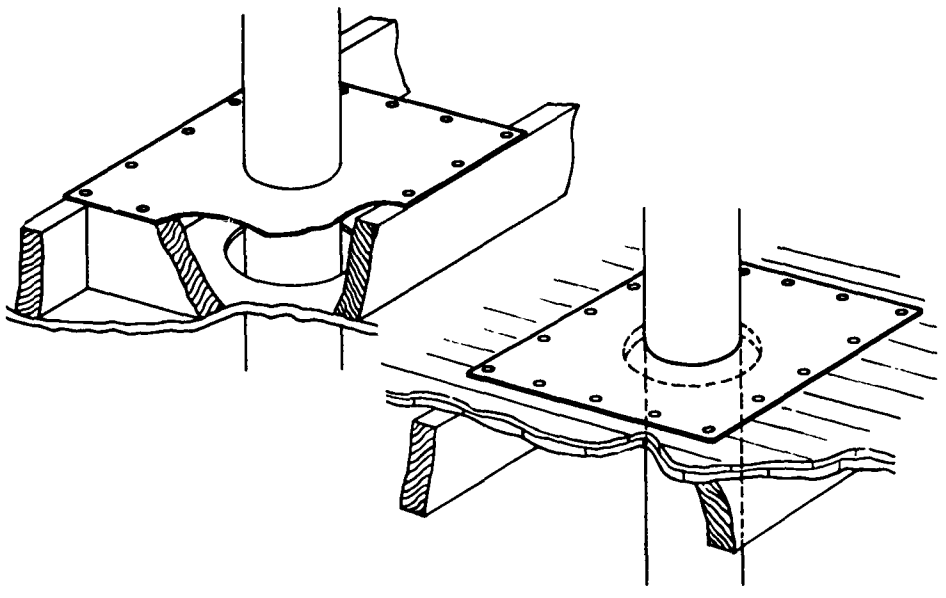
For installation in 2"x6" stud partition, use pipe (Cat. No. 4-2A 2x6) in sizes No. 3 and No. 4 which is furnished with angle spacers installed at factory to maintain proper clearance. See Section III below.

© FIRESTOPPING & MAINTENANCE OF CLEARANCES

All vents regardless of size or style, must be firestopped at each point encountered passing a floor or ceiling. The firestopping shown below should position the vent and maintain required clearances at floors and ceilings. Firestopping can be placed at floor or ceiling except in attic, where it should be placed on floor or on joists, with joists framed on four sides.

SECTION I

ROUND PIPE — For all sizes, firestop with sheet metal or asbestos-cement board. For sizes 8"-12", note Support Assembly in Section II which provides firestop at first floor level.

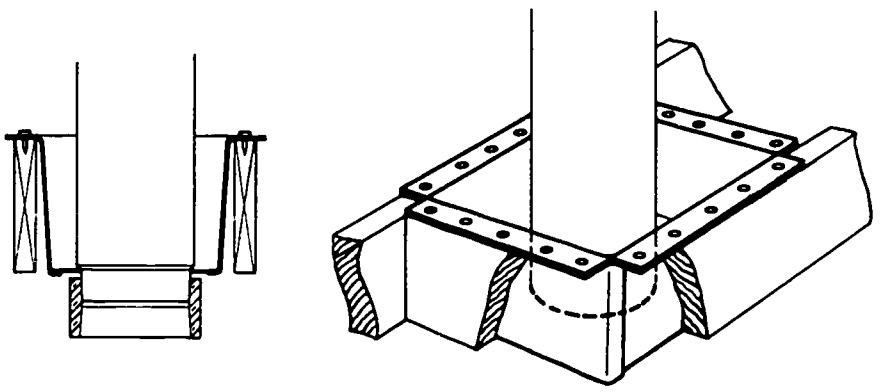


Attic Installation
(with unfinished attic above)

Floor Installation
(with unfinished basement below)

SECTION II

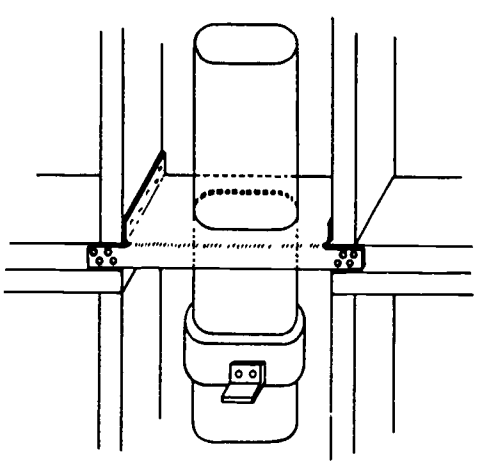
ROUND PIPE Sizes 8"-12" at first floor level



The length starting at the first floor level in sizes 8½-12 must be supported and firestopped. When passing through other levels, use fire-stopping methods shown in Section 1. The height of the vent of 8", 10" and 12" pipe should not exceed 50 ft.

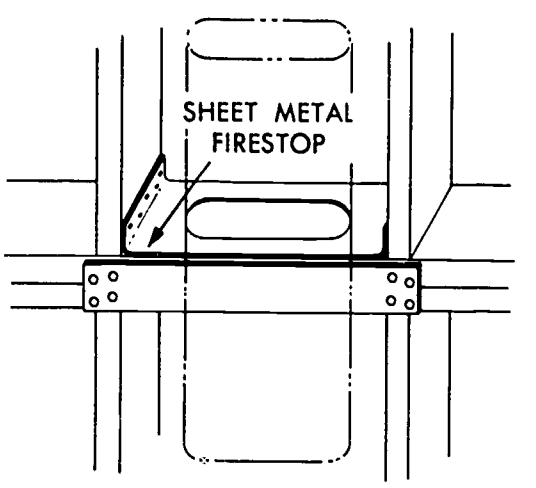
OVAL PIPE No. 3 and No. 4 when enclosed in 2" x 6" stud space must be installed with Firestop Sapcer.

SECTION III



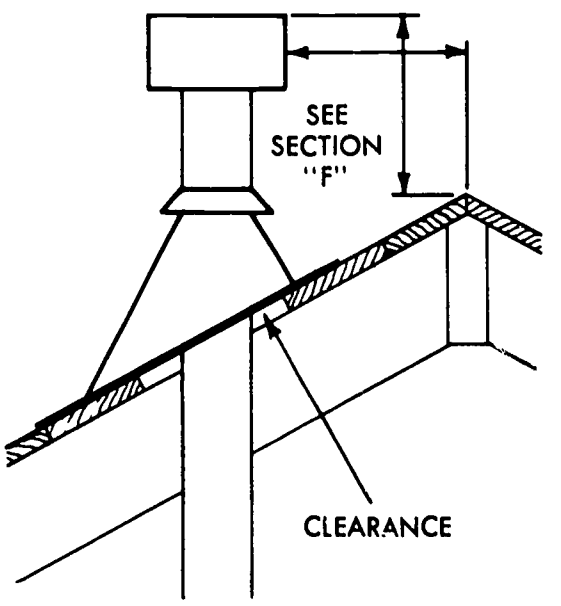
SECTION IV

Firestop with metal when installed at required 1 ½" clearance for sizes No. 3 and No. 4, and 3" clearance for sizes No. 5 and 6.



The cut plate must be rejoined by plate joiners (16 gauge sheet metal).

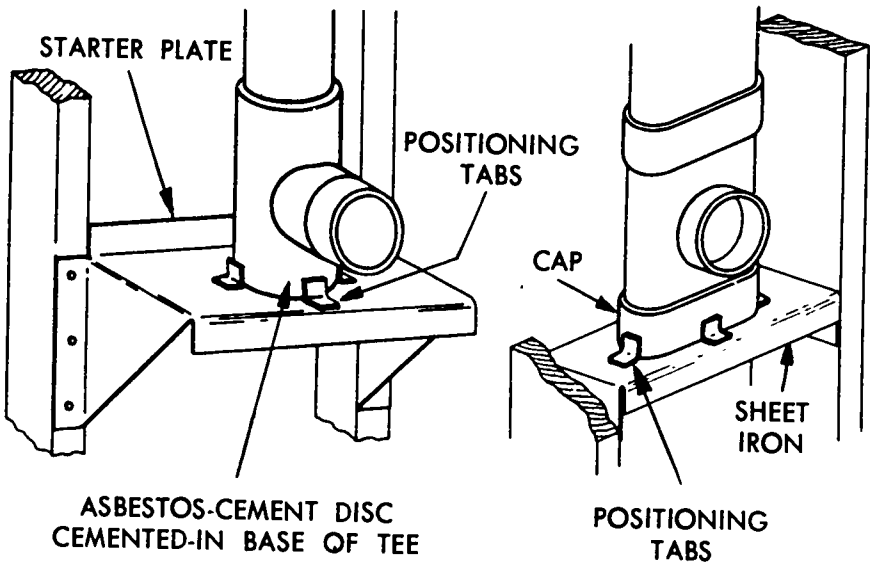
CLEARANCES TO ROOF

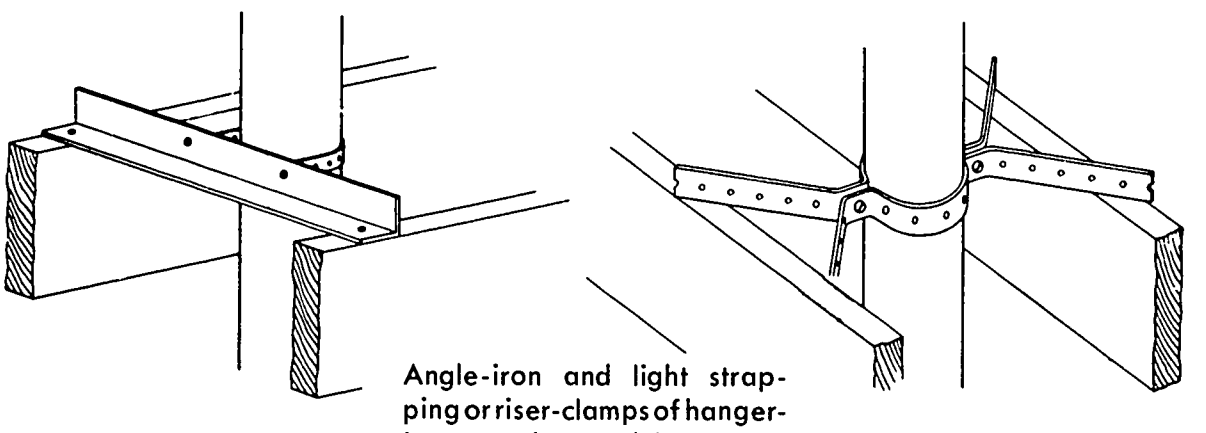


SHAPE	SIZES	CLEARANCE
Round	3"-7"	1 ½ inches
Round	8"-12"	3 inches
Oval	No. 3 & No. 4	1 ½ inches
Oval	No. 5 & No. 6	3 inches

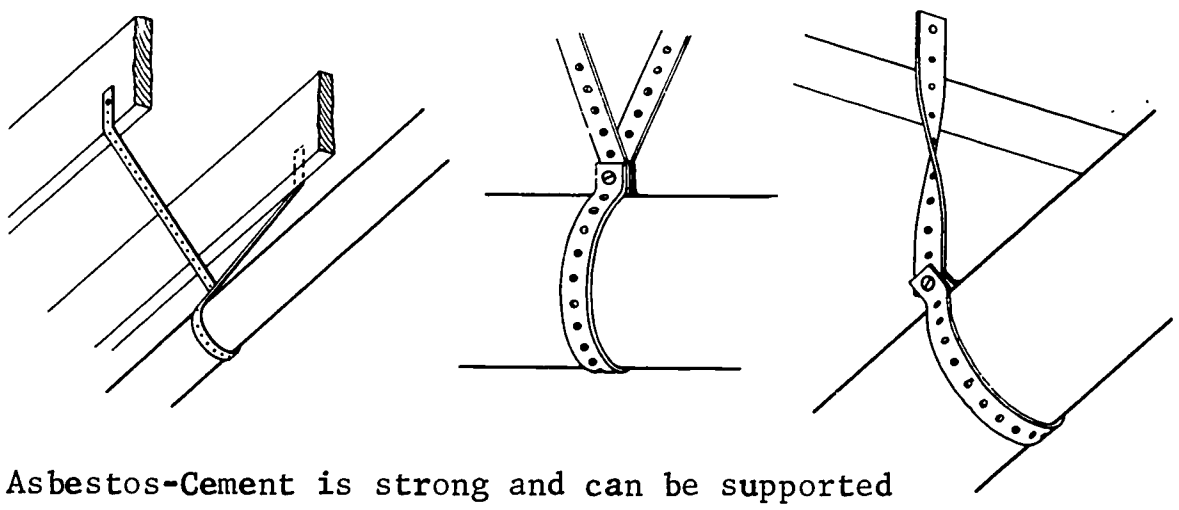
(D) TYPICAL METHODS OF SUPPORT

When supporting vent, minimum clearances must be observed.

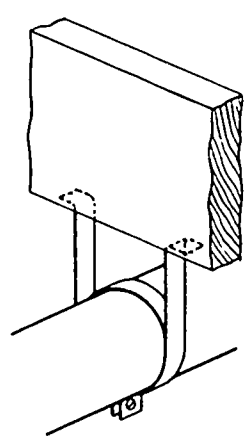




Angle-iron and light strapping or riser-clamps of hanger-iron can be used in various ways for supporting the run of vent.

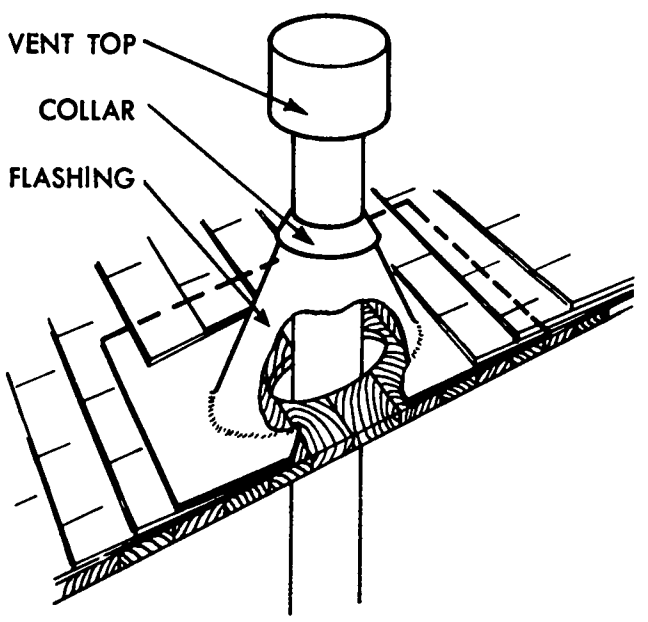


Asbestos-Cement is strong and can be supported and braced at any point along the length of the vent and at fittings and couplings.



STANDARD HANGERS

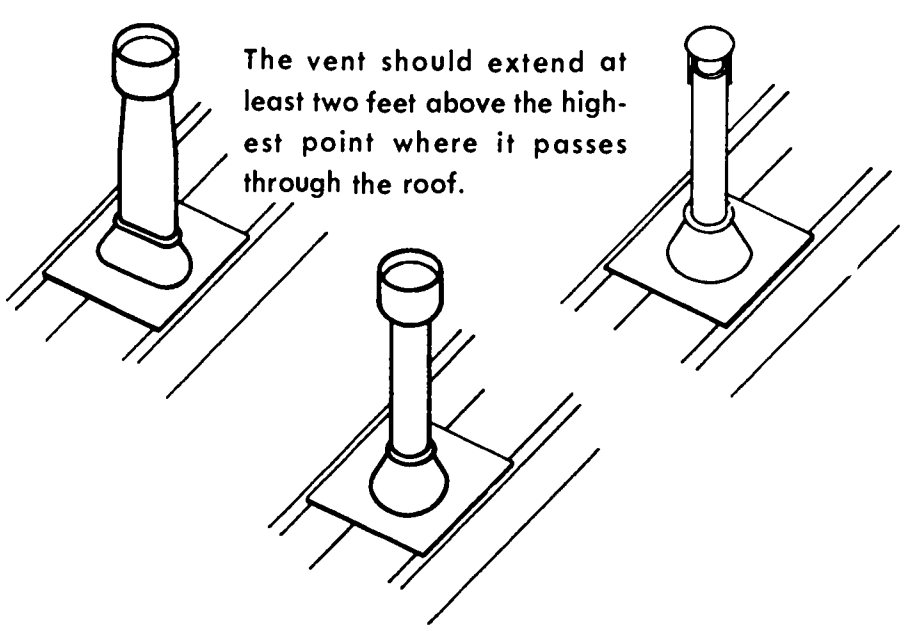
(E) FLASHING VENT THROUGH ROOF



Standard flashing practice is followed when asbestos-cement vent passes through the roof.

NOTICE - This gas vent is for appliances which burn only gas. Do not connect to incinerators or solid or liquid fuel-burning appliances.

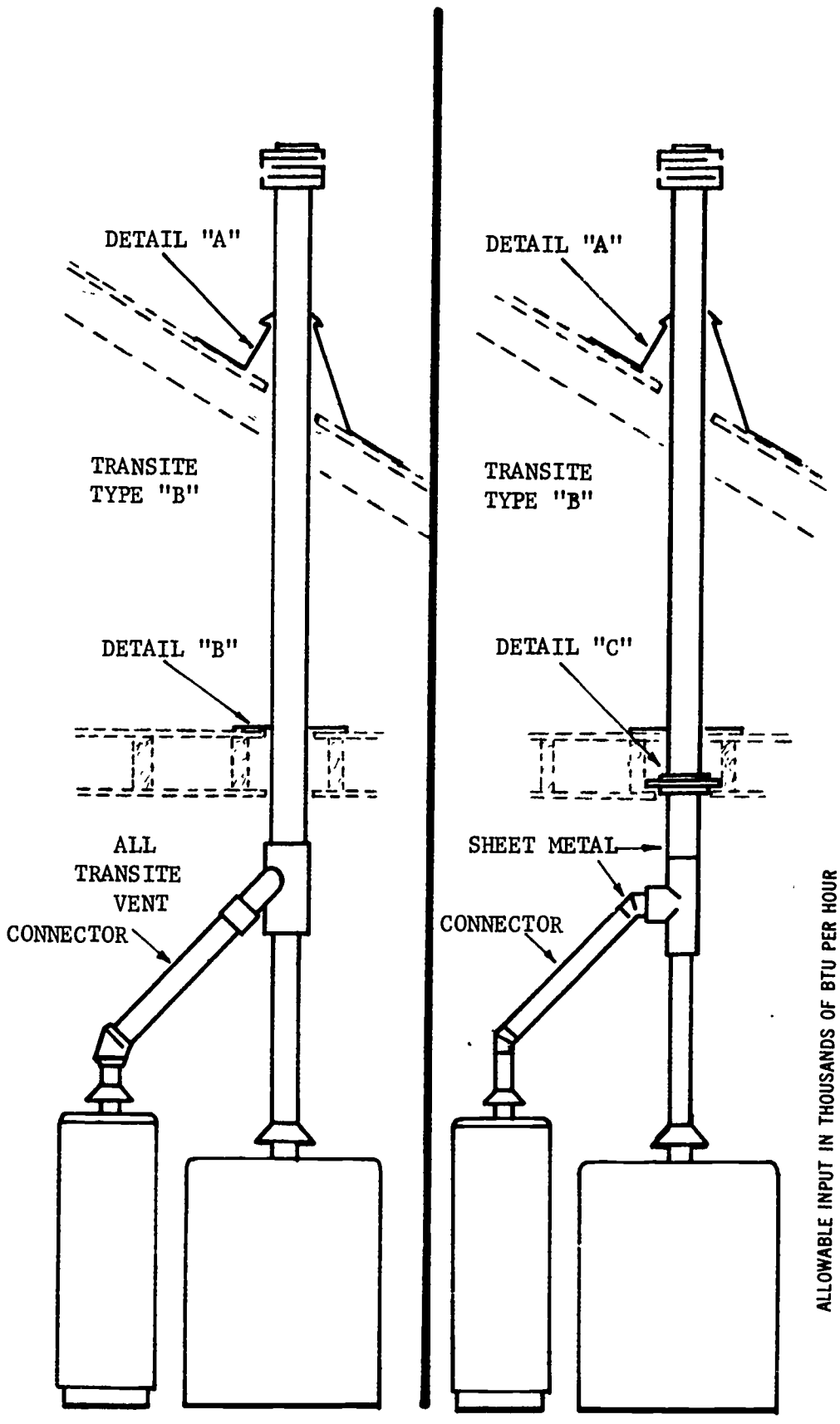
(F) VENT TERMINATION



Vent must terminate not less than 2 feet above any structure within 10 feet and not less than 4 feet above the highest connected appliance draft hood or flue collar.

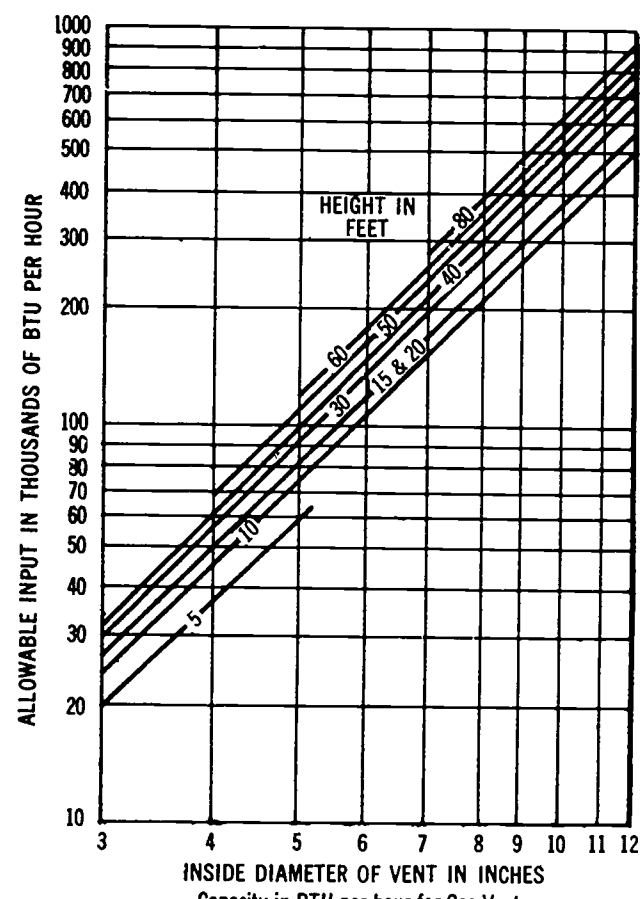
Gas vents need not comply with the above when equipped with an "approved" (such as by the city of Los Angeles Code, etc.) device which assures proper and effective venting as installed.

MULTIPLE APPLIANCE VENT SYSTEM



SIZING A MULTIPLE APPLIANCE VENT SYSTEM

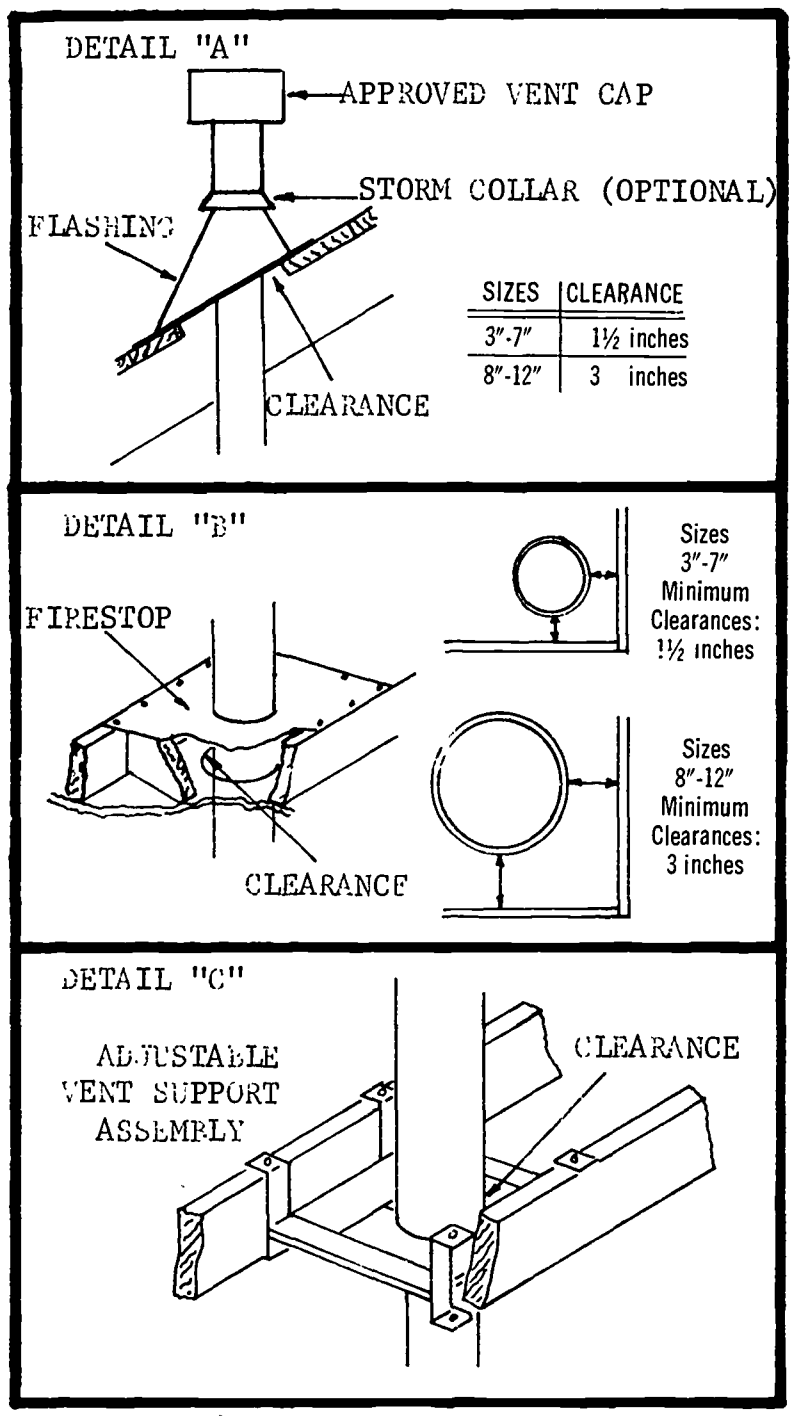
When more than one appliance is connected to a gas vent the area of the passageway shall be not less than the area of the largest vent connector plus 50 per cent of the areas of additional vent connectors. (NBFU No. 54)

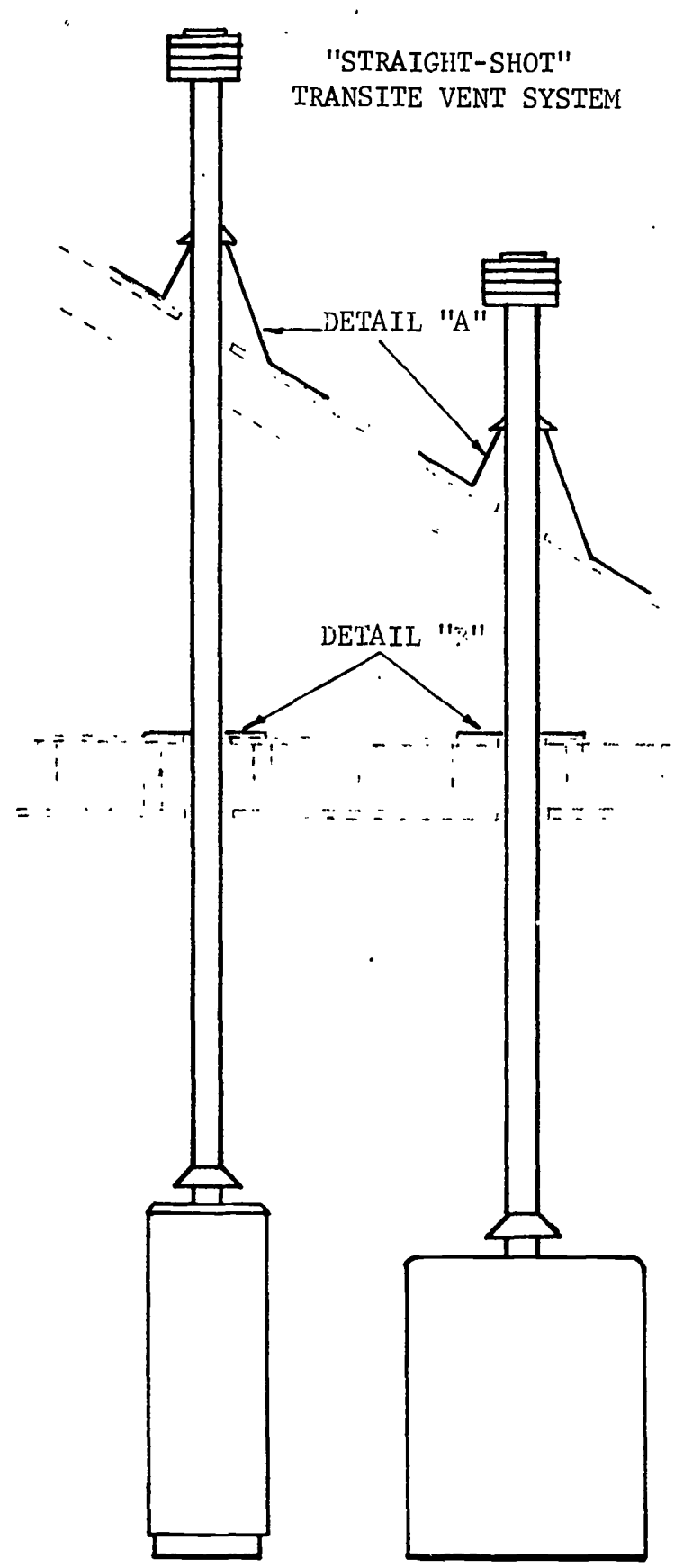


Capacity in BTU per hour for Gas Vents serving more than one appliance.

SPECIFICATIONS:

"STRAIGHT SHOT" VENT SYSTEM





SIZING A SINGLE APPLIANCE VENT SYSTEM

(Individual vents provide greater reliability)

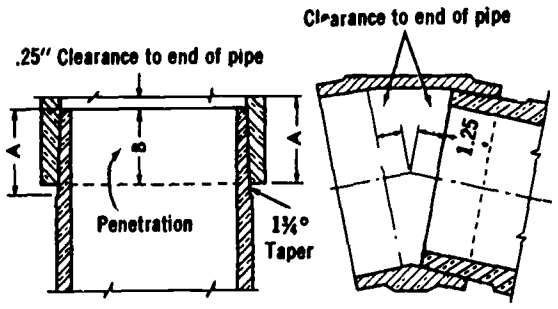
When connected to a single appliance, the gas vent shall be not less than the size of the draft hood outlet.

(SOURCE: STANDARD OF NBFU NO. 54 FOR INSTALLATION OF GAS APPLIANCE AND GAS PIPING AS RECOMMENDED BY THE NATIONAL FIRE PROTECTION ASSOCIATION.)

PIPE AND FITTINGS - To determine center-line roughing-in dimensions, following drawings are planned to indicate distance between pipe ends within couplings and from pipe end to point of intersection of center-lines of fittings. Asbestos-Cement Gas Vent cement available in 1, 2, 4, 8 and 15 pound containers.

GENERAL END DETAIL

Size	A	B
3"	1.8	1.5
4"	2.0	1.8
5"	2.0	1.8
6"	2.0	1.8
7"	2.5	2.3
8"	2.5	2.3
10"	2.5	2.3
12"	3.0	2.8

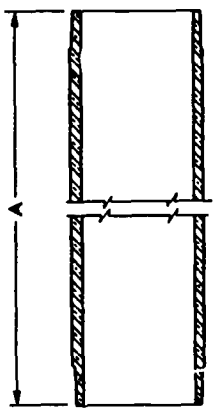


At left: typical penetration of pipe into couplings, laterals and tees.

At right: penetration into elbows.

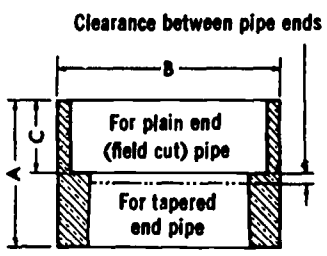
PIPE

Size	A
3"	5'0" and 10'0"
4"	5'0" and 10'0"
5"	5'0" and 10'0"
6"	5'0" and 10'0"
7"	5'0" and 10'0"
8"	5'0" and 10'0"
10"	6'6" and 13'0"
12"	6'6" and 13'0"



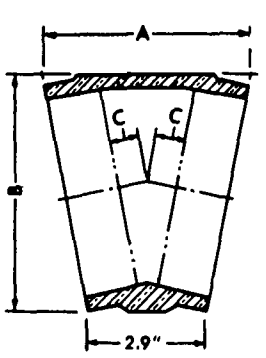
NIPPLES

Size	A
3" 4" 5" 6"	COMES IN 4" AND IN 12"—36" IN INCREMENTS OF 6"
7"	12"—36" IN INCREMENTS OF 6"



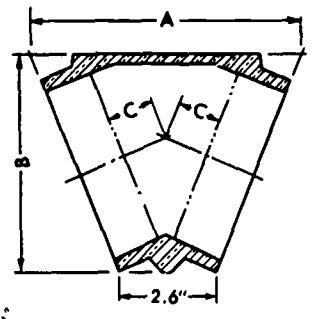
DUPLEX COUPLING

Size	A	B	C
3"	3.5	5.0	1.8
4"	4.0	6.0	2.0
5"	4.0	7.1	2.0
6"	4.0	8.1	2.0
7"	5.0	9.4	2.5
8"	5.0	10.4	2.5
10"	5.0	12.4	2.5
12"	6.0	14.7	3.0



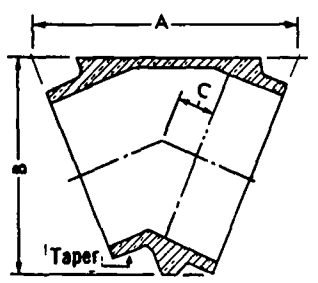
22½° ELL

Size	A	B	C
3"	4.7	4.4	.7
4"	5.1	5.4	.8
5"	5.5	6.4	.9
6"	5.9	7.4	1.0



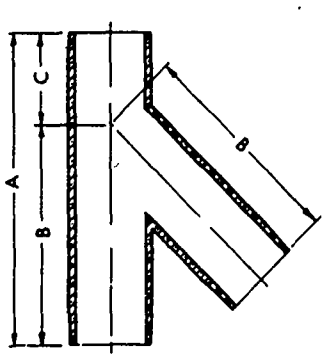
45° ELL NO. 1

Size	A	B	C
3"	6.4	4.6	1.0
4"	7.2	5.5	1.3
5"	8.0	6.5	1.5
6"	8.8	7.5	1.7



45° ELL NO. 2

Size	A	B	C
3"	6.4	4.6	1.0
4"	7.2	5.5	1.3
5"	8.0	6.5	1.5
6"	8.8	7.5	1.7



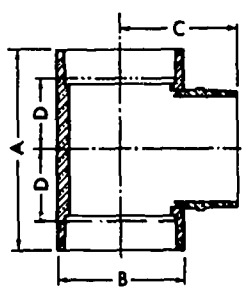
WYE

Size	A	B	C
7"	23.0	16.5	6.5
8"	24.5	17.5	7.0
10"	28.0	20.5	7.5
12"	33.0	24.5	8.5

Reducing branches available

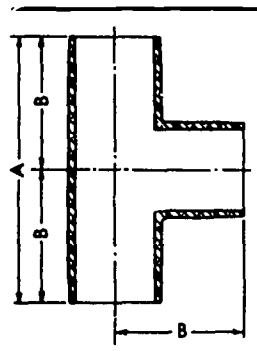
TEE

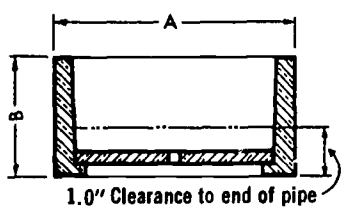
Size	A	B	C
3"	8.0	4.5	5.3
4"	9.5	5.5	6.0
5"	10.5	6.7	6.5
6"	11.5	7 7	7.0



Size	A	B
7"	17.0	8.5
8"	18.0	9.0
10"	22.0	11.0
12"	24.0	12.0

Reducing branches available

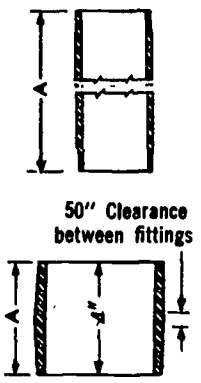


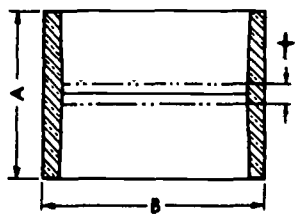


TEE CAP

Size	A	B
3"	4.4	2.5
4"	5.4	2.8
5"	6.6	2.8
6"	7.6	2.8
7"	8.8	3.3
8"	9.8	3.3
10"	11.8	3.3
12"	14.0	3.8

A Tee Cap, with hole, is used at the bottom of any run of pipe. A Tee Cap, without hole, is used at the end of other runs of pipe.





TAPERED COUPLING

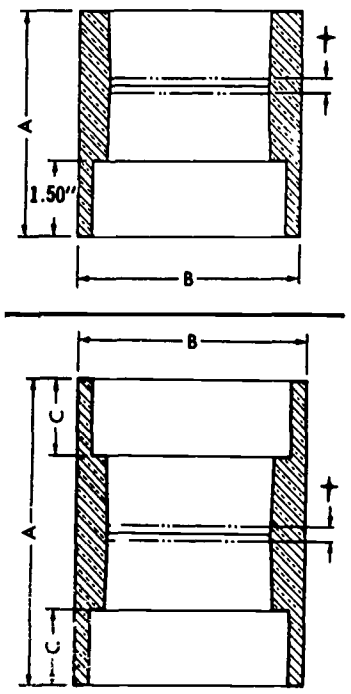
Size	A	B
3"	3.5	4.4
4"	4.0	5.4
5"	4.0	6.6
6"	4.0	7.6
7"	5.0	8.8
8"	5.0	9.8
10"	5.0	11.8
12"	6.0	14.0

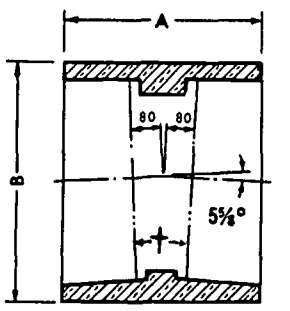
† Clearance between pipe ends

FLASHING COUPLING

Size	A	B
3"	5.0	5.3
4"	5.5	6.3
5"	5.5	7.4
6"	5.5	8.4

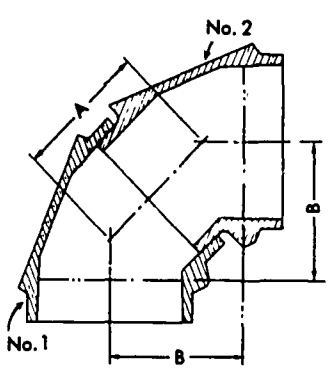
Size	A	B	C
7"	10.0	9.7	2.5
8"	10.0	10.7	2.5
10"	10.0	12.7	2.5
12"	12.0	14.9	3.0





DEFLECTION COUPLING

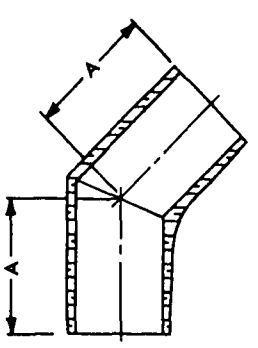
Size	A	B
3"	4.3	4.4
4"	4.8	5.4
5"	4.8	6.5
6"	4.8	7.5



90° ELL ASSEMBLY

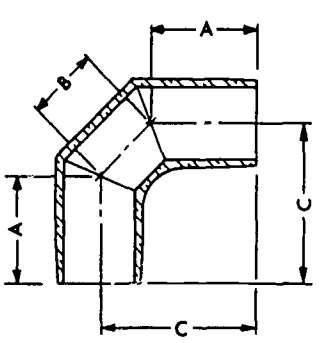
(by joining 45° ells 1 & 2)

Size	A	B
3"	4.0	3.8
4"	4.2	4.3
5"	4.5	4.8
6"	4.6	5.1



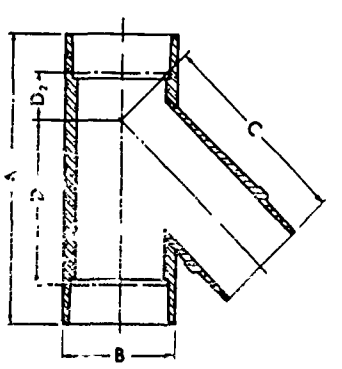
45° ELL

Size	A
7"	6.5
8"	6.8
10"	7.3
12"	8.5



90° ELL

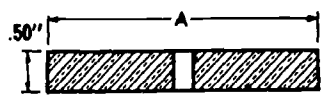
Size	A	B	C
7"	6.5	7.0	11.5
8"	6.8	8.0	12.4
10"	7.3	10.0	14.3
12"	8.5	12.0	17.0



WYE

Reducing branches available

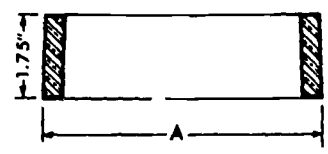
Size	A	B	C	D	D_2
3"	10.9	4.5	7.9	5.9	2.0
4"	12.8	5.5	9.1	7.3	2.0
5"	14.5	6.6	11.1	8.8	2 3
6"	16.0	7.6	12.6	10.0	2.5



TEE DISK

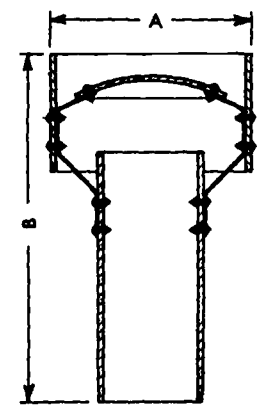
Size	A
3"	3.6
4"	4.6
5"	5.6
6"	6.6

A Tee Disk, with hole, is used at the bottom of any run of pipe. A Tee Disk, without hole, is used at the end of other runs of pipe.



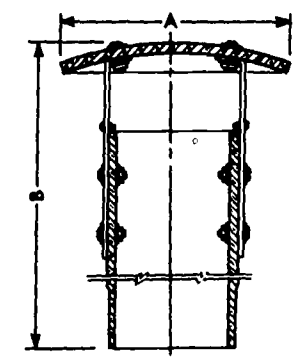
INCREASING RING

Size	A
3" x 4"	4.6
3" x 5"	5.7
4" x 5"	5.7
4" x 6"	6.7
5" x 6"	6.7
5" x 7"	7.8
6" x 7"	7.8
6" x 8"	8.8
7" x 8"	8.8
8" x 10"	10.8
10" x 12"	12.9



VENTILATOR TOP

Size	A	B
3"	6.7	20.6
4"	8.8	22.0
5"	10.8	23.0
6"	12.9	24.0
7"	14.9	25.0
8"	17.0	26.0
10"	21.1	28.0
12"	25.2	30.0

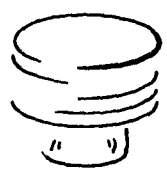


CONE TOP

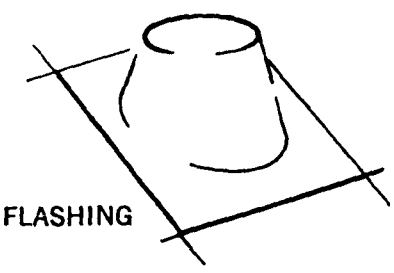
Size	A	B
3"	5.6	20.3
4"	8.0	20.9
5"	9.6	21.8
6"	11.2	22.3
7"	14.4	23.5
8"	16.0	25.3
10"	20.0	26.5
12"	24.0	27.5

ACCESSORIES

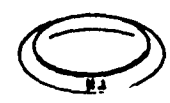
Typical accessories available through local sources of supply.



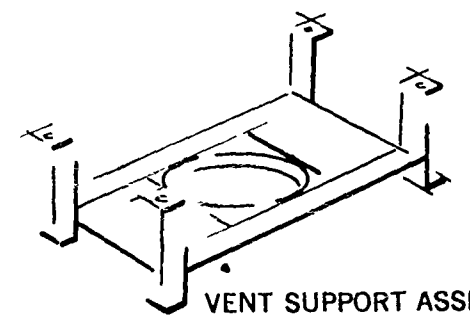
VENT CAP



FLASHING



STORM COLLAR



VENT SUPPORT ASSEMBLY

Name:_____

Approved by:_____

Date:_____

Venting Gas Equipment

Key: BI - WB9 - 4A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Venting Gas Burning Equipment

Purpose: To help you realize the necessity of proper venting for gas fired appliances or equipment

Reference: Information Sheet
Metalbestos Gas Vent Tables and Handbook

General Information: Venting gas burning equipment is often considered too elementary. The efficient use of gas burning equipment depends to a great extent upon proper venting.

A factor no less important to the mechanic installing equipment is the safety with which gas may be utilized. A vent properly installed will prevent the poisonous and obnoxious gases as well as moisture entering the room. There are certain basic fundamental but essential rules that must be followed in the installation and adjustment of vents.

Procedure: Answer the following questions and work the problems as a guide to study the reference listed.

Questions and Problems:

1. What is the purpose for venting gas burning equipment?

2. What are the products of perfect combustion?

3. Answer the following questions from Figure 1, of BI - WB9 - 4I.

   a. How many cubic feet of natural gas is necessary to produce 100,000 BTU's?

   b. How many cubic feet of air is needed to burn 100,000 BTU for perfect combustion?

c. How many cu. ft. of oxygen?

d. How many gallons of water is produced per 100,000 BTU?

4. List five factors to insure correct venting.

a.

b.

c.

d.

e.

5. What are the two factors which determine the efficiency with which a vent operates?

6. List two factors determined by the average temperature of the vent gases.

7. Answer the following questions pertaining to suggested specifications or procedures in the installation of the vent.

a. To what extent should insulated pipe be used for vents?

b. What is specified as to change of direction?

c. What is suggested for the pipe leaving the draft hood?

8. Explain what is meant by maximum input for a particular vent.

9. Give two probable conditions resulting from excess cooling of flue gases.

10. Define "Minimum Input".

11. Define Vent Capacity.

12. From the chart, Figure 8, list the four conditions that may exist in gas venting.

a.

b.

c.

d.

13. Show which conditions are satisfactory by answering yes or no as shown by chart, Figure 9. Answer yes or no under both insulated and uninsulated.

	BTU	Length of Vent	Insulated	Uninsulated
a.	80,000	15 ft.		
b.	100,000	25 ft.		
c.	20,000	5 ft.		
d.	40,000	5 ft.		
e.	20,000	15 ft.		
f.	40,000	15 ft.		
g.	60,000	10 ft.		
h.	60,000	15 ft.		
i.	100,000	15 ft.		

14. What conditions would exist using 4" vent pipe, 15 ft. long for 100,000 BTU input?

15. List four conditions governing the location of an appliance as set by American Gas Association and National Board of Fire Underwriters.

    a.

    b.

    c.

    d.

16. List the five locations suggested for vents.

    a.

    b.

    c.

    d.

17. What type of vent pipe is suggested by both Metalbestos and Johns-Manville?

18. What sizes are available in asbestos-cement pipe?

19. Name the most important factor in favor of installing vents in interior partitions over exterior walls or partitions.

20. Why is it not advisable to vent gas burning equipment into an ordinary masonry chimney?

21. What is generally formed by condensation to cause corrosion?

22. What factors should be considered when venting two or more appliances?

23. What effect does insufficient fresh air have on the action of the flue gases?

24. How is the necessary air for combustion and dilution generally provided?

25. What restriction as to size is set up for draft hood connections?

26. How much rise per foot is usually required for horizontal laterals where conditions require it?

27. What provision is made for vents for fire prevention?

28. From what sources are the rules taken governing installation of Central heating units and boilers?

29. In the installation of Water heaters, what conditions make it especially important that they be well vented?

30. When the main burner is properly adjusted and lighted, how can the venting action be checked?

VT 009 976
Phipps, D. Bart
Sketching and Plan Reading for Apprentice Training in the Plumbing and Pipe Fitting Industry; Workbook No. 21.

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PUB DATE - ND 47p.

DESCRIPTORS - *STUDY GUIDES; *TRADE AND INDUSTRIAL EDUCATION; *APPRENTICESHIPS; *PLUMBING; WORKBOOKS; *GEOMETRIC CONCEPTS; ILLUSTRATIONS; GRAPHIC ARTS; ASSIGNMENTS

ABSTRACT - This workbook was prepared by a subject matter specialist for use in the training of plumbing and pipe fitting apprentices in sketching and in reading plans and blueprints. Contents include student progress records, both for student use and for the instructor's files, information sheets, and student assignment sheets providing subject, purpose, references, general information, procedures, and questions. Some areas covered are projection of views, sketching techniques, multi-view drawings, and free hand circles. Line drawings, diagrams, and sketches illustrate the bulletin. (AW)

VT 009 976

ED0 45856

SKETCHING AND PLAN READING

for

APPRENTICE TRAINING
in the
PLUMBING AND PIPE FITTING INDUSTRY

Workbook No. 21

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Prepared by

D. Bart Phipps, Specialist
Apprentice Training
Plumbing and Pipe Fitting

ENGINEERING EXTENSION SERVICE
Texas A&M University
cooperating with
INDUSTRIAL EDUCATION SERVICE
Texas Education Agency
and
Texas State Joint Apprenticeship and Training Committee
for the Plumbing and Pipe Fitting Industry

11-5-300

VT 009 976

Name: _____

Sketching & Plan Reading

Packet No. 21

STUDENT PROGRESS RECORD
in
BASIC INSTRUCTION FOR APPRENTICE TRAINING
for the
PLUMBING AND PIPE FITTING INDUSTRY

	Information Sheets	Student Assignments	Date Complete
*1. Introduction to Plan Reading	1-4 Pages	1-2 Pages	
*2. Projection of Views	1-3 Pages	1-4 Pages	
3. Sketching Technique	1-3 Pages	1-2 Pages	
*4. Multi-View Drawings	NONE	1-5 Pages	
5. Free hand Circles	NONE	1-3 Pages	
6. Reading Multi-View Drawings	NONE	1-3 Pages	
7. Lettering	NONE	1-3 Pages	
8. Size Description	1-5 Pages	1-4 Pages	

NOTE: Green Sheet for student's note book
Gold sheet for instructor's file

Also in this packet:
1 - 1/8" scale guide sheet
28 - sheets 13# Bond

Price of this packet, .60¢

Instructor's Lesson Plan for Group Instruction

Name: _____

Sketching & Plan Reading

Packet No. 21

STUDENT PROGRESS RECORD
in
BASIC INSTRUCTION FOR APPRENTICE TRAINING
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Instructor's Lesson Plan for Group Instruction

Information Sheet
in
Plumbing and Pipe Fitting

Subject: INTRODUCTION TO PLAN READING

We are living in an age in which the machine has made unbelievable progress almost to the point of doing all of our work for us. The progress of the machine age has necessitated and made possible, changes and improvements in building construction, both for efficiency and living comfort.

A moments thought will cause us to realize that a great many hours of thinking and planning was necessary in order to bring our standards of living and progress far above other countries of the world.

In order to accomplish these things, the planner or designer must convey his thoughts to the craftsman in such a manner as to describe completely to the finest detail, his thoughts and plans.

How is it possible to convey this information to the workman who actually makes it possible for us to accomplish such things? Through progress and experience, industry has developed a language of its own in which we use lines, symbols, notes and dimensions to express ideas and thoughts with very accurate descriptions of the object to be built. This language which we use is nothing more than a standard method of simple drawing.

The questions naturally arise in the minds of the craftsman, what type of drawings must we become familiar with? What technical information must we know to be able to read and understand these drawings?

Most of us have seen and become somewhat familiar with working drawings which we normally refer to as blueprints. Quite naturally, these drawings seem rather complicated to some of us, but we must remember that at one time the simpliest print was difficult for us to read and understand. We learned to read and write a language we speak by simple progressive steps until we can now read practically everything we care to. Then in the same manner, we shall study the language of industry, by learning and doing, step by step, until we have developed a practical understanding of working drawings.

When we speak of working drawings, what exactly do we mean? What is their purpose? What information can we get from them?

By comparison, we may appreciate the value of a working drawing. Let us consider the artist view as shown in Figure 1 which is a picture or a pictorial drawing.

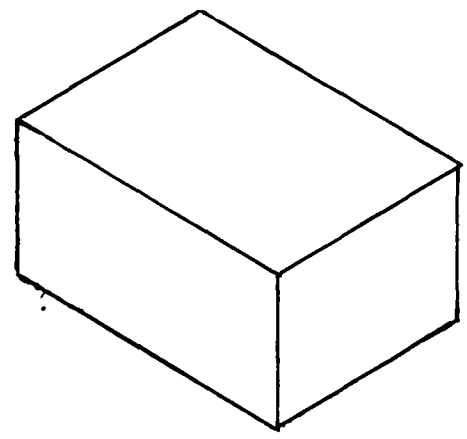


Fig. 1 Pictorial Drawing

As a craftsman, very little necessary information is derived from it. It suggests the shape of a block, but does not give the actual shape, size or any detail of the several sides. We suppose that the corners are square, but can we safely do a job on supposition? Not very satisfactorily.

We must have a drawing that will give accurate description of the shape, details and size of the object to be built if we are to do accurate work. These are usually referred to as shape description and size description of dimensioning.

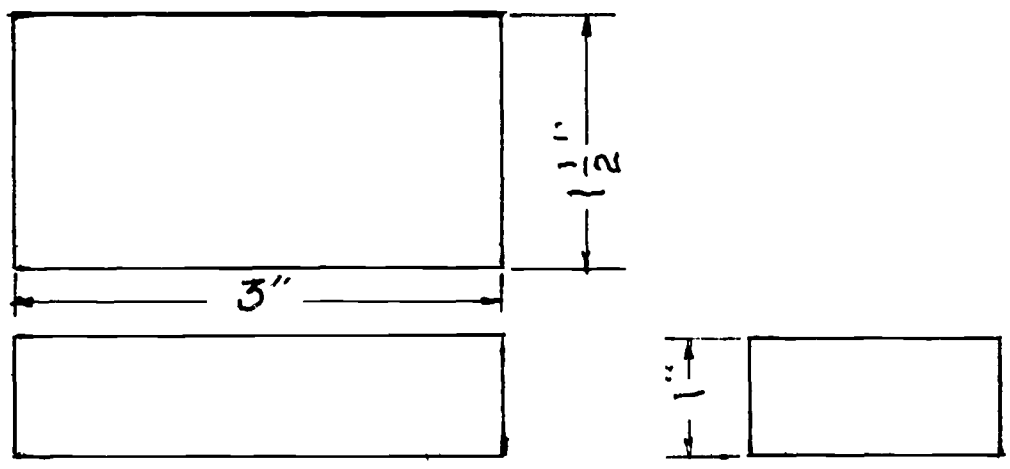


Fig. 2 Working Drawing

The lower figure represents the front view of the block since that is the side that is seen from a point directly in front of it. Only the length and height is shown in this view so it is necessary to show the width in the upper view of

It is obvious, as we have mentioned before, that six views are not necessary to show an accurate shape or size description of the block. Only the views that are required to show the information necessary to build or describe the object are usually drawn on the working drawing. We shall, hereafter, refer to these views as the necessary views. An example is shown in Figure 5 below.

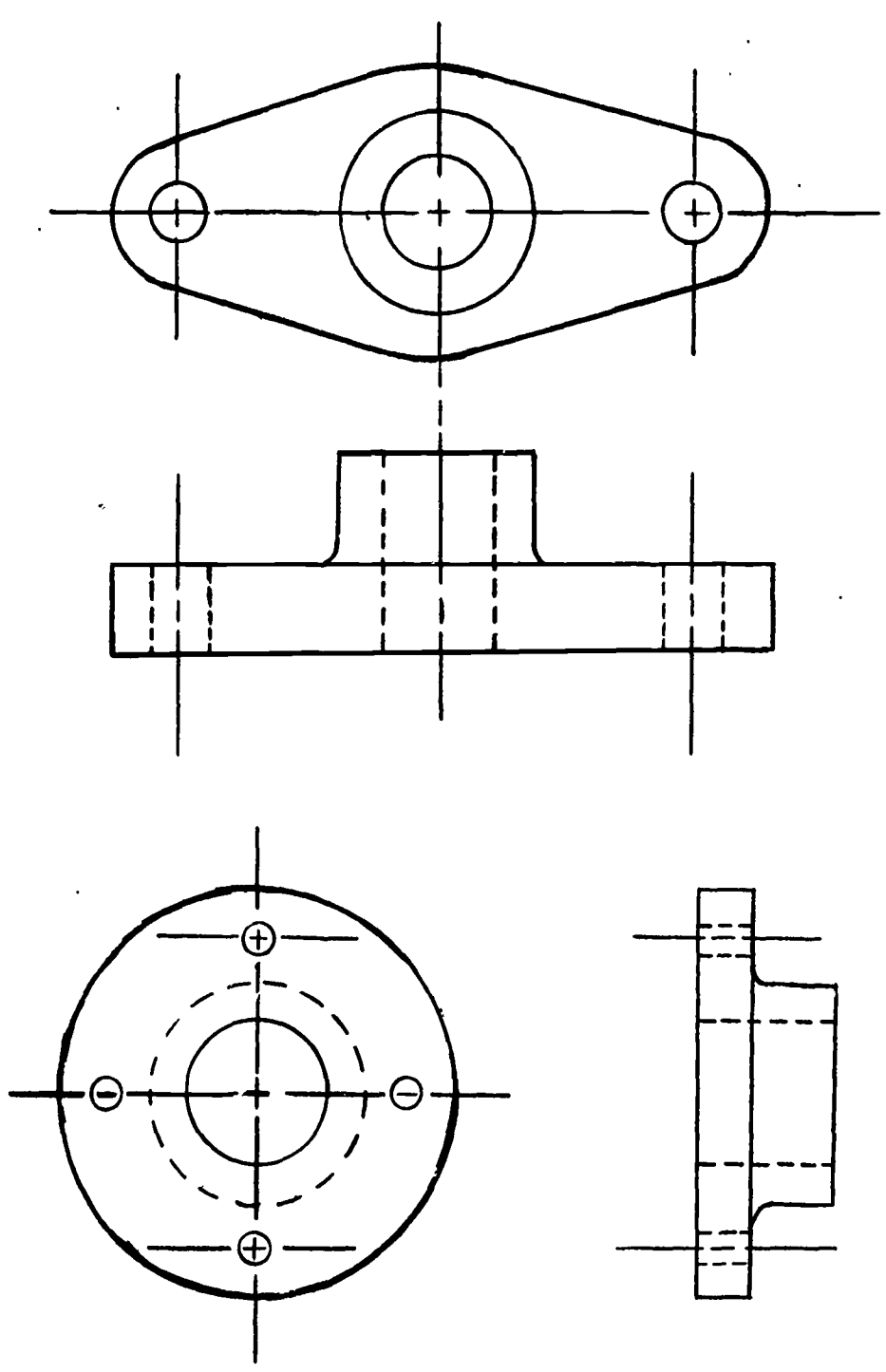
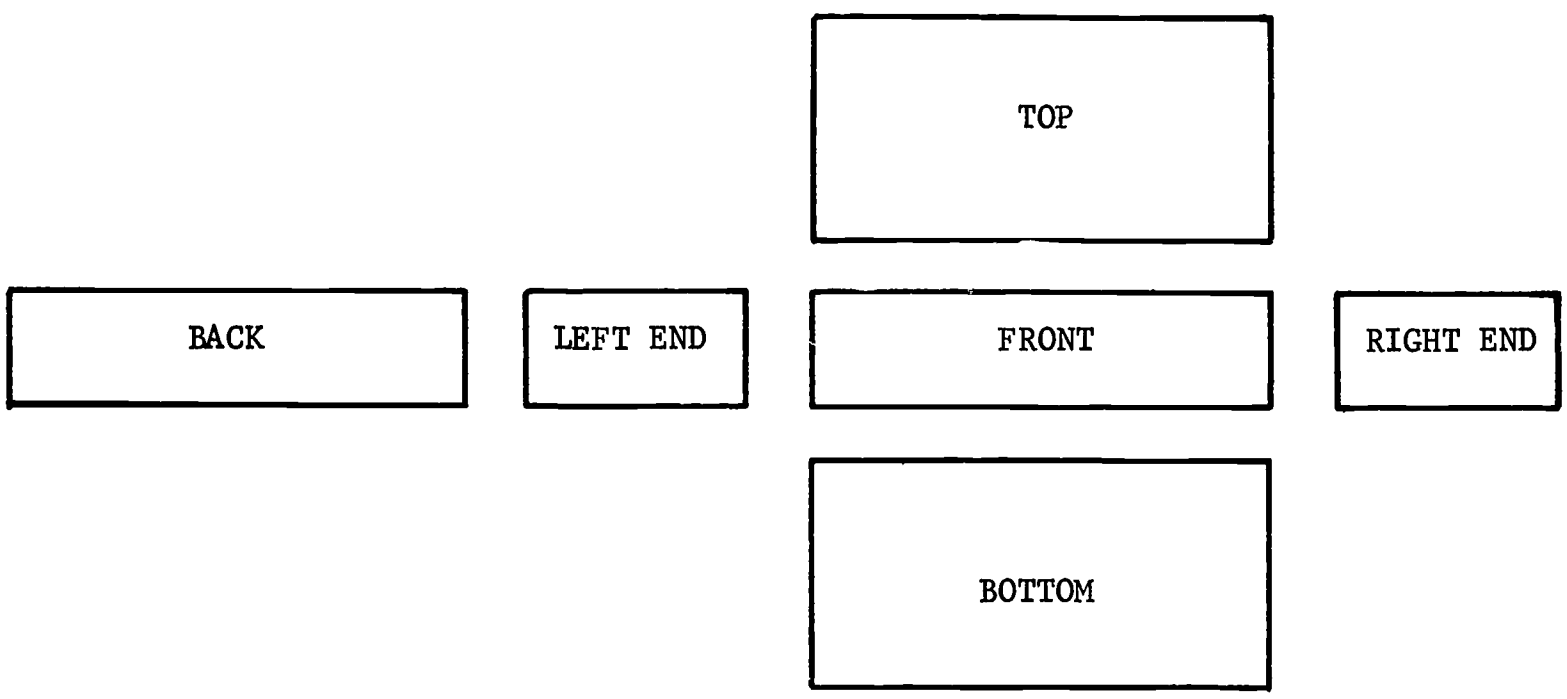


Fig. 5

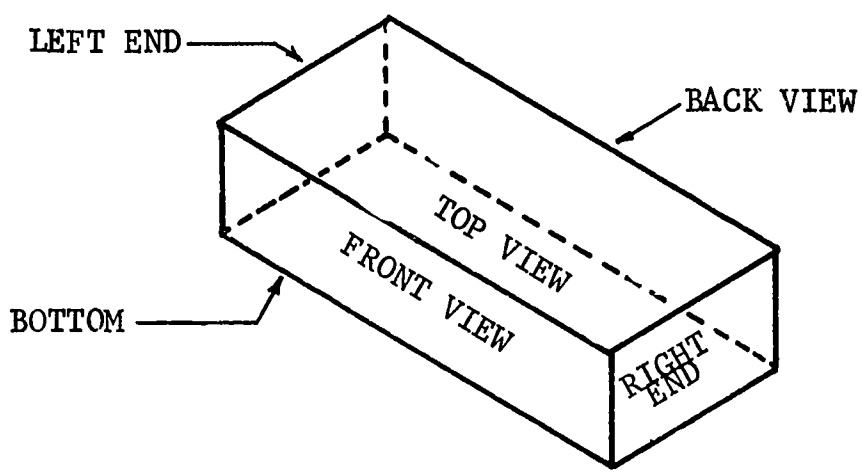
the working drawing, which represents the top of the block. Now we have the width, the height, and the length of the block as well as an accurate description of the shape of the sides. Notes may be added to the drawing, giving the type of material from which the object is to be built, or any other pertinent information.

Then we may say that a Working Drawing is one which shows the actual shape and size and any other information necessary to build the object.

These are actually six (6) views that may be drawn of any object.



This is the arrangement which represents the views as shown in the pictorial. Notice that the end and back views are drawn in line with the front view and the top and bottom views are drawn in a vertical line with the front view.



Name: _____

Approved by: _____

Date: _____

Sketching & Plan Reading

Key: D P - P 21 - 1 A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: INTRODUCTION TO PLAN READING

Purpose: To become familiar with and understand the basic principles of drawings as applied to industry.

References: Information sheet on Introduction to Plan Reading. An approved High School or Vocational School drawing book will add much useful information that we will not have time to cover in class.

Introductory Information: Blueprints or plans are a very necessary beginning for most jobs applying to the piping industry. For this reason, it naturally becomes essential for the plumber or pipe fitter to have a good knowledge of working drawings. All of the information covered in this assignment and those to follow should be given a practical application by the Apprentice.

Procedure: Answer the questions or fill in the spaces in your own words on the following page. If you have difficulty in supplying the information on the following page recheck your information sheet and if necessary, confer with your instructor.

Name: _____

Approved by: _____

Date: _____

Sketching & Plan Reading

Key: D P - P 21 - 1 A

Student Assignment
in
Plumbing and Pipe Fitting

1. The working drawing furnishes two major types of information - they are:

   1. _____ 2. _____

2. A working drawing may have _____ views.

3. In figure 2, the front view of the block shows the _____ and the _____ of the block.

4. The top view is shown _____ the front view.

5. View drawings are more valuable than pictorial drawings because _____ _____.

6. A craftsman cannot properly do a job from a pictorial for the following reason: _____

7. What medium of communication is used for ideas between the designer and the craftsman?

8. To the craftsman, view drawings are known as _____ drawings.

9. Give three reasons why the average person might benefit by a knowledge of a drawing.

10. Name some of the jobs you have worked on where knowledge of blueprint reading was helpful to your journeyman plumber or pipe fitter.

Information Sheet
in
Plumbing and Pipe Fitting

Subject: THE PROJECTION OF VIEWS

We know that a working drawing may have one or more views. How do we know the views should be in certain positions in relation to the front view? The theory behind this is called the theory of projection which is simply demonstrated by a box real or imaginary. (The instructor may be able to demonstrate if the materials are available.)

Imagine the block suspended in a transparent box. See Figure 1.

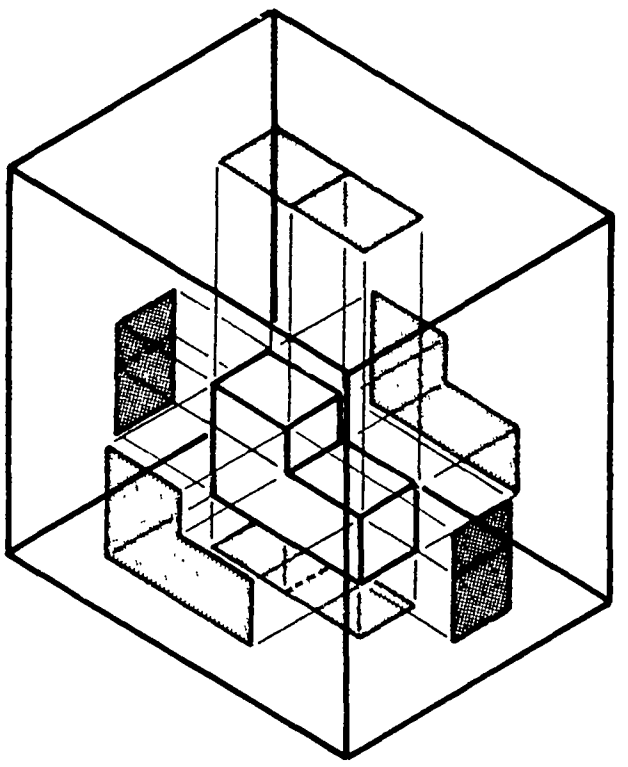


Fig. 1

Now, if this is a glass box, we could, with a soft crayon, mark the views of each side of the block as they are seen through the respective sides of the glass box. This is a very simple but impractical method of drawing the six views of an object. There is a practical method whereby we can draw these views in one plane on a sheet of paper.

If the box is properly hinged, it can be opened as shown in figure 2. After opening the box, we revolve it into the vertical plane and the six views appear as in figure 3. Figure 4 shows the elimination of views not ordinarily shown in working drawings. However, the shape of the object dictates which views will be needed to make the drawing completely clear to the person having to do the interpretation to construct the object drawn.

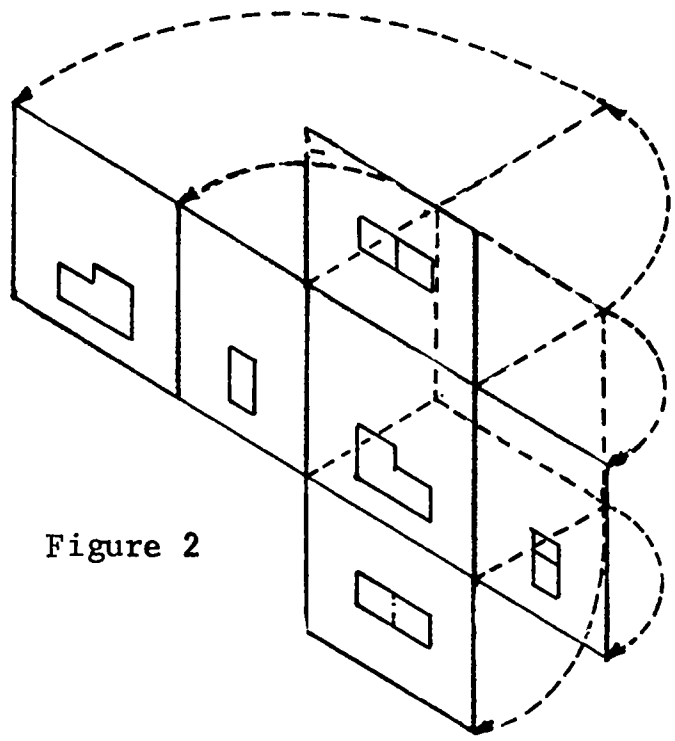


Figure 2

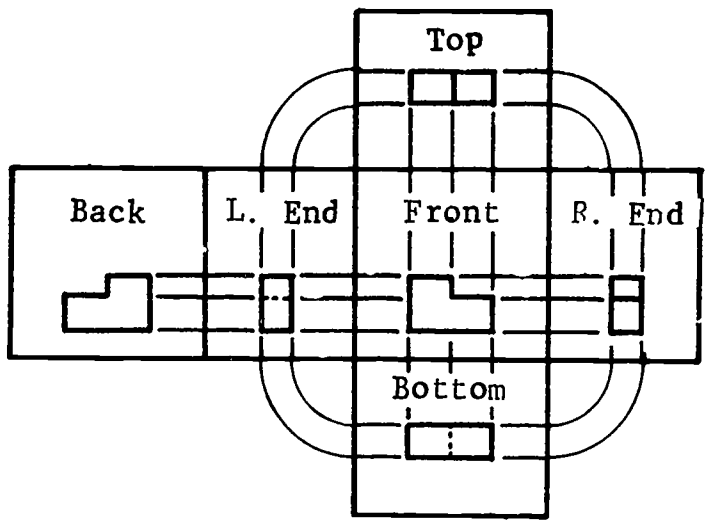


Figure 3

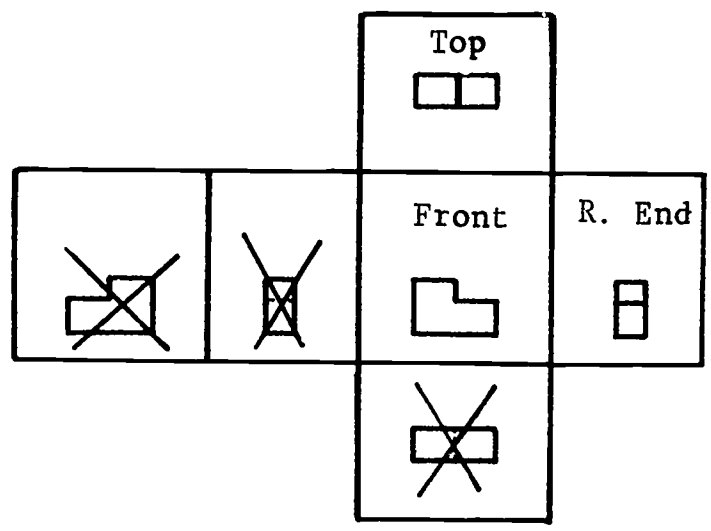


Figure 4

In one sense, the lines that determine the location of the views project through and are perpendicular to the plane that would be represented by the side of the glass box. As shown in Fig. 3.

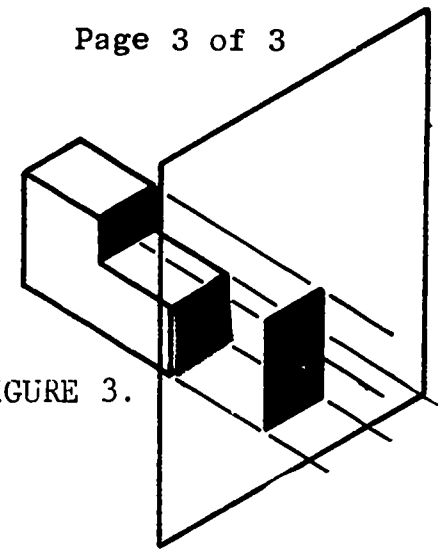


FIGURE 3.

This method of extending the views of an object is called projection of the views, (technically it is Orthographic Projection).

The theory of Orthographic Projection is very important and should be understood by the Apprentice before proceeding further with the study of drawing or blue print reading. In fact, it will be necessary to refer back to this section as we attempt to put this theory into practice.

A third view may be determined by lines of projection after we have determined front and top or the front and end views. See Figure 4.

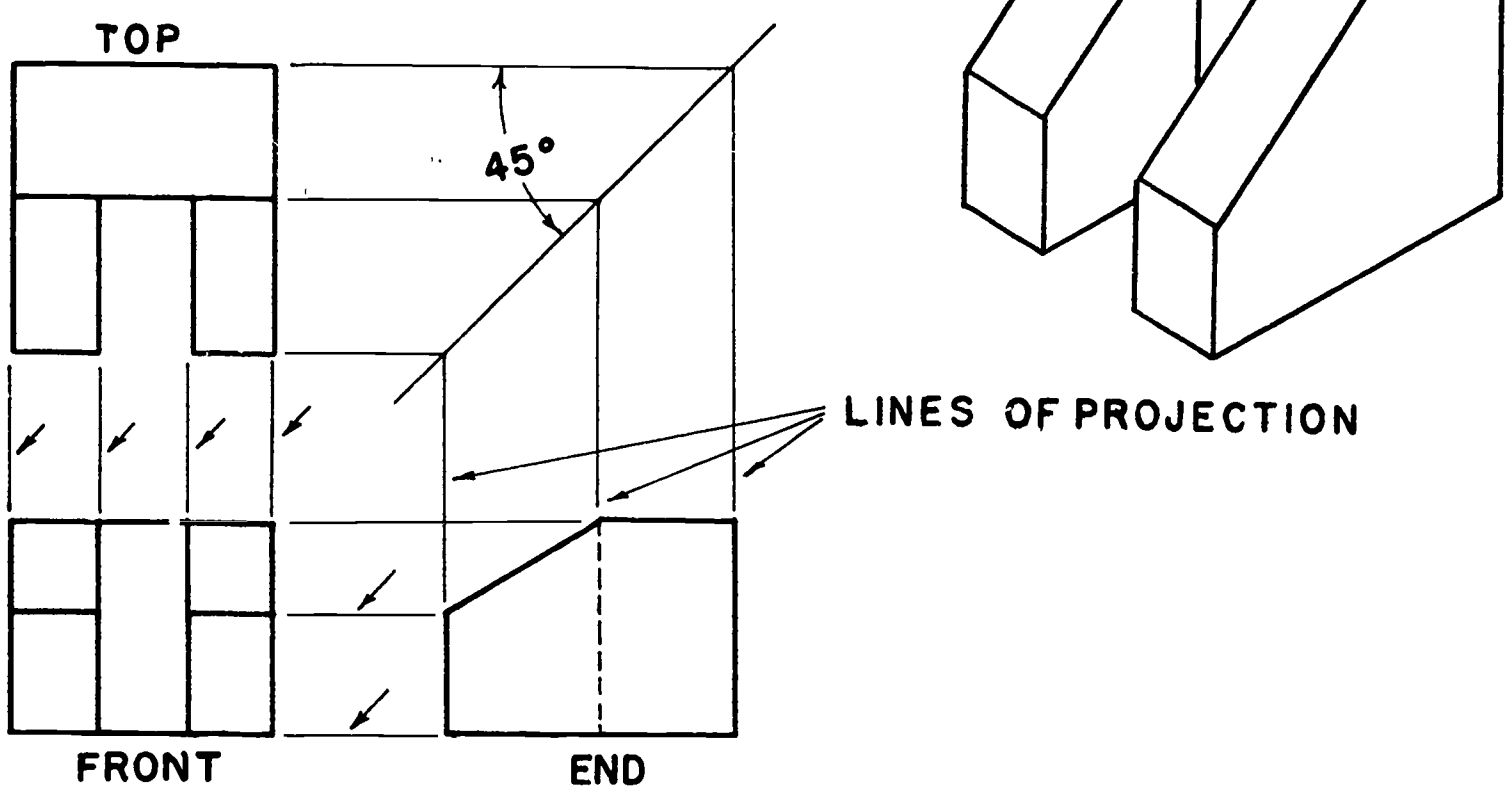


FIGURE 4.

Name: _____ The Projection of Views

Approved by: _____ Key: D P - P 21 - 2 A

Date: _____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: THE PROJECTION OF VIEWS

Aim: To thoroughly understand the theory of shape description in order to be able to read any type of working drawing.

References: Information sheet on Theory of Projection supplemented by any approved text that may be in your own library or local high school.

Introductory Information: Orthographic Projection being the basis for all view drawings it becomes necessary for us to have a thorough understanding of the theory. If this particular assignment seems elementary then we have made a big step toward reaching our goal of causing the Apprentice to understand and be able to read working drawings. Study the model, that we are going to make, both as a box and as a view drawing. This should give us a fair idea of the relation between the object and the drawing. It is our intention that this model will be an aid both to the apprentice and the instructor, and must be used as such.

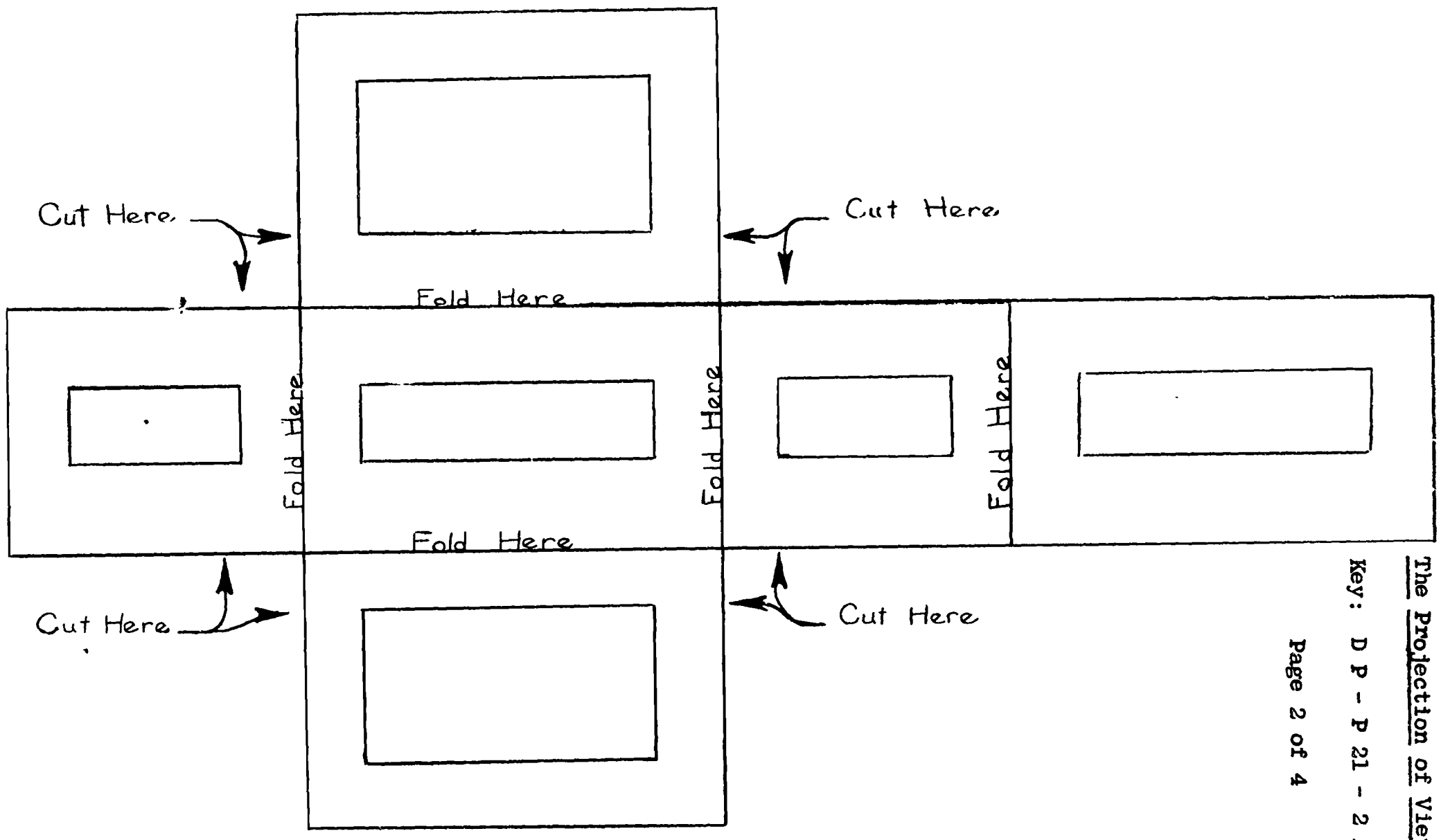
Procedure: Study the layout of the box briefly in order to understand how it is to be used to the best advantage.

Cut the model out with your pocket knife as indicated and fold to form a box with the projected views outside.

Examine the model and the instructor will demonstrate and explain the purpose and theory of it as well as the manner in which you will use it to the greatest advantage.

After you have studied the model of the box until you understand how the several views have been represented as having been projected on the sides of the box, and with the front view facing you, open the box and notice the position of the views in relation to the front view.

PROJECTION BOX



The Projection of Views

Key: D P - P 21 - 2 A

Study
Questions and/or
Problems:

From this demonstration can you understand why we must use more than one view to accurately describe the block. At the same time, you should see that it is not necessary to use all 6 views, to give the size and shape description of the block.

Answer the following questions in the spaces provided:

1. How are the positions of the various views determined?

2. What views are in line with the front view vertically?

3. What views are in line horizontally?

4. Give your conception of the advantages of the Theory of Projection to the draftsman and to the Journeyman of the piping industry?

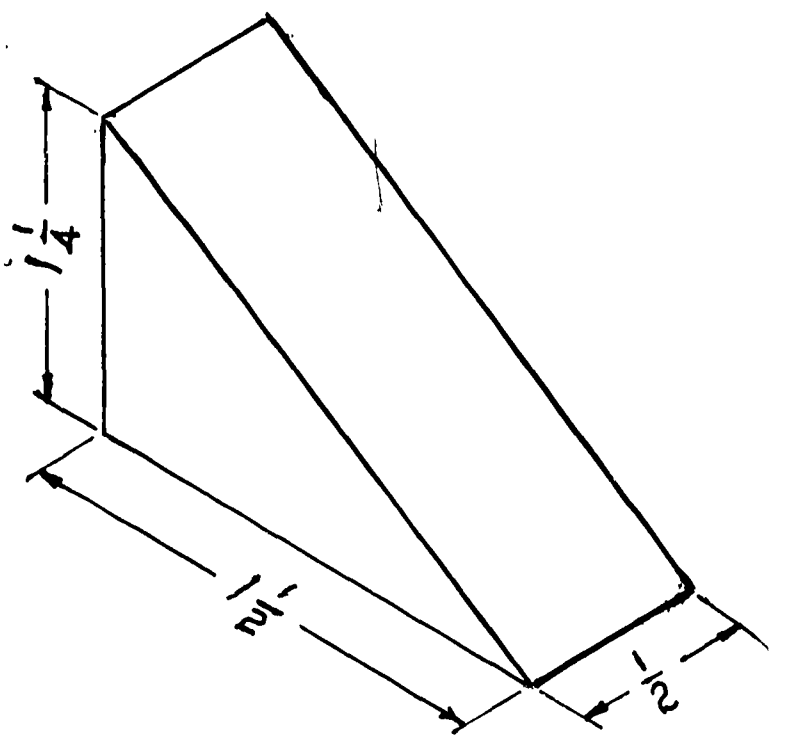
5. Which views shown the height of the object?

6. Which views show the width?

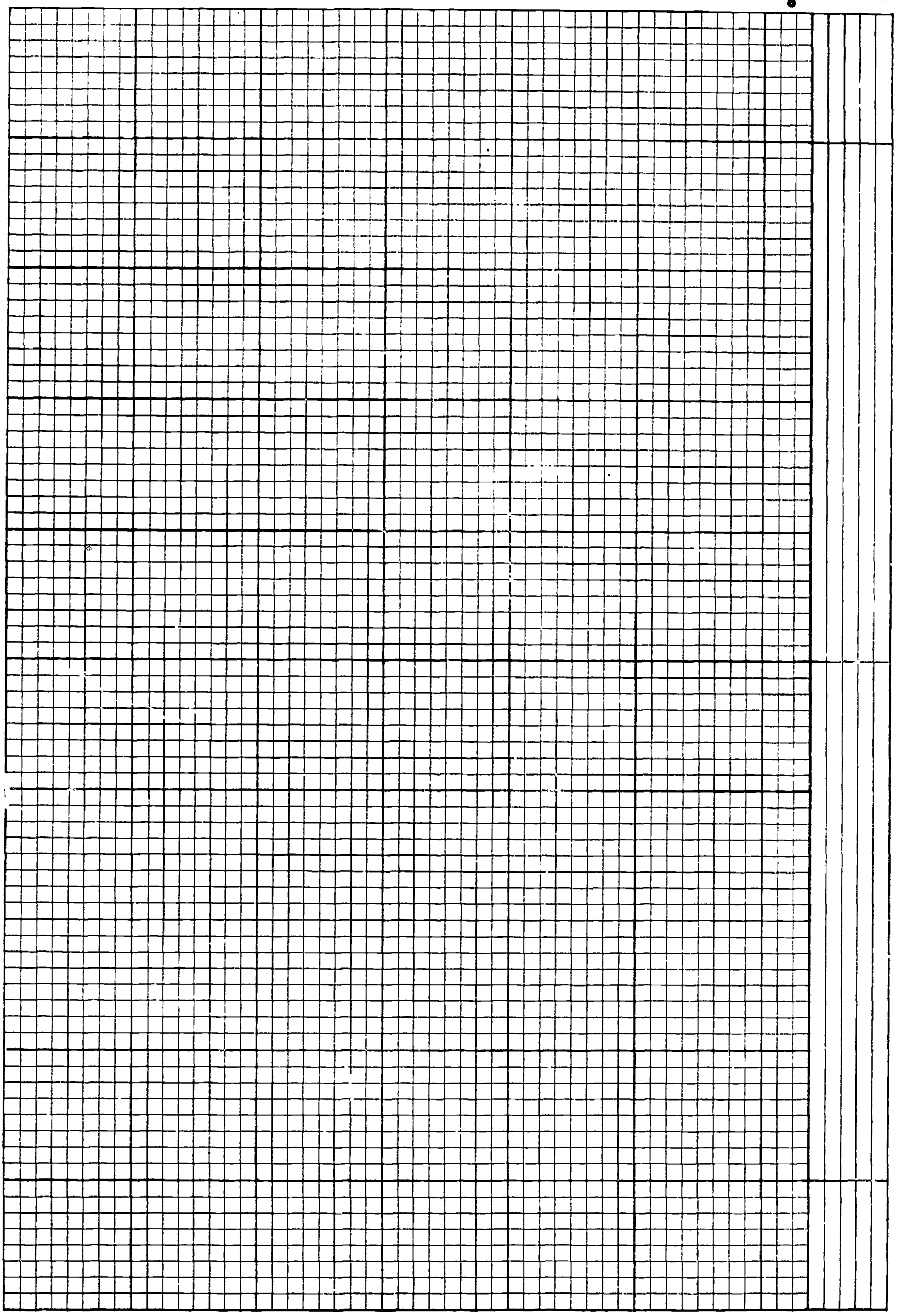
7. Which views show the length?

1. After answering the questions, make your own model of a perfect cube $1\frac{1}{2}$" x $1\frac{1}{2}$" x $1\frac{1}{2}$", using the 1/8" scale guide under the paper provided for the drawing.

2. Study the preceding models carefully and make another model of the object shown below.

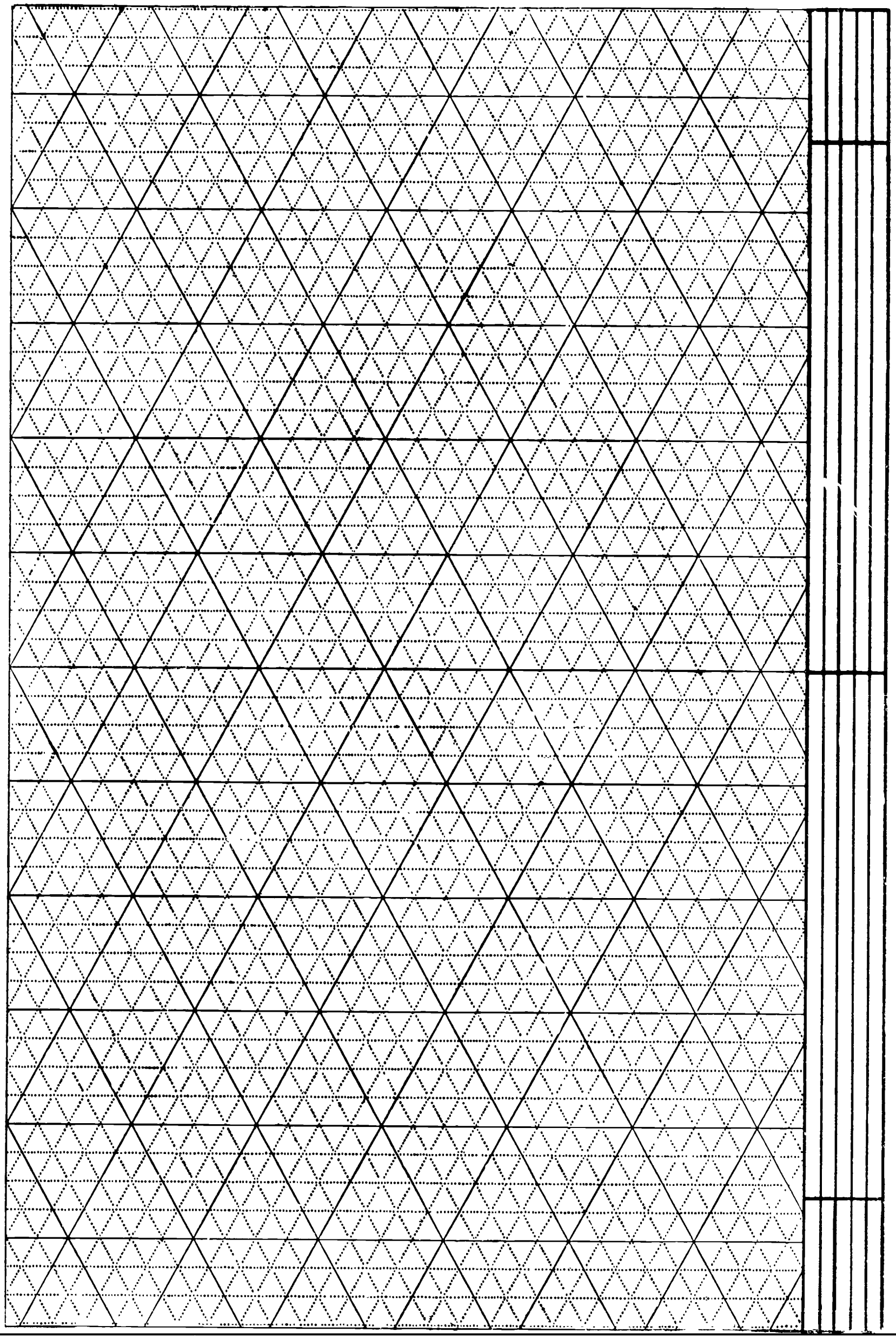


$\frac{1}{8}$ SCALE



A & MCS—EES

ISOMETRIC SCALE

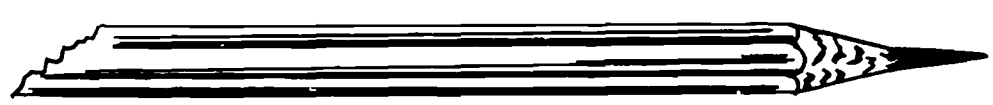


Information Sheet
in
Plumbing and Pipe Fitting

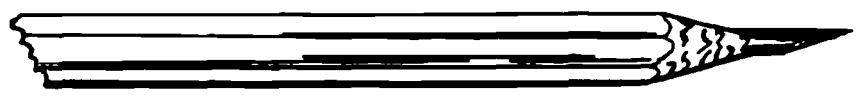
Subject: TECHNIQUE OF SKETCHING

There are certain important techniques to develop by practice that the apprentice should learn and remember when making sketches.

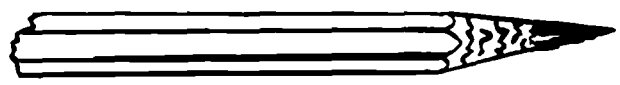
1. The pencil should always be sharpened to a long sharp point.



2. For lines, a chisel or wedge point may be preferable.

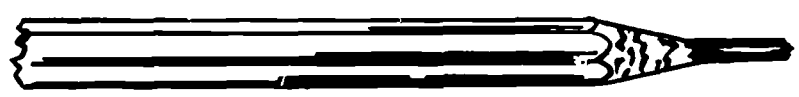


Chisel Point



Wedge Point

3. To sharpen a pencil, remove the wood with a knife or mechanical pencil sharpener.



Then sharpen the lead with sandpaper or a fine file to the desired fine point.

4. When drawing lines freehand, the horizontal line is drawn from left to right, as in Fig. 1, vertical line from top down as in Fig. 2.

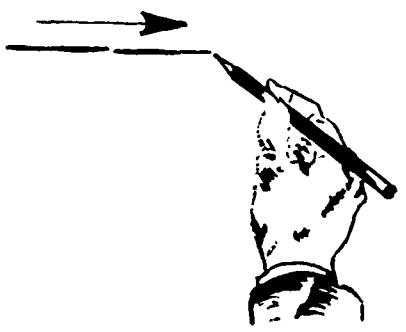


Fig. 1

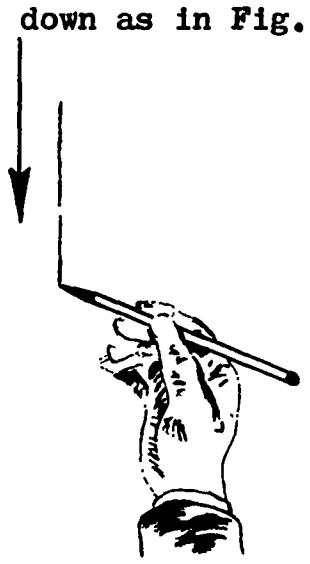
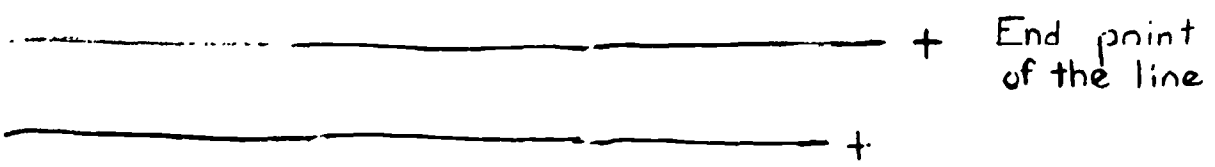


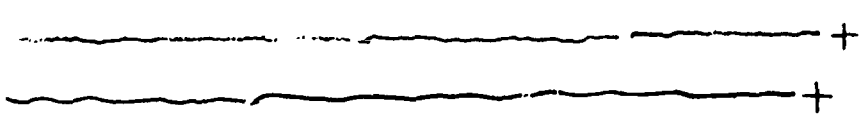
Fig. 2

5. Lines are sketched by making short strokes rather than trying to make a long continuous line.

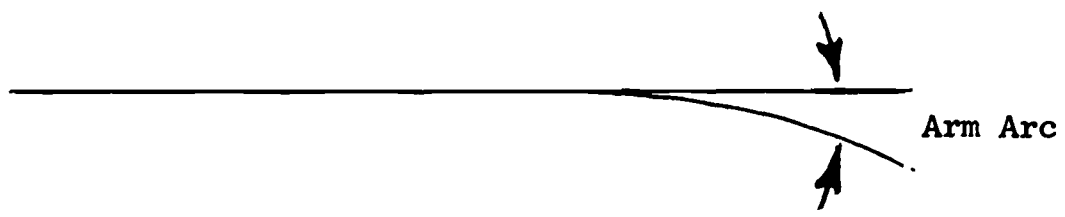
6. Too much stress should not be placed on an attempt to sketch straight lines.



7. A slightly wavy line does not detract from a freehand drawing. The direction of the line is important; that is draw the line to a certain end point.



8. The natural tendency is to draw the line in an arc because of the natural position of the arm.



Always draw the line to a certain predetermined point for neater sketches.

9. All drawings should be made as neat and accurate as possible. They should follow a certain form whether it is the enclosed form or that of the instructor.

10. Although the apprentice should learn to make field sketches with material available, he may use more than one type of pencil in the classroom to make neater drawings. The instructor will make helpful suggestions.

11. The word, sketching, does not mean that the drawing is made in haste. The sketch should be complete in all details, because the notes included in a complete sketch are often more important that the finished blueprint.

12. Form a habit of sketching any changes or improvements to be made on the job or in the shop.

Student Assignment
in
Plumbing and Pipe Fitting

Subject: TECHNIQUE OF SKETCHING

Aim: To teach the Apprentice enough of the technique of sketching that he may be able to do a neat and ledgible drawing in the field without the aid of instruments, etc.

Reference: Information Sheet #3 I.

Material: A soft pencil, #2 or H, eraser, plain white paper and the 1/8" scale guide.

Introductory Information: The Apprentice must keep in mind that sketching is a very definite skill to be developed as an aid to a Journeyman in the piping industry. It is not a hap-hazard substitute for instrument drawing. The assignments which follow should be done with a properly sharpened pencil in order that the sketches will be of neat, sharp, black lines. Neat clean drawings will reduce the degree of error in interpreting the thoughts to be conveyed by the drawing.

Procedure: Fasten the drawing paper to the desk or drawing board with tape or thumb tacks with the 1/8" scale guide fastened under the paper as a guide for sketching.

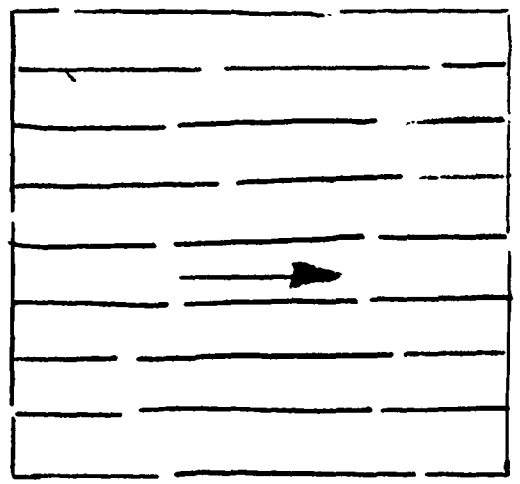
Draw the border lines, using the previously discussed techniques for sketching lines. Sketch the title strip and letter the title strip as suggested by the sample sheet.

The border lines are heavier than the object lines.

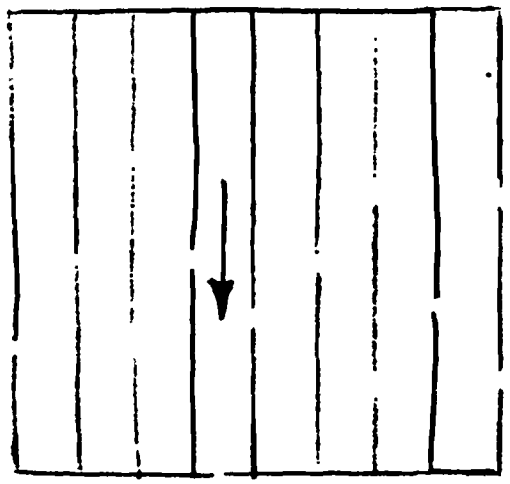
Duplicate the sample plate as nearly as you can with the exception of the arrows which show the direction of the strokes for various lines.

TECHNIQUE OF SKETCHING
KEY DP-P21-3A
PAGE 2 of 2

BORDER LINES

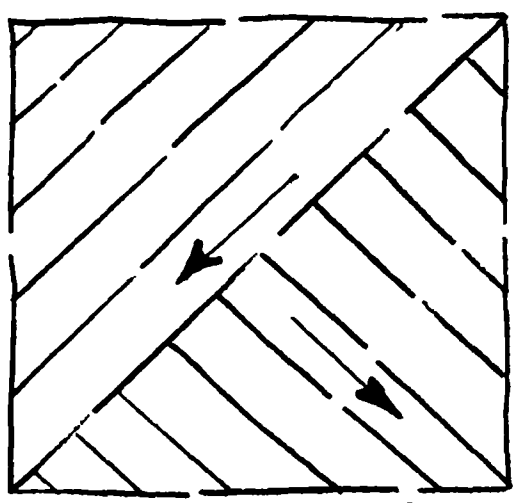


HORIZANTAL

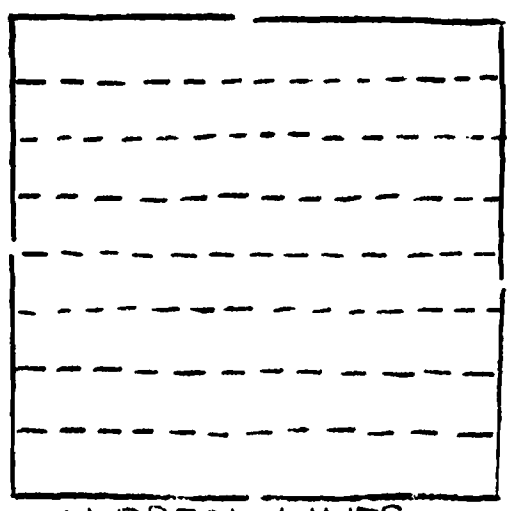


VERTICAL LINES

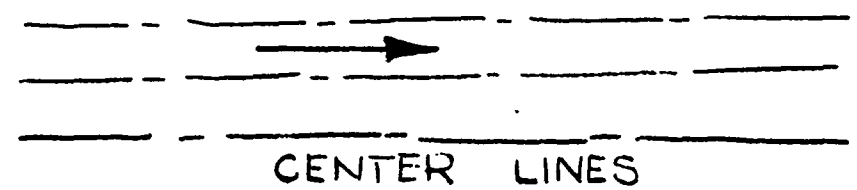
SLOPING LINES



SLOPING LINES



HIDDEN LINES



CENTER LINES

COORDINATION OF HAND AND EYE

TITLE STRIP

NOV. 21 1952	PLUMBING APPRENTICE CLASS COLLEGE STATION, TEXAS	TECHNIQUE OF SKETCHING JOHN DOE	DP-P5-3A 2 of 2

Student Assignment
in
Plumbing and Pipe Fitting

Subject: MULTI-VIEW DRAWINGS

Aim: To learn the purpose and meaning of Multi-View Drawings by drawing objects to show shape description.

Introductory Information: The purpose of a working drawing is to furnish certain necessary information. In order to be able to incorporate all of this information on one drawing, we must have more than one view of the object to accurately describe it.

The front view of an object is the view which shows the largest surface or the most detail.

Procedure: These sketches are to be made freehand with the aid of the guide grid which is marked off in 1/8" squares. The blank sheets are to be placed over the guide and fastened to the desk or drawing board with scotch tape or thumb tacks. Follow the sample sheet given and draw the border lines and title strip first. Use a soft pencil and make the border lines heavier than the object lines which we use to draw the block as shown on the sample drawing.

Problems:

1. If the material is available, the instructor will furnish an object to be drawn.

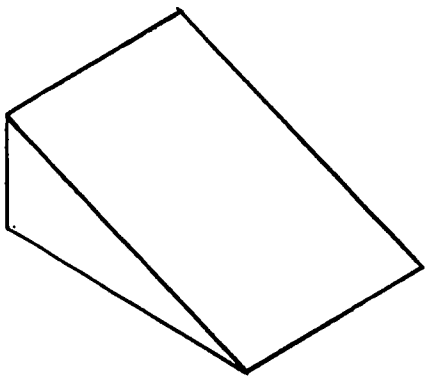
   A. Show by a freehand sketch, the necessary view of the object. Remember what you have learned about the front and other necessary views. Do not use a rule or straight edge.

   B. Use the 1/8" scale guide provided as a guide for the drawings.

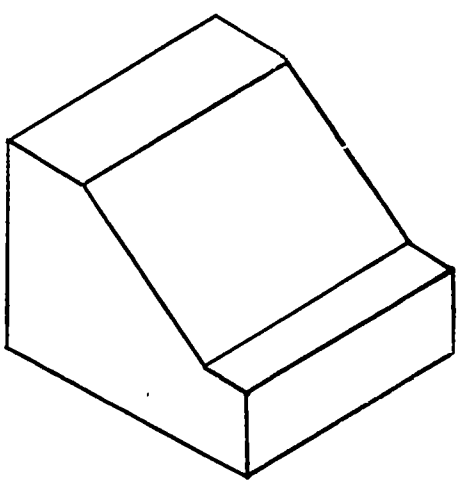
   C. Draw the object as near to proper proportion as possible without measuring it.

Problems (continued)

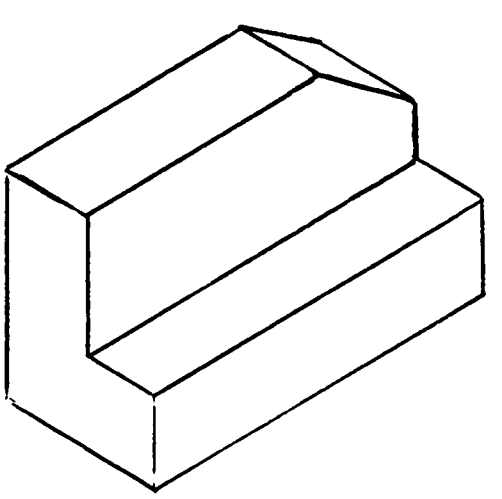
2. Sketch the necessary views of the following object.



3. Sketch the necessary views of the object shown below.



4. Sketch necessary view of object shown below.

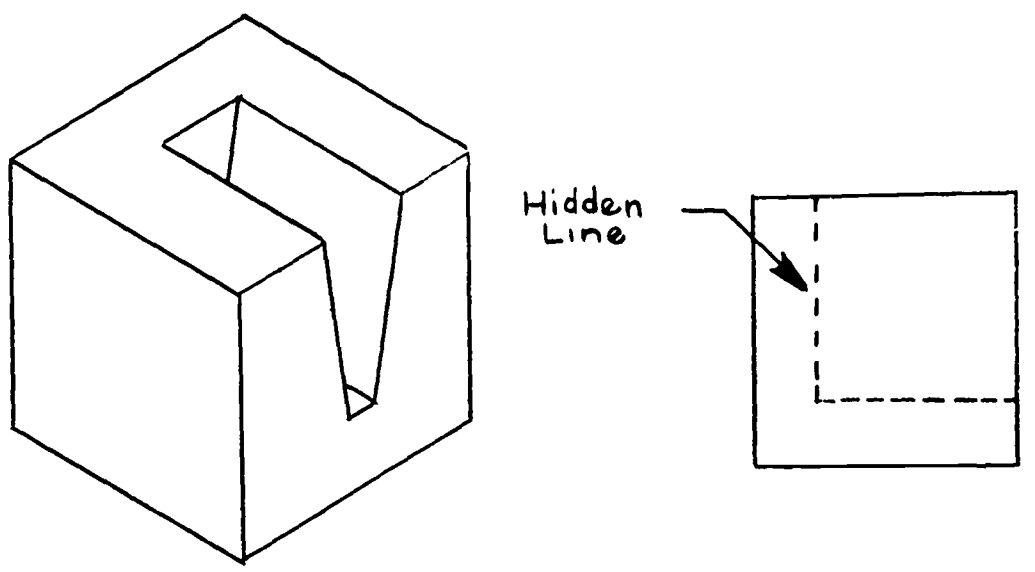


Note: Most objects will have parts that do not show in all views, but must be described. The edges of these surfaces will be shown by a line we refer to as a hidden line. A hidden line is shown by short dashes closely and evenly spaced.

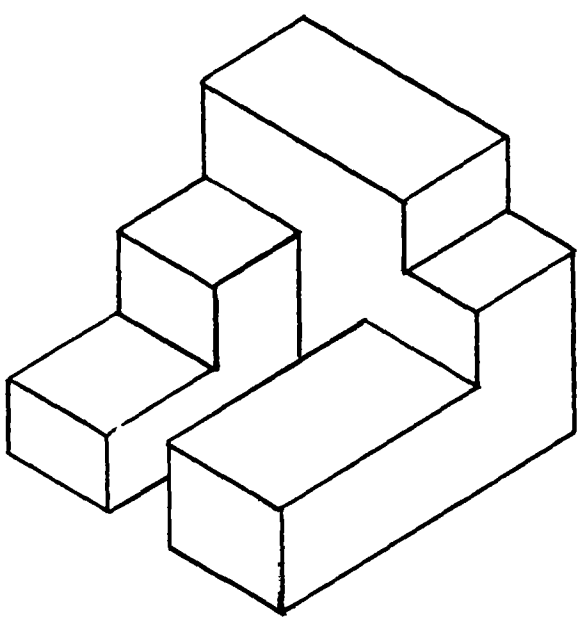
For example:

Show hidden lines in the necessary views of the objects, a, b, c, and d shown below.

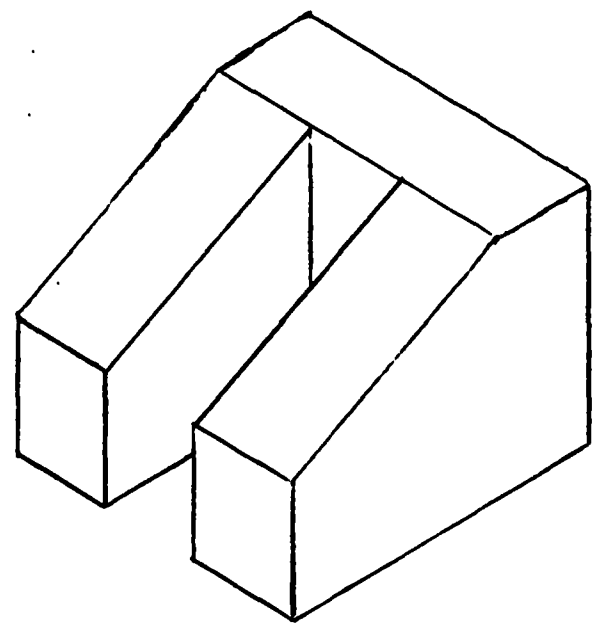
A.



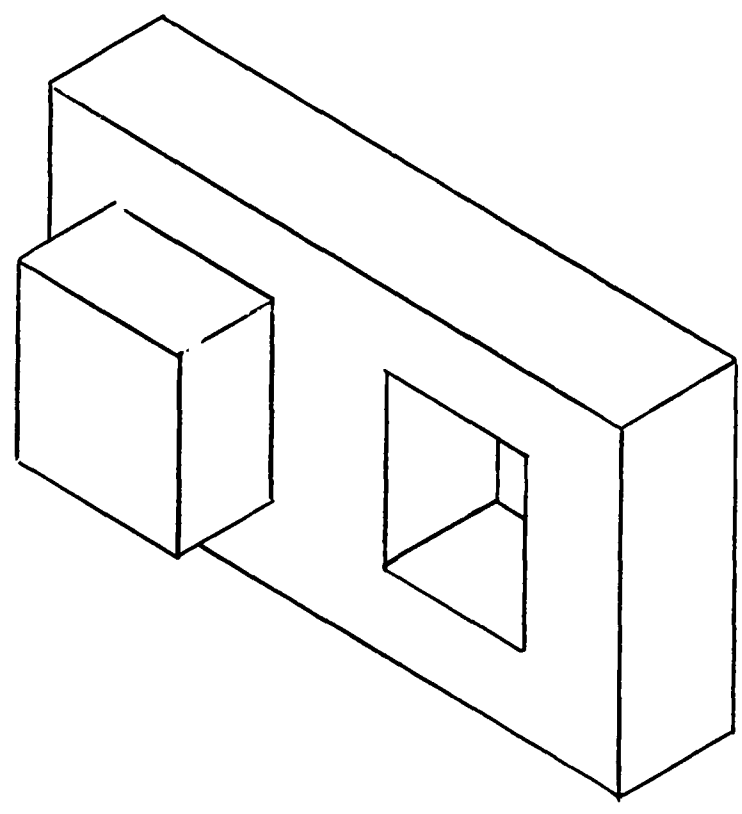
B.

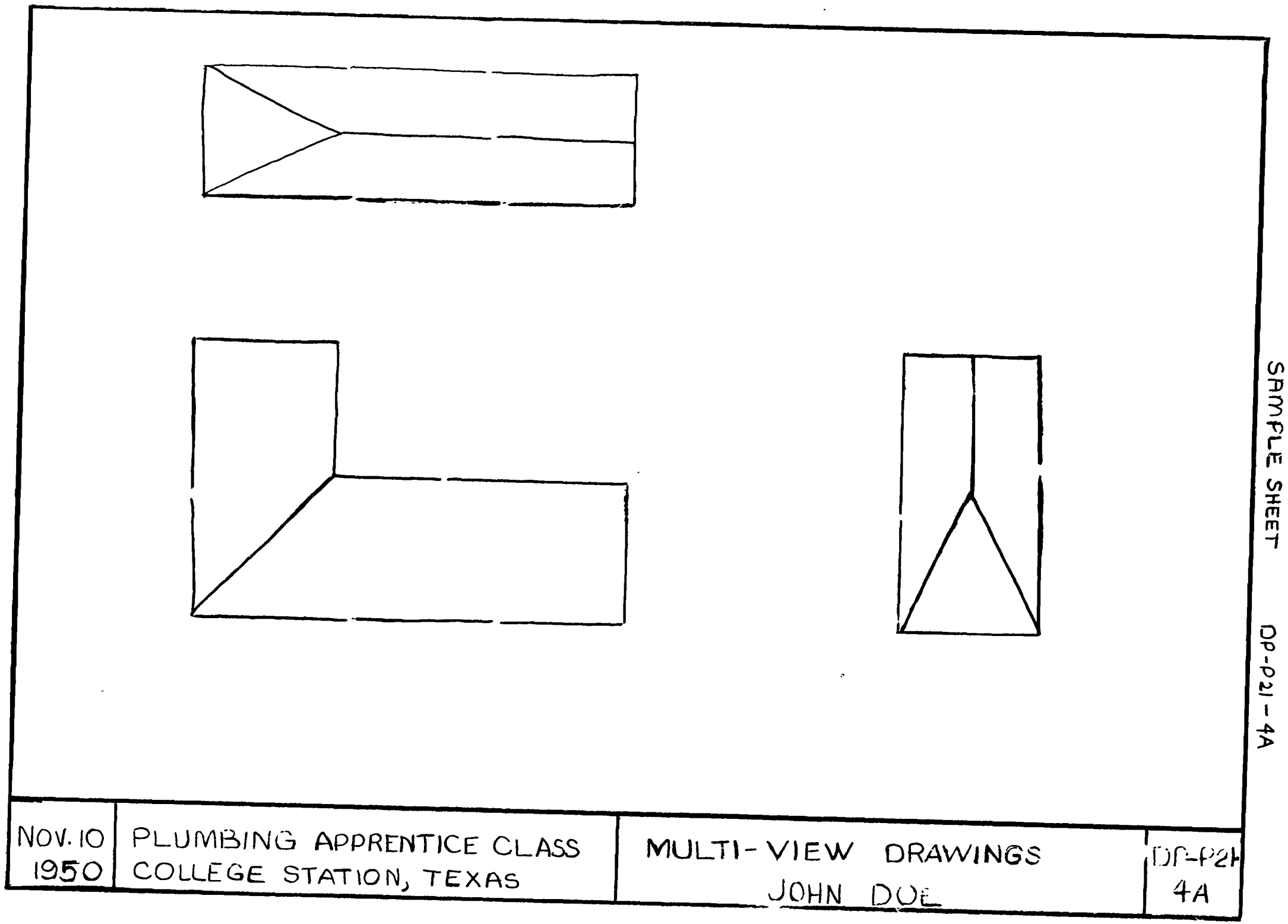


C.



D.




SAMPLE SHEET
DP-P21-4A
NOV. 10 1950
PLUMBING APPRENTICE CLASS
COLLEGE STATION, TEXAS
MULTI-VIEW DRAWINGS
JOHN DOE
DP-P21
4A

Free Hand Circles

Name: _____

Key: D P - P 21 - 5 A

Approved by: _____

Date: _____

Drawing and Plan Reading Assignment
in
Plumbing and Pipe Fitting

Subject: FREE HAND CIRCLES

Aim: To learn to sketch circles

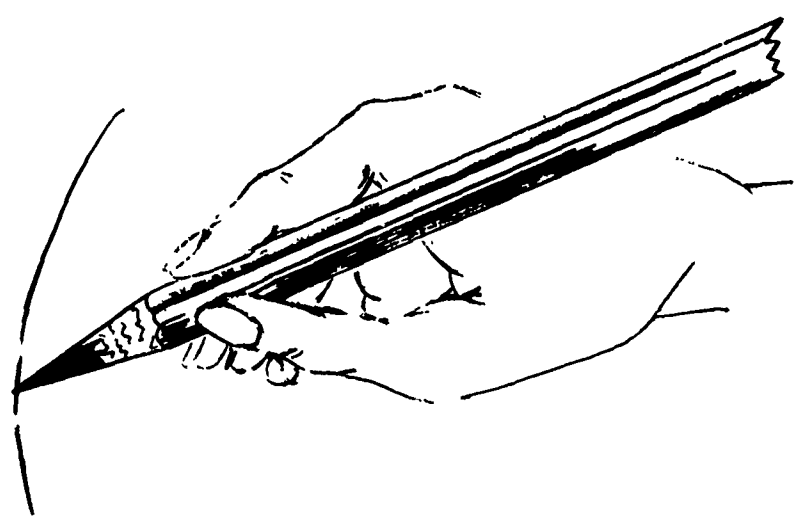
Introductory Information: A plumber or pipe fitter is frequently required to sketch circles in showing layouts of pipe, fittings, cylindrical tanks, vats, etc. Neat circles are easy to sketch after you learn a few basic principles and devote a little time to practice.

Procedure; After the centers of the circles have been proportionately located in the drawing, sketch a center line through the centers both horizontally and vertically.

Center lines are drawn with one long and one short dash evenly spaced.

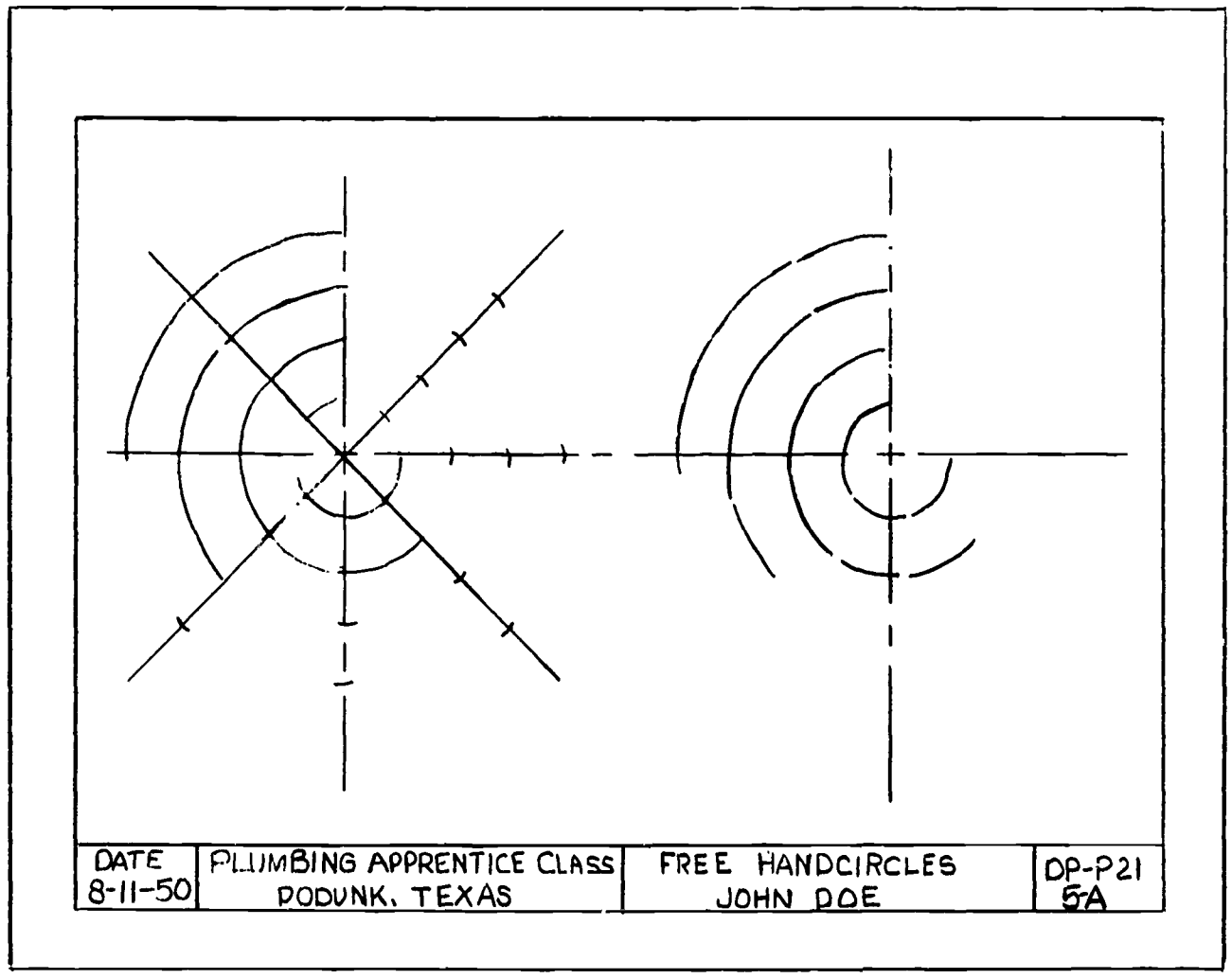
For example: ——— - ——— - ——— - ———

After guide points have been established sketch the arc of the circle with the pencil "inside" of the circle as illustraded below.

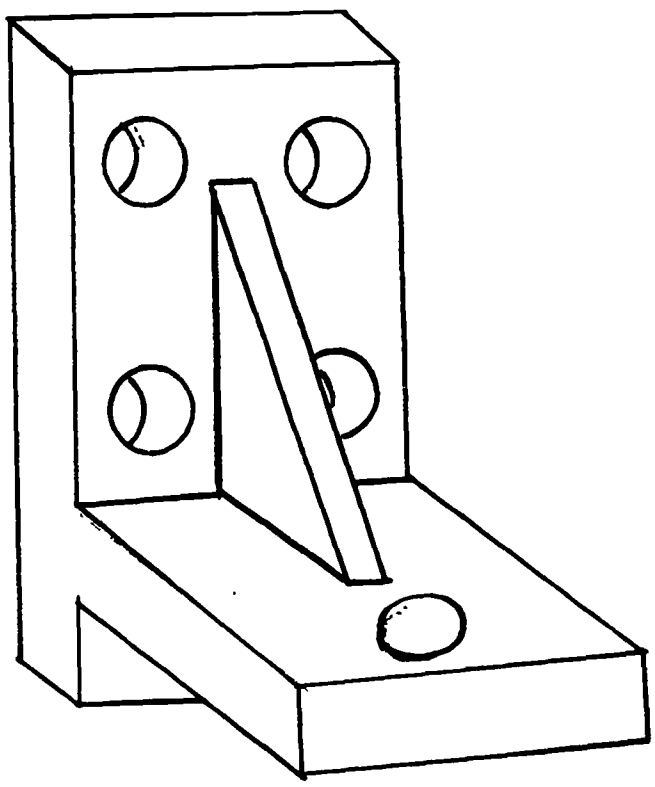


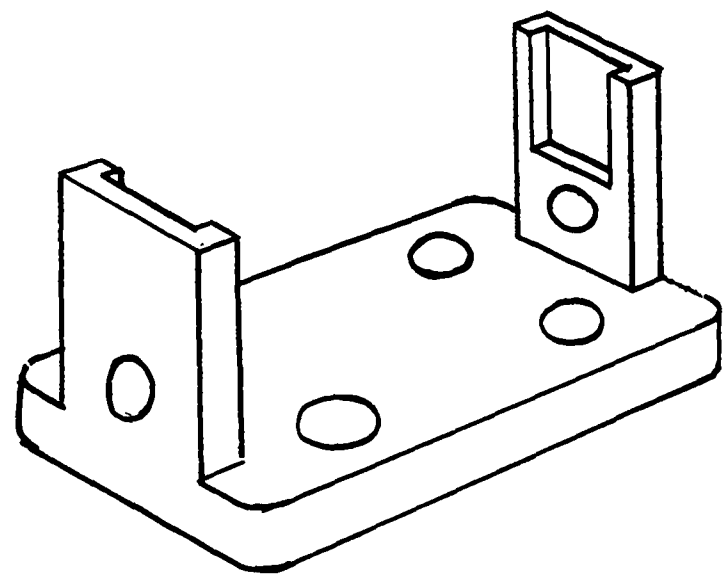
Sketching and Blue Print Reading
in
Plumbing and Pipe Fitting

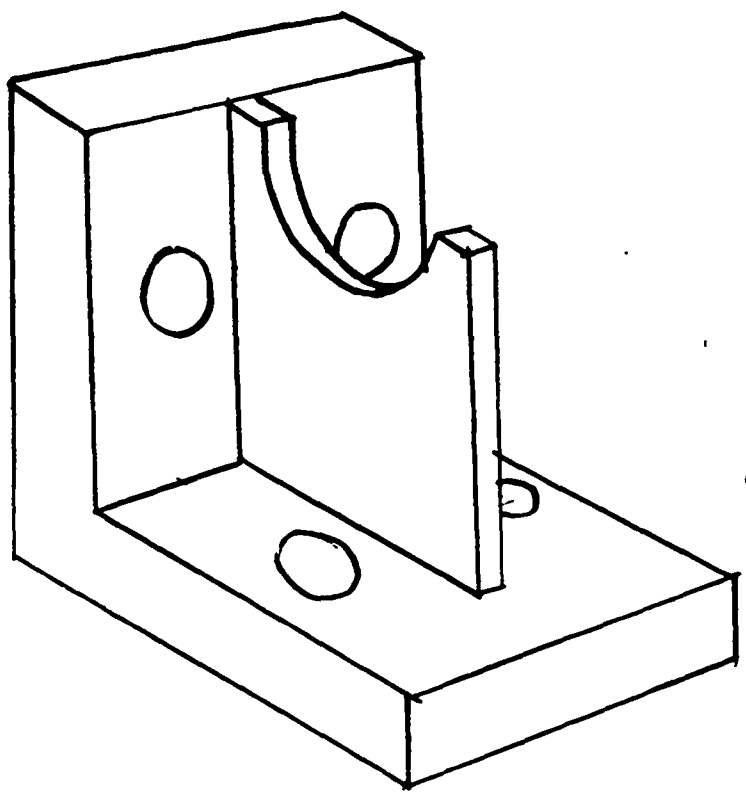
Sketch two sets of free hand circles as shown in the incompleted one half size sketch shown below. Place the centers of the circles on the plate so that the drawing will be neat and symmetrical:

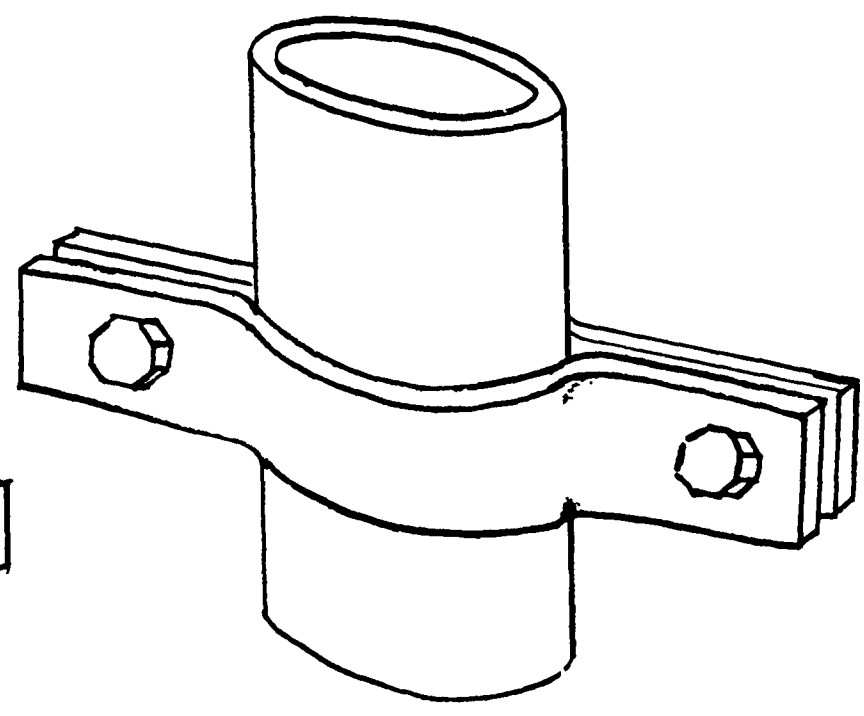


Sketch the following objects showing hidden lines and center lines in the necessary views.









Student Assignment
in
Plumbing and Pipe Fitting

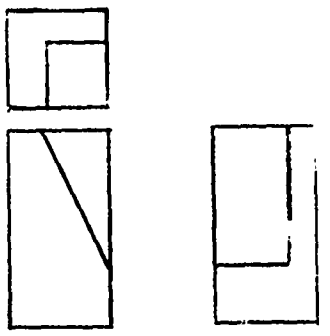
Subject: READING MULTI-VIEW DRAWINGS

Aim: To give the Apprentice a mental picture of an object from a multi-view drawing.

Introductory Information: The ability to visualize an object, piping layout, or any project that is described by a drawing, is a distinct advantage to the journeyman. Being able to visualize all or any part of a job from the working drawing saves time, money and worry. It often determines the difference between being a supervisor and an ordinary workman.

Procedure: On the multi-view drawing on page two, write the number which corresponds to the object on page three in the space provided. For example, if object #4 corresponds to the first drawing, then, write #4 in space provided.

A. No. _____



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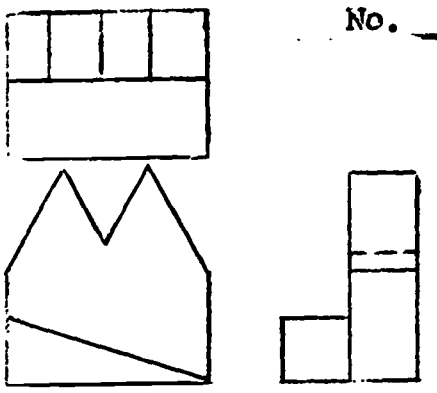

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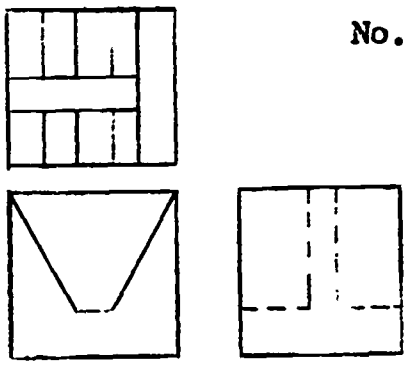

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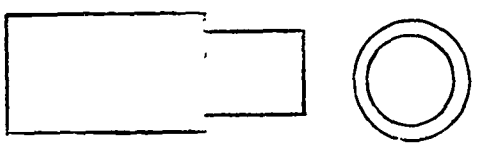

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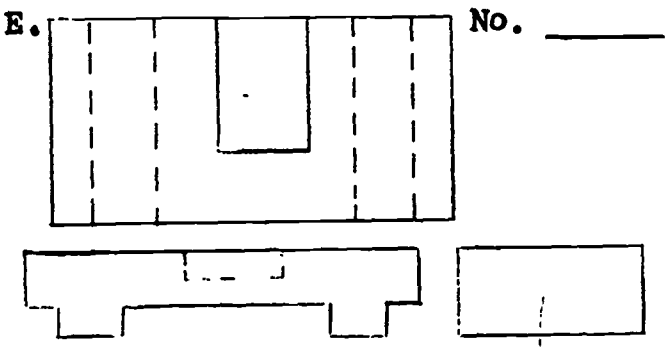

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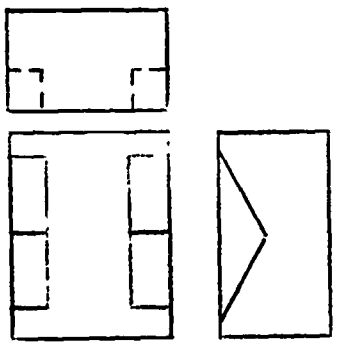

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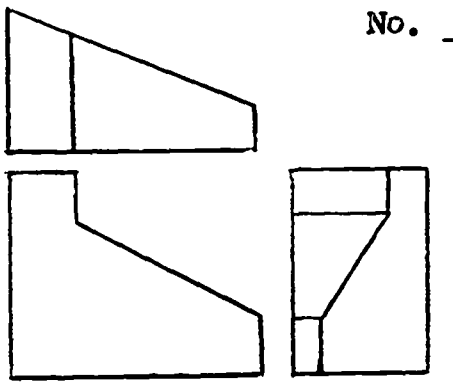

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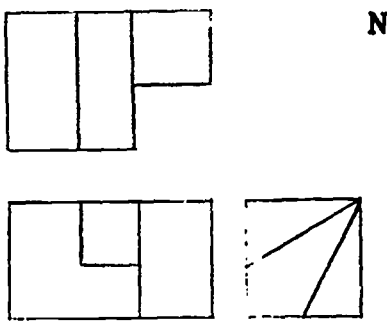
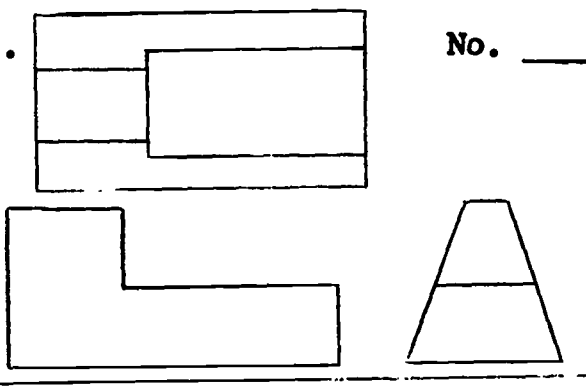


I. No. _____



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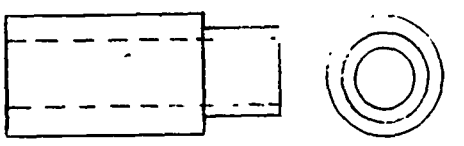
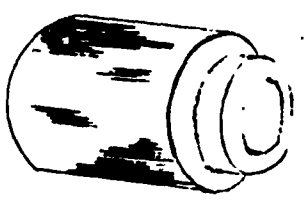


Reading Multi-View Drawings

Key: D P - P 21 - 6 A

11



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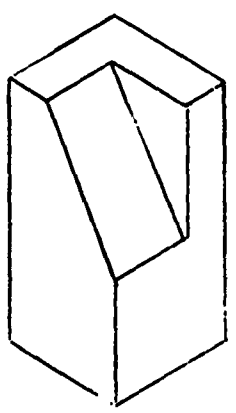

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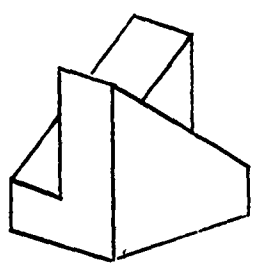

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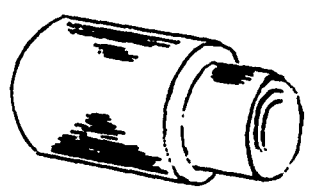

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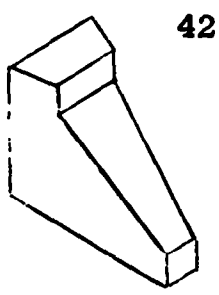

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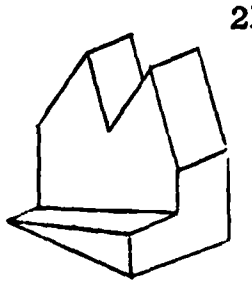

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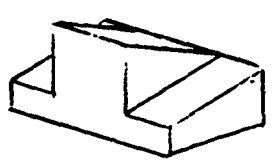

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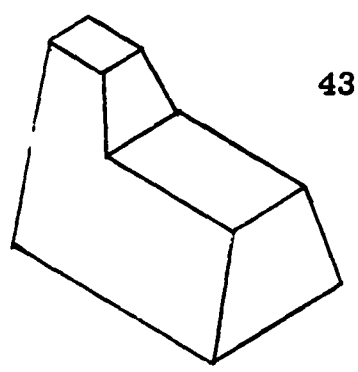

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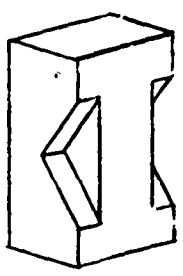

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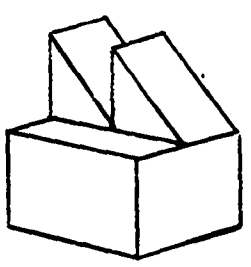

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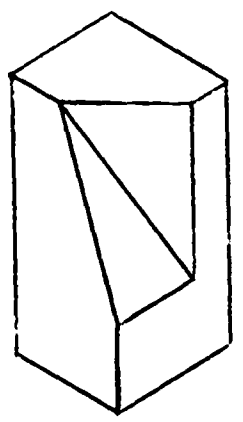

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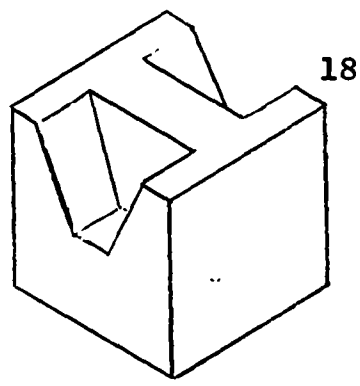

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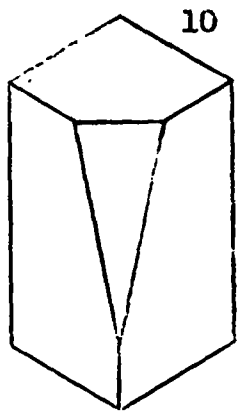

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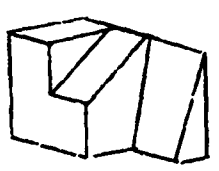

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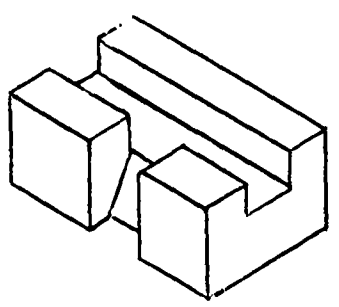

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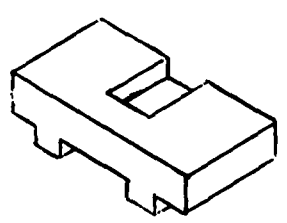


Student Assignment
in
Plumbing and Pipe Fitting

Subject: LETTERING

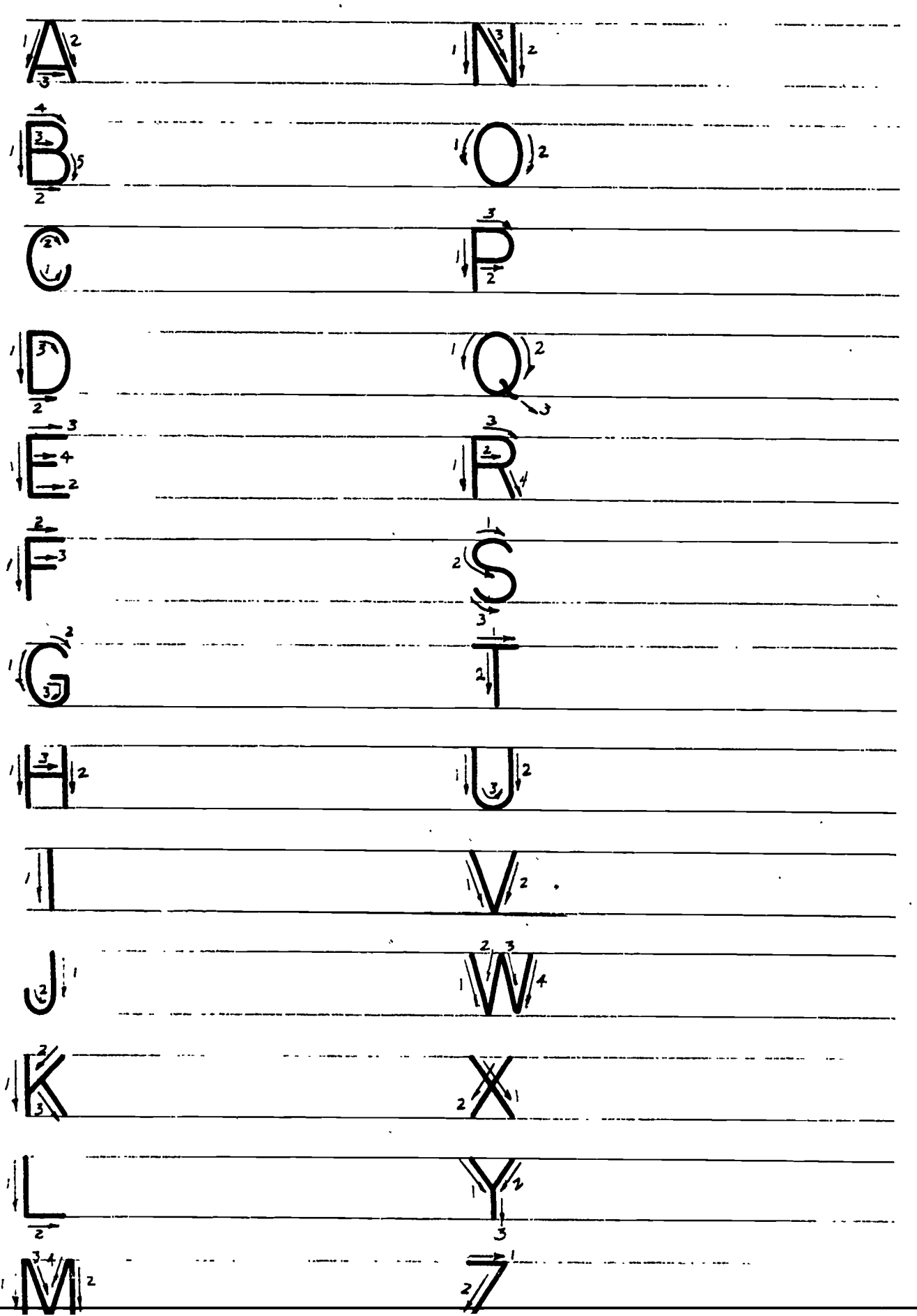
Aim: To cause the Apprentice to appreciate neat lettering and to teach him the proper strokes and proportions of neat letters.

Introductory Information: The purpose of this instruction is to improve the Apprentice in his trade. It is not intended to attempt to make a draftsman of him, nevertheless, the graphical language is written on drawings in the form of lettering and not in plain handwriting. The value of neat lettering will become apparent after having made some important sketches in the field simply because neat lettering is so much more ledgible than hap-hazard scrip writing. We suggest that from this time forward, the Apprentice form a habit of printing as much and as often as is normally convenient. In so doing, the individual will develop a form of lettering suitable to his own personality. We shall spend very little time in actual lettering practice, but every drawing that is completed will have some lettering on it. The Apprentice should take pride in the lettering on each drawing.

Material: Soft pencil and letter sheet provided.

Procedure: On page #2, the large capital letters are marked as to the proper strokes that should be used in making these letters. Copy several letters on the same line, using the strokes as shown on the sheet. On page #3 of this same assignment, copy the lettering as shown in the spaces provided, still using the strokes demonstrated on page #2. We suggest that each person develop his own desired style of lettering.

Student Assignment
in
Plumbing and Pipe Fitting



Student Assignment
in
Plumbing and Pipe Fitting

VERTICAL STROKES ARE DRAWN FROM THE TOP TO THE BOTTOM. HORIZONTAL STROKES ARE DRAWN FROM THE LEFT TO THE RIGHT. THE CROSSBAR IS SLIGHTLY ABOVE THE CENTER ON EACH OF THE FOLLOWING: B-E-F-G-H P-R. IT IS BELOW THE CENTER ON-A

$2\frac{1}{2}$ $3\frac{5}{8}$ $4\frac{9}{16}$ $7\frac{3}{4}$ $\frac{7}{8}$ $\frac{1}{4}$

Student Assignment
in
Plumbing and Pipe Fitting

Subject: DIMENSIONING

We have learned that two things must be told about an object in order to describe it. The size and shape must be described. In the previous assignments, we have learned how to show shape description. We know by this time that a working drawing cannot be complete without size description. For example, we could not build an object knowing only its shape and not its size or dimensions, Size, then, is a very necessary and important part of a working drawing.

It is true that drawings could be made of jobs or objects to a scale whereby the dimension could be determined by actually measuring the drawing, but such a method is obviously slow and inaccurate.

To insure accuracy and save time, size description is given in the form of dimentions and notes and arranged on the drawing in a definite form..

Dimension lines are thin lines.

Example: ————————————————

These lines are not as heavy as the object lines.

Example: ————————————————

Dimension lines are terminated by neat correctly formed arrows. Arrowheads are made ($2\frac{1}{2}$ times) as long as wide:

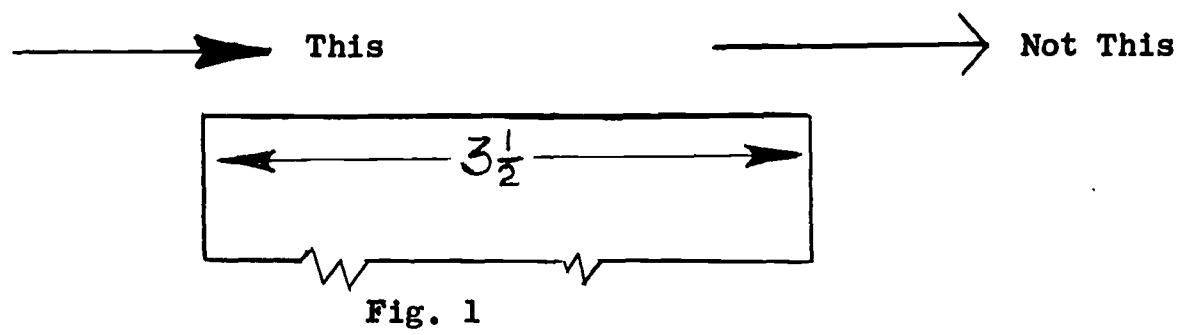


Fig. 1

When practical to place a dimension on the view it is done in the manner shown in Figure 1 with a space left in the dimension lines for a figure telling the actual dimension.

When it is necessary to place the dimension outside of the object lines of a view, we use extension lines. Extension lines are of the same weight as the dimension lines. Since they are not a part of the view, the extension lines do not touch the object lines as shown in Figure 2.

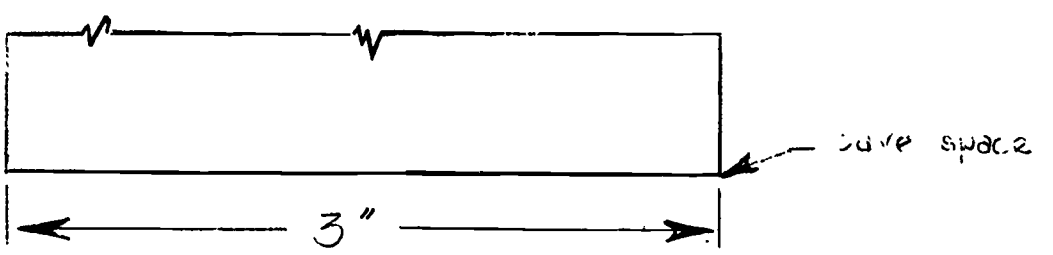


Fig. 2

Figures and letters should be neat and properly proportioned so as to keep the drawing balanced. They should not be too large or too small.

Dimension lines should be spaced at least 1/4" from the object lines and from each other to avoid crowding.

Inches are always indicated by " and feet by ', and a dash is always placed between feet and inches in this manner:

6' - 4½" or 0' - 10"

The letter D should be placed after figures indication diameters as shown in Figure 3

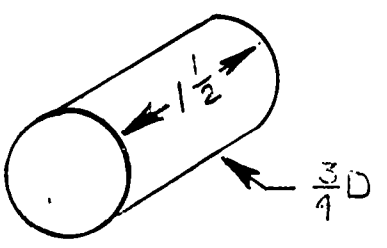


Fig. 3

R should be placed after dimensions indicating radius as shown in Figure 4.

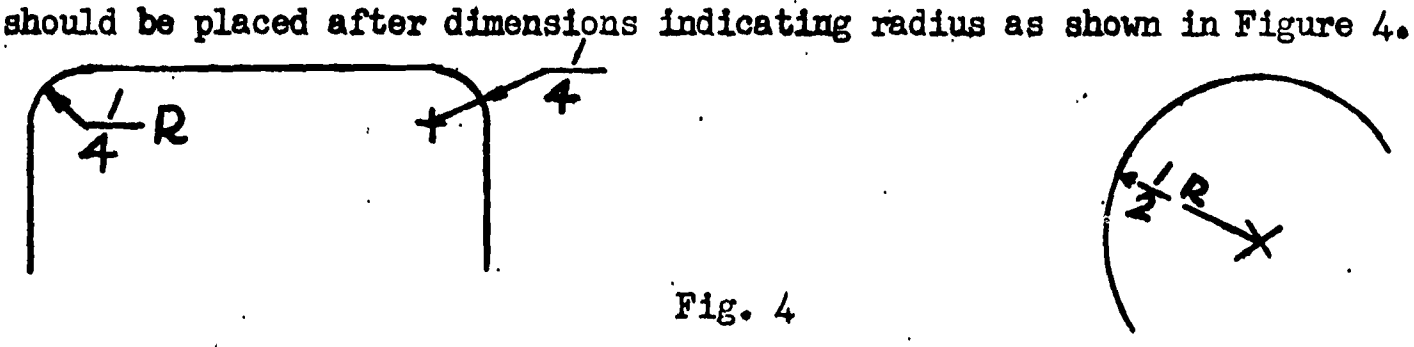


Fig. 4

Angles are indicated in this manner as shown in Figure 5.

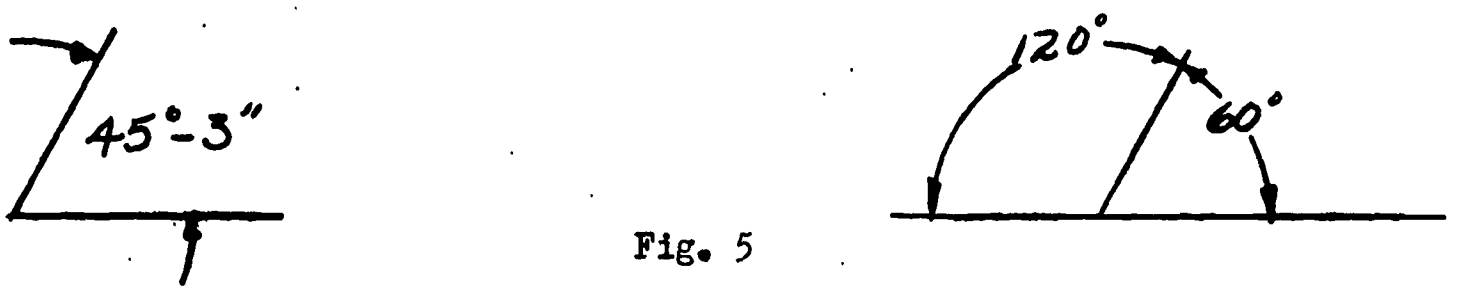


Fig. 5

There are numerous situations which will appear that will require the individual to use his own experience and common sense in making the drawings neat, balanced and ledgible. Only a few can be illustrated herein examples in Figure 6.

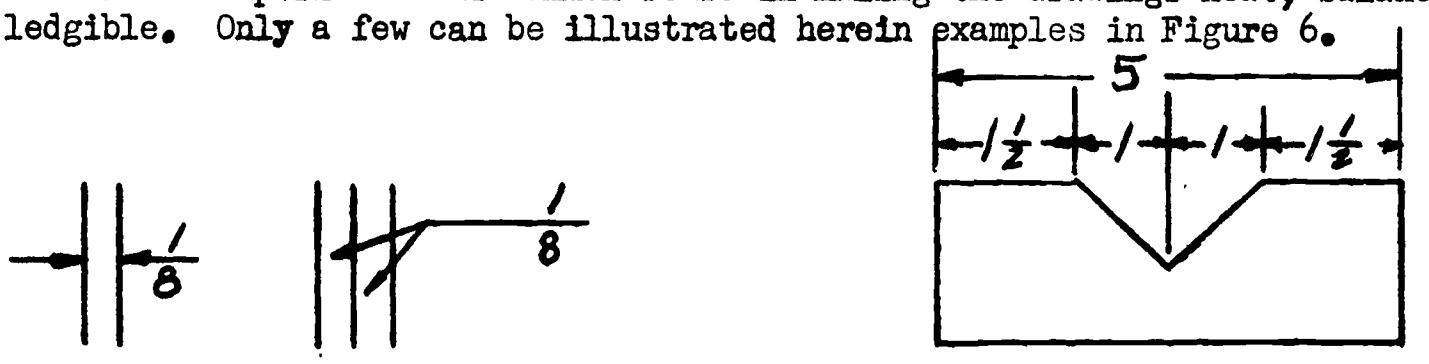


Fig. 6

Large dimensions should be placed outside of small dimensions as shown in Figure 7.

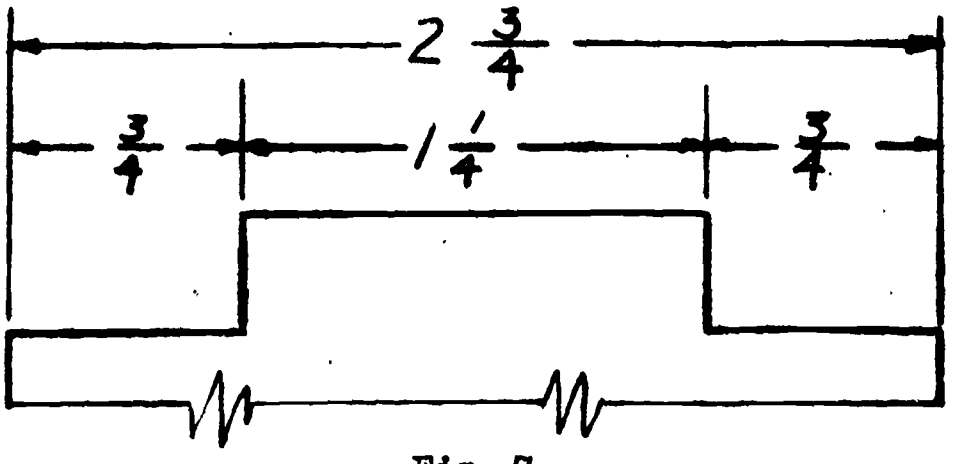


Fig. 7

Dimension lines and figures kept in a neat line add much to a drawing.

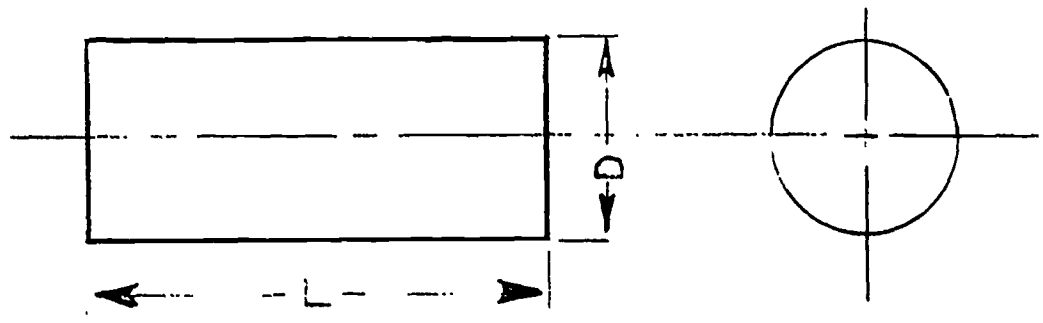


Fig. 8

Length and diameter of a cylinder are given on the same view as shown in Figure 8.

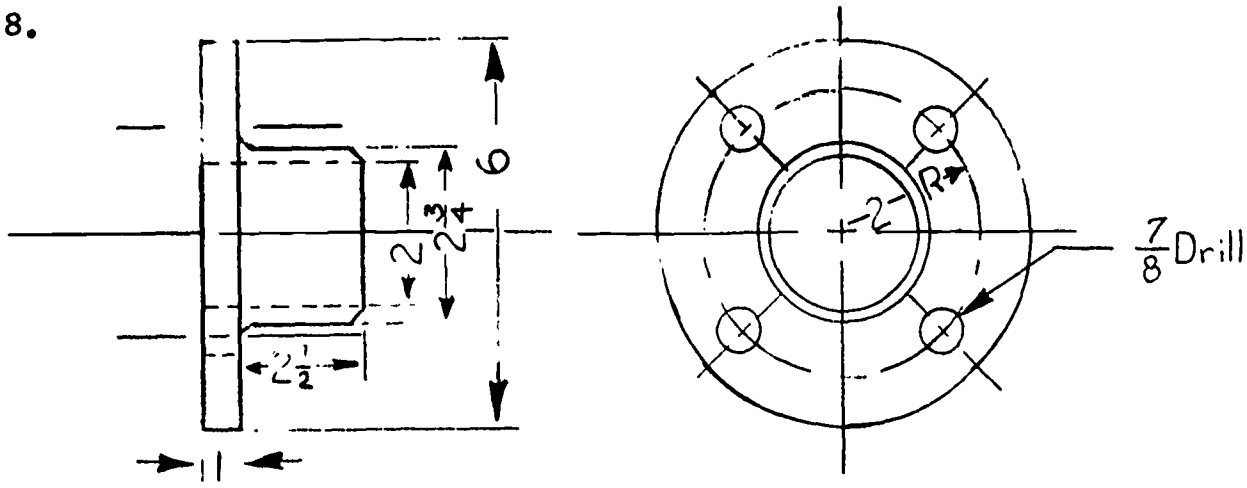


Fig. 9

On a drawing of a flat piece give the thickness on one of the edge views and other dimensions on the view showing the outline. Where possible, the dimensions are placed between the views as shown in Figures 9 and 10.

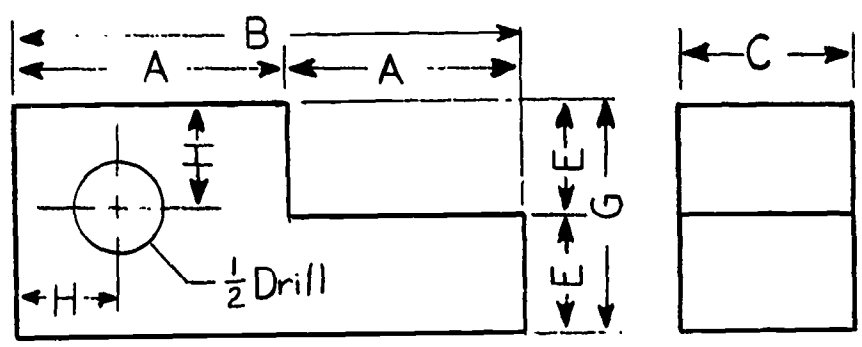


Fig. 10

The theory of dimensioning boils down to this:

An object or job is made up of a number of parts in various shapes, as cylinders, cubes, cones, etc.

Then it is only a matter of dimensioning a number of simple shapes, and locating them on the drawing in relation to other parts of the object. Dimensions might be classed as size and location dimensions.

Keep in mind that the job done on the project is built strictly from the information on the drawing. Include any note or dimension that gives helpful information. Don't clutter up the sketch with repetition and unnecessary information.

Student Assignment
in
Plumbing and Pipe Fitting

Subject: DIMENSIONING

Aim: To teach the Apprentice the value of a properly dimensioned drawing.

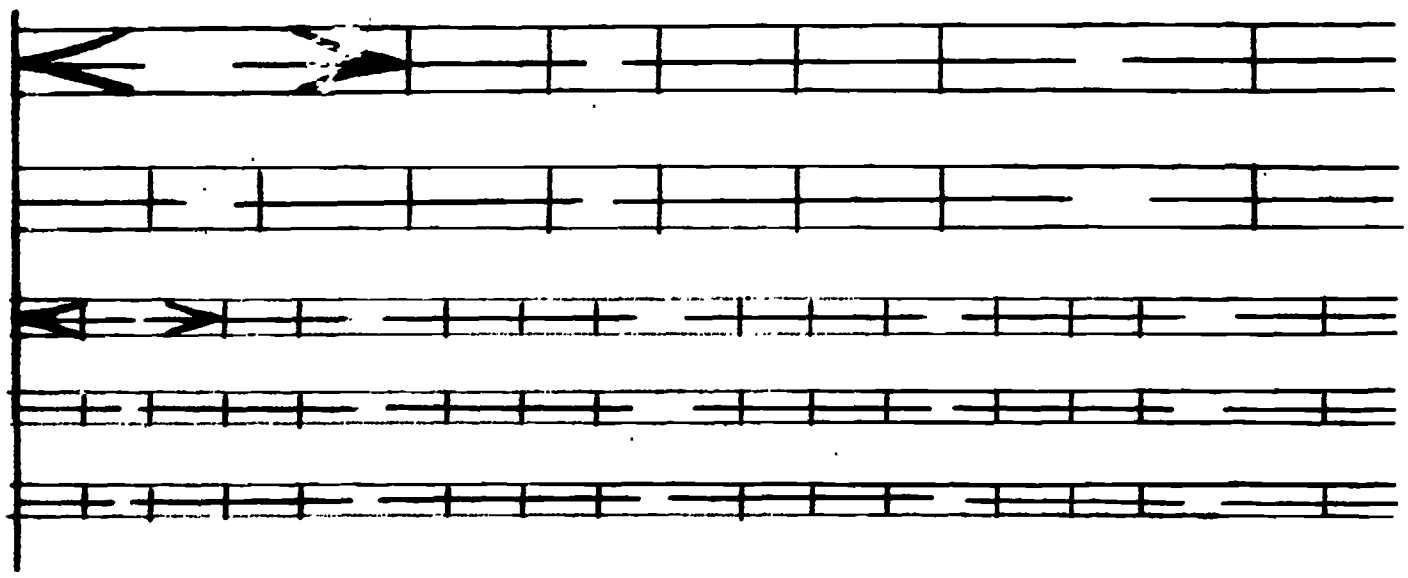
Introductory Information: We cannot emphasize too much, the importance of neat, accurate extension lines, dimension lines, and arrows. Neat ledgible figures giving size are of very little value if the part referred to cannot be distinguished because the exact point of the measurement is not properly identified.

Again it should be pointed out that it is not intended to attempt to make a draftsman out of the Apprentice, but to teach him to appreciate neat and accurate drawings.

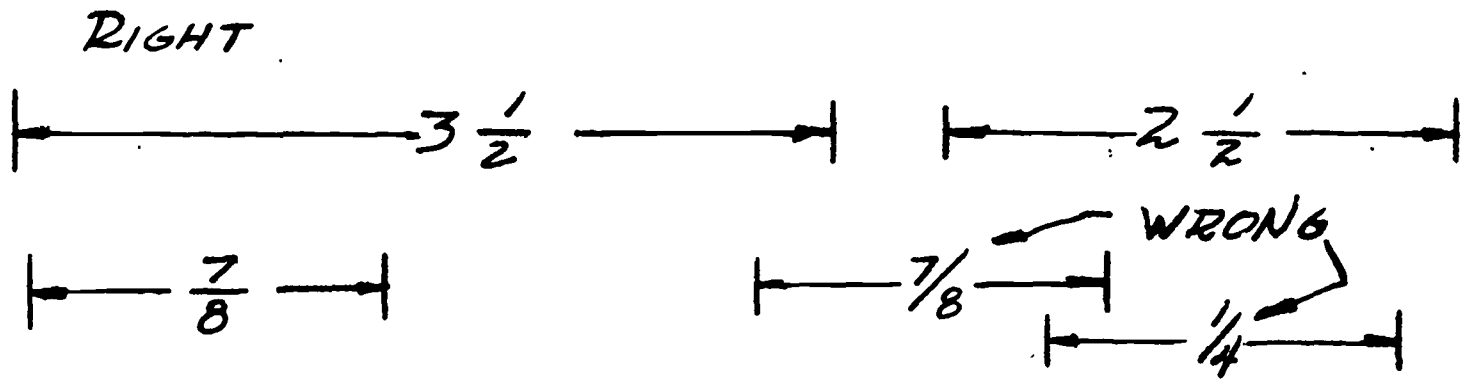
Materials: Soft, sharp pencil, assignment sheets, rule or scale.

Procedure: Follow the instructions on each sheet. Neatness and accuracy of figures, lines and arrows should be the chief concern of the Apprentice as well as the proper application of the rules of dimensioning.

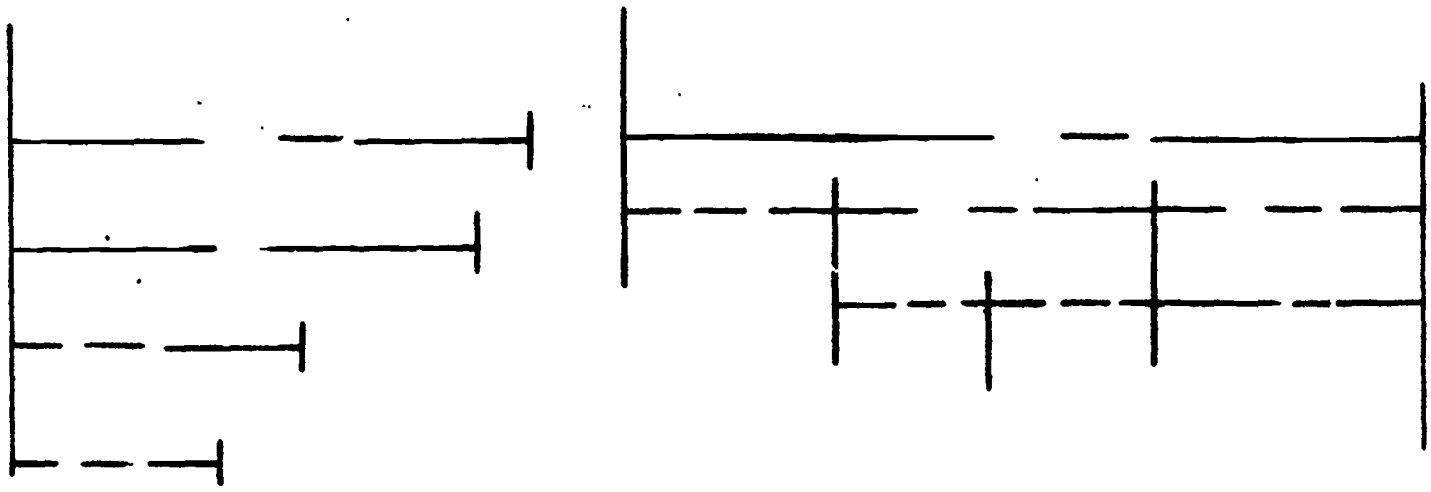
1. Study the examples given and fill in the spaces:



2. Lines for fractions should be made at the same time and in line with the dimension line:



3. Measure the following and put in the actual figures and arrowheads:



4. Show the proper dimensions on the following by actual measurement.

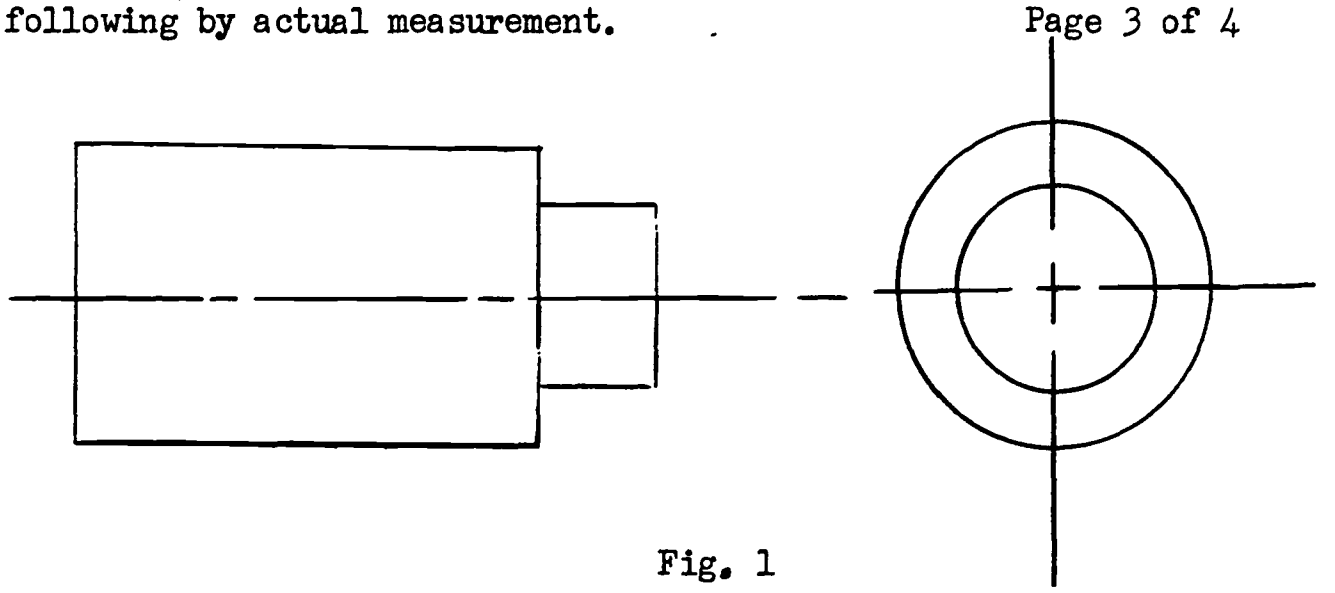


Fig. 1

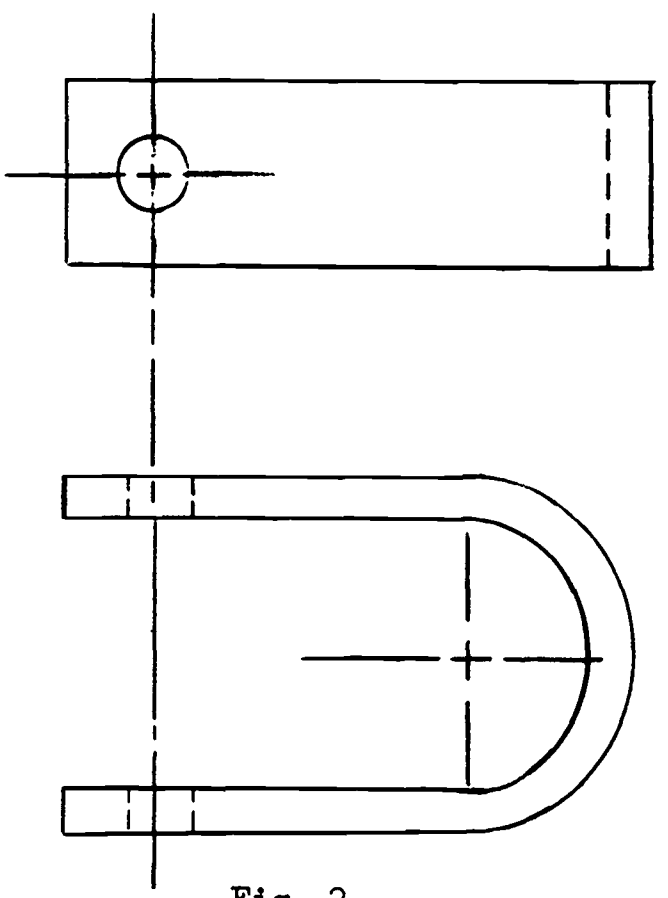


Fig. 2

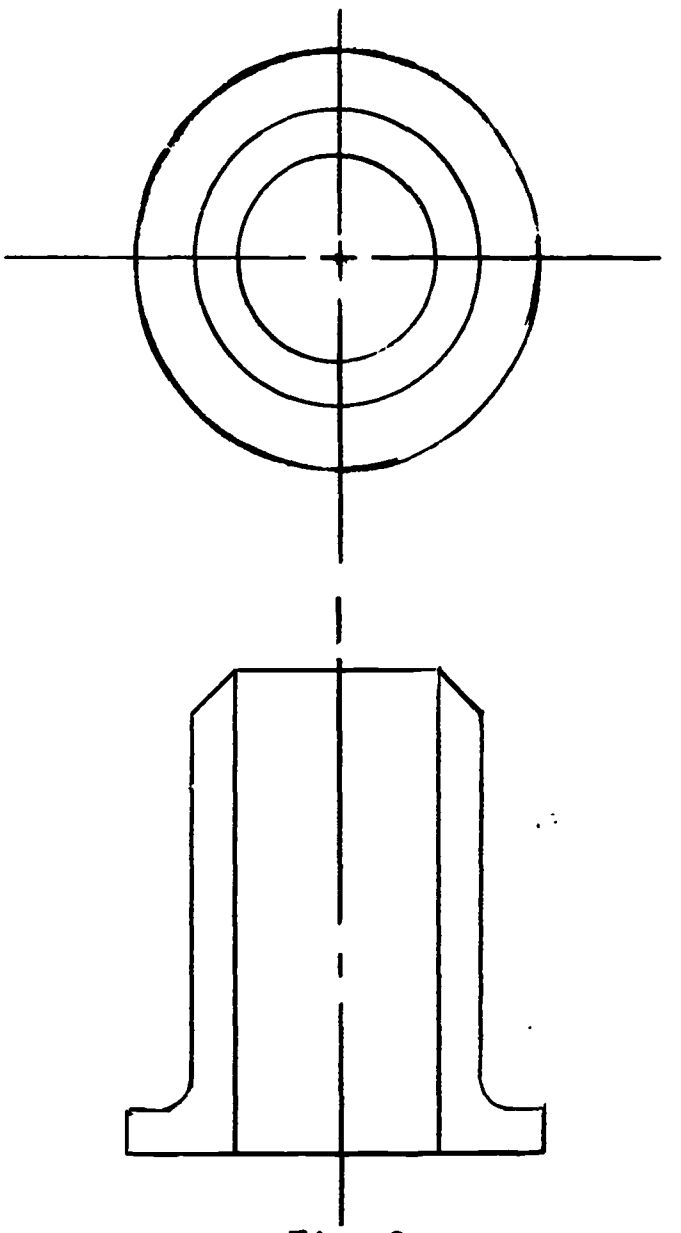
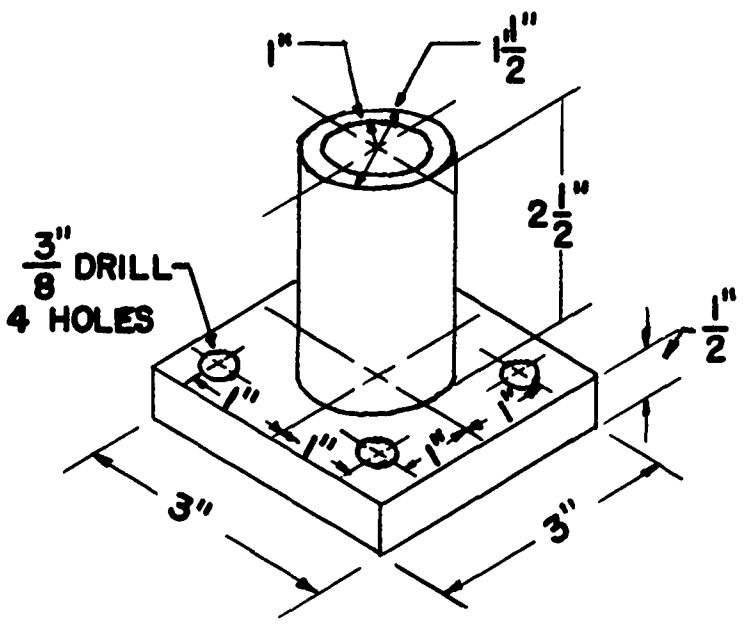
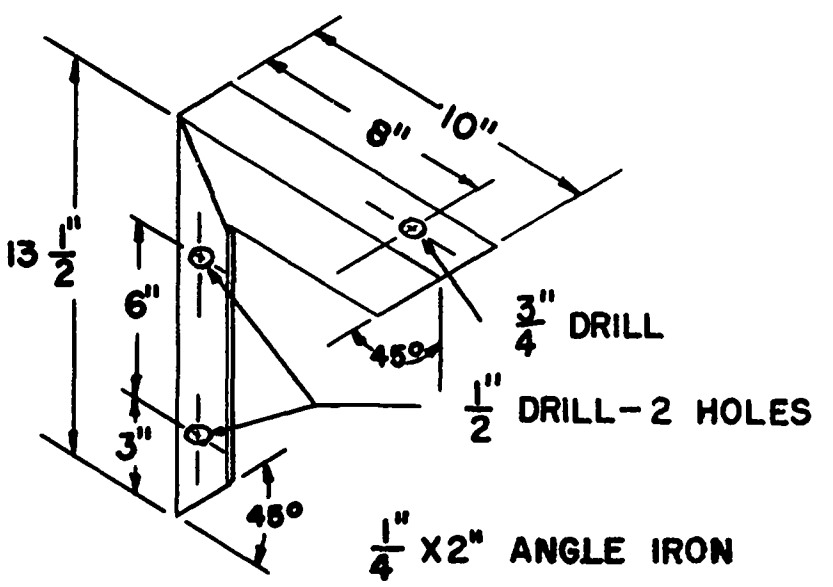


Fig. 3

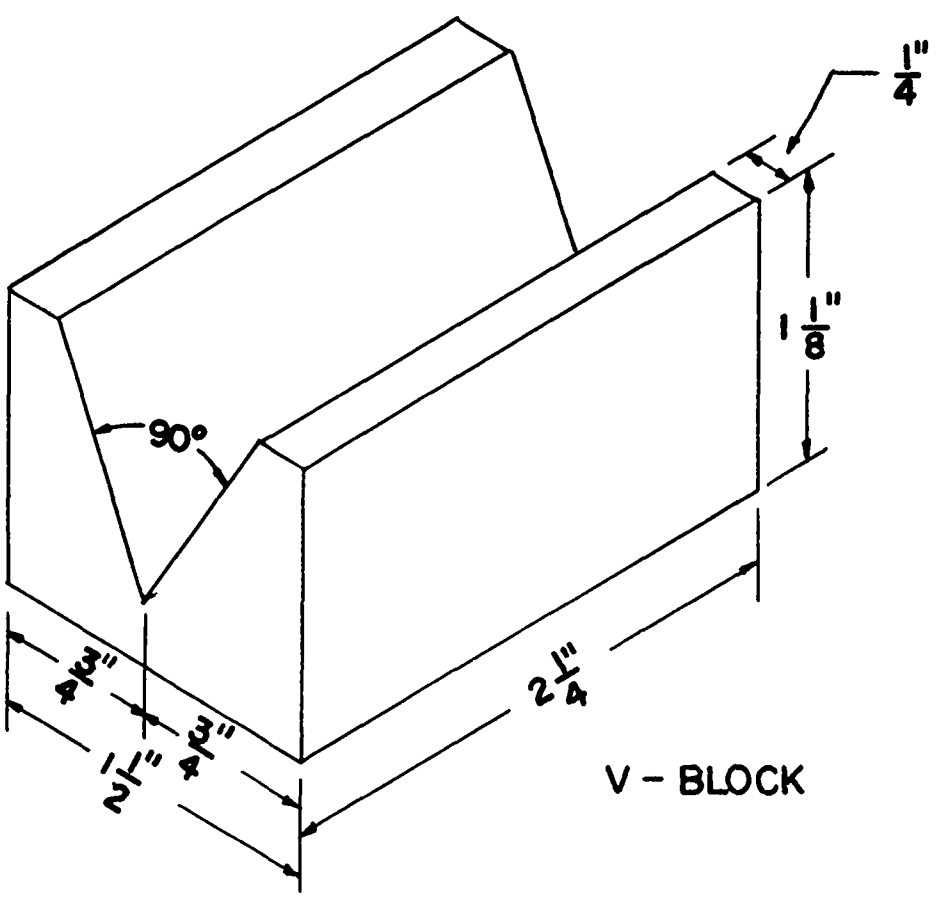
5. Sketch necessary views of following objects showing hidden lines, center lines and all necessary dimensions. This should be a <u>complete</u> working drawing.



FLANGE



PIPE HANGER BRACKET



V - BLOCK

VT 009 996
Phipps, D. Bart
Fundamentals of Plumbing Installation for Apprentice Training in the Plumbing and Pipe Fitting Industry; Packet 8.

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ABSTRACT - This bulletin was prepared by a subject matter specialist for use in plumbing and pipe fitting apprenticeship training classes studying fundamentals of plumbing installation. Instructors' lesson plans are provided, including subject, materials needed, references, introductory information, and assignments to be made, followed by the corresponding student assignment sheets. Areas covered include: (1) plumbing traps, (2) venting and vents, (3) installing and testing house drains, and (4) cross connections in plumbing and water supply systems. Student progress records are provided for both student and teacher files. (AW)

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FUNDAMENTALS OF PLUMBING INSTALLATION

for

APPRENTICE TRAINING

in the

PLUMBING AND PIPE FITTING INDUSTRY

Packet 8

* * * * * * * * * * * *

Prepared by

D. Bart Phipps, Specialist
Apprentice Training
Plumbing and Pipe Fitting

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VT 009 996

Instructors Lesson Plans
in
Plumbing and Pipe Fitting

Subject: The Plumbing Trap

Materials: The Lesson Plans for Chapter 29 of Volume 5 is not available at this writing. You will find, however, suggested in the reference listed below a suggested method to demonstrate the action of the siphon. The following Materials are suggested:

Two glass jars (Milk bottles, fruit jars, etc.)
A glass U tube (Both legs of the tube may be the same length. Use a rubber tube to lengthen one leg for siphoning.)
Blackboard, chalk, etc.

References: Plumbing Practice and Design - Vol. II by Svend Plum, Chap. 7 & 8 pages 163 to 212

How to Design and Install Plumbing - by A. J. Mathias and E. Smith, Sr. Chapter 10 and 11, pages 129 to 157

Vol. 5 Plumbing Appr. Text.

Introduction: The information to be derived from the contents of this Assignment will give the Apprentice a background for one of the most important phases of the trade. It is our responsibility to see that he has not developed any of the mistaken ideas most prevalent among some of our present journeymen. Encourage discussion of the various topics or phases to be studied in this assignment.

Assignment: Demonstrate, individually or as a group, the action of the siphon using the equipment suggested above or some variation which you may find more suitable or complete.

Some of the points to be covered:

1. What makes the siphon work.
2. How the siphon may be broken.
3. Demonstrate how the siphon is undesirable in the plumbing system.
4. Show instances where the siphon is helpful.

Instructors Lesson Plans
in
Plumbing and Pipe Fitting

Subject: Vents and Venting

Purpose: To give the Apprentice a good background or foundation for another important phase of Plumbing. To be sure that he understands the principles and does not develop false ideas.

Materials: Use the same materials suggested in Assignment No. 1 to demonstrate the principle of the siphon in the water closet. Blackboard, etc.

References: Plumbing Practice and Design - by Svend Plum
Chap. 7, pages 163 - 198

How to Design and Install Plumbing - By A. J. Mathias and E. Smith, Sr., Chap. 12 and 13, Pages 159 to 208

Introduction: This assignment follows very closely assignment number one of this Packet. The principles,purpose,and use of vents in the plumbing system is a must in the education of the apprentices. It is our responsibility to see that they are exposed to the information that will help them to understand and to develop the right concepts. The apprentice should be supervised as closely as possible while he is studying this phase of the trade in order to keep him on the right track.

Assignment: The apprentice is expected to answer all of the questions in chapter 30 of Volumn 5. Encourage discussion of the various phases covered. This will not only serve as a check on his rate of learning, but it will stimulate his interest by giving him the practical application of the theory that he is studying.

The answers to these questions will be found in the answer book in the instructors guide prepared for these seven volumns by Apprentice Texts. Inc.

Instructors Lesson Plans
in
Plumbing and Pipe Fitting

Subject: Installing the House Drain

Materials: Architect's Scale
Blackboard

References: Plumbing Practice and Design - by Svend Plum, Vol. I, Page 138 - 203

How to Design and Install Plumbing - by Mathias and Smith Chap. 5, 6, 7, page 53; Chap. 27 - 28 page 373

Introduction: There should be no argument as to the value of the material or information in this assignment. The problem to be concerned with is the interest of the apprentice. It will be the responsibility of the instructor to keep him interested by showing him the value of this experience on the job. It would be well to supplement this material by discussions of local jobs or situations

Assignment: The first 21 questions of Chap. 31 has been omitted as a part of the apprentice's assignment. The information to be gained from that section is important but the apprentices will need more guidance while studying this material. Using the questions as a guide the instructor should discuss this topic for the entire class using the black board to illustrate and demonstrate the proper use of the architect's scale.

Instructor's Lesson Plan
in
Plumbing and Pipe Fitting

Subject:	Testing the House Drain
Purpose:	To point out the importance of a proper test of a system, and to familiarize the apprentice with the tools and methods.
Materials:	Test plugs, new rubber expansion ring, old rubber expansion ring, short section of pipe.
Introductory Information:	A number of ideas gained from experience may be passed on to the apprentices by the instructor. Experience always affords some knowledge that is not easily put into writing.
Assignment:	As in other assignments, point out the value of certain points covered here. Demonstrate how a test plug is installed. Compare the difference between the old rubber expansion ring and the new. Review the difficulty often encountered using an old ring.

Instructors Lesson Plan
in
Plumbing and Pipe Fitting

Subject: Cross Connections in the Plumbing and Water Supply System.

Purpose: To cause the apprentices to realize the dire circumstances that may be caused from cross connection due to ignorance or carelessness.

References: How to Design and Install Plumbing, Mathias and Smith, Chap. 15, pages 307-322.

Plumbing Practice and Design - by Svend Plum, pages 1 - 12

Assignment: If it is possible, list instances where cross connections have caused illness either in your own city or reports from other cities. Point out possible cross connections in a building due to lack of air space or the omission of vacuum breaks. Do everything that is possible to make the apprentice realize his responsibility to the public so far as cross connection or contamination of a water system is concerned.

Films available to you through the Board of Plumbing Examiners and the State Health Department will be listed on your reference sheet for this Packet.

Name:_____

BASIC INSTRUCTION

Packet No. 8

STUDENT PROGRESS RECORD
in
BASIC INSTRUCTION FOR APPRENTICE TRAINING
for the
PLUMBING AND PIPE FITTING INDUSTRY

	Information Sheets	Student Assignments	Date Completed
1. The Plumbing Trap	1 - 1 page	1 - 1 page	
2. Vents and Venting	1 - 1 page	1 - 1 page	
3. Installing the House Drain	1 - 1 page	1 - 1 page	
4. Testing the House Drain	1 - 1 page	1 - 1 page	
5. Installing the Plumbing Stack	none	1 - 1 page	
6. The Building Water System	none	1 - 1 page	
7. Cross Connections	1 - 1 page	1 - 1 page	

Note: Green sheet for student's notebook
Gold sheet for instructor's file

Price of this Packet $0.35

A&MCS-TEES
May 1954

Name:_____

BASIC INSTRUCTION

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Note: Green sheet for students notebook
Gold sheet for instructor's file

Price of this Packet $0.35

A&MCS-TEES
May 1954

REFERENCES FOR PACKET NO. 8

Additional copies of the following references may be obtained from the addresses given if they are needed for the apprentice classes.

Plumbing Practice and Design Vol. I & II - Svend Plum - John Wiley and Sons Inc., New York City, New York

How to Design and Install Plumbing - A. J. Mathias, Jr. and E. Smith, Sr. - $4.25 - (Schools are allowed 20% discount. Orders of 25 or more 30% discount) - 848 East Fifty-eighth Street, Chicago 37, Illinois.

Eljer Roughing in Measurements - Eljer Company, Ford City, Pennyslvania.

Brass Pipe Handbook for Plumbing Installations - Copper and Brass Research Association, 420 Lexington Avenue, New York 17, New York.

Piping Pointers - Crane Company, 836 South Michigan Avenue, Chicago 5, Illinois.

Revere Tube and Pipe for General Construction - Revere Copper and Brass, Inc. - 230 Park Avenue, New York 17, New York.

Plumbing Apprentice Training - ($15.00 per set of Textbooks, $6.50 Instr. Guide) Apprentice Text Inc., C/O United Association of Journeyman and Apprentices of the Plumbing and Pipe Fitting Industry, 502 Ring Bldg., Washington 6, D.C.

Name: _____

Approved by: _____

Date: _____

THE PLUMBING TRAP

Key: BI - P8 - 1A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: The Plumbing Trap

Purpose: To familiarize the apprentice with the various types of traps used in the plumbing system, and to point out the proper use and installation.

References: Plumbing Practice and Design - by Svend Plum, Chap. 8, page 199

How to Design and Install Plumbing - A. J. Mathias, Jr., and E. Smith, Sr., Chap 10 and 11 pages 129 - 157

Vol. 5, Plumbing Apprentices Training.

Introductory Information: Read the references listed above before attempting to answer the questions assigned below. Take advantage of the opportunity of discussing some of the topics included in this chapter. Much of the information covering these are broadened considerably by experience. The instructor will give you the benefit of his experience.

Directions: Answer all of the questions in Chapter 29 of Volume 5, Plumbing Apprentice Training.

Use sketches if necessary to clarify your answers. You will find it very helpful to develop the habit of sketching throughout your entire trade experience.

Name: _____

Approved by: _____

Date: _____

VENTS AND VENTING

Key: BI - P8 - 2A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Vents and Venting

Purpose: To introduce the Apprentice to the theory of venting so that you might understand the use and purposes of vents in the plumbing system.

References: Plumbing Practice and Design - by Svend Plum., Chap. 7, pages 163 - 198

How to Design and Install Plumbing - by A. J. Mathias and E. Smith - Chap. 12 and 13, pages 159 to 208

Vol. 5 - Plumbing Apprentice Training

Introductory Information: After studying the references for this assignment you will find that Atmosphere has a great deal to do with the operation of the plumbing systems. Study these references carefully. Be sure that you understand the principles envolved. Discuss any of the phases of vents with your instructor. He will give a practical application to the principles discussed. You will find that a review of your high school science will be helpful.

Directions: After studying the references listed above, answer all the questions in Chapters 30, Volume 5 pages 51 to 84.

The instructor will demonstrate or explain any part of this chapter that you do not understand.

Name: _____

Approved by: _____

Date: _____

Installing The House Drain

Key: BI - P 8 - 3 A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Installing The House Drain

Purpose: To introduce as many problems and solutions as possible pertaining to the installation of the house drain and its branches as is practical in the classroom.

References: Plumbing Practice and Design - by Svend Plum Volumn I, Page 138 - 203

How to Design and Install Plumbing - by Mathias and Smith Chap. 5 - 6 - 7, page 53; chap. 27 - 28, page 373

Elger Roughing in Measurements

Vol. 5 - Plumbing Apprentice Training

Introductory Information: This assignment will require a little more work and concentration on the part of the apprentice. Take advantage of this opporturnity to learn the solution to many problems that will be faced on the job. These problems will be much easier in the classroom with assistance of the instructor. Do not hesitate to ask questions or discuss this work with the instructor. You will find this experience very valuable on the job.

Directions: Answer questions 22 to 91, Volumn 5, Chap. 31, Page 95 to 139
Omit questions No. 1 through 21.

Name: _____

Approved by: _____

Date: _____

Testing the House Drain

Key: BI - P8 - 4A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Testing the House Drain

Purpose: To point out the proper tools and methods of testing a plumbing system.

References: How to Design & Install Plumbing, Mathias & Smith, Chap. 14, page 209

Vol. 5 - Plumbing Apprentice Training

Introductory Information: Any piping job that is installed must be tested in the same manner. This job just as any other may be done easily and with a minimum of wasted time, provided the journeyman is familiar with tools and methods of doing the job.

Directions: Answer all the questions in Vol. 5, Chapter 32, page 140 after checking the reference listed.

Consult your instructor to clarify any point that you do not fully understand.

Name: _____

Approved by: _____

Date: _____

Installing the Plumbing Stack

Key: BI - P 8 - 5A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Installing the Plumbing Stack and its Branches

Purpose: To bring to your attention the safe, economical and efficient methods of installation.

References: How to Design and Install Plumbing, Mathias & Smith, page 404, Chapter 8, page 197.

Introductory Information: Knowledge of the different types of stacks used in a plumbing system is a must for a journeyman plumber. This type of information requires study as well as experience.

Directions: Answer the questions in Chapter 33, Vol. 5, page 148.

Name: _____

Approved by: _____

Date: _____

The Building Water System

Key: BI - P 8 - 6A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: The Building Water System

Purpose: To point out standards, as well as practices, in the installation of a building water system.

References: How to Design and Install Plumbing, Mathias and Smith, Chapter 16, 17, 18, and 19 pages 222-255.

Plumbing Practice & Design - by Svend Plum, Pages 1 - 12

Brass Pipe Handbook for Plumbing Installation, Copper and Brass Research Association, Pages 10-24, 30-45.

Piping Pointers, Crane, pages 2-9, 28-32.

Revere Tube and Pipe for General Construction, 1949, pages 3-9, 13-23.

Vol. 6 - Plumbing Apprentice Training

Introductory Information: There are many things involved in the installation of a water system. This installation is very often considered too simple, consequently, very important points are overlooked which will make for a much neater, safer and more efficient and potable water system.

Circumstances control to a great extent the types of material that should be used on a water system. The references for these questions provide information, both educational and interesting, pertaining to proper installation of a building water system. Take advantage of this opportunity to learn precautions as well as the methods of installation.

Directions: Answer the questions in Chapter 35, page 46, Vol. 6. Omit question number 44.

Name: _____

Approved by: _____

Date: _____

Cross Connections

Key: BI - P8 - 7A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Cross Connections in the Plumbing and Water Supply System

Purpose: To make you aware of the danger so prevalent in many installations caused by possible and positive cross connections.

References: How to Design and Install Plumbing, Mathias and Smith, Chap. 15, pages 307-322

Vol. VII, Plumbing Apprentice Training

Introductory Information: It is not too hard to understand why the public can be ignorant of the prevalence of the dangers of cross connection which contaminates the building water supply. Too many journeymen plumbers disregard the possibility of cross connections in the installation of a plumbing system. The plumber must learn what a cross connection actually is and how it can be prevented.

Directions: Study the references given above and ask your instructor for specific instances of cross connections in your city.

Answer the questions in Vol. 7, Chapter 38, page 1.

VT 010 012
Phipps, D. Bart
Industrial Blueprints for Apprentice Training in the Plumbing and Pipe Fitting Industry; Apprentice Workbook 25.

Texas A and M Univ., College Station. Engineering Extension Service
Texas State Board for Vocational Education, Austin
Texas State Joint Apprenticeship Committee for Plumbing and Pipe Fitting
MF AVAILABLE IN VT-ERIC SET.
Instructional Materials Production, Engineering Extension Service, Texas A and M University, F.E. Drawer K, College Station, Texas 77843 ($1.00).
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DESCRIPTORS - *STUDY GUIDES; *TRADE AND INDUSTRIAL EDUCATION; *APPRENTICESHIPS; *PLUMBING; WORKBOOKS; *ASSIGNMENTS

ABSTRACT - Prepared by a subject matter specialist, this bulletin is designed to acquaint plumbing and pipe fitting apprentices with typical plans and specifications of industrial installations. Included in the workbook are student progress record sheets, both for the student's notebook and instructor's file, information sheets, and student assignment sheets providing subject, purpose, references, introductory information, detailed procedures and questions to be answered. A reference for this workbook is available as VT 009 974, also in this issue. (AW)

VT 010 012

ED0 45856

INDUSTRIAL BLUEPRINTS

for

APPRENTICE TRAINING

in the

PLUMBING AND PIPE FITTING INDUSTRY

Apprentice Workbook

25

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Prepared by

D. Bart Phipps, Specialist
Apprentice Training
Plumbing and Pipe Fitting

ENGINEERING EXTENSION SERVICE

Texas A&M University
College Station, Texas

In Cooperation with
State Board for Vocational Education

and

Texas State Joint Apprenticeship Committee
for Plumbing and Pipe Fitting

VT010 012

Name:_____

INDUSTRIAL BLUEPRINTS

Apprentice Workbook

STUDENT PROGRESS RECORD
in
APPRENTICE TRAINING
for the
PLUMBING AND PIPE FITTING INDUSTRY

	Information Sheet	Student Assignments	Date Completed
1. Flow Diagram	1 - 2 pages	1 - 4 pages	
2. Plan Views	1 - 1 page	1 - 5 pages	
3. Piping Sections	None	1 - 4 pages	
4. Symbols and Legend	None	1 - 4 pages	
5. Notes and Specifications	1 - 2 pages	1 - 4 pages	
6. Blueprint Problems	None	1 - 2 pages	

Note: Green sheet for student's notebook
Gold sheet for instructor's file

Name:_____

INDUSTRIAL BLUEPRINTS

Apprentice Workbook

STUDENT PROGRESS RECORD
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APPRENTICE TRAINING
for the
PLUMBING AND PIPE FITTING INDUSTRY

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Note: Green sheet for student's notebook
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Information Sheet
in
Plumbing and Pipe Fitting

This set of Piping Plans has been furnished the Apprenticeship program by the Gas Processes Division of the Girdler Corporation for use as instruction material. These are typical plans of an industrial installation. It is not always necessary for the journeyman to know all of the operations of the plant under construction, but he should be able to read and understand the terms used in the plans and specifications.

To help the apprentice better understand this set of plans, the flow diagram is included. It does not show how the pipe is actually run, but it shows the flow, as the name implies, of the various liquids and gases necessary in the process of desulfurization of the liquid hydrocarbon.

By way of explanation Petroleum is made up of a mixture consisting mainly of hydrocarbons, i.e., hydrogens and carbon (80 to 89 percent), it also contains sulphur, nitrogen, and impurities as it comes from the earth in its natural state.

Sulphurs are the most objectionable compounds in crude oil or the distillates, consequently they are, in process of refining, removed by various methods. The unit for which this set of piping plans were drawn is one method of desulphurization in which Amine solutions are used to absorb the sulphur from the liquid hydrocarbons. An Amine solution is any class of compounds derived from ammonia by the replacement of hydrogen. This solution comes in contact with the liquid hydrocarbon in an absorption tower where it picks up the sulphur and is pumped through the various stages described below and reactivated and again pumped through the absorption tower as a lean solution to repeat the same cycle.

Description of the Flow

The liquid hydrocarbon enters the absorption or scrubbing tower which is equipped with baffles to effect closer contact between amine solution and the charge.

The amine solution enters the tower near the top while the liquid hydrocarbon or charge enters lower down and flows countercurrent to the lean amine solution. The purified product flows from the top and enters a cylindrical drum called a separator.

Flow Diagram for Liquid
Hydrocarbon Desulfurization Plant
Key: D P - WB 25 - 1I

The rich amine solution containing the sulphur and possibly carbon dioxide flows through a heat exchanger to the reactivator where the acid gases are separated from the amine solution by indirect heating and steam stripping. The acid gas from the top of the reactivator is passed through a cooler or condenser and is recovered or flared. The steam is condensed and returned to the system.

The lean Amine solution from the reboiler returns to the absorber or scrubbing tower to repeat the cycle after passing through the heat exchanger, where it exchanges heat with rich amine solution, and through a cooler where it receives additional cooling before starting the new cycle.

Sheet number D 3615 - 1 - 2 included in this set of plans shows the vessels mentioned in the description above but they are identified by figures or symbols that are shown in the legend in the upper right hand corner of this sheet. It would be wise for the apprentice to become familiar with this legend since much of it is used throughout the entire set, for example, the method of identification of the lines, fittings, and valves.

Name: _____

Approved by: _____

Date: _____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Flow Diagram for Liquid Hydrocarbon Desulfurization Plant

Purpose: To familiarize the apprentice with the general operation of the plant and the legend used for identification, throughout the Blueprints used here, of the various piping systems and of the necessary vessels, instruments, etc.

References: Information sheet
Drawing No. D3615 - 1 - 2

Introductory Information: The journeyman who is working on the construction of this type of Plant must know something about the flow of the various gases and liquids used in the process since the flow is a factor in determining the manner in which the various types of fittings and instruments are installed. Although he could not be expected to learn the entire process he will be able to find the necessary information, and understand the meaning of the symbols as well as other methods of identification.

Directions: Turn to drawing No. D 3615 - 1 - 2 and look it over in order to become familiar with it so that you will experience no difficulty in locating the equipment and lines mentioned later. Read through the Legend and Summaries, and locate an example of each on the drawing. Be sure that you understand the method of identification.

Study Questions and/or Problems: The following questions are taken from the Flow Diagram only. As you answer these questions remember that the purpose is only to be a guide to help you become familiar with this drawing and the process.

I. Locate and identify the following equipment as it is shown on the flow diagram. (For example, the absorber is identified as T1 and is located on the sheet at B-2 approximately. Use the letters and figures around the border of the drawing to locate the various positions on this drawing.)

Flow Diagram
Key: D P - WB 25 - 1A
Page 2 of 5

A. Description	Identification	Location on Drawing
1. Reboiler		
2. Hydrocarbon Separator		
3. Solution Heat Exchanger		
4. Solution Cooler		
5. Steam Separator		
6. Solution Pumps		
7. Acid Gas Cooler		
8. Reactivator		

B. Give the line identification for the following lines as described below. (Example: The described hydrocarbon inlet to tower T-1 is identified by the code HCL - 1 - 2" - 5B)

1. Hydrocarbon outlet from the absorption tower to the hydrocarbon separator_____

2. Discharge line for the amine solution from the hydrocarbon separator_____

3. Inlet line for the amine solution into the absorption tower_____

4. Discharge line from solution pumps_____

5. Suction line from heat exchanger to solution pumps._____

6. Line from mix tank to solution pump_____.

7. Line from mix tank to spare solution pump _____.

8. The amine solution discharge line from the absorption tower_____.

9. The amine solution inlet from the absorption tower into the heat exchanger_____.

NAME OF EQUIPMENT	CODE NO.	LINE NUMBER
1. Absorber	_____	_____
2. Hydrocarbon separator	_____	_____

TEMPERATURE INSTRUMENTS

1. Temp Indicator	_____	_____
2. Thermometer well	_____	_____

B. 1. Trace the amine solution from the tower to T-1 to T-2.

2. List each piece of equipment through which it passes.

3. Give the line identification numbers in order.

4. Give the equipment name and code number.

EQUIPMENT NAME	EQUIPMENT NO.	LINE NO.
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____

C. 1. Trace the flow of the amine solution from the Reboiler E-4 back to tower T-1.

2. Give name and number of the equipment.

3. Give the identification numbers of the lines.

EQUIPMENT NAME	EQUIPMENT NO.	LINE NO.
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____

10. Inlet from reboiler into heat exchanger _____
_____.

11. Outlet from heat exchanger to reactivator_____
_____.

12. The amine solution discharge from the solution cooler_____.

13. Water inlet to solution cooler_____.

14. Steam supply to reboiler_____.

15. Condensate line from the reboiler_____.

16. Discharge from condensate trap for the steam separator_____.

17. Gas discharge line from the acid gas cooler
_____.

18. Water discharge from acid gas cooler_____.

19. Identify the line that connects the flow recording controller #2 in the amine solution line (M L-6-1"-5A) to the control valve in the steam line (SL-2-1"-4C)_____.

20. On what equipment is the gauge glass # 2 located?
_____

II. A. 1. Trace the flow of the liquid hydrocarbon from line (173-2"-5B) to the line marked "to storage" (802-2"-5B).

2. Give the code number and name of each piece of equipment as shown on the flow diagram.

3. Give the line identification numbers.

4. Identify the two points where the temperature of the solution may be checked by code number and name.

5. List the lines and equipment in order of flow.

4. _____ _____ _____

5. _____ _____ _____

D. Trace the acid gas from tower T-2 to line (875-2"-4A)

EQUIPMENT NAME	EQUIPMENT NO.	LINE IDENTIFICATION
1.		
2.		

Information Sheet
in
Plumbing and Pipe Fitting

The flow diagram gives a broad general picture of the operation of the plant. Although it does not give the true proportion or positions of lines and equipment, it shows the direction of flow of the various liquids and gases in the process. It alsow shows the sequence of each piece of equipment and the part it plays in the purification of the liquid hydrocarbon or the reactivation of the amine solution.

The many details necessary to the construction of the plant are shown on the elevation, plan, and various section views. There is much information however that cannot be shown by drawings. Notes, legends and symbols go together to supplement the information shown on the plans.

Of equal importance and just as necessary as the plans are the specifications. The journeyman must depend on both the plans and specification from the very beginning of the estimating, or so-called figuring of the job, to the completion of the construction.

In a plant of this type the specifications play an especially important role. In the process of desulfurization, liquids and gases of varying temperatures, pressures, and composition, must be moved through the various units by means of the piping system. The flow, pressure, and temperature must be controlled in order to properly process the hydrocarbons. These conditions necessitate the use of wide variety of materials. A mistake in the interpretation of the plans or specifications can be both dangerous and expensive.

The plans used in this packet of assignments consists of 8 drawings of a set of (10) ten drawings by the Girdler Corporation. Drawings number D-3615-2, D-3615-200, and D-3615-300 have been omitted since they will be of little particular value in the construction of the piping systems.

By working the following assignments the apprentice will have used these plans enough to become familiar with this type plan for process piping installation.

Student Assignment in Plumbing and Pipe Fitting

Subject: Plan View of the Installation

Purpose: To show the information that may be obtained from the plan view only.

References: Information sheet
Drawing No. 3615 - 500

Introductory Information: Before attempting to work with a set of plans they should be studied in order to become familiar with the general layout of the job, for example, the location of pieces of equipment in relation to each other, the Legend and the methods of identification, revisions, and special notes or symbols.

Too often a set of plans appear only to be a maze of pipe and equipment rather than a series of piping systems serving a definite purpose in an installation. A craftsman should be able to form a mental picture of the general layout.

Procedure: Sheet # D - 3615 - 500 - 1 "Plan of Piping at Elevation 4217'-0" is a plan of the grade elevation or ground level. This sheet shows the actual locations of equipment and actual dimensions. The dimensions, symbols, methods of identification, and other information of this drawing is as complete and accurate as possible for the benefit of the craftsmen doing the construction.

I. Answer the following questions as a guide to study this plan:
   A. Check the location of the various pieces of equipment by indicating the distance from the match line at the bottom of the sheet or other points indicated below.

      1. Reactivator tower T - 2 _____

      2. Mix Tank D - 2 _____

3. Distance center to center from D-2 to T-2 _____

4. Distance of center of T-1 from the edge of the curb on the North Side _____

5. Distance of T-1 from edge of trench _____

6. Distance between edge of curb on north side and the north edge of trench _____

7. What is the width of the trench? _____

8. What is the distance center to center between the solution heat exchanger and cooler? _____

9. Distance between #-1 and Tower T-2? _____

10. Pipe Support PS-2 is supported on each end by a column, what is the distance of each from the center of Tower T-1? _____

B. It is sometimes necessary to estimate a distance or dimension by scaling the blue print. Since the processing of blueprints may cause the paper to stretch or shrink, this method can be very inaccurate. The scale of drawing # D-3615-500-1 is 1/2" = 1' - 0". To check the degree of accuracy to which this plan may be scaled, measure the distance center to center between D-1 and D-2. Seven feet at this scale should be 3 1/2", the actual measurement is 3 9/16". This proves that scaling on this blueprint can only be an approximation.

Check further by measuring the following dimensions.

1. The 12' - 0" wide trench should measure to scale _____

2. Distance from the edge of the trench to the center of D - 2 should measure _____", actual measurement _____".

3. The total measurement from the match line at the bottom of the sheet to the match line at the top should be _____", the actual measurement _____".

4. The distance from the south edge of the trench to the edge of the curb should be _____".
   It actually measures _____".

5. What is the approximate distance between the following pipe supports?

   a. PS-1 & PS-2?_____ft._____in.

   b. PS-2 & PS-3?_____ft._____in.

   c. PS-3 & PS-4?_____ft._____in.

   d. PS-3 & PS-17?_____ft._____in.

   e. PS-5 & PS-4?_____ft._____in.

6. Identify the following and explain briefly the purpose of each in this system:

   a. E - 1 _____

   _____

   _____

   b. E - 2 _____

   _____

   _____

   _____

7. What lines connect to E - 1?

   a._____b._____

   c._____d._____

8. What lines connect to E - 2?

   a._____b._____

   c._____d._____

9. After (ML - 1 - 1" - 5A) leaves T - 1, into which end of E - 2 does it connect? (North or South)_____

10. What is the distance center to center between E - 2 and T - 1?_____

11. What is the distance from the center of T - 2 to center of T - 1 as indicated on sheet No. D 3615-500?

_____ East and West

12. From the Flow Diagram we know that (ML - 6 - 1" - 5A) flows from E - 1 to T - 1. On the Plan of the First Level, does this line cross over or under E - 2?_____

13. (ML - 6 - 1" - 5A) changes elevation at what distance from the center line of T - 1 and T - 2?

_____

14. Does this line turn up or down?_____
Show by symbol the reason for your answer.

_____

15. What is the distance between the center of the Fitting mentioned in question 14 and the Pipe Support #4?_____

16. How are the lines spaced running east and west on PS - 1 and PS - 2?_____

17. What is the elevation of the piping plan of First level?_____

18. From what direction does the water supply inter this installation?_____

19. From what direction does the Liquid Hydrocarbon enter the installation?_____

20. How can information be obtained on the job for continuation of lines beyond the Match line on Drawing # 3615-500?_____

Name:_____

Approved by:_____

Date:_____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Piping Section Drawings

Reference: Drawings # D - 3615 - 500 through # 506

Introductory Information: It is impossible to obtain all the necessary information or visualize each detail of an installation from a plan view only. Consequently, through practice and study the craftsman learns the relation and purpose of the various sheets or drawing that make up a set of plans. Elevations and sections must be used to show details.

Procedure: Answer the following questions as practice toward becoming familiar with the continuation of lines shown by the various drawings.

A. As an example locate the line (SL - 1 - 1 1/2 - 4C) on Dwg. D 3615 - 500 - 1 and answer the following questions. (The line is located by the letters & figures on the border of the sheet at approximately 3A)

1. What is the line designated by "SL"?_____

2. What size pipe is indicated by (SL - 1 - 1 1/2 - 4C)?
_____

3. List the fittings shown between the 90° ells on either end. a._____b._____

4. How far past the center of the towers does this line terminate or change elevation?_____

5. The symbol for the fitting at the point 4'-2" from the center of the tower indicates what change of direction or elevation?_____

Note: There is no indication or description of the line on this plan after it changes direction. It becomes necessary at this point to refer to other drawings.

This symbol (A/502) shown at points A and G indicates a section drawing sheet D-3615 - 502 which shows a view of the installation as though you were standing on the match line at the bottom of this sheet D 3615 - 500 looking West. You will notice that these symbols are in pairs with the arrows indicating the direction of the view. Also notice that "A" indicates the section while "502" indicates sheet or drawing on which the section will be found.

Before attempting to trace the continuation of the line mentioned above, check all of the section views and get a mental picture of the installation.

To determine the continuation of line (S1 - 1 - 1 1/2" - 4C) refer to drawing # D 3615 - 505 which is section "D-D" as indicated on the "Plan of Piping at Elevation 4217' - 0".

6. What lines are supplied by line (SL - 1 - 1 1/2 - 4C) through the valve assembly at 3G.?_____

7. What equipment is supplied by line (SL - 2 - 1" - 4C)? (Check drawing # D-3615-500)_____

8. What equipment is served by (SL - 4 - 1 1/2 - 4C)?_____(Locate from "plan of First Level" # 3615-500, check yourself on the flow sheet)

Note: The line identification as (HCL - 1 - 2" - 5B) are set up according to the flow of the line. Example: The hydrocarbon lines indicated as HCL - #1, 2, 3, 4, and 5 continues from its source through the absorber tower T - 1 and the separator D - 1 to storage. Lines HCL - 4 and 5 are by-pass and vent lines that are not actually in direct line of flow but are necessary as the by-pass and vent. Check this system on the flow chart and keep it in mind when locating or working on the various lines or drawings.

9. Line (HCL - 1 - 2" - 5B) is connected into the supply line (172 - 2" - 5B) at approximately 3A. A change of elevation is indicated by a symbol. On which drawing can the elevations of these lines be determined at this point?_____

10. What are the exact elevations of these lines?

    (173 - 2 - 5B)_____

    (HCL - 1 - 2" - 5B)_____

11. In relation to the pipe what elevation is given in the trench?_____

12. (HCL - 1 - 2" - 5B) changes elevation near tower T - 1. Which section drawing will show accurately the continuation of (HCL - 3 - 2" - 5B) at this point?_____

13. What is the difference in elevation center to center between HCL - 1 and HCL - 3 as shown on Drawing # 3615-504?_____

14. At what elevation does HCL - 1 tie in to tower T - 1?_____

15. Into what piece of equipment does HCL-3 connect?

    _____

16. What is the length of the section of pipe running East and West in line (HCL - 3 - 2" - 5B)?

    _____

17. What is the length of the parallel section of (HCL - 1 - 2" - 5B)?_____

18. Locate line (HCL - 4 - 2" - 5B) and give the length of the line center to center._____

19. What is the purpose of line (HCL - 4 - 2" - 5B)?

    _____

20. At what elevation does (HCL 2 - 2" - 5B) connect to tower T - 1?_____

B. It is often necessary to refer to several drawings to determine the accurate details of an installation. Section drawings are made which show only a small part of the over-all installation. A good example of this is the piping of the solution end of the solution pumps P-1 and P-1A.

1. What piping section drawings are necessary to determine the details of piping connecting lines ML-4 and ML-5? a._____ b._____

   c._____

2. Make an iso-metric sketch of the piping connecting (ML - 4 - 1" - 4A) to P-1 and P-1A. (Show all fittings as they are shown on this set of plans.)

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Use of Symbols and Legend in Reading Blueprints

References: ASME Standard Bulletin, Z32.2.3 - Graphical Symbols for Pipe Fittings, Valves and Piping.

Introductory Information: Blueprint reading, just as in any other phase of piping trade, is much more simple and accurate if you are familiar with all of the tools available. One of the most frequently used tools in blueprint reading are the symbols. It has been said that they are the "ABC's" of blueprints.

Symbols are supplemented by information contained in the legend of each set of blueprints. Most of the information in the legend is peculiar only to that particular set of plans. For example the line summary in the legend shown on the Flow Sheet D-3615-1 of this set of plans would apply only to this set.

Procedure: Study the legend and answer the following questions as to its application.

1. Indicate the meaning of each figure in the line -- identification number shown below.

   (ML - 1 - 1" - 3A)

   _____

   _____

   _____

2. Show the line symbols for the following lines as indicated by the following abbreviations:

   a. HCL _____

   b. WL _____

   c. ML _____

d. CL _____

e. IL _____

f. GL _____

3. Show the line symbol and identification of the line described below:

   1" Hydrocarbon line number 3 pipe and fittings specifications under 5A. _____

4. The gate valves and globe valves are distinguished on these plans in the following manner:

   _____ gate valve

   _____ globe valve

5. Refer to the flow sheet and piping section D-D and show the symbol for "strainer". _____

6. Identify the following piping symbols: (indicate elbow up or down, etc.)

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

   f. _____

   g. _____

   h. _____

7. Refer to Drawing No. D - 3615 - 500. Locate line (ML - 4 - 1" - 4A) flowing from E-2 to P-1. Make a free hand isometric sketch showing the change of elevations as indicated only on this plan view. Dimensions can not be shown.

8. Identify this symbol _____

9. Identify the following and give the line or equipment on which the fitting or instrument is located:

Identification	Name	Location
Example:		
PC - 1	Pressure Control	(GL-2-1 1/2"-4A)
RV - 2		
RV - 1		
LO - 1		
SC		
TI - 2		
TW		
RV - 6		
ST - 7		
FRC - 2		
TI - 1		
LLA		
RV - 3		
LLR - 1		
LLC - 1		

Information Sheet
in
Plumbing and Pipe Fitting

By way of review we should discuss the purpose of Specifications in order to make sure we realize the value of a complete set of specifications with notes and the inevitable revisions.

The specifications for the Girdler Corporation Blueprints are set up in a form different to that used in previous packets of this instruction material. Although the forms vary, the purpose is the same. They are a written description of the work to be done. The drawings and specifications supplement each other. One furnishes information that the other cannot. Specifications in general cover all of the phases of the work that cannot be shown on the drawings such as general conditions, the quality and quantity of materials, the methods of construction and the standards of workmanship. In addition to general clauses very specific information is included covering workmanship and materials.

Revisions of blueprints and specifications are merely changes that have been made by an authorized person after the drawing is completed. It is very important that drawings are always checked for revisions. They are generally marked by a note near the title plate listing the revisions, the date made by whom they were authorized. Each revision is marked by a letter or number. The revision is often made on the print by circling the old dimension or change and is marked by a corresponding letter or figure on the print. It is sometimes necessary to remake the entire drawing if a major change is to be made.

In any case, when a new revised drawing is received, all previous drawings should be collected and disposed of in such a way that they will not be used by anyone.

The line identification method used on this set of plans gives reference to a particular section of the specifications. This is explained in the legend on the flow sheet. As an example, turn to sheet number D-3615-500. Line number (HCL-1-2"-5B) refers to section 5B of the specifications.

Under each section may be found headings under which any material for this line is specified. The pipe, for example, is "schedule 40 seamless steel pipe conforming to ASTM A-53". We find these specifications by the following general procedure:

1. The line identification on the blueprint refers to section 5B of the Specification.

2. Piping under sections 5B refers to section 4A for piping.

3. Under section 4A we find that specifications vary with the size of pipe. The size of pipe is shown on the blueprint by the line identification number.

Pipe from 2" to 18" under specification 4A refers to notes 1, 2, 3, and 4. In these notes are given conditions under which pipe must be installed.

All of this information is furnished for a definite purpose and must be carefully studied by the men responsible for the construction or installation.

You will notice that these sources of information supplement each other. They are closely interwoven to supply all of the information necessary if the merchanic responsible for the job has the experience necessary to translate or classify it.

Name: _____

Approved by: _____

Date: _____

Student Assignments
in
Plumbing and Pipe Fitting

Subject: Notes and Specifications

Purpose: To point out the purpose of Specifications and their relation to drawings.

References: Information Sheets
Blueprints and Specifications

Introductory Information: Volumes of information could be written pertaining to blueprints and the various types of supplementary information and their use. Basic information, supervised study and field practice or experience comprise the only method of well rounded training along these lines. Many mechanics lack self-confidence because they did not have the opportunity to spend more time working on blueprints in the classroom than is possible on the job.

Procedure: Use the following questions and problems as a guide to study the plans and specifications in relation to each other. It is necessary to check all specifications for notes and revisions. Answer the following questions from the information supplied by the Specifications and Blueprints.

A. 1. On the Girdler Corporation Plans where is a revision first indicated on a drawing? _____

2. Where are the revisions listed on the sheet? _____
_____

3. What information is listed in reference to revisions on the blueprints?

a. _____

b. _____

c. _____

d. _____

4. How many times has the flow sheet diagram been revised? Give the dates.

_____

5. List the revisions for each sheet as indicated?

Drawing Number	Revisions
D-3615-500-1	_____
D-3615-501-1	_____
D-3615-502-1	_____
D-3615-503-1	_____
D-3615-504-1	_____
D-3615-505-1	_____
D-3615-506-0	_____

6. Under specification Section No. 1, a revision is indicated by this figure in the Pipe section. Write the revised note in the space below:

_____

7. There is two other revised notes in section 4A. What is the number of the note and to what particular type of fitting does it refer?_____

_____

_____

8. In line (SL-1-1 1/2"-4C) write the specifications for Orifice flange for FRC-1._____

_____

_____

9. What are the specifications for ordering Orifice flanges?

a. _____

_____

b. _____

_____

10. What are the specifications as to the joints in the line HCL-1-2"-5B? _____

_____

_____

B. Check all notes and revisions when taking off material. Write the Specifications for the items listed below identified by the line number.

1. Specification for pipe in line (HCL - 1 - 2" - 5B).

_____

2. Valve number 2" - 979 in line listed in #1 above

_____

_____

_____

_____

3. Flanges # T - 311 and G 312

_____

_____

_____

4. From the information given in any standard catalog explain the meaning of small T and G facing as specified under flange section # 4B.

_____

_____

5. Turn to Drawing D 3615-504. List the materials and specifications for line (HCL - 4 - 2" - 5B).

a. _____

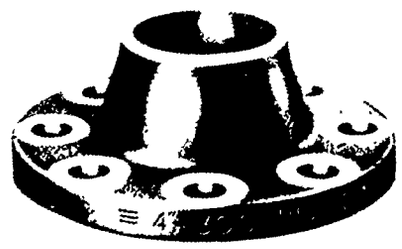
b. _____

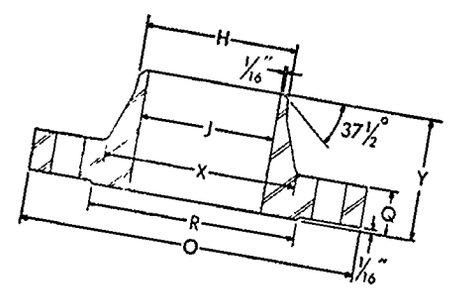
c. _____

d. _____

Note: (Refer to page 29 for specified flanges. Check flanges ASA B16e part #31 for flange and stud bolt dimension).

300 LB.
WELDING NECK FLANGES





Part No. 31

ASA B16e — ASTM A181—GRADE I▲

NOMINAL PIPE SIZE	OUTSIDE DIAM. OF FLANGE O	THICK. OF FLANGE Q[1]	DIAM. OF RAISED FACE R	DIAM. OF BORE J[2]	LENGTH THRU HUB Y[1]	DIAM. OF HUB AT BASE X	DIAMETER OF HUB AT POINT OF WELDING H	DRILLING TEMPLATE: NO. OF HOLES	DIAM. OF BOLTS[4]	DIAM. OF BOLT CIRCLE	LGTH. OF STUD BOLTS[3]: 1/16" RAISED FACE	LGTH. OF STUD BOLTS[3]: RING JOINT	APPROX. WEIGHT IN POUNDS	LIST PRICE
½	3¾	9/16	1 3/8	.62	2 1/16	1 ½	.84	4	½	2⅝	2½		4	$11.00
¾	4⅝	⅝	1 11/16	.82	2¼	1⅞	1.05	4	⅝	3¼	3		4	11.00
1	4⅞	11/16	2	1.05	2 7/16	2 ⅛	1.32	4	⅝	3½	3		4	11.00
1¼	5¼	¾	2½	1.38	2 9/16	2½	1.66	4	⅝	3⅞	3¼		6	11.00
1½	6⅛	13/16	2⅞	1.61	2 11/16	2¾	1.90	4	¾	4½	3½		8	11.00
2	6½	⅞	3⅝	2.07	2¾	3 5/16	2.38	8	⅝	5	3½	4¼	9	11.00
2½	7½	1	4⅛	2.47	3	3 15/16	2.88	8	¾	5⅞	4	4¾	12	13.00
3	8¼	1⅛	5	3.07	3⅛	4⅝	3.50	8	¾	6⅝	4¼	5	15	15.00
3½	9	1 3/16	5½	3.55	3 3/16	5¼	4.00	8	¾	7¼	4¼	5¼	18	19.00
4	10	1¼	6 3/16	4.03	3⅜	5¾	4.50	8	¾	7⅞	4½	5¼	25	20.00
5	11	1⅜	7 5/16	5.05	3⅞	7	5.56	8	¾	9¼	4¾	5½	32	24.00
6	12½	1 7/16	8½	6.07	3⅞	8⅛	6.63	12	¾	10⅝	4¾	5¾	42	27.00
8	15	1⅝	10⅝	7.98	4⅜	10¼	8.63	12	⅞	13	5½	6¼	67	44.00
10	17½	1⅞	12¾	10.02	4⅝	12⅝	10.75	16	1	15¼	6¼	7¼	91	62.00
12	20½	2	15	12.00*	5⅛	14¾	12.75	16	1⅛	17¾	6¾	7½	138	96.00
14 O.D.	23	2⅛	16¼	13.25*	5⅝	16¾	14.00	20	1⅛	20¼	7	7¾	186	130.00
16 O.D.	25½	2¼	18½	15.25*	5¾	19	16.00	20	1¼	22½	7½	8½	246	165.00
18 O.D.	28	2⅜	21	17.25*	6¼	21	18.00	24	1¼	24¾	7¾	8¾	305	220.00
20 O.D.	30½	2½	23	19.25*	6⅜	23⅛	20.00	24	1¼	27	8¼	9¼	378	290.00
24 O.D.	36	2¾	27¼	23.25*	6⅝	27⅝	24.00	24	1½	32	9¼	10¼	545	380.00

All dimensions are in inches.

Flanges are furnished faced, drilled and spot faced or back faced. For Standard flange facings see page 184.

(1) The 1/16" raised face is included in Thickness "Q" and Length Through Hub "Y."

(2) Flanges will be furnished bored to these dimensions (Standard Wall Pipe I.D. ASA B36.10) unless otherwise ordered. Extra Strong Wall bore also furnished from stock.

(3) These lengths include thickness of two nuts, but do not include height of crown.

(4) Bolt holes are ⅛" larger than bolt diameters.

The smallest bores to which the forgings for these flanges may be machined are found on page 180.

* Bores for sizes 12" and larger are not listed in the American Standard.

For Ring Type Joint details see page 188.

For Dimensional Tolerances see page 198.

For Pressure-Temperature Ratings see page 219.

For extras see page 182.

▲ Same as ASME Boiler Construction Code SA181. Also furnished in A181—Grade II and A105—Grade I and II.

Name:_____

Approved by:_____

Date:_____

Student Assignments
in
Plumbing and Pipe Fitting

Subject: Problems in Blueprint Reading

Purpose: To afford as much practical experience as possible in blueprint reading.

References: Blueprints and Specifications
Manufacturers' Catalogs

Introductory Information: A certain amount of practical experience is necessary to become profficient in blueprint reading. This is an attempt to give you an opportunity to work problems as near to actual job problems as is practical.

Procedure: Make the necessary sketches as near as possible and follow standard procedure as practiced in previous Packets of instructional material.

List the materials and specifications as accurately as though you were ordering out the material.

A. 1. Draw a plan view and an elevation view C-C of lines (HCL-5-6"-5B) and (GL-3-6"-4A) from fitting RV-1 to RV-2. Do not show these valves on the sketch. Show coupling for vent connections.

2. List the material on the forms furnished. Show quanity, size, description, and item number if possible.

3. Make an isometric sketch for fabrication.

4. Show field welds to be made in place.

B. 1. Make an isometric sketch of the typical layout for TP-1 and S-1.

2. Take off the material and list on forms furnished. (note: No specifications are provided for TP-1 and S-1)

C. 1. Make an isometric sketch of the "Typical hook-up" for steam only on the solution Pumps P-1 and P-1A.

2. Take off the material giving quanity, size, description and item numbers that are provided.

3. Include notes necessary to install this piping.

D. 1. Draw a plan view of tower T-2 and acid gas cooler E-3 showing only line (GL-1-2"-4A). Show all dimensions possible of this line on the plan view.

2. Draw an elevation of the items above from piping section C-C and show all necessary dimensions of (GL-1-2"-4A). Take off the materials and list on the take off sheets furnished.

3. Make an isometric drawing of line (GL-1-2"-4A) and show approximate location and number of the pipe supports specified.

PIPE LINE BILL OF MATERIAL

Dwg. No._____ Line No._____

No. Req'd	Size	Description	Item No.

VT 010 013
Phipps, D. Bart
Basic Instruction for Apprentice Training in the Plumbing and Pipe Fitting Industry; Workbook No. 2.

Texas A and M Univ., College Station. Engineering Extension Service
Texas Education Agency, Austin. Industrial Education Service
Texas State Joint Apprenticeship and Training Committee for the Plumbing and Pipe Fitting Industry
MF AVAILABLE IN VT-ERIC SET.
Instructional Materials Production, Engineering Extension Service, Texas A and M University, F.E. Drawer K, College Station, Texas 77843 ($1.00).
PUB DATE - May59 72p.

DESCRIPTORS - *STUDY GUIDES; *TRADE AND INDUSTRIAL EDUCATION; *APPRENTICESHIPS; *PLUMBING; WORKBOOKS; ASSIGNMENTS; MACHINE TOOLS; *HAND TOOLS

ABSTRACT - This basic instruction workbook was prepared by a subject matter specialist for use in training programs for plumbing and pipe fitting apprentices. Contents consist of information sheets and student assignments for the following topics: (1) Drills and Drilling, (2) Steel and Wrought Iron Pipe, (3) Cutting, Threading, and Holding Tools for Screw Pipe Work, (4) Cutting and Threading Pipe, (5) Standard Pipe Threads, (6) Range of Pipe Fittings, (7) How to Read Fittings, (8) Types of Valves and Cocks, (9) How to Make Up a Screwed Joint, (10) Files and Their Uses, and (11) Hack Saws. Student progress records are included for both student and instructor use. The workbook is illustrated with numerous drawings, diagrams, and photographs. (AW)

VT 010 013

ED0 45856

BASIC INSTRUCTION

for

APPRENTICE TRAINING
in the
PLUMBING AND PIPE FITTING INDUSTRY

Workbook No. 2

U.S. DEPARTMENT OF HEALTH, EDUCATION
& WELFARE
OFFICE OF EDUCATION
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Prepared by

D. Bart Phipps, Specialist
Apprentice Training
Plumbing and Pipe Fitting

ENGINEERING EXTENSION SERVICE
Texas A&M University
cooperating with
INDUSTRIAL EDUCATION SERVICE
Texas Education Agency
and
Texas State Joint Apprenticeship and Training Committee
for the Plumbing and Pipe Fitting Industry

VT010 013

9-5-300

FOREWORD

Packet number two, which was originally prepared by Robert A. Camp in 1949, has been revised May 1959, by D. Bart Phipps. Additional information sheets, illustrations and problems have been prepared.

By permission of manufacturers and publishers, information originally contained in other publications for reference has been incorporated in information sheets within this packet. The change is made to expedite the use of this material for the benefit of the local instructor and apprentices. The number of outside references necessary for this packet has been reduced.

The assistance and suggestions for the improvement of this instructional material is hereby acknowledged and sincerely appreciated.

Name_____

BASIC INSTRUCTION

Packet No. 2

STUDENT PROGRESS RECORD
in
BASIC INSTRUCTION FOR APPRENTICE TRAINING
for the
PLUMBING AND PIPE FITTING INDUSTRY

	Information Sheets	Student Assignments	Date Completed
1. Drills and Drilling	10 pages	4 pages	
2. Steel and Wrought Iron Pipe	5 pages	3 pages	
3. Cutting, Threading, and Holding Tools for Screw Pipe Work	8 pages	3 pages	
4. Cutting and Threading Pipe	4 pages	2 pages	
5. Standard Pipe Threads	2 pages	2 pages	
6. Range of Pipe Fittings	None	3 pages	
7. How to Read Fittings	None	4 pages	
8. Types of Valves and Cocks	None	2 pages	
9. How to Make Up a Screwed Joint	None	2 pages	
10. Files and Their Uses	5 pages	2 pages	
11. Hack Saws	3 pages	2 pages	

NOTE: Green sheet for student's notebook
Gold sheet for instructor's file

Name _____

BASIC INSTRUCTION

Packet No. 2

STUDENT PROGRESS RECORD
in
BASIC INSTRUCTION FOR APPRENTICE TRAINING
for the
PLUMBING AND PIPE FITTING INDUSTRY

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4. Cutting and Threading Pipe	4 pages	2 pages	
5. Standard Pipe Threads	2 pages	2 pages	
6. Range of Pipe Fittings	None	3 pages	
7. How to Read Fittings	None	4 pages	
8. Types of Valves and Cocks	None	2 pages	
9. How to Make Up a Screwed Joint	None	2 pages	
10. Files and Their Uses	5 pages	2 pages	
11. Hack Saws	3 pages	2 pages	

NOTE: Green sheet for student's notebook
Gold sheet for instructor's file

Drills and Drilling

DRILLING TOOLS AND MACHINES

The mechanic generally uses machines designed or adapted for drilling. Wherever possible, work is brought to a drill press or lathe for drilling, boring or reaming. Some classes of work are of such a nature that it is impractical or impossible to bring it to a machine. In such instances, drilling is done by a portable drilling machine which is readily carried to the work. Although it is seldom used for metal working, the simplest drilling machine (tool) is the Carpenter's brace.

The hand drill, shown in Figure 1, is both "fed" and turned by hand and is used for very light work. Twist drills up to 1/4" may be used in this tool. The breast drill, Figure 2, is similar to the hand drill except it is more ruggedly constructed and is fed by pressure from the operator's chest applied to the breast plate. Such tools usually take drills up to 1/2" in diameter and may be used on fairly heavy work.

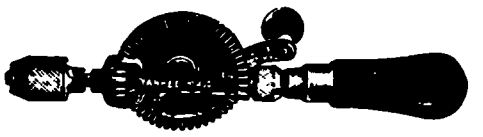


Figure 1 - Hand Drill

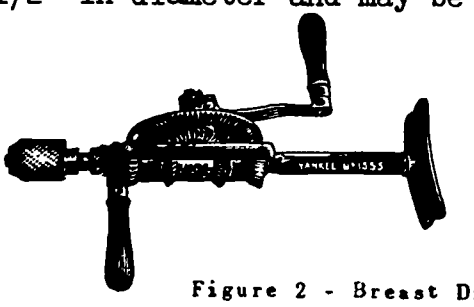


Figure 2 - Breast Drill

The ratchet drill is used for heavy work which cannot be done on a drilling machine. The drill, usually of the square or tapered shank type, is turned by means of a ratchet handle. It is fed by means of a feed screw that is provided with a "center" and tightened by hand after each pull on the ratchet handle. Figure 3 shows a ratchet drill without the twist drill in place.

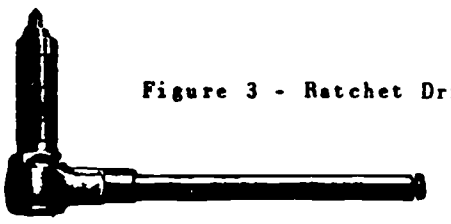
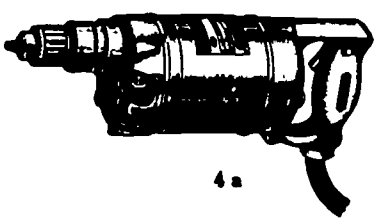
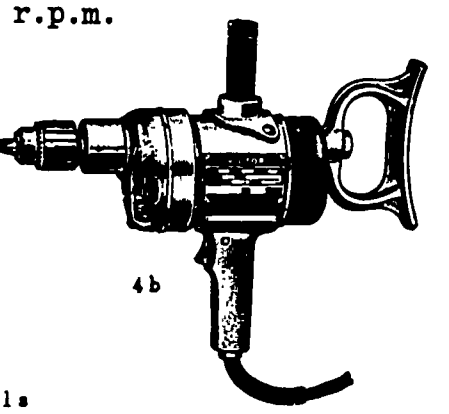


Figure 3 - Ratchet Drill

Electric drills are avilable in a variety of types and sizes. Figure 4a shows a light 1/2 inch drill which is used chiefly in drilling holes in sheet metal. This type of electric drill turns relatively fast (from 1200 to 2000 r.p.m.) and is guided and fed by hand. The heavy duty electric drill shown in Figure 4b, receives drills of 1/2, 5/8, and 3/4 inches and is fed with both the hands and chest. Such a drill is geared down to turn relatively slow and seldom exceeds 400 r.p.m.



4a



4b

Figure 4 - Electric Drills

Pneumatic drills, also called "air" drills, are frequently used where a large number of holes are to be drilled in production work. They are turned by means of compressed air and are lighter and smaller than the heavy duty electric drill. The chucks may be in line with the body of the tool or may be at right angles to it as shown in Figure 5.

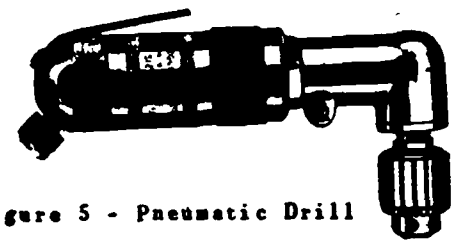


Figure 5 - Pneumatic Drill

TYPES OF DRILLS

Several types of drills have been designed for drilling holes in different materials - wood, glass, plastics, masonry, metal and the like. However, the twist drill is the only type of drill used to any extent in drilling metal, and will be the only type discussed in this section.

PARTS OF A TWIST DRILL

A twist drill may be divided into three principal parts: the body, point and shank. These parts are shown in Figure 6 and each part and its function is discussed below.

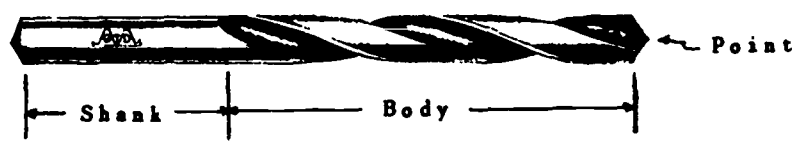


Figure 6 - Parts of a Twist Drill

The Drill Body

The body of a twist drill contains "flutes" or spiral grooves. Although the drill may have four, three, or two flutes, the most common type of twist drill has two. The flutes perform four important functions:

1. They form the two properly shaped cutting edges on the point.
2. They cause the chip to curl tightly within itself so as to occupy minimum space.
3. They are the channels through which the chips escape from the hole.
4. They allow drill lubricants to reach the cutting edges of the drill.

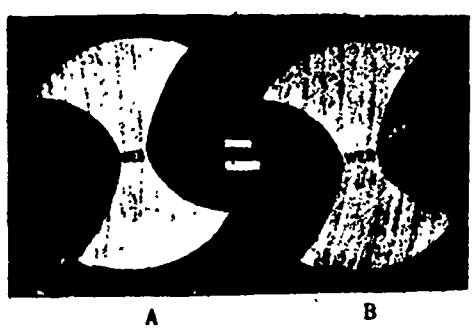


Figure 7 - The Web of a Drill

The web of a drill is the metal column which separates the flutes. It runs the entire length of the drill between the flutes. This web is the supporting section of the drill--the drill's backbone in fact. It gradually increases in thickness toward the shank. Figure 7A shows a section of a drill near the point while 7B shows a section of the same drill near the shank.

If the two spiral sections of the drill were not tied together by the web, they would compress under pressure like a spring; and if one tried to drill with these sections, the twisting strain of the drilling would tend to lengthen the drill by actually untwisting the flutes. The web overcomes both of these tendencies. The thickening of the web as it nears the shank naturally decreases the area of the flutes. This condition would seriously handicap the chips in their escape from a deep hole, but for the fact that the flutes widen as they approach the shank. Thus, the sectional area of the flutes remains substantially the same throughout their length.

The Drill Point

The cone-shaped end of the twist drill is called the "point" and contains the parts which are illustrated in Figure 7.

The dead center is the straight, sharp edge at the extreme tip end of the drill. It is formed by the intersection of the two curved surfaces of the point and should always be on the exact center of the axis of the drill.

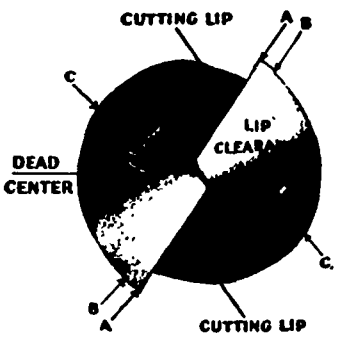


Figure 7 - The Drill Point

The lips (also called "cutting lips") are the cutting edges of the drill. They are formed by the intersection of the flutes and the cone-shaped "point". In order to give a real cutting edge to the lips the surface of the "heel" is ground away or "relieved", back of the lips. This relief is called lip clearance and in most instances is about 12°.

The narrow strip between A and B, Figure 7, is called the margin. It is the full diameter of the drill and extends the entire length of the flute. From B to C, Figure 7 is of less diameter than the margin. This lessened diameter, called body clearance, reduces the friction between the drill and the walls of the hole, while the margin A and B, which is a full diameter, insures the hole being of accurate size. If the drill did not have the body clearance between B and C, more power would be required to overcome the friction between the drill and the wall of the hole. The friction thus generated might be sufficient to draw the temper of the drill itself or cause the drill to become "frozen" in the hole. Another view of the margin is shown in Figure 8.

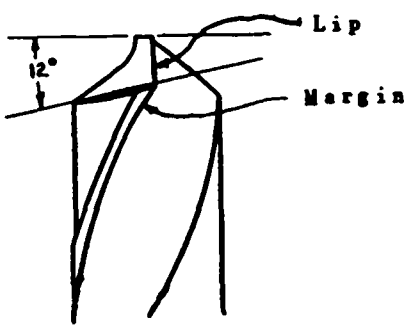


Figure 8 - The Margin of a Drill

Drill Shanks

The shank of a drill is the portion opposite the point which is chucked or held in the drilling machine or tool. There are four types of twist drill shanks shown in Figure 9.

The straight shank, Figure 9a, is by far the most common type of drill shank, and is held in an adjustable drill chuck, such as the popular Jacobs chuck.

The taper shank, Figure 9b, is used on large size twist drills from (1/2" to 3-1/2") which are used in heavy duty drill presses. The taper is the standard Morse taper and ranges from No. 1 through No. 5.

The bit stock shown in Figure 9c is designed for use in an ordinary carpenter's brace while the square (or ratchet shank) is used on drills to be turned with a ratchet handle.

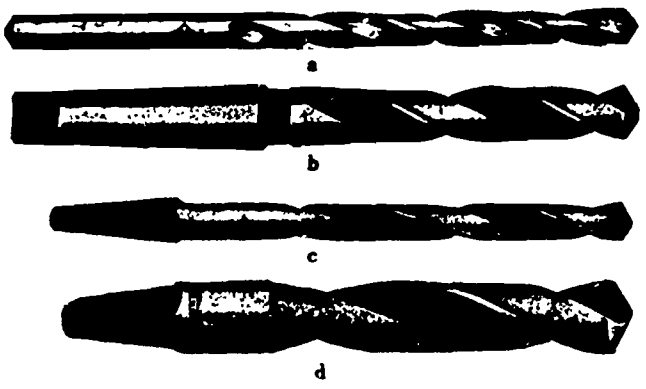


Figure 9 - Types of Drill Shanks

DRILL SIZES

Twist drills are designated in four different ways:

1. By numbers from 0 to 80, corresponding to wire sizes. Such drills are usually called "numbered" or "wire size" drills.

2. By letters from A to Z (some letters excluded), the former being the smallest size (.234") and the latter being the largest (.413").

3. By fractional inch sizes from 1/64" to 3-1/2".

4. By the metric system (.1 to 25 millimeters). This system is seldom used in general mechanical work.

These four systems include a total of over 300 different drills, no two being exactly the same diameter, with one exception - "E" and 1/4".

Ordinarily, the size of a drill is stamped in the end of the shank by the manufacturer. However, after use, the shank may become so worn that the letters or numbers cannot be read. In this case, the correct size of a given drill is determined by measurement with Vernier Calipers or micrometer or with a drill gage. A drill gage is a metal plate with holes of different sizes, corresponding to the different drill sizes.

DRILL GRINDING

The proper grinding or pointing of twist drills, especially the larger sizes, is best done on a drill grinding machine or with a drill grinding attachment on a bench grinder. However, drills smaller than 1/4" may be ground by hand successfully after a considerable amount of practice and by strict attention to the following details:

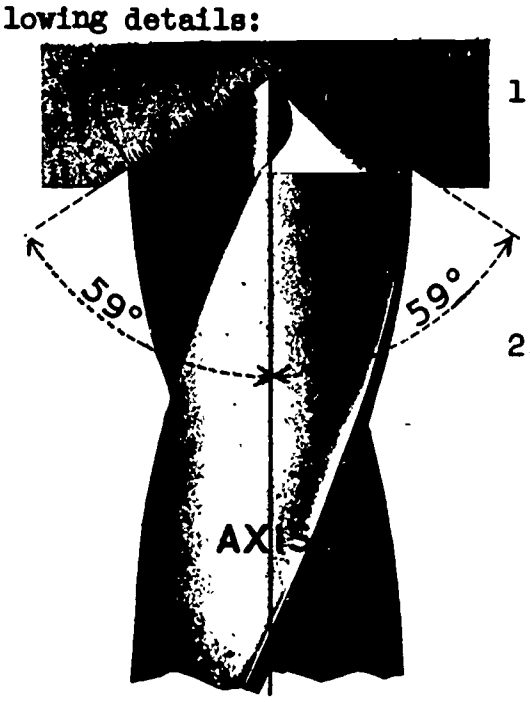


Figure 10 - Drill Grinding Gage

1. Equal lengths and angles of the lips - These details may be checked fairly accurately with the eye after considerable drill grinding experience, especially on smaller drills, but it is best to check them with a drill grinding gage. See Figure 10.

2. Proper lip clearance - Lip clearance is provided by grinding away a small amount of the metal behind the cutting lip on a slight angle of 12° to 15° (See Figure 8). This clearance is necessary to make the lip cut into the metal. For example, if a knife blade is laid perfectly flat on a board and moved with the cutting edge forward, very little cutting results. However, if the back of the blade is elevated at a slight angle, the edge will cut into the board. Too much lip clearance will likely result in chipped or broken lips.

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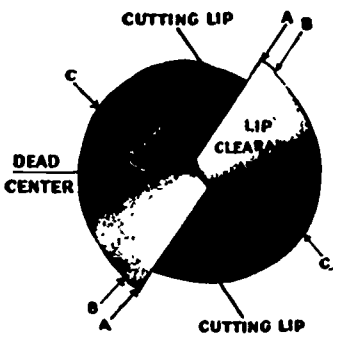

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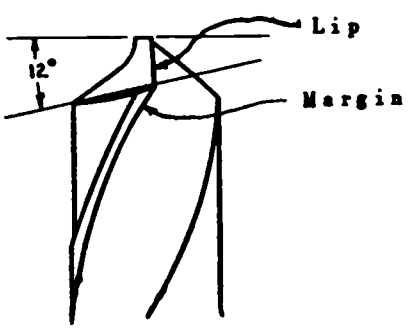

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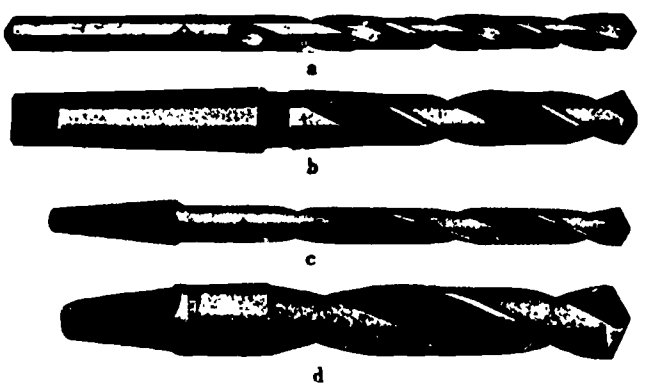

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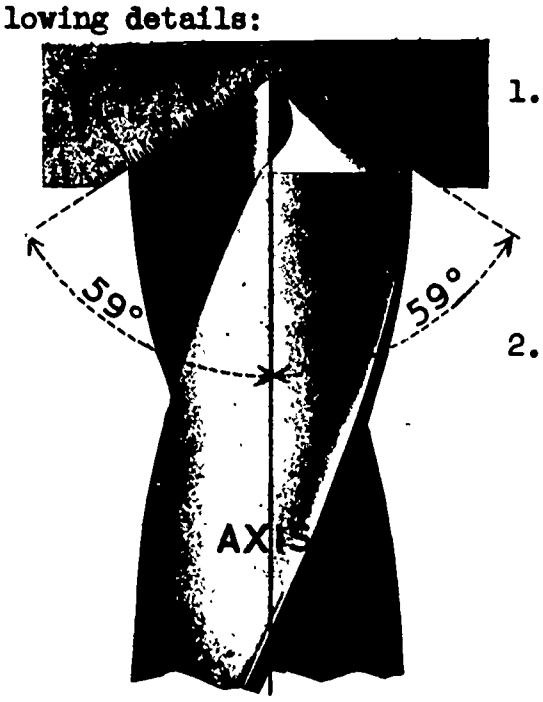

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Proper lip clearance can be checked by:

a. Placing the drill grinding gage at the heels of the drill point and noting the clearance.

b. Checking the angle of the dead center to the lips as explained below.

3. Proper location of dead center -- The dead center of the point, see Figure 8, is a small line formed by the intersection of the two ground surfaces. It is useful as a check on equal lengths and angles of the lips as well as proper lip clearance:

   If the above conditions are true, the dead center will be:

   a. Exactly centered on the axis of the drill.

   b. At an angle of about 50° to the cutting lips.

      NOTE: If there is no clearance, the dead center would be at right angles to the lips.

Hints on Grinding Drills by Hand

It is suggested that one begin practice grinding with an old drill of about 3/8" size and progress to smaller drills. The emery wheel should be comparatively true.

1. The drill is held in the fingers of the right hand near the point as shown in Figure 11. The shank is held in the fingers of the left hand, the axis of the drill being as near to an angle of 59° to the face of the grinding wheel as the eye can judge. The cutting lip, which is to be sharpened, should be level, and if the drill was previously ground properly, will be parallel to the face of the wheel.

2. The lip is moved slowly to touch the wheel. As soon as contact is made, the left hand should immediately be moved downward causing the drill to "pivot" on the forefinger of the right hand, the point moving upward. This upward movement of the point is sufficient to give the proper angle of lip clearance. See Figure 12. If the lip is allowed to remain on the wheel before the upward motion is started, there will be little or no clearance immediately behind the cutting edge and the drill will not "bite" into the metal when used.

3. The other lip is ground in the same manner and with the drill in the same relative position to the wheel.

Speeds and Feeds

In machine drilling, the speed at which a drill "turns in" a particular material is important. However, in hand drilling, as with an electric drill, the operator has no control over the speed. If the electric drill turns relatively slow, a carbon twist drill may be used. However, if the electric drill is high speed, the operator should use a high speed drill, which is capable of withstanding the high temperature created by the drilling operation.

The design of the cutting edges of a twist drill requires the application of a constant pressure upon it in order to drill through the work. The rate at which the drill penetrates the work is called "feed" and is expressed in inches per revolution of the drill. In the case of the sensitive drill press, the feed is maintained by the pressure exerted by the hand of the operator. On power feed machines, the feed is constant and mechanically controlled.

In drilling with hand drills or electric drills, the operator must rely on "feel", gained through experience, to determine if he is applying too much or too little pressure on the drill point.

The pressure should be firm and uniform throughout the drilling operation until the tip of the drill breaks through the work, at which point the pressure should be decreased. If hand drills are being used, the pressure should be eased and the drill turned slowly until the body of the drill emerges from the bottom of the hole.

Use of Lubricants or Cutting Compounds

Cutting oils are used in drilling to carry away the heat which is developed in the drilling operation and to prevent a rise in temperature caused by the accumulation of heat. Cutting compounds prevent undue friction by lubricating the chips as they are formed; improve the finish of the work; increase the durability of the cutting tool; wash away the chips from the cutting area; and permit faster cutting speeds. Cutting compounds are applied to the work with a brush or oil can for light work.

Cutting compounds recommended for use in drilling different metals are given in the following table:

CUTTING COMPOUNDS

Metal	Cutting Compound
Hard and refractory steel	Turpentine, kerosene, soluble oil
Soft steel and wrought iron	Lard oil, soda water
Malleable iron	Soda water
Brass	Dry
Aluminum and soft alloys	Kerosene, soda water
Cast iron	Dry

Trouble Shooting

The following table lists the most common troubles encountered in drilling, their probable causes, and their remedies. Although the list was prepared for drill press operators, most of the information is applicable to drilling with electric or pneumatic drills as well.

If a drill is not operating properly, it should be checked immediately and the trouble corrected.

SYMPTOMS	PROBABLE CAUSE	REMEDY
BREAKING of drill.	Spring or back lash in press or work. Too little lip clearance. Too low speed in proportion to the feed. Dull drill.	Test press and work for rigidity and alignment. Regrind properly. Increase speed or decrease feed. Sharpen drill.
BREAKING down of outer corners of cutting edges.	Material being drilled has hard spots, scale or sand inclusions. Too much speed. Improper cutting compound. No lubricant at point of drill.	Reduce speed. Use proper cutting compound and correct application.
BREAKING of drill when drilling brass or wood.	Chips clog up flutes.	Increase speed. Use drills designed for these materials.
BROKEN TANG.	Imperfect fit of taper shank in the socket—due to nicks, dirt, burrs or worn out socket.	Get a new socket or ream old one to prevent recurrence.
CHIPPING of margin.	Oversize jig bushing.	Use proper size bushing.
CHIPPING of lip or cutting edges.	Too much feed. Too much lip clearance.	Reduce feed--see table on page 33... Regrind properly.
CHIPPING or checking of a high speed drill.	Heated and cooled too quickly while grinding or while drilling. Too much feed.	Warm slowly before using. Do not throw cold water on hot drill while grinding or drilling. Reduce feed.
CHANGE in character of chips while drilling.	Change in condition of the drill such as chipping of cutting edge, dulling, etc.	Regrind drill properly.
HOLE too large.	Unequal angle or length of the cutting edges—or both. Loose spindle.	Regrind properly. Test spindle for rigidity.
ONLY one lip cutting.	Unequal length or angle of cutting lips or both.	Regrind drill properly.
SPLITTING up center.	Too little lip clearance. Too much feed.	Regrind with proper lip clearance. Reduce feed.
ROUGH HOLE.	Dull or improperly ground drill. Lack of lubricant or wrong lubricant. Improper set-up. Too much feed.	Regrind properly. Lubricate or change lubricant. Reduce feed.

Masonry Drills:

The effective use of expansion bolts in masonry depends largely upon the drilling of proper size holes correctly. Holes must be round, straight, clean and of the proper diameter and depth; otherwise, expansion bolts may fail to hold or fixtures may be improperly positioned. Moreover, holes should be drilled with a minimum of time and cost.

Two factors must be considered to assure correct drilling:

1. Selection of proper drill
2. Proper use of the drill

The newest type of drill for masonry is the carbide tipped spiral fluted drill for fast rotary drilling. It drills masonry easily, accurately and automatically cleans the dust from the holes. It can be resharpened by grinding.

Use of Masonry Twist Drills:

When twist drills are started, all possible pressure is exerted while drilling. If the drilling surface is glazed tile or porcelain, time is saved by breaking through the glaze with a "star drill" or four-point drill before using the rotary drill. For most materials and drill diameters up to 3/8", the usual speeds of the portable electric drills are satisfactory. For both hard materials and large diameters, speeds of from 100 to 200 are preferable. The harder the material, the slower the speed.

Star Rotrtwist Carbide Tipped Masonry Drills:

When to sharpen--As soon as the cutting edges show the first signs of rounding, the drill should be sharpened. Do not continue to use a dull drill.

The wheel--Star Rotrtwist Masonry Drills usually are ground dry on a silicon carbide or diamond wheel, on a pedestal or bench-type grinder. (Wheels of approximately 100 grit size are satisfactory.) Where no such grinding equipment is available, a fair job of sharpening can be done on a hand operated bench grinder.

Grinding--1. Bring drill against grinding wheel at 15-degree angle as shown. Drills, when new, have a 15-degree relief angle, and this is the angle to grind to in resharpening. Be sure to maintain this relief angle or drill will fail to cut properly.

2. Using moderate pressure, keep drill moving back and forth across the wheel to avoid overheating. If overheating should occur, do not dip hot drill into liquids to cool.

3. Keep cutting edges of the drill of equal length. Otherwise drill will cut oversize.

Backing off--As repeated resharpenings grind down the carbide tip, it will be necessary to grind away the steel behind the tip so that nowhere is the steel closer than 1/32 inch to working surface of carbide tip. The steel shank can be backed off free hand at about 35 degrees. This prevents drill from dragging in hole.

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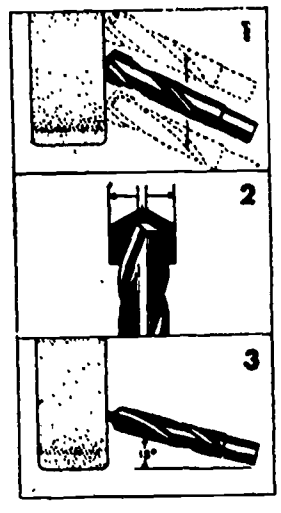

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Information pertaining to Masonry Drills is provided courtesy of Star Expansion Bolt Company, Inc.

Name: _____

Approved by: _____

Date: _____

DRILLS AND DRILLING

Key: B I - P 2 - 1 A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: DRILLS AND DRILLING

Purpose: To become familiar with the care and use of twist drills

References: Information Sheet, "Drills and Drilling"

Introductory Information: The drilling that a plumber or pipe fitter has to do is not exactly the same as that done by a machinist. It is important, however, that he know the basic principles of the use and care of drills.

To intelligently and correctly use drills the plumber and pipe fitter should know about feeds and speeds, types of steels from which drills are made, correct sharpening procedures and the proper care of drills as well as techniques involved in drilling different types and thicknesses of plumbing and pipe fitting materials.

In this assignment you will learn about drills and drilling and the application of some of the principles of metal cutting.

Directions:

1. Study the reference listed above.
2. Answer all the questions given below.
3. Rewrite or correct any answers to the questions that your instructor has marked "incorrect."

Questions:

1. Name four types of hand operated tools for holding and turning twist drills.

   a. _____

   b. _____

Name: _____

DRILLS AND DRILLING

Key: B I - P 2 - 1 A

Questions: (continued)

c. _____

d. _____

2. Name two types of portable power operated drilling machines.

a. _____ b. _____

3. Name the three principle parts of a twist drill.

a. _____ b. _____ c. _____

4. What part of a drill is called the back-bone of the drill?

Answer: _____

5. Name the two principle parts of the point of a twist drill.

a. _____ b. _____

6. At what angle should a drill point be ground to provide proper lip clearance?

Answer: _____

7. What part of a twist drill provides body clearance, thus reducing friction?

Answer: _____

8. Give the names of four types of drill shanks.

a. _____ b. _____

c. _____ d. _____

Seamless pipe is produced from a round block of steel and has no weld or seam. The first step in the operation is to soften the steel by heating it to about 2200 degrees Fahrenheit, after which a hole is pierced through it.

Piercing is accomplished by two barrel-shaped rolls set at an angle. Both rotate in the same direction, rather than in opposite directions as in a rolling mill. The rolls squeeze the steel from two sides, causing the other two sides to bulge. They also rotate the steel so that each point on its surface is alternately squeezed and bulged.

This alternating action places severe stresses on the center of the block of steel, and soon causes it to break apart along its axis. At the same time the rolls are pushing the outside of the steel over a long bar or mandrel, as shown below, the same way that a tight glove is pushed over a finger. The mandrel serves principally to guide the steel and to make the hole fairly uniform in diameter.

Other sets of rolls and mandrels then smooth both the exterior and the interior of the pierced steel.

Very fine seamless tubing, such as is used for hypodermic needles, is produced by drawing the steel through a series of progressively smaller round dies.

"Seamless Pipe"
Process

Name:_____

DRILLS AND DRILLING

Key: B I - P 2 - 1 A

Questions: (continued)

13. List 3 advantages of the rotary twist drill for drilling masonry.

a._____

b._____

c._____

14. What is the first step in drilling glazed tile?

Answer:_____

15. What two factors govern the speed with which masonry is drilled?

a._____

b._____

16. When should a masonry drill be sharpened?

Answer:_____

17. To what relief angle must the drill be sharpened?

Answer:_____

Information Sheet
in
Plumbing and Pipe Fitting

A journeyman of the Plumbing and Pipe Fitting Industry uses many types of pipe. Probably the most widely used types are wrought iron and steel pipe for water, gas, oil, air and many other similar or related installations.

Wrought iron and steel pipe are very similar and very often the journeyman does not know the difference between these two types of pipe or the composition of either.

Wrought iron was put into use long before the history of this world was recorded. It is an iron which is produced by modern methods from highly refined iron ore from which impurities such as carbon, sulphur, manganese and phosphorous have been removed. By a process known as "puddling" a certain controlled amount of siliceous slag is introduced into the metal. The iron is then dumped onto a press and formed into a particular form of wrought iron such as a slab or bar.

From the time that wrought iron was first developed until the present modern methods, the natural combination of pure iron and siliceous slag has never been changed. This is found only in wrought iron.

The presence of slag in wrought iron pipe causes it to have characteristics somewhat different from other materials. It is a fibrous structure as compared to a crystalline structure of steel. From a practical standpoint the characteristics of wrought iron are: resistance to corrosion due to the presence of the glass-like silica slag, resistance to fatigue failure, good threading and machining qualities and good welding qualities, although the welder must know how to manipulate the heat to take care of the slag which melts at a lower temperature than the iron and may cause air pockets in the weld.

Threading wrought iron pipe correctly depends upon a properly adjusted hand die or threading machine in good condition. The presence of slag fibres are said to be an advantage in threading. This structure of the metal produces strips instead of long spirals of metal, thereby keeping the dies clear.

Acknowledgment: The Committee on Steel Pipe Research for the American Iron and Steel Institute, 350 Fifth Avenue, New York 1, New York, publish two interesting and informative bulletins which should be in every apprentice

library. They are "Pipe in American Life" and "The Picture Story of Steel." Copies can be obtained free of charge from the above address.

The Committee has very generously granted permission to print the following text taken from these publications.

Steel Pipe: Although steel pipe may be found in almost every home, cross-country oil lines, water, steam and sewer lines, boilers and countless other places, it receives little notice because it generally serves quietly but efficiently in hidden locations. In recent years the modernization of farms and farm homes has called for large quantities of pipe where little was used before.

There are two broad classifications of steel pipe. Welded pipe has a tight seam along its length, while seamless pipe, as its name implies, has no seam or weld.

Welded pipe may be made by the butt-weld, lap-weld or electric-weld processes. Pipe is joined by the principle of sufficiently heated steel that can be permanently joined by the application of pressure.

Butt-weld pipe is made by two processes. In one method, long, flat pieces of steel called "skelp" are heated and pulled through a hollow, bell-shaped metal die. The die curves the skelp passing through and welds a tight seam by abutting one edge of the skelp against the other under pressure. In the other method, butt-weld pipe is made from a heated strip of steel which is formed and welded in grooved rolls and cut into uniform lengths, all in one continuous operation.

Lap-welded pipe is made from skelp which is pre-formed, reheated and welded over a mandrel held between grooved rolls. The edges of the skelp overlap and are welded together.

In electric welding, flat steel is cold shaped into tubular form and the union of the seam is effected by the application of pressure and heat, or by an electrode which deposits molten metal in the seam. The heat required for making the weld is generated electrically.

The electric welding process has been used mainly in the past few years to manufacture much of the rapidly increasing tonnage of large diameter line pipe for long distance transmission of oil and gas.

Seamless pipe is produced from a round block of steel and has no weld or seam. The first step in the operation is to soften the steel by heating it to about 2200 degrees Fahrenheit, after which a hole is pierced through it.

Piercing is accomplished by two barrel-shaped rolls set at an angle. Both rotate in the same direction, rather than in opposite directions as in a rolling mill. The rolls squeeze the steel from two sides, causing the other two sides to bulge. They also rotate the steel so that each point on its surface is alternately squeezed and bulged.

This alternating action places severe stresses on the center of the block of steel, and soon causes it to break apart along its axis. At the same time the rolls are pushing the outside of the steel over a long bar or mandrel, as shown below, the same way that a tight glove is pushed over a finger. The mandrel serves principally to guide the steel and to make the hole fairly uniform in diameter.

Other sets of rolls and mandrels then smooth both the exterior and the interior of the pierced steel.

Very fine seamless tubing, such as is used for hypodermic needles, is produced by drawing the steel through a series of progressively smaller round dies.

"Seamless Pipe"
Process

Bursting Tests for
Commercial Steel Pipe

Barlow's Formula

This formula is widely used because of its convenience of solution. Comprehensive bursting tests conducted by The National Tube Company have proven that Barlow's Formula predicts the pressure at which commercial steel pipe will rupture with very reasonable accuracy. Results of tests show that generally failure occurred at a pressure approximately 3 per cent higher than predicted by the use of Barlow's Formula.

This formula has been used in many well recognized standards.

Barlow's Formula is:

$$BP = \frac{2T \times S}{0}$$

Let: BP = bursting pressure in pounds per square inch
T = wall thickness in inches
S = tensile strength of the material in pounds per square inch
O = outside diameter of pipe in inches

Example:

Find the bursting pressure of a 1" standard welded steel pipe. The tensile strength is taken as 40,000 pounds.

T = 0.133"
O = 1.315"

Substituting the above values in the formula:

$$BP = \frac{2 \times 0.133 \times 40,000}{1.315} = 8,091$$

8,091 pounds per square inch = bursting pressure of 1" standard welded steel pipe

PIPE DATA

Nominal Pipe Size	O. D.	I. D.			Wall Thickness			Weight per foot			Weight of Water per Ft.St.Pipe	Threads per Inch
		ST	XS	XX	ST	XS	XX	ST	XS	XX		
1/8	.405	.269	.215		.068	.095		.245	.314		.025	27
1/4	.540	.364	.302		.088	.119		.425	.535		.045	18
3/8	.675	.493	.423		.091	.126		.568	.739		.083	18
1/2	.840	.622	.546	.252	.109	.147	.294	.851	1.088	1.715	.132	14
3/4	1.050	.824	.742	.434	.113	.154	.308	1.131	1.474	2.441	.231	14
1	1.315	1.049	.957	.599	.133	.179	.358	1.679	2.172	3.659	.374	11 1/2
1-1/4	1.660	1.380	1.278	.896	.140	.191	.382	2.273	2.997	5.215	.648	11 1/2
1-1/2	1.900	1.610	1.500	1.100	.145	.200	.400	2.718	3.632	6.409	.882	11 1/2
2	2.375	2.067	1.939	1.503	.154	.218	.436	3.653	5.022	9.030	1.453	11 1/2
2-1/2	2.875	2.469	2.323	1.771	.203	.276	.552	5.794	7.662	13.700	2.073	8
3	3.500	3.068	2.900	2.300	.216	.300	.600	7.580	10.250	18.580	3.200	8
3-1/2	4.000	3.548	3.364	2.728	.226	.318	.636	9.110	12.510	22.850	4.280	8
4	4.500	4.026	3.826	3.152	.237	.337	.674	10.790	14.990	27.540	5.510	8
5	5.563	5.047	4.813	4.063	.258	.375	.750	14.620	20.780	38.770	8.660	8
6	6.625	6.065	5.761	4.897	.280	.432	.864	18.980	28.580	53.170	12.510	8
8	8.625	7.981	7.625	6.875	.322	.500	.875	28.560	43.400	72.400	21.680	8
10	10.750	10.020	9.750		.365	.500		40.500	54.700		34.100	8
12	12.750	12.000	11.750		.375	.500		49.600	65.400		49.000	8
14	14.000	13.250	13.000		.375	.500		54.600	72.100		59.700	8

ST - Standard Pipe - Schedule 40
XS - Extra Strong - Schedule 80
XX - Double Extra Strong

STEEL AND WROUGHT IRON PIPE

Key: BI - P2 - 2I

Name: _____

Date: _____

Approved by: _____

STEEL AND WROUGHT IRON PIPE

Key: B I - P 2 - 2 A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: STEEL AND WROUGHT IRON PIPE

Purpose: To become familiar with the uses, sizes, weights, wall thicknesses and characteristics of steel and wrought iron pipe.

References: Information Sheet

Introductory Information: Steel and wrought iron pipe are two of the most commonly used materials in the plumbing and pipe fitting industry. A good mechanic is able to judge by sight the sizes of pipe with which he works. He should be familiar with the characteristics and weight classifications of pipe. A journeyman should know the common trade terms as applied to steel and wrought iron pipe.

Directions:

1. Study the references listed above.

2. Examine and measure several different sizes of steel or wrought iron pipe. Learn to name the various sizes by sight.

3. Answer the following questions or problems.

NOTE: Answers marked "incorrect" by your instructor should be corrected.

Questions & Problems:

1. What is the principal difference between steel and wrought iron?

_____

_____

_____

2. Briefly describe the following three types of steel pipe.

   (a) Butt-Weld Pipe: _____

   _____

   (b) Lap-Weld Pipe: _____

   _____

   (c) Seamless Pipe: _____

   _____

3. Name six industrial uses of steel pipe.

   (a) _____

   (b) _____

   (c) _____

   (d) _____

   (e) _____

   (f) _____

4. What is the nominal size of a pipe with an O.D. of 0.84 inches?

   Answer: _____

5. Name the sizes of five pieces of pipe which will be shown to you by your instructor.

   (a)_____ (b)_____ (c)_____ (d)_____ (e)_____

6. One half inch standard weight steel pipe is shipped in bundles of twelve lengths. If the lengths average 21 feet, what is the weight of the bundle?

   Answer: _____

7. The approximate weight of a bundle of 1/4 inch steel pipe in 20 foot lengths is 202 pounds. How many lengths are in the bundle?

Answer: _____

8. In the table in the information sheet the wall thickness is given for standard pipe (schedule 40), extra strong pipe (schedule 80) and double extra strong. Give the I. D. of the following size pipe:

1/2 inch standard steel pipe Answer: _____

1/2 inch XS steel pipe Answer: _____

1/2 inch XX steel pipe Answer: _____

9. Give the wall thickness of the following size pipe:

3/4 inch standard steel pipe Answer: _____

1 inch XS steel pipe Answer: _____

1 inch standard steel pipe Answer: _____

10. The "nominal pipe size" refers to what dimension of 14 inch pipe?

_____

11. Steel pipe up to and including one inch size is tested at the mill with a pressure of 700 psi (pounds per square inch). By the use of Barlow's formula, using the figure 40,000 psi as the tensile strength of the pipe material, calculate the bursting pressure of:

(a) 3/4 inch standard steel pipe

Answer: _____

(b) 3/4 inch double extra strong steel pipe

Answer: _____

Information Sheet
in
Plumbing and Pipe Fitting

Subject: CUTTING, THREADING AND HOLDING TOOLS FOR SCREW PIPE WORK

A description of pipe tools may be found in tool catalogs. The following discussion of these tools has been arranged in the order in which they are most commonly used.

Pipe Vises

Pipe vises are of several general types; malleable iron hinged-yoke pipe vise, open side pipe vise, and chain pipe vise. In some instances, replaceable hardened steel jaws may be used in a regular bench vise. There are many types of portable vise stands and vises that can be attached to a post or stud, etc. It is well to remember that the teeth of the pipe vise should be kept sharp or they will slip and cut a furrow around the pipe, which mars and weakens the pipe. The zinc coating is removed from galvanized pipe if it skips in the vise. The tightening screw and hinge bolts of a vise should be oiled with lubricating oil to prevent wear.

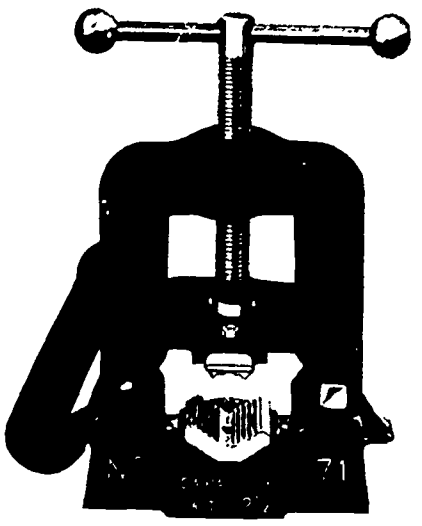
Pipe Cutters

There are several general types of pipe cutters.

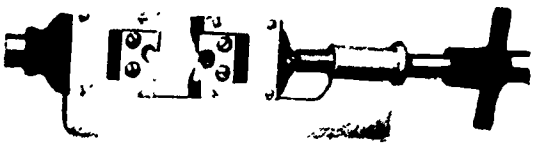
The "One Wheel" cutter has one cutting wheel and two rollers and is the most commonly used hand pipe cutter. This type cutter requires a full revolution around the pipe, the rollers help the wheel to make a true cut and they also prevent a burr from forming on the outside of the pipe.

The "Three Wheel" or "Four Wheel" cutters do not require a full revolution and are convenient to use to cut in trenches or in corners where the cutter cannot be revolved completely around the pipe. Care must be used in placing these cutters on the pipe to see that the cutter makes a true or square cut. Badly worn wheels or wheel pins tend to make the cutter cut several grooves instead of one. Lubricating oil should be used on the wheels and pins of all cutters to prevent excessive wear.

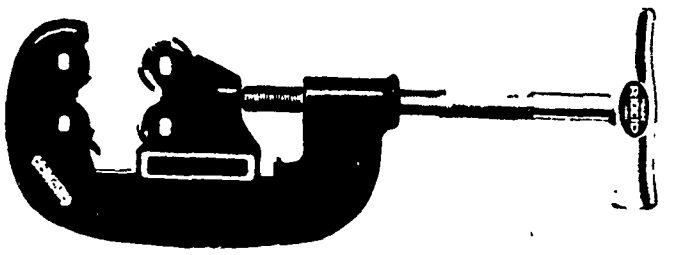
There are several types of cutter wheels. Some of the more widely used are heavy duty wheels, thin blade wheels, serrated cutter wheels, and special cutter wheels for cast iron pipe. The thin blade wheels are used mainly in



Hinged Yoke Vise

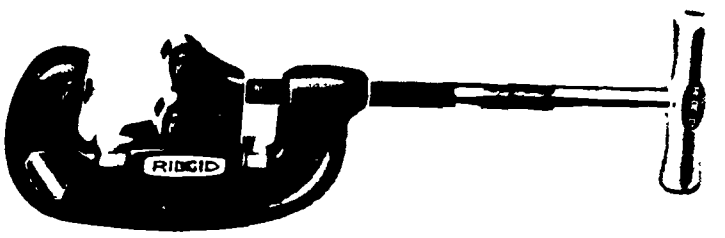


Square End Cutter

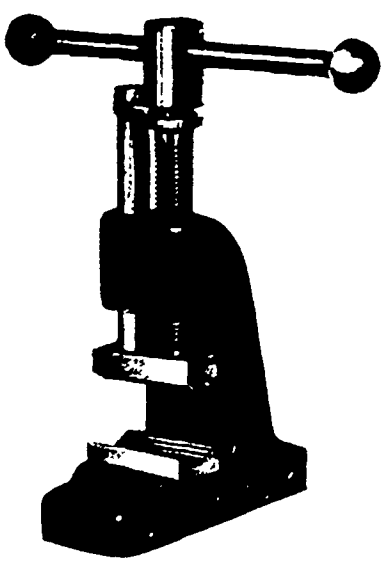


Four Wheel Cutter

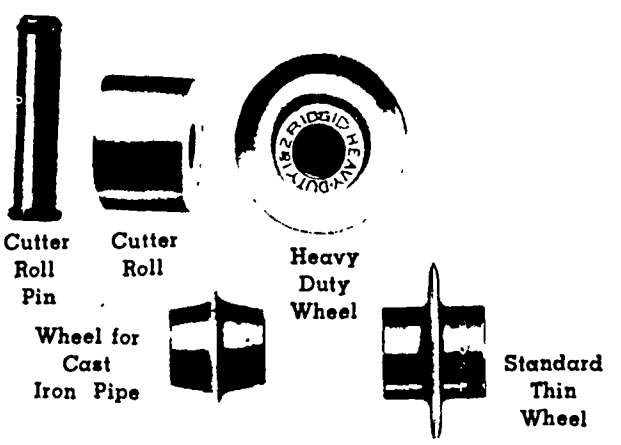
Chain Pipe Vise



One Wheel Cutter



Open Side Vise



Cutter Wheels

the one wheel cutters. They cut faster and leave less burr than the heavy duty wheels.

Care must be exercised in using thin blade cutter wheels as they are more easily broken than the heavy duty type, should the pipe end be permitted to drop and break in two while the cutter is still engaged on the pipe.

Another type of hand pipe cutter is the "Square End" cutters. This cutter has cutting knives or blades that cut a groove in the pipe. It leaves no burr and the cut is square across the end of the pipe.

Pipe threading machines are equipped with pipe cutters. Some are of the wheel cutter type and some are the square end type.

Pipe cutters for large size pipe are hand or power operated. These cutters are generally equipped with cutting knives similar to the square end cutters. The cutting blades are fed automatically into the pipe on many of these cutters, while others are hand fed.

Pipe may be cut with hack saws and cutting torches. These tools will be discussed in separate lessons.

Pipe Reamers

After a pipe is cut, the internal burr should be removed so as to give the pipe end the full internal bore of the pipe, thus reducing friction and resistance to the flow of liquids or gases in the pipe.

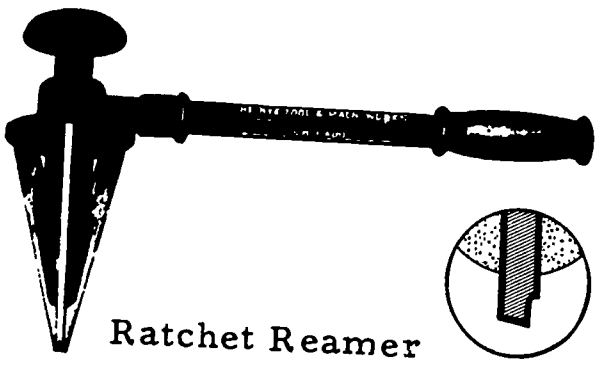
Small burring reamers are made with shanks that fit the ordinary bit brace.

Ratchet pipe reamers are made in several sizes and are used for pipe in sizes from 1/8" to 3". Reamers should be kept sharp to save time and labor on the job.

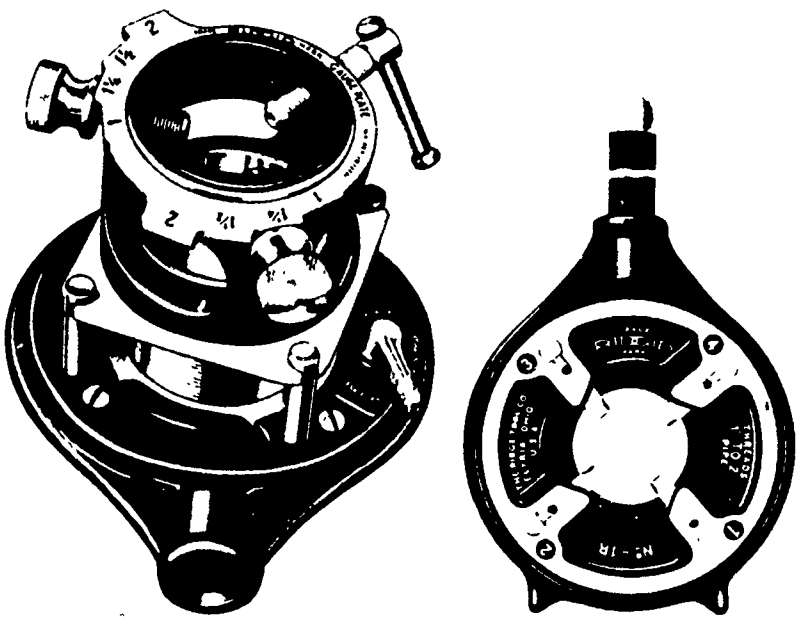
It is dangerous to hold a hand reamer in the end of a pipe that is being turned by a power drive or machine. The reamer may grab, thus causing the operator to lose control of it.

The burr may be removed from larger size pipe with a hammer and sharp cold chisel, finishing the job with a half round file.

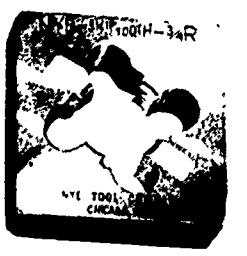
Two-piece Adjustable Dies



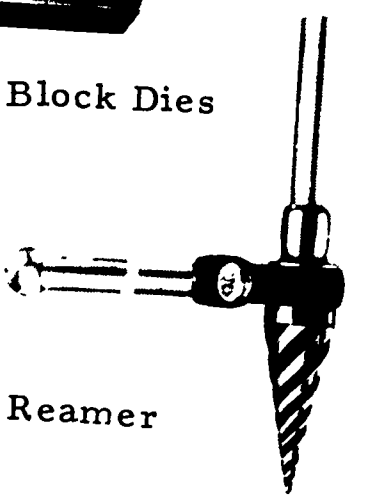
Ratchet Reamer



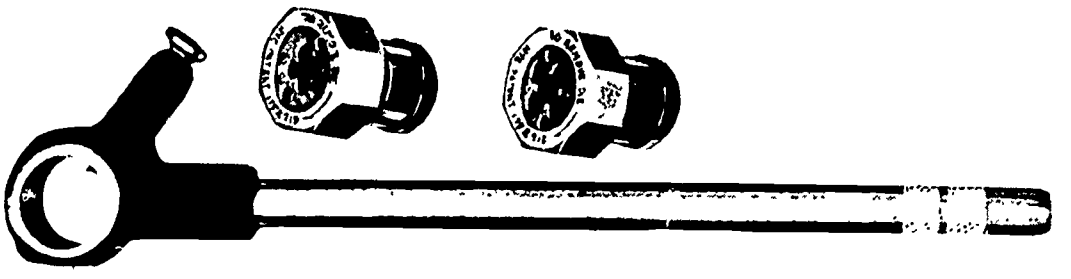
Receding Die Stocks



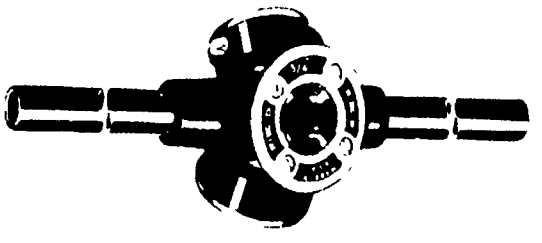
Solid Block Dies



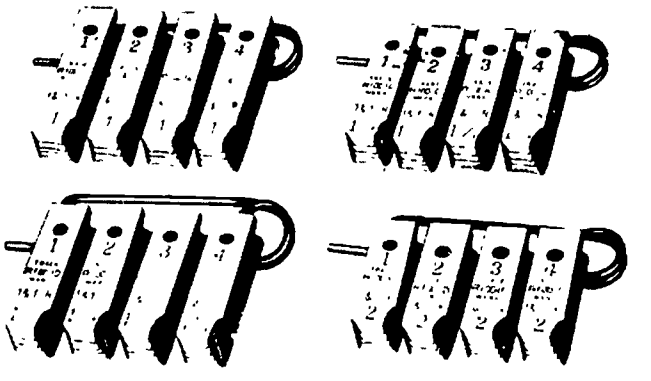
Spiral Reamer



Ratchet Stock



Three-Way Stock & Dies



Separate Segment Dies

Stocks and Dies

There are many kinds and types of stocks and dies.

Stocks may be classified as follows: Plain stocks, three way stocks, ratchet stocks, adjustable stocks, lead screw stocks, receding die stocks, quick releasing stocks, and geared stocks.

Pipe dies may be classified as follows: solid block dies, two piece adjustable dies, and separate segment dies. Special dies include: left hand thread dies, brass pipe dies, wrought iron pipe dies, cast iron pipe dies, and stainless steel pipe dies.

These special dies are designed to cut better threads due to the difference in materials--for example, a brass pipe die needs the cutting lip ground off somewhat so as to push the metal out of the groove or cut, rather than trying to curl the metal out as in cutting threads on steel pipe. Wrought iron pipe dies are similar to brass pipe dies, since wrought iron chips will not curl. In order to get the material out of the way, a special grinding of the dies is necessary to produce perfect threads. The same applies to cast iron. As for stainless steel pipe, which is one of the hardest pipe materials known, a special type steel for the die segments is required.

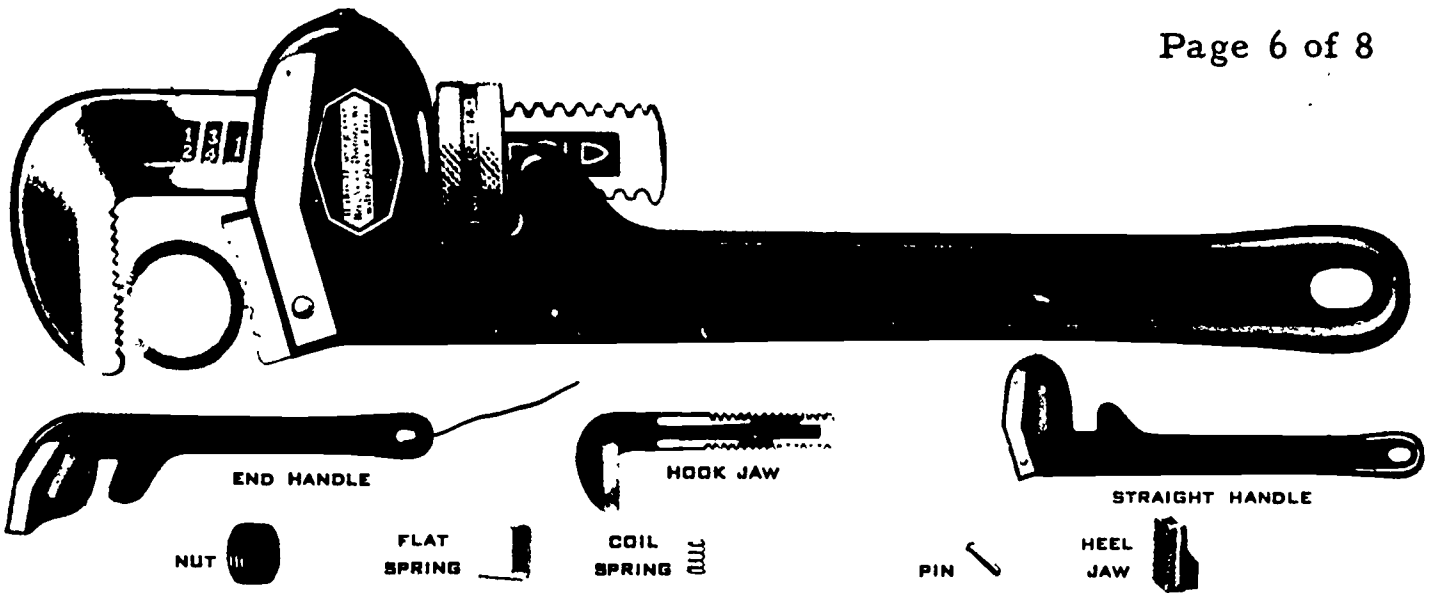
Dies should be kept sharp and a good grade of cutting oil should be used on the dies to insure good threads. Cutting oil should be used only on the cutting dies. Lubricating oil should be used on the lead screws or other wearing parts of the stocks but never on the dies when cutting threads.

There are many good patented cutting oils, some of which have a sulphur base. Lard oil is also a very good cutting oil. The purpose of a cutting oil is to cool the cutting edges and lubricate the drag of the dies and chips.

The oil can filled with a good grade of cutting oil is a most important tool in pipe threading.

Pipe Wrenches

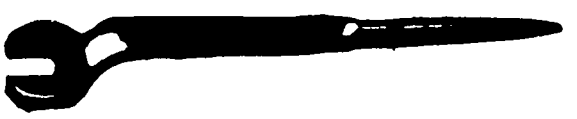
Pipe wrenches are the tools used to turn or to hold the pipe. These tools are made in many sizes and types, which include hardened-jaw wrenches, strap wrenches, and pipe tongs. Many mechanics call for a pipe wrench by its trade name; as Trimo, Stillson, Rigid, Self-adjusting, Crescent, Parmalee, Vulcan, Little Giant, etc.



Straight Pipe Wrench

Chain Tongs

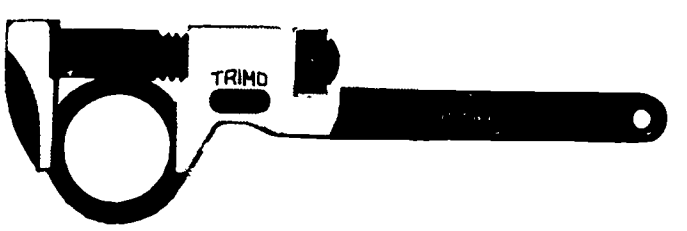
Flare Nut Wrench



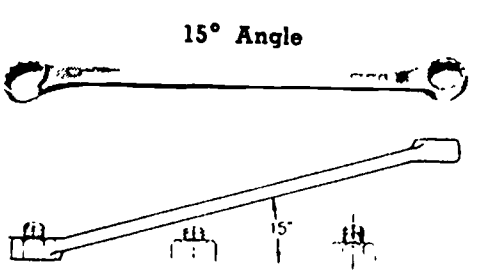
Construction Wrench

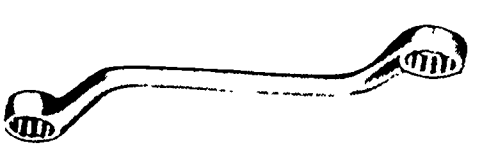
Open End Wrench

Crescent Type Wrench



Spud Wrench





Box Wrenches

Even though the capacity of these wrenches are in a wide range, it is wise to use the correct size for each particular job. For example: when a small wrench is used on a large pipe, the amount of pull required to tighten the pipe may either break the wrench of spring it out of shape. When a large wrench is used on a small pipe, the fitting into which the pipe is being screwed may be stretched or broken. The length of the handles of wrenches is designed to give the correct leverage that the wrench will withstand. Using a piece of pipe on wrench handles to increase the leverage is poor practice. Many wrenches have been damaged in this way.

When the teeth in the wrench jaws become dull, they should be resharpened or the jaws should be replaced. Many accidents have been caused by wrenches that slip.

Pipe wrenches are made in the following sizes and capacities:

Size	Capacity
6"	1/8" to 1/2" pipe
8"	1/8" to 3/4" pipe
10"	1/8" to 1" pipe
12"	1/8" to 1-1/4" pipe
14"	1/4" to 1-1/2" pipe
18"	1/4" to 2" pipe
24"	1/4" to 2-1/2" pipe
36"	1/2" to 3-1/2" pipe
48"	1" to 5" pipe
60"	1" to 8" pipe

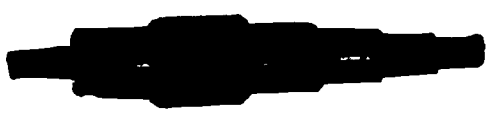
Chain tongs are usually employed in working with large size pipe. Special chain tongs are available for tightening fittings. For tightening pipe flanges a flange link may be used with these tongs. A flange link consists of a special cast steel link and pin which is readily attached to the chain tong in place of the chain.

Crescent type or Monkey wrenches are used for tightening hexagonal parts of brass valves and other similar fittings without marring them. A person who uses a pipe wrench on a polished or plated brass fitting is classed as a poor mechanic.

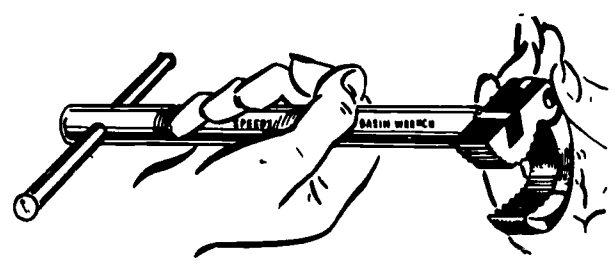
These wrenches may also be used to tighten flange bolts; however, open end or box wrenches are more convenient for this purpose.

In working with polished or plated pipe, Parmalee or Strap wrenches are used. These wrenches do not mar or scratch the pipe. Powdered rosin is applied to the strap to keep the wrench from slipping. The rosin may be removed from the pipe with a rag soaked in gasoline.

There are many other types of special wrenches; such as spud wrenches, spud holders, basin cock wrenches, and others which are used by the plumber and pipe fitter.



Union Valve Nipple Wrench



Basin Wrench

Strap Wrench

Closet Spud Wrench

Name: _____

Date: _____

Approved by: _____

PIPE TOOLS

Key: B I - P 2 - 3 A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: CUTTING, THREADING, AND HOLDING TOOLS FOR SCREW PIPE WORK

Purpose: To become familiar with the types and uses of the most commonly used pipe tools.

References: Information sheet on the above subject.
Any pipe tool manufacturer's catalog.

Introductory Information: A plumber or pipe fitter must have a complete knowledge of the tools he needs in order to do his work in an efficient and satisfactory manner. A good mechanic will always plan his work before he actually proceeds to do the job. He will also see that he has all the tools required to do the job before he begins his work.

Good tools are an asset to any good mechanic. The proper care of tools will greatly lengthen their useful life. It is a poor workman who abuses his tools.

Directions: Study the information sheet and one or more catalogs of pipe tools.

Answer the following questions.

Questions:

1. Give a list of the tools that you would select if you were given the job of connecting a gas range with 3/4" steel pipe and malleable fittings.

_____

_____

_____

2. Give two advantages that a ratchet stock and die has over a plain one.

3. If you are assigned the job of installing a yard hydrant which is to be connected to a 1 inch service line, half way between the house and the curb, and the service is covered with 18 inches of earth, what pipe tools will be required to do the job?

4. Make a list of the pipe tools that you are using on your present job or a job that you have been working on recently. Give the trade name and number of the tools, such as: 14" Rigid pipe wrench, Trimo No. 2 cutter, Toledo No. 1-A Stock and Die, etc.

5. List five points that you think should be remembered in the proper use and care of pipe tools.

6. Why is it a bad practice to use a pipe on the handle of a pipe wrench to increase the leverage ?

_____

_____

7. What type of oil should be used on pipe to insure a good clean thread ?

_____

8. What two purposes does oil serve when cutting threads ?

_____

_____

9. What is the purpose of the Parmalee or strap wrenches ?

_____

_____

10. Name the parts of a pipe wrench.

a. _____ b. _____

c. _____ d. _____

e. _____ f. _____ g. _____

11. Name the two parts of a pipe wrench that require the most attention to insure its safe and proper use ?

_____

12. Why is it necessary to have different types of cutter wheels for pipe cutters and different type dies for stocks ?

_____

_____

Information Sheet
in
Plumbing and Pipe Fitting

Cutting Pipe

Pipe cutting is a job that is worthy of extreme care and skill. Pipe that is cut correctly can be threaded accurately whether cut by a hand cutter, hack saw or power machine. When a hand cutter is used the first revolution by the cutter should be only a slight bite to insure that the starting channel will be square with the pipe before a deep bite is taken. Pipe that is not cut off square is difficult to thread accurately, and a leaky joint may result.

When one or more of the cutter wheels are dull, so much physical pressure on the pipe cutter will be necessary in order to get a starting channel that the cutter is likely to get "cocked," especially a three wheel cutter, and produce a crooked cut or damage the pipe. Sharp cutters are essential for square-end cuts, and are also time and labor savers.

Reaming Pipe

Wheel pipe cutters cause an internal burr which reduced the size of the pipe. Burrs and ragged sharp edges of an unreamed end of pipe catch and accumulate sediment and retard the flow of the liquid or gas. Pieces of metal from the burr may be loosened by corrosion, lodge in valve seats and damage them.

Three wheel pipe cutters not only cause an internal burr but they also produce an upset of the metal on the outside of the pipe. It is sometimes necessary to remove this upset metal by filing to allow the pipe to enter the threading tool properly.

Pipe ends should be reamed with any one of the various types of pipe reamers. Many plumbing codes require the pipe ends to be reamed.

Threading Pipe

Good stocks with sharp dies are essential for good threading and good threads are essential for good tight joints. Needless to say, good tight joints are essential for a good job.

Some of the causes of rough, chewed threads cut by machine and by hand are: dull dies, improper lubrication, out-of-round dies (caused by chips or dirt),

and a broken tooth or die. A broken tooth should be ground off or the entire die should be replaced. Worn pipe tools will cause an unnecessary waste of time, labor and materials.

When the circumference of the threads, cut on a pipe, is wavy and out of true instead of forming a perfect circle, they are called wavy or drunken threads. A good leakproof connection cannot be made with wavy threads on the pipe. One way to overcome this condition is to center the die when putting it on the pipe, tighten the thumb screws with a wrench, and make sure the thumb screws stay tight. If a pipe has not been cut off square, certain dies will engage the pipe and others will not. This causes the die to start diagonally and cut crooked threads. When one or more of the dies are doing most of the work, chip sizes and depth of threads will not be uniform.

In machine threading, wavy threads usually come from worn die slots which allow the dies to tilt. Tilting dies increase the clearance, and increased clearance causes the loss of the necessary steady g effect. A loose die should prompt cautious use. Loose dies are the cause of leaky joints as they will cut a wavy thread on the pipe which will not mesh properly with the accurately cut threads on the fitting. A leakproof joint is possible only with clean-cut threads on the pipe and clean-cut threads on the fitting.

Another cause of leaky joints is chewed threads which may be traced to dies that are out of line. Chips or dirt in the bottom of the die slots keep the dies from going to the bottom of the slots, and the failure of the dies to seat properly causes the cutting edges on one or more dies to be thrown out of line with the cutting edges of the other dies. Incorrect grinding of the lip angle on dies results in the crumbling of chips and roughly chewed threads. When threading steel pipe, properly ground lip angles on dies result in spiral chips, the sign of the correct cutting action which produces strong, clean threads.

IMPORTANT THINGS TO REMEMBER IN PIPE THREADING

1. Inspect die slots to make sure that they are clear of all dirt, gummy oil and chips.

2. Check the cutting edges on dies and make sure that lip angles are accurately ground. Excessive lip angles on die bits are the cause of many threading troubles.

3. Be sure that pipe ends are cut off square before starting to thread.

4. Do not use dull pipe cutter wheels if you would avoid cracked cuts, excessive upset metal, or internal burrs on the pipe end.

5. Do not insert new or reground dies in a worn stock or die head and expect good results.

6. The use of plenty of good cutting oil will insure better threads and longer life of the dies.

7. Do not try to economize by using dies after it is obvious that they cannot cut precision threads.

8. Be sure the die is properly centered on the pipe.

9. Make it a rule to tighten thumb screws with a wrench instead of with thumb and finger.

10. Grinding away the lip on a die in order to fix a broken tooth, ruins the whole die. Grind the broken tooth away clear down into the root.

11. Pipe cutters with a sprung frame will cut a crooked track. Check up on these tools frequently.

12. When replacing dies in a die stock or die head, put them back in accordance with the numbered marking on the stock or die head. If they are not marked, the order of their insertion should be clockwise.

13. Tighten the vise enough to keep the pipe from turning, but not tight enough to pinch or flatten the pipe. Zinc from the coating of galvanized pipe and pipe scale sometimes fills the spaces between the teeth of the

vise, causing the pipe to slip in the vise. Watch the vise and clean the teeth when necessary.

14. Remove all cuttings from the threads. A tap on the pipe will usually jar the cuttings loose. If left in the pipe, these cuttings will injure faucets and valve seats.

Name: _____ CUTTING AND THREADING PIPE

Date: _____ Key: B I - P 2 - 4 A

Approved by: _____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: CUTTING AND THREADING PIPE

Purpose: To become familiar with some of the common causes of trouble encountered in cutting and threading pipe.

References: Information sheet on Cutting and Threading Pipe.

Introductory Information: The tightness of a screwed joint depends largely on the accuracy with which the threads are cut. Some of the causes of bad threads are discussed in the information sheet.

Directions: Study the information sheet and answer the following questions.

Questions:

1. Why is it important that pipe be cut square before threading?

_____

_____

2. Why should the pipe end be reamed?

_____

_____

3. Why is it important that the thumb screws on a stock be tightened with a wrench?

_____

_____

4. If the die chasers are not placed in the stock or die head according to the numbered markings, what is the result?

5. If you want to purposely cut a crooked thread in order to line up a pipe that is slightly out of line, how will you set the stock and dies to do this?

6. Why should the teeth of the pipe vise be kept clean and sharp?

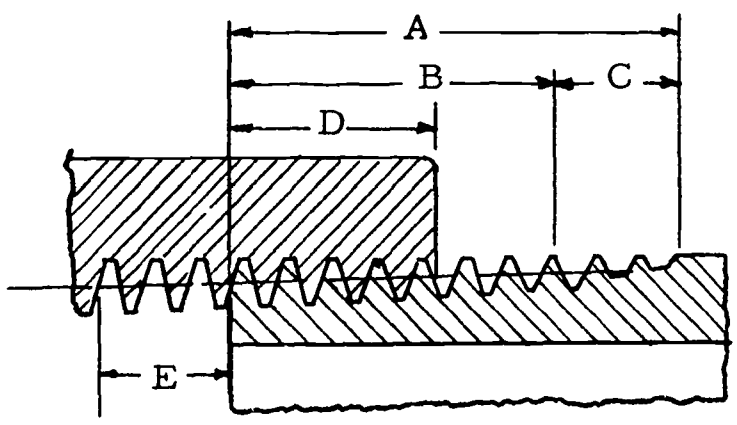
7. Why should the die slots in the stock be clear of chips?

8. Why should the cuttings from reaming and threading a pipe be removed before installing the pipe?

Information Sheet
in
Plumbing and Pipe Fitting

The American Standard taper thread is cut with a taper of 1 to 16 (1/16" per 1") or 0.75 per foot measured on the diameter of the pipe along the axis or center line.

AMERICAN STANDARD TAPER PIPE THREAD



LEGEND:
A - Overall length of external thread
B - Length of effective thread
C - Length of imperfect thread
D - Length of hand tight engagement
E - Wrench make-up length for internal thread

The normal length of the effective thread is shown by the figure above. The effective length includes two threads slightly imperfect that, due to the lead of the die, do not enter the fitting. They are only pertinent to the process of cutting the threads.

The threads for the fittings are the same as for the pipe. The threads per inch vary with the size of the pipe. It is the standard practice to provide straight tapped couplings for standard pipe (schedule 40) 2" and smaller. Line pipe couplings may be ordered which are taper tapped for pipe sizes under 2" if they are required. Taper tapped couplings are furnished on all sizes of extra strong pipe (schedule 80) and standard pipe for sizes over 2".

A joint or fitting should always be made up at least 3 turns by hand to avoid cross threading and to determine that the threads are properly cut.

Never use an oversize wrench to make up a joint. Fittings may be damaged, particularly in case of valves, if all of the threads are forced into the fittings. The imperfect threads should be left exposed.

A lubricant, or pipe dope, is not meant to seal a joint to compensate for poor workmanship, but to reduce friction when making up a joint.

The length of the effective thread for any size pipe may be calculated by this formula:

$$\text{Length of effective thread (B)} = \frac{0.8D + 6.8}{N}$$

Where D is the actual outside diameter and N is the number of threads per inch.

This information may be found on the chart "Pipe Data" in the information sheet 2I for assignment 2A of this Packet.

Example:

Substituting in the formula above using 3/8" pipe:

O.D. = .675
No. of threads = 18

$$B = \frac{.8 \times .675 + 6.8}{18}$$

$$= .4078 = 7/16''$$

Name: _____

Approved by: _____

Date: _____

STANDARD PIPE THREADS

Key: B I - P 2 - 5 A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: STANDARD PIPE THREADS

Purpose: To become familiar with the American Standard Pipe Threads

References: Information Sheet 5I
Information Sheet 2I, Chart "Pipe Data"

Introductory Information: The most common method of joining pipe is the screwed connection. All of us know that it consists merely of threaded male and female ends screwed together. Yet, the perfection that has been attained in standardizing the threading of piping materials is actually amazing. Pick up a valve made in Chicago, a fitting from Los Angeles, and join them to a pipe from Pittsburgh threaded with tools from Cincinnati. There is no question they will fit perfectly.

This outstanding example of standardization practice began with the establishment of American Pipe Threads Standards. They rigidly guide the entire piping industry and are responsible today for the simplicity of making up a screwed joint.

The secret of good screwed joints is "GOOD PIPE THREADS."

Directions: Study the references listed above.
Answer or solve the following questions and problems.

Study Questions and/or Problems:

1. Give the number of threads per inch for the following sizes of pipe.

   1/8" _____ 3/8" _____ 3/4" _____

   1-1/2" _____ 2-1/2" _____ 6" _____

2. What is the principal difference between the American Standard Screw Threads and the American Standard Pipe Threads?

_____

_____

3. From the formula in the information sheet calculate the length of effective threads that enter a fitting for the following pipe sizes.

1/8" _____

1/4" _____

1/2" _____

1-1/4" _____

2" _____

3-1/2" _____

6" _____

4. What would be the probable result if a pipe was screwed into a fitting far enough to hide all of the threads ?

_____

_____

5. What is the purpose of pipe "dope"?

_____

_____

6. Internal threads in fittings are taper tapped to the same specifications as for standard pipe threads. Name a fitting that is an exception to this standard.

_____

Name: _____ RANGE OF PIPE FITTINGS

Approved by: _____ Key: B I - P 2 - 6 A

Date: _____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: RANGE OF SCREW PIPE FITTINGS

Purpose: To become familiar with the various types and sizes of screw pipe fittings.

References: Any good pipe fitting catalog.
"Piping Pointers," Crane Company, pp. 13-15.

Introductory Information: Fittings are the connecting links in every pipe line. They join pipe into a continuous line, either in a straight line or turned various angles. They are also used to reduce or increase the size of pipe lines.

Fittings are made of a variety of metals and pressure classifications. Malleable fittings that are zinc coated are referred to as "galvanized" fittings and the uncoated fittings are designated as "black" fittings.

Not all types of fittings are made in all sizes. Even the most common types of fittings are too numerous to name. Experience both on the job and in the classroom will help the apprentice to become familiar with all types of fittings and their uses.

Directions: Study the references listed above and answer the study questions. Consult your instructor for further instructions if necessary.

Study Questions:

1. What is the term used to describe a fitting that has been coated with zinc?

_____

2. If the fitting is not coated, what is the term used to describe it?

_____

3. Give the smallest and largest sizes of fittings of the following types:

   (a) 150 lb. malleable-iron elbows:

   Smallest: _____ Largest: _____

   (b) 125 lb. cast-iron elbow:

   Smallest: _____ Largest: _____

   (c) 250 lb. cast-iron elbow:

   Smallest: _____ Largest: _____

   (d) Cast-iron drainage fitting elbow:

   Smallest: _____ Largest: _____

4. A 150 lb. malleable fitting is rated to carry a working pressure of 150 pounds of steam. What is the cold water non-shock working pressure rating of this same fitting?

   Answer: _____

5. What is the cold water non-shock working pressure rating of a 125 lb. cast-iron fitting?

   Answer: _____

6. What is a pipe nipple?

   Answer: _____

   _____

7. Name three types of bushings.

   (a) _____

   (b) _____

   (c) _____

8. Give the lengths of the following close and short nipples ?

	Close	Short
1/8"		
1/2"		
4"		
8"		
12"		

9. Name three types of pipe unions.

(a) _____

(b) _____

(c) _____

10. What is the difference in the thread tapping in a railing fitting and a standard fitting? What is the purpose of this difference?

_____

_____

_____

_____

_____

Name: _____ HOW TO READ FITTINGS

Approved by: _____ Key: B I - P 2 - 7 A

Date: _____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: HOW TO READ PIPE FITTINGS

Purpose: To become familiar with the method of describing pipe fittings such as: Elbows, Tees, Crosses, etc.

References:

"Piping Pointers," Crane Company, page 17.

Introductory Information: Pipe fittings that connect only one size of pipe are described by the nominal pipe size, such as: 3/4 inch elbow or 3/4 ell, 1 inch cross, 1-1/2 inch tee, etc.

When reducing fittings are used to connect more than one size of pipe, the size of the largest-run opening is given first, followed by the size at the opposite end of the run, and then the size of the side opening or branch. When both ends of the run are the same size, only one size is named, then the branch (example: 1-1/4" x 3/4" tee).

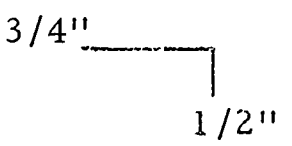
A tee fitting which has the side or branch of larger size than the run is known as a "bull head tee." A tee which has all openings the same size may also be called a bull head tee when the side of the tee is screwed onto a piece of pipe, and the flow is from the side to the run.

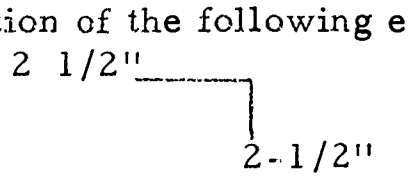
Directions: Read the definitions given in the text book.

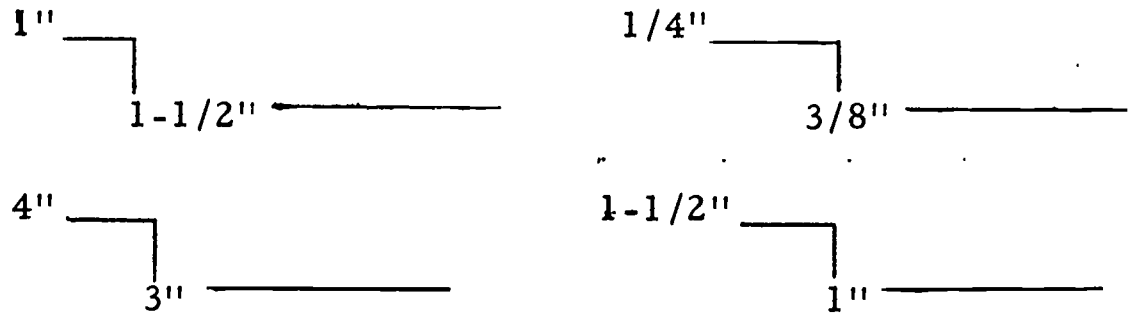
Notice how the fittings are named in the fitting catalog.

Answer the following questions.

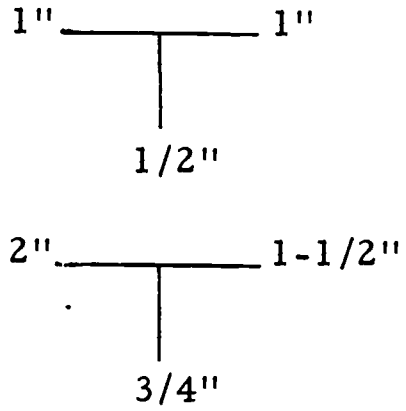
Questions: 1. Write the correct description of the following elbows.



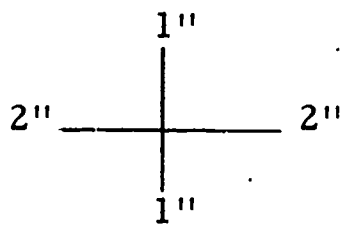


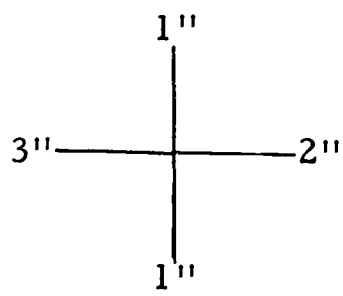


2. Write the correct description of the following tees.



3. Write the correct description of the following crosses.





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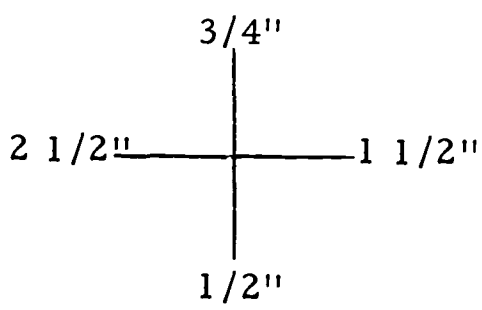

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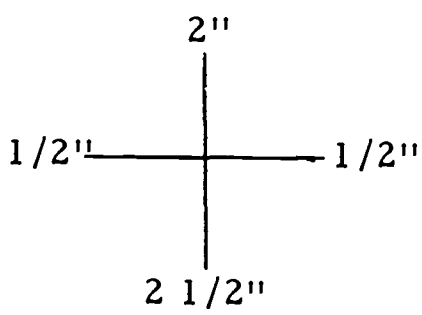

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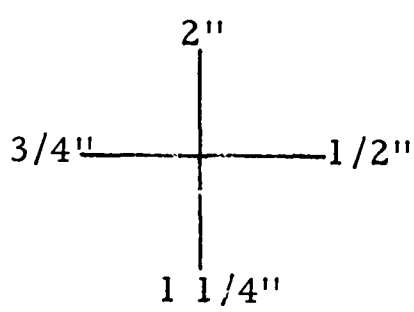

_____

4. Give the description of ten fittings which will be shown to you by your instructor.

(a) _____

(b) _____

(c) _____

(d) _____

(e) _____

(f) _____

(g) _____

(h) _____

(i) _____

(j) _____

5. If one end of an elbow fitting has a one inch female thread and the other end has a three quarter inch male thread, what is the name of the fitting?

Answer: _____

Name: _____ TYPES OF VALVES AND COCKS

Approved: _____ Key: B I - P 2 - 8 A

Date: _____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: TYPES OF VALVES AND COCKS

Purpose: To become familiar with some of the more commonly used valves and cocks.

References:

"Piping Pointers," Crane Company, pp. 8-12.

Introductory Information: Piping systems would be of little value if valves were not used to control the flow of liquids and gases. It is important that the right type of valves be used in any system of piping. This lesson should help to identify some of the valves used by the plumber and pipe fitter and to learn their uses.

Directions: Study the references and answer the following questions.

Questions:

1. What are the two general classifications concerning the use of valves and controls?

   (a) _____

   (b) _____

2. Name the five main points of a globe valve.

   (a) _____

   (b) _____

   (c) _____

   (d) _____

   (e) _____

3. What is the purpose of a check valve?

_____

_____

4. Which offers the greater resistance to flow, a globe valve or a gate valve?

Answer: _____

5. If it is necessary to throttle the flow of liquids in a piping system, which should be used, a gate valve or a globe valve?

Answer: _____

6. What is the difference between a globe valve and an angle valve?

_____

_____

7. Name the two types of discs used in gate valves.

(a) _____

(b) _____

8. Name the three disc types used in globe valves.

(a) _____

(b) _____

(c) _____

9. Name the two types of check valves.

(a) _____

(b) _____

10. What is the difference between a ground key cock and a globe valve?

_____

Name: _____

Approved by: _____

Date: _____

HOW TO MAKE UP A SCREWED JOINT

Key: B I - P 2 - 9 A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: HOW TO MAKE UP A SCREWED JOINT

Purpose: To acquaint the student with the proper procedures and precautions that should be observed in making screw pipe joints.

References: "Piping Pointers," Crane Company, pp. 16, 17, and 20.

Introductory Information: If pipe threads were perfect, a light oil to lubricate them would only be necessary to make up tight joint. Since the threads are rarely ever perfect, pipe joint compound (commonly called pipe "dope") is applied to the threads to insure tightness of the joint. The compound should be applied to the male threads only. It should be put on with a brush to avoid the use of excessive amounts of the dope. One coating of the threads is all that is needed.

If female threads are doped, most of the compound is pushed inside the fitting and it may cause a partial stoppage of the pipe line.

For water, air, steam and gas, red or white lead mixed in oil is sometimes used. There are also many patented pipe joint compounds on the market. These are put up in one pound, five pound and larger containers. The labels on the containers usually give the uses for which the compound is recommended.

Gasoline, butane and oil, especially when hot, will dissolve the ordinary oil base compounds. Special compounds, such as litharge and glycerin, shellac and permatex, are required for joints in piping for these products.

Directions: Study the introductory information and the references.

Answer the following questions.

Study Questions:

1. Why should dirty or rusted threads be cleaned before making a screw joint?

_____

_____

2. Why are copper or lead covers sometimes used on vise jaws ?

_____

_____

3. Give three reasons why an oversize pipe wrench should not be used.

(a) _____

(b) _____

(c) _____

4. Why should dirt, sand or other foreign matter be removed from pipe, valves, and fittings.

_____

_____

5. From the table on page 18 of "Piping Pointers" give the dimensions of "normal engagement between male and female threads" for the following sizes of pipe.

(a) 1/2 inch _____

(b) 1 inch _____

(c) 4 inch _____

6. When is a monkey wrench used in making screwed joints ?

_____

7. Why should ordinary pipe joint compound never be used in making joints in gasoline piping systems ?

_____

Information Sheet
in
Plumbing and Pipe Fitting

Subject: FILES AND THEIR USES

A plumber or pipe fitter's tool kit would not be complete without an assortment of files as there are many occasions when a file is a very necessary tool.

There are many types of files, and sizes may range from 3 to 18 inches. The portion of the file on which the teeth are cut is called the "face." The sharp tapered end that fits into the handle is called the "tang," while the end opposite the tang is called the "tip." The part of the file where the tang begins is called the "heel" and the length of the file is measured from the heel to the top, leaving off the length of the tang.

The grade of the file is designated by the spacing of the teeth. A smooth file has fine teeth while a course file has large teeth. The terms used to indicate the fineness or courseness are: dead smooth, smooth, second-cut, bastard, coarse, and rough.

"Single Cut" files have a single row of parallel teeth. "Double Cut" files have one row of teeth criss-crossing another row. The first cut is designated as the "up-cut" and the other is called the "over-cut."

Files are further classified by the cross sectional shapes.

Rasps differ from files in the respect that the teeth are individually formed and are disconnected from each other.

Special files that are useful to the plumber, pipe fitter, and lead burner are: Shoe Rasps, Lead Float File, Brass File, Auger Bit File, and Triangular File.

The Shoe Rasp is made in half round shape, and has no tang. One end is rasp cut and the other end is file cut. This tool is used for squaring and leveling the ends of lead pipe.

The Lead Float File has coarse, short-angle, single cut teeth that are virtually a series of stubby blades which shear away the metal rapidly under ordinary pressure. Light pressure produces the smoothing effect. This file is to be used only on lead or other very soft metals.

The Brass File has a short angle upcut and a fine long angle over-cut. This special cut enables the file to break up the chips and clear itself of filings. Brass is a difficult metal to file. It is softer than steel, yet is tough and ductile. This special cut file has very sharp, sturdy teeth and cuts at an angle that prevents "clogging" of the teeth and "grooving." It is quite useful to the plumber in filing brass fittings for tinning.

The Auger Bit File is a special file with double ends (each with different cut) for sharpening auger bits. One end of this type of file has its edge left safe or uncut; the other end has its sides left safe. Thus the sides may be used on bit cutters, and the edge on the lip of the bit, without causing damage to adjacent surfaces. In filing auger bits, it is necessary only to follow the original bevel, removing sufficient metal to take out the nicks of the cutting edge. This filing is done on the top surface of the bit's cutting edge. The lip is filed on its inside edge.

A double cut triangular file is usually called a "Three Square File" while a triangular tapered saw file is single cut. The saw file, as the name indicates, is used for sharpening hand saws and compass saws. Triangular files are useful in filing damaged pipe threads; the 60 degree angle of the file is the same as the angle of the American Standard Pipe Threads.

In addition to these special files, the plumber and pipe fitter has many uses for the more common types of files such as the "Mill File," "Flat Bastard File," etc.

THE CARE AND USE OF FILES

Before using a file, it should be equipped with a good file handle. The tang of many files is quite sharp and if the file is suddenly stopped by an obstruction while you are using it, the pressure of your hand against the end of the tang may result in a badly cut hand.

File handles are usually made of wood and are equipped with a metal sleeve or ferrule on the hole end to keep the handle from splitting. Make sure that the handle is the right size.

To put a handle on a file, insert the tang into the hole and tap the end of the handle on the vise or bench. In removing the handle, hold the file in one hand and the handle in the other; with a sharp blow, strike the ferrule end of the handle against the edge of the bench or vise.

In using a file, remember that the teeth are made to cut in one direction only (when the file is being pushed forward). All pressure of the file against the work should be relieved on the back stroke. Holding a file against the work on the back stroke serves only to help dull the cutting edges of the teeth. The preferred method of using a file is to raise it off the work before drawing it back. Files stay sharper longer when used this way.

The part to be filed should be clamped rigidly in a vise whenever possible. If the use of a vise is impractical, the work should be placed against some solid object to prevent it from moving or vibrating. Rigidly held work is much easier to file than that which tends to "give" with the file pressure.

The file is normally held in both hands with handle against the palm of the right hand (for right handed persons), the thumb on top of the handle and the fingers extended around it. The point of the file is held between the thumb and forefinger of the left hand. When considerable pressure is required, as in rough filing, the left hand is usually placed with the heel of the hand on the point of the file.

The chief fault of beginners is the tendency to take too rapid strokes. About 60 or 70 strokes per minute are considered sufficient. Too rapid strokes not only remove less metal than slower ones, but are extremely tiresome. Another fault of beginners is the tendency to take only short strokes, thus overburdening the teeth near the point or middle. A full stroke of the file from the point to the heel should be taken.

Beginners frequently have difficulty in knowing how much pressure to use on a file. They usually are told to "bear down" on the file without being told that using too much pressure is almost as bad as using too little pressure. The point to remember is to use only sufficient pressure to keep the file cutting. Different metals and different files call for a difference in the amount of pressure that should be applied to the file.

Files should be cleaned frequently to remove the small particles of metal, called "pins," from the teeth when they become clogged. "Pins" will scratch the surface of the work if they are large. Clogged teeth do not bite into the metal and the file does not cut properly.

Ordinarily, bumping the tip of the file or the end of the handle on the bench every now and then will jar loose the particles which stick in the teeth. This will not always get all of the chips out though, so the thing to do is to clean the file with a file card.

This is a brush like tool with wire bristles. If metal particles cannot be removed with the file card, a corner of a sheet of thin metal may be used to scrape or dig out the lodged particles. Many file cards have a metal strip attached for this purpose.

Chalk, applied to the teeth of the file, will prevent clogging of the teeth to a certain extent.

Files should be protected when not in use to keep them sharp. The best way to protect files in the shop is to hang them in a rack. Files which are carried in a tool box should be wrapped in paper or cloth, to protect them from others tools.

"File Filosophy" is the title of a booklet published by the Nicholson File Co., Providence, R.I. This booklet will give you further information on files and their uses.

"DO'S" IN FILING

1. Always take time to get the correct file for the job.
2. Always use a handle on a file; be sure it is tight.
3. Take a full stroke; all the teeth should share the work.
4. File with a slow, rhythmical stroke; let the body help.
5. Always relieve the pressure or lift the file on the back stroke.
6. Use just enough pressure to make the file cut.
7. Keep files away from moisture and water to prevent rusting.
8. Always use a vise for holding work if possible.

"DON'TS" IN FILING

1. Don't toss files in tool boxes or on benches and expect them to stay sharp.
2. Don't file copper, lead, and other soft metals with fine tooth files.
3. Don't hammer on files; they are brittle and may chip or break.
4. Don't use a file for a pry bar.
5. Don't let the file slip over the work without cutting; this dulls the teeth of the file.

Name: _____

Approved by: _____

Date: _____

FILES AND THEIR USES

Key: B I - P 2 - 10 A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: FILES AND THEIR USES

Purpose: To become familiar with files, their proper use and care; uses of special purpose files.

References: Information sheet on Files and Their Uses

Introductory Information: The file is a very common tool that is used by nearly everyone. Too few of us take the time to select the right file for the job or use and care for this tool in the proper manner. Better work can be produced and time and effort can be saved by proper use and care of files.

Directions: Study the references listed above.

Answer the following questions.

Questions:

1. Name the three most common cuts of files as regards to the coarseness of the file teeth.

   _____ _____ _____

2. If you had a pipe with damaged threads that would not screw into a fitting, what type of file would be best to use to straighten the threads?

   _____

3. Why is a rasp better than a mill file for squaring and beveling the ends of lead pipe?

   _____

   _____

4. Give the names of six different types of files.

_____ _____ _____

_____ _____ _____

5. Why is chalk sometimes rubbed on a file?

_____

_____

6. With a 12 inch ruler, scale, or any convenient object resembling a file, practice the filing stroke on the edge of your desk or table. Try to make 60 to 70 strokes per minute. Ask another student to time your strokes for one minute. How many strokes did you make?

_____

_____

_____

Information Sheet
in
Plumbing and Pipe Fitting

Subject: HACK SAWS

Hack saws are used to cut pipe, tubing and other metals. Most hack saw frames are adjustable and are designed to take blades which are 8, 10 or 12 inches long. Several types of frames and handles may be found in tool catalogs.

Some hack saw frames permit only two positions of the blade, that is, vertical and horizontal. In some of the better frames the blade may be positioned in several different angles. There is quite an advantage in using a hack saw of this type as it enables the saw to be used in places where there is not sufficient clearance to use a saw with only two positions of the blade.

Hack saw blades are made in two types, differing only in the hardening. The majority of blades are heat treated on the tooth edge only, leaving the body of the blade tough and capable of standing the severest strains. This type of blade is best adapted for general purpose cutting. Many mechanics prefer the "all hard blade" which is hardened throughout. This blade should not be used where work is insecurely held or in places where severe strain may be put on the blade.

Most manufacturers make blades in three types of steel. Blades made of "Standard Steel" cut almost all materials satisfactorily and are the general purpose blades. "Molybdenum Steel" gives a longer wearing blade, with exceptional cutting qualities. "High Speed Steel" blades will cut the toughest of material and will resist much better the heat generated in the cutting action.

Hand hack saw blades are made with 14, 18, 24, 32 teeth per inch. This is known as the pitch of the blade. The teeth of the 14 and 18 pitch blades are individually set while the 24 and 32 pitch blades have what is known as wavy set.

14 pitch blades are used to cut:

cast iron	aluminum
solid babbitt	annealed tool steels
brass	heavy structural steel
copper	soft steel
bronze	

18 pitch blades are used to cut:

tool steel	steel pipe
hard metals	brass pipe
light structural steel	angle iron

24 pitch blades are used to cut:

steel pipe	light angle iron
brass pipe	strap iron
medium tubing	drill rod

32 pitch blades are used to cut:

thin walled tubing	sheet metal

There's a limit to the hardness of metal that can be cut with a hack saw. Before ruining all the teeth on the saw blade, test the hardness of the metal with the tip of a file or the very front or rear teeth of the saw blade.

To place a blade in a hack saw frame, first see that the frame is adjusted for the length of the blade with sufficient adjustment remaining to permit the blade to be tightly stretched. Place the blade on the pins so that the teeth point toward the front of the frame (away from the handle). The saw does its cutting on the push stroke. A beginner sometimes puts the blade in backwards and then wonders why it does not cut. Tighten the wing nut or thumb screw to put tension on the blade. A blade with insufficient tension is more likely to break than a tight one. Insufficient tension also makes the blade difficult to guide.

The edge of your left thumb may be placed against the side of the saw blade to guide the saw in starting a cut on the mark. Use enough pressure in

starting the cut so that the saw immediately begins to bite into the metal. The cutting action of a hack saw blade and a file are similar; if sufficient pressure is not used to make the teeth of the saw actually bite into and cut the metal, the rubbing action helps to dull the blade.

The hack saw should be held with both hands; one hand on the handle and the other at or near the front of the frame. Short strokes may be used in getting the saw started, then full strokes should be used, using the entire length of the blade. The stroke should be slow, 40 to 50 strokes per minute for most metals and even slower strokes for harder metals. If a hack saw is worked too fast, the heat generated by the friction may ruin the blade by drawing the temper.

Wobbly strokes should be avoided because the blades are easily kinked or broken. If a blade breaks, finish the cut with another old blade. New blades have more set than worn ones and may jam in the narrow "kerf" (that is the term for the slot made by the saw) of an old blade. If a new blade must be used, it is best to start a new cut by rotating the pipe or starting at the other edge of the material to be sawed.

As in filing, you should relieve the pressure on the hack saw in making the return stroke. It is not necessary to lift the blade off the work when the cut is being started, but when the kerf becomes deep enough to guide the blade, it should be lifted slightly on the return stroke.

When sawing thin materials always use a fine tooth blade. If the thickness of the material is less than the distance between the teeth, the teeth will straddle the material causing the teeth to break off. Always remember that at least two teeth should contact the work at all times. Many times the material can be sawed at an angle so that two teeth will contact the work. Sheet metal can often times be clamped between two pieces of wood for sawing.

Fine tooth saws should not be used to cut thick soft metals. Soft metals make large chips that will stick in the gullets of fine tooth blades, causing them to bind.

Hack saws in the shop should be hung up. When carried in a tool box, they should be placed in a box so that other tools do not rub against the teeth of the blade. A little oil spread on the blades will keep them from rusting.

Name: _____ HACK SAWS

Approved by: _____ Key: B I - P 2 - 11 A

Date: _____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: HACK SAWS

Purpose: To become familiar with the care and use of hack saws.

References:
1. Information Sheet on "Hack Saws"
2. Booklet "Metal Cutting," by Clemson Bros., Inc. Manufacturers of Star Hack Saw Blades

Introductory Information: Hand hack saws are one of the most universally used tools. Even though the use of a hack saw requires no great amount of skill, a knowledge of the characteristics of hack saws and blades will enable a mechanic to do better cutting. The proper selection and use of hack saw blades will greatly lengthen the useful life of the blades.

Directions: Study the information and answer the following questions.

Questions:

1. What kind of hack saw blades should be used for cutting the following materials:

   a. Steel pipe _____

   b. Copper tubing _____

   c. Copper water tube _____

   d. 20 gage brass tubing _____

   e. Cast iron pipe _____

   f. Brass pipe _____

   g. Steel hanger rods _____

2. When cutting metal by hand, with a hand hack saw, what part of the cutting operation is done on the back stroke?

_____

_____

3. Name three precautions which the worker should take to avoid breaking hack saw blades.

_____

_____

_____

4. What is the proper cutting speed for a hack saw in strokes per minute?

_____

5. What is the result of operating a hack saw too fast?

_____

_____

_____

VT 010 014
Phipps, D. Bart
Drawing and Plan Reading for Apprentice Training in the Plumbing and Pipe Fitting Industry; Apprentice Workbook 22.

Texas A and M Univ., College Station. Engineering Extension Service
Texas Education Agency, Austin. Industrial Education Div.
Texas State Joint Apprenticeship Committee for Plumbing and Pipe Fitting
MF AVAILABLE IN VT-ERIC SET.
Instructional Materials Production, Engineering Extension Service, Texas A and M University, F.E. Drawer K, College Station, Texas 77843 ($1.75).
PUB DATE - ND 87p.

DESCRIPTORS - *STUDY GUIDES; *TRADE AND INDUSTRIAL EDUCATION; *APPRENTICESHIPS; *PLUMBING; WORKBOOKS; ASSIGNMENTS; *GRAPHIC ARTS

ABSTRACT - Prepared and revised by subject matter specialists, this plumbing and pipe fitting apprentice workbook provides instruction in drawing and plan reading. Information sheets and student assignments are given for the topics: (1) Line Values, (2) Standard Graphical Symbols, (3) Scale Drawings, (4) Sectional Views, (5) Isometric Drawings, and (6) Blueprint Reading. The workbook also includes an isometric scale guide and drawing paper, and student progress record sheets for both teacher and student use. (AW)

VT 010 014

ED0 45856

DRAWING AND PLAN READING

for
APPRENTICE TRAINING

in the

PLUMBING AND PIPE FITTING INDUSTRY

Apprentice Workbook 22

* * * * * * *

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and
Texas State Joint Apprenticeship Committee
for Plumbing and Pipe Fitting

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2-8-500

REFERENCES FOR APPRENTICE WORKBOOK #22:

Plans for classroom and lab building

Sheet #2
Sheet M-1
Sheet M-2

SPECIFICATIONS for the Construction of A CLASSROOM & LABORATORY BUILDING for the Poultry Husbandry Department

(Either or both of books listed below should be the apprentice school library)

A Manual of Engineering Drawing for Students and Draftsmen, T. E. French and Charles J. Verick, Eighth ed.; New York: McGraw-Hill: 1953.

Mechanical Drawing, T. E. French and Carl Swensen; New York: McGraw-Hill: 1948

Any standard school Mechanical Drawing Text.

DRAWING AND PLAN READING
Apprentice Workbook No. 22

Name: _____

STUDENT PROGRESS RECORD
IN
BASIC CONSTRUCTION FOR APPRENTICE TRAINING
FOR THE
PLUMBING AND PIPE FITTING INDUSTRY

	Information Sheets	Student Assignment	Date Completed
*1. Line Values	1-3 pages	1-4 pages	
2. Standard Graphical Symbols	1-25 pages	1-7 pages	
*3. Scale Drawings	1-2 pages	1-3 pages	
*4. Sectional Views	1-2 pages	1-3 pages	
*5. Isometric Drawings	1-6 pages	1-3 pages	
*6. Blueprint Reading	1-6 pages	1-4 pages	

NOTE: Green sheet for student's notebook
Gold sheet for instructor's file
Also in this packet:
Isometric Scale Guide
13 lb. bond drawing paper

*Instructor's Lesson Plan for Group Instruction

DRAWING AND PLAN READING
Apprentice Workbook No. 22

Name: _____

STUDENT PROGRESS RECORD
IN
BASIC CONSTRUCTION FOR APPRENTICE TRAINING
FOR THE
PLUMBING AND PIPE FITTING INDUSTRY

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NOTE: Green sheet for student's notebook
Gold sheet for instructor's file
Also in this packet:
Isometric Scale Guide
13 lb. bond drawing paper

*Instructor's Lesson Plan for Group Instruction

Information Sheet
in
Plumbing and Pipe Fitting

Subject: LINE VALUES

In the previous Workbook No. 21, you were introduced to some of the basic phases of Drawing and Plan Reading. In this Workbook No. 22, we shall attempt to give a practical application to the theories and practices you have already learned as well as the more advanced practices to be studied in this workbook.

You know by this time that certain types and weights of lines have a very definite value in plan reading. It becomes necessary, therefore, that you remember the names of the lines, their purpose, and their proper application.

In this, as in all other phases of the Plumbing and Pipe Fitting Industry, the Apprentice must broaden his learning by using the related classroom knowledge on the job at every opportunity. The aim of the Apprentice program is to parallel the Related Information and the job training. With this thought in mind, let us review the work you have already done and add to your knowledge and experience by using lines that have not been used heretofore in this course of study.

In Apprentice Workbook No. 22, the ASA bulletins published by the American Society of Mechanical Engineers may be used as reference materials. Also bulletins and catalogues from reputable manufacturers of materials used by the Plumbing and Pipe Fitting Industry will be very helpful in working out assignments included in Apprentice Workbook No. 22.

1. OUTLINE OR OBJECT LINE

2. HIDDEN LINES

3. CENTER LINES

4. 32′

EXTENSION AND DIMENSION LINES

5. CUTTING PLANE LINES

6. SECTION LINES

7. LONG BREAK LINES

8. SHORT BREAK

9. ADJACENT PARTS AND ALTERNATE POSITIONS

10. DITTO LINES

11. REFERENCE LINES

DATE	PLUMBING APPRENTICE CLASS CITY	LINE SYMBOLS John Doe	DP - AW 22 1 I

1. Outline or object lines may vary in thickness according to the size of the drawing. The outline of an object should be the outstanding lines of the drawing.

2. Hidden lines are made up of short dashes closely and evenly spaced and are used to indicate hidden edges or parts.

3. Center lines are alternate long and short lines evenly spaced.

4. Din ension and extension lines are light unbroken lines except where dimensions are lettered in.

5. Cutting plane lines are made up of one long and two short dashes alternately and evenly spaced. These lines are used to show the point at which the plane cuts the object in sectional drawing.

6. Section lines are usually evenly spaced to give a shaded effect in sectional drawings.

7. & 8.
Break lines are used as the name implies to show broken out sections.

9. Adjacent parts or alternate positions are made up of long dashes to show that an object may be placed in more than one position and may be used to show other parts adjacent to the part to be drawn in order to better identify it or locate it.

10. Ditto line is made up of short double dashes to indicate a repetition of details.

Name: _____

Approved by: _____

Date: _____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: LINE VALUES

Aim: To broaden the knowledge of lines used in plan reading and show their application to the piping industry.

References: Information Sheet DP - AW 22 - 1 A

Introductory Information: Although there are variations in lines used on plans, these variations are normally accompanied by notes of explanation. The appreciation of line values and symbols speeds up the accurate reading of blueprints used in your trade.

Procedure: Answer the following questions in spaces provided.

1. What principal types of lines should a journeymen know in order to be able to read any type of plan? Name 6 of the more important.

   a.
   b.
   c.
   d.
   e.
   f.

2. Define or describe the use of lines listed in question 1.

   a.

   b.

   c.

Name: _____

Approved by: _____

Date: _____

Continued -

d.

e.

f.

3. Using line symbols as shown on Page 2 of the Information Sheet as an example and the 1/8" scale guide from Packet No. 21 as a guide, draw each type of line shown on the drawings. Draw border line and letter title strip.

4. List the different types of lines used in the drawing in Figure 1.

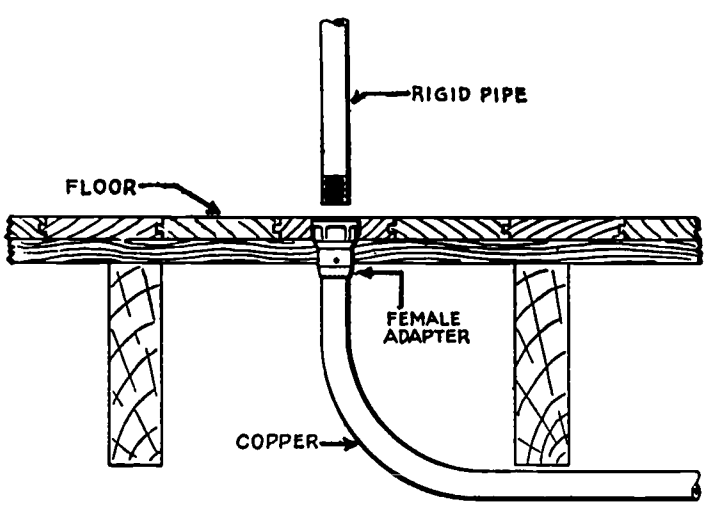


Figure 1

a.

b.

c.

d.

Name: _____

Approved by: _____

Date: _____

Continued -

5. List the types of lines used in the drawings in Figure 2.

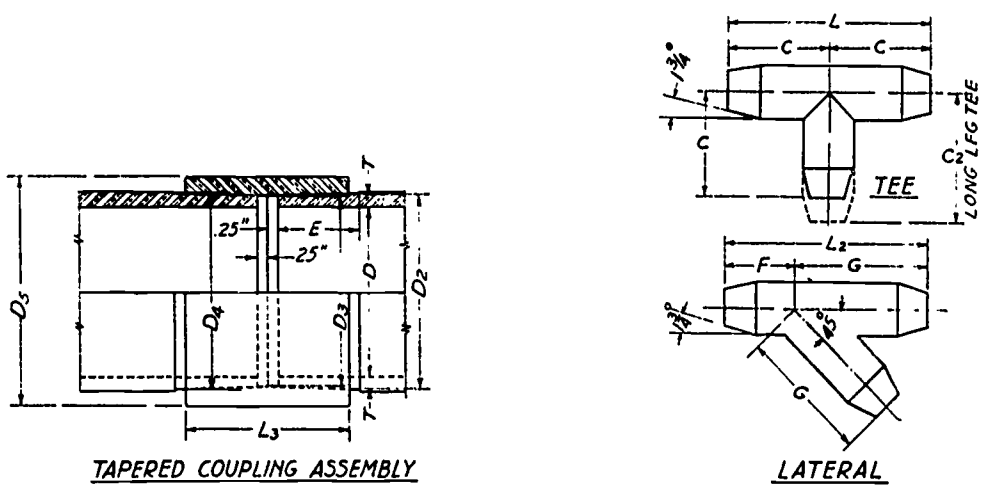


Figure 2

a.

b.

c.

d.

e.

f.

g.

h.

6. Why is it necessary to use more lines in the drawings in Figure 2 than in Figure 1?

_____

_____

_____

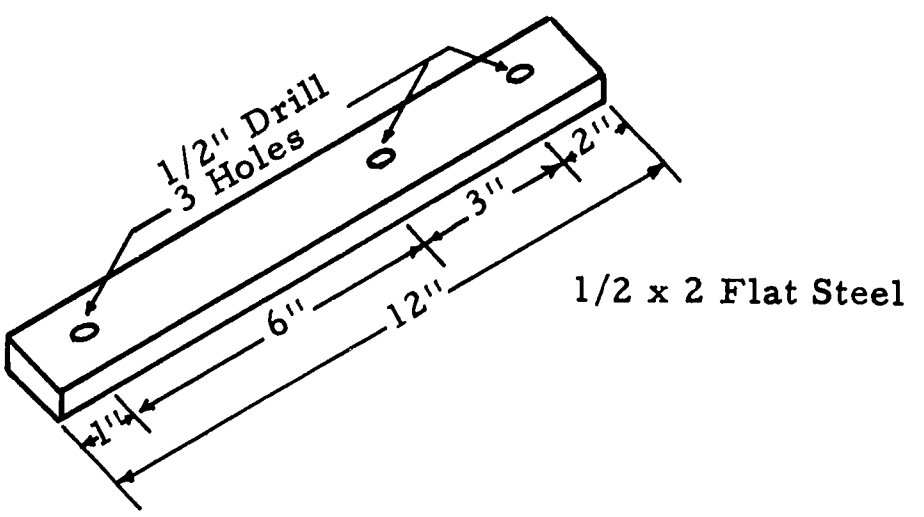
Name: _____

Approved by: _____

Date: _____

Continued -

7. Make a two view sketch of the hanger support illustrated below. Use the 1/8" scale guide from Packet No. 21. Use proper lines and insert dimensions.



Information Sheet
in
Plumbing and Pipe Fitting

Subject: Standard Graphical Symbols

Fortunately for the average person it is not necessary for us to be an artist to convey ideas and instructions in the form of a plan or sketch. A picture or an artist's drawing is very pleasing to the eye, but it gives very little information needed by the craftsman in building trades. Instead of pretty pictures, a tradesman finds it necessary to work from plans which are largely made up of symbols and single line drawings. To simplify the task for the draftsman, engineer or journeyman, standard symbols for pipe, fittings, equipment, and fixtures have been adopted and printed in ASA Bulletins by the American Society of Mechanical Engineers.

Drawings for power plants, pumping stations, refineries, heating systems, cooling systems and plumbing systems, the piping layouts and diagrams may be made as single line drawings or double line drawings. Double line drawings are usually used to show a special detail. Double and single line drawings may be made as multiview projections or isometric projections.

A mechanic should be able to read and interpret any and all symbols that in any way pertain to the building trades. In general, where any parts come into contact with brick work, hollow tile, etc., the journeyman should know what those parts are and what, if any provisions must be made in order to tie in to or hang fixtures, pipe, or any other equipment to the structure or any work that must be done on or near the wall or partition.

In orthographic projection we studied "Views" of an object, for example; top, bottom, side, etc. In architectural or engineering planning, the views are commonly referred to as "plans" or "elevations".

An elevation is a view of a side, front, or back of a structure projected to a vertical plane.

A plan - In building trades all of the blueprints for a building are frequently called "plans". Actually a plan view is a horizontal section showing arrangement or layout for one floor, hence, it is commonly called a "floor plan".

Very often many details are not taken into consideration by the architect. The assembling and connecting of appliances and fixtures, according to codes and specification is left to a great extent to the knowledge and experience of the journeyman. It may become necessary for the foreman or superintendent to visualize a complete installation. The Blueprints show the location and sizes of pipe, the kind of material, the location and size of units or fixtures and such other necessary information. From this information, the foreman must relay to other journeymen the ideas and information necessary to get the materials needed and make the installation.

If it were necessary to draw all fixtures and fittings it would be a tremendous job, but fortunately by the use of standard symbols it is possible to convey ideas and necessary information by single line drawings. Also on a large job, journeymen working on the job may be from different parts of the country, so it is very important that such symbols be used as may be understood by any journeyman who may have to interpret the plan.

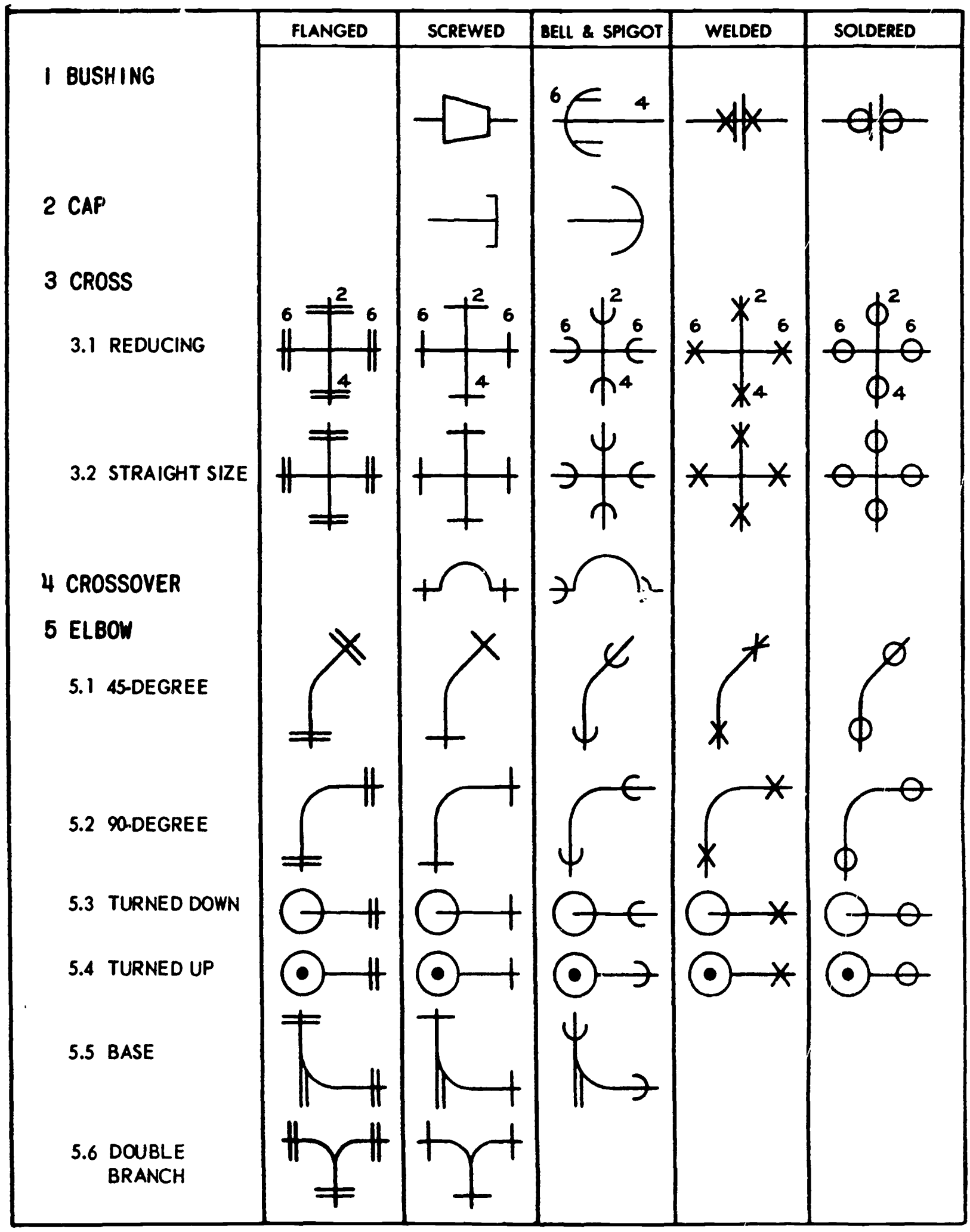
It should hardly be necessary to say here that an Apprentice should be well acquainted with all types of symbols used in the trade for reasons already mentioned.

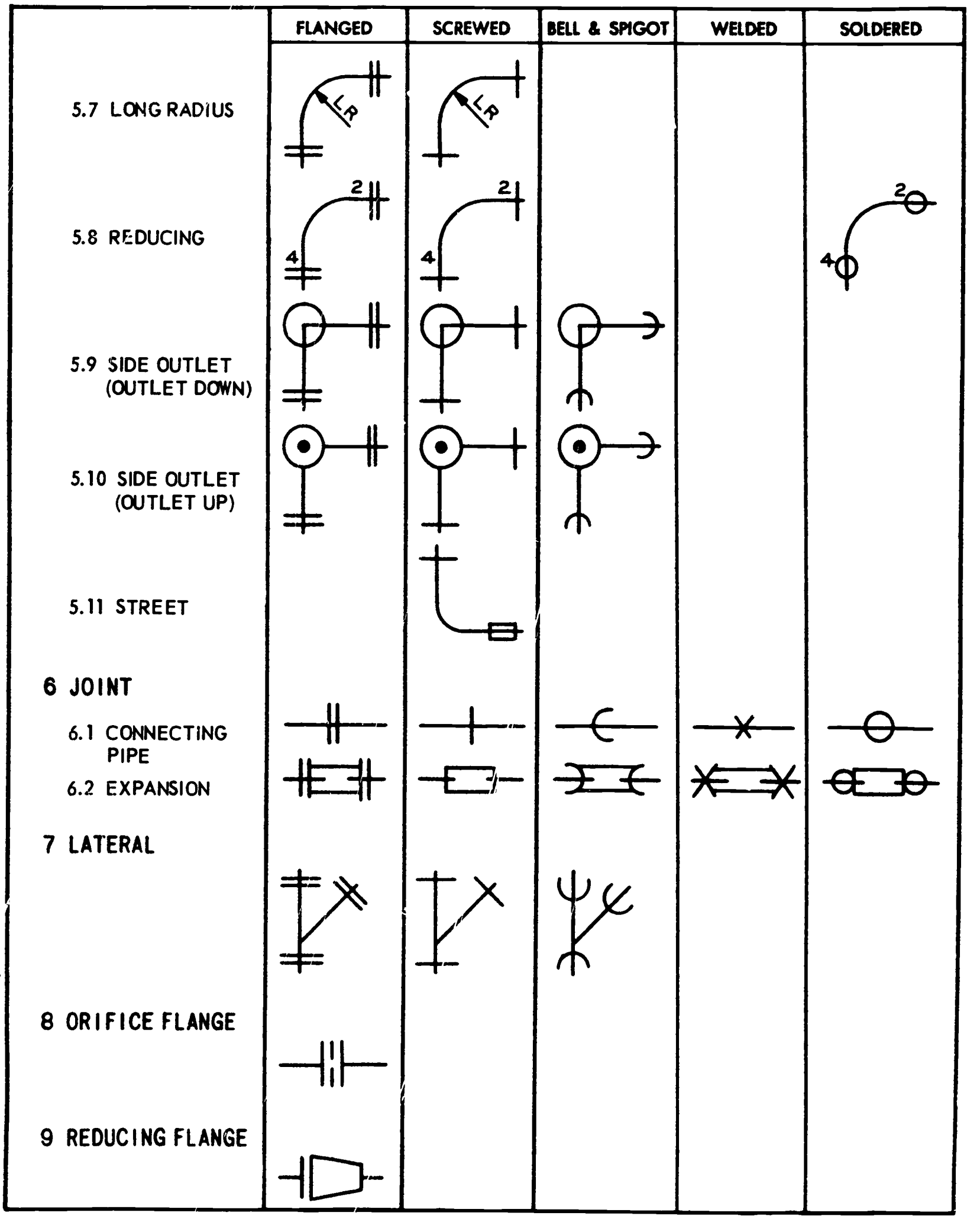
The American Standard (ASA) symbols herein provided will be a guide to working assignments that follow as well as being an aid to blueprint reading. Blueprints usually will have a legend providing supplementary symbols and symbols pertaining to that particular set of plans.

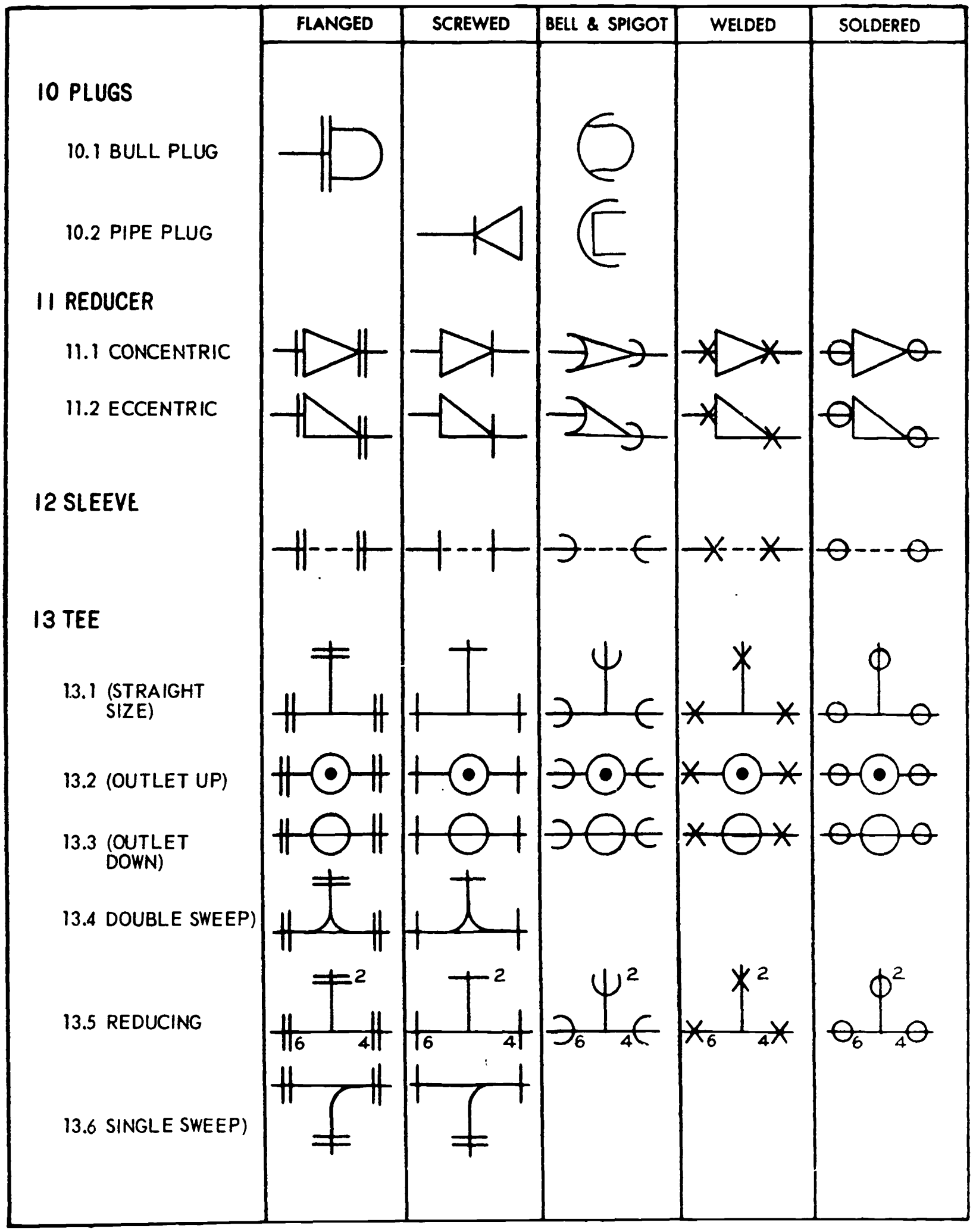
AMERICAN STANDARD
for
Graphical Symbols
PIPE FITTINGS, VALVES AND PIPING

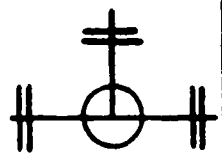
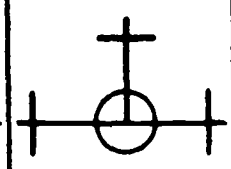
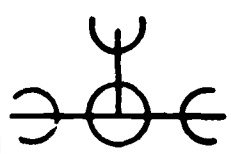
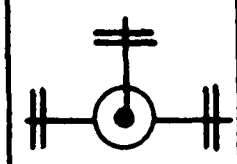
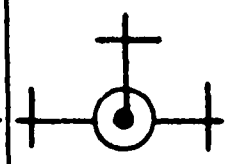
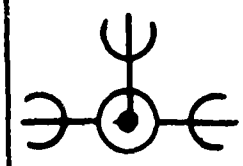
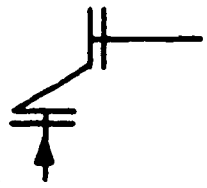
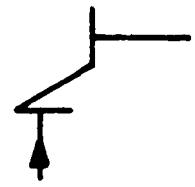
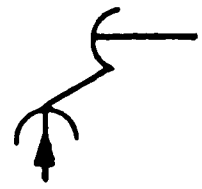
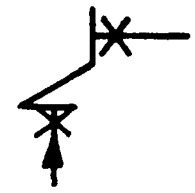
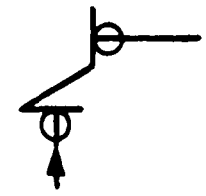
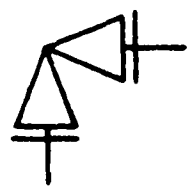
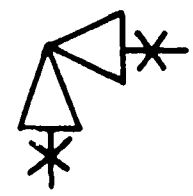
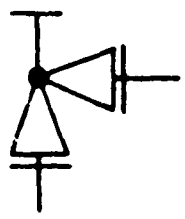
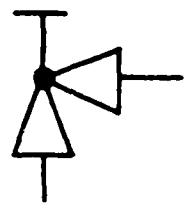
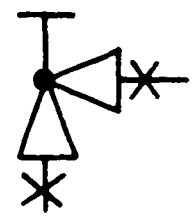
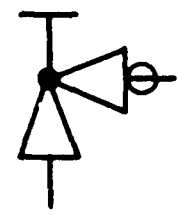
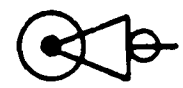
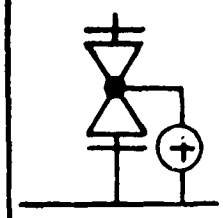
ASA Z32.2.3. - 1949

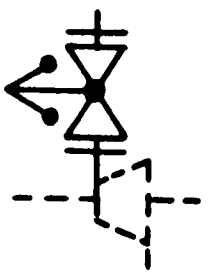
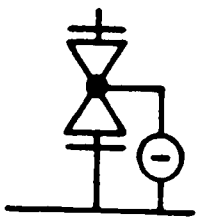
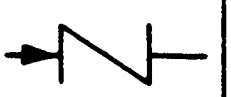
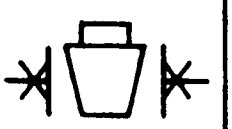
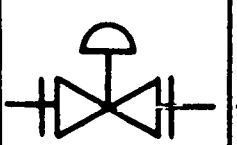
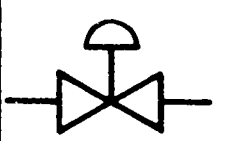
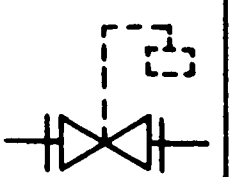
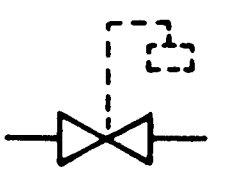
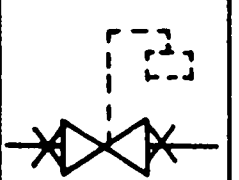
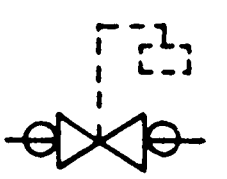
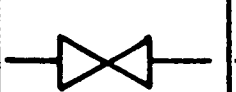
Note: Extracted from American Standard Graphical Symbols for Pipe Fittings, Valves, and Piping ASA Z32.2.3. - 1949 by permission of the publishers, The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, New York.


FLANGED
SCREWED
BELL & SPIGOT
WELDED
SOLDERED
1 BUSHING
2 CAP
3 CROSS
3.1 REDUCING
3.2 STRAIGHT SIZE
4 CROSSOVER
5 ELBOW
5.1 45-DEGREE
5.2 90-DEGREE
5.3 TURNED DOWN
5.4 TURNED UP
5.5 BASE
5.6 DOUBLE BRANCH


FLANGED
SCREWED
BELL & SPIGOT
WELDED
SOLDERED
5.7 LONG RADIUS
LR
LR
5.8 REDUCING
2
4
2
4
2
4
5.9 SIDE OUTLET (OUTLET DOWN)
5.10 SIDE OUTLET (OUTLET UP)
5.11 STREET
6 JOINT
6.1 CONNECTING PIPE
6.2 EXPANSION
7 LATERAL
8 ORIFICE FLANGE
9 REDUCING FLANGE


FLANGED
SCREWED
BELL & SPIGOT
WELDED
SOLDERED
10 PLUGS
10.1 BULL PLUG
10.2 PIPE PLUG
11 REDUCER
11.1 CONCENTRIC
11.2 ECCENTRIC
12 SLEEVE
13 TEE
13.1 (STRAIGHT SIZE)
13.2 (OUTLET UP)
13.3 (OUTLET DOWN)
13.4 DOUBLE SWEEP)
13.5 REDUCING
13.6 SINGLE SWEEP)
2
6
4

	FLANGED	SCREWED	BELL & SPIGOT	WELDED	SOLDERED
13.7 SIDE OUTLET (OUTLET DOWN)					
13.8 SIDE OUTLET (OUTLET UP)					
14 UNION					
15 ANGLE VALVE					
15.1 CHECK					
15.2 GATE (ELEVATION)					
15.3 GATE (PLAN)					
15.4 GLOBE (ELEVATION)					
15.5 GLOBE (PLAN)					
15.6 HOSE ANGLE	SAME AS	SYMBOL	23.1		
16 AUTOMATIC VALVE					
16.1 BY-PASS					

	FLANGED	SCREWED	BELL & SPIGOT	WELDED	SOLDERED
16.2 GOVERNOR-OPERATED					
16.3 REDUCING					
17 CHECK VALVE					
17.1 ANGLE CHECK	SAME AS	SYMBOL	15.1		
17.2 (STRAIGHT WAY)					
18 COCK					
19 DIAPHRAGM VALVE					
20 FLOAT VALVE					
21 GATE VALVE					
*21.1					
21.2 ANGLE GATE	SAME AS	SYMBOLS	15.2 & 15.3		
21.3 HOSE GATE	SAME AS	SYMBOL	23.2		

*ALSO USED FOR GENERAL **STOP VALVE** SYMBOL WHEN AMPLIFIED BY SPECIFICATION

	FLANGED	SCREWED	BELL & SPIGOT	WELDED	SOLDERED
21.4 MOTOR-OPERATED	M	M		M	
22 GLOBE VALVE					
22.1					
22.2 ANGLE GLOBE	SAME AS	SYMBOLS	15.4 & 15.5		
22.3 HOSE GLOBE	SAME AS	SYMBOL	23.3		
22.4 MOTOR-OPERATED	M	M		M	
23 HOSE VALVE					
23.1 ANGLE					
23.2 GATE					
23.3 GLOBE					
24 LOCKSHIELD VALVE					
25 QUICK OPENING VALVE					
26 SAFETY VALVE					
27 STOP VALVE	SAME AS	SYMBOL	21.1		

AIR CONDITIONING

28 BRINE RETURN — BR —

29 BRINE SUPPLY — B —

30 CIRCULATING CHILLED OR HOT-WATER FLOW — CH —

31 CIRCULATING CHILLED OR HOT-WATER RETURN — CHR —

32 CONDENSER WATER FLOW — C —

33 CONDENSER WATER RETURN — CR —

34 DRAIN — D —

35 HUMIDIFICATION LINE — H —

36 MAKE-UP WATER

37 REFRIGERANT DISCHARGE — RD —

38 REFRIGERANT LIQUID — RL —

39 REFRIGERANT SUCTION — RS —

HEATING

40 AIR-RELIEF LINE

41 BOILER BLOW OFF

42 COMPRESSED AIR — A —

43 CONDENSATE OR VACUUM PUMP DISCHARGE — O —

44 FEEDWATER PUMP DISCHARGE — OO —

45 FUEL-OIL FLOW — FOF —

46 FUEL-OIL RETURN — FOR —

47 FUEL-OIL TANK VENT — FOV —

48 HIGH-PRESSURE RETURN

49 HIGH-PRESSURE STEAM

50 HOT-WATER HEATING RETURN

51 HOT-WATER HEATING SUPPLY

52 LOW-PRESSURE RETURN

53 LOW-PRESSURE STEAM

54 MAKE-UP WATER

55 MEDIUM PRESSURE RETURN

56 MEDIUM PRESSURE STEAM

PLUMBING

57 ACID WASTE — ACID

58 COLD WATER

59 COMPRESSED AIR — A

60 DRINKING-WATER FLOW

61. DRINKING-WATER RETURN

62 FIRE LINE — F F

63 GAS — G G

64 HOT WATER

65 HOT-WATER RETURN

66 SOIL, WASTE OR LEADER (ABOVE GRADE)

67 SOIL, WASTE OR LEADER (BELOW GRADE)

68 VACUUM CLEANING — V V

69 VENT

PNEUMATIC TUBES

70 TUBE RUNS

SPRINKLERS

71 BRANCH AND HEAD

72 DRAIN — S S

73 MAIN SUPPLIES — S

AMERICAN STANDARD

Graphical Symbols

for

HEATING, VENTILATING, AND AIR CONDITIONING
ASA. Z32.2.4. - 1949

Note: Extracted from American Standard Graphical Symbols for Heating, Ventilating and Air Conditioning ASA. Z32.2.4. - 1949 by permission of the publisher, The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, New York.

1 AIR ELIMINATOR

2 ANCHOR

3 EXPANSION JOINT

4 HANGER OR SUPPORT

5 HEAT EXCHANGER

6 HEAT TRANSFER SURFACE, PLAN
(INDICATE TYPE SUCH AS CONVECTOR)

7 PUMP
(INDICATE TYPE SUCH AS VACUUM)

8 STRAINER

9 TANK (DESIGNATE TYPE)

10 THERMOMETER

11 THERMOSTAT

12 TRAPS

12.1 BOILER RETURN

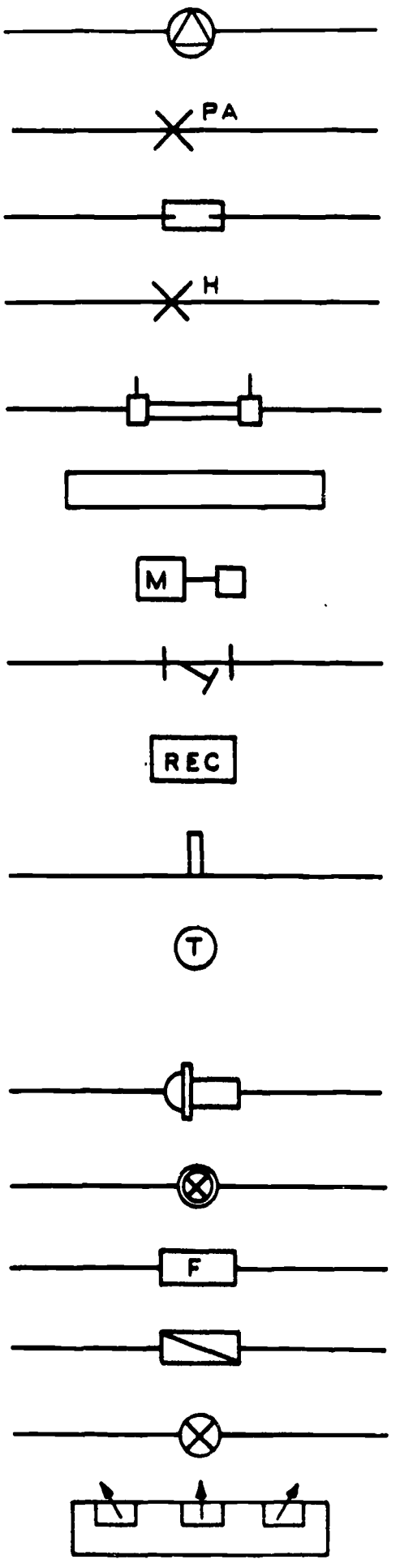
12.2 BLAST THERMOSTATIC

12.3 FLOAT

12.4 FLOAT AND THERMOSTATIC

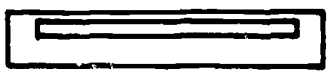
12.5 THERMOSTATIC

13 UNIT HEATER
(CENTRIFUGAL FAN), PLAN



14 UNIT HEATER (PROPELLER), PLAN

15 UNIT VENTILATOR, PLAN



16 VALVES

16.1 CHECK

16.2 DIAPHRAGM

16.3 GATE

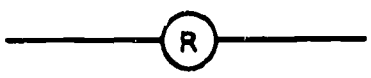
16.4 GLOBE

16.5 LOCK AND SHIELD

16.6 MOTOR OPERATED

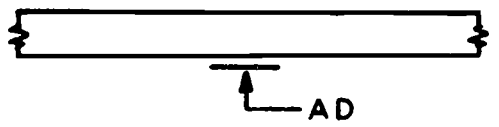
16.7 REDUCING PRESSURE

16.8 RELIEF
(EITHER PRESSURE OR VACUUM)

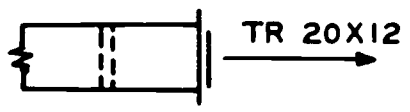


17 VENT POINT

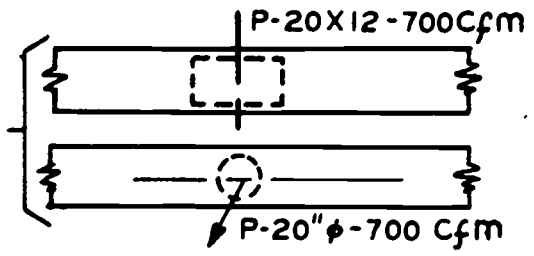
18 ACCESS DOOR



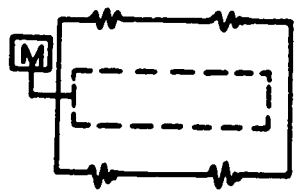
19 ADJUSTABLE BLANK OFF



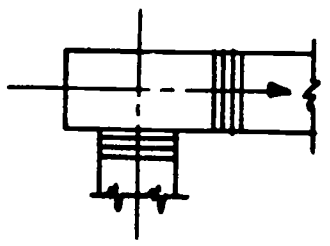
20 ADJUSTABLE PLAQUE



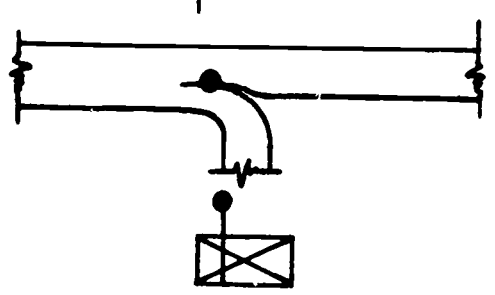
21 AUTOMATIC DAMPERS



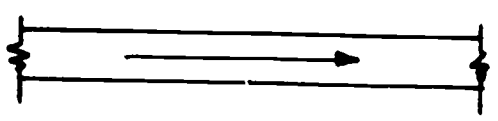
22 CANVAS CONNECTIONS



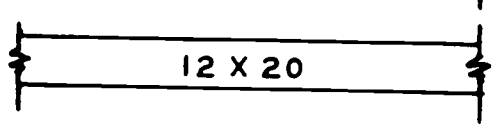
23 DEFLECTING DAMPER



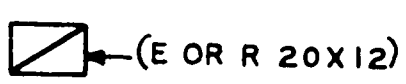
24 DIRECTION OF FLOW



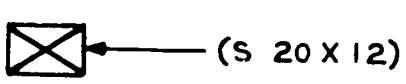
25 DUCT (1ST FIGURE, SIDE SHOWN; 2ND SIDE NOT SHOWN)



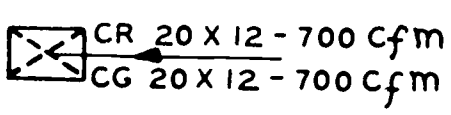
26 DUCT SECTION (EXHAUST OR RETURN)



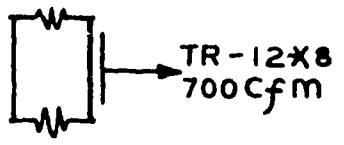
27 DUCT SECTION (SUPPLY)



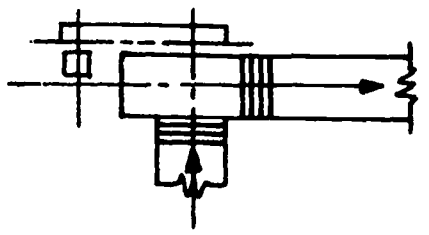
28 EXHAUST INLET CEILING (INDICATE TYPE)



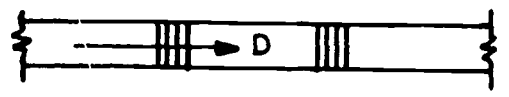
29 EXHAUST INLET WALL (INDICATE TYPE)



30 FAN AND MOTOR WITH BELT GUARD

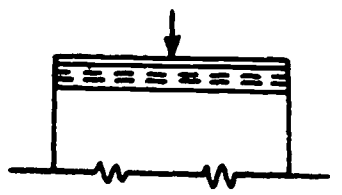


31 INCLINED DROP IN RESPECT TO AIR FLOW

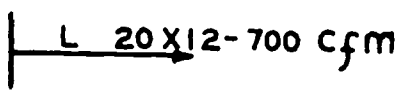


32 INCLINED RISE IN RESPECT TO AIR FLOW

33 INTAKE LOUVERS ON SCREEN

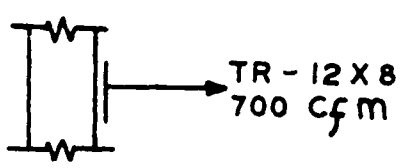


34 LOUVER OPENING

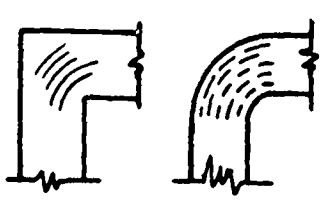


35 SUPPLY OUTLET CEILING (INDICATE TYPE)

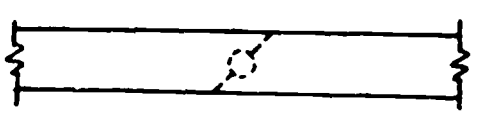
36 SUPPLY OUTLET WALL (INDICATE TYPE)



37 VANES



38 VOLUME DAMPER



39 CAPILLARY TUBE

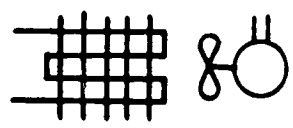
40 COMPRESSOR

41 COMPRESSOR, ENCLOSED, CRANKCASE, ROTARY, BELTED

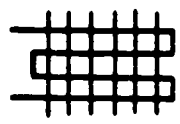
42 COMPRESSOR, OPEN CRANKCASE, RECIPROCATING, BELTED

43 COMPRESSOR, OPEN CRANKCASE, RECIPROCATING, DIRECT DRIVE

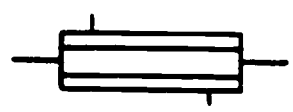
44 CONDENSER, AIR COOLED, FINNED, FORCED AIR



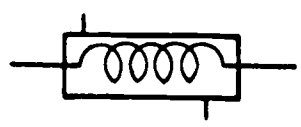
45 CONDENSER, AIR COOLED, FINNED, STATIC



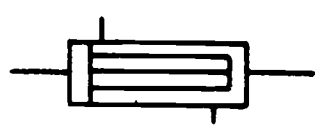
46 CONDENSER, WATER COOLED, CONCENTRIC TUBE IN A TUBE



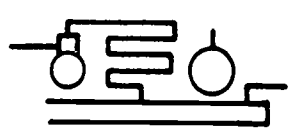
47 CONDENSER, WATER COOLED, SHELL AND COIL



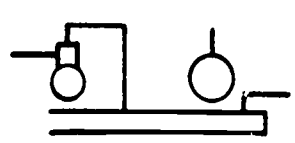
48 CONDENSER, WATER COOLED, SHELL AND TUBE



49 CONDENSING UNIT, AIR COOLED



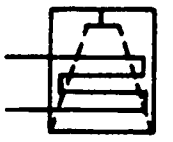
50 CONDENSING UNIT, WATER COOLED



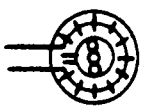
51 COOLING TOWER

52 DRYER

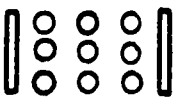
53 EVAPORATIVE CONDENSER



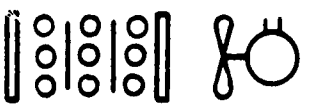
54 EVAPORATOR, CIRCULAR, CEILING TYPE, FINNED



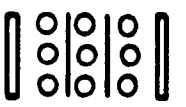
55 EVAPORATOR, MANIFOLDED, BARE TUBE, GRAVITY AIR



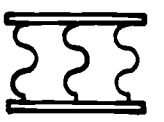
56 EVAPORATOR, MANIFOLDED, FINNED, FORCED AIR



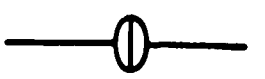
57 EVAPORATOR, MANIFOLDED, FINNED, GRAVITY AIR



58 EVAPORATOR, PLATE COILS, HEADERED OR MANIFOLD

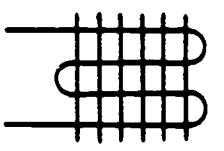


59 FILTER, LINE

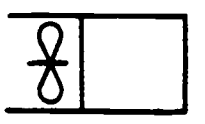


60 FILTER & STRAINER, LINE

61 FINNED TYPE COOLING UNIT, NATURAL CONVECTION



62 FORCED CONVECTION COOLING UNIT



63 GAUGE

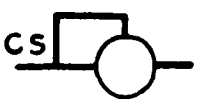
64 HIGH SIDE FLOAT

65 IMMERSION COOLING UNIT

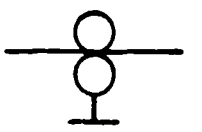
80 VALVES

80.1 AUTOMATIC EXPANSION

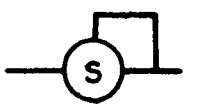
80.2 COMPRESSOR SUCTION PRESSURE LIMITING, THROTTLING TYPE (COMPRESSOR SIDE)



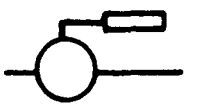
80.3 CONSTANT PRESSURE, SUCTION



80.4 EVAPORATOR PRESSURE REGULATING, SNAP ACTION



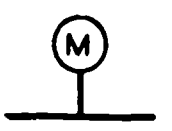
80.5 EVAPORATOR PRESSURE REGULATING, THERMOSTATIC THROTTLING TYPE



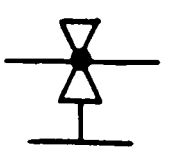
80.6 EVAPORATOR PRESSURE REGULATING, THROTTLING TYPE (EVAPORATOR SIDE)

80.7 HAND EXPANSION

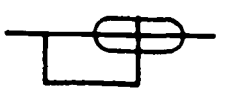
80.8 MAGNETIC STOP



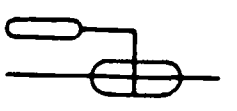
80.9 SNAP ACTION



80.10 SUCTION VAPOR REGULATING

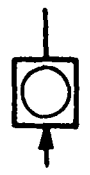


80.11 THERMO SUCTION

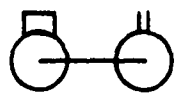


80.12 THERMOSTATIC EXPANSION

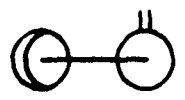
66 LOW SIDE FLOAT



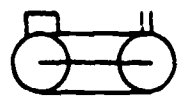
67 MOTOR-COMPRESSOR, ENCLOSED CRANKCASE, RECIPROCATING, DIRECT CONNECTED



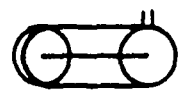
68 MOTOR-COMPRESSOR, ENCLOSED CRANKCASE, ROTARY, DIRECT CONNECTED



69 MOTOR-COMPRESSOR, SEALED CRANKCASE, RECIPROCATING



70 MOTOR-COMPRESSOR, SEALED CRANKCASE, ROTARY

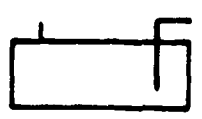


71 PRESSURESTAT

72 PRESSURE SWITCH

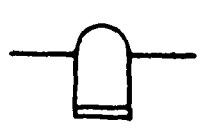
73 PRESSURE SWITCH WITH HIGH PRESSURE CUT-OUT

74 RECEIVER, HORIZONTAL

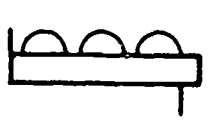


75 RECEIVER, VERTICAL

76 SCALE TRAP

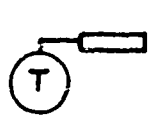


77 SPRAY POND

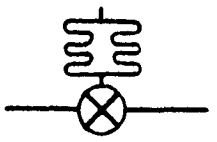


78 THERMAL BULB

79 THERMOSTAT (REMOTE BULB)



80.13 WATER



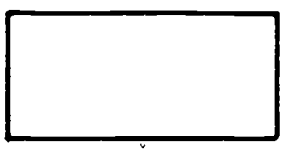
81 VIBRATION ABSORBER, LINE

AMERICAN STANDARD

Graphical Symbols
for
PLUMBING
ASA Y32. 4. - 1955

Note: Extracted from American Standard Graphical Symbols for Plumbing ASA Y32. 4 - 1955 by permission of the publisher, The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, New York.

1 AUTOPSY TABLE



AT

2 BATH

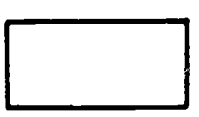
B-1
B-2, etc.

USE SPECIFICATION TO DESCRIBE

3 BED PAN WASHER

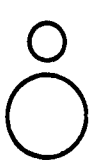
BPW

4 BED PAN STERILIZER



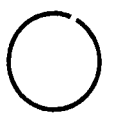
BPS

5 BIDET



B

6 CAN WASHER

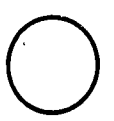


CW

7 CLEANOUT

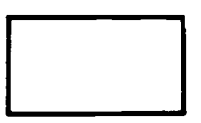
CO

8 DENTAL UNIT



DU

9 DISH WASHER

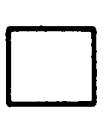


DW

10 DRAIN

FD

11 DRINKING FOUNTAIN



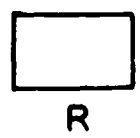
DF-1
DF-2, etc.

USE SPECIFICATION TO DESCRIBE

12 GAS OUTLET

G

13 RANGE



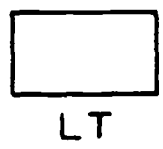
14 GREASE TRAP

15 HOSE BIBB

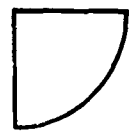
16 HOSE RACK

17 HOT WATER TANK

18 LAUNDRY TRAY

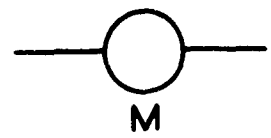


19 LAVATORIES



USE SPECIFICATION TO DESCRIBE

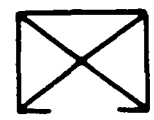
20 METER



21 ROOF DRAIN

22 SHOWER
22.1 HEAD

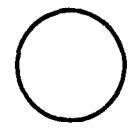
22.2 STALL



23 SINK

USE SPECIFICATION TO DESCRIBE

24 WASH FOUNTAIN
24.1 CIRCULAR



24.2 HALF CIRCULAR

WF

25 URINAL

U-1
U-2,etc.

USE SPECIFICATION TO DESCRIBE

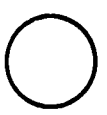
26 VACUUM OUTLET

27 WATER CLOSET

WC-1
WC-2,etc.

LL USE SPECIFICATION TO DESCRIBE

28 WATER HEATER



WH

STANDARD GRAPHICAL SYMBOL
Key: D P - AW 22 - 2 A

Name: _____

Approved by: _____

Date: _____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Standard Graphical Symbols

Aims: To learn a quick accurate and thorough method of making legible sketches as well as further improving your ability to read blue prints by learning the following:

1. Symbols
2. Value of symbols in plan reading
3. The proper use of symbols in making drawings and sketches

References: Information Sheet - DP - AW 22 - 2 I

Introductory Information: You will find some variations from standard practices and policies in blueprints. This is due primarily to the scope of the building trades and the influence of individual interpretations. This will present no great problem if you are familar with the basic fundamentals of blueprint reading and take advantage of every experience in the Trade. Experiences being a very vital factor in learning we are going to spend as much time as possible actually working with various phases of blueprint reading to gain as much experience as possible in your period of apprentice training.

Procedure: To become acquainted with Standard symbols used in this assignment, study the information sheet pertaining to symbols and their use. Draw the symbols as indicated below:

1. Air eliminator
2. Expansion joint
3. Thermostat
4. Pressure Reducing Valve
5. Strainer
6. Louvre Opening
7. Float and Thermostatic trap

STANDARD GRAPHICAL SYMBOLS
Key: D P - AW 22- 2 A

Name: _____

Approved by: _____

Date: _____

8. Condenser, water cooled, shell and tube

9. Thermostatic trap

10. Vent point

11. Filter and strainer in line

12. Hand expansion valve

13. Automatic expansion valve

14. Thermostatic expansion valve

15. Snap action valve

16. Scale trap

17. Vertical receiver

18. Water valve

19. Pressurestat

20. Pressure switch

21. Dryer

22. Straight size cross

Screwed

23. 90° elbow turned up

24. 90° elbow turned down

25. Reducing elbow 4 x 3

26. Expansion Joint

27. Orifice Flange

28. Angle Check Valve

29. Eccentric reducer

30. Tee (outlet up)

31. Pipe plug

32. Angle Globe valve (side view)

33. Long Radius 90° elbow

34. Lateral

Welded Pipe & Fittings

35. Connecting Low Pressure Steam Pipe

36. Connecting Low Pressure Return

37. Motor operated valve

38. Safety valve

39. Cock

40. Gate Valve

41. Check valve

42. General Stop Valve

Name: _____

Approved by: _____

Date: _____

A. Sketch the symbol for the pipe as well as the fitting or instrument:

1. Pressure reducing valve in high pressure steam line
2. Expansion joint in hot water heating supply
3. Check valve in high pressure steam return line
4. Line filter and strainer in a refrigerant liquid line ahead of an automatic expansion valve.
5. A cock screwed into a gas line
6. Show a lateral in a soil line above grade
7. Air eliminator in an air relief line
8. An expansion joint welded into high pressure steam line with anchor in one end and support on the opposite end.
9. Soil line below grade with 4 x 2 tee in line
10. Unit heater showing medium pressure steam supply and return with gate valve in supply and strainer ahead of Float and Thermostatic trap in the return.
11. Unit heater showing hot water flow and return

Name: _____ _____

Approved by: _____

Date: _____

B. Show the symbols for the following lines:

1. Boiler Blow off
2. Feed water pump discharge
3. Fuel oil flow
4. Vacuum pump discharge
5. High Pressure return
6. Hot water heating supply
7. Hot water heating return
8. Domestic hot water
9. Domestic hot water return
10. Refrigerant discharge
11. Refrigerant liquid
12. Refrigerant suction

C. Show the symbols for the following fixtures:

1. Recessed bath tub
2. Corner bath tub
3. Wall drinking fountain
4. Pedestal drinking fountain
5. Corner Lavatory
6. Water heater
7. Pedestal Lavatory

Name: _____

Approved by: _____

Date: _____

8. Urinal
9. Kitchen Sink
10. Laboratory Sink
11. Two-compartment Sink
12. Laundry Sink
13. Dental Lavatory
14. Syphon jet wall closet
15. Bidet
16. Shower stall
17. Gas outlet
18. Gas range
19. Floor drain
20. Shower head

Information Sheet
in
Plumbing and Pipe Fitting

Scale drawing may be defined as the ratio or relation between the drawing and the actual object or structure. Small objects can be drawn full size or may be enlarged in order to allow room for necessary notes, dimensions, and details.

In the plumbing and piping industry, the drawings most commonly used are reduced drawings of buildings or installations.

On a full size drawing, one inch on the drawing is equal to one inch on the object. On a half scale drawing, one inch would be represented by one-half inch or 6" = 1 foot.

The scale most commonly used for blueprints of the average structure is 1/4" to represent 1 foot or 1/8" = 1 foot. It is written: 1/4" = 1'-0" or 1/8" =1'-0".

The architect has a special rule with which to scale drawings. It has different scales marked on the rule. The journeyman usually has a folding 6-foot rule to use in all his work which often includes "scaling" a blueprint. In order to scale a drawing, the journeyman must first know the scale to which the drawing is made. It is found usually on or near the title of the drawing. As you know, the 6-foot rule normally used is divided into inches and fractions of an inch such as 1/2, 1/4, 1/8, and 1/16. On a drawing to 1/8" =1 foot, then 1" on the drawing would represent 8 feet and 1/16"=0'-6".

If the scale used in 1/4"=1'0, it indicates that each 1/4" on the drawing represents 12" or 1'. To scale such a drawing with a folding rule, measure the distance between the points whose distance you want to know, multiply this measurement by 4 and change any remaining fractions to inches by multiplying it by 12. If the scale is 1/2"=1', multiply by 2 and change the fraction to inches by multiplying by 12. If the scale is 1/8"=1' mulitply by 8.

Example: The distance measured on the blueprint is found to be 2-5/8". The scale of the drawing is 1/4"=1'-0. To find the distance between the two points measured, multiply 2-5/8' by 4. 4x2-5/8 = 10-1/2. Multiply the fractions 1/2 by 12 which equals 6. Then the actual full scale distance is 10'-6".

There are certain precautions that should be taken when it is recessary to scale a blueprint. Due to the fact that paper is easily affected by moisture, temperature, and other conditions, the scaling of a blueprint may be very inaccurate. In making blueprints, paper sometimes stretches or shrinks in the process of washing or drying. For this reason dimensions of a building, particularly if drawn to a small scale (1/8" - 1/4" or less) should not be scaled from a blueprint. Dimensions should be scaled from a blueprint only when the total of scaled dimension can be checked by a given dimension on the blueprint.

Another point in blueprint reading no less important and one that must not be overlooked by craftsman, is the matter of revisions. A revised blueprint is one on which changes have been made after completion. Two very important things must be remembered, first, to be able to recognize when and where revisions have been made; secondly, be sure that the latest revision is being used.

Revisions are commonly noted at the point of revision. If only a dimension is changed, the old one is circled and the new one added above or below. This change would probably be designated by a letter which would refer to the same letter near the title sheet with the date of the revision and the authorization.

The most important factor in any phase of Plan Reading is the ability to think and to take an interest in the job or duty which the craftsman is expected to perform.

Student Assignment
in
Plumbing and Pipe Fitting

Subject: SCALE DRAWING

Aim: To learn to accurately reproduce drawings of objects or details to the proper proportions.

To be able, if necessary, to determine certain dimensions by measuring that particular detail on a drawing or blueprint.

References: Information Sheet D P - AW 22 - 2 I & 3 I

Introductory Information: It has been suggested in assignment 2 A of this Apprentice Workbook that the apprentice should learn the symbols in order to be able to read the blueprints necessary to build an ordinary building. We will begin in this assignment to use these symbols as they will be used on blueprints in the trade. The apprentice should soon realize the value of the knowledge of the symbols.

Procedures: In order to be able to read a plan accurately to a certain scale, it is necessary for the apprentice to practice as well as study. Begin this assignment by drawing horizontal lines to scale specified for each line.

1. When scaling a blueprint, the lines on the blueprint are actually measured and the scale to which it is drawn is specified. Give the actual distance represented below at the scale specified:
   Example: 13 1/4" (scale 1/4" = 1 foot) = 52'-3", then 13 1/4" on this blueprint actually represents 52'-3".

A. 12" (1/4" = 1 foot) =

B. 12-1/8" (1/8" = 1 foot) =

C. 10-5/8" (1/4" = 1 foot) =

D. 7-3/16" (1/4" = 1 foot) =

E. 26" (1/8" = 1 foot) =

F. 19-19/16" (1/8 = 1 foot) =

G. 8-3/4" (1/2" = 1 foot) =

H. 12-7/8" (12" = 1 foot) =

I. 22-1/2" (1/8" = 1 foot) =

J. 15" (6" = 1 foot) =

K. 13-3/16" (1/4" = 1 foot) =

L. 2-3/8" (1/4" = 1 foot) =

M. 19-1/2" (1/4" = 1 foot) =

N. 26" (1/4" = 1 foot) =

O. 15-1/2" (1/4" = 1 foot) =

P. 9-3/16"(1/8" = 1 foot) =

Q. 4-3/4" (1/2" = 1 foot) =

R. 7-3/4" (1/2" = 1 foot) =

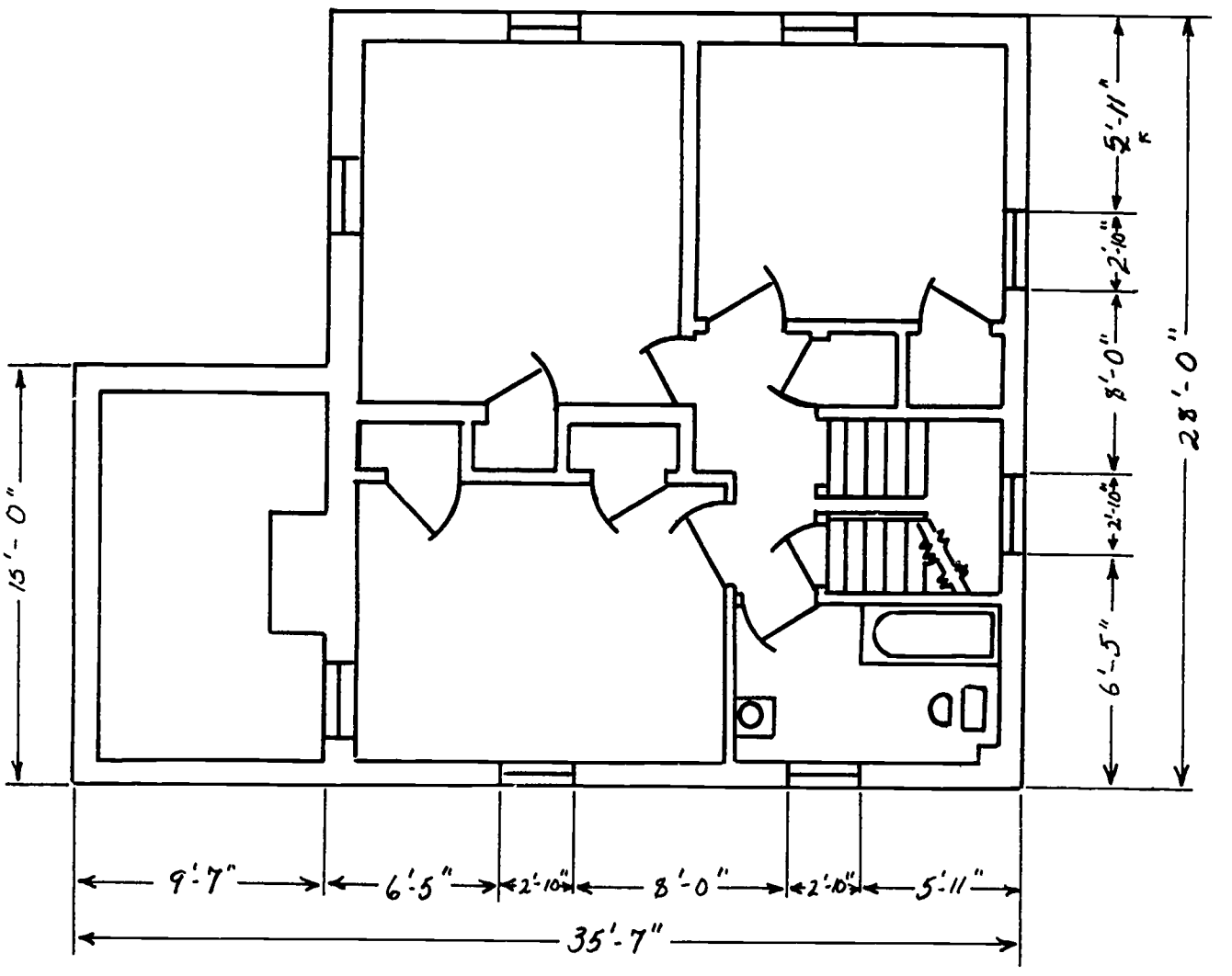
S. 8" (1/4" = 1 foot) =

T. 9" (1/8" = 1 foot) =

U. 9" (6" = 1 foot) =

SCALE DRAWING
Key: D P - AW 22 - 3 A
Page 3 of 3

2. Draw the floor plan shown below to scale of 1/4" = 1'. Use the 13 lb. bond paper and the 1/8" scale guide. Use any kind of a straight edge that might be available to a journeyman on the job.



3. On the sketch that you have just drawn of the floor plan to the scale of 1/4" = 1', what is the inside measurement scaled diagonally across the house from corner to corner _____

4. Scale the distance from the center of the lavatory to the bathroom door. _____

5. How much clearance is there between the bathtub and the wall for the water closet _____

Information Sheet
for
Plumbing and Pipe Fitting

Sectional views are drawings that are used when interior construction or details cannot be shown by outside views. In Figure 1, details of the interior construction of the drum trap's screw cap and ring can only be shown by a "section" view. The cap details are shown by half section while the ring is shown by full section.

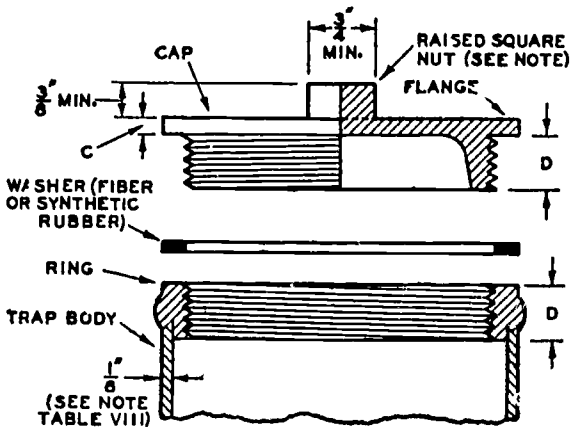
Sectional drawings are used extensively by manufacturers to illustrate their products for parts or price lists. Operating parts of the valves flushometers, controls and various instruments are shown by sectional drawings. Details may be shown by offset sections broken out or revolved sections.

The drawing of the Grayson Thermostatic control in Figure 2 is illustrated by a broken out section and a full section. The use of sectional views in this manner saves many words of description and provides information much more accurately and thoroughly to show the operation and details of parts.

Figure 3 illustrates the use of a full section as it may be used in construction blueprints. This use of a full section drawing is very typical of the manner in which it is used on all types of piping blueprints. Notice that section A-A does not show the hub on the clay pipe. The reason for this is that the section line "A-A" on the drawing is below the hub with the arrows pointing down, which indicates that the rack and pipe is viewed from that position in the section "A-A".

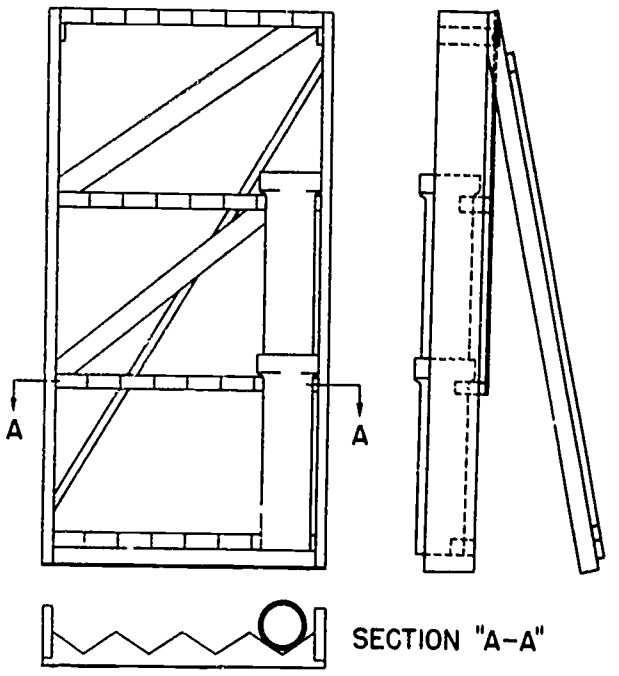
It is very important that the apprentice understands the use of section drawings. It is used extensively in all types of piping blueprints.

SECTIONAL VIEWS
Key: D P - AW 22 - 4 I
Page 2 of 2



DETAIL OF SCREW CAP AND RING
(SECTIONAL VIEWS)

Figure 1



Details of rack for pouring clay pipe joints with the pipe in vertical position.

Figure 3

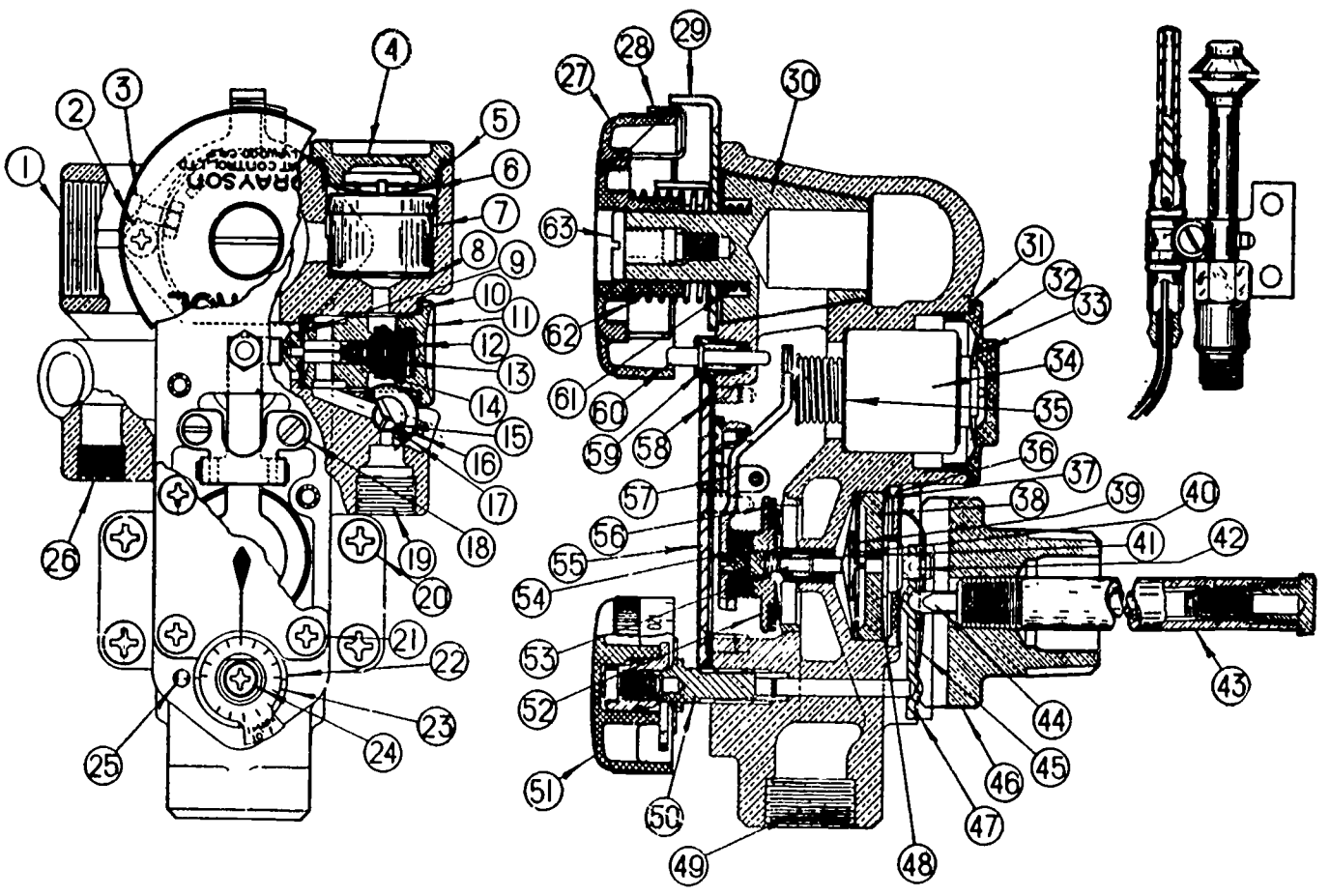


Figure 2

SECTIONAL VIEWS

Key: D P - AW 22 - 4 A

Name:_____

Approved by:_____

Date:_____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Sectional Views

Aim: To become familiar with the use of sectional drawings for piping blueprints.

References: Information Sheet D P - AW 22 - 4 I

Introductory Information: Sectional drawings or "sections" are used by the journeyman of the Plumbing and Pipe Fitting Industry to illustrate or transmit information to other people. He also must be able to read section drawings or blueprints which are necessary to show many details.

Procedure: Answer the question or make sketches as directed for experience in the use of "sections".

1. Identify the type of sectional drawings used in the figures below:

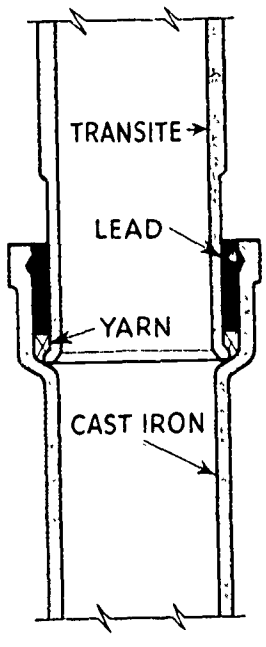


Figure 1

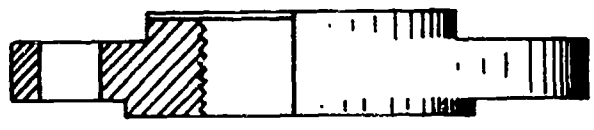


Figure 2

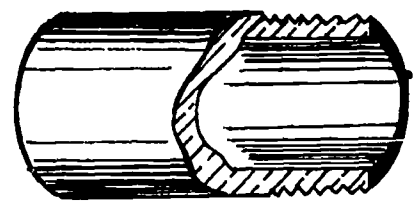


Figure 3

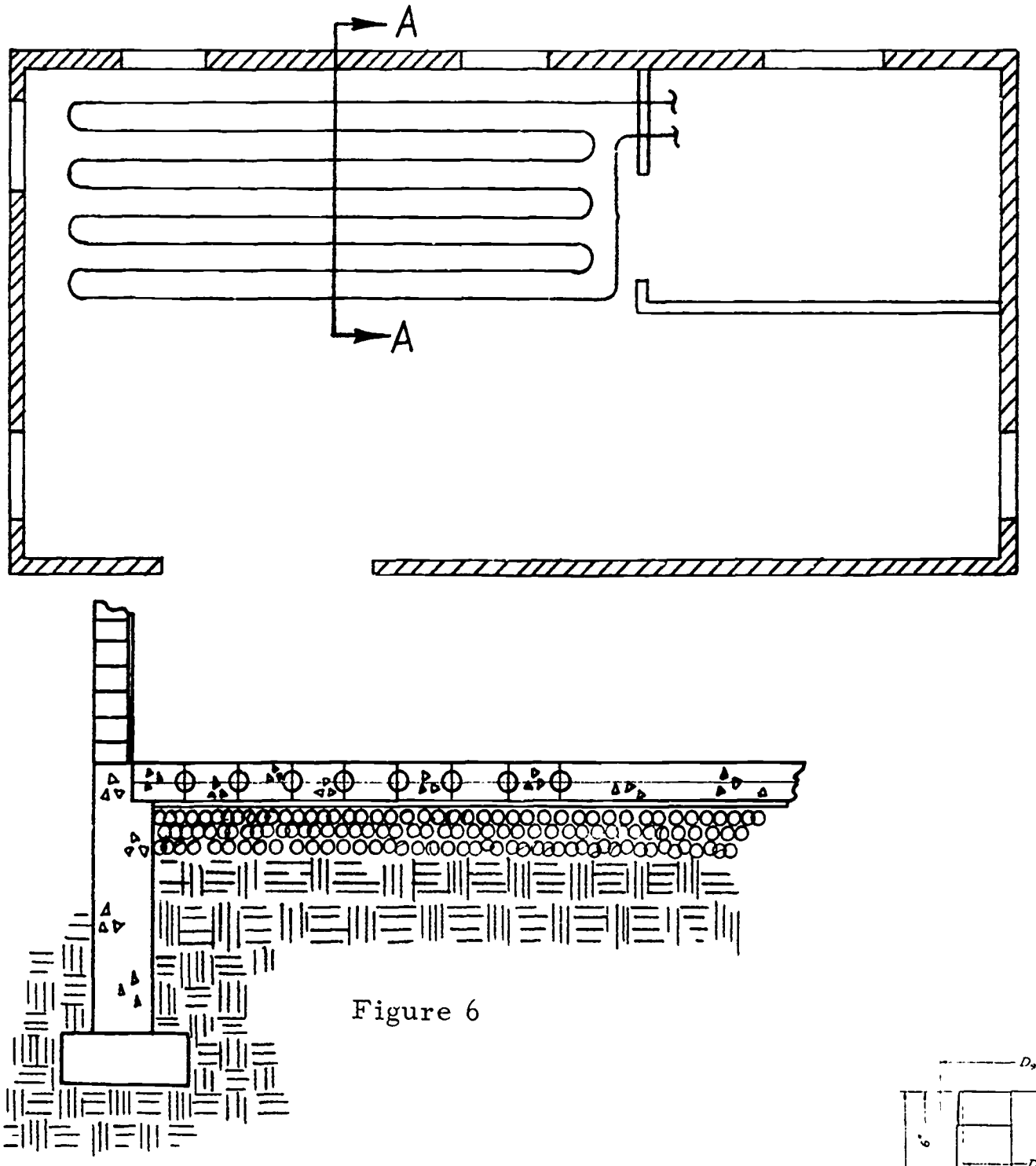


Figure 6

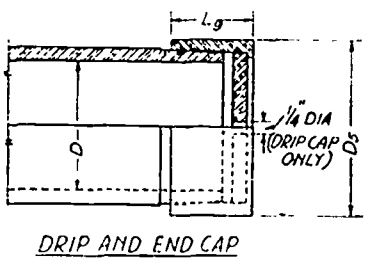


Figure 4

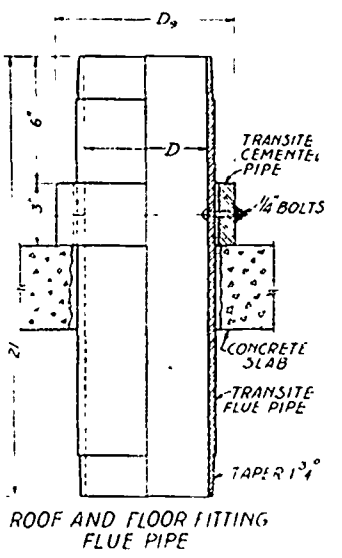


Figure 5

Student Assignment
in
Plumbing and Pipe Fitting

2. Using the single line drawing and proper symbols, draw a plan or elevation of a simple piping layout of at least three lines of pipe supported by a single ceiling hanger. By full section "A-A" draw a detail of the hanger showing the position and sizes of pipe and type of hanger. Show the point from which the section is taken on the plan of the layout. Letter necessary notes in the detail drawing.

3. Show a 1/2" - 25 pound cast iron Tee with steel nipple screwed into one end. Show nipple in the Tee by broken out section of that end of nipple and Tee. Take the dimensions for the fitting from a manufacturer's catalog.

Information Sheet
in
Plumbing and Pipe Fitting

Subject: ISOMETRIC DRAWINGS

Isometric drawing is a subject that is very important to the piping industry. No other type of pictorial drawing provides a picture of a plumbing or piping installation, which can be used as a working drawing since the true dimensions are shown. This makes isometric drawing valuable for estimating as well as instructing other journeymen as to how piping is to be installed.

Isometric sketches are easily made once the method or technique is learned. It is a method of illustration particularly adaptable to the Piping Industry.

Three points should be remembered.

a. Vertical lines of an object remain vertical in isometric drawings.
b. Horizontal lines are not horizontal in isometric drawings but are drawn at a 30° angle with the horizontal.
c. The lengths of the lines remain the same in isometric drawings as in orthographic.

The figures in Figure 1 are used as a guide to simplify the use of isometric drawings or sketches in the field. These figures show the axis along which vertical and horizontal lines are drawn. These figures may be adapted to individual use.

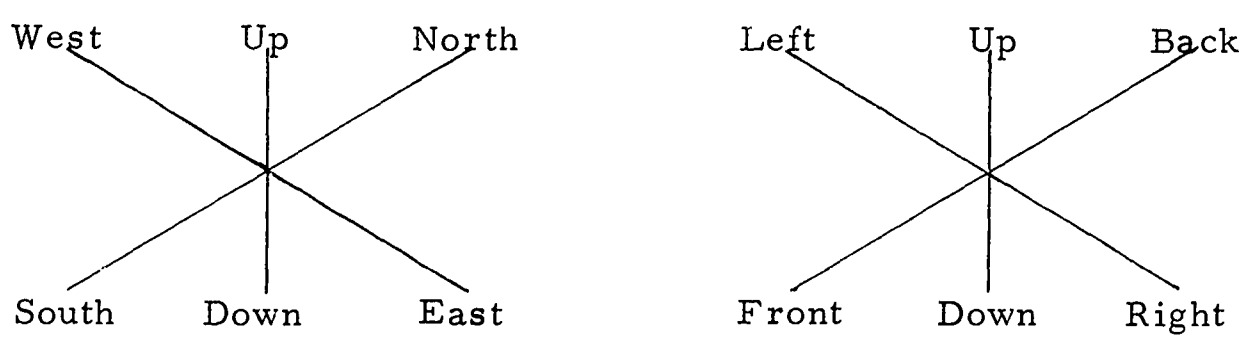


Figure 1

If the object to be drawn is rectangular, as in Figure 2, start the drawing with a point representing the front corner, as in Figure 3. The axes or sides of the rectangle first drawn at angles of 120 degrees with each other. This may be done by using the isometric scale sheet furnished or the "T" square and 30-60 degree triangle as shown in Figure 4.

All other isometric lines in the drawing of the rectangle are drawn parallel to these axes. The measurements of each side are made actual length along these axes. The rectangular block may be drawn by beginning at point "D" instead of "A" if necessary as in Figure 5.

The method of locating one part with respect to another is illustrated in Figure 6. The part is located by actual measurement from the drawing or measurement of the object and located from the isometric drawing or measured parallel to the primary axes. The true measurement of the part is taken from this point to measure the height, width and length of this part and is measured along the axes parallel to the other sides.

A hole or opening in the block may be determined in the same manner as shown in Figure 7 with the exception that hidden lines need not be drawn unless their use improves the understanding of the drawing. Drawings very often have non-isometric lines which cannot be measured directly. As in Figure 8, in order to draw an object with non-isometric lines, an isometric box may be drawn in the same dimension as the major dimensions of the box. Since the lines are not parallel, the distance "C" must be determined on the view drawing and marked on the isometric box.

In Step 3 under 8, the points are connected "A", "B", and "C" to form one side of the block. The remaining lines are drawn in the same manner as previously explained. Any angle may be drawn in isometric by determining the points of intersection of the sides of the angles with the lines of the isometric box.

A curved section of a block may be drawn in isometric by locating a number of points on the arc in a view drawing. In transferring these measurements to the isometric drawing after the isometric box has been drawn as shown in Figure 9. After the arc is determined by drawing through the pre-determined points, the object is completed as shown in Step 3, Figure 9.

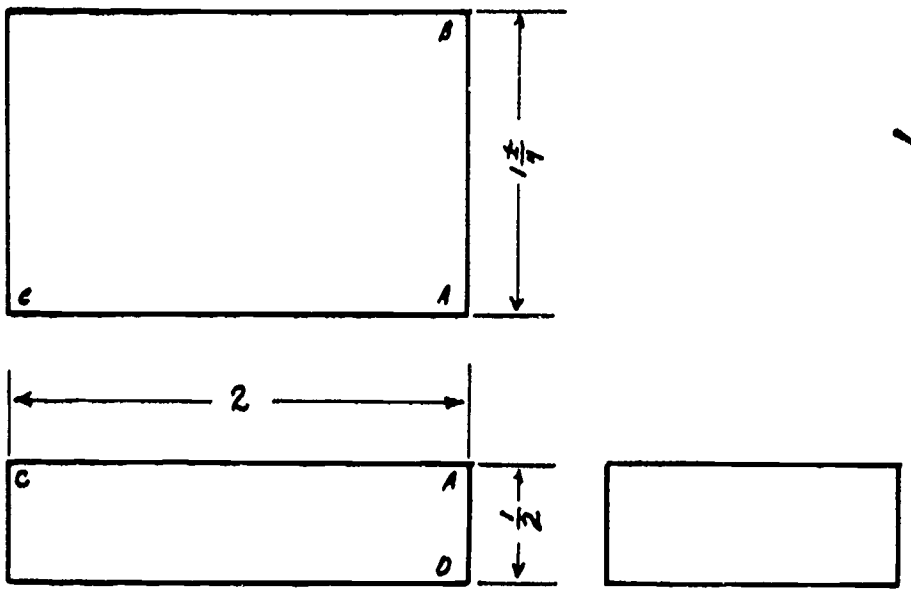


Figure 2

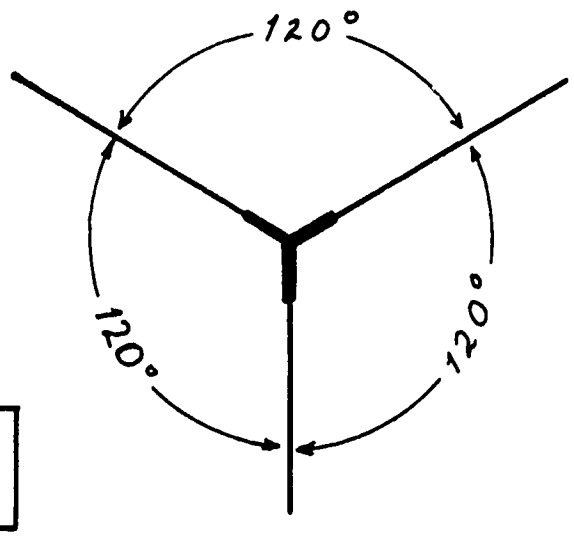


Figure 3

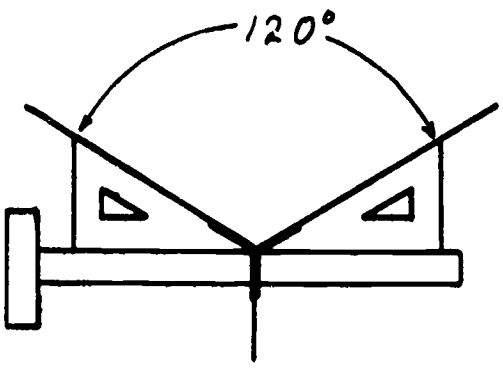


Figure 4

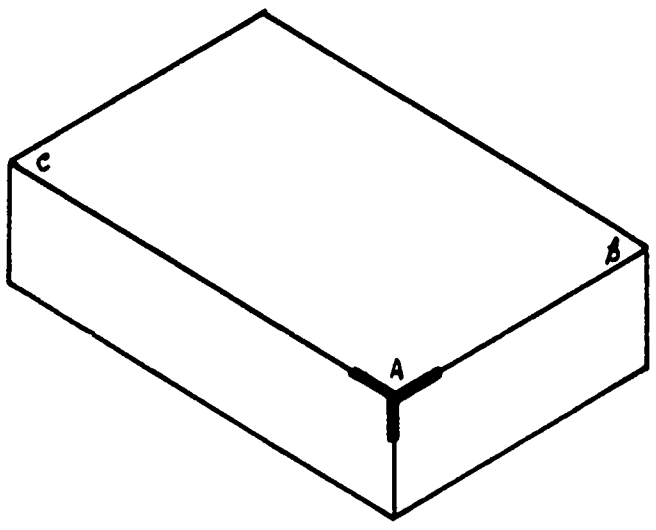
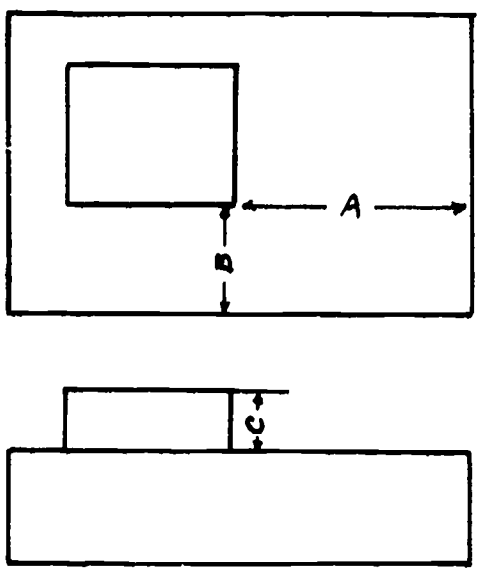


Figure 5



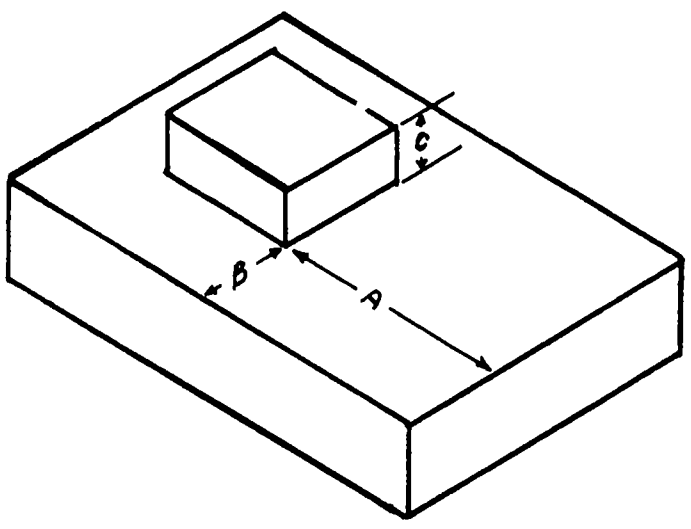


Figure 6

A circle appears in an isometric drawing as an elipse or an oval which is drawn by a four center method as shown in Figure 10. This method is not the most accurate, but for all practical purposes, is sufficiently accurate and is the most simple to use. The isometric square is first drawn the same as the desired diameter of the circle on the same axis as previously studied, Step 1, Figure 10. Draw perpendicular lines from the mid-point of the side of the isometric square to the opposite corners, Step 2, Figure 10. The two corner inter-sections are centers for the radii of the large arcs, Step 3, Figure 10. This method should be learned step by step in the manner illustrated and will become a very simple method with a little practice.

A cylinder such as a section of pipe or a cylindrical tank may be developed by using the four center method and the isometric box as illustrated in Figure 11. First draw the box to the dimensions of the cylinder then determine the shape of the end view by the four point method shown in Figure 10.

It is necessary to gain a knowledge of the principles of isometric drawings and the apprentice should be able to use these principles which we will learn by practice. The most important use of isometric drawing to the journeyman of the piping industry is that applied to running lines of pipe or plumbing layouts. We will attempt to apply these principles that we have learned by making isometric drawings of simple piping layouts, as shown on the Mechanical Drawing of the Poultry Lab and Classroom. On the isometric drawings of piping layouts, the points are located on the various floors shown in the plan views and the direction of pipe shown by proper symbols on the plan view. From this, plus the dimensions given, the journeyman should be able to read an isometric drawing as taken from a plan for the purpose of estimating the material or cost of the job.

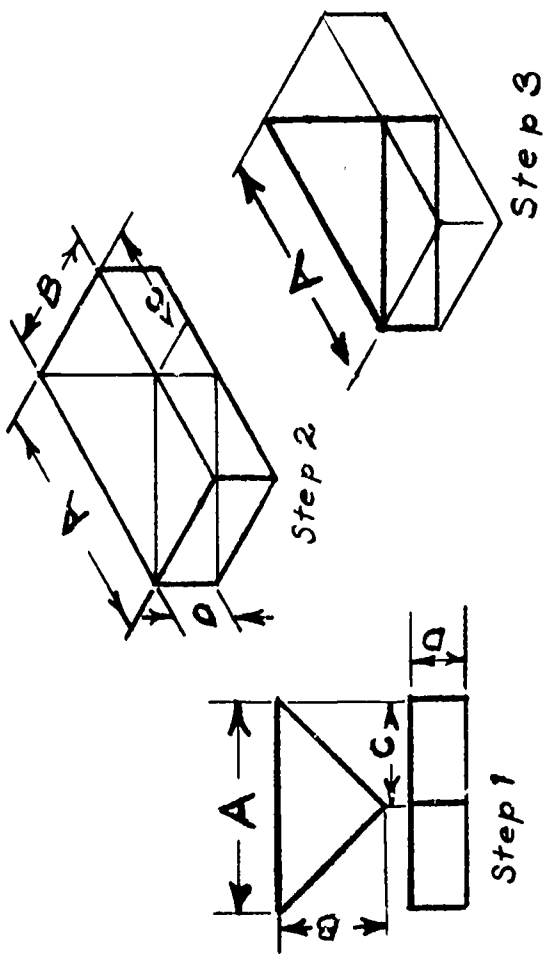


Figure 8

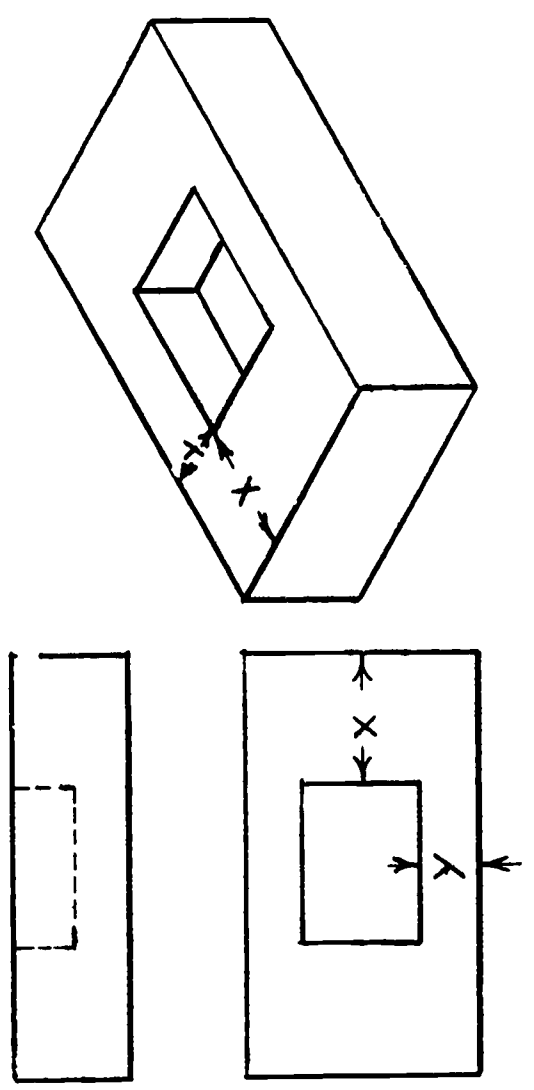
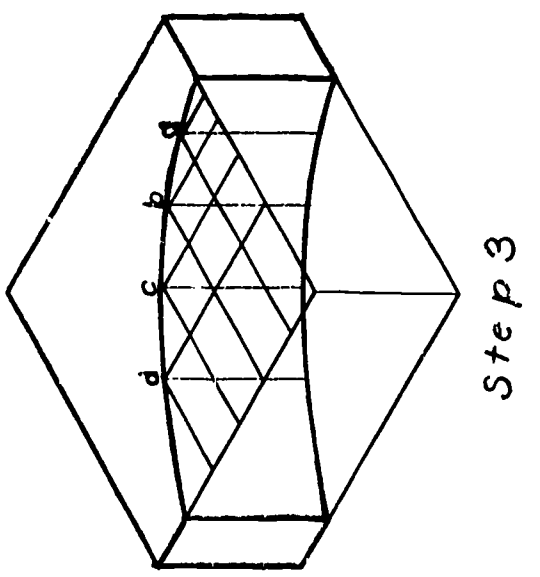


Figure 7



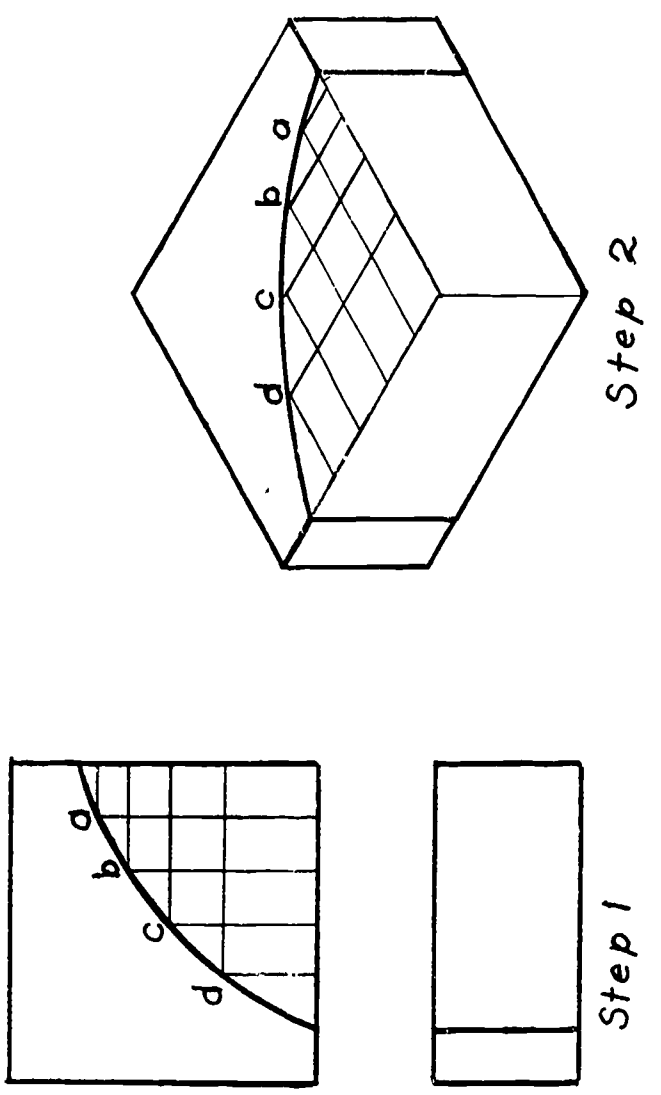
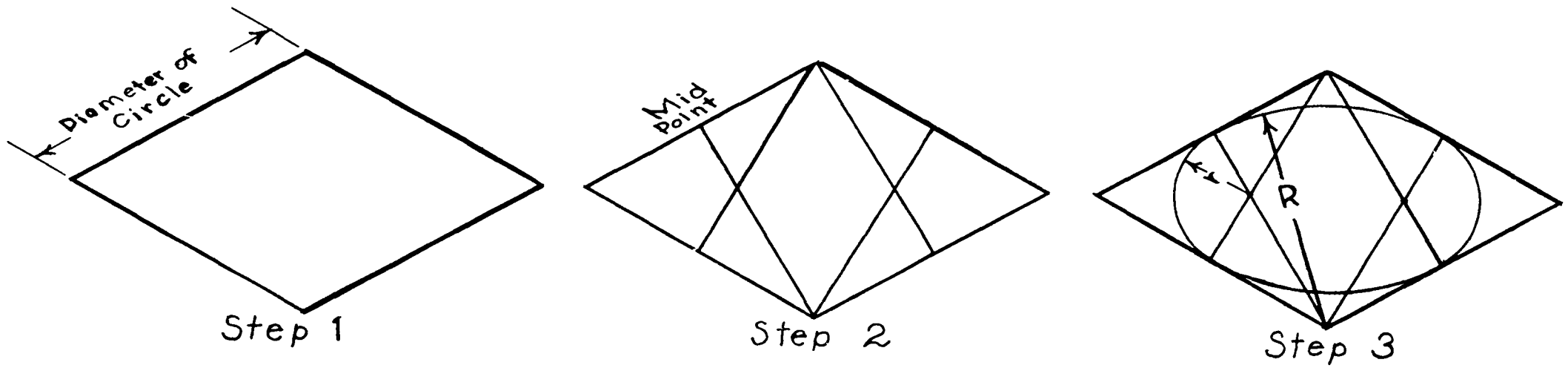
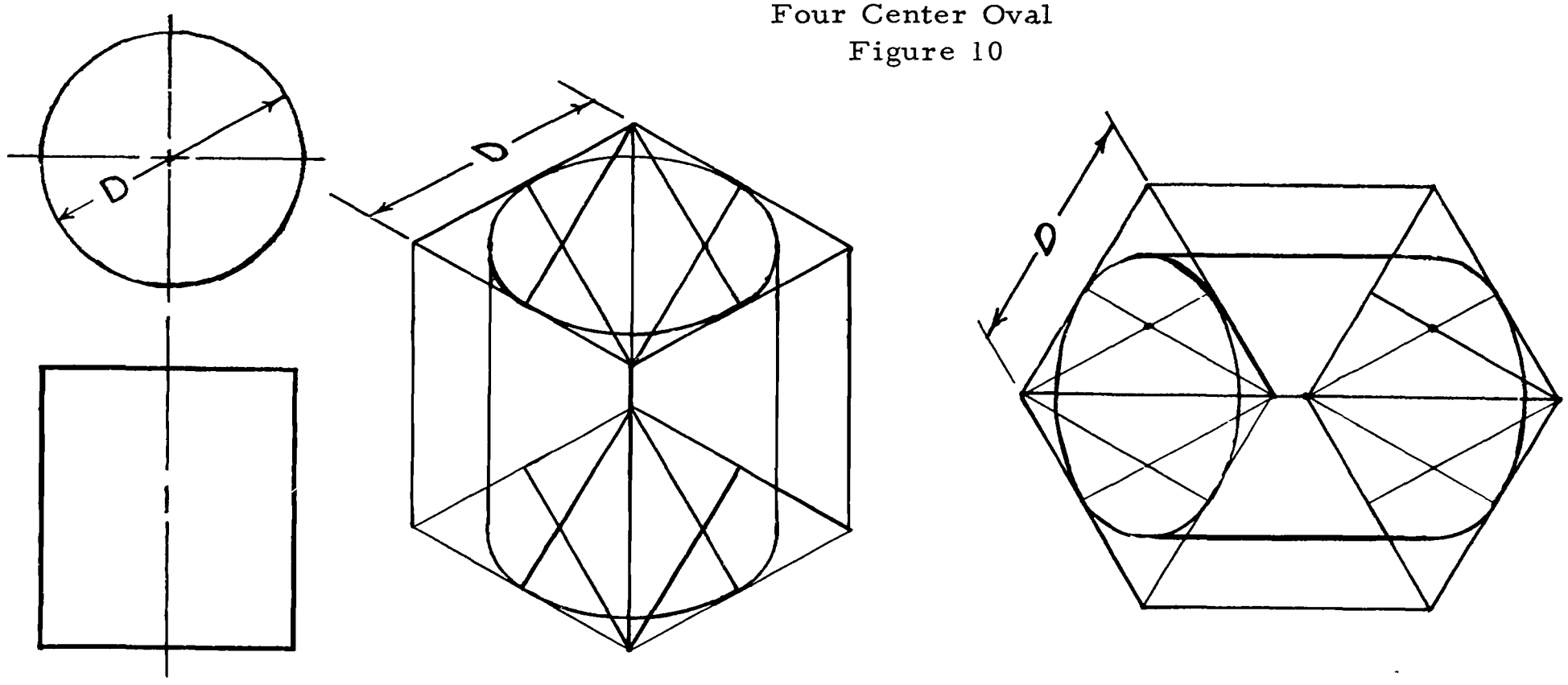


Figure 9



Four Center Oval
Figure 10



Cylinders by the four center oval method
Figure 11

ISOMETRIC DRAWINGS
Key: D P - AW 22 - 5 A

Name: _____

Approved by: _____

Date: _____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: ISOMETRIC DRAWINGS

Aim: To learn the principles of isometric drawing well enough to be able to use it on the job as applied to the piping industry.

References: Information Sheet, supplemented, if necessary, by a good drawing book from the school library. *
Building Plans for Classroom and Laboratory Buildings Sheet # 2, M-1, and M-2.

Introductory Information: Isometric drawing is quite different from any drawing that we have done in this course previously, but with practice and some concentration, the principles should be easy to learn and applied very practically. To craftsmen of the piping industry, it is a very necessary method of illustration.

Procedure: 1. Using the isometric scale guide furnished and the 13 lb. bond paper draw isometric views of the objects illustrated by the drawings. Figure 1, 2 and 3.

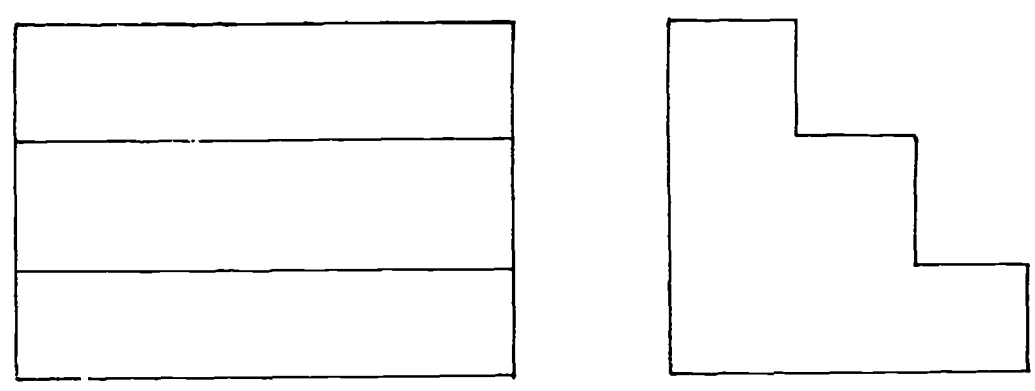


Figure 1

* French & Svensen, etc.
French & Verick, etc.

Name: _____

Approved by: _____

Date: _____

Student Assignment
in
Plumbing and Pipe Fitting

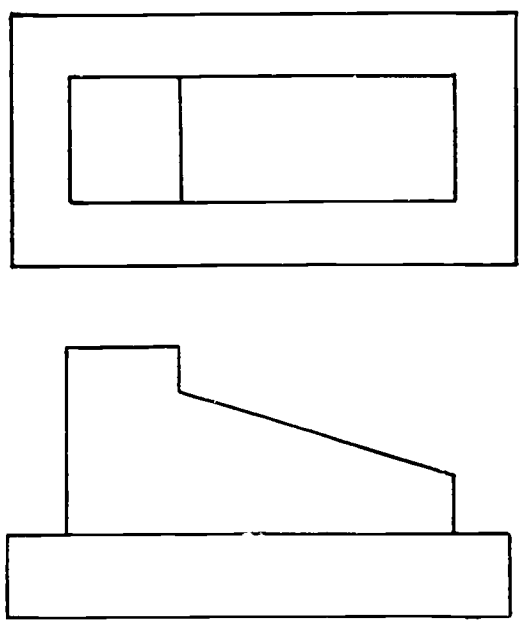


Figure 2

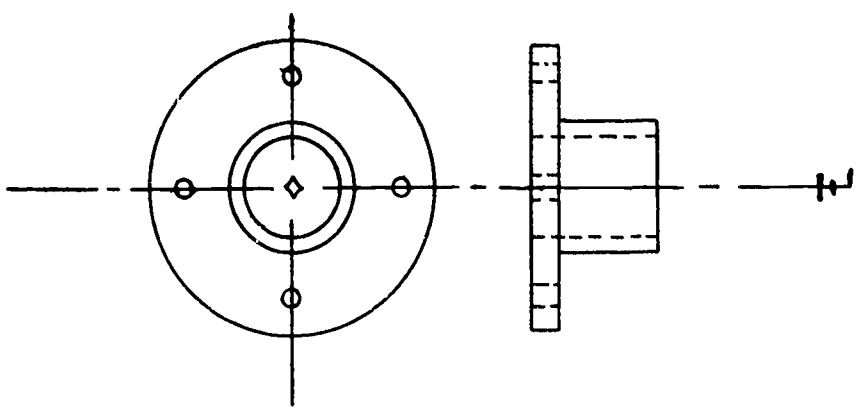
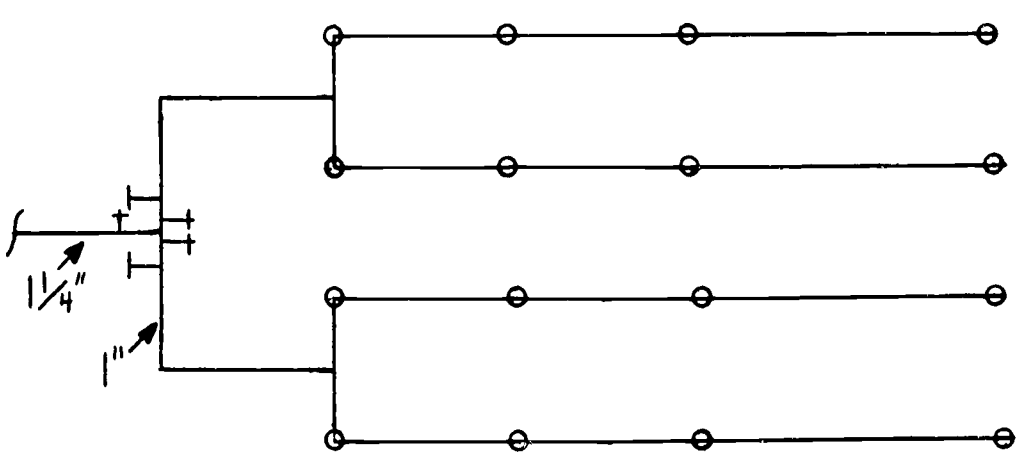


Figure 3

2. Make an isometric sketch of the lawn sprinkling system shown below.



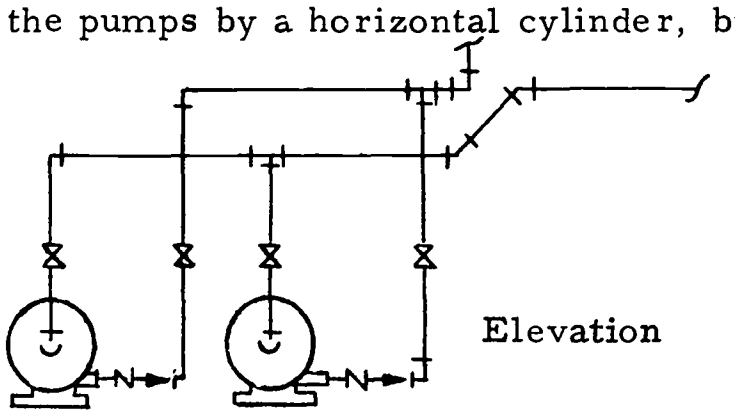
Name: _____

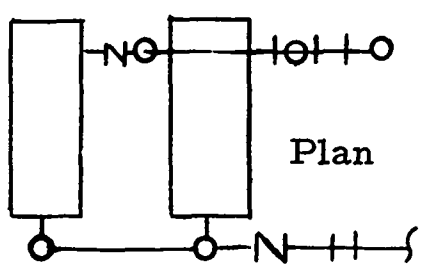
Approved by: _____

Date: _____

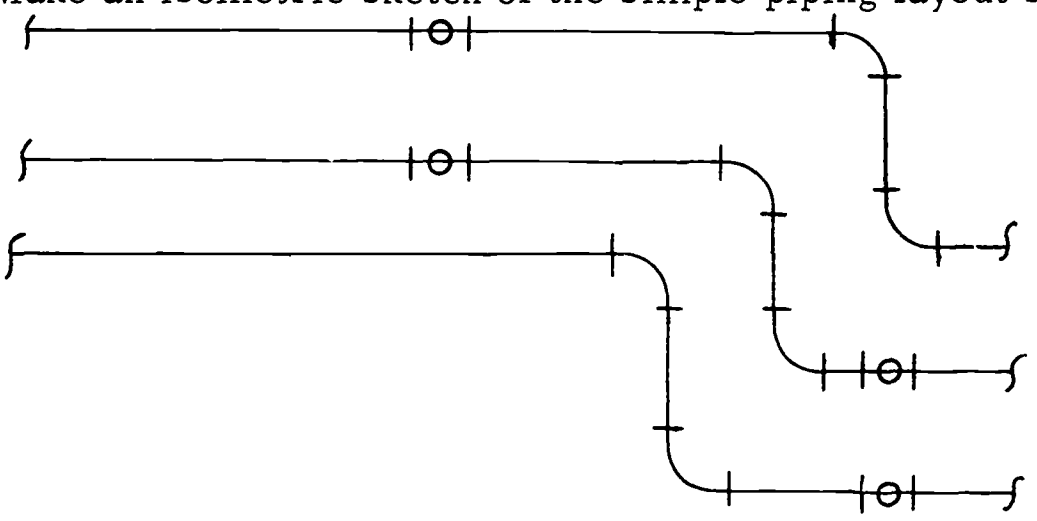
Student Assignment
in
Plumbing and Pipe Fitting

3. Draw a detail of the pumps and piping layout, as shown below, by an isometric sketch. Show the suction header and discharge header. Represent the pumps by a horizontal cylinder, but show valves and fittings.

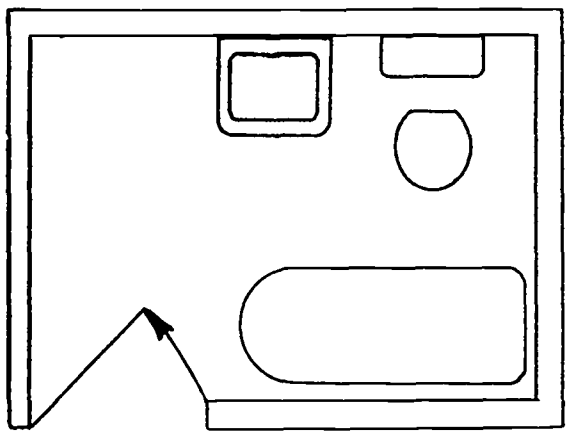




4. Make an isometric sketch of the simple piping layout shown below:



5. Draw an elevation of the soil and vent piping for the lavatory and water closet in the layout shown by the plan below. Make an isometric sketch of the piping layout.



Information Sheet
in
Plumbing and Pipe Fitting

Subject: BLUEPRINT READING

Working drawings are intended to be complete enough in their instructions to enable the contractor to build a structure and to estimate the cost. In order to do this, a working plan must be comprised of several types of drawings.

A set of architect's drawings are usually comprised of plot plans, floor plans, elevations, sections, scale details, mechanical drawings, and shop drawings.

The plot plan usually show the following:

1. The boundaries of the property
2. Location of the building
3. Water mains, sewers
4. Walks and driveways
5. Out buildings

A Floor Plan, as has been illustrated previously, is a horizontal section taken at a level where it will show as many of the details as possible such as this is commonly referred to as the "general" plan and the one from which many of the dimensions must be taken.

1. Walls and partitions
2. Windows and doors
3. Fire places
4. Closets
5. Types of materials
6. Lighting outlets
7. Location of plumbing and heating

Elevations show the exterior or outside of the building. They may be designated as front, right and left side elevations, or North elevation, South elevation, etc. Elevations show the following:

1. True picture of the side of the building
2. Type, size, and material of:
   a. Windows
   b. Doors
   c. Cornices
   d. Other details of design

Sections show interior structural arrangements that cannot be shown on floor plans or elevations. Sections referred to on the architectural drawings are usually vertical sections. A building construction section may be thought of as having a saw large enough to cut the building in half from the roof through the foundation.

Scale Details - There are certain parts of nice homes, large structures and industrial installations that must be shown by a larger scale or "special details" in order to give a clear understanding of their construction or design.

The following are some of the things that require special details:

1. Entrance doorways
2. Chimneys and fire places
3. Special Windows
4. Stairways
5. Boiler fittings and piping
6. Details of heating equipment
7. Fabrication of industrial piping

A structure such as the "Classroom and Lab. Building" for the Poultry Husbandry Department requires special details such as the following:

1. Numbers 1 and 3 above
2. Folding partitions
3. Classroom blackboards
4. Special cabinets and laboratory equipment
5. Refrigerator rooms and equipment
6. Sterilizer room
7. Heating equipment

Full Size details are not used by the piping industry as often as the other building trades. For example, trim, sash, ornamental work, molding, and special arrangements of mechanical equipment in some cases.

Notes: Although most sets of blueprints are accompanied by definite specifications, the architect and engineer furnish numerous notes and sub-titles which eliminates guessing to a great extent. A craftsman should never take the responsibility of making any change without authorization of responsible persons.

There are a number of drawings or details that do not directly pertain to the piping industry, but the piping or plumbing contractor must be familiar with the entire set of blueprints and be able to understand them since some part of his work will be adjacent to practically every type of equipment or structure in the building. He is directly responsible for mistakes or damage done to any part of the building in the process of construction or installation of plumbing or heating equipment. Type of construction and equipment in the building may present certain problems for which allowance must be made by the estimator to avoid unforseen expense. The journeyman must also be familiar with the equipment in, and construction of, the building because his knowledge and experience is a vital and necessary factor in the construction of a building of any size or type.

We suggest that as the apprentice studies this assignment #6, he should not try to memorize any part of it. By referring to the three drawings furnished or a complete set of drawings, it will be more practical and he will have learned the information more thoroughly as he applies this information to actual working drawings instead of trying to memorize it.

Specifications - Specifications are the written description of the work. They cover features of the work not covered in the drawings such as the quantity and quality of building materials and the standards of workmanship.

Specifications merely suppliment the working drawings and vice versa. The drawings furnish what the specification cannot and the specifications describe what the drawing cannot.

For example, in the specifications furnished with the plans of the "Classroom and Lab. Building", Page VII, compare the information given on the boiler compared to that of the blueprint.

On Page IV, compare the specification for "Gas Piping" and the description on the drawing.

By comparison, we may see that in practically every case mentioned, the specifications and drawings are each supplementing the other.

Very interesting as well as informative stipulations are noted in "General" section, Page I, parts (d)-(e)-(f)-(g) and (h).

Sheet M-1 and M-2 of the drawings furnished are only two sheets of the mechanical drawings which in turn are only one section of the entire set of drawings necessary to build this structure.

The following is a list of the drawings that comprise the complete set as furnished the contractor from which to make his estimate for the bid for this building:

CLASSROOM BUILDING
for
Poultry Husbandry Department

Sheet 1 Plot Plan

Scale: 1' - 60"

A. Classroom and Lab Building
B. Staff Cottages
   1. Superintendents House
   2. Three laborers cottages
   3. Students dormitory
C. Brooder Houses
D. Broiler Houses
E. Breeder Houses
F. Trap Houses
G. Utility Houses
   1. Feed Storage
   2. General Storage
   3. Garage Storage
   4. Litter
H. Houses for breeds and varieties
I. Turkey Houses

Sheet 2

A. Floor Plan	Scale: 1/8" = 1' - 0"
B. Roof Plan	Scale: 1/16" = 1' - 0"
C. Door and Window Schedule	Scale: 1/4" = 1' - 0"
D. Toilet Elevation	Scale: 1/2" = 1' - 0"
E. Room Finish Schedule	

Sheet 3

Southwest elevation	Scale: 1/8" = 1' - 0"
Southeast elevation	
Northeast elevation	
Northwest elevation	
Longitudinal section	
Transverse section	

Sheet 4

6 miscellaneous construction details

Sheet 5

Wall sections	Scale: 1 1/2" = 1' - 0"
Door and Window details	

Sheet 6

Details cabinets	Scale: 1/2" = 1' - 0"

Sheet 7

Sections through storage and refrigeration room

Sheet 1-S

Foundation Plan	Scale: 1/8" = 1' - 0"
Sections	
Details	

Sheet 2-S

Roof framing Plan — Scale: 1/8" = 1' - 0"

Sheet M-1

Boiler schematic — No detail

Sheet M-2

Plumbing, piping and refrigeration details

Sheet M-3

Electrical wiring details

We have attempted to furnish typical drawings which journeymen of the plumbing and piping industry work from ordinarily. The methods and principles of individuals may vary, but reputable architects and engineers as these men represent, generally follow an established pattern or standard.

As in any other phase of the trade, the apprentice must keep in touch with blueprints of the industry and use the knowledge acquired in order to broaden his knowledge and experience. A good journeyman must be proficient in plan reading.

Student Assignment
in
Plumbing and Pipe Fitting

Subject: READING BLUEPRINTS

Aim: To learn to use some of the basic principles of plan reading that have been previously studied by actually working with drawings and specifications.

References: Information Sheet
Working Drawings for Classroom and Laboratory Building
Specifications for Plumbing and Heating in "Classroom and Lab. Buildings"

Introductory Information: Notice that although the plan of the Classroom and Lab Building #M-2 has a legend giving the symbols used on this drawing, there are still other symbols used which the Craftsman is expected to know and understand since they are generally standard symbols.

Also notice on or near the title strip of both drawings, there is the architect's seal as well as the seal of approval of engineers and other persons of authority. Make a practice never to change a dimension or vary from the instructions given without the proper authorization.

Procedure: The first step that should be taken in estimating or starting construction is to become familiar with the plans and specifications. By answering the following questions true or false we shall have learned enough to form a general mental picture of the job.

1. Answer the question "T" for true and "F" for false.

   a. The plumbing and heating specifications were taken from set No. 1 of the specification of construction of the Classroom and Lab. Building. _____

Continued -

b. Arch C. Baker, Architect, and J. W. Hall, Assistant to Architect. _____

c. Plumbing must be in accord with the plumbing code of the City of College Station as well as A&M University _____

d. In case a conflict should occur between the specifications and the blueprints, the blueprints shall be taken as the corrected _____

e. All work must be done by skilled mechanics or be under the supervision of the same. _____

f. All drawings will be furnished by the Architect. _____

g. Where manufacturers names are mentioned concerning certain equipment, other brands may not be substituted. _____

h. Bleeding Shackles are to be installed at the hight point of the return mains of the heating system. _____

i. Four inch vitrified clay sewer pipe is to be run from a point approximately five (5) feet from the building to a manhole about 60' behind the building. _____

j. Shower fittings shall be concealed two valve type built-in showers. _____

k. Hot and cold water shall be roughed in to the shower 1/2". _____

l. The outdoor anticipator shall be mounted in outside air in a location not affected by the sun heat. The chronotherm will be located in the corridor. The two controls work together to control the frequency of the circulator. _____

m. Sinks and lavatories shall be cast iron, enameled equal to "Kohler Sutton" and "Kohler Ashley".

Continued -

n. Heating piping mains shall be suspended from the ceiling joist in the manner specified under "Supports". Piping shall be of sizes noted on plan. _____

o. Type of boiler specified shall be of the cast iron, sectional, hot water, heating type. _____

p. Upon completion of work the general contractor is responsible for clean-up work. _____

q. The 20-gallon welded steel expansion tank shall be constructed according to A&M University System Code. _____

r. The plumbing contractor is completely responsible for placing roof flashings of all vents extending through the finished roof. _____

s. The contractor shall quarantee all materials, equipment, and workmanship for a period of one year from, and after the date of acceptance of the work. _____

t. All gas lines will be tested at a hydrostatic pressure of 150 p. s. i. for a period of one hour. _____

II.
The scale of Sheet M-2 of the "Classroom and Lab. Building" will be taken as 1/4" = 1'-0". The isometric drawing of P-1, P-2, P-3, and P-4 are not drawn to scale.

a. To begin roughing in a building of this type, the first material on the job will probably be castiron soil pipe. Disregarding the fittings at present, estimate and amount of soil pipe of various sizes necessary to lay the waste lines under the slab as shown on the plan view by scaling the plan.

III.
List the fittings and give the specifications for both hot and cold water mains only, through the entire length of the building take off as shown on print.

Note: Disregard ventilating fan.

IV.

a. Give specification for the refrigerant lines and fittings.
b. Describe the evaporator for the egg storage vault.
c. What is the capacity of the specified refrigerant compressor.

V.

a. Referring to Sheet #2 of the "Classroom and Lab. Bldg.", what is the measurement from the rear outside wall to the center of the floor drain in room #25?

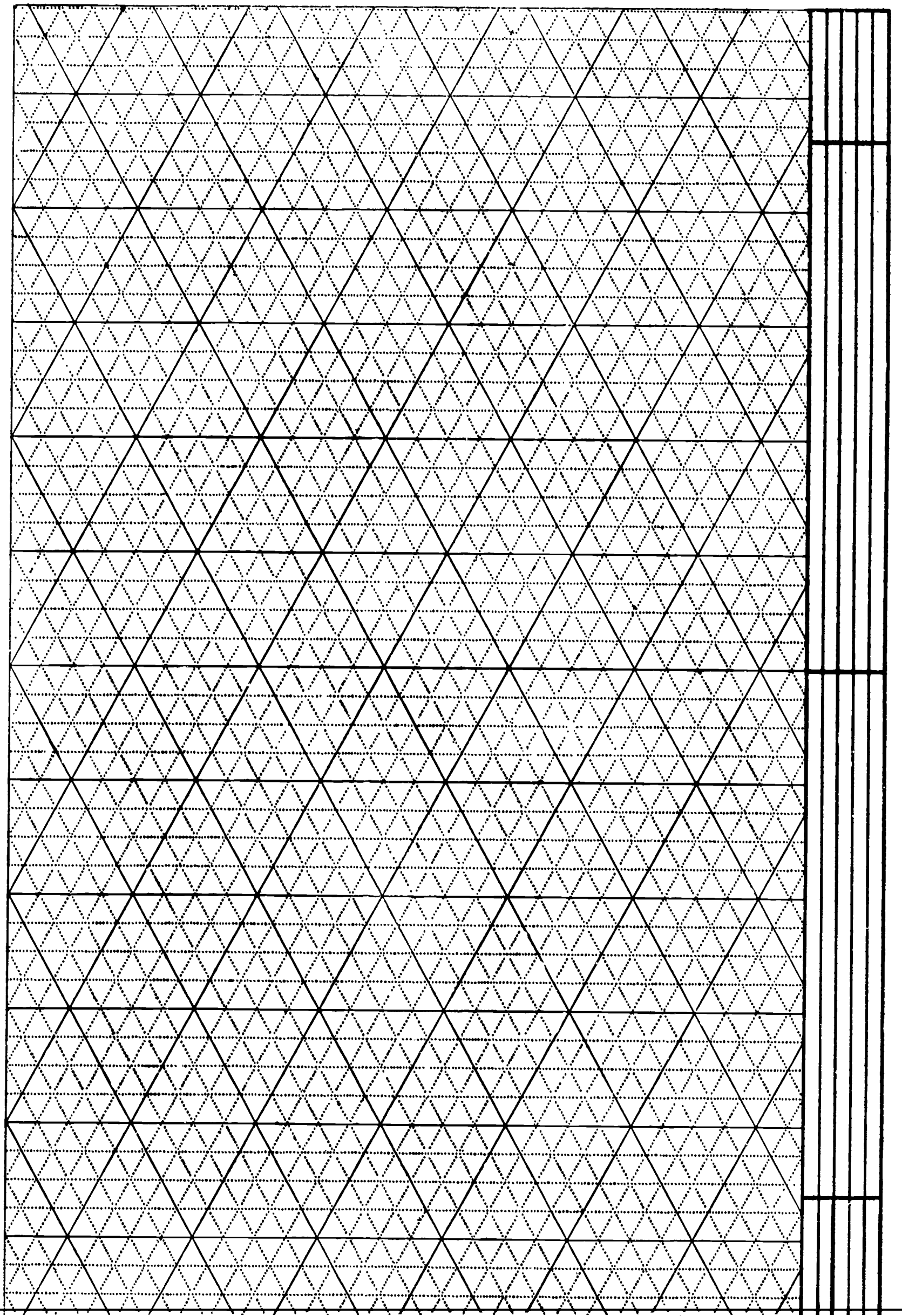
b. What is the area of room #5?

c. In what room is the "ceiling scuttle" to be located?

d. What is the floor, base, wall, wainscoat, and ceiling finish to be in rooms 10 and 18?

ERIC

ISOMETRIC SCALE



SPECIFICATIONS

For the construction of

A CLASSROOM & LABORATORY BUILDING

For the

Poultry Husbandry Department

At the

TEXAS A&M UNIVERSITY

College Station, Texas

Project No. I-A-307

SET NO. 2

Arch. C. Baker, University Architect

ERIC

Plumbing and Heating Specifications

Reference is made to Part I of this specification which applies to the plumbing and heating and Part I is hereby made a part of these Plumbing and Heating Specifications.

The Plumbing and Heating is to be included as a part of the General Contract. The Consulting Engineer for this work is J. W. Hall, Jr., Bryan, Texas.

General: (a) The work covered and included in this part of the specifications consists in the furnishing of all labor, materials, equipment, plant fixtures, tools, and transportation necessary for the installation of a complete plumbing and heating system as shown on the plans and/or hereinafter described. The plumbing and heating shall include cold water piping, wastepiping, sewer service, butane tank, gas service, gas piping, hot water heating piping, convectors, boiler, heating controls, valves, traps, drains, plumbing fixtures, refrigeration equipment and piping, and all incidentals for full function of each unit in the systems.

(b) All work shall be performed in accordance with the plans and specifications and in accordance with the rules and regulations of the State of Texas for plumbing, as well as the governing rules and regulations for the City of College Station and Texas A&M University.

(c) It shall be the responsibility of the Contractor to visit the site before submitting a proposal in order that he may become familiar with all phases of work under this Contract. Failure to do so shall not relieve him of the burden of omissions on his part, made because of his incomplete knowledge of the situation. Should the Contractor during the preparation of his proposal find conflict between existing conditions and the work as planned, it shall be his responsibility to notify the Architect without delay so that corrections may be made before proposals are submitted.

(d) Plans and specifications have been prepared as a supplement one to the other and work shall be accomplished as shown and/or specified. In the instance that a conflict shall occur between the plans and specifications, the specifications shall govern. In the instance of conflict between general dimensions and detail dimensions, the detail dimensions shall govern.

(e) All plumbing shall be installed with proper regard for, and in harmony with, the general or other construction. General construction adjacent to plumbing work shall not be damaged or weakened, and should any question arise as to placement of lines or fixtures, reference shall be made to the Architect for instructions.

(f) All work shall be done with skilled mechanics. All material and equipment shall be new and the best of their respective kinds, also the latest design or type of product made by the manufacturer.

(g) All work shall be properly protected during construction including temporarily plugging lines as necessary.

(h) Shop drawings, as necessary, shall be furnished by the Contractor, in accordance with requirements of Part I of this Specification.

(i) No payment for plumbing permit or inspection will be required.

Substitute Materials: (a) Where manufacturers' names are mentioned in those specifications, it has been done in order to establish a standard. The products of others than the particular manufacturers mentioned will be acceptable, if of suitable type and construction, but any substitution must be of quality as good, or better than the named articles, and be subject to the approval of the Architect.

(b) On being awarded the Contract for this work, this Contractor shall within thirty (30) days submit for approval by the Architect a complete list in triplicate of the materials which he proposes to use. This list shall give the manufacturer's names and designations corresponding to each and every item; and where submitted material is different from that specified by name, the submission shall be accompanied by complete descriptive literature and/or any supplementary data, drawings, etc., necessary to give full information and complete details.

(c) Any item on this list which is rejected on account of unsuitability or inferior quality, must be replaced by acceptable items within two (2) weeks following notification to the Contractor of such rejection. If no satisfactory material is submitted within two (2) weeks, then the Architect and Engineer reserve the right to notify the Contractor as to type and make of materials he will be required to furnish, which will be these specifically named in the specification.

Excavation: (a) Perform all excavation and backfill necessary for the installation of piping occuring below grades. Excavation shall be done true to grade so that all pipe shall rest on firm undistrubed earth. All backfill material covering the pipe shall be free of debris, and be thoroughly wetted and tamped in place.

(b) In all places where the piping below grade is to be covered by a floor slab, the backfilling material shall be firmly compacted in accordance with the Architect's requirements for preparation of foundation earth.

Temporary Facilities: Install for use by all on this job three temporary water supply outlets terminating in hose bibbs with 3/4" hose connections. Location for these outlets shall be as directed by the General Contractor. On completion of this job, the Plumbing and Heating Contractor shall take up and remove all temporary water lines and outlets.

Sewer Service: Extend and connect a 4" vitrified clay sewer service line from the several points approximately 5' outside the building to a manhole about 60' directly behind the building. Install clean-outs in each of the several locations indicated, and make connection to the manhole with a standard drop manhole connection. All tile service piping shall be made up of first quality, hard-burned, salt-glazed clay tile of bell and spigot pattern. Each tile joint shall be carefully inspected for soundness and clean bore, free of blisters and irregularities. Make all joints with twisted oakum rammed tight to a depth of 3/4" in the annular space of the bell, and then fill the remainder of the annular space with hot asphaltum mastic poured in place by the use of "running ropes".

Lay all sewer service piping true to a uniform grade of 1" in 15'. The barrel of each joint of pipe shall rest on firm undesturbed earth, and access for pouring joints shall be accommodated by bell holes at each joint. Install tile or cast iron clean-out positions indicated on Plumbing Plan.

Water Service: Water service will be extended to a point 5' to 15' outside the back of the building in the approximate location indicated. Make connection to this service line and install 2 1/2" bronze-bodied wedge-disk gate valve with 3/4" gate valve drain in tee branch. Cover stop and drain valves with 12" diameter cast iron meter box, having keyed cast iron removable cover.

Gas Service: Extend a 2" black steel gas service line from the stop and drain at the butane tank to the first point of entry into the Poultry Husbandry Classroom and Laboratory Building. Grade all piping with a reverse pitch toward the butane tank, and install at a depth of not less than 18" below the finished grade. Cut all pipe accurately to length, ream to full bore, and thread with new, sharp, full taper, standard pipe threading dies. Use only graphite and linseed oil as joint compound. Rise not less than 6" above the finished grade at each point of entry into the building, and install a roundway "T" head iron-bodied gas stop of full branch line size.

Paint all gas service piping with heavy coat of hot asphaltum mastic after testing and before backfilling.

Test as hereinafter described.

Butane Tank: Furnish and install in approximate location indicated on plans one 1000 gallon Butane Storage Tank arranged for above ground mounting. Tank shall be in accordance with the Railroad Commission Docket #141 for construction, and shall be complete with standard foundation.

Waste and Vent Piping: (a) All new waste piping occurring within the lines of the building shall be of extra heavy weight cast iron soil pipe and fittings, of bell and spigot pattern.

(b) Vent piping larger than 2" shall be the same as wastepiping. Vent piping 2" and smaller in diameter where occurring above the finished grade may be standard weight galvanized steel pipe with galvanized malleable fittings.

(c) Joints in cast iron waste piping shall be made with picked oakum rammed tight, molten virgin lead placed in a continuous pour, and caulked tight. Each joint shall have not less than 12 oz. of lead for each inch of nominal diameter. Joints in galvanized vent piping shall be full taper, standard screw pipe thread, having threads cut with new, sharp dies, pipe reamed to full bore after cutting, and linseed oil and graphite only used as a joint compound.

(d) All horizontal runs of waste and vent piping shall have a grade of not less than 1/8" per foot in the direction of flow except sewer service line which shall have a uniform grade of 1" in 15'. Waste piping occurring below grade shall be laid with barrel of pipe resting on firm undistrubed earth. Waste and vent piping occurring above finished grade shall be rigidly supported as hereinafter described.

Water Piping: All water piping, both hot and cold, within the lines of the building and extending to the stop and waste at the point of entry shall be of galvanized genuine wrought iron pipe and nipples, with 150# galvanized malleable fittings. Grade all water piping in the direction indicated, and where not indicated grade accurately to length, ream to full bore, and thread with new sharp, full taper, standard pipe threading dies. Use linseed oil and graphite only as joint compound.

Gas Piping: All interior gas piping shall be done with standard weight black steel pipe and 150# black malleable fittings. All horizontal runs of gas piping occurring below the finished floor shall be cast within the chases.

Support interior gas piping as described under Supports. Test as described under Tests. Terminate each gas outlet by connecting to appliance specified through lever-handled gas stop and condensate drip. Grade in reverse pitch of 1" in 40' toward butane tank.

Heating Piping: Heating piping is arranged as typical reverse return hot water heating system, employing convector radiators and hot water unit heaters as heating units and cast iron sectional boiler as heat generator, with booster pump for controlled force circulation.

Run all heating piping in mains in the attic space, supported from building framing members. Piping shall be of sizes noted, branch drops shall be run exposed in a neat and workmanlike manner or concealed in chases in positions indicated. Horizontal branch runs at the lower extremity of branch drops where exposed in the room shall be run not more than 6" above the finished floor and fastened directly to the walls of the building where exposed piping will be inspected critically for neatness or arrangement and workmanlike manner in which installed.

All heating piping shall be done with standard weight black steel and first quality 125# gray cast iron screw fittings. Cut all pipe accurately to length, ream to full bore, and thread with new, sharp, full taper, standard pipe threading dies. Use only linseed oil and graphite as a joint compound. Install valves on mains on both sides of circulator pumps and on each main supply as it leaves the Boiler Room.

Refrigerant Piping: Refrigerant piping, both liquid and suction, shall be done with hard-drawn, Type "K" 300 p. s. i. test copper tubing and wrought copper fittings. Make joints with Silfoss, Silbraz, or other approved refrigerant piping joint material. Refrigerant piping shall be of sizes indicated, shall be kept free of all debris and foreign matter.

On installation of refrigerant equipment charge the system with Freon and operate for a period of 24 hours, after which bleed the system, and keep sealed against outside air, and again recharge with new Freon and replace oil in compressor with fresh change dehydrated refrigerant compressor oil. This purging of the system is necessary in order to remove moisture and other impurities that may impair the operation.

Control Valves: Control valves on cold water piping and on heating water piping shall be bronze-bodied, wedge-disk, non-rising stem, gate valves, equal to Crane 125# brass gate valve #438. Valves shall be installed in all positions indicated and in other positions not indicated if necessary or desirable for control and full function of the several units in each system. Install 3/4" gate valve as drain on cold water service.

Furnish and install in high point of supply main and high point of return main as well as on expansion tank, one float type air relief vent, rated at 30 p. s. i. Air relief vent shall be equal to Hoffman, Marsh, or other as approved by the Architect.

Install iron-bodied "T" head round-way gas stop at each point of gas entry into the building. Set not less than 6" above the finished grade, and leave fully accessible. Install lever-handled gas stop at each gas outlet and point of connection of gas appliance.

Supports: (a) All horizontal runs of water, heating, waste, and vent piping shall be rigidly supported to the framing of the building by means of split ring malleable pipe hangers, adjustable swivels, rods, and bolts, of proper size to accommodate each pipe supported. Waste piping and cast iron vent piping shall have one support placed behind the hub of each 5' length of pipe. Piping 2 1/2" nominal diameter and larger shall be supported at intervals not to exceed 12', o. c. Piping smaller than 2 1/2" nominal diameter shall be supported at intervals not to exceed 8' o. c. Where two or more pipes have adjacent parallel runs, they may be suspended on a common angle iron sling placed at intervals not greater than 8' o. c. If the Contractor elects to use this form of suspension, heating lines shall have cast iron pipe roll stands supporting pipes on angle iron. All horizontal runs of insulated piping within the building shall have pipe covering protection saddle at the point of each pipe support, equal to Crawford Company Saddle #2 for standard thickness insulation.

(b) Bracket type extension pipe clamps and bolts shall be used to support all vertical runs of piping occurring within chases and concealed spaces. Exposed piping in rooms, corridors, etc., shall have vertical runs supported by heavy wall mounting strap iron clamps, equal to Crawford Company Type A. In all instances pipe clamps shall be of such size as to fit snugly around the pipe supported.

(c) Perforated hanger iron, wire, nails, and sheet metal straps shall not be used in any portion of this job.

Sleeves: (a) All pipes passing through walls, grade beams, or floors shall be run through galvanized steel pipe sleeves having an inside diameter not less than 1/2" greater than outside diameter of the pipe received, except sleeves for heating main risers and heating branch runouts, which shall have sleeves with an inside diameter not less than 1/8" greater than outside diameter of pipe received.

(b) Extra heavy cast iron waste pipe may be used as sleeves through the grade beam to receive 6" diameter waste pipe. All sleeves passing

through grade beam must have the annular space between pipe received and sleeve filled with braided jute rammed tight from the outside and a seal ring of molten asphaltum mastic poured to a depth of not less than 1" as a moisture seal.

Escutcheons: All exposed piping passing through walls, floors, or ceilings, shall have heavy chrome-plated brass escutcheons, of sizes to suit the particular size pipe placed for covering the entering hole.

Flashings: (a) All waste line vents shall extend approximately 12" above the roof and be flashed with 6# sheet lead extending not less than 12" in all directions from the base of the pipe and not less than 12" up the barrel of the pipe and be turned down not less than 1" inside the vent.

(b) All flashings for extensions of vents through roof shall be furnished by the Roofing Contractor and set in place by the Roofing Contractor in such manner as to maintain durability and tightness.

Insulation: All hot water heating piping, both supply and return within the Boiler Room and within the attic space of the building shall be insulated with 85% magnesia standard thickness, rigid, sectional pipe covering, complete with 8 oz. canvas jacket. Secure sectional pipe covering by placing welted metal lacquered bands, three for each 36" length of covering.

All pipe covering shall be of size to fit snugly around pipe to which applied, and shall be placed with full laps pasted down. Finish irregularities around pipe fittings, branches, and devices by application of asbestos cement plaster to a thickness equal to that of adjacent pipe covering. Apply over asbestos cement plaster and paste down neatly an 8 oz. canvas jacket finish. Over all pipe insulation before placing of metal bands, paint two coats of clear, water-proofing canvas sizing.

Refrigerant suction piping shall be insulated with ice-water thickness, mounded vegetable cork pipe and fittings. Secure with 4" spirals of soft copper wire, paint with two coats hot asphaltum mastic, and over all apply an approved refrigerant insulation sealer.

No pipe covering shall be applied until after tests are satisfactorily performed.

Boiler: Furnish and install in Boiler Room one natural gas fired, cast iron, sectional hot water heating boiler, complete with burner, insulated jacket, draft divertor, combination water temperature and altitude gauge, automatic 100% safety pilots, air shutter, Minneapolis-Honeywell immersion type

high limit controller, appliance type gas pressure regulator, and diaphragm type high limit controller, appliance type gas pressure regulator, and diaphragm type gas firing valve. Boiler shall have a capacity to deliver not less than 504M BTU per hour, and shall be in all respects equal to Mueller Type 20 boiler with 11 sections. Install boiler in strict accordance with manufacturer's recommendations, and arrange expansion tank, make-up water, etc., as indicated on schematic diagram.

Expansion Tank: Provide and install welded steel expansion tank with not less than 20 gal. capacity, and install approximately as shown on schematic drawing. Tank shall be constructed according to ASME Code for pressure vessels, and shall be equipped with 10" water glass and try-cocks set in one end. Connect heating system cold water fill line to bottom of expansion tank through 3/4" gate valve.

Boiler Breeching: Extend 12" diameter round double lined galvanized sheet steel flue pipe from draft diverter through roof, complete with galvanized sheet steel roof flashing and galvanized sheet steel rain-proof of a pattern as approved by the Architect. Vent pipe shall be equal to Johns-Manville Metalbestos of Payne-A.

Heating Controls: Furnish and install an M-H #Y210A standard control package of Electronic Moduflow, for control of circulator water pump. This package shall consist of one (1) #TA7002A Chronotherm, one (1) #TA7001A outdoor anticipator, one (1) #R7017A relay amplifier, and one (1) #Q202A cycler.

Setting of the Chronotherm shall be arranged to provide full heating operation between 7:00 a.m. and 6:00 p.m. From 6:00 p.m. until 7:00 a.m. the system shall be arranged to provide either lowered night temperature or night shutdown as desired by the Owner. The above listed settings are approximate and changing of any setting shall be easily made at the Chronotherm.

The outdoor anticipator shall be mounted in outdoor air in a location that is not affected by sun heat. The Chronotherm shall be located in corridor. These two controllers shall function together to control frequency of circulator operation. Minimum circulator-on-time shall be approximately 3 1/2 minutes.

An M-H #T418B hot water ratio controller shall be installed with one bulb located in outdoor air and the other bulb in boiler water. This controller shall be arranged to control operation of the gas valve for the hot water boiler so that boiler water temperature is maintained in proportion to outdoor air temperature.

The ratio of the controller shall be so that a 1° F. decrease in outdoor air will increase boiler water temperature by 2° F.

Provide a toggle switch labeled summer-winter which shall be arranged to stop the hot water circulator for summer operation, and to place circulator under automatic control for winter operation.

Circulator Pump: Furnish and install one in-line mounted booster type circulator pump, having capacity to deliver not less than 35 gpm against a TDH of 13' of water. Pump motor shall be 110 volt, 60 cycle, single phase, A. C. not less than 1/3 h. p., and shall be controlled through Moduflow panel as above described. Install pump in return line to boiler in strict accordance with manufacturer's recommendations. Pump shall be equal to Bell and Gossett booster type heating pump #HHD-3.

Install with circulator water pump one Bell and Gossett straight pattern screw connection flow control valve #S-2".

Gauges: Furnish and install on suction and discharge side of each circulator pump one dial type pressure gauge having 4 1/2" face and graduated from -30" mercury to 30 p. s. i. Gauge shall be equal to J. A. Marsh standard-gauge Type 3 for high Temperature.

Furnish and install on each return line near circulator pump one insertion type mercury column thermometer, having reinforced steel case and frame, equal to "American" industrial glass thermometer #203. Thermometer shall have a range of 30° F. to 300° F. with a 9" scale length.

Drains: Floor drains in Wash Room #12 and Wash Room #20 shall be of sizes noted, cast iron, integral trap and integral clean-out plug, equal to Josam Series #810V with backwater valve and cast iron grate.

Shower drain shall be as noted under Fixtures.

Floor drains in each of the refrigerated storage rooms shall be of sizes noted, double drainage pattern, cast iron floor drains, with cast iron grates, equal to Josam Series #500. Furnish and install complete with clamping ring and 18" x 18" square 6 # sheet lead flashings coated both sides with hot asphaltum mastic. Exercise care in installation to have grate finished flush with insulated floor. Install remote running "S" trap in approximate positions indicated and vent as shown on plans and schematic drawing.

Drains under Killing Floor and Eviscerating Table shall be cast iron removable sediment bucket type, with 3" nominal diameter outlet, and 12" x 12 1/4" grate size, equal to Josam Series #5063. Install complete with 3"

cast iron "P" trap and set grate flush with finished floor.

Sill Cocks: Sill cocks in the several positions around the exterior of the building shall be of the non-freeze type with key handle, equal to Josam Series #Y-200, complete with 3/4" hose thread head and operating key.

Refrigerant Compressors: (a) Egg storage vault- Furnish and install where shown on plans one Mills or approved equal vertical, single acting Freon condensing unit equal to Model F -100-A-S. Compressor shall be a 2-cylinder single acting, reciprocating type, and shall operate with a maximum speed of 395 RPM. Motor shall be of standard manufacturer, equal to Century, Wagner, or approved equal, 220 volt, single phase, 60 cycle, induction type.

Compressor shall be equipped with fly wheel for "V" belt drive, suction and discharge, stop and service valves, and high and low pressure cut-out. Condensing unit shall have a copper tube, copper fin, air cooled condensing coil, mounted on common base and shall have a capacity of 9200 BTU per hour when operating with 95° F. ambient air temperature. Compressor shall have a liquid receiver complete with liquid line stop valve, soft plug, and liquid test cock.

(b) Meat Refrigerator - Furnish and install where shown on plans one Mills or equal condensing unit, Model F-100-A-L, with the exact specifications as above except that the RPM shall be 450.

(c) Storage room - Furnish and install where shown on plans one Model F-75-A2-S Mills condensing unit or approved equal. Compressor shall be a 2 cylinder, single acting, reciprocating type, and shall operate at a speed not exceeding 360 RPM. Condensing unit shall be equipped with a 3/4 h.p., 220 volt single phase, Wagner, Century, or approved equal induction motor, copper tube, copper fin, air cooled condensing coil, shell type Freon receiver with liquid stop valve, soft plug, and liquid test cock. The compressor body shall be equipped with discharge and suction, stop valves, fly wheel for "V" belt drive, and high and low pressure cut-out.

Evaporators: (a) Egg storage vault - Furnish and install where shown on plans one suspended type cold diffuser, equal to Marlo Model #867UC. Unit shall be equipped with propeller type fan capable of delivering approximately 1650 cfm, copper fin cooling coil, and an Alco Model TCL expansion valve.

(b) Meat Refrigerator - Furnish and install where shown on plans one Kold-Hold Catalog #9032 serpentine plate stand unit, consisting of five 22" x 30" Kold-Hold Freon plates piped in series. This stand shall be

equipped with an Alco type TCL expansion valve, with an external equalizer. Provide for this stand unit a 2" insulated metal casing with a 26" x 5' insulated cold storage door.

In the Meat Storage furnish two Kold-Hold serpentine plate bank units Catalog #9019, consisting of four each 12" x 72" Kold-Hold plates banked in series with each bank having a Model TCL Alco externally equalized expansion valve. Each bank shall be equipped with manufacturer's plate spacers and hangers.

(c) Storage room - Furnish and install where shown on plans one Model #540UC Marlo or approved equal suspended cold diffuser, complete with propeller type fan and copper tube, copper fin cooling coil, with a Tupe TCL Alco expansion valve. This unit shall deliver approximately 950 cfm. Fan motor shall be for 115 volt, 60 cycle, single phase current.

Controls: (a) Egg storage vault - Furnish with one h. p. condensing unit Allen Bradley Bulletin #709 "Across-the-line" magnetic starters with reset button in the case. For the Egg Storage Vault furnish a Penn Catalog #260T15 remote bulb temperature control with an adjustable range from 35°F. to 55° F. This control shall operate the holding coil on the compressor starter. The fan unit shall be operated by a standard fused toggle switch, equal to Allen Bradley Bulletin #600., and shall be equipped with an indicating pilot light.

(b) Meat refrigerator - Furnish one Type LT penn temperature control with an adjustable range of -50° F. to +45° F. This control shall operate an Alco Catalog #m620 solenoid valve, installed in the suction line from the plate bank units to the compressor. The compressor low pressure control shall be set to stop machine at 0# suction pressure.

(c) Storage room - Furnish and install Penn Catalog #260T15 remote bulb temperature control with a range of 35° F. to 55° F. This control shall be wired in the line to the 3/4 h.p. compressor motor. Furnish and install an Allen Bradley or equal Bulletin #600 fused toggle switch with pilot light to operate fan motor on the cold diffuser.

Convectors: Furnish and install in the positions indicated convector type radiators with sloping top, damper, convector element, of wall-hung pattern, similar and equal to Young Radiator Company Type S. Unit shall have non-ferrous, extended fin convector elements, and each shall be equipped with air climator assembly. Convectors shall be sized in accordance with convector schedule on the drawings.

Unit Heaters and Thermostats: Furnish and install in the several positions indicated on the drawings propeller fan type hot water unit heaters with 2-speed motors and M-H #T42A thermostats and "Lovelier" switches. Suspend unit heaters at minimum of 8' above the finished floor. Attach thermostat on handy box mounted on 6" nipple to the side of the cabinet. Attach "Lovelier" switch to side or bottom of handy box. Unit heater for Wash Room #20 and Egg Sorting Room #24 be equal to Young Radiator Company Unit Heater Model #SH19B.

The two unit heaters for the Processing and Dressing Room #14 shall be Young Radiator Company unit heaters Model #SH-49B.

Work by others: The Electric Contractor will rough-in complete through disconnect switches 3 phase, 220 volt, outlets for refrigerant compressors. The Electric Contractor will rough-in 110 volt, single phase outlets for unit heaters, refrigerant units, and controls, and heating circulator pumps. This Contractor shall make connection from rough outlets to all units of equipment furnished under this Contract.

The Roofing Contractor will assist in placing roof flashings for all vents extending through finished roof.

Fixtures: (a) Lavatories - 19" x 17" cast iron enamel shelf back lavatories, with center fitting and lifting lever waste. Lavatories complete with fittings shall be equal to Kohler "Hampton" #K-2720-A.

(b) Water closets - Water closets shall be vitreous china, siphon jet, elongated rim, flush valve type water closets, equal to Kohler "Rockwell" #K-3800-ET complete with hard rubber, black, open front seat, Sloan "Crown" #110FYV flush valve and china bolt caps.

(c) Shower - Shower fitting shall be concealed two valve type built-in shower, with ball-joint shower head and volumn regulator, equal to Kohler #K-1720. Shower drain shall be equal to Josam integral trap Series #812-V with Chrome-plated brass grate and 2" screw clean-out plug.

(d) Laboratory sink and Posting Room sink - Sink shall be cast iron enamel, double compartment, flat rim sink, complete with swing spout faucet, continuous waste, "P" trap, and basket type strainer, equal to Kohler "Ashley" #K-6500, 42" x 20" with #K-8601 fitting, #K-9101 strainers, #9060 continuous waste, and #K-9004 adjustable cast brass "P" trap.

(e) Shower room sink and Candling Room Sink - 24" x 18" cast iron, enameled roll rim sink, equal to Kohler "Sutton" #K-6325, complete with

#K-8658 swing spout faucet, #K-9101 strainer, #K-9004 adjustable "P" trap, and wall bracket hangers.

(f) Service sink - 22" x 18" cast iron enameled roll rim, with 12" back and concealed hanger, equal to Crane #7-561. Furnish complete with #7-623, cast iron "P" trap standard, metal strainer, cast brass rim guard #-980, #8-219 1/2" "Dial-ease" faucet. Cover open hole with chrome-plated faucet hold cover.

(g) Sterilizing Room Sink - Furnish sink for Sterilizing room (Space #20) as detailed on general drawing. Furnish complete with wall mounting, chrome-plate swing spout faucet, #K-9101 strainer, and #K-9004 "P" trap.

(h) Sterilizing Room Sterilizer - Furnish and install Sterilizing Room (Space 20) sterilizer as detailed in general plan drawing. Sterilizer shall be complete with cold water supply and gas burner, with manual control only.

(i) Scalding vat - Furnish and install one 6' x 2' x 16" deep scalding vat, having 30" long drains at both ends. Vat shall have hot and cold water supply, drain connection with valve stop, and shall be made of 14 gauge galvanized sheet steel with rolled rim edges and soldered flat seams. Support only 1 1/4" galvanized angle iron frame. Submit shop drawings for approval before ordering. Vat and drain boards shall be integrally mounted, and drain boards shall slope toward scalding vat. Drain boards shall have 1" raised rim on 3 sides.

(j) Eviscerating table - This Contractor shall allow the sum of $500 for the purchase or fabrication of an eight-place poultry eviscerating table, having galvanized angle iron frame and stainless steel top with 8 cold water supply faucets. Rough-in 1" cold water supply for connection to cold water header on top of table.

(k) Grease Trap - Furnish and install approximately 3' outside the lines of the building in the position shown on the design drawing one Josam "Cascade" grease intercepter #J-O, having a flow rating of 6 g. p. m. and a grease capacity of 12 lb. Install in strict accordance with manufacturer's recommendations and cover with oval or rectangular cast iron meter box and removable cover of sufficient size to allow easy access to grease interceptor for grease removal. Cover shall be set flush and finished grade.

Bleeding Shackles: Furnish and install over Killing area three 21' lengths of galvanized steel pipe with 2" nominal diameter. Suspend these pipes parallel to each other, approximately 2' apart over the Killing area. Suspend each pipe in three places from roof framing members with 3/8" rods, split ring hangers, and adjustable swivels to a height of 8' above the finished floor.

Install braces between the pipes to prevent swaying.

Furnish and install 30 "Barkers" extra heavy spring type poultry shackle #25, suspended from the above pipes specified (10 on each) to a height of 5' above the finished floor. Suspension from pipe shall be with extra heavy galvanized chain as furnished by shackle manufacturer, and shall be fastened to pipe by bolt with eye on one end, and double locknut on the top side. Shackles shall be equally spaced along the pipes, approximately 2' o. c.

Testing: Test all waste and vent lines by plugging inlets and outlets below the highest point on all lines and filling each system of risers to the highest point on the vent with water and allowing to stand for one hour. All leaks in cast iron joints shall be made tight by caulking. Leaks found within the cast iron pipe or fittings shall be corrected by the replacing of that unit.

Test all water and gas lines at a hydrostatic pressure of 150 p. s. i. for a period of one hour. Leaks found in pipe or fittings shall be corrected by replacement of fittings and cutting of new thread on the pipe. After testing, drain gas lines and dry by blowing compressed air through all parts until lines are dry.

All tests shall be made in the presence of and verified by the Architect or his representative. In the instance any one of the above tests is not satisfactory, additional tests shall be made until above-mentioned authority is satisfied.

Test refrigerant piping at a hydrostatic pressure of 250 p. s. i. and prove sound for a period of one hour.

Cleaning: On completion of all work under this portion of the Contract, remove from the site, all unused materials, equipment, waste, and rubbish occasioned by work performed in compliance with this portion of the Contract. All fixtures and equipment shall be left free of stamps, labels, markings, etc., except those permanent markings of identification and instruction.

Guarantee: The Contractor shall guarantee all materials, equipment, and workmanship to be free from defects for a period of one year from, and after, the date of acceptance of the work. The Contractor shall replace all parts found to be defective within the period of the guarantee without cost to the Owner.

VT 010 015
Phipps, D. Bart
Rigging and Safety for Apprentice Training in the Plumbing and Pipe Fitting Industry; Workbook No. 7.

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ABSTRACT - Prepared by a subject matter specialist, this manual provides instructional material on rigging and safety as part of apprentice training for the plumbing and pipe fitting industry. Information sheets and student assignments are included for the following topics: (1) Material Handling, (2) Trenches, (3) Types and Uses of Slings, (4) Manila Rope, (5) Knots and Hitches, and (6) Cranes and Derricks. Also included are student progress reports for both student and instructor use. The manual is illustrated with numerous drawings, diagrams, and photographs. The reference to be used with this workbook is "Standard Practices in Mechanical Construction," available from the Grinnell Company, Providence, Rhode Island. (AW)

VT 010 015

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RIGGING AND SAFETY

for

APPRENTICE TRAINING
in the
PLUMBING AND PIPE FITTING INDUSTRY

Workbook No. 7

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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Prepared by

D. Bart Phipps, Specialist
Apprentice Training
Plumbing and Pipe Fitting

ENGINEERING EXTENSION SERVICE
Texas A&M University
cooperating with
INDUSTRIAL EDUCATION SERVICE
Texas Education Agency
and
Texas State Joint Apprenticeship and Training Committee
for the Plumbing and Pipe Fitting Industry

10-5-300

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Name: _____

Rigging & Safety

Packet No. 7

STUDENT PROGRESS RECORD
in
BASIC INSTRUCTION FOR APPRENTICE TRAINING
for the
PLUMBING AND PIPE FITTING INDUSTRY

	Information Sheet	Student Assignments	Date Completed
1. Material Handling	1 page	1 - 5 pages	
2. Trenches	1 - 2 pages	1 - 4 pages	
3. Types and Uses of Slings	none	1 - 4 pages	
4. Manila Rope	1 - 2 pages	1 - 4 pages	
5. Knots and Hitches	1 - 5 pages	1 - 2 pages	
6. Cranes and Derricks	1 - 5 pages	1 - 4 pages	

NOTE: Green sheet for student's note book
Gold sheet for instructor's file

Price of this packet, .35

A&MCS-TEES
Aug. 1955

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A&MCS-TEES
Aug. 1955

Reference For Packet No. 7

The Grinnell handbook, "Standard Practices in Mechanical Construction", will be used as a reference for Packet #7.

It will be necessary to order these references from the Executive Offices of the Grinnell Company, Providence, Rhode Island, reference Mr. F. L. Jackson, Publicity and Promotion Manager.

These handbooks are listed at $2.50 each but the Grinnell Company has offered these books for the use of the apprentice training program at a 20% discount ($2.00 per copy).

When ordering, do not fail to indicate that they are to be used for the apprentice training program of the Plumbing and Pipe Fitting Industry.

These books may be obtained from a local Grinnell office.

Name: _____ MATERIALS HANDLING

Approved by: _____ Key: B I - P 7 - 1 A

Date: _____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Safe Methods of Material Handling

Purpose: To point out precautions that should be taken for the sake of personal safety and ease of handling materials on the job.

References: Standard Practices in Mechanical Construction - Grinnell - Pages, 1-11, Pages 12-27

Introductory Information: A journeyman of the Plumbing and Pipe Fitting Industry is expected to be able to move, raise, set or in any manner handle materials used in plumbing and pipe fitting. There is certain information which will supplement your experience in material handling. Factors concerned in the handling of materials are safety, economy, and time. The information provided here supplemented by experience should help you do a safe job of material handling within a reasonable period of time.

Procedure: Study the reference handbook and answer the following questions as a study guide:

1. It is the journeyman's job to handle the material in the stockpile. List five (5) safety rules suggestions here for stockpile in the pipe yard.

2. What are the rules for stacking pipe?

3. Why should you keep your back straight and bend your legs when lifting heavy objects?

4. Why is it necessary to caution adult workmen about "poor house keeping?"

5. It is very often necessary to use "built up" ladders on a job. They must never be taken for granted. Although there may be no choice as to the type of materials, such as pine, spruce, etc., list three very necessary specifications which the lumber must meet for use as side rails.

6. List five (5) specifications for the rungs or cleats?:

   a.
   b.
   c.
   d.
   e.

7. As a reminder to yourself list the six (6) most important safety rules in the order of importance on page 8 of the reference, as # 8, 1, 6, etc.

8. A ladder is 25 ft. long. How far from the wall must it be set?

9. A journeyman is very often required to specify the type of scaffold needed and will usually supervise the building of it because his life may depend upon the manner in which they are constructed, the type of material used, and the purpose for which they are constructed.
   Read the section pertaining to scaffolds in the reference - pages 12 - 27.

   a. List the types of scaffolds described in the reference:

      (1)
      (2)
      (3)
      (4)

   b. Make a check list of things that you must consider for any type of scaffold to be safe:

      (1)
      (2)
      (3)
      (4)

Write the specifications for the parts of a pole scaffold to insure a safe scaffold.

c. Angle braces:

(1)
(2)
(3)
(4)

d. Footing:

e. Decking:

(1)
(2)
(3)
(4)

f. Access:

(1)
(2)

10. List the specifications for safe Tubular Scaffolds:

a.

b.

c.

d.

e.

11. List the specifications for safe Swinging Scaffolds:

a.

b.

c.

d.

e.

f.

g.

12. Needle Beam Scaffolds:

a. What is the maximum allowable span of a needle beam?

b. What is the minimum size rope that is considered?

c. What precaution should be taken to prevent damage to ropes?

d. Two men of average weight, approximately 185 pounds, plus tools and equipment and platform of approximately 350 pounds will be on a needle beam scaffold requiring a span of 12 ft. What size timber will be necessary?

e. Solve the following from the chart in the reference page 24.

1. 2 x 6 - 5' - 6" long will support _____ lbs.

2. 2 x 12 - 13' - 6" long will support _____ lbs.

3. 800 lbs. load is to be supported over a minimum span of 10 ft. What size timber must be used?

13. Horse Scaffolds:

a. Horse scaffolds should not be more than _____ tiers or _____

b. Supporting foundation shall conform to _____ scaffolds.

14. Scaffold planks:

a. A scaffold plank 2 x 12 - 12 ft. long will support _____ lbs.

b. Two men average 185 will work on a scaffold with a span of 10 feet. What size plank is specified?

c. Estimate the load on a scaffold which you have recently used and check those conditions against these figures and let your instructor check the figures.

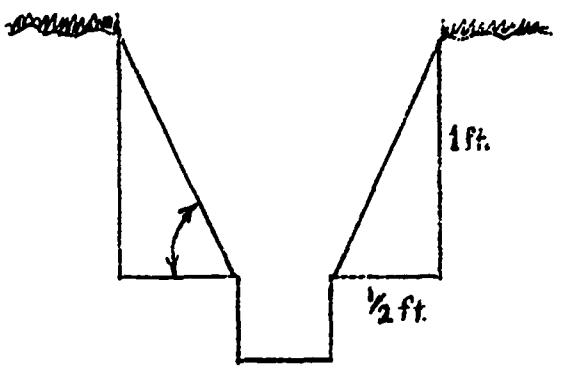
Information Sheet
in
Plumbing and Pipe Fitting

The reference listed for this assignment uses a term that may be unfamiliar to you.

The term "angle of repose" is used in reference to trenches. An explanation b definition and sketch for practical use is shown below.

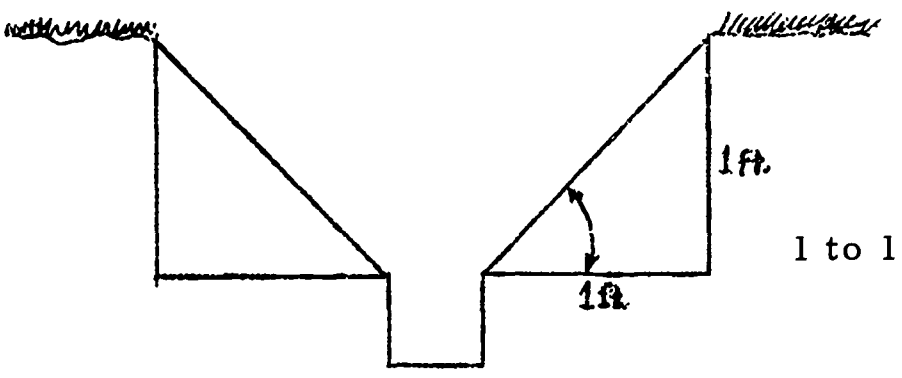
It is often unsafe or impractical to dig a trench with vertical walls. In such cases the walls are sloping at a specified angle. This angle or slope, simply speaking, is the angle of repose and definite specifications depending upon the soil condition and circumstances will govern the angle. Fig. 1 and 2

Fig. 1



2 to 1 slope

Fig. 2



1 to 1 slope

Other information which is usually taken for granted, but means dollars and cents to the contract or to the efficiency with which the system may operate, is discussed here briefly below.

A formulae has been provided for the proper width of a ditch for a certain size pipe. The formula:

(4/3 ID + 8")

Where:

I. D. = Inside diameter of pipe

Note: Allowance must be made for sheathing.

Example:

8" pipe (I. D.)

(4/3 x 8" + 8") = 10 2/3 + 8

= 10 11/16" + 8" = 18 11/16

= 19" + thickness of sheathing in trench

Using 2" (2 x 8 or 2 x 10) lumber for sheathing, add approximately 4" for sheathing on either side of the trench.

19" + 4" = 23" total width of trench

It is recommended that sheathing should be left in the trench below the top of the pipe when back filling to prevent undue weight on the pipe where the back fill load is a factor.

For sewer pipe in particular, the back fill load must be considered since it may move or crush the pipe. The load on the pipe increases with the square of the width. At least from the bottom to the level of the top of the pipe, the trench should be a narrow as is practically possible. All available information proves that the width or shape of the trench above the level of the top of the pipe does not increase the load on the pipe. So long as the trench at the level of the top of the pipe is held to a practical minimum width, the trench may slope outward at any angle without adding to the load on the pipe.

Suggested standards are provided for the use of sheathing, stringers and bracing in trenches. Conditions are set up in the following problems to help you to become familiar with proven safety practices in trenches. No workman should ever attempt to work in a ditch or trench that is not properly braced.

7. A trench is 10 ft. deep, 36 inches wide in hard soil.

   a. Sheathing will consist of _____ x _____ planks spaced approximately _____.

   b. Stringers for this trench: _____.

   c. Cross braces for this trench: _____.

8. Trench 42 inches wide and 8 ft. deep in soft soil.

   a. Stringers: _____.

   b. Up right sheathing: _____.

   c. Cross Braces: _____.

9. What is specified as a method of joining or fastening cross braces to stringers:

10. A trench 48 inches wide, 6 ft. deep in soil likely to crack:

   a. Upright sheathing: _____.

   b. Stringers: _____.

   c. Cross braces: _____.

11. A trench is 375 ft. long, 10 ft. deep. How many ladders should be provided?

12. Describe how ladders should be situated in a trench.

a.

b.

13. How should the rungs or steps be spaced on the ladder?

14. What should the maximum distance between stringers in a trench be?

15. A trench is dug in sandy soil. What is specified for the following: 48" wide, 10 ft. deep?

a. Upright sheathing: _____.

b. Stringers: _____.

c. Cross braces: _____.

Name: _____

Approved by: _____

Date: _____

TYPES & USES OF SLINGS

Key: B I - P 7 - 3 A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Types and Uses of Slings

Purpose: To describe the various types of slings, their proper care and use.

References: Standard Practices in Mechanical Construction - Grinnell - pp. 32-49

Introductory Information: Hoisting equipment is engineered, tested, and rated for certain capacities under definite conditions. The lifting capacity, however, depends on every link from the power unit to the manner in which the load is secured to the "hook". Therefore, regardless of the capacity of the equipment, much depends upon the knowledge of the man who uses the slings to hook onto the material or equipment. Improperly used slings can very easily nullify the ratings of any equipment.

Directions: With the experience that you will gain on the job, information provided here will help you to learn both the safe and the effective use of the proper slings.

Study questions and problems:

1. What type of slings are more widely used and preferred?

2. Name two other types of slings.

   a.

   b.

3. What is to be considered in the "proper" use of slings?

   a.
   b.
   c.

4. Name the two precautions or procedures that are of prime importance as safety measures in the use of rigging equipment.

5. List two reasons why wire rope or cable is considered safest for average use as a sling.

a.

b.

6. What is a simple method of keeping a cable sling from slipping on pipe?

7. Describe another method of rigging to handle pipe.

8. List five ways in which wire rope or cable may be damaged.

a.

b.

c.

d.

e.

Note: In the example problem for table 3 page 33 in the reference, notice that the safe working load is given as 5.56 tons for a 5/8 two leg bridle sling with legs vertical. Safe working loads for each size wire rope with the legs set at vertical 60°, 90° and 120° is given in table 5 page 35. The same figure is obtained for a two leg bridle sling from table 4 by multiplying by 2 the figure under heading "Straight Pull".

Example: Safe load for 5/8" cable or wire rope on a straight pull is 2.78 tons. 2.78 x 2 = 5.56 tons as a safe load for that size wire rope as a two leg sling.

Notice further on table 4 that safe loads for "choker hitch" and basket hitch is given. Choker hitches are often used in pairs in the same manner as the two "leg bridle slings" on pipe. We should be able to estimate from these figures the safe load for various types of slings.

9. What is the first and one of the most important precautions given concerning the loading of a multiple leg sling?

10. What is the capacity of 1/2" cable 2 leg bridle sling with straight pull.

11. What is the capacity of the same bridle sling which has a spread of 90°? What is the difference in capacity in tons?

12. Substitute 2 choker hitches for the bridle hitch above spread 90°. What is the capacity?

13. How does the capacity of a two leg hitch with chokers compare in capacity with a 2 leg bridle hitch?

14. The weight of 10" Schedule 80 steel pipe is given as 64.33 pounds per foot. What is the smallest size cable that may be used as two leg choker hitch spread at 90° to lift a 40 ft. section of this pipe?

15. What is the minimum length of material that should be lifted with a single sling when two or more pieces are to be hoisted?

16. Hooks and shackles are necessary component parts of various types of slings. How do hooks and shackles compare in strength?

17. When a shackle is used on a choker, why is it considered unsafe to have the bolt of the shackle on the running line?

18. What advantage does the hook have over the shackle used on slings?

19. What precaution must be observed, other than overloading, in the use of hooks?

20. Compare the capacity of the hook and shackle 1 1/2" in diameter in terms of a safe working load in pounds.

Information Sheet
in
Plumbing and Pipe Fitting

There are many factors which effect the capacity of Manila rope. The manufacturer rates it at the factory as new rope under the most favorable conditions. Below are listed points of information pertaining to the care and use of Manila rope.

1. There are several grades of Manila rope. One of the factors governing the grade is the condition of the fibre which is taken from a plant. The grade is judged to some extent by the color.

2. The grades of Manila rope are listed below in the order of its quality as a rope for use in hoisting:

   a. Yacht rope
   b. Bolt rope
   c. No. 1 Manila rope
   d. No. 2 Manila rope
   e. No. 3 Manila rope
   f. Hardward store rope (the poorest grade of manila rope)

The number 1, 2, and 3 grade ropes are graded approximately the same in capacity as new rope, but the lesser grades (2 and 3) lose their strength proportionately more in service than either number 1 or bolt rope.

3. Substitutes for Manila are available such as : Sisal, hemp and cotton rope.

4. Rope is normally made up in three (3) strands, but four (4) strand ropes are available which is more resistant to abrasion. Its capacity for hoisting is slightly less than three strand rope.

5. Rope is made with the strands laid in loosely or tightly. This is known as soft lay or hard lay. The rope most commonly used is of medium lay.

6. Storage of rope effects the life and capacity to a great extent.

   a. Rope should never be stored away when it is wet.
   b. Rope should <u>not</u> be stored near radiators or boilers.
   c. It should be stored on wood above the floor or hung on wood pegs where sufficient circulation of air is provided.
   d. The ideal condition for storing is 60° to 70° and 40 to 60 percent relative humidity.

A&MCS-TEES
Aug. 1955

7. The rated capacity of a rope can be very easily avoided by improperly fastening to hooks or around cartons or objects with sharp edges.

Thimbles should be used where the rope is attached to a hook, pully or any equipment requiring sharp bends. Sharp bends set up great internal stresses in the rope permanently imparing the strength of the rope.

8. When a rope makes an angle from 30° to 60°, the capacity is reduced up to 50 percent.

From the information listed, it is very obvious that the safe working load of a rope depends to a great extent upon the manner in which it is used. To learn some of these points by experience or the "hard way" could prove to be fatal. Since every rigging operation is not started with new rope, it is necessary for the journeyman to be able to inspect and recognize the flaws which reduce the strength or capacity of the rope.

Such things as grit or sand that has been allowed to work into a rope can cause internal damage which may not be apparent by a casual examination. Freezing a rope can cause damage if it is moved or handled before allowing it to thaw. When allowed to thaw, comparatively little damage may result.

To examine the internal strands, untwist the rope only enough to examine condition of the strands. They should be clean and look like new rope, being clean and bright. Look for broken fibre and an accumulation of very small pieces of fibre which indicates that excessive loads have caused internal wear. A rope that has been over loaded may have excessive oil on the outside. A rope that has been in contact with chemicals or a hot pipe will show discoloration and should not be used. Knots and hitches cause excessive strain and cause weak spots in ropes.

Every precaution should be taken when using rope for hoisting since there are so many ways in which it can be misused and weakened to the point of being extremely dangerous to use.

Name: _____ TRENCHES

Approved by: _____ Key: B I - P 7 - 2 A

Date: _____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Safe Practices in the Use of Trenches

Purpose: To encourage safe practices when working in trenches by pointing out hazards and proper preventive measures.

References: "Standard Practices in Mechanical Construction" - Grinnell Company, Inc., Pages 28 - 31.
Information Sheet

Introductory Information: Hazards encountered by men working in trenches are too often ignored, yet we very often see people killed or seriously injured from various causes while working in or about trenches.

Factual information is provided by the reference for this short assignment by which you may judge, with a greater degree of safety, the trenches in which it is necessary to work on underground piping.

The instructor will supplement this information by his experience in your particular area and he can suggest modifications and applications for that type soil and other conditions.

Directions: Questions and problems are framed here to act as a guide to the references which have been listed for this assignment. The purpose of these questions are to emphasize high points in the discussion in the safe use of trenches.

Answer the following questions after reading the references.

1. Before going to work in a trench 4 ft. deep, what precaution should be taken for the safety of the workman in the trench as well as the public or workman on the bank?

2. What should be done in trenches with vertical walls over 4 ft. deep for the safety of the workman?

3. List three conditions which increases the danger of cave-in of trench.

a.

b.

c.

d.

4. Trench banks should be inspected daily. What obvious condition indicates the possibility of cave-in?

5. Describe sheet piling or sheathing in reference to trenches in your own words.

6. What purpose do the braces and stringers serve?

Name: _____ MANILA ROPE

Approved by: _____ Key: B I - P 7 - 4 A

Date: _____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Manila Rope

Purpose: To provide information which will enable you to determine the safe use of manila rope.

References: Standard Practices in Mechanical Construction - Grinnell - pp 38 & 39; 42- 49
Information sheet

Introductory Information: Information is provided in the reference listed above which will enable you to recognize signs of weakness or deterioration of Manila rope. You cannot take the condition of it for granted. Certain natural rules of safety must be followed including daily inspection of all lines and equipment.

Directions: The questions and problems are offered as a guide to illustrate that safety is practical and logical. Your life will depend on your knowledge of the care and use of Manila rope.

Study Questions: Work these problems and remember the "rules of thumb" provided to help you estimate the capacities under various circumstances.

1. List three uses for which Manila rope is recommended.

2. What is the maximum load recommended by the reference for which Manila rope should be used?

3. When should ropes, being used in rigging, be inspected?

4. Describe a rope that is apparently in good condition.

5. By the formula provided in the reference show the capacity of the following sizes of ropes:

   a. 3/4"

   b. 5/8"

   c. 1"

   d. 1 1/4"

6. Using the figures determined in question No. 5 calculate the safe working load of the same rope when a bowline or clove hitch is used.

   a.

   b.

   c.

   d.

7. Explain why the safe working load is reduced when knots or hitches are used in a Manila rope.

8. How does the capacity or tensile strength of sisal rope compare with Manila Rope?

9. Compare the strength of 3 strand and 4 strand Manila rope.

10. Explain what is meant by a soft lay rope.

11. List three precautions that should be taken when rope is stored.

12. When inspecting Manila rope what should you look for?

13. List five reasons why wire rope has replaced Manila rope for hoisting operations:

a.

b.

c.

d.

e.

14. List the three classes of wire rope.

15. Which of the three is considered the best and safest type wire rope for cranes and derricks and why?

16. How can iron wire and steel wire cable each be distinguished?

17. How can the minimum size Sheave for a certain size wire rope be determined?

18. Give the minimum size sheave for the following sizes of wire rope or cable.

a. 3/8"

b. 1/2"

c. 3/4"

d. 7/8"

e. 1"

19. When a thimble is used on a cable, why is it recommended that the "U" bolts always be clamped on the loose or dead end of the rope instead of the live end?

20. How is the strength of a cable effected by the use of the U-bolt clamps?

21. Describe the method of determining the number of parts or lines necessary to raise a certain load. This applied to rigging a tackle with manila rope.

a.

b.

c.

22. Show the number of lines or parts necessary for the given size and load specified below.

a. One ton with a 3/4" rope

b. 1 1/2 ton - 1" rope

c. 500 lbs - 3/4" rope

Information Sheet
in
Plumbing and Pipe Fitting

There are many different rope knots and hitches. The average journeyman can get along with the knowledge of only a few good knots.

The knowledge of knots does not simply imply that the journeyman must only know how to tie the knots. If a knot is to be used to an advantage and safely, there is knowledge he must have such as the proper application and circumstances under which the knot is to be used. In the previous assignment we learned that knots reduce the capacity of a rope in varying amounts.

An example of valuable information is the fact that the use of a bowline in a line reduces the capacity of that rope to 60% of the original capacity. (See chart on page 45 of the Grinnell Handbook).

Sharp bends necessary to make a knot weakens a rope. By the same token the capacity of a rope is reduced by any sharp bend.

It is necessary to protect a manila rope to avoid cutting or chafing. This and other safety measures in the use of manila rope are described in the Grinnell Handbook on page 38.

The first and basic knowledge and skill that must be acquired is the tying of knots. The following illustrations and descriptions will help you in tying some of the most commonly used knots:

1. The square or reef knot is a safe one for tying two ropes together of the same size.

Fig. 1

2. The figure 8 Knot may be used to prevent the end of an extended fall line from running out through the block.

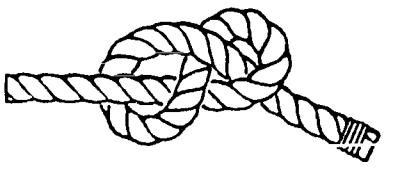


Fig. 2

3. The clove hitch is a good knot for fastening a rope around a pipe, timber or column.

It is a simple knot to tie but it will require practice to be proficient and to be assured of maximum safety. To make a clove hitch, take the rope around the pipe and over itself; then take it around again and under itself as shown in Fig. 3.

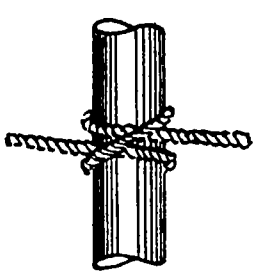


Fig. 3

4. The Timber hitch with a half hitch as illustrated in figure 4 is useful in towing or dragging a pipe or timber. This hitch will not slip under a load but it is easily loosened when the load is relieved.

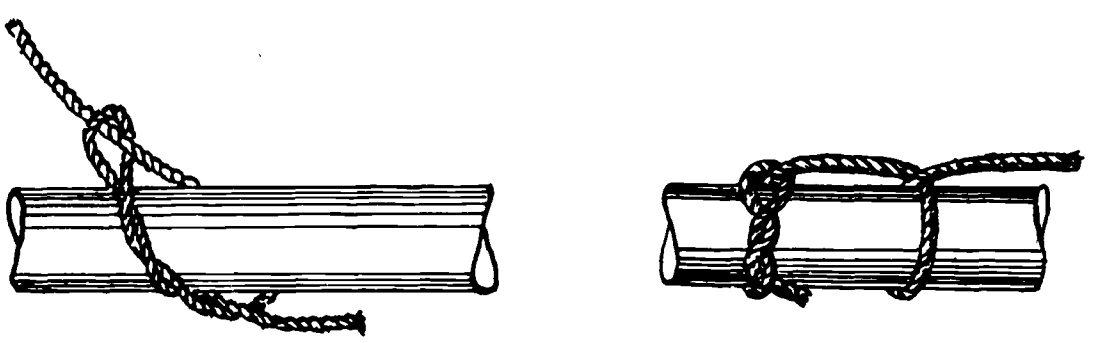


Fig. 4

5. The bowline is known as the "king of knots". It is the safest and most secure knot where it is applicable and properly tied. It is most useful because it will not slip or jam.

The steps in tying a bowline are illustrated in fig. 5. Begin by laying the end of the rope over the standing part to form a loop. This is known as "throwing a bite". Leave enough rope to make the desired or necessary size Bowline. Then pass the end of the rope through the bight from the bottom and procede to complete it as illustrated in fig. 5.

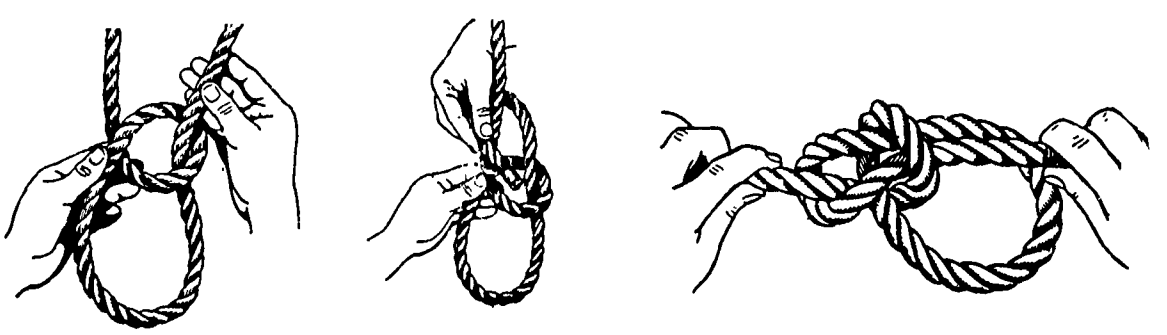


Fig. 5

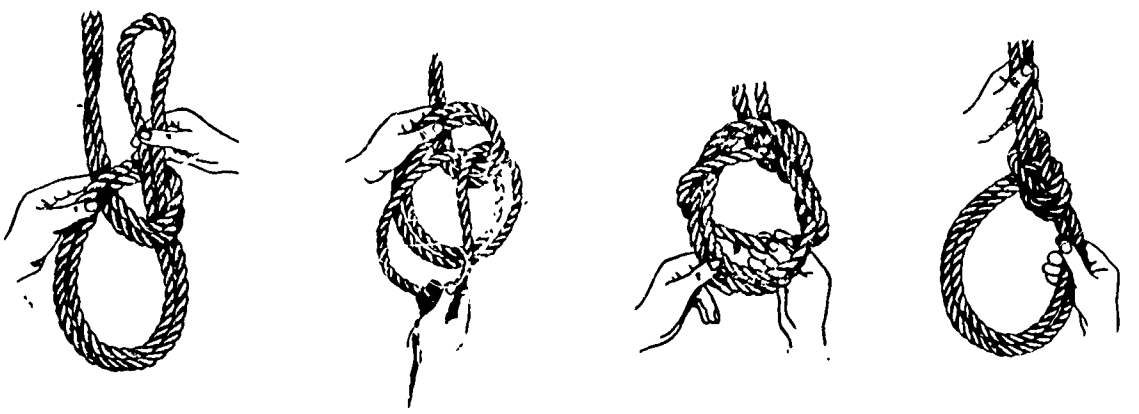


Fig. 6

6. The Bowline on a Bight is useful and safe where a double line is necessary. The application and characteristics are practically the same as the regular bowline.

To tie a Bowline on a bight, double the rope first. Form a bight near the loop end and pass the loop end though the bight exactly the same as the regular bowline and carry it over the standing loop as shown in fig. 6.

7. The double bowline is a knot that may be used safely and more comfortably as a seat sling than any other type knot.

To tie this knot simply pass the end of the rope through the bight twice instead of once as in the regular bowline, but complete the knot in exactly the same manner.

Fig. 7

8. One knot in particular that is taken for too lightly is the life line knot or triple rolling hitch. Far too many workers disregard safety rules and fail to use life lines and safety belts. Read the section in the Grinnell Handbook on Page 23 regarding the use of the life line knot when working swinging scaffolds.

9. A knot that is very useful and practical if it is properly tied is the barrel hitch. It is often necessary to hoist barrels of materials. This can be done safely or it can be very dangerous. The use of the proper knot and a rope of sufficient capacity to carry the load. The basic hitch is the half hitch. It is a very simple hitch and is tied as shown in Fig. 9.

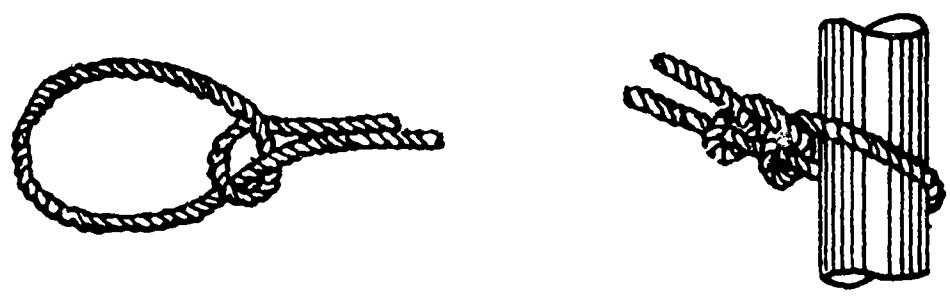


Fig. 9

10. The barrel hitch is formed with a single rope. Place the center of the rope under the barrel standing on end. Bring one end of the rope on the opposite side of the barrel. Tie the ends together using a square knot to form the sling. Then hook on and hoist it as shown in Fig. 10.

Fig. 10

Knots and hitches are the basic fundamentals that a journeyman should know in order to be a good and safe rigger. The knots described in this assignment have many applications, but the first thing to concentrate on is proficiency in the tying of the knot itself in practically any position. In addition to experience the instructor will demonstrate some of the uses of these knots and hitches.

Name: _____ KNOTS & HITCHES

Approved by: _____ Key: B I - P 7 - 5 A

Date: _____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Knots and Hitches

Purpose: To teach you to tie the knots necessary to good and safe rigging

References: Grinnell - Standard Practices in Material Handling, Pages 28-29, 23

Information Sheet

Introductory Information: This assingment is meant to guide you through a practice session with knots and hitches. You may become proficient in the use of these knots and hitches only by practice and experience.

Study the characteristics of each knot and you will be able to size up a situation in such a way as to know which knot or hitch will be most practical and safe to use for a particular rigging job.

Procedure: The instructor will demonstrate and assist you in tying each knot. After practicing these knots, tie each knot for the instructor as he calls for them. He will check each knot below as you tie them.

List at least one use for each knot as you tie it.

1. Square knot

2. Figure eight

3. Clove hitch

4. Timber hitch

5. Bowline on a bight

7. Double bowline

8. Life line hitch

9. Half hitch

10. Two half hitches

11. Barrell hitch

Note:

Tie each of these knots, in the order listed above, on a piece of pipe, chair, waste basket, or other convenient articles in the classroom or shop.

You will probably need additional practice for this operation since the application of the knot is not as simple as merely learning to tie them.

Information Sheet
in
Plumbing and Pipe Fitting

The crane type of boom, as used on the average mobile units in the form of a crawler traction type or truck mounted units, accomodates a broad use of working tools and conditions.

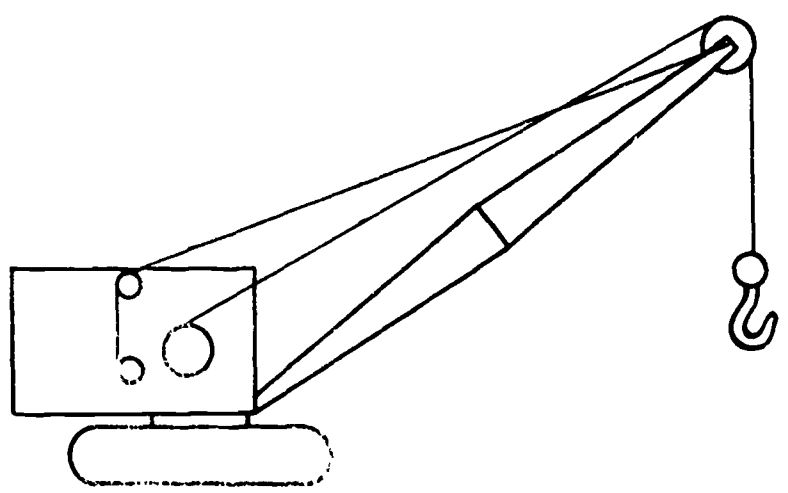


Fig. 1

For lifting purposes only, the crane-type boom attachment is equipped primarily with a single line (main hoist cable) leading from the hoist drum to the load carrier or whatever device is used to attach the line to the load. (Fig. 1) Should the crane-type boom be equipped with a jib, a second or auxiliary cable and drum is required.

In the applications involving lifting only, a sheave block can be attached to the load-carrier and the hoist line passed through the sheave and anchored at the boom point to provide a two-part line. This increases the lifting capacity (within limits of stability and boom capacity) and slows the speed of vertical travel for greater accuracy in load handling. By using a sheave block at the boom point and multiple-part sheave at the load-carrier, still greater lifting capacity can be obtained (again within stability limitations and boom capacity) plus even slower vertical load travel. Fig. 1.

To gain the most effective use of this type of equipment, and to position the basic unit to the greatest advantage, it is first necessary to analyze the job. This may be done by determining the following factors.

1. Type of load
2. Size and shape of load
3. Location of load

4. Height of lift
5. Radius of work zone
6. Load weights in relation to the basic unit capacity
7. Clearance for boom and rear end

1. Determining the type of Load to be Handled - This should cause little trouble. Most loads are readily classified into solids, semi-liquids such as concrete, bulk materials such as sand and gravel. The physical state and shape of the load almost immediately indicates the most suitable tool to use in conjunction with the crane type boom. For example, a crane hook is commonly used with sling arrangement when the load is in the form of an I-beam, a crate, a boiler, a stack of lumber, a machine tool, stone slab, pipe, etc.

2. The Size and Shape of Load is an important factor in determining necessary clearances. Normally, large bulky loads require greater clearances than small concentrated loads, however, damage to surrounding structures should be avoided and load interference with the boom easily can cause boom failure.

3. Location of Load relative to its ultimate position and whether there will be like repetitive loads has a direct and important bearing on positioning the basic unit and the boom length required.

4. Height of Lift Dimension also is necessary to determine the length of boom and the position of the basic unit.

5. Radius of Work Zone is the area the basic unit can serve with a given boom length.

6. Load Weight should be determined as it has a direct bearing on the capacity of the basic unit. Footing for cranes in lifting position must be considered since ratings are established for solid level footing. Since the applications of cranes are unusually broad in their scope and job factors seldom duplicated, general suggestions rather than a specific series of applications are given in the following page.

7. Clearance for Boom point and rear-end swing always must be considered when lifting will be handled in confined quarters or under wire or other overhead obstructions.

General Rules for Crane Operation

1. The crane should be positioned on level ground.

2. The load to be lifted should be determined, remembering that the heavier loads should be handled slower as they involve greater safety precautions.

3. The load should be handled at the shortest radius, always keeping in mind the boom length, height of lift and boom clearances at all points in the swing cycle. On repetitive lifting, more than usual precaution should be exercised in determining proper clearances to eliminate necessity for raising and lowering boom on each cycle.

4. In construction or steel erection work, and similar work with sequence of loads, the basic unit is best positioned when the loads can be lifted to the most remote points first. This provides greater assurance of boom clearances and avoids blocking subsequent crane operations.

Suggestions for Safe and Effective Crane Operations

1. Where repetitive lifting is involved, the crane should be positioned for shortest possible swing cycle to reduce cycle time. For heavy lifts, crane should be positioned to lift over end of mounting, where it has maximum lift capacity.

2. Crane footing should be checked carefully before lifting capacity or near capacity loads. Ratings are based on firm packed footings.

3. All overhead obstructions should be inspected carefully before moving a crane or starting lifting operations. Power wires should be located so as to avoid contact with boom, hoist cable, boom support rigging, or A--frame.

4. In attaching loads, a secure hitch must be made and lift started when all helpers are in clear.

5. Operator should swing crane slowly enough to avoid outward throw of load and overswinging when machine stops Crane work is similar to moving a long pendulum which can be controlled only in slow motion. Fast swinging of crane loads will lose more time than it gains through loss of control and is very dangerous. A tagline device, similar to that used for clam-shell buckets, can be attached to loads to control outward swing.

6. Loads should be placed on solid footing that have no tendency to overbalance before helpers release hitch.

7. In figuring height of lift, the block, hook and any sling-slack between hook and load must be included. When making capacity lifts, the entire lifting cycle should be calculated and planned before picking up load. It takes less time to check clearances and position than to lift and try then reposition and try again. Besides it's safer. With repetitive lifting, a planned cycle is the best way to high production at low costs.

8. Organize work for minimum travel time. All needed lifts possible in one area should be completed before moving to another location

9. Booming up and down lengthens the cycle and should be avoided as much as possible on repetitive lifting.

10. With track mounted cranes, outriggers should be securely set before undertaking any near-capacity loads Footing under jacks must be level and solid.

11. Jerky operations on crane work should be avoided. It is hard on cable and also dangerous

12. Adding a jib to the boom increases the working range both horizontally and vertically, but materially decreases lifting capacity.

13. With a given boom length, the steeper the working angle the shorter the working radius. The nearer the boom moves to the vertical the greater the loss in radius for each degree of increase in boom angle.

14. In construction or steel erection, the crane should be located to handle lifts to farthest points first. This provides greatest assurance of boom and load clearance and avoids blocking subsequent crane operations.

15. Level operation footing avoids swing "up or down hill". It requires less power, is faster and safer.

16. When picking a heavy load from a high position to be lowered to a lower position, for example, into a basement or hole of a ship, it is of prime importance that adequate length of hoist cable is assured to facilitate full travel of the block to the lowest point required

17. Stand clear of boom when "booming" up or down.

In addition to the flexibility made possible by the various types of attachments, manufacturers for power cranes and shovels offer many models of varied capacities mounted on various types of traction. These are primarily classified as Crawler Traction Mountings and Rubber Tire Traction Mountings.

Application of Crawler Traction

Although the crawler is the best type of traction for soft ground or wet bottom operations, it has a universal use under almost any and every condition.

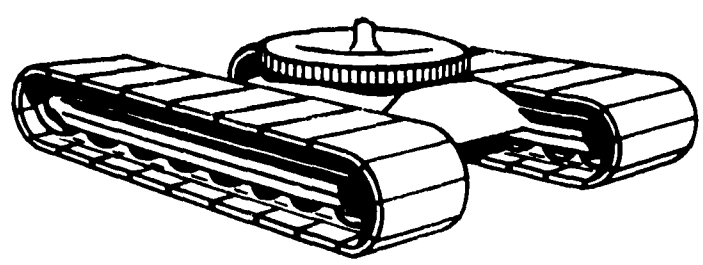


Fig. 2

Conditions where crawlers are most advantageous can be grouped, for the most part, in the following classifications:

1. In soft terrain where the large bearing area of the crawler tracks insures proper movement and stability.
2. In heavy excavation, such as quarry and mining operations or on highway, dam and airport work, where crawlers afford better stability and more resistance to the shock loads of digging. Crawlers are even more important where the working floor or terrain is uneven, or sharp rock fragements are detrimental to tires.
3. Where the size and weight of machine is such that rubber-tired mounting is impractical.
4. Where there is no need for frequent and high speed movement of the machine over a widely separated series of operations.

Crawler traction mountings are available in a wide range of sizes to give most effective bearing areas for meeting ground conditions. Both extra long and extra wide tracks are available and wide shoes in the belts can be used to increase bearing area. Cleats also are available to increase grip of the belts in soft or slippery material.

Application of Rubber-Tire Traction

Fig. 3

There are two types of self-propelled rubber-tired wheel mountings in use. These are the single engine or, so called wheel mountings, and the two engine or truck mounting.

Conditions under which these wheel mountings are especially applicable are as follows:

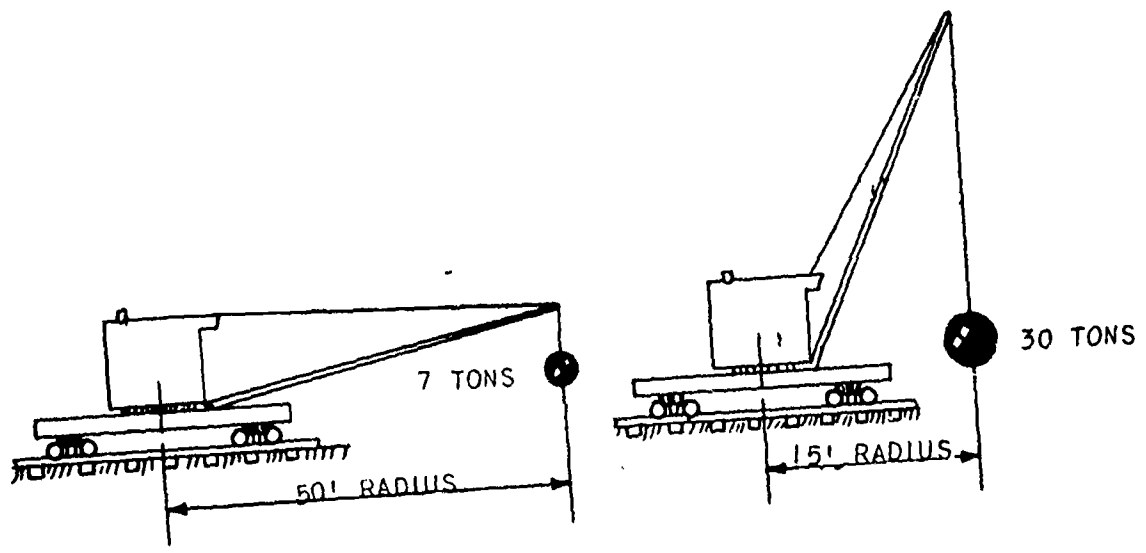
1. Where the ability of the machine to transport itself quickly from one location to another is important.
2. Where ground conditions or working floor are sufficiently firm and level to permit moving and working on rubber tires.
3. Where the use of crawler traction is prohibitive either for reasons of damage to footing or legal regulations.
4. Where abrasive materials on roadway causes abnormal wear of crawlers and rubber-tired mounting meets operating conditions.

The crawler type crane and the truck mounted type crane both have varying capacities as shown on the side of the cab. Capacities of any type crane is effected very much by the position of the boom. The capacity load can only be lifted when the boom is straight ahead.

Fig. 4 shows the comparative reduction in load lifting capacity when the boom is at the side of the tracks or truck.

The effect of the angle of the boom is also shown in Fig. 4. These factors must be taken into consideration when setting the crane in position to do a job. Lowering the boom increases the "reach" or radius of operation but reduces the lifting capacity.

The journeymen working on the job usually have a better conception of the weight and balance of a piece of his equipment than the crane operators. It is his responsibility to set the load in place without damage. Knowledge of the operation of this type of equipment will eliminate a great many hazards which endanger his own life as well as the rest of the crew.


7 TONS
50' RADIUS
30 TONS
15' RADIUS

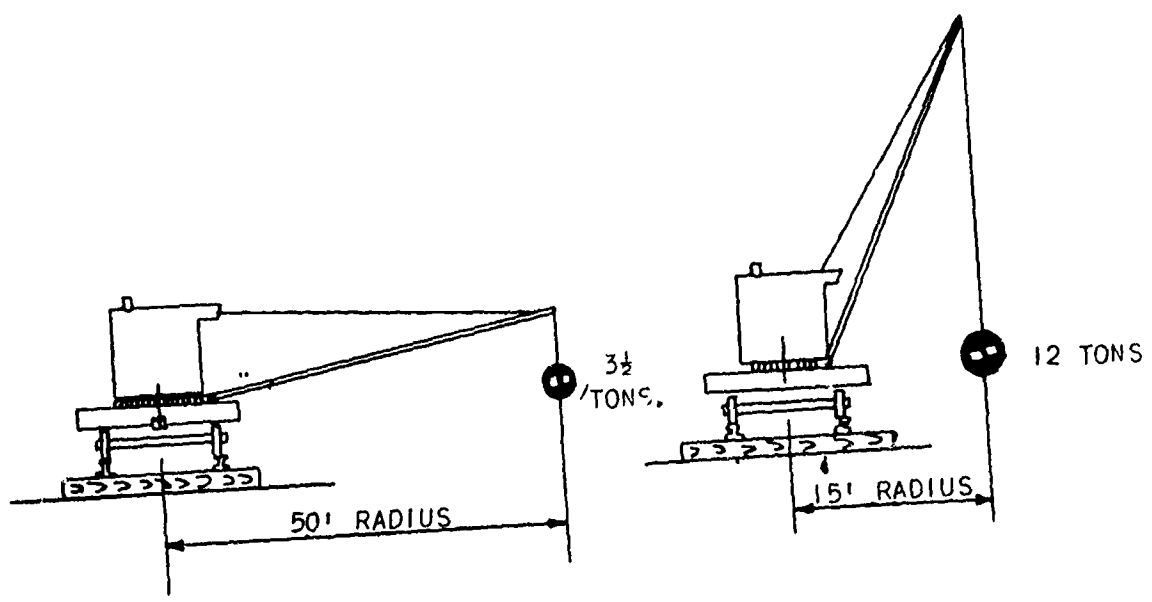

3½
TONS
50' RADIUS
12 TONS
15' RADIUS

Fig. 4

Name: _____

Approved by: _____

Date: _____

CRANES & DERRICKS

Key: B I - P 7 - 6 A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Types and Safe Use of Cranes and Derricks

Purpose: To familiarize you with the methods, uses and precautions pertaining to Derricks and Cranes that are used in various piping jobs.

References:
1. Standard Practices in Mechanical Construction - Grinnell
2. Information Sheet (Pages 50-56 & 76-78)

Introductory Information: Cranes, Derricks and other heavy equipment are used on many jobs in the piping industry. This equipment provides a means of moving heavy pipe and equipment much more economically and safely. This naturally is dependent upon the degree of safety and the knowledge with which this equipment is used. In the case of this equipment safety depends upon the crews knowledge of capacity and procedure in its use.

Procedure: Study the references and become familiar with procedures and safety involved in the operation of equipment.

1. Nine hazards are listed in the reference. List them here and list the precaution that should be taken to prevent serious accidents as a result.

   a. (1)

   (2)

   b. (1)

   (2)

   c. (1)

   (2)

   d. (1)

e. (1)

(2)

(3)

(4)

f. (1)

(2)

g. (1)

(2)

h. (1)

(2)

2. What rules should be followed pertaining to riding a load, sling or hook while it is in motion?

3. What procedure should be followed by a foreman or supervisor in giving orders to a crane operator?

4. Describe the hand signal that is given to the operator to raise or hoist the load.

5. Describe the hand signal indicating that you want to swing the load in a certain direction.

6. What is meant by the signal "dog off the load and boom"?

7. Describe the signal for raising the boom.

8. Describe a situation requiring a hook man to give a signal to boom down and raise load.

9. List two precautions that must be taken during the operation mentioned in question No. 8.

a.

b.

10. In preparation for moving a crane into a particular position what is the first consideration?

11. What precaution should be taken when moving heavy loads?

12. What precaution is taken before releasing the hitch from a load?

13. What provision is made to stabalize or prevent a truck mounted crane from turning over when lifting from the side?

14. What are the advantages of a truck mounted crane over a crawler type?

15. What is the greatest advantage of a crawler type track unit over a truck mounted unit?

16. When using guy derricks, why is it recommended to use an odd number of guys to support the mast?

17. In your own words explain the difference between a guy derrick and a gin pole.

Instructor's Lesson Plan

Subject: Safe Methods of Material Handling

Reference: Standard Practices in Mechanical Construction - Grinnell

Introductory Information: This assignment is meant to bring such information before the apprentice that he may be confronted with at the beginning of a job. The information in this manual is partially supported by the National Safety Council. Parts of the rules may not follow exactly the local working rules or practices to the letter. Some interpretation will be needed by the instructor.

The information covered in this particular assignment is such that it may be used as a class discussion after the class has studied the assignment in the handbook. The questions and problems will serve as a follow up.

Accidents are most frequently caused by improper construction or use of a scaffold which can be easily prevented.

Don't let the class run through this material too fast. Stress all points of safety and precaution.

VT 010 024
Pulaski, Richard E.
Basic Instruction: Apprentice Training in the Plumbing and Pipe Fitting Industry, Apprentice Workbook 4.

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DESCRIPTORS - *STUDY GUIDES; *TRADE AND INDUSTRIAL EDUCATION; *APPRENTICESHIPS; *PLUMBING; WORKBOOKS; *MATHEMATICS; CALCULATION; ASSIGNMENTS

ABSTRACT - This workbook was prepared by a subject matter specialist to provide basic instruction in plumbing and pipe fitting apprentice training programs. Information sheets and student assignment sheets listing subject matter, purpose, references, general information, directions, and problems to be solved are provided for the following subjects: (1) calculating area of quadrilaterals, triangles, circles, and cylinders, (2) calculating volume of rectangles and cylinders, (3) calculating measurements of volumes and weights of water, and (4) water pressure, head and force. Reference tables and student progress reports for both students' and instructors' files are also included. (AW)

VT 010 024

ED0 45856

BASIC INSTRUCTION

APPRENTICE TRAINING

in the

PLUMBING AND PIPE FITTING INDUSTRY

Apprentice Workbook 4

Prepared by

Richard E. Pulaski, Specialist
Apprentice Training
Plumbing and Pipe Fitting

ENGINEERING EXTENSION SERVICE
Texas A&M University
cooperating with
INDUSTRIAL EDUCATION SERVICE
Texas Education Agency
and
Texas State Joint Apprenticeship and Training Committee
for the Plumbing and Pipe Fitting Industry

VT 010 024

9-4-500

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Revised
September 1964

by

Richard E. Pulaski, Specialist
Apprentice Training
Plumbing and Pipe Fitting

Name_____

BASIC INSTRUCTION
Apprentice Workbook No. 4

STUDENT PROGRESS RECORD
in
BASIC INSTRUCTION FOR APPRENTICE TRAINING
for the
PLUMBING AND PIPE FITTING INDUSTRY

	Information Sheets	Student Assignments	Date Completed
1. Percentage	2 pages	2 pages	
2. Area Calculations, Quadrilaterals	2 pages	3 pages	
3. Area Calculations, Triangles	3 pages	2 pages	
4. Volume Calculations, Rectangular Figures	7 pages	2 pages	
5. Area Calculations, Circles and Cylinders	5 pages	4 pages	
6. Volume Calculations, Cylinders	None	3 pages	
7. Calculations of Measurements of Volumes and Weights of Water	1 page	2 pages	
8. Water Pressure, Head and Force	3 pages	3 pages	

Note: Green sheet for student's notebook
Gold sheet for instructor's file

Name_____

BASIC INSTRUCTION
Apprentice Workbook No. 4

STUDENT PROGRESS RECORD
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BASIC INSTRUCTION FOR APPRENTICE TRAINING
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Note: Green sheet for student's notebook
Gold sheet for instructor's file

Information Sheet
in
Plumbing and Pipe Fitting

Subject: PERCENTAGE

Ratio is often expressed by means of the word "per". For example, we speak of a line of piping having a grade of 2 feet per hundred feet of run. When the two numbers of the ratio refer to quantities of the same kind, in this case feet, the ratio is expressed as percentage.

A 2% grade is the same as a 2 foot fall (or rise) in 100 feet of lateral travel. This 2% signifies .02 ft. fall per foot lateral travel or 2 ft. per hundred or 2 per "Cent". (Cent coming from Century or 100)

Example:
3% = .03 or 3/100
25% = .25 or 25/100 or ¼
62½% = .625 or 5/8
75% = .75 or 3/4

NOTE: In making percentage calculations the sign % is dropped and the percent is expressed as a decimal.

1. To find a percentage of a number, such as 25% of 50, multiply it as a decimal, as .25 x 50 = 12.5. Find 25% of 8.

   Solution: 25% of 8

   .25 x 8 = 2.00 or 2
   or
   ¼ x 8 = 2

2. 1022 is 28% of what number?

   Solution: Since 1022 is 28%,
   1% is 1/28 of 1022
   1/28 x 1022 = 36.5
   Multiply by 100:
   Then 1022 is 28% of 3650

PERCENTAGE

Key: B I - AW 4 - 1I
Page 2 of 2

3. 16.5 is what percent of 64.8?

Solution: Divide 16.5 by 64.8

$$\frac{16.5}{64.8} = .2546$$

Multiply by 100

100 x .2546 = 25.46%

Then: 16.5 is 25.46% of 64.8

Example: Molten tin and lead are mixed together to make plumbers wiping solder. A pot of solder contains 50 pounds of tin and 75 pounds of lead. What are the percents of tin and lead in the solder?

50 + 75 = 125 lbs. of solder
50 ÷ 125 = .40 or 40% of tin
75 ÷ 125 = .60 or 60% of lead
or
100 - 40 = 60% lead

Name_____ PERCENTAGE

Approved by_____ Key: B I - AW 4 - 1A

Date_____

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Percentage

Purpose: To review the methods of calculating percentage.

References: Information Sheet, "Percentage".

Introductory Information: Percentage calculations are used by the plumber and pipe fitter in estimating labor and materials, figuring cost prices of materials, laying out grades for sewer and drain lines, figuring wage scales, and many other uses. This assignment is simply a review of percentage calculations.

Directions:

1. Study the Information Sheet.
2. Solve the following problems.
3. Make your calculations on separate sheets of paper and hand in with this assignment.

1. A contractor estimates 80 hours to do a complete job. The roughing-in requires 70% of this time. How many hours are required for the roughing-in?

   _____hours.

   How many hours were left for the finishing?

   _____hours.

2. Before receiving a $12\frac{1}{2}$% increase in wages, the plumbers and pipe fitters wage scale was $2.00 per hour. What is the wage rate after the increase?

   _____per hour.

3. After a period of a few years it was decided to reduce the wage scale (answer in problem 2) by $12\frac{1}{2}$%. What is the wage scale after the reduction?

   _____per hour.

PERCENTAGE

Key: B I - AW 4 - 1A
Page 2 of 2

4. A sewer line 180 feet long is laid on a 2% grade, which means that the line has 2 feet of fall in every 100 feet of run. What is the difference in the levels of the upper and lower ends of the line? Give your answer in feet and inches to the nearest ¼ inch.

_____feet _____inches.

5. A plumber used all of the 40-60 wiping solder that he had in stock. He had 30 pounds of 50-50 solder and added lead to this solder to make wiping solder. How many pounds of lead were required to make the solder 40% tin and 60% lead?

_____pounds.

6. A drain line is laid with a slope of ¼ inch drop for each foot of run. What is the grade in terms of per cent?

_____per cent.

7. A contract for a job is $4,963.00. 35% of this amount was for material, 30% for labor, 15% for overhead expense, and 20% for profit. Give the money figures for each of these items.

Material: $_____ 35%

Labor: $_____ 30%

Overhead: $_____ 15%

Profit: $_____ 20%

Total: $_____100%

8. Try to solve the following problems mentally without figuring them out on paper. Write your answers down and then figure them out on paper to see if they are correct.

a. 25 is 5% of what number? _____

b. 40 is 20% of what number? _____

c. 75 is 100% of what number? _____

d. 81 is 90% of what number? _____

e. What is 25% of 300? _____

Information Sheet
in
Plumbing and Pipe Fitting

Subject: AREA CALCULATIONS, QUADRILATERALS

Areas refer to surface measuring, and are expressed in square inches, square feet, square miles, etc. One square inch covers a surface of 1" each way as shown in Fig. 1. Areas do not have thickness so that only two dimensions (width and length) are used in obtaining an area.

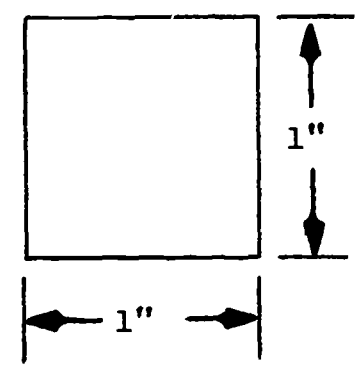


Fig. 1

A square foot is 12" long by 12" wide and if divided into inches like Fig. 2 it will show 12 x 12 or 144 square inches = 1 sq. ft. A figure does not have to be square or have right angles in the corners to enable one to figure its area, but it is easier to find the area of a square or rectangle because they do have right angles and the sides are paralleled. To find the area of a square or rectanble, multiply the length of one side by the length of the other side.

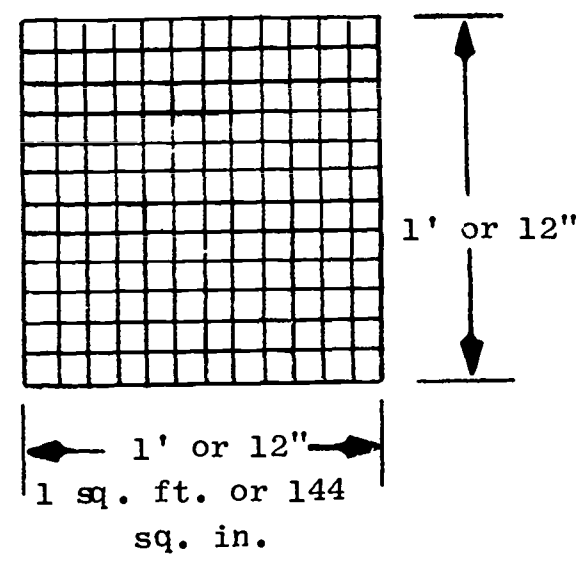


Figure 2

The formula is most often written: A(area) = L(length) X W(width)

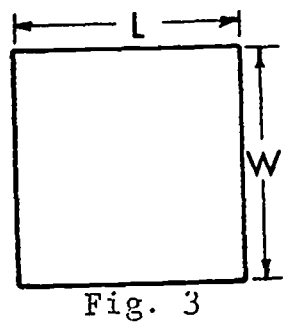


Fig. 3

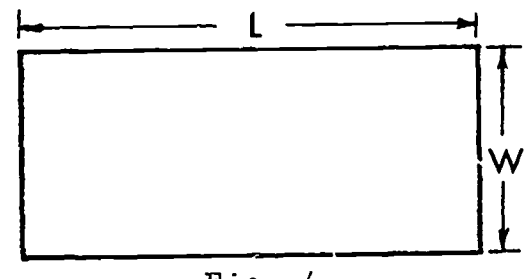


Fig. 4

(Note the length and width of a square are equal. The square is a special case of the rectangle.)

AREA CALCULATIONS, QUADRILATERALS

Key: B I - AW 4 - 2I
Page 2 of 2

A parallelogram is a quadrilateral with opposite sides parallel but does not have right (90°) angles. To find the area of a parallelogram, multiply the length by the width.

NOTE: The width is the perpendicular distance between two parallel sides.

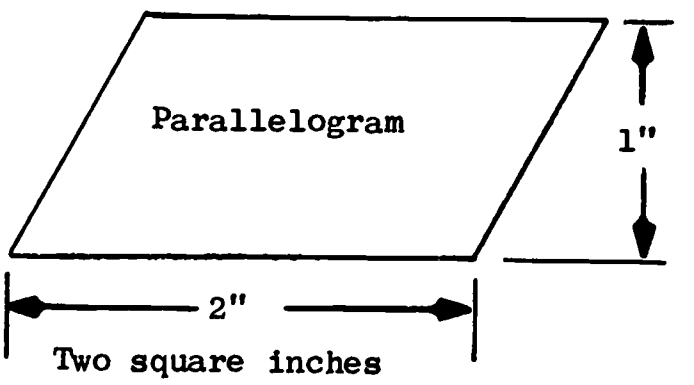
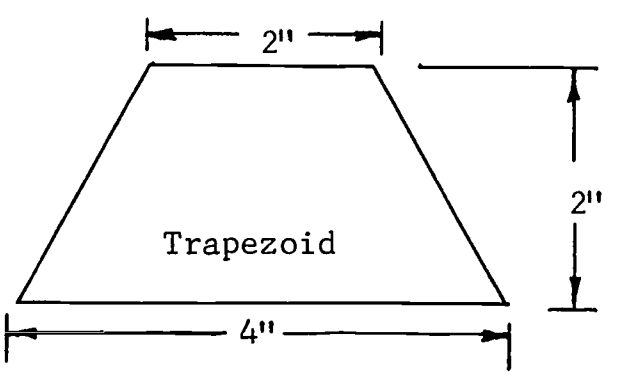


Fig. 5

A **trapezoid** is a quadrilateral with only two sides parallel. To find the area of a trapezoid, add the two parallel sides and divide by two; multiply the figure obtained by the perpendicular distance between the two parallel sides.

Example: Fig. 4

$$\frac{2 + 4}{2} \times 2 = 6 \text{ sq. in.}$$



6 square inches

Fig. 6

Name: _____

Approved by _____

Date _____

AREA CALCULATIONS, QUADRILATERALS

Key: B I - AW 4 - 2A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Area Calculations, Quadrilaterals

Purpose: To review the methods of calculating the area of quadrilaterals (four sided figures).

Reference: Information Sheet.

Introductory Information: It is necessary that a plumber or pipe fitter be able to calculate areas. This knowledge is useful in making and installing sheet lead linings for shower stalls, acid tanks and X-Ray rooms as well as many other problems encountered in the trade. It is not essential that you remember the names of the various types of quadrilaterals such as "parallelogram, trapezoid", etc. The important thing to learn is how to calculate the areas.

Directions:

1. Study the reference listed above.
2. Solve the following problems.
3. Make your calculations on separate sheets of paper and hand them in with this assignment.

1. The dimensions of a shop are: 48 feet wide and 104 feet long. What is the floor space area?

   _____ square feet

2. A tool room is 14 feet 6 inches by 10 feet 4 inches. What is the floor space area?

   _____

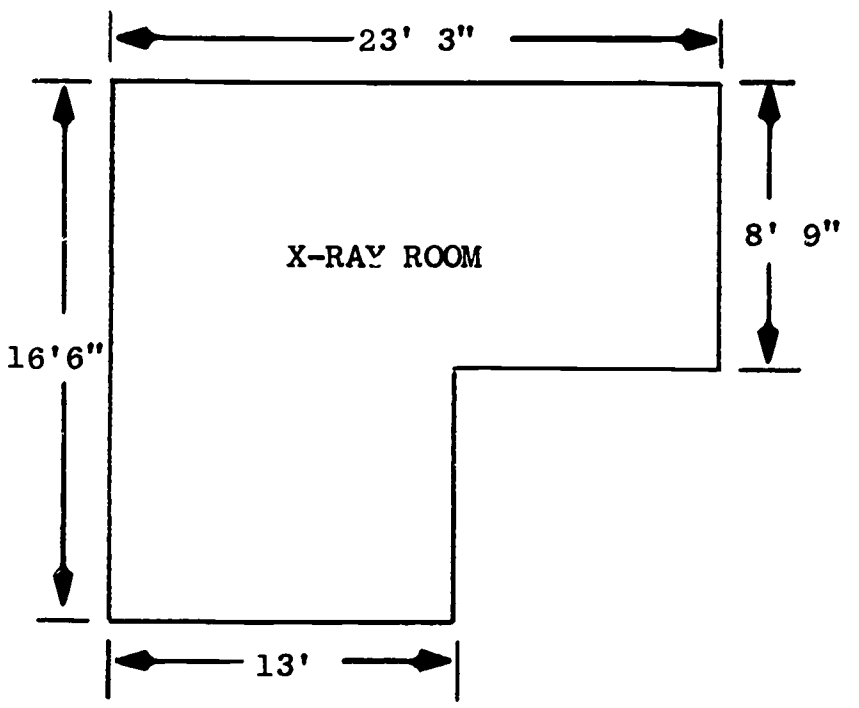
3. A shower stall, 3 feet 6 inches square, is to be lined with 4 pound sheet lead (4 pounds per square foot). The sheet lead is to be turned up 6" on each wall. There will be no waste cut out of the corners because the pan is to have folded corners. How many pounds of lead will be required?

   _____

AREA CALCULATIONS, QUADRILATERALS

Key: B I - AW 4 - 2A
Page 2 of 3

4. The floor of the X-Ray room shown below is to be covered with 8 lb. sheet lead (1/8" thickness). The walls are to be covered with 6 lb. lead (3/32"). There is no ceiling because the room is on the top floor of the building. The walls of the room are 10' 9" high. Add 4% for lap joints. How many pounds of each weight will be required?



_____lbs. 8 lb. lead

_____lbs. 6 lb. lead

5. Calculate the area and weight of steel plates as given below: these plates are shaped like Fig. 5 in the Information Sheet.

Thickness of Plates	Weight per Sq. Ft.	Length	Width	Area		Total Weight Pounds
				Square Inches	Square Feet	
1/8"	5.1 lbs.	25"	9"			
¼"	10.2 lbs.	36"	15"			
½"	20.4 lbs.	66"	50"			

6. Calculate the weight of the steel plates as given below: these plates are shaped like Figure 6 in the Information Sheet (trapezoid).

Thickness of Plates	Weight per Sq. Ft.	Length Long Side	Length Short Side	Width	Total Weight Pounds
3/16"	7.65	26"	12"	12"	
3/8"	15.3	3' 5½"	1' 3"	2' 4"	
3/4"	30.6	5' 6"	2' 11½"	2' 10"	

Information Sheet
in
Plumbing and Pipe Fitting

Subject: AREA CALCULATIONS, TRIANGLES

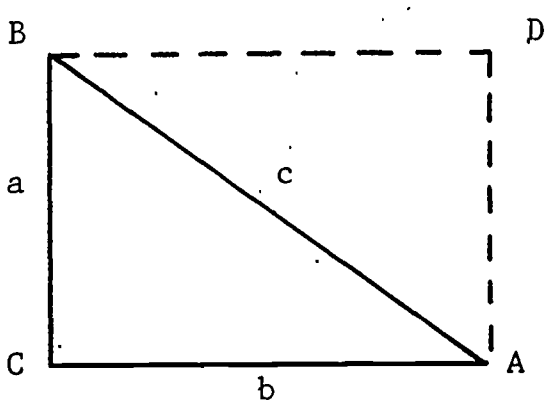


Fig. 1

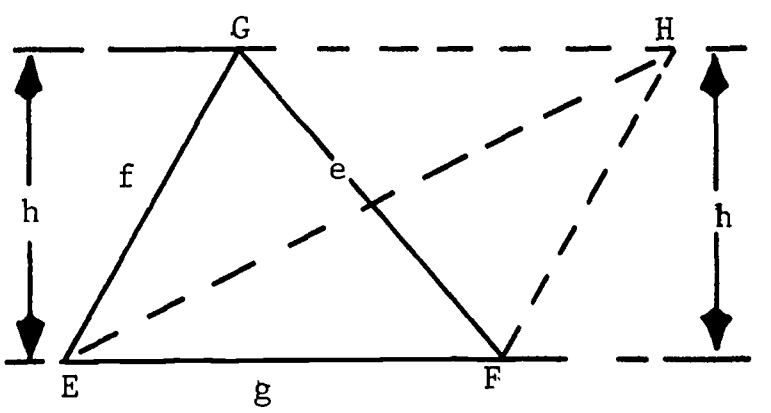


Fig. 2

To find the area of a triangle, multiply the base by the altitude and divide by two.

That side of a triangle on which it rests (bottom side) is usually known as the base; however, any side may be considered as the base.

The perpendicular distance from the base to the angle opposite the base is known as the altitude or height of a triangle.

In the right triangle ABC, Figure 1, the short side "a" is the altitude while the side "b" is the base. It can be seen that this triangle is one-half the area of the rectangle ADBC, since the area of this rectangle is equal to one-half of "a" times "b". This may be expressed as a formula:

$$\text{Area } \triangle \text{ ABC} = \frac{\text{a times b}}{2} \text{ or } \frac{ab}{2}$$

In the triangle EFG, Figure 2, "h" is the altitude because "h" is the perpendicular distance from the base "g" to the opposite angle "G". Since "g" is the length and "h" is the width of the parallelogram EFHG, so "g" x "h" = Area of the parallelogram.

AREA CALCULATIONS, TRIANGLES

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Since the side "e" divides the parallelogram into two equal parts, it can be seen that the area of the triangle EFG may be found by the following formula:

$$\text{Area } \triangle \text{ EFG} = \frac{g \times h}{2} \text{ or } \frac{gh}{2}$$

Also, Area $\triangle$ EFH = Area EFG, because both triangles have the same base and altitude.

In some cases the altitude of a triangle is not known. If the lengths of the three sides are known, the area of any triangle may be found by use of the following formula:

$$\text{Area } \triangle = \sqrt{s \times (s - a) \times (s - b) \times (s - c)}$$

"a", "b" and "c" are the lengths of the sides.

"s" is one-half the distance around the triangle, or

$$s = \frac{a + b + c}{2} \text{ or } s = \tfrac{1}{2}(a + b + c)$$

Example: Using the triangle EFG, Figure 2, suppose that the base "g" is 6 feet, the side "f" is 4 feet, and the side "e" is 5 feet.

$$s = \frac{6 + 5 + 4}{2} = \frac{15}{2} = 7.5 \text{ feet}$$

Substituting in the formula above:

$$A \triangle = \sqrt{7.5 \times (7.5 - 6) \times (7.5 - 5) \times (7.5 - 4)}$$

$$\sqrt{7.5 \times 1.5 \times 2.5 \times 3.5}$$

$$\sqrt{98.4375} = 9.92 \text{ sq. ft.} = \text{Area of Triangle EFG}$$

With this answer, we can now find the altitude of this triangle.

On the preceding page we have: Area $\triangle = \frac{g \times h}{2}$

Substituting the values that we now know,

$$9.92 = \frac{6 \times h}{2}$$

By dividing the 2 into the 6, we have:

$$9.92 = 3 \times h$$

By dividing both sides by 3, we have:

$$\frac{9.92}{3} = \frac{\cancel{3} \times h}{\cancel{3}}, \text{ or } h = \frac{9.92}{3}$$

So: $h = 3.306$ feet = Altitude of $\triangle$ EFG.

Name:_____ AREA CALCULATIONS, TRIANGLES

Approved:_____ Key: B I - AW 4 - 3A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: AREA CALCULATIONS, TRIANGLES

Purpose: To review the methods of calculating the area of triangles.

References: Information Sheet, "Area Calculations, Triangles".

Introductory Information: Occasionally the plumber and pipe fitter will find it necessary to calculate the areas of a triangular space, as for example, finding the size of roof drains for triangular shaped buildings; finding the volume of partially filled horizontal cylindrical tanks and boilers; finding the areas and weights of triangular and odd shaped pieces of steel plates or sheet metal, etc.

Directions:

1. Study the Information Sheet, "Area Calculations, Triangles".
2. Work the following problems. Make your calculations on separate sheets of paper and hand these in with this assignment.

1. Calculate the areas of right triangles with the short side as follows:

   a. 4" and 6" Answer_____sq. in.

   b. 15" and 21" Answer_____sq. in.

   c. 3'-4" and 5'-3" Answer_____sq. ft.

   d. 5'-5" and 11'-11" Answer_____sq. ft.

2. The triangle EFG (Figure 2 in the Information Sheet) has a base of 17" and an altitude of 9½". What is the area?

   Answer_____sq. in.

3. The triangle EFH (Figure 2) has an altitude of 19 feet and the base is 26 feet. What is the area?

   Answer_____sq. ft.

AREA CALCULATIONS, TRIANGLES

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4. The sides of a triangle are 34 feet, 55 feet, and 75 feet. The altitude is not known. Find the area.

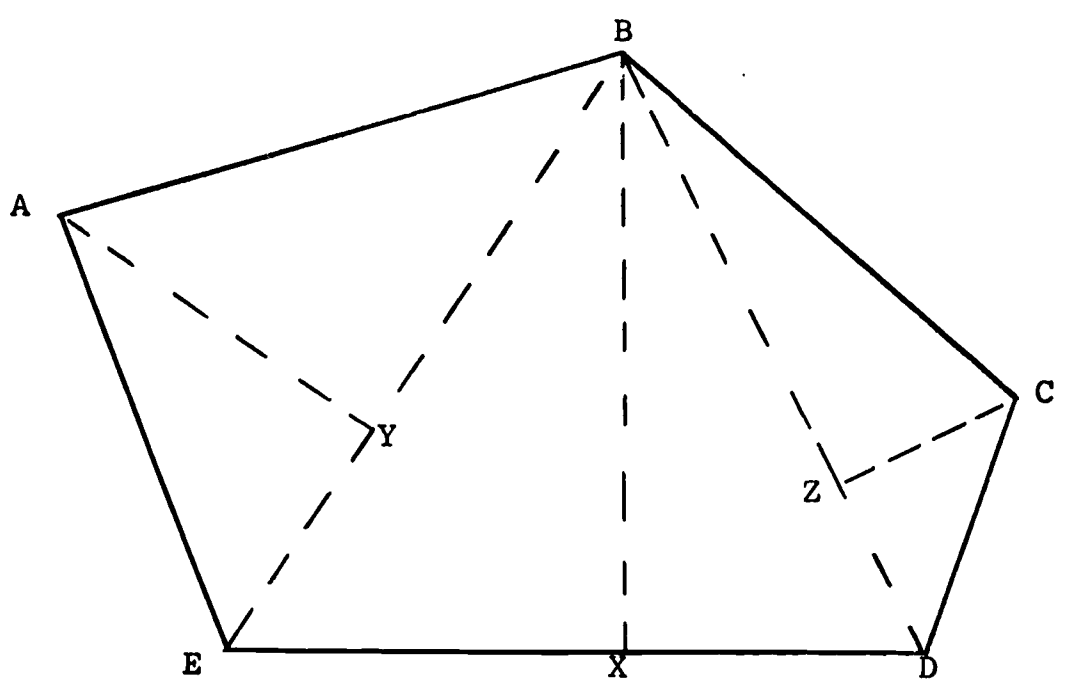
Answer_____ square feet

5. The wall dimensions of a triangular shaped building are 120 feet, 88 feet, and 60 feet. Find the cross-sectional area of a single roof drain. (Allow one square inch sectional area of the roof drain for each 130 square feet of roof area). The building has a flat roof.

Answer_____ square inches

6. The figure below, ABCDE, represents the roof plan of a flat-roofed, irregularly shaped building. Find the roof area in square feet. NOTE: The figure is divided into triangles by the dotted lines. The combined area of the three triangles, ABE, BED, and BCD, will be the roof area. Scale your measurements to the nearest one-half foot.

Scale: 1/8" = 1' 0"



Answer_____ square feet

Information Sheet
in
Plumbing and Pipe Fitting

Subject: VOLUME CALCULATIONS, RECTANGULAR FIGURES

The plumber and pipe fitter is often required to calculate the volumes of rectangular figures such as rooms, trenches, vats, tanks, etc.

Volumes are usually calculated in cubic inches or cubic feet. Such volume figures may be converted to gallons or pounds. A cubic yard is the volume unit ordinarily used for gravel, sand, and earth such as is removed from trenches.

CUBIC MEASURE

Review briefly the concepts of measure studied so far; there was first considered the units of linear measure, which used one dimension only - length. This was followed by square measure dealing with "two" dimensions, length and width - giving area.

"Cubic measure" deals with an additional dimension, "thickness" and so requires three dimensions, length, width, and thickness in determining volumes, capacities, weights and the like.

HOW CUBIC MEASURE IS DETERMINED

In the study of square measure, it was explained that a square foot was the area of surface 12 in. long and 12 in. wide, and that the product of these two dimensions was 144 square inches.

By referring to the following drawing, the student will see that if this 144 square inches is extended 12 inches in a third direction adding thickness to it, this amount will be increased or multiplied 12 times.

This gives a solid 12 inches long, 12 inches wide, and 12 inches thick, and contains 1,728 cubic inches which is the product of 12 x 12 x 12. This is the cubic inch measure of a solid which is 1 ft. wide, 1 ft. high, and 1 ft. thick or 1 cubic foot.

From this explanation and from a study of the illustration which follows, the student will develop a clear understanding of what is meant by cubic foot and cubic measure in general.

VOLUMBE CALCULATIONS,
RECTANGULAR FIGURES

Key: B I - AW 4 - 4I
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The solid picture below contains twelve sections of cubes 1 in. on the edge, with 144 cubes in each section, or a total of 1,728 one-inch cubes.

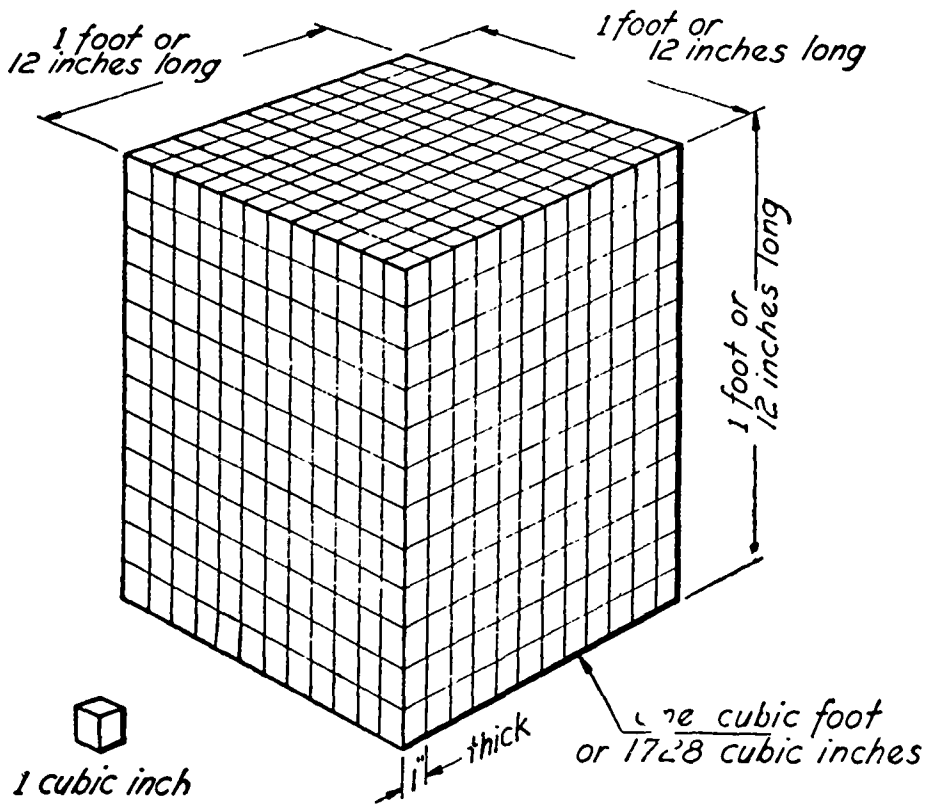

Fig. I Fig. 2

It being 1 ft. long, 1 ft. wide, and 1 ft. thick, it is called one cubic foot. To show the relation of the standard units of cubic measure to each other, and to aid in changing units of one denomination to equivalent units of another denomination the following table and illustrations are given.

1,728 cubic inches (cu. in.)	=	1 cubic foot (cu. ft.)
27 cubic feet	=	1 cubic yard (cu. yd.)
231 cubic inches	=	1 gallon (gal.)
7.48 gallons	=	1 cubic foot

The following illustrations show the relation of standard units to the cubic yard and gallon.

VOLUME CALCULATIONS,
RECTANGULAR FIGURES

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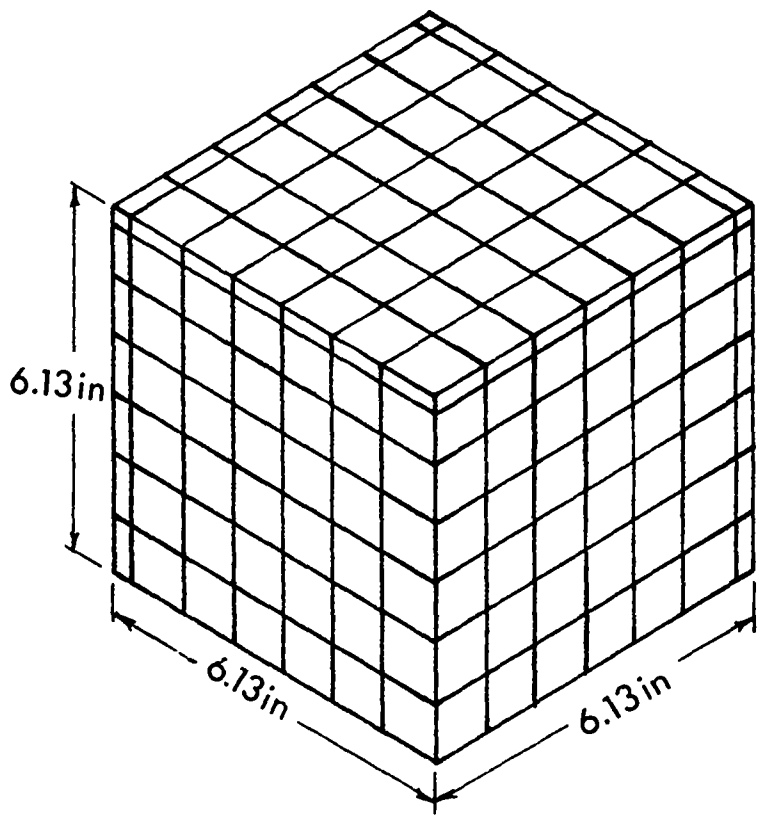
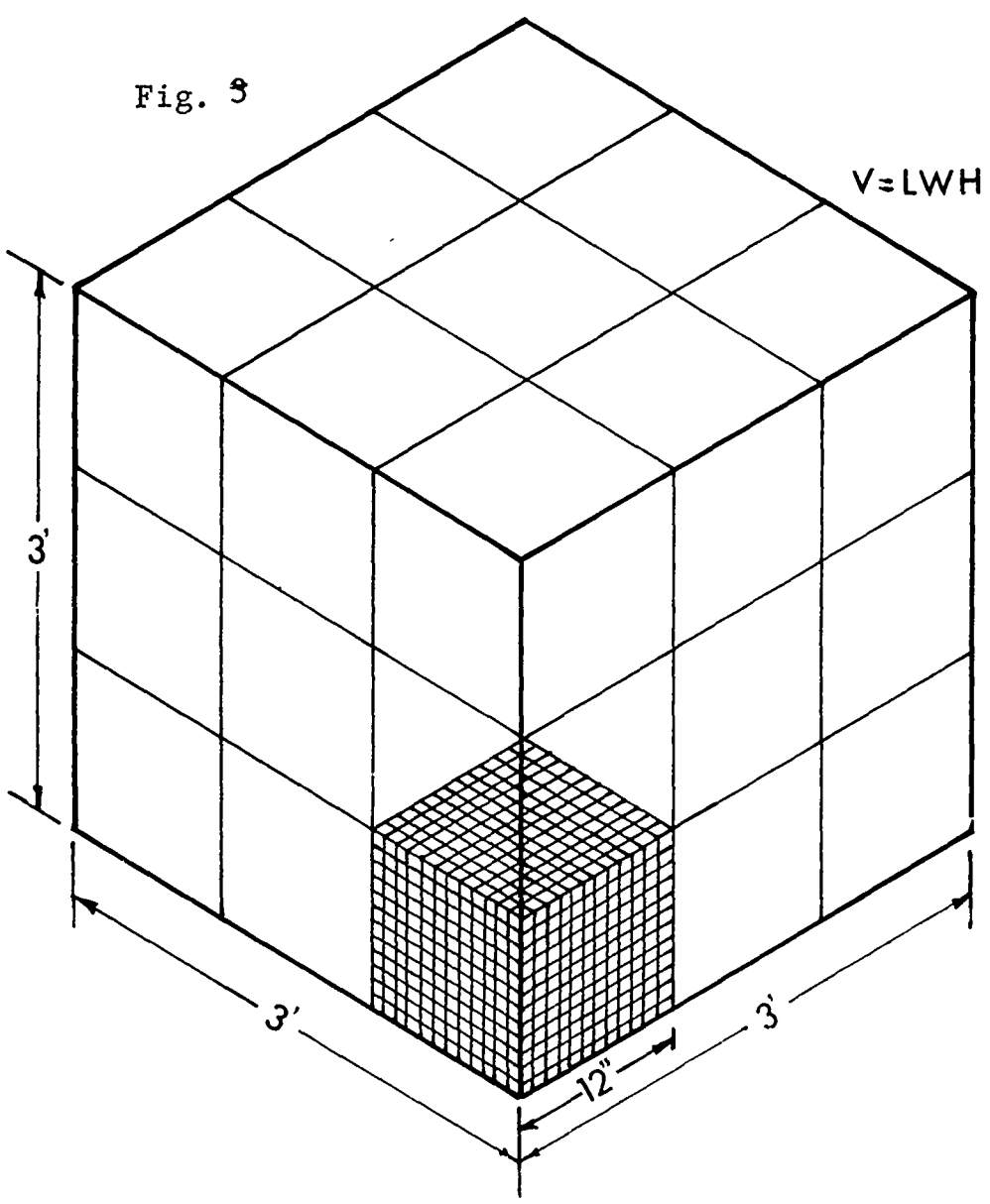
Fig. 4



1 Gal. = 231 Cu. In.

$V = LWH = (6.13in)(6.13in)(6.13in) = 231\ In^3$

Fig. 5



$1\ Yd^3 = 217\ Ft^3 = 46{,}656\ In^3 = 201.97$ Gal.

VOLUME CALCULATIONS,
RECTANGULAR FIGURES

Key: B I - AW 4 - 4I
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To change from units of one denomination to equivalent units of another denomination, the process in cubic measure is similar to that used in square measure and linear measure, as shown in the following examples.

Example 1

In excavating for a utility tunnel between two buildings, 15 truck loads of dirt were hauled away. If each truck load contained 2½ cu. yd., what was the equivalent number of cubic feet of dirt removed?

Solution and explanation:

First determine the number of cubic feet per truck load.

$$\frac{(2.5\ \cancel{yd^3})(27\ ft^3)}{(\ load\ )(\ \cancel{yd^3}\ )} = \frac{67.5\ ft^3}{load}$$

The equivalent number of ft^3 in 15 truckloads is found by multiplying

$$\frac{(67.5\ ft^3)}{(\ \cancel{load}\ )}(15\ \cancel{load}) = 1012.5\ ft^3 \text{ of dirt removed}$$

WEIGHTS OF MATERIALS

For reference in solving problems that involve weights of materials there are listed herewith the more commonly used materials and their approximate weights per unit of cubic measure.

aluminum	.09	lb. per cu. in.
brass	.30	lb. per cu. in.
bronze	.32	lb. per cu. in.
cast iron	.26	lb. per cu. in.
copper	.32	lb. per cu. in.
lead	.41	lb. per cu. in.
steel	.28	lb. per cu. in.
concrete	150.00	lb. per cu. ft.
earth (dirt)	100.00	lb. per cu. ft.
sand	100.00	lb. per cu. ft.
water (fresh)	62.425	lb. per cu. ft.
(the weight of water is often given as 62½ lb. per cu. ft.)		
water (salt)	64.00	lb. per cu. ft.

To obtain a fair degree of accuracy in calculations that involve weights or volumes, the answers, should be carried to the second decimal place, unless otherwise specified.

Example 2

How many tons of dirt were removed in the exacation referred to in Example 1?

$$(1012.5\ ft^3)\frac{(100\ lb.)}{(\quad ft^3)} = 101250\ lb.\ of\ dirt$$

$$(101250\ \cancel{lb.})\frac{(\quad ton)}{(2000\ \cancel{lb.})} = 50.625\ tons\ of\ dirt$$

Note: This problem could be set up all in one operation as follows:

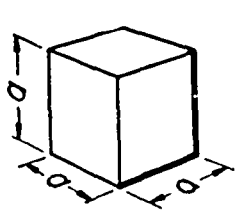
$$\frac{(2.5)\ \cancel{yd^3}}{(\quad \cancel{load})}\frac{(27\ \cancel{ft^3})}{(\quad \cancel{yd^3})}\frac{(\overset{3}{\cancel{15}}\ \cancel{load})}{(\qquad)}\frac{(\cancel{100}\ \cancel{lb.})}{(\quad \cancel{ft^3})}\frac{(\quad ton)}{(\underset{4}{\cancel{2000}}\ \cancel{lb.})} = \frac{(2.5)(27)(3)}{4} = 50.625\ tons\ of\ dirt$$

VOLUMES OF REGULAR SOLIDS

The cubical measure of regular solids, for example, a cube, a sphere, or a rectangular prisim, or a solid resembling any of these, is found by multiplying the three dimensions expressing length, width, thickness, or their equivalents. If these dimensions are in inches, the product is cubic inches; if they are in feet, the product is in cubic feet. If they are in yards, the product is in cubic yards.

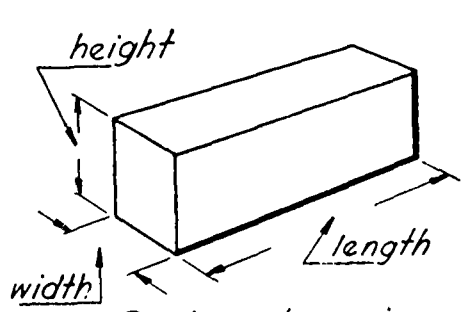
The method used in calculating the cubic measure of the more common regular figures is explained and illustrated below.

Cubes, Rectangular Prisms, or Forms Resembling Them



Cube

Fig. 5



Rectangular prism

Fig. 6

In the cube, all edges and all faces, or sides are equal and its volume is equal to a x a x a, or a^3.

(Note: When a number or a quantity is multiplied by itself in this manner, it is said to be "cubed", or "raised to the third power". This multiplication is more briefly expressed by placing the small figure ^{3} to the right and slightly above the number, or quantity, to be cubed. In this case, a x a x a would become a^3. The volume of the cube would be equal to a^3, where "a" equals the length of one of the edges.)

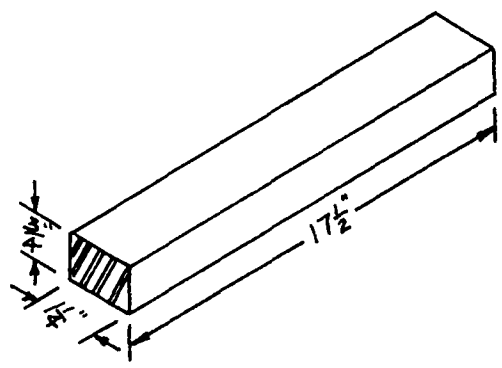
In a rectangular solid, or a rectangular prism, as it is sometimes called, the faces or sides are rectangular in shape and only the opposite sides and opposite edges are equal.

The volume of such a solid is found by multiplying the length, width, and thickness. This is also the equivalent of multiplying the area of the base by the vertical height.

An application of these rules is seen in the following example.

Example 3

Calculate the weight of the steel bar in the following sketch when this material 0.28 lb/in.^{3}



The weight of the bar is found by first calculating the volume in cubic inches and then multiplying that amount by 0.28 lb/in^3.

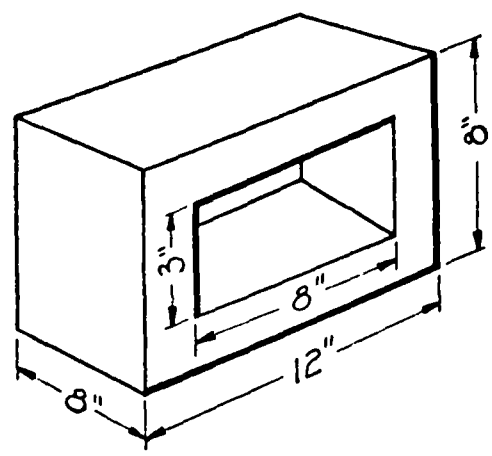
$$(17.5\ \cancel{in})(1.25\ \cancel{in})(0.75\ \cancel{in})\frac{(0.28\ lb)}{(\ \ \cancel{in^3})} = \underline{\underline{4.59\ lb.}}$$

CALCULATIONS RELATING TO HOLLOW RECTANGULAR SOLIDS

The volumes or weights of hollow rectangular forms or solids based on the rectangular form, such as hollow concrete blocks and the like, may be calculated by using the previous rules relating to volumes of rectangular solids. This is illustrated in the following problem.

Example 1

Calculate the weight of a concrete block made according to the dimensions in the illustration below.



Solution and Explanation:

The weight of such a solid is determined by first finding the volume of the entire piece, then subtracting from this the volume occupied by the hole.

Considering this block as a rectangular solid without a hole in it the volume would be:

8 in. x 12 in. x 8 in. = 768 cu. in.

The volume occupied by the rectangular hole would be:

8 in. x 3 in. x 8 in. = 192 cu. in.

The volume occupied by the material then equals:

$$768 \text{ in}^3 - 192 \text{ in}^3 = 576 \text{ in}^3$$

VOLUME CALCULATIONS,
RECTANGULAR FIGURES

Key: B I - AW 4 - 4A

1. A room measures 12 feet by 14 feet, with a ceiling 9 feet high. How many cubic feet of space are in the room?

   _____

2. A concrete septic tank is 3 feet, 3 inches wide, 8 feet long. The depth of the sewage is 3 feet, 2 inches. How many gallons of sewage does the tank contain?

   _____gallons

3. To what depth would 600 gallons of water fill a tank that is 6 feet square?

   _____

4. A rectangular lead lined acid vat is to be constructed to hold 1000 gallons of sulphuric acid, with the rim of the vat 8 inches above the level of the acid. The vat is to be 4 feet wide and 10 feet long What is the required depth? Give your answer to the nearest 1/2 inch.

   _____

5. A sewer trench is cut across a level paved street 50 feet wide. The trench is 27 inches wide and 5 feet deep at one side of the street with a gradual slope to 6 feet deep at the other side. The cut is to be back-filled with gravel. How many cubic yards of gravel will be required? Give your answer to the nearest cubic yard.

   _____cubic yard

6. The inside dimensions of a concrete septic tank are 4 feet wide, 4 feet, deep, and 6 feet long. The top of the tank is one foot below the grade line (ground level). The depth of the sewage in the tank is 3 feet. The top, bottom, and side walls are 6 inches thick.

   a. How many gallons of sewage does the tank hold?

      _____gallons

   b. How many cubic yards of concrete are required to build the tank?

      _____cubic yards

VOLUME CALCULATIONS,
RECTANGULAR FIGURES

Key: B I - AW 4 - 4A
Page 2 of 2

c. How many cubic yards of earth must be exacavated for the tank?

_____cubic yards

d. After the tank has been covered with earth to the grade line, how many yards (cubic yards) of earth must be hauled away?

_____cubic yards

Information Sheet
in
Plumbing and Pipe Fitting

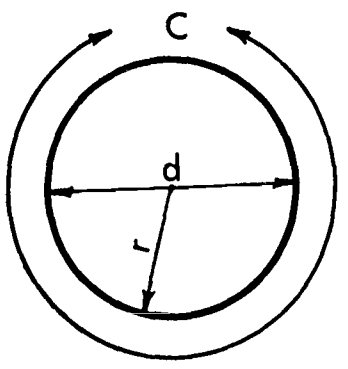
Subject: AREA CALCULATIONS, CIRCLES AND CYLINDERS

The measurements of the area of pipes, cylindrical and rectangular tanks, surfaces of walls, roofs, etc., is very often a part of necessary calculations pertinent to the installation of piping systems or equipment.

1. To find the circular area, the following formulas may be used:

   The area of a circle may be found by multiplying the square of its radius by (3.1416).

   When: A = Area
   C = Circumference (distance around circle)
   d = Diameter
   r = Radius



$$A = \pi r^2; \quad A = 3.1416 \times r^2$$
$$A = \frac{\pi d^2}{4}; \quad A = \frac{3.1416 \times d^2}{4}$$
$$C = 2\pi r; \quad C = 3.1416 \times d \text{ or } 6.28 \times r$$

When the area of a circle is known, the radius may be found by the formula:

$$r^2 = \frac{A}{\pi} = \frac{A}{3.1416} \quad \text{and } r = \sqrt{\frac{A}{3.1416}} = \sqrt{\frac{A}{1.7725}}$$

When the area of a circle is known, the diameter may be found by the formula:

$$d^2 = \frac{4A}{\pi} = \frac{4A}{3.1416}$$

$$d = \sqrt{\frac{4A}{\pi}} = \sqrt{\frac{4A}{3.1416}}$$

Size	Outside Diam.	Inside Diam.	Thickness	Weight Per Foot	No. Threads Per In.	Sq. Ft. Outside Surface Per Ft. of Pipe	Length of Pipe Per Sq. Ft. Outside Surface	U. S. Gals. Per Ft. of Pipe	Length of Pipe Per Gal.
1/8	.405	.269	.068	.245	27	.106	9.431	.0030	338.8
1/4	.540	.364	.088	.425	18	.141	7.074	.0054	185.0
3/8	.675	.493	.091	.568	18	.177	5.659	.0099	100.8
1/2	.840	.622	.109	.852	14	.220	4.547	.0158	63.4
3/4	1.050	.824	.113	1.134	14	.275	3.638	.0277	36.1
1	1.315	1.049	.133	1.684	11-1/2	.344	2.905	.0449	22.3
1-1/4	1.660	1.380	.140	2.281	11-1/2	.435	2.301	.0777	12.87
1-1/2	1.900	1.610	.145	2.731	11-1/2	.497	2.010	.106	6.46
2	2.375	2.067	.154	3.678	11-1/2	.622	1.608	.174	5.74
2-1/2	2.875	2.469	.203	5.819	8	.753	1.329	.249	4.02
3	3.500	3.068	.216	7.616	8	.916	1.091	.384	2.60
3-1/2	4.000	3.548	.226	9.202	8	0.47	.955	.514	1.95
4	4.500	4.026	.237	10.890	8	1.178	.849	.661	1.51
4-1/2	5.000	4.506	.247	12.538	8	1.309	.764	.828	1.207
5	5.563	5.047	.258	14.810	8	1.456	.687	1.029	.962
6	6.625	6.065	.280	19.185	8	1.734	.577	1.501	.666
7	7.625	7.023	.301	23.544	8	1.996	.501	2.012	.497
8	8.625	7.981	.322	28.809	8	2.258	.443	2.599	.385
10	10.750	10.136	.307	34.240	8	2.814	.355	4.096	.244

STANDARD STEEL AND GALVANIZED WROUGHT IRON PIPE

TABLES FOR REFERENCE

CIRCUMFERENCE AND AREAS OF CIRCLES

Diameter	Circumference	Area	Diameter	Circumference	Area
1/64	0.0491	0.00019	43/64	2.1108	0.35454
1/32	0.0982	0.00077	11/16	2.1598	0.37122
3/64	0.1473	0.00173	45/64	2.2089	0.38829
1/16	0.1964	0.00307	23/32	2.2580	0.40574
5/64	0.2454	0.00479	47/64	2.3071	0.42357
3/32	0.2945	0.00690	3/4	2.3562	0.44179
7/64	0.3436	0.00940	49/64	2.4053	0.46039
1/8	0.3927	0.01227	25/32	2.4544	0.47937
9/64	0.4418	0.01553	51/64	2.5035	0.49874
5/32	0.4909	0.01918	13/16	2.5525	0.51849
11/64	0.5400	0.02320	53/64	2.6016	0.53862
3/16	0.5890	0.02761	27/32	2.6507	0.55914
13/64	0.6381	0.03241	55/64	2.6998	0.58004
7/32	0.6872	0.03758	7/8	2.7489	0.60132
15/64	0.7363	0.04314	57/64	2.7980	0.62299
1/4	0.7854	0.04909	29/32	2.8471	0.64504
17/64	0.8345	0.05542	59/64	2.8962	0.66747
9/32	0.8836	0.06213	15/16	2.9452	0.69029
19/64	0.9327	0.06922	61/64	2.9943	0.71349
5/16	0.9818	0.07670	31/32	3.0434	0.73708
21/64	1.0308	0.08456	63/64	3.0925	0.76105
11/32	1.0799	0.09281	1	3.1416	0.78540
23/64	1.1290	0.10144	1 1/64	3.1907	0.81013
3/8	1.1781	0.11045	1 1/32	3.2398	0.83525
25/64	1.2272	0.11984	1 3/64	3.2889	0.86075
13/32	1.2763	0.12962	1 1/16	3.3379	0.88664
27/64	1.3254	0.13979	1 5/64	3.3870	0.91291
7/16	1.3744	0.15033	1 3/32	3.4361	0.93956
29/64	1.4235	0.16126	1 7/64	3.4852	0.96660
15/32	1.4726	0.17258	1 1/8	3.5343	0.99402
31/64	1.5217	0.18427	1 9/64	3.5834	1.02182
1/2	1.5708	0.19635	1 5/32	3.6325	1.05001
33/64	1.6199	0.20881	1 11/64	3.6816	1.07858
17/32	1.6690	0.22166	1 3/16	3.7306	1.10753
35/64	1.7181	0.23489	1 13/64	3.7797	1.13687
9/16	1.7671	0.24850	1 7/32	3.8288	1.16659
37/64	1.8162	0.26250	1 15/64	3.8779	1.19670
19/32	1.8653	0.27688	1 1/4	3.9270	1.22718
39/64	1.9144	0.29165	1 17/64	3.9761	1.25806
5/8	1.9635	0.30680	1 9/32	4.0252	1.28931
41/64	2.0126	0.32233	1 19/64	4.0743	1.32095
21/32	2.0617	0.33824	1 5/16	4.1233	1.35297

CIRCUMFERENCE AND AREAS OF CIRCLES — Continued

Diameter	Circumference	Area	Diameter	Circumference	Area
1 21/64	4.1724	1.38538	2 1/8	6.6759	3.5466
1 11/32	4.2215	1.41817	2 3/16	6.8722	3.7584
1 23/64	4.2706	1.45134	2 1/4	7.0686	3.9761
1 3/8	4.3197	1.48489	2 5/16	7.2649	4.2
1 25/64	4.3688	1.51883	2 3/8	7.4613	4.4301
1 13/32	4.4179	1.55316	2 7/16	7.6576	4.6664
1 27/64	4.4670	1.58786	2 1/2	7.8540	4.9087
1 7/16	4.5160	1.62295	2 9/16	8.0503	5.1573
1 29/64	4.5651	1.65843	2 5/8	8.2467	5.4119
1 15/32	4.6142	1.69428	2 11/16	8.4430	5.6727
1 31/64	4.6633	1.73052	2 3/4	8.6394	5.9396
1 1/2	4.7124	1.76715	2 13/16	8.8357	6.2126
1 33/64	4.7615	1.80415	2 7/8	9.0321	6.4918
1 17/32	4.8106	1.84154	2 15/16	9.2284	6.7772
1 35/64	4.8597	1.87932	3	9.4248	7.0686
1 9/16	4.9087	1.91748	3 1/16	9.6211	7.3662
1 37/64	4.9578	1.95602	3 1/8	9.8175	7.6699
1 19/32	5.0069	1.99494	3 3/16	10.0138	7.9798
1 39/64	5.0560	2.03425	3 1/4	10.2102	8.2958
1 5/8	5.1051	2.07394	3 5/16	10.4066	8.6179
1 41/64	5.1542	2.11402	3 3/8	10.6029	8.9462
1 21/32	5.2033	2.15448	3 7/16	10.7992	9.2807
1 43/64	5.2524	2.19532	3 1/2	10.9956	9.6211
1 11/16	5.3014	2.23654	3 9/16	11.1919	9.9678
1 45/64	5.3505	2.27815	3 5/8	11.3883	10.3206
1 23/32	5.3996	2.32015	3 11/16	11.5846	10.6796
1 47/64	5.4487	2.36252	3 3/4	11.7810	11.0447
1 3/4	5.4978	2.40528	3 13/16	11.9773	11.4160
1 49/64	5.5469	2.44843	3 7/8	12.1737	11.7933
1 25/32	5.5960	2.49195	3 15/16	12.3701	12.1768
1 51/64	5.6450	2.53586	4	12.5664	12.5664
1 13/16	5.6941	2.58016	4 1/16	12.7628	12.9622
1 53/64	5.7432	2.62483	4 1/8	12.9591	13.3641
1 27/32	5.7923	2.66989	4 3/16	13.1554	13.7721
1 55/64	5.8414	2.71534	4 1/4	13.3518	14.1863
1 7/8	5.8905	2.76117	4 5/16	13.5481	14.6066
1 57/64	5.9396	2.80738	4 3/8	13.7445	15.0330
1 29/32	5.9887	2.85397	4 7/16	13.9408	15.4656
1 59/64	6.0377	2.90095	4 1/2	14.1372	15.9043
1 15/16	6.0868	2.94831	4 9/16	14.3335	16.3492
1 61/64	6.1359	2.99606	4 5/8	14.5299	16.8002
1 31/32	6.1850	3.04418	4 11/16	14.7262	17.2573
1 63/64	6.2341	3.0927	4 3/4	14.9226	17.7206
2	6.2832	3.1416	4 13/16	15.1189	18.19
2 1/16	6.4795	3.3410	4 7/8	15.3153	18.6655

CIRCUMFERENCE AND AREAS OF CIRCLES — Concluded

Diameter	Circumference	Area	Diameter	Circumference	Area
4 15/16	15.5116	19.1472	10 1/2	32.9868	86.5903
5	15.7080	19.6350	10 5/8	33.3795	88.6643
5 1/8	16.1007	20.6290	10 3/4	33.7722	90.7625
5 1/4	16.4934	21.6476	10 7/8	34.1649	92.8858
5 3/8	16.8861	22.6907	11	34.5576	95.0334
5 1/2	17.2788	23.7583	11 1/8	34.9503	97.2055
5 5/8	17.6715	24.8505	11 1/4	35.343	99.4019
5 3/4	18.0642	25.9673	11 3/8	35.7357	101.6234
5 7/8	18.4569	27.1084	11 1/2	36.1284	103.8691
6	18.8496	28.2744	11 5/8	36.5211	106.1394
6 1/8	19.2423	29.4648	11 3/4	36.9138	108.4338
6 1/4	19.635	30.6797	11 7/8	37.3065	110.7537
6 3/8	20.0277	31.9191	12	37.6992	113.098
6 1/2	20.4204	33.1831	12 1/4	38.4846	117.859
6 5/8	20.8131	34.4717	12 1/2	39.2700	122.719
6 3/4	21.2058	35.7848	12 3/4	40.0554	127.677
6 7/8	21.5985	37.1224	13	40.8408	132.733
7	21.9912	38.4846	13 1/4	41.6262	137.887
7 1/8	22.3839	39.8713	13 1/2	42.4116	143.139
7 1/4	22.7766	41.2826	13 3/4	43.1970	148.490
7 3/8	23.1693	42.7184	14	43.9824	153.938
7 1/2	23.5620	44.1787	14 1/4	44.7678	159.485
7 5/8	23.9547	45.6636	14 1/2	45.5532	165.130
7 3/4	24.3474	47.1731	14 3/4	46.3386	170.874
7 7/8	24.7401	48.7071	15	47.1240	176.715
8	25.1328	50.2656	15 1/4	47.9094	182.655
8 1/8	25.5255	51.8487	15 1/2	48.6948	188.692
8 1/4	25.9182	53.4561	15 3/4	49.4802	194.828
8 3/8	26.3109	55.0884	16	50.2656	201.062
8 1/2	26.7036	56.7451	16 1/4	51.051	207.395
8 5/8	27.0963	58.4264	16 1/2	51.8364	213.825
8 3/4	27.489	60.1319	16 3/4	52.6218	220.354
8 7/8	27.8817	61.8625	17	53.4072	226.981
9	28.2744	63.6174	17 1/4	54.1926	233.706
9 1/8	28.6671	65.3968	17 1/2	54.9780	240.529
9 1/4	29.0598	67.2008	17 3/4	55.7634	247.450
9 3/8	29.4525	69.0293	18	56.5488	254.470
9 1/2	29.8452	70.8823	18 1/4	57.3342	261.587
9 5/8	30.2379	72.7599	18 1/2	58.1196	268.803
9 3/4	30.6306	74.6619	18 3/4	58.905	276.117
9 7/8	31.0233	76.5888	19	59.6904	283.529
10	31.4160	78.5400	19 1/4	60.4758	291.040
10 1/8	31.8087	80.5158	19 1/2	61.2612	298.648
10 1/4	32.2014	82.5158	19 3/4	62.0466	306.355
10 3/8	32.5941	84.5409	20	62.8320	314.16

Name:_____

Approved by:_____

Date:_____

AREA CALCULATIONS,
CIRCLES AND CYLINDERS

Key: B I - AW 4 - 5A
Page 1 of 4

Student Assignment
in
Plumbing and Pipe Fitting

Subject: AREA CALCULATIONS, CIRCLES AND CYLINDERS

Purpose: To review the methods of calculating the areas of circles and cylinders.

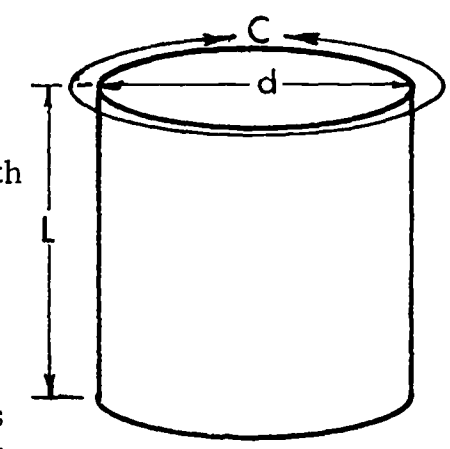
References: Information Sheet, 5I

Introductory Information: Calculating the areas of circles is one of the steps in finding the surface areas and volume of cylinders. The plumber and pipe fitter will find many instances in which he will need to be able to make such calculations in his work with pipe, tanks, and boilers.

To find the area of a cylinder, multiply the circumference of the cylinder by its length. This may be expressed as a formula as follows:

$$A = \pi dL = 2\pi rL$$
$$A = C \times L$$

A = Area, C = Circumference, L = Length



Directions:

1. Study the references listed above.
2. Solve the following problems.
3. Make your calculations on separate sheets of paper and hand in with this assignment.

1. Find the circumference and the area of the following circles. The diameter is given.

	Diameter	Circumference	Area
a.	10"		
b.	20"		
c.	5"		

AREA CALCULATIONS,
CIRCLES AND CYLINDERS

Key: B I - AW 4 - 5A
Page 2 of 4

2. Give the cross section areas of the following sizes of pipe. Consider these nominal sizes as the actual size.

a.	1"	_____ sq. in.	g.	4"	_____ sq. in.
b.	$1\frac{1}{4}$"	_____ sq. in.	h.	5"	_____ sq. in.
c.	$1\frac{1}{2}$"	_____ sq. in.	i.	6"	_____ sq. in.
d.	2"	_____ sq. in.	j.	8"	_____ sq. in.
e.	$2\frac{1}{2}$"	_____ sq. in.	k.	10"	_____ sq. in.
f.	3"	_____ sq. in.	l.	12"	_____ sq. in.

After making your calculations, check your answers with the tables on "Circumference and Areas of Circles".

3. From problems 1 and 2 you have learned that doubling the diameter of a circle increases its area how many times?

_____ times

4. The diameter of the piston of a steam engine is 15 inches, the steam pressure is 150 pounds per square inch. Find the total force on the piston.

_____

5. Sheet lead (sleeve type) roof flashings are to be made for the following sizes of vent pipes. Allow $\frac{1}{4}$" larger diameter to permit the flashing to slip easily on the pipe. The lead is to be soldered with a butt joint. Give the widths that the lead should be cut for both X.H. cast iron soil pipe and Std. steel pipe. Give your answers to the nearest 1/8 inch.

	Size	Cast Iron	Steel
a.	2"		
b.	3"		
c.	4"		
d.	5"		
e.	6"		

6. A vertical storage tank type booster water heater is 24 inches in diameter and 5 feet high. It has 10 three-inch flues or fire tubes.

   a. What is the heating surface area on the bottom of the heater? (Subtract the combined cross section area of the flues from the area of the bottom of the tank.)

   _____ sq. in.

   b. What is the heating surface area of the flues?

   _____ sq. in.

   c. Give the total heating surface area in both square inches and square feet.

   _____ sq. in. _____ sq. ft.

7. A pipe coil is required to have 50 square feet of radiating surface (outside surface area). Give the number of feet of pipe required for the following sizes. (NOTE: See table in Information Sheet.)

   a. 3/4" _____ ft. c. $1\frac{1}{2}$" _____ ft.

   b. 1" _____ ft. d. 2" _____ ft.

AREA CALCULATIONS,
CIRCLES AND CYLINDERS

Key: B I - AW 4 - 5A
Page 4 of 4

8. From the lower right hand corner of this sheet of paper mark off points on the bottom and right hand edges of the sheet at the following distances: ½", 3/4", 1", 1¼", 1½", 2", 2½", 3", 4", 5", 6" and 8". To determine the diameter of a larger pipe equal in cross section area to any two smaller pipe, draw a diagonal line between the two sizes and measure that distance.

EXAMPLE: Measuring between the 4 on the bottom edge and the 3 on the right hand edge will show a distance of 5" which is the size pipe with cross section area equal to the cross section area of 3" pipe plus that of 4" pipe. (This may also be determined by using a framing square.)

Find the pipe size that is equal in area to the following sizes. (Give your answer to the nearest pipe size.)

a. ½" plus ½" = _____

b. 2½" plus 3" = _____

c. 3/4" plus 1" = _____

d. 6" plus 5" = _____

NOTE: As a point of information, when the pipe size is doubled, the carrying capacity is theoretically increased 4 times. Actually, due to the reduction in friction loss in the larger pipe, the actual carrying capacity or volume delivered is increased 5.7 times.

Name: _____

Approved by: _____

Date: _____

VOLUME CALCULATIONS, CYLINDERS

Key: B I - AW 4 - 6A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: VOLUME CALCULATIONS, CYLINDERS

Purpose: To review the methods of finding the volumes of cylindrical figures, such as pipe, tanks, boilers, etc.

Reference: Information Sheet B I - AW 4 - 5I

Introductory Information: Since most forms of pipe are cylindrical and many other cylindrical objects, such as tanks, water heaters, boilers, etc., are used in the trade, the knowledge of how to calculate the volumes of cylindrical figures is especially important to the plumber and pipe fitter.

Volumes are usually calculated in cubic inches or cubic feet. Such volume figures may be converted to gallons or pounds.

To find the volume of a cylindrical tank use this formula:

$$V = \pi r^2 h \qquad V = 3.1416\ r^2 h$$

v = volume r = radius h = height

Calculations Relating to Hollow Cylindrical Solids

The volumes or weights of hollow cylindrical forms or solids based on the cylindrical form, such as pipe, round concrete tanks and the like, may be calculated by using the previous rules relating to volumes of cylindrical shapes.

The formula reduces to:

First, calculate the volume without hole,

$$V_t = r_1^2 h$$

Then, calculate the volume of the hole and subtract,

$$V_H = r_2^2 h$$

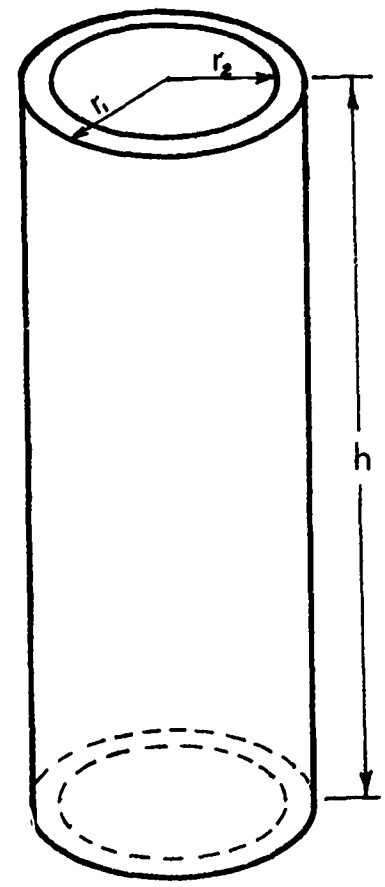
$$V_s = V_t - V_H \text{ or } V_s = h\,(r_1^2 - r_2^2)$$

(remember: square the radii, then subtract)

VOLUME CALCULATIONS, CYLINDERS

Key: B I - AW 4 - 6A
Page 2 of 3

V_s = Volume of sleeve
V_t = Total volume
r_1 = Total radius
h = Height
v_H = Volume of hole
v_2 = Radius of hole



1. A galvanized range boiler is 12 inches in diameter and 5 feet high. What is its capacity? Give your answer in cubic inches and also in gallons.

   _____cu. in. _____gallons

2. A 500 gallon gasoline storage tank is 10 feet long. What is its diameter? Give your answer to the nearest 1/4 inch.

   _____

3. A vertical cylindrical steel tank is to be constructed to hold 1000 gals. The diameter of the tank is to be 6 feet. What is the required height of the tank? Give your answer to the nearest inch.

   _____

4. A domestic water heater has a tank which is 12 inches in diameter and 42 1/2 inches high. It has a single flue or fire tube made of 2 inch standard steel pipe (2-3/8" O.D.). How many gallons does the tank hold? Give your answer to the nearest gallon.

   _____

5. A 6-inch steel pipe steam pipe line is 1000 feet long. How many cubic feet of steam will be required to fill the line?

   _____cubic feet.

6. Give the number of gallons of water required to fill a 20 foot length of each of the following sizes of pipe:

a. ½" _____gals.

b. 3/4" _____gals.

c. 2" _____gals.

d. 4" _____gals.

e. 10" _____gals.

f. 12" _____gals.

7. The cylinder of a single action water pump is 4 inches in diameter, and the piston makes a 10 inch stroke. The pump operates at the rate of 30 strokes per minute. How much water will the pump deliver in one hour? Make no allowance for leakage. Give your answer in cubic feet and also in gallons.

_____cu. ft. per hr. _____gal. per hr.

8. The dimensions of a steam boiler are 40 inches diameter and 9 feet long. It has 21 flues or fire tubes which are 3 inches OD. How much water will the boiler hold? Give your answer in gallons.

_____gallons

9. What is the weight of a steel shaft 2 inches in diameter and 10 feet long? Steel weighs 0.28 pounds per cubic inch.

_____lbs.

10. How many cubic inches of steel are used in making a piece of 2" schedule 40 black steel pipe 18' long? O.D. = 2.375"; I.D. = 2.067".

v_s = _____

11. How many yards of concrete will it take to build a concrete water tank 15' high with an outside diameter of 12'. The tank is to have an 8" thick wall up 7' from the bottom, the remainder to be 6" thick. The bottom is to be 10" thick.

_____

Information Sheet
in
Plumbing and Pipe Fitting

Subject: DATA ON WATER

Water is a compound composed of one part oxygen and two parts hydrogen. Its chemical symbol is H_2O.

Water boils at atmospheric pressure (14.7 psi) at 212° Fahrenheit and freezes at 32° Fahrenheit.

The weight of water depends upon its temperature. It is at maximum density at 39.1° Fahrenheit. At maximum density its weight is usually taken at 62.425 pounds per cubic foot.

The following information is used in calculations pertaining to water:

1 lb. per sq. in.

2.0355" of mercury at 32°F
2.0416" of mercury at 62°F
2.309' of water at 62°F
27.71" of water at 62°F

1 atmosphere
(14.7 lbs. per sq. in.)

2116.3 lbs. per sq. ft.
33.947' of water at 62°F
29.921" of mercury at 62°F

1" of water at 62°F

0.03609 lbs. or 0.5774 oz. per sq. in.
5.195 lbs. per sq. ft.
0.0735" of mercury at 62°F

1' of water at 62°F

0.433 lbs. per sq. in.
62.355 lbs. per sq. ft.

1" of mercury at 62°F

0.491 lbs. or 7.86 oz. per sq. in.
1.134' of water at 62°F
13.61" of water at 62°F

Name:_____

Approved by:_____

Date:_____

CALCULATIONS AND MEASUREMENTS
OF VOLUMES AND WEIGHTS OF WATER

Key: B I - AW 4 - 7A
Page 1 of 2

Student Assignment
in
Plumbing and Pipe Fitting

Subject: CALCULATIONS OF MEASUREMENTS OF VOLUMES AND WEIGHTS OF WATER

Purpose: To learn some of the properties of water and to learn how to measure water by volume and weight.

References: Information Sheet B I - AW 4 - 7I
Information Sheet B I - AW 4 - 5I

Introductory Information: At times a plumber and pipe fitter must determine pipe sizes required to deliver certain amounts of water at given rates of flow. To do this he must be able to determine the effect of pressure and head on flow rates.

The ability to determine the capacities and weights of water tanks, water heaters, boilers and pipe lines, is essential for the man who is to design a water supply system.

This assignment deals with some of the primary principles involved in making such calculations, such as some of the properties of water, and calculations of volumes, weights and water pressures.

Directions:

1. Study the references listed above.

2. Answer the following questions and solve the problems.

3. Make your calculations on separate sheets of paper and hand in with this assignment.

1. What is the chemical symbol for water?_____

2. At what temperature will a gallon container hold the most water (maximum density)?

_____ degrees Fahrenheit

CALCULATIONS OF MEASUREMENTS
OF VOLUMES AND WEIGHTS OF WATER

Key: B I - AW 4 - 7A
Page 2 of 2

3. Find the weight of 12 U.S. gallons of water at 62°F._____lbs.

4. How many cubic feet are there in 7½ U.S. gallons of water?

_____ cubic feet

5. What is the difference in weight of 100 cubic feet of water at 62°F, and 100 cubic feet of water at 39.1°F?

_____ pounds

6. Find the number of cubic feet necessary to contain 1 ton of water at 39.1°F.

_____ cubic feet

7. Give the capacity in gallons and the weight of water in a cylindrical tank 18 inches in diameter and 5 feet high (at 62°F).

a. _____ gallons

b. _____ pounds

8. Several water pipe lines are to be suspended from a basement ceiling. The hangers are to be spaced 10 feet apart. Give the weight that each hanger will support when the pipe is empty, and also full of water at 62°F for the following sizes. (NOTE: See Information Sheet B I - P 4 - 5I.)

	Weight per 10 ft. (Empty)	Weight per 10 ft. (Full)
a. 1" pipe	_____ lbs.	_____ lbs.
b. 2" pipe	_____ lbs.	_____ lbs.
c. 4" pipe	_____ lbs.	_____ lbs.
d. 6" pipe	_____ lbs.	_____ lbs.
e. 10" pipe	_____ lbs.	_____ lbs.

Information Sheet
in
Plumbing and Pipe Fitting

Subject: WATER PRESSURE HEAD AND FORCE

There are two terms which are misinterpreted in studying liquids--"force" and "pressure". Force means a push or a pull and is expressed in pounds, while pressure, which means the push or pull per unit area of the surface acted upon, is expressed in pounds per square inch.

The downward pressure of a liquid is independent of the shape of the vessel. This means that the tanks containing liquids may be built with sides that are vertical, flaring or conical, and the pressure and total force on the bottom will be the same if the base areas are the same, as shown in Figure 11.

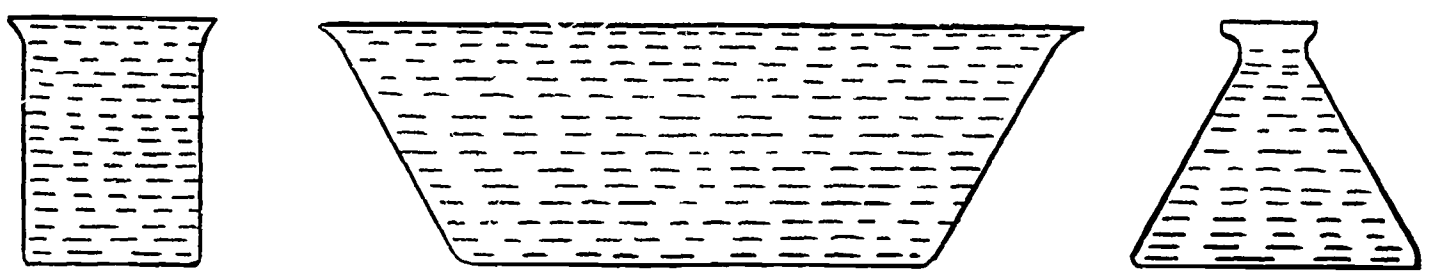


Fig. 11

Liquids also exert an upward pressure, which is usually equal to the downward pressure that would be exerted by the same liquid at the same depth. Moreover, liquids exert a sidewise pressure because of their weight. Sidewise pressure increases with the depth and density of the liquid, and at a given depth the liquid exerts the same pressure in all directions.

An open mercury manometer is the most accurate form of pressure gage for measuring water pressure, particularly for small pressures. However, the Bourdon spring gage is commonly used because the mercury gage is expensive, fragile and awkward.

When a body is immersed in a liquid, it is buoyed up by force equal to the weight of the bulk of the liquid displaced by the body. The weight of a floating body is equal to the weight of the bulk of the liquid which is displaced. The upward pressure or buoyancy usually is regarded as exerted at the center of gravity of the displaced water.

WATER PRESSURE HEAD AND FORCE

Key: B I - AW 4 - 8I
Page 2 of 3

RULE 1: TO FIND THE PRESSURE FOR LIQUIDS IN OPEN TANKS OR VESSELS, MULTIPLY THE DEPTH BY THE DENSITY.

RULE 2: TO FIND THE TOTAL FORCE ON THE BOTTOM, MULTIPLY THE AREA BY THE DEPTH AND THEN BY THE DENSITY.

RULE 3: TO FIND THE TOTAL FORCE ON THE SIDES, MULTIPLY THE AREA BY THE AVERAGE PRESSURE.

Expressed as a formula

1. Pressure = depth x density (density of H_2O = 62.425 #/ft.^{3});
2. Total force = area x depth x density
3. Sidewise force = area x average pressure ($\frac{1}{2}$ bottom pressure)

ILLUSTRATIVE PROBLEMS

A. The water in a standpipe is 10' deep. Find the pressure on the bottom.	10 ft. x 62.425 #/ft.^{3} = 624.25 #/ft.^{2} The pressure is 624.25 lbs. per sq. ft.
B. If a tank 10' wide, 20' long, and 5' deep is full of water, find the total force on the bottom.	10 ft. x 20 ft. = 200 sq. ft. 200 ft.^{2} x 5 ft. x 62.425 #/ft.^{3} = 62,425 lbs. The total force is 62,425 lbs.
C. If a tank 1' wide by 20' long by 15' deep is full of water, what is the total force tending to push out the end of the tank?	1 ft. x 15 ft. = 15 ft.^{2} 7.5 ft. x 62.425 #/ft.^{3} = 467.2. per sq. ft 467.2 #/ft.^{2} x 15 ft.^{2} = 7,008 #

The area of the end of the box is 15 sq. ft.; one-half the bottom pressure, which is equal to the pressure half way down equals 7.5 ft. x 62.425 #/ft.^{3} or 468.2 lbs. per #/ft.^{2}. The total end thrust is 15 x 467.2 or 7,008 lbs. or 3.5 tons.

The pressure of still water in pounds per square inch against the sides of any pipe or vessel of any shape is due solely to the "head" and is equal to 0.433 pounds per square inch for every foot of height, or 62.355 pounds per square foot for every foot of height (at 62° Fahrenheit). The water exerts a force on the bottom of a pipe or tank because the water has weight, the total force being the total weight of the water. The pressure is the weight of so much of the water as rests on one square foot or one square inch of the bottom.

This water may be thought of as forming a little column of unit cross-sectional area extending from the bottom of the pipe or tank to the surface of the water. The volume of this column is numerically equal to its height, or head, of the water, and the weight of the column is its volume times its density. This weight is the pressure at the bottom.

RULE: TO FIND THE PRESSURE, MULTIPLY THE HEAD BY THE WEIGHT OF A CUBIC FOOT OF WATER. EXPRESSED AS A FORMULA:

Pressure = head x 62.355 lbs. (weight of 1 cu. ft. of water)

Name: _____

Approved by: _____

Date: _____

WATER PRESSURE, HEAD AND FORCE

Key: B I - AW 4 - 8A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: WATER PRESSURE, HEAD AND FORCE

Purpose: To learn some of the fundamental principles of the relationship of water pressure to head force, and to learn how to make calculations involving pressure, head and force.

References: Information Sheet B I - AW 4 - 7I
Information Sheet B I - AW 4 - 8I

Introductory Information: It is a well known fact that the most important thing to a city or a community is an ample supply of pure water. Proper installations for handling the supply and protecting it from contamination are the responsibility of the plumbing industry.

To properly design, install, and maintain a water supply, a plumber should know how to calculate pressures, heads and force. This assignment deals with problems of this nature.

Directions:

1. Study the reference pages listed above and solve the following problems.

2. Make your calculations on separate sheets of paper and hand in with this assignment.

1. What is the difference in the meaning of the terms "water pressure" and "force"?

_____

_____

_____

_____

_____

_____

WATER PRESSURE, HEAD AND FORCE

Key: B I - AW 4 - 8A
Page 2 of 3

2. The density or weight of water is 62.425 pounds per cubic foot at 39.1 degrees Fahrenheit and 62.355 pounds per cubic foot at 62 degrees Fahrenheit. What is the density per cubic inch? Carry the answer to 6 decimal places.

   a. At 39.1°F _____ lbs. per cu. in.

   b. At 62°F _____ lbs. per cu. in.

3. What is the weight or the pressure exerted by a column of water one inch square and one foot high? Carry the answer to four decimal places.

   a. At 39.1°F _____ lbs. or lbs. per sq. in.

   b. At 62°F _____ lbs. or lbs. per sq. in.

4. Find the pressure in pounds per square inch at the bottom of a water stand pipe which is 150 feet high and full of water.

   _____ lbs. per sq. in.at 39.1°F

5. The stand pipe in problem 4 is 15 feet in diameter. What is the total force on the bottom? Give your answer in tons.

   _____ tons (39.1°F)

6. The plumbing fixtures on the top floor of a six story building are 60 feet above the street level. The pressure in the water service line is 50 lbs. per square inch at the street level. What is the pressure at the fixtures on the top floor of the building? NOTE: Disregard any pressure loss due to friction.

   _____ lbs. per sq. in.

7. What is the required height of a stand pipe or overhead tank to provide 50 pounds water pressure per square inch at the ground level?

   _____ feet

8. Find the head of water required to produce the following pressures in pounds per square inch (gage pressure).

   a. 100 lbs. per sq. in. _____ feet

   b. 75 lbs. per sq. in. _____ feet

   c. 30 lbs. per sq. in. _____ feet

9. Find the gage pressure in pounds per square inch for the following heads of water.

   a. 5 feet _____ lbs. per sq. in.

   b. 12 feet _____ lbs. per sq. in.

   c. 50 feet _____ lbs. per sq. in.

   d. 140 feet _____ lbs. per sq. in.

10. A four inch house drain and soil stack is filled with water to the roof line for a test. The roof is 17 feet higher than the outlet end of the house drain. The house drain (soil pipe) is plugged with a 4 inch plug.

    a. What is the pressure at the test plug?_____lbs./sq. in.

    b. What is the total force tending to push out the test plug?

    _____ lbs.

11. A building has a five inch house drain, five 4-inch stacks, and seven 2-inch stacks. The waste and vent system is filled with water for a test. The water level at the roof is 35 feet higher than the test plug. What is the pressure at the test plug and what is the total force against it?

    a. _____ lbs. per sq. in.

    b. _____ lbs. total force

VT 010 025
Pulaski, Richard E.
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ABSTRACT - Prepared by a subject matter specialist, this workbook provides basic mathematical instruction for apprenticeship training in plumbing and pipe fitting. Information sheets and student assignment sheets give subject, purpose, references, general information, directions, and problems using triangle formulas, and figuring square roots and offsets. Reference tables are appended, and the workbook is illustrated with numerous diagrams and line drawings. (AW)

VT 010 025

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BASIC INSTRUCTION

APPRENTICE TRAINING

in the

PLUMBING AND PIPE FITTING INDUSTRY

Apprentice Workbook 3

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Name_____ Apprentice Workbook 3

STUDENT PROGRESS RECORD
IN
BASIC INSTRUCTION FOR APPRENTICE TRAINING
FOR THE
PLUMBING AND PIPE FITTING INDUSTRY

	Information Sheets	Student Assignments	Date Completed
1. Square Root	3 pages	2 pages	
2. Right Triangle Formulas	2 pages	2 pages	
3. Figuring Offsets by use of Constants	4 pages	10 pages	
4. Figuring 45° Offsets by the "Plus 5" Method	None	2 pages	
5. Rolling Offsets and 45° Wye & 1/6 Bend Offsets	6 pages	1 page	
6. 60° Wye Bend Offsets	2 pages	1 page	

Appendix

Note: Green sheet for student's notebook
Gold sheet for instructor's file

Name_____ Apprentice Workbook 3

STUDENT PROGRESS RECORD
IN
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Appendix

Note: Green sheet for student's notebook
Gold sheet for instructor's file

Information Sheet
in
Plumbing and Pipe Fitting

Subject: SQUARE ROOT

To square a number means to multiply that number by itself. For example: $2 \times 2 = 4$, or $2^2 = 4$; $5^2 = 5 \times 5 = 25$.

The square root of a number is that number which when multiplied by itself equals the original number. For example: the square root of 25 is 5.

The radical sign $\sqrt{}$ is used to indicate square root. $\sqrt{36}$ means to find the square root of 36.

Numbers such as 4, 9, 25, 36, 49, 64, 81 and 100 have simple whole number square roots which are known or are easily derived mentally. The square root of larger numbers and numbers that are not perfect squares may be found by a process similar to long division which is explained in the example and directions on the following page.

SQUARE ROOT

Key: BI - AW 3 - 1I
Page 2 of 3

Example: Find the square root of 703.8409:

```
                                  2   6.  5  3   = Answer
                              √  7 '03. 84 '09
            2 x 2     =         4
 ------------------------------------------------
  20  x  2  = 40                3  03                Proof:
            + 6
            46 x 6 =            2  76
 ------------------------------------------------      26.53
 20 x 26  =  520                  27  84            x 26.53
            +  5                                      79 59
            525 x 5=            26  25              1326 5
 ------------------------------------------------   15918
 20 x 265 = 5300                  1  59  09          5306
            +  3                                    703.8409
            5303 x 3 =          1  59  09
 ------------------------------------------------
```

1. Point off the number into periods of two figures each, beginning at the decimal point, both left and right as shown.

2. Find the largest number which when multiplied by itself will not be larger than the number in the left hand period. This is 2, so place a 2 as the first figure of the answer, then square the 2 (2 x 2 = 4), and place the 4 under the left hand period which is 7. Now subtract 4 from 7 and then place the 3 under the 4.

3. Bring down the next two figures which are 03 and place them alongside the 3 which makes 303.

4. Multiply the answer 2 by 20, which is 40 and place this to the left on the same line with the 303.

5. 40 will go into 303 seven times, but 7 x 47 = 329 which is greater than 303, so 6 is the next figure of the answer. The answer is now 26.

6. Place the 6 under the 40 and add, which gives 46. Multiply 46 by 6, giving 276 and place the 276 under the 303. Subtract 276 from 303 which gives 27.

7. Place the 27 under the 276 and bring down the next period 84; then we have 2784.

8. Multiply the answer 26 by 20 and repeat the above operation.

To find the square root of a number which is not a perfect square, didgets may be added after the decimal point to obtain a near perfect answer. The number 8 is not a perfect square.

EXAMPLE:

```
                    2. 8 2 8 4
                √ 8.00'00'00'00   = Answer

                  2 x 2 =  4
20 x 2      =  40          4 00
               + 8
                48 x 8 =    3 84
20 x 28     = 560            16 00
               + 2
                562 x 2 =     11 24
20 x 282    =5640             4 76 00
               + 8
                5648 x 8 =    4 51 84
20 x 2828   =56560             24 16 00
               + 4
               56564 x 4 =      22 62 56
                                  1 53 44
```

Proof

```
        2.8284
      x 2.8284
      11 3136
     226 272
     565 68
  2 2627 2
  5 6568
  7.9998 4656
```

SQUARE ROOT

Name: _____

Approved by: _____

Date: _____

Key: B I - AW 3 - 1 A
Page 1 of 2

Student Assignment
in
Plumbing and Pipe Fitting

Subject: SQUARE ROOT

Purpose: To give the student a review in the process of extracting the square root of numbers.

Reference: Information Sheet on "Square Root."

Introductory Information: Square root has many everyday uses arising in the shop or on the job in solving problems dealing with diagonals of squares or rectangles, areas, volumes, quantities, and pressure-surface relationships.

There are many books, reference tables, and charts that give the squares and square root of various numbers. These can be used when available if they include the number wanted. In many cases the charts are not readily available, so it is important to know how to extract square root quickly and easily by mathematical calculations.

Directions: Study the information sheet on "Square Root"

Extract the square root of the following numbers:

1. $\sqrt{225}$ = _____ Answer

2. $\sqrt{1936}$ = _____ Answer

3. $\sqrt{207.36}$ = _____ Answer

4. $\sqrt{2}$ = _____ Answer

5. $\sqrt{184}$ = _____ Answer

SQUARE ROOT

Key: B I - AW 3 - 1 A
Page 2 of 2

Square each of your answers so as to check your calculations:

1. _____

2. _____

3. _____

4. _____

5. _____

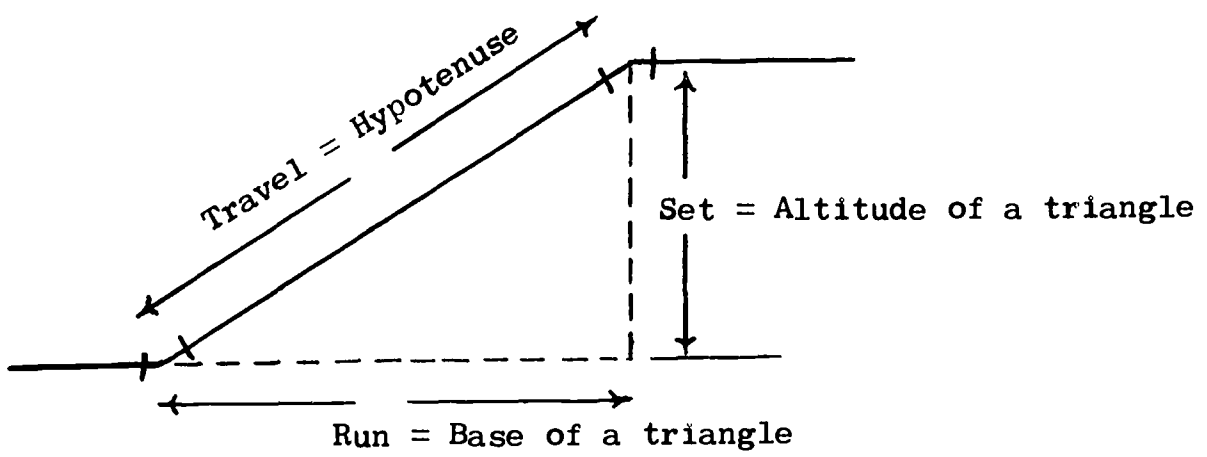
ERIC

Information Sheet
in
Plumbing and Pipe Fitting

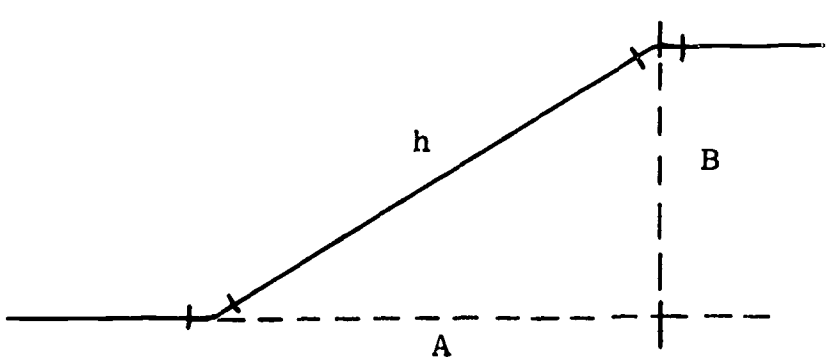
Subject: DETERMINING DIAGONAL MEASUREMENTS BY USE OF RIGHT TRIANGLE FORMULAS

It is practically impossible to install piping for any type application without the necessity of offsetting the pipe. Therefore, a knowledge of the methods of calculating piping offsets becomes an important part of the fundamental knowledge of a plumber or pipe fitter.

Piping offsets are based on the right triangle. Consequently, all rules applying thereto govern the methods of calculating piping offsets.



In the layout above, the piping terms are substituted in the triangle.



A - Run
B - Set (offset)
h - Travel

There may be an occasion at any time when it is necessary for a journeyman to calculate a diagonal, either horizontally or vertically. In most cases a diagonal can be calculated more easily and accurately than it can be measured with a rule or tape.

RIGHT TRIANGLE FORMULAS

Key: B I - AW 3 - 2 I
Page 2 of 2

The formulas for solving any side of a right triangle is as follows:

$$h^2 = A^2 + B^2$$

$$h = \sqrt{A^2 + B^2}$$

Illustrative Problem: Find: Length of h

Given: A = 3 feet
B = 4 feet

Then: $h = \sqrt{3^2 + 4^2} = \sqrt{9 + 16} = \sqrt{25} = 5$ feet

Name: _____

Approved by: _____

Date: _____

RIGHT TRIANGLE FORMULAS

Key: B I - AW 3 - 2A
Page 1 of 2

Student Assignment
in
Plumbing and Pipe Fitting

Subject: DETERMINING DIAGONAL MEASUREMENTS BY USE OF RIGHT TRIANGLE FORMULAS

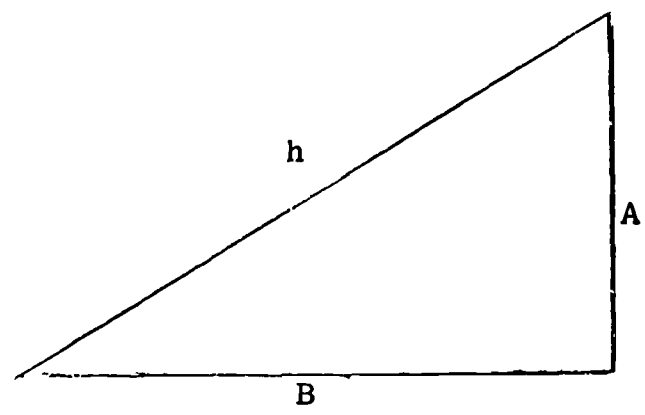
Purpose: To give the student a review of right triangle problems involving diagonals and offsets.

References: Information Sheet 2I
Reference tables (see Appendix)

Introductory Information: Short diagonal measurements are often very easily and accurately made by direct measurement with a rule. However, such measurements are generally more accurately and more conveniently calculated by the use of formulas. Obstructions often make it impossible to measure a diagonal with a tape or rule. Triangle formulas are also useful in figuring piping offsets.

Directions: Study the reference and fill in the blank spaces in the table on the following page. Give your answers in feet, inches, and fractions of an inch as they would be read on your rule.

This assignment may also be considered a drill in the use of the reference tables, squares, square roots, and decimal equivalents.



RIGHT TRIANGLE FORMULAS

Key: B I - AW 3 - 2 A
Page 2 of 2

Problems:

	a.	b.	h.
1.	2"	2"	
2.	40"	50"	
3.	15"	20"	
4.	30"	35"	
5.		15"	25"
6.	30"		50"
7.	9"	6"	
8.	36"	48"	
9.	18"		30"
10.	24"	32"	
11.	21"		35"
12.	4"		5"
13.		16"	48"
14.	32"		36"
15.	14"	22"	
16.	18"	37"	
17.	9"		21"
18.	39"		45"
19.	1'-7"	2'-5"	
20.	2'-3"	3'-7"	

Information Sheet
in
Plumbing and Pipe Fitting

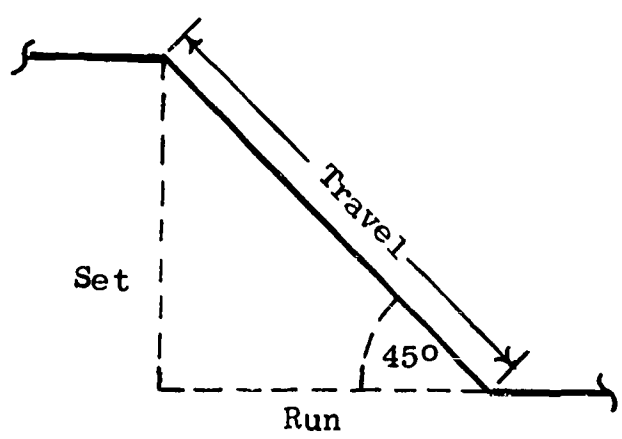
Subject: FIGURING OFFSETS BY THE USE OF CONSTANTS

In the previous assignment information on right triangle formulas was covered in reference to piping offsets. As stated, the calculation of a diagonal or travel of a piping offset by a given formula is usually more accurate and convenient than an actual measurement. An even faster method which is more convenient and accurate is that in which a constant is used.

A constant is a figure, such as 1.414, which when multiplied by one side of a triangle, will give the length of the hypotenuse. Likewise, there are constants that may be used to multiply the hypotenuse or travel and determine the length of the run or offset.

The angles of the triangle in which the plumber and pipe fitter is interested are governed by the degree of the offset or angle of the fitting.

The angle of the fitting is the number of degrees the pipe changes direction. Allowance must be made for fittings when calculating the length of pipe since these calculations are made from center to center of the offset. Allowances for screw fittings are made as shown on Chart "P" in the Appendix.



Travel is calculated by multiplying the set or run by a constant.

For example, the predetermined constant for calculating travel for a 45 degree offset is 1.414. Multiply the set or run by the constant. (NOTE: For 45° offsets only, the set and run are equal and to determine length of travel, the same constant is used to multiply both.)

FIGURING OFFSETS

Key: B I - AW 3 - 3 I
Page 2 of 4

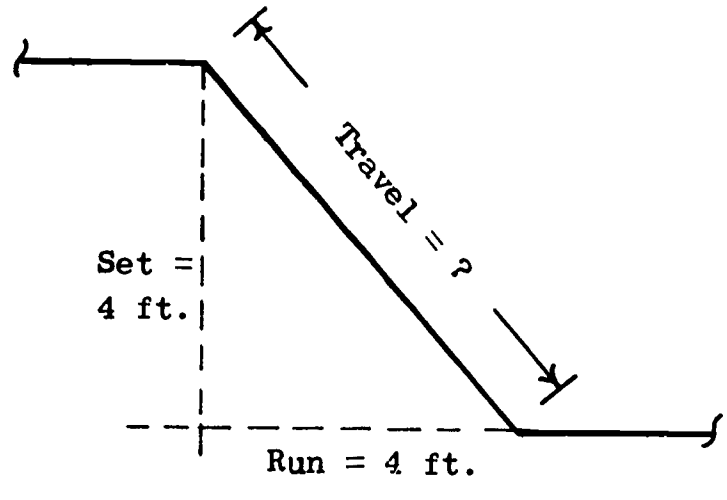
SAMPLE PROBLEM #1

Given: 45° Offset
Set - 4 feet
Constant - 1.414

Find: Length of travel

Formula: Set x 1.414

LENGTH OF TRAVEL = 4 x 1.414
= 5.6 feet



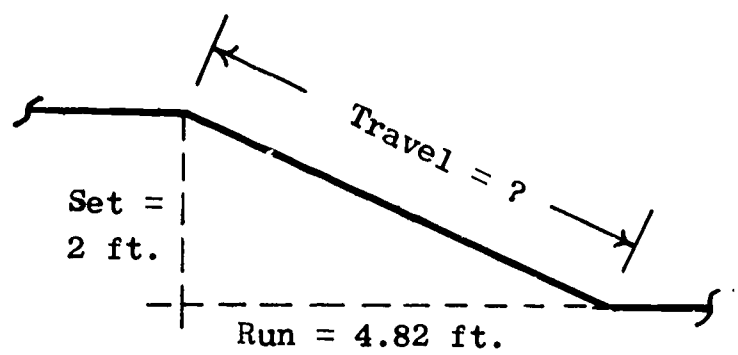
SAMPLE PROBLEM #2

Given: $22\frac{1}{2}^{\circ}$ Offset
Set - 2 feet
Run - 4.82 feet

Find: Length of travel

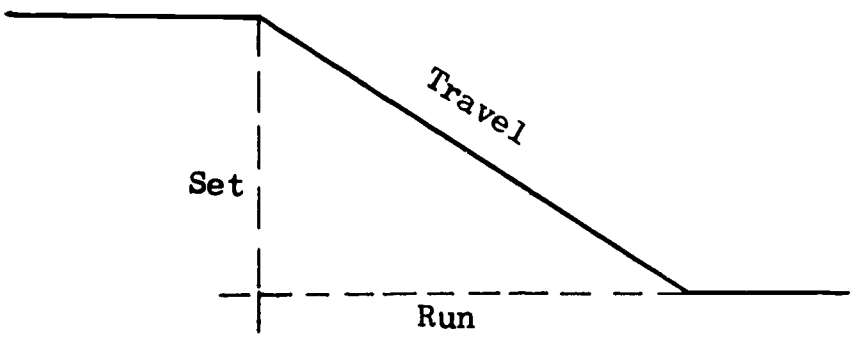
Constants for travel of $22\frac{1}{2}^{\circ}$ offset:
-- 2.613 x 2 feet (set)
-- 1.082 x 4.82 feet (run)

Formula: Set x 2.613, or
Run x 1.082



LENGTH OF TRAVEL = 2 x 2.613 = 5.226 feet, or
LENGTH OF TRAVEL = 1.082 x 4.82 = 5.215 feet

A different constant must be used to determine the travel in triangles other than the 45° offset for run and set. Tables showing constants for offsets of various degrees are shown on the following page.



To Find	Known	Multiply Side	For 60° by	For 45° by	For 22½° by
Travel	Set	Set	1.157	1.414	2.613
Set	Travel	Travel	.866	.707	.382
Run	Set	Set	.577	1.000	2.414
Set	Run	Run	1.732	1.000	.414
Travel	Run	Run	2.000	1.414	1.082
Run	Travel	Travel	.500	.707	.932

EXAMPLE: To find: The travel of a pipe on a 60° offset

Given: Set = 4 feet

Formula: Travel = set x 1.157

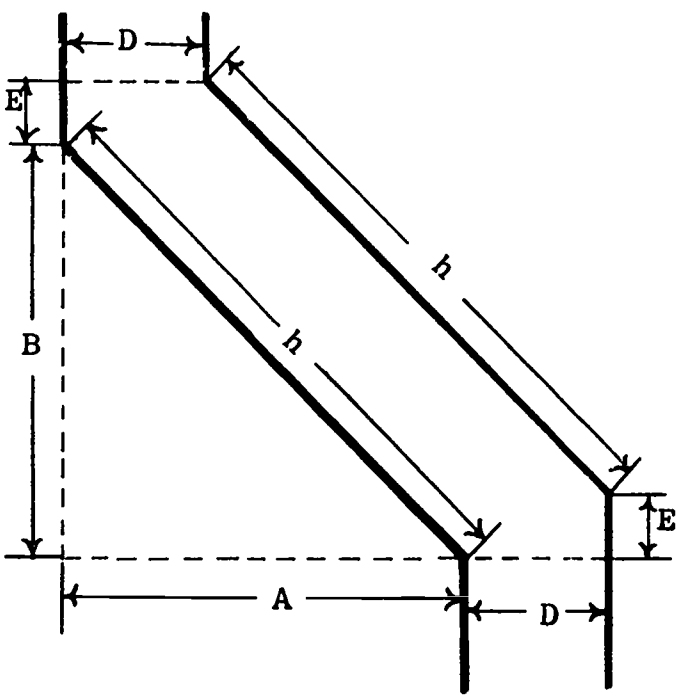
LENGTH OF TRAVEL = 4 x 1.157 = 4.628 feet

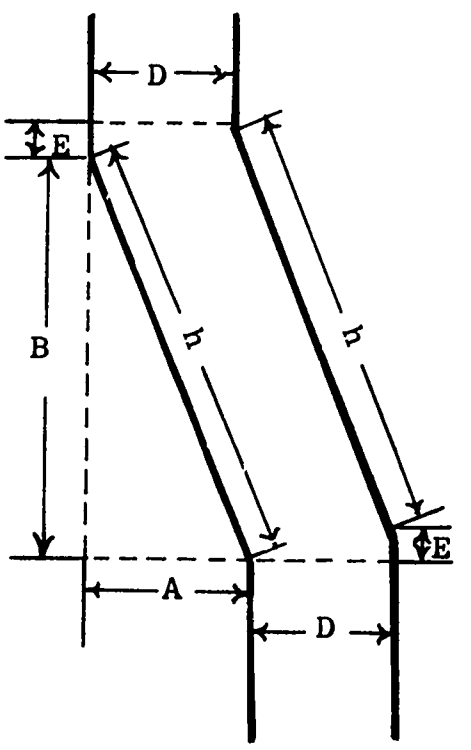
TWO OR MORE PIPE OFFSET AND EQUALLY SPACED

When two or more pipe are offset and equally spaced the fitting or angle of cut must be at the proper angle or position in order for the pipe to be equally spaced at all points. A simple accurate and convenient means of doing this is illustrated on the following page.

FIGURING OFFSETS

Key: B I - AW 3 - 3I
Page 4 of 4





Equally Spaced 45° Offsets

D = Spread
A = Set
B = Run

h = A x 1.414
h = B x 1.414
E = D x .414

Equally Spaced 22½° Offsets

D = Spread
A = Set
B = Run

h = A x 2.613
B = A x 2.414
E = D x .1989

NOTE: Although no trigonometry has been reviewed in these assignments, it is worth while to know that the constant for determining the travel of an offset is the "cosecant" of the angle of the offset and may be found in any set of trigonometry tables.

For example, the constant 1.414 is the constant used for a 45° offset. In the trigonometric tables it is found to be the cosecant.

Knowing this, the travel of any offset to any degree and minute can be solved using the constant.

Name: _____

Approved by: _____

Date: _____

FIGURING OFFSETS

Key: BI - AW 3 - 3A
Page 1 of 10

Student Assignment
in
Plumbing and Pipe Fitting

Subject: FIGURING OFFSETS BY THE USE OF CONSTANTS

Purpose: To learn to calculate the length of pipe needed for the diagonal or travel of piping offsets

Reference: Information Sheet 3I
Reference tables (see Appendix)

Introductory Information: Proper tools and the knowledge of their use saves a good journeyman time and effort. Formulas and constants are tools of the trade used by those who have bothered to learn and use them as such for a better, more efficient job.

Directions:

1. Study the references and illustrated problems.

2. Reference tables "L" through "O" in the Appendix will give you the center-to-center diagonal measurements on offsets up to 4 feet.

3. Make your calculations on separate sheets of paper to show the method used to solve the following problems. Use the tables to check your answers.

4. Work the problems below.

Problems:

1. The run of a 45° offset is 4'-6". How long is the travel center-to-center of the fitting?

_____ Answer

2. A 1" pipe is offset 45°. The offset is 14". What is the travel or diagonal?

_____ Answer

FIGURING OFFSETS

Key: B I - AW 3 - 3A
Page 2 of 10

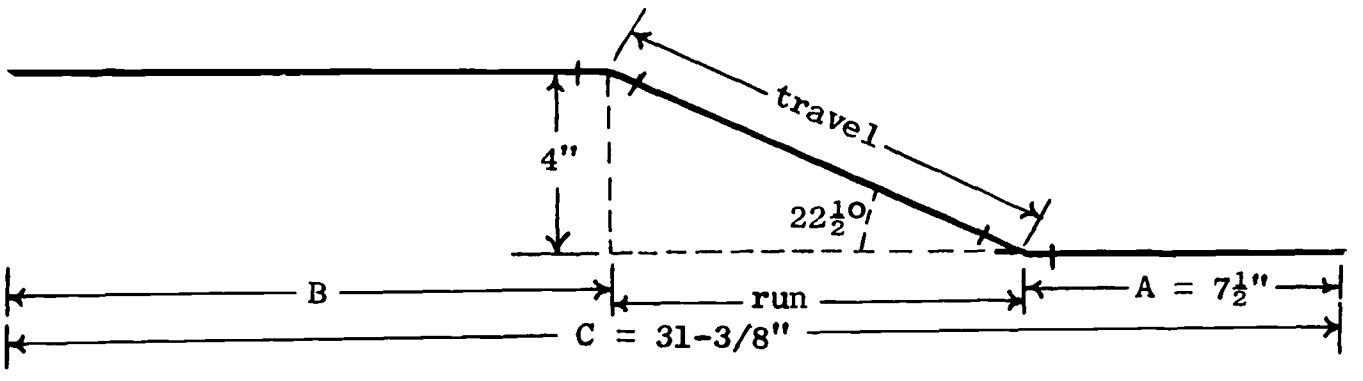
3. Calculate the length of travel center-to-center and end-to-end for the 45° offsets below.

	Pipe Size	Offset	C-to-C	E-to-E
a)	2"	3' - 8"		
b)	1"	28"		
c)	1 1/2"	5' - 4 1/2"		
d)	3/4"	2' - 3 1/2"		
e)	1 1/4"	3' - 1J"		
f)	1"	5"		

4. Figure offsets center-to-center to the nearest 1/16" as indicated in the spaces below.

60° or 1/6 Bends

	Pipe Size	Offset	Run	Travel
a)	1"		4 5/8"	
b)	1 1/4"	1' - 8"		23 1/8"
c)	1 1/2"	28"	16 1/8"	
d)	2"		27 3/4"	55 1/2"



5. In the figure above the following is given:

Angle of the offset = 22½°
Amount of offset = 4"
Length "A" = 7½"
Overall length "C" = 31 3/8"

Find:

a) Run _____

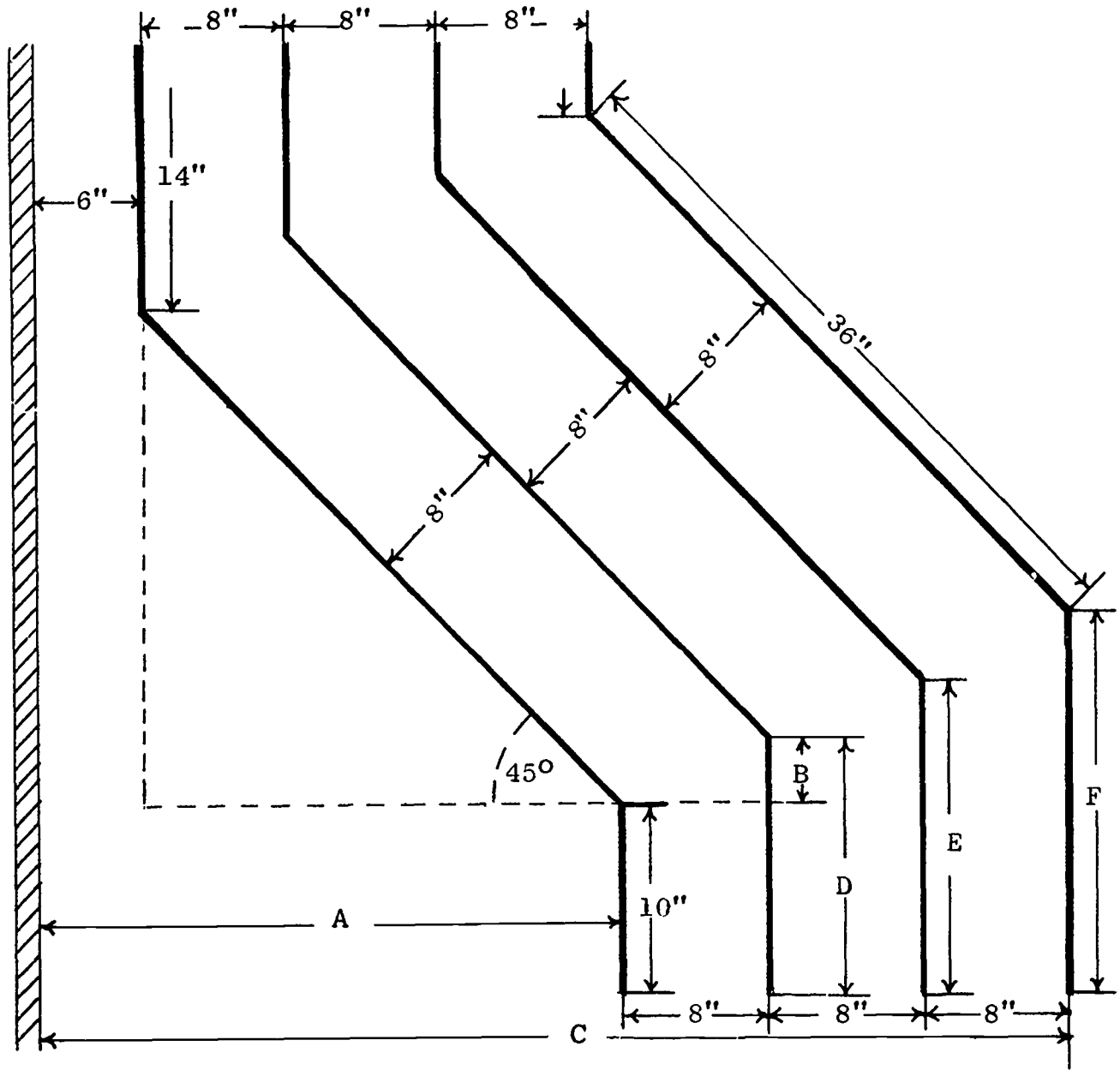
b) Travel _____

c) Length "B" _____

NOTE: All measurements given are center-to-center.

FIGURING OFFSETS

Key: BI - AW 3 - 3A
Page 4 of 10



6. Solve the following:

A = _____

B = _____

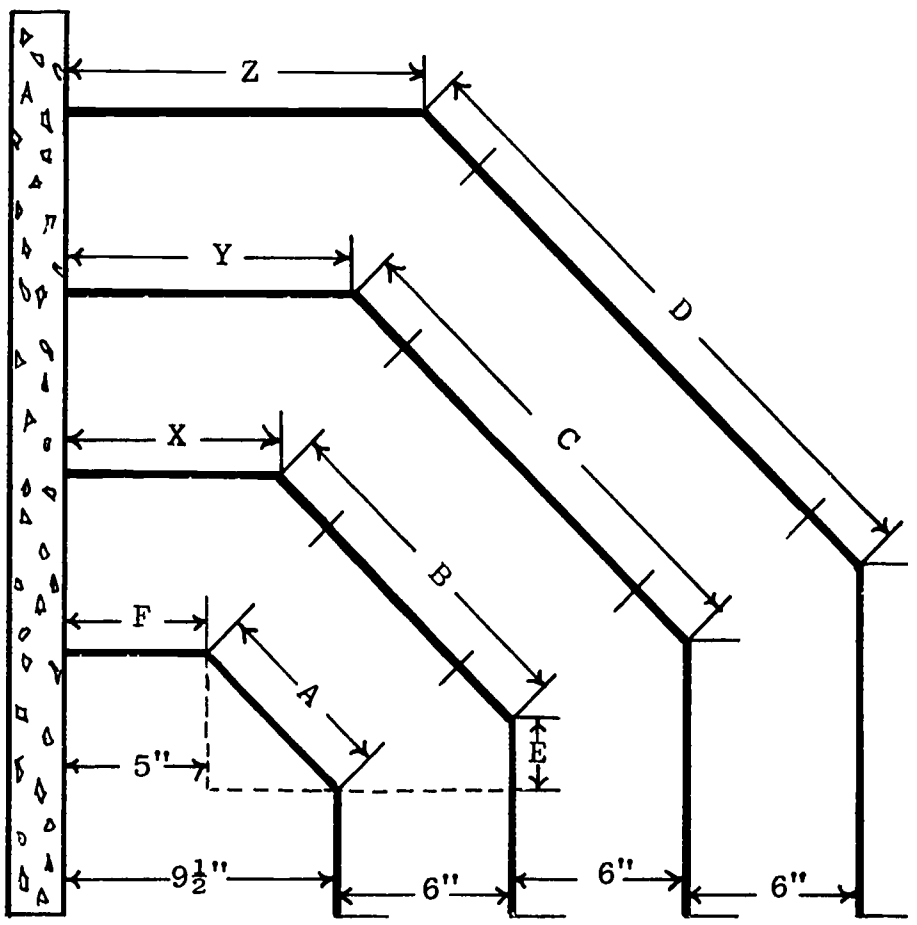
C = _____

D = _____

E = _____

F = _____

G = _____



7. In the above figure, the following is given:

45° Parallel offsets

Find (to the nearest 1/16"):

A = _____

B = _____

C = _____

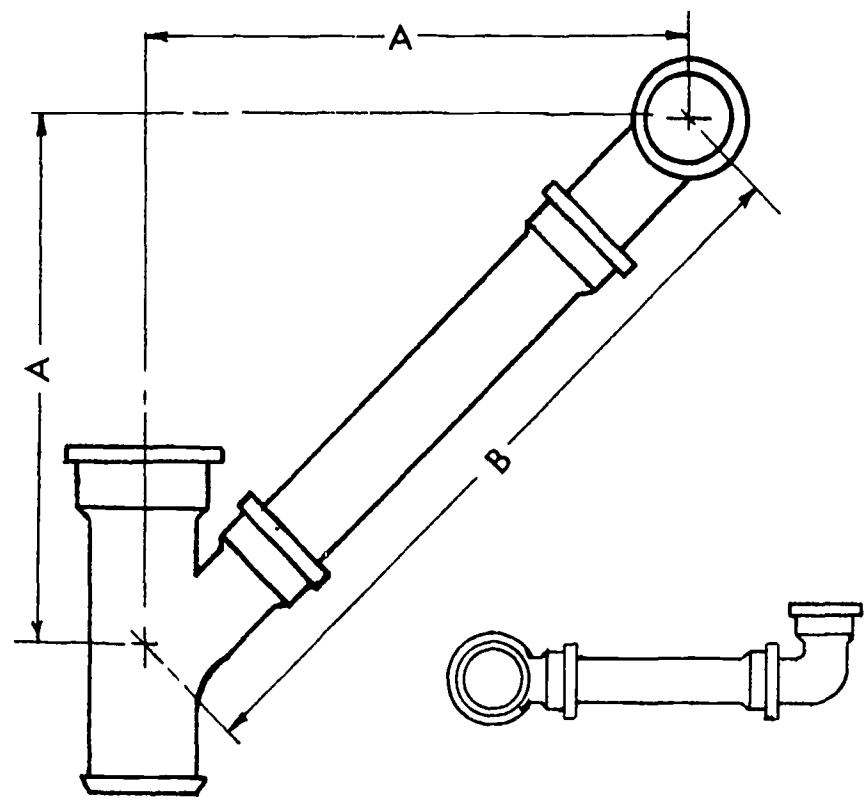
D = _____

E = _____

X = _____

FIGURING OFFSETS

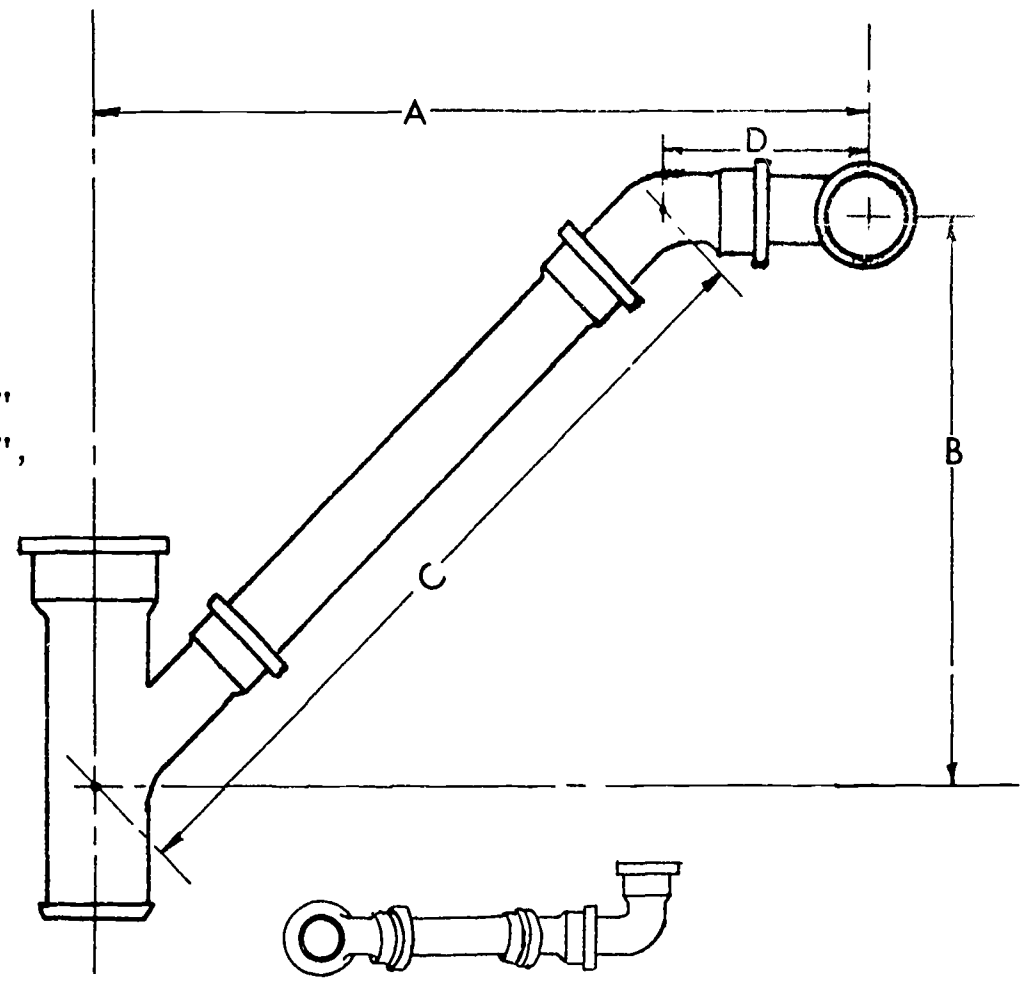
Key: BI - AW 3 - 3A
Page 6 of 10



8. If measurement A = 17", what is measurement:

B = _____CC

4″ x 2″ Y and 2″ 1/4 BEND

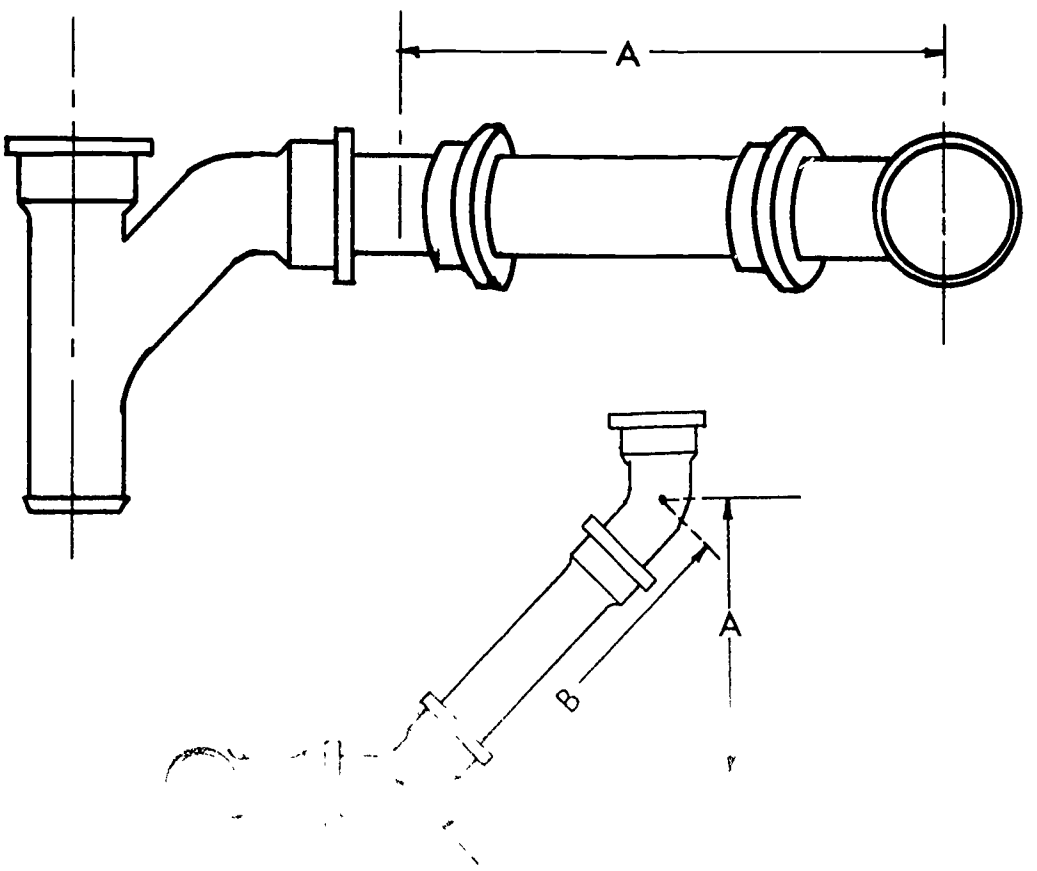


9. If measurement B = 16 3/4" and measurement D = 7 1/2", what are measurements:

A = _____ CC

C = _____ CC

4″ x 2″ Y—2″ 1/8 BEND and 2″ 1/4 BEND



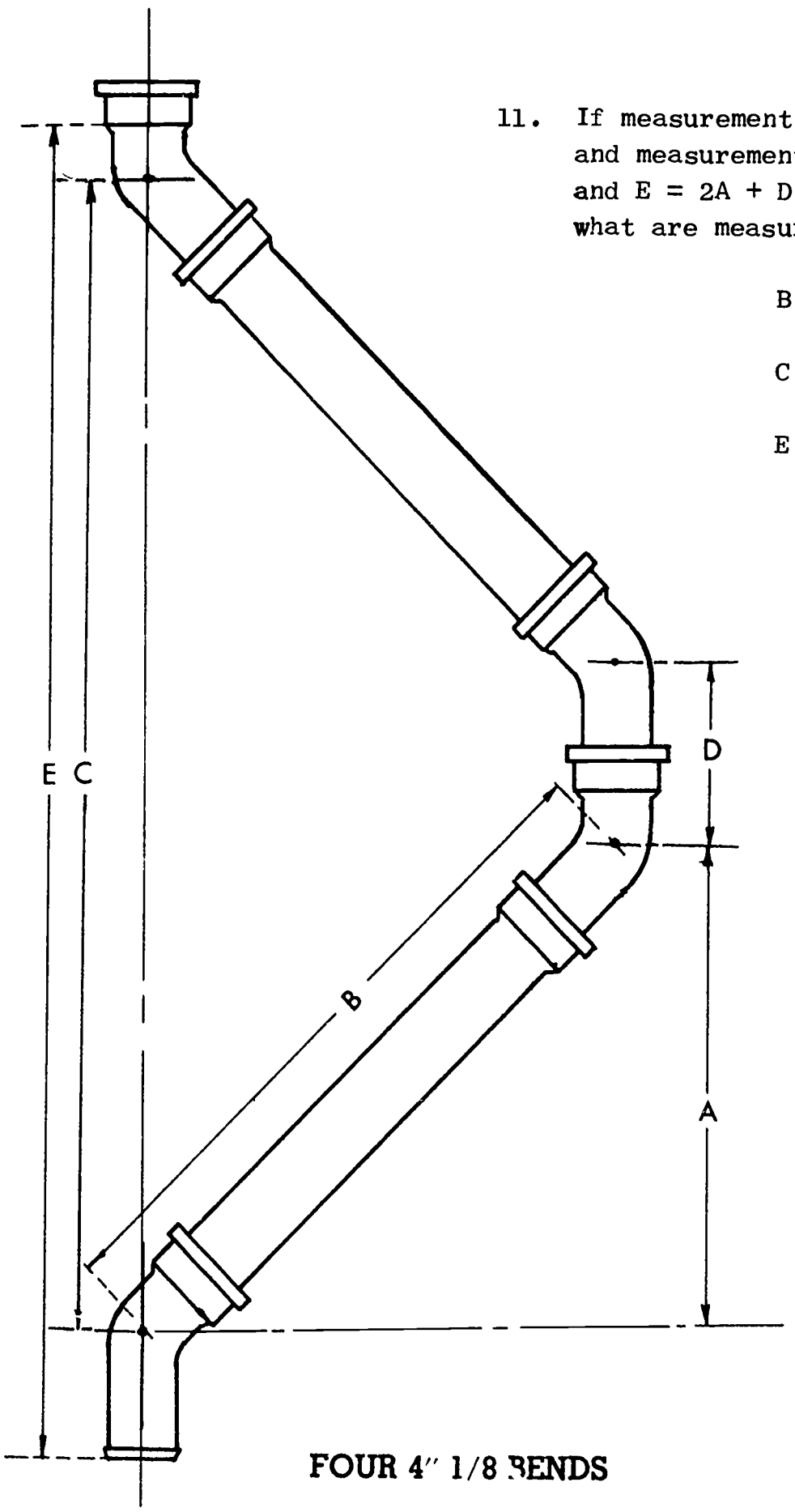
4″ COMBINATION T-Y and TWO 4″ 1/8 BENDS

10. If measurement A = 29 1/2", what is measurement:

B = _____ CC

FIGURING OFFSETS

Key: BI - AW 3 - 3A
Page 8 of 10



FOUR 4" 1/8 BENDS

11. If measurement A = 3'- 10 1/4",
and measurements C = 2A + D, D = 7 7/8"
and E = 2A + D + 7 7/8",
what are measurements:

B = _____CC

C = _____CC

E = _____EE

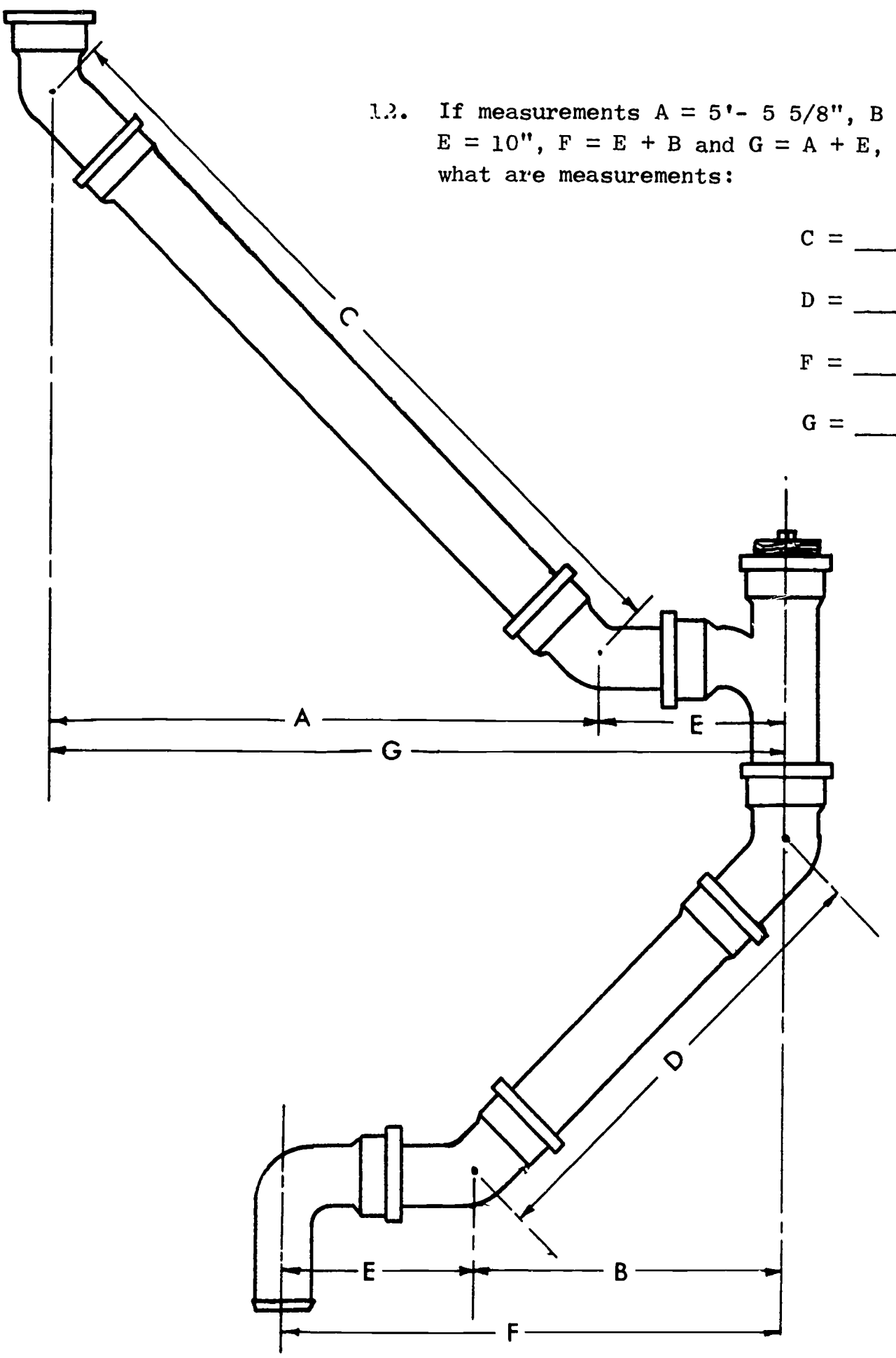
12. If measurements A = 5'- 5 5/8", B = 4'- 2 1/4", E = 10", F = E + B and G = A + E, what are measurements:

C = _____CC

D = _____CC

F = _____CC

G = _____CC



FOUR 4" 1/8 BENDS—4" SAN TEE—4" 1/4 BEND

FIGURING OFFSETS

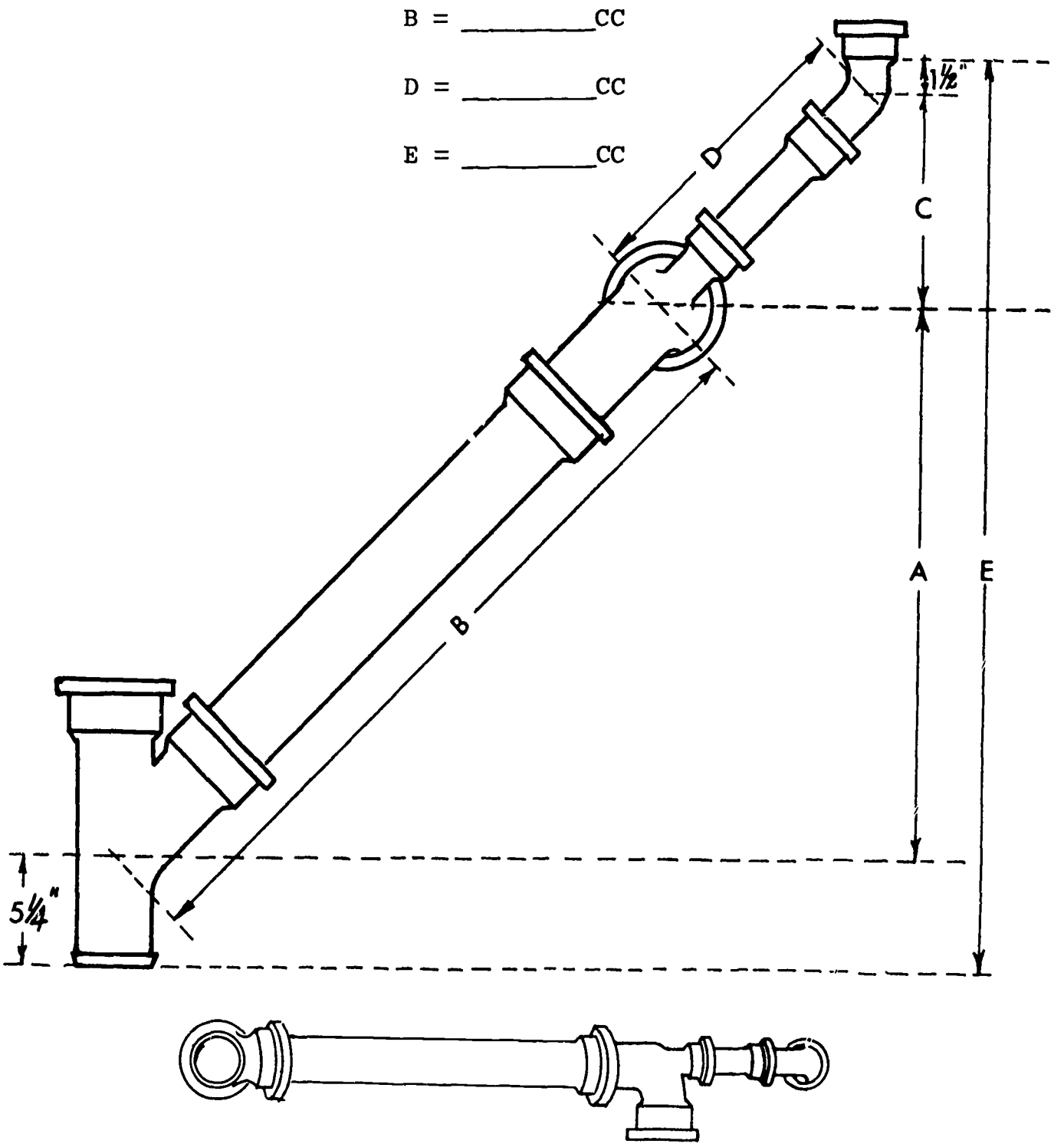
Key: BI - AW 3 - 3A
Page 10 of 10

13. If measurement A = 6'- 4 5/8" and measurement C = 1'- 8 1/4" what are measurements:

B = _____CC

D = _____CC

E = _____CC



4" Y—4" x 2" HEEL ELL 1/4 BEND & 2" 1/8 BEND

Name: _____

Approved by: _____

Date: _____

FIGURING 45° OFFSETS

Key: BI - AW 3 - 4A
Page 1 of 2

STUDENT ASSIGNMENT
IN
PLUMBING AND PIPE FITTING

Subject: FIGURING OFFSETS BY THE "PLUS 5 METHOD"

Purpose: To learn a quick, easy method for determining the length of pipe needed for 45° offsets without the use of pencil and paper calculations.

Reference: Reference tables (see Appendix).

Introductory Information: The "plus 5" method of figuring offsets is not quite as accurate as methods using constants, but in many practical applications it is sufficiently accurate.

The rule is:
ADD 5" TO EVERY FOOT, AND 5/12" TO EVERY INCH OF AN OFFSET.

Example: Given - Set = 1' - 3"
3/4 pipe and 45° ells

Find - Travel of the pipe from end to end (cutting length)

(1) Add 5 inches to the 1 foot.
1' plus 5" = 1' - 5"
(2) Multiply 5/12" x 3" and add to the 3"
5/12" times 3" = 1 1/4"
3" plus 1 1/4" = 4 1/4"
(3) Total 1' - 5" + 4 1/4" = 1' - 9 1/4" center to center
(4) Refer to Table "P", the dimension of fittings. For 3/4" pipe and 45° elbow, subtract Column "A" from Column "D" which will give the amount that the fitting takes up from the center of the fitting to the end of the pipe when the pipe is screwed into the fitting.

A = 9/16", D = 1"
1" minus 9/16" = 7/16" for one fitting
7/16" times 2 = 7/8" take up for two fittings

FIGURING 45° OFFSETS

Key: B I - AW 3 - 4A
Page 2 of 2

(5) Subtract the fitting dimensions from the center to center measurement of the travel, or diagonal measurement.

1' - 9 1/4" minus 7/8" = 1' 8 3/8" cutting measurement (end to end)

Directions: 1. Fill in the blank spaces in the following table.

2. Compute your answers to the nearest 1/8".

NOTE: You should learn to do this with mental calculations without the use of pencil and paper calculations.

Study Problems:

	Offset	Pipe Size	Diagonal C to C	Make up of two 45° ells	Cutting Measurements
1.	12"	1"			
2.	6"	1/2"			
3.	10"	2"			
4.	20"	3"			
5.	3' - 8"	1 1/2"			
6.	4"	6"			
7.	42"	4"			
8.	5' - 10"	5"			
9.	3"	1/4"			
10.	2' - 4"	1 1/4"			

Information Sheet
in
Plumbing and Pipe Fitting

ROLLING OFFSETS

Key: BI - AW 3 - 5I
Page 1 of 6

A compound, or as some call it, a rolling or rolled, offset is an offset in which the pipe changes both elevation and lateral position. The need for calculating rolled offsets arise in many common installations.

In waste lines anytime a wye is rolled off the horizontal or vertical and straightened up with a bend this is a rolled offset. Anytime the vertical and lateral alignment of a lines is moved, a rolled offset or a swing joint (which is a special case of the rolled offset with the run equal to zero) must be used.

A typical problem in using a rolled offset would be as illustrated in Figure 1.

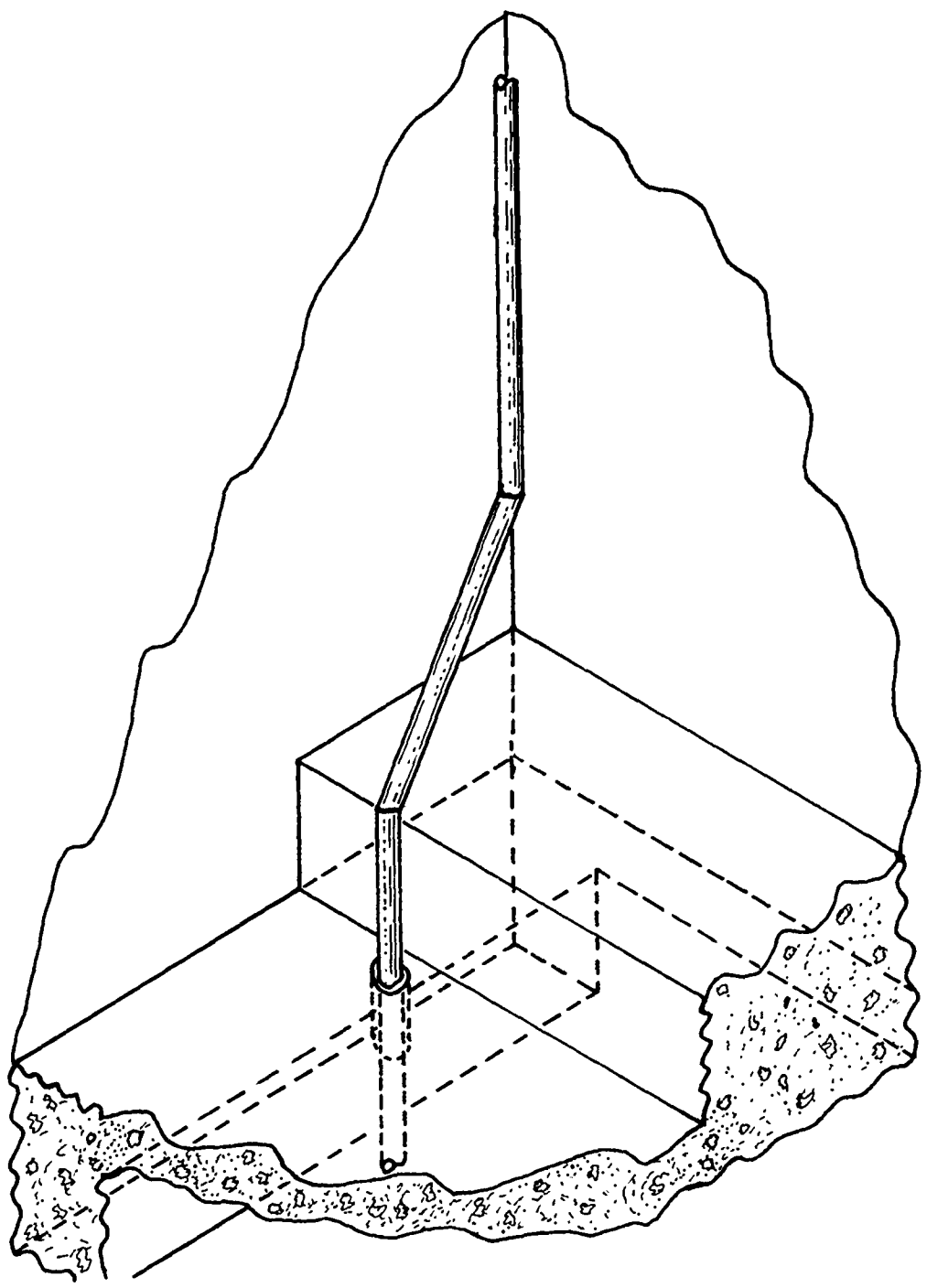
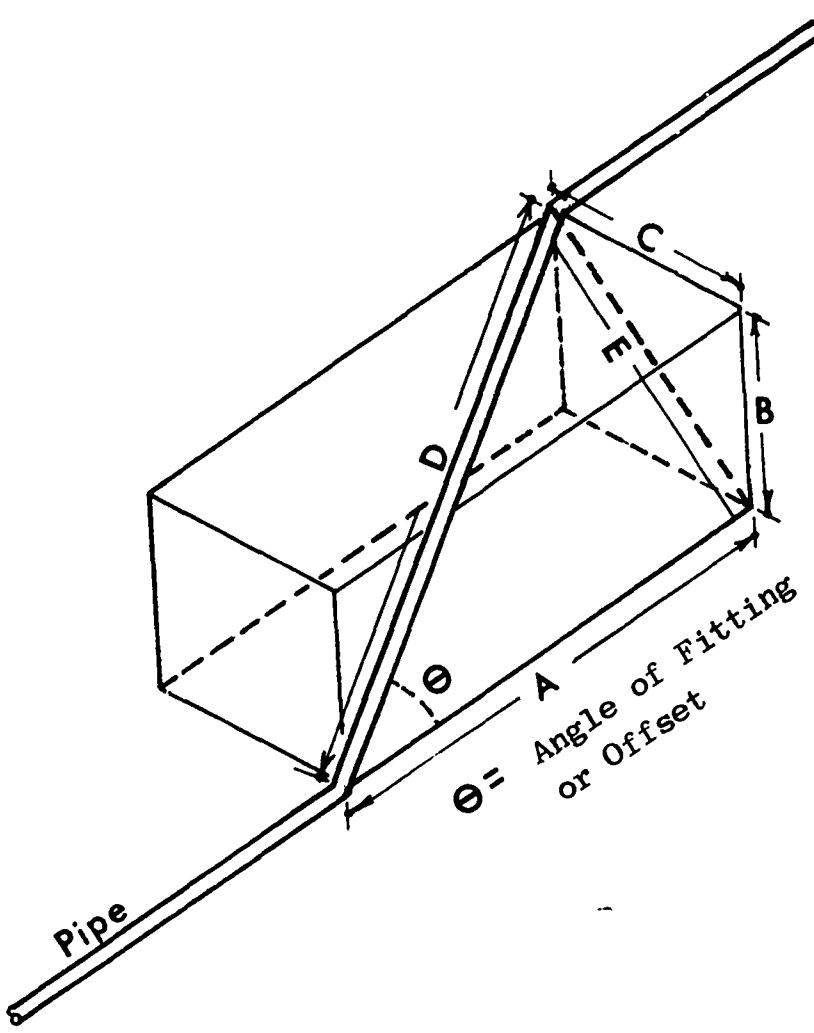


Figure 1

ROLLING OFFSETS

Key: BI - AW 3 - 5I
Page 2 of 6

To aid in visualizing and analyzing the bounds of the rolled offset imaginary bounds resembling a rectangle will be used in the figures as shown in Figure 2.



A = Run
B = Set (Offset)
C = Roll
D = Travel
E = True Set

Figure 2.

The student may analyze Figure 3 and notice the "travel" (D) of the pipe and the "run" (A) with the addition of another side, which we shall call the "true set" (E) make up a simple right triangle.

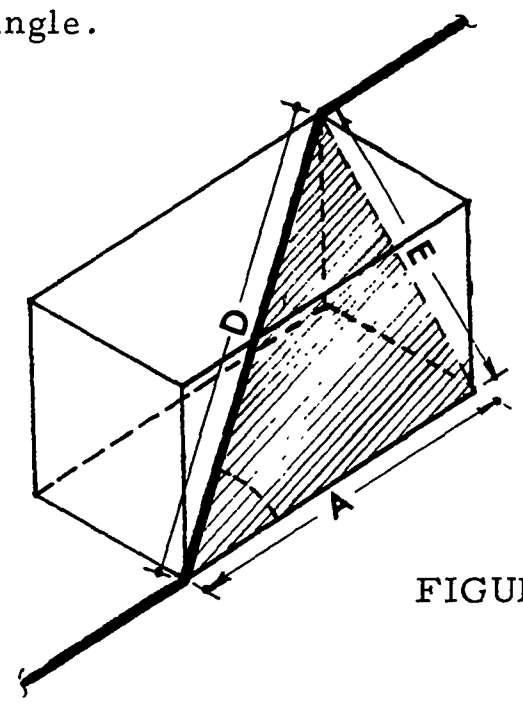


FIGURE 3

Figure 4 shows sides "set" (B), "roll" (C), and "true set" (E) also make up the sides of a simple right triangle, and the length of "true set" may be calculated thus:

$$E = \sqrt{B^2 + C^2}$$

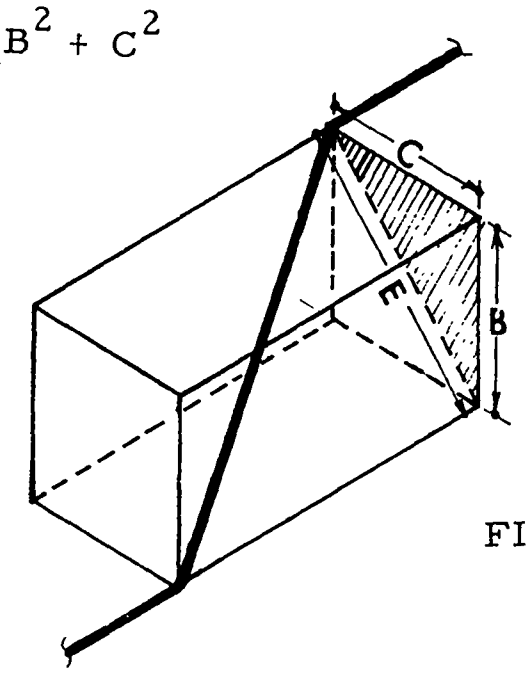


FIGURE 4

ROLLING OFFSETS

Key: B I - AW 3 - 5I
Page 4 of 6

Putting these two observations together we find:

$$D = \sqrt{A^2 + E^2}$$

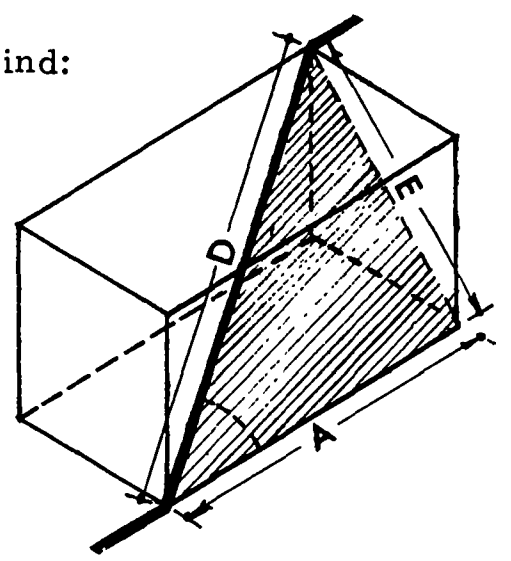


Figure 5

The student may also observe in the figure below that the travel can be calculated by the following formula which is an extension of the "sums of squares" formula which is used in the calculations of simple offsets:

$$D = \sqrt{A^2 + B^2 + C^2}$$

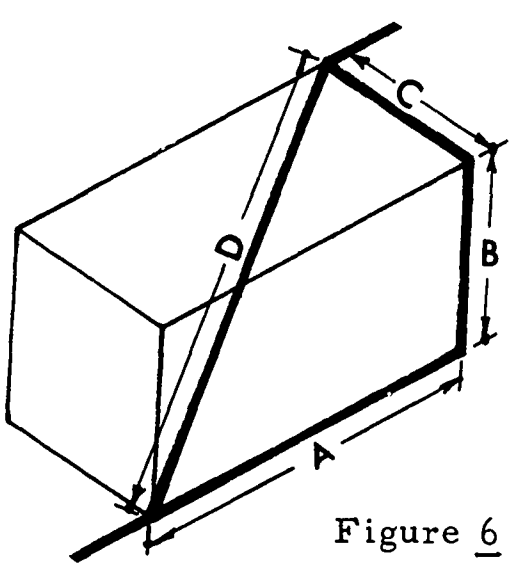


Figure 6

Study the progressive figures and formulas carefully - learn to visualize the situation contained in a rolled offset and the so called mysteries of the problem will bother you no more.

Contrary to some solutions, at this point only is it necessary to resort to trigonometry - and this is only to calculate the angle of the bevel to be cut

EXAMPLE - Given:

Angle of Fitting	= 45°	$E^2 = 4^2 + 3^2$
Roll	= 4	$E = \sqrt{16 + 9} = \sqrt{25}$
Set	= 3	
True Set	= E	$E = 5$

Fitting Angle = 45° (1/8 bend)
True Set = Run
Travel^2 = $5^2 + 5^2$
Travel = $\sqrt{5^2 + 5^2} = \sqrt{50} = 7.071$

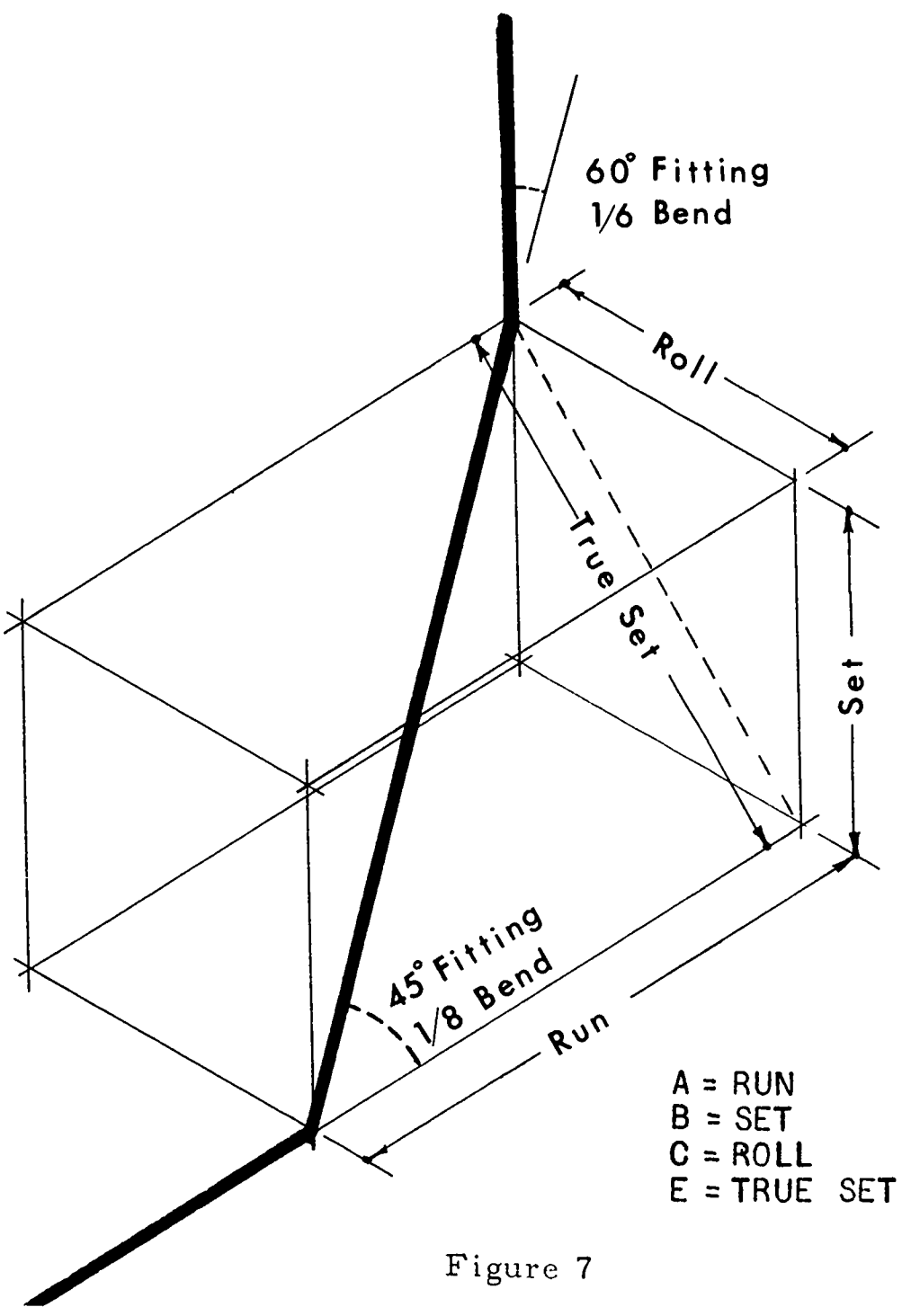


Figure 7

A 45° rolling or compound offset may be made from a horizontal line to a vertical line as shown in Figure 7. In this case, however, it is necessary to use a 60° fitting (1/6 bend) in order to turn the pipe vertically at 90° to the horizontal run of pipe.

on the pipe for a welded joint. If standard fittings are to be used (I.E. 45, 60, 22 1/2° ells or 1/6 bend, 1/16 bend, etc. constants may be used as shown in the following exercises.

Name: _____

Approved by: _____

Date: _____

45° WYE & 1/6 BEND OFFSETS

Key: B I - AW 3 - 5A
Page 1 of 1

Student Assignment
in
Plumbing and Pipe Fitting

Subject: 45° WYE AND 1/6 BEND OFFSETS

Purpose: To learn how to figure offsets using 45° and 60° fittings.

Reference: Information Sheet 5I

Introductory Information: A plumber and pipe fitter is often required to install piping offsets as shown in Figure 6. This method of figuring the length of pipe needed for such offsets is simple and easy to learn. This knowledge will save time on the job for you.

Directions:

1. Study the information sheet. Pay particular attention to the illustrative problems on page 2.

2. Find to the nearest one-eighth inch each of the missing specifications in the columns below:

Study Problems:

	A	B	C	D
1.			1' - 3"	
2.	3'			
3.		4' - 6"		
4.				10' - 5"
5.			5' - 5"	
6.				7' - 8 1/4"
7.	6' - 4 1/2"			
8.		2' - 4 5/8"		
9.				6' 1"
10.	4' - 3 3/4"			

Information Sheet
in
Plumbing and Pipe Fitting

Subject: 60° WYE AND 1/8 BEND OFFSETS

The other combination which is difficult consists of (1) a 60° Y and 1/8 bend or 45° elbow, (2) a 1/6 bend and a 1/8 bend, or (3) a 60° elbow and a 45° elbow. The sketch below shows a 60° Y in a horizontal drain connecting with a 1/8 bend to a vertical stack.

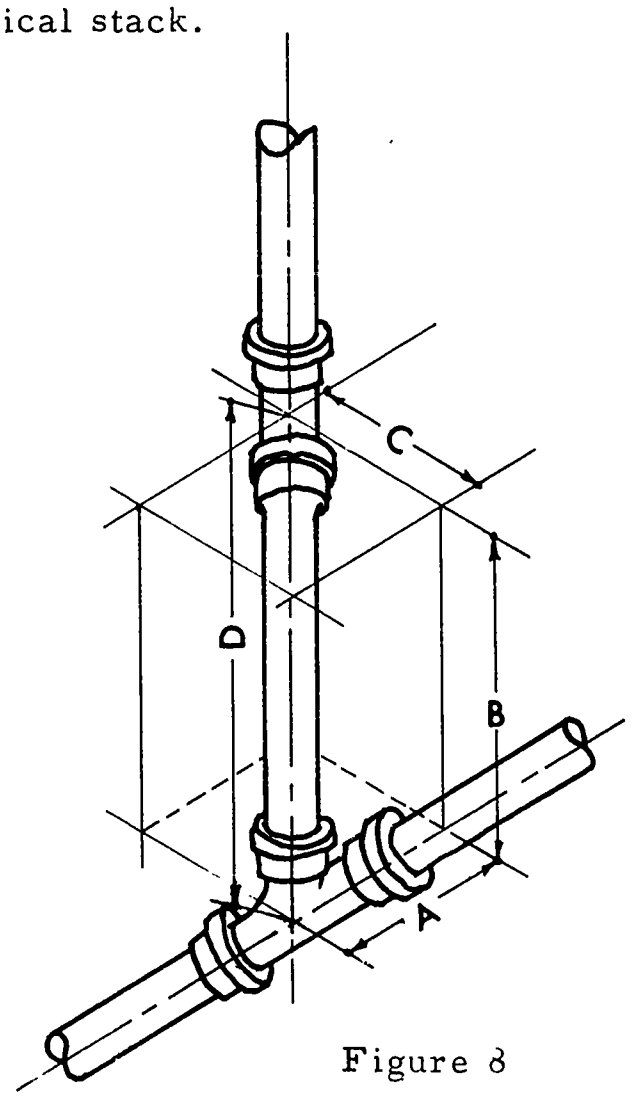


Figure 8

In this combination: D = C x 2 = A x 2 = B x 1.41
A = C
D = A x 1.41 = C x 1.41

C = offset, D = diagonal, A = distance from the center of the vertical stack to the center of the Y on the horizontal drain, B = rise.

60° WYE & 1/8 BEND OFFSETS

Key: B I - AW 3 - 6I
Page 2 of 2

ILLUSTRATIVE PROBLEMS

(a) Find the diagonal when the offset is 4'. Therefore, the diagonal is 96" or 8'.

4' = 48"
D = A x 2
= 48 x 2 = 96

(b) Find the rise when the offset is 4'. 4' = 48". B = C x 1.41 = 48 x 1.41 = 67.68. Therefore the rise is 67.68" or 5' - 7 3/4".

4' = 48"
B = A x 1.41
= 48 x 1.41 = 67.68

(c) Find the distance back from the center of a vertical stack to the center of a 60° Y in a horizontal drain in order to connect later with a 45° elbow, when the offset is 4'. 4' = 48". A = C. Therefore, A = 48" or 4'.

Name: _____

Approved by: _____

Date: _____

60° WYE & 1/8 BEND OFFSETS
Key: B I - AW 3 - 6A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: 60° WYE AND 1/8 BEND OFFSETS

Purpose: To learn how to figure offsets using 60° and 45° fittings.

Reference: Information Sheet 6I

Introductory Information: A plumber and pipe fitter is sometimes required to install piping offsets as shown in Figure 8. This method of figuring the length of pipe needed for such offsets is simple and easy to learn. This knowledge will save time on the job for you.

Directions:

1. Study the Information Sheet. Pay particular attention to the illustrative problems on page 2.

2. Find to the nearest 1/8" each of the missing specifications in the columns below:

Study Problems:

	A	B	C	D
1.			17"	
2.	23"			
3.		35"		
4.				5'
5.	15' - 3"			
6.			4' - 3"	
7.		5'		
8.				15"
9.			3' - 3 1/2"	
10.		4' - 9 1/2"		

A P P E N D I X

TABLES FOR REFERENCE

Apprentice Workbook 3

REFERENCE TABLE "A"

DECIMAL EQUIVALENTS			
1/64 = .0156	17/64 = .2656	33/64 = .5156	49/64 = .7656
1/32 = .0312	9/32 = .2812	17/32 = .5312	25/32 = .7812
3/64 = .0468	19/64 = .2968	35/64 = .5468	51/64 = .7968
1/16 = .0625	5/16 = .3125	9/16 = .5625	13/16 = .8125
5/64 = .0781	21/64 = .3281	37/64 = .5781	53/64 = .8281
3/32 = .0937	11/32 = .3437	19/32 = .5937	27/32 = .8437
7/64 = .1093	23/64 = .3593	39/64 = .6093	55/64 = .8593
1/8 = .125	3/8 = .375	5/8 = .625	7/8 = .875
9/64 = .1406	25/64 = .3906	41/64 = .6406	57/64 = .8906
5/32 = .1562	13/32 = .4062	21/32 = .6562	29/32 = .9062
11/64 = .1718	27/64 = .4218	43/64 = .6718	59/64 = .9218
3/16 = .1875	7/16 = .4375	11/16 = .6875	15/16 = .9375
13/64 = .2031	29/64 = .4531	45/64 = .7031	61/64 = .9531
7/32 = .2187	15/32 = .4687	23/32 = .7187	31/32 = .9687
15/64 = .2343	31/64 = .4843	47/64 = .7343	63/64 = .9843
1/4 = .25	1/2 = .5	3/4 = .75	64/64 = 1.0

REFERENCE TABLE "B"

SQUARE AND SQUARE ROOT OF NUMBERS FROM 1 TO 99
DIAMETERS, CIRCUMFERENCES, AREAS, FROM 1 TO 99

No.	Square	Square Root	No. = Diam.		No.	Square	Square Root	No. = Diam.	
			Circum.	Area				Circum.	Area
					50	2500	7.0711	157.08	1963.50
1	1	1.0000	3.142	0.7854	51	2601	7.1414	160.22	2042.82
2	4	1.4142	6.283	3.1416	52	2704	7.2111	163.36	2123.72
3	9	1.7321	9.425	7.0686	53	2809	7.2801	166.50	2206.18
4	16	2.0000	12.566	12.5664	54	2916	7.3485	169.65	2290.22
5	25	2.2361	15.708	19.6350	55	3025	7.4162	172.79	2375.83
6	36	2.4495	18.850	28.2743	56	3136	7.4833	175.93	2463.01
7	49	2.6458	21.991	38.4845	57	3249	7.5498	179.07	2551.76
8	64	2.8284	25.133	50.2655	58	3364	7.6158	182.21	2642.08
9	81	3.0000	28.274	63.6173	59	3481	7.6812	185.35	2733.97
10	100	3.1623	31.416	78.5398	60	3600	7.7460	188.50	2827.43
11	121	3.3166	34.558	95.0332	61	3721	7.8103	191.64	2922.47
12	144	3.4641	37.699	113.097	62	3844	7.8740	194.78	3019.07
13	169	3.6056	40.841	132.732	63	3969	7.9373	197.92	3117.25
14	196	3.7417	43.982	153.938	64	4096	8.0000	201.06	3216.99
15	225	3.8730	47.124	176.715	65	4225	8.0623	204.20	3318.31
16	256	4.0000	50.266	201.062	66	4356	8.1240	207.35	3421.19
17	289	4.1231	53.407	226.980	67	4489	8.1854	210.49	3525.65
18	324	4.2426	56.549	254.469	68	4624	8.2462	213.63	3631.68
19	361	4.3589	59.690	283.529	69	4761	8.3066	216.77	3739.28
20	400	4.4721	62.832	314.159	70	4900	8.3666	219.91	3848.45
21	441	4.5826	65.973	346.361	71	5041	8.4262	223.05	3959.19
22	484	4.6904	69.115	380.133	72	5184	8.4853	226.19	4071.50
23	529	4.7958	72.257	415.476	73	5329	8.5440	229.34	4185.39
24	576	4.8990	75.398	452.389	74	5476	8.6023	232.48	4300.84
25	625	5.0000	78.540	490.874	75	5625	8.6603	235.62	4417.86
26	676	5.0990	81.681	530.929	76	5776	8.7178	238.76	4536.46
27	729	5.1962	84.823	572.555	77	5929	8.7750	241.90	4656.63
28	784	5.2915	87.965	615.752	78	6084	8.8318	245.04	4778.36
29	841	5.3852	91.106	660.520	79	6241	8.8882	248.19	4901.67
30	900	5.4772	94.248	706.858	80	6400	8.9443	251.33	5026.55
31	961	5.5678	97.389	754.768	81	6561	9.0000	254.47	5153.00
32	1024	5.6569	100.531	804.248	82	6724	9.0554	257.61	5281.02
33	1089	5.7446	103.673	855.299	83	6889	9.1104	260.75	5410.61
34	1156	5.8310	106.814	907.920	84	7056	9.1652	203.89	5541.77
35	1225	5.9161	109.956	962.113	85	7225	9.2195	267.04	5674.50
36	1296	6.0000	113.097	1017.88	86	7396	9.2736	270.18	5808.80
37	1369	6.0828	116.239	1075.21	87	7569	9.3274	273.32	5944.68
38	1444	6.1644	119.381	1134.11	88	7744	9.3808	276.46	6082.12
39	1521	6.2450	122.522	1194.59	89	7921	9.4340	279.60	6221.14
40	1600	6.3246	125.66	1256.64	90	8100	9.4868	282.74	6361.73
41	1681	6.4031	128.81	1320.25	91	8281	9.5394	285.89	6503.88
42	1764	6.4807	131.95	1385.44	92	8464	9.5917	289.03	6647.61
43	1849	6.5574	135.09	1452.20	93	8649	9.6437	292.17	6792.91
44	1936	6.6333	138.23	1520.53	94	8836	9.6954	295.31	6939.78
45	2025	6.7082	141.37	1590.43	95	9025	9.7468	298.45	7088.22
46	2116	6.7823	144.51	1661.90	96	9216	9.7980	301.59	7238.23
47	2209	6.8557	147.66	1734.94	97	9409	9.8489	304.73	7389.81
48	2304	6.9282	150.80	1809.56	98	9604	9.8995	307.88	7542.96
49	2401	7.0000	153.94	1885.74	99	9801	9.9499	311.02	7697.69

REFERENCE TABLE "C"

SQUARE AND SQUARE ROOT OF NUMBERS FROM 100 TO 199
DIAMETERS, CIRCUMFERENCES, AREAS, FROM 100 TO 199

No.	Square	Square Root	No. = Diam.		No.	Square	Square Root	No. = Diam.	
			Circum.	Area				Circum.	Area
100	10000	10.0000	314.16	7853.98	150	22500	12.2474	471.24	17671.5
101	10201	10.0499	317.30	8011.85	151	22801	12.2882	474.38	17907.9
102	10404	10.0995	320.44	8171.23	152	23104	12.3288	477.52	18145.8
103	10609	10.1489	323.58	8332.29	153	23409	12.3693	480.66	18385.4
104	10816	10.1980	326.73	8494.87	154	23716	12.4097	483.81	18626.5
105	11025	10.2470	329.87	8659.01	155	24025	12.4499	486.95	18869.2
106	11236	10.2956	333.01	8824.73	156	24336	12.4900	490.09	19113.4
107	11449	10.3441	336.15	8992.02	157	24649	12.5300	493.23	19359.3
108	11664	10.3923	339.29	9160.88	158	24964	12-5698	496.37	19606.7
109	11881	10.4403	342.43	9331.32	159	25281	12.6095	499.51	19855.7
110	12100	10.4881	345.58	9503.32	160	25600	12.6491	502.65	20106.2
111	12321	10.5357	348.72	9676.89	161	25921	12.6886	505.80	20358.3
112	12544	10.5830	351.86	9852.03	162	26244	12.7279	508.94	20612.0
113	12769	10.6301	355.00	10028.7	163	26569	12.7671	512.08	20867.2
114	12996	10.6771	358.14	10207.0	164	26896	12.8062	515.22	21124.1
115	13225	10.7238	361.28	10386.9	165	27225	12.8452	518.36	21382.5
116	13456	10.7703	364.42	10568.3	166	27556	12.8841	521.50	21642.4
117	13689	10.8167	367.57	10751 3	167	27889	12.9228	524.65	21904.0
118	13924	10.8628	370.71	10935.9	168	28224	12.9615	527.79	22167.1
119	14161	10.9087	373.85	11122.0	169	28561	13.0000	530.93	22431.8
120	14400	10.9545	376.99	11309.7	170	28900	13.0384	534.07	22698.0
121	14641	11.0000	380.13	11499.0	171	29241	13.0767	537.21	22965.8
122	14884	11.0454	383.27	11689.9	172	29584	13.1149	540.35	23235.2
123	15129	11.0905	386.42	11882.3	173	29929	13.1529	543.50	23506.2
124	15376	11.1355	389.56	12076.3	174	30276	13.1909	546.64	23778.7
125	15625	11.1803	392.70	12271.8	175	30625	13.2288	549.78	24052.8
126	15876	11.2250	395.84	12469.0	176	30976	13.2665	552.92	24328.5
127	16129	11.2694	398.98	12667.7	177	31329	13.3041	556.06	24605.7
128	16384	11.3137	402.12	12868.0	178	31684	13.3417	559.20	24884.6
129	16641	11.3578	405.27	13069.8	179	32041	13.3791	562.35	25164.9
130	16900	11.4018	408.41	13273.2	180	32400	13.4164	565.49	25446.9
131	17161	11.4455	411.55	13478.2	181	32761	13.4536	568.63	25730.4
132	17424	11.4891	414.69	13684.8	182	33124	13.4907	571.77	26015.5
133	17689	11.5326	417.83	13892.9	183	33489	13.5277	574.91	26302.2
134	17956	11.5758	420.97	14102.6	184	33856	13.5647	578.05	26590.4
135	18225	11.6190	424.12	14313.9	185	34225	13.6015	581.19	26880.3
136	18496	11.6619	427.26	14526.7	186	34596	13.6382	584.34	27171.6
137	18769	11.7047	430.40	14741.1	187	34969	13.6748	587.48	27464.6
138	19044	11.7473	433.54	14957.1	188	35344	13.7113	590.62	27759.1
139	19321	11.7898	436.68	15174.7	189	35721	13.7477	593.76	28055.2
140	19600	11.8322	439.82	15393.8	190	36100	13.7840	596.90	28352.9
141	19881	11.8743	442.96	15614.5	191	36481	13.8203	600.04	28652.1
142	20164	11.9164	446.11	15836.8	192	36864	13.8564	603.19	28952.9
143	20449	11.9583	449.25	16060.6	193	37249	13.8924	606.33	29255.3
144	20736	12.0000	452.39	16286.0	194	37636	13.9284	609.47	29559.2
145	21025	12.0416	455.53	16513.0	195	38025	13.9642	612.61	29864.8
146	21316	12.0830	458.67	16741.5	196	38416	14.0000	615.75	30171.9
147	21609	12.1244	461.81	16971.7	197	38809	14.0357	618.89	30480.5
148	21904	12.1655	464.96	17203.4	198	39204	14.0712	622.04	30790.7
149	22201	12.2066	468.10	17436.6	199	39601	14.1067	625.18	31102.6

REFERENCE TABLE "D"

SQUARE AND SQUARE ROOT OF NUMBERS FROM 200 TO 299
DIAMETERS, CIRCUMFERENCES, AREAS, FROM 200 TO 299

No.	Square	Square Root	No. = Diam.		No.	Square	Square Root	No. = Diam.	
			Circum.	Area				Circum.	Area
200	40000	14.1421	628.32	31415.9	250	62500	15.8114	785.40	49087.4
201	40401	14.1774	631.46	31730.9	251	63001	15.8430	788.54	49480.9
202	40804	14.2127	634.60	32047.4	252	63504	15.8745	791.68	49875.9
203	41209	14.2478	637.74	32365.5	253	64009	15.9060	794.82	50272.6
204	41616	14.2829	640.88	32685.1	254	64516	15.9374	797.96	50670.7
205	42025	14.3178	644.03	33006.4	255	65025	15.9687	801.11	51070.5
206	42436	14.3527	647.17	33329.2	256	65536	16.0000	804.25	51471.9
207	42849	14.3875	650.31	33653.5	257	66049	16.0312	807.39	51874.8
208	43264	14.4222	653.45	33979.5	258	66564	16.0624	810.53	52279.2
209	43681	14.4568	656.59	34307.0	259	67081	16.0935	813.67	52685.3
210	44100	14.4914	659.73	34636.1	260	67600	16.1245	816.81	53092.9
211	44521	14.5258	662.88	34966.7	261	68121	16.1555	819.96	53502.1
212	44944	14.5602	666.02	35298.9	262	68644	16.1864	823.10	53912.9
213	45369	14.5945	669.16	35632.7	263	69169	16.2173	826.24	54325.2
214	45796	14.6287	672.30	35968.1	264	69696	16.2481	829.38	54739.1
215	46225	14.6629	675.44	36305.0	265	70225	16.2788	832.52	55154.6
216	46656	14.6969	678.58	36643.5	266	70756	16.3095	835.66	55571.6
217	47089	14.7309	681.73	36983.6	267	71289	16.3401	838.81	55990.3
218	47524	14.7648	684.87	37325.3	268	71824	16.3707	841.95	56410.4
219	47961	14.7986	688.01	37668.5	269	72361	16.4012	845.09	56832.2
220	48400	14.8324	691.15	38013.3	270	72900	16.4317	848.23	57255.5
221	48841	14.8661	694.29	38359.6	271	73441	16.4621	851.37	57680.4
222	49284	14.8997	697.43	38707.6	272	73984	16.4924	854.51	58106.9
223	49729	14.9332	700.58	39057.1	273	74529	16.5227	857.65	58534.9
224	50176	14.9666	703.72	39408.1	274	75076	16.5529	860.80	58964.6
225	50625	15.0000	706.86	39760.8	275	75625	16.5831	863.94	59395.7
226	51076	15.0333	710.00	40115.0	276	76176	16.6132	867.08	59828.5
227	51529	15.0665	713.14	40470.8	277	76729	16.6433	870.22	60262.8
228	51984	15.0997	716.28	40828.1	278	77284	16.6733	873.36	60698.7
229	52441	15.1327	719.42	41187.1	279	77841	16.7033	867.50	61136.2
230	52900	15.1658	722.57	41547.6	280	78400	16.7332	879.65	61575.2
231	53361	15.1987	725.71	41909.6	281	78961	16.7631	882.79	62015.8
232	53824	15.2315	728.85	42273.3	282	79524	16.7929	885.93	62458.0
233	54289	15.2643	731.99	42638.5	283	80089	16.8226	889.07	62901.8
234	54756	15.2971	735.13	43005.3	284	80656	16.8523	892.21	63347.1
235	55225	15.3297	738.27	43373.6	285	81225	16.8819	895.35	63794.0
236	55696	15.3623	741.42	43743.5	286	81796	16.9115	898.50	64242.4
237	56169	15.3948	744.56	44115.0	287	82369	16.9411	901.64	64692.5
238	56644	15.4272	747.70	44488.1	288	82944	16.9706	904.78	65144.1
239	57121	15.4596	750.84	44862.7	289	83521	17.0000	907.92	65597.2
240	57600	15.4919	753.98	45238.9	290	84100	17.0294	911.06	66052.0
241	58081	15.5242	757.12	45616.7	291	84681	17.0587	914.20	66508.3
242	58564	15.5563	760.27	45996.1	292	85264	17.0880	917.35	66966.2
243	59049	15.5885	763.41	46377.0	293	85849	17.1172	920.49	67425.6
244	59536	15.6205	766.55	46759.5	294	86436	17.1464	923.63	67886.7
245	60025	15.6525	769.69	47143.5	295	87025	17.1756	926.77	68349.3
246	60516	15.6844	772.83	47529.2	296	87616	17.2047	929.91	68813.4
247	61009	15.7162	775.97	47916.4	297	88209	17.2337	933.05	69279.2
248	61504	15.7480	779.11	48305.1	298	88804	17.2627	936.19	69746.5
249	62001	15.7797	782.26	48695.5	299	89401	17.2916	939.34	70215.4

REFERENCE TABLE "E"

SQUARE AND SQUARE ROOT OF NUMBERS FROM 300 TO 399
DIAMETERS, CIRCUMFERENCES, AREAS, FROM 300 TO 399

No.	Square	Square Root	No. = Diam.		No.	Square	Square Root	No. = Diam.	
			Circum.	Area				Circum.	Area
300	90000	17.3205	942.48	70685.8	350	122500	18.7083	1099.6	96211.3
301	90601	17.3494	945.62	71157.9	351	123201	18.7350	1102.7	96761.8
302	91204	17.3781	948.76	71631.5	352	123904	18.7617	1105.8	97314.0
303	91809	17.4069	951.90	72106.6	353	124609	18.7883	1109.0	97867.7
304	92416	17.4356	955.04	72583.4	354	125316	18.8149	1112.1	98423.0
305	93025	17.4642	858.19	72061.7	355	126025	18.8414	1115.3	98979.8
306	93636	17.4929	961.33	73541.5	356	126736	18.8680	1118.4	99538.2
307	94249	17.5214	964.47	74023.0	357	127449	18.8944	1121.6	100098
308	94864	17.5499	967.61	74506.0	358	128164	18.9209	1124.7	100660
309	95481	17.5784	970.75	74990.6	359	128881	18.9473	1127.8	101223
310	96100	17.6068	973.89	75476.8	360	129600	18.9737	1131.0	101788
311	96721	17.6352	977.04	75964.5	361	130321	19.0000	1134.1	102354
312	97344	17.6635	980.18	76453.8	362	131044	19.0263	1137.3	102922
313	97969	17.6918	983.32	76944.7	363	131769	19.0526	1140.4	103491
314	98596	17.7200	986.46	77437.1	364	132496	19.0788	1143.5	104062
315	99225	17.7482	989.60	77931.1	365	133225	19.1050	1146.7	104635
316	99856	17.7764	992.74	78426.7	366	133956	19.1311	1149.8	105209
317	100489	17.8045	995.88	78923.9	367	134689	19.1572	1153.0	105784
318	101124	17.8326	999.03	79422.6	368	135424	18.1833	1156.1	106362
319	101761	17.8606	1002.2	79922.9	369	136161	19.2094	1159.3	106941
320	102400	17.8885	1005.3	80424.8	370	136900	19.2354	1162.4	107521
321	103041	17.9165	1008.5	80928.2	371	137641	19.2614	1165.5	108103
322	103684	17.9444	1011.6	81433.2	372	138384	19.2873	1168.7	108687
323	104329	17.9722	1014.7	81939.8	373	139129	19.3132	1171.8	109272
324	104976	18.0000	1017.9	82448.0	374	139876	19.3391	1175.0	109858
325	105625	18.0278	1021.0	82957.7	375	140625	19.3649	1178.1	110447
326	106276	18.0555	1024.2	83469.0	376	141376	19.3907	1181.2	111036
327	106929	18.0831	1027.3	83981.8	377	142129	19.4165	1184.4	111628
328	107584	18.1108	1030.4	84496.3	378	142884	19.4422	1187.5	112221
329	108241	18.1384	1033.6	85012.3	379	143641	19.4679	1190.7	112815
330	108900	18.1659	1036.7	85529.9	380	144400	19.4936	1193.8	113411
331	109561	18.1934	1039.9	86049.0	381	145161	19.5192	1197.0	114009
332	110224	18.2209	1043.0	86569.7	382	145924	19.5448	1200.1	114608
333	110889	18.2483	1046.2	87092.0	383	146689	19.5704	1203.2	115209
334	111556	18.2757	1049.3	87615.9	384	147456	19.5959	1206.4	115812
335	112225	18.3030	1052.4	88141.3	385	148225	19.6214	1209.5	116416
336	112896	18.3303	1055.6	88668.3	386	148996	19.6469	1212.7	117021
337	113569	18.3576	1058.7	89196.9	387	149769	19.6723	1215.8	117628
338	114244	18.3848	1061.9	89727.0	388	150544	19.6977	1218.9	118237
339	114921	18.4120	1065.0	90258.7	389	151321	19.7231	1222.1	118847
340	115600	18.4391	1068.1	90792.0	390	152100	19.7484	1225.2	119459
341	116281	18.4662	1071.3	91326.9	391	152881	19.7737	1228.4	120072
342	116964	18.4932	1074.4	91863.3	392	153664	19.7990	1231.5	120687
343	117649	18.5203	1077.6	92401.3	393	154449	19.8242	1234.6	121304
344	118336	18.5472	1080.7	92940.9	394	155236	19.8494	1237.8	121922
345	119025	18.5742	1083.8	93482.0	395	156025	19.8746	1240.9	122542
346	119716	18.6011	1087.0	94024.7	396	156816	19.8997	1244.1	123163
347	120409	18.6279	1090.1	94569.0	397	157609	19.9249	1247.2	123786
348	121104	18.6548	1093.3	95114.9	398	158404	19.9499	1250.4	124410
349	121801	18.6815	1096.4	95662.3	399	159201	19.9750	1253.5	125036

REFERENCE TABLE "F"

SQUARE AND SQUARE ROOT OF NUMBERS FROM 400 TO 499
DIAMETERS, CIRCUMFERENCES, AREAS, FROM 400 TO 499

No.	Square	Square Root	No. = Diam.		No.	Square	Square Root	No. = Diam.	
			Circum.	Area				Circum.	Area
400	160000	20.0000	1256.6	125664	450	202500	21.2132	1413.7	159043
401	160801	20.0250	1259.8	126293	451	203401	21.2368	1416.9	159751
402	161604	20.0499	1262.9	126923	452	204304	21.2603	1420.0	160460
403	162409	20.0749	1266.1	127556	453	205209	21.2838	1423.1	161171
404	163216	20.0998	1269.2	128190	454	206116	21.3073	1426.3	161883
405	164025	20.1246	1272.4	128825	455	207025	21.3307	1429.4	162597
406	164836	20.1494	1275.5	129462	456	207936	21.3542	1432.6	163313
407	165649	20.1742	1278.6	130100	457	208849	21.3776	1435.7	164030
408	166464	20.1990	1281.8	130741	458	209764	21.4009	1438.9	164748
409	167281	20.2237	1284.9	131382	459	210681	21.4243	1442.0	165468
410	168100	20.2485	1288.1	132025	460	211600	21.4476	1445.1	166190
411	168921	20.2731	1291.2	132670	461	212521	21.4709	1448.3	166914
412	169744	20.2978	1294.3	133317	462	213444	21.4942	1451.4	167639
413	170569	20.3224	1297.5	133965	463	214369	21.5174	1454.6	168365
414	171396	20.3470	1300.6	134614	464	215296	21.5407	1457.7	169093
415	172225	20.3715	1303.8	135265	465	216225	21.5639	1460.8	169823
416	173056	20.3961	1306.9	135918	466	217156	21.5870	1464.0	170554
417	173889	20.4206	1310.0	136572	467	218089	21.6102	1467.1	171287
418	174724	20.4450	1313.2	137228	468	219024	21.6333	1470.3	172021
419	175561	20.4695	1316.3	137885	469	219961	21.6564	1473.4	172757
420	176400	20.4939	1319.5	138544	470	220900	21.6795	1476.6	173494
421	177241	20.5183	1322.6	139205	471	221841	21.7025	1479.7	174234
422	178084	20.5426	1325.8	139867	472	222784	21.7256	1482.8	174974
423	178929	20.5670	1328.9	140531	473	223729	21.7486	1486.0	175716
424	179776	20.5913	1332.0	141196	474	224676	21.7715	1489.1	176460
425	180625	20.6155	1335.2	141863	475	225625	21.7945	1492.3	177205
426	181476	20.6398	1338.3	142531	476	226576	21.8174	1495.4	177952
427	182329	20.6640	1341.5	143201	477	227529	21.8403	1498.5	178701
428	183184	20.6882	1344.6	143872	478	228484	21.8632	1501.7	179451
429	184041	20.7123	1347.7	144545	479	229441	21.8861	1504.8	180203
430	184900	20.7364	1350.9	145220	480	230400	21.9089	1508.0	180956
431	185761	20.7605	1354.0	145896	481	231361	21.9317	1511.1	181711
432	186624	20.7846	1357.2	146574	482	232324	21.9545	1514.3	182467
433	187489	20.8087	1360.3	147254	483	233289	21.9773	1517.4	183225
434	188356	20.8327	1363.5	147934	484	234256	22.0000	1520.5	183984
435	189225	20.8567	1366.6	148617	485	235225	22.0227	1523.7	184745
436	190096	20.8806	1369.7	149301	486	236196	22.0454	1526.8	185508
437	190969	20.9045	1372.9	149987	487	237169	22.0681	1530.0	186272
438	191844	20.9284	1376.0	150674	488	238144	22.0907	1533.1	187038
439	192721	20.9523	1379.2	151363	489	239121	22.1133	1536.2	187805
440	193600	20.9762	1382.3	152053	490	240100	22.1359	1539.4	188574
441	194481	21.0000	1385.4	152745	491	241081	22.1585	1542.5	189345
442	195364	21.0238	1388.6	153439	492	242064	22.1811	1545.7	190117
443	196249	21.0476	1391.7	154134	493	243049	22.2036	1548.8	190890
444	197136	21.0713	1394.9	154830	494	244036	22.2261	1552.0	191665
445	198025	21.0950	1398.0	155528	495	245025	22.2486	1555.1	192442
446	198916	21.1187	1401.2	156228	496	246016	22.2711	1558.2	193221
447	199809	21.1424	1404.3	156930	497	247009	22.2935	1561.4	194000
448	200704	21.1660	1407.4	157633	498	248004	22.3159	1564.5	194782
449	201601	21.1896	1410.6	158337	499	249001	22.3383	1567.7	195565

REFERENCE TABLE "G"

SQUARE AND SQUARE ROOT OF NUMBERS FROM 500 TO 599
DIAMETERS, CIRCUMFERENCES, AREAS, FROM 500 TO 599

No.	Square	Square Root	No. = Diam.		No.	Square	Square Root	No. = Diam.	
			Circum.	Area				Circum.	Area
500	250000	22.3607	1570.8	196350	550	302500	23.4521	1727.9	237583
501	251001	22.3830	1573.9	197136	551	303601	23.4734	1731.0	238448
502	252004	22.4054	1577.1	197923	552	304704	23.4947	1734.2	239314
503	253009	22.4277	1580.2	198713	553	305809	23.5160	1737.3	240182
504	254016	22.4499	1583.4	199504	554	306916	23.5372	1740.4	241051
505	255025	22.4722	1586.5	200296	555	308025	23.5584	1743.6	241922
506	256036	22.4944	1589.7	201090	556	309136	23.5797	1746.7	242795
507	257049	22.5167	1592.8	201886	557	310249	23.6008	1749.9	243669
508	258064	22.5389	1595.9	202683	558	311364	23.6220	1753.0	244545
509	259081	22.5610	1599.1	203482	559	312481	23.6432	1756.2	245422
510	260100	22.5832	1602.2	204282	560	313600	23.6643	1759.3	246301
511	261121	22.6053	1605.4	205084	561	314721	23.6854	1762.4	247181
512	262144	22.6274	1608.5	205887	562	315844	23.7065	1765.6	248063
513	263169	22.6495	1611.6	206692	563	316969	23.7276	1768.7	248947
514	264196	22.6716	1614.8	207499	564	318096	23.7487	1771.9	249832
515	265225	22.6936	1617.9	208307	565	319225	23.7697	1775.0	250719
516	266256	22.7156	1621.1	209117	566	320356	23.7908	1778.1	251607
517	267289	22.7376	1624.2	209928	567	321489	23.8118	1781.3	252497
518	268324	22.7596	1627.3	210741	568	322624	23.8328	1784.4	253388
519	269361	22.7816	1630.5	211556	569	323761	23.8537	1787.6	254281
520	270400	22.8035	1633.6	212372	570	324900	23.8747	1790.7	255176
521	271441	22.8254	1636.8	213189	571	326041	23.8956	1793.9	256072
522	272484	22.8473	1639.9	214008	572	327184	23.9165	1797.0	256970
523	273529	22.8692	1643.1	214829	573	328329	23.9374	1800.1	257869
524	274576	22.8910	1646.2	215651	574	329476	23.9583	1803.3	258770
525	275625	22.9129	1649.3	216475	575	330625	23.9792	1806.4	259672
526	276676	22.9347	1652.5	217301	576	331776	24.0000	1809.6	260576
527	277729	22.9565	1655.6	218128	577	332929	24.0208	1812.7	261482
528	278784	22.9783	1658.8	218956	578	334084	24.0416	1815.8	262389
529	279841	23.0000	1661.9	219787	579	335241	24.0624	1819.0	263298
530	280900	23.0217	1665.0	220618	580	336400	24.0832	1822.1	264208
531	281961	23.0434	1668.2	221452	581	337561	24.1039	1825.3	265120
532	283024	23.0651	1671.3	222287	582	338724	24.1247	1828.4	266033
533	284089	23.0868	1674.5	223123	583	339889	24.1454	1831.6	266948
534	285156	23.1084	1677.6	223961	584	341056	24.1661	1834.7	267865
535	286225	23.1301	1680.8	224801	585	342225	24.1868	1837.8	268783
536	287296	23.1517	1683.9	225642	586	343396	24.2074	1841.0	269703
537	288369	23.1733	1687.0	226484	587	344569	24.2281	1844.1	270624
538	289444	23.1948	1690.2	227329	588	345744	24.2487	1847.3	271547
539	290521	23.2164	1693.3	228175	589	346921	24.2693	1850.4	272471
540	291600	23.2379	1696.5	229022	590	348100	24.2899	1853.5	273397
541	292681	23.2594	1699.6	229871	591	349281	24.3105	1856.7	274325
542	293764	23.2809	1702.7	230722	592	350464	24.3311	1859.8	275254
543	294849	23.3024	1705.9	231574	593	351649	24.3516	1863.0	276184
544	295936	23.3238	1709.0	232428	594	352836	24.3721	1866.1	277117
545	297025	23.3452	1712.2	233283	595	354025	24.3926	1869.3	278051
546	298116	23.3666	1715.3	234140	596	355216	24.4131	1872.4	278986
547	299209	23.3880	1718.5	234998	597	356409	24.4336	1875.5	279923
548	300304	23.4094	1721.6	235858	598	357604	24.4540	1878.7	280862
549	301401	23.4307	1724.7	236720	599	358801	24.4745	1881.8	281802

REFERENCE TABLE "H"

SQUARE AND SQUARE ROOT OF NUMBERS FROM 600 TO 699
DIAMETERS, CIRCUMFERENCES, AREAS, FROM 600 TO 699

No.	Square	Square Root	No. = Diam.		No.	Square	Square Root	No. = Diam.	
			Circum.	Area				Circum.	Area
600	360000	24.4949	1885.0	282743	650	422500	25.4951	2042.0	331831
601	361201	24.5153	1888.1	283687	651	423801	25.5147	2045.2	332853
602	362404	24.5357	1891.2	284631	652	425104	25.5343	2048.3	333876
603	363609	24.5561	1894.4	265578	653	426409	25.5539	2051.5	334901
604	364816	24.5764	1897.5	286526	654	427716	25.5734	2054.6	335927
605	366025	24.5967	1900.7	287475	655	429025	25.5930	2057.7	336955
606	367236	24.6171	1903.8	288426	656	430336	25.6125	2060.9	337985
607	368449	24.6374	1907.0	289379	657	431649	25.6320	2064.0	339016
608	369664	24.6577	1910.1	290333	658	432964	25.6515	2067.2	340049
609	370881	24.6779	1913.2	291289	659	434281	25.6710	2070.3	341083
610	372100	24.6982	1916.4	292247	660	435600	25.6905	2073.5	342119
611	373321	24.7184	1919.5	293206	661	436921	25.7099	2076.6	343157
612	374544	24.7386	1922.7	294166	662	438244	25.7294	2079.7	344196
613	375769	24.7588	1925.8	295128	663	439569	25.7488	2082.9	345237
614	376996	24.7790	1928.9	296092	664	440896	25.7682	2086.0	346279
615	378225	24.7992	1932.1	297057	665	442225	25.7876	2089.2	347323
616	379456	24.8193	1935.2	298024	666	443556	25.8070	2092.3	348368
617	380689	24.8395	1938.4	298992	667	444889	25.8263	2095.4	349415
618	381924	24.8596	1941.5	299962	668	446224	25.8457	2098.6	350464
619	383161	24.8797	1944.7	300934	669	447561	25.8650	2101.7	351514
620	384400	24.8998	1947.8	301907	670	448900	25.8844	2104.9	352565
621	385641	24.9199	1950.9	302882	671	450241	25.9037	2108.0	353618
622	286884	24.9399	1954.1	303858	672	451584	25.9230	2111.2	354673
623	388129	24.9600	1957.2	304836	673	452929	25.9422	2114.3	355730
624	389376	24.9800	1960.4	305815	674	454276	25.9615	2117.4	356788
625	390625	25.0000	1963.5	306796	675	455625	25.9808	2120.6	357847
626	391876	25.0200	1966.6	307779	676	456976	26.0000	2123.7	358908
627	393129	25.0400	1969.8	308763	677	458329	25.0192	2126.9	359971
628	394384	25.0599	1972.9	309748	678	459684	26.0384	2130.0	361035
629	395641	25.0799	1976.1	310736	679	461041	26.0576	2133.1	362101
630	396900	25.0998	1979.2	311725	680	462400	26.0768	2136.3	363168
631	398161	25.1197	1982.4	312715	681	463761	26.0960	2139.4	364237
632	399424	25.1396	1985.5	313707	682	465124	26.1151	2142.6	365308
633	400689	25.1595	1988.6	314700	683	466489	26.1343	2145.7	366380
634	401956	25.1794	1991.8	315696	684	467856	26.1534	2148.9	367453
635	403225	25.1992	1994.9	316692	685	469225	26.1725	2152.0	368528
636	404496	25.2190	1998.1	317690	686	470596	26.1916	2155.1	369605
637	405769	25.2389	2001.2	318690	687	471969	26.2107	2158.3	370684
638	407044	25.2587	2004.3	319692	688	473344	26.2298	2161.4	371764
639	408321	25.2784	2007.5	320695	689	474721	26.2488	2164.6	372845
640	409600	25.2982	2010.6	321699	690	476100	26.2679	2167.7	373928
641	410881	25.3180	2013.8	322705	691	477481	26.2869	2170.8	375013
642	412164	25.3377	2016.9	323713	692	478864	26.3059	2174.0	376099
643	413449	25.3574	2020.0	324722	693	480249	26.3249	2177.1	377187
644	414736	25.3772	2023.2	325733	694	481636	26.3439	2180.3	378276
645	416025	25.3969	2026.3	326745	695	483025	26.3629	2183.4	379367
646	417316	25.4165	2029.5	327759	696	484416	26.2818	2186.6	380459
647	418609	25.4362	2032.6	328775	697	485809	26.4008	2189.7	381554
648	419904	25.4558	2035.8	329792	698	487204	26.4197	2192.8	382649
649	421201	25.4755	2038.9	330810	699	488601	26.4386	2196.0	383746

REFERENCE TABLE "I"

SQUARE AND SQUARE ROOT OF NUMBERS FROM 700 TO 799
DIAMETERS, CIRCUMFERENCES, AREAS, FROM 700 TO 799

No.	Square	Square Root	No. = Diam.		No.	Square	Square Root	No. = Diam.	
			Circum.	Area				Circum.	Area
700	490000	26.4575	2199.1	384845	750	562500	27.3861	2356.2	441786
701	491401	26.4764	2202.3	385945	751	564001	27.4044	2359.3	442965
702	492804	26.4953	2205.4	387047	752	565504	27.4226	2362.5	444146
703	494209	26.5141	2208.5	388151	753	567009	27.4408	2365.6	445328
704	495616	26.5330	2211.7	389256	754	568516	27.4591	2368.8	446511
705	497025	26.5518	2214.8	390363	755	570025	27.4773	2371.9	447697
706	498436	26.5707	2218.0	391471	756	571536	27.4955	2375.0	448883
707	499849	26.5895	2221.1	392580	757	573049	27.5136	2378.2	450072
708	501264	26.6083	2224.3	393692	758	574564	27.5318	2381.3	451262
709	502681	26.6271	2227.4	394805	759	576081	27.5500	2384.5	452453
710	504100	26.6458	2230.5	395919	760	577600	27.5681	2387.6	453646
711	505521	26.6646	2233.7	397035	761	579121	27.5862	2390.8	454841
712	506944	26.6833	2236.8	398153	762	580644	27.6043	2393.9	456037
713	508369	26.7021	2240.0	399272	763	582169	27.6225	2397.0	457234
714	509796	26.7208	2243.1	400393	764	583696	27.6405	2400.2	458434
715	511225	26.7395	2246.2	401515	765	585225	27.6586	2403.3	459635
716	512656	26.7582	2249.4	402639	766	586756	27.6767	2406.5	460837
717	514089	26.7769	2252.5	403765	767	588289	27.6948	2409.6	462041
718	515524	26.7955	2255.7	404892	768	589824	27.7128	2412.7	463247
719	516961	26.8142	2258.8	406020	769	591361	27.7308	2415.9	464454
720	518400	26.8328	2262.0	407150	770	592900	27.7489	2419.0	465663
721	519841	26.8514	2265.1	408282	771	594441	27.7669	2422.2	466873
722	521284	26.8701	2268.2	409416	772	595984	27.7849	2425.3	468085
723	522729	26.8887	2271.4	410550	773	597529	27.8029	2428.5	469298
724	524176	26.9072	2274.5	411687	774	599076	27.8209	2431.6	470513
725	525625	26.9258	2277.7	412825	775	600625	27.8388	2434.7	471730
726	527076	26.9444	2280.8	413965	776	602176	27.8568	2437.9	472948
727	528529	26.9629	2283.9	415106	777	603729	27.8747	2441.0	474168
728	529984	26.9815	2287.1	416248	778	605284	27.8927	2444.2	475389
729	531441	27.0000	2290.2	417393	779	606841	27.9106	2447.3	476612
730	532900	27.0185	2293.4	418539	780	608400	27.9285	2450.4	477836
731	534361	27.0370	2296.5	419686	781	609961	27.9464	2453.6	479062
732	535824	27.0555	2299.7	420835	782	611524	27.9643	2456.7	480290
733	537289	27.0740	2302.8	421986	783	613089	27.9821	2459.9	481519
734	538756	27.0924	2305.9	423138	784	614656	28.0000	2463.0	482750
735	540225	27.1109	2309.1	424292	785	616225	28.0179	2466.2	483982
736	541696	27.1293	2312.2	425447	786	617796	28.0357	2469.3	485216
737	543169	27.1477	2315.4	426604	787	619369	28.0535	2472.4	486451
738	544644	27.1662	2318.5	427762	788	620944	28.0713	2475.6	487688
739	546121	27.1846	2321.6	428922	789	622521	28.0891	2478.7	488927
740	547600	27.2029	2324.8	430084	790	624100	28.1069	2481.9	490167
741	549081	27.2213	2327.9	431247	791	625681	28.1247	2485.0	491409
742	550564	27.2397	2331.1	432412	792	627264	28.1425	2488.1	492652
743	552049	27.2580	2334.2	433578	793	628849	28.1603	2491.3	493897
744	553536	27.2764	2337.3	434746	794	630436	28.1780	2494.4	495143
745	555025	27.2947	2340.5	435916	795	632025	28.1957	2497.6	496391
746	556516	27.3130	2343.6	437087	796	633616	28.2135	2500.7	497641
747	558009	27.3313	2346.8	438259	797	635209	28.2312	2503.8	498892
748	559504	27.3496	2349.9	439433	798	636804	28.2489	2507.0	500145
749	561001	27.3679	2353.1	440609	799	638401	28.2666	2510.1	501399

REFERENCE TABLE "J"

SQUARE AND SQUARE ROOT OF NUMBERS FROM 800 TO 899
DIAMETERS, CIRCUMFERENCES, AREAS, FROM 800 TO 899

No.	Square	Square Root	No. = Diam.		No.	Square	Square Root	No. = Diam.	
			Circum.	Area				Circum.	Area
800	640000	28.2843	2513.3	502655	850	722500	29.1548	2670.4	567450
801	641601	28.3019	2516.4	503912	851	724201	29.1719	2673.5	568786
802	643204	28.3196	2519.6	505171	852	725904	29.1890	2676.6	570124
803	644809	28.3373	2522.7	506432	853	727609	29.2062	2679.8	571463
804	646416	28.3549	2525.8	507694	854	729316	29.2233	2682.9	572803
805	648025	28.3725	2529.0	508958	855	731025	29.2404	2686.1	574146
806	649636	28.3901	2532.1	510223	856	732736	29.2575	2689.2	575490
807	651249	28.4077	2535.3	511490	857	734449	29.2746	2692.3	576835
808	652864	28.4253	2538.4	512758	858	736164	29.2916	2695.5	578182
809	654481	28.4429	2541.6	514028	859	737881	29.3087	2698.6	579530
810	656100	28.4605	2544.7	515300	860	739600	29.3258	2701.8	580880
811	657721	28.4781	2547.8	516573	861	741321	29.3428	2704.9	582232
812	659344	28.4956	2551.0	517848	862	743044	29.3598	2708.1	583585
813	660969	28.5132	2554.1	519124	863	744769	29.3769	2711.2	584940
814	662596	28.5307	2557.3	520402	864	746496	29.3939	2714.3	586297
815	664225	28.5482	2560.4	521681	865	748225	29.4109	2717.5	587655
816	665856	28.5657	2563.5	522962	866	749956	29.4279	2720.6	589014
817	667489	28.5832	2566.7	524245	867	751689	29.4449	2723.8	590375
818	669124	28.6007	2569.8	525529	868	753424	29.4618	2726.9	591738
819	670761	28.6182	2573.0	526814	869	755161	29.4788	2730.0	593102
820	672400	28.6356	2576.1	528102	870	756900	29.4958	2733.2	594468
821	674041	28.6531	2579.3	529391	871	758641	29.5127	2736.3	595835
822	675684	28.6705	2582.4	530681	872	760384	29.5296	2739.5	597204
823	677329	28.6880	2585.5	531973	873	762129	29.5466	2742.6	598575
824	678976	28.7054	2588.7	533267	874	763876	29.5635	2745.8	599947
825	680625	28.7228	2591.8	534562	875	765625	29.5804	2748.9	601320
826	682276	28.7402	2595.0	535858	876	767376	29.5973	2752.0	602696
827	683929	29.7576	2598.1	537157	877	769129	29.6142	2755.2	604073
828	685584	28.7750	2601.2	538456	878	770884	29.6311	2758.3	605451
829	687241	28.7924	2604.4	539758	879	772641	29.6479	2761.5	606831
830	688900	28.8097	2607.5	541061	880	774400	29.6648	2764.6	608212
831	690561	28.8271	2610.7	542365	881	776161	29.6816	2767.7	609595
832	692224	28.8444	2613.8	543671	882	777924	29.6985	2770.9	610980
833	693889	28.8617	2617.0	544979	883	779689	29.7153	2774.0	612366
834	695556	28.8791	2620.1	546288	884	781456	29.7321	2777.2	613754
835	697225	28.8964	2623.2	547599	885	783225	29.7489	2780.3	615143
836	698896	28.9137	2626.4	548912	886	784996	29.7658	2783.5	616534
837	700569	28.9310	2629.5	550226	887	786769	29.7825	2786.6	617927
838	702244	28.9482	2632.7	551541	888	788544	29.7993	2789.7	619321
839	703921	28.9655	2635.8	552858	889	790321	29.8161	2792.9	620717
840	705600	28.9828	2638.9	554177	890	792100	29.8329	2796.0	622114
841	707281	29.0000	2642.1	555497	891	793881	29.8496	2799.2	623513
842	708964	29.0172	2645.2	556819	892	795664	29.8664	2802.3	624913
843	710649	29.0345	2648.4	558142	893	797449	29.8831	2805.4	626315
844	712336	29.0517	2651.5	559467	894	799236	29.8998	2808.6	627718
845	714025	29.0689	2554.6	560794	895	801025	29.9166	2811.7	629124
846	715716	29.0861	2657.8	562122	896	802816	29.9333	2814.9	630530
847	717409	29.1033	2660.9	563452	897	804609	29.9500	2818.0	631938
848	719104	29.1204	2664.1	564783	898	806404	29.9666	2821.2	633348
849	720801	29.1376	2667.2	566116	899	808201	29.9833	2824.3	634760

REFERENCE TABLE "K"

SQUARE AND SQUARE ROOT OF NUMBERS FROM 900 TO 999
DIAMETERS, CIRCUMFERENCES, AREAS, FROM 900 TO 999

No.	Square	Square Root	No. = Diam.		No.	Square	Square Root	No. = Diam.	
			Circum.	Area				Circum.	Area
900	810000	30.0000	2827.4	636173	950	902500	30.8221	2984.5	708822
901	811801	30.0167	2830.6	637587	951	904401	30.8383	2987.7	710315
902	813604	30.0333	2833.7	639003	952	906304	30.8545	2990.8	711809
903	815409	30.0500	2836.9	640421	953	908209	30.8707	2993.9	713306
904	817216	30.0666	2840.0	641840	954	910116	30.8869	2997.1	714803
905	819025	30.0832	2843.1	643261	955	912025	30.9031	3000.2	716303
906	820836	30.0998	2846.3	644683	956	913936	30.9192	3003.4	717804
907	822649	30.1164	2849.4	646107	957	915849	30.9354	3006.5	719306
908	824464	30.1330	2852.6	647533	958	917764	30.9516	3009.7	720810
909	826281	30.1496	2855.7	648960	959	919681	30.9677	3012.8	722316
910	828100	30.1662	2858.8	650388	960	921600	30.9839	3015.9	723823
911	829921	30.1828	2862.0	651818	961	923521	31.0000	3019.1	725332
912	831744	30.1993	2865.1	653250	962	925444	31.0161	3022.2	726842
913	833569	30.2159	2868.3	654684	963	927369	31.0322	3025.4	728354
914	835396	30.2324	2871.4	656118	964	929296	31.0483	3028.5	729867
915	837225	30.2490	2874.6	657555	965	931225	31.0644	3031.6	731382
916	839056	30.2655	2877.7	658993	966	933156	31.0805	3034.8	732899
917	840889	30.2820	2880.8	660433	967	935089	31.0966	3037.9	734417
918	842724	30.2985	2884.0	661874	968	937024	31.1127	3041.1	735937
919	844561	30.3150	2887.1	663317	969	938961	31.1288	3044.2	737458
920	846400	30.3315	2890.3	664761	970	940900	31.1448	3047.3	738981
921	848241	30.3480	2893.4	666207	971	942841	31.1609	3050.5	740506
922	850084	30.3645	2896.5	667654	972	944784	31.1769	3053.6	742032
923	851929	30.3809	2899.7	669103	973	946729	31.1929	3056.8	743559
924	853776	30.3974	2902.8	670554	974	948676	31.2090	3059.9	745088
925	855625	30.4138	2906.0	672006	975	950625	31.2250	3063.1	746619
926	857476	30.4302	2909.1	673460	976	952576	31.2410	3066.2	749151
927	859329	30.4467	2912.3	674915	977	954529	31.2570	3069.3	749685
928	861184	30.4631	2915.4	676372	978	956484	31.2730	3072.5	751221
929	863041	30.4795	2918.5	677831	979	958441	31.2890	3075.6	752758
930	864900	30.4959	2921.7	679291	980	960400	31.3050	3078.8	754296
931	866761	30.5123	2924.8	680752	981	962361	31.3209	3081.9	755837
932	868624	30.5287	2928.0	682216	982	964324	31.3369	3085.0	757378
933	870489	30.5450	2931.1	683680	983	966289	31.3528	3088.2	758922
934	872356	30.5614	2934.2	685147	984	968256	31.3688	3091.3	760466
935	874225	30.5778	2937.4	686615	985	970225	31.3847	3094.5	762013
936	876096	30.5941	2940.5	688084	986	972196	31.4006	3097.6	763561
937	877969	30.6105	2943.7	689555	987	974169	31.4166	3100.8	765111
938	879844	30.6268	2946.8	691028	988	976144	31.4325	3103.9	766662
939	881721	30.6431	2950.0	692502	989	978121	31.4484	3107.0	768214
940	883600	30.6594	2953.1	693978	990	980100	31.4643	3110.2	769769
941	885481	30.6757	2956.2	695455	991	982081	31.4802	3113.3	771325
942	887364	30.6920	2959.4	696934	992	984064	31.4960	3116.5	772882
943	889249	30.7083	2962.5	698415	993	986049	31.5119	3119.6	774441
944	891136	30.7246	2965.7	699897	994	988036	31.5278	3122.7	776002
945	893025	30.7409	2968.8	701380	995	990025	31.5436	3125.9	777564
946	894916	30.7571	2971.9	702865	996	992016	31.5595	3129.0	779128
947	896809	30.7734	2975.1	704352	997	994009	31.5753	3132.2	780693
948	898704	30.7896	2978.2	705840	998	996004	31.5911	3135.3	782260
949	900601	30.8058	2981.4	707330	999	998001	31.6070	3138.5	783828

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REFERENCE TABLE "L"

LENGTH OF THREAD ON STANDARD PIPE THAT IS SCREWED INTO FITTINGS AND DIMENSIONS OF STANDARD FITTINGS

The general dimensions for fittings are subject to slight variation and change

Dimension "A" is the length of thread that is screwed into fittings and valves to make a tight joint

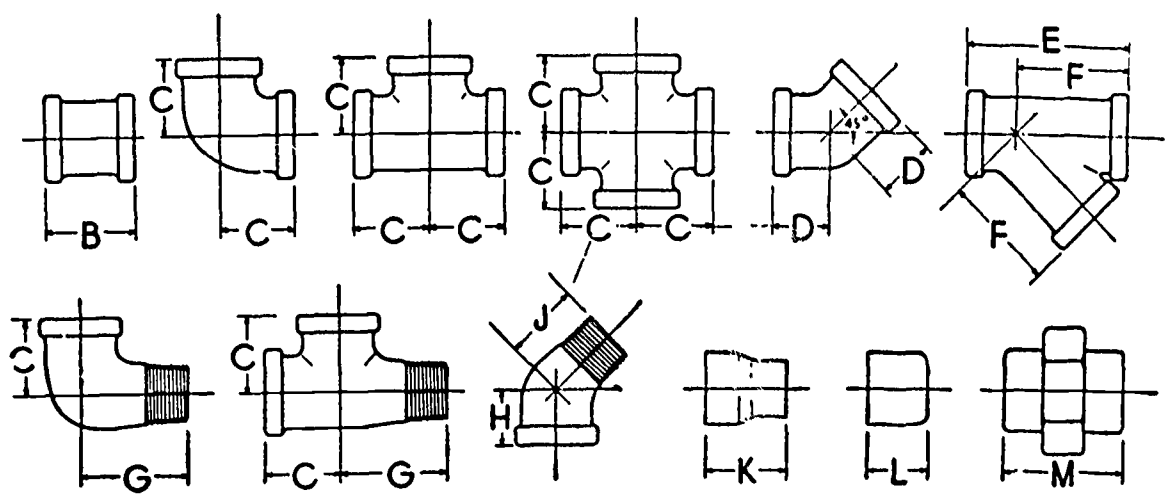

Table of Dimensions in Inches

Pipe Size	A	B	C	D	E	F	G	H	J	K	L	M
$\frac{1}{8}$	$\frac{5}{16}$	...	$\frac{11}{16}$	...	...	...	$1\frac{1}{8}$	...	...	...	$\frac{17}{32}$	$1\frac{1}{2}$
$\frac{1}{4}$	$\frac{7}{16}$	$1\frac{1}{16}$	$\frac{13}{16}$	$\frac{3}{4}$	...	...	$1\frac{5}{16}$	$\frac{5}{8}$	$\frac{15}{16}$	1	$\frac{5}{8}$	$1\frac{5}{8}$
$\frac{3}{8}$	$\frac{7}{16}$	$1\frac{3}{16}$	$\frac{15}{16}$	$\frac{13}{16}$	$2\frac{1}{8}$	$1\frac{7}{16}$	$1\frac{7}{16}$	$\frac{11}{16}$	$1\frac{1}{16}$	$1\frac{1}{8}$	$\frac{3}{4}$	$1\frac{3}{4}$
$\frac{1}{2}$	$\frac{9}{16}$	$1\frac{5}{16}$	$1\frac{1}{8}$	$\frac{7}{8}$	$2\frac{1}{2}$	$1\frac{11}{16}$	$1\frac{5}{8}$	$\frac{13}{16}$	$1\frac{3}{16}$	$1\frac{1}{4}$	$\frac{7}{8}$	$1\frac{7}{8}$
$\frac{3}{4}$	$\frac{9}{16}$	$1\frac{1}{2}$	$1\frac{5}{16}$	1	$2\frac{7}{8}$	2	$1\frac{7}{8}$	$\frac{15}{16}$	$1\frac{5}{16}$	$1\frac{7}{16}$	$1\frac{1}{16}$	$2\frac{1}{8}$
1	$\frac{11}{16}$	$1\frac{11}{16}$	$1\frac{7}{16}$	$1\frac{1}{8}$	$3\frac{7}{16}$	$2\frac{7}{16}$	$2\frac{1}{8}$	$1\frac{1}{16}$	$1\frac{1}{2}$	$1\frac{11}{16}$	$1\frac{3}{16}$	$2\frac{3}{8}$
$1\frac{1}{4}$	$\frac{11}{16}$	$1\frac{15}{16}$	$1\frac{3}{4}$	$1\frac{5}{16}$	$4\frac{1}{16}$	$2\frac{15}{16}$	$2\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{11}{16}$	$2\frac{1}{16}$	$1\frac{1}{4}$	$2\frac{5}{8}$
$1\frac{1}{2}$	$\frac{11}{16}$	$2\frac{1}{8}$	$1\frac{15}{16}$	$1\frac{7}{16}$	$4\frac{1}{2}$	$3\frac{5}{16}$	$2\frac{11}{16}$	$1\frac{3}{8}$	$1\frac{7}{8}$	$2\frac{5}{16}$	$1\frac{5}{16}$	$2\frac{15}{16}$
2	$\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{1}{4}$	$1\frac{11}{16}$	$5\frac{7}{16}$	$4\frac{1}{16}$	$3\frac{3}{16}$	$1\frac{11}{16}$	$2\frac{1}{4}$	$2\frac{13}{16}$	$1\frac{7}{16}$	$3\frac{1}{4}$
$2\frac{1}{2}$	$1\frac{1}{16}$	$2\frac{7}{8}$	$2\frac{11}{16}$	$1\frac{15}{16}$	$6\frac{1}{4}$	$4\frac{11}{16}$	$3\frac{13}{16}$	...	...	$3\frac{1}{4}$	$1\frac{5}{8}$	$3\frac{9}{16}$
3	$1\frac{1}{8}$	$3\frac{3}{16}$	$3\frac{1}{8}$	$2\frac{3}{16}$	$7\frac{1}{4}$	$5\frac{9}{16}$	$4\frac{1}{2}$	$2\frac{1}{8}$	3	$3\frac{11}{16}$	$1\frac{3}{4}$	$3\frac{15}{16}$
$3\frac{1}{2}$	$1\frac{3}{16}$	$4\frac{1}{8}$	$3\frac{7}{16}$	$2\frac{3}{8}$	...	...	$5\frac{1}{8}$	...	...	4	$1\frac{15}{16}$	$4\frac{3}{16}$
4	$1\frac{3}{16}$	$4\frac{1}{2}$	$3\frac{3}{4}$	$2\frac{5}{8}$	$8\frac{7}{8}$	$6\frac{15}{16}$	$5\frac{11}{16}$	$2\frac{1}{2}$	$3\frac{3}{4}$	$4\frac{3}{8}$	2	$4\frac{3}{8}$
5	$1\frac{5}{16}$	...	$4\frac{7}{16}$	$3\frac{1}{16}$	...	...	$6\frac{7}{8}$	...	...	...	$2\frac{5}{16}$	...
6	$1\frac{3}{8}$	...	$5\frac{1}{8}$	$3\frac{7}{16}$	...	...	8	...	...	...	$2\frac{9}{16}$	...
8	$1\frac{7}{16}$	...	...	...	...	...	...	...	...	...	...	...
10	$1\frac{5}{8}$	...	...	...	...	...	...	...	...	...	...	...
12	$1\frac{3}{4}$	...	...	...	...	...	...	...	...	...	...	...

Note. Dimension "A" as given does not allow for variation in tapping and threading. Dimensions of standard fittings as given are approximate.

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REFERENCE TABLE "M"

MEASUREMENTS FOR OFFSETS
1/8 Bends and 45° Elbows

A	h	C	D	E	A	h	C	D	E
1″	1 3/8″	1″	1″	7/16″	2′-1″	2′-11 3/8″	2′-1″	2′-1″	11 1/4″
2″	2 3/4″	2″	2″	7/8″	2′-2″	3′-0 3/4″	2′-2″	2′-2″	11 5/8″
3″	4 1/4″	3″	3″	1 1/4″	2′-3″	3′-2 1/8″	2′-3″	2′-3″	12 1/8″
4″	5 3/8″	4″	4″	1 5/8″	2′-4″	3′-3 1/4″	2′-4″	2′-4″	12 1/2″
5″	7″	5″	5″	2″	2′-5″	3′-5″	2′-5″	2′-5″	12 7/8″
6″	8 1/2″	6″	6″	2 1/2″	2′-6″	3′-6 1/2″	2′-6″	2′-6″	1′-1 1/4″
7″	9 7/8″	7″	7″	2 7/8″	2′-7″	3′-7 3/4″	2′-7″	2′-7″	1′-1 3/4″
8″	11 1/4″	8″	8″	3 1/4″	2′-8″	3′-9 1/4″	2′-8″	2′-8″	1′-2 1/8″
9″	12 3/4″	9″	9″	3 3/4″	2′-9″	3′-10 3/4″	2′-9″	2′-9″	1′-2 1/2″
10″	1′-2 1/8″	10″	10″	4 1/8″	2′-10″	4′-0 1/8″	2′-10″	2′-10″	1′-3″
11″	1′-3 5/8″	11″	11″	4 1/2″	2′-11″	4′-1 1/2″	2′-11″	2′-11″	1′-3 3/8″
12″	1′-5″	12″	12″	4 7/8″	3′-0″	4′-2 7/8″	3′-0″	3′-0″	1′-3 3/4″
1′-1″	1′-6 3/8″	1′-1″	1′-1″	5 3/8″	3′-1″	4′-4 1/4″	3′-1″	3′-1″	1′-4 1/8″
1′-2″	1′-7 3/4″	1′-2″	1′-2″	5 3/4″	3′-2″	4′-5 3/4″	3′-2″	3′-2″	1′-4 1/2″
1′-3″	1′-9 1/8″	1′-3″	1′-3″	6 1/8″	3′-3″	4′-7 1/4″	3′-3″	3′-3″	1′-5″
1′-4″	1′-10 5/8″	1′-4″	1′-4″	6 1/2″	3′-4″	4′-8 1/2″	3′-4″	3′-4″	1′-5 3/8″
1′-5″	2′-0″	1′-5″	1′-5″	7′	3′-5″	4′-10″	3′-5″	3′-5″	1′-5 7/8″
1′-6″	2′-1 1/2″	1′-6″	1′-6″	7 3/8″	3′-6″	4′-11 3/8″	3′-6″	3′-6″	1′-6 1/4″
1′-7″	2′-2 7/8″	1′-7″	1′-7″	7 3/4″	3′-7″	5′-0 3/4″	3′-7″	3′-7″	1′-6 5/8″
1′-8″	2′-4 1/4″	1′-8″	1′-8″	8 1/4″	3′-8″	5′-2 1/4″	3′-8″	3′-8″	1′-7″
1′-9″	2′-5 3/4″	1′-9″	1′-9″	8 5/8″	3′-9″	5′-3 5/8″	3′-9″	3′-9″	1′-7 1/2″
1′-10″	2′-7 1/8″	1′-10″	1′-10″	9″	3′-10″	5′-5″	3′-10″	3′-10″	1′-7 7/8″
1′-11″	2′-8 1/2″	1′-11″	1′-11″	9 1/2″	3′-11″	5′-6 1/2″	3′-11″	3′-11″	1′-8 1/4″
2′-0″	2′-10″	2′-0″	2′-0″	9 7/8″	4′-0″	5′-7 7/8″	4′-0″	4′-0″	1′-8 1/2″

Apprentice Workbook 3

REFERENCE TABLE "N"

MEASUREMENTS FOR OFFSETS
1/6 Bends and 60° Elbows

A	h	C	D	E	A	h	C	D	E
1″	1 1/8″	5/8″	1″	1/2″	2′-1″	2′-4 7/8″	1′-2 1/2″	2′-1″	1′-2 1/2″
2″	2 1/4″	1 1/8″	2″	1 1/8″	2′-2″	2′-6″	1′-3″	2′-2″	1′-3″
3″	3 3/8″	1 3/4″	3″	1 1/4″	2′-3″	2′-7 1/8″	1′-3 5/8″	2′-3″	1′-3 5/8″
4″	4 5/8″	2 3/8″	4″	2 1/4″	2′-4″	2′-8 1/4″	1′-4 1/4″	2′-4″	1′-4 1/8″
5″	5 3/4″	2 3/4″	5″	2 7/8″	2′-5″	2′-9 1/2″	1′-4 3/4″	2′-5″	1′-4 3/4″
6″	6 7/8″	3 3/8″	6″	3 1/2″	2′-6″	2′-10 5/8″	1′-5 1/4″	2′-6″	1′-5 1/4″
7″	8″	4 1/8″	7″	4″	2′-7″	2′-11 3/4″	1′-5 7/8″	2′-7″	1′-5 7/8″
8″	9 1/4″	4 5/8″	8″	4 5/8″	2′-8″	3′-0 3/4″	1′-6 1/2″	2′-8″	1′-6 1/2″
9″	10 3/8″	5 1/4″	9″	5 1/8″	2′-9″	3′-2 1/8″	1′-7 1/8″	2′-9″	1′-7″
10″	11 5/8″	5 3/4″	10″	5 3/4″	2′-10″	3′-3 1/4″	1′-7 5/8″	2′-10″	1′-7 3/8″
11″	12 5/8″	6 3/8″	11″	6 3/8″	2′-11″	3′-4 1/2″	1′-8 1/4″	2′-11″	1′-8 1/4″
12″	1′-1 7/8″	6 7/8″	12″	6 7/8″	3′-0″	3′-5 5/8″	1′-8 3/4″	3′-0″	1′-8 3/4″
1′-1″	1′-3″	7 1/2″	1′-1″	7 1/2″	3′-1″	3′-6 3/4″	1′-9 3/8″	3′-1″	1′-9 3/8″
1′-2″	1′-4 1/4″	8 1/8″	1′-2″	8 1/8″	3′-2″	3′-7 7/8″	1′-9 7/8″	3′-2″	1′-9 7/8″
1′-3″	1′-5 3/8″	8 5/8″	1′-3″	8 5/8″	3′-3″	3′-9″	1′-10 1/2″	3′-3″	1′-10 1/2″
1′-4″	1′-6 1/2″	9 1/4″	1′-4″	9 1/4″	3′-4″	3′-10 1/4″	1′-11 1/8″	3′-4″	1′-11 1/8″
1′-5″	1′-7 5/8″	9 3/4″	1′-5″	9 7/8″	3′-5″	3′-11 3/8″	1′-11 3/4″	3′-5″	1′-11 5/8″
1′-6″	1′-8 3/4″	10 3/8″	1′-6″	10 1/8″	3′-6″	4′-0 1/2″	2′-0 1/4″	3′-6″	2′-0 1/4″
1′-7″	1′-9 7/8″	11 1/8″	1′-7″	10 7/8″	3′-7″	4′-1 5/8″	2′-0 3/4″	3′-7″	2′-0 7/8″
1′-8″	1′-11″	11 3/4″	1′-8″	11 1/2″	3′-8″	4′-2 7/8″	2′-1 3/8″	3′-8″	2′-1 3/8″
1′-9″	2′-0 1/4″	12 1/8″	1′-9″	12 1/8″	3′-9″	4′-3 7/8″	2′-2″	3′-9″	2′-2″
1′-10″	2′-1 3/8″	12 5/8″	1′-10″	12 3/4″	3′-10″	4′-5 1/8″	2′-2 5/8″	3′-10″	2′-2 1/2″
1′-11″	2′-2 5/8″	1′-1 1/4″	1′-11″	1′-1 1/4″	3′-11″	4′-6 1/4″	2′-3 1/8″	3′-11″	2′-3 1/8″
2′-0″	2′-3 5/8″	1′-1 7/8″	2′-0″	1′-1 7/8″	4′-0″	4′-7 1/2″	2′-3 3/4″	4′-0″	2′-3 3/4″

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REFERENCE TABLE "O"

MEASUREMENTS FOR OFFSETS
1/32 Bends and 11 1/4° Elbows

A	h	C	D	E	A	h	C	D	E
1″	5⅛″	5″	1″	⅛″	2′-1″	10′-8⅛″	10′-5½″	2′-1″	2½″
2″	10¼″	10″	2″	16″	2′-2″	11′-1¼″	10′-10½″	2′-2″	2½″
3″	1′-3⅜″	1′-3″	3″	¼″	2′-3″	11′-6⅜″	11′-3½″	2′-3″	2⅝″
4″	1′-8½″	1′-8″	4″	⅜″	2′-4″	11′-11½″	11′-8½″	2′-4″	2¾″
5″	2′-1⅝″	2′-1″	5″	½″	2′-5″	12′-4⅝″	12′-1½″	2′-5″	2⅞″
6″	2′-6¾″	2′-6½″	6″	⅝″	2′-6″	12′-9¾″	12′-6⅝″	2′-6″	3″
7″	2′-11⅞″	2′-11½″	7″	⅝″	2′-7″	13′-2⅞″	12′-11⅝″	2′-7″	3″
8″	3′-5″	3′-4⅛″	8″	¾″	2′-8″	13′-8″	13′-4⅝″	2′-8″	3⅛″
9″	3′-10⅛″	3′-9⅛″	9″	⅞″	2′-9″	14′-1⅛″	13′-9⅝″	2′-9″	3¼″
10″	4′-3¼″	4′-2⅛″	10″	1″	2′-10″	14′-6¼″	14′-2⅝″	2′-10″	3⅜″
11″	4′-8⅜″	4′-7⅛″	11″	1″	2′-11″	14′-11⅜″	14′-7¾″	2′-11″	3⅜″
12″	5′-1½″	5′-0¼″	12″	1⅛″	3′-0″	15′-4½″	15′-0¾″	3′-0″	3½″
1′-1″	5′-6⅝″	5′-5¼″	1′-1″	1¼″	3′-1″	15′-9⅜″	15′-5¾″	3′-1″	3⅝″
1′-2″	5′-11¾″	5′-10¼″	1′-2″	1⅜″	3′-2″	16′-2½″	15′-10¾″	3′-2″	3¾″
1′-3″	6′-4⅞″	6′-3¼″	1′-3″	1½″	3′-3″	16′-7⅜″	16′-3¾″	3′-3″	3¾″
1′-4″	6′-10″	6′-8¼″	1′-4″	1½″	3′-4″	17′-0¾″	16′-8¾″	3′-4″	3⅞″
1′-5″	7′-3⅛″	7′-1¼″	1′-5″	1⅝″	3′-5″	17′-5⅞″	17′-1¾″	3′-5″	4″
1′-6″	7′-8¼″	7′-6⅜″	1′-6″	1¾″	3′-6″	17′-11″	17′-6⅞″	3′-6″	4⅛″
1′-7″	8′-1⅜″	7′-11⅜″	1′-7″	1⅞″	3′-7″	18′-4⅛″	17′-11⅞″	3′-7″	4¼″
1′-8″	8′-6½″	8′-4⅜″	1′-8″	2″	3′-8″	18′-9¼″	18′-4⅞″	3′-8″	4¼″
1′-9″	8′-11⅝″	8′-9⅜″	1′-9″	2″	3′-9″	19′-2⅜″	18′-9⅞″	3′-9″	4⅜″
1′-10″	9′-4¾″	9′-2⅜″	1′-10″	2⅛″	3′-10″	19′-7½″	19′-2⅞″	3′-10″	4½″
1′-11″	9′-9⅞″	9′-7½″	1′-11″	2¼″	3′-11″	20′-0⅝″	19′-7⅞″	3′-11″	4⅝″
2′-0″	10′-3″	10′-0½″	2′-0″	2⅜″	4′-0″	20′-6″	20′-1″	4′-0″	4⅝″

Apprentice Workbook 3

REFERENCE TABLE "P"

MEASUREMENTS FOR OFFSETS
1/16 Bends and 22 1/2° Elbows

A	h	C	D	E	A	h	C	D	E
1″	2⅝″	2⅜″	1″	¼″	2′-1″	5′-5¼″	5′-0¼″	2′-1″	5″
2″	5¼″	4¾″	2″	⅜″	2′-2″	5′-7⅞″	5′-2⅝″	2′-2″	5⅛″
3″	7⅞″	7¼″	3″	⅝″	2′-3″	5′-10½″	5′-5″	2′-3″	5⅜″
4″	10½″	9⅝″	4″	¾″	2′-4″	6′-1″	5′-7½″	2′-4″	5½″
5″	1′-1″	12″	5″	1″	2′-5″	6′-3⅝″	5′-9⅞″	2′-5″	5¾″
6″	1′-3⅝″	1′-2½″	6″	1⅛″	2′-6″	6′-6¼″	6′-0¼″	2′-6″	6″
7″	1′-6¼″	1′-4⅞″	7″	1⅜″	2′-7″	6′-8⅞″	6′-2¾″	2′-7″	6⅛″
8″	1′-8⅞″	1′-7¼″	8″	1⅝″	2′-8″	6′-11½″	6′-5⅛″	2′-8″	6⅜″
9″	1′-11½″	1′-9⅝″	9″	1¾″	2′-9″	7′-2⅛″	6′-7½″	2′-9″	6½″
10″	2′-2⅛″	2′-0⅛″	10″	2″	2′-10″	7′-4¾″	6′-10″	2′-10″	6¾″
11″	2′-4¾″	2′-2½″	11″	2⅛″	2′-11″	7′-7⅜″	7′-0⅜″	2′-11″	6⅞″
12″	2′-7⅜″	2′-4⅞″	12″	2⅜″	3′-0″	7′-10″	7′-2¾″	3′-0″	7⅛″
1′-1″	2′-9⅞″	2′-7⅜″	1′-1″	2⅝″	3′-1″	8′-0½″	7′-5⅛″	3′-1″	7¼″
1′-2″	3′-0½″	2′-9¾″	1′-2″	2¾″	3′-2″	8′-3⅛″	7′-7½″	3′-2″	7½″
1′-3″	3′-3⅛″	3′-0⅛″	1′-3″	3″	3′-3″	8′-5¾″	7′-10″	3′-3″	7¾″
1′-4″	3′-5¾″	3′-2½″	1′-4″	3⅛″	3′-4″	8′-8⅜″	8′-0⅜″	3′-4″	7⅞″
1′-5″	3′-8⅜″	3′-5″	1′-5″	3⅜″	3′-5″	8′-11″	8′-2⅞″	3′-5″	8⅛″
1′-6″	3′-11″	3′-7⅜″	1′-6″	3½″	3′-6″	9′-1⅝″	8′-5¼″	3′-6″	8¼″
1′-7″	4′-1⅝″	3′-9¾″	1′-7″	3¾″	3′-7″	9′-4¼″	8′-7⅝″	3′-7″	8½″
1′-8″	4′-4¼″	4′-0¼″	1′-8″	4″	3′-8″	9′-6⅞″	8′-10″	3′-8″	8¾″
1′-9″	4′-6⅞″	4′-2⅝″	1′-9″	4⅛″	3′-9″	9′-9½″	9′-0½″	3′-9″	8⅞″
1′-10″	4′-9½″	4′-0″	1′-10″	4⅜″	3′-10″	10′-0″	9′-2⅞″	3′-10″	9⅛″
1′-11″	5′-0″	4′-7½″	1′-11″	4½″	3′-11″	10′-2⅝″	9′-5¼″	3′-11″	9¼″
2′-0″	5′-2⅝″	4′-9⅞″	2′-0″	4¾″	4′-0″	10′-5¼″	9′-7⅝″	4′-0″	9½″

VT 010 026
Phipps, D. Bart
Principles of Heating for Apprentice Training in the Plumbing and Pipe Fitting Industry, Packet 10.

Texas A and M Univ., College Station. Engineering Extension Service
Texas Education Agency, Austin
Texas State Joint Apprenticeship Committee for the Plumbing and Pipe Fitting Industry
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DESCRIPTORS - *STUDY GUIDES; *TRADE AND INDUSTRIAL EDUCATION; *APPRENTICESHIPS; *PLUMBING; ASSIGNMENTS; *HEATING

ABSTRACT - Prepared by a subject matter specialist, this bulletin is for student use in learning basic principles of heating in apprenticeship training programs in plumbing and pipe fitting. Contents consist of student assignment sheets providing subject, purpose, references, general information, directions and questions to be answered in the following areas: (1) pressure of liquids, (2) weight, density and specific gravity, (3) characteristics of heat, (4) steam tables, (5) heating systems, (6) theory of heat and properties of water, (7) types and functions of boilers, and (8) piping systems. Student progress records for student and instructor use are included. (AW)

VT 010 026

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PRINCIPLES OF HEATING

for

APPRENTICE TRAINING

in the

PLUMBING AND PIPE FITTING INDUSTRY

Packet 10

* * * * * * * * * * * *

Prepared by

D. Bart Phipps, Specialist
Apprentice Training
Plumbing and Pipe Fitting

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ENGINEERING EXTENSION SERVICE

Texas A. & M. College System
College Station, Texas

In Cooperation with
State Board for Vocational Education

and

Texas State Joint Apprenticeship Committee
for Plumbing and Pipe Fitting

VT010 026

Name: _____

BASIC PRINCIPLES OF HEATING

Packet No. 10

STUDENT PROGRESS RECORD
in
BASIC INSTRUCTION FOR APPRENTICE TRAINING
for the
PLUMBING AND PIPE FITTING INDUSTRY

	Information Sheets	Student Assignments	Date Completed
1. Pressure of Liquids	None	1 page	
2. Weight, Density and Specific Gravity	None	1 page	
3. Characteristics of Heat	None	2 pages	
4. Steam Tables	None	1 page	
5. Heating Systems	None	3 pages	
6. Theory of Heat and Properties of Water	None	3 pages	
7. Types and Functions of Boilers	None	3 pages	
8. Piping Systems	None	3 pages	

NOTE: Green sheet for student's note book
Gold sheet for instructor's file

Price of this packet, $0.35

A&MCS-TEES
Sept. 1954

Name: _____

BASIC PRINCIPLES OF HEATING

Packet No. 10

STUDENT PROGRESS RECORD
in
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for the
PLUMBING AND PIPE FITTING INDUSTRY

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6. Theory of Heat and Properties of Water	None	3 pages	
7. Types and Functions of Boilers	None	3 pages	
8. Piping Systems	None	3 pages	

NOTE: Green sheet for student's note book
Gold sheet for instructor's file

Price of this packet, $0.35

A&MCS-TEES
Sept. 1954

Name: _____

Approved by: _____

Date: _____

Pressure of Liquids

Key: BI - P 10 - 1A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Pressure of Liquids & Pressure due to Head

Purpose: To help you understand the principles of fluid pressures.

References: Instruction Manual for Steam Fitting Apprentices, Vol. I
Washburn Trade School

1. Assignment sheet #1, Pressure of Liquid Head, page 11, 12, 13 and 14.

2. Assignment sheet #2

Atmospheric pressure	Page 19
Barometer	Page 23
Vacuum	Page 25
Absolute pressure	Page 26

Introductory Information: The journeyman plumber or pipe fitter is concerned with the installation of materials and equipment in which liquids and gases are controlled. It becomes necessary then for the journeyman to be familiar with the principles of fluid pressure.

Atmospheric pressure effects the temperatures, pressures and reaction of fluids under various conditions. A working knowledge of such information will be invaluable to you in any phase of the trade.

Directions: Study the references given and answer the following questions:

1. Volumn I, answer questions 1 through 12, page 16.

2. Volumn I, answer questions 1 through 10, page 27.

(Disregard experiments where equipment cannot be provided). Refer to page 17 for helpful information in addition to references listed above.

Name: _____

Approved by: _____

Date: _____

Weight, Density & Specific Gravity

Key: BI - P 10 - 2A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Weight, Density & Specific Gravity

Purpose: To understand the necessity and purpose of the knowledge of specific gravity and density.

References: Washburn Instruction Manual for Steamfitting Apprentices, Vol. I

1. Assignment #3, Page 28

2. Assignment #6, Page 42

Introductory Information: In order to be able to use charts, formulas and other information pertaining to heating as well as other phases of the trade, it is necessary to learn the meaning of density and specific gravity.

The meaning of head pressure and the effect of pressure due to head should be common knowledge to the journeyman plumber or pipefitter. A great many practical problems may be solved by the help of this information.

Directions: Read the references listed above and answer the following questions and work the problems:

1. Questions 1 through 10, pages 35 and 36 and problems 1, 2, and 3 in volumn 1.

2. Answer questions 1 through 20, page 30, volumn I.

Name: _____

Approved by: _____

Date: _____

Characteristics of Heat

Key: BI - P 10 - 3A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Characteristics of Heat

Purpose: To teach you some of the sources of heat, how it is generated, how it is measured, and the effect of heat on various bodies.

References: Washburn Instruction Manual for Steamfitting Apprentices, Vol. I

1. Assignment Sheet # 9, Page 50
2. Assignment Sheet #10, Page 53
3. Assignment Sheet #11, Page 58
4. Assignment Sheet #12, Page 61
5. Assignment Sheet #13, Page 65
6. Assignment Sheet #14, Page 71

Introductory Information: The elementary study of heat is the foundation upon which to base your study and experience in the field of heating as well as air conditioning and other phases of the trade. Topics covered in this assignment such as the Measurement of Heat and Temperature will be invaluable to you in the application of the theory studied under other topics of this assignment. Give this information a practical application. This will help you retain more of the information that you will need as a journeyman.

Directions: Study the reference for each set of questions assigned below before moving on to the next topic. Retain as much information as possible on each topic. It will help you in the succeeding topics.

1. Answer questions 1 through 10, page 52, Vol. I
2. Answer questions 1 through 10, page 57, Vol. I
3. Answer questions 1 through 5, page 60, Vol. I

4. Work problems 1 through 4, page 62, Vol. I
5. Answer questions 1 through 8, page 70, Vol. I
6. Work problems 1 and 2, page 71, Vol. I

Name: _____

Approved by: _____

Date: _____

Steam Tables

Key: BI - P 10 - 4A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Steam Tables

Purpose: To help you learn the use of steam tables in making various calculations in heating, air conditioning and refrigeration.

References: Washburns Instruction Manual for Steamfitting Apprentices

1. Assignment sheet #15, page 72

Introductory Information

There is a wealth of information covered by this assignment. This material will require more study and concentration but will be time well spent.

This assignment will give a practical application to information previously studied. It will provide a foundation of information with which to approach and understand future problems.

Directions: Study assignment number 15 of Volumn I, page 72 very carefully. Follow examples given for clarifications. Make a special effort to work and understand the following problems. They will cast considerable light on a phase of theory with which you will be concerned.

1. Answer questions 1 through 10, pages 79 and 80

2. Work problems 1 through 15, pages 81 and 82. Heat in Liquid and Latent Heat

3. Work problems 23 through 26, pages 86 and 87

Name: _____

Approved by: _____

Date: _____

Heating Systems

Key: BI - P 10 - 5A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Heating Systems

Purpose: To introduce briefly to you the various types of heating systems.

References: Washburns Instruction Manual for Steamfitting Apprentices, Vol. 1

1. Information sheet #1, Page 252
2. Information sheet #3, Page 264
3. Information sheet #8, Page 314
4. Assignment sheet #1, Page 460

Introductory Information: This assignment is set up to give you brief descriptions of the various heating systems and the conditions under which they operate. You will notice that these systems are similar in some respects but operate more efficiently under various conditions. Read the references carefully and form a general mental picture of each system. A fair knowledge of the characteristics and operations of each system will help you to appreciate the value of the material covered in future assignments.

Directions: Read the information sheets listed above. Watch the page number referred to that covers information which is closely related.

After carefully studying the references, answer only the questions listed below:

1. What are the two general purposes or classifications of heating systems?

2. What are the minimum requirements for comfort heating?

3. On what do the heating systems depend to fulfill the requirements listed in #2 above?

4. Upon what does the rapid progress in design and installation depend?

5. In order to perform these functions properly, what is required of a steam heating system?

A.
B.
C.
D.
E.

6. What two purposes do the risers serve for a one pipe steam system?

7. How is air eliminated from a one pipe steam system?

8. As a result of a flow of steam and condensate in a one pipe steam system, why is the selection of pipe sizes so critical?

9. Define critical velocity.

10. What must be done to prevent steam from entering the return risers of some of the radiators in a two pipe system?

11. What are the functions of a radiator trap in a vapor system?

12. What is a particular advantage of a vacuum system to a commercial heating job?

13. List two advantages of a differential system.

14. What is the difference in the source of heat in a hot water system and a steam system?

15. What are the two chief classifications of a hot water heating system?

16. How do hot water radiators and steam radiators differ in their respective systems?

17. What causes the water to circulate in a two pipe gravity hot water system?

18. Upon what does the distribution of heat depend in a one pipe forced flow hot water system?

19. What is the maximum temperature of water in an open water system?

20. Why is this true?

21. What are two advantages of a high pressure hot water system?

Name: _____

Approved by: _____

Date: _____

Theory of Heat and Properties of Water

Key: BI - P 10 - 6A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Theory of Heat and Properties of Water

Purpose: To acquaint you briefly with the molecular theory of heat, the methods of transmission of heat, and the properties of water.

Reference: Washburns Instruction Manual for Steam Fitting Apprentices, Vol. I

1. Information sheet #2, page 257

2. Information sheet #4, page 265

3. Reference Sheet #2, page 270

Introductory Information: To understand the molecular basis of heat is to understand why various forms of substances react as they do when they are heated or cooled. We are concerned as a journeyman in the plumbing and pipe fitting industry with gases, liquids and solids. A very sensible and practical description of this phase of the molecular theory is presented in the reference listed above. It will be to yourdvantage to understand and retain as much of the information as possible. This theory is closely related to the methods by which heat is transmitted, all of which will help you solve and understand both theoretical and practical problems.

Directions: Study the references listed above before attempting to answer the following questions:

1. In what two forms of heat may energy appear?

2. To what is the action of the molecule of gas compared in this assignment?

3. How do the molecules of a solid differ from that of liquid and gas?

4. From assignment 3A of this Packet, write the definition of heat.

5. How is radiant heat transmitted?

6. How is radiant from the sun changed to climatic energy?

7. Why does a colder object become warm when placed in a room of normal temperature?

8. Give your own definition of radiant heat.

9. How is heat transmitted in the copper rod described in this text?

10. Why is porous material a poor conductor of heat?

11. Why is polished aluminum used as insullation?

12. Why does a vacuum bottle hold heat?

13. How does a vacuum bottle repel radiant heat?

14. Give your definition of heat by convection.

15. List three methods of transferring heat.

16. Water like all other substances is composed of molecules, each molecule is made of atoms. From the chemical formula H_2O, what is the composition of water?

17. Why is ice lighter than air?

18. What two conditions are always constant when the state of water is changed?

19. How much heat is required to raise one pound of ice one degree fahrenheit?

20. Define heat of fusion.

21. How much heat is required to melt one pound of ice?

22. Why does it require 144 Btu's to melt ice?

23. Why does it require more heat to raise the temperature of water than to raise the temperature of an equal quantity of ice?

24. Define latent heat of vaporization.

25. How much heat is required to change water to steam at atmospheric pressure?

26. How much heat is required to raise the temperature of one pound of steam one degree fahrenheit?

Name: _____

Approved by: _____

Date: _____

Types and Functions of Boilers

Key: BI - P 10 - 7A

Student Assignment
in
Plumbing and Pipe Fitting

Subject: Types and Functions of Boilers

Purpose: To teach you to understand the functions of a boiler and the effect of the various reactions or conditions that take place within the boiler.

References: Washburn Instruction Manual for Steam Fitting Apprentices, Vol. I

1. Information sheet #1, page 273

2. Information sheet #6, page 279

3. Information sheet #7, page 286

Introductory Information: The journeyman is concerned constantly with various types of boilers. This makes it necessary to know something about each type of boiler that he may be required to install.

In the installation of boilers and heating systems, certain conditions exist which require some knowledge of the reactions within the boiler and system. The knowledge of the material covered by this assignment will assist the journeyman in understanding the cause and cure of conditions which prevent the system from operating efficiently.

Directions: Read the references listed above and answer the following questions:

1. Define boiling point.

2. Explain evaporation by the molecular theory.

3. Why does heat effect the rate of evaporation?

4. Why does pressure slow down the evaporation of a liquid?

5. Why is the vapor pressure of a liquid at the point of equilibrium higher when air has not been extracted from the vessel than that in which air has been extracted from the vacuum bell?

6. From reference sheet #1, page 276, give the boiling point of water at the following absolute pressure in degrees fahrenheit.

   a. 14.69 pounds per square inch
   b. 4.33 pounds per square inch
   c. 69 pounds per square inch
   d. 29.92 inches of mercury
   e. 0 inches of mercury
   f. Absolute 0
   g. Absolute 0 centigrade
   h. 14.69 pounds per square inch centigrade

7. At what temperature does water reach its maximum density approximately?

8. What is the purpose of the boiler in a heating system?

9. What is the ratio of the total weight of fuel and air entering the boiler to the total weight of the products of combustion for an equal period?

   (Note: Study page 281, reference #2)

10. How can the loss due to radiation be reduced in boilers?

11. What is indicated by the formation of carbon monoxide as a product of combustion?

12. How does excess air effect the efficiency of a boiler?

13. List two sources of water vapor as a product of combustion.

14. What are the five classifications of boilers?

15. What is the advantage of a cast iron sectional boiler?

16. What type of boiler is most commonly used for heating?

17. What is the purpose of fins in a boiler?

Sutdent Assignment
in
Plumbing and Pipe Fitting

Subject: Piping Systems

Purpose: To give you information pertaining to piping system which will enable you to properly install necessary piping.

References: Washburns Instruction Manual for Steam Fitting Apprentices, Vol. I

1. Information Sheet #12, page 320

2. Information Sheet #13, page 325

3. Figures #1 and #2, page 310

4. Sheet #3, page 471

Introductory Information: The journeyman plumber and pipefitter is usually solely responsible for the proper installation of the piping for heating systems as well as piping connections to the boiler. Although much of this knowledge is gained through experience, it is necessary to gain some of it by studying the theory behind certain systems and the reaction of steam and hot water in both the boiler and the various systems.

Directions: Study the references above and answer the following questions:

1. List four purposes which a piping system for a steam boiler must serve.

2. List the four prime considerations in the design of boiler piping systems.

3. In figure #1, page 321, what should be the size of the header as compared to the boiler openings?

4. In figure #1, how is expansion compensated for in this piping?

5. In figure #3, page 323, why is the riser not taken off between the two boiler openings?

6. How is the water separated from the steam to the supply piping?

7. What is the purpose of a Hartford Loop?

8. By what other name is the Hartford Loop known?

9. Where does it tie in to the header drip in relation to the water level of the boiler?

10. Describe the method of shutting down only one circut in a system.

11. Explain how the Hartford Loop provides protection against emptying the boiler.

12. What may result from cutting off a steam main without closing the return?

13. What is the danger of a steam main being filled with water?

14. Where should dirt pockets be located? What is their purpose?

15. Why is the city water connection for make up, connected to the return just before it enters the Hartford Loop?

16. Why are the drains and water supply both equipped with stop cocks requiring the use of a wrench to turn them on and off?

17. List four common piping materials used in heating systems.

18. Define the term riser.

19. Define a stub.

20. How much pitch should be given steam mains?

21. How are branches taken off steam mains?

22. What is the purpose of an eccentric reducer?

23. What is the purpose of an air valve?

24. What is a dry return?

25. What is a wet return?

26. What valves are required where two or more circuits are taken off of a header?

VT 010 054
Police Administration; Suggested Basic Course Outline.

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PUB DATE - ND 179p.

DESCRIPTORS - *CURRICULUM GUIDES; *TEACHING GUIDES; *TRADE AND INDUSTRIAL EDUCATION; *POLICE; *LAW ENFORCEMENT; SECONDARY GRADES

ABSTRACT - This curriculum guide is for teacher use in planning and implementing high school level courses designed to prepare students for entry into law enforcement work or for continued education on the postsecondary level or at police training academies. The 1-semester course is intended to furnish students with an understanding and knowledge of the functions and importance of law enforcement services, to inform them of employment opportunities, and to acquaint them with the responsibilities, knowledge, and skills required of police officers. Contents include topical outlines covering: (1) Introduction, (2) Criminal Law, (3) Criminal Procedure, (4) Traffic Procedures, (5) Identification Procedures, (6) Office Procedures, (7) Police Emergencies and Special Assignments, and (8) Moot Court; with each outline providing information and skills to be taught, methods, techniques and aids, and information sources. A chart of suggested teaching methods, a bibliography, and a list of training films are included. (AW)

VT 010 054

ED0 45856

Suggested Basic Course
Outline for

POLICE ADMINISTRATION

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VT010 654

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NOTES TO THE INSTRUCTOR

In order to appropriately give the instruction herein outlined and to attain the objectives of this course the instructor must have a clear concept of what the objectives are. He should carefully review the entire course outline in relation to the prescribed objectives which are briefly stated as follows:

1. To give high school students an understanding and appreciation of the functions and importance of law enforcement services in the community where they live.

2. To inform them of the opportunities for young people in this field of public service work.

3. To acquaint them with the responsibilities of policemen and other law enforcement personnel.

4. To teach them selected knowledge and skills required of police officers.

It is intended that this course will help prepare interested students for entry into the field of law enforcement work when they have reached acceptable stage of maturity or will prepare them to enter training programs in law enforcement technology offered at post-secondary level or at a police training academy operated by a governmental agency.

Since this course it to be completed in four and one-half months or one semester of a school term there is a limit to the scope and depth of instruction that can be given. To accomplish the objectives stated previously the instructor will find it necessary to do a great deal of preparation from day to day. This course outline is to serve only as a guide to the teacher regarding the subject matter to be covered. Using the listed reference materials and other available sources of information the instructor will need to prepare his detailed lesson plans based upon the sequence of the topics in the outline. The methods used in conducting each class session is a very important factor in determining how much interest the students will have in the course and how much they will learn about Police Administration and law enforcement services. The instructor should continuously refer to the Methods of Teaching described on the following pages and select the methods or teaching procedures that seems most appropriate for each lesson to be taught. Experienced teachers realize the importance of maximum envaluement of students in appropriate activities, discussions and the like. In other words. instead of the teacher using the major portions of the class time for his presentations he should use every opportunity to keep the students constructively busy in performing activities pertinent to the lesson. The following chart of the methods of teaching can be very helpful in planning for students class activities.

METHODS OF TEACHING

METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	WHEN TO USE
1. LECTURE	Transferring information verbally. An explanation of the teaching points of each topic	Ability to handle large groups Ability to utilize radio Easy to provide facilities	Limits type of subjects Limits chance to learn Liable to confuse learner Can't measure efficiency	To impart new information To supplement other methods.
2. ILLUSTRATION	Use of pictures, charts, maps, sketches, models, films, chalkboard	Brings out hidden features Learn by seeing Good substitution for demonstration Cheaper than demonstration	Sometimes hard to get Doesn't always teach what you want Eliminates teaching for doing ability	Profitable supplement to any other method As a substitute for demonstration
3. DEMONSTRATION	Actually doing the job step by step, explaining the how and why of each step	Builds confidence in instructor Proves information reliable More nearly affords complete learning	Lack of suitable place Lack of suitable equipment Excessive cost Takes time Limits size of class	Instructing for doing ability To supplement other methods
4. CONFERENCE	Drawing information from group and through discussion arrive at conclusion	Uses group experience Brings out best point of experience for new ideas Every man has chance	Experience of group Lack of trained leaders Conference may get out of control Takes a lot of time	Instructing for improved practices To reach conclusions Supplement to other methods

METHOD	DESCRIPTION	ADVANTAGES	DISADVANTAGES	WHEN TO USE
5. QUESTIONS & ANSWERS	Key questions planned by instructor on subject matter of lesson --tie-in with other lessons -- review of previous lesson -- application of lesson	To promote thinking To review Emphasize key points To promote individual participation Helps in developing understanding	Requires time and thought on part of instructor to select and frame good questions Sometimes used to kill time May allow some students to do all the talking if not properly directed	To review & tie-in preceding lesson Before concluding a lesson to review and emphasize major points To bring in experience of class members use with all methods
6. PRACTICE	If skill is to be developed Learner practices performance of skill under close supervision	Develops performance skill	Danger of improper supervision	After instructor demonstrates a doing job the learner should always practice doing the job under supervision of the instructor
7. DRILL	If information is to be understood Learner reviews and repeats main points of information or problem solving until he has it mastered and understands it.	Helps master and retain points of information	Danger of improper supervision	After the instructor has presented an informational lesson with proper teaching aids and explanation, the opportunity to discuss, review or use the information is provided

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
I. Introduction A. Introduction to course 1. Objectives a. To provide the students with orientation, knowledge and skills, to prepare them for entry into the field of police work b. To prepare the student to enter programs of law enforcement technology offered at the post-secondary level, or a police academy operated by a government agency	Discuss and explain with chalkboard Use overhead if available	Outline
2. Plan of course a. Hours class will meet b. Students requirements (1). Research (2). Class work (3). Homework 3. Rules and regulations of school	Explain and discuss with group	
B. Employment opportunities in law enforcement 1. Federal a. F. B. I. b. Secret Service c. Alcohol, tobacco tax unit d. Internal revenue service e. Border patrol 2. State a. Department of Public Safety (1). Highway patrol (2). Drivers license examiner (3). Weights and Measures (4). Intelligence	Representative from each agency when feasible	Brochures and personnel from various agencies Civil Service Information Sheets (U. S. Post Office)

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(5). Texas Rangers (6). Narcotics (7). Crime Lab (8). I. D.		
3. City Police a. Police patrol b. Traffic patrol c. Accident investigation d. Criminal Investigation (1). Against property (2). Against person e. Records f. Identification g. Planning and research h. Intelligence (1). Internal security (2). External security i. Juvenile j. Personnel and training k. Vice l. Crime lab m. Communications n. Supply and maintenance o. Jail division p. Polygraph examiner	Organization chart - illustrate on chalkboard or overhead Discuss, chalkboard Obtain brochures, literature application, qualifications, etc. from Police Departments, when possible Guest speakers from City Police Departments	Municipal Police Administration (Internation City Managers Association) A. Chapt. 7, p. 235-261 B. Chapt. 10, p. 315-347 C. Accident Investigators Manual - Northwestern Traffic Inst. D. Fundamentals of Criminal Investigation. Charles O'Hara -- all. Municipal Police Ad., Int. City Managers Assn., Chapt. 8, pp. 263-287
4. Sheriffs Department a. Sheriffs patrol b. Criminal investigation (1). Against property (2). Against person (3). Criminal warrants (4). Court attendant c. Civil division (1). Investigation (2). Services of civil papers d. Identification	Organization of Sheriffs Dept. on chalkboard or overhead - explain Explanation Discussion and lecture when possible bring in sheriff officials	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
e. Traffic patrol f. Accident investigation g. Records h. Planning and research i. Intelligence (1). Internal security (2). External security j. Juvenile k. Personnel and training l. Vice m. Crime lab n. Communications o. Supply and maintenance p. Jail division	Explanation with illustrations Prepare information sheets (pass-outs) as needed Lecture and chalk	
5. Constable a. Serves civil papers b. Criminal investigation (1). Offenses against property (2). Offenses against person (3). Serves criminal processes c. Court attendants	Explain types of communications Lecture, chalkboard, passout material on organization of sheriff department	
C. History of Law Enforcement 1. Development of Police Admin. a. Historic background (1). English pledge system of the late ninth century (2). Standing watch system of 1263. London England (3). Sir Robert Peel, London England. 1829 (a). Revamping London police system	Discuss, chalkboard Reading assignments from Municipal police administration	Municipal Police Admin: International City Managers As: New Horizons in Criminology. Harvey Elmer Barnes and Negley K. Teeters
(b). Is considered founding father of modern police organization	Discussion - reading assignments	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(4). In 1838 Boston adopted first day patrol force (5). In 1844, New York legislature passed an act making it possible to combine day and night watch (This date marks the first organized police force in America)		
(6). In 1850 Police control boards spread in larger cities	Discussion - Reading Assignments	
(7). Changes in twentieth century - scientific methods and apparatus to the deduction of crime (a). Transportation (b). Communication 1. Radio 2. Telephone 3. Telegraph 4. Teletype 5. Revolutionized entire communication in America (c). Police records (d). Improved methods of selection and training of police personnel (e). New concept of management	Discuss, chalkboard, passout material, visit local agency - Field trips to local police departments	
D. The organization and role of Law Enforcement 1. Quasi military organization a. Governing body	Discuss, chalkboard, prepare passout material, visit local agency	Organization manual - Field Service Division, International Association of Chiefs of Police, Washington, D. C.

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
b. Chief administrator c. Assistant administrator d. Chain of command 2. Role of law enforcement a. Public service (1). Protection of life and property (2). Prevention of crime (3). Apprehension of offenders (4). Enforcement processes b. Public leadership		Municipal Police Administration (Int. City Managers Assn.)
E. Civil Service and Police work 1. Systems a. Federal b. State c. Municipal	Pass out information sheets from local civil service systems	
2. Administrative Organization a. Civil Service Commission (1). Appointed (2). Governmental control (3). Appellant jurisdiction		Local Civil Service Bulletins Vernons Civil Statutes
3. Advantages a. Job security b. Salary c. Promotional opportunities d. Equal opportunity	Discuss, chalkboard, passout material from local departments	
4. Disadvantages a. Administrative limitations (1). Restricts appointment of qualified personnel by rigid civil service standards		
(2). The inequities of the administration	Discuss, chalkboard, overhead projector	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(3). Physical defects vs. mental ability		
F. City Government and Police work 1. Table of organization a. Types (1). Mayor - council (a). Strong mayor appoints department heads (b). Weak mayor appointments must be confirmed by council (2). City manager form appoints department heads b. Civil Service Board (if applicable) c. Police Administrator 2. Methods of selecting police administrator a. Appointed b. Elected	Pass out information sheets on local city table of organization charts	Municipal Government and administration in America, Jewel, Cass, Phillips, MacMillian Co., N. Y. Texas Government 34th edition, Stuart A. MacCorkle and Dick Smith - McGraw-Hill Book Co., Inc., N. Y.
G. County Government and Police Work 1. Table of organization a. County commissioners b. County judge c. Sheriff 2. Methods of selecting sheriff a. Election b. Appointment (where circumstances warrant)	Pass out sheets Table of organization charts Discuss and explain local methods of selection	
H. Police Codes and Regulations 1. Types of codes and regulations a. Code of conduct (1). Uniform regulations	Discuss and explain types of codes	Municipal Police Admin. (Inst. City Managers Assn.)

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(2). Personal hygene (3). Off duty, on duty b. Canons of police ethics (1). Primary responsibility of job (a). Protection of life and property (b). Upholding constitution of the U. S. and other laws (c). Represents the whole of the community and its legally expressed will (2). Limitation of authority (a). Know the bounds of enforcement (b). Must recognize the genuis of the American system of government, which gives to no man, groups of men, or institution, absolute power (c). Must not pervert its character (3). Duty to be familiar with the laws and with responsibilities of self and other public officials (4). Utilization of proper means to gain proper ends (a). Must pay strict heed to the selection of means in discharging duties of his office	When teaching canons of ethics, be sure to explain fully and it is suggested that the instructor reproduce this section and pass out to the students for a reading assignments. Discuss and ask questions and test on this section	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(b). Violations of law or disregard for public safety and property or the part of an officer are intrinsically wrong (c). The employment of illegal means, no matter how worthy the need, is certain to encourage disrespect for the law and the officer (d). If the law is to be honored, it must first be honored by those who enforce it		
(5). Cooperation with public officials in the discharge of their authorized duties (a). Regardless of party affilliation or personal prejudice (b). Guard against the use of his office, knowingly or unknowingly, in any improper or illegal action (c). Seek authority from his superior officer in any situation open to question, giving him a full report of the proposed service or action	Discuss, explain, give examples	
(6). Private conduct (a). Be mindful of his public identification		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(b). Laxity in conduct or manner in private life, expressing either disrespect for the law, or seeking to gain special privelege, cannot but reflect upon the police officer and the police service		
(c). Following the career of a policeman gives no man special privileges		
(7). Conduct toward the public		
(a). Be mindful of his responsibility to the whole community		
(b). Shall deal with individuals of the community in a manner calculated to instill respect for its laws and police service		
(c). Shall conduct his official life so as to inspire confidence and trust		
(8). Conduct in arresting and dealing with law violators	Discuss, give examples	
(a). Arrest strictly in accordance with the law and with due regard to the rights of the citizen concerned		
(b). His office gives him no right to prosecute the violator, nor to mete out punishment		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(c). Have a clear appreciation of his responsibilities and limitations regarding detention of the violator		
(d). He shall conduct himself in such a manner as will minimize the possibility of having to use force		
(9). Gifts and Favors		
(a). Guard against placing himself in a position in which any person can expect special consideration		
(b). Be firm in refusing gifts favors or gratuities large or small		
(10). Presentation of evidence	Discuss, give examples, explain	
(a). Shall be concerned equally in the prosecution of the wrong-doer and the defense of the innocent		
(b). Ascertain what constitutes evidence		
(c). Present evidence impartially and without malice		
(d). Ignore social, political and all other distinctions among the persons involved		
(11). Attitude toward profession	Discuss with students in detail	
(a). Shall regard the discharge of his duties as a		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
public trust and recognize his responsibilities as a public servant (b). He shall by diligent study and sincere attention to self improvement, shall strive to make the best possible application of science to the solution of crime (c). Strive for effective leadership and public influence in matters affecting public safety and human relations (d). He shall hold police work to be an honorable profession, rendering valuable service to his community and to his country		
H. Regulations 1. General rules for all members including classified and non-classified personnel 2. Rules for superior officers a. Leadership b. Orders c. Performance of duties d. Dicipline e. Morale 3. Rules for commanding officers a. Authority and responsibilities b. Operations c. Property and equipment	Pass out lists of rules and regulations of local departments and discuss fully Explain fully Ask questions Discuss and explain fully Give examples	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
d. Personnel accounting e. Personnel management f. Discipline 4. Rules for departmental operations a. Days off b. Rotating shift c. Court attendance	Explain reasons "why"	
I. Duties and responsibilities 1. Protect life and property; preserve the peace 2. Guardian of Constitutional Rights 3. Arrest offenders (with and without warrant) a. Set legal goal - know laws of arrest applicable b. File proper charge in court having legal jurisdiction 4. Keep public informed (within legal limits) 5. Prevention of crime 6. Represion of crime	Discuss, chalkboard Explain fully and discuss Ask questions	Municipal Police Admin. (Int. City Managers Assn.)
J. Special Terminology of Police 1. Of law enforcement 2. Of offenders	- Shoptalk - Produce a list of police terminology used in your area. Discuss briefly - Do not go into great detail Produce a list of the offenders special terminology in your area - Do not go into great detail	

Introduction to the Study of Criminal Law

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
II. Criminal Law A. Introduction to the Study of Law 1. Varying uses of the word "Law" a. Laws of God (1). It is a command from a source entitled to obedience and imposes a compulsive obligation upon all believers (2). Derives its ultimate force from fear of the consequences of devine displeasure	Chalkboard, discuss Explain fully, discuss, give examples	La Salle Extension University School of Law Text - American Law and Procedure, Volume I, Chapter I
b. Moral Laws (1). The compulsive force of this moral obligation is: (a). Public or class-opinion (b). Dictates of the individual conscience (2). May exercise stronger influence over mans actions than the command of the legislature	Explain, discuss, ask questions and give examples	
c. Laws of Nature (1). Certain facts regularly accompany or follow certain other facts (a). Gravity (b). Inertia (c). Mass	Explain, discuss, ask questions and give examples	
d. Laws of logic and esthetics (1). Things identical with the same thing are identical with each other (2). Compulsion that exist is inherent in the nature of reasoning	Explain, discuss, ask questions and give examples	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(3). Example - laws of beauty, art, drama. architecture. The term is used to indicate a rather indefinite body of conventions of taste approved more or less generally by persons familiar with these fields of effort		
e. Economic laws	Explain, discuss, ask questions - "why"	
(1). "Men buy in the cheapest market and sell in the dearest"		
(a). A classical law of political economy		
(2). The so-called law here describes merely a strong tendency in human conduct and not a relation that exist independently of human will		
f. Law as a rule of human conduct enforced by the state	Explain, discuss and ask questions	
(1). Organized society enforces it supported by the whole physical power of the state, if necessary		
(2). A law, in the true legal sense, is a rule of human conduct that will be enforced by the state through its public tribunals or officers. Its obligations bind human beings only, and its sanction proceeds from politically organized human society		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
2. Sources of our criminal law in general a. The criminal law of England as it existed at the time of the settlement of this country (1). The law of their mother country being esteemed by them their choicest possession; they were subject to the law of their country and continued so subject when they moved to the new colony (2). Parts of the English law deemed not applicable in this country (a). Not suitable nor adopted to our institutions and national ideals (3). Additions have been made to this law by customs that have grown up in this country. as a continuation of the growth of custom which was the origin of the law of England - the common law (4). Further additions to our law have been made by statutes from time to time, enacted by the various legislatures for their several jurisdictions (5). Summary - our law consists of that ancient custom plus the old English statutes as the two existed at the time	Chalkboard, discuss Explain, ask questions, and discuss	La Salle Extension University School of Law - Text American Law and Procedure Volume 3, Chapters 1 and 2

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
of the settlement of this country, less such parts as were foreign to our national ideals. To this original body of our criminal law we have since added by American Customs, common law, and statutes (a). These, to a certain extent have also abrogated and displaced part of the law which we obtained from the mother country		
3. Crimes against the United States a. There are no common law crimes against the United States (1). United States Government is a government of derivative powers (2). It has no powers except those expressly or impliedly given to the United States Government by the several states in the constitution of the United States	Chalkboard, discuss Explain - Amendments of Constitution of U. S. Prepare and hand out information sheets - Discuss Explain limits of authority Discuss Ask Questions	La Salle Extension University School of Law Test - American Law and Procedure, Volume 3, Chapter 1
(3). The states have all the powers which they have not given to the U. S. government by the constitution, or are not by it forbidden to exercise, except as they are further restrained by their own particular state constitutions	Explain - Discuss 14th Amendment Ask Questions	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
b. Summary - The acts which were crimes at common law, are not crimes against the United States, unless made so by the Constitution or some act of Congress enacted in the exercise of powers given to Congress by the Constitution	Prepare and hand out information sheets - Discuss and ask questions	
B. A survey of the Texas Criminal Statutes		
1. Definitions	Prepare information sheets	
a. Criminal law - That part of law that treats with crime and punishment		
b. Crime - The commission or ommissions of an act forbidden by written law under pain of punishment	Explain in full Give examples	
2. Persons punishable and the circumstances which excuse, extinuate, or aggrivate offenses	Discuss, chalk and chalkboard, overhead projector	Texas Code of Criminal Procedure
a. Criminal capacity	Explain, discuss, and prepare informational sheets	
(1) Under 9 years old-no capacity to commit crime, except perjury and that only when it can be shown the child has sufficient discretion to understand the nature and obligation of an oath.		
(2). From 9 through 13 years old - no capacity unless it can be shown that the infant had sufficient discretion to understand the		Texas Code of Criminal Procedure

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
nature and illegality of his acts		
(3). Over 13 and under 21 - no question of criminal discretion		
(4). Punishment of infants		
(a). Under certain ages and circumstances infant offenders are prosecuted as juvenile delinquents instead of penitentiaries		
(b). An infant under 17 may not be punished with death		
b. Married women	Explain, discuss and ask questions	
(1). Acts committed by command or persuasion of her husband		
(a). In capital cases penalty may not be death, but may be imprisonment for life		
(b). In non-capital cases, the sentence may be only one-half of what it otherwise would be	Explain and discuss Ask questions	
(2). May be a principal with her husband when not acting under duress		
c. Insane person		
(1). Act done by a person who in a state of insanity cannot be punished as an offender, except in case of temporary insanity produced by recent use of ardent spirits		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(2). A person who is found quilty cannot be punished while insane		
d. Intoxicated persons		
(1). Neither intoxication nor temporary insanity produced by voluntary recent use of ardent spirits constitutes and excuse for commission of an offense.		
(2). Evidence of intoxication may be introduced in mitigation of the penalty		
(3). Chronic alcoholism to point of "settled insanity" or delirium tremens is an absolute defense		
e. Person under influence of drugs - Temporary insanity produced by drugs is a defense		
f. Defenses to crime		
(1). Alibi - That defendent was at a different place when the crime was committed	Explain	
(2). Consent - permission of person affected		
(a). In general a private individual does not have power to license the commission of a crime. Thus consent would not be a defense to abortion in case a woman desires the operation nor to bribing a witness even though the witness		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
accepted the money (b). In certain cases, consent of the person affected would preclude the act being a crime, as in rape (if women were legally capable of giving consent) theft, robbery, or burglary		
(3). Duress - forcing a person by threats or actual violence to do an act (a). Duress is a defense under certain circumstances. Some requisites are as follows: 1. Person cannot get away 2. Injury would be loss of life or personal injury 3. Person must possess ordinary firmness 4. Person must be at disadvantage in combat 5. Possible injury must be immediate 6. Act must be committed by person while under immediate constraint	Discuss, chalk and chalkboard	Texas Code of Criminal Procedure
(4). Agreements not to prosecute (a). The prosecuting attorney, with the sanction of the judge	Explain, discuss and ask questions	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
of the district court, may extend immunity in some cases from prosecution to a person who testifies in behalf of the state to facts which he has a right to withhold because they would constitute incriminating evidence against himself		
(b). An agreement for Immunity Applies 1. Only in jurisdiction where given 2. Only to the act or transaction involved in the particular agreement and not to crimes in general 3. Only when given by prosecuting attorney with sanction of court	Explain local policy	
(5). Immunity Persons are required to give testimony, even when unfavorable to themselves in criminal cases involving intoxicating liquors, and gaming, and in anti-trust suits, but cannot be punished for acts disclosed by such testimony	Explain, discuss and ask questions	
(6). Custom - The fact that a criminal act is customarily		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
done is not defense (7). Discrimination - The fact that other who committed a similar act were not apprehended and prosecuted is no defense (8). Restitution - The fact that a person restores property that is embezzled or stolen is not a defense, but may lighten the punishment (9). Lack of criminal capacity (see heading above) (10). Justifiable - A person is entitled to use means appropriate under the circumstances in self-protection		
3. Offense and punishments a. Seriousness of offenses (1). Felonies - punishment may be death or confinement in penitentiary (a). Capital - punishable by death (b). Not capital - punishable by confinement in penitentiary (2). Misdemeanors - not punishable by death or confinement in penitentiary	Explain, discuss Give examples	
4. Principals, accomplices and accessories a. Parties to a crime (1). Principals - All persons acting together in the	Chalk, chalkboard, discuss, overhead projector - prepared transpariences	Vernons Penal Code of the State of Texas Art. 65-67

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
commission of an offense (a). Include persons who are involved as follows: 1. Present; know unlawful intent; and aid, encourage or keep watch. 2. Not present - but use innocent agent or indirect means to accomplish offense 3. Present; have agreed to assist or advise in commission of act 4. Lay poison or prepare other means knowingly by which another person is injured 5. Knowingly lure away from place of crime persons who would witness or prevent its commission (b). Do not include persons involved as follows: 1. Merely present when crime was committed 2. Merely owns property where crime was committed 3. Knows crime is to be committed but makes no effort to prevent its commission 4. Fails to disclose offender's connection	Discuss, explain and ask questions	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
with crime after its commission		
(2). Accomplices - persons not present at commission of offense, but who beforehand advise, command, encourage, aid or promise rewards or make threats to another person in order to induce him to commit the offense	Explain, discuss Give examples	
(a). Under common law, such persons were accessories before the fact		
(b). There may be accomplices in all felony offenses except manslaughter and negligent homicide		
(3). Accessories - persons knowing that an offense has been committed, and conceal or give other aid to an offender in order that he may evade arrest. trial or execution of sentence	Discuss, explain Give examples	
(a). Under common law, such persons were accessories after the fact		
(b). Persons who cannot be accessories, but are responsible for any separate substantive crime committed by them in attempting to aid the offender		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
1. Husband or wife 2. Brother or sister 3. Child, parent, grand-parent, brother-in-law, or son-in-law 4. Domestic servant		
(4). Examples of acts that make a person an accessory (a). Warning principal that officers are approaching the house (b). Making false statements to officers, or grand jury favorable to person committing offense (c). Hiring material witnesses to leave	Give examples Discuss Explain Ask questions	
(5). Examples of acts that do not make a person an accessory (a). Innocently transporting stolen goods for a thief (b). Abiding in arranging or preparing a defense (c). Obtaining bail		
5. Offenses against the state, its territory and revenue a. Treason and misprision of treason - Art. 83 b. Misapplication of public money - Art. 86 c. Illegal contracts affecting the state - Art. 108 d. Collection of Taxes and other	Discuss, chalk, chalkboard, pass out material (not recommended that instructor attempt to teach the students the elements of these individual statutes) For familiarization only	Vernons Penal Code

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
Public Money -Art. 114 e. Public Lands - Art. 142 f. Personal Property of the State Art. 146 g. The Flag and Loyalty - Art. 148 6. Offenses against Public Policy and Economy a. Banking - Art. 536 b. Insurance - Art. 568 c. Wife and child desertion - Art. 610 d. Vagrancy - Art. 607 e. Prize fighting, roping contests, etc. - Art. 610 f. Gaming - Art. 615 g. Intoxicating Liquor - Art. 666 h. Texas Liquor Control Act - Art. 666-1		
7. Offenses against the person a. Assault and assault and battery - Art. 1138 b. Aggravated assaults and other offenses - Art. 1147 c. Hazing and other violence - Art. 1152 d. Assaults with intent to commit some other offense - Art. 1159 e. Maiming, disfiguring and castration - Art. 1166 f. False imprisonment - Art. 1169 g. Kidnapping and abduction - Art. 1177 h. Rape - Art. 1183 i. Abortion - Art. 1191 j. Administering poisons, and injurious potions - Art. 1197	Explain Discuss Ask Questions Discuss, chalkboard. pass out material, (For familiarization only)	Vernons Penal Code

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
k. Homicide - Art. 1201 l. Justifiable homicide - Art. 1207 m. Excusable homicide - Art. 1228 n. Homicide by negligence - Art. 1230 o. Manslaughter - Art. 1244 p. Murder - Art. 1256 q. Dueling - Art. 1259 r. Mobs and lynching - Art. 1260 a s. General Provisions relating to homicide - Art. 1261 t. Threats - Art. 1265	Discuss Explain Ask Questions Prepare a list of offenses and pass out to students	
8. Offenses against property a. Arson - Art. 1304 - 1316 b. Other willful burning - Art. 1317 1330 c. Malicious mischief - Art. 1331 - 1378 a d. Timber and logs - Art. 1379 - 1388b - 1 e. Burglary - Art. 1389 - 1402 f. Offenses on vessels. steamboat, railroad cars - Art. 1403 - 1407 g. Robbery - Art. 1408 - 1409 h. Theft in general - Art. 1410 - 1436 i. Theft from person - Art. 1437 - 1439 j. Theft of animals - Art. 1440 - 1444 k. Relating to recovery of stolen animals and theft thereof - Art. 1445-1457 l. Other offenses relating to stock - Art. 1458 - 1470 m. Protection of stock raisers - Art. 1471 - 1503		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
n. Diseases of animals and bees - Art. 1504 - 1533 o. Embezzlement and conversion - Art. 1534 - 1544 p. Swindling and cheating - Art. 1545 - 1555 q. Property under lien - Art. 1556 - 1558 r. Offenses committed in another county or state - Art. 1559 - 1560		
9. Driver license law a. Chauffeurs b. Commercial c. Operators	Chalkboard, discuss Prepare pass out material Overhead projector Explain - Give examples and ask questions	Vernons Civil Statute Art. 6687 - B Texas motor vehicle laws Department of Public Safety
10. Safety responsibility a. Words and phrases defined b. Administration of act c. Security following accident d. Proof of financial responsibility e. Violations of provisions of the Act and penalities f. General provisions		Vernons Civil Statute - Art. 6701 - H Texas Mtr. Vehicle Laws. D. P. S. Local Driver Training Agency Department of Public Safety Code of Criminal Procedure, Art. 38
11. Driver improvement a. Driver education training b. Examination and re-examination c. Strict enforcement		Fundamentals of criminal investigation, Charles E. O'Hara, Charles C. Thomas, Publisher. Springfield. Illinois
12. Laws of evidence a. Purpose for evidence b. Classifications and definitions (1). Direct evidence (2). Circumstantial (3). Real evidence c. Admissibility of Evidence (1). Materiability (2). Relevancy	Explain fully Give examples Ask Questions Discuss	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
d. Competency of witness	Give Examples	Vernons Code of Criminal Procedure, Art. 38.06 note # 201
(1). Mental		
(a). Ability to see		Douglas vs. State 1914 - Art. 38.06
(b). Ability to recall		
(c). Ability to relate		
(2). Moral		Note # 205
(a). Understanding of the truth	Explain.	Johnson vs. State 1877
(b). Consequencies of a false hood		
(3). Children	Discuss, chalkboard, prepare pass out material	
(a). 14 years and over is competent		
(b). Under 14, competency established by examination of judge		
e. Judicial Notice	Give examples	
(1). Certain kinds of facts need not be proved by formal presentation of evidence, since the court is authorized to recognize their existance without such proof	Explain fully Discuss	
(2). Examples:		
(a). States own laws		Fundamentals of Criminal Investigation, Charles E. O'Hara, Charles C. Thomas, Publisher, Springfield, Illinois
(b). Historical and geographical facts		
f. Burden of proof		
(1). No person required to prove his innocence	Explain fully - discuss	
(2). Rests solely with the prosecution		
(3). Beyond a reasonable doubt		
(4). Accused must prove own alligations		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(a). Alibi (b). Self-defense (c). Insanity		
g. Opinion Evidence (1). Opinion rule (a). Not admissable in a trial (b). Only facts which involve the use of the five senses are admissable 1. Sight 2. Hearing 3. Smell 4. Taste 5. Touch	Give examples - Discuss Ask questions Explain "why"	
(2). Exceptions to the opinion rule (a). Lay witness 1. May express an opinion on matters of common observation a. Physical properties such as color, weight, size, and visibility b. Gross estimate of a persons age c. Implications of race, nationality and language d. Intoxication	Give examples - discuss Explain "why"	
(b). Expert testimony 1. Testimony of a person skilled in some art, trade or	Give examples - Discuss Explain "why"	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
science to the extent that he possesses information not within the common knowledge of man a. Medical doctors b. Fingerprint specialist c. Scientists		
h. Hearsay Evidence	Explain - Give examples Ask questions	
(1). Definition (a). Proceeds not from the personal knowledge of the witness but from mere repetition of what the witness has heard others say		
(2). Not admissable (a). Author of the statement is not present and under oath (b). No opportunity for crossexamination (c). Possibility of error in information	Discuss	
(3). Exceptions (a). Confessions 1. Direct acknowledgement of guilt 2. Must be voluntarily given, after statuatory warning (b). Dying declaration (statement by victim) 1. Must be given in a trial for homicide		(Caution - extremely technical) For familiarization only

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
2. Must be that of the victim 3. Must concern the circumstance of the act causing the victims condition, including the idenity of the person who caused the injury 4. The victim must believe he is dying 5. The victim must in fact have died 6. The victim must have been competent at the time the statement was made	Discuss, give examples, chalkboard, overhead projector	
(c). Spontaneous exclamations (Res Gestae)	Ask Questions	
1. Definition a. Is an utterance concerning the circumstances of the startling event by individual in a condition of excitement, shock, or surprise	Have Class discussion	
2. Should be close in time	"Ditto"	"Ditto"
3. Should be clear and preclude the possibility of fabrication or deliberation	Give example - explain	
(d). Corpus Delicti 1. Proof of the crime 2. Must be proven in		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
order to establish crime		
3. Proof of Corpus Delicti can be real, direct or circumstantial evidence	Explain each Give examples	
13. Federal Agency Jurisdiction		
a. United States Marshal's Office		
(1). Department of Justice		
(2). Executes orders of Federal District Courts. Disbursing officer of the judicial district		
b. Immigration and Naturalization Service - Laws relating to admission, exclusion, and deportation of aliens, and relating to naturalization of aliens legally in the United States. Investigates violations of Immigration and Naturalization Laws and candidates for citizenship. Border Patrol on International boundaries and coastal parts. Arrest without warrant any alien believed making illegal entry. May search any conveyance, boat, etc. within territorial limits for aliens	Explain and have class discussion Invite guests, when possible, from each of the following agencies	
c. Federal Bureau of Investigation - Aircraft stowaways; antitrust; assaulting or killing Federal Officer; bank robbery; bankruptcy; bribery; civil rights and domestic violence; con-		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
spiracy crimes on high seas; crimes on Indian and Government Reservations; deserters; harboring deserters; election laws; escpaed Federal prisoners; espionage; extortion; falsely claiming citizenship; fraud against the Government; harboring fugitives; illegal wearing of uniforms; impersonation; internal security; interstate transportation of lottery tickets; involuntary servitude and slavery kick-back racket act; kidnapping; National Bank and Federal Act; National Motor Vehicle Theft Act; National Stolen Property Act; Obscene Matter; overthrow or destruction of the Government; Parole and Conditional Released Violators; Probation Violators; passport and visas; perjury; Red Cross Act; sabotage; sedition; Servicemen's Dependents Allowance Act of 1942; theft from interstate shipment; theft of Government property; Train Wreck Statute; treason, unlawful flight to avoid prosecution or testifying; White Slave Traffic Act		
d. Federal Aviation Agency - Investigating alleged violators of incidents involving safety		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
Investigating Civil Aircraft accidents, also investigating military aircraft violations of flying regulations and air traffic e. Division of Investigation - Department of Interior – Violations of laws governing Department of Interior and its Bureaus Taylor Grazing Act. Protection of public domain. Investigations concerning titles of land. Indian affairs, National Park Service, etc. General policing of Indian Reservations f. Indian Police - General policing of Indian Reservations g. Civil Service Investigators - Civil Service Commission - Civil Service applicants; charges of misconduct; violations of rules and regulations of Civil Service h. F. C. C. Investigators - Federal Communications Commissions - Laws pertaining to radio, telegraphs, telephones, etc. i. Investigators - Federal Security Agency - Laws of Food and Drug Administration j. Investigators - Interstate Commerce Commission - Interstate Commerce Act		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(1887) to regulate interstate commerce. Hepburn Act (1906) to set rates for common carriers (1). Motor Carrier Bureau Inspectors and Investigators. (a). Motor Carrier regulations; qualifications of driver; driving regulations equipment. Reporting of accidents; hours of service of drivers; inspection and maintenance k. Secret Service Division - United States Treasury - Protection of President and family and President-elect. Counterfeiting, forging or altering of obligations, coins, securities, etc., of the United States. Responsibility of bidders on Government contracts Counterfeiting of G. T. R.'s and revenue stamps. War Finance Corporation Act. Protection of Treasury Department building and equipment. Supervision of White House police l. Bureau of Narcotics - United States Treasury - Harrison Narcotics Law (1914). Opium Poppy Control Act of 1942. Marijuana Act of 1937. Investigates, detects, and punishes violators. Investigates		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
books, records and returns. Seizes property, real and personal, for violations and controls sales and disposition of same m. Bureau of Customs - United States Treasury - Importation and entry of merchandise into, and exportation of merchandise from, the United States. Collection of import duties, detection of customs revenue frauds; and prevention of smuggling. Assists State Department in control of entrance and departure of persons whose movements. n. Bureau of Internal Revenue - United States Treasury Dept. - Internal Revenue laws; Social Security Act; Miscellaneous Tax Act; Income Tax Act; Alcohol Tax Act; National and Federal Firearms Act violations o. Alcohol Tax Unit - Administration of the Internal Revenue Laws pertaining to National and Federal Firearms Act violations Supervision of legitimate liquor industries and suppression of illicit traffic in alcohol p. The Special Intelligence Unit - Investigation of attempts to defraud Government of taxes due under Revenue Acts.		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
Investigations of charges against employees of Internal Revenue Service. Investigations of fradulent income tax returns, other frauds, fake claims against government in tax matters. Investigation of unethical practices by attorneys who practice before the Bureau of Internal Revenue and attempted bribery of officers of Bureau of Internal Revenue		
q. Division of Inspection (Post Office Inspectors) - United States Post Office Department- Violations of Postal Laws, depredation of the mails domestic and international robbery or burglary of Post Offices. Use of mails to defraud; promotion of lotteries. Mailing of explosives, firearms, poisons, letters of extortion; forgery of money orders; mailing of obscene matter; tampering with mails; Government monopoly of transportation of letter mail		
r. Bureau of Customs - United States Treasury - Would be prejudicial to the interests of the United States. Cooperates with Foreign Funds Control to enforce prohibition against traiding with persons or firms on the "Proclaimed List of Certain Blocked Nation"		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
s. Customs Agency Service (Investigative Unit of Bureau of Customs) - Seizes Goods; collects fines and penalities; and apprehends violators of customs laws		
t. Customs Patrol (Enforcement Unit of Bureau of Customs) - Patrols international boundaries sea coasts and air fields. Detects and prevents smuggling. Prevents exportation of articles from the United States without filing proper exportation declarations		
u. Coast Guard - United States Treasury Department in Time of Peace. United States Navy, under Secretary of Navy, in Time of War - Smuggling, customs laws, navigation rules governing anchorage and movement of merchant vessels and motor boats. Oil pollution; Immigration Quarantine and neutrality; fisheries in Alaska; International Conventions relative to fishing on high seas; sponge fishing; examinations of seamen for certificates as life boatmen. Cares for and transports shipwrecked and destitute persons in Alaska and elsewhere. Transports Government agents and on occasions United States mail over certain routes		

Code of Criminal Procedures

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
III. Criminal Procedures A. Code of Criminal Procedure 1. Objects of the code a. To adopt measures for preventing the commission of crime b. To exclude the offender from all hope of escape c. To insure a trial with as little delay as is consistent with the ends of justice d. To bring to the investigation each offense on the trial all the evidence tending to produce conviction or acquittal e. To insure a fair and impartial trial, and -- f. The certain execution of the sentence of the law when declared	Lecture, chalkboard, information sheets Invite District Attorneys office in to talk Question class	Art. 1.03 CCP Vernons Texas Statutes Annotated
2. Due course of Law - No citizen of this State shall be deprived of life, liberty, property, priviledges or immunities, or in any manner disfranchised, except by due course of the law of the land	Class discussion	Art. 1.04 CCP Vernons Texas Statutes Annotated
B. Confessions and self-incrimination 1. The confession of a defendent may be used in evidence against him if it appears: a. That the same was freely made b. Without compulsion or persuasion, under the rules hereafter prescribed	Discuss, chalkboard, information sheets	Art. 38.21 CCP Vernons Texas Statutes Annotated

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
2. When oral and written confessions shall be used - The oral or written confession of a defendant made while the defendant was in jail, or other place of confinement or in custody of an officer shall be admissible if:	Lecture, chalkboard, information sheets containing briefs of the: Mallory vs. U. S. Mapp vs. Ohio Miranda vs. Arizona Use overhead projector if possible Field trip to court room and magistrate	Art. 38.22 CCP Vernons Texas Statutes Annotated
a. It be shown to be the voluntary statement of the accused taken in the presence of an examining court in accordance with laws; <u>or</u> . . .		
b. It be made in writing and signed by the accused, and show that the accused has at some time prior to the making thereof received from the person to whom the statement is made the warning set out in Subsection (c), (1), (2) and (3) below <u>or</u> received from the magistrate the warning provided in Article 15.17, and shows the time, date, and place of the warning and the name of the person or magistrate who administered the warning; <u>or</u> . . .	Class discussion and questions	
c. It be made in writing to some person who has warned the defendant from whom the statement is taken that . . .		
(1). He has the right to have a lawyer present to advise him either prior to any questioning or during any		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
questioning or during any questioning		
(2). If he is unable to employ a lawyer, he has the right to have a lawyer appointed to counsel with him prior to or during any questioning and..		
(3). He has the right to remain silent and not make any statement at all and that any statement he makes may be used in evidence against him at his trial	Ask questions of the class	
The defendant must knowingly, intelligently, and voluntarily waive these rights prior to and during the making of the statement		
d. If a written statement is taken and if the defendant is unable to write his name and signs the statement by making his mark, such statement shall not be admitted in evidence, unless it be witnessed by some person other than a peace officer, who shall sign the same as witness	Class discussion	
e. Oral confessions: Even though oral confessions are not usually admissible in the trial of a defendant, an exception to this rule permits oral statements, made by the defendant which leads to the fruits of the crime, to be admitted as evidence. Our present law is the same as the law was in 1925		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
f. "Nothing contained herein shall preclude the admissibility of any statement made by the defendant in open court at his trial or at his examining trial in compliance with Articles 16.03 and 16.04 or of any statement that is the res gestae of the arrest of of the offense "	Lecture	
3. Procedure by officer to obtain an admissible confession from a criminal suspect:	Invite officer in to class Use overhead projector if possible Lecture Chalkboard	
a. Before a confession can be admitted as evidence, it must be shown that the defendant had a proper warning		
(1). The magistrate may give the warning as set forth in Art. 15.17 CCP		
(a). Requires the accused be informed "in clear language":		
1. The accusation against him		
2. Any affidavit filed		
3. His right to retain counsel		
4. His right to remain silent		
5. His right to have an attorney present during any interview with peace officers or attorneys representing the state		
6. His right to terminate the interview at any		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
time he chooses 7. His right to request appointment of counsel if he cannot afford counsel 8. His right to examining trial 9. That he does not have to make any statement, and if he does it may be used against him (2). The second method permits the officer to give the warning which must include the following items: (a). Made in writing (b). To person giving defendant the warning (c). Right to have lawyer present prior to and during the interview (d). Right to have a lawyer appointed if he cannot afford one (e). Right to remain silent (f). That he does not have to make any statement (g). Any statement made by him may be used in evidence against him	Invite officer into class Lecture Chalkboard Overhead projector Class discussion Questions	
C. Arrest, search and seizure 1. Arrest without warrant a. No arrest without a warrant can be made unless it is specifically authorized by statute or constitution	Explain, give examples	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
b. Five general groups of offenses which authorize <u>any</u> peace officer to arrest without a warrant		
(1). Group #1, CCP 14.1, Felony or offense against the public peace	Explain, give examples	CCP 14.1
(a). Peace officer or any other person may arrest		
(b). When offense is committed in his presence or view		
(c). An offense is within presence when one is apprised of it through any of the five senses		
(d). "Any peace officer may arrest without a warrant for any offense committed in his presence or within his view"		CCP Art. 14.01c
(e). Offenses against public peace		
1. Affray		
2. Disturbing the peace		
3. Profane language over the telephone		Articles 473 through 482 Vernons Texas Penal Code Annotated
4. Drunk in a public place or a private house not his own		
5. Drinking liquor on a train		
6. Peddler refusing to leave		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
7. Shooting in a public place 8. Shooting on a public road 9. Abusive language 10. Unlawful assemblies 11. Riots		
(2). Group #2 CCP 14.02 - When a felony or breach of the peace has been committed in the presence of a magistrate, and such magistrate verbally orders the arrest of the offender (a). Who are magistrates under Texas Law 1. Judges of the Texas Court of Criminal Appeals 2. Judges of the Supreme Court of Texas 3. District court judges 4. County court judges 5. County court at law judges 6. County criminal court judges 7. Justices of the peace 8. Corporation court judges 9. Mayor and recouler of a town	Explain, give examples	Articles 439 through 454q Vernons Texas Penal Code Annotated Articles 455 through 472 Vernons Texas Penal Code Annotated Article 14.02 CCP

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(3). Group #3 CCP 14.03 Any peace officer may arrest without a warrant persons found in suspicious circumstances which reasonably show that such persons have been quilty of some felony or breach of the peace, or thereafter, or are about to commit some offense against the laws	Explain, give examples	Article 14.03 Vernons Texas Code of Criminal Procedure
(4). Group #4, CCP 14.04 Where it is shown by satisfactory proof to a peace officer upon the representation of a creditable person, that a felony has been committed, and that the offender is about to escape, so that there is no time to procure a warrant, such peace officer may, without a warrant, pursue and arrest the accused. (This pertains only to felony offenses)		Article 14.04 Vernons Texas Code of Criminal Procedure
(5). Group #5 - Specific Statutes - Some of these offenses do not grant the peace officer any authority to arrest without a warrant under any of the preceding groups. Each law must stand on its own merits and the procedure to make the arrest without a warrant		

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differs with each statute		
(a). Carrying prohibited weapons		Article 487 Vernons Texas Penal Code Annotated
(b). Preventing the consequences of shoplifting		Article 1436e Vernons Texas Penal Code Annotated
1. This law requires that the good seized, as well as the person arrested, be taken before a magistrate immediately		
(c). Preventing the consequences of the theft	Give examples	Article 18.22 Vernons Texas Code of Criminal Procedure
1. All persons have the right to prevent the consequences of theft		
2. This law requires that the good seized, as well as the person arrested, be taken before a magistrate immediately		
(d). Escaped prisoners - If a person arrested shall escape, or be rescued, he may be retaken without any warrant; and for this purpose. all the means may be used which are authorized in making the arrest the first instance		Article 15.27 Vernons Texas Code of Criminal Procedure

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(e). Juvenile Deliquency - 1. Authorized deliquents and run-away children to be taken into custody without a warrant 2. The juvenile courts must handle case	Explain, give examples	Article 23.38 - 1 Texas Revised Civil Statutes
(f). Parole Violator - May arrest without a warrant when parole or probation has been revoked. (Cannot arrest for parole violation unless the parole violator is committing some offense)		Article 44.12 Vernons Texas Code of Criminal Procedure
(g). Extradiction - Arrest without a warrant a person upon reasonable information that the accused stands charged in the courts of a state with a crime punishable by death or imprisonment for a term exceeding one year	Explain, give examples	Article 51.13 Vernons Texas Code of Criminal Procedure
(h). Arrest without a warrant if a warrant has been issued. 1. In executing a warrant of arrest, it shall always be made known to the accused under what		Article 15.28 Vernons Texas Code of Criminal Procedure

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authority the arrest is made 2. The warrant shall be executed by the arrest of the defendant 3. The officer need not have the warrant in his possession of the time of the arrest, provided the warrant was issued under the provisions of this code, but upon request he shall show the warrant to the defendant as soon as possible 4. If the officer does not have the warrant in his possession at the time of arrest, he shall then inform the defendant of the offense charged and of the fact that a warrant has been issued		
(i). Identification of witness- Whenever a peace officer has reasonable grounds to believe that a crime has been committed, he may stop any person whom he reasonably believes was present at	Discuss, explain, give examples	Article 2.24 Vernons Texas Code of Criminal Procedure

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
the commission of the crime, and may demand of him his name and address 1. If such person fails or refuses to identify himself, to the satisfaction of the officer, he may take the person forthwith before a magistrate 2. If the person fails to identify himself to the satisfaction of the magistrate, the latter may require him to furnish bond, or may commit him to jail until he identifies himself		
2. Arrest with a warrant a. Definition - A warrant of arrest is a written order from a magistrate, directed to a peace officer or some other person specially named, commanding him to take the body of the person accused of an offense, to be dealt with according to law b. Requisites of warrant (1). It issues in the name of The State of Texas (2). Must specify the name of the person whose arrest is ordered, if it be known, if	Explain, give examples	Article 15.01 through Article 15.27 Vernons Texas Code of Criminal Procedure

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ordered, if it be known, if unknown, then some reasonably definite description must be given (3). It must state that the person is accused of some offense against the laws of the State, naming the offense (4). It must be signed by the magistrate and his office be named in the body of the warrant, or in connection with his signature		
c. Magistrate may issue warrant or summons: (1). A summons may be issued in any case where a warrant may be issued (2). It shall be in the same form as the warrant except that it shall summon the defendant to appear before a magistrate at a stated time and place (3). The summons shall be served upon a defendant by delivering a copy to him personally, or by leaving it at his dwelling house or usual place of abode with some person of suitable age and discretion then residing therein or by mailing it to the defendants' last known address	Explain, give examples, illustrate by showing prepared transparancy of a warrant and summons forms Use overhead projector	

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(4). If defendant fails to appear in response to the summons a warrant shall be issued		
d. Complaint defined - The affadavit made before the magistrate or district or county attorney is called a "complaint" if it charges the commission of an offense.	Explain, give examples, illustrate by using prepared transparancy of a complaint form Use overhead projector	
e. Requisites of complaint		
(1). It must state the name of the accused, if known, and if not known, must give some reasonably definite description of him		
(2). It must show that the accused has committed some offense against the laws of the State, either directly or that the affiant has good reason to believe and does believe, that the accused has committed such offense		
(3). It must state the time and place of the commission of the offense. as definitely as can be done by the affiant		
(4). It must be signed by the affiant by writing his name or affixing his mark		
f. Warrant extends to every part of the State		
(1). A warrant of arrest, issued any county or district clerk, or by any magistrate, except		Article 15.06 Vernons Texas Code of Criminal Procedure

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mayors or recorders of an incorporated city or town, shall extend to any part of the State (2). And any peace officer to whom said warrant is directed, or into whose hands the same has been transferred, shall be authorized to execute the same in any county in this State		
g. Warrant issued by other magistrate (1). When a warrant of arrest is issued by a mayor or recorder, it cannot be executed in another county than the one in which it issues, except (a). It be endorsed by a judge of a court of record, in which case it may be executed anywhere in the State. (b). If it be endorsed by any magistrate in the county in which the accused is found, it may be executed in such county (2). The endorsement may be: Let this warrant be executed in any county of _____". or "Let this warrant be executed in	Explain, give examples	Article 15.07 Vernons Texas Code of Criminal Procedure

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any county of the State of Texas"		
h. Warrant may be telegraphed		Article 15.08 Vernons Texas Code of Criminal Procedure
i. Complaint by telegraph		
j. Warrant may be directed to any person		Article 15.09 Vernons Texas Code of Criminal Procedure
(1). If it is made known by satisfactory proof to the magistrate that a peace officer cannot be procured to execute a warrant of arrest		Article 15.14 Vernons Texas Code of Criminal Procedure
(2). Or that such delay will be occasioned in procuring the services of a peace officer that the accused will probably escape		
(3). Such warrant may be directed to any suitable person who is willing to execute the same; and in such case, his name shall be forth in the warrant		
k. Private person executing warrant	Discuss, explain, give examples	Article 15.15 Vernons Texas Code of Criminal Procedure
(1). No person other than a peace officer can be compelled to execute a warrant of arrest		
(2). But if any person shall undertake its execution. he shall be bound to do so under all the penalities to which a peace officer would be liable		

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(3). He has the same rights, and is governed by the same rules as apply to peace officers		
l. How warrant is executed: (1). The officer or person executing a warrant of arrest shall without unnecessary delay: (a). Take the person or have him taken before the magistrate who issued the warrant (b). Or before the magistrate named in the warrant, if the magistrate is in the same county where the person is arrested (c). If the issuing or named magistrate is in another county, the person arrested shall without unnecessary delay be taken before some magistrate in the county in which he was arrested	Discuss, explain, give examples	Article 15.16 Vernons Texas Code of Criminal Procedure
m. Duties of the arresting officer and magistrate (1). In each case enumerated in this code, the person making the arrest shall without unnecessary delay take the person arrested or have him taken before some	Discuss, explain, give examples	Article 15.17 Vernons Texas Code of Criminal Procedure

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
magistrate of the county where the accused was arrested		
(2). The magistrate shall inform in clear language the person arrested:	Discuss, explain, give examples	
(a). Of the accusation against him		
(b). Of any affidavit filed therewith		
(c). Of his right to retain counsel		
(d). Of his right to remain silent		
(e). Of his right to have an attorney present during any interview with peace officers or attorneys representing the state		
(f). Of his right to terminate the interview at any time		
(g). Of his right to request the appointment of counsel if he is indigent and cannot afford counsel		
(h). Of his right to have an examining trial		
(i). That he is not required to make a statement and that any statement made by him may be used against him		
(j). The magistrate shall allow the person		

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arrested reasonable time and opportunity to consult counsel and shall admit the person arrested to bail if allowed by law		
n. Arrest for out-of-county offense	Discuss, explain, give examples	Article 15.18 Vernons Texas Code of Criminal Procedure
(1). One arrested under a warrant issued in a county other than the one in which the person is arrested shall		
(a). Be taken before a magistrate of the county where the arrest takes place		
(b). Who shall take bail, if allowed by law		
(c). And immediately transmit the bond taken to the court having jurisdiction of the offense		
o. Notice of arrest		Article 15.19 Vernons Texas Code of Criminal Procedure
(1). If the accused fails or refuses to give bail, as provided in preceding article		
(a). He shall be committed to the jail of the county where he was arrested		
(b). And the magistrate committing him shall immediately notify the sheriff of the county in which the offense is alleged to have been com-		

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mitted of the arrest and commitment, which notice may be given by telegraph, by mail or by other written notice		
p. Duty of sheriff receiving notice - shall forthwith go or send for the prisoner and have him brought before the proper court or magistrate	Discuss, explain, give examples	Article 15.20 Vernons Texas Code of Criminal Procedure
q. Prisoner discharged if not timely demanded. "If the proper officer of the county where the offense is alleged to have been committed does not demand the prisoner and take charge of him within ten days from the day he is committed, such prisoner shall be discharged from custody"		Article 15.21 Vernons Texas Code of Criminal Procedure
r. When a person is arrested, "A person is arrested when he has been actually placed under restraint or taken into custody by an officer or person executing a warrant of arrest, or by an officer or person arresting without a warrant"		Article 15.22 Vernons Texas Code of Criminal Procedure
s. Time of arrest - "An arrest may be made on any day or at any time of the day or night."		Article 15.23 Vernons Texas Code of Criminal Procedure
t. What force may be used - "In making an arrest, all reasonable means are permitted to be used to effect it. No greater force, however, shall	Discuss, give examples by citing actual cases	

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be resorted to than is necessary to secure the arrest and detention of the accused		
u. May break door - "In case of felony, the officer may break down the door of any house for the purpose of making an arrest, if he be refused admittance. After giving notice of his authority and purpose "		Article 15.25 Vernons Texas Code of Criminal Procedure
v. Authority to arrest must be made known:		Article 15.26 Vernons Texas Code of Criminal Procedure
(1). The warrant shall be executed by the arrest of the defendant		
(2). The officer need not have the warrant in his possession at the time of the arrest, provided the warrant was issued under the provisions of this code		
(3). But upon request he shall show the warrant to the defendant as soon as possible		
(4). If the officer does not have the warrant in his possession at the time of arrest he shall then inform the defendant of the offense charged and of the fact that a warrant has been issued		
3. Search and Seizure - <u>Constitutional History</u> - The law	The following is written verbatum since the information contained	Dallas, Texas Police Academy Manual on Search and Seizure

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of search and seizure. like the law of arrest, is founded upon principles contained in both the Constitution of the United States and the Constitution of the State of Texas. The harsh treatment received by the colonies with respect to their liberties and property rights resulted in the demand for a Bill of Rights upon the adoption of the Constitution of the United States in 1788. The Bill of Rights consisted of the first Ten Amendments to the Constitution, which were ratified by the states and became effective in 1791. While several provisions of the Constitution have been held to regulate the authority and conduct of Police Officers. the Fourth Amendment is the basic authority with respect to the laws of arrest, search and seizure. Amendment Four,. searches and seizures. Constitution of the United States. "The right of the people to be secure in their persons. houses, papers. and effects, against unreasonable searches and seizures shall not be violated and no warrants shall issue, but upon probable cause, supported by oath or affirmation, and particularly describing the place to be searched. and the persons or things to be seized." The early court decisions held	herein is not readily available to the student or teacher. It is suggested that the teacher reproduce said material, pass out to students, make the student responsible for the material by having a discussion and examination over material read and discussed. Discuss one section at a time - do not assign entire section for class reading	by: Inspector Edward Preston, Detective Edwin O. Heath. Jr

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that the provisions of the Constitution of the United States regulated the authority of federal officers. Prosecutions in the state courts were regulated almost wholly by rules of evidence and procedures of the individual states. The United States Supreme Court, in the decision of Mapp vs. Ohio, 367 U.S. 643. 81 S. Ct. 1684 (1961) held that the Constitutional protections of the Fourth Amendment were extended to persons prosecuted in the state courts by virtue of the "due process clause" of the Fourteenth Amendment to the Constitution of the United States. It also held that states must exclude any evidence seized as a result of an unlawful search or seizure. Amendment Fourteen. Constitution of the United States "Section 1 - No state shall make or enforce any law which shall abridge the priviledges or immunities of citizens of the United States. nor shall any state deprive any person of life. liberty or property. without due process of law: nor deny to any person within its jurisdiction the equal protection of the laws." The United States Supreme Court held that the right to provacy embodied in the Fourth Amendment is enforcable against the states		

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through the due process clause of the Fourteenth Amendment, and evidence obtained by unconstitutional searches is inadmissible in State prosecutions. The decision does not require the states to adopt the federal law or standards with respect to search and seizure but does exclude all evidence which is illegally seized as the result of an unreasonable search. The States, however, must now have reasonable standards on the admissibility of evidence regarding search and seizures, which standards will be measured and controlled by the provisions of the Constitution of the United States. This decision had little effect in Texas, since the State of Texas has had a similar constitutional provision since the adoption of the present Constitution in 1876. Article 1, Section 9, Searches and Seizures Constitution of State of Texas The people shall be secure in their persons, houses, papers, and possessions, from all unreasonable seizures or searches, and no warrant to search any place, or to seize any person or thing, shall issue without describing them as near as may be nor without probable cause supported by oath of affirmation . A similar provision is contained in the code of		

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Criminal procedure: Article 1.06 (4) CCP Searches and Seizures -- "The people shall be secured in their persons houses, papers and possessions from all unreasonable seizures or searches. No warrant to search any place or to seize any person or thing shall issue without describing them as near as may be nor without probable cause supported by oath or affirmation". The code of criminal procedure further provides that any evidence seized as a result of an unlawful search is excluded from evidence in a criminal prosecution in Texas. Article 38.23 (727a) CCP Evidence not to be used "No evidence obtained by an officer or other person in violation of any provisions of the Constitution or laws of the State of Texas, or of the Constitution or laws of the United States of America shall be admitted in evidence against the accused on the trial of any criminal case." "In any case where the legal evidence raises an issue hereunder, the jury shall be instructed that if it believes, or has a reasonable doubt, that the evidence was obtained in violation of the provisions of this Article, then and in such event, the jury shall disregard any such evidence so obtained."		Article 38.23 Vernons Texas Codeof Criminal Procedure

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a. Reasonable searches and seizures: (1). Only the results of unlawful searches and seizures are unreasonable (2). There are at least eight instances in which a search or seizure may be lawful: (a). By authority of a search warrant (b). Incidental to an arrest with a warrant (c). Incidental to a lawful arrest without a warrant (d). Searches and seizures of things in public places (e). Searches or seizures of places or things where the defendant has no status to complain (f). Consent searches (g). Where the matter is open to view (h). Under direction of a magistrate	Explain, discuss, give examples by citing cases	
(3). By authority of a search warrant (a). Authority to issue a search warrant is strictly controlled by statute (b). The following statutes authorize the issuance	Explain, discuss, give examples	Article 18.01 Vernons Texas Code of Criminal Procedure

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of a search warrant 1. General authority "A search warrant is a written order, issued by a magistrate and directed to a peace officer, commanding him to search for personal property, and to seize the same and bring it before such magistrate; or it is a like written order, commanding a peace officer to search a suspected place where it is alleged stolen property is commonly concealed or implements kept for the purpose of being used in the commission of any designated offense. No search warrant shall issue for any purpose in this State unless a sworn complaint therefore shall first be filed with the issuing magistrate setting forth sufficient facts to		

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satisfy the magistrate that probable cause does in fact exist for its issuance"		
2. When it may issue	Discuss, explain, give examples	Article 18.02 Vernons Texas Code of Criminal Procedure
a. To discover property acquired by theft or in any other manner which makes its acquisition a penal offense		
b. To search suspected places where it is alleged property so illegally acquired is commonly kept or concealed		
c. To search places where it is alleged implements are kept for use in forging or counterfeiting		
d. To search places where it is alleged arms or munitions are kept or prepared for the purpose of insurrection or riot		
e. To seize and bring before a magistrate any		Article 666-20 Vernons Texas Penal Code Annotated

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such property, implements, arms, and munitions 3. Liquor Law violations 4. Gambling law violations 5. Slot machine violations 6. Narcotics law violations 7. Bomb law violations	Discuss, explain, give examples	Article 663, Vernons Texas Penal Code Annotated Article 633, Vernons Texas Penal Code Annotated Article 642a Vernons Texas Penal Code Annotated Article 725b Vernons Texas Penal Code Annotated Article 1723 Vernons Texas Penal Code Annotated
(4). Incidental to an arrest with a warrant "Where an arrest is made with a felony warrant of arrest only the arresting officers may forcibly enter a residence and search the person of the arrested party and the area under his immediate control. If probable cause is found as to the existance of the other violations, then the officers may search the entire premises"	Prepare information sheets for pass out which sets out a brief of Barns vs. State, 390 S. W. 2d 206 (1964) Barns vs. Texas, 380 U. S. 253, 85 S. ct. 942 (1965) Abel vs. United States, 362 U. S. 217, 80 S. Ct. 632 (1960) Harris vs. United States, 33[illegible] U. S. 4[illegible] 67 S. Ct. 1098 (1947) Instructor should be familiar with the context of these case decisions	
(5). Incidental to a lawful arrest without a warrant "The courts have held that a search may be made incidental to a lawful arrest without a warrant. So long as the arrest is legal, any evidence seized incidental to the search is	Prepare information sheets for pass out which sets out briefs on the following case decisions: Johnson vs. State 3[illegible] S. W. 2d [illegible] (1966) Walker vs. State, 397 S. W. 2d 433 (1966) Rodriguez vs. State 397 S. W. 2d [illegible] (1965)	

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admissible as evidence. The arresting officer is not limited to the arrest violation only, but may seize <u>any</u> evidence of another violation to be used in evidence against the arrested person. An example of this rule may be found in numerous case decisions involving all types of offenses "	Ker vs. California 374 U. S. 23, 83 S. Ct. 1623 (1963) James vs. Louisiana, 86 S. Ct. 151 (1965) Instructor should be familiar with the context of these case decisions	
(6). Searches or seizures of things in public places "The courts have held that where evidence, stolen property or contraband has been abandoned or left on the property of another or in public places, such as on streets, in parks, or on playgrounds, the defendant may not claim the privilege of the Fourth Amendment to the Constitution. Police officers are <u>not required</u> to have a warrant or probable cause to search for or seize such property. Likewise, if evidence or contraband is dropped by a defendant or if it is thrown from a car, it is admissible because under these circumstances it is not found as the result of a search incidental to an	Discuss, explain, give examples	51 Tex. Jur. 2d Search and Seizure, Sec. 8 Rodrigues vs. State, 397 S. W. 2d 75(1965)

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arrest. The defendant has been held not to be in a position to complain against such a seizure"		Henley vs. State 387 S.W. 2d 877 (1964)
(7). Searches or seizures of places or things where the defendant has no status to complain. "The courts have held that a defendant has no status to complain where the search and seizure is made in the residence of another where he has no ownership interest and is not present at the time the search and seizure is made."	Discuss, explain, give examples	Jones vs. State, 388 S.W. 2d 429 (1965)
The same rule applies to the search of automobiles, and persons having no ownership interest in them or not occupying them at the time of the search have no position to complain about such search and seizure of eivdence. Formerly guests, invitees or visitors of the owner of a residence or an automobile had no status to complain about a search of the residence or automobile. However, the United States Supreme Court, in Jones vs. United States 362 U. S. 257, 80 S. Ct. 725 (1960), in most cases		Vines vs. State 397, S. W. 2d 868 (1966)

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extended the protection which is afforded owners to their invitees, guests or other occupants who are present and legitimately on the premises at the time a search is made		
(8). Consent searches - While a person is protected from unreasonable searches and seizures, he may consent to a search. The consent may be oral and may be given while the defendant is under arrest	Discuss, explain give examples	
(a). A consent search is not a confession, and there is no requirement that the defendant be warned of his rights prior to obtaining his permission to search, even when he is under arrest at the time the consent is given		Griffin vs. State, 159 Tex. Cr. R. 142, 261 S. W. 2d 838 (1953)
(b). The consent must be voluntarily given		Joslin vs. State, 165, Tex. Cr. R. 161 305 S. W. 2d 351 (1957)
(c). It is better procedure to obtain a written consent. No warning is required, but this written consent can help resolve any later conflict on the issue of consent		Phelper vs. State, 396 S. W. 2d 396, Cert. Den. 86 S. Ct. 387 (1965)

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(d). Who may give consent: 1. Husband or wife 2. Co-owners, partners in a business 3. Leasee consent binding on leasor 4. Borrower or lender consent is binding on the other in most cases 5. Consent to a search by one who is in charge or managing property would probably be binding on the owner since such person is an agent of the owner during his absence		Joslin vs. State, 165 Tex. Cr. R. 161, 305 S. W. 3d 351 (1957)
(9). Where the matter is open to view - "When a defendant commits a criminal offense in the presence of an officer, which offense is open to public view through a window or open door, the officer may enter without a warrant and arrest the defendant and seize any evidence open to view (a). It is not a search to observe that which is open to view	Discuss, explain, give examples by citing cases	Crowell vs. State. 147 Tex. Cr. R. 299, 180 S. W. 2d 343 (1944) Williams vs. State. 370 S. W. 2d 889 (1963) Gomes vs. State. 161 Tex. Cr. R. 589. 281 S. W. 2d 94 (1955) Gizzo vs. State. 160 Tex. Cr. R. 593, 272 S. W. 3d 898 (1955) Platt vs. State. 170 Tex. Cr. R. 483. 341 S. W. 2d 930 (1960)

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		Giacono vs. State, 372 S. W. 2d 328 (1963) Cert. Den. 84 S Ct. 92 (1963) Capuchino vs. State, 390 S. W. 2d 296 (1965) Gil vs. State, 394 S. W. 2d 810 (1965) Parsons vs. State, 160 Tex. Cr. R. 387; 271 S. W. 2d 643 (1953)
(10). Under the direction of a magistrate - "In Parsons vs. State the Texas Court of Criminal Appeals held that a justice of the peace who is called to the scene of a homicide investigation is not bound by the usual rules of search and seizure which usually apply to peace officers. The court held that the justice of the peace in his capacity as a coroner is charged with the duty of obtaining information as to whether the death was caused by some criminal act. The court also held that peace officers working with the justice of the peace had 'a duty to conduct the search at the scene of the homicide and to preserve evidence there found which might show that the death was the result of an un-	Discuss, explain, give examples by citing cases	

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lawful and criminal act "		
D. Admissibility of Evidence	Discuss, chalkboard, information sheets	
1. Evidence is said to be admissible when it meets the various tests which determine its reliability to be offered to the judge or jury.		
2. Tests of admissibility of evidence		
a. Relevant		
(1). It must have some probative value to logically influence the decision at issue in the trial	Give examples and explain	
(2). The evidence must prove an issue of fact or facts and should make more or less probable a fact question in issue	Ask questions of class	
(3). Evidence is irrelevant when it does not prove a fact or issue or has no logical connection to any question or issue in the trial		
b. Material		
(1). Material evidence must be a fact which has a substantial and legitimate relationship to the issues involved in the trial		
(2). The evidence offered must have some value to prove the issues involved or it will be held to be immaterial		

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(3). Immaterial indicates that evidence offered does not prove some fact in issue in the trial		
c. Requirement of first hand knowledge	Discuss and explain Give examples Ask Questions	
(1). The common law system of evidence insisted upon the most reliable source of information		
(2). One of the earliest rules required that a witness who testifies to a fact must have actually observed the fact, whether the fact proved is by direct or indirect evidence		
(3). The actual observation may be by any of the five senses of the witness		
d. Hearsay evidence		
(1). Hearsay evidence is that evidence which is offered in court of a statement made out of court to show the truth of matters contained in the statement		
(2). Normally excluded from evidence upon the objection of the adverse party unless it is a legally recognized exception to the hearsay rule and admissible as such.		
(3). Exceptions to the hearsay rule		

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(a). Confessions (b). Res Gestae (spontaneous declarations) (c). Dying declarations (d). Declaration as to body condition	Explain, discuss and give examples	
(e). Declarations as to a state of mind (f). Declarations and statements against interest (g). Business records (h). Opinion evidence	Class discussion	
(4). Confessions in criminal cases are admissions of guilt by the accused	Question class	
(5). Res Gestae are spontaneous declarations, either by a witness or the accused, based on impulse and caused by excitement or a startling event		
(6). Dying declarations are those statements of a person now deceased as to the cause or events of his death (a). May be offered in evidence, either for or against a defendant charged with the homicide of such deceased person (b). Declarant must be concious of approaching death, and believe there is no hope of recovery		

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(c). That such declaration was voluntarily made, and not through the persuasion of any person (d). That such declaration was not made in answer to interrogatories calculated to lead the deceased to make any particular statement (e). That he was of sane mind at the time of making the declaration (7). Declarations as to body condition (a). Include statements made by a person as to his health, general feelings, injuries (b). Made in a natural and unsolicited way for purposes other than litigation (8). Declarations as to state of mind (a). Include statements which describe a present mental or emotional condition of feeling (b). These are often used to prove premeditated intent in a criminal case and may be circumstantial evidence of guilt		Moore vs. State, 127 Tex. Cr. R. 637, 78 S. W.. 2d 189 (1935)

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(9). Declarations against interest (a). The civil counterpart of a confession (b). In criminal cases they may be made where a person is not under arrest or where he is not a suspect in a criminal case (10). Business Records (a). Documents which are regularly kept or received in a business (b). Normally the custodian of these records must show by oral testimony that the record offered in evidence was received in the normal and regular course of business (11). Opinion evidence (a). The inference or conclusion or conclusion of a witness (b). Normally, only expert witnesses may give opinion evidence (c). This witness has special knowledge, training or experience to reliably state an inference, opinion or conclusion		

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3. Best evidence, secondary evidence rule a. Applies only to the contents of written documents b. The rule requires that the original document, paper, manuscript, etc. be admitted into evidence because the original is the best possible evidence c. Carbon copies, photographs or other type of reproduced copies may, however, be properly admitted into evidence where the original is destroyed or lost, in the possession of an adverse party or where for some other reason the document cannot be presented in court	Explain and give examples	
4. Judicial Notice a. Is that notice or knowledge of a fact or facts which a judge will accept without the requirement of formal proof by one of the parties to the case b. Judges will take judicial notice of the law of the U. S. and the State of Texas, but city ordinances must be offered into proof	Class discussion and questions Give quiz	Sanchez vs. State. 385 S. W. 2d 851 (1964)
E. Texas Court Systems 1. What courts have criminal jurisdiction a. The court of criminal appeals b. The district courts	Discuss, chalkboard, information sheets Visual aid - Chart listing courts in order Invite magistrate to discuss this if	Articles 4.01 through 4.16 Vernons Texas Code of Criminal Procedure Annotated

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c. The criminal district courts	possible	
d. Courts of domestic relations where they have criminal jurisdiction by legislative enactment		
e. The county courts		
f. All county courts at law with criminal jurisdiction		
g. County criminal courts		
h. Justice courts		
i. Corporation courts		
2. Function and jurisdiction of the criminal courts of Texas		Article 4.03 Vernons Texas Code of Criminal Procedure Annotated
a. Court of criminal appeals	Discuss with class and explain	
(1). Shall have appellant jurisdiction coextensive with the limits of the State in all criminal cases		
(2). This article shall not be so construed as to embrace any case which has been appealed from any inferior court to the county court, the county criminal court, or county court at law, in which the fine imposed by the county court, the county criminal court or county court at law shall not exceed one hundred dollars	Have class discussion and questions	
(3). If the fine does not exceed one hundred dollars, exclusive of cost, the judgment of the county court, county criminal court or county court at		

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law shall be final when they are acting as appellate courts		
b. District courts		Article 4.05 Vernons Texas Code of Criminal Procedure Annotated
(1). District courts and criminal district courts shall have original jurisdiction in criminal cases of the grade of felony		
(2). Any of all misdemeanors involving official misconduct		
c. County Courts		Article 4.07 Vernons Texas Code of Criminal Procedure Annotated
(1). The county courts shall have original jurisdiction of all misdemeanors of which exclusive original jurisdiction is not given to the justice courts		
(2). And when the fine to be imposed shall exceed two hundred dollars		
(3). Appellate jurisdiction of county courts - The county courts shall have appellate jurisdiction in criminal cases of which justice courts and other inferior courts have original jurisdiction		Article 4.08 Vernons Texas Code of Criminal Procedure Annotated
d. Jurisdiction of Justice courts - Justices of the peace shall have jurisdiction in criminal cases where the fine to be imposed by law may not exceed two hundred dollars		Article 4.11 Vernons Texas Code of Criminal Procedure Annotated

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e. Corporation courts (1). The corporation court in each incorporated city, town or village of this State shall have jurisdiction within the corporate limits in all criminal cases arising under the ordinances of such city, town or village (2). and shall have concurrent jurisdiction with any justice of the peace in any precinct in which said city, town or village is situated in all criminal cases arising under the criminal laws of this State, in which punishment is by fine only, and where the maximum of such fine may not exceed two hundred dollars, and arising within such corporate limits		Article 4.14 Vernons Texas Code of Criminal Procedure Annotated
F. Court preparation and appearance 1. Seven steps in case preparation: a. Finding the facts b. Recording the facts c. Selecting the charge d. Translating notes to formal report e. Preparing case folder f. Interviewing prosecutor and witnesses g. Preparing to testify in court	Discuss, chalkboard, information sheets Field trip to observe some court in session if possible Explain and give examples	Manuscript on case preparation by Wallace D Beasley, Director Texas Commission on Law Enforcement Officers Standards and Training, Austin, Texas

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2. Case preparation a. Finding the facts (1). Constitutes very foundation of the case (2). Calls for a thorough examination of the five W's and the H: Who, where, when, why and how		
(3). In applying the five W's and the H of case preparation the investigating officer should concern himself with the following questions: What: --crime was committed? --action was taken by suspect? --do the witnesses know? --evidence was obtained? --was done with the evidence? --tools were used? --knowledge, skill or strength was needed to commit the crime? --means of transportation to and from scene? Who: --was the victim? --made the report? --discovered the crime? --saw or heard something? --had a motive for crime? --committed the crime? --marked the evidence? Where: --was crime discovered?	Discussion, chalkboard, overhead projector Explain and give examples	

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--was crime committed? --were tools or weapons obtained? --was victim last seen? --was suspect last seen? --was witness? --did criminal live? --did he hang out? --is he likely to go? --was evidence marked? --was evidence stored? When: --was crime committed? --was crime discovered? --was crime reported? --did police arrive at scene? --was victim last seen? --was suspect last seen? Why: --was crime committed? --were certain tools or weapons used? --was crime reported? --was witness reluctant to talk, if so? --was witness anxious to talk, if so? How: --was crime committed? --did criminal get to scene? --did he get away? --did he obtain information needed to commit crime? --was crime discovered? --were tools or weapons obtained?		

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b. Recording the facts:	Explain and discuss Ask questions	
(1). Usually carried out simultaneously with step one		
(2). Tools for step two: pencil, notebook, and camera		
(3). All information should be recorded on a field sheet or in a notebook, it is too important to trust to memory	Overhead projector	
(4). Another important reason for recording the facts at the scene of a crime or accident, these original notes may be used to refresh the investigators memory when testifying in court	Passout material Discuss and explain	
(5). An investigator should review his notes prior to giving testimony		
(a). Don't memorize		
(b). Get facts in mind		
(c). Prevents differences in testimony where more than one officer is testifying to same case.		
(6). Legibility in notetaking very important		
(7). In recording notes at the scene, special attention should be given to physical evidence		
(a). Record where it was found, who found it, and		

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when it was found. (b). Never let physical evidence out of your hand without getting a receipt, you must establish a continuous chain		
(8). Photograph (a). One of the best methods of recording facts at scene of crime (b). Must be introduced as part of testimony of a witness (c). Used to establish a fact issue or to help establish a fact issue (d). They must be an accurate portrayal of facts (e). Person taking photographs must be able to testify as to methods used and equipment used (f). Photographs must be identified	Explain and give examples Chalkboard Overhead Projector Passout material	
(9). Diagrams (a). Very useful to assist in explaining facts to grand jury or trial jury (b). Should be drawn to scale after accurate measurements have been made and recorded		

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(10). Voluntary statements and confessions (a). Taken according to form prescribed by law (b). Sworn affidavit may be introduced in lieu of witness testimony under certain conditions		
(11). Tape recorder very useful to record conversation for future study and analysis		
(12). Polygraph (a). Very useful for recording psycho-physiological responses (b). Testimony of examiner may be used on stipulation (c). A very important aid to the investigator	Field trip to observe machine in operation. Have technician explain how machine works Test on field trip Discuss with class and explain	
c. Selecting the charge (1). Must be familiar with criminal statutes (2). Consult advise of county or district attorney (3). Remember every offense has its particular elements which must be proven (4). Remember the corpus delicti rule of evidence		
d. Translating field notes to formal report (1). Basic principles to be followed (a). Make reports complete, accurate and factual		

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(b). Complete reports as soon after investigation as possible (c). Be sure that reports are neat and legible (d). Recheck report and notes for possible errors or omissions		
(2). The "why" of report writing (a). It furnishes a complete and permanent record (b). Furnishes clues that lead toward identification and apprehension of criminals (c). Enables superior officer and prosecutor to review work of investigator (d). Provides information concerning the offense (e). Furnishes information for statistical purposes (f). Is of use in preparing department budget (g). Makes the department look more efficient to the public (h). Helps officers keep up with repeaters (i). Furnishes a guage by which the efficiency of officers can be measured (j). Is vitally essential in preventing crimes and	Field trip to records and I. D. section of local agency. Class discussion Test on field trip	

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accidents (k). Form the basis for selective enforcement work (l). Preparing the case folder: 1. What should be placed in the case folder? a. Original reports made from field notes b. Statements of witnesses c. Statements of victims d. Copy of confession e. Fingerprint card on report from fingerprint expert f. Reports on physical evidence submitted to crime lab g. Suspects criminal record h. Photographs of crime scene, mug shots, etc. i. Diagram of crime scene j. Any documentary evidence you need to keep e. Interviewing witnesses and prosecutor		

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(1). Importance (a). Renews prosecutors' interest in the case (b). Prosecutor will be able to make some helpful suggestions for further investigation that will help in preparation for court (2). The prosecutor should know all the facts the officer is going to testify to (3). Interviewing the witness (a). What should the witness be questioned about? 1. What happened 2. What did he see 3. What did he hear 4. What he is intending to say in court 5. What other person has talked to him about the case 6. What did the witness tell the others	Invite prosecutor to class for discussion	
f. The officer's conduct in court (1). When should an officer start thinking about his conduct in court (a). At the very outset of the investigation (b). A thorough investigation at the scene of the crime will often determine whether he will be an intelligent	Invite magistrate to class for discussion Explain and discuss Give examples	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
witness or a poor one (2). Why should officers give special attention to their appearance in court? (a). The officer stands out more in eyes of the judge, jury and others in court room than any other witness (b). The judge and jury inevitably take into consideration the personal appearance of the officer in giving weight to his testimony		
(3). Attention should be given to the following: (a). Uniform and clothes clean and neat (b). Shoes shined (c). Face shaven (d). Fingernails clean (e). Posture has a lot to do with appearance; sit errect, but not stiff when giving testimony (f). Avoid nervous mannerisms: scratching head, picking teeth, chewing gum, holding hand over mouth	Discuss, explain, give examples	
(4). Speak distinctly (a). Don't shout (b). Direct speech to judge and jury		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(5). Tell the truth		
(a). A person who tells a lie under oath while testifying commits perjury		
(b). Self respect means more than winning a case		
(6). Correct errors		
(a). Honest errors are made but should be corrected immediately		
(b). Strengthens the case		
(7). Courtesy in court room		
(a). Best weapon against a shrewd defense lawyer		
(b). Do not loose temper		
(c). Be courteous to both sides		
(d). Do not regard the defense lawyer as an enemy		
(e). Don't get in a hurry while testifying		
(f). Avoid volunteering information		
(g). Avoid air of self importance		
(h). Avoid acting bored when taking the oath		
(i). Avoid expressing personal opinions	Give quiz	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
IV. Traffic procedures A. Introduction to Traffic Law Enforcement 1. Objectives a. To identify the so-called "Traffic Problem" b. To develop an understanding of the National Official Control Program c. To see what Texas does to solve this traffic problem 2. Definition a. Traffic management (1). Traffic management in the broadest sense, is the regulation and control of all elements of highway traffic so as to achieve efficient operation. A traffic management program includes all activities of government and organized citizens designed to effect efficient (roped, safe and economical) operation of the highway transportation system (2). Traffic management. in a restricted sense, is the direction, leadership and coordination of the activities of all government agencies, and citizen groups dealing with motor vehicle highway traffic in order to achieve maximum results from	Discuss, chalkboard, prepared information sheets, overhead projector Invite safety officer from Dept. of Public Safety to lead discussion IV. A. "Traffic Procedures if feasible: or explain and discuss Secure passout material from D. D. S.	Paper on "Introduction to Traffic Management" by Texas Department of Public Safety Personnel and Training Division, Austin, Texas

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
their efforts to provide efficiency in the highway transportation system.		
3. History		
a. First internal combustion motor about 1875		
b. First horseless carriage about 1896		
(1). First recorded motor vehicle traffic accident in 1896		
c. First motor vehicle traffic death about 1907.		
d. Motor vehicles first assumed importance in our way of life about the time of World War I		
e. Today, our way of life is based on the motor vehicle		
4. Size		
a. Made up of three component parts	Discuss, compare, relate to prior years and other states statistical data	Secure the statistics from Texas Department of Public Safety
(1). Driver		
(a). Texas has _____ licenses drivers		
(b). Anybody's guess as to how many unlicensed. Over a million if you court those who rarely drive		
(2). Roadway		Secure these statistics from Texas Department of Public Safety
(a). Total Miles		
(b). State & Fed. Miles		
(c). Farm-to-Market Miles		
(d). Paved county roads Miles		
(e). City streets Miles		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(3). Vehicles (a). Registered motor vehicles - _____ (b). _____ of these are trucks b. Travel in Texas in 1959 added up to _____ vehicle miles.		
5. Importance a. Use of motor vehicle has changed our way of life (1). Increased our ability to go where we want to go, when we want to go, and at an increased speed (2). Reduced the cost of many things (3). Made many things available in every town (a). Fresh vegetables: trucks haul 89% of farm products, 95% of citrus crop (4). 95% of passenger miles by motor vehicle (5). 75% of all freight b. Motor vehicle and kindred industries make up largest single block of our economy (1). Wages paid and materials bought amount to above 25% of total in Texas (2). One pay check in six is based on trucks alone 500,000 jobs	Discuss, explain, relate, give examples	
6. The problem	Discuss, explain, g e examples	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
a. Symptoms which prove that we have a problem (1). Accidents (a). Frequency 1. Total 2. Property damage 3. Personal injury a. Injured people 4. Fatal a. Killed people (b). Cost in Dollars in Texas 1. 1935 - $60 million - $ million (2). Congestion (a). Leads to loss of time (b). Major sympton is lack of place to park (c). Economic loss due to congestion is more than the dollar cost of accidents (3). Fatalities stay about the same 1935 1,864 1940 1,757 1950 2,410 b. The one ingredient still lacking despite the fact that many groups have studied and worked at the problem (1). That ingredient is Top Management (a). Other transportation systems must have it to survive		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(b). Same factors involved in the highway transportation system as in private industry 1. Units - Cars, trains, ships, planes 2. Operators - Drivers, conductors, captains, pilots 3. Facilities over which they operate - Roadways, rails, channels, airways c. Statement of problem (1). How to correlate all activity in the field of traffic safety to provide an efficient (safe, rapid, economical) highway transportation system (a). This is the end product of management d. Who must manage - only government can do it		
7. The solution a. Philosophy of management (1). Elements of the system (a). Drivers 1. If all drivers were as good as the best, we would reduce accidents 90% (b). Vehicles - possible reduction of 10% (c). Roadways - possible reduction of 50%	Discuss, explain, give examples	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(2). All interested agencies direct their activity toward one of these elements (3). Management's job is to correlate these activities (4). Must be a function of the top level of government		
8. Tools to work with a. The action program (1). Came out of "President's Highway Safety Conference" (a). First organized in 1946 (b). Now called "President's Committee for Traffic Safety" (c). Bore fruit in 1949 (2). Now accepted as the blue-print for traffic safety (3). Outlined eight areas in which there must be major and coordinated activity (a). Said what must be done in each (b). Said who must do it (c). Provided some standards that say how must must be done b. The eight areas: How Texas ranks in each (1). Laws and ordinances (a). Passed by legislatures (b). Should be uniform (c). Should be reviewed periodically (d). Must be uniformly interpreted and enforced	Discuss, explain, give examples	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(e). How do we compare 1. No basis for numerical comparison with other states a. We need: chemical test law, new speed law, new drivers license law, new accident reporting laws, court system, driver education in high schools 2. Accident records a. Kept at State and City level b. Must be uniform c. Must be utilized 1. Analysis of records 2. Information furnished to all interested agencies d. How do we compare 1. 82% of recommended minimum performance a. Need is mainly in personnel. Minimum standard is .7 people	Discuss, give examples	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
per 1000 reported accidents -- we have .2 persons		
3. Education a. Elementary schools b. Secondary schools c. Colleges d. How do we compare 1. Achieve 71% of recommended performance 2. Need more Driver Education in high schools a. 49% of schools now offer approved course b. 29% of 9th grade students get approved course	Discuss, give examples	
4. Enforcement a. Consists of two groups 1. Police 2. Courts b. Most other areas depend heavily on enforcement		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
c. How do we compare 1. Adequate court system badly needed 2. Police rate 82% of minimum performance a. Need more manpower, better salaries, shorter hours, improvement in accident investigation rates, more chemical tests in DWI cases and better training for supervisors		
5. Engineering a. The vehicle b. The roadway c. Traffic control devices and systems d. How do we compare 1. Better off here than in any other area. We rate 90% of	Discuss, give examples	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
minimum standards		
6. Motor Vehicle Administration		
a. Includes:		
1. Driver licensing		
2. Motor vehicle inspection		
3. Financial responsibility		
4. Certificate of Title and Registration		
b. Should be uniform	Discuss, give examples	
c. How do we compare		
1. Driver licensing 84% of minimum standards		
2. Motor vehicle inspection - One of 15 states having Motor Vehicle Inspection 93% compliance		
3. Financial Responsibility - o.k. here - ours is about standard. Enforcement often fails because of lack of interest		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
on part of prosecutor or court 4. Certificate of Title and Registration - Standard Certificate of Title Law. Liberal reciprocity on registration		
7. Public Information a. Involved all news media b. Should be coordinated c. Should be factual and in keeping with known and accepted facts 1. Editorials and feature stories often written without knowledge of the complete picture d. How do we compare 1. 49% of minimum performance 2. Need clearly defined program, which gets back to	Discuss, give examples	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
need for top management 8. Official coordination and organized public support a. Appraise existing conditions b. Acquaint the public with facts c. Lend support to worthy objectives and activities of public agencies engaged in traffic activity d. Furnish leadership and coordination to all civic groups showing interest in traffic safety e. How do we compare 1. Rate 69% of minimum performance 2. Next year will probably show improvement		
B. Officer - Violator relations 1. Your task in dealing with violators has two parts a. An immediate objective, which is to take some kind of enforcement action against the	Lecture - illustrations, practical demonstrations and applications in classroom	Traffic Digest and Review - Department of Public Safety printed materials

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
driver		
b. An ultimate objective, which is to change his future driving behavior		
2. What you do positively during your interview with the violator to develop good driving behavior is very important, you can, by your actions and manner, win a strong supporter for good driving behavior or you can create an active or passive enemy		
3. Principles of human behavior important in officer violator relations		
a. People differ in:	Explain and discuss - examples, chalkboard explanation	
(1). Development of their various senses, such as sight, smell and hearing		
(2). Physical skills, such as ability to shift gears, throw a ball or drive a car	Demonstrate or illustrate if feasible	
(3). Mental abilities, such as reasoning and memory	Explain and discuss	
(4). Character, which is made of such traits as arrogance persistence, introversion or extroversion. It is usually the organization of these traits in meeting social situations which defines character	Lecture with explanation and discussion	
(5). Will to do, or motivation, which usually varies from one time to another	Lecture with explanation	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(6). Attitudes, which are how they feel about people, things and situations	Define,. lecture and discuss	
4. Motives are the chief "whys" of behavior. They usually determine what behavior will result from a given situation. Motives are constantly changing	Examples, lecture discuss	
5. Although motives change, the following are almost always present in most people, and it is important to consider them when dealing with violators	Lecture	
a. We all like to feel important and worthwhile		
b. We like to have people treat us with respect, to listen to our opinion and by action defer to us		
c. We like to feel we are free agents; that we can do as we want and say what we please		
d. We like to feel our opinions and ways of doing things are the best		
e. We like to feel secure and free from arbitrary actions which may be unpleasant to us		
(1). Motives are important mostly because of what happens when a person is prevented from getting what he wants		
(2). If a person becomes emotionally upset, phychologists call it		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
frustration (3). This distrubance often takes the form of arguing, insulting, name calling, or in extreme cases, actual physical violence, usually this behavior is not rational		
6. The violator may have many beliefs and attitudes concerning traffic law enforcement which are quite different from the officers a. He knows more about the traffic situation and its solution than the officer b. Arrest are made for revenue, which is received by the officer or the department c. The officer is an arrogant bully showing authority. Police are arbitrary and unreasonable d. Police are generally corrupt and dishonest e. The officer has a quota of arrests to make f. His rights are being infringed upon	Discuss, give examples	
7. The officer may feel: a. The violator is another stupid driver making another stupid mistake b. The officer has been personally offended by the violators action c. The violator is trying to get away with something	Discuss, give examples	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
d. The officer has to make arrests to obtain public respect (1). Differences in attitudes motivations or point-of-view between the officer and violator may lead to violent disagreement over matters which do not pertain to the violation (a). Neither is in a frame of mind to welcome compromise (b). You are influenced by your own experiences which determine how you interpret what you see and hear (2). The officer responds to motivations and attitudes in the same manner as the violator (a). There is one important difference: "The officer is in a position by virtue of his formal authority to relieve his emotional tensions by taking them out on the violation "		
8. Rules for talking to the violator a. Get your emotions under control (1). Don't begin interview under a handycap (2). Take time to compose yourself before approaching violator	Examples, discuss Information sheets prepared by instructor	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(3). Your attitude will set the stage for the entire interview		
(4). Use the "cooling off" period to write down license numbers	Have class discussion	
b. Let the violator talk		
(1). It helps relieve emotional tension		
(2). Often takes considerable effort to listen		
(3). Letting violator talk helps put him in frame of mind to listen to your instructions		
c. Don't argue, berate or threaten the violator	Examples, discuss	
(1). Such actions only tend to increase the violator's emotional tension		
(2). Keep your remarks neutral in nature and as few as possible		
d. Be courteous and respectful		
(1). Avoid actions which make violator feel inferior		
(2). Tone of voice, facial expressions are important in showing real courtesy and respect	Question class, have class discussion	
(3). Anything which tends to hurt a person's ego produces emotional response of the highest order		
e. Request compliance		
(1). Use request words such as "May I" "Please" and		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
"Kindly" when directing the violator		
(2). These words recognize the dignity of the individual and utilize the natural desire to follow		
f. Avoid telling violator what not to do		
(1). Negative directions conflict with the natural desire for freedom of action and are contrary to the way we usually think		
(2). Phrase your requests and instructions in a positive way		
(3). Whenever possible, explain why you want him to do it.		
g. Don't allow the violator to get on the defensive	Examples	
(1). Never open your conversation with:	Explain	
(a). "Don't you know . . ."		
(b). "Where do you think you're going?"		
(c). "Who do you think you are?"		
(d). "What's your hurry?"		
(2). Questions like these cannot be answered intelligently		
(3). The violator is moved to defend his actions		
(4). Often through the process of excuse making, the violator conceals the real reason from himself		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
h. Watch for signs of emotional disturbance		
(1). If any detected might be well to postpone or eliminate certain phases of your instructions	Explain and give examples	
(2). People in a state of emotional tension are not receptive to new ideas or instructions		
9. Make your actions and procedure correct		
a. Be alert at all times for the unexpected		
(1). You never know who you are stopping in most instances, or what they may have previously been involved in		
(2). Use caution in approaching the violators car	Show film on "routine stops"	Department of Public Safety film library, Austin, Texas
(3). Other moving traffic poses a constant threat	Tell class what to watch for and give short test after film	
(a). Stop the patrol car approximately 8 feet to rear of violators vehicle off set to the left approximately 3 feet		
(b). Jot down license of violator vehicle before leaving patrol car	Explain and give examples	
(c). Radio dispatcher of your location giving him the license number make model of violator vehicle		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
b. Take time to get ready to talk with violator		
(1). Know what you are going to do and say before you begin the contact		
(2). Have any equipment you will need such as flashlight, clipboard or citation pad with you		
(3). Review the facts of the situation which led to your stopping the violator before you begin to talk		
c. The appearance of your uniform. equipment and person help create the violators impression of you		
(1). A neat. clean uniform, properly worn. and a well-groomed person will create a good impression	Discuss	
(2). A dirty uniform. unshaven face. tilted hat or open coat will give a bad first impression	Class discussion	
(3). Such impressions are often the difference between a successful and unsuccessful contact	Questions	
d. Greet the driver courteously but in a business-like manner	Explain	
(1). Your greeting should be extended in the most natural manner for you		
(2). Introduction of yourself and department		

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(3). Strive to put the violator at ease and establish a common ground free of affectation, superiority or deference		
e. Decide what enforcement action you are going to take before you approach the violator.		
(1). Any lessening or increasing of the charge should be based on a re-evaluation of conditions or circumstances		
(2). Examples - "You stop a man to warn him for minor traffic infraction and find he has no drivers license." "You stop a man to give him a citation for speeding and find he is enroute to the hospital "	Explain, give examples	
f. Make a direct and positive statement: "Sir you were going 70 MPH in a 60 MPH zone. A notice to appear for speeding will be issued, may I see your drivers license, please?"	Class discussion Question class	
(1). Try to avoid the use of the word "I" as much as possible		
(2). This tells the driver what he did and what you are going to do about it		
(3). Your decisiveness will eliminate any idea that you can be talked out of the citation		

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(4). You also create the feeling that you know what you are talking about which helps to avoid argument		
(5). Never keep the driver in doubt about what you intend to do		
(6). Remember it is not the officers perogative to pass judgment, to punish, or to embarrass the violator		
g. Identify every violator you stop by requesting his drivers license	Explain	
(1). Ask for the drivers license Do not put your head or arms in the car window	Discuss with class and give examples	
(2). While waiting for the license ask the driver. "What is your name, sir?"		
(3). Take the license. Never accept anything other than the papers requested		
(a). Ask that it be removed from the billfold or other container		
(b). Do not reach into the car to accept the papers		
(c). Have the driver hand them to you outside the window		
(4). Check drivers license data	Discuss and give examples	
(a). Compare the name on the license with the name the driver gave		

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(b). Ask the driver where he lives "now" and compare the address he gives you with the one on the license (c). Compare the physical description on the license with the driver (d). Look for restrictions, expiration date, evidence of alterations of name, age and description (5). Check registration data (6). Do not return license until you are about to terminate the interview		
h. When you have the required information. begin to write citation or warning (1). You may go to the rear of violator's car on the shoulder side and to the right (2). This position will minimize the opportunity for argument or fruitless discussions (3). It will also place you in a position to check the registration place (4). You will be protected from passing traffic in this position. and if the violator leaves his car, he too will be in a safe spot	Discuss and explain, chalkboard, overhead projector, illustrate	

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(5). Do not enter violator's car unless it is necessary to search it or move it to another position		
(6). Also do not allow the violator to enter the police car unless he is under custody arrest		
(7). If the weather is bad, return to your car to write the citation		
i. When you have finished writing the citation:	Illustrate - Demonstrate, discuss, explain	
(1). Return to violators car		
(2). Have him sign citation		
(3). Explain where to sign, where he is to go and to whom		
(4). If he objects to signing, explain to him that his signature only means that he promises to appear instead of "my having to arrest you"	Ask questions "May use role playing method for this section"	
(5). If he still rejects, don't become impatient or sarcastic		
(6). Advise him, "Your refusal to sign will require me to take you directly to the office of the judge"	Explain	
j. Give the citation to the driver separately from the other papers you are holding. Identify each paper as you hand them back	Demonstrate	

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k. Be sure the violator understands your instructions (1). Do not discuss probable bail or probable penalties (2). Avoid any suggestions that he engage counsel or how he should plea	Explain "why"	
l. When you are certain the driver understands what he is to do, close the interview. However, be careful not to give the violator the impression you are sorry you gave him the citation	Explain "why"	
m. Help the driver get safely back into traffic	Demonstrate, explain	
n. When violator leaves, don't follow him (1). He may feel you are just waiting to nab him again (2). Either turn around and patrol in the opposite direction or move around him and go on your way	Discuss results of field trip on return to classroom -- Quiz on field trip	
C. Techniques of traffic supervision 1. Traffic road checks a. Special purposes of traffic road checks (1). To detect concentrated, specific violations (2). To detect violations of Driver License and Registration Laws (3). To detect faulty lighting or mechanical equipment	Discuss, chalkboard, information sheets prepared by instructor Explain "why"	Training manuscripts from Texas Department of Public Safety, Personnel and Training, Austin, Texas and Police Training Division, Engineering Extension Service, Texas A&M University. The Patrol Operation, by George W. O'Conner and Charles G. Vanderbosch International Chiefs of Police, Inc. Washington, D. C.

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(4). To detect drivers whose operator's license has been suspended or revoked		
(5). To inspect the load or cargo of commercial or transportation vehicles for load weight, size and compliance with other legal requirements		
b. Types of traffic road checks	Explain "why"	
(1). Physical barriers - use only in emergency		
(2). Officer directed road checks (several officers)	Give examples	
(3). Single unit road checks		
(4). Blockades for wanted vehicles		
2. Stationary traffic observation		
a. Definition: Traffic observation at a selected place usually one with unfavorable accident experience or traffic flow	Explain fully	
problems, for traffic law enforcement purposes, especially to detect violations and deter possible violations	Illustrate	
b. Types of stationary observations		
(1). Conspicuous traffic observation - Stationary observation in which the observer tries to attract attention by keeping in full view of traffic		
(2). Visible traffic observation - Stationary observation in which the observer is in full view but is located, for example, on a side street.	Give examples	

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as to require effort on the part of traffic to discover the observer		
(3). Concealed traffic observation Stationary observation in which the observer is not visible to persons using ordinary powers of observation from the roadway being used	Explain "why"	
(4). Policy (a). Conspicuous (b). Visible (c). Concealed	Discuss, explain	
3. Open or moving patrol		
a. Definition: walking or driving around a post or certain area for the purpose of guarding or inspecting	Give examples Illustration	
b. Specific purposes		
(1). Deterring violators	Demonstrations	
(2). Detecting and apprehending violators		
(3). Observation and reporting of traffic conditions		
(4). Observing road conditions, including view obstructions which need attention		
(5). Providing service to the public		
4. Miscellaneous		
a. Reports or complaints: From citizens, in person, by telephone	Give examples Use samples as teaching aids	
b. Accident investigation - Find evidence of violation committed		

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c. Information sources: From established contacts such as route men for bakeries, dairies and other deliverymen, all night restaurant operators, garages and wrecker services	Give quiz	
D. State Traffic Code 1. Accidents a. Accidents involving death or personal injury (1). Requirements (a). Shall stop (b). Give reasonable assistance -- getting person medical aid 1. Necessary aid 2. Requested aid (c). Shall give name, address, registration number, and exhibit operator's license, if requested (2). Penalty (a). Penitentiary - not to exceed 5 years (b) Jail - not to exceed 1 year (c). Fine - not to exceed $5,000 (d). Automatic suspension of operator's license	Discuss with class, chalkboard, information sheets on Texas Traffic Code Texas Uniform Traffic Code used throughout this section	Art. 6701d R.C.S. Texas Uniform Traffic Code Sec. 38
b. Accidents involving damage to vehicle (1). Requirements		Art. 6701d R.C.S. Sec. 39

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(a). Shall stop (b). Remain until compliance with section 40 (c). Shall not obstruct traffic		
(2). Misdemeanor penalty		R. C. S. 6701d Sec. 41
c. Duty upon striking unattended vehicle (1). Requirements (a). Shall stop (b). Locate operator or owner and give name and address or leave note in conspicious place in or on vehicle, giving the above, also statement of circumstances		
d. Duty upon striking fixtures upon the highway or adjacent thereto (1). Requirements (a). Stop	Discuss with class	R. C. S. 6701d Sec. 42
(b). Locate owner or person in charge	Explain in detail	
(c). Give name and address, registration number, exhibit operator's license, and make accident report		
(2). Accident reporting (a). Immediate report of accident. Where death or personal injury results (by quickest means of communication shall give notice)		Art. 6701d R. C. S. Texas Uniform Traffic Code Sec. 43

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1. In inside of city limits, to the city police 2. If outside the city limits, to the Sheriff or Highway Patrol		
(b). Written report of accidents 1. If death or injury results, or there is property damage of $25.00 or more, written accident report must be made to Department of Public Safety within 10 days	Pass out drivers confidential accident report forms	
(c). Accidents occuring on streets and privately owned access ways and parking areas provided by business establishments without charge, for the convenience of their customers, clients, or patrons, but not privately owned residential property or to the property of any garage or parking lot where a fee is charged for the privilege of parking or storing a motor vehicle 1. When such accident results in injury to or death or death of any person, or total	Discuss, give examples	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
property damage to an apparent extent of Fifty Dollars ($50) or more 2. Officers may investigate the accident and file any justifiable charges relating thereto without regard to whether the accident occured on a public street or highway or other public property or on private property commonly used by the public such as supermarket or shopping center parking lots, parking areas provided by business establishments for the convenience of their customers, clients. or patrons, parking lots owned and operated by the State or any other parking area owned and operated for the convenience of, and commonly used by. the public		
(3). Rate and speed of vehicle (Prima facie law) (a). Passenger cars	Discuss prima facie speed - explain	Text R. C. S. 6701d Sec. 166

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
1. Day - 70 mph 2. Night - 65 mph (b). Trucks - 65 mph (c). Buses 1. Passenger bus - 70/ 65 mph 2. School bus - 50 mph day and night		
(d). Trailers with metal tires - 15 mph	Discuss and explain	
(e). Other provisions of this law 1. Definition of day - that period of time between 30 minutes of sun-up to 30 minutes after sun-down 2. Reasonable and prudent speed with due regards to special hazards such as weather, traffic, streets, etc.		
3. Speed zones - city can zone speed down or up. State Highway Department can zone portions of highway	City ordinance - explain	
4. Officers must specify alleged and legal speed on speeding tickets		
(f). Speed of vehicles drawing two trailers, operating outside the city		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMAT
limits and used exclusively in actual harvest of perishable fresh fruits and vegetables are not to exceed 25 miles per hour 1. The origin of fruits and vegetables must be an orchard or a packing or processing plant or shed not more than fifty (50) miles distant from such field or orchard 2. The combination of vehicles must be operated only during the period from sunrise to sunset 3. The fruits and vegetables transported in such trailers must be in bulk or field crates		
(4). Driving while intoxicated (a). Elements of the offense 1. Operating motor vehicle 2. Operating on street or highway 3. Intoxicated or under the influence (b). Penalty	All elements is a must - explain in detail Question class	Vernon's Annotated Penal Code, Art. 802, 802c. 8

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
1. First offense a. Not less than 3 days or more than 2 years in jail, or by fine of not less than $50.00 or more than $500.00 (both fine and imprisonment may be imposed) b. Automatic suspension of operator's license		
2. Subsequent offenses - felony -- penitentiary - 1 to 5 years, or fine $100.00 to $5,000.00 or jail 10 days to 2 years		Vernons Penal Code Art. 802e
3. Other offenses a. Acts if done voluntarily would be felonies. Such as killing some person while driving intoxicated - charge would be murder	Explain, discuss	
b. Operate vehicle on beaches while intoxicated - penalty - fine not to exceed $200.00 or jail not to exceed 30 days		V. P. C. 827F

INFORMATION & SKILLS TO BE TAUGHT	METHODS. TECHNIQUES & AIDS	SOURCE OF INFORMATION
c. Operate motor boat while intoxicated - penalty -- fine not less than $5.00 nor more than $100.00		
(5). Aggravated assault with motor vehicle (a). Elements of the offense 1. Identify the defendant as the one operating vehicle 2. Collided with or caused injury, less than death, to another person 3. Show willful intent or negligence on part of defendant (b). Penalty 1. Fine - $25 nor more than $1,000 2. Jail - not less than one month nor more than 2 years 3. Automatic suspension of operator's license	Explain, discuss	V. P. C. 1149
(6). Driving while under the influence of drugs (a). Unlawful to drive while under the influence of narcotics, or any other drug (b). Being entitled to its use by law is not a defense	Explain in detail Discuss sub. Section C Question class	Art. 67[illegible] R. C. S. Texas Uniform Traffic Code Sec. 50

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(c). Acts, if done voluntarily would be felonies unless it can be proved that such narcotic drug was legally administered (d). Penalty - not less than 10 days nor more than 2 years -- not less than $50 fine nor more than $500 fine		
(7). Driving on right side of roadway; overtaking and passing, etc. (a). Shall drive upon the right side, except as follows: 1. When overtaking 2. When right half is obstructed 3. Roadway marked for three lanes of traffic 4. One-way street	Opaque projector Discuss with class Overhead projector Chalkboard	Art. 6701d R. C. S. Uniform Traffic Code Sec. 52
(b). Overtaking vehicle on left 1. Vehicle being overtaken shall give way to right on audible signal, and shall not increase speed 2. Overtaking vehicle shall not turn back to right side until safely clear of overtaken vehicle		Art. 6701 d R. C. S Sect. 54
(c). When overtaking on the		Art. 6701d R C. S. Sec. 55

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
right is permitted 1. When overtaken vehicle is making left turn 2. When street is wide enough for two or more lines of moving traffic in both directions 3. Upon one-way streets NOTE: In no case shall driver drive off pavement of main traveled portion of roadway to pass on right		
d. Limitations on overtaking on left 1. Left side must be clearly visible, and free of traffic to permit safe passing 2. Must return to right side of roadway before coming within 100 feet of on-coming vehicle from opposite direction		Art. 6701d R. C. S. Sect. 56
e. Further limitation on passing on left. No vehicle shall drive to left of roadway under the following conditions 1. In a no passing zone 2. When within 100 feet of intersection	Discuss, explain, give examples	Art. 6701d R. C. S. Texas Uniform Traffic Code Sec. 57

INFORMATION & SKILLS TO BE TAUGHT	METHODS. TECHNIQUES & AIDS	SOURCE OF INFORMATION
3. When within 100 feet of railroad crossing 4. When within 100 feet of bridge, viaduct, or tunnel 5. While traversing intersection or railroad crossing NOTE: The foregoing limitations do not apply on a one-way street		
(f). No passing zones - State Highway Commission is hereby authorized to: 1. Determine those portions of any highway where overtaking and passing or driving to the left of the roadway would be especially hazardous 2. May by appropriate signs or markings on the roadway indicate the beginning and end of such zones 3. Drivers of vehicles shall obey the directions thereof		Sec. 58 Art. 6701d R. C. S.
(g). One-way roadways and rotary traffic islands 1. The State Highway Commission may designate any highway or any separate road-	Discuss, explain, give examples	Sec. 59 Art. 6701d R. C. S.

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
way under its jurisdiction for one-way traffic and shall erect appropriate signs giving notice thereof 2. Upon a roadway designated and sign posted for one-way traffic the driver of a vehicle shall drive only in the direction designated 3. The driver of a vehicle passing around a rotary traffic island shall drive only to the right of such island		
(h). Driving on roadways laned for traffic. Whenever any roadway has been divided into two (2) or more clearly marked lanes for traffic the following rules in addition to all others consistent herewith shall apply: 1. The driver of a vehicle shall drive as nearly as practical entirely within a single lane and shall not be moved from such lane until the driver has first	Questions, chalkboard, overhead projector, class discussions	Art. 6701d R. C. S. Texas Uniform Traffic Code Sec. 60

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
ascertained that such movement can be made with safety 2. Upon a roadway which is divided into three (3) lanes the driver of a vehicle shall not drive in the center lane except when overtaking and passing another vehicle where the roadway is clearly visible and such center lane is clear of traffic within a safe distance, or in preparation for a left turn or where such center lane is at the time allocated exclusively to traffic moving in the direction the vehicle is proceeding and is sign-posted to give notice of such allocation 3. Official signs may direct slow moving traffic to use a designated lane, or designate those lanes to be used by traffic moving in a particular direction regardless of the center of the		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
roadway		
(i). Following too closely	Discuss relative to speed and traffic	Sec. 61, Art. 6701d R. C. S.
1. The driver of a motor vehicle shall not follow another vehicle more closely than is reasonable and prudent. having due regard for the speed of such vehicles and the traffic upon the conditions of the highway		
2. One truck following another shall leave sufficient space so that an overtaking vehicle may enter and occupy such space without danger		
3. The drivers of motor vehicles driven upon any roadway outside of a business or residential district in a caravan or motorcade whether or not towing other vehicles shall drive so as to allow sufficient space between each such vehicle or combination of vehicles so as to enable any other vehicles to enter and occupy such space without danger.	Chalkboard. overhead projector, discuss, explain, give examples	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
This provision shall not apply to funeral processions		
(8). Turning and starting, and signals on turning and stopping	Opaque projector - discuss, explain, give examples	Art. 6701d R. C. S. Texas Uniform Traffic Code Sec. 65
(a). Position and method of turning at intersections		
1. All right turns. Both approach for and the right turn must be made as close as practical to right hand edge of curb or roadway		
2. Left turn from a two-way roadway into a two way	Chalkboard, discuss and explain Question class Discuss, explain, give examples	
a. Near center stripe or center of roadway		
b. Right half of roadway		
c. Enter intersection to right of center line		
d. Leave intersection to right of road being entered		
3. Left turn from two way into a one way		
a. Leave intersection near and to the right of center line		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
b. Enter either lane when leaving 4. Left turn from one way into a two way a. Enter intersection from either lane b. Leave intersection by passing to right of center of road being entered 5. Left turn from one way into a one way a. Approach in left lane b. Close as practical to left curb or edge of roadway c. Enter left lane		
(b). No "U" turn is permitted in a "No Passing" zone		Sec. 68 Art. 6701d R. C. S.
(c). No vehicle shall be started from a stopped, standing, or parked position unless such movement can be made in safety		
(d). Signals must be given when turning, if such turning will effect other traffic. Signal given for last 100 feet before turning. Signal for slowing or stopping to be given. Signals may be given with hand and arm, or by signal lamps		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
or devices		
(9). Right-of-way -- Vehicles approaching or entering intersection		Art. 6701d R. C. S. Texas Uniform Traffic Code Sec. 71
(a). First vehicles in intersection has right-of-way		
(b). Two vehicles entering intersection from different highways at approximately same time. vehicle to right has right-of-way		
(c). Vehicle intending to turn left shall yield right-of-way to vehicle approaching from opposite direction which is within the intersection or so close as to create a hazard. After having so yielded then vehicle making turn has right-of-way	Explain, discuss. chalkboard. overhead projector	Sec. 72 Art. 6701d R. C. S.
(d). Vehicle entering highway from private road or driveway yields right-of-way		Sec. 74 Art. 6701d R. C. S.
(10). Pedestrians' Right and Duties -- Pedestrian has right-of-way when crossing at crosswalks when he is in that half of roadway or so close to that half of roadway, upon which vehicle is traveling as to be		Sec. 77 Art. 6701d R. C. S.

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
in danger		
(a). When vehicle is stopped at crosswalk to give right-of-way to pedestrian, no other vehicle shall pass such stopped vehicle		
(b). Vehicles have right-of-way when pedestrians are crossing at places other than crosswalks		Sec. 78 Art. 6701d R. C. S.
(c). Between adjacent intersections at which traffic signals are in operation, pedestrians shall not cross at any place except in marked crosswalks		
(d). Pedestrian should use right half of crosswalk		
(e). It is unlawful for pedestrian to walk in street if sidewalks are provided		
(f). If sidewalks are not provided then pedestrian shall walk on left side of roadway		
(g). No pedestrian shall stand on roadway to solicit rides		Sec. 81, 6701d R. C. S.
(h). It is unlawful for any person, unless totally or partially blind or otherwise incapacitated, while on a public street or highway, to carry in a		Art. 6701d R. C. S. Texas Uniform Traffic Code Sec 81

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
raised or extended position a cane or walking stick which is metallic or white in color or white tipped with red (i). Whenever a pedestrian is crossing or attempting to cross a public street or highway, at or near an intersection or cross-walk, guided by a guide dog. or carrying in a raised or extended position a cane or walking stick which is metallic or white in color, or white tipped with red, the driver of every vehicle approaching the intersection or cross-walk shall take such precaution as may be necessary to avoid injuring or endangering such pedestrian, and if injury or danger can be avoided only by bringing his vehicle to a full stop. he shall bring his vehicle to a full stop		
(11). Special stops and restricted speeds required (a). Obedience to signal indicating approach of train - must stop within	Discuss and explain, chalkboard Overhead projector. class discussion, question class	Sec. 86, 6701d R. C. S.

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
50 feet and not closer than 15 feet to nearest rail, when 1. Clearly visible signal 2. Crossing gate lowered 3. Train approaching within 1500 feet, or at a rate of speed as to create an immediate hazard		
(b). All vehicles must stop at certain railroad crossings - when stop signs are erected indicating a dangerous crossing		Sec. 87, 6701d R. C. S.
(c). Certain vehicles must stop at all railroad crossings 1. Buses carrying passengers for hire 2. School buses NOTE: These vehicles shall not change gears while making such crossings. No stop need be made where a traffic control signal or officer directs traffic to proceed		Sec. 88, 6701d R. C. S.
(d). Certain vehicles must reduce speed at all railroad crossings		Sec. 89, 6701d R. C. S.

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
1. Vehicles carrying explosives 2. Vehicle carrying flammable liquids as its principal cargo NOTE: If traveling in excess of 20 miles per hour, reduce speed to 20 miles per hour before coming within 200 feet of nearest rail, and shall listen and look in both directions along such track for any approaching train, and for signals indicating the approach of the train, and shall proceed until precautions have been taken to ascertain that course is clear	Discuss in detail Question class Overhead projector Chalkboard	Sec. 91, 6701d R. C. S. Sec. 92, 6701d R. C. S.
(e). Vehicles must stop at through highways (f). Vehicles must stop before emerging from alley or private driveway		Art. 6701d R. C. S. Texas Uniform Traffic Code Sec. 93
(12). Stopping, standing and parking (a). Stopping, standing or parking outside of business or residence districts		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
1. Clear the paved or main traveled portion of highway when it is practical 2. Whenever a vehicle is parked or stopped upon a roadway or shoulder adjacent thereto, whether attended or unattended during the times mentioned in Section 109, such vehicle shall be equipped with one or more lamps which shall exhibit a red or amber light on the roadway side visible from a distance of five hundred (500) feet to the front of such vehicle and a red light visible from a distance of five hundred (500) feet to the rear, except that local authorities may provide by ordinance or resolution that no lights be displayed upon any such vehicle when stopped or parked in accordance with local parking regulations upon a		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
highway where there is sufficient light to reveal any person within a distance of five hundred (500) feet upon such highway. Any lighted head lamps upon a parked vehicle shall be depressed or dimmed		
3. Any person employed as a mail carrier or letter carrier by the United States Government or any person under contract to deliver mail or letters for the United States Government, may stop, park, or leave standing any vehicle, whether attended or unattended upon the paved or main-traveled part of the highway when it is impractical to stop, park, or so leave vehicle off such part of said highway, when within the scope of him employment, but in every event, an unobstructed width of the highway opposite a standing	Discuss with class	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
vehicle shall be left for the free passage of other vehicles and a clear view of such stopped vehicle shall be available from a distance of at least two hundred (200) feet in each direction upon such highway		
(b). It is a violation to park in the following places:	Discuss, explain, give examples	Art. 6701d R. C. S. Texas Uniform Traffic Code Sec. 95
1. On a sidewalk	Discuss and explain, chalkboard	
2. In front of public or private driveway	Overhead projector	
3. Within an intersection	Question class	
4. Within 15 feet of fire hydrant		
5. On a crosswalk		
6. Within 20 feet of crosswalk at intersection		
7. Within 30 feet of flashing beacon, stop sign, or traffic control signal located at the side or roadway		
8. Within 50 feet of nearest rail of railroad crossing		
9. Within 20 feet of driveway entrance to fire station, or within 75 feet on		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
opposite side of street 10. On the roadway side of any vehicle stop at the curb 11. Upon a bridge, or within a tunnel 12. Where signs prohibit 13. When parked parallel and right hand wheels are not within 18 inches of curb		—
(13). Overtaking and passing school bus -- Bus stopped for the purpose of loading and unloading students (a). All vehicles must stop, but then may proceed at speed not to exceed 10 miles per hour (b). Bus must have words "School Bus" in letters at least 8 inches in height on both sides and front and rear (c). This law does not apply inside the city limits		Sec. 104, 6701d R. C. S.
(14). Miscellaneous rules (a). Unattended motor vehicle 1. Stop motor 2. Set brakes 3. Cut front wheels to curb		Sec. 97. 6701d R C. S.
(b). Coasting prohibited		Art. 6701d R. C. S. Texas Uniform traffic Code Sec. 99

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(c). Following fire apparatus 1. Not closer than 500 feet 2. Not to enter block where there is a fire (d). Putting glass, etc. on highway prohibited 1. Glass bottles 2. Nails, tacks, wire, cans, or any substance likely to injure person, animal or vehicle 3. Persons removing wrecked vehicles must clean up glass, etc.		Sec. 102, 6701d R.C.S.
(15). Equipment required on vehicles (a). When lighted lamps are required -- from a half hour after sunset to a half hour before sunrise and at any other time when there is not sufficient light to render clearly discernible persons or vehicles for distance of 500 feet (b). Head lamps on motor vehicles 1. At least two lamps, one on each side of front of vehicle 2. Motorcycle shall be equipped with at	Discuss and explain Overhead projector. chalkboard Question class	

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least one, and not more than two (c). Tail lamps 1. Every motor vehicle, trailer, semi-trailer etc., shall be equipped with at least one red tail lamp 2. Must have an illumination light for rear registration plate, rendering it clearly legible from a distance of 500 feet (d). New motor vehicles to be equipped with reflectors -- red reflectors, located at not less than 24 inches above and not more than 60 inches above the ground for commercial vehicles and 20 inches to 60 inches on passenger cars (e). Stop lamps required on new motor vehicles after January 1, 1948. except in truck tractor in combination (f). Lamp or flag on projecting load -- load extending to rear 4 feet or more 1. Red flag in daytime 2. Red light at night		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(g). Spot lamps 1. Unlawful to burn when meeting traffic 2. If other lights fail, then permissible to use by shining beam not more than 50 feet in front of car		
(h). Stop lamp 1. Lamp on rear that must emit a red or yellow light when foot brakes are applied 2. Must be visible for distance of 100 feet both day and night 3. No stop or signal lamp shall project a glaring or dazzling light	Chalkboard, class discussion Explain in detail, overhead projector	Art. 6701d R.C.S. Texas Uniform Traffic Code
(i). Additional lighting equipment 1. May be equipped with not more than 2 side cowl or fender lamps. May be amber or white without glare 2. Not more than one running board courtesy lamp on each side. Amber or white without glare 3. May be equipped with not more than two either separately or		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
in combination back up lamp, but it shall not be lighted when vehicle is moving forward 4. Any vehicle may be equipped with lamps which may be used for the purpose of warning the operators of other vehicles of the presence of vehicular traffic hazard requiring the exercise of unusual care in approaching, overtaking or passing, and when so equipped may display such warning in addition to any other warning signals required by this Act. The lamps used to display such warning to the front shall be mounted at the same level and as widely spaced laterally as practicable and shall display simultaneously flashing white or amber lights, or any shade or color between white and amber. The lamps used to display		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
such warning to the rear shall be mounted at the same level and as widely spaced laterally as practicable, and show simultaneously flashing amber or red lights, or any shade of color between amber and red. These warning lights shall be visible from a distance of not less than 500 feet under normal atmospheric conditions at night		
5. Any commercial vehicle 80 inches or more in overall width may be equipped with not more than three identification lamps showing to the front which shall emit an amber light without glare and not more than three identification lamps showing to the rear which emit a red light without glare. Such lamps shall be placed in a row and may be mounted either horizontally or vertically	Chalkboard. explain fully class discussion	

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(j). Head lights must be dimmed before coming within 500 feet of an oncoming vehicle and when following another vehicle closer than 200 feet		Art. 6701d R.C.S. Texas Uniform Traffic Code
(k). Brakes 1. With brakes on all wheels must be able to stop vehicle within 30 feet when traveling at 20 miles per hour. Brakes on two wheels must stop within 40 feet 2. Must be equipped with muffler and horn		
(l). Special restrictions on lamps 1. Any lighted lamp or illuminating device upon a motor vehicle other than head lamps, spot lamps. auxiliary lamps. or flashing turn signals, emergency vehicle warning lamps, and school bus warning lamps, which projects a beam of light of an intensity greater than three hundred (300) candlepower shall be so directed that no	Discuss, explain, give examples	

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part of the high intensity portion of the beam will strike the level of the roadway on which the vehicle stands at a distance of more than seventy-five (75) feet from the vehicle		
2. No person shall drive or move any vehicle or equipment upon any highway with any lamp or device, thereon displaying a red light visible from directly in front of the center thereof. This Section shall not apply of any vehicle upon which a red light visible from the front is expressly authorized or required by law		
3. Flashing lights are prohibited except on an authorized emergency vehicle, school bus, snow-removal equipment, or on any vehicle as a means for indicating a right or left turn, or as authorized in Section 125 hereof	Discuss and explain Chalkboard, overhead projector class discussion, Question class	

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(16). Offenses by persons owning or controlling vehicles - "It is unlawful for the owner, or any other person, employing or otherwise directing the driver of any vehicle to require or knowingly to permit the operation of such vehicle upon a highway in any manner contrary to law "		
(17). When a person arrested must be taken immediately before a magistrate (a). When a person demands an immediate hearing (b). Upon a charge of negligent homicide (c). Driving while intoxicated, or driving while under influence of narcotics (d). Failure to stop and render aid (e). Failure to give written promise to appear in court on ticket	Discuss with class Chalkboard Questions Class discussion Explain fully	Art. 6701d R.C.S. Texas Uniform Traffic Code
(18). When person arrested to be given 10 days' notice to appear in court for any violation of the Uniform Act when punishable as a misdemeanor, and person is not immediately taken before a magistrate as directed in the above provisions	Discuss, explain. give examples	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(a). Prepare in duplicate written notice to appear (b). Give the following: 1. Name 2. License number of vehicle 3. Offense 4. Time and place, when and where person is to appear (c). Violator entitled to 10 days after such arrest (d). The original of said notice shall be retained by the officer		
(19). Noise Devices (a). Shall be equipped with a horn capable of emitting an abrupt sound audible not less than 200 feet. Shall be used as warning only	Explain, discuss	
(b). Devices to prevent unusual noises 1. Exhaust pipe 2. Muffler (muffler cut-out unlawful)	Discuss, ask questions	
(c). Unlawful for vehicle to be equipped with: 1. Bell 2. Siren 3. Exhaust whistle	Give quiz	
E. Patrol procedures 1. How to patrol an area a. Familiarize self with area	Discuss, chalkboard, information sheets prepared by instructor	Prepared lecture material from Police Training Division

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
(1). Geography (streets, alleys, building, etc.)	Use maps, use models of devices, use drawings	Engineering Extension Service, Texas A&M Universi
(2). Signal devices (Fire alarm, boxes, telephones, etc.)		
(3). Opening and closing times of business and persons who open and close them		
(4). Location of safes		
(5). Location of lights and customs of leaving them on or off		
(6). Locations of entrances and exits	Use floor plans, use spot maps	
(7). Locations of crime hazards such as beer joints, pool halls, dance halls, and cheap hotels		
(8). Get acquainted with people who live or work in the area. or who frequent it especially:	Explain "why", discuss	
(a). Car hops		
(b) Paper boys		
(c). Milk men		
(d). Railroad flagmen		
(e). Taxi drivers		
(f) Filling station operators and employees		
(g). Bread delivery men		
(h). Soft drink delivery men		
b. Give special attention to school grounds. parks, and parking lots	Explain, discuss	
c. Give special attention to parties and other public gatherings		
d. Irregular route and irregular time		
e. Backtracking	Explain "why", discuss	

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f. Look for hazards such as: trees fouling electric wires, fire hazards, open manholes, warning lanterns not burning, traffic signals out, street lights out, etc.		
g. Familiarize self with community conditions likely to produce crime	Explain, discuss	
2. Preventing crime through patrol work		
a. Eliminate through patrol work drunks from public places	Give examples Ask questions	
b. Familiarize self with names and reputation of operators, employees and hangers-on of beer joints, dance halls, etc.		
c. Inspect permits, licenses and health cards		
d. Look into the booths in beer joints		
e. Inspect rest rooms and report unsanitary conditions to health department		
f. Look out for minors in beer joints and report to juvenile authorities		
g. Familiarize self with truancy regulations, problems and conditions		
h. Enforce closing law on beer joints		
i. Watch for improper conditions in public places		
j. Blockade beer joints - look for drunk drivers		

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(1). Be sure to select proper men for this job		
k. Investigate neighborhood difficulties		
l. Learn the jargon of criminals		
m. Urge citizens to call on police whenever any suspicious circumstances occur	Explain, class discussion	
n. Teach citizens to register property, such as bicycles, guns, etc.	Examples	
o. Teach businessmen how to prevent burglaries and hijackings		
p. Urge citizens to lock doors and refrain from leaving valuables around		
q. Make friends with children		
r. Acknowledge all greetings		
s. Explain to citizens the rackets of solicitors and peddlers		
t. Show appreciation of information		
F. Procedures for handling DWI and DUID	Discuss, chalkboard, information sheets prepared by instructor	Prepared lecture material Department of Public Safety Personnel and Training Division. Austin, Texas
1. D. W. I. and D. U. I. D.		
a. Use all techniques as used in routine violations down to the interview		
b. Special cautions		
(1). When the subject's driving is especially hazardous, every effort must be exerted to get him stopped as quickly and safely as possible	Explain, discuss	
(2). Extra caution must be used to avoid collision when	Explain and discuss	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
alongside his vehicle and sometimes great effort is required to attract his attention		
c. The interview	Explain, class discussion	
(1). When evidence of intoxication is immediately apparent		
(a). Get the driver out from behind the wheel as soon as possible -- never let him drive the vehicle from the stop where it is stopped	Discuss	
(b). Take driver to right rear of vehicle for confirmation of his condition. Question, observe and check identification. Ask him what he has been drinking (res gestae and is admissible in court.)	Explain and demonstrate	
(c). When you have decided he is under the influence sufficiently to justify arrest, search for weapon, keep drivers license and take into custody		
(d). Secure chemical test if possible	Explain, discuss	
(e). Secure warrant or jail without as per local policy		
(f). When intoxication is not apparent, proceed as		

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routine until discovered, then follow procedure for D. W. I.		
d. Get written statement if possible when subject has sobered	Give example	
e. Complete D. W. I. case summary, file complaint and take subject before a magistrate	Explain and discuss Give quiz	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
V. Identification procedures (16 hours) A. Law of evidence 1. Gathering evidence a. Be sure evidence is legal b. Be sure evidence is relevant c. Be sure evidence is material d. Continuity must be maintained	Chalkboard, discussion, explain, give examples	
2. Use proper search warrant a. Have probable cause b. Have reason to believe c. Have reliable information	Explain and discuss, give examples, ask questions	
3. Have a legal arrest a. For search <u>without</u> warrant to legal b. For evidence to be admissible in court		
B. Collection and Preservation of evidence 1. Recognize good evidence (identified) a. Know what is evidence and what is not evidence b. Be sure and get all the evidence	Chalkboard, discussion, property as teaching aids	Fundamentals of Criminal Investigation - Charles C. Thomas Co., by Charles E. O'Hara
2. Protect the evidence from being destroyed a. Fragile evidence (1). Fingerprints (2). Foot impressions (3). Blood (4). Semen	Illustrate and demonstrate methods Discussion with class	Modern Criminal Investigation Funk & Wagnalls Co. - By Harry Soderman and John J. O'Connell
b. Physical objects undergoing accidental or intentional change (1). Natural causes - ice melting rain, etc. (2). Color bleaching (3). Negligence of officer	Explain	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
C. Laboratory Evaluation 1. Identify evidence - pure clean evidence a. Human blood or animal blood b. Human hair or animal hair c. Water or some other liquid d. Comparison to know objects 2. Determine if evidence can prove crime, or disprove crime a. Tools and tool marks b. Guns and bullets c. Tires and marks d. Finger and finger prints 3. Scientific techniques a. Spectrograph b. X-ray differaction c. Electron microscope d. Chemical detectors e. Toxicology f. Dactyloscopy	Samples as teaching aids, chalkboard discussion May use field trips to I.D. section of local police department Give examples	Fundamentals of Criminal Investigation - By Charles E. O'Hara Modern Criminal Investigatior by Harry Soderman & John J. O'Connell
D. Securing specimens for chemical tests 1. Consent to take samples must be given a. Blood b. Urine c. Intoxication test 2. Specimen should be taken as soon as possible and preserved 3. Take a sufficient quantity of the specimen to be examined	Samples as teaching aids, chalkboard, discussion Illustrate, demonstrate methods of securing specimens Explain, discuss	Fundamental of Criminal Investigation - by Charles E. O'Hara Modern Criminal Investigation by Harry Soderman & John J O'Connell

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
E. Reports and records 1. Reports of findings a. Positive b. Negative c. Identification 2. Maintain proper records a. Continuity of evidence b. Date, time and place of examination c. Proper storage of evidence 3. Report findings to court at time of trial	Samples of reports for teaching aids, chalkboard, discuss, show examples, explain	Fundamental of Criminal Investigation - by Charles E. O'Hara Modern Criminal Investigation by Harry Soderman & John J. O'Connell
F. Fingerprinting 1. Most successful means of identifying a person a. Permanence b. Universality c. Unicity d. Ease of recording e. Simplicity of classification 2. Equipment for recording fingerprints a. Ink b. Rubber roller c. Slab d. Card holder e. Fingerprint card form f. Table	May use field trips Use samples as teaching aids, explain, demonstrate, use equipment as teaching aids	Modern Criminal Investigation by Harry Soderman & John J. O'Connell
3. Recording prints a. Inking the slab b. Cleaning fingers c. Rolling the prints 4. Types of fingerprints a. Latent prints	Use a fingerprint kit as a teaching aid, discussion	Fundamentals of Criminal Investigation - by Charles E. O'Hara

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
b. Plastic prints c. Visible prints	Demonstrate, explain	
5. Lifting process a. Transparent tape b. Rubber lifter c. Powder d. Application	Use a fingerprint kit as a teaching aid, discussion	Fundamentals of Criminal Investigation - by Charles E. O'Hara
6. Pattern types a. Arches (1). Plain arch (2). Tented arch b. Loops (1). Radial loop (2). Ulnar loop	Use poster cards, illustrate	
c. Whorls (1). Plain whorl (2). Central pocketloop (3). Double loop (4). Accidental whorl	Ask questions	Fundamentals of Criminal Investigation - by Charles E. O'Hara
7. Classification a. Primary b. Secondary c. Sub-secondary d. Final e. Henry system	Explain and discuss	
G. Firearm identification 1. Calibre 2. Make 3. Model 4. Type 5. Serial number 6. Finish 7. Additional data a. Barrel length b. Overall length	Use models as teaching aids, explain, discuss May use field trips to I. D. section of your police department	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
c. Number of chambers or magazine capacity		
8. Cartridge case	Illustrate, demonstrate, explain	
a. Trademark		
b. Shape		
c. Calibre		
d. Firing pin impressions		
e. Breech face markings		
f. Extractor marks		
g. Ejector marks		
9. Bullet	Ask questions Show examples	
a. Manufacturer		
b. Firearm rifling impressions		
c. Scratches - striations		
d. Impressions near bullet nose		
10. Powders -		
a. Smokeless powder		
b. Black powder		
VI. Office procedure (26 hours)	Discussion, chalkboard, field trips	Municipal Police Admin. by International City Managers Association
A. Communications systems	Explain, demonstrate, illustrate	
1. Telephone	Use radio as teaching aids	
a. Outside calls coming in		
b. Inside building calls		
(1). Station to station		
(2). Office to jail, etc.		
c. Officer to station		
2. Radio		
a. Station to car		
b. Station to station		
c. Car to car and station		
d. To all points		
3. Teletype	Explain and discuss	
a. Station to station	Illustrate and demonstrate	
b. City to city		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
c. State to state d. To all points 4. Recall system a. Red light system b. Horn system c. Radio		Municipal Police Admin. by International City Managers Association
5. Written Communication a. Officer memo b. Standing order c. Special order d. General order 6. Oral communication a. Voice command b. Personal direction	Give Examples	Municipal Police Admin. by International City Managers Association
B. Booking and desk procedures 1. Identifying prisoner 2. Searching prisoner 3. Inventory of prisoners property 4. Photographs of bruises and cuts 5. Fingerprinting of major criminals 6. Make the arrest card 7. Let prisoner use telephone or talk to lawyer 8. Place prisoner in cell 9. Have magistrate set bond	May use field trips Illustrate and demonstrate Explain and Discuss	Municipal Police Admin. by International City Managers Association
C. Search of prisoners 1. Wall search a. Hands on wall b. Feet spread wide apart c. Stand behind prisoner d. Search one side at a time 2. Kneel search a. Kneeling on ground b. Stand behind prisoner	Demonstrate, discuss, explain	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
c. Search one side at a time 4. Always search prisoner before placing in patrol car 5. Take all property from prisoner and inventory it 6. Search all prisoners as soon as possible	Chalkboard, discuss, practical exercise in classroom Overhead projector Illustrate Pass out material	
D. Mechanics of arrest as related to office procedures 1. Physical arrest 2. Searching prisoner 3. Identifying prisoner 4. Take prisoner before magistrate 5. Book the prisoner 6. Make arrest card and file charges 7. Have magistrate set bond 8. Let prisoner talk to lawyer and use telephone 9. Place prisoner in cell or let him make bond 10. Make offense report 11. Make follow up investigation if necessary 12. Appear in court against him 13. Make case disposition		
E. Report writing 1. Good english a. Spelling b. Capitalization and numbers c. Abbreviations d. Sentence structure 2. Reporting the case a. Telephone complaint slip b. Location	Discuss, chalkboard. Police Reports as teaching aids Pass out material Class discussion	Basic Police Report Writing. by Allen Z. Gammage, PHD. Charles C. Thomas. Publisher Springfield, Illinois

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
c. Time d. Nature of complaint 3. Field notetaking a. Who b. What c. Why d. Where e. When f. How 4. Reporting the preliminary investigation a. Patrol officers duties b. First officer on the scene duties c. Beat officer duties		
5. Supplementary progress report a. Criminal investigators b. Detectives c. Undercover investigators	Discuss, chalkboard. Police Reports as teaching aids; papers, forms, etc. as aids	Basic Police Report Writing
6. Final investigation report a. All files on case b. All reports from lab c. All reports from all investigators d. All reports on all leads		
7. Arrest records a. Case history b. Other case histories on other earlier cases c. Alias, modus operandi, etc. d. Other police agencies records e. FBI records	Explain Pass out samples	
F. Records 1. Complaint record files 2. Defendant record files 3. Location record files	Field trip to local agency Questions on field trip	

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
4. Records room a. All records kept here b. Central file room c. A copy kept in identification department d. A copy kept in the detectives department 5. Records on all police action a. Accident b. Crime against property c. Crime against persons d. Traffic reports e. Non-police service		
VII. Police emergencies and special assignments A. Disasters 1. Airplane crashes 2. Floods 3. Fires 4. Train wrecks 5. Storms 6. Earthquakes 7. Must set up first aid stations 8. Must form search parties 9. Must keep law and order 10. Must control traffic 11. Must control crowds 12. Must help lost persons		
B. Riots 1. Make a show of force 2. Seal area off 3. Order the crowd to disperse 4. Control the leaders	Discuss, chalkboard Note - for students information only - Don't go into details	Departmental policy of your city

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
5. Leave avenues of escape 6. Use military formations and arrest leaders if necessary 7. Use only that force which is necessary 8. Disperse crowd by force if necessary		
C. Civil Disturbances 1. Labor strikes 2. Racial demonstrations 3. All demonstrations 4. Set ins, etc. 5. Should be handled by city police	Discuss, chalkboard	Your city policy
D. Civil defense and the police 1. Emergency first aid stations 2. Emergency traffic control 3. Emergency communication systems 4. Emergency search parties and food distribution 5. Maintenance of law and order	Discuss, chalkboard	Your city policy
E. First aid as related to the police 1. Disaster first aid stations 2. Accidents 3. Any time first aid is needed 4. Emergencies a. Stop bleeding b. Protect the wound c. Prevent shock d. Artifical respiration e. Splint broken bones 5. Give emergency care until the doctor arrives or person is sent to a hospital		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
F. Mob psychology 1. A mob of people act as one person 2. The individual is swept up in the mob 3. The mob makes an individual do things that he would not normally do 4. The mob attitude 5. The excitement 6. Has snow ball effect on crowd 7. Can be led by one or two individuals	Discuss with class Chalkboard	
G. Vice and narcotics 1. Very big problem 2. Very profitable 3. Police must work "under cover" 4. Must have informants 5. Very hard to prove crime 6. Complaintant will not testify 7. Street walker 8. Call girl 9. House of prostitution 10. Heroin 11. Barbituates 12. Marijuana 13. LSD 14. Gambling a. Dice b. Cards c. Numbers d. Horses e. Fights		

INFORMATION & SKILLS TO BE TAUGHT	METHODS, TECHNIQUES & AIDS	SOURCE OF INFORMATION
VIII. Moot court		
A. Review of law enforcement procedures	Field trip	
1. Review laws of arrest		
2. Review laws of search and seizure		
3. Review code of criminal procedure		
4. Review admissibility of evidence		
5. Review laws on confession		
B. Moot court involving traffic cases	Field trip to court	
1. Mock trial of an accident	Have mock trial in local court room in corporation with chief of police or judge	
2. Mock trial of an speeding case		
3. Other traffic violations		
C. Moot court involving criminal cases		
1. Mock trial of homicide case		
2. Mock trial of burglary case		
3. May use offense reports as guidelines. Change names and dates and places		
D. Moot court involving both a traffic and criminal case	Field trip to court room	
1. Mock trial for negligent homicide	Work in corporation with chief or judge	
2. Mock trial for murder by auto		
3. Mock trial for DWI - DWLS		

BIBLIOGRAPHY

NOTE: Prices shown below for publications are approximate

Barnes, Harvey Elmer and Teeters, Negley K., New Horizons in Criminology, $10.00

Beasley, Wallace D., Director, Texas Commission on Law Enforcement Officers Standards and Training, Manuscript on Case Preparation, Austin, Texas, $1.00

Canons of Police Ethics, $1.00

Crowd and Riot Control, published by The Stockpale Co., Harrisburg, Pennsylvania, $8.00

Department of Public Safety, Traffic Digest and Review, Austin, Texas, $1.00

Gammage, Allen Z., PHD, Basic Police Report Writing, Charles C. Thomas, Publisher, Springfield, Illinois, $8.00

International City Managers Association, Municipal Police Administration, $10.00

International Association of Chiefs of Police, Field Service Division, Organization Manual, Washington, D.C. $1.00

MacCorkle, Stuart A. and Smith, Dick, Texas Government, McGraw-Hill Book Co., Inc., New York, 34th Edition, $8.50

Municipal Government and Administration in America, Jewel, Cass, Phillips, MacMillan, Co., New York, $10.00

Northwestern Traffic Institute, Accident Investigators Manual, Evanston, Illinois $7.50

O'Conner, George W. and Vanderbosch, Charles G., The Patrol Operation, International Chiefs of Police Association, Washington, D. C., $2.50

O'Hara, Charles, Fundamentals of Criminal Investigation, $10.50

Preston, Edward, Inspector, and Heath, Edwin O. Jr. Detective, Dallas Texas Police Academy Manual on Search and Seizure, $5.00

Soderman, Harry and O'Connell, John J., Modern Criminal Investigation, Funk and Wagnalls Co., $10.00

Task Force Report Juvenile Delinquency and Youth Crime, U. S. Government Printing Office $2.25

Task Force Report Science and Technology, U. S. Government Printing Office $2.25

Task Force Report, The Police, U. S. Government Printing Office $2.50

Texas A&M University, Engineering Extension Service, Police Training Division, Texas Manuscripts, College Station. Texas $1.00

Texas Department of Public Safety, Personnel and Training Division, Paper on Introduction to Traffic Management, Austin, Texas $1.00

Texas Highway Department, Texas Revised Civil Statutes, Article 6701-D, Motor Vehicle Traffic Laws. No Charge

U. S. Post Office, (Civil Service Announcements and Brochures) No Charge

*Vernon's Annotated Civil Statutes, $500.00

*Vernon's Annotated Penal Code, $86.00

*Vernon's Annotated Texas Code of Criminal Procedure, $75.00

* These references may be available for instructors examination in local law offices.

LIST OF TRAINING FILMS

Charles Cahill and Associates, Broken Class

Charles Cahill and Associates, Inc., Mob and Riot Control, Hollywood, California

Charles Cahill and Associates, Routine Stops

Marshall Field and Company, By Supiter

Northwestern Traffic Institute, Detecting and Recording Skidmarks, Evanston, Illinois

Northwestern Traffic Institute, Hit and Run Investigation, Evanston, Illinois

Northwestern Traffic Institute, Officer Violator Relationship, Evanston, Illinois

Northwestern Traffic Institute, Questioning Drivers and Witnesses, Evanston, Illinois

Northwestern Traffic Institute, Protecting the Scene of the Accident, Evanston, Illinois

Northwestern Traffic Institute. Traffic Violation Case Preparation, Evanston, Illinois

Northwestern Traffic Institute, Signals and Gestures, Evanston, Illinois

Northwestern Traffic Institute, Traffic Officer in Court, Evanston, Illinois

VT 010 114
Bright, Don
Supplementary Materials Handbook for Intensive Business and Office Education. Bulletin 18.

Bowling Green State Univ., Ohio
Ohio State Dept. of Education, Columbus. Div. of Vocational Education
MF AVAILABLE IN VT-ERIC SET.
PUB DATE - Jun69 93p.

DESCRIPTORS - *RESOURCE GUIDES; *BUSINESS EDUCATION; *INSTRUCTIONAL MATERIALS; AUDIOVISUAL AIDS; BOOKS; WORKBOOKS; PHONOGRAPH RECORDS; TAPE RECORDINGS

ABSTRACT - Resource materials, examined by a study group and organized by a teacher educator, are listed for these vocational programs: (1) Accounting and Computing Occupations, (2) Business Data Processing Occupations, (3) Filing, Office Machines, and General Clerical Occupations, (4) Stenographic, Secretarial, and Related Occupations, and (5) Typing and Related Occupations. The resources are organized into these categories: (1) films, filmstrips, slides, and transparencies, (2) booklets, charts, pamphlets, posters, records, and tapes, and (3) books, practice sets, and workbooks. An address list of distributors is included. (SB)

VT 010 114

EDO 45856

SUPPLEMENTARY MATERIALS HANDBOOK for INTENSIVE O E

U.S DEPARTMENT OF HEALTH. EDUCATION & WELFARE
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Bulletin 18

State of Ohio - DEPARTMENT OF EDUCATION

Martin Essex, Superintendent of Public Instruction

Division of Vocational Education
Business & Office Education Service
In cooperation with Bowling Green State University

ED0 45856

SUPPLEMENTARY MATERIALS HANDBOOK

for

INTENSIVE BUSINESS AND OFFICE EDUCATION

I - Films, filmstrips, slides, transparencies
II - Booklets, charts, pamphlets, posters, records, tapes
III - Books, practice sets, workbooks

as developed by

Don Bright, Teacher Educator

Bowling Green State University
Bowling Green, Ohio

for

Ohio State Board of Education

Martin Essex

State Superintendent of Public Instruction
State Department of Education
Columbus, Ohio 43215

Business & Office Education Services
Division of Vocational Education

Byrl R. Shoemaker, Director

JUNE, 1969

ERIC

INTRODUCTION

Note: The resources listed in this bulletin are those examined by the study group. If any particular resources were missed, it was not intentional, and will be included when revision is made.

Dr. Don Bright, Teacher Educator of Business & Office Education at Bowling Green State University, Bowling Green, Ohio, organized material that has been collecting into this booklet for use of Intensive Office Education teachers.

Students in his classes that worked on this project included:

Charles Eschedor, Firelands Branch, Bowling Green State University
Sara Frey, Student, Bowling Green State University
Kenneth Searfoss, BOE Supervisor, Toledo Public Schools
Joan Clark, Teacher, Toledo DeVilbiss High School
Carol Harris, Teacher, Toledo Bowsher High School

PURPOSE:

Teachers had the problem of moving into block-time or simulated programs of Intensive Office Education and at the same time expand the volume of materials necessary to perform in these programs.

Also, as new schools are being built, central resource centers are being included. Sometimes these resource centers are in the Business & Office Education department itself; other times these centers are located in place of the older concept of a library to serve the total school.

Dr. Bright has brought together 3 categories of resource materials and organized them into the various vocational program categories for use by the teachers of Ohio. In addition, related classes that were identified by the class were also categorized and materials selected for them after examination.

The reporting format includes the following vocational programs:

14.0100 Accounting and Computing Occupations
14.0200 Business Data Processing Occupations
14.0300 Filing, Office Machines, and General Clerical Occupations
14.0700 Stenographic, Secretarial, and Related Occupations
14.0900 Typing and Related Occupations

The various resources are organized into the following 3 categories:

Section I - Films, filmstrips, slides, transparencies
Section II - Booklets, charts, pamphlets, posters, records, tapes
Section III - Books, practice sets, workbooks

We hope this listing helps the IOE teacher in finding the materials from which they can select specifics for their programs. This will obviously be obsolete quickly, but at least it is a start. Revision will be forthcoming within 2 years.

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Workbooks and Practice Sets 85
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RESOURCE MATERIAL FOR

Programs

14.0100 Accounting and Computing

14.0200 Business Data Processing

14.0300 Filing, Office Machines, and General Office Clerical

14.0700 Stenographic, Secretarial, and Related

14.0900 Typing and Related

and

Related

Business English

Business Law

Human Relations

Economics

Business Math

Films

Filmstrips

Slides

Transparencies

SECTION I

ADDRESSES OF DISTRIBUTORS

A. B. Dick
5700 Touhy Avenue
Chicago, Illinois

American Bankers Association
90 Park Avenue
New York, New York 10016

Association Films, Inc.
561 Hillgrove Avenue
LaGrange, Illinois 60425

Association Films, Inc.
600 Madison Avenue
New York, New York 10022

Association Film, Inc.
324 Delaware Avenue
Oakmont, Pennsylvania 15139

Bailey Films, Inc.
6509 De Longpre Avenue
Hollywood, California

Films Rental Service
Audio-Visual Center
The City College
Bernard M. Baruch School of
Business and Public
Administration
17 Lexington Avenue
New York, New York 11204

Business Education Films
5113 16th Avenue
Brooklyn, New York11204

Audio-Visual Services Department
Chamber of Commerce ofthe
United States
1615 H. Street, N.W.
Washington, D.C. 20006

Coronet Films
65 E. South Water Street
Chicago, Illinois 60601

ADDRESSES OF DISTRIBUTORS CON'D.

Cousino Visual Education Service
1945 Franklin Avenue
Toledo, Ohio 43624

Eye Gate House, Inc.
146-01 Archer Avenue
Jamaica, New York, 11435

Friden, Inc.
Division of the Singer Company
San Leandro, California 94577

General Anilines and Film Corporation
140 West 51 Street
New York, New York 10020

Harcourt, Brace & World
Midwestern Region
7555 Caldwell Avenue
Chicago, Illinois 60648

IBM
160 East Grand Avenue
Chicago, Illinois 60611

Indiana University
Audio-Visual Center
Bloomington, Indiana

McGraw-Hill Book Company
330 West 42nd Street
New York, New York 19036

Modern Talking Picture Service
160 East Grand Avenue
Chicago, Illinois 60611

NABAC
205 Touhy Avenue
P. O. Box 500
Park Ridge, Illinois

NAM Films
277 Park Avenue
New York, New York

Nate Quillen Instructional Systems, Inc.
620 East Smith Road
Medina, Ohio 44256

ADDRESSES FOR DISTRIBUTORS, CON'd.

Ohio Bankers Association
33 North High Street
Columbus, Ohio 43215

Roundtable Films, Inc.
321 S. Beverly Drive
Beverly Hills, California

Society for Visual Education, Inc.
1345 Diversey Parkway
Chicago, Illinois 60614

South-Western Publishing Co.
5101 Madison Road
Cincinnati, Ohio 45227

Stanley Bowmar Co., Inc.
4 Broadway
Valhalla, New York 10595

Sterling Educational Films
241 East 34 Street
New York, New York

Visual Aids Service
University of Illinois
Division of University Extension
Champaign, Illinois 61822

Audio-Visual Education Service
55 Westbrook Hall
University of Minnesota
Minneapolis, Minnesota

Bureau of Audio-Visual Instruction
University of Wisconsin
P. O. Box 2093
Madison, Wisconsin 53701

Valiant
172 Walker Lane
Englewood, New Jersey

Western Publishing Education
1220 Mound Avenue
Racine, Wisconsin 43404

Price Code

R - Rental Fee

F - Free

P - Purchase only

Films

If no comment is made regarding color, the film is black and white.

If there is no comment regarding the length or the price, this information was not given in the catalogue.

Transparencies

Any number in parentheses after the name of a transparency indicates the number of transparencies in the set.

ERIC

14.0100 ACCOUNTING AND COMPUTING

FILMS

Distributor	Name of Film	Length	Price Code
Association Films, Inc.	Banking in Action (Color)	20 min.	F
	CPA	28 min.	F
	How to Use Your Bank	10 min.	F
	Inc. (Color)	22 min.	F
	The Information Explosion (Color)	21 min.	R
Bernard M. Baruch School of Business and Public Administration	Banks and Credit	11 min.	R
	Charge It Your Way	10 min.	R
	Electronic Computers Improve Management Control	15 min.	R
	Engine at the Door	29 min.	R
	Introduction to Digital Computers	35 min.	R
	Managers and Models	29 min.	R
Business Education Films	Accounting: Basic Procedures	11 min.	R
	Accounting and Calculating Machines	11 min.	R
	Accounting, The Language of Business	11 min.	R
	At Any Given Moment	10 min.	R
	Banks and Credit	11 min.	R
	Bookkeeping and Accounting	11 min.	R
	Bookkeeping and You	10 min.	R
	The Check Collection Process	21 min.	R
	Credit: Man's Confidence in Man	30 min.	R
	Federal Reserve Bank and You	30 min.	R
	Federal Reserve System	20 min.	R
	Fred Meets a Bank	11 min.	R
	A Future to Bank On	12 min.	R
	Future Unlimited	13 min.	R
	How Banks Serve	11 min.	R
	How to Use Your Bank	10 min.	R
	Introduction to Accounting	15 min.	R
	A Man to Know	13 min.	R
	Money Talks	12 min.	R
	Pay to the Order of	11 min.	R
	Science of Money	22 min.	R
	The Story of Money	16 min.	R
	Understanding the Dollar	10 min.	R
	Using Bank Credit	10 min.	R
	Using the Bank	11 min.	R
	What is Money	11 min.	R
	You and Your Money	12 min.	R

14.0100 ACCOUNTING AND COMPUTING

Distributor	Name of Film	Length	Price Code
Visual Aids Service University of Illinois	Banking Holiday Crisis of 1933	27 min.	R

14.0100 ACCOUNTING AND COMPUTING

FILMSTRIPS

Distributor	Name of Filmstrips	Length	Price Code
American Bankers Association	The Dollar Tour		
Bernard M. Baruch School of Business and Public Administration	Collection of Data (Color)	22 min.	R
	The Computer System	22 min.	R
	Controlling Accounts (si)	107 frames	R
	Data and Decision Series (Four Filmstrips in series)	19 min.	R
	The Electronic Frontier in Business	16 min.	R
	How to Balance Accounts (Silent)	106 frames	R
	Posting--One Journal, One Ledger (Silent)	76 frames	R
Business Education Films (All are Silent Filmstrips)	The Accounting Cycle		R
	The Accounting Cycle-Direct Ledger Entry-Routine Each Month		R
	The Accounting Cycle-Direct Ledger Entry-Year End Closing		R
	Adjusting the Books, Part I		R
	Adjusting the Books, Part II		R
	The Bank Reconciliation Statement		R
	Bookkeeping and Accounting Errors-How to Locate, Correct and Avoid Them		R
	Bookkeeping Cycle, Part I		R
	Bookkeeping Cycle, Part II		R
	Bookkeeping Cycle, Part III		R
	Bookkeeping Equation and the Balance Sheet		R
	Books of Original Entry		R
	Closing Entries		R
	Closing the Books		R
	Columnar Journals		R
	Controlling Accounts		R
	Financial Statements-Analysis and Interpretation		R
	General and Subsidiary Ledgers		R
	How to Balance Accounts		R
	Interest, 60 Day 6% Method, Part I		R
	Interest, 60 Day 6% Method, Part II		R

14.0100 ACCOUNTING AND COMPUTING

Distributor	Name of Filmstrip	Length	Price Code
Business Education Films (All are Silent Filmstrips)	The Journal - First Lesson		R
	Journalizing and Posting		R
	Petty Cash Systems		R
	Posting-One Journal-One Ledger		R
	Preparation of the Worksheet and Financial Statement		R
	Preparing the Trial Balance		R
	Proper Handling of Checks		R
	Readjusting Entries		R
	The Trade Acceptance		R
	Use of Accounts and Analysis of Transactions		R
	What is Accounting		R
	The Work Sheet		R
Harcourt, Brace & World	Automation: Promise or Threat? (Color) (One 12" LP record)		P
McGraw-Hill	Bookkeeping Equations and Balance Sheet	30 frames	P
	Closing Entries	30 frames	P
	Complete Set		P
	Journalizing and Posting	30 frames	P
	Preparation of Worksheet and Financial Statement	30 frames	P
	Preparing the Trial Balance	30 frames	P
	Use of Accounts and Analysis of Transaction	30 frames	P
South-Western Publishing Co.	The Opening Phase of Bookkeeping	45 frames	P
	The Closing Phase of Bookkeeping	43 frames	P
	The Recording Phase of Bookkeeping	47 frames	P
	Complete Set		P

14.0100 ACCOUNTING AND COMPUTING

TRANSPARENCIES

Distributor	Name of Transparency	Price Code
Eye Gate House, Inc.	Balance Sheet	P
	Bookkeeping Cycle (2 Color)	P
	Cash Journal	P
	Cash Receipts Journal	P
	Combination Journal	P
	Complete Set	P
	General Journal	P
	Ledger Accounts	P
	T Accounts Bal. Col. Ledger	P
	T Accounts General Ledger	P
	T Accounts Two Col. Ledger	P
	Work Sheet	
South-Western Publishing Co.	Automated Data Processing Cycle of a Tabulating System (Overlays)	
	Balance Sheet (Account Form) and Income Statement (2Column)	
	Cash Journal	
	Cash Receipts Journal and Cash Payments Journal	
	Combination Journal	
	Complete Bookkeeping Cycle	
	Controlling Accounts and Subsidiary Ledgers	
	Electronic Computer System (Overlays)	
	Four-Column General Ledger	
	General Journal and Ledger Accounts	
	Preparing a Six-Column Work Sheet (Overlays)	
	Preparing an Eight-Column Work Sheet With Adjustments (Overlays)	
	Recording Cash Payments	
	Recording Cash Receipts	
	Recording the Buying of Merchandise	
	Recording the Selling of Merchandise on Account	
	Recording and Posting Entries (Overlays)	
	Steps in Preparing a Balance Sheet (Overlays)	
	T Accounts, Balance-Column Ledger, and Sales Journal or Purchases Journal	
	T Accounts and General Journal	
	Three Column Balance Sheet or Income Statement	
	Work Sheet	P

14.0100 ACCOUNTING AND COMPUTING

Distributor	Name of Transparency	Price Code
United Transparencies Inc.	Eleven Transparencies for Bookkeeping	
	Single Color Sets	P
	Two-Color Sets	P
Valiant	Check Forms and Procedures (5)	P
	Fixed Assets (6)	P
	Merchandising Businesses (19)	P
	Payroll Procedures (8)	P
	Service Businesses (16)	P
	Complete Set (60)	P
	Accounts Payable Ledger	
	Accounts Receivable	
	Cash Journal	
	Cash Receipts	
	Combination Journal	
	General Journal	
	Purchases Journal	
	T Sheet	
	Work Sheet	
	Complete Set	P
Visual Products Division 3M Company	Accounting--A Guide to Decisions	
	Printed Originals	
	Prepared Color Transparencies	P
	Accounting--Records and Controls	
	Printed Originals	
	Prepared Color Transparencies	P
	Bookkeeping and Accounting	
	Printed Originals	
	Prepared Color Transparencies	
	Printed Spirit Masters	P

14.0200 BUSINESS DATA PROCESSING

FILMS

Distributor	Name of Film	Length	Price Code
IBM	Man and Computer. . . A Perspective	20 min.	
Indiana University	Control Revolution	29 min.	R
	Computer Sketchpad	29 min.	R
	Logic By Machine	29 min.	R
	Managers and Models	29 min.	R
	Universal Machine	29 min.	R
	Universe of Numbers	29 min.	R
Sterling Educational Films	The Living Machine		
Film Distribution Division University of Southern California	Careers in Business Data Processing (COLOR)	16 min.	R

14.0200 BUSINESS DATA PROCESSING

FILMSTRIPS

Distributor	Name of Filmstrip	Length	Price Code
Bernard M. Baruch School of Business and Public Administration	Data Processing and the Computer Control	15 min.	R
Friden, Inc.	Automation in Today's Modern Office (Color)	20 min.	F
	Basic Data Processing (Color)	20 min.	F
NABAC The Association for Bank Audit	Challenge of Electronic Data Processing		
	Electronic Data Processing Feasibility Study		
	NABAC Teller Model		

14.0200 BUSINESS DATA PROCESSING

TRANSPARENCIES

Distributor	Name of Transparency	Price Code
South-Western Publishing Company	Automated Data Processing Cycle of a Tabulating System --Automated Equipment (Two Overlays) Electronic Computer System--Computer Equipment (Must be purchased with the entire set of transparencies on bookkeeping.)	P
Visual Products Division 3 M Company	Visuals 1-77 for Volume 1	P
	Visuals 78-149 for Volume II	P
	Visuals 150-258 for Volume III	P
	Visuals 1-99 for Volume IV	P
	All Visuals--Volumes I-IV	P

14.0300 FILING, OFFICE MACHINES, AND GENERAL OFFICE CLERICAL

FILMS

Distributor	Name of Film	Length	Price Code
Bailey Films, Inc.	Duplicating by the Spirit Method (Color)	14 min.	R
	Black and White		R
Bernard M. Baruch School of Business and Public Administration	Fundamentals of Filing	11 min.	R
	Know Your Money	17 min.	R
	Story of Money	15 min.	R
	Work Simplification (Clerical Operations)	10 min.	R
Business Education Films	Dictaphone and Ediphone Operation	16 min.	R
	Dictaphone and Ediphone Techniques	16 min.	R
	Duplicating by the Spirit Method	14 min.	R
	How to Operate a Mimeograph Duplicator	20 min.	R
	Maintenance of Office Machines	35 min.	R
	A Matter of Form (Color)	23 min.	R
	Mimeographing Techniques (Black and White)	15 min.	R
	(Color)		R
	Modern Business Machines	20 min.	R
	Mail in Motion	13 min.	R
	Men and Mail in Transit	27 min.	R
	Window Clerk Meets the Public	20 min.	R
	Your Postal Service	19 min.	R
	You're on the Team (Color)	15 min.	R
Cousino Visual Education	The Spirit Duplicator: Preparing Masters (Color)		
	The Spirit Duplicator: Operation (Color)		
Massachusetts Bankers Association	The Life of a Check (Color)	14 min.	F
Ohio Bankers Association	Paying by Check	15 min.	F
	(also 35 mm, color, sound-slide film	10 min.	F
	Your Town (also 35 mm, color,	15 min.	F
	sound-slide film)	10 min.	F
	Banking: No limit to Dimensions		

14.0300 FILING, OFFICE MACHINES, AND GENERAL OFFICE CLERICAL

Distributor	Name of Filmstrip	Length	Price Code
Eye Gate House, Inc.	Occupational Education--The Job Interview	30 fr.	
Gregg Division McGraw-Hill Book Co.	Filing Filmstrip Set		P
Text-Film Division McGraw-Hill	Effective Business Correspondence	40 frames	P
	Files and Filing	40 frames	P
	Getting a Job and Keeping It	40 frames	P
	Proper Handling of Checks	40 frames	P
	Secretary as a Receptionist	40 frames	P
	Trace Acceptance	40 frames	P
	Complete Set		P
	Filing Methods and Procedures, Part I	14 min.	
	Filing Methods and Procedures, Part II	14 min.	
	Indexing and Filing Rules, Part I	14 min.	
	Indexing and Filing Rules, Part II (Two records accompany)	14 min.	
	Complete Set		P
Ohio Bankers Assoc.	Proper Methods for Handling Cash		F
	They Shall Not Pass (Bad Checks)		F
	You and Your Community Bank (Color)		F

14.0300 FILING, OFFICE MACHINES, AND GENERAL OFFICE CLERICAL

SLIDES

Distributor	Name of Slides	Price Code
Bernard M. Baruch School of Business and Public Administration	Principles of a Wide Range of Business Machines (IBM slides--26)	R

14.0300 FILING, OFFICE MACHINES, AND GENERAL OFFICE CLERICAL

TRANSPARENCIES

Distributor	Name of Transparency	Price Code
Visual Products Division 3M Company	Care of Equipment	
	Printed Originals	P
	Prepared Color Transparences	P
	Clerical Occupations and Responsibilities	
	Printed Originals	P
	Prepared Color Transparencies	P
	Copying and Duplicating	
	Printed Originals	
	Prepared Color Transparencies	P
	Office Machines--Functions	
	Printed Originals	P
	Prepared Color Transparencies	P

14.0700 STENOGRAPHIC, SECRETARIAL, AND RELATED

FILMS

Distributor	Name of Film	Length	Price Code
Business Education Films	As Others See Us	10 min.	R
	The Champions Write	15 min.	R
	Cooperative Office Occupations	15 min.	R
	The Court Reporter	10 min.	R
	Developing Shorthand Speed	15 min.	R
	Do I Want to Be a Secretary	10 min.	R
	Down at the Office	10 min.	R
	Getting What You're After	6 min.	R
	The Grapevine	8 min.	R
	How Much Cooperation	8 min.	R
	I Want to Be a Secretary	17 min.	R
	In the Middle	8 min.	R
	Introductions	10 min.	R
	Journey for Miss James	7 min.	R
	Life Insurance Occupations	11 min.	R
	Minutes are Pennies	17 min.	R
	Promotion By-Pass	8 min.	R
	The Right Touch (Color)	18 min.	R
	Safety in Offices	10 min.	R
	Secretary Takes Dictation	10 min.	R
	Secretary Transcribes	10 min.	R
	Secretary's Day	10 min.	R
	The Successful Secretary (Color--Produced by Royal Office Typewriters)	10 min.	R
	Teaching Marginal Reminders	10 min.	R
	University Secretary	30 min.	R
	Vocational Office Training	10 min.	R
NAM Films	Making Contact		
Roundtable Films	Writing Letters That Get Results	28 min.	P
	Accompanying Booklet		
	The Modern Business Letter		

14.0700 STENOGRAPHIC, SECRETARIAL, AND RELATED

Distributor	Name of Film	Length	Price Code
Visual Aids Service University of Illinois	The Secretary: A Normal Day	11 min.	R
	(Color)	11 min.	R
	The Secretary: Taking Dictation (Black & White)	11 min.	R
	(Color)	11 min.	R
	The Secretary: Transcribing (Black and White)	11 min.	R
	(Color)	11 min.	R
	Your Career as a Secretary (Color)	27 min.	R
Audio-Visual Education University of Minnesota	Recording with Magnetic Tape	8 min.	P
Bureau of Audio-Visual Instruction University of Wisconsin	See Them Write	15 min.	R

14.0700 STENOGRAPHIC, SECRETARIAL, AND RELATED

Distributor	Name of Filmstrip	Length	Price Code
Association Instructional Materials	How to Write Better Business Letters 3 sound Color		
Business Education Films (All are Silent)	The Ideal Secretary		R
	Miss Do and Miss Don't		R
	Secretarial Etiquette		R
	Secretaries with Wings		R
	The Secretary as a Receptionist		R
Business Education Films (All are Sound)	Adjusting to Change (Color)	10 min.	R
	Adjusting to the Job	10 min.	R
	Duties of A secretary	22 min.	R
	The First Job	10 min.	R
	Getting the Job	10 min.	R
	Initiative Versus Aggressiveness	10 min.	R
	Job Growth	10 min.	R
	Organizing and Planning (Color)	10 min.	R
	Secretarial Attitudes	10 min.	R
	Secretarial Cooperation	10 min.	R
	Secretarial Shortcuts, Part I, (Color)	10 min.	R
	Secretarial Shortcuts, Part II, (Color)	10 min.	R
Education Productions, Ltd.	Secretarial Duties		P
Gregg Division McGraw-Hill Book Co.	Gregg Shorthand--Diamond Jobilee Series		P
Text-Film Division McGraw-Hill	Adjusting to the Job	10 min.	
	The First Job	10 min.	
	Getting a Job	19 min.	
	Job Growth	10 min.	
	Secretarial Attitudes	10 min.	
	Secretarial Cooperation	10 min.	
	Complete set of 6 filmstrips and records		P
	Adjusting to Change	10 min.	
	Filing, Finding, and Follow-up	10 min.	
	Initiative Versus Aggressiveness	10 min.	
	Organizing and Planning	10 min.	
	Secretarial Shortcuts, Part I	10 min.	
	Secretarial Shorts, Part II	10 min.	
	Complete set of 6 filmstrips and 6 records		P

14.0700 STENOGRAPHIC, SECRETARIAL, AND RELATED

Distributor	Name of Filmstrip	Length	Price Code
Stanley Bowmar Co., Inc.	Just a Secretary (Color) (Also a record)		P

14.0900 TYPING AND RELATED

FILMS

Distributor	Name of Film	Length	Price Code
Business Education Films	Addressing Envelopes	12 min.	R
	Advanced Typing: Duplicating and Manuscript	25 min.	R
	Advanced Typing :Shortcuts	33 min.	R
	Basic Typing: Machine Operation	20 min.	R
	Basic Typing: Methods	31 min.	R
	Building Typing Skill	11 min.	R
	Electric Typing Time (C)	20 min.	R
	Keys to the Future	30 min.	R
	Know Your Typewriter	30 min.	R
	Ready to Type	10 min.	R
	Right at the Start	62 min.	R
	Tips on Typing	21 min.	R
	Typewriter in Business	21 min.	R
	Typing Techniques	21 min.	R
	Using a Carbon Pack	12 min.	R
Coronet films	Typing Skills: Building Speed (COlor)	11 min.	P
	Black and White		P
	Typing Skills: Daily Job Techniques (Color)	13 min.	P
	Black and White		P

14.0900 TYPING AND RELATED

FILMSTRIPS

Distributor	Name of Filmstrip	Length	Price Code
A. B. Dick	The Mimeograph		F
	The Stencil		F
Bernard M. Baruch School of Business and Public Administration	Retail Credit--Behind the Scenes	73 frames	R
Business Education Films	Bank Reconciliation		
	Business Facilities		R
	Business Letters-Features, Styles and Types		R
	Business Letters - Placement and Envelope Addressing		P
	Effective Business Correspondence		R
	Files and Filing		R
	Filing, Finding and Follow-up	10 min.	R
	Getting That Raise in Salary		R
	Indexing and Filing Rules Parts 1 and 2	14 min.	R
	Introduction in Business		R
	Methods and Procedures Parts land 2	14 min.	R
	Receiving Customers and Callers		R
	Why Etiquette in Business		R
Business Teaching Aids	Adventures in Typewriter Art	80 frames	P
Gregg Division McGraw-Hill Book Co.	Card Punch		P
	10-Key		P
	Typing--Keyboard Introduction		P
	Typing--Skill Development		P
Text Film Division McGraw-Hill	Gregg Typewriters Series Set of 6 filmstrips and 3 records		P
	Gregg Typewriting Set of 8 filmstrips and 4 records		P
Victor Comptometer Corp.	A Career That Counts		F
Visual Sciences	History of the Typewriter		P

14.0900 TYPING AND RELATED

TRANSPARENCIES

Distributor	Name of Transparency	Price Code
General Anilines and Film Corporation	Part I-What Makes a Typewriter Function	
	Part II-How to Make the Typewriter Work Better for You	
	Part III-Writing a Letter	
	Part IV-Business Forms	
	Part V-Typing the Manuscript	
	Part VI-Making Routine Duties Interesting	
	Complete Set	P
Gregg Division McGraw-Hill Book Co.	Volume I-Keyboard	P
	Volume II-Keyboard	P
Visual Products Division 3M Center	Beginning Typing	
	Typing Exercise	
	Typing Fundamentals	
	Typing Production	
	Printed Originals	P
	Prepared Color Transparencies	P
Western Publishing Education	Office Skills (92 Transparencies) May be purchased Separately or in complete set	P

RELATED

BUSINESS ARITHMETIC

FILMS

Distributor	Name of Film	Length	Price Code
Business Education Films	Meaning of Percentage	10 min.	R
	Property Taxation	11 min.	R
	What Are Fractions?	10 min.	R
Indiana University	Fractions	30 min.	R

FILMSTRIPS

Distributor	Name of Filmstrip	Length	Price Code
Gregg Division McGraw-Hill Book Co.	General Mathematics--Business Mathematics		P

TRANSPARENCIES

Visual Products Division 3M Center	Fundamental Operation		
	Printed Originals		P
	Color Transparencies		P
	Printed Spirit Masters		P
	Rate Pairs		
	Printed Originals		P
	Color Transparencies		P
	Printed Spirit Masters		P

RELATED

BUSINESS ENGLISH

FILMS

Distributor	Name of Film	Length	Price Code
Association Films, Inc.	The Exact Small Thing	30 min.	R
	From Sentences to Paragraphs	30 min.	R
	Grammar: Part I	30 min.	R
	Grammar: Part II	30 min.	R
	Nouns and Verbs Versus Adjectives and Adverbs	30 min.	R
	Writing Forceful Sentences: Part I	30 min.	R
	Writing Forceful Sentences: Part II	30 min.	R
	Who Wrote That	13 min.	F
Business Education Films	Fundamentals of Public Speaking	10 min.	R
	Group Discussion	10 min.	R
	Is There Communication When You Speak	17 min.	R
	Speech: Conversation	10 min.	R
	Speech Preparation	15 min.	R
	Better Choice of Words	10 min.	R
	Build Your Vocabulary	11 min.	R
	Building an Outlne	10 min.	R
	Effective Listening	10 min.	R
	Getting the Facts	11 min.	R
	Grammar: Verbs and Why We Use Them	11 min.	R
	High Speed Reading	8 min.	R
	How to Remember	10 min.	R
	Improve Your Pronunciation	11 min.	R
	Improve Your Punctuation	11 min.	R
	Improve Your Spelling	10 min.	R
	Making Sense with Sentences	11 min.	R
	Making Yourself Understood	14 min.	R
	Penmanship Improver	10 min.	R
	Speeding Your Reading	10 min.	R
	Why Punctuation?	11 min.	R
	Writing Better Business Letters	10 min.	R

BUSINESS ENGLISH

Distributor	Name of Film	Length	Price Code
Indiana University	English Noun Constructions	30 min.	R
	English Verb Constructions	30 min.	R
	From Sentences to Paragraphs: Part I	30 min.	R
	From Sentences to Paragraphs: Part II	30 mnn.	R
	From Sentences to Paragraphs: Part III	30 min.	R
	Hiding Behind the Dictionary	29 min.	R
	Nouns and Verbs versus Adjectives and Adverbs	30 min.	R
	Sentence Variety and Grammar	30 min.	R
Text Film Division McGraw-Hill Book Co.	Communications	12 min.	P
	Conversation	12 min.	P
	Say What You Mean	20 min.	P
	Using Your Voice	10 min.	P
	Why Punctuate	11 min.	P
Hank Newenhouse, Inc.	Phrases and Sentences	10 min.	P
	Paragraphs	13 min.	P
	Speech Preparation	13 min.	P
Roundtable Films, Inc.	Writing Letters That Get Results	27 min.	P or R
Visual Aids Service University of Illinois	Sentences: Simple, Compound, Complex	11 min.	R
	Sentences: Subject, and Predicate	14 min.	R
	Verbs: Principal Parts	11 min.	R
	Verbs: Recognizing and Using Them	11 min.	R

BUSINESS ENGLISH

FILMSTRIPS

Distributor	Name of Filmstrip	Length	Price Code
Association Films, Inc.	The Clay Bell (Color)	16 min.	P
	Dear Mrs. Calvin (Color)	8 min.	P
	The Language of Letters	15 min.	P
Stanley Bowmar, Inc.	Basic Organization of A Speech (Record accompanies each)		
	Introduction to Public Speaking		
	Sold only as a set		P
	Basic Principles of Sentence Structure (Color)		
	The Complex Sentence (Color)		
	The Compound Sentence (Color)		
	The Simple Sentence (Color)		
	Complete Set		P
	Adjectives (Color)	48 frames	P
	Adverbs (Color)	48 frames	P
	Nouns (Color)	48 frames	P
	Phrases and Clauses (Color)	48 frames	P
	Prepositions, Conjunctions, Interjections (Color)	48 frames	P
	Pronouns (Color)	48 frames	P
	Verbs (Color)	48 frames	P
	Why Study Grammar? (Color)	48 frames	P
	COMPLETE SET		P
	Kinds of Sentences (Color)	49 frames	P
	Making Words Agree	49 frames	P
	Parts of the Sentence or Clause (Color)	49 frames	P
	Recognizing Clauses (Color)	49 frames	P
	Recogniging Phrases (Color)	49 frames	P
	Using Personal Pronouns Color	49 frames	P
	The Verb and the Sentence	49 frames	P
	COMPLETE SET		P
McGraw-Hill Book Co.	Adjectives and Adverbs color	50 frames	P
	Nouns and Their Uses color	50 frames	P
	Prepositions and Conjunctions	40 frames	P
	Pronouns and Their Uses	50 frames	P
	Simple Sentences	50 frames	P
	Verbs (Color	50 frames	P
	Complete Set - Fundamental of English Series		P

BUSINESS ENGLISH

Distributor	Name of Filmstrip	Length	Price Code
McGraw-Hill	Adjective Clauses and Relative Pronouns	45 frames	P
	Adverbial Clauses and Complex Sentences	45 frames	P
	Compound Sentences: General Review	45 frames	P
	Linking Verbs and Predicate Nominative	45 frames	P
	Transitive Verbs and Direct Objects (Color	45 frames	P
	Using Perfect Tenses: Building Sentences	45 frames	P
	Complete Set - Coach for Good English Series		P
	Consonant Sound	42 frames	P
	Hearing Sounds in Words	42 frames	P
	Letters Which Work Together	42 frames	P
	Long Vowel Sounds	42 frames	P
	Studying Long Words	42 frames	P
	Tricky Consonant Sounds	42 frames	P
	Complete Set Goals in Spelling		P
Nate Quillen Instructional Systems	The Apostrophe, the Colon, and Italics	22 frames	P
	Capital Letters	22 frames	P
	The Comma in a Friendly Letter	22 frames	P
	The Comma: Other Uses	22 frames	P
	End Punctuation	22 frames	P
	Punctuating Direct Quotations	22 frames	P
	Complete Set - Using Punctuation and Capital Letters		P
Society for Visual Education, Inc.	In Addresses and Dates	40 frames	P
	In a Series	43 frames	P
	In Miscellaneous Usage	34 frames	P
	With Appositives and Parenthetical Expressions	34 Frames	P
	With Clauses and Phrases	46 frames	P
	With Direct Address, Introductory Words, Final Query	37 frames	P
	Complete Set - The Comma		P
	Apostrophe and Quotation Marks	55 frames	P
	Capitalization	40 frames	P
	Colon & Semicolon	55 frames	P
	End Punctuation	55 frames	P
	Italics & Hyphen	40 frames	P
	Complete Set - End and other		P

BUSINESS ENGLISH

TRANSPARENCIES

Distributor	Name of Transparency	Price Code
Valiant Instructional Materials Corp.	Form Class Words (25)	P
	Structure Words (16)	P
	Sentences (32)	P
	Paragraphs (12)	P
	Complete set of 85	P
	Dictionary Skills (Complete set of 51 with overlays)	P
	Reading Skills (Complete set)	P
	Homonyms (10)	P
	Following Directions (8)	P
	Using the Dictionary (13)	P
Visual Products Division 3M Company	Oral Communications	
	Printed Originals	P
	Prepared Color Transparencies	P
	Written Communications	
	Printed Originals	P
	Prepared Color Transparencies	P

RELATED

BUSINESS LAW

FILMS

Distributor	Name of Film	Length	Price Code
Business Education Films	Basic Court Procedures	15 min.	R
	Common Law	13 mnn.	R
	Country Magistrate	20 min.	R
	English Criminal Justice	22 min.	R
	Law and Social Controls	10 min.	R
	Man on Trial	30 min.	R
	Our Basic Civil Rights	14 mnn.	R
	Practice Courtroom-Fell vs. Manlock	7 min.	R
	Problem Clinic	12 min.	R
	Procedure in the Traffic Court	20 min.	R
	The Supreme Court	10 min.	R
	Traffic Court	8 min.	R
	Trial by Jury	30 min.	R
	Trial-The Case for the Defendant	30 min.	R
	Understanding the Law	11 min.	R
	Village Notary	10 min.	R
	What is a Contract	10 min.	R
	What is a Corporation	11 min.	R
	Why We Respect the Law	14 min.	R
	With Benefit of Counsel	15 min.	R
Indiana University	Witness to an Accident	11 min.	R
	Witness to the Accident	30 min.	R
The National Education Program	Structure of the American Way of LIfe	12 min.	R

TRANSPARENCIES

Distributor	Name of Transparency	Price Code
Visual Products Div. 3M Center	Law in Business	
	Printed Originals	P
	Prepared in Color Transparencies	P

RELATED

ECONOMICS

FILMS

Distributor	Name of Film	Length	Price Code
Association Films, Inc. Pennsylvania	The Case for Competition	30 min.	R
	Economic Education: A Part of the Main	28 min.	F
	Eddie, Inc.	26 min.	F
	The Little Giant	14 min.	F
	Personal Financial Planning	11 min.	F
	Personal Money Management	13 min.	F
	Symbols and Signatures	11 min.	F
	Wise Use of Credit	11 min.	F
Association Films, Inc. Illinois	This is Lloyds	35 min.	F
Association Films New York	A Penny Saved	15 min.	F
Business Education Films	Before the Day	30 min.	R
	Capitalism	10 min.	F
	The Care and Feeding of Ideas	13 min.	R
	Competition and Big Business	22 min.	R
	Democracy's Diary	16 min.	R
	Economy is Everybody's Business	15 min.	R
	Everybody Knows	15 min.	R
	Federal Taxation	11 min.	R
	Inflation	17 min.	R
	Law of Demand and Supply	11 min.	R
	Looking Ahead	14 min.	R
	Meaning of the Industrial Revolution	10 min.	R
	Owning a Share of America	13 min.	R
	Profit System	13 min.	R
	Sam'l and Social Security	14 min.	R
	Secret of American Production	13 min.	R
	Small Business U.S.A.	30 min.	R
	Spirit of Enterprise	13 min.	R
	The Structure of Union	11 min.	R
	A Voice in Business	13 min.	R
	Why Play Leapfrog?	10 min.	R
	Work of the Stock Exchange	16 min.	R
	Your Money Is What You Make It	30 min.	R

ECONOMICS

Distributor	Name of Film	Length	Price Code
Chamber of Commerce of the U.S.	Competition in Business	13 min.	
	Everybody Knows	15 min.	
	It's Everybody's Business		
	The Story of Creative Capital	14 min.	R
Consumers Union Film	Consumers Want to Know		
Creativision Incorporated	The Power of Paper	27 min.	F
General Mills, Inc.	Sound of Freedom	29 min.	F
Indiana University	America: On the Edge of Abundance	59 min.	R
	Challenge of Management	30 min.	R
	Economic Growth	30 min.	R
	Entrepreneur: Part I	29 min.	R
	Entrepreneur: Part II	29 min.	R
	Financial Management	30 min.	R
	How It Evolved	30 min.	R
	Liability and Insurance	30 min.	R
	Market and the Individual	30 min.	R
	Mass Production Workers	29 min.	R
	Role of the Market	30 min.	R
The Jam Handy Organization	American Thrift	25 min.	F
McGraw-Hill Book Co.	The Bank Holiday Crisis of 1933	27 min.	P
	The '29 Boom and '30's Depression	14 min.	P
	The Rise of Organized Labor	18 min.	P
Modern Talking Picture Service	Dialogue with Life	26 min.	
	Life Insurance-What It Means and How It Works	13 min.	
	Time. .And A Place to Grow	26 min.	
National Association of Manufacturers	Getting Started	14 min.	F
	What's on Your Mind		

ECONOMICS

Distributor	Name of Film	Length	Price Code
The National Education Program	The Profit and the Loss	15 min.	R
Public Relations Library	You Decide		
Nate Quillen Instructional Systems	Ben Franklin Sells Today	23 min.	
	Through the Mirror	27 min.	
Sterline Movies, U.S.A.	The Challenge		
	Good Old Sam	30 min.	F
	How to Invest and Why	20 min.	F
	Of Mutual Interest	14 min.	F
	How Stocks are Bought and Sold	20 min.	F
	The Speculators	30 min.	F
Visual Aids Service University of Illinois	American Business System: Economic Growth	30 min.	R
	American Business System: Financial	30 min.	R
	American Business System: Government	30 min.	R
	American Business System: How It Evolved	30 min.	R
	American Business System: The Challenge of Management	30 min.	R
	American Business System: The Nation's Resources	30 min.	R
	American Business System: The Role of the Market	30 min.	R
	Cooperative and the Community	11 min.	R
	Money Talks, Part III	28 min.	R
	Social Security	10 min.	R
	Social Security Story	15 min.	R

ECONOMICS

FILMSTRIPS

Distributor	Name of Filmstrip	Length	Price Code
American Bankers Assoc.	The Dollar Tour		
Association Films, Inc. New York	Directing Your Dollar	62 frames	F
	Dollars for Health	60 frames	F
	Dollars for Security	62 frames	F
	Marriage and Money	67 frames	F
Business Education Films	Basic Economic Concepts		R
	Business and Government		R
	Federal Courts and Law Enforcement		R
	Money, Prices, and Interst		R
	Post Office Department		R
	Stamps--How They Are Made		R
	Stock Exchange--It's Nature and Function		R
	Stock Exchange--How It Operates		R
	Supply and Demand		R
Stanley Bowmar Co., Inc.	Advertising--A Force in Modern Living	40 frames	R
	The Growth of American Labor	40 frames	P
	Pensions for All	40 frames	P
	Stock Exchange--How it Operates	40 frames	P
	Stock Exchange--Its Nature and Function	40 frames	P
	Taxes--Your City's Income	40 frames	P
	The Technological Revolution	40 frames	P
	What is Automation?	40 frames	P
	What's the Price?	40 frames	P
	Women and Work	40 frames	P
	(Any 8 filmstrips)		P

ECONOMICS

TRANSPARENCIES

Distributor	Name of Transparency	Price Code
Cousino Visual Education	Check Forms and Procedures (5)	P
	Fixed Assets (6)	P
	Merchandising Businesses (19)	P
	Payroll Procedures (8)	P
	Service Businesses (16)	P
	Special Journal Forms and Entries	P
	Complete Set	P
Educational Audio Visual	Allocating Resources	
	Business Cycles	
	Flow of Economic Activity	
	Holding Co. Pyramid	
	Trustee Corp. Vs. Holding Corp.	
	U.S. Growth and Unemployment	
	U.S. Income and Spending Flow	
	Complete Set	P
Gregg Division McGraw-Hill	Personal Checking Accounts and Income Taxes	P
Visual Products Div. 3M Center	Economics in Business	
	Printed Originals	P
	Prepared Color Transparencies	P
	The Income Tax	
	Printed Originals	P
	Prepared Color Transparencies	P

SLIDES

Chamber of Commerce of the U.S.	Economic Growth	35	
	Education-- An Investment in People	50	
	Ulysses B. George and the Chamber of Commerce	42	P
	Who Controls Your Price Strings	32	
	Who Profits from Profits	32	

RELATED

HUMAN RELATIONS

FILMS

Distributor	Name of Film	Length	Price Code
Association Films, Inc. Pennsylvania	The Big Question--Choosing Your Career	28 min.	F
	Down at the Office	10 min.	
	You are Not Alone		F
Business Education Films	Aptitudes and Occupations	16 min.	R
	Careers for Girls	18 min.	R
	Choosing Your Occupation	10 min.	R
	Developing Leadership	11 min.	R
	Developing Responsibility	11 min.	R
	Developing Self-Reliance	11 min.	R
	Everyday Courtesy	10 min.	R
	Finding the Right Job	11 min.	R
	Finding Your Life Work	22 min.	R
	Getting a Job	16 min.	R
	How to be Well Groomed	11 min.	R
	How to Investigate Vocations	10 min.	R
	How to Keep a Job	11 min.	P
	How to Study	11 min.	R
	How to Succeed in School	10 min.	R
	How to Take a Test	10 min.	R
	How We Learn	10 min.	R
	Improve Your Personality	10 min.	R
	Make Your Own Decisions	11 min.	R
	Personal Qualities for Job Success	11 min.	R
	Planning for Success	10 min.	R
	Planning Your Career	16 min.	R
	State Employment Service	20 min.	R
	Work	30 min.	R
	Working for the U.S.A.	14 min.	R
	Communications	12 min.	R
	Developing Cooperation	15 min.	R
	Discipline: Giving Orders	14 min.	R
	Discipline: Reprimanding	10 min.	R
	Employment Interview	11 min.	R
	First Impressions	20 min.	R
	Five Keys	20 min.	R
	Fragile, Handle Feelings with Care	10 min.	R
	Getting Along with Others	20 min.	R
	Grievance Hearing	15 min.	R
	How to Give and Take Instructions	11 min.	R
	Job Evaluation and Merit Rating 13 min.	13 min.	R

HUMAN RELATIONS

Distributor	Name of Film	Length	Price Code
Business Education Films	Let's Be Human	14 min.	R
	Maintaining Good Working Condition	9 min.	R
	New Supervisor Takes . Look at His Job	11 min.	R
	Working Together	20 min.	R
Coronet Films	Personal Health for Girls	11 min.	P
	Improve Your Personality	11mmin.	P
Henk Newenhouse, Inc.	Three Young Women	17 min.	P
	Three Young Men	16 min.	P
Text Film Div. McGraw-Hill	The Bright Young Newcomer	8 min.	P
	Employment Interview	12 min.	
	The Follow-Through	8 min.	P
	The Grapevine	8 min.	P
	How Much Cooperation	8 min.	P
	In the Middle	8 min.	P
	Promotion By-Pass	8 min.	P
	The Missing Interest	8 min.	P
	A Self-Made Man	8 min.	P
Roundtable Films, Inc.	I Just Work Here	17 min.	R
	Judging People	23 min.	R
	Person to Person Communication		R
	That's Not My Job		R
Visual Aids Service University of Illinois	Body Care and Grooming	17 min.	R
	Boss Didn't Say Good Morning	17 min.	R
	Getting Along with Others	10 min.	R
	Good Grooming for Girls	10 min.	R
	Good Grooming for Girls : Hair Care	14 min.	R
	Good Grooming for Girls Makeup	11 min.	R
	Good Grooming for Girls: Posture	9 min.	R
	Good Grooming for Girls: Wardrobe	14 min.	R
	Posture and Personality	11 min.	R

HUMAN RELATIONS

FILMSTRIPS

Distributor	Name of Filmstrip	Length	Price Code
Association Films, Inc.	Charm by Choice	14 min.	P
	How Does Your Future Look?	16 min.	P
Better Selling Bureau	Supervisory Training on Human Relations		
Business Education Films	Finding the Right Job for You		R
	Getting a Job and Keeping It		R
	Getting Ahead in Your Job		R
	I Want That Job		R
	Looking at Business Careers		R
	Natures of a Job		R
	New Employee and Fellow Workers		R
	Selling Yourself to an Employer		R
	Succeeding in Your Career		R
	You Want to Look Right		R
	Your New Job		R
Harcourt, Brace & World	Preparing for the Jobs of the 70's		P
	Preparing for the World of Work		P
McGraw-Hill Book Company	Making Friends is Easy	45 frames	P
	Popularity Comes to You	45 frames	P
	So You Want to Make a Good Impression	45 frames	P
	Yes, Politeness Is For You	45 frames	P
	Your Boss Is Proud of You	45 frames	P
	Complete Set		P
	Personal Appearance	38 frames	P
	Personal Relationships	38 frames	P
	School Functions	38 frames	P
	Table Manners	38 frames	P
	You're in Public	39 frames	P
	You're on a Trip	38 frames	P
	Complete Set		P
	Clean as a Whistle	40 frames	P
	Fit as a Fiddle	40 frames	P
	Strictly Business	40 frames	P
	Time to Attire	40 frames	P
	Complete Set		P

HUMAN RELATIONS

TRANSPARENCIES

Distributor	Name of Transparency	Price Code
Eye Gate House, Inc.	I want a Job (15)	P
Gregg Division McGraw-Hill	Charm Transparencies	
Social Studies School Service	Guide to Finding a Job (7)	P
Tecnifax Corporation	How to Find a Job	P
Visual Products Division 3M Center	Fundamentals of Grooming	
	Printed Originals	P
	Prepared Color transparencies	P
	Office Behavior, Attitudes and Traits	
	Printed Originals	P
	Prepared Color Transparencies	P
	Procedures and Policies in the Office	P
	Personality and Appearance in the Office	P
	Career Planning	
	Printed Originals	P
	Prepared Color Transparencies	P

RESOURCE MATERIALS FOR

Programs

14.0100 Accounting and Computing

14.0200 Business Data Processing

14.0300 Filing, Office Machines, and General Office Clerical

14.0700 Stenographic, Secretarial, and Related

14.0900 Typing and Related

and

Related

Business English

Business Law

Economics

Human Relations

Booklets
Charts
Pamphlets
Posters
Records
Tapes

SECTION II

ADDRESSES OF DISTRIBUTORS

A. W. Faber Castell Pencil Company
41 Dickerson Street
Newark, New Jersey 07103

Alumnae Advisory Center, Inc.
541 Madison Avenue
New York, New York 10002

American Bankers Association
90 Park Avenue
New York, New York

American Institute of Certified Public Accountants
666 Fifth Avenue
New York, New York 10019

Am. of Men's and Boy's Wear, Inc.
1290 Avenue of the Americas
New York, New York 10019

Bank of America
Small Business Advisory Service
P. O. Box 3415
San Francisco, California 94120

Barnes & Noble
105 Fifth Avenue
New York, New York

Business Equipment Manufacturers Association
235 East 42 Street
New York, New York 10017

Careers, Inc.
P. O. Box 135
Largo, Florida 33540

Carter's Ink Company
Cambridge, Massachusetts
02412

CED
711 Fifth Avenue
New York, New York 10022

Chamber of Commerce of the United States
1615 H Street, N.W.
Washington, D. C. 20006

Connecticut Mutual Life Insurance Company
Hartford, Connecticut
06115

ADDRESSES OF DISTRIBUTORS (Cont'd)

Converisa-Phone Institute
132 West 32 Street
New York, New York

Dartnell Corporation
4660 Ravenswood Avenue
Chicago, Illinois 60607

Dictation Disc Company
170 Broadway
New York, New York 10038

Ditto, Inc.
(Local Representative)

Eaton Paper Company
Public Affairs Committee
Pittsfield, Massachusetts 01203

The Economics Press, Inc.
270 Pleasant Valley Way
West Orange, New Jersey 07052

Educational Record Sales
157 Chambers Street
New York, New York 10007

EMC Recording Company
606 East Seventh
St. Paul, Minnesota

Enterprise Publications
20 North Wacker Drive
Chicago, Illinois 60606

Federal Deposit Insurance Corporation
Office of Education and Publications
550 17th Street, N.W.
Washington, D. C. 20259

Federal Reserve Bank of Atlanta
Atlanta, Georgia
30303

Federal Reserve Bank of Boston
Boston, Massachusetts

Federal Reserve Bank of Minneapolis
Minneapolis, Minnesota

Federal Reserve Bank of New York
33 Liberty Street
New York, New York 10045

ADDRESSES OF DISTRIBUTORS (Cont'd)

Federal Reserve Bank of Philadelphia
Philadelphia, Pennsylvania
19101

Federal Reserve Bank of Richmond
Richmond, Virginia
23213

Federal Reserve Bank of St. Louis
St. Louis, Missouri

Future Business Leaders of America
1201 16th Street, N. W.
Washington, D. C. 20036

Superintendent of Documents
Department T
Government Printing Office
Washington, D. C. 20402

Money Management Institute
Household Finance Corporation
Prudential Plaza
Chicago, Illinois 60601

Imperial Productions, Inc.
Department K
Kankakee, Illinois 60901

Institute of Life Insurance
277 Park Avenue
New York, New York 10017

The Institute of Research
537 South Dearborn Street
Chicago, Illinois 60605

Director of Educational Relations
Insurance Information Institute
267 West 25th Street
New York, New York 10001

Internal Revenue Service
(District Office)

International Bank for Reconstruction and Development
1818 H Street, N. W.
Washington, D. C. 20433

Joint Council on Economic Education
1212 Avenue of the Americas
New York, New York 10036

ADDRESSES OF DISTRIBUTORS (Cont'd)

Keane Records
1313 North Vine Street
Suite 110
Holywood, California

Kerlin Graphics
Box 58
Elnora, New York 12065

The Lansford Publishing Company
2516 Lansford Avenue
San Jose, California 95125

Gregg Division
McGraw-Hill Book Company
Manchester Road
Manchester, Missouri 63011

National Blank Book Company
National School Service Bureau
Holyoke, Massachusetts 01040

Educational Service Division
National Consumer Finance Association
1000 16 Street, N.W.
Washington, D.C. 20006

Education Department
National Industrial Conference Board
845 Third Street
New York, New York 10022

National Secretaries Association
1103 Grand Avenue
Kansas City, Missouri

Mr. Allen O. Felix, Manager
New York Stock Exchange
11 Wall Street
New York, New York 10005

Ohio Bell Telephone
(Local Representative)

The Ohio Consumer Loan Association
79 East State Street
Columbus, Ohio 43215

Old Town Corporation
750 Pacific
Brooklyn, New York 11238

ADDRESSES OF DISTRIBUTORS (Cont'd)

Poster Visual Aids
58 Union Street
Milford, New Hampshire 03055

Prudential Insurance Company
Prudential Plaza
Newark, New Jersey

R. C. Allen Business Machines, Inc.
Education Department
Grand Rapids, Michigan

Regents Publication Company
200 West Park Avenue South
New York, New York

Dr. Peter Jacyk
Rider College
Trenton, New Jersey

Royal Typewriter Co., Inc.
Div. of Litton Industries
150 New Park Avenue
Hartford, Connecticut 06106

Science Research Associates, Inc.
259 East Erie Street
Chicago, Illinois

Social Security Office
(Local Area)

Sound Education
Box 414
Port Huron, Michigan

South-Western Publishing Company
5101 Madison Road
Cincinnati, Ohio 45227

Special Teaching Aids
3408 North Potomac Street
Arlington, Virginia 22213

Teaching Aids, Inc.
P. O. Box 3527
Long Beach, California 90803

Reprint Department
Today's Secretary
330 West 42 Street
New York, New York 10036

ADDRESSES OF DISTRIBUTORS (Cont'd)

Training Development Center
34 West 36th Street
New York, New York 10018

Twentieth Century Fund
41 East 70 Street
New York, New York

United States Printing Office
Washington, D. C. 20402

United States Savings & Loan League
221 North LaSalle Street
Chicago, Illinois 60601

Vocational Guidance Manual
235 East 45th Street
New York, New York 10017

J. Weston Walch
Box 1075
Portland, Maine

Western Tape Duplicators
P. O. Box 544
2273 East Middlefield Road
Mountain View, California 94040

14.0100 ACCOUNTING AND COMPUTING

BOOKLETS, KITS, PAMPHLETS, TEACHING UNITS

Distributor or Publisher	Title	Price Code
American Bankers Association	Banking--A Career for Today and Tomorrow	F
	Banking: An Opportunity For You	F
Bank of America	Understanding Financial Statements	F
Federal Reserve Bank of New York	The Story of Checks	F
Future Business Leaders of America	Bookkeeping and Accounting	P
Government Printing Office	Your Federal Income Tax	F
Internal Revenue Service	Income Tax Kits	F
New York Stock Exchange	You and the Investment World	F
Social Security Office	Social Security Kit	F

CHARTS

Internal Revenue Service	Income Tax Charts	F
Social Security Office	Social Security Charts	F
South-Western Publishing Co.	Adjusting the Ledger The Bookkeeping Cycle Closing the Ledger for a Service Business A Comparison of Manual and Unit Record Systems The Data Processing Cycle Journalizing, Posting and Preparing the Trial Balance Recording and Posting the Opening Entry Work Sheet and Financial Statements	P

14.0100 ACCOUNTING AND COMPUTING

POSTERS

Distributor or Publisher	Title	Price Code
American Institute of Certified Public Accountants	A Career as a Certified Public Accountant	F
	Wanted	F
National Blank Book Co.	Bookkeeping Procedures Visualized	F
Special Teaching Aids	Cartoon Posters for Bookkeeping	P

14.0200 BUSINESS DATA PROCESSING

PERIODICALS

Distributor or Publisher	Title	Price Code
American Data Processing, Inc.	Computer Digest	P
	Data Processing for Education	P
	Forms and Systems	P
	Information Retrieval Letter	P
Business Press International	Business Automation News Report	P

POSTERS

South-Western Publishing Co.	Automated Processing of an Order (Must be purchased in the set with six book-keeping charts)	
	The Data Processing Cycle	P
Teaching Aids, Inc.	Data Processing Chart	P
J. Weston Walch	Posters on Computers (18 posters 8 1/2 x 11)	P
	Scientific Research Centers (18 posters 8 1/2 x 11)	P

PROGRAMMED INSTRUCTIONAL MATERIALS

Gregg Division	Computer Language	P

TAPES

Imperial Productions, Inc.	Computers and Data Processing: An Introduction	P
	Programmer	P

14.0300 FILING, OFFICE EQUIPMENT, AND GENERAL CLERICAL

BOOKLETS, PAMPHLETS, TEACHING KITS

Distributor or Publisher	Title	Price Code
Carter's Ink Co.	Fundamentals of Offset	P
	How to Be an Expert on Carbons and Ribbons	F
	Techniques of Mimeographing	F
Connecticut Mutual Life Insurance Co.	Speak When You Write	F
Ditto, Inc.	Ditto Billheads Master	F
	How to Use the Ditto Duplicator	F
Government Printing Office	The Seven Keys to Better, Faster Typing	P
Old Town Corporation	Facts About the Purchase and Use of Carbon Paper	F
Prudential Insurance Co.	The Writing Yardstick - A Tool for More Effective Writing	F
United States Printing Office	Clerical Occupations for Women - Today and Tomorrow	P

CHARTS

Teaching Aids, Inc.	Letter-Style Charts	P

14.0300 FILING, OFFICE EQUIPMENT, AND GENERAL CLERICAL

POSTERS

Distributor or Publisher	Title	Price Code
The Lansford Publishing Co.	Earnings	
	Employment in Major Industries	
	Employment in White and Blue Collar Occupations	
	Importance of Clerical Workers	
	Importance of Education	
	Importance of Sales Occupations	
	Job Opportunities	
	Unemployment and Schooling	P
South-Western Publishing Co.	Careers in Business	F
Teaching Aids, Inc.	Clerical Record Chart	P
J. Weston Walch	Opportunities Through Business Education (Set of 20)	P

RECORDS

Gregg Division	First Year Speed Course Set I	P
	Second Year Speed Course Set II	P
South-Western Publishing Co.	Part I (Correlated with Part I of South-Western Typing Text)	P

TAPES

Imperial Productions, Inc.	Switchboard Operator	P
South-Western Publishing Co.	Typing Tapes (Correlated with Part I of South-Western Typing Text)	P
Western Tape Duplicators	Business Machines	P

14.0900 TYPING AND RELATED

BOOKLETS, PAMPHLETS, TEACHING UNITS

Distributor or Publisher	Title	Price Code
Carter's Ink Co.	How to Be an Expert on Carbons and Ribbons	F
Government Printing Office	The Seven Keys to Better and Faster Typing	P
National Blank Book Co.	A Typists Day in the Office of National Blank Book Co.	F
Royal Typewriter Co., Inc.	Electric Keyboard Mastery Electric Typing Methods Typing Do's and Dont's	F

CHARTS

A. W. Faber-Castell Pencil Co.	The Right Eraser for the Job	F
Business Equipment Manufacturers Assoc.	Typewriter Keyboard Wall Chart	F

14.0900 TYPING AND RELATED

POSTERS

Distributor or Publisher	Title	Price Code
Business Equipment Manufacturers Assoc.	Keyboard Chart	F
Gregg Division	Gregg Typing Wall Chart Instructor Letter-Style Series	
	Personal Use Series	P
Poster Visual Aids	The Case of the New, New Ribbon Personality, Ugh!	
	Steps in Correct Ribbon Change	
	Tap Tapnick	
	Typing Do's and Duds (7)	
	Typing Habits, Ugh! (6)	P
R. C. Allen Business Machines, Inc.	Posture Chart	
	Progress Chart	F
Royal Typewriter Co., Inc.	Keyboard Diagram--Royal Electric Typewriter	
	Keyboard Diagram--Royal Manual Typewriter	
	Posture Chart	
	Progress Chart	
	Royal Electric Diagrammatic Wall Chart	
	Royal Manual Diagrammatic Wall Chart	F
South-Western Publishing Co.	Speed Charts	
	Wall Chart	F

RECORDS

Dictation Disc Corp.	Twentieth Century Typewriting Set 20	
	Typing Records, Musical Set 99	P
Gregg Division	Typing Rhythm Records	P
Sound Education	Typing by Sound	P
South-Western Publishing Co.	Homework Typing Records	P

BUSINESS ENGLISH AND COMMUNICATIONS

BOOKLETS, PAMPHLETS, TEACHING UNITS

Distributor or Publisher	Title	Price Code
Alumnae Advisory Center, Inc.	How Not to Write Letters of Application	P
Barnes & Noble	Spell it Right	P
Connecticut Mutual Life Insurance Co.	Speak When You Write	F
Eaton Paper Corp.	Your Personality Pops on Paper	P
Prudential Insurance Co.	The Writing Yardstick - A Tool For More Effective Writing	F

RECORDS

Conversa-Phone Institute	2 record Spelling Course	P
Educational Record Sales	Better Speech and Diction Mend Your Speech Speak Well	P
Sound Education	Spelling Made Easy	P

TAPES

Western Tape Duplicators	Grammar - Punctuation Set I (5 tapes & key) Vocabulary - Letter Set II	P

BUSINESS LAW

POSTERS

Distributor or Publisher	Title	Price Code
Kerlin Graphics	Learn Your Legal Terms Set No. 80	
	Learn Your Legal Terms Set No. 81	P
Teaching Aids, Inc.	Business Law Charts	P

RECORDS

Educational Record Sales	Supreme Court Cases Volume I	
	Supreme Court Cases Volume II	P

TAPES

Western Tape Duplicators	Business Law 30 Tapes 60 Lectures	P

HUMAN RELATIONS

BOOKLETS, PAMPHLETS, TEACHING UNITS

Distributor or Publisher	Title	Price Code
Alumnae Advisory Center, Inc.	Part Time Employment: Employment Attitudes	
	The Job Interview	P
Am. of Men's & Boy's Wear, Inc.	Dress Right: A Resource Unit for Business Education (1 for student & 1 for teacher)	F
Barnes & Noble	How You Can Get the Job You Want	P
Careers, Inc.	Business Careers Kit (120 briefs of various jobs)	F
Connecticut Mutual Life Insurance Co.	Growing Pains	
	The Next Promotion	
	Satisfaction Guaranteed	F
Dartnell Corporation	Poise for the Successful Business Girl	P
Eaton Paper Corp.	Your Personality Pops on Paper	P
The Economics Press, Inc.	All in a Day's Work	
	Dollars Down the Drain	
	Full Speed Ahead	
	Help Wanted	
	How Good Would You Be?	
	How to Communicate Ideas	
	How to Kill Progress	
	How's Your Attitude?	
	Let's Face It!	
	Old-Fashioned Honesty	
	Personality Pays	
	Quality is People	
	Slow Poison	
	Taking Stock	
	That's Not My Job	
	Who Me?	P

HUMAN RELATIONS

BOOKLETS, PAMPHLETS, TEACHING UNITS (Cont'd)

Distributor or Publisher	Title	Price Code
Enterprise Publications	Career Preview	
	Courtesy - Does it Still Pay?	
	The Day Everybody was Absent	
	Everyday Human Relations	
	Getting Along and Getting Ahead on Your Job	
	Getting Along with Other People	
	The High Cost of a Blabbermouth	
	How You Communicate Accidentally	
	Looking Toward that First Job	
	What Role Do Employers Play in Building Company Relations	P
Government Printing Office	School or Else	F
The Institute of Research	Careers Research Monographs	P
Regents Publishing Co.	Career Information Monographs	P
Science Research Assoc.	If you are Not Going to College	F
Vocational Guidance Manuals	VGM Opportunities	F

CHARTS

National Industrial Conference Board	Business Outlook Chart	F
Poster Visual Aids	Personality, Ugh!	P
South-Western Publishing Co.	Careers in Business	F

SPEAKERS

Ohio Bell Telephone Representative	Femmes, Fashions, & Phones	
	Your Voice Is You	F

ECONOMICS AND INSURANCE

BOOKLETS, PAMPHLETS, TEACHING UNITS

Distributor or Publisher	Title	Price Code
American Bankers Assoc.	Materials on Money and Banking	F
	Using Banking Services	F
	You, Money and Property	F
CED	A Stabilizing Budget for 1969	P
	The World Monetary System	P
Chamber of Commerce of the United States	Small Business: Its Role and Its Problems	P
Enterprise Publications	Have Quality and Pride of Workmanship become a National Challenge:	P
	A Tale of 4 Companies	P
	What Role Do Employees Play in Building Company Reputation	P
Federal Deposit Insurance Corporation	Annual Report of the Federal Deposit Insurance Corp.	F
Federal Reserve Bank of Atlanta	Fundamental Facts about United States Money	F
Federal Reserve Bank of Boston	The Federal Reserve System - Trustee of the Nation's Money	F
Federal Reserve Bank of Minneapolis	Your Money and the Federal Gov't.	F
Federal Reserve Bank of New York	Genuine or Counterfeit	F
	The Story of Checks	F
Federal Reserve Bank of Philadelphia	The Four Hats of the Federal Reserve System	F
	Series on Economic Education	
	Gold - Automation	
	The Balance of Payments	
	Inflation and/or Unemployment	
	The Mystery of Economic Growth	
	The National Debt	
	The New Poverty	
	The Price System	
	Unemployment in Prosperity - Why?	F

ECONOMICS AND INSURANCE

BOOKLETS, PAMPHLETS, TEACHING UNITS (Cont'd)

Distributor or Publisher	Title	Price Code
Federal Reserve Bank of Richmond	Readings on Money	F
	The Federal Reserve Today	F
	You and Your Money	F
Federal Reserve Bank of St. Louis	Your Money Supply	F
Household Finance Corp.	Money Management for Young Moderns	P
	Money Management, Your Health and Recreation Dollar	P
	(Numerous other booklets available)	
Institute of Life Insurance	Life Insurance Fact Book	F
	Policies for Protection (Life and health insurance)	F
International Bank for Reconstruction and Development	IFC General Policies	F
	International Finance Corp.: Annual Report	F
	This Growing World	F
	World Bank IDA	F
	(and IDA Annual Reports)	F
Joint Council on Economic Education	Economics and the Consumer	P
National Consumer Finance Assoc.	Basic Principles on Family Money and Credit	P
	Consumer Credit and You	F
	Facts You Should Know About Your Credit	F
	Finance Facts Yearbook	P
	Understanding and Using Economics	P
New York Stock Exchange	Careers in Stocks and Bonds	F
	Understanding Financial Statements	F
	Understanding Preferred Stocks and Bonds	F
	You and the Investment World (Complete teaching unit with teacher's manual)	F

ECONOMICS AND INSURANCE

BOOKLETS, PAMPHLETS, TEACHING UNITS (Cont'd)

Distributor or Publisher	Title	Price Code
The Ohio Consumer Loan Association	Teacher's Guide and Kit One week teaching unit on Consumer Finance	F
Rider College	A Teacher's Guide for a Class Stock Project	P
Social Security Office	Social Security Kit	F
United States Savings & Loan League	Job Opportunities in a Business With a Future	F
	Safeguards of Freedom Thrift and Home Ownership	F
	Savings & Loan Fact Book	F
	What You Should Know Before You Buy a Home	F

POSTERS

Insurance Information Institute	Charts on Automobile Insurance	F
National Consumer Finance Assoc.	What is the Consumer's Net Worth	F
	Who Provides Credit to Consumers	F
	Who Uses Consumer Credit?	F
	Why do People Use Consumer Credit?	F
Twentieth Century Fund	U. S. in the World Economy	F

14.0700 STENOGRAPHIC, SECRETARIAL, AND RELATED

BOOKLETS, PAMPHLETS, TEACHING KITS

Distributor or Publisher	Title	Price Code
A. W. Faber Castell Pencil Company	A. W. Faber Castell Pencil Company	F
Connecticut Mutual Life Insurance Co.	Speak When You Write	F
Dartnell Corporation	How to Take the Fog Out of Writing	P
	Poise for the Successful Business Girl	P
Future Business Leaders of America	Secretarial Occupations	P
National Blank Book Co.	A Secretary's Day in the Office of National Blank Book Co.	F
The National Secretaries Association	Secretarial Career Kit	F
Old Town Corporation	Facts about the Purchase and Use of Carbon Paper	F
	Seven Suggestions for Smart Secretaries	F
Prudential Insurance Co. of America	The Writing Yardstick - A Tool for More Effective Writing	F
Royal Typewriter Co., Inc.	Electric Keyboard Mastery	F
	Electric Typing Methods	F
	The Successful Secretary	F
	Typing Do's and Dont's	F
	You as a Secretary	F
Special Teaching Aids	Shorthand Set	P
Training Development Center	Secretarial Practice Set	P

14.0700 STENOGRAPHIC, SECRETARIAL, AND RELATED

POSTERS

Distributor or Publisher	Title	Price Code
A. W. Faber Pencil Co.	The Right Eraser for the Job	F
Dictation Disc Co.	Eight Important Shorthand Practice Techniques	F
	Shorthand Homework Can be Fun	F
Gregg Division	Gregg Shorthand Picture Posters Brief Forms and Derivatives Diamond Jubilee Series	P
National Blank Book Co.	Efficient Notetaking	F
Special Teaching Aids	Twelve Cartoons	P
Teaching Aids, Inc.	A Real Motivation Chart for Shorthand	P
	Shorthand Wall Chart Set No. S-1	P
Today's Secretary	Perfect Boss	P
	Perfect Secretary	P

14.0700 STENOGRAPHIC, SECRETARIAL, AND RELATED

RECORDS

Distributor or Publisher	Title	Price Code
Dictation Disc Co. 45 RPM Records	Business Letters	
	Set 40 (40-60)	
	400 (50-70)	
	400B (50-70)	
	41 (60-80)	
	41B (60-80)	
	41C (60-80)	
	410 (70-90)	
	410B (70-90)	
	410C (70-90)	
	42 (80-100)	
	42B (80-100)	
	42C (80-100)	
	42D (80-100)	
	420 (90-110)	
	420B (90-110)	
	420C (90-110)	
	43 (100-120)	
	43B (100-120)	
	44 (110-130)	
	44B (110-130)	
	430 (120-140)	
	440 (130-150)	
	441 (140-160)	P
	Challenge Series	
	Set 52 (50-160)	
	53 (50-120)	
	54 (80-150)	P
	5-Minute Dictations	
	Set 450 (60-100)	
	460 (100-140)	
	461 (60-90)	
	462 (100-130)	
	500 Commonest Words	
	Set 39 (60-90)	
	390 (100-130)	
	50 (80-120) Legal	
	51 (80-120) Medical	P
	Homework - Unit No. 12	
	(12 records 40-120)	P
	Theory Records	
	Set 480 (40-80)	
	481 (40-80)	
	482 (60-90)	
	483 (80-120)	P

14.0700 STENOGRAPHIC, SECRETARIAL, AND RELATED

RECORDS (Cont'd)

Distributor or Publisher	Title	Price Code
Educational Record Sales 33 1/3 Records	No. 400 - Brief Forms	
	401 - Word Phrases	
	500 - Business Letters for Beginners	
	501 - Business Letters 60-90	
	502 - Business Letters 70-100	
	504 - Business Dictation on Advanced Level	
	505 - Business Dictation 110-140	
	506 - Business and Legal Dictation 130-160	
	507 - Congressional Records 150-180	
	508 - Congressional Records 170-200	
	509 - Congressional Records 190-220	
	510 - Congressional Records 210-240	
	200 - Speed Writing Course	
	201 - 50-80	
	202 - 90-130	
	204 - Medical Dictation 60-120	
	205 - Legal Dictation 60-120	
	206 - 140-180	P
Gregg Division	Speed Dictation Records (Five records per box)	
	Box 1 (50-70)	
	2 (70-90)	
	3 (90-110)	
	4 (110-130)	
	5 (130-150)	P
	Student Dictation Practice	
	Set 1 (60-90)	
	2 (80-120)	
	3 (100-120)	
	4 (50-80)	
	5 (80-100)	
	6 (100-130)	P
Keane Records	Business Dictation	P
Sound Education	Home Study Dictation	P
	Shorthand by Sound	P

14.0700 STENOGRAPHIC, SECRETARIAL, AND RELATED

REFERENCE AIDS

Distributor or Publisher	Title	Price Code
Post Office	National Zip Code Directory	P

TAPES

EMC Recording Corp.	Office Style Dictation	P
	Real Office Dictation	P
	Step Plan Dictation	P
Gregg Division	Challenger Speed Set	P
	Comprehensive Starter Set	P
	Reinforcement Speed Set	P
Imperial Productions, Inc.	Secretary (Career Tape)	P
	Speed Dictation	P
Teaching Aids, Inc.	Grammar-Punctuation Dictation Set I	P
	Letter Dictation-Vocabulary Set II	P
	Speed Development Set III	P
Western Tape Duplicators	Dictation Disc Speed Building (32 tapes 50-100)	P
	New York State Course Part I (72 Letters) Part II (108 Letters)	P
	San Francisco State Series Set I Grammar-Punctuation II Vocabulary-Letter III Speed Development	P
	Transcription Norelco Transcription Course	P
	Student Manual	P
	Teacher Manual	P

RESOURCE MATERIALS FOR

Programs

14.0100 Accounting and Computing

14.0200 Business Data Processing

14.0300 Filing, Office Machines, and General Office Clerical

14.0700 Stenographic, Secretarial, and Related

14.0900 Typing and Related

and

Related

Business English

Business Law

Business Math

Economics

Human Relations

Books

Practice Sets

Workbooks

SECTION III

ADDRESSES OF PUBLISHERS

Gregg Division
McGraw-Hill Book Company
330 West 42 Street
New York, New York 10036

3M Company
2501 Hudson Road
St. Paul, Minnesota 55101

Pitman Publishing Corporation
20 East 46 Street
New York, New York 10017

Prentice-Hall Book Division
Englewood Cliffs, New Jersey
07632

Rowe Publishing Company
600 West Van Buren
Chicago, Illinois 60607

South-Western Publishing Company
5101 Madison Road
Cincinnati, Ohio 45227

Special Teaching Aids
3408 North Potomac Street
Arlington, Virginia 22213

Training Development Center
34 West 36 Street
New York, New York 10017

Wadsworth Publishing Company
Belmont, California
94002

14.0100 ACCOUNTING & COMPUTING

TEXTBOOKS

Publisher	Title
Gregg Division	Accounting 10/12 Accounting--Bookkeeping--Recordkeeping Research Index Applied Bookkeeping, 4th Edition Gregg Bookkeeping, 3rd Edition
Pitman Publishing Corp.	Fundamentals of Modern Bookkeeping
Prentice-Hall Book Div.	Bookkeeping & Accounting (Introductory) Zelliot-Leidner Bookkeeping, Advanced Course
South-Western Publishing Co.	20th Century Bookkeeping & Accounting 23rd Edition (First Year Course) 20th Century Bookkeeping & Accounting 23rd Edition (Second Year Course)
Wadsworth Publishing Co.	Accounting for Non-Profit Organizations Auditing Electronic Systems Auditing Methods Long-Lived Assets

14.0100 ACCOUNTING & COMPUTING (Cont'd)

WORKBOOKS & PRACTICE SETS

Publisher	Title
Gregg Division	Use with: Accounting 10/12 Comprehensive Workbooks, Parts 1-4 Part 1 - Elements of Financial Records 2 - Accounting Systems & Procedures 3 - Special Accounting Procedures 4 - Business Data Processing Fundamentals Practice Sets, Parts 1-4 Study Guide & Working Papers Parts I & II Study Guide & Working Papers Parts III & IV Text-Workbook Combination (use in place Part III)
	Use with: Applied Bookkeeping Sullivan's Practice Set Working Papers
	Use with: Gregg Bookkeeping & Accounting Practice Set 1 Practice Set 2 Working Papers - Learning Guides (Part 1) Working Papers - Learning Guides (Part 2)
Pitman Publishing Co.	Use with: Fundamentals Modern Bookkeeping Standard Payroll Project, 4th Edition (Workbook or Project) Workbook I Workbook II
Prentice-Hall	Use with: Zelliot-Leidner Bookkeeping Corporation Set Partnership Set Practice Materials Workbook I Workbook II
South-Western Publishing Co.	Use with: 20th Century Bookkeeping & Accounting Working Papers - Study Guides Chapters 1-35 Working Papers - Study Guides Chapters 1-21 Working Papers - Study Guides Chapters 22-35

14.0100 ACCOUNTING & COMPUTING (Cont'd)

WORKBOOKS & PRACTICE SETS (Cont'd)

Publisher	Title
South-Western Publishing Co. (cont'd)	Practice Sets - **Spencer** Athletic Goods Chapters 17 or 20 Practice Sets - Taylor Hardware Chapter 30 Practice Sets - Weston Leather Goods Chapter 35 Practice Sets - Farm Set Chapter 33 For Advance Course - Practice Sets Norton and Page - Chapter 12 Reed Auto Supplies - Chapter 22 Stanley Manufacturing - Chapter 27
Special Teaching Aids	Bookkeeping Set

Related Texts, Workbooks, Practice Sets may be integrated from other Vocational Business Areas.

14.0200 BUSINESS DATA PROCESSING

TEXTBOOKS

Publisher	Title
Gregg Division	Business Data Processing Card-Punch Machine Operation Card-Punch Simulator Operation Understanding Modern Business Data Processing
3M Company	3M Data Processing Texts Volume 1 2 3 4
South-Western Publishing Co.	Keypunch Training Course
Wadsworth Publishing Co.	An Introduction to Business Data Processing & Computer Programming Automatic Data Processing Systems Business Data Processing & Programming IBM Machine Operation & Wiring Introduction to Business Data Processing

14.0200 BUSINESS DATA PROCESSING

WORKBOOKS & PRACTICE SETS

Publisher	Title
Gregg Division	Use with: Understanding Modern Business Data Processing Problems & Exercises
South-Western Publishing Co.	Automation Office Practice - Practice Set Use with: Keypunch Training Course Keypunch Training Kit Sorter & Tabulator Materials
Wadsworth Publishing Co.	Use with: IBM Machine Operation IBM Machine Operation Workbook

Related Texts, Workbooks, Practice Sets may be integrated from other Vocational Business Areas.

14.0300 FILING, OFFICE EQUIPMENT, & GENERAL CLERICAL

TEXTBOOKS

Publisher	Title
Gregg Division	Charm--Career Girl's Guide
	Communication Word Power
	Essentials of Business Law
	General Office Practice
	General Record Keeping
	How to Use Adding & Calculating Machines
	Introductory Business Practice
	Mathematics for Business Occupations
	Medical Typing Practice
	Progressive Filing & Records Management
	The Receptionist
	300 Commas
Pitman Publishing Co.	Applied Clerical Practice
	Business Correspondence in Practice
	Business English in Practice
	Business Speller & Vocabulary Builder
	Comprehensive Business Machines
	Modern Clerical Practice
	Today's Business Law
	Today's Business Mathematics
	Typewriting Office Practice
Prentice-Hall	Basic Typing Jobs
	Business & Consumer Arithmetic
	Business English in Communications
	Business Law
	Clerical Office Training
	English for Business
	Filing & Finding
	General Clerical Procedures
	Spelling & Word Power
Rowe Publishing	Applied Arithmetic Essentials
	Essential Business Practice
	Principles of Indexing & Filing
South-Western Publishing Co.	Applied Business Law
	Applied Business Math
	Applied Economics
	Business Behavior
	Business Filing & Record Control
	Business Principles & Management
	Clerical Office Practice
	Clerical Record Keeping
	Effective English for Business
	Secretarial Office Practice
	Word Studies

14.0300 FILING, OFFICE EQUIPMENT, & GENERAL CLERICAL

TEXTBOOKS (Cont'd)

Publisher	Title
Wadsworth Publishing Co.	Business Communications - Principles and Methods
	Business Communication & Typing
	English for Business

14.0300 FILING, OFFICE EQUIPMENT, & GENERAL CLERICAL

WORKBOOKS & PRACTICE SETS

Publisher	Title
Gregg Division	Business Machine Exercises - Workbook English Style Skill-Builders Kit Essentials of Business Law - Guide General Office Practice Workbook Gregg Quick Filing Practice Set How to Use Calculator & Comptometer Introductory Business Practice Kit Math for Business Occupations - Workbook Modern Business English - Workbook & Text Progressive Filing - Workbook Progressive Filing - Practice Materials Record Keeping Practice Set Using the Rotary Calculator in Modern Office Workbook Exercises in Alphabetic Filing
Pitman Publishing Co.	Applied Clerical Practice Workbook Arithmetic Review Clerical Office Practice Set Modern Clerical Practice Workbook Today's Business Law Workbook Typewriting Office Practice Set
Prentice-Hall	Business & Consumer Arithmetic Workbook Business English in Communications Workbook Business Law Workbook Clerical Office Training Workbook English for Business Workbook Filing & Finding Job Sheets & Workbook General Clerical Procedures Workbook Spelling & Word Power Workbook
Rowe Publishing Co.	Key Punch Practice Office Machine Practice Office Practice for Typists Office Typing, Revised - Working Materials Practical Punctuation Drills

14.0300 FILING, OFFICE EQUIPMENT, & GENERAL CLERICAL

WORKBOOKS & PRACTICE SETS (Cont'd)

Publisher	Title
South-Western Publishing Co.	Advanced Key Driven Calculator - Text - Workbook
	Alphabetic Indexing - Text - Workbook
	Applied Business Math Problems - Drills
	Basic Rules for Alphabetic Filing - Workbook
	Effective Business English Study Projects
	English the Easy Way - Workbook
	Filing Office Practice for Business Filing and Record Control
	Intensive Clerical - Civil Service Training Kit
	Key Driven Calculator - Text - Workbook
	Key Punch Training Course Kit
	Machine Office Practice Set
	Mathematics Skill Builder Workbook
	Projects in Clerical Practice Kit
	Rotary Calculator Course Text Workbook
	Secretarial Office Practice Workbook
	Supplement to Math Skill Builder
	Ten-Key Adding-Listing Machine Calculator Course
	Typing Office Practice Set
	Word Studies Workbook

Related Texts, Workbooks, Practice Sets may be integrated from other Vocational Business Areas.

14.0700 STENOGRAPHIC, SECRETARIAL & RELATED

TEXTBOOKS

Publisher	Title
Gregg Division	Applied Secretarial Practice
	Charm - The Career Girl's Guide to Business
	Dictation for Transcription
	Directed Homework in Gregg Shorthand
	Graded Transcribing Tests
	Gregg Dictation, Diamond Jubilee Series
	Gregg Medical Shorthand Manual & Dictionary
	Gregg Shorthand, Diamond Jubilee Series
	Gregg Shorthand Dictionary
	Gregg Shorthand, Functional Method, Diamond Jubilee Series
	Gregg Transcription, Diamond Jubilee Series
	Handbook for the Legal Secretary
	Most Used Words & Phrases
	Speed Dictation with Previews in Gregg Shorthand
	The Medical Secretary
	The Receptionist -- Office Reception Techniques
	The Secretary at Work
	The Technical Secretary
	Timed Writings for Typing and Transcribing
	20,000 Words Spelled & Divided
Prentice-Hall	Secretary's Complete Model Letter Handbook
	Shorthand Dictation Pamphlet Series Booklets 1-13
	Word Finder
Rowe Publishing Co.	Applied Arithmetic Essentials
	English for Business Use
	Principles of Indexing & Filing
South-Western Publishing Co.	Applied Business Law
	Applied Economics
	Business Behavior
	Business Principles & Management
	Integrated Secretarial Studies
	Secretarial Office Practice
	Shorthand Dictation Studies
	Shorthand Transcription Studies

14.0700 STENOGRAPHIC, SECRETARIAL & RELATED

WORKBOOKS & PRACTICE SETS

Publisher	Title
Gregg Division	Applied Dictation & Transcription Text - Workbook
	Charm for the Modern Woman Text-Kit
	English Style Skill-Builders
	Gregg Dictation, Diamond Jubilee Student Transcript
	Transcription Workbook
	Gregg Shorthand, Diamond Jubilee Student Transcript
	Workbook
	Gregg Shorthand, Functional Method Workbook
	Gregg Quick Filing Practice
	Gregg Speed Building Student Transcript
	Workbook
	Gregg Transcription Student Transcript
	Workbook
	The Secretary on the Job Practice Set
	Workbook Exercises in Alphabetic Filing
Rowe Publishing Co.	Applied Arithmetic Essentials
	Filing Practice Set
	Indexing & Filing Workbook
	Practical English Drills
	Practical Punctuation Drills
South-Western Publishing Co.	Applied Business Law Workbook
	Applied Economics Study Guide
	Automation Office Practice Set
	Basic Rules Alphabetic Filing Text-Kit
	Business Principles & Management Study Guide
	Integrated Secretarial Studies Workbook
	Secretarial Office Practice Workbook
	Typewriting Office Practice Set
Training Development Center	Business Correspondence Package

Related Texts, Workbooks, Practice Sets may be integrated from other Vocational Business Areas.

14.0900 TYPING & RELATED

TEXTBOOKS

Publisher	Title
Gregg Division	English Usage Drills Programmed for the Typewriter
	Gregg Typing, 191 Series Book 1
	Gregg Typing, 191 Series Book 2, Vocational Typing
	Gregg Typing, 191 Series Book 2, Office Production Typing
	Legal Typewriting
	Progressive Typewriting Speed Practice
	Quick Survey Course in Forms Typing
	Sustained Timed Writings
	Tabulation Typing
	Typing Power Drills
Pitman Publishing Co.	Modern Basic Typewriting
	Modern Typing Practice
Prentice-Hall	Basic Typing Jobs
	Graded Timed Writings
	Tested Typing Drills
	Typing Speed Builders
Rowe Publishing Co.	Brief Typing
	Faster Typing
	High Speed Typing
	Rowe Typing
South-Western Publishing Co.	Statistical Typing
	20th Century Typewriting
	First Year Course
	Second Year Course
	Typewriting Techniques & Shortcuts

14.0900 TYPING & RELATED

WORKBOOKS & PRACTICE SETS

Publisher	Title
Gregg Division	Applied Office Typewriting
	English Style Skill-Builders
	Kit for Typists
	Legal Typewriting Kit
	Gregg 191 Series, Book 1
	Learning Guides & Working Papers Parts 1-6
	Learning Guides & Working Papers Parts 7-12
	Gregg 191 Series, Book 2
	Learning Guides & Working Papers Parts 1-6
	Learning Guides & Working Papers Parts 7-12
	Typing Mailable Letters - Text Workbook
Pitman Publishing Co.	Advanced Typing Projects
	Business Letters for Typing
	Handbook for Typists
	Modern Typing Practice Supplies
	Thirty Typing Tests
Rowe Publishing Co.	Rowe Typing
	Brief Typing Workbook
	Budget Business Papers (For Parts 3-4)
	Budget Working Papers
	Envelope of Working Materials
	Laboratory Materials for Office Practice for Typists
	Office Typing Revised
	Typing Mini-Drills
South-Western Publishing Co.	20th Century Typing
	Laboratory Materials Parts 1-2
	Part 3
	Part 4
	Letterheads Pad
	Typewriting Office Practice Set
Special Teaching Aids	Advanced Typing Set

Related Texts, Workbooks, Practice Sets may be integrated from other Vocational Business Areas.

BUSINESS ENGLISH & COMMUNICATIONS

TEXTBOOKS

Publisher	Title
Gregg Division	Business English & Communication Business English Essentials Communication Word Power Communications Handbook for Secretaries English Usage Drills & Exercises 300 Commas
Prentice-Hall	Business English in Communications English for Business Spelling & Word Power
Rowe Publishing Co.	English for Business Use
South-Western Publishing Co.	Effective Business English

WORKBOOKS & PRACTICE SETS

Gregg Division	Business English & Communications Workbook Business English Kit Communications Handbook for Secretaries Workbook Part I Workbook Part II English Style Skill-Builders Improvement Kit Modern Business Correspondence Workbook
Pitman Publishing Co.	Business Correspondence in Practice Business English in Practice Business Speller & Vocabulary Builder How to Punctuate a Business Letter
Prentice-Hall	Business English in Communication Activities Book English for Business Workbook Spelling & Word Power Workbook
Rowe Publishing Co.	Practical English Drills Practical Punctuation Drills
South-Western Publishing Co.	Effective Business English Study Projects

BUSINESS LAW

TEXTBOOKS

Publisher	Title
Gregg Division	Essentials of Business Law Personal Business Law Understanding Business Law
Pitman Publishing Co.	Today's Business Law
Prentice-Hall	Business Law
South-Western Publishing Co.	Applied Business Law Uniform Commercial Code Teaching Guide
Wadsworth Publishing Co.	Law in a Business Environment

WORKBOOKS & PRACTICE SETS

Gregg Division	Essentials of Business Law Activity Guide Personal Business Law Activity Guide Understanding Business Law Activity Guide
Pitman Publishing Co.	Today's Business Law Workbook
Prentice-Hall	Business Law Workbook
South-Western Publishing Co.	Applied Business Law Workbook

BUSINESS MATHEMATICS

TEXTBOOKS

Publisher	Title
Gregg Division	Arithmetic for Business & Consumer Use Business Mathematics Business Mathematics (Modern Math Concepts) Mathematics for Business Occupations Essentials of Business Mathematics Programmed Business Mathematics Books 1, 2, 3
Pitman Publishing Co.	Today's Business Mathematics
Prentice-Hall	Business Consumer Arithmetic
Rowe Publishing Co.	Applied Arithmetic Essentials
South-Western Publishing Co.	Applied Business Arithmetic Applied Business Mathematics Programmed Supplement to Mathematics Skill Builder

WORKBOOKS & PRACTICE SETS

Gregg Division	Arithmetic for Business & Consumer Use Workbook Business Mathematics Workbook Business Mathematics Workbook (Modern Math) Essentials of Business Math Workbook Math for Business Occupations Workbook
Pitman Publishing Co.	Arithmetic Review
Prentice-Hall	Business Consumer Arithmetic Workbook
South-Western Publishing Co.	Applied Business Arithmetic Problems and Drills Applied Business Mathematics Problems and Drills Mathematics Skill Builder Workbook

ECONOMICS & INSURANCE

Publisher	Title
Gregg Division	Consumer Economics Economics, U.S.A.
Prentice-Hall	Everyday Consumer Business
South-Western Publishing Co.	Applied Economics Consumer Economic Problems
Wadsworth Publishing Co.	Economics in Action

WORKBOOKS & PRACTICE SETS

Gregg Division	Consumer Economics Activity Guide
Prentice-Hall	Everyday Consumer Business Workbooks
South-Western Publishing Co.	Applied Economics Study Guide Buying Guides for Consumer Economic Problems Consumer Economic Problems Workbook

HUMAN RELATIONS

TEXTBOOKS

Publisher	Title
Gregg Division	Charm - The Career Girl's Guide to Business & Personal Success Executive Profile - Young Man's Guide to Business Success Fitting Yourself for Business How to Improve Your Personality Personality & Human Relations
Pitman Publishing Co.	Business Review for Professional Secretaries The Complete Secretary
South-Western Publishing Co.	Business Behavior

WORKBOOKS & PRACTICE SETS

Gregg Division	Charm for the Modern Woman Text - Kit Executive Profile Study Guide

VT 010 201
Vocational Industrial Education Service; Radio and Television Repair.

West Virginia State Board of Education, Charleston. Bureau of Vocational, Technical, and Adult Education
MF AVAILABLE IN VT-ERIC SET.
PUB DATE - ND 42p.
DESCRIPTORS - *CURRICULUM GUIDES; *TRADE AND INDUSTRIAL EDUCATION; ADULT VOCATIONAL EDUCATION; *TELEVISION REPAIRMEN; *RADIO TECHNOLOGY; ELECTRONICS

ABSTRACT - This teaching outline, developed by a committee of teachers, is for use in planning and implementing a 2-year course in radio and television service designed to prepare the student for entry-level work as a radio and television serviceman, or for further technical training in the field. The manual is divided into three main sections, the first of which provides safety hints and a suggested partial list of items to be included in all vocational-industrial courses as specific objectives to develop necessary abilities, appreciations and understandings. Section II is the suggested course outline for the 1,080-hour course, including (1) AC Fundamentals, (2) Basic Electronics, (3) Basic Radio and Radio Receiver Servicing, (4) Television Theory, (5) Television Theory and Service, and (6) Color Television Theory. The third section (Appendix) provides a suggested equipment list for vocational radio and television, suggested shop layout, references, instructional aids, and visual aids and filmstrips. (AW)

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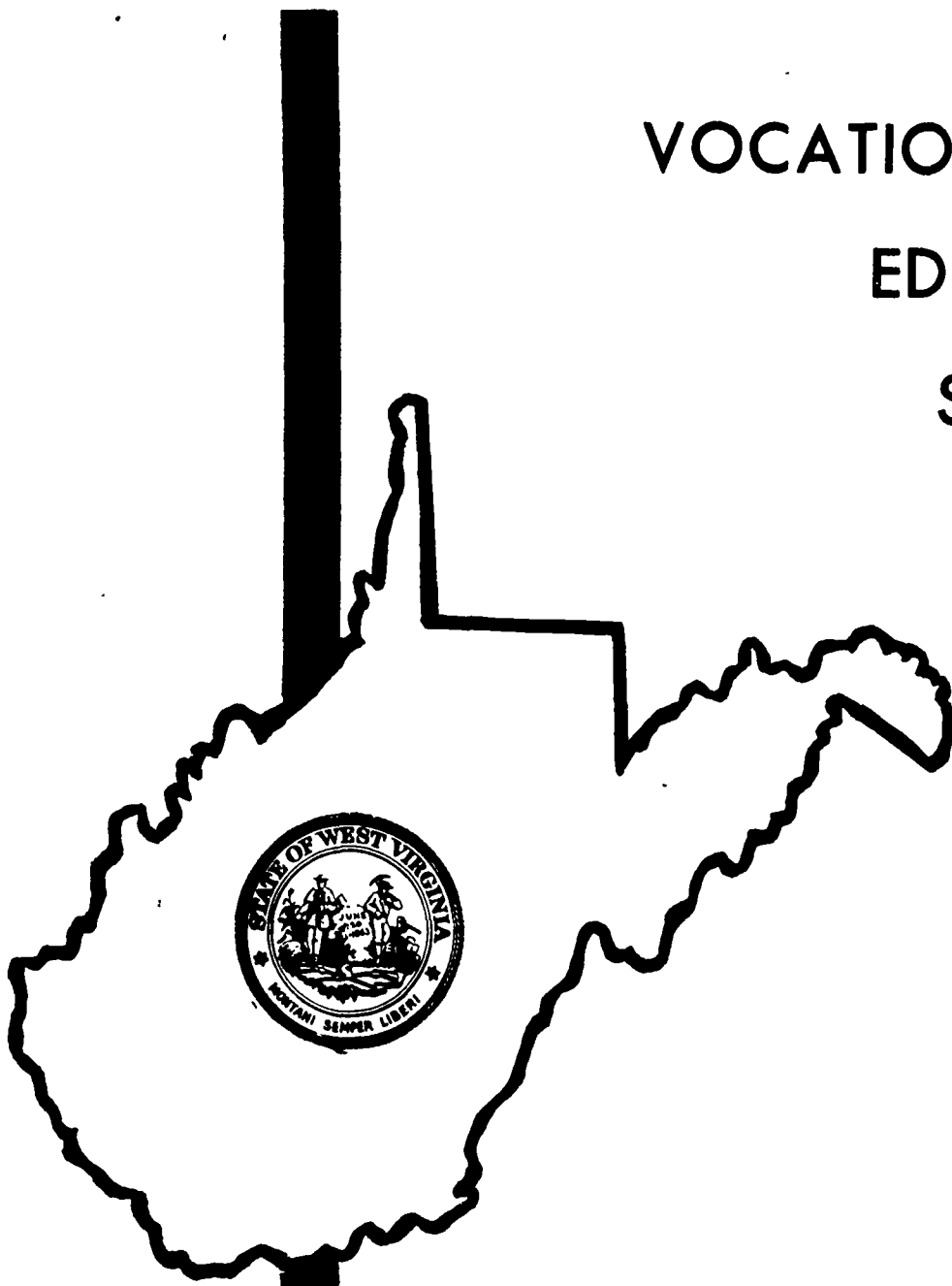
42p*

VOCATIONAL INDUSTRIAL EDUCATION SERVICE



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OFFICE OF EDUCATION
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RADIO AND TELEVISION REPAIR

WEST VIRGINIA
STATE BOARD OF EDUCATION
Bureau of Vocational, Technical and Adult Education
STATE CAPITOL
Charleston, West Virginia

VT010203

PREFACE

This teaching outline is arranged to provide content for a two-year course in Radio and TV Service.

In this time of accelerated industrial progress, the need for the development of a Radio and TV Service guide that will serve in the construction and teaching of the occupation of Radio and TV Service is readily apparent.

This Radio and TV Serviceman guide includes ideas that should aid in making courses of study more effective and more interesting. It has been designed to be used in a flexible manner with consideration given to basic differences.

The swift development of scientific knowledge with its application to business and industry brings new opportunities and responsibilities to our nation, our people, and our schools.

The maintenance of our security and our standard of living depends upon the full use of all of our people at the highest level of their capabilities.

Students successfully completing the course in Radio and TV Repair with a high degree of attainment are expected to be employed as wage earners in this field of work. They will be assisted by the instructor in making contacts for jobs.

FOREWORD

This teaching outline should be recognized as a syllabus and not a course of study. The outline content is arranged to provide for 1080 hours of basic instruction. The course is offered in two school years. Each year of 540 hours contains 3 hours per day, 5 days per week and 36 weeks. Since the trainee needs a basic background of understanding and skill development in order to be employable some time has been given to all of the important phases of the entry job where he will be employed.

Although mathematics, science, and communications necessary to success in this field of employment are taught as related information, it is expected that a student entering this special course will already have an adequate general education upon which this course content may be presented. This will enable him to grasp and retain what is taught. A student who enters this course and who does not possess the essential foundation may not expect to succeed. This course is designed to prepare the student for entrance into industry as a Radio and TV Serviceman, and at the same time prepare him to pursue further technical training in this field.

It is recognized that the development and improvement of teaching outlines is a continuous process and necessary for operating progressive and up-to-date programs.

Clifton C. Detamore
Program Specialist

OBJECTIVES

1. To provide education and training in the manipulative skills which are needed for successful entrance into the Radio and Television field.

2. To develop proper personality traits, character, and work habits.

3. To develop the ability to select and use the materials and products of industry intelligently.

4. To develop desirable behavior traits in student for good workmanship and ability to work and get along with others.

Specific Objectives:

1. To help student discover and analyze their interest and abilities; to aid them in their understanding of the requirement of various job opportunities.

2. To aid them in shop practice fundamentals.

3. To provide opportunities for problem solving.

4. To acquaint student with variety of Radio and Television jobs for which they can qualify upon completion of the course.

5. To equip student with a thorough understanding of basic Radio and Television circuits and how to service them.

6. To prepare students to enter the Radio and Television field as servicemen and technicians in the installation, testing, adjusting, and repair of Radio and Television sending and receiving equipment.

ACKNOWLEDGMENTS

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A SUGGESTED PARTIAL LIST OF ITEMS THAT SHOULD BE INCLUDED
IN ALL VOCATIONAL INDUSTRIAL COURSES AS SPECIFIC OBJECTIVES
TO DEVELOP ABILITIES, UNDERSTANDINGS, AND APPRECIATIONS

Related technical information
Basic manipulative operations-jobs
Good work habits
Good safety habits
Problem solving
Administering first aid
Make working sketches
Make good use of library
Communicate
Talk effectively
Leadership skills
Reading skills
Everyday science
The value of other courses
Basic economics, business & management
State & National issues, related
Keeping up to date
Civic needs of the community
Adapt to changes in technology
Relate work to manpower situation
Pride in a work well done
Live harmoniously with others
Broad aspects of work-trends-factors
Reading related literature
Professional trade associations
Goals of voc. & tech. education
Social security & benefits
Free enterprise system
Techniques of job application
Recognize hazards & remove them
True meaning of loyalty to trade-self
Needs of others
A Willingness to do more than minimum
Recreational & avocational activities

Open-minded & receptive to change
Affiliate with progressing groups
A sense of balance & proportion
A high quality of workmanship
Workmanship having recognized value
Work vs security at any cost
Respect for authority
Rise above failure
Overcome boredom
Value of time
Speak up in defense of principles
A willingness to accept assignment
Reliability-dependability to deliver
Knowledge as applied to other fields
Value of experience
Value of speed in production
Value of the tools of trade
Clean-safe work areas
Plan work effectively
Employee-employer relations
Democratic society
Special aptitudes
Select & use materials of industry
Individual initiative & responsibilities
Values of moral conduct & ethical living
Our standard of living
Automation
Important people in this field
Mass production
Legislation (related)
Industrial processes
History of industry
Conservation
Listening effectively

ACTIVITIES SHOULD BE PROVIDED TO PROMOTE THE DEVELOPMENT OF EACH ITEM

Safety . . .uctions
Electrical and Electronic Equipment

These safety hints should be worked into the course outline where needed along with other safety ideas of your own.

CIRCUITS

1. Consider all wires and other conductors in a circuit live until proved dead by a safe method of testing.

2. Use test lamp or suitable meter for testing a circuit.

3. Turn on switch only when you know what it operates.

4. Turn off power before replacing a fuse.

5. Locate and correct fault that caused circuit breaker open or fuse to blow before turning on power.

6. Be sure circuit is protected against overload by a fuse or circuit breaker of correct current-carrying capacity.

7. Make changes in the wiring of a circuit only when power is turned off.

8. Select and use wire of correct current-carrying capacity.

ELECTRICAL EQUIPMENT

1. Disconnect portable, electrically powered equipment from power source before servicing or repairing the equipment.

2. Examine electric cord for possible defects and correct any defects found before using.

3. Make certain frame or housing of portable, electrically powered equipment is properly grounded before operating it.

4. Connect with power source and turn on your own equipment.

ELECTRONIC DEVICES

1. Keep chassis of an AC-DC radio clear of ground wires and other grounded conductors.

2. Avoid coming in contact with grounded objects when making adjustments on an AC-DC radio connected to a power source.

3. Be sure capacitor is discharged before touching its terminals.

4. Disconnect electric cord from power before touching anything behind transmitter panel.

5. Remove headphones while working on a transmitter or receiver.

6. Keep one hand behind your back or in your pocket when testing high voltage.

7. Make certain chassis, cabinet, and cable shields of a transmitter or receiver are grounded.

8. Wear gloves and a face shield when handling a cathode-ray tube.

ERIC

DC Fundamentals

I. Introduction

A. Brief History of Communication

1. Sound and sight signals
2. Morse's electric telegraph
3. Bell's telephone
4. Commercial radio transmission

B. Wave Motion and the Nature of Radio Waves

1. Water waves
2. Wave motion with a rope
3. Wavelength, frequency, and amplitude
4. Polarization

C. A Simple Radio Receiver

1. Aerial
2. Tuning or selection device
3. Source of power

D. Components Found in Radio Receivers and Brief Description

1. Tubes
2. Resistors and capacitors
3. Loudspeaker
4. Coils, chokes, and transformers
5. Transistors

E. Radio Symbols and the Schematic Diagram

F. Soldering Techniques

G. Use of Hand Tools in Radio

II. Nature of Electricity and Direct Current

A. Nature of Matter

1. Elements and compounds
2. Structure of the atom

B. Nature of Electricity

1. Static electricity
2. Law of electrical charges

3. Electron motion defined as current flow
4. Electrical units
   a. volt
   b. ampere
   c. ohm
   d. coulomb
   e. watt
5. Opposition to direct current flow
6. EIA resistor color code

C. Sources of EMF

1. Chemical
2. Thermal
3. Other

D. Dry Cells and Batteries

1. Primary and secondary cells
2. Radio batteries
3. Secondary cells
4. Commercial storage battery

E. Use of Voltmeter for Measuring DC

1. Safety

F. Use of Ohmmeter for Measuring Resistance

1. Safety

G. Ohm's Law

H. Direct Current Circuits

1. Series
2. Parallel and combination series and parallel

I. Kirchhoff's Law

J. Power Dissipation

K. Variable Resistors and Their Uses in Radio

L. Voltage-Divider Circuits

M. Scientific Notation

1. Coefficients
2. Expressing large and small numbers as powers of 10

III. Magnetism and DC Measuring Instruments

A. Magnetism

1. Types of magnets
2. Poles of a magnet
3. Theory of magnetism
4. Magnetic Properties of materials
5. Magnetic shielding

B. DC Measuring Instruments

1. How a meter movement works
2. Sensitivity of a meter movement
3. How a voltmeter, multipliers, ohmmeter, VOM works
4. Bridge
5. Safety

AC Fundamentals

I. Alternating Current

A. Induced EMF

1. Factors determining strength of induced EMF

B. Generating Alternating EMF

1. AC generator
2. AC cycle

C. The Sine Curve and How It Is Used

1. Definition of sine of an angle
2. AC waveform
3. Characteristics of sine curve
   a. Amplitude
   b. Frequency
   c. Period
4. Values of AC voltage
5. Meaning of phase and phase angle; Vector representation of alternating current
6. AC measurement
   a. Oscilloscope
   b. AC voltmeter and output meters

D. AC Characteristics

1. Impedance
2. Ohm's Law

3. Power factor
4. True power and apparent power

II. Introduction to Coil

A. Inductance and Inductances

1. Characteristics of inductance
2. Coils
3. Transformers, their characteristics and use
4. Testing coils and transformers
5. Safety

III. Introduction to Capacitor

A. Capacitance and Capacitors

1. What a capacitor is and what it does
2. Electron theory of capacitor action
3. Factors affecting capacitance
4. Unit of capacitance
5. Charge Q on a capacitor
6. Types of capacitors
   a. Fixed capacitors
   b. Variable capacitors
   c. Distributed capacitance
7. Voltage characteristics of capacitors
   a. Nonelectrolytic
   b. Electrolytic
8. EIA capacitor color code
9. Capacitive reactance
   a. XC and factors affecting it
   b. Phase angle between I and E in a pure capacitance
10. Capacitor combinations
11. Testing capacitors

B. Use of a signal generator (Test Oscillator) as a signal source

IV. Resonant Circuits

A. Resonance

1. LCR series circuits
2. Parallel LCR circuits
3. Other

B. AC Circuit

1. Equivalent circuit of a capacitor showing LCR
2. Equivalent circuit of a coil showing LCR

3. Equivalent circuit of a wire wound resistor
4. Filter circuits
5. Coupling circuits

C. Time Constants

D. R-F Signals

E. Periodic Nonsinusoidal Waveforms

1. Their frequency composition
2. Waveform characteristics

Basic Electronics

I. Vacuum Tubes

A. Introduction

1. Thermionic emission
2. Electron emitters and their effect

B. Diodes

1. Fleming valve
2. Physical structure and circuit diagram
3. Diode characteristics
4. Duodiodes and gas filled diodes
5. The diode as a rectifier
   a. Rectifying action
   b. Use in radio as a low and a high voltage rectifier

C. Solid State Transistors

II. Addition of Control Grid

A. Triodes

1. DeForest's discovery
2. Construction of the triode
3. How grid controls plate current
4. Characteristic curves of triodes
5. Tube parameters of dynamic characteristics
6. The triode as an amplifier
7. Use of triode as an amplifier in radio
8. Interelectrode capacitances
   a. Grid to plate
   b. Grid to K, Plate to K

B. Physical Characteristics of Tubes

1. Early types
2. Octal types
3. Loktal base
4. Miniature base
5. Solid state

C. Tube Ratings (Manufacturers' Specifications)

D. Tube Defects and How They May Be Checked

1. Types of defects
2. Methods for checking tubes
3. Transistor Defects
4. Checking Transistors
5. Safety

III. Semiconductor Fundamentals

A. Introduction to Semiconductors

1. Basic concepts of semiconductors
2. Precautions concerning semiconductors
3. Safety

B. Semiconductor Diodes

1. Characteristics of semiconductors
2. Junction transistor characteristics

C. The Point-Contact Transistor

D. Germanium and Silicon Transistors

E. Transistor Circuits

1. Transistor equivalent circuits
   a. Common - Base AMP characteristics
   b. Common emitter AMP characteristics
   c. Common collector AMP characteristics
   d. Bias and stabilization
2. Transistor static characteristics

F. Transistor Tetrodes

G. Power Transistors

H. Special Purpose Transistors

I. Tube and Semiconductor Manual and Specification Interpretation

J. Transistor Audio Amplifiers

1. Cascaoe Audio Amplifier
2. Push-Pull AA

K. Transistor R-F and I-F Amplifiers

L. Transistor Oscillators

1. Audio Oscillators
2. R-F Oscillators
3. Blocking Oscillators
4. Multivibrators

M. Transistor Converters and Detectors

N. Transistor Transmitter

O. Transistor Superheterodyne Receiver

IV. Power Supplies

A. Power Supply Requirements for Radio

B. AC Power Supply

1. Why alternating current must be changed into DC
2. Power transformer
3. Rectification and rectifiers
4. Filtering action and filter
   a. Capacitor input, pi-type filter
   b. Choke input filter
   c. RC filter
   d. Bleeder resistor
   e. Voltage dividers used in power supplies
   f. Safety

C. AC-DC Type Power Supply

1. Basic rectifier circuit
2. Filament circuit
3. Voltage doubler circuit
4. Selenium rectifiers and their use
5. Safety

D. Maintenance Problems

1. Common power supply defects and their effects on output voltage
2. Locating the defect
3. Safety

V. Audio Amplification Voltage

A. Sound

1. Physical nature of sound
2. Electrical transmission of sound
3. Sound reproduction

B. Voltage Amplifiers

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2. Equivalent circuit of a voltage amplifier
3. The load line
4. The pentode as a voltage amplifier
5. Amplifier coupling
6. Additional classes of operation
7. The volume control
8. The tone controls
9. Inverse feedback
10. Direct coupled amplifier

C. Maintenance Checks

1. Tubes
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3. AC voltage
4. Resistance readings
5. Signal substitution
6. Checking distortion with an oscilloscope
7. Response characteristics of an A-F amplifier
8. Safety

VI. Transmitters and Modulation

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A. Demodulating the A-M Carrier

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3. Grid-leak detector

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1. Oscillator (separate tube)
2. Mixer
3. The pentagrid converter
4. Other types of converters

K. R-F Amplifier in Superheterodyne Receivers

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2. Antenna input
3. Types of tubes
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6. Resistance and voltage analysis
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3. Isolating defective part

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C. VTVM

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J. Wattmeter

K. Capacitance Tester

L. Selenium Rectifier Tester

M. Isolation Transformer

N. Variac

O. Grid-Dip Meter

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A. Servicing the Audio-Frequency Amplifiers and Speaker

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2. Normal voltage and resistance data both for AC and AC-DC
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B. Multiplexing or interleaving

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D. Wrong Colors

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F. Purity Troubles

G. Convergence Troubles

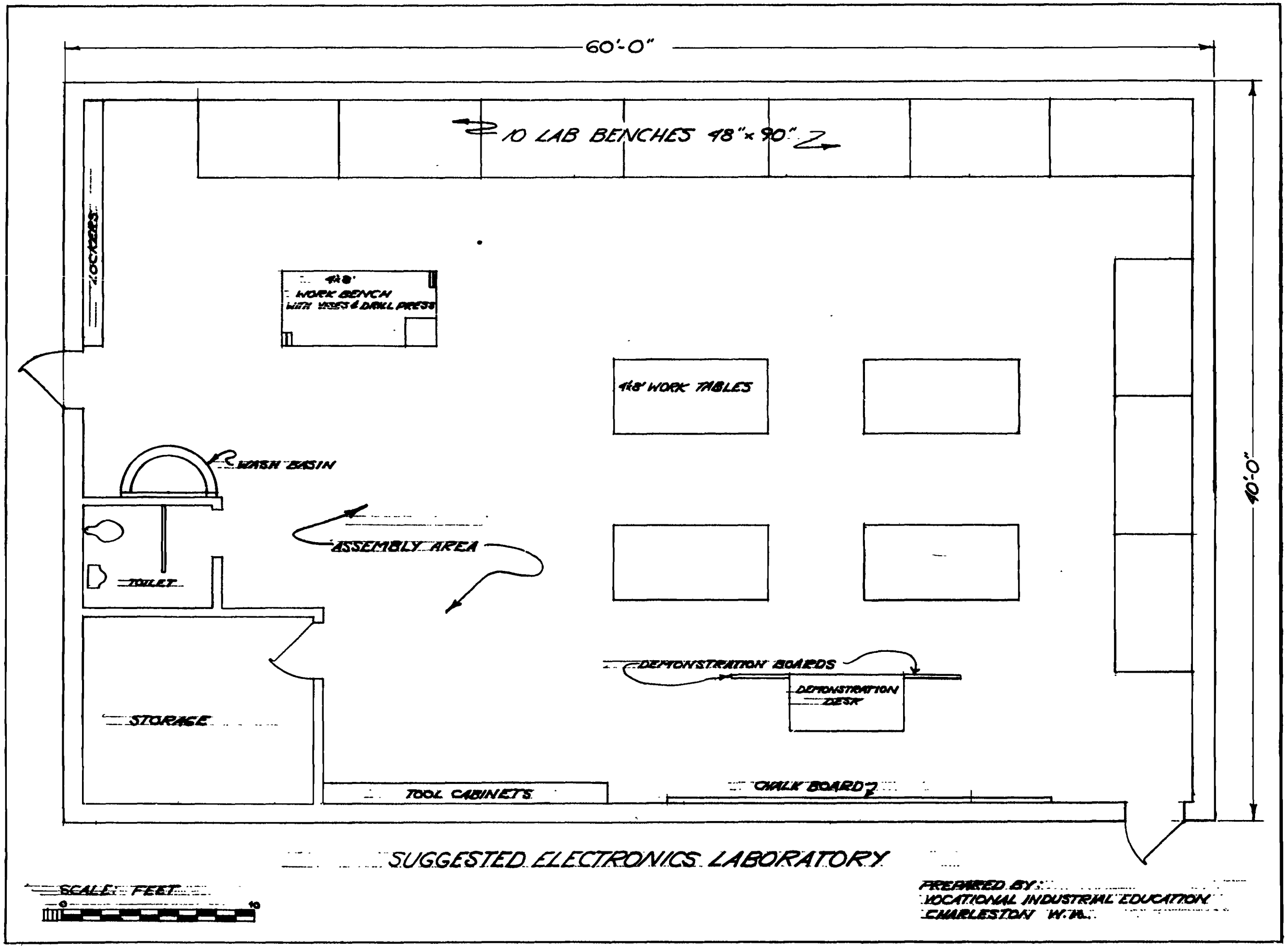
H. Safety

NOTE: Equipment To Be Purchased As Stated Or Equivalent

QUANTITY	DESCRIPTION	UNIT COST	TOTAL COST
11	Electronic Fundamental Unit	$ 325.00	$3,575.00
1	Lecture Demonstration Unit	1,975.00	1,975.00
10	Oscilloscope Precision ES 55B or equivalent	225.80	2,258.00
8	Philco TV Receiver Laboratory or equivalent	750.00	6,000.00
10	Audio Sine-Square Wave Oscillator - Precision E 310	161.25	1,612.50
10	Vacuum tube voltmeters - Simpson 311	59.55	595.50
1	Channel analyst (TV) B & K 1076	380.10	380.10
2	Electronic switch, EICO 488	32.75	65.50
10	Signal Generator, Precision E 200 C	96.75	967.50
5	Marker Generator, Hickok 691	129.50	647.50
5	TV Sweep Alignment Generator, Hickok, Model 615	339.50	1,797.50
10	Precision Probe Sets, SP-5	34.30	343.00
1	Philco 9" VTVM Item 27 w/probes	125.50	125.50
1	Transistor Lecture Demonstration Unit, Item 20	786.00	786.00
10	Transistor Lab. Circuit Analysis Unit, Item 21-A	79.50	795.00
10	AM-FM Radio Laboratory Circuit Analysis Unit, Item 3D	605.00	6,050.00
2	Laboratory Circuit Analysis Trouble-shooting Unit, #4	35.00	70.00
1	Frequency Modulation Lecture Demonstration Unit, Item 7	168.00	168.00

QUANTITY	DESCRIPTION	UNIT COST	TOTAL COST
10	Volt-Ohm-Milliammeter - Hickok 4550	$ 79.00	$ 790.00
2	Grid Diameter Millen 90651	68.50	137.00
5	Cap-Resistance Substitution Box - EICO 1140	20.00	100.00
1	Resistance, Capacitance Bridge & RCL Capacitor, EICO 950-7	29.95	29.95
1	Wattmeter - Simpson 391	39.95	39.95
1	Battery Eliminator - EICO 1060, wired	49.95	49.95
10	Tool Sets, Xcelite 995M	23.95	239.50
1	Capacity Checker, Sprague TO-6	99.50	99.50
2	Signal Tracer - EICO 147A	45.75	91.50
10	Soldering Gun, Weller 8100B (Dual heat)	5.95	59.50
2	De-Soldering Kit	12.00	24.00
1	Electro Tech V-7	189.50	189.50
1	Terminal Service Kit - VACO 6175	10.00	10.00
1	GC #5028 Spline Wrench Kit	1.21	1.21
10	Strip-er-clips	1.24	12.40
2	Tube Extractor	1.76	3.52
10	RCA WP 25A Isolation Transformer	22.50	225.00
1	CRT Tester & Rejuvenator B & K	89.95	89.95
1	Oscilloscope 5" Lab. Scope, with Xtal Probe, Hickok 770C	525.00	525.00
1	B & K 960 Radio Analyst	99.50	99.50
1	Tube & Transistor Tester, Hickok 800A	195.50	195.50
1	GC 8280 TV Alignment Tool Kit	7.40	7.40

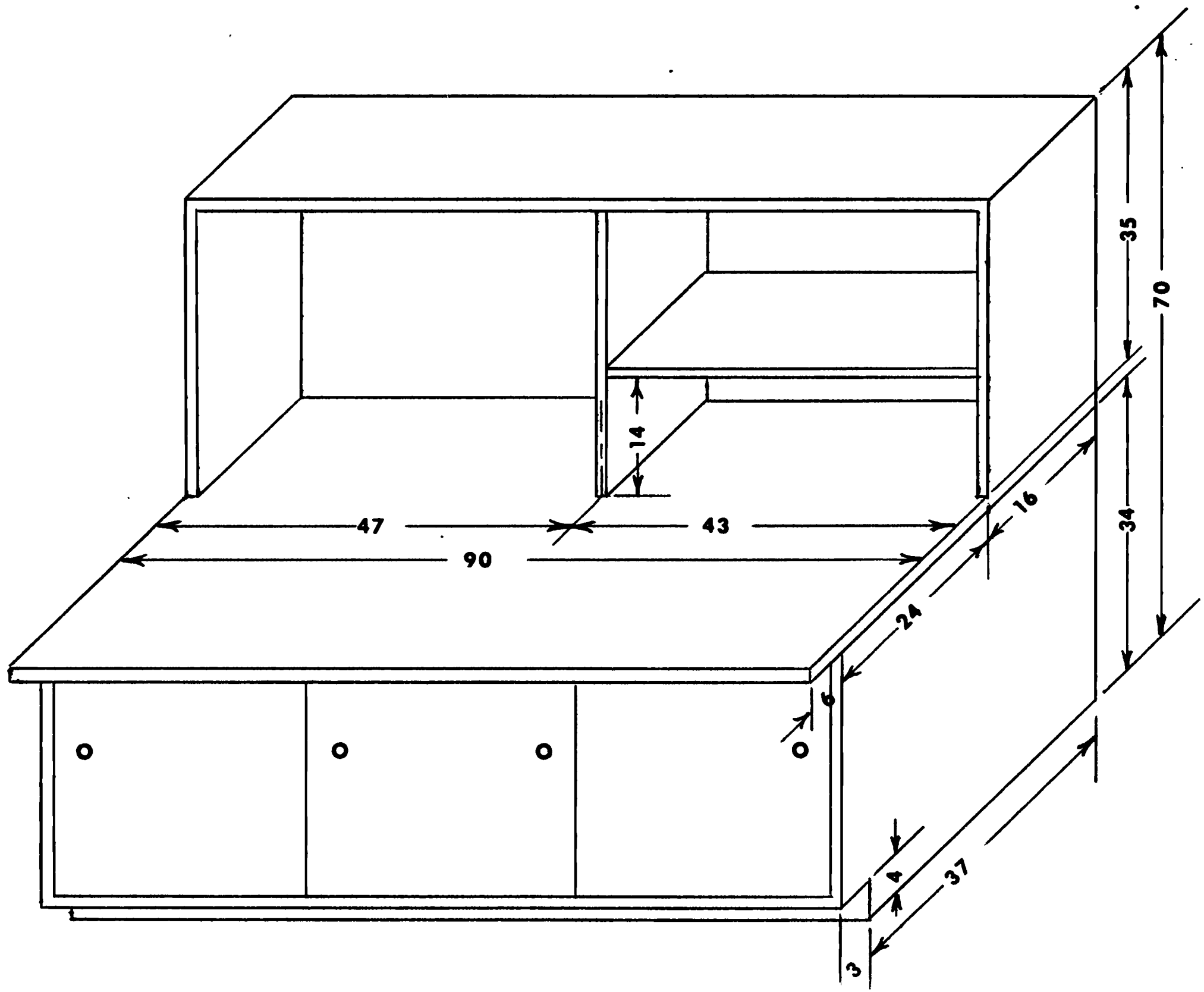
QUANTITY	DESCRIPTION	UNIT COST	TOTAL COST
10	Benches	$185.00	$ 1,850.00
20	Stools	7.65	153.00
		TOTAL.....	$33,234.43



SUGGESTED ELECTRONICS LABORATORY

SUGGESTED

ELECTRONIC LABORATORY BENCH



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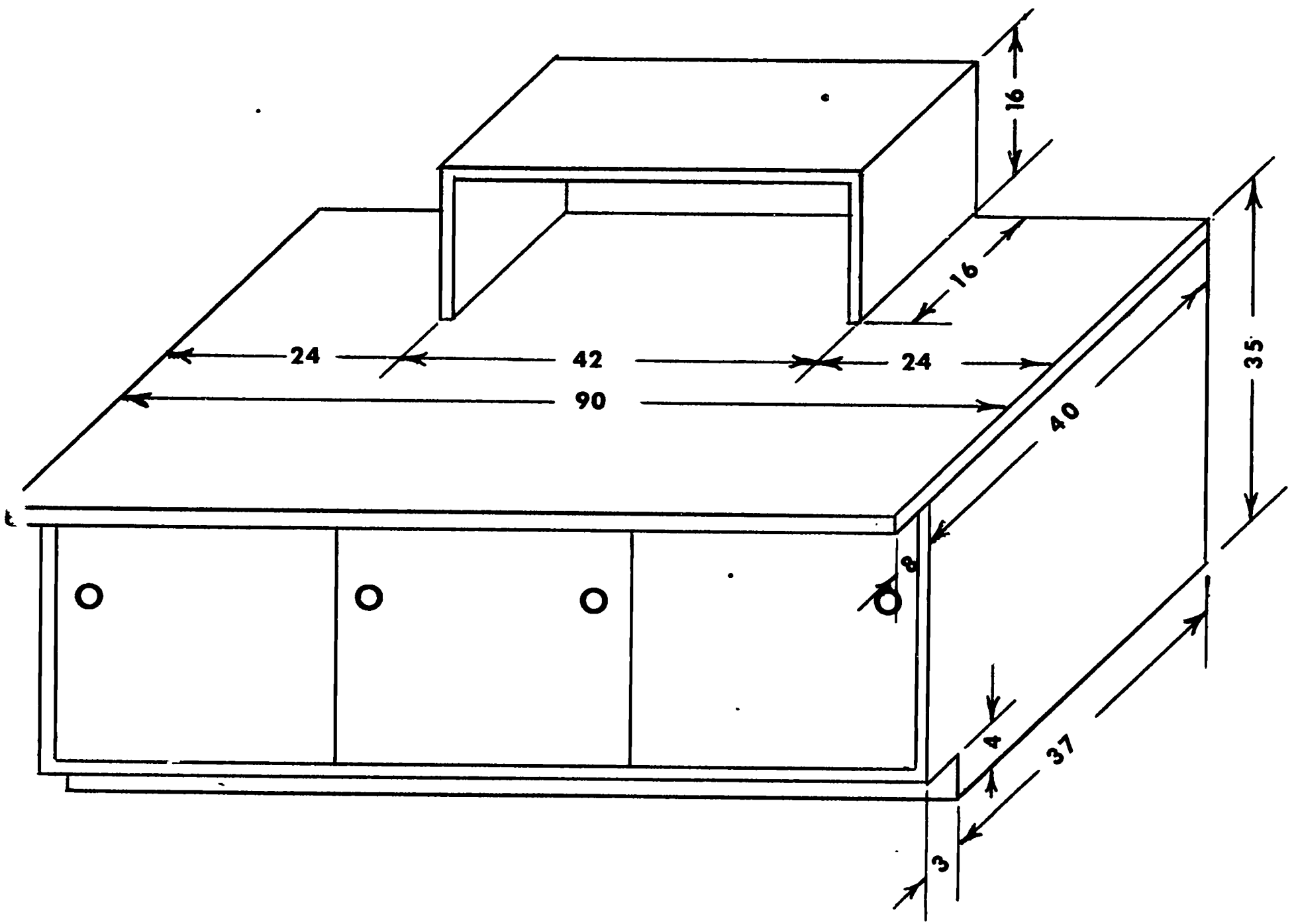

REFERENCE LIBRARY

QUANTITY	TITLE	UNIT COST	TOTAL COST
2	Basic Mathematics for Electronics By: Nelson B. Cook Published By: McGraw-Hill	$7.50	$15.00
2	Essentials of Electricity for Radio and Television By: Morris Slurzberg and William Osterheld Published By: McGraw-Hill	6.60	13.20
2	Essentials of Radio By: Morris Slurzberg and William Osterheld Published By: McGraw-Hill	8.25	16.50
4	Radar Circuit Analysis AFM52-8 (Gov't Printing Off. #D301.7:52-8) Published By: Sup't. of Documents	2.75	11.00
2	Principles of Radar, Third Edition By: J. Francis Reintjes and Godfrey T. Coate Published By: McGraw-Hill	8.55	17.10
2	Radar System Engineering, Vol. One of MIT Radiation Laboratory Series By: Louis N. Ridenour Published By: McGraw-Hill	9.35	18.70
2	FM Transmission and Reception By: Rider and Uslan Published By: Rider	5.45	10.90
2	Electronic Time Measurements, Vol. Twenty of MIT Radiation Laboratory Series By: Chance, Hulsizer, MacNichol and Williams Published By: McGraw-Hill	7.50	15.00
2	Electrical Fundamentals of Communication By: Albert Published By: McGraw-Hill	7.00	14.00
2	Fundamentals of Telephony By: Albert Published By: McGraw-Hill	6.00	12.00
4	The Radio Amateur's Handbook Published By: Amer. Radio Relay League	3.00	12.00

QUANTITY	TITLE	UNIT COST	TOTAL COST
2	Servo Mechanism Practice By: Wm. R. Ahrendt Published By: McGraw-Hill	$7.90	$15.80
2	Digital Computer Fundamentals By: T. C. Bartee Published By: McGraw-Hill	6.50	13.00
2	Fundamentals of Sonar By: J. M. Horton Published By: U. S. Naval Inst.	10.00	20.00
2	Fundamentals of Radio Telemetry By: M. Tepper Published By: Rider	2.95	5.90
2	Modulation Theory By: Black Published By: D. Van Nostrand	8.75	17.50
4	Fundamentals of Transistor Electronics - AN-452 Published By: Philco Corp.	2.75	11.00
1	Modern Dictionary of Electronics Published By: Howard W. Sams & Company	6.95	6.95
1	Electronic Measuring Instruments By: Harold E. Soisson Published By: McGraw-Hill	7.50	7.50
1	Handbook of Transistor Circuit Design By: Keats A. Pullen Published By: Prentice-Hall	13.00	13.00
1	Electronic Drafting By: Karl Kuller Published By: McGraw-Hill	5.50	5.50
1	Physics and Chemistry of Electronic Technology By: Harry L. Van Velzer Published By: McGraw-Hill	10.00	10.00
2	Basic Electronics By: Grob Published By: McGraw-Hill	6.50	13.00
2	Transistors By: Milton S. Kiver Published By: McGraw-Hill	6.50	13.00
1	Electronics and Nucleonics Dictionary By: Cooke and Markus Published By: McGraw-Hill	14.00	14.00

QUANTITY	DESCRIPTION	UNIT COST	TOTAL COST
1	Periodic Chart of the Elements Published By: Central Scientific Company	$4.00	$ 4.00
2	RCA Radiatron Designers Handbook	6.50	13.00
2	RCA & GE Tunnel Diode Manuals	1.75	3.50
20	Sylvania Tube Manuals	.25	5.00
2	GE Controlled Rectifier Manuals	1.75	3.50
2	TV Servicing Guides	1.75	3.50
2	TV Tube Symptoms and Troubles	1.35	2.70
2	Photofact Guide to TV Troubles	2.50	5.00
2	Color TV Servicing	2.50	5.00
4	Tube Substitution Handbook	.675	2.70
4	Transistor Sub. Handbook	.675	2.70
2	1967 Radio Amateur's Handbook	4.00	8.00
		TOTAL.....	$380.15

INSTRUCTIONAL AIDS

To better present the instructional material to the class, the following instructional aids are recommended.

QUANTITY	DESCRIPTION	UNIT COST	TOTAL COST
1	Seven Ft. Demonstration Slide Rule (Central Scientific Co. #73283-2)	$ 25.00	$ 25.00
1	Overhead Projector (Bessler Vu Graph #56016)	285.00	285.00
1	Vacuum Tube Voltmeter Demonstrator (EICO Model 249 D)	89.95	89.95
1	Dynamic VTUM Demonstrator (EICO 221 D)	10.00	10.00
1 set	Overhead Projectuals (Optional) (RCA Electricity E-1 - E-104)	695.00	695.00
20	Electronic Drafting Template (Alvin #311 R)	3.00	60.00
		TOTAL.....	$1,164.95

VISUAL AIDS

NOTE: The following films can be obtained from McGraw-Hill Book Company, Text-Films Division, New York, New York, (Package of six (6) films with accompanying filmstrip may be purchased for approximately $400.00).

Antenna Installation

Localizing TV Troubles

Practical TV Alignment

The Television System

Television Interference Patterns

Television Receiver

Antenna Is The Pay-Off, Channel Master Corporation, Naponock Road, Ellensville, New York (Loan)

Basic Electricity, General Electric Company, Schenectady, New York, (or local distributors) (Loan)

Basic Principles of Frequency Modulation, United World Films, Inc., 1445 Park Avenue, New York 29, New York, (no price available)

Naturally, It's Frequency Modulation, General Electric Company, Schenectady, New York, (or local distributors) (Loan)

Filmstrips:

NOTE: The following filmstrips can be purchased from McGraw-Hill Book Company, Text-Films Division, New York, New York, (Set of filmstrips may be purchased for approximately $30.00).

Alignment
- Part I - The I.R. Stage
- Part II - The Mixer Osc. Stage

How Color Television Works

How to Use the Signal Generator

The Converter
- Part I - The Oscillator Stage
- Part II - The Mixer Stage
- Part III - Identification of Parts

VT 010 215
Training Recommendations: Apprentice Bricklayer.

Construction Industry Training Board, Belfast (Northern Ireland)
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ABSTRACT - One of a series prepared by the Construction Industry Training Board to provide training recommendations for building trades occupations, this guide relates to apprentice bricklayers. Principal feature of the program is a topical outline of a basic skills course for "off-the-job" training, including operations to be performed, and skills and knowledge to be acquired. Part I of the three-part course outline covers hand tools, mortar, foundations, brick walling, and partitions; Part II outlines formation and bridging of openings, fireplaces, and reinforced brickwork; and Part III deals with foundations, drainage, cladding, and decorative and functional features. General information on the program, such as recruitment, training records and job description is presented briefly, and interviewing hints, a sample application, and personal trainee qualifications are appended. (AW)

VT010 215

NORTHERN IRELAND

ED0 45856

Construction Industry Training Board

VT010215

Training Recommendations—Apprentice Bricklayer

RECOMMENDATIONS

NOVEMBER, 1968

U.S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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ERIC

CONSTRUCTION INDUSTRY TRAINING BOARD

TRAINING RECOMMENDATIONS—APPRENTICE BRICKLAYER

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Construction Industry Training Board
Northern Ireland

Londonderry House 21 Chichester Street Belfast BT1 4JJ telephone Belfast 34871
Replies should be addressed to the 'Secretary'

Your ref.
Our ref. 52/0

Dear Sir(s),

Period of "Off-the-Job" Training - Apprentice Joiners, Apprentice Bricklayers and Apprentice Plasterers

The following is an extract from Information Bulletin No.16 which was published by the Board on the 29th November, 1968. This extract should be read in conjunction with the Board's Training Recommendations for Apprentice Bricklayers, Apprentice Plasterers and Apprentice Carpenters and Joiners:

"From 1965 until the Summer, 1968, the Board made arrangements with the Ministry of Health and Social Services for the "off-the-job" training for apprentices in these occupations to be available for the complete 50 weeks in the first year of apprenticeship. But the Board has been giving thought to alternative approaches which involve experimenting with periods of "off-the-job" training spread over the first two or three years of apprenticeship.

Thus, the training recommendations for these three occupations do not make provision for specific periods of "off-the-job" training until experience has been gained in both approaches. For the training year commencing on the 1st September, 1968, employers sponsoring boys for "off-the-job" training in bricklaying and joinery were, where possible, given the option of sponsoring the boys for a 6-month (joinery and bricklayers) or 9-month (plasterers) course or for the full 12-month course. It is hoped that any boys taking the shorter courses would return for further training to complete their basic "off-the-job" training in their second and/or third years of apprenticeship.

The following table.....

The following table summarises the periods of training under both schemes in each of the three crafts:

Occupation	Period of "off-the-job" training			
	Scheme A			Scheme B
	1st Year	2nd Year	3rd Year	1st Year
Apprentice Carpenter and Joiner	26 weeks - Basic Skills Course - Part 1 (including Common Training)	14 weeks - Basic Skills Course - Part II	9 weeks - Basic Skills Course - Part III	50 weeks - Basic Skills Course - Parts 1, II and III
Apprentice Plasterers	36 weeks - Basic Skills Course - Part I (including Common Training)	*11 weeks - Basic Skills Course - Part II	#This may be taken in the 3rd Year	50 weeks - Basic Skills Course - Parts 1 and II
Apprentice Bricklayers	26 weeks - Basic Skills Course - Part I (including Common Training)	11 weeks - Basic Skills Course - Part II	12 weeks - Basic Skills Course - Part III	50 weeks - Basic Skills Course - Parts I, II and III

The training given in Parts II and III under Scheme A must, of course, be at a more advanced level than the corresponding parts in Scheme B. It is hoped to obtain comparative evidence of the effectiveness of "off-the-job" training undertaken completely in the first year of apprenticeship or spread over the first two or three years. It is also hoped to obtain information on any difficulties encountered in maintaining viable classes of suitable size throughout the year. These arrangements obviously mean that there will be a period of transition before the most beneficial period of training in these occupations has been determined. As soon as the Board has reached any conclusions on the matter, firms will be notified.

Other Aspects of Training

It is emphasised that these experiments with the "off-the-job" training periods in no way affect the recommendations contained in the booklets about "on-the-job" training and associated further education. Both planned experience in the firm and further education are of great importance and it is hoped all firms will comply with these aspects of the recommendations.

TRAINING RECOMMENDATIONS—
APPRENTICE BRICKLAYER

1. INTRODUCTION

1.1 It has become clear that the traditional way of acquiring skills by watching and copying another man is not now adequate or efficient. It would obviously be of considerable benefit to the industry if all craft apprentices could be brought up to the standard of the best in the industry. Craft apprenticeship trains young men to become skilled in a wide range of operations. In his apprenticeship the apprentice must learn the skills of the craft, have practice and planned experience on the job with his firm, and gain technical knowledge complementary to those skills.

1.2 The Construction Industry Training Board was set up to help employers improve training at all levels.

2. TRAINING RECOMMENDATIONS

2.1 Training recommendations set out how systematic training can ideally be achieved showing where and how training should be given. These training recommendations have been prepared by the Board, in conjunction with the industry, and are based on a careful examination of the separate skills of the craft and the knowledge required by a craftsman. Employers are expected to implement the recommendations as fully as possible within the scope of the firm's activities.

3. OBJECTIVES OF RECOMMENDATIONS

3.1 The objectives of the recommendations are to achieve in the industry—

(a) A sound recruitment policy.

(b) A systematic programme of induction and practical training, both "on-the-job" and "off-the-job", to achieve planned progressive experience.

(c) Release from employment for associated further education.

(d) Acceptance of responsibility for training by a principal, or a senior member of management.

4. RECRUITMENT

4.1 A sound recruitment policy is necessary if the industry is to have the manpower it requires. Employers should, therefore, ensure that sufficient numbers of suitable apprentices enter employment each year. Advice on recruitment is given in Appendix 2. A personal specification is shown in Appendix 3.

5. INDUCTION

5.1 The induction programme is the first part of industrial training. Its purpose is to help the apprentice to settle down in his job as soon as possible. An apprentice's initial period of employment should be carefully planned bearing in mind the great change from school to work. Induction arrangements should deal particularly with—

(a) the objects of the firm, its conditions of employment, the relevant trade unions and welfare arrangements;

(b) the National Apprenticeship Agreement;

(c) general safety precautions and safety aids (e.g. helmets, goggles, boots, etc.) observed on sites and in workshops; use of ladders, scaffolding, tools, machinery, electrical installations, fire;

(d) name, use and care of tools;

(e) recognition of basic materials;

(f) the opportunities for training, associated further education and apprenticeship awards; and

(g) the importance of good workmanship and productivity.

5.2 It should be made clear to whom the apprentice is responsible for his work and general behaviour and to whom he should turn for advice and guidance.

6. "OFF-THE-JOB" TRAINING

6.1 "Off-the-job" training is practical training given away from the apprentice's normal work place.

6.2 The Board recommends that an apprentice should follow a Basic Skills Course in a government training centre, technical college or other suitable training centre for a period which is designed to equip him with the practical knowledge and basic techniques of his trade. This training allows the apprentice to acquire skill more quickly than on site or in a workshop. This will not make him a fully skilled craftsman, but it will provide a sound foundation for his further development of skill during the remainder of his apprenticeship. It will also enable him, under expert guidance, to acquire the habit of safe and efficient working.

6.3 The apprentice should be nominated to the Board for this course when it has been confirmed that the recruit is satisfactory to train as an apprentice.

6.4 The basis of the syllabus for the "off-the-job" Basic Skills Course in training centres is as shown in Appendix 1.

7. "ON-THE-JOB" TRAINING

7.1 This is the training given on site or in workshops during the remainder of apprenticeship while on productive work. The training should be progressive and under the supervision of a suitably qualified person.

7.2 Work "on-the-job" should be planned to give, where possible, a wide variety of experience in the company as set out in the job description.

7.3 When an apprentice is set a task, he should be given—

(a) Adequate instructions with drawings or sketches as appropriate.

(b) Guidance on the economic use of materials.

(c) An indication of the quality standards required.

(d) The estimated completion time.

(e) Instruction in the care of tools and materials.

8. ASSOCIATED FURTHER EDUCATION

8.1 Associated further education is technical instruction on a day release or number of weeks block release basis.

8.2 Technical education is an essential feature of craft training. Apprenticeship Schemes in the construction industry emphasise the need for technical education by providing for attendance at day or block release classes for all or most of the period of training.

8.3 Progress reports from the college are sent to the firm which should discuss them with the apprentice regularly.

9. ESSENTIAL ELEMENTS IN CRAFT TRAINING

9.1 Responsibility for training should be accepted by a principal or a senior member of management who should ensure that the apprentice—

(a) learns each separate skill of the occupation quickly and practises it by experience on the job, until the skills can be applied efficiently in a wide variety of circumstances, without close supervision;

(b) acquires and uses the technical knowledge which is complementary to those skills;

(c) develops mental flexibility to adapt to new methods, materials and techniques;

(d) appreciates other skills with which he may come in contact. Approximately 4 weeks common training in trades other than his own is included in the "off-the-job" training.

9.2 Overall the firm should develop the character of the apprentice so that he will become a responsible craftsman and a good citizen.

10. RECORDS OF TRAINING

10.1 Records of training of all employees for whom grants will be claimed must be kept on form T.R.1 or other suitable record, and be open to inspection by the Board's representatives who will have the right to examine any relevant records to substantiate a claim for grants. Supplies of form T.R.1 are available from the Board on request.

11. GRANTS

11.1 The cost of the training described in these recommendations is recognised and the Board's Training Grants Scheme is designed to assist employers financially. In this respect employers are advised to study the scheme and consult the Board's officers about the scheme and on the implementation of the Training Recommendations.

11.2 All claims for grant must be received by the Board by the 31st March after the end of each training year as claims received after this date will not be considered for grant purposes.

11.3 The Board may withhold or reduce grants if it is not satisfied that adequate training is being given.

11.4 In all cases, grants are payable to the employer and not to the trainee.

12. JOB DESCRIPTION

12.1 The apprentice should be given experience in the following operations within the ability of the firm and should be given the opportunity to acquire the complementary technical knowledge.

(a) Hand Tools.

(b) Mortar.

(c) Brick Walling.

(d) Partitions.

(e) Floor, Wall and Roof Tiling.

(f) Scaffolding.

(g) Timbering.

(h) Roof Repairs.

(i) General Repairs.

(j) Formation and Bridging of Openings.

(k) Fireplaces.

(l) Solid Fuel Appliances.

(m) Reinforced Brickwork.

(n) Foundations.

(o) Drainage.

(p) Cladding.

(q) Decorative and Functional Features.

(r) Firework.

13. THE TRAINING PROGRAMME

13.1 The following training programme was compiled from a study of the operations of the craft.

	PLANNED EXPERIENCE IN THE FIRM	"OFF-THE-JOB" TRAINING	FURTHER EDUCATION BY DAY OR BLOCK RELEASE
1st Year	See paragraph 12.1	See Appendix I and paragraph 13.2 below	City and Guilds Course No. 82—Craft Certificate Course
2nd Year			City and Guilds Course No. 82—Craft Certificate Course
3rd Year			City and Guilds Course No. 82—Craft Certificate Course (where desirable)
4th Year		—	City and Guilds Course No. 82—Advanced Craft Certificate Course (where desirable)

13.2 The Ministry of Health and Social Services and the Board will be experimenting to see what is the optimum length of "off-the-job" course which can be run in government training centres etc. and whether it is better that all such training should be done in the first year of apprenticeship or at intervals throughout the first three years. The arrangements for courses are referred to in Information Bulletin No. 16 which is issued with this booklet.

BASIC SKILLS COURSE **APPENDIX I**

FOR "OFF-THE-JOB" TRAINING

PART 1

OPERATIONS	TRAINING	
	SKILLS	KNOWLEDGE
HAND TOOLS: Use, care and handling of common tools used by bricklayer. Use of line, level, plumbrule, square and gauge rod.	Handling of trowel, hammer, bolster level, line, plumbrule, square and gauge rod, quoin blocks.	Placing of spotboards and materials for convenient use. Setting out walling by means of mortar screed and chalk lines. Use of quoin blocks. The function and safe working of tools on site and in the workshop. Ability to read rule and measure out correct dimensions. Reading of simple drawings.
MORTAR: Lime mortars, Wallcrete, sand and cement, gauged mortars and additives.		Preparing and mixing mortar. Names and quantities of material used in making mortar. Colouring.

OPERATIONS	TRAINING	
	SKILLS	KNOWLEDGE
FOUNDATION: Foundation for solid and cavity walls.	Use of pegs—straight edge and level. Placing, curing and protection of concrete.	Necd for foundations. Concrete mixing — manual and mechanical. Methods of gauging and selecting aggregates. Simple calculations.
BRICK WALLING: Solid, cavity, quoins and junctions, piers, stopped ends, toothings, raking back, blockwork.	Setting out in relation to bonding, aligning and building the various types of walling. Plumbing of quoins. Jointing of blockwork to brickwork in cross walls.	English, Flemish and Stretcher bonds. Various bonds used. Necessity and position of D.P.C.. Damp-proofing of openings for doors and windows. Sealing of walls at eaves level. Parapet walls including damp-proofing. Simple weather precautions for brickwork. Basic calculations in brickwork.

OPERATIONS	TRAINING	
	SKILLS	KNOWLEDGE
PARTITIONS: Half brick partitions, hollow clay block and concrete block partitions including lightweight concrete units.	Building various types of blocks. Forming and bridging of openings. Cutting and pinning partitions to soffits. Bonding or fixing partitions to walls or columns. Chasing and cutting for services.	Various materials in general use. Brick and block sizes. Need of securing partitions.
MISCELLANEOUS: Floor, Wall and Roof Tiling.		
Scaffolding.		Erection of scaffolding with particular attention to safety.
Timbering.		Trench timbering including safe working. Temporary supports during alterations or repairs.
Roof Repairs.		Safe use of cradles and roof ladders.
General Repairs	Repairing or replacing existing brickwork.	

BASIC SKILLS COURSE

FOR "OFF-THE-JOB" TRAINING

PART II

OPERATIONS	TRAINING	
	SKILLS	KNOWLEDGE
FORMATION AND BRIDGING OF OPENINGS: Bonding and setting out reveals, reinforced concrete lintols, soldier arches, shaped arches. Sills and thresholds, fixing of frames.	Setting out openings, positioning broken bond, bonding square and recessed reveals including D.P.C. in cavity walls. Temporary openings in walls, use of toothings, racking back.	The function of reinforcement and the importance of correct positioning. Methods of bridging openings in brick walls. Lintols in concrete and brick. Easing, striking and removal of wood centres, and turning pieces.
FIREPLACES: Fireplace openings and jambs. Flue formation, groupings, linings, chimneys and stacks, cappings, fixing pots. Gas flues and terminals, airbricks. Fixing tiles, surrounds and slabbed hearths.	Building fireplaces in ground and upper floors, layout and building of flues including gathering: Setting of flue liners for solid fuel and gas fires, lintol or arch construction. Building of stacks in various bonds including D.F.C.. Fixing of chimney pots.	Means of supporting openings. Purpose of gathering of flue. Minimum sizes of flues. Jointing of liners.

OPERATIONS	TRAINING	
	SKILLS	KNOWLEDGE
Solid Fuel Appliances.		Modern solid fuel appliances including continuous burners and free standing stoves.
REINFORCED BRICKWORK: Horizontal reinforcement.	Placing of reinforcement in brickwork.	The need of reinforcing brickwork and types of reinforcement.

PART III

FOUNDATIONS: Foundations for solid and cavity walls.	Levelling out foundations on first course.	Need for foundations, width and depth of foundations for the various thicknesses of walls. Effect of frost and erosion in shallow foundations. Foundations for the several types of soils. Stepping foundations on sloping site. Concrete calculations.

OPERATIONS	TRAINING	
	SKILLS	KNOWLEDGE
DRAINAGE: Simple systems of drainage. Inspection chamber testing.	Setting out and building manholes, laying stoneware pipes, jointing, connection to sewer by means of saddle. Setting and building in of half channels and branches in manholes, benching and step irons. Setting of gulleys, traps and rainwater outlets.	Correct fall for various sizes of pipes. Positioning of manholes on pipes. Various jointing materials. Bedding of drain pipes. Testing of drains.
CLADDING: Cladding panels. Exposed aggregate panels. Use of cranes for placing.	Fixing precast panels to framework of building by use of bolts, lugs, clamps or patent fasteners. Building inside lining to cladding.	Jointing, notching, drilling units. The use of fixing sketches. Bedding and pointing slabs, back fillings. Filling of expansion joints. Surface treatments, protection of work during and after completion.

OPERATIONS	TRAINING	
	SKILLS	KNOWLEDGE
DECORATIVE AND FUNCTIONAL FEATURES: Facing bricks, clay bricks, concrete bricks, terra cotta and faience. Mortars for facings. String courses, oversailing courses, corbelling and cornices, decorative bonds.	Techniques in laying, facing engineering and glazed bricks. Jointing and pointing. Decorative panels, flush, recessed and projecting. Laying pavings. Oversailing courses. Lining and cutting up to gables, string courses, copings and cappings. Tile creasings, plinths. Steps in precast concrete and brickwork.	Classification of facing bricks. Characteristics of clay bricks, concrete bricks, terra cotta, wall finishes. Mortar for facing work including colouring. Reasons for the use of various bonds. Purpose and methods of forming plinths. Copings in various materials, reconstructed stone and terra cotta, drips and throatings. Frost effects on bricks and mortar. Formation of ducts for services and drainage. Party walls. Cavity party walls. Concrete floors including horizontal and vertical D.P.C.. Floor finishes in clay and concrete products. Causes of condensation. Straight flight of stairs in precast concrete or brick.

OPERATIONS	TRAINING	
	SKILLS	KNOWLEDGE
FIREWORK:	Use of mallet. Working to templates.	Composition and preparation of mortars, cements, fireclay and concrete. General principles and types of furnaces and kilns. Bonds used in refactory work. Expansion joints.

NOTE—The reading and interpreting of working drawings should be included in the various operations where applicable.

APPENDIX II

SELECTION AND RECRUITMENT

(a) General

Selection and recruitment are key factors in a training scheme, as the value of the training is lost if it is given to unsuitable trainees. Sufficient trainees should be recruited to fulfil both present and future needs.

(b) Requirements

An apprentice should conform with the requirements of the National Apprenticeship Agreement regarding age and fitness and probation. He should undergo any selection or aptitude test currently agreed in Northern Ireland.

After satisfactory completion of the probationary period the employer should register the apprentice with the National Joint Council for his trade, and the apprentice should be employed under the terms and conditions of the National Apprenticeship Agreement.

(c) Selection

Good selection does not necessarily mean picking the best from a group of applicants—it means picking the right man for the job. Wrong selection is bad for the firm and for the apprentice, so every effort must be made to ensure that the apprentice has the necessary aptitude and right ability for the job and will be happy working in the industry.

(d) Application Form

The use of an application form may often be convenient, and serves as a useful guide to the interviewer to test the accuracy of the detail, and to ask for further explanation as necessary.

APPENDIX III

PERSONAL SPECIFICATION

FACTOR	ESSENTIALS	DESIRABLE	UNDESIRABLE
Physique	Normal good health and fitness. Normal good vision. Normal good hearing. Reasonable appearance, manner and bearing.	—	Vertigo. Allergy to building materials. Deafness. Poor sight.
Attainments	Educational ability to continue studies in City and Guilds Course to craft level.	Pre-apprentice training or similar experience of work.	—
General Intelligence	Average, in relation to the population as a whole.	—	—
Aptitude	Average, in relation to craftsmen.	—	—
Disposition	Reliable, acceptable by other people.	Evidence of leadership.	—
Circumstances	Free to stay away from home for training or work.	—	—
Interests	Outdoor activities.	Creative activity.	—

APPENDIX IV

HINTS ON INTERVIEWING

Sufficient time should be allowed, without interruption or distraction, for a satisfactory interview.

Preparation for an interview involves more than arranging the time and place. The following points are important:

(a) The object of the interview is to assess if the candidate will be suitable for craft training.

(b) The interview should, if possible, be conducted in a place where you cannot be disturbed by the telephone or other interruptions; additional information about the job and the training should be available to pass on to the candidate.

(c) The candidate should be made to feel relaxed; remember he is unlikely to be used to being interviewed, so he will not know what to expect.

(d) The candidate should do most of the talking; volunteered information is usually more reliable than that prompted by the person doing the interviewing.

Interviewing is a difficult technique and careful attention in planning and conducting an interview will result in more relevant and consistent selection. The following general points may be useful:

(i) REMEMBER the main purpose of the interview.

(ii) ESTABLISH right relationship with candidate at the beginning of the interview.

(iii) MAKE SURE that the questions are understood by the candidate.

(iv) AVOID leading questions where the answer is suggested by the question.

(v) BE THOROUGH in exploring the relevant details of candidate's application.

(vi) BEWARE of preconceived opinions.

(vii) REMEMBER that most people have bias and prejudice in one way or another and you should discount this or at least be aware of it.

(viii) BEWARE of the "Halo Effect" where the person being interviewed has the same background or opinions as the interviewer.

APPENDIX V

SPECIMEN APPLICATION FORM

Name.....

Address.....

Date of Birth..... Place of Birth.....

Father's/Guardian's Occupation.....

Education

Schools Attended.....

.....

Examinations Passed/Certificates Taken .....

Examination Results.....

Which subjects did you enjoy most?.....

.....

Health

What is your present state of health?.....

Have you had any serious illness?.....

If so, give details.....

.....

Do you suffer from any physical disabilities?.....

.....

If so, give details.....

.....

Interests

Hobbies, sports, clubs, etc. .....

.....

Previous Employment

Name and Address of previous/present employer.....

.....

.....

Live Away from Home

Are you prepared to live away from home during initial training and occasionally during your employment?

Date..... Signature .....

Parent's/Guardian's Signature.....

VT 010 216
Training Recommendations: Built-Up Roofing.

Construction Industry Training Board, Belfast (Northern Ireland)
MF AVAILABLE IN VT-ERIC SET.
PUB DATE - Nov68 24p.

DESCRIPTORS - *PROGRAM GUIDES; *TRADE AND INDUSTRIAL EDUCATION; CURRICULUM GUIDES; *APPRENTICESHIPS; *FOREIGN COUNTRIES; ON THE JOB TRAINING; *BUILDING TRADES; ADULT VOCATIONAL EDUCATION; CONSTRUCTION INDUSTRY; ROOFERS
IDENTIFIERS - *IRELAND

ABSTRACT - One of a series prepared by the Construction Industry Training Board to provide training recommendations for building trades occupations, this guide presents recommendations for training roofers. Principal features of the program are outlines of basic skills courses for both the "learner" and "improver" trainee, listing the knowledge required and the operations and skills involved. The entire training program, including various aspects of training, duration of training time for each aspect, and general information concerning each aspect of training is also outlined. A detailed job description, objectives, recruitment, induction, training records, and grants are covered briefly. Appendixes provide additional information on selection and recruitment, personal qualifications of trainees, interviewing hints, and a sample application form. (AW)

VT 010 216

NORTHERN IRELAND

These recommendations set out a systematic training programme for the operation of built-up roofing: they are not intended to indicate the category of worker who should carry out the operations involved.

ED0 45856
VT010216

Construction Industry Training Board

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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Training Recommendations
Built-up Roofing

NOVEMBER, 1968

CONSTRUCTION INDUSTRY TRAINING BOARD, (N.I.)
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ERIC

CONSTRUCTION INDUSTRY TRAINING BOARD

TRAINING RECOMMENDATIONS— BUILT-UP ROOFING

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APPENDIX 1 — BASIC SKILLS COURSES FOR "OFF-THE-JOB" TRAINING FOR "LEARNER" AND "IMPROVER"

APPENDIX 2 — SELECTION AND RECRUITMENT

APPENDIX 3 — PERSONAL SPECIFICATION

APPENDIX 4 — HINTS ON INTERVIEWING

APPENDIX 5 — SPECIMEN APPLICATION FORM

TRAINING RECOMMENDATIONS—
BUILT-UP ROOFING

1. INTRODUCTION

1.1 It has become clear that the traditional way of acquiring skills by watching and copying another man is not now adequate or efficient. It would obviously be of considerable benefit to the industry if all operatives could be brought up to the standard of the best in the industry. The training outlined in these recommendations aims to produce a competent operative at an economic cost.

1.2 The Construction Industry Training Board was set up to help employers improve training at all levels.

2. TRAINING RECOMMENDATIONS

2.1 Training recommendations set out how systematic training can ideally be achieved showing where and how training should be given. These training recommendations have been prepared by the Board, in conjunction with the industry, and are based on a careful examination of the separate skills of and knowledge required by an operative. Employers are expected to implement the recommendations as fully as possible within the scope of the firm's activities.

3. OBJECTIVES OF RECOMMENDATIONS

3.1 The objectives of the recommendations are to achieve in the industry –

(a) A sound recruitment policy;

(b) A systematic programme of induction and practical training, both "on-the-job" and "off-the-job", to achieve planned progressive experience;

(c) Release from employment for associated further education, where applicable;

(d) Acceptance of responsibility for training by a principal, or a senior member of management.

4. RECRUITMENT

4.1 A sound recruitment policy is necessary if the industry is to have the manpower it requires. Employers should, therefore, ensure that sufficient numbers of suitable trainees enter employment each year. Advice on recruitment is given in Appendix 2. A personal specification is given in Appendix 3.

5. INDUCTION

5.1 The induction programme is the first part of industrial training. Its purpose is to help the trainee to settle down in his job as soon as possible. A trainee's initial period of employment should be carefully planned. Induction arrangements should deal particularly with –

(a) the objects of the firm, its conditions of employment, the relevant trade unions and welfare arrangements;

(b) general *safety* precautions and safety aids (e.g., helmets, goggles, boots, etc.) observed on sites and in workshops; use of ladders, scaffolding, tools, machinery, electrical installations, fire;

(c) name, use and care of tools;

(d) recognition of basic materials;

(e) the opportunities for training; and

(f) the importance of good workmanship and productivity.

5.2 It should be made clear to whom the trainee is responsible for his work and general behaviour and to whom he should turn for advice and guidance.

6. "OFF-THE-JOB" TRAINING

6.1 "Off-the-job" training is practical training given away from the trainee's normal work place.

6.2 The Board recommends that a trainee should follow an "off-the-job" Basic Skills Course for a period which is designed to equip him with the practical knowledge and basic techniques of his occupation. This training allows the trainee to acquire skill more quickly than on site. This will not make him a fully skilled operative, but it will provide a sound foundation for his further development of skill during the remainder of his training. It will also enable him, under expert guidance, to acquire the habit of safe and efficient working.

6.3 The trainee should be nominated to the Board for this course when it has been confirmed that the man is satisfactory to train.

6.4 The basis of the syllabus for the "off-the-job" Basic Skills Course is as shown in Appendix 1 (pages 10 – 19).

7. "ON-THE-JOB" TRAINING

7.1 This is the training given on site during the remainder of training while on productive work. The training should be progressive and under the supervision of a suitably qualified person.

7.2 Work "on-the-job" should be planned to give, where possible, a wide variety of experience in the company as set out in the job description.

7.3 When a trainee is set a task, he should be given –

(a) adequate instructions with drawings or sketches as appropriate;

(b) guidance on the economic use of materials;

(c) an indication of the quality standards required;

(d) the estimated completion time;

(e) instruction in the care of tools and materials.

8. ASSOCIATED FURTHER EDUCATION

8.1 Associated further education is technical instruction on a day release or number of weeks block release basis.

8.2 The employer should consider some form of further education which would be valuable. The Board's officers would be glad to assist.

8.3 Progress reports from the college are sent to the firm which should discuss them with the operative regularly.

9. ESSENTIAL ELEMENTS IN TRAINING

9.1 Responsibility for training should be accepted by a principal or a senior member of management who should ensure that the trainee –

(a) learns each separate skill of the occupation quickly and practices it by experience on the job, until the skills can be applied efficiently in a wide variety of circumstances, without close supervision;

(b) acquires and uses the technical knowledge which is complementary to those skills;

(c) develops mental flexibility to adapt to new methods, materials and techniques;

(d) appreciates other skills with which he may come in contact;

(e) gets continuous assessment during training.

9.2 Overall the firm should develop the character of the trainee so that he will become a responsible operative and a good citizen.

10. RECORDS OF TRAINING

10.1 Records of training of all employees for whom grants will be claimed must be kept on form T.R.1 or other suitable record, and be open to inspection by the Board's representatives who will have the right to examine any relevant records to substantiate a claim for grants. Supplies of form T.R.1 are available from the Board on request.

11. GRANTS

11.1 The cost of the training described in these recommendations is recognised and the Board's Training Grants Scheme is designed to assist employers financially. In this respect employers are advised to study the scheme and consult the Board's officers about the scheme and on the implementation of the Training Recommendations.

11.2 All claims for grants must be received by the Board by the 31st March after the end of each training year as claims received after this date will not be considered for grant purposes.

11.3 The Board may withhold or reduce grants if it is not satified that adequate training is being given.

11.4 In all cases, grants are payable to the employer and not to the trainee.

12. JOB DESCRIPTION

12.1 The trainee should be given experience in the following within the ability of the firm and should be given the opportunity to acquire the complementary technical knowledge.

12.2 **"LEARNER"**

Preparing roof surfaces for felt finishing.

Acquiring access to roofs, and site safety.

Taking necessary safety precautions during work.

Lifting and carrying and storing materials.

Operating boiler.

Hoisting materials manually.

Laying felt by built-up method on flat surfaces of various types of construction.

Recognising and handling decking materials.

12.3 **"IMPROVER"**

Inspecting roof surfaces for felt finishing.

Preparing roof surfaces for felt finishing.

Acquiring access to roofs, and site safety.

Measuring materials required for roofing.

Requisitioning and delivering materials.

Taking necessary safety precautions during work.

Lifting and carrying and storing materials.

Operating boiler.

Hoisting materials manually and mechanically.

Laying felt by build-up method on flat, sloping and vertical surfaces of various types of construction.

Forming finishes at abutments and open edges of roofs and at gutters and outlets and rising pipes.

Fixing decking of various materials to the different types of roof construction.

Maintaining and repairing felt roofs.

Fixing various types of insulating materials.

13. TRAINING PROGRAMME

13.1 The training programme was compiled from a study of the operations of the job as follows–

Aspect of Training	*Period*	*Remarks*
Selection and Recruitment	—	The minimum age of employment in roofing should be 18 years. (See "Personal Specification" at Appendix 3 for requirements).
Induction Training	Approximately 6 months	A trainee should be employed as a labourer for approximately six months, on built-up roofing work, to familiarise him with the nature of the work, and show his potential to benefit from further training.
Learner Course	2 weeks "Off-the-Job" Training	Having completed induction training satisfactorily or otherwise shown that he can benefit from further training, a trainee should attend a "Learner Course." (See Appendix 1).
Planned Experience	Several Months "On-the-Job"	Following the "Learner Course" a trainee should have the opportunity to practice what has been taught on the course.
Improver Course	4 weeks "Off-the-Job" Training	A man who has attained a suitable standard of competence and has the ability to benefit from training should attend an "Improver Course". (See Appendix 1).

(*continued on page 9*)

13. TRAINING PROGRAMME (*continued*)

Aspect of Training	*Period*	*Remarks*
Planned Experience	Several Months "On-the-Job"	Following the "Improver Course" a trainee should have the opportunity to practice what has been taught on the course.
Charge-hand Course	"Off-the-Job" Training	A skilled fixer who has demonstrated ability for further progress to become a charge-hand should attend a "charge-hand course."

APPENDIX 1.

BASIC SKILLS COURSE FOR "OFF-THE-JOB" TRAINING

1. COURSE FOR "LEARNER"

Operations	*Knowledge Required*	*Skills Involved*
Laying felt by built-up methods.	Types of felt, bitumen, primers.	
	Starting positions. Sequence of work. Breaking bond. Setting out to suit widths of felt.	
		Envisaging progress of work.
Laying and bedding felt.	Lapping and bonding techniques.	
	Methods of spreading hot bitumen and safety precautions.	
	Methods of setting, applying and bedding felt.	
	Methods of damping felt edges and stripping off bitumen.	
		Use of bucket, trowel, mop and brush.
		Handling a roll of felt on hot bitumen.
		Use of brush and water.

(*continued on page 11*)

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1. COURSE FOR "LEARNER" *(continued)*

Operations	*Knowledge Required*	*Skills Involved*
Forming finishes at abutments and open edges and at gutters, outlets and rising pipes.	Methods of weathering and disposal of surface water including – fillets turn-ups (upstands) drips ridges and hips valleys box gutters dressing to lead or plastic outlets; dressing to rising pipes; types and uses of cover flashings and metal trims.	
Priming.	Uses of primers on concrete roofs, metal decking, screeded roofs. metal trims.	Use of brushes and primers.
Nailing.	Uses and types of nails on boarded roofs.	Use of hammer and nails.
Cutting.	Methods of measuring and scribing.	Use of knife, straight-edge and rule.
Acquiring access to roofs.	Handling and usage of ladders. Handling and usage of scaffolding. Safety precautions.	Use of ladders. Climbing ladders.

(continued on page 12)

1. COURSE FOR "LEARNER" *(continued)*

Operations	*Knowledge Required*	*Skills Involved*
Preparing roof surfaces.	Cleaning methods. Drying methods. Reasons for priming.	Use of cleaning methods. Use of drying methods. Use of primers.
Lifting, carrying and storing materials.	Methods for each. Safety precautions for personnel and materials. Dangers of fire, frost damage, dampness, etc.	Lifting and carrying.
Operating boiler.	Positioning boiler. Erecting boiler. Loading boiler. Topping-up boiler. Breaking bitumen blocks. Control of temperature. Control of fire. Handling hot bitumen. Cleaning boiler and utensils. Safety precautions and "first-aid."	
Hoisting materials for roofing.	Methods of hoisting boards, buckets, rolls, barrows, etc., by hand gin-wheel. Safety precautions.	Carrying a heavy weight up ladders and on slopes, and for distances. Use of gin-wheel.

(continued on page 13)

1. **COURSE FOR "LEARNER"** (*continued*)

Operations	*Knowledge Required*	*Skills Involved*
Hoisting, handling and storing materials for decking.	Methods of hoisting Methods of handling Methods of storing Precautions against fire, breakage, damage, overloading, loss, inaccessability.	
Decking.	Types and uses of decking– Metal Woodwool Compressed straw Chipboard	
Insulating.	Reasons for, and methods of fixing– Fibre boards Glass fibre boards Cork Polystyrene	

2. COURSE FOR "IMPROVER"

Operations	*Knowledge Required*	*Skills Involved*
Laying felt by built-up methods.	Types of felt, bitumen, primers. Starting positions. Sequence of work. Breaking bond. Setting out to suit widths of felt.	Envisaging progress of work.
Laying and bedding felt.	Lapping and bonding techniques. Methods of spreading hot bitumen and safety precautions. Methods of setting, applying and bedding felt. Methods of damping felt edges and stripping off bitumen.	Use of bucket, trowel, mop and brush. Handling a roll of felt on hot bitumen. Use of brush and water.

(*continued on page 15*)

2. COURSE FOR "IMPROVER" (*continued*)

Operations	*Knowledge Required*	*Skills Involved*
Forming finishes at abutments and open edges and at gutters, outlets and rising pipes.	Methods of weathering and disposal of surface water including– fillets turn-ups (upstands) drips ridges and hips valleys box gutters dressing to lead or plastic outlets; dressing to rising pipes; types and uses of cover flashings and metal trims.	Measuring and marking. Use of tools for cutting and fixing: turn-ups drips ridges valleys box gutters dressings to outlets; dressings to pipes.
Laying and bedding felt sloping and vertical surfaces.	Methods of handling and applying materials.	Handling and fixing materials.
Cutting.	Methods of measuring and scribing.	Use of knife. straight-edge and rule.

(*continued on page 16*)

2. COURSE FOR "IMPROVER" *(continued)*

Operations	*Knowledge Required*	*Skills Involved*
Acquiring access to roofs.	Handling and usage of ladders.	
	Handling and usage of scaffolding.	
	Safety precautions.	
		Use of ladders. Climbing ladders.
Inspecting roof surfaces.	Location – with reference to availability of materials and labour and accessability.	
		Assessing requirements.
	Condition and type of surface and outfalls.	
		Assessing suitability for type of covering.
	Appreciation of shapes of roofs.	
		Measuring and assessing method of covering.
	Appreciation of sizes of roofs.	
		Measuring.
	Dangers of fire, frost damage, dampness, etc.	

(continued on page 17)

2. COURSE FOR "IMPROVER" (*continued*)

Operations	*Knowledge Required*	*Skills Involved*
Operating boiler.	Positioning boiler. Erecting boiler Loading boiler. Topping-up boiler. Breaking bitumen blocks. Control of temperature. Control of fire. Handling hot bitumen. Cleaning boiler and utensils. Safety precautions and "first-aid."	Handling heavy materials. Handling hot materials. Working cleanly.
Hoisting materials for roofing.	Methods of hoisting boards, buckets, rolls, barrows, etc., by-gin-wheel, mechanical hoist, crane. Safety precautions.	Use of gin-wheel. Use of mechanical hoist. Use of crane.
Hoisting, handling and storing materials for decking.	Methods of hoisting. Methods of handling. Methods of storing. Precautions against fire, breakage, damage, over-loading, loss, inaccessability.	
Decking.	Types and uses of decking – Metal Woodwool Compressed straw Chipboard	

(*continued on page 18*)

2. COURSE FOR "IMPROVER" (*continued*)

Operations	*Knowledge Required*	*Skills Involved*
Tools.	Methods of cutting. Methods of drilling. Methods of fixing.	Use of hack-saw. Use of hand-saw. Use of brace and bit. Use of hammer. Use of electric saw. Use of electric drill. Use of hammer pin and cartridge fixings. Use of manual metal cutter. Riveting and bolting.
Fixing.	Positioning, and lining up. Methods of cutting. Methods of fixing.	Lining and placing. Cutting. Fixing.
Insulating.	Reasons for, and methods of fixing – Fibre boards. Glass fibre boards. Cork. Polystyrene.	

(*continued on page 19*)

COURSE FOR "IMPROVER" (*continued*)

Operations	*Knowledge Required*	*Skills Involved*
Requisitioning materials within the firm.	Methods. Communicating. Following up delivery.	Writing. Communicating.
Measuring materials required.	Mensuration. Calculating. Quantities/areas of felt, bitumen, flashings, trimmings.	Measuring. Calculating. Writing.
Drawings.	Interpretation of drawings and specifications.	

APPENDIX 2

SELECTION AND RECRUITMENT

(a) General

Selection and recruitment are key factors in a training scheme, as the value of the training is lost if it is given to unsuitable trainees. Sufficient trainees should be recruited to fulfil both present and future needs.

(b) Requirements

A trainee should undergo any selection or aptitude test currently agreed in Northern Ireland.

(c) Selection

Good selection does not necessarily mean picking the best from a group of applicants – it means picking the right man for the job. Wrong selection is bad for the firm and for the trainee, so every effort must be made to ensure that the trainee has the necessary aptitude and right ability for the job and will be happy working in the industry.

(d) Application Form

The use of an application form may often be convenient, and serves as a useful guide to the interviewer to test the accuracy of the detail, and to ask for further explanation as necessary.

APPENDIX 3.

PERSONAL SPECIFICATION

Factor	*Essentials*	*Desirable*	*Undesirable*
Physique	Normal good health and fitness. Normal good vision. Normal good hearing. Reasonable appearance, manner and bearing.	—	Vertigo. Allergy to building materials. Deafness. Poor sight.
Attainments	—	Able to read and write legibly and count accurately.	—
General Intelligence	—	Average, in relation to other operatives.	—
Aptitude	Average, in relation to general construction operatives.	—	—
Disposition	Reliable, acceptable by other people.	Evidence of leadership.	—
Circumstances	Free to stay away from home for training or work.	—	—
Interests	Outdoor activities.	Creative activity.	—

APPENDIX 4.

HINTS ON INTERVIEWING

Sufficient time should be allowed, without interruption or distraction, for a satisfactory interview.

Preparation for an interview involves more than arranging the time and place. The following points are important –

(a) the object of the interview is to assess if the candidate will be suitable for operative training;

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Name .....

Address.....

Date of Birth ..... Place of Birth.....

Father's/Guardian's Occupation.....

Education

Schools Attended.....

.....

Examinations Passed/Certificates Taken.....

Examination Results.....

Which subjects did you enjoy most?.....

.....

Health

What is your present state of health?.....

Have you had any serious illness?.....

If so, give details.....

Do you suffer from any physical disabilities?.....

If so, give details.....

.....

Interests

Hobbies, sports, clubs, etc.....

Previous Employment

Name and Address of Previous/Present Employer.....

.....

Live Away from Home

Are you prepared to live away from home during initial training and occasionally during your employment?

Date..... Signature.....

Parent/Guardian's Signature.....

VT 010 217
Training Recommendations: Apprentice Constructional Steel Fabricator.

Construction Industry Training Board, Belfast (Northern Ireland)
MF AVAILABLE IN VT-ERIC SET.
PUB DATE - Nov68 24p.

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IDENTIFIERS - *IRELAND

ABSTRACT - One of a series prepared by the Construction Industry Training Board to provide training recommendations for building trades occupations, the main feature of this guide for apprentice constructional steel fabricators is a topical outline of a 2-year basic skills course for "off-the-job" training, which includes operations to be performed, skills to be acquired, and knowledge to be gained. Topics covered are: (1) Reading Drawings and Specifications, (2) Template Making and Setting Out, (3) Preparation of Structural Steel Members, (4) Assembly, and (5) Protecting Steel Against Corrosion. Objectives, recruitment, induction, associated education, craft training, training records, and grants are discussed briefly. (AW)

VT 010 217

NORTHERN IRELAND

ED0 45856
VT010217

Construction Industry Training Board

Training Recommendations— Apprentice Constructional Steel Fabricator

RECOMMENDATIONS

NOVEMBER, 1968

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CONSTRUCTION INDUSTRY TRAINING BOARD

TRAINING RECOMMENDATIONS—

APPRENTICE CONSTRUCTIONAL STEEL FABRICATOR

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TRAINING RECOMMENDATIONS—
APPRENTICE CONSTRUCTIONAL STEEL FABRICATOR

1. INTRODUCTION

1.1 It has become clear that the traditional way of acquiring skills by watching and copying another man is not now adequate or efficient. It would obviously be of considerable benefit to the industry if all craft apprentices could be brought up to the standard of the best in the industry. Craft apprenticeship trains young men to become skilled in a wide range of operations. In his apprenticeship the apprentice must learn the skills of the craft, have practice and planned experience on the job with his firm, and gain technical knowledge complementary to those skills.

1.2 The Construction Industry Training Board was set up to help employers improve training at all levels.

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(d) Acceptance of responsibility for training by a principal, or a senior member of management.

4. RECRUITMENT

4.1 A sound recruitment policy is necessary if the industry is to have the manpower it requires. Employers should, therefore, ensure that sufficient numbers of suitable apprentices enter employment each year. Advice on recruitment is given in Appendix 2. A personal specification is shown in Appendix 3.

5. INDUCTION

5.1 The induction programme is the first part of industrial training. Its purpose is to help the apprentice to settle down in his job as soon as possible. An apprentice's initial period of employment should be carefully planned bearing in mind the great change from school to work. Induction arrangements should deal particularly with—

(a) the objects of the firm, its conditions of employment, the relevant trade unions and welfare arrangements;

(b) the National Apprenticeship Agreement;

(c) general safety precautions and safety aids (e.g. helmets, goggles, boots, etc.) observed on sites and in workshops; use of ladders, scaffolding, tools, machinery, electrical installations, fire;

(d) name, use and care of tools;

(e) recognition of basic materials;

(f) the opportunities for training, associated further education and apprenticeship awards; and

(g) the importance of good workmanship and productivity.

5.2 It should be made clear to whom the apprentice is responsible for his work and general behaviour and to whom he should turn for advice and guidance.

6. "OFF-THE-JOB" TRAINING

6.1 "Off-the-job" training is practical training given away from the apprentice's normal work place.

6.2 The Board recommends that an apprentice should follow a Basic Skills Course in a government training centre, technical college or other suitable training centre for a period which is designed to equip him with the practical knowledge and basic techniques of his trade. This training allows the apprentice to acquire skill more quickly than on site or in a workshop. This will not make him a fully skilled craftsman, but it will provide a sound foundation for his further development of skill during the remainder of his apprenticeship. It will also enable him, under expert guidance, to acquire the habit of safe and efficient working.

6.3 The apprentice should be nominated to the Board for this course when it has been confirmed that the recruit is satisfactory to train as an apprentice.

6.4 The basis of the syllabus for the "off-the-job" Basic Skills Course in training centres is as shown in Appendix 1.

7. "ON-THE-JOB" TRAINING

7.1 This is the training given on site or in workshops during the remainder of apprenticeship while on productive work. The training should be progressive and under the supervision of a suitably qualified person.

7.2 Work "on-the-job" should be planned to give, where possible, a wide variety of experience in the company as set out in the job description.

7.3 When an apprentice is set a task, he should be given—

(a) Adequate instructions with drawings or sketches as appropriate.

(b) Guidance on the economic use of materials.

(c) An indication of the quality standards required.

(d) The estimated completion time.

(e) Instruction in the care of tools and materials.

8. ASSOCIATED FURTHER EDUCATION

8.1 Associated further education is technical instruction on a day release or number of weeks block release basis.

8.2 Technical education is an essential feature of craft training. Apprenticeship Schemes in the construction industry emphasise the need for technical education by providing for attendance at day or block release classes for all or most of the period of training.

8.3 Progress reports from the college are sent to the firm which should discuss them with the apprentice regularly.

9. ESSENTIAL ELEMENTS IN CRAFT TRAINING

9.1 Responsibility for training should be accepted by a principal or a senior member of management who should ensure that the apprentice—

(a) learns each separate skill of the occupation quickly and practises it by experience on the job, until the skills can be applied efficiently in a wide variety of circumstances, without close supervision;

(b) acquires and uses the technical knowledge which is complementary to those skills;

(c) develops mental flexibility to adapt to new methods, materials and techniques;

(d) appreciates other skills with which he may come in contact. Approximately 4 weeks common training in trades other than his own is included in the "off-the-job" training.

9.2 Overall the firm should develop the character of the apprentice so that he will become a responsible craftsman and a good citizen.

10. RECORDS OF TRAINING

10.1 Records of training of all employees for whom grants will be claimed must be kept on form T.R.1 or other suitable record, and be open to inspection by the Board's representatives who will have the right to examine any relevant records to substantiate a claim for grants. Supplies of form T.R.1 are available from the Board on request.

11. GRANTS

11.1 The cost of the training described in these recommendations is recognised and the Board's Training Grants Scheme is designed to assist employers financially. In this respect employers are advised to study the scheme and consult the Board's officers about the scheme and on the implementation of the Training Recommendations.

11.2 All claims for grant must be received by the Board by the 31st March after the end of each training year as claims received after this date will not be considered for grant purposes.

11.3 The Board may withhold or reduce grants if it is not satisfied that adequate training is being given.

11.4 In all cases, grants are payable to the employer and not to the trainee.

12. JOB DESCRIPTION

12.1 The apprentice should be given experience in the following operations within the ability of the firm and should be given the opportunity to acquire the complementary technical knowledge.

(a) Reading of drawings and specifications.

(b) Template making and setting out.

(c) Preparation of steel involving:

- Drilling
- Cutting with cold saws
- Cropping
- Guillotining
- Oxy-acetylene cutting
- Plate rolling
- Straightening
- Edging
- Flanging

(d) Shop marking.

(e) Assembly, involving:

- Drilling
- Electric arc welding
- Rivetting
- Caulking
- Bolting
- Material handling.

(f) Painting, involving:

- De-scaling
- Galvanizing
- Shot blasting

13. THE TRAINING PROGRAMME

13.1 The following training programme was compiled from a study of the operations of the craft.

	PLANNED EXPERIENCE IN THE FIRM	" OFF-THE-JOB " TRAINING	FURTHER EDUCATION BY DAY RELEASE
1st Year	Selection and recruitment Approximately 26 weeks Induction Training Approximately 11 weeks on site or in workshops	13 weeks Basic Skills Course (including common training)	City and Guilds Course No. 360 Part I.
2nd Year	37 weeks on site or in workshops	13 weeks Basic Skills Course (second part)	City and Guilds Course No. 360 Part I.
3rd Year	50 weeks on site or in workshops	—	City and Guilds Course No. 360 Part II—Platework and fabrication (where desirable).
4th Year	50 weeks on site or in workshops	—	City and Guilds Course No. 360 Part II—Platework and fabrication (where desirable).
5th Year	50 weeks on site or in workshops	—	—

APPENDIX I

BASIC SKILLS COURSE FOR "OFF-THE-JOB" TRAINING

In the first year:

Reading drawings and specifications.
Template making and setting out.
Handling and moving stock.
Cutting by hand and oxy-acetylene.
Marking off.
Drilling.
Tapping.
Grinding.
Assembling.
Bolting.
Electric-arc welding.
Protection against corrosion.

In the second year:

Advanced template making.
„ stock handling.
„ oxy-acetylene cutting.
„ marking off.
„ drilling.
„ assembly.
„ bolting.
„ welding.
Rivetting.

OPERATIONS	SKILLS	KNOWLEDGE
READING DRAWINGS AND SPECIFICATIONS	Interpretation of the intention of drawings and specifications into practical terms.	Recognition and appreciation of uses of— 1. Standard steel sections. 2. Bolts and rivets. 3. Welds. 4. Plates. 5. Constructional principles. 6. Constructional methods. 7. Constructional designs. 8. Symbols. 9. Cross centres. 10. Back marks. 11. Standard methods of indicating plans, elevations and sections. 12. Tolerances, clearances and allowances. 13. Rivet pitches, and edge distances. 14. Terms—'in pairs', 'as drawn' and 'opposite hand'.
TEMPLATE MAKING AND SETTING OUT	Use of, and safety precautions with— 1. Circular saw. 2. Planing machine. 3. Wood drilling machine. 4. Fret saw. 5. Buffing machine. 6. Hand tools. 7. Steel tape. 8. Steel rule.	

OPERATIONS	SKILLS	KNOWLEDGE
	9. Compasses. 10. Trammels. 11. Protractor. 12. Back gauges. 13. Chalk-line. 14. Straight-edge. Preparing templates for the various steel sections from wood, plywood, hardboard, millboard, paper. Measuring. Marking. Setting out from baseline to square, parallel, angles, cambers and circles.	Methods and procedures for marking and setting out on loft floor to full size from drawings. Geometrical principles and practices. English and metric systems of measurements.
PREPARATION OF STRUCTURAL STEEL MEMBERS 1. Handling and moving stock, and single items.	Manual handling of items of steel. Lifting heavy weights. Stacking.	Safe and efficient procedures for lifting, carrying and placing single items.

OPERATIONS	SKILLS	KNOWLEDGE
		Safe and efficient procedures for lifting, carrying and placing quantities of steel.
	Care, maintenance and safe use of— pinch bars, turning dogs, slings, rollers, lifting tackle, cranes.	
		Safe and efficient procedures with mechanical equipment including— slings, chains, cranes, lifting tackle, signals.
2. Selecting.	Selecting materials economically. Measuring and marking.	
		Principles and procedures for stocking and stacking.
		Principles and procedures for cutting lists.
3. Cutting.	Care, maintenance, safe and efficient use of— oxygen-flame cutter, hand hack-saw, mechanical hack-saw, circular saws, guillotines, cropping machines.	
		Methods and procedures for safe use of— flame cutting, hack sawing, cutting with circular saws, shearing, cropping.

OPERATIONS	SKILLS	KNOWLEDGE
4. Marking-off.	Care, maintenance and efficient use of— steel tape, steel rule, squares, scribers, hand hammers, centre and nipple punches, chisels, chalk-lines, back gauges, trammels, compasses, marking pegs and paint, templates.	Reading and interpreting drawings and transferring the information from the drawings to the steel. Principles and methods of drilling and punching without templates. Methods of marking and centre-punching for holes, notches and bends, using templates. Methods of marking for job numbers, part numbers, and counter-sinks. Tolerances, clearances and allowances.
5. Bending and straightening.	Detecting faults and twists or bends in steel members. Correct placing of steel members in machines.	

OPERATIONS	SKILLS	KNOWLEDGE
	Correct and efficient use of— plunger and shoulder machines, hydraulic presses, rolling machines, hammers, flanging machines.	
	Assessing and measuring bent and straightened work.	
		Reasons for, and purposes of, bending and straightening.
		Procedures and methods to be adopted.
		Safe and efficient use of methods.
6. Drilling.	Handling material to the drill, or the drill to the material.	
	Centring the drill on the punch marks.	
	Safe and efficient use of drill machines.	
	Care and maintenance of machines and drills.	
		Types and sizes of drills. Drill speeds and feeds. Materials to be drilled. Types of drilling machines. Safe and efficient procedures and methods of drilling.
7. Tapping.	Care, maintenance and use of taps.	
		Principles and procedures. Safe and efficient methods. Sizes of ho[illegible] and threads.

OPERATIONS	SKILLS	KNOWLEDGE
8. Planing.	Care, maintenance and use of planing machines and cutters. Placing materials in machines. Setting cutters.	Principles and procedures. Safe and efficient methods and machines. Types and reasons for planed edges.
9. Ending.	Placing material to machine or machine to material. Care, maintenance and efficient use of machine and cutters.	Reasons for ending. Length allowances for ending. Methods adopted for ending. Requirements of accuracy.
10. Grinding.	Care, maintenance and efficient use of fixed and portable grinding machines and grinding wheels.	Reasons for grinding methods adopted by fixed and portable grinders.

OPERATIONS	SKILLS	KNOWLEDGE
ASSEMBLY		Reading and interpreting drawings. Understanding principles and methods of steel construction and erection. Procedure to be adopted for assembly of component parts. Methods of assembly. Methods of jointing— 1. Bolting. 2. Rivetting. 3. Welding. Types and sizes of— 1. Bolts. 2. Washers. 3. Rivets. 4. Welds. Handling assembled sections.
1. Bolting.	Use of— Steel tape, steel rule, steel square, steel scriber, podger, box spanner, hammers, chisels, pinch-bars, drifts, clamps, files, screw-jacks, pull-backs, strong-backs, dogs.	

OPERATIONS	SKILLS	KNOWLEDGE
		Methods of positioning members. Methods of adjusting members. Methods of bolting and use of washers and tightening nuts. Methods of truing-up members and checking for alignment.
2. Rivetting.		Reasons for rivetting. Principles of rivetting. Methods of rivetting. Types of rivetting machines. Types of rivets.
	Selecting size and type of rivet. Heating and handling rivets. Safe and efficient use of riveting machines. Recognising faults. Handling assembled section when hot, to avoid distortion.	
3. Electric-arc welding.		Reasons and principles of welding. Types of welds, and standard symbols used. Square butt. Single V butt. Double V butt. Single U butt. Double U butt. Single bevel butt.

OPERATIONS	SKILLS	KNOWLEDGE
		Double bevel butt. Single J butt. Fillett. Stud. Edge. Seal. Sealing run. Methods of welding. Properties of materials to be welded. Recognition of faults in welds: Variation in width of bead. Unevenness of surface. Unequal legs. Bad joints. Undercut edges. Porosity of weld. Slag inclusions. Poor penetration. Necessity for cleaning and wire brushing joints. Chipping. Distortion caused by heat of welding, and advantages and disadvantages of this. Dangers and safety precautions. 'First Aid' to injured—B.S. requirements.

OPERATIONS	SKILLS	KNOWLEDGE
	Care, maintenance and efficient use of— helmets, face shields, protective clothing, wire brushes, chipping hammers. clamps, hammers and chisels, electrode holders and earthing systems. Selection and use of electrodes. Selection and use of current and voltage. Positioning materials to be welded. Preparing surfaces to be welded. Deciding sequences of welding. Welding — in horizontal, vertical and overhead positions.	
PROTECTING STEEL AGAINST CORROSION		Causes and effects of rust. Reasons for protection. Methods of de-scaling and preparing steel— pickling, blast cleaning, flame cleaning, wire brushing. Methods of protecting— painting, galvanising, metal spraying.

OPERATIONS	SKILLS	KNOWLEDGE
	Efficient use of chipping hammers, scrapers, wire brushes and oxy-fuel flame. Care and uses of brushes and paints. Care, use and maintenance of blasting equipment. Care, use and maintenance of paint-spraying equipment.	

APPENDIX II

SELECTION AND RECRUITMENT

(a) General

Selection and recruitment are key factors in a training scheme, as the value of the training is lost if it is given to unsuitable trainees. Sufficient trainees should be recruited to fulfil both present and future needs.

(b) Requirements

An apprentice should conform with the requirements of the National Apprenticeship Agreement regarding age and fitness and probation. He should undergo any selection or aptitude test currently agreed in Northern Ireland.

After satisfactory completion of the probationary period the employer should register the apprentice with the National Joint Council for his trade, and the apprentice should be employed under the terms and conditions of the National Apprenticeship Agreement.

(c) Selection

Good selection does not necessarily mean picking the best from a group of applicants—it means picking the right man for the job. Wrong selection is bad for the firm and for the apprentice, so every effort must be made to ensure that the apprentice has the necessary aptitude and right ability for the job and will be happy working in the industry.

(d) Application Form

The use of an application form may often be convenient, and serves as a useful guide to the interviewer to test the accuracy of the detail, and to ask for further explanation as necessary.

APPENDIX III

PERSONAL SPECIFICATION

FACTOR	ESSENTIALS	DESIRABLE	UNDESIRABLE
Physique	Normal good health and fitness. Normal good vision. Normal good hearing. Reasonable appearance, manner and bearing.	—	Allergy to steel materials. Deafness. Poor sight.
Attainments	Educational ability to continue studies in City and Guilds Course to craft level.	Pre-apprentice training or similar experience of work.	—
General Intelligence	Average, in relation to the population as a whole.	—	—
Aptitude	Average in relation to craftsmen.	—	—
Disposition	Reliable, acceptable by other people.	Evidence of leadership.	—
Circumstances	Free to stay away from home for training or work.	—	—
Interests	Practical Constructional.	Creative activity.	—

APPENDIX IV

HINTS ON INTERVIEWING

Sufficient time should be allowed, without interruption or distraction, for a satisfactory interview.

Preparation for an interview involves more than arranging the time and place. The following points are important:

(a) The object of the interview is to assess if the candidate will be suitable for craft training.

(b) The interview should, if possible, be conducted in a place where you cannot be disturbed by the telephone or other interruptions; additional information about the job and the training should be available to pass on to the candidate.

(c) The candidate should be made to feel relaxed; remember he is unlikely to be used to being interviewed, so he will not know what to expect.

(d) The candidate should do most of the talking; volunteered information is usually more reliable than that prompted by the person doing the interviewing.

Interviewing is a difficult technique and careful attention in planning and conducting an interview will result in more relevant and consistent selection. The following general points may be useful:

(i) REMEMBER the main purpose of the interview.

(ii) ESTABLISH right relationship with candidate at the beginning of the interview.

(iii) MAKE SURE that the questions are understood by the candidate.

(iv) AVOID leading questions where the answer is suggested by the question.

(v) BE THOROUGH in exploring the relevant details of candidate's application.

(vi) BEWARE of preconceived opinions.

(vii) REMEMBER that most people have bias and prejudice in one way or another and you should discount this or at least be aware of it.

(viii) BEWARE of the "Halo Effect" where the person being interviewed has the same background or opinions as the interviewer.

APPENDIX V

SPECIMEN APPLICATION FORM

Name.....

Address.....

Date of Birth..... Place of Birth.....

Father's/Guardian's Occupation.....

Education

Schools Attended.....

.....

Examinations Passed/Certificates Taken.....

Examination Results.....

Which subjects did you enjoy most?.....

.....

Health

What is your present state of health?.....

Have you had any serious illness?.....

If so, give details.....

.....

Do you suffer from any physical disabilities?.....

.....

If so, give details.....

.....

Interests

Hobbies, sports, clubs, etc.....

.....

Previous Employment

Name and Address of previous/present employer.....

.....

.....

Live Away from Home

Are you prepared to live away from home during initial training and occasionally during your employment?

Date..... Signature.....

Parent's/Guardian's Signature.....

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ABSTRACT - One of a series prepared by the Construction Industry Training Board to provide training recommendations for building trades occupations, this guide is designed to aid in training civil engineering technicians. Principal features of the program are detailed descriptions of: (1) on-the-job training, including a detailed outline listing subjects to be covered, year and quarter of study, and position of instructor, and (2) technical college training, giving entry requirements, subjects to be covered each year, and information on certification for various levels of training. Recruitment, occupational description, induction training and other general information are covered briefly. Interviewing hints are appended. (AW)

VT 010 219

NORTHERN IRELAND

ED0 45856
VT010219

Construction Industry Training Board

Training Recommendations—Civil Engineering Technicians

RECOMMENDATIONS

JANUARY, 1968

U.S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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CONSTRUCTION INDUSTRY TRAINING BOARD

TRAINING RECOMMENDATIONS– CIVIL ENGINEERING TECHNICIANS

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TRAINING RECOMMENDATIONS—
CIVIL ENGINEERING TECHNICIANS

1. INTRODUCTION

1.1 The purpose of these training recommendations is to specify formal theoretical and practical training suitable for people training as Civil Engineering Technicians.

1.2 The prime object of the training is to provide Civil Engineering Technicians with a high standard of knowledge and skill on a broad basis. It is recognised that trainees may, at a later stage, specialise in particular fields and that further training will be necessary for this development.

1.3 The intention of this booklet is to offer guidance on systematic training for Civil Engineering Technicians. It is not intended that the recommendations be applied as a rigid system, but should be adopted to individual requirements.

1.4 An important aim of any firm must be to secure a proper hierarchy of staff. The ability of staff is wasted if they are allowed or required to carry out activities which could well be done by a less skilled person. The more competent technicians are, the more they can take some of the burden off the fully qualified engineers. Having qualified to an acceptable standard academically whilst "growing up" in the industry, the technician will be capable of accepting responsibility and will make a greater contribution to the industry at an earlier age.

1.5 We need more better educated and well trained personnel to run our projects more efficiently. The industry's affairs make heavy demands on its administration and demand the highest qualifications in those who direct its activities.

1.6 The aim is to develop the qualities which will enable both the trainee and his employer to work towards the same end—the utilisation of his intelligence and experience to the best possible advantage in the appraisal and understanding of the wide variety of activities which constitute the construction industry.

Good training and several years of hard ground work aimed at making the man generally conversant with the industry and its methods is necessary if this result is to be achieved. The end product will be a man who can successfully take on a responsible job at head office or on a site.

1.7 The supply of men capable of filling the more responsible posts in the industry is largely dependent upon:—

(a) recruitment of young men of sufficient calibre and

(b) the provision of suitable opportunities to allow these young men to gain the necessary experience and training.

1.8 There is a growing shortage of such people in the industry and the industry has not yet recruited sufficient young people of the kind needed. Obviously the industry cannot expect to have an adequate supply of technicians tomorrow if it is not prepared to train an adequate number of technicians today.

1.9 One of the main objectives of the Construction Industry Training Board is to ensure that the rhythm of economic growth and technical progress is not retarded by a scarcity of people with the required skills. If the industry is to provide for growth and not wastage alone, it must have a realistic manpower policy based on forecasts of likely developments in the industry.

1.10 The success of any plans, such as are outlined in this booklet, depends upon the personal involvement of top management in training and the appointment of a specific individual within the firm with written terms of reference and a recognisable function of responsibility and authority. This personal involvement of top management must not be passive, but must be seen by all levels of employees to be an essential part of the company policy. Regular assessment of each trainee's capabilities and training needs throughout his career is to the long term advantage of his company in producing the fully-trained man intent upon making his maximum contribution to the firm and the community.

1.11 Every opportunity should be seized to impress upon a boy's parents the value of the training, and to enlist their support.

1.12 Training takes time, uses scarce resources, and is costly. The Board appreciates this and, through the provisions of the Training Grants Scheme, is trying to help and encourage employers who undertake training. Employers are advised to consider the Scheme carefully and to consult Board Officers on how to make best use of available training facilities. The Board is keenly concerned to help raise the standards of training and hopes that these recommendations will meet with a positive response from individual firms.

1.13 The vital importance to the construction industry of effective training is self evident.

As the living standards of the people rise so the calls on the industry inevitably grow. The community is dependent on the industry to provide the new roads, bridges, services, factories, houses, offices, hospitals and other works which are needed.

1.14 The skill and potential of our young people is our greatest asset. Existing training arrangements have served a very useful purpose, but the needs of the industry now demand a more systematic approach to training at all levels. Training is an integral part of industry and the aim should be to raise the standard of training in order to utilise to the maximum the ability of all workers.

2. RECRUITMENT

2.1 To maintain its position it is important that the Industry should recruit young men who have the necessary personal qualities and educational attainments, together with adequate physical ability and fitness.

2.2 A levy is collected from the industry, and from this, grants are paid to firms which encourage training.

Training Grants will obviously be misused, if unsuitable people are recruited and an attempt made to train them.

2.3 Young men being recruited as trainee technicians should be capable of acquiring the knowledge and skill needed for responsible positions in the industry. An adequate standard of general education is needed to provide the breadth of mental outlook on which to build suitable technical training and practical experience.

2.4 Reasonably good health is essential. There should be no physical defects or evidence of chest complaints or rheumatism. The technician must be able to stand for long periods every day and walk distances of up to two miles several times a day.

2.5 Other desirable qualities include:—

(a) good character;

(b) capacity to mix with other members of the industry; to be something of an all rounder—with wide interests;

(c) good work habits;

(d) a sense of responsibility;

(e) a well balanced personality;

(f) willingness to move around;

(g) self reliance and ability to take initative and work Independently, a certain toughness of fibre;

(h) a liking for outdoor life;

(i) an ability to work things out in the mind or on paper— to sift facts to get at the core of a problem;

(j) a questioning and practical turn of mind to appreciate how things go together;

(k) an ability to communicate by writing, or word of mouth in committee and at site meetings.

2.6 As is noted in paragraph 8, the main off-the-job training will be by means of a national certificate course in Construction or in Engineering. The minimum requirements for entry to the national certificate courses are stated in paragraphs 8.5 and 8.6 and these requirements should be looked for from technician entrants to the industry. Employers with well developed staff recruitment schemes should be in a position to attract boys with one or more subjects at 'A' level.

2.7 The main sources of recruitment will be:—

(a) the Youth Employment Service;

(b) local schools through careers masters;

(c) direct applications by boys to individual firms;

(d) local press advertising.

2.8 One of the best methods of recruitment is to establish contact with appropriate local schools and to interest their careers masters in the industry. The best means of doing this is through the local Youth Employment Officer or by personal contact with careers masters, Youth Employment Officers and careers masters may require additional information from the employer on:—

(i) the work of the industry generally;

(ii) the work required of the industry's technicians;

(iii) the training given at technical college and on site;

(iv) the future prospects of the technician;

(v) information about the company concerned.

This knowledge enables them to evaluate and sift the applications thoroughly so that only suitable boys are sent along for interview.

2.9 The interview forms the most important part of the selection procedure and its purpose is twofold:—

(a) to assess whether the candidate is suitable for the job;

(b) to acquaint the candidate with the nature of the job and what will be expected of him.

No punches should be pulled about the nature of the job and the requirements listed above.

Interviews should not be curtailed (serious contenders will require at least 20 minutes each) and it is important to get the candidate to do most of the talking.

2.10 Good selection does not necessarily mean picking the best from a group of applicants—it means picking the right man for the job. The best is often too good for the job and may leave for a better job after training. Wrong selection is bad for the firm and for the trainee, so every effort must be made to ensure that the trainee has the necessary aptitude and the right ability for the job, and will be happy working in the industry.

3. OCCUPATIONAL DESCRIPTION AND SPECIFICATION

To be competent as a fully trained Civil Engineering Technician requires experience and knowledge of the following:—

3.1 **Surveying**

Surveying with chain and tape.

Use and adjustment of surveyor's level.

Use of theodolite.

Preparation of clear and accurate plans.

3.2 **Engineering Quantities**

Taking off quantities from scaled engineering drawings in accordance with standard methods.

Knowledge of mensuration.

Interpretation of civil engineering drawings.

3.3 **Draughtsmanship**

Ability to prepare detailed working drawings from engineers' sketches.

In filling of details and elementary design work.

Ability to produce clear and accurate drawings, layout and lettering.

3.4 **Elements of Design**

Elementary design of civil engineering works.

Elementary graphics, statics, mechanics and hydraulics.

General knowledge of elementary concrete technology.

Ability to prepare neat working sketches for draughtsmen.

3.5 **Soil Testing**

Knowledge of general methods of obtaining samples and of common laboratory tests.

3.6 **Concrete Technology**

Knowledge of bar bending schedules.

Knowledge of the basic principles of quality control of concrete including the selection of materials.

Basic knowledge of British Standards relevant to concrete.

Knowledge of techniques of mixing, placing and curing.

Some knowledge of appropriate field tests.

3.7 **Work Study**

Knowledge of work study investigation, including the appreciation of method study and work measurement, together with knowledge of organisation and methods technique.

3.8 **Testing of Materials, Components and Structures**

Working knowledge of laboratory and field testing techniques for civil engineering materials. Testing structures including pile foundations, loading failure, constant rate-of-penetration tests.

3.9 **Costing and Cost Control**

Knowledge of basic principles of Cost Control and Analysis and Coding of Expenditure in relation to value of work.

Knowledge of Measurement and Valuation for Bonusing.

Appreciation of the use of expenditure graphs, calculations and diagrams.

3.10 **Planning and Programming**

Knowledge of the site organisation and the preparation of the time-tables and time progress schedules and of methods of programming and scheduling construction works.

Knowledge of the resources planning and scheduling method would also be desirable.

3.11 **Human Relations**

Psychology, personality, leadership, discipline, decisions.

Relationship with client, sub-contractors, consultants.

3.12 **Plant**

The necessary knowledge to understand and deploy all plant and machinery on site.

3.13 **Temporary Structures**

Drawing and detailing of temporary structures.

3.14 **Safety**

Safety related to all operations and works.

3.15 **Knowledge of Office Routine**

Payment of wages—invoicing—insurance claims, Working Rule Agreement. Conversant with current Safety and Welfare Regulations. Engagement and discharge. Stores ordering and recording. Types of contracts, I.C.E. general conditions. Methods of payment.

3.16 **Building Construction**

Appreciation of structure and methods of construction.

4. SKILLS AND KNOWLEDGE REQUIREMENT

4.1 Although the skills and knowledge requirement of a Civil Engineering Technician is that he should be competent to carry out the work of a Civil Engineering Technician as detailed above, several years of experience after training will, of course, be necessary before the technician is fully competent to carry out the tasks listed.

4.2 The technician should be essentially a practical man well trained in all aspects of civil engineering, rather than a specialist. He should be capable of taking charge of sections of a large contract with a mimimum of supervision.

4.3 The basic skill requirement is ability to use the tape, theodolite and level when setting out and to be a competent draughtsman, including the ability to prepare simple freehand sketches.

5. DETAILS OF TRAINING PLAN

5.1 A system of training may be:—

(a) a general training throughout the whole period;

(b) initial general training followed by specialised training towards the end of the period; or

(c) specialist training throughout.

5.2 Unless the trainee acquires an appreciation of a wide range of civil engineering activities, his general ability and his chances of passing technician examinations will be reduced. It is hoped that employers will bear in mind the importance of developing as broad an ability as possible. The training would be up to a basic skill and knowledge. On this plateau would be built special knowledge as required.

5.3 All too often technicians under training are treated purely as production workers being taught to use a level and theodolite and then used as much as possible on setting out pegs etc. Trainees for their first year at least should be regarded, to some extent, as supernumerary.

5.4 A training period of four years, under agreement, is recommended.

6. INDUCTION TRAINING

6.1 The trainee should spend the first few days of his training on a planned induction programme designed to make him familiar with the structure of the firm, the nature of the industry, the conditions of employment, the opportunities for practical training and further education, and the first simple jobs which he will asked to do.

6.2 The purpose of Induction Training is to help the trainee settle down in his job as soon as possible, to know what he can expect of the firm, and what it will expect of him. A careful introduction by the employer can help the trainee to develop good habits from the start and encourage him to take pride in his firm and in his work.

6.3 It is essential to bear in mind the great change from school to work and an important aim of induction arrangements should be to facilitate this transition.

6.4 Induction Training should include instruction on safety and should also make clear to whom the trainee is responsible for his work and general behaviour, and to whom he should turn for advice and guidance.

6.5 Induction Training need not be elaborate but it should be carried out on systematic lines and integrated within the overall training programme.

7. TRAINING ON THE JOB

7.1 The technician is essentially a man with practical aptitude and therefore practical training and experience in various fields of civil engineering must form an integral part of his training.

7.2 There is a need to have a plan of the practical training worked out. Too often there is no prior warning that a technician is being moved to another department or site and this is often unexpected. It is very discouraging to the technician and the negation of good training practice.

Many people who have not been properly briefed on the importance of training seem to have great difficulty in finding time to meet the needs of those being trained.

7.3 The list of activities in the Occupational Description and Specification is intentionally extensive and all embracing to show the full range of skill and knowledge which will eventually be required by the fully-trained technician. The amount of importance, and the depth of training, given to the items listed would be a matter for the firm's own decision depending on its organisation and the types of work carried out. It may be necessary, therefore, for certain items to be studied in detail and others either dealt with at appreciation level only or omitted. In such cases these activities can be included in further experience after the initial training period is completed.

7.4 In attempting to organise training it has to be borne in mind that technicians on, for example, a motorway contract may have their workplace varied from day to day.

7.5 Employers should see that young people are given every opportunity to benefit from the skill and experience of staff who have the ability to impart knowledge, and by a suitable variety of work to learn and become skilled in the techniques and procedures used in the industry.

7.6 Trainees should seldom be told just "how" a job is to be done, but also "why" it is done that way.

7.7 The trainee must occupy positions in which he will be confronted with situations of increasing responsibility and which will make progressively greater demands on his abilities so that ultimately he may be able to appreciate and co-ordinate the activities of others.

7.8 If possible, training on-the-job should be planned to bear some relationship to further education, and should have the general objective of meeting the requirements of the job specification in Section 3.

7.9 Training records, even if only in simple form, are essential if any check is to be made on the trainee's progress. Firms should follow guidance given by the Board in Information Bulletin No. 8 in this matter.

7.10 The Board recognises that many small firms in the industry will find it difficult to provide the range of desirable experience because of the

nature of their business. It is hoped, through direct contact between the Board's Training Development Officers and firms, to establish any areas of general deficiency in experience, and to remedy it by specially-mounted short courses or by co-operation with other firms.

7.11 The trainee should be given an appreciation of accuracy when:—

(a) Setting out;

(b) Setting out for drainage;

(c) Steel fixing;

(d) Measuring work for Progress, Payment, Day Works, Cost Bonus and Plant Allocation.

7.12 Leave of absence should be granted to enable the trainee to visit other sites, where work involving special techniques or of special difficulty is in progress, together with visits to quarries, suppliers, etc.

7.13 Overleaf is a schedule of items in which it is suggested that training should be given in the firm at the various stages of the technician's training. No target times have been placed on the various items as it is realised that the range of experience will largely be determined by the range of contracts available. It is hoped, however, that in considering the training of the technician, management will, at the outset, consider this point in relation to the opportunities available.

Subject	Instructor
1st YEAR	
1st Quarter	
Setting up of Theodolite ready for use.	Engineer
Setting up Dumpy Level ready for use.	Engineer
Practice setting up Theodolite and Dumpy Level.	Engineer
Setting out levels under supervision.	Engineer
Collating and preparing setting out information reports.	Engineer
Explanation and demonstration of setting out profiles.	Engineer
Practice setting out profiles.	Engineer
Using Theodolite turn simple angles to produce a straight line.	Engineer
2nd Quarter	
Demonstration and explanation of:—	
Setting out simple curves given control points.	Engineer
Practice setting out simple curves.	Engineer
Elementary tape setting out.	Engineer
Demonstration and practice.	
Explanation and practice of reading elementary drawings.	
3rd Quarter	
Demonstration of plant in operation on Site including work capabilities of each item of plant.	
Practice allocating plant to jobs.	
Practice work of 1st and 2nd quarter.	
4th Quarter	
Explanation of materials used on Site:—	
Rock fill, Hard core, Lean mix, Asphalt dressing, types of pipes used etc.	
Revise and practice 1st, 2nd and 3rd quarters' work.	
2nd YEAR	
1st and 2nd Quarters	
Taking off Quantities	Estimator
Invoicing — Head Office, Sub-contractors, Resident Engineer	Office Manager
Payment — Sub-contractor (advances and full payment), Wages and Bonus, Petty cash vouchers	Site Cashier
Drawings — Drawing of simple temporary structures. Reading more advanced drawings.	Engineer
Stores — Methods of issue and accounting.	Chief Storekeeper
Operator Relations — Working Rule Agreement, Bonus qualifications, Sick pay, Redundancy payments.	Office Manager
Simple programming and progress charts.	Deputy Project Manager

Subject	Instructor
3rd and 4th Quarters	
Revise and execute work of Years 1 and 2.	Under supervision of Senior Engineer
3rd YEAR	
1st Quarter	
Methods of measurement for progress.	Deputy Project Manager
Methods of measurement for costing.	Senior Engineer
Measurement for bonus.	Senior Engineer
2nd Quarter	
Demonstration and explanation of setting out curves using Theodolite.	Senior Engineer
Tacheometrical Surveys (Tips etc.)	Senior Engineer
Installation and practice in the reading of any drawing on site.	Engineer
Instruction on the meaning of Day Works.	Senior Engineer
3rd and 4th Quarters	
Head Office	Assistant Chief Accountant
Accounts Department	
,, ,, Payments	Office Manager
,, ,, General Office	Office Manager
Cost Department	Cost Accountant
Engineering Department—Drawing Office	Chief Engineer
Estimating Department	Chief Estimator
Return to site and revise and practice previous work.	
4th YEAR	
Calculations relating to setting out measurement of Day Works.	Chief Engineer
Steel Fixing, cutting and bending of steel for structural work.	Chief Engineer
Drawing and detailing of temporary structures.	
Allocation of plant and payment for plant.	

8. TRAINING IN THE TECHNICAL COLLEGE

8.1 Technical education should be by day release for one day per week for the full period of the training, together with the prescribed evening classes to permit the trainee to study for national certificates.

Successful students will be awarded the Ordinary National Certificate at the end of the second year and the Higher National Certificate at the end of the fourth year.

8.2 The appropriate Higher National Certificate for civil engineering technicians is the Higher National Certificate in Civil Engineering.

8.3 At the Ordinary National Certificate level the employer and trainee are free to choose between:—

(a) an Ordinary National Certificate in Construction; or

(b) an Ordinary National Certificate in Engineering.

8.4 In the opinion of the Board, the Ordinary National Certificate in Construction is the more appropriate course to meet best the needs of the technician employed in contracting firms.

8.5 **Ordinary National Certificate in Construction** (Two Years, Part-Time)

Minimum Entry Requirements: G.C.E. 'O' level Mathematics plus an appropriate science, plus English (or a subject involving a descriptive use of English), plus one other subject. An appropriate science is G.C.E. Physics, Chemistry, Physics with Chemistry, Applied Mathematics and Mechanics, General Science (provided an acceptable content of Physics and Chemistry is included), Mechanical Science, Building and Engineering Science.

First Year (01)

Construction Technology;
Science;
Mathematics;
Elements of Land Surveying and Construction Drawing;
General Studies (including History of Building and Structure of the Industry).

Second Year (02)

Construction Technology;
Science;
Materials and Structures;
Mathematics;
General Studies.

8.6 **Ordinary National Certificate Course in Civil Engineering** (Two Years, Part-Time)

Minimum Entry Requirements: G.C.E. 'O' level Mathematics plus an appropriate science, plus two other subjects. An appropriate science is G.C.E. Physics, Applied Mathematics, Physics with Chemistry, Mechanics Science (Building and Engineering), Applied Mathematics and Mechanics.

Exemptions are given from parts of the Ordinary National Certificate course to students with certain G.C.E. 'A' level and 'O' level passes.

First Year (01)

Mathematics;
Mechanical Engineering Science;
Electrical Engineering Science:
Physics;
Engineering Drawing;
General Studies.

Second Year (02)

Mathematics;
Applied Mechanics;
Materials and Structures;
Elementary Surveying;
General Studies.

8.7 **Higher National Certificate in Civil Engineering** (Two Years, Part-Time)

Entry qualifications:

(i) Ordinary National Diploma Engineering; or
(ii) Ordinary National Diploma Building or Construction; or
(iii) Ordinary National Certificate Engineering to include Materials and Structures and Elementary Surveying; or
(iv) Ordinary National Certificate Construction to include 02 Mathematics; or
(v) Ordinary National Certificate Building (Structures), plus endorsements for Materials and Structures and Land Surveying.

A.1 Year:

Mathematics I;
Theory of Structures I;
Civil Engineering Construction I;
Soil Mechanics I;
General Studies.

A.2 Year:

Hydraulics I;
Theory of Structures II;
Civil Engineering Construction II;
Public Health Engineering; or
Structural Design and Detail I; or
Engineering Quantities;
General Studies.

Subjects for supplementary certificates:

Mathematics II;
Hydraulics II;
Soil Mechanics II;
Structural Design and Detailing II;
Surveying;
Theory of Structures III;
Properties of Materials.

and, the following if not taken in A.2:—

Engineering Quantities;
Structural Design and Detailing I;
Public Health Engineering;
Surveying.

9. WORK BOOK

It is important that there should be systematic supervision of the training and experience given in the firm and the Board recommends that each trainee should keep a Work Book to record progress, and to give an appraisal of his work during training. A suitable Work Book for this purpose will be available from the Board.

APPENDIX

HINTS ON INTERVIEWING

Preparation for an interview involves more than arranging the time and place and making sure that the candidate knows where to come. The following points are also important:—

(a) The interview should be conducted in a place where you cannot be disturbed by the telephone or other interruptions.

(b) All additional information about the job and its training should be available to pass on to the candidate.

(c) The candidate should be made to feel relaxed and at home; remember he is unlikely to be used to being interviewed, so he will not know what to expect.

(d) Formulate what you are looking for. The completed application form will also probably raise several questions which will need discussion.

(e) It is important to get the candidate to do most of the talking; volunteered information is usually more reliable than that prompted by the person doing the interviewing.

Interviewing is a difficult technique and everyone who carries out interviewing will agree that careful attention in planning and conducting an interview means more accuracy and consistency in selection. The following general points may be useful:—

(i) REMEMBER the main purposes of the interview.

(ii) ESTABLISH right relationship with candidate at the beginning of the interview.

(iii) MAKE SURE that the questions are understood by the candidate.

(iv) AVOID leading questions where the answer is suggested by the question.

(v) BE THOROUGH in exploring the relevant details of candidate's application.

(vi) BEWARE of preconceived opinions.

(vii) BEWARE that most people have bias and prejudice in one way or another and you should discount this or at least be aware of it.

(viii) BEWARE of the "Halo Effect" where the person being interviewed has the same background or opinions as the interviewer.

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Training Recommendations: Apprentice Plumbers.

Construction Industry Training Board, Belfast (Northern Ireland)
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ABSTRACT - One of a series prepared by the Construction Industry Training Board to provide training recommendations for building trades occupations this guide for apprentice plumbers features: (1) general information, (2) objectives of the program, (3) job description, (4) tips on recruitment and selection of apprentices, (5) induction training suggestions, (6) an outline of the training program, and (7) information on grants. Appendixes include an outline of skills and operations to be taught in on-the-job training, a sample application form, hints on interviewing, and a basic outline for first year "off-the-job" training. (AW)

VT010 223

NORTHERN IRELAND

VT010223
ED0 45856

Construction Industry Training Board

Training Recommendations—Apprentice Plumbers

RECOMMENDATIONS

JUNE 1967

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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TRAINING RECOMMENDATIONS— APPRENTICE PLUMBERS

1. GENERAL

1.1 The main object of apprenticeship in the plumbing industry is to train young people to become skilled craftsmen who are capable of performing as wide a range as possible of skilled operations within the framework of the craft. There are certain essential elements of the craft which can be set out in terms of what the apprentice can be taught and these involve—

(*a*) learning each separate skill found in the occupation and acquiring practice and experience on the job until the skills can be applied efficiently in a wide variety of circumstances and without constant and close supervision;

(*b*) gaining technical knowledge which is complementary to those skills and acquiring ability to use this knowledge in conjunction with them;

(*c*) learning to behave in a responsible way in relation to the craft, the employer, the trade union and to the community.

Apprenticeship also aims to encourage in young people the habit of learning and help develop in them a mental flexibility which will help them to adapt to new methods, materials, and techniques which they will meet in the future.

1.2 It has become clear that the traditional method of acquiring skills by standing alongside a skilled man, watching what he does, and taking advantage of any tips he may give, is neither an adequate nor an efficient way to train. The Board believes that training must be systematic. The apprentice should be given the opportunity to acquire the basic skills under expert instruction away from his normal workplace. He should be allowed to attend an allied course of further education at a technical college by day or block release. His work in the firm should be planned to give him as wide a range of experience as possible.

1.3 The recommendations outlined in this booklet prescribe a plan of training which plumbing apprentices in Northern Ireland should follow. They describe the skills which an apprentice should acquire, and how and when he should be taught these skills. The booklet has been prepared after careful investigation by experienced and qualified men with an intimate knowledge of the requirements of the plumbing sector of the construction industry.

1.4 The Board realises that training arrangements on the lines suggested in this booklet will involve cost, and they will, of course, be taken into account in the Training Grants Scheme. Investment in training and apprenticeship is essential and the cost of not investing in them is one that the industry cannot afford in terms of reduced efficiency, increased labour turnover, higher accident rates, greater damage to equipment, poorer industrial relations in the long term.

2. OBJECTIVES

2.1 In general terms the Board has kept in mind the following objectives:

(*a*) A sound recruitment policy which will meet present and future manpower needs in the firm

(*b*) Induction training designed to make the new recruit familiar with the nature of the industry, the conditions of work in which he is employed and his opportunities for training and further education.

(*c*) A systematic programme of practical training and planned experience which will provide the knowledge and basic skills necessary for present employment and a foundation for future training and employment.

(*d*) Release for appropriate courses of further education.

2.2 The Board appreciates that practical effect can only be given to these aims in individual firms in the light of their particular circumstances and conditions. It is also appreciated that small firms may find it difficult to achieve the necessary standards and provide the range of experience without receiving direct help from the Board.

3. JOB DESCRIPTION

3.1 The plumbing apprentice should be trained in the following skills which are essential to his craft, and should be given the technical knowledge which is complementary to these skills.

1. Installing of sanitation systems.
2. Installing water supply to buildings.
3. Installing water tanks.
4. Installing sanitary appliances.
5. Installing hot and cold water systems.
6. Roofwork.
7. Heating installation.
8. Pipe bending.
9. Maintenance and repairs.
10. Safety regulations and working procedures.

4. RECRUITMENT

4.1 General

An apprentice must have reached the age of 16 years, have a healthy physique, and have reached a suitable standard of education to enable him to undertake both theoretical and practical training.

Self-reliance and initiative are other desirable qualities.

4.2 Sources of Recruitment

There is little doubt that the best method of recruitment is to establish contact with appropriate local schools and to interest their careers masters in the industry. The best means of doing this is through the local Youth Employment Officer or by personal contact with careers masters. When approaching Youth Employment Officers or careers masters it is essential that they should be briefed on:

(i) the work of the industry generally;

(ii) the work required of the industry's craftsmen;

(iii) the craft apprenticeship arrangements including the education and training given at Government Training Centres, technical colleges and on site;

(iv) the future prospects of the apprentice;

(v) information about the company concerned.

This knowledge enables them to evaluate and sift the applications thoroughly so that suitable boys only are sent along for interview.

5. SELECTION

5.1 General Principles

Good selection does not necessarily mean picking the best from a group of applicants — it means picking the right man for the job. The best is often too good for the job and may leave for a better job after training. Wrong selection is bad for the firm and for the apprentice, so every effort must be made to ensure that the apprentice has the necessary aptitude and the right ability for the job and will be happy working in the industry.

5.2 Application Form

The use of an application form may often be convenient and serves as a useful guide to the interviewer to test the accuracy of the detail and to ask for further explanation as necessary. A draft form is shown in Appendix II.

5.3 Evaluation

In order to assist in the evaluation of candidates a list of the main relevant factors is set out below. Employers can adapt this to suit their own particular requirements. No candidate can be expected to have all the desired qualities.

(i) Character
- Personal background satisfactory?
- Likely to be honest and hardworking?
- Likely to be dependable and co-operative?

(ii) Personal qualities
- Likely to have the necessary degree of commonsense and initiative?
- Potential chargehand qualities? (Required of roughly one in three apprentices.)
- Able to communicate at required level?
- Willing to travel?
- Willing to work in conditions which are often dirty or unpleasant?

(iii) Physique
- Sufficiently strong and healthy?

(iv) Education
- Sufficient ability in Maths. and English?

(v) Mechanical aptitude
- Liking for working with the hands?

5.4 The Interview

The interview forms the most important part of the selection procedure and its purpose is twofold:

(*a*) to assess whether the candidate is suitable for the job;

(*b*) to acquaint the candidate with the nature of the job and what will be expected of him.

5.5 No punches should be pulled about the nature of the job and the requirements listed in paragraph 5.3 above. In addition, the candidates should be advised of the ultimate terms of employment (viz. the National Apprenticeship Agreement), the probationary period prior to apprenticeship; the apprenticeship indenture itself and the role of the Joint Council.

Interviews should not be skimped (serious contenders will require at least 20 minutes each) and it is important to get the candidate to do most of the talking. Some hints on interviewing are set out in Appendix III.

5.6 **Decision**

When a candidate is assessed as being suitable, it will often be necessary to make an offer of employment on the spot — the offer being to take the boy on for the usual probationary period. In some cases it may be possible to defer a decision so that a choice can be made from a number of candidates deemed to be suitable. Once again, however, it is important to emphasise that the decision should be based on suitability, which does not necessarily mean choosing the 'best' candidates.

6. INDUCTION TRAINING

6.1 The reception of apprentices into employment should be carefully planned, bearing in mind the great change from school to work. The aim of induction arrangements should be to facilitate this transition by assisting the apprentice to settle down in his job as soon as possible. A careful introduction by his employer can help him to develop good habits from the start and to take pride in craftsmanship.

6.2 Arrangements for this introduction need not be elaborate but they should be carried out on systematic lines and integrated within the overall training programme. It is a mistake to assume that induction training is complete at the end of the first few days. Certain items should be covered at the beginning of employment; others may be left until the apprentice has had some experience in the work.

Induction arrangements should deal particularly with —

(*a*) the terms and conditions of apprenticeship;

(*b*) instruction on safety;

(*c*) the rules of the company;

(*d*) the history, organisation and policies of the company;

(*e*) the amenities provided by the company.

They should also make clear to whom the apprentice is responsible for his work and general behaviour, and to whom he should turn for advice and guidance.

7. TRAINING PROGRAMME

7.1 The Training Programme recommended by the Board for plumbing apprentices is described below. It combines the elements of training by expert instruction "off-the-job", associated further education, and planned experience in the firm, in a plan designed to equip the boy with the basic skills early in the apprenticeship, and at the same time makes use of training facilities which are readily available in Northern Ireland.

7.2 **Further Education**

The recommended course is —

City and Guilds of London Institute Course No. 86 Plumbing Craft Practice, If taken in conjunction with the practical Basic Skills Course described below. the apprentice should be able to obtain his Craft Certificate in two years instead of three.

7.3 " Off-the-Job " Training

The Board recommends training " off-the-job " during apprenticeship as follows:

I. 1st Year 9 months Basic Skills Course.

II. 3rd Year 3 months Oxy-acetylene Welding Course.

III. 4th Year 3 months Metal Arc Welding Course.

The Board will arrange to have these courses provided in Government Training Centres and technical colleges in those areas where they can be justified by demand.

I. The apprentice should be nominated to the Board for the Basic Skills Course when he has completed a satisfactory probation period with adequate induction training.

The Basic Skills Course is designed to equip the apprentice with the practical knowledge and basic techniques of his job. It will not make him a fully skilled craftsman. It will, however, provide a sound foundation for the development of skill during the remainder of his apprenticeship. It will also enable him to acquire the habit of safe and efficient working under expert guidance.

II and III. Although the elements of welding techniques are included in the Basic Skills Course, the Board feels that the time to acquire these skills up to the standard required by craftsmen is towards the end of apprenticeship, when the apprentice is thoroughly versed in the other main aspects of his job and is familiar with his work. Both courses are of a highly practical nature, and will also be made available to existing craftsmen in the industry.

7.4 " On-the-Job " Training

Systematic training " on-the-job " is a natural extension of " off-the-job " training, providing the opportunity to develop skills in the work situation. Without a planned and carefully supervised follow-up to the Basic Skills Course to consolidate techniques, the initial advantage of this course may be lost.

Work should be planned to give as wide a variety of experience as possible, and in company only of the most highly skilled craftsmen for the duration of the apprenticeship.

It should be planned if possible to bear some relationship to further education, and should have the general objective of meeting the requirements of the job specification in Section 3.

Training records, even if only in simple form, are essential if any check is to be made on the apprentice's progress. Firms should follow the Board's General Guide in this matter.

The Board recognises that many small firms in the industry will find it difficult to provide the range of experience desired because of the nature of their business. It is hoped through direct contact between the Board's Training Development Officers and firms to establish any areas of general deficiency in experience, and to remedy it by specially mounted short courses or by co-operation with other firms.

A full description is given in Appendix I of the skills and operations which the apprentice should be allowed to practise on site.

7.5 **Plan**

The training programme for the apprentice thus becomes:

	PLANNED EXPERIENCE IN THE FIRM	"OFF-THE-JOB" TRAINING	FURTHER EDUCATION BY DAY RELEASE
1st Year	3 months Induction Training	9 months Basic Skills Course	City and Guilds Course No. 86
2nd Year	12 months	—	City and Guilds Course No. 86
3rd Year	9 months	3 months Oxy-acetylene Welding Course	City and Guilds Course No. 86 (if required)
4th Year	9 months	3 months Metal Arc Welding Course	—
5th Year	12 months	—	—
Total	45 months	15 months	

Details of the Basic Skills Course are given in Appendix IV.

7.6 **Supervision of Training**

The implementation of the Training Recommendations should be the responsibility of a senior member of the firm. He must be fully aware of their importance both to the firm and the boy. He should ensure that a periodic check is made on the apprentice's progress, and should take steps to counter any tendency towards too narrow a range of experience.

8. GRANTS

8.1 Grants are available from the Board for all the courses in the Training Programme. Full details are given in the Training Grants Scheme.

9. CONCLUSIONS

9.1 The training which this booklet advocates is within the reach of every firm, whatever its size or organisation. The practices have been tried and proven. Technical colleges have shown clearly over many years how invaluable further education is to the craftsmen. More recently it has been demonstrated how effective systematic training given to craft apprentices in Government Training Centres and technical colleges can be. The Board is anxious to raise the overall quality of skill in the industry and hopes that these recommendations will meet with a positive response from individual firms.

APPENDIX I

"ON-THE-JOB" TRAINING

Listed below are the skills and operations in which the apprentice should gain experience under site conditions. This experience should be gained under the supervision of a first class journeyman who has the ability to instruct and the right temperament for working with young people.

No target times have been placed on the various skills, as it is realised that the range of experience will largely be determined by the range of contracts available. Again the abilities and aptitudes of apprentices will differ and variations should be made to take this into account. These are guide lines only to indicate the facets of experience which the apprentice should have.

The value of the Basic Skills Course will only be fully realised if the experience on site is planned to allow the boy to consolidate the techniques which he learned under intensive instruction. Site experience should be systematically planned and this means a written programme. It need not be elaborate but should provide a simple record of progress.

SKILLS	OPERATIONS
1. Installing of Sanitation Systems	
(*a*) Setting out, fitting, and fixing supporting brackets for pipework.	(*a*) Making brackets.
(*b*) Installation of sanitation systems in — (1) Cast iron. (2) Plastic. (3) Asbestos. (4) Copper pipe, including cutting and jointing.	(*b*) Installing — Two pipe, One pipe, Single stack drainage systems.
(*c*) 1. Connecting pipework to sanitary appliances. 2. Connecting lead pipe to W.C. and soil stack using brass ferrule and wipes joint.	(*c*) Connecting soil, vent and waste pipes to soil stacks and sanitary appliances.
(*d*) Connecting soil and waste stacks to underground drainage systems.	(*d*) Connecting soil and waste stacks to — 1. Septic tanks. 2. Sewerage ejectors.
(*e*) Setting out and laying underground drainage systems in cast iron, glazed earthenware and plastic piping.	
(*f*) Testing soil pipe systems.	(*f*) Testing pipe systems with — 1. Smoke. 2. Water. 3. Air pressure.
2. Installing water supply to buildings	
(*a*) Installation of water mains in — 1. Cast iron. 2. Plastic. 3. Asbestos, including jointing with patent joints and caulked lead joints.	(*a*) Jointing water main piping. 1. Cast iron — Caulked lead joint. Patent joint. 2. Plastic — Rubber ring joint. Paste joint. 3. Asbestos — Patent joint

SKILLS	OPERATIONS
(*b*) Fixing fittings to water mains.	(*b*) Fitting — Sluice valves. Fire hydrants. Water meters. Fire loops. Mains ferrule.
(*c*) Installation of service pipes in — 1. Copper. 2. Plastic. 3. Lead.	
(*d*) Connecting service pipes to — 1. Drinking water points. 2. Storage tanks.	(*d*) Installation of service pipe from stopcock to storage tanks with drinking water connections.
(*e*) Fitting pressurising sets and pumps.	(*e*) Fitting pressurising sets and pumps to supply from wells and main.
3. Installing water storage tanks	
(*a*) Installation of water storage tanks and cisterns, including — 1. Drilling for and fitting tank connections. 2. Connecting pipes to tanks. 3. Fitting and connecting ball valves.	(*a*) Installation of storage tanks and cisterns of— 1. Galvanised steel. 2. Asbestos. 3. Plastic. Fitting B.S.S. — Portsmouth. Croydon. Equilibrium ball valves.
(*b*) Erection of sectional storage tanks.	(*b*) Erection of cast iron and steel sectional storage tanks.
4. Installing sanitary appliances	
(*a*) Fitting and fixing supporting brackets for sanitary appliances.	
(*b*) Fitting and fixing — Baths. Shower trays. Sinks. Basins, including fitting and fixing of— Taps. Waste and overflow fittings.	(*b*) Fitting and fixing — Foot baths. Bidets. Slop sinks. Drinking fountains. Hospital appliances.
(*c*) Fitting and fixing — Sanitary appliances, including Water closets and urinals,	(*c*) Fitting leadtrays, Under shower trays, Urinals.
(*d*) Fitting and fixing — Flushing and Syphonic cisterns and flushing valves.	(*d*) Fitting and fixing Automatic flushing cisterns and sparge pipes. Flushing valves, complete with pipework and tanks.
(*e*) Connecting — Supply. Waste. Overflow and vent pipes to fittings.	

SKILLS	OPERATIONS
5. Installing hot and cold water supply systems	
(*a*) Installation of copper pipe systems, including jointing with — 1. Compression fittings. 2. Capillary fittings. 3. Brazed joints.	
(*b*) Installation of — 1. Back boilers. 2. Independent boilers. 3. Water storage tanks and cisterns. 4. Hot water storage cylinders. 5. Pumps.	(*b*) Installation of direct and indirect hot water cylinders. Fitting circulating pumps on hot water circuits.
(*c*) Connecting pipework including control valves to: Boilers, Cylinders, Tanks, Pumps and Fixtures.	(*c*) Fitting — Control valves and thermo-static controls to pipework. Installation of — Oil burners. Oil storage tanks. Automatic stokers. Fuel hoppers. Flues and flue equipment.
(*d*) Pressure testing, venting and balancing hot water supply systems.	
(*e*) Installation of — Water heaters. Immersion heaters.	(*e*) Installation of — Pressure type heaters, Non-pressure type heaters, Single point type heaters, Multi-point type heaters. Drilling cylinders and tanks and fitting immersion heaters.
6. Roofwork	
(*a*) Covering roofs in — Copper or Aluminium or Lead, including flashings at weatherings and chimneys.	(*a*) Covering roofs in — Copper and Aluminium seam jointing as follows: Standing seam, Conical roll, Batten roll. Covering in lead — Flats and projections.
(*b*) Fitting and fixing — Copper, Aluminium or Lead in — Flashings and weatherings to roof projections. Coverings and weatherings to dormer lights. Canopies. Expansion joints.	(*b*) Making and fitting — Front aprons, Back gutters, Stepped flashings, Straight flashings, Soakers, Lead slates, Drop nozzle outlets, Parapet outlets.
(*c*) Laying and fixing — Copper, Aluminium or Lead in — Valleys and gutters.	

SKILLS	OPERATIONS
(*d*) Making and fitting — Copper, Aluminium or Lead Roof outlets.	(*e*) Fixing — Cast iron, copper and plastic — Rainwater pipes, Gutters, Hopper heads.
(*e*) Fixing — Metal or plastic rainwater pipes or gutters.	
7. Heating Installation	
(*a*) Installation from drawings of heating systems, including small bore systems in — Mild steel piping with Screwed joints, Welded joints.	(*a*) Pipe threading using stocks and dies. Pipe jointing using oxy-acetylene plant.
(*b*) Installation from drawings of small bore heating systems in — Copper piping.	(*b*) Installation of — Copper and mild steel piping in — 1. One or two pipe heating systems. 2. Combined heating and hot water systems.
(*c*) Fitting — Steel panel, and cast iron radiators and convector heaters.	(*c*) Fitting — Heating coils and underfloor heating systems.
(*d*) Installation of boilers, including assembly of sectional boilers.	(*d*) Installation of boilers, including fitting — Flow and return pipes, Cold feeds to boilers, Expansion pipes, Flue pipes, Circulating pumps.
(*e*) Installation of — Oil burners and other equipment required for the fueling of boilers.	(*e*) Installation of — Automatic stokers, Fuel hoppers, Oil tanks.
(*f*) Testing completed heating systems.	(*f*) Testing and balancing heating and hot water supply systems.
8. Pipe Bending	
(*a*) Bending — Copper, Steel, Lead and Plastic to form — Bends, Offsets and Sets.	(*a*) Bending copper pipes using — Springs, Sand and Bending machine. Bending lead pipes using — Bobbins, Sand. Bending plastic pipes using — Springs, Sand.
(*b*) Prefabricating pipework for ducts and boilerhouse work.	(*b*) Forming knuckle bends on lead pipe.

SKILLS	OPERATIONS
9. Maintenance and Repair Work	
(*a*) Replacing defective plumbing appliances.	
(*b*) Repairing burst pipes.	(*b*) Wiping joints on lead pipe.
(*c*) Re-washering and repairing taps	(*c*) Re-packing — Taps, Valves, Pumps.
(*d*) Repairing and replacing defective roof coverings.	(*d*) Wiping cracks on lead roof work.
(*e*) Clearing blocked drains and pipes.	(*e*) Clearing blocked drains and pipes with — Rods, Pressure pumps, Springs.
10. Welding and Brazing	
(*a*) Use of oxy-acetylene equipment for — 1. Lead burning. 2. Brazing copper pipe and brass fittings. 3. Welding mild steel. 4. Use of cutting torch.	(*a*) Lead burning of pipe and sheet lead. Brazing copper pipe to form — Butt joints, Bell joints, Branch joints. Brazing copper pipe to brass fittings. Welding steel pipe to form — Butt welds, Branch welds, Welding steel pipe to flanges. Oxy-acetylene cutting torch for cutting — Steel piping, Steel plate.
(*b*) Use of electric welding plant.	(*b*) Electric welding plant for welding pipe and fabricating brackets.
11. Industrial Pipework and Equipment	
(*a*) Installation of industrial pipework and equipment.	(*a*) Installation of pipes for — Air, Oil, Gas and steam. Installation of steam boilers — Canteen equipment, Laundry equipment.

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APPENDIX II

APPLICATION FORM

Surname .....

Christian Names.....

Address .....

.....

Date of Birth .....

Father's/Guardian's Occupation .....

EDUCATION

Schools attended since age of 11 .....

.....

.....

.....

Which subjects did you enjoy most .....

.....

.....

Results of any examinations taken.....

.....

HEALTH

What is your present state of health.. .....

Have you had any serious illness .....

If so, give details .....

Do you suffer from any physical disabilities.....

If so, please give details .....

Do you suffer from any chest troubles — such as Asthma .....

If so, please give details .....

INTERESTS

Hobbies, Sports, Clubs, etc. .....

.....

APPENDIX III

HINTS ON INTERVIEWING

Preparation for an interview involves more than arranging the time and place and making sure that the candidate knows where to come. The following points are also important:

(*a*) The interview should, if possible, be conducted in a place where you cannot be disturbed by the telephone or other interruptions.

(*b*) All additional information about the job and the training should be available to pass on to the candidate.

(*c*) The candidate should be made to feel relaxed; rememember he is unlikely to be used to being interviewed, so he will not know what to expect.

(*d*) Formulate what you are looking for. The completed application form will also probably raise several questions which will need discussion.

(*e*) The candidate should do most of the talking; volunteered information is usually more reliable than that prompted by the person doing the interviewing.

Interviewing is a difficult technique and careful attention in planning and conducting an interview will result in more accuracy and consistency in selection. The following general points may be useful:

(i) REMEMBER the main purposes of the interview.

(ii) ESTABLISH right relationship with candidate at the beginning of the interview

(iii) MAKE SURE that the questions are understood by the candidate.

(iv) AVOID leading questions where the answer is suggested by the question.

(v) BE THOROUGH in exploring the relevant details of candidate's application.

(vi) BEWARE of preconceived opinions.

(vii) REMEMBER that most people have bias and prejudice in one way or another and you should discount this or at least be aware of it.

(viii) BEWARE of the "Halo effect" where the person being interviewed has the same background or opinions as the interviewer.

APPENDIX IV

BASIC SKILLS COURSE

FIRST YEAR "OFF-THE-JOB" TRAINING

The following is the programme of training which first-year apprentices will follow in the Training Centres under the Board's training scheme. Times are approximate and the training will be co-ordinated with the further education syllabus, which will be followed by means of day release.

Training will be supported by visits to sites and project work where possible.

Syllabus Items	Training	Approximate duration in training weeks of 4 days each
GENERAL	Workshop rules and routine. Personal cleanliness and hygiene. The need for safety at all times. Training for safety to be a continuous process. Fire hazards and precautions. Simple first aid	***
TERMINOLOGY	Terms relative to materials, equipment and components	***
PROPERTIES OF METALS	Elementary appreciation of the characteristics and uses of ferrous and non-ferrous metals	***
GENERAL WORKSHOP PRACTICE	The use of hand tools, and their care and maintenance. Basic fitting exercises, cutting and filing mild steel to accurate sizes and shapes. Elementary exercises in sheetmetal work, cutting and shaping to given dimensions	5 weeks
PIPEWORK	The preparation and wiping of joints on lead pipes up to 1½" diameter by any recognised method to include branch, underhand and upright joints, non-positional lead-welding joints on lead pipes up to 1½" diameter ..	4 weeks
	Bending of light gauge copper tubes up to 1¼" diameter by any recognised method. Use of capillary and compression joints and fitting to fixed dimensions	2 weeks
	Bronze welding and brazing of copper tubes to form branch or straight joints up to 1½" diameter	2 weeks
	Bending of mild steel tube up to 1½" diameter by any recognised method ..	1 week

Syllabus Items	Training	Approximate duration in training weeks of 4 days each
	Cutting, screwing, jointing and fitting to fixed dimensions of mild steel tube up to 1½″	2 weeks
	Manipulation, jointing and fixing of plastic pipes up to 4″ diameter. Jointing methods restricted to compression, fusion, solvent-cementing and socket forming	1 week
	Gas welding of mild steel non-positioning exercises of ⅛″ thickness sheet or strip ..	2 weeks
	Installation, fixing and supporting of pipe-work to all types of background including connections to appliances. Pressure testing of installations	2 weeks
SHEETWORK	The following roof weatherings and coverings are to be executed in the following materials where appropriate: Sheet Lead, Sheet Copper, Sheet Aluminium, Non-metallic flexible sheeting (other than bituminous felt).	
	The preparation and formation of solid rolls, standing seams, single and double welts and drips	1 week
	Working the ends of solid rolls, standing seams, single and double welts and drips ..	2 weeks
	Setting out and fixing all types of flashings, the preparation and fixing of soakers ..	2 weeks
	Chimney aprons and gutters; ridge and hip pieces, weathering of pipes passing through roofs including the formation of internal and external angles and corners	2 weeks
	The covering of canopies, bay window and dormer tops, dormer cheeks and sills ..	1 week
	Preparation and welding of butt and lapped lead seams in horizontal and inclined planes	1 week

Syllabus Items	Training	Approximate duration in training weeks of 4 days each
	The setting out and fabrication by welding of sheet lead aprons, sills, gutters, cesspools, chutes and small cisterns	2 weeks
	The use of bituminous adhesives, sealing compounds and laminated joints in non-metallic flexible sheetings	1 week
PRELIMINARY TRAINING IN THE INSTALLATION OF HOT AND COLD WATER SUPPLY SYSTEMS	(*a*) Installation of copper pipe systems including jointing with — 1. Compression fittings. 2. Capillary fittings. 3. Brazed joints. (*b*) Installation of — 1. Back boilers. 2. Independent boilers. 3. Water storage tanks and cisterns. 4. Hot water storage cylinders. 5. Pumps. (*c*) Pressure testing, venting and balancing hot water supply systems. (*d*) Methods of locating and rectifying faults.	4 weeks

*** Instruction will be given in these subjects throughout the training period.

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ABSTRACT - One of a series prepared by the Construction Industry Training Board to provide training recommendations for the building trades occupation of scaffolder. This guide for training scaffolders includes: (1) an outline of the training program, including aspects of training, length of time recommended for each aspect, and general information, and (2) basic skills courses for beginning and advanced scaffolders and scaffolder charge-hands, listing skills and abilities to be acquired in each course. Objectives, recruitment, on- and off-the-job training, induction, training records, job description, and grants are also covered briefly. Interviewing hints and personal trainee qualifications are appended. (AW)

VT 010 235

NORTHERN IRELAND

ED0 45856

Construction Industry Training Board

Training Recommendations Scaffolders

RECOMMENDATIONS

NOVEMBER, 1968

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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CONSTRUCTION INDUSTRY TRAINING BOARD

TRAINING RECOMMENDATIONS— SCAFFOLDERS

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TRAINING RECOMMENDATIONS—
SCAFFOLDERS

1. INTRODUCTION

1.1 It has become clear that the traditional way of acquiring skills by watching and copying another man is not now adequate or efficient. It would obviously be of considerable benefit to the industry if all operatives could be brought up to the standard of the best in the industry. The training outlined in these recommendations aims to produce a competent operative at an economic cost.

1.2 The Construction Industry Training Board was set up to help employers improve training at all levels.

2. TRAINING RECOMMENDATIONS

2.1 Training recommendations set out how systematic training can ideally be achieved showing where and how training should be given. These training recommendations have been prepared by the Board, in conjunction with the industry, and are based on a careful examination of the separate skills of and knowledge required by an operative. Employers are expected to implement the recommendations as fully as possible within the scope of the firm's activities.

3. OBJECTIVES OF RECOMMENDATIONS

3.1 The objectives of the recommendations are to achieve in the industry –

(a) A sound recruitment policy;

(b) A systematic programme of induction and practical training, both "on-the-job" and "off-the-job", to achieve planned progressive experience;

(c) Release from employment for associated further education, where applicable;

(d) Acceptance of responsibility for training by a principal, or a senior member of management.

4. RECRUITMENT

4.1 A sound recruitment policy is necessary if the industry is to have the manpower it requires. Employers should, therefore, ensure that sufficient numbers of suitable trainees enter employment each year. Advice on recruitment is given in Appendix 2. A personal specification is given in Appendix 3.

5. INDUCTION

5.1 The induction programme is the first part of industrial training. Its purpose is to help the trainee to settle down in his job as soon as possible. A trainee's initial period of employment should be carefully planned. Induction arrangements should deal particularly with –

(a) the objects of the firm, its conditions of employment, the relevant trade unions and welfare arrangements;

(b) general safety precautions and safety aids (e.g., helmets, goggles, boots, etc.) observed on sites and in workshops; use of ladders, scaffolding, tools, machinery, electrical installations, fire;

(c) name, use and care of tools;

(d) recognition of basic materials;

(e) the opportunities for training; and

(f) the importance of good workmanship and productivity.

5.2 It should be made clear to whom the trainee is responsible for his work and general behaviour and to whom he should turn for advice and guidance.

6. "OFF-THE-JOB" TRAINING

6.1 "Off-the-job" training is practical training given away from the trainee's normal work place.

6.2 The Board recommends that a trainee should follow an "off-the-job" Basic Skills Course for a period which is designed to equip him with the practical knowledge and basic techniques of his occupation. This training allows the trainee to acquire skill more quickly than on site. This will not make him a fully skilled operative, but it will provide a sound foundation for his further development of skill during the remainder of his training. It will also enable him, under expert guidance, to acquire the habit of safe and efficient working.

6.3 The trainee should be nominated to the Board for this course when it has been confirmed that the man is satisfactory to train.

6.4 The basis of the syllabus for the "off-the-job" Basic Skills Course is as shown in Appendix 1 (pages 11–12).

7. "ON-THE-JOB" TRAINING

7.1 This is the training given on site during the remainder of training while on productive work. The training should be progressive and under the supervision of a suitably qualified person.

7.2 Work "on-the-job" should be planned to give, where possible, a wide variety of experience in the company as set out in the job description.

7.3 When a trainee is set a task, he should be given –

(a) adequate instructions with drawings or sketches as appropriate;

(b) guidance on the economic use of materials;

(c) an indication of the quality standards required;

(d) the estimated completion time;

(e) instruction in the care of tools and materials.

8. ASSOCIATED FURTHER EDUCATION

8.1 Associated further education is technical instruction on a day release or number of weeks block release basis.

8.2 The employer should consider some form of further education which would be valuable. The Board's officers would be glad to assist.

8.3 Progress reports from the college are sent to the firm which should discuss them with the operative regularly.

9. ESSENTIAL ELEMENTS IN TRAINING

9.1 Responsibility for training should be accepted by a principal or a senior member of management who should ensure that the trainee –

(a) learns each separate skill of the occupation quickly and practises it by experience on the job, until the skills can be applied efficiently in a wide variety of circumstances, without close supervision;

(b) acquires and uses the technical knowledge which is complementary to those skills;

(c) develops mental flexibility to adapt to new methods, materials and techniques;

(d) appreciates other skills with which he may come in contact;

(e) gets continuous assessment during training (appendix 6 shows the "Test").

9.2 Overall the firm should develop the character of the trainee so that he will become a responsible operative and a good citizen.

10. RECORDS OF TRAINING

10.1 Records of training of all employees for whom grants will be claimed must be kept on form T.R.1 or other suitable record, and be open to inspection by the Board's representatives who will have the right to examine any relevant records to substantiate a claim for grants. Supplies of form T.R.1 are available from the Board on request.

11. GRANTS

11.1 The cost of the training described in these recommendations is recognised and the Board's Training Grants Scheme is designed to assist employers financially. In this respect employers are advised to study the scheme and consult the Board's officers about the scheme and on the implementation of the Training Recommendations.

11.2 All claims for grants must be received by the Board by the 31st March after the end of each training year as claims received after this date will not be considered for grant purposes.

11.3 The Board may withhold or reduce grants if it is not satified that adequate training is being given.

11.4 In all cases, grants are payable to the employer and not to the trainee.

12. JOB DESCRIPTION

12.1 The trainee should be given experience in the following operations within the ability of the firm and should be given the opportunity to acquire the complementary technical knowledge.

SCAFFOLDER

Loading and unloading scaffolding materials from vehicles.

Carrying tubes, planks and fittings from the unloading place to required position on the site and on scaffolding.

Sorting out and stacking fittings.

Handing-up fittings as required.

Hauling-up fittings and tubes by use of rope and gin wheel.

Erection and placing of ladders as directed.

Collecting and stacking materials during dismantling.

Setting out sole plates and base plates as directed by the charge-hand.

Measuring of distances required by use of rule.

Erecting of standards (vertical tubes) on base plates.

Adjusting standards to vertical by use of bubble level.

Fitting all different types of fittings as required, by use of podger, swing-over spanner or open-ended spanner.

Fitting of ledgers (horizontal tubes) including levelling by use of bubble level.

Fitting of transom and braces (rakers).

Fitting of boards during course of erection.

Fitting of boards as working platforms, including toe-guards.

Fitting guard rails, guards and sign boards.

Climbing up and down scaffolds.

Inspecting tubes and boards and fittings for serviceability.

SCAFFOLDER CHARGE-HAND

The scaffolder charge-hand should have the knowledge and skills of a scaffolder, to which should be added:

Planning the erection of scaffolds as required by the supervisor.

Measuring out and marking the positions on which scaffolds are to be erected.

Directing and controlling the work of the scaffolder and scaffolder's labourer in the erection of scaffolds.

Positioning and marking off tubes and fittings for erection of scaffolds.

Reading drawings of scaffolds.

Inspecting scaffolds after erection to ensure compliance with safety and other regulations.

Inspecting roof and building structures for suitability for erection of scaffolds or tying in of scaffolds.

Liaison with site agents and other construction industry personnel necessary for the erection of scaffolds.

13. TRAINING PROGRAMME

13.1 The training programme was compiled from a study of the operations of the job.

Aspect of Training	*Period*	*Remarks*
Selection and Recruitment		The minimum age of employment in scaffolding should be 18 years (See "Personal Specification" in Appendix 3 for requirements).
Induction Training	Approximately 3 months "on-the-job"	A trainee should be employed as a labourer for approximately 3 months on scaffolding work to familiarise him with the nature of the work and show his potential to benefit from further training.
Scaffolder Part I course	2 weeks "off-the-job" training	Having completed induction training satisfactorily — or otherwise shown that he can benefit from further training – a trainee should attend the Part I scaffolder course (see Appendix I).
Planned Experience	Minimum of 6 months "on-the-job" training	Following the Part I scaffolder course a trainee should have the opportunity to practise what has been taught on the course.
Scaffolder Part II course	2 weeks "off-the-job" training	A man who has attained a suitable standard of competence and has the ability to benefit from training should attend a Part II scaffolder course (see Appendix 1).

(continued on page 10)

13. TRAINING PROGRAMME (*continued*)

Aspect of Training	*Period*	*Remarks*
Planned Experience	Several months	Following the Part II scaffolder course a trainee should have the opportunity to practise what has been taught on the course.
Charge-hand/ supervisor	1 week "off-the-job" training	A scaffolder who has demonstrated ability for further progress to become a charge-hand or supervisor should attend a charge-hand course (see Appendix 1).

APPENDIX 1.

BASIC SKILLS COURSES FOR "OFF-THE-JOB" TRAINING

Course for Scaffolders (Part I)

Unloading and loading lorries or other vehicles.

Handling and fitting of fittings.

Use of podger and swing-over spanner.

Handling of boards and tubes and methods of lifting heavy weights.

Erection of simple scaffolds and frame scaffolds, including an independent scaffold near a building, a trussed (jib) scaffold, ladder stagings, builders hoist, bridge, and shoring for a concrete flat roof.

Material requirements for simple scaffolds.

Movement of materials to positions required on site, and stacking.

Types and handling of tubes and fittings.

Types of scaffolds and rules for scaffold construction.

Sorting and inspecting boards and fittings for effective use.

Fixing gin wheel, methods of slinging, tying and off-loading.

Fixing and lashing of ladders.

Methods of overcoming obstacles.

Site hazards.

Building Regulations as applied to scaffold erection and the job of a scaffolder.

Course for Scaffolders (Part II)

Further experience in the handling of fittings, tubes and boards for the erection of the following complex types of scaffold –

- Line crossing with towers.
- Cantilever scaffold.
- Trussed (jib) scaffold.
- Shoring scaffold.
- Masts.
- Shoring frame.
- Suspended scaffold.
- Slung scaffold.
- Cradle.
- Erection of towers with anchorages and guy wires.

Practical examples of overcoming obstacles to scaffold erection.

Course for Scaffolder Charge-Hand

Planning the erection and layout of all types of scaffold, i.e., putlog, light independent, general purpose independent, heavy duty independent, birdcage, mobile and fixed towers, hoist towers, frame, slung, trussed, suspended, shoring, etc. scaffold.

Correct methods of fitting all types of fittings and their use in the construction of various types of joints.

Correct methods of tying scaffolds to buildings and other structures and of overcoming obstacles to erection.

Correct safe working methods for the erection of all types of scaffold.

Local authority rules for the erection of scaffolds on pavements and for lighting of scaffolds.

Building regulations for scaffold erection and methods of ensuring compliance by other persons.

Correct methods of dismantling scaffolds, by lifts and vertical slices.

Inspection procedures for scaffolds.

Knowledge of British Standard Code of Practice for erection of scaffolds of different weight bearing requirements.

The course should also include practical rules for the:

Strength requirements for board, tubes and fittings.

Methods of fixing sheeting to scaffolds and the additional strength requirements when this is done.

Construction and use of prefabricated beams.

Construction and erection of line crossings.

Material requirements for different types and sizes of scaffolds.

Conventions of drawings for scaffolds.

Normal construction methods for typical roofing.

Simple rules of labour organisation.

General understanding of construction industry organisation and practice.

Basic rule of human relations.

This course should include practical work in the application of the knowledge and rules set out in the above.

APPENDIX 2

SELECTION AND RECRUITMENT

(a) General

Selection and recruitment are key factors in a training scheme, as the value of the training is lost if it is given to unsuitable trainees. Sufficient trainees should be recruited to fulfil both present and future needs.

(b) Requirements

A trainee should undergo any selection or aptitude test currently agreed in Northern Ireland.

(c) Selection

Good selection does not necessarily mean picking the best from a group of applicants – it means picking the right man for the job. Wrong selection is bad for the firm and for the trainee, so every effort must be made to ensure that the trainee has the necessary aptitude and right ability for the job and will be happy working in the industry.

(d) Application Form

The use of an application form may often be convenient, and serves as a useful guide to the interviewer to test the accuracy of the detail, and to ask for further explanation as necessary.

PERSONAL SPECIFICATION

APPENDIX 3.

Factor	*Essentials*	*Desirable*	*Undesirable*
Physique	At least 18 years of age. Normal good health and fitness. Normal good vision. Normal good hearing. Reasonable appearance. manner and bearing.	—	**Vertigo.** Allergy to building materials. Deafness. Poor sight. Muscular or chest ailment.
Attainments	Able to read and write legibly and count accurately.	—	—
General Intelligence	Average, in relation to other operatives.	—	—
Aptitude	Average, in relation to general construction operatives in climbing and and handling tools.	Above average in climbing.	—
Disposition	Reliable, acceptable by other people.	Evidence of leadership.	—
Circumstances	Free to stay away from home for training or work.	—	—
Interests	Outdoor activities.	Creative activity.	—

APPENDIX 4.

HINTS ON INTERVIEWING

Sufficient time should be allowed, without interruption or distraction, for a satisfactory interview.

Preparation for an interview involves more than arranging the time and place. The following points are important –

(a) the object of the interview is to assess if the candidate will be suitable for operative training;

(b) the interview should, if possible, be conducted in a place where you cannot be disturbed by the telephone or other interruptions; additional information about the job and the training should be available to pass on to the candidate;

(c) the candidate should be made to feel relaxed; remember he is unlikely to be used to being interviewed, so he will not know what to expect;

(d) the candidate should do most of the talking; volunteered information is usually more reliable than that prompted by the person doing the interviewing.

Interviewing is a difficult technique and careful attention in planning and conducting an interview will result in more relevant and consistent selection. The following general points may be useful:

(i) REMEMBER the main purpose of the interview;

(ii) ESTABLISH right relationship with candidate at the beginning of the interview;

(iii) MAKE SURE that the questions are understood by the candidate;

(iv) AVOID leading questions where the answer is suggested by the question;

(v) BE THOROUGH in exploring the relevant details of candidate's application;

(vi) BEWARE of preconceived opinions;

(vii) REMEMBER that most people have bias and prejudice in one way or another and you should discount this or at least be aware of it.

(viii) BEWARE of the "Halo Effect" where the person being interviewed has the same background or opinions as the interviewer.

APPENDIX 5.

SPECIMEN APPLICATION FORM

Name .....

Address.....

Date of Birth..... Place of Birth.....

Father's/Guardian's Occupation.....

Education

Schools Attended.....

.....

Examinations Passed/Certificates Taken.....

Examination Results.....

Which subjects did you enjoy most?.....

.....

Health

What is your present state of health?.....

Have you had any serious illness?.....

If so, give details.....

Do you suffer from any physical disabilities?.....

If so, give details.....

.....

Interests

Hobbies, sports, clubs, etc.....

Previous Employment

Name and Address of Previous/Present Employer.....

.....

Live Away from Home

Are you prepared to live away from home during initial training and occasionally during your employment?

Date..... Signature.....

Parent's/Guardian's Signature .....

APPENDIX 6.

THE TEST

Continuous Assessment

The main objective of this training scheme is to enable trainees to reach the experienced worker's standard of output, quality and safety, as quickly as possible. All training, therefore, should aim at this standard, and in order to achieve this, each individual's performance should be subject to continuous assessment throughout the scheme.

Certificates of Training

Certificates of Training will be issued after each "off-the-job" training course showing the activities and various types of scaffolding in which men have been trained. Individual companies should then see that men are given an extended practice in these activities so that the desired experienced worker's standard may be attained.

VT 010 245
Introduction to Automatic Data Processing; A Suggested Adult Course Outline.

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ABSTRACT - This course outline is for teacher use in introducing adults to the use of automatic data processing equipment. An advisory committee developed the scope of the course from which this guide was written by a staff of business and distributive education personnel. In addition to developing a basic understanding of automatic data processing and of the data flow through electromechanical and electronic systems, the course should also suggest the social implications of automatic data processing, and motivate adults toward further training. Fifteen sessions are needed to cover the eight lessons, which are: (1) Introduction to Data Processing, (2) The Punched Card, (3) The Punched-Card Data Processing System, (4) Electronic Data Processing Systems, (5) Designing, Programming, and Using an Electronic Computer System, (6) Computer Uses, (7) Recent Developments, and (8) The Impact of Computers on Our Society. Each lesson gives objectives, content outline, and teaching suggestions and references. Ten masters for transparencies, a bibliography, and a list of sources of audiovisual aids are appended. (GR)

VT010 245

ED0 45856

INTRODUCTION TO AUTOMATIC DATA PROCESSING.

A Suggested Adult Course Outline

THE UNIVERSITY OF THE STATE OF NEW YORK
THE STATE EDUCATION DEPARTMENT
BUREAU OF CONTINUING EDUCATION CURRICULUM DEVELOPMENT,
ALBANY, NEW YORK 12224
1968

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FOREWORD

The need for this teacher's guide made itself felt from many areas of New York State by the comments and suggestions of school superintendents, adult education directors, teachers, and others involved in adult education. This guide is related to two other adult course outlines: Keypunch Operation, which was published earlier this year, and Unit Record Equipment Operation, which will be published later.

The scope of the course was outlined by an advisory committee consisting of Ronald E. Fink, Assistant Professor, Division of Business Management, Agricultural and Technical College at Delhi; Dr. Nathan Goldfarb, Director, Computer Center, Hofstra University; Miss Helen Safford, Assistant Professor, School of Education, State University of New York at Albany; Miss Stephanie Yaworski, Greece Arcadia High School, Rochester, New York. A draft of the guide was then written by Professor Fink and Miss Yaworski under the guidance of Hobart H. Conover, Chief of the Bureau of Business and Distributive Education, and Eugene Whitney, Associate in that bureau.

E. Noah Gould, Associate in the Bureau of Continuing Education Curriculum Development, revised and edited the manuscript for this teacher's guide and prepared it for publication. Ronald W. Wing, Associate in the Bureau of Business and Distributive Education, reviewed the final manuscript before publication.

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Curriculum Development Center

INTRODUCTION

As young as it is, automatic data processing plays a vital role in American business. The size and complexity of the modern business requires not only more data but speedier access to masses of information to guide management in its decision-making. This great need for more information together with the mounting volume of paperwork make business managers strong advocates of automatic data-handling.

In spite of a popular conception, automatic data processing is not a tool of big business only. Data-processing service centers have sprung up and equipment costs have dropped. This has brought automated methods to many smaller businesses.

The classified advertising columns of newspapers show us the impact of office automation on employment. A great many new jobs are now available to people who can work in automated office procedures. The course covered in this teacher's guide should help prepare people for such work.

This course, which can be covered in 15 sessions, has the following objectives:

To develop a basic understanding useful to people working in business which use automatic data processing

To develop an understanding of how data flows through both electro-mechanical and electronic data processing systems

To provide some understanding of the social implications of automatic data processing

To motivate adults toward further training for specific data-processing jobs

Following is a general guide to the instructor:

Lesson		No. of Class Sessions Needed
1	Introduction to Data Processing	2
2	The Punched Card	1-2
3	The Punched-Card Data Processing System	2
4	Electronic Data Processing Systems	3-4
5	Designing, Programming, and Using an Electronic Computer System	4
6	Computer Uses	1
7	Recent Developments	½
8	The Impact of Computers on Our Society	½

Both the Bureau of Business and Distributive Education and the Bureau of Continuing Education Curriculum Development will welcome suggestions from instructors to help improve this publication.

HOBART H. CONOVER, *Chief*
Bureau of Business and Distributive Education

JOHN E. WHITCRAFT, *Director*
Division of Occupational Education

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Lesson 1

Introduction to Data Processing

OBJECTIVES

1. To present an overview of the course.
2. To provide understanding of (a) the data processing cycle, (b) methods of processing data, (c) need for improved data processing systems, and (d) the evaluation of data processing devices.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
I. Introduction to the Course	Introduce the students to one another to achieve an informal class atmosphere.
A. Course purpose	Explain to the class that this course is a general orientation to automatic data processing. No attempt will be made to develop marketable skills.
B. Textbooks and references	You should have the students buy a textbook. Three suitable books are listed below; each one covers most of the course material but you may need other references for some topics. These books are: Arnold, Hill & Nichols. Introduction to Data Processing. Awad & Data Processing Management Assn. Automatic Data Processing: Principles and Procedures. Robichaud. Understanding Modern Business Data Processing. Full citations are in the Bibliography. For some parts of each lesson you will find specific references listed. Each of these is identified by author; you can then find the full citation in the Bibliography. For the part of Lesson 1 above:

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	Suggested teacher references: Data Processing Management Assn. (DPMA), 1965. Martin, Chap. 1 and 2. VanNess, Chap. 1 and 2.
C. Course content	Review each lesson briefly with the class, in general terms. Mention the objectives and content of each.
II. Modern Society Needs Accurate Information A. To handle more data B. To use manpower more effectively C. To reduce guesswork D. To speed up decision-making E. To plan future activities F. To evaluate operations	Introduce the concept that modern business can no longer operate on intuition alone. More and more data is needed to cut out guesswork in decision-making and for long range planning and evaluation. Suggested teacher reference: Awad, Chap. 1 and 2. McCarthy & McCarthy, Chap. 1.
III. Data Processing Defined	A simple definition of data processing: "Data is information, processing is handling, data processing is information handling. Information can be handled manually, mechanically, electronically, or electromechanically." Suggested teacher references: Data Processing Management Association, 1965. McGill, Chap. 2. Robichaud, Chap. 1. Schmidt & Meyers, Chap. 1.
IV. The Data Processing Cycle	
A. Sources of data	Explain the nature of *source documents* such as bills, checks, time cards, sales orders, etc.
B. Input preparation 1. Punched cards 2. Magnetic tape 3. Paper tape	Stress the importance of accurate input for any data processing system. Discuss ways of verifying the accuracy of data before it is put into the system.
C. Manipulation of data	
1. Classifying	Explain that classifying is identifying common characteristics among items of data for grouping them into classes.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
2. Sorting	State that sorting is arranging data in order of rank of a common characteristic.
3. Calculating	Explain that calculating covers multiplication, division, addition, and subtraction used to convert data into a more meaningful form. Discuss the advantages of sorting and calculating by mechanical methods. Compare a *fully* automated system with a semi-automated system which uses key-driven and rotary calculators.
4. Summarizing	Explain to the class that summarizing is the condensing of data in a way that emphasizes main points.
5. Recording	Point out that recording is registering the results of calculations in a written form or other suitable form. Discuss various forms in which data may be presented to ease human understanding.
6. Communicating	State that communicating is transferring data from one point to another during processing. Delivering final results to a user is also communicating. Suggested teacher references: Awad, Chap. 4-9. Awad & DPMA, Chap. 5. Robichaud, Chap. 2.
	Explain that in a modern sense data processing includes *a series* of operations used for information handling. Data processors are any group of people and/or machines organized and acting together to process information.
D. Output	Explain that output is the processed information that results from data processing. Suggested teacher references: Awad, Chap. 4-9. Awad & DPMA, Chap. 5. International Business Machines Corporation. 1967. Robichaud, Chap. 2.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
V. Methods of Data Processing	Explain the ways of processing data:
A. Manual	A. Recording and processing by hand
B. Mechanical	B. Recording and processing by machine
C. Electro-mechanical	C. Recording and processing using machines with punched cards or punched paper tape
D. Electronic	D. Recording and processing by electronic computer
	Suggested teacher reference: Robichaud, Chap. 2-7.
VI. Progress in Data Processing Devices	Demonstrate how an abacus is used. Discuss the Roman counting board, Pascal's counting machine, and Babbage's computing machine to expedite arithmetic calculations.
A. Stylus on wet clay B. Pebbles and beads C. Abacus D. Greek model of analog machine E. Leibnitz calculator F. Slide rule G. Babbage calculators H. Hollerith machines I. Typewriters J. Desk calculators K. Bookkeeping machines	Emphasize the new technology as a tool by which man may effectively meet the demands of his environment. Suggested teacher references: Awad, Chap. 3. Haga, Chap. 1.
VII. Development of Digital Computers	Explain the relationship between technological and social needs.
A. Charles Babbage Analytical Engine, 1883	Suggested teacher references: Awad, Chap. 2. Awad & DPMA, Chap. 3. Natl. Science Teachers Assn., Chap. 2. Schmidt & Meyers, Chap. 2.
B. Harold Aiken Mark I, 1937-1944	
C. Eckert and Mauchley ENIAC, 1942-46	
D. Commercially available computer UNIVAC, 1951	

Lesson 2

The Punched Card

OBJECTIVE

To give students an understanding of the functions and types of punched cards, punched-card terminology and codes, and punched-card design

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
I. Functions of the Punched Card	
1. Communications medium 2. Data storage	Explain that the punched card is used to communicate with a machine and to store data.
a. Kinds of data	Discuss the two kinds of data, constant and variable. Example: On an invoice the customer's name and address are constant data; the items purchased by a customer and item prices are variable data. Suggested teacher references:* Arnold, Hill & Nichols, Chap. 7. Elliott & Wasley, Chap. 9. Van Ness, Chap. 6.
II. Basic Card Formats A. 80-column B. 90-column	Show the class sample cards, both 80-column and 90-column. Explain that the 80-column card is becoming universal. Suggested teacher references: Awad, Chap. 3. Awad & DPMA, Chap. 7. McGill, Chap. 3.
III. Card Terminology	
A. Columns B. Rows	South-Western Publishing Company has a large punched-card wall chart which

*Full reference citations are shown in the Bibliography.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
C. Punching zones D. Fields E. Corner cuts	shows vividly the one-hole numeric punch and the two-hole alphabetic punches, as well as special characters. Columns, rows, punching zones, and fields are clearly shown on the chart. Also use Figures 1 and 2, Appendix A.
IV. Card Codes	
A. Numeric data B. Alphabetic letters C. Special characters	Explain the coding for these three types of information and show examples of punches on cards.
V. Control Punch A. Purpose	A *control* punch is one that instructs the machine to do a specific operation with the data in the card. Examples: 1. Treat the amount in a given field as a debit. 2. Separate cards of female employees from those of males. Suggested teacher reference: Awad, Chap. 3.
VI. Card Types	
A. Master	As an example of a master card use a customer master card. This can contain the name and address of a customer and other data permanently associated with one customer, such as credit limits, billing discounts, etc.
B. Detail C. Transcript D. Dual E. Mark-sense	Explain that a detail card usually represents one transaction, for example, a card representing one product sold to a customer. It might show customer's name, quantity sold, a catalog number for the product, and the amount (dollars and cents) of the sale. Suggested teacher references: Awad & DPMA, pp. 71-73. Walsh, pp. 129-34.
VII. Punched Card Design A. Definition: Planning of fields B. What design depends on	Explain that design of a card is planning the arrangement of fields on the card, and it includes determining the sequence and size of fields. The design depends on arrangement of data

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	in the source document, how information will be used in the application, the size of each entry on the card, etc. Suggested teacher references: Awad, pp. 39-40. Awad & DPMA, pp. 70-71. McCarthy & McCarthy, Chap. 5.

Lesson 3

The Punched-Card Data Processing System

OBJECTIVE

To provide understanding of the functions, physical components, and operating procedures of a punched-card data processing system

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
I. Elements Common to Punched-Card Machines	Explain that several parts are common to punched-card machines--the machines listed and discussed below.
A. Card feeding device	Point out a card feeding device on an actual machine or in an illustration, and explain its operation.
B. Card reading device C. Control panel D. Card stacking device	Do the same for the card reading device, the control panel, and the card stacking device. For the card reading device also use Figure 3, *How a Card is Read*, if necessary. Suggested teacher references:* International Business Machines Corp., 1961. Robichaud, Chap. 4.
II. Machine Types and Functions	
A. Card punch 1. Function	Explain the similarity of the keyboards of the card punch machine and the typewriter. Explain the use of the card punch to punch information into a standard-size punched card.
2. Physical components	Show how a card punch machine and an electric typewriter operate similarly.
3. Operating procedures	If card punch machines are available,

*Full reference citations are shown in the Bibliography.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	let each member of the class punch a card with his complete name and home address. Let him keep this card temporarily; later he can learn use of a tabulator with it.
B. Verifier	
1. Functions	Discuss the checking of the original keypunching for accuracy. Explain the parts and functions of a key verifier.
2. Physical components	Point out the parts of the machine on either an actual verifier or an illustration.
3. Operation	Point out that the IBM Verifier and the Univac Photoelectric Key Verifier, machines similar in appearance to a card punch machine, do not punch holes in cards being verified. Explain "notching," including the difference between a correct and an incorrect card. Show that a verifier and a keypunch machine work similarly.
C. Reproducer	
1. Functions	
a. Reproducing	Explain that in data processing you often need to *repunch* all the data of a whole set of cards. Mention that this is done on the reproducer. The reason for doing it might be that the cards are worn, or that you want to do the same operations with the same data on two machines at the same time.
b. Gang punching c. Summary punching	Discuss using the reproducer to repunch data from specified fields of one set of cards into other cards, as in gang punching and summary punching.
d. Mark-sense punching	Explain how you might record information on a card with a special electrographic pencil. This is most often done in a field project. Then tell how the reproducer converts this data into punched holes on the same card.
2. Physical components	Discuss physical components, functional

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
3. Functional controls 4. Operating procedure	controls, and operating procedures briefly.
D. Interpreter	
1. Function	Point out that early in the development of punched-card data processing it was found that, although machines could read the punches rapidly, people could not. The interpreter was then designed to solve this problem by *printing* the punched information along the top (12-edge), or elsewhere on the card. Data can be interpreted from all or only selected fields, and in any order.
E. Sorter	
1. Functions	Discuss the need to arrange cards in a certain order to obtain a desired result. Example: Arrange customer cards by customer number. Explain that a sorter does this and can also select certain cards from a deck.
2. Physical components	Point out important parts and their names.
3. Operating procedure	Explain that the sorter will sort only one column at a time, and the operator must decide which column to use first. The rule is to sort the *low-order* position of a field first, and other positions in order of increasingly higher order. Example: To sort cards by a two-digit number, sort the 1's column first and then the 10's column. Discuss briefly: Grouping, Block sorting, Alphabetic sorting.
F. Collator	Explain that the collator is more versatile than a sorter and can read and compare data in several columns at the same time. But even with a collator you still need a sorter.
1. Functions a. Matching b. Merging c. Match-merging d. Selecting e. Sequence checking	Discuss how the collator does each of the operations listed at the left.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
2. Physical components	Point out important parts of the machine.
3. Operating procedures	Explain briefly how a control panel programs a collator.
G. Calculating punch	
1. Functions	Discuss use of the calculating punch to perform addition, subtraction, multiplication, division, etc.
2. Physical components	Explain parts of the machine, particularly the control panel which programs the machine.
3. Operating procedures	Mention the main procedures in use of the calculator.
H. Tabulator	
1. Functions	Discuss the basic functions of the tabulator (or accounting machine): 1. To print alphabetical and numerical data from punched cards. 2. To accumulate totals for each of certain classifications.
2. Physical components	Explain how a control panel is used to program the machine.
3. Operating features	Discuss detail and group printing. Point out how summary punching can be done by connecting a summary punch to the accounting machine. Explain the purpose of the summary. If a tabulator is available within the school, run off the class list that was developed earlier, when participants punched their names and addresses on punch cards.
III. Comparison of Data Processing Systems	
A. Factors for a comparison	Point out that the following four factors are used to determine the advantages and disadvantages of manual, mechanical, and punched-card data processing systems:

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	1. Speed of operations 2. Accuracy 3. Kind of manpower needed 4. Cost of doing the operations
B. Compare the systems	Compare one-write bookkeeping systems, machine bookkeeping systems and punched-card systems. Note: Making a simple payroll is a good example for comparing the three kinds of systems. Suggested teacher reference: Robichaud, Chap. 2, 3, and 4. Walsh, Chap. 2 and 3.

Lesson 4

Electronic Data Processing Systems

OBJECTIVE

To give the student an understanding of types of computers, and of capabilities, limitations, functions, components, and operations of digital computers

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
I. Types of Computer	
A. Analog computer	Explain that an analog computer measures rather than counts. It represents a number by a physical quantity such as voltage, current, distance, etc. Example: A mercury thermometer is an analog device (but not a computer); it represents a number (degrees of temperature) by the height of the mercury column. Other analog devices are the slide rule and the odometer on an automobile.
B. Digital computer	Point out that a digital computer counts discretely--like a subway turnstile counting people walking through it. It represents a number by one or more digits.
C. General purpose computer	Explain that general purpose computers can do many different kinds of job. Example: One general purpose computer can do payroll sales analysis, cost accounting and inventory control.
D. Special purpose computer	A special purpose computer does only one specific kind of problem. Examples: A computer for tracking missiles, and a computer for controlling the quality of oil produced in a refinery.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	Suggested teacher references: Awad, pp. 131-132. Awad & DPMA, pp. 12-14. Siegel, Chap. 1.
II. What Digital Computers Can Do	Point out that digital computers process vast quantities of information, do repetitive tasks with great speed, make decisions, run automatically, and check on the accuracy of the work. Mention that they must, however, be programmed (that is, receive instructions) for every step of the work.
A. Limitations	Explain that any computer is limited in the following ways: 1. It can handle only the information it has been programmed to handle. 2. It cannot write its own program nor determine its own course of action. 3. It is highly accurate but not perfect. The computer in business is best used for tasks which are continuous, routine, and repetitive.
III. Computer System Components	Point out that a computer consists essentially of four components: an input device, a processing unit, a storage unit, and an output device. Use Figure 4 of Appendix A to illustrate. (See Instructions for Use of Illustrations in Appendix A.)
A. Input device	Explain that this device *reads* the input--punched cards, for example. Mention that other forms of input can be used, but punched cards will be stressed at this time.
B. Processing unit	Explain that the processing unit does computations and makes comparisons on which logical decisions are based.
C. Storage	Explain that both data and instructions received by the computer can be put into storage. They are put into numbered

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	locations like the numbered lock boxes in a post office. From each location an item of instruction can be withdrawn to be executed, or an item of data can be withdrawn for processing or output.
D. Output device	Explain that an output device translates the electrical impulses, representing data processed by the machine, into recorded results. These can be punched cards, magnetized tape, printed forms, and others. Suggested teacher references: Awad, Chap. 13-16. Awad & DPMA, Chap. 13-17. International Business Machines Corp., 1967, pp. 32-81. Laurie, Chap. 1 and 2. Robichaud, Chap. 6 and 7.
IV. Functions of a Computer System	
A. Accepts communicated data (input)	Develop the concept that data must be presented to a computer in a form it can use. Explain the forms of input as in Figure 5.
B. Stores data	Explain how data are stored and discuss several kinds of storage. Use Figure 6 to illustrate.
1. Primary (or main) storage	Point out that internal storage is called main (or primary) and its data can be called out immediately.
2. Auxiliary (or external) storage	Auxiliary or external storage is used to hold information before or after it has been processed by the computer. Thus, card files, and paper and magnetic tape files are used to store data; retrieving this data usually takes longer than retrieving data stored internally. Compare *on-line* and *off-line* data storage. Point out that on-line storage uses equipment in direct communication with the central processing unit (CPU). Off-line storage is in equipment *not* directly controlled by the CPU.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
C. Performs arithmetic operations	Explain that the arithmetic-logic section of the CPU does addition, subtraction, multiplication, and division. Use Figure 7 to illustrate.
D. Makes logical decisions based on data comparisons	Explain how the arithmetic-logic unit does certain logic operations by comparing two numbers to see if one is larger than the other or if they are equal. Also discuss how it sequences data.
E. Controls the timing of operations	Indicate that the control section of the CPU directs and controls the whole computer system as a single multipurpose machine. (Use Figure 8 to illustrate.) This includes control of: 1. the input-output devices, 2. the arithmetic-logic section, and 3. transfer of data to and from storage.
F. Communicates results of operations (output)	Point out that after the processing in the computer is completed, the output is produced. (Use Figure 9 to illustrate the concept of output and the forms output takes.) This can be in either of two general types: 1. A type which can be read by a computer or other data processing device. This includes punched cards, punched paper tape, magnetic tape, etc. 2. A type which can be read by people. This includes such things as pay checks, invoices, tables of figures, etc. Suggested teacher references: Arnold, Hill & Nichols, pp. 187-212. International Business Machines Corp., 1967, pp. 6-14.
V. Computer Codes and Arithmetic	
A. Data representation	Explain that the process of changing information from ordinary numbers and words to a form that the computer can read is coding. Point out that this

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	code can then be impressed on an input medium by magnetizing (for a magnetic tape), by punching (for a punched card), etc.
1. Pure binary	Explain the binary number system for the digits 0 through 9. Also discuss the card code. Use illustrations which you can find in several of the reference books.
2. Binary coded decimal	Take an example of a 3-digit number and show how each digit is coded in binary form to make a binary coded decimal (BCD).
3. Alphanumeric code	Explain the need for coding of alphabetic as well as numeric information in electronic data processing. Use Figure 10 to point out examples of alphanumeric coding (the 8-column binary code) which can be used on magnetic tape and on memory devices. Also point out how the card code in Figure 2 is an alphanumeric code for punched cards.
B. Binary arithmetic	Explain that adding is the basis of all arithmetic operations on a computer.
1. Addition	Mention the parallel adder and the serial adder and when each is used. Discuss in detail the serial adder and how it uses the "add-to-storage" concept. Work out for the class an example using the serial adder. Make clear how binary addition is done.
2. Subtraction	Mention that most digital computers perform binary subtraction by adding the complement of the subtrahend to the minuend. Explain this by comparing it to decimal subtraction with complements.
3. Multiplication	Explain binary multiplication and illustrate with an example.
	Suggested teacher references: Arnold, Hill & Nichols, pp. 182-88. Awad, Chap. 12 and 13. Awad & DPMA, Chap. 17. Humble Oil and Refining Co.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
VI. Media and Devices for Input, Storage, and Output	
A. Input media and devices	Mention that a printed, typed or hand-written document is an input source but that the kinds of input to be discussed here are those which a computer can read. Use Figure 5, *Basic Computer Concepts--Input*, in your discussion.
1. Punched card	Mention that the punched card was for several years the primary medium for communicating with a computer. Discuss its limitations as an input medium. Explain how a punched card is read by a punched-card reader; use Figure 3, *How a Card is Read.*
2. Punched paper tape	Explain that most punched paper tape used today has either five or eight channels, or rows of holes. Mention that it is often punched by a punch connected directly to a typewriter or keypunch. Discuss its limitations as compared with more advanced input media.
3. Magnetic tape	Mention that most magnetic tape used in computers today is made of a plastic, coated on one side with a metallic oxide. State that data can be read from a magnetic tape at very high speed. Point out that data is recorded on it as a pattern of magnetized spots across its width. Explain that 7-channel tape, half an inch wide is very common today. Illustrate the 7-channel data representation code used on magnetic tape as shown in some of the reference books. Point out that an 8-channel data representation code is now coming into wide use; it is called EBCDIC--Extended Binary Coded Decimal Interchange Code. (See Figure 10.) This is one of the main coding schemes for IBM's System 360. However, it is also being used by other manufacturers in 9-channel magnetic tape and in other devices.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	Suggested teacher references: Arnold, Hill & Nichols, pp. 187-88. Elliott & Wasley, pp. 237-240. Robichaud, pp. 109-110.
4. Console typewriter	Explain how the typewriter on the console of a computer can be used to put data into the computer.
5. Character reader	Point out that input devices for computers are available to read characters magnetically and optically.
a. Magnetic ink characters	Explain that magnetic ink characters are printed on paper and can be read both by man and machine. The language consists of the 10 numerical digits and four special characters. Discuss the range of size and thickness of the paper used; also discuss applications.
b. Optically readable characters	State that certain printing and some pencil marks can be read with an optical device. The language includes the alphabet, the numerical digits and special characters.
B. Storage devices	Point out that information can be placed into, held in, or removed from computer storage. The information can include instructions to the CPU, data to be processed, and reference data.
1. Magnetic tape 2. Magnetic drum 3. Magnetic disk	Discuss the characteristics of these three commonly used kinds of storage. Go into the direct access feature of drums and disks, and the sequential access needed for tapes.
C. Output media and devices	Explain that all of the input devices listed above are used as output devices, too. A printer, which prints out hard copy, is another kind of output device.
1. Punched card 2. Punched paper tape 3. Magnetic tape 4. Console typewriter 5. Other printers	Point out that the first three media listed here produce output in machine language only, while the other two produce copy in man language. Discuss these media and devices as used for output.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	Suggested teacher references: Awad, Chap. 12, 14, 15, and 16. Awad & DPMA, Chap. 13-15. International Business Machines Corp., 1967, pp. 13-31, 32-34, 47-64. Robichaud, Chap. 6 and 7. Schmidt & Meyers, Chap. 8.
VII. Other Characteristics of Computer Systems*	
A. Serial and parallel operation	Tell the students that movement of data into or out of storage is either serial or parallel, depending on the way the computer does the arithmetic. In a serial computer, numbers to be added are processed one column at a time, the same as adding with paper and pencil. In a parallel computer, addition is done on complete data words, including any numbers in the words. This means that any two numbers, regardless of their size, are added in one operation, including carries.
B. Internal and external control	Discuss the need for control and how internal and external controls are achieved.
C. Buffered and unbuffered	Explain the need on some computers to temporarily hold information being transmitted between external and internal storage, or between an input-output device and storage.
D. Fixed and variable word-length	Differentiate between fixed word-length and variable word-length. Emphasize that variable word-length uses storage more efficiently and may also ease programming.
E. Kinds of processing	Discuss with the class the following kinds of data processing:
1. Batch processing	Batch processing--a method in which a number of similar transactions are coded and grouped and are then processed in sequence. Also called sequential processing.

*This topic is optional, depending upon the backgrounds of the students.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
2. Inline processing	Inline processing--processing of transactions in whatever order they occur, without coding or sorting them. Also called direct-access processing.
3. Real-time processing	Real-time processing--processing of data from a physical operation, as the operation takes place, and fast enough so the results of the data processing are useful in the physical operation. Sometimes called on-line real-time control. Suggested teacher references: Awad, Chap. 21 and 22. Elliott & Wasley, Chap. 12. International Business Machines Corp., 1967, pp. 43-44. Schmidt & Meyers, Chap. 8.

Lesson 5

Designing, Programming, and Using
an Electronic Computer System

OBJECTIVES

To give the students an understanding of how to do systems analysis and design, and how to program a solution to a data processing problem

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
I. Steps in Designing a Data Processing System	
A. State the objectives of the proposed data processing system.	Point out to the students that the first step in design is to state the *general* objectives, such as the kinds of inputs and outputs you want the system to process and the general kinds of processing needed. More specific objectives, including capacity of the system (quantities of input and output, and processing speed) will be discussed later.
B. Make a system analysis of the existing data processing system.	Explain that the system analysis will include collecting, organizing and evaluating facts about the system and the environment in which it operates.
1. Steps in the analysis	Discuss the steps with the students:
a. Obtain facts.	Obtain facts by interviewing people and observing such things as origin and processing of documents, files of information, reports issued, and the processing steps done at each work station.
b. Collect documents.	Collect sample copies of filled-in documents, filed papers, reports, etc.--also figures for the volume of activity in a period.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
c. Study processing operations.	Find out the how and why of every document each person receives or processes, what operations he does, the kinds of files he uses, and the content of any reports he prepares.
d. Interview users of forms and reports.	Learn from the users what information they use and what other data they need.
e. Make flow charts.	On the flow charts show the movement and processing of each item of data from its origin until it is discarded. The charts will help to understand the facts gathered and will show gaps in the system, if there are any.
C. Design the new system.	Explain to the students that the first steps in system design should be done without specific equipment in mind. As the design proceeds, the equipment needed will become clear. This will then lead to decisions on specific pieces of hardware.
1. Specify inputs, outputs, and files.	Use the flow chart of the existing system and the objectives of the new system to find the inputs, outputs and files needed. Also specify the kinds of input-output media needed.
2. Specify kinds of operations.	Now state what arithmetic and logic operations are needed to convert the inputs into the desired outputs.
3. Select the data processing equipment.	Write complete specifications for equipment. Specify data inputs, kinds of processing, files, outputs, and applications. Obtain proposals from manufacturers.
4. Install the new system.	Install the equipment and put it into operation; this is a long, drawn-out process. It requires making and revising detailed flow charts, designing forms, using decision tables, trying out equipment, debugging, etc.
	Suggested teacher references: Arnold, Hill & Nichols, Chap. 15. Awad & DPMA, Chap. 19. Elliott & Wasley, Chap. 6.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	Gregory & Van Horn, Automatic data processing systems, Chap. 5 and 6. Gregory & Van Horn, Business data processing and programming, Chap. 5 and 6. McCameron. Withington, Chap. 2, 7, and 8.
II. Programming the Computer	Point out to the students that programming is presented here after installation of equipment, but in an actual situation the computer program will probably be written before the equipment is completely installed.
A. Analyze the problem to be programmed.	Explain that the problem must be defined and thoroughly analyzed. This includes analyzing source data, stating the procedures needed to solve the problem and the form of output required.
1. Use a simplified example.	To teach the students how to write a computer program, take a simplified example like *How to Prepare a Status-of-Stock Report*. Write the essential steps on the board: 1. Determine the beginning stock balance. 2. Add stock received. 3. Subtract stock issued. 4. Print out the new balance.
2. Make a *system* flow chart as in Section I, B.	Make a system flow chart of the simplified example and explain that this chart is a basic step toward writing the program.
B. Make the *program* flow chart.	Tell the students that a *program* flow chart should use conventional symbols and should be made in such a way that another analyst could write a program from it, if necessary.
1. Use conventional symbols and methods.	Draw symbols for flow direction, input-output, and processing on the chalkboard and state that these are the basic symbols; others are also used, in most charts.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
2. Illustrate with a flow chart of the sample problem.	Make a program flow chart on the chalkboard for the sample problem above. Explain and discuss each step as you write the symbol for it.
C. Write the *symbolic* program.	Explain that only for a few years when computers first came into use were programs written in machine language. Today most programs are written in *symbolic* language, a language which aids the memory of the programmer, but which cannot be read by the machine.
1. The symbols and the coding sheet	Give some examples of the mnemonic symbols in the symbolic language. Explain that the symbolic program is written on a coding sheet; show an example of such a sheet.
2. Transcribing the program	Point out that this program is then transcribed into a form that the computer can process. For example, it might be punched onto cards. This deck of cards is called a *source* program.
D. Assemble the *object* program	State that the *source* program is now fed into the computer and translated into an *object* program, which is in machine language. This program may be recorded on punched cards, magnetic tape, or some other auxiliary storage medium. It can then be loaded into the memory of the machine and used to perform operations. Point out that the program for translating is called a *processor*. Also explain the terms *assemble* and *compile*.
E. Test and correct the program.	Explain that the object program is now tested by processing test data through it. This data may be hypothetical or a part of the object program.
1. How errors are shown	Mention that the computer might indicate an error by incorrect output or by stopping because of an invalid instruction.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
F. Prepare the program for production.	Explain that the *Operating Instruction Sheet* is now prepared. This shows what the operator is to do and what the machine is to do; it also tells the operator how to solve operating problems which are likely to occur.
III. Types of Instructions	Explain to the class that some computers have as many as 200 kinds of operation codes in their instruction formats, while other computers use as few as 20. Mention that all instructions will not fit into a single class but that there are four basic types.
A. Input-output instructions	Describe the input instructions which direct the computer to a particular input device to read the next record, and to put the information from it into a specific storage location. Mention output instructions which tell the computer to move certain data from storage to an output device and to record it on an output medium.
1. Editing of input and output	Also discuss instructions for editing which include extracting part of a record for computer use or for output, and punctuating quantitative data.
B. Arithmetic instructions	Explain that computers generally can do all four basic arithmetic operations. In some computers, however, multiply and divide must be done by use of *subroutines*. Point out also that computers can round a number (to shorten it), and can recognize the sign of a factor and operate with it algebraically.
C. Branching instructions	Discuss branching instructions as those which move the processing from one point in a program to another. Whether or not the computer branches (in a given problem solution) may depend on a decision in logic the computer has made. Example: If A is bigger than B, go back to START.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
D. Logic instructions	Explain that logic instructions are used to sequence, compare, and rearrange items of data, including not only letters and numbers, but also punctuation and special characters.
1. Comparison instruction	Point out that a data item at one storage location can be compared with another data item in a register, accumulator, or other storage location. For numerical data the comparison will show which of two numbers is bigger, or whether they are equal. For letters and special symbols, comparison will show which word (or combination of characters) should come before another in either alphabetical sequence or some other specified sequence.
a. Branching instruction may follow comparison.	Add that a branch instruction often follows a comparison: If a specified condition is met (for example, if A is greater than B) the branching instruction is executed; if the condition is not met the computer continues with the regular sequence of instructions.
2. Editing instruction	Explain that data can be edited by use of an *extraction* command; this would remove from a set of items all that meet some criterion. Example: Extract the number 25.18 from the item $25.18. The number without the dollar sign can then be added to or subtracted from another number.
3. Shifting instruction	Discuss the shifting instruction as one which moves a data word to right or left (shifting each character from one column to the next). This is used to line up two data words so they can be compared.
4. Testing instruction	Explain that this instruction uses the same techniques as the comparison instruction. It tests for such conditions as positive or negative sign on a quantity, zeros or blanks, last card, end of file, and end of job.
E. Stored program	Introduce the idea of a *stored* program

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	and discuss how it is brought into the memory with a *load program*. Suggested teacher references: Arnold, Hill & Nichols, Chap. 11. Awad & DPMA, Chap. 18. Elliott & Wasley, Chap. 11-13. Gregory & Van Horn, Business Data Processing & Programming, pp. 62-67.
IV. Programming Systems	
A. Need for programming systems	Explain to the students that to write a program in *machine* language not only is extremely difficult but also takes a tremendous amount of time. Besides that, the resulting program is not very flexible and has other disadvantages. For these reasons programming systems have been developed to ease the programmer's job.
B. Elements of a programming system	Point out that a programming system consists of a *language* and a *processor*.
1. The language	Mention that the language used is the *symbolic* language referred to earlier in this lesson. The basic purpose of this language is to help a programmer write a program and ease the burden on him. The biggest part of the burden is then on the computer. The symbolic language is easily understood by man and can also be translated by the computer. Remind the students of the term *source program*.
2. The processor	Explain that the *processor* is a program, usually supplied by the computer manufacturer, which translates the source program into machine language. The resulting program, called an *object* program, is the one executed by the computer. Explain further that while translating the source program into an object program, the processor: assigns storage locations to the labels of the source program and indexes them for future use,

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	prints reminders about labels which need individual attention from the programmer, and prepares instructions for loading the object program into the computer.
C. Types of programming systems	
1. Assembler	State that the *basic* processor is an *assembly program*. It translates the source program into machine language on a one-to-one basis, that is, one machine-language instruction for each symbolic-language instruction. Add that an assembly program permits the programmer to include subroutines where needed.
2. Compiler	Explain that a compiler system is more sophisticated than an assembler. In addition, some compiler languages are problem-oriented rather than machine-oriented, and with minor changes can be used on many different computers.
a. Macro-instructions	Introduce the term *macro-instruction*, which is an instruction that can generate more than one machine-language instruction. Point out that a compiler language can take a macro-instruction from a source program and produce several instructions (a one-to-many basis) in the object program.
b. Other advantages of compilers	Explain that a compiler can choose from several media (for example, punched cards, magnetic tape, and disks) for recording the object program. Also, it has more error indicators and better program checking techniques than an assembly program.
3. Example of programming languages	
a. COBOL	Mention COBOL as a language used mainly in business applications. Explain that the name is derived from Common Business-Oriented Language. Discuss the nature of this language and its advantages and disadvantages.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
b. FORTRAN	Mention FORTRAN as a language oriented toward science and engineering. Explain that its name is derived from Formula Translator. Discuss its characteristics and compare it with COBOL.
c. PL/I	Give PL/I as a language which is convenient for both business and science applications and which can be used with the IBM 360 Computer System. Discuss this language briefly.
D. Utility programs	Mention that utility programs further relieve the programmer of routine work and are very helpful in a data processing facility. Discuss the following utility programs briefly: 1. Sort and merge programs 2. Translators 3. Simulators 4. Housekeeping routines, such as *Clear storage, Print storage* 5. File conversion routines 6. Program-testing aids
E. Practice in writing a program	To give the students the feel of instructing a computer have them do some simple programming exercises. For example, using FORTRAN have them write a short program to read-in alphabetic and numeric data, do some adding and subtracting, and print out the results. Suggested teacher references: Arnold, Hill & Nichols, Chap. 11 and 12. Awad & DPMA, Chap. 17 and 18, and Appendix A. International Business Machines Corp., pp. 82-93. Laurie, Chap. 6, 7, and 9.

Lesson 6

Computer Uses

OBJECTIVE

To give students an appreciation of the many uses for computers

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
I. Uses of Computers in Business and Government	Point out that this section can also be called "Managerial and Administrative Uses," and that such uses are found in business, industry, and government.
A. Business uses	
1. Main types	Explain that the two main kinds of use in business are: 1. To signal a condition needing action. Example: Signaling that the inventory of bond paper has dropped down to the *reorder* point. 2. To feed back information on the status of operations which will help management control these operations. Example: Printing out a list of customers who are late in paying for goods they have bought.
2. Reasons a computer is needed	State that because business is now extremely complex it is impossible for routine functions to be completed manually. Non-electronic methods are becoming obsolete. Give some figures on the increase (and potential increase) in number of clerical employees, and on the saving made by a computer as compared with other methods for routine administrative work.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
3. Examples of business uses: a. Payroll b. Accounts receivable c. Accounts payable d. Order processing e. Inventory management f. Purchasing g. Sales analysis h. Check handling (in a bank)	Mention the examples of business uses. For one or more of them, discuss the following: 1. The general objective 2. The kinds of source documents and source information used 3. The kinds of input media and storage media used 4. The kinds of processing done 5. The kinds of output information and output media
4. System analysis and programming for each use	Explain that for each use an individual system analysis and an individual computer program are needed. Also mention that subroutines are often available to ease the programmer's job; give examples of subroutines. Use one or more of Figures 4 through 9 and fill-in the blocks with information to illustrate a particular use.
B. Industrial uses of computers	State that many of the business uses also apply to industry. Besides, industry has other uses peculiar to its own needs.
1. Examples of uses in industry	Discuss the uses in industry. Follow the factors listed for business and add others which apply.
a. Production planning b. Production control c. Process control d. Numerically controlled metalworking machines	Explain that production planning and production control are used mainly in manufacturing. Process control by use of a computer has been used in the refining of oil, and in the manufacture of paint, drugs, chemicals, tools, and other products. Numerically controlled metalworking machines, contrary to popular conception, are used more for short-run, highly complex production jobs than for long-run mass production jobs. Other computer-controlled production, however, with a combination of many metalworking machines, is used in mass production.
C. Government uses of computers	Explain that computers are being used in many different ways in Federal,

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
1. Examples of uses in government a. Motor vehicle registration b. Traffic control c. Income tax accounting d. Collecting tolls on highways e. Police records f. Mail movement g. Social Security records	state, and local government agencies. Some of the uses for business and industry also apply in government. Discuss the government uses in the same way as business and industry uses. Mention the use of computers by the U.S. Internal Revenue Service for checking income tax returns, a use which has been very much publicized.
II. Other Applications	Explain that computers have been put to use in many ways and the number of uses is growing rapidly.
A. Uses in engineering 1. Design of highways and bridges 2. Design of buildings 3. Airframe design and test 4. PERT 5. Air traffic control	Mention the uses in engineering. Besides uses in design, the computer is used to plot graphs and specialized diagrams. Point out that PERT (Program Evaluation and Review Technique) is used in scheduling the parts of a complicated engineering project.
B. Uses in science 1. Medical research 2. Exploration of outer space 3. Nuclear science 4. Research in materials	State that science probably uses computers more than any other profession because of the tremendous number of calculations needed. The computer very rapidly does statistical analysis for many different kinds of research. Mention that in some research and in planning space travel, simulation is used. Also much scientific research is done with an *analog* computer rather than a *digital*.
C. Other uses 1. Weather forecasting 2. Making airline reservations 3. Codification of law 4. Simulation 5. Planning war strategy 6. Computer-assisted instruction 7. Counting of election results	Point out that "other uses" includes newer uses and also covers some ground not covered under previous categories. Simulation is itself a *technique*. Besides the uses mentioned above a business can be simulated to determine the effects of applying various policies before actually applying them.
III. More Teaching Suggestions	If, possible, take your students to

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	visit a computer center. Also encourage them to scan periodicals for new developments and new uses of computers. Suggested periodicals: Wall Street Journal Dun's Review Computer Digest Business Automation Suggested teacher references: American Telephone and Telegraph Co., pp. 96-115. Awad & DPMA, Chap. 24. Elliott and Wasley, Chap. 14 and 15. McCarthy & McCarthy, Chap. 18-21. Robichaud, Chap. 8-14. Walsh and others, pp. 212-13.

Lesson 7

Recent Developments

OBJECTIVE

To give the student knowledge of recent developments in computer technology

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
I. New Input-Output Devices	
A. Optical character reading	Explain that machines are available which can read certain marks made with an ordinary lead pencil, as well as material typed or printed with an ordinary carbon ribbon on a typewriter, a high-speed output printer, or a special imprinter.
1. Example of machine-readable type	Mention the NCR optical font which is specially designed for machine reading but is still man-readable. This font may be attached to National Cash Register adding machines, cash registers and accounting machines; a printed paper tape is then produced which is readable by both man and machine.
2. Reading of pencil marks	State that a machine is now in use which reads marks of ordinary pencil made in designated places on a card.
3. Problem in reading type	Point out that optical reading is limited to a very few type faces.
B. Reading of mark-sensed cards	Discuss the use of an electrically conductive pencil to mark cards in designated locations to indicate information. Explain that these marks can then be read by a machine which will punch cards.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	Suggested teacher references: Elliott & Wasley, pp. 75-78, 235. Gregory & Van Horn, Automatic Data-Processing Systems, pp. 103-104. Withington, pp. 22-23.
C. Microfilm reader-printer	Mention the use of microfilm and aperture cards for storing and retrieving information. Explain that aperture cards are sorted on punched-card equipment and that some electronic data-processing equipment using microfilm has been developed only recently.
D. Hard-copy terminals	Point out that printed copy can be produced from the output of a computer by many different devices. The major ones are the print-wheel printer, the wire-matrix printer, the chain printer, the incremental-bar printer, and the typewriter. Discuss the characteristics of these printing devices, the speeds at which they print, and typical uses of each.
E. Visual display	Mention the visual display output that can be obtained from a computer. This display appears on the face of a cathode ray tube that looks like a television screen.
1. Kinds of information displayed	Explain that display of characters, points, lines, and graphs can be obtained much faster than a print-out by normal printing methods. Point out that a *light pen* can be used to *write* on the face of the tube and that the information *written* can then be recorded in the computer system. Mention that the visual display is often used as an operator console. This display can be used to present a client's account record during a telephone conversation (and to make changes in it), and to show the flight routes of an airline company. Suggested teacher references: American Telegraph & Telephone Co., pp. 131-32.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	Elliott & Wasley, p. 258. International Business Machines Corp., 1967, pp. 30-31.
II. Long-distance Data Transmission	Explain that data transmission takes place in any data processing system, even if the whole system is contained in one room. Then point out that with business firms and Government agencies having activities spread throughout the world, data must be transmitted for long distances, to take full advantage of automatic data-processing systems.
A. Relation to automatic data processing	Discuss the various places in a data-processing system where data must be transmitted and mention which of them might be long distance.
B. Characteristics	Explain the physical characteristics of the data transmission system including such things as kinds of transmission channels, media and equipment used, and speeds of transmission. Also discuss costs briefly.
C. Example	Use an example in your discussion. For example, the Westinghouse Electric Corporation produces many different products and has 300 locations throughout the United States and Canada. By the use of data transmission its computer center in Pittsburgh is connected (directly or indirectly) with all of the company's factories, laboratories, warehouses, offices and other locations. Discuss the advantages of this widespread network and the problems which might arise in its use.
	Suggested teacher references: American Telegraph & Telephone Co., Chap. 1 and pp. 118-32. Parkhill, pp. 125-28.
III. New Processing Procedures	
A. Time-sharing and real-time use of computers	

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
1. Definitions	Present the definitions: Time-sharing: A method in which a computer facility is shared by several users for different purposes at (apparently) the same time. The computer actually services each user in sequence, but the high speed of the computer makes it appear that the users are all serviced simultaneously. Real-time: Computation and processing (usually in a computer facility) in a short time as compared with the actual time the related physical process takes. This makes it possible for the results of the computation and processing to guide the physical process. Explain that *time-sharing* and *real-time* are commonly used almost interchangeably.
a. Examples of use	Mention that real-time processing is used in making airline reservations, in inventory control, and in guiding a space vehicle.
2. Kinds of uses	Explain that a job to be done by time-sharing must not involve a very large amount of data. Discuss other characteristics of the jobs it is feasible to do by time-sharing. Mention that most time-sharing today is in science and engineering. Also there is some use in business but apparently it will not become as widespread in business. Point out that one problem in business is the protecting of private information.
3. Characteristics of the computer facility used	Mention that a computer facility used for time-sharing must have a random-access memory. Discuss other aspects of the system such as that it must have its own program to control the sequencing of use by users.
4. Costs	Discuss costs briefly including costs of equipment, costs of operation, and costs to customer-users.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	Suggested teacher references: American Telegraph & Telephone Co., pp. 81-83, 151, 154. International Business Machines Corp., 1967, p. 8. Parkhill, Chap. 5. Withington, pp. 103-104, 80, 91.
B. Random-access processing	
1. Definition	Explain that random-access processing is based on storage in which the time needed to put data in or take it out (that is, the *access time*) does not depend on the location of the data last put in or taken out. Point out that the objective of random-access *storage* is to use the least amount of time to put data in or take it out of storage, regardless of what the data is or what address is used. The objective of random-access *processing* is to process data as fast as possible as it comes to the computer, regardless of its sequence. Mention that *direct-access* is sometimes used instead of *random-access*.
2. Characteristics	Explain that a random-access computer system needs an extremely big memory (storage, that is) because it is used to process information from many different departments of an organization, or from many different companies. Besides the great amount of data involved, many different instructions (or programs) are also needed.
3. Used for time-sharing	State that time-sharing data processing is not possible without a random-access computer. It follows that real-time data processing also requires random-access. Contrast random-access data processing with batch processing, where data must be accumulated before being processed.
C. Mass storage devices	Explain that to get the random-access feature and the extremely big storage

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	capacity needed, the following kinds of equipment are used: 1. Magnetic cores 2. Magnetic drums 3. Magnetic disks 4. Data cells (which use magnetic strips) 5. Rods with thin-film memory Discuss these storage devices and contrast the rapid access they permit as compared with magnetic tape. Explain the principle of storage on magnetic media as involving spots of magnetism on a magnetic material. Suggested teacher references: Elliott & Wasley, pp. 216-17, 254-56. International Business Machines Corp., 1967, p. 5. Parkhill, pp. 20-33. Withington, pp. 15-22.

ERIC

Lesson 8

The Impact of Computers on Our Society

OBJECTIVE

To develop an awareness of the impact computers may have on business in particular and society in general

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
I. Impact of the Computer on the Organization	Explain to the class that most authorities agree that greatly expanded use of a computer will change the structure of the business organization and its method of operating. Mention briefly how the nature of computer operations in an organization will do this. Authorities do not agree on just what these changes will be, but at least one authority makes the prediction given below. Caution the students that the changes described are a prediction and that they are not certain to happen.
A. Change in the basic structure	State that this discussion will assume a conventional manufacturing organization to start with. As it increases its use of a computer system it evolves toward a structure with basically only two parts: an operating segment and a support segment.
1. The operating segment	Point out that the operating segment in the new organization would consist of an Operations Control Group and a group of "Agents."
a. Operations Control	Explain that the Operations Control Group would include a Planning Department that would do all the planning previously done by planning sections

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	of Manufacturing, Marketing, Accounting, Finance and other departments. This Planning Department together with the top management of the whole firm would constitute Operations Control.
b. Agents	The Agents would include salesmen, managers of manufacturing plants, and buyers of raw materials and supplies.
2. The support segment	Explain that the support segment would consist of such departments as Engineering, Manufacturing, and Marketing. The Engineering Department would develop products, test them and prepare them for manufacture as in a conventional organization. The Manufacturing Department would still be responsible for the efficiency and economy of its plants, and the training and administration of the workers. The Marketing Department would still be responsible for sales personnel, for market research and for setting sales quotas.
B. Change in method of operating	Point out that the expanded use of a computer system would permit Operations Control to assemble (in only hours or less) all the information needed for planning, to evaluate it, and to formulate plans for action. The computer and the communications system connected with it would then allow Operations Control to pass instructions on to the Agents who would execute them.
1. Example	Clarify the method of operation by this example: Suppose a salesman obtains a very large order which requires a change in manufacturing schedule. Using the expanded computer capacity, Operations Control would develop new production schedules within hours and issue new instructions to production plants and buyers of raw materials. Suggested teacher reference: Withington, pp. 181-86 and 191-96.
C. Other changes in management of the organization	Explain that the expanded use of computers would affect the size of

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	functional departments and the responsibilities of middle management.
1. Functional departments would grow in size.	Point out that computers in the new organization would cut down tremendously on paperwork and ease communication on business matters. Since a supervisor would get very accurate information with little effort, he would have more time to spend with his subordinates. This would permit him to supervise a much larger department, perhaps one containing hundreds of people. The ease of communication, both by the computer and by people, would also make it likely that a department could function properly even if its members are spread great distances apart.
2. Responsibilities of a middle manager would broaden.	Point out that the computer would relieve a middle manager from making many routine decisions. This would give him more time to take on other responsibilities--thus broadening his job. Mention that he would also cover a greater variety of problems. This means that his work would require more independent thought and more broad, general judgment. It is also likely that there would be fewer middle managers. Suggested teacher reference: Laurie, pp. 540-44.
II. Effect of Expanded Computerization on Employees	
A. Changes in kinds of employees	Explain that the highly computerized firm will need more employees (than at present) who can help set up the firm as a system and plan the details of the system. This would include system analysts on various levels, programmers, and equipment specialists. Point out that there would still be a great need for people who maintain

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	contact with customers (such as salesmen and servicemen), those who negotiate with other firms, and those who supervise human-operated production and distribution facilities. In fact, these kinds of employees are likely to be a much greater percentage of the total organization.
	State that expanded computerization is likely to cut down drastically on the number of administrative and clerical employees, other than those mentioned above.
B. Effect on performance of employees	Mention that some authorities say that the highly centralized decision-making would make the new organization very much like the old one-man business. Employees below top management would be practically eliminated from decision-making; this would depersonalize their work. That, in turn, would very likely lower their motivation.
	Point out that no computer system can make *all* decisions, nor can a computer system make perfect decisions, regardless of how detailed the programming is. People must still take part in handling operations in an organization, if only because of human idiosyncracies and intangible factors.
C. Effect on development of management personnel	The new organization will need a great many highly trained, highly specialized staff people who must be trained almost completely outside the organization. Since these specialists would have little experience within the organization, they would very likely not "pull together" with the rest of the organization.
	There would also be a gap between the "Agents" in the field and the managers in the Operations Control Group.
	A further problem (and perhaps a more serious one) would be how to develop people to fit into top management jobs.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
	Such people would need both highly specialized training in systems and years of experience in the organization. To find personnel with both kinds of background would be extremely difficult.
III. Impact of the Computer on Other Facets of Society	
A. Money, banking, and shopping	Explain how the use of a computer in banking, together with a communication network could eliminate present methods of clearing checks. It could also verify account balances, and could charge or credit an account in one bank for transactions made in another bank.
1. Elimination of cash and checks	Continue with a discussion of how stores and other places of business could be connected into the banking network. This would make cash and checks unnecessary for buying at these places and would eliminate tremendous amounts of paperwork.
2. Reduction of mail volume	State that payment of bills for utilities and other services could also be handled through the banking network. This would cut down the volume of mail considerably.
B. Automation of production	Explain that computers are already being used to control some production processes as explained previously. It is likely that many more production processes and plants will be automated in the future. Mention some of the possible extensions of this automation.
C. Information services	Point out that a tremendous amount of information will eventually be available through a computer network, to anyone who needs it.
1. For use by physicians, lawyers, scientists, etc.	Discuss the use of this store of information by physicians to aid in diagnosis of disease, by lawyers to get up-to-date details on court cases, by scientists to inform themselves on recent developments in their specialty, and by others.

CONTENT OUTLINE	TEACHING SUGGESTIONS AND REFERENCES
2. For use in education	Explain that computer-assisted instruction (CAI) is an extension of *programmed instruction*. CAI is already being used to a limited extent. It promises to adapt teaching by computer to each student's individual needs. Mention the use of a computer by time-sharing to permit engineering students to do design operations and computations as part of their course work.
D. Unemployment	Explain that the size of working force to produce all the goods and services needed by our society is likely to decrease gradually as computerization expands. Some of the people thrown out of work, however, will be employed in new jobs in computer operations, and some will go into the expanding service industries. But the net effect after many years will very likely be a big drop in employment. Mention, however, that viewed from another angle, computerization would make it possible to provide everybody's needs with much less human work than now possible.
E. Invasion of privacy	State that opinions vary as to whether the mass of personal information in computers will result in violations of privacy. Mention the information recorded in files of state and Federal governments, such as Social Security records and tax records. Suggested teacher references: Laurie, pp. 544-48, 553. Parkhill, Chap. 8.

APPENDIX A
ILLUSTRATIONS

The illustrations in this teacher's guide are as follows:

		Page
Figure 1	80-Column Punched Card Showing Punched Characters . .	49
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Figure 4	Basic Computer Concepts: Computer Schematic. . . .	55
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Figure 8	Basic Computer Concepts: Control	63
Figure 9	Basic Computer Concepts: Output.	65
Figure 10	Extended Binary Coded Decimal Interchange Code (EBCDIC)	67

They are referred to by figure number at appropriate places in the text of the guide. Use them at these places to clarify the text in covering the material in class.

When you use them for illustrations to go with class discussion you can project them with an opaque projector as they are in the guide, or make transparencies and project them with an overhead projector, or make enough copies to give one to each student.

These illustrations are printed on one side of the sheet only. If you want to make a transparency of one, cut it carefully out of the guide and make a transparency on any thermal copier, using an appropriate transparency blank. For those figures which contain blank boxes, fill in the boxes with appropriate lettering, using a grease pencil.

Besides using the figures for illustrating the text material, you may make copies and give them to the students to fill in as practice exercises or to test them. For those which do not have blank boxes, you may give the students questions to answer, using the figures as illustrations.

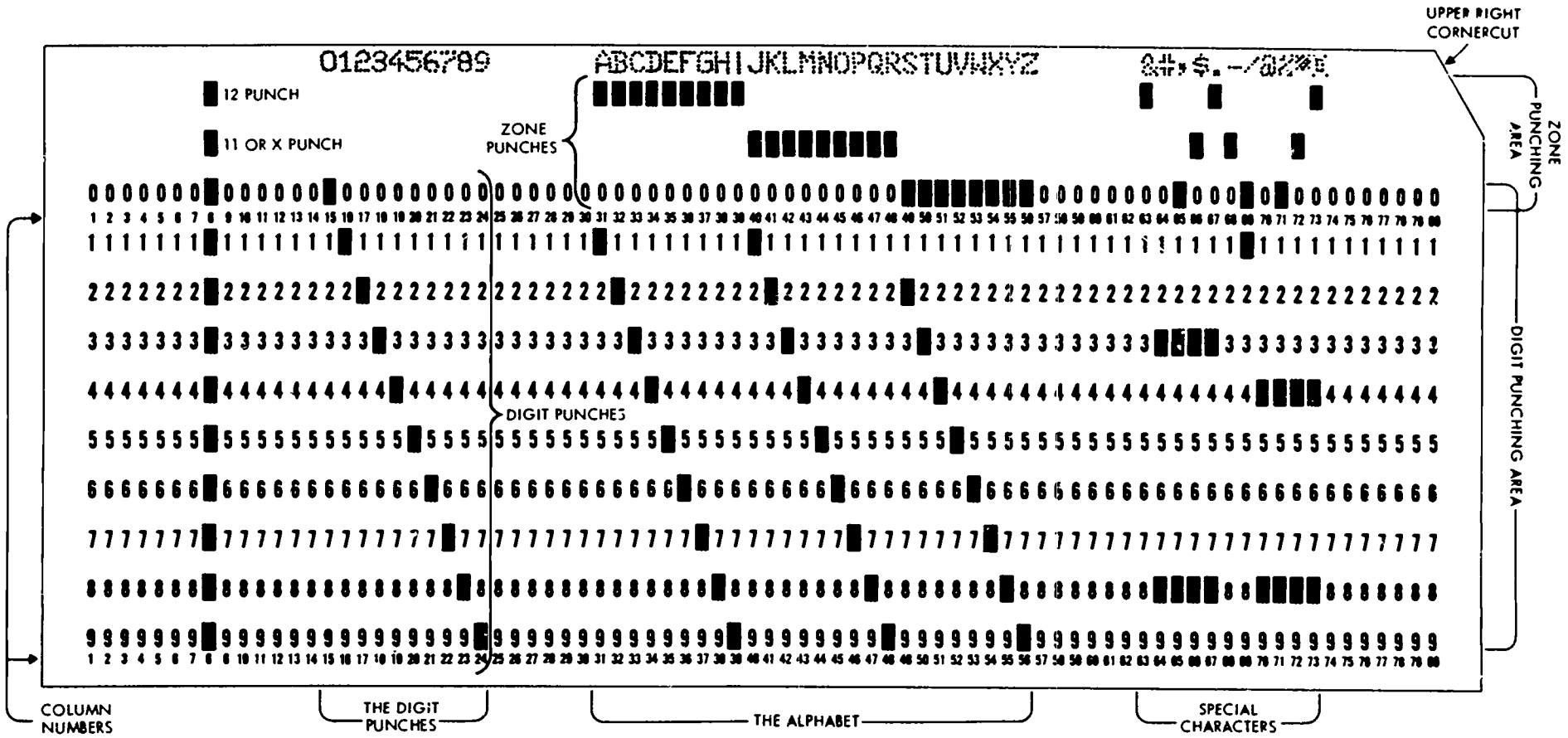

Figure 1
80-COLUMN PUNCHED CARD
SHOWING PUNCHED CHARACTERS

Letter	Card Code	Letter	Card Code	Character	Card Code
A	12-1	N	11-5	0	0
B	12-2	O	11-6	1	1
C	12-3	P	11-7	2	2
D	12-4	Q	11-8	3	3
E	12-5	R	11-9	4	4
F	12-6	S	0-2	5	5
G	12-7	T	0-3	6	6
H	12-8	U	0-4	7	7
I	12-9	V	0-5	8	8
J	11-1	W	0-6	9	9
K	11-2	X	0-7	&	12
L	11-3	Y	0-8	.	12-3-8
M	11-4	Z	0-9	-	11
				$	11-3-8
				*	11-4-8
				/	0-1
				,	0-3-8
				%	0-4-8
				#	3-8
				@	4-8

Figure 2
IBM PUNCHED-CARD CODE

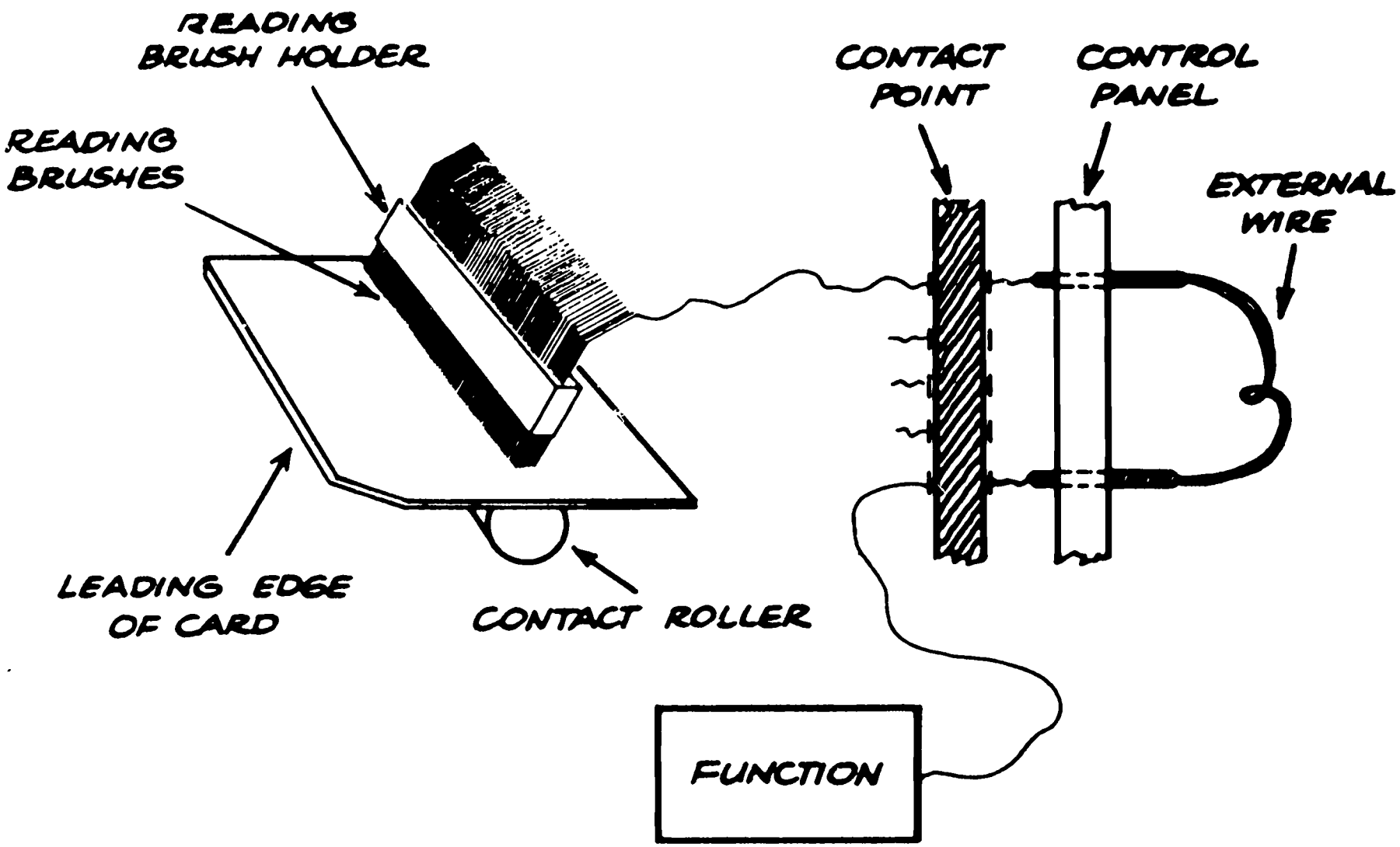

FIG. 3

HOW A CARD IS READ

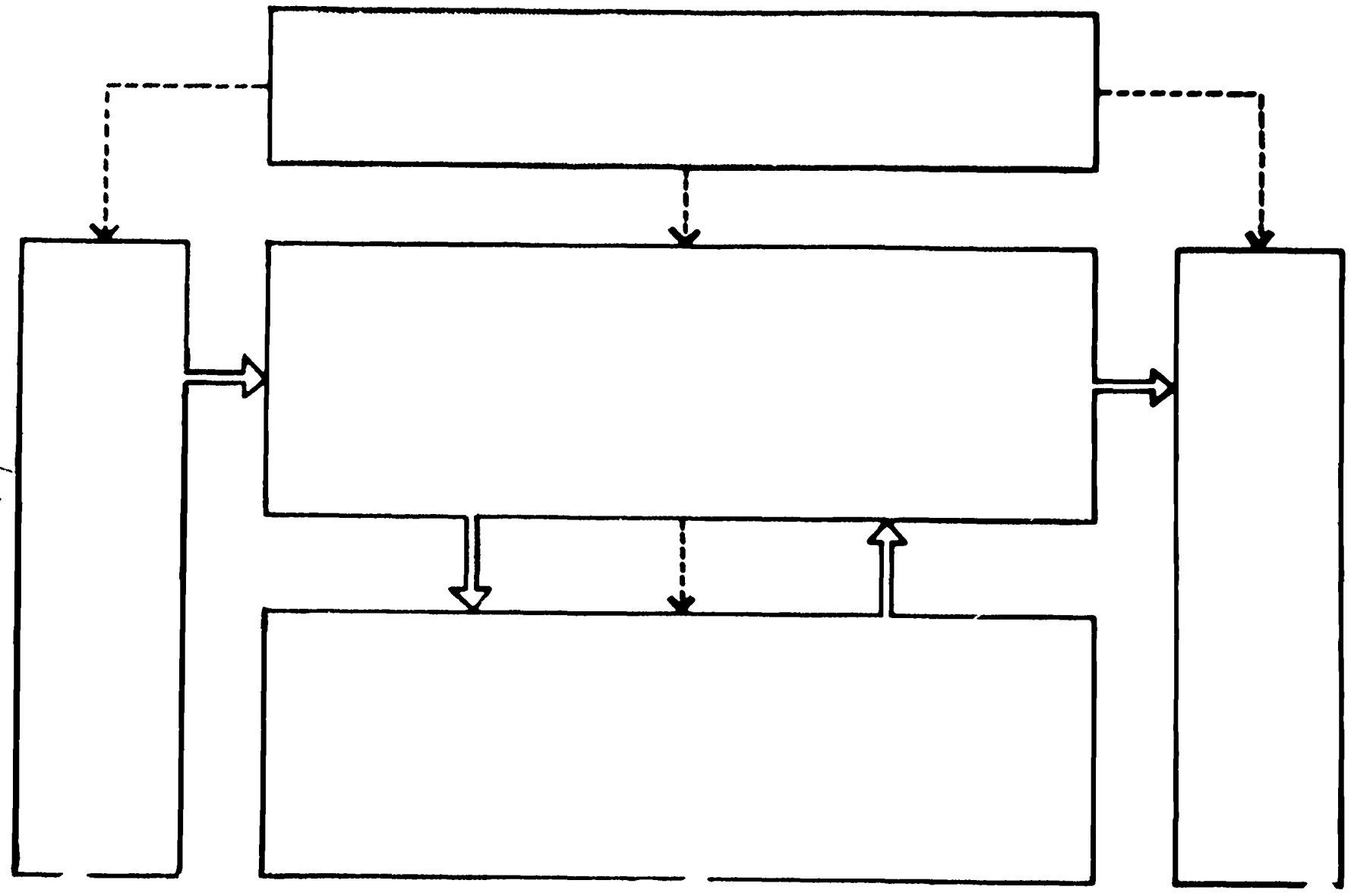

FIG. 4
BASIC COMPUTER CONCEPTS
COMPUTER SCHEMATIC

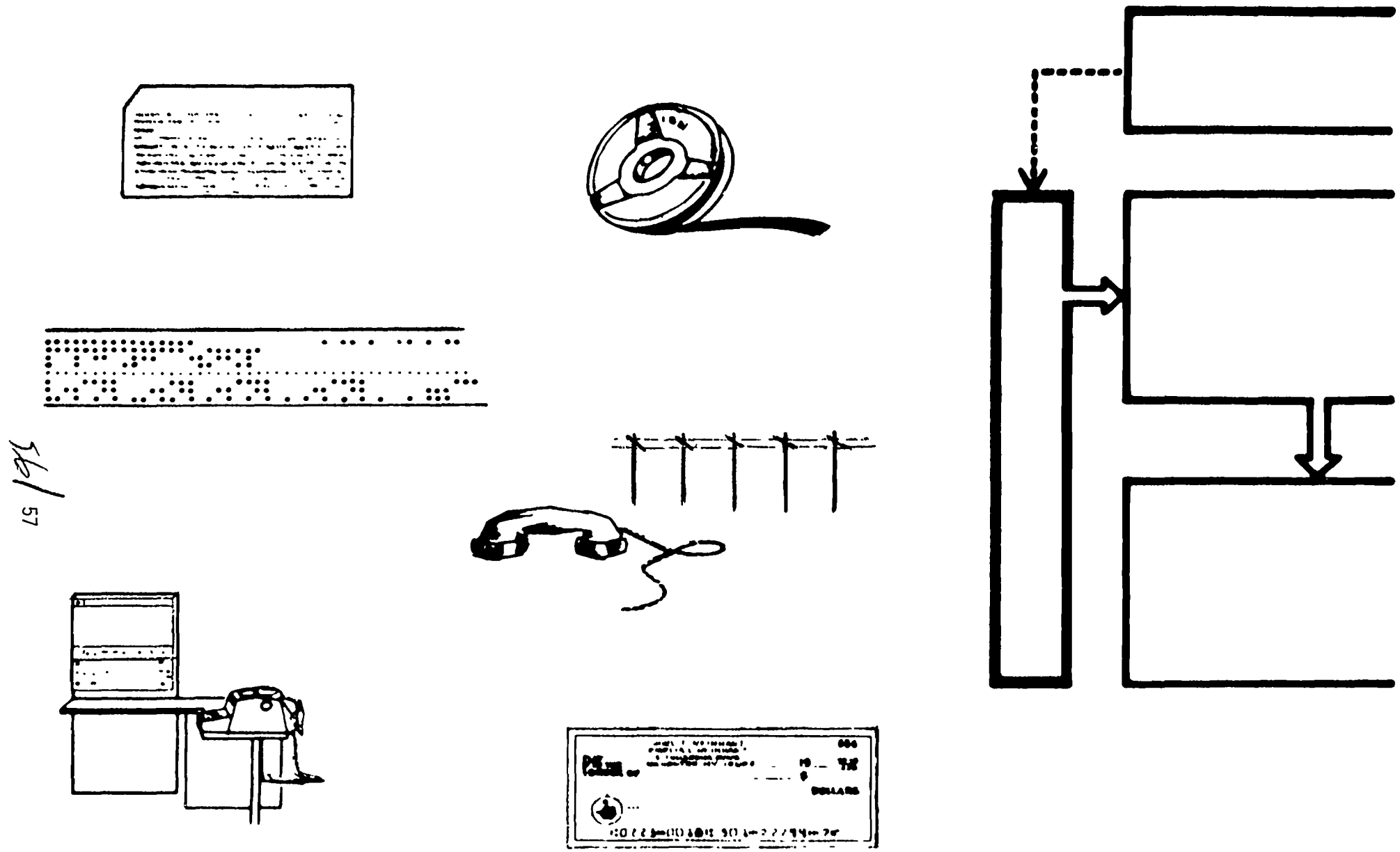

FIG.5

BASIC COMPUTER CONCEPTS....INPUT

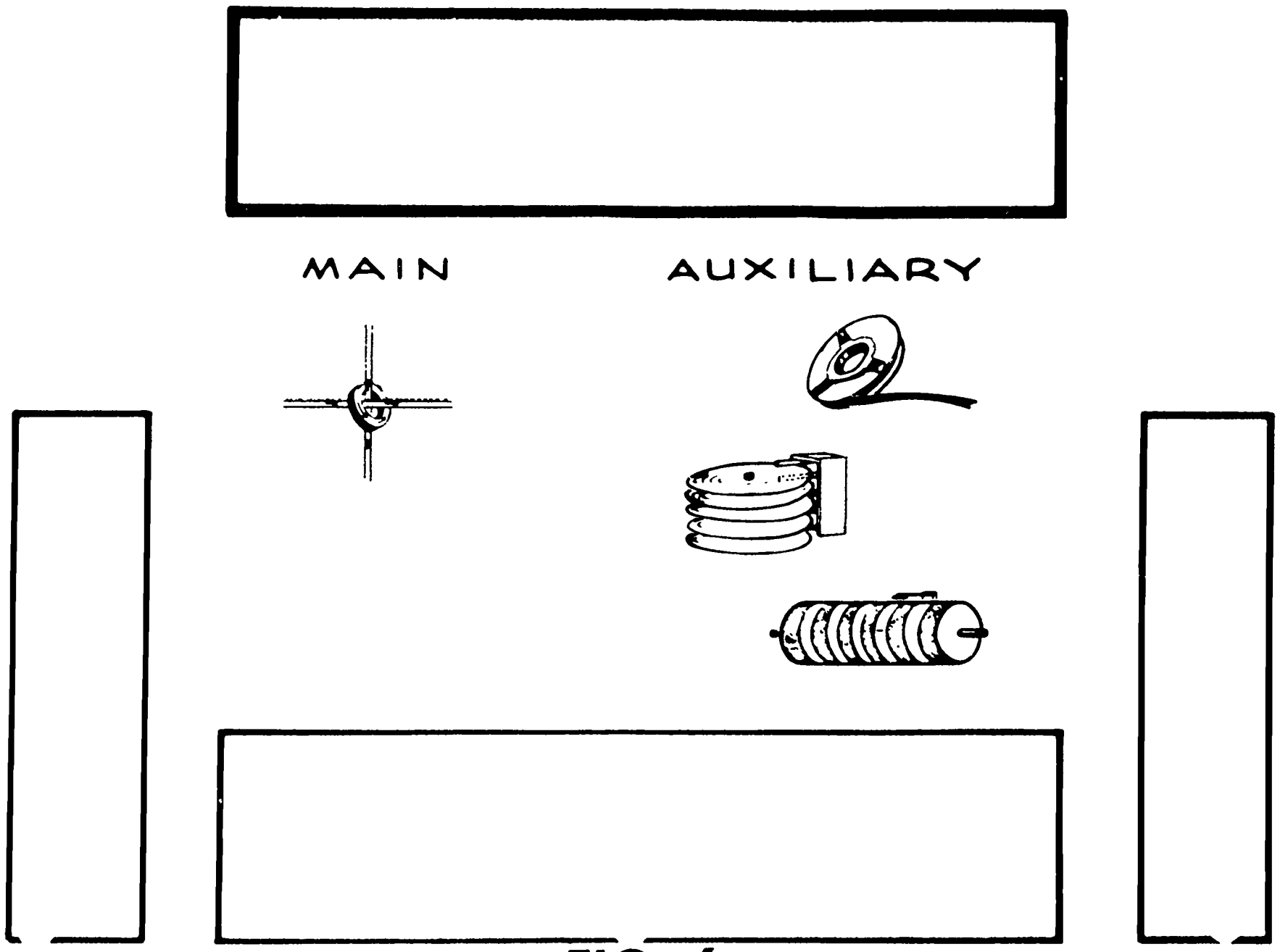

FIG. 6
BASIC COMPUTER CONCEPTS...STORAGE

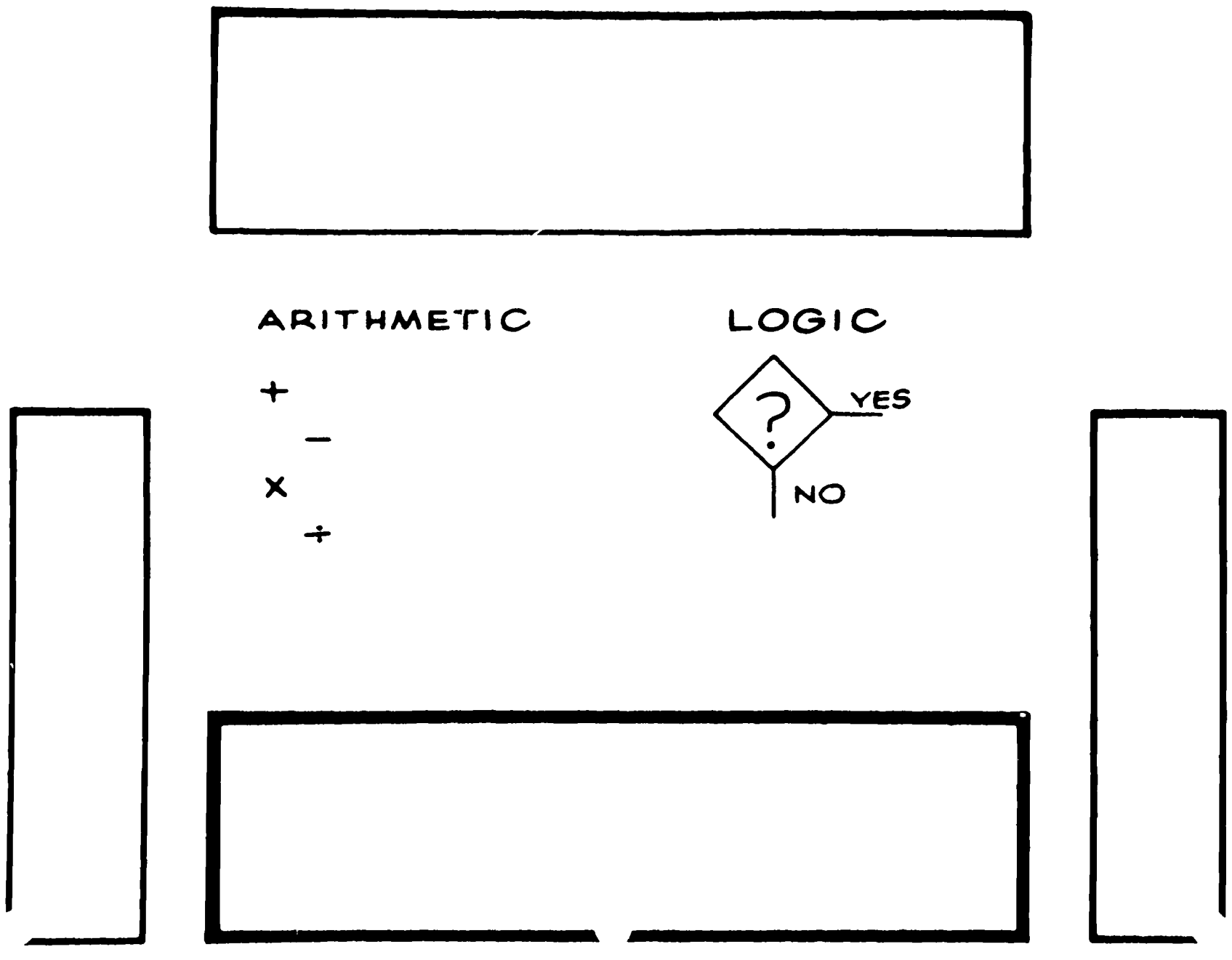

FIG. 7
BASIC COMPUTER CONCEPTS....PROCESSING

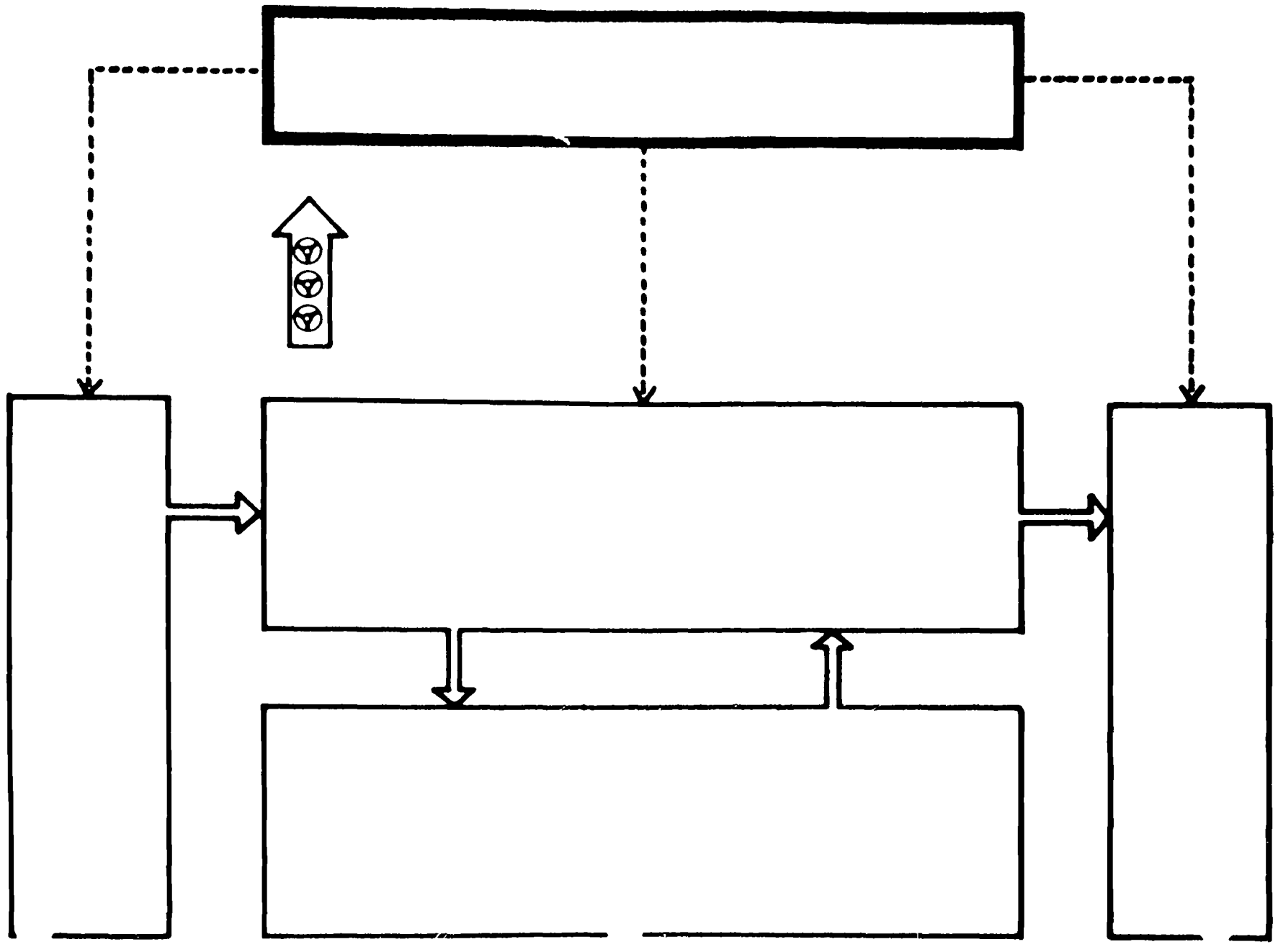

FIG. 8
BASIC COMPUTER CONCEPTS....CONTROL

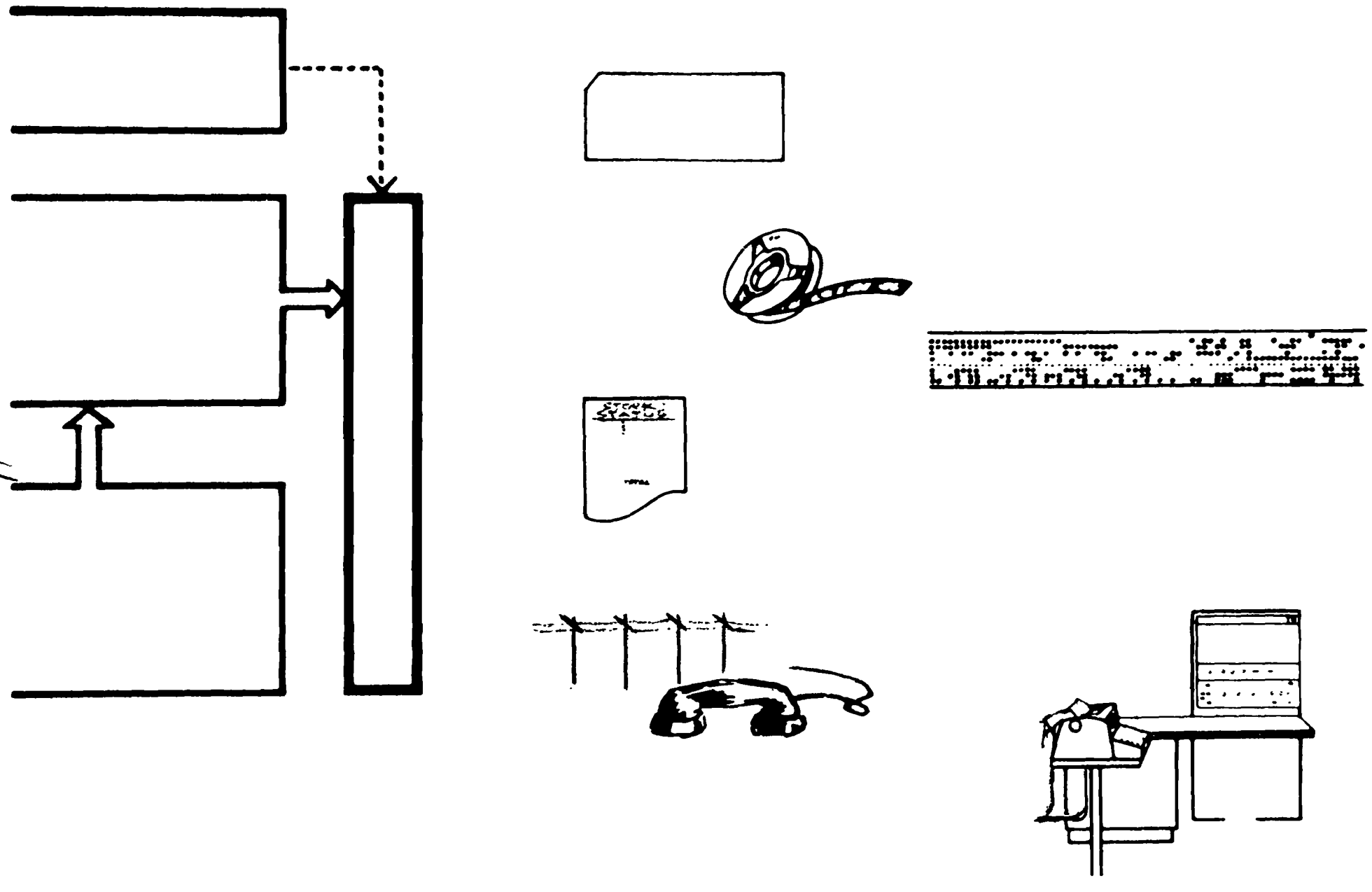

FIG. 9
BASIC COMPUTER CONCEPTS....OUTPUT

Letter	Bit Configuration	Letter	Bit Configuration	Character	Bit Configuration
A	1100 0001	N	1101 0101	0	1111 0000
B	1100 0010	O	1101 0110	1	1111 0001
C	1100 0011	P	1101 0111	2	1111 0010
D	1100 0100	Q	1101 1000	3	1111 0011
E	1100 0101	R	1101 1001	4	1111 0100
F	1100 0110	S	1110 0010	5	1111 0101
G	1100 0111	T	1110 0011	6	1111 0110
H	1100 1000	U	1110 0100	7	1111 0111
I	1100 1001	V	1110 0101	8	1111 1000
J	1101 0001	W	1110 0110	9	1111 1001
K	1101 0010	X	1110 0111		
L	1101 0011	Y	1110 1000	&	0101 0000
M	1101 0100	Z	1110 1001	.	0100 1011
				-	0110 0000
				$	0101 1011
				*	0101 1100
				/	0110 0001
				,	0110 1011
				%	0110 1100
				#	0111 1011
				@	0111 1100

FIGURE 10
EXTENDED BINARY CODED DECIMAL
INTERCHANGE CODE
(EBCDIC)

APPENDIX B
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APPENDIX C
SOURCES OF AUDIOVISUAL AIDS

1. TRW, Inc.
   8433 Fallbrook Avenue
   Canoga Park, California

2. NASA
   Technical Information Division
   1520 "H" Street, N. W.
   Washington, D. C.

3. Modern Talking Picture Service, Inc.
   10 Rockefeller Plaza
   New York, New York

4. The Rand Corporation
   1700 Main Street
   Santa Monica, California

5. System Development Corporation
   2500 Colorado Avenue
   Santa Monica, California

6. Audio Visual Education Center
   University of Michigan
   720 E. Huron Street
   Ann Arbor, Michigan

7. Colburn Film Distributors, Inc.
   P. O. Box 470
   668 N. Western Avenue
   Lake Forest, Illinois

8. University of California
   Public Film Rental Library
   2272 Union Street
   Berkeley, California

9. Arthur Andersen and Company
   120 S. La Salle Street
   Chicago, Illinois

10. Remington Rand UNIVAC
    315 Park Avenue South
    New York, New York

11. Hamilton Film Service
    245 West 55th Street
    New York, New York

12. Your local Bell Telephone business office

13. National Cash Register Co.
    Data Processing Systems and Sales
    Dayton, Ohio

14. Association Films, Inc.
    561 Hillgrove Avenue
    La Grange, Illinois

15. Educational Testing Service
    Horizons of Science
    Princeton, New Jersey

16. G. E. Film Library Service
    3 Penn Center Plaza
    Philadelphia, Pa.

17. North American Aviation, Inc.
    9150 East Imperial Highway
    Downey, California

18. Data Processing Management Association
    International Headquarters
    505 Busse Highway
    Park Ridge, Illinois

19. International Business Machines local office

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New Mexico State Univ., University Park. Agricultural Education
MF AVAILABLE IN VT-ERIC SET.
State Department of Agriculture Education, 130 South Capitol Street, Santa Fe, New Mexico 87501 (single copies available).
PUB DATE - ND 8p.

DESCRIPTORS - *LESSON PLANS; *TEACHING GUIDES; *VOCATIONAL AGRICULTURE; *AGRICULTURAL ENGINEERING; *METAL WORKING OCCUPATIONS; METALS

ABSTRACT - This teacher-developed bulletin is comprised of five suggested lesson plans for use by vocational agriculture teachers in advanced agricultural mechanics courses. Under the unit topic "Cold Metal Work," lessons cover (1) Identifying Kinds of Metal, (2) Cutting Metal, (3) Drilling Metal, (4) Bending Metal, and (5) Threading. Lesson plans include objectives, references, study Questions, summary of information, and teaching suggestions. (AW)

VT010 251

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SUGGESTED

LESSON PLANS

FOR

COLD METAL WORK

IN

VOCATIONAL AGRICULTURE

U.S DEPARTMENT OF HEALTH, EDUCATION
& WELFARE
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VT010251

AGRICULTURAL MECHANICS II

Subunit: Cold Metal Work

Lesson: Identifying Kinds of Metal

Objectives:

1. To teach students to distinguish between the different types of metals.
2. To teach students to identify different types of steel stock and how it is measured.

References:

1. Shopwork on the Farm
2. Farm Welding
3. The Farm Shop

Motivation:

Hold up a piece of 3" channel iron and ask the class what kind of iron it is. How is it measured? What is the correct name for it?

Study or Discussion Questions:

1. What type of spark does each type of metal give off?
2. What is an easy way of determining hardness in metal?
3. What are the common characteristics of metal?
4. How can one distinguish ferrous from non-ferrous metals?
5. How can you identify high carbon metals from low carbon metals?
6. Explain each of the following:
   a. Tensile strength
   b. Elasticity
   c. Yield point
   d. Yield strength
   e. Ductility
   f. Brittleness
   g. Toughness
   h. Hardness

Summary of Information:

1. Cast iron gives off a small volume of numerous small sparks. They are dull red changing to yellow.
   Wrought iron sparks are more numerous in volume, light yellow and follow straight lines.
   Mild steel sparks are more explosive or forked.
   Tool steel gives off a moderately large stream of sparks that are lighter in color and more explosive or forked than is mild steel.
2. A machinist's hand file is used to determine the resistance of the material to the cutting action of the file and from this an estimate of the hardness can be made.
3. If some treatment is given to a piece of metal so that hardness is increased, tensile strength will be increased, and the ductility will be reduced. As a metal is heated, it becomes soft and its ductility increases while its tensile strength is lowered.

Identifying Kinds of Metal (continued)

4. By use of a magnet.
5. The high carbon will file much harder than the low carbon.
6. Tensile strength - the measure of the strength a part will stand in direct pull before it breaks.
   Elasticity - the amount a metal part will stand either pulled, twisted, bent or squeezed, before it permanently deforms.
   Yield point - a point at which the length of the metal will increase without further pull.
   Yield strength - the pounds per square inch required to produce a deformation in a material.
   Ductility - a material that can be permanently deformed without failure.
   Brittleness - the ability of the metal not to distort before failure.
   Toughness - a material that can withstand considerable stress, slowly or suddenly, continuously or often applied, and which will deform before failure.
   Hardiness - the resistance of a material to the forceable penetration of another material.

Teaching Suggestions:

1. Have students dress down a grinding wheel.
2. Demonstrate the spark test on an assortment of metals.
3. Have students identify an assortment of metals by appearance.
4. Have students determine hardiness of metals.
5. Demonstrate the use of a magnet to determine ferrous from non-ferrous metals.
6. Demonstrate the sound method for determining carbon content of metals.
7. Have students identify various stock and sizes from a previously prepared assortment of material.
8. Have students measure various sizes of pipe and other steel stock.

AGRICULTURAL MECHANICS II

Subunit: Cold Metal Work

Lesson: Cutting Metal

Objective:

To teach the proper procedure for cutting metal with the hand hacksaw and with power metal cutting saws.

Reference:

Shopwork on the Farm

Study or Discussion Questions:

1. What are the three types of hacksaw blades? What are their uses?
2. How many teeth should be cutting at the same time?
3. How tight should the blade be in the frame?
4. What are the different ways for starting a saw in the metal?
5. What determines the kind of blade (number of teeth) to use?
6. List the key points on using the power hacksaw.

Summary of Information:

1. (a) All hard, (b) flexible, and (c) high speed steel. All hard blades have the whole blade tempered; they are suitable for general use where the work to be sawed is held securely. The flexible blades have only the teeth hardened, not the back; they are used where there is danger of cramping and breaking. High speed steel blades are made of a special steel that will cut much faster and longer.
2. There should be two or more teeth in the metal at all times.
3. The blade should be tight but not overstrained. A blade is usually tightened until it gives a humming note when picked with the thumb.
4. A file notch makes it easier to start the hacksaw exactly on a line and decrease the danger of breaking out teeth.
5. Blades are selected according to the kind of metal to be sawed. Blades with 18 or more teeth per inch are used for thin metal. Coarser-toothed blades are used for faster cutting in heavy stock.
6. Always clamp the work securely in the saw vice. Always set the blade in motion and start the blade in the work under light pressure. Use less pressure on thin metal than on heavier stock. Always keep the blade tight in the saw frame. Clamp thin sections of metal so the blade does not cut across the thin dimension. Clamp angle iron with the ridge up. Make sure the blade is in so the teeth are pointing in the direction of cutting. Do not push down on the saw to increase pressure. Run the power saw according to the manufacturer's specifications.

Teaching Suggestions:

Demonstrate the proper procedure for clamping angle iron, round stock, pipe, channel iron, short pieces, and thin metal.

AGRICULTURAL MECHANICS II

Subunit: Cold Metal Work

Lesson: Drilling Metal

Objective:

To teach students how to drill holes in metal satisfactorily.

Motivation:

Equipment for drilling holes in metal is one of the more useful operations in the farm shop. A few drilling tools permits a farmer to make many necessary repairs.

Demonstration:

1. Use a center punch to locate or start a twist drill.
2. Demonstrate how to measure a drill bit with a caliper and rule.
3. Show students the procedure for securing the drill into the chuck.
4. Emphasize clamping all work to the drill table.
5. Demonstrate drilling in round stock. Emphasize how to secure metal using a v block.
6. Explain the use of cutting oil to lubricate the bit. Discuss why cutting oil should not be used to lubricate bearings.
7. Discuss how bits are damaged in drilling.
8. Explain why a small pilot hole is drilled first in drilling largeholes.
9. Show how to drill in thin metal.
10. Show how to countersink with a drill bit.

Teaching Suggestions:

Discuss the "points on drilling", Shopwork on the Farm.

AGRICULTURAL MECHANICS II

Subunit: Cold Metal Work

Lesson: Bending Metal

Objective:

To teach the students the methods and procedures to use in bending metal in the shop.

References:

1. Shopwork on the Farm
2. The Farm Shop

Motivation:

It is usually more satisfactory to bend small pieces of metal cold than it is to heat them. The thicker the metal the weaker a bend becomes.

Demonstration:

1. Make a uniform bend of large size, slip the end of the stock through the jaws of a vice and pull gently. Make a series of short bends.
2. Clamp a short heavy bar in a vice and bend by hammering.
3. Bend a bar of strap iron around a pipe or rod to make a uniform bend.
4. Use a vice and a wrench to twist a piece of flat metal.
5. Make a twist in a long piece of metal by fitting a pipe over it to keep the metal from bending.

AGRICULTURAL MECHANICS II

Subunit: Cold Metal Work

Lesson: Threading

Objectives:

1. To teach the students the proper procedure for threading bolts.
2. To teach students to become proficient in the use of taps and dies or screw plate.

References:

1. Shopwork on the Farm
2. The Farm Shop

Motivation:

Take students to the shop and demonstrate the proper procedure for threading a bolt and tap.

Study or Discussion Questions:

1. How is the rod prepared for threading? How is this accomplished?
2. How should a tap or die be started?
3. How is the size and kind of die to use determined?
4. What are the different kinds of threads? How are they different?
5. What kind of oil should be used to make threads?

Summary of Information:

1. File, hammer, or grind a slight taper on the rod so the die will start on easily.
2. Exert equal pressure on the two handles of the stock and turn, being careful that the die is started on straight. Lubricate the die by applying threading oil. Do not back die up until thread is completed.
3. The hole must be drilled somewhat smaller than the size of the bolt to be screwed into it, about 1/16" smaller for 1/2 to 1/4 inch bolts. It is usually best to refer to a table (Shopwork on the Farm).
4. Bolt threads are of two standards: national coarse and national fine. Coarse threads are commonly used on farm machinery and fine threads are used on automobiles, trucks and tractors. Machine screw threads are really small bolts under 1/4 inch in size. These have much smaller or more threads per inch. Pipe threads, known as Briggs standard threads have a slight taper of about 1/16" per inch of threads.
5. Threading oil or lard oil.

Teaching Suggestions:

Review the threading procedure demonstrated in the motivation. If possible, have each student practice making threads in the shop.

VT 010 253
Vocational Industrial Education Service; Sheet Metal (Course Outline and Equipment List).

West Virginia State Board of Education, Charleston. Bureau of Vocational, Technical, and Adult Education
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ABSTRACT - Developed by teachers attending inservice workshops, this course outline and equipment list is intended to provide statewide standards for courses in vocational sheet metal. The first section of the manual is a topical outline of the 2-year program, broken down into individual 6-week periods. Some subject areas covered are sheet metal hand tools and machines, manipulative procedures, layout and construction of air-conditioning fittings, and cornice and gutter problems. Section II lists suggested equipment and tools for the program, including description of the item, quantity, and unit and total cost. Also included are suggestions for shop layout, sheet metal facilities and equipment standards, textbooks, reference books, instructional aids and films, and projects. (AW)

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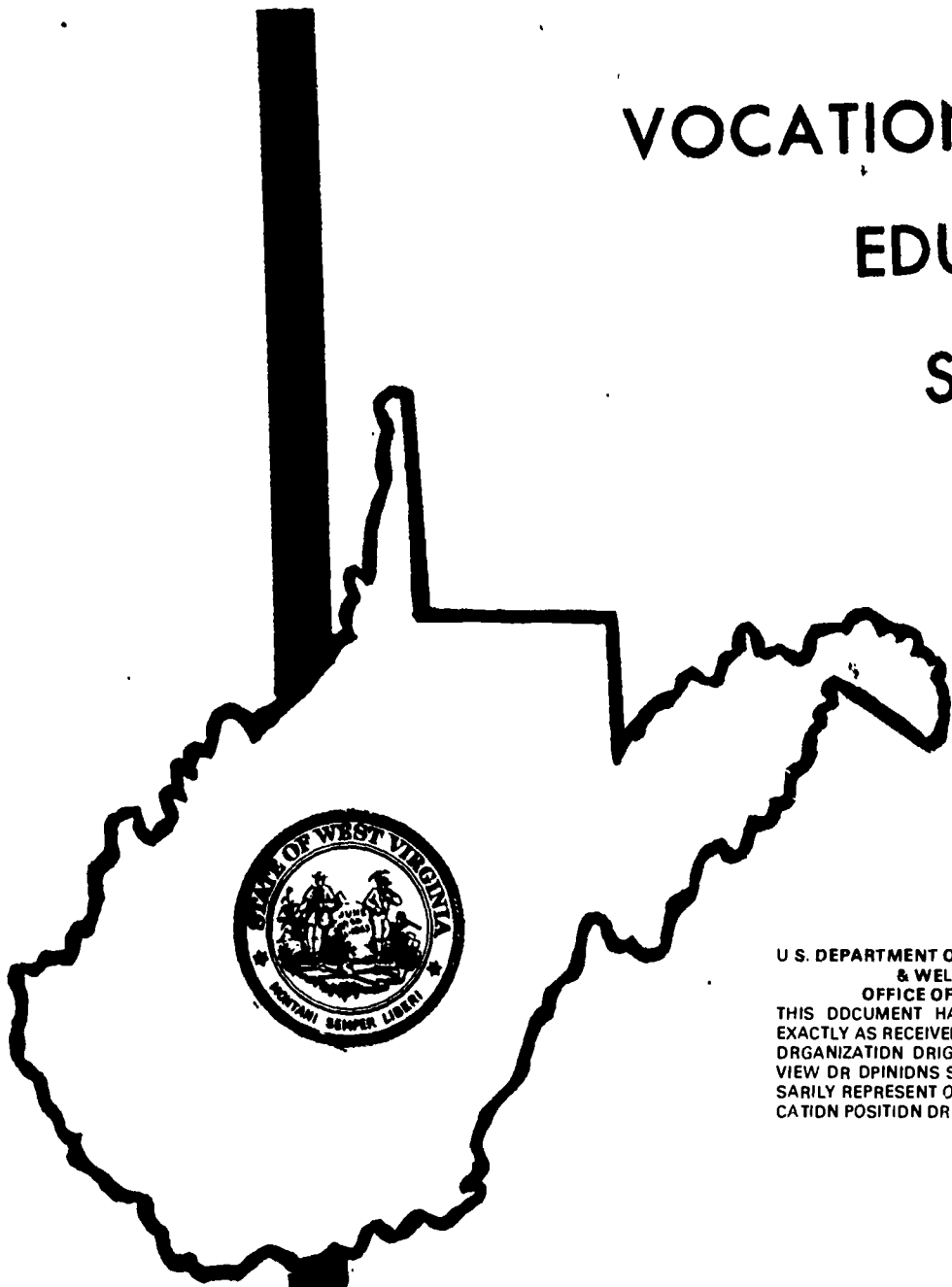
VOCATIONAL INDUSTRIAL EDUCATION SERVICE



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SHEET METAL

WEST VIRGINIA
STATE BOARD OF EDUCATION
Bureau of Vocational, Technical, and Adult Education
STATE CAPITOL
Charleston, West Virginia

VT010253

FOREWORD

The underlying purpose of this Sheet Metal course outline and equipment list is to establish a set of standards which can be used on a statewide basis by an instructor teaching a Vocational Sheet Metal course.

This outline and equipment list was developed as a result of several in-service workshops by the Vocational Sheet Metal instructors of West Virginia and the State Staff of Vocational Industrial Education.

OBJECTIVES

1. To develop the essential skills, attitudes, knowledge, and appreciations necessary for a successful entrance into the field of Sheet Metal.

2. To develop an appreciation for the use and care of tools.

3. To develop the principles and practices of Sheet Metal as related to industry.

4. To develop layout abilities and blueprint reading as they relate to the field of Sheet Metal.

5. To provide a knowledge of the conventional practices of Sheet Metal.

6. To prepare the student to meet intelligently, the problems that will arise as he takes his place in the work force as a Sheet Metal worker.

7. To provide an understanding of employer-employee relationships.

8. To develop manipulative abilities comparable to those required by the Sheet Metal industry for successful entrance into this field.

9. To provide some of the skills and knowledges unique to the specialized fields of Sheet Metal.

10. To provide the vocabulary necessary to communicate within the field of Sheet Metal.

11. To provide an insight into the conduct required of workers in the Sheet Metal industry.

PURPOSE OF VOCATIONAL INDUSTRIAL EDUCATION

The major purpose of Vocational Industrial Education is to help the individual develop effective ability in order that he may have or make an advantageous entrance into an industrial, technical, trade, or service occupation in which he will be socially accepted and prepared to assume his leadership role.

Vocational Industrial Education is a definite part of the public school program in West Virginia. It does not take the place of any other form of education but supplements and enhances it. Students desiring the training for any industrial, technical, trade, or service occupation may select Vocational Industrial Education and still earn sufficient credits to satisfy requirements for graduation from a high school. It should also provide him with a background for many of the related or similar occupations.

The program of Vocational Industrial Education also provides for other categories of training such as: trade extension, occupational extension, apprentice related instruction, work cooperative program, supervisory training, public service training, i.e., in other words it is a broad program of continuing practical education for those who are preparing to enter, or upon having entered extend their work knowledges.

"The primary purposes of a Vocational Industrial Education program may be stated as follows:

(1) To provide extension or preparatory courses and services for employed and unemployed adults of the community that will lead to the development of skills or technical knowledge or both in accordance with their need for such courses. In order to provide worker replacements and to meet changing work requirements as these are determined by the schools in cooperation with employers and labor representatives.

(2) To assist youth while still in school in selecting occupations in manufacturing or service fields of work; to provide training of less than college grade preparatory to employment; and to assist those so prepared in obtaining employment in the occupations for which training has been given.

(3) To design all courses so that the principles of good citizenship and good workmanship as well as the organization and economy of our industrial system will be considered."

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ANALYSIS

First Year
1st - 6 Wks.

I. Introduction

A. Sheet Metal and Steel Shapes

1. Kinds and Identification of Materials and Supplies
2. Gauges, Weights, and Comparisons

B. Sheet Metal Work

1. Scope
2. Standard of Workmanship

C. The Apprentice and Journeyman

1. Definition and Comparison
2. Knowledge and Background
3. Craftsmanship

II. Sheet Metal Hand Tools

A. Measuring and Layout Tools

1. Description
2. How to Use
3. Care and Treatment
4. Safety
5. Grades of Manufacture

B. Fabricating and Assembling Tools

1. Description
2. How to Use
3. Capacities
4. Care and Treatment
5. Adaptability to Job
6. Sizes
7. Grades of Manufacture
8. Lubrication
9. Safety

C. Forming Stakes and Dollies

1. Description and Names
2. Uses
3. Methods of Holding Stakes
4. Care and Treatment
5. Construction
6. Safety

<u>First Year</u>
<u>2nd - 6 Wks.</u>

I. Sheet Metal Machines

A. Bar Folder

1. Description
2. Adjustments and Stops
3. Edges and Folds Formed on a Bar Folder
4. How to Use - Including Precautions in Operating
5. Checking and Setting

B. Standard Hand Brake

1. Description
2. Types of Work Formed on a Brake
3. How to Use
4. Determining Proper Sequence of Forming
5. Precautions in Operating
6. Safety

C. Square and Gap Shears

1. Description
2. Kinds of Gauges and Hold-Down Attachments
3. Sizes and Capacities
4. How to Use - Operating Precautions
5. Safety Precautions

D. Slip Roll Forming Machine

1. Description (Types and Kinds)
2. Adjustments
3. How to Use - Operating Precautions
4. Procedure for Forming Cylindrical and Tapering Shapes

E. Ring and Circle Shear

1. Description
2. Difference Between Circle and Ring and Circle Shear
3. Adjustments
4. How to Use - Operating Precautions
5. Sizes and Capacities
6. Slitting
7. Safety

<u>First Year</u>
<u>3rd - 6 Wks.</u>

I. Sheet Metal Machines (continued)

A. Burring, Turning and Wiring Machines

1. Description of Machines
2. Comparison of Edges
3. Gage Adjustments and Setting
4. Adjustment of Rolls
5. Holding of Work
6. Procedure for Forming Operations
7. Safety

B. Beading and Crimping Machines

1. Description of Machines
2. Description of Beads and Crimps
3. Correct and Incorrect Beading and Crimping
4. Adjustments and Capacities
5. Safety

C. Foot and Lever Punches

1. Description
2. Differences in Construction
3. Selection of Punches and Dies
4. Procedures for Changing Punches and Dies
5. Safety

D. Drill Press

1. Description
2. Types
3. Devices for Holding Work
4. Adjustments and Stops

5. Drills, Sizes, Speeds, Kinds
6. Lubricants
7. Safety

E. Bench and Portable Grinders

1. Description of Grinders
2. Types and Kinds of Grinding Wheels
3. Manufacturers Specifications
4. Selection of Proper Wheels
5. Dressing Wheels
6. Operation of Grinder
7. Safety

F. Spot Welder

1. Description and Kinds
2. Operation
3. Processes and Methods
4. Capacities
5. Safety

G. Oxy-Acetylene Welding

1. Description
2. Types of Torches and Operation
3. Rods and Fluxes - Their Uses
4. Safety Equipment

H. Arc Welding

1. Description
2. Kinds of Machines
3. Polarities
4. Types of Rods - Sizes and Uses
5. Proper Operation of Machines
6. Safety Equipment

<u>First Year</u>
<u>4th - 6 Wks.</u>

I. Manipulative Procedures

A. Measurement and Layout

1. Definitions and Background
2. Description of Layout and Measuring Tools

3. How to Use Layout and Measuring Tools
4. Methods and Sequences
5. Patterns
6. Care and Uses of Patterns
7. Transferring Patterns

B. Cutting and Notching

1. Description of Notches
2. Tools Used in Cutting and Notching
3. Care Used in Cutting and Notching
4. Sequences and Procedures
5. Safety

C. Drilling, Punching and Piercing

1. Drills - Kinds, Structure, Speeds and Sizes
2. Description of Electric Drill Motors
3. Care and How to Use Drill Motors
4. Lubricants
5. Description of Hand Punches - Types and Operation
6. Punches and Dies - Sizes and Construction
7. Proper Use of Hand Punches
8. Chisels - Types and Uses
9. Cutting Angles of Chisels
10. Grinding and Care of Chisels
11. How to Cut and Pierce

<u>First Year</u>
<u>5th - 6 Wks.</u>

I. Manipulative Procedures (continued)

A. Bending and Forming

1. Tools and Machines Used in Bending and Forming
2. Angle of Bends - Accuracy and Checking
3. Limits of Bends
4. Setting for Gauge Thicknesses
5. Proper Sequences in Bending and Forming

B. Seaming and Joining

1. Kinds, Types and Construction of Seams and Joints
2. Allowances for Seams and Joints
3. Seams Best Suited for Different Jobs
4. Machines Used in Construction of Seams and Joints

5. Tools Used in Seaming and Joining
6. Care and Precaution in Seaming and Joining
7. Procedures in Seaming and Joining
8. Rivets - Sizes and Types
9. Rivet Sets - Uses, Care and Sizes
10. Hand Grooves - Uses, Care and Sizes
11. Safety

C. Soldering

1. Description and Uses of Common Types of Soldering Coppers
2. Sizes of Soldering Coppers
3. Methods of Heating Soldering Coppers
4. Filing, Tinning and Forging Soldering Coppers
5. Properties of Soft Solders
6. Fluxes-Kinds, Metals Best Suited For
7. Fluxes-Necessity and Action in Soldering
8. How to Solder - Lap Seams, Grooved Seams, Riveted Seams and Bottoms

<u>First Year</u>
<u>6th - 6 Wks.</u>

I. Manipulative Procedures (continued)

A. Assembling

1. Methods of Assembling
2. Jigs
3. Clamping
4. Fasteners - Bolts, Rivets, Screws, and Welding
5. Filing, Buffing, and Sanding
6. Files - Parts of, Shapes, Cuts and Care
7. Checking - Correct Dimensions and Workmanship
8. Painting and Touch-Up
9. Live Work Projects

<u>Second Year</u>
<u>1st - 6 Wks.</u>

I. Layout and Construction of Air Conditioning Fittings

A. Air Conditioning Seams and Joints

B. Elbows - Regular

1. 90 Degree Elbow with Square Throat & Heel
2. 90 Degree Elbow with Square Throat & Curved Heel
3. 90 Degree Elbow with Curved Throat & Heel
4. Change Elbow
5. 45 Degree Change Elbow

C. Y's

1. 90 Degree Y Branch
2. 90 Degree two-way Y Branch
3. Two-way Y Branch with a 60 and 30 Degree Branch
4. 45 and 60 Degree Y Branch
5. Three-way Y Branch One at 60 Degree

D. T's

1. 90 Degree T with Clinch Edges on the Cheeks, Throat, and Heel
2. 90 Degree T with S Edges on the Cheeks and Clinch Edges on the Throat and Heel
3. T on a Pitch with Clinch Edges on the Throat, Heel, and Cheeks
4. Elbow T with Clinch Edges

Second Year
2nd - 6 Wks.

I. Layout and Construction of Air Conditioning Fittings (continued)

A. Elbows - Riveted

1. 90 Degree Riveted Elbow
2. 90 Degree Soldered Elbow
3. 90 Degree Elbow with Curved Vanes
4. 90 Degree Square Throat and Heel Elbow with Vanes

B. Elbows - Standing Seam

1. 90 Degree Standing Seam Gore Elbow
2. 90 Degree Change Gore Elbow

C. Transitions

1. Transition Joint with Three Sides Straight
2. Transition Joint with Two Sides Straight
3. Transition Joint with the Top Flat and One Side Straight
4. Transition Joint with All Sides Tapering

Second Year
3rd - 6 Wks.

I. Layout and Construction of Air Conditioning Fittings (continued)

A. Offsets

1. Offset with a Square Throat and Back
2. Offset with Radius Given
3. Plain Offset with Curved Throat and Back
4. Transition Offset
5. Double Offset
6. Y Branch and Offset Combined

II. Triangulation Layout and Construction of Transitional Fittings

A. Square to Round Transitions

1. Square to Round Fittings
2. Square to Round with Two Sides Straight
3. Irregular Twisted, Square to Square

Second Year
4th - 6 Wks.

I. Triangulation Layout and Construction of Transitional Fittings (continued)

A. Rectangle to Round Transitions

1. Rectangle to Round Fitting
2. Rectangular to Round
3. Rectangular to Round Off Center
4. Rectangular to Round On A Pitch
5. Rectangle to Round Offset

Second Year
5th - 6 Wks.

I. Practical Cornice and Gutter Problems

A. Roman Moldings

B. Cornice Moldings

1. Square Return Miter
2. Butt Miter
3. Pediment Molding, Mitering on a Wash

C. Octagonal Roof

<u>Second Year</u>
<u>6th - 6 Wks.</u>

I. Practical Cornice and Gutter Problems (continued)

A. Conductor Head

II. Sky Lights

A. Flat Sky Light

B. Double Pitch Sky Light

C. Live Work

OPTIONAL -- (To be determined by area needs)

III. Thermo-Plastics

A. Theory and Practice

B. Moulding

C. Forming

D. Welding

E. Injection

F. Extrusion

G. Layout

I. Fabrication

1. Adhesives
2. Tools

EQUIPMENT AND TOOL SPECIFICATIONS
For
VOCATIONAL SHEET METAL SHOP

Part 1 - EQUIPMENT

QUANTITY	DESCRIPTION	UNIT COST	TOTAL COST
1	Angle Iron Bender, cutter and notcher capacity 2" x 2" x 1/4"	$ 275.00	$ 275.00
2	Bar Folder, 36" adjustable, with encased counterbalance, 22 gauge	350.00	700.00
1	Beading machine, heavy duty, 18 gauge, 12" throat complete	350.00	350.00
1	Chicago-Smith or equivalent Box and Pan Brake, 14 gauge 4' long	950.00	950.00
3	Combination Bench machine with burring turning and wiring rolls, 22 gauge 1 1/2" rolls	120.00	360.00
1	Crimping and Beading Machine, 20 gauge complete	135.00	135.00
1	Drill Press 20" Floor Model 1" key chuck, variable R.P.M., adjustable table, motor 2 speed	600.00	600.00
1	Easy Edger, 22 gauge, 7/32" flange	90.00	90.00
1	Lever Punch, 12 gauge, 24" throat 2" hole capacity. Complete set of punches and dies by 32's and punch and die adapters	700.00	700.00
1	12" Grinder bench 2 H.P. capacitor start, 1725 R.P.M., three phase, ball bearing motor, complete with wheel guards and eye shields	400.00	400.00
1	8" Grinder, 1/2 H.P., 3450 R.P.M. 115/230 volts, single phase, 60 cycle, with eye shields, tray and pot	120.00	120.00
1	Gap Shears, 16 gauge, 48" gap, foot operated, 18" throat length	1,000.00	1,000.00

QUANTITY	DESCRIPTION	UNIT COST	TOTAL COST
1	Pittsburgh Lock Former, 20 gauge, 3/4 H.P. with double seam rolls, drive cleat rolls	$ 825.00	$ 825.00
1	Ring and circle shear, 20 gauge, 3 1/2" x 20 1/2" diameter	375.00	375.00
1	Slip Roll Former, 22 gauge, 2" diameter, rolls x length of rolls for 36" sheets	175.00	175.00
1	Power Slip Roll Former, 16 gauge, 3" diameter, rolls x length of rolls for 48" sheets, safety equipped	1,400.00	1,400.00
1	Squaring Shears, 16 gauge, 36" long	475.00	475.00
1	Standard Hand Brake, 14 gauge, 10 ft. capacity, with complete set of forming moulds	1,350.00	1,350.00
1	Welder, spot, 12 gauge, 24" throat, floor model, equipped with electronic timer	1,000.00	1,000.00
1	Welder, spot, portable 12 gauge 24" throat, 30 amps. 1/8" capacity	195.00	195.00
1	Combination Brake and Folder, 22 gauge, 42" long	600.00	600.00
1	Hossfeld Bender No. 1 with hydraulic unit	1,000.00	1,000.00
1	Welder, combination arc and Heliarc 250 amp.	900.00	900.00
1	Welding, oxy-acetylene outfit-complete	170.00	170.00
1	Pull Max or equivalent 3/16 capacity complete	2,850.00	2,850.00
1	20" Metal cutting band saw	1,400.00	1,400.00
1	6" x 6" horizontal metal cutting band saw	400.00	400.00
10	2 1/2' x 10' work benches with laminated wood top with storage beneath	175.00	1,750.00

QUANTITY	DESCRIPTION	UNIT COST	TOTAL COST
1	Air compressor or access to one rated 10 C.F.M.	$ 550.00	$ 550.00
1	16' chalk board	250.00	250.00
1	Instructor's desk	75.00	75.00
20	Stools, adjustable height 24" to 33"	9.00	180.00
1	Squaring shear 10' - 16 gauge - 144" - Pexto U-1120 or equivalent	4,550.00	4,550.00
			$26,150.00
	Part 2 - HAND TOOLS		
6	Bench Plates 8" x 30"	$24.00	$144.00
6	Bench Vise 4" Jaw Mach.	55.00	330.00
1	Pipe Vise 2" cap.	15.00	15.00
36	C-Clamps 4"	3.00	108.00
12	C-Clamps 6"	3.50	42.00
12	C-Clamps 8"	5.25	63.00
12	Chisels, assorted		16.00
1 ea.	Chisel, Diamond, cape, gouge		4.00
6	Drills 1/4" Jacob Chuck, Heavy Duty	57.00	342.00
1	Drill 5/16" Jacob Chuck, Heavy Duty	75.00	75.00
1	Drill 1/2" Jacob Chuck, Heavy Duty	85.00	85.00
12	Files Half-round Bastard 10"		15.00
12	Files Half-round Smooth cut 10"		18.00
12	Files Mill Bastard Cut 10"		12.00
12	Files Mill Second Cut 10"		13.00
12	Files Mill Smooth Cut		15.00

QUANTITY	DESCRIPTION	UNIT COST	TOTAL COST
12	Files Round Second Cut		$ 11.00
72	Handles for above	$ 3.60 doz.	21.60
12	File card	1.00	12.00
5	Gas furnace, 2 burner	50.00	250.00
3 sets	Groovers, (hand) 1/8" - 1/2"	17.00	51.00
6	Hacksaw tubular frames pistol grip 8" - 12"	2.50	15.00
2	Hammers, ball pein 2 lb.	2.75	5.50
3	Hammers, ball pein 8 oz.	2.00	6.00
10	Hammers, riveting 12 oz.	3.20	32.00
10	Hammers, riveting 24 oz.	4.20	42.00
6	Hammers, setting 12 oz.	3.20	19.20
6	Hammers, setting 24 oz.	4.50	27.00
12	Mallets, hickory 2 1/4" dia.	1.50	18.00
6 sets	Bar clamps, 36" - 48" - 60"	17.00	102.00
12	Pliers, button pattern 6"	1.00	12.00
6	Vise grips, standard 10"	2.00	12.00
6	Vise grips, C-Clamps	3.00	18.00
4	Punches, Hand Whitney #5	14.00	56.00
6	Hand tongs	17.00	102.00
2 sets	Rivets 0-8	21.00	42.00
	Screwdrivers - Phillips		
1	1 set - 5/32 x 3"	.70	.70

QUANTITY	DESCRIPTION	UNIT COST	TOTAL COST
	Screwdrivers - Phillips		
1	1 set - 3/8 x 8"	$ 1.60	$ 1.60
	Screwdrivers - Standard		
6	4" blade Plastic handle	.80	4.80
6	6" blade Plastic handle	1.10	6.60
6	Snips, Aviation, Lefthand Wiss or equiv.	3.00	18.00
12	Snips, Aviation, Righthand Wiss or equiv.	3.00	36.00
2	Snips, Aviation, Bulldog	3.00	6.00
6	Snips, Bulldog, Inlaid blades	7.00	42.00
20	Snips, #18, Combination, Wiss	6.00	120.00
1	Snips, Compound lever shears, 12 gauge	4.85	4.85
2	Snips, Double cutting 12 3/4"	6.20	12.40
1	Shear, Beverly, Throatless lever	180.00	180.00
6 ea.	Solder coppers 1 1/2 - 2 - 3# pointed	2.00	36.00
6 ea.	Solder coppers 1 1/2 - 2 - 3# bottom	2.00	36.00
6 sets	Stakes, Beakhorn	70.00	420.00
6 sets	Stakes, Bevel edge square	24.00	144.00
6 sets	Stakes, Blowhorn	42.00	252.00
1	Stakes Bottom	13.00	13.00
2	Stakes, Candle Mold	34.00	68.00
6	Stakes, Common Square	13.00	78.00
6	Stakes, Conductor	38.00	228.00
2	Stakes, Copper Smith Square	16.00	32.00
2	Stakes, Creasing with horn	39.00	78.00

QUANTITY	DESCRIPTION	UNIT COST	TOTAL COST
2	Stakes, Double seaming	$ 44.00	$ 88.00
2	Stakes, Double seaming with 4 head	64.00	128.00
2	Stakes, Hatchet 11" face	23.00	46.00
4	Stakes, Hand dolly 5 x 5 1/2	25.00	100.00
4	Stakes, Hollow mandrel 40" long	46.00	184.00
2	Stakes, Needle case	23.00	46.00
6	Stakes, Solid mandrel 34 1/2" long	50.00	300.00
1	Gage, U. S. Metal 0-36	2.00	2.00
4	Wrenches, adjustable 6"	2.00	8.00
2	Wrenches, adjustable 8"	2.25	4.50
1	Wrench, adjustable 10"	3.00	3.00
1	Wrench, adjustable 12"	4.20	4.20
1 set	Combination, Box & Open 3/8" - 1"	11.30	11.30
1 set	Socket Midget 1/4" drive	3.30	3.30
1 set	Socket 1/2" drive 3/8 - 1 1/2	17.20	17.20
2 sets	Allen wrenches	1.05	2.10
1 ea.	Lever Punch Whitney #7 & 8 with punches and dies	75.00	150.00
1	Screw punch, Whitney with punches and dies	108.50	108.50
1	Grinder, portable 6" wheel with wire wheel and buffer attachment	125.00	125.00
1	Flexible shaft grinding wheel 1/2 H.P., 7 ft. extension	164.00	164.00
1 set	1/2" to 1" high speed drill bits by 32's Morse taper shank	164.00	164.00
1 set	1/16 to 1/2 high speed drill bits by 32's straight shank	22.00	22.00

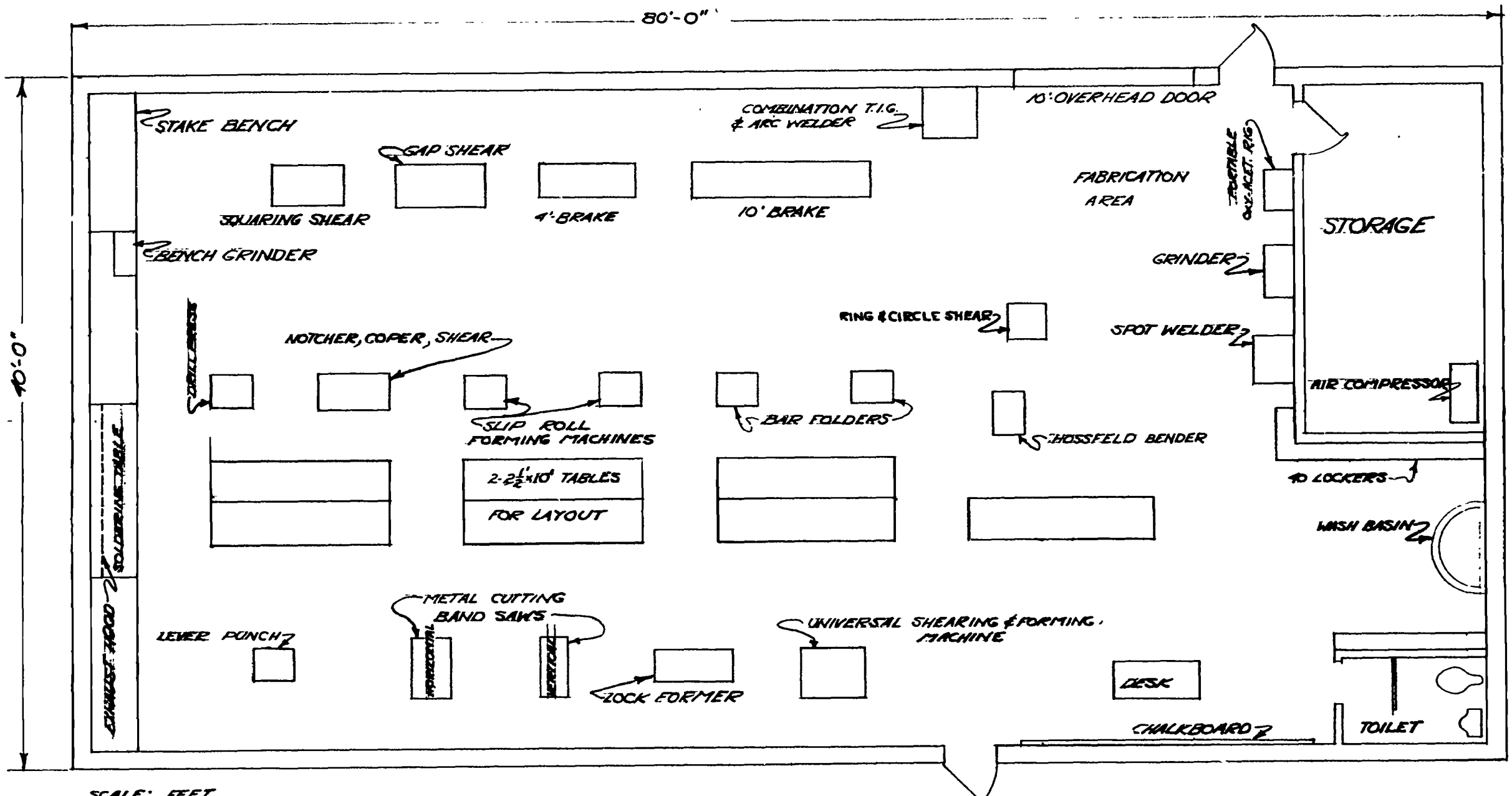
QUANTITY	DESCRIPTION	UNIT COST	TOTAL COST
6 doz. ea.	3/32 - 1/8 - 5/32 - 3/16 - 7/32 - 1/4 high speed drill sets		200.00
4	1/8 Pop Rivet Guns	$15.00	60.00
4	3/16 Pop Rivet Guns	20.00	80.00
24	6 ft. aluminum folding rule	3.75	90.00
1	50 ft. steel tape	6.00	6.00
			$6,086.35

Part 3 - MEASUREMENT & LAYOUT TOOLS

20	Center punches 4"	$ .75	$ 15.00
20	Circumference rules 3 feet	7.00	140.00
5	Circumference rules 4 feet	8.50	42.50
20	12" reg. scales	4.00	80.00
20	Combination squares 6"	9.50	190.00
10	Combination squares 12"	12.00	120.00
20	Dividers spring 4"	3.75	75.00
20	Dividers wing 10"	6.00	120.00
20	Flat steel squares 12" x 8"	2.00	40.00
20	Flat steel squares rafter 24 x 16	4.20	84.00
20	Irregular curves, french large size simple curve	1.25	25.00
3	Micrometer 0 - 1"	19.00	57.00
2	Oil stones 6 x 2 x 1	2.50	5.00
20	Compass, pencil 6 1/2"	4.45	89.00
1 Gr.	Pencils 2H	10.00	10.00
1 Gr.	Pencils 6H	10.00	10.00

QUANTITY	DESCRIPTION	UNIT COST	TOTAL COST
20	Prick punches 4"	$ .60	$ 12.00
20	Scratch awl, shank type	1.00	20.00
2	Scratch gages	10.00	20.00
2	Adjustable T Bevel Square	2.75	5.50
20	Semi-circular, Protractor 6"	.75	15.00
1	Straight Edge, 8 ft.	36.00	36.00
1	Straight Edge, 10 ft.	46.00	46.00
10	Swing blade protractor 6"	9.25	92.50
5	Trammel points precision adjustable 3" point	10.00	50.00
20	Stainless steel blade tee squares	15.00	300.00
20	24 x 18 Drawing Boards	3.00	60.00
40	Plastic safety goggles	1.50	60.00
2	Sterilizer for above - 24 goggle cabinet with ultra-violet germicidal lamp	120.00	240.00
			$2,059.50

GRAND TOTAL.....$34,295.85



SCALE: FEET

0 10

SHEET METAL SHOP LAYOUT

PREPARED BY:
VOCATIONAL INDUSTRIAL EDUCATION
CHARLESTON, WEST VIRGINIA

SHEET METAL FACILITIES
AND
EQUIPMENT STANDARDS

CLASS OF 20 STUDENTS

I. Facilities

A. Shop Area — 2,950 square feet

B. Toilet — 50 square feet

C. Storage Area — 200 square feet

II. Heating

A. Sufficient to maintain uniform temperature of 68 to 72 degrees controlled within the shop

III. Lighting - All Areas

A. 75 F.C.

IV. Floor

A. Wood or Concrete

V. Entrance and Doors

A. Should be on ground level floor or accessible to trucks from outside

B. A 10' x 10' overhead door should be provided accessible to trucks from the outside

C. Two entrance doors of not less than 3'-0" in width shall be included in addition to the overhead door

VI. Ceiling

A. Ceiling height should be 12'-0"

TEXTBOOKS FOR SHEET METAL WORK - FIRST YEAR

Name of Book	Author	Publisher
Sheet Metal Work Hand Processes Part I	New York State University	Delmar Publishers, Inc. Albany 5, N. Y.
Sheet Metal Work Machine Process Part I	New York State University	Delmar Publishers, Inc. Albany 5, N. Y.
Sheet Metal Work Measurement and Layout Part I	New York State University	Delmar Publishers, Inc. Albany 5, N. Y.
Sheet Metal Work Job Sheet Series Part I	New York State University	Delmar Publishers, Inc. Albany 5, N. Y.
Sheet Metal Worker's Manual w/study guide	Broemel	Frederick J. Drake and Company Chicago, Ill.
Sheet Metal Shop Practice	Bruce	American Tech. Society Chicago 37, Ill.
Acetylene Welding	Potter	American Tech. Society Chicago 37, Ill.
Electrical Welding	Potter	American Tech. Society Chicago 37, Ill.
Sheet Metal Principals & Procedures	Stiert	Prentice-Hall Englewood Cliffs, N. J.
Safe Work in Sheet Metal Work	Silvius and Baysinger	American Tech. Society Chicago, Ill.

TEXTBOOKS FOR SHEET METAL WORK - SECOND YEAR

Name of Books	Author	Publisher
Air Conditioning Metal Layout	Kaberlein	Bruce Publishing Co. Milwaukee
Sheet Metal Pattern Drafting and Shop Problems	Daugherty	Chas. A. Bennett Co. Peoria
Practical Problems in Mathematics Sheet Metal Work		Delmar
Pattern Development for Air Conditioning Fittings	Neubecker	American Artisan 6 N. Michigan Ave. Chicago, Ill.
Fundamentals of Pattern Drafting & Blueprint Reading for Sheet Metal Shops		American Rolling Mill Company Middletown, Ohio

REFERENCE BOOKS

TITLE	PUBLISHER
Visualized Basic Sheet Metal Drafting	Bruce Publishing Company New York
56 Graded Problems in Elementary Sheet Metal Work	McKnight and McKnight Pub. Company Bloomington, Ill.
Sheet Metal Drafting	McGraw-Hill New York
New Methods for Sheet Metal Work	Technical Press London
Techniques of Pressworking Sheet Metal	Prentice-Hall Englewood Cliffs, N. J.
Audels Sheet Metal Workers Handy Book for Pattern Layout Men	Audel and Company New York
Manual for Plastic Welding: Polyethylene	Industrial Publishing Co. Cleveland
Short Cuts for Round Layouts	Bruce Publishing Company Milwaukee
Triangulation Short-Cut Layouts	Bruce Publishing Company Milwaukee
Sheet Metal Work: How To Do Blueprint Reading, Template Layout, Pattern for Bends, Riveting, Soldering, Brazing, Welding and Drop Hammer Work	American Technical Society Chicago
Welding Processes and Procedures	Prentice-Hall Englewood Cliffs, N. J.
Sheet Metal Practice	McGraw-Hill New York
Basic Technical Drawing	MacMillan Company New York
Textures in Metal Sheets	MacDonald & Company London

INSTRUCTIONAL AIDS

ITEM	POSSIBLE SOURCE OF SUPPLY
Oversize scales and rules	Welch Scientific Company
Tables and Charts	Stanley and Others
Small Mock-Ups	By Instructor

FILMS

Forming and Bending of Stainless Steel	Republic Steel Corporation
Metal Shop Safety	McGraw-Hill Book Company
Metal Working Trades No. II Sheet Metal Worker	Federal Department of Labor Ottawa, Canada
Pageant of Steel	Bethlehem Steel Company
The Production of U. S. S.	U. S. Steel Corporation

SUGGESTED PROJECTS FOR SHEET METAL

Training projects taken from Job Sheet Series (Part I), University of State of New York.

I. Square and Rectangular Projects

A. Square Pipe with 90° Flange; pp. 3-6
B. One Piece Supply Box; pp. 7-10
C. Square Pipe with 48° Flange; pp. 17-20
D. Two Piece 60° Rectangular Elbow; pp. 25-28
E. Three Piece 90° Rectangular Elbow; pp. 81-84
F. Rectangular Hopper; pp. 99-102
G. Rivet Box; pp. 111-114
H. Drip Pan; pp. 115-118
I. Square Hopper with a 30° Flange; pp. 153-156

II. Round Projects

A. Round Pipe; pp. 15-16
B. Round Pipe with a 90° Flange; pp. 11-14
C. Round Pipe with a 34° Flange; pp. 21-24
D. Two Piece 45° Cylindrical Elbow; pp. 29-32
E. 90° Cylindrical T Joint of Equal Diameters; pp. 37-40
F. 90° Cylindrical T Joint of Unequal Diameters; pp. 41-44
G. 45° Cylindrical T Joint of Equal Diameters; pp. 45-48
H. 40° Cylindrical T Joint of Unequal Diameters; pp. 49-52
I. Five Piece 90° Cylindrical Elbow; pp. 89-92
J. 60° Cylindrical Y Joint; pp. 123-126

III. Containers

A. Round Pan; pp. 53-56
B. Round Container with Lid; pp. 65-72
C. Semicircular Container with Lid; pp. 73-80
D. Tapered Filler; pp. 95-98
E. Flairing Paint Pail; pp. 127-130

IV. Special Projects

A. Ventilator Top; pp. 119-122
B. Motor Guard; pp. 157-162
C. Belt Guard; pp. 163-166
D. 90° Ogee Outside Gutter Meter; pp. 103-106
E. 30° Ogee Inside Gutter Meter; pp. 107-110

VT 010 255
Dalton, L.C.; Richardson, Joe A.
Overhead Projection; Transparency Masters for Vocational Agriculture (Including Supplements I-III).

New Mexico State Univ., University Park. Agricultural Education
MF AVAILABLE IN VT-ERIC SET.
State Department of Agriculture Education, 130 South Capitol Street, Santa Fe, New Mexico 87501 (single copies available).
PUB DATE - ND 243p.

DESCRIPTORS - *TRANSPARENCIES; *VOCATIONAL AGRICULTURE; *AGRICULTURAL ENGINEERING; INSTRUCTIONAL AIDS; ANIMAL SCIENCE; SOIL SCIENCE; *AGRICULTURAL MACHINERY; *ENGINES; EQUIPMENT; PLANT SCIENCE; WELDING; ELECTRICITY

ABSTRACT - Instructional aids produced from these transparency masters may be used by vocational agriculture teachers in presenting courses in agricultural mechanics. Various suggestions for using the masters are given, including tracing of masters for chalkboards and displays and duplication for student handouts or testing. The initial series and supplements include masters relating to (1) cattle, (2) swine, (3) sheep, (4) horses, (5) retail and wholesale meat cuts, (6) plant science, (7) insects, pests, and animal parasites, (8) electricity, (9) welding, (10) land judging, (11) weed identification and control, (12) animal feeds, (13) marketing procedures, (14) agricultural machinery and engines, (15) farm and ranch equipment, (16) crop equipment, (17) tools, (18) land measurement, (19) soil science, (20) farm costs, and (21) Future Farmers of America. (AW)

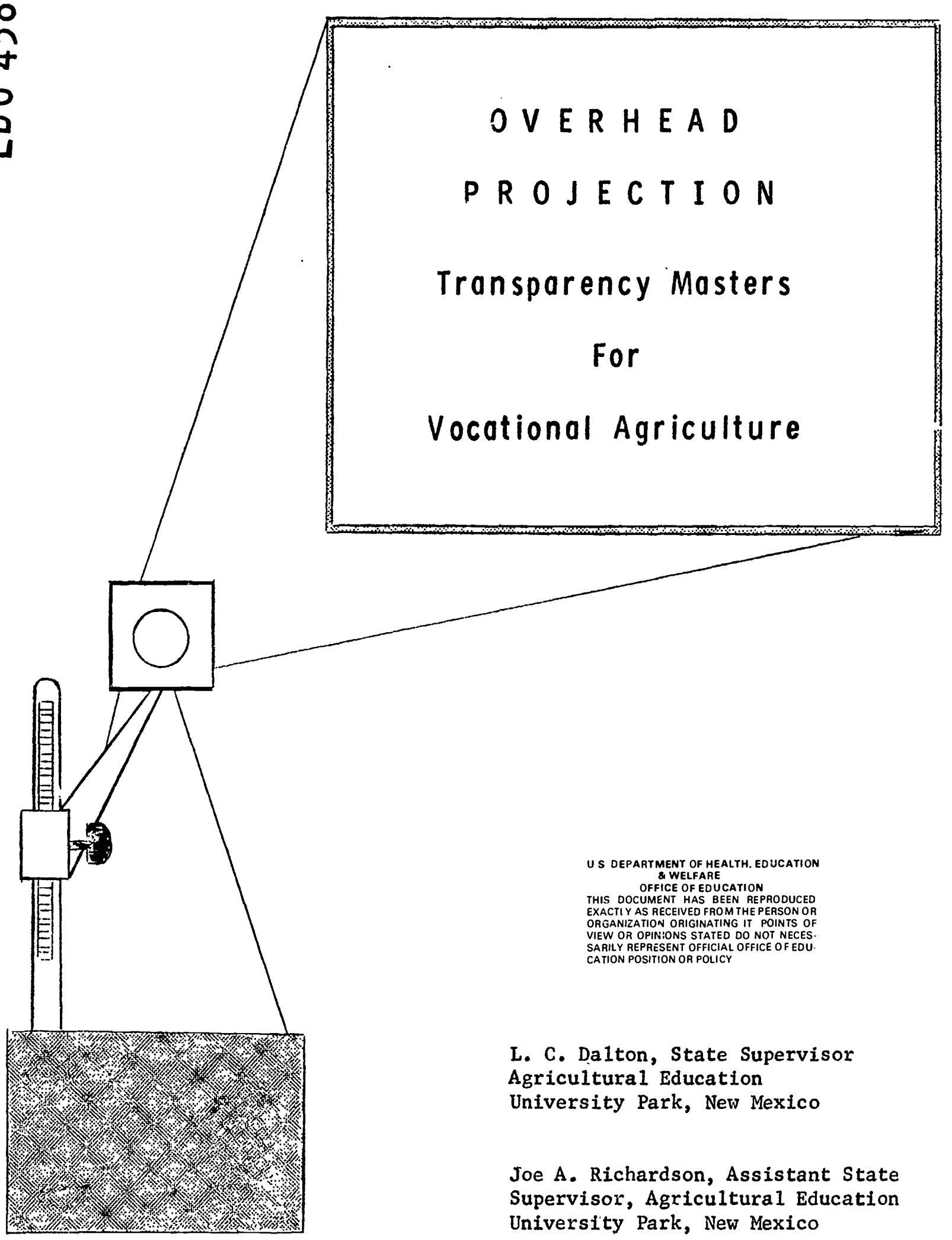
VT010 255

ED0 45856

243

OVERHEAD PROJECTION

Transparency Masters For Vocational Agriculture



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OFFICE OF EDUCATION
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L. C. Dalton, State Supervisor
Agricultural Education
University Park, New Mexico

Joe A. Richardson, Assistant State
Supervisor, Agricultural Education
University Park, New Mexico

VT001255

USING THE TRANSPARENCY MASTER

Transparency masters may be utilized by the teacher in a variety of ways. The flexibility of use of the transparency master is probably as diverse as the talents of the teacher using it. Described herein are several suggestions for use of the overhead projection transparency master.

PRESENTATIONS

Most teachers will first think of using the overhead projection transparency as an aid in the presentation of material to a class of students. Several of the masters in this initial series are in sets allowing the preparation of a basic transparency to which may be hinged one or more overlays to illustrate special features, teach nomenclature, or number sets for use in drill, review or testing. When transparencies are produced in color by the diazo process, variety and distinguishing features may be produced with more clarity.

The skillful teacher will plan his presentation carefully, selecting appropriate transparencies which cnntribute to the presentation objective, and avoid the danger of merely basing instruction on available aids.

The transparency may be modified with the use of a wax pencil, felt pen, or special overhead pencil. During a presentation the teacher may mark, shade, draw or write on the transparency, but it is helpful to do this on a cover sheet of clear acetate to avoid leaving permanent scratches on the transparency.

MULTIPLE COPIES

Spirit duplicating masters may be produced by a thermal transfer process in a dry copier (thermofax) and multiple copies prepared on a spirit type duplicator. These multiple copies of the overhead projection transparency masters will afford the teacher with the opportunity of providing each student with a copy of the material being presented on the screen for his notebook, so that he might label, take notes, review and test himself. When overlays are involved, an additional spirit duplicating master might be prepared for each overlay, possibly in different colors, and used to develop a multi-colored multiple copy.

SELF - INSTRUCTION

Students may use the overhead projection transparency on the machine themselves (individually or in groups) for enrichment, remedial or study purposes.

CHALKBOARD AND DISPLAY PATTERNS

An overhead projection transparency may be used to project an enlarged image on a chalkboard so that the teacher might work up a satisfactory sketch or diagram for variety or for referral when using the overhead projector for other purposes in the same presentation.

As a means of preparing displays for fairs, bulletin boards and posters, the transparency is appropriate for the projection of an enlarged image which can be quickly traced with accuracy. The distance of the projector from the paper may be adjusted to enlarge or reduce the size of the image.

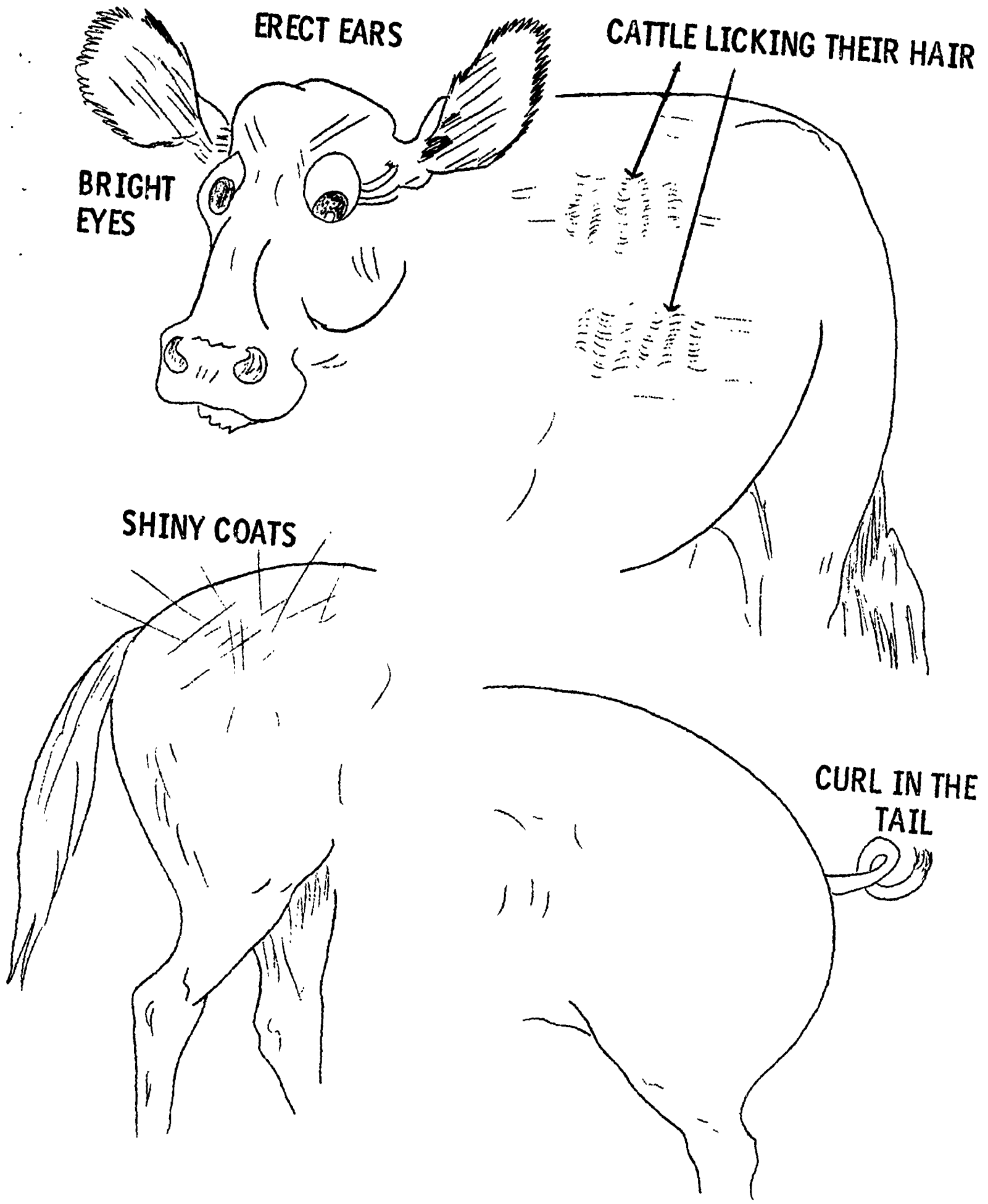
REVIEW AND TESTING

Several sets in this series include an overlay which provides a set of numbers. These numbers may be used in reviewing nomenclature without the benefit of the labels (on another overlay). The teacher may wish to use these numbers for testing of the students' knowledge of the nomenclature, in which case he should avoid using the numbers prior to the test as students may have a tendency to memorize numbers rather than parts. Additional sets of numbers may be prepared with pencil or pen on clear acetate.

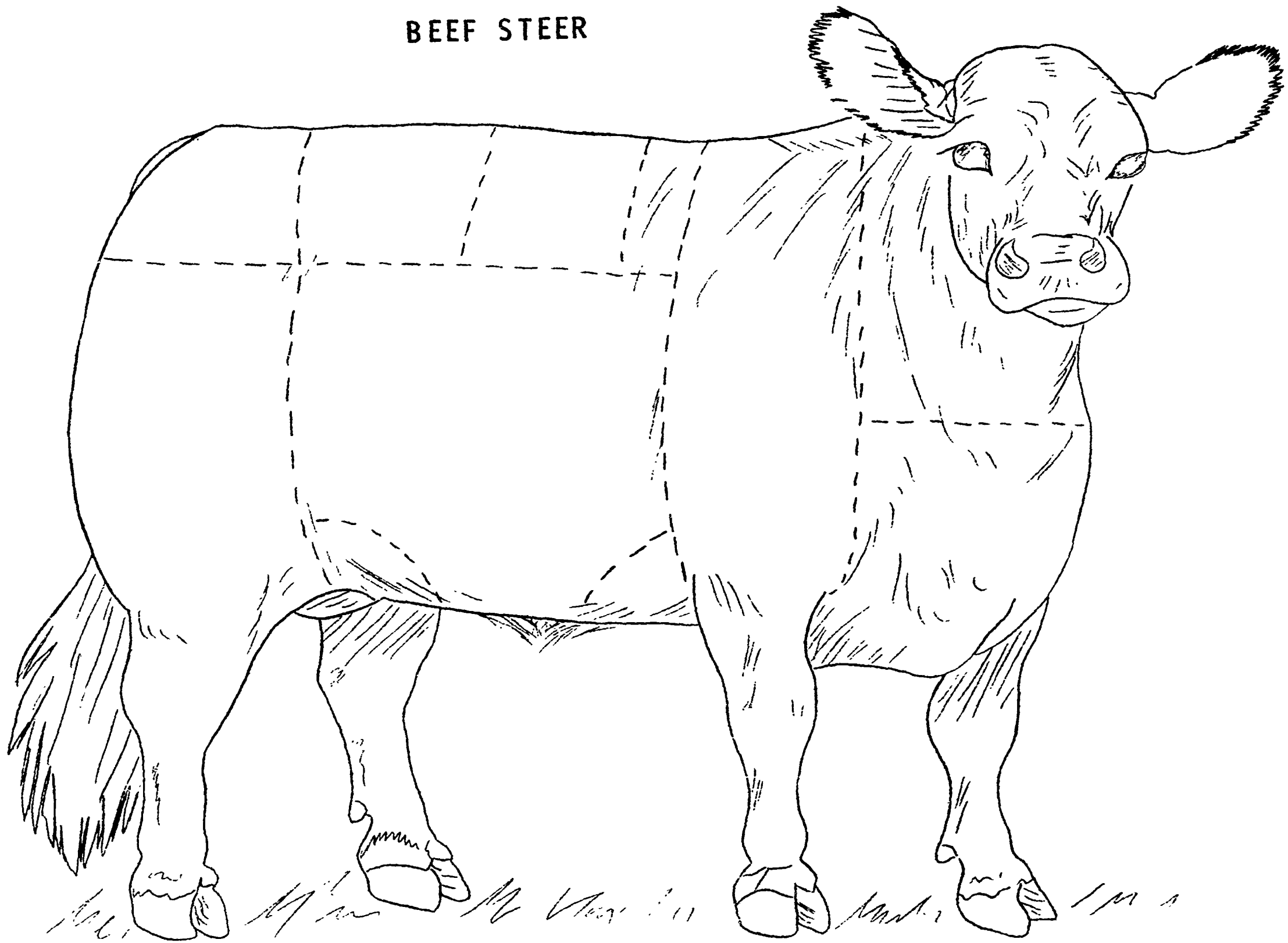
Additions to this overhead projection transparency masters series will be periodically published in the form of supplements and disseminated to the teachers of Vocational Agriculture.

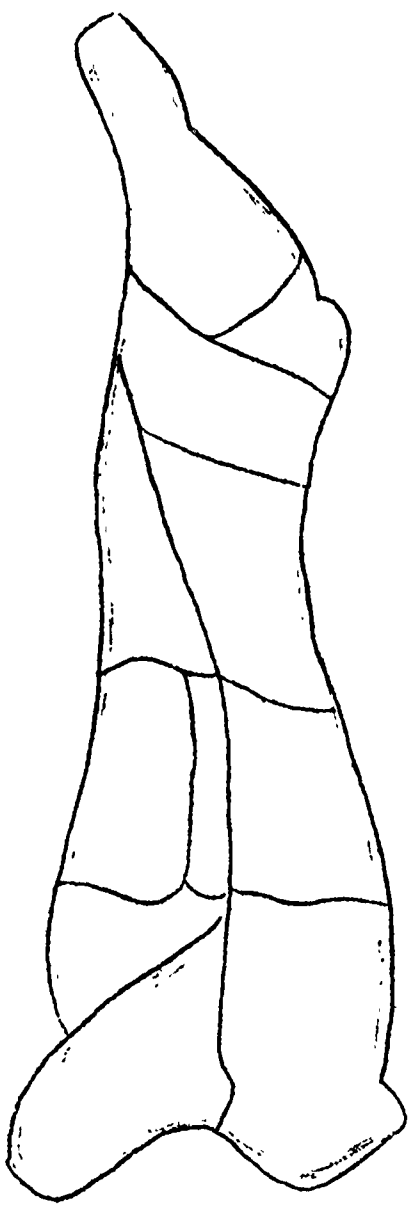
ERIC

SIGNS OF HEALTHY ANIMALS



BEEF STEER





BEEF CARCASS

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NAME THE WHOLESALE CUTS

WHOLESALE
CUTS

ROUND →

RUMP →

LOIN →

FLANK →

SHORT LOIN →

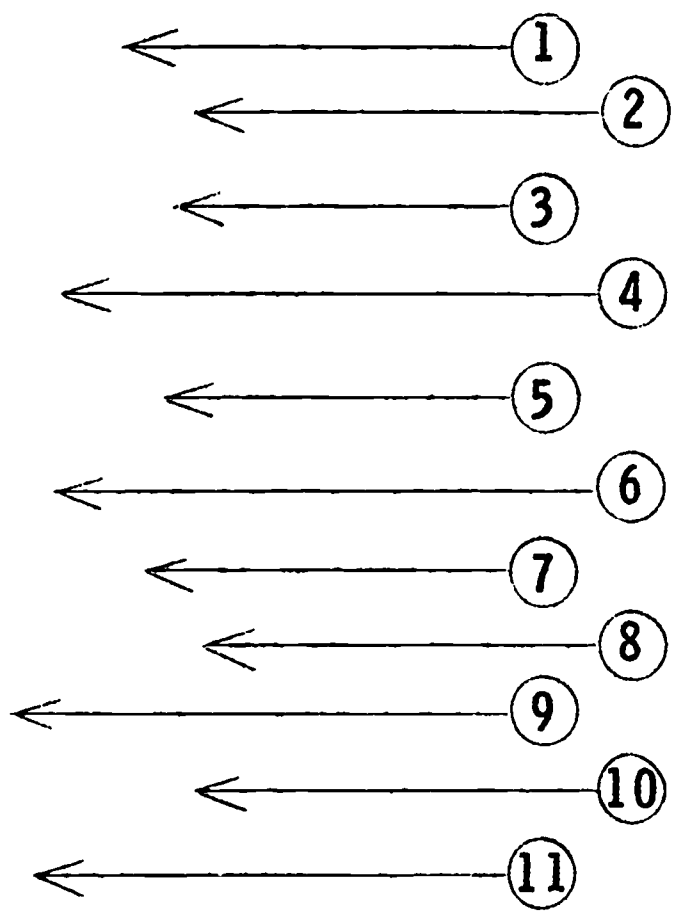
RIB →

PLATE →

BRISKET →

CHUCK →

SHANK →



NAME THE RETAIL CUTS

RETAIL
CUTS

← ROUND STEAK

← RUMP

← SIRLOIN STEAK

← FLANK

← "T" BONE

← ROLLED PLATE

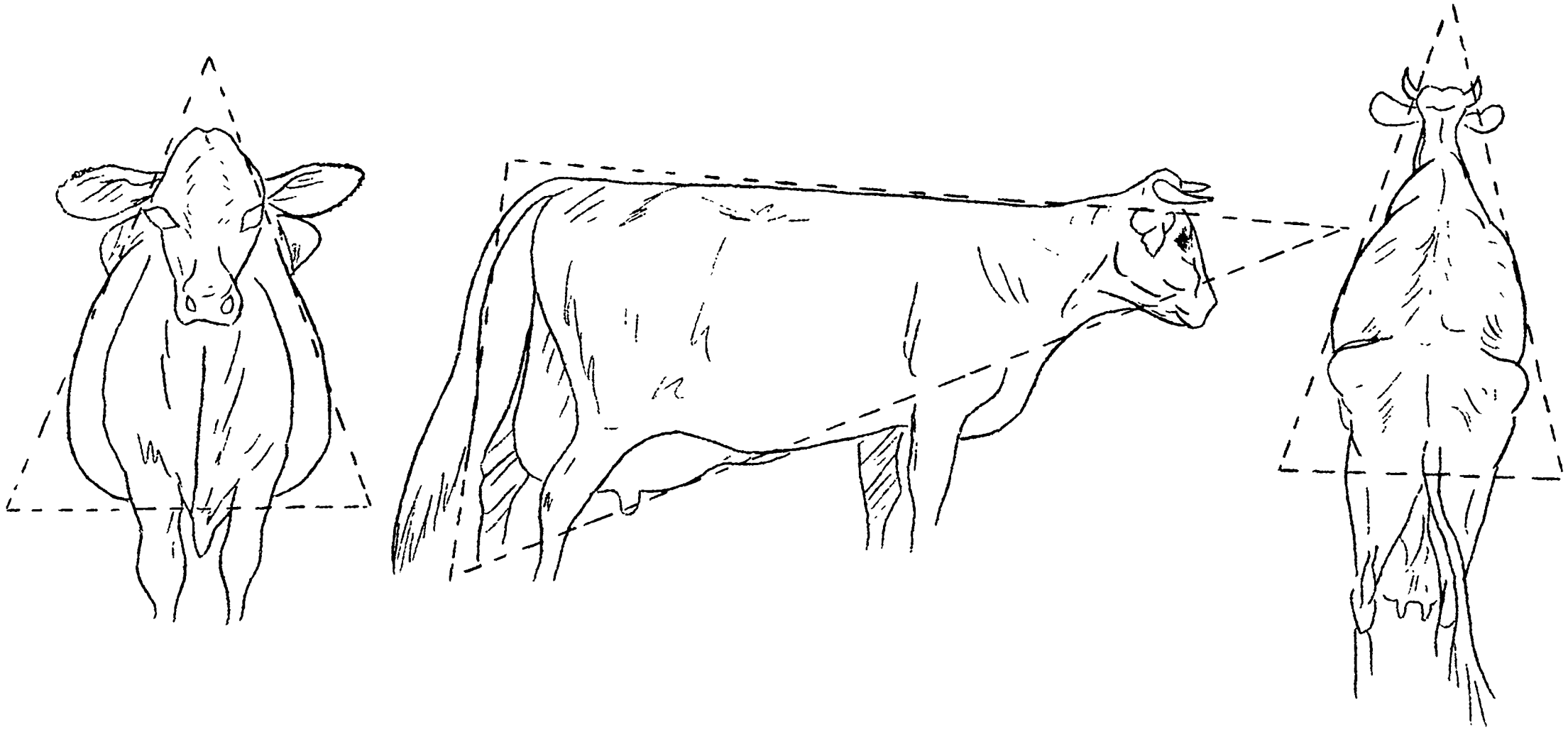
← SHORT RIBS

← RIB STEAK

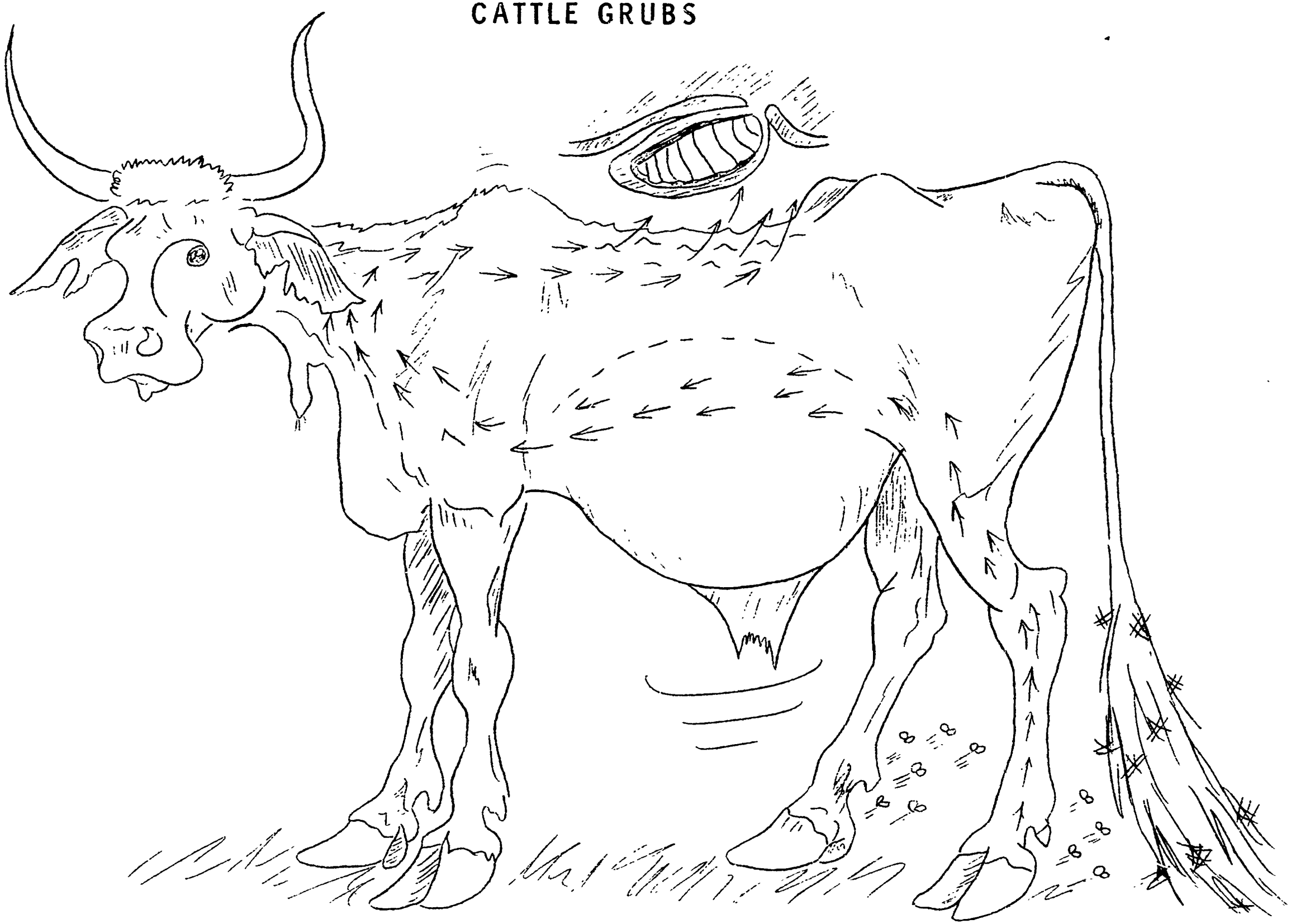
← CORNED BEEF
POT ROAST

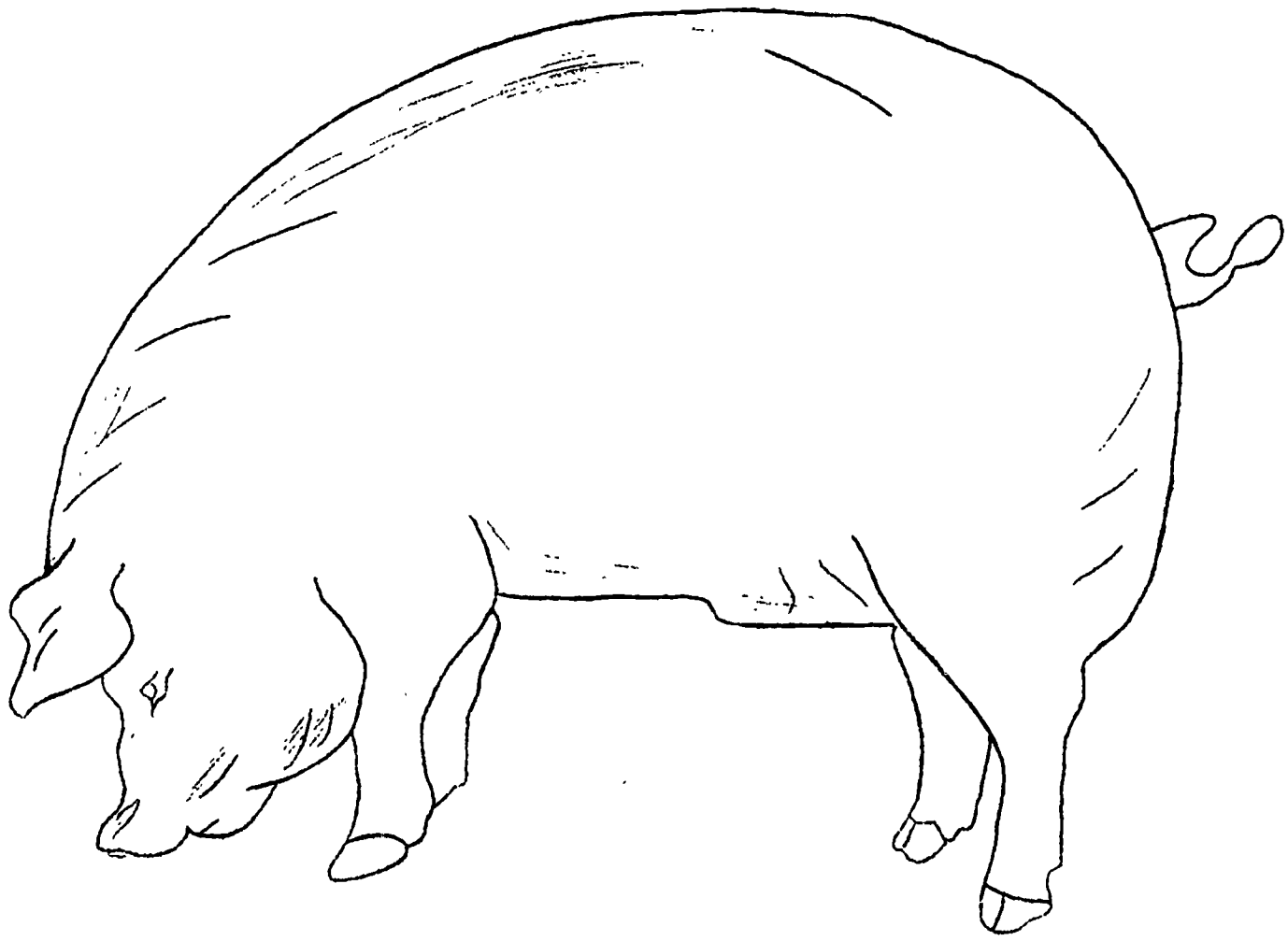
← STEW

3 TRIANGLES OF A DAIRY COW

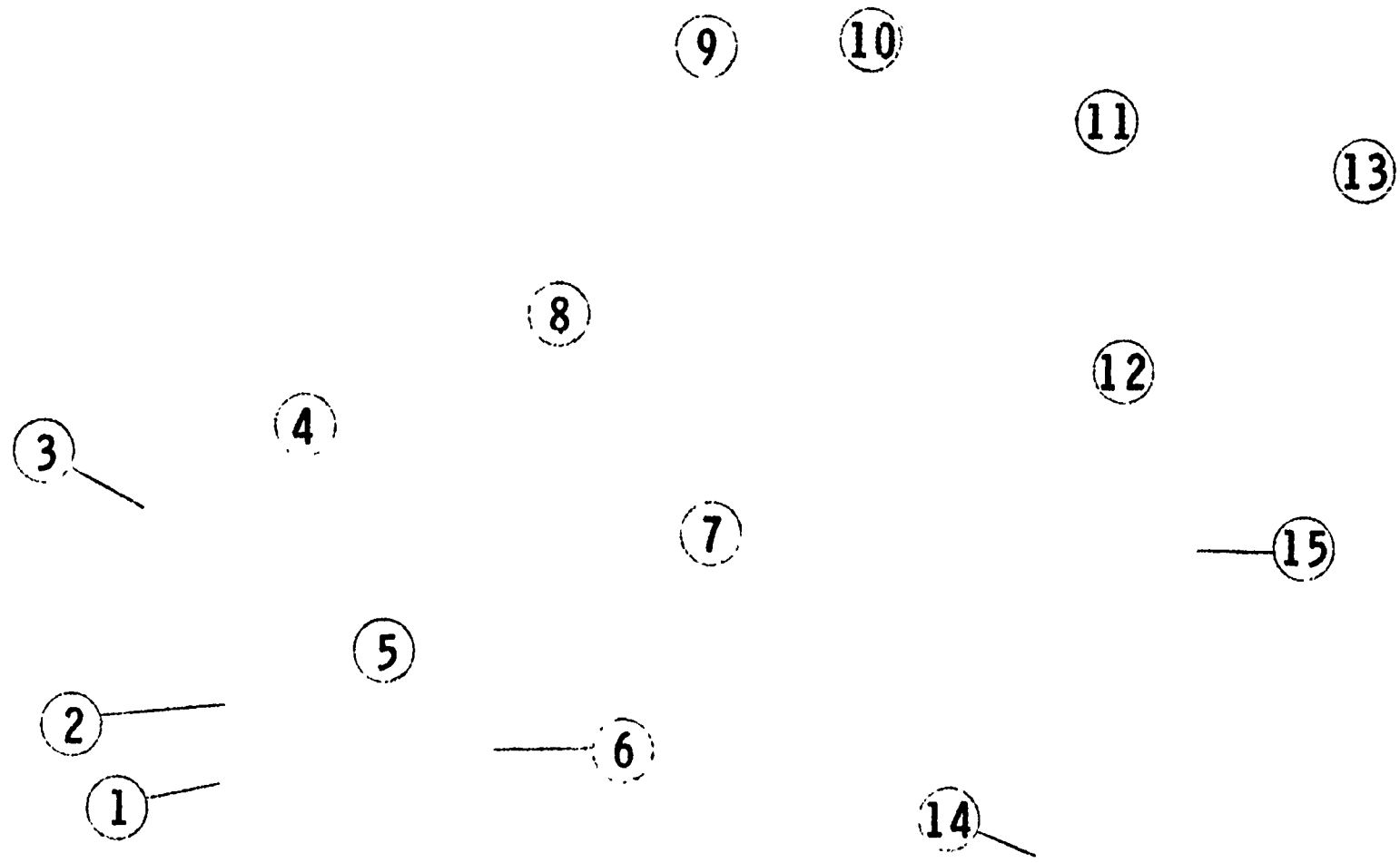


CATTLE GRUBS





PARTS OF BOAR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1
14

BACK LOIN

RUMP

TAIL

SHOULDER

HAM

NECK

POLL

SCROTUM

BELLY

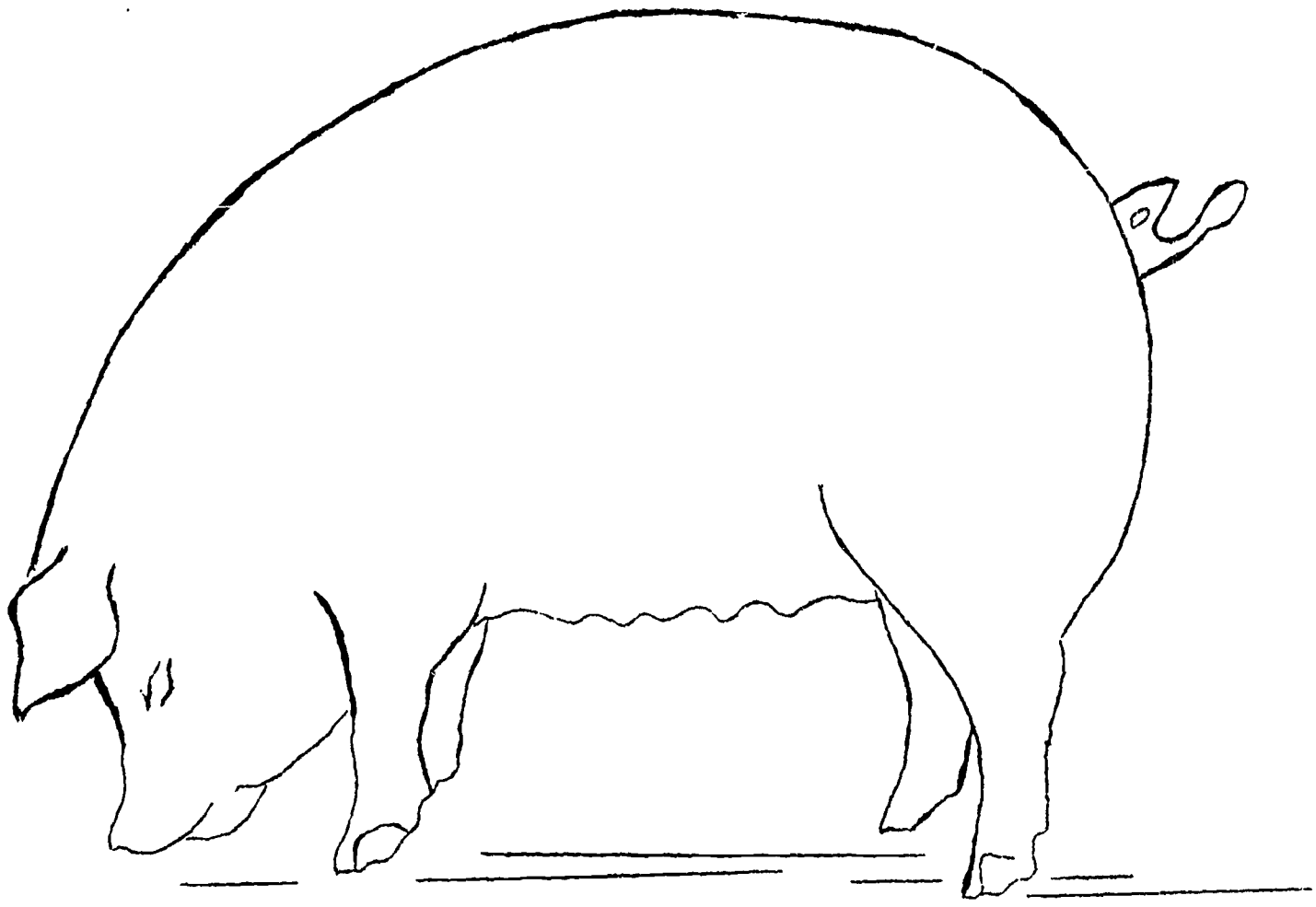
JOWL

FACE

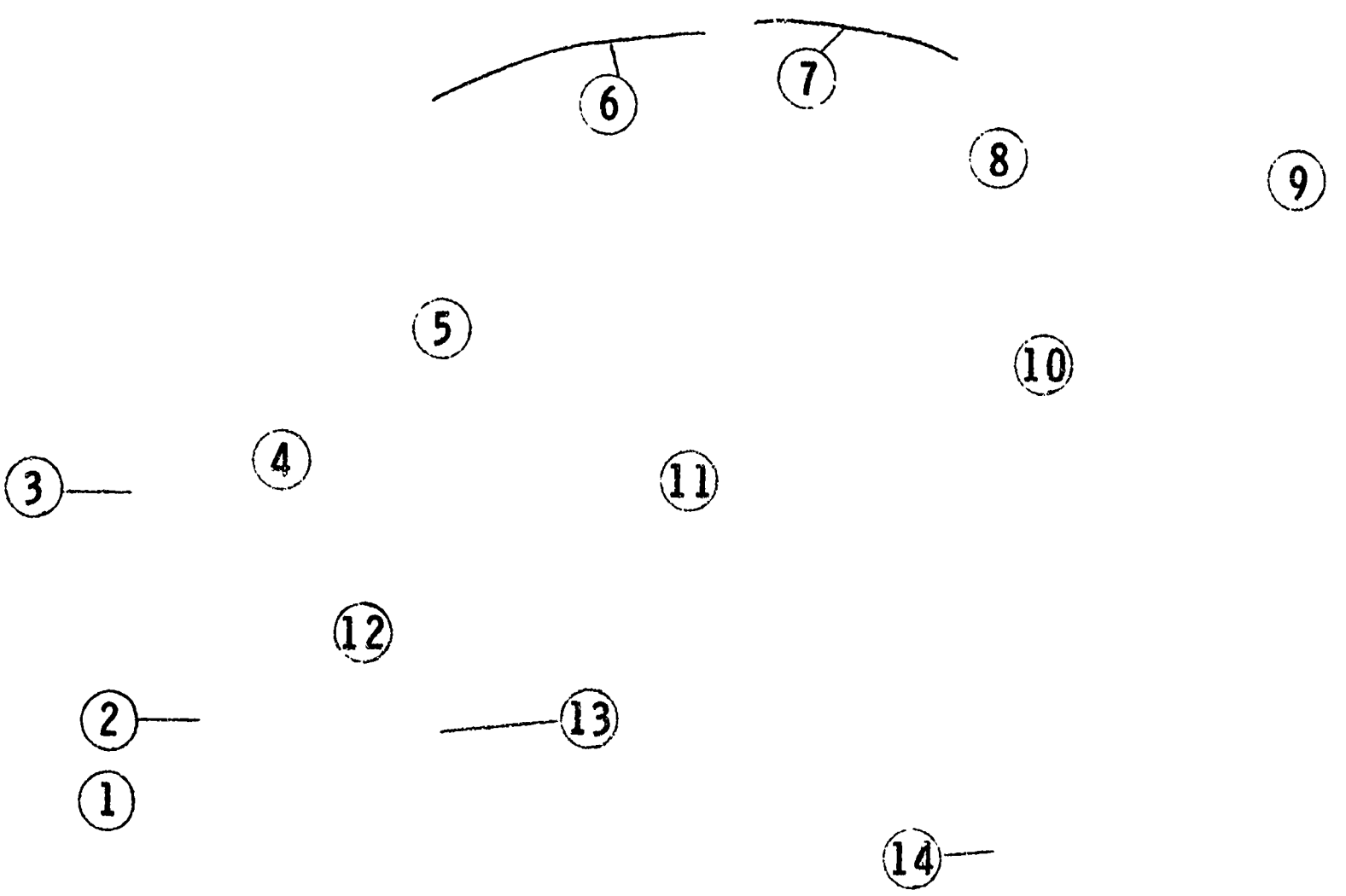
SNOUT

PASTERN

TOES



PARTS OF A SOW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BACK LOIN

RUMP

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NECK

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JOWL

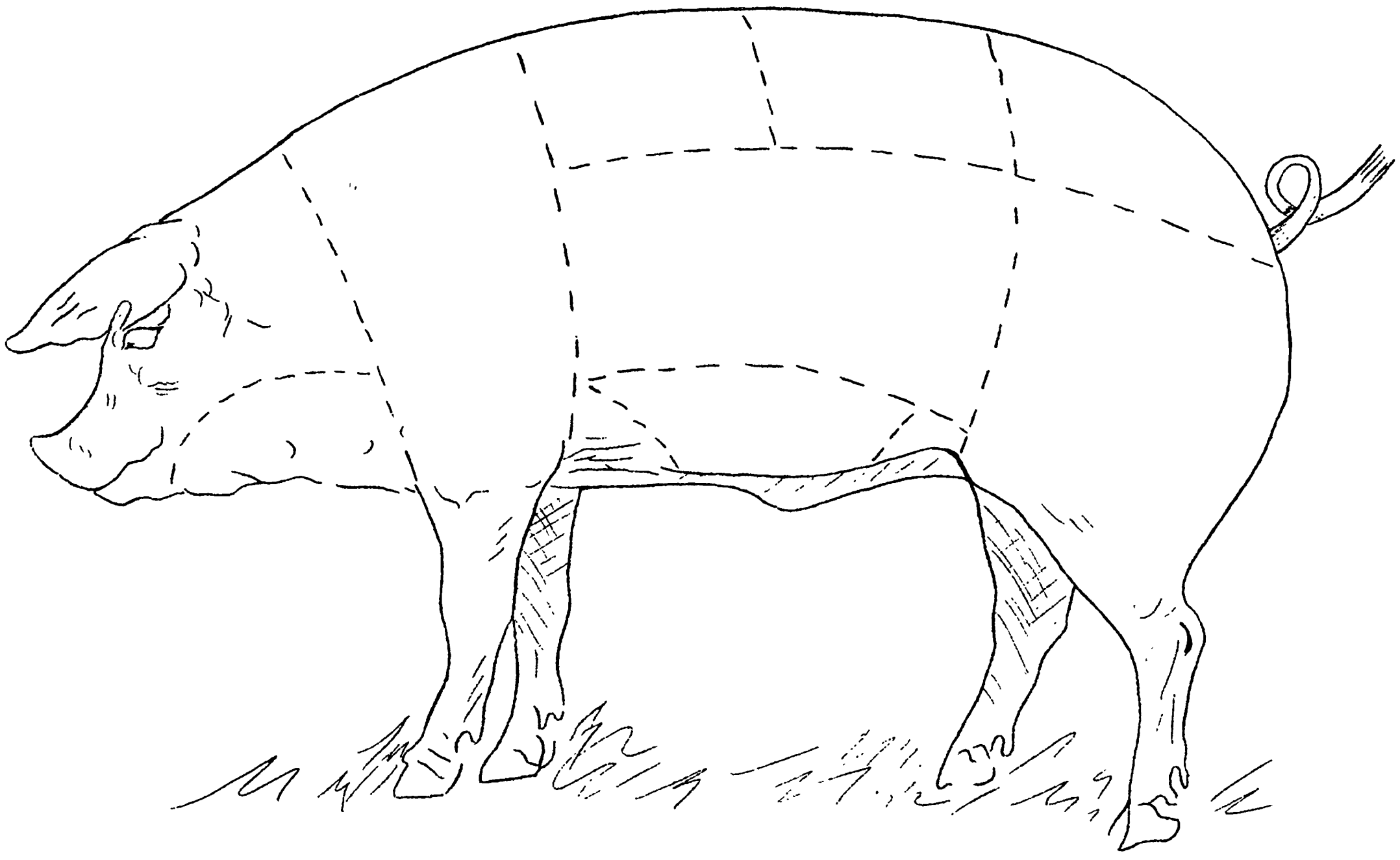
FACE →

← PASTERN

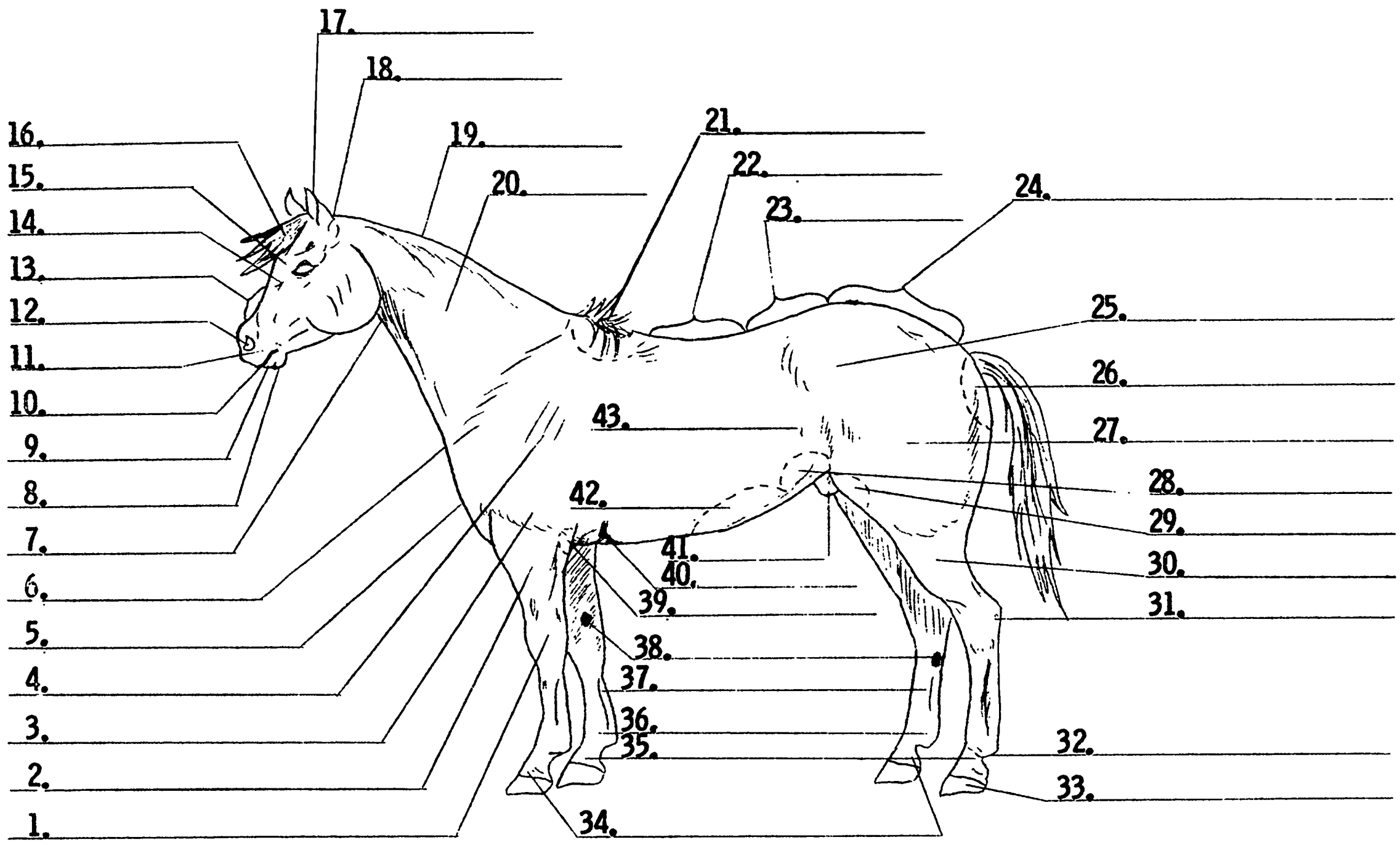
SNOUT →

TOES →

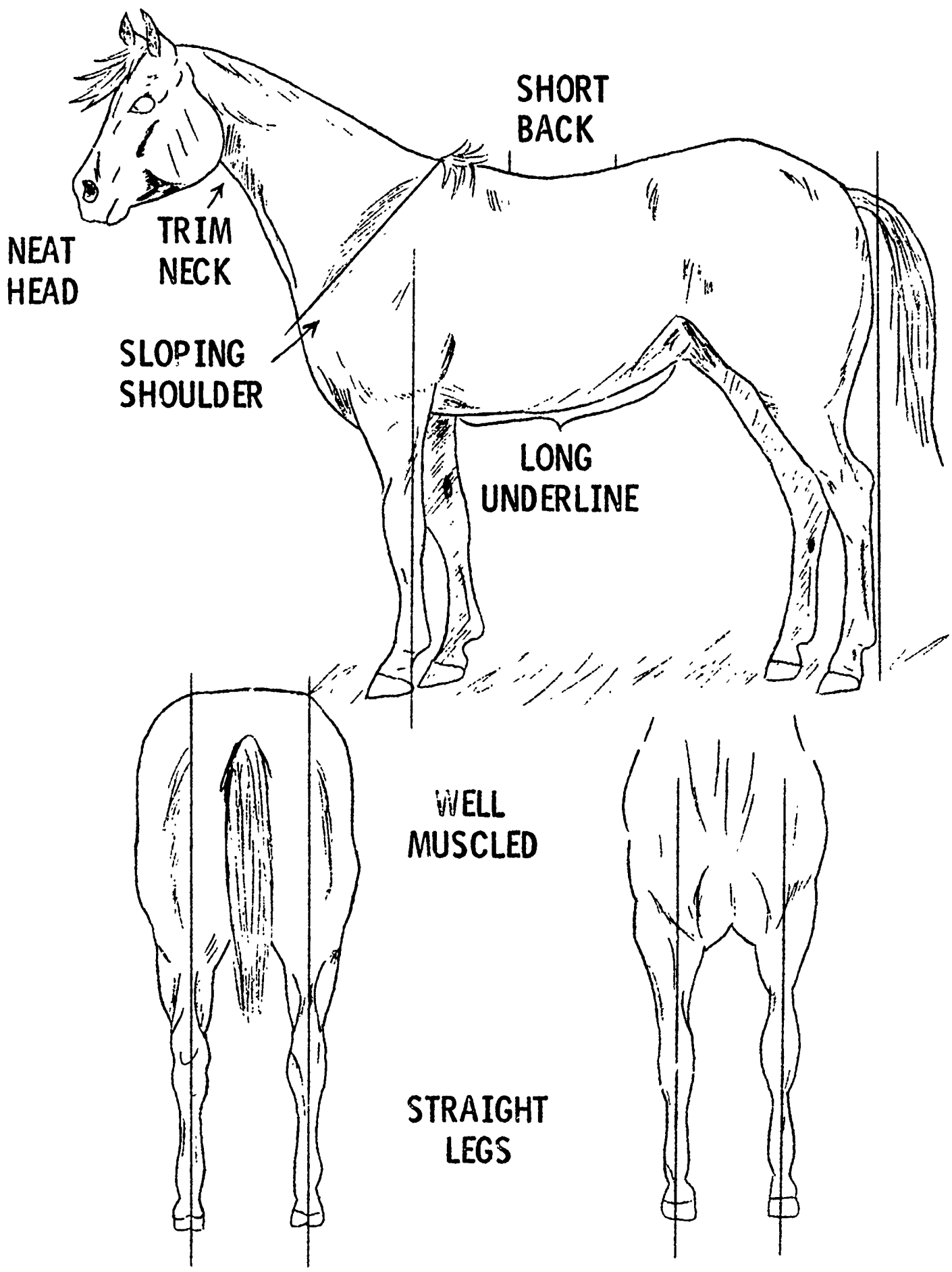
MEAT TYPE HOG



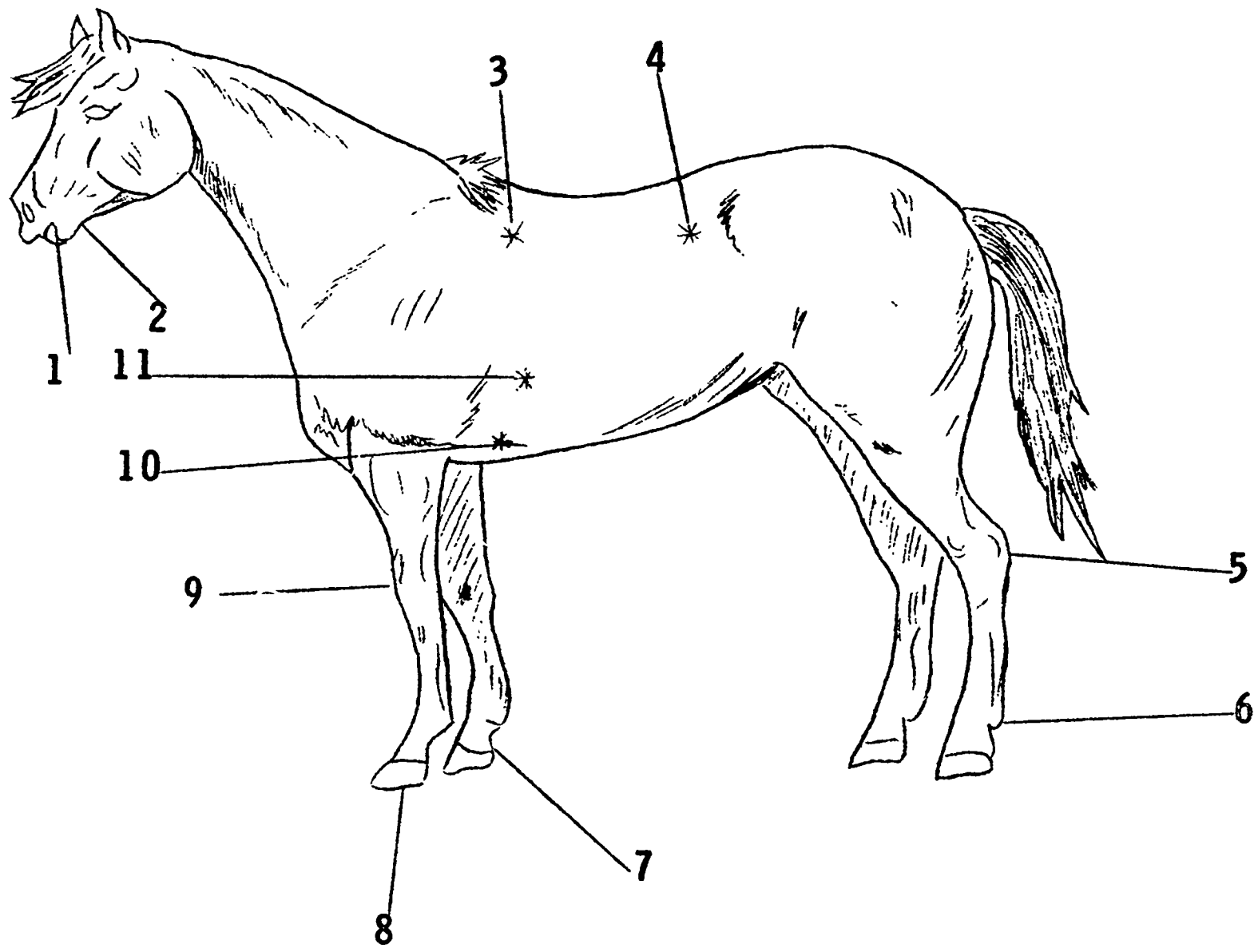
PARTS OF THE HORSE



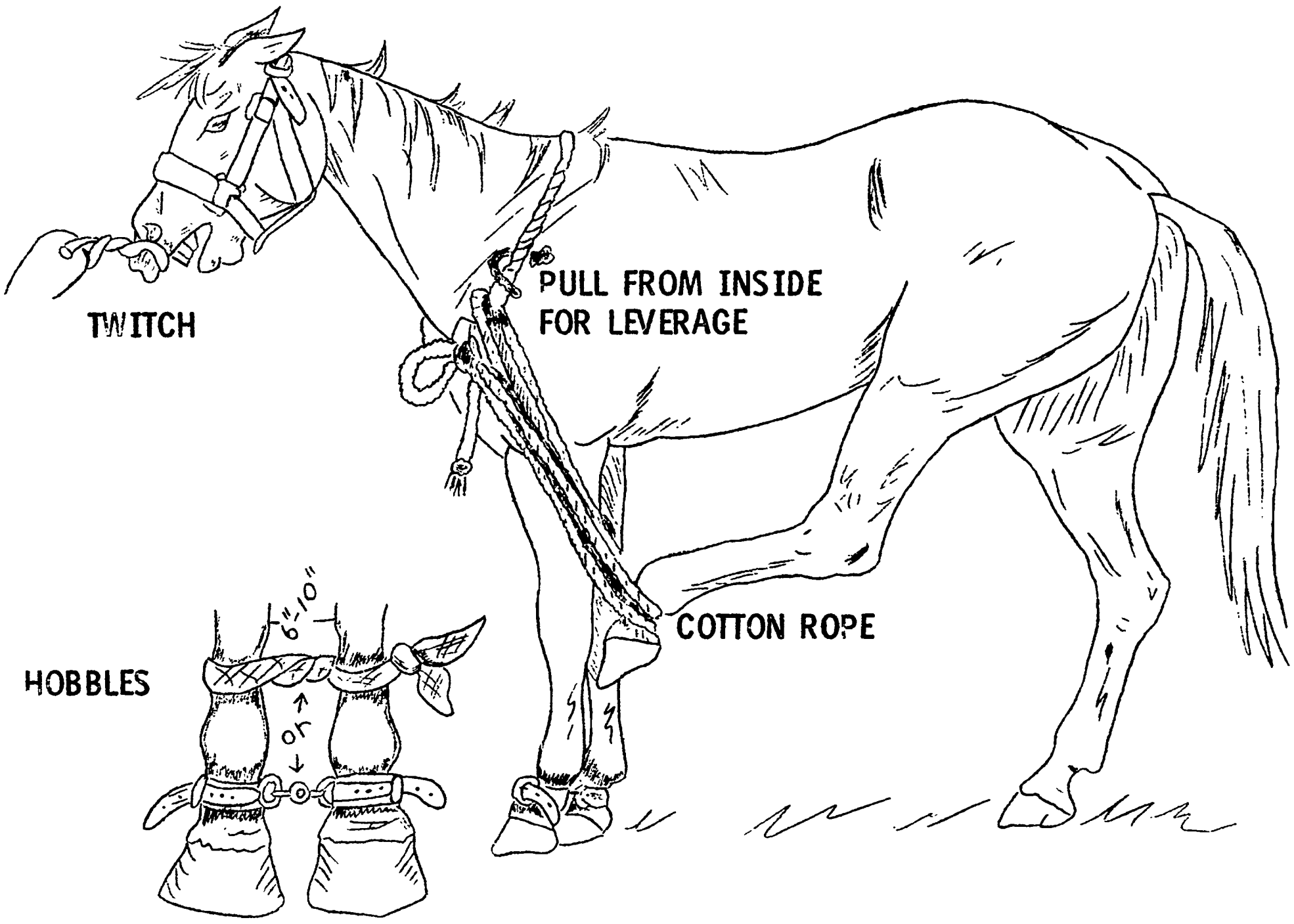
CONFORMATION

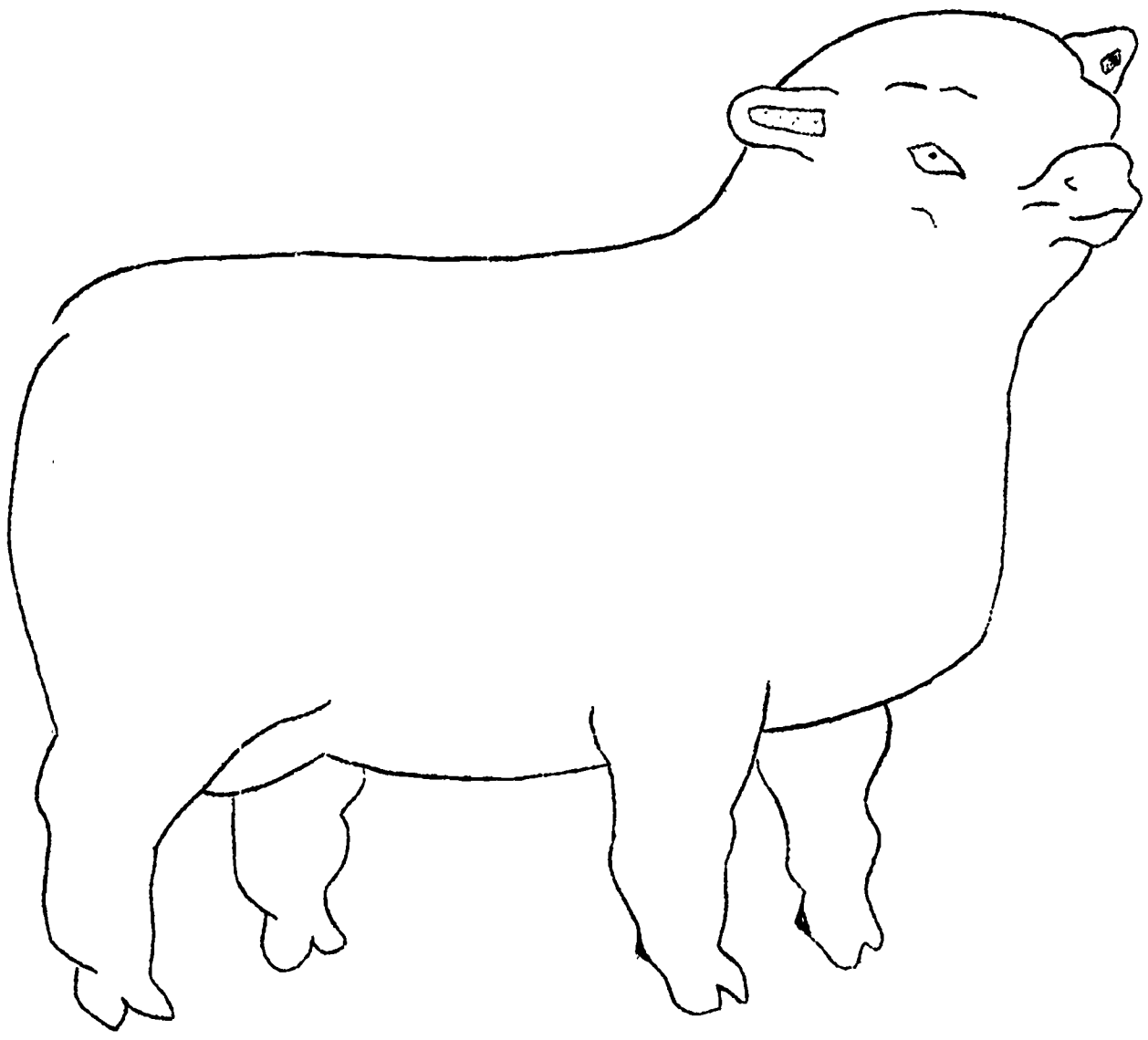


COMMON SORE POINTS
OF SADDLE HORSES

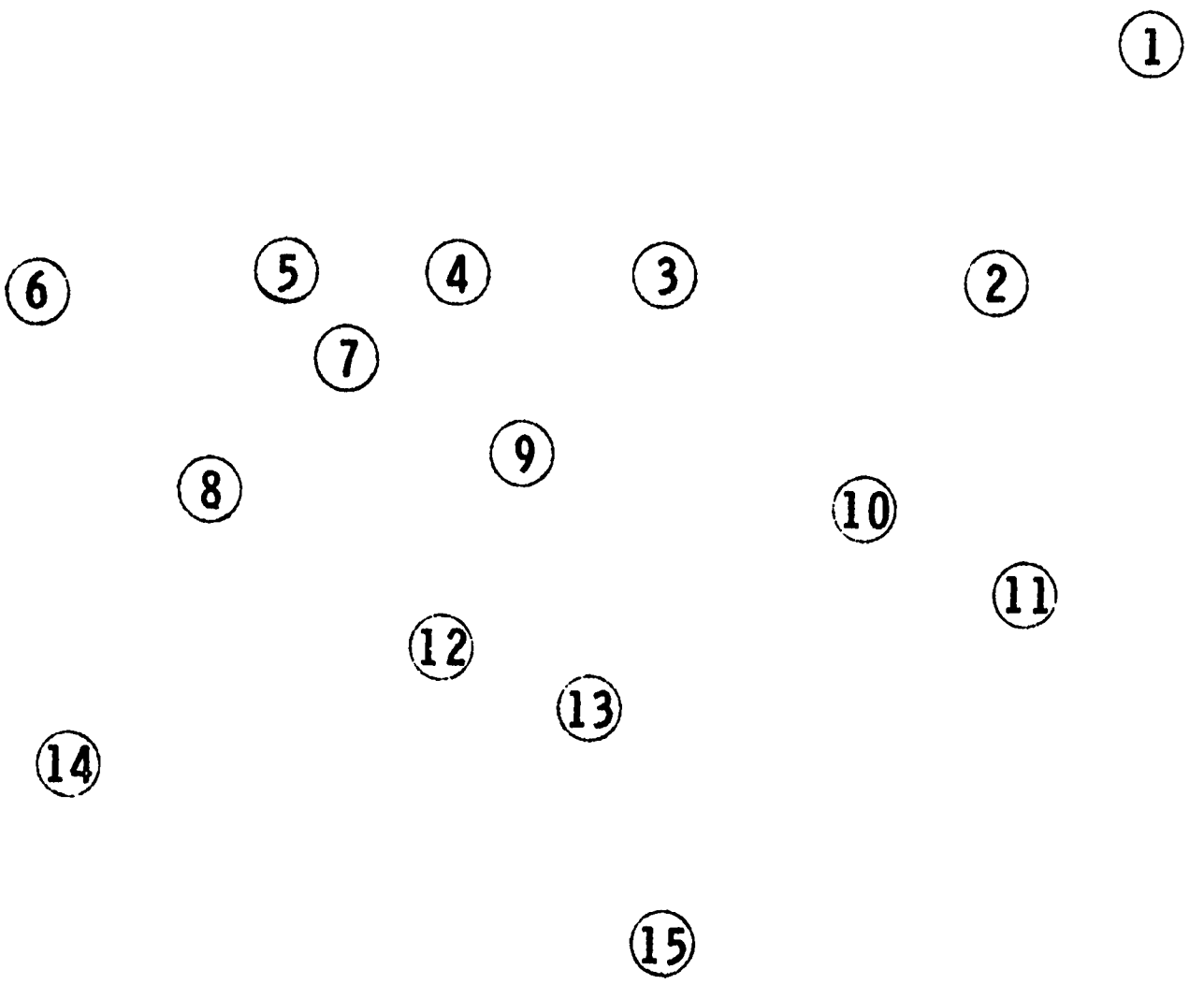


TWITCH - HOBBLES - TIEING A LEG UP





PARTS OF A SHEEP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FOREHEAD

DOCK

RUMP

LOIN

BACK

NECK

HIP

RIBS

THIGH

SHOULDER

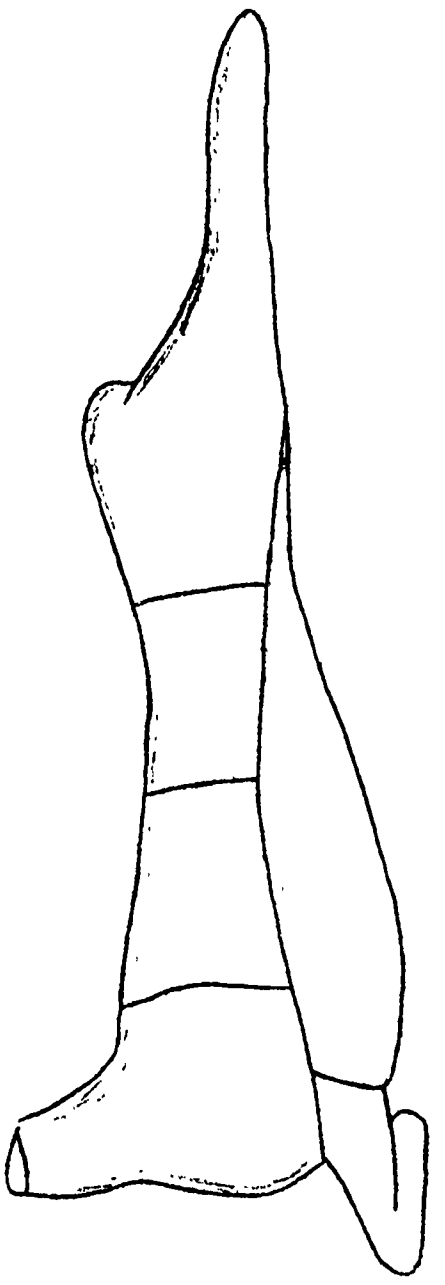
BREAST

FLANK

BELLY

HOCK

DEW CLAW



LAMB CARCASS

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NAME THE WHOLESALE CUTS

WHOLESALE
CUTS

LEG →

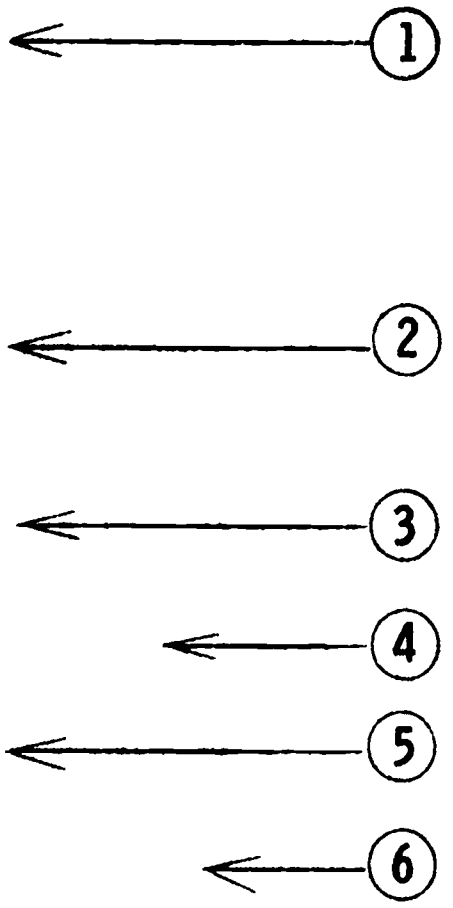
LOIN →

BREAST →

RACK →

SHOULDER →

SHANK →



NAME THE RETAIL CUTS

RETAIL CUTS

← LEG OF LAMB

← LOIN CHOPS

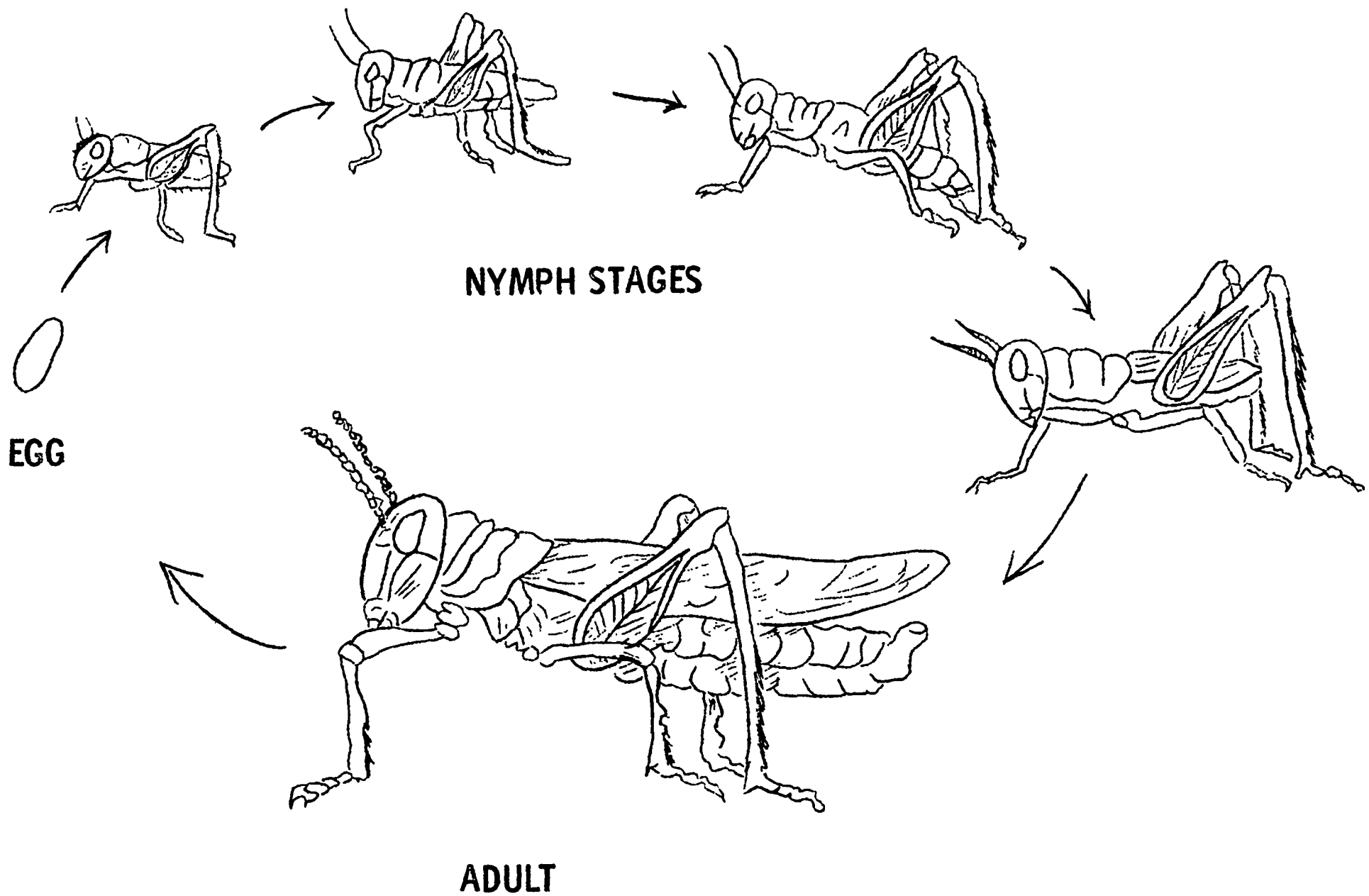
← RIB CHOPS

← STEW MEAT

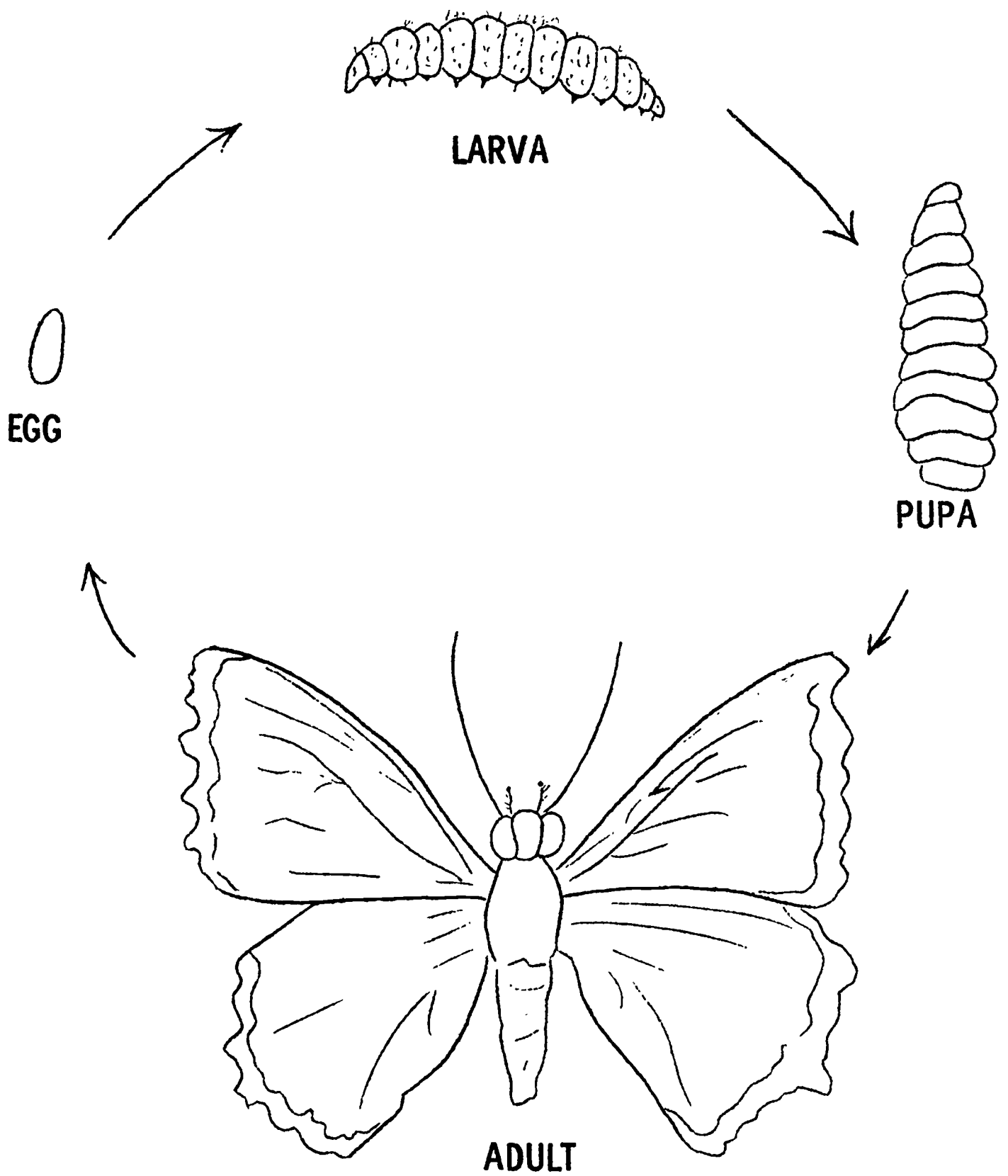
← ROLLED SHOULDER

← LAMB SHANKS

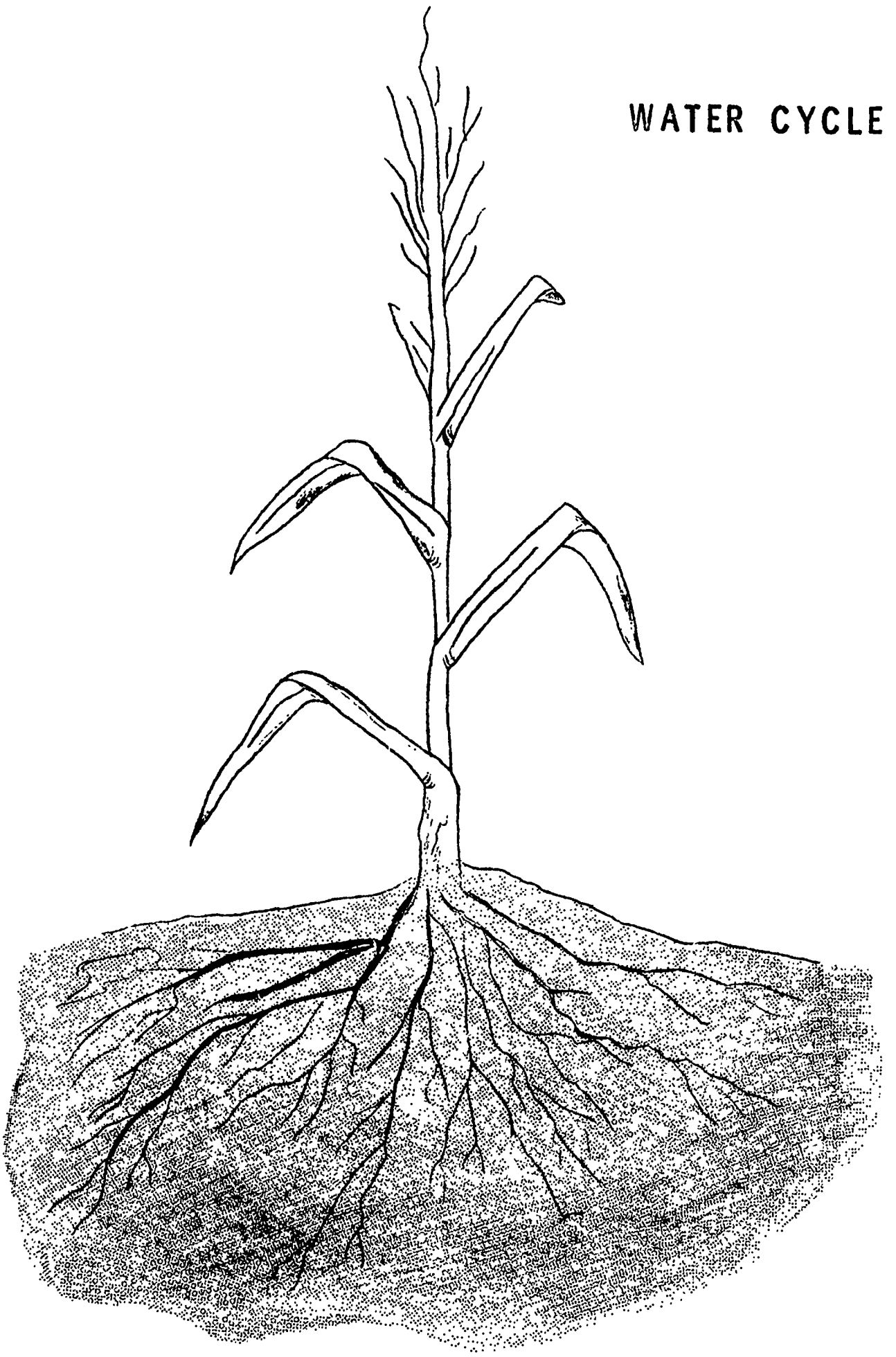
GRADUAL METAMORPHOSIS

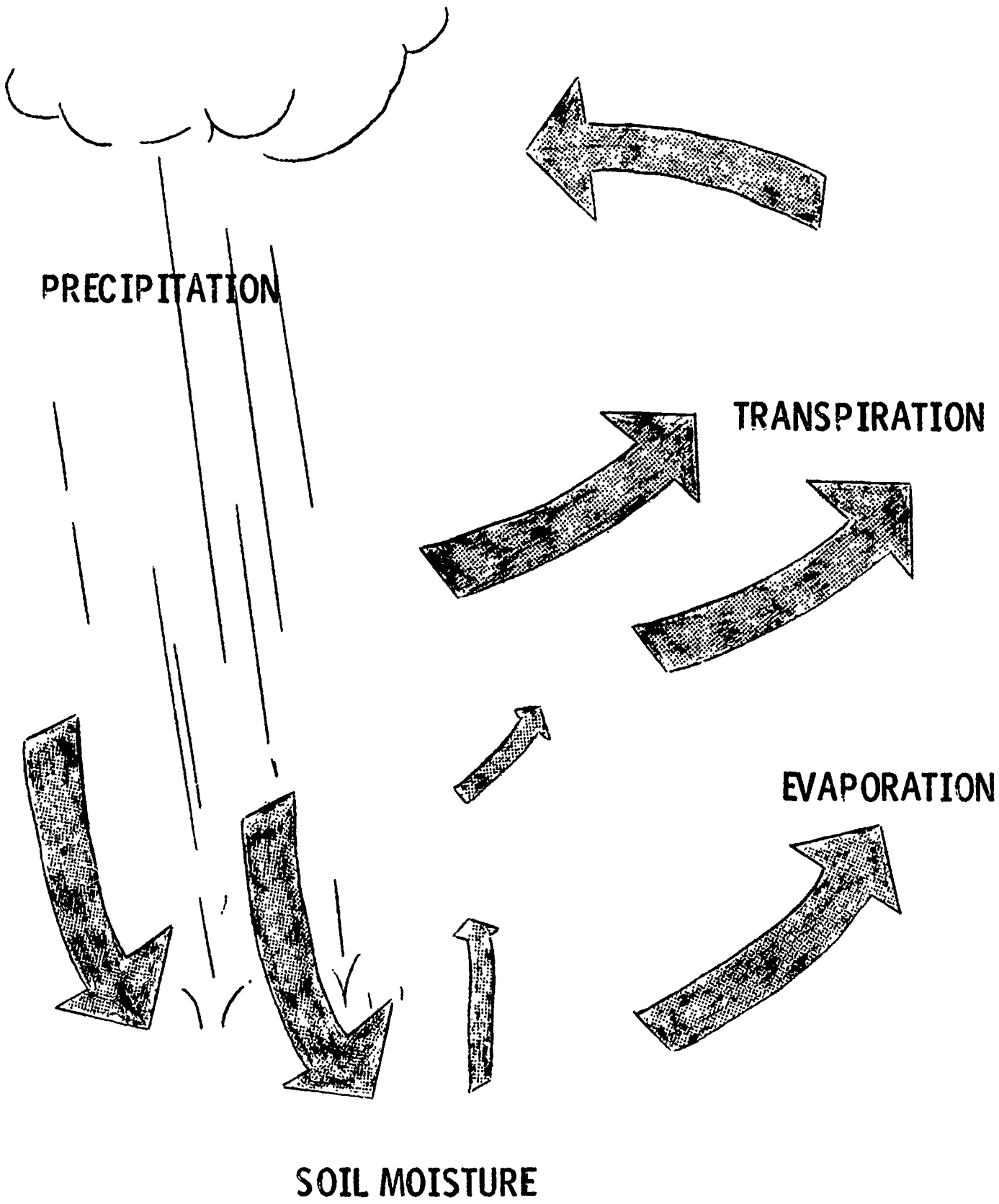


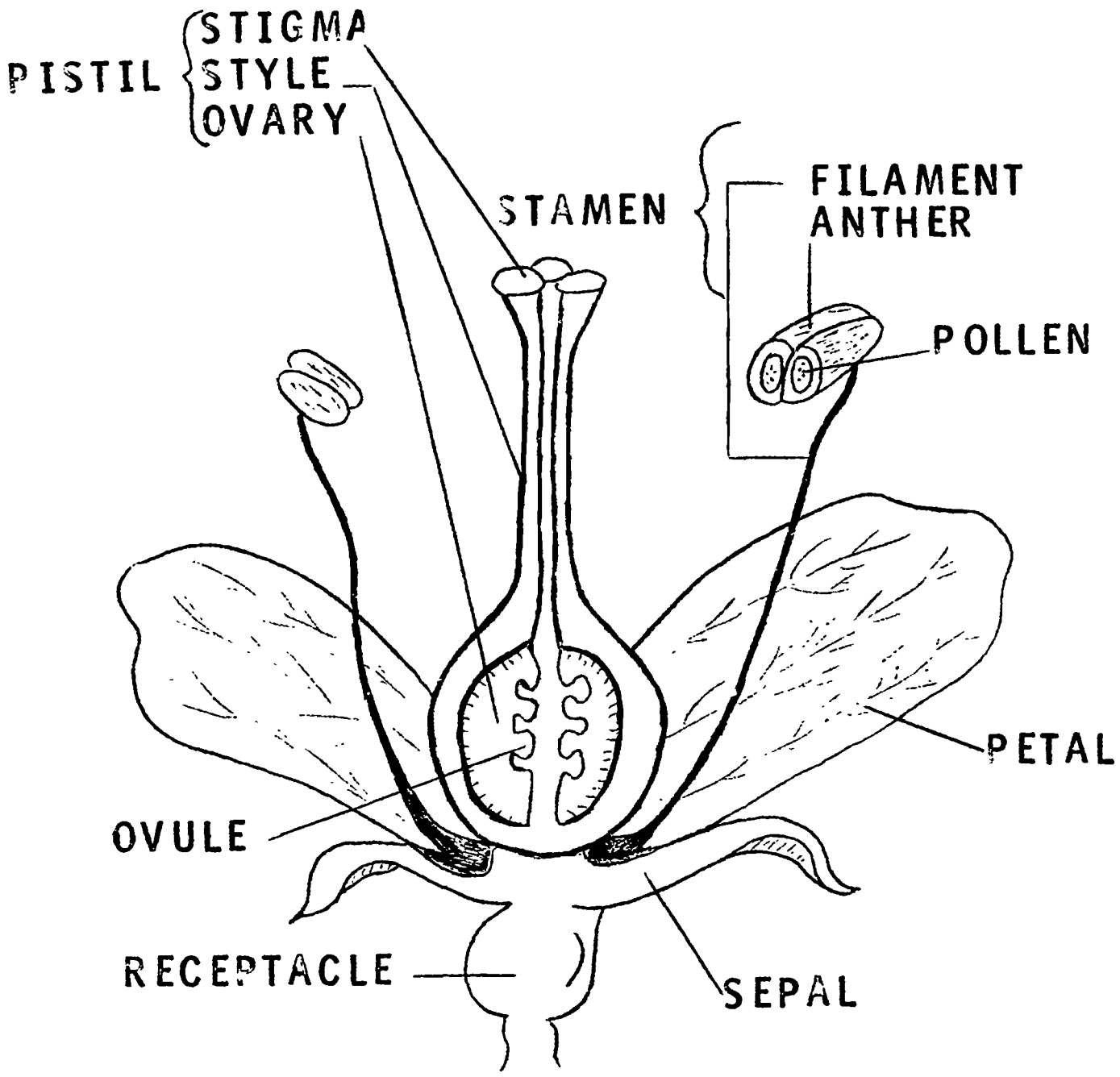
COMPLETE METAMORPHOSIS

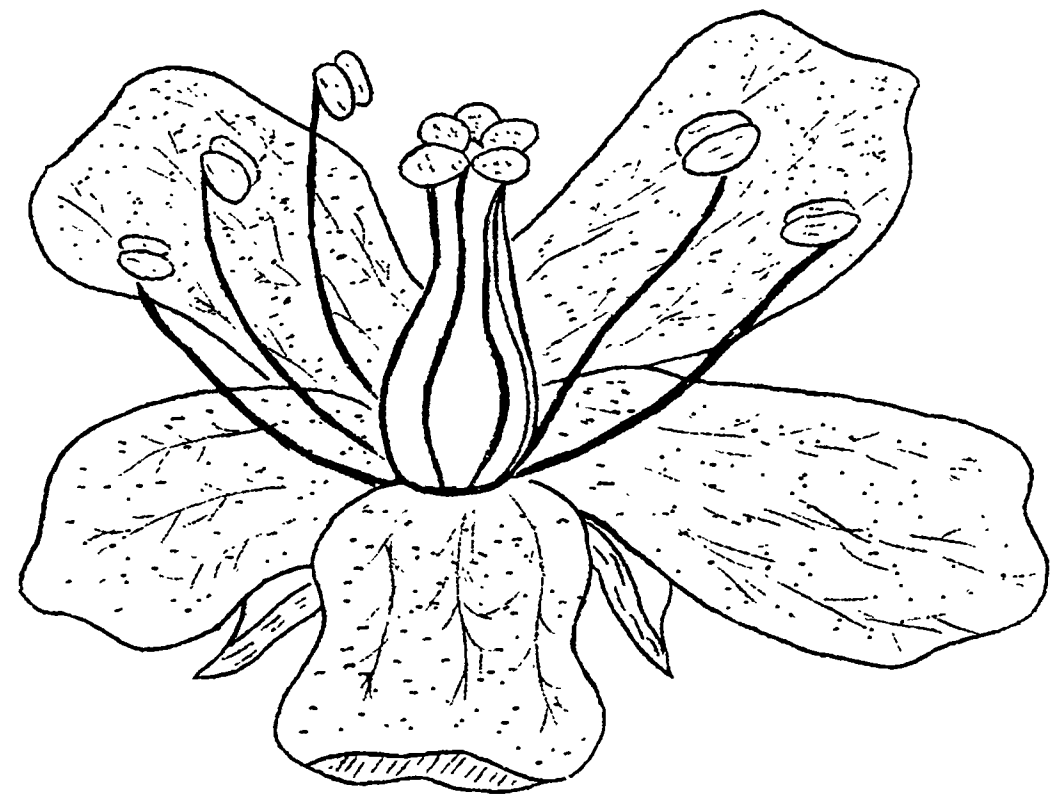


WATER CYCLE



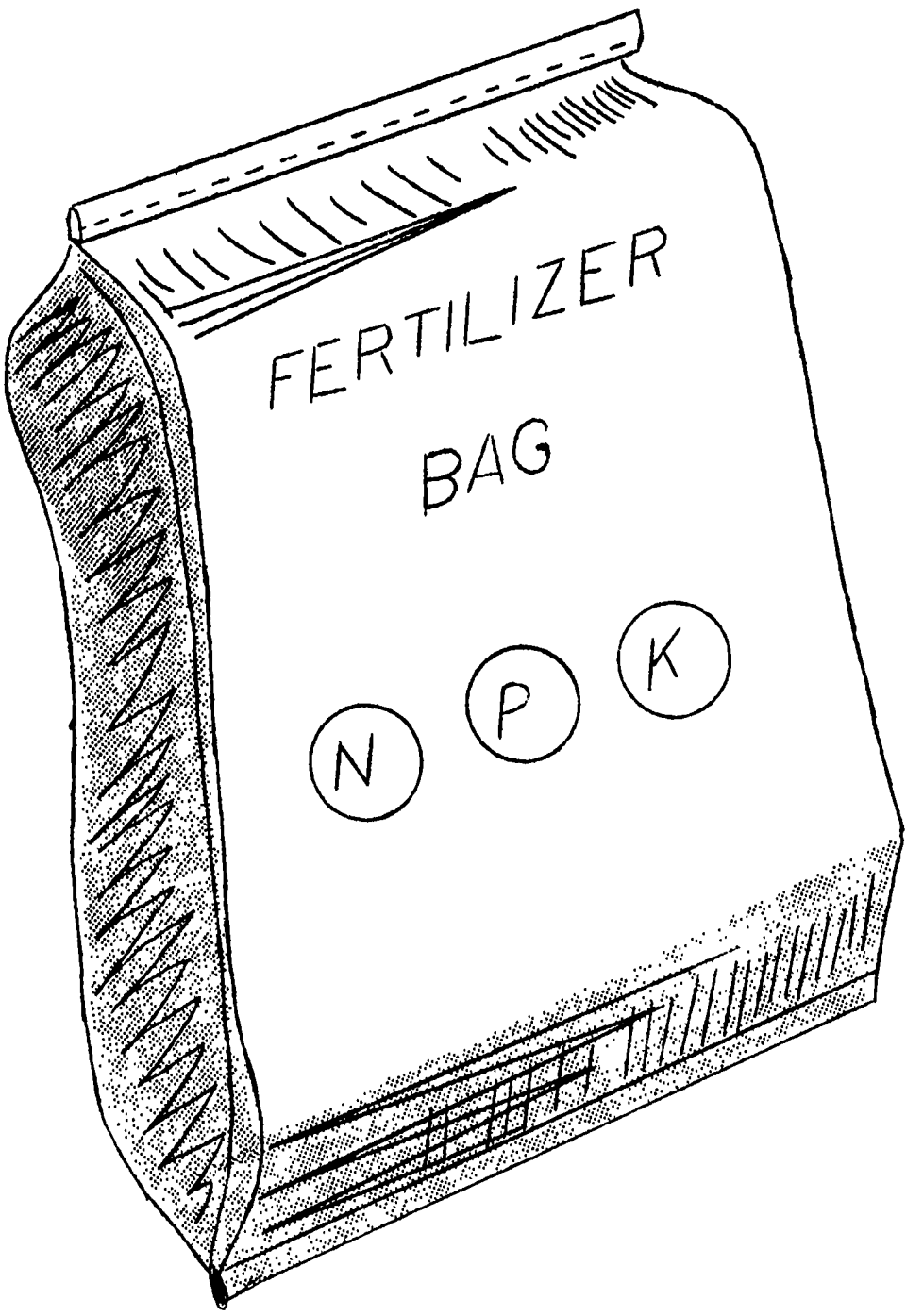

PRECIPITATION
TRANSPIRATION
EVAPORATION
SOIL MOISTURE





TYPICAL

DICOT FLOWER


FERTILIZER
BAG
N
P
K

PRIMARY PLANT NUTRIENTS

1.

2.

3.

N NITROGEN

P PHOSPHORUS

K POTASSIUM

N

NITROGEN

1. Dark green
2. Rapid growth
3. Increases yields
4. Increases protein
5. Feeds micro-organisms

ERIC

P

PHOSPHORUS

1. Early root formation
2. Rapid vigorous start
3. Hastens maturity
4. Stimulates blooming
5. Winter hardiness
6. Important to germinate
7. Conversion of sugar

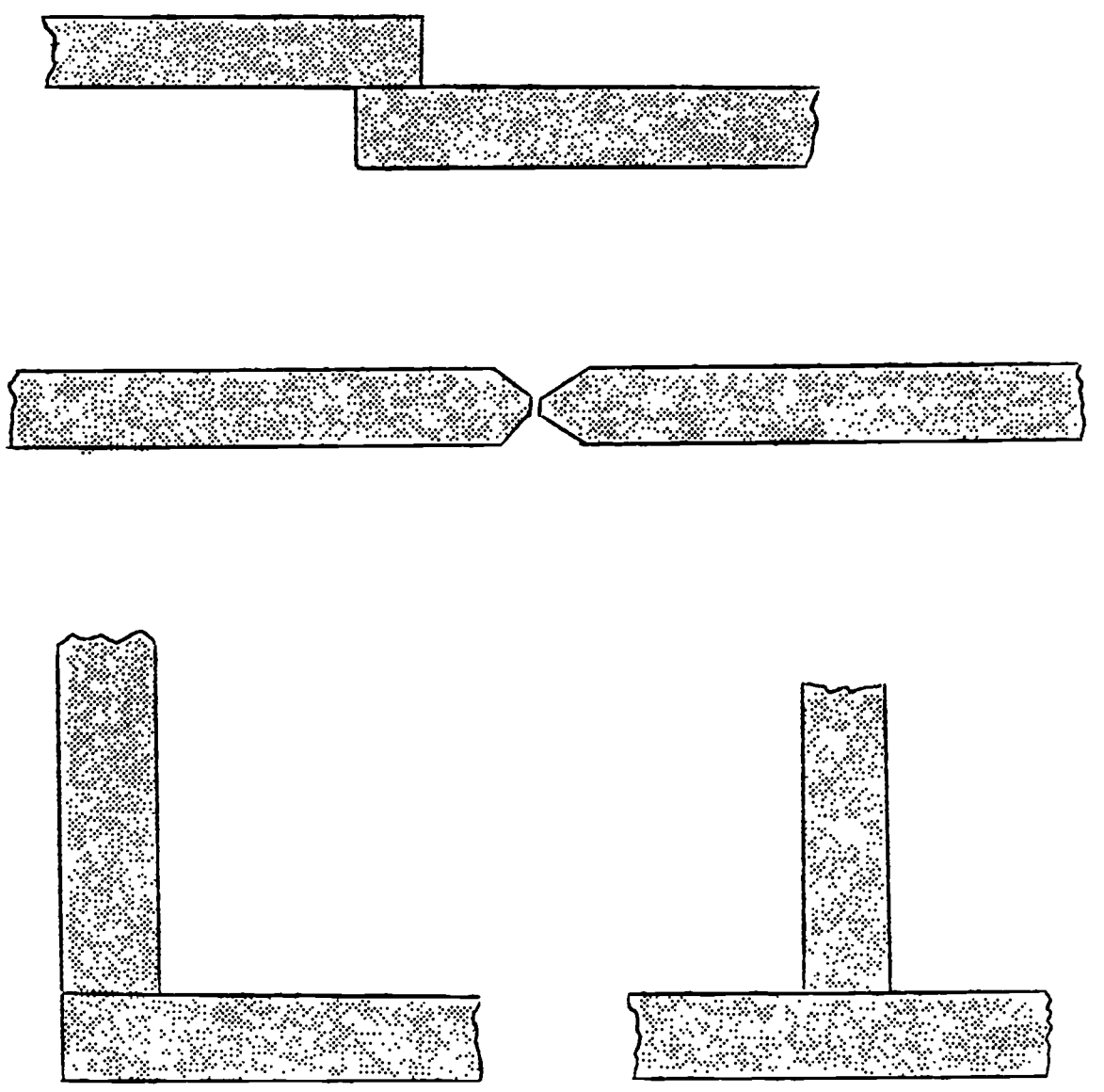
ERIC

K

POTASSIUM

1. Vigor, disease resistance
2. Stiff stalks
3. Plump seed
4. Transfer of nutrients
5. Winter hardiness

ERIC



WELDING JOINTS

1

2

3

4

NAME THE JOINTS

LAP JOINT

BUTT JOINT

FILLET JOINT

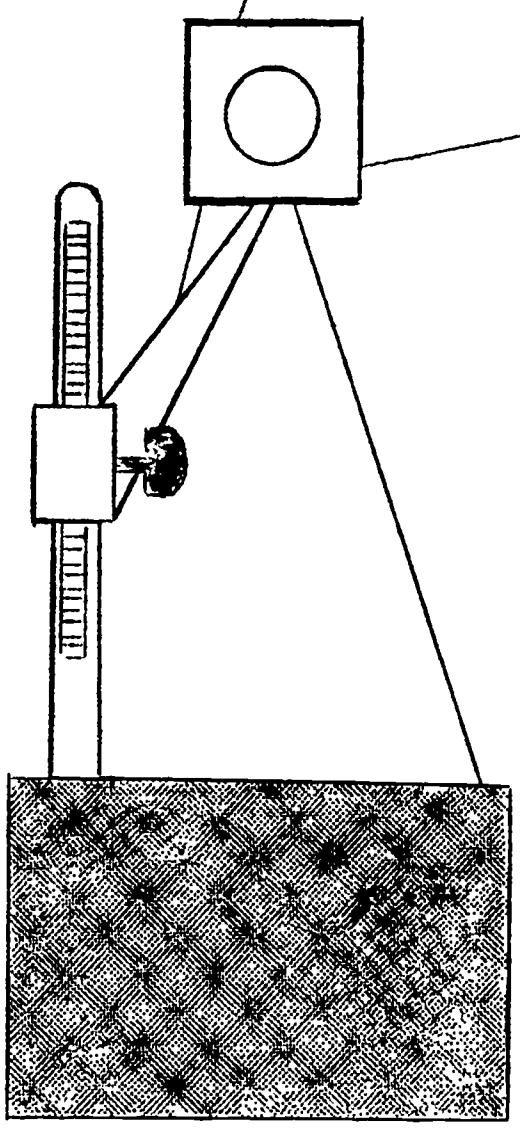
"T" JOINT

Part 1

OVERHEAD PROJECTION

Transparency Masters For Vocational Agriculture

(Supplement I.)



L. C. Dalton, State Supervisor
Agricultural Education
University Park, New Mexico

Joe A. Richardson, Assistant State
Supervisor, Agricultural Education
University Park, New Mexico

VT010255

R 216-(SF)

MEMORANDUM Revised 5/69

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
1900 Kenny Road
Columbus, Ohio 43210

FROM: (Person) L. C. Dalton (Agency) State Dept. of Agriculture Education

(Address) 130 South Capitol Street, Santa Fe, New Mexico 87501

DATE: December 19, 1969

RE: (Author, Title, Publisher, Date) Dalton, L.C. Overhead Projection; Transparency Masters for Vocational Agriculture (Including Supplements I-III). New Mexico State University, University Park. 1969.

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Provide information below which is not included in the publication. Mark N/A in each blank for which information is not available or not applicable. Mark P when information is included in the publication. See reverse side for further instructions.

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(2) Means Used to Develop Material:
Development Group State Dept. of Agriculture Education
Level of Group Teacher
Method of Design, Testing, and Trial

(3) Utilization of Material:
Appropriate Educational Setting
Type of Program Agriculture Mechanics
Occupational Focus
Geographic Adaptability
Uses of Material
Users of Material

(4) Requirements for Using Material:
Teacher Competency
Student or Trainee Selection Criteria

Time Allotment

Supplemental Media --
Necessary ____ } (Check Which)
Desirable ____ }

Describe

Source (agency)
(address)

SOIL DEFINITIONS

Soil--is the mineral and organic material that supports plant growth on the earth's surface. It is a mixture of particles of rock, organic materials, air and water

Soil Texture--the fineness or coarseness of the mineral particles

Soil Structure--the way the individual soil particles are grouped together to form clusters of particles called aggregates

SOIL CLASSES

Group	Soil Textural Classes
Fine-Textured:	Clay Silty Clay Sandy Clay
Moderately Fine-Textured:	Silty Clay Loam Clay Loam Sandy Clay Loam
Medium-Textured:	Loam Silt Loam Silt
Coarse-Textured:	Sandy Loam Loamy Sand
Very Coarse-Textured:	Sand

FACTORS RESPONSIBLE FOR SOIL FORMATION

1. Parent Material
2. Climate
3. Life
4. Topography
5. Age

CHARACTERISTICS OF AN IDEAL SEEDBED

1. Finely pulverized
2. Loose, mellow condition
3. Firm
4. Free of weeds
5. Fertile
6. Free of insects
7. Free of disease

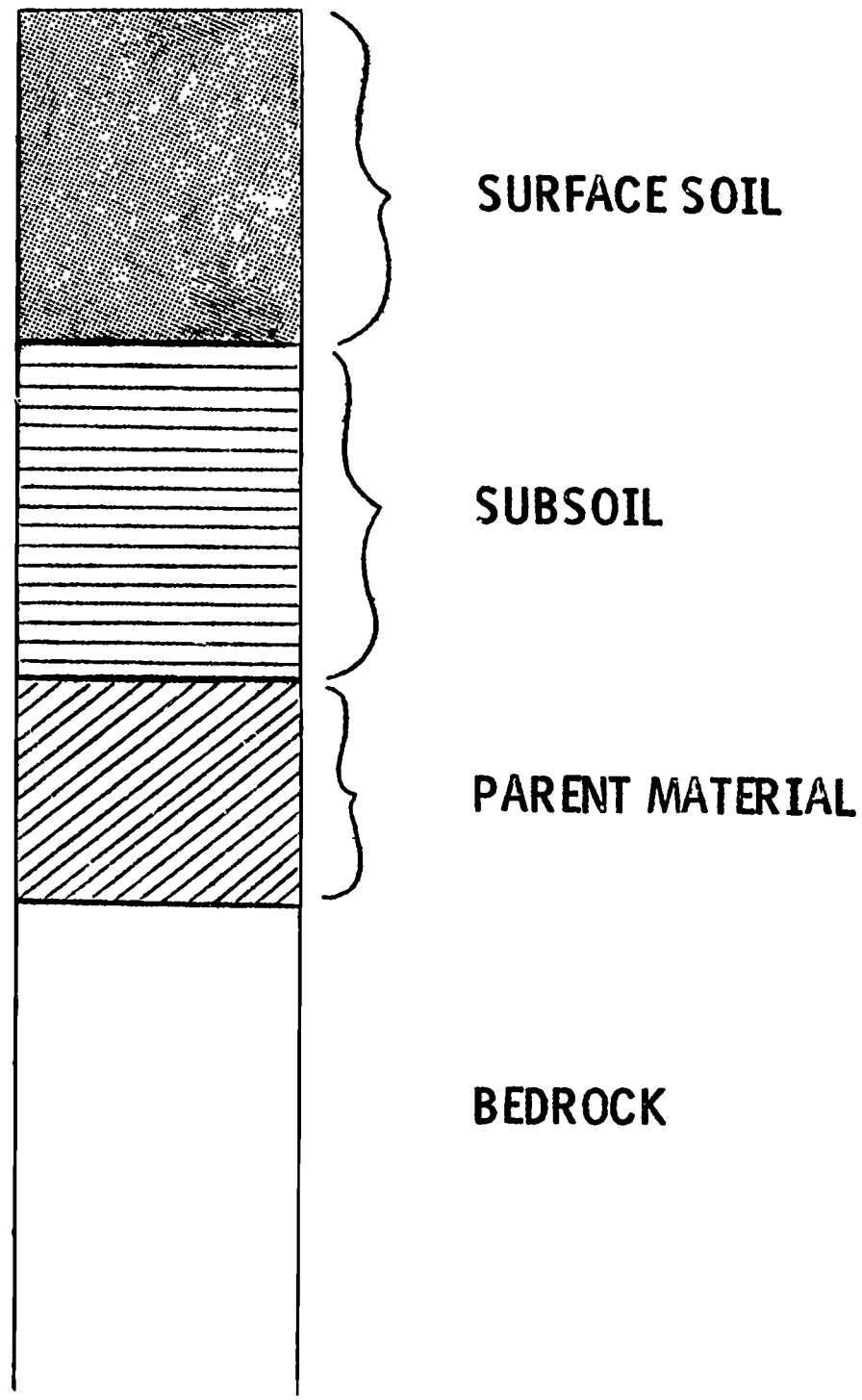
EFFECTS OF EROSION

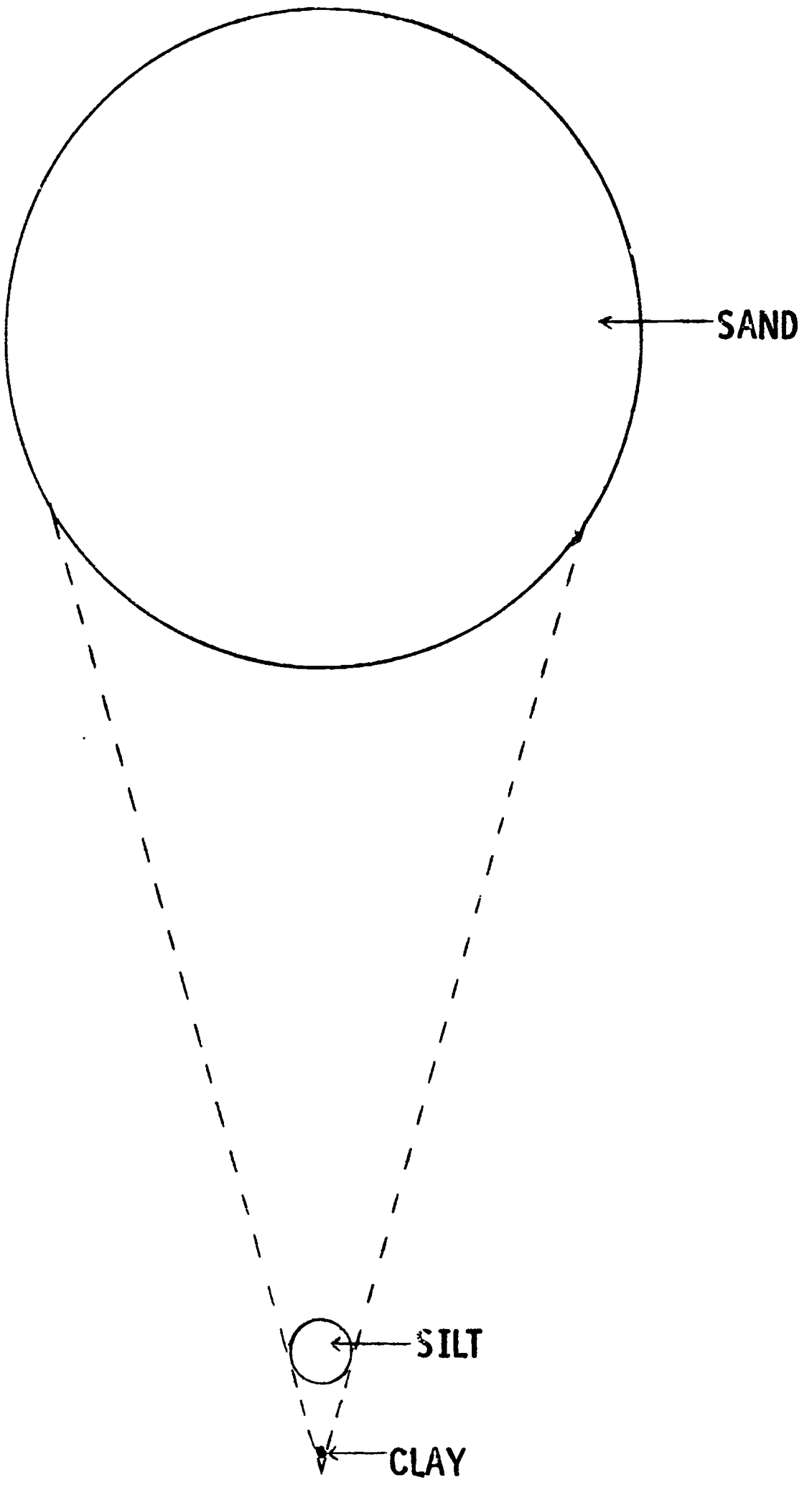
1. Loss of best part of the soil
2. Reduced yields
3. Increased fertilizer requirements
4. Production of lower-income crops
5. Formation of gullys
6. Covering of rich bottomlands by soils from poorer uplands
7. Destruction of roadbanks and bridges
8. Silting of dams, lakes, and reservoirs
9. Increased flood hazards
10. Waste of needed water

FACTORS INFLUENCING WATER EROSION

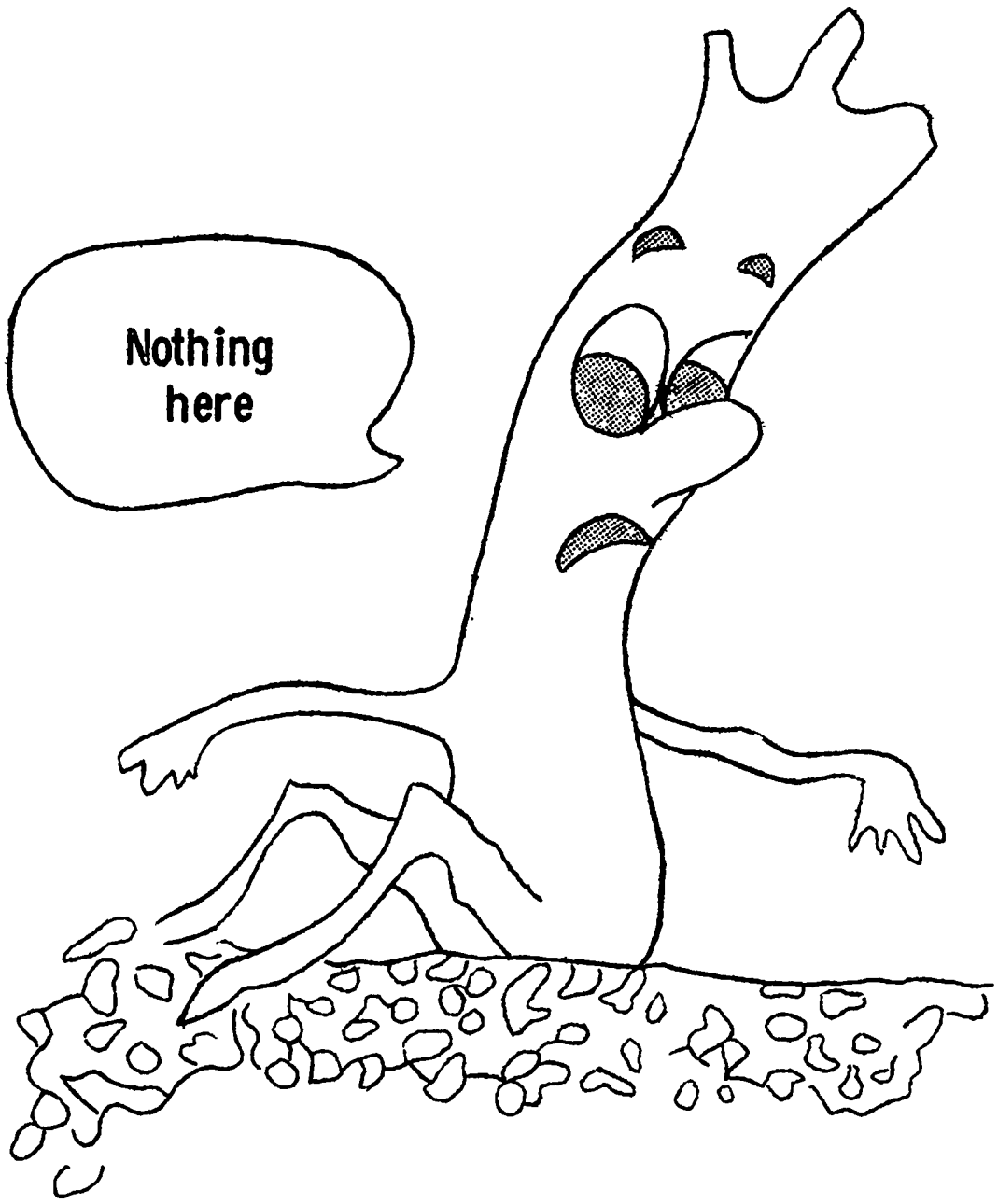
1. Cover
2. Slope
   a. Percent
   b. Length
   c. Uniformity
3. Soil Condition
   a. Organic Matter
   b. Structure
4. Rainfall
   a. Intensity
   b. Duration
   c. Frequency of Occurrence
   d. Seasonal Distribution

SOIL PROFILE



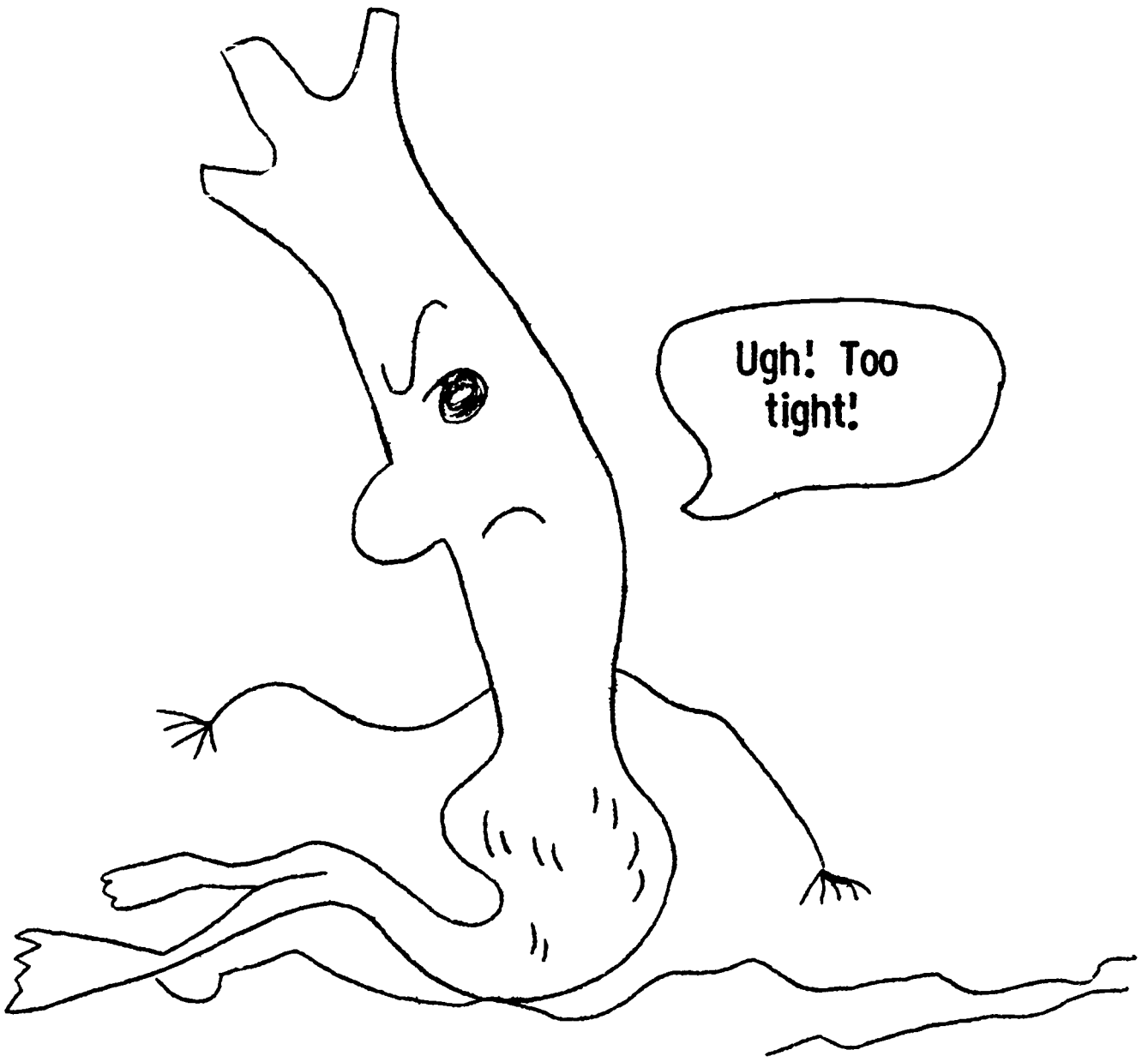


THE RELATIVE SIZE OF SAND, SILT, AND CLAY



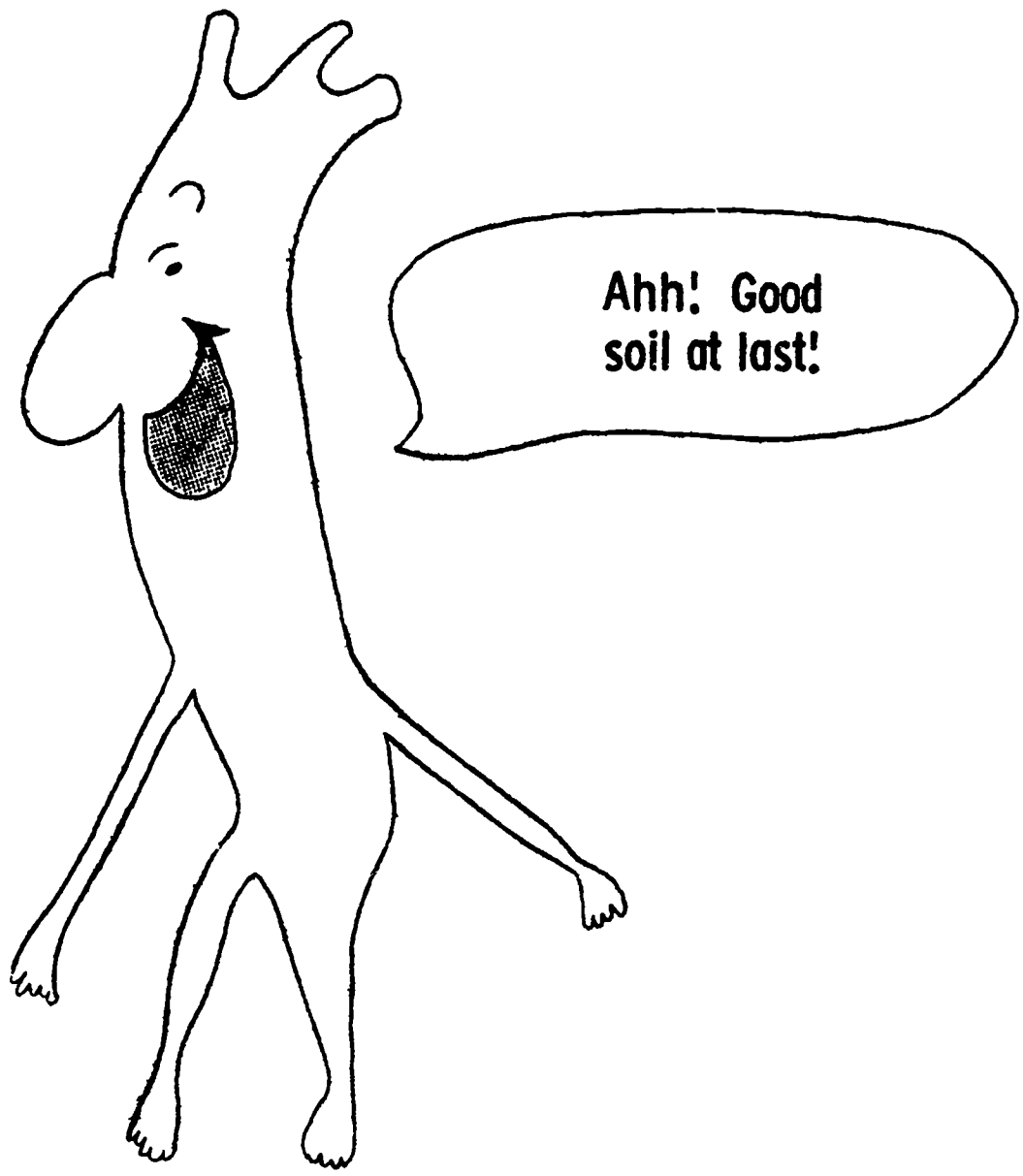
SAND

Coarse-textured soils do not hold and store plant nutrients or water very well and tend to be droughty and infertile.



TIGHT CLAY

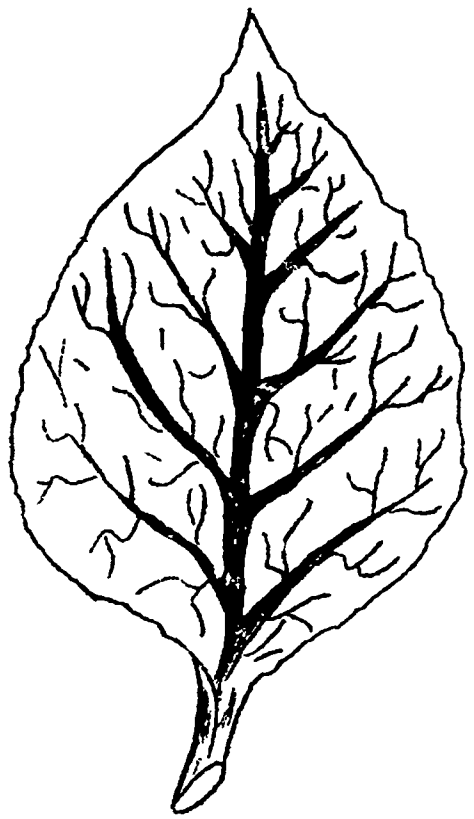
A soil made up mostly of clay will not be very permeable to air, water, and plant roots.



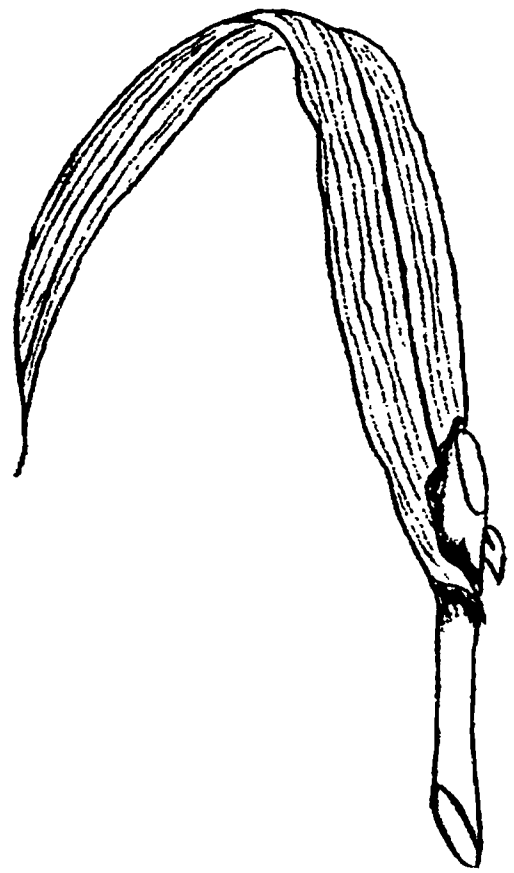
LOAM

Medium-textured soils, such as loams, are desirable because they have both fine and coarse particles; the coarse particles make the soil permeable, the fine particles help hold water and nutrients.

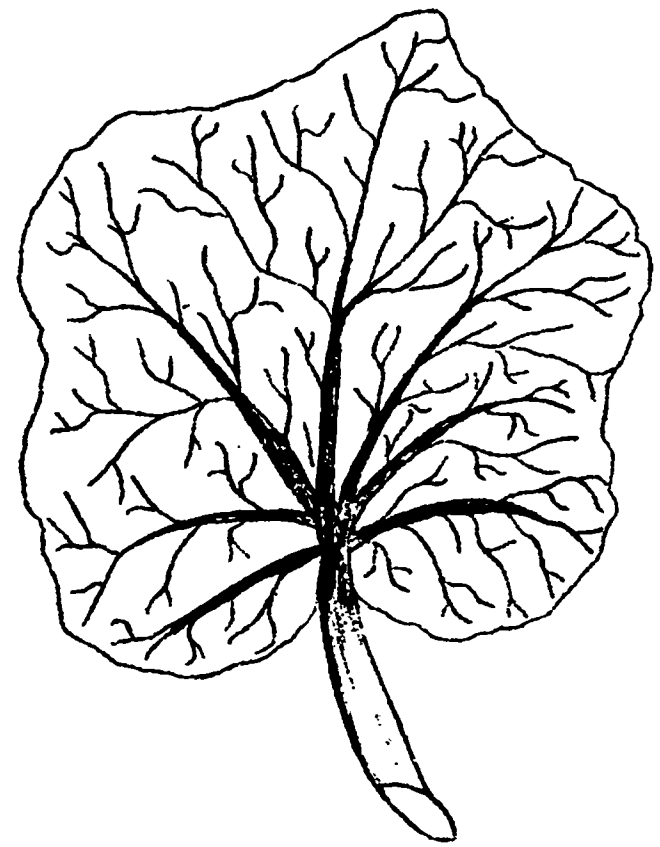
VENATION IN SIMPLE LEAVES



PINNATE

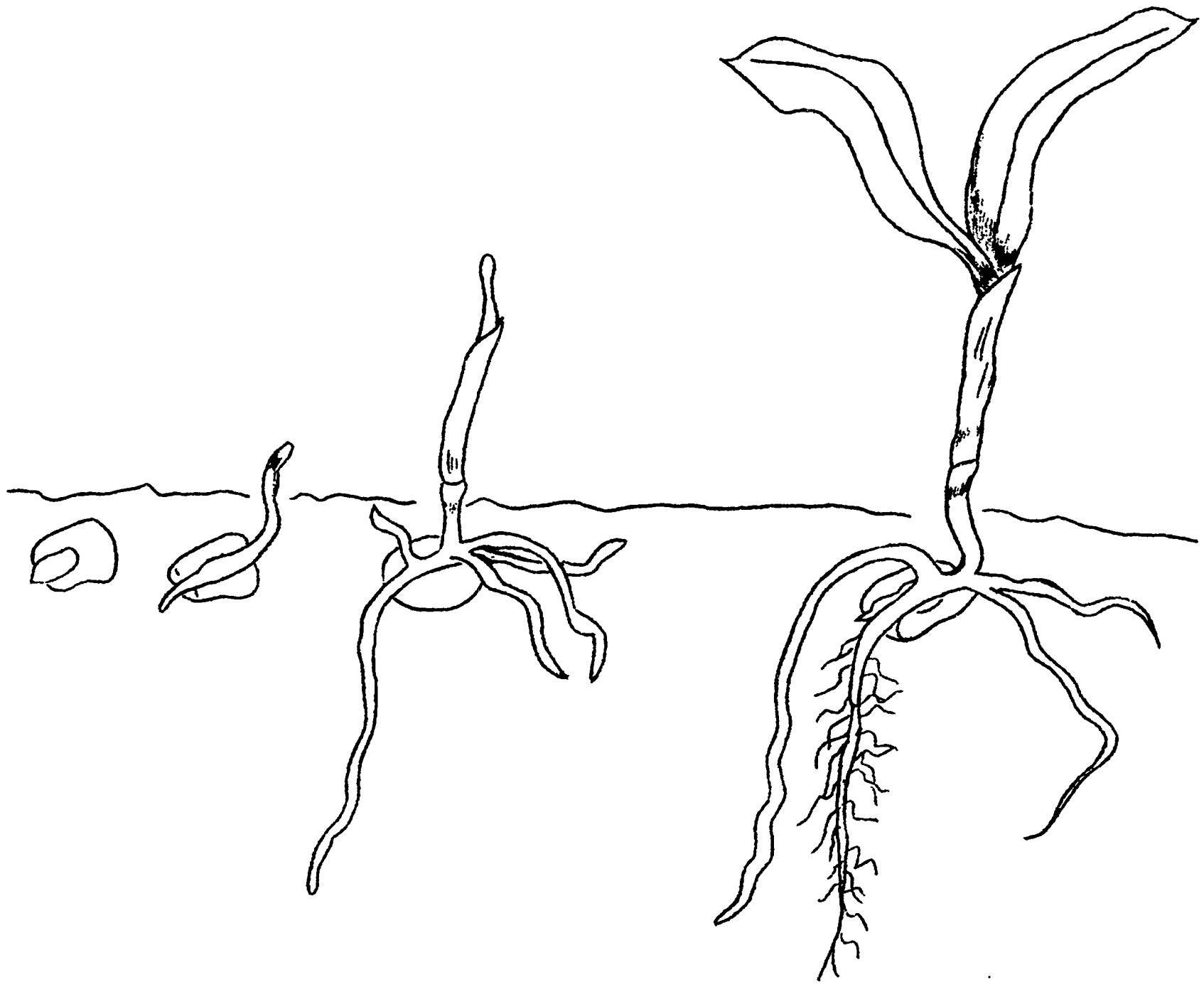


PARALLEL



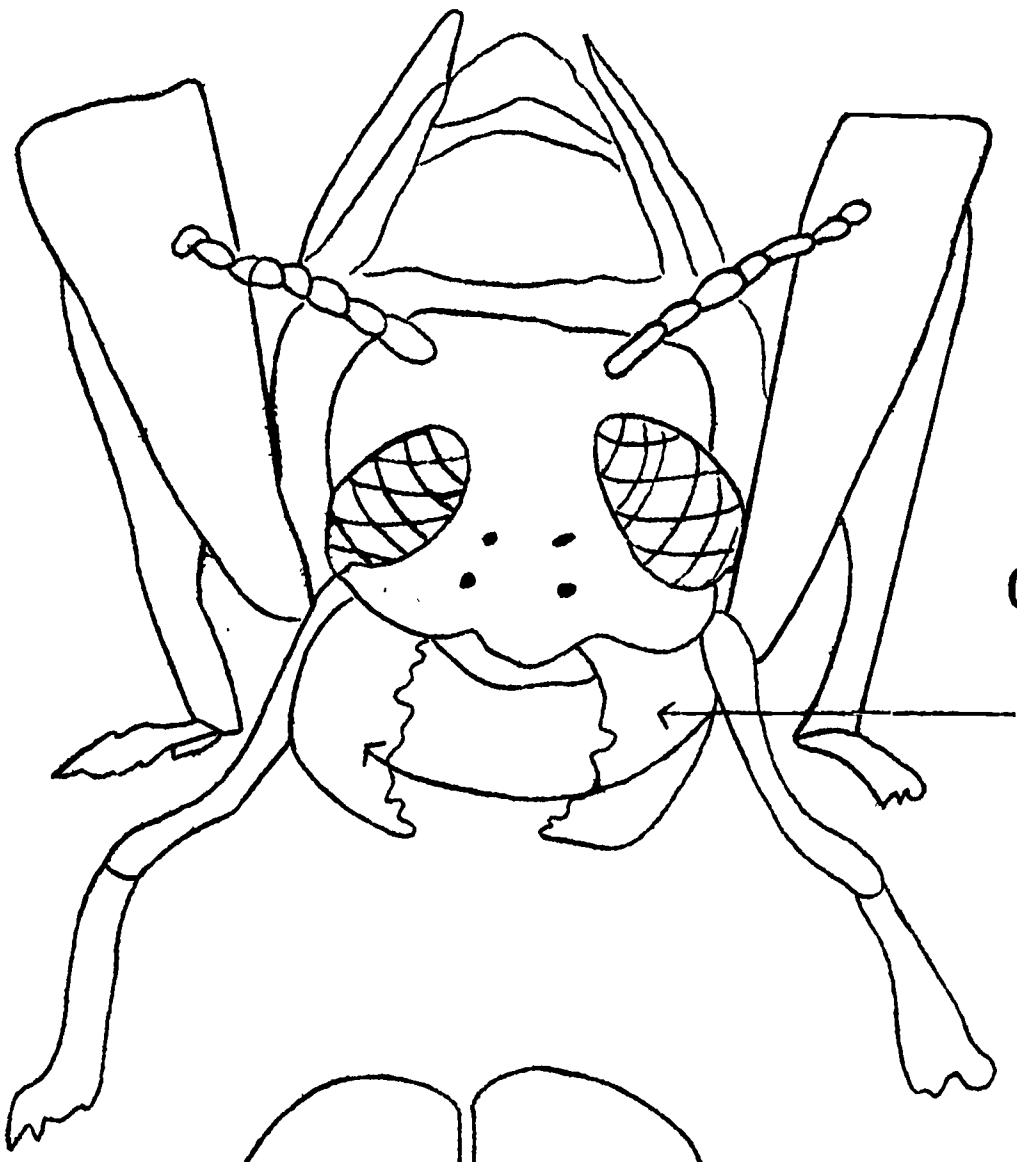
PALMATE

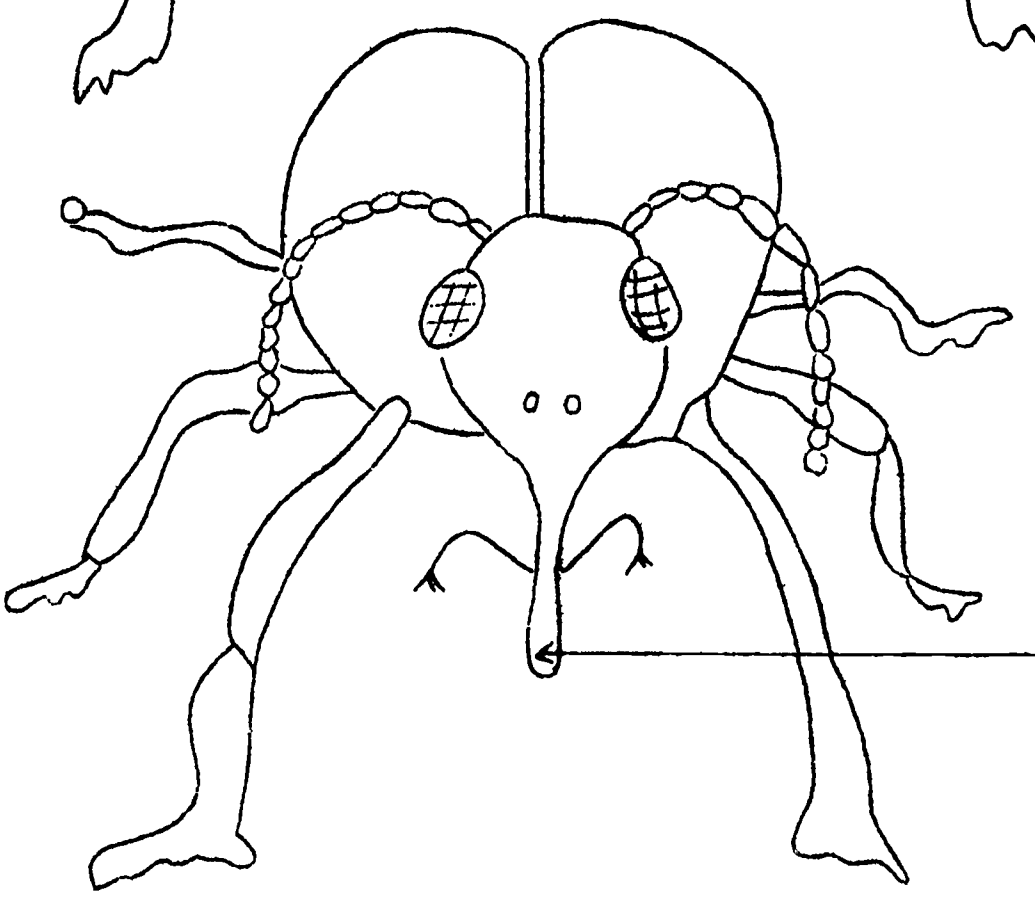
GERMINATION STAGES OF A MONOCOTYLEDON
(CORN)



GERMINATION STAGES
OF A DICOTYLEDON
(BEAN)

INSECTS
(CHEWING AND SUCKING)





BEEF BREEDS

Breed	Color	Origin	Head Characteristics
Angus			
Red Angus			
Galloway			
Hereford			
Polled Hereford			
Shorthorns			
Polled Shorthorns			
Charolais			
Brahman			
Santa Gertrudis			
Brangus			
Beefmaster			
Charbray			

DAIRY BREEDS

Breed		Jersey	Guernsey	Holstein	Ayrshire	Brown Swiss
Origin						
Color						
Size	Cows	1000	1100	1500	1200	1400
	Bulls	1500	1700	2200	1050	2000
World Record (Milk)		M. 26,364 F. 1,212	M. 29,665 F. 1,190	M. 42,805 F. 1,246	M. 26,731 F. 1,072	M. 34,851 F. 1,579
World Record (Fat)		M. 24,088 F. 1,384	M. 26,695 F. 1,461	M. 36,821 F. 1,866	M. 23,500 F. 1,079	M. 34,811 F. 1,733

SHEEP BREEDS CLASSIFIED BY WOOL TYPE

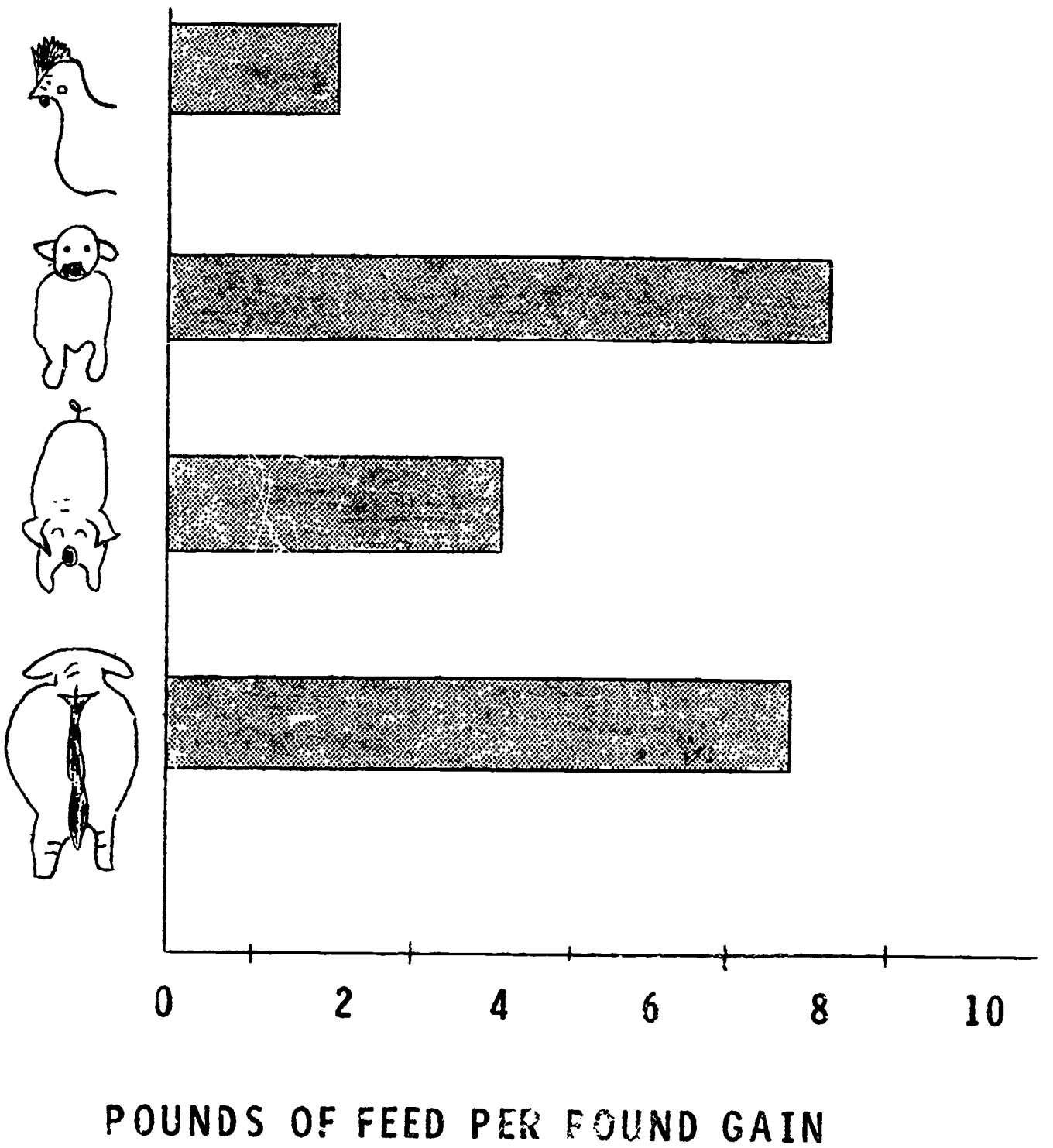
BREED	COLOR MARKINGS	HORNS	WEIGHT	ORIGIN
FINE WOOL				
MERINO				
RAMBOUILLET				
MEDIUM WOOL				
CHEVIOT				
DORSET				
HAMPSHIRE				
OXFORD				
SHROPSHIRE				
SOUTHDOWN				
SUFFOLK				

HOG BREED CHARACTERISTICS

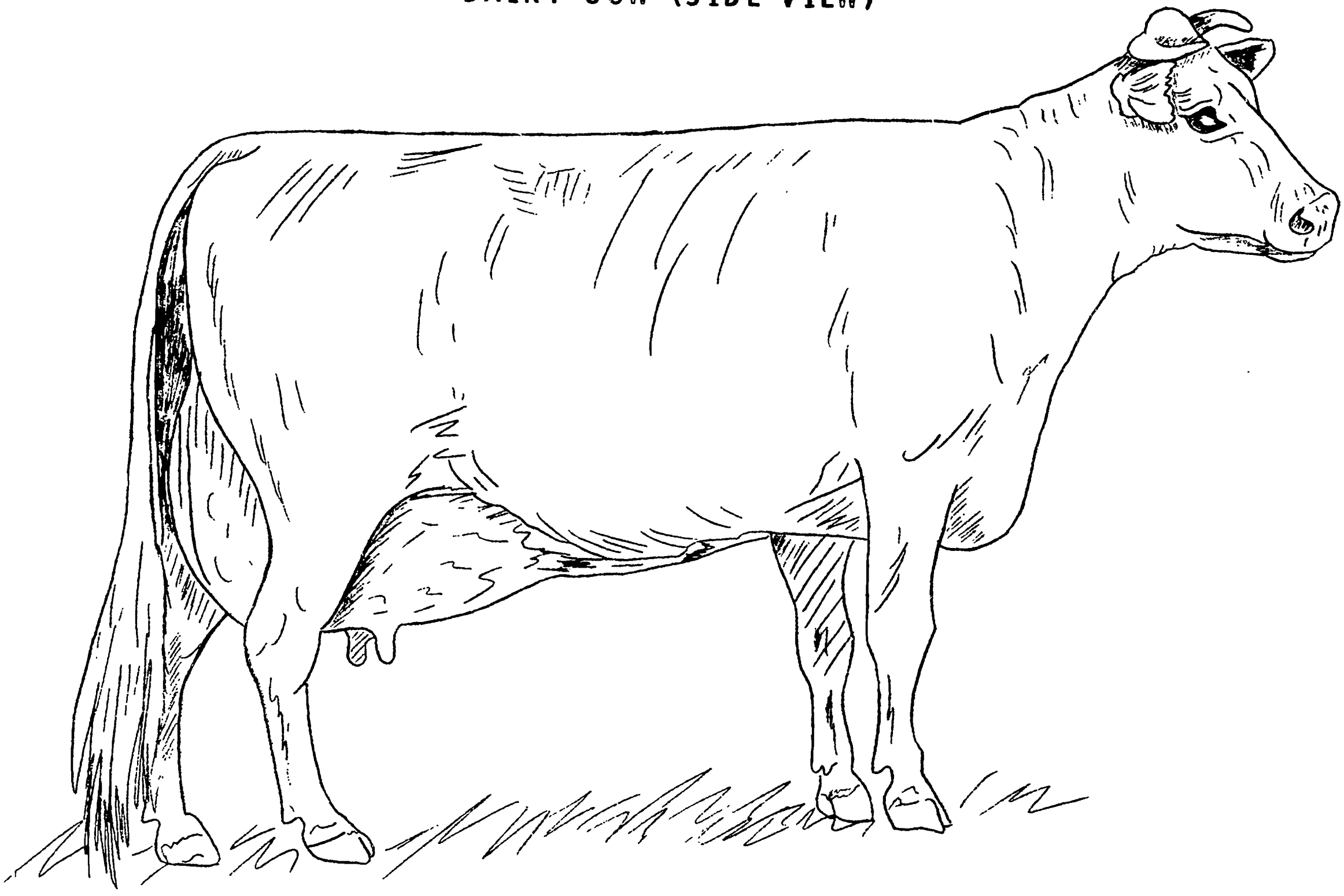
BREED	COLOR	EARS	ORIGIN
Berkshire			
Chester White			
Duroc			
Hampshire			
Hereford			
OIC			
Poland China			
Spotted Poland China			
Tamworth			
Yorkshire			
Landrace			

SHEEP BREEDS CLASSIFIED BY WOOL TYPE - CONTINUED

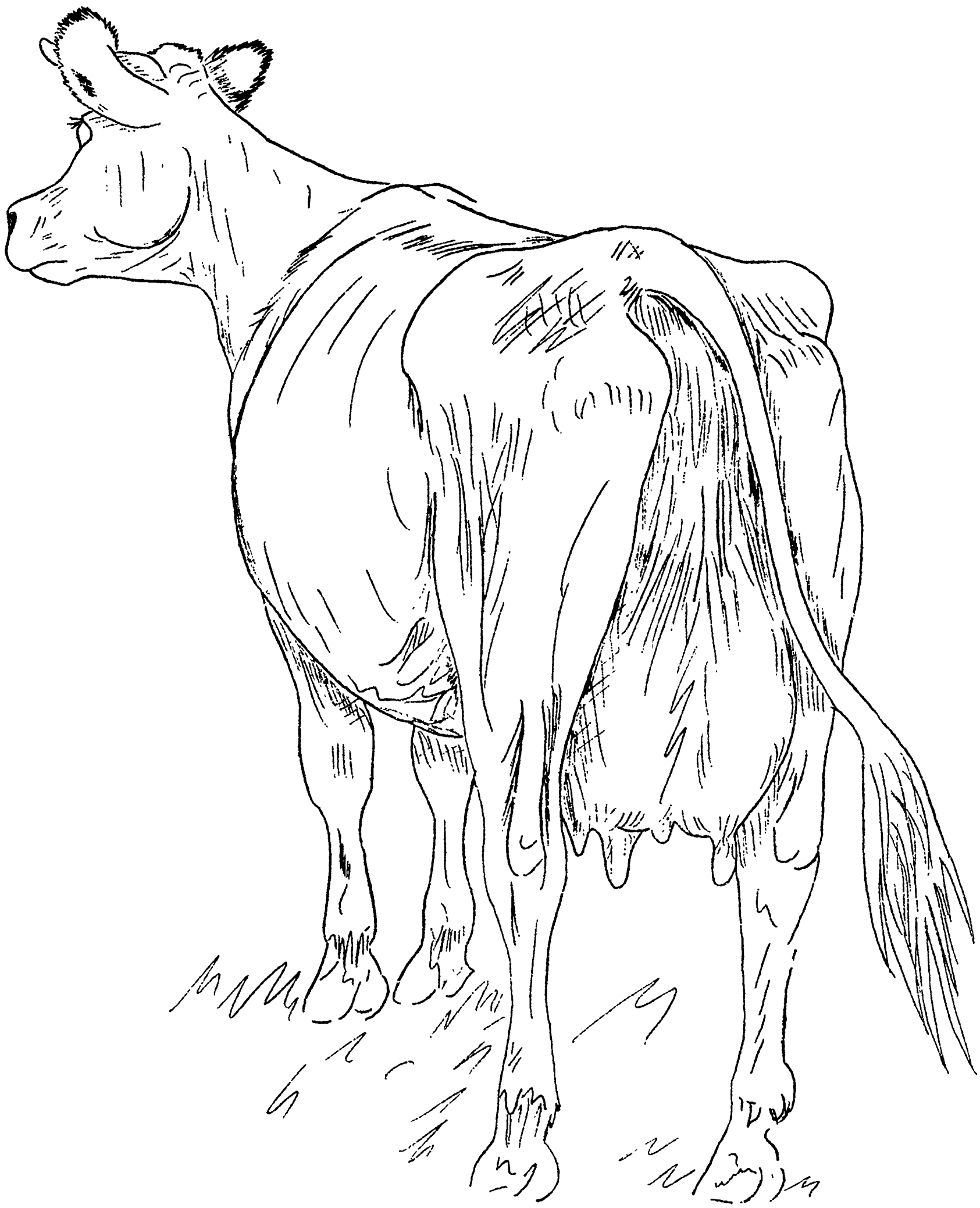
BREED	COLOR MARKINGS	HORNS	WEIGHT	ORIGIN
		LONG WOOL		
COTSWOLD				
LEICESTER				
LINCOLN				
ROMNEY				
		CROSSBRED WOOL		
COLUMBIA				
CORRIEDALE				
		FUR		
KARAKUL				


0
2
4
6
8
10
POUNDS OF FEED PER POUND GAIN

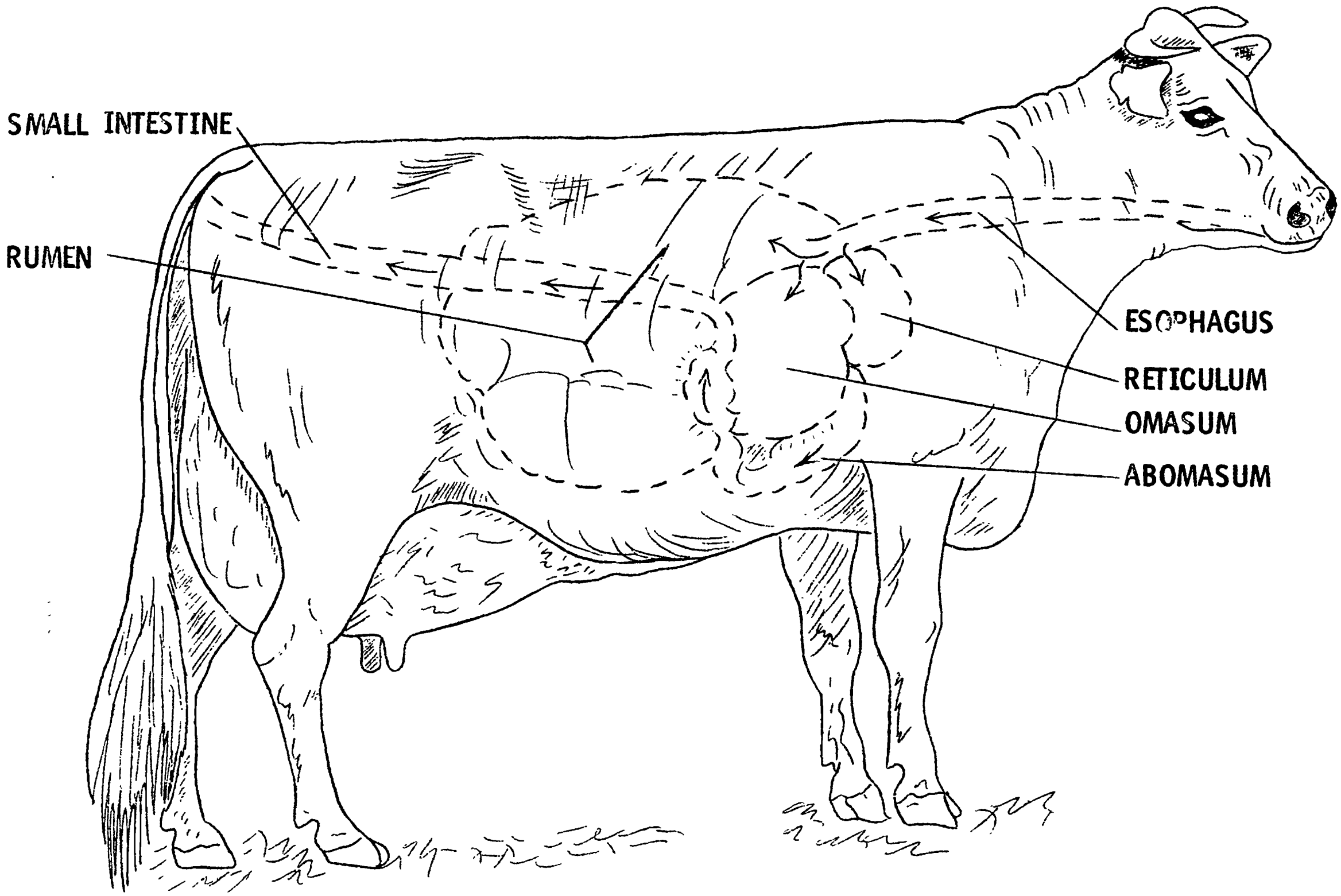
DAIRY COW (SIDE VIEW)

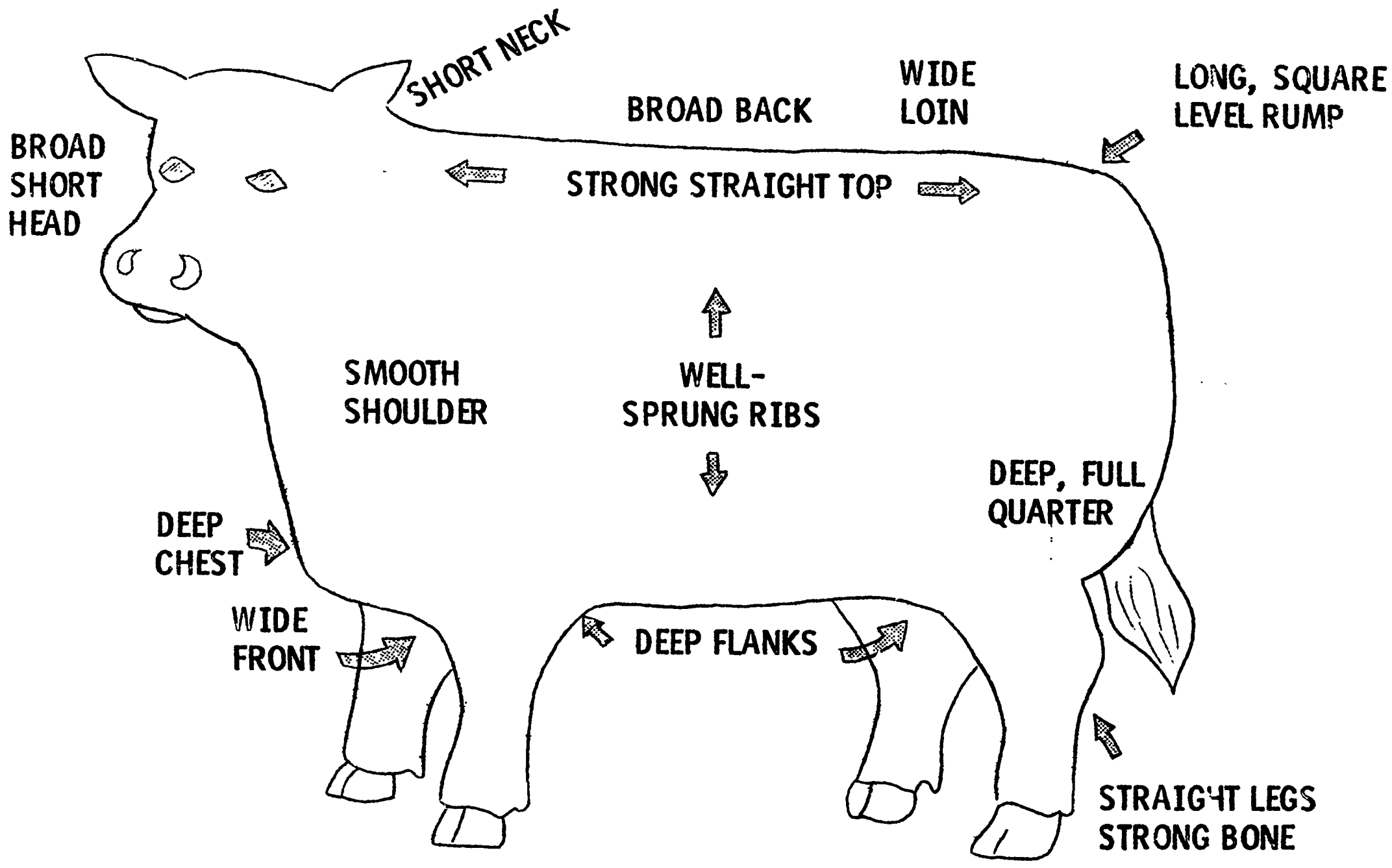


DAIRY COW (REAR VIEW)



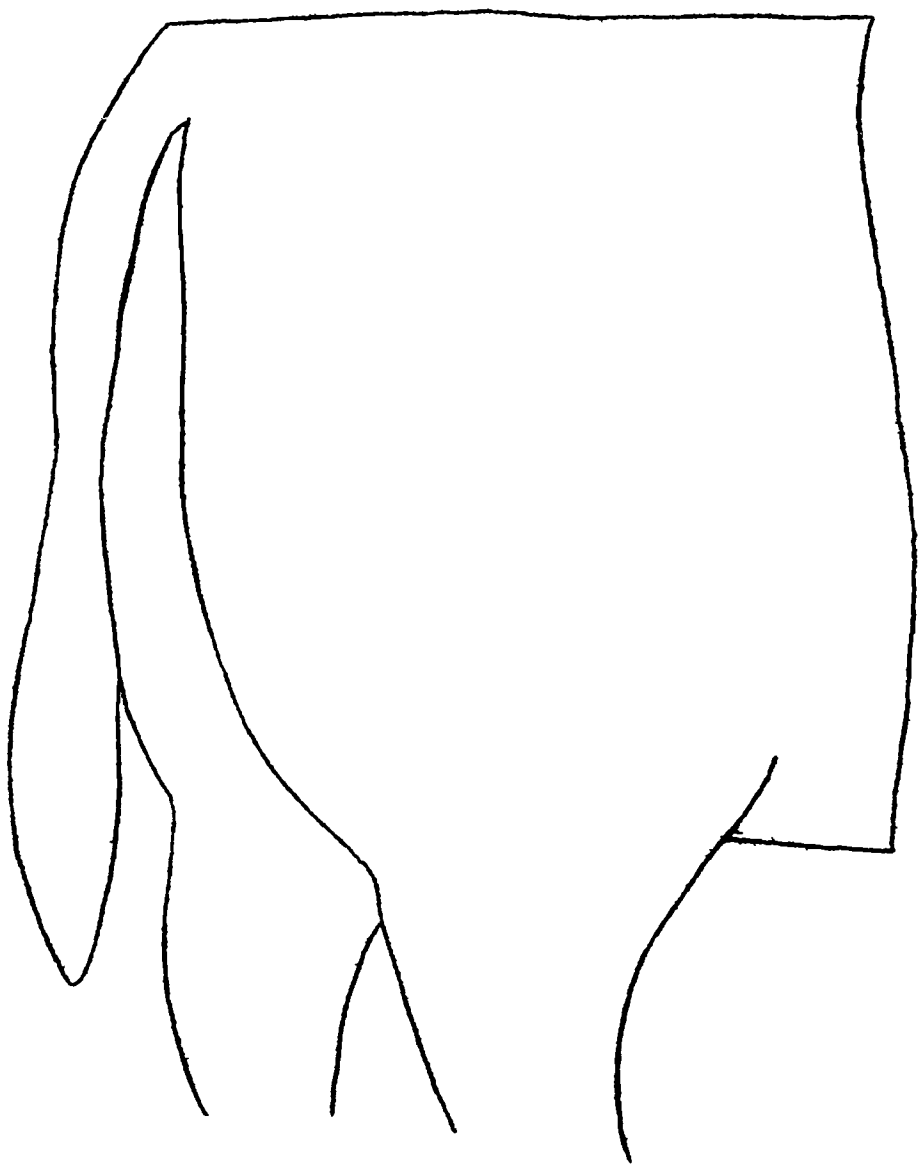
DIGESTIVE TRACT OF THE COW

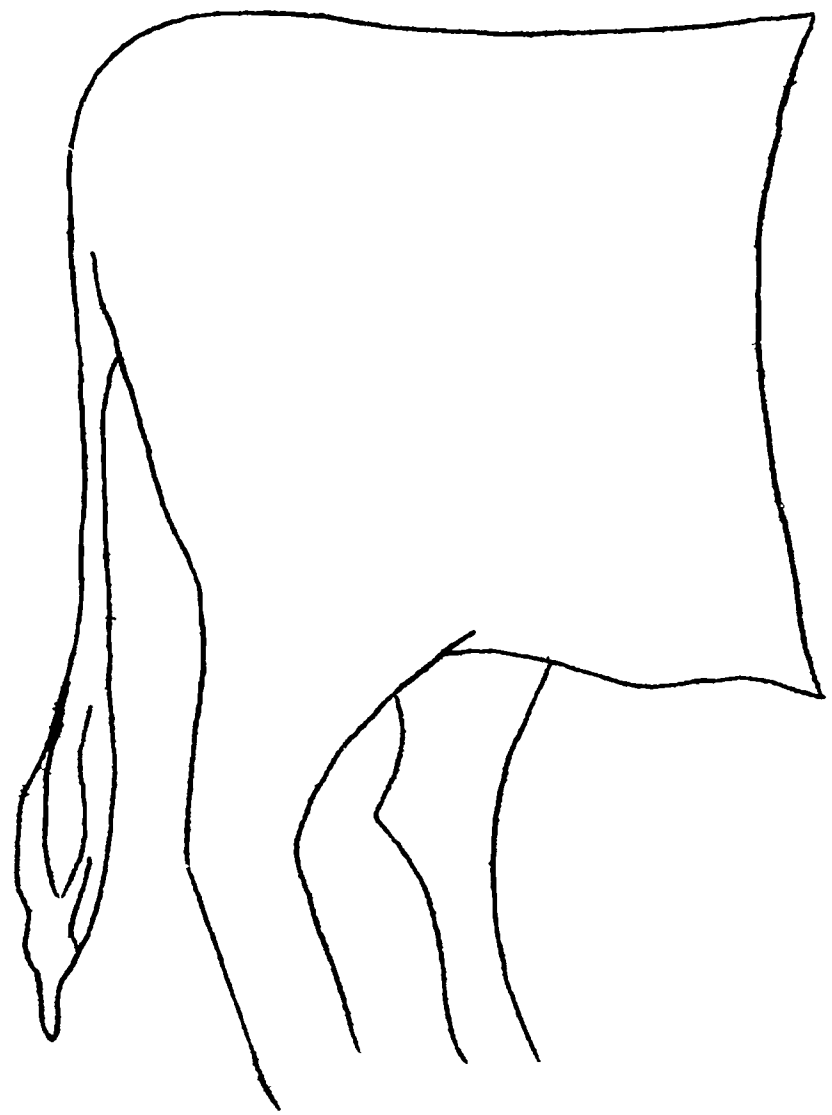


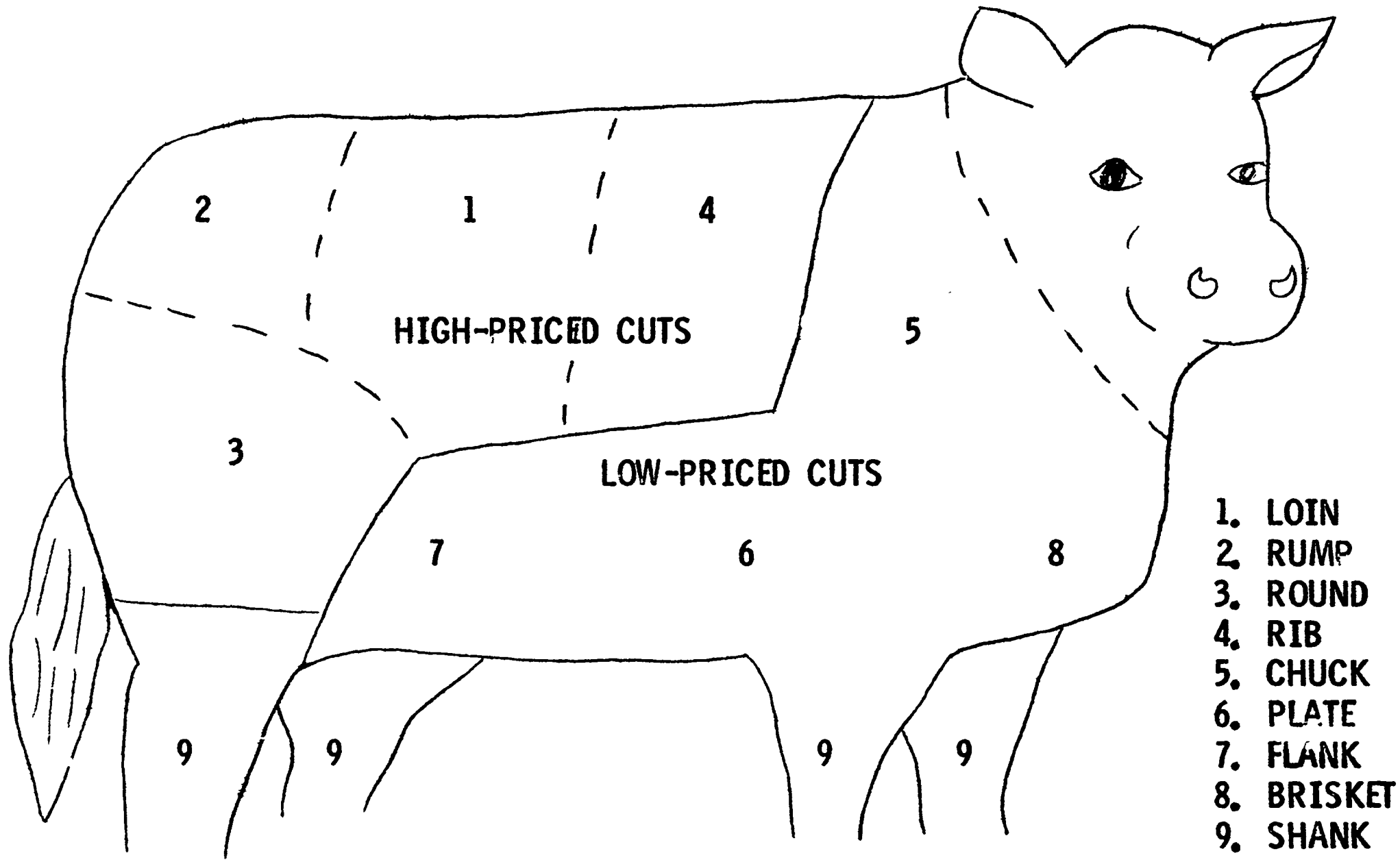


MAJOR PARTS OF A BEEF ANIMAL

THIS OR THIS

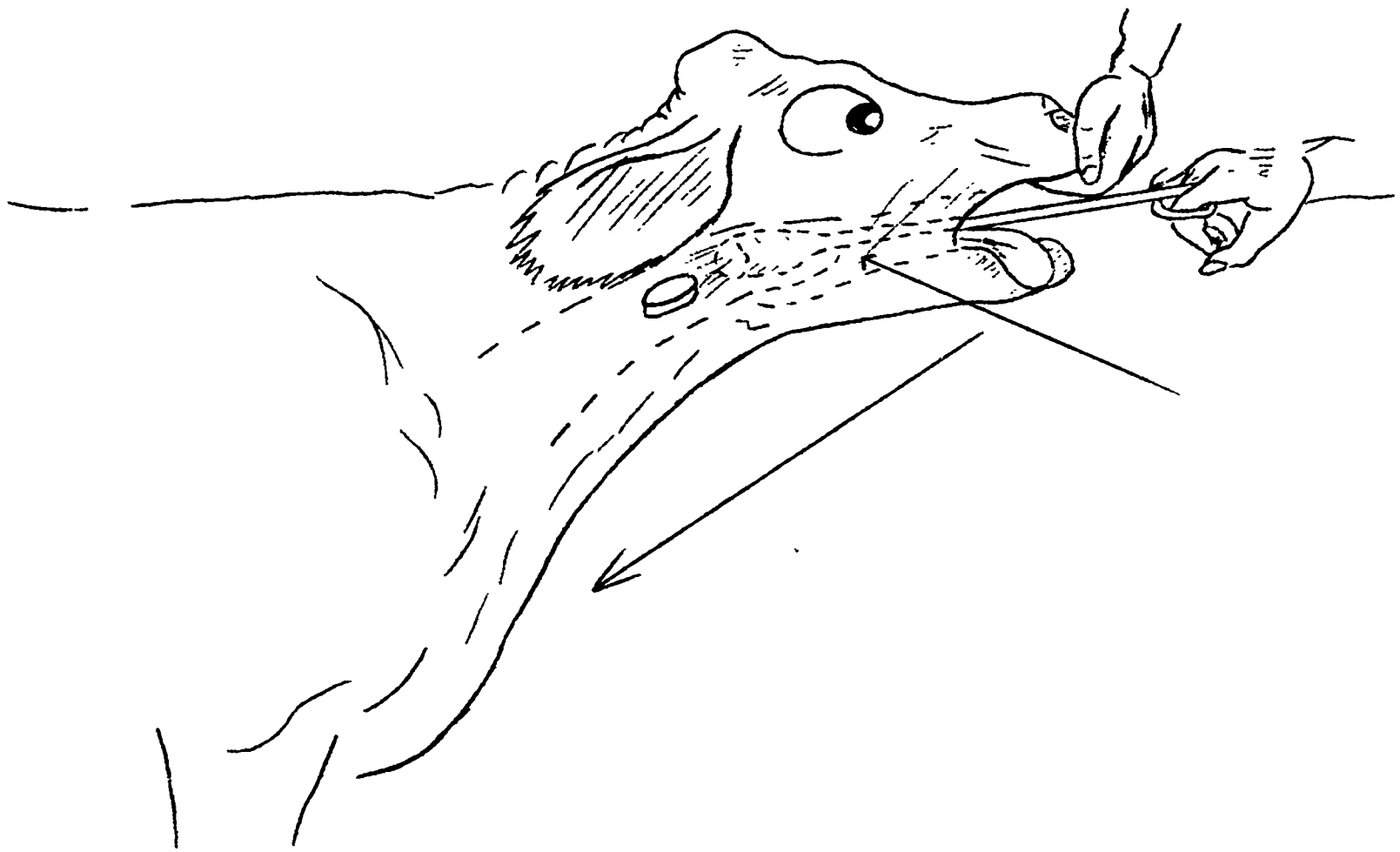




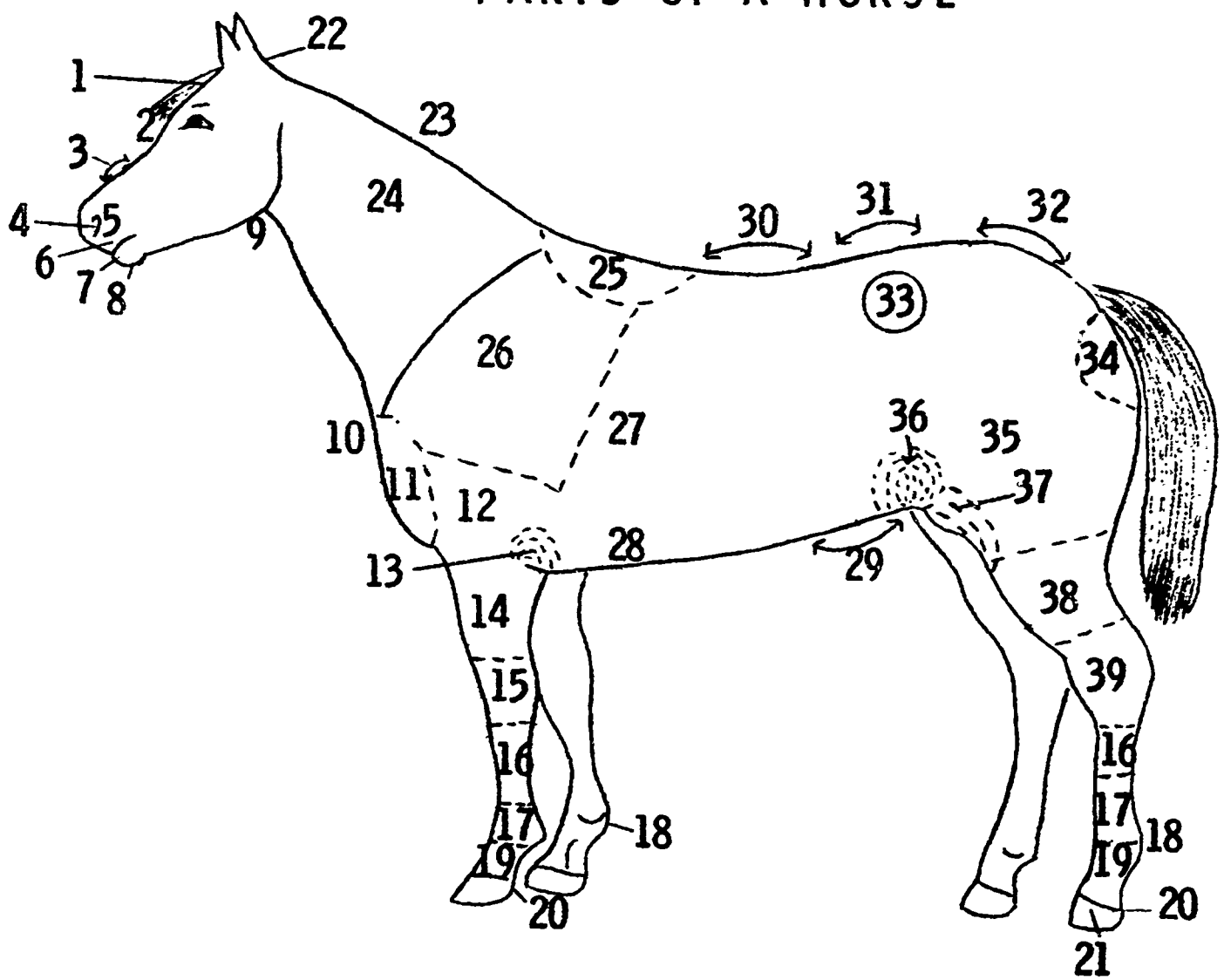


WHOLESALE CUTS OF A BEEF CARCASS

USING THE BALLING GUN

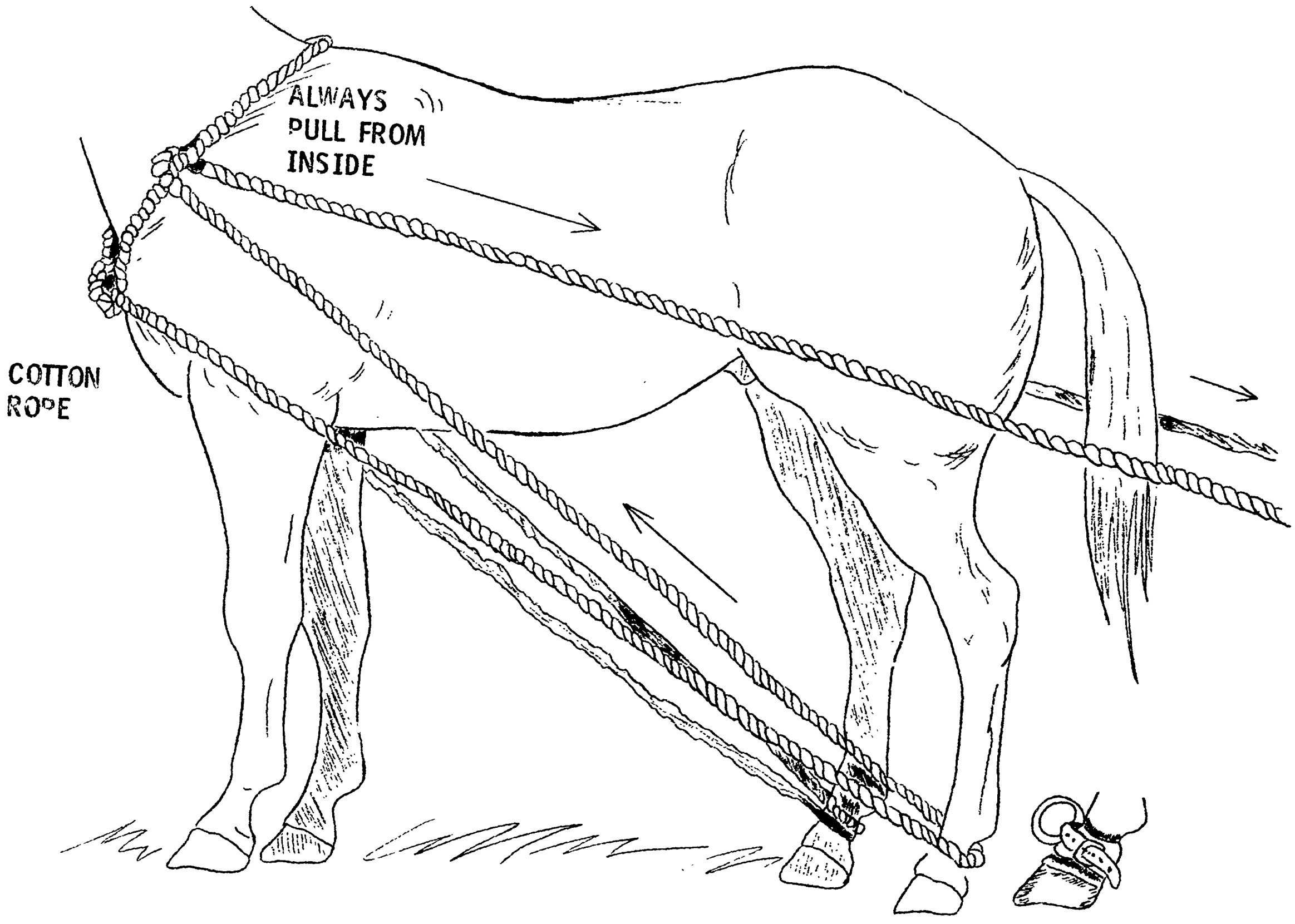


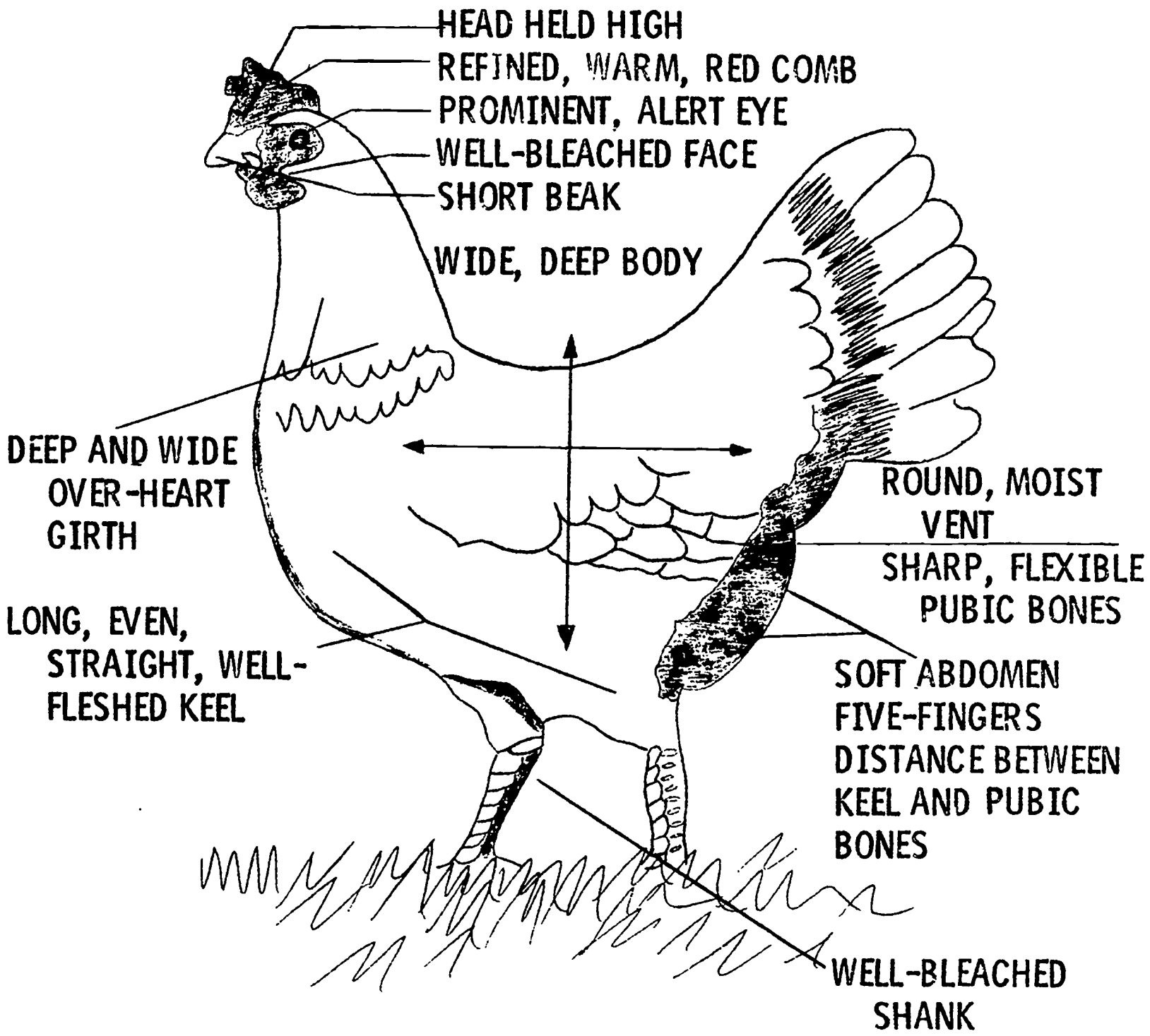
PARTS OF A HORSE



1. Forehead
2. Face
3. Bridge of Nose
4. Nostril
5. Muzzle
6. Upper Lip
7. Lower Lip
8. Under Lip
9. Throat Latch
10. Point of Shoulder
11. Chest
12. Arm
13. Elbow
14. Forearm
15. Knee
16. Cannon
17. Ankle
18. Fetlock
19. Pastern
20. Coronet
21. Hoof
22. Poll
23. Crest
24. Neck
25. Withers
26. Shoulder
27. Barrel
28. Girth
29. Abdomen
30. Back
31. Loin
32. Rump
33. Point of Hip
34. Buttock
35. Thigh
36. Flank
37. Stifle
38. Gaskin
39. Hock

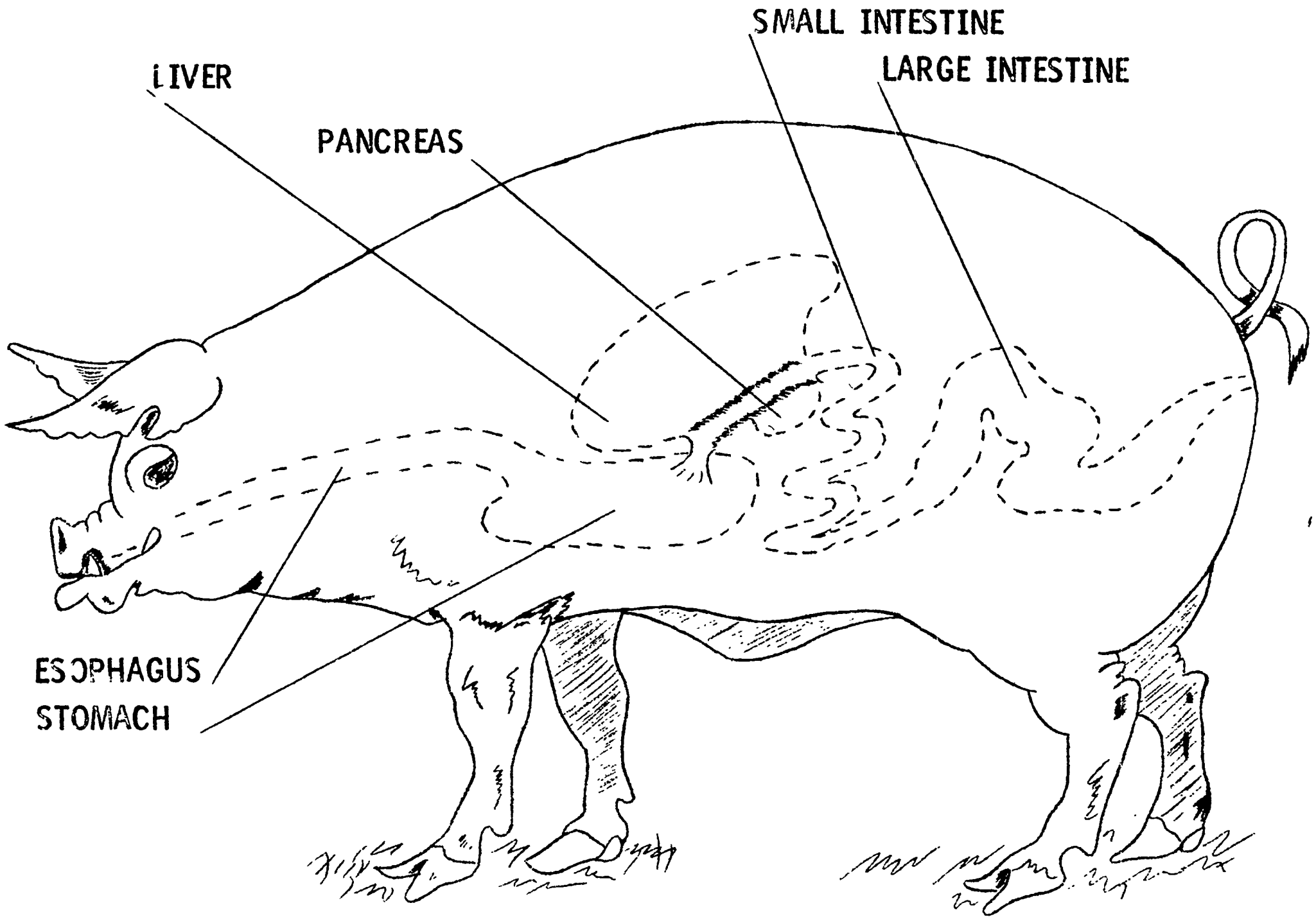
CASTING A HORSE

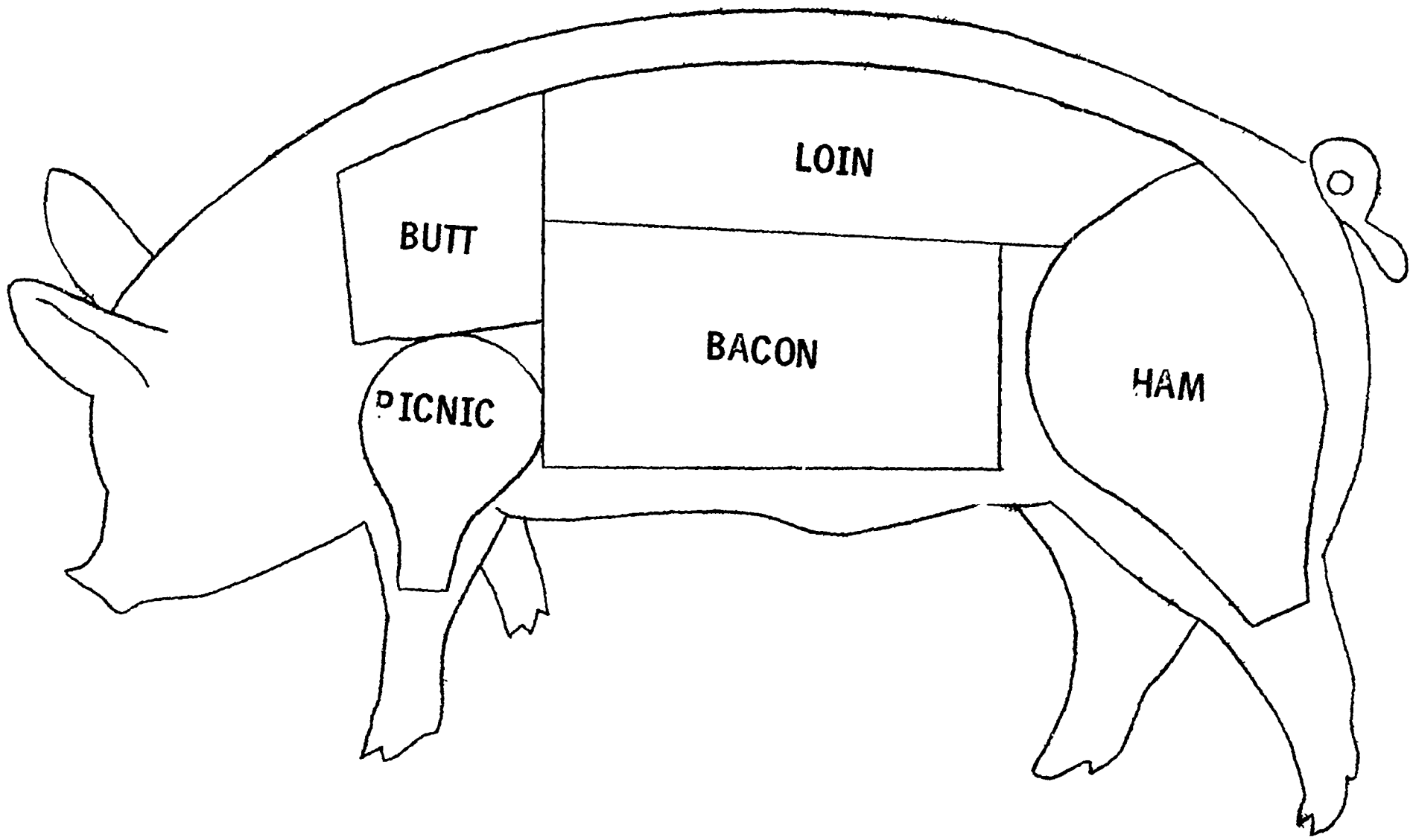



HEAD HELD HIGH
REFINED, WARM, RED COMB
PROMINENT, ALERT EYE
WELL-BLEACHED FACE
SHORT BEAK
WIDE, DEEP BODY
DEEP AND WIDE OVER-HEART GIRTH
ROUND, MOIST VENT
SHARP, FLEXIBLE PUBIC BONES
LONG, EVEN, STRAIGHT, WELL-FLESHED KEEL
SOFT ABDOMEN
FIVE-FINGERS DISTANCE BETWEEN KEEL AND PUBIC BONES
WELL-BLEACHED SHANK

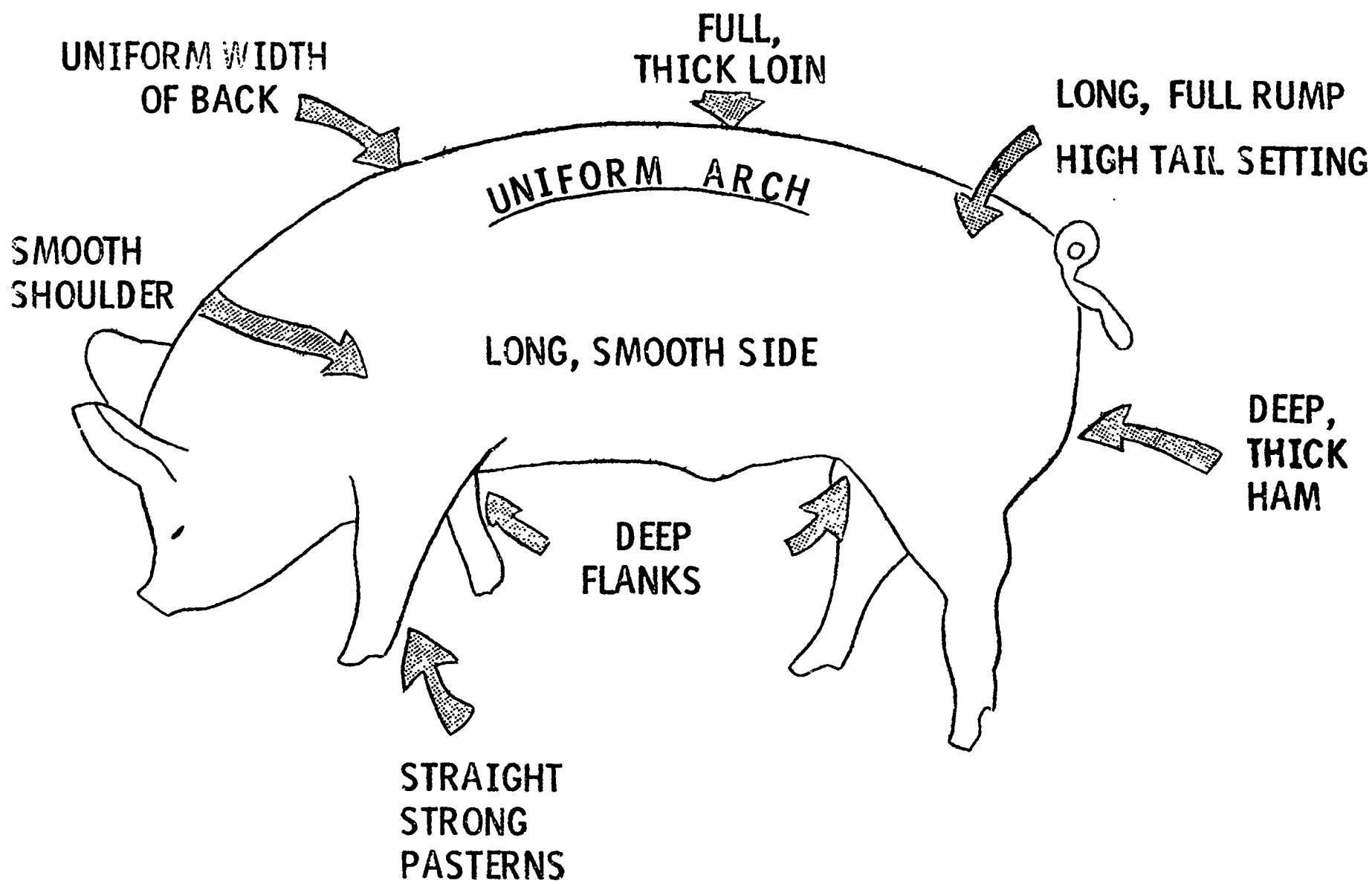
A GOOD LAYER

DIGESTIVE TRACT OF THE PIG

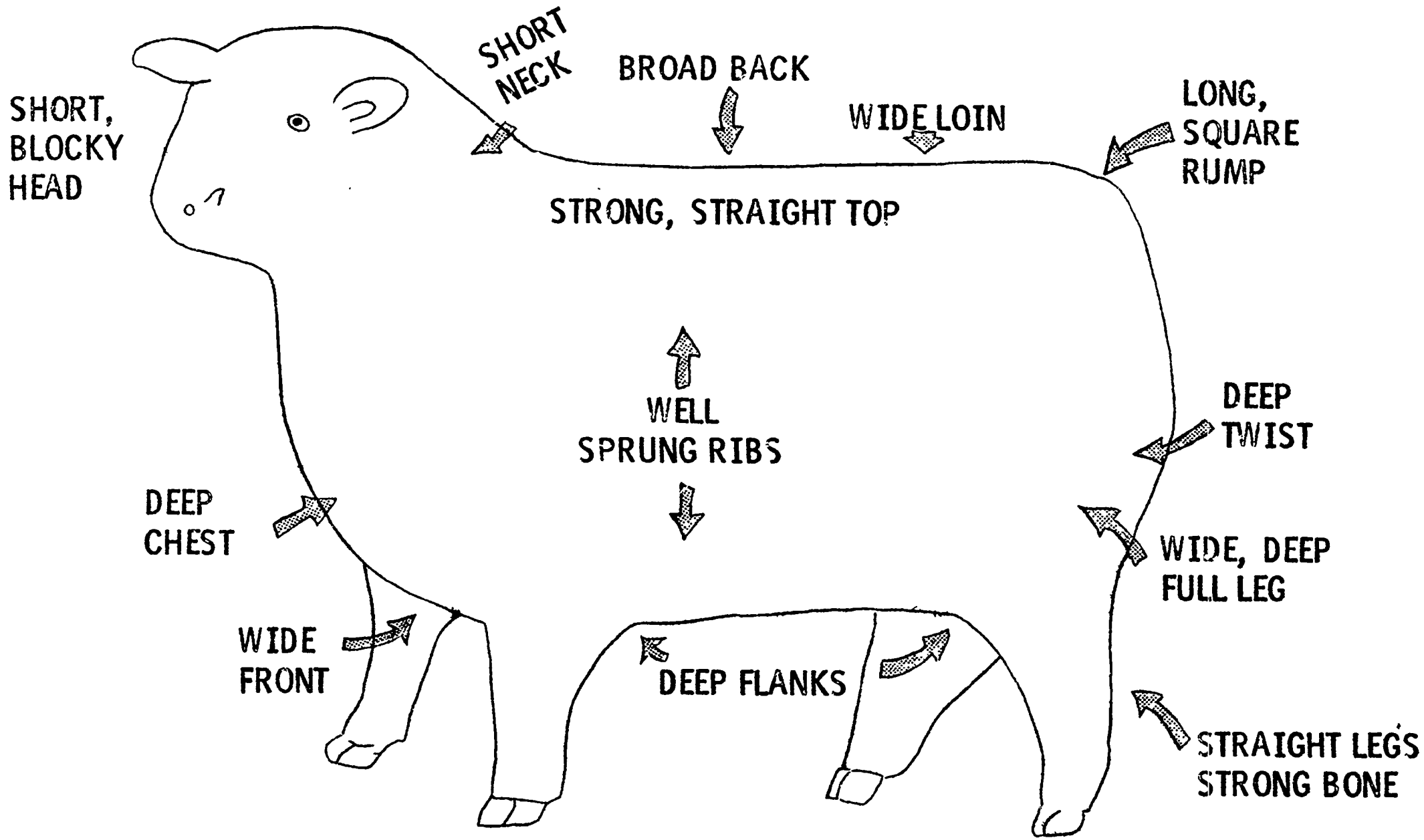




WHOLESALE CUTS OF A PORK CARCASS



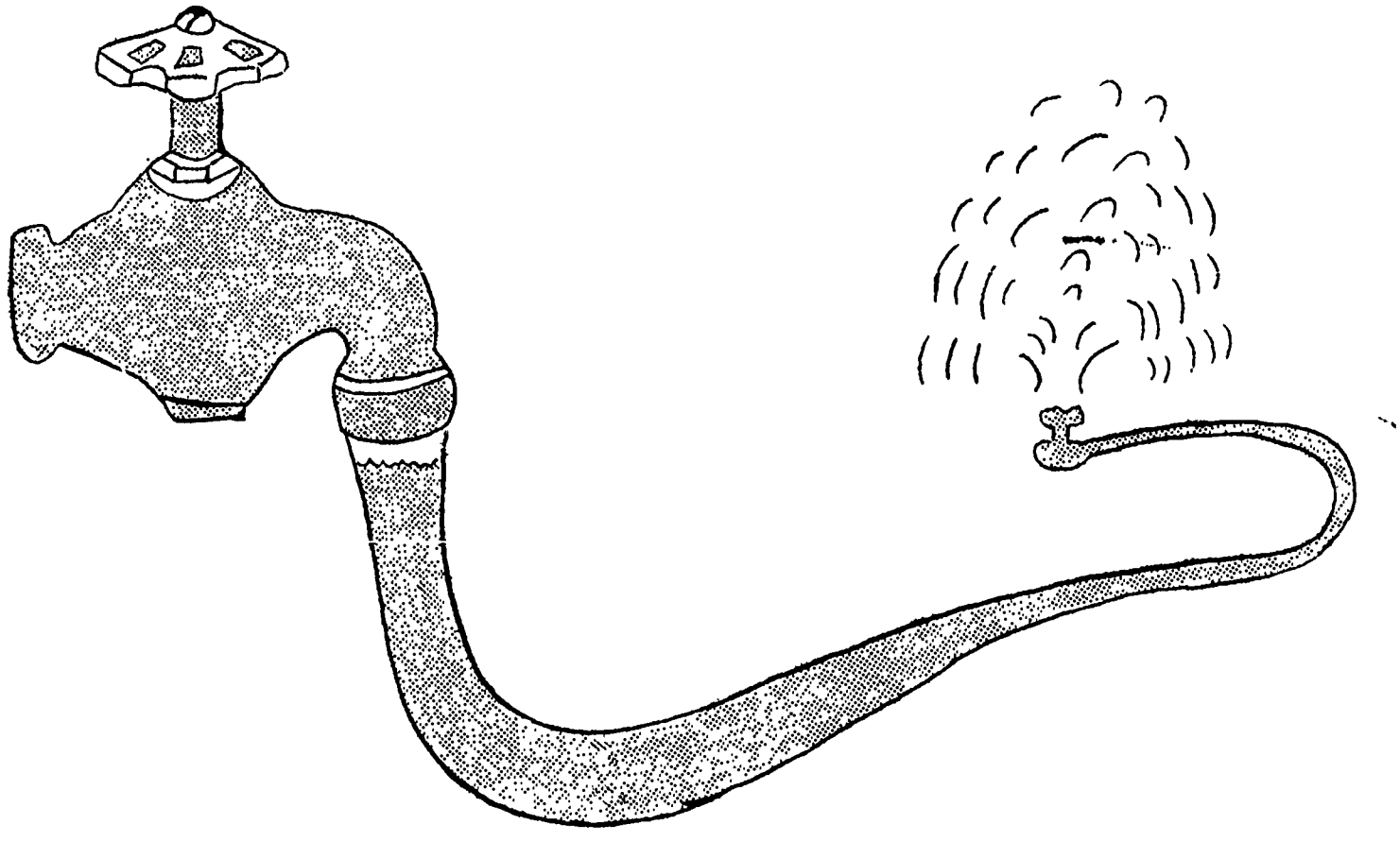
MAJOR PARTS OF A HOG



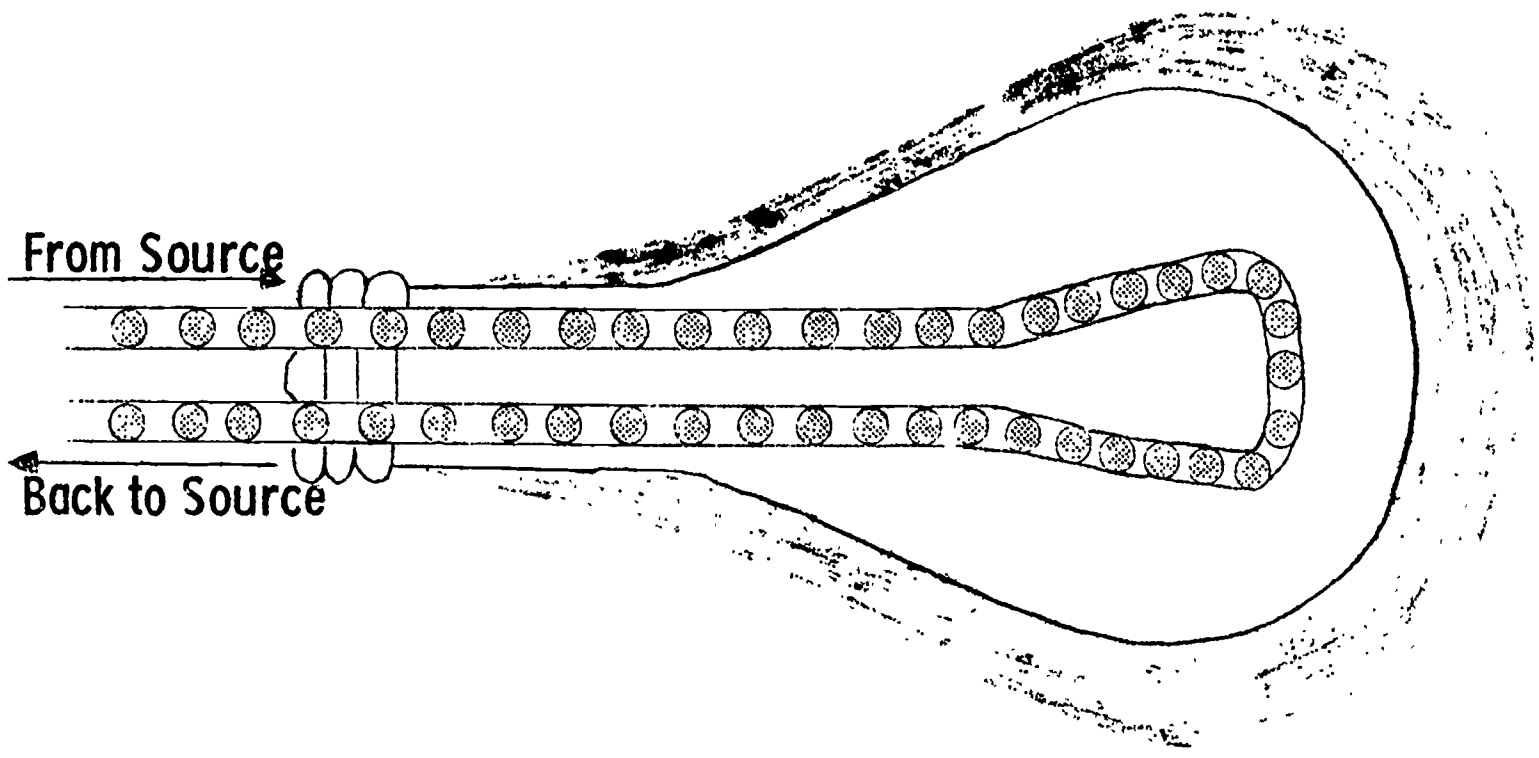
MAJOR PARTS OF A SHEEP

TYPES OF ELECTRIC MOTORS

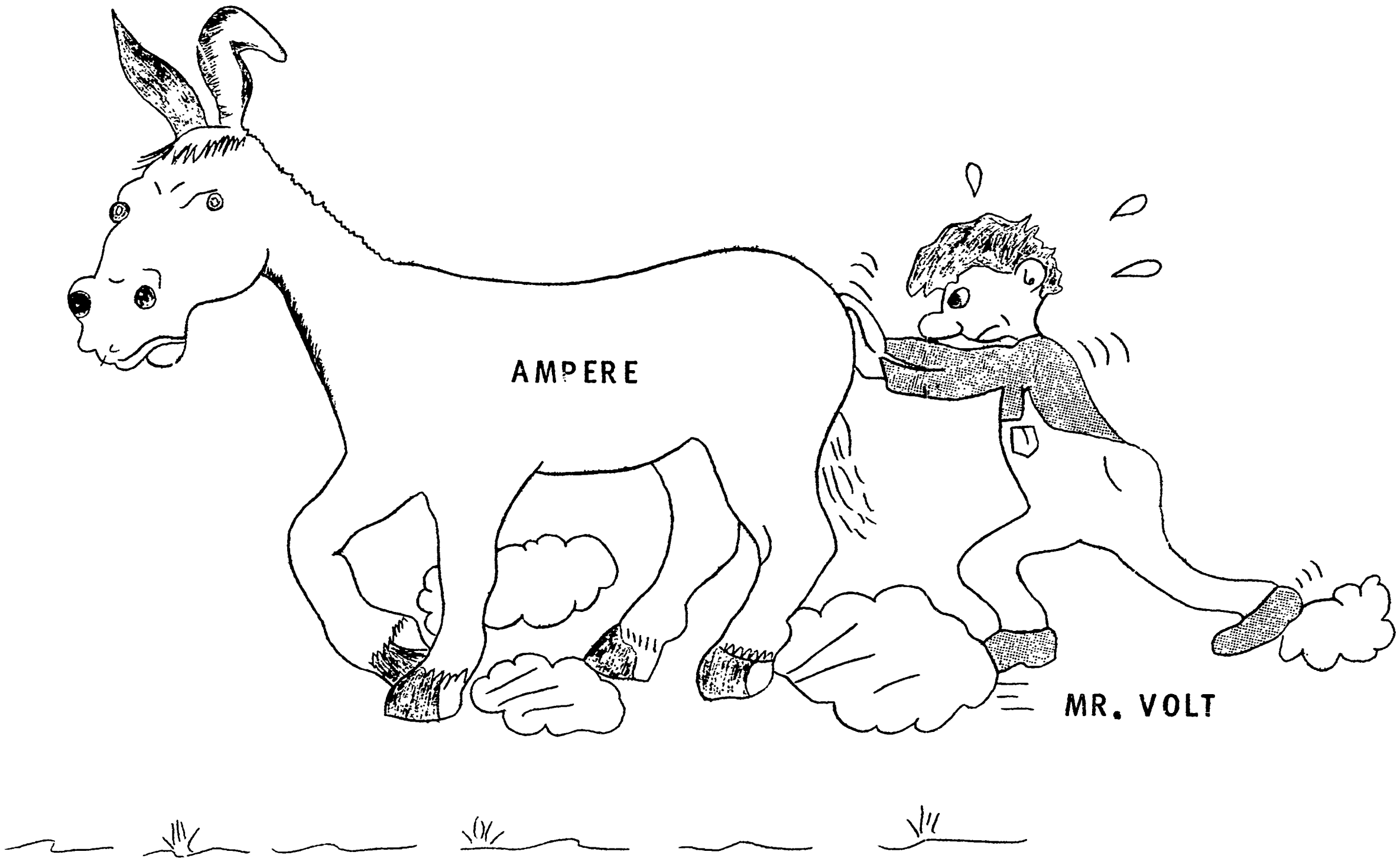
1. Split-Phase
2. Capacitor
3. Repulsion-Induction



WATER FLOWING IN PIPE--Rate of Flow Measured in Gallons Per Minute

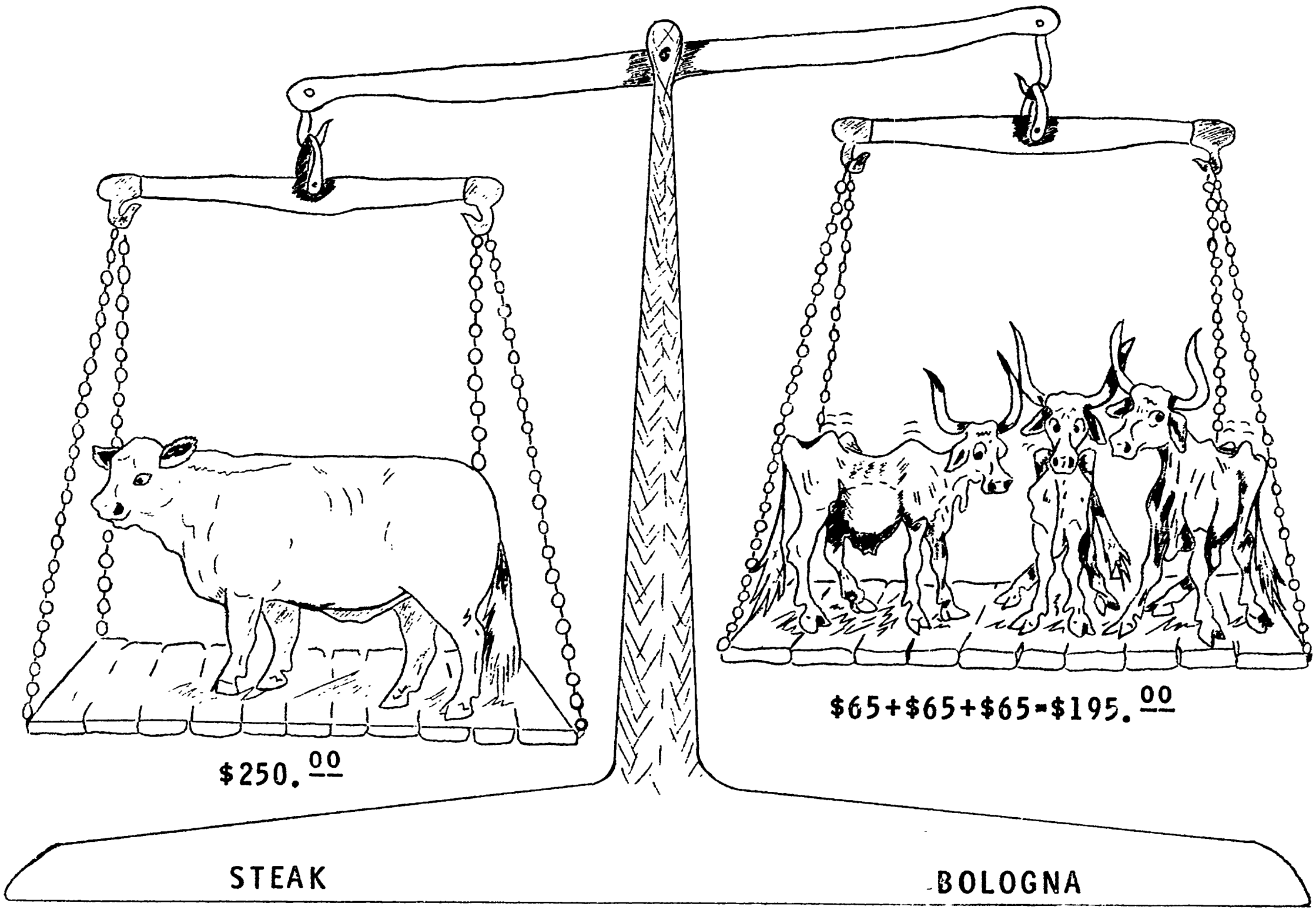


ELECTRIC CURRENT FLOWING THROUGH WIRE--Rate of Flow Measured in Amperes

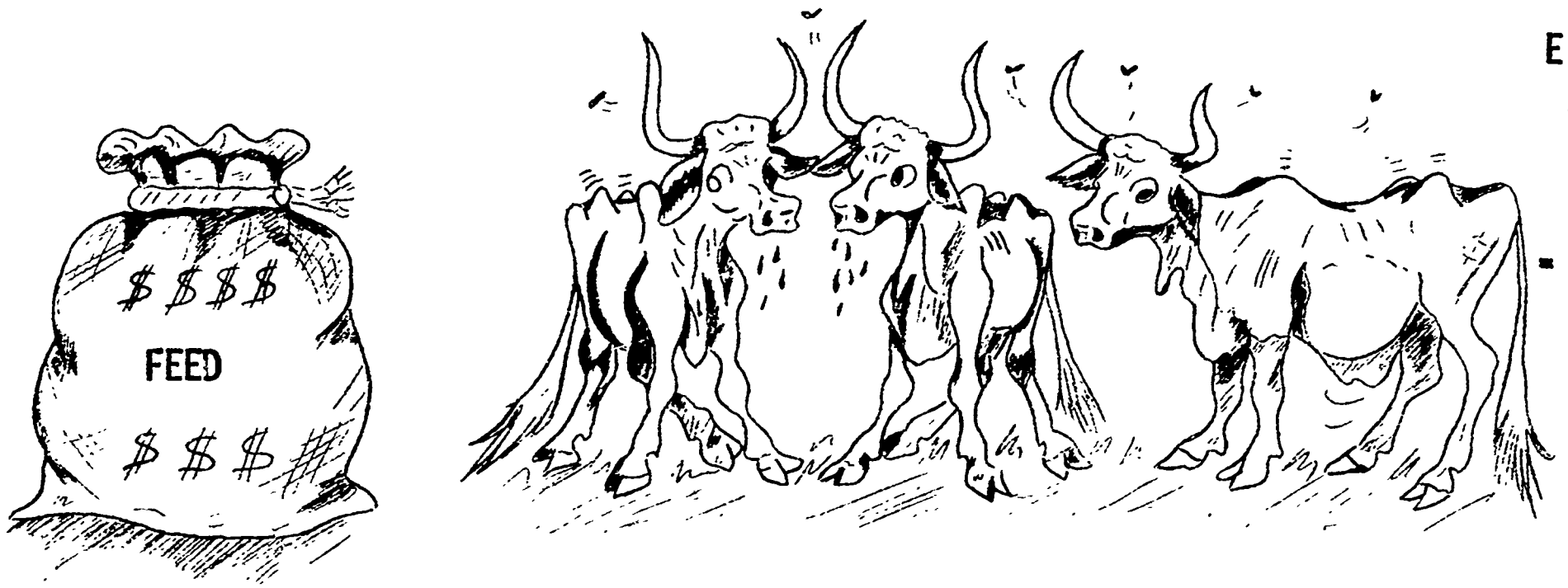


Mr. Volt Exerts Pressure To Force The Ampere Along The Path

Mr. Volt Does Work (Watt)

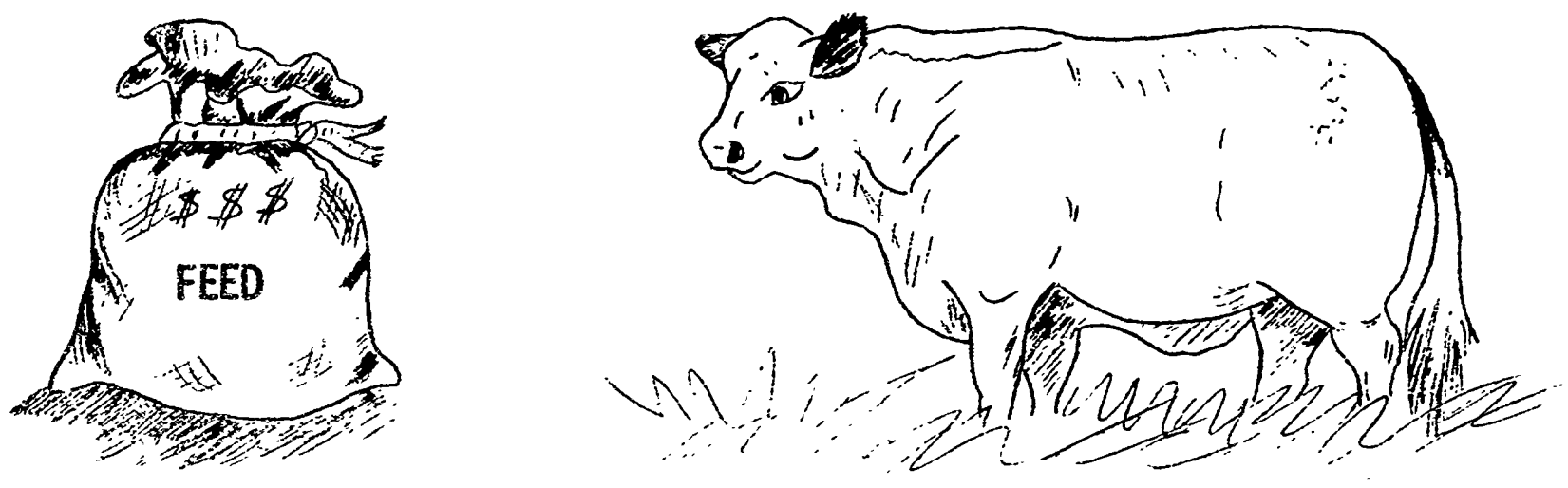

$ SALE VALUE $
$250.00
$65+$65+$65=$195.00
STEAK
BOLOGNA

PRODUCTION COSTS



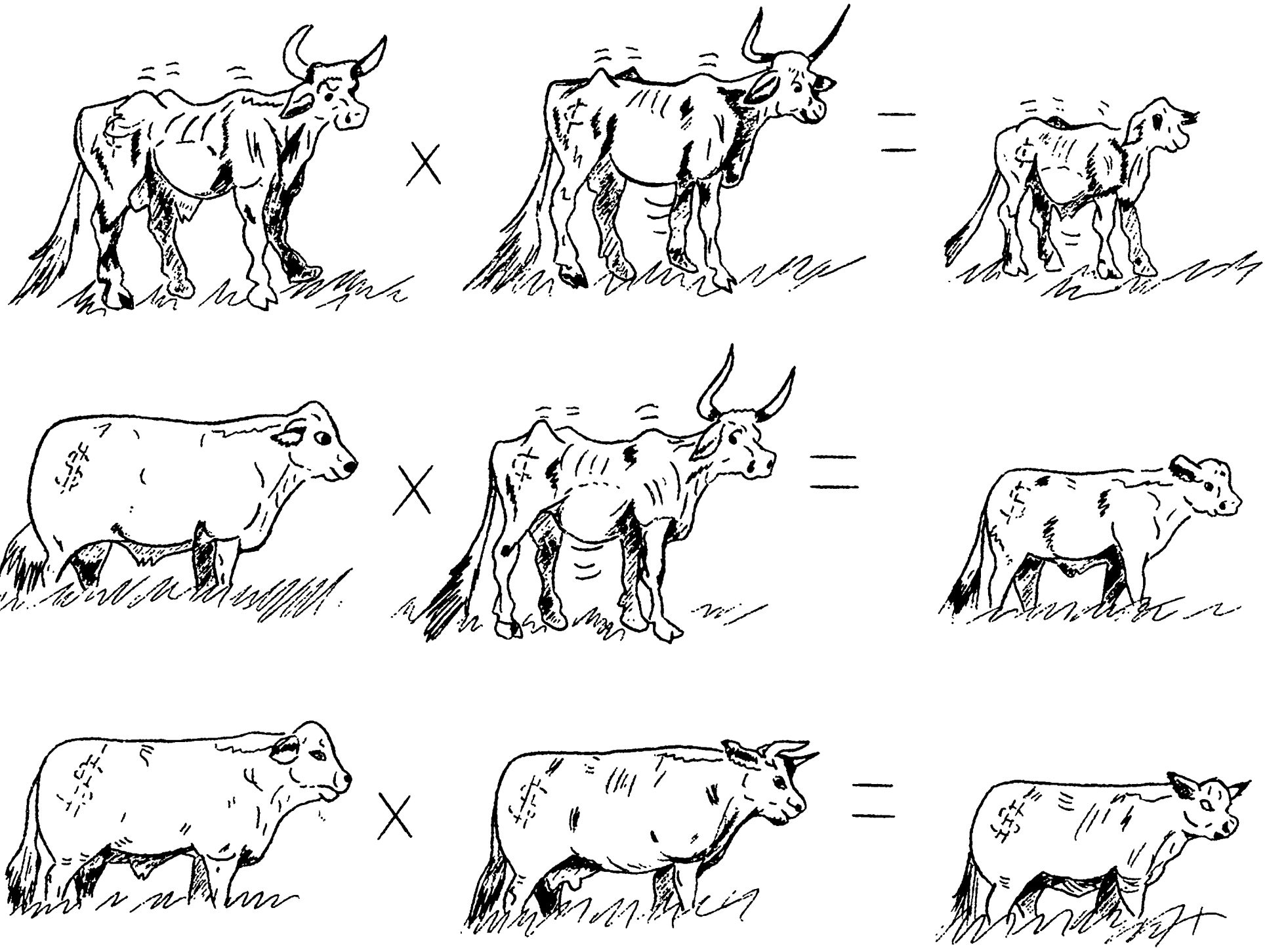
EDIBLE MEAT

= 400 lbs.



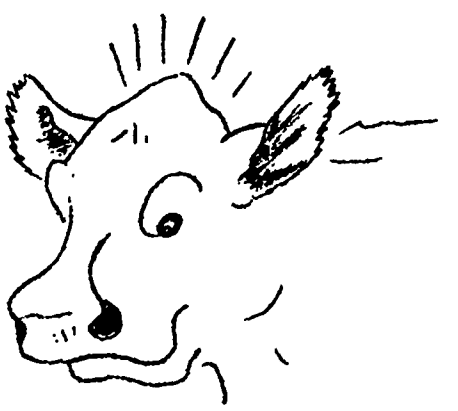
= 600 lbs.

GENETIC PRINCIPLES

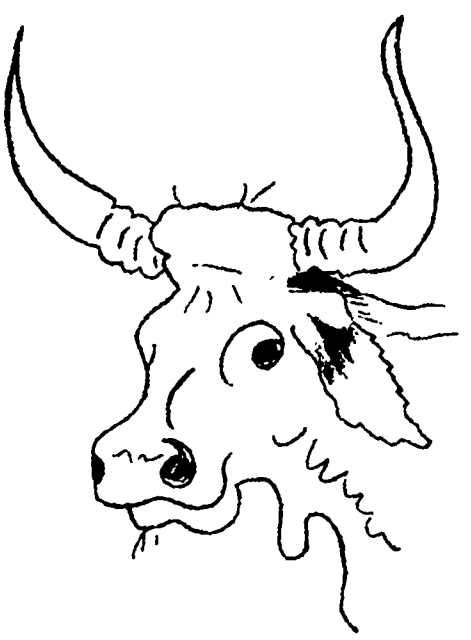


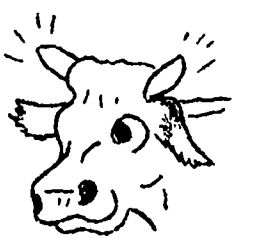
HETEROZYGOUS X HOMOZYGOUS CROSS

Heterozygous polled bull

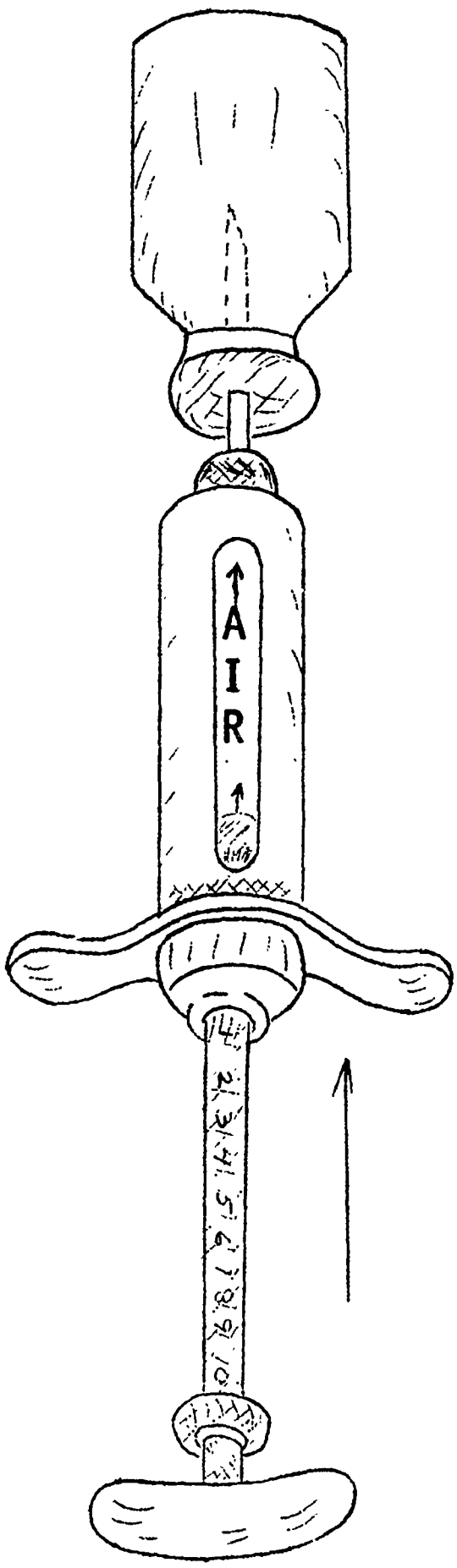


Homozygous horned cow

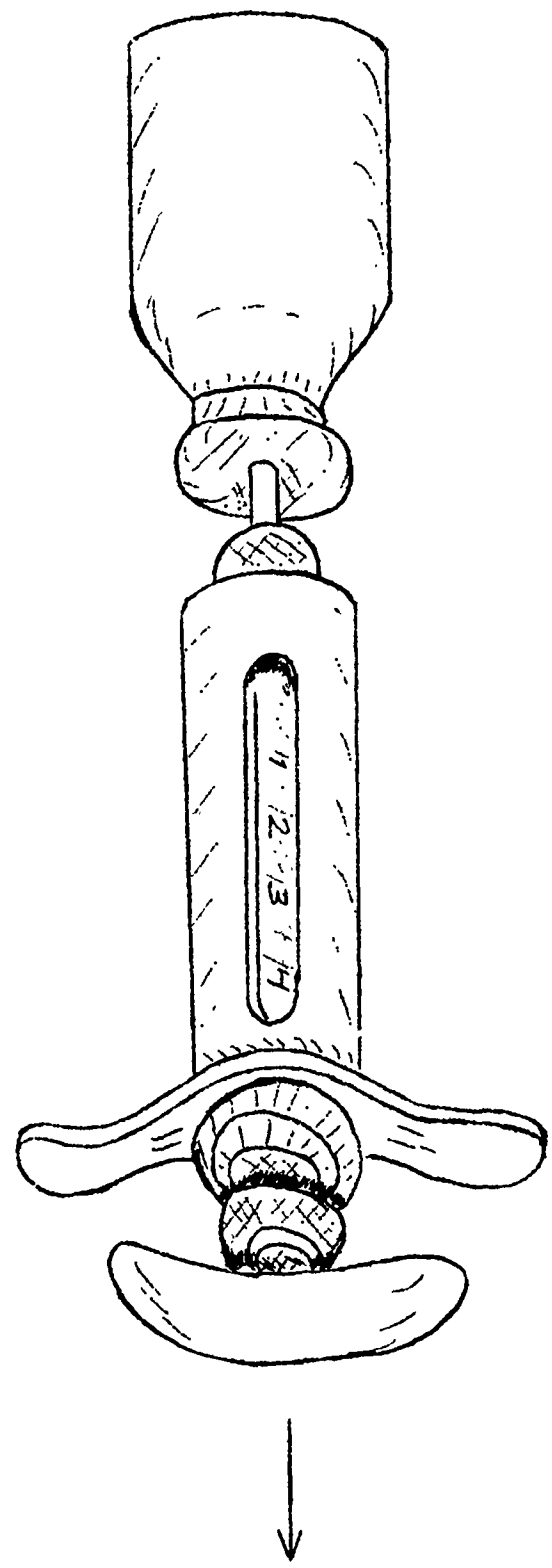


	P	P
P	Pp	PP 
P	Pp	PP

FILLING A SYRINGE



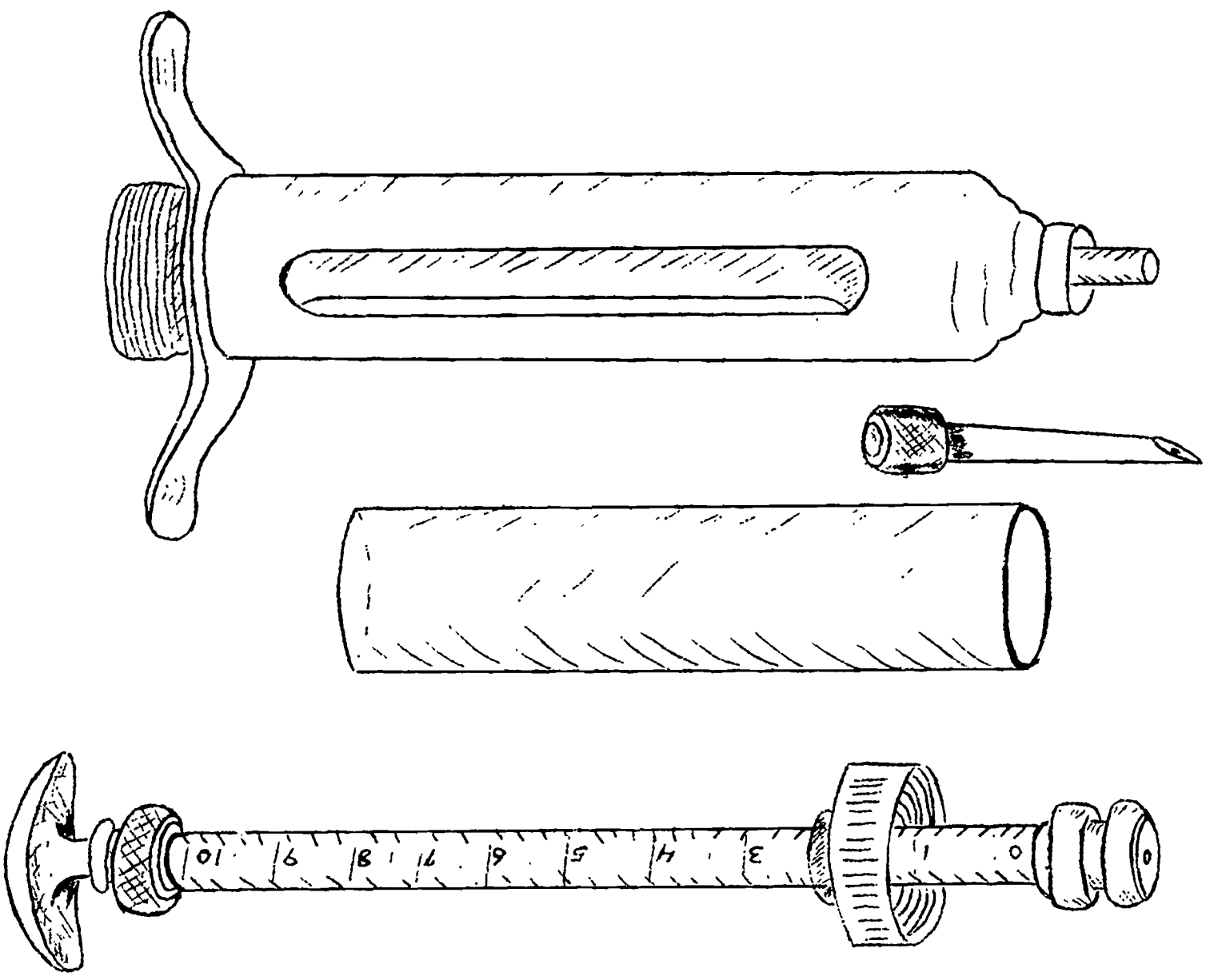
STEP 1



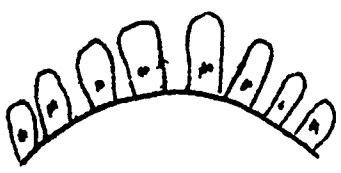
FILL

STEP 2

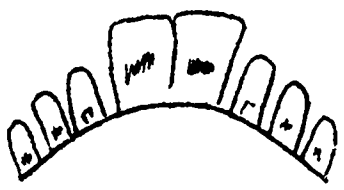
PARTS OF A SYRINGE



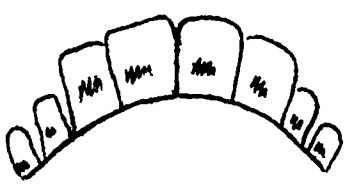
DETERMINING THE AGE OF SHEEP BY THEIR TEETH



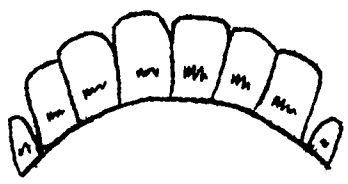
1. Lamb's mouth with 8 incisors, these temporary teeth are called milk teeth



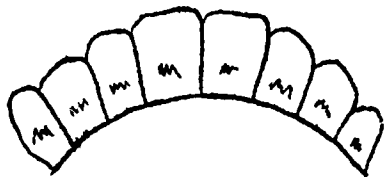
2. Yearling mouth with one pair of permanent incisors



3. 2-year old mouth with 2 pairs of permanent incisors

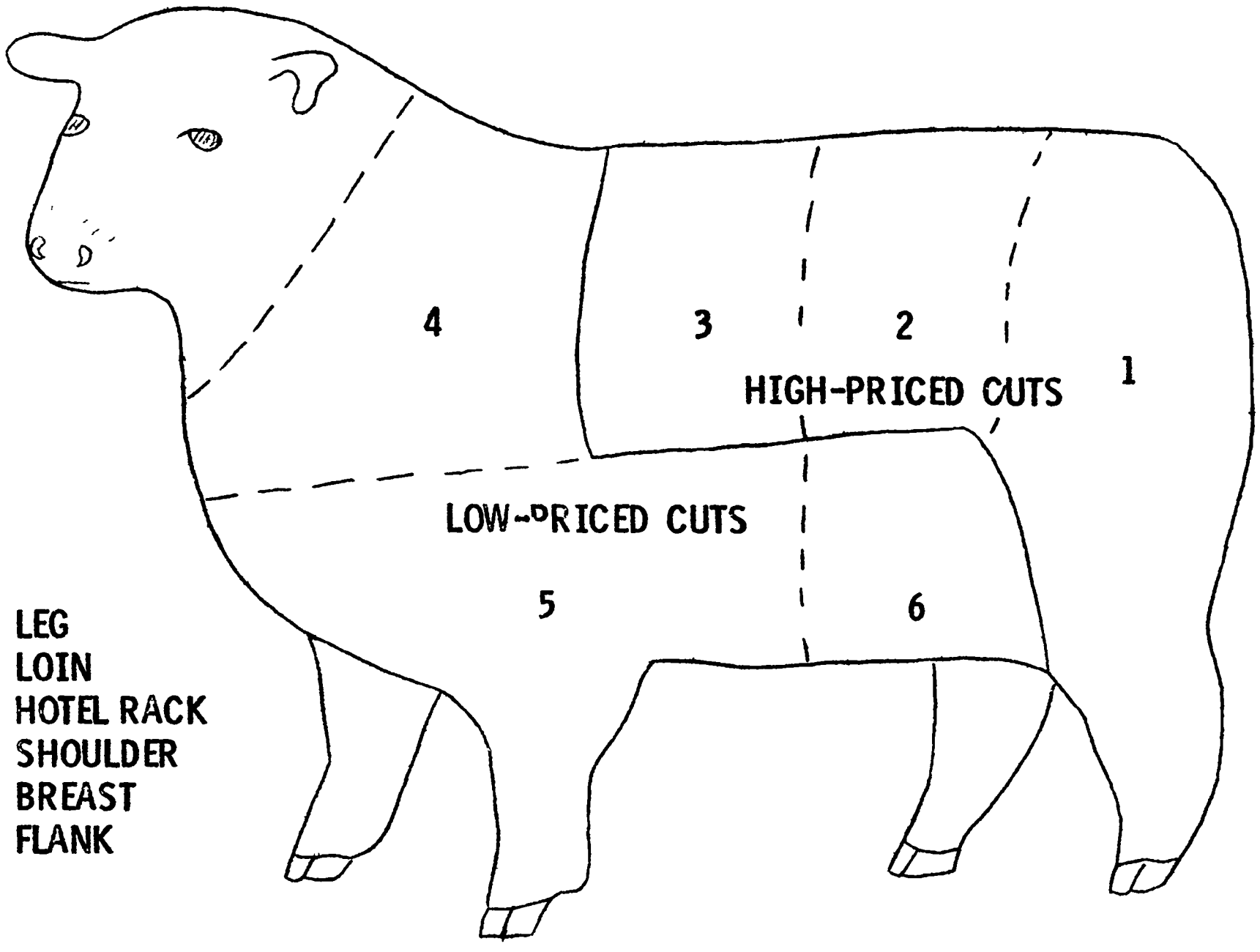


4. 3-year old mouth with 3 pairs of permanent incisors



5. 4-year old mouth with 4 pairs of permanent incisors

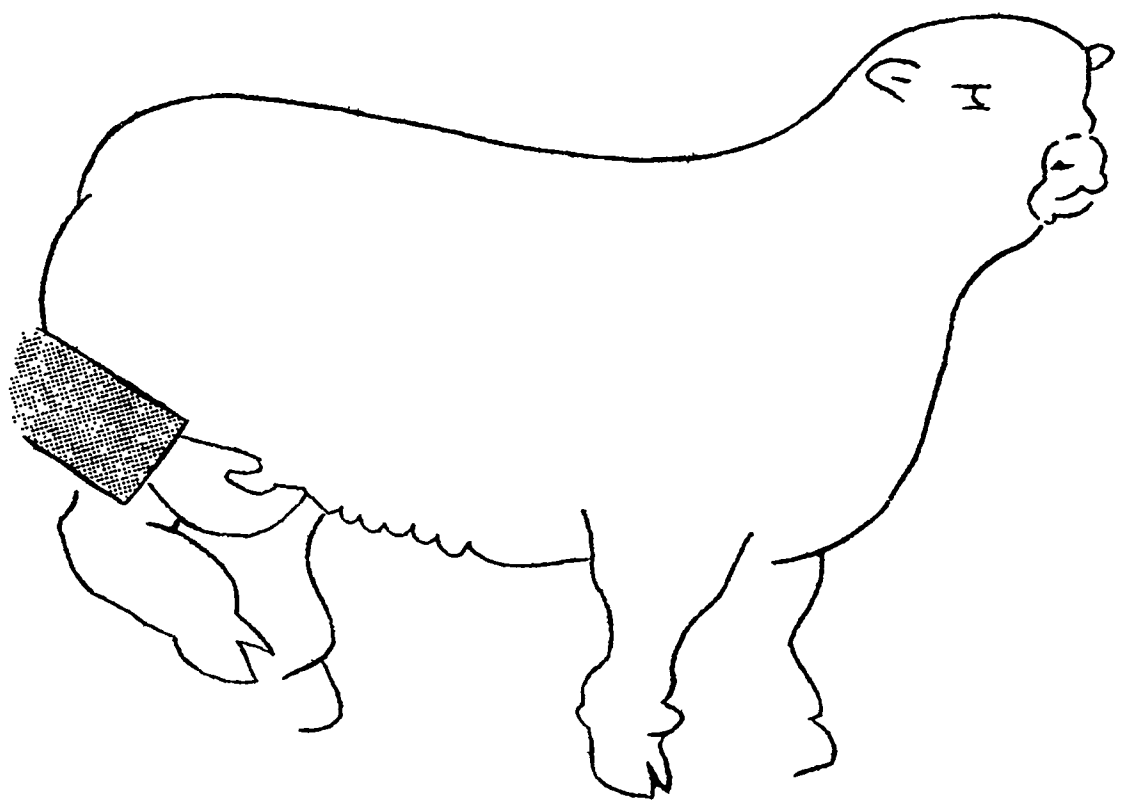
6. broken mouth condition which may begin to occur about 6 years of age, a sheep that has lost all incisors is called a gummer



1. LEG
2. LOIN
3. HOTEL RACK
4. SHOULDER
5. BREAST
6. FLANK

WHOLESALE CUTS OF A LAMB CARCASS

CATCHING A SHEEP



- Confine the animals in a small area
- Move up quietly on the desired animal after working it into a position near you
- With a swift, sure movement grasp well up into the right rear flank with the right hand
- Hold firmly with the right hand, quickly grasp under the lower jaw with the left

COMMON ELECTRICAL TERMS

Ampere
Volts
Watt
Watt-Hour
Kilowatt-Hour
Circuit
Direct Current
Alternating Current
Single-Phase
Three-Phase
Grounding

Transformer
Electricity
Conducter
Fuse
Voltage Drop
Meter
Insulation
Conduit
Neutral Wire
Short Circuit
Hot "Wires"

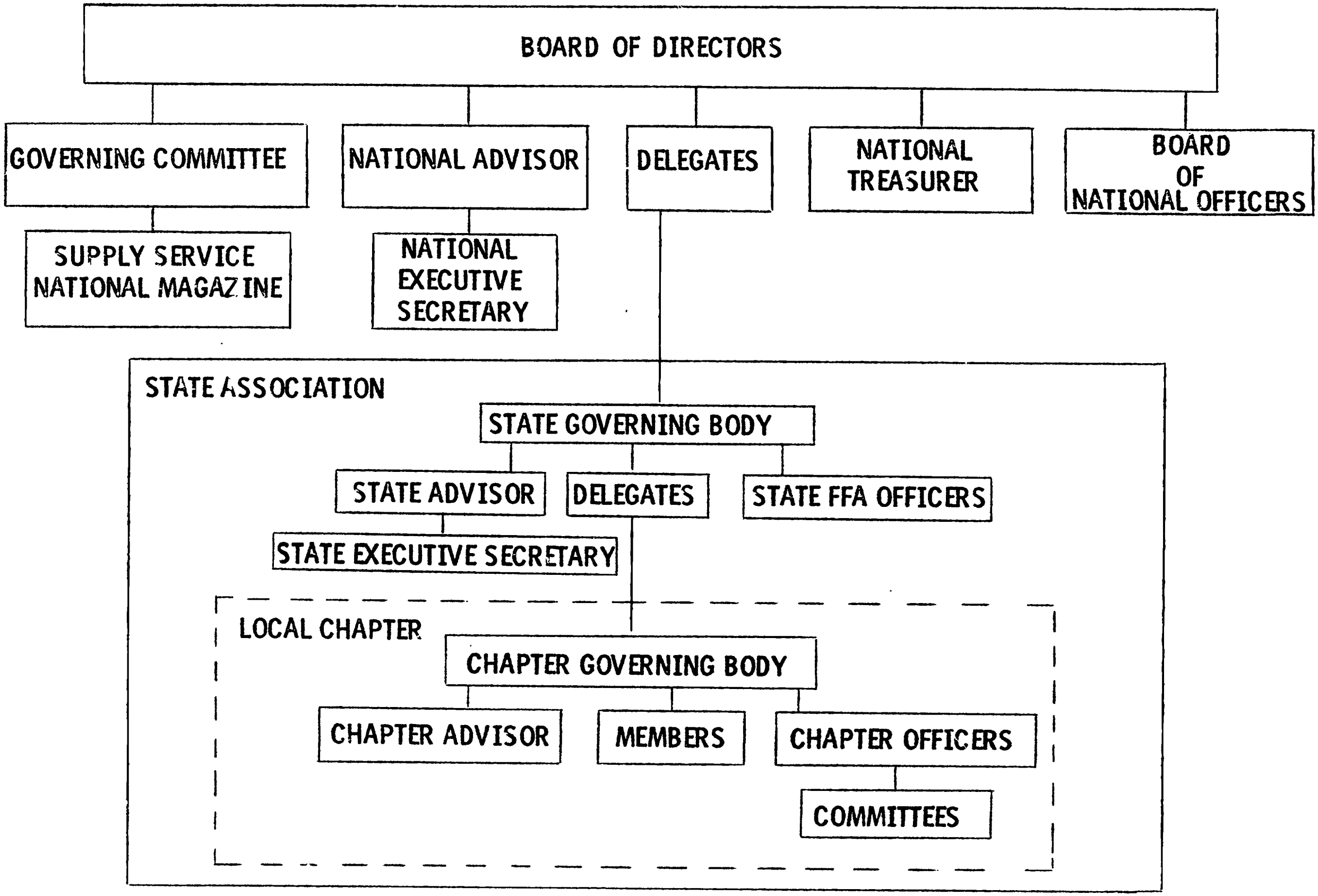
ELECTRICAL TERMS

TERMS	DEFINITION
1.	A unit of electrical pressure or "push."
2.	A unit of electric power. Is figured: 1 volt X 1 ampere. Is the amount of power used by 1 volt to push 1 ampere.
3.	One hot wire and one ground wire. Similar to one man driving a stake.
4.	Is a measure of rate of flow. Rate of flow of current. Will measure the same in any part of line.
5.	Refers to the use of 1000 watts of electricity for one hour.
6.	One wire to carry the current from the source of supply to where it is to be used and the other wire to carry it back.
7.	To decrease the voltage from the main line.
8.	Insulated and identified by color. Means of conducting electric energy from source to load.
9.	Interrupted or alternating flow of current.
10.	Uninterrupted or constant flow of current.

KINDS OF ELECTRIC MOTOR ENCLOSURES

1. Open
2. Splash-proof
3. Dirt-proof
4. Explosion-proof

CHART OF ORGANIZATION FUTURE FARMERS OF AMERICA



MAGNITUDE OF THE FFA ORGANIZATION

1928	16,000 Members
1955	385,000 Members
1967	460,000 Members
1975	600,000 Members

Additional 4,000 Vocational Agriculture will be needed in 1975

FFA CODE OF ETHICS

We will conduct ourselves at all times in order to be a credit to our organization, chapter, school and community by:

1. Dressing neatly and appropriately for the occasion
2. Showing respect for rights of others and being courteous at all times
3. Being honest and not taking unfair advantage of others
4. Respecting property of others
5. Refraining from loud boisterous talk, swearing and horseplay
6. Demonstrating sportsmanship in the show ring, judging contests and meetings
7. Attending meetings promptly and respecting the opinion of others in discussion
8. Taking pride in our organization, in our activities, in our farming programs, in our exhibits and in the occupation of farming and ranching
9. Sharing with others experiences and knowledge gained by attending national and state meetings

ERIC

SOME VALUES IN BELONGING TO THE FFA

1. Students learn to be leaders and to recognize, accept, and follow good leadership.
2. They learn to work with others.
3. They are able to identify themselves with a strong school organization.
4. They can be recognized by their fellow members, by their communities, by their state association, and their national organization for accomplishments in the FFA.
5. They develop the ability to express themselves.
6. They learn to accept responsibilities as citizens of the community.
7. They are more interested in Vocational Agriculture because of motivation by the FFA.

FFA FOUNDATION AWARDS

	Local	District	State	Regional	National
Star Greenhand	Medal	------	-------	-------	--------
Star Farmer	Medal	$50.00	$200.00	$500.00	$1000.00
Public Speaking	Medal	------	$100.00	$200.00	$250.00 (1st)
Soil and Water Management	Medal	------	$100.00	$200.00	$250.00
Dairy	Medal	------	$100.00	$200.00	$250.00
Livestock	Medal	------	$100.00	$200.00	$250.00
Crops	Medal	------	$100.00	$200.00	$250.00
Farm Mechanics	Medal	------	$100.00	$200.00	$250.00
Safety	Medal	------	$100.00	$200.00	$250.00

Future Farmers of America

The National Organization of Boys Studying Vocational Agriculture

Founded 1928

GREENHAND

CHAPTER FARMER

STATE FARMER

AMERICAN FARMER

HONORARY

HONORARY

HONORARY

CHARACTERISTICS OF A GOOD CHAPTER

1. Interested members
2. Capable officers and leaders
3. A challenging program of work
4. Adequate financing
5. Distributed responsibility shared by all members
6. Proper equipment and records
7. A knowledge of the FFA on the part of every member
8. Support by school officials and community leaders

MAJOR DIVISIONS OF PROGRAM OF ACTIVITIES

1. Supervised Agricultural Program
2. Cooperation
3. Community Service
4. Leadership
5. Earnings and Savings
6. Conduct of Meetings
7. Scholarship
8. Recreation
9. Public Relations
10. State and National Activities

WHAT MAKES A GOOD LEADER

Be Well-Prepared
Be Group-Minded
Like People
Be Poised
Have Humility
Be Creative
Be A Hard Worker
Be Responsible
Be Cooperative
Be A Fun-Lover

Be Clear
Be Proud
Be Neat
Be Courteous
Think Ahead
Set Goals
Take Advice
Get the Facts
Do Your Best
Have Vision

VALUES OF LEADERSHIP ABILITY

1. Education
2. Respect
3. Advancement in an occupation
4. Financial betterment
5. Pride
6. Security

FREQUENTLY USED MOTIONS
(By Order of Rank)

Kind	Second Required	Debatable	Amendable	Vote Required
I. Privileged				
Adjourn	yes	no	no	Majority
Question of Privilege	no	no	no	None
II. Incidental				
Point of Order	no	no	no	None
Appeal	yes	yes	no	Majority
Division	no	no	no	None
Close Nominations	yes	no	yes	Two-Thirds
III. Subsidiary				
Lay on the Table	yes	no	no	Majority
Refer	yes	yes	yes	Majority
Amend	yes	yes	yes	Majority
IV. Main Motion	yes	yes	yes	Majority

SOME CHARACTERISTICS OF HIGH SCHOOL STUDENTS CONCERNING OCCUPATIONS

1. Needing to decide on occupations
2. Wanting advice on what to do after school
3. Wanting to learn trades
4. Trying to choose the best subjects to prepare for jobs
5. Needing to know more about occupations
6. Needing to decide whether or not to go to college

WORK

GOOD OR BAD

TRAITS DESIRED

ATTITUDES

INITIATIVE

WORK WITH OTHERS

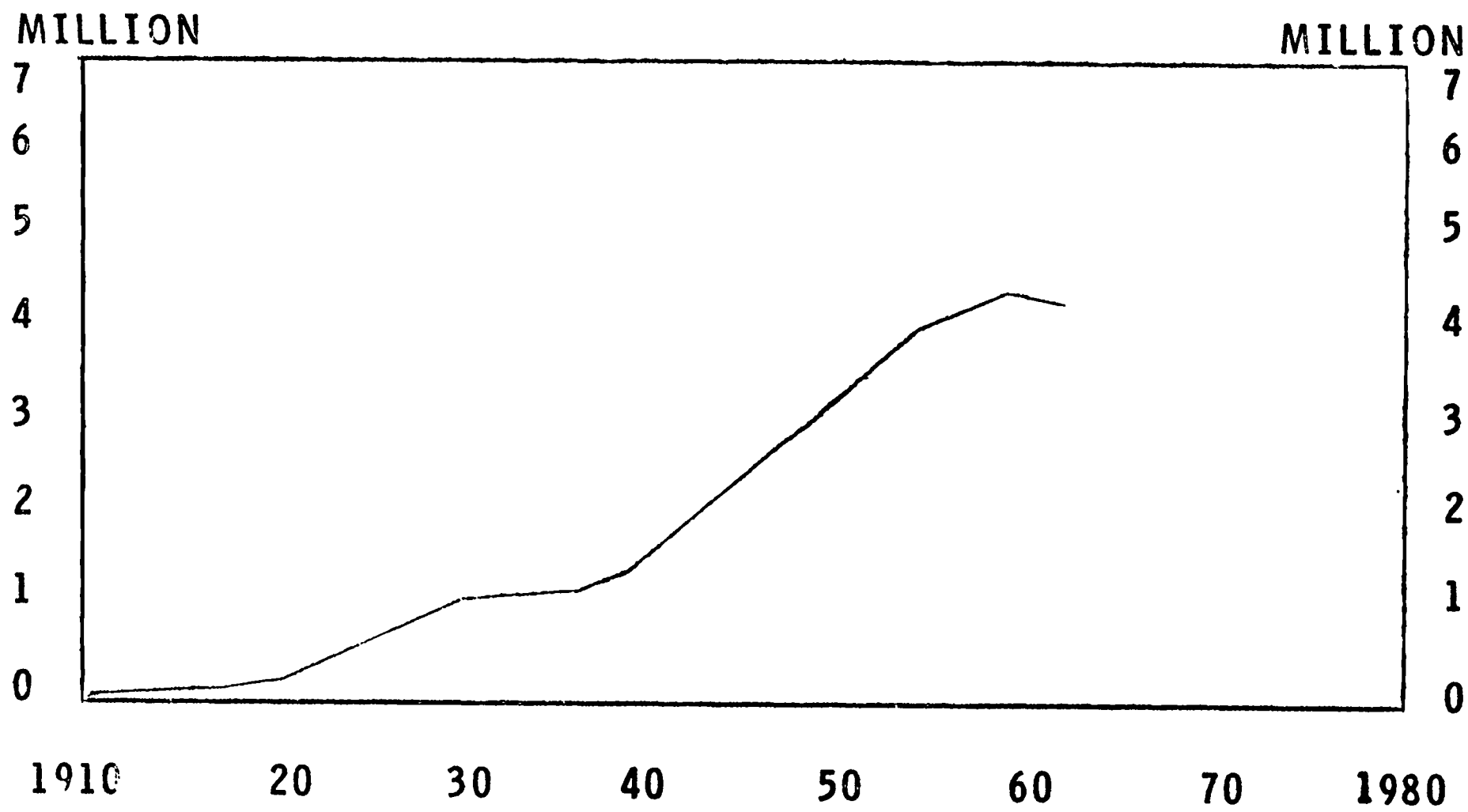
TAKE CRITICISM

LOYALTY

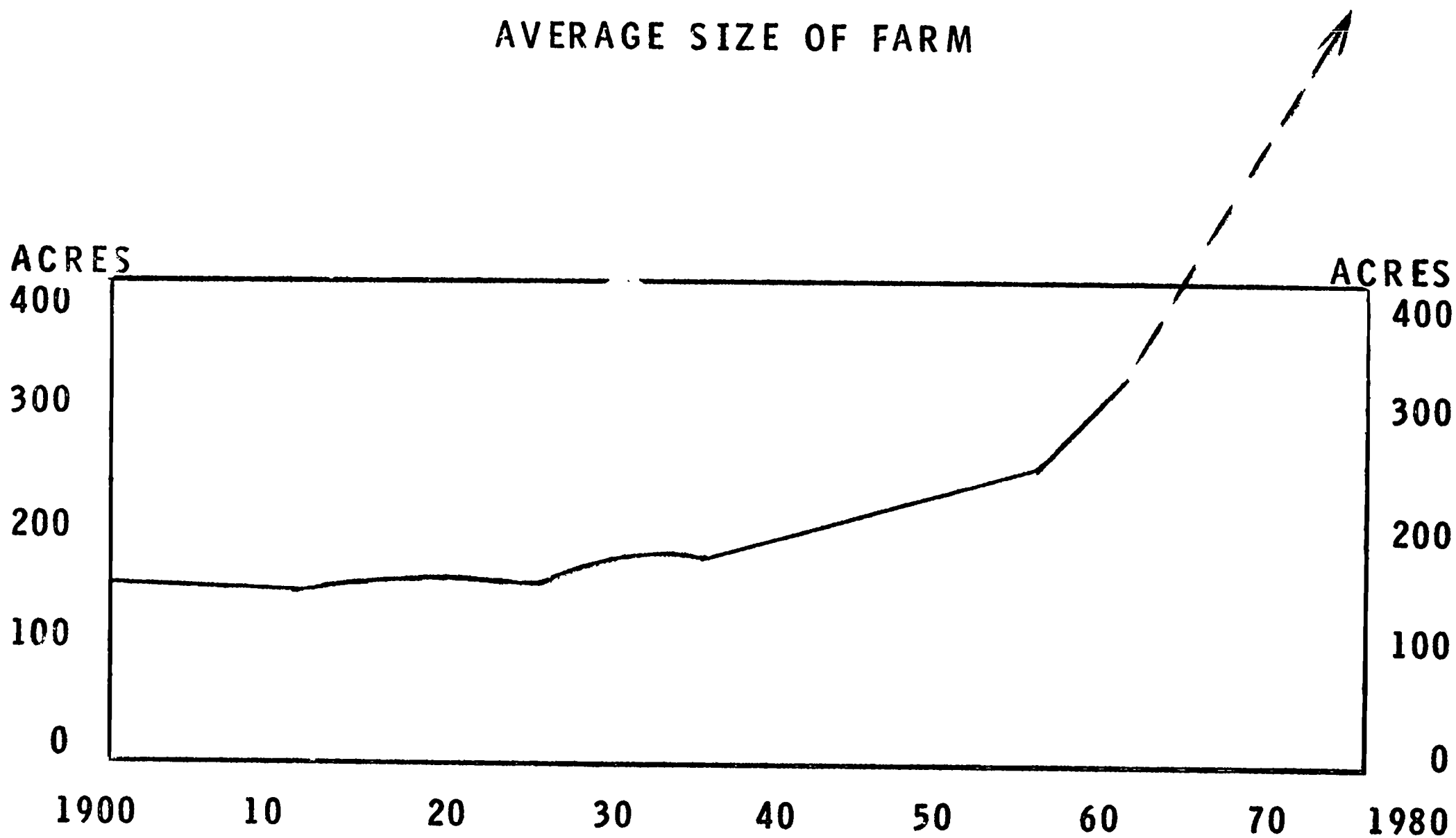
SERVICE

ALL ATTRIBUTES OF GOOD CITIZENSHIP.....

TRACTORS ON FARMS



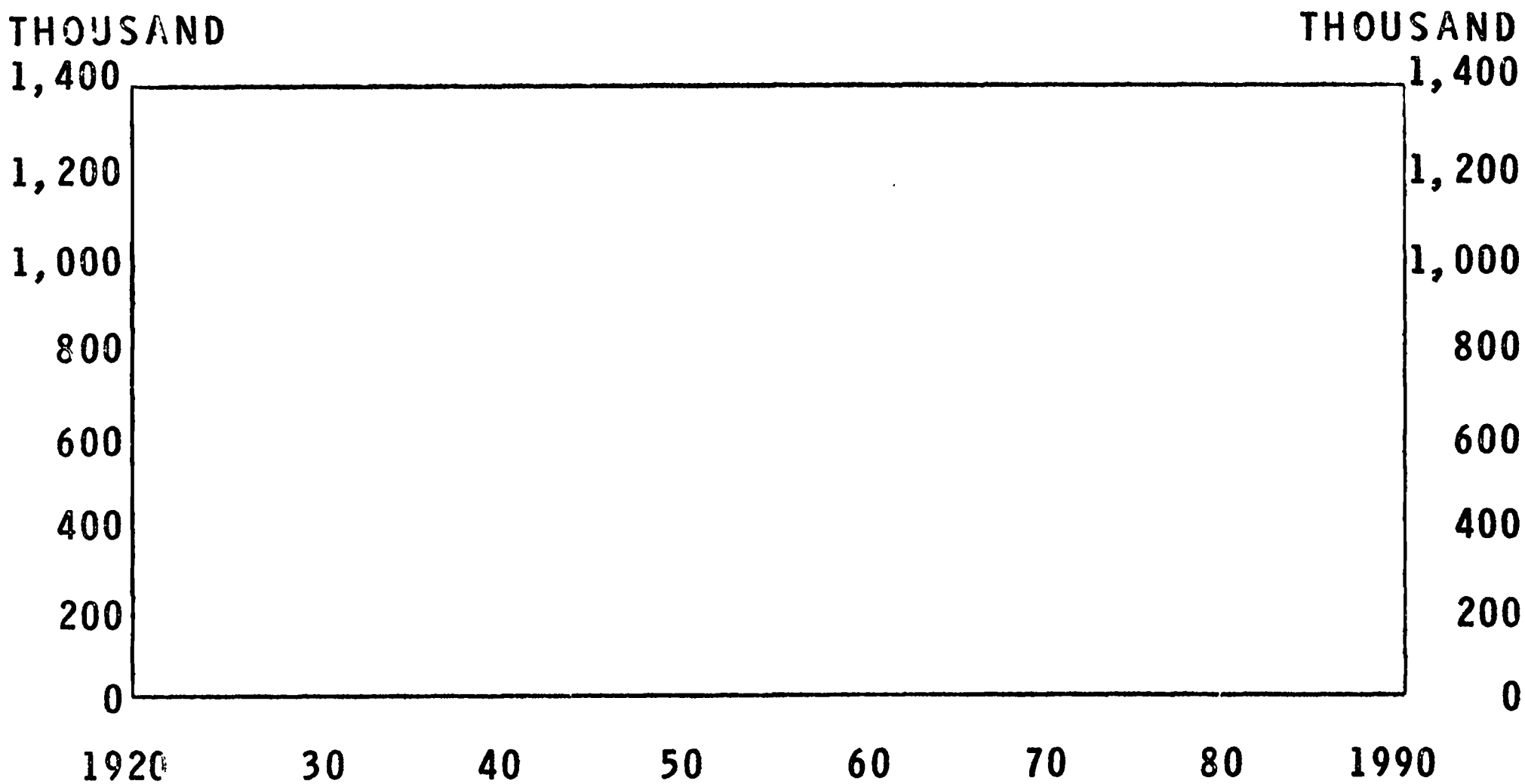
AVERAGE SIZE OF FARM



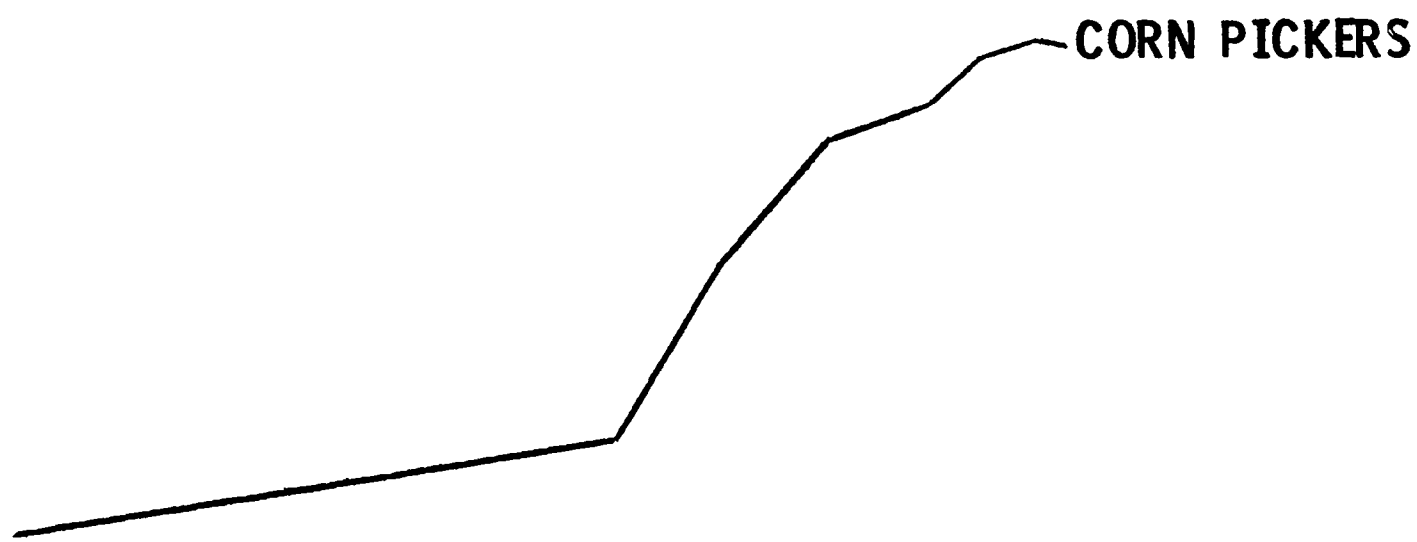
COMBINES, PICKERS, BALERS

AND

CHOPPERS ON FARMS



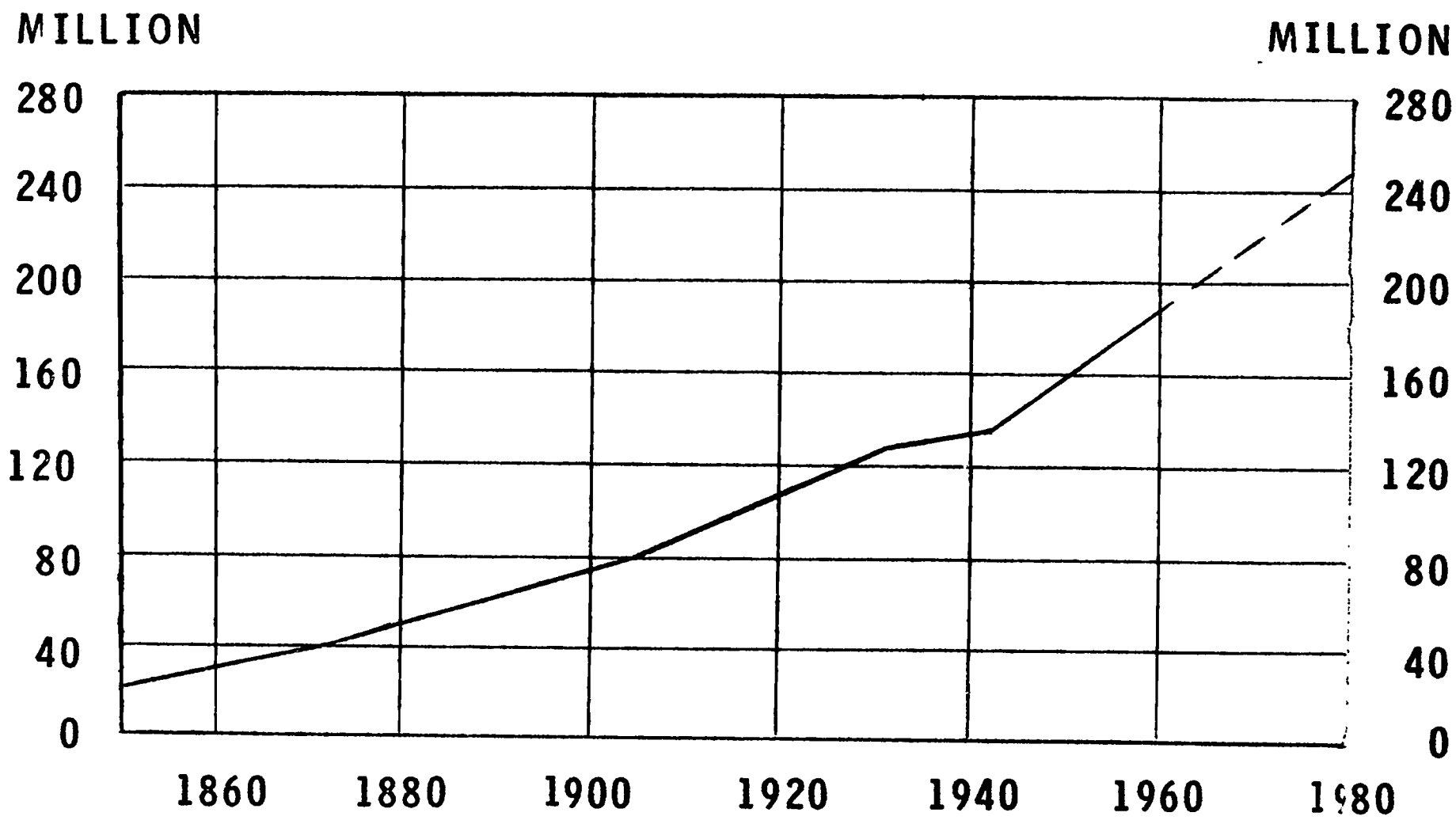
COMBINES


CORN PICKERS

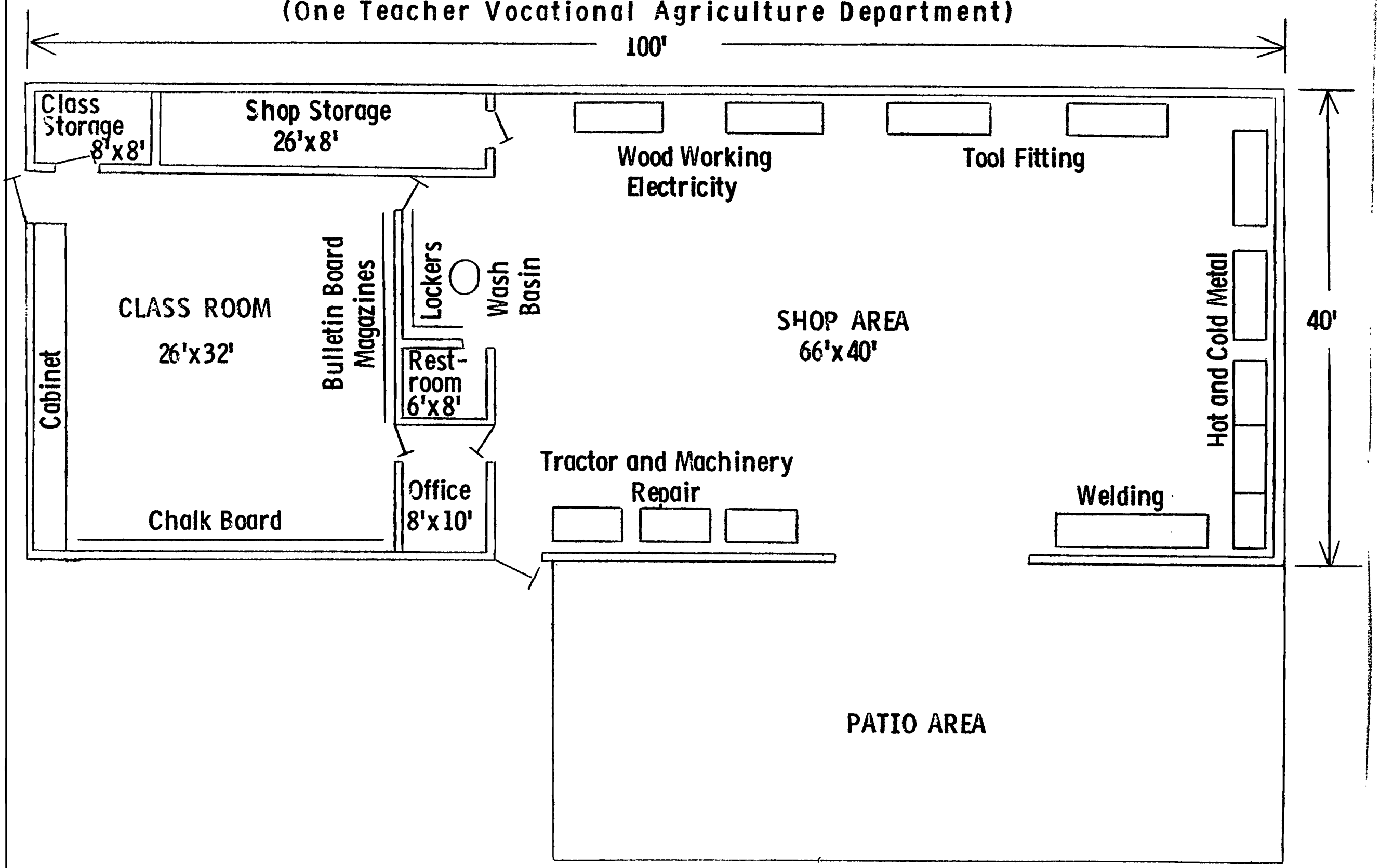
BALERS

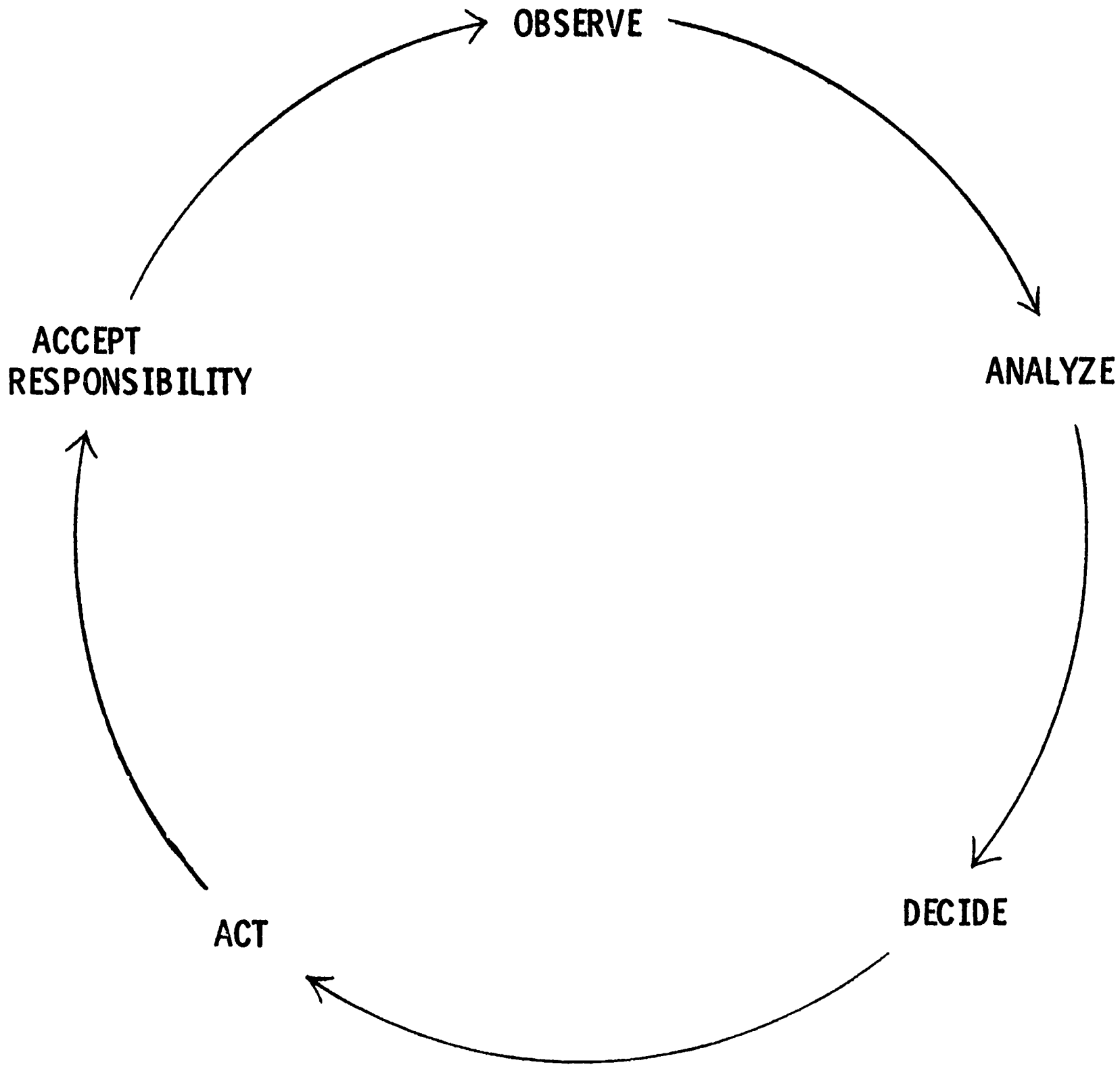
CHOPPERS

U. S. POPULATION



SUGGESTED FLOOR PLAN
(One Teacher Vocational Agriculture Department)





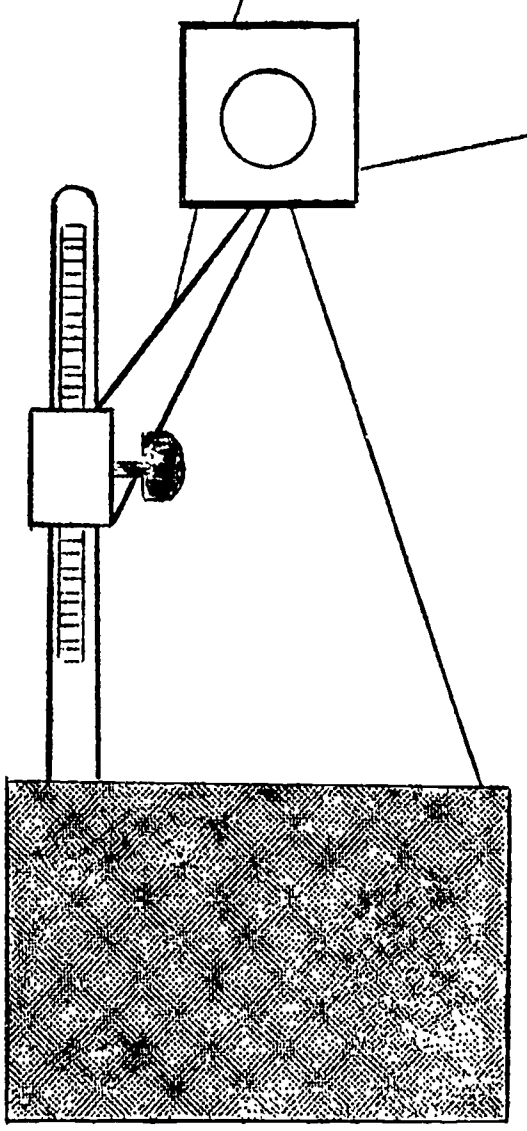
THE DECISION-MAKING CYCLE

part 2

OVERHEAD PROJECTION

Transparency Masters For Vocational Agriculture

(Supplement II)



L. C. Dalton, State Supervisor
Agricultural Education
University Park, New Mexico

Joe A. Richardson, Assistant State
Supervisor, Agricultural Education
University Park, New Mexico

VT010255

R 216 (SF)

MEMORANDUM

Revised 5/69

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
1900 Kenny Road
Columbus, Ohio 43210

FROM: (Person) L. C. Dalton (Agency) State Dept. of Agriculture Education

(Address) 130 South Capitol Street, Santa Fe, New Mexico 87501

DATE: December 19, 1969

RE: (Author, Title, Publisher, Date) Dalton, L.C. Overhead Projection; Transparency Masters for Vocational Agriculture (Including Supplements I-III). New Mexico State University, University Park. 1969.

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Address 130 South Capitol Street, Santa Fe, N. M. 87501
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(Free to State Supervisors and teachers of Education Dept.)

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Development Group State Dept. of Agriculture Education
Level of Group Teacher
Method of Design, Testing, and Trial

(3) Utilization of Material:
Appropriate Educational Setting
Type of Program Agriculture Mechanics
Occupational Focus
Geographic Adaptability
Uses of Material
Users of Material

(4) Requirements for Using Material:
Teacher Competency
Student or Trainee Selection Criteria

Time Allotment

Supplemental Media --
Necessary ____ } (Check Which)
Desirable ____ }

Describe

Source (agency)
(address)

CLASSES AND COMMON BREEDS OF SHEEP

FINE WOOL TYPE	MEDIUM WOOL TYPE	LONG WOOL TYPE
American Merino	Cheviot	Cotswold
Delaine Merino	Dorset	Leicester
Rambouillet	Hampshire	Lincoln
	Montadale	Romney
	Oxford	
	Shropshire	
	Southdown	
	Suffolk	
	Columbia	
	Corriedale	

COMMON DISEASES OF SHEEP

Foot Rot
Mastitis (Blue Bag)
Anthrax
Shipping Fever
Lamb Dysentery
Foot and Mouth
Sore Mouth
Overeating (Enterotoxemia)
Stiff Lamb Disease
White Muscle
Navel Ill and Joint Ill
Chronic Arthritis
Lambing Paralysis
Bloat

COMMON PARASITES OF SHEEP

EXTERNAL PARASITES	INTERNAL PARASITES
Stomach Worms	Blowfly
Tapeworm	Screw Worm
Grub (Sheep Bots)	Lice
Coccidiosis	Ticks
	Sheep Scab

COMMON SHEEP DISEASES

DISEASE	CAUSE	SYMPTOMS	TREATMENT OR PREVENTION

COMMON SHEEP PARASITES

PARASITE	DAMAGE	TREATMENT OR PREVENTION

GRADE AND CLASSES OF SHEEP

FEEDER LAMBS	SLAUGHTER SHEEP
Prime	Prime
Choice	Choice
Good	Good
Utility	Utility
	Cull

GRADE OF FLEECE PRODUCED BY THE COMMON BREEDS OF SHEEP

BREED	AMERICAN BLOOD GRADE	ENGLISH SPINNING GRADE
Rambioullet	Fine	64's and Better
Delaine Merino	Fine	64's and Better
Southdown	1/2 Blood	58's and 60's
Hampshire	3/8 Blood	56's
Shropshire	3/8 Blood	56's
Suffolk	1/4 Blood	48's and 50's
Corriedale	3/8 Blood	56's
Columbia	3/8 Blood	56's
Dorset	1/4 Blood	48's and 50's
Cheviot	1/4 Blood	48's and 50's
Lincoln	Low 1/4 Blood	46's
Leicester	Braid	36's and 40's
Cotswald	Braid	36's and 40's

AMERICAN AND ENGLISH SYSTEMS OF WOOL GRADES

AMERICAN BLOOD GRADE	ENGLISH SPINNING GRADE
Fine	64's, 70's, 80's
1/2 Blood	60's
3/8 Blood	56's, 58's
1/4 Blood	50's
Low 1/4 Blood	46's, 48's
Common	44's
Braid	36's, 40's

LENGTH REQUIREMENTS FOR THE MARKET CLASSES OF WOOL

GRADE	STAPLE	FRENCH COMBING	CLOTHING
Fine	2 1/2" or Longer	1 1/2" to 2 1/2"	1 1/2" or Less
1/2 Blood	2 3/4" or Longer	1 3/4" to 2 3/4"	1 3/4" or Less
3/8 Blood	3" or Longer	2" to 3"	2" or Less
1/4 Blood	3 1/4" or Longer	2 1/4" to 3 1/4"	2 1/4" or Less
Low 1/4 Blood	3 1/2" or Longer	None	3 1/2" or Less
Common	3 3/4" or Longer	None	3 3/4" or Less
Braid	4" or Longer	None	4" or Less

FLEECE TERMS

Fineness

Length

Shrinkage

Kemny

Burry

Density

Uniformity

Yolk

Crimp

Inert Material

Wool Blind

BREEDS OF SWINE

OLD ESTABLISHED BREEDS	NEW BREEDS
Bershire	Beltsuille No. 1
Chester White	Beltsuille No. 2
Duroc	American Landrace
Hampshire	Maryland No. 1
O I C	Minnesota No. 1
Poland China	Minnesota No. 2
Spotted Poland China	Montana No. 1
Tammworth	Polouse
Yorkshire	San Pierre

COMMON SWINE DISEASES AND PARASITES

DISEASES	PARASITES
Hog Cholera	Roundworms
Erysipelas	Mange
Necrotic Enteritis	Lice
Scours	
Rhinitis	
Brucellosis	
Flu or Pneumonia	
Anemia	
Leptospirosis	
Parakeratosis	

COMMON SWINE PARASITES

PARASITE	DAMAGE	TREATMENT OR PREVENTION

COMMON SWINE DISEASES

DISEASE	CAUSE	SYMPTOMS	PREVENTION OR TREATMENT

SWINE BREEDING SYSTEMS

Upgrading

Purebred Breeding

Crossbreeding

Criss-Crossing

Rotation Breeding

Inbreeding

Line Breeding

Crossline Breeding

U. S. D. A. HOG GRADES

U. S. No. 1

U. S. No. 2

U. S. No. 3

U. S. No. 4

Medium

BREEDS OF BEEF CATTLE

Aberdeen Angus

Red Angus

Galloway

Hereford

Polled Herefords

Shorthorns

Polled Shorthorns

Charolais

Brahman

Santa Gertrudis

Brangus

COMMON CATTLE DISEASES

INFECTIOUS	NON-INFECTIOUS
Blackleg	Milk Fever
Anthrax	Ketosis
Shipping Fever	X Disease
Foot Rot	Bloat
Pink Eye	Prussic Acid
Foot Mouth Disease	
Warts	
Calf Scours	
Ringworm	
Leptospirosis	
Pneumonia	
Coccidiosis	
Brucellosis	

COMMON CATTLE PARASITES

EXTERNAL	INTERNAL
Screw Worms	Stomach Worm
Cattle Grub	
Cattle Lice	
Horn Flies	
Stable Flies	
Ticks	
Mites	

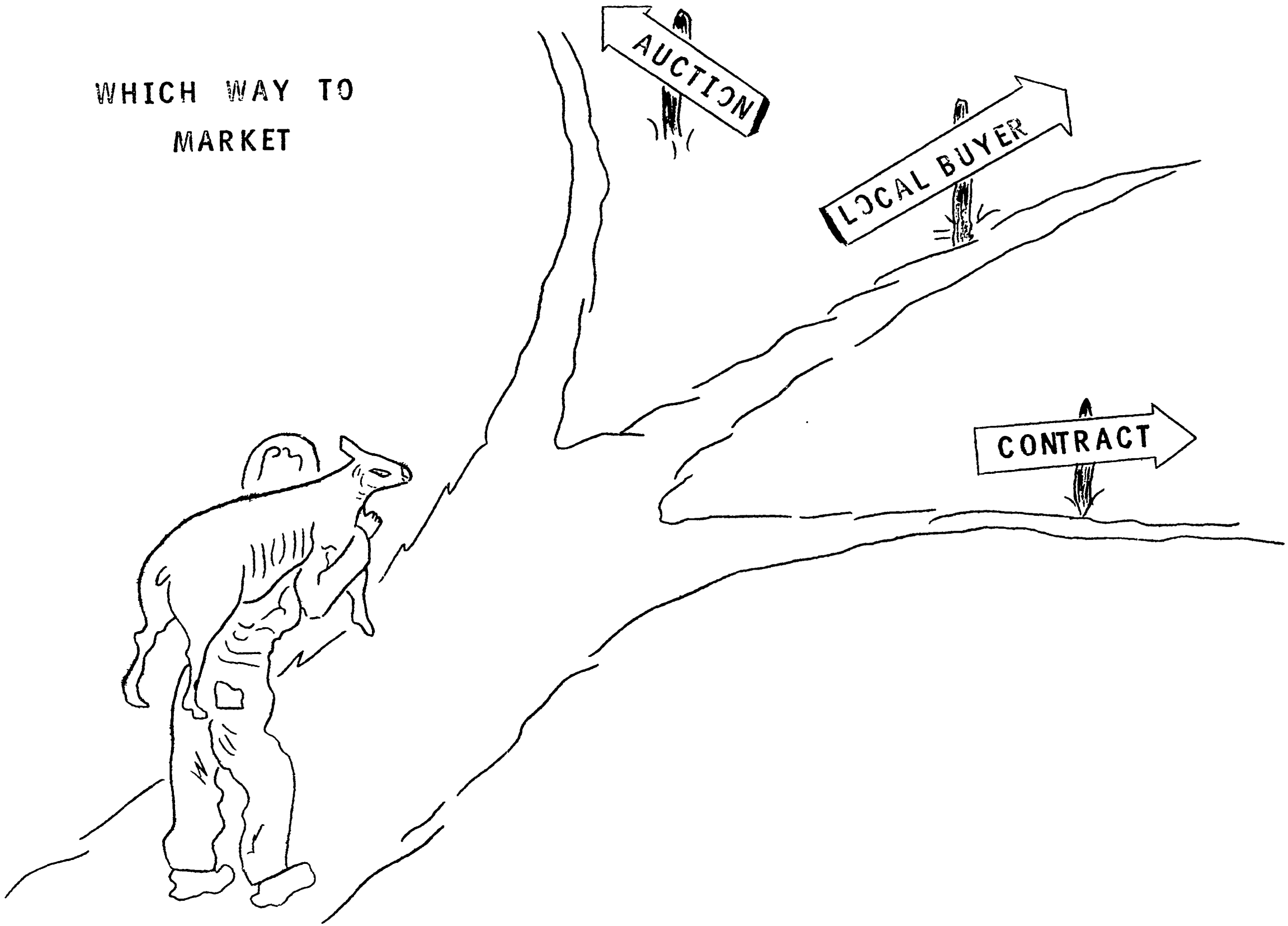
COMMON CATTLE DISEASES

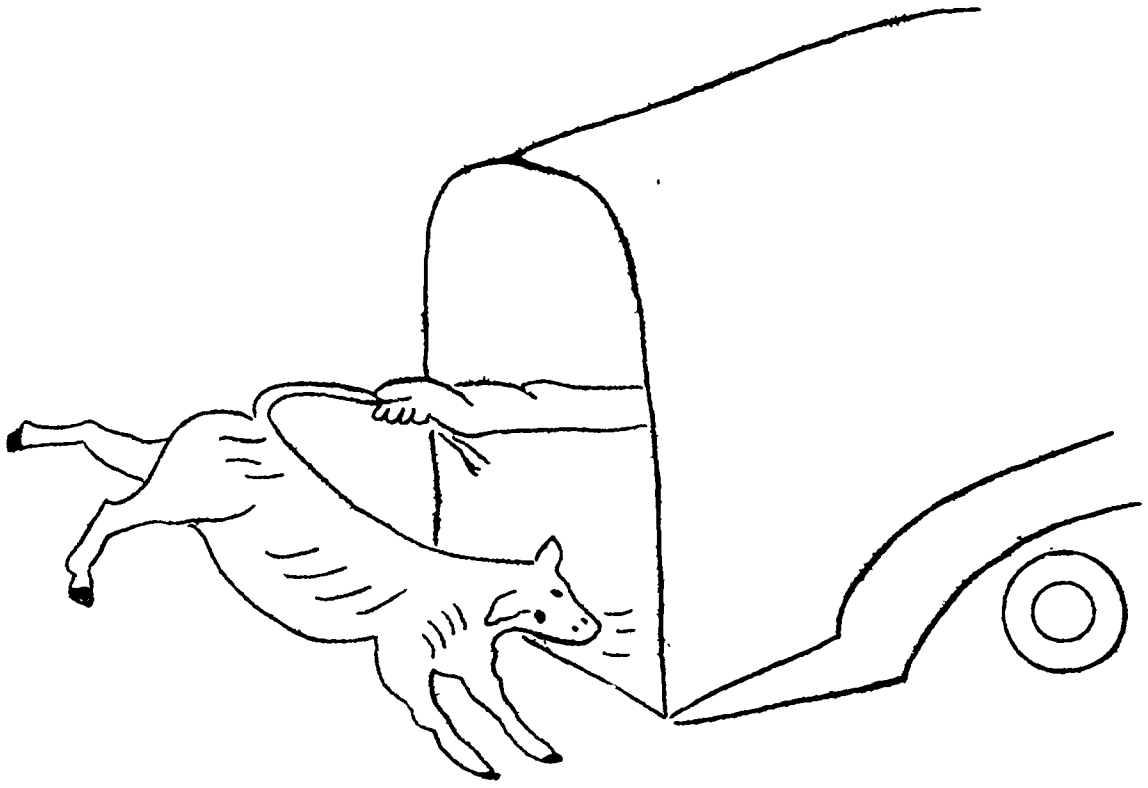
DISEASE	CAUSE	SYMPTOMS	TREATMENT OR PREVENTION

COMMON CATTLE PARASITES

PARASITE	DAMAGE	TREATMENT OR PREVENTION

WHICH WAY TO MARKET





DON'T USE THE COMMON HANDLES

TYPES OF BEEF MARKET PROCEDURE

1. Selling to the Packer or Packer Buyer.
2. Ship to a Central Market and Consign to a Commission Firm.
3. Sell to a Private Buyer, Who Buys From the Feeder and Either Sells Directly to the Packer or Ships to a Central Market.
4. Cooperative Marketing ---- These Commission Companies Operate Much Like Private Concerns Except the Profits are Paid to the Members in the Form of Patronage Dividends.

CLASSES AND GRADES OF BEEF CATTLE

FEEDER CATTLE	SLAUGHTER STEERS AND HEIFERS
Fancy	Prime
Choice	Choice
Good	Good
Medium	Standard
Common	Commercial
Inferior	Utility
	Cutter
	Canner

FEED ADDITIVES

Antibiotics

Harmones

Iodinated Casein

Arsenicals

Dynafac

Detergents or Surfactants

Tranquilizers

Rumen Organisms

CLASSES OF NUTRIENTS AND THEIR FUNCTION

CARBOHYDRATES ------	Furnish Heat and Energy for Animals and Provides Materials Necessary for Fattening
FATS ----------	Provide 2.25 Times as Much Heat and Energy as do Carbohydrates
PROTEINS ----------	They Help to Form the Greater Part of the Muscles, Internal Organs, Skin, Hair, Wool, Feathers, Hoofs, and Horns
MINERALS ----------	Primarily Used in the Development of Bones and Teeth
VITAMINS ----------	Promotes Growth, Avoids Eyesight Impairment, Aids Reproductive System, Resists Diseases and Muscular Disorders, and Stimulates Blood Clotting

LIVESTOCK FEEDING AND NUTRITION TERM

Nutrient

Feed Additives

Antibiotics

Digestible Nutrients

Ration

Balanced Ration

Roughages

Concentrates

Nitrogen-Free Extract

CLASSIFICATION OF FEEDS

ROUGHAGES

NON-LEGUME
- Corn Fodder
- Corn Silage
- Sorghum Silage
- Brome Grass
- Bluegrass
- Prairie Grass
- Sorghum Fodder

LEGUME
- Alfalfa
- Clovers
- Trefoil
- Soybeans
- Lespedeza

CONCENTRATES

GRAINS
- Corn
- Oats
- Barley
- Wheat
- Rye
- Grain Sorghums

PROTEIN
- Soybean Oil Meal
- Cottonseed Meal and Cake
- Linseed Meal
- Peanut Oil Meal
- Corn Gluten Meal

ANIMAL
- Tankage and Meat Scraps
- Meat and Bone Scraps
- Blood Meal
- Fish Meal
- Skim Milk

CLASSES AND BREEDS OF POULTRY

AMERICAN	MEDITERRANEAN	ENGLISH	ASIATIC
Plymouth Rock	Leghorn	Cornish	Brahma
Wyandotte	Minocra	Ordington	Cochin
Rhode Island Red	Ancona	Australord	Langshan
New Hampshire			
Jersey Black Giant			

CROP PLANTS OR SEEDS

Hard Red Winter Wheat (s)
Hard Red Spring Wheat (s)
Soft Red Winter Wheat (s)
Red Oats (s)
White Oats (s)
Two - rowed Barley (s)
Six - rowed Barley (s)
Rye (s)
Hegari (s)
Martin Milo (p)
Plainsman Milo (p)
Broomcorn (e)

Atlas Sorgo (s)
Sumac Sorgo (s)
Common Sedangrass (e)
Sweet Sudangrass (e)
Dent Corn (s)
Pop Corn (s)
Sweet Corn (s)
Egyptian Cotton (s)
Upland Cotton (s)
Sugar Beet (s)

RANGE PASTURE PLANTS

Buffalograss (p)
Hairy Grama (p)
Blue Grama (p)
Black Grama (p)
Side - Oats Grama (p)
Vine Mesquite (p)
Tobosa (p)
Little Bluestem (p)
Poverty Three - Awn (p)
Western Wheatgrass (p)
Alkali Sacaton (p)
Tumblegrass (p)
Ring Muhly (p)
Kentucky Bluegrass (p)
Saltgrass (p)
Needle - and - Thread Grass (p)
Burrograss (p)
Mormon Tea (p)

Indian Ricegrass (p)
Mountain Muhly (p)
Arizona Fescue (p)
Big Bluestem (p)
Indiangrass (p)
Switchgrass (p)
Chamiza (p)
Big Sage (p)
Broomweed (p)
One Seeded Juniper (p)
Mesquite (p)
Creosote Bush (p)
Rabbit Brush (p)
Greasewood (p)
Mountain Mahogany (p)
Winter Fat (p)
Apache Plume (p)

PERMANENT PASTURE PLANTS OR SEEDS

Tall Wheatgrass (e)

Italian Ryegrass (e)

Perennial Ryegrass (e)

Orchardgrass (e)

Smooth Bromegrass (e)

Tall Fescue (e)

Crested Wheatgrass (e)

Sand Dropseed (e)

Sand Lovegrass (e)

Weeping Lovegrass (e)

Bermudagrass (e)

VEGETABLE SEEDS

Watermelon (s)

Chili (s)

Carrot (s)

Tomato (s)

Lettuce (s)

Cucumbers (s)

Cantaloupe (s)

Onion (s)

LEGUMES

SMALL - SEEDED LEGUMES

Alfalfa (e)

Biennial White Sweetclover (e)

Madrid Sweetclover (e)

Red Clover (e)

Ladino Clover (e)

LARGE - SEEDED LEGUMES

Blackeye Cowpea (s)

Yellow Soybean (s)

Pinto Fieldbean (s)

Common Vetch (e)

Hairy Vetch (e)

POISONOUS PLANTS

Pinque Weed (p)

Loco Weed (p)

Larkspur (p)

Thread - Leaf- Groundsel (p)

Whorled Milkweed (p)

Rayless Golden Rod (p)

COMMON WEEDS

Wild Sunflower (e)

Russian Thistle (e)

Puncture Vine (p)

Cocklebur (p)

Grassbur (e)

Rough Pigweed (e)

Lamb's Quarters (e)

Curled Dock (e)

Yellow Foxtail (e)

Barnyardgrass (e)

Rescuegrass (e)

Cheat (e)

SECONDARY NOXIOUS WEEDS

Dodder (e)

Johnsongrass (e)

Texas Blueweed (e)

White Horsenettle (e)

Wild Oats (e)

PRIMARY NOXIOUS WEEDS

Field Bindweed (e)

Camelthorn (e)

Nutgrass (p)

Russian Knapweed (e)

Whitetop (e)

LAND JUDGING PIT CONDITION POSTER

PIT _____ CONDITIONS

1. Soil Test Shows
   a. N _____
   b. P _____
   c. K _____
   d. TSS _____
   e. EXCH NA _____
2. Manure _____ Available.
3. Thickness of Original Topsoil was _____ inches.
4. Size of Field Considered is _____;
5. Crop to be Grown _____.
6. Irrigation Water _____ Available.
7. Climatic Zone _____.

LAND CLASS FACTOR

EROSION

1	None to Little ----------	Less Than 25 percent
3	Moderate ----------	25 to 75 percent
4	Severe ----------	Over 75 percent with Occassional Gullies
7	Very Severe ----------	Over 75 percent with Frequent Gullies

LAND CLASS FACTOR

SLOPE

1	Nearly Level ----------	0' to 1'
2	Gently Sloping ---------	1' to 3'
3	Moderately Sloping -----	3' to 5'
4	Steep ----------	5' to 9'
6	Very Steep ----------	Over 9'

LAND CLASS FACTOR

SOIL DEPTH

1	Deep ----------	More Than 36 Inches Deep
2	Moderately Deep -------	20 to 36 Inches Deep
3	Shallow ----------	10 to 20 Inches Deep
4	Very Shallow ----------	Less Than 10 Inches Deep

LAND CLASS FACTOR

SURFACE TEXTURE

3	Coarse ------	Sands, Loamy Sands, and Sandy Loams
1	Medium -----	Loams, Silt Loams, Sandy Clay Loams, and Silts
2	Fine --------	Clays, Clay Loams, Silty Clay Loams, and Silty Clays

LAND CLASS FACTOR

PERMEABILITY

2	Very Slow ----------	Dense, Tight Clay Subsoils
1	Slow ----------	Clay or Clay Loam Subsoils
1	Moderate ----------	Loamy and Sandy Loam Subsoils
2	Rapid ----------	Sandy, Loamy Sand, or Gravel Subsoils

DETERMINE LAND CAPABILITY CLASS

Problem Number	Surface Texture	Permeability	Depth	Slope	Erosion	Land Capability Class
1	Fine	Slow	Deep	Level	Moderate	
2	Medium	Moderate	Mod. Deep	Moderate	None to Little	
3	Coarse	Rapid	Shallow	G. Sloping	Moderate	
4	Medium	Rapid	Deep	Level	None to Little	
5	Coarse	Rapid	Mod. Deep	G. Sloping	None to Little	
6	Fine	Moderate	Mod. Deep	Level	Moderate	
7	Medium	Slow	Deep	Level	None to Little	
8	Medium	Slow	Deep	Level	Moderate	
9	Coarse	Rapid	Very Shallow	Moderate	Severe	
10	Fine	Very Slow	Deep	Level	Moderate	

LAND JUDGING

A. Vegetative Treatments

1. Crop rotation with soil-building crops 1/3 of the time.
2. Crop rotation with soil-building crops 1/2 of the time.
3. Crop rotation with soil-building crops 4/5 of the time.
4. Production of high residue row crops.
5. Use of a flexible cropping system of sorghum and wheat.
6. Use of a flexible cropping system of wheat, sorghum, and fallow.
7. Crop residue management.
8. Proper pasture or range management.
9. Wildlife improvements.

LAND JUDGING

B. Mechanical Treatments

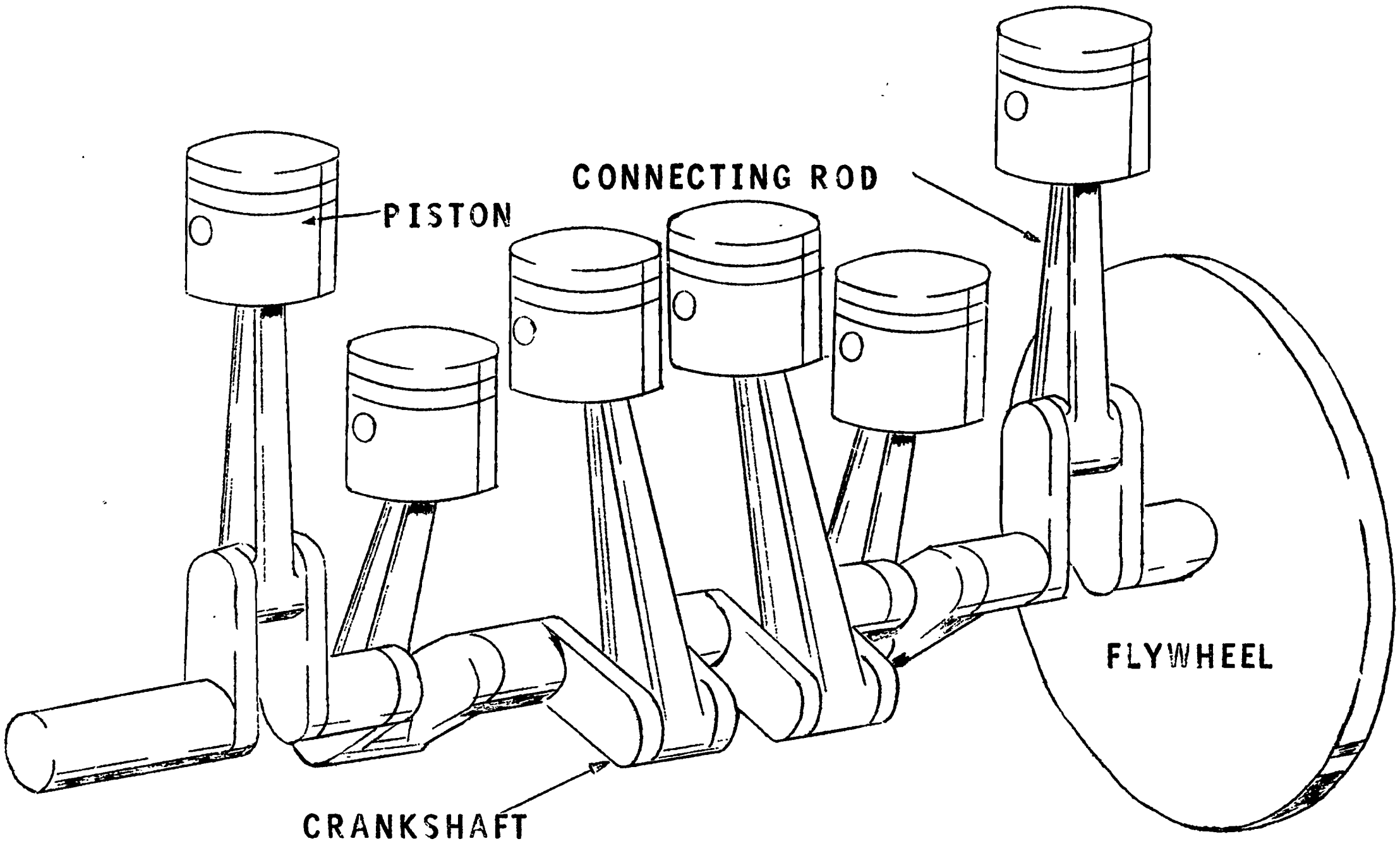
10. Land leveling, cuts limited by unfavorable materials within 36 inches.
11. Land leveling, cuts not limited by unfavorable materials within 36 inches.
12. Use of small flows of water when irrigating.
13. Use of medium flows of water when irrigating.
14. Use of large flows of water when irrigating.
15. Leaching of excessive salts.
16. Control of gullies.
17. Terrace and contour farming.
18. Rough tillage.

LAND JUDGING

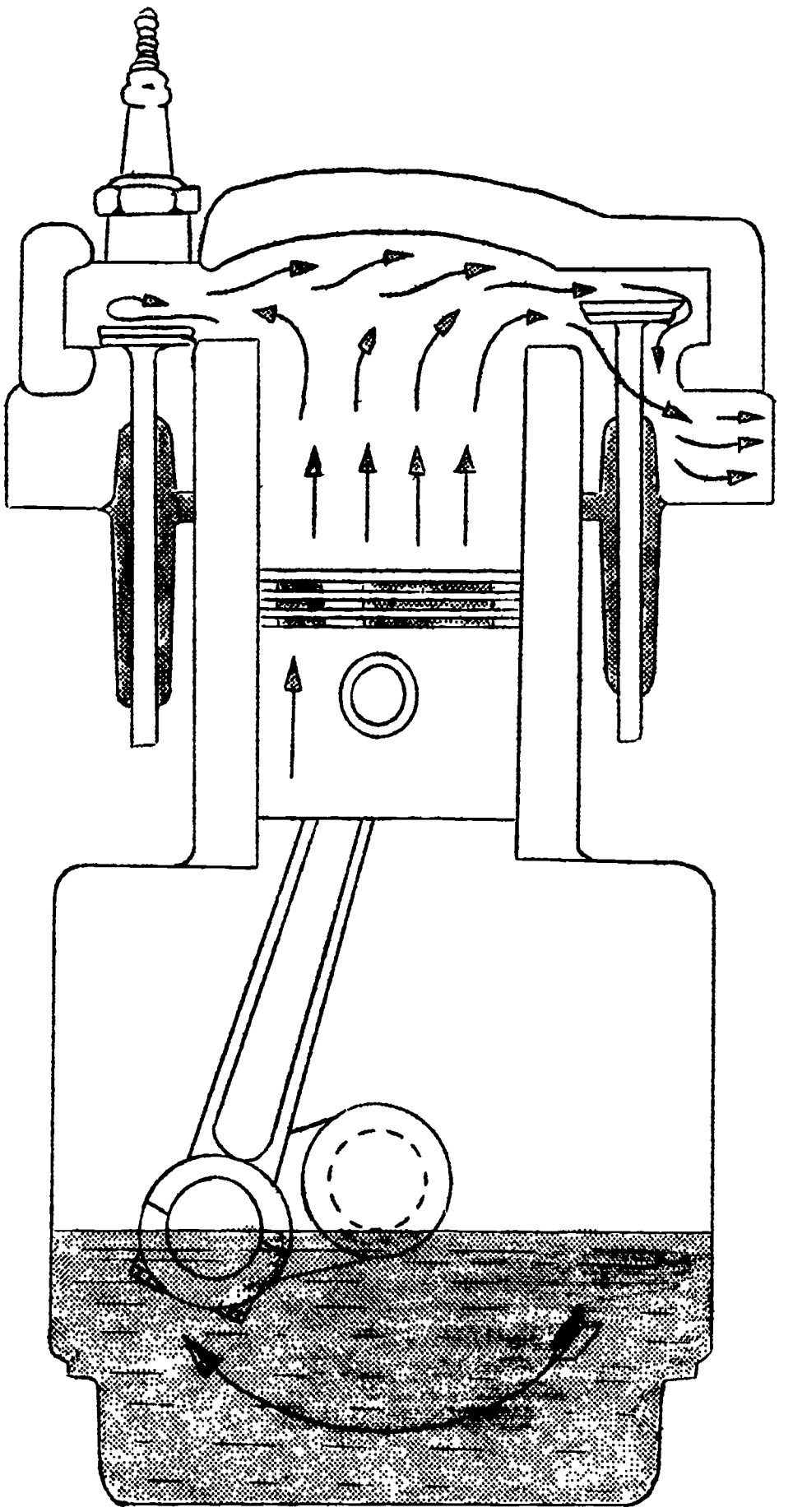
C. Fertilizer and Soil Amendments

19. Gypsum
20. Manure
21. Nitrogen
22. Phosphorus
23. Potassium

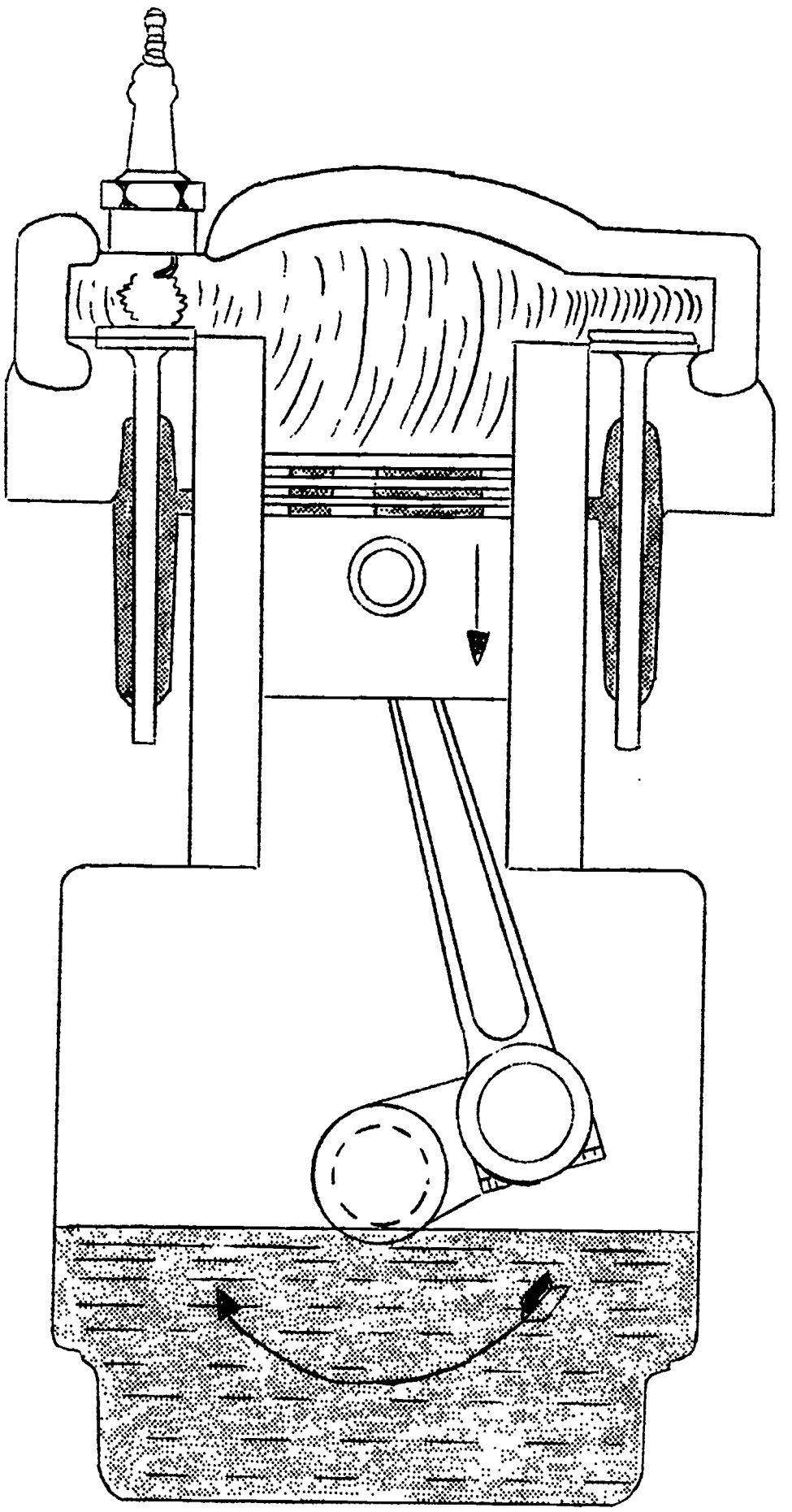
ARRANGEMENT OF CYLINDERS AND CRANKSHAFT



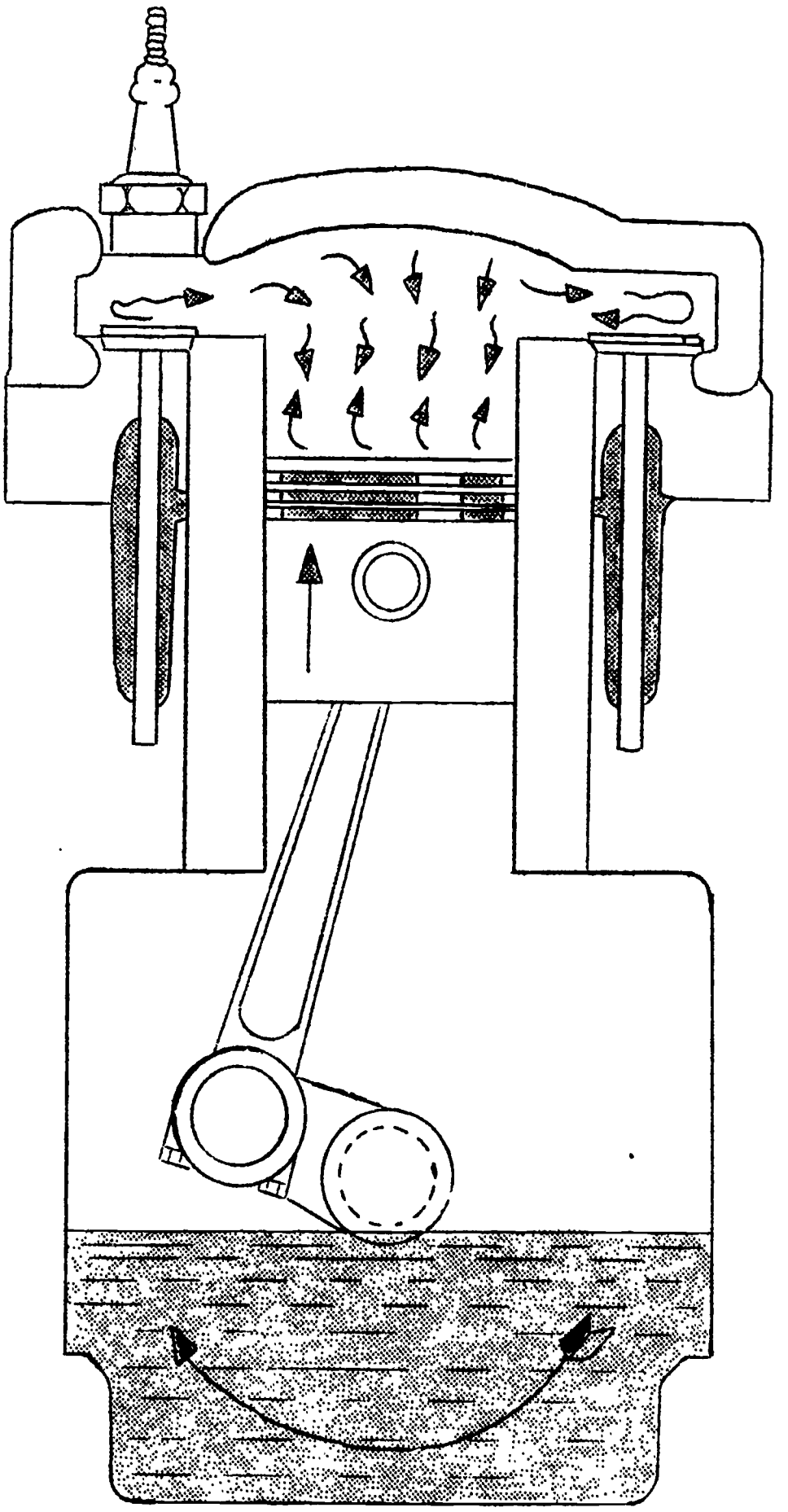
FOUR-CYCLE ENGINE -- EXHAUST STROKE



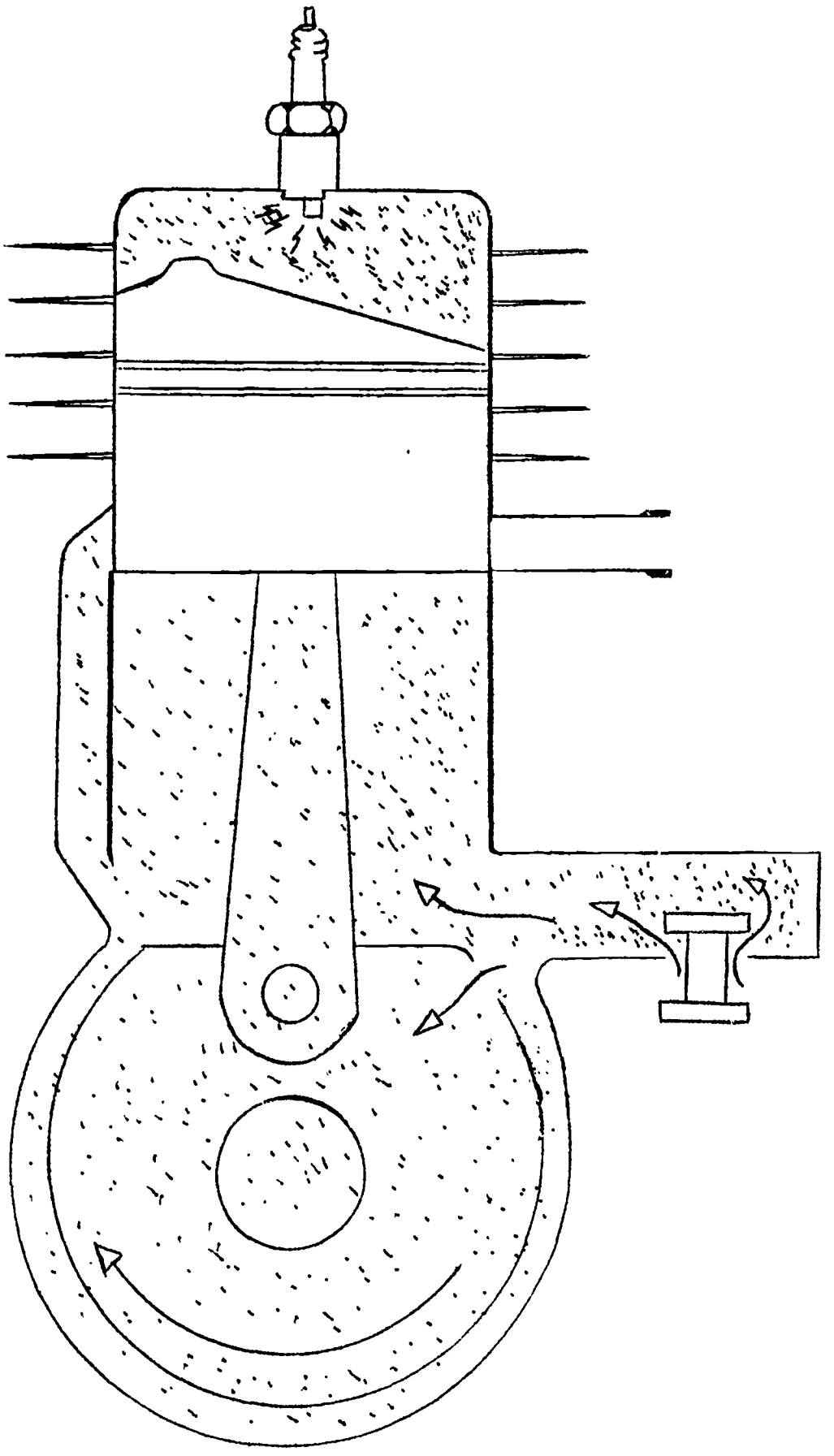
FOUR-CYCLE ENGINE -- POWER STROKE



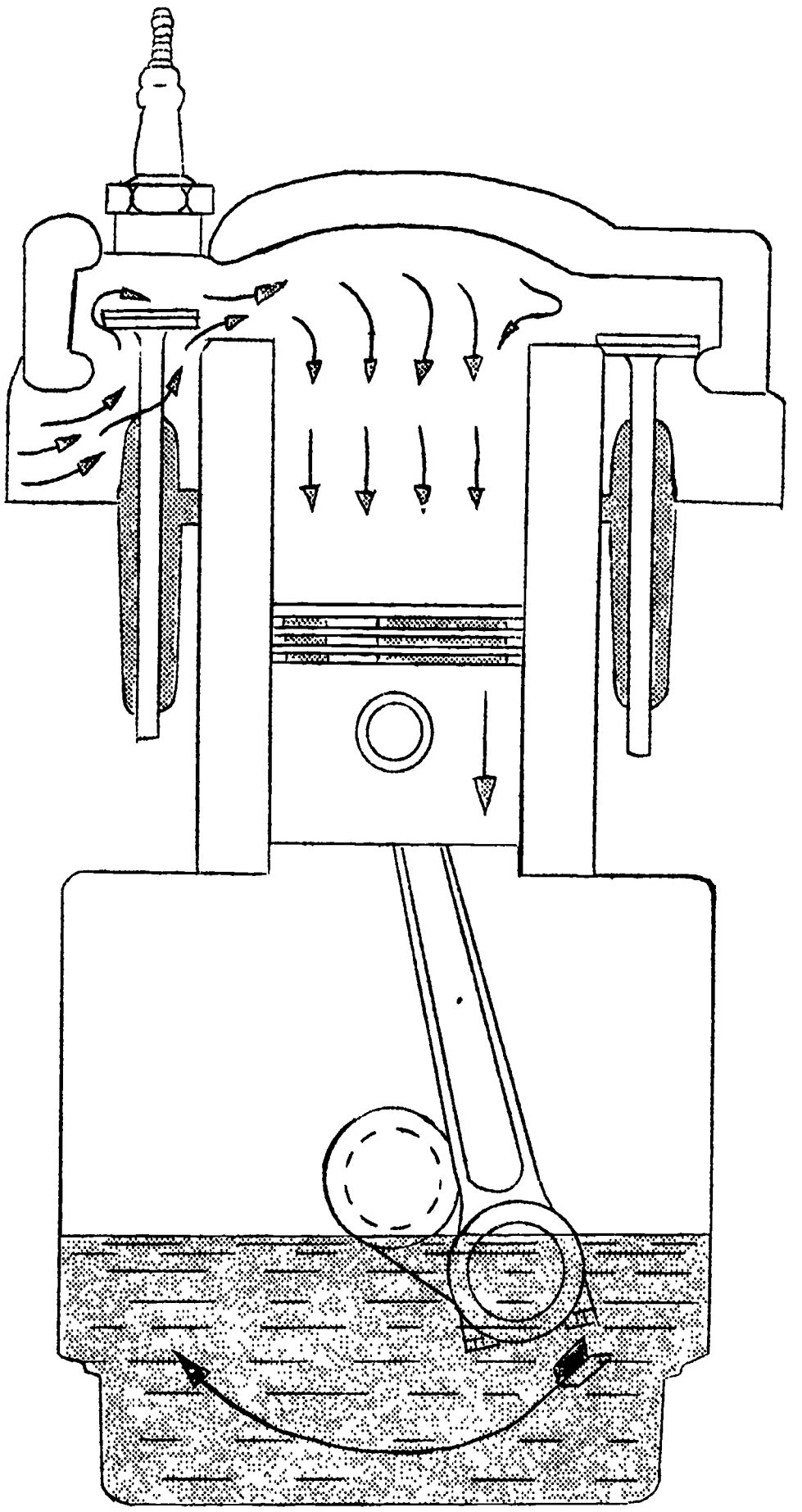
FOUR-CYCLE ENGINE -- COMPRESSION STROKE



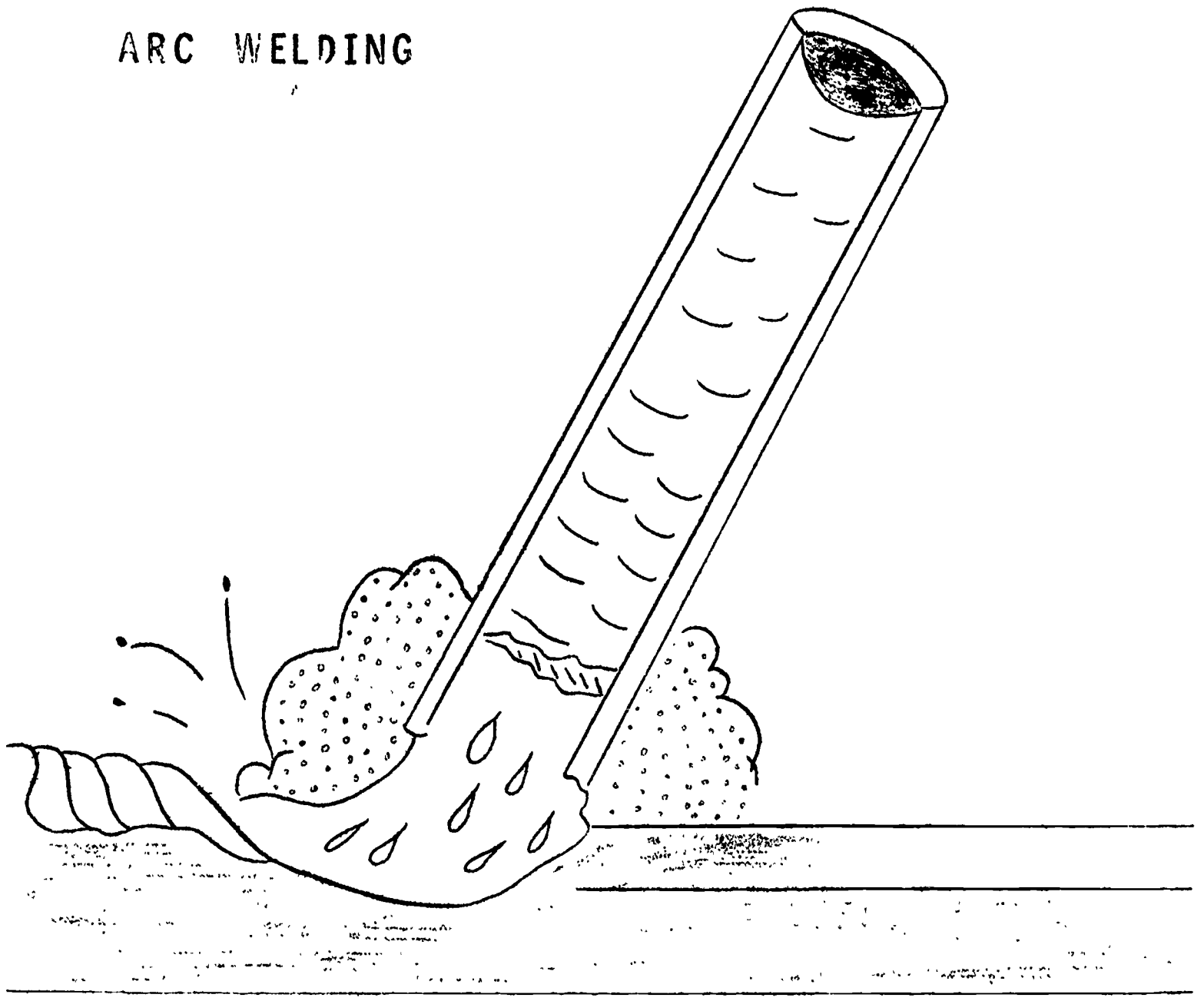
TWO-CYCLE ENGINE -- INTAKE AND COMPRESSION

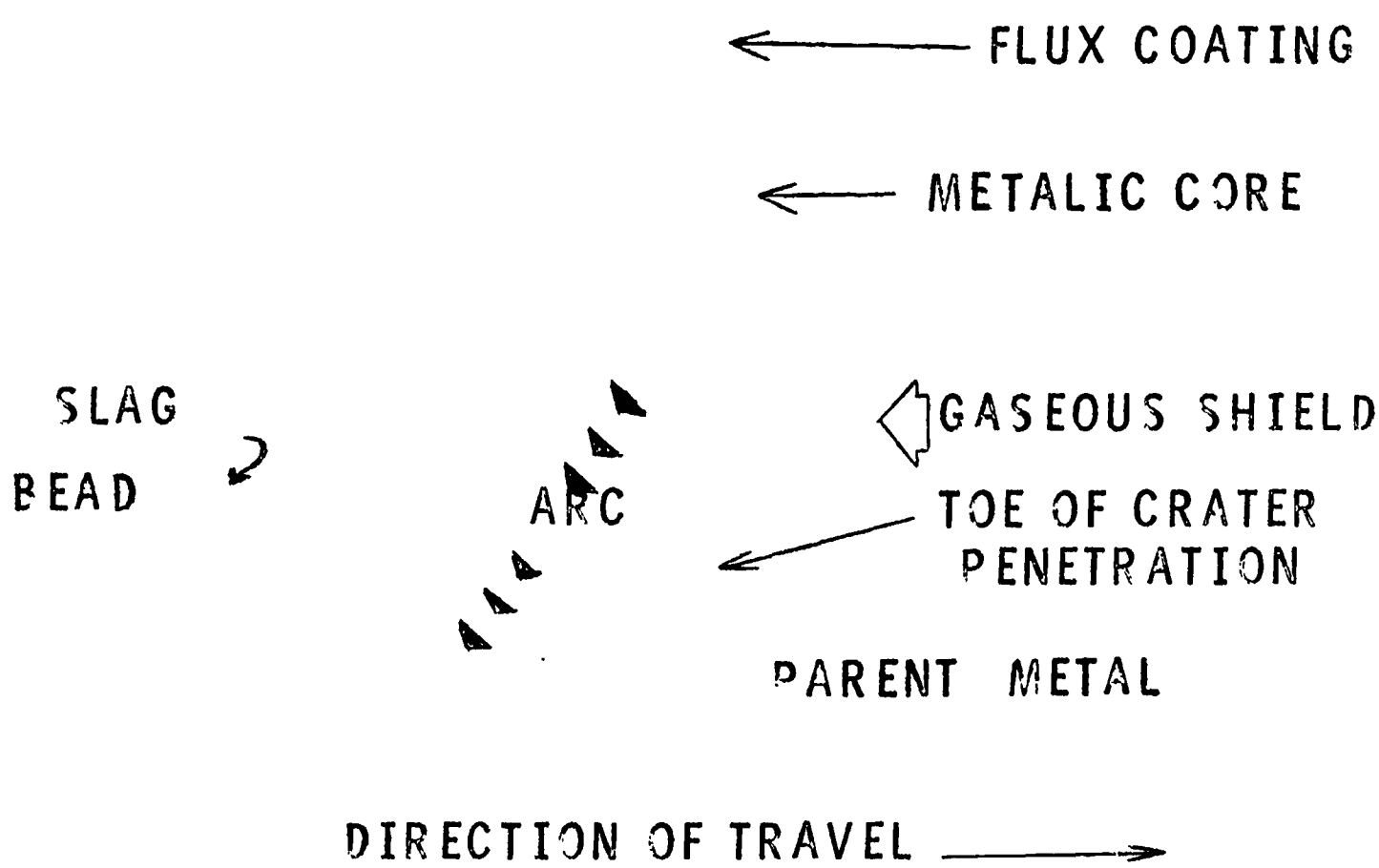


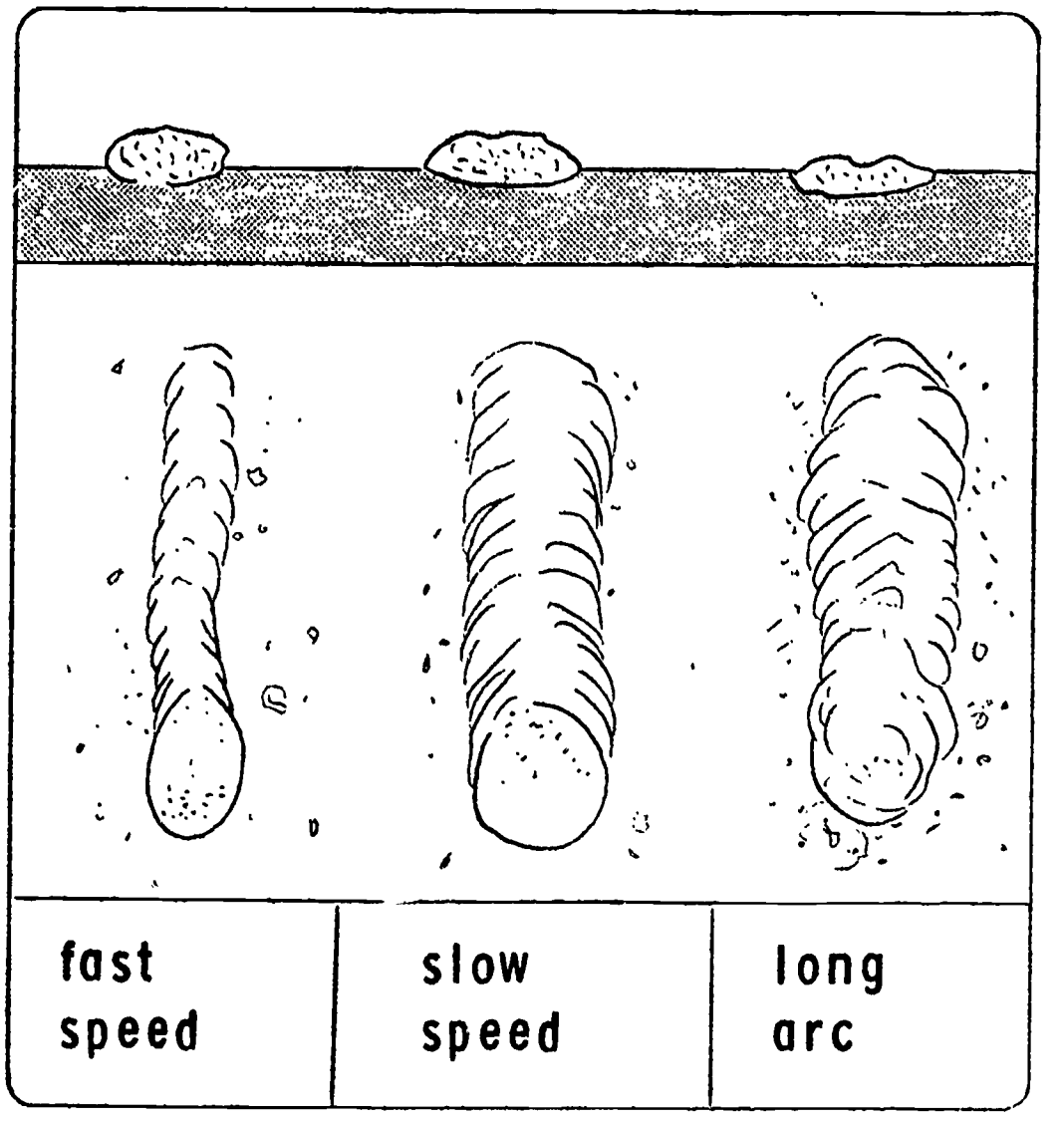
FOUR-CYCLE ENGINE -- INTAKE STROKE



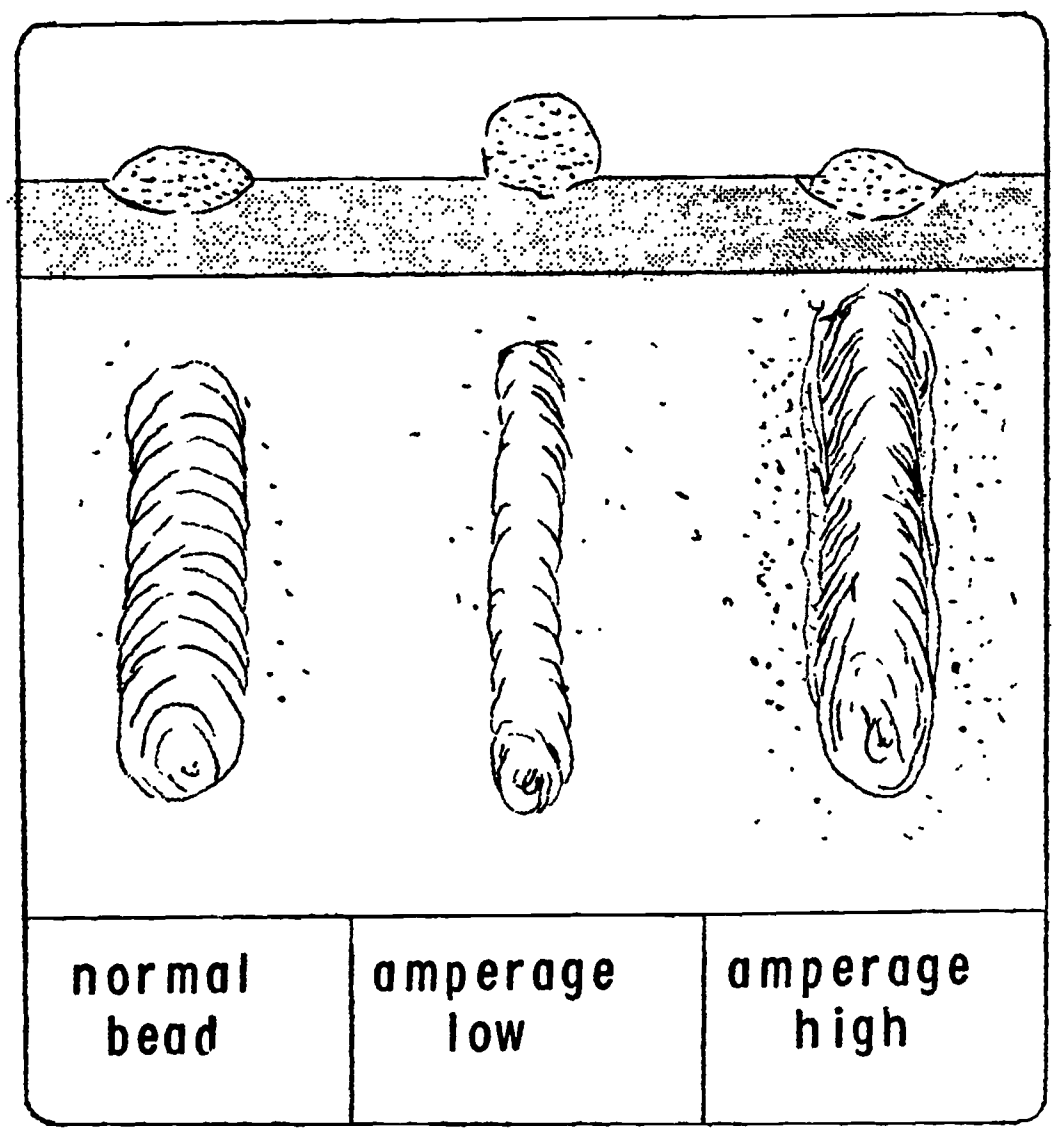
ARC WELDING




FLUX COATING
METALIC CORE
SLAG
BEAD
ARC
GASEOUS SHIELD
TOE OF CRATER
PENETRATION
PARENT METAL
DIRECTION OF TRAVEL

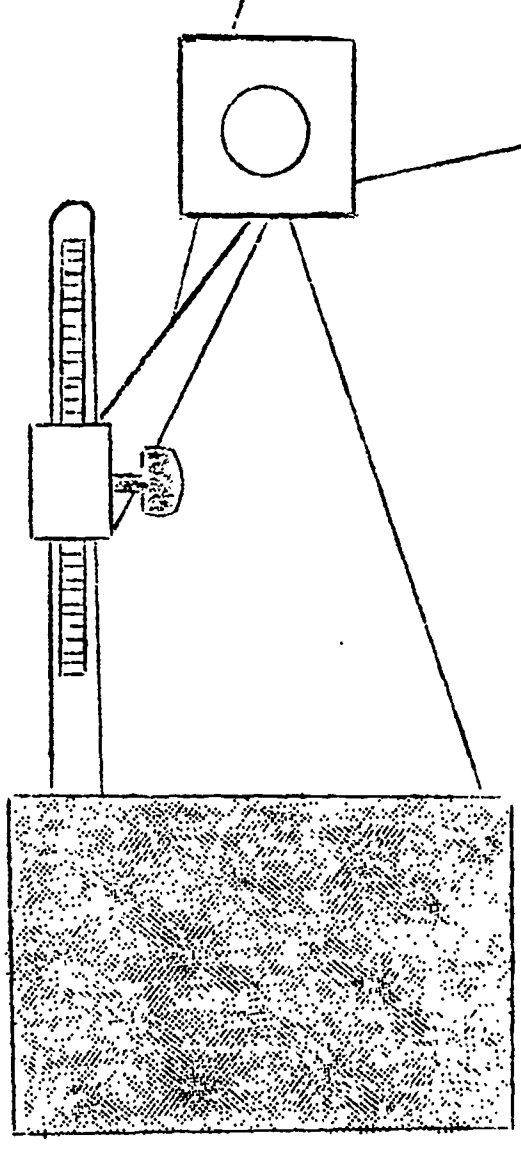


Arc Welding Beads


normal bead
amperage low
amperage high

(CD part 3

OVERHEAD PROJECTION Transparency Masters For Vocational Agriculture (Supplement III)



L. C. Dalton, State Supervisor
Agricultural Education
University Park, New Mexico

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VT010255

R 216 (SF)

MEMORANDUM

Revised 5/69

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
1900 Kenny Road
Columbus, Ohio 43210

FROM: (Person) L. C. Dalton (Agency) State Dept. of Agriculture Education

(Address) 130 South Capitol Street, Santa Fe, New Mexico 87501

DATE: December 19, 1969

RE: (Author, Title, Publisher, Date) Dalton, L.C. Overhead Projection; Transparency Masters for Vocational Agriculture (Including Supplements I-III). New Mexico State University, University Park. 1969.

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Users of Material

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Teacher Competency
Student or Trainee Selection Criteria

Time Allotment

Supplemental Media --
Necessary ____ } (Check Which)
Desirable ____ }

Describe

Source (agency)
(address)

IDENTIFICATION OF BEEF CUTS

ROUND
- Round Steak
- Top Round Steak
- Bottom Round Steak
- Eye of Round Steak
- Tip Roast
- Heel of Round

RUMP
- Standing Rump
- Rolled Rump

SIRLOIN
- Sirloin Steak
- Boneless Top Sirloin Steak

SHORT LOIN
- T-Bone Steak
- Club Steak
- Top Loin Steak
- Tenderloin Steak

FLANK
- Flank Steak

RIB
- Standing Rib
- Rib Steak
- Rib Eye Steak
- Rib Eye Roast

CHUCK
- Arm Pot Roast
- Arm Steak
- Blade Pot Roast
- Blade Steak
- English Cut
- Inside Chuck Pot Roast

SHORT PLATE
- Plate (Bone In)
- Rolled Plate
- Short Ribs

BRISKET
- Brisket (Bone In)
- Boneless Fresh Brisket
- Boneless Corned Brisket

FORESHANK
- Foreshank
- Shank Cross Cuts

IDENTIFICATION OF PORK CUTS

(FRESH)

FRESH HAM

Fresh Ham (Leg), Butt Portion

Fresh Ham (Leg), Shank Portion

Fresh Ham (Leg), Boneless

Fresh Ham (Leg), Center Cut Steak

LOIN

Loin Roast, Center Cut

Sirloin Roast (Ham End)

Blade Loin Roast (Shoulder End)

Rib Chop

Loin Chop

Tenderloin

Back Ribs

FRESH SIDE

Fresh Side Pork

SPARERIBS

Spareribs

FRESH PICNIC SHOULDER

Fresh Picnic Shoulder

Arm Roast

Arm Steak

BOSTON BUTT

Boston Butt

Blade Steak

IDENTIFICATION OF PORK CUTS

(CURED AND SMOKED)

SMOKED HAM

Smoked Ham, Butt Portion
Smoked Ham, Shank Portion
Smoked Ham, Center Slice

SMOKED LOIN

Smoked Loin Chop

SMOKED PICNIC SHOULDER

Smoked Picnic Shoulder

SMOKED SHOULDER BUTT

Smoked Shoulder Butt

BACON

Slab Bacon
Sliced Bacon
Jowl Bacon Square
Canadian-Style Bacon
Sliced Canadian-Style Bacon

SALT PORK

Salt Side Pork
Salt Fat Back

IDENTIFICATION OF LAMB CUTS

LEG

Leg, Sirloin On
Leg, Sirloin Off
Leg, Shank Half
Leg, Sirloin Half
Sirloin Chop

LOIN

Loin Roast
Loin Chop

RACK

Rib Roast
Rib Chop

SHOULDER

Square Shoulder
Rolled Shoulder
Arm Chop
Blade Chop

BREAST

Breast
Riblets

FORE SHANK

Fore Shank

IDENTIFICATION OF VARIETY MEAT CUTS

Beef Heart

Pork Heart

Beef Tongue

Pork Tongue

Beef Ox-Joints

Beef Tripe

Sweatbreads

Brains

Beef Liver

Lamb Liver

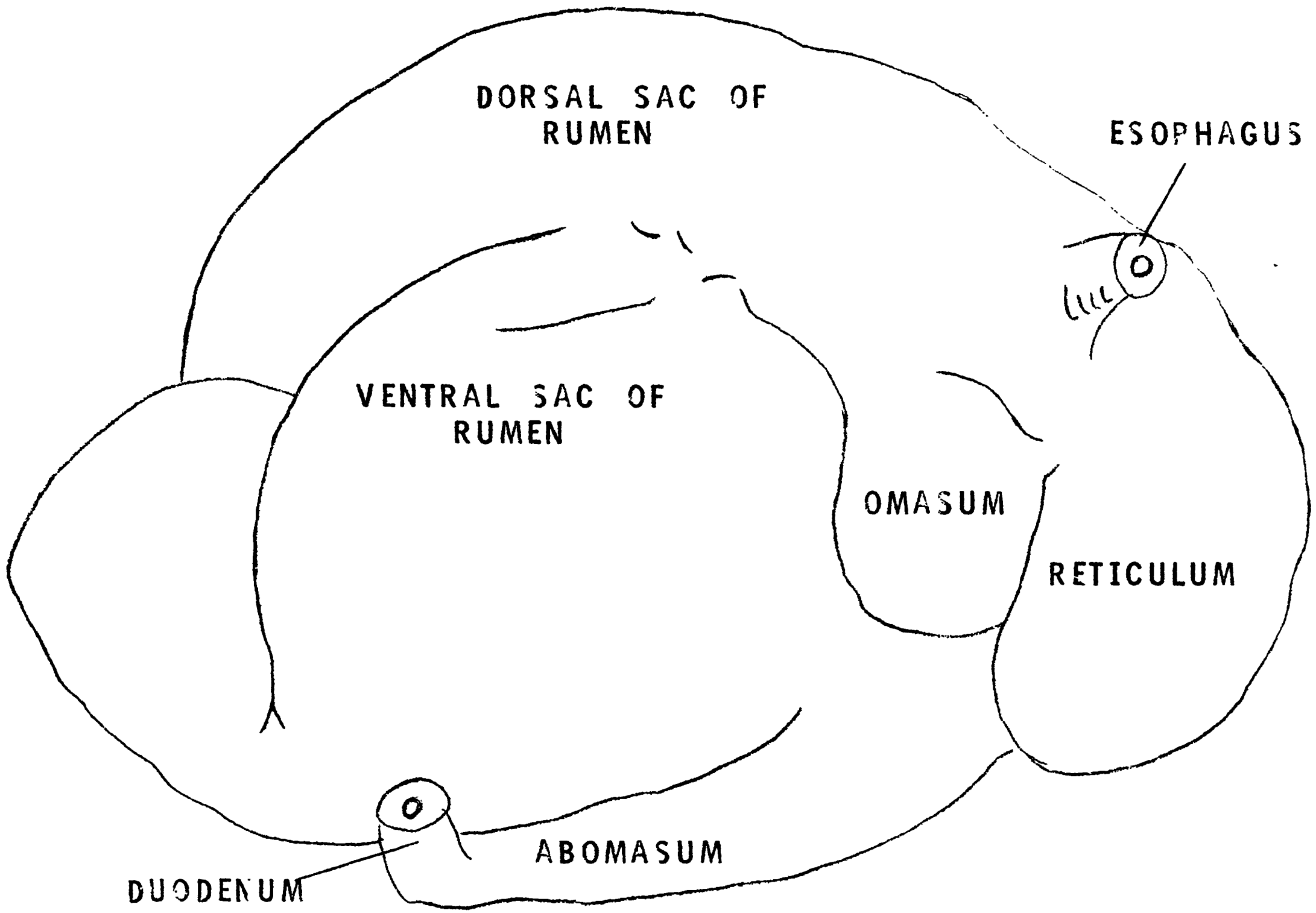
Pork Liver

Beef Kidney

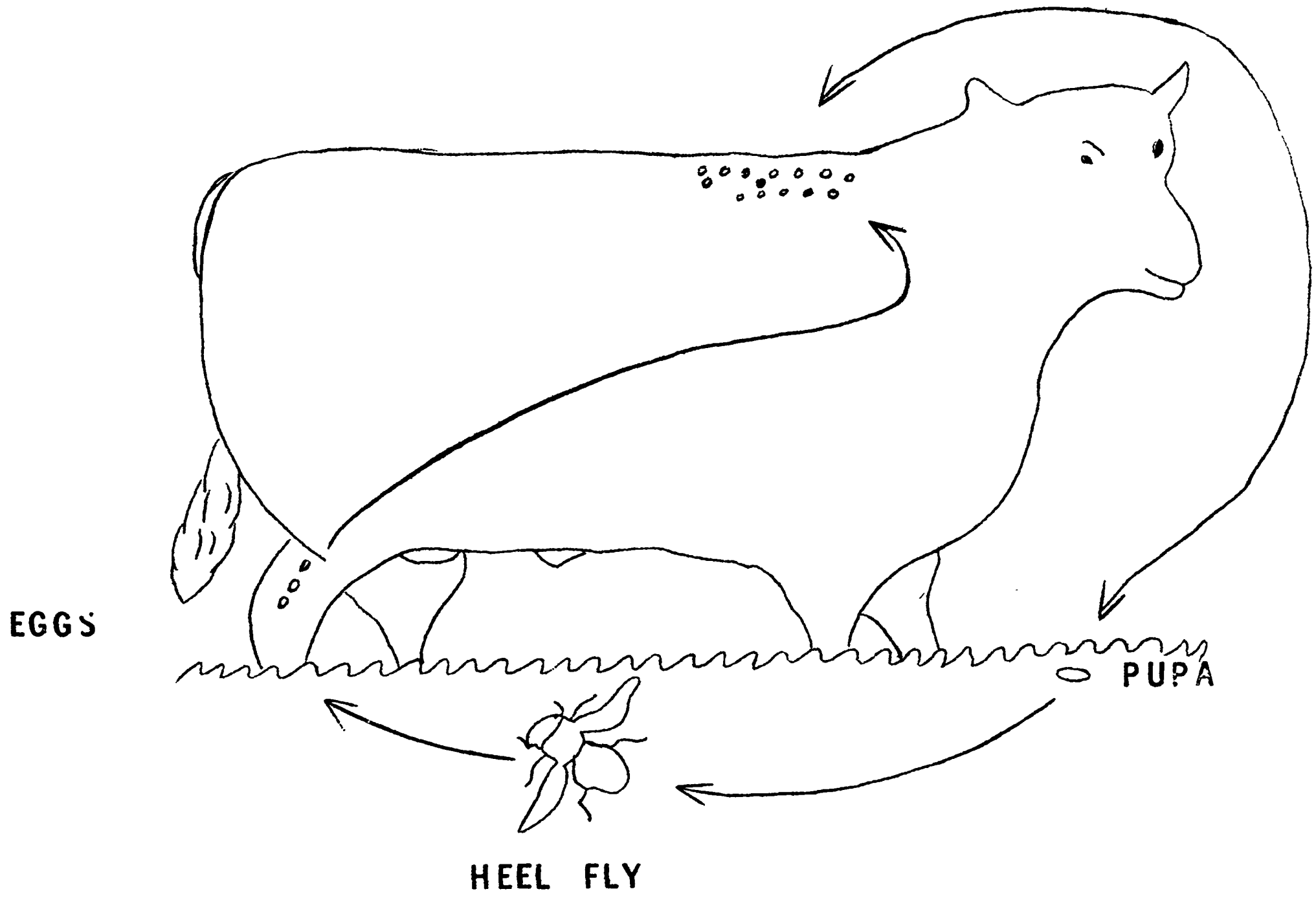
Lamb Kidney

Pork Kidney

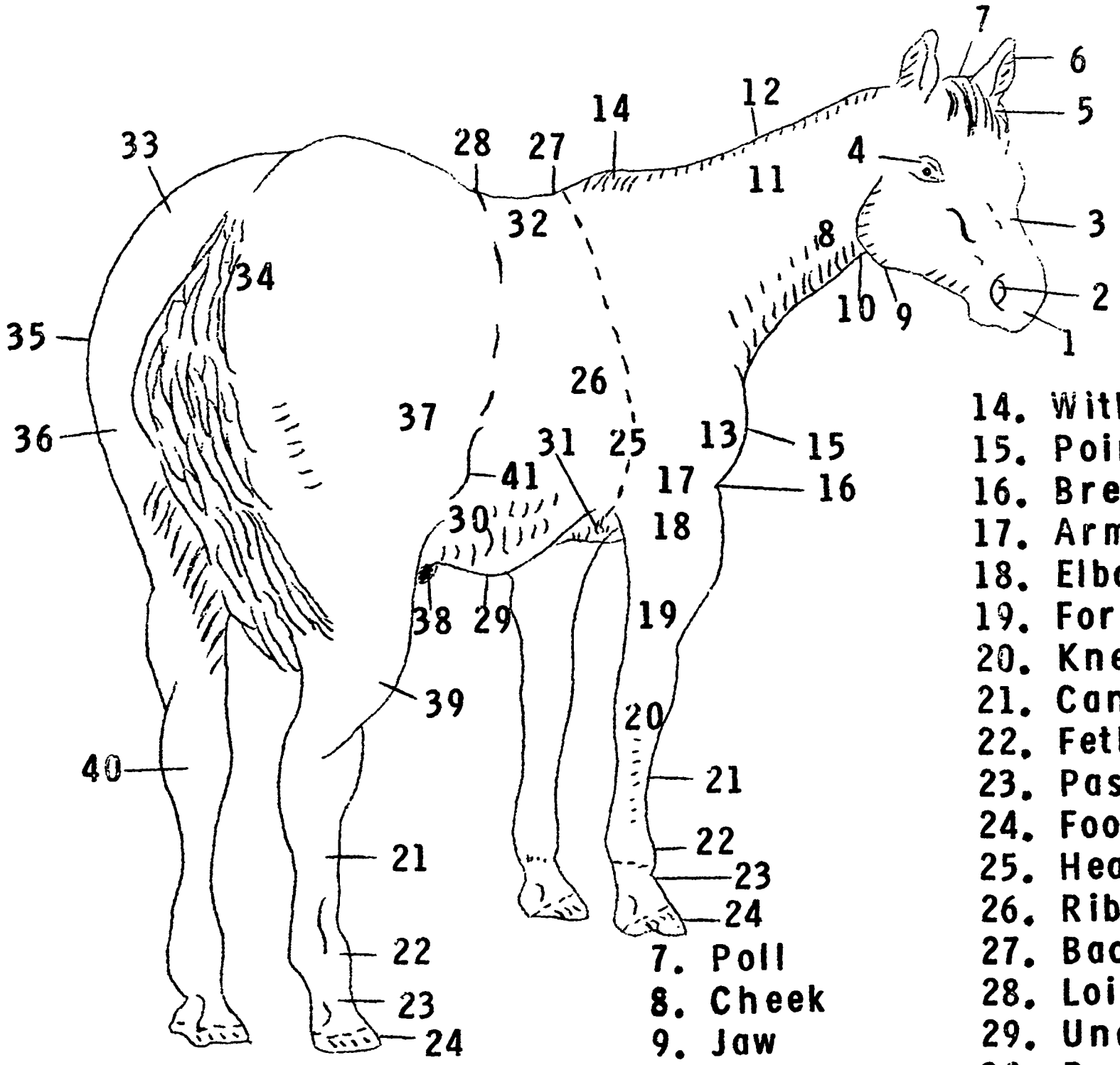
RUMENANT STOMACH



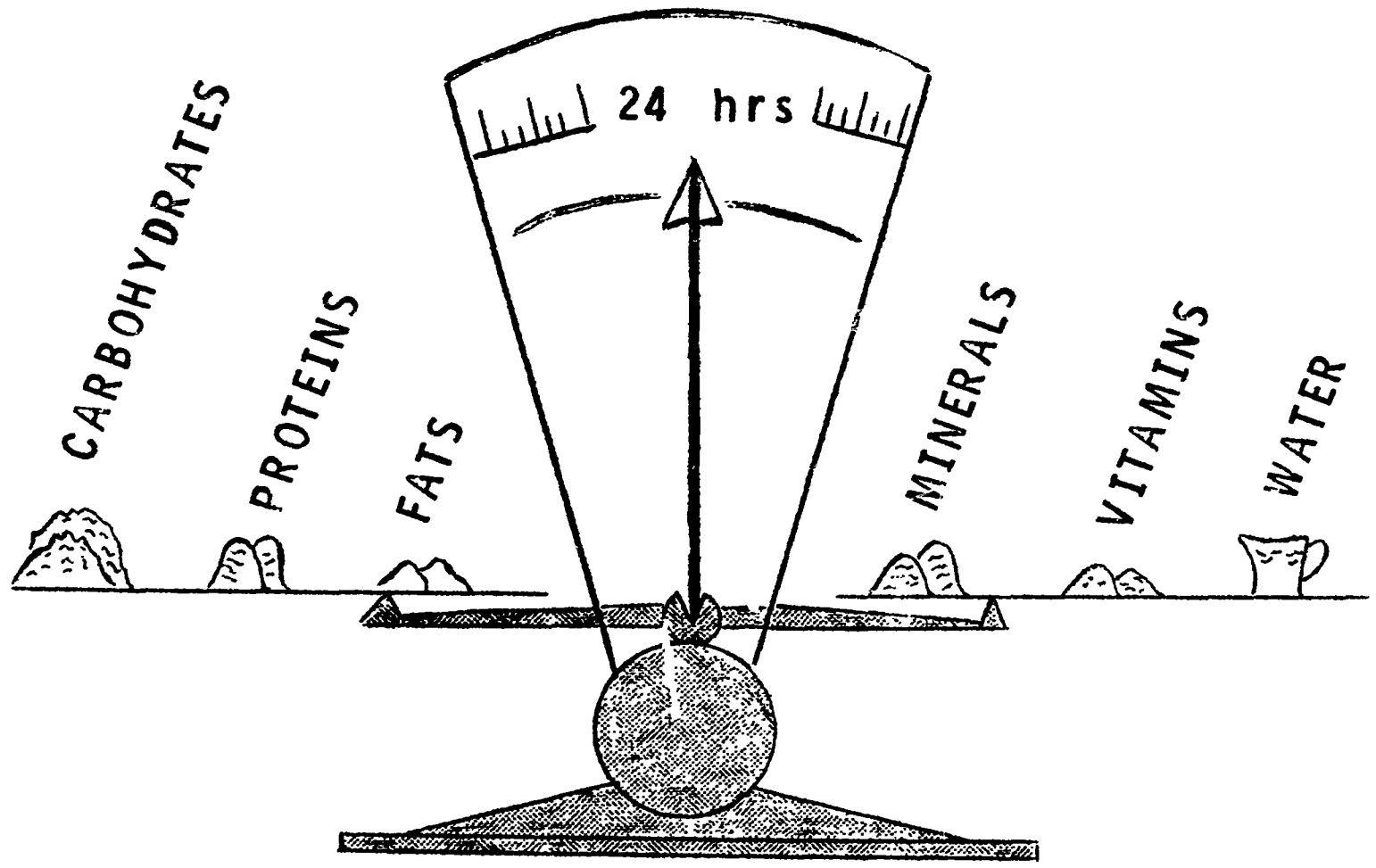
CYCLE OF GRUBS



PARTS OF A HORSE

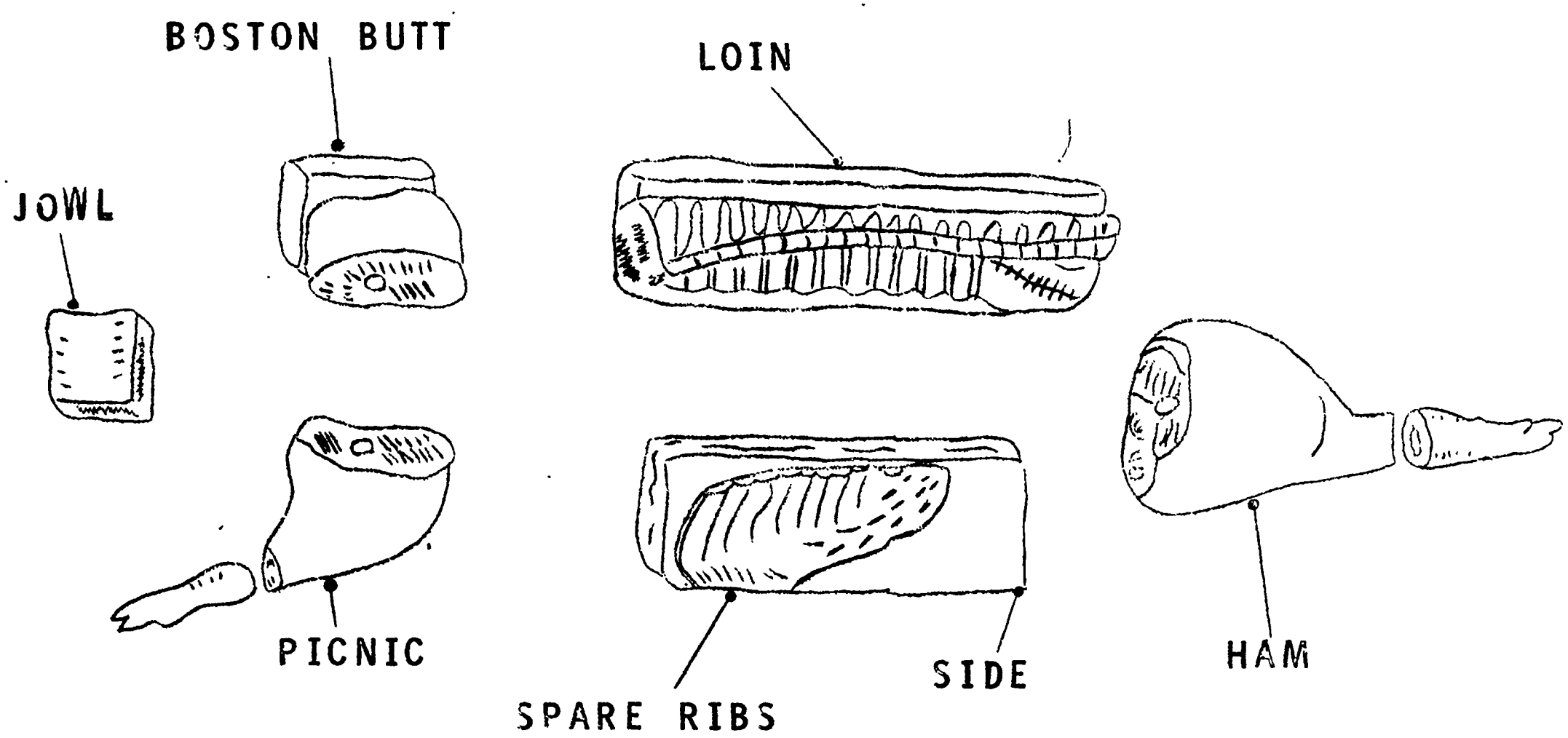


1. Muzzle
2. Nostrils
3. Face
4. Eye
5. Forehead
6. Ear
7. Poll
8. Cheek
9. Jaw
10. Throatlatch
11. Neck
12. Crest
13. Shoulder
14. Withers
15. Point of Shoulder
16. Breast
17. Arm
18. Elbow
19. Forearm
20. Knee
21. Cannon
22. Fetlock Joint
23. Pastern
24. Foot
25. Heart Girth
26. Ribs
27. Back
28. Loin
29. Underline
30. Rear Flank
31. Fore Flank
32. Coupling
33. Croup
34. Tail
35. Point of Buttock
36. Quarters
37. Thigh
38. Sheath
39. Gaskin
40. Hock
41. Stifle

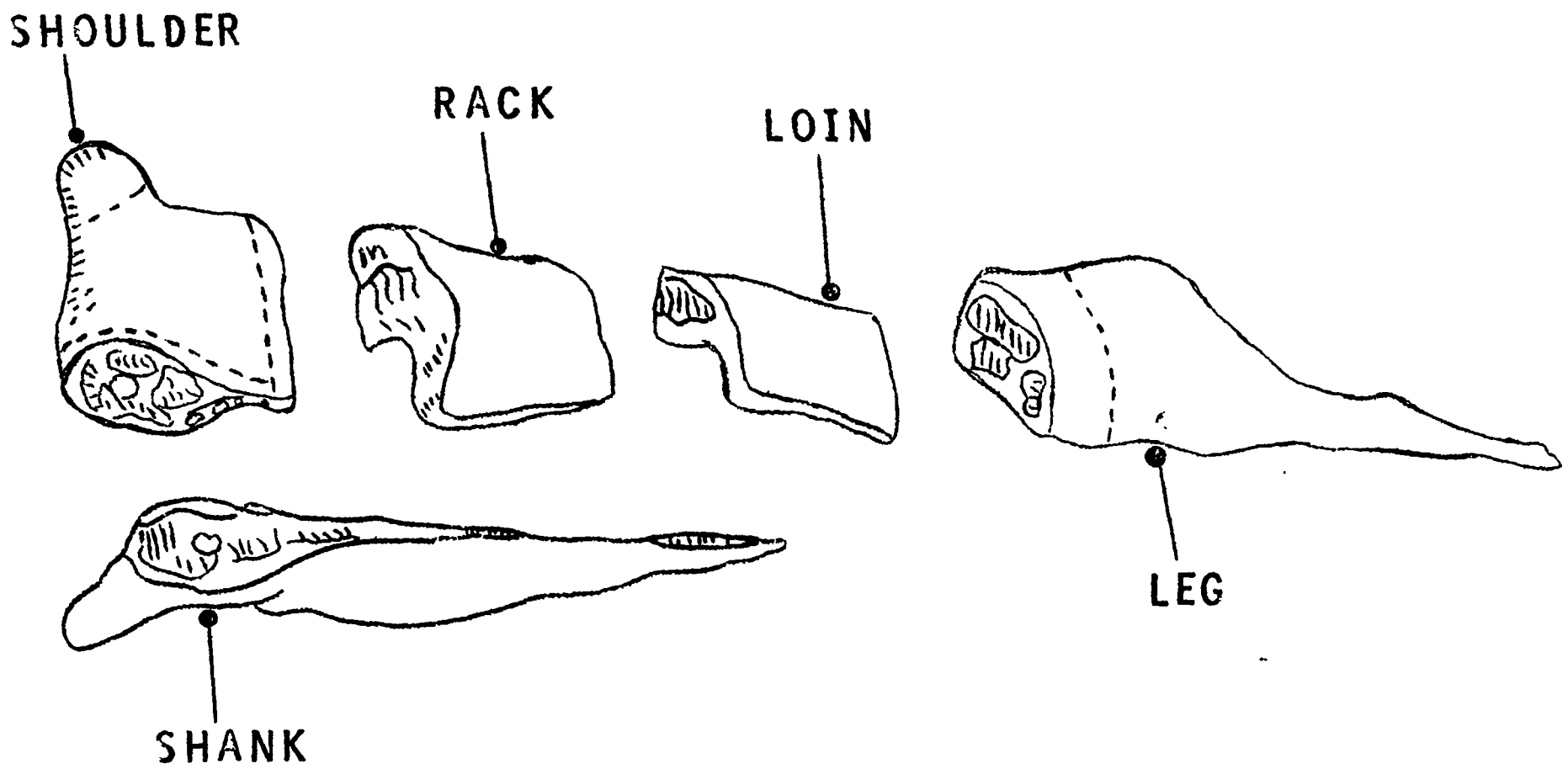


A BALANCED RATION

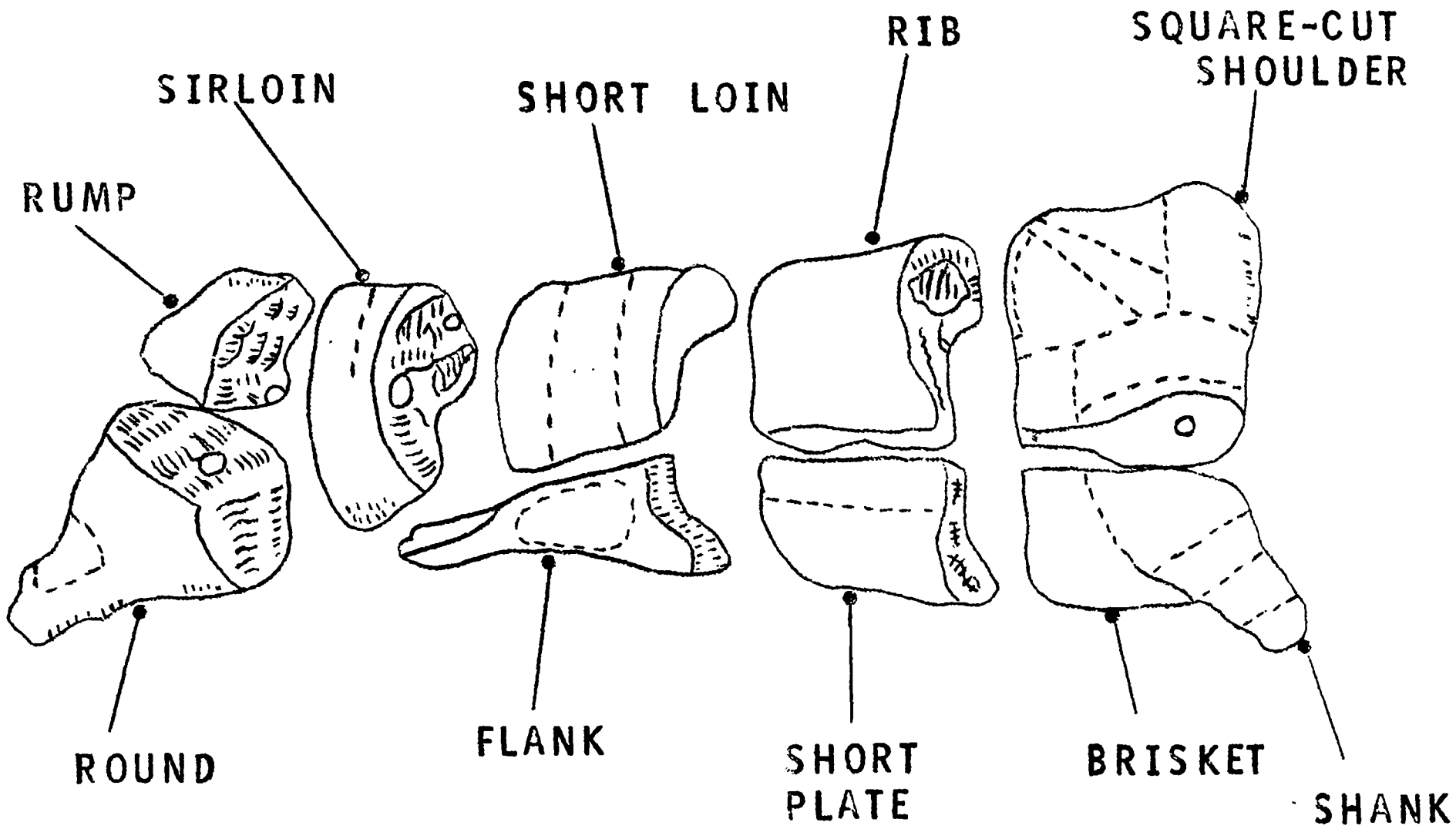
PORK CUTS CHART



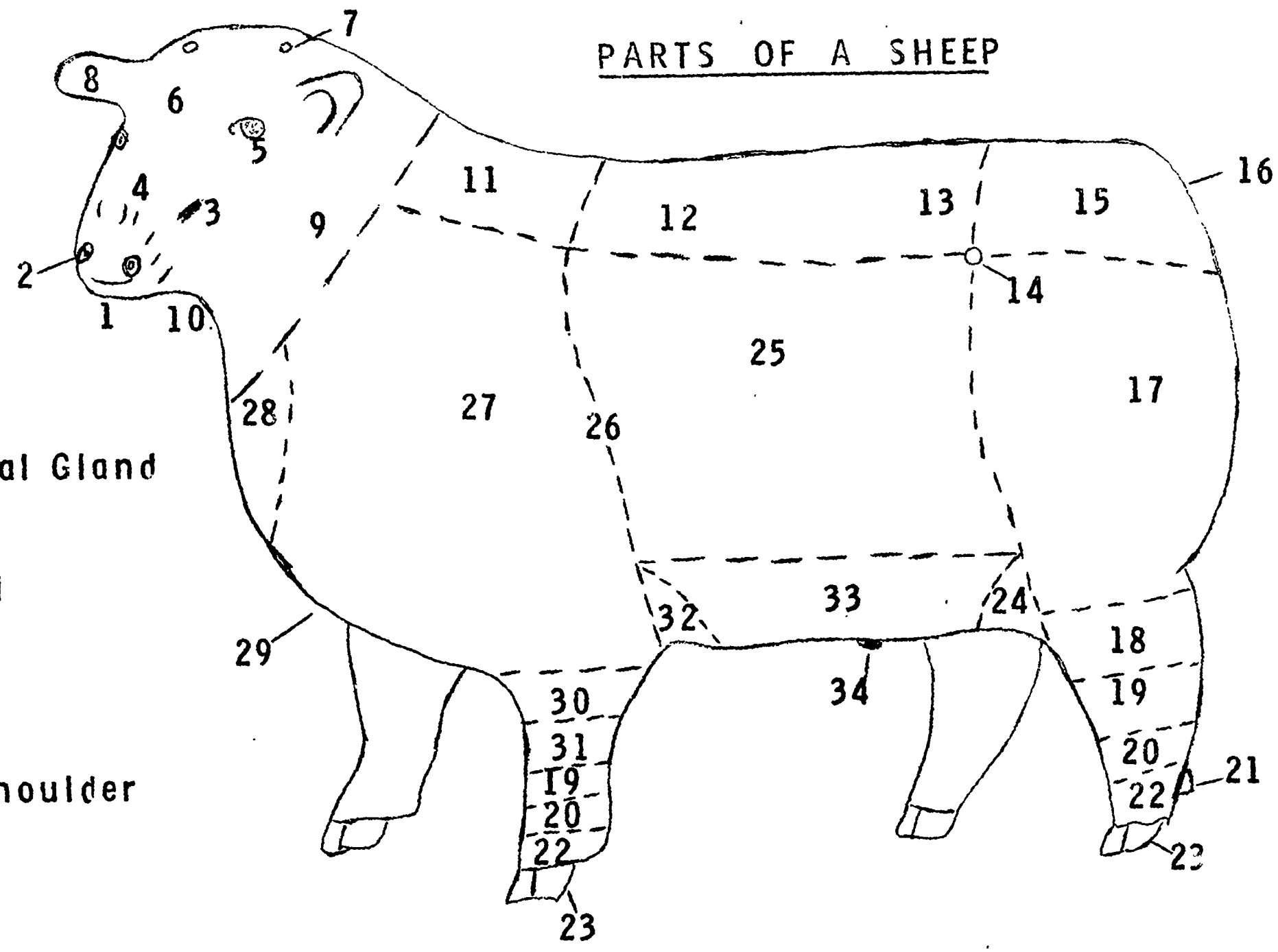
LAMB CUTS CHART



BEEF CUTS CHART

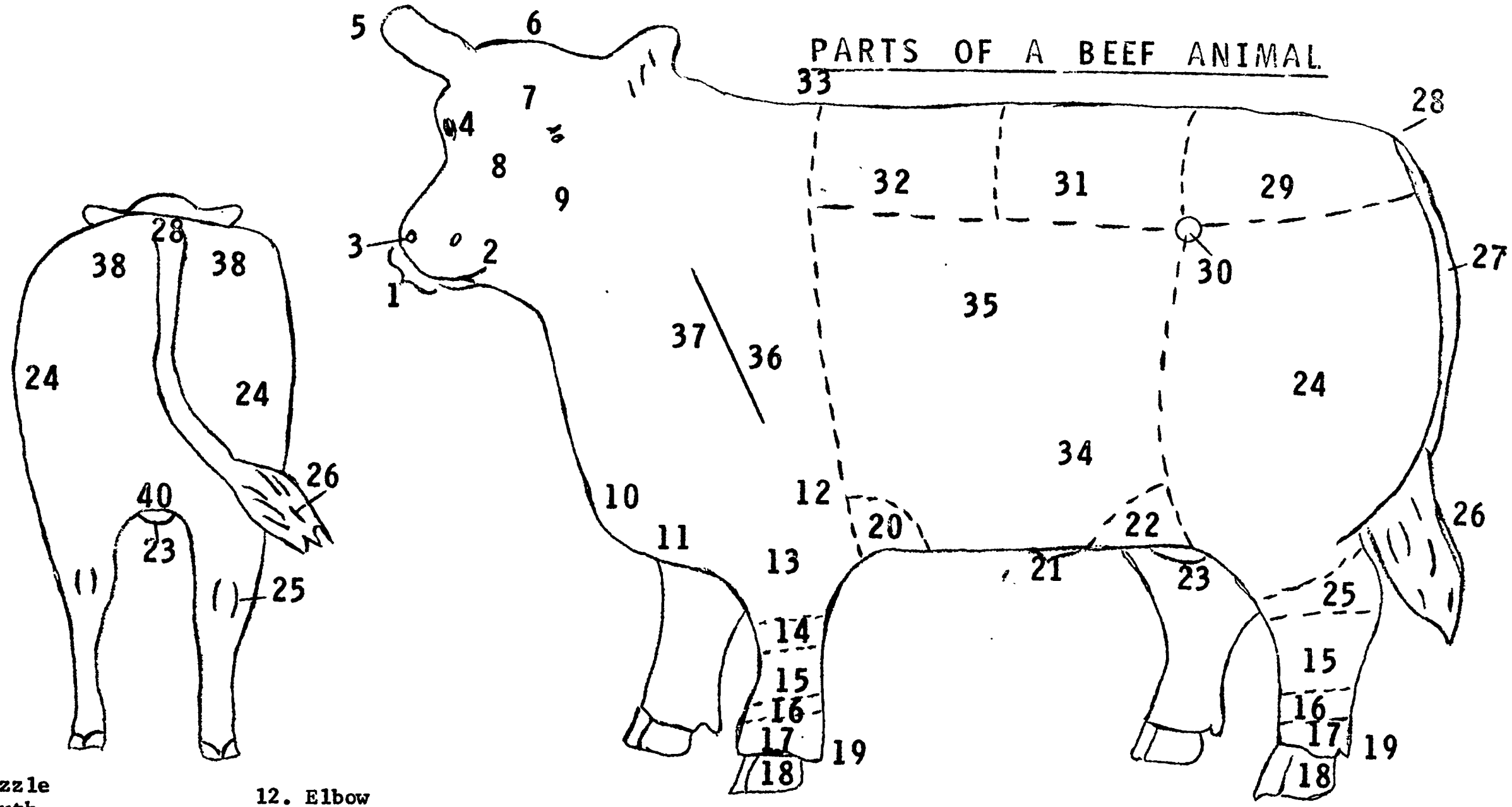


PARTS OF A SHEEP



1. Mouth
2. Nostril
3. Suborbital Gland
4. Face
5. Eye
6. Forehead
7. Horn Pit
8. Ear
9. Neck
10. Throat
11. Top of Shoulder
12. Back
13. Loin
14. Hip
15. Rump
16. Dock
17. Leg
18. Hock
19. Shank
20. Ankle
21. Dewclaw
22. Pastern
23. Toe
24. Hind Shank
25. Ribs
26. Heart Girth
27. Shoulder
28. Breast
29. Brisket
30. Forearm
31. Knee
32. Foreshank
33. Belly
34. Sheath

PARTS OF A BEEF ANIMAL



1. Muzzle
2. Mouth
3. Nostril
4. Eye
5. Ear
6. Poll
7. Forehead
8. Face
9. Jaw
10. Dew Lap
11. Brisket
12. Elbow
13. Forearm
14. Knee
15. Shank
16. Ankle
17. Pastern
18. Toe or Hoof
19. Dewclaw
20. Fore Flank
21. Sheath
22. Hind Shank
23. Cod
24. Round
25. Hock
26. Switch
27. Tail
28. Tail Head
29. Rump
30. Hook
31. Loin
32. Back
33. Top of Shoulders
34. Paunch or Belly
35. Ribs
36. Shoulder
37. Shoulder Vein
38. Pin Bones
39. Heart Girth
40. Twist

BREEDS OF HORSES

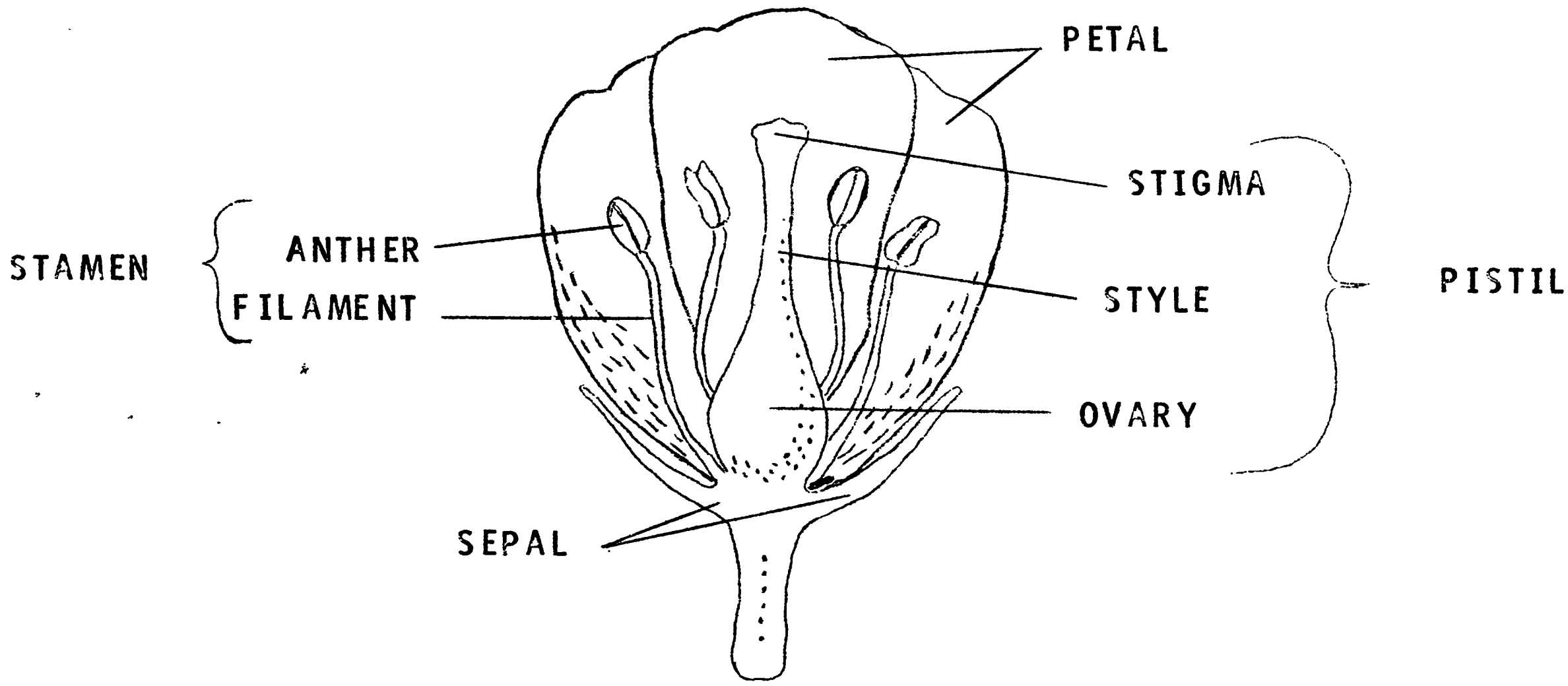
LIGHT HORSES

BREED	USE	ORIGIN	COLOR
AMERICAN SADDLE			
ARABIAN			
APPALOOSA			
MORGAN			
PALOMINO			
THOROUGHBRED			
TENNESSEE WALKING			
HACKNEY			

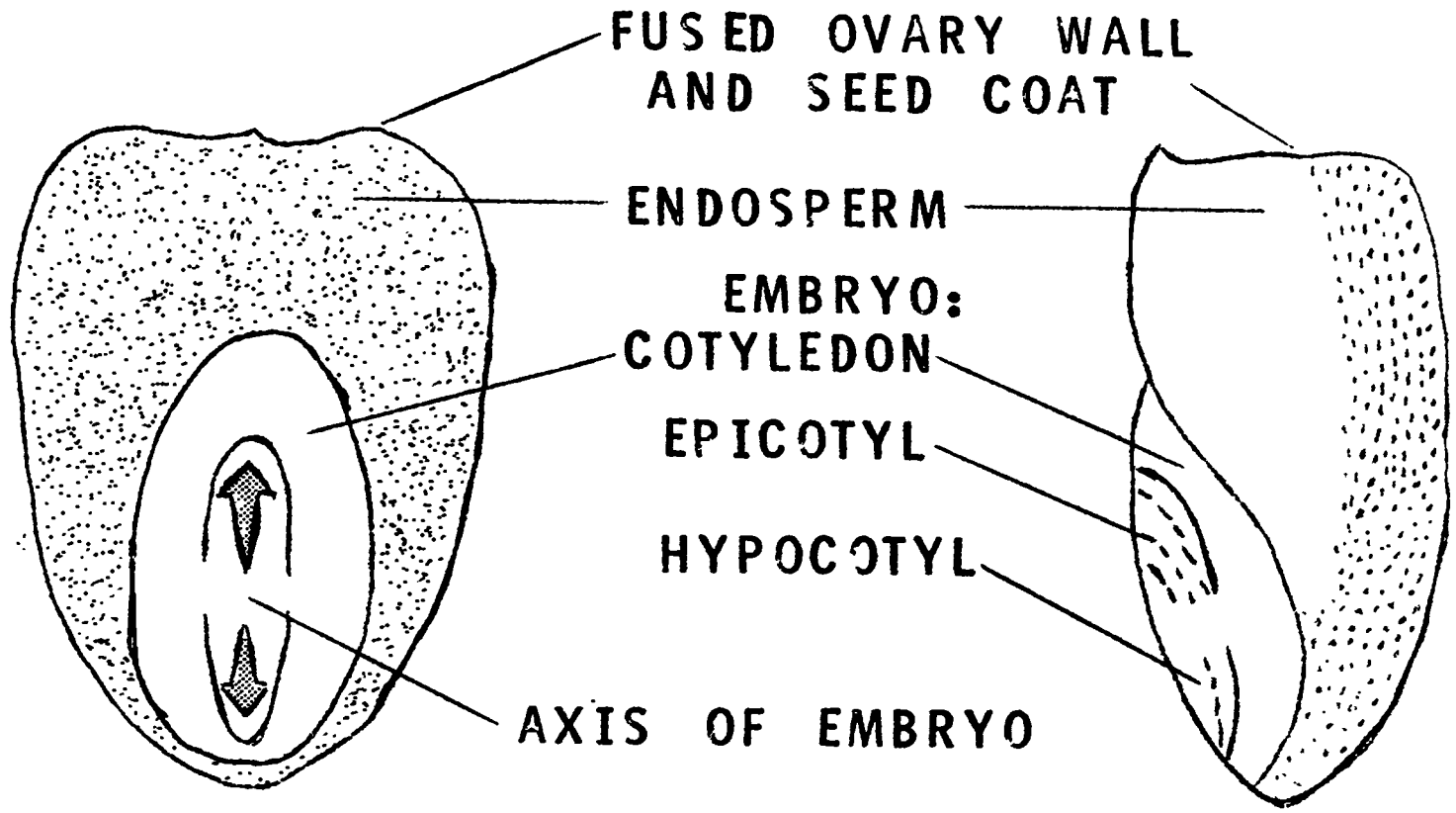
BREEDS OF HORSES - CONTINUED

BREED	USE	ORIGIN	COLOR
LIGHT HORSES			
QUARTERHORSE			
SHETLAND			
WELCH			
DRAFT HORSES			
BELGIAN			
CLYDESDALE			
PERCHERON			
AMERICAN CREAM			
SHIRE			

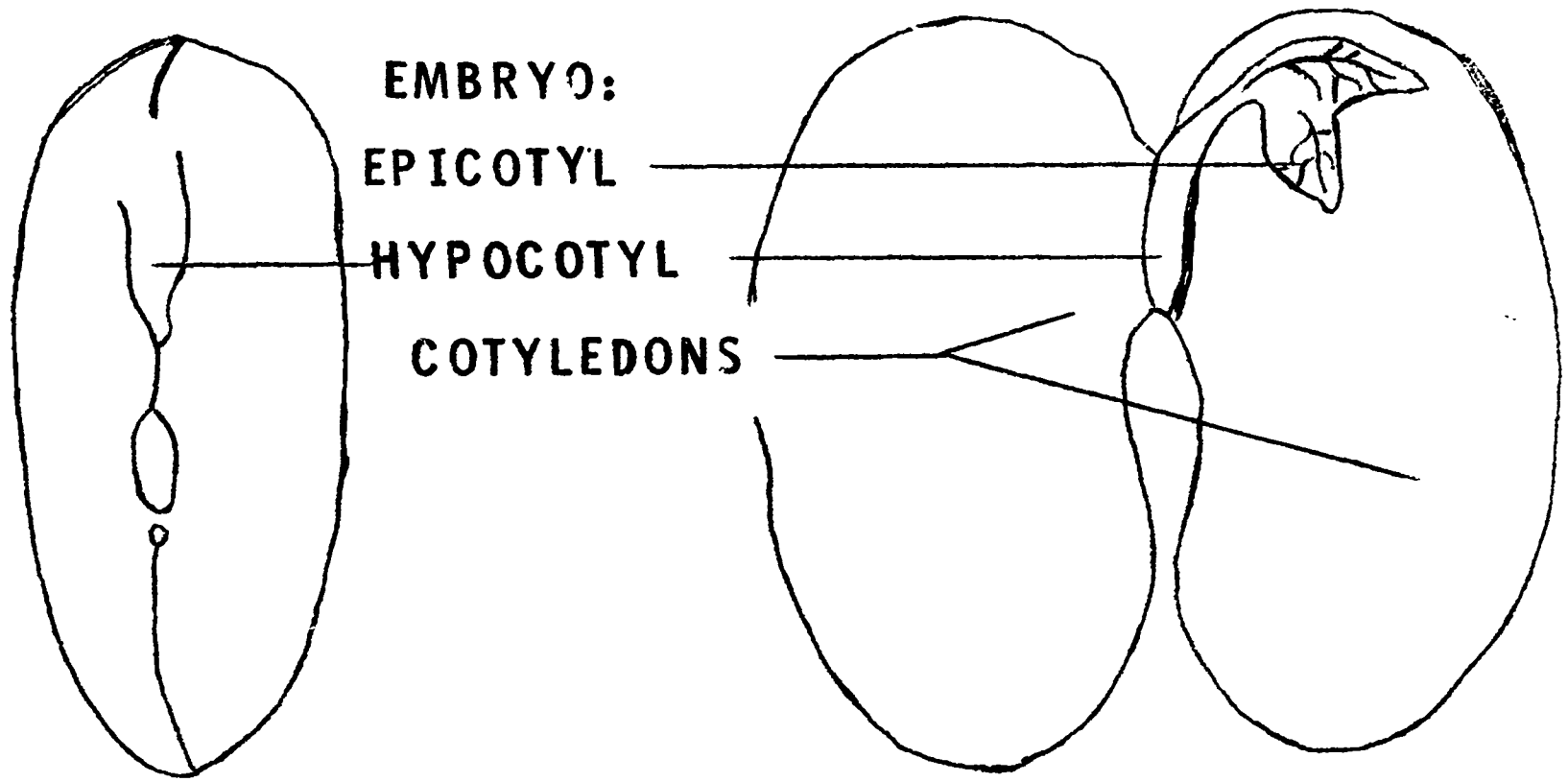
PARTS OF A COMPLETE FLOWER



A CORN GRAIN AND ITS PARTS



A BEAN SEED AND ITS PARTS



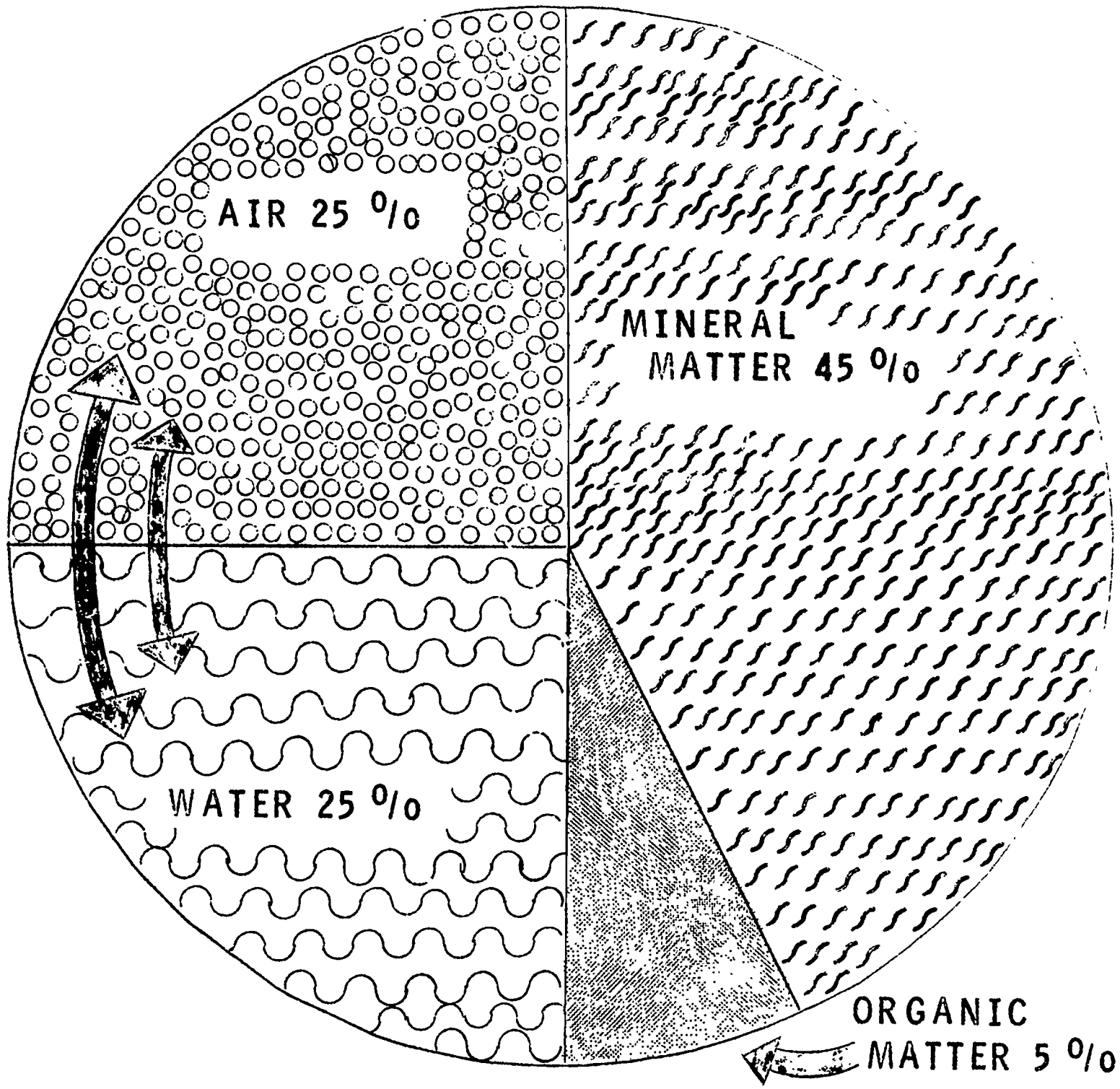
WAYS TO IDENTIFY SEEDS

1. Size
2. Shape
3. Color
4. Surface Markings
5. Botanical Characteristics

PESTS OF ALFALFA

HARMFUL	BENEFICIAL
Lygus Bugs	Bees
Stink Bugs	Ladybug
Spotted Alfalfa Aphid	Lacewing
Pea Aphid	Syrphus Flies
Three-Cornered Alfalfa Hopper	Damsel Bugs
Alfalfa Caterpillar	Big-Eyed Bug
Beet Webworm	Minute Pirate Bug
Beet Armyworm	Parasitic Wasp
Bollworm	
Cutworms	
Yellow-Striped Armyworm	
Grasshoppers	
Red Spiders	
Thrips	
Leafhoppers	
Alfalfa Weevil	

COMPOSITION OF AVERAGE SOIL



COTTON DISEASES

Seedling Disease

Fusarium Wilt

Verticillum Wilt

Nematodes

Bacterial Blight

Ascochyta Or Wet-Weather Blight

Boll Rots

Cotton Root Rot

Cotton Rust

Leaf Spots

COTTON DISEASES AND THEIR CONTROL

DISEASE	SYMPTOMS	CONTROL

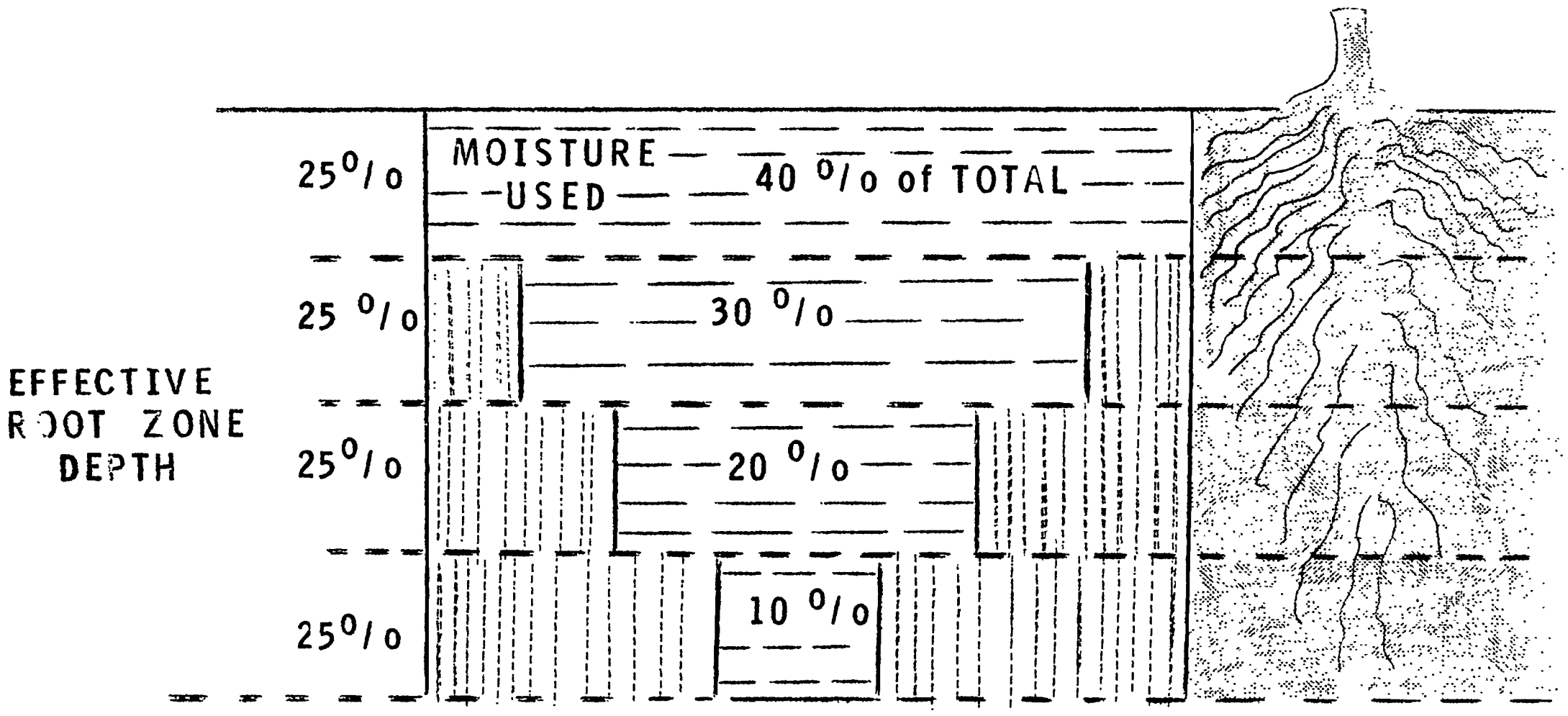
SEED ANALYSIS SCORECARD

CONTESTANT'S NO. _____ NAME OF SAMPLE _____ SCORE _____

ANALYSIS

ENTER HERE ONLY IF SAMPLE IS PURE, IF NOT PURE, TELL WHY IT IS NOT

MOISTURE USED AT DIFFERENT DEPTHS



U. S. GOVERNMENT LAND MEASURES

A Township = 36 Sections, Each a Mile Square.

A Section = 640Acres or One Square Mile.

A Quarter Section is a Half Mile Square and = 160 Acres.

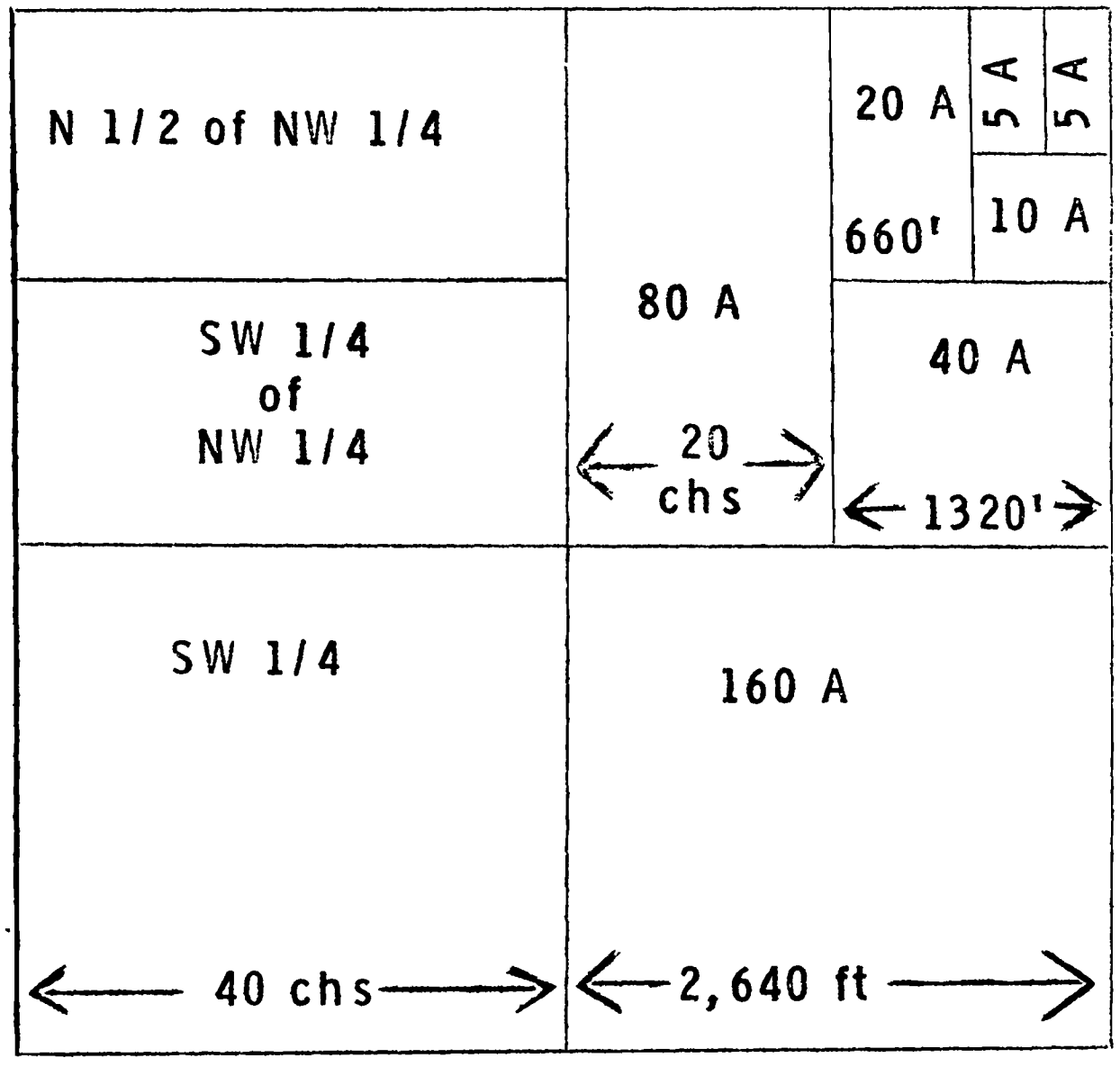
A Eighth Section is a Half Mile Long and a Quarter Mile Wide and = 80 Acres.

A Sixteenth Section is a Quarter Mile Square and = 40 Acres.

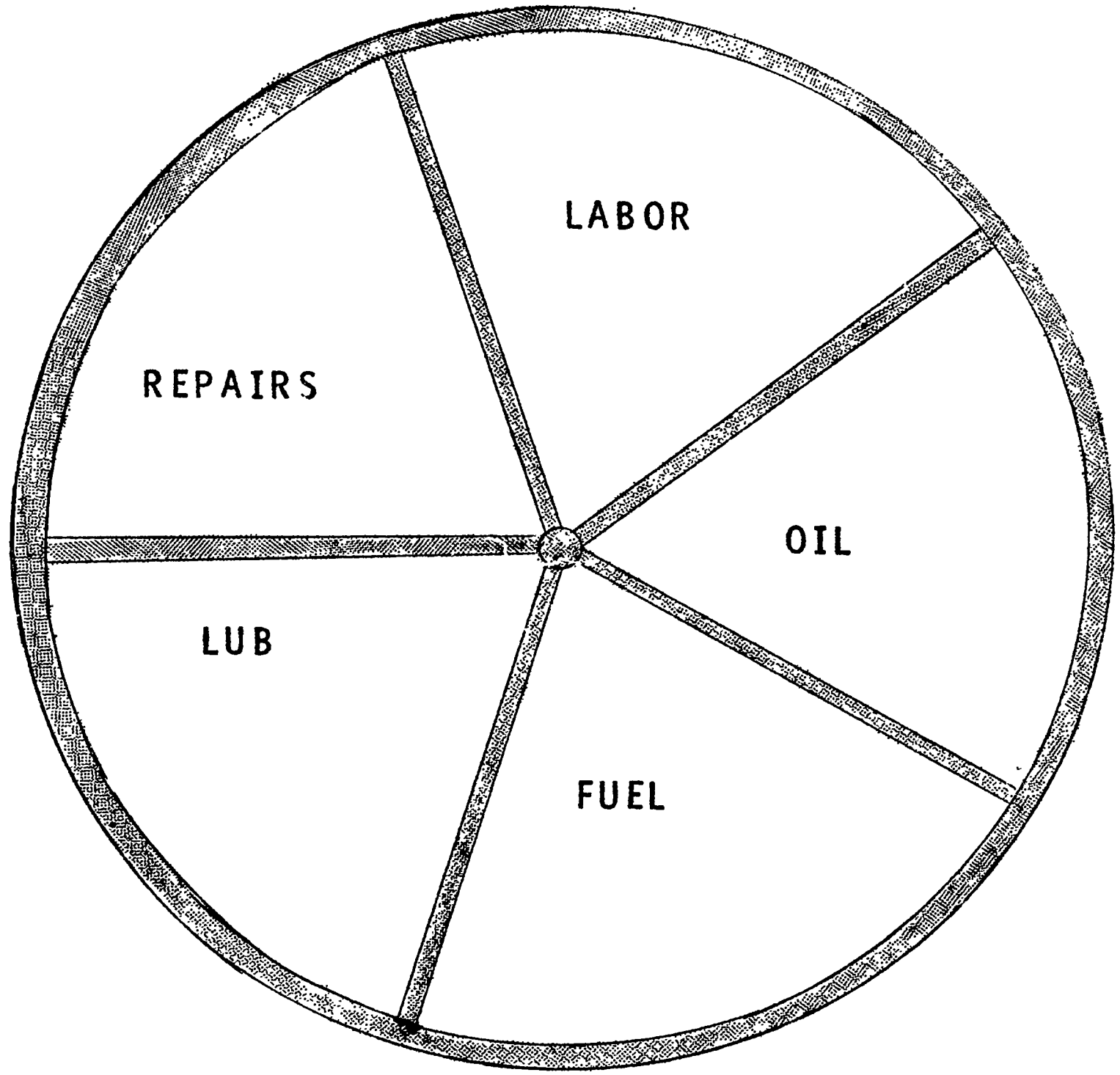
43,560 Square Feet = 1 Acre

160 Square Rods = 1 Acre

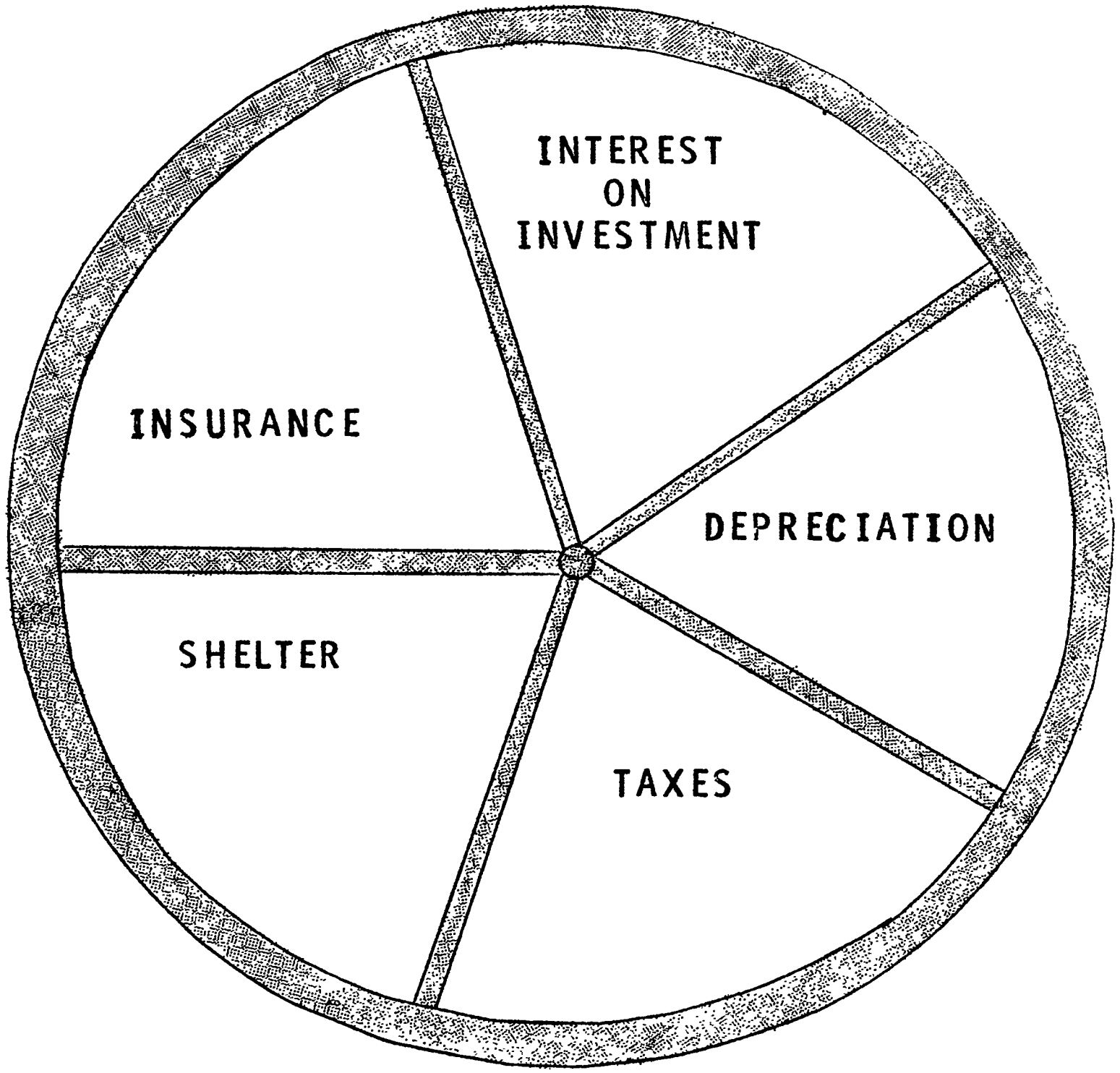
ACREAGE


N 1/2 of NW 1/4
20 A
5 A
5 A
660'
10 A
80 A
SW 1/4
of
NW 1/4
20
chs
40 A
1320'
SW 1/4
160 A
40 chs
2,640 ft

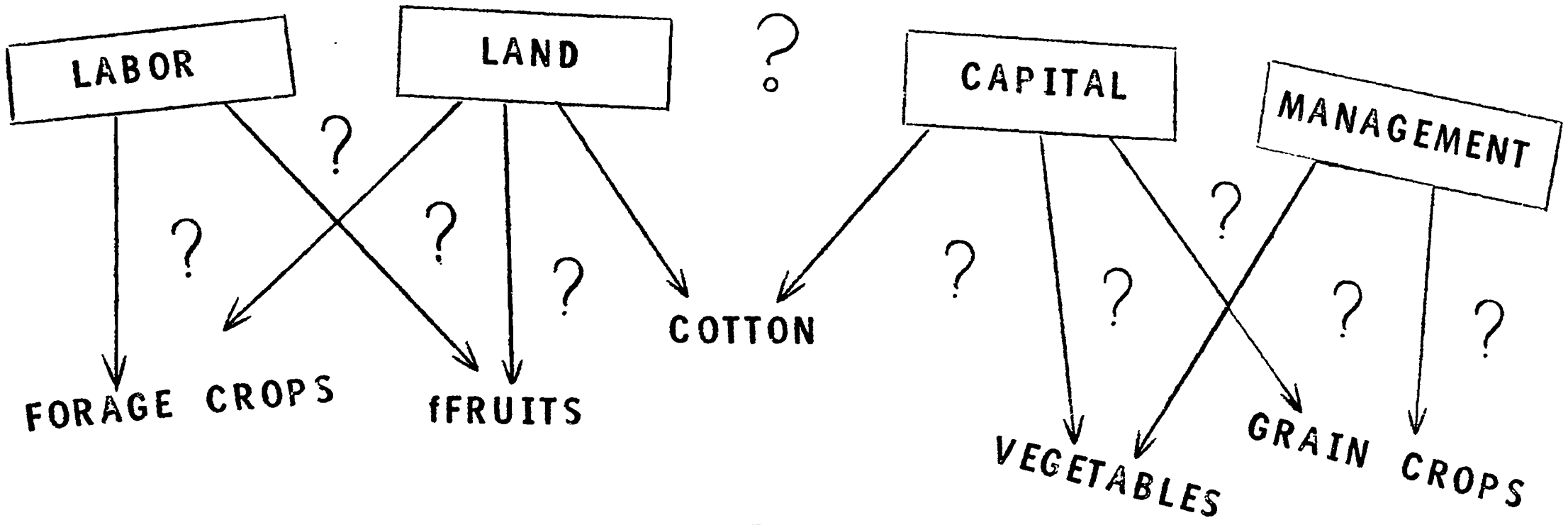
VARIABLE COSTS



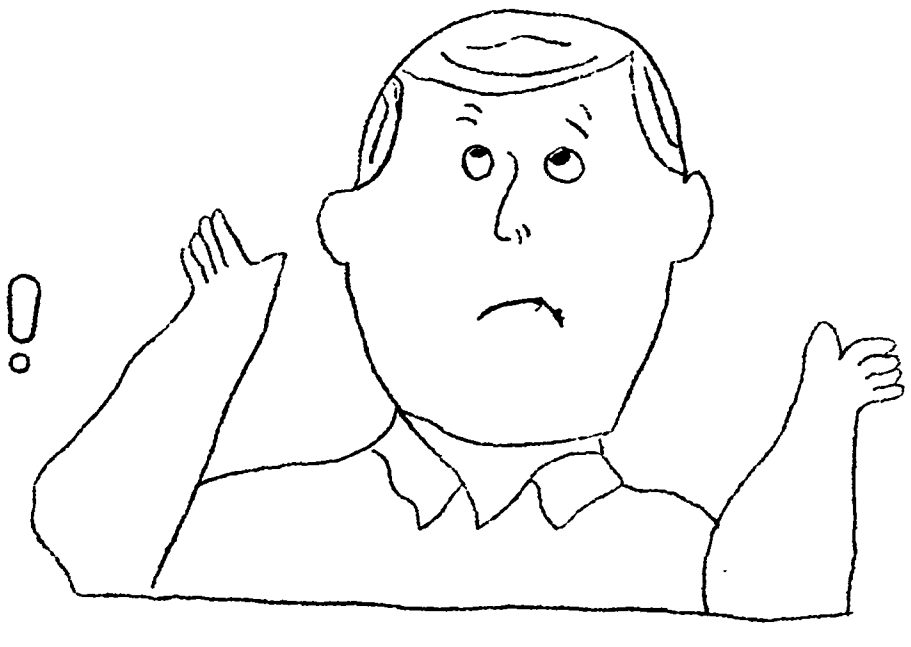
FIXED COSTS


INTEREST
ON
INVESTMENT
INSURANCE
DEPRECIATION
SHELTER
TAXES

ENTERPRISE SELECTION



WHAT!



WHY!

DETERMINING ACREAGE

$$\text{NO. OF ACRES} = \frac{\text{AREA IN SQ. FEET}}{43,560}$$

$$\text{NO. OF ACRES} = \frac{\text{AREA IN SQ. YARDS}}{4,840}$$

$$\text{NO. OF ACRES} = \frac{\text{AREA IN SQ. RODS}}{160}$$

$$\text{NO. OF ACRES} = \frac{\text{AREA IN SQ. CHAINS}}{10}$$

$$\text{NO. OF ACRES} = \text{AREA IN SQ. MILES} \times 640$$

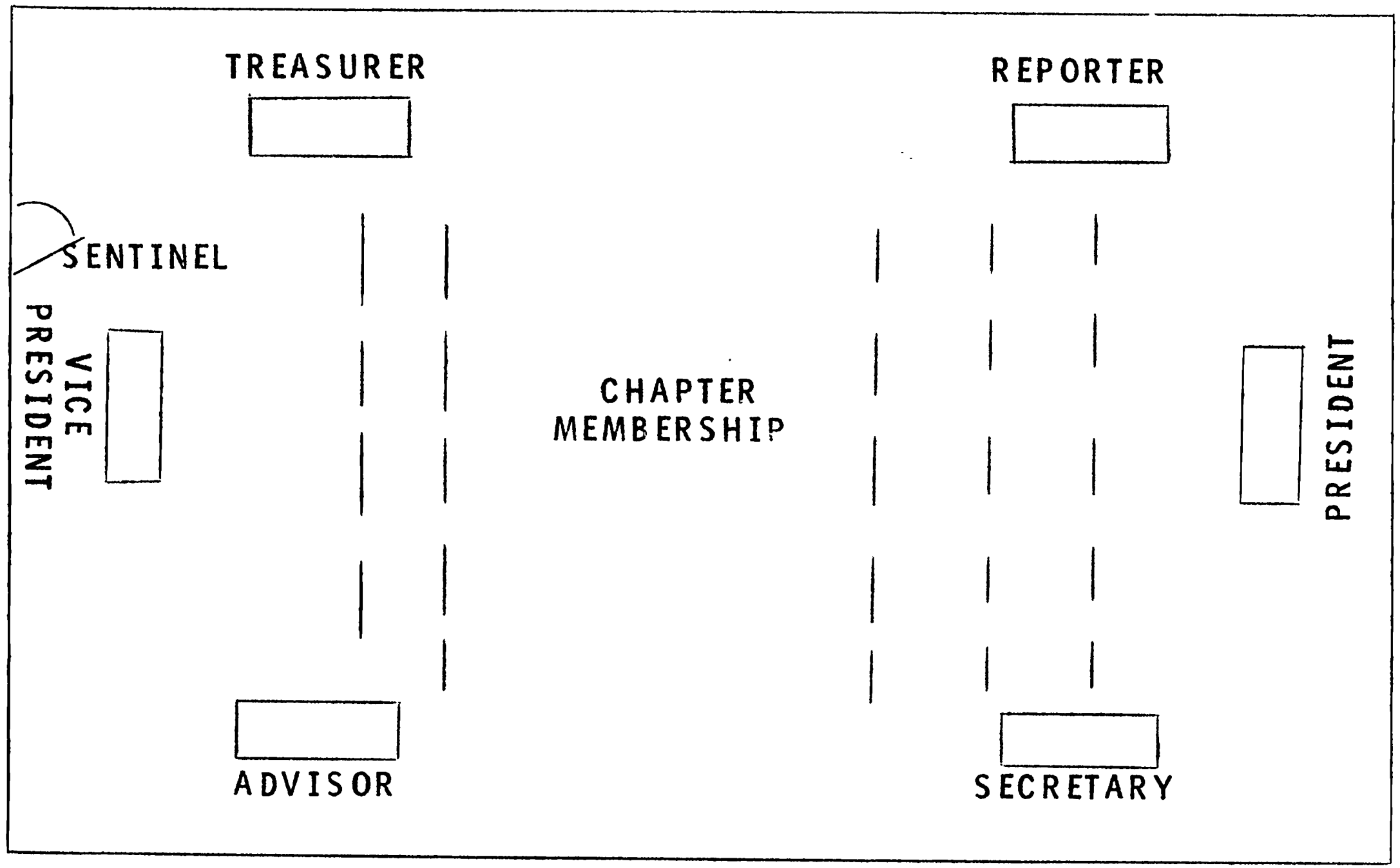
SECTIONAL MAP OF A TOWNSHIP WITH ADJOINING SECTIONS

1	6	5	4	3	2	1	6
12	7	8	9	10	11	12	7
13	18	17	16	15	14	13	18
24	19	20	21	22	23	24	19
25	30	29	28	27	26	25	30
36	31	32	33	34	35	36	31
1	6	5	4	3	2	1	6

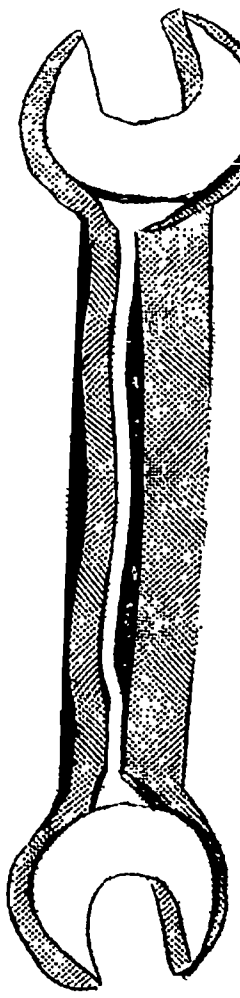
ACTIVE FFA MEMBERSHIP REQUIREMENTS

DEGREE	MINIMUM QUALIFICATIONS FOR ELECTION
Greenhand	1. Be enrolled in Vo-Ag class. 2. Recite the FFA Creed. 3. Familiar with FFA aims and purposes. 4. Receive a majority vote.
Chapter Farmer	1. Completed one year of Vo-Ag instruction. 2. Lead 15 minute group discussion. 3. Earned or invested $50.00.
State Farmer	1. Completed two years of Vo-Ag instruction. 2. Lead a group discussion for 40 minutes. 3. Earned or invested $500.00.
American Farmer	1. Must have the State Farmer Degree. 2. Completed 3 years of Vo-Ag instruction. 3. 36 months of active membership. 4. Earned or invested $1,000.00. 5. Show outstanding leadership ability. 6. Satisfactory scholarship record. 7. Have been out of high school for 12 months.

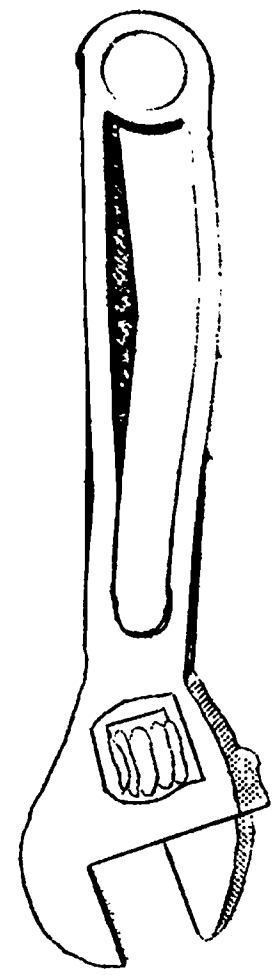
FFA
MEETING ROOM ARRANGEMENT



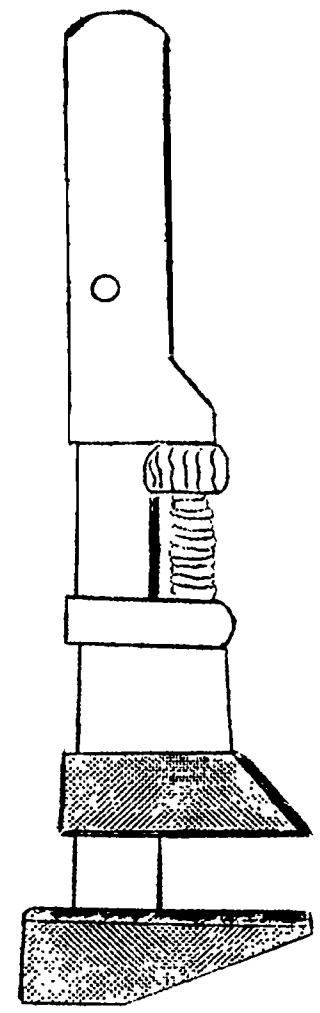
TYPES OF WRENCHES



OPEN-END

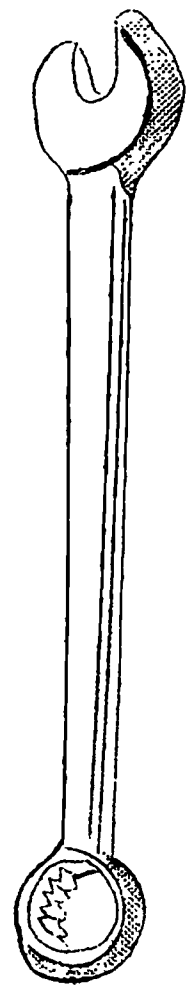


ADJUSTABLE

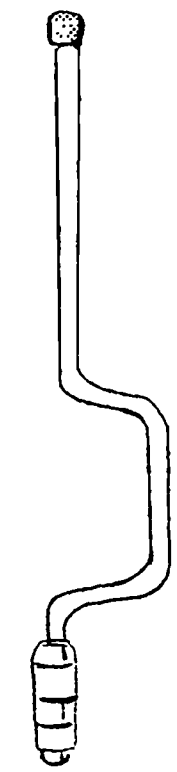


MONKEY

BOX-END

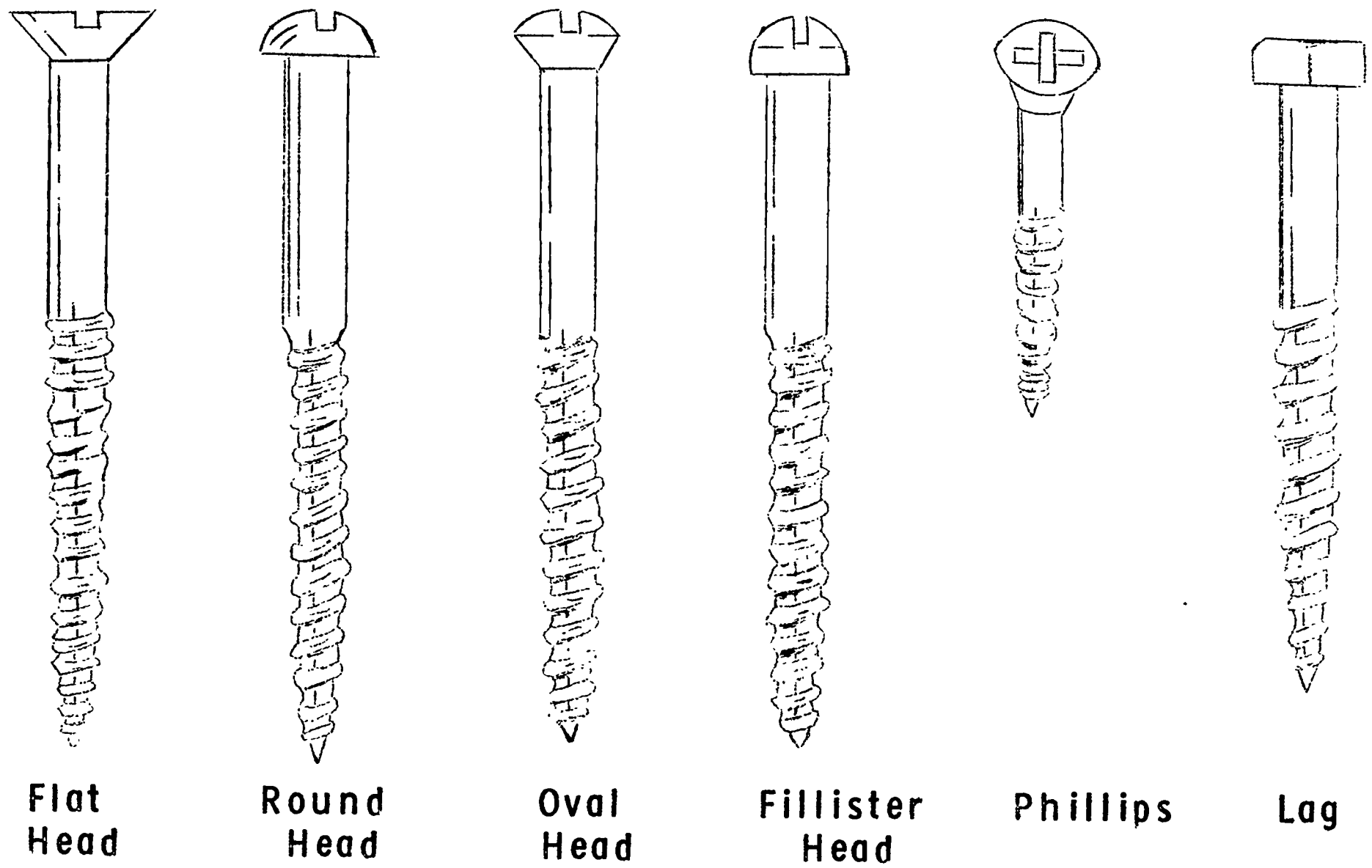


BOX
AND
OPEN-END

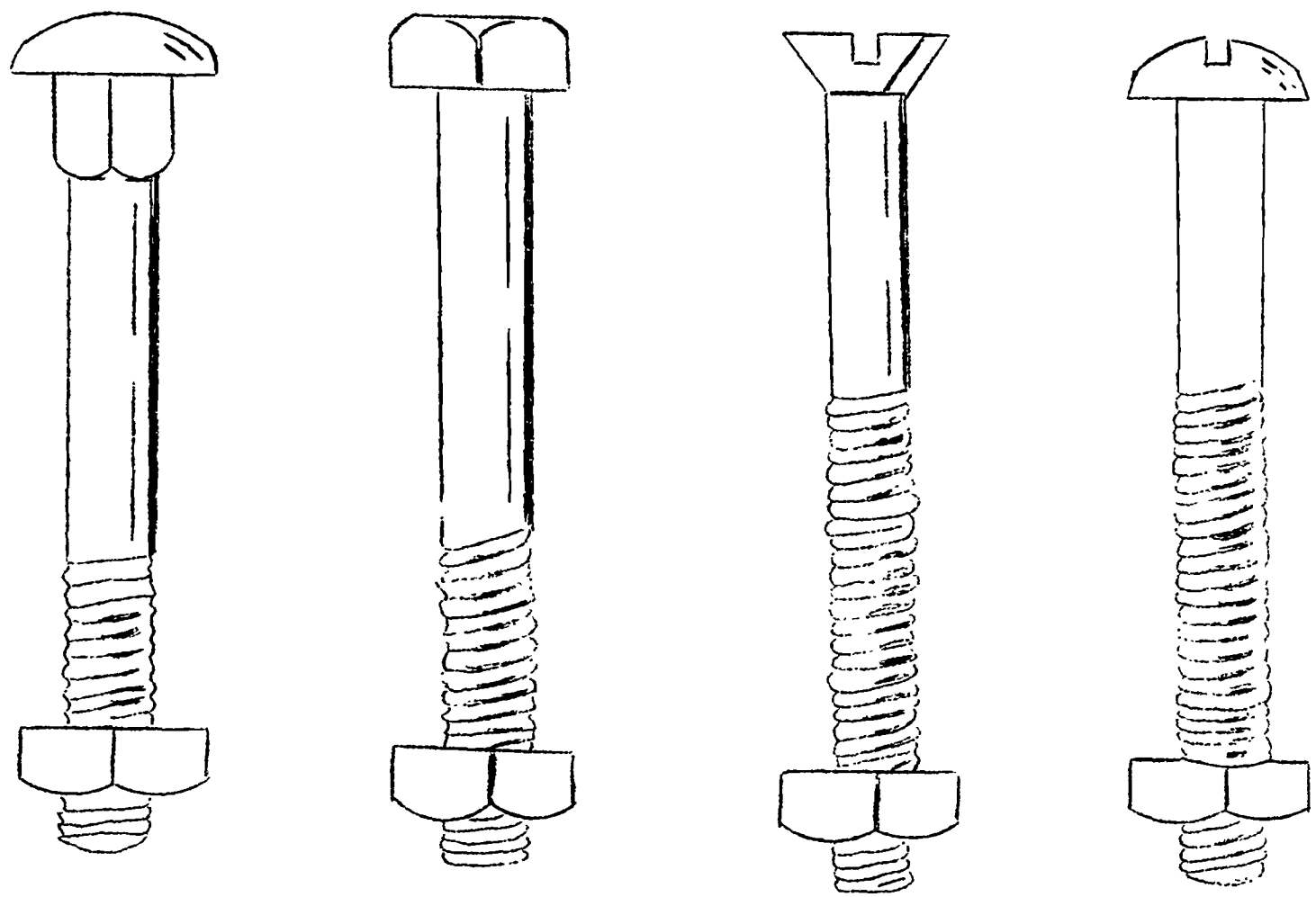


SPEED HANDLE
SOCKET
WRENCH

IDENTIFICATION OF SCREWS

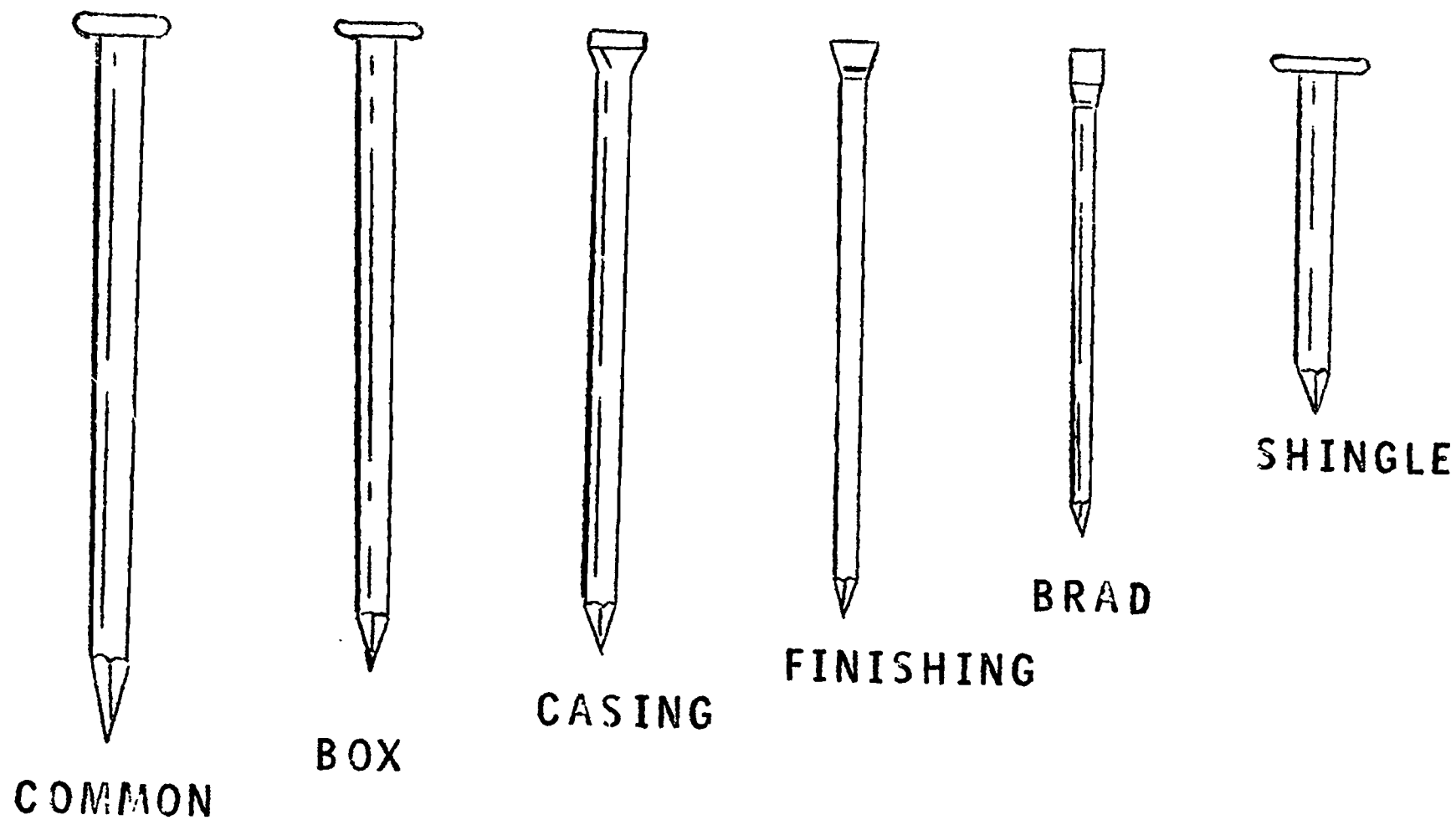


BOLT IDENTIFICATION

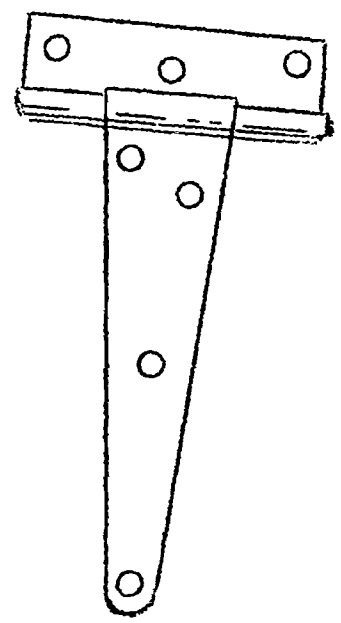


Carriage | Machine | Flat Head Stove | Round Head Stove

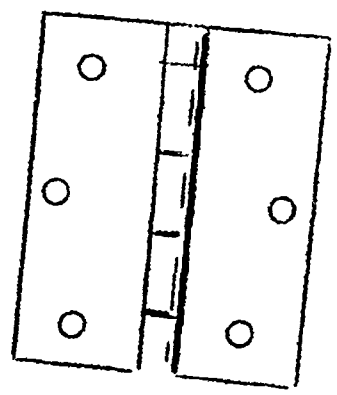
NAIL IDENTIFICATION



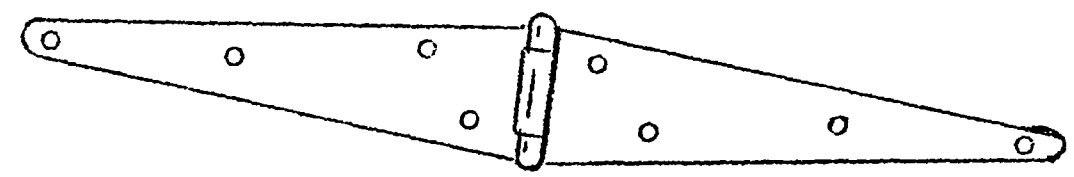
TYPES OF HINGES



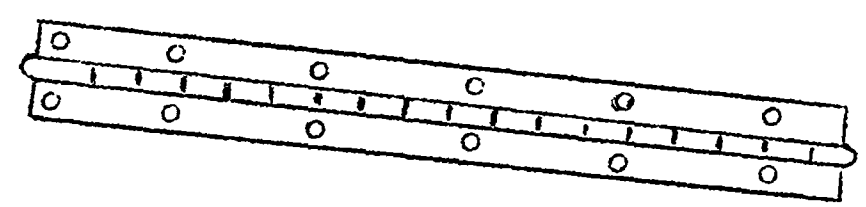
"T"
HINGE



BUTT
HINGE

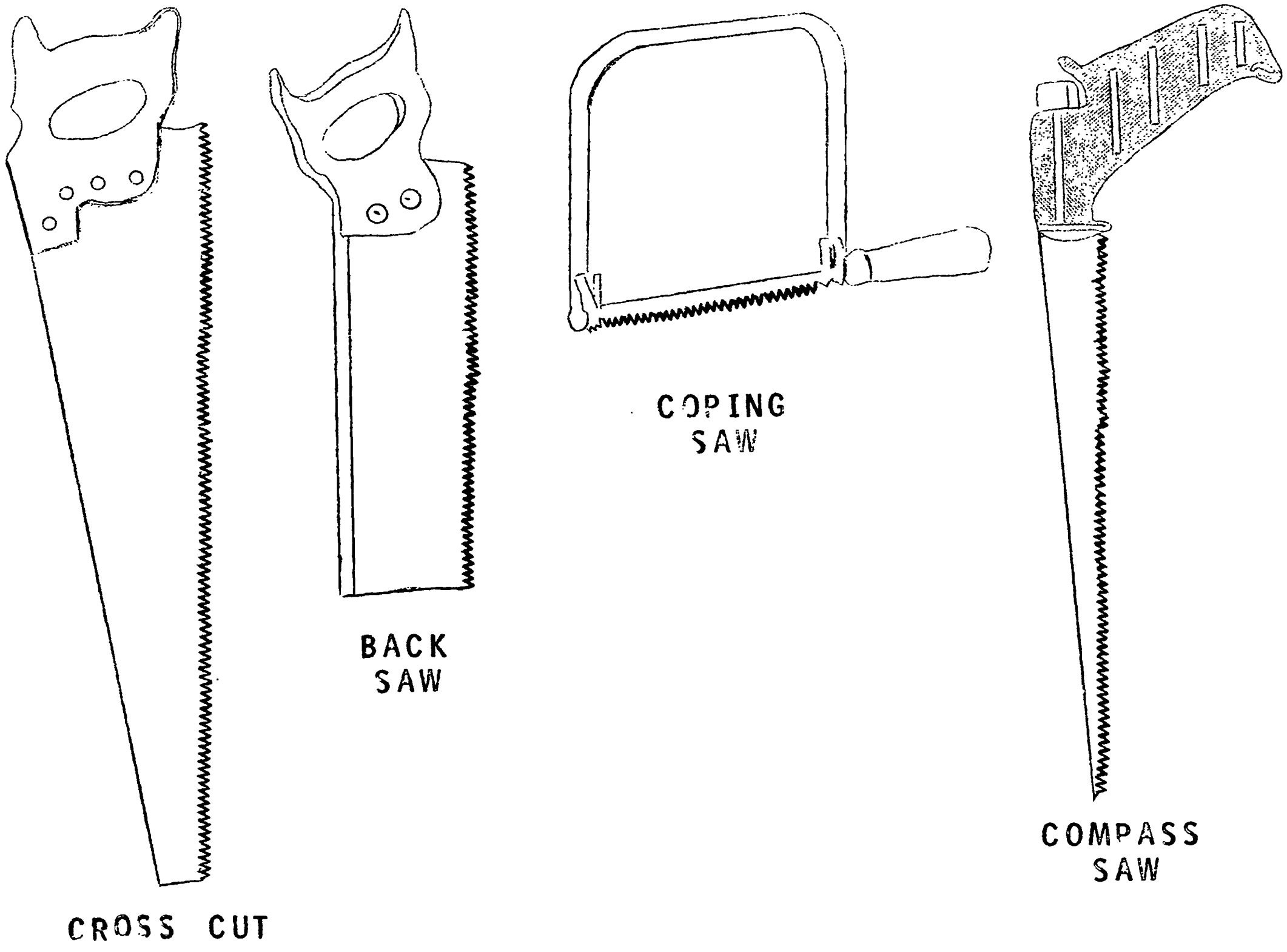


STRAP
HINGE



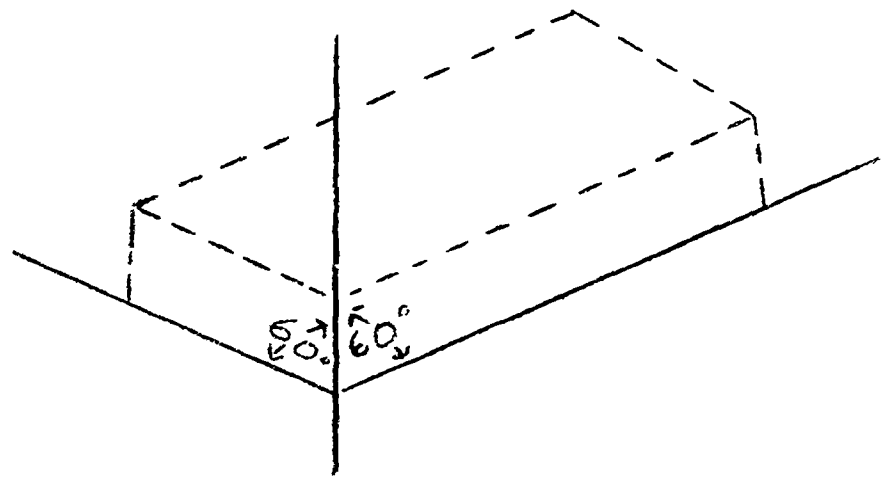
PIANO

KINDS OF SAWS

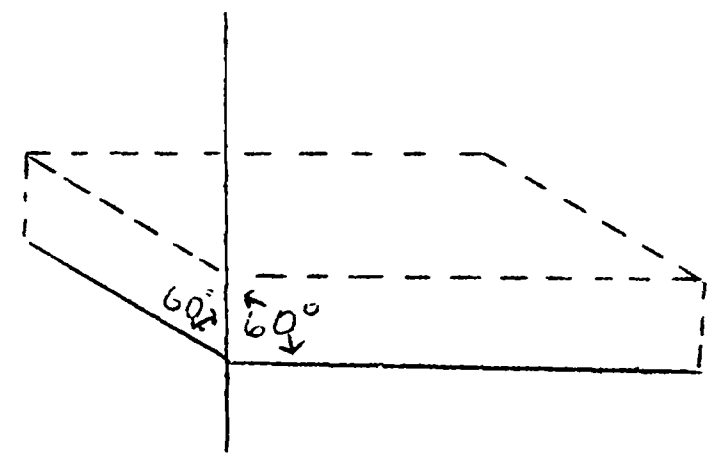


FARM LEVEL RECORDINGS

STATION	BACK SIGHT	HEIGHT OF INSTRUMENT	FORE SIGHT	ELEVATION
BM				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				



ISOMETRIC PROJECTION



OBLIQUE PROJECTION

SCHOOL _____	TITLE _____	DATE _____
CLASS _____	DRAWN BY _____	SCALE _____

SCHOOL _____	TITLE _____	DATE _____
CLASS _____	DRAWN BY _____	SCALE _____

COMMON PIPE FITTINGS

Pipe Elbow

Pipe 45° Elbow

Pipe Tee

Pipe Y Bend

Pipe Cross

Pipe Reducer

Pipe Shoulder Bushing

Pipe Coupling

Pipe Cap

Pipe Lock Nut

Square Head Plug

Countersunk Plug

Pipe Close Nipple

Pipe Shoulder Nipple

Pipe Union

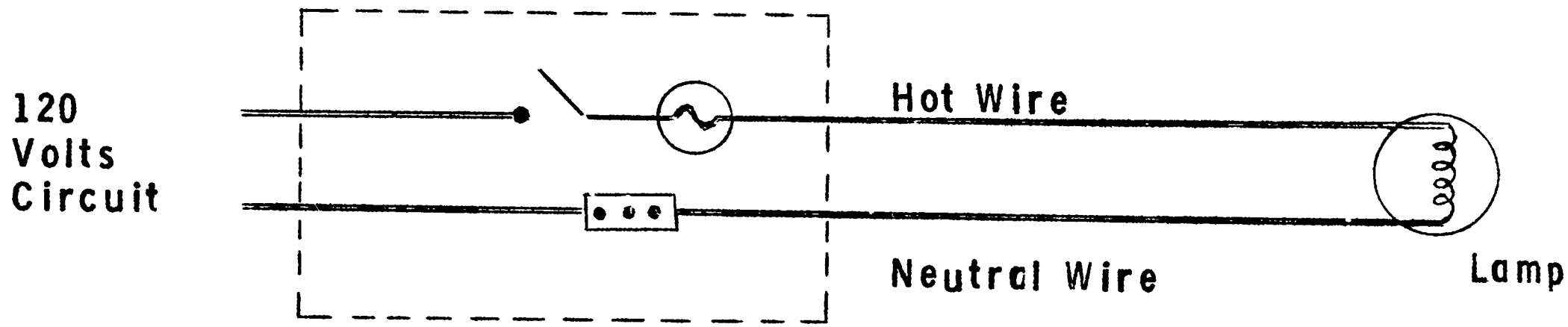
APPROXIMATE NUMBER OF NAILS PER POUND

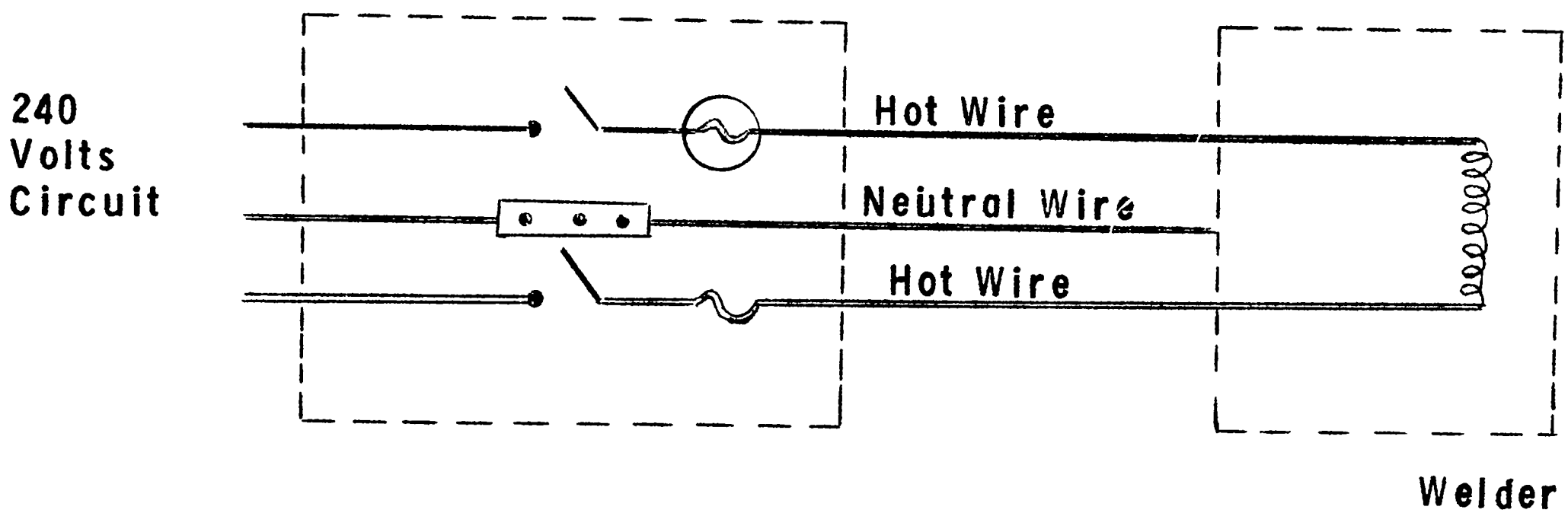
	Common Nails
6d	180
8d	105
10d	70
12d	65
16d	50
20d	30

CHARACTERISTICS OF ELECTRIC MOTORS

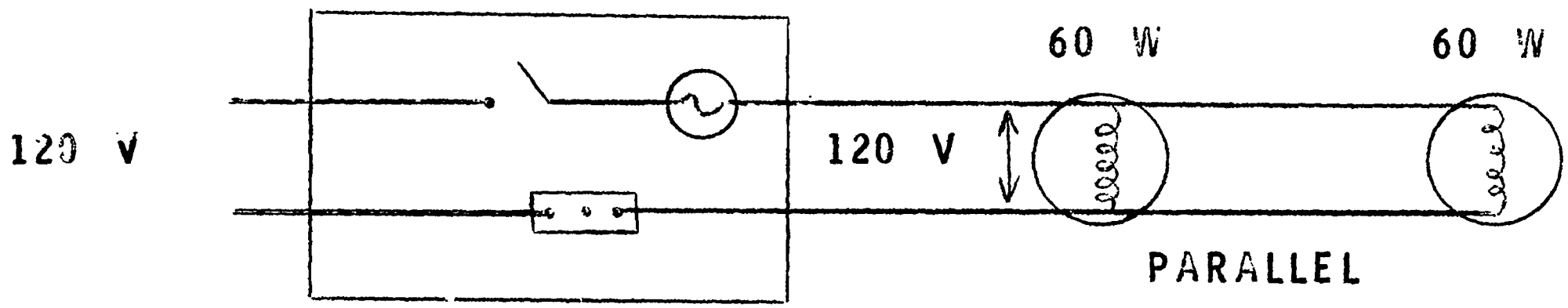
	SPIT PHASE	CAPACITOR START	REPULSION START
Starting Ability	Easy Starting Loads	Hard Starting Loads	Very Hard Starting Loads
Starting Current	High	Medium	Low
Size (HP)	1/20 to 1/3	1/6 to 5 HP	1/6 to 10 HP
Speed	Constant	Constant	Constant
Starting Device	Starting Winding	Starting Winding and Capacitor	Brushes and Wound Rotor
Characteristics	Inexpensive, Simple Constructive, small for given motor power, nearly constant speed with varying load	Simple Construction, good general purpose, motor nearly constant, speed with varying load	Large -- Requires more maintenance because of brush wear
Application	Emery Wheels Bench Saws Grind Stones	Air Compressors Refrigerators Milking Machine Feed Mixers Augar Conveyor	Deep Well cylinder pump, large grain Elevator, Hammer Mill, Silo Unloader

120/240 VOLT CIRCUITS

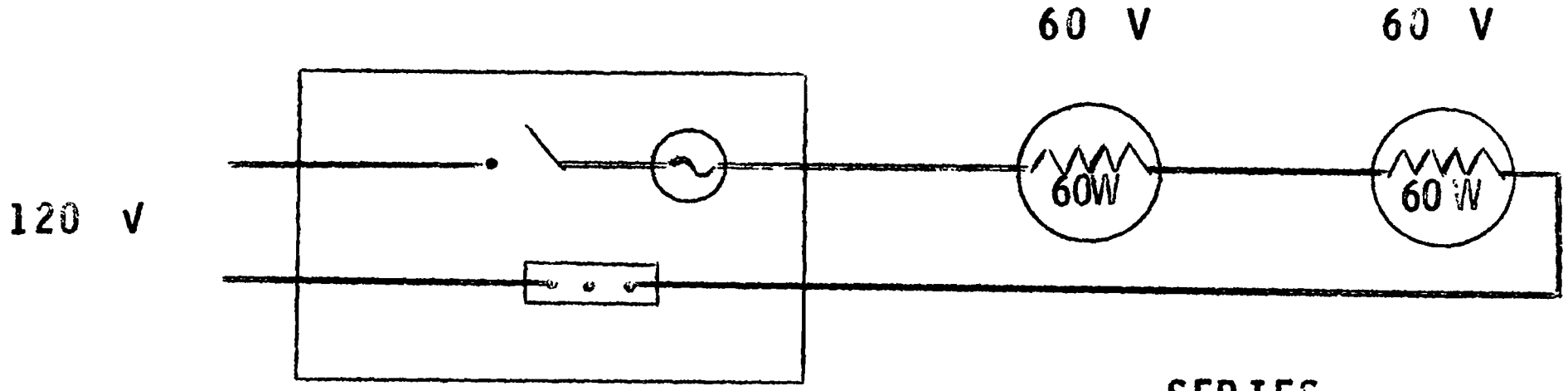




SERIES AND PARALLEL CIRCUITS

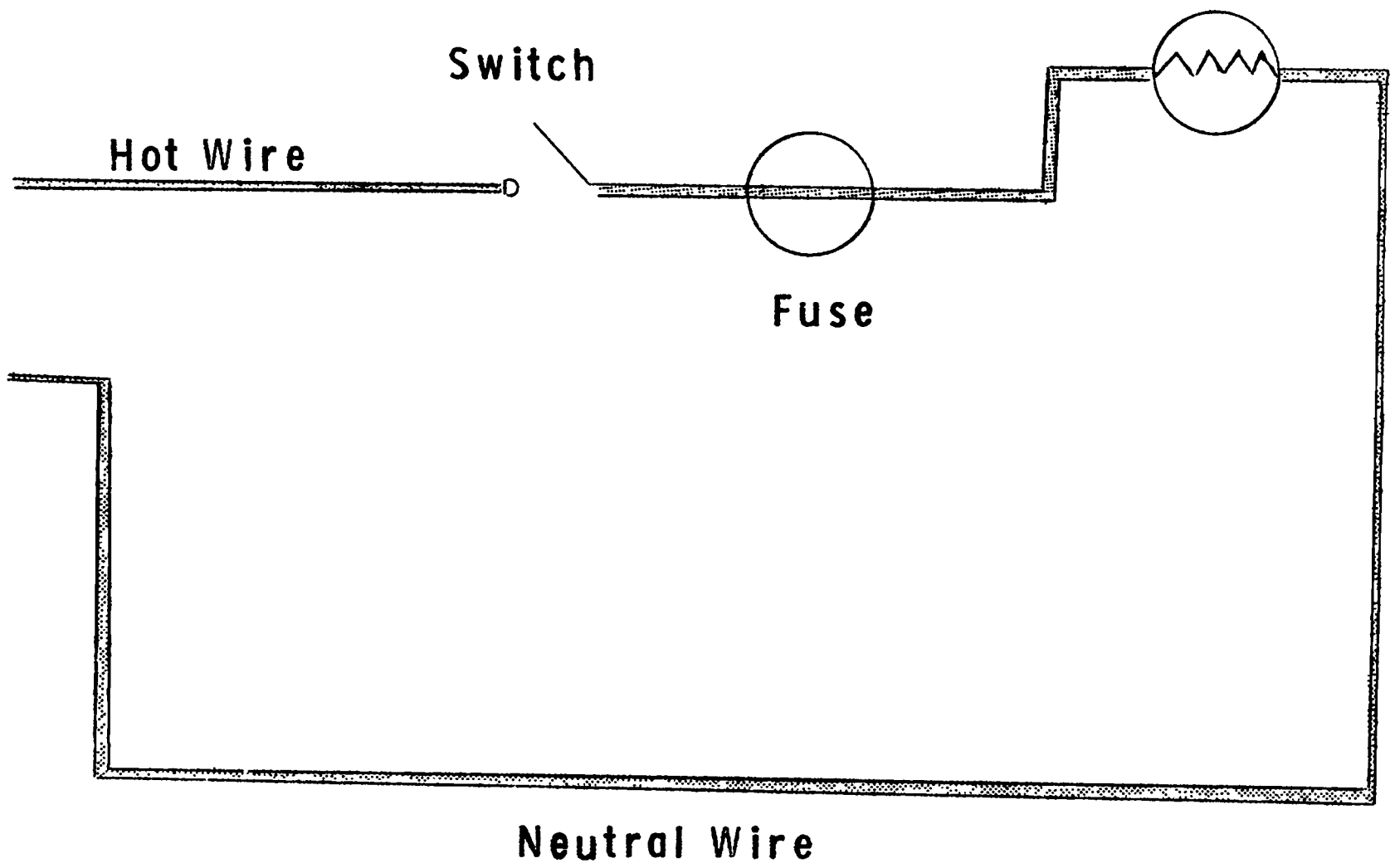


PARALLEL

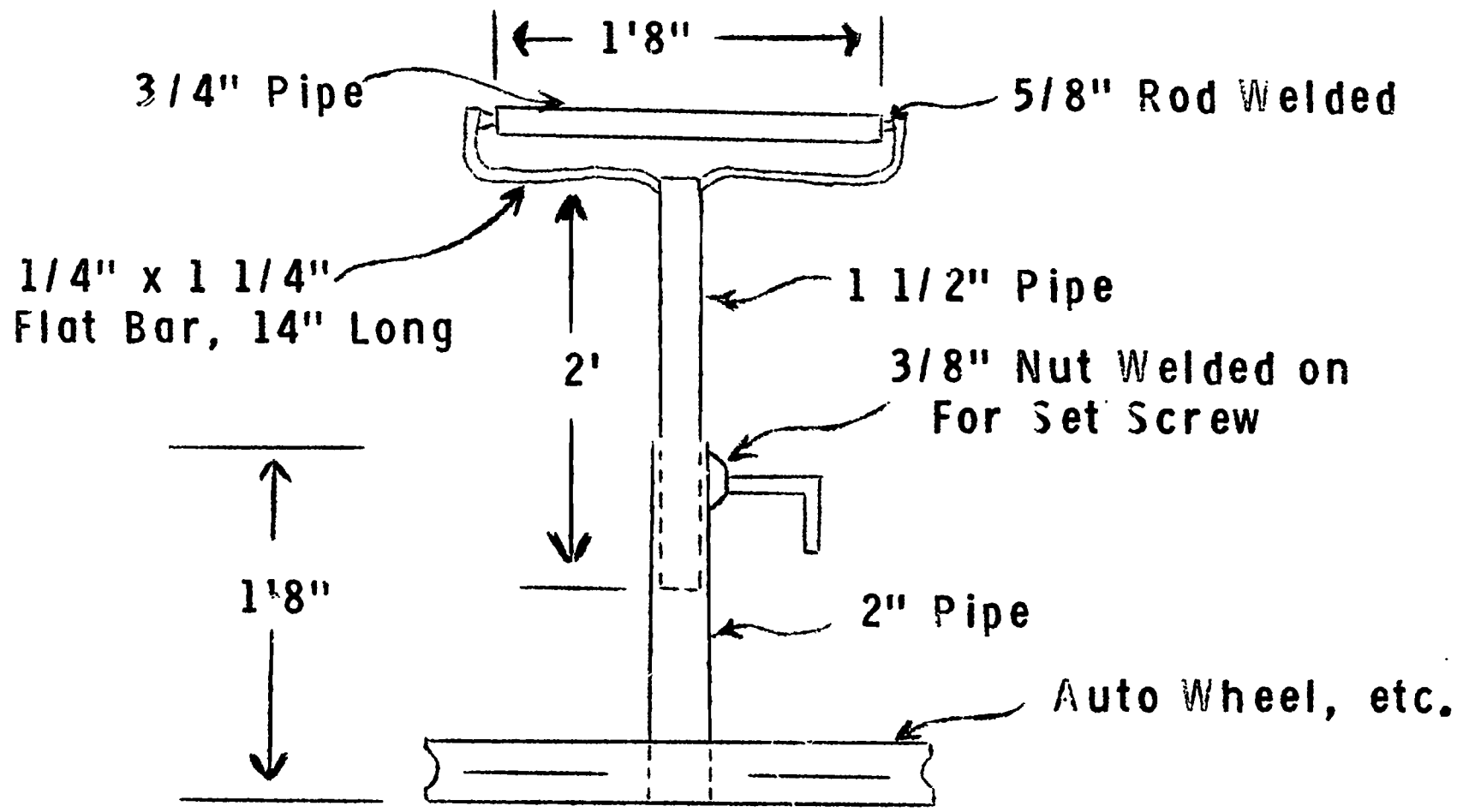


SERIES

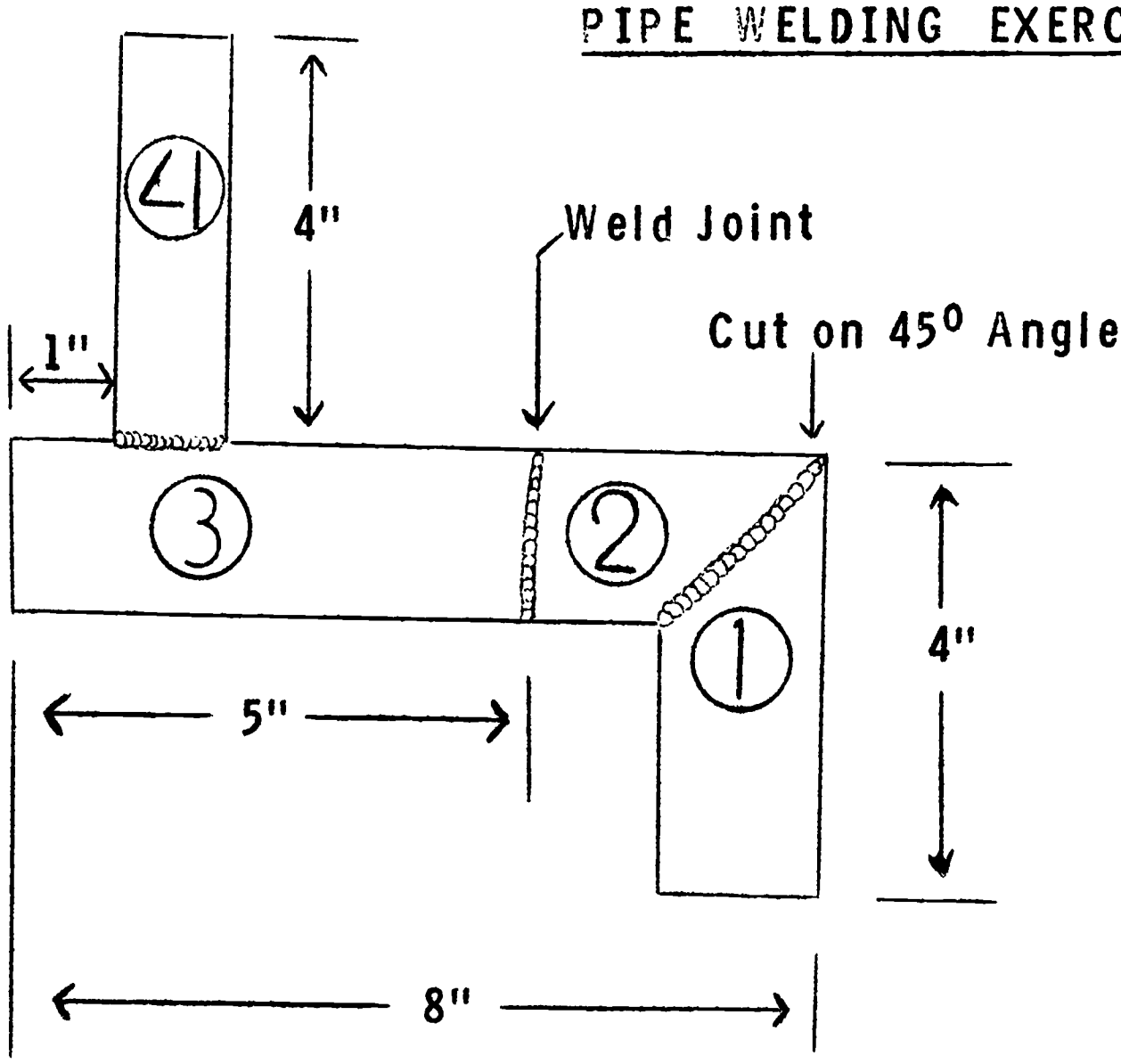
SIMPLE ELECTRIC CIRCUIT



A SAW ROLLER


1'8"
3/4" Pipe
5/8" Rod Welded
1/4" x 1 1/4"
Flat Bar, 14" Long
1 1/2" Pipe
2'
3/8" Nut Welded on
For Set Screw
1'8"
2" Pipe
Auto Wheel, etc.

PIPE WELDING EXERCISE



BILL OF MATERIALS

1 pc Pipe 16" Long _____ Diameter

PROCEDURE:

1. Cut pc No. 1 ----- 4" Long
2. Cut pcs No. 2 and 3 (Total 8" Long)
3. Cut pc No. 4 and Flatten
4. Weld pcs 2 and 3 Together
   _____ Amp Welder
5. Weld pcs 1 and 4 into Position
6. Clean and Hand in

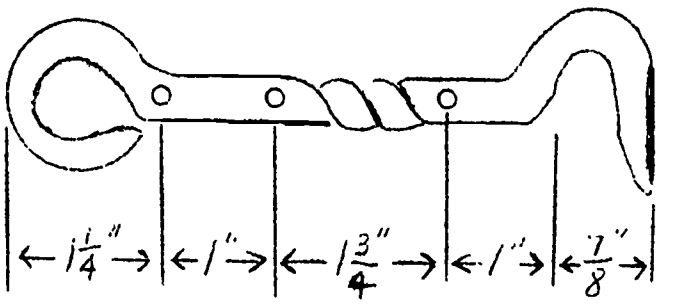
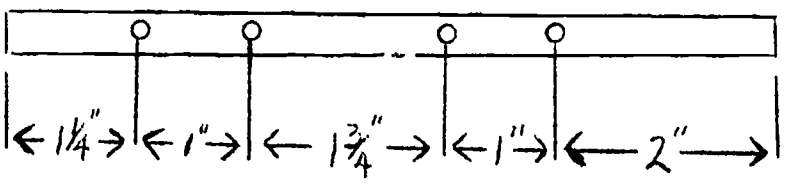


Fig. 1



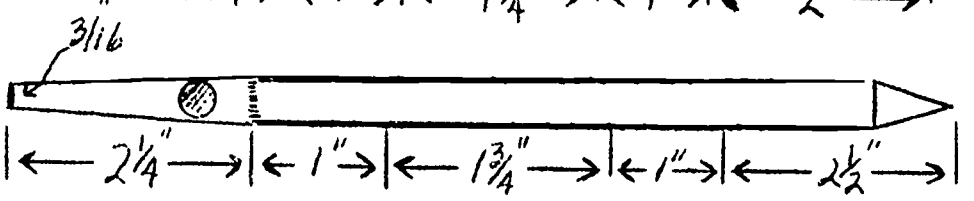


Fig. 2

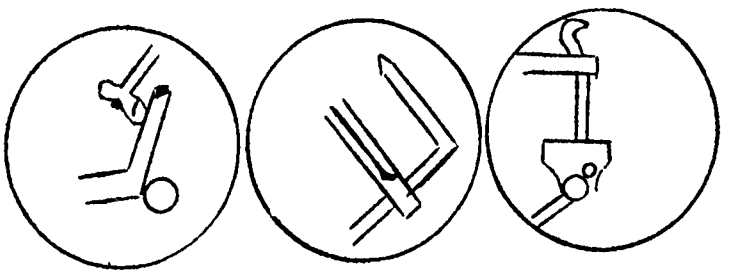


Fig. 3 Fig. 4 Fig. 5

THIS MAY BE DONE AS FOLLOWS:

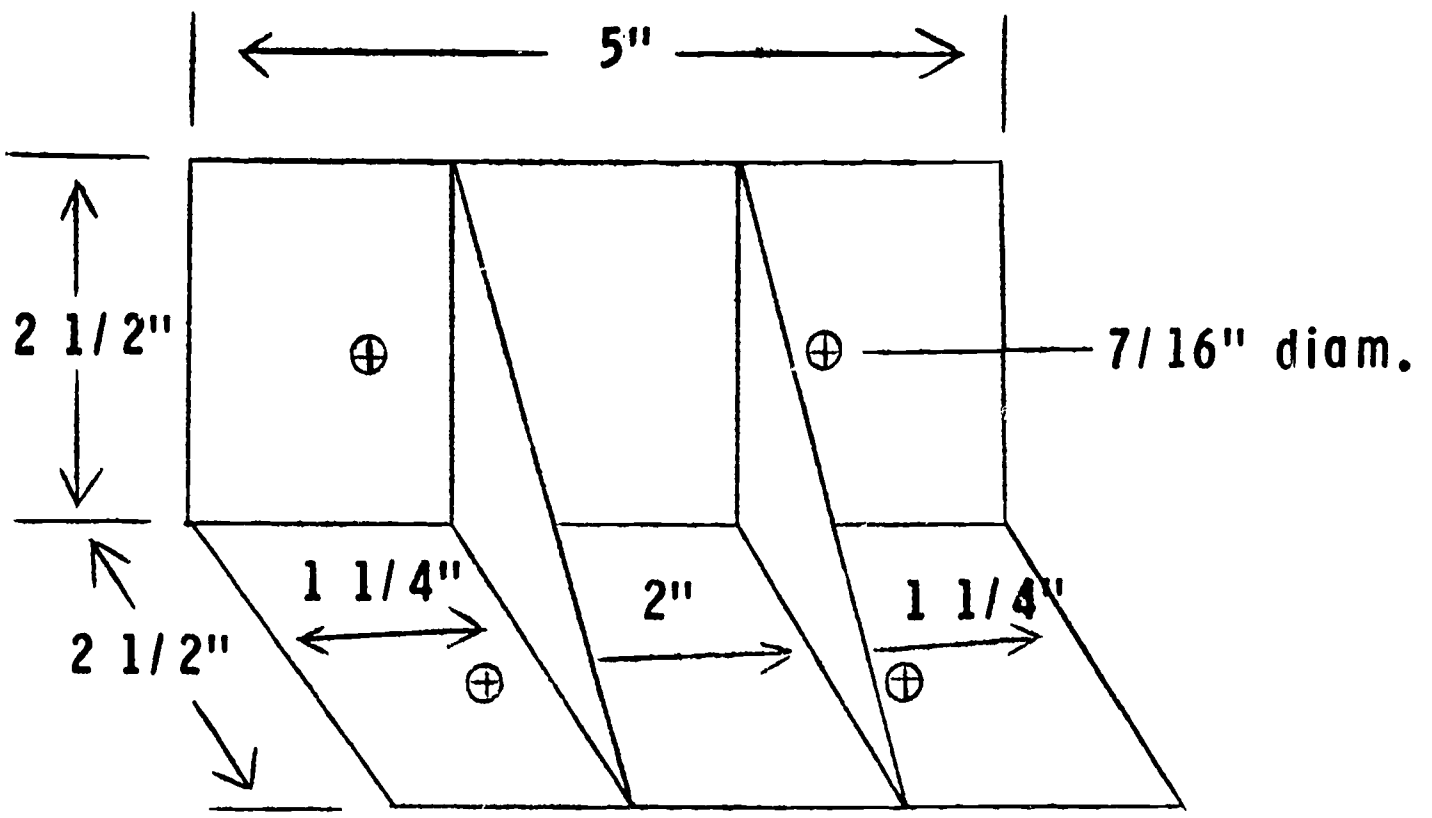
(1) Mark off the stock with a center punch.
(2) Heat the section to be twisted to a uniform bright red heat.
(3) Place one end of stock in a vise and clamp securely.
(4) Clamp other end of stock with monkey wrench and twist. If some portions twist too rapidly cool with a little water.
(5) When the twist is completed, straighten the stock with a wooden mallet.

STEP 1 - Lay off piece as shown in Fig. 1.
STEP 2 - Point one end, draw and round the other, Fig. 2.
STEP 3 - Form eye as shown in Fig. 3.
STEP 4 - To form hook bend back as shown in Fig. 4, cool up to the bend, then turn back.
STEP 5 - Heat piece to a dull cherry red and place in vise as in Fig. 5 and twist one full turn.

NOTE: Iron is softer at a dull cherry than at a

TESTING WELDING PROFICIENCY

The diagram shows a right angle brace which, in its construction, provides opportunity to test several welding and metal working skills. The completed object can be used to brace situations in other projects. The parts of the brace are fabricated in any manner the student chooses. He may use such equipment as the drill press, oxyacetylene torch, or arc welder, and a power or hand hack saw. He makes all decisions regarding the use of the welder, including the type of electrode and amerage setting. The rating scale serves as a guide to students in compieting the assignment and simplifies grading.



90 DEGREE ANGLE BRACE

STOCK: 11 1/4" x 2 1/2" mild steel TIME LIMIT: 90 minutes

PROCEDURES	POINTS	SCORE
1. Plates cut to exact dimension	10	_____
2. Angle of finished brace is 90 degrees	10	_____
3. Angle of gusset to brace is 90 degrees	10	_____
4. Size and location of holes is correct	10	_____
5. Six-pass fillet weld at plate joint	10	_____
6. Single-pass fillet weld each side of gusset	10	_____
7. Edges finished without burrs	10	_____
8. Surface free of spatter and slag	10	_____
9. Weld is uniform and of good quality	10	_____
10. Evidence of correct amerage and		

FARM AND RANCH EQUIPMENT

Welding Benches
Saw Horses
Mechanic Creepers
Wall Tool Cabinets
Rural Mail Box Supports
Farm or Ranch Signs
Playground Equipment
Ladders -- Step, Etc.
Trailers
Post Pullers
Pick-up Racks
Manure Loaders
Tool Boxes
Shoe Scrapers
Jigs for Welding

Portable Hoists
Work Benches
Electric Hack Saws
Bee Equipment
Lawn Mowers
Steps Over Stiles
Foot Scrapers
Fuel Barrel Stand
Cattle Guards
Wire Stretchers
Sprayers
Garden Tractors
Clothes Line Posts
Funnels
Electrode Holders

Bench Drills
Portable Tool Racks
Concrete Mixers
Lawn Chairs
Shelves for Storage
Benches
Picnic Tables
Gates
Post Hole Diggers
Trailer Hitches
Safety Pin Trailer Hitches
Mail Boxes
Chipping Hammers
Farm Wagons

LIVESTOCK EQUIPMENT

Weighing Crates
Feeders
Water Troughs
Feed Mixers
Mineral Feeders
Stocks or Squeeze Chutes
Loading Chutes
Hurdles
Cake (Protein) Distributors
Display Cases for Trophies
Automatic Oilers
Poultry Picking Machines
Horse Trailers

Stanchions
Sorting Gates
Record Racks
Wool Sack Holders
Portable Houses
Self Feeders
Brooders
Farrowing Crates
Show Feeders
Show Boxes
Feed Carts
Halters

Portable Livestock Pens
Feed Troughs and Bunks
Panels
Salt Boxes
Portable Shades
Breeding Racks and Crates
Shipping Crates
Blocking Stand for Sheep
Tack Room Equipment
Automatic Watering Devices
Feed Scoops
Bridles and Other Riding Equipment

CROP EQUIPMENT

Hay Hooks
Seed Mixers
Ditchers
Land Leveling Equipment
Hay Loaders
Crop Dusters
Harrows
Cotton Trailers
Fruit Grading Tables
Orchard Ladders

Sack Holders
Augers for Handling Grain
Dump Trailers
Floats
Brush and Weed Burners
Implement Trailers
Stockers (Hay)
Ditch Boxes, Gates, etc.
Pecan Tree Shakers

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ABSTRACT - This teacher-developed course guide will aid vocational agriculture instructors in planning and teaching basic agricultural mechanics. Designed for use in the first 2 years of the vocational agriculture program, these units of instruction provide a broad base of mechanical knowledge, skills, and abilities as a foundation for more advanced instruction either in production agriculture or in a specialized area of agricultural training. Titles of the 16 instructional units include: (1) Making and Using Drawings and Plans, (2) Tool conditioning, (3) Cold Metal Work, (4) Pipework, (5) Soldering and Sheet Metal Work, (6) Hot Metal Work, (7) Arc Welding, (8) Using Electricity, and (9) Tractor Operation. Objectives, abilities to be developed, teaching-learning activities, references, and job operation sheets are provided for most units, with safety precautions included for several. (AW)

VT 010 259

ED0 45856

Course Guide

For

BASIC AGRICULTURAL MECHANICS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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FOREWORD

The Course Guide for Basic Agricultural Mechanics is an outgrowth of a need identified by Arizona vocational agriculture teachers to up-date their agricultural mechanics course of study in light of changes taking place in vocational agriculture within the state. The expansion of vocational agriculture to serve training needs of agricultural occupations other than production agriculture and the structuring of vocational agriculture curricula to provide for specialized courses of instruction have necessitated revision and reorganization of agricultural mechanics instruction.

The objective of this course guide is to provide the teacher a guide for his planning and instruction in those areas of agricultural mechanics which are rather basic to the field of agriculture. It is intended that this instruction will provide the basic or introductory knowledges and skills as a foundation for more advanced agricultural mechanics instruction as well as to provide a broad background for the student who will pursue a specialized phase of instruction in agriculture.

Many persons shared in the development, evaluation, and selection of the content of this guide. Arizona teachers of vocational agriculture, Roy A. Clark, Richard T. Meder, Odro F. Ragsdale, and Charles Turpin shared in the development of an earlier publication, Course Guide for Instruction in Farm Mechanics, which served as the basis for many of the units in this guide. Many other Arizona teachers, whose names are not available, served in the development and evaluation of preliminary drafts of this course guide and of units within the guide. Other teachers contributed materials and suggestions which have been incorporated within the guide.

It is anticipated that Arizona teachers of vocational agriculture will find the Course Guide for Basic Agricultural Mechanics a valuable aid in their planning and instruction in this important phase of the vocational agriculture program. It is realized that the development of course guides is a continuous process and that this guide will be used under a variety of situations. Therefore, we solicit the suggestions and comments of teachers concerning the guide and its use in teaching basic agricultural mechanics in their classes.

J. B. Hamilton, Assistant Professor
Department of Agricultural Education
University of Arizona
Tucson, Arizona
January, 1968

INTRODUCTION

Planning the Program of Instruction

The Course Guide for Basic Agricultural Mechanics is designed for use in the first two years of the vocational agriculture program. Instruction in agricultural mechanics these two years is largely concerned with the development of basic shop skills, learning safe and proper use of tools and materials, and the development of good work habits.

It is intended that units of instruction provided in the Course Guide for Basic Agricultural Mechanics will provide a broad base of mechanical knowledges, skills, and abilities upon which the vocational agriculture student may build in his advanced years in vocational agriculture, whether he pursues training in production agriculture or pursues study in one of several specialized agricultural training areas.

Considerable variation exists from school to school in the numbers of class periods devoted to vocational agriculture per week, the length of class periods, the importance of specific mechanical abilities in the areas served by the school, and in the skills and interest of teachers regarding the mechanics phase of the vocational agriculture program. Due to these variables among schools, each teacher of vocational agriculture will need to plan his program of agricultural mechanics, placing emphasis upon those units which are most appropriate in order for his students to achieve their vocational objectives, allotting the necessary time for this important phase of instruction, and maintaining a balanced program of instruction. Generally, from 40-50 per cent of instructional time should be devoted to agricultural mechanics in the first two years of the vocational agriculture program.

USING THE COURSE GUIDE FOR BASIC AGRICULTURAL MECHANICS

The units in this course outline were prepared to be used as guides in planning and conducting instruction in basic agricultural mechanics. They are to serve as a reservoir of content to teach, teaching-learning activities to use, demonstrations to give, repair and construction projects that students may do, and references that may be used by teachers and students.

The suggested abilities with their associated content in the left-hand column of each page of the teaching units should be used by the instructor as a guide:

1. In selecting content to teach.

2. For selecting and procuring tools, equipment, and materials for teaching the unit.

3. For making plans and provisions for demonstrations and other teaching procedures appropriate to the teaching content.

The suggested teaching-learning activities, listed in the right-hand column of each page should suggest to the instructor:

1. Real materials, specimens, charts, films, and other audio-visual materials that will make the instruction more interesting.

2. Demonstrations, field classes and other teaching methods that will increase the efficiency of the instruction.

3. Participating experiences for the students that will give practice in the skills to be learned.

4. Safety precautions to observe while practicing the skills. (Lists of suggested safety precautions are included with units.)

Job Operation Sheets are included at the end of each unit. It is suggested that the teacher:

1. Use Job Operation Sheets as guides in giving demonstrations to his classes.

2. May reproduce Job Operation Sheets and use them as guides for students to follow in performing specific operations.

3. May use Job Operation Sheets as skill development exercises within the unit.

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COURSE GUIDE FOR BASIC AGRICULTURAL MECHANICS

Suggested Course Content for the First Two Years
of Vocational Agriculture in
Arizona High Schools

UNIT NO. 1: Introduction to Basic Mechanics

OBJECTIVE: To help the students become familiar with the nature, objectives, and content of the course and the organization, procedures, rules, facilities, materials, and general safety regulations used in the shop.

Ability to:	Teaching-Learning Activities
A. Know the content and objectives of the course. 1. Units to be studied 2. Objectives of course	A. Acquaint students with the course of study in basic mechanics. Distribute copies of course guide and objectives.
B. Understand methods used in instructing the course and evaluating the students' achievement and work habits 1. How shop work will be graded: a. Evaluating skills b. Evaluating information and knowledge c. Evaluating projects constructed or repaired 2. Methods of teaching shopwork: a. Demonstration b. Study and discussion of related information c. Practicing skills d. Constructing and repairing projects 3. Taking field trips	B. Acquaint students with the use of the skills chart or shop record card and the evaluation of farm shop skills and projects. Have a group discussion with students where materials that have been graded are discussed and inspected for their weaknesses.
C. Know and appreciate shop management rules 1. Opening the class period 2. Closing the class period 3. Management of tools and equipment a. Securing tools for working b. Putting away tools c. Care of tools while working d. Assignment to equipment and stations	C. Explain the reasons and logic behind each rule so students will understand the reason for making such rules. Give each student a copy of rules to be observed when working in the shop.

UNIT NO. 1: Introduction to Basic Mechanics

Ability to:	Teaching-Learning Activities
4. Keeping the shop clean and orderly a. Selecting temporary foreman b. Procedures for cleaning shop and storing materials	Distribute to students copy of the clean-up duties explained in sufficient detail and explain the use of clean-up wheel or other devices used during clean-up period.
5. Procedure regarding use of power tools in the shop	
6. Procedure regarding loss and breakage of tools	Post shop rules and regulations in areas of the shop where they best fit the needs.
7. Cooperating with other students in use of tools and benches and working on large projects	
8. Methods of procuring materials for use in constructing projects	Clarify that once material is cut for a project the student becomes liable for it.
9. Procedure to follow when paying for material used	
10. Student's behavior in shop a. Keeping busy b. Rules regarding distracting noises and unseeming behavior c. Attention during discussions and demonstrations	Show a plan for rotation when several groups are working at various stations.
11. Observing demonstrations a. Seating facilities b. Helping with demonstration c. Try-out of skills 12. Wearing appropriate shop clothes 13. Using shop lockers	Explain rules on the use of protective clothing and equipment. Inform the students of the protective articles they are to furnish.
D. Use high standards of workmanship 1. Using sharp tools and keeping tools sharp 2. Selecting proper materials for the job	D. Show examples of desirable and undesirable practices, designs, finishing and material usage such as burnt welding glove and a new one.
3. Using materials properly on the job	
4. Using acceptable practices for nailing setting screws and other skills	Practice welding with uniform beads closely spaced. (Avoid hen scratching)

UNIT NO. 1: Introduction to Basic Mechanics

Ability to:	Teaching-Learning Activities
5. Selecting a functional and durable design for projects	Clarify who is responsible for sharpening and fitting tools.
6. Painting or finishing all projects before removing from shop	
7. Rule on selecting or drafting a plan and having it approved before proje . is started	
E. Use safety precautions	E. Give each student a copy of general safety rules. (See enclosed "General Shop Safety")
1. Need for safety precautions	
2. Using dangerous tools	
3. Preventing fires	
4. Using the fire extinguisher	
5. Reporting accidents promptly	Explain that a safety test must be passed on all units in which hazards exist. These tests will be kept on file.
6. Using the first aid kit	
7. General safety regulations	
8. Procedure for repairing and making unusual adjustments of machinery, power tools, and electrical devices	
9. Color codes	Organize each class as "a safety emergency squad" and drill class to react to hazards which may occur.
F. Shop tool identification and storage	F. Survey all shop texts, plans, blueprints and charts for student se.
1. Location of tools and method of storage	
2. Location of working areas	
3. Location of shop references	Students tour shop areas and storage and tool rooms.
4. Location of material and storage of materials and supplies	
5. Tool checkout system	Assign lockers.

REFERENCES:

Agricultural Mechanics Course of Study for the Department "Safety Practices in Farm Mechanics," Department of Vocational Education, Colorado State University, Fort Collins, Colorado.

SAFETY PROCEDURES IN AGRICULTURAL MECHANICS SHOP*

A. GENERAL SHOP SAFETY

1. Keep shop well ventilated and lighted.
2. Dress properly for work.
3. Keep the shop clean and orderly; be a good housekeeper.
4. Have a place for everything and keep everything in place.
5. Never tolerate "horse play" in the shop.
6. Keep floor clean of metal chips; have waste container.
7. Keep floors free from any objects that might cause someone to trip and fall.
8. Treat all injuries immediately.
9. Always shut off a machine before making any adjustments.
10. Discard obsolete equipment which cannot be brought up to existing safety standards.
11. See that all machines are properly guarded when in use.
12. Avoid congregating around machines that are in operation.
13. Machines must not be operated in absence of instructor. Permit no student to operate dangerous machinery until he has received permission from the instructor.
14. Never leave a machine until it has stopped, even though power is off; another student might not see that it is running.
15. Never use hands or stick to stop machine by force after power is off. All portable and stationary electric hand tools should be grounded.
16. Design safety tests for each piece of dangerous machinery and require that a student perform a satisfactory test before he is permitted to use the equipment.
17. Never hurry a student when he is operating dangerous machinery.
18. When repairing machinery, always break the circuit at the standing switch and lock it in the open circuit position.
19. Always stop machinery before oiling it.
20. Never permit anyone to stand in line with a revolving tool or fly wheel.
21. Permit no conversation between a machine operator and another student.
22. Discard all unsafe ladders or make repairs to render them safe.
23. Do not permit oil on the floors.
24. Keep hand edge tools sharp. A dull tool requires so much more uncontrollable force that it causes accidents.
25. Always wear face shields whenever flying chips, injurious light rays, or molten metal may endanger the eyes. (De-fogging face shields: Apply soapy film to both sides of glass and wipe off excess, leaving very thin coating of soap suds through which you can see. Or, use glycerine pencils for this purpose.)
26. Use tools with care. Never point them at anyone or leave them lying around unattended.
27. Stack supplies and materials carefully.
28. Hand tools or materials to a fellow student; never throw them.

*Most of these procedures and regulations are taken from Safe Practices in Farm Mechanics, prepared and published by the Department of Vocational Education, Colorado State University, Fort Collins, Colorado.

GENERAL SHOP SAFETY (continued)

29. Whenever students note that a machine is out of order, they should notify the instructor.
30. Avoid working with sleeves which are unbuttoned or which have buttons missing at the cuffs unless rolled up. When running a machine, keep sleeves rolled.
31. Use a switch lever or a belt pole to shift a belt.
32. Use files only when they are equipped with handles. Insist on only safety handles for all files and rasps.
33. Do not use machines for trivial operations. Use hand tools.
34. Inspect all lumber for loose knots, nails, splits, or other hazards before sawing or machining.
35. Know that rings on your fingers are safety hazards.
36. Feed stock only as fast as machine will take it with ease. Never force the stock.
37. Floor lines designate the operator's area. All other students must stay outside of these safety lines.
38. No student, except in an emergency, shall start or stop a machine for another student.
39. Allow no condition to exist which will divert the attention of the machine operator.
40. Do not carry sharp or pointed tools in pockets.
41. Keep both hands behind the cutting edge of any tool.
42. Never permit lumber with nails protruding to lie around the shop or storeroom; pull nails out.
43. Do not wash face or hands with turpentine to remove paint. Some people are allergic to turpentine.
44. Do not carry articles in the mouth.
45. When the instructor must be out of the shop, he should turn off the power.
46. Operate all machines at proper designated speeds.
47. Always keep inflammable liquids in safety containers painted red and marked.
48. Fire extinguishers should be conveniently located and students should be instructed in their use.
49. Students should not prank or point an air hose at another student. A serious accident or a skin abrasion may result.
50. Use utmost safety precautions in handling corrosive acids and always wear rubber gloves when handling them.
51. Keep only enough gasoline on hand for immediate use and store it in safety containers.
52. Get help in handling long or heavy materials; use leg muscles, not those of the back.
53. All electrical wires should be considered alive until proven otherwise. Always play safe when handling electricity.

UNIT NO. 2: Making and Using Drawings and Plans

OBJECTIVE: To aid the learner in developing an appreciation for and the ability to communicate construction details through the medium of mechanical drawings.

Ability to:	Teaching-Learning Activities
A. Appreciate the value of making and using drawings and plans 1. Interpreting ideas to others 2. Gaining structural ideas from others 3. Saving material when building projects 4. Basis for making a bill of materials for project and determining cost 5. Determine skills to be learned before starting project 6. Provides the builder with details of construction	A. Illustrate the need of plans for even simple projects by having students suppose they are to hang a door in another room similar to one in the classroom. Have them look at the door and then back to you (away from the door). Ask questions: Is the knob centered closer to top or bottom of the door? Are the top hinge and bottom hinge the same distance from the top and bottom edge of door? etc. Have them try to sketch the door including detail and dimensions. Save better practice drawings and sketches to place on bulletin board, and for future reference. Show good and poor construction projects and relate them to the plans used in their development. Show wasted material as a result of inadequate plans or relate accounts of such.
B. Recognize the common types of projections 1. Orthographic: views, relationships of views to each other 2. Pictorial: isometric and oblique 3. Value and uses of each 4. Characteristics of each projection	B. Illustrate with a folding box or a box and glass, the relationship of orthographic views to pictorial views. Show examples of the common types of projections.

UNIT NO. 2: Making and Using Drawings and Plans

Ability to:	Teaching-Learning Activities
C. Read and interpret simple drawings 1. Shape of object 2. Dimensions 3. Minor details 4. Proper terminology	C. Distribute duplicate copies of simple drawings or views and have students interpret shape and dimensions.
D. Use mechanical drawing equipment 1. Drawing board 2. T-square 3. Triangles 4. Scales or rulers 5. Protractor 6. Pencils 7. Compass, dividers	D. Demonstrate the proper use of the equipment.
E. Know and be able to use conventional lines and symbols 1. Conventional lines a. Hidden edges b. Broken lines c. Extension d. Center lines e. Dimension lines f. Object lines 2. Symbols a. Steel b. Concrete c. Glass d. Earth e. Sand f. Water g. Wood h. Building block i. Window j. Door	E. Show how these conventions are used in drawings.
F. Dimension drawings properly 1. Correct method of making dimension and extension lines 2. Proper location of dimensions on drawings	F. Illustrate on board and with drawings the correct and incorrect methods of dimensioning drawings.
G. Make working drawings 1. Selecting: scale, T-square drawing board, and other equipment 2. Fastening paper 3. Determining the scale 4. Make drawing using the various projections	G. Place objects to be drawn in front of room and list measurements on chalkboard.

UNIT NO. 2: Making and Using Drawings and Plans

Ability to:	Teaching-Learning Activities
H. Make freehand sketches 1. Choosing views 2. Using pictorial, orthographic projections 3. Projecting the views	H. Students sketch irregular blocks of wood and other simple objects. Students make both pictorial and orthographic projections. (See Job Operation Sheet)
I. Letter neatly and correctly 1. Upper case 2. Lower case	I. Students make a page each of upper and lower case letters and numerals. (See Job Operation Sheet) Place the legend on the drawing made earlier.
J. Read and interpret more complex drawings and blueprints (squeeze chute, loading ramp, livestock self feeder)	J. Draw a simple floor plan, using symbols, dimension lines, etc. Read and interpret plans. Use large drawings or duplicate copies of smaller drawings.
K. Learn glossary 1. Drawing 2. Sketching 3. Orthographic 4. Isometric 5. Oblique 6. Legend 7. Horizontal 8. Verticle 9. Lettering 10. Scale 11. Blueprint	K. Have students search out meanings of the terms.

REFERENCES:

Jones, Mack M., Shopwork on the Farm, Chapter 2.
Phipps, L. J., Mechanics in Agriculture, Chapter 7.
Phipps, L. J.; N. F. McColly; L. L. Scranton; and G. C. Cook, Farm Mechanics Text and Handbook, Chapter 6.
Wakeman, T. J.; L. L. McCoy, The Farm Shop, Chapter 1.

JOB OPERATION SHEET

UNIT NO. 2: Making and Using Drawings and Plans

JOB: Drawing Orthographic Views of Nailbox

What To Do	How To Do It
A. Plan the lay-out	1. Arrange for maximum use of paper 2. Have a margin on all sides 3. Scale 1/4" = 1"
B. Lay out the top	1. Place in the upper left quarter 2. Do lightly at first
C. Lay out the front	1. Place directly under the top 2. Leave spaces for dimensions 3. Scale 1/4" = 1"
D. Lay out the side or end	1. Draw directly to the right of the front 2. Have margin also on all sides 3. Scale 1/4" = 1"
E. Draw details	1. All sides 2. Add internal details 3. Add hidden lines
F. Complete	1. Darken lines 2. Add lettering 3. Add dimensions
G. Check for any omission	

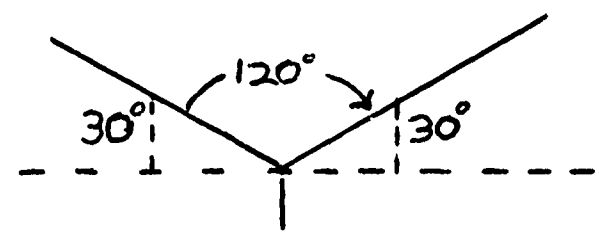
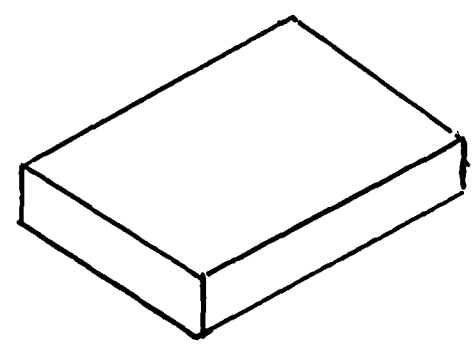
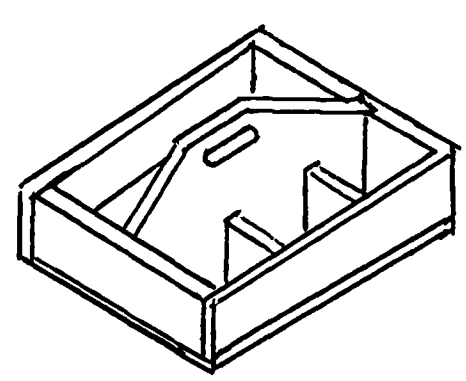
Materials Needed:

1. Blocked paper
2. Scales and rulers
3. Pencils
4. Nail box model

JOB OPERATION SHEET

UNIT NO. 2: Making and Using Drawings and Plans

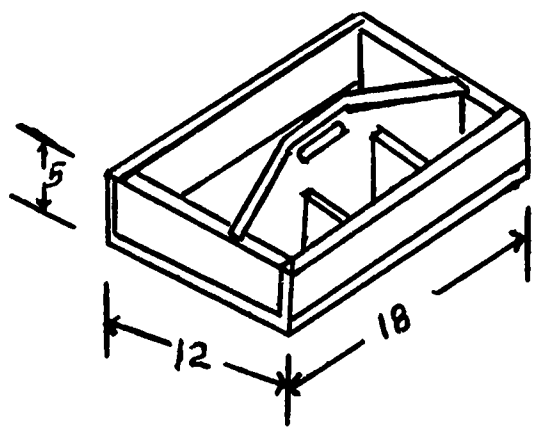
JOB: Drawing Pictorial Isometric Views of a Nail Box

What To Do	How To Do It
A. Lay out the three axes	1. Use scale 1/4" = 1". 2. Plan so the complete box can be put on paper. 3. Lay out the three axes as shown. 
B. Complete the rectangular box	1. Must be drawn to scale. 2. Do lightly at first. 
C. Draw details of basic box on all sides	

UNIT NO. 2: Making and Using Drawings and Plans

JOB: Drawing Pictorial Isometric Views of a Nail Box

What To Do	How To Do It
D. Add internal lines	1. Complete details. 2. Darken lines. 3. Add all lettering and dimensions.



Materials needed:

1. Model-Nail Box
2. Pencils
3. Paper
4. 30° Triangle
5. Straight edge
6. Scale ruler

JOB OPERATION SHEET

UNIT NO. 2: Making and Using Drawings and Plans

JOB: Lettering

What To Do	How To Do It
A. Lay out paper	1. Draw a 1/2 inch margin all around the sheet. Use heavy lines. 2. Make guide lines (very light lines). a. First line 1/4 inch from top margin b. Follow with 3 lines 1/8 inch apart c. Next line 1/4 inch from line above, followed by 3 lines 1/8 inch apart. d. Continue to line out the sheet with groups of four lines 1/8 inch apart with each group of lines separated by a 1/4 inch space.
B. Make upper-case or capital letters	1. Use the first three groups of lines to practice making capital letters. On the fourth group of lines make one complete alphabet of capital letters for a grade. a. Spaces between letters should be adjusted so that they appear to be equal. b. Use American Standard vertical letters. (See references)
C. Make lower-case letters	1. Use the next three groups of lines to practice making lower case letters. On the fourth group of lines make one complete alphabet of lower-case letters for a guide. (See references)
D. Make numbers	1. Use the next group of lines to practice making numbers, then make a complete set of numbers on the next group of lines for a grade.

UNIT NO. 2: Making and Using Drawings and Plans

JOB: Lettering

What To Do	How To Do It
	a. Use American Standard vertical numbers (See references)
E. Practice printing your name and date	1. Practice on the next group of 4 lines and then print your name and the date on the last line for a grade. a. Make the first letter of each word in capital letters and the rest of the letters lower-case.

UNIT NO. 3: Selecting Materials of Construction and Repair and Determining Quantities Needed

OBJECTIVES:
1. To acquaint the students with the materials used in construction and repairing; their forms, grades, shapes, sizes, types, composition, cost, mechanical properties, and specific uses.
2. To aid the student in developing an ability to select the material for the job and figure quantities needed.
3. To develop in the student an appreciation for the properties of construction material.

Ability to:	Teaching-Learning Activities
A. Understand the mechanical and other properties of materials of construction 1. Strength and types of strength a. Tensile b. Impact c. Compressive d. Fatigue e. Torsion f. Shear 2. Elasticity 3. Ductility 4. Malleability 5. Hardness 6. Brittleness 7. Roughness 8. Softness 9. Conductivity 10. Magnetism 11. Specific gravity 12. Combustibility	A. Show examples of materials with the various mechanical properties. Give a demonstration, if possible, on one of the strength tests.
B. Know the different characteristics of lumber and how to buy it 1. Kinds of wood and their characteristics a. Soft woods: Pine, spruce, firs, redwood, cedar, cypress, hemlock b. Hardwoods: Oak, maple, hickory, walnut, ash, birch c. Plywoods, masonite, etc. 2. Kind of wood to use for different agricultural purposes a. Rough dimension lumber b. Cabinets, trim and siding c. Wood to resist rotting	B. Study samples of wood, and identify. Classify these woods as to strength, hardness, wear, resistance, etc. Demonstrate the variation in hardness of some woods. Have students drive nails or push thumb tacks into the different kinds of wood. Make a list of woods commonly used for these different agricultural purposes.

UNIT NO. 3: Selecting Materials of Construction and Repair and Determining Quantities Needed

Ability to:	Teaching-Learning Activities
d. Handles, machinery, hardwood floors e. Benches, trailer beds, etc.	
3. Common grades of lumber a. Select grades b. Common grades c. Grades of hard wood d. Grades of plywood	Have a field representative of Western Wood Association or other company bring slides and samples and discuss with class.
e. Defects of lumber and how they affect it	On a field trip to a lumber yard, have lumberman grade lumber and show lumber defects. Show different kinds of lumber and purposes for which each is sold.
4. Stock sizes of lumber a. Lengths commonly carried by lumber yards b. Actual width and thickness of stock lumber such as 2" x 4" and 1" x 6" c. Size of planks; timbers	Show students samples of different sizes of lumber and have them learn to identify them by sight.
5. Figure board feet in a piece of lumber a. Scaling b. Using the lumber formula	Prepare a problem set on determining board feet, running feet, costs, board feet needed to cover a floor or roof.
6. Figure a lumber bill a. Amount of lumber b. Cost c. How lumber is sold	Students help make a lumber bill for the school shop, and when the lumber arrives, check it against the bill as to the grade and board feet.
7. Handling methods that affect lumber a. Logging methods b. Methods of sawing c. Methods of curing and drying d. Care in grading lumber e. Caring for lumber: handling and storing	Show film on logging and operations in a sawmill.
C. Select nails for specific uses 1. Kinds of nails: common, box, finishing, grooved, threaded, cement coated, etc.	C. Show samples of different kinds of nails and get students familiar with sizes of nails, kinds of nails and uses of each.

UNIT NO. 3: Selecting Materials of Construction and Repair and Determining Quantities Needed

Ability to:	Teaching-Learning Activities
2. Uses and characteristics of the different kinds 3. Sizes of nails: 2D to 60D a. Length formula	Display nail chart in shop.
4. Selecting nails for different uses and different thicknesses of wood	Give students problems to determine what kind and size of nail they would use for certain jobs or projects.
D. Select screws for specific purposes 1. Kinds of screws: flat head, round head, lag, etc. 2. Uses and characteristics of the different kinds 3. Finish of screws: blued, brass, nickel, etc. 4. Sizes of screws: length, gauge or diameter 5. Selecting screws for different purposes and thicknesses of materials	D. Lay 30 or more samples of nails, screws and other hardware in numbered squares for students to identify and determine size.
E. Select and use bolts 1. Types of threads 2. Machine: Sizes, uses and characteristics 3. Carriage: Sizes, uses and characteristics 4. Stove bolts and machine screws: Sizes, uses and characteristics	E. Illustrate how different kinds of bolts are being used in machinery and projects in the school shop.
F. Select and use hinges 1. Kinds of hinges: strap, butt, T, cabinet, etc. 2. Uses and characteristics of the different kinds 3. Finish of hinges: steel, brass, nickel, etc.	F. Exhibit display board or chart showing hinges and others. hardware.
G. Select and use locks 1. House door locks: kinds and characteristics 2. Padlocks: kinds and characteristics 3. Locks for garden and corral gates	G. Exhibit several examples

UNIT NO. 3: Selecting Materials of Construction and Repair and Determining Quantities Needed

Ability to:	Teaching-Learning Activities
H. Select and use other miscellaneous hardware 1. Washers: kinds and uses of each 2. Nuts: kinds and uses of each 3. Expansion shields 4. Toggle bolts: types and uses 5. Door pulls 6. Hasps 7. Corner braces 8. Elbow catches and door buttons 9. Others	H. Show examples of each kind of item.
I. Select metal for construction and fabrication 1. Kinds of metal; their characteristics and uses a. Ferrous metals (1) Cast iron (a) Gray (b) White (2) Wrought iron (3) Steel (a) Low carbon (b) Medium carbon (c) High carbon (4) Steel alloys	I. Show examples of each kind of metal. Have students make a list of as many specific uses of each metal as they can. Advise students to select iron according to the function they want it to perform. Learn these different metals by spark test, hardness, color, strength, surface appearance, in order to identify each.* (See enclosed "Metals and Their Characteristics")
b. Nonferrous metals (1) Copper (a) Brass (b) Bronze (2) Aluminum (3) Zinc (4) Magnesium (5) Nickel (6) Lead	
2. Shapes and stock sizes of the various types of metal (including sheet metal)	Show examples of the various shapes of metal and explain why they are so shaped. *Spark-O-Meter, spark test samples and identification chart. Distributed by: Paxton Equipment and Supply Co., Chicago, Illinois.

UNIT NO. 3: Selecting Materials of Construction and Repair and Determining Quantities Needed

Ability to:	Teaching-Learning Activities
3. Identification of the various kinds of metal a. Color codes b. Code number c. Spark test d. Visual inspection e. Test for magnetism f. Others	Show a projection of the steel numbering system and code colors. Demonstrate identifying metals by various testing techniques. (See "Metals and Their Characteristics")
J. Select other materials 1. Plastics 2. Fabrics 3. Masonry 4. Rubber	
K. Make a bill of materials for a project 1. Interpreting plans or measuring projects to: a. Determine exact size and kind of each piece of material b. Determine size, kind, and number of screws, nails, bolts, pieces, and etc. c. Determine kind, size and shape used 2. Determine stock bill as it would be purchased a. Lumber: nominal width and thickness, length, grade, etc. b. Metal: size and type	K. Distribute multiple copies of a plan for a wood-metal project. Have each student make a bill of materials for the project and determine the cost. (Use "Guide for Planning Projects in Agricultural Mechanics")
L. Learn Glossary 1. Live load 2. Mechanical property 3. Yield point 4. Load 5. Alloy 6. Ferrous 7. Nonferrous 8. Stress 9. Bill of material 10. Stock bill 11. Casting 12. Case hardening	L. Have students search out the meanings of the terms

UNIT NO. 3: Selecting Materials of Construction and Repair and Determining Quantities Needed

REFERENCES:

Catalogue of Hardward Supplies such as Broadhead and Garrett, Arizona Hardward, Ocott and Bilbert, Stanley, etc.

Jones, Mack M., Shopwork on the Farm, 1955, p. 11.

Phipps, L. J., Mechanics in Agriculture, 1967, Chapter 6, 8 and 9.

Phipps, L. J.; H. F. McColly; L. L. Scranton; and G. C. Cook, Farm Mechanics Text and Handbook, 1959, (814), p. 7.

Selection of Lumber for Farm and Home Building, Farmers Bulletin No. 1756, U. S. Department of Agriculture.

Wakeman, T. J.; and L. L. McCoy, The Farm Shop, 1960, p. 10.

Wood Handbook, Agriculture Handbook No. 72, U. S. Department of Agriculture.

Metals and Their Characteristics

Kinds of Metals	Common Uses	Special Properties	How Identified
Cast Iron	1. Castings 2. Housings 3. Fly wheels 4. Engine blocks	1. Hard, brittle, and cannot be bent 2. Cannot be forged 3. Can be welded 4. Can be drilled, filed and sawed	1. Coarse grain texture 2. Small volume of numerous small sparks on the grinding wheel
Mild Steel	1. Repair of farm machinery and equipment 2. Construction of: appliances made of steel, e.g., nails, wire, pipes, etc. 3. Farm machine frames	1. Cannot be hardened 2. Can be bent and hammered cold to some extent 3. Easily sawed, filed and ground 4. Easily forged and welded	1. Sparks from grinding wheel are light yellow or red 2. Sparks are forked and explosive
Tool Steel	1. Hammers 2. Cold chisels 3. Saw blades 4. Etc.	1. Can be softened 2. Must be softened to be readily cut, sawed, filed or drilled 3. Can be welded	1. Fine grain texture 2. Gives off moderately large stream of sparks on grinding wheel 3. Sparks are white to light yellow and very explosive
Soft-Centered Steel	1. Plow moldboard 2. Cultivator shovels	1. Very hard wearing surface 2. Has high strength 3. Consists of a layer of mild steel between 2 layers of high carbon steel	1. Filing slight notch in edge of metal will reveal 3 layers

Improving Projects in Agricultural Mechanics

One of the objectives of instruction in agricultural mechanics is to provide an opportunity for students to repair or construct equipment needed on their home farms or for their occupational experience programs. Unfortunately, many of the projects built in agricultural mechanics shops by vocational agriculture students are not carefully designed and some materials used are of improper size or grade. Frequently, poor quality workmanship proclaims that the students had inadequate instruction in basic skills and that the standards of workmanship are low.

In order to encourage more and better planning, a guide for planning projects was developed by a group of experienced vocational agriculture teachers. This guide was duplicated and used for several years by teachers in their agricultural mechanics classes. The guide was then revised in the light of that experience and printed. The use of this form should serve to eliminate or at least minimize many of the above problems by directing the attention of the student and the instructor to:

1. Selecting and sketching an adequate and functional plan.
2. Selecting and procuring the proper kind and amount of materials before starting construction.
3. Planning procedures for doing the jobs involved in the project.
4. Selecting the proper tools to use.
5. Reviewing skills and abilities needed to complete the project, and securing instruction and practice in new skills needed.
6. Securing instructor's approval of the choice of project, the plan to be used, the design, the materials, and estimating the cost.
7. Securing the instructor's evaluation of the workmanship and finish of the complete project.

The suggestions may be followed completely or you may wish to make changes in this procedure to suit particular needs. However, the more closely the plan is followed, the easier it will be to objectively evaluate it in terms of meeting the needs for improving the planning, construction or repair of projects in agricultural mechanics.

1. Student and instructor cooperatively select the project to be constructed, remodeled or repaired.
2. The student should sketch or procure a plan of functional design. The back of the Guide for Planning Projects is marked off in 1/4" grids to facilitate sketching plans to scale. It should not be considered necessary to draw a plan if a suitable drawing can be located and the student has the ability to read and interpret it. It is, however, highly desirable that students develop the ability to visualize and sketch projects that they plan to construct. The instructor may therefore wish to require his students to draw accurate and complete plans for projects they wish to make until he is satisfied that they have acquired that skill. A student may wish to construct a project using plans that are on file in the department that meet his needs except for minor details. In such cases, the instructor may require only a sketch showing the needed modifications of the plan. For remodeling or repair jobs or projects, only certain parts of the project would need to be

drawn, and free-hand drawings may suffice. Before approving the plan, the instructor should discuss with the student the appropriateness of the design in terms of durability, economy and efficiency and suggest any changes he considers advisable. Under no circumstances should a student be permitted to construct a project without a written plan which has been approved by the instructor.

3. The student should then prepare a bill of materials for the project. Before approving this bill, the instructor should check it for errors, and when necessary, suggest any changes in materials that may make the project more durable or economical. Sometimes materials already on hand may be substituted for those suggested in the plan. The bill of materials should list sizes of materials procurable at the lumber yard, hardware store, or carried in stock in the agricultural shop. In order to prepare the bill, the student must first study the plan and list the size and number of pieces of each kind of material to be used in the project.
4. The procedures or steps in doing the job should then be listed, considering the sequence of the different operations for efficiency, key points that may make or break the job, short cuts in procedure, etc.
5. The next step is for the student to procure the materials needed for the project. Those materials purchased or brought from home should be of acceptable quality. Materials to be used from the stock in the school shop should be selected, and arrangements made for their purchase.
6. Any skills required in constructing the project, but not yet acquired by the student, should be listed. The instructor should then determine whether the skills should be taught on an individual basis to the student or taught to the entire class.
7. During the progress of the project, the instructor should always be aware of the techniques and workmanship used by the student and be alert to the problems that arise. At the opening and closing of the shop period, challenging problems pertaining to different projects should be discussed with the class and tentative solutions offered.
8. Not only should the completed project be graded, but also frequent evaluations should be made during the progress of the project, particularly of the tool skills and quality of workmanship. The student should be aware that poor quality workmanship will be unacceptable.
9. Since each project acts as a more or less permanent advertisement of the quality of instruction being offered in the agricultural mechanics shop, no student should be allowed to take his project from the school shop until it has been completed and properly painted or finished.
10. Each completed and approved project guide should be kept by the student in the agricultural mechanics section of his notebook until he has completed his project. Then it should be given to the teacher for his evaluation and kept on file by the teacher. These guide sheets will provide information for determining student grades and may serve other purposes such as a record of money owed for materials furnished by the school, provide accurate information for certain FFA contests and awards, enable the teacher to accurately summarize the value of projects completed in his shop for any length of time, etc.

VOCATIONAL AGRICULTURE
GUIDE FOR PLANNING PROJECTS IN AGRICULTURAL MECHANICS
(For construction and repair jobs)

Student's name _____ Date started _____ Date completed _____

Job or project _____

Title and page number of references used for plans and procedures (books, bulletins, blueprints) _____

_____

Bill of Materials (lumber, metal, hardware, etc.)

No. of Pieces	Dimensions	Description (kind, quality, finish, etc.)	Quantity (bd.ft., etc.)	Price per unit	Cost

Total Cost _____

Procedures; steps in doing the job	Tools to be used

New skills or tool operations to be learned before starting this job _____

_____

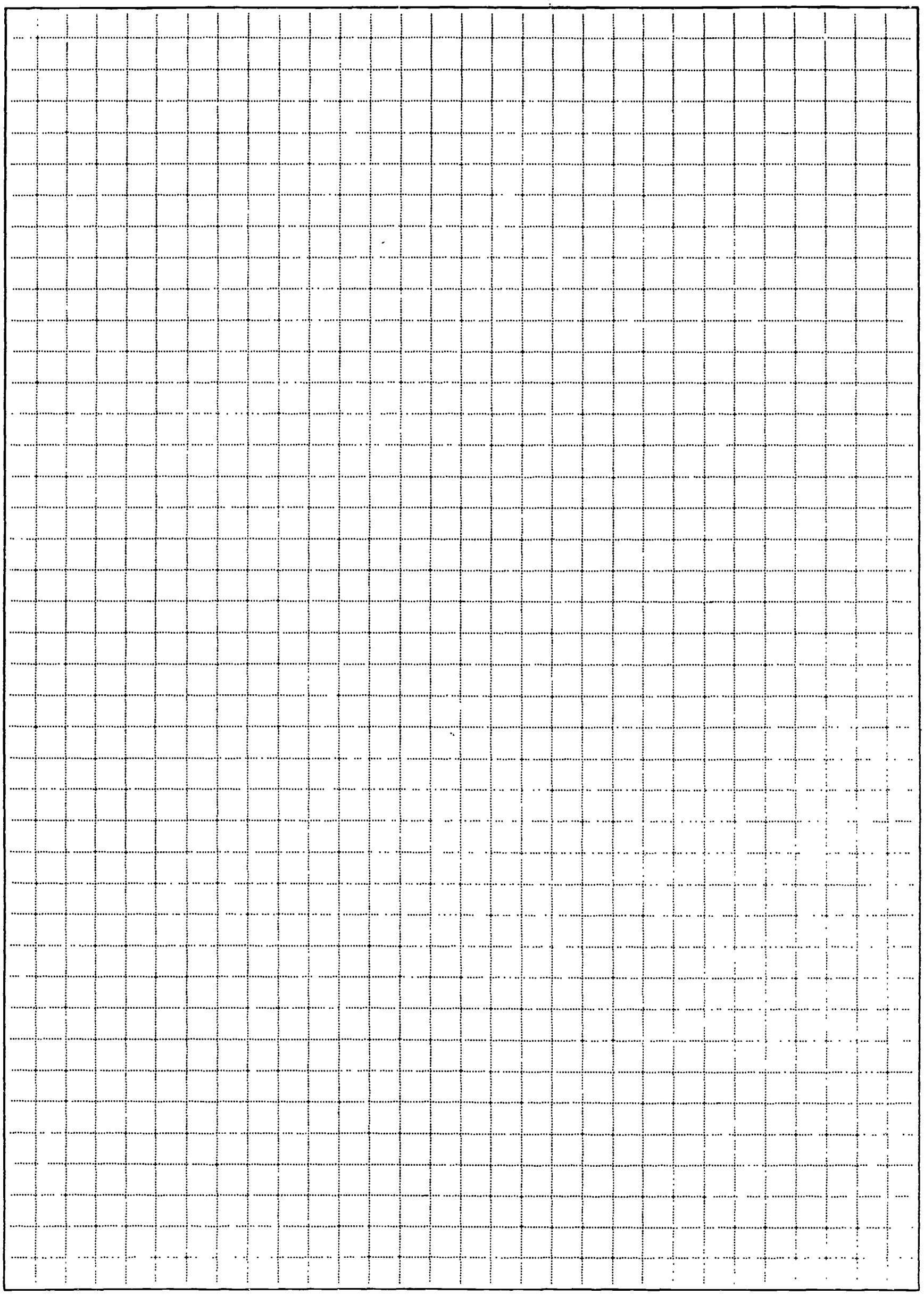
_____

Instructor's Approval

Sketch of project: Practicability of design _____ Completeness _____ Neatness _____
Plan _____ Bill of materials _____ Plan of procedure _____ List of tools _____
New skills or operations learned _____ Materials on hand for project _____

Evaluation Of The Completed Project

Durability _____ Quality of workmanship _____ Quality of finish _____
Hours used _____ Estimated value of finished products _____ Final grade _____



UNIT NO. 4: Tool Conditioning

OBJECTIVES: To aid the learner

1. To become acquainted with the materials and tools used to condition tools.
2. To develop the ability to use the conditioning materials and tools properly.
3. To learn how to condition common tools.
4. To understand why tools are conditioned in specified ways.
5. In using good safety procedures and in being aware of hazards involved.

Ability to:	Teaching-Learning Activities
A. Select, service and use grinders 1. Sizes and types of grinders 2. Grinding wheels; types of abrasive, grit size, grades, bonding material 3. Testing and mounting a wheel 4. Understand why and how to dress a wheel 5. Observe safety precautions	A. Make students safety conscious when using grinder. Keep goggles or face shields above grinding wheel where they cannot be overlooked. (See Job Operation Sheet and Safety Precautions)
B. Select and use oil stones and dry stones 1. Types and combinations of stones 2. Cleaning and oiling the stone	
C. Use the grinding template for grinding and sharpening 1. Sharpen cold chisels and punches a. Cutting angle of cold chisel b. Method of grinding chisel c. Grinding center punches d. Grinding prick and pin punches 2. Sharpen plane irons and wood chisels a. Check angle and shape of cutting edge b. Grinding c. Whetting d. Stropping 3. Sharpen twist drills a. Proper shape of drill point b. Lip clearance c. Length and angle of cutting edges	C. Each student make grinding template for checking proper angles of tools conditioned. (See Job Operation Sheet) Keep a tool grinding template at the grinder and use template to check angles of different tools while sharpening. (See Job Operation Sheet) Show how a chisel with too sharp an angle will not stand up under heavy use. (See Job Operation Sheet) Students bring twist drills to class for grinding.

UNIT NO. 4: Tool Conditioning

Ability to:	Teaching-Learning Activities
d. Placing drill in position e. Grinding the drill f. Grinding a drill for special materials g. Understand why bit is sharpened as it is h. Understand the relation of drill speed to cutting ability of bits.	Drill holes with a sharp bit and an improperly sharpened bit. Show how the shavings curl when a bit is sharp and the proper pressure is used. Demonstrate differences in speed and cutting ability of twist drills. (See Job Operation Sheet)
D. Sharpen auger bits 1. Type of file to use 2. Filing scoring nib 3. Filing cutting lips	D. Demonstrate the difference between sharp tools and dull tools in ease of using and quality of workmanship. (See Job Operation Sheet)
E. Sharpen knives 1. Grinding: when to grind, method 2. Whetting method 3. Testing for sharpness 4. Sharpening butcher knives a. Grinding: when to grind, method b. Whetting method c. Steeling	E. Emphasize caution against overheating when grinding thin edge tools. Show several methods of checking edge tools for sharpness - shaving hair, light reflection, etc. (See Job Operation Sheet)
F. Sharpen axes and hatchets 1. Grinding: when to grind, method 2. Whetting method	
G. Sharpen scissors and snips 1. Angle to grind 2. Grinding and whetting	
H. Sharpen hoes, mattock, spades and shovels 1. Straightening nicks and dents on edge 2. Holding the tool 3. Grinding or filing	
I. Fit tool handles 1. Axe and hatchet handles: removing old handle, fitting new handle, wedging 2. Hammer handles: removing old handle, fitting new handle, wedging	I. Visit shop where saws are filed by machine and observe demonstration of the machine in use.

UNIT NO. 4: Tool Conditioning

Ability to:	Teaching-Learning Activities
3. Shovel, hoe and rake handles: removing old handle, shaping new handle, riveting 4. Fork handles	
J. Recondition tools 1. Removing rust from tools 2. Oiling tools 3. Fit screw drivers a. Angle, shape and thickness of blade b. Re-shaping and re-tempering 4. Sharpen: Pocket knives, butcher knives, twist bits, hoes, shovels, cold chisels, wood chisels, plane bits, scissors, screw drivers, punches 5. Replace handles in: axes, hatchets, hammers, sledges, hoes, shovels, saws 6. Clean and oil: saws, bit braces, auger bits, axes	J. Encourage students to gather together all the tools in and around the home and shop and recondition them. Each student sharpen six or more different kinds of tools, replace handles in one or more tools and clean and oil one or more tools.

REFERENCES:

Hunt; DeWitt, Shop Tools, Care and Repair, Van Nostrand, 1958.
Jones, Mack M., Shopwork on the Farm, Chapter 7.
Phipps, L. J., Mechanics in Agriculture, Chapter 5.
Phipps, L. J.; N. F. McColly; L. L. Scranton; and G. C. Cook, Farm Mechanics Text and Handbook, Chapter 5.
Wakeman, T. I.; V. L. McCoy, The Farm Shop, Chapter 2.

POWER GRINDER SAFETY PRECAUTIONS

1. Emery wheel operators must wear goggles, or the grinder should be equipped with safety glass eye shields.
2. When grinding, hold tools securely.
3. Forbid the grinding of fiber, brass, wood, etc. Such grinding damages the cutting properties of the wheel.
4. Operators should stand slightly to one side so the face will not be in line with the grinding wheel.
5. If operator is struck by steel slivers, remove slivers immediately and give first aid.
6. Never force so hard as to burn the edge of the tool being sharpened.
7. Avoid letting fingers come in contact with the grinding wheel.
8. When using grinder, make sure the grinding wheel is securely tightened.
9. A wheel may be tested for hidden flaws by striking lightly with a small hammer. A clear ring indicates a sound wheel; a dull thud, a wheel that is cracked.
10. Do not tamper with the tool rest or the wheel guard. Tool rests should be adjusted as close to the wheel as possible without rubbing.
11. Do not hold material to be ground with pliers. Use a safety holding clamp (vise grip pliers).
12. Grind only on the face of the grinding wheel.
13. Do not permit tools or articles being ground to slip down between the wheel face and the tool rest. Such slipping can cause injury, break the stone, or bend the shaft.
14. Keep grinder wheels clean and sharp by frequent dressing.
15. Do not remove guards unless special grinding demands this removal.

JOB OPERATION SHEET

UNIT NO. 4: Tool Conditioning

JOB: Dressing a grinding wheel

What To Do	How To Do It
A. Place the tool rest in line (horizontally level) with the center of the wheel arbor.	1. Use proper size wrench. 2. Leave a 1/16" clearance between tool rest and grinding wheel.
B. Check the wheel for roundness.	1. Turn grinding wheel slowly with fingers; margin of clearance with tool rest should remain the same for a complete revolution. 2. Or, turn on the grinder and hold a piece of chalk 1/16" from the wheel on the tool rest. Move from side to side to check the full surface. High spots will be marked white.
C. Check the wheel for squareness of the cutting area.	1. Lay a combination square on the tool rest, with the ruler extending toward the wheel arbor. 2. Hold the ruler against the side of the wheel and check grinding face for squareness. 3. Rotate wheel slowly by hand and check entire wheel.
D. Use grinding wheel dresser to correct the roundness, squareness of edge, and to remove any glaze of foreign material.	1. Grasp the grinding wheel dresser with both hands and hold close to body. 2. Place the dresser on tool rest with 1/3 of the cutters extending to the right of the wheel. Hold dresser steady so it will not follow the curve of the wheel but will take off high spots. 3. Move the hands and body to the left until 1/3 of the cutters extend over the left edge of the wheel. 4. Repeat two or three times then turn off motor and let grinder stop.

UNIT NO. 4: Tool Conditioning

JOB: Dressing a grinding wheel

What To Do	How To Do It
E. Recheck for trueness and squareness	1. Repeat steps 2 and 3.
F. Continue dressing until wheel becomes round, the grinding face square, and all glaze is removed.	1. Repeat step 4 until complete.

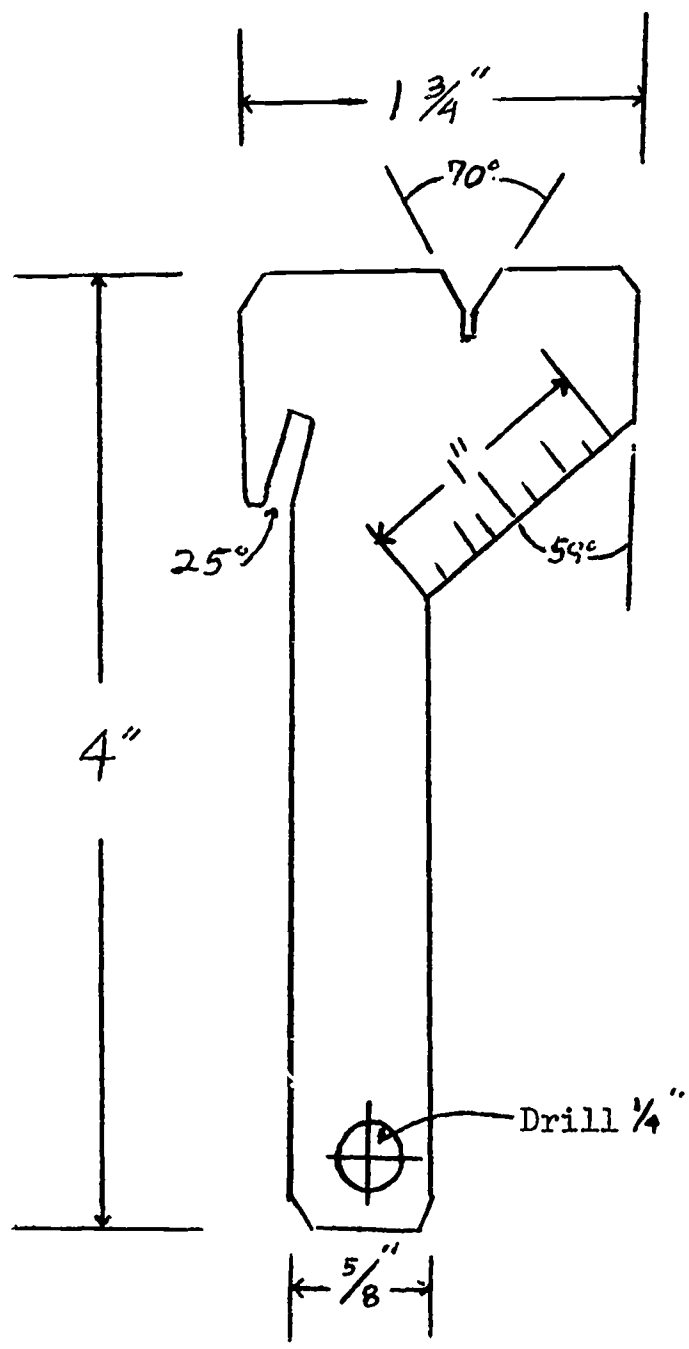
JOB OPERATION SHEET

UNIT NO. 4: Tool Conditioning

JOB: Making a Drill Gauge or Template

What To Do	How To Do It
A. Secure material	1. Obtain the material from the instructor. 2. Use a heavy gauge sheet metal.
B. Lay out the gauge	1. Carefully measure the dimensions. 2. Mark on the metal using an awl.
C. Cut out the gauge	1. Cut the gauge out with either tin snips or a hack saw, depending upon the metal. 2. Carefully file the edges down to the accurate dimensions.
D. Drill the hole	1. Center punch the gauge 2. Drill a 1/4" hole in the gauge as shown in the diagram.
E. Polish the gauge	1. Polish the gauge with emery cloth to a bright finish. 2. Coat with a thin coat of oil or the gauge may be blued using a light application of cold gun blue. 3. If gun blue is to be used, follow the directions on the bottle.

GRINDING GAUGE

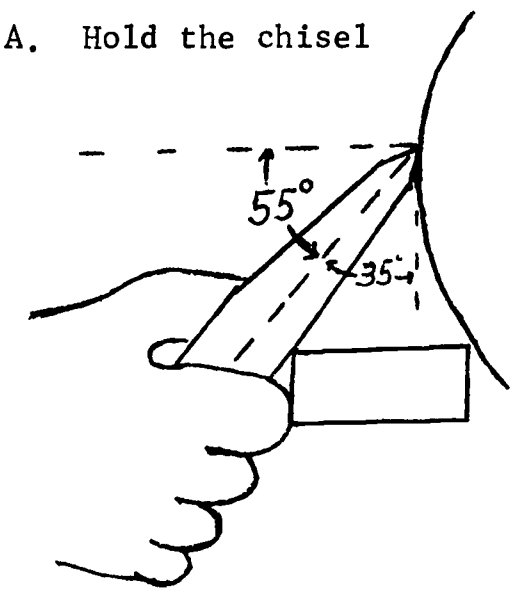
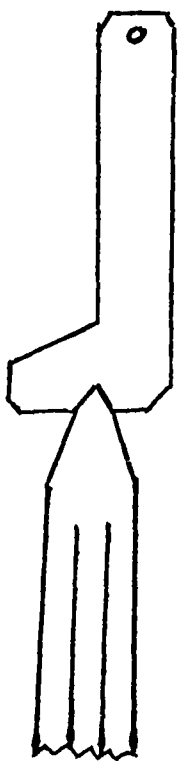


A plan for a homemade grinding gauge for checking twist drills, cold chisels, and plane bits and wood chisels.

JOB OPERATION SHEET

UNIT NO. 4: Tool Conditioning

JOB: Sharpen a Cold Chisel

What To Do	How To Do It
A. Hold the chisel 	1. Grasp the chisel firmly so that when the first finger comes up against the tool, the rest of the chisel will bear against the wheel at a 35° angle. 2. Do not release this hold until the job is completed.
B. Sharpen the chisel 	1. Hold the cutting edge of the chisel firmly against the wheel and swing it from side side, pivoting it over the tool rest. 2. While the grinding proceeds, check with the gauge to see if the 70° angle of bevel is being produced. 3. During the process, cool the chisel frequently in cool water to prevent over-heating and drawing of temper. 4. A cold chisel need not be sharpened to as keen an edge as woodworking tools.

JOB OPERATION SHEET

UNIT NO. 4: Tool Conditioning

JOB: Sharpening a plane iron (or wood chisel)

What To Do	How To Do It
A. Determine if grinding or just whetting is needed.	1. When tool is only slightly dull from normal use (Step D). 2. Grind tool if unusually dull or nicked, if level is incorrect or if cutting edge is not square with sides.
B. Check level and shape of cutting edge.	1. Use the tool fitting template to check the bevel of the cutting edge. It should be either straight or slightly concave and have an angle of 25° to 30° for general work. 2. Check the edge for squareness by holding a combination square on top of the blade.
C. Grind the blade.	1. Hold the tool against the wheel in a manner that will produce a slightly concave smooth, even bevel with an angle of 25° or adjust the tool rest so that the desired angle is achieved. 2. Grasp the tool so that the first finger will come against the tool rest, this enables you to replace the tool in position after cooling or inspecting it. 3. Move the tool from side to side across the face of the wheel. 4. Dip the tool frequently to prevent overheating. 5. Inspect the work frequently to insure proper shape and bevel. Check for 25° bevel with tool fitting template.
D. Whet the plane iron.	1. Place a few drops of oil on the fine side of the stone. 2. Place the plane iron on the stone with the cutting edge making an oblique angle with the edge of the stone.

UNIT NO. 4: Tool Conditioning

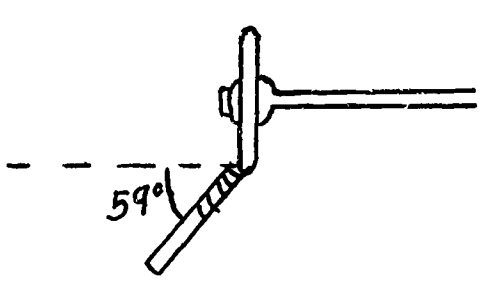
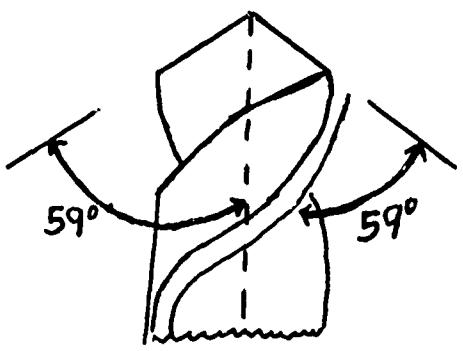
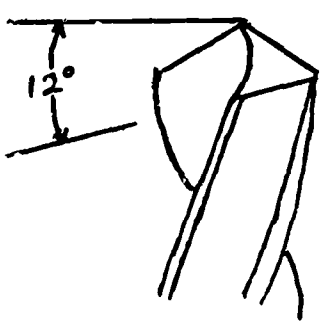
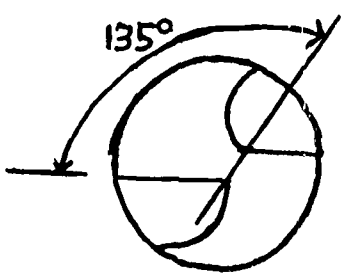
JOB: Sharpening a plane iron (or wood chisel)

What To Do	How To Do It
	3. Keep the bevel of the tool flat on the stone, or with the heel raised very slightly.
	4. Push the tool forward and backward, bearing down on the forward stroke and relieving the pressure on the backstroke. Use full-length strokes.
E. Remove wire edge	1. Place the tool perfectly flat on the fine side of the oil-stone with the bevel edge up and the cutting edge at an oblique angle with the stone edge.
	2. Push the blade forward until the wire edge disappears. It may be necessary to whet on the bevel edge lightly to remove the wire edge.
F. Test for sharpness	1. Check for sharpness by dragging the cutting edge across a soft wood block.

JOB OPERATION SHEET

UNIT NO. 4: Tool Conditioning

JOB: Sharpening Twist Drills

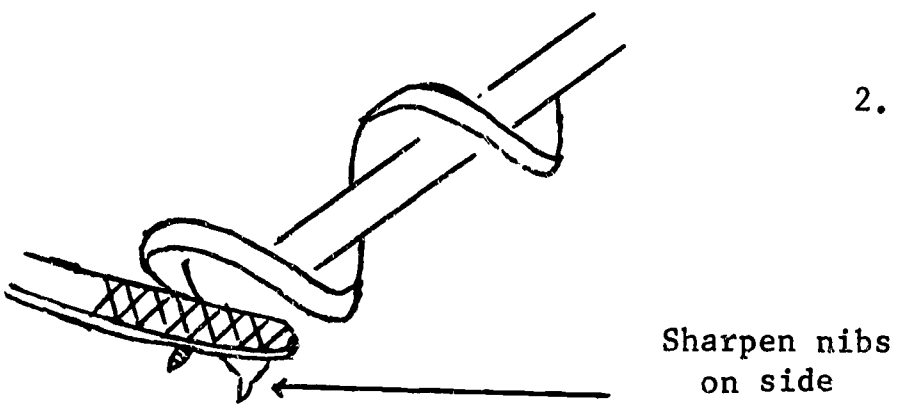
What To Do	How To Do It
A. Sharpening a twist drill 1. Hold the drill in the proper position  	1. Hold shank of the the drill firmly in the right hand and support the fore part of the drill on the index finger of the left hand, which in turn lies on the grinder tool rest. 2. Hold the drill at an angle of 59° to the face of the grinder and level with the tool rest and wheel arbor.
B. Sharpen drill	1. Touch the drill on the grinding wheel and at the same time lower the shank of the drill and rotate slightly in a clockwise direction to ensure the correct 12° clearance. 2. Cool the drill frequently in water.
C. Check angles    	1. Each cutting lip must be straight, the same length, and at an angle of 59° to the center line of the drill. Check the angles with the tool fitting template. 2. The trailing edge of the cutting lip must have a clearance of 12° to the horizontal. Check this with the template. When the trailing edge is at the proper angle, the short line across the end of the bit will be approximately 135° to the cutting edge.

JOB OPERATION SHEET

UNIT NO. 4: Tool Conditioning

JOB: Sharpening a Wood Auger Bit

What To Do	How To Do It
A. File the spurs or scoring nibs	1. Hold the bit firmly near the edge of a bench or other support. 2. File on the inside of the nibs with an auger-bit file or a small triangular file. If nibs have been bent outward or have burrs on the outside, file lightly on the outside, taking care not to undercut or bevel the nibs on the outside.
B. File the cutting lips	1. Rest the bit firmly on a bench top and file the lips from the top side. 2. File both lips the same amount and be careful to retain the original level or suction.



Sharpen
cutting lips
top side

JOB OPERATION SHEET

UNIT NO. 4: Tool Conditioning

JOB: Sharpening a knife (or other sharp edge tool)

What To Do	How To Do It
A. Grind the knife	1. Place the blade flat against the wheel with the point a little higher than the handle. 2. Raise the back edge of the blade just enough to grind on the cutting edge. 3. Move the blade slowly back and forth across the wheel at an angle. 4. Do not overheat the blade, dip in water frequently.
B. Whet the knife	1. Start on coarse side and finish on fine side of oilstone. 2. Place the blade flat on the stone and raise the back of the blade just enough to make the cutting edge touch the stone. 3. Draw the knife diagonally across the stone, cutting edge first. 4. At the end of the first stroke, flip the blade over and pull it back, cutting edge first. Then flip the blade over and repeat the steps making it a continuous motion. 5. After a wire edge is produced on the coarse side, flip the stone over and whet lightly on the fine side.
C. Strop the knife to produce a keen edge	1. Use a piece of smooth leather or a shoe sole. 2. Use pulling strokes with the cutting edge trailing.
D. Test for sharpness	1. A sharp knife will shave the hair on your arm. 2. Or, hold tool up to light and move it back and forth. The edge of a sharp tool cannot be seen. A dull edge is a narrow shiny line.

ERIC

UNIT NO. 5: Using Wood Working Tools

OBJECTIVES: To aid the learner to:

1. Become acquainted with the various hand tools and how to use them.
2. Develop an ability to match tools and jobs.
3. Develop an appreciation for functional and well-conditioned tools.
4. Become safety minded concerning hazardous wood tools.

Ability to:	Teaching-Learning Activities
A. Measure and mark wood 1. Reading a rule 2. Measuring with a rule 3. Using a combination square 4. Using a steel square a. Laying off angles b. Squaring corners of projects, frames and forms. c. Testing and correcting a square d. Using the tables on squares 5. Using adjustable T level 6. Using a marking gauge 7. Using chalk line 8. Using plumb bob 9. Using a level 10. Testing a level for accuracy 11. Measuring width of openings 12. Using a compass	A. Show the film A. B. C. of HAND Tools (Number 1 film only). Have students cut a set of rafters with various pitches and nail them on plates three feet apart (utility lumber can be used)
B. Saw wood 1. Types of hand saws a. Cross cut saw b. Rip saw c. Back saw d. Compass saw	B. Show different types and sizes of saws, explaining their uses and characteristics. Make a large cross cut saw tooth and a rip saw tooth out of a 1" x 6" board. Use these enlarged teeth to show differences in saw teeth. Have students saw lumber with each type of saw. Place boards on saw horses for demonstrations and practice in sawing.

Ability to:	Teaching-Learning Activities
2. Use hand cross cut saw a. Placing and holding board b. Starting cut: grip, body position c. Type and angle of stroke d. Procedure in finishing cut	Have students practice cutting lumber properly using each type of saw.
3. Using a hand rip saw 4. Using a back saw a. Holding board b. Starting saw: grip, body position c. Type and angle of stroke 5. Using a compass saw a. Methods of holding board b. Methods of starting saw c. Sawing curved lines	Students build a bench hook from materials used in sawing practice. Teacher and selected students demonstrate correct procedures in rip sawing and cross cut sawing. (See Job Operation Sheet)
6. Use power hand saws a. Adequate safety precautions b. Proper procedures when sawing with electric hand saw	(See Safety Precautions for Saws) Demonstrate uses and safety measures of the table and radial arm saw. See: Wakeman, T. T.;and McCoy, V. L., The Farm Shop, pp. 268-299. Jones, Mack M., Shopwork on Farm, pp. 137-157, 161-164. Mix; Floyd and Moore, Farm Mechanics Power Tool Manual, pp. 7-49.
7. Use table or radial arm saw a. Using adequate safety precautions b. Adjusting saw to thickness wood c. Adjusting rip fence d. Adjusting miter gauge e. Making dados and rabbets	
C. Plane wood 1. Different types of planes a. Jack plane: uses b. Smooth plane: uses c. Jointer plane: uses d. Block plane: uses e. Other types	C. Show types of planes and demonstrate how each is used. Have students practice using each type of plane properly. Hand in an exercise in which at least three different planes have been used.

Ability to:	Teaching-Learning Activities
2. Assembling the plane 3. Adjusting the plane a. Depth of cut b. Lateral adjustment c. Adjustment of lever cap screw	Hand in exercise in which students have to plane one side of a board and then saw off one end checking that the sawed and planed edges are square. (See Job Operation Sheet)
4. Using the plane a. Holding the board properly b. Proper grip and position c. Planing board: direction of grain, forward stroke, return stroke 5. Precautions in planing a. Condition of blade: dullness nicks, high corners b. Incorrect adjustment c. Nails in boards d. Position when not in use	
6. Using the jointer a. Adequate safety precaution b. Adjusting for depth of cut (1) Rear table set level with top of knives	Demonstrate the proper use of jointer to class. See: Wakeman, T. I; and McCoy, V. L., The Farm Shop, pp. 303-312. Jones, Mack M., Shopwork on the Farm, pp. 170-182. Mix, Floyd, and Moore, Farm Mechanics Power Tool Manual, pp. 108-124.
D. Sand wood surfaces 1. Selecting kinds and grades of sanding materials 2. Methods of holding sanding materials 3. Sand flat surfaces 4. Sand round or irregular edges 5. Precautions: using with grain, using as final smoothing operation	D. Display collection of sanding materials, demonstrate how to use, and have students practice using the materials.
E. Use wood chisels 1. Selecting chisels: tang and socket type; common sizes, etc. 2. Keeping chisel sharp 3. Chiseling with the grain	E. Show the use of the different types and sizes of chisels. See: Jones, Mack M., Shopwork on the Farm, pp. 81-91.

Ability to:	Teaching-Learning Activities
4. Chiseling across grain 5. Cutting curves with chisel 6. Using the mallet 7. Paring chamfers 8. Making dados and rabbets 9. Gaining in for butt hinges	
F. Bore and drill holes in wood 1. Types of boring tools a. Braces: ratchet and non-ratchet types b. Automatic push drill c. Hand drill d. Electric hand drill e. Drill press 2. Boring with auger bit a. Starting the auger bit b. Boring to depth c. Finishing the hole d. Counterboring 3. Drilling with twist drills a. Hand drills b. Electric hand drills 4. Drilling with automatic push drill 5. Drilling with drill press 6. Power bits (for wood)	F. Show the advantages and disadvantages of each type of boring tool.
G. Fasten wood with nails 1. Sizes and types of hammers: bell-faced, plain-faced, ripping 2. Driving nails with a hammer 3. Pulling or removing nails 4. Clinching a. Length to project through surface b. Direction of bending 5. Setting nails 6. Draw nailing 7. Toenailing 8. Preparing nails to prevent splitting 9. Placement of nails for strength and to prevent splitting 10. Holding power of different kinds and sizes of nails	G. Show class different types of hammers used and the characteristics and uses of each. Have all students do a practice exercise using different kinds of nailing and types of nails. Show examples of correct and incorrect method of nailing and proper use of the different kinds of nails.

UNIT NO. 5: Using Wood Working Tools

Ability to:	Teaching-Learning Activities
H. Fasten wood with screws 1. Selecting screws for a particular job a. Proper length and diameter b. Proper head c. Proper finish 2. Determining sizes of holes to drill 3. Locating and drilling holes 4. Selecting and using proper type and safe screw drivers for the job: standard, off-set, Phillips, ratchet and screw driver bit	H. Display chart showing proper size hole to drill for various screw sizes. Show samples of jobs with screws used correctly and incorrectly.
I. Fasten wood with glue 1. Kinds of glue 2. Application of glue 3. Clamping pieces together 4. Doweling	I. Demonstrate how to apply glue and hold with clamps.
J. Fasten wood with corrugate fasteners 1. When to use corrugated fasteners 2. Proper method of driving	
K. Shape curved and irregular surfaces 1. Using the draw knife 2. Hewing to shape 3. Using the spokeshave 4. Using wood chisels 5. Whittling 6. Using rasps, files, and Stanley tool 7. Sawing curves (see section on sawing) 8. Planing a piece round 9. Fitting board against irregular surface	K. For practice in shaping wood, have students make file handles.
L. Construct farm woodworking project using hand tools (Use project plan drawn in first unit of woodworking area.) Select from among tool box, carry-box, etc.	L. (See Job Operation Sheet)

UNIT NO. 5: Using Wood Working Tools

Ability to:	Teaching-Learning Activities
M. Construct more advanced wood-working project using combination of hand and power tools, such as: livestock feeders, gates, farrowing crates, tool cabinet, work bench, picnic table, saw horse, etc.	M. Have student construct simple projects in shop which they may need at home. (See Job Operation Sheet)

REFERENCES:

Cook, 380 Things to Make, 500 More Things to Make, 600 More Things to Make, Chapter 10,11.

Jones, Mack M., Shopwork on the Farm, Chapter 3.

Phipps, L. J., Mechanics in Agriculture, Chapter 4.

Phipps, L. J.; and J. A. Jenns, Ideas for Farm Mechanics Projects and Activities.

Phipps, L. J.; N. F. McColly; L. L. Scranton; and G. C. Cook, Farm Mechanics Text and Handbook, 1959, Chapters 6-11.

POWER SAW SAFETY PRECAUTIONS

1. No student is to use the circular saw unless properly authorized to do so by the instructor.
2. The top guard must be kept down over the guard at all times. Be sure that it will move freely up and down when work passes under it.
3. The saw blade must not extend more than 1/8 inch above the stock when stock is being cut.
4. The splitter guard must be raised above the table at least as high as the saw blade when ripping stock.
5. Be sure that all fences and tilting devices are securely fastened before power is turned on.
6. The edge of the material, which will run against the fence or meter gauge, must be square and true.
7. All adjustments must be made when saw is at a dead stop.
8. Make certain that saw table and the floor around the saw is clear of scraps and materials before power is turned on.
9. Sliding table must be securely locked except when in use.
10. All special setups and dado heads must be inspected by the instructor before power is turned on.
11. Be sure that saw on tilting arbor will clear both sides when sawing angles before power is turned on.
12. Always clamp stops securely on table when cut is shorter than length of stock.
13. Do not use a dull blade.
14. Have saw running at full speed before starting work.
15. Do not cut used stock, stock with knots, stock with warp, stock with wind, or stock with checks or splits.
16. No board under 12 inches in length may be ripped on the saw.
17. Re-sawing must never be done on the circular saw.
18. Cylindrical stock must not be cut on the circular saw.
19. A clearance block must be securely fastened to the ripping fence when using the fence as a stop for cross-cutting.
20. A push stick must be used when ripping stock into pieces less than 4 inches in width.
21. Stand to one side of the saw when turning on power.
22. Do not stand directly in back of the saw when cutting stock.
23. No stock is to be ripped without the use of the ripping fence or cut off without the use of the sliding crosscutting fence.
24. Do not overcrowd or bind the saw.
25. Never pull material through a circular saw.
26. Do not place your hands in front of or over moving blade.
27. Never attempt to clear away scraps close to the saw with your fingers. If they must be cleared away, permit saw blade to come to a dead stop or use a push stick at least ten inches long.
28. When helping to "tail-off" the saw, students must never pull on a board being ripped. They should hold board up and allow the operator to push the stock through.
29. Stock must never be lowered over a blade unless a stop block has been securely fastened to the table of the saw.
30. The dado head must be taken off the saw after use.
31. Stop the saw when you are through using it, or when going on an errand.
32. Clear saw table and floor around saw after use.

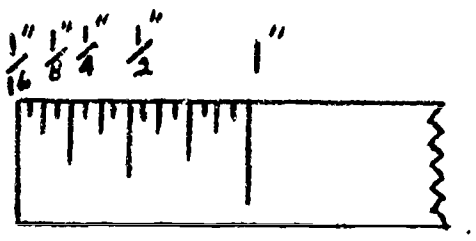
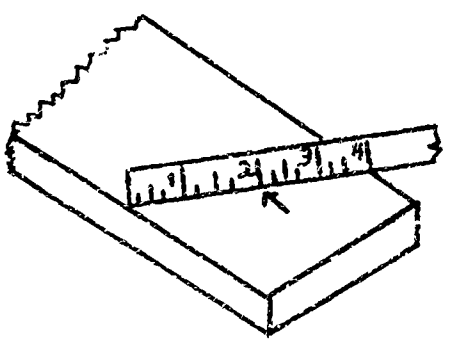
SKILL SAW SAFETY PRECAUTIONS

1. Never attempt to use this saw for sawing a short piece of work.
2. The operator must keep his hand away from the saw track at all times.
3. Do not attempt to saw a piece of lumber unless it is clamped or held securely to the saw horses.
4. Do not cut a piece of board deeper than specified by the guide book; 2" "depth of cut" for a 6" saw.
5. Grasp the handle firmly and rest the front of the shoe on the work before starting the motor.
6. Be sure that the saw blade teeth are not contacting the wood before turning on the motor.
7. Never force the saw any faster than it can cut.
8. Follow your guide line by watching the front right hand edge of the shoe.
9. Avoid using dull or incorrectly set blades.
10. If motor stalls, do not release switch, but back saw out until saw regains full momentum. Then either stop saw or start cutting again.
11. As a cut is completed, release switch and allow the blade to come to a complete stop before lifting the saw from the work.
12. Use the proper blade for the job to be done.
13. When changing blades, be sure the blade is properly seated and holding screw tight.
14. Make all set-ups before starting the saw.
15. Use motor housing for an extra left hand grip.
16. Never remove the telescoping lower blade guard.
17. Before making an inspection or adjustment, disconnect the cable plug.
18. Always disconnect the saw when not in active use.
19. Connect "grounding" wire to a ground (water pipe, conduit, etc.) before plugging in.
20. If extension is to be used, it should be at least #16 gauge wire to prevent loss of power and overheating.
21. Coil the cable around the saw and avoid dragging across sharp surfaces.
22. Avoid using the cable for a handle to lift the saw.

JOB OPERATION SHEET

UNIT NO. 5: Using Wood Working Tools

JOB: Measuring and Marking Wood

What To Do	How To Do It
A. Reading a rule 	1. The graduation lines on a rule are varied in length for quick and accurate reading. 2. The 1 inch lines are longest, the 1/2 inch lines a little shorter, the 1/4 inch still shorter, etc.
B. Measuring with a rule	1. To measure a distance between two points, place the end of the rule even with one, and read the measurement on the rule at the other point. 2. Mark points on the wood with a knife or pencil when laying out measurements. 3. For extremely accurate measurements, lay the rule on the edge so the graduations touch the work.
C. Marking wood 	1. To locate and mark the middle of a board, place the rule across the board at an angle so that major divisions, coincide with the edges of the board, and mark midway between these two major divisions. 2. Use a pencil, and a straight edge to mark the work between 2 points. 3. Angles can be marked using a square or T-bevel, and a marking gauge and combination square may be used for gauging.

JOB OPERATION SHEET

UNIT NO. 5: Using Wood Working Tools

JOB: Using Hand Saws

What To Do	How To Do It
A. Holding the saw	1. Grasp the handle firmly. 2. Extend the forefinger along the side of the handle, not through the handle with the other fingers.
B. Sawing position	1. Stand back from the work a little and in a position so that a line across the chest and shoulders is at an angle of 45 to 60 degrees with the line of sawing. 2. Place the saw arm elbow, shoulder and eye all in the same vertical plane.
C. Holding the work	1. The wood should be held securely so that it does not move. 2. Hold it in a vice, clamp, or hold firmly with the hand and knee.
D. Starting the crosscut saw	1. Grasp the far edge of the board, using the thumb to guide the saw while starting. 2. Start with 2-3 backstrokes, hold the blade square with the board. 3. Start the sawcut, or kerf, beside the line in the waste material, leaving the line.
E. Sawing off a board	1. Saw with long, easy strokes and light pressure. 2. Hold the saw at a 45 degree angle with the board. 3. When finishing the cut, to avoid splintering, hold up the outer end of the board and use short, easy strokes.

UNIT NO. 5: Using Wood Working Tools

JOB: Using Hand Saws

What To Do	How To Do It
F. Using a rip saw	1. Used about the same as a cross-cut saw, except used to cut lengthwise on a board and held at a 60° angle to the board. 2. If the saw binds while ripping, insert a wedge in the kerf.

JOB OPERATION SHEET

UNIT NO. 5: Using Wood Working Tools

JOB: Using a plane

What To Do	How To Do It
A. Adjusting the plane	1. Set the plane to cut about 1/64 of an inch, by adjusting the knurled nut just in front of the handle. 2. Check the adjustment by turning the plane upside down and note that the blade shows through evenly and just about the thickness of a sheet of paper.
B. Holding the plane	1. Grasp the handle with one hand and the knob with the other, palm on top. 2. Stand beside the work, with one foot slightly ahead. 3. As the plane is pushed forward, shift the weight to the forward foot. 4. Keep the forearm in line with the plane.
C. Securing the work	1. Hold the wood firmly so that it doesn't move. 2. Either hold it in a vise, clamp it, or hold it against a stopper on the bench.
D. Planing	1. Plane with the grain of the board. 2. To start the plane, press down firmly on the knob and push with the handle. 3. As the plane passes over the opposite end of the work, shift the pressure to the handle. 4. Continue this process until the work is smooth and true. 5. Planing can be done on the edge, end, or surface. Be sure blade is sharp and properly adjusted. Check frequently with a square or straight edge for trueness.

JOB OPERATION SHEET

UNIT NO. 5: Using Wood Working Tools

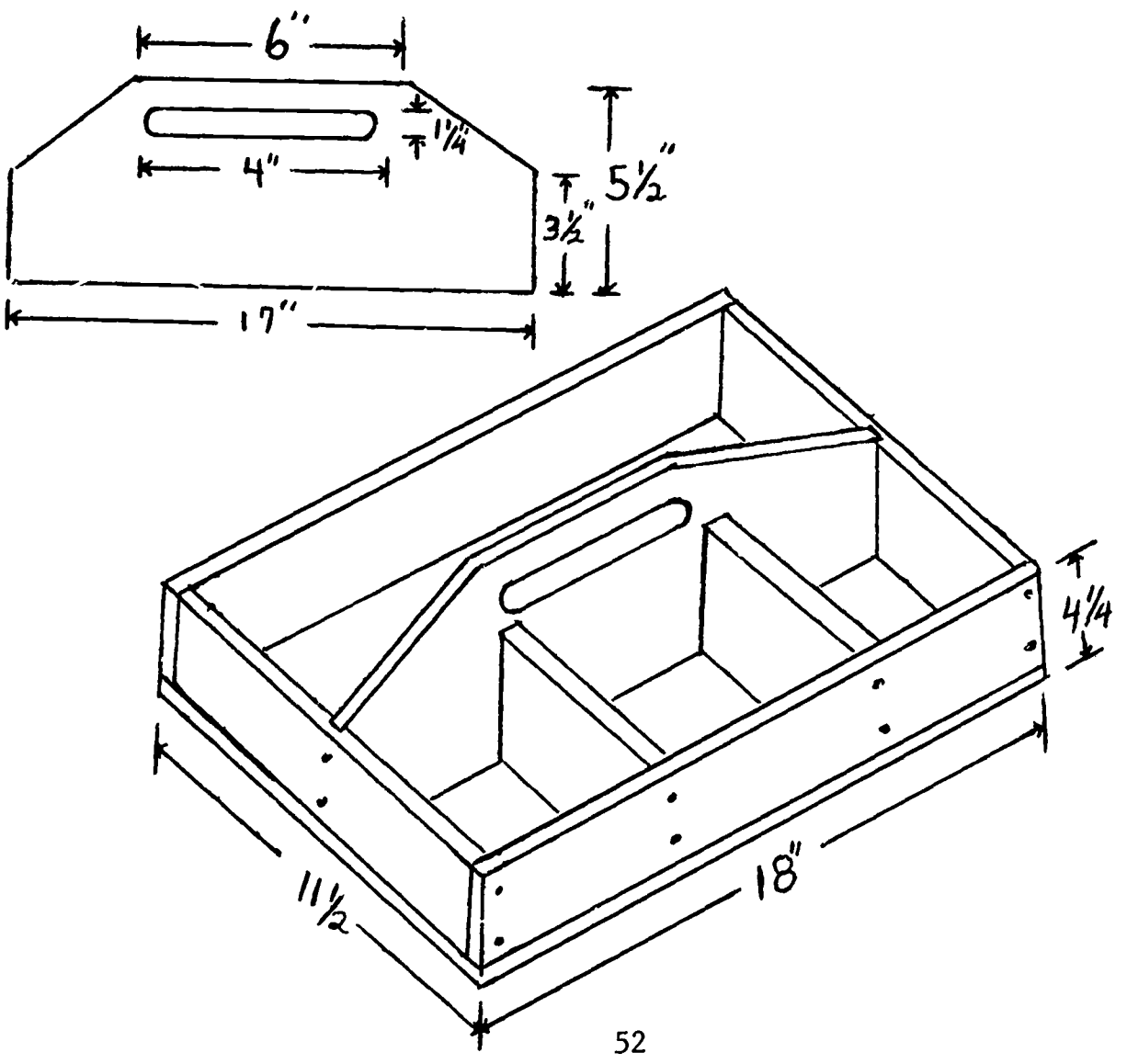
JOB: Making a Nail Box

What To Do	How To Do It
A. Cut all pieces to correct sizes	1. Get dimensions from drawing. 2. Measure accurately, draw lines with a try square. 3. Cut boards squarely with a hand saw. Do not cut lines off the board with your hand saw.
B. Square all boards	1. Use jack or smooth plane for edger with grain. 2. Use block plane for end grain.
C. Dado two end boards	1. Mark carefully using handle board for width. Handle must fit snuggly. 2. Cut with back saw. 3. Remove waste stock with wood chisel.
D. Cut finger slot in handle	1. Mark accurately for length and make center lines to mark place to bore holes. 2. Use proper size wood auger bit. Bore until feed screw starts through board, then complete the hole from the opposite side. 3. Remove waste stock between holes with a keyhole saw. 4. Square edges of slot with rasp.
E. Cut taper in handle board	1. Mark handle so that the taper will meet top of each end. 2. Be careful not to split handle board.
F. Sand all pieces	1. Sand with grain. 2. Remove all scratches, marks, etc.
G. Assemble box	1. Use 1 1/2" #7 flathead wood screw. 2. Attach ends of handle first, then two partitions to handle, then sides and last the bottom. Use two screws to attach bottom.

UNIT NO. 5: Using Wood Working Tools

JOB: Making a Nail Box

What To Do	How To Do It
H. Stain box light walnut color	1. Apply linseed oil to all end grain that shows, so that stain will not be too dark. 2. Brush oil stain on a small area and when the desired color is reached, wipe off excess stain. 3. All exposed surfaces should be the same shade of color. 4. Let dry for 24 hours.
I. Varnish box	1. Apply varnish to inside surfaces first, brushing out smoothly with the grain to avoid any runs. Be sure to cover all surfaces. 2. Place in dust free area to dry 24 hours.
J. Present to instructor for grade	



JOB OPERATION SHEET

UNIT NO. 5: Using Wood Working Tools

JOB: Sawhorse (power tool project)

What To Do	How To Do It
A. Cut all pieces to proper length and angle	1. Use framing square to determine exact angles to cut legs. Mark angles on scrap lumber, set angle on adjustable T bevel and set both angles in radial arm saw. 2. Determine proper length to cut each leg by adding the difference between the length of the hypotenuse and the longest leg of the right triangle for both angles of the leg. 3. Cut all 4 legs using the same setting of the radial arm saw. 4. Cut the 2 x 6 end pieces for style A sawhorse using the same angle as the bevel on the ends of the legs.
B. (Style A) Bevel the top and bottom edges of the two 3 foot side boards	1. Set the same angle on the adjustable T bevel as you used for the end bevel of your sawhorse legs. Set this angle on the jointer. 2. Set jointer to cut 1/32 " depth. 3. Join both edges so they are parallel to each other.
C. (Style B) Notch the edges of the 2 x 6 to receive the 1 x 4 legs	1. Set the same angle on the adjustable T bevel you used to cut the bevel on the end of your sawhorse legs. 2. Mark on the end of the 2 x 6 the angle of your notch. It should be in 3/4" at the top so the outside edge of the leg will be in line with the outside edge of the 2 x 6. 3. Set the same angle on the adjustable T bevel that you used to mark the angle on the side of each leg. Use this angle to mark the slope of the notch for each leg. The legs must have a very snug fit.

UNIT NO. 5: Using Wood Working Tools

JOB: Sawhorse (power tool project)

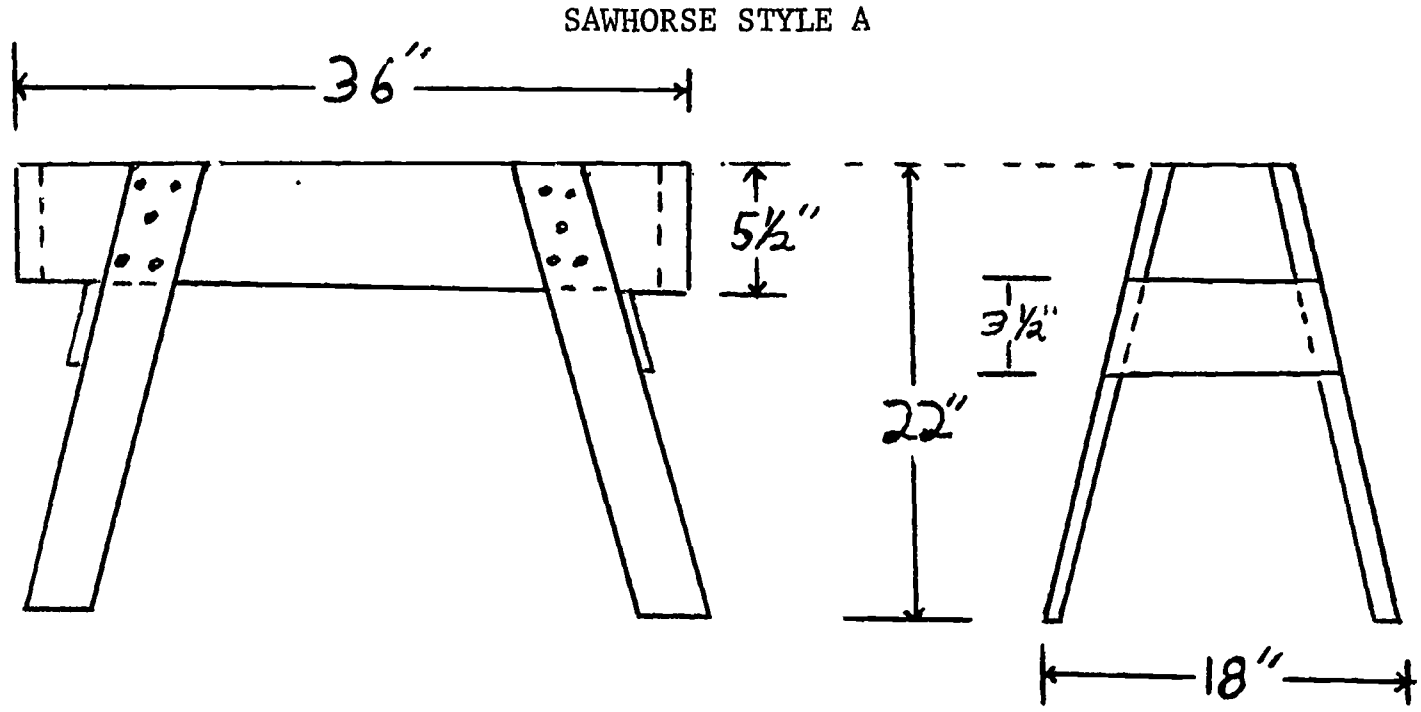
What To Do	How To Do It
	3. (continued) Cut the notch about 1/32 inch narrow. When notch is complete plane off the side of the end of the leg that fits into the notch so it will fit into the notch when forced.
D. Bevel a board on both edges for end braces.	1. Set the angle described in C-3, above on the adjustable T bevel and set that angle on the jointer. 2. Make certain the angles of the bevel in each edge are parallel.
E. Put the pieces together	1. (Style A) Fasten the two side boards to the two 2 x 6 end pieces. Use 3 screws at each joint. 2. Fasten legs. Drill anchor hole, shank hole and countersink hole for each #10 1 1/2 inch flathead wood screw. Place 5 screws for each leg in Style A sawhorse, 3 screws for each leg in Style B sawhorse. 3. Spread sawhorse legs to proper width, mark leg brace boards for proper length and angle, cut with handsaw and attach with screws. Make certain each brace is up solidly against the top of the sawhorse.
F. Even sawhorse legs if necessary	1. Plane sawhorse on work bench or on level place on the floor and see if all legs touch the floor evenly. 2. If sawhorse rocks, cut off longest leg. Hold sawhorse so that 3 legs are firmly on the floor, measure the height the 4th leg is off the floor. Mark that distance on all 4 sides of the other leg at the same end of the sawhorse, and cut off carefully with a hand saw.

UNIT NO. 5: Using Wood Working Tools

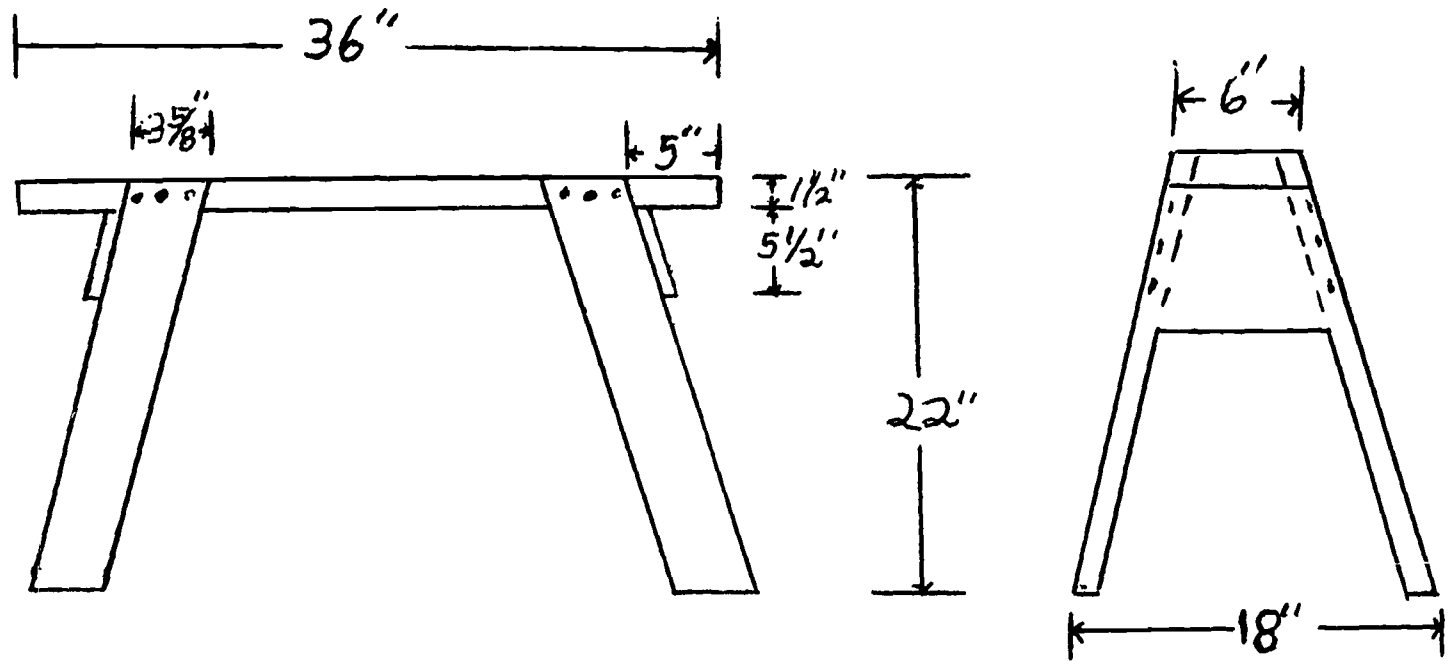
JOB: Sawhorse (power tool project)

What To Do	How To Do It
G. Sand and paint	1. See job operation sheet on painting.
H. Present to instructor for evaluation	

SAWHORSE STYLE A



SAWHORSE STYLE B



UNIT NO. 6: Painting

OBJECTIVES: To help the learner gain:

1. An understanding of what should be painted and when it should be painted.
2. A knowledge of the general types of paint and how they differ.
3. The ability to apply paint with brushes, rollers and sprayers.

Ability to:	Teaching-Learning Activities
A. Know the principles of painting 1. Value of painting: appearance, wear, increased real estate value 2. Number of coats or thickness of a good paint film 3. Characteristics of a good paint: durable, self-cleaning (outside paint), good hiding value, fast color, washable for most uses, easy to apply, etc. 4. Weather for painting: temperature, moisture conditions	A. Short tour of physical plant to point out good and poor examples of painting.
B. Types of paint 1. Outdoor types 2. Indoor types 3. Enamels 4. Implement paints 5. Concrete and masonry paints	
C. Know paint ingredients 1. Vehicles: linseed oil (boiled and raw), soy bean oil, tung oil, others	C. Show different ingredients of paints and demonstrate their characteristics in oil. Show samples of various types of paints such as white lead-linseed oil base, resin base, cement base, varnish, enamel, synthetic bases.
D. Prepare surfaces for painting 1. Tools to use 2. New wood surface 3. Wood surface with old paint job 4. Masonry surface 5. Metal surface 6. Filling cracks and holes 7. Removing dirt, grease, etc. 8. Sanding or scraping blistered or swollen paint.	D. Show paint failures where the surface was not properly prepared. (See Job Operation Sheet)

UNIT NO. 6: Painting

Ability to:	Teaching-Learning Activities
E. Select and care for painting equipment 1. Breaking in new brushes 2. Cleaning brushes and rollers 3. Storing brushes and rollers 4. Cleaning buckets and other equipment	E. Drill holes in brush handles for temporary storing in buckets. (See Job Operation Sheet)
F. Purchase and use paint for specific purposes 1. Knowledge of conditions to which paint will be submitted: type surface, weather, dirt, wear, moisture 2. Buying from reliable dealers - guarantees 3. Ingredients that are harmful to some paints: water and considerable inert pigments in white lead-linseed oil paints, etc. 4. Following exact directions on can when using new type paints	F. Paint a project. Have each student apply paint with brush and spray gun. Show how to use brush to paint edges of boards and windows. Demonstrate feathering for a smooth surface. (See Job Operation Sheet)
G. Apply paint with a brush 1. Selecting size and type of brush for purpose 2. Dipping brush 3. Removing excess paint 4. Holding brush 5. Applying paint: starting to paint, brushing out laps, painting difficult places, etc.	G. Encourage students to select, purchase, and apply paint for their room at home as improvement project.
H. Apply paint with a paint sprayer 1. Selecting appropriate sprayer and renting or purchasing it 2. Preparing and thinning paint 3. Adjusting sprayer: adjusting pressure, adjusting nozzle 4. Applying paint: amount, feathering out, starting and stopping 5. Cleaning paint spray equipment: method, materials to use	H. Paint all farm machinery and other equipment brought in for repair. Demonstrate the proper method of adjusting and cleaning a paint sprayer
I. Apply paint with a roller 1. Selecting types and sizes 2. Applying paint	

UNIT NO. 6: Painting

Ability to:	Teaching-Learning Activities
J. Recognize and control different paint failures 1. Alligatoring 2. Bleeding 3. Blistering and peeling 4. Cracking and scaling 5. Running and sagging 6. Wrinkling 7. Tackiness and slow drying 8. Failures due to certain kinds of woods	J. Show samples of wood with different paint failures or take field trip to see paint failures.

REFERENCES:

Jones, Mack M., Shopwork on the Farm, 1955, Chapter 6.
Phipps, L. J., Mechanics in Agriculture, Chapter 11.
Phipps, L. J.; N. F. McColly; L. L. Scranton; and G. C. Cook, Farm Mechanics Text and Handbook, 1959, Chapter 12, 13, 14.
Maintenance and Buying Guide, Pittsburgh Plate Glass Company, Paint Division, Torrance, California.
The ABC's of Spray Equipment, The DeBilbiss Company, Toledo, Ohio.
Wakeman, T. I., The Farm Shop, 1960, Chapter 12.

JOB OPERATION SHEET

UNIT NO. 6: Painting

JOB: Preparing to Paint and Painting

What To Do	How To Do It
Prepare the Surface	
A. Clean	1. Clean off mud, dust, grease, plaster, rust or loose scaly paint with wire brush, turpentine, gasoline, solvent, sandpaper, blowtorch, liquid paint remover or soap and water.
B. Dry	1. Naturally or with compressed air.
C. Repairs	1. Replace any broken parts, make sure all parts are correctly fastened, seal against moisture as completely as possible.
Prepare the Paint	
A. Remove lid	1. Don't damage lid or can. 2. Use old screwdriver.
B. Pour off the free oil	1. Into a clean container.
C. Mix the remaing paint	1. Stir in a circular motion until smooth and creamy.
D. Stir in the free oil	1. Very gradually, make two or three small additions.
E. Thin when needed	1. Follow manufacturer's directions, don't guess.
F. Complete the mixing	1. Pour paint back and forth from one pail to another several times
G. Strain	1. Use window screen or cheese cloth - strain into paint bucket.

UNIT NO. 6: Painting

JOB: Preparing to Paint and Painting

What To Do	How To Do It
Painting With a Brush	
A. Hold brush	1. Hold brush lightly with long part of handle resting in hollow between the thumb and first finger. 2. Ends of the fingers should be well up on the ferrule, but not touching the bristles.
B. Dip and remove brush	1. Dip 1/3 to 1/2 the length of the bristles. 2. Remove excess paint by gently tapping brush on the side of the pail.
C. Stroke	1. Use long sweeping strokes. 2. Feather strokes by bringing brush down to surface and removing from surface gradually. 3. Brush paint out well to form an even coat.
D. Where to start and finish	1. Start at the top of surface and at one edge, work across and down. 2. Try to finish day's work at an edge or other natural break in the surface if job cannot be completed.

JOB OPERATION SHEET

UNIT NO. 6: Painting

JOB: Cleaning a Paint Brush

What To Do	How To Do It
A. Remove paint from the brush.	1. Wipe out excess paint with old rags or paper towels. 2. Rinse in solvent twice or as often as necessary to completely remove all paint. a. Oil paint, varnish or enamel, rinse in turpentine or paint solvent. b. Latex or water thinned paints; rinse in running water. c. Shellac; rinse in alcohol. d. Lacquer; rinse in lacquer thinner.
B. Remove cleaning agent from brush	1. Wipe out excess cleaning agent with rag or paper towel. 2. Wash in warm soapy water. 3. Rinse in warm water. 4. Leave small amount of soap in to preserve brush.
C. Shape bristles	1. Straighten and smooth by hand.
D. Put on paper jacket	1. Keep bristles straight.
E. Store	1. Let dry at room temperature. 2. Hang in a vertical position, bristles down.

JOB OPERATION SHEET

UNIT NO. 6: Painting

JOB: Staining and Varnishing

What To Do	How To Do It
Applying Oil Stain	
A. Select materials	1. This exercise is for an oil stain; select a suitable one. 2. Test the stain on a piece of waste stock of the same kind that is to be stained.
B. Prepare materials	1. If the stain is too dark, it may be lightened by adding linseed oil and turpentine. 2. Apply a coat of linseed oil to the end grain of all parts to be stained. (This prevents the open grain from becoming too dark)
C. Apply the stain	1. Apply the stain with long, even strokes from the middle out toward the ends. 2. Do not allow stain to build up at the middle by overlapping brush strokes. 3. Stain the inside and lower parts of the project first, leaving the top until last.
D. Remove excess stain	1. When the stain has remained on the surface for a minute or two, remove the surplus with a dry cloth, rubbing with the grain. 2. The degree of staining can be increased by letting the stain remain longer before wiping off.
E. Allow to dry for 6 hours	
Varnishing	
A. Select materials	1. Use a clean, dry, fine-bristled brush. 2. Use varnish suitable for the project and for the use of the project.

UNIT NO. 6: Painting

JOB: Staining and Varnishing

What To Do	How To Do It
B. Prepare materials	1. Make sure the surface is clean, dry, and smooth. 2. Varnish usually does not need to be thinned; but should it become necessary, use pure turpentine.
C. Apply varnish	1. Dip brush in varnish one-half to two-thirds the length of the bristles. 2. Draw the brush lightly over the edge of the can to remove the surplus varnish. 3. Since varnish does not dry quickly, it may be brushed out well to ensure an even coat. (Avoid brushing quick drying varnish)
D. Allow to dry thoroughly	1. Slow drying varnish requires from 24 to 48 hours. Quick drying varnish dries in 6 to 8 hours. 2. Let dry in a completely dust-free area.
E. Fine finishes	1. For a very smooth surface the first coat may be rubbed down with No. 6-0 finishing paper and a second coat applied. 2. Consult references for means to produce fine finishes on furniture.

UNIT NO. 7: Cold Metal Work

OBJECTIVES: To aid the learner to:

1. Know what common tools are used when working with cold metal and how to use these tools properly and safely.
2. Gain an understanding of the uses and limitations of tools involved.
3. Develop an ability to match tools and jobs.

Ability to:	Teaching-Learning Activities
A. Measure and mark metal 1. Measuring devices a. Awl b. Scriber c. Prick 2. Marking devices a. Punch b. Center punch c. File d. Soap stone	A. Define terminology and explain fundamentals of cold metal work.
B. Bend mild steel 1. With hammer and anvil 2. In a vise 3. Using piece of pipe 4. With bending machines	B. Demonstrate all metal working skills and try out at least one learner on each skill.
C. Cut cold metal to length and shape 1. Using cold chisel: shearing thin bars and sheets, cutting thick bars and round stock in the vise and on the anvil	C. (See Job Operation Sheet)
2. Using hacksaw: type and sizes of hacksaws and blades, choosing blade and putting in frame, starting cut, holding saw, speed of sawing, holding the work	Show how to insert blade and tighten in frame. Show how number of teeth per inch effects the job to be done. (See Job Operation Sheet)
3. Using bolt cutters and clippers 4. Cutting tool steel: using hacksaw or chisel 5. Cutting slots: drilling holes, cutting between with hacksaw 6. Using metal shears	
D. Punch holes in thin metal 1. Using solid punch 2. Using hollow punch	D. Demonstrate proper techniques of using a hammer and punch.

UNIT NO. 7: Cold Metal Work

Ability to:	Teaching-Learning Activities
E. Drill holes in metal 1. Selecting drilling equipment; electric drill, drill press, hand drill 2. Locating hole, marking and center punching 3. Counter sinking 4. Choosing proper size and type of drill bit for the work 5. Holding metal while drilling: methods, safety precautions 6. Drilling metal: speed, pressure, using coolant and lubricant, precautions 7. Drilling holes in round rod or pipe 8. Drilling holes in thin metal 9. Drilling extra large holes	E. Have students practice on scrap pieces. Use uniform class exercises on each major skill to check student performance (See Job Operation Sheet) Show how to prevent injury while drilling short pieces. (See Safety Precautions)
F. Select, care for, and use files effectively 1. Classifying files a. Shape, style or use: mill, flat, round, half round, etc. b. Size of file c. Kind of teeth: single cut, double cut, rasp d. Cut or size of teeth: coarse, bastard, second cut, etc. 2. Caring for files: storing, cleaning 3. Holding the file: position of hand and body, holding the material, using handles on all files. 4. Using the file a. Speed and pressure of strokes and backstrokes 5. Filing a surface flat and true 6. Drawfiling 7. Filing soft metal 8. Filing cast iron	F. Show several different kinds, sizes, and types of files and demonstrate how each is used. Have students select files for a particular job and give complete description of the file selected. Demonstrate how to do special filing jobs. Each student use files to dress metal working projects. (See Job Operation Sheet)
G. Thread bolts and nuts 1. Making a bolt a. Selecting rod: diameter, length, kind of material b. Selecting the proper kind and size of die for the job: N. C., N. F. c. Tapering the rod	G. Demonstrate cutting threads. Have each student make a bolt and nut using the various tools to measure, mark, drill, cut, shape and thread. (See Job Operation Sheet)

Ability to:	Teaching-Learning Activities
d. Threading the rod: holding rod, starting die, lubricating, unclogging, removing die e. Cleaning die 2. Making a nut a. Selecting tap: Size, kind of thread (N. F. or N. C.), kind of tap (taper, plug, bottoming) b. Selecting metal for nut: length and width, thickness c. Drilling proper size hole d. Tapping threads: holding nut, starting tap, unclogging, removing tap	
3. Reconditioning damaged bolt and nuts	Each student recondition two or more bolts and nuts.
4. Tapping threads in a blind hole using taper, plug and bottoming taps	Demonstrate how to remove bolt broken off flush with threaded surface.
H. Countersink and counterbore metal	
I. Ream holes in metal	
J. Construct cold metal projects in the school shop 1. Make: 1/2" bolt 8" long with nut 2. Recondition and/or repair: bolts and nuts, screw drivers, pieces of farm machinery, trailers, etc. (See suggestions in Farm Mechanics Skills Workbook)	J. After acquiring the basic cold metal skills, each student make or repair one or more cold metal projects.
K. Use floor grinder and portable grinder 1. Safety precautions 2. Grinding metal on both types of grinders	K. Demonstrate how to hold large and small items for grinding Students calculate FPM for various grinders.

REFERENCES:

Jones, Mack M., Shopwork on the Farm, 1955, Chapter 12.
Phipps, L. J., Mechanics in Agriculture, Chapter 16.
Phipps, L. J.; N. F. McColly; L. L. Scranton; and G. C. Cook, Farm Mechanics Text and Handbook, 1959, Chapter 17, 18.
Wakeman, The Farm Shop, 1960, Chapter 4.

ELECTRIC HAND DRILL SAFETY PRECAUTIONS

1. When drilling in a horizontal position, do not use space between index finger and thumb for guiding twist drill.
2. Before drilling, be sure material is fastened securely.
3. Center punch metal before drilling.
4. Always remove key from check before starting electric hand drill.
5. Avoid "plugging in" the electric hand drill with the switch on.
6. Apply slow, uniform pressure when drilling.
7. Avoid overloading, may cause the drill to short and burn.
8. When the drill is breaking through the work, feed slowly.
9. Always stand in a comfortable position when using the electric hand drill.
10. Avoid letting the electric hand drill slip off the work and inflict bodily injury.
11. Always stop an electric hand drill when moving from one hole to another.
12. When using a wire brush or other accessories, be sure to guide the hand drill firmly on the work and do not let the drill run off the work.
13. Always disconnect the electric drill when not in actual use.
14. Check the cable frequently for flaws.
15. Avoid using the cable for a pick-up handle.
16. See that motor is properly grounded.

DRILL PRESS SAFETY PRECAUTIONS

1. Check to see that drill bit is running true before using.
2. Before starting to drill, always remove key from chuck.
3. When operating the drill press, be careful regarding loose clothing and long hair.
4. Do not attempt to shift belt from one pulley to another until machine has come to a complete stop.
5. Before starting to drill, be sure that material is firmly held to the press vise or clamped to the table.
6. Before starting to drill, center punch all work.
7. Keep the drill cool and sharp by using the proper lubricant for the job.
8. File burrs off drilled holes.
9. Brush chips away with a brush only, do not use hands or rags.
10. Before starting to drill, be sure that the table is level and head and table are securely clamped.
11. Never attempt to stop a revolving piece of work. Shut off the power and allow the press to stop.
12. When drilling thin material, clamp the material between two pieces of wood and then drill.
13. Do not throw on the automatic feed before the drill is started in the hole.
14. Always remove the chuck and taper shank drill with a drift (special tool).
15. When the drill is breaking through the work, feed slowly.
16. When a drill slips in the chuck, do not attempt to tighten it until the spindle has come to a stop.
17. Never strike a drill, chuck, or socket with a hammer. Use a piece of wood or a lead hammer.
18. When drilling large holes, always clamp the work securely to the table and use straps to prevent the work's tearing loose and causing injury.
19. In operating a drill press, do not lean over so far that hair or clothing may be caught in the revolving spindle or belt.
20. A block of wood on the drill table prevents drilling holes into the tables.
21. Stop frequently and remove metal chips when the hole being drilled becomes deeper than the flutes on the twist drill.
22. Always use the correct designated speed for the size drill used. Peripheral speed, 30 ft. per minute recommended.
23. See that motor is properly grounded..

JOB OPERATION SHEET

UNIT NO. 7: Cold Metal Work

JOB: Using a Cold Chisel

What To Do	How To Do It
A. Selecting the chisel	1. Always use a sharp chisel and one suited to the size of the job. 2. Use: a cape chisel for cutting key slots, round-nosed chisel for cutting round grooves, diamond point for cutting grooves, slitting chisel heavy sheet metal, oil drums, water tanks, etc., cold chisel for for shearing and nicking.
B. Beginning the cut	1. Tap the chisel once or twice to get the direction of striking then use firm, well-directed strikes. 2. Nicking the metal deeply, then breaking by bending usually is easier than cutting all the way.
C. Cutting on the anvil	1. Always use the chipping block, not the face because the face is hard and will damage chisel. 2. When using the hardy, do not strike the hardy with the hammer handle.
D. Cutting in the vise	1. Use a heavy vise, hold pieces firmly. 2. Hammer so that the force of the blow is against the stationary jaw of the vise. 3. Place cutting line even with top of jaws. 4. Keep chisel at angle of 60° to the cutting line.

JOB OPERATION SHEET

UNIT NO. 7: Cold Metal Work

JOB: Hand Hack Sawing

What To Do	How To Do It
A. Selecting the blade	1. There are three general kinds of blades available; all-hard, flexible, and high-speed steel. 2. In general, use blades with larger teeth for sawing thick pieces and soft metals and blades with smaller teeth for thin pieces and hard metals. 3. A general rule is use a blade that will have at least two teeth cutting at the same time.
B. Holding the work	1. A piece to be sawed should be held securely. 2. Using clamps or a vise, clamp the work tightly so it does not spring and vibrate.
C. Holding and using the saw	1. Hold the handle of a hand hacksaw in much the same way as you would hold the handle of a hand wood saw. 2. Hold the front of the saw frame with the left hand to help guide and apply pressure. 3. Use long, slow, even strokes. DO NOT work too fast; 40-50 strokes per minute. 4. Exert pressure on the forward stroke and release pressure on the backstroke. 5. Use long, slow, even strokes through the metal, slowing down further as you end the job.

JOB OPERATION SHEET

UNIT NO. 7: Cold Metal Work

JOB: Using an Electric Hand Drill and Drill Presses

What To Do	How To Do It
A. Center punching	1. Always start the drill in a center punch mark large enough to take the end of the drill. 2. Mark two (2) lines through the point you want to drill. Punch where the lines intersect.
B. Selecting bits	1. There are two (2) general classes of twist drills, carbon steel and high-speed steel. 2. It is a good practice to use high speed drills in the smaller sizes (up to 3/8 inch) and carbon steel for larger sizes.
C. Securing the work	1. DO NOT ATTEMPT TO HOLD PIECES BEING DRILLED WHILE DRILLING. 2. Use a wooden block under the work to prevent drilling the table. 3. Clamp the work securely using C clamps, and, for round pieces use blocks with a V notch, a drill vise, or stop bolts on the drill table.
D. Drilling	1. With electric hand drill a. Have the motor running when the drill is inserted in the punch mark. b. Apply cutting oil when the drill begins to cut. c. Ease up on pressure as drill begins to break through the work. 2. With drill press a. Use a proper drilling speed, depending upon: (1) Drill size - small drills fast, large drills slow. (2) Kind of metal - soft metals higher speed, hard metals slower speed.

UNIT NO. 7: Cold Metal Work

JOB: Using an Electric Hand Drill and Drill Presses

What To Do	How To Do It
	continued (3) Type of drill - RPM for high speed drills about twice as much as for carbon-steel. b. Apply cutting oil when the drill begins to cut. 3. Enlarging holes a. When using a small electric drill, drill a small hole first (pilot) then use a larger bit. b. Holes can be enlarged with a tap reamer, except this gives a tapered hole. 4. Thin metals a. Use a light pressure and high speed drilling. b. When possible, clamp metal between two pieces of wood and drill through both pieces to prevent gouging and distorting.

JOB OPERATION SHEET

UNIT NO. 7: Cold Metal Work

JOB: Filing

What To Do	How To Do It
A. Selecting the proper file	1. Choose the file to fit the job. 2. Select the file based on size, kind of teeth, shape or style, and degree of coarseness or fineness. 3. For rough, fast cutting, use a flat bastard (double-cut) 10, 12, or 14 inches. 4. For finer work, a mill bastard (single-cut) 8 or 10 inches. 5. For still finer, a mill smooth should be used.
B. Holding the file	1. For heavy filing, grasp the right hand, thumb on top. Hold the end of the file between the ends of the first two fingers and the base of the thumb on the left hand. Apply moderate to heavy pressure. 2. For light filing, hold the end of the file between the end of the thumb and the fingers of the left hand. Use light to moderate pressure.
C. Using the file	1. Use rather slow, full-length cutting strokes, lift the file or release the pressure on the backstrokes. 2. In heavy filing, push the file with a combination slow rhythmic swing from both the body and the arms. 3. For light filing use the same process with less pressure on the file. 4. NEVER use short, jerky, or seesaw strokes. Do not use a file for prying.

UNIT NO. 7: Cold Metal Work

JOB: Filing

What To Do	How To Do It
D. Cleaning the file	1. After every few strokes, tap the end of the file on the bench to shake the filings from the teeth. 2. Using a file brush or a file card, frequently brush the teeth of the file to remove soft cuttings, grease, and grime.

JOB OPERATION SHEET

UNIT NO. 7: Cold Metal Work

JOB: Making a Bolt (Threading and tapping)

What To Do	How To Do It
A. Select and cut materials	1. Cut a 6" length of 1/2" round stock with hand hack saw. 2. Cut two pieces 7/8" square from scrap 3/8" mild steel plates.
B. Cut 2 inches of NC thread on one end of the 1/2" round stock	1. Place the round stock in a vise in a vertical position. 2. Remove any burr on the end with a file. 3. Select the proper die and mount in the die stock. 4. Grasp the die stock in the center, place on the stock to be threaded, and holding it in a horizontal position, press down and turn in a clockwise direction. 5. When the die catches, pour a few drops of lard oil or cutting oil on the end of the work. Turn the die round and round without backing up until the thread is finished. (Apply more oil from time to time as required. If chips and cuttings clog the die, stop and clean the die). 6. To remove the die, simply screw it back off; clean out chips.
C. Cut 1/2" of thread on the other end of the stock	1. Repeat steps listed in B above.
D. Make head and nut from 7/8" square stock.	1. Find center by marking diagonal lines to each corner. 2. Center punch. 3. Drill hole 1/16" smaller than size of bolt stock, or refer to table. 4. Select proper taper tap and fasten it in tap wrench.

UNIT NO. 7: Cold Metal Work

JOB: Making a Bolt (Threading and tapping)

What To Do	How To Do It
	5. Hold piece to be tapped in vise with the top of the piece parallel with the top of the jaws. 6. Grasp the wrench in the center with one hand, place the point of the tap in the hole, holding it in a vertical position, press downward and turn to the right. 7. After the tap is started, turn with both hands, and apply threading oil as needed. Turn until the tapered part is all the way through the hole and the tap turns easily. 8. Stop and unscrew from the hole.
D. Braze head on bolt	1. Screw head on the end of stock with only 1/2" of thread. 2. Cut off any part of round stock that protrudes beyond head with hacksaw. 3. Heat to dull red color and let heat draw the braze rod from top of bolt down threads.

UNIT NO. 8: Pipework

OBJECTIVES: To aid the student
1. To become acquainted with materials and tools used in pipework.
2. To develop the ability to use pipe tools and materials properly.

Ability to:	Teaching-Learning Activities
A. Know pipe tools and their uses 1. Wrenches: types and sizes 2. Pipe cutters: types and sizes 3. Reamers: types and sizes 4. Pipe dies: types and sizes, methods of changing dies and adjusting. 5. Pipe vises: chain and hinged yokes	A. Use plumbing shop and tool catalogues to familiarize students with different types of tools than those available in the school shop.
B. Know the different kinds of pipe and their uses 1. How the diameter of pipe is measured: iron pipe, tubing 2. Black wrought iron pipe: sizes, uses 3. Galvanized wrought iron pipe: sizes, uses 4. Cast iron pipe: sizes, uses 5. Copper pipe and tubing: sizes, uses 6. Plastic pipe type, sizes, uses, advantages and disadvantages	B. Make demonstration panel of flexible and rigid copper tubing; plastic, galvanized, and black pipe and fittings. Take students to plumbing shop to study the different kinds of pipe and fittings.
C. Know the different pipe fittings and their uses: 1. Malleable iron fittings: standard and heavy duty, black and galvanized Tees, 45° ells, 90° ells, street ells, couplings, gate valves, globe valves, close nipples, shoulder nipples, etc. 2. Cast iron fittings 3. Copper pipe fittings 4. Copper tubing fittings a. Compression type b. Flange or flare type 5. Plastic fittings	C. After study and discussion, put 20 or more fittings on numbered squares for students to identify and determine sizes. Take trip to a job to observe a variety of pipe fittings being used.
D. Thread wrought iron pipe 1. Measuring 2. Holding pipe: methods 3. Cutting: pipe cutter, hack saw	D. (See Job Operation Sheet) (See Job Operation Sheet)

UNIT NO. 8: Pipework

Ability to:	Teaching-Learning Activities
4. Reaming: reamer, file 5. Threading	(See Job Operation Sheet) Each student make nipples, using different methods and different tools.
E. Install fittings on copper pipe 1. Cutting and reaming pipe 2. Cleaning pipe and fitting 3. Using flux 4. Heating pipe and fitting: blow torch, acetylene torch, etc. 5. Soldering or sweating the joint	E. Each student sweat a copper pipe fitting on a pipe. This may be done, if desirable, while working at soldering and sheet metal work. (See Job Operation Sheet)
F. Assemble pipe and pipe fittings 1. Determining fittings to use and where to use them 2. Determining the length of pipes necessary 3. Measure, cut and thread pipe to proper length 4. Tightening fittings: how tight to tighten, using threading compounds	F. Allowing for fittings and threads, each student determine the exact lengths of pipe for a specified pipe run. (See Pipe Fitting Exercise)

REFERENCES:

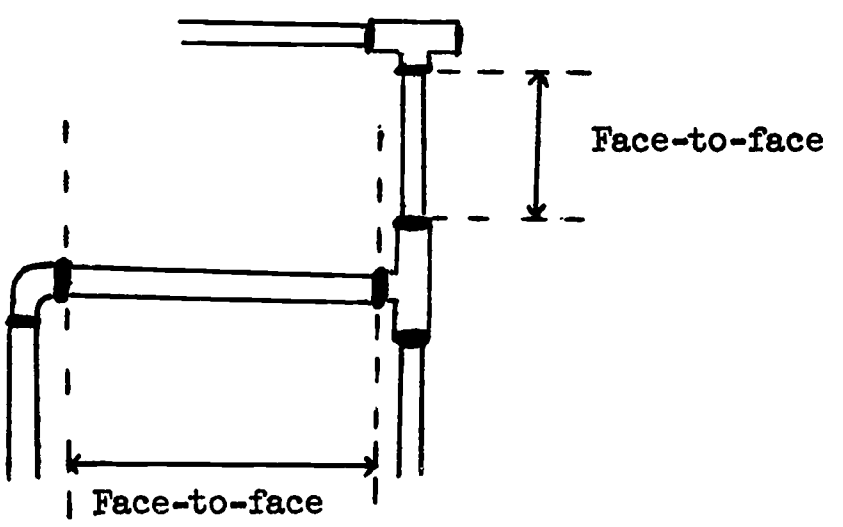
Jones, Mack M., Shopwork on the Farm, Chapter 15.
Phipps, L. J., Mechanics in Agriculture, Chapter 34.
Phipps, L. J.; N. F. McColly; L. L. Scranton; and G. C. Cook, Farm Mechanics Text and Handbook, Chapter 41.
Wakeman, T. I.; V. L. McCoy, The Farm Shop, Chapter 13.

JOB OPERATION SHEET

UNIT NO. 8: Plumbing

JOB: Measuring Pipe for Cutting

What To Do	How To Do It
A. Measure the pipe to the proper length for the job	1. The best method is face-to-face. Measure the exact distance from face-to-face of the fittings.
NOTE: Lengths should be cut very carefully, and allowances must be made for the threads needed to engage the fittings.	2. Refer to the table to determine the allowance necessary for threading. Remember, double this length is necessary for two ends.



Distance Screwed Into Fittings

Pipe Size	Standard	Drainage
1/2"	1/2"	
3/4"	1/2"	
1"	5/8"	
1 1/4"	5/8"	5/8"
1 1/2"	5/8"	5/8"
2"	3/4"	5/8"
3"		7/8"
4"		1"

JOB OPERATION SHEET

UNIT NO. 8: Pipework

JOB: Cutting Pipe for Threading

What To Do	How To Do It
A. Cut pipe with a pipe cutter	1. Tighten pipe in a pipe vise. 2. Loosen the cutter wheel by turning the handle until the cutter will slide over the pipe. 3. Place the cutting wheel exactly on the cutting mark and tighten the handle until the cutting wheel is forced slightly into the pipe. 4. Apply cutting oil to the cutter wheel and the pipe. 5. Rotate the cutter one complete turn around the pipe. 6. Tighten the cutter wheel and go around the pipe again. Repeat this operation until the pipe is cut. Remove the burrs with a pipe reamer or round file.
B. Cut pipe with a hack saw	1. Tighten pipe in a pipe vise. 2. Hold the saw at a 90 degree angle to the pipe, and make your cut with smooth, even strokes. 3. Remove the burrs with a pipe reamer or round file.

JOB OPERATION SHEET

UNIT NO. 8: Pipework

JOB: Threading Pipe

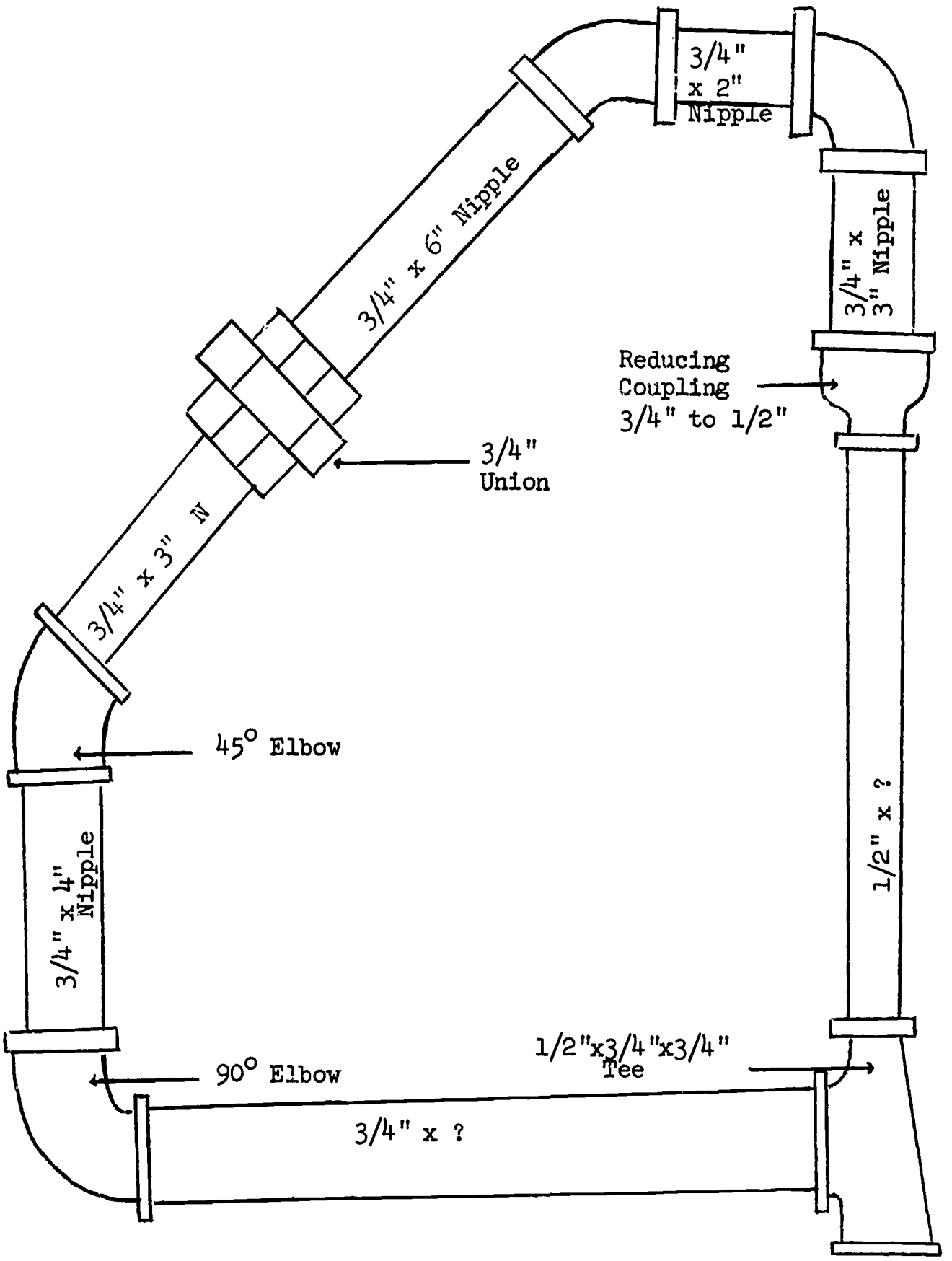
What To Do	How To Do It
A. Select the proper die	1. Each die is marked with its size. Select the same size die as the size the thread should be on the pipe.
B. Insert the die into the stock	1. Loosen the thumb nut on the stock, slide the cover plate over, insert the die. The stock contains a receptacle on one side in which the die sets. 2. Make certain the printing on the die faces up toward the cover. Slide the cover plate back in place and tighten the thumb nut. 3. Either an adjustable guide or an individual guide can be used. Each individual guide is marked for the size pipe it fits. Select the right size guide, insert it in the opening in the stock, and tighten it in place with the lock bolt. 4. The guide makes it possible to start the die squarely.
C. Holding the pipe	1. Place the pipe in the pipe vise. 2. Allow plenty of room to work, but close enough to keep the pipe stationary.
D. Starting the die	1. Slide the stock over the end of the pipe with the guide on the inside. 2. Push it onto the pipe until the die catches the pipe. 3. Turn the stock slowly in a clockwise direction keeping the die pressed firmly against the pipe.

UNIT NO. 8: Pipework

JOB: Threading Pipe

What To Do	How To Do It
E. Oil the die and threads	1. After cutting just enough thread so the die is firmly on the pipe, apply plenty of cutting oil to the threads of the die and those on the pipe. 2. Keep all threads oiled during the entire operation.
F. Threading the Pipe	1. Continue turning the stock, backing off about 1/4 turn after each 1/2 turn forward to clear away the chips. 2. Turn the die onto the pipe until about one thread projects through the die. NOTE: If the die is screwed on further, the end of the pipe that projects through will have straight threads instead of tapered threads. Pipe threads are tapered so that they will tighten securely into the fittings.
G. Remove the tool after threading	1. Turn the stock counter-clock wise to unscrew it. 2. Remove it from the pipe.
H. Clean the die.	1. Shake the cuttings from the die, as they will interfere with threading the next pipe. 2. Wipe the oil from the die and stock with a cloth before putting them away.
I. Clean the threads on the pipe	1. Using a wire brush, wipe the threads to remove the cuttings. 2. Wipe off excess oil with a cloth.

PIPE FITTING EXERCISE



JOB OPERATION SHEET

UNIT NO. 8: Pipework

JOB: Sweating Fitting on Copper Tubing

What To Do	How To Do It
A. Select and measure material to be joined	1. Cut a 4" piece from the material provided. Use a hacksaw. 2. Remove all burrs left by cutting.
B. Prepare the tubing	1. Clean the tubing back 1 inch on the end which will go into the fitting with steel wool. 2. Clean the inside of the fitting where the tubing will be inserted using steel wool. 3. Bring the material to a bright color.
C. Apply flux to tubing and fitting	1. Apply a thin coating of flux to the tubing with a small brush. 2. Apply a thin coating of flux to the inside of the fitting.
D. Join tubing and fitting together	1. Rotate fitting on tubing to spread flux evenly. 2. Be sure the fitting is in the proper position. 3. Remove excess flux with a cloth. 4. Place in a positioner to hold in horizontal position.
E. Apply heat evenly	1. Apply flame to the fitting, moving it back and forth. 2. DO NOT OVERHEAT. The correct temperature will be reached when the flux starts to bubble. 3. Remove heat and touch end of wire solder around edge of the fitting. If the temperature is correct, the solder will be drawn into the space between the tubing and fitting by capillary action. 4. Do not hold heat on the fitting after it is filled. 5. Remove excess solder with cloth.

UNIT NO. 8: Pipework

JOB: Sweating Fitting on Copper Tubing

What To Do	How To Do It
F. Allow to cool	1. Allow to cool before moving.
G. Examine solder	1. The solder should have moved to the end of the tubing inside the fitting. 2. There shouldn't be an excessive amount of solder around the fitting and the tubing.

Material Needed:

1. Copper tubing and fitting
2. Steel wool or emery cloth
3. Solder
4. Soldering flux
5. Small Brush
6. Acetylene-air torch or oxygen-acetylene welder
7. Lighter
8. Pliers
9. Positioner
10. Cloth

UNIT NO. 9: Hot Metal Work

OBJECTIVES: To Aid the learner

1. Gain a knowledge of the tools and equipment when working with hot metals.
2. Develop an ability to use the tools and equipment concerned properly and safely.
3. Develop an ability to shape and temper metal.

Ability to:	Teaching-Learning Activities
A. Know the characteristics of and be able to identify the metals commonly forged 1. Mild steel and wrought iron 2. Tool steels	A. Demonstrate how to identify these metals by spark test, fracture, hardness, color, sound. (See Job Operation Sheet) (See Safety Precautions in Unit 4)
B. Know the common forging tools and their uses 1. Gas forge and its parts 2. Anvil and its parts 3. Tongs: pickup, bolt, etc. 4. Hammers, kinds and sizes: ball pein, cross pein, straight pein, etc. 5. Anvil tools: hardy, hot cutter	B. Show how these different forge tools are used.
C. Light and adjust gas forge or heating torch 1. Lighting the forge and torch 2. Adjusting heat in forge and torch 3. Safety precautions of each	
D. Shape and temper tool steel 1. Colors to observe in heating 2. Heating and shaping 3. Annealing 4. Hardening before tempering 5. Tempering: methods, colors to observe	D. Forge a cold chisel or punch, or recondition an old tool to demonstrate these practices. (See Job Operation Sheet) Demonstrate tempering a cold chisel. Show the flow of colors. (See Job Operation Sheet) Make and use a color chart.
E. Construct and repair hot metal projects in school and home shop 1. Make: cold chisel and punch 2. Recondition or temper: Cold chisels and punches 3. Make eye bolts, hay hooks, gate hooks, etc.	E. After practicing the basic forging skills, each student make and recondition one or more projects. (See Job Operation Sheet)

UNIT NO. 9: Hot Metal Work

Ability to:	Teaching-Learning Activities
F. Learn glossary 1. Tempering 2. Annealing 3. Drawing 4. Upsetting	F. Have students search out the meanings of the terms.

REFERENCES:

Jones, Mack M., Shop Work on the Farm, Chapter 14.
Phipps, L. J., Mechanics in Agriculture, Chapter 15.
Phipps, L. J.; N. F. McColly; L. L. Scranton; and G. C. Cook, Farm Mechanics Text and Handbook, Chapter 17, 18.
Smith, Robert E., Units in Forging and Welding.
Wakeman, T. I.; and V. L. McCoy, The Farm Shop, Chapter 5.

JOB OPERATION SHEET

UNIT NO. 9: Hot Metal Work (or welding)

JOB: Identifying different metals by the spark test

What To Do	How To Do It
A. Select and prepare materials	1. Obtain different types of metals provided by instructor for this exercise. 2. (May use "Spark-O-Meter")
B. Lay out and set up materials	1. Use a power grinder that turns about 1750 R. P. M. with an 8 inch diameter grinding wheel. 2. Locate grinder in a dark corner of the shop. 3. Hold the metal in a position so that the sparks will be given off horizontally. 4. Apply the metal against the grinding wheel with about 1 to 2 lbs. pressure.
C. Become familiar with terms used in spark description.	1. Compare sparks from different metals held against the grinder wheel with sketch to learn terms.
D. Practice with known metals to learn to recognize metals by their spark characteristics	1. Low carbon steel a. Color white b. Average length of stream with power grinder 70 inch. c. Volume moderately large. d. Shafts in forks and appendages. e. Forks become more numerous and sprigs appear as carbon content increases. 2. High carbon steel a. Color white b. Average stream length with power grinder 55 inch. c. Volume large. d. Numerous small and repeating sprigs. 3. Alloy steel a. Color near grinding wheel will be straw yellow. b. Shafts may end in forks, buds, or arrows.

UNIT NO. 9: Hot Metal Work

JOB: Identifying different metals by the spark test

What To Do	How To Do It
	c. Frequently with break between shaft and arrow. Few, if any, sprigs. d. Color after about 1 foot away from grinder will be white. e. Average stream length with power grinder 60 inches. 4. White cast iron a. First color is red. b. Remainder will be straw yellow. c. Average stream length with power grinder 20 inches. d. Volume -- very small e. Sprigs finer than gray iron, small and repeating. 5. Gray Cast Iron a. First Color red remainder of spark is straw yellow. b. Average stream length with power grinder 25 inches. c. Volume small. d. Many sprigs small and repeating. 6. Malleable iron a. Color - straw yellow. b. Average stream length with power grinder 30 inches. c. Volume - moderate. d. Longer shafts than gray cast iron ending in numerous small repeating sprigs.
E. Practice with unidentified metal	1. Identify sample of metal furnished by observation of spark characteristics. Sample #1_____Why? Sample #2_____Why? Sample #3_____Why?

JOB OPERATION SHEET

UNIT NO. 9: Hot Metal Work

JOB: Tempering Hand Tools

What To Do	How To Do It
A. Locate materials and equipment.	1. Provide forge fire or welding torch; tongs; tempering bath (water, brine or oil); abrasive material (emery cloth, file, brick, etc.) 2. Set tempering bath in mellow light -- not brilliant or not dim.
B. Heat tool	1. Heat 3" to 4" of cutting end to a cherry red.
C. Harden point by quickly cooling	1. Plunge about 1" to 1 1/2" of end in bath, vertically. 2. While cooling, move sideways and about 1/2" up and down. 3. Remove when red has practically disappeared from upper part of tool.
D. Polish cool end	1. Polish one side of cooled tip quickly with emery cloth, or other abrasive.
E. Temper (soften) point to desired hardness	1. Watch (in proper light) band of colors move toward end of tool (light yellow followed by darker shades). 2. When desired color reaches tip, plunge 1" to 2" of end into bath and move up and down and sideways. 3. After most of heat has disappeared from upper part, immerse entire chisel. 4. Tempering colors to use: a. Yellow -- stone drills, woodworking tools, lathe tools, taps and dies. b. Brown -- hammers, center punches, prick punches, high carbon twist drills. c. Purple -- cold chisels. d. Blue -- screw drivers, picks.

UNIT NO. 9: Hot Metal Work

JOB: Tempering Hand Tools

What To Do	How To Do It
F. Testing for hardness	1. Test tool under usual working conditions. For example, sever spike nail or small mild steel rod with cold chisel. 2. If edge chips, it was tempered too hard. 3. If edge bends or mushrooms, it is too soft.

JOB OPERATION SHEET

UNIT NO. 9: Hot Metal Work

JOB: Making a Cold Chisel

What To Do	How To Do It
A. Locate materials and equipment	1. Forge fire, anvil, blacksmith hammer, three-cornered file, hacksaw, piece of tool steel 1/2", 5/8" or 3/4" in diameter, tongs to fit steel, ashes or lime.
B. Measure and mark stock	1. Measure desired length on stock. a. 6 1/2" long for 1/2" diameter stock. b. 7" long for 5/8" diameter stock. c. 7 1/2" long for 3/4" diameter stock. 2. Mark or score deeply with edge of file.
C. Cut stock	1. Place stock firmly in vise, with mark located 1/2" to 1" beyond jaws. 2. Saw stock about 1/2 through with hacksaw. 3. Turn stock 1/4" turn so the cut faces operator. 4. Strike sharply with hammer.
D. Heat stock	1. Place horizontally in fire. 2. Heat 3" to 4" of end to cherry red color.
E. Forge or shape point	1. Place heated end on face of anvil, with opposite end slightly raised, and strike firm blows. 2. Turn stock over and hammer both sides. 3. Rotate stock and strike edges to keep point from widening. (Point should not be more than 1/8" wider than stock) 4. Reheat when necessary, but 3 times should be enough. 5. Never heat tool steel above a yellowish red or hammer steel below a dull red.

JOB OPERATION SHEET

UNIT NO. 9: Hot Metal Work

JOB: Making a Cold Chisel

What To Do	How To Do It
F. Cut off tip	1. If tip of chisel is thin (less than 1/8" thick) or split from hammering, saw off 1/2" to 1" of point with hacksaw. 2. Or heat to cherry red and cut off with hardy or hot cutter.
G. Anneal chisel	1. Heat entire chisel to a cherry red. 2. Cool slowly in ashes, lime dry sand or other appropriate materials.
H. Dress chisel head	1. Round off head of chisel and smooth out rough edges and hammer marks with grinder or file.
I. Sharpen chisel	1. Sharpen point to 60° or 70° depending upon expected usage. 2. Use grinding gauge for checking.
J. Temper chisel	1. (See job sheet on tempering)

JOB OPERATION SHEET

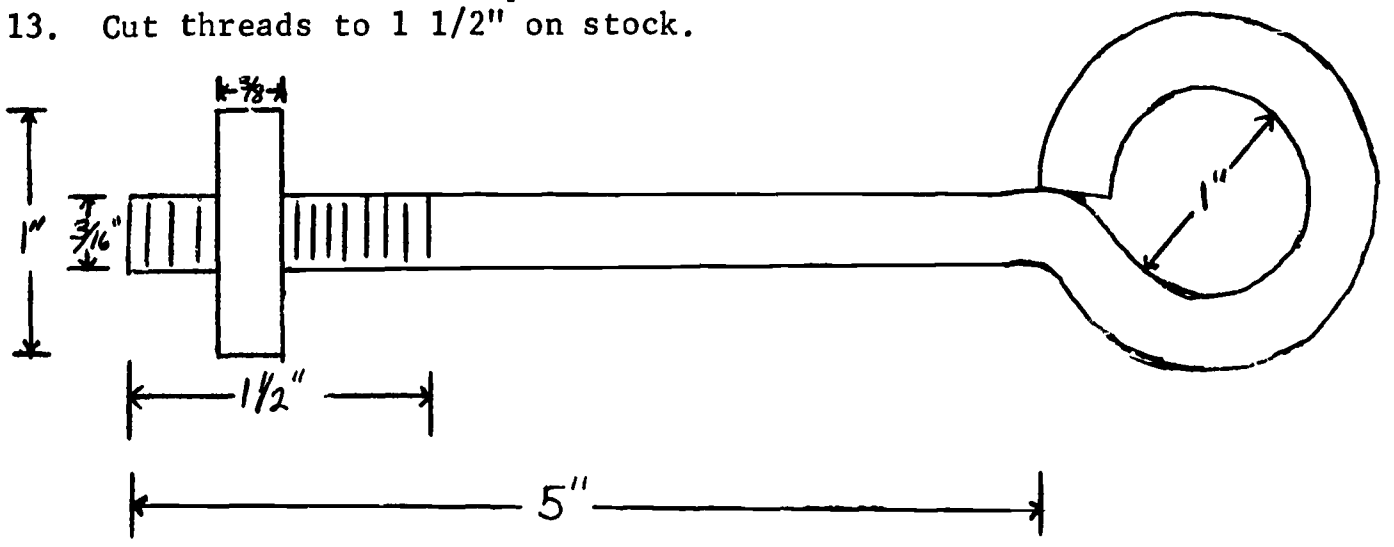
UNIT NO. 9: Hot Metal Work

JOB: Making an eyebolt and nut using the forge

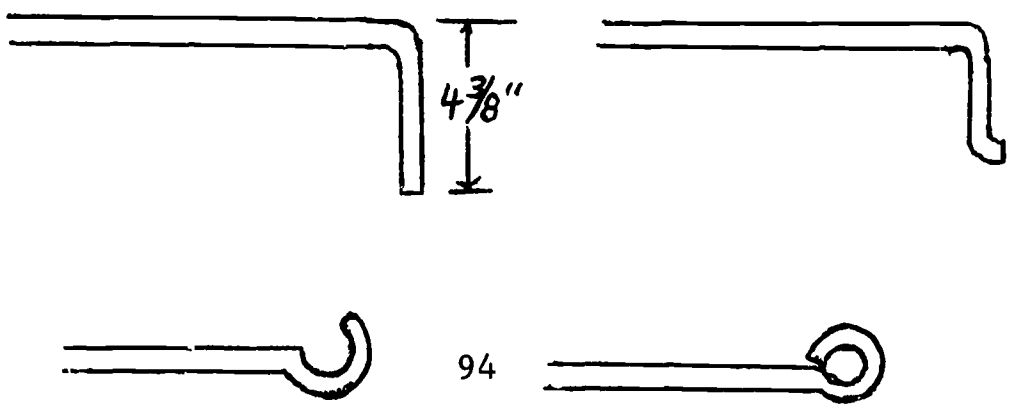
MATERIAL: 1 - 3/8" x 9" round mild steel
1 - 3/8" x 1" x 1" flat mild steel

PROCEDURE:

1. Estimate the amount of stock needed for turning a 1" eye by the use of the following formula:
   length of stock = (inside diameter) + (diameter of stock) x 3 1/7.
2. Mark area with center punch.
3. Heat area to be bent to a uniform light cherry-red to orange-yellow color.
4. Using the rounded edge of the face of the anvil bend to 90° angle at the mark.
5. Start bending the tip end around the small part of the horn. Strike bending blows. Gradually work back from the end to the square bend. Turn eye over and close.
6. Eye should be centered with the bolt stock.
7. Make nut from 3/4" to 1" flat stock.
8. Cut 1 1/2" of N. C. threads on bolt; - check depth of threads.
9. Square stock carefully to measurements with file.
10. Determine tap-drill size from table. (5/16)
11. Establish center by the use of diagonals and mark with center punch.
12. Drill hole for the tap.
13. Cut threads to 1 1/2" on stock.



STEPS IN FORMING THE EYE



UNIT NO. 10: Soldering and Sheet Metal Work

OBJECTIVES: To aid the learner

1. Gain a knowledge of the tools, equipment, and materials used when working with sheet metal.
2. Develop an ability to use the tools and equipment concerned properly and safely.
3. Become acquainted with the methods used to measure, shape, and join sheet metal.

Ability to:	Teaching-Learning Activities
A. Appreciate the importance and value of sheet metal work 1. What soldering is and how it is done 2. Repair jobs that may be done	A. Use a chart such as is found in Welding Engineering to show the heat range of soldering process and compare it to other processes of joining metals. (See Safety Precautions)
B. Select tools, materials, and equipment for soldering 1. Soldering coppers a. Kinds, sizes and uses of common coppers b. Electric soldering irons; type and sizes c. Soldering irons powered by an arc welder	B. Have tools and equipment where students can see and handle during discussion. Demonstrate operating a gasoline blow torch. (Job Operation Sheet)
2. Heating equipment a. Blow torch and gas furnace: sizes and types b. Acetylene torch, alcohol torch, furnace, gas burner and others	Cut a hole in the side of a twelve inch length of a three or four inch pipe and mount it on a pedestal. Use this as a device for heating several soldering coppers at one time with one blowtorch.
3. Solder a. Forms of solder: bar, wire, acids, and rosin core b. Composition of solder c. Kinds of solder: 50-50, 40-60	Show that 50-50 solder is easier to use than poorer grades.
4. Fluxes a. Kinds of fluxes, their uses and characteristics: corrosive fluxes, non-corrosive, acids, salts, pastes 5. Other equipment: rivet sets, tin snips, sheet metal screws	
C. Know metals that can be soldered 1. Ease of soldering sheet iron, galvanized sheet iron, tin, lead, aluminum, copper, brass, others.	C. Show soldered projects of different kinds of metal.

UNIT NO. 10: Soldering and Sheet Metal Work

Ability to:	Teaching-Learning Activities
D. Tin a soldering copper 1. Purpose: removing oxide, making heat flow readily 2. Cleaning and shaping 3. Applying coat of solder	D. After demonstration and try-out of student, have student check off other students. (See Job Operation Sheet)
E. Solder holes in sheet metal objects 1. Heating the copper: method temperature 2. Selecting solder and flux for the particular metal 3. Soldering small holes and cracks, using solder only 4. Repairing hole with rivet and solder 5. Repairing hole with patch and solder a. Sweating on patch b. Soldering edges	E. Display projects with different types of repairs. Turn a gallon can upside down. Punch several holes in it and demonstrate how to solder holes. Demonstrate acceptable practices in doing the skills from D to M of this unit. (See references)
F. Solder seams 1. Cleaning and fluxing 2. Running solder	F. Solder the seam of a tub or bucket. Show good and poor seams and proper lap seam penetration.
G. Solder electrical splices and connectors 1. Fluxing 2. Running solder	
H. Rivet sheet metal objects 1. Selecting rivets: length diameter 2. Punching and drilling hole 3. Heading the rivet	H. (See Job Operation Sheet)
I. Use sheet metal screws 1. Drilling holes 2. Selecting screws	
J. Cut sheet metal, using different tools and methods 1. Cold chisel 2. Hack saw 3. Straight shears 4. Circle cutting shears	J. Students perform soldering exercise which requires using as many of the methods of joining sheet metal as possible. (See Job Operation Sheet)

UNIT NO. 10: Soldering and Sheet Metal Work

Ability to:	Teaching-Learning Activities
K. Solder aluminum objects 1. Selecting solder and flux 2. Method of soldering	
L. Lay out sheet metal work and make project 1. Measuring and marking 2. Cutting 3. Forming and making seams	
M. Perform sheet metal exercise and make repairs on occupational experience program equipment 1. Soldering exercise found at end of chapter on soldering in Jones' book, Shopwork on the Farm 2. Repair: chicken feeders, tubs, pails, kettles, metal roof, poultry drinking containers, cracked tubing, cracked pipe, cracked faucet, sheet metal nests, brooders, coolers, etc.	M. After acquiring the basic skills, each student make and/or repair one or more sheet metal projects. Encourage students to bring in all damaged sheet metal objects and repair them.
N. Learn glossary 1. Sal ammoniac 2. Galvanized 3. Flux 4. Sweating	N. Have students search out the meanings of the terms.

REFERENCES:

Jones, Mack M., Shopwork on the Farm, Chapter 11.
Phipps, L. J., Mechanics in Agriculture, Chapter 17, 18.
Smith, Robert E., Units in Sheet Metal Work.
Wakeman, T. I; and V. L. McCoy, The Farm Shop, Chapter 8.

SHEET METAL WORK SAFETY PRECAUTIONS

1. Avoid spilling gasoline when filling a blowtorch. If spilled, wipe off torch before lighting.
2. Locate the torch so that the flame will not come in contact with combustible materials.
3. Avoid placing hot coppers where they will come in contact with wood.
4. Crimp the end of acid core solder so that the acid will not run on hands and clothing.
5. Beware of sharp corners or points caused by cutting; round or file smooth before using or storing.
6. Pick up soldering coppers by the handle.
7. Avoid spilling cut-acid (soldering flux) on clothing and flesh.
8. Use an asbestos table top for soldering.
9. Use the proper kind of tinner snips for the cutting job being done.
10. When cutting a large sheet, allow one part to bend down somewhat to allow room to operate the snips. Beware of cutting hands on sharp edge.

JOB OPERATION SHEET

UNIT NO. 10: Soldering and Sheet Metal

JOB: Operating a Gasoline Blowtorch

What To Do	How To Do It
A. Fill fuel chamber (When necessary)	1. Wipe dust, etc. from funnel, tank filler, hole and plug. 2. Using strained white gasoline (not leaded), fill 2/3 to 3/4 full. 3. Wipe spilled gas from tank and table. 4. Replace and tighten plug.
B. Pump air into chamber	1. 10 or 12 strokes is sufficient if pump is in good condition.
C. Fill priming cup	1. Hold palm of hand over end of burner. 2. Open needle valve, tip torch so gas will run into priming cup. (If torch has a special valve for filling cup, merely open valve). 3. Fill cup almost full. Close needle valve. Wipe off spilled gasoline.
D. Generate torch	1. Light gasoline in cup, allowing it to burn until cup is almost empty. 2. Protect torch from air currents while generating.
E. Light torch	1. Open gas needle valve 1/2 turn or more. 2. Be sure torch does not point toward anyone. 3. If torch does not light, light with match through holes in side of burner. 4. If torch pulsates, squirts a stream of gasoline, or does not adjust to a blue or colorless flame, generate torch again.
F. Turn torch off	1. Turn gas valve off just enough to stop flow of gas, no tighter.

JOB OPERATION SHEET

UNIT NO. 10: Soldering and Sheet Metal Work

JOB: Cleaning and Tinning a Soldering Copper

What To Do	How To Do It
A. Select a soldering copper that needs to be cleaned.	1. The copper may be pitted and rough from over-heating.
B. Hold the copper in a vise to prevent slipping	
C. Using a metal file, file the faces of the point.	1. The faces must be smooth and flat to provide a good heating surface.
D. After cleaning, tin the faces of the point of the soldering copper.	1. Heat the copper until it will melt the solder readily. 2. Rub the faces of the copper on a brick of sal ammoniac or dip into a flux solution like zinc chloride. 3. Apply a small amount of solder to the copper. Wipe the solder with a damp rag to spread it. 4. Continue doing this until all the faces of the point are tinned or covered with solder.

JOB OPERATION SHEET

UNIT NO. 10: Soldering and Sheet Metal Work

JOB: Soldering with arc

What To Do	How To Do It
A. Select materials	1. Two pieces of galvanized metal, 2" x 6". 2. Use acid core solder and zinc chloride or similar flux. 3. A 5/32" copper-coated carbon or carbon provided by instructor.
B. Prepare materials	1. Clean and brighten metal using steel wool, sand paper or by scraping. 2. Apply flux 3. Attach ground clamp and set machine at 20 to 30 amps. 4. Clamp or secure pieces together, make a 1/2" lap.
C. Apply solder	1. Place tip of carbon on metal to be heated and rotate the tip of carbon in 1/2" circle over the area to be soldered to heat the base metal. Keep tip of carbon in contact with metal to avoid arcing. 2. Apply solder to the base metal. When hot enough, the solder will flow. 3. Complete the seam.
D. Present to instructor for grading	

JOB OPERATION SHEET

UNIT NO 10: Soldering and Sheet Metal Work

JOB: Riveting

What To Do	How To Do It
A. Prepare the metal	1. Place the pieces to be riveted and clamp them in place. 2. Center punch and drill a hole that the rivet will fit.
B. Countersink the hole (if desired)	1. Using a larger drill or a countersink, enlarge the hole at the ends to allow for countersinking e.g.- guard plates on sickle. 2. Peen the ends into the countersunk holes.
C. Select the rivet	1. Soft steel rivets should be 1/8 " to 1/4" longer than the thickness of the metals to be riveted, to allow for a head.
D. Hammer rivet in place	1. Insert the rivet in the hole. 2. Strike with one or two blows with the flat face of the hammer. 3. Finish with light blows, preferably with the ball peen of the hammer, to form the head. 4. A rivet set may be used when a neat, round head is desired.

JOB OPERATION SHEET

UNIT NO. 10: Soldering and Sheet Metal Work

JOB: Exercise Project Using Soldering

What To Do	How To Do It
A. Hook Joint	1. Prepare sheet metal. a. Cut sheet metal furnished by instructor into 3 pieces 4" x 4 1/2". b. Clean metal of all rust, dirt, oil, etc. 2. Mark metal a. Using an awl, draw a line 3/8" from the edge of two of the pieces of sheet metal. 3. Bend metal a. Bend the metal along the line. Hold it between two pieces of angle iron in a vise. Use a wooden mallet. Do not beat the metal until it stretches. b. After the edges are bent to a 90° angle, bevel them further back to form hooked edges. 4. Apply flux a. Clean and apply flux to hooked edges to be joined. Apply flux sparingly only to area you want to apply solder. 5. Join pieces a. Hook edges together and close joint by striking lightly with mallet. 6. Solder a. Hold the face of the soldering copper firmly along the seam so that heat from the soldering iron will heat the metal to the point where solder will flow back into the lock seam. Solder should flow from the tip of the soldering copper into the seam. If solder is dull and rough the copper is too cold.

UNIT NO. 10: Soldering and Sheet Metal Work

JOB: Exercise Project Using Soldering

What To Do	How To Do It
	A final pass may be necessary to leave the desired finished looking seam. Wipe the seam while still warm with a damp cloth to remove all excess flux. b. Use the same process to solder the other side of the lock seam.
B. Lap Seam	1. Prepare pieces a. Draw a line 3/8" along the edge of the two pieces of metal. b. Clean each edge and apply a suitable flux. Apply carefully and sparingly. c. Place the two pieces together overlapping along the seam. 2. Solder a. "Tack" the two together with a drop of solder at each end of the seam. b. Move the hot soldering copper along the seam keeping the face pressed firmly against the edge of the seam and feed solder into the seam by touching it to the tip of the soldering copper. Hold the two pieces together until the solder cools by applying pressure to the top piece of metal with a piece of scrap iron. c. Wipe clean with a damp cloth. d. Use the same procedure to solder the other side of the lap joint.
C. Repair small holes	1. Prepare metal a. Make 5 small holes in the left piece of sheet metal with a nail.

JOB OPERATION SHEET

UNIT NO. 10: Soldering and Sheet Metal Work

JOB: Exercise Project Using Soldering

What To Do	How To Do It
A. Hook Joint	1. Prepare sheet metal. a. Cut sheet metal furnished by instructor into 3 pieces 4" x 4 1/2". b. Clean metal of all rust, dirt, oil, etc. 2. Mark metal a. Using an awl, draw a line 3/8" from the edge of two of the pieces of sheet metal. 3. Bend metal a. Bend the metal along the line. Hold it between two pieces of angle iron in a vise. Use a wooden mallet. Do not beat the metal until it stretches. b. After the edges are bent to a 90° angle, bevel them further back to form hooked edges. 4. Apply flux a. Clean and apply flux to hooked edges to be joined. Apply flux sparingly only to area you want to apply solder. 5. Join pieces a. Hook edges together and close joint by striking lightly with mallet. 6. Solder a. Hold the face of the soldering copper firmly along the seam so that heat from the soldering iron will heat the metal to the point where solder will flow back into the lock seam. Solder should flow from the tip of the soldering copper into the seam. If solder is dull and rough the copper is too cold.

UNIT NO. 10: Soldering and Sheet Metal Work

JOB: Exercise Project Using Soldering

What To Do	How To Do It
	A final pass may be necessary to leave the desired finished looking seam. Wipe the seam while still warm with a damp cloth to remove all excess flux. b. Use the same process to solder the other side of the lock seam.
B. Lap Seam	1. Prepare pieces a. Draw a line 3/8" along the edge of the two pieces of metal. b. Clean each edge and apply a suitable flux. Apply carefully and sparingly. c. Place the two pieces together overlapping along the seam. 2. Solder a. "Tack" the two together with a drop of solder at each end of the seam. b. Move the hot soldering copper along the seam keeping the face pressed firmly against the edge of the seam and feed solder into the seam by touching it to the tip of the soldering copper. Hold the two pieces together until the solder cools by applying pressure to the top piece of metal with a piece of scrap iron. c. Wipe clean with a damp cloth. d. Use the same procedure to solder the other side f the lap joint.
C. Repair small holes	1. Prepare metal a. Make 5 small holes in the left piece of sheet metal with a nail.

JOB OPERATION SHEET

UNIT NO. 10: Soldering and Sheet Metal Work

JOB: Exercise Project Using Soldering

What To Do	How To Do It
A. Hook Joint	1. Prepare sheet metal. a. Cut sheet metal furnished by instructor into 3 pieces 4" x 4 1/2". b. Clean metal of all rust, dirt, oil, etc. 2. Mark metal a. Using an awl, draw a line 3/8" from the edge of two of the pieces of sheet metal. 3. Bend metal a. Bend the metal along the line. Hold it between two pieces of angle iron in a vise. Use a wooden mallet. Do not beat the metal until it stretches. b. After the edges are bent to a 90° angle, bevel them further back to form hooked edges. 4. Apply flux a. Clean and apply flux to hooked edges to be joined. Apply flux sparingly only to area you want to apply solder. 5. Join pieces a. Hook edges together and close joint by striking lightly with mallet. 6. Solder a. Hold the face of the soldering copper firmly along the seam so that heat from the soldering iron will heat the metal to the point where solder will flow back into the lock seam. Solder should flow from the tip of the soldering copper into the seam. If solder is dull and rough the copper is too cold.

What To Do	How To Do It
	A final pass may be necessary to leave the desired finished looking seam. Wipe the seam while still warm with a damp cloth to remove all excess flux. b. Use the same process to solder the other side of the lock seam.
B. Lap Seam	1. Prepare pieces a. Draw a line 3/8" along the edge of the two pieces of metal. b. Clean each edge and apply a suitable flux. Apply carefully and sparingly. c. Place the two pieces together overlapping along the seam. 2. Solder a. "Tack" the two together with a drop of solder at each end of the seam. b. Move the hot soldering copper along the seam keeping the face pressed firmly against the edge of the seam and feed solder into the seam by touching it to the tip of the soldering copper. Hold the two pieces together until the solder cools by applying pressure to the top piece of metal with a piece of scrap iron. c. Wipe clean with a damp cloth. d. Use the same procedure to solder the other side of the lap joint.
C. Repair small holes	1. Prepare metal a. Make 5 small holes in the left piece of sheet metal with a nail.

UNIT NO. 10: Soldering and Sheet Metal Work

JOB: Exercise Project Using Soldering

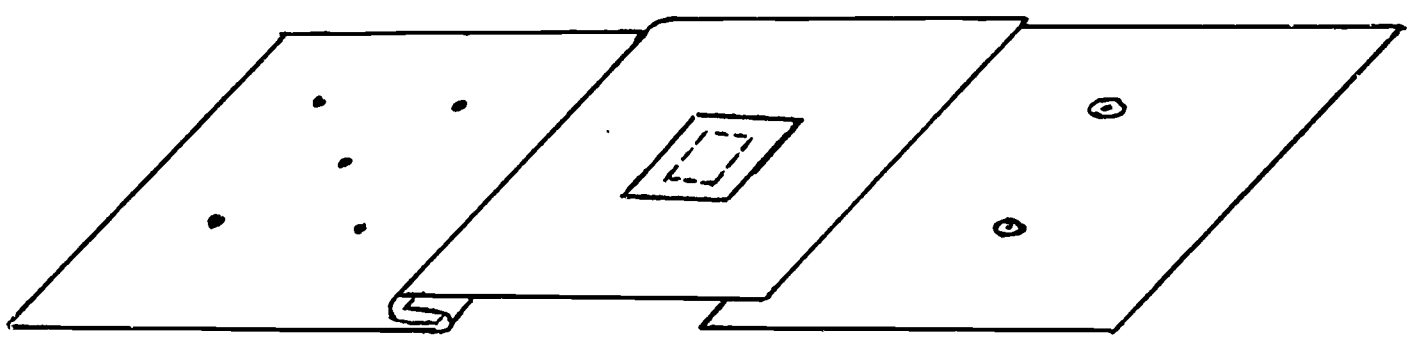
What To Do	How To Do It
	b. Clean the metal around the hole on both sides. (use emery cloth, steel wool, etc.) c. Apply a suitable flux. 2. Solder a. Apply a drop of solder to the hole. Hold the clean, well tinned hot soldering copper perpendicular to the hole. Push the tip of the copper into the hole and rotate it slowly. The solder should run off the tip of the copper and fill the hole. b. Wipe off excess flux with rag.
D. Repair holes with rivet	1. Prepare metal a. Punch 2 holes about 1/4" in diameter in the right hand piece of metal. b. Clean metal around each hole on both sides. 2. Install rivet a. Insert a short copper or galvanized rivet in each hole and hammer them down. (Use clean rivets) 3. Solder a. Apply a suitable flux. b. Flow solder over and around each rivet on both sides. c. Clean excess flux off with rag.
E. Sweat on a patch	1. Prepare the metal a. Using a cold chisel, cut a hole about 3/4" square in the center of the middle piece of sheet metal. b. Cut a patch out of sheet metal of the same thickness and large enough to lap over the metal around the hole at least 1/2" on all sides.

UNIT NO. 10: Soldering and Sheet Metal Work

JOB: Exercise Project Using Soldering

What To Do	How To Do It
	c. Clean the patch and the area around the hole that the patch will cover and apply flux to both the patch and the area around the hole. 2. Solder a. Tin the area around the hole that the patch will cover and the entire patch. b. Place the patch over the hole so that the tinned areas touch. Press and hold the patch firmly on the metal with a piece of scrap iron or the tong of a file. Use a hot soldering copper to heat the patch and the metal under it so that the solder will melt and join the patch to the metal below. Continue to hold the patch in place until the solder cools. c. Run a bead of solder around the edge of the patch to guarantee a water tight bond. Be careful not to melt the patch loose during this step.

Completed exercise should look like this:



UNIT NO. 11: Arc Welding

OBJECTIVES: To aid the learner to
1. Understand the fundamental and safe practices of welding.
2. Select electrodes, machines, and accessories.
3. Become proficient in basic welding skills.

Ability to:	Teaching-Learning Activities
A. Appreciate the advantages and characteristics of arc welding 1. What arc welding is and how it operates. 2. Jobs that can be done by arc welding 3. Metals most commonly welded 4. Cost of equipment and supplies	A. Demonstrate the basic fundamentals of arc welding.
B. Recognize dangers and use precautions in welding 1. Burns: Eye or skin arc ray burn, splattering metal, handling hot metal 2. Shock: uninsulated electrode holder handle, wet floor, damaged cable 3. Safety precautions: shields, clothing, eliminating inflammable materials, etc. 4. Ventilation -- avoid fumes of zinc and lead bearing materials	B. Administer a safety test, requiring a perfect score before allowing students to weld. Keep on file. (See Arc Welder Safety Precautions) Demonstrate the proper electrical hook up of a welder.
C. Select equipment and supplies 1. AC transformer welders: manufacturers, duty cycle, sizes, costs, advantages and disadvantages 2. AC-DC welders a. Generator type b. Transformer type (sizes costs, advantages and disadvantages) c. Rectifier AC-DC type welder 3. Gasoline engine DC generator welders: sizes, costs, advantages and disadvantages 4. Electrodes a. By understanding classifications system for mild steel and alloy steel electrode	C. Place all equipment and materials where students can see during discussion. Determine the duty cycle of welders in shop. Quiz students on size of electrodes. Give the students pseudo cases and have them determine which electrode to use. Glue one each of the several electrodes on stiff poster paper for students to study. Include description and characteristics of electrodes.

Ability to:	Teaching-Learning Activities
b. By understanding the characteristics of the various electrodes commonly used (E-XX10, E-XX11, E-XX18, E-XX24)	Give the meaning of each digit in an electrode number such as E-6011.
c. By understanding the general characteristics such as fast fill, fast freeze, and low hydrogen.	
d. By knowing the sizes and cost of common steel electrodes	
5. Equipment: kinds and costs of gloves, welding tables, cables, ground clamps, electrode holders, shields, colored and clear lens, arc torch, slag hammer, wire brush, etc.	Hang electrode chart on wall near welders and teach students how to use it. Show how to replace lens in a shield.
D. Hook up and adjust welder and equipment 1. Plugging in welder 2. Making good ground connections 3. Switching on welder and adjusting controls a. Amperage b. Other controls	D. Prepare "ideal" specimens of the various welds and joints for student references.
E. Know the essential of a good weld 1. Correct electrode 2. Correct arc length 3. Correct angle of electrode 4. Correct speed of travel 5. Correct amperage	E. Demonstrate correct angle of electrode, amperage setting, arc length, and speed of travel.
F. Recognize a good weld 1. Characteristics of welds as to: a. Appearance of bead b. Amount of bend weld will take c. Appearance of broken weld d. Appearance of sawed cross section	F. Break welds in vise and show students failures caused by insufficient penetration, slag inclusions, burned metal, etc. (A weld should bend 90° without breaking.)
G. Weld mild steel 1. Prepare metal, cleaning, spacing, grooving, tacking and etc.	G. Grade each weld after inspecting and testing
2. Perform the following skills: a. Beads with various electrodes b. Wide or weaving bead c. Padding or build up	Demonstrate approved welding practices whenever appropriate. (See Job Operation Sheet)

Ability to:	Teaching-Learning Activities
d. Butt weld e. Fillet weld (1) Flat (2) Horizontal	Have students run beads parallel with edge of metal and close together to conserve metal. Bead work should include joining beads together.
H. Recognize and control distortion 1. Backstep method 2. Peening welds 3. Placement of metal to allow for distortion	H. Demonstrate how to crack a tee weld. Demonstrate how to place metal to insure straight line and fit.
I. Cutting and punching metal with the arc welder 1. Cut and pierce thin and thick metal with cutting and piercing electrodes	I. (See Job Operation Sheet)
J. Construct and repair welding projects in the school and home shops 1. Make: welding table, chipping hammer, saw horse, electrode stand, trailer hitch, clothes line poles, welding stool, home-made anvil 2. Repair: broken chains, bumper, hoes, shovels, holes in tanks and barrels, plow discs, fenders	J. After learning the basic skills have each student do one or more welding projects. These should be practical jobs to be used if possible, in the student's occupational experience program.
K. Learn glossary 1. Arc blow 2. Arc length 3. Arc voltage 4. Back-step welding 5. Base metal 6. Butt weld 7. Crater 8. Direct current 9. Alternating current 10. Fillet weld 11. Flux 12. Gas pocket 13. Low hydrogen 14. Pass 15. Peening 16. Penetration 17. Porosity 18. Pre-heating	K. Have students search out the meanings of these terms.

UNIT NO. 11: Arc Welding

Ability to:	Teaching-Learning Activities
19. Puddle	
20. Reversed polarity	
21. Root of weld	
22. Slag inclusion	
23. Spatter	
24. Straight polarity	
25. Toe of weld	
26. Undercut	
27. Weaving	
28. Duty cycle	
29. Ferrous	
30. Electrode	
31. Electrode holder	
32. Brazing	
33. Butt joint	
34. Oxidizing	
35. Reduction	
36. Fusion	
37. Adhesion	
38. Cohesion	

REFERENCES:

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Kugler, H. L., Arc Welding Lessons for School and Farm Shop.
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Phipps, L. J.; N. F. McColly; L. L. Scranton; and G. C. Cook, Farm Mechanics Text and Handbook, Chapter 15.
James F. Lincoln Arc Welding Foundation, Metals and How to Weld Them.
James F. Lincoln Arc Welding Foundation, New Lessons in Farm Welding.
James F. Lincoln Arc Welding Foundation, Welding Helps for Farmers.
Rossi, Boniface E., Welding Engineering.
Wakeman, T. J.; L. L. McCoy, The Farm Shop, Chapter 6.

ARC WELDER SAFETY PRECAUTIONS:

1. Don't operate welder with wet hands or in a damp area.
2. Keep welder properly grounded.
3. Don't work on live circuits or conductors.
4. Avoid operating polarity switch under load.
5. Avoid operating motor generators or transformers without a power ground.
6. Avoid leaving the electrode holder on the table top or in contact with a grounded metallic surface.
7. Don't permit cables to operate hot.
8. Do not operate with worn or poorly connected cables, or loose cable connections.
9. Do not operate electrode holder with defective jaws.
10. Avoid using cracked or defective helmets or shields.
11. Never strike the arc until helmet is in place and you see that all observers are using the proper protective equipment. Never look at the arc with the naked eye.
12. Do not use cracked, ill-fitting, or defective color plates, use the proper lenses.
13. Do not use color plates without a protecing clear cover plate.
14. Always wear suitable clothing to protect all parts of the body exposed to the rays of the arc and the spatter of hot metal. Have no open pockets.
15. Always wear leather gloves while using the welder. In sitting position, wear leather or canvas apron.
16. Wear trousers without cuffs, as sparks may fall in the cuffs and burn trousers. Wear heavy shoes tightly laced.
17. Keep the booth or screen properly closed to protect other workers from the arc rays.
18. Pick up the electrode holder by the insulated handle.
19. Do not pick up hot objects with the hands. Use tongs or pliers.
20. Avoid adjusting the welding machine while it is in operation.
21. Avoid welding near inflammable or combustible materials.
22. Avoid welding on containers which have held combustible or inflammable materials without exercising the proper precautions.
23. Do not weld in confined spaces without adequate ventilation.
24. Keep tools and metal in the proper position so that they will not fall over on your feet. Make sure that they are not on the floor to stumble over.
25. Wear goggles when chipping or grinding metal.

JOB OPERATION SHEET

UNIT NO. 11: Arc Welding

JOB: Striking an Arc and Running a Bead

What To Do	How To Do It
A. Select and prepare materials	1. Prepare 1/4" or 3/16" mild steel plate for practice; clean, well-grounded. 2. Use E6013 or E6011 electrodes. 3. Select size of electrodes according to the thickness of the metal. 1/8" electrodes are adequate for 1/4" steel
B. Lay-out and set up materials	1. Determine direction of travel and position metal in an easily reached or comfortable position for the operation. (Right handers travel left to right) 2. Machine settings: E6011 - 95 to 120 amps. E6013 - 100 to 130 amps.
C. Striking arc	1. Place electrode tip about 1/2" above starting point, lower shield, then produce arc by scratching electrode on work. Similar to striking a match. 2. Hold short arc, (app. 1/8") and proceed with bead. Move electrode in a straight line. 3. Arc should produce a frying sound at proper arc length. 4. If arc is too long, a fuzzy, hissing sound will be made.
D. Failure to strike arc	1. Reasons a. Metal not grounded b. Coating of electrode may be covering end of core wire.
E. Freezing of electrode to work	1. Reasons a. Amperage is too low. b. Arc booster not on. (Lincoln welder only) c. Electrode wrong type for machine.
F. Running a bead	1. Slant or tip electrode 15-25° ahead in direction of travel.

UNIT NO. 11: Arc Welding

JOB: Striking an Arc and Running a Bead

What To Do	How To Do It
	Keep tip of the rod 1/8" from molten pool. 2. Speed of travel should be such that the crater will have time to fill properly. This will eliminate undercutting. 3. Speed of travel results: a. Too slow: gives high irregular shaped bead. b. Too fast: long, thin irregular bead. 4. Normal, straight bead width should not exceed twice the width of the electrode. 1/8" - 1/4"

JOB OPERATION SHEET

UNIT NO. 11: Arc Welding

JOB: Padding with E6011 and E6013 Electrodes

What To Do	How To Do It
A. Select and prepare materials	1. 1/8" mild steel electrode, either E6011 or E6013. 2. Prepare a piece of 3/16" or 1/4" mild steel plate 4" square. Clean off all rust, grease, etc. 3. Set welder at about 100 amps if E6011 or 120 amps if E6013.
B. Padding is used to build up worn surfaces. In this exercise you will place two layers of beads to build up your piece of metal	1. Strike arc at one corner of plate and lay a straight bead near the edge of the plate. 2. Clean the bead with a chipping hammer and wire brush. 3. Lay a second bead parallel to the first bead, making certain it is fused to both the first bead and the steel plate. The second bead should be the same height as the first. There should be very little or no groove between the two beads. 4. Clean the second bead and continue to deposit beads until the entire plate has been covered. Clean each bead before laying the next. 5. Thoroughly clean the layer of beads of all slag, oxide or scale with a wire brush and chipping hammer. 6. Lay a second layer of beads across the first layer at a 90° angle to the first layer. 7. Clean thoroughly and have checked by instructor. 8. Cut in two with a power hacksaw to inspect for slag inclusions.

JOB OPERATION SHEET

UNIT NO. 11: Arc Welding

JOB: Making Butt Welds With 6011 and 6013 Rods

What To Do	How To Do It
A. Select materials	1. 1/8" mild steel electrode, either AWS 6011 or AWS 6013. 2. Thickness of metal pieces should not exceed 1/4" without veeing edges -- mild steel. 3. Machine set between 95 and 150° -- the 6013 rod requires approximately 20 - 40° more heat (amperage) than the 6011. 4. Pieces should be at least 6" in length, 2" wide.
B. Lay out and prepare materials	1. Position work on flat plane. 2. Ground is securely clamped to make positive contact. 3. 1/16" to 1/8" gap left between edges of plates being welded, for adequate penetration. 4. Veeing edges not necessary.
C. Tack weld pieces	1. Tack weld pieces at each end of seams to prevent distortion. 2. Tacks should be flat and short to facilitate welding over them.
D. Make weld	1. In order to produce a good weld use: a. Correct amperage setting b. Correct speed of travel c. Correct arc length 2. Use same techniques as in running a straight bead. Angle of rod not to exceed 25°. 3. Width of bead should not exceed 3 times diameter of electrode. 4. Speed of travel should be such that craters will have time to fill properly from puddle. This will also tend to eliminate undercutting. 5. A slight pause should be made at the end of bead to fill crater formed by arc.

UNIT NO. 11: Arc Welding

JOB: Making Butt Welds With 6011 and 6013 Rods

What To Do	How To Do It
E. Clean and test weld	1. Chip slag and brush from weld. 2. Examine underside of seam to determine percentage of penetration. 3. Weld should stand a 90° bend without cracking.

JOB OPERATION SHEET

UNIT NO. 11: Arc Welding

JOB: Making Fillet Welds

What To Do	How To Do It
A. Select and prepare materials	1. Prepare two 1/4" plates at least 6" in length, 2" wide. 2. Clean metal to remove all dirt, rust, grease, etc. 3. Select proper electrodes, E6011 or E6013 and set machine according to the recommendation for electrode being used. 4. Be sure work is securely grounded.
B. Lay-out materials	1. Determine direction of movement and place pieces accordingly. 2. Welder should be as comfortable and steady as possible at all times.
C. Tack pieces together	1. Place one plate perpendicular to another plate laying flat, so that it forms a "T" upside down. 2. Place a small tack-weld at each end of the pieces to be welded while holding them in position.
D. Make weld	1. Same procedure as used in making butt welds. Travel slowly, and have electrode divide angle between two plates. 2. Weld metal should be divided evenly between two plates; 50% on vertical plate; 50% on flat plate. 3. Sidewise weaving is not recommended for single-pass flat fillet welds.
E. Clean and test weld	

JOB OPERATION SHEET

UNIT NO. 11: Arc Welding

JOB: Cutting and Piercing With an Electrode

What To Do	How To Do It
A. Select materials	1. Select a piece of mild steel at least 4" by 6" and up to 1/4" thick. 2. Use 1/8" E-Coll electrode and set the machine between 125 and 140 amperes.
B. Lay out and prepare materials	1. When cutting metals 1/8" thick or less, place in a flat position; from 1/8" to 1/4", place in a vertical position. 2. Make a soapstone line 2" from one edge for the length of the metal piece. 3. Be careful of the flying molten metal. Roll down cuffs. Put all inflammable materials at a safe distance.
C. Cut metal	1. Strike arc at top edge of metal, directly above where cut is to be made. If metal is in a flat position, use angle iron guide. 2. When heat of arc melts metal in the crater, move the electrode tip toward the crater. Force of the arc will push molten metal from the kerf. 3. Weave the electrode slightly from side to side to widen kerf when cutting thick metal. 4. Cut 4" x 6" piece into two halves.
D. Pierce metal	1. Select one of the 2" x 6" pieces made above. 2. Mark a 1/2" diameter hole at one end. 3. Use electrode and amp setting as when cutting. 4. Strike and maintain a relatively long arc until plate sweats at spot where hole is to be made. Move electrode in a circular motion and move arc into molten pool.

UNIT NO. 11: Arc Welding

JOB: Cutting and Piercing With an Electrode

What To Do	How To Do It
	Push electrode down until hole is made: true up hole using a circular motion.
E. Clean and present for grading	1. Use a cold chisel to remove slag from pierced hole and the cut edge. 2. Present to the instructor for grading.

DIFFICULTIES IN METAL-ARC WELDING

Difficulty	Possible Causes	Possible Corrections
Incomplete Penetration	1. Joint design faulty	1. Check root opening, root face dimension, included angle
	2. Welding speed too rapid	2. Slow down welding speed
	3. Insufficient welding current	3. Increase welding current
	4. Too large an electrode size	4. Decrease electrode size
Poor Appearance	1. Current either too high or too low	1. Adjust current values
	2. Improper use of electrode	2. Check welding procedure
	3. Faulty electrode	3. Dry electrode to remove moisture; change electrode
Undercutting	1. Current too high	1. Use lower current
	2. Arc length too long	2. Shorten arc length
	3. Improper manipulation of the electrode	3. Change angle of holding electrode so that arc force will be used to fill undercut
	4. Welding speed too rapid	4. Slow down the welding speed
Excessive Spatter	1. Current too high	1. Use lower current
	2. Arc length too long	2. Shorten the arc length
	3. Excessive arc blow	3. See remedies for "arc blow"
	4. Faulty electrode	4. Replace electrode
Arc Blow	1. Magnetic field, created when using d-c causes the arc to wander	1. Use a-c machine
		2. Counteract blow with angle of electrode
		3. Rearrange split ground clamp
		4. Replace magnetic work bench
		5. Use brass or copper back-up bar
Pinholes	1. Foreign matter in joint	1. Remove rust, scale and other foreign matter from edges
Slag in Weld	1. Joint design: sharp V-shaped recess	1. Proper preparation of groove before each bead is deposited. Avoid contours that are difficult to penetrate with arc
	2. High viscosity of molten metal, rapid chilling, too low a weld temperature	2. Use preheat and obtain higher heat input per unit
Porous Welds	1. Welding speed too rapid	1. Slow down welding speed
	2. Current too low	2. Increase current values
	3. High sulphur or other impurities	3. Use low-hydrogen electrodes
	4. Faulty electrodes	4. Dry electrodes to remove moisture; replace electrodes

Difficulty	Possible Causes	Possible Corrections
Cracked Welds	1. Faulty electrode	1. Use low-hydrogen electrodes
	2. Rigidity of joint; stressed weld	2. Redesign joint; use preheat and postheat; weave
	3. Shape of bead	3. Use slower travel or faster freezing electrode to give a more convex bead
	4. Craters	4. Back step to fill craters
	5. Fast cooling rate	5. Preheat and/or postheat

UNIT NO. 12: Oxy-Acetylene Welding

OBJECTIVES: To aid the learner to
1. Understand the fundamentals of the oxy-gas welding and cutting processes
2. Acquire the ability to select, set up, and operate the oxy-gas equipment properly and safely
3. Become proficient in joining and cutting metal with the oxy-gas equipment

Ability to:	Teaching-Learning Activities
A. Recognize the advantages and disadvantages of oxy-acetylene welding 1. Jobs that can be done with equipment 2. Saving in time and cost of doing jobs 3. Cost of welding equipment and supplies	
B. Recognize dangers and use precautions in welding 1. Handling oxygen and acetylene tanks 2. Sparks and splattering metal 3. Spontaneous combustion: oil, oily rags 4. Handling hot metal 5. Protecting the eyes 6. Using proper clothing	B. Teacher demonstrate safe practices and emergency procedures. Administer a safety test, requiring a perfect score before allowing students to weld. Keep on file.
C. Select equipment and materials 1. Manufacturers, quality and size of torches and regulators 2. Tanks: sizes, pressures, whether to own or rent 3. Generators: kinds, sizes, whether to own or rent 4. Rods and fluxes: kinds, sizes, uses, cost 5. Other equipment: goggles, lighters, tip cleaners, gloves, etc.	C. Place all equipment and materials where students can see during discussion.
D. Know the parts of the oxy-acetylene outfit 1. Cylinder 2. Cylinder valve 3. Regulator 4. Cylinder pressure gauge 5. Working pressure gauge 6. Diaphragm valve assembly	D. Give students an identification quiz on parts of oxy-acetylene outfit.

Ability to:	Teaching-Learning Activities
7. Hoses 8. Blowpipe valves 9. Blow pipes 10. Tips 11. Mixers 12. Cutting attachment	
E. Properly hook up equipment, dismantle equipment, and light and adjust welding and cutting torches 1. Distinguishing between oxygen and acetylene equipment 2. Procedures in fastening tanks, blowing out valves, putting on regulators, hooking up hoses and torches, etc. 3. Proper steps in opening tank, hose and torch valves, and securing working pressures 4. Proper steps in closing valves and regulators and draining hoses 5. Lighting and adjusting blowpipe to carbonizing, neutral and oxidizing flames 6. Lighting and adjusting cutting torch 7. Dismantling and storing equipment	E. Teacher demonstrate these practices and check out each student on proper procedure. (See Job Operation Sheet)
F. Control backfires and flashbacks 1. Backfires: causes and controls 2. Flashbacks: causes and controls	F. (See Controlling Backfires) (See Controlling Flashbacks)
G. Cut metal with cutting torch 1. Adjusting working pressure to particular torch and to thickness of metal 2. Starting cut, angle or torch, distance from metal, speed of travel, keeping cut free from slag 3. Cutting thin metal, heavy plate, rivet heads, holes 4. Cutting angle iron, pipe, cast iron and other miscellaneous materials	G. Do not allow a student to weld until he has been checked out for properly hooking up equipment, lighting and adjusting torches, cutting metal. (See Job Operation Sheet)

UNIT NO. 12: Oxy-Acetylene Welding

Ability to:	Teaching-Learning Activities
H. Manipulate torch and rod 1. Making melt strips or puddles 2. Running practice beads	H. (See Job Operation Sheet)
I. Weld iron and mild steel 1. Proper beveling and spacing of joints 2. Tacking joints 3. Making thin butt welds 4. Making thick butt welds 5. Making lapp joints 6. Making tee joints 7. Welding pipe 8. Other types of joints	I. (See Job Operation Sheet) Grade each weld after inspecting and testing. (A weld should not break when bent at a 90° angle) for uniformity, use 2" x 4" pieces for butt welds, tee joints and lap welds. Have a field representative of Eutetic Welding Alloys Corporation demonstrate their low heat methods of welding.
J. Solder sheet metal with oxy-acetylene torch	
K. Construct and repair welding projects in the school shop and in the home shop 1. Make: welding table, chipping hammer, saw horse, trailer hitch, clothes line posts 2. Repair: broken chain, hoes, shovels, holes in tanks and barrels, plow discs, pipes	K. After learning the basic skills, each student should do one or more welding projects.
L. Learn glossary 1. Oxidizing flame 2. Carburizing flame 3. Inner cone 4. Tinning 5. Brazing 6. Bronze welding 7. Clockwise and counter-clockwise 8. Diaphragm 9. Acetone 10. Orifice 11. Combustion	L. Have students search out the meaning of these terms.

UNIT NO. 12: Oxy-Acetylene Welding

REFERENCES:

Jones, Mack M., Shopwork on the Farm, Chapter 17.
Linde Air Products Co., The Oxy-Acetylene Handbook.
Phipps, L. J., Mechanics in Agriculture, Chapter 14.
Phipps, L. J.; N. F. McColly; L. L. Scranton; and G. C. Cook, Farm Mechanics Text and Handbook, Chapter 16.
Wakeman, T. I.; and V. L. McCoy, The Farm Shop, Chapter 7.

OXY-ACETYLENE WELDER SAFETY PRECAUTIONS

1. Avoid dropping cylinders; cylinders should be strapped to walls or carriage.
2. Keep the valves closed when not in use. Never open acetylene valve more than 1 1/2 turns.
3. Store oxygen containers in separate place from acetylene cylinder. Tear tag on empty cylinder.
4. Keep clothing and tools away from top of cylinders.
5. Keep the cylinders away from electrical service and avoid contacting the cylinders with flame.
6. Avoid using acetylene or oxygen from a cylinder without first attaching a regulator to control and regulate the pressure.
7. Avoid unnecessary release of free acetylene into the air because acetylene is combustible.
8. Open cylinder valves gradually to insure regulator valve is closed. Crack cylinder before and after attaching regulator.
9. Use no oil on any connections or other parts of the oxy-acetylene equipment.
10. Never move cylinders, empty or full, without protective caps in place and screwed down tightly.
11. Never use soda-acid type fire extinguishers, use CO_2 or C-tetrachloride.
12. Do not hang torch or regulator valves.
13. Do not crack valves on tanks of hydrogen.
14. Do not force or pry regulator when attaching to the cylinder.
15. Do not attempt to use or repair a damaged regulator. Send it back to the factory for repairs.
16. Do not play with regulator valves. Consult chart for proper setting of pressure.
17. Always use a standard blowpipe because mixtures of oxygen and acetylene being explosive, should not be permitted except in approved apparatus having specially designed mixing chambers.
18. Avoid welding near combustible materials (flammable gases or liquids, waste rags, paper, paint, wooden flooring or partitions).
19. Always wear gloves and goggles while welding.
20. Keep clothes, hands, and gloves free from grease and oil.
21. Weld in a well-ventilated place because clothing and other combustible material will readily ignite and burn in an oxygen saturated atmosphere.
22. Avoid laying down a lighted blowpipe.
23. Never substitute oxygen under pressure for compressed air for dusting clothes, blowing out pipes, paint spraying, or other similar activities.
24. Keep oxygen and acetylene cylinders in upright positions.
25. Use proper hoses and fittings: red hose for acetylene; green for oxygen.
26. Avoid too long lengths of hoses (15 to 25 feet).
27. Connections should always be tight. Test connections with soap, not with a match.
28. Protect hoses from hot iron, sparks, and traffic. Replace all worn hoses.
29. Do not operate any acetylene generators or do any work on them unless instructions are fully understood. See operator's manual for instructions.
30. Calcium carbide should be stored only in approved places.
31. Do not allow carbide to come in contact with water or moisture outside the generator.
32. Never put a light of any kind, or any other possible source of ignition, into or near a carbide container.

33. Handle carbide and carbide drums with resonable care.
34. Before welding on a container, check to see if material was water soluble.
    a. If water soluble, wash container thoroughly with hot water.
    b. If not water soluble, steam thoroughly then fill with carbon dioxide before attempting to weld.

JOB OPERATION SHEET

UNIT NO. 12: Oxy-Acetylene Welding

JOB: Turning On and Turning Off Oxy-Acetylene Equipment

What To Do	How To Do It
A. Turning on Equipment	1. Check the equipment to see that it is in order and has been turned off correctly. a. The tank and torch valves should be turned off. b. The pressure regulator screws should be released (screwed out). c. The regulator gauges should register "zero." 2. Open the oxygen cylinder valve. a. Open it slowly and as far open as possible. This is a back-seated valve. 3. Secure oxygen working pressure. a. Open the oxygen torch valve. b. Adjust the oxygen regulator by turning the screw in slowly until the gauge registers 5# working pressure for welding (or 15# for cutting). c. Close the oxygen torch valve <u>quickly</u> to save gas. 4. Open the acetylene cylinder valve. a. Open it 1 1/2 turns only. This is not a back-seated valve. b. <u>Leave your wrench in place</u>. This is an important safety precaution. 5. Secure acetylene working pressure. a. Open the acetylene torch valve. (The acetylene hose is red). b. Adjust the acetylene regulator valve by screwing it in slowly until the gauge reads 5#. Never get above 15# in acetylene as it is explosive. c. Close the acetylene torch valve <u>quickly</u> to save gas.
B. Turning Off Equipment	1. Turn off the tank valves. a. Both acetylene and oxygen tanks. <u>Close</u> acetylene tank valve first.

UNIT NO.12: Oxy-Acetylene Welding

JOB: Turning On and Turning Off Oxy-Acetylene Equipment

What To Do	How To Do It
	2. Drain acetylene gauges, hose and torch. a. Open acetylene torch valve. When gauge reads "zero", close torch valve. b. Release regulator screw by turning to left until loose. 3. Drain oxygen gauges, hose and torch. a. Open oxygen torch valve. When gauges read "zero", close torch valve. b. Release oxygen regulator screw. 4. Recheck gauges. a. If tank pressure gauge creeps or again registers pressure, the tank valve was not closed tightly. b. Turn tank valve tightly and repeat step (2) or (3) above.

JOB OPERATION SHEET

UNIT NO. 12: Oxy-Acetylene Welding

JOB: Lighting, Adjusting and Turning Off a Cutting Torch

What To Do	How To Do It
A. Lighting and Adjusting	1. Check tip of cutting torch. a. See that tip holes are open, free of slag. b. Select proper size tip for metal to be cut. (Follow manufacturer's suggestions for tip size and gas pressure). 2. Secure gas working pressures. a. Use same procedure as for welding torch, except oxygen preheating valve must be open for gas to flow. b. Acetylene working pressure, 5# - 8#, oxygen, 15# - 30#, according to thickness of metal to be cut. 3. Check torch valve. a. See that oxygen and acetylene torch valves and oxygen preheating valve are closed. 4. Light torch. a. Open acetylene valve approximately 1/4 turn. b. Point torch away from operator, tanks, hoses, and bystanders. c. Light with spark lighter. 5. Adjust acetylene pressure. a. Open acetylene torch valve slowly until flame jumps away from tip. 6. Adjust oxygen pressure. a. Open oxygen torch valve approximately 1 1/2 turns. b. Open oxygen preheating valve and adjust flame to neutral. c. Open (press down) oxygen cutting lever and readjust oxygen preheating valve until flame is neutral.

UNIT NO. 12: Oxy-Acetylene Welding

JOB: Lighting, Adjusting and Turning Off a Cutting Torch

What To Do	How To Do It
B. Turning Off Equipment	1. Close acetylene torch valve. 2. Close oxygen torch valve. 3. Close oxygen preheating valve.

Controlling Backfires and Flashbacks

Controlling Backfires: (Torch flame snaps or goes out with a loud pop)

Causes:
1. Touching tip of flame against the metal.
2. Overheated tip (turn on oxy-valve slightly and dip tip in water).
3. Incorrect gas pressures.
4. Dirty tip (clean with tip cleaners in up and down motion, not rotary).
5. Loose tip on the torch (sometimes).

Controlling Flashbacks: (Burning occurs back inside torch or hoses)

Causes:
1. Loose tips or fittings
2. Leaky valves

Symptoms:
1. A squealing or hissing noise inside the blowpiece.
2. Sparks coming from the blow pipe.
3. Smoke coming from the blow pipe.
4. Torch butt or hoses become hot.

What To Do:
1. Close blow pipe oxy and acy valves, closing acy valve first.
2. Close oxy and acy cylinder valves, closing acy valve first.
3. Stand behind and away from regulators when closing cylinder valves.
4. Examine connections and valves for leaking after a minute or so.
5. Correct any leakage and clean tip before relighting.

JOB OPERATION SHEET

UNIT NO. 12: Oxy-Acetylene Welding

JOB: Cutting Exercise

What To Do	How To Do It
A. Select materials	1. 3/16" or 1/4" mild steel plate.
B. Prepare metal	1. Clean surface of rust, especially grease.
C. Lay out, or position metal and center-punch lines	1. Work outlines to be cut with soapstone and center-punch every half inch. 2. Lay metal on cutting table. 3. Place metal in an easily accessible position.
D. Light and adjust torch	1. Use flint lighter. 2. Adjust torch to proper flame for cutting.
E. Cutting metal	1. Allow for width of cut in following lines.
F. Finish	1. Remove slag with light scraping or tapping of slag hammer. 2. Do not grind edges.

JOB OPERATION SHEET

UNIT NO. 12: Oxy-Acetylene Welding

JOB: Practice beads, with and without rod

What To Do	How To Do It
A. Practice carrying a puddle without filler rod	1. Select metal. a. Obtain a piece of metal 2" x 6" and 1/16" or 1/8" thick. b. Clean the surface of oil, dirt, and scale. 2. Select tip. a. Use a larger tip for thicker metals. For 1/16" - No. 1, 3/32" - No. 2, 1/8" - No. 3. 3. Adjust gas pressures. a. For No. 3 tip, use approximately 3 pounds oxygen and 3 pounds acetylene. b. For smaller tips, decrease by one or two pounds. c. Consult a chart for larger tip sizes. 4. Adjust flame. a. Use a neutral flame. b. Acetylene feather should be pulled to edge of inner cone. 5. Hold the torch properly. a. The torch may be held like a pencil, with the hoses passing over the top of the wrist. b. Another position is to grasp the handle much like a hammer with the fingers coiled underneath. c. Any position should be comfortable to avoid fatigue. 6. Making the bead a. Hold the torch so the flame points in the direction of travel at a 45° angle. b. If right-handed, start the bead at the right edge (reverse if left-handed) c. Bring the inner cone of the flame within 1/8" of the metal and hold until a molten pool forms. d. Move the puddle across the plate in a straight line, rotating the torch to form a series of overlapping ovals.

UNIT NO. 12: Oxy-Acetylene Welding

JOB: Practice beads, with and without rod

What To Do	How To Do It
	e. Do not move too quickly, or the metal will not melt enough; if held too long in one spot, the flame will burn a hole in the metal.
B. Laying practice beads with a filler rod	1. Follow the same general procedure as outlined before to select metal, select welding tip and adjust flame. a. See A. 2. Select filler rod. a. A general rule is to use a rod with a diameter equal to the thickness of the base metal and of the same composition as the base metal. 3. Laying the bead. a. Hold the rod at approximately the same angle as the torch but slant it away from the torch. b. Melt a small pool of the base metal and insert the tip of the rod into this pool. c. As the rod melts, advance the torch forward. Concentrate the flame on the base metal, not the rod. d. Rotate the torch to form overlapping ovals; keep raising and lowering the rod as the puddle moves forward. e. To make beads of uniform height and width, keep forward travel at a constant rate. 4. Clean and present to instructor for grading. a. Present one bead of each type to be graded. (On same piece of metal)

JOB OPERATION SHEET

UNIT NO. 12: Oxy-Acetylene Welding

JOB: Correcting Oxy-Acetylene Welding Troubles

WELDING TROUBLES	CAUSES	REMEDIES
1. Popping flame (but flame does not go out)	a. Tip dirty. b. Not enough gas pressure for size of tip used.	Clean with tip cleaner. Increase the pressure or change to smaller tip.
2. Back fire (flame pops out)	a. Touching tip to work. b. Loose tip or head. c. Wrong gas pressure. d. Over-heated tip.	Keep tip at proper distance. Check tip and other connection. Adjust pressure or change tip. Reduce heat or change tip.
3. Welding puddle has frosty, foamy or dirty appearance	a. Acetone - near empty or reclining tank. b. Torch out of adjustment. c. Metal too dirty or rusty.	Change to full acetylene tank. Keep acetylene tank in upright position. Adjust to neutral flame. Clean metal properly.
4. Rod sticks frequently	a. Not keeping rod in puddle. b. Puddle too small, narrow. c. Rod too large for puddle.	Keep rod in puddle while welding and swing rod opposite direction from torch. Swing torch in wider arc or increase heat. Change rods or increase heat.
5. Weld bead is lumpy, irregular	a. Not enough heat used. b. Puddle too small, narrow. c. Poor control of torch and/or rod.	Increase heat. Swing torch in wider arc, or increase heat. More practice
6. Metal piled high sides of weld not tapered	a. Insufficient heat or puddle too narrow.	Increase heat and/or swing torch in wider arc.
7. Completed weld is crusted with oxide, dirty appearance	a. Torch out of adjustment.	Adjust torch to neutral flame.

UNIT NO. 12: Oxy-Acetylene Welding

JOB: Correcting Oxy-Acetylene Welding Troubles

WELDING TROUBLES	CAUSES	REMEDIES
8. Completed weld is depressed, concave.	a. Insufficient rod added to puddle.	Keep rod in puddle, slow-up speed of travel.
9. Weld metal brittle, broken edges show holes and oxide	a. Too much heat, torch out of adjustment. b. Parent metal dirty, rusty, scaly.	Watch torch adjustment throughout weld. Clean metal before welding.
10. Insufficient penetration in welded joints	a. Metal not grooved and/or spaced sufficiently.	Prepare joint properly. (Double "V" metal over 1/4" thick). Space joint properly. Tack pieces at each end before welding.
	b. Insufficient heat.	Increase heat or size of puddle.
	c. Sides and bottom of groove not melted sufficiently.	Increase heat or size of puddle. Swing torch in wider arc. Slow up speed of travel.
	d. Melted rod flows into groove ahead of puddle.	Change angle of torch. Fuse bottom of groove for 1/2" to 1", then go back and build up weld.

JOB OPERATION SHEET

UNIT NO. 12: Oxy-Acetylene Welding

JOB: Welding Sheet Metal

What To Do	How To Do It
A. Select materials	1. 1/16" mild steel rod, depending on size of tip and weld. 2. Two pieces of metal.
B. Prepare metal	1. Clean metal surface of all rust, grease and dirt. 2. Cut pieces to proper sizes. 3. No veeing of the edge of thin metal is necessary.
C. Lay-out materials	1. Lay metals flat in an easily accessible position on welding table or fire brick.
D. Tack pieces together	1. Tack two ends and middle of seams to be welded.
E. Make weld	1. Use proper size tip for thickness of pieces. 2. Move fast enough to prevent excessive melting of metal pieces, and yet allow proper fusion of weld puddle, rod and pieces. 3. Weld surfaces should be slightly above surface of metals.
F. Test weld	1. Weld should stand a 90° bend or more.

JOB OPERATION SHEET

UNIT NO. 12: Oxy-Acetylene Welding

JOB: Welding Mild Steel with Steel Rod

What To Do	How To Do It
A. Select materials	1. 3/32" mild steel rod. 2. Two pieces of 3/16" or 1/4" plates.
B. Prepare metal	1. Clean metal of all grease and dust. 2. Bevel edges to 1/16" edge to give adequate penetration.
C. Lay-out materials	1. Lay metal, pieces flat on welding table or fire brick. 2. Allow 1/6" gap between piece edges.
D. Tack pieces together	1. A small tack at each end is adequate. 2. Be sure tacks do not contract and pull pieces apart.
E. Make weld	1. Use adequate size tip and flame to apply heat. 2. Apply enough weld metal to fill beveled edges to slightly above metal surface. 3. Be sure to fill puddle at end of weld -- try not to drip metal over edge.
F. Test weld	1. Weld should stand 90° bend.

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JOB OPERATION SHEET

UNIT NO.12: Oxy-Acetylene Welding

JOB: Making Horizontal Fillet Welds

What To Do	How To Do It
A. Select materials	1. Use two pieces of metal 2" x 6" from 1/16" to 1/8" thick. 2. Use mild steel rod of the same approximate diameter as the thickness of the base metal.
B. Make tack welds	1. Tack one plate in position 90° to the other. 2. Heat until puddle forms and apply a little filler rod to form the tack.
C. Weld the joint	1. Start at right end if right-handed (reverse if left-handed) and proceed to the left, using a semi-circular torch movement. 2. Hold the torch so the tip forms an angle of about 45° to the flat plate and 45° to the line of weld. 3. Point the filler rod toward the welding tip at about a 30° angle to the line of weld. 4. Direct the flame evenly over both plates, keeping the inner cone of the flame about 1/8" away from the surface. Be careful not to heat the vertical plate too much or undercutting will result. 5. Move the torch just fast enough to keep the puddle active and flowing forward. 6. Do not hold the rod too high above the pool so the molten metal drops into the puddle.
D. Complete the joint	1. When the end of the joint is reached, raise the flame away to give the puddle a chance to solidify and fill evenly.
E. Present to instructor for grading	1. Cool and brush. 2. Test for strength.

UNIT NO. 13: Using Electricity

OBJECTIVES: To aid the learner to:

1. Develop an appreciation for the adaptability of electrical energy to man's needs.
2. Understand the basic theories and principles of electricity.
3. Develop an understanding of electrical terms.
4. Know the dangers of electricity and how to avoid injury when working with it.
5. Identify and use the tools and equipment needed.
6. Gain the ability to use electricity by installing safety switches, circuits, receptacles, lights, etc.

Ability to:	Teaching-Learning Activities
Follow the outline found in "Handbook on the Application of Electricity to Farm Work", to develop the following abilities.	Follow suggestions for teaching-learning activities found in "Farm Electrification Teaching Manual for Vocational Agriculture Instructors."
A. Understand the value of electricity to agriculture	A. Diagram some circuits on chalk board. (See Job Operation Sheets)
B. Understand and use electrical terms.	B. In addition, use problem sets and wiring diagram exercises as homework assignments. (See References)
D. Use electricity safely	D. As an alternative to using a wiring board, a wiring frame made of 2" x 4" lumber can be built inexpensively and easily. Two of the 2" x 4"'s (18" long) representing the studs in a wall are nailed to top and bottom plates (17 1/4" long). A steel box for the light can be attached to the top plate. Two other steel boxes can be mounted on the studs to hold switches or receptacles. A short piece of cable with a mole end can serve as the source. Many different circuits can be wired with this frame using the same cable and devices, including several 3-way switch circuits. (See References)
E. Select wire size and types	

UNIT NO. 13: Using Electricity

Ability to:	Teaching-Learning Activities

F. Perform simple wiring skills

REFERENCES:

Brown, Robert H., Farm Electrification.
Jones, Mack M., Shopwork on the Farm, Chapter 19.
Phipps, L. J., Mechanics in Agriculture, Chapter 37, 38.
Phipps, L. J.; N. F. McColly; L. L. Scranton; and G. C. Cook, Farm Mechanics Text and Handbook, Chapter 45, 46, 47.
Richter, H. P., Wiring Simplified.
SAAE and VA Coordinator's Office, Electrical Terms, Their Meaning and Use.
Sears, Roebuck and Company, Simplified Electrical Wiring Handbook, Last Edition.
The Application of Electricity to Farm Work, Farm Electricity Study Manual for Vocational Agriculture Students.
Wakeman, T. I., The Farm Shop, Chapter 16.

APPROXIMATE WATTAGE OR ENERGY USE FOR FARM AND HOME ELECTRICAL EQUIPMENT

Equipment	Approximate Wattage
Air conditioner	1 to 1 1/2 hp
Blanket, electric	100 to 200
Cleaner, vacuum	200 to 1000
Clock	1 to 10
Clothes dryer	1600 to 5000
Coffee maker	500-1000
Dishwasher	500-1000
Evaporative cooler	1/3 to 3/4 hp
Fan (8")	35
Fan (16")	210
Floor polisher	220-400
Food freezer	300-800
Furnace blower	500-700
Garbage disposal	1/4 to 1/3 hp
Griddle	450-1000
Grill	660-1300
Hair dryer	200-1200
Heater, portable	660-1620
Heating pad	25-100
Hot plate	500-1650
Iron, hand	400-1100
Mixer, food	50-200
Motion picture projector	300-1000
Radio	100-300
Range, electric	8500-16,000
Razor	15
Record player	100
Refrigerator	300-600
Sewing machine	30-100
Television	200-300
Toaster	500-1200
Waffle iron	600-1300
Washing machine	250-600
Water heater, automatic	1200-7000
Water pump, deep well	300-5000
Feed grinder	1 to 10 hp
Feed mixing	1 to 7 1/2 hp
Grain elevating	1/4 to 5 hp
Milker, portable	1/4 to 1/2 hp
Milker, pipeline	1/2 to 3 hp

Typical Rate Schedule for Residential
Electric Service

Monthly Rate

Minimum Bill -- $1.15 which entitles the customer to 14 kw-hrs.

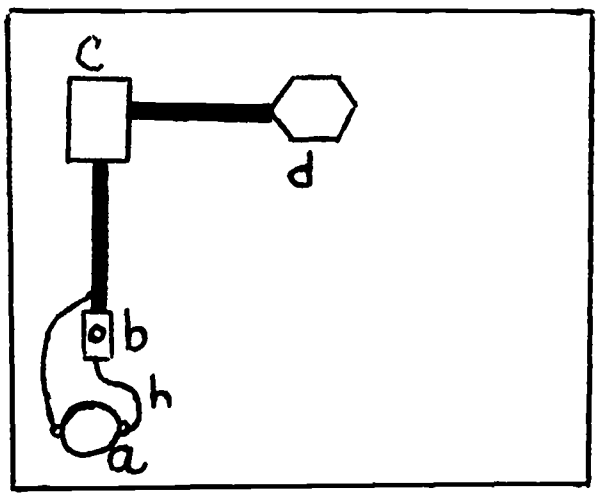
1.15 min. for the first 14 kw-hr/mo.
3.323 per kw-hr for the next 86 kw-hr/mo.
2.753 per kw-hr for the next 200 kw-hr/mo.
1.893 per kw-hr for the over 200 kw-hr/mo.

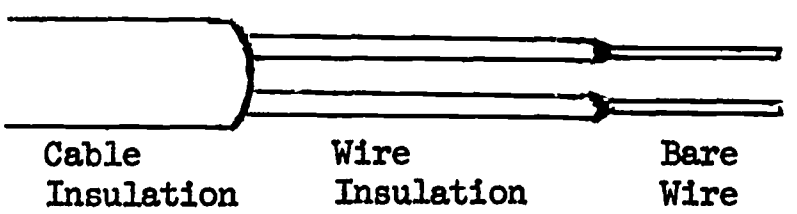
JOB OPERATION SHEET

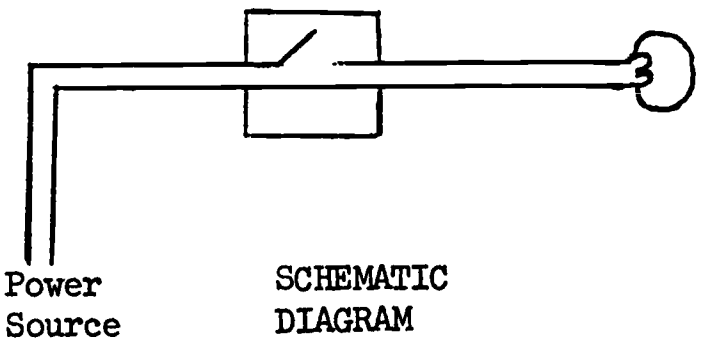
UNIT NO. 13: Using Electricity

JOB: Wiring Board Exercise #1
Ceiling Light Controlled by a Single Pole Switch

What To Do	How To Do It
A. Cut two pieces of two-wire cable	1. Cut a two-wire cable long enough so that it will reach from the power entrance receptacle (a) past the fuse (b) and into the first switch box (c) with at least 6" of wire in the box. 2. Cut the other piece of two-wire cable long enough so that it will reach from the switch box (a) to the ceiling light outlet box (b) with at least 6" of wire inside both boxes.
B. Remove cable and wire insulation	1. Strip cable insulation 6" back from the end of the first cable that goes into the switch box, and enough cable insulation from the other end so that the black (h) wire will run from the power entrance (b) to the fuse receptacle (c) to be cut and attached to each side of the fuse receptacle. (See Wiring Diagram) 2. Remove about 1" insulation from each wire. Cut like sharpening a pencil taking care not to nick the wire. Clean by scraping. 3. Strip cable insulation back 6" from each end of the second cable and remove wire insulation one inch from each wire.
C. Attach cables in outlet boxes	1. Tighten securely using cable clamps provided.
D. Attach wires to proper fixtures	1. Fasten the two white wires in the switch outlet box together using a solderless connector.





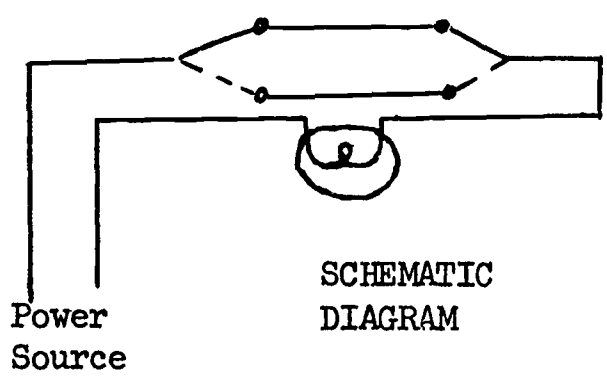
What To Do	How To Do It
	2. Fasten the other end of the white wire to the silver terminal on the power entrance receptacle (a). Make certain that the twist in the wire turns the same direction the screw in the terminal turns to tighten. 3. Cut the black (h) wire so that it can be attached to both sides of the fuse receptacle (b) and the brass terminal of the power entrance receptacle. (a) Attach the wire, making certain they turn the correct direction around each terminal screw. 4. Fasten one of the black (h) wires in the switch box to one of the terminals in a single pole switch and the other black wire to the other terminal. 5. Attach the black wire in the ceiling light outlet box (d) to the brass terminal of the light fixture and attach the white wire to the silver terminal.
E. Attach switch to outlet box	1. Fold the wires so they can be pushed to the bottom of the switch outlet box and fasten the switch in the box.
F. Attach light fixture to outlet box	1. Fold the wire so it will go into the outlet box and attach the light fixture to the outlet box.
G. Check all connections	1. Check all connections for correctness, tightness, etc. Do not test with electric power unless told to do so by instructor in his presence.
H. Show to instructor for test and evaluation	1. Instructor will test your board by connecting it to power source.

JOB OPERATION SHEET

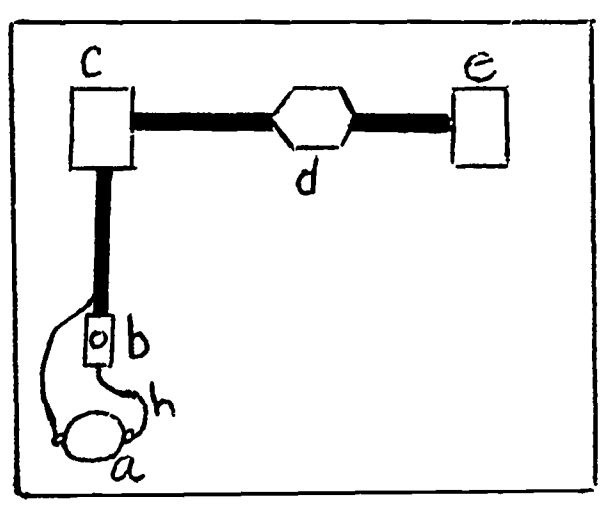
UNIT NO. 13: Using Electricity

JOB: Wiring Board Exercise, #2
Ceiling Light Controlled by Two 3 Way Switches

What To Do	How To Do It
A. Cut cables	1. Use the same 2 wire cable attached to power source, fuse receptacle and switch box (c). 2. Cut 2 pieces of 3 wire cable long enough to reach from switch outlet box C to light outlet box D and from switch outlet box E to light outlet box D, making certain that at least 6" of cable will be inside each box.
B. Remove cable and wire insulation	1. Remove cable insulation 6" from each end of both cables. Remove wire insulation 1" from end of each wire and scrape clear.
C. Attach cables to outlet boxes	1. Tighten securely using cable clamps provided.



D. Attach wires to proper fixtures	1. Fasten the two white wires in switch outlet box C together, using a solderless connector. 2. Fasten the black wire from the two wire cable to the common post (usually dark colored) on a 3-way switch. 3. Fasten the black wires from the 3 wire cable to one of the light colored terminal on the 3-way switch and fasten the red wire from the 3 wire cable to the other light colored terminal.



What To Do	How To Do It
	4. Fasten the two black wires from the two 3 wire cables that meet in the light outlet box (d) together, using solderless connectors. Do the same with the two red wires. Attach the white wires coming from outlet box C to the silver terminal on the light fixture and the other white wire to the brass terminal.
	5. Attach the black and red wires from the 3 wire cable in switch outlet box (e) to the two light colored terminals of a 3-way switch and attach the white wire to the dark terminal.
E. Correct polarization color circle for safety	1. Paint the white wire in the light outlet box (d) that comes from box (e) and is attached to the brass terminal of the fixture block.
	2. Paint the white wire in the switch outlet box (e) black.
F. Attach switches and light fixtures to outlet boxes	1. Fold the wires so they can be pushed to the bottom of the switch outlet box and fasten the switches and fixture in their boxes.
G. Check all connections	1. Check all connections for correctness, tightness, etc. Do not test with electric power unless told to do so by instructor and in his presence.
H. Show to instructor for test and evaluation	1. Instructor will test your board by connecting it to a power source.

UNIT NO. 14: Introduction to Concrete

OBJECTIVES: 1. To assist the students
   a. To appreciate the value of concrete
   b. To select suitable concrete mixtures
   c. To estimate the quantities of each ingredient needed
   d. To use concrete for construction purposes

Ability to:	Teaching-Learning Activities
A. Understand the uses of concrete in agriculture 1. Fence posts 2. Feed troughs 3. Driveways 4. Floors 5. Others	A. Have students name several uses of concrete at home.
B. Know reasons why concrete is widely used 1. Permanent 2. Sanitary and easily cleaned 3. Rat and rodent proof 4. More nearly fireproof than other materials 5. Can be used by almost anyone	
C. Know what concrete is 1. Mixture of a. Portland cement b. Sand c. Gravel d. Water	
D. Know equipment needed for concrete work 1. Gravel 2. Shovels 3. Wheelbarrow 4. Water container 5. Trowels 6. Cement mixer	D. Have students name several other tools not mentioned. (See Conducting a Silt Test - Job Operation Sheet)
E. Select mixtures of concrete 1. Learn use of trial mix charts a. 5-gallon paste b. 6-gallon paste c. 7-gallon paste 2. 1 - 2 1/4 - 3 mix 3. Determine amounts of each item needed for a particular job	E. Work problems on the board showing the students how to use the charts. (See estimating quantities of cement and aggregate - Job Operation Sheet)

UNIT NO.14: Introduction to Concrete

Ability to:	Teaching-Learning Activities
F. Pour and finish concrete 1. Construct an item using concrete	F. Have students mix and pour concrete for a grade by constructing a stepping stone or similar project. (See mixing, placing, finishing, and curing concrete - Job Operation Sheet)
G. Learn glossary 1. Sand 2. Coarse aggregate 3. Cement 4. Fine aggregate 5. Bank run gravel	G. Have students search out the meanings of these terms.

REFERENCES:

Jones, Mack M., Shop Work on the Farm, Chapter 10.
Phipps, L. J., Mechanics in Agriculture, Chapter 31, 32.
Phipps, L. J.; N. F. McColly; L. L. Scranton; and G. C. Cook, Farm Mechanics Text and Handbook, Chapter 36, 37, 38, 39.
Portland Cement Association, Making Quality Concrete for Farm Construction, 1960.
Wakeman, T. I.; V. L. McCoy, The Farm Shop, Chapter 14.

JOB OPERATION SHEET

UNIT NO. 14: Introduction to Concrete

JOB: Conducting a Silt Test

What To Do	How To Do It
A. Conduct the test	1. Place 2" of a representative sample of the sand or gravel in a clean quart fruit jar. 2. Add water until the jar is 3/4 full, fasten the cover and shake vigorously until the sand and water are thoroughly mixed. 3. Set the jar aside until the water over the material becomes clear. (An hour or two will generally suffice)
B. Measure your results	1. Measure the layer of silt on top of the sand or gravel. If the layer is more than 1/8" thick the material is not clean enough for concrete and should be washed before it is to be used.

JOB OPERATION SHEET

UNIT NO. 14: Introduction to Concrete

JOB: Estimating Quantities of Cement and Aggregate Needed for a Given Job

What To Do	How To Do It
A. Determine amount of concrete necessary for your given job	1. Multiply the length times the width times the thickness. a. Make certain all three measurements are either in feet or in yards. b. If the job being done is a large one, convert to cubic yards. If it is small, leave or convert into cubic feet.
B. Determine the water-cement ratio and the cement-sand-gravel ratio you wish to use	1. Check the table which was given you or one of the tables in a reference book and determine: a. Which water-cement ratio is most applicable to the job being done. b. Which cement-sand-gravel ratio is most applicable to the job being done. c. Use most applicable ratio for your calculations.
C. Estimate the amount of each item needed for your job	1. Refer again to the table and see what amounts of each item are required for one cubic yard of concrete. 2. Multiply this amount for each item times the total number of cubic yards needed for the job being done. 3. Your answer for each item will be the amount of that item needed: a. Your answer for cement needed should come out in number of sacks needed. b. Your answer for sand and gravel needed should come out in either cubic feet or cubic yards, depending on which unit you used from your table.

JOB OPERATION SHEET

UNIT NO. 14: Introduction to Concrete

JOB: Mixing, Placing, Finishing and Curing Concrete

What To Do	How To Do It
A. Prepare form for concrete slab 4' x 6' and 4" thick.	1. Level ground. 2. Make form from 2" x 4" material. 3. Make certain corners are square and all sides level. 4. Support form with stake braces every 2'.
B. Prepare form for pouring	1. Level and tamp soil inside form so that concrete will have uniform thickness. 2. Dampen soil so dry soil will not draw H_2O from concrete. 3. Oil inside of boards of form so boards can easily be removed.
C. Proportion and mix concrete	1. Using the 1/2 cubic foot measure, measure out 2 cubic feet sand and 2 1/2 cubic feet of gravel and mix thoroughly with one cubic foot of cement in mortar box. 2. Test sand for dampness. If dry, add 6 gallons of water/sack of cement. If damp, use 5 1/2 gallons; if wet, use 5 gallons. 3. Mix cement, sand, gravel and water thoroughly. If mixture is too dry <u>do not</u> add water alone -- add dry cement and water. For each quart of water add 1 1/2 quarts of loose dry cement.
D. Place concrete in form	1. Place concrete in area of form where needed -- do not move in form any more than necessary. Place as quickly as possible. 2. Tamp enough to fill all air spaces (Do not tamp enough to push gravel below surface). "Spade" along edge of form to ensure a smooth, dense surface next to the form.
E. Level concrete with top of form	1. Use 5' "screed" or strike-off board to level.

UNIT NO. 14: Introduction to Concrete

JOB: Mixing, Placing, Finishing and Curing Concrete

What To Do	How To Do It
	2. If gravel sticks above surface, tap with edge of screed board.
F. Finish concrete	1. Smooth with wooden float. Fill in holes by moving float in circular motion. Use float as little as possible until concrete is stiff. 2. Use edger all around edge of form. 3. Use grover across middle of form (to divide into 2 areas 4' x 3'). 4. When concrete is quite stiff, finish with steel trowel to give dense, smooth surface.
G. Cure slab	1. Cover entire slab with plastic or canvas sheet to retain moisture for at least 3 days.
H. Clean all tools and equipment	1. Wash with water.

UNIT NO. 15: Introduction to Surveying

OBJECTIVES: 1. To give the student a knowledge of
a. Parts of an instrument
b. How to set it up
c. Basic fundamentals of using it

Ability to:	Teaching-Learning Activities
A. Know the parts of a surveying instrument 1. Tripod 2. Instrument 3. Telescope 4. Thumb screws 5. Tripod head	A. Have students draw and label a surveying instrument.
B. Understand how a level works 1. Parts of a level and the function of each: telescope, cross hairs, bubble vial, leveling plate, leveling screws, tripod, etc. 2. Parts of a rod and the function of each: divisions or marks, target, extension rod 3. Reading and interpreting the marks on a rod 4. Line of sight or line of vision a. What it is b. How it compares with a level surface	B. Set target at different readings and have student record readings on paper. Repeat until students are getting uniform results.
C. Set up a level and handle a rod 1. Setting up the tripod 2. Placing instrument head on tripod 3. Leveling the instrument 4. Handling rod: method of holding, keeping rod straight up and down, moving target up or down 5. Surveying signals to use in handling and reading rod 6. Reading the rod to nearest 100th of a foot	C. Use the classroom facilities (blackboard, comfortable seating) for teaching how a level works, how to read a rod, and for demonstrating how to set up the level and handle the rod. Use school ground for student practice of these activities. (See Job Operation Sheet)
D. Know precautions and rules in using the level 1. Keeping instrument level a. Preventing body contact with tripod or instrument head	D. Have students set up level, observing all necessary precautions.

Ability to:	Teaching-Learning Activities
b. Checking bubble often 2. Carrying instrument through brush 3. Balancing the length or distance of backsight and foresight shots 4. Battering end of rod 5. Getting mud on end of rod 6. Other precautions	
E. Determine difference in elevation or height between two or more points with one set-up of instrument 1. Locating and setting up instrument a. Balancing distance of shots 2. Taking shots at the different points 3. Recording rod readings 4. Interpreting the readings (Highest rod reading means lowest elevation)	E. Use score card for FFA Field Day surveying contest for practice in determining differences in elevations.
F. Lay out a square corner for a foundation or a fence 1. Measuring and marking first side 2. Setting up instrument over corner a. Plumb bob over exact location of corner 3. Turning instrument in line with known side 4. Setting vernier at zero on horizontal direction plate 5. Turning instrument 90° to determine direction line of other side 6. Setting stakes in order to mark side 7. Repeat at other corners, or use 3-4-5 formula and/or equal diagonals	
G. Level a form for a foundation or floor 1. Determining the height above grade line that form should be 2. Locating elevation stakes 3. Taking shots, and driving stakes to the proper elevation or level	G. Lay out, square, and level a small foundation form for practice

UNIT NO. 15: Introduction to Surveying

Ability to:	Teaching-Learning Activities
H. Roughly determine the area of a plot of ground by stepping or pacing 1. Stepping or pacing a. Learning to consistently step 3 feet, or b. Consistently stepping the most normal step 2. Determining the distance covered by a series of steps 3. Determining the area of a plot in square feet 4. Determining the acreage by dividing the square feet of area by 43,560	H. Use score card for the FFA Field Day land area contest when practicing area determinations. (Fewer mistakes in computation will be made if students practice estimating area by eye before computing area).
I. Learn glossary 1. Bench mark 2. Back sight 3. Fore sight 4. Tripod 5. Height of instrument	I. Have students search out the meanings of these terms.

REFERENCES:

Phipps, L. J., Mechanics in Agriculture, Chapter 40, 41.
Phipps, L. J.; N. F. McColly; L. L. Scranton; and G. C. Cook, Farm Mechanics Text and Handbook, Chapter 49.
Schwab; Frevert; and Barnes, Elementary Soil and Water Engineering, Chapter 4.

JOB OPERATION SHEET

UNIT NO. 15: Introduction to Surveying

JOB: Set up the Tripod and Instrument

What To Do	How To Do It
A. Set up the tripod	1. Loosen the thumb screws which fasten the tripod legs to the head. 2. Spread the legs 3 to 4 feet and push firmly into the ground, keeping the head as level as possible. 3. Tighten the thumb screws holding the legs to the tripod head.
B. Mount the instrument on the tripod	1. Screw the instrument on the head of the tripod. 2. Remove the lens cap. 3. Place sunshade over the objective lens.
C. Level the instrument	1. Be sure the telescope clamp screw is loose and swing the telescope in position directly over an opposite pair of leveling screws. 2. Turn the leveling screws simultaneously to level the bubble tube. Note: the screws should be turned so the thumbs move toward <u>or</u> away from one another. The bubble will follow the left thumb. 3. Turn the telescope to a position across the other opposite pair of leveling screws and level the bubble. 4. Continue this leveling process over all the opposite screws until the telescope remains level in all directions. 5. Focus on the rod and the cross hairs using their adjustments.

UNIT NO. 16: Tractor Operation

OBJECTIVE: To acquaint the student with the various makes of tractors and their differences in operation.

Ability to:	Teaching-Learning Activities
A. Introduction 1. Safety rules and safety test 2. Types a. Gasoline, diesel, or L. P. b. Row crop as opposed to regular cropping tractor 3. Makes a. John Deere b. Allis Chalmers c. International d. Case e. Ford f. Massey Ferguson g. Moline h. Oliver	A. Explain differences in the makes of tractors.
B. Tractor maintenance 1. Check oil 2. Check water 3. Check hydraulics 4. Check fan belt 5. Check fuel 6. Check tractor lubrication 7. Check transmission	B. Show the student where the check points are on each make of tractor.
C. Starting the tractor 1. Special features a. Warm-up devices b. Special fuel shut-off 2. Safety precautions a. Disengage clutch b. Take out of gear c. Power take-off - shaft disengage	C. Show each student how to start each tractor.
D. Tractor operation a. Horseshoe course and stop it	D. Have each student drive each tractor through this course.
E. Evaluation of operating skills 1. Drive one tractor through a modified S course and then back through and stop it with the drawbar on a designated point	E. Add points for each stake hit and for each second over safety minimum it takes to complete the course. Lowest score wins.

UNIT NO. 16: Tractor Operation

REFERENCES:

Brown; and Morrison, Farm Tractor Maintenance, Chapter 17.
Cook; Walker; and Snowden, Practical Methods in Teaching Farm Mechanics, 1952, Chapter 14.
4-H Tractor Program, Tractor Care and Safety, National 4-H Service Committee, Chicago, Illinois, 1963.
Phipps, L. J., Mechanics in Agriculture, Chapter 25.
Phipps, L. J.; N. F. McColly; L. L. Scranton; and G. C. Cook, Farm Mechanics Text and Handbook, 1959, Chapter 29.

VT 010 333
Service Station Safety for Young Workers.

Bureau of Labor Standards (DOL), Washington, D.C.
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Bureau of Labor Standards, U.S. Department of Labor, Washington, D.C. 20210.
PUB DATE - 65 28p.

DESCRIPTORS - *MANUALS; *DISTRIBUTIVE EDUCATION; *SERVICE OCCUPATIONS; SEMISKILLED OCCUPATIONS; *SAFETY EDUCATION; COOPERATIVE EDUCATION; CLASSROOM MATERIALS; *WORK EXPERIENCE PROGRAMS
IDENTIFIERS - NATIONAL SAFETY COUNCIL

ABSTRACT - This handbook for young workers was prepared in consultation with representatives of the petroleum industry and the National Safety Council. It is a summary of safe work habits for service station employees and presents general information and safety tips to follow when lubricating a car, changing a tire, or checking the radiator. (JS)

VT 010 333

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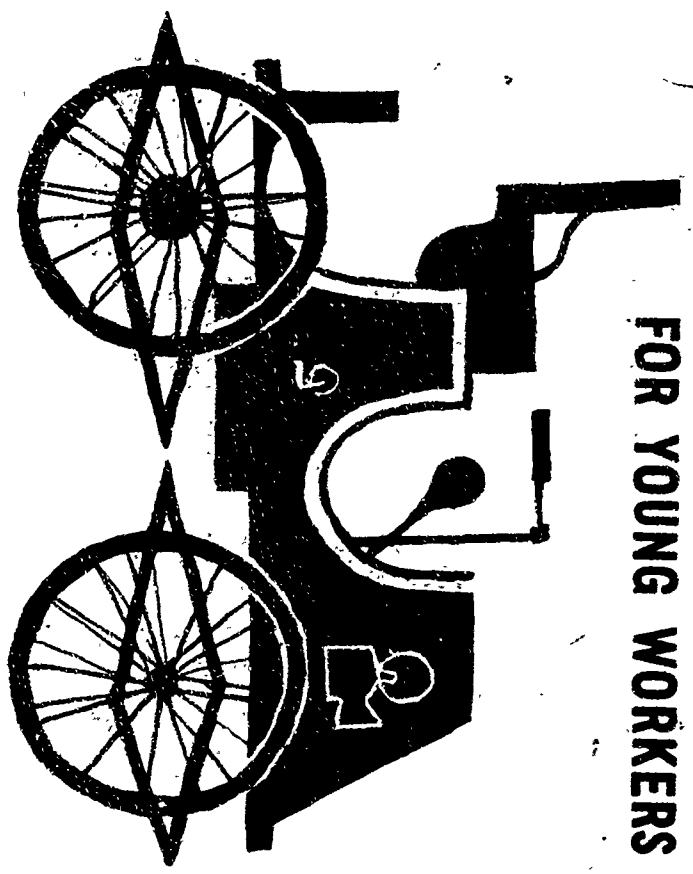
SERVICE STATION SAFETY

FOR YOUNG WORKERS



Name

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Emergency Phone Numbers

Fire Department.....

Ambulance.....

Police.....

Other Station Personnel

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TAKE TIME TO BE SAFE

ERIC

ED0 45856

Hi!

All of us want you to feel welcome, to feel you are a part of the team. Help *us* to help *you* by using all safety devices provided, and by following the safety rules designed to protect you, your fellow employees, and our customers. To you, a new employee, some of the precautions may seem excessive, but the failure to follow the rules can result in very painful and perhaps serious injury.

Please remember that working safely is an important part of your job. If there is anything you do not understand, ask questions. Keep this booklet handy and refer to it often until you are familiar with your new surroundings and with the safe way to do each job.

GENERAL

The way you dress and your personal cleanliness are important to your health and safety. Clothing should be neat, clean, and in good condition because:

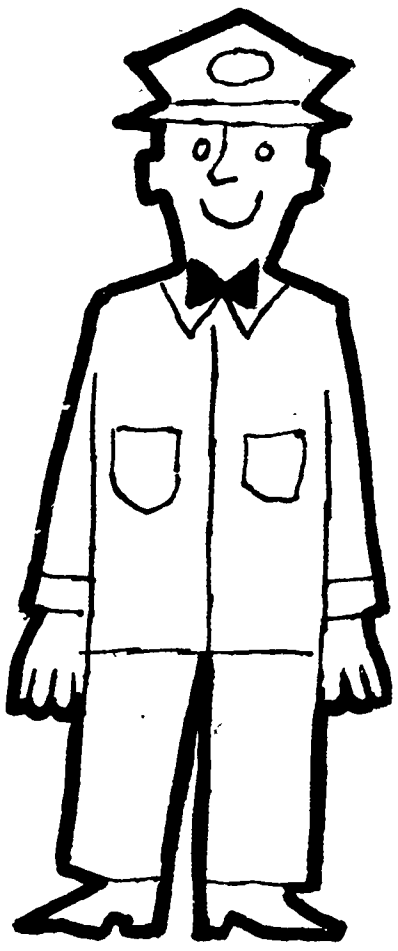
- Loose or ragged clothing may catch on objects or in moving machinery.
- Clothes soaked with gasoline or oil may catch fire.
- Some petroleum products, such as gasoline, left on the skin may cause irritating skin rashes or chemical burns.
- Shoes in need of repair, or those which are greasy or muddy can result in trips, slips, and falls.

So—

- Keep clothing repaired.
- Change your clothes as soon as possible if they become saturated with gasoline or oil.
- Wash your hands often with soap and water, especially before eating.
- Do not use gasoline to remove dirt or grease from your hands.
- Safety shoes will save you pain and injury.
- Wear eye protection when required on specified jobs.

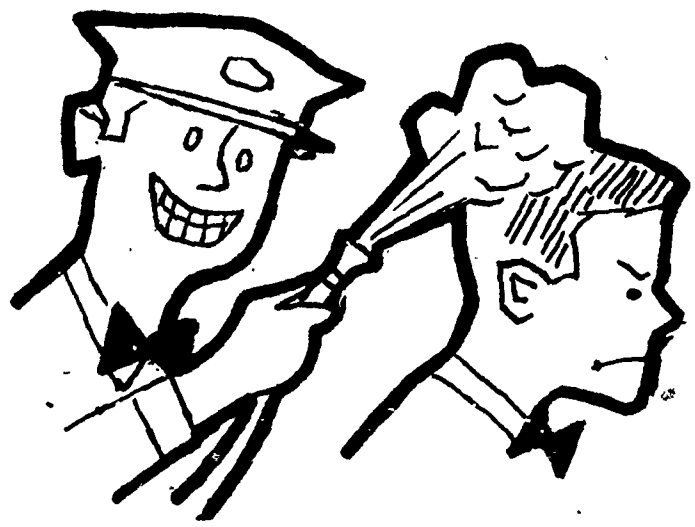
CAP—keeps hair clean as well as offers protection.

BOW TIE or NO TIE—long neckties can get caught in moving machinery.



CUFFLESS TROUSERS—cuffs can trip you, especially on stairs or ladders.

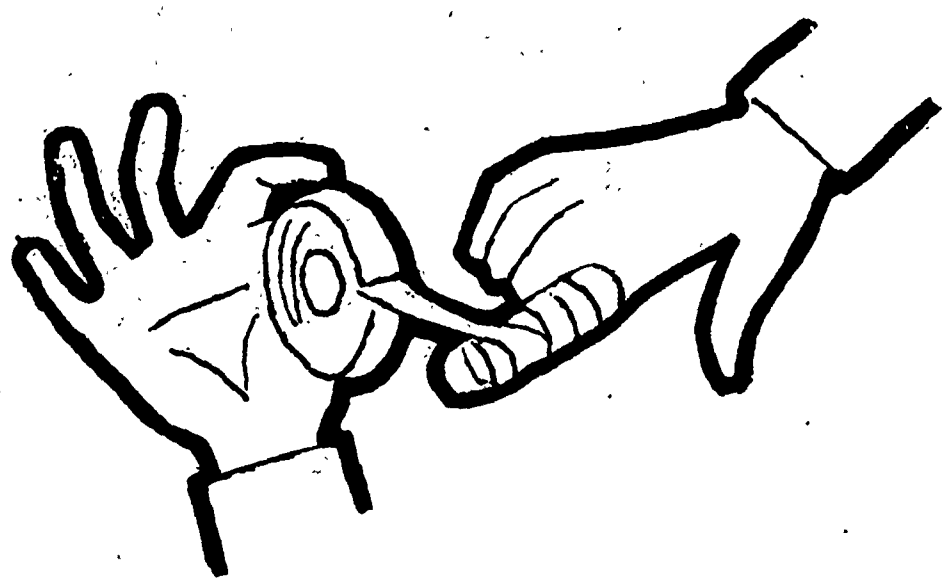
STURDY SHOES—(preferably safety-toe shoes) should be well fitted and in good repair.



Many people are injured—some crippled for life—every year by practical jokes. Never engage in horseplay.

Get first aid, no matter how slight the injury. Painful infections are often the result of small cuts or punctures that have not been treated.

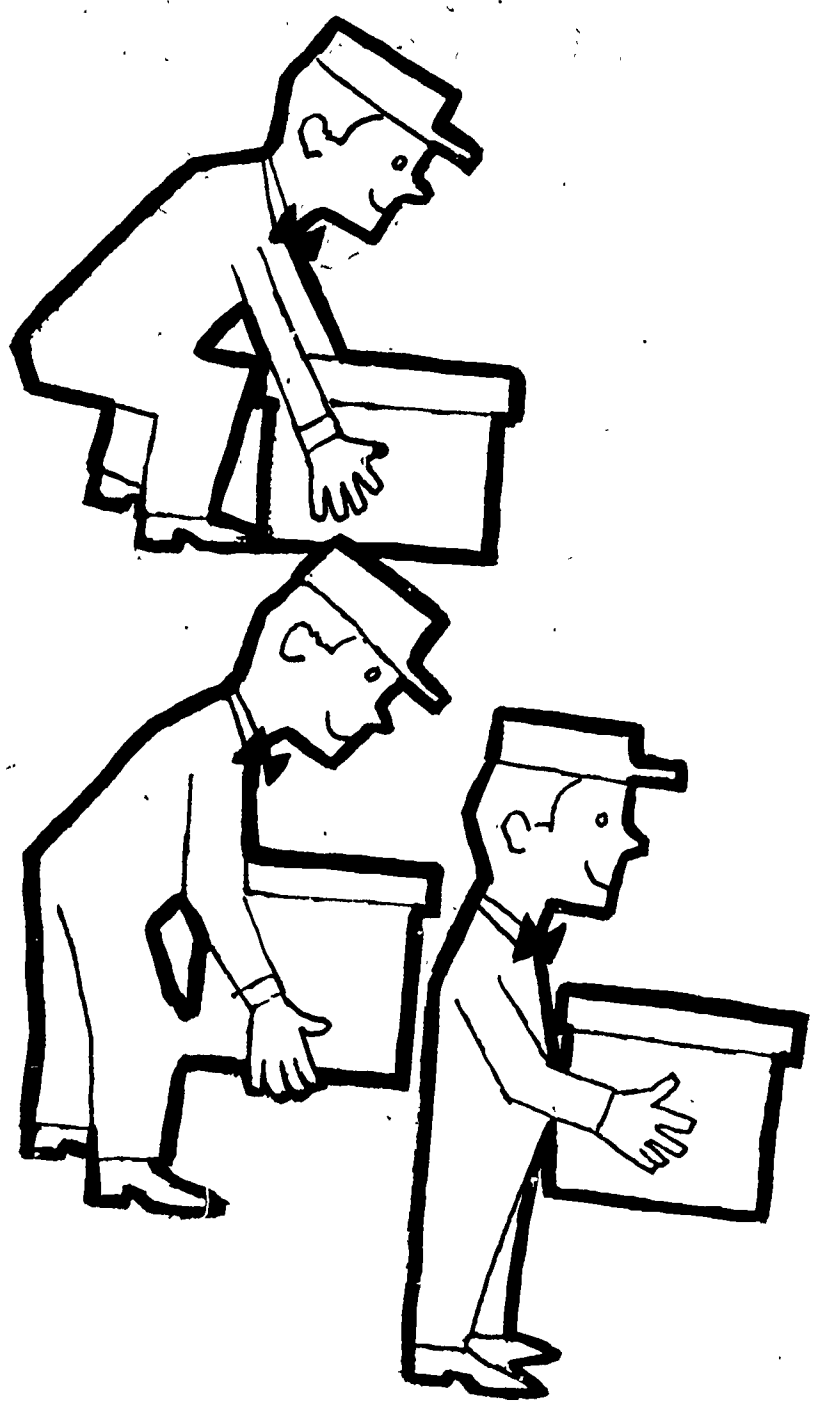
Before placing a bandage over a wound, wash the area with soap and water.



- Use commonsense when working in a storage area. Store supplies so that they will not fall or cause a fire hazard.
- Keep storage area free of tripping hazards and trash.
- If something spills, clean it up.
- Don't use makeshifts for climbing.
- Don't climb on shelves.

Here are some tips for correct and safe use of ladders:

- Be sure ladder is in good condition.
- See that ladder has firm footing and is correctly placed.
- Do not work from a ladder that is standing in front of a door which could be opened against it. Lock or block the door.
- Do not lean off balance to reach the work—move the ladder.
- Open a stepladder to its full width and lock in position before you climb.



If available, use lifting equipment, such as trucks, dollies, jacks, hoists, instead of back or leg power.

Learn to lift the right way and save your back. Follow these simple rules:

- Size up the load first. Get help if you need it. Be sure of your footing.

- Plant your feet firmly, well apart, and squat down. Watch for sharp edges. Get a good grip on the load. Keep your back as straight as you can. Bend your knees, not your back.

- Lift slowly by pushing up with your legs. Keep the load as close to the body as you can. Lift the load to the carry position. If necessary to change your direction after you are in an upright position, change foot position—don't twist your body.

- When putting a load down, reverse the procedure, let it down easy, don't use your back—watch your fingers.

DRIVEWAY

Watch for cars entering or leaving service area. The driver may not see you, or he may be unable to stop.

Be careful when walking near the front or back of a car while the driver is at the wheel. If possible, avoid walking between the front bumper and back bumper of two cars parked at the gas island.

Use extreme caution during a storm or when area is covered with ice or snow.

Watch for projections on cars, such as trailer hitch and exhaust pipe, as you move around the car. They can cause injuries to the legs.

Watch for sharp edges and damaged areas of car bodies.

Observe the "No Smoking" rule around gasoline pumps. If the customer has not turned off the ignition, politely ask him to do so.

Make sure the nozzle is securely in the fill pipe at all times during dispensing of gasoline.

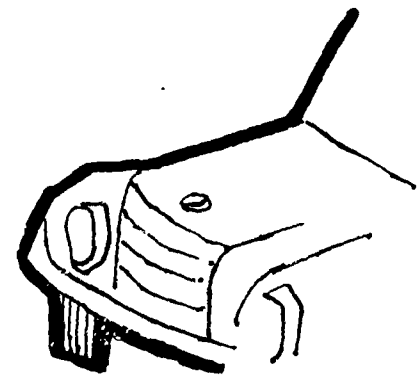
When checking under the hood:

Make sure the hood of the car won't fall; if in doubt, use a prop.

Watch for sharp edges of metal.

When reaching for the dipstick, avoid touching the manifold or other parts of the motor which may be hot.

If any inspection or adjustment must be made while motor is running, use extreme caution around fan blades, belts, and pulleys.



When cleaning windshield and windows, watch for broken glass and sharp metal edges. Keep your fingers out of open doors and windows where they may be pinched.

The battery solution (electrolyte) is almost pure sulphuric acid, which can cause a painful burn. Keep the following rules in mind:

- The rubber tip on the hydrometer or the battery filling hose may, if mishandled, flip the acid solution into your eyes.
- Never use a match or other open flame to check the level of the battery. An explosion may result.
- When brushing the corrosive particles from the battery, be very careful, especially if the wind is blowing, that they do not fly into your eyes.
- After servicing battery, wash your hands before you touch your face or eyes.

Check with your supervisor for special instructions on filling portable containers and motorcycle and scooter tanks.

Checking the radiator is dangerous as easy and simple as it may seem. Many attendants are severely burned by scalding water and steam from overheated radiators. Consider every radiator as being overheated until the cap is removed.

Here's the safe way:

- For cars equipped with pressure caps, place a large heavy rag or special cover over the cap and surrounding area. Then, while standing at arm length, turn cap clockwise to tightened position (the last attendant may have left the cap loose). You can now judge how much

to turn cap to remove it. Turn cap counterclockwise to first position, wait for pressure to be released, then continue to turn cap until it can be removed.

- If the cap is equipped with a pressure-release valve, open valve to allow pressure to escape. Then, as an added precaution, place heavy rag over the cap before it is removed.

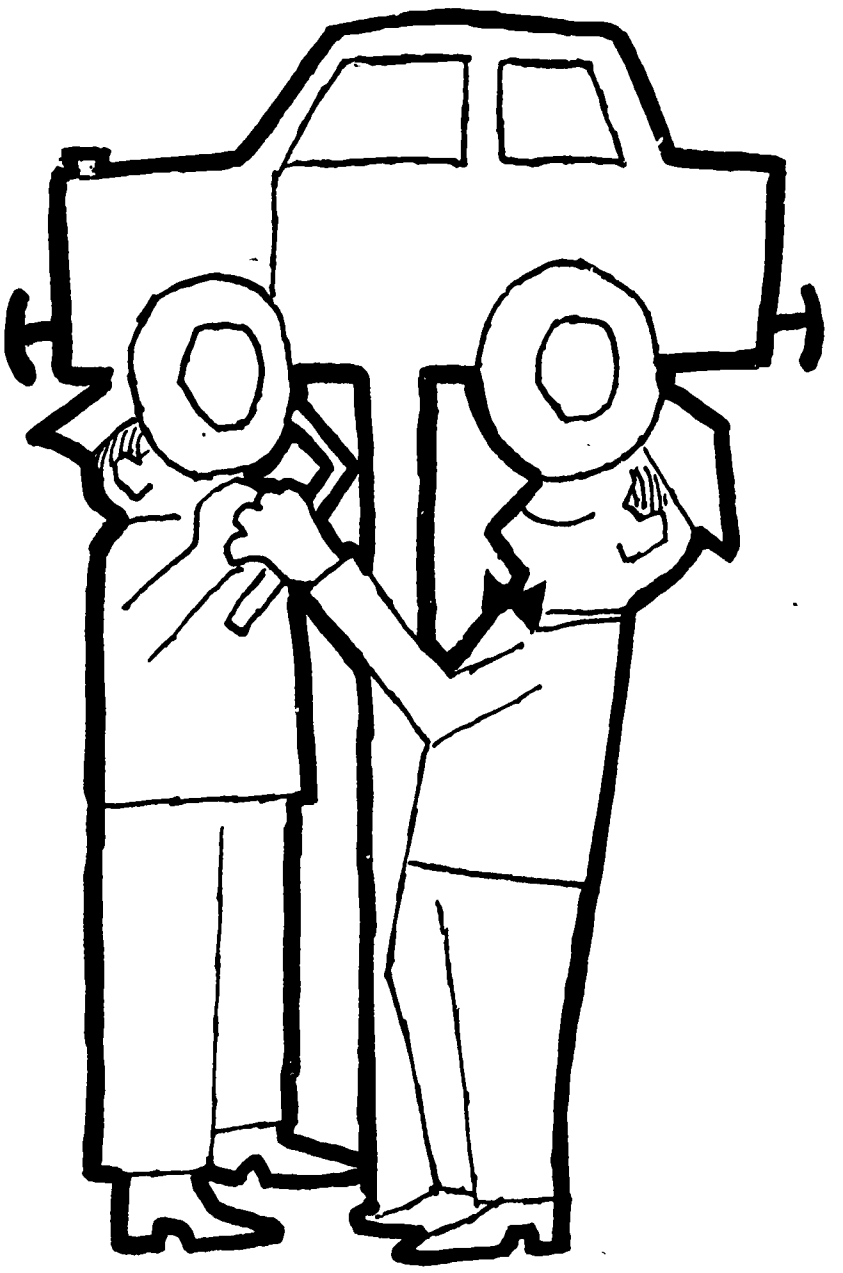
- If you can hear the water boiling before removing the cap, wait until the boiling stops, then proceed as above.

- Remember, boiling may not occur until after the pressure in the radiator has been released.

Remember—

- When checking or inflating tires for customers, don't place any part of your body under a wheel where it would be run over if the car should move.
- When inflating the tire, keep face above fender or to one side.
- When checking spare tire, make sure trunk lid will not fall on your head. If the spare is in poor condition, keep your head to one side when adding air.
- Replace air hose neatly after using it to avoid a tripping hazard.
- Never skylark or play practical jokes with the air hose. People can be severely injured with high pressure air blasts.

LUBRICATION



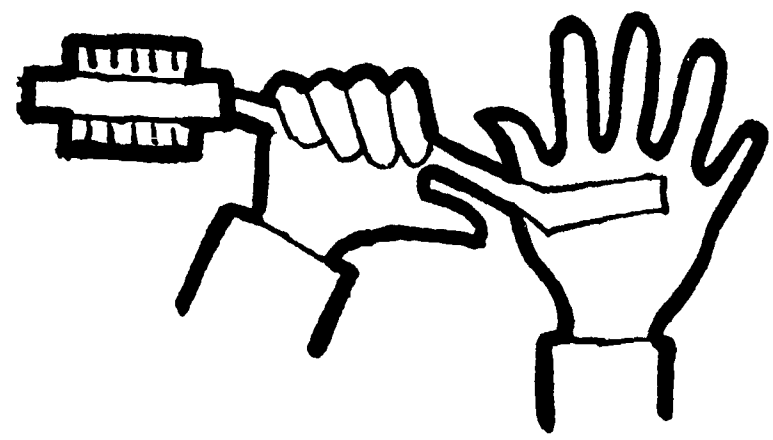
When directing a car onto the hoist, keep to one side, so driver won't pin you against a wall. Make sure everything is in the clear and all safety precautions are observed and the handbrake is set before the car is raised on the hoist. Before going under the car or hoist, make sure all safety blocks and chocks are in proper position. Good housekeeping is very important to your safety around the lubrication area, so—

- Keep supplies, equipment, and trash out of the work area.

- Clean up oil or grease spots immediately. Use a scraper, then clean area with a dry absorbent, hot soapy water, detergent or a safe solvent. **NEVER USE GASOLINE.**

- Clean tools and put in proper place.

Before you trigger the lube gun, seat the nozzle firmly on the grease fitting. Never discharge a gun in the direction of another person or into a cloth held in the hand. If the grease is discharged against the skin, it may cause a very painful injury, requiring surgery.



To remove the drain plug from the crankcase, transmission, or differential, *use the proper tool.* Be careful—crankcase and transmission oil may cause burns. Force should be applied smoothly. If plug is unusually tight, hold wrench on plug with one hand and strike other end of wrench with palm of hand. This will prevent skinned knuckles or other injuries. When working under the car, it is wise to wear goggles to avoid dirt, gravel, and other debris.

When packing wheel bearings, the wheel should be raised a few inches off the floor. Then you can work from a squatting position with your back upright.

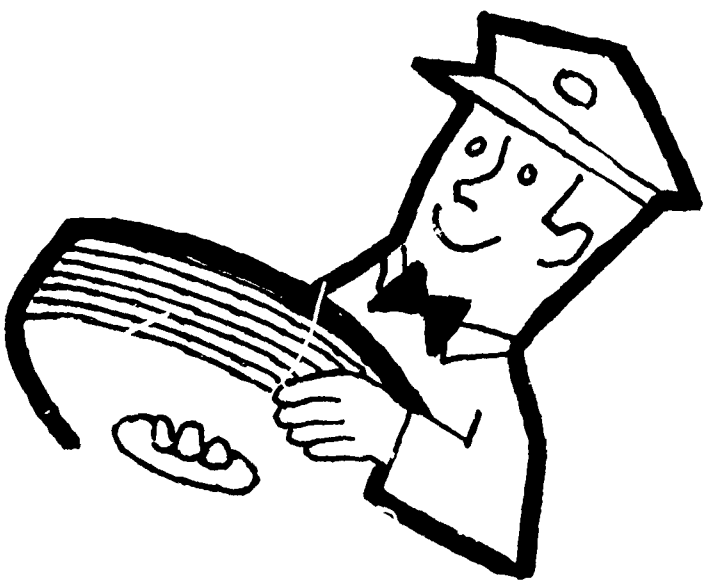
If the lubrication is done from a pit, be careful to avoid grease spots on the steps. Do not use an open flame or create a spark while working in the pit. Do not jump across an open pit.

TIRES

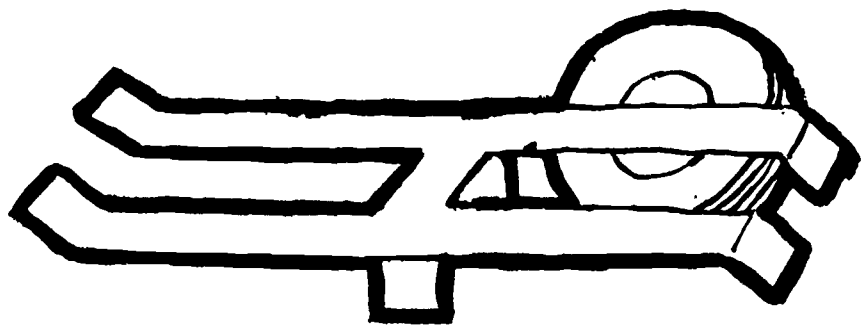
The many types of tires used today and the specialized tire changing equipment required present a wide variety of safety problems. Before using this equipment, study the instructions and illustrations published by the manufacturer, and ask your supervisor how to use it safely.

Use extreme caution when repairing or servicing a tire mounted on a rim with a lockring.

- Completely deflate the tire before attempting to remove the lockring.
- Before inflating the tire, make sure the lockring is properly seated.



- If the station does not have a special cage for inflating tires mounted with lockrings, place tire flat on floor under the hoist with the rail of the hoist over the center of lockring and lower hoist to a point where it will not interfere with inflating the tire.

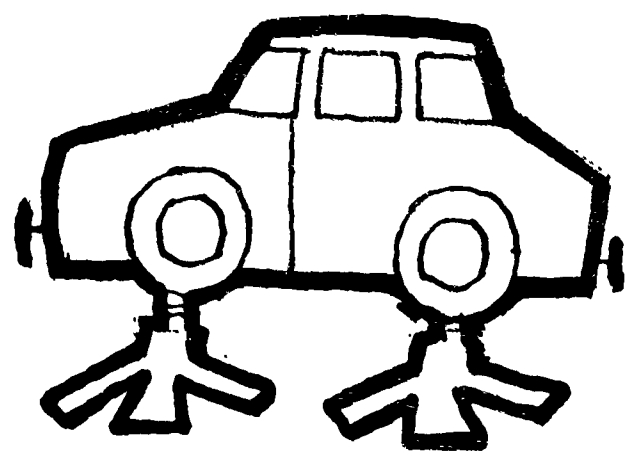


- Avoid overinflating any tire. If you are not sure, check chart for recommended pressure.

MECHANICAL

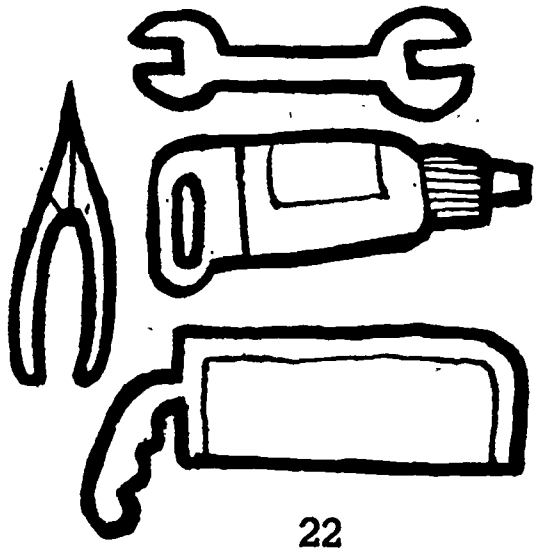
Here are a few suggestions for making repair jobs safer and easier:

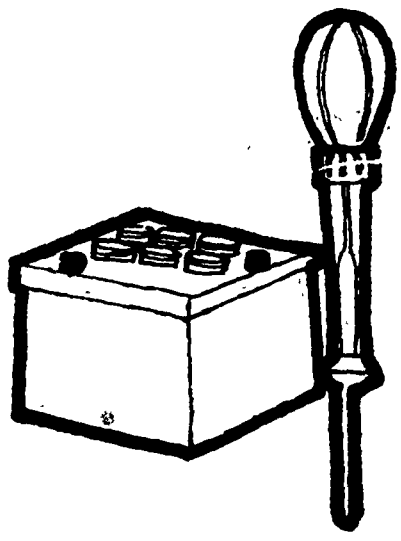
- Never depend on jacks or a chain hoist alone to support a car you have to work under. Block it.



- Remember, carbon monoxide gas is produced when a motor is running. Use exhaust hose or keep lube bay doors open.
- Use appropriate goggles or shield on any job where needed. Examples are: grinding or drilling metal, welding, or wire-brushing.
- Use proper position for lifting. Get help when needed.

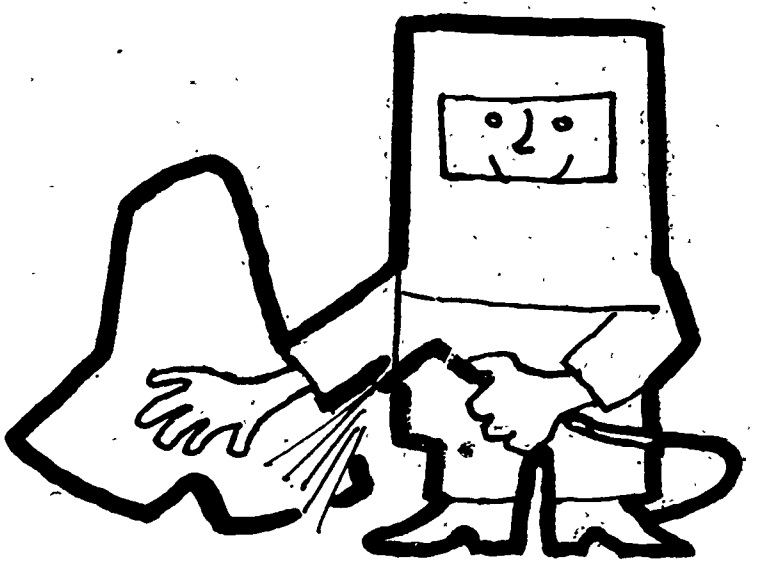
- Keep your feet clear of moving vehicles when you are working under a car.
- Contact with the ignition system while the motor is running may not produce an injury, but it can cause you to get your hand or elbow into the fan blade or some other moving part. Be careful what you touch.
- Use each tool only for the purpose for which it was intended.
- Return tools to rack when you have completed job.
- Keep tools in good repair and stored in their proper place.
- Keep tools clean—wipe them off when you have finished the job.
- Never use gasoline or carbon-tet for cleaning or degreasing jobs.
- Don't leave gasoline in open containers.
- Pour used solvent into proper container after use.





Battery charging generates a highly flammable gas—hydrogen. Avoid open flames and arcing electrical equipment. There are several precautions to be followed when filling dry-charged batteries:

- Follow the instructions on the container.
- Use proper tool for opening container.
- Use goggles, acid-resistant gloves, and apron when pouring the solution.
- Immediately wash all acid spills on skin with water—do not use baking soda on skin.
- Use baking soda to neutralize spilled acid on working surface, then flush with water.



Gasoline and gasoline vapors around a service station make welding and flame cutting dangerous. Don't attempt to use welding and cutting equipment until trained or told to do so by your supervisor.

Prevent eye injuries by wearing correct eye protection when welding, or acting as a welder's helper, or when just looking on.

Do not handle oxygen tanks or pressure regulators with oily or greasy hands—an explosion may result.

In areas where cutting or welding is done, expect every piece of metal to be hot. Check it before you pick it up.

Acknowledgment

This publication was prepared by the U.S. Department of Labor's Bureau of Labor Standards in consultation with the American Petroleum Institute, Gasoline Merchants of Brooklyn, National Refiners Association, and the National Safety Council.

Copies may be obtained upon request from

U.S. DEPARTMENT OF LABOR

Bureau of Labor Standards

Washington, D.C. 20210

U.S. GOVERNMENT PRINTING OFFICE: 1965—O-766-204

VT 010 350
Reviews of Film on Related Subjects for Plumbing and Pipe Fitting Apprentices.

Texas A and M Univ., College Station. Engineering Extension Service
Texas State Joint Apprenticeship and Training Committee for the Plumbing and Pipe Fitting Industry
MF AVAILABLE IN VT-ERIC SET.
Series 2
Instructional Materials Production, Engineering Extension Service, Texas A and M University, F.E. Drawer K, College Station, Texas 77843 ($.75).
PUB DATE - ND 66p.

DESCRIPTORS - *TRADE AND INDUSTRIAL EDUCATION; *PLUMBING; *APPRENTICESHIPS; *INSTRUCTIONAL FILMS; FILMSTRIPS; *FILM STUDY; TESTS; ANSWER KEYS

ABSTRACT - Designed for instructor use in conducting apprentice training programs, this bulletin provides content and availability sources for 15 films related to the plumbing and pipe fitting industry. Following brief reviews of the films, questions, with answers, are given, to be used at the instructor's discretion. Also included are objective tests and answer sheets covering six additional films which are named but not reviewed. The films cited may be borrowed for only the cost of return postage. (AW)

VT 010 350

REVIEWS OF FILM ON RELATED SUBJECTS

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY

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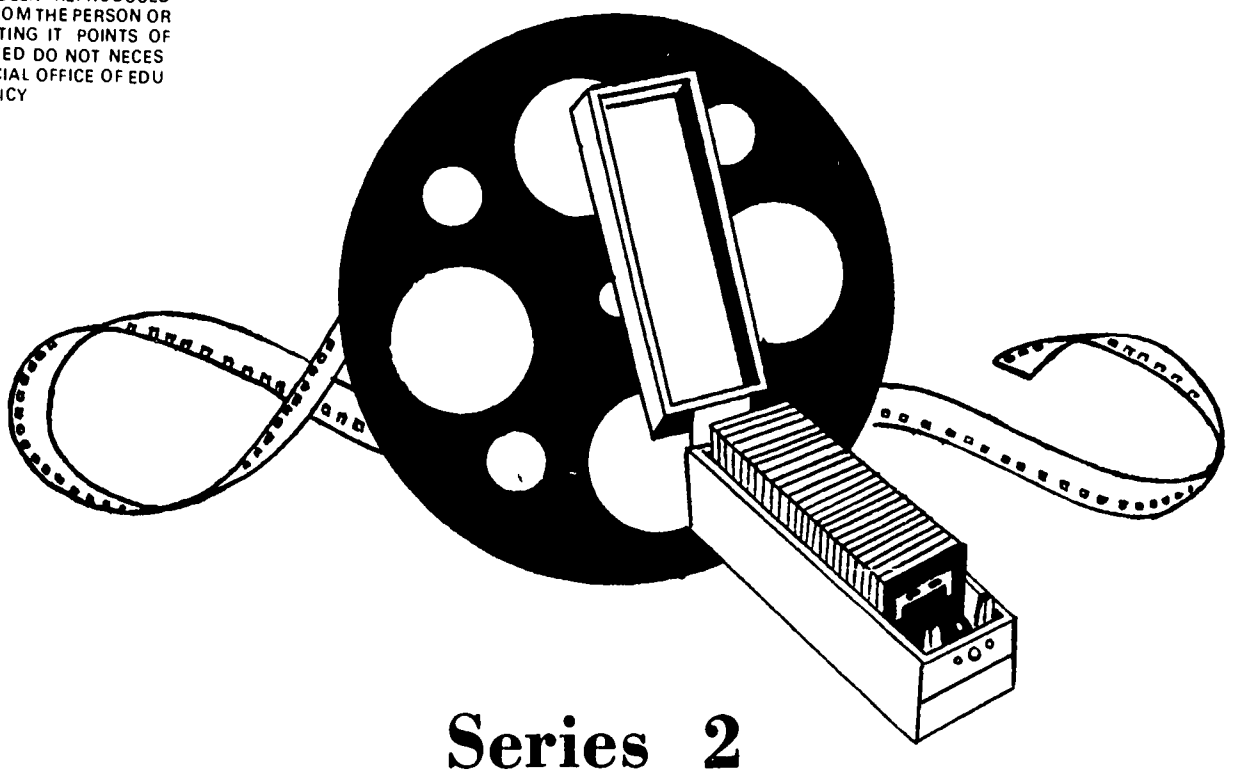

Series 2

for

PLUMBING AND PIPE FITTING APPRENTICES

ED0 45856

FOREWORD

This is the second series of Film Review questions prepared to assist the apprentice instructor. These questions are to be used at the discretion of the instructor. Highlights of the film may be discussed or the questions may be used as a follow-up in order to be sure that the class gains some benefit from the film.

The film may be borrowed, at no cost other than return postage, from the source listed on each review sheet.

The various manufacturers and associations are doing a great service to the apprentice training program and to them we are greatly indebted.

D. Bart Phipps, Specialist
Apprentice Training for the
Plumbing and Pipe Fitting
Industry

Film Reviews

1. Little Known Facts About a Well Known Product
2. Pipeline to the Clouds
3. Installing Cast Iron Pipe
4. Permanent Investment
5. Toward A Uniform Plumbing Code
6. Municipal Sewage Treatment Processes
7. Installation of Vitreous China Fixtures
8. The Ominous Arms Case
9. Down the Drain
10. Circulation and Stratification of Water in Hot Water Tanks
11. The Fundamentals of Silver Alloy Brazing
12. Safe Water in the Home
13. Mechanical Refrigeration, How It Works
14. Explosion, Danger Lurks
15. Covering Hot and Cold Pipe

Objective Tests For Film

1. The Second Hundred Years
2. Life Lines of Industry
3. Moulders of Progress
4. Selecting The Right Valve
5. Piping Pointers
6. Penny Wise - A Story of Anaconda Copper Tube

Price 60¢

D. Bart Phipps
Engineering Extension Service
Box 236 F.E.
College Station, Texas

Film: "Little Known Facts About a Well Known Product"

A visit and a guided tour through a plant which produces one of the most commonly used tool proves to be educational as well as very interesting.

The Ridge Tool Company has provided this color film to show the many steps that go into manufacturing pipe wrenches plus other tools such as dies, cutters, reamers and vises. The fact that some of the tools used by the piping trades are precision made and are precision tools which should be maintained as such is very well illustrated.

The requirements of the various tools are shown as well as the rugged tests given before they are released for sale.

This film may be ordered from:

National Association of Plumbing Contractors
1016-18 20th Street N.W.
Washington 6, D.C.

Film: "Pipeline to the Clouds"

A situation that should be a very serious concern of everyone, layman and craftsman alike, is very pointedly illustrated by this film.

The matter of water conservation is the theme of the film produced by General Electric Company. It is a color sound film that illustrates very beautifully the water presently available from natural resources. In the same manner the normal use and waste of this precious item is illustrated.

Finally the processes necessary to purify water are illustrated and an estimate of the facilities that may be necessary in the not too distant future to maintain a sufficient reserve of water.

The responsibility of the craftsman to the community and the service which is rendered by him is very pointedly presented.

This film is recommended for apprentices and journeymen, but particularly for beginning apprentices.

It is provided by and may be obtained from the film library of:

National Association of Plumbing Contractors
1016-19 20th Street N.W.
Washington 6, D.C.

Film: "Installing Cast Iron Pipe"

The safe and sane methods of handling and installing cast iron pipe for water service is the theme of this film.

Various types of joints and methods of making them is demonstrated and explained. This film does not deal with cast iron soil pipe. There is information to be gained that the apprentice might learn only on the job otherwise.

This film may be obtained from the Texas State Board of Plumbing Examiners Film Library:

Mr. Lynn Brown, Administrator
Texas State Board of Plumbing Examiners
904 Lavaca
Austin, Texas

ERIC

Film: "Installing Cast Iron Pipe

1. List three uses of cast iron pipe.

   Ans: Sewer, gas and water

2. Before accepting pipe that has been shipped, how is it tested for cracks?

   Ans: It is tested by "Ringing" with a hammer

3. When distributing the cast iron pipe where it is to be installed, what precaution is taken?

   Ans: To prevent damage to the pipe by rough handling

4. What is the first important responsibility or operation in laying cast iron pipe?

   Ans: A good trench with a level and smooth bottom is the first important step in the installation of laying cast iron pipe at a proper depth

5. At what position is the block placed for the cutting operation?

   Ans: Directly under the mark or point at which the pipe is to be cut

6. What is the name of the tool used to cut cast iron pipe?

   Ans: Cold cut, hardy, cleaver, or pipe cutting chisel

7. What is one outstanding safety precaution that is disregarded by the men cutting this cast iron pipe?

   Ans: No safety goggles are worn to protect the eyes

8. Explain the procedure for cutting cast iron pipe with the tool mentioned above.

   Ans: Mark the pipe completely around by striking the cold cut lightly and increasing the blows as the cut is completed

9. What is the advantage of the wheel cutter?

   Ans: Cutting stationary pipe and pipe 16 inches or less in diameter

10. To what depth is the yarn driven into the joint to allow for lead?

    Ans: $2\frac{1}{2}$ inches

11. In your own words describe the steps necessary in making a lead joint with cast iron pipe.

    Ans:
    1. Clean the bell and spigot carefully
    2. Yarn the joint
    3. Drive the yarn in $2\frac{1}{2}$ inches
    4. Set the runner
    5. Pour the lead
    6. Caulk or drive it

12. Describe the sulphur compound joint.

Ans:
1. Clean the bell and spigot carefully
2. Yarn the joint
3. Drive braided yarn in $2\frac{1}{2}$ inches
4. Set the runner
5. Pour sulphur by use of funnel

13. Describe the cement joint.

Ans:
1. Proper cement mixture
2. Clean the bell and spigot carefully
3. Yarn the joint
4. Drive yarn in 3 inches into the joint
5. Tamp cement into joint by hand
6. Tamp cement into joint three times

14. Describe mechanical jointing.

Ans:
1. Clean the bell and spigot
2. Place cast iron gland back about 10 inches on pipe
3. Place rubber gasket next
4. Clean bell and spigot again
5. Push rubber gasket into place
6. Push gland into place
7. Bolt gland in place and tighten

15. What is the advantage of the mechanical jointing over other joints?

Ans: More flexibility

16. What is the purpose of a tapping machine?

Ans: To enable the contractor to make a tap in a line with the pressure on for laterals or service lines off the main line

17. Describe the boring bit used in the tapping machine.

Ans: It is combination bit and tap

18. What is the name of the valve that is installed in the main by the tapping machine?

Ans: Corporation stop

19. Why is the first back filling done very carefully?

Ans: To avoid damage to the pipe and to give the pipe a good foundation.

20. Describe a very simple method of chlorination by the journeyman installing the pipe.

Ans: By putting a handfull of dry disinfectant into each joint before it is joined

Film: "Permanent Investment"

The theme of the story of cast iron pipe follows the title by demonstrating and explaining the permanence of a plumbing installation using cast iron soil pipe.

This film lauds the merits and advantages of cast iron soil pipe and shows concrete proof of the claims made. The information provided herein will be very worthwhile to apprentices of the Plumbing and Pipe Fitting Industry.

The Cast Iron Soil Pipe Institute has provided a film that is well edited and prepared for the use of the industry.

This film may be scheduled through:

The Association Films, Inc.
1108 Jackson Street
Dallas 2, Texas

National Association of Plumbing Contractors
1016-18 20th Street N.W.
Washington 6, D.C.

Film: "Permanent Investment"

1. What is the primary purpose of the soil and waste system?

   Ans: The removal of soil and waste for the protection of the family health

2. How are sewer gases sealed into the sewer system?

   Ans: a. Fixture traps b. Vent system

3. List some of the dangers of improperly laid sewer lines and inferior materials used for sewers or house drains?

   Ans: Leaky joints allow sewage to flow into the yard and basement to contaminate water service and corrode gas piping allowing explosive gas to enter the house

4. What is the most common cause of damage to a sewer pipe underground?

   Ans: Tree roots

5. Why is this true?

   Ans: Sewer lines often leak around the joints attracting the small roots of the tree which enter the pipe through a very small crack

6. What is the nature of the damage that is done by these roots?

   Ans: Roots grow inside the pipe causing complete stoppage and will break pipe made of some types of materials

7. What is the advantage of using cast iron soil pipe for house drains underground?

   Ans: a. Joints made with soil pipe are water tight and will not attract roots and are too tight to allow roots to enter the pipe that is already present in the ditch

   b. Soil pipe does not break with the natural movement of the earth as will other types of material

8. Give two reasons why sewer failures within the house can be very serious.

   Ans: a. The health of the occupants of the house is endangered

   b. The expense of repair as a result can be very expensive

9. Give reasons why the architect recommended cast iron soil pipe.

   Ans: Quality and durability of cast iron soil pipe

10. What particular specification applies to soil pipe that does not apply to any other material as set forth by the coordinating committee working on a minimum standard National Code?

Ans: Cast iron pipe may be used throughout the entire plumbing system inside or outside of the house, underground or otherwise.

11. How long had the cast iron soil pipe been in service in the old house shown being razed?

Ans: 96 years

12. Why should people, when building homes, never try to economize with the sanitary sewer system?

Ans: The sanitary sewer system is the most important health safe gaurd in the home

13. Why is good material and workmanship cheaper for new construction in the entire plumbing system?

Ans: Replacement and repair due to failure of plumbing materials is much more expensive than the original installation

14. What year was the cast iron soil pipe installed for the fountains of Versaille?

Ans: 1664

15. Why is cast iron soil pipe used in so many large buildings and installations?

Ans: Because of the long and dependable service rendered by this permanent type of material.

16. Give another advantage of using cast iron soil pipe underground as demonstrated.

Ans: May be buried in a shallow ditch without danger of breaking from heavy traffic

17. Give two reasons why this type of cast iron soil pipe joint is so highly recommended for permanent installation.

Ans: a. Because of the flexibility of the materials used
b. Because of the lasting ability of these materials

18. What are the materials used in making a cast iron soil pipe joint?

Ans: Lead and oakum

19. Of what material is oakum made?

Ans: Hemp fibre

20. What is the tool called that is used to drive the oakum into the joint?

Ans: Yarning iron

21. What is the purpose of the molten lead?

Ans: To seal the joint

22. What is the particular calking iron called that is used in the calking demonstration?

Ans: Inside iron

23. Why is it so called?

Ans: Because it is first used to calk the lead "inside" first next to the barrel of the spigot end of the soil pipe

24. Why is this type of pipe and joint recommended to encourage a smooth flow of soil and waste?

Ans: The smooth surface of the pipe and the smooth inside joint made by this method of bell and spigot joined by lead and oakum

25. Describe the test that was given the cast iron soil pipe joint.

Ans: Twelve pounds of hydrostatic pressure plus the weight of three "lab assistants" on the joint.

ERIC

Film: "Toward a Uniform Plumbing Code"

Tests made by the National Bureau of Standards in an effort to establish certain standard practices and to develop a basis for a minimum National Standard Plumbing Code.

These tests are made with plastic pipe where possible as well as other materials that will produce test results and conclusions.

This film should be shown to apprentice classes by a person experienced in the Plumbing Industry in order to prevent misconceptions and to provide necessary supplementary information in the group discussion.

This film may be ordered from:

National Association of Plumbing Contractors
1016-18 20th Street N.W.
Washington 6, D.C.

Texas State Board of Plumbing Examiners
904 Lavaca
Austin, Texas

Film: "Toward a Uniform Plumbing Code"

Highlights of This Film

Three complete systems are set up for testing:

1. For investigating self siphonage
2. To determine the merits of stack venting
3. To study the problems of wet venting

All three of these systems were constructed with plastic pipe all equivalent in dimension and standard to standard materials.

All of the three systems collected into an 8" public sewer so arranged that it could be flooded to capacity or reduced in flow.

Self Siphonage

Tests showed that lavatories were more subject to self siphonage than any other fixture. The size of the fixture did not alter the test result.

First test was made with a 1 3/8 p.o. plug which allowed 11 g.p.m. An unusually long unvented waste connected to a sanitary tee resulted in a 1 1/4" trap seal reduction. A 1 1/8" p.o. plug allowing 7 1/2 g.p.m. resulted in zero trap seal reduction. The larger p.o. plug was used to allow greater flow.

Venting systems are ordinarily designed to prevent air pressure of over 1" of water being formed in fixture wastes. This means that a 1/2" seal remaining in the trap after self siphonage is sufficient to resist any pressure found in the system shown. Self siphonage is increased corrosion and fouled traps.

Tests continued as follows:

Length of lavatory wastes reduced from 59" to 48" with same slope of 1/4" to the foot

Result: Zero trap seal loss.

Conclusion: The length of an 1 1/4" lavatory waste with 1/4" slope per foot over 4 ft. and under the conditions of the test is considered safe.

The same 48" lavatory waste with 1/2" slope resulted in a trap seal loss.

Conclusion: The length of a 1 1/4" unvented waste on a 1/2" slope should be limited to 30".

Fitting connecting to stack for the test above shows a trap seal loss using T-Y or a combination Y and 1/8 bend but the sanitary Tee caused no trap seal loss. The maximum length of waste using TY and an 1/4" slope should be 18". Using 1/2" slope the length is limited to 9".

A large number of variables enter into the problem of lavatory self siphonage. Some of them are:

1. Size and shape of the lavatory
2. The variation in size of outlet (P.O. Plug)
3. Diameter length and slope of lavatory waste
4. The actual dimension of the trap
5. Type of waste and vent fitting on the lavatory drain

Stack venting

All fixtures stack vented in this test to 3" soil stack to a 3" building drain.
In this type of system there is a tendency of the fixtures above the water closet when discharged to form a vacuum in the stack sufficient under same conditions to pull water out of the water closet and tub traps as shown in this test.

Conclusion to this test:
Stack venting is considered safe by this committee using any of these fittings:

1. Double sanitary tee or cross
2. A long turn TY
3. Separate sanitary tee

Stack venting properly installed in a one story building or on the top floor is considered safe by this group as a result of this test.

Test for Wet venting:

Two story building with two kitchens and two combination fixtures back to back on the first floor.

On the top floor, two bathrooms back to back

Problem:
To find out if the discharge of fixtures attached to the wet vent adversely effected the bath tub trap seal.

There is a total of 22 fixture units draining into a 3" soil stack.

Bath tub drain 7 ft. long with 1/4" slope was found to be safe but 7 ft. drain with 1/2" slope resulted in trap seal failure.

Six ft. bath tub drain with 1/2" slope into a 3" wet vent was found to be safe.

The conclusion of this test was:

A wet vented 1 1/2" tub drain of 6 ft. or less is a safe installation.

One story wet vented bathroom and kitchen back to back.

Tests were made with a combination fixture and lavatory connected into a wet vent.

First test 6 ft. drain 1/4" per ft.
Second test 6 ft. drain 1/2" per ft.
(both seals safe)

Size of wet vent should not be less than 2" according to this test. The tub drain wet vented should be less than 6 ft.

Conclusion: Wet venting a bath tub drain under certain conditions is perfectly safe.

These tests formed a basis for part of the sections of the code covering drainage and venting prepared by the uniform code committee.

Note to Instructor:

There is a great deal of information here that the apprentice should learn. After reviewing this film it is abvious that the instructor should make sure that the apprentices understand the terms and the theory as applied to his own code and standard plumbing practices.

The variables involved in these tests should be pointed out to the class. It may be necessary to maintain a greater safety factor on the job that has been provided here, or for that matter, in his own Plumbing code.

This film should be shown only by an instructor who has a good working knowledge of the various systems of venting and other related phases of the plumbing system. This suggestions is made simply to avoid any misconception that may be formed in the apprentices mind due to inexperience or lack of overall knowledge.

The following review questions are provided as a follow up for this film.

REVIEW QUESTIONS AND ANSWERS

FILM: "TOWARD A UNIFORM PLUMBING CODE"

1. For what purposes are the three systems set up for testing?

   Ans: 1. Investigating self siphonage
   2. To determine the merits of stack venting
   3. To study the problems of wet venting

2. What fixture proved to be more subject to self siphonage than any other?

   Ans: The lavatory

3. Why does the 1-3/8" P.O. plug cause a greater trap seal reduction than when using 1-1/8" P.O. plug under the same conditions?

   Ans: The 1-3/8" P. O. plug allows a flow of 11 gallons of water while the 1-1/8" allows only 7-1/2 g.p.m.

4. What is the maximum length of 1-1/4" unvented waste on a 1/2" slope that is considered safe according to this test?

   Ans: 30"

5. Compare the effect on self siphonage by the use of a combination Y and 1/8 bend against the use of a Sanitary Tee in the stack.

   Ans: Under the same condition the combination Y and 1/8 bend will cause a lavatory to siphon when a sanitary tee will not.

6. List the five variables effecting lavatory self siphonage.

   Ans: 1. Size and shape of lavatory
   2. Variation in size of outlet
   3. Diameter length and slope of lavatory waste
   4. The actual dimension of the trap
   5. Type of waste and vent fitting on the lavatory drain

7. What size soil stack and building drain is used in the test for stack venting?

   Ans: 3"

8. Describe the conclusion to the stack venting test.

   Ans: Stack venting is considered safe by this committee using the following fittings:
   1. Double Sanitary Tee or Cross
   2. A long turn TY
   3. Separate Sanitary Tee

9. Compare this conclusion with your local code requirements.

10. Describe the set up in terms of a normal residence installation that was set up for the test for wet venting.

    Ans: Two story building:

Two kitchens and two combination fixtures back to back on the first floor.
Two bathrooms back to back on the top floor.

11. What is the first problem considered in this test?

Ans: To find out whether the discharge of fixtures attached to the wet vent will effect the bath tub trap seal.

12. How many fixture units were draining into the 3" stack?

Ans: 22

13. Mark the following "safe" or "unsafe" according to the committees' decision:

_____ 7 ft. tub drain with 1/4" slope Ans: Safe

_____ 7 ft. tub drain with 1/2" slope Ans: Unsafe

_____ 6 ft., 1/2" slope into 3" wet vent Ans: Safe

14. What conclusion was reached as a result of the test for wet venting?

Ans: A wet vented 1-1/2" tub drain 6 ft. or less is a safe installation

15. How does this conclusion compare with your local code requirements?

16. Define a wet vent.

Ans: A portion of the vent pipe system through which liquid flows.

Film: "Municipal Sewage Treatment Processes"

A film has been made available here that very clearly and concisely describes the purpose of the sewage plant and the various stages in the process of treating municipal sewage. The treatment is described by demonstration as well as by excellent photography of the actual plant in operation.

Although we are not interested in making sewage plant operators of the apprentices, they should be familiar with the plant as well as understanding its purpose. The apprentice must be taught the possibilities and the dangers of contamination.

This film (CDC-M6) is prepared by the U. S. Department of Health Education and Welfare, Public Health Service and is made available to the Plumbing and Pipe Fitting Industry by:

National Association of Plumbing Contractors
1016 - 18 20th Street N.W.
Washington 6, D.C.

Film: "Municipal Sewage Treatment Processes"

Sewage Treatment modifies and reduces the destructive effect of water carried wastes on our rivers, lakes, and harbers. It's aim is CONSERVATION OF WATER RESOURCES.

1. List five sources of <u>used</u> water that makes up municipal sewage.

   Ans: Kitchen waste, fecal waste, bath water, laundry water, many types of industrial wastes and often storm water

2. List the deseases caused by the contaminated stream of waters.

   Ans:
   a. Gastro-intestinal infections
   b. Typhoid fever
   c. The dysentaries
   d. Diarrhea
   e. Cholera (in Oriental Countries)

3. How are these desease bacterias transmitted to streams?

   Ans: The desease bacteria is transmitted by an infected person by the fecal wastes to streams where they stay alive for days

4. What is done by committies to protect the public?

   Ans: Sewage treatment plants have been built to take care of municipal sewage

5. List the steps in the principles of sewage treatment processes shown by demonstration.

   Ans:
   a. The largest materials are intercepted and removed
   b. Suspended materials are deposited by gravity
   c. Oil and grease are skimmed from the surface
   d. Desolved matter is biologically oxidized either by filter or aeration
   e. The solids are removed through a heated sludge digester
   f. The sludge is dried on sand beds and later used as fertilizer
   g. After disinfection the treated sewage is discharged into a stream

6. What is the most widely used filtering process?

   Ans: The standard trickling filter bed is the most widely used filtering process

7. What other method of disposing of large floating solids is used?

   Ans: Shredding of large solids so that it can be carried on with the other sewage

8. How is such material as gravel removed?

Ans: In a grit chamber, plows scrape the grit through an inclined channel

9. What is the purpose of the settling basin?

Ans: To remove other suspended matter by gravity

10. Where is the grease removed?

Ans: It is collected and removed at the inlet end of the tank

11. Where do the solids from the settling basin go next?

Ans: The sludge digesting chamber

12. How is the flow to the trickling filter controlled?

Ans: By an automatic syphon

13. What is the purpose of the trickling filter?

Ans: To biologically treat the sewage

14. Describe the manner in which the biological action is brought about.

Ans: The trickling filter is made up of a deep bed of broken stone over which the sewage is evenly spread. The stone is coated with slime which is composed of active bacteria, protozoa and other living organisms. These organisms feed on the unstable organic materials of the sewage. The waste products which they return are stable.

15. Name another method of biological treatment.

Ans: Activated sludge

16. How is the activated sludge mixed with the settled sewage?

Ans: By aeration

17. How is the oxygen provided for the above process?

Ans: Air compressors force air through grates in the bottom of the chambers which also keep the activated sludge suspended in the sewage

18. How is the sewage disinfected after passing through the final clarifier?

Ans: By chlorination

19. What gas is chiefly liberated from the decomposed sludge?

Ans: Methane

20. What is the purpose of heating the activated sludge?

Ans: To speed up the action

21. What is the final disposition of the sludge?

Ans: It is spread on sand beds to dry. Or filtered through a specially designed vacuum filter

22. What is the ultimate objective of sewage treatment?

Ans: To modify and reduce the destructive effects of water carried wastes on our rivers, lakes and harbors. In most cases this can be done by: (1) the removal of the solids from the liquids, (2) removal of floating matter, (3) removal of light organic matter, (4) removal of suspended and desolved matter, (5) disinfection. The solids removed by settling are digested, dried and disposed of by incineration or used as fertilizer.

SEWAGE TREAMENT HELPS CONSERVE OUR WATER RESOURCES

ERIC

Film: "Installation of Vitreous China Fixtures"

The process illustrated in this film is peculiar to plumbing aboard ships. There are several good points emphasized, however, that makes the film worthwhile. Precautions to observe in the handling of fixtures is pointedly illustrated.

A good demonstration of drilling and tapping is given since the fixture in this case is set on a steel deck.

With this review an outline of high points for discussion in lieu of questions and answers is provided since the procedures are somewhat different than the average cottage fixture setting job.

This can be considered a very worthwhile film provided the high points are emphasized and the apprentice understands that the setting of fixtures on the steel deck presents problems different to that of the average fixture setting job.

This film may be ordered from:

National Association of Plumbing Contractors
1016 - 18 20th Street N.W.
Washington 6, D.C.

Film: "Installation of Vitreous China Fixtures"

1. What is the first precaution in installing fixtures?
   Ans: Avoid breakage

2. Steps in the installation of fixtures.
   Ans: 1. Base or method of setting. Laying out for the studs, in this case, to hold down the water closet.
   2. The bowl is set in a cushion of putty.
   3. Connect flushometer.
   4. Seat installation.

3. First be sure to have all necessary tools and materials on the jobs before starting to work.

4. Check and prepare soil pipe whatever the material may be.

5. Handle fixtures in the crate as much as possible.

6. Set bowl over soil pipe, square it up with the wall and mark each bolt or closet screw.

7. Turn bowl up side down on paper or packing to protect it.

8. Prepare the bolts for fastening. Discuss the various methods.

9. Precaution overlooked, stop up soil pipe to prevent dropping materials or tools in it.

10. Why holes must be drilled perfectly straight.

11. Use of oil when drilling. Purpose of cutting oil.

12. Tap reversed $\frac{1}{4}$ turn for every full turn forward to clear the threads.

13. Putty is used in this installation (2 lbs.) This type of installation is necessary to prevent moisture under the bowl which would cause rust or corrosion of the steel plate.

14. Line up holes and studs and again handle bowl carefully when setting in place.

15. Use washers and cap nuts.

16. Tighten nuts alternately and evenly in criss cross order.

17. Avoid too much pressure by tighting nut too much.

18. Remove excess putty.

19. This inlet pipe or closet spud is first checked.

20. Notice type of wrench used on the nuts on the tail piece of connecting the flushometer.

21. An important difference in this installation and the usual plumbing installation is the vacuum breaker. It is hooked to salt water line here, contamination is no problem.

22. Set valve to get accurate measurement. It must be accurate to avoid strain on valve.

23. Check all nuts for tightness.

24. Protect fixtures.

25. After 24 hours tighten bowl nuts too.

26. Washers top and bottom of seat bolts to protect bowl.

27. Take pride in the job.

ERIC

Film: "The Ominous Arms Case"

This is an impressive story illustrating how easily city water lines may become contaminated. The serious illness resulting from contamination caused by "cross connections".

The plumber is reminded of his responsibility the gullible public who are generally speaking ignorantly of many dangerous conditions that can result from improperly installed plumbing.

This film serves well for both the laymen and apprentices in training.

This film may be ordered from:

National Association of Plumbing Contractors
1016 - 18 20th Street N.W.
Washington 6, D.C.

Film: "The Ominous Arms Case"

1. What disease did the Thompson boy have as reported by the M.D.?
   Ans: Amoebic disentary

2. From what source did he suggest that the water might have become contaminated?
   Ans: From the apartment house in question

3. How often are the tests made in the city water mains?
   Ans: Daily

4. What two violations were reported by the inspector?
   Ans: a. Submerged inlet in the bathtubs (faucets installed below the rim of the tub)
   b. No vacuum breakers were installed with the toilet flush valves

5. What condition must exist in the water line to cause back siphonage?
   Ans: Reduced water pressure

6. What type of toilet bowl was used for comparison by the professor?
   Ans: Siphon jet

7. What is suggested to prevent back siphonage from a bath tub?
   Ans: The faucets should be installed well above the tub rim

8. How can back siphonage occur without water valves being closed in the supply line?
   Ans: Excessive use of water on the ground level may cause the pressure to be reduced in the upper floors.

9. How did it happen that the plumbing originally installed in the Ominous Arms apartments passed the inspection?
   Ans: The ancient code had since been revised based on modern research

Film: Down the Drain"

The use of copper is emphasized in this film for both water service, waste and soil lines. Much valuable information is provided as to the use of water and the safe disposal of waste in the home.

Very good information is offered to accompany the demonstrations as to the proper installation of sweat fittings.

This film will provide a great deal of "nice to know" information in the process of presenting the "must know" processes and information

This film may be ordered from:

National Association of Plumbing Contractors
1016 - 18 20th Street N.W.
Washington 6, D.C.

ERIC

Film: "Down the Drain"

1. How much water, approximately, is brought into the average house?
   Ans: Over 200 gals.

2. What are the advantages to the use of copper pipe?
   Ans: a. A copper pipe cannot rust or corrode yet is strong and durable
   b. Ease of installation

3. What causes the solder to be drown into the joint when copper pipe is heated?
   Ans: Capillary action

4. What advantage does copper pipe claim over other materials for drainage lines?
   Ans: Smoother interior joint, leak proof and strong

5. What advantage are the longer lengths of pipe?
   Ans: Fewer joints, stronger and smoother flow

6. How much water is used by the housing project shown in the film?
   Ans: Five million gallons per day

ERIC

Film: "Circulation and Stratification of Water in Hot Water Tanks"

The movement of hot and cold water in hot water tanks is well illustrated. The various layers or stratas of water are shown by inserting dye into the lines. The effect of heat on the movement of the water can be plainly seen on the film.

It will be very helpful in the instruction of the operation of a water heater.

This film may be ordered from:

National Association of Plumbing Contractors
1016 -- 18 20th Street N.W.
Washington 6, D.C.

ERIC

Film: "Circulation and Stratification of Water in Hot Water Tanks"

1. What causes the circulation of water between a heater and tank?
   Ans: The difference in density between the colder water and the water and the water that has been heated

2. In what part of the tank is the hot water shown by the dye?
   Ans: At the top of the tank

3. How does the hot water lay in the tank?
   Ans: In a definite layer

4. What effect do the proper piping connections have on the mixing of the cold and hot water?
   Ans: Properly piped, the hot water may be drawn off at the top of the tank as the cold water enters the bottom

5. When hot water is drawn off, where is the layer of cold water in the tank?
   Ans: At the bottom of the tank

6. Name the three layers of water demonstrated.
   Ans: Hot, warm, and cold

7. Where was the cold water supply connected to the horizontal hot water tank?
   Ans: At the top of the tank

8. Name one cause of the mixture of hot and cold water when hot water is withdrawn at a high rate.
   Ans: Cold water supply too small

9. How is it possible to operate a hot water tank efficiently with the cold water connection at the top of the tank?
   Ans: A cold water tube is installed inside the tank running to the bottom of the tank

10. What caused the short circuiting of hot and cold water - as demonstrated?
    Ans: Hot and cold water connected directly opposite on the tank

Film: "The Fundamentals of Silver Alloy Brazing"

This is a training film which is very worthy of its classification. The information presented is up-to-date and is applied specifically to copper piping.

It is filmed in color and well narrated. The demonstrations are very good. They are photographed in such a manner that the effectiveness could not be approached by an actual demonstration. It would be impossible for the apprentice to be able to see the effect of heat or the flow of the alloy as clearly as is shown in this film.

We consider this film a must for apprentices of the Plumbing and Pipe Fitting Industry.

This film may be ordered from:

National Association of Plumbing Contractors
1016 - 18 20th Street, N.W.
Washington 6, D.C.

Film: "The Fundamentals of Silver Alloy Brazing"

1. List the six steps required to produce a good silver brazed joint.
   Ans: a. Good fit and proper clearance
   b. Clean metal
   c. Proper fluxing
   d. Assembling and supporting
   e. Heating and flowing the alloy
   f. Final cleaning

2. What is necessary to be done to assure a good fit?
   Ans: Remove burrs and smooth edges by filing

3. Why is proper clearance important?
   Ans: Assures strong, economical and leak tight joint

4. Name the steps in cleaning.
   Ans: a. Clean oil and grease with carbon tetrachloride
   b. Remove oxides, scale and dirt using emery cloth

5. What are the foreign materials that are likely to spoil a joint?
   Ans: Oil, grease, oxides, scale and dirt

6. What oxides are desolved by the flux?
   Ans: Desolves copper, zinc and iron oxides as well as chrome and nickel

7. At what degree of heat is the flux effective?
   Ans: Effective from 1100° to 1600° Fahrenheit

8. How is the flux used as a temperature indicator?
   Ans: 212° water boils off flux
   600° flux turns white
   800° flux wets surface
   1100° completely clear and liquid like water

9. What are the purposes of a flux?
   Ans: The purpose of a flux is to protect the metal surface from oxidation during heating, to desolve residual oxides that may be on the surface and to present a clean surface for the oxides to flow over.

10. What type of flame should be used for silver brazing?
    Ans: A soft bulbous flame, slightly reducing or Acetylene rich

11. What precaution should be taken when brazing copper and steel?
    Ans: Apply more heat to the copper because of its high conductivity

12. Name the four types of alloy rods.
    Ans: Easy flo 45, Easy flo 35, Easy flo #3, Sil fos

13. Which allow is recommended for copper tubing?
    Ans: Sil fos

14. What caused the copper plate to slide over the other and the alloy to flow between the plates?
    Ans: Capillary action

15. How is the capillary action controlled?
Ans: By the manner in which the heat is applied

16. Why is it not necessary to use flux on copper when using sil fos?
Ans: The phospherous in the alloy acts as a fluxing agent

17. When preparing copper pipe and fittings for brazing, why is the pipe inserted into the fitting immediately after fluxing?
Ans: To prevent the flux from drying and cracking off when inserted into the fitting

18. Where is the heat first applied on the vertical down joint in copper pipe?
Ans: To the pipe then to the fitting evenly

19. What is the result of excessive heat on a vertical "up" joint on copper pipe?
Ans: The flux will run out of the fitting

20. How is the proper brazing temperature determined when no flux is used to guage it as is the case with sil fos?
Ans: The copper is heated until it is a dull cherry red

21. What is the proper brazing temperature as indicated?
Ans: From 1100° to 1300° for sil fos

22. How is the alloy drawn into the fitting or joint?
Ans: By playing the flame of the torch along with the alloy after reaching the proper heat.

23. Review the 6 necessary steps in silver brazing.
Ans: See answer to No. 1

Film: "Safe Water in the Home"

"This film was prepared for the Housing and Home Finance Agency, Washington, D.C., on the basis of investigations carried out by the State University of Iowa, College of Engineering under the direction of Dean Francis M. Dawson. It is issued as a public service to aid in the improvement of housing for American families".

The quotation above is copied verbatum from the film. The information is presented in the form of the story of a family's experience in their home. It is a story of the danger and prevention of back siphonage well presented.

This film may be ordered from:

National Association of Plumbing Contractors
1016-18 20th Street, N.W.
Washington 6, D.C.

and

Housing and Home Finance Agency
Office of the Administrator
Division of Housing Research
Washington 25, D.C.

Film: "Safe Water in the Home"

1. What is the stated purpose of this film?
   Ans: A public service as an aid in the improvement of housing for American families

2. After the water stopped in the lavatory, what condition occurred in the faucet or water lines in the bath room?
   Ans: Air was drawn into the lavatory faucet

3. How is such a condition possible?
   Ans: Water flows back or down the pipe causing a vacuum or sub-atmospheric pressure which draws air into the line

4. What is given as the most common cause of this condition?
   Ans: Water lines too small when installed or corrosion may reduce the capacity

5. What caused the excessive damand in the house causing the upstairs bath to be robbed of water?
   Ans: The faucet in the laundry tub down stairs was opened

6. What other cause of this condition is demonstrated?
   Ans: a. Cutting off house service valve
   b. Fire engines pumping from hydrants in the neighborhood
   c. Broken water main lines

7. Why is this condition considered dangerous?
   Ans: The vacuum can draw water back into the water lines through submerged inlets contaminating the entire water system

8. How can this be prevented?
   Ans: a. By proper piping
   b. Approved fixtures
   c. Use of vacuum breakers

9. What precaution is suggested in the installation of piping to be assured of having the full capacity of a pipe?
   Ans: Ream all piping that is cut and threaded

10. What is suggested to prevent the lavatory faucet from picking up water from the lavatory?
    Ans: There must be a sufficient air gap between the inlet and the flood level of the fixture

11. What is the name of the fitting used with the water closet to prevent back flow?
    Ans: a. Vacuum breaker
    b. Backflow preventer

12. How was this particular problem solved?
    Ans: Installing larger pipe where it was needed

Film: "Mechanical Refrigeration, How It Works"

In this film a very concise, thorough, but brief description of the operation of a mechanical system is given. The theory behind a refrigeration system is explained in a manner that is easily understood.

This film will be an effective aid in the instruction of apprentices in refrigeration.

This film may be ordered from:

National Association of Plumbing Contractors
1016-18 20th Street, N.W.
Washington 6, D.C.

Film: "Mechanical Refrigeration How It Works"

1. To what is the refrigeration system compared at the beginning?
   Ans: To a simple heating system because of heat flow

2. State the law of heat flow.
   Ans: Heat always flows from warmer substances to cooler substances

3. The heat system shows two changes of the state of the water, name them.
   Ans: Evaporation and condensation

4. What causes a liquid to evaporate or turn to gas?
   Ans: It absorbs heat

5. What is the effect of a liquid losing heat?
   Ans: It condenses

6. How is the amount of heat measured?
   Ans: In British Thermal Units or BTU

7. Define BTU
   Ans: It is the heat required to raise one pound of water one degree farenhiet at sea level.

8. In what substances is this unit of measure used?
   Ans: Solid, liquid or gas

9. What is latent heat?
   Ans: It is the number of BTU that must be added to change a liquid to a gas or taken away to change a gas to a liquid

10. Why does the wet canvas cool the water in the canteen?
    Ans: It absorbs its heat of evaporation from the water in the canteen

11. Why is Freon such a good refrigerant?
    Ans: It boils or evaporates at such a low temperature

12. What is the advantage of using Freon?
    Ans: It is safe to use and the equipment required is light and compact

13. Trace the flow of refrigerant in a system.
    Ans: a. Expansion valve
         b. Evaporator
         c. Compressor
         d. Condenser
         e. Receiver

14. Why must the gas be cooled?
    Ans: In order to condense it back to a liquid

15. List the parts of the system that are on the high side of the system.
    Ans: a. compressor
         b. condensor
         c. receiver

16. List the parts of the system that are on the low side of the system.
Ans: a. Expansion valve
b. Evaporator

17. What is meant by the tonnage of a system?
Ans: Measurement of the refrigerating capacity of the system

18. Upon what is the ton based?
Ans: It is based upon the number of BTU's the system absorbs per hour

19. How is this rating determined?
Ans: 1 ton of ice absorbs 12,000 BTU's per hour. A system freezing that amount of ice is considered a 1 ton system. This does not apply to air conditioning. Operating conditions are different.

20. What happens to the refrigerant at the expansion valve?
Ans: The high pressure liquid refrigerant breaks up into small particles and expands, coming out as a low pressure liquid and going into the evaporator. There it evaporates and absorbs the heat from the articles in the cabinet.

21. To what piece of equipment can the compressor be compared?
Ans: A pump

22. What are its functions?
Ans: It raises the pressure of the hot gas and keeps the refrigerant circulating through the system

23. Name the parts of a compressor.
Ans: Cylinder, pistons, valves, connecting rods, and crank shaft

24. What happens to the refrigerant in the condenser.
Ans: The warm high pressure refrigerant gas flows around the series of tubes. The water in the tubes cools the gas until it condenses

25. What is flowing inside of the tubes of this particular condenser?
Ans: Cool sea water

26. Where is the refrigerant stored when it condenses?
Ans: The liquid receiver

27. What is the key to modern mechanical refrigeration?
Ans: Latent Heat

Film: "Explosion, Danger Lurks"

The danger, possibility and results of exploding water heaters is very effectively demonstrated by the Watts Regulator Engineers on this film. The unbelievable force of such explosions and cause are very pointedly shown. Several water heaters are caused to explode in the field tests. Twenty and thirty gallon heaters in various types of structures are used.

In addition to the film, a Watts Bulletin is highly recommended, "52 Questions and Their Answers". A wealth of information on "hot water" is provided.

Both the film and the bulletin may be obtained in Texas from:

Mr. J. L. FitzGerald
Manufactueres Agent
4612 Cole Avenue
Dallas, Texas

The film only may be obtained from:

National Association of Plumbing Contractors
1016 - 18 20th Street N.W.
Washington 6, D.C.

Film: "Explosion - Danger Lurks"

1. In your own words, give the purpose of this film.
   Ans: To promote a better understanding of the protection of water heaters

2. What size tank was set up in the small cottage that was demolished by its explosion?
   Ans: 30 gallons

3. How were the tanks made to rupture at a predetermined time?
   Ans: A water hammer condition was created

4. In the lab test set up for an open system if the temperature in the tank increased to 210° and the temperature in the cold water line increased to 80°, how was the original pressure of 60 pounds in the cold water supply affected?
   Ans: There is no change in pressure

5. What is indicated by the increase in temperature in the cold water line?
   Ans: The hot water is backed up into the cold water supply as in an open system.

6. Explain why the pressure relief valve does not protect the tank?
   Ans: The pressure in the system has not been increased. The temperature only has been increased

7. In a closed system, why does the pressure increase in direct proportion with the temperature?
   Ans: Because the water has no place to back up

8. What device is provided for the relief of thermal expansion in the system?
   Ans: A pressure relief valve

9. What happens to the temperature of the water in the closed system when the expansion or pressure is relieved?
   Ans: Temperature continues to rise

10. When the tank which was equipped with a pressure relief valve reached a temperature of 300° and exploded with rocket like force, what was the pressure at the time of the explosion?
    Ans: Pressure was normal, 65°

11. Explain why there was no explosion in the tank subjected to extreme high pressure and punctured with a pointed hammer did not explode?
    Ans: The cold water contained no energy to release, only pressure was present to be relieved

12. Explain why with the supply cut off of a system having 60 pounds pressure at normal temperature releases only a small amount of water when relieved?
    Ans: Since water cannot be compressed and has no energy at normal temperature and since there is no expansion of the water, it is necessary to release a very small amount of water to relieve the pressure

13. What is the relation of the temperature of water to pressure?
    Ans: If the temperature increases, the pressure increases in direct proportion

14. What is the highest temperature to which water may be heated at atmospheric pressure?
    Ans: 212°

15. What causes the violent reaction in the model glass water heater when pressure is released?
Ans: As the pressure is released, the water releases energy until the atmospheric pressure temperature relationship is reached

16. Under what conditions can water cause explosions?
Ans: Only water at a temperature above atmospheric temperature can cause an explosion

17. When water becomes overheated in a tank to the point that the steam overcomes the pressure in the supply line, what condition may cause a serious explosion?
Ans: The sudden release of pressure by opening a valve or a rupture of a corroded tank

18. Why should a temperature relief valve not be placed in the cold water supply line?
Ans: The water in the supply line would be released and the cold water would not be permitted to flow through the tank thereby lowering the tank temperature

19. What is the only correct installation for a T & P valve on a hot water system?
Ans: It is installed in the hot water outlet line in the average water heater installation

20. What is the advantage of the extended thermostat relief valve?
Ans: The thermostat is in contact with the hottest water in the system

21. What type of pipe is recommended for the discharge from the relief valve?
Ans: Non-ferrous type pipe

ERIC

Film: "Covering Hot and Cold Pipe"

This film is made available by the National Association of Plumbing Contractors.

Fundamental methods of covering pipe with various materials is covered by this film. The necessity of covering pipe is stressed and explained. The demonstrations of the various jobs involved are very good.

This film may be ordered from:

The National Association of Plumbing Contractors
1016-18 20th St., N.W.
Washington 6, D.C.

ERIC

Film: "Covering Hot and Cold Pipe"

1. Why does a thermos keep coffee hot?

   Ans: Walls of the thermos are heated so heat cannot escape

2. What materials are used to make up insulation for hot pipes?

   Ans: Magnesium and asbestos

3. Molded covering is used up to what size pipe?

   Ans: 10"

4. Of what material is the paste made for the canvas cover?

   Ans: Flour and water

5. Why are unions not covered?

   Ans: To be accessible for repair work

6. Describe the procedure for covering curved pipe.

   Ans: Molded covering is mitered and wired on the pipe

7. What is used in the place of a trowel for smoothing the mud?

   Ans: Rubber hand pad

8. Describe the method of covering elbows and valves.

   Ans: Troweled mud and scrap covering is used to cover elbows and valves the same thickness as pipe covering

9. How thick are flanges covered?

   Ans: Nuts and bolts on flanges are covered 1-1/2"

10. What is the greatest objection to uninsulated cold pipe?

    Ans: Moisture collecting on the pipe and dripping

11. What materials are used in this film to cover cold pipe?

    Ans: Hair felt

12. How is this covering water proofed?

    Ans: Tar paper and resin paper

13. What is used as a final covering?

    Ans: Sew canvas

14. How can bends best be covered with canvas?

Ans: With spiral canvas tape

15. Where is canvas stitched on pipe?

Ans: On the top side

16. What kind of stitch is used to sew canvas?

Ans: Cross stitch. On lap joints a hidden stitch is used.

NEATNESS AS WELL AS EFFICIENCY IS STRESSED IN THE APPLICATION OF PIPE COVERING

ACKNOWLEDGMENT

The following tests and reviews of film have been prepared by O. F. Higginbotham, Coordinator of Plumbing Apprentice Training at Houston, Texas. He has provided true-false, multiple choice and completion tests with answer sheets.

This material has been passed on for what it may be worth to other apprentice instructors.

We are indebted to Mr. Higginbotham for passing on materials which he has prepared and used in his own classes.

REVIEW QUESTIONS

FILM: "THE SECOND HUNDRED YEARS"

1. "The Second Hundred Years" portrays the era beginning _____ and brings us up to the present.
2. Does the film claim Mr. Crane to be the developer of the first foundry?
3. Does the film say that Mr. Crane was the first to ever build a plumbing fixture
4. Was there necessarily any improvement of Mr. Crane's original foundry over those of ancient times?
5. On what date did Mr. Crane open his foundry?
6. What was Mr. Crane's given name or initials?
7. What was the name of his original company?
8. Does Mr. Crane lay any claim to casting the first faucet, valve, cock, etc?
9. What was the first machine used in the Crane shop?
   How was it built?
   How was it powered?
10. What important change in source of power had come about from the time of Crane's boyhood to middle age?
11. In Crane's foundry what percent of the total work was manual?
    What change has taken place since then?
12. In a sixteen year period Crane's company grew from one workman to _____ employees.
13. If heating equipment was needed in a building 100 years ago, could the plumber go to the supply house and purchase same?
14. Would you say that mass production has taken work away from the skilled mechanic?
15. In a modern factory does the man go to the work or does the work go to the man?
16. What was the population of Chicago 100 years ago? Of the United States?
17. According to the film what one thing has been most responsible for pushing up living standards?
18. In Crane's opinion what is the real history of America?
19. Although Mr. Crane believed in hard work and high principles, did he not also believe in better working conditions?
20. What brought about the industrial age?
21. Where was the first Crane Company branch warehouse founded?
22. What are some of the advantages of titanium?
23. What are some disadvantages of titanium?
24. What did Mr. Crane say was the most important thing in industry?
25. What does film suggest for progress for the next 100 years?

ANSWERS

FILM: "THE SECOND HUNDRED YEARS"

1. July 4, 1855

2. No.

3. No.

4. No.

5. July 4, 1855

6. Richard Tiller

7. Brass and Bell Foundry

8. No.

9. Turning lathe; by hand; man power (foot treadle)

10. Water power replaced by steam power

11. 95%
    95% by machines

12. 800

13. No. Everything was hand made.

14. No. On the contrary it has created millions of skilled jobs.

15. Work goes to the man.

16. 75,000
    20,000,000

17. Invention of simple machines.

18. How the people learned to work together.

19. Yes.

20. Necessity and the growth of population

21. Omaha, Nebraska, 1885

22. Strength to weight ratio -- lightness, good alloying possibilities, corrosion resistance.

23. Cannot be produced in air; therefore, presents manufacturing difficulties.

24. Power

25. We have just started.

REVIEW QUESTIONS

FILM: "LIFE LINES OF INDUSTRY"

1. How many separate foundries comprise the present Crane Company's home plant?

2. In how many buildings is this plant housed?
   How many acres does it cover?
   How many square feet of floor space?

3. What controls the power that takes us where we want to go?

4. How many separate items does Crane Company manufacture?

5. How many branch warehouses do they now have?

6. In what lines does Crane claim to be the world's largest manufacturer?

7. What are some other lines they manufacture?

8. The home foundry in Chicago pours how many tons of steel per day?
   How many tons of brass?

9. What important change has taken place in the limitation of machines?

10. Where rigid control of metals is necessary, what type furnace is used?

11. Any new product gets its beginning in what department?

12. What test is given each charge of metal before it leaves the furnace?

13. With whom do Crane engineers work to develop new materials and products?

14. What is metallography?

15. After castings have been made, where do they go?

16. Are all fittings and valve bodys cast?

17. What was the weight of the steam drop hammer?

18. Are all valves tested before shipping?
    Are all unions tested?
    Are all fittings tested?

19. Corrosion problems are studied by whom?

20. What new material promises to bring great advancement in combatting corrosion?

21. Name some industries that serve all of us that could not function at all without pipe, fittings, valves and controls.

22. How is a seamless weld elbow made?

23. Why are valves and fittings ever being made stronger and more durable?

24. After fittings are cast why are they heat treated?

25. In addition to the actual production of his products, what other major problem is the manufacturer confronted with before his product is value to the user?

ANSWERS

FILM: "LIFE LINES OF INDUSTRY"

1. Seven

2. 47, 167, 3½ million

3. Valves and fittings

4. 40,000

5. 100

6. Valves and fittings

7. Plumbing fixtures, brass trim, kitchen cabinets, heating equipment, etc.

8. 250, 100

9. At first the product was limited to what the machine could do. Now machine can be built to do the job.

10. Electric Induction Furnace

11. Engineering and research

12. Speetograph

13. Industrial engineers

14. Microscopic study of metal structure and alloys

15. To machine shop

16. No. Some are forged, some are shaped in hydraulic presses.

17. 22,000 pounds

18. Yes
Yes
No. Random samples of standard weight fittings are tested. All extra strong fittings are tested.

19. Chemists and physicists

20. Titanium

21. Light and power, food processing plants, transportation (fuel for automobiles, planes, trains, etc.)

22. Hydraulic press forces seamless steel tube through a dye to make the weld ell.

23. To meet higher pressure, higher temperature, and lower temperature demands, as well as solve corrosion problems.

24. To take away brittleness and give strength and flexibility.

25. Distribution.

REVIEW QUESTIONS

FILM: "Moulders of Progress"

1. What contribution has plumbing made to civilization?
2. Does Eljer claim to be the largest manufacturer of plumbing fixtures?
3. Where is the chief Eljer plant located?
4. Was this site chosen because all of the clays are obtainable locally?
5. From what raw materials is vitreous fixtures made?
6. To what constituency are these clays mixed?
7. What is this mixture called?
8. How are the impurities removed from this mixture?
9. How is this mixture stored?
10. How is the slip conveyed to the moulding rooms?
11. The castings are called what on being removed from the moulds?
12. The potter's skill utilizes the experience of how many years?
13. In the Eljer plant the potter made a master mould to exact drawing board specifications. Of what material was the master mould made?
14. For what is the master mould used?
15. How many times can a production mould be used?
16. Are there any advantages of using a production mould made of material more durable than plaster of Paris?
17. Were the vitreous casting cast to exact size?
18. What was done with the green ware before spraying with the glazing material?
19. The circular revolving table that the potterer places the green ware on to give it the final finishing touches is called what?
20. How long must the casting remain in the mould before being removed as green ware?
21. What happens to rejects on coming out of the moulds?
22. How does the green ware change in appearance on being dried?
23. Through how many actual firings does vitreous ware go?
24. Where does the firing take place?
25. How long are the Eljer kilns?

26. What is the temperature at each end of the kiln?
What is the temperature at the center of the kiln?

27. What is the name of the cars on which green ware is placed for firing?

28. How long does it take for one of the cars to pass through the kiln?

29. The firing of pottery is the most important steps in its manufacture. The first fire which hardens the clay is called what?

30. About what is the peak temperature in the biscuit firing?

31. What name is applied to the second firing?

32. About what is the peak temperature in the second firing?

33. Whether one or two firings are used, what precautions are necessary?

34. What could cause a steam explosion?

35. At what temperature has the casting passed the stage of dehydration?
What is its appearance?
What are its characteristics?

36. During the next stage in firing, what happens?

37. Questions 29-36 were raised to help better understand firing in general. According to the film what are the steps at Eljer in manufacturing vitreous ware?

38. What was done to prevent green ware from sticking in the mould?

39. The ceramic materials sprayed on the body to do the glazing is made chiefly of what?

40. At what temperature was the flint and feldspar a liquid?

41. How is this material prepared in a usable form?

42. How was the powdered frit applied to cast iron fixtures?

43. What is the cast iron in a bathtub or sink called? Of what is it made?
What other ingredients are necessary in the production of this cast iron?

44. What purpose does each of these ingredients serve?

45. What is the pouring temperature for the cast iron?

46. The moulds for making a cast iron tub are made of what?

47. The top half of the mould is called what?

48. The bottom half of the mould is called what?

49. What are the cope and drag made in?

50. How is the sand removed from the casting?

51. How are the castings further cleaned?

52. What other preparation was necessary before enameling?

53. What is the purpose of the bonding coat?

54. What basic colors beside white were shown?

55. Why do manufacturers use these colors?

56. What were the basic elements that go into the manufacture of faucets, etc?

57. How are these cast?

58. At what temperature was this metal poured?

59. What is the name of the sand casting that leaves the place that the water and parts will occupy in the body of the casting?

60. How many production moulds did the narrator say a skilled workman could produce in one day from a master mould?

61. The two basic jobs about building a faucet was said to be what?

62. To what accuracy do the parts have to be machined?

63. How many places does a combination faucet have to be machined to this tolerance?

64. According to "General Requirements - Commercial Standards CS20-29" what is the minimum thickness that vitreous china can be at any point?

65. What surfaces must be glazed?

66. How are vitreous plumbing fixtures graded?

67. How are seconds discernable to the observer?

68. What dimensional tolerances are allowed?

69. What is the minimum depth of integral trap in vitreous china fixture?

70. The test pieces of citreous china that were fired along with the fixtures were subjected to what tests?

**This test designed November 1955 for Houston Plumbing Apprentices

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DEFINITIONS taken from the encyclopedia "Americana", Vol. II, Page 543:

COPE--The top box or uppper half of a green sand mould.

DRAG--The bottom section of a mould. In "bedding-in" work the portion of the mould in the foundry floor.

FLASK--The box which holds the sand in which the pattern is rammed up in the making of a mould. Flasks are made either of wood or of metal, and are parted horizontally into two or more sections. In a mould composed of two parts, the lowermost or the one which is moulded first is called the "drag", and the uppermost, or the one which is on top when the casting is poured, is called the "cope". When a flask consists of more than two

parts, the sections between the cope and the drag are called "cheeks" or "intermediates". Flasks are provided with two loose covers called top and bottom boards and they are designated as "two part flasks", "Three part flask", "four part flasks", etc., according the number of component parts.

ANSWERS

FILM: "Moulders of Progress"

1. Reduced disease and added to pleasure by carrying away unpleasant odors and dangerous wastes.

2. The largest manufacturer of strictly plumbing fixtures.

3. Ford City, Pennsylvania.

4. No. These clays are shipped from all over the world.

5. China clay, bald clay, flint and feldspar. China clay for whiteness; bald clay for strength and elasticity.
clay

6. The constituency of maple syrup.

7. Slip.

8. Through very fine mesh filter screens, magnetic filter and hydraulic filter press.

9. The slip is stored in underground storage tanks equipped with agitators. Each tank holds 100 tons.

10. Through piping systems.

11. Green ware.

12. 3,500

13. Plaster of Paris.

14. To make production moulds.

15. The production moulds for vitreous ware are used many times.

16. Plaster of Paris has a tendency to chip away.

17. They were cast 9/64 inch oversize to allow for shrinkage.

18. They were thoroughly dried in hot air drafts. This takes several hours.

19. Potterer's wheel.

20. $1\frac{1}{2}$ hours

21. They go back into slip.

22. It becomes much whiter.

23. One

24. In the kilns.

25. 430 feet.

26. 300° F. 2200° F.

27. Kiln cars.

28. 50 hours

29. The "biscuit" fire.

30. 1080° F.

31. "Glost" fire

32. Around 2200° F. Sometimes as high as 2450° F.

33. Slow progress in the beginning stages are necessary to avoid steam explosions and cracking of ware.

34. At the beginning of the firing the casting contains atmospheric water or water of plasticity depending as to whether it has been previously fired.

35. 1080° F. It is visibly red throughout. The clay is porous, brittle and absorbent, but little shrinkage has occurred.

36. The clay is oxidized and all carbonaceous matter is removed. This happens during the temperature rise from 1080° F to 1620° F.

37. Green ware, dried, glazed, fired.

38. Powder was sprinkled on the mould.

39. Feldspar and flint.

40. About 2200° F.

41. The hot liquid flows into a vat of cold water and on contact with the water, it breaks into small crystallin particles. This sand-like material is called frit. The coarse frit goes on the ball mills where it is ground into a fine powder. The heavy balls in the ball mill is porcelain.

42. The fixtures were heated to a red heat -- 1800 degrees -- and the powdered frit powdered on. The fixtures were reheated and another application made. As many reheatings and applications as the enameler's skilled eyes deem necessary was made.

43. Grey iron. Pig iron and scrap iron. Limestone and coke.

44. The limestone acts as a flux. The coke produces the necessary heat to melt the iron.

45. Around 2700° F.

46. Sand.

47. The "cope".

48. The "drag".

49. Each is made in a flask.

50. It is vibrated loose.

51. They are blasted with steel grit at machine bullet speed.

52. The rough burs were ground off and a ground coat or base coat was sprayed on.

53. It aids in binding the enamel to the cast iron.

54. Ivory, peach brown, green and blue.

55. They are in accordance with "Simplified Practice Recommendations and Commercial Standards developed by manufacturers, distributers and users in cooperation with Commodity Standards Division of the National Bureau of Standards".

56. Copper, tin, lead and zinc.

57. In sand moulds.

58. 2000° F.

59. The core.

60. 250

61. Foundry and machinest.

62. 5/1000

63. 10

64. $\frac{1}{4}$ inch

65. The glaze shall be thoroughly fused to the fixture body.

66. All exposed surfaces except those coming in contact with walls on floors: on lavatories set away from walls, those portions of the rear aprons used for supporting the fixtures in the kilns, and also the back of overflows and underside of outlet boss may be without glaze; the inside and underside of watercloset tanks and the underside of lids need not be glazed. Other fixtures may have unglazed portions at points where supported in the kilns, but such unglazed surfaces shall be located so as not to be visible when the fixture is installed in the normal manner. Inside of trapways of watercloset bowls shall be glazed.

67. They shall be indelibly marked with two parallel lines cut through the glaze into the body of the ware. These cuts are filled with bright red enamel or varnish. These are placed on the back of water closets and inside the water closet tank. Seconds cannot be labeled. All packages containing "seconds" shall be marked with two red splashes on one end of the package, so as to be visible without tearing down stacks of packages.

68. Not more than 5 percent, plus or minus, except where maximum and minimum limits are specified.

69. 2 inches

70. Contraction ratio, color accuracy and tensil strength.

** This test designed November 1955 for Houston Plumbing Apprentices

TEST ON FILM "MOULDERS OF PROGRESS"

TRUE FALSE STATEMENTS

____ 1. The production mould used to cast the vitreous china green water can be used only once.

____ 2. In a two firing process of vitreous china the second firing is called the glost fire.

____ 3. In casting vitreous fixtures the excess water in the slip is absorbed by the moulds.

____ 4. The recorded history of the manufacture of pottery covers 3500 years.

____ 5. The skill of the potterer unlike many of our other trades is generally not handed down from father to son.

____ 6. The peak temperature in the firing of vitreous fixtures is around 1620° F.

____ 7. The glazing material is applied to a water closet by powdering it on while the body is hot enough to fuse with the material being applied.

____ 8. A cast iron bathtub can be heated to a somewhat higher temperature than can a vitreous fixture in the enameling process.

____ 9. The top half of a green sand mould is called the drag.

____10. The second step in cleaning the cast iron castings was blasting with steel grit.

____11. The maximum dimensional tolerances allowed in the manufacture of vitreous china fixtures is plus or minus 11 percent.

____12. The first coat applied to the cast iron casting after it is ground free from rough burs is called the bonding coat.

____13. After the enamel has been applied to a cast iron tub, it must remain in the firing kiln 36 to 50 hours.

____14. If a plumbing fixture has no label on it, you would conclude it is a second.

____15. The minimum thickness at any place in vitreous china plumbing fixtures is $\frac{1}{4}$ inch.

*** This test designed November 1955 for Houston Plumbing Apprentices

TEST ON FILM "MOULDERS OF PROGRESS"

Multiple Choice

1. The largest manufacturer of strictly plumbing fixtures is:

___ a. Universal-Rundle
b. Eljer
c. Crane Company
d. American Standard

2. One of the following is not an ingredient for the body of vitreous china fixture.

___ a. loam b. feldspar c. flint d. clay

3. The ingredients for the manufacture of vitreous china fixtures is mixed to the consistuency of:

___ a. biscuit dough b. cake batter c. heavy molasses d. maple syrup

4. The carbonaceous matters present in the earthen materials used in the body of vitreous china is removed:

___ a. while in the form of slip
b. during the drying of the green ware
c. during the glost firing
d. none of the above

5. The main Eljer plant is located at:

___ a. Ford City, Pennsylvania
b. Detroit, Michigan
c. San Antonio, Texas
d. Wilmington, Delaware

6. The Eljer kilns are:

___ a. 50 ft. long b. 36 ft. long c. 430 ft. long d. 2200 ft. long

7. The temperature of the molten feldspar and flint on entering the vat of cold water was:

___ a. 1080° F b. 1620° F c. 1800° F d. 2200° F

8. The heavy balls in the ball mills which ground the crystalline frit into a fine powder were made of:

___ a. porcelain b. steel c. bronze d. carbon steel

9. The cast iron was poured at a temperatre of:

___ a. 1800° F b. 2200° F c. 2250° F d. 2700° F

10. The wood or metal box which holds the sand in which the pattern is rammed up in the making of a mould is called the:

___ a. flask b. cope c. drag d. core

11. One of the following is not one of the basic colors in which plumbing fixtures are manufactured:

___ a. peach brown b. blue c. green d. yellow

12. One of the following metals is not an ingredient of the alloy that makes up the body of a faucet:

____ a. zinc b. magnesium c. tin d. lead

13. The metal of which faucets are cast is poured at a temperature of around:

____ a. 1620° F b. 2000° F c. 2450° F d. 2700° F

14. The hole in the sand mould which leads to the space formed by the pattern and into which the molten metal is poured is called the:

____ a. core b. spore c. sprue d. spigot

15. The combination faucet has to be machined to within a tolerance of .005 inches in:

____ a. 3 places b. 10 places c. 12 places d. 21 places

16. The minimum depth integral trap seal in vitreous china fixtures is:

____ a. 1½ inches b. 2 inches c. 2½ inches d. 3 inches

17. In enameling a cast iron tub, the tub is heated to the proper temperature to fuse the enamel:

____ a. once b. twice c. three times d. no specified number of times

18. The amount of time required to cast a water closet tank on the casting machine was:

____ a. 1 minute b. 2½ minutes c. 25 minutes d. 2½ hours

19. The enamelers wore:

____ a. blue denim overalls b. khaki suits c. leather suits d. asbestos suits

20. One of the following does not appear on an Eljer faucet in the form of a separate coating:

____ a. silver b. copper c. nickle d. chromium

21. In the details of the manufacture of a water closet as presented by Universal-Rundle's New Horizons a water closet is cast in:

____ a. one piece b. two parts c. three parts d. four parts

22. According to Universal-Rundle's New Horizons the United States uses what percent of the world's supply of bathtubs:

____ a. 25% n. 50% c. 75% d. 95%

23. The name of Universal-Rundle's research laboratory is The:

____ a. Anton Dohrn Laboratorier c. W. Keith McAfee Laboratories
b. Phillips Gustav Jolly Laboratory d. The W. C. Keith Laboratories

TEST ON FILM "MOULDERS OF PROGRESS"

COMPLETION

1. The original model of a lavatory is made of _____.

2. The original pattern of the cast iron bathtub is made of _____.

3. Before green ware can be sprayed for glazing it must be _____.

4. The liquid clays which are poured into the mould to form vitreous china is called _____.

5. The still somewhat plastic casting on being removed from the mould is called _____.

6. The materials with which vitreous china are glazed is chiefly _____ and _____.

7. At the Eljer plant it required ____ hours to fire the vitreous china fixtures.

8. In a two firing process of vitreous china the first firing is called the _____ fire.

9. Complete dehydration has taken place at a temperature of around _____ degrees.

10. The vitreous casting must remain in the mould _____ hours before being removed.

11. Slow progress in the beginning stages of firing vitreous ware is necessary to avoid _____ and _____ of ware.

12. The moisture still remaining in the vitreous casting on being removed from the mould is called the water of _____.

13. The powdered material applied to the cast iron tub to form the enamel is called _____.

14. The grey iron of which the bathtub is made is made of _____ and _____.

15. The ingredient that acts as a flux placed in the charge of which cast iron is made is _____.

16. The ingredient that combined with a blast of air produces the necessary heat to melt the iron in the charge of which cast iron is made in _____.

17. The mould in which a cast iron tub is poured is made of _____.

18. The sand mould is removed from the casting by _____.

19. The two basic jobs involved in building a faucet were said to be _____ and _____.

20. The parts of a faucet must be machined to a tolerance of _____ inch.

21. Vitreous plumbing fixtures according to grades are _____ and _____.

22. The first test applied to the test pieces of vitreous china was _____ ratio.

*** This test designed November 1955 for Houston Plumbing Apprentices.

TEST ON FILM "SELECTING THE RIGHT VALVE"

(_____) 1. The basic valve types are: Gate, globe, and flush.

(_____) 2. Basically there are four types of check valves.

(_____) 3. The chief disadvantage of a swing check valve is its greater resistance to flow.

(_____) 4. In pairing shutoff valves and check valves, you would use swing check and globe valves together.

(_____) 5. A gate valve should be either completely closed or completely opened.

(_____) 6. Gate valves should be used only where they are used frequently.

(_____) 7. The globe valve offers less resistance to flow than does the gate valve

(_____) 8. The solid wedge shape disc is used more than any other type disc in gate valves.

(_____) 9. One of the chief advantages of the double disc gate valve is the fact that it can be installed in any position.

(_____) 10. In the use of gate valves it has been impossible to overcome the disadvantage of the discs sticking due to cooling and shrinking.

(_____) 11. Double disc gate valves are suitable for steam lines.

(_____) 12. An angle valve offers more resistance to flow than does a globe valve.

(_____) 13. A disadvantage of the angle valve is that it increases the number of fittings required to make an installation.

(_____) 14. The plug type valve is excellent for throttling purposes.

(_____) 15. Composition disc globe valves are less suitable for throttling purposes than globe valves having metallic discs.

(_____) 16. A loose connection between the stem and the disc in a valve is necessary to reduce strain on the stem.

(_____) 17. The stem in the globe valve must act as a guide to insure proper seating of the disc on the seat.

(_____) 18. In valve terminology U. S. & Y. means on ships and yachts.

(_____) 19. Packless diaphragm valves offer more resistance to flow than do globe valves.

(_____) 20. Packless diaphragm valves are sealed around the stem by a neoprene diaphragm.

_____ SCORE _____

* This test designed October 1955
for Houston Plumbing Apprentices.

TEST ON FILM "PIPING POINTERS"*

1. Brass and iron materials described as Standard are recommended for working pressure of _____ pounds.

2. Brass and iron materials described as Extra Heavy are recommended for working pressure of _____ pounds.

3. The manner in which pipe are joined is referred to as _____ connection.

4. The two general types of gate valves are: _____ disc, and _____ disc.

5. The globe valve gets its name by the _____ of the _____ of the valve.

6. Globe valves are recommended over gate valves for flow _____.

7. The three main variations of globe valve design by type of disc are: _____ disc, _____ disc and _____ disc.

8. The two basic designs of check valves are: _____ check and _____ check.

9. For safety purposes a valve is marked 125 S - 200 WOG.
The 125 S means 125 _____ _____.
The 200 WOG means 200 _____ _____ _____ and _____.

10. Pipe dope should be used solely to _____ the threads.

11. Before applying pipe dope to pipe threads, the threads should be _____.

12. Pipe dope should be applied to the _____ thread only.

13. Steam should be allowed to enter a valve at the _____ of the disc of a globe valve.

14. A globe valve installed in a boiler feed line should be installed so the flow is _____ the seat.

15. The material used to test the reseating of a valve is _____ blue.

16. The material used to lap the face of a valve disc is _____ _____ _____.

17. To lock the disc to the stem of a globe valve for grinding; unscrew the disc, place a _____ between the end of the stem and the disc and retighten.

18. The individual trait upon which complete success as a tradesman depends is personal _____.

19. When making flange connections tighten bolts of the flanges evenly by the _____ method.

20. When making flange connections, before tightening, be certain the flanges are _____.

21. If a globe valve is installed in a steam line so that the pressure is against the bottom of the disc, the valve will probably leak after being closed because of _____ of the stem as it cools off.

22. When using a machinists' vice to repair valves, the jaws of the vice should be covered with _____ _____.

_____ SCORE _____

* This test designed October 1955
for Houston Plumbing Apprentices

1. Associate the functions in the right-hand column with the valves in the left-hand column by placing the letters before the functions in the blanks before the valves. A letter may be used in more than one blank.

_____ Globe valve	a. Starting and stopping flow
_____ Gate valve	b. Regulating or throttling flow
_____ Angle valve	c. Preventing back flow
_____ Relief valve	d. Regulating pressure
_____ Plug cock	e. Relieving pressure
_____ Swing check	
_____ Lift check	
_____ Pressure regulator	

2. Associate the variations in disc design on the right with the basic valve designs on the left by placing the letters before the disc designs in the blanks before the valve designs. More than one letter may be used in one blank.

_____ Gate	a. Conventional disc
_____ Globe	b. Double disc
_____ Angle	c. Plug disc
	d. Composition disc
	e. Solid wedge disc
	f. Plug type disc

REVIEW QUESTIONS*

FILM: "Penny Wise" - A Story of Anaconda Copper Tube

1. List six advantages of copper tube.
2. What proof did the narrator offer as to the permanence of copper?
3. What change in the trend in building was pointed up?
4. Cite an example substantiating the space-saving claim.
5. What can be said on time saving?
6. What was said concerning maximum strength of material?
7. What was said concerning maximum economy of material?
8. For what service is type K copper water tube recommended?
9. For what is type L recommended?
10. For what is type M recommended?
11. What was said concerning the sweat joints?
12. What can be said concerning the trim design?
13. What can be said concerning the weight of copper?
14. What can be said concerning the quality of material in copper tube and fittings?
15. What can be said concerning initial cost of installation and subsiquent maintenance?
16. What can be said concerning the durability of copper?
17. What can be said concerning the tools necessary to make an installation?
18. How is copper tube made?
19. What causes solder to flow into the sweat joints?
20. Name some ancient civilizations that used copper.

* These questions designed December 1955 for Houston Plumbing Apprentices.

ANSWFRS*

FILM: "Penny Wise" - A Story of Anaconda Copper Tube

1. a. Space saving b. Time saving c. Trim design
   d. Appearance e. Durability f. Safety

2. He presented copper coins that have been in existence many centuries. Still the metal has not oxidized.

3. The change has been from the ornate and expensive to simplicity of design and moderate cost.

4. A 3-inch copper stack goes into 4-inch wall as snugly as 4-inch cast iron goes into 7-inch wall.

5. There are fewer joints in long runs, since the pipe comes in 20-foot lengths.

6. Full thickness is utilized at all times.

7. Copper tube is made in three weights. Each weight satisfactory for purpose for which it is recommended.

8. Underground water service.

9. Water distribution pipes within the building.

10. Non pressure purposes such as soil, waste and vent lines.

11. They are permanent and will not work loose.

12. The wrought fittings are particularly streamlined in appearance.

13. It is lighter to carry and lighter to support after installed.

14. It is all virgin material.

15. Initial installation and subsiquent maintenance are cheap.

16. Installed as recommended and for the purpose for which designed, any copper installation will outlast the building in which it is placed.

17. Probably no other material could be installed with so few tools.

18. Billets are made in the rolling machines. These are pierced on a Mannesman machine and drawn to the proper dimensions.

19. Capillary attraction.

20. Ancient Rome, Aztecs, Peru, Egypt.

* These answers designed December 1955 for Houston Plumbing Apprentices.

VT 010 360
The Internal Combustion Engine, An Instructional Unit for Vocational Agriculture. Teacher's Manual.

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ABSTRACT - This resource unit is for teacher use in planning a unit on internal combustion engine operation for junior or senior students of vocational agriculture in the power and machinery phase of a program in agricultural mechanization. The 12 teaching units include objectives, introduction, questions for study and discussion, supervised study, review techniques, references, and a unit test. Additional information includes: (1) Recommended Teaching Procedures and Policies, (2) Required Student Reference Literature, (3) Teacher's Instructional Materials and Visuals, (4) Sources of Instructional Materials, (5) Recommended Equipment List, and (6) A Suggested Engine Storage System. (GR)

VT 010 360

ED0 45856

THE

INTERNAL COMBUSTION ENGINE

AN
- INSTRUCTIONAL -
UNIT

for

VOCATIONAL AGRICULTURE

(TEACHER'S MANUAL)

U.S. DEPARTMENT OF HEALTH, EDUCATION
& WELFARE
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Tucson

VT 010 360

PREFACE

This is a unit of instruction in the "Internal Combustion Engine" using the small gasoline engine as the teaching model or tool. The primary purpose of the unit is to acquaint high school students with the principles of internal combustion engine operation as it applies to the Power and Machinery phase of a complete program in Agricultural Mechanization. Lessons which involve tune-up, maintenance, and repair are considered secondary in importance to introductory principles even though these experiences also have elements which are common to most agricultural heat engines.

Upon completion of this unit, it is suggested that students be allowed sufficient laboratory time to tune-up or repair their own engine as a supervised Agricultural Mechanics project.

Numerous references and teaching materials are suggested in this unit however, the list is not exhaustive. Therefore, teachers will want to use materials and procedures to which they have access and make substitutions to fit their needs.

It is assumed that teachers would use this unit for junior or senior students.

Clint Jacobs

Recommendated Teaching Procedures and Policies

The following general recommendations are suggested as they may assist providing a successful learning experience for all students:

1. Where possible, teach this as an uninterrupted unit.

2. Allow one engine of the type listed in the recommended equipment for each two students.

3. Use new engines of the same type and manufacturer.

4. Use a "demonstration" engine for class instruction and to introduce each unit.

5. During laboratory experiences, keep "teams" of students in "phase" with other teams.

6. Require that the "correct tool for the job" philosophy be applied at all times.

7. Assign outside reading and homework. When applicable check out sets of recommended literature to each student.

8. "Inspect" each work station before the close of each period to insure that proper mechanics practices are being followed, ie., storage of removed parts, hardware and tools.

9. During reassembly, be sure to systematically inspect all major components for proper assembly and correct hardware.

10. The repair section of this unit is a step-by-step check-off procedure which should be first taught using the laboratory engine. Provide each student with check-off procedure sheets to be completed and submitted for a grade.

11. After assembly of the laboratory engine require that the engine pass an instructor's inspection before starting.

12. Have students operate the assembled laboratory engine and adjust engine speed and carburetor setting according to operator's manual. If a dynamometer or loading device is available, check each engine for proper performance.

REQUIRED STUDENT REFERENCE LITERATURE

Number in ( ) indicates number of copies recommended for a class of 16 students.

1. General Theories of Operation, MS-3553-24, Briggs-Stratton Corporation*, Quantities for class use Free, additional copies $.25 (16)

2. Repair Instruction III, MS-4750-48, Briggs-Stratton Corporation*, Quantities for class use Free, additional copies $.50 (16)

3. Illustrated Parts List, MS-4255-108, Briggs-Stratton Corporation*, Quantities for class use Free, (16)

4. Operating & Maintenance Instructions, Form No. 27842-108, Briggs-Stratton Corporation*, Quantities for class use Free (16)

5. Farm Tractors, Engineering Bulletin, FT53-A, Revised 1968 American Oil Company, cost $1.00 (16)**

6. How to Read, Use, and Care for Micrometers (Also Wall Charts) L. S. Starrett Company, Athol, Mass., 01331, Free in Quantity (16)

7. Torque Manual, P. A. Sturtevant Co., Addison, Illinois (16), No Cost. (Use and operation torque wrenches)

Additional References for Students

A. Books

1. American Association for Agricultural Engineering and Vocational Agriculture***; Small Engine Care - Operation - Maintenance and Repair, Volume I ($5.30) and Volume II ($7.75) (1 each)

2. Purvis, Jud, All About Small Gas Engines, The Goodheart Willcox Company, Inc., Chicago, Illinois, $4.50 (1)

3. Technical Publications, Inc., Small Engine Service Manual, 1014 Wyandotte Street, Kansas City, Missouri 64105, $4.65 (4)

4. Stephenson, G. E., Small Gasoline Engines, Delmar Publishers, Albany, New York, $3.12 (1)

B. Booklets

1. ABC's of Internal Combustion Engine, Public Relations Department, General Motors Corp., 3044 West Grand Boulevard, Detroit 2, Michigan. Free in Quantity (16)

2. Basic School Kit, 21 copies of Technical Information Manual, EN-1 plus other booklets. No Cost. Kohler Co.* Also available:

   1) Technical Information Manuals, Option Kit BK-2, ($3.00) containing 21 copies each:

      a. Mangeto ignition systems
      b. Gaseous fuels
      c. Battery ignition systems

   2) Specification Wall Chart BD-3 ($1.00)

   3) Engine Service Manual ($10.00)

*See address under Engine Section

**Order from Arizona 4-H Club Office, Cooperative Extension Service, University of Arizona 85721, Make school voucher payable to National 4-H Supply Service, Chicago, Illinois.

***Coordinator's Office, Agricultural Engineering Center, Athens, Georgia 30601.

TEACHER'S INSTRUCTIONAL MATERIALS
AND VISUALS

A. Books:

1. AEA Engine Service Institute Training Manual, Principles of Operation, Service, Maintenance Air Cooled Engines, Automotive Electric Association, 16223 Meyers Road, Detroit, Michigan 48235 ($4.95)

2. Jones, Fred R., Farm Gas Engines and Tractors, 4th Edition, McGraw-Hill Company, 1963.

B. Visuals:

1. Transparency Masters, 3M Visual Products, 3M Company.

2. Transparency Masters, Set of 95 for Small Engines (From Briggs-Stratton Repair Instruction Manual) Vo-Ag Service, 434 Mumford Hall, University of Illinois, Urbana, Illinois 61081, $2.50/set.

3. Briggs-Stratton Corporation

   Flip chart set. NC
   Slide sets - No. 1, 3, 4, 5, 7, 9, 20, 21 $18.90
   Service Manual, No. M53222 $4.00

4. Tecumseh-Lawson Power Products Co., Grafton, Wisconsin.

   Master Parts Manual 690166 $10.00
   Mechanics Handbook 690249 $ 1.00
   Color slide set, 35 mm 690141 $30.00
   Diaphragm Carburetor Wall Chart 800131
   Float-feed Carburetor Wall Chart 691012 NC
   Notebook size of 800131, 690627 NC
   Cutaway engine, 2 or 4 cycle $75.00

5. Clinton Engine Corporation, Maquokata, Iowa 52060

   Field Service Manual - S-1213 - $1.00
   Specification Wall Chart - S-1496 - $0.07
   Torque Data Wall Chart - S-1498 - $0.07
   Magneto Wall Chart - S-1499 - $0.07
   2-cycle Principle Wall Chart - S-1500 - $0.07
   Diaphragm Carburetor Flow Wall Chart - S-1501 - $0.05
   Clinton Service Handbook - S-1505 - $0.05

6. AC Spark Plug Division, General Motors, Flint, Michigan 48556

   Wall Chart - "What Your Spark Plugs Can Tell You About Your Engine"

7. General Motors Corporation, 3044 West Grand Boulevard, Detroit, Michigan 48202

   Take-Apart Spark Plug AC Spark Plug Kit

SOURCES OF INSTRUCTIONAL MATERIALS

A. Engines

1. Briggs and Stratton Engine
   J. M. Gerathy
   Service Products Manager
   Briggs & Stratton Corp.
   27[illegible] North 13th Street
   Milwaukee, Wisconsin 53201

   One free 4-cycle engine to a department plus educational literature and wall charts.

   Order additional engines at 40% off list price from Arizona distributors, as follows: Motor Supply Company, 402 North Central Avenue, P. O. Box 1830, Phoenix, Arizona 85001.

2. Clinton Engine
   Clinton Engines Corporation
   Maquokata, Iowa 52060

   Two and four cycle engines, 50% off list price.
   2-cycle, 2 3/4 HP - $27.95
   4-cycle, $2\frac{1}{2}$ - $3\frac{1}{2}$ - $27.90
   4-cycle, cast iron $3\frac{1}{2}$ - $4\frac{1}{2}$ - $44.65

3. Jacobsen Engines
   Jacobsen Manufacturing Co.
   1721 Packard Avenue
   Racine, Wisconsin 53403
   Attention: Ken G. Weill

   Institution package, one each:
   3 HP two-cycle engine
   Repair manual
   Engine wall chart
   Cost $45.00 FOB Racine, Wis.
   Order Part No. 500564

4. Tecumseh-Lawson-Power Products
   Tecumseh Products Co.
   Lawson-Power Products
   Engine Division
   Grafton, Wisconsin 53204

   Lawson 4-cycle #29035 - $18.00
   Power Products 2-cycle
   #710245 - $14.00

5. Kohler Company
   Kohler, Wisconsin 53044
   Attention: F.L. McNamara
   Supervisor, Technical Pubs.
   Engine & Electric Plant Div.

   Contact local dealer or distributor* for new engines at discounts; also, junkers and saleable trade-ins.
   *Nelson Electric Co. Inc.
   1750 Grande Ave. or 224 N. 24th Ave.
   Phoenix, Ariz. Tucson, Ariz.

6. Wisconsin
   Wisconsin Motor Corporation
   Milwaukee, Wisconsin 53246

7. Lawn-Boy Service Department
   Gale Products
   Galesburg, Illinois 61401

   "D" Series 2-cycle engine
   $19.94 each

RECOMMENDED EQUIPMENT

ENGINES

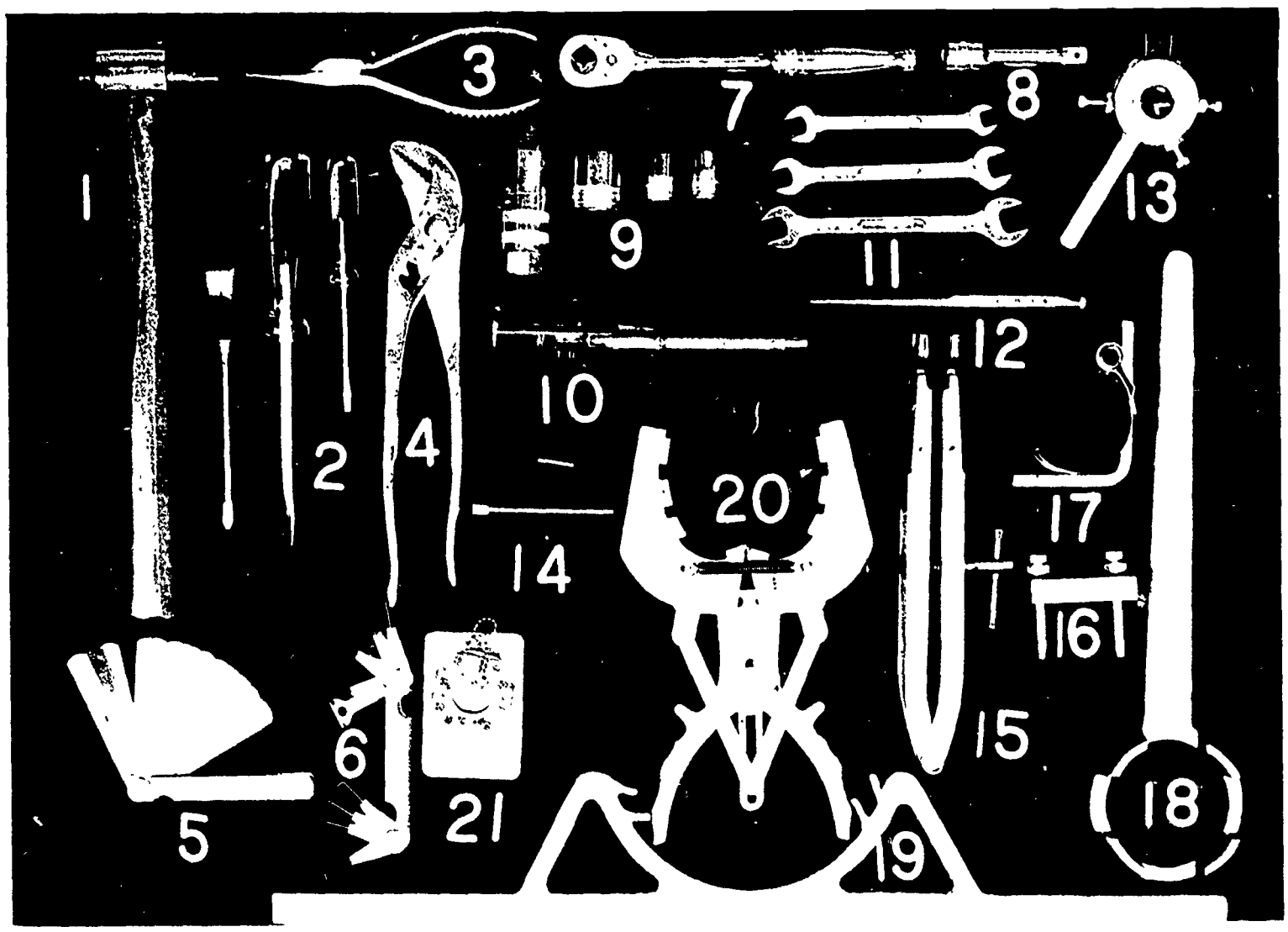
1. Number: One for each two students studying this unit.

2. Type: One cylinder, 4-cycle, Horizontal crankshaft, Float carburetor, rope starter, 8 cu. in. displacement.

3. Recommendation: Briggs-Stratton Model 80300
   Order from: Motor Supply Co.
   402 North Central Avenue
   FOB Phoenix (school cost) each $34.66

BASIC TOOLS SET

(See reverse side of page for description)



BASIC TOOLS SET

SNAP ON TOOL SET 118BS (one set recommended per engine)
Snap-On Tool Corporation
3006 N. 30th Avenue
P. O. Box 11349
Phoenix, Arizona 85001

Item No.	No.	Tool	Size	Stock No.	Cost
1	1	Hammer, plastic tip	½ lb.	BH-91	$ 5.26
2	1	Screw driver, Phillips	No. 2 x 4	UDP-142	2.32
2	1	Screw driver, standard tip	¼ x 4	SSD-44	1.89
2	1	Screw driver, cabinet	3/16 x 3	SSD-143	1.47
3	1	Pliers, needle nose	6 inch	95	4.21
4	1	Pliers, pump	6 inch	HL-14	3.01
5	1	Gauge, feeler	.0015-.025, 25 leaf	FB-325	2.63
6	1	Gauge, spark plug		FB-301	1.37
7	1	Ratchet	3/8" drive	F-71M	6.53
8	1	Extension	3" x 3/8" drive	FX-2	1.92
9	1	Socket	7/16" x 3/8" drive	F-141	1.05
9	1	Socket	½" x 3/8" drive	F-161	1.05
9	1	Socket	7/8" x 3/8" drive	F-281	1.47
9	1	Socket	3/4" x 3/8" drive	SFS-241	2.06
10	1	Hex Nut Driver	¼"	ND-108	1.95
11	1	Wrench	5/16" - 3/8"	VS-1012	1.83
11	1	Wrench	3/8" - 7/16"	VS-1214	1.96
11	1	Wrench	7/16" - ½"	VS-1416	2.06
12	1	Punch, starting	1/8"	PPC-204	1.68

Order the following from: Briggs Stratton Company
Motor Supply Co.
402 North Central Avenue
P. O. Box 1830
Phoenix, Arizona 85001

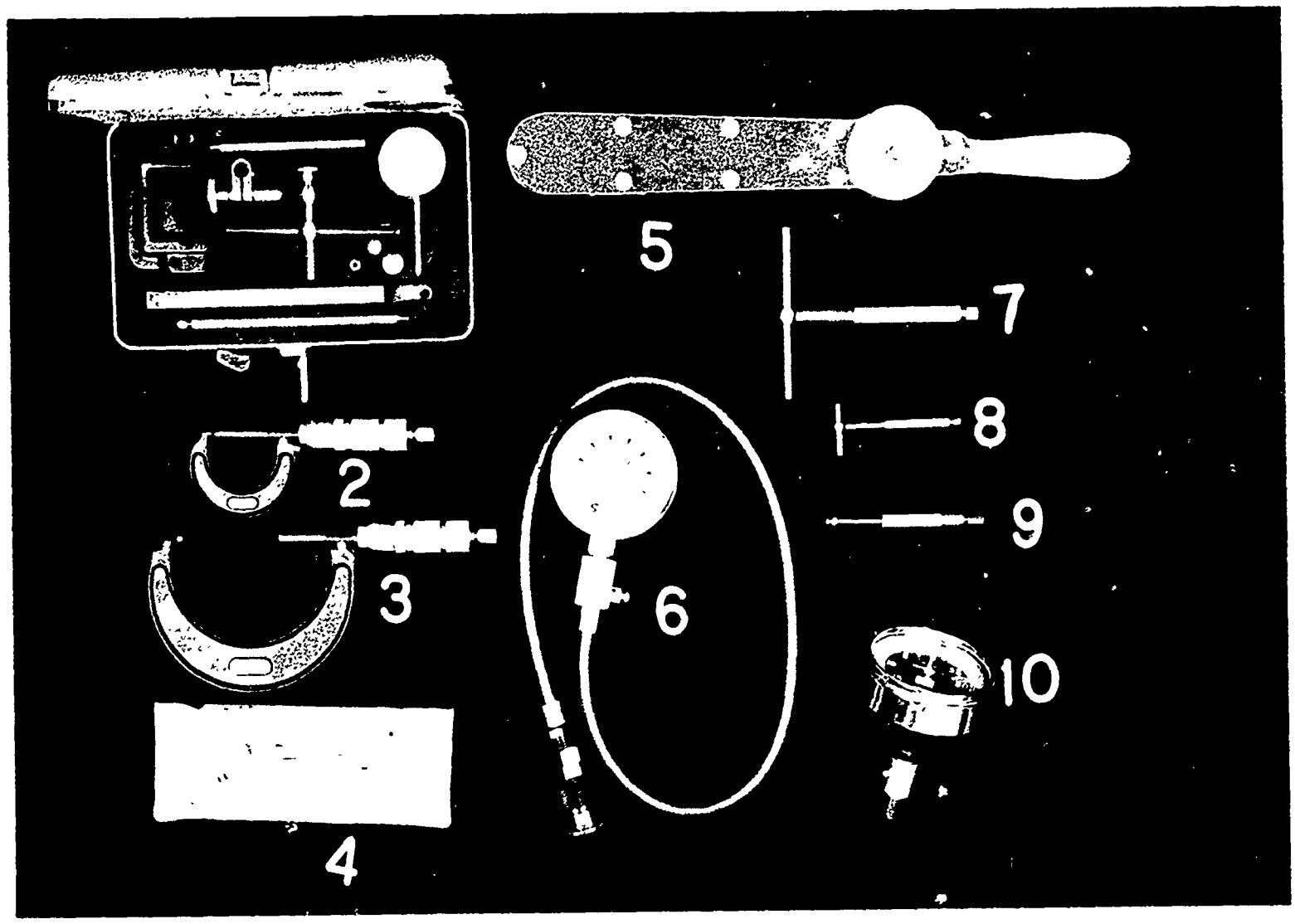
13	1	Spark tester		19051	1.65
14	1	Plug gauge, breaker point plunger		19055	.45
14	1	Plug gauge, valve guide		19122	2.15
15	1	Valve spring compressor		19063	2.25
16	1	Puller, flywheel		19069	.50
17	1	Compressor, piston ring		19070	.95
18	1	Clutch wrench		19114	1.85
19	1	Holder, flywheel		19167	3.35
20	1	Piston ring expander	1¼" - 2½"	8330	2.80

Ammco Tools Inc., Complete Auto Supply
530 N. Stone
Tucson, Arizona

21 1 Piston land wear gauge, (one free/instructor), additional ea. .50
Perfect Circle, Dana Parts Co.
P. O. Box 500
Hagerstown, Indiana 47346

Total Basic Engine and Tool Kit, each

Engine	$34.66
Tools	43.88
	$78.54



SECONDARY TOOLS

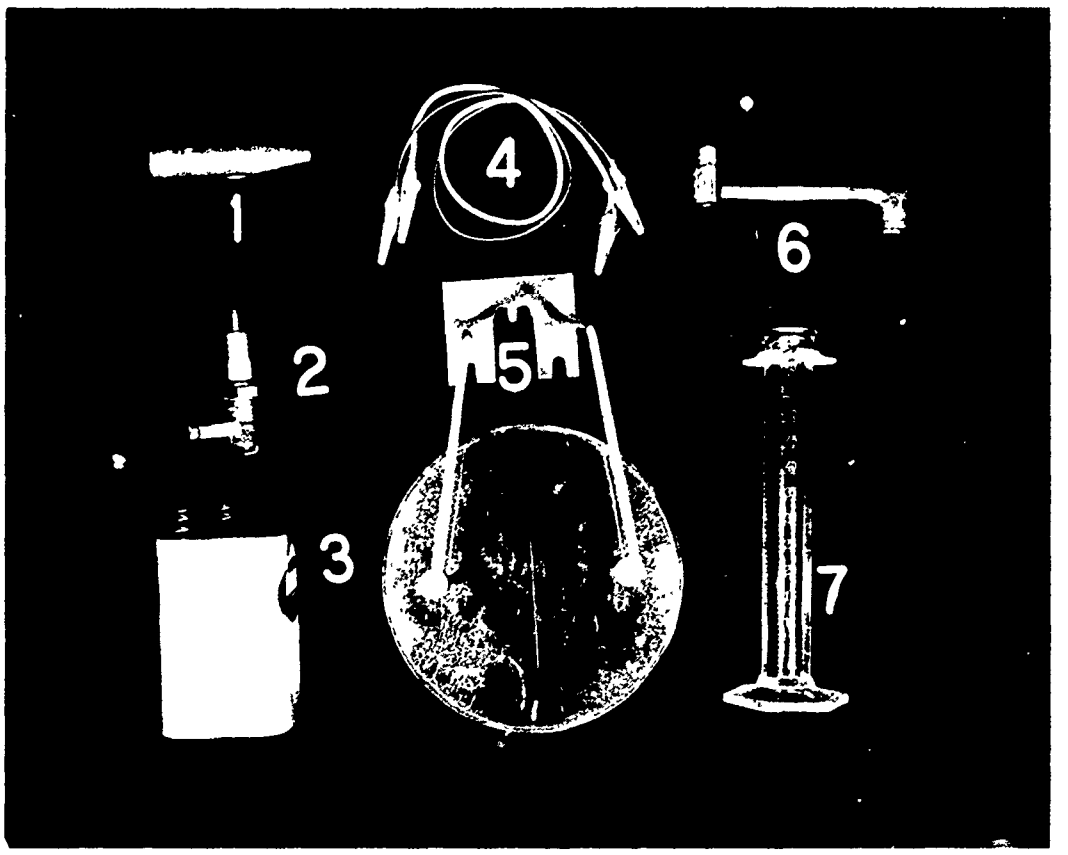
Snap-On Tool Set 108-BS (One set recommended per three engines)

Item No.	No.	Tool	Size	Stock No.	Cost
1	1	Dial Indicator Set		CM-200	$15.39
2	1	Micrometer, outside	0-1	CM12RL	16.40
3	1	Micrometer, outside	2-3	CM32RL	21.15
4	1	Allen Wrench Set		AW-1013K	3.71
5	1	Wrench, Torque meter	0-600 in. lb.	TQ-50AL	49.11
6	1	Cylinder Compression Gauge	0-300 lbs.	MT-26D	20.53

Starrett Tool Co. (One set recommended per three engines)

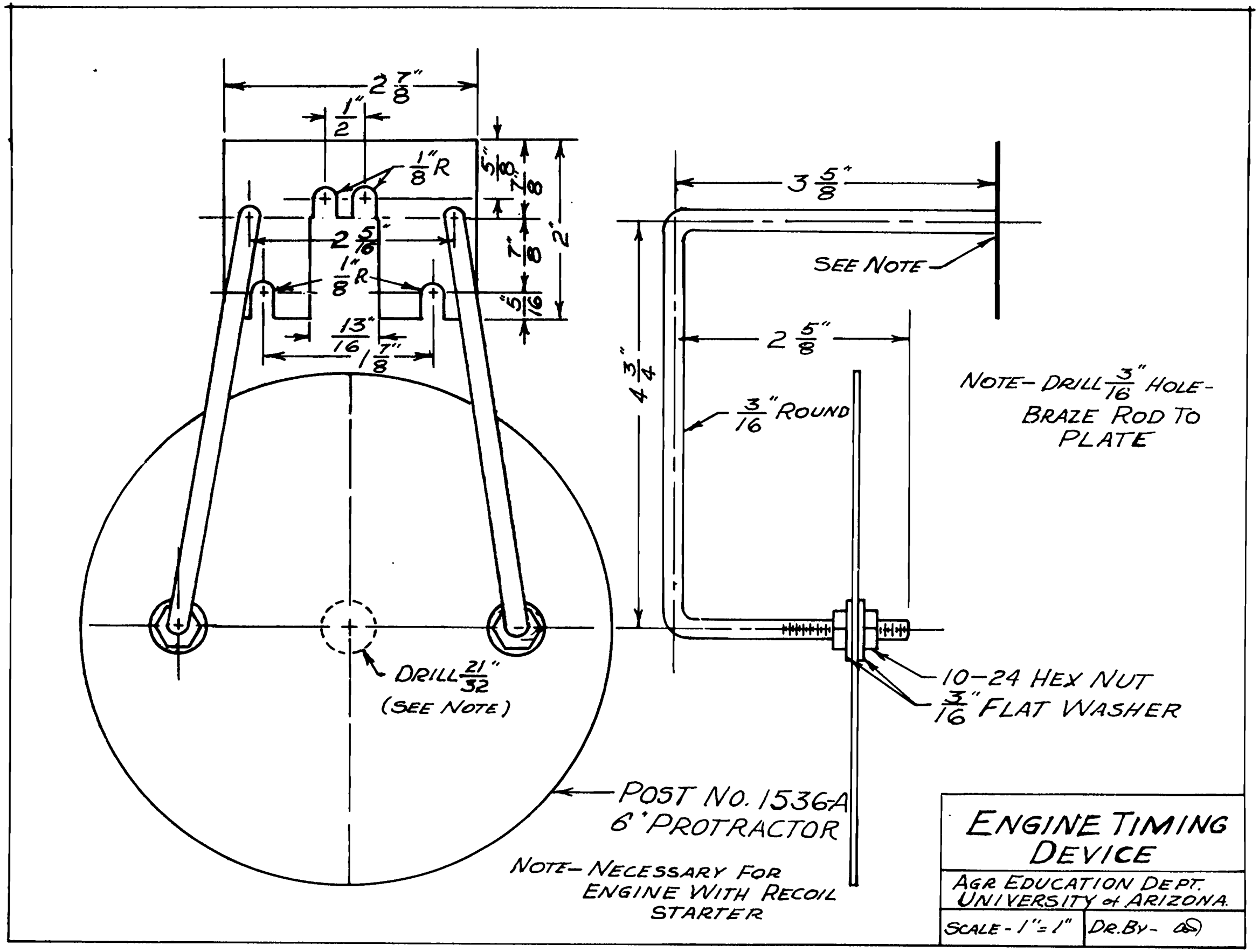
7	1	Telescoping Gauge*	2 1/8" - $3\frac{1}{2}$"	229D	6.35
8	1	Telescoping Gauge*	3/4" - $1\frac{1}{4}$"	229B	4.70
9	1	Small Hole Gauge*	.200 - .300	829	4.00
10	1	Tachometer, dial type, direct reading Stewart-Warner Model 757-W			12.70

*Order from: Industrial Tool Supply Co.
830 E. 22nd
Tucson, Arizona



SPECIAL LABORATORY EQUIPMENT (FOR TEACHER)

Item No.	No.	Item	Cost
1	1 ea.	Sleeve, oil seal installation, (See drawing p.8 , Shop Constructed)	
2	1 ea.	Test Spark Plug, 3/16" gap (substitute for BS 19051 Spark Tester) shop constructed	$ .80
3	1 ea.	Battery, dry cell, 6 volt lantern	.50
4	2 ea.	Test Leads, with alligator clips	
5	1 ea.	Timing Disc, Circle (360°) Protractor, Post No. 1536A-6 (See drawing p.xii)	1.25
6	1 ea.	Torque wrench adapter, (Shop constructed)	
7	1 ea.	Graduated cylinder, 50 ml	.90
			$6.45


2 7/8"
1/2"
1/8" R
5/8"
7/8"
2 5/16"
1/8" R
7/8"
2"
5/16"
13/16"
1 7/8"
3 5/8"
SEE NOTE
2 5/8"
4 3/4"
3/16" ROUND
NOTE- DRILL 3/16" HOLE- BRAZE ROD TO PLATE
DRILL 21/32" (SEE NOTE)
10-24 HEX NUT
3/16" FLAT WASHER
POST NO. 1536-A 6" PROTRACTOR
NOTE- NECESSARY FOR ENGINE WITH RECOIL STARTER
ENGINE TIMING DEVICE
AGR EDUCATION DEPT. UNIVERSITY of ARIZONA.
SCALE - 1" = 1"
DR. BY -

SPECIAL TOOLS (One each recommended when including engine repair instruction)

No.	Item	Mfg & Stock No.	Cost
1	Valve Seat Cutter Kit	Neway No. 102A**	$42.00
1	Cylinder Hone, Deglazer	Snap-On Tool B-200*** with IT63-21 stones $8.70 less 40%	5.22
1	Cylinder Ridge Reamer	Snap-On Tool No. WR150*** $9.21 less 40%	5.53
1	Valve Refacer Complete	Snap-On Tool No. VR-300* $629.47 less 40%	377.68
1	Cylinder Hone (Include following stone sets)	Sunnen Co. JN-90	35.00
	1 set JN 100 JN 300	2.0" - 2.2"	6.00
	1 set JN 231 JN 501	2.2" - 2.4"	6.00
	1 set JN 102 JN 302	2.4" - 2.6"	6.00
1	Valve Guide Brush, nylon $\frac{1}{4}$"		1.50
1	Brush, carbon removal, wire end	3/4 x 1 x $\frac{1}{4}$	1.50

SPECIAL TOOLS (The following tools provide additional instruction opportunities and accuracy of repair and maintenance.)

1	Magneto Analyzer, one of following for testing coils and condensors:		
	Simpson Electric Company	Model CCM $140.00 less 50%	70.00
	Merc-O-Tronic Company	Model 98	75.00
	Morris Sales Company	Model 619	26.25
1	Valve Seat Grinder	Snap-On VG 124C-B Set* $299.53 less 40%	179.80
1	Small Engine Dynamometer	Go Power DY-7D 1880 Embarcadero Rd. Palo Alto, California	400.00
1	Parts Washer Graybilt	Model 100	275.00

GENERAL TOOLS AND SUPPLIES

1	Gasoline can, safety type, $2\frac{1}{2}$ gal., Eagle No. W255	9.00
1	Solvent gun, air type (degreaser)	
1	Cylinder holder for honing (See plan, shop constructed)	

*Order from: Snap-On Tool Corporation - Phoenix, Arizona
**Order from: Neway Sales Inc.
Palm Beach Gardens, Florida 33403
***Order from: Industrial Tool & Supply Co.
830 E. 22
Tucson, Arizona

GENERAL TOOLS & SUPPLIES (continued)

10 lbs.	Shop towels for cleaning
1 case	SAE 30 ML Engine Oil
10 gal.	Stoddard Solvent
5 each	Wash pans (Shop constructed)
1 doz.	Cardboard tags -- .006" - .010" (air gap)
1 tube	Plasti-Gauge -- .002" - .006"
1 gal.	Carburetor cleaner, non-inflamable type
1 pt.	Gasket sealer, Tabers type
1 gal.	Honing oil -- Sunnen No. MAN-345-6 Aluminum cylinders
1 gal.	Degreaser solvent (Gunk)
1 lot	Assorted paint, touch-up aerosol spray cans

Estimated total cost for a set of instructional equipment for a class of 18 students.

No.	Item	Cost Each	Cost Total
9 each	Engines	$ 34.66	$311.94
9 each	Basic Tool Sets	43.88	395.55
3 each	Secondary Tool Sets	101.23	303.69
1 each	Special Laboratory Equipment (For teachers)	6.45	6.45
1 each	Special Tools	21.70	21.70
1 each	Special Tool Set (Repair Equipment)	445.82	445.82
			$1464.58

Total estimated cost of equipment

For basic instruction $1060.00

For basic plus repair instruction $1500.00

SUGGESTED
ENGINE STORAGE SYSTEM

Teachers who have pilot tested the use of this method of teaching the principles of internal combustion engines have expressed the importance of a systematic method of controlling the damage to engines and loss of engine parts and tools. Numerous suggested techniques or methods have been proposed. The success of any system depends upon the follow up and discipline which the teacher requires of his students.

The following represents a suggested technique of storing and controlling the engine parts and basic tools for an engine. It also therefore, represents a work station for two students. Since tools and parts can be stored and the cabinet locked after each work day, student confidence can be reinforced. Figure I shows the front view of the box while Figure II illustrates interior arrangement of tools and part storage. Each teacher would want to arrange the storage to suit his individual desires. The reverse side of this page contains a drawing for cabinet construction.

Figure I

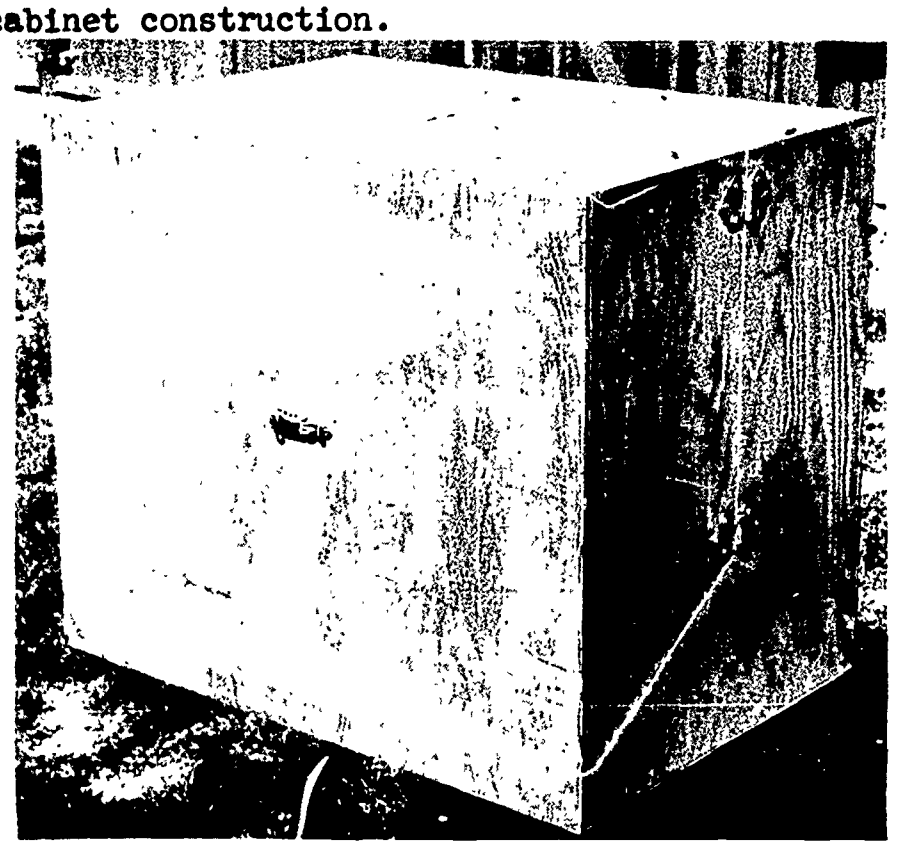
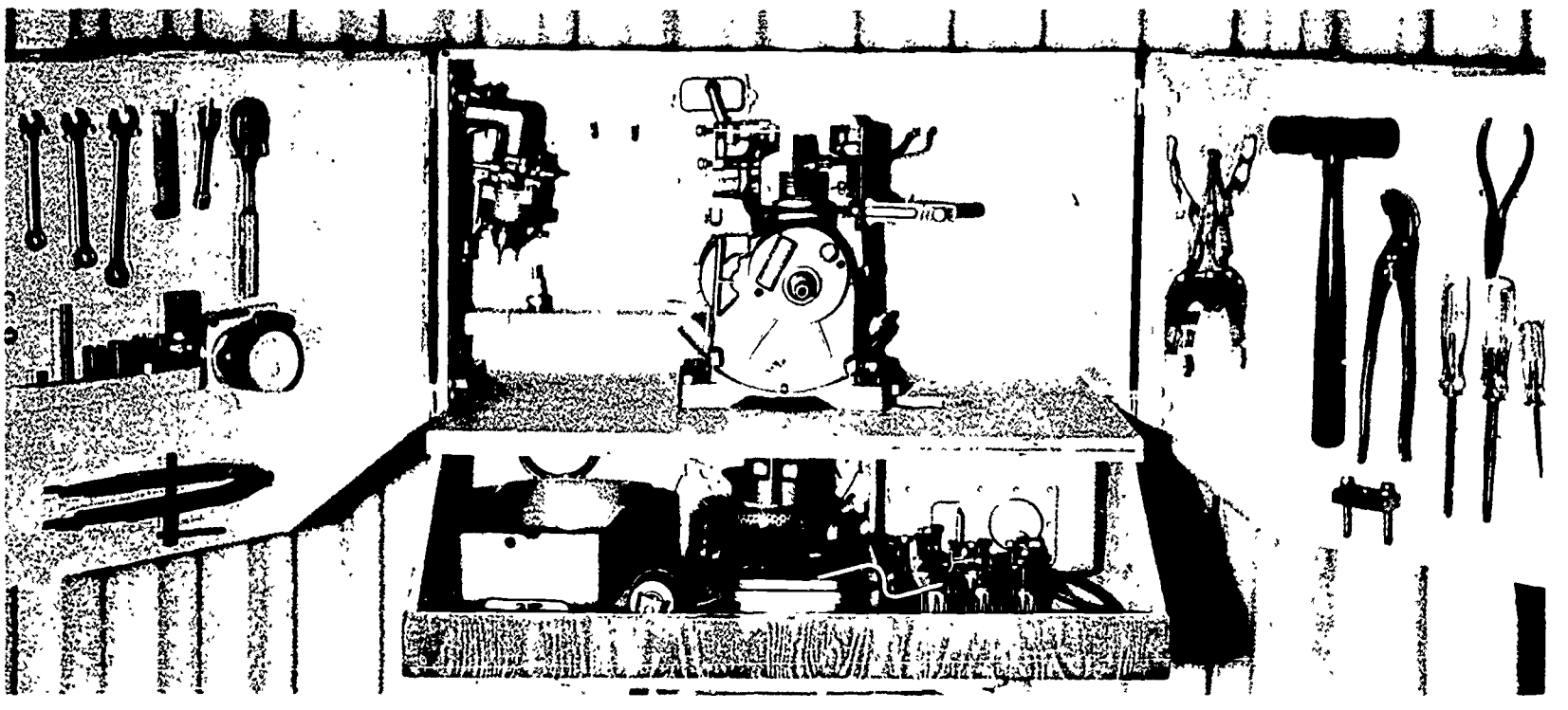
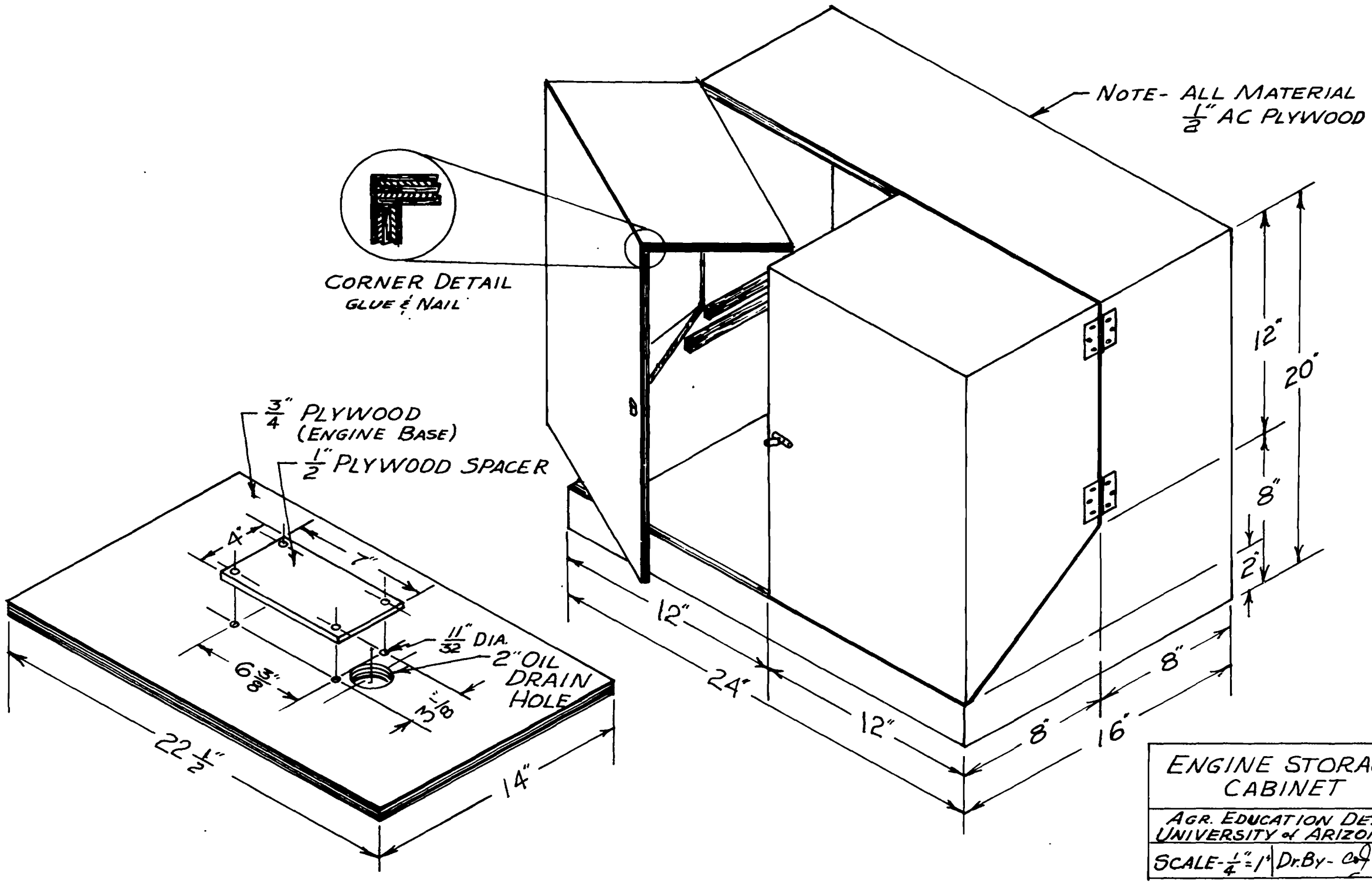


Figure II





ENGINE STORAGE CABINET

AGR. EDUCATION DEPT
UNIVERSITY of ARIZONA

SCALE- 1/4" = 1' | Dr. By- CJ

TABLE OF CONTENT

- UNITS OF INSTRUCTION -

I. PRINCIPLES OF INTERNAL COMBUSTION ENGINES

II. IDENTIFICATION AND FUNCTION OF ENGINE PARTS

III. DEFINITION OF TERMS

IV. VALVE AND IGNITION TIMING

V. FUEL INDUCTION - CARBURETION

VI. MAGNETO IGNITION

VII. SPARK PLUGS

VIII. TAKING ACCURATE MEASUREMENTS

IX. USING THE TORQUE WRENCH

X. MAINTENANCE AND REPAIR TECHNIQUES

XI. GOVERNORS

XII. DAILY SERVICE AND OPERATION

I. Teaching Unit No. I: Principles of Internal Combustion Engines, Historical Background.

II. Objectives:

1. To discover fundamental concepts about heat and motion.

2. To develop an appreciation for history of the internal combustion engine.

III. Introduction:

Technique for Introducing Unit:

The basic concepts to develop from this unit are those principles concerned with the basic law of nature that "motion causes heat" and that "heat does not cause motion"! Historically man has been attempting to reverse the law of nature by developing machines which would convert raw materials into heat and subsequently into motion.

Leading Questions:

1. When your body starts to sweat from having exercised hard, what is being released? (Heat)

2. Have you ever taken hold of a steel chip that came from a hole you were drilling? How did it feel? (Hot)

3. Would it be possible to take the heat that was developed from your body and in turn cause you to run? Or heat from the chip and cause the drill to turn? (Very improbable as we know the nature of heat!)

Conclusion: Write on board --

Motion (causes) Heat $\longrightarrow$

Heat (does/not/cause) Motion $\longrightarrow$

] Basic Law of Nature

4. How then has man changed the energy of heat into motion? (Heat engines)

IV. Questions for Study and Discussion

1. Do we have engines or motors in our tractors, trucks and cars? (Engines -- converts energy into mechanical work.)

2. What kind of engines do we have in our tractors and cars? (Internal combustion)

/Teachers Note/: Develop a list of internal combustion engines by type, kind, and size from a class survey of engines students have at home.

3. Is a steam engine an internal combustion engine? (No; combustion of fuel occurs outside the working parts.)

4. How does burning fuel cause motion in an IC engine? (Combustion heats air which expands against a movable engine part called a piston.)

5. What then are the four basic parts of an internal combustion engine? (Show parts; crankshaft, connecting rod, piston, and cylinder)

6. What are the two main types of Internal Combustion engines? (Spark ignition and compression (diesel) ignition.)

7. When were they developed?

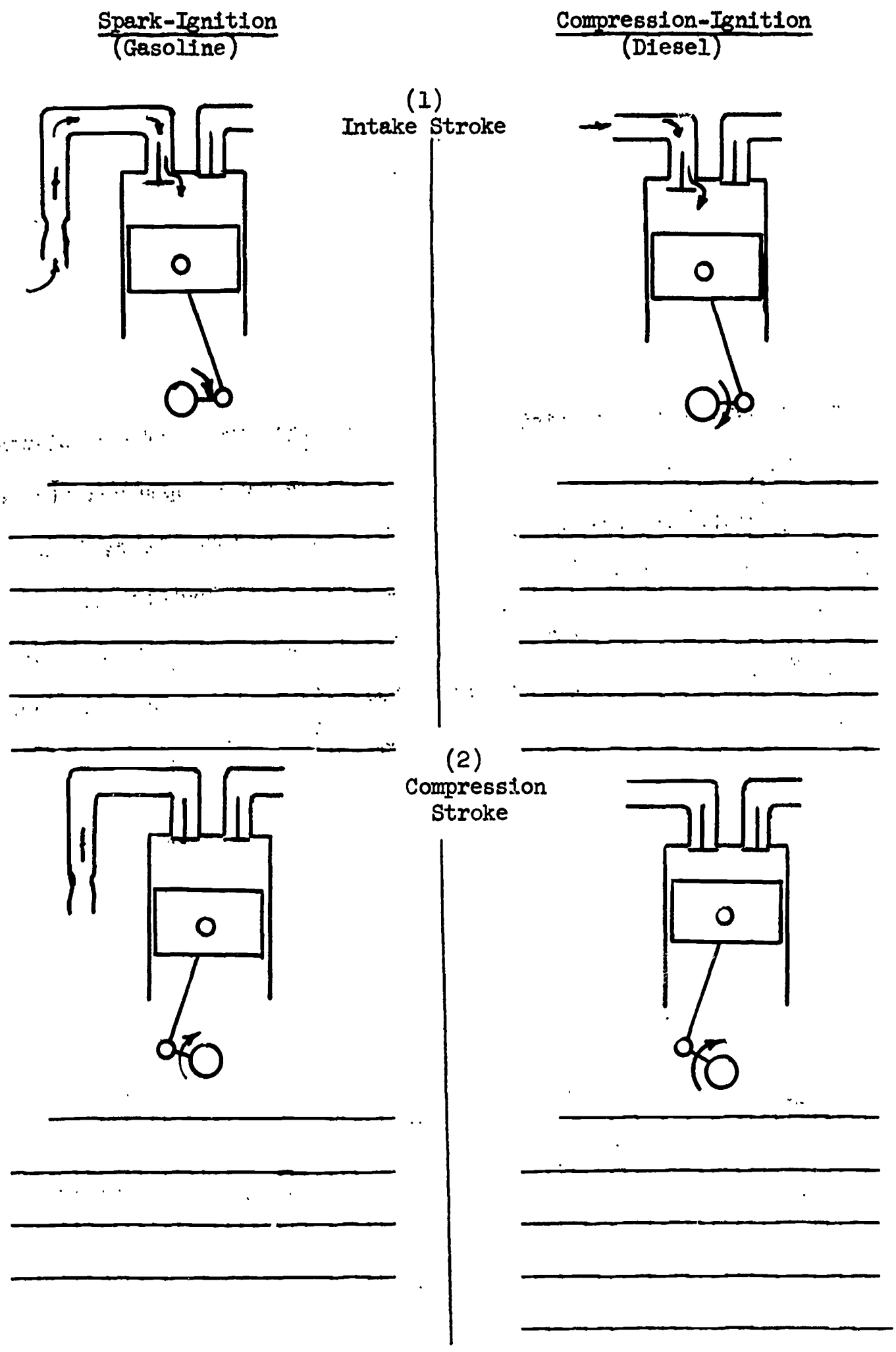
   1862 -- principles of four (4) events required, ie. intake of fuel, compression, ignition and expansion, and exhausting burnt fuel proposed by Beau de Rochas, a Frenchman.
   1876 -- First successful application of above principles by Dr. N. A. Otto, Germany, patented first 4-stroke cycle.
   1878 -- Dugald Clerk, England, patented first 2-stroke cycle engine.
   1892 -- First compression ignition engine patented by Dr. Rudolph Otto, German.

8. When we speak of a two and four stroke cycle engine, what is the meaning of the term "cycle"? (Completion of all events, before events are repeated, ie. spring, summer, fall, winter is a cycle of seasons. In an IC engine a cycle is intake, compression, power and exhaust.)

V. Supervised Study

1. Use transparency to show four-stroke cycle. Then have class complete the attached hand-out comparing the various engines and cycles.

Comparison of Spark and Compression
Ignition Four-Stroke Cycle Engines



On downward stroke of piston intake valve is open and air "sucked through" the carburetor picks up fuel, forming a combustible mixture which is drawn into the cylinder past the open throttle valve.

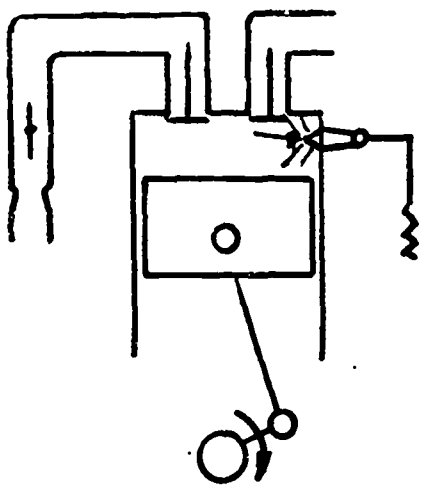
On downward stroke of piston intake valve is open and air alone is "sucked" into the cylinder. There is no carburetor or throttle valve and practically the same quantity of air enters cylinder regardless of speed or load.

On upstroke of piston, intake and exhaust valves are closed and fuel mixture is compressed.

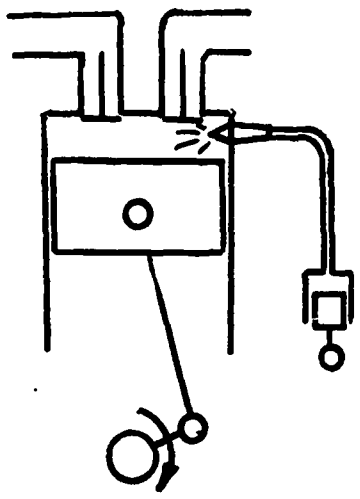
On upstroke of piston intake and exhaust valves are closed and the air is compressed. Compression pressure is much higher than in spark-ignition engine.

(3)
Power Stroke

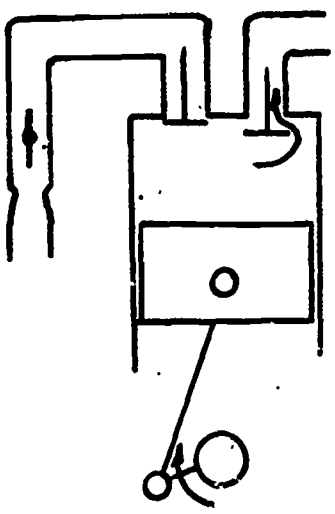
Spark-Ignition
(Gasoline engine, distillate

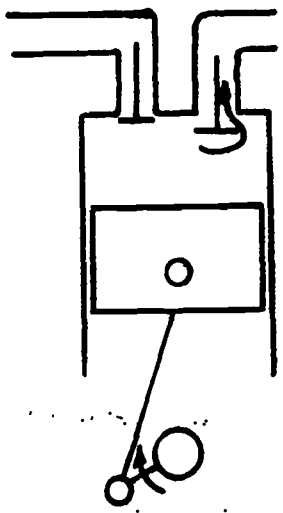


Compression-Ignition
(Diesel)



(4)
Exhaust Stroke





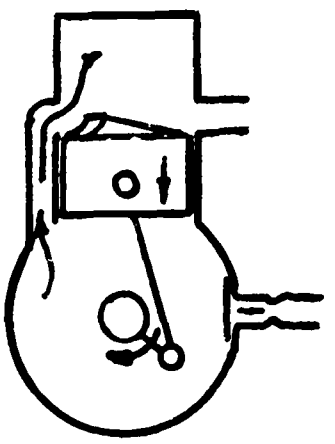
Compressed fuel-air mixture is ignited near end of compression stroke by time electric spark. Heat of combustion expands gases against piston forcing it downward in power stroke.

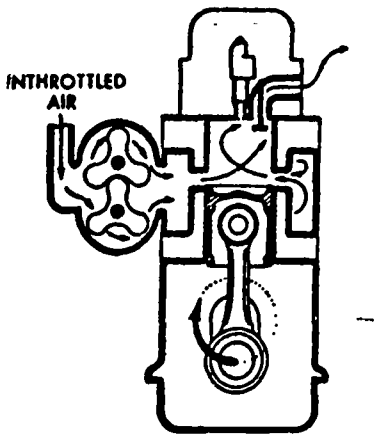
Fuel oil is injected near end of compression stroke and ignited by spontaneous ignition due to high temperature of the air in the cylinder because of its high compression.

Upward exhaust stroke forces cylinder gases out through open exhaust valve, clearing cylinder and making ready for next intake stroke.

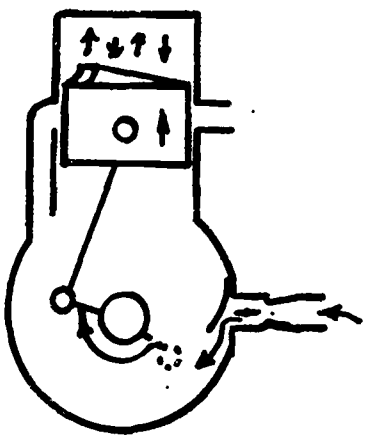
Upward exhaust stroke forces cylinder gases out through open exhaust valve, clearing cylinder and making ready for next intake stroke.

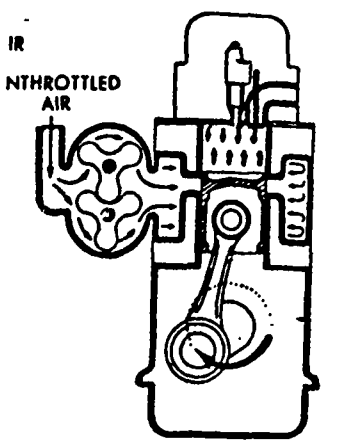
Intake Stroke





Compression Stroke





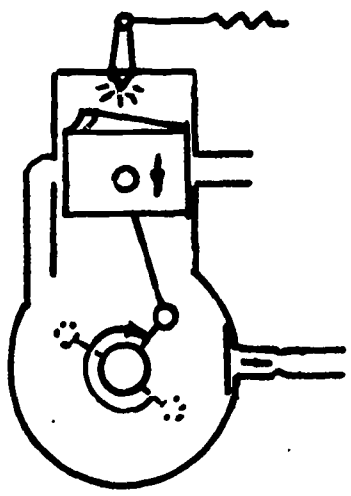
Decending piston compresses fuel-air and lubricating oil mixture in crankcase. When piston uncovers intake ports in cylinder the compressed gas enters cylinder.

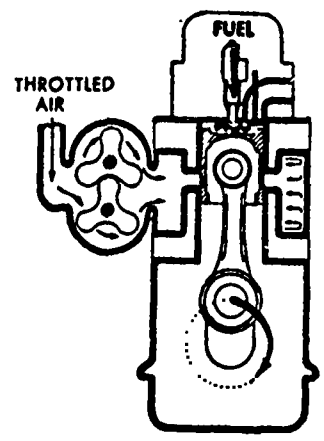
Exhaust valve is open and piston has uncovered intake ports in cylinder near bottom of stroke. Air under pressure from blower enters ports and clears cylinder of exhaust gases through exhaust valve.

Piston moving upward in cylinder covers intake and exhaust ports permitting fuel air mixture to be compressed. A partial vacuum in the crankcase cause reed valve to open allowing fuel air mixture to enter from carburetor from atmospheric pressure.

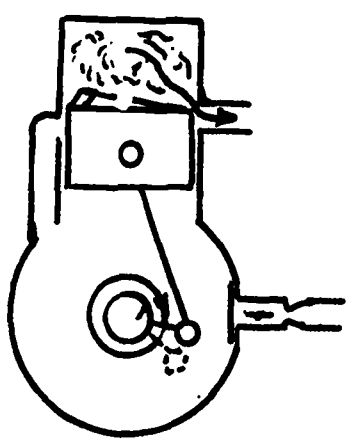
Piston rises in cylinder covering ports and exhaust valve closes causing air only to become highly compressed as piston reaches top of first stroke.

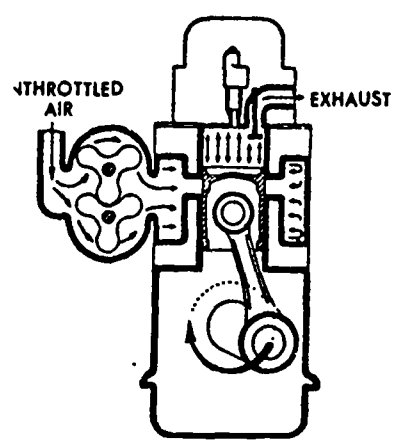
Power





Exhaust





Near top of stroke, the fuel mixture is ignited by spark from spark plug. Reed valve to crank-case automatically closes. Burning gases expands driving the piston downward.

Near top of the stroke fuel is sprayed into the highly compressed air. When fuel mixes with the hot air it burns causing an expansion of gases forcing piston down.

During downward movement fuel-air mixture is compressed in crank-case. When the piston decends to a position in the cylinder where the exhaust ports are uncovered, exhaust gases are released to atmosphere.

Exhaust valve opens before decending piston uncovers intake ports in cylinder thus releasing cylinder of high pressures. One revolution of crankshaft has been completed.

2. Compare operating characteristics by completing the following table for gasoline engines.

Characteristic	2 Cycle	4 Cycle
1) Number of piston strokes required per cycle	(2)	(4)
2) Fuel mixture required	(Fuel-oil & air)	(Fuel & air)
3) Type of valves	(Automatic reed and port)	(Mechanical poppet)

3. Compare advantages and disadvantages of 2 and 4 stroke cycle gasoline engines upon

   a) Efficiency -- (2 stroke loses fuel out exhaust port)
   b) Speed control -- (2 stroke tends to "hunt" for proper speed)
   c) Power out put per pound of weight -- (2 stroke higher)
   d) Vibration -- (2 stroke has less vibration)
   e) Number of working parts required -- (2 stroke - less valve mechanism)

4. What mechanism is used to induce air into cylinder of a 2 stroke cycle diesel engine? (Blower) Why is it not necessary on a four stroke diesel? (Down stroke of piston "sucks" in fuel.)

VI. Review

Introduce the film The Diesel Story, Shell Oil Company, a documentary which illustrates two and four stroke cycle and engine history. (Order from film library, University of Arizona) Also, ABC's of Internal Combustion, General Motors Corporation, Public Relations Staff, Film Library, General Motors Building, Detroit, Michigan 48202.

VII. References

1. General Theories of Operation, Briggs-Stratton, p. 3.

2. Farm Tractors, FT 53A, American Oil Company, pp. 3-7.

3. Gas Engines & Tractors, McGraw-Hill, pp. 20-29.

4. Small Engines, Vol. I, AM Association Agr. Eng. & Voc. Agr., pp. 10-16.

UNIT TEST

Circle T if true, and F if the statement is false.

T F 1. Motion causes heat, heat does not cause motion.

T F 2. We have motors in our cars, trucks, and tractors which convert energy into mechanical work.

T F 3. A good example of an internal combustion engine is the steam engine.

T F 4. The two main types of internal combustion engines are the spark ignition and the compression ignition.

T F 5. The four events required to complete a cycle in an internal combustion engine are the intake, compression, explosion, and exhaust.

T F 6. The first successful application of the internal combustion engine was achieved by Dr. N. A. Otto in 1876.

T F 7. The term cycle means the completion of all events, before the events are repeated.

T F 8. In an internal combustion engine the burning fuel heats the air which expands against the piston, causing motion.

T F 9. The diesel engine requires a spark to ignite the compressed air-fuel mixture for operation.

T F 10. Both valves are closed on the compression stroke.

I. Teaching Unit No. II: Identification and Function of Engine Parts

II. Objectives:

1. To be able to identify the components which constitute functional parts of a 4-stroke small engine.

2. To know how to make use of illustrated parts catalog.

3. To be able to converse intelligently about engine parts.

III. Introduction:

Technique for Introducing Unit:

To become familiar with the construction, repair or service of machines requires that one be able to communicate effectively in the subject. The goal of this unit should be two-fold:

1. Have students become involved in laboratory work with the small engine to which they have been assigned.

2. Compare actual parts with manufacturers parts list, illustrations, and descriptions.

Leading Questions:

1. If you happened to be talking to a friend over the telephone about the recent ball game, what would be at least two requirements for you to understand each other? (a) same language and b) each of you understand the game and terms used)

2. If you were employed as a parts manager for a local dealer in small engines, what information would you expect the owner to provide if he came to you for parts? (a) Manufacturer's name, b) engine model number, c) engine type number, d) engine serial number, and f) name of part.)

IV. Supervised Study

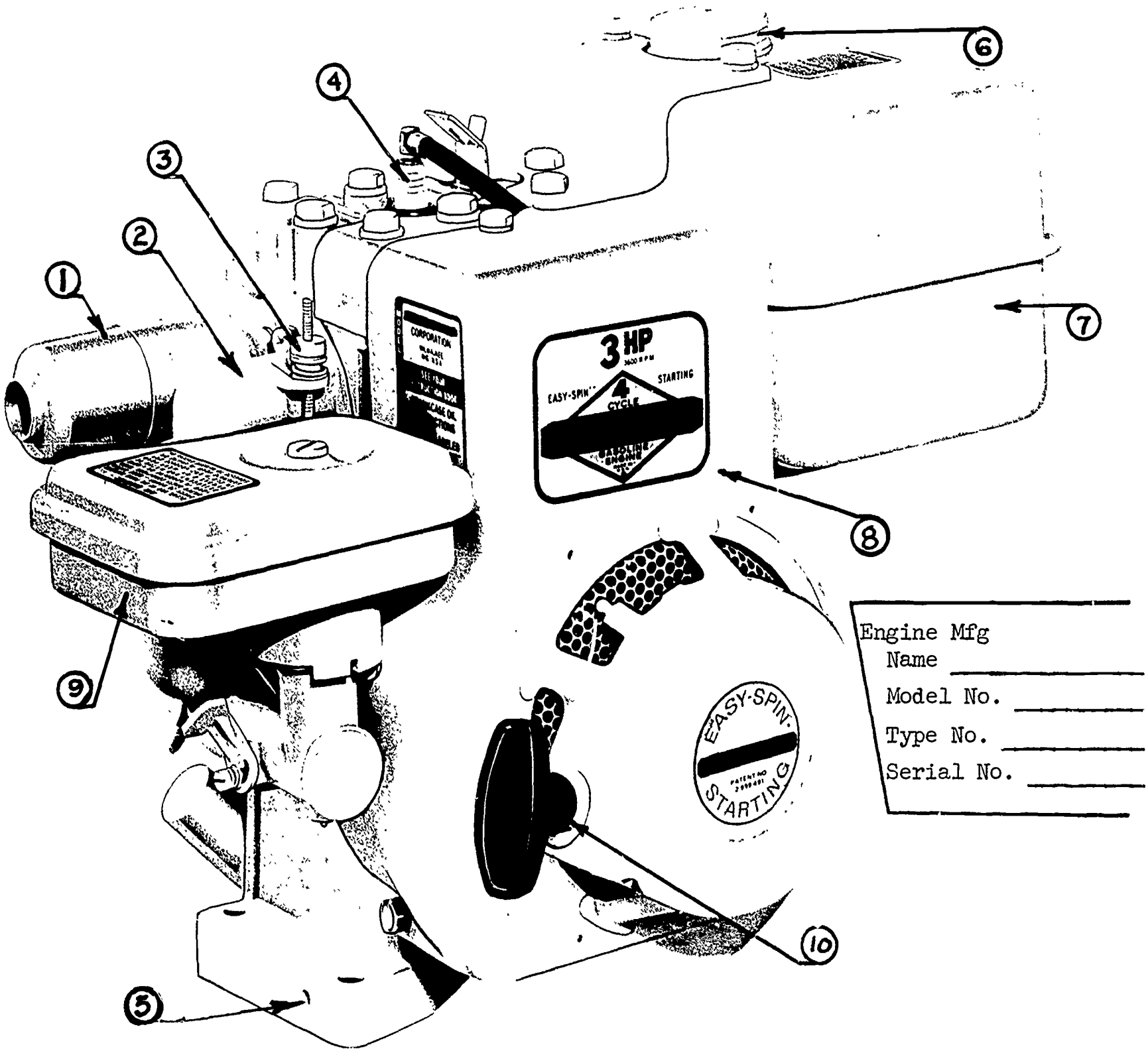
Assign students to engines and furnish hand-out materials to each for recording information. Proceed to shop for laboratory assignment. Stress the following procedure:

1. Inspect and compare external actual engine parts with those pictured on attached two sheets. Use illustrated parts list and record manufacturers reference number, name and brief function of part.

2. As each team of students completes the assignment require that they check the tool kit list for each engine completing the tool check out sheet and handing it to the teacher.

3. Proceed to disassembly procedure and have students remove parts in the step-by-step sequence. Emphasize that all nuts, bolts and loose hardware should be returned to the position from which they were taken to avoid loss. Functional parts are to be stored in work stations. Use the following procedure:

Steps in Procedure (Disassembly)	Key Points	Ref. Page No.*
1. Drain oil from crankcase		R-87
2. Remove air cleaner and gasket		R-27
3. Remove fuel line	a. Turn off fuel at tank b. Use $\frac{1}{2}$" open end wrench	
4. Remove fuel tank		
5. Remove blower housing		
6. Raise armature (do not remove)	a. As far up as possible	R-18, Fig. 17
7. Remove air vane governor assembly	a. Secure linkage to arm with rubber band.	R-52
8. Remove intake manifold (elbow) with carburetor attached.	a. Use No. 2 Phillips screwdriver	
9. Remove muffler	a. Loosen lock nut with pin punch	
10. Remove spark plug	a. Use deep socket	
11. Remove cylinder head	a. Note location of cap screws by size b. Note location of washers and air shroud c. Avoid damaging gasket	R-69



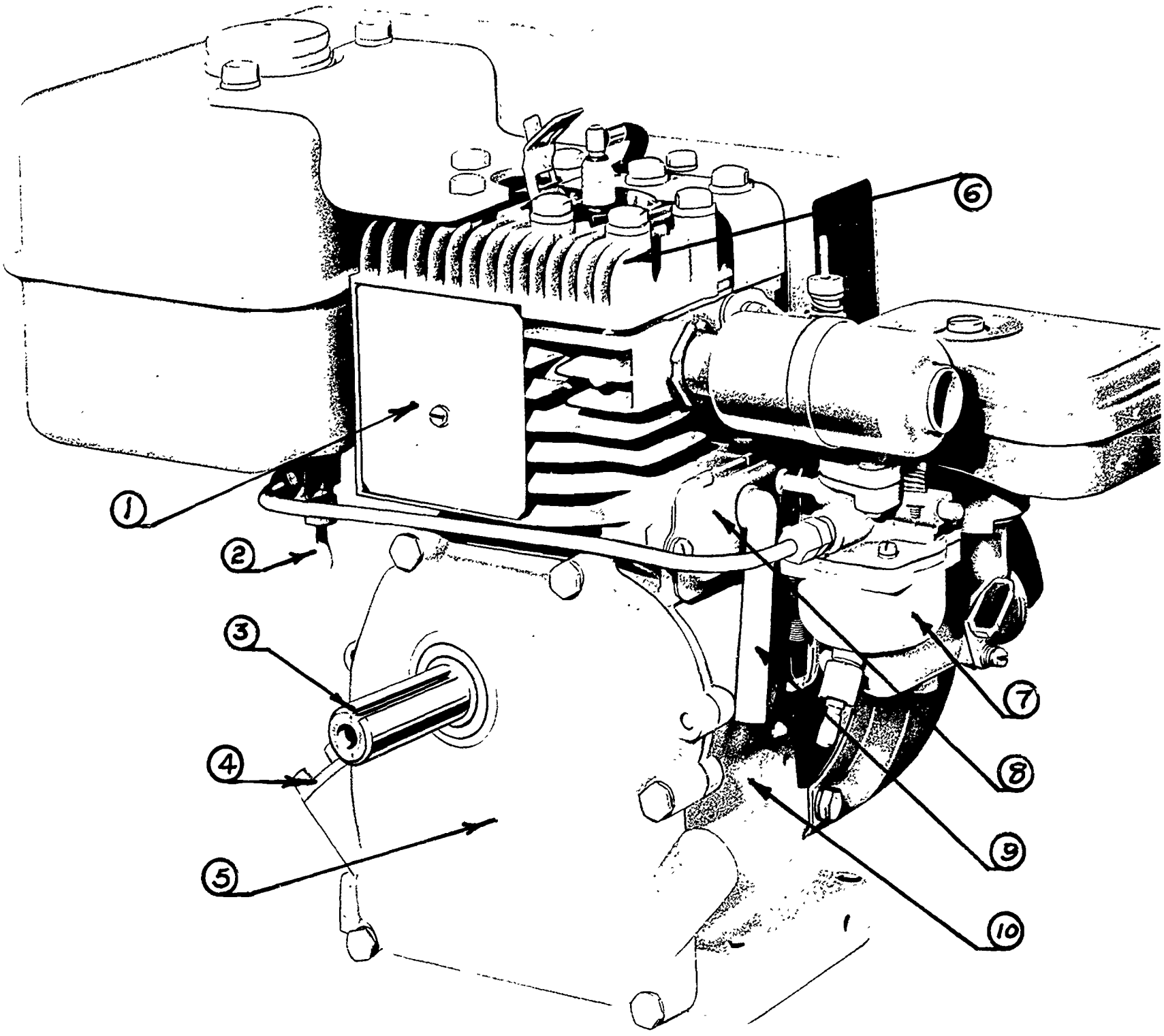
Engine Mfg
Name _____
Model No. _____
Type No. _____
Serial No. _____

Item No.	Mfg. (1) Ref. No.	Name of Part	Function of Part (Brief)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

(1) Obtain from - Illustrated Parts List, Form No. MS4255-68 Briggs Stratton Co.

Item	Mfg. (1) Ref. No.	Name of Part	Function of Part (Brief)
1	300	Muffler	
2	50	Intake elbow	
3	206	Control nut	
4	337	Spark plug	
5	15	Oil drain plug	
6	181	Filler Cap	
7	180	Fuel tank	
8	304	Blower Housing	
9	536	Air cleaner	
10	60	Rope starter	

(1) Obtain from - Illustrated Parts List, Form No. MS4255-68, Briggs-Stratton Co.



Item No.	Mfg. (1) Ref. No.	Name of Part	Function of Part (Brief)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

(1) Obtain from - Illustrated Parts List, Form No. MS4255-68, Briggs-Stratton Co.

Item No.	Mfg. (1) Ref. No.	Name of Part	Function of Part (Brief)
1	306	Cylinder shield	
2	198	Fuel shut off valve	
3	16	Crankshaft	
4	21	Oil filler plug	
5	18	Crankcase cover	
6	5	Cylinder head	
7	90	Carburetor	
8	8	Crankcase breather	
9	11	Breather tube	
10	1	Cylinder assembly	

(1) Obtain from - Illustrated Parts List, Form No. MS4255-68, Briggs-Stratton Co.

12. Remove crankcase cover plate	a. Avoid damage to gasket b. Tap lightly with plastic hammer	R-97
13. Remove valve chamber cover	a. Avoid damaging gasket	

4. Identify and complete the following table of functional internal parts.

Mfg. Ref. No.	Part No.	Name of Part	Function
23A	296884	FLY WHEEL	Smooths power impulses
16	260104	CRANKSHAFT	Transmits vertical motion to rotary.
29	294367	CONNECTING ROD	Connects piston and crankshaft
30	220670	OIL DIPPER, CONNECTING ROD	Oil splash lubricator
25	295587	PISTON	Compresses mixture and absorbs power
33	296676	VALVE, EXHAUST	Release burnt gases
34	296677	VALVE, INTAKE	Fuel mixture enters combustion chamber
35	260552	SPRING, INTAKE VALVE	Closes valves
36	26478	SPRING, EXHAUST VALVE	
46	210453	CAM GEAR & SHAFT	Actuates valves
45	230173	TAPPETS, VALVE	Lifts valves from cam
200A	297309	GOVERNOR	Controls speed
333A	298502	ARMATURE, MAGNETO	Ignition system

5. Count the number of teeth in the cam gear and crankshaft gear, then answer the following questions:

a) What is the ratio of cam to crankshaft gear diameter if:

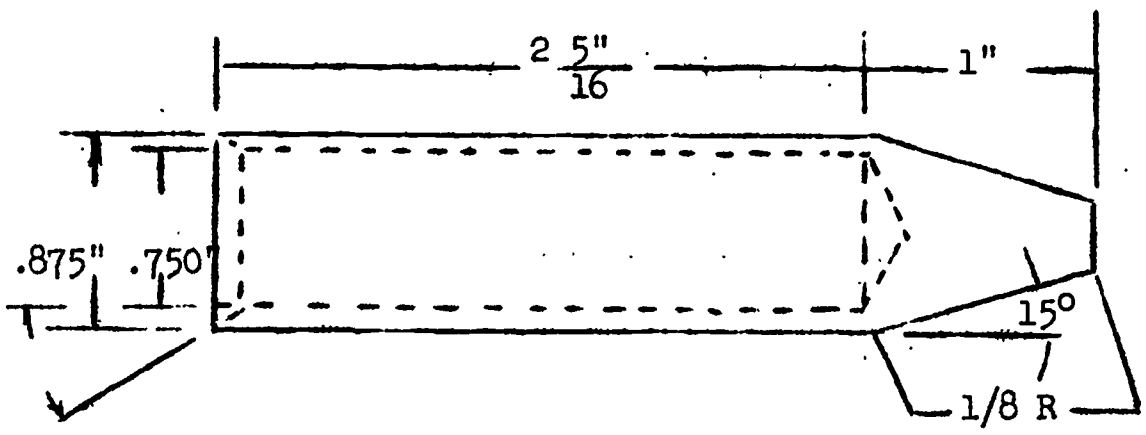
$$\text{Ratio} = \frac{\text{No. cam gear teeth}}{\text{No. crank gear teeth}}$$

b) If the crankshaft turns two revolutions how many revolutions will the cam gear rotate? (1)

c) Why is this ratio necessary?

6. Find the cam and crank gear timing marks.

7. Return crankcase cover assembly to engine. Use sleeve or paper on crankshaft PTO shaft to avoid damaging oil seal.



V. Review

Have students carefully rotate crankshaft in the normal direction of rotation and observe the internal operation of parts and sequence of valve operation in relation to strokes. Stress that all 4-stroke cycle engines operate on these principles. Construction details will vary.

VI. References

1. Form No. MS 4255-68, Illustrated Parts List, Briggs-Stratton Company.

2. Form No. MS 4750-54, Repair Instruction III, Briggs-Stratton Company.

UNIT TEST

Circle T if the statement is true, and F if the statement is false.

T F 1. Using the same language is necessary for communication when discussing and handling engines and their parts.

T F 2. Engine parts catalog supplies the most reliable information on the name of the part and its function.

T F 3. Proper disassembly of an engine requires that you first remove the spark plug so as not to get a shock.

T F 4. As the engine is disassembled all nuts, bolts and loose hardware should be returned to the position from which they were taken.

T F 5. When the camshaft turns two revolutions the crankshaft turns one revolution.

T F 6. The cylinder head serves as a sealing cap for the cylinder assembly.

T F 7. The crankcase cover of a small engine is similar in function to the oil pan of a tractor engine.

T F 8. The camshaft is driven from the crankshaft by sprocket and chain on most small engines.

T F 9. The gear ratio of camshaft to crankshaft gear is always 4:1 on a four stroke cycle engine.

T F 10. There is direct contact between the camshaft and valve when the valve is being actuated.

I. Teaching Unit No. III: Definition of Terms

II. Objectives:

1. To know terms which are associated with engine operation and specification.

2. To know how size and output of an engine is expressed.

III. Introduction:

Technique for Introducing Unit:

The concepts to be developed in this unit are (1) size of an engine within types is a direct function of displacement and (2) output is a direct relation between force and engine speed.

Leading Questions:

1. How do most automobile manufacturers specify the size of engine in their cars? (By total cubic inch displacement.)

2. Which type of engine has the most cylinder compression, a gasoline or a diesel? (Diesel)

3. How is compression usually compared between engines? (a) lbs. per square inch and b) compression ratio.)

/Teachers Note/: The method of teaching this unit will depend upon the available equipment and desires of the teacher to present the information as a class demonstration or as a student laboratory experiment. The latter will require that considerable more time be allowed to reach conclusions.

IV. Supervised Study

1. Define the following terms:

a) Top dead center (TDC)
b) Bottom dead center (BDC)
c) Crankshaft degrees of rotation

2. Record the following:

a) Bore of cylinder _____ inches.
b) Stroke of piston _____ inches.
c) If a manufacturer list 4" x 5" for the size of his engine which number is bore? (First, 4")

d) What part of the engine determines the stroke of the piston?

3. a) What is piston displacement? (See reference No. 1, p. 4) In what units is it expressed? (Cubic inches)

b) Write the formula for determining piston displacement and determine the piston displacement for your engine.

$$Pd = \left(\frac{\pi d^2}{4}\right) h$$

When: d = bore in inches
h = stroke in inches

c) If this engine had 4 cylinders, what would be the total piston displacement? (Pd of one cylinder x 4).

4. a) What is meant by the term "compression ratio"? (Ratio of total cylinder volume to clearance volume)

b) Determine compression ratio for your engine by:

1) Turn fly wheel to <u>TDC</u> <u>compression</u> <u>stroke</u> (both valves closed)
2) Return cylinder head and gasket to position and snuggly tighten head bolts.
3) Fill a 50 ml cylinder to 50 ml level with clean engine oil and pour slowly into spark plug hole until oil is level with bottom of hole. Read the remaining oil in cylinder and calculate <u>clearance</u> <u>volume</u> by:

Cl. Vol. = 50 ml - _____ml x .061 = _____cu. in.

4) Compression ratio = $\frac{\text{piston displacement vol. cu. inches} + \text{clearance vol. cu. in.}}{\text{Clearance vol. cu. inches}}$

Compression ratio = $\frac{_____\text{inches}^3 + _____\text{inches}^3}{_____\text{inches}^3}$

Compression ratio = _____ : 1

5. What is the range of compression ratios for the following engines? (Reference 1, p. 4 and reference 2, p. 6)

a) Small air cooled engine (_____).
b) Gasoline tractor engine (_____).
c) Diesel tractor engine (_____).

6. What relationship is there between:

a) Compression ratio and cylinder pressure in pounds per square inch? (Yes, the greater the compression ratio, the greater the compression pressures, but at an increasing rate.)

1) Student activity -- Have students measure compression pressures in a cylinder by inserting a screw-in compression gauge into spark plug hole and motor engine with vigorous pulls on starter rope or by attaching a $\frac{1}{2}$" electric drill to the PTO end of the crankshaft. The latter will turn the crank opposite to the normal direction of rotation, but the reading will probably be more accurate because of the "Easy-Spin" starting.

b) Do you think there would be a relation between compression ratio and engine efficiency? (Yes) See reference 1, p. 4.

1) Using figure 232, page 99 of reference II, determine thermal efficiency of a typical heat engine as follows:

Loss of heat to exhaust _____ percent
Loss of heat to cooling _____ percent
Loss of heat to friction _____ percent
Heat available at crankshaft _____ percent.

2) Can you say that a gasoline engine is relatively efficient or inefficient in utilization of fuel to power produced from a given amount of fuel?

c) Is there a relationship between compression ratio and engine horsepower? (No, See reference 1, p. 4)

d) What device could be used to measure horsepower at the crankshaft? (Prony brake or dynamometer. See reference 2, pp. 99 & 100)

V. Review

Stress how cubic inch displacement indicates relative size of an engine and horsepower is usually in direct proportion to displacement.

VI. References

1. General Theories of Operation, Briggs & Stratton Company.

2. Farm Tractors, FT53A, American Oil Company.

UNIT TEST

Circle T if the statement is true, and F if the statement is false.

T F 1. The size of most engines is specified by the number of horsepower they deliver.

T F 2. The diesel engine has less cylinder compression than a gasoline engine.

T F 3. The bore of an engine refers to the diameter of the cylinder.

T F 4. Piston size determines the stroke.

T F 5. Piston displacement is the space displaced by the valves on their up and down movement.

T F 6. Compression ratio refers to the ratio of the total cylinder volume to the clearance volume.

T F 7. The greater the compression ratio, the greater the cylinder pressure.

T F 8. There is a definite relationship between engine horsepower and compression ratio.

T F 9. Horsepower is usually in direct proportion to displacement.

T F 10. A gasoline engine is relatively inefficient in utilization of fuel to power produced.

I. Teaching Unit No. IV: Valve and Ignition Timing

II. Objectives:

1. To discover with the characteristics of four-stroke cycle small engine valve and ignition timing.

2. To discover the importance of correct valve tappet clearance as it affects timing.

3. To discover the standard methods for expressing valve and ignition timing in relation to fly wheel degrees.

III. Introduction:

The purpose of this unit is to develop the concept that valve and ignition timing is an exacting requirement if four-stroke cycle engines are to perform properly. The principles learned in this unit have practical application to agricultural engines and relates directly to periodic adjustment of valve tappet and ignition breaker point clearance for proper valve and ignition timing.

Leading Questions:

1. When in the power stroke would it be most efficient to open the exhaust valve and release the high pressures against the piston? (Before BDC)

2. When should ignition of the fuel occur to obtain proper burning? (Before TDC)

/Teachers Note/: As in the previous lesson this unit may be taught as a classroom demonstration or if sufficient equipment is available as a student laboratory experience. It is assumed that the previous lesson has been completed and that the circle protractor is still attached to locate accurately TDC of piston by flywheel position.

IV. Questions for Study and Discussion (Reference 1, pp. 4-6 and reference 2, pp. 31-33)

1. What important functions must engine valves perform? (Seal cylinder to provide good compression, must open and close at correct time.)

2. Compare the importance of good valves operation in a single cylinder engine to a multi-cylinder engine? (One cylinder must provide total power)

3. Under what operating conditions is an exhaust valve subjected? (Pressures of up to 500 psi and 1200°F temperatures, must open and close in 1/50 of a second at 3000 rpm)

4. Why are valves and seats of a single cylinder engine seldom badly burned? (Because engine won't be motorized by other cylinders.)

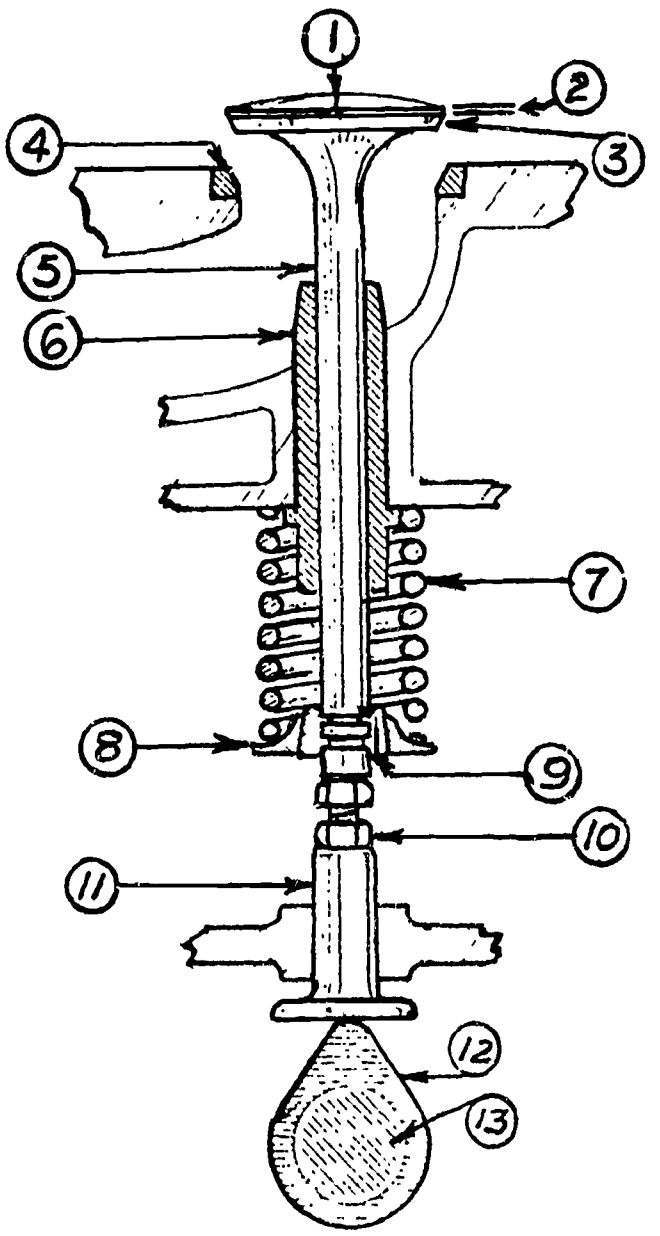
5. What are the usual causes of valve seat burning? (Accumulation of carbon or fuel lead on valve face or stem or insufficient tappet clearance)

6. Identify causes of (a) dished valves and (b) necked valves. (See reference 1, p. 6)

7. What are the common valve arrangements found in modern 4 cycle engines. Reference 2, p. 32. Which arrangement is more commonly used for high compression engines?

8. Identify the parts of the following valve assembly. Reference 2, p. 33.

1. Head
2. Margin
3. Face
4. Seat
5. Stem
6. Guide
7. Spring
8. Washer
9. Retainer
10. Adjusting lock nut
11. Tappet
12. Cam
13. Camshaft



Courtesy of Tecumseh Prod. Co.

9. What is meant by a Timing Diagram? (See reference 2, p. 31)

V. Supervised Study (Laboratory)

/Teachers Note/: The object of this portion of the study is to develop timing diagrams for the small air cooled engine as found on the following sheet for (1) Valve and ignition timing as found and (2) Valve timing with valve clearance reduced by .004 inches. Equipment required is as follows:

1 - Feeler gauge
1 - Test spark plug
1 - Circle protractor set
1 - 6 volt dry cell lantern battery
1 - Lead set with alligator clips
1 - AC Power timing light

Demonstrate how to attach equipment to the engine and obtain data. Accuracy of the demonstration depends upon one being able to determine when valves are actually leaving and returning to their seats. One procedure to accomplish this is to mount a dial indicator over the valve and note the exact time of needle movement. In absence this tool, a thin strip of cigarette pack cellophane wrap can be extended through the valve port and between valve and seat when the valves are off their seats. This technique identifies the exact moment the valve leaves or returns to the seat if tension is placed on the cellophane. A third way to determine when a valve is leaving or returning to seat is by close visual observation and feel.

Ignition timing can be made dramatic and alive by energizing the magneto coil with a 6 volt dry cell battery so that when the fly wheel is truned and the ignition breaker points are opened a spark will occur. In addition, a power timing light can be used to identify the exact moment of ignition output by attaching it to the spark plug ignition wire. (Caution: The coil can be ruined easily if the ignition wire is not held to a 1/8" or 3/16" spark gap at the time of electrical discharge. Therefore, always hook the ignition cable to the test spark plug and clamp the plug to the engine block.)

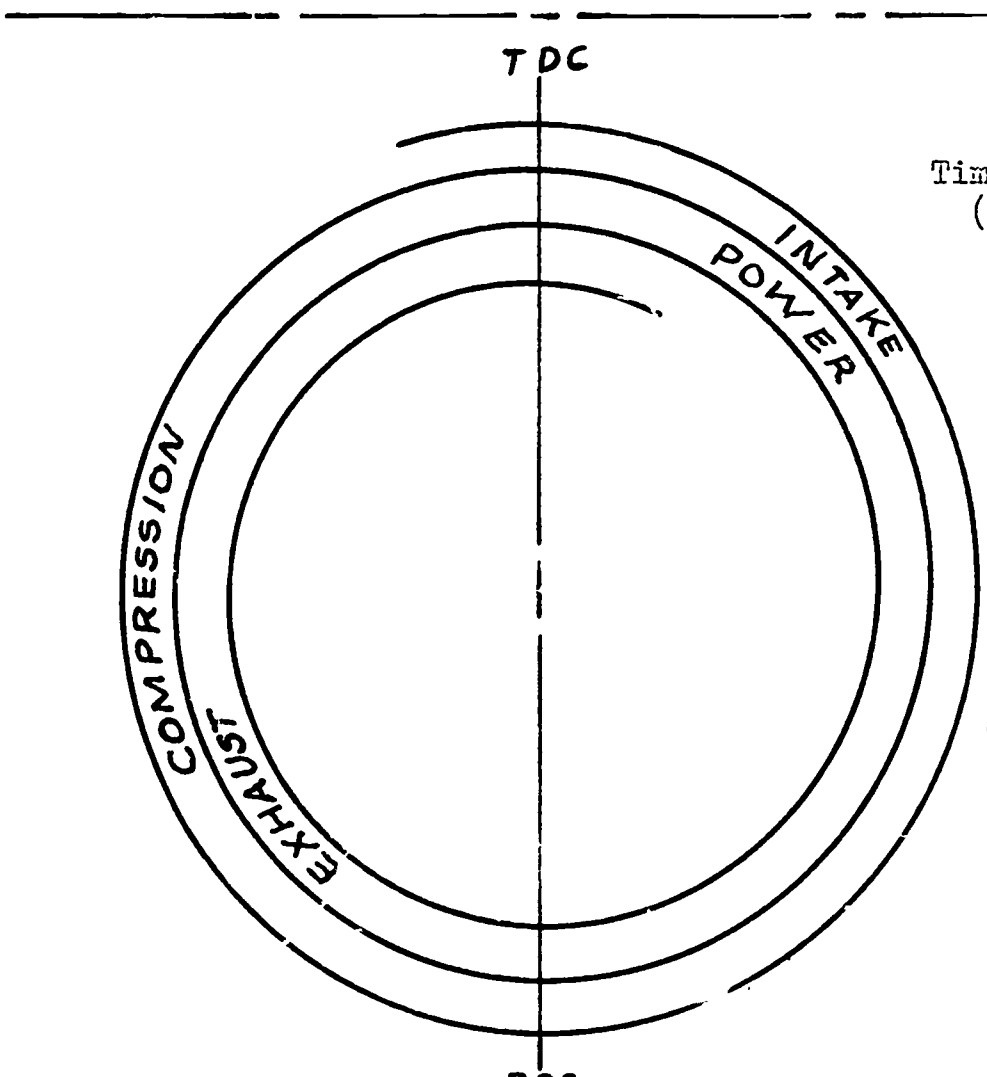
Laboratory Procedure

1. Recheck location of circle protractor for accuracy.

2. Turn the fly wheel in normal direction of rotation until intake valve starts to open. Record degrees of opening in Timing Diagram A.

3. Continue to rotate fly wheel until intake valve closes. In same manner record closing degrees in diagram A.

VALVE AND IGNITION
TIMING DIAGRAM
SINGLE CYLINDER, AIR COOLED ENGINE



Timing Diagram "A"
(condition as found)

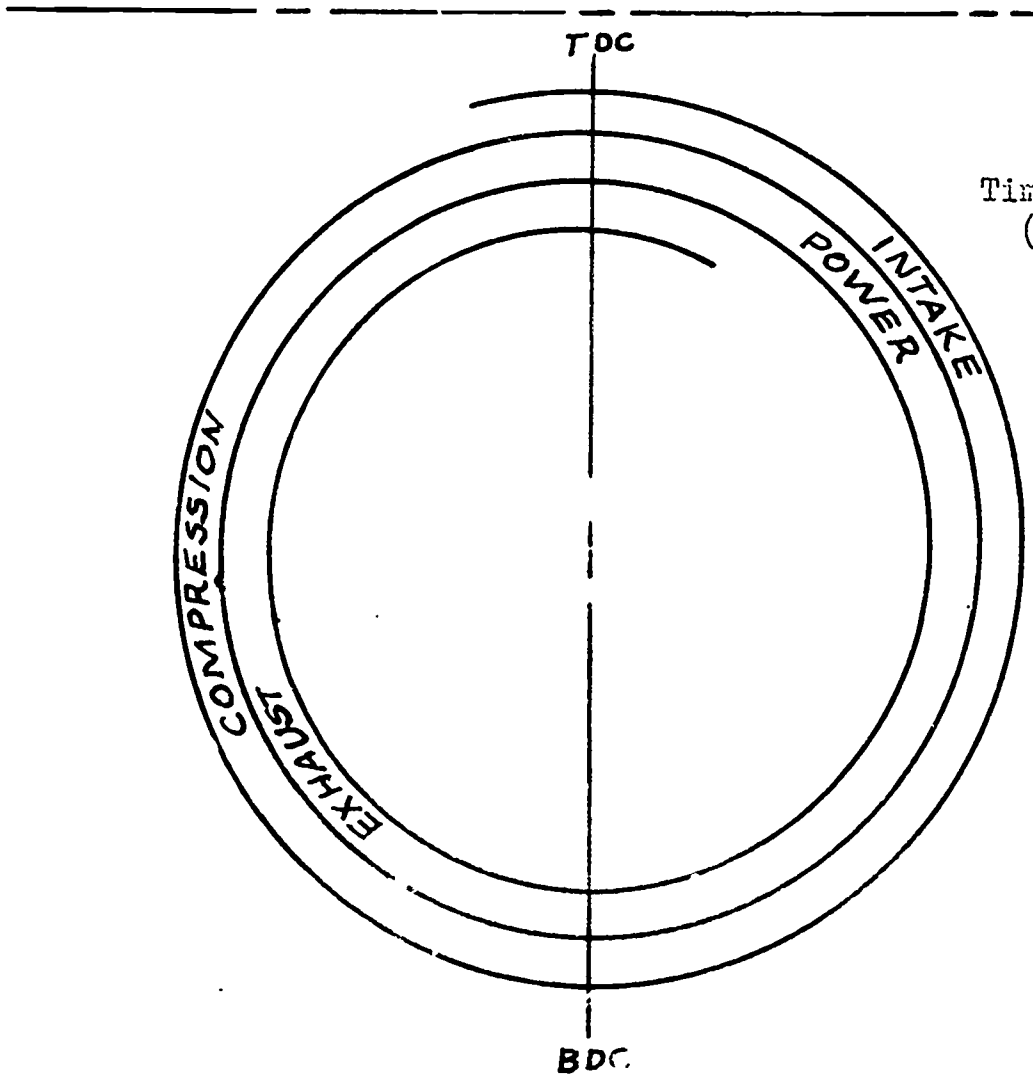
Valve Clearance:

Intake _____ inches
Exhaust _____ inches

Valve Range:

Intake _____ degrees
Exhaust _____ degrees

Ignition
Timing _____ degrees



Timing Diagram "B"
(valve clearance reduced)

Valve Clearance

Intake _____ inches
Exhaust _____ inches

Valve Range

Intake _____ degrees
Exhaust _____ degrees

4. Attach 6 Volt battery to coil by removing ground wire connection of coil and attaching one terminal of battery to coil and other terminal to a part of the cylinder assembly. See figure 1.

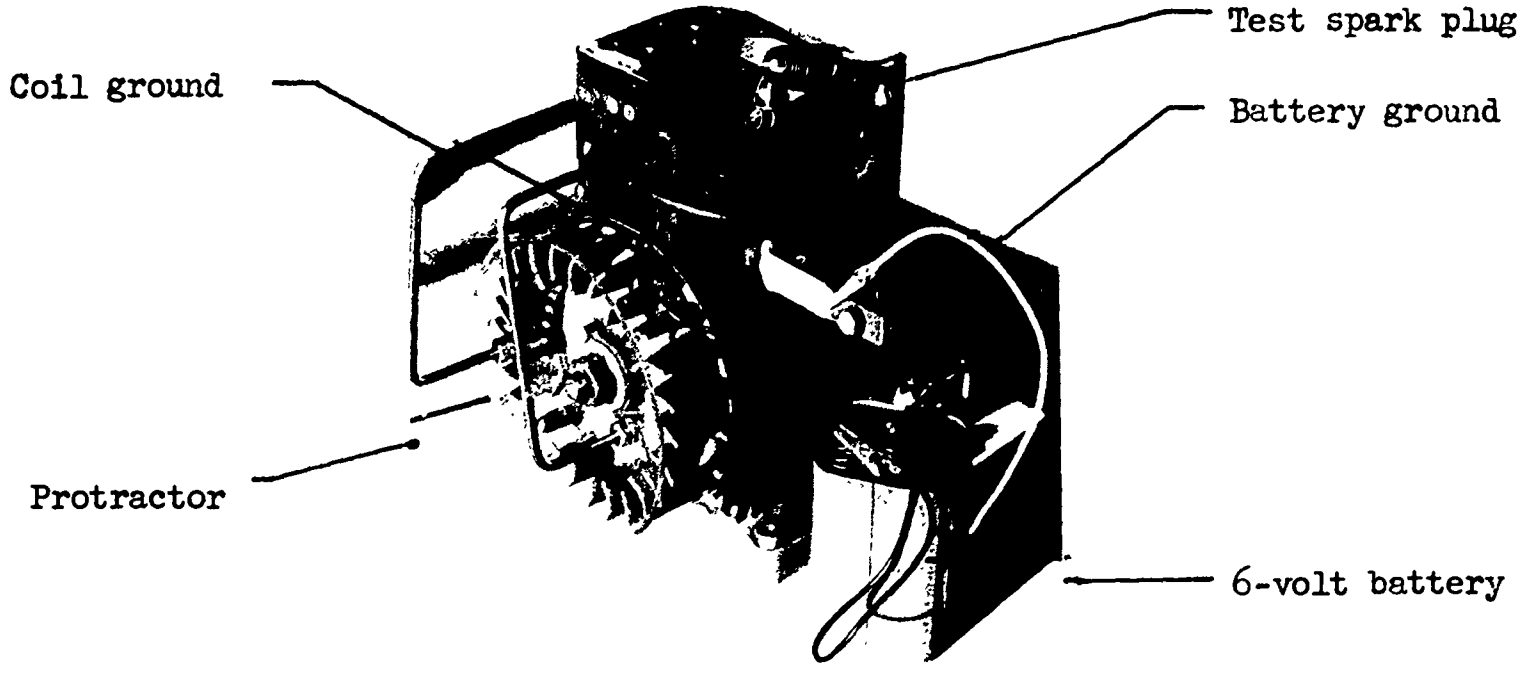


Figure 1

5. Attach test spark plug to plug wire lead and clamp plug to cylinder block.

6. Attach timing light to plug wire.

7. Slowly rotate flywheel in normal direction on compression stroke until timing light flashes. Note firing degrees on protractor and record same on diagram A.

8. Disconnect battery and timing light.

9. Continue to rotate flywheel until exhaust valve starts to open - record the degrees in diagram A.

10. Continue flywheel rotation until exhaust valve closes and record the degree position in diagram A.

11. Determine the following:

    a) No. of degrees valves are open:

        1) Intake valve _____
        2) Exhaust valve _____

    (Note: This is referred to as valve range of operation.)

    b) Indicate on diagram "A" the points of opening and closing in degrees before or after TDC or BDC. See figure 69, reference 2 for example.

12. Place piston on compression stroke and measure valve clearance. Record information on Timing Diagram A.

13. Following the procedure used to obtain information for Timing Diagram "A", insert a .004" thickness feeler gauge between the valve tappet and end of valve stem and determine opening and closing positions for intake and exhaust valve. Record information on Diagram "B".

14. Determine the following:

    a) Number of degrees valves are open:
       1) Intake valve _____
       2) Exhaust valve _____
    b) Indicate on Diagram "B" the points of opening and closing in degrees before or after TDC or BDC.

15. From the above, what statement can you accurately make regarding the effect of valve timing on:

    a) Proper valve clearance.

    _____

    _____

    b) Proper timing of cam and crankshaft gear.

    _____

    _____

    _____

16. Is there a point in the cycle of valve operation when both valves are off their seats at the same time? Why should this arrangement be desirable? Reference 2, p. 31.

17. Return the piston to TDC. Then rotate fly wheel exactly 90°. Measure the piston travel in cylinder. Record your measurement in space below.

    Stroke of piston = _____ inches
    TDC to 90° rotation = _____ inches
    Difference = _____ inches

    a) Why did the piston move a greater distance in the cylinder on the first half of the stroke? (Ref. 2, p. 8)

18. What relation can you draw between:

    a) Valve timing and movement of piston in the cylinder?
    b) Engine balance? (Reference 2, p. 8)

19. Why does ignition timing require the spark to occur before TDC? (Reference 2, p. 50)

VI. Review

Review the relationship between valve timing and piston travel in the cylinder and the need for correct timing. Emphasize that the engine manufacturer established proper clearance specifications to provide correct valve and ignition timing.

VII. References

1. General Theories of Operation, Briggs-Stratton Company.

2. Farm Tractors, FT53A, American Oil Company

UNIT TEST

Circle T if the statement is true, and F if the statement is false.

T F 1. In the internal combustion engine the timing of operation of the valves and the ignition are of upmost importance for proper performance.

T F 2. The ignition of the fuel should occur immediately after top dead center to obtain proper burning and utilization of the fuel.

T F 3. A timing diagram shows the sequence of events of the inlet and exhaust valves in one cylinder.

T F 4. The exact moment of ignition can be identified by attaching a timing light to the ground wire on the magneto.

T F 5. When the valve clearance is reduced, the length of the timing event will be increased.

T F 6. There is a point in the cycle of valve operation when both valves are off their seats at the same time.

T F 7. The manufacturer for almost all engines has established proper clearance specifications to provide correct valve and ignition timing.

T F 8. Valves and valve seats are seldom badly burned in a one cylinder engine because there are no other cylinders to motorize it.

T F 9. When testing ignition timing the coil can be ruined if the ignition wire is not held to a 1/8" to 3/16" spark gap.

T F 10. When engine timing is not correct the cylinders could actually be working against or negative to each other.

I. Teaching Unit No. V: Fuel Induction System, Carburetion

II. Objectives:

1. To discover the specific fuel-air relationship required for proper engine operation.

2. To discover the basic principles which are fundamental to carburetion.

3. To identify the working parts of carburetors which are characteristic of those used in modern farm tractors.

4. To discover the functional systems common to float-type carburetors.

5. To discover how the all-position diaphram carburetor operates.

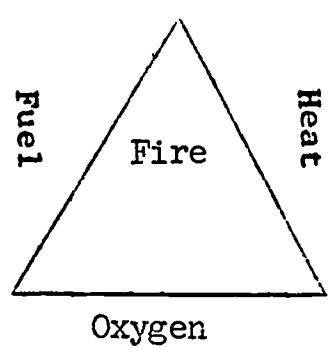
III. Introduction:

This unit can be effectively taught entirely as a classroom activity. Carburetors taken from the laboratory engines can be disassembled on classroom tables (protected by clean shop cloths) where parts can be displayed, discussed, and reassembled under the close supervision of the instructor.

Leading Questions:

1. If a spark plug were placed on the bottom of a can filled with gasoline and an electric spark is caused to arc across the gap, will the gasoline be ignited. (No!) Light a candle and note where the flame occurs.

2. What is required to cause combustion to take place? (Draw combustion triangle on board or show transparency.)



3. How is each of the factors required to generate heat supplied in an internal combustion engine?
   a) Heat -- Spark and/or heating of air from compression
   b) Fuel -- Gasoline or diesel fuel
   c) Oxygen -- Air

4. Can improper carburetor adjustment be expensive? (Yes; waste of fuel and possible damage to rings or valves.)

5. Does it make an difference in power developed by the engine whether there is a proper mixture of fuel and air? (Yes, very much so)

IV. Questions for Study and Discussion

/Teachers Note/: Allow sufficient time for students to read the following references then answer the following questions.

General Theories of Operation, p. 8
Farm Tractors FT53A, pp. 22-24

Also, allow sufficient time to discuss each question thoroughly. Do not start to disassemble carburetors until the basic principle of operation are firmly in mind.

1. What is the basic purpose of a carburetor? (Reference 1, p. 8) (Produce a mixture of fuel and air on which an engine will operate.)

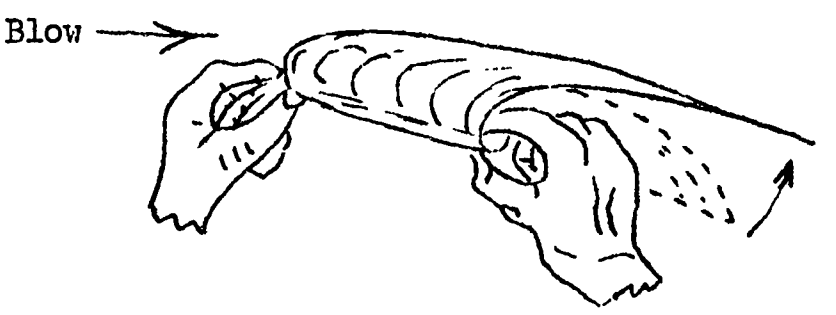
2. What are the two basic requirements of an engine that a simple carburetor such as a mixing valve cannot alone provide? (See reference 1, p. 8; a) economical fuel usage over, b) wide range of engine speeds.)

3. Why is atmospheric pressure such an important force in the operation of a carburetor? (Reference 1, p. 8 We can make it work for us because air always moves from an area of high to low pressure.)

4. What is the difference and need for an, a) airfoil and b) venturi in a carburetor? (Reference 1, pp. 8 & 9)

   a) air foil - create an area of low and high pressure

/Teachers Note/: Demonstrate an air foil by blowing over piece of tablet paper held between two fingers.



End of paper will raise because of low pressure

b) venturi - a constricted passage to speed up flow of air by increasing its velocity and force without decreasing the volume (amount) of air.

5. a) What part of the carburetor acts as an air foil? (Reference 1, p. 10; the main nozzle)
   b) Where is it located in relation to the venturi? (Reference 1, pp. 9 & 10; nozzle discharge holes are located in the smallest part of the venturi.)

6. What is the correct ratio of fuel to air for an ideal combustion mixture? (Reference 1, p. 10 and reference 2, pp. 23-25; 14-15 lbs. of air to 1 pound of fuel)

7. What are the three necessary systems of a modern carburetor that make it possible for it to perform the important functions of delivering a correct ratio of fuel and air for different engine speeds? (Reference 2, p. 12; a) idle and slow speed, b) main metering, and c) full-power)

8. What are the functions of: (reference 1, pp. 9-11)

   a) Float valve (To automatically control flow of fuel to bowl)
   b) Throttle butterfly (To regulate the flow of fuel-air mixture to engine's demands for power and speed)
   c) Idel valve (Controls flow of fuel to engine when throttle valve is nearly closed.)
   d) Choke butterfly (Create an area of low pressure in venturi and throat of carburetor for starting)

9. Why is a vent hole required in the tank cap of a gravity feed fuel system? (Reference 1, p. 9; so a vacuum won't be formed as fuel leaves tank thus retarding flow of fuel from tank.)

10. What kind of fuel supply system is required for an engine that must be used in many positions such as a chain saw engine? (Fuel bowl must be replaced with a diaphram type fuel control system which operates from a difference of fuel and atmospheric air pressure on a diaphram and that fuel tank have a special valve.)

V. Supervised Study

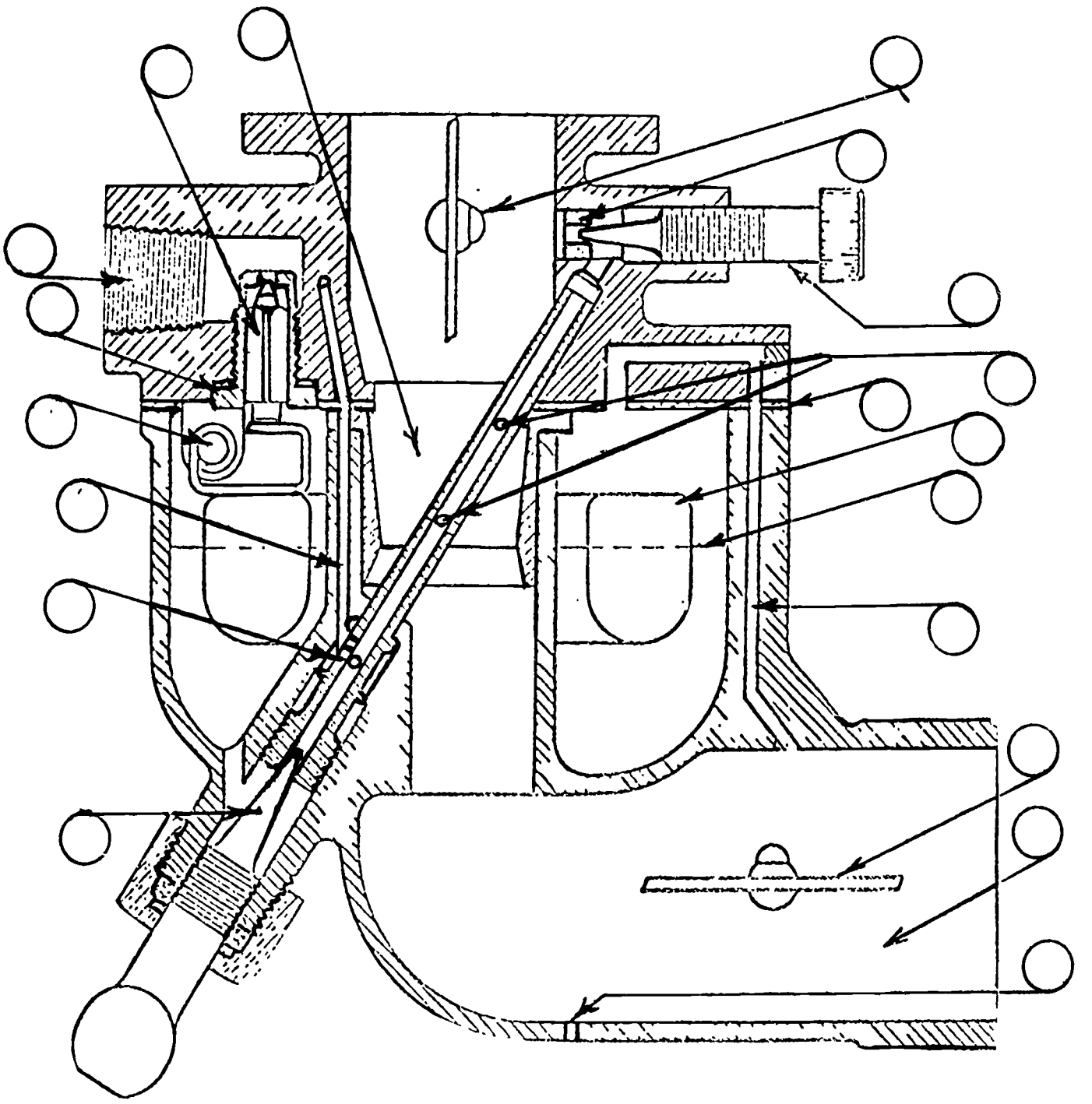
/Teachers Note/: Have students bring the float type (Flo-Jet) carburetor to the classroom and disassemble it in accordance with the procedure listed in reference 3, pages 38 and 41, and the following check-off procedure. When disassembled, have each student identify parts and systems of carburetor on the attached cross-section. While disassembled have them trace the air, fuel and air-fuel mixture through the carburetor at each of the three positions suggested on the attached handout.

A. Disassembly

Steps in Procedure	Key Points
1. Check upper body for warpage	a) See Figure 48, p. 35. b) Check at air vent boss
2. Check throttle shaft and bushing wear	a) See Figure 49, p. 37
3. Remove idle valve	a) Place on clean cloth
4. Loosen load mixture needle valve	a) ½" open-end wrench
5. Screw out pack nut and needle together	
6. Remove nozzle from body	a) Use 3/16" narrow cabinet type screwdriver
7. Remove screws holding upper and lower body	
8. Separate upper and lower bodies carefully	a) Use care to avoid damage to gasket
9. Remove float axle pin	a) Use needle nose pliers
10. Remove float and needle valve	
11. Check float for leakage or crushed	a) Shake to see if it contains gasoline
12. Remove float seat	a) Use wide blade screwdriver
13. Remove bowl gasket	a) Use care to avoid damage
14. Remove venturi	a) Take care of lower gasket

B. Identify working parts by completing the attached cross-section drawing.

BRIGGS-STRATTON CARBURETOR CROSS-SECTION
OF PARTS



1. Choker butterfly valve
2. Throttle butterfly valve
3. Idle mixture needle valve
4. Idle discharge port
5. Load mixture needle valve
6. Venturi
7. Main nozzle
8. Main nozzle discharge
9. Float
10. Float axle
11. Float needle valve
12. Float needle valve seat
13. Fuel inlet
14. Bleeder compensator
15. Bowl vent (balancer)
16. Air horn
17. Over-flow drain
18. Fuel level in bowl

C. Identify the flow of fuel, air, and fuel-air mixture through the three cross-sections according to the following operating characteristics:

1. Choke closed for starting
2. Throttle butterfly in idle position
3. Throttle butterfly in high speed full load position.

D. Reassembly and Bench Adjustment

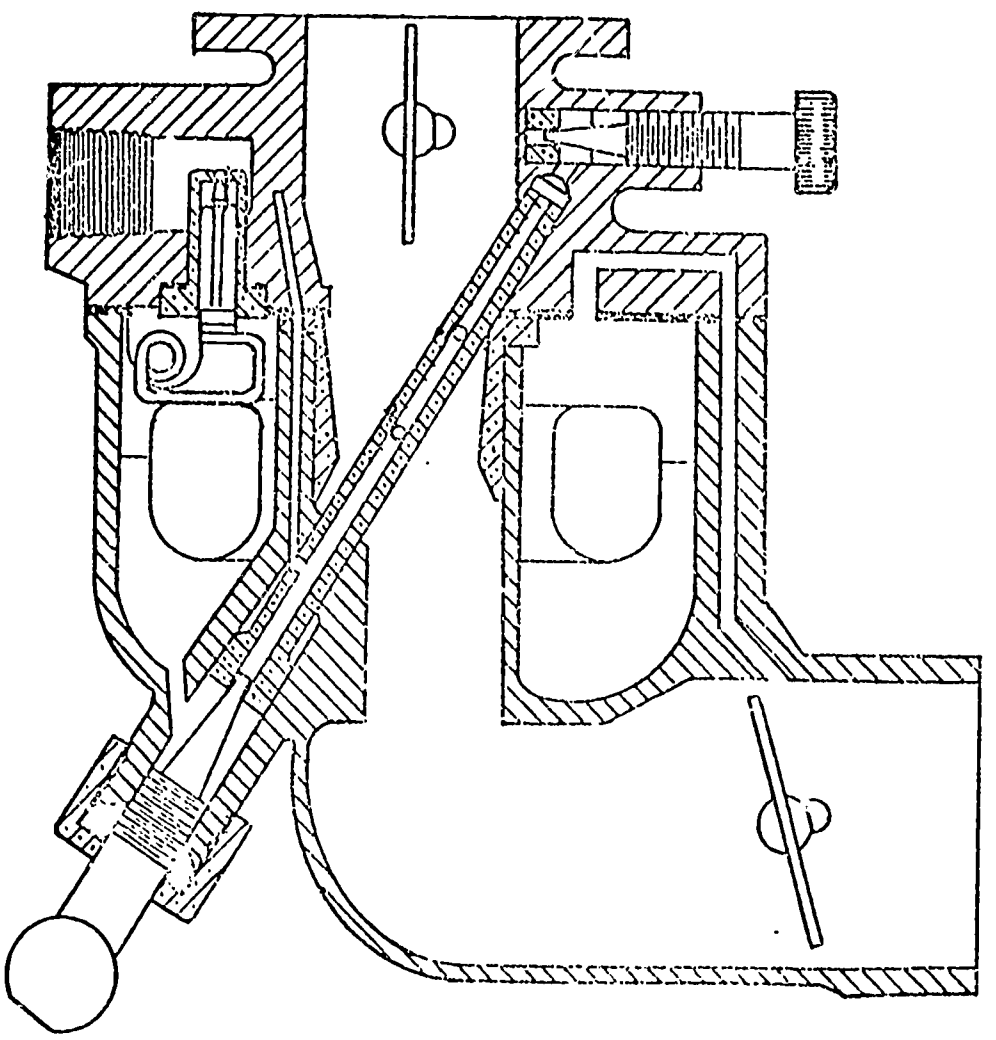
Steps in Procedure	Key Points
1. Return gasket and float seat to position	a) Have float seat gasket in place b) Tighten securely
2. Attach float needle to	a) See Figure 54, p. 40
3. Attach float axle pin	
4. Check float setting	a) See Figure 55, p. 40
5. Assemble venturi and gasket	a) Align holes in venturi and gasket
6. Fasten upper and lower bodies together with mounting screws	
7. Return nozzle to body	a) Use proper screwdriver b) Don't force c) Tighten nozzle securely
8. Screw in needle valve	a) Tighten needle against seat, very lightly.
9. Back off needle valve $1\frac{1}{2}$ turns	a) See Figure 57, p. 41
10. Install idle valve -- back off 3/4 turn	
11. Adjust idle speed adjusting screw	a) Until throttle valve just "cracked"

E. Make a brief statement on the need for the following sections of the carburetor just studied:

1. Bleeder compensator. See reference 1, p. 10 and reference 2, p. 13.

2. Bowl vent. (balancer)

C. 1) Trace flow of fuel and air through the cross-section of the float type carburetor when in the choke stage of operation. Use a blue colored pencil and indicate where only air would be present. Use a red colored pencil to show presence of fuel only. Where there is a mixture of fuel and air use dashed ---- alternate red and blue colors.



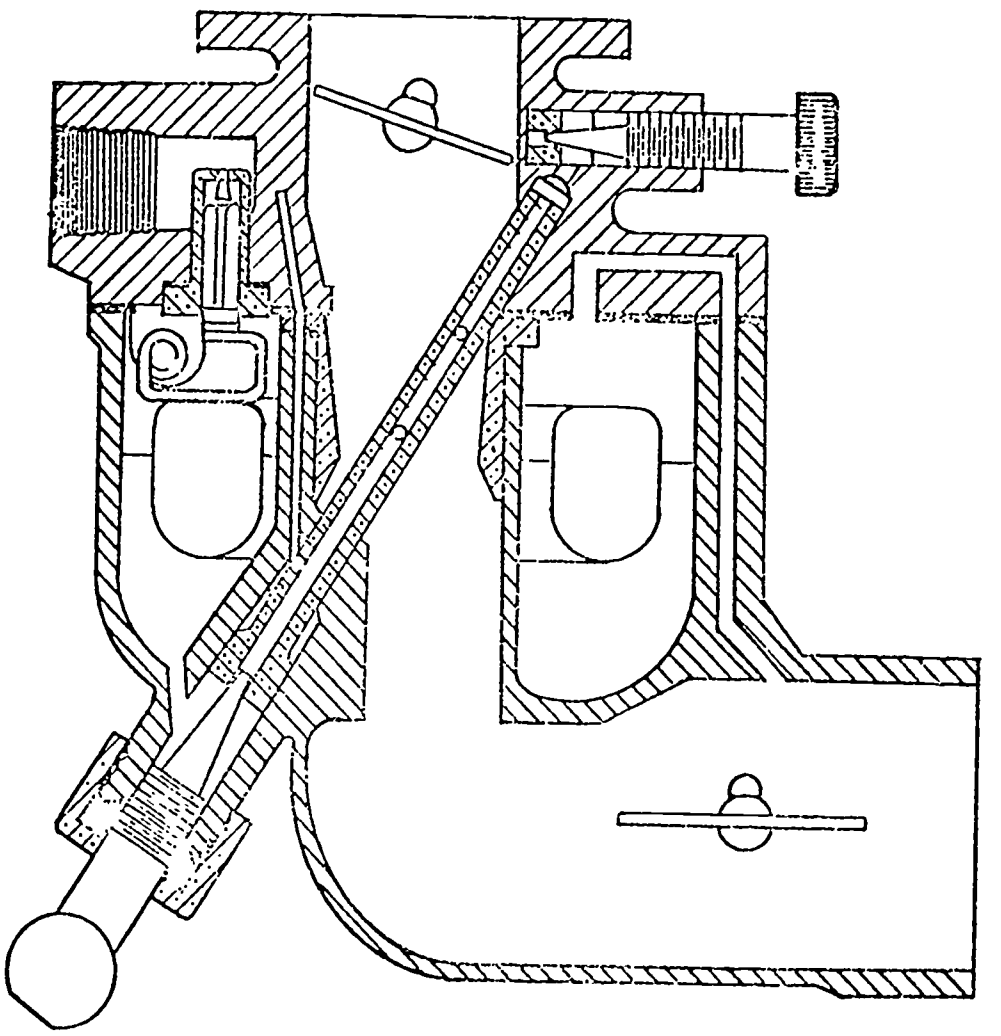
CHOKE SYSTEM

Red Color = Fuel

Blue Color = Air

Red & Blue = Fuel-Air Mixture

C. 2) Trace flow of fuel and air through the cross-section of the float type carburetor when in the idle stage of operation. Use a blue colored pencil and indicate where only air would be present. Use a red colored pencil to show presence of fuel only. Where there is a mixture of fuel and air use dashed ---- alternate red and blue colors.



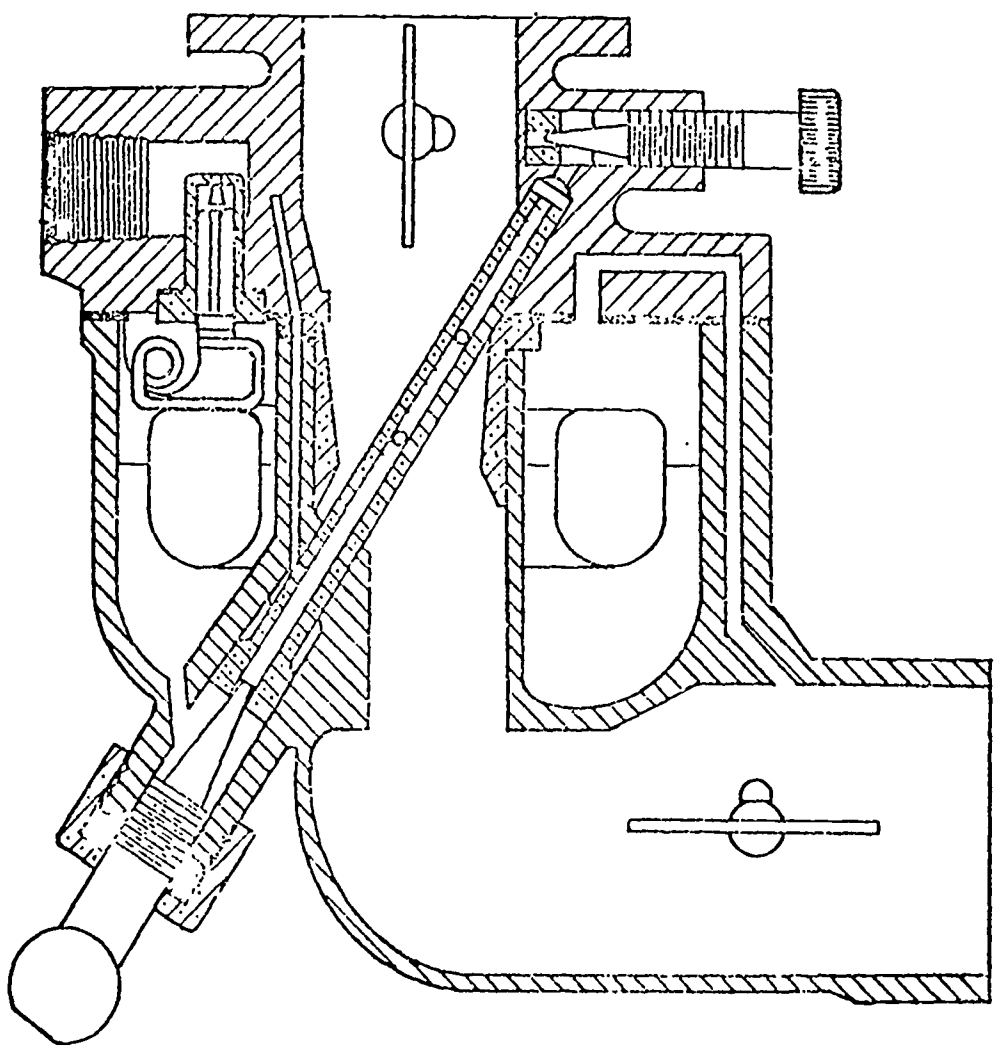
IDLE SYSTEM

Red Color = Fuel

Blue Color = Air

Red & Blue = Fuel-Air Mixture

C. 3) Trace flow of fuel and air through the cross-section of the float type carburetor when in the full load or full throttle stage of operation. Use a blue colored pencil and indicate where only air would be present. Use a red color pencil to show presence of fuel only. Where there is a mixture of fuel and air use dashed ---- alternate red and blue colors.



FULL LOAD SYSTEM

Red Color = Fuel

Blue Color = Air

Red & Blue = Fuel-Air Mixture

F. Why should the bowl gasket be kept in good condition? (reference 2, p. 18)

G. Reidentify where to make the following adjustments on the float carburetor:

1. Idle speed
2. Idle mixture
3. Load mixture

H. Read carefully pages 16 and 17, reference 2 regarding the importance and method of tractor carburetor adjustment and relate this to the carburetor.

I. Examine the cross-section drawing of the following diaphram carburetor and identify the diaphram and how it functions. Why does this type carburetor permit the engine to be tilted in a more extreme position than a float type.

VI. Review

Stress importance of understanding carburetor operation and the close relation of the small engine carburetor to the farm tractor type. Review how efficiently a tractor engine will operate depends upon correct carburetor setting.

VII. References

1. General Theories of Operation, Briggs-Stratton Company, pp. 8-14.

2. Farm Tractors, FT53A, American Oil Company, pp. 10-14; pp. 22-24.

3. Repair Instruction III, Briggs-Stratton Company, pp. 38-41.

UNIT TEST

Circle T if the statement is true, and F if the statement is false.

T F 1. To cause combustion to take place fuel, heat, and oxygen are required.

T F 2. Improper carburetor adjustment can be expensive.

T F 3. A proper mixture of fuel and air is essential for developing maximum power in an engine.

T F 4. We can make atmospheric pressure work for us in the operation of a carburetor because air always moves from an area of low pressure to an area of high pressure.

T F 5. The correct ratio of fuel to air for an ideal combustion mixture is 18-20 lbs. of air to one pound of fuel.

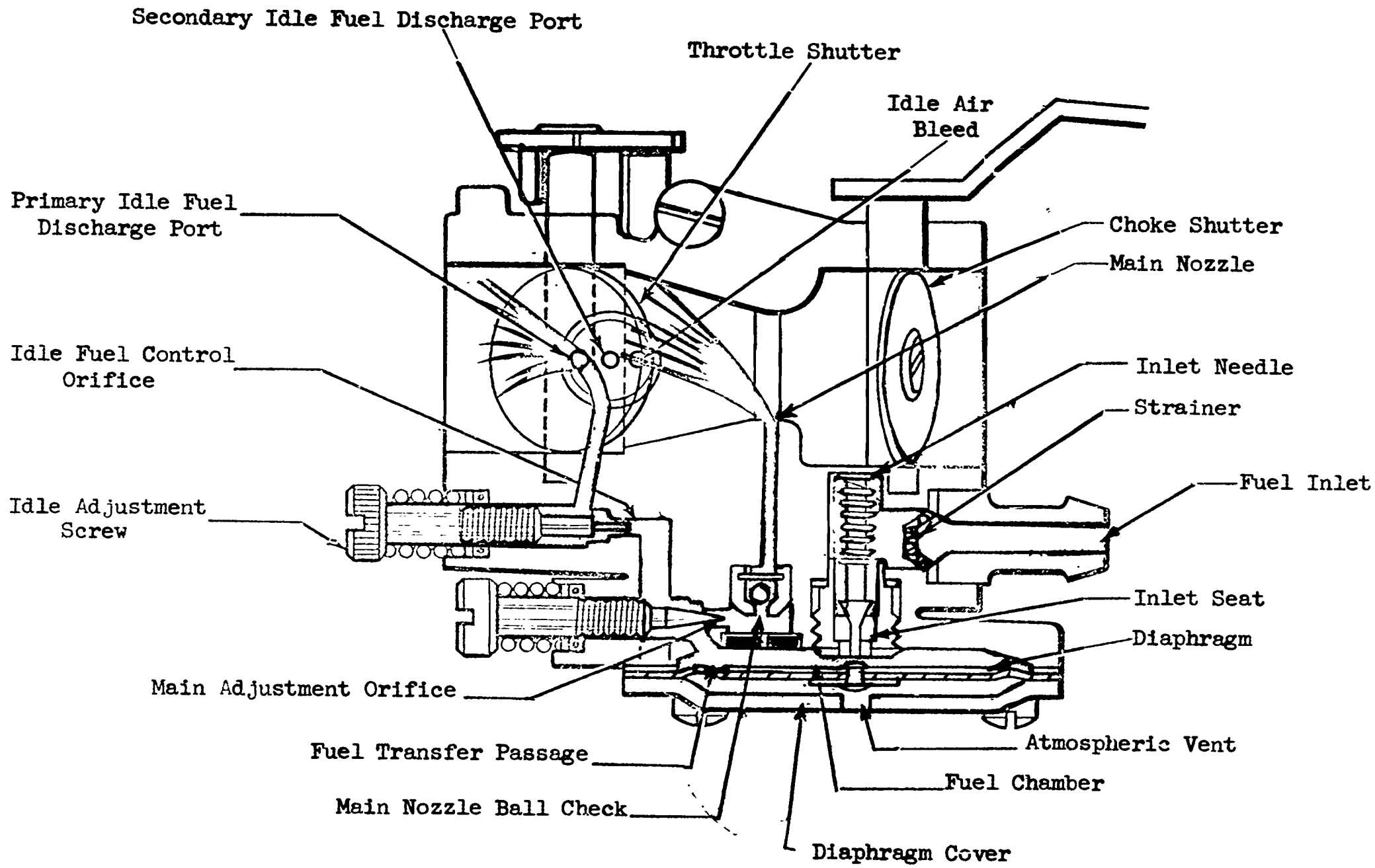
T F 6. The function of the choke butterfly is to create an area of low pressure in the venturi and throat of the carburetor for starting.

T F 7. The load mixture needle could possibly be bent or broken if it is not removed from the carburetor before the bodies of the carburetor are separated.

T F 8. For an engine that may be in many positions, the fuel bowl must be replaced by a diaphram type fuel control system.

T F 9. The operation of a carburetor on a small engine is entirely different from the operation of a carburetor on a tractor engine.

T F 10. The average tractor owner wastes about 10% of his fuel each year because the carburetor on his tractor is improperly adjusted.



Courtesy of
Tecumseh Products Company

I. Teaching Unit No. VI: Principles of Magneto Ignition

II. Objectives:

1. To discover the basic principles of electromagnetic induction as it relates to magneto ignition.

2. To identify the basic operating parts required of a magneto.

3. To be able to check the ignition, condensor, and coil.

4. To be able to adjust breaker points and armature air gap.

III. Introduction:

The previous lesson on the fuel system gave emphasis that some source of heat is needed to raise the combustion temperature of a fuel to the ignition temperature. The function of an engine's electric spark ignition system is to raise the temperature of the fuel in the immediate area of the spark plug electrodes to a temperature which will cause burning. In addition, the exact timing of the burning action must be such that high pressure will develop in the cylinder or after TDC for best power.

Leading Questions:

1. If a two-cycle chain saw engine runs at 5000 revolutions per minute, how many times a minute must the spark plug fire? (5000 times)

2. Does a chain saw or small engine require a battery like the one in an automobile or tractor? (No)

3. If it doesn't have a battery, how is the engine capable of getting an electric spark? (Magneto)

4. What kind of a spark does an engine require? ("Hot", high voltage - 10,000 or more volts.)

IV. Questions for Study and Discussion

/Student preparation/: Assign readings, reference 1, pp. 15-18 and reference 2, pp. 41-43.

/Teachers Note/: Use Briggs-Stratton Training Charts

1. What are two common types of ignition systems in use on carburetor-type engines? (Reference 2, p. 41; a) magneto and b) battery)

2. What is the principle difference between the two systems? (Reference 2, p. 41; source of electric energy -- rotation of permanent magneto v/s chemical action of battery.)

3. How can a magnet produce electric current?

/Teachers Note/: Place horseshoe magnet on overhead projector and cover with glass. Sprinkle iron filings on glass to show magnetic field. Stress key points:

A. Invisible lines of magnetic force around a magnet is called a magnetic field.

B. A magnetic field is not affected by insulating materials. (point out glass is a good insulator.)

C. Manetic field may be called magentic "flux". Change of flux occurs when lines of force change directions of N and S.

4. How is a flow of electric current produced?

/Teachers Note/: Cut lines of force (iron filing) on overhead projector by moving a pencil through center of magnet. (Stress key points)

A. If lines of force are cut by a conductor <u>a flow of electric current</u> is produced in the conductor.

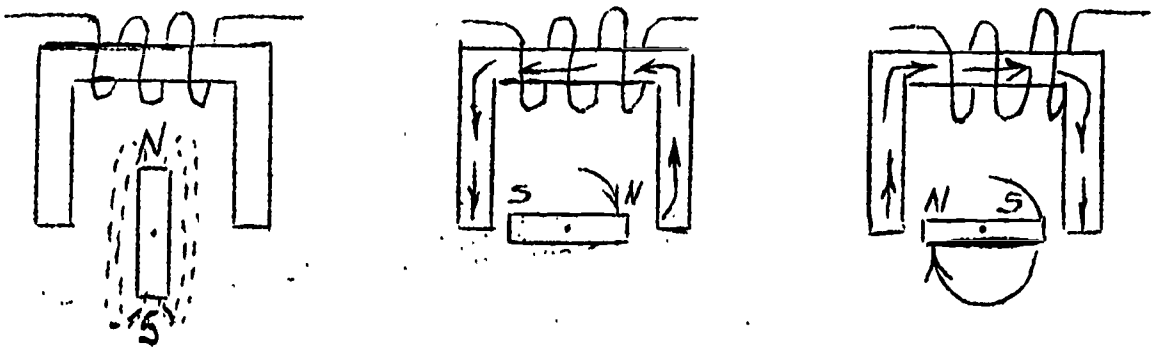
B. The electric current force developed is proportional to the number of conductor which "cut" the magnetic field and the speed of conductor or flux movement.

C. The amount of electric current developed depends upon:

1) Field strength of permanent magnets
2) Speed by which flux cuts conductors
3) Area of conductor.

5. What device within a magneto "cuts" the lines of force? (The coil)

6. How can lines of force be cut by a coil if it is stationary? (The flux is caused to move -- Show following)



7. What terms are used to describe the process of electric current being produced by magnetic lines of force? (Electro-Magnetic Induction)

8. What types of "induced" current is there in a magneto?
   (a) Self-induction - induction due to each conductor creating its own magnetic field which cuts adjacent conductors. When abruptly halted, (points opening) much self-induction results from collapse of field.
   (b) Mutual-induction - results when a separate but intimate conductor is placed in the magnetic field of the primary coil such that when the primary circuit is rapidly broken, the primary field "cuts" through the secondary coil.

9. What are the two circuits which comprise a high voltage ignition system? (Reference 1, p. 15; a) primary and b) secondary circuits)

10. What are basic parts of each circuit which constitute a complete magneto? (Reference 1, p. 15 - figure 26)

    A. Primary Circuit

       1) Magnets, permanent
       2) Armature, temporary magnets
       3) Coil, primary, self-induction
       4) Condensor
       5) Breaker points
       6) Cam and plunger
       7) Frame of engine (ground for circuit)

    B. Secondary Circuit

       1) Secondary coil (mutual induction)
       2) High voltage conductor (ignition cable)
       3) Spark plug

-Instructor's Notes-

A. Coil and Condensor Testing with Electric Test Instruments

The purpose of this discussion is to explain the objectives and electrical terms associated with magneto coil and condensor testing using test instruments.

1. Coil Tests

After the fly wheel and breaker pointcover have been removed the crankshaft can be rotated to open the breaker points. The coil tester is then connected into the primary circuit of the coil via the insulated point and a ground. The heavy secondary lead of the tester is then attached to the secondary since most testers check secondary output over a 5 mm gap.

a. Secondary output - most testers check the minimum input amperes to the coil to cause a spark to jump the 5 mm gap. This amperage is then compared to manufacturers standards. If the coil fails this test, repeat by attaching the secondary lead to the coil output tap since the ignition cable may be faulty or grounded at some way, point, insulator crack, moisture, or broken wire.

b. Probe tests - are severe coil tests and should be performed only when an absolute guarantee is required that the coil or lead will not leak.

c. Secondary coil continuity - an important test since a broken wire in the secondary or loose wire at the clip may allow the coil to pass the firing test by arcing internally. Under heavy engine load the engine may misfire. Continuity check would pick this up.

d. Primary coil continuity - same purpose as above - normally, a coil has a bad primary would have failed the firing test. An unsatisfactory test may be due to a broken wire, grounded wire or circuit at some point, insulation broken. Wiggle wires when making this test.

2. Condensor Tests

a. Capacitance (capacity expressed in microfarads)
Capacity of a condensor may be compared with the cubic capacity of a tank which depends upon its height and area. Capacityof a condensor is dependent upon the surface area and the spacing of condensor plates. Condensors for spark

ignition systems are selected upon their capacity to absorb current flow during the time the points are beginning to open. A condensor with over capacity will cause weak spark output while one with insufficient capacitance will cause excessive breaker point arcing.

b. Leakage
This test checks the quality of insulation between the condensor foils or plates. Most small engine magnetos have an allowable 2 meg ohm of leakage. Leakage may contribute to hard starting a warm engine or ignition failute after warmed up. This may be caused by a condensor that has expanded during heating. A condensor that checks OK at room temperature should be rechecked at 100-110°F. Heat condensors slowly -- matches and torches will ruin them. Leakage tests can be conducted by "loading" the condensor with an external source of current such as from the tests points of a growler. If the condensor will snap and show a blue fire when the lead is brought close to the case it does not have leakage problems.

c. Series resistance - as the name implies, this is a test of resistance in series with lead and case. It is used to pick out a bad lead, or a bad connection of lead to foil. It is a good idea to wiggle the lead to see what effect it has on the test.

3. Coil and Ignition Wiring Tests with 6-Volt Lantern Battery

With the fly wheel and breaker point cover removed one lead of a 6-volt lantern battery can be attached to the engine frame. With the breaker points open touch the insulated breaker point with the other battery lead. If the high intensity spark occurs at the plug when you remove the lead from the points, it indicates the primary and secondary circuit is functioning properly.

If no spark occurs or if it is weak, suspect trouble in the primary circuit by being grounded or having leakage at some point. Suspect a defective coil or condensor only when a process of elimination fails to detect defective circuits.

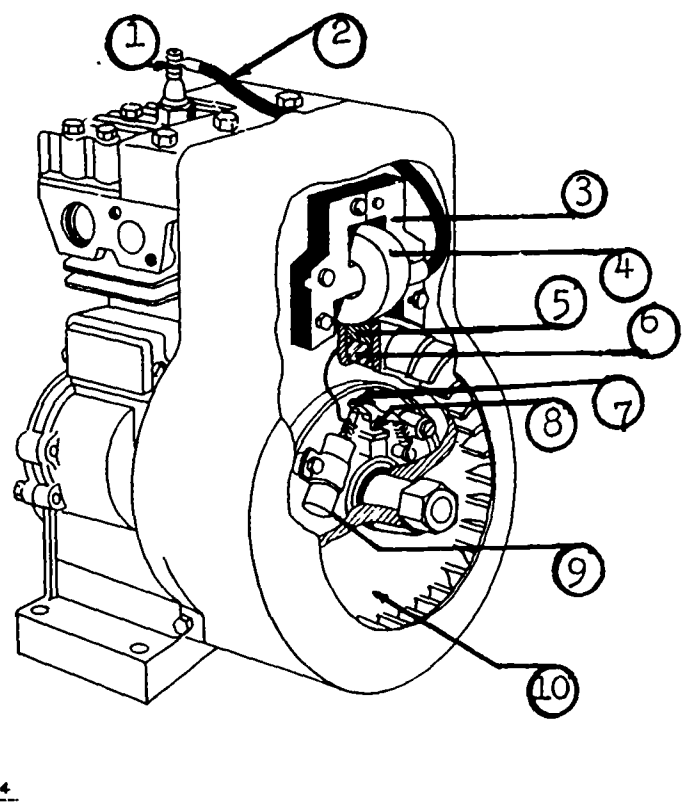
V. Supervised Study

A. Study of Parts

1. Remove fly wheel from laboratory engine.

2. Remove dust cover from ignition points.

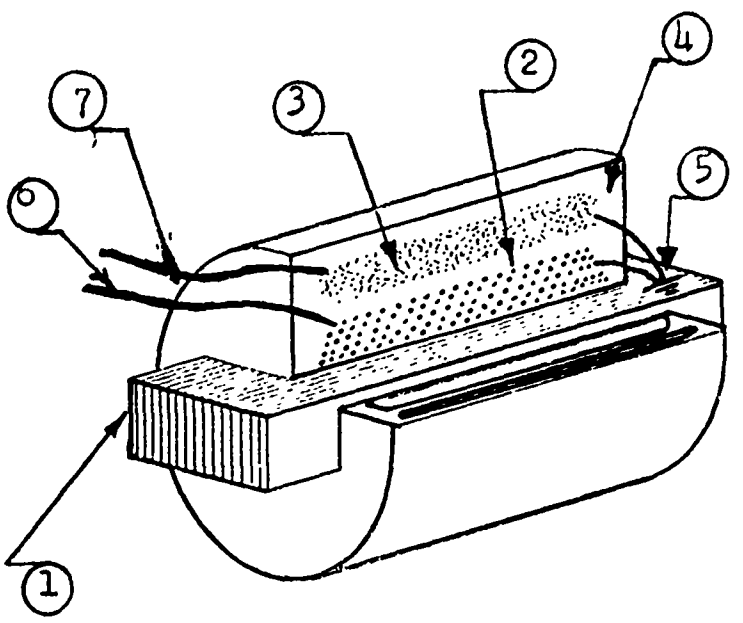
3. Compare and identify actual parts of the ignition system with the following drawing: (Reference 1, p. 15 and Reference 3, p. 13)



Courtesy of Briggs-Stratton Corporation

1.	Spark Plug	6.	Magnet
2.	Ignition Cable	7.	Points
3.	Armature	8.	Plunger
4.	Coil	9.	Condensor
5.	Pole Piece	10.	Flywheel

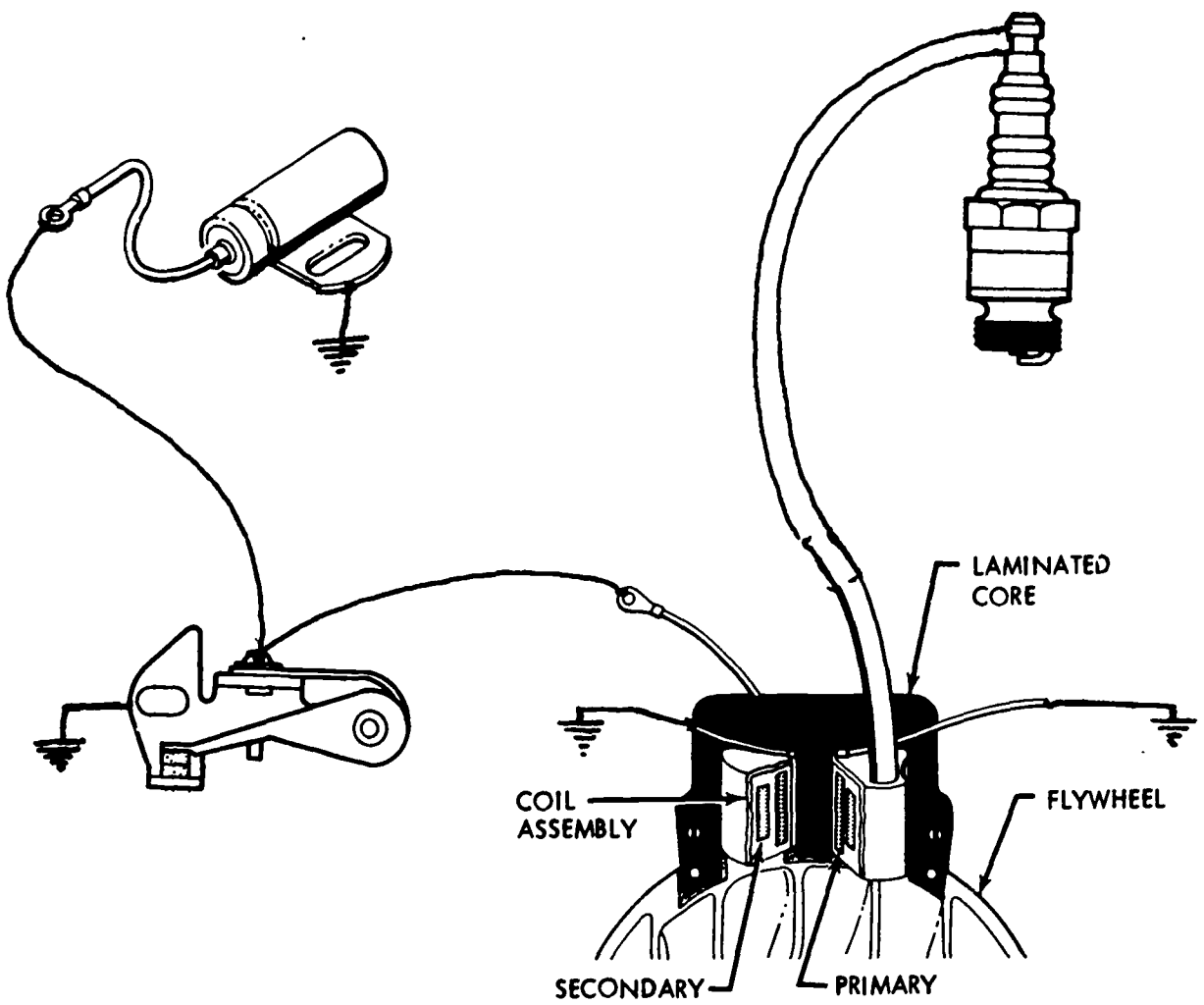
4. Identify the following parts of a magneto ignition coil by completing the chart below the drawing. (Reference 1, p. 16)



Courtesy of The Kohler Company

Part No.	Name of Part	Characteristics and/or Function
1	Iron Laminated Core	Efficient carrier of magnetic field
2	Primary winding	Few hundred turns (35 ft.) of relatively heavy wire
3	Secondary winding	Few thousand turns (2/3 mile) of very fine wire
4	Insulation	Protects winding from moisture
5	Ground	Common ground for primary and secondary
6	Primary lead	Low voltage (170 volts) conductor
7	Secondary lead	High voltage (10,000 volts conductor

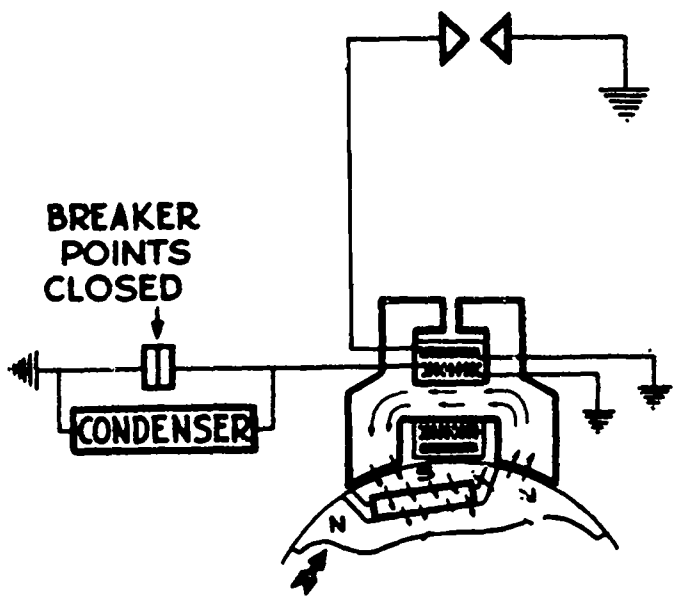
5. Using blue and red pencils, complete the circuit for the following drawing:
(Blue color = primary circuit; Red color = secondary)
Reference 1, p. 16.



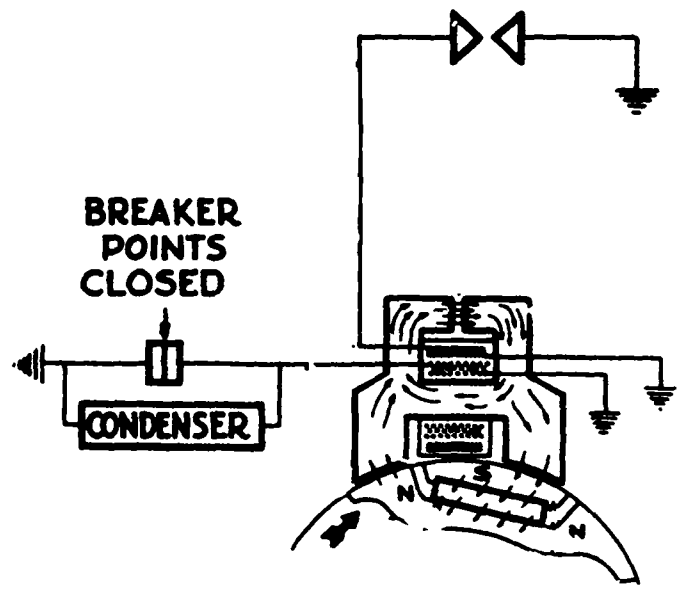
Courtesy of McCulluch Corporation

6. Under each of the following drawings describe the action that is taking place in the operation of a magneto to produce a spark. (Reference 1, p. 16)

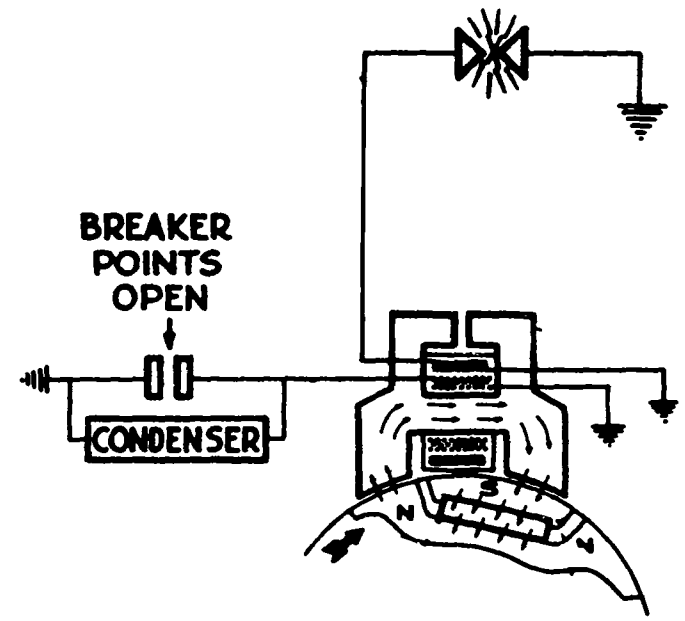
Courtesy of Briggs-Stratton Corporation



Stage I



Stage 2



Stage 3 and
"Spark"

B. Study Questions

1. a) What is the function of a condensor? (Reference 1, p. 17)

   A safety valve to produce strong spark by preventing arcing at points.

   b) What unit of measure is used to express capacity of a condensor? (Reference 1, p. 17)

   Microfarads

   c) Inspect figure 104, reference 2, p. 44; what is the effect on contact points of over or under capacity condensor?

   Over capacity - stationary point will pit
   Under capacity - breaker arm point will pit

2. What determines ignition timing of engine in a flywheel magneto? Why? (Reference 3, p. 15)

   Opening of breaker points - because primary circuit is broken causing induced secondary current.

3. a) What is meant by "armature air gap"? (Ref. 3, p. 18)

   Gap between face of armature poles and edge of flywheel.

   b) How is air gap adjusted for this engine? (Ref. 3, p. 18)

   By moving armature up or down on its mounting.

   c) Proceed to adjust the air gap.

4. a) How can the magneto be tested for output? (Ref. 3, p. 18)

   Remove spark plug and spin flywheel rapidly observing for spark across a .166" tester gap.

   b) What damage could be done to the ignition system if an engine is stopped by pulling the ignition cable from the spark plug? (Reference 1, p. 18)

   Damage to coil by ruining insulation.

   c) Check ignition output.

5. What effect would a partly sheared flywheel have on internal timing of the magneto itself? (Reference 1, p. 13) Why?

   Cause hard starting or even failure because the flywheel is out of time.

6. If a tractor engine having four or more cylinders is equipped with magneto ignition, what type magneto would be used? (Reference 2, p. 41)
   Rotating magnet

7. Follow the procedures in Reference 3, pp. 16 & 17, remove the condensor breaker points and armature from the engine. Be especially careful to avoid losing parts.

8. Check condensor and coil with testers and record the following:

a) Condensor --

Capacity _____ mfd.
Series resistance _____
Leakage _____

b) Coil --

Secondary output _____
Secondary continuity _____
Primary continuity _____

VI. Review

VII. References

1. General Theories of Operation, Briggs-Stratton Company.

2. Farm Tractors, FT53-A, American Oil Company

3. Repair Instruction III, Briggs-Stratton Company, pp. 14-18.

UNIT TEST

Circle T if the statement is true, and F if the statement is false.

T F 1. A flywheel magneto produces a spark at the spark plug every revolution of the crankshaft.

T F 2. Ignition must occur before the piston reaches top dead center (TDC) to obtain greatest efficiency.

T F 3. The principle purpose of the breaker points is to cause a controlled interruption of current flow in the primary circuit.

T F 4. The magneto ignition system relies on the chemical action of its battery to generate an electric spark.

T F 5. The ignition coil is primarily the source of electric energy for spark production.

T F 6. It is the primary electric circuit in the ignition system which is directly connected to the spark plug.

T F 7. A condensor when located in the secondary circuit of a magneto system will cause a more intensive spark at the spark plug.

T F 8. The condensor acts or functions in the capacity of an electrical shock absorber.

T F 9. Repeated stopping of an airecooled engine by pulling the ignition wire from the spark plug could result in early failure of the engine coil.

T F 10. The "time" (timing) of ignition at the plug is controlled by the closing of the breaker points.

I. Teaching Unit No. VII: Understanding Spark Plugs

II. Objectives:

1. To discover basic function and operation of spark plug.

2. To identify engine operating characteristics from visual inspection of firing end of spark plug.

3. To be able to service spark plugs.

III. Introduction:

Poor spark plug performance contributes to poor engine performance by a) loss of power and b) increase fuel consumption. Spark plug designs are many and varies. Selection of the wrong spark plug can result in serious engine damage due to pre-ignition.

Leading Questions:

1. How is it possible that installing new spark plugs in a car or tractor engine might pay for themselves? (More miles per gallon or more acres plowed per gallon)

2. How do you know when spark plugs need replacing? (Increased power and economy)

3. Spark plugs look about the same - are there differences?

IV. Supervised Study

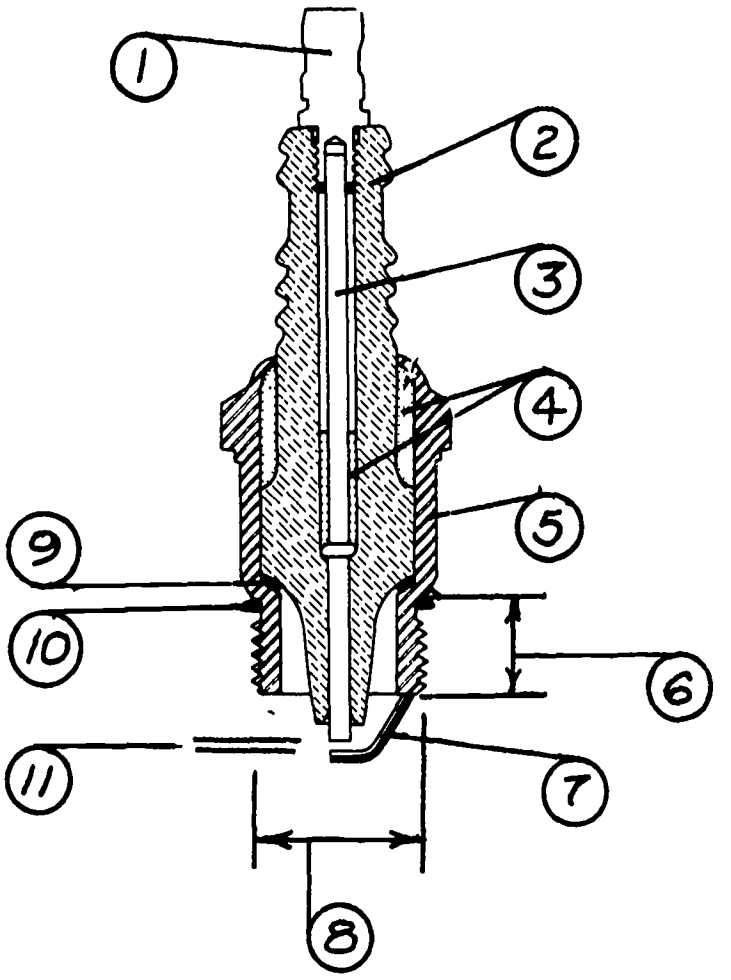
/Student preparation/: Assign reading in reference 2, pp. 48-50.

1. Identify the parts of the following spark plug cross-section. (Reference 2, figure 115, p. 48) See following page.

V. Questions to be Answered

1. What are three basic types of spark plugs? (Reference 2, pp. 48-49, figure 115 & 118; a) standard, b) spark gap, and c) resistor)

2. What is meant by the "heat range" of a spark plug? (Reference 2, p. 50; Operating temperature of the firing chamber end of insulator)



1. _____ (Terminal)
2. _____ (Insulator)
3. _____ (Center Electrode)
4. _____ (Seal)
5. _____ (Shell)
6. _____ (Reach)
7. _____ (Ground Electrode)
8. _____ (Thread Diameter)
9. _____ (Inside Seal)
10. _____ (Gasket)
11. _____ (Electrode Gap)

3. How hot or cold should a spark plug operate? (Reference 2, p. 50; hot enough to prevent fouling; cold enough to avoid pre-ignition (about 1600°F)

4. How can you tell if a spark plug is the right heat range for an engine? (Reference 2, p. 49; by color and cleanliness of firing end; grey-brown)

5. What could cause the following spark plug failures: (Reference 2, p. 49)

   a) Oil fouling
   b) Gas fouling
   c) Burned electrode.

6. How is the "gap" of a spark plug set? (Reference 2, p. 48; use wire gauge and bend only the side electrode.)

7. When is a spark plug correctly installed? (Reference 2, p. 50; a) threads cleaned, b) gasket properly compressed, and c) correct gap setting)

8. How are sizes of spark plugs designated? (By mm diameter of threads)

9. Why is it necessary to clean dirt from around spark plug base before removing plug? (Dirt may fall in cylinder)

V. Class Activity

1. Cleaning, checking, and setting spark plugs.
2. Inspect and grade student work.

Steps in Procedure	Key Points
1. Remove spark plug	a) Clean dirt from around seat b) Correct wrench and procedure
2. Degrease plug	a) Clean insulator and threads b) Air blast dry
3. Clean spark plug	a) Scrape end with penknife b) Wire brush threads
4. Inspection	a) Check for cracked insulator
5. Adjust gap	a) Bend ground electrode b) Use wire gauge (.030")

VI. Reference

1. Farm Tractors, FT53A, American Oil Company.

UNIT TEST

Circle T if the statement is true, and F if the statement is false.

T F 1. A "spark gap" type spark plug is used when standard spark plugs foul and fail to perform.

T F 2. Heat range of a spark plug refers to the operating temperature of the spark plug insulator and not the engine.

T F 3. The best method for determining the proper heat range spark plug to use for an engine is to measure temperature of the plug during operation.

T F 4. A spark plug "gap" setting is adjusted by bending only the side or ground electrode.

T F 5. It is always best to use a wire electrode gauge to check spark plug gap settings.

T F 6. It is always necessary to clean the dirt from around a spark plug base before it is removed to prevent foreign matter from falling into the cylinder.

T F 7. The best rule of thumb for proper tightness of spark plugs is to use a wrench with a six inch handle and pull until snug.

I. Teaching Unit No. VIII: Taking Accurate Measurements with the Micrometer Caliper

II. Objectives:

1. To know how to properly handle a micrometer.

2. To discover how to read the micrometer.

III. Introduction:

Measurement tolerances which are used in engine construction require that if one is to effectively learn repair techniques it is necessary to know how to accurately read and use the micrometer.

Leading Questions:

1. What kind of measuring tool would you use to measure:

   a) Thickness of a sheet of tablet paper?
   b) Diameter of a hair? (Micrometer)

2. Why should we want to know how to take measurement with a micrometer when working with engines? (Bearing and working clearances are in thousandths of an inch and require the use of a micrometer.)

IV. Supervised Study

Reference reading assignment:
How to Read, Use, Care for Micrometers and Vernier Gages; pp. 2-3; 7.

1. Identify the numbered parts of the following drawing of a micrometer: (See the following page)

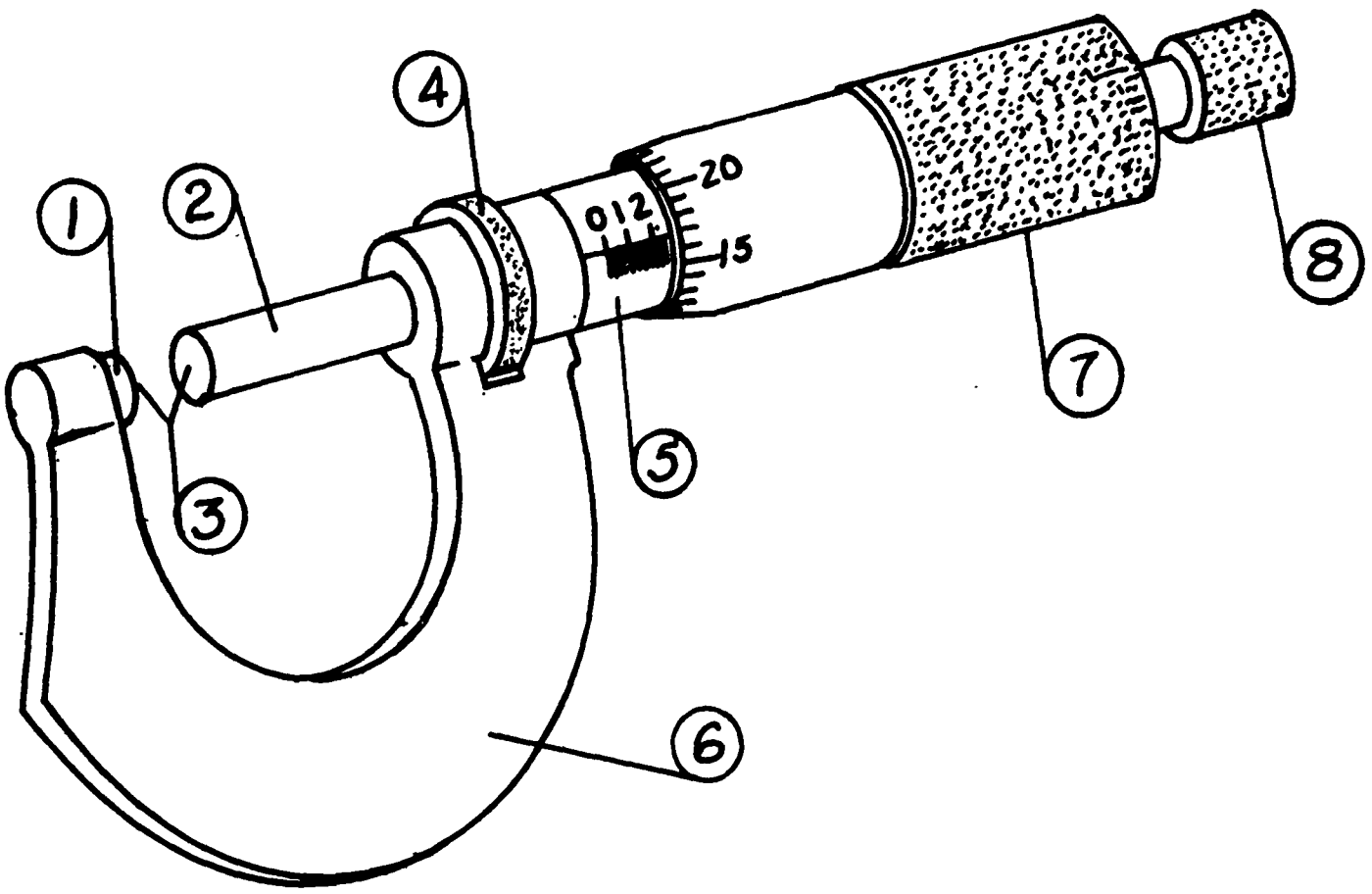
2. Identify the graduations of an inch found on the:

   a) Sleeve (Hundredths)
   b) Thimble (Thousandths)

3. The number of threads per inch found on the screw threads of a micrometer is 40. If the thimble is turned one revolution it will advance the spindle 1/40 of an inch or .025 thousandths of an inch.

4. Since the spindle of themicrometer is limited to a travel of one inch, the frame of the "mike" is made in sizes which can accomodate a range of diameters in increment of one inch.

Micrometer

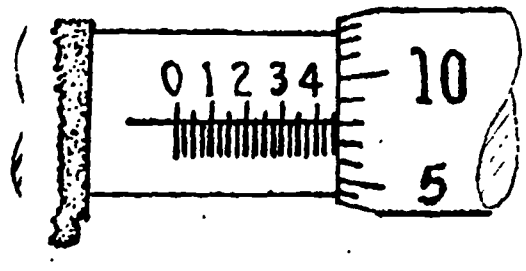


1. Anvil
2. Spindle
3. Contact faces
4. Spindle lock
5. Sleeve
6. Frame
7. Thimble
8. Ratchet

5. Using the following example determine the micrometer reading in problem (1) and (2):

Example

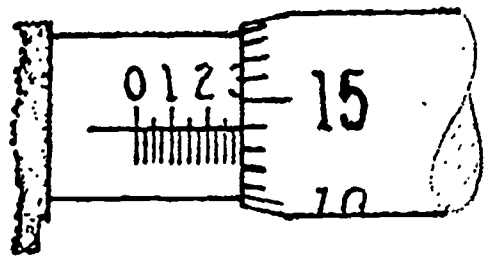
1. This is an 0-1 Micrometer ------0.000
2. The highest visible number ----- .400
3. The lines show after No. 4 ----- .050
4. Eight lines show on thimble ---- .008
5. Total ----------0.458



Frame size 0 - 1"

Problem No. (1)

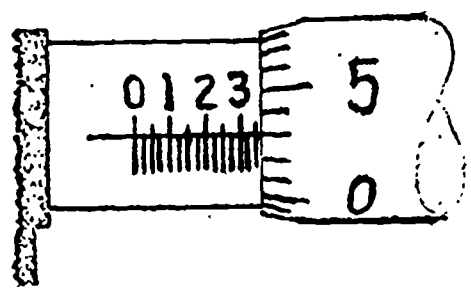
1. 1" - 2" Micrometer ----------1.000
2. Highest visible number --------- .200
3. Lines showing after no. -------- .075
4. Lines showing on thimble ------- .014
5. Total ----------1.289



Frame size 1" - 2"

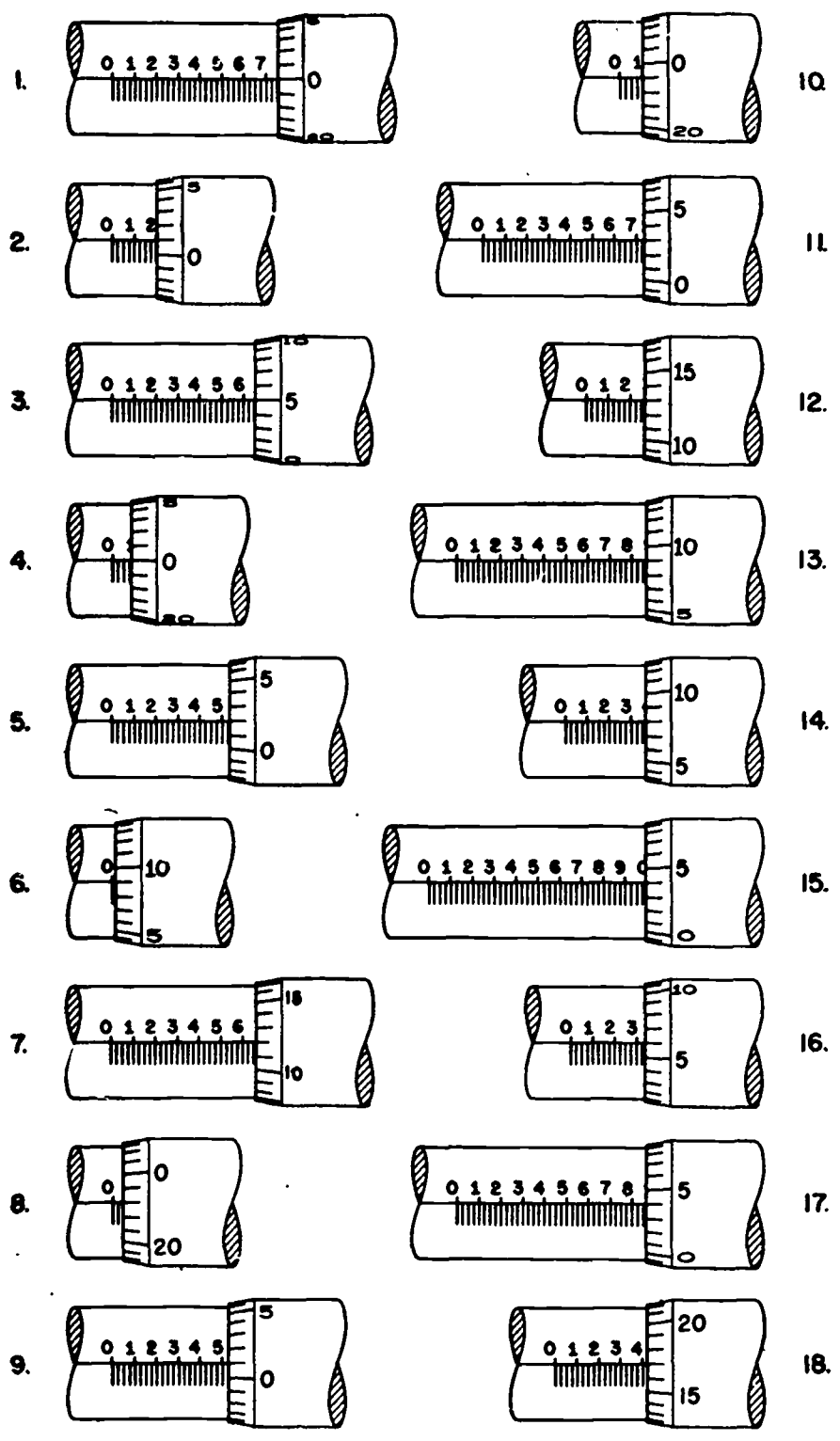
Problem No. (2)

2.000
.300
.050
.004
2.354



Frame size 2" - 3"

6. Determine the micrometer readings of the following problems:



(1) 0.750

(2) 0.201

(3) 0.655

(4) 0.075

(5) 0.527

(6) 0.009

(7) 0.662

(8) 0.048

(9) 0.526

(10) 0.099

(11) 0.728

(12) 0.263

(13) 0.859

(14) 0.358

(15) 0.979

(16) 0.331

(17) 0.854

(18) 0.417

Courtesy of Missouri State Department of Vocational Education

7. a) How should the micrometer be held? (Reference 1, p. 7)
   b) How much tension should be placed on the spindle when taking a reading? (Reference 1, p. 7)
   c) What adjustments can be made to a micrometer? (Reference 1, p. 7)

Notes on Care of the Micrometer

1. Apply the micrometer to the work carefully so as not to damage the measuring faces. The same applies when removing it from the work after the measurement has been taken.

2. Keep it clean. Wipe it down with an oily cloth to prevent rust and tarnish. A drop of light oil on the screw thread will keep it operating smoothly.

3. Do not spring micrometers frames by applying too much pressure on thimble. This tool is not a "C" clamp.

4. Clean the measuring face surfaces by lightly closing on a piece of paper and drawing paper out.

5. Check for accuracy of measurement by closing spindle to anvil on 0"-1" size or using setting gauge for larger sizes, and noting whether the zero line on the thimble coincides with zero line on sleeve. Where necessary make adjustments by following manufacturer's recommendations.

6. Place micrometers in a space where they will not fall to the floor or where other tools will be placed on them.

7. To open the spindle considerable distance, roll the thimble on the palm of the hand -- do not "twirl" frame.

8. Store a micrometer in a protective cabinet.

V. References

1. How to Read, Use, Care for Micrometers and Vernier Gages, L. S. Starrett Company.

UNIT TEST

Circle T if the statement is true, and F if the statement is false.

T F 1. Micrometers are sensitive enough to measure the diameter of a human hair.

T F 2. Bearing and working clearances are in tenths of an inch and therefore require the use of a micrometer.

T F 3. The graduations of an inch found on the sleeve of the micrometer are in tenths.

T F 4. If the thimble of the micrometer is turned one revolution it will advance the spindle 1/40 of an inch.

T F 5. The micrometer can serve a dual purpose as a "C" clamp on small projects.

T F 6. For measurement of a piece of work place it on the spindle and turn the thimble until it reaches the anvil.

T F 7. The thimble of the micrometer should be held between the thumb and forefinger with the frame in the palm of the hand.

T F 8. The faces of a micrometer are easily damaged if not correctly applied to the work.

T F 9. When using the micrometer light contact pressure on the work assures correct reading.

T F 10. For measuring diameters of cylinders, setting calipers and comparing gages the length of the inside micrometer must be added to the reading obtained.

I. Teaching Unit No. IX: Use of Torque Wrench

II. Objectives:

1. To discover how to properly handle and use torque wrench.

2. To be able to convert inch pounds to foot pounds.

3. To identify resistance torque and set or seizure torque.

4. To select proper torque settings or requirements.

III. Introduction:

/Teachers Informational Note/:

Without limits on torque applied to important structural threaded engine parts, either the parts would not be tightened enough to provide rigid joints or if too tightly torqued the parts would be overstressed. If an engine, unequal tension could result in distortion of basic parts. This can be demonstrated by suspending an inside micrometer in the cylinder bore of a cast iron engine of reasonable size supported entirely by friction against the cylinder wall. Then by squeezing the side walls of the block together with hand pressure show how the block can be stressed out-of-round by hand pressure since the micrometer will fall out of the cylinder. Point out that the cylinder bores and valve ports can be distorted out of shape due to uneven or excessive stress.

Also, fatigue life of parts is indirectly proportional to the percentage the threaded fasteners (bolt or screw) changes in load (tension) during service. The less percentage change the longer the fatigue life. Therefore, the higher the initial tension applied during lightening (torque) operations the longer will be its fatigue life.

This can be demonstrated by a rubber band. Any pull on a rubber band causes a stretch proportional to the amount of pull-up to the elastic limit (when it will break) of the band. Now, loop the band tightly about two wooden dowels or pencils. Then, assume this holds the dowels together with a force of two pounds. If you then try to separate them with a force of one pound nothing apparently happens - the dowels do not separate - the rubber doesn't stretch and the rubber doesn't feel the pull. Why? Because the rubber band was preloaded to a force greater than the one pound load and will not "stretch" until a force greater than two pounds is applied. If the band is made of metal instead of rubber and a load greater than two pounds is applied inter-

mittently, the fastener will foil from fatigue. Fatigue life will be greatly increased if the preload is equal to or greater than the alternating load imposed. Manufacturers provide torque information to identify preload and reduce part distortion.

Accuracy of obtaining equal torque on all bolts and nuts in an assembly depends upon:

1. Thread cleanliness
2. Condition of threads
3. Condition of mating surface
4. Use of high stress anti-sieze lubricant
5. Plated threads (cadium bolts)
6. Threaded aluminum

Leading Questions:

1. How can we be assured of installing the nuts and bolts we have removed from our engine with the same tightness as when they were removed?

2. Is this a torque or tension wrench?

3. How many of you have used a tool like this?

IV. Supervised Study

/Teachers Note/: Assign outside reading from Torque Manual, eighth edition 1968, P. A. Sturdevant Company, pp. 3-8; 14-15; 17-19; 22-24.
Complete the following statements by finishing the missing letters of the word.

1. Torque wrenches are Measuring Tools. (p. 3)

2. Resistance to turning is referred to as Torque. (p. 3)

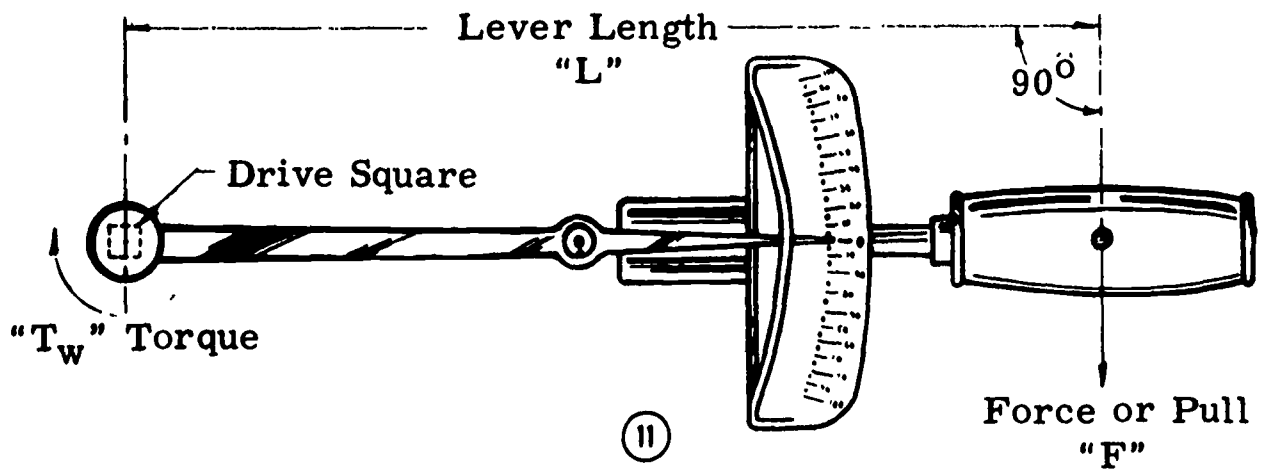
3. Two basic types of torque wrenches are Bending Beam and Rigid Frame. To obtain accurate readings in the Bending Beam type, accuracy Lever Length is very important since deflection of the beam depends upon the amount of pull at a fixed point on the handle. (p. 4)

4. Construction principle of all torque wrenches is based upon Hooke's Law which says that within the Elastic Limits of steel, Defelction is proportional to the load applied. (p. 7) Thus, if a 1 lb. load caused $\frac{1}{4}$" deflection, an 8 pound load would cause a spring to stretch 2 inches. (p. 7)

5. Torque is based on the law of mechanics that

   Distance x Force = Torque about a point. (p. 6)

6. In order to determine the torque at the "drive square" in the following figure, it is necessary to multiply Lever Length x Force. In this instance, Force must be applied at an angle of 90 degrees to the lever. (p. 6)



7. A lever length measured in inches and a force in pounds develops a torque referred to as Inch - Pounds. (p. 5) If the length of the lever were expressed in feet the torque measured would be Foot - Pounds. (p. 5)

8. Complete the following: (p. 5)

60 inch-pounds	=	5	foot-pounds
36 inch-pounds	=	3	foot-pounds
480 inch-pounds	=	40	foot-pounds
12 foot-pounds	=	144	inch-pounds
50 foot-pounds	=	600	inch-pounds

9. When using a bending beam type torque wrench a Pivot type handle permits accuracy if thehandle is grasped as in Figures 12 or 13, (p. 7) and the pull is at a 90 degree angle. (p. 15) It is also considered best to Pull on the handle for safety. (p. 14)

10. Define the following terms (p. 8)

    a) Run-down resistance: _____

    b) Set or Seizure: _____

    c) Break-away torque: _____

11. When adapters are used with torque wrenches, the torque reading on the scale of the wrench by the following formula:

$$Tw = \frac{Ta \times L}{(L + A)}$$

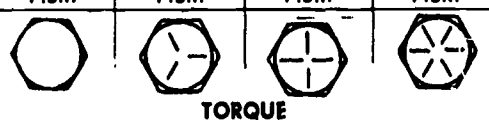
12. Adapters can be used to (increase) (decrease) the capacity of torque wrenches.

(Laboratory Exercise)

Additional references required: Repair Instructions III.

1. Determine the following torque requirements for the laboratory engine from Repair Instructions III, pp. 62-63.
   a) Cylinder head torque using torque wrench without adapter 140 in. lbs.
   b) Connecting rod bolt torque if the adapter length is ____ in length and the shop torque wrench is used. Answer _____.
   c) Fly wheel nut torque if the adapter length is _____ length and the shop torque wrench dial reading desired is in inch-pounds.
2. From the following chart determine the maximum torque in inch-pounds for a SAE 5, 3/8" cadium plated bolt. Answer 240 inch-pounds.

U. S. Standard Torque Specifications*

GRADE OF BOLT		SAE 1 & 2	SAE 5	SAE 6	SAE 8		
MIN. TENSILE STRENGTH		64,000 P.S.I.	105,000 P.S.I.	133,000 P.S.I.	150,000 P.S.I.		
GRADE MARKINGS ON HEAD						SOCKET OR WRENCH SIZE	
U.S. STANDARD		TORQUE (IN FOOT POUNDS)				U.S. REGULAR	
BOLT DIA.	U.S. DEC. EQUIV.					BOLT HEAD	NUT
1/4	.250	5	7	10	10.5	3/8	7/16
5/16	.3125	9	14	19	22	1/2	9/16
3/8	.375	15	25	34	37	9/16	5/8
7/16	.4375	24	40	55	60	5/8	3/4
1/2	.500	37	60	85	92	3/4	13/16
9/16	.5625	53	88	120	132	7/8	7/8
5/8	.625	74	120	167	180	15/16	1.
3/4	.750	120	200	280	296	1-1/8	1-1/8
7/8	.875	190	302	440	473	1-5/16	1-5/16
1.	1.000	282	466	660	714	1-1/2	1-1/2
MULTIPLY READINGS BY 12 FOR INCH POUND VALUES							

*-Use torque figures directly if high stress anti-seize lubricants are used.
-Increase torque 20% if engine oil or grease is used as lubricant.
-Reduce torque 20% if cadium plated bolts are used.

UNIT TEST

Circle T if the statement is true, and F if the statement is false.

T F 1. Distortion of parts in an engine could result from unequal tension.

T F 2. Life of parts is indirectly proportional to the percentage the threaded fasteners change in load during service.

T F 3. Grease on the threads of a bolt could make the torque reading inaccurate on that bolt.

T F 4. In removing the threaded fasteners from the engine, it is important to remember the exact location that the fastener came from to achieve proper torque on that fastener.

T F 5. Resistance to turning is referred to as torque.

T F 6. Torque is based on the law of mechanics that area multiplied by length gives us torque about a given point.

T F 7. When converting inch-pounds to foot-pounds 480 inch pounds is equal to 25 foot pounds.

T F 8. Almost every type of threaded fastener has its own torque specification.

T F 9. The two basic types of torque wrenches are the bending beam and the rigid frame.

T F 10. When using an adapter on the torque wrench to increase capacity just add the length on to the lever length and determine the torque.

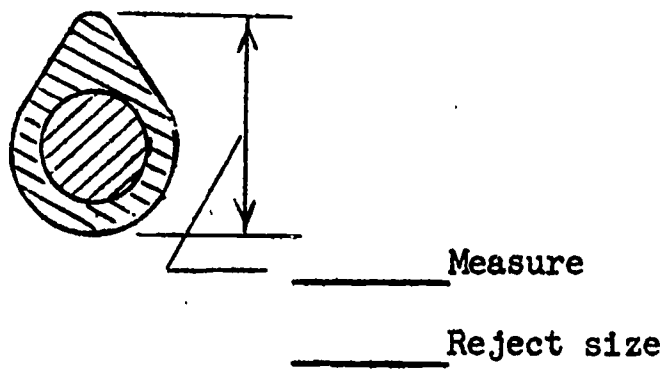
I. Teaching Unit No. X: Engine Repair

II. Engine disassembly - From the present stage which you have disassembled your laboratory engine, use the following as a study guide to engine repair operations.

A. Laboratory Procedure

Steps in Procedure	Key Points	Ref. Page No.
1. Remove valves	a. Observe for different size springs and record location. b. Use spring compressor to remove keeper. c. Caution! If valve will not slip out file and smooth keeper end of valve.	R-70
2. Store valves and springs	a. In properly marked rack.	
3. Remove crankcase cover assembly	a. Clean PTO end of crankshaft. b. Place piston TDC compression stroke. c. Use care to avoid damaging gasket. d. Bump with plastic hammer.	R-97
4. Remove camshaft	a. Stand engine on head of cylinder. b. Align timing marks on gears	R-97
5. Check cam gear	a. Wear and nicks or broken teeth	
6. Measure lobe and record size.		R-98 Table 2

A. Laboratory Procedure (continued)



7. Check connecting rod bearing for position on journal	a. Note oil dipper position.	R-95 Fig. 12
8. Remove piston	a. Use hammer and punch to straighten lock plate on connecting rod. b. Push piston and rod assembly out top	R-91 Fig. 1
9. Attach connecting rod bearing cap to rod	a. To avoid loss and damage.	
10. Protect piston and connecting rod.	a. Wrap in shop towel	

B. Study Questions Piston - Rings - Cylinder

Reference reading assignments:

1. Farm Tractors, FT53-A, p. 38-40.
2. Repair Instructions III, pp. 91-94; 105-106.

1. State the function of the two types of piston rings used in an engine: (Reference 1, p. 39)

   a) Compression rings
      1) Form a seal between piston and cylinder
      2) Transmit heat from piston to cylinder walls

   b) Oil control ring prevent excessive oil from passing into combustion chamber.

2. Why is it important to check the following:

   a) Ring end clearance (Reference 1, p. 40)
      1) Too much - excessive oil consumption
      2) Too little - scored cylinder walls

   b) Ring side clearance (Reference 1, p. 40)
      1) Too much clearance, rings act as pump causing oil consumption.

3. Where does most of the wear occur in a cylinder? (Reference 1, p. 39) Why?

   Rings exert heavy outward pressure on power stroke.

4. What is meant by a scored piston? (Reference 2, p. 92)

   Vertical scratches and metal remove from thrust faces of piston.

5. When is it necessary to resize a cylinder on this engine? (Reference 2, p. 105)

   If more than .003" oversize or .0025" out-of-round.

6. What are the standard oversizes to which one must hone or bore? (Reference 2, p. 105)

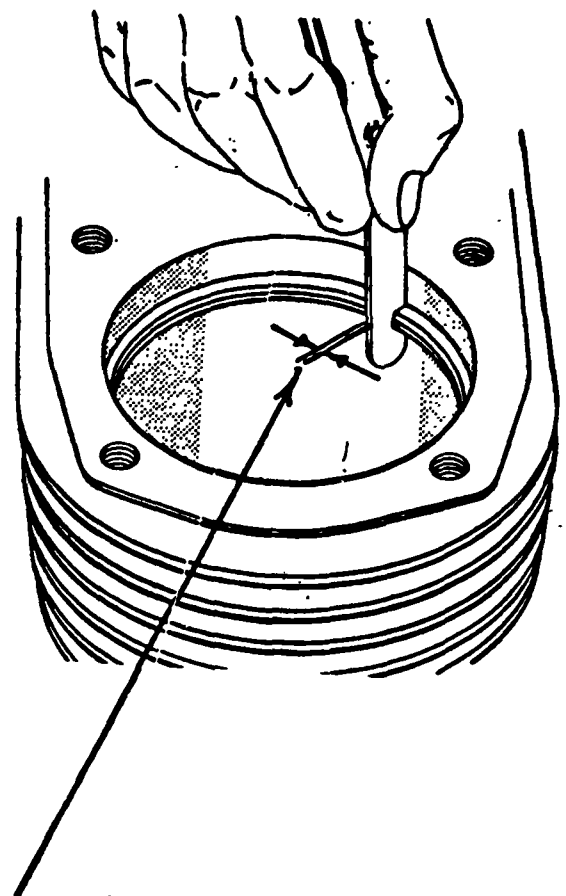
   a) .010"

   b) .020"

   c) .030"

C. Laboratory Procedure (continued)

Steps in Procedure	Key Points	Ref. Page No.
1. Remove rings from piston	a. Use expander tool b. Store in box	R-92
2. Check ring gap clearance	a. One inch down in cylinder	R-92
3. Record findings		

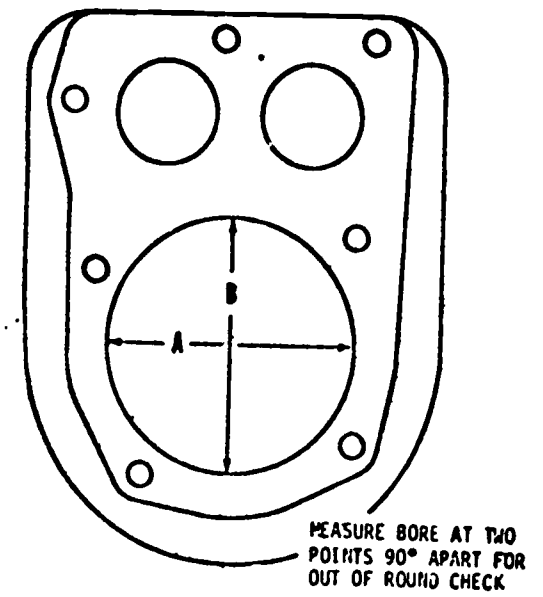


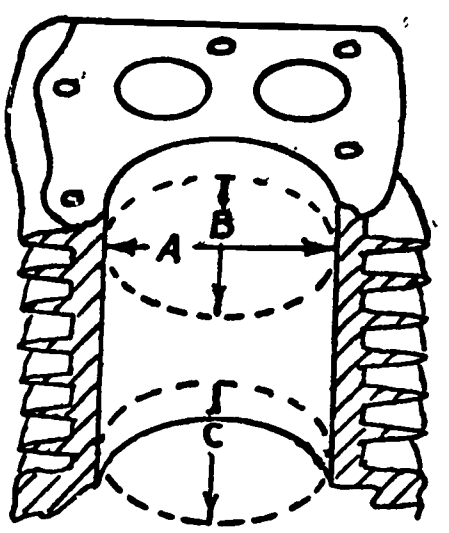
Ring End Gap

	Mfg. Specs.	As Measured
Top Compression Ring		
Oil Ring		

Recommendations:

4. Inspect cylinder	a. Cracks - scoring	
5. Measure cylinder	a. Taper and out-of round	R-105
6. Record findings below.		





Cylinder

Position	Mfg. Specs. Bore	As Measured Bore
"B"		
"A"		
Out-of-Round "B"-"A"		
"C"		
Taper "B"-"C"		

7. Remove piston pin — a. Check assembly closely — R-91 Figure 3

8. Check piston, pin and rod pin bearing for wear — a. Groove wear gauge; b. "Mike" and telescope gauge — R-93

9. Record findings on the following sheet.

D. Study Questions Crankshaft Bearings

Reference reading assignments:

1. Farm Tractors, FT53-A, pp. 71-74.
2. Repair Instructions III, pp. 97-98; 108-110.

1. What are the three bearing surfaces of the crankshaft called? (Reference 2, p. 98; figure 5)

   a) Drive end journal
   b) Crank pin journal
   c) Magneto end journal

2. What is meant by "undersize connecting rod bearings"? (Reference 2, p. 98)

   Bore is smaller than standard when used on reground crankshafts.

3. List at least four factors which may be a cause of short bearing life? (Reference 1, p. 72)

   a) Lack of oil
   b) Contamination by dirt
   c) Faulty installation
   d) Overloading the engine

4. What is "Plastigage"? How is it used? (Reference 1, p. 72-73)
   Plastic string which flattens when clamped between bearing and journal surface and measures clearance by width relationships.

5. What is a "Precision insert bearing"? (Reference 1, p. 71, figure 164)
   Removable bearing linings which are accurately cut to size.

6. When should plain bearings in a small engine be replaced? (Reference 2, p. 107) When excessively worn or scored.

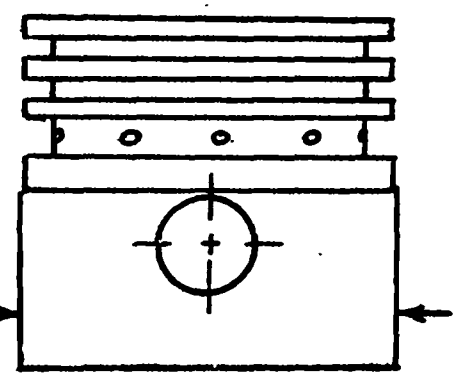
7. How are plain bearings in the magneto side of the small engine replaced? (Reference 2, pp. 108-110)
   Reamed out and a replacement bushing installed and reamed to size.

E. Laboratory Procedure (continued)

Steps in Procedure	Key Points	Ref. Page No.
1. Remove and check crankshaft	a. Record measurements on attached sheet	R-97 R-98
2. Measure connecting rod bearing	a. Torque cap bolts	R-98
	b. Measure and record on spec. sheet	
3. Check rod bearing clearance on journal	a. Use plastigauge	
	b. Record on spec. sheet.	
4. Check main bearings	a. Use "mike" and telescoping gauge.	R-108

	Mfg Specs Limits	As Measured
Top Ring Groove Wear		

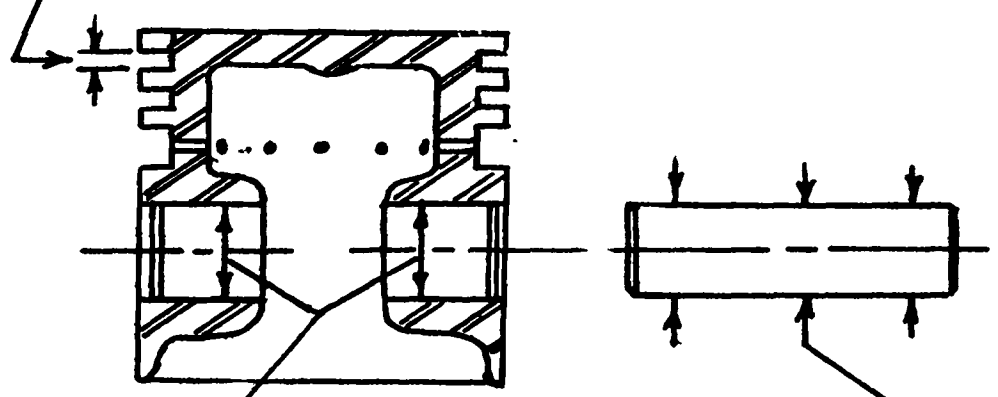
Recommendations:



Piston

	Mfg Specs	As Measured
Cyl. Bore Diameter		
Piston Skirt Diameter		
Piston Clearance		

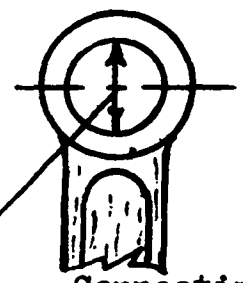
Recommendations:



Piston Pin

	Mfg Specs	As Measured
Boss Diameter		
Pin Diameter		
Clearance		

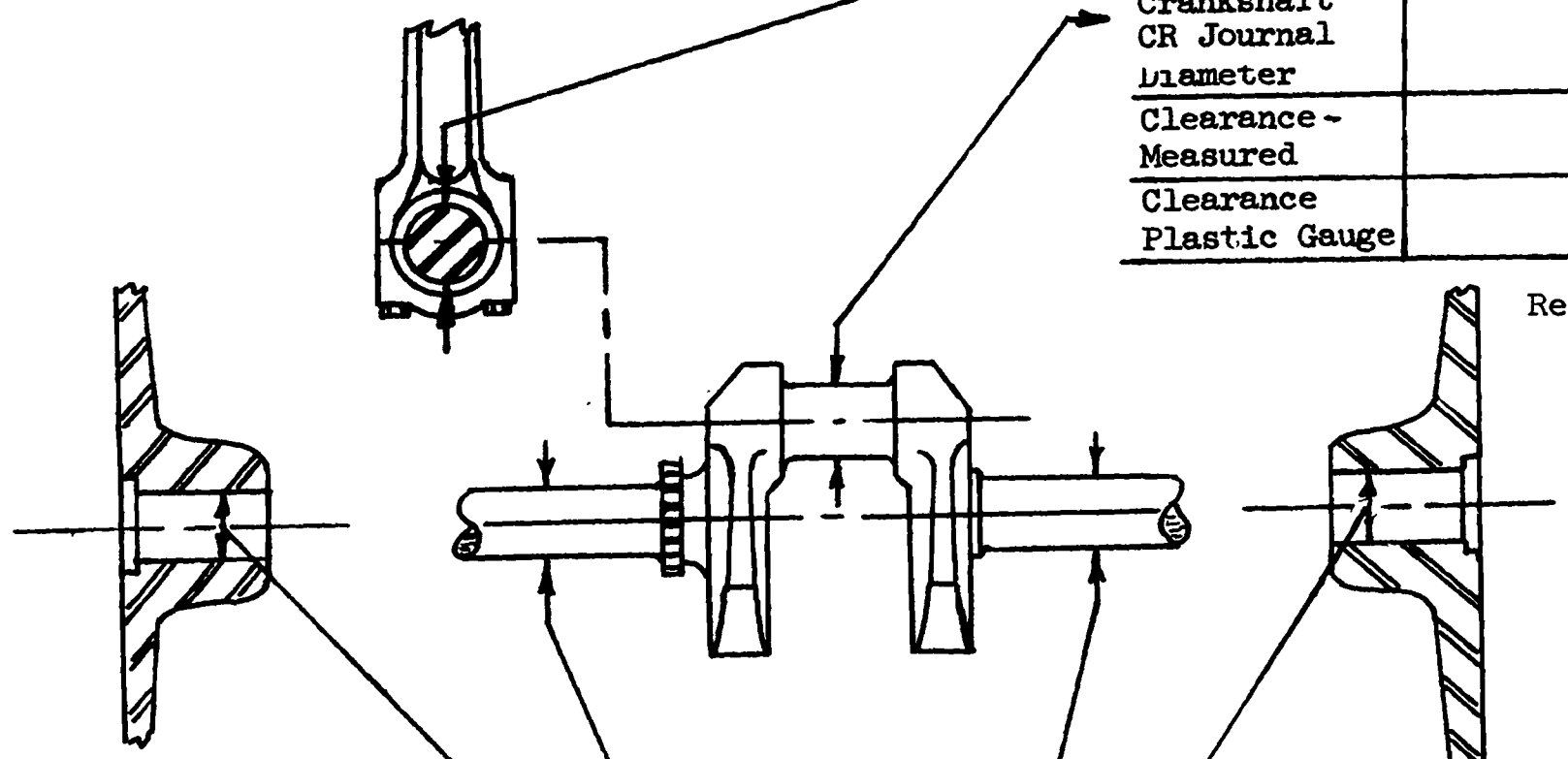
Recommendations:



Connecting Rod

	Mfg Specs	As Measured
Rod Pin Bore		
Pin Diameter		
Clearance		

Recommendations:



Connecting Rod Bearing Clearance

	Mfg Specs	As Measured
Rod Bearing Diameter		
Crankshaft CR Journal Diameter		
Clearance - Measured		
Clearance Plastic Gauge		

Recommendations:

Main Bearing Clearance PTO End

	Mfg Specs	As Measured
Main Brg. Bore		
Crankshaft Journal Dia.		
Clearance		

Recommendations:

Main Bearing Clearance Magneto End

	Mfg Specs	As Measured
Main Brg. Bore		
Crankshaft Journal Dia.		
Clearance		

Recommendations:

F. Study Questions Valves

Reference reading assignments

1. Farm Tractors, FT53A, pp. 34-38.
2. General Theories of Operation, pp. 6-7.
3. Repair Instruction III, pp. 70-75.

1. How can worn valve guides cause: (Reference 1, p. 35)

   a) Excessive oil consumption: Oil is pulled into combustion chamber on intake stroke.

   b) Sloppy valve action: Valve moves side ways instead of upward.

2. Why will carburetor adjustment affect exhaust valve temperature? (Reference 1, p. 35)
   To lean a setting may cause overheating and burning of exhaust valve.

3. What are three ways that valve stem corrosion can be reduced? (Reference 1, p. 35)

   a) Keep exhaust covered so moisture can't enter.
   b) Stopping engine before warmed up.
   c) Operating engine too low temperature.

4. What are the principle causes of: (Reference 2, p. 6)

   a) Valve seat burning. Carbon or fuel lead accumulating on valve stem or valve face.

   b) Valve sticking. Formation of fuel lead, gum or varnish forming on valve stem and guide.

5. When grinding valves, what are the specifications for:

   a) Thickness of margin. (Reference 2, p. 6)
      If thinner than 1/64 ($\frac{1}{2}$ thickness of new valve)

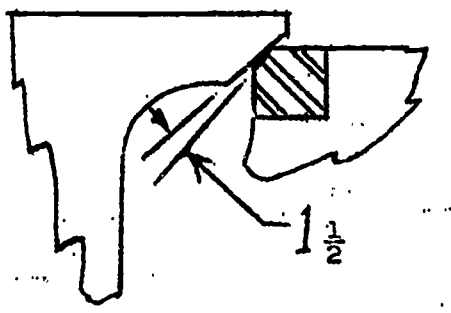
   b) Width of valve seat. (Reference 2, p. 7)
      3/64" - 1/16" width

   c) Location of valve on seat. (Reference 2, p. 7 and reference 1, p. 36; figure 86)
      Valve should seat near center to upper one third of valve face.

   d) Angle of valve and seat. (Reference 2, p. 7)
      45° - (44° if interference angle used)

6. a) Why are valves sometimes fitted to their seats with an interference angle? (Reference 1, p. 37; figure 87)
      To improve seating ability when first placed in service.

b) Make a sketch showing the correct interference angle and position of valve on seat. (Reference 1, p. 37)



7. How can worn valve guides be:

   a) Checked for wear? (Reference 3, p. 71)
   Use the flat end of valve guide plug gauge.

   b) Repaired? (Reference 3, p. 71)
   Rebushed by using counter bore and drive in bushing.

8. How can valve seats be repaired? (Reference 3, pp. 72-75)

   New seats can be installed by removing old seat or counterboring casting and driving in new seat.

9. How can exhaust valve life be extended? (Reference 3, p. 76)

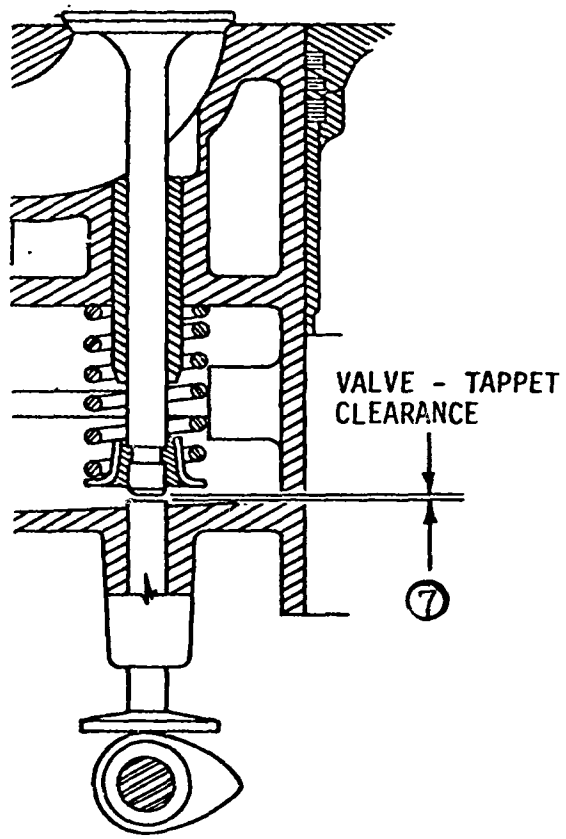
   a) Use of valve rotators
   b) Use of stillite valve faces

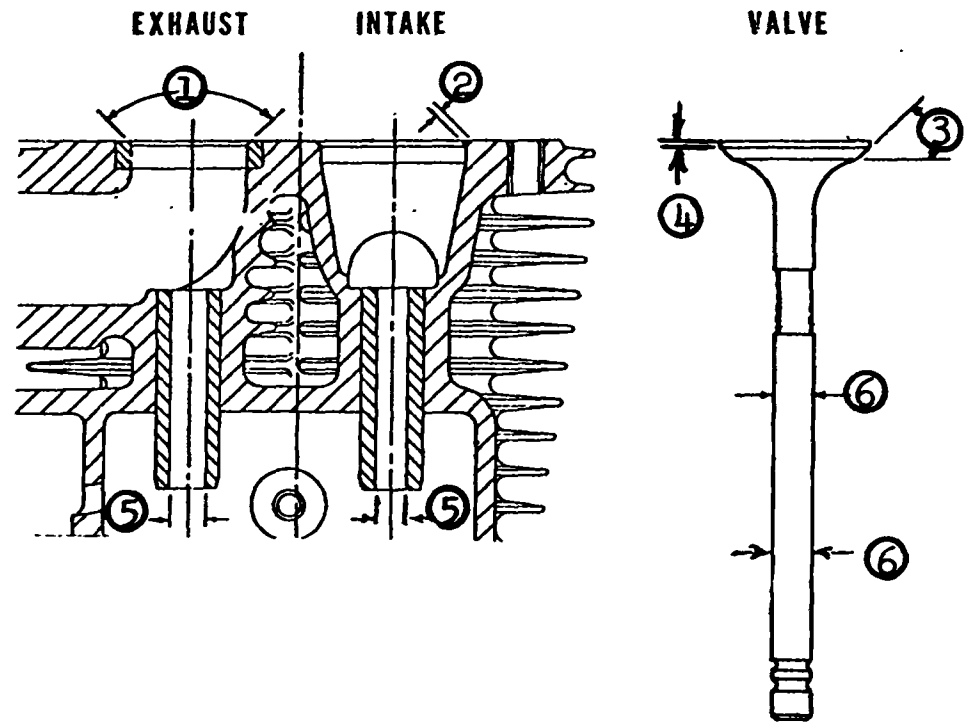
10. How is valve tappet clearance adjusted? (Ref. 3, p. 71)

   Turn crankshaft until one valve is at its highest position then turn one turn more. Check with feeler gauge.

G. Laboratory Procedure (continued)

Steps in Procedure	Key Points	Ref. Page No.
1. Inspect valves and record measurements on spec. sheet.	a. Check head for dishing, excessive burning and pitting	R-5
	b. Check stem for scuffing - rust.	
	c. Measure stem.	
2. Inspect valve guides (record measurement on spec. sheet).	a. Measure (small hole gauge) one half down guide and at top.	R-71
3. Inspect valve seats (record measurement on spec. sheet).	a. Check for cracked or loose seats	R-71
	b. Measure width	





VALVE ASSEMBLY

ITEM NO.	WHAT TO MEASURE	MFG. SPECIFICATIONS		DIMENSIONS AS FOUND		NOTES-CONDITION OF PARTS
		INTAKE	EXHAUST	INTAKE	EXHAUST	
1.	Valve Seat Angle					
2.	Valve Seat Width					
3.	Valve Face Angle					
4.	Valve Face Margin					
5.	Valve Guide Diameter					
6.	Valve Stem Diameter					
	Valve Stem Clearance, Item 5 minus Item 6.					
7.	Valve Tappet Clearance					

Recommendations:

II. Repair Operations

A. Study Questions Preparing Cylinder for Rings

Reference reading assignments

1. Farm Tractors, FT53-A, p. 39
2. Repair Instruction III, p. 105-107.

1. Why should cylinder "glaze" be removed before installing new rings? (Reference 1, p. 39) To allow rings to "seat" themselves to cylinder wall surfaces.

2. How should cylinders be cleaned after honing? (Reference 1, p. 39) Thoroughly swabbed with clean engine oil until surfaces of cylinder wall are clean to cotton waste.

B. Laboratory Procedure

Steps in Procedure	Key Points	Ref. Page No.
1. Prepare cylinder for rings	a. Determine need to hone or deglaze	R-105
	b. Remove glaze with 200 grit flexible hone	
	c. Check for proper cross-hatched surface	R-106 Fig. 3
2. Clean cylinder	a. Swab cylinder with oil rag	
	b. Swab until rag comes out clean	
3. Grind valves	a. Install proper size collet in grinder	
	b. Set proper angle	
	c. True stone	
	d. Use light cuts on valve until face is "clean"	
	e. Check margin - not less than ½ width new valve	R-71
4. Grind or cut seats	a. Clean carbon and dirt from seat with wire brush	
	b. Clean guide	
	c. Install proper pilot	
	d. Select proper angle stone or cutter	
	e. Grind or cut seat	R-71
5. Check width of seat	a. 1/16" - 3/32"	
	b. Narrow with proper stone or cutter	
6. Adjust valve to seat	a. Chalk valve face with soft pencil lead	
	b. Seat should contact valve about middle of face	

Supplemental Information Engine Repair Operations and Demonstrations

A. Replacing Valve Guides

1. Show how to check guides with

   a) 19122 gauge - If flat end goes in more than 5/16 of an inch then bushing is necessary.

   b) Use small hole-gauge - Check at top of guide and compare with that in middle. If .002" difference, bushing is necessary.

2. Use 19064 reamer in drill press, drill only 1/16" deeper than length of bushing.

3. Clean filings from reamed guide.

4. Install bushing with 19065 drives until bushing is flush with guide.

5. Ream guide with 19066 reamer.

B. Cutting Valve Seats

1. Recondition valve guide if necessary.
2. Wire brush valve seat and port.
3. Clean valve guide with nylon brush.
4. Insert proper size pilot in guide.
5. Place 46° angle cutter on pilot.
6. Turn cutter 2-3 rounds with very slight downward pressure.
7. Check cutting action often until all of seat is renewed.
8. Check seat for width (3/64" - 1/16"). If too wide turn cutter over using 31° side. Cut a slight amount and check.
9. Use 46° cutter and remove bur formed.
10. Check contact point on valve face with divider - should be in outer $\frac{1}{4}$ of face. If too high cut with 31° cutter.
11. Check seat closure with Prussian blue or cellophane feeler gauge made from cigarette package wrapper. Gauge should be 1/8" wide.
12. If open spots are found, lapping valve to seat may be necessary.

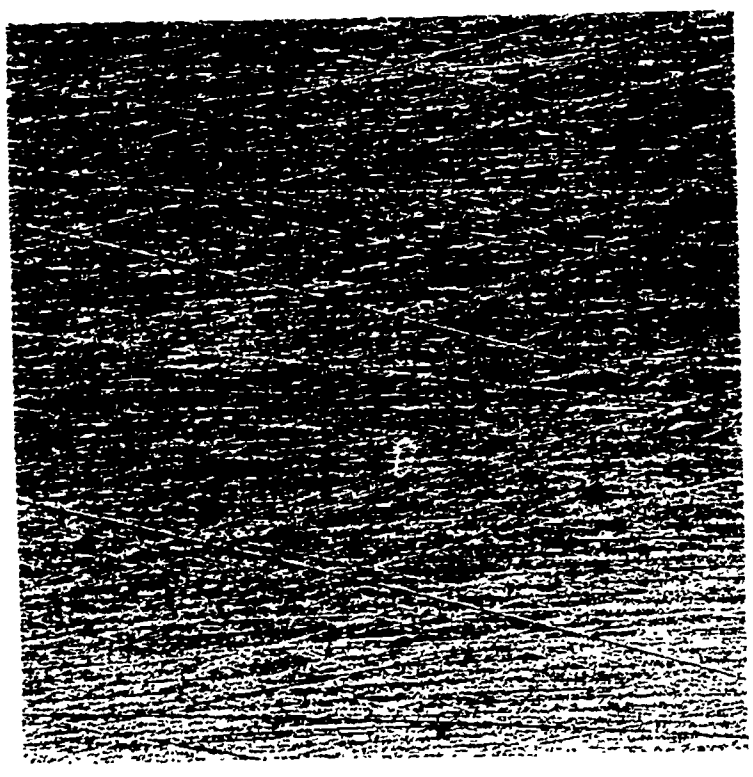
C. Honing cylinders to oversize using Sunnen Hone.

1. Thoroughly clean cylinder of carbon and oils with solvent. Have cylinders dry.
2. Secure cylinder to jig and level. (Figure 1)
3. Oil surface of drill press table and set cylinder with jig on table.
4. Set drill press to operate at 400-500 rpm.

5. Stone and guide blocks must be kept in sets -- never interchange.
6. Use honing oil, vegetable oil or shortening only on aluminum and on 500 grit finishing stones. Caution - stones are expensive! Oil soaked stones cannot be used dry.
7. Stroking procedure. Start stroking at the bottom, or least worn section of the cylinder, using short strokes in order to concentrate honing in the smallest section of cylinder. Allow stones to go through lower end of the bore ½" to 3/4". Gradually lengthen stroke as metal is removed and stones contact higher on the cylinder walls. Stroke all the way to the top occasionally, to remove ring ridge as the bore is enlarged. Allow stones to extend about ½" from the cylinder at top of stroke. Expand stones as needed to compensate for stock removal and keep stones firmly against cylinder wall.

   An excellent indication of cylinder condition is speed of the drill if using an electric hand drill. A reducation in drill speed, during honing, indicates a smaller diameter. Localize stroking at such sections until drill speed is constant over at least 75% of the cylinder length; than stroke the full length of the cylinder.

Figure 1. Cylinder wall after 25 strokes with flexible hone. Note boring marks.



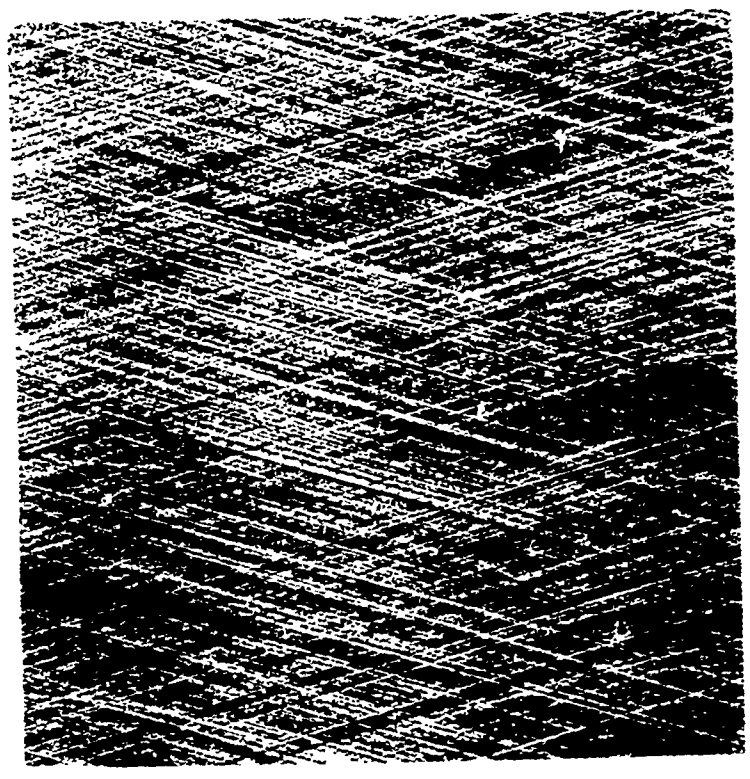


Figure 2. Proper honing leaves cross-hatch pattern.

8. Check cylinder size frequently. When within .0015 of finished size change to finishing stones.
9. If cylinder is aluminum, remove any built up metal from scored areas before honing.
10. Always allow cylinder bore to cool to room temperature before final measurement since honing develops heat end the cylinder expands.
11. For finish size, use proper over size piston ring and check and gap.
12. Clean cylinder by swabbing with oil then washing with soap and water.

D. Installing Rings and Piston

1. Inspect piston to be sure oil holes are open and ring grooves are clean.
2. Check end gap of ring in cylinder. Check measurement against mf. specs.
3. Check top piston ring groove with Perfect Circle wear gauge or new ring and feeler gauge -- .007" wear is too much.
4. Install oil ring expander in oil ring groove.
5. Use ring expander and install all rings.
6. Orientate ring gaps on piston 180° opposite one another.
7. Oil piston liberally with ML 20 oil.
8. Compress ring with compressor.
9. Install piston carefully guiding connecting rod into proper position on crank pin. Tap top of piston lightly with hammer handle to push into bore.
10. Torque connecting rod cap to specs.
11. Bend locking lug against rod bolt heads.

BRIGGS & STRATTON CORP.

CYLINDER HOLDER

FOR RESIZING 6, 8, AND 14 CU. IN. ALUMINUM ALLOY CYLINDERS

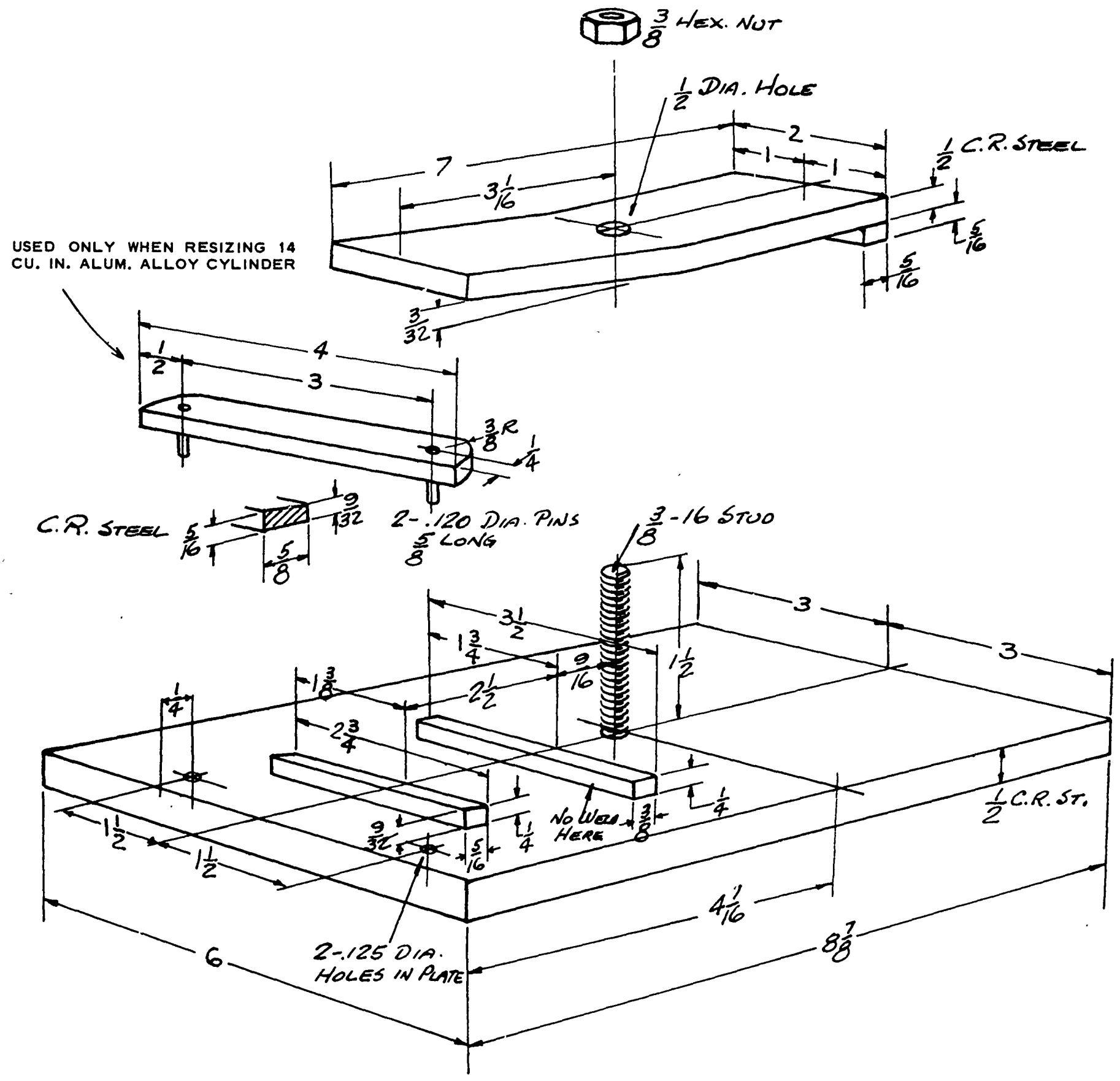


Figure 1

C. Study Questions Installing Piston Rings

Reference reading assignment

1. Repair Instruction III, pp. 94-95.

1. Compare rings taken from your engine with end view of rings, Figure 8, p. 94, Reference 1. Note that top compression rings have groove in upper-inner side of ring while in the second compression ring the groove is on outer lower edge of ring.

2. Does it make any difference how the piston pin is installed in a piston? (Reference 1, p. 93)

   Yes, if solid pin, flat end first into piston; hollow pin, either end .

3. a) Does it make any difference how connecting rod is positioned to the piston for your engine? (Reference 1, p. 94)

   No, piston can be attached to connecting rod either of two positions.

   b) Is this true of the 300,000 series engine? Why? (Reference 1, p. 9)

   No, piston has an "F" stamped near pin hole - "F" must be on same side as assembly marks of connecting rod - install on flywheel side of cylinder.

4. Which side of the cylinder is the major thrust face?

   The side toward which the piston moves on power stroke due to angularity of connecting rod.

5. What is the purpose of a ring compressor? (Reference 1, pp. 94-95)

   Rings are drawn into piston grooves so that piston can be pushed into cylinder.

III. Assembly of Engine Parts

A. Laboratory Procedure

Steps in Procedure	Key Points	Ref. Page No.
1. Clean engine of abrasive	a. Clean with oily rag b. Wash with soapy water c. Rinse d. Oil cylinder and valve seat thoroughly	
2. Install crankshaft	a. Oil journals b. Have throw at BDC	
3. Install piston pin	a. Oil pin b. Assemble connecting rod in piston as removed c. Be sure snap rings are in place!	R-93 Fig. 7
4. Install rings on piston	a. Use ring expander, oil ring first b. Position rings so gaps won't align c. Rings should be free in grooves	
5. Install piston in cylinder	a. Dip piston in engine oil b. Check rings for end gap position c. Compress rings d. Check for correct position of rod on crankshaft e. Push piston into cylinder; guide rod with other hand to avoid crankshaft journal damage	R-95
6. Attach rod to crankshaft	a. Match bearing cap to connecting rod b. Install oil slinger c. Torque rod bolt d. Check for side movement of rod on crank pin. e. Use water pump pliers to bend lock plate	 R-95 Table 4
7. Install valve lifters	a. Install in proper bore as marked	

8.	Install camshaft	a. Mesh in time with crankshaft	R-52
9.	Replace crankcase cover assembly	a. Make sure all tools and objects are removed from engine b. Check gasket c. Use sleeve or paper to protect oil seal d. Tighten bolts just snug	 R-100
10.	Check crankshaft end-play	a. Use dial indicator	R-100
11.	Adjust valve clearance	a. Insert correct valve in guide b. Use valve grinder to grind valve stem for clearance if needed	 R-71
12.	Install valves	a. Compress spring and install keeper	R-71
13.	Install armature, condensor and breaker points	a. Raise armature to full height b. Adjust point gap	R-17
14.	Install breaker point cover assembly	a. Seal coil wire with gasket sealer	
15.	Install flywheel	a. Be sure key is installed properly b. Torque nut using extension	R-14 Table 1
16.	Install head	a. Check gasket b. Use proper bolts and washers c. Torque	R-69 Table 1
17.	Install carburetor	a. Tighten mounting screws securely	

UNIT TEST

Circle T if the statement is true, and F if the statement is false.

T F 1. The two valve springs in a small gas engine are exactly the same size.

T F 2. When removing the piston it is a recommended practice to use a hammer and punch to straighten the lock plate on the connecting rod.

T F 3. One of the functions of the compression ring is to transmit heat from the piston to the cylinder wall.

T F 4. A scored piston refers to vertical scratches and metal removed from the thrust face of the cylinder.

T F 5. If a cylinder is more than .003" oversize or .0025" out-of-round, it is necessary to resize the cylinder.

T F 6. The ring gap is necessary to allow a little oil to go past the piston and lubricate the area around the spark plug.

T F 7. If the lobe on the camshaft is worn down, it could greatly affect the timing of the engine.

T F 8. An undersize connecting rod bearing refers to the bore being smaller than standard when used on reground crankshafts.

T F 9. The cap bolts on the crankshaft should be properly torqued for proper and efficient operation.

T F 10. Worn valve guides can cause excessive oil consumption by pulling oil into the combustion chamber on the intake stroke.

T F 11. Valve and seat are usually ground or cut to the same angle when seating valves.

T F 12. The margin of a valve should never be less than one-fourth the thickness of a new valve.

T F 13. Valve sticking is principally caused by the valve springs becoming weak due to excessive use.

T F 14. The glazed surface of the cylinder should be honed lightly to aid in seating new rings.

UNIT TEST (continued)

T F 15. When making final measurements after honing, make sure the cylinder is at a temperature that is hot to the touch.

T F 16. The oil and the compression piston rings are interchangeable in their position in the cylinder.

T F 17. In a 300,000 series engine the connecting rod must be positioned to the piston in a specific way.

T F 18. Crankshaft end play is adjusted to recommended amounts by adding or removing end plate shims or gaskets.

I. Teaching Unit No. XI: Governors

Reference reading assignments

1. General Theories of Operation, pp. 20-21.
2. Farm Tractors, FT53-A, p. 18.

A. Study Questions

1. What is the real purpose of the governor on an engine? (Reference 1, p. 20) Maintain a desirable engine speed regardless of load.

2. When less load is placed on an engine the governor responds by: (Reference 1, p. 20)
Causing the throttle butterfly to be closed.

3. State the two types of basic governor systems and briefly discuss their principles of operation. (Reference 1, pp. 20-21)
   a) Pneumatic or air vane - air from flywheel forces against air vane and moves vane against spring tension.
   b) Mechanical or flyball weight - centrifugal force acts against spring tension.

4. In both systems, what functional governor part causes:
   a) Throttle butterfly to open? Spring tension forces overcome air vane or centrifugal force.
   b) Throttle butterfly to close? Air vane or centrifugal force overcomes spring tension forces.

B. Laboratory Procedure

	Steps in Procedure	Key Points	Ref. Page No.
1.	Install air vane governor and throttle linkage	a. Make sure linkage is "hooked" correctly	R-52
2.	Adjust armature air gap	a. Place magnets under armature	R-18
		b. Use paper shim of correct thickness	R-14 Table 1
3.	Install muffler		
4.	Install spark plug	a. Set gap .030" b. Torque - 27 ft. lbs.	
5.	Install air shrouds and shields		
6.	Install gas tank and fuel line		

UNIT TEST

Circle T if the statement is true, and F if the statement is false.

T F 1. The purpose of a governor on an engine is to maintain the speed of an engine at a pre-determined speed.

T F 2. Essentially, there are two types of engine governors insofar as principles of operation are concerned.

T F 3. The forces acting upon a governor produce a response which causes the governor to work against spring tension to control speed.

T F 4. Governor linkage is such that the engine speed control lever or screw is connected directly and positively to the carburetor throttle plate linkage.

T F 5. As an engine speeds up, the governor's immediate reaction is to slow it down.

I. Teaching Unit No. XII: Operating and Maintaining Air Cooled Engines

Reference reading assignments

1. Farm Tractors, FT53-A, pp. 24-25; 63-70.
2. Operating and Maintenance Instructions Form No. 27842-88, Briggs-Stratton.

A. Study Questions Fuel and Oils

1. What jobs must an engine oil perform in an engine besides lubricate? (Reference 1, p. 63)
   Cool, reduce wear, absorb shock, seal

2. What is meant by the SAE grade of oil? (Reference 1, p. 64)
   Society of Automotive Engineers rating of oil viscosity.

3. What does the letter "W" stand for when associated with SAE grades of oil? (Reference 1, p. 64)
   A designator to indicate increased cranking ability in cold weather - rating is at 0°F.

4. What is the function of the following when associated with engine oil additives? (Reference 1, p. 67)
   a) Oxidation inhibitor: Increase resistance of oil to forming varnish and carbon.
   b) Detergent: Performs cleaning action in the engine similar to a soap.
   c) Dispersant: Holds harmless non-abrasive particles of fuel soot in suspension.

5. What is the meaning of the API service classification of oils? (Reference 1, p. 69)
   American Petroleum Institute classification of engine oil by service type.

6. Identify the meaning of the following: (Reference 1, p. 69)
   a) ML Motor Light (for LP and gasoline)
   b) MM Motor Moderate (for LP and gasoline)
   c) MS Motor Severe (for LP and gasoline)
   d) DG Diesel General
   e) DM Diesel Severe (Series 1)
   f) DS Diesel Very Severe (Series 3)

7. What are reasons why fresh fuel (gasoline) give best performance? (Reference 1, p. 24)
   Provide easy starting, quick warm up

8. What is the effect of using fuel with too low an anti-knock value? (Reference 1, p. 25)
May cause loss of power and serious engine damage due to detonation or knocking.

9. What are the engine manufacturers requirements for the following: (Reference 2, p. 1)

   a) SAE grade of oil Summer - SAE 30; Below 40°F, 5w-20 or 10w.
   b) API classification of oil Service MS
   c) Grade of fuel Regular

10. How often is it recommended to perform the following maintenance practices for this engine? (Reference 2, p. 3)

   a) Check oil level Every 5 hours of operation
   b) Change oil After first 5 hours and every 25 hours thereafter
   c) Clean air cleaner Every 25 hours
   d) Check spark plug Every 100 hours regap and clean
   e) Remove carbon deposits Every 100-300 hours

11. How is it recommended to clean: (Reference 2, p. 3)

   a) Foam type air cleaner Wash in kerosene, wrap i. cloth and squeeze dry, saturate with engine oil, squeeze out excess.
   b) Oil bath air cleaner Pour out old oil, wash element and bowl in kerosene; dry; refill bowl with engine oil to level.

12. What are the steps to preform to adjust the carburetor? (Reference 2, p. 4)

   a) To get engine started (initial adjustment)
   Close needle valve carefully then back off 1½ turns
   Close idle valve then open ½ - 3/4 turns.
   b) After engine is warmed up (final adjustment)
   Turn needle valve in until engine misses, then out past even operating point, then in to point where engine runs smoothly. Set idle speed to 1750.
   Turn idle needle in or out until smooth operation - readjust speed. Test for acceleration.

13. What is the recommended operating speed for: (Reference 2, p. 4)

   a) Idle speed 1750 rpm

b) Governed speed 1800-3600 rpm
c) Where is idle speed adjusted? On throttle butterfly stop screw
d) Governor adjustment Thumb nut on govem or linkage

B. Laboratory Procedure

Steps in Procedure	Key Points	Ref. Page No.
1. Clean and service air cleaner	a. Wash foam in solvent b. Wrap foam in cloth and squeeze dry c. Saturate foam in engine oil - squeeze to remove excess oil.	R-27
2. Install air cleaner		
3. Pre-operation inspections and adjustments	a. Add recommended oil b. Add recommended fuel c. Crank engine slowly by hand and listen for unusual sounds.	R-5
4. Start engine	a. Turn fuel "on" b. Make sure governor linkage is free c. Adjust governor to slow speed	
5. Warm engine to operating temperature and stop!	a. Check for oil leaks b. Torque head bolts while hot	R-69
6. Run engine	a. Adjust idle and load mixture b. Adjust speed with tachometer	

UNIT TEST

Circle T if the statement is true, and F if the statement is false.

T F 1. The letter "W" when associated with SAE grades of oil refers to the cleaning qualities that the oil possesses.

T F 2. The most important function of a lubricant is to decrease the amount of friction between two moving parts.

T F 3. Use of a low quality fuel could cause a loss of power and serious damage to an engine.

T F 4. The recommended operating idle speed for a small air cooled engine is approximately 1,000 rpm.

T F 5. After repairing an engine when adjusting the carburetor, you should carefully close needle valve and then back off $1\frac{1}{2}$ turns.

T F 6. The head bolts should be torqued after the engine has been warmed to operating temperature.

T F 7. After repairing an engine you should run the engine at idle speed in order that the new parts and repair work will become "broken in" before it is used with a load.

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Curtis, Samuel L.
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ABSTRACT - Prepared by an assistant professor of agricultural education with the aid of an attorney, this unit plan is for use in teaching farm law in an 18-hour course to high school and adult agriculture students to meet the need for farmer-businessmen to be more aware of law. The nine lesson plans, each giving objectives, learning activities, references, and a subject matter outline, are: (1) Wills and Estate Planning, (2) Life Insurance and Estate Planning, (3) Transferring Property to the Next Generation, (4) Contracts, (5) Liability and Liability Insurance, (6) Real Estate, (7) Motor Vehicle Laws Relating to Farm Machinery and Equipment, (8) Laws Governing the Marketing of Farm Products, and (9) Where Law Comes From. A teaching schedule, teaching aids for each lesson, and reference materials needed for the unit supplement the lesson plans. Suggestions are also included for a field trip to a courthouse. The unit contains numerous sample forms, charts, and records. (AW)

VT 010 362

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Legal Principles for Farm Managers

A unit plan for teaching farm law to high school and adult students in agriculture developed to meet the need for an increased awareness of law on the part of farmer-businessmen.

Prepared by

Samuel M. Curtis

Assistant Professor of Agricultural Education

The Pennsylvania State University, College of Agriculture, Department of Agricultural Education, University Park, Pennsylvania in cooperation with The Pennsylvania Young Farmers Association; and Agricultural Education Section of the Bureau of Vocational, Technical and Continuing Education, Department of Public Instruction, Harrisburg, Pennsylvania.

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VT010 362

Legal Principles

for

Farm Managers

Introduction

Outline material in this publication is intended for use with either adult or high school classes in farm law. The teacher should secure class copies of Correspondence Course #125 and/or the Extension Service leaflets, circulars, and bulletins listed for each lesson. An outline of subject matter to be taught is part of each lesson.

This unit is not intended to make lawyers of the class members. It is intended to create an awareness of the law so that class members can avoid the pitfalls of ignorance in law. Ordinarily, this will mean seeking the counsel of a lawyer on matters of law prior to involvement.

When teaching this unit, the teacher should secure the help of a local lawyer as a resource person. A field trip to the court house should also be planned, probably in conjunction with the lesson on real estate.

In addition to the student reference materials for each unit, the teacher should have an up-to-date text on Pennsylvania business law and the Consumer's Union Report on Life Insurance.

The contributions of J. Edward Pawlick, attorney at law, and assistant professor of Farm Management Extension are acknowledged. His interest and cooperation in preparing this teaching plan are appreciated.

Major contributions to the unit were made by the in-service education class held in Indiana, Pennsylvania, during the 1968 Spring Term. This group developed the course outline and tried out the original materials in the classrooms.

The Pennsylvania Young Farmers Association, through its education committee, voiced the need for this unit and promoted its development. The committee reviewed the preliminary copy of this publication and made suggestions for improvements.

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Teaching Schedule

Lesson	Title	Estimated Time Allotment for Adults
1	Wills and Estate Planning	2 hours
2	Life Insurance and Estate Planning	3 hours
3	Transferring Property to the Next Generation	3 hours
4	Contracts	1 hour
5	Liability and Liability Insurance	2 hours
6	Real Estate	2 hours
7	Motor Vehicle Laws Relating to Farm Machinery and Equipment	1 hour
8	Laws Governing the Marketing of Farm Products	3 hours
9	Where Law Comes From	1 hour
		18 hours

Adaptability of Lessons to Various Agricultural Education Programs

Instructional Areas	Lessons								
	1	2	3	4	5	6	7	8	9
Agricultural Production	X	X	X	X	X	X	X	X	X
Agricultural Supplies	X	X	X	X	X	X	X		X
Agricultural Products	X	X	X	X	X		X	X	X
Ornamental Horticulture	X	X	X	X	X	X	X	X	X
Agricultural Mechanization	X	X	X	X	X	X	X		X
Agricultural Resources	X	X	X	X	X	X	X	X	X
Forestry	X	X	X	X	X	X	X	X	X

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Reference Materials Needed for Unit

Text:

Correspondence Course #125. College of Agriculture, The Pennsylvania State University, University Park, Pennsylvania.

Books:

Adams, R. L. and W. W. Bedford. Everyday Farm Laws. Danville, Ill.: Interstate, 1955.

Hannah, H. W. and D. F. Storm. Law for the Veterinarian and Livestock Owner. Danville, Ill.: Interstate, 1959.

The Consumer's Union Report on Life Insurance. Mount Vernon, N. Y.: Consumer's Union, 1967.

Kelsey, R. Wilfred. Handbook of Life Insurance. (1967) New York: Institute of Life Insurance, 1967.

Pawlick, J. Edward. How To Avoid Being Overcharged By Your Life Insurance Salesman. York, Pa.: New Salem Press, 1968.

Leaflets and Circulars: Agricultural Extension Service

Leaflet 277. "Why Bother With a Will?

Circular 526. "Father and Son Partnerships"

Circular 528. "Partnership Agreements for Farmers"

Circular 529. "Buying Farms on Sales Agreements"

Circular 530. "How to Buy or Sell a Farm"

Circular 535. "Farm Liability and Insurance"

Circular 539. "So They're Taking Your Land"

Farm Management 31. "Water Rights and the Farmer"

Farm Management 32. "A Discussion of Motor Vehicle Laws for Pennsylvania Farmers"

Special Circular 72. "Pesticides On Your Farm"

Other:

Smith, R. S. "Incorporation of the Farm Business." Cornell Extension Bulletin 1016, New York State College of Agriculture, Ithaca, New York.

Miscellaneous Publication No. 837. "Your Livestock-Share Farm Lease" USDA, Washington, D.C.

Miscellaneous Publication No. 838. "Your Crop-Share Farm Lease" USDA, Washington, D.C.

Lesson 1. Wills and Estate Planning

Objectives:

1. To list reasons why a person should make a will

2. To teach the law on inheritance and gift taxes

Student Learning Activities:

1. Each adult class member should make a complete list of his assets

2. Check distribution of assets under Pennsylvania Inheritance Laws when there is no will

3. Students plan appointment with a lawyer for the purpose of making a will

4. Calculate inheritance tax using sample problem as a guide

References:

Leaflet 277. "Why Bother With a Will?" Agricultural Extension Service, College of Agriculture, The Pennsylvania State University, University Park.

Correspondence Course #125. College of Agriculture, The Pennsylvania State University, University Park, Lesson #2.

Subject Matter Outline:

A. Why Bother With a Will?

1. Distribution of an estate by law when there is no will

a. Share of surviving spouse

1. One-third to spouse if the decedent is survived by more than one child

2. One-half to spouse if the decedent is survived by one child only

3. No children: First $20,000 to spouse and one-half of balance of estate

4. All of estate if: No children, decedent's parents, brother, sister, child of brother or sister, grandparent, uncle or aunt

b. Order of distribution to heirs - after spouse

1. Children

2. Parents of decedent (if no child)

3. Brothers and sisters of decedent (their children)

4. Grandparents - where deceased, children and grandchildren

5. Aunts and uncles and children of deceased aunts and uncles

6. Commonwealth

2. Limitations on distribution of an estate by will

a. What constitutes a will?

1. Testamentary capacity of maker

2. Form

3. Age of maker - 21 years (some exceptions)

4. Witness

5. Signature

b. Oral wills

1. $500 limitation

2. Cannot change an existing will

3. No real property

4. Must be reduced to writing within 10 days

c. Rights of spouse and children

1. Taking against a will is limited to spouse

3. Revocation of wills

a. A later will in writing

b. Destroying a will with intent to remake

c. Automatic revocation

1. Contrary to public decency and morals

2. Illegal - example: homicide

3. Gift to charity within 30 days of death

4. Clarity of intent

5. Gifts - under Wills Act

   a. Types of gifts under the Wills Act

      1. Gift inter vivos

         a. An intention or purpose to give

         b. A delivery, actual, symbolic or constructive

            (1) Essential elements:

                donee - full control

                donor - divested of control

      2. Gift causa mortis - gift made in comtemplation of death

         a. If recovery of health - gift may be revoked

         b. Same conditions as gift inter vivos

   b. Gift taxes

      1. No gift tax in Pennsylvania (except causa mortis - inheritance tax applies)

      2. Federal gift tax - limited to $30,000 + $3,000 per year to as many people as he wishes. Page 10, Correspondence Course #125.

6. Inheritance Taxes

   a. Pennsylvania tax

      1. 6 percent for immediate family (lineal descent only)

      2. 15 percent for others

      3. Joint property passing to remaining spouse not taxed

      4. Joint property passing to others is taxable

   b. Federal estate tax

      1. Marital exemption - one-half of estate left to husband or wife

      2. $60,000 exemption

      3. List property subject to federal estate tax

Should I Make a Will? - Worksheet

Circumstances

Wife Living? _____ Children: _____, _____, _____

Relatives: _____, _____, _____, _____, _____

1. Inventory of Assets Owned Jointly:

	Current value	Distribution by law, no will		Preferred distribution by will	
		Name	Amount	Name	Amount
Personal property	_____				
Real estate	_____				
Cash	_____				
Other	_____				
_____	_____				

2. Inventory of assets owned separately:

Personal property	_____				
Livestock	_____				
Machinery	_____				
Supplies	_____				
Auto	_____				
Other	_____				
Real Estate:					
Buildings	_____				
Land	_____				
Cash	_____				
Bonds	_____				
Other	_____				
_____	_____				

Sample Problem:

Inheritance Tax Problem

Situation: Edward Jones, a successful farmer, dies leaving an estate valued at $300,000. In his will he stipulates that his wife receives $200,000. His only child preceded him in death; however, he had one grandchild, a minor, to whom he willed $60,000. The remaining $40,000 was divided equally between his church and a younger brother.

Calculate the state inheritance and federal estate taxes on Edward Jones' estate.

Pennsylvania Inheritance Tax*		% Tax	Amount of Tax
$200,000	Amount inherited by wife	6	$12,000.00
60,000	Amount inherited by grandchild	6	3,600.00
20,000	Amount inherited by brother	15	3,000.00
20,000	Amount inherited by church	None	--------
	Total State Inheritance Tax		$18,600.00

*Paid by beneficiary

Federal Estate Tax**

A.	Total estate	$300,000.00
B.	Amount of estate left to wife	200,000.00
C.	Amount of marital exemption (one-half of A, maximum)	150,000.00
D.	Remaining value (B - C)	50,000.00
E.	Amount of estate left to other than wife (fully taxable)	100,000.00
F.	Total amount taxable (D + E) (See tax table)	150,000.00
G.	Exemption for estate	60,000.00
H.	Amount of estate taxable (F - G)	90,000.00
I.	Amount of tax (see tax table, Lesson 2, page 11, Correspondence Course #125)	20,000.00

**Paid by estate

Sample Problem:

Inheritance Tax Problem

Situation: Edward Jones, a successful farmer, dies leaving an estate valued at $300,000. In his will he stipulates that his wife receives $200,000. His only child preceded him in death; however, he had one grandchild, a minor, to whom he willed $60,000. The remaining $40,000 was divided equally between his church and a younger brother.

Calculate the state inheritance and federal estate taxes on Edward Jones' estate.

Pennsylvania Inheritance Tax*		% Tax	Amount of Tax
_____	Amount inherited by wife	_____	_____
_____	Amount inherited by grandchild	_____	_____
_____	Amount inherited by brother	_____	_____
_____	Amount inherited by church	_____	_____
		Total State Inheritance Tax	_____

*Paid by beneficiary

Federal Estate Tax**

A. Total estate _____

B. Amount of estate left to wife _____

C. Amount of marital exemption (one-half of A, maximum) _____

D. Remaining value (B - C) _____

E. Amount of estate left to other than wife (fully taxable) _____

F. Total amount taxable (D + E) (See tax table) _____

G. Exemption for estate _____

H. Amount of estate taxable (F - G) _____

I. Amount of tax (see tax table, Lesson 2, page 11, Correspondence Course #125) _____

**Paid by estate

Sample Problem:

Distribution of an Estate

Case of John Wilnot:

Thinking that he was about to die (doctor concurred), John Wilnot called in a friend, Harry Hand, and his housekeeper, Bessie Smith. Neither Hand nor Smith were related to Wilnot. While the doctor and a nurse looked on, Wilnot gave Hand $2,000 in cash. He gave Smith the key to his safe and stated that when he died the contents belonged to her. Wilnot died the next day. The safe contained $4,000. In addition to the cash given to Hand and the money in the safe, Wilnot had property valued at $50,000 (amount received at auction). The debts and cost of administration amounted to $10,000. Wilnot died without making a will. Surviving were:

Homer Wilnot, a brother
Albert Wilnot, nephew, child of his deceased sister, Sarah
Walter Wilnot, nephew, a posthumous son of his deceased brother, William
Elmer Wilnot, nephew, an adopted son of his deceased brother, James
Jane Wilnot, niece, daughter of deceased brother, James

1. Was the gift of the $2,000 cash given to Hand a valid gift? If so, how much is the Pennsylvania Transfer Inheritance Tax? Who pays it?

2. Was the $4,000 cash gift to Smith valid and enforceable? If so, how much is the Pennsylvania Transfer Inheritance Tax? Who pays the tax?

3. Divide John Wilnot's estate. Give size of portion and reasons for each allocation.

4. What kind of gift is involved in each of the gifts to Smith and Hand?

Distribution	Amounts	Reasons
Harry Hand	$2,000	Gift causa mortis
Bessie Smith	4,000	Gift causa mortis - giving of key symbolic of delivery of gift
Homer Wilnot	10,000	Four brothers and sisters of John Wilnot - each takes one-fourth of estate
Albert Wilnot	10,000	Take mother's share (Sarah) by representation
Elmer Wilnot Jane Wilnot	5,000 5,000	Each takes one-half of James Wilnot's share by representation (adopted children have same rights as natural child)
Walter Wilnot	10,000	Takes William Wilnot's share by representation (posthumous child has same rights as child born during father's lifetime)

FAMILY ESTATE RECORD

Completing this record will provide you an inventory of your estate that will be helpful to you, your attorney, and others in estate planning and in drafting a will. It will also be useful as a continuous family record of assets and liabilities. Date this when you first fill it out. Then as you make changes in it later, be sure to date each new entry.

DATE_____

FAMILY INFORMATION

HUSBAND'S NAME_____ Soc. Sec. No._____ Date of birth_____

WIFE'S NAME_____ Soc. Sec. No._____ Date of birth_____

CHILDREN (if married, give married names)

1. Name_____ Date of birth_____
   Address_____
2. Name_____ Date of birth_____
   Address_____
3. Name_____ Date of birth_____
   Address_____
4. Name_____ Date of birth_____
   Address_____

NAMES OF GRANDCHILDREN

_____

CHECKLIST OF DOCUMENTS AND OTHER IMPORTANT INFORMATION

Documents and information	*(√)*	*Location*
Abstracts and title policies		
Birth certificates		
Marriage certificate		
Armed forces papers		
Income tax returns		
Life insurance policies		
General insurance policies		
Savings account books		
Safety deposit box		
Safety deposit box key		
Stocks and bonds		
Wills, husband and wife	H____ W____	
Cemetery deed		
Automobile and truck titles		
Household goods inventory		

Important papers belonging to someone else:

Document_____ Name_____ Location_____

If you are a trustee or guardian, describe property held and person involved_____

ASSETS

SCHEDULE A — BANK, SAVINGS, AND MUTUAL ACCOUNTS

1. Checking Accounts

Bank_____ In whose name(s)_____ Ave. amt. $_____

Bank_____ In whose name(s)_____ Ave. amt. $_____

2. Savings and Mutual Accounts (including bank savings, savings and loan, credit union, and mutual accounts)

_____ In whose name(s)_____ Ave. amt. $_____

_____ In whose name(s)_____ Ave. amt. $_____

_____ In whose name(s)_____ Ave. amt. $_____

_____ In whose name(s)_____ Ave. amt. $_____

TOTAL (carry to page 8) $_____

SCHEDULE B — U.S. SAVINGS BONDS

Date purchased	*Serial number*	*Owner(s)**	*Maturity value*
			$
			$
			$
			$
			$
			$
			$
			$
			$

TOTAL (carry to page 8) $_____

SCHEDULE C — CORPORATE OR MUNICIPAL BONDS

Number	*Issuer*	*Owner(s)**	*Amount paid*
			$
			$
			$
			$

TOTAL (carry to page 8) $_____

* Names of owners should be taken directly from the face of the bond(s). Show such language as "and/or" to indicate how title is held.

SCHEDULE D — STOCKS

No. of shares	*Company*	*Common or preferred*	*Owner(s)**	*Value*
				$
				$
				$
				$
				$
				$
				$
				$
			TOTAL (carry to page 8)	$

SCHEDULE E — NOTES AND MORTGAGES HELD FOR LOANS YOU MADE TO OTHERS

Name of person in debt to you	*Name of person note is made out to**	*Date due*	*Amount*
			$
			$
			$
		TOTAL (carry to page 8)	$

SCHEDULE F — AUTOMOBILES AND TRUCKS

1. Make and year_____ Registered owner(s)_____

2. Make and year_____ Registered owner(s)_____

3. Make and year_____ Registered owner(s)_____

TOTAL VALUE (carry to page 8) $_____

SCHEDULE G — FARM MACHINERY

Brief description_____

TOTAL VALUE (carry to page 8) $_____

* Names of owners should be taken directly from the face of the stocks and notes. Show such language as "and/or" to indicate how title is held.

SCHEDULE H — LIVESTOCK

Kind and number _____

_____

TOTAL VALUE (carry to page 8) $ _____

SCHEDULE I — HOUSEHOLD GOODS

Brief description of any special items _____

_____

TOTAL VALUE (carry to page 8) $ _____

SCHEDULE J — GRAIN

Kind and amount _____

_____

TOTAL VALUE (carry to page 8) $ _____

SCHEDULE K — FARM REAL ESTATE

Tract 1. Legal description _____

_____

Location _____

Owned in name(s) of _____

If more than one owner, how held: _____ Joint tenancy (right of survivorship) or _____ Tenancy in common

Date of acquisition _____ How acquired: _____ Gift; _____ Purchase; _____ Inheritance

Price paid or value when acquired _____ PRESENT VALUE $ _____

Tract 2. Legal description _____

_____

Location _____

Owned in name(s) of _____

If more than one owner, how held: _____ Joint tenancy (right of survivorship) or _____ Tenancy in common

Date of acquisition _____ How acquired: _____ Gift; _____ Purchase; _____ Inheritance

Price paid or value when acquired _____ PRESENT VALUE $ _____

Tract 3. Legal description _____

_____

Location _____

Owned in name(s) of _____

If more than one owner, how held: ____ Joint tenancy (right of survivorship) or ____ Tenancy in common

Date of acquisition _____ How acquired: ____ Gift; ____ Purchase; ____ Inheritance

Price paid or value when acquired _____ PRESENT VALUE $ _____

Tract 4. Legal description _____

_____

Location _____

Owned in name(s) of _____

If more than one owner, how held: ____ Joint tenancy (right of survivorship) or ____ Tenancy in common

Date of acquisition _____ How acquired: ____ Gift; ____ Purchase; ____ Inheritance

Price paid or value when acquired _____ PRESENT VALUE $ _____

TOTAL VALUE ALL TRACTS (carry to page 8) $ _____

SCHEDULE L — URBAN REAL ESTATE

Tract 1. Legal description _____

Owned in name(s) of _____

If more than one owner, how held: ____ Joint tenancy (right of survivorship) or ____ Tenancy in common

Date of acquisition _____ How acquired: ____ Gift; ____ Purchase; ____ Inheritance

Price paid or value when acquired _____ PRESENT VALUE $ _____

Tract 2. Legal description _____

Owned in name(s) of _____

If more than one owner, how held: ____ Joint tenancy (right of survivorship) or ____ Tenancy in common

Date of acquisition _____ How acquired: ____ Gift; ____ Purchase; ____ Inheritance

Price paid or value when acquired _____ PRESENT VALUE $ _____

TOTAL VALUE ALL TRACTS (carry to page 8) $ _____

LIABILITIES

SCHEDULE M — BILLS AND ACCOUNTS PAYABLE

1. _____ Amount $_____

2. _____ Amount $_____

3. _____ Amount $_____

TOTAL AMOUNT (carry to page 8) $_____

SCHEDULE N — CHATTEL MORTGAGES (SECURITY INTERESTS)

	Property mortgaged	*Name of creditor or lender*	*Due date*	*Amount*
1.				$
2.				$
3.				$

TOTAL AMOUNT (carry to page 8) $_____

SCHEDULE O — REAL ESTATE MORTGAGES AND AMOUNTS OWED ON REAL ESTATE PURCHASE CONTRACTS

	Property	*Name of creditor or seller*	*Due date*	*Amount*
1.				$
2.				$
3.				$

TOTAL AMOUNT (carry to page 8) $_____

SCHEDULE P — UNSECURED NOTES

	Name of creditor or lender	*Due date*	*Amount*
1.			$
2.			$
3.			$

TOTAL AMOUNT (carry to page 8) $_____

INSURANCE INFORMATION

HUSBAND'S LIFE INSURANCE

	Company	*Policy number*	*Kind of policy*	*Beneficiary*	*Premium date*	*Amount*
1.						$
2.						$
3.						$
4.						$
					TOTAL	$

WIFE'S LIFE INSURANCE

	Company	*Policy number*	*Kind of policy*	*Beneficiary*	*Premium date*	*Amount*
1.						$
2.						$
					TOTAL	$

CHILDREN'S LIFE INSURANCE (TAKEN OUT BY PARENTS)

	Company	*Policy number*	*Kind of policy*	*Beneficiary*	*Premium date*	*Amount*
1.						$
2.						$
3.						$
4.						$
					TOTAL	$

HEALTH AND ACCIDENT INSURANCE

1. Company _____ Coverage _____ Premium $ _____
2. Company _____ Coverage _____ Premium $ _____

CASUALTY INSURANCE (on buildings, household goods, machinery, and vehicles)

1. Company _____ Coverage _____ Premium $ _____
2. Company _____ Coverage _____ Premium $ _____
3. Company _____ Coverage _____ Premium $ _____
4. Company _____ Coverage _____ Premium $ _____

SUMMARY OF ASSETS AND LIABILITIES

(Excluding Life Insurance)

ASSETS	*Schedule*	*Total* (Date_____)	*Total* (Date_____)	*Total* (Date_____)
Bank Accounts	A	$_____	$_____	$_____
U.S. Savings Bonds	B	$_____	$_____	$_____
Corporate or Municipal Bonds	C	$_____	$_____	$_____
Stocks	D	$_____	$_____	$_____
Notes and Mortgages Held for Loans You Made to Others	E	$_____	$_____	$_____
Automobiles and Trucks	F	$_____	$_____	$_____
Farm Machinery	G	$_____	$_____	$_____
Livestock	H	$_____	$_____	$_____
Household Goods	I	$_____	$_____	$_____
Grain Inventory	J	$_____	$_____	$_____
Farm Real Estate	K	$_____	$_____	$_____
Urban Real Estate	L	$_____	$_____	$_____
TOTAL ASSETS		$_____	$_____	$_____

LIABILITIES	*Schedule*	*Total*	*Total*	*Total*
Bills and Accounts Payable	M	$_____	$_____	$_____
Chattel Mortgages	N	$_____	$_____	$_____
Real Estate Mortgages and Amounts Owed on Real Estate Purchase Contracts	O	$_____	$_____	$_____
Unsecured Notes	P	$_____	$_____	$_____
TOTAL LIABILITIES		$_____	$_____	$_____
NET ESTATE		$_____	$_____	$_____

Form developed by N. G. P. Krausz, Professor of Agricultural Law, Department of Agricultural Economics

Cooperative Extension Work, University of Illinois, College of Agriculture, and the U.S. Department of Agriculture cooperating. JOHN B. CLAAR, *Director.*
Acts approved by Congress May 8 and June 30, 1914 / Urbana, Illinois / April, 1968 6M—4-68—96476—O-1434

Lesson 2. Life Insurance and Estate Planning

Objectives:

1. To acquaint students with the various kinds of life insurance

2. To have students compare term insurance and ordinary life insurance

3. To show students how to calculate their needs for life insurance (Use worksheet)

4. To teach students how to compare the actual value and return on different kinds of insurance

5. To encourage students to understand enough about life insurance to be able to request the provisions their circumstances require

6. To make students aware of the necessity for consulting competent counsel concerning contracts or investments

Student Learning Activities:

1. Each student determines his social security status. Four weeks prior to beginning of course obtain proper cards at local social security office, and have students mail them in to federal social security office.

2. Calculate life insurance needs - Life Insurance Needs Worksheet

3. Discuss types of life insurance policies and their applicability to each student's needs

References:

Social Security Handbook. Washington, D. C.: Government Printing Office.

Consumers Union Report on Life Insurance. Mount Vernon, N. Y.: 1967.

Kelsey, R. Wilfred. Handbook of Life Insurance. New York: Institute of Life Insurance, 1967.

Life Insurance Trust. Indiana, Pa.: First National Bank, 1967.

Pawlick, J. Edward. How To Avoid Being Overcharged By Your Life Insurance Salesman. York, Pa.: New Salem Press, 1968.

"Life Insurance: The Immaculate Deception," The Nation, September 30, 1968.

Subject Matter Outline:

A. Different Kinds of Life Insurance Policies

1. Cash-Value Life Insurance

a. Characteristics

b. Kinds of Policies:

1. Ordinary Life

2. Limited-Payment Life

3. Single-Payment Life

4. Endowment Policy

5. Minimum Deposit Plan

2. Term Life Insurance

a. Characteristics

b. Kinds of Term Insurance Policies:

1. Level Nonrenewable Term Insurance

2. Level Renewable Term Insurance

3. Decreasing Term Insurance

4. Family Income Plans

B. Reasons for Purchasing Life Insurance

1. Protect dependents financially against the untimely death of the wage earner

2. Provide protection when involved in a large indebtedness

3. Minimize estate taxes

4. Buy out the heirs of a business partner

5. Compensate a corporation for the death of a key executive

6. Underwrite a savings objective

7. Provide additional income at retirement

8. Provide lifetime support for a handicapped person or elderly parent

C. Circumstances when Insurance Protection is not necessary

1. Single person without dependents

2. Families endowed with independent wealth

3. Wife with a high earning capacity and capable of supporting herself and children

D. Facts to Consider in Determining the Amount of Life Insurance Necessary

(See Worksheet, Page 23)

1. Measure insurance policy's adequacy against the consequences of imminent death of the wage earner

   a. Family income fund

   b. Children's education fund

   c. Widow's retirement fund

2. Re-evaluate insurance frequently in respect to needs (at least once every five years)

   a. Changing responsibilities

      1. Birth of a child

      2. Permanent disability of child or wife

      3. Higher standard of living

      4. Inheritance or financial success that would decrease insurance needs

      5. Decision as to whether wife could or should work

   b. Household expenses usually require 65 to 75 percent of present take-home pay

   c. Determine amount necessary for protection of family now and in the future

   d. Consider other income and benefits that would accrue from social security

   e. Consider whether to include provision for the widow during the time that social security benefits end for the children and she reaches her sixty-second birthday

f. Review earnings in social security account (Absolutely essential)

g. Don't insure unnecessarily - wage earner first; women and children last

E. Protection Provided by Social Security - A Form of Life Insurance

1. Survivors of a "fully insured" wage earner entitled to receive both child-rearing benefits and widow's retirement benefits

   (Fully insured -- having required quarters)

2. Survivors of a "currently insured" person entitled only to child-rearing benefits. Widow not entitled to retirement benefits unless she earned them by working herself

3. Child-rearing income for a mother and her children continues until the youngest child's eighteenth birthday

4. Child's income will be paid until twenty-second birthday if he or she is a full-time student and does not marry

5. Disability benefits available under social security

6. Death benefit available

F. Life Insurance Trust

1. Provisions of a Life Insurance Trust

   a. The trustee, usually a financial institution, is named the beneficiary of the life insurance policies. At death the trustee collects the insurance proceeds and invests the money in income-producing stocks and bonds

   b. The interest and dividend income will be paid to wife during her life in monthly or quarterly installments

   c. Wife may be paid part of the principal if she needs it to maintain herself in her accustomed standard of living

d. If wife should become sick or otherwise incapacitated, the trustee will pay directly from the trust her medical, hospital, household and living expenses

e. When wife dies, any remaining principal divided equally among children. A child who will need financial protection for a life-time can have a portion held in trust, and any that remains at death can be distributed to heirs or beneficiaries.

f. To minimize estate tax, the wife should have a "general power of appointment" over part of the trust. This will enable her to direct, in her will, the person or persons who receive her share

g. Policies can be added to or withdrawn. A person can borrow on them, cash them in, or change the beneficiary at any time

h. The entire agreement completely revocable during lifetime of policy holder

2. Reasons for establishing a Life Insurance Trust

a. Frees beneficiary from burden of managing affairs of estate

b. High estate taxes if the wife receives the estate outright

c. Possible costly guardian fees for children in case of death of both parents at the same time

G. Do's and Don'ts of Buying Life Insurance

1. Do --

a. Study available information concerning insurance

b. Know needs and outline them to the insurance salesman

c. Read the fine print of a proposed policy

d. Compare premiums, protection, and value of savings made on premium

e. Purchase protection necessary until retirement age

f. Know the value of assets and the need for protection

g. Deal with reputable companies and representatives

h. Seek legal and tax advice when estate planning

2. Don't --

a. Purchase with only savings in mind

b. Accept a policy without consideration and investigation

c. Change policies without knowing the benefits

d. Burden yourself with more insurance than absolutely necessary for protection

e. Purchase from unknown companies or by mail. Choose your company and representative carefully

ERIC

LIFE INSURANCE NEEDS WORKSHEET

Objectives: to provide Family Income Fund, Education for Children Fund, Widow's Retirement Fund

A. Family Income Fund

Monthly income needs (wage earners present salary ($600) x .65 to .75)	a.	$390.00
Number of years needed (18 minus age of youngest child) or number of years until wife can work (use in f)	b.	15
Number of children	c.	3
Social security income per month (widow + children benefit)[1]	d.	354.40
Balance needed per month (a-d)	e.	35.60
Amount of capital fund needed (years needed multiplier)[2] x (e)	f.	5,020.

B. Widow's Retirement Fund

Estimated monthly income needed	a.	$275.00
Social security monthly benefits	b.	$115.50
Balance needed per month (a-b=c)	c.	$159.50
Price of life annuity for 20 years (174 x balance in c)	d.	$27,753
Amount of capital fund needed (d)	e.	$27,753

C. Education for Children Fund

Number of children	a.	3
Estimated cost of college per child ($10,000)	b.	$10,000
a x b = c	c.	$30,000
Social security contribution (No. of child.x$5,000)	d.	$15,000
Balance needed (c-d = e)	e.	$15,000

Number of years until needed for:

1st child	10
2nd child	14
3rd child	15
4th child	

Discount factor based on number of years until needed[3]

1st child	.71
2nd child	.62
3rd child	.60
4th child	
Total	1.93

Ave. discount factor (total ÷ No. of child.)	f.	.643
Amount of capital fund needed (f x e)		$9,645.00

Inventory of Assets & Liabilities

Family Assets

Life insurance	$10,000
Widow's pension fund accumulated (not social security)	$ 4,000
Cash on hand	$ 3,000
Equity in real estate	$ 6,000
Securities	
Other	
Total	$23,000

Family Liabilities

Uninsured debts (exclude home mortgage)	
Family income fund (A)	$ 5,020
Widow's retirement fund (B)	$27,753
Education for children fund (C)	$ 9,645
Total	$42,418

Amount of Additional Life Insurance Needed

Family assets - Family liabilities equals $19,418

[1] Table 1, page 27 [2] Table 2, page 28 [3] Table 3, page 29

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Monthly income needs (wage earners present salary x .65 to .75) a._____

Number of years needed (18 minus age of youngest child) or number of years until wife can work (use in f) b._____

Number of children c._____

Social security income per month (widow + children benefit)[1] d._____

Balance needed per month (a-d) e._____

Amount of capital fund needed (years needed multiplier)[2] x (e) f._____

B. Widow's Retirement Fund

Estimated monthly income needed a._____

Social security monthly benefits b._____

Balance needed per month (a-b=c) c._____

Price of life annuity (174 x balance in c) d._____

Amount of capital fund needed (d) e._____

C. Education for Children Fund

Number of children a._____

Estimated cost of college per child ($10,000) b._____

a x b = c c._____

Social security contribution (no. of child.x$5,000) d._____

Balance needed (c-d = e) e._____

Number of years until needed for:

1st child _____

2nd child _____

3rd child _____

4th child _____

Discount factor based on number of years until needed[3]

1st child _____

2nd child _____

3rd child _____

4th child _____

Total _____

Ave. discount factor (total ÷ No. of child.) f._____

Amount of capital fund needed (f x e) _____

Inventory of Assets & Liabilities

Family Assets

Life insurance _____

Widow's pension fund accumulated (not social security) _____

Cash on hand _____

Equity in real estate _____

Securities _____

Other _____

Total _____

Family Liabilities

Uninsured debts (exclude home mortgage) _____

Family income fund (A) _____

Widow's retirement fund (B) _____

Education for children fund (C) _____

Total _____

Amount of Additional Life Insurance Needed

Family assets - Family liabilities equals _____

---

[1] Table 1, page 19 [2] Table 2, page 20 [3] Table 3, page 21

TABLE 1. EXAMPLES OF MONTHLY CASH PAYMENTS FROM SOCIAL SECURITY

Average yearly earnings after 1950[1]	$1800	$3000	$4200	$5400	$6600	$7800
Retired worker - 65 or older						
Disabled worker - under 65	88.40	115.00	140.40	165.00	189.90	218.00
Wife 65 or older	44.20	57.50	70.20	82.50	95.00	105.00
Retired worker at 62	70.80	92.00	112.40	132.00	152.00	174.40
Wife at 62, no child	33.20	43.20	52.70	61.90	71.30	78.80
Widow at 62 or older	73.00	94.90	115.90	136.20	156.70	179.90
Widow at 60, no child	63.30	82.30	100.50	118.10	135.90	156.00
Disabled widow at 50, no child	44.30	57.60	70.30	82.70	95.10	109.20
Wife under 65 and one child	44.20	87.40	140.40	165.00	190.00	214.00
Widow under 62 and one child	132.60	172.60	210.60	247.60	285.00	327.00
Widow under 62 and two children	132.60	202.40	280.80	354.40	395.60	434.40
One child of retired or disabled worker	44.20	57.50	70.20	82.50	95.00	109.00
One surviving child	66.30	86.30	105.30	123.80	142.50	163.50
Maximum family payment	132.60	202.40	280.80	354.40	395.60	434.40

[1]Generally, average earnings are figured over the period from 1950 until the worker reaches retirement age, becomes disabled, or dies. Up to 5 years of low earnings can be excluded. The maximum earnings creditable for social security are $3,600 for 1951-1954; $4,200 for 1955-1958; $4,800 for 1959-1965; and $6,600 for 1966-1967. The maximum creditable in 1968 and after is $7,800 but average earnings cannot reach this amount until later. Because of this, the benefits shown in the last two columns on the right generally will not be payable until later. When a person is entitled to more than one benefit, the amount actually payable is limited to the larger of the benefits.

Table 2. Multipliers for number of years that a monthly income is needed when money is deposited at 3.5 percent and 4 percent interest

Years needed	Multiplier factor 3.5%	Multiplier factor 4.0%	Years needed	Multiplier factor 3.5%	Multiplier factor 4.0%
1	12	12	24	196	183
2	23	23	25	202	187
3	34	32	26	207	192
4	45	44	27	211	196
5	55	53	28	216	200
6	65	62	29	221	204
7	75	72	30	225	208
8	84	81	31	229	212
9	93	89	32	233	215
10	102	97	33	237	218
11	110	105	34	241	221
12	118	112	35	245	224
13	126	117	36	248	227
14	134	125	37	252	230
15	141	133	38	255	233
16	148	139	39	258	236
17	155	145	40	261	238
18	161	151	41	264	240
19	168	158	42	267	242
20	174	163	43	270	244
21	180	168	44	272	246
22	185	173	45	275	248
23	191	178			

Table 3. Discount factors at 3.5 percent and 4 percent discount rates

Years until needed	Discount factor 3.5%	Discount factor 4.0%
1	.97	.96
2	.93	.92
3	.90	.89
4	.87	.85
5	.84	.82
6	.81	.79
7	.79	.76
8	.76	.73
9	.73	.70
10	.71	.66
11	.69	.64
12	.66	.62
13	.64	.61
14	.62	.58
15	.60	.56
16	.58	.54
17	.56	.52
18	.54	.51
19	.52	.49
20	.50	.46

Lesson 3. Transferring Property to the Next Generation

Objectives:

1. To help students realize some of the technicalities involved in the transfer of property

2. To have students seek competent counsel before entering into real estate and other property transfer arrangements

3. To have students learn the alternative methods for property transfer

4. To discuss property transfer as an aid in the operation and management of the farm business

Student Learning Activities:

1. Students fill out checklist page 36 - Are You Considering Incorporation?

2. Study alternative methods for transferring property. List advantages and problems of each method

3. Survey class members for present plans to transfer their property. In individual instruction, evaluate the adequacy of these plans

References:

Correspondence Course #125. The Pennsylvania State University, College of Agriculture, University Park, Pennsylvania. Lesson #2.

Leaflet 277. "Why Bother With a Will?" Agricultural Extension Service, College of Agriculture, The Pennsylvania State University, University Park, Pennsylvania.

Circular 529. "Buying Farms on Sales Agreements." Agricultural Extension Service, College of Agriculture, The Pennsylvania State University, University Park, Pennsylvania.

Circular 530. "How To Buy or Sell a Farm." Agricultural Extension Service, College of Agriculture, The Pennsylvania State University, University Park, Pennsylvania.

Circular 526. "Father and Son Partnerships." Agricultural Extension Service, College of Agriculture, The Pennsylvania State University, University Park, Pennsylvania.

Circular 528. "Partnership Agreements for Farmers." The Agricultural Extension Service, College of Agriculture, The Pennsylvania State University, University Park, Pennsylvania.

Smith, R. S. "Incorporation of the Farm Business." Cornell Extension Bulletin 1016, New York State College of Agriculture, Ithaca, New York.

Hoards Dairymen, April 25, 1968.

Subject Matter Outline:

A. Sales Agreements (Installment Land Contract)

1. Why use a sales agreement?

a. Easier to take back property than with a mortgage. Deed not given until a specified amount has been paid (usually 25 percent)

b. Can include flexible payment terms

c. Seller can finance buyer

d. Save on federal income tax (capital gains)

e. Command a higher price

2. What property can be included?

a. Real estate - buyer records agreement in Recorder of Deeds office

b. Personal - record in Prothonotary's office in courthouse

3. Down payments, terms, and title

a. Amount of down payment and term of contract subject to agreement

b. Legal title - deed is given to buyer when a certain agreed upon portion of selling price has been paid. Method for financing the remaining sale price is determined.

Where applicable - pay off cattle and machinery first

c. Agreement may include right to pay off seller at any time

4. Major Improvements

a. Buyer runs same risk as under a mortgage - borrowing money without a deed

b. Seller be sure there is a non-lien agreement filed in courthouse by contractor

1. Buildings

2. Improvements

5. Taxes and Insurance

   a. Paid by buyer

   b. Buyer and seller should be listed as payees on insurance contracts

6. Tax advantages for seller

   a. If payment is 30 percent or less of purchase price, capital gains tax only on payment received in a particular year. Advantage applies to <u>any</u> sale where less than 30 percent of selling price is received in the first year.

      Problem - page 37

   b. Agreement must include interest charge of at least 4 percent

   c. Personal property tax

      Four-tenths of one percent county personal property on balance due

B. Partnership Agreements

   1. What makes a successful partnership?

      a. Compatibility

      b. Size of farm operation

   2. What is a partnership?

      a. Jointly-operated business

      b. Debt liability

      c. Liability insurance

   3. Operational conditions

      a. Ownership of property

      b. Management control

      c. Wages for partner

      d. Partnership bank account

      e. Division of profits

      f. Records

4. Continuity of partnership

   a. Length partnership is to run

   b. When a partner dies

   c. Sickness

5. Settling controversies

   a. Arbitration

   b. Separate living

   c. Written agreement

6. Taxes

C. Incorporation of the Farm Business

1. Advantages of incorporation

   a. Division of ownership

   b. Insulation from personal liability

   c. The owners may become employees of the corporation

2. Disadvantages of incorporation

   a. Legal red tape

   b. Costs of incorporation

3. The Tax question

   a. Federal income tax

   b. Less than ten stockholders, may bypass corporation taxes and pay as individuals

4. Corporate expectations

   a. Cannot settle family disputes

   b. May require more businesslike approach

   c. Not usually a method for raising capital

5. Transfer of ownership

   a. Convenient for transferring ownership to a number of heirs without forcing sale

   b. Does not automatically transfer ownership from parents to children. Stock may be sold, given, or willed.

6. Pre-incorporation agreement

   a. Determine parties to the agreement

   b. Determine general purpose of the agreement

   c. Determine value and nature of farm property or other capital contributed by each part

   d. Number and ownership of shares of stock

   e. Officers and directors

   f. Conducting business and decision-making

   g. Time and compensation

   h. Disposal of stock

   i. Determine value of stock

   j. What happens at death of stockholder

ERIC

Are You Considering Incorporation?

Use This Checklist*

	Yes	No
_____ Are you now farming with two or more members of your family?	_____	_____
_____ Is it likely that three or more of your sons, sons-in-law, or other family members will be owning and operating your farm together within the next ten years?	_____	_____
_____ Does your farm real estate, equipment, and livestock inventory at $200,000 or more?	_____	_____
_____ Do you have $25,000 or more in non-farm assets?	_____	_____
_____ Do you employ a large amount of seasonal labor?	_____	_____
_____ Do you retail a large part of your farm produce?	_____	_____
_____ Do you operate another business in addition to your farm?	_____	_____
_____ Is your business so profitable that you can frequently expect to be in the 22 percent personal income tax bracket or above? ($8,000 after exemptions and deductions).	_____	_____

If you checked "yes" for any of these questions you should consider incorporating your farm business. Incorporation will not always be the best solution in these situations, but deserves special attention if any of the above conditions exist.

* Cornell Extension Bulletin 1016.

Sales Agreement: Taxes

Sale for Cash:

Selling Price	$75,000
Basis	$50,000
Long Term Capital Gain	$25,000
Taxable	$12,500

Sales Agreement:

Selling Price	$75,000 / 10% down payment
Basis	$50,000
Long Term Capital Gain	$25,000
% Profit =	$25,000 / $75,000 = 33-1/3%
First Year Payment	$ 7,500
Capital Gain =	1/3 x 7,500 - $2,500
Taxable First Year	$ 1,250
Yearly Payments for 20 Years	$ 3,375
% Profit	33-1/3
Capital Gain	$ 1,124
Taxable Each Year	$ 562

SUMMARY OF PARTNERSHIP AGREEMENTS FOR FARMERS

What is a partnership?

A partnership is an agreement whereby two or more persons operate a business jointly for profit. The partnership may own all, some, or none of the property used in the business. The profits may be divided between the partners in any manner they decide. However, a businesslike basis is essential.

Each partner is solely, as well as jointly, responsible for all debts of the partnership. It is wise for each partner to carry adequate liability insurance. Each partner should make sure he knows of all debts contracted in his name. If one partner dies, the partnership ends unless alternatives are specified in the agreement.

Characteristics of Partnerships

Question	Two or more persons	Father and Son
Should You Have a Partnership?	Are you compatible? Is the farm business large enough for two or more families, or can it be made large enough?	Are you compatible? Is farm business large enough for two or more families, or can it be made large enough?
Ownership of property	In average cases, both partners own one-half of all partnership property. Depends on equity of each in partnership	Partnership may be based on labor and management share only, personal property share and/or real estate and personal property share. Often father rents real estate to partnership at determined rate
Management	Equal control by partners or one takes crops, other takes livestock	Equal control or father may keep power of final veto on management decisions
Wages	Each partner reimbursed for labor on equal basis	Each partner reimbursed for labor on equal basis

	Two or more persons	Father and Son
Bank Account		
	Separate partnership bank account from which all accounts are paid	Separate partnership bank account from which all accounts are paid
	Either one partner is designated to sign checks, or both sign; preferably both	Either one partner is designated to sign checks, or both sign, preferably both
Records		
	Accurate records are a necessity	Accurate records are a necessity
Protection for Wives		
	Wives should be present at all negotiations and initial planning	Wives should be present at all negotiations and initial planning
Options to buy		
	If partner retires or dies, written agreement provides for disposition of property	Son should have guarantee of eventually owning property
	Usual provision is for remaining partners to buy share of partnership	Should have option to buy Option should be by agreement and not by will
	Agreement either provides: (1) automatic purchase of partners interest, or (2) option to purchase or sell entire business and split proceeds	Son may use mortgage, but this is not recommended as it may tie up estate
	Value can be set at beginning of each year or agree to appraisal at death of partner	
	Term insurance on other partner will provide needed money (insurable interest)	
Length of Partnership		
	Any partner usually allowed to withdraw with reasonable notice	Any partner usually allowed to withdraw with reasonable notice
	Details similar to those in item "Options to buy if partner retires or dies" also should be provided for withdrawal	Details similar to those in item "Options to buy if partner retires or dies" should also be provided for withdrawal
Sickness		
	Usually wages for additional help are deducted from sick partner's share	Usually wages for additional help are deducted from sick partner's share
	Health and accident insurance needed	Health and accident insurance needed

	Two or more persons	Father and Son
Arbitration		
	Provision should be made for arbitrating disagreements	Provision should be made for arbitrating disagreements
	Problem could be submitted to outsider, or each could select a person who in turn would select a third person	Problem could be submitted to outsider, or each could select a person who in turn would select a third person
	Decision of outsiders would be binding	Decision of outsiders would be binding
Separate Living		
	Separate house for each family	Each partner supplies own housing Son could rent tenant house If single, pay room and board
Legal Problems		
	Plan a "blueprint for the future"	Avoid family problems by having all arrangements on a business level
	Select a good lawyer	
	Prepare inventory, financial statement, and goals	Avoid oral statements or "understandings."
Written agreement		
	All details should be out in writing because:	
	If it is in writing, there can be little question about the agreement between the parties	If it is in writing, there can be little question about the agreement between the parties
	Details will not be forgotten, even after many years, if it is written down. It will reduce misunderstandings	Details will not be forgotten, even after many years, if it is written down. It will reduce misunderstandings
	The surviving partner will not have to convince heirs of the terms of the agreement	The surviving partner will not have to convince heirs of the terms in the agreement
Liability		
	Partner's interest can be attached if unable to pay debts	Partner's interest can be attached if unable to pay debts
	Neither partner should endorse a note for anyone	Neither partner should endorse a note for anyone
	Liability insurance on each partner's car should be high	Liability insurance on each partner's car should be high
	Liability insurance on farm machinery and farm itself should be carried	Liability insurance on farm machinery and farm itself should be carried

	Two or more persons	Father and Son
Taxes		
	Federal Income Tax - on Partnership, using Form 1065	Federal Income Tax - on Partnership, using Form 1065
	Individual partners use regular 1040 forms	Individual partners use regular 1040 forms
	Owner of real estate can take less than 30 percent on purchase price each year and pay capital gains tax on this basis	Father can take less than 30 percent on purchase price each year and pay capital gains tax on this basis
	Other taxes handled on individual basis	Other taxes handled on individual basis
Social Security		
	Provisions should be made to insure Social Security income for each partner	Provisions should be made to insure Social Security income for father
Wills		
	Each partner should have a will.	Each partner should have a will.
	Wills should be reviewed periodically	Wills should be reviewed periodically

Documents - Lawyer will probably prepare the following:

1. A partnership agreement which lists all the details of the agreement
2. A buy- and sell-agreement which details what will happen upon the death of a partner
3. Any bill of sale necessary for the sale of personal property
4. Any I.O.U. notes that are necessary
5. Wills for all
6. Any other necessary documents

Lesson 4. Contracts

Objectives:

1. To teach what constitutes a valid contract

2. To show the consequences of failing to live up to a contract

3. To teach that knowledge of the law on contracts is important to the farmer

Student Learning Activities:

1. Landlords and/or tenants in class? Use a panel discussion of landlord-tenant problems and relationships

2. Ask lawyer to discuss with class the basic requirements of a contract

3. Work with individual class members and a lawyer on written lease contracts

References:

Miscellaneous Publication No. 837. "Your Livestock-Share Farm Lease." United States Department of Agriculture, Washington, D.C.

Miscellaneous Publication No. 838. "Your Crop-Share Cash Farm Lease." United States Department of Agriculture, Washington, D.C.

Correspondence Course #125. The Pennsylvania State University, College of Agriculture, University Park, Pennsylvania. Lesson #3.

Circular 529. "Buying Farms on Sales Agreements." Agricultural Extension Service, College of Agriculture, The Pennsylvania State University, University Park.

Adams, R. L. and W. W. Bedford. Everyday Farm Laws. Danville, Ill.: Interstate, 1955, pp. 25-33.

Hannah, H. W. and D. F. Storm. Law for the Veterinarian and Livestock Owner. Danville, Ill.: Interstate, 1959, pp. 10, 40-43.

Subject Matter Outline:

A. The requirements of a contract - An agreement that courts will enforce.

1. Basic requirements

a. Agreement among the parties

b. Consideration (sufficient)

c. Contractual capacity

d. Legal - courts will not enforce a contract for illegal acts

2. Oral contracts

a. Requires nothing in writing

b. Agreement on terms of contract

c. Statute of limitations - 6 years

3. Written contracts (contracts that must be in writing to be enforceable in Pennsylvania)

a. Sale of real estate

b. Lease of real estate for three or more years

c. Sale of personal property over $500

B. Breaking a contract (breach of contract)

1. Damages

a. Must be actual damages for second party to recover

b. Can recover only to the extent of the damages incurred

2. Forced compliance with contract

a. "Unique" items - court may enforce completion of contract

b. Contract for personal services usually can be broken subject to damages

c. Minors

C. Auction sales - When does the contract exist?

1. Offer and acceptance

a. Offer (bid) can be rescinded at any time prior to acceptance

b. Auctions without reserve

2. By-bidding illegal

D. Payment of debts

1. No dispute on amount of debt

a. Check tendered as full payment does not erase remainder of debt

b. Principle: Payee would be giving up remainder of debt without consideration

2. Amount of debt is in dispute or uncertain

a. Check tendered as full payment may be a binding contract

E. Fraud - In general, contracts may be voided upon proof of deliberate misrepresentation

1. Caveat emptor - "Let the buyer beware"

a. Common law rule applies now only where information is obvious upon inspection of buyer

b. Test is whether buyer purchased with reliance upon representation by seller

F. Warranty

1. Implied warranty

a. Law guarantees that goods were fit for the purpose intended

b. Waiver of implied warranty may be part of "express" warranty

2. Express warranty

a. May recover fully under the terms of the warranty

b. Express warranties frequently only "give" what the law already requires

G. Leases

1. Types of contract

a. Lease of real property is a "lesser estate"

b. Types of leases

1. Cash

2. Livestock-share

3. Crop-share

2. Characteristics of a "good" lease

   a. Fairness to all parties - a matter of ethics and not necessarily a matter of law

   b. Based on ability of property to produce income

3. Property rights under lease (must be stipulated in lease)

   a. Reservation of any land and buildings for landlord's use

   b. Right-of-entry provisions

   c. Sale of farm

   d. Heirs and successors

   e. Landlord guarantees he has right to lease property

4. Land and livestock use

   a. Lease should designate clearly the use of the land

   b. Number and kind of livestock to be raised

   c. Home use of farm produce and products by tenant should be specified

Method of Estimating Sharing of Expenses for the Agreement

Current Farm Expenses	Whole farm	Landlord's share	Tenant's share
1. Hired labor			
2. Repairs: a. Building			
b. Fence			
c. Machinery			
3. Depreciation:			
a. Buildings			
b. Fences			
c. Tractors and machinery			
d. Conservation investment			
4. Tractor fuel			
5. Machine work hired			
6. Veterinary charges, breeding fees, and other livestock expense			
7. Feed			
8. Seed			
9. Fertilizer and lime			
10. Other crop expense			
11. Insurance: a. Buildings			
b. Personal property			
12. Taxes: a. Land and buildings			
b. Personal property			
13. Miscellaneous			
14. Total current farm expenses			

Investment expenses	Est. value	Est. Int.rate		
16. Land and buildings				
17. Tractors				
18. Productive livestock				
19. Machinery and equipment				
20. Feed and supplies				
21. Conservation				
22. Other				
23. Total investment expense				
24. Total non-labor expense (14 plus 23)				
25. Tenant labor				
26. Landlord labor				
27. Unpaid family labor				
28. Total labor expense				
29. Total all expenses				

Lesson 5. Liability and Liability Insurance

Objectives:

1. To make student aware of liability arising from ownership and use of land

2. To teach student sufficient knowledge of the law so that he can intelligently protect himself against liability

Student Learning Activities:

1. Each adult class member reviews his liability insurance coverage: activities covered, amount of coverage, Workmen's Compensation

2. Study and discuss the employment of minors in agriculture, including hazardous occupations order

3. Conduct a farm or business survey (individual or field trip) to discover situations where liability through negligence might be incurred.

4. For discussion use opinionaire - Legal Concepts in Establishing Liability, page 52.

References:

Circular 535. "Farm Liability and Insurance." Agricultural Extension Service, College of Agriculture, The Pennsylvania State University.

Correspondence Course #125. The Pennsylvania State University, College of Agriculture, University Park, Pennsylvania. Lesson #4.

Farmer's Bulletin No. 2137. "Insurance Facts for Farmers." United States Department of Agriculture, Washington, D.C.

Hannah, H. W. and D. F. Storm, Law for the Veterinarian and Livestock Owner. Danville, Ill.: Interstate, 1959, pp. 15-24.

Adams, R. L. and W. W. Bedford. Everyday Farm Laws. Danville, Ill.: Interstate, 1955, p. 40.

Pennsylvania Agricultural Education, "Hazardous Occupations Order for Persons Under 16 Employed in Agriculture." Volume 47, No. 6 (February, 1968), p. 9.

Subject Matter Outline:

A. When is a person liable?

1. Causes intentional injury to another person

2. Negligence

a. What is negligence

b. Contributory negligence

3. Assumption of risk doctrine

B. Liability for action of hired man

1. Employer responsible for acts of agent or employee while acting in the scope of his employment

2. Employer held liable for acts of hired man may sue him for redress of damages

3. Employer's defense for liability suit on part of employee

a. Contributory negligence

b. Due to ordinary risks

c. Caused by negligence of a fellow worker

C. Employer's liability for safety of hired man

1. Negligence of employer - contributory negligence on part of employee

2. Workmen's Compensation Act

a. Voluntary for Pennsylvania farmers

1. Provides benefits to employee whether or not the employer is liable

b. Absolves employer of responsibility for civil damages. Worker covered by Workmen's Compensation cannot sue employer for damages under common law.

c. Costs to employer

d. Alternatives for farmer

D. Hazardous occupations in agriculture

1. Employment of minors (under 16 years of age) limited to non-hazardous occupations

a. Does not apply to own children on the home farm

b. Student-learner certificates

c. Sixteen hazardous occupations in agriculture listed by Secretary of Labor (see PAE - February 1968)

E. Liability of Farmer to Visitors

1. Trespasser on farm

a. Owner liable only for willful and wanton negligence

b. Exception, children

2. Guests on the farm

a. Duty to correct any dangers that are known

b. Not liable to hunters and fishermen except for willful negligence

3. Business visitors on the farm

a. Required to inspect premises to be certain that no hazard exists

F. Fences

1. Maintenance of adequate fences

a. Test for negligence

b. Poor fences - presumption is negligence

2. Animals

a. On the highway - depends on who was negligent

b. Damage to crops

G. Dogs

Opinionnaire:

Legal Concepts in Establishing Liability

Indicate whether you agree or disagree with the statements below:

A person harmed as a result of an activity by another should be compensated by the other irrespective of his fault.

Agree_____ Disagree_____

A person who harms another should be required to compensate the other only when his activity was intentionally wrongful or the result of negligence.

Agree_____ Disagree_____

Notes:

Lesson 6. Real Estate

Objectives:

1. To explain the different types and degrees of ownership in land

2. To acquaint students with deeds

3. To encourage students to seek competent counsel before entering into real estate transactions

4. To teach students the law and legal remedies in eminent domain proceedings

5. To teach students the water rights of land owners

Student Learning Activities:

1. Class completes courthouse field trip plans. Use plan; Field Trip to Courthouse, page 77

2. Take field trip - discuss observations

3. Have lawyer explain judgments, liens, and mortgages. Discuss questions with class

4. Determine if there are land-use zoning provisions in the area. If so, class should lay out land use areas on a map

References:

Correspondence Course #125. The Pennsylvania State University, College of Agriculture, University Park, Pennsylvania. Lessons #5, 6.

Circular 535. "So They're Taking Your Land." Agricultural Extension Service, College of Agriculture, University Park, Pennsylvania.

Farm Management 31. "Water Rights and the Farmer." Agricultural Extension Service, College of Agriculture, The Pennsylvania State University, University Park, Pennsylvania.

Doane's Agricultural Report. "Land Condemnation." p. 575.

Subject Matter Outline:

A. Property rights in land

1. Requirements of a deed

a. Must be in writing and signed by the grantor

b. Must contain words indicating the intention to transfer title to the property

c. Must contain a sufficient description of the realty to unmistakably identify it

d. Must be witnessed

e. Must be acknowledged before a notary public or other authorized official

f. Must be recorded in the courthouse to serve notice to all the world that the grantee has become the owner of the property involved. Failure to do so would give, to a subsequent innocent purchaser for value, title to the property that would be good even against the original buyer, if such subsequent purchaser records his deed before the prior purchaser has done so

g. Deed must be delivered to the grantee and accepted by him. A delivery in escrow results when the deed is prepared, executed, and delivered to a third person with the understanding that he is to deliver it to the grantee when some condition is performed. (Sometimes used in sales agreement contracts.)

2. Kinds of deeds

a. Quitclaim, or release deed conveys to the grantee whatever title the grantor has in the realty.

b. Bargain and sale deed conveys to the grantee the title, but makes no warranties with respect to the title to or the use of the property.

c. Full warranty deed conveys the title of the grantor to the grantee, and special warranties, called covenants, are made by the seller

3. Estates - The interest or right that a person has in land

   a. Freehold estates

      1. Estate in fee simple -- a person owns the land outright forever. Owner has right to use it or to dispose of it as he pleases, so long as his use does not interfere with the rights of others or contravene public policy

      2. Life estates -- a person holds the real property only for his own life, or during the life of another

   b. Estate Less Than Freehold -- The holder of such an estate has the right of enjoyment only for a fixed time

      1. Lease

      2. Rent

4. Joint tenancy -- estate owned by two or more persons together

   a. Tenancy in common

   b. Tenancy with right of survivorship

   c. Tenancy by the entireties

5. Contracts involving real estate

   a. Contract to purchase real estate

   b. Judgment

   c. Mortgage

6. Precautions to take before purchasing real estate

   a. Obtain the services of a good lawyer

   b. Have the title carefully searched

   c. Check county and state planning offices concerning future changes that might affect the property

   d. Have all necessary papers duly recorded

7. Selling real estate

   a. Profit on sale on real estate is taxable except in some cases where you purchase like property within one year. See federal income tax laws

   b. Receiving payment for real estate over a period of several years may result in lower income tax payments

   c. Investigate all possibilities to save money on the sale

   d. Protect yourself on extended payments by means of a mortgage or installment land contract

   e. Sales-transfer taxes must be paid to state and local government

B. Eminent domain

1. Who may take your land?

   a. Government - local, state, federal

   b. Quasi-public corporations - public utilities for public purposes

   c. "Just" compensation required

2. Reasons for condemnation

   a. Leases, right-of-ways

   b. Purchase for permanent installations

3. Procedures for land condemnation

   a. Taking agency will show landowner the exact extent of the land to be taken

   b. Taking agency will make or have made an appraisal

   c. Taking agency will make settlement offer

4. Legal remedies for landowner who is not satisfied

   a. Have an appraisal made by recognized appraiser

   b. Hire a lawyer

   c. Methods to determine value of property to be taken

d. Negotiate with taking agency

e. Court contest

f. Tax considerations

C. Water rights

1. Ownership of stream

a. Land under stream

b. Water in the stream

2. Riparian

a. Ownership - accrues to owner of one or both banks of a stream

b. Rights

3. Non-riparian owners

a. No right to use of water

b. Riparian owner has no right to transport water for use on non-riparian land

4. Dams on streams

a. Need permit (Water and Power Resources Board)

b. Exceptions

5. Surface water

a. Belongs to landowner

b. Drainage to other lands limited to natural drainage area

D. Rural zoning

1. Reasons

a. Protect farm land for farm use

b. Provide for orderly community and area development

2. Agricultural interest

a. Represented on planning board

Lesson 7. Motor Vehicle Laws Relating to Farm Machinery and Equipment

Objectives:

1. Acquaint the students with the motor vehicle laws that pertain to the operation and use of farm machinery and equipment on public highways

Student Learning Activities:

1. Each class member lists his machinery which is used on the highway

   Name purpose, distances, and other details

2. Supervised study, each class member finds the law pertaining to the use of the equipment he has previously listed

3. Discuss Problems for Class, page 61

References:

Correspondence Course #125. The Pennsylvania State University, College of Agriculture, University Park, Pennsylvania, Lesson 7.

Farm Management 32. "A Discussion of Motor Vehicle Laws for Pennsylvania Farmers." Agricultural Extension Service, College of Agriculture, The Pennsylvania State University, University Park, Pennsylvania.

The Vehicle Code (1964). Commonwealth of Pennsylvania, Department of Revenue, Harrisburg. Sec 401 (f) p. 32, Sec 834, p. 136.

Subject Matter Outline:

A. Registration

   1. Use of unregistered vehicles

      a. Farm work

      b. Inspection

      c. Eight-mile limitation

      d. Exemption certificate

   2. Reasons for non-registration

      Non-registered vehicles exempt from 6 percent Sales and Use Tax

B. Inspection

   1. Trucks used on the highways must be inspected whether registered or not

   2. Tractors do not need to be inspected

C. Operator's license

1. Required for operation of all registered vehicles

2. Persons driving trucks on highway must be licensed drivers

3. Limitations for children under 14

D. Size limitations

1. Width

2. Height

3. Length

a. Trucks

b. Tractors

4. Oversized equipment

a. Special permit

b. Daylight hours

ERIC

Problems for Class:

1. State the laws of the following:

   a. You are exchanging work with your neighbor and get no pay. You take your hay baler and wagons one-quarter mile down the road to his farm to bale hay.

      Answer: Neither tractor, wagon, nor baler needs registration and the driver does not need a license. Nothing needs to be inspected.

   b. You are doing custom work for your brother who lives 10 miles away. You take your tractor and wagon down the road for him and you also take some corn to sell to him.

      Answer: The tractor must be registered but the wagon does not because you are hauling your own agricultural products (corn) to market. The driver must be licensed because the tractor is registered, but the tractor does not need to be inspected.

   c. You use a truck to pull a wagon loaded with hay from a farm you rent back to the home farm, and they are in the same or adjoining counties.

      Answer: Nothing needs to be registered; however, the truck needs an exemption certificate which can be obtained free of charge from the Bureau of Motor Vehicles, Harrisburg, Pennsylvania. The truck must be inspected, the wagon does not, the driver must have license.

   d. You buy a tractor, use it for a year exclusively on the farm, and the register it.

      Answer: You owe the state 6 percent tax on the value of the tractor if you did not pay the tax at the time of purchase. Once the tractor is registered you lose exemption and must pay tax at that time.

RMV-538 (4-64)

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF REVENUE
BUREAU OF MOTOR VEHICLES
HARRISBURG 17122

APPLICATION FOR EXEMPTION FROM REGISTRATION

FOR DEPARTMENT USE ONLY

THIS FORM TO BE USED WHEN EXEMPTION FROM REGISTRATION IS CLAIMED FOR MOTOR VEHICLES, TRAILER OR SEMI-TRAILER TO BE USED ON THE HIGHWAY BETWEEN FARMS OWNED AND/OR OPERATED BY THE APPLICANT.

COMMONWEALTH OF PENNSYLVANIA
COUNTY OF _____ } SS:

(PRINT OR TYPEWRITE ALL INFORMATION IN FULL)
NO FEE REQUIRED

1. I (WE) _____
(NAME) (ADDRESS)
ENGAGED IN FARMING, DULY SWORN, MAKE APPLICATION FOR EXEMPTION FROM REGISTRATION OF THE VEHICLE/S LISTED BELOW, AND HEREBY AVER THAT THE STATEMENTS MADE HEREIN ARE TRUE AND CORRECT, AND THAT THE VEHICLE/S ARE FULLY EQUIPPED AS PROVIDED BY LAW.

2. GIVE INFORMATION REQUESTED BELOW OBTAINABLE FROM CERTIFICATE OF TITLE:

CERTIFICATE OF TITLE NO.	MAKE	TYPE OF BODY	MANUFACTURER'S NO.

3. GIVE LOCATION OF FARMS BETWEEN WHICH THE VEHICLE/S WILL BE USED _____

4. ARE THESE FARMS OWNED BY YOU? _____
(IF FARMS ARE OWNED BY YOU, ATTACH CERTIFICATION OF OWNERSHIP OBTAINABLE FROM COUNTY RECORDER'S OFFICE)

5. ARE THESE FARMS OPERATED BY YOU? _____
(IF OPERATED BY YOU, ATTACH CERTIFIED COPY OF CONTRACT OR LEASE AGREEMENT)

6. WHAT IS THE MOST DIRECT ROUTE BETWEEN THESE FARMS? (MAP OF ROUTE MAY BE DRAWN BY HAND ON BACK OF FORM AND MARKED TO SHOW LOCAL ROADS AND ROUTE NUMBERS) _____

7. WHAT MATERIALS, PRODUCTS OR EQUIPMENT WILL BE TRANSPORTED? _____

8. WILL THE ABOVE VEHICLE/S BE USED EXCLUSIVELY ON OR BETWEEN FARMS WHICH YOU OWN AND/OR OPERATE OR UPON THE HIGHWAY BY THE MOST DIRECT ROUTE CONNECTING SAID FARMS? _____

SEAL

SUBSCRIBED AND SWORN TO BEFORE ME THIS _____
_____ DAY OF _____, 19____

(SIGNATURE IN INK OF PERSON ADMINISTERING OATH)

Municipality County

(ADDRESS IN INK OF PERSON ADMINISTERING OATH)

MY COMMISSION EXPIRES _____, 19____

(APPLICANT'S SIGNATURE IN INK)

(PRINT NAME IN INK EXACTLY AS IT APPEARS ABOVE IN SIGNATURE)

SIGNATURE:—THE APPLICATION SHALL BE SIGNED BY THE OWNER, IF A NATURAL PERSON AND IN THE CASES WHERE THE OWNER IS A CORPORATION, COPARTNERSHIP, OR ASSOCIATION, BY AN EXECUTIVE OFFICER THEREOF OR SOME PERSON SPECIFICALLY AUTHORIZED BY SAID CORPORATION, TO SIGN THE APPLICATION, TO WHICH SHALL BE ATTACHED WRITTEN EVIDENCE OF HIS AUTHORITY.

Lesson 8. Laws Governing the Marketing of Farm Products

Objectives:

1. To create an awareness of the importance of grading, container, sanitary, and pesticide regulations and laws

2. To teach practices that will insure safe and wholesome farm products

3. To develop an attitude of concern for legal aspects of producing and marketing farm products

4. To understand market orders

Student Learning Activities:

1. Have each student explore an area or commodity of interest through independent study

2. Each farmer should initiate a pesticide-application records program. Follow-up on individual instruction

3. Have student survey and list the laws that govern the sale and marketing of products produced on his farm

References:

Special Circular 72. Pesticides On Your Farm, College of Agriculture, Extension Service, The Pennsylvania State University, University Park, Pennsylvania.

A Summary of Laws Administered by the Department of Agriculture, Pennsylvania Department of Agriculture, Harrisburg, Pennsylvania.

Requirements of the United States Food, Drug, and Cosmetic Act, Food and Drug Administration, U.S. Department of Health, Education and Welfare, Publication No. 2 (Revised September 1967), Washington, D.C.

4-H Leaders Handbook on Pesticides, College of Agriculture, Extension Service, The Pennsylvania State University, University Park, Pennsylvania.

The Federal Insecticide, Fungicide, and Rodenticide Act, United States Department of Agriculture, Agricultural Research Service, Pesticides Regulation Division, Washington, D.C.

Pennsylvania Pesticide Act (As amended April 3, 1968) Act No. 125.

Pennsylvania Fresh Eggs Law, Act of July 10, 1919, as amended.

Official Bulletin, Title 2, Commonwealth of Pennsylvania, Department of Agriculture, Bureau of Markets, Chapter XLIII - Standards for Grading and Marketing Eggs.

Leaflet 281. How To Read A Pesticide Label, The Pennsylvania State University, College of Agriculture, Extension Service, University Park, Pennsylvania.

Subject Matter Outline:

A. Sanitary requirements for farm products offered for sale

1. Milk

a. Purposes

b. Inspection and compliance

2. Fruits and vegetables

3. Grains

a. Livestock feed

b. Human consumption

4. Meat and meat products

a. Meat inspection

b. Poultry inspection

5. Eggs

6. Other

B. Pesticide and drug residues

1. Materials included

a. Pesticides

b. Drugs

2. Residues on crops

a. Tolerance factors

b. Zero tolerance

3. Residues in meat, milk, and eggs

4. Records of pesticide use

5. Reading and interpreting labels

C. Grading and standards

1. Fruits and vegetables

2. Grains

3. Meat and poultry

4. Eggs

5. Other

D. Containers and packages

1. Size, general requirements

2. Labeling

E. Market orders

1. Procedures and uses

2. Commodities

a. Milk

b. Other products

F. Enforcement and regulatory agencies

1. Pennsylvania Department of Agriculture (see attached list of laws administered by Pennsylvania Department of Agriculture).

2. Food and Drug Administration, Department of Health, Education and Welfare.

3. United States Department of Agriculture.

4. Local and municipal government regulations.

List of Laws Administered by the Pennsylvania
Department of Agriculture
(to June 30, 1966)

Animal Industry

Domestic Animal Law (Act of July 22, 1913, P. L. 928, as amended)
Animal Appraisal and Indemnity Law (Act of June 22, 1931, P. L. 682, as amended)
Dead Animal Disposal Law (Act of May 18, 1945, P. L. 796)
Equine Slaughtering Law (Act of April 20, 1949, P. L. 650)
Garbage Feeding Law (Act of June 19, 1953, P. L. 279)
Humane Slaughter Law (Act of Sept. 14, 1965, No. 263)
Livestock Dealers' and Brokers' Law (Act of June 22, 1931, P. L. 650, as amended)
Livestock Quarantine Law (Act of April 17, 1929, P. L. 533, as amended)
Livestock Trespassing Law (Act of June 10, 1931, P. L. 492)
Meat Hygiene Laws (Act of May 28, 1915, P. L. 587, as amended)
Poultry Technician Law (Act of April 6, 1956, P. L. 1429)
Reportable Diseases Law (Act of March 30, 1905, P. L. 78, as amended)
Stallion Law (Act of June 3, 1911, P. L. 631, as amended)

Dog Law Enforcement

Dog Law of 1965 (Act of Dec. 22, 1965, No. 437)
Mink Law (Act of Sept. 23, 1959, P. L. 933, as amended)

Foods and Chemistry

General Food Law (Act of May 13, 1909, P. L. 520, as amended)
Bakery Law (Act of May 22, 1933, P. L. 912, as amended)
Butter Law (Act of April 13, 1921, P. L. 129, as amended)
Candy Law (Act of May 23, 1887, P. L. 157)
Coffee and Chicory Law (Act of May 5, 1915, P. L. 247)
Cold Storage Law (Act of May 20, 1949, P. L. 1511, as amended)
Fresh Meat, Poultry, Game and Fish Law (Act of Mar. 28, 1905, P. L. 64, as amended)
Fruit Syrup Law (Act of March 3, 1925, P. L. 10, as amended)
Ice Cream Law (Act of Sept. 1, 1965, No. 215)
Identity of Milk and Dairy Products Law (Act of August 8, 1969, P. L. 975, as amended)
Kosher Products Law (Section 864, Penal Code of 1939)
Lard Law (Act of Mar. 11, 1909, P. L. 17)
Milk Can Law (Act of May 25, 1907, P. L. 233)
Milk Sanitation Law (Act of July 2, 1935, P. L. 589, as amended)
Non-Alcoholic Drinks Law (Act of July 5, 1957, P. L. 485, as amended)
Oleomargarine Law (Act of December 15, 1965, No. 412)
Oyster Law (Act of March 17, 1925, P. L. 34, as amended)
Processed Butter Law (Act of July 10, 1901, P. L. 643)
Sanitary Container Law (Act of May 21, 1937, P. L. 788)
Sausage Law (Act of April 6, 1911, P. L. 51, as amended)
Vinegar Law (Act of June 11, 1891, P. L. 297)

Agricultural Lime Act (Act of August 9, 1961, P. L. 971)
Caustic Law (Act of May 7, 1923, P. L. 139)
Commercial Feed Law of 1966 (Act of Sept. 1, 1965, No. 221)
Fertilizer Law (Act of May 29, 1956, P. L. 1795, as amended)
Paint Law (Act of April 10, 1925, P. L. 229)
Pesticides Law (Act of June 5, 1957, P. L. 248)

Markets

Bureau of Markets Law (Act of April 4, 1929, P. L. 144, as amended)
Fair Fund Section of State Harness Racing Law (Act of December 22, 1959, P. L. 1978, as amended)
Compulsory Marking Law (Act of May 28, 1929, P. L. 86, as amended)
Cooperative Law (Capital Stock) (Act of April 30, 1929, P. L. 885, as amended)
Cooperative Law (non-stock) (Act of June 12, 1919, P. L. 466, as amended)
Egg Laying Test Law (Act of May 20, 1931, P. L. 136)
Eggs Unfit for Food Law (Act of March 11, 1909, P. L. 13, as amended)
Fresh Eggs Law (Act of July 10, 1919, P. L. 900, as amended)
Produce Dealers License Law (Act of May 27, 1937, P. L. 901, as amended)
Encouragement of Agricultural Exhibitions (Act of July 25, 1917, P. L. 1195, as amended)

Plant Industry

Plant Pest Law (Act of April 21, 1937, P. L. 318, as amended)
Apiary Law (Act of April 6, 1921, P. L. 95, as amended)
Exposure of Poison (Act of June 24, 1939, P. L. 872, Section 638 of Penal Code, as amended)
Grape Herbicides Act (Act of Sept. 10, 1965, No. 262)
Seed Act of 1965 (Act of August 17, 1965, No. 187)
Seed Certification Law (Act of April 11, 1929, P. L. 488, as amended)
Stem Rust Control Law (Act of July 28, 1953, P. L. 652)

State Farm Products Show Commission (Administrative Code of 1929, P. L. 177, as amended)

State Harness Racing Commission

Harness Racing Law (Act of December 22, 1959, P. L. 1978, as amended)
Administering Drugs to Race Horses (Act of June 24, 1939, P. L. 872, Penal Code, as amended, by adding Section 950.1)

State Soil and Water Conservation Commission

Soil and Water Conservation Law (Act of May 15, 1945, P. L. 547, as amended)

Interpretations, Rules and Regulations pertaining to the laws listed are contained in the Department of Agriculture Rules and Regulations. This list was compiled from A Summary of Laws Administered by the Department of Agriculture.

Lesson 9. Where Law Comes From

"A rule of civil conduct, prescribed by the supreme power in a state, commanding what is right and prohibiting what is wrong." - Blackstone

Objectives:

1. To define law
2. To show the purpose and function of law
3. To show the origin and development of Common Law
4. To show the relationship and development of Constitutional and Statutory Law
5. To show the relationship of Statutory Law to the Common Law
6. To teach students how to find the law in a specific case
7. To realize why a knowledge of farm law is important to the farmer

Visual Aids:

Film: Why We Respect the Law (color, 14 min.), Coronet Instructional Films.

Student Learning Activities:

1. Supervised study using lesson #1 in the Correspondence Course #125 and the key questions for the unit
2. Make plans for court house field trip. What areas of the court house pertain to the "making of law?" Depending upon time and distance, a field trip for this specific purpose might be desirable. Otherwise, include this purpose in the over-all field trip for the unit
3. Discuss: How is knowledge of law important in agriculture?
4. List areas of concern about law

References:

Adams, R. L. and W. W. Bedford. Everyday Farm Laws. (1955) Interstate, Danville, Illinois, pp. 5-14.

Correspondence Course #125. The Pennsylvania State University, College of Agriculture, University Park, Pennsylvania, Lesson #1.

Hannah, H. W., and Donald F. Storm. Law for the Veterinarian and Livestock Owner. (1959) Interstate, Danville, Illinois, pp. 4-10.

Subject Matter Outline:

A. Common Law

1. "Stare decisis" - to stand by the decisions and not to disturb settled points. The decision is binding.

a. Based on precedent

1. Local (state courts)

2. Other states' decisions

3. In lack of precedent - related cases

b. Precedent (duty of the court)

1. Uphold precedent

2. Modify previous decisions

3. Overrule previous decisions

c. Ex Post Facto law - the Common Law is what the court will decide

2. Reasons for judicial law making

a. Essential to have some system for settling disputes

b. Impossible to anticipate in advance the infinite variety for possible situations

3. Relationship of Common Law to Legislative Law

a. Legislative Law may modify or repeal Common Law

b. Judicial decisions interpret and apply Legislative Law

4. Reasons for Common Law

a. Justice - Common Law is always based on reason

b. Convenience

B. Statutory Law

1. Origin of statutes

a. Local government (borough, city, county) ordinances

b. State government

c. Congress

2. Declaratory statutes

a. Purpose to make law uniform among the states

b. Makes law more readily available to the public

3. Remedial Statutes

a. Modify or repeal Common Law

b. Modify or repeal Statutory Law

C. Constitutional law

1. State Constitution

a. Guidelines for legislature

2. Federal constitution

a. Guidelines for congress

D. Administrative regulations stem from enabling acts of the legislature or congress

1. Examples

a. I.C.C. (Interstate Commerce Commission)

b. P.U.C. (Public Utilities Commission)

c. USDA

1. Marketing orders

2. Acreage allotments

E. The specific objectives of the law

1. Protection of the State

2. Protection of the public health, safety, and morals

3. Personal protection

4. Property protection

5. Title (ownership) protection

6. Freedom and limitations of personal action

7. Protection from exploitation, fraud, and oppression

8. Furtherance of trade

9. Defines creditor and debtor relationships

10. Political stability

11. Practical expediency

Key Questions:

1. What are the four sources of law?

2. What are ten specific objectives of law?

3. How is Common Law changed by Statutory Law?

4. For a case under Common Law, what is the duty of the court?

5. How does Common Law develop?

6. In what ways can you find the law for a specific case?

7. Why is Common Law necessary for our legal system?

8. How do courts make laws?

ERIC

Field Trip to Courthouse

Objectives:

1. To have students learn where records such as deeds, judgments, and liens are maintained

2. To familiarize students with the courthouse, library, and records

3. To teach procedures for recording deeds and mortgages

Advance Preparation:

1. Make arrangements to have a lawyer accompany the class as a resource person

2. List the offices to be visited: recorder of deeds, prothonatory, and others

3. Contact each office and make arrangements

Student Activity:

1. Have several of the students find the deeds to their property in the Deed Book

2. Have students check on liens and mortgages against their property (optional)

References:

Correspondence Course #125, The Pennsylvania State University, College of Agriculture, University Park, Pennsylvania. Lesson #5

VT 010 363
Oliver, J.D.
Agricultural Cooperatives; Curriculum Materials for Agricultural Education.

Virginia Polytechnic Inst., Blacksburg. Agricultural Education Div.
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DESCRIPTORS - *TEACHING GUIDES; LESSON PLANS; *COOPERATIVES; CURRICULUM GUIDES; *INSTRUCTIONAL MATERIALS; *AGRICULTURAL EDUCATION

ABSTRACT - Prepared with the assistance of personnel of Virginia Polytechnic Institute and evaluated by teachers of agriculture, this guide contains a series of teaching outlines intended to aid agriculture teachers in lesson planning. Teacher objectives, introductory information, group objectives, problems and concerns of students, references, visual aids and other equipment, content summaries, and suggestions for special activities and application and evaluation are provided for the following problem areas: (1) Understanding the Nature of Cooperatives, (2) Comparing a Cooperative with other Methods of Doing Business, (3) Organizing and Operating Cooperatives, (4) Financing Cooperatives, and (5) Understanding the Types of Cooperatives and the Services Provided. (AW)

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AGRICULTURAL COOPERATIVES

Curriculum Materials
for
Agricultural Education

U.S. DEPARTMENT OF HEALTH, EDUCATION
& WELFARE
OFFICE OF EDUCATION
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A Virginia Polytechnic Institute
Extension Division
Educational Field Services Publication

HOW TO USE THESE MATERIALS

This publication contains a series of teaching outlines for agricultural education programs. These outlines are for use by teachers of agriculture as guides in developing teaching plans. The various sections of the outlines are intended to be used as follows:

Situation. The teacher will need to develop the local situation as appropriate to each problem area as a basis for adjusting the plan to his or her situation.

Teacher Objectives. These are for the teacher's use only. They indicate what the teacher hopes to accomplish in each of the problem areas.

Introduction. Provides for introducing the lesson, helping students recognize the problem as their own and giving the teacher an indication of what the students already know. These things may be accomplished through discussion, use of visual aids, use of a field trip, or some other way.

Group Objectives. These are the students' reasons for studying the problem areas and should be developed with the group.

Problems and Concerns of Students. This section reflects the things that students should know in order to accomplish their objectives. The problems and concerns should be drawn from the group. The teaching outlines contain lists of problems students would be likely to suggest.

After the problems have been listed, the teacher should lead the students in a discussion of each problem, one at a time or in logical groups, to find out what they know; conduct supervised study on the things that students do not know or use the most appropriate of the many other teaching techniques available for helping students secure needed information (films, field trips, panels, lectures, resource persons, other visual aids); and lead the students in a final discussion and drawing of conclusions appropriate to the local situation and in supervised agricultural occupation experience programs.

References. A list of references is included in the outline for each problem area. The references listed are appropriate for use in supervised study.

Visual Aids and Other Equipment. Each outline contains a list of suggested visual aids and other equipment for use in studying the problem area.

Special Events and Activities. Suggestions are made for special events and activities as appropriate. These should be planned well in advance.

Application and Evaluation. A few suggestions for occupational experience activities and testing are included.

Content Summary. This section is for use only by the teacher. It is related to the "problems and concerns" section and contains a summary of the material in the references which pertains to the problems and concerns.

ERIC

Activity: Agricultural Cooperatives

Problem Area: I. Understanding the Nature of Cooperatives

Situation (local):

Teacher Objectives:

A. To develop an understanding of what a cooperative is.

B. To acquaint students with the importance of cooperatives in agribusiness.

C. To develop an understanding of the three basic cooperative principles.

D. To acquaint students with some reasons why farmers use cooperatives.

E.

Introduction (discussion questions):

A. What is a cooperative?

B. Who uses the services of cooperatives?

C. What are some of the benefits that may be obtained from using cooperatives?

D. What employment opportunities do cooperatives provide for you?

E.

Group Objectives (develop with group):

Suggested lead question: Why should we understand the nature of cooperatives?

A. Most of us now use or will use the services of cooperatives.

B. Cooperatives are a very important part of agribusiness.

C. We may wish to seek employment in a cooperative or to participate in the organization of one.

D.

Problems and Concerns of Students (develop with group): Suggested lead question: What things do we need to know about cooperatives in order to accomplish our objectives?

A. What is a cooperative?

B. How important are cooperatives in agribusiness?

C. What are the three basic cooperative principles?

D. What are some of the reasons why farmers use cooperatives?

E.

References:

Basic Cooperative Features, Bulletin Reprint 3, Farmer Cooperative Service, USDA, Washington, D. C. 20250. pp. 1-8.

Cooperatives in Agribusiness, Educational Circular 33, Farmer Cooperative Service, USDA, Washington, D. C. 20250. p. 1 and pp. 10-12.

Farmer Cooperatives -- Farm Business Tools, Agricultural Information Bulletin 275, Farmer Cooperative Service,USDA, Washington, D. C., 20250. pp. 3-25.

Krebs, A. H., Agriculture in Our Lives, Interstate Printers and Publishers, Danville, Illinois 61832. pp. 651-657.

Sample Legal Documents for New Cooperatives, Educational Circular 19, Farmer Cooperative Service, USDA, Washington, D. C. 20250. pp. 26-27.

The Family of Cooperatives Serving Virginia Farmers, Virginia Council of Farmer Cooperatives, Inc., Richmond, Va. 23208.

Visual Aids and Other Equipment:

A. Chalkboard.
B. Slide projector and screen.
C. Set of slides on "Visual Tour of Virginia Cooperatives" (obtain from the assistant supervisor in your area).
D. Slides 1-15 of the set "Cooperative Action: The Why and The Way" (obtain from the assistant supervisor in your area).
E.

Special Events and Activities:

A. Have students determine what cooperative memberships are held by their own families.
B. Have an informed member-patron or a director of a local farmer cooperative provide information on why farmers use cooperatives.
C. Assign a student to prepare and present a report on the topic "History of Cooperative Enterprise".
D.

Application and Evaluation:

A. Occupational experience activities.
   1. Compare cooperatives with other businesses as sources for purchasing inputs and as markets for products for occupational experience program and home farm.
   2.

B. Testing.
   1. Problem.
      A cooperative's gross proceeds were $2,000,000 for the services rendered to its patrons; its gross expenses were $1,900,000. If the net margins were distributed by patronage refunds and one farmer did $4000 business with the cooperative, how much would his refund be? Answer: $200.
   2. Short answer test (to be prepared by teacher).

Content Summary (for use by teacher):

A. A cooperative is a business owned and controlled by its member-patrons and operated for them on a non-profit basis. (Section 13.1-312 of the Code of Virginia contains the following policy regarding agricultural cooperative associations: "It is the declared policy of this State, as one means of improving the economic position of agriculture to encourage the organization of producers of agricultural products into effective nonprofit cooperative associations under the control of such producers, and to that end this act should be liberally construed.")

B. Cooperatives are important in agribusiness. Over 23,000 separate cooperative organizations serve the needs of rural America and at least indirectly serve all America.

C. The three basic cooperative principles are:

1. Operations at cost. Cooperatives operate on the basis of providing services at their cost. Since it is practically impossible to anticipate exact cost, cooperatives usually charge prices similar to other businesses and accomplish the operations at cost principle by returning the margin above cost to the patrons. The margin is returned to the patrons on a basis proportional to their use of the services and is usually called a patronage refund. To illustrate how patronage refunds are calculated, suppose a cooperative's gross annual proceeds were $1,000,000 and its gross annual expenses were $950,000. Subtracting the expenses from the receipts, the margin above cost to be returned to patrons is $50,000. Dividing the $50,000 net margin by the $1,000,000 gross proceeds, the net margin is 5% of the gross proceeds. Patrons would then receive a refund equal to 5% of the business done with the cooperative. For example, if a farmer did $10,000 business with the cooperative, he would receive a patronage refund of 5% of $10,000 or $500.

2. Democratic control. The final authority to control the affairs of the cooperative rests with the members who use it. This control is exercised by voting at meetings. Traditionally, voting is done on the basis of one vote per member. In some states, however, a member may have additional votes based upon patronage, shares of stock held, or some other measurement. Such a procedure relates voting power to the amount of economic interest a member has. (Section 13.1-321 of the Code of Virginia dealing with agricultural cooperative associations states that no member shall have more than one vote.)

3. Limited dividends on capital stock. Cooperatives must have capital to finance their operations just the same as any other business. A substantial portion of the capital is invested by members and the returns paid on this capital are limited by law (usually to an 8% maximum or less; Section 13.1-322 of the Code of Virginia limits dividends to a 6% maximum).

D. The main reasons why farmers use cooperatives (purposes for which they are organized) are:

1. To help improve market returns. Some of the ways that cooperatives help improve market returns are by strengthening bargaining power, producing quality products, merchandising more effectively, processing when profitable, developing new products and marketing practices, and selling more products abroad.

2. To obtain supplies at a lower cost. Some of the ways that cooperatives reduce the cost of supplies are by operating at cost, by volume buying, by providing direct plant-to-farm services, and by doing their own manufacturing and processing. Cooperatives have also aided farmers in getting the type and quality of supplies needed.

3. To improve farming practices. Through cooperatives, farmers often are able to receive the help of specialists, to have their products and supplies handled in bulk, to receive personalized services, and to keep better informed.

4. To get other services more economically. Cooperatives provide a number of additional services closely related to farming such as electricity and telephones, credit, insurance, and artificial breeding.

Activity: Agricultural Cooperatives

Problem Area: II. Comparing a Cooperative with Other Ways of Doing Business

Situation (local):

Teacher Objectives:

A. To acquaint students with the four ways of doing business in the United States.

B. To develop an understanding of various features of the different ways of doing business.

C. To familiarize students with the taxation of the different ways of doing business.

D. To make students aware of the advantages and disadvantages of each way of doing business.

E.

Introduction (discussion questions):

A. What are the four ways of doing business in the United States?

B. What are the names of some local firms that are organized according to each of the ways of doing business?

C. Do cooperatives pay taxes the same as other ways of doing business?

D. Why do we have different ways of doing business in our private enterprise system?

E.

Group Objectives (develop with group):

Suggested lead question: Why should we compare a cooperative with other ways of doing business?

Expected responses:

A. All the different ways of doing business are found in the industry of agriculture.

B. So that we can make wise use of the agricultural businesses in our community.

C. To assist us in preparing for agricultural business employment opportunities.

D.

Problems and Concerns of Students (develop with group): Suggested lead question: What things do we need to know about the different ways of doing business in order to accomplish our objectives?

A. What are the four ways of doing business in the United States?

B. How do the four ways of doing business compare with regard to the following features:

1. Who is served?
2. Who decides policy?
3. Who manages?
4. How is voting done?
5. Who owns the business?
6. How is the business financed?
7. What are the returns on invested money?
8. How may net margins be used?
9. What is owners' liability?

C. What taxes do the different ways of doing business pay?

D. What are the advantages and disadvantages of each way of doing business?

E.

References:

Cooperatives in Agribusiness, Educational Circular 33, Farmer Cooperative Service, USDA, Washington, D. C. 20250. pp. 5-9.

Farmer Cooperatives -- Farm Business Tools, Agricultural Information Bulletin 275, Farmer Cooperative Service, USDA, Washington, D. C. 20250. pp. 33-34.

How We Organize to Do Business in America, National Education Association and American Institute of Cooperation, Washington, D. C. pp. 15-27, particularly pp. 21-27.

Krebs, A. H., Agriculture in Our Lives, Interstate Printers and Publishers, Danville, Illinois 61832. pp. 658-660.

Visual Aids and Other Equipment:

A. Chalkboard.
B. Overhead projector, screen, and transparency of Table 1 in the content summary of this outline.
C. Slide projector, screen, and set of slides on "Cooperatives and Their Business Neighbors" (obtain from the assistant supervisor in your area).
D.

Special Events and Activities:

A. Invite the manager of a local business to present information regarding his type of business (the way he does business).
B. Assign a student to prepare and present a report on "The American Private Enterprise System."
C.

Application and Evaluation:

A. Occupational experience activities.
   1.

B. Short answer test (to be prepared by teacher).

Content Summary (for use by teacher):

A. The four ways of doing business in the United States are:
   1. Individual ownership. The business is owned and controlled by a single individual. This is the most common type of farm business structure.

2. Partnership. A business firm that is jointly owned by two or more people who have agreed to operate on a partnership basis. Father-son partnerships are not uncommon in farming.
3. Ordinary business corporation. A state-chartered business firm operated to make a profit for the stockholders who own it.
4. Cooperative business corporation. A state-chartered business firm operated to perform services for its member-owners as users rather than make a profit for investor-owners.

B. A comparison of various features of the four ways of doing business is shown in Table 1.

C. All the different ways of doing business pay local and state taxes (such as real estate, personal property, state income, franchise and the like except as provided in Section 13.1 - 341 of the Code of Virginia which reads as follows: "For the privilege of storing and/or marketing farmers' crops or products including dairy products, fruit or livestock, an association shall, however, pay only an annual license fee of ten dollars which shall be in lieu of all other corporation, franchise and income taxes, taxes on capital, taxes and charges upon reserves held by the association, and all State and local license taxes on that part of its business which is solely and exclusively the storing and/or marketing of farmers' crops or products").

The different ways of doing business are all subject to federal income tax. (The net income of a partnership is immediately income to the partners, so only the individual partners pay income taxes on their share of the net income; the partnership simply files an information return on its net income, showing how much is received by each partner.) In computing their net income, all businesses may exclude refunds to their customers if the refunds are paid to fulfill an existing agreement (such refunds are not income to a business). Cooperatives are thus able to exclude patronage refunds from their income calculations.

On the net income that they have, "nonexempt" cooperatives pay federal income tax the same as other businesses (at the corporate rate). Farmers' cooperatives which meet certain government provisions may become "tax exempt" -- that is, they are exempt from federal income taxes on any net income which they may have. Only about one-half of all farmer cooperatives get the "tax exempt" status each year. Patronage refunds are, of course, included in the taxable income of the patrons if the refunds arise from business activity of the patrons.

Table 1. Comparison of Four Ways of Doing Business in the United States

Features Compared	Type of Business			
	Individual Ownership	Partnership	Ordinary Business Corporation	Cooperative Business Corporation
1. Who is served?	The consumer	The consumer	The consumer	Chiefly the members
2. Who decides policy?	The owner	Partners agree	Board of directors	Board of directors
3. Who manages?	The owner	One or both partners	Officers and their assistants	General manager and staff
4. How is voting done?	None necessary	Partners agree	Each shareholder has one vote per share	Members (usually one vote each)
5. Who owns the business?	The individual	The partners	The stockholder	The member-patrons
6. How is business financed?	Personal capital and loans	Partners' capital and loans	Stocks, bonds, and loans	Members' capital and loans from banks and individuals.
7. What are the returns on invested money?	Unlimited	Unlimited	Unlimited	Limited to 8% or less in some states
8. How may net margins be used?	As owner desires	As agreed by partners	Dividends, reserves, surplus	After payment of dividends on stock, balance allocated to patrons on a patronage basis
9. What is owners' liability?	All property of owner	All property of partners	Limited to assets of corporation	Limited to their investment in cooperative.

D. There are certain major advantages and disadvantages of each of the ways of doing business. The following are a few of the more important ones:

1. Individual ownership.
   Advantages:
   a. It is easy to control--owner's judgment is final.
   b. All profits are sole property of the owner.
   c. It is very flexible and offers great opportunity for personal initiative and ingenuity.
   d. Usually requires no special legal formalities to form individual business.
   Disadvantages:
   a. All losses are borne by the owner.
   b. Capital is limited by what the owner can put up or borrow.

2. Partnership.
   Advantages:
   a. Amount of capital available is usually greater than for individually owned business.
   b. Several partners may bring special skills and training into the firm.
   Disadvantages:
   a. Each partner is liable for any and all debts of the partnership.
   b. If one partner dies or wishes to leave the partnership, it is dissolved.

3. Ordinary business corporation.
   Advantages:
   a. Stockholders have limited liability. If business fails, stockholders lose only the amount of their investment in stock.
   b. Continuity of existence. A business corporation is a legal entity, an artificial person created when the business is chartered, usually with perpetual existence.
   c. Transferability of shares. Shares of stock in many corporations may be bought and sold daily on stock exchanges.
   Disadvantages:
   a. Stockholders have limited control of business.
   b. Considerable legal formalities and costs involved in organizing and operating business.

4. Cooperative business corporation.
   Advantages:
   a. Stockholders have limited liability.
   b. Continuity of existence.
   c. Exists in order to provide economic benefits to its members rather than make a profit.

Disadvantages:

a. Member-owners have limited control of business.
b. Considerable legal formalities and costs involved in organizing and operating business.

Activity: Agricultural Cooperatives

Problem Area: III. Organizing and Operating Cooperatives

Situation (local):

Teacher Objectives:

A. To familiarize students with how cooperatives are organized.

B. To develop an appreciation of the role of the various people involved in the operation of a cooperative.

C.

Introduction (discussion question):

A. What does it mean for a business to be incorporated?

B. What is the purpose of the bylaws of a corporation?

C. How does a person become a member of a cooperative?

D. What are the four groups of people involved in the operation of a cooperative?

E.

Group Objectives (develop with group):

Suggested lead question: Why should we know how cooperatives are organized and operated?

Expected responses:

A. We may wish to take the lead in organizing a cooperative.

B. Many of us will be involved in the operation of a cooperative.

C. The corporate form of business is widely used in our economy.

D.

Problems and Concerns of Students (develop with group): Suggested lead question: What do we need to know about the organization and operation of cooperatives in order to accomplish our objectives?

A. Cooperative organization:
   1. What are the articles of incorporation?
   2. What are the bylaws?
   3. What is a marketing agreement?
   4. How does one become a member of a cooperative?
   5. What is the difference between local and regional cooperatives and how are regional cooperatives classified?
   6.

B. Cooperative operation:
   1. What are the four groups of people involved in the operation of a cooperative?
   2. What is the role of each of the groups of people in the operation of a cooperative?
   3.

References:

Cooperatives in Agribusiness, Educational Circular 35, Farmer Cooperative Service, USDA, Washington, D. C. 20250. pp. 13-20.

Farmer Cooperatives -- Farm Business Tools, Agricultural Information Bulletin 275, Farmer Cooperative Service, USDA, Washington, D. C. 20250. pp. 26-31.

Sample Legal Documents for New Cooperatives, Educational Circular 19, Farmer Cooperative Service, USDA, Washington, D. C. 20250. pp. 3-20, 25-26.

Visual Aids and Other Equipment:

A. Chalkboard.
B. Overhead projector, screen, and transparency of Figure 1 on page 28 of the bulletin "Farmer Cooperatives -- Farm Business Tools" (see references section of this outline).
C. Slide projector, screen, and slides 16-37 of the set "Cooperative Action: The Why and The Way" (obtain from the assistant supervisor in your area).
D.

Special Events and Activities:

A. Determine what officers (including board of directors) in cooperatives are held by members of students' families.
B. Secure a copy of each of the following from a local cooperative: (1) articles of incorporation, (2) bylaws, (3) marketing agreement (if it is a marketing cooperative), (4) membership application (if one is used), and (5) membership certificate (if one is used).
C. Assign a student to prepare and present a report on "How to Start a Cooperative".
D.

Application and Evaluation:

A. Occupational experience activities.
   1. Become a member of a cooperative.
   2. Organize a student cooperative.
   3. Attend annual meeting of a local cooperative.
   4.

B. Short answer test (to be prepared by teacher)

Content Summary (for use by teacher):

A. Cooperative organization.

   1. The articles of incorporation are a statement of the kind and scope of business the cooperative is designed to do. These articles specify the name of the organization, its purpose, the scope of its authority, its registered agent who must be a member of the board of directors and his business office address, the number of directors, and whether the capital is stock or nonstock.

   2. The bylaws tell how a cooperative is going to operate. They are more descriptive and detailed than the articles of incorporation. Typically the bylaws contain provisions for membership eligibility, election of directors, annual meetings, officers' duties, voting rights, dues and assessments, and rate of dividends (if any) to be paid on members' capital invested.

   3. Many marketing cooperatives use what is called a marketing agreement. This agreement, which may be referred to in the bylaws as a separate document or included as a section of the bylaws, is a

contract between the cooperative and a member. It states the duty and intent of the member to deliver a specified amount or percent of his production to the cooperative.

4. The procedure to follow in becoming a member varies with the type of cooperative. Some associations, particularly marketing associations, require a formal application for membership and issue a membership certificate. In other cooperatives, particularly purchasing cooperatives, membership is identified with patronage. A patron making a purchase becomes eligible for membership if he qualifies as a producer.

5. Cooperatives may be classified as locals or regionals depending upon the geographic area served and the makeup of membership.

   A local association provides services for a community, a county, or several counties. Individuals are the members of a local cooperative.

   A regional cooperative is one that usually serves an area comprising a number of counties, an entire state, or a number of states. There are two important classifications of regionals based entirely upon the makeup of their membership -- federated or centralized (some regionals are combinations of the two).

   A federated cooperative is a cooperative of cooperatives with local cooperatives being its members. These local cooperatives are operated by local managers appointed by and responsible to local boards of directors.

   The federated cooperative has its own general manager and staff and a board of directors elected by and representing the local associations. The locals are autonomous but depend in varying degrees on the federation for a variety of services.

   A centralized cooperative may serve patrons in an area covering at least 5 to 10 counties and often a greater area. A regional centralized association is structurally like a small-scale local cooperative -- individual persons make up the membership.

   A centralized cooperative has one central office, one board of directors, and one general manager who supervises the entire operation which may be conducted through several branch offices.

B. Cooperative operation.

1. The four groups of people involved in the operation of a cooperative are:

   a. Directors.
   b. Manager and his key assistants.
   c. Clerical and operating employees.
   d. Member-patrons.

2. The role of each of the groups of people involved in a cooperative is as follows:

   a. Directors. Elected by members at the annual member meeting. The board of directors is responsible for managing the affairs of the association. This includes selecting managerial personnel, delegating authority and assigning duties to managerial personnel, formulating policies, checking to see that policies are being followed, and evaluating the results obtained from the operation of policies adopted. (Section 13. 1 - 324 of the Code of Virginia specifies that the business of an agricultural cooperative association shall be managed by a board of not less than five directors. The directors, with the exception of the public directors, shall be elected from the membership of the association or from the officers, directors, or membership of a member association. The bylaws shall provide that one or more directors shall be appointed by the Director of the State Agricultural Extension Service. The director or directors so appointed shall be known as public directors. They need not be members of the association or officers, directors or members of a member association, but shall have the same powers and rights as the directors elected by the members.)

   b. Manager and his key assistants. The manager is selected by the board of directors and he selects his assistants. After the board has decided what a cooperative will do, the manager and his staff decide how it can best be done. Ideally, the manager's principal tasks are planning, reporting to the board of directors, conferring with members of his management "team", maintaining good organizational relations, and controlling the cooperative's operations.

   c. Clerical and operating employees. These are selected by the manager on the basis of their qualifications for the job. They

carry on the various operations in the cooperative business. In many cases, cooperatives have training programs for their employees.

d. Member-patrons. Cooperatives are organized by members and exist only to serve the need of members. At the annual meeting, members larn how their cooperative is doing and have a chance to make their wishes known.

Members are responsible for using the services of their cooperative and encouraging others to do so. As a cooperative grows, members provide a portion of the new capital needed.

Members are also responsible for serving as directors, for serving on committees, calling on prospective new members, and representing the cooperative in various community activities. (According to Section 13. 1 - 321 of the Code of Virginia, an agricultural cooperative association may admit as members only bona fide producers of agricultural products, including tenants and landlords receiving a share of the crop, and cooperative associations of such producers.)

Activity: Agricultural Cooperatives

Problem Area: IV. Financing Cooperatives

Situation (local):

Teaching Objectives:

A. To acquaint students with the capital structure of cooperatives.

B. To develop an understanding of the capital needs of cooperatives and the possible sources of this capital.

C. To familiarize students with the initial capital needed by cooperatives and how it is provided.

D. To develop an understanding of the revolving-capital financing plan used by cooperatives.

E. To acquaint students with the types of reserves that cooperatives build up.

F.

Introduction (discussion questions):

A. Do cooperatives issue stock as other corporations do?

B. For what purposes do cooperatives need capital?

C. Who provides the capital needed by cooperatives?

D.

Group Objectives (develop with group):

Suggested lead question: Why should we know how cooperatives are financed?

Expected responses:

A. We may wish to participate in organizing a cooperative.

B. Many of us will be members of cooperatives and will assist in financing them.

C. The information will be helpful in preparing for employment in a cooperative or in some other type of agricultural business.

D.

Problems and Concerns of Students (develop with group): Suggested lead question: What do we need to know about financing cooperatives in order to accomplish our objectives?

A. What is the difference between a cooperative organized with capital stock and one organized without?

B. What are the capital needs of cooperatives and the sources of this capital?

C. For what purpose is initial capital needed by cooperatives and how is it provided?

D. How does a revolving-capital financing plan work?

E. What types of reserves do cooperatives build up?

F.

References:

Cooperatives in Agribusiness, Educational Circular 33, Farmer Cooperative Service, USDA, Washington, D. C. 20250. pp. 21-26.

Farmer Cooperatives -- Farm Business Tools, Agricultural Information Bulletin 275, Farmer Cooperative Service, USDA, Washington, D. C. 20250. pp. 31-33.

Visual Aids and Other Equipment:

A. Chalkboard.

B.

Special Events and Activities:

A. Borrow from parents samples of cooperative stock certificate, membership certificate, membership agreement, etc., for class inspection.

B. Study a financial statement from a local cooperative.

C.

Application and Evaluation:

A. Occupational experience activities.
   1. Develop plan for financing a student cooperative.
   2.

B. Short answer test (to be prepared by teacher).

Content Summary (for use by teacher):

A. In most states, a cooperative may be organized with capital stock or without.

   If the association is a capital stock organization, members receive stock certificates as evidence of their ownership interest. More than one type of stock may be issued but usually no more than two types are necessary. Most stock cooperatives issue one share of common stock per member to show membership. Common stock is usually the voting stock. Preferred stock is issued to show additional capital contributions and is generally non-voting stock.

   If the association is a non-capital stock organization, it issues some kind of membership certificate -- sometimes called a revolving fund certificate -- to show capital contributions of members. Many nonstock cooperatives raise some or most of their original member capital by means of a membership fee.

B. Cooperatives need two kinds of capital--fixed and operating. Fixed capital is money to buy such things as land, buildings, and equipment. Operating capital is the money required to keep the business going --

advancing members money on the products marketed for them, obtaining farm supplies, paying the light and water bills, paying the employees, and buying the operating supplies such as packing cartons, office supplies, and miscellaneous items. The three sources of this capital are:

1. Members who invest in the cooperative to get needed services.

2. Nonmember patrons; other cooperatives; marketing and supply companies; and individuals, firms, and organizations that invest in the cooperative to earn dividends or because they are interested in the welfare of the cooperative.

3. Loans from such lending agencies as a bank for cooperatives, a commercial bank, or, in certain cases, one of the number of government agencies.

C. Initial capital is needed (1) to buy land, buildings, equipment, and other facilities and (2) to operate the business the first year.

Part or all of this original capital will come from the members. Usually some of it comes from outside credit sources.

Member capital. It is desirable that each member's share be proportionate to his expected use of the cooperative. If members contribute more than their share, this will not entitle them to any special privileges. Under certain conditions, if members of a cooperative do not have enough funds or credit to subscribe their share of the initial capital, the cooperative may be eligible to obtain special loans from the Farmers Home Administration, USDA, under the Economic Opportunity Act of 1964.

Facility Loans. Long-term credit is the usual way of acquiring part of the money to construct buildings, and buy equipment or plant sites. Main sources of facility loans are Banks for Cooperatives, Commercial Banks, insurance companies, Farmers Home Administration, and other cooperatives. It is also possible for cooperatives serving low-income rural patrons to obtain facility loans jointly from Farmers Home Administration and a district bank for cooperatives under provisions of the Economic Opportunity Act of 1964. Rural Electrification Administration, through rural electric cooperatives, may lend funds to a cooperative to purchase electric equipment and related items.

Operating Loans. Cooperatives may obtain operating loans from Banks for Cooperatives and the Farmers Home Administration as well as commercial banks and other lenders.

Special Loan Capital. A number of Federal Government agencies lend money to cooperatives providing special services (for example, an important source of loan funds to rural electric cooperatives is the Rural Electrification Administration).

D. The revolving capital financing plan is peculiarly suited to cooperatives. It works in such a manner that as a member does business through a cooperative, he authorizes the cooperative to use a portion of the money the cooperative has accumulated or saved through his patronage, or the members may furnish capital based on the dollar value or physical volume of products sold or bought through the cooperative. In either case this money is identified as a capital investment of the member and is used for capital purposes only.

The capital accumulated in this manner may be treated as a revolving fund. The funds may be used for repayment of debt, expansion, or for such other capital purposes as authorized by the board of directors. As such funds continue to be accumulated, the board authorizes the repayment of funds to those members who contributed funds in the past.

The revolving capital plan allows members to build up an equity in their association in proportion to the amount of business they do. Also, current patrons provide capital for the cooperative as past patrons are paid off.

E. Like any other business firm, a cooperative builds up two types of reserves -- valuation and capital. Reserves for such items as depreciation are called valuation reserves and are accumulated by a charge to operations. Capital reserves are usually, although not always, built up from net operating margins.

Capital reserves are of two general types: (1) those reserved to meet an unexpected crisis, such as a poor business year; and (2) those to meet a large planned outlay such as new or expanded facilities, and the like. When such a need arises, the cooperative can use its reserves instead of borrowing money, curtailing its services, or impairing its capital.

Activity: Agricultural Cooperatives

Problem Area: V. Understanding the Types of Cooperatives and the Services Provided

Situation (local):

Teacher Objectives:

A. To acquaint students with the different types of cooperatives.

B. To develop an appreciation of why the different types of cooperatives have been organized, the services provided by them, and the requirements for membership.

C.

Introduction (discussion questions):

A. What are the different types of cooperatives?

B. Can you name local examples of the different types?

C. What services are provided by the cooperatives named as local examples?

D.

Group Objectives (develop with group):

Suggested lead question: Why should we understand the different types of cooperatives and the services provided by them?

Expected responses:

A. This will help us make better use of the cooperatives in our community.

B. We will be better prepared to decide whether to seek employment in a cooperative and, if we seek employment, the type of cooperative we would be most interested in.

C.

Problems and Concerns of Students (develop with group): Suggested lead question: What do we need to know about the services provided in order to accomplish our objectives?

A. What are the different types of cooperatives?

B. With regard to the different types of cooperatives --
   1. Why have they been organized?
   2. What services do they provide?
   3. What are the requirements for membership in them?

C.

References:

Cooperatives in Agribusiness, Educational Circular 33, Farmer Cooperative Service, USDA, Washington, D. C. 20250. pp. 27-50.

Krebs, A. H., Agriculture in Our Lives, Interstate Printers and Publishers, Danville, Illinois, 61832. pp. 660-670.

The Family of Cooperatives Serving Virginia Farmers, Virginia Council of Farmer Cooperatives, Inc., Richmond, Va., 23208.

Visual Aids and Other Equipment:

A. Chalkboard.

B. Movie projector (16mm.), screen, and film "An A for the B C Way" (color, sound, 22 minutes; obtain from Director of Information, Farm Credit Banks of Baltimore, St. Paul and 24th Streets, Baltimore, Maryland 21203).

C.

Special Events and Activities:

A. Conduct a field trip to a local cooperative (refer to pages 51-54 of the Circular Cooperatives in Agribusiness listed in the references section for a list of important things to learn about a cooperative).

B. Assign students to prepare and present reports on the following topics:
   1. The Farm Credit System.
   2. Job Opportunities in Cooperatives.
   3. The number of different types of cooperatives of which their parents are members or patrons.
   4.

C. Invite manager of a local cooperative to describe each of the several job positions in his cooperative.

D. Encourage students to enter cooperative public speaking contests.

E.

Application and Evaluation:

A. Occupational experience activities.
   1. Determine interest of class members in placement in cooperative businesses as their occupational experience program.
   2.

B. Short answer test (to be prepared by teacher).

Content Summary (for use by teacher):

A. Cooperatives are generally classified as one of the following types:
   1. Marketing.
   2. Purchasing.
   3. Service.

B. Marketing Cooperatives.
   1. Farmers tend to specialize in the production of food and fiber. Frequently they lack the time or capacity to understand and satisfy the demands of today's mass markets. They have been active in organizing cooperatives to provide them with the marketing tools they need.
   2. Marketing cooperatives provide services such as the following:
      a. Assemble products from many producers.
      b. Grade products.
      c. Process or pack products in form acceptable to large volume buyers.
      d. Transport, store, advertise and promote products.
      e. Develop new products or new uses for products through research.

f. Bargain for the farmer.
g. Provide standardized packs of food and food products to help consumers shop more efficiently.
h. Teach producers about marketing and markets.
i. Develop a broad market for products.

3. Membership in most marketing cooperatives is open to all producers who fully meet membership and production requirements.

Purchasing (Supply) Cooperatives:

1. Farmers characteristically have sold their output at wholesale prices while paying retail prices for many of the inputs needed. In order to buy at more favorably retail prices, farmers have organized purchasing (supply) cooperatives.

2. Services provided by the typical purchasing cooperative vary with the area in which it operates. Some carry a relatively limited line of supplies related to a particular need while others carry a wide variety of supplies needed for the production of several farm commodities. Those carrying a wide variety of supplies may purchase or mix feed and blend fertilizer, clean and sell seed, distribute automotive needs such as gasoline and tires, and carry a full ine of building supplies and tools. Some cooperatives have developed more adequate farm service centers designed to provide members with one-stop shopping. A basic service extended by most purchasing cooperatives is on-farm delivery (plus custom fertilizer spreading).

3. Farmers obtain membership in most purchasing cooperatives by acquiring a share of common stock and agreeing to abide by the bylaws. In others, patronage (by the producer) is the sole requirement for membership. Purchasing cooperatives do not usually require members to sign an agreement. However, a few purchasing cooperatives stipulate a minimum annual patronage requirement. Non-producers may be patrons but cannot become members in farmer cooperatives.

Service Cooperatives:

1. Service cooperatives have been organized to solve mutual problems and provide specialized services not available at a reasonable cost.

2. Service cooperatives have been organized to provide services such as medical care, electricity, telephones, insurance, artificial breeding, record keeping, and credit.

3. Generally, a person becomes a member of a service cooperative when he is served or becomes eligible to be served by such a cooperative. For example, nearly all consumers served by an electric cooperative are members; a person becomes a member of a Federal land bank association when he successfully qualifies for a land bank loan and buys the required amount of stock in the association.

VT 010 372
Directory of Conservation Education in Minnesota.

Minnesota State Dept. of Education, St. Paul
MF AVAILABLE IN VT-ERIC SET.
PUB DATE - 68 63p.

DESCRIPTORS - *DIRECTORIES; *CONSERVATION EDUCATION; *COURSES; SHORT COURSES; SEMINARS; NATURE CENTERS; WORKSHOPS; *REFERENCE MATERIALS; *INSTRUCTIONAL MATERIALS

ABSTRACT - This brochure is a compilation of data collected from agencies, institutions, and organizations during the winter of 1967-1968 to provide information about the kinds of conservation education programs available in Minnesota. Fifty-seven programs are listed, arranged under the following classifications: (1) courses (both credit and non-collegiate), (2) workshops, (3) tours, short courses, and seminars, (4) nature study centers, such as zoological gardens, parks and museums, and (5) others, including farms, forests, camps, and clubs. The title and type of conservation program, name and address of sponsor, location of program activity, dates offered, duration of program, costs, level of participants, and person to contact for information are provided for each program listed. (AW)

VT 010 372

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Code: IV-A-2

DIRECTORY OF Conservation Education in Minnesota

Prepared with funds made available under provisions of the National Defense Education Act of 1958, Title V-A.

A Publication Developed With the Cooperation of the Department of Conservation and Sponsored by

Program Planning and Development Section, Division of Vocational-Technical Education

and

Guidance and Pupil Personnel Section, Division of Instruction

MINNESOTA DEPARTMENT OF EDUCATION

1968

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Introduction

This brochure was prepared for use by the public, particularly students, leaders and teachers as information about the kinds of conservation education programs available in Minnesota. It is hoped to also assist counselors in helping students to make realistic career plans.

Data were collected from institutions, agencies and organizations during the winter of 1967-1968 and so reflects the information about programs which was valid at that time. Public desiring more specific information about indvidual programs will want to make further inquiries of said agencies, organizations or institutions.

A survey and directory of this nature can never be complete. The compiler can only ask your indulgence for omissions, oversights, misinterpretations, and errors.

The programs in this directory are classified as follows:

Courses (Credit, non-collegiate)

Workshops

Tours; Short Courses; and Seminars

Nature Study Centers (Zoological gardens, parks, and museums)

Others (Farms, forests, camps, and clubs)

Conservation Education in Minnesota Elementary, Secondary and Post-High Schools

Emphasis on conservation education is growing in Minnesota.

Forty-three Minnesota school districts have school forests covering over 3,500 acres. Outdoor educational activities in these forests offer students the opportunity to learn about fire protection, tree identification, seed extraction, planting, timber stand improvement, inventory, growth studies, forest products, and other areas related to natural resources.

Five school districts – Columbia Heights, St. Cloud, Winona, Hutchinson, and Bloomington – conduct summer programs in grades 4-12 for students interested in outdoor education.

Three Area Vocational-Technical Schools – Brainerd, Duluth and Anoka – offer two-year, semi-professional training in natural resource education.

Twenty-five districts conduct natural resources education programs in grades 3-12 or offer an elective course in grades 11-12 for students interested in outdoor education. Earl Brown Elementary School of the Brooklyn Center School district and John F. Kennedy Senior High in Bloomington offer excellent programs at the elementary and senior high levels.

The Minnesota Department of Education endorses the belief that a child's education can be enhanced and enlightened by outdoor education. Such programs can teach students respect for natural resources and concern over their waste.

The Department's Division of Instruction (St. Paul, Minnesota 55101) provides guides for instruction, reference sources, and consultative services regarding natural resource education.

The recent development by schools of many outdoor nature centers is evidence of enduring affection for our natural heritage. It is hoped that all elementary and secondary schools will have outdoor conservation programs in the near future.

Commissioner of Education

Minnesota Department of Conservation

The mission of the Department of Conservation is to promote the wise use and management of our state's vital resources – its forests, water, fish, wildlife, minerals and state parks. How the Department functions in this mission is paramount as the well-being of our citizens and our standards of living are directly involved. Minnesota covers a vast area, some 84,000 square miles. Of this expanse, the Department has direct management responsibilities on approximately 8,000 square miles of land, water and related resources.

There are five divisions in the Conservation Department. These are the divisions of Game and Fish; Waters, Soils and Minerals; Parks and Recreation; Lands and Forestry; and Enforcement and Field Service. The last division is composed of the Game Warden force (now called Conservation Officers) that until 1967 was included in the Division of Game and Fish.

In addition to the five divisions, six bureaus have been established by Commissioner's Order and affirmed by the Legislature to assist the Commissioner and the five divisions. These are the bureaus of Boat and Water Safety, Business Management, Engineering, Planning and the Legal staff, under the supervision of the State Attorney General's Office and paid and furnished office space by the Department.

The Commissioner is the head of the Department and is appointed by the Governor upon the advice and consent of the Senate. The Commissioner appoints a Deputy Commissioner and five technically qualified Division Directors when a vacancy occurs. Through the Commissioner's leadership, the activities of the Department are governed and the broad policies by which the Department operates are laid down. The functions of the Department are channeled into the divisions and bureaus. From the helm of each Division, the Director charts the course of established policy and actions of his respective Division.

Working toward a common conservation goal are approximately 2,100 persons at peak employment. This includes 1,100 regular or full-time employees, about 1,000 season and hourly (part-time) personnel and several in the state's Natural Resources Program. Personnel are available for assistance and for presenting programs to the public on conservation matters.

Commissioner of Conservation

TOUR AND COURSE

Title and Type of Conservation Program	Ecology and Natural History
Name and Address of Sponsor	Extension Division University of Minnesota
Location of Program Activity	Bell Museum University of Minnesota
Dates Offered	Year-round as arranged
Duration	Tours as arranged, one day; plus, extension class, one academic quarter.
Costs	Tours are free Extension class — $40.00
Level of Participants	Youth and Adults (teachers and researchers)
Person to Contact	Mr. Richard Barthelemy University of Minnesota Museum of Ecology and Natural History Minneapolis, Minnesota 55455

COURSE

Title and Type of Conservation Program	Training in Basic Ecology and Natural Resource Conservation
Name and Address of Sponsor	Minnesota Conservation Federation St. Cloud Public Schools St. Cloud Wildlife Club
Location of Program Activity	Long Lake Conservation Center Aitkin County Palisade, Minnesota
Dates Offered	June 17-June 28 – Girls July 1-July 12 – Boys July 14-July 26 – Boys July 28-August 9 – Teachers August 11-August 23 – Boys
Duration	
Costs	$50.00 per person
Level of Participants	Youth as recommended by science, 4-H, or F.F.A. Leaders.
Person to Contact	Aitkin County Park Commission Aitkin, Minnesota 56431

COURSE AND WORKSHOP

Title and Type of Conservation Program	Ecology, Field Zoology, NSF Summer Institute for Junior High Teachers, Hill Family Summer Institute for Elementary Teachers, Field Station and Natural Area Available for Teachers. Course, Workshop, Tour, Nature Study Center, Museum, Forest, Prairie, Lake, Ponds, Springs, River.
Name and Address of Sponsor	Macalester College St. Paul, Minnesota 55101
Location of Program Activity	St. Paul, Minnesota
Dates Offered	Ecology, fall semester; Field Zoology, spring semester; Individual courses, either semester; Institutes, summer.
Duration	Courses, full semester; NSF Institute, 8 weeks; Hill Family Institute, 5 weeks; other by arrangement.
Costs	College tuition for college courses. NSF provides stipend. Hill Family, transportation to and from college and personal items. Other, no charge.
Level of Participants	Elementary grades, Secondary grades, Post-high School, College level, Teachers, Adult leaders, College credits offered.
Person to Contact	Professor James A. Jones Biology Department Macalester College St. Paul, Minnesota 55101

COURSE

Title and Type of Conservation Program	Conservation Course
Name and Address of Sponsor	Department of Ecology and Behavioral Biology University of Minnesota
Location of Program Activity	Minneapolis, Minnesota
Dates Offered	Winter Quarter (each year)
Duration	10 weeks
Costs	Regular University tuition
Level of Participants	College level, Three undergraduate college credits offered per quarter.
Person to Contact	Dr. A. J. Brook Department of Ecology and Behavioral Biology Museum of Natural History University of Minnesota Minneapolis, Minnesota 55455

COURSE

Title and Type of Conservation Program	Nature Recreation Conservation of Natural Resources Course
Name and Address of Sponsor	Department of Recreation and Park Administration 204 Cooke Hall University of Minnesota Minneapolis, Minnesota 55455
Location of Program Activity	To be arranged.
Dates Offered	Course in nature recreation, March 25-June 1 (Spring Quarter). Course in conservation of natural resources offered on demand and when sufficient interest is indicated.
Duration	Offered during academic quarters, normally consisting of eleven weeks.
Costs	$8.25 per credit hour for Minnesota residents or $23.50 for non-Minnesota residents per credit hour.
Level of Participants	Post-high School, College level, Teachers, Adult leaders, the nature recreation course yields three credits and the conservation course two credits.
Person to Contact	Dr. Frederick M. Chapman 204 Cooke Hall University of Minnesota Minneapolis, Minnesota 55455 **or** Office of Admissions and Records University of Minnesota Minneapolis, Minnesota 55455

COURSE

Title and Type of Conservation Program	Conservation Education Course Includes a basic understanding of ecological principles.
Name and Address of Sponsor	The General College University of Minnesota
Location of Program Activity	University of Minnesota
Dates Offered	Offered each quarter of academic year.
Duration	By quarters.
Costs	Regular University Tuition
Level of Participants	College level, 5 Undergraduate college credits offered per quarter.
Person to Contact	Mr. Merrill Rassweiler 106 Nicholson Hall University of Minnesota Minneapolis, Minnesota 55455

COURSE

Title and Type of Conservation Program	Workshop, Short Course, Nature Study Center, Forest
Name and Address of Sponsor	Aitkin County Park Commission Court House Aitkin, Minnesota 56431
Location of Program Activity	Aitkin, Minnesota
Dates Offered	July 28-August 9, 1968
Duration	5 sessions — 10 weeks duration.
Costs	Boys and Girls. . .$50.00 Adults . . . . . 60.00 room and board 24.50 tuition
Level of Participants	Secondary grades, Teachers, 4 Undergraduate and Graduate college credits offered per quarter.
Person to Contact	Secretary Aitkin County Park Commission Court House Aitkin, Minnesota 56431

COURSE

Title and Type of Conservation Program	Field Biology Program Course Conservation and Outdoors Training
Name and Address of Sponsor	Lake Itasca Forestry & Biological Sessions c/o Field Biology Program University of Minnesota 140 Gortner Hall St. Paul, Minnesota 55101
Location of Program Activity	St. Paul Minnesota (Lake Itasca)
Dates Offered	Term I: June 12-July 18 Term II: July 21- August 26
Duration	10 weeks (summer)
Costs	Fees $85.00 Room 15.00 Board 80.00
Level of Participants	College level, Teachers, 10 Undergraduate college credits offered per quarter, 10 Graduate college credits offered per quarter.
Person to Contact	Dr. William H. Marshall, Director Field Biology Program 112 Snyder Hall University of Minnesota St. Paul, Minnesota 55101

COURSE

Title and Type of Conservation Program	Biology 101, 102, and 103 Course (Emphasis on Conservation and Outdoor Recreation)
Name and Address of Sponsor	Northland Junior College Thief River Falls, Minnesota 56701
Location of Program Activity	Thief River Falls, Minnesota 56701
Dates Offered	Beginning fall quarter and ending at the end of the spring quarter.
Duration	All year
Costs	Tuition – $5.00 per quarter hour.
Level of Participants	College level, College credits offered.
Person to Contact	Mr. Charles R. Samuelson Biology Instructor Northland Junior College Thief River Falls, Minnesota 56701

COURSE

Title and Type of Conservation Program	Biology Course (Stresses outdoor education)
Name and Address of Sponsor	Rainy River State Junior College International Falls, Minnesota
Location of Program Activity	International Falls, Minnesota
Dates Offered	Spring Quarter
Duration	11 weeks
Costs	$5 per quarter hour, "In State Tuition".
Level of Participants	College level, Col'ege credits offered.
Person to Contact	Mr. Lee Grim Biology Department Rainy River State Junior College International Falls, Minnesota 56649

COURSE

Title and Type of Conservation Program	Forest Course
Name and Address of Sponsor	Bemidji State College Bemidji, Minnesota
Location of Program Activity	Bemidji, Minnesota
Dates Offered	Each quarter of the regular school year.
Duration	One quarter
Costs	Regular enrollment
Level of Participants	College level, three undergraduate credits offered per quarter.
Person to Contact	Registrar, Bemidji State College Bemidji, Minnesota 56601

COURSE

Title and Type of Conservation Program	Forest Harvesting Technology Course (Training for Forest Harvesting Technician Employment)
Name and Address of Sponsor	Duluth Area Vocational-Technical School Duluth, Minnesota
Location of Program Activity	Duluth, Minnesota
Dates Offered	September through June
Duration	Nine months
Costs	Tutition free under 21.
Level of Participants	Post-high School
Person to Contact	Mr. Robert Bergstrom, Director Area Vocational-Technicial School Duluth, Minnesota 55802

COURSE

Title and Type of Conservation Program	Job Training Forest Technician Course
Name and Address of Sponsor	North Central School University of Minnesota Grand Rapids, Minnesota
Location of Program Activity	Grand Rapids, Minnesota
Dates Offered	First Term – October through March.
Duration	Six months
Costs	Tuition and registration – $77.50. Plus room and board.
Level of Participants	Post-high School. No college credit offered.
Person to Contact	North Central School University of Minnesota Grand Rapids, Minnesota 55744

COURSE

Title and Type of Conservation Program	Forestry 11 and Wild-Life Management Conservation of Natural Resources Course
Name and Address of Sponsor	School of Forestry Institute of Agriculture University of Minnesota St. Paul, Minnesota 55101
Location of Program Activity	
Dates Offered	Spring Quarter, January-March.
Duration	Full Spring Quarter, approximately 10 weeks, one hour on Monday, Wednesday, Friday (3 hours a week).
Costs	Approximately $30, including fees and text (write the University of Minnesota, Minneapolis, for information about Adult Special registration).
Level of Participants	College level, Teachers, Three undergraduate college credits offered per quarter.
Person to Contact	Mr. Carl H. Reidel, Instructor School of Forestry University of Minnesota St. Paul, Minnesota 55101

COURSE

Title and Type of Conservation Program	Pre-forestry Training
Name and Address of Sponsor	Rochester State Junior College Rochester, Minnesota
Location of Program Activity	Rochester, Minnesota
Dates Offered	Annually – Academic year.
Duration	One year.
Costs	Approximately $400 one year.
Level of Participants	College level, College credits offered.
Person to Contact	Biology Department Rochester State Junior College Rochester, Minnesota 55901

ERIC

COURSE

Title and Type of Conservation Program	Environmental Science Program Ecological Techniques and Investigations
Name and Address of Sponsor	Environmental Science Center 4800 Glenwood Avenue Minneapolis, Minnesota 55422
Location of Program Activity	Spring Meadow Farm Carver, Minnesota
Dates Offered	Saturdays, beginning on or about April 6.
Duration	Four sessions are tentatively planned. The number may be increased depending upon the needs of the class.
Costs	Materials are provided by the Center. Participants will be responsible for their own transportation.
Level of Participants	Teachers
Person to Contact	Mr. Richard J. Myshak, Director Environmental Science Center 4800 Glenwood Avenue Minneapolis, Minnesota 55422

COURSE

Title and Type of Conservation Program	Environmental Science Program Field Experiences in Summer School Biology
Name and Address of Sponsor	Environmental Science Center 4800 Glenwood Avenue Minneapolis, Minnesota 55422
Location of Program Activity	Golden Valley Middle School
Dates Offered	June 17-July 19
Duration	Five weeks, approximately one and one-half hours per day.
Costs	Yet to be determined. The Center will supply all materials. Possible transportation costs.
Level of Participants	Lower elementary, students entering third and fourth grades. Upper elementary, students entering fifth, sixth, and seventh grades.
Person to Contact	Mr. Richard J. Myshak, Director Environmental Science Center 4800 Glenwood Avenue Minneapolis, Minnesota 55422

COURSE

Title and Type of Conservation Program	Environmental Science Program Utilizing the Outdoor Laboratory: Techniques and Strategies for Elementary School Teachers
Name and Address of Sponsor	Environmental Science Center 4800 Glenwood Avenue Minneapolis, Minnesota 55422
Location of Program Activity	Environmental Science Center
Dates Offered	June 17-July 19, 1968
Duration	Five weeks, 8:00 a.m. to 12:00 noon.
Costs	For those desiring graduate credit, the cost will be $47.00. All laboratory equipment and supplies will be furnished by the Center.
Level of Participants	Elementary School Teachers
Person to Contact	Mr. Richard J. Myshak, Director Environmental Science Center 4800 Glenwood Avenue Minneapolis, Minnesota 55422

COURSE

Title and Type of Conservation Program	Environmental Science Program Photography in Laboratory and Outdoors
Name and Address of Sponsor	Environmental Science Center 4800 Glenwood Avenue Minneapolis, Minnesota 55422
Location of Program Activity	Environmental Science Center
Dates Offered	June 17-July 19
Duration	The group will meet for two hours a day for a five week period. Half day field trips will be held periodically.
Costs	No tuition. Political nominal fee for transportation and incidental expenses.
Level of Participants	Junior and Senior High Students
Person to Contact	Mr. Richard J. Myshak, Director Environmental Science Center 4800 Glenwood Avenue Minneapolis, Minnesota 55422

COURSE

Title and Type of Conservation Program	Natural Science 102: Life Science Course
Name and Address of Sponsor	Metropolitan State Junior College 50 Willow Minneapolis, Minnesota 55403
Location of Program Activity	Minneapolis, Minnesota
Dates Offered	Winter quarter – January 3 to March 15.
Duration	One quarter
Costs	Tuition
Level of Participants	Post-high School, College level, Four undergraduate college credits offered per quarter.
Person to Contact	Metropolitan State Junior College 50 Willow Minneapolis, Minnesota 55403

COURSE (Seminar)

Title and Type of Conservation Program	Environmental Science Program Pollution, Its Imminent Consequences
Name and Address of Sponsor	Environmental Science Center 4800 Glenwood Avenue Minneapolis, Minnesota 55422
Location of Program Activity	To be held in High School Auditoria of West Suburban Schools.
Dates Offered	8:00 p.m., February 12, March 7, April 4, May 2, June 13.
Duration	As indicated above.
Costs	No charge to attending persons.
Level of Participants	All concerned individuals including teachers, students, and lay public.
Person to Contact	Mr. Richard J. Myshak, Director Environmental Science Center 4800 Glenwood Avenue Minneapolis, Minnesota 55422

COURSE

Title and Type of Conservation Program	Environmental Science Program Environmental Research Program
Name and Address of Sponsor	Environmental Science Center 4800 Glenwood Avenue Minneapolis, Minnesota 55422
Location of Program Activity	Environmental Science Center
Dates Offered	To be arranged
Duration	Indefinite
Costs	Center will supply all equipment and supplies at no cost to participants.
Level of Participants	Science teachers and junior-senior high school students.
Person to Contact	Mr. Richard J. Myshak, Director Environmental Science Center 4800 Glenwood Avenue Minneapolis, Minnesota 55422

COURSE

Title and Type of Conservation Program	Outdoor Careers Conservation Resource Technology Course (Semi-professional Training) Job Training Program
Name and Address of Sponsor	Brainerd Area Vocational-Technical School Brainerd, Minnesota
Location of Program Activity	Brainerd, Minnesota
Dates Offered	June through May 31.
Duration	2-Year Program
Costs	Tuition free under 21.
Level of Participants	Post-high School
Person to Contact	Mr. Harry Nysather, Director Area Vocational-Technical School Brainerd, Minnesota 56401

COURSE

Title and Type of Conservation Program	Recreation and Conservation of Natural Resources College Curriculum
Name and Address of Sponsor	University of Minnesota Technical Institute Crookston, Minnesota
Location of Program Activity	Crookston, Minnesota
Dates Offered	The regular college academic year.
Duration	This course is a regular two-year program as one of a group of Agricultural Technologies.
Costs	Regular fees and charges for attending the University of Minnesota Technical Institute.
Level of Participants	College level, Six undergraduate college credits offered per quarter.
Person to Contact	Mr. Harland Hasslen, Chairman Division of Agriculture University of Minnesota Technical Institute Crookston, Minnesota 56716

COURSE

Title and Type of Conservation Program	Horticultural and Recreation Technology Course (Training for Technician job employment)
Name and Address of Sponsor	Mr. Howard Rosenwinkel, Director Anoka Technical Education Center Anoka, Minnesota
Location of Program Activity	Anoka, Minnesota
Dates Offered	September through June
Duration	Nine months
Costs	$5.00 application fee. Tuition free under 21.
Level of Participants	Post-high School
Person to Contact	Mr. Howard Rosenwinkel, Director Technical Education Center Anoka, Minnesota 55303

WORKSHOP

Title and Type of Conservation Program	Conservation Camp Program for Scout groups. Course, workshop, museum and forest.
Name and Address of Sponsor	Viking Council, Boy Scouts of America 314 Clifton Avenue Minneapolis, Minnesota 55403
Location of Program Activity	Many Point Scout Reservation
Dates Offered	July 7 to 14, 1968.
Duration	Yearly
Costs	$25.00 per week.
Level of Participants	Elementary grades, Secondary grades, Adult leaders, No College credit offered.
Person to Contact	Robert E. Burt, Director of Camping Viking Council, Boy Scouts of America 314 Clifton Avenue Minneapolis, Minnesota 55403

WORKSHOP

Title and Type of Conservation Program	Camping Caravan Workshop
Name and Address of Sponsor	Girl Scouts of the U.S.A. – Region X 1801 Nicollet Avenue Minneapolis, Minnesota
Location of Program Activity	To be arranged.
Dates Offered	May 8, 1968
Duration	One day
Costs	$3.50
Level of Participants	Adult leaders. No college credit offered.
Person to Contact	Local Girl Scout Council

WORKSHOP

Title and Type of Conservation Program	Conservation Workshop for Youth, and Workshop for Teachers
Name and Address of Sponsor	Long Lake Conservation Center Palisades, Minnesota c/o Aitkin Co. Park Commission Aitkin, Minnesota
Location of Program Activity	Long Lake Conservation Center in Aitkin County.
Dates Offered	July 28-Agust 9, 1968.
Duration	5 Sessions – 12 days each.
Costs	Youths – $50 for 12-day session. Teachers – $92 for 12-day session.
Level of Participants	Secondary grades, Teachers 4 undergraduate college credits offered and 4 graduate college credits offered
Person to Contact	Youths – Aitkin Co. Park Commission Aitkin, Minnesota Teachers – Dr. Max Partch Biology Department St. Cloud State College St. Cloud, Minnesota 56301

WORKSHOP

Title and Type of Conservation Program	Conservation Workshop
Name and Address of Sponsor	St. Cloud State College St. Cloud, Minnesota 56301
Location of Program Activity	Long Lake Conservation Center in Aitkin County.
Dates Offered	July 28-August 9, 1968.
Duration	13 days
Costs	Undergraduate: Resident $26.00; Non-resident 32.00 Graduate: Resident $28.00; Non-resident 40.00
Level of Participants	Teachers, College credits offered.
Person to Contact	Dr. Max Partch Conservation Workshop St. Cloud State College St. Cloud, Minnesota 56301

WORKSHOP

Title and Type of Conservation Program	Conservation Education Workshops
Name and Address of Sponsor	University of Minnesota Department of Soil Science and the School of Forestry
Location of Program Activity	To be determined as interest and requests develop.
Dates Offered	By arrangement
Duration	One day
Costs	None
Level of Participants	Elementary grades, Teachers
Person to Contact	James Swan, Department of Soil Science William Miles, School of Forestry University of Minnesota St. Paul, Minnesota 55101

WORKSHOP

Title and Type of Conservation Program	Conservation Workshop Workshop
Name and Address of Sponsor	Winona State College Winona, Minnesota
Location of Program Activity	Whitewater State Park
Dates Offered	July 21-27, 1968
Duration	One week
Costs	$55.00
Level of Participants	Teachers, 4 undergraduate college credits offered and 4 graduate college credits offered per quarter.
Person to Contact	Joseph P. Emanuel Director of Conservation Workshop Pasteur Hall Winona State College Winona, Minnesota 55987

WORKSHOP

Title and Type of Conservation Program	The Minnesota Rose Society Workshop, Tour, Annual Rose Show, Exhibits on roses, Spring pruning demonstration, Meetings have programs on rose culture.
Name and Address of Sponsor	Mr. Kenneth Sorenson, President Minnesota Rose Society 4736 Gaywood Drive Minnetonka, Minnesota 55343
Location of Program Activity	To be arranged.
Dates Offered	Regular Meetings – Second Friday of Jan., March, May, Sept., Nov. Pruning Demonstration – April 27, 1968. Rose Show Workshop – June 7, 1968. Rose Show – June 29 and 30. Tour – August 11, 1968.
Duration	2 to 4 hours.
Costs	Regular meetings or workshops, no charge. No charge for Rose Show. Bus fare is charged for Tours. Membership in the Minnesota Rose Society is $2.50 a year.
Level of Participants	Anyone interested in roses and learning more about their culture. No college credit offered.
Person to Contact	Mrs. Charles R. Campbell Administrative Secretary 4128 Brunswick Avenue South Minneapolis, Minnesota 55416

WORKSHOP

Title and Type of Conservation Program	Federated Garden Clubs of Minnesota, Inc. Workshop
Name and Address of Sponsor	Federated Garden Clubs of Minnesota, Inc. 6738 15th Avenue South Richfield, Minnesota 55423
Location of Program Activity	To be arranged.
Dates Offered	May 23, 1968
Duration	All day – 10:00 a.m. to 3:30 p.m.
Costs	$3.00 including lunch.
Level of Participants	Open to public.
Person to Contact	Mrs. W. E. Tomlinson 3634 Rainbow Drive Minnetonka, Minnesota 55343

WORKSHOP

Title and Type of Conservation Program	Natural Resources Workshop Workshop, Tour (Outdoor classroom science study activities)
Name and Address of Sponsor	Minnesota Federation of Women's Clubs Upper Midwest Building Room 912 425 Hennepin Avenue Minneapolis, Minnesota 55401
Location of Program Activity	To be arranged.
Dates Offered	First part of May.
Duration	Only two day.
Costs	Defrayed by local clubs.
Level of Participants	Elementary grades and Secondary grades.
Person to Contact	Mrs. James E. Paulsen State Conservation Chairman MFWC Clarkfield, Minnesota 56223

WORKSHOP CAMP

Title and Type of Conservation Program	Laketrails Camp, Inc. Nature trails, canoeing, camping experiences.
Name and Address of Sponsor	Laketrails Base Camp, Inc. Minnesota Non-profit, non-sectarian
Location of Program Activity	Lake of the Woods Area (Island near Canadian border)
Dates Offered	June, July, and part of August (as arranged)
Duration	4 weeks for boys 4 weeks for girls (8 weeks during summer)
Costs	$40.00 per week
Level of Participants	Urban and Rural High School Students
Person to Contact	Mr. J. W. Knoblauch Education Administrator 13017 Maywood Lane Hopkins, Minnesota 55343

NATURE STUDY CENTER

Title and Type of Conservation Program	Spring Meadow Natural Resource Education Center Workshop, Nature Study Center, Camp
Name and Address of Sponsor	Mrs. Edith H. Herman, Owner-Coordinator Route 5, Box 107 Excelsior, Minnesota 55331
Location of Program Activity	Carver, Minnesota
Dates Offered	By appointment.
Duration	One day – weekend – one week.
Costs	Bus fare, Food.
Level of Participants	Elementary grades, Secondary grades, Post-high School, College level, Teachers, Adult leaders.
Person to Contact	Mrs. Edith H. Herman Route 5, Box 107 Excelsior, Minnesota 55331

NATURE CENTER (Environmental)

Title and Type of Conservation Program	Instructional, Research & Demonstration Laboratory in Biological Sciences
Name and Address of Sponsor	Golden Valley Independent School District #68
Location of Program Activity	Golden Valley High School Aquatic Biology Outdoor Laboratory
Dates Offered	To be arranged.
Duration	Year-round
Costs	None
Level of Participants	Elementary and Secondary School Students, Adult leaders and Teachers.
Person to Contact	Mr. Robert J. Johnston Director of Elementary Education School District #275 Minneapolis, Minnesota 55427

NATURE CENTER

Title and Type of Conservation Program	Outdoor Biological Science Center for Elementary and Secondary Pupils
Name and Address of Sponsor	Independent School District #275 Golden Valley, Minnesota
Location of Program Activity	Golden Valley Outdoor Laboratory
Dates Offered	Year-round (to be arranged)
Duration	Year-round
Costs	None
Level of Participants	Elementary and Secondary students, Teachers, and Adult leaders.
Person to Contact	Mr. Howard B. Casmey Superintendent of Schools Golden Valley, Minnesota 55422 or Mr. Richard J. Myshak, Director Science Center 4800 Glenwood Avenue Minneapolis, Minnesota 55427

NATURE CENTER

Title and Type of Conservation Program	Area Outdoor Education Training
Name and Address of Sponsor	Independent School District #894 Granite Falls, Minnesota
Location of Program Activity	Granite Falls, Minnesota
Dates Offered	Year-round program
Duration	Year-round
Costs	None
Level of Participants	Students – grades K-12
Person to Contact	Mr. Milton H. Lindback Superintendent of Schools Independent School District #894 Granite Falls, Minnesota 56241

NATURE CENTER

Title and Type of Conservation Program	Outdoor Education Programs for Elementary Grades
Name and Address of Sponsor	Metropolitan Nature Centers In conjunction with Hennepin County Park Reserve Board Court House, Minneapolis, Minnesota
Location of Program Activity	Metro Nature Center Carver Park Victoria, Minnesota
Dates Offered	Year-round
Duration	As arranged for by teachers
Costs	To be arrived at.
Level of Participants	Elementary Grades
Person to Contact	Mr. Goodrich Lowry Metro Nature Centers Hennepin County Park Reserve District Court House Minneapolis, Minnesota 55414

NATURE CENTER

Title and Type of Conservation Program	Nature Resource Education Outdoor Programs for elementary grades
Name and Address of Sponsor	St. Paul Art and Science Museum Tenth Street St. Paul, Minnesota
Location of Program Activity	Wilder Camp, Washington County
Dates Offered	Spring and Summer
Duration	To be arranged.
Costs	To be arranged.
Level of Participants	Elementary Grades
Person to Contact	Mr. Bernie Fashingbauer St. Paul Science Museum 30 E. Tenth Street St. Paul, Minnesota 55101

NATURE CENTER

Title and Type of Conservation Program	Tours, Courses, Workshops
Name and Address of Sponsor	Wilder Camp, Washington County
Location of Program Activity	Wilder Camp, Washington County
Dates Offered	Summer
Duration	Summer
Costs	To be arranged.
Level of Participants	Open to all.
Person to Contact	Mr. Bernie Fashingbauer St. Paul Science Museum 30 E. Tenth Street St. Paul, Minnesota 55101

NATURE CENTER

Title and Type of Conservation Program	Izaak Walton Nature Study Center
Name and Address of Sponsor	Izaak Walton League of America Minneapolis Chapter 6601 Auto Club Road Minneapolis, Minnesota 55431
Location of Program Activity	63 South 4th Street
Dates Offered	Spring and Summer Months
Duration	Upon arrangement.
Costs	None
Level of Participants	Elementary and Secondary grade students, college students, teachers and adult leaders.
Person to Contact	Mrs. Virginia Sorensen Chapter Secretary 1556 Jefferson St. Paul, Minnesota 55105 Phone: 698-5978

NATURE STUDY CENTER

Title and Type of Conservation Program	Minnesota State Fair, Conservation Exhibit Complex Tour, Nature Study Center, Zoo, Park, Museum, Exhibit
Name and Address of Sponsor	Bureau of Information Minnesota Conservation Department St. Paul, Minnesota 55101
Location of Program Activity	St. Paul, Minnesota
Dates Offered	August 24 through September 2, 1968.
Duration	9:00 a.m. – 10:00 p.m.
Costs	None
Level of Participants	Open to all.
Person to Contact	Bureau of Information Minnesota Conservation Department St. Paul, Minnesota 55101

NATURE CENTER

Title and Type of Conservation Program	Landscape Arboretum Tour, Short Course, Nature Study Center
Name and Address of Sponsor	Minnesota State Horticultural Society in cooperation with the University of Minnesota, University of Minnesota Institute of Agriculture
Location of Program Activity	Arboretum corner of Highway 5 and 41 near Excelsior, Minnesota
Dates Offered	Spring, Summer and Fall
Duration	Short courses by arrangement. Guided tours by arrangement.
Costs	None
Level of Participants	Elementary grades, Secondary grades, Post-high School, College level, Teachers, Adult leaders.
Person to Contact	Leon C. Snyder, Superintendent Agriculture Experiment Station University of Minnesota 110 Horticulture St. Paul, Minnesota 55101

SHORT COURSE AND SEMINAR

Title and Type of Conservation Program	Outdoor Recreation General Ecology Seminar
Name and Address of Sponsor	Mankato State College Mankato, Minnesota
Location of Program Activity	Mankato State College
Dates Offered	Summer 1968, July 17 to August 18 Spring Quarter, March-June 1968
Duration	5 weeks and 12 weeks
Costs	Part of regular tuition and laboratory studies.
Level of Participants	College level, Teachers College credit offered.
Person to Contact	Dr. William Edwards Mankato State College Mankato, Minnesota 56001

SHORT COURSE

Title and Type of Conservation Program	(Elementary Grades) The Outdoor Education of America Minnesota Section (Local Affiliation of the National Organization for All Interested in the Development and Promotion of Outdoor Education National Office) Workshop, Short Course, Seminar
Name and Address of Sponsor	Earle Brown School 5900 Humboldt Avenue North Brooklyn Center, Minnesota
Location of Program Activity	Brooklyn Center, Minnesota
Dates Offered	To be arranged.
Duration	To be arranged.
Costs	None
Level of Participants	Teachers
Person to Contact	Mr. Warren Lindquist, President Principal Earle Brown School 5900 Humboldt Avenue North Brooklyn Center, Minnesota 55429

SHORT COURSE

Title and Type of Conservation Program	Minnesota's Youth Firearms Safety Training Program Course
Name and Address of Sponsor	State of Minnesota Department of Law Enforcement and Field Service Firearm Safety Centennial Office Building St. Paul, Minnesota 55101
Location of Program Activity	Held locally in a variety of places depending on the instructor's arrangements.
Dates Offered	Throughout the year, depending on locality.
Duration	Minimum of 7 hours.
Costs	$2 fee to State Treasurer, collected at class.
Level of Participants	Boys and girls 11 to 16 years of age.
Person to Contact	Local Conservation Officer OR Minnesota Youth Firearm Safety Office Centennial Office Building St. Paul, Minnesota 55101

MINNESOTA CONSERVATION DEPARTMENT

Title and Type of Conservation Program	Reference Source for Conservation Education Radio programs, publications, films, personnel available for speaking engagements, courses and workshops, public and fair exhibits.
Name and Address of Sponsor	State Conservation Department Centennial Office Building Third Floor St. Paul, Minnesota
Location of Program Activity	By arrangement with Directors of Parks, Forestry, Game and Fish Divisions.
Dates Offered	Year-round basis.
Duration	As desired.
Costs	No costs other than park permits and film loan fees.
Level of Participants	All – public – youth and adults level.
Person to Contact	Bureau of Information State Department of Conservation Centennial Building St. Paul, Minnesota 55101 Phone: 221-2549

WILDLIFE RELEASE PROJECT

Title and Type of Conservation Program	Minnesota Pheasants Unlimited Pheasant Management and Release Youth Program
Name and Address of Sponsor	Minnesota Pheasants Unlimited Post Office Box 520 Minneapolis, Minnesota 55440
Location of Program Activity	Statewide Through F.F.A., 4-H and Farmer Cooperation.
Dates Offered	Year-round
Duration	Summer – Feeding and rearing. Fall – Release. Winter – Management and feeding.
Costs	Contribution and membership cost.
Level of Participants	F.F.A., 4-H, Farmers, and Public Conservationists.
Person to Contact	Mr. Ronald R. Forrond 2955 Logan Avenue North Minneapolis, Minnesota 55411 Minnesota Pheasants Unlimited Post Office Box 520 Minneapolis, Minnesota 55440 Mr. Waino J. Kortesmaki State F.F.A. Executive Secretary Department of Education Centennial Building St. Paul, Minnesota 55101 Mr. Wayne Carlson, 4-H Leader Institute of Agriculture University of Minnesota St. Paul, Minnesota 55101

SECONDARY HIGH SCHOOLS

Title and Type of Conservation Program	Future Farmers of America Wild Mallard Duck Release Project Future Farmers Encampment
Name and Address of Sponsor	Minnesota State Department of Education Vocational Agriculture
Location of Program Activity	On high school students' farms.
Dates Offered	Twelve months
Duration	Spring, Summer and Fall.
Costs	To be determined.
Level of Participants	High school students, Members of Future Farmers of America
Person to Contact	Mr. W. J. Kortesmaki State Executive Secretary of F.F.A. Centennial Building St. Paul, Minnesota 55101

SCIENCE MOBILE LABORATORY

Title and Type of Conservation Program	Science Resource, Study and Research Mobile Laboratory
Name and Address of Sponsor	Independent School District #241 Albert Lea, Minnesota
Location of Program Activity	District #241 Freeborn County
Dates Offered	By arrangement
Duration	Flexible
Costs	None
Level of Participants	Student priority
Person to Contact	Mr. Charles D. Carpenter Science Department, Chairman Central Junior High School Albert Lea, Minnesota 56007

OTHER

Title and Type of Conservation Program	Organization of Natural Resource and Sportsman Minded Public (Education and Exhibit Programs)
Name and Address of Sponsor	Minnesota Conservation Federation
Location of Program Activity	Headquarters 4313 Shady Oak Road Hopkins, Minnesota
Dates Offered	Year-round
Duration	Year-round
Costs	None
Level of Participants	Open to all
Person to Contact	President – Mr. Joe Sekula Crookston, Minnesota 56716 Office Manager – Mrs. Marion McKinley 1200 Welcome Avenue North Minneapolis, Minnesota 55422 Education Co-Chairman – Mrs. Rose Gunderson Earle Brown Elementary School Brooklyn Center, Minnesota 55429

OTHER

Title and Type of Conservation Program	Association of Science Personnel for Betterment of Natural Resource Management
Name and Adress of Sponsor	Minnesota Academy of Science 3100 38th Avenue South Minneapolis, Minnesota
Location of Program Activity	Minnesota Academy of Science 3100 38th Avenue South Minneapolis, Minnesota
Dates Offered	Year-round
Duration	Year-round
Costs	As arranged
Level of Participants	Public
Person to Contact	Mr. M. I. Harrigan, Director Minnesota Academy of Science 3100 38th Avenue South Minneapolis, Minnesota 55406

OTHER

Title and Type of Conservation Program	Minnesota Canoe Association
Name and Address of Sponsor	Minnesota Canoe Association, Inc. 101 79th Avenue North Minneapolis, Minnesota 55430
Location of Program Activity	To be arranged.
Dates Offered	Dues-paying year is from November 1, to October 31.
Duration	To be arranged.
Costs	Regular Members — $5.00 annual dues. Junior Members — $3.00 annual dues. Associate Members — $2.00 annual dues. Life Members — twenty times current annual dues for regular members.
Level of Participants	All ages.
Person to Contact	Minnesota Canoe Association, Inc. 101 79th Avenue North Minneapolis, Minnesota 55430

OTHER

Title and Type of Conservation Program	Monthly meetings and Audubon Wildlife Films
Name and Address of Sponsor	St. Paul Audubon Society c/o M. G. Goldberg 1915 Palace Avenue St. Paul, Minnesota 55105
Location of Program Activity	Films shown in the Auditorium of the St. Paul Science Museum.
Dates Offered	Meetings are on the fourth Thursday of each month from September through May, except November and December. Films are shown four times a year.
Duration	By arrangement.
Costs	Single Membership is $2.50 a year. Anyone may attend any meeting without charge. The Audubon Wildlife Films are $4.00 for season tickets or $1.25 single admission for adults. Students $.50.
Level of Participants	Elementary grades, Secondary grades, Post-high School, College level, Adult leaders, Teachers.
Person to Contact	Mr. and Mrs. M. G. Goldberg 1915 Palace Avenue St. Paul, Minnesota 55105

OTHER

Title and Type of Conservation Program	Minnesota Association of Conservation Education (Conservation Education Coordinating Agency)
Name and Address of Sponsor	Institute of Agriculture Administration Building University of Minnesota St. Paul, Minnesota
Location of Program Activity	Statewide
Dates Offered	Year-round
Duration	Year-round
Costs	None
Level of Participants	Public
Person to Contact	Richard J. Myshak Environmental Science Center 4800 Glenwood Ave. Minneapolis, Minnesota 55422

VT 010 406
Green, John R.
Calculus For Technicians.

Union County Technical Inst., Mountainside, N.J.
Rutgers, The State Univ., New Brunswick, N.J. Curriculum Lab.
MF AVAILABLE IN VT-ERIC SET.
Vocational-Technical Curriculum Laboratory, Rutgers University, 10 Seminary Place, New Brunswick, New Jersey 08903 ($2.00).
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ABSTRACT - Developed by a technical institute instructor for technicians in a postsecondary technical institute, this workbook contains problems relating to the basic concepts of analytical geometry and calculus, and also includes problems aligned to physics and electronics. Following a basic mathematics quiz, chapters cover: (1) Review of Fundamentals of Algebra, (2) Graphical Mathematics, (3) Plane Analytical Geometry, (4) Differentiation, (5) Integration, (6) Calculus of Logarithmic and Exponential Functions, and (7) Calculus of Trigonometric Functions. The units in each chapter contain explanatory matter accompanied by examples and problems. A formulas and derivative table is included. (SB)

VT 010 406

FORMULAS AND DERIVATIVE TABLE

Analytical Geometry

(G-1) $y = mx + b$ (St. line)

(G-2) $y - y_1 = m(x - x_1)$

(G-3) $\frac{x}{a} + \frac{y}{b} = 1$

(G-4) $\tan\theta = \frac{m_2 - m_1}{1 + m_2 m_1}$

(G-5) $Ax + By + C = 0$

(G-6) $x^2 + y^2 = R^2$ (Circle)

(G-7) $(x - h)^2 + (y - k)^2 = r^2$

(G-8) $y^2 = 4px$ (Parabola)

(G-9) $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ (Ellipse)

(G-10) $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ (Hyperbola)

Trigonometric Identities

(T-1) $\tan\theta = \frac{\sin\theta}{\cos\theta}$

(T-2) $\sin^2\theta + \cos^2\theta = 1$

(T-3) $\tan^2\theta + 1 = \sec^2\theta$
(Divide T-2 by $\cos^2$)

(T-4) $1 + \cot^2\theta = \csc^2\theta$
(Divide T-2 by $\sin^2$)

(T-5) $\cos^2\theta = \frac{1 + \cos 2\theta}{2}$

(T-6) $\sin^2\theta = \frac{1 - \cos 2\theta}{2}$

(T-7) $\sin 2\theta = 2\sin\theta\cos\theta$

(T-8) $\cos 2\theta = \cos^2\theta - \sin^2\theta$

(T-9) $\sin A - \sin B = 2\cos\frac{A+B}{2}\sin\frac{A-B}{2}$

(T-10) $\cos A - \cos B = -2\sin\frac{A+B}{2}\sin\frac{A-B}{2}$

Algebraic

(D-1) $\frac{d}{dx}(c) = 0$

(D-2) $\frac{d}{dx}(x) = 1$

(D-3) $\frac{d}{dx}(cu) = c\frac{du}{dx}$

(D-4) $\frac{d}{dx}(u \pm v) = \frac{du}{dx} \pm \frac{dv}{dx}$

(D-5) $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$

(D-6) $\frac{d}{dx}(u)^n = n(u)^{n-1}\frac{du}{dx}$

(D-7) $\frac{du}{dx} = \frac{du}{dy} \times \frac{dy}{dx}$

(D-8) $\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}$

(D-9) $\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$

Logarithmic

(D-10) $\frac{d}{dx}(\ln u) = \frac{1}{u}\frac{du}{dx}$

(D-11) $\frac{d}{dx}(\ln x) = \frac{1}{x}$

(D-12) $\frac{d}{dx}(e^u) = e^u\frac{du}{dx}$

(D-13) $\frac{d}{dx}(e^x) = e^x$

(D-14) $\frac{d}{dx}(a^u) = a^u\frac{du}{dx}\ln a$

Trigonometric

(D-15) $\frac{d}{dx}(\sin u) = \cos u\frac{du}{dx}$

(D-16) $\frac{d}{dx}(\cos u) = -\sin u\frac{du}{dx}$

(D-17) $\frac{d}{dx}(\tan u) = \sec^2 u\frac{du}{dx}$

(D-18) $\frac{d}{dx}(\cot u) = -\csc^2 u\frac{du}{dx}$

(D-19) $\frac{d}{dx}(\sec u) = \sec u\tan u\frac{du}{dx}$

(D-20) $\frac{d}{dx}(\csc u) = -\csc u\cot u\frac{du}{dx}$

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CALCULUS FOR TECHNICIANS

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PREFACE

This book was written for technicians in the post-high school technical institute.

An effort was made to organize and develop some of the basic concepts of analytical geometry and calculus in their most simple form and to instill motivation in the subject by developing practical problems, so that the student understands why he is studying and above all is made to think.

Since mathematics is the language of science, and technology is the application or practical use of science, it is imperative that a technician comprehend the concepts of mathematics to perform his duties well.

Many of the problems in the text are aligned to physics and electronics, since those two fields are important to many technicians. It was felt that the mathematics course should not be a discrete entity but should overflow into the sciences and perhaps teach some parts of them together, especially where the mathematical principles are applied.

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QUIZ ON BASIC MATHEMATICS

The major point in the following problems is to understand <u>what</u> must be done and <u>why</u>, in order to solve the problems. Correct answers are important provided you obtain them with understanding. Perform the following operations:

1. <u>Add</u>

$$\frac{1}{2} + \frac{2}{3}$$

$$\frac{3}{8} + 2\frac{1}{5}$$

$$\frac{1}{12.2} + \frac{1}{11.1}$$

2. <u>Subtract</u>

$$\frac{1}{2} - \frac{2}{3}$$

$$\frac{3}{8} - 2\frac{1}{5}$$

$$\frac{1}{12.2} - \frac{1}{11.1}$$

3. <u>Multiply</u>

$$\frac{1}{2} \times \frac{2}{3}$$

$$\frac{3}{8} \times 2\frac{1}{5}$$

$$\frac{1}{12.2} \times \frac{1}{11.1}$$

4. <u>Divide</u>

$$\frac{1}{2} \div \frac{2}{3}$$

$$\frac{3}{8} \div 2\frac{1}{5}$$

$$\frac{1}{12.2} \div \frac{1}{11.1}$$

5. If 1 inch equals 2.54 cms., how many centimeters are there in 1 foot and in 1 yard?

6. Square the following:

0.16
1.6
16.0

7. Determine the square root of the following:

0.16
1.6
16.0

Solve each of the following for x:

8. $x + 3 = 5$

9. $2x - 7 = 3x + 4$

10. $\frac{3}{x} = 6$

11. $\frac{3}{2x} - 4 = 0$

12. $3x^2 - 67 = 8$

13. $\sqrt{2x} = 4$

14. $\sqrt{\frac{2}{3x}} = 2$

15. $x^2 + 8x + 16 = 0$

16. $x^2 + x - 20 = 0$

17. $6x^2 - 3x - 10 = 4x + 10$

18. $x + 3 = \sqrt{14x}$

19. $v_f^2 - v_i^2 = 2as$. Solve the equation for v_i.

20. If $\frac{1}{2\pi fc} = 2\pi fL$, solve for f.

21. Write the equation from the following description. Two electrostatically charged bodies q_1 and q_2 repel each other with a force that is directly proportional to the products of their charge and inversely proportional to the square of the distance between them. The proportionality may be converted to a statement of equality by using the constant G in such a way that F is proportional to G.

22. Determine the length and width of a lawn which is twice as long as it is wide and which has an area of 1250 square feet.

23. In 3 years Jeffrey will be twice as old as David. Determine their ages now if Jeffrey is 6 years older than David.

24. A manufacturing plant has equal stocks of two different raw materials. In one month it used $\frac{4}{5}$ of one kind and $\frac{9}{10}$ of the other. What portion of the total metal is unused after the month?

CHAPTER I

REVIEW OF FUNDAMENTALS OF ALGEBRA

(1-1) Solution of Equations

To understand mathematics, an understanding of the solution of equations is important, since many problems are in an equation or proportionality relationship. Let us take some simple examples and show the method of solution.

Ex.: $x + 2 = 12$ $\qquad$ $\underline{x + 2 = 12}$

In this equation, our objective is to determine the value of x, the unknown. The equation sign means we have a balance. Expressions that are equal can have the same operation performed on both and still remain equal — operations such as adding, subtracting, multiplying, dividing, taking the roots, or raising to powers. In the above problem we must determine the value of x alone, so it would seem logical to subtract 2 from both sides. This would give

$$\underline{x + 2 - 2 = 12 - 2} \quad \text{(subtracting)}$$

or $x = 10$

You will notice that the solution is correct since $10 + 2 = 12$. Our solution maintains a balance.

Let us try some other different examples, which you will find to be just as simple.

Ex.: $x - 5 = 8$

To get rid of the -5 on the left side, add + 5 to each side.

$$x - 5 + 5 = 8 + 5 \quad \text{(adding)} \qquad \underline{x - 5 + 5 = 8 + 5}$$

$$x = 13$$

Check: $13 - 5 = 8$

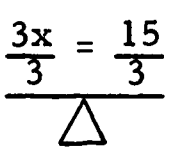
$$8 = 8$$

Ex: $3x = 15$

In this problem 3 is a multiplying coefficient of x. To eliminate the multiplying factor 3 in order to obtain the value of x, we must divide both sides by 3:

$$\frac{3x}{3} = \frac{15}{3} \quad \text{(dividing)}$$

$$x = 5$$



Check:

$$3x = 15$$

$$3(5) = 15$$

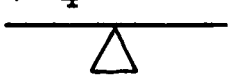
$$15 = 15$$

Ex: $\frac{x}{4} = 3$

In this problem, x is divided by 4. To obtain the value of x we must get rid of this 4. Let us perform the inverse (or opposite) operation of division on both sides. This is, of course, multiplication by 4.

$$(4)\frac{x}{4} = 3(4) \quad \text{(multiplying)}$$

$$x = 12$$



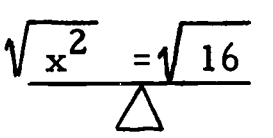
Check: $\frac{12}{4} = 3$

Ex: $x^2 = 16$

Here again the problem involves finding the value of x. The inverse of squaring is taking the square root. So let's take the square root of both sides.

$$\sqrt{x^2} = \sqrt{16} \quad \text{(taking square root)}$$

$$x = \pm 4$$



Check: $4^2 = 16$ and $(-4)^2 = 16$

$16 = 16 \qquad 16 = 16$

Ex: $\sqrt[3]{x} = 2$ or $x^{\frac{1}{3}} = 2$

The equation of the above problem involves the cube root. The inverse process of the cube root is raising to the cube power. Do this to both sides of the equation to maintain your balance.

$(x^{\frac{1}{3}})^3 = (2)^3$ (cubing both sides) $\quad \underline{(x^{\frac{1}{3}})^3 = (2)^3}$

$\triangle$

$x^1 = 8$ or $x = 8$

Check: $\sqrt[3]{8} = 2$

You will note that solving an equation for the value of the unknown, x, involves using the inverse or opposite operation of that which is in the equation. The above examples involved only one operation each. In practical problems, multiple operations may be performed. The important point to remember is that if the same thing is done to both sides of the equation, the equation or balance is maintained, and the correct solution for the unknown may be obtained.

Now let us take an example with multiple operations:

Ex: $\frac{x}{3} + 6 = 3y - 1$ — Solve for x.

$\frac{x}{3} + \cancel{6} - \cancel{6} = 3y - 1 - 6$ — Subtract 6 from both sides

$(3)\frac{x}{3} = (3)(3y - 7)$ — Multiply both sides by 3

$x = 9y - 21$ — Answer

Ex: Given: $E_{KE} = \frac{1}{2} mv^2$, solve for v in terms of the other letters

$E_{KE} = \frac{1}{2} mv^2$

$(2)E_{KE} = (2)\frac{1}{2} mv^2$ — Multiply both sides by 2 to to get rid of $\frac{1}{2}$

$\frac{2E_{KE}}{m} = \frac{mv^2}{m}$ — Divide both sides by m, which is a multiplying factor of v.

$\frac{2E_{KE}}{m} = v^2$

$\sqrt{\frac{2E_{KE}}{m}} = \sqrt{v^2}$ — Take the square root of both sides

$\sqrt{\frac{2E_{KE}}{m}} = v$ — Answer

If an equation involves multiplication and division and also addition and subtraction, the multiplication and division must be performed before the addition and subtraction.

Ex: $3(2x + 1) = 4$

$6x + 3 = 4$	Multiply ( ) by 3
$6x + 3 - 3 = 4 - 3$	Subtract
$\frac{6x}{6} = \frac{1}{6}$	Divide by 6
$x = \frac{1}{6}$	Answer

In other words, perform the indicated operation on any parenthesized term first, then proceed as above.

The reciprocal of a quantity is 1 divided by the quantity, and it may be expressed by using the negative exponent.

Ex: $\frac{1}{x} = x^{-1}$

$\frac{1}{3} = 3^{-1}$

$\frac{1}{x^4} = x^{-4}$

(1-2) Binomial Expansion

Any binomial, such as (a + b), may be raised to any power by multiplying it by itself as many times as the power to which it is raised. This may also be done by using the general expansion formula:

$$(a + b)^n = a^n + \frac{n}{1} a^{n-1}b + \frac{n(n-1)}{2!} a^{n-2}b^2 + \frac{n(n-1)(n-2)}{3!} a^{n-3}b^3 + \ldots\ldots + b^n$$

The expression 3! means 1 x 2 x 3 and is read "three factorial." Five factorial (5!) equals 1 x 2 x 3 x 4 x 5. Note that the expansion is continued until the second term of the binomial is raised to the proper power (n).

Expand the expression $(a + b)^3$ by just multiplying $(a + b)$ by itself three times:

$$
\begin{array}{rcl}
(a + b)(a + b) & = & a + b \\
 & & \underline{a + b} \\
 & & a^2 + ab + b^2 \\
\hline
(a + b)(a + b)^2 & = & a^2 = 2ab + b^2 \\
 & & \underline{a + b} \\
 & & a^3 + 2a^2b + ab^2 \\
 & & \quad + a^2b + 2ab^2 + b^3 \\
\hline
(a + b)^3 & = & a^3 + 3a^2b + 3ab^2 + b^3 \quad \text{Ans.}
\end{array}
$$

This is simple, but as the parenthesized terms get larger and the power becomes higher, the general expansion formula becomes a handy tool. Try writing out $(a + b)^3$ using the binomial equation for expansion:

$$(a + b)^n = a^n + na^{n-1}b + \frac{n(n-1)}{2!}a^{n-2}b^2 + \frac{n(n-1)(n-2)}{3!}a^{n-3}b^3 + \ldots$$

$$(a + b)^3 = a^3 + 3a^{3-1}b + \frac{3(2)}{1x2}a^{3-2}b^2 + \frac{3x2x1}{1x2x3}a^{3-3}b^3$$

$$(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$$

Another useful application of the binomial equation is the solution of problems with fractional exponents, positive or negative. Take the following problem as an example.

Ex. $(a + b)^{\frac{1}{2}}$

The general form is as follows:

$$(a + b)^n = a^n + na^{n-1}b + \frac{n(n-1)}{2!}a^{n-2}b^2 + \frac{n(n-1)(n-2)}{3!}a^{n-3}b^3 + \ldots$$

$$(a + b)^{\frac{1}{2}} = a^{\frac{1}{2}} + \frac{1}{2}a^{-\frac{1}{2}}b + \frac{\frac{1}{2}\left(-\frac{1}{2}\right)}{1x2}a^{-\frac{3}{2}}b^2 + \frac{\frac{1}{2}\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)}{1x2x3}a^{-\frac{5}{2}}b^3 + \ldots$$

$$= a^{\frac{1}{2}} + \frac{b}{2a^{\frac{1}{2}}} - \frac{b^2}{8a^{\frac{3}{2}}} + \frac{b^3}{16a^{\frac{5}{2}}} + \ldots$$

You will note that, when expanding a binomial to a fractional power, the solution is irrational and the extent to which it is carried is a function of the accuracy required. This expansion yields what is called an infinite series. When the power is integral (or a whole number), the expansion eventually results in a "disappearance" of the first term of the binomial (since $a^{n-n} = a^0 = 1$). This case gives a finite (definite) solution.

In the expansions illustrated, we were only concerned with positive values, which give us positive results in all cases except fractional powers. If the binomial is of the form (a-b), all terms containing odd powers of b will be negative and those with even powers of b will be positive. Another way of saying this is, when expanding a binomial containing a difference (a-b), the expansion starts out positive, then goes negative, and alternates in that sequence throughout the series of terms.

In expanding a binomial to a power, we get an expression consisting of a number of terms. If the inverse operation is performed on the expansion, called factoring, we obtain the original binomial raised to its proper power. For example, $(a-b)^2$ when expanded gives $a^2 - 2ab + b^2$. Now suppose we had the expression $a^2 - 2ab + b^2$ and were asked to factor it, that is, perform the inverse operation of expansion. We would get $(a-b)^2$, which is read as "the quantity (a-b) squared," or multiplied by itself.

Let's take an example to see if we can use this sort of factoring to solve an equation.

Ex. $4x^2 + 12x = -9$ Factor and solve for x

$4x^2 + 12x + 9 = -9 + 9$ Add +9 to both sides

$4x^2 + 12x + 9 = 0$

$(2x + 3)(2x + 3) = 0$ Factor (what are a and b in this case?)

$(2x + 3)^2 = 0$

We now have a product $(2x + 3)(2x + 3)$ equal to zero. When a product equals zero, any or all of its factors must equal zero. Setting each one equal to zero (in this case, both factors are the same), we get

$2x + 3 = 0$

$2x + 3 - 3 = 0 - 3 \longleftrightarrow$ Add -3 to both sides

$\frac{2x}{2} = -\frac{3}{2} \longleftrightarrow$ Divide by 2

$x = -\frac{3}{2}$

Check in the original equation:

$$4x^2 + 12x = -9$$

$$4(-\tfrac{3}{2})^2 + 12(-\tfrac{3}{2}) \stackrel{?}{=} -9$$

$$9 - 18 = -9$$

(1-3) Quadratic Equations

The above example is a quadratic equation, which is an equation in which the highest power of the unknown is the square (the second power). The above example was also a perfect square, but in most cases quadratic equations are not perfect squares, which means that we cannot obtain solutions by means of factoring.

When a quadratic equation is not a perfect square, its solution may be obtained by "completing the square" or by using the quadratic formula, which is a general shorthand method of completing the square. For example, consider the equation

$$4x^2 + 12x = 5$$

When 5 is subtracted from both sides we get

$$4x^2 + 12x - 5 = 0$$

The above equation cannot be factored with rational integers to obtain the value or roots of the unknown.

To complete the square the following simple method is used:

$$4x^2 + 12x = 5$$

$$x^2 + 3x = \frac{5}{4}$$ Divide both sides of the equation by the coefficient of x^2.

$$x^2 + 3x + \frac{9}{4} = \frac{5}{4} + \frac{9}{4}$$ Add to both sides of the equation the square of $\frac{1}{2}$ the coefficient of x.

$$(x + \frac{3}{2})^2 = \frac{14}{4}$$ Factor left side.

$$x + \frac{3}{2} = \pm\frac{1}{2}\sqrt{14}$$ Take the square root of both sides.

$$x = -\frac{3}{2} + \frac{1}{2}\sqrt{14} \qquad x = -\frac{3}{2} - \frac{1}{2}\sqrt{14}$$

$$x = \frac{-3 + \sqrt{14}}{2} \qquad x = \frac{-3 - \sqrt{14}}{2}$$

$$\text{or } x = \frac{-3 \pm \sqrt{14}}{2}$$ Ans.

Check <u>each</u> solution in the original equation, $4x^2 + 12x = 5$

$$x = \frac{-3 + \sqrt{14}}{2} \qquad x = \frac{-3 - \sqrt{14}}{2}$$

$$4\left(\frac{-3 + \sqrt{14}}{2}\right)^2 + 12\left(\frac{-3 + \sqrt{14}}{2}\right) \stackrel{?}{=} 5 \qquad 4\left(\frac{-3 - \sqrt{14}}{2}\right)^2 + 12\left(\frac{-3 - \sqrt{14}}{2}\right) \stackrel{?}{=} 5$$

$$4\left(\frac{9 - 6\sqrt{14} + 14}{4}\right) + 6(-3 + \sqrt{14}) \stackrel{?}{=} 5 \qquad 4\left(\frac{9 + 6\sqrt{14} + 14}{4}\right) + 6(-3 - \sqrt{14}) \stackrel{?}{=} 5$$

$$23 - 6\sqrt{14} - 18 + 6\sqrt{14} = 5 \qquad 23 + 6\sqrt{14} - 18 - 6\sqrt{14} = 5$$

<u>Derivation of the Quadratic Equation</u>

$$ax^2 + bx + c = 0$$ Gen. quadratic equation.

$$ax^2 + bx = -c$$ Add -c to both sides

$$x^2 + \frac{b}{a}x = \frac{-c}{a}$$ Divide both sides by coefficient of x^2

$$x^2 + \frac{b}{a}x + \frac{b^2}{4a^2} = \frac{-c}{a} + \frac{b^2}{4a^2}$$ Add the square of half the coefficient of x to both sides

$$\left(x + \frac{b}{2a}\right)^2 = \frac{b^2 - 4ac}{4a^2}$$ Factor left-hand side and combine right-hand side of equation

$$x + \frac{b}{2a} = \frac{\pm\sqrt{b^2 - 4ac}}{2a}$$ Take square root of both sides

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Solution of an equation by use of quadratic formula:

$$4x^2 + 12x = 5$$

$$\underset{a}{(4)}x^2 + \underset{b}{(12)}x\ \underset{c}{(-5)} = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-12 \pm \sqrt{144 - 4(4)(-5)}}{2(4)}$$

$$x = \frac{-3 \pm \sqrt{14}}{2}$$

Note: Answer is the same as that obtained by completing the square

Problems

Solve the following algebraic equations

1. $x^2 - 25 = 0$
2. $9x^2 - 81 = 0$
3. $x^2 - 2x - 3 = 0$
4. $x^2 - 5x = 0$
5. $y^2 - 3y - 10 = 0$
6. $9I^2 - \frac{4}{25} = 0$
7. $(x + 2)^2 + (x - 2)^2 - 40 = 0$
8. $5x^2 - 8x - 6 = 0$
9. $x^2 - 9x + 14 = 0$
10. $mx^2 + 17mx - 3 = 0$

Solve the following for unknowns indicated:

	Given	Solve for	Application
11.	$R_T = R_1 + R_2 + R_3$	R_3	Total resistance in series
12.	$E = IR$	I	Ohm's Law
13.	$P = I^2R$	I	Electric power

	Given	Solve for	Application
14.	$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$	T_2	General perfect gas law
15.	$IHP = \frac{PLAN}{33000}$	N	Indicated H. P.
	(N = number of power strokes per min = $\frac{\#cyl \times RPM}{2}$)		
16.	$w = mg$	g	Weight
17.	$\frac{V_f - V_i}{t} = a$	V_i	Definition of average acceleration
18.	$T = 2\pi\sqrt{\frac{\ell}{g}}$	ℓ	Period of a pendulum
19.	$F = \frac{mv^2}{r}$	v	Centripetal force
20.	$Fd = \frac{1}{2}mv^2$	v	Potential energy equal kinetic energy

Solve the following, using the equations above where necessary:

21. A one-kilogram car is traveling around a track which is 100 meters in diameter at 30 meters per second. Determine the centripetal force imposed by the road on the tires.

22. If the length of a pendulum is doubled, by what factor is the period increased?

23. A car travels halfway around a 4-mile track at 30 miles per hour. What must its speed be for the remaining distance to average 40 miles per hour for the whole trip?

24. The volume of a sphere is given by the equation $V = \frac{4}{3}\pi R^3$. If the radius is tripled, by what factor is the volume changed?

25. Find two consecutive integers such that the difference between their squares is 37.

26. The units digit of a given two-place natural number exceeds the ten's digit by 7. If the number increased by 4 is divided by the sum of the digits, the quotient is 3. Find the number.

27. The sum of the roots of a quadratic equation is 8 and their product is 15. Determine the quadratic equation.

28. Determine the dimensions of a rectangle which has a perimeter of 80 feet and an area of 391 square feet.

29. A rocket is shot upwards with a speed of 800 feet per second. After t seconds its height is given by the equation $S = 800t - \frac{1}{2}gt^2$ If $g = 32$ ft/sec^2, in what time will it be 1800 feet above the ground?

CHAPTER II

GRAPHICAL MATHEMATICS

Graphics, that is, lines, curves and other representations of mathematical relationships, are usually made for one of two reasons. One, to simplify what the mathematical equation is expressing, and two, to take plotted data and derive a mathematical relationship between the functions.

Generally, mathematical functional relations fall into three types:

1. Linear: $y = 3x + 1$
2. Power: $y = \pi R^2$
3. Exponential: $y = e^x$ where e = constant

(2-1) Linear Functions

The linear function will be explained in this section and the latter two in the section on exponents and logarithms.

Linear functions, when graphed, are always straight lines.

Use will be made of distance, time, velocity, and acceleration to explain these functions, with the hope that the student will learn the meaning of these terms while he learns about linear functions.

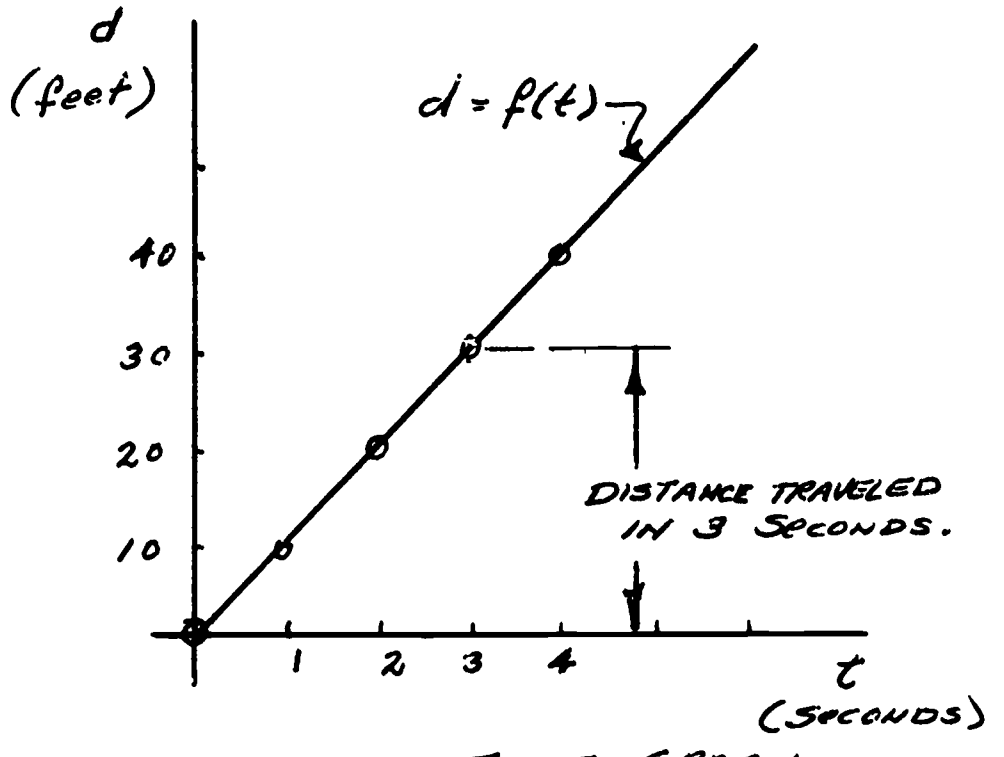
Time is something almost impossible to explain. In a sense it is like many things in the physical world which are not basically understood - gravity, electricity, light, magnetism, etc. We can study their behavior through mathematical relations, even though we may not be able to fully define them.

Graphs and mathematical equations can be used to express the behavior of these phenomena of the physical world.

Everyone is familiar with displacement, which is simply a change of position. Every time you walk or move something, a change of position results.

Suppose we have an object moving at a uniform speed. It passes a designated point. We can measure the distance traveled from this point and from this moment. Here we have two variables which can be plotted on a two-coordinate axis system.

Let's draw a graph of distance versus time. For convenience, time is always plotted on the x-axis, and distance on the y-axis.



DISTANCE-TIME GRAPH

On the above graph, we have written d = f(t) to indicate that d is a function of t, that is, that d is a variable whose value depends on the value of another variable, t.

You will note from the straight-line relationship, that after 3 seconds the object moved 30 feet from the zero or starting point. On the distance-time graph this is represented by the ordinate (y-value) as marked.

If we divide d by t, or $\frac{\text{feet}}{\text{seconds}}$, we recognize this as speed (velocity), or rate of change of distance with respect to time.

$$V = \frac{d}{t}$$

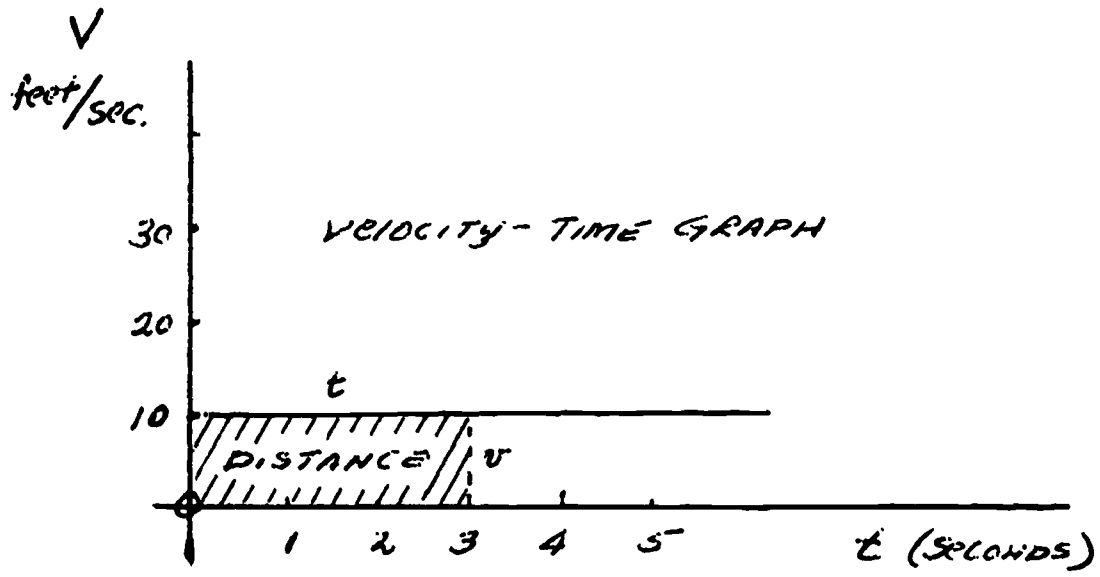
Now let's solve for the speed from the distance-time curve.

For the 3-second point, the distance traveled is 30 feet.

$$V = \frac{d}{t} = \frac{30 \text{ feet}}{3 \text{ sec.}} = 10 \text{ ft./sec.}$$

Worked out for any time interval on this graph, the speed is still 10 ft./sec., a constant. So the straight line on the distance-time graph represents constant speed.

Now let us draw a speed-time graph of the above. This is a straight line also, with a constant value for V, so that the graph is parallel to the time-axis.



The product of speed by time gives distance covered.

$$v \times t = d$$

10 ft. /sec. x 3 sec. = 30 ft., distance

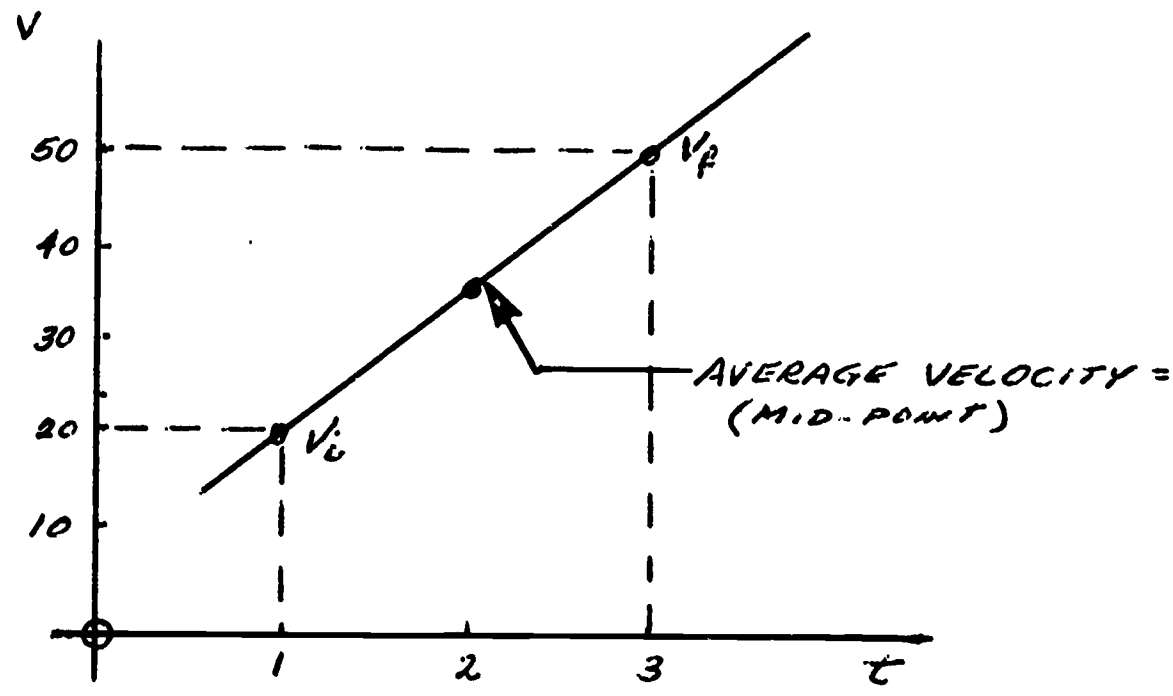
Distance may therefore be pictured by the area under the velocity-time graph.

Let us go back to the definition of speed:

$$v = \frac{d_2 - d_1}{t_2 - t_1} = \frac{d}{t} \text{ if } (d_1) \text{ and } (t_1) \text{ are zero.}$$

The equation says that speed is the time rate of change of distance.

Suppose that the velocity-time curve was not a straight line parallel to the time-axis, but a straight oblique line. Such would be the case if the velocity changed constantly at the same rate - at a uniform acceleration.



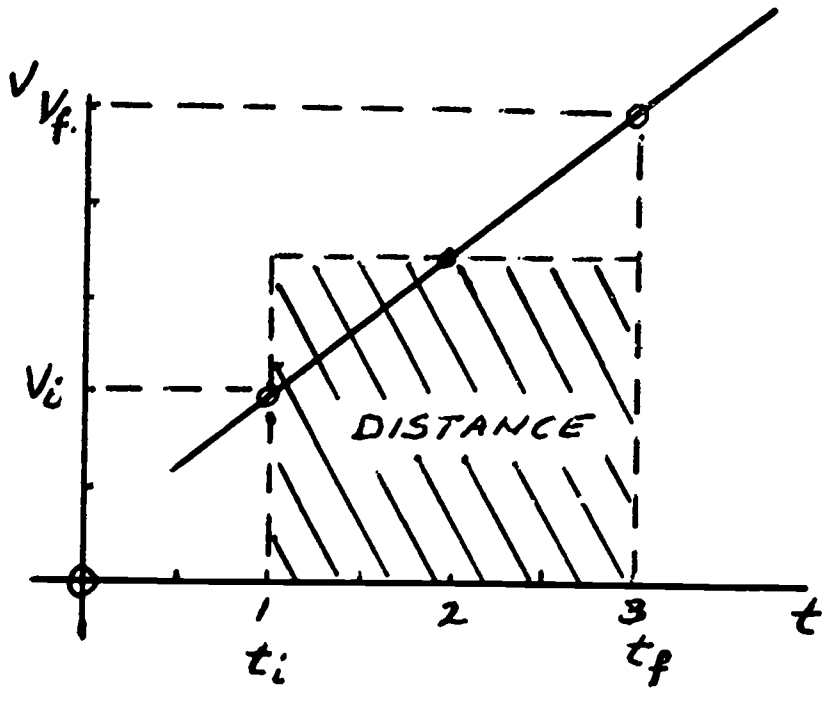
The above graph indicates that the velocity changes in a constant ratio with time. The equation d = vt cannot be used unless the velocity is either <u>constant</u> or <u>average</u>. In this case, it is easy to find the average velocity.

From the graph, the ordinates are v = 20 at t = 1 and v = 50 at t = 3. When acceleration is constant, as it is here, the average velocity between 20 and 50 is obtained the same way you obtain the average of two tests: add the scores and divide by the number of tests. For velocity, this would be

$$V_{AV.} = \frac{V_i + V_f}{2} \qquad \begin{array}{l} i = \text{initial} \\ f = \text{final} \end{array}$$

$$V_{AV.} = \frac{20 + 50}{2} = 35 \text{ ft./sec.}$$

Remember this important point: Velocity or speed in an equation always means <u>average</u> velocity unless otherwise noted.



VELOCITY-TIME GRAPH

On the above velocity-time graph, the area under the curve once again gives the distance traveled.

$$d = V_{AV.}\, t$$

$$\text{But } V_{AV.} = \frac{V_i + V_f}{2}$$

$$\text{Therefore } d = \frac{V_i + V_f}{2}(t) = \frac{20 + 50}{2}(2) = 70 \text{ feet}$$

Or, by using the average velocity found previously,

$$d = V_{AV.}\, t = 35\frac{\text{ft.}}{\text{sec.}} \times 2 \text{ sec.} = 70 \text{ ft.}$$

The change of velocity with respect to time is the acceleration:

$$a = \frac{V_f - V_i}{t_f - t_i}$$

When the initial velocity and time are zero, then

$$A = \frac{V}{t}$$

From basic definitions and plotted data, three fundamental equations are known which define distance, average velocity, and acceleration in the most fundamental form. From these three all other equations of straight-line or rectilinear motion are derived by algebraic manipulation.

These equations and verbal definitions must be remembered:

$$\left.\begin{aligned} d &= V_{AV.}\,t \\ a &= \frac{V_f - V_i}{t} \\ V_{AV.} &= \frac{V_f + V_i}{2} \end{aligned}\right\}$$

Basic Equations
(t = elapsed time)

The second and third equations assume a constant acceleration.

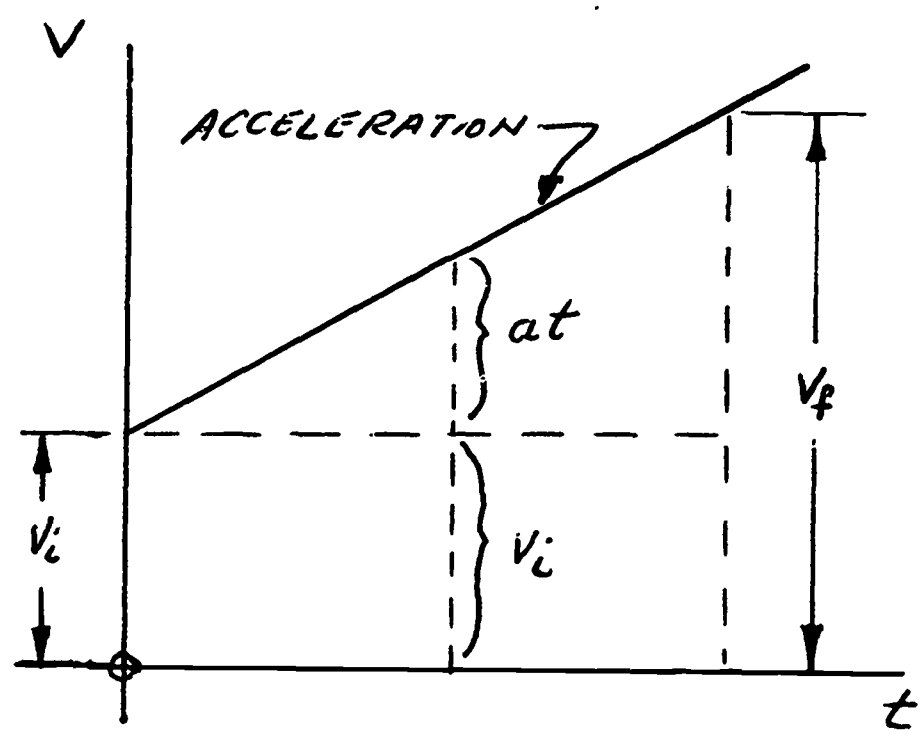
Suppose we take the equation for acceleration and manipulate it.

$$a = \frac{V_f - V_i}{t}$$

$$at = V_f - V_i \qquad \text{Multiply both sides by } t$$

Derived equation $\quad V_f = V_i + at \qquad$ Add V_i to both sides

Graphically this equation becomes



VELOCITY-TIME GRAPH

A verbal problem of this type will perhaps insure understanding.

A stone is thrown from the Empire State Building at an initial velocity of 60 ft/sec. Determine its velocity after 2 and 4 seconds if acceleration due to gravity is 32 ft. /sec^2.

Given Data of Problem

V_i = 60 ft. /sec. Find V_f

t = 2 and 4

a = 32 ft. /sec. ^{2}

Now the problem is what equation to use. Obviously, the given data must supply everything in the equation except one unknown factor.

$$V_f = V_i + at$$

For t = 2, $V_f = 60 \frac{\text{ft.}}{\text{sec.}} + (32 \frac{\text{ft.}}{\text{sec.}^2} \times 2 \text{ sec.}) = 124 \text{ ft. /sec.}$

For t = 4, $V_f = 60 \frac{\text{ft.}}{\text{sec.}} + (32 \frac{\text{ft.}}{\text{sec.}^2} \times 4 \text{ sec.}) = 188 \text{ ft. /sec.}$

Both of these values are represented by the ordinates of the graph at t = 2 and t = 4.

An important point to remember is that this same problem could have been solved by simply substituting in the equation which defines acceleration.

$$a = \frac{V_f - V_i}{t}$$

Substitution $32 = \frac{V_f - 60}{4}$

$$V_f = 188 \text{ ft. /sec.}$$

Now let's try to derive an equation which involves all four units and which will give distance in some relation to the others. Using the three basic equations:

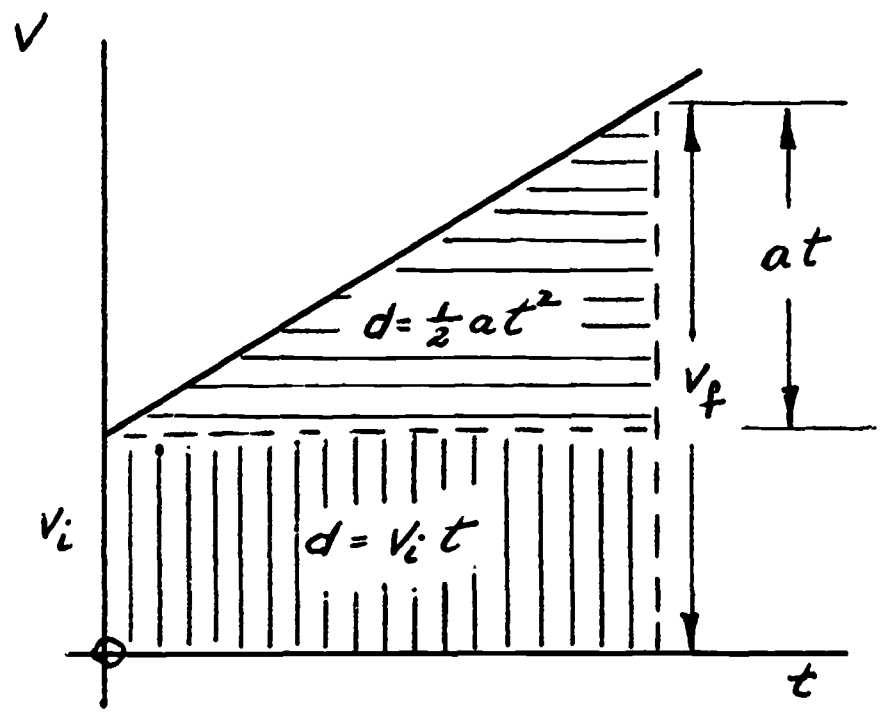
$d = V_{AV.} t$ $\quad a = \frac{V_f - V_i}{t}$ $\quad V_{AV.} = \frac{V_f + V_i}{2}$

$d = \left(\frac{V_f + V_i}{2}\right) t$ Substituting for $V_{AV.}$

$d = \left[\frac{(V_i + at) + V_i}{2}\right] t$ Substituting $(V_i + at)$ for V_f (Previously derived from acceleration formula)

Derived Equation: $d = V_i t + \frac{1}{2} at^2$ Combining and simplifying

From the previous problem and graph of velocity-time, the ordinate gave the final velocity. Using the same graph, the distance can also be pictured.



Let us divide the area under the curve into a triangle and a rectangle, as shown.

Rectangle: $d = V_i t$ (since V_i is constant, and distance is the area under the velocity-time graph).

Triangle: The altitude of the triangle is $a \cdot t$ (as shown previously) and the base is t. Area of a triangle $= \frac{1}{2}$ bh. By substitution, $A = \frac{1}{2}(t)(at) = \frac{1}{2}at^2$.

Since the rectangle and the triangle represent the total area, and since the area under a velocity-time graph represents distance, the two components must be added to give the total distance traveled.

Therefore

$$\underbrace{d = V_i t}_{\text{Area of rectangle}} + \underbrace{\frac{1}{2}at^2}_{\text{Area of triangle}}$$

Now, for the previous stone problem, using t = 4 seconds, let's find the distance traveled.

$$d = V_i t + \frac{1}{2} a t^2$$

$$= 60(4) + \frac{1}{2}(32)(4)^2 \qquad \text{Substitution}$$

$$= 240 + 256$$

$= 496$ feet, or roughly $\frac{1}{3}$ the distance to the ground.
(The building is approximately 1500 feet tall.)

The distance could have been found by using the area of the trapezoid under the curve, as follows:

$$d = A = \frac{V_i + V_f}{2}(t)$$

$$= \frac{60 + 188}{2}(4)$$

$$= 496 \text{ feet}$$

Another and final manipulative derivation involves an equation which excludes the time (t) and uses V, a, and d.

$$d = V_{AV.}\, t$$

$$d = \frac{V_f + V_i}{2} \times \frac{V_f - V_i}{a} \qquad \text{Substituting for } V_{AV.} \text{ and t from acceleration formula.}$$

$$d = \frac{V_f^2 - V_i^2}{2a} \qquad \text{Multiplying}$$

$$2ad = V_f^2 - V_i^2 \qquad \text{Multiply both sides by 2a}$$

Derived equation: $V_f^2 = V_i^2 + 2ad$

With the facts derived from the problem so far, we could state a problem as follows to fit the last derived equation:

Find the final velocity of an object at a distance of 496 feet when the initial velocity is 60 ft./sec. (a = 32 ft./sec.^{2}) (You will note, no mention of time is made.)

Solution:

$$V_f^2 = V_i^2 + 2ad$$

$$V_f^2 = (60)^2 + 2(32)(496)$$

$$V_f = 188 \text{ ft./sec. (as before)}$$

Try to represent this last equation graphically.

Summary

From three basic definitions of physical terms, graphs and equations were presented which represented relationships according to the definitions.

With the three derived equations, all problems in rectilinear motion can be solved.

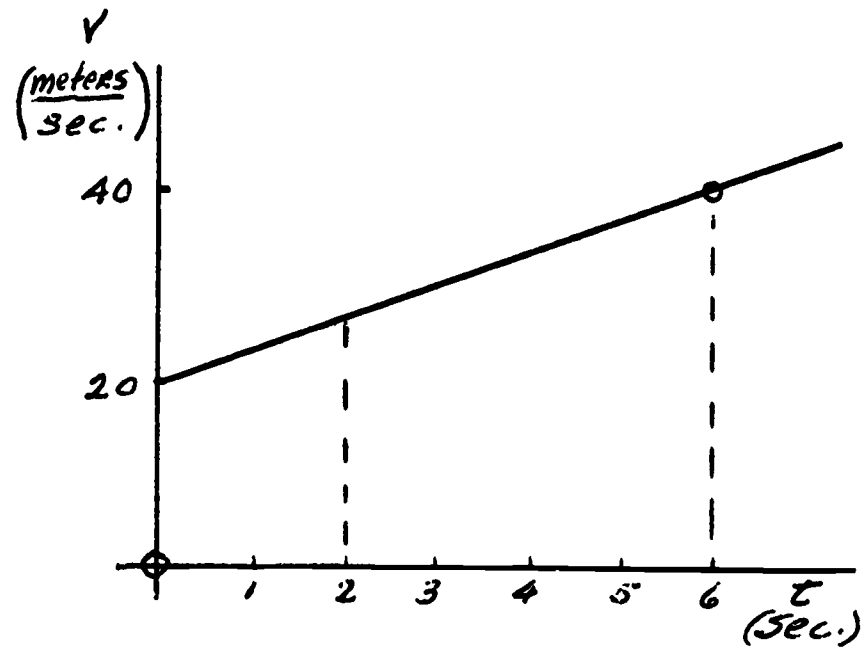
In plotting linear functional relations on graphs, it is possible to derive a third term from the slope relationship of the curve. The study of these relations of graphs is what is called calculus.

Straight-line relationships are plotted on regular coordinate paper. All of the equations except the last were linear - meaning that none of the terms had powers of the unknowns greater than one.

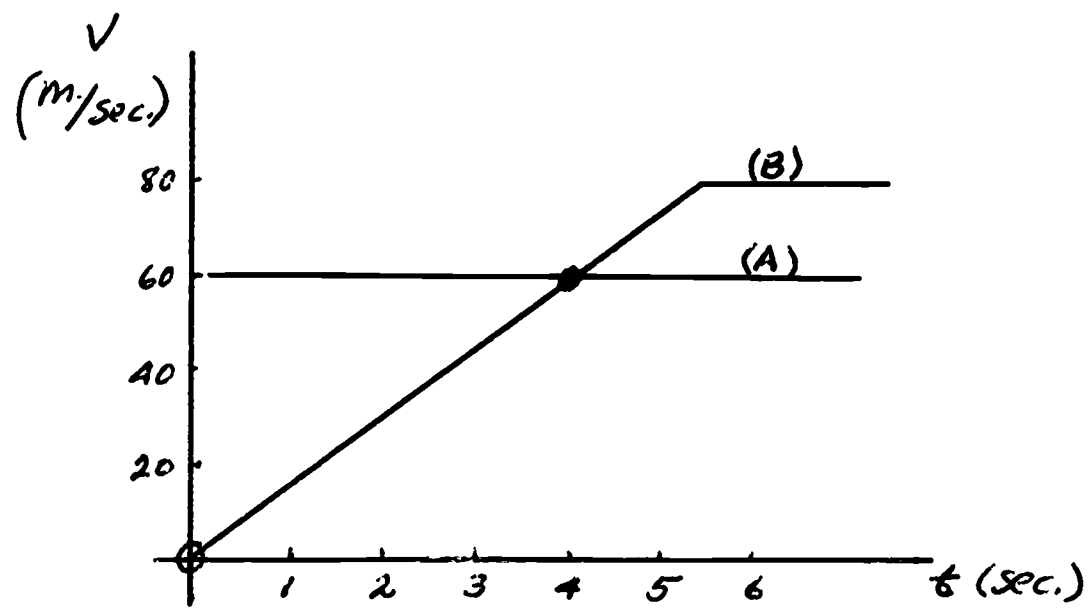
The power and exponential functions will be given in the section on logarithms.

Problems

1. From this velocity-time diagram, find the acceleration and the distance traveled between 2 and 6 seconds.



2. Object A is traveling at a constant velocity of 60 meters per second when B starts from a standstill.



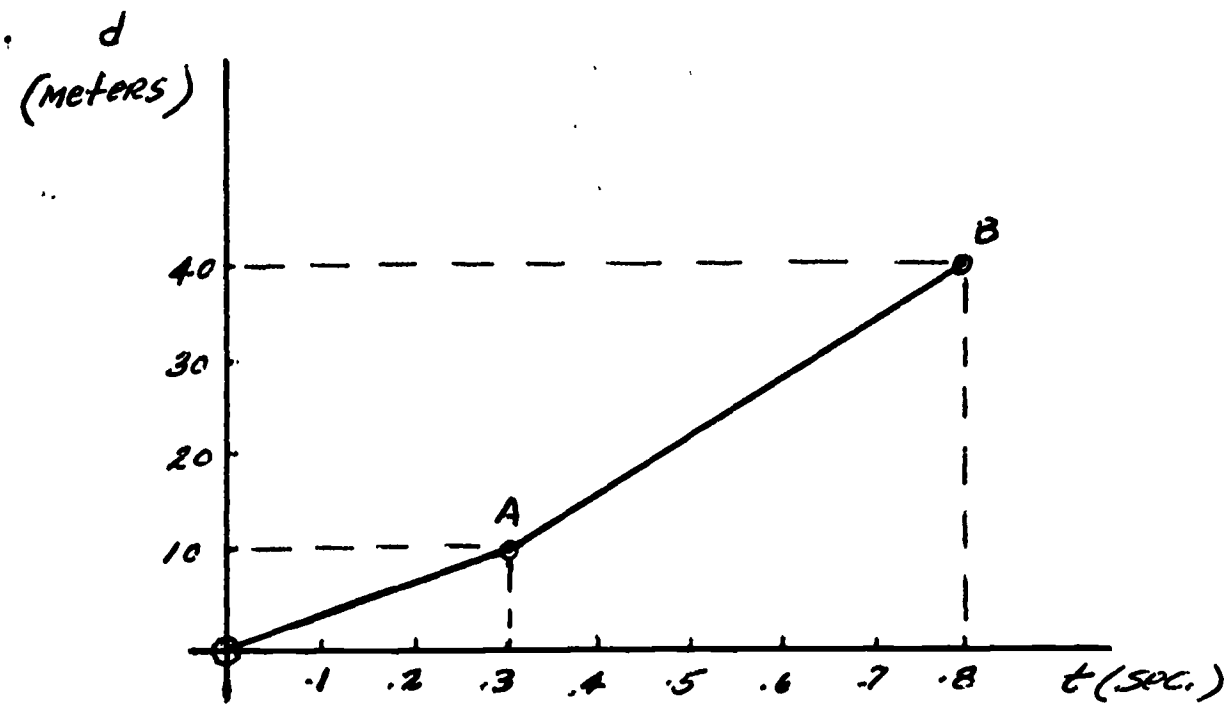
a. At what time are their velocities the same?

b. At this time how far behind is B?

c. At what time are they together?

d. What is the acceleration of A and B?

3.



From the distance-time graph determine the velocity from O to A and from A to B.

4. Draw a velocity-time graph of problem 3 and determine the distance at $t = 0.6$ seconds.

5. An object is traveling at $10 \frac{m}{s}$ accelerated for a distance of 50 meters. Determine its final velocity.

6. An object is dropped from a bridge and takes 4 seconds to hit the water. Draw a graph of the velocity-time and distance-time.

7. A rocket-sled is accelerated for 6 seconds at 150 m./sec.^{2} After 3 seconds the acceleration is -100 m./sec.^{2} until it stops.

   a. Draw the acceleration diagram.

   b. Draw the velocity-time diagram.

   c. Draw the distance-time diagram.

   d. Calculate the total distance traveled.

CHAPTER III

PLANE ANALYTICAL GEOMETRY

In algebra, trigonometry, and vectors, one gets involved with analytical geometry, although the term is not generally used. Every time you plotted a straight line or a curve of an algebraic equation, you were involved with analytic geometry. You plotted the figures on a grid in a plane which was divided by an x-axis and a y-axis into four quadrants.

Specifically we could define analytic geometry by using an equation:

Cartesian Coordinate System + Geometry = Analytic Geometry

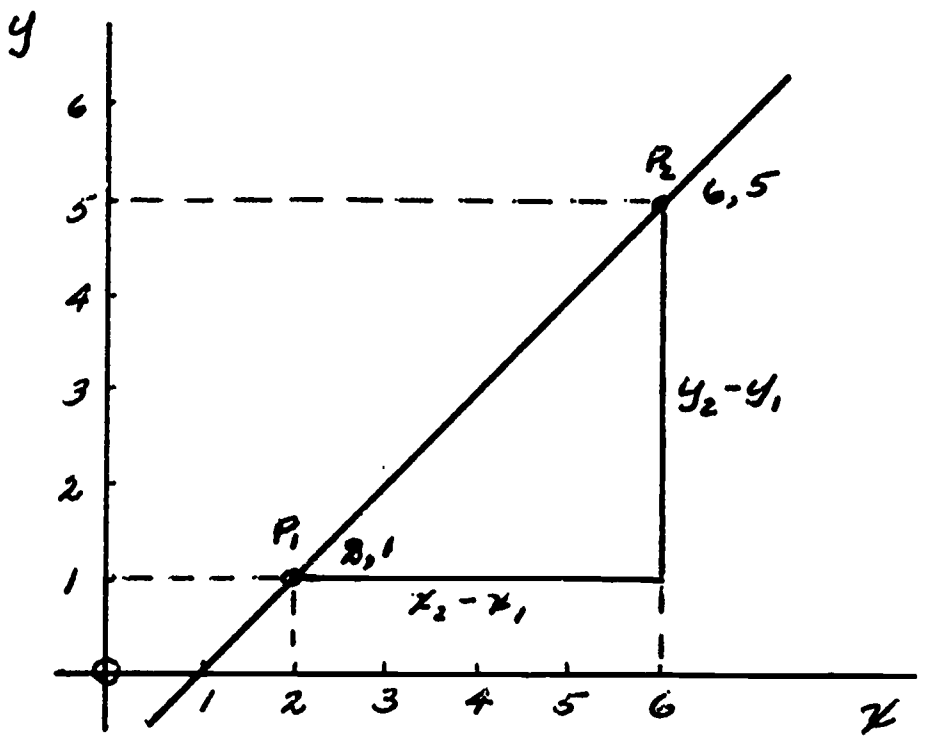
In algebra you were involved with plotting linear and quadratic functions of algebraic equations, which resulted in straight lines or curves. In analytic geometry, from the curves or straight lines we will learn how to write the algebraic equations. From plotted data, equations are derived, and from the equations the relationship of one function to another may be determined.

(3-1) The Straight Line: Linear Equations

If you had a straight oblique line on a coordinate system, how would you determine the length of the line? This is quite simple if you recall the Pythagorean theorem in geometry: The square of the hypotenuse of a right triangle is equal to the sum of the squares of the other two sides, or

$$c^2 = a^2 + b^2$$

Knowing this, determine the length of the line between P_1 and P_2 on the graph below. (Note that P_1 and P_2 are both in the first quadrant, and so the values for both x and y are positive.)



Let $d = P_2P_1$

$d^2 = (y_2 - y_1)^2 + (x_2 - x_1)^2$ by Pythagorean Theorem

$d = \sqrt{(y_2 - y_1)^2 + (x_2 - x_1)^2}$ Take the square root of both sides

But $x_2 - x_1 = 6 - 2 = 4$

$y_2 - y_1 = 5 - 1 = 4$

Numerical substitution gives

$d = \sqrt{4^2 + 4^2} = \sqrt{32}$

$d = 4\sqrt{2}$

Problems

Determine the distance between the following coordinate points:

1. (7, 4), (6, 2)

2. (6, 9), (-2, 6)

3. (.8, 5), (-4, -3)

4. (1, -3), (-3, -4)

5. Find the point on the x-axis which is equidistant from (3, 2) and (1,-4).

6. Prove by using the distance formula that the following three points form an isosocles triangle: (2, -3), (8, 6), (-7, -9).

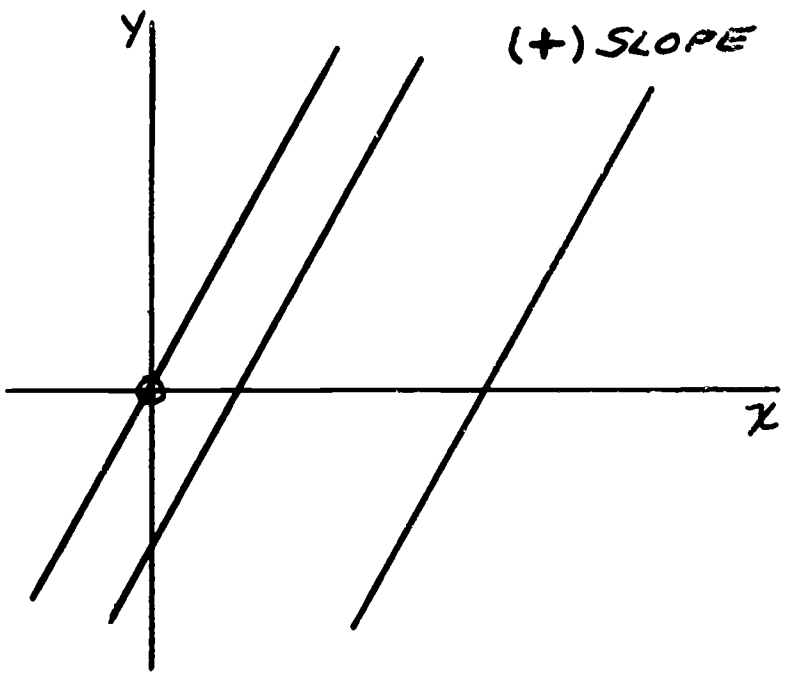
7. Find the equation of the perpendicular bisector (that is, the locus of points) of the line joining (-2, 3) and (3, 6).

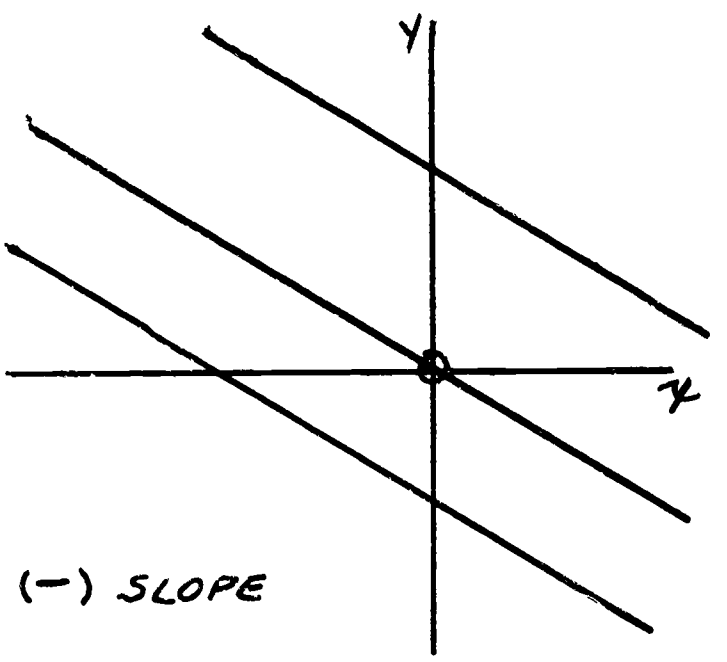
8. Find the area of the triangle formed by the following coordinate points (2, 5), (-2, 1), and (1, -3). (Hint: Use the following equation: $A = \sqrt{S(S-a)(S-b)(S-c)}$ where S equals the semi-perimeter and a, b, c equal the lengths of the sides.)

9. The bearing of boat A is 10 miles at 45° from its base and boat B is 5 miles at 60° from the same base. Analytically determine the distance between them. (Bearing is clockwise angular rotation from north.)

(3-2) The Inclination or Slope of a Line

Look at the lines in the drawings below. Think of them as having been made by points, moving across the coordinate axes. In the left-hand diagram, as a point moves from left to right, the x-value increases and so does the y-value. These lines are said to have a positive direction or slope. In the right-hand diagram, as a point moves from the left to right, the x-value increases, but the y-value decreases. These lines are said to have a negative direction, or slope.



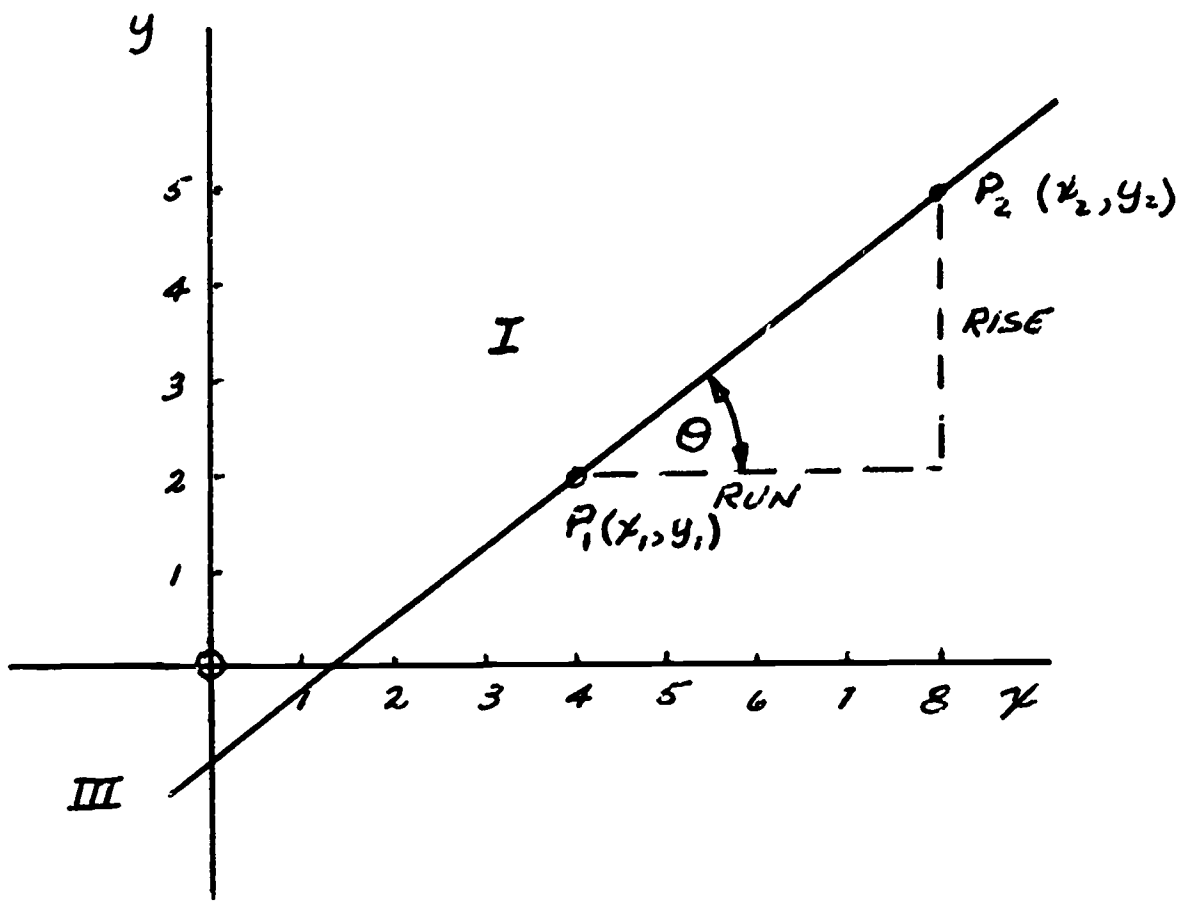


The slope of a line is equal to the $\frac{\text{rise}}{\text{run}}$ between any two points on the line. That is,

$$\text{Slope} = \frac{\text{change in the ordinate value between the two points}}{\text{change in the abscissa value between the two points}}$$

As a symbol for the slope of a line, we will use the letter m.

$$m = \frac{\text{rise}}{\text{run}} = \tan \theta$$



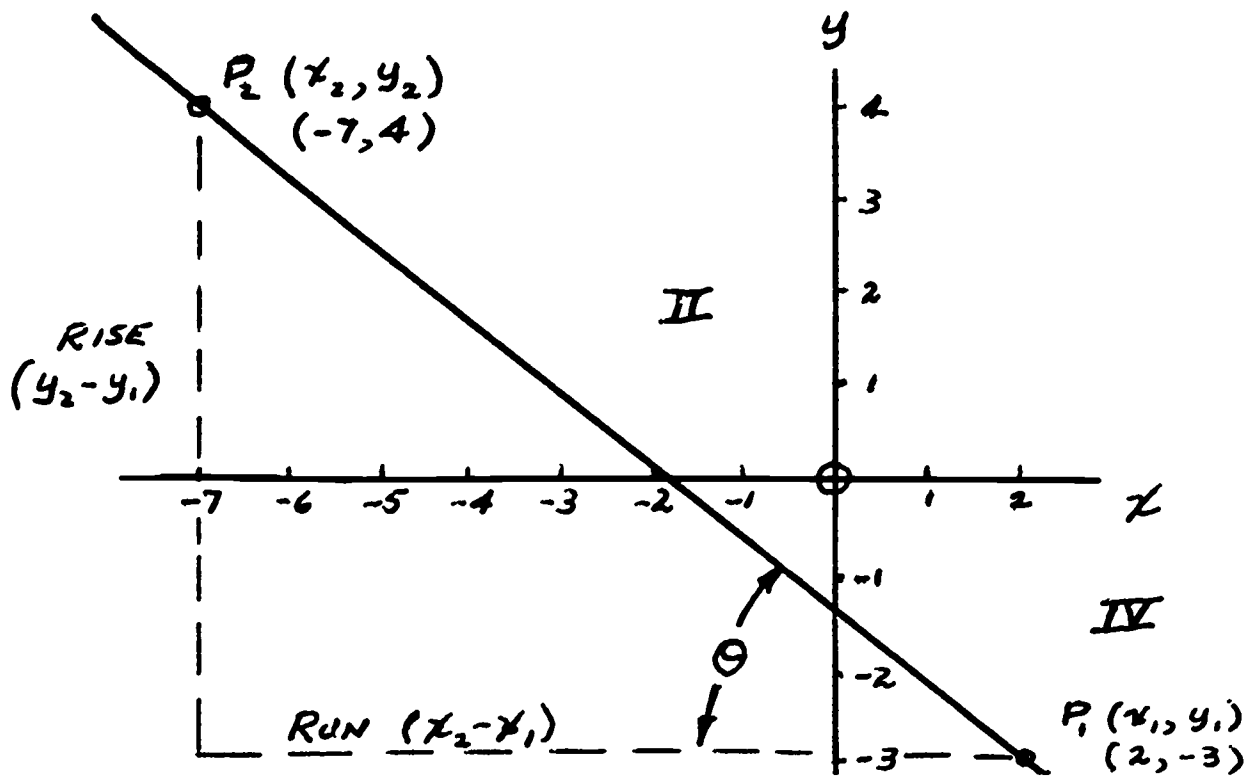
In the above graph,

$$m = \frac{\text{rise}}{\text{run}} = \frac{y2 - y1}{x2 - x_1} = \frac{5-2}{8-4} = \frac{3}{4}$$

Or

$$\tan = \frac{\text{opp. side}}{\text{adj. side}} = \frac{3}{4}$$

Now let's find the slope of a line in quadrants II and IV.



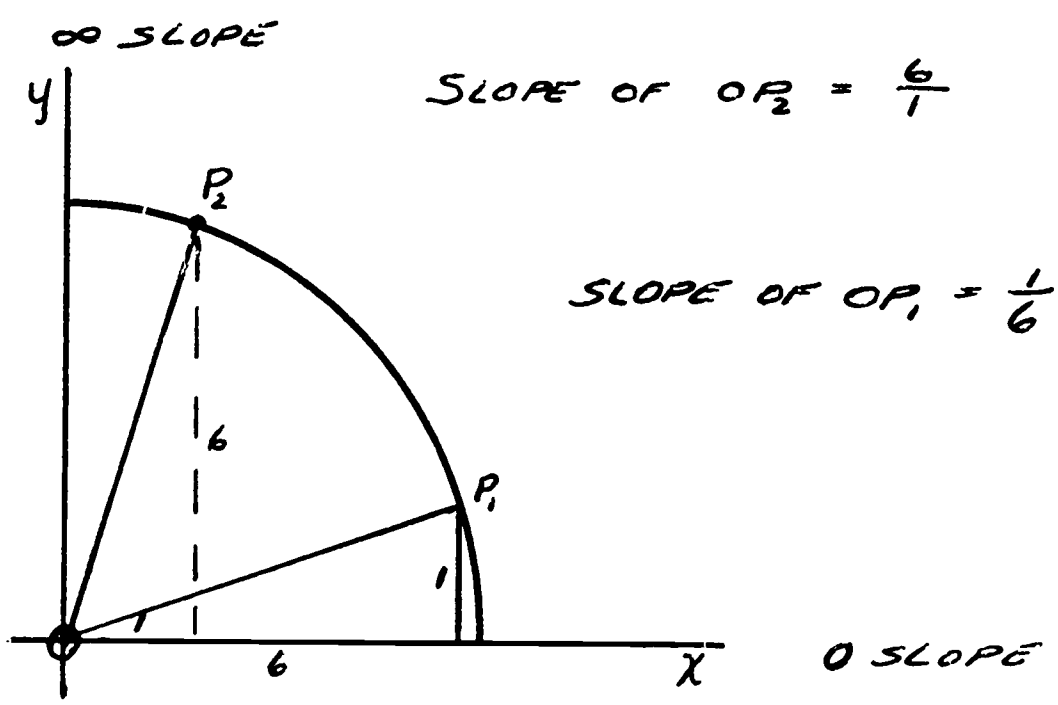
$$m = \frac{\text{rise}}{\text{run}} = \frac{y2 - y1}{x2 - x1} = \frac{(4) - (-3)}{(-7) - (2)} = \frac{7}{-9}$$

$m = -\frac{7}{9}$ (Note negative value)

(3-3) Special Cases of Slopes

1. The slope of a line parallel to the x-axis is zero (0).

2. The slope of a line parallel to the y-axis is infinite (∞).



3. If two lines are parallel ($\parallel$), their slopes are equal.

4. If two lines are perpendicular ($\perp$), their slopes are negative reciprocals of each other.

$$m_1 = -\frac{1}{m_2}$$

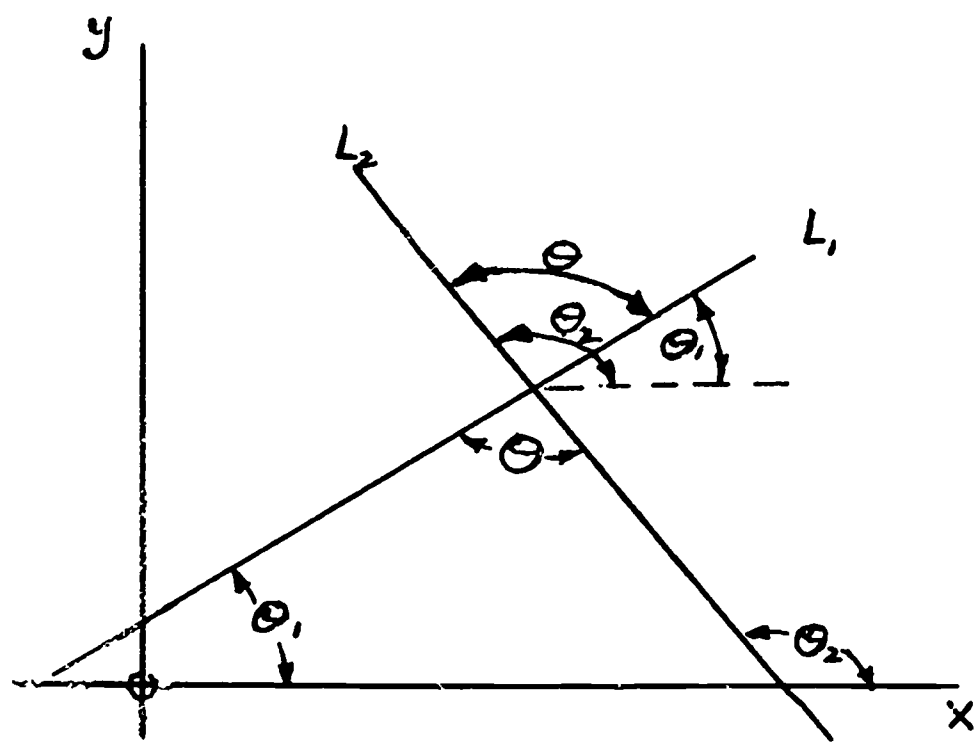
5. If two lines are perpendicular to each other, the product of their slopes is always equal to -1. This follows, of course, from #4.

$$m_1 m_2 = -1$$

(3-4) <u>Angle between Two Intersecting Lines</u>

If we know the slopes of two intersecting lines, we can determine the angle between those lines. We will call the angle θ.

Let us say that line 1 forms angle θ_1 with the x-axis and line 2 forms angle θ_2 with it. Then, as the diagram makes clear, the angle of intersection between lines 1 and 2 (θ), equals the difference between θ_2 and θ_1.



$\theta = \theta_2 - \theta_1$

Therefore $\text{Tan}\ \theta = \tan(\theta_2 - \theta_1)$

From the subtraction formula of trigonometry:

$$\text{Tan}\ \theta = \tan(\theta_2 - \theta_1) = \frac{\tan\theta_2 - \tan\theta_1}{1 + \tan\theta_2 \tan\theta_1}$$

But $\tan\theta_1 = m_1$ or slope of line 1

$\tan\theta_2 = m_2$ or slope of line 2

By substitution:

$$\tan\theta = \frac{m_2 - m_1}{1 + m_2 m_1}$$

With this last equation we are able to analytically determine the intersecting angle, knowing the slopes of the lines.

Example: The slope of line $1 = -\frac{7}{6}$ and of line $2 = -\frac{1}{3}$. Determine the angle formed between these intersecting lines.

$$\tan\theta = \frac{m_2 - m_1}{1 + m_2 m_1} = \frac{-\frac{1}{3} - (-\frac{7}{6})}{1 + (-\frac{1}{3})(-\frac{7}{6})} = \frac{3}{5} = 0.6000$$

$\tan\theta = .6000$

$\theta = 31^\circ$

Problems

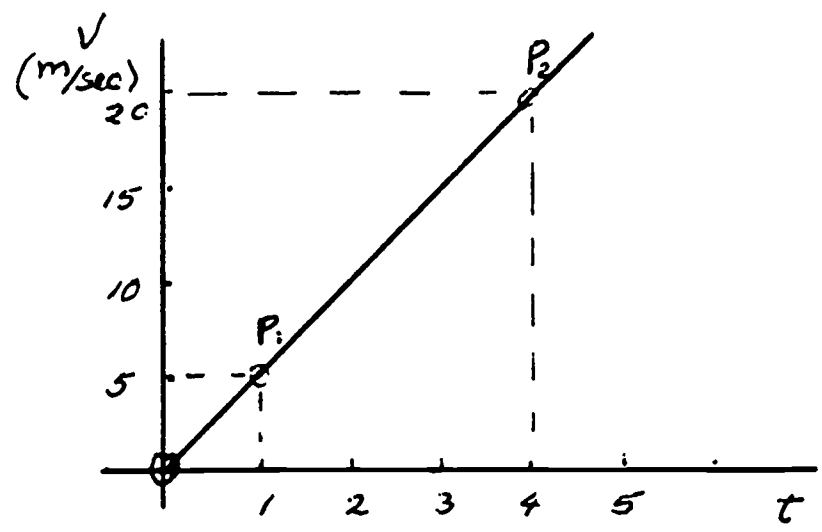
1. Determine the length and slope of the following line segments:

   a. (5, -3), (2, 1)

   b. (-6, -1), (2, 1)

   c. (2, 1), (2, 12)

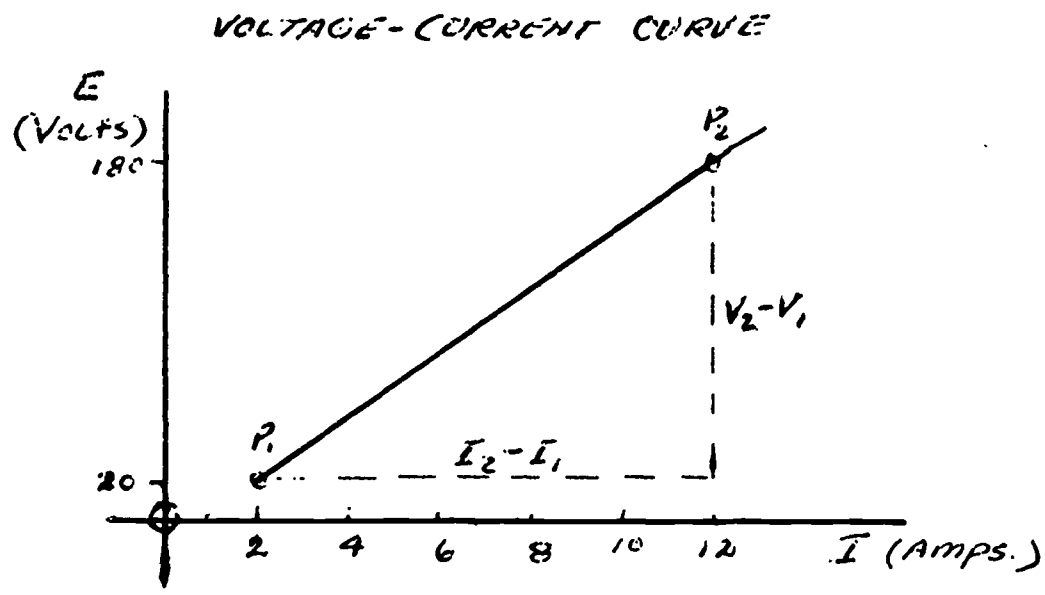
2. Draw a straight-line graph representing the variation of Centigrade temperature and Fahrenheit temperature ($0^{o}C. = 32^{o}F.$) and ($100^{o}C. = 212^{o}F.$). Find the slope (both magnitude and unit).



VELOCITY-TIME CURVE

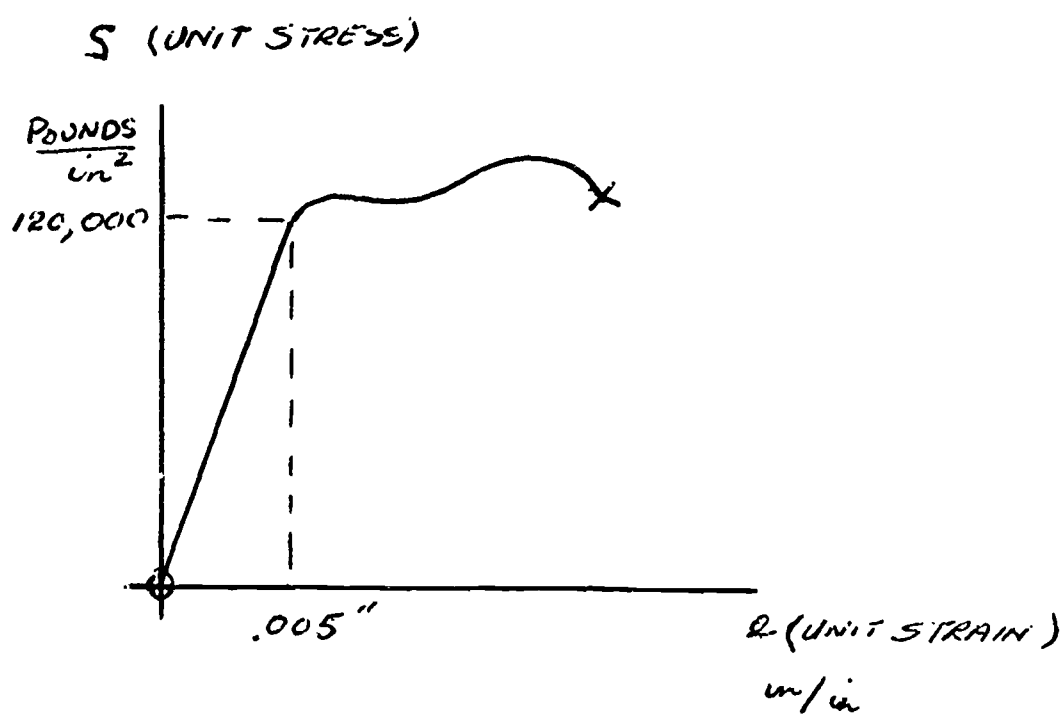
The velocity-time graph is plotted as shown. Determine the slope of P_1P_2 in magnitude and unit. What name is given to the slope of the velocity-time curve?

4.



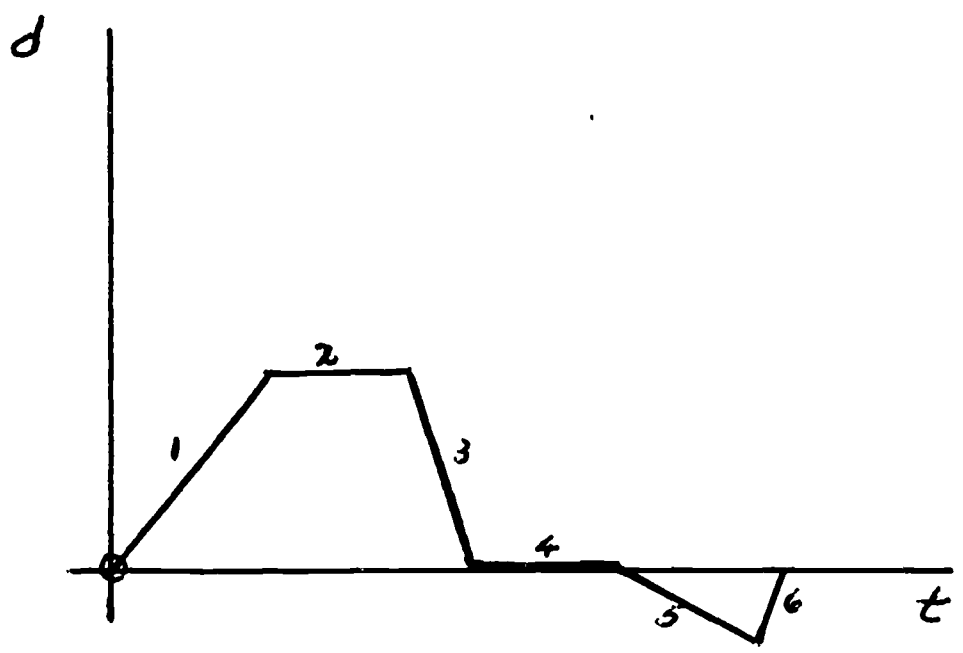
A plot of the voltage to current is represented by this curve. Determine the slope and its unit. What name is given to this slope? Is this slope constant?

In strength of materials, the modulus of elasticity (E) is defined as unit stress per unit strain. For a particular material, it is represented by the following curve. Within the proportionality limits, the load (or unit stress) is 120,000 pounds per sq. in. and the unit strain (or elongation) is .005". Determine the slope (modulus of elasticity) and its unit.



STRESS-STRAIN CURVE

6.

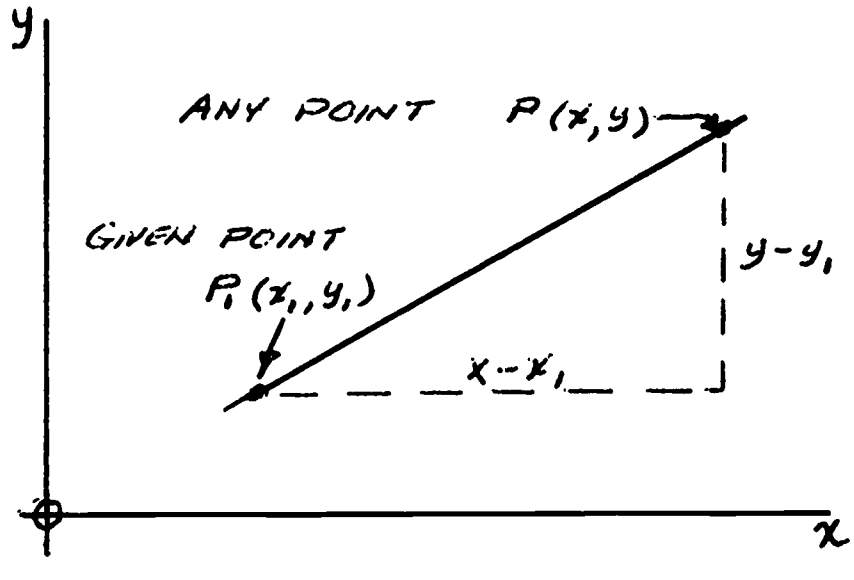


With reference to the above distance-time diagram, describe the slope of each section.

(3-5) Linear Equations

1. The Point-Slope Method

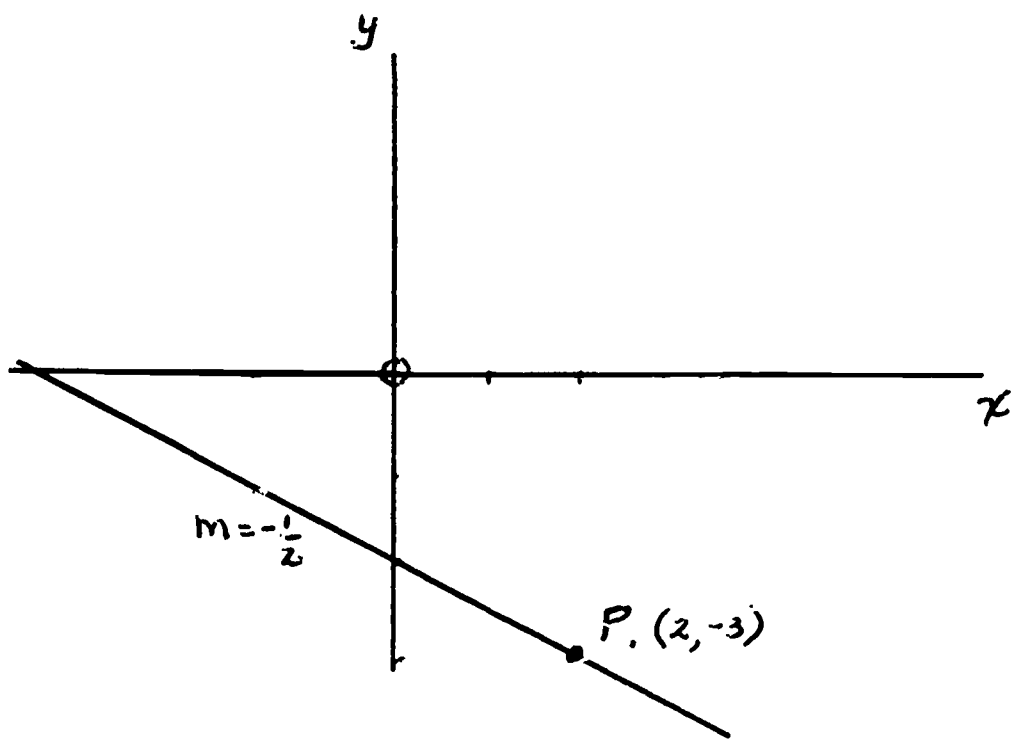
Since the slope (m) = $\frac{\text{rise}}{\text{run}}$, we would like to derive an equation which passes through a known point P_1 (x_1, y_1) with a given slope.



$m = \frac{y - y_1}{x - x_1}$ Multiply both sides by denominator, to get

$$\boxed{m(x - x_1) = y - y_1}$$ (Standard Point-Slope Form)

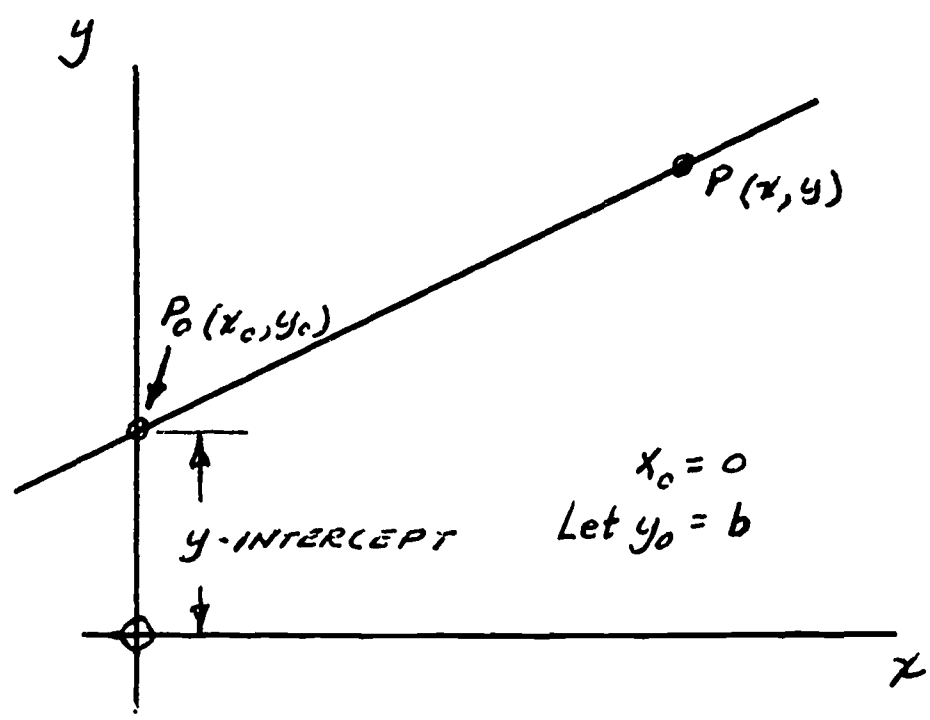
Example: Determine the linear equation of a line with a slope of $-\frac{1}{2}$ which passes through the point (2, -3). Draw the curve.



$y - y_1 = m(x - x_1)$	Standard form
$y - (-3) = -\frac{1}{2}(x - 2)$	Substitution
$2(y + 3) = 2 - x$	Multiply both sides by 2
$2y + 6 = 2 - x$	
$x + 2y + 4 = 0$	Req. equation

2. <u>The Slope-Intercept Method</u>

This method is a special case of the point-slope form. In this case, the slope (m) is given and the intercept is known. Select some point (P) on the curve.



$$m = \frac{y - y_o}{x - x_o}$$

$$m(x - x_o) = y - y_o$$

$m(x - 0) = y - b$ By substitution

$\boxed{y = mx + b}$ (Standard Slope-Intercept Form)

Example: Find the slope and y-intercept of $3x - 2y + 6 = 0$

$2y = 3x + 6$ (To approach standard form)

$y = \frac{3}{2}x + 3$ Divide both sides by 2

$y = (m)x + (b)$ Standard form

Slope (m) $= \frac{3}{2}$; y-intercept (b) $= 3$

Problems

Find the linear equation for each of the following sets of conditions (m = slope and b = y-intercept).

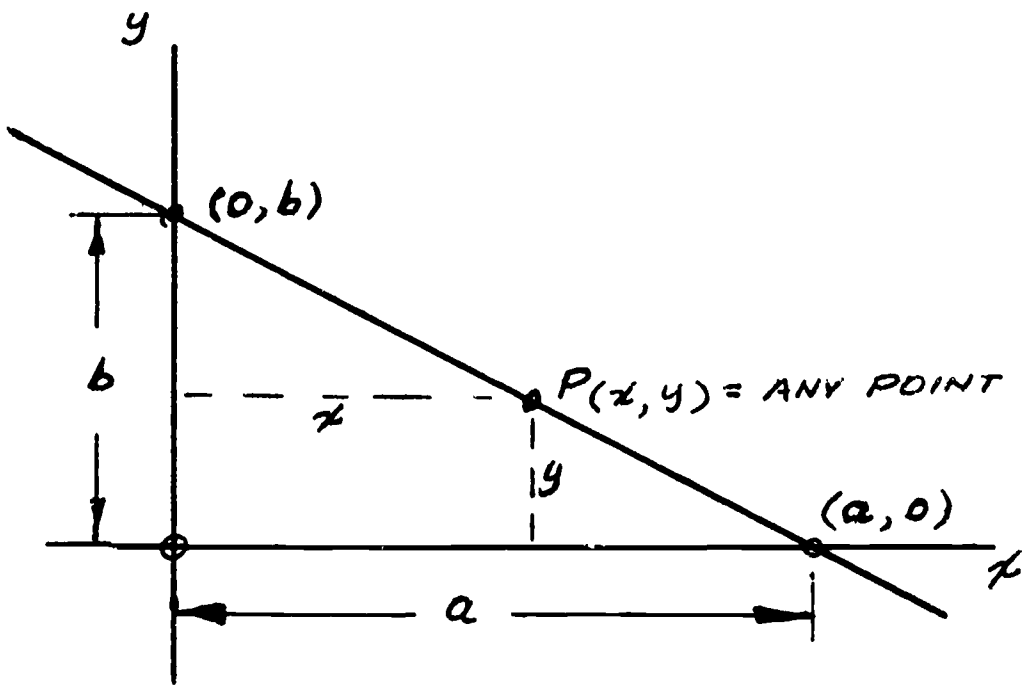
1. $(4, 3)$, $m = \frac{1}{2}$
2. $(4, 3)$, $m = -2$
3. $(-2, 2)$, $m = 4$
4. $(2, 6)$, $m = -\frac{1}{3}$
5. $m = \frac{2}{3}$, $b = -3$
6. $m = -1$, $b = 5$
7. $(4, 3)$, $\theta = 45^\circ$
8. $(2, -5)$, $\theta = 135^\circ$
9. $b = 2$, $\theta = 30^\circ$
10. $b = -2$, $\theta = 60^\circ$

Find the slope and y-intercept of the following:

11. $2x - y + 7 = 0$
12. $2x - y - 5 = 0$
13. $3x - 5y + 2 = 0$
14. In the equation $y = mx + b$, what is the value of b when the graph passes through the origin?
15. What does the equation $y = mx + b$ become for a line parallel to the x-axis?

3. The Intercept Method

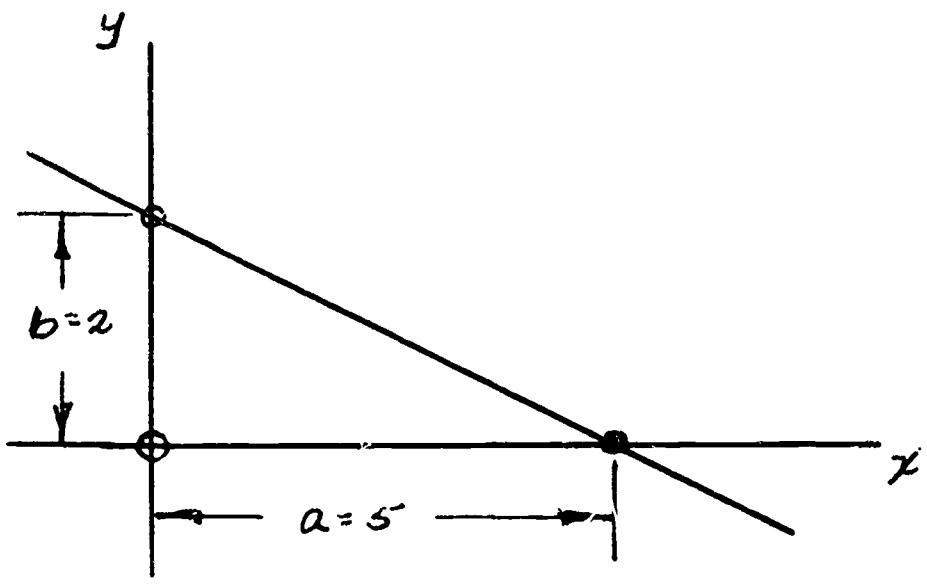
This form makes it simple to graph a linear equation, since points are located on the x and y coordinate axes. The reverse process is also simple: writing the equation from the graph.



$m = \frac{y}{x}$	Definition of slope
In this case, $\frac{y}{x} = \frac{b}{-a}$	
Therefore $m = -\frac{b}{a}$	
But $y = mx + b$	Standard slope-intercept form
Therefore $y = -\frac{b}{a}x + b$	Substitute
$ay = -bx + ab$	Multiply each term by a
$\frac{ay}{ab} + \frac{bx}{ab} = \frac{ab}{ab}$	Divide equationby ab

$$\boxed{\frac{x}{a} + \frac{y}{b} = 1}$$ (Standard Intercept Form)

Example: Write the equation of the graph which intersects the x-axis at 5 and the y-axis at 2.



$\frac{x}{a} + \frac{y}{b} = 1$ Standard form

$\frac{x}{5} + \frac{y}{2} = 1$ Substitution of intercepts for a and b

$2x + 5y - 10 = 0$ Desired equation

Problems

Find the equations of the following:

1. x-intercept 1, y-intercept 4
2. x-intercept -2, y-intercept -3
3. x-intercept 6, y-intercept -3

Reduce to standard form and determine both intercepts:

4. $3x + 2y = 6$
5. $2x + 3y + 4 = 0$
6. $4x - 5y + 7 = 0$
7. Write the equation of the line which passes through (3, 5) and has equal intercepts.

(3-6) General Linear Equation of First Degree

A linear equation of the first degree is a straight line. It can be written in the general form:

$$Ax + By + C = 0$$

The student should understand how to distinguish this form from a nonlinear form upon inspection. This understanding is essential for sketching curves and for understanding the variation of the ordinate with respect to the abscissa.

The degree of an algebraic expression determines whether it is a curve or a straight line. The degree is equal to the sum of the exponents of the variables in the term of highest order.

The equation $4x^2y + xy + 7 = 0$ is a third-degree equation because the sum of the exponents in x^2y^1 equals 3.

$4x^1 + 5y^1 = 7$ is a first-degree equation (straight line)

$x^1y^1 = 3$ is a second-degree equation (curve)

$x^3 + x^2 + x = 6$ is a third-degree equation ("S" curve)

Problems

Sketch the graphs of the following and indicate the slope and intercepts:

1. $F = ma$ (m is constant)
2. $\frac{S - S_o}{t} = v$ (v is constant)
3. $E = IR$ (R is constant)
4. $\frac{v_f - v_i}{t} = a$ (v_i is constant)
5. $\frac{V_f + V_i}{2} = V_{av}$ (V_{av} is constant)
6. $S = V_{av}t$ (V_{av} is constant)
7. The Fahrenheit to Centigrade equation is $F = \frac{9}{5}C + 32$. Graphically determine the temperature which is the same on both scales.
8. Find the resistance of an electrical circuit when the voltage (E) = 12 volts and the current (I) = 2 amperes. Plot this point and determine the slope of this line. What electrical unit does the slope measure?

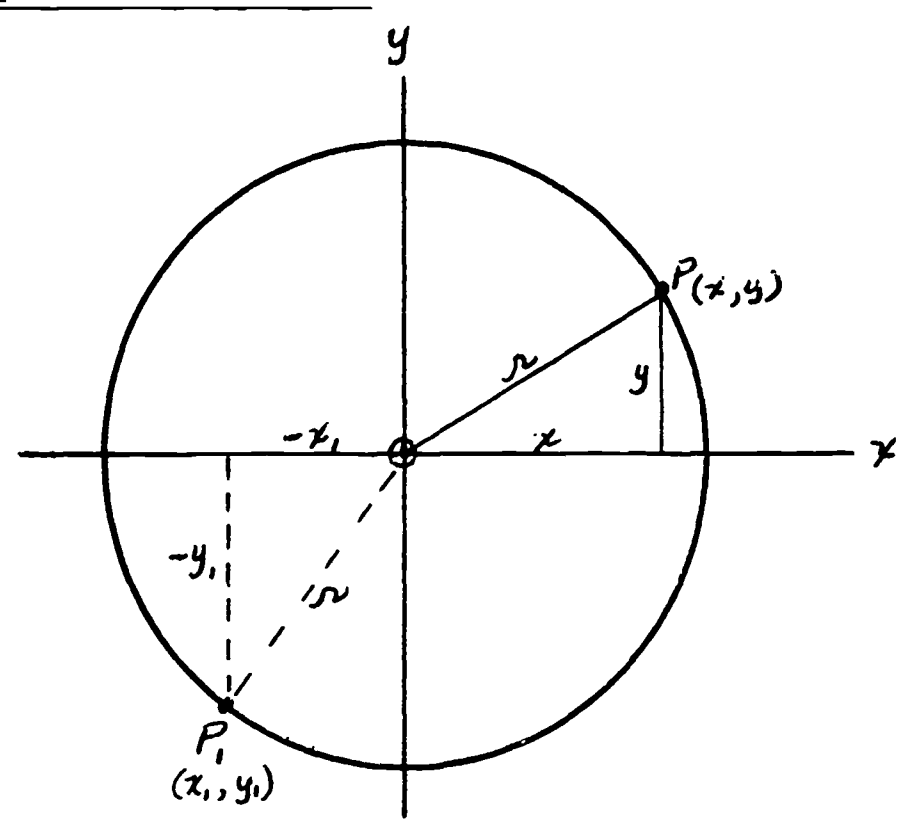
(3-7) Conics, or Equations of Curves

To further develop the student's ability to analyze physical situations by mathematical means, the study of curves is important, since many physical relations do not follow straight-line relationships.

We will start with the simplest conic, which is a circle. A circle may be defined as the locus of all points equidistant from a given point, called the center.

Here again we will concern ourselves with translating the geometrical problems into algebraic equations and vice-versa.

(3-8) Equations of a Circle



Suppose the center of the circle lies at the origin. Take any point P (x, y) in the above diagram, and, with the use of the Pythagorean theorem, the following relation results for all points on the circle:

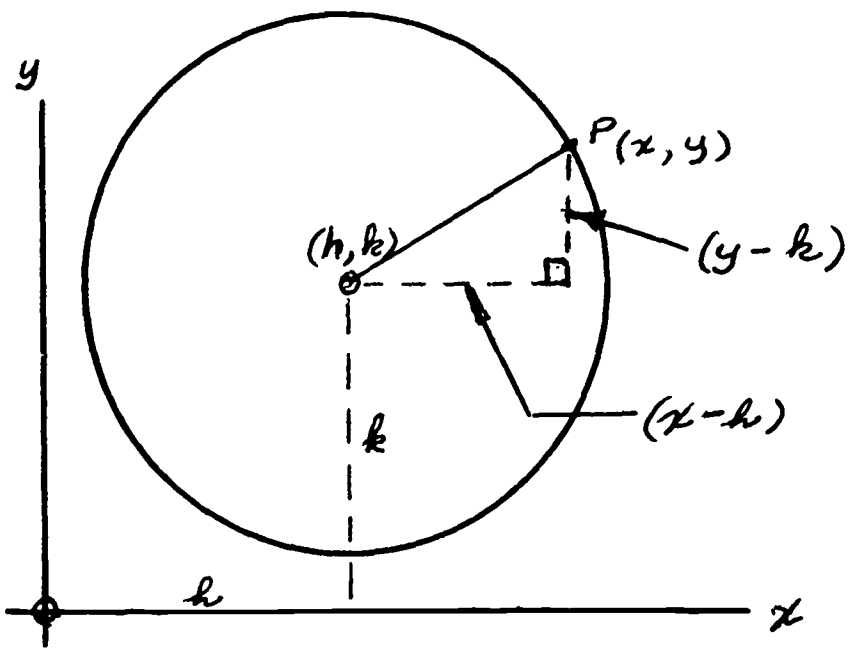
$$\boxed{x^2 + y^2 = r^2} \quad \text{(Standard Form - Circle)}$$

If point P_1 in the third quadrant is used, where both x_1 and y_1 are negative, we get

$$(-x)^2 + (-y)^2 = r^2$$

$$x^2 + y^2 = r^2$$

A general equation for a circle would be one with the center located anywhere within a quadrant rather than on a coordinate axis. Let us assign the coordinates h and k to the center.



$$\boxed{(x - h)^2 + (y - k)^2 = r^2}$$ (General equation of a circle)

If the above equation is expanded, we get

$$(x^2 - 2hx + h^2) + (y^2 - 2ky + k^2) = r^2$$

Collecting terms, we get

$$x^2 + y^2 - 2hx - 2ky + h^2 + k^2 - r^2 = 0$$

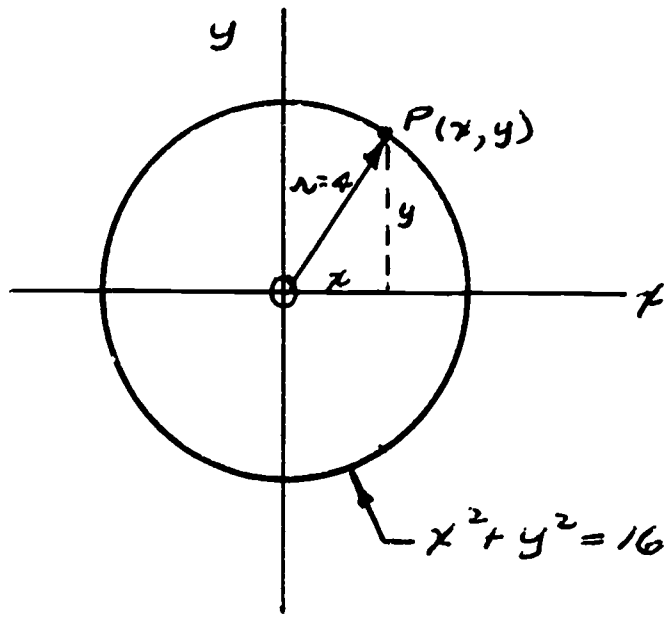
Or, in general:

$$Ax^2 + Cy^2 + Dx + Ey + F = 0$$

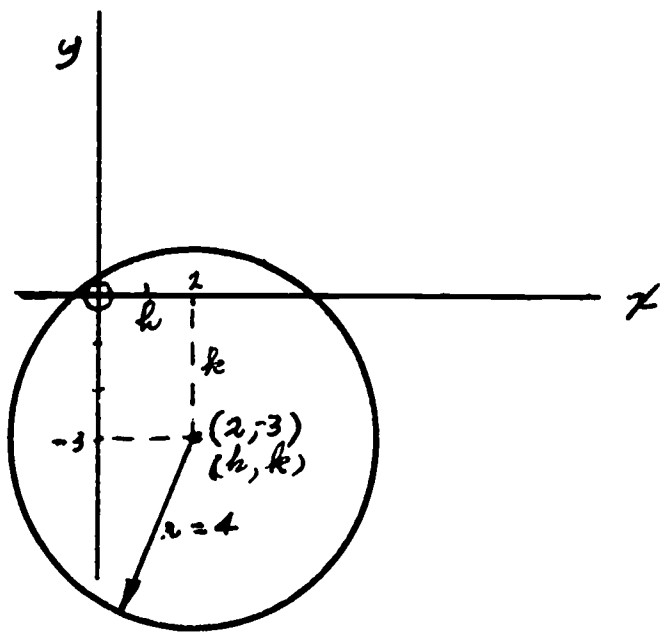
where all the beginning letters, A, B, C, etc., of the alphabet represent constant coefficients.

$$\boxed{Ax^2 + Cy^2 + Dx + Ey + F = 0}$$ (General quadratic equation for conics)

Example 1: Draw the circle for the equation $x^2 + y^2 = 16$



Example 2: Draw the circle for the following: h = 2, k =-3 and r = 4. Write the equation.



$(x - h)^2 + (y - k)^2 = r^2$	General equation
$(x - 2)^2 + \left[y - (-3)\right]^2 = 4^2$	Substituting values of h and k
$(x - 2)^2 + (y + 3)^2 = 16$	
$(x^2 - 4x + 4) + (y^2 + 6y + 9) = 16$	Expanding
$x^2 + y^2 - 4x + 6y - 3 = 0$	Rearranging

Example 3: Find the center and radius of the circle:

$$x^2 + y^2 - 4x + 6y - 3 = 0$$

Transpose, rearrange, and complete the square for each unknown:

$$(x^2 - 4x + 4) + (y^2 + 6y + 9) = 3 + 4 + 9$$

(Since 4 and 9 were added to complete the squares on the left side of equation, they must also be added on the right side.)

$$(x - 2)^2 + (y + 3)^2 = 16 \qquad \text{Factoring}$$

$$(x - h)^2 + (y - k)^2 = r \qquad \text{Standard form}$$

Therefore $h = 2$, $k = -3$ and $r = 4$, or the circle's center is at $(2, -3)$ and its radius is 4.

Problems Write the equations of the following circles:

1. With center at $(3, -2)$ and radius = 6.

2. Center at $(1, 2)$ and radius = 5.

3. Draw, after determining center location and radius: $x^2 + y^2 + 2x - 4y = 20$.

4. Determine the center and radius of $4x^2 + 4y^2 - 4x + 2y = -1$.

5. Draw the following circle: $2x^2 + 2y^2 - 3x - 5y + 3 = 0$.

6. Find the equation of a circle with a center at $(2, 3)$ which is tangent to the line $x + y = 2$.

7. Determine the equation of a circle formed by the following three points: $(0, 0)$ and the x- and y-intercepts of the equation $3x + 2y = 6$.

8. In Problem 7, what are the two equations which determine the center?

9. The following three points were obtained from plotted data: $(0, 0)$ $(3, 2)$ $(6, 0)$. It is known that they form an arc of a circle. Write the relationship of the variables.

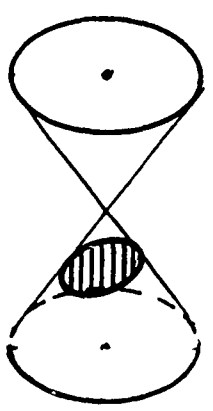
10. In Problem 9, determine the linear distance traveled by a pointer in going through these points along the arc of the circumference.

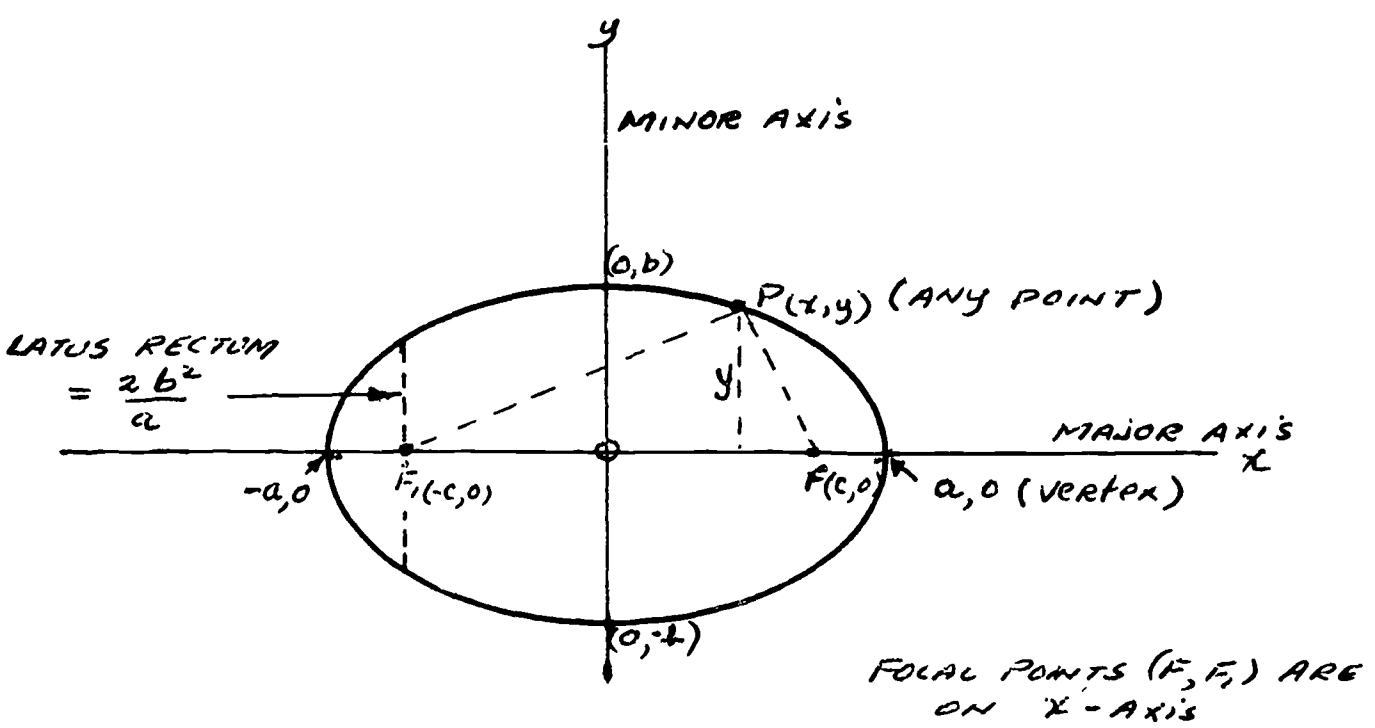
(3-9) Equation of an Ellipse

Ellipse - Locus of a point in a plane which moves so that the sum of its distances from 2 fixed points (foci) is constant. This sum is equal to the distance between the vertices (see diagram).

Applications:

1. Satellites
2. Electron orbits
3. Cams
4. Arches of modern bridges use semi-ellipse





$PF_1 + PF = 2a$ (distance between the two vertices)

$$\sqrt{(x+c)^2 + y^2} + \sqrt{(c-x)^2 + y^2} = 2a \quad \text{(by Pythagorean theorem)}$$

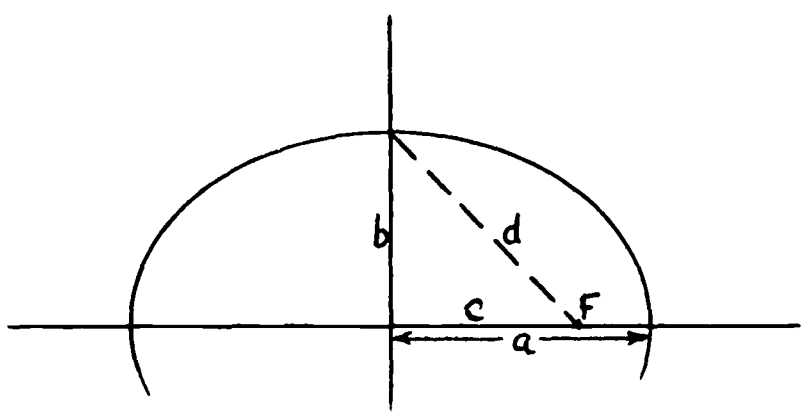
Transposing: $\sqrt{(c-x)^2 + y^2} = 2a - \sqrt{(x+c)^2 + y^2}$

Squaring both sides and collecting terms: $cx + a^2 = a\sqrt{(x+c)^2 + y^2}$

Squaring both sides again and collecting terms: $(c^2 - a^2)x^2 - a^2y^2 = a^2(c^2 - a^2)$

Since $a > c > b$, we multiply by -1: $(a^2 - c^2)x^2 + a^2y^2 = a^2(a^2 - c^2)$

However, as indicated below, $a^2 - c^2 = b^2$



$d^2 = b^2 + c^2$

But $d = a$ From definition of ellipse

$a^2 = b^2 + c^2$

or $a^2 - c^2 = b^2$

Since $a^2 - c^2 = b^2$, we may substitute b^2 for $(a^2 - c^2)$ in the above equation.

We obtain: $b^2x^2 + a^2y^2 = a^2b^2$

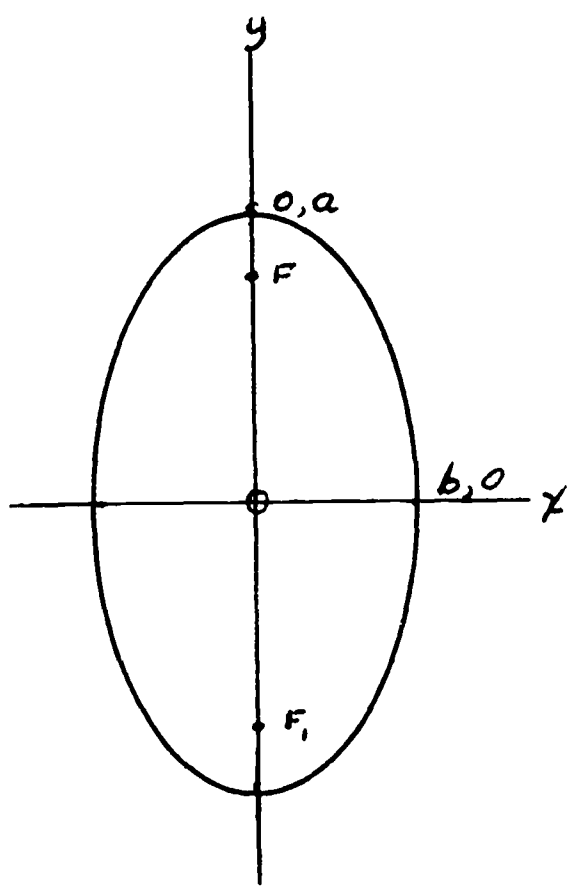
Dividing through by a^2b^2: $\dfrac{b^2x^2 + a^2y^2 = a^2b^2}{a^2b^2}$

$$\boxed{\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1}$$

$a^2 > b^2$ (Standard form - Ellipse)
Major axis: $y = 0$

$$\boxed{\frac{y^2}{a^2} + \frac{x^2}{b^2} = 1}$$

$a^2 > b^2$
Major axis: $x = 0$ (see diagram below)



When the focal points and vertices are on the y-axis, the ellipse has the major axis (a) on the y-axis and the minor axis (b) on the x-axis. When the major and minor axes are equal, our equation becomes $x^2 + y^2 = a^2$, which we recognize as the equation of a circle of radius a whose center is at the origin.

As in the case of the circle, if the center of the ellipse is at (h, k), the standard equation takes the following forms:

$\dfrac{(x - h)^2}{a^2} + \dfrac{(y - k)^2}{b^2} = 1$ Major axis: $y = k$

$\dfrac{(y - k)^2}{a^2} + \dfrac{(x - h)^2}{b^2} = 1$ Major axis: $x = h$

The most important feature of the ellipse is the focus. The sum of the distances from any point on the curve to the focal points is constant for the curve and is always equal to the distance between the vertices.

The ellipse has many applications in sound, light, radio waves, where concentration or focusing is needed. Any wave emanating from one focal point of an ellipse returns through reflections to the other focal point.

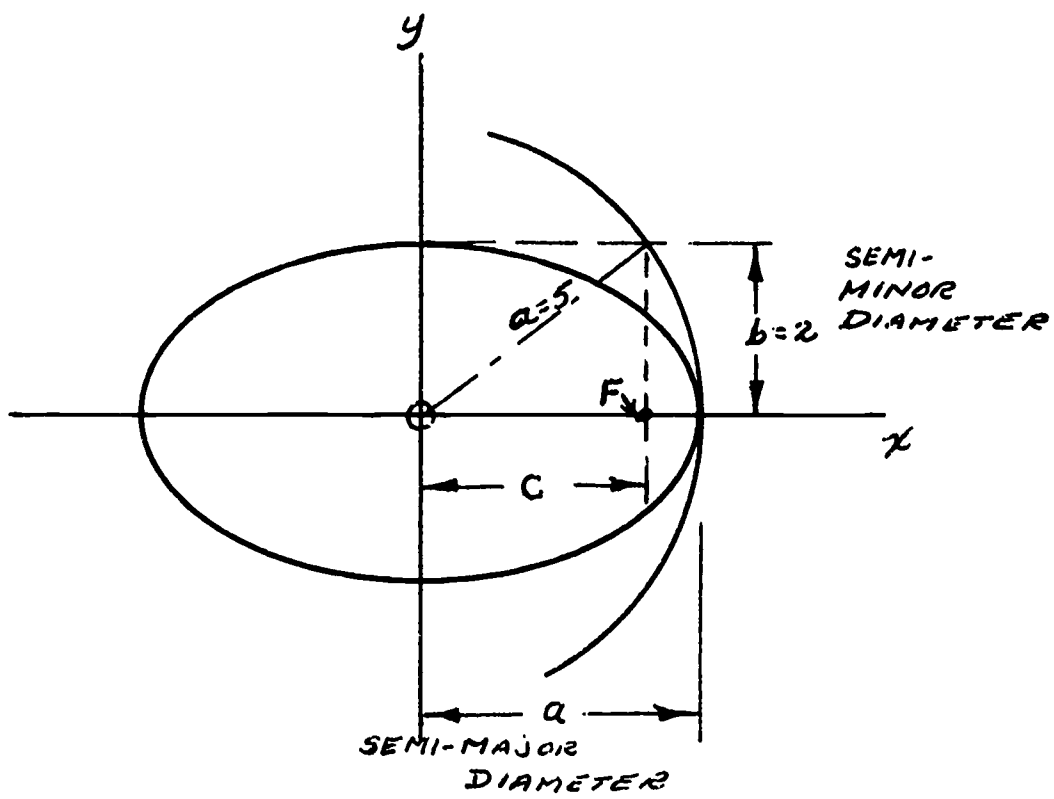
Example 1: Find the length of the major and minor diameters of the ellipse whose equation is $4x^2 + 25y^2 = 100$. Locate the focal points. Draw the ellipse.

$$\frac{4x^2}{100} + \frac{25y^2}{100} = \frac{100}{100}$$ Divide by 100 so right side equals 1

$$\frac{x^2}{25} + \frac{y^2}{4} = 1$$ In standard form

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$ Standard form

Semi-major diameter (a) = 5; semi-minor diameter (b) = 2
Major diameter = 10; minor diameter = 4



To determine the focus, draw an arc from the center with a radius equal to the semi-major diameter (a). Draw a line parallel to the principle axis at distance (b). Where they intersect, drop a perpendicular to the principle axis; its intersection with the axis determines the focal point (F) of the ellipse. Since this is a right-angled triangle, by the use of the Pythagorean theorem we get:

$$c = \sqrt{a^2 - b^2}$$

$$c = \sqrt{25 - 4}$$

$$c = \sqrt{21}$$

Example 2: Suppose in the above example, the height of the arch above the focal point was required.

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

$$\frac{x^2}{(5)^2} + \frac{y^2}{(2)^2} = 1$$

Since $x = c = \sqrt{21}$

$$\frac{(\sqrt{21})^2}{(5)^2} + \frac{y^2}{(2)^2} = 1$$

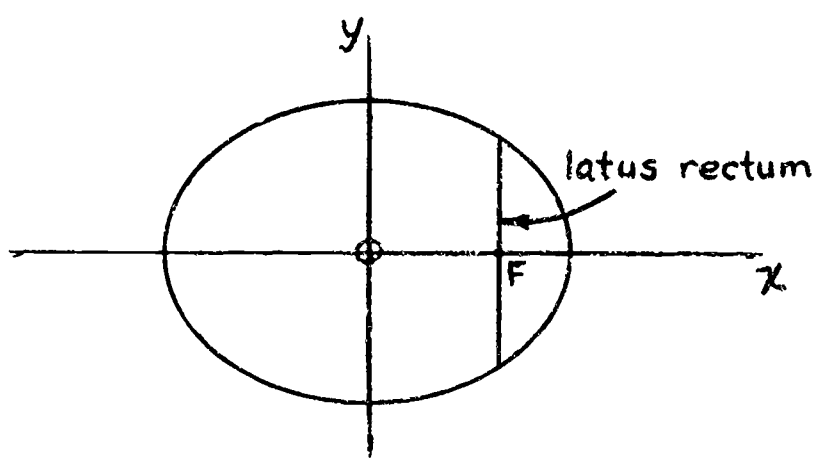
$$\frac{21}{25} + \frac{y^2}{4} = 1$$

$$84 + 25y^2 = 100$$

$$25y^2 = 16$$

$$y = \frac{4}{5}$$

The chord of the ellipse measured through the focal point and perpendicular to the principle axis is called the latus rectum. In the above example, the latus rectum equals $2 \times \frac{4}{5}$ or $\frac{8}{5}$.



Problems

Draw and determine semi-minor axis, semi-major axis, and focal points of the following:

1. $4x^2 + y^2 = 16$

2. $x^2 + 4y^2 = 16$

3. $\frac{x^2}{36} + \frac{y^2}{16} = 4$

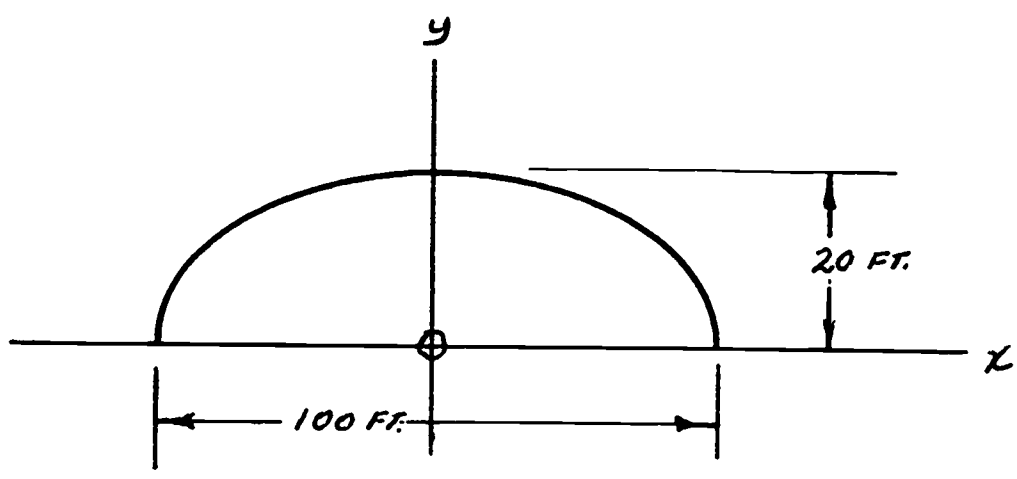
4. $\frac{x^2}{16} + \frac{y^2}{36} = 4$

5. Length of major axis = 8, distance between focal points = 6 on major axis. Sketch the ellipse and find its equation.

6. Sketch and find the equation of an ellipse with focal points (-3, 0), (3, 0) which has a major axis three times the minor axis.

7. Write the equation of the ellipse which has a major axis of 12 and a minor axis of 6, with a center at (-2, 3).

8. Describe and draw the ellipse formed by the equation $x^2 + 4y^2 - 24y - 78 = 0$

9. 

A roadway arch is represented by the semi-ellipse diagram above. Determine the equation and focal point for the arch.

10. How high is the above arch 30 feet from the center?

11. Write the equation of an ellipse which has a minor axis of 4, a focus at (-2, -1) and a vertex at (-2, +1).

12. An ellipse has its vertices at (4, -2) and (10, -2). If the ellipse is tangent to y = 0, write the equation for the ellipse and the coordinate location of the foci.

13. The outer edge of a 20-foot high truck is to ride under a semi-elliptical bridge which is 30 feet high and has a 120-foot major axis or distance between the vertices. If the outer edge of the truck is 12 feet from the right vertex, calculate the truck interference or clearance under the bridge.

14. Determine the maximum distance from the center in Problem 13 which will allow a clearance of 25 feet.

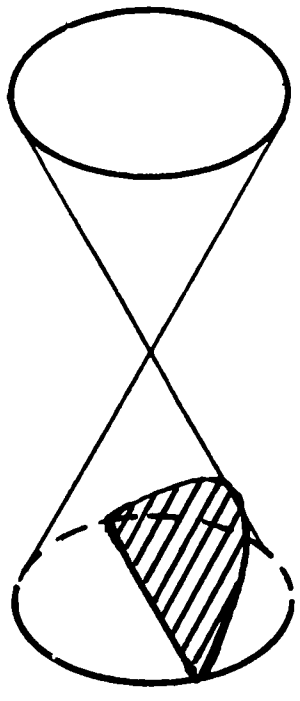
15. A semi-elliptical school gymnasium is 40 feet high and has a 160-foot major diameter. Locate the focal points.

16. In Problem 15, if a wall 20 feet high had to be secured to the floor and ceiling, how far from the focal point must the wall be located?

17. A satellite is orbiting the earth (radius = 3900 miles) with a perigee (nearest distance to the earth's surface) of 100 miles. Assume the earth's center as one focal point and that the orbit is elliptical. The distance from the center of the earth to the center of the orbit is 6000 miles. Calculate the minor diameter of the orbit and the apogee (maximum distance from the earth's surface).

(3-10) Equations of Parabolas

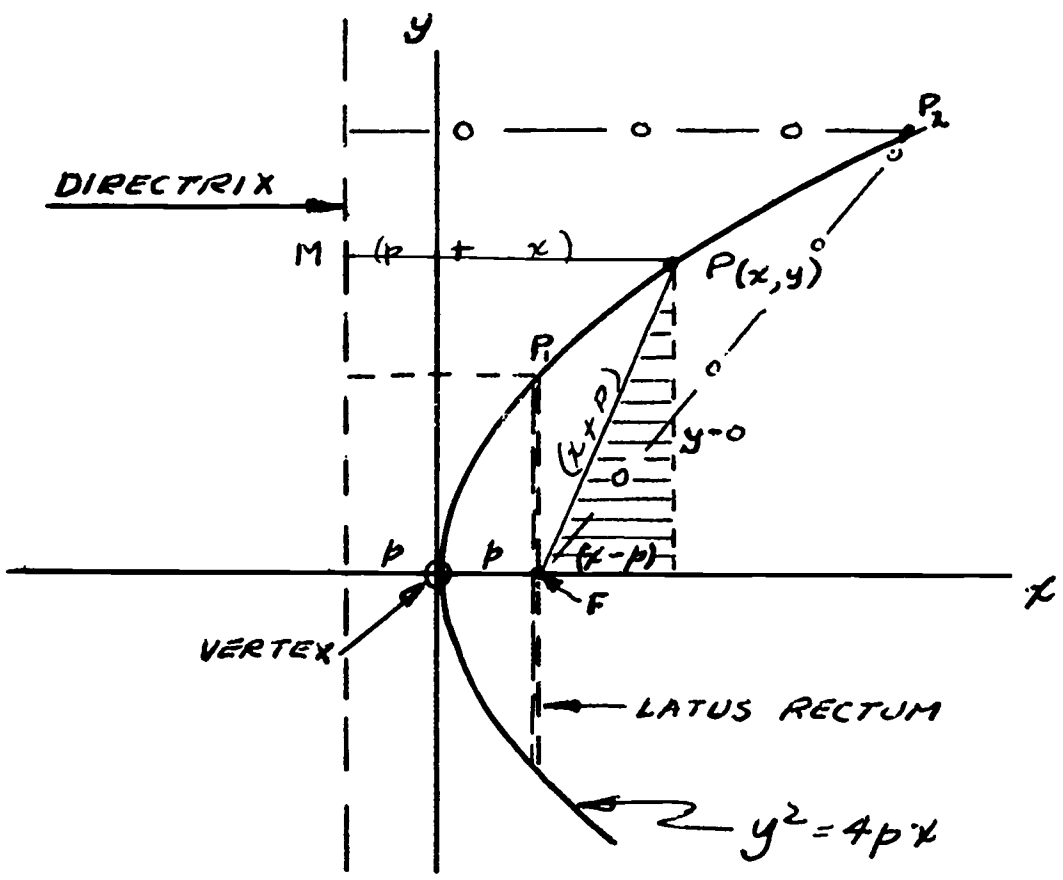
Parabola: Locus of a point in a plane which moves at the same distance from a point, called the focus, as from a fixed line, called the directrix.



Applications:

1. Projectiles
2. Suspension bridges
3. Second-order equations
4. Reflecting and focusing devices (light and electronic)
5. Physics relations
6. Solar furnaces

A parabola is always symmetrical about the line through its focus and its vertex (see diagram). This line is called the axis of symmetry. The focal point is always inside the curve the same distance from the vertex as the directrix is outside the curve.

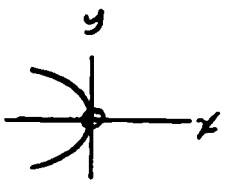


$$FP = PM = (x + p)$$

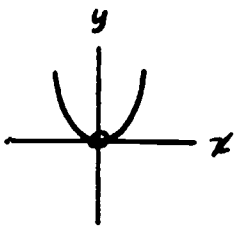
$$(x + p)^2 = (x - p)^2 + (y - 0)^2$$

$$\boxed{y^2 = 4\,px}$$ Standard Form (Parabola)

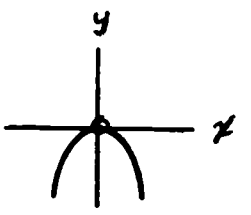
$y^2 = -4px$



$x^2 = 4py$



$x^2 = -4py$



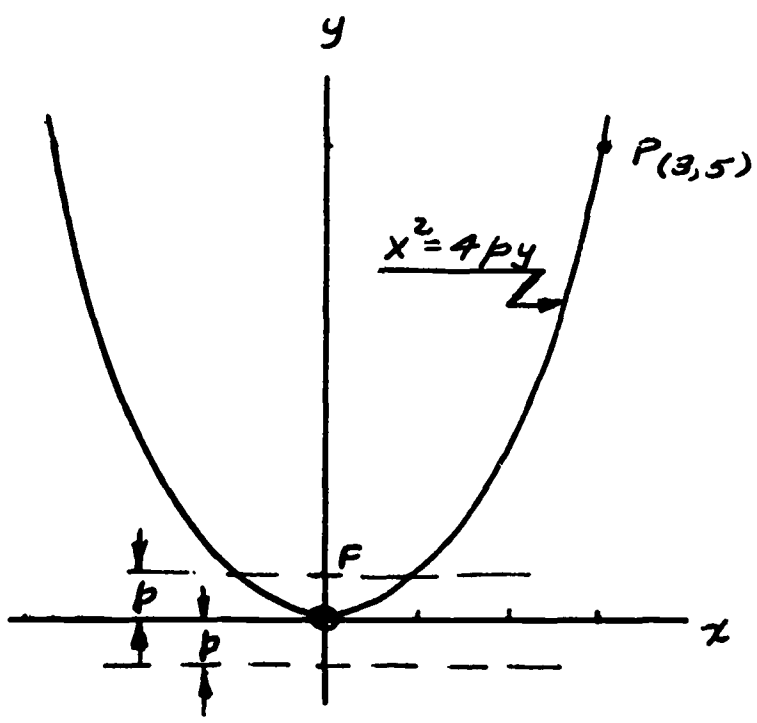
When $x = p$ (see P_1 on large diagram, above)

$$y^2 = 4(p)(p)$$

$$y = \pm\ 2p$$

Note that this means that the latus rectum is always equal to 2p, that is, twice the distance from the focus to the vertex.

Example 1: Find the equation of the parabola whose axis of symmetry coincides with the y-axis, whose vertex is at the origin, and which passes through the point (3, 5).



$x^2 = 4py$	Standard form
$(3)^2 = 4p(5)$	Substitute the coordinates of P (3, 5)
$p = \frac{9}{20}$	Solve for p
$x^2 = 4\frac{9}{20}y$	Substitute for p in standard form
$x^2 = \frac{9}{5}y$	
$5x^2 = 9y$	Ans.

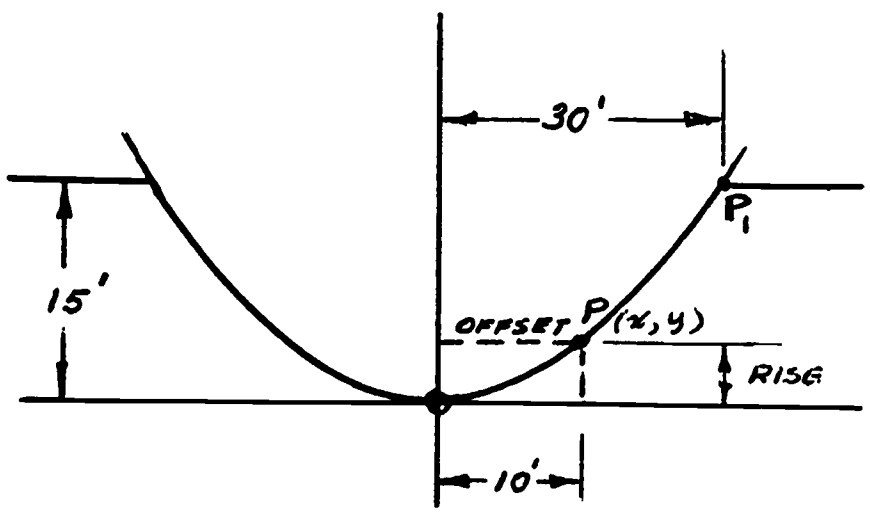
When a parabola is offset from a coordinate axis, the same techniques apply as were used in the circle and ellipse.

$$\boxed{(y - k)^2 = 4p(x - h)}$$ Axis of symmetry parallel to x-axis

$$\boxed{(x - h)^2 = 4p(y - k)}$$ Axis of symmetry parallel to y-axis

Here h and k are the offsets of the vertex from the origin.

An important property of the parabola is that the rises for any two points are proportional to the square of the corresponding offsets (see diagram below).



$$\frac{y}{15} = \frac{(10)^2}{(30)^2}$$

$$y = \frac{15}{9} \text{ feet}$$

Example 2:

The vertex of a parabola is located at (3, -3). The directrix is $y = -5$. Determine all the essential facts about the parabola, and write the equation for the curve.

Solution:

Make a sketch of the parabola.

Since the vertex is located at (3, -3), the offsets from the coordinate axis are $h = 3$, $k = -3$.

The directrix is located below the vertex; therefore the parabola must be symmetrical about an axis parallel to the y-axis and be dished upwards.

The general equation is

$$(x - h)^2 = 4p\ (y - k)$$

We know that p is the absolute distance of the directrix from the vertex. The directrix is $y = -5$, the y-value of the vertex is -3; p therefore is equal to 2.

Substituting for h, k, and p:

$$(x - 3)^2 = 4(2)\left[y - (-3)\right]$$

$$x^2 - 6x + 9 = 8y + 24$$

$$x^2 - 6x - 8y = 15 \qquad \text{Desired equation}$$

Problems

Find the equations of the following parabolas:

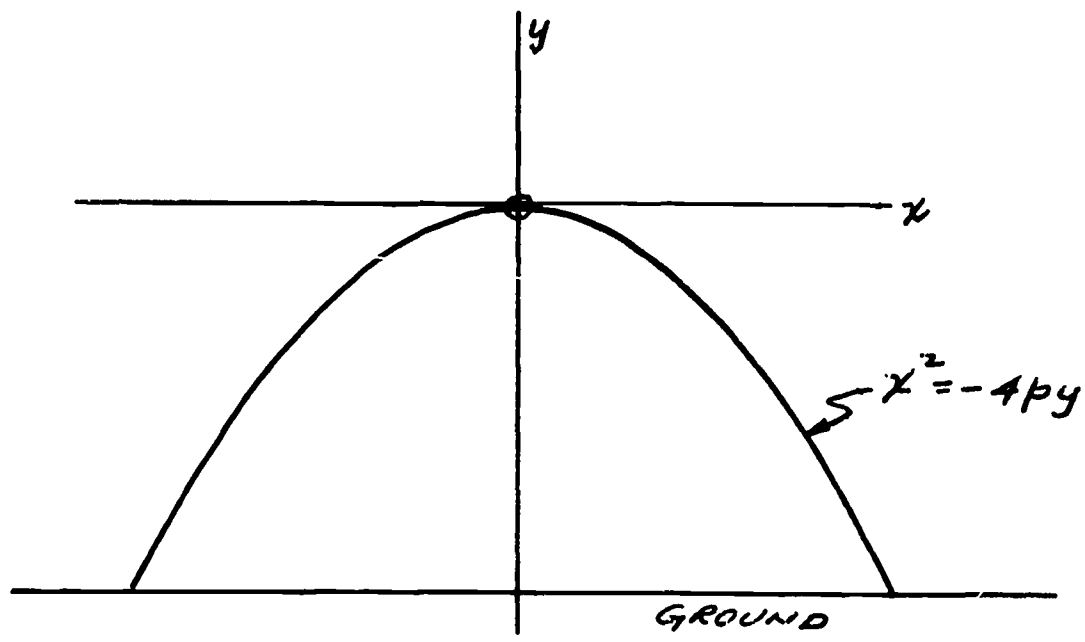
1. Vertex at (0, 0), focus at (3, 0).

2. Vertex at (0, 0), focus at (-6, 0).

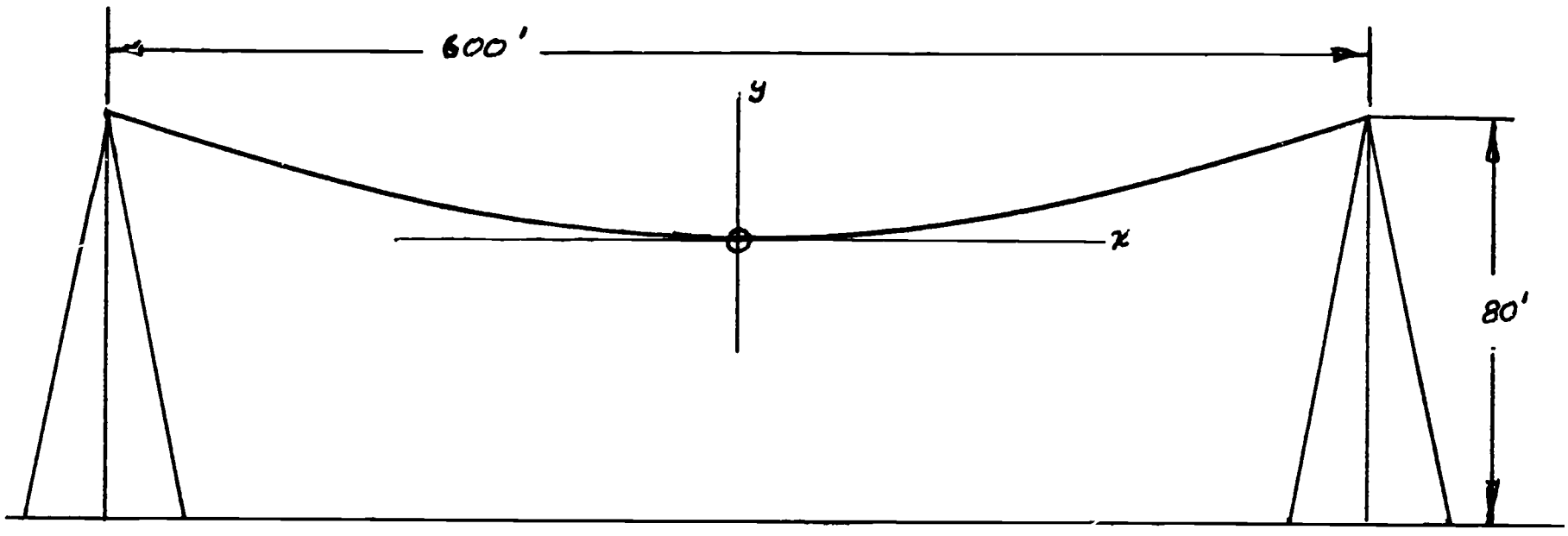
3. Vertex at (0, 0), axis coincides with the y-axis, and curve passes through point (2, 4).

4. Vertex at (0, 8), with the x-axis as directrix.

5. A ball is thrown into the air and reaches a maximum height of 150 feet. If the ball strikes the ground 356 feet from the starting point, what is the equation of the parabolic curve of its flight?



6. An 8-inch diameter plate of glass is to be lapped to form a concave mirror of 12-inch focal length. How deep must it be lapped in the center?



7. A leaded telephone cable which is supported by two towers 600 feet apart has a sag of 30 feet at the center. Determine the equation for this cable.

8. How high is the cable off the ground at a point 100 feet from a tower?

9. Write the equation of a parabola which has a directrix of $y = -2$; $h = 2$, $k = -3$.

10. Write the equation of a parabola which has latus rectum of 8 and an offset of $h = -1$, $k = -3$.

11. A 32-foot diameter parabolic microwave antenna is dished upward. It has a dish height of 12 feet. Determine the equation of the curve. Where must the transmitting or receiving probe be located (focal point)?

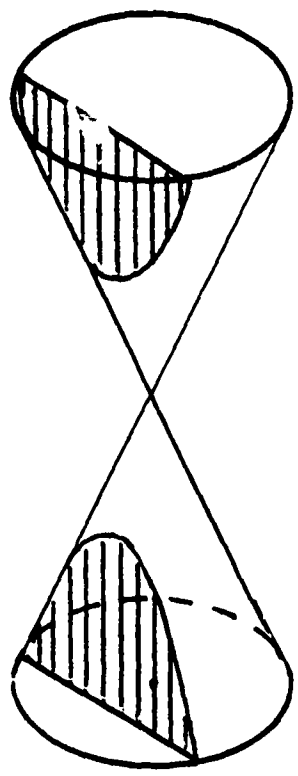
12. If the parabola in Problem 11 is rotated 90° counterclockwise, write the equation for the parabola, and determine the length of the latus rectum.

13. The sun's rays in a solar furnace strike a piece of metal so that the focal point of the rays is 11 inches above the metal surface. Determine the equation of the parabolic mirror.

14. In the above problem, if the coordinate axis center is located at the focal point, write the equations for the parabola and the directrix.

(3-11) Hyperbolas

A hyperbola is the locus of a point which moves in a plane so that the difference of its distances from two fixed points (foci) is a constant. This difference is always equal to the distance between the vertices.



Applications:

1. Comet motion
2. Electrostatic force repulsion
3. Magnetic repulsion forces
4. Alpha particle shot near an atomic nucleus
5. Gas laws

$F_2P - F_1P = 2a$ = constant = distances between vertices

$$\sqrt{(x + c)^2 + y^2} - \sqrt{(c - x)^2 + y^2} = 2a$$

It can be shown that

$b^2 = c^2 - a^2$ (where b is the ordinate distance from the vertex to the asymtote)

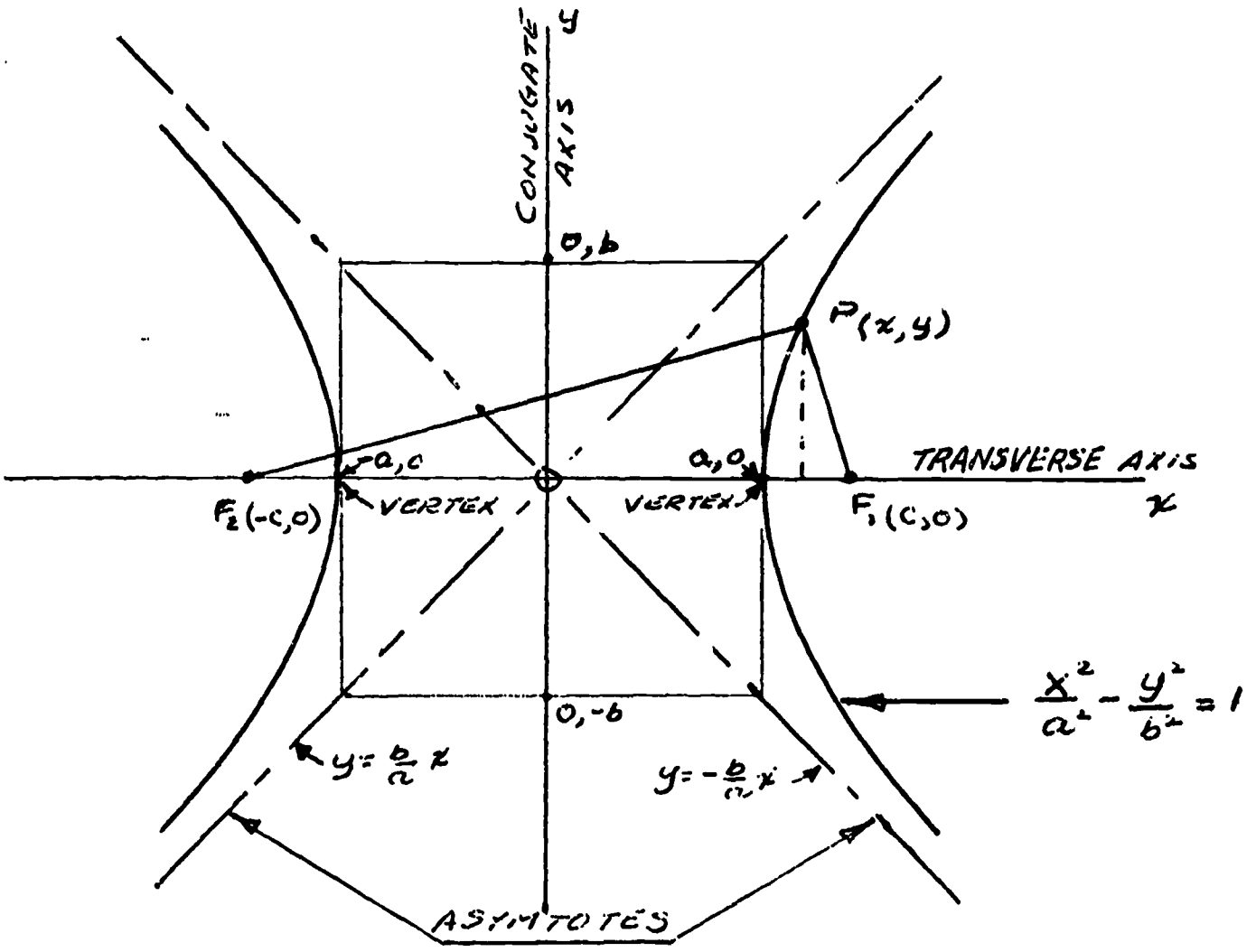
$$\boxed{\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1} \qquad \boxed{\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1}$$

Standard Forms

Symmetrical about the x-axis

Symmetrical about the y-axis

Note that, for both formulas, the vertex distance (a) is the denominator of the positive variable - whether x or y.



Note: When working with ellipses and hyperbolas, the focal points must always lie inside the curve. The vertex (a) must always lie along the axis about which the figure is drawn.

An equation which is equal to the difference of the squares of the variables is hyperbolic. The hyperbola, like the other conics, may have the center offset (h, k) from the coordinate-axis origin. The equations then take the following forms:

$$\boxed{\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2}} = 1$$

General Standard form (Hyperbola)

$$\boxed{\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2}} = 1$$

(3-12) Rectangular Hyperbola

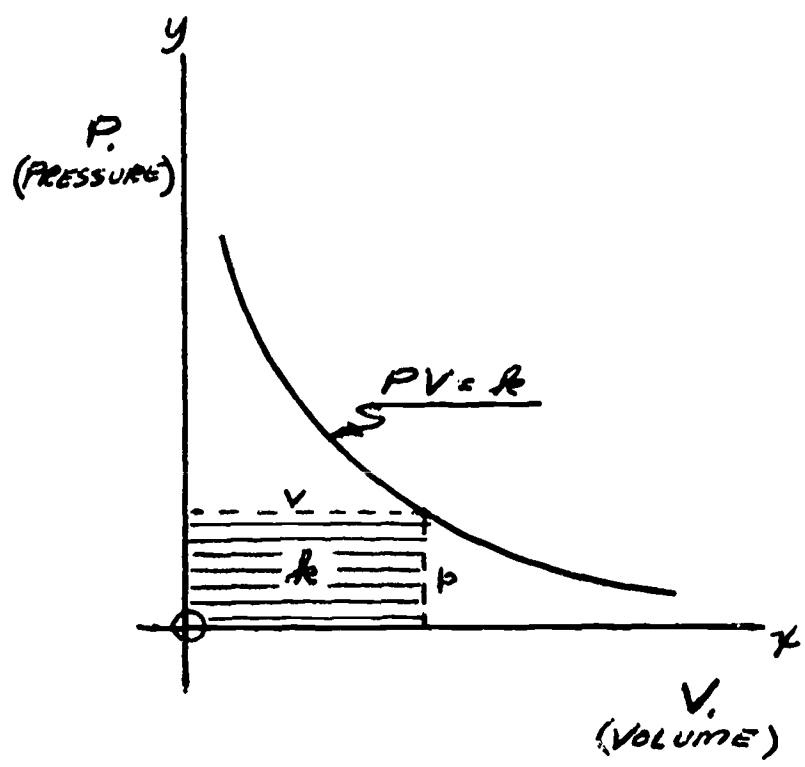
Boyle's law in physics states that the volume (V) of an enclosed gas varies inversely as the pressure (P). This simply means that a cubic foot of gas at 15 p. s. i. pressure would occupy $\frac{1}{2}$ cubic foot volume at twice the pressure (30 p. s. i.), assuming the temperature constant. Mathematically this relationship may be expressed as follows:

$$V \sim \frac{1}{P}$$

Any proportionality ($\sim$) may be converted to an equality by inserting a constant (k).

Therefore $V = k(\frac{1}{P})$

$$PV = k$$



Note: As the volume increases, the pressure must decrease to maintain the constant area (k) under the curve for all points along the curve.

Example 1: A stationary magnet is located at the coordinate axis center. Another magnet of the same charge is swung toward the stationary magnet along the asymtote $y = x$; it crosses the x-axis at (2, 0) and then becomes asymtotic to $y = -x$. Determine the equation for the hyperbola, draw the figure, and locate the focus.

Solution:

Since the hyperbola cuts the x-axis at (2, 0), this point is the vertex, which lies along the transverse axis, and its distance from the origin is called a.

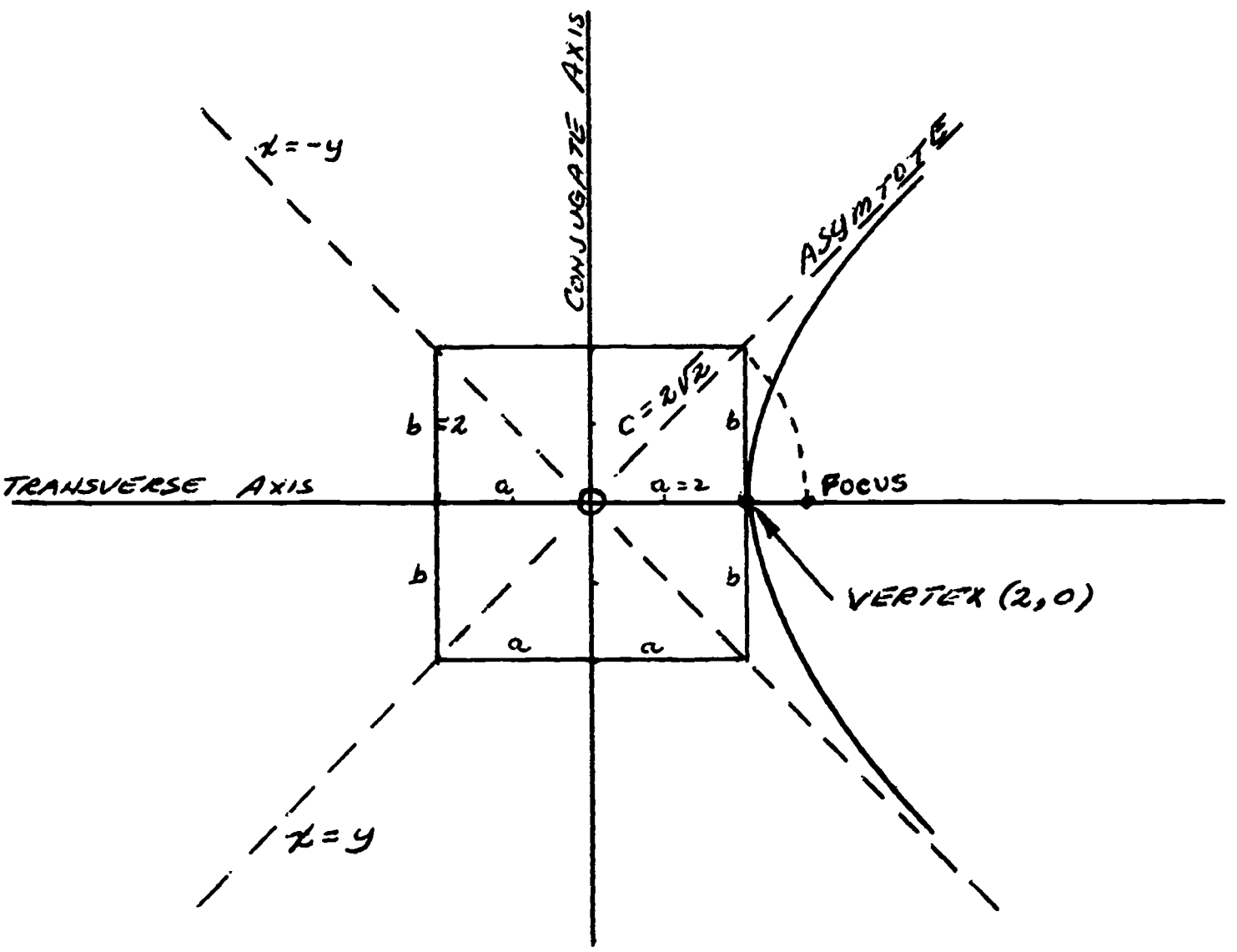
Since the equation for the asymtote is $y = x$, when $a = 2$, b, on the perpendicular or congugate axis, is also 2.

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$ Standard form

$$\frac{x^2}{(2)^2} - \frac{y^2}{(2)^2} = 1$$ Substituting values for a and b

$$x^2 - y^2 = 4$$ Equation for this hyperbola

To draw the figure:



Note: The focus must lie inside the curve. It must be equal to the hypotenuse of the semi-transverse and semi-congugate axes.

$$c^2 = a^2 + b^2$$

$$c^2 = (2)^2 + (2)^2$$

$$c = \pm 2\sqrt{2}$$

Focus location is $(\pm 2\sqrt{2}, 0)$

Example 2: Write the equation for Example 1 if the center is located at (-3, -4).

Solution:

$h = -3$ $\qquad$ $a = 2$

$k = -4$ $\qquad$ $b = 2$

$$\frac{(x - h)^2}{a^2} - \frac{(y - k)^2}{b^2} = 1$$ Standard Form

$$\frac{[x - (-3)]^2}{(2)^2} - \frac{[y - (-4)]^2}{(2)^2} = 1$$ Substituting

$$\frac{x^2 + 6x + 9}{4} - \frac{y^2 + 8x + 16}{4} = 1$$

$$x^2 + 6x + 9 - y^2 - 8y - 16 = 4$$

$$x^2 - y^2 + 6x - 8y - 11 = 0$$ Answer

Example 3: From the equation $x^2 - y^2 + 6x - 8x - 11 = 0$, determine what type of curve it is, and find the pertinent points for drawing it.

Solution:

The difference of the square terms indicates that the figure is a hyperbola. The plus squared term (x) indicates that the x-axis is the transverse axis, or axis through the foci of the figure, about which the figure is symmetrical.

In order to determine the values of the semi-transverse (a) and semi-congugate (b) axes, in order to draw the asymtotes, the equation must be set in standard form of perfect-square terms. This is done as follows:

$$x^2 - y^2 + 6x - 8y - 11 = 0$$

$$(x^2 + 6x \quad) - (y^2 + 8y \quad) = 11$$ Regrouping x- and y-terms

$$(x^2 + 6x + 9) - (y^2 + 8y + 16) = 11 + 9 - 16$$ Completing the squares

$$(x + 3)^2 - (y + 4)^2 = 4$$ Factoring

$$\frac{(x + 3)^2}{4} - \frac{(y + 4)^2}{4} = 1$$ Putting equation in standard form

$$\frac{(x - h)^2}{a^2} - \frac{(y - k)^2}{b^2}$$ Standard form

Since $x + 3 = x - h, \quad h = -3$

Since $y + 4 = y - k, \quad k = -4$

$a = 2$

$b = 2$

Note: When completing the square, the -1 term is factored out, making the y^2 and 8y terms positive. When they are multiplied by -1, they are identical to the terms in the original algebraic expression

(3-13) General Equation for Conics

When planes intersect cones at various angles, different types of curves of intersection result. They are called conic sections. They include all the curves we have discussed up to this point, including the circle, ellipse, parabola, and hyperbola.

$$Ax^2 + Cy^2 + Dx + Ey + F = 0$$

This expression is a general algebraic expression which includes all conics. The beginning letters of the alphabet are coefficients of the unknown terms.

From the above expression and some analysis, the type of figure can be determined readily by observing the following about the equations:

1. $A = C$ (circle)
2. $A \neq C$; + sign for x^2 and y^2 (ellipse)
3. A and C have different signs (hyperbola)
4. A or C = 0 (parabola)

Problems 12 through 27 in the following set will give you practice in distinguishing the figures and in sketching them.

Problems

Discuss and sketch the following:

1. $x^2 - y^2 = 1$

2. $y^2 - 4x^2 = 36$

3. $4y^2 - x^2 = 25$

4. $x^2 - 16y^2 + 4x + 9y - 120 = 0$ (Rearrange to standard form)

5. $x^2 - y^2 - 4x - 12 = 0$

6. $xy = 1$

7. $xy = -5$

8. Sound and light intensity follow similar laws. Write the equation for the following: The illumination received from a source of light varies directly as the candlepower of the source and inversely as the square of the distance from the source. Assuming a candlepower of 100, write the equation and sketch the illumination — distance-squared curve.

9. The electrical resistance of a wire varies directly as its length and inversely as the diameter squared. Sketch the resistance to diameter-squared for a given length of wire.

10. Find the equation of a hyperbola with foci at $(0, \sqrt{15})$ and $(0, -\sqrt{15})$ which has a transverse axis distance twice the congugate axis distance. Determine the slope of the asymtotes.

11. Find the equation of a hyperbola with foci at (20, 0) and (-20, 0) with a conjugate axis distance $\frac{1}{3}$ of the transverse axis distance.

Determine the offset and all the pertinent facts, and draw the following conics:

12. $y^2 - 12x - 6y - 51 = 0$

13. $x^2 - 4x - 2y - 10 = 0$

14. $x^2 + 4y^2 + 8x - 8y - 5 = 0$

15. $x^2 + 2x - 11 = 4y^2 - 8y$

16. $x^2 - 4x = 4y$

17. $x^2 - 4x + 4y + 16 = 0$

18. $y^2 - 6y + 2x + 7 = 0$

19. $4y^2 - 16x^2 - 32y - 96x + 144 = 0$

20. $9y^2 + 4x^2 + 8x - 54y - 59 = 0$

21. $4y^2 - x^2 - 6x + 3y + 28 = 0$

22. $x^2 + 12x - 2y = 0$

23. $3x^2 + 3y^2 - 6x + 12y - 60 = 0$

24. $x^2 - 6x - 8y - 15 = 0$

25. $4x^2 + 9y^2 - 32x + 36y + 64 = 0$

26. $x^2 - 4y^2 - 6x + 32y - 59 = 0$

27. $x^2 + 12x - 8y - 4 = 0$

28. A positively charged particle is shot toward the nucleus of an atom along the asymtote $y = -\frac{1}{2}x$. It follows a hyperbolic path and crosses the coordinate axis at (0, -.02). Write the equation for this hyperbolic motion in its most simple form. Hint: Use scientific notation.

29. Draw the above hyperbola.

30. Determine the location of the focus.

31. When y = .06 cm, calculate the distance between the particle and the nucleus.

CHAPTER IV

DIFFERENTIATION

You have no doubt heard of calculus and have been told about the difficulty of this form of mathematics. An attempt will be made to develop the basic concepts and a working knowledge of this most important and functional branch of mathematics.

Calculus is concerned with the notions of rate of change and areas under curves. Most problems in nature are problems involving rates of change. For example, when reading the thermometer and recording the temperature at different time intervals, different readings of temperature at different time intervals are obtained. A plot of this data would be represented as a series of straight lines between the discrete points. If the same temperature variations were recorded by a temperature recorder, it could readily be observed that the straight lines really are curves, indicating that temperature has a varying rate of change or velocity.

To develop this subject with comprehension, it is essential to review a few pertinent concepts of mathematics.

(4-1) The Concept of a Function and Slope

Take a simple equation with which everyone is familiar:

$$\text{distance} = \text{average velocity} \times \text{time}$$

If the velocity is constant, then one can say that distance is a function of time. We write this in mathematical symbolism - distance as a function of time.

$$d = f(t)$$

But since $\quad d = vt$ (where v = average velocity)

$$d = f(t) = vt$$

Let's take a simple problem. A car is traveling at 30 mi./hr. After 1 hour it has obviously traveled 30 miles.

$$d = 30\,t$$

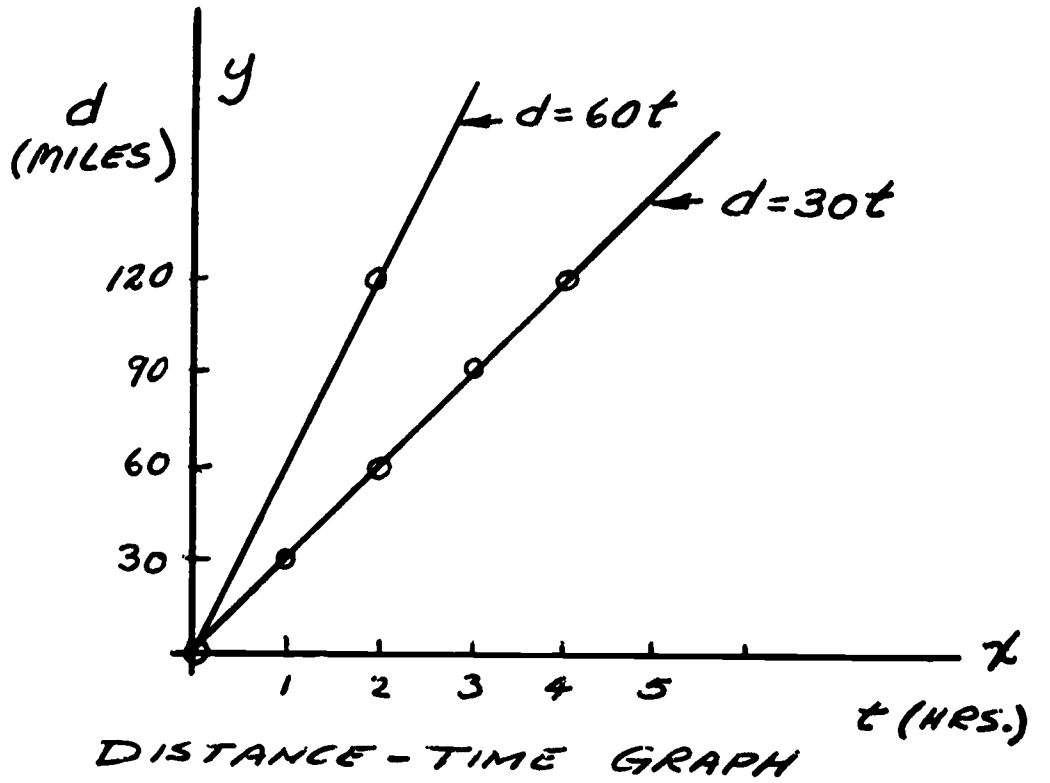
$$d = f(t) = 30t$$

$$d = f(1) = 30(1) = 30 \text{ miles}$$

Now plot the equation d = 30t. Our variables are d and t. If t is assigned values, it is known as an <u>independent</u> variable; the results obtained from the equation give d, which is called the dependent variable, since its values are dependent on the assigned values given t.

$d = 30t$

d	t
30	1
60	2
90	3
120	4

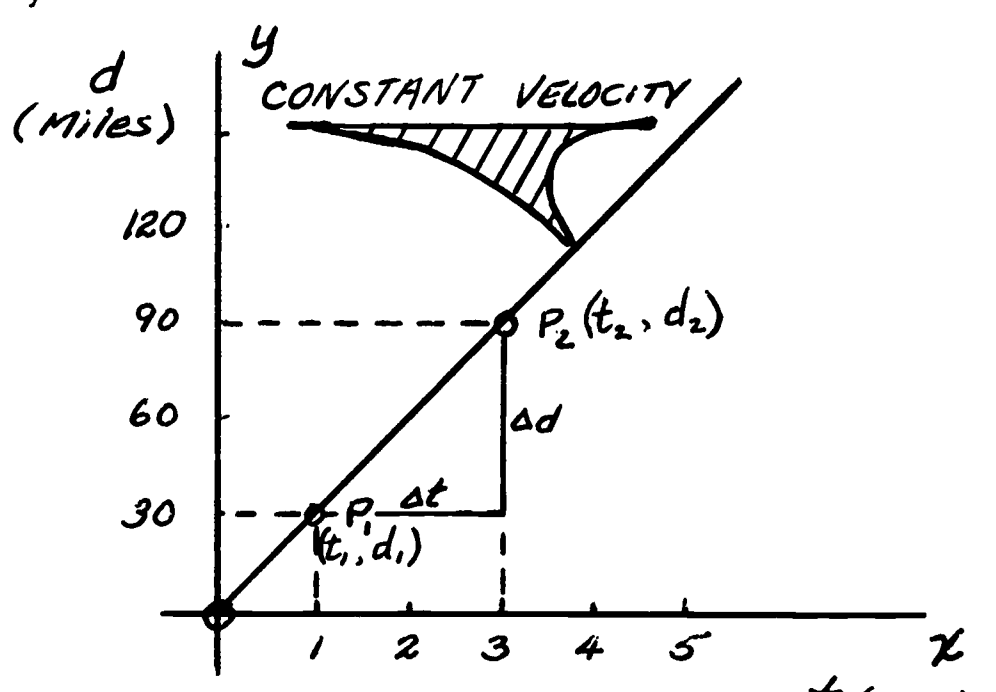


DISTANCE-TIME GRAPH

Usually the independent variable (here, t) is plotted along the x-axis, and the dependent variable (here, d) is plotted on the y-axis.

If the velocity in this problem were 60 mi. /hr., the equation would then be d = 60t, which is also plotted above. You will observe that, for a given graph dimension, the steepness of the linear equation is a function of its velocity.

Now let's assume that the graph on the right has been plotted from some collected data, and the problem is to determine the velocity of this object.



DISTANCE – TIME

$$\text{Constant velocity} = \frac{d}{t} = \frac{\text{distance}}{\text{time}} = \frac{30 \text{ mi.}}{1 \text{ hr.}} = 30 \text{ mi. /hr.}$$

The solution was simple when we used 1 hour for the time.

Suppose we had used two distances and times. The problem could be stated as follows: After one hour, a car had traveled 30 miles, and after 3 hours it had traveled 90 miles; determine its velocity.

$$v = \frac{d_2 - d_1}{t_2 - t_1} = \frac{\text{change in distance}}{\text{change in time}} = \frac{\Delta d}{\Delta t}$$

$$v = \frac{90 - 30}{3 - 1} = \frac{60}{2} = 30 \text{ mi./hr.}$$

Note that, no matter what sets of Δd and Δt are used, the velocity comes out the same. It must, because the data indicated a constant velocity.

The above is an example of a very important concept - <u>all constant functions plot as linear, or straight-line, functions.</u>

Things are pretty simple so far, so let's get an equation for the above problem by using the slope-intercept technique. Assume the data has been plotted, and our problem is to obtain an equation for this graph. The general equation is

$y = mx + b$ (linear equation)

$b = 0$ since the graph intersects the y-axis at 0

$m = \text{slope} = \frac{\text{rise}}{\text{run}} = \frac{30}{1} =$ velocity in the above graph

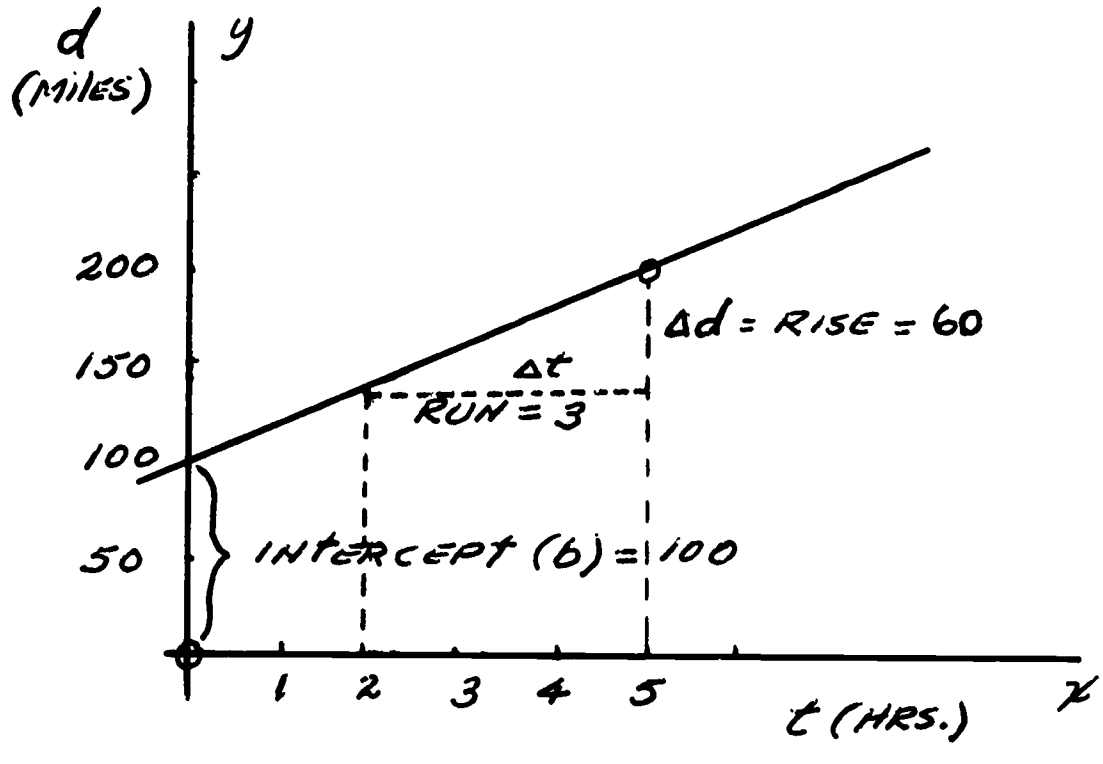
d is plotted along y

t is plotted along x

Therefore, by substitution

$$d = 30t + 0$$

Example 1: Write an equation for the plot below.



$y = mx + b$, or in this case, $d = mt + b$

$$m = \text{slope} = \frac{\text{rise}}{\text{run}} = \frac{\Delta d}{\Delta t} = \frac{60}{3} = 20 = \text{velocity}$$

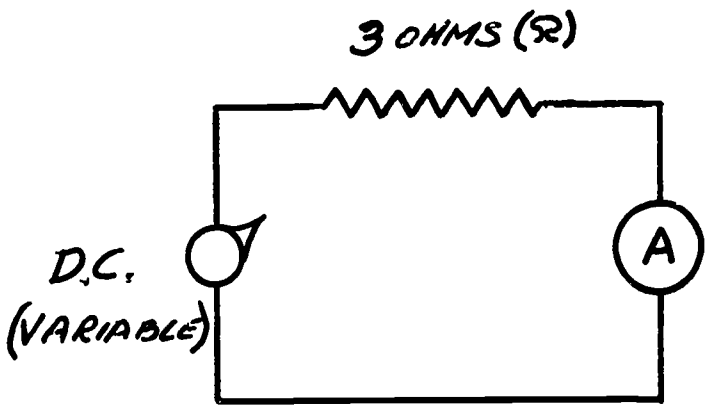
$b = 100$ (d-intercept)

$d = 20t + 100$

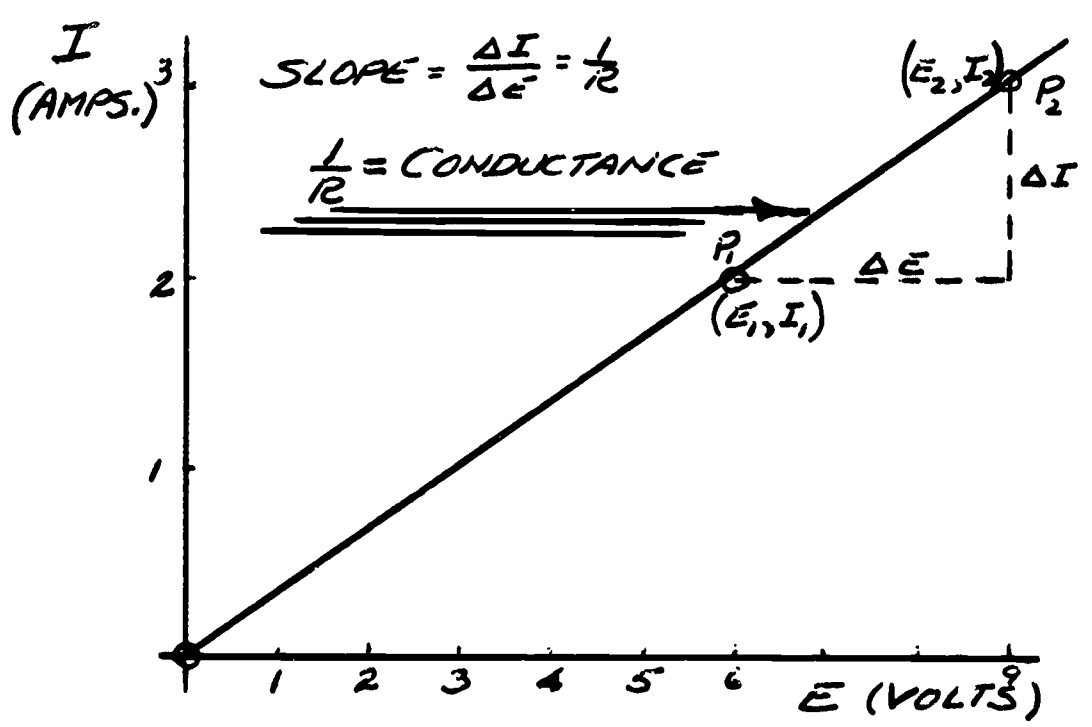
Therefore the above equation indicates that at time $t = 0$, the object has already traveled 100 miles, and at $t = 5$, it has traveled 200 miles.

Example 2: Now let's take a problem in electricity which has a functional relationship comparable to the problem above.

We will assume that we have set up our apparatus according to this diagram. Our resistance is 3 ohms. We varied the voltage (E) and read off the corresponding current (I), obtaining the values shown in the chart below. Since E was our independent variable, we plotted it on the x-axis, and plotted I on the y-axis.



I	E
$\frac{1}{3}$	1
1	3
2	6
3	9



Working from the data above, we obtained the straight line shown. Let us find its equation.

We will use the slope-intercept form again, $y = mx + b$. Since $b = 0$, one need only to determine m, the slope, that is, the rise over the run. Take any two points (P_1 and P_2) on the curve. Their coordinates are (E_1, I_1) and (E_2, I_2).

$$m = \text{slope} = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{I_2 - I_1}{E_2 - E_1} = \frac{3 - 2}{9 - 6} = \frac{1}{3}$$

Let's use another set of increments (again we use the word delta, written Δ) to check the slope. Use (0-9V) as ΔE; this obviously gives (0-3) for ΔI on the plot. Since

$$m = \frac{\text{rise}}{\text{run}} = \frac{\Delta I}{\Delta E} = \frac{\text{increment of I}}{\text{increment of E}} = \frac{3 - 0}{9 - 0} = \frac{1}{3} \text{ again}$$

The important point to remember is that one can choose the increment of one of the variables. This will determine the increment of the other variable from the plot. The $\frac{\text{rise}}{\text{run}}$ of any set of values gives the same slope in any straight-line or linear function.

The equation of the above plot is therefore

$$I = mE + b$$

$$I = \frac{1}{3}E$$

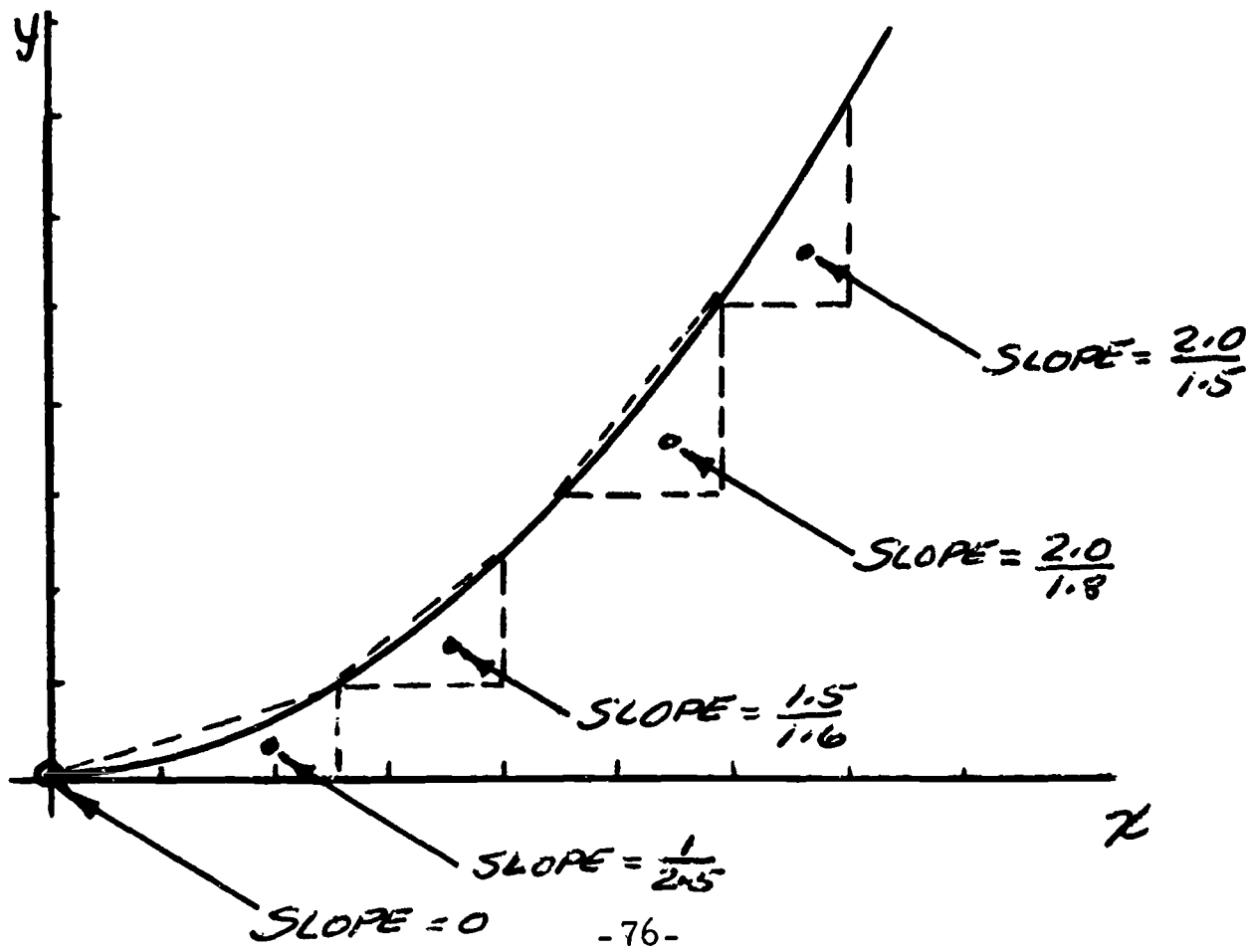
Actually, we might expect to get this equation from Ohm's law, E = IR.

$$I = \frac{E}{R} = \frac{I}{R}E$$

But $R = 3$ Therefore $I = \frac{1}{3}E$, as above

Since $\frac{I}{E} = \frac{1}{R}$ (the reciprocal of the resistance), which is known as the conductance, the slope of the I-E plot gives the conductance of the circuit. This gives a technique for determining the resistance of a circuit from the actual plot of the current and voltage.

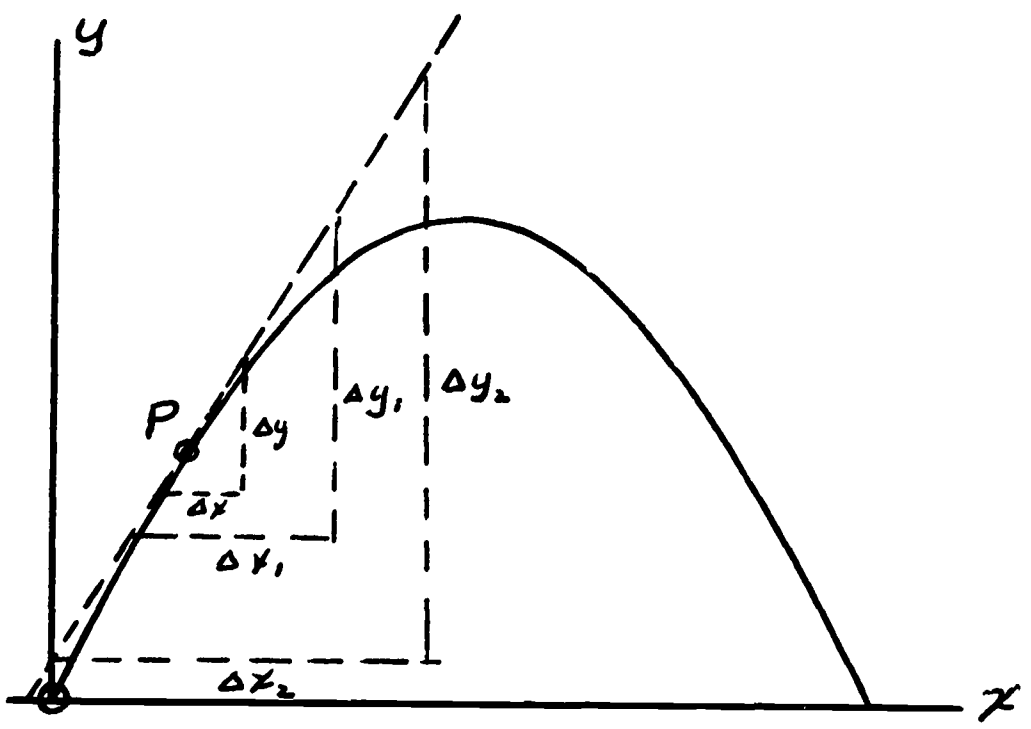
Up to this point, all our plots have been of straight lines, and the slope has been constant no matter which points we used to determine it. Let us now look at a non-linear curve (below). Note that the slope varies as the curve changes direction.



$$\text{Slope} = \frac{\text{rise}}{\text{run}} = \frac{\Delta y}{\Delta x}$$

change or increment of the ordinate (y)

change or increment of the abscissa (x)



To determine the slope of the above curve at a given point P:

1. Draw a tangent to the curve at point P.

2. Draw horizontal and vertical lines parallel to the axes and terminating in the tangent.

3. All slopes, $\frac{\text{rise}}{\text{run}}$, are the same for each triangle, since all the triangles are similar to each other. Any one could be used to determine the slope of the curve at point P.

(4-2) Functional Notation

The previous problems were involved with functions. Functions are variables which are so related that, when certain values are assigned to one variable, one obtains definite values for the other variable, according to some equation or plot.

To indicate that y is a function of x, write $y = f(x)$. This is read as "y equals a function of x." The expression represents the way y is related to x. The symbol $f(x)$ may be used to represent any mathematical expression involving x as a variable, or any quantity which is a function of x.

In functional notation, f(x) may be assigned values such as f(1) or f(-3), which simply means that 1 or -3 is substituted for x in the relationship.

For example:

constant

$$A = \pi r^2$$

dependent variable independent variable

$$A = f(r) = \pi r^2$$

$$A = f(1) = \pi(1)^2 = 3.14 \text{ sq. in.}$$

$$A = f(3) = \pi(3)^2 = 28.26 \text{ sq. in.}$$

The area (A), or dependent variable, is a "function of," that is, is dependent upon the value of the radius (r), the independent variable. As we have seen, we may write this as

$$A = f(r)$$

to represent the equation for the area of a circle.

Let's take some examples:

1. $y = z^2$, that is, $y = f(z) = z^2$

   When $z = 1$, $y = f(1) = (1)^2 = 1$

   When $z = 2$, $y = f(2) = (2)^2 = 4$

   If $z = a + b$, then $y = f(a + b) = (a + b)^2 = a^2 + 2ab + b^2$

2. $A = \pi r^2$

   $A = f(r) = \pi r^2$

   $A = f(a + b) = \pi(a + b)^2 = \pi(a^2 + 2ab + b^2)$

3. $S = 20t - 16t^2$

   $S = f(t) = 20t - 16t^2$

   when $t = 4$

   $S = f(4) = 20(4) - 16(4)^2$

   $S = f(4) = 80 - 256 = -176$

4. $y = \sqrt{25 - t^2}$

$y = f(t) = \sqrt{25 - t^2}$ when $t = 3$

$y = f(3) = \sqrt{25 - (3)^2} = \sqrt{16} = 4$

Problems

Solve the following:

1. $y = f(x) = 2x - 3$; find $f(2)$, $f(3)$, $f(a)$
2. $y = f(t) = t^2 - 2t$; find $f(3)$, $f(6)$, $f(a)$
3. $y = f(x) = \frac{x^3 - x^2 + x}{2x}$; find $f(1)$, $f(-4)$, $f(a)$
4. $y = f(x) = x^2$; find $f(x + \Delta x)$, $f(x - \Delta x)$
5. $y = f(x) = \sqrt{x^2 - 2x}$; find $f(z)$, $f(4)$

Write the following in functional (f) notation:

6. $A = \pi r^2$ (area of circle)
7. $V = \frac{4}{3}\pi r^3$ (vol. of sphere)
8. $A = 4\pi r^2$ (area of sphere)
9. $V = \frac{1}{3}\pi r^2 h$ (vol. of cone) (h is constant)
10. $K = \frac{1}{2} mv^2$ (Kinetic energy) (m is constant)
11. $U = mgh$ (Potential energy) (m and g are constant)
12. Express the circumference of a circle in terms of its area. Write it also in functional notation.
13. In the equation $HP = \frac{Fd}{550t}$, F is in pounds, d is in feet, and t in seconds. How does the HP vary if d is increased? If t is increased? If t is decreased?
14. The intensity (I) of light and radioactivity varies inversely as the square of the distance from the source (d). Write this in functional notation and determine the intensity when d = 1, 3, 5, 6, 8, 10. Draw a graph of this relationship.

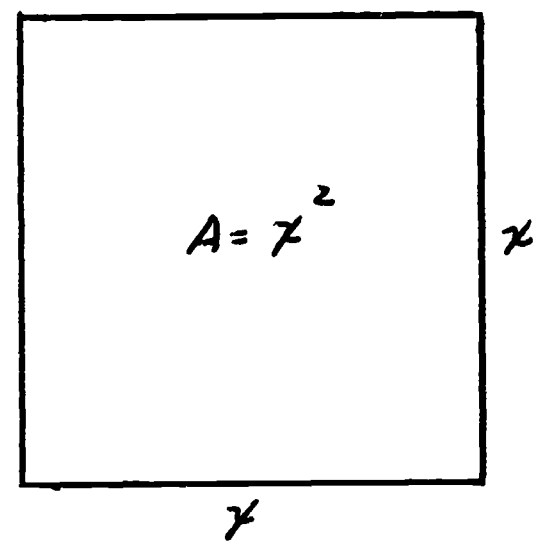
(4-3) Delta (Δ) Notation: Increments

The area of a square with x as a side is

$$A = x^2$$

$$A = f(x) = x^2$$

$$A = f(3) = (3)^2 = 9 \text{ in.}^2$$

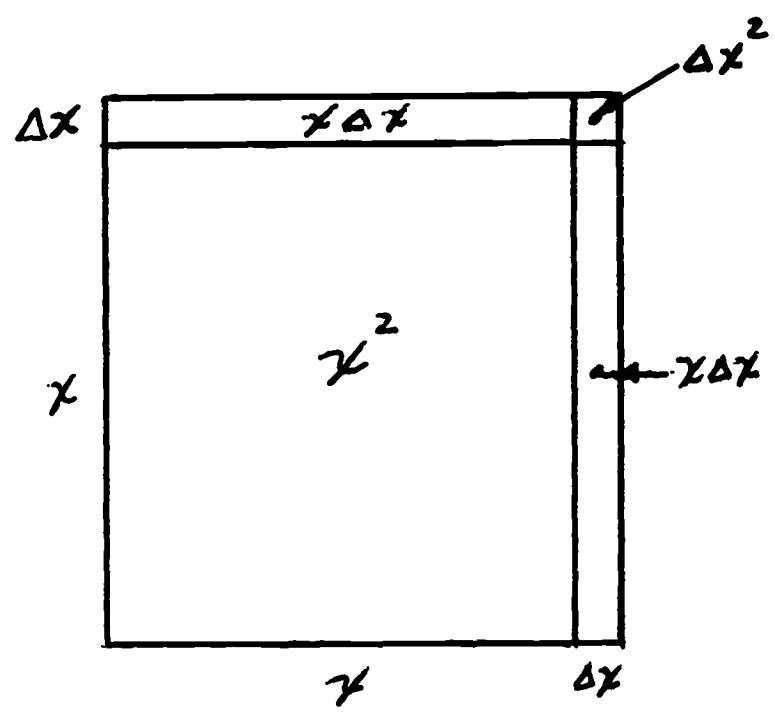


Suppose the square was heated, and it expanded a small increment, Δ A, produced by the expansion of each side by Δ x. Let's determine what happens to the square when each side is increased by the small increment, Δ x.

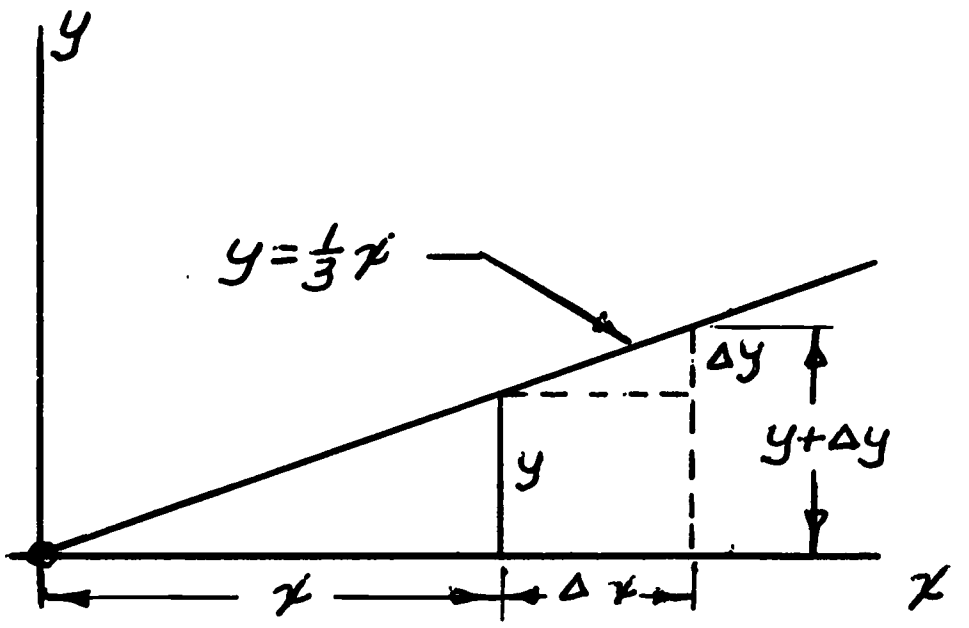
$$A = f(x) = x^2$$

$$A + \Delta A = f(x + \Delta x) = (x + \Delta x)^2$$

$$= x^2 + 2x\Delta x + \Delta x^2$$



The new area with respect to the original is increased by a small increment, of which Δx^2 plays a negligible part.
(If Δx were $\frac{1}{1000}$ inch, Δx^2 would be $\frac{1}{10^6}$ inch^2.)



Now let's take a straight-line function, $y = \frac{1}{3}x$

$$y = \frac{1}{3}x$$

$$y = f(x) = \frac{1}{3}x$$

$$y + \Delta y = f(x + \Delta x) = \frac{1}{3}x + \frac{1}{3}\Delta x$$

If x increases or grows by an increment of Δx, obviously y must increase correspondingly by an increment of Δy.

$$y + \Delta y = \frac{1}{3}x + \frac{1}{3}\Delta x$$

But $\quad y = \frac{1}{3}x \quad$ Subtract from above

$$\Delta y = \frac{1}{3}\Delta x$$

$$\frac{\Delta y}{\Delta x} = \frac{1}{3}\frac{\Delta x}{\Delta x} \quad \text{Divide by } \Delta x$$

$$\frac{\Delta y}{\Delta x} = \frac{1}{3}$$

$\frac{1}{3}$ is the slope of the line, which may be obtained by taking

$\frac{y}{x}$ or $\frac{\Delta y}{\Delta x}$ or $\frac{y + \Delta y}{x + \Delta x}$

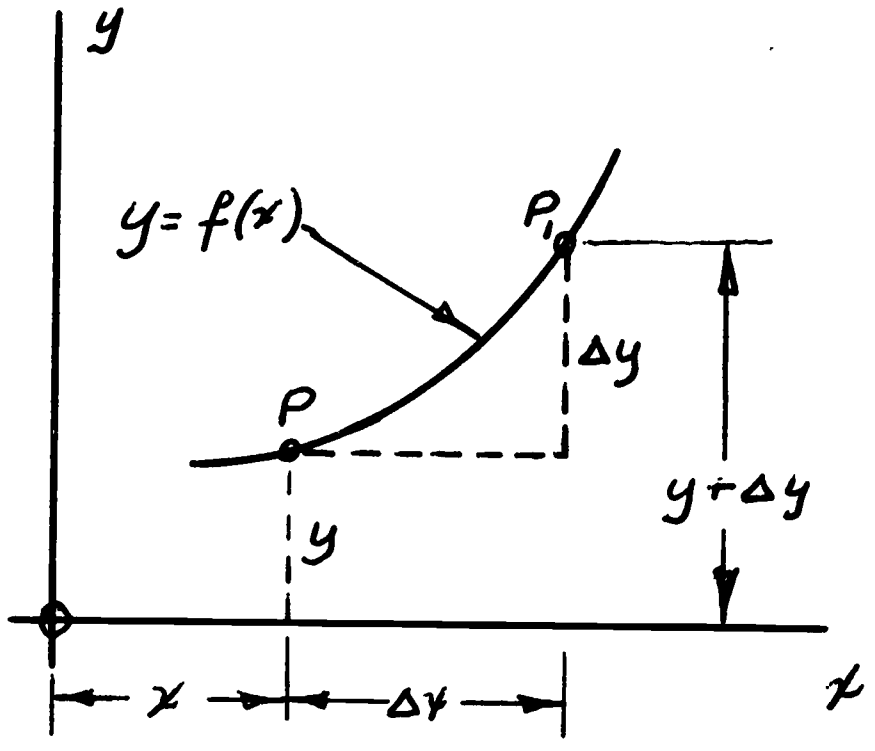
We will take a general example to show how to compute increment Δy corresponding to an increment Δx.

$$y + \Delta y = f(x + \Delta x)$$

$$\Delta y = f(x + \Delta x) - y \quad \text{Subtract y from both sides}$$

$$\Delta y = f(x + \Delta x) - f(x)$$

Example 1:



Compute Δy if x changes from 1 to 1.5 for $y = f(x) = 2x^2 + 3$

Given: $x = 1, \ \Delta x = 0.5$

$f(x) = 2(1)^2 + 3 = 5$

$- f(x + \Delta x) = f(1.5)$

$= 2(1.5)^2 + 3$

$= 7.50$

But $\Delta y = f(x + \Delta x) - f(x)$

$= 7.50 - 5 = 2.50$

$\frac{\Delta y}{\Delta x} = \frac{2.5}{.5} = 5$ Average rate of change of y with respect to x

Example 2: Compute the average rate of change of $y = f(x) = x^2 - 2$ between $x = 3$ and $x = 4$.

$$\text{Given} \begin{cases} x = 3 \\ \Delta x = 4 - 3 = 1 \end{cases}$$

$$y = f(x) = f(3) = 3^2 - 2 = 7$$

$$y + \Delta y = f(x + \Delta x) = f(4) = 4^2 - 2 = 14$$

$$\Delta y = f(x) + \Delta x) - f(x) = 14 - 7 = 7$$

$$\frac{\Delta y}{\Delta x} = \frac{7}{1} = 7 \quad \text{(Average rate of change)}$$

Example 3: Compute the increment (Δy) of $y = 3x + 7$ between $x = -1$ and $x = 1$.

$$\text{Given} \begin{cases} x = -1 \\ \Delta x = 1 - (-1) = 2 \end{cases}$$

$$y = f(x) = 3(-1) + 7 = 4$$

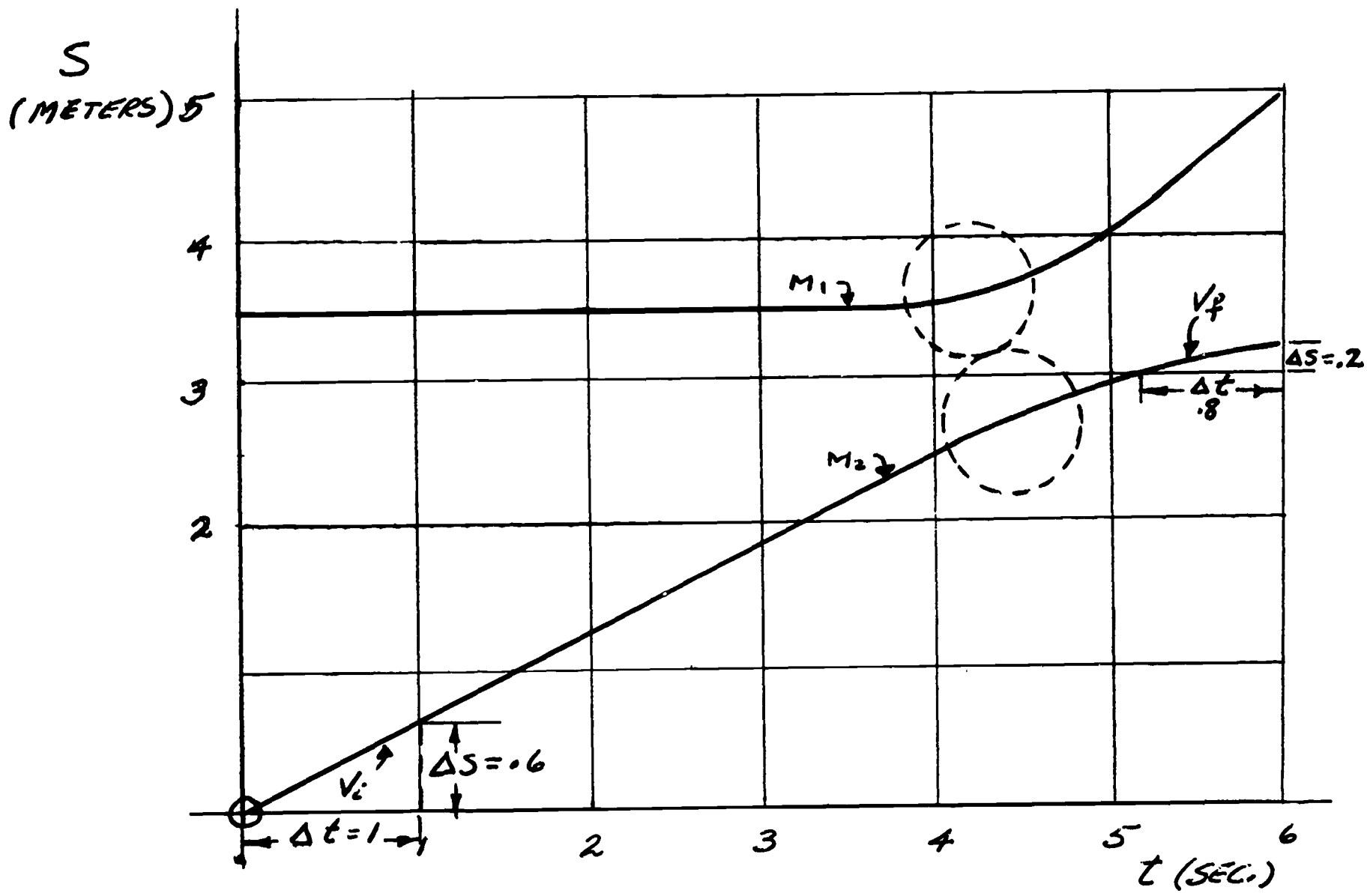
$$y + \Delta y = f(x + \Delta x) = f(1) = 3(1) + 7 = 10$$

$$\Delta y = f(x + \Delta x) - f(x)$$

$$\Delta y = 10 - 4 = 6$$

$$\left[\frac{\Delta y}{\Delta x} = \frac{6}{2} = 3 \quad \text{(Average rate of change of y with respect to x)}\right]$$

Example 4: Use of Delta (Δ) Notation to Determine Velocity



Two balls are moving from the left and their displacement is plotted against time on a piece of carbon paper. The plot and collision are indicated by the curves.

For M_2, initial slope = $V_i = \frac{\Delta s}{\Delta t}$ $\frac{0.6}{1}$ = .6 m./s., initial velocity

Final slope = $V_f = \frac{\Delta s}{\Delta t}$ $\frac{.2}{.8}$ = .25 m./s., final velocity

Problems

Compute the increments of the dependent variable of the following functions:

1. $y = 8x - 2$ at $x = 2$, $\Delta x = 0.5$

2. $y = x^2 + 2x + 1$ at $x = 3$, $\Delta x = -1$

3. $y = \frac{1}{x}$ at $x = 4$, $\Delta x = -0.5$

4. $V = \frac{4}{3}\pi r^3$ at $r = 3$, $\Delta r = 0.5$

5. $P = I^2R$ at $R = 2$, $I = 10$, $\Delta I = 0.5$

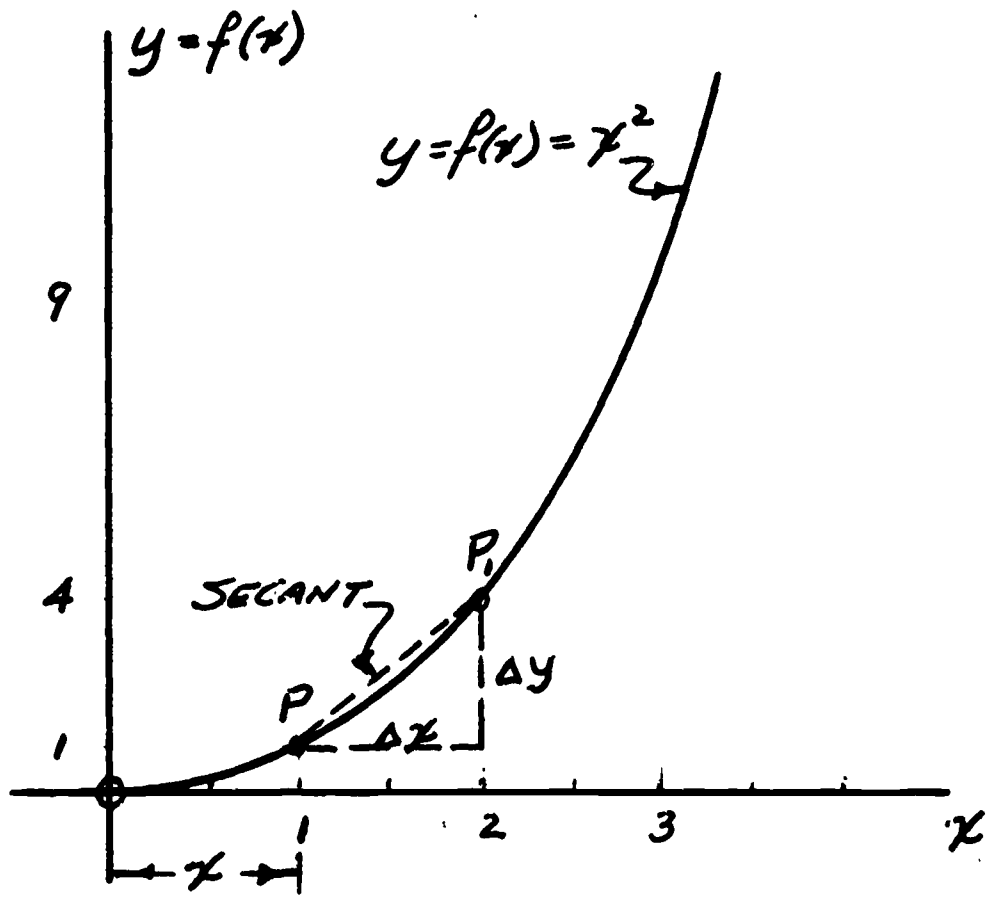
6. The power in an A. C. circuit is given by the equation $P = IE\cos\theta$. Compute the change in power of 110 volts at 10 amperes when θ changes from 30° to 45°.

7. An object is dropped from the Empire State Building at 1000 feet. The object falls according to $d = \frac{1}{2}gt^2$. Find the distance the object falls between times $t = 4$ and $t = 5$. ($g = 32$ ft. /sec. ^{2})

8. An object is thrown with an initial speed of 100 feet per second according to $d = 100t - 16t^2$. Find Δd at time 3 to 4.

(4-4) <u>The Average Rate of Change</u>

Now that we have learned how to compute th y increment for a given x increment, if we divide $\frac{y}{x}$, we get the slope of the secant between two points - which is the average rate of change between the points.



Given: $y = x^2$

$y = f(x) = x^2$	Functional Notation
$y + \Delta y = f(x + \Delta x) = (x + \Delta x)^2$	Add corresponding increments to y and x
$y + \Delta y = x^2 + 2x\,\Delta x + \Delta x^2$	Expand the binomial
$-y \quad = -x^2$	Subtract given equation
$\frac{\Delta y}{\Delta x} = \frac{2x\,\Delta x}{\Delta x} + \frac{\Delta x^2}{\Delta x}$	Divide equation by Δx

$\frac{\Delta y}{\Delta x} = 2x + \Delta x$ Average rate of change

Problems

Solve the following:

1. A ball is thrown into the air and its distance from the point of throwing is represented by the equation $d = 100t - 16t^2$. Find the distance it traveled between the 2nd and 3rd seconds and the average velocity during that time interval.

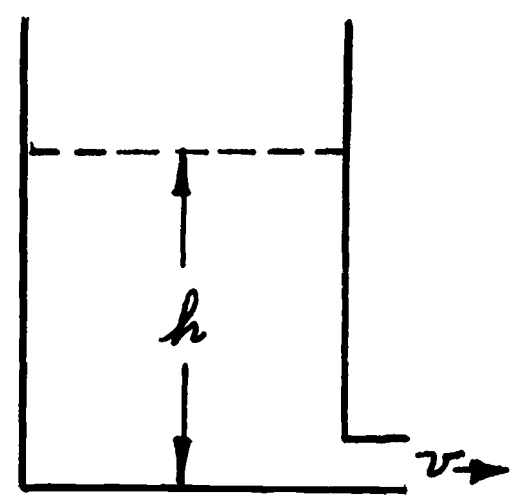
2. Water was found to boil under the following conditions: at 150°C at a pressure of 360 cm. of mercury, and at 200°C at 1100 cm. of mercury. Compute the average rate of change of temperature to pressure.

3. $y = \sin x$. Compute the average rate of change between 30° and 45°.

4. $y = \log x$. Compute the average rate of change between $x = 10$ and $x = 20$.

5. $d = \frac{1}{2}gt^2$ ($g = 32$ ft./sec.^{2}). Compute the velocity between $t = 2$ and $t = 5$ seconds.
(Velocity = $\frac{\Delta d}{\Delta t}$ = average rate of change of distance with respect to time.)

6. The velocity of efflux is equal to $v = \sqrt{2gh}$ ($g = 32$ ft./sec^2). Compute the average change of velocity between heights in the tank of 10 and 20 feet.



7. Compute the average change in volume of a spherical plastic balloon which changes in diameter from 10 to 12 feet.

8. The momentum of a 10-kg. mass is given by the equation $P = mv^2$. Determine the average change of momentum when the velocity changes from 10 to 12 m./sec.

9. The relation between grid potential in volts to plate potential in milliamperes is given by

$$I_p = f(E_g) = 0.5\,(12 + E_g)^{\frac{3}{2}}$$

If grid potential changes from -8 to -6, compute the average rate of change of current.

10. A pilot flies from one airport to another at an average speed of 100 mi./hr. and returns at an average speed of 140 mi./hr. Determine his average speed for the whole trip. (The answer is not 120 mi./hr.)

(4-5) The Limit

The concept of limit is important in understanding mathematics and calculus. "Taking the limit" of an expression will enable us to deal more realistically with rates of change.

Consider the following sequence of numbers:

$$1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} \ldots\ldots\ldots\ldots\ldots\ldots$$

This sequence, when continued to infinity (∞), gives a sum of 2. We say that 2 is the limit of the given sequence. The extremely important number e, which is the base of natural logarithms, is obtained by using the limit technique.

$$e = \lim_{x \to 0} (1 + x)^{\frac{1}{x}} = 2.718 \ldots\ldots\ldots\ldots\ldots$$

The symbol $x \to 0$ is read, "x approaches 0." but it must be remembered that x never becomes 0. The above equation simply states that, if numbers are substituted for x in the expression $\sqrt[x]{1 + x}$, as x gets smaller and smaller, or $x \to 0$, this results in an important constant 2.718..., which is the base of natural logarithms.

Let us try some numbers for x in this expression:

If $x = 1$, $(1 + 1)^{\frac{1}{1}} = 2$

If $x = \frac{1}{2}$, $(1 + \frac{1}{2})^{1/\frac{1}{2}} = (1 + .5)^2 = 2.25$

If $x = \frac{1}{3}$, $(1 + \frac{1}{3})^{1/\frac{1}{3}} = (1.333)^3 = 2.3686\ldots$

If $x = \frac{1}{4}$, $(1 + \frac{1}{4})^{1/\frac{1}{4}} = (1.25)^4 = 2.4414\ldots$

Note that, as x gets smaller, e gets bigger, and finally the constant (2.718...) is obtained as a limit.

Example 1: $\lim_{n \to \infty} (2 + \frac{1}{n}) = 2$ Since $\frac{1}{\infty} = 0$

Example 2: $\lim_{n \to \infty} (\frac{20}{n^2} + 8) = 8$

Example 3: $\lim_{n \to \infty} \frac{(2n + 1)}{n + 1}$

$= \lim_{n \to \infty} \left(\frac{2 + \frac{1}{n}}{1 + \frac{1}{n}}\right)$ Divide numerator and denominator by n

$= 2$

Problems

What does each of the following expressions equal?

1. $\lim_{t \to \infty} 3^{-t}$

2. $\lim_{R_2 \to \infty} \frac{(R_1 R_2)}{R_1 + R_2}$ (2 parallel resistances)

3. $\lim_{x \to \infty} \frac{(2x + x^2)}{3 - 2x^2}$

4. $\lim_{C_1 \to \infty} \frac{2\pi f c_1 c_2}{c_1 + c_2}$ (Reactance of 2 capacitors in series)

5. Solve Problem 4 if $c_2 \to 0$

6. $\lim_{n \to \infty} \frac{n}{n + 1}$

7. $\lim_{n \to \infty} (1 - \frac{1}{n})$

8. $\lim_{x \to 1} (3x + 6)$

9. $\lim_{x \to 2} \frac{1}{x} 2$

10. $\lim_{x \to 3} (x^3 - 2x^2 - 9)$

11. By assigning several values for n in the expression in Problem 6, show that your answer "makes sense."

12. Do the same for Problem 7.

(4-6) <u>Instantaneous Rate of Change</u> $= \frac{dy}{dx} = \lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x}$

The use of the average rate of change is not applicable to all types of problems. We will now investigate the most useful type of change, known as the instantaneous rate of change. In throwing a ball into the air, we were able to calculate the average rate of change between two time intervals. But actually the ball is changing velocity at every small increment of time. When a car is started from a stop and its velocity is steadily increased to 30 mi. /hr., its velocity changes every instant until it reaches the constant velocity of 30 mi. /hr.

At a constant velocity, we have seen previously that $\frac{\Delta d}{\Delta t}$ remains the same, since (d) changes with respect to (t) at a constant value. The instantaneous rate of change in this case is the same as the average rate of change.

Now let us investigate how the instantaneous rate of change is obtained for a curve of the equation:

$$y = x^2$$

$$y = f(x) = x^2$$

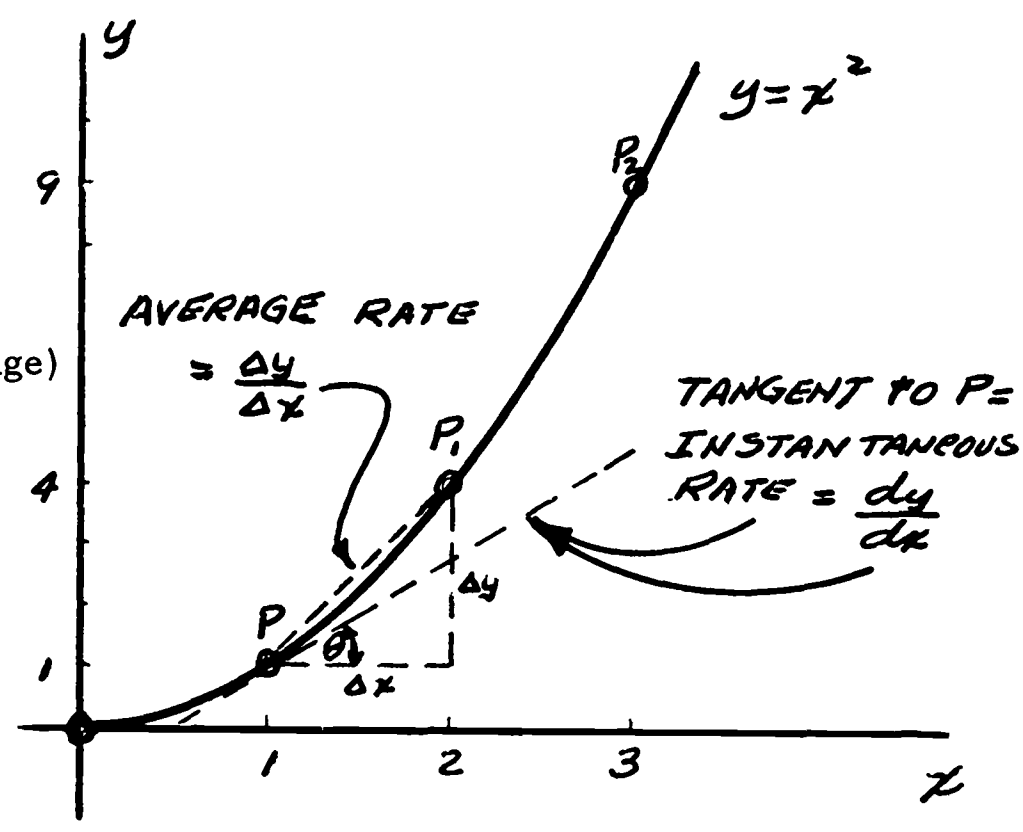
$$y + \Delta y = f(x + \Delta x) = (x + \Delta x)^2$$

$$y + \Delta y = x^2 + 2x\Delta x + \Delta x^2$$

$$-y = -x^2$$

$$\frac{\Delta y}{\Delta x} = \frac{2x\Delta x}{\Delta x} + \frac{\Delta x^2}{\Delta x}$$

$$\frac{\Delta y}{\Delta x} = 2x + \Delta x \text{ (average rate of change)}$$



In order to get the instantaneous rate of change for a point on the curve from the average rate of change $\frac{y}{x}$, we take the limit of the expression for the average rate by letting x 0. (We make x smaller and smaller until it approaches 0.) The average rate of change was

$$\frac{\Delta y}{\Delta x} = 2x + \Delta x$$

$$\lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x} = \lim_{\Delta x \to 0} (2x + \Delta x) = 2x$$

This gives us the instantaneous rate of change of 2x. The instantaneous rate of change of y with respect to x is written $\frac{dy}{dx}$ and is called the derivative of the function. From the diagram above, the average rate of change between P and P_1 is the slope of the secant line, which is represented by $\frac{\Delta y}{\Delta x}$. The instantaneous rate of change $\frac{dy}{dx}$ is the slope of the tangent to the curve at point P.

$$\boxed{m = \tan \theta = \frac{dy}{dx} = \text{derivative at P. (at P).}}$$

$$\boxed{\lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x} = \frac{dy}{dx}}$$

Note an important point above the derivative in the diagram. For the equation $y = x^2$, $\frac{dy}{dx} = 2x$. For point P when $x = 1$, $\frac{dy}{dx} = 2$. The tangent at point P has a slope of 2. When $x = 3$, the tangent of P_2 is $\frac{dy}{dx} = 2x = 2(3) = 6$. The angle here is steeper, as can readily be seen from the diagram.

The instantaneous rate of change (or derivative) of a function has different values depending on its location on the curve. This is an important point to remember.

Example 1: Find the instantaneous rate of change of force if the following equation for work is given:

$$1000 = Fd$$

Work (in joules)	=	Force (in newtons)	x	distance (in meters)

$$F = \frac{\text{Work}}{\text{distance}} = \frac{1000}{d} \quad \text{in this problem}$$

Find $\frac{dF}{dd}$ by the delta (Δ) method

$$F + \Delta F = \frac{1000}{d + \Delta d}$$

$$\Delta F = \frac{1000}{d + \Delta d} - F \qquad \text{(Subtract F from both sides)}$$

$$\Delta F = \frac{1000}{d + \Delta d} - \frac{1000}{d} \qquad \text{Substituting value of F}$$

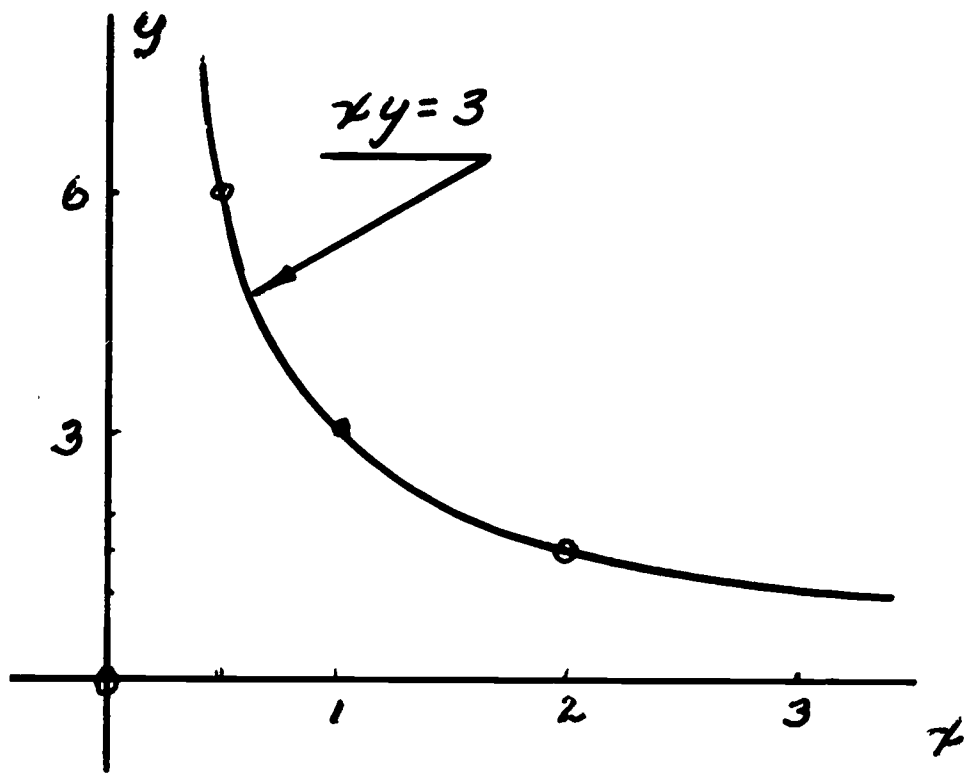
$$F = -\frac{1000\ (\Delta d)}{(d + \Delta d)\ d} \qquad \text{Common denominator}$$

$$\frac{\Delta F}{\Delta d} = -\frac{1000}{(d + \Delta d)\ d} \qquad \text{Divide equation by } \Delta d$$

$$\lim_{\Delta d \to 0} \frac{\Delta F}{\Delta d} = \frac{dF}{dd} = -\frac{1000}{d^2} \quad \left(\frac{\text{newtons}}{\text{meter}^2}\right)$$

Problems

1.



Find the derivative of a rectangular hyperbola xy = 3. Find its value at the points (1, 3) ($\frac{1}{2}$, 6), (2, $1\frac{1}{2}$).

2. Find $\frac{dP}{dI}$ of $P = 24I^2$ by the delta method.

Find the derivatives of the following by the delta method and draw the curves:

3. $A = \pi r^2$

4. $V = \frac{4}{3}\pi r^3$

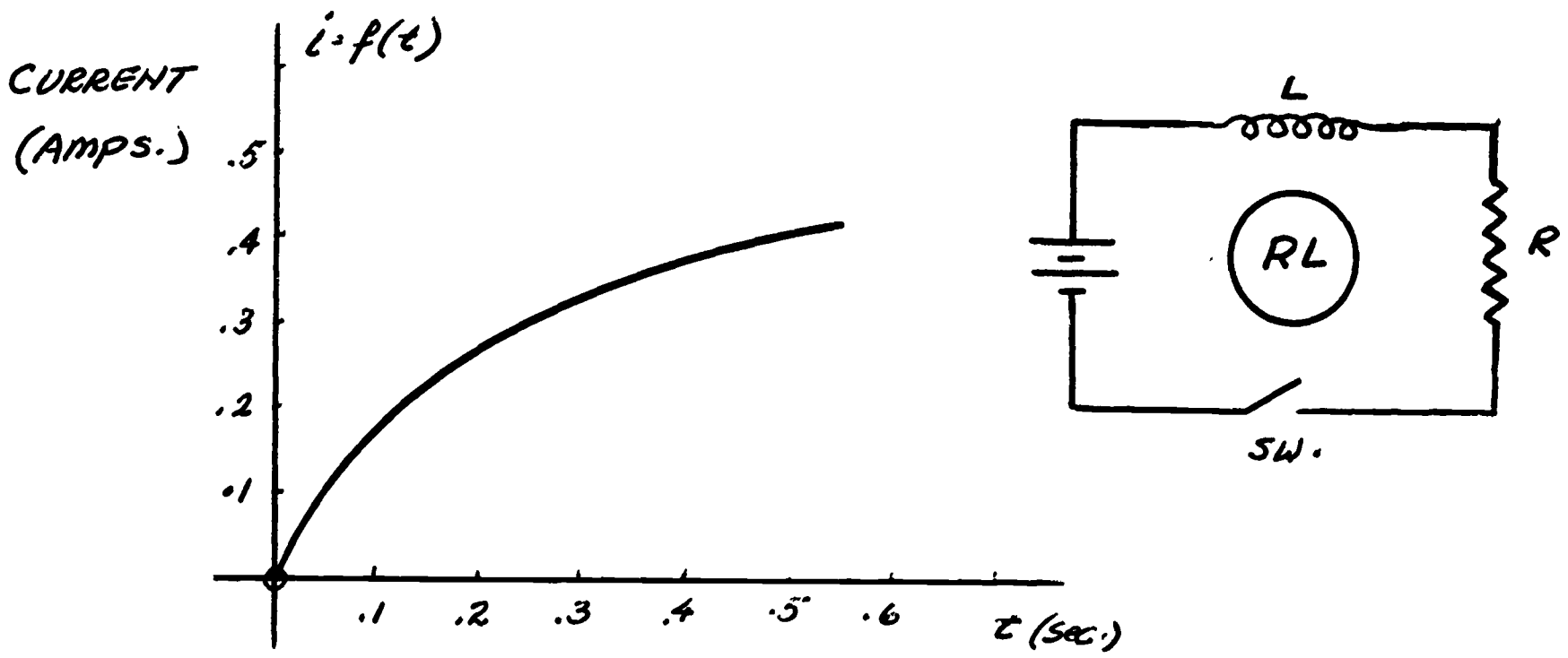
5. P (momentum) = mv, when m = 100 kilograms

6. Impulse = F x t, when Force = 10 newtons

7. The height of a falling bomb is given by $d = 2000 - 16t^2$. Find the equation for its velocity at any time before it hits the ground.

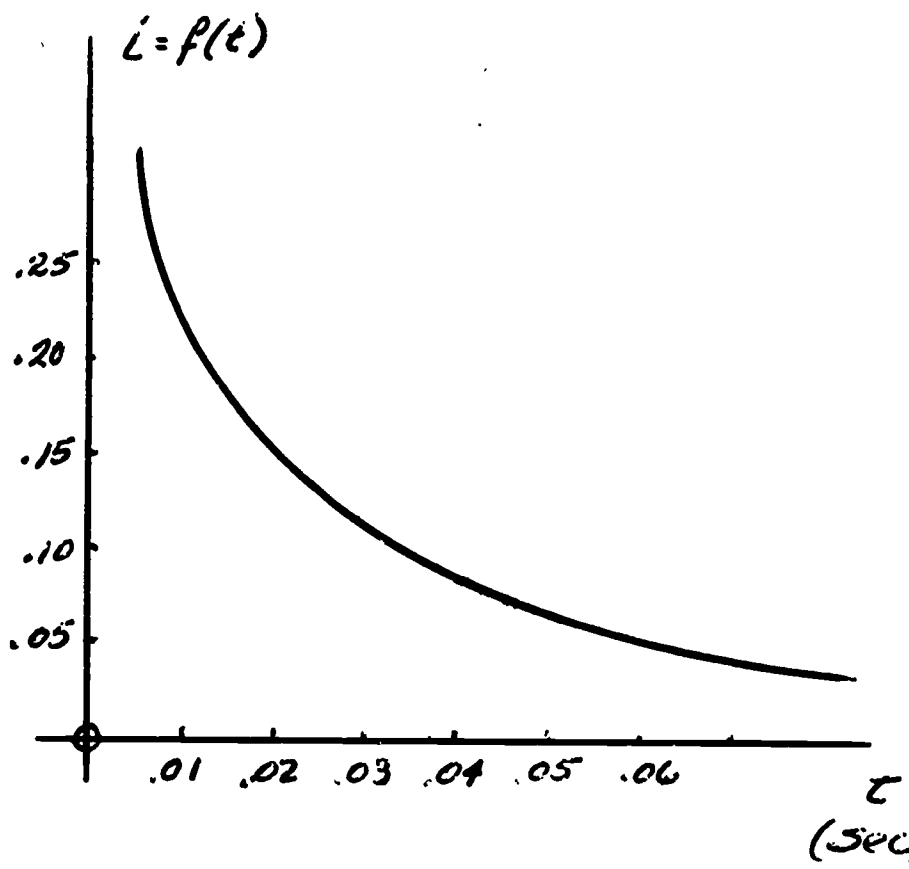
8. The force required to stretch a spring is proportionate to the distance stretched (d). Find the instantaneous rate of change of force with respect to distance ($\frac{dF}{dd}$).

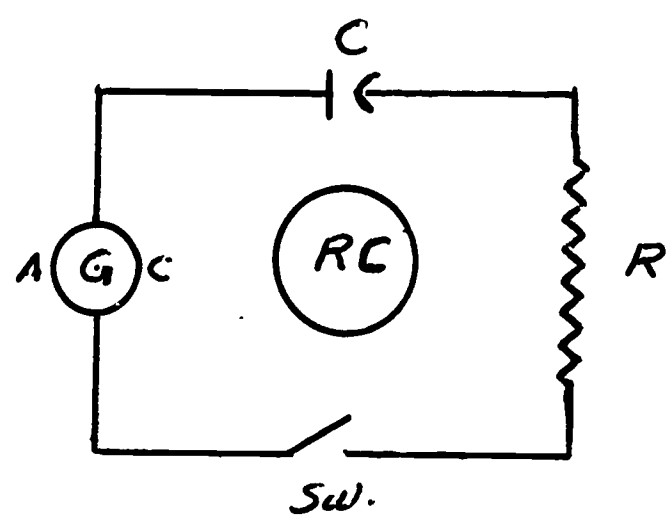
The graph of a series RL circuit is indicated by the diagram below.



9. From the plot, find the average rate of current change between t = .1 and t = .3 sec.

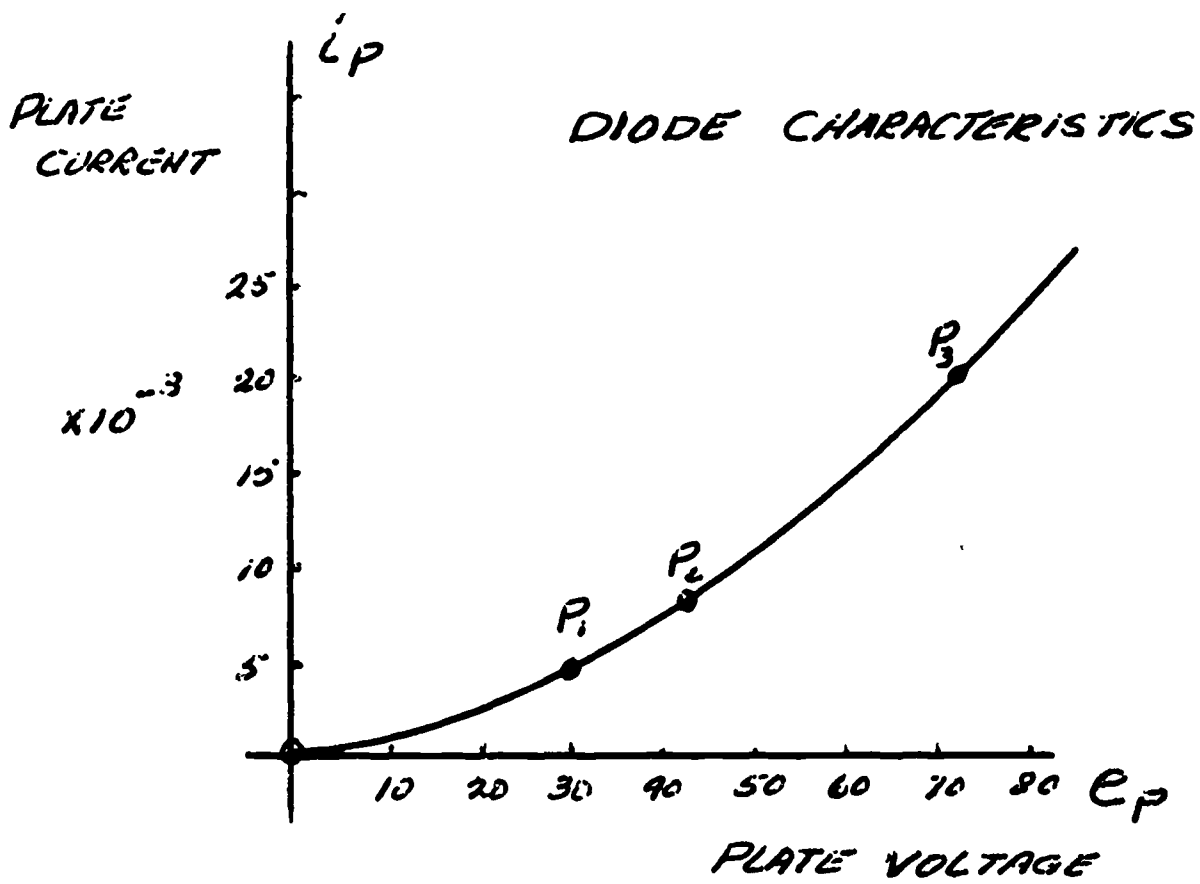
The graph of a series RC circuit is indicated by the diagram below.





10. From the plot, determine the average rate of change between t = .01 and t = .04 sec.

The graph of a diode circuit current flow is indicated below.



11. Find the diode plate resistance at points P_1, P_2, P_3.

12. Find the average rate of change between points P_1 and P_3.

(4-7) Differentiating Forms - Algebraic

In the past sections, the basic ideas of the average rate of change, the limit, and the instantaneous rate of change lead to a method of obtaining the derivatives by the delta method.

We will concern ourselves now with different, short-hand techniques of finding the derivative or instantaneous rate of change for a point on a curve. These forms will be derived by using the delta method. When we find the derivative, we say we are differentiating the mathematical expression. Hence the name "differential calculus."

The derivative of y with respect to x is, by definition,

$$\frac{dy}{dx} = \lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x}$$

1. Derivative of a Constant

The derivative of a constant is equal to zero.

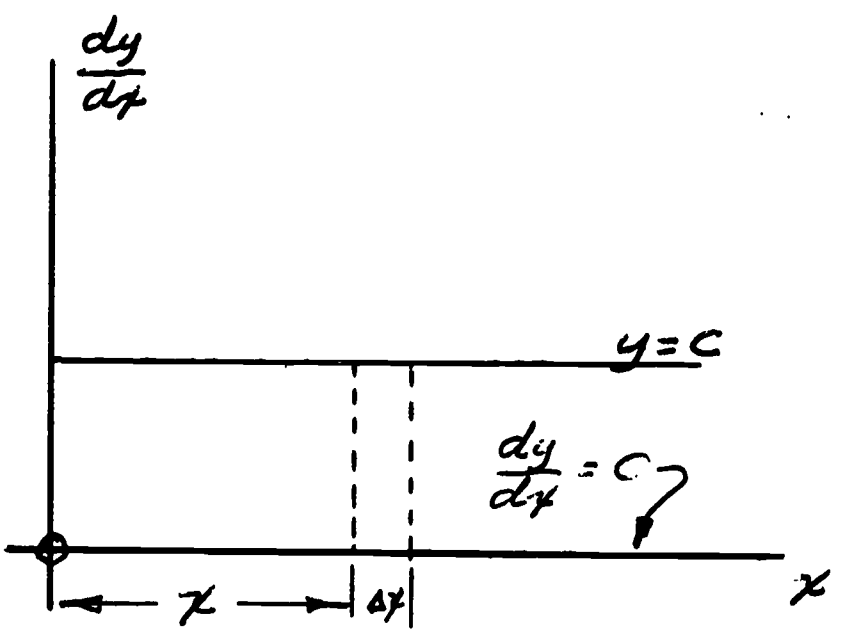
$y = c$ (given)

Since there is no rise, $\Delta y = 0$ for all increments of x.

$\Delta y = 0$

$\frac{\Delta y}{\Delta x} = \frac{0}{\Delta x}$

$\frac{dy}{dx} = \lim_{\Delta x \to 0} \frac{0}{\Delta x} = 0$



$$\boxed{\frac{d}{dx}(c) = 0} \qquad \text{D-1}$$

Example 1: Differentiate $y = 5$

$\frac{d}{dx}(5) = 0$ (D-1)

2. <u>Derivative of a Constant Times a Function</u>

The derivative of the product of a constant and a function equals the constant times the derivative of the function.

$$y = Cu \qquad C = \text{constant; } u \text{ is any function of } x$$

$$y + \Delta y = C(u + \Delta u)$$

$$y + \Delta y = Cu + C\Delta u)$$

$$-y \qquad = -Cu$$

$$\frac{\Delta y}{\Delta x} = \frac{C\,\Delta u}{\Delta x}$$

$$\lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x} = \frac{dy}{dx} = C\frac{du}{dx}$$

$$\boxed{\frac{d}{dx}(Cu) = C\frac{du}{dx}} \qquad \text{(D-3)}$$

Example 2: Differentiate $y = 6x$

$$\frac{dy}{dx} = 6\frac{dx}{dx} \qquad \text{(D-3)}$$

But $\frac{dx}{dx} = 1$

$$\frac{dy}{dx} = 6$$

3. <u>The Derivative of a Sum or Difference</u>

The derivative of the sum or difference of two functions is equal to the sum or difference of the derivatives of the functions.

$$y = u \pm v \text{ (Given)}$$

where u and v are any functions of x.

$$y + \Delta y = (u + \Delta u) \pm (v + \Delta v)$$

$$\frac{\Delta y}{\Delta x} = \frac{\Delta u}{\Delta x} \pm \frac{\Delta v}{\Delta x} \quad \text{(Subtract y from both sides and divide by } \Delta x\text{)}$$

Take the limit of both sides as $\Delta x \rightarrow 0$.

$$\lim_{\Delta x \rightarrow 0} \frac{\Delta y}{\Delta x} = \frac{dy}{dx} = \frac{du}{dx} \pm \frac{dv}{dx}$$

$$\boxed{\frac{d}{dx}(u \pm v) = \frac{du}{dx} \pm \frac{dv}{dx}} \qquad \text{D-4}$$

Example 3: Differentiate $y = 3x + 7$

$$\frac{dy}{dx} = 3\frac{dx}{dx} + 0 \quad \text{(D-4)}$$

$$\frac{dy}{dx} = 3$$

Example 4: Differentiate $y = mx + b$

$$\frac{dy}{dx} = m + 0 = m \quad \text{(D-4)}$$

4. <u>The Derivative of a Power Function</u>

$y = x^n$ (given)

(a) $$\boxed{\frac{dy}{dx} = \frac{d(x)^n}{dx} = n(x)^{n-1}}$$ (Special case of <u>b</u> below)

Proof of the above derivative involves delta notation and expansion by the binomial theorem. The general application of this formula involves u^n rather than x^n, where u may represent any expression which is not impossible to differentiate.

Now let $y = u^n$

(b) $$\boxed{\frac{dy}{dx} = \frac{d(u)^n}{dx} = n(u)^{n-1}\frac{du}{dx}}$$ D-6

<u>The power function is probably the most useful form in differentiating.</u> The importance of the $\frac{du}{dx}$ term cannot be overemphasized. <u>It must always be applied to obtain the correct derivative.</u>

Example 5: Differentiate $y = x^5$

$$\frac{dy}{dx} = 5x^4 \quad \text{(D-6, a)}$$

Example 6: Differentiate $y = 3x^2$

$$\frac{dy}{dx} = 3\frac{dy}{dx}(x^2) \quad \text{(D-3)}$$

$$= 3 \cdot 2x \quad \text{(D-6, a)}$$

$$= 6x$$

Example 7: $d = 16t^2$ Find the velocity at $t = 5$ seconds

$\frac{dd}{dt} = 32t$ (D-3, D-6, a)

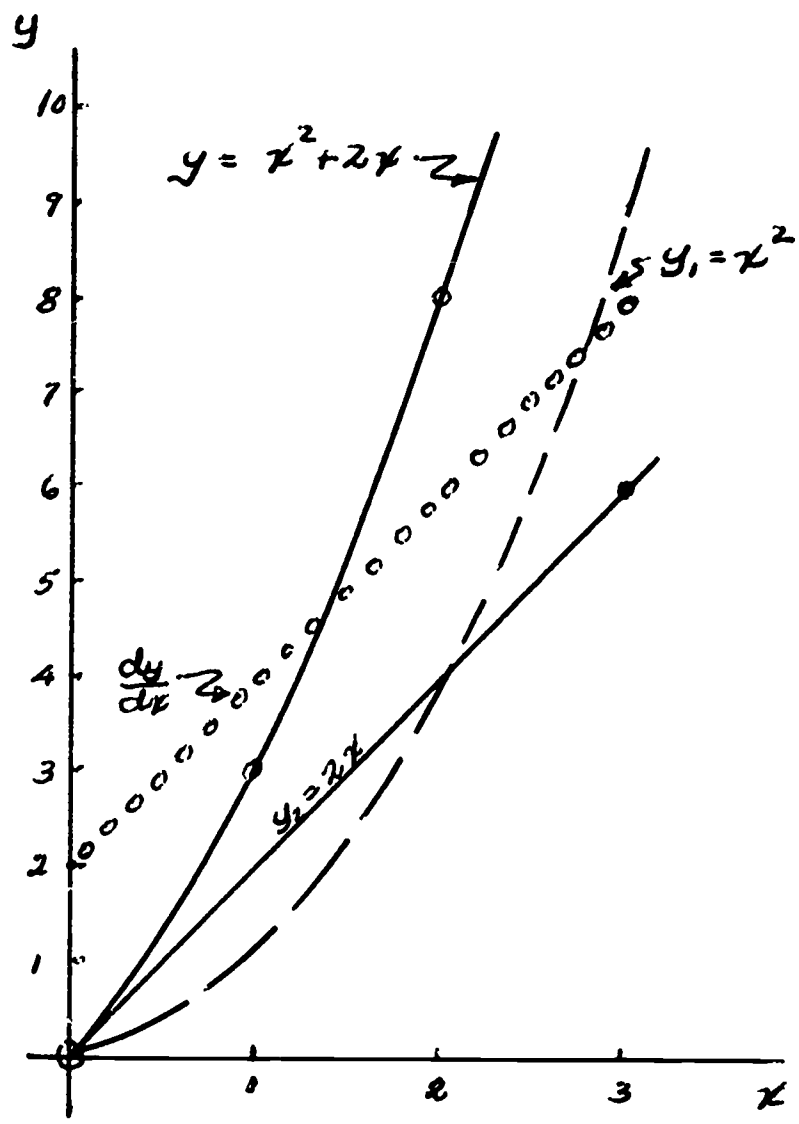
$V = \frac{dd}{dt} = 32t = 32(5) = 160$ ft./sec.

Example 8: Differentiate $y = x^2 + 2x$

$\frac{d}{dx}(u + v) = \frac{du}{dx} + \frac{dv}{dx}$ (D-4)

$u = x^2, \quad v = 2x$

$\frac{dy}{dx} = \frac{d}{dx}(u + v) = 2x + 2$



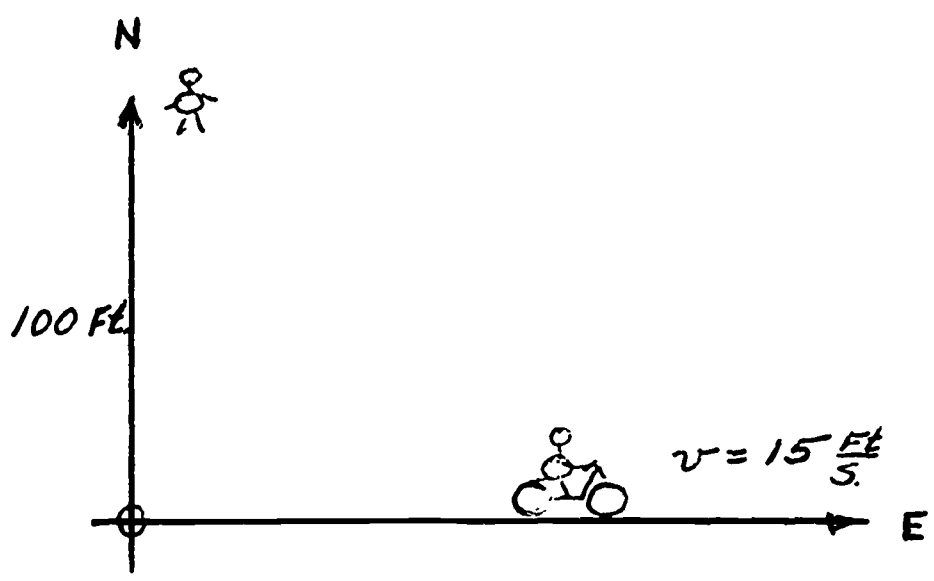
(Note from the diagram that $\frac{dy}{dx}$ is the straight line $2x + 2$ and represents the slope of the tangent to the curve $y = x^2 + 2$ at every point on the curve. Check this by assigning several values to x and getting the value of the slope for each of these points.)

Example 9: Differentiate $y = (x^3 - 4x)^{\frac{1}{2}}$

Let $(x^3 - 4x) = u \qquad (y = u^{\frac{1}{2}})$

$$\frac{dy}{dx} = \underset{n}{\frac{1}{2}} \underbrace{(x^3 - 4x)^{-\frac{1}{2}}}_{u} \underbrace{(3x^2 - 4)}_{\frac{du}{dx}} \qquad \text{By D-6 (b)}$$

$$\frac{dy}{dx} = \frac{3x^2 - 4}{2\sqrt{x^3 - 4x}}$$

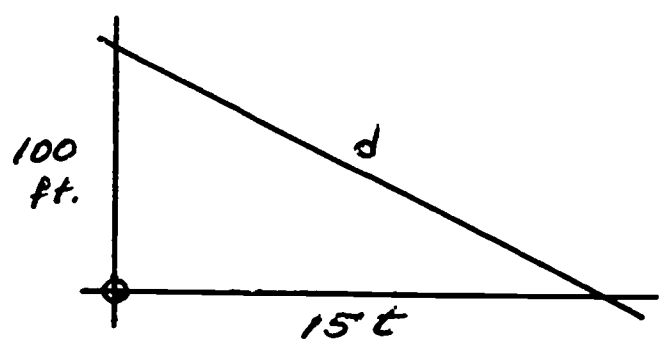


Example 10: A person is standing 100 feet north of a crossing when a boy on a bicycle crosses the intersection at 15 feet/second going east. After 20 seconds, find the velocity of the boy with respect to the person standing.

General Procedure for Solving Word Problems

Step 1: Make a sketch and indicate what is given.

Step 2: Connect the given information to an algebraic, geometrical, trigonometric, or physical relationship to make an equation.



Find velocity, which has a distance-time relationship.

$$d^2 = 100^2 + (15t)^2$$ (Pythagoream Theorem)

$$d = (10,000 + 225t^2)^{\frac{1}{2}}$$ Type is D-6 (b)

$$\frac{d(u)^n}{dx} = n(u)^{n-1}\frac{du}{dx}$$

Step 3: Take the derivative $\frac{dd}{dt} = \frac{1}{2}\ (10,000 + 225t^2)^{-\frac{1}{2}}(450t)$

$$v = \frac{dd}{dt} = \frac{450t}{2(10,000 + 225t^2)^{\frac{1}{2}}}$$

Sub. t = 20 sec.

Step 4: Substitution

$$v = \frac{450(20)}{2\left[(10,000 + 225(20)^2\right]^{\frac{1}{2}}} = \frac{4500}{310}$$

Step 5: Result v = 14.24 ft./sec.

Note: This problem could have been done a simple way. Can you think of the way?

Problems

Differentiate with respect to x:

1. $y = \frac{1}{4}$

2. $y = 200$

3. $y = x^2 + x$

4. $y = x^2 - x^3$

5. $y = x^{-\frac{3}{2}}$

6. $y = ex^{-\pi}$

7. $y = 4\sqrt[4]{x}$

8. $y = 100t - 50t^2 + 4t^3$

9. $y = x^3 + x^2 - x + 1$

10. $y = x^{\frac{5}{4}} - x^{\frac{4}{3}} + x^{\frac{3}{2}} + x^2$

11. $I = t^{-\frac{5}{3}}$; find $\frac{dI}{dt}$

12. A formula for kinetic energy is $E_k = \frac{mv^2}{2}$. Find the rate at which E_k varies with velocity. (m = mass, which is constant.)

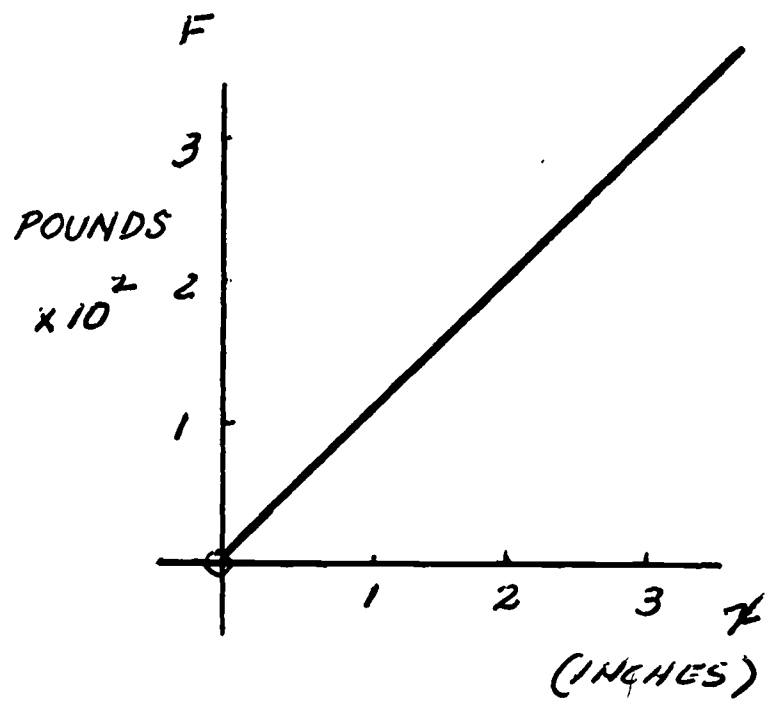
13. The work of kinetic energy needed to charge a condenser is given by $W = \frac{cv^2}{2}$ (c = capacitance; v = voltage.) Find the derivative of work with respect to voltage. Consider c a constant.

14. The charge of a capacitor (q) in coulombs is directly proportional to the capacity of the condenser (c) in farads and the voltage (v) impressed across it

$$q = cv$$

If the voltage (v) is increased, the charge (q) is increased. Find $\frac{dq}{dv}$.

15. The charge of a capacitor varies according to $q = 100t^2$. Determine the current flow at $t = 0.1$ sec. $(I = \frac{dq}{dt})$



16. A spring is compressed and the data is recorded as indicated on the graph above.

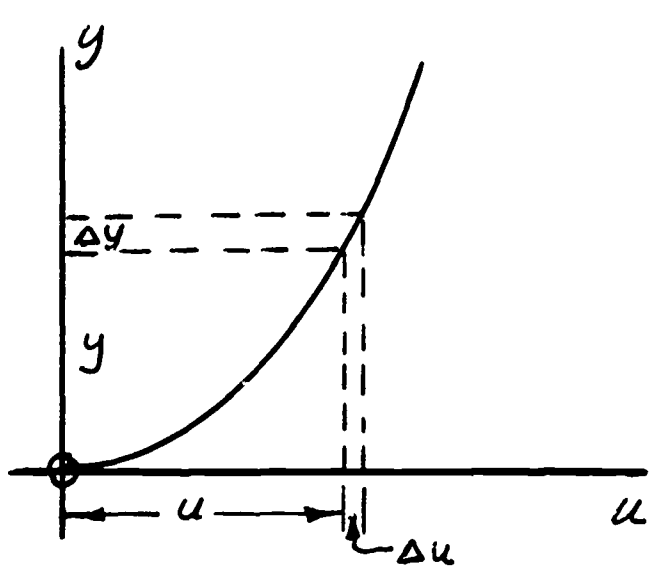
a. Find the proportionality constant of the spring (pounds per inch of compression).

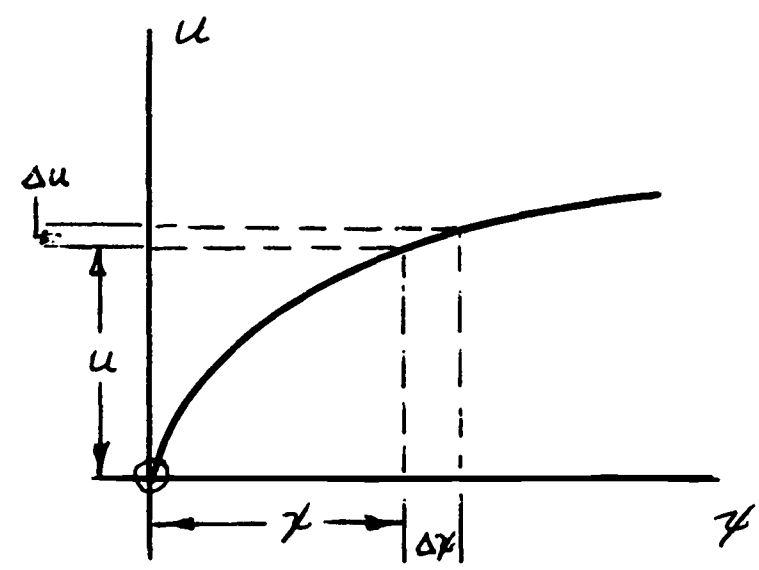
b. Work is equal to the force x distance. For a given force, determine the derivative of work with respect to distance.

c. Find the instantaneous rate of change when $x = 3$.

5. <u>The Derivative of a Function of a Function</u>

Many problems cannot be solved directly. At times the data given or known is such that two related derivatives can be obtained. Then the product of the derivatives will give the derivative that we are looking for.





$$\frac{\Delta y}{\Delta x} = \frac{\Delta y}{\Delta u} \times \frac{\Delta u}{\Delta x}$$

$$\boxed{\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}} \qquad \text{(D-5)}$$

Note: u is the independent variable of x and y.

Example 1: $y = t^4 - t^2$ (given)

$x = 2t - 3t^2$ (given)

Find $\frac{dy}{dx}$

Here the independent variable (u) is t.

$$\frac{dy}{dt} = 4t^3 - 2t = 2t(2t^2 - 1)$$

$$\frac{dx}{dt} = 2 - 6t = 2(1 - 3t)$$

$$\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dt}{dx} \qquad \text{(By (D-5)}$$

$$\frac{dy}{dx} = \frac{dy}{dt} \div \frac{dx}{dt}$$

$$\frac{dy}{dx} = \frac{2t(2t^2 - 1)}{2(1 - 3t)}$$

$$\frac{dy}{dx} = \frac{2t^3 - t}{1 - 3t}$$

6. <u>Derivative of a Product</u>

The derivative of a product of two functions is equal to the first function times the derivative of the second plus the second times the derivative of the first.

$$y = uv \qquad \text{(given)}$$

$$y + \Delta y = (u + \Delta u)\ (v + \Delta v)$$

$$y + \Delta y = uv + v\Delta u + u\Delta v + \Delta v\,\Delta u$$

$$-y \qquad = -uv \qquad \text{Subtract equals from equals}$$

$$\frac{\Delta y}{\Delta x} = \frac{v\Delta u}{\Delta x} + \frac{u\Delta v}{\Delta x} + \frac{\Delta v\,\Delta u}{\Delta x} \qquad \text{Divide by } \Delta x$$

$$\frac{dy}{dx} = \lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x} = v\frac{du}{dx} + u\frac{dv}{dx}$$

The limit of the term $\frac{\Delta v\,\Delta u}{\Delta x} = 0$ since the product of two increments approaches 0.

$$\boxed{\frac{dy}{dx} = \frac{d(uv)}{dx} = v\frac{du}{dx} + u\frac{dv}{dx}} \qquad \text{(D-8)}$$

Example 2: Differentiate $y = (x^2)(x^3)$ by the product method.
Let $u = x^2$ and $v = x^3$

$$\frac{dy}{dx} = x^2\left[\frac{d(x^3)}{dx}\right] + x^3\left[\frac{d(x^2)}{dx}\right] \qquad \text{By D-8}$$

$$= x^2(3x^2) + x^3(2x)$$

$$= 3x^4 + 2x^4 = 5x^4$$

Of course, by multiplying first, we would use the power method.

$$y = (x^2)(x^3) = x^5$$

$$\frac{d(x^5)}{dx} = 5x^4 \qquad \text{By D-6(b)}$$

$$\frac{dy}{dx} = 5x^4$$

7. <u>Derivative of a Quotient or Fraction</u>

The derivative of a quotient is equal to the denominator times the derivative of the numerator minus the numerator times the derivative of the denominator all divided by the square of the denominator.

$$y = \frac{u}{v} \qquad \text{(given)}$$

$$y + \Delta y = \frac{u + \Delta u}{v + \Delta v}$$

$$y + \Delta y = \frac{u + \Delta u}{v + \Delta v}$$

$$-y = \left(-\frac{u}{v}\right) \qquad \text{Subtract the original equation}$$

$$\Delta y = \frac{u + \Delta u}{v + \Delta v} - \frac{u}{v}$$

$$\Delta y = \frac{v(u + \Delta u) - u(v + \Delta v)}{v(v + \Delta v)} \qquad \text{Common denominator}$$

$$y = \frac{vu + v\Delta u - uv - u\Delta v}{v(v + \Delta v)} = \frac{v\Delta u - u\Delta v}{v(v + \Delta v)}$$

$$\frac{\Delta y}{\Delta x} = \frac{v\frac{\Delta u}{\Delta x} - u\frac{\Delta v}{\Delta x}}{v(v + \Delta v)} \qquad \text{Divide both sides by } \Delta x$$

$$\boxed{\frac{dy}{dx} = \lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}} \qquad v \neq 0 \quad \text{(D-9)}$$

Example 3: Differentiate $y = \frac{\overset{u}{(4x^3)}}{\underset{v}{(2x^2)}}$ by the quotient method.

$$\frac{dy}{dx} = \frac{2x^2\left[\frac{d(4x^3)}{dx}\right] - 4x^3\left[\frac{d(2x^2)}{dx}\right]}{(2x^2)^2} \qquad \text{By D-9}$$

$$= \frac{2x^2(12x^2) - 4x^3(4x)}{4x^4}$$

$$= \frac{24x^4 - 16x^4}{4x^4} = \frac{8x^4}{4x^4} = 2$$

The above problem was designed so that it could be checked by dividing the denominator into the numerator before taking the derivative. Doing this gives

$$y = 2x$$

$$\frac{dy}{dx} = \frac{d(2x)}{dx} = 2 \qquad \text{(check)}$$

In many cases, of course, prior division is not feasible, and the solution must be obtained by the quotient method.

The last three rules for obtaining derivatives should enable you to handle most of the algebraic operations required for simple problems. It is important to develop a good working knowledge of these types and their applications before further exposure to other types. They are repeated below.

$$\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$$

$$\frac{dy}{dx} = \frac{d(uv)}{dx} = v\frac{du}{dx} + u\frac{dv}{dx}$$

$$\frac{dy}{dx} = \frac{d(\frac{u}{v})}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$$

Problems Differentiate the following:

1. $y = 3x^3$

2. $y = (2x - x^2)^4$

3. $y = \dfrac{2}{x^2 - 1}$

4. $y = \dfrac{x^2 + 2x}{2}$

5. $y = 4x^5 - 3x^4 + 2x^3 - x^2 + 3x$

6. $y = x^{-\frac{3}{2}}$

7. $y = 5\sqrt[3]{5x}$

8. $y = \dfrac{2 - x}{x}$

9. $v = 3\sqrt{2 - w^2}$

10. $y = (x - 2)^2 (x - 2)^2$

11. $y = \dfrac{1 - x^2}{1 + x^2}$

12. $r = \sqrt{x}\ (2 + x)^3$

13. Calculate the instantaneous velocity of a body at the 5th second of a fall if $d = 16t^2$.

14. The height of an elevator during any time is given by the equation

$$h = 3t^2 + 10$$

Find the equation for its instantaneous velocity and find its value at the 4th second.

15. Find the velocity of a particle which moves according to

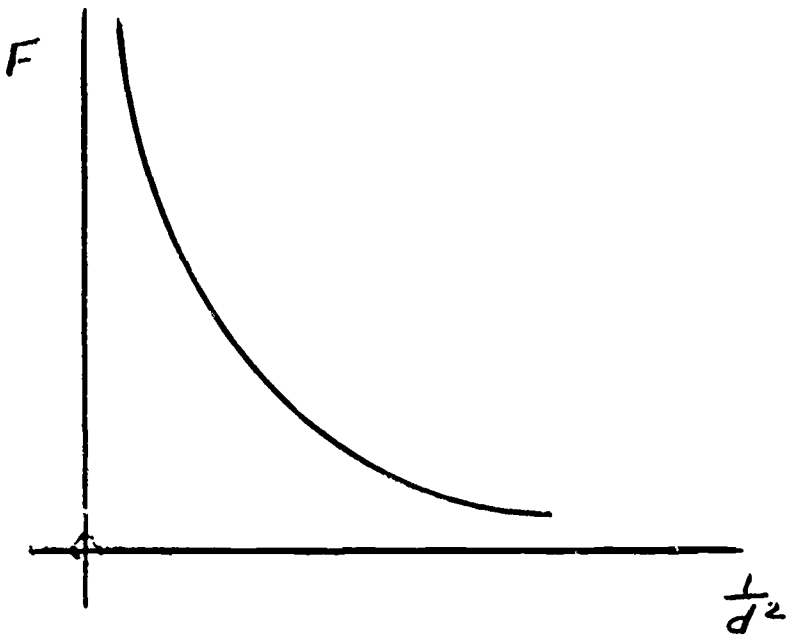
$$d = v_i t + \frac{1}{2} gt^2$$

16. For Problem 15, find the velocity at time ($t = 6$) when $g = 32$ ft./sec.^{2}.

17. The electromotive force (E) in a circuit of resistance R ohms, inductance L henrys, and current I amperes is given by

$$E = RI + L\frac{dI}{dt}$$

Find E if R = 40 ohms and L = 0.5 henrys when $I = (4t^2 - 3t - 2)$



18. The force of electrostatic repulsion or attraction between charged particles (q_1, q_2) is $F = \frac{kq_1q_2}{d^2}$

where k is the proportionality constant, which varies according to the units which are used. Determine the derivative of Force to time when d varies with time according to $d = 3t^{\frac{2}{3}}$.

19. If $y = 2t - 3t$ and $x = t^3 - 5t$, find the points on those curves that satisfy $\frac{dy}{dx} = 2$. Hint: (Use $\frac{dy}{dt}$ and $\frac{dx}{dt}$)

20. The theory of relativity is given by the equation

$$m_a = \frac{m_o}{\sqrt{1 - (\frac{v}{c})^2}}$$

m_a = apparent mass

m_o = mass when at rest

v = particle speed

c = speed of light

Obtain an equation which will give the relation of m_a to v.

21. The period of a pendulum is given by

$T = 2\pi\sqrt{\frac{\ell}{g}}$ $\quad g = 32$ ft./sec.^{2}, ℓ = length (in feet)

Find $\frac{dT}{d\ell}$

(4-8) Higher Order Derivatives

So far we have considered only the first order derivative in our calculations. Derivatives may be taken of an expression as many times as it takes to make the expression become zero. For example:

$$y = x^6 - x^5 + x^4 - x^3 + x^2$$

$$y^{I} = \frac{dy}{dx} = 6x^5 - 5x^4 + 4x^3 - 3x^2 + 2x \qquad \text{(1st derivative)}$$

$$y^{II} = \frac{d^2y}{dx^2} = 30x^4 - 20x^3 + 12x^2 - 6x + 2 \qquad \text{(2nd derivative)}$$

$$y^{III} = \frac{d^3y}{dx^3} = 120x^3 - 60x^2 + 24x - 6 \qquad \text{(3rd derivative)}$$

$$y^{IV} = \frac{d^4y}{dx^4} = 360x^2 - 120x + 24 \qquad \text{(4th derivative)}$$

$$y^{V} = \frac{d^5y}{dx^5} = 720x - 120 \qquad \text{(5th derivative)}$$

$$y^{VI} = \frac{d^6y}{dx^6} = 720 \qquad \text{(6th derivative)}$$

$$y^{VII} = \frac{d^7y}{dx^7} = 0 \qquad \text{(7th derivative)}$$

The ideal application of higher order derivatives is in the distance-time relationship.

The acceleration of a body is related to its velocity in the same way as velocity is related to distance.

Velocity equals the instantaneous slope or derivative at P on the distance-time graph.

$$V = \frac{dd}{dt}$$

Acceleration $= \frac{dV}{dt}$ = time-rate of change of velocity

or $\frac{d^2d}{dt^2}$ = the second derivative of distance with respect to time

Besides enabling us to calculate the acceleration, or the rate of change of the rate of change, the second derivative has applications in determining the maximum and minimum values of quantities. This application will be explained in the next section.

Problems

1. Find the velocity and acceleration of a body which has a distance-time equation of $d = v_i t - 16t^2$, when $t = 1$, and when $t = 2$ seconds.

2. The distance an object moves is given by the equation $d = 4t^3 - 3t^2$. Find the velocity and acceleration at any instant.

3. Newton's second law of motion, one of the most important concepts of physics, is expressed as $F = ma$. Write this equation in terms of velocity and distance instead of acceleration.

4. The displacement (d) of an object was given as $d = 3t^3 + 0.1t$. The mass of the object was 4 kilograms. Using Newton's second law, determine the equation for the force on the object.

5. Find y^{III} of $y = f(x) = (x^3 - 1)(x^2 - 1)$

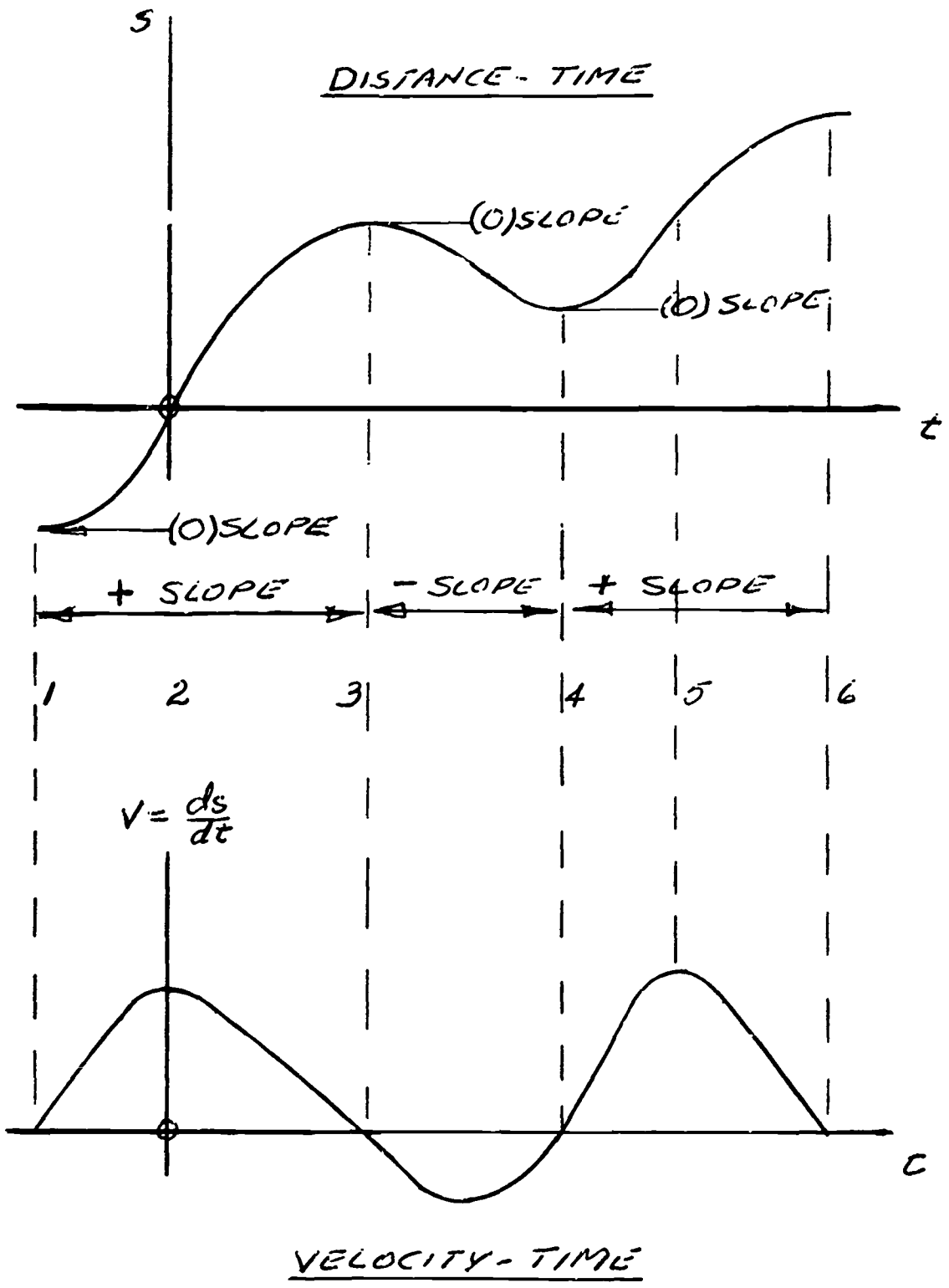
6. $y = \sqrt{1 - x^2}$, find y^{II} or $\frac{d^2y}{dx^2}$

(4-9) Maximums and Minimums

In solving many practical problems in calculus, we need to know at what point a function has a minimum or maximum value.

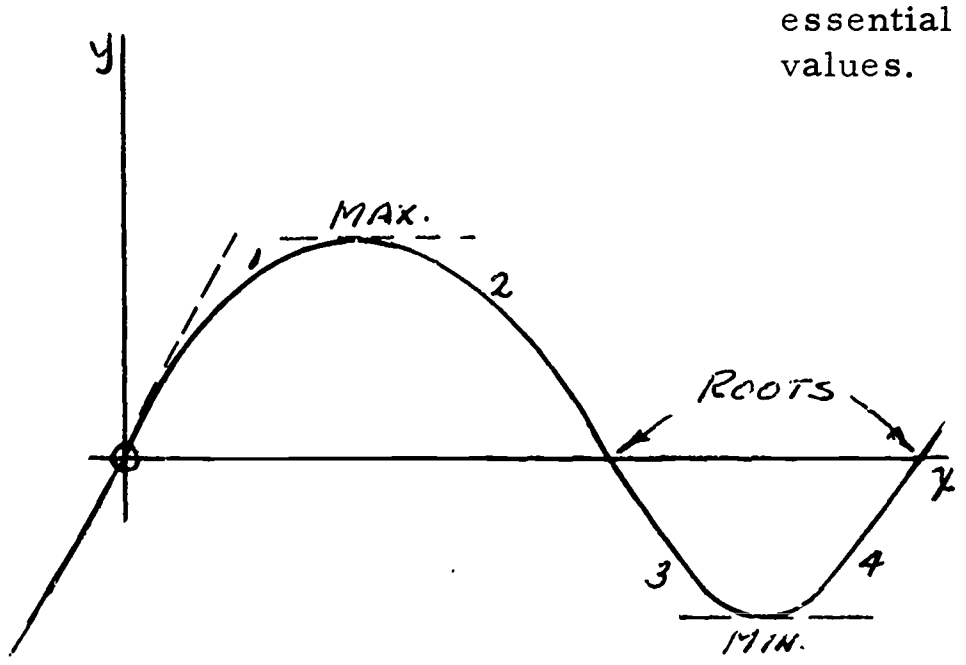
A straight-line or linear function does not have a minimum or maximum, because the derivative or instantaneous rate of change remains constant.

When equations of higher degree than one are plotted, they generally give curves which change direction. Whenever a curve changes from an upward to a downward direction, or vice versa, the instantaneous slope (or derivative, $\frac{dy}{dx}$) will always be parallel to the x-axis and hence will have a slope of zero. By using this important concept, we are able to solve a great many practical problems involving maximum or minimum values of a function.



Note: Between points 1 and 2, and 2 and 3, the derivative or instantaneous slopes are in quadrants I and III and are positive. This gives a positive velocity, according to convention. Between points 3 and 4, the curve shows a negative velocity, since its slope is negative. Between 4 and 5, and 5 and 6, the slope and velocity again become positive. The lower graph is the plot of velocity - time for the upper curve of distance - time. The slopes of the lower curve indicate positive and negative acceleration.

The derivative of any function, as we have said, represents the instantaneous slope at any and all points on the curve. When the derivative of a function is taken and set equal to zero, we obtain values for the independent variable that could be either minimum or maximum, so it becomes essential to check these values.



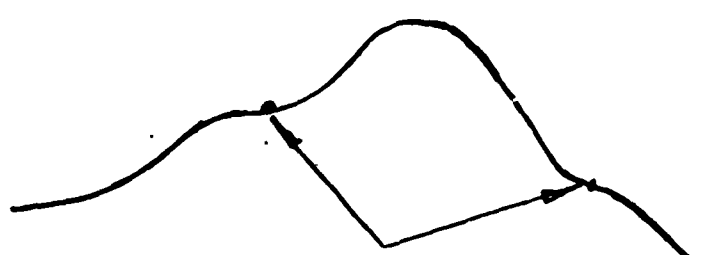
MAXIMUM POINT

1. A value less than that found results in a positive slope
   and
2. A value more than that found results in a negative slope.

MINIMUM POINT

1. A value less than that found results in a negative slope
   and
2. A value more than that found results in a positive slope.

When a curve has a zero slope but continues to move in the same direction, the point of zero slope is called the inflection point and does not determine the minimum or maximum value for a problem.



INFLECTION POINTS

The second-derivative test may be applied to test for minimum-maximum points:

1. Find the maximum-minimum values of the function by setting $\frac{dy}{dx}$ equal to zero.
2. Find the second derivative of the function $\frac{d^2y}{dx^2}$ and substitute in it a value found for x. If then $\frac{d^2y}{dx^2}$ comes out negative, it means that the value of x was for a maximum point. If $\frac{d^2y}{dx^2}$ comes out positive, it means that the x-value was for a minimum point.
3. If $\frac{d^2y}{dx^2}$ becomes zero, the test fails and the previous increment test or a plot must be used.

The reason the second derivative can be used in this way is that it is actually the first derivative of $\frac{dy}{dx}$, that is, it measures the variation in the slope of $\frac{dy}{dx}$. At a maximum point, the slope of $\frac{dy}{dx}$ is changing from positive to negative, hence is decreasing. Therefore, its slope $\frac{d^2y}{dx^2}$ is negative. The converse is true for a minimum point.

Refer to the two diagrams on page 114. The lower represents the first derivative of the upper. Note that, for both maximum points on the upper diagram, the slope of the lower diagram $(\frac{d^2s}{dt^2})$ is negative. For the minimum point on the upper diagram, the slope of the lower is positive.

Hints on Solving Problems

1. Make a sketch and indicate what is given and what is unknown.

2. Read the problem carefully to determine what relations exist, especially as to what is to be minimized or maximized.

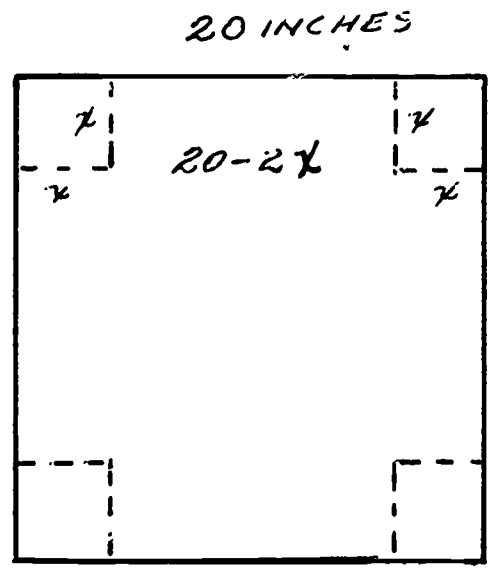
3. Write the equation in terms of known and unknown, that is, a functional relationship.

4. Differentiate and equate the derivative to 0.

5. Test for minimum or maximum by using the second derivative method.

Example 1:

A sheet of copper which is 20 inches on a side must be made into a box of maximum volume. Calculate the size of the squares which must be cut out of the corners.



Let x = height of box, or side of square to be cut.

$$v = l\,wh$$

$$v = (20 - 2x)^2 x$$

$$v = 400x - 80x^2 + 4x^3$$

$$\frac{dv}{dx} = 400 - 160x + 12x^2$$

Minimum or maximum is obtained when $\frac{dv}{dx} = 0$

$$12x^2 - 160x + 400 = 0$$

$$3x^2 - 40x + 100 = 0 \qquad \text{(Simplify)}$$

$$(3x - 10)(x - 10) = 0 \qquad \text{(Factor)}$$

$$x = 10,\ \frac{10}{3} \text{ inch}$$

The obviously correct answer is $\frac{10}{3}$ inch.
Determine the correctness of this answer by plotting

$v = 400x - 80x^2 + 4x^3$. Notice what happens between $x = 3$ and $x = 4$.

If the correct value were not obvious, we would proceed to get the second derivative of the equation.

$$\frac{dv}{dx} = 400 - 160x + 12x^2$$

$$\frac{d^2v}{dx^2} = -160 + 24x = -160 + 24\left(\frac{10}{3}\right) \qquad \left(\text{Since } x = \frac{10}{3}\right)$$

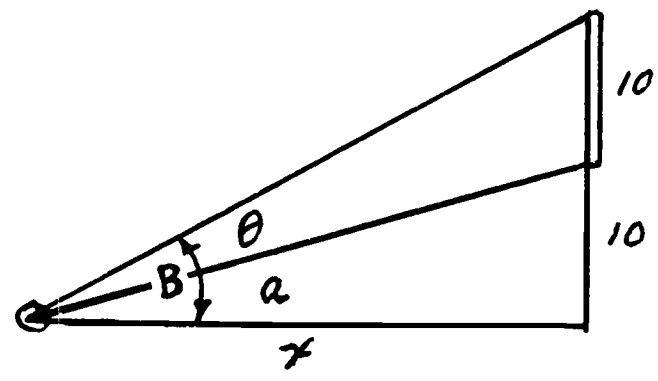
$$= -80$$

According to the previous explanation, the quantity $\frac{10}{3}$, when substituted in the second derivative, gives a <u>negative</u> value; therefore that quantity gives a <u>maximum</u> for the conditions of the problem.

Note that the other answer to the problem, $x = 10$, represents the minimum volume - so "minimum," in fact, that the volume is zero. Check the value of the second derivative for this value of x.

Example 2:

A 10-foot sign is 16 feet off the ground. A 6-foot man walks away from the sign. Determine his distance from the sign where he subtends the greatest angle relative to the sign. Let θ be the required angle.



$$\tan B = \frac{20}{x}$$

$$\tan a = \frac{10}{x}$$

$$\tan\theta = \tan(B-a) = \frac{\tan B - \tan a}{1 + \tan B \tan a} = \frac{\frac{20}{x} - \frac{10}{x}}{1 + \frac{20}{x}\cdot\frac{10}{x}} = \frac{\frac{10}{x}}{\frac{x^2 + 200}{x^2}}$$

$$\frac{d}{dx}(\tan\theta) = \frac{d}{dx}\left(\frac{10x}{x^2 + 200}\right)$$

$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$$

$$= \frac{(x^2 + 200)(10) - 10x(2x)}{(x^2 + 200)^2}$$

For a maximum value of θ (and hence of $\tan\theta$),

$$\frac{10x^2 + 200(10) - 20x^2}{(x^2 + 200)^2} = 0$$

$$10x^2 = 200(10)$$

$$x = \pm 14.1 \text{ ft.}$$

Problems

Determine the maximum and minimum values for x in the following functions and check each by using the second derivative. Draw the graph in each case.

1. $y = x^2 - 4x + 2$
2. $y = x^3 + \frac{3}{x}$
3. $y = \frac{4x}{x^2 + 1}$

4. Find the base forming the maximum area of an isoceles triangle which has legs 10 inches long. (Hint: Find the height of the triangle first.)

5. Find the dimensions of an isosceles triangle which circumscribes a circle of 10-inch radius, so that the triangle has a minimum area.

6. Two positive numbers have a sum of 10. Find the two numbers such that their product is a maximum.

7. A bullet is shot straight up into the air at a velocity of 1000 ft./sec. The equation for the height with respect to time is $h = 1000t - 16t^2$. Determine the time to reach its maximum height and the height.

8. The work done by a solenoid is $W = 6t^2 - t^3$. Find the time when maximum power is developed.

9. Determine the largest product that can be obtained by multiplying two numbers whose sum is 20.

10. A rectangle is made up with two semi-circular ends and has a perimeter of 20 ft. Find its dimensions so its area is maximum.

11. A 10-foot sign is 20 feet off the ground. A 5-foot boy is walking toward the sign and he would like to calculate how far he must be from the sign to subtend the greatest angle to the sign.

12. Find two numbers whose sum is 12, such that the product of one number by the square of the other is a maximum.

13. A string of length 96 inches is cut into two parts to form a circle and a square. Find the diameter of the circle and the side of the square which will make the total area of the two figures a maximum.

14. Repeat Problem 13 for a length of ℓ inches.

(4-10) Implicit Differentiation

So far use has been made of the explicit form of a function $y = f(x)$, which simply means that y is solved in terms of x. Sometimes equations are of a form which makes them difficult to solve by the explicit method, so another method is desirable. This method will be explained in this section.

Example 1: Find $\frac{dy}{dx}$ for a 5-inch circle by the explicit and implicit method.

$$x^2 + y^2 = 25 \qquad \text{Equation of a circle}$$

By the explicit function relation, this equation becomes

$$y = \sqrt{25 - x^2}$$

$$y = f(x) = \sqrt{25 - x^2} = (25 - x^2)^{\frac{1}{2}}$$

$$\frac{dy}{dx} = \frac{1}{2}(25 - x^2)^{-\frac{1}{2}}(-2x) \qquad \text{(D-6)}$$

$$\frac{dy}{dx} = \frac{-x}{\sqrt{25 - x^2}}$$

But $\sqrt{25 - x^2} = y$

Therefore $\frac{dy}{dx} = -\frac{x}{y}$

By the implicit form of a function:

$$f(x, y) = x^2 + y^2 = 25$$

$$x^2 + y^2 = 25$$

Differentiate each term with respect to x by treating each as a function and using $u^n = nu^{n-1}\frac{du}{dx}$

$$2x\frac{dx}{dx} + 2y\frac{dy}{dx} = 0$$

$$2x + 2y\frac{dy}{dx} = 0$$

$$\frac{du}{dx} = \frac{-2x}{2y} = -\frac{x}{y}$$

Another example will be solved using both methods.

Example 2:

The equation for a rectangular hyperbola is $xy = 1$.

Determine $\frac{dy}{dx}$ by the explicit and implicit methods.

By the <u>explicit</u> method:

$$xy = 1$$

$$y = f(x) = \frac{1}{x} = x^{-1} \qquad \frac{d(x)^n}{dx} = nx^{n-1} \qquad \text{(D-6)}$$

$$\frac{dy}{dx} = -1x^{-2} = -x^{-2}$$

By the <u>implicit</u> method:

$$xy = 1$$

$$x\frac{dy}{dx} + y\frac{dx}{dx} = 0$$

Using the product method, differentiate with respect to x:

$$\frac{d(uv)}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$$

$$x\frac{dy}{dx} = -y$$

$$\frac{dy}{dx} = -\frac{y}{x} = -\frac{\frac{1}{x}}{x} = -\frac{1}{x^2} = -x^{-2}$$

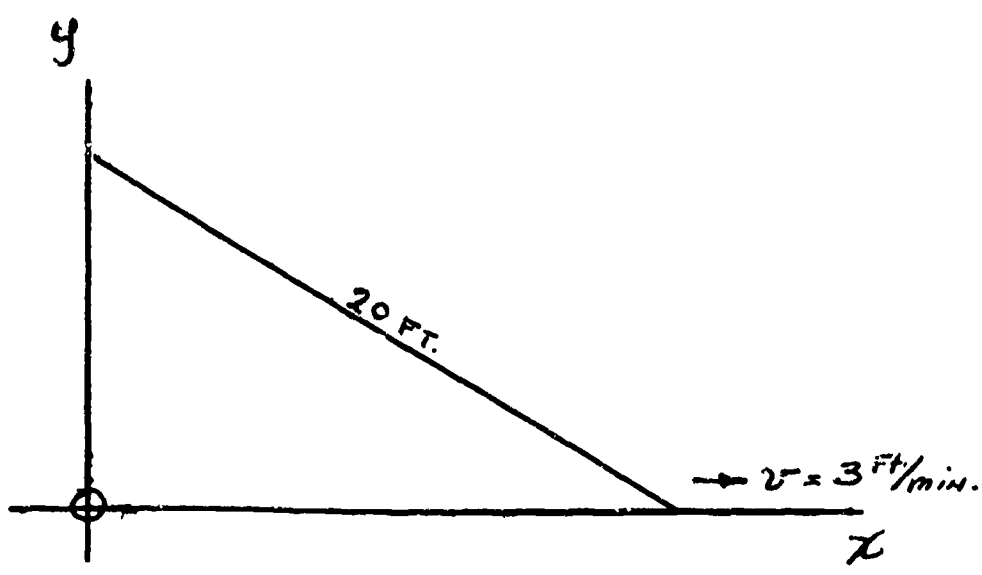
Substitution, since $y = \frac{1}{x}$

Example 3:

The bottom of a 20-foot ladder is sliding along the ground at a speed of 3 feet/min. Find the velocity of the top at any instant by using the implicit method.

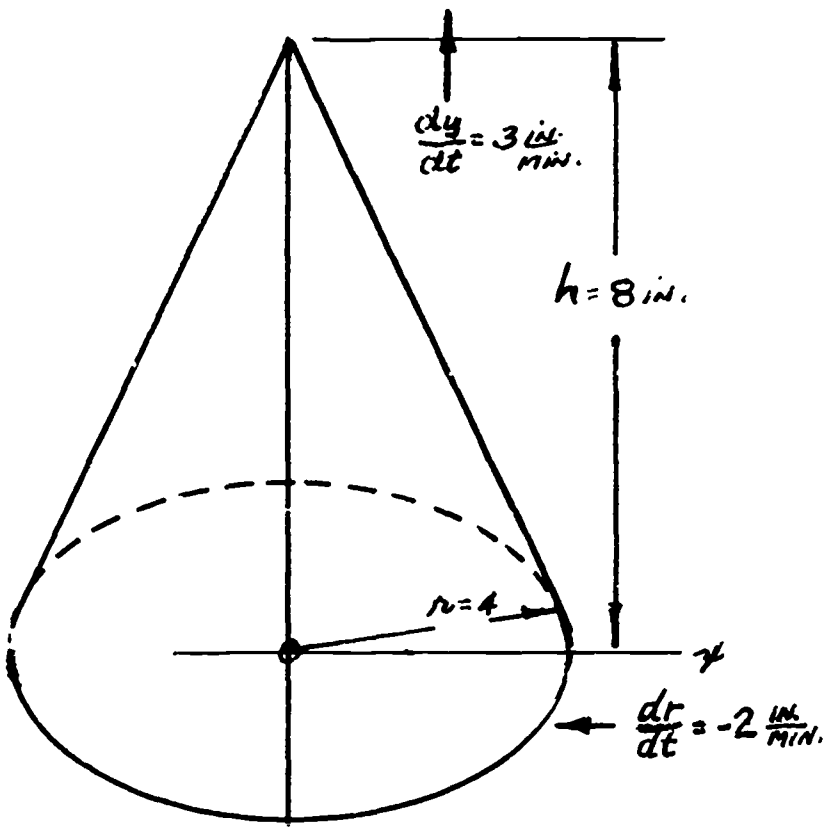
Solution:

$x^2 + y^2 = (20)^2$	Pythagorean theorem
$2x\frac{dx}{dt} + 2y\frac{dy}{dt} = 0$	Implicit derivative with respect to t.
$v = \frac{dx}{dt} = 3$	
$2y\frac{dy}{dt} = -6x$	Substituting and transposing
$\frac{dy}{dt} = -\frac{6x}{2y} = -\frac{3x}{y}$	Answer



Technique of Solving Problems

Example 4: The radius of a right circular cone decreases at 2 inches/min. and the height increases at 3 inches/min. Determine the rate of change in its volume when the height is 8 inches and the radius is 4 inches.



Solution Procedure:

Step 1: Determine the variables involved. Draw a picture and locate values.

Given
(V = volume
(r = radius
(h = height

$\frac{dr}{dt} = -2$ in. /min.

$\frac{dh}{dt} = 3$ in. /min.

Find $\frac{dV}{dt}$ when h = 8 in. and r = 4 in.

Step 2: Write equations to connect the variables.

$$V = \frac{1}{3}\pi r^2 h \qquad \text{Formula for volume of cone}$$

Step 3: Differentiate the above equation with respect to t for each variable.

$$\frac{dV}{dt} = \underbrace{\frac{1}{3}\pi r^2 \frac{dh}{dt}}_{\text{Differential with r constant}} + \underbrace{\frac{2}{3}\pi rh \frac{dr}{dt}}_{\text{Differential with h constant}}$$

Step 4: Substitute the values of the knowns in the differential equation and solve for unknown.

Caution: Since this is a linear equation, there must be only one unknown. Here, it is $\frac{dV}{dt}$.

$$\frac{dV}{dt} = \frac{\pi}{3}(4)^2 \underset{\left(\frac{dh}{dt}\right)}{(3)} + \frac{2\pi}{3}(4)(8)\underset{\left(\frac{dr}{dt}\right)}{(-2)}$$

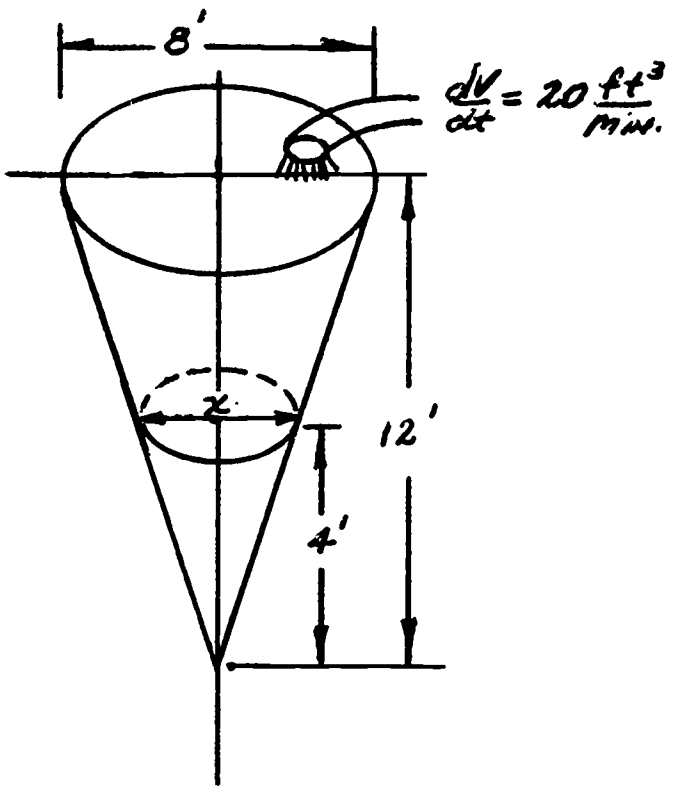
$$\frac{dV}{dt} = 16\pi - \frac{128}{3}\pi$$

$$\frac{dV}{dt} = -\frac{80}{3}\pi \frac{in^3}{min.} = \text{rate of volume change at the designated conditions.}$$

Note: This problem illustrates a simple technique of solving a problem, but the method is applicable to many types of problems - in statistics, physics, electronics, etc. Once this technique is understood, the student will find that the so-called difficult problems are really easy.

Example 5: Water is flowing into an 8-foot diameter conical tank at the rate of 20 cubic feet/min. Determine the rate of water level rise when the depth of the water is 4 feet if the tank is 12 feet high.

Solution Procedure:



1. Given: $R = 4$ ft. for base

   $r = \frac{x}{2}$ when water is 4 feet high

   $H = 12$ feet

   $\frac{dV}{dt} = 20 \frac{ft^3}{min.}$

   Find: $\frac{dh}{dt}$

2. Equation

   $$V = \frac{1}{3} \pi r^2 h$$

   In this problem $\frac{dV}{dt}$ is known, the radius-term (r) in the volume equation is a variable and it must be related to the h-term.

   By similar triangles $\frac{x}{h} = \frac{8}{12}$

   $$\text{Or} \quad x = \frac{2}{3} h$$

   x = diameter of water with respect to height

   $r = \frac{1}{3} h$

3. Substituting

   $$V = \frac{1}{3} \pi \left(\frac{h}{3}\right)^2 h$$

   $$V = \frac{\pi h^3}{27}$$

   Now in this equation, V is known and h is the only unknown.

4. Take the derivative with respect to t.

$$\frac{dV}{dt} = \frac{3\pi h^2}{27}\frac{dh}{dt}$$

5. Substituting values

$$20 = \frac{\pi(4)^2}{9}\frac{dh}{dt}$$

$$\frac{dh}{dt} = \frac{20 \times 9}{\pi(16)} = 3.6 \text{ feet/min.}$$

Note: The (+) value of the answer indicates that the height is increasing.

Problems

Differentiate the following by the implicit and explicit methods.

1. $x^2 + 3y^2 = 30$
2. $xy = 9$
3. $y^2 = 8x$
4. $x^2 + y^2 = 4$
5. $x = 3y^3$
6. $x^2 - y^2 = 9$
7. $\frac{x^2}{4} - \frac{y^2}{9} = 1$
8. $z^2 + 4w^2 = 36.$ Find $\frac{dz}{dw}$ when $w = 2$
9. $(x - 2)^2 + (y - 5)^2 = 25.$ Find $\frac{dx}{dy}$
10. $a^2 - 2ab + b^2 = 10.$ Find $\frac{db}{da}$

(4-11) Rates and Differentials

One of the most important functions of differential calculus involves its applications to rates of change and differentials. So far in our discussion, the derivative $(\frac{dy}{dx})$ was used only in its quotient form. It was obtained by taking the limit of $\frac{\Delta y}{\Delta x}$ as $\Delta x \rightarrow 0$. This $\frac{dy}{dx}$, or instantaneous rate of change for a point on a curve, turned out to be the tangent to the curve at the point. Let's say that

$$y = f(x)$$

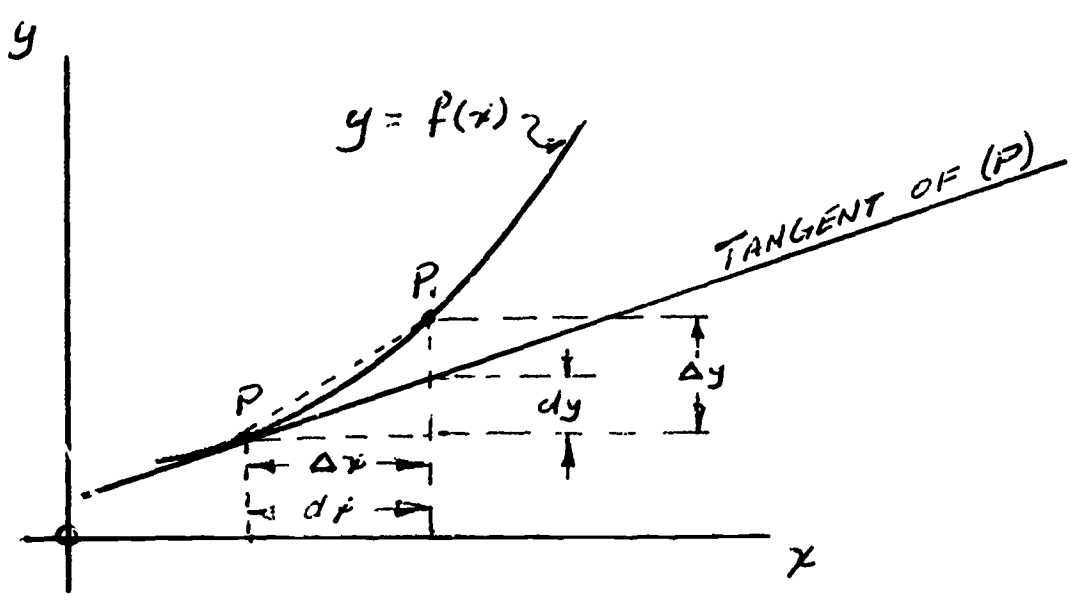
$$\frac{dy}{dx} = f'(x) \qquad \text{(derivative)}$$

Now if both sides are multiplied by the <u>differential dx</u>, we get

$$dy = f'(x)dx$$

In words, this equation states that the differential dy equals the product of the differential coefficient $f'(x)$ and the differential dx.

Solving differential problems gives solutions which are approximate. Exact results may be obtained by the delta (Δ) method. The following illustration will show why this is so.



For a given point (P) on a curve, the average rate of change is $\frac{\Delta y}{\Delta x}$, which is represented by the secant line (P, P_1). The derivative ($\frac{dy}{dx}$) is the instantaneous rate of change, or the tangent at the point P. Note that in the above diagram the dependent variables Δx and dx are the same, but the independent variable Δy is different from dy.

Example 1: $V = IR$. Find dV if R is constant.

$$\frac{dV}{dI} = R$$

$$dV = R\,dI$$

Example 2: $y = x^2$. Find dy.

$$\frac{dy}{dx} = 2x$$

$$dy = 2x\,dx$$

Example 3: The horsepower of an engine is given by the formula $P = .4nd^2$ where n = number of cylinders and d = bore of cylinders. Determine the power differential added when a 4-cyl. Volkswagon has the cylinders rebored from 3.250 inches to 3.265 inches.

$$P = .4nd^2$$

$$\frac{dP}{dd} = .8nd$$

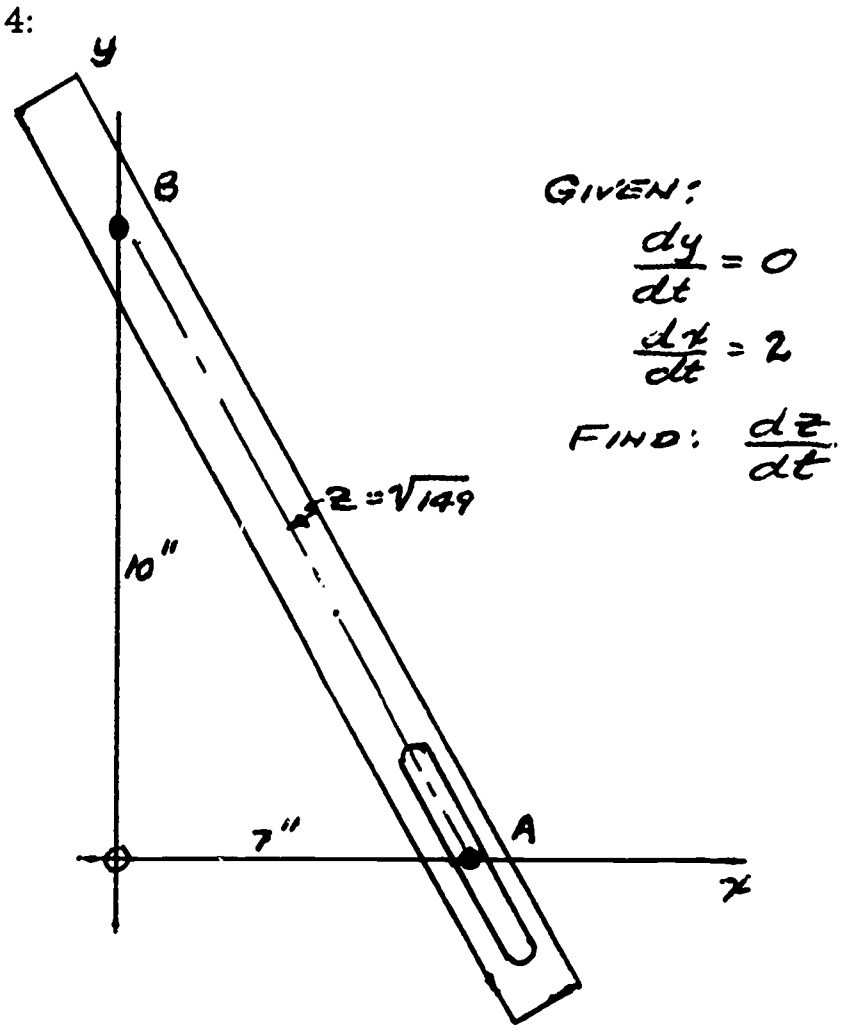
$$dP = .8nd(dd)$$

Here $dd = .015$, $n = 4$, and $d = 3.250$, or $\frac{13}{4}$

Therefore $dP = .8(4)(\frac{13}{4})(.015)$

$$dP = .156 \text{ HP.}$$

Example 4:



Block A must move along the x-axis. At a certain instant OA = 7 inches and is increasing at a rate of 2.0 in./sec. Find the rate at which Block A is moving along the slot. (Block B is fastened.)

$$z^2 = x^2 + y^2$$

$$2z\frac{dz}{dt} = 2x\frac{dx}{dt} + 2y\frac{dy}{dt}$$

Differentiate each unknown with respect to t.

$$2\sqrt{149}\,\frac{dz}{dt} = 2(7)(2) + 2(10)(0)$$

$$\frac{dz}{dt} = \frac{28}{2\sqrt{149}} = 1.1 \text{ in./sec.}$$

Example 5: A square piece of metal 6 inches on a side is heated, which causes it to expand 0.1 inch. Compare the change in area (A) by the delta method and the differential method.

Solution:

(A) Approximate differential method:

$$A = x^2$$

$$\frac{dA}{dx} = 2x$$

$$dA = 2x\,dx$$

$$dA = 2(6)(0.1) = 1.2 \text{ sq. in.}$$

This answer is approximate, since $(\Delta x)^2$ is neglected (see diagram).

(B) The delta method gives the exact change in area:

$$A = x^2$$

$$A + \Delta A = (x + \Delta x)^2$$

$$A + \Delta A = x^2 + 2x\Delta x + \Delta x^2$$

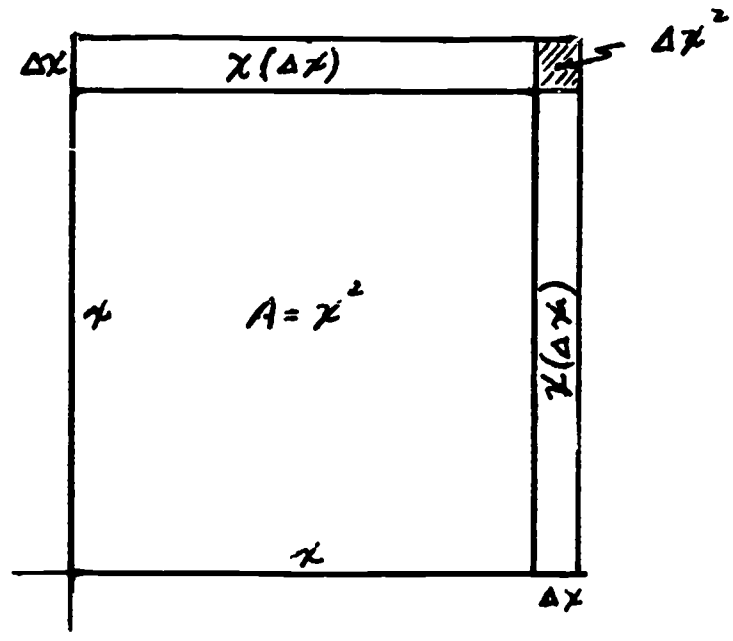
$$A = x^2$$

$$\Delta A = 2x\Delta x + \Delta x^2$$

$$= 2(6)(0.1) + (0.1)^2$$

$$\Delta A = 1.2 + .01$$

$$\Delta A = 1.21 \text{ sq. in.}$$



Problems

1. Find dV for the volume of a sphere.

$$V = \frac{4}{3}\pi R^3$$

2. If a basketball has a diameter of 12 inches and is inflated so that it increases in diameter by $\frac{1}{2}$ inch, find the change in volume by the differential method.

3. If $P = I^2R$, where R is constant, find dP.

4. Find dy if $y = 3x^3 - 2x^2$.

5. For free fall, $d = \frac{1}{2} gt^2$. Find dd for t = 3 to t = 3.2 seconds if g equals 32 ft/sec^2.

6. In Problem 3, if R = 10 ohms and I changes from 5 to 5.5 amps, find dP.

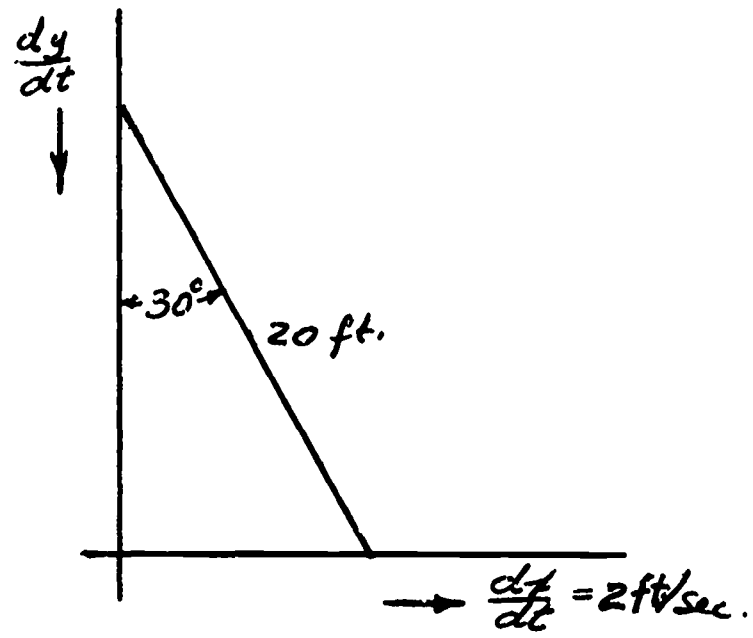
7. The illumination on a surface is given by $E = \frac{I}{R^2}$ in foot-lamberts. I is the candlepower of the source of light and R is the distance from the source. Determine the differential of E (dE) for a small change in R when I is constant.

8. Voltage is directly proportional to charge and inversely proportional to the capacitance of a condenser (c). $(v = \frac{q}{c})$ For a given condenser, find the approximate equation for dv.

9. Two boats leave the same point, with one heading north at 30 knots and the other east at 40 knots. Find their rate of separation after $\frac{1}{2}$ hour.

10. A 6" diameter hole in a steel plate is heated so that the diameter increases .006 inch. Determine the approximate change in the circumference.

11. If the bottom of the ladder in the diagram moves at a velocity of 2 ft/sec., determine $\frac{dy}{dt}$ at the end of 3 seconds; 4 seconds.



12. Calculate the approximate amount of material needed to make a hemispherical shell of inner radius of 12 inches and a thickness of $\frac{1}{16}$ inch. (Use the differential method to find dV.)

13. A right circular cone with a base radius of 5 inches and a height of 7 inches has a height increase (dh) of 0.2 inch. Determine the change in radius (dr) needed to keep the change in volume (dV) equal to zero.

14. At what rate is the surface area of a 10-in. diameter ball changing as its diameter changes? (Find dA)

15. The power in watts of a circuit is $P = RI^2$, where R is in ohms and I is in amperes. If I changes from 5 to 5.1 amperes, determine the approximate change in power in watts (dP) if the circuit has a resistance of 20 ohms.

16. An object falls d feet in t seconds according to $d = \frac{1}{2} gt^2$ where $g = 32$ ft./sec^2. Approximately what distance (dd) does the object fall in the time between 3 and 3.01 seconds?

CHAPTER V

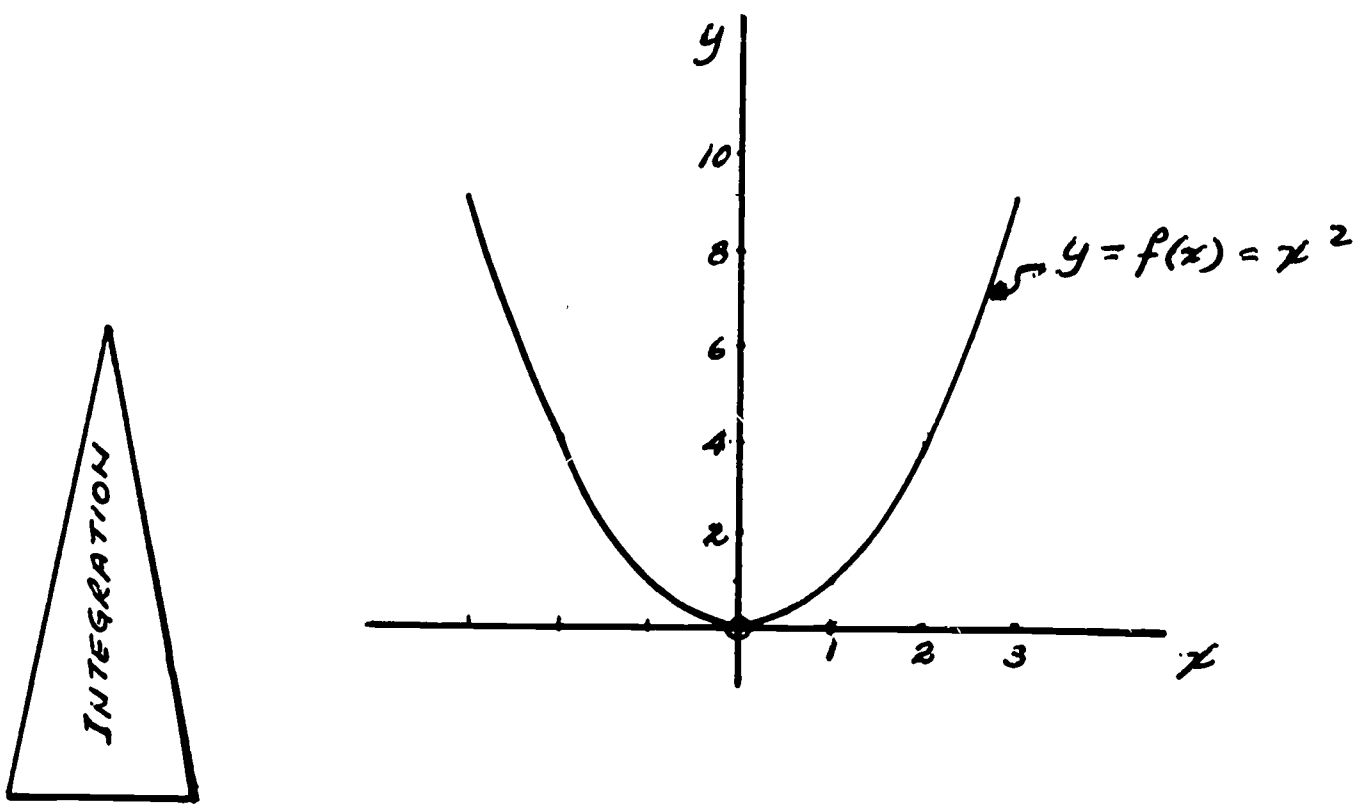
INTEGRATION

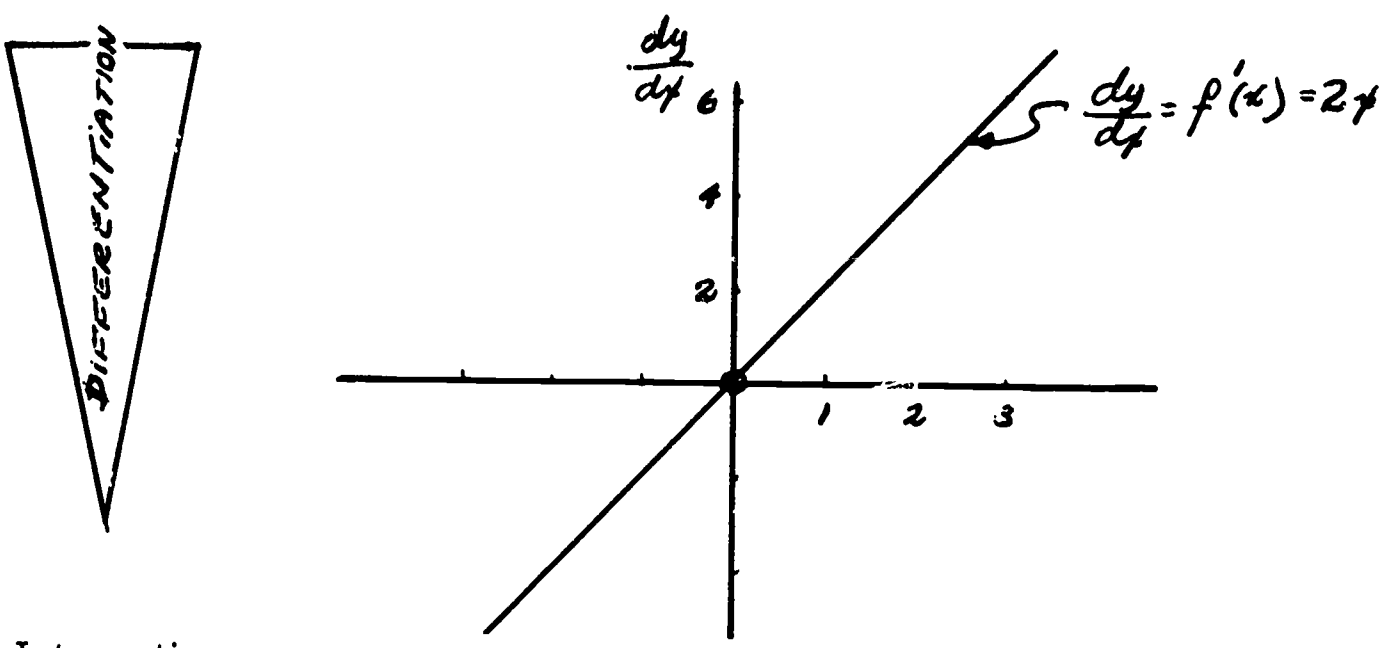
Up to this point we concerned ourselves with differentials and derivatives. We worked with functions and solved for the instantaneous rate of change, or derivative. Integration is simply the inverse of differentiation. In algebra we were involved with multiplication of terms, and then with factoring, the inverse process. Differentiation and integration in calculus are similarly related to each other.

(5-1) Indefinite Integral

The indefinite integral, like the derivative, is a general expression which may become specific for a condition when values or conditions are put into the problem. The indefinite integral must always have the "constant of integration" (C) added after each integration operation. The following examples bring out the relationship between differentiation and integration.

Example 1: Integrate $\frac{dy}{dx} = 2x$





Integration

1. Given $\frac{dy}{dx} = 2x$

2. $dy = 2xdx$ (differential equation)

3. $\int dy = \int 2xdx$ Integrate both sides

   Reversing the process of differentiation, we get

4. $y = \frac{2(x^{1+1})}{(1+1)} + C$

5. $y = \frac{2\,x^2}{2} + C = x^2 + C$

6. Check the result by taking the derivative

   $\frac{dy}{dx} = 2x + 0$ (same as (1) above)

You will note that we started with a differential equation and got back to the original equation. This is the process of integration.

The constant of integration C is always added when determining the <u>indefinite</u> integral.

Example 2:

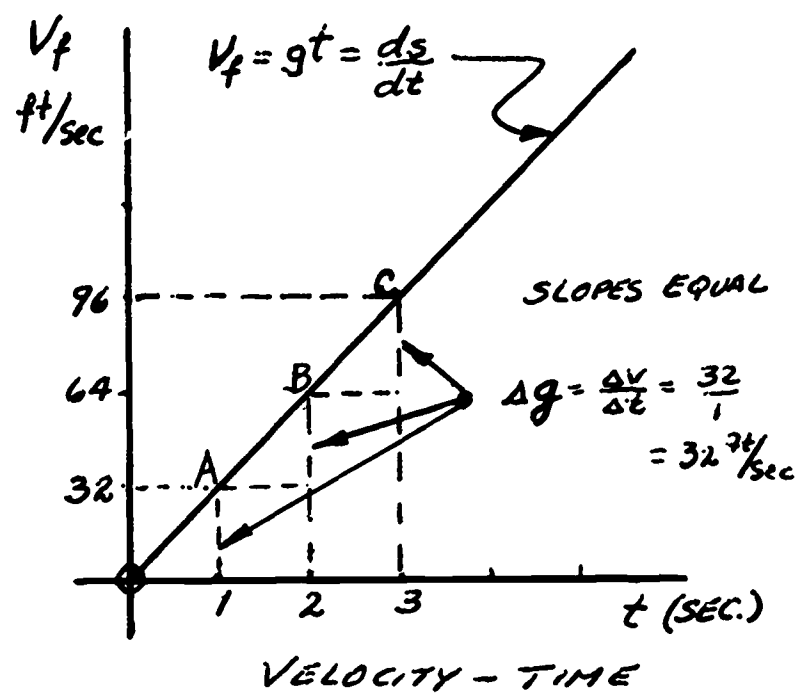
$$\int 2x^2 dx = \frac{2x^{(2+1)}}{(2+1)} + C$$

$$= \frac{2x^3}{3} + C$$

Example 3:

$$\int Kx^n dx = \frac{Kx^{(n+1)}}{(n+1)} + C$$

Example 4: In free fall, the final velocity with respect to time is $V_f = gt$ where $g = 32$ ft. / sec^2 (approximately). From this equation, determine the distance -time equation.



$$V = gt$$

$$V = \frac{ds}{dt}$$

$$\frac{ds}{dt} = gt$$

$$ds = gt\,dt \text{ (differential equation)}$$

The differential equation must be in terms of distance-time as specified in the problem.

$$\int ds = \int gt\,dt \quad \text{Integrate both sides}$$

Reversing the process of differentiation, we get

$$\boxed{s = \frac{gt^2}{2} + C}$$

In the next lesson we will determine how to find the value of C.

In the above graph, note that the triangular area under the velocity-time curve equals distance traveled, since

$$s = (v_{av.})(t) \text{ and } V_{av} = \frac{V_{initial} + V_{final}}{2}$$

In this case, since the object started from rest,

$$V_i = 0$$

$$\text{Therefore } V_{av} = \frac{0 + V_f}{2}$$

$$= \frac{V_f}{2}$$

$$\text{And } s = \frac{V_f}{2}(t)$$

After the first second, the body will have fallen a distance S_1.

$$S_1 = \text{area of } \triangle OA1$$

$$S_1 = \tfrac{1}{2}(\text{base x altitude})$$

$$= \tfrac{1}{2}(1 \text{ sec x } 32 \text{ ft./sec})$$

$$S_1 = 16 \text{ ft.}$$

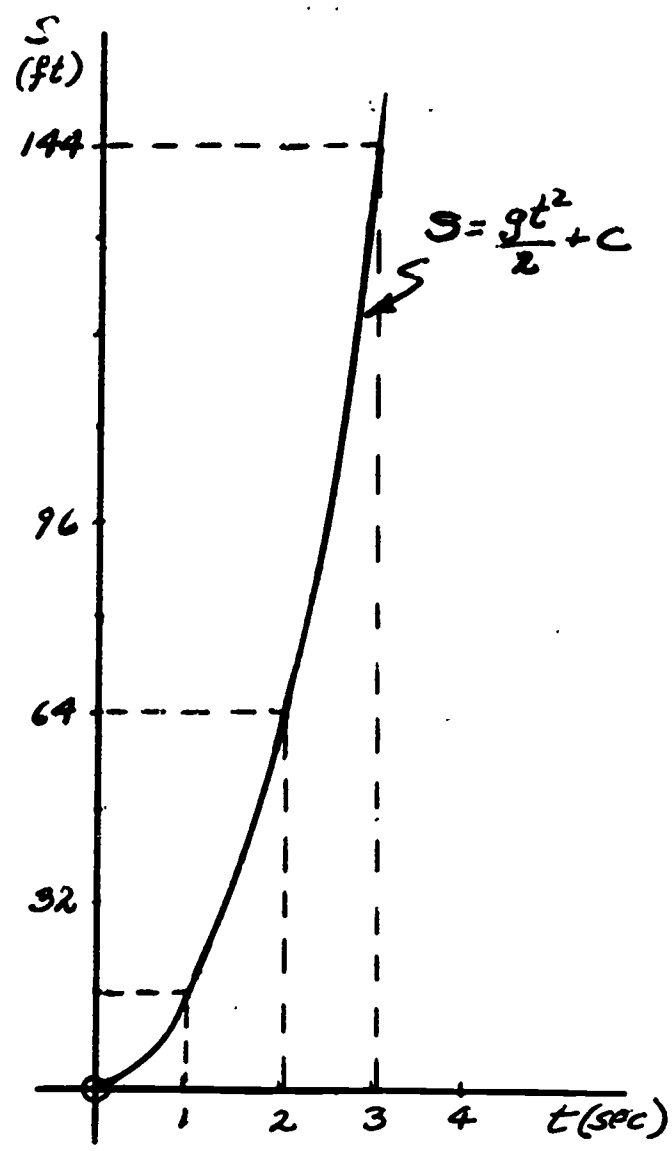
In like manner,

$$S_2 = \tfrac{1}{2}(2 \text{ sec x } 64 \text{ ft./sec}) = 32 \text{ ft.}$$

$$S_3 = \tfrac{1}{2}(3 \text{ sec x } 96 \text{ ft./sec}) = 144 \text{ ft.}$$

The student will determine the distances after 4, 5, and 6 seconds.

By plotting the above distances on a distance-time graph, we get the parabola shown. It is the graph of the equation $s = \frac{gt^2}{2} + C$, which is the original function which we obtained by integrating $V_f = gt$.



Note that the <u>area</u> under the original curve $V_f = gt$ was equal to <u>S</u> in the derived formula $S = \frac{gt^2}{2} + C$ for every value of t. This illustrates the fact that integration is not only the reverse process of differentiation, but is a means of computing the area under a curve.

The two examples illustrate the technique of obtaining the indefinite integral, which is the process of finding the function when given a derivative.

As in differentiation, a few rules must be learned before one can start to solve problems involving integration. It is essential that the rules which are boxed be understood and memorized so that you know them as well as you know your multiplication tables.

You will note that the two previously illustrated examples are of the form:

$$\int u^n du = \frac{u^{n+1}}{n+1} + C$$

Example 1: $$\int 2x\, dx = \frac{2x^2}{2} + C = x^2 + C$$

Example 2: $$\int gt\, dt = \frac{gt^2}{2} + C$$

$$\boxed{\int u^n du = \frac{u^{n+1}}{n+1} + C} \qquad n \neq -1 \qquad (I-1)$$

This is known as the power function and is probably the most widely used function in integration. The u term may represent any function, and the differential term (du) must <u>always</u> be part of the term which is being integrated. This form will not work when n = -1.

<u>Illustrative Examples</u> Problems using $\int u^n du = \frac{u^{n+1}}{n+1} + C$

1. $$\int x^6 dx = ?$$
$$= \frac{x^7}{7} + C$$

2. $$\int \sqrt{x}\, dx = ?$$
$$= \int x^{\frac{1}{2}} dx$$
$$= \frac{x^{\frac{3}{2}}}{\frac{3}{2}} + C = \frac{2}{3}x^{\frac{3}{2}} + C$$

3. $\int \sqrt{x^2 - 4}\ 2x\,dx = ?$

This can be written $\int (x^2 - 4)^{\frac{1}{2}}\ 2x\,dx$

Note that 2x dx is the differential of $(x^2 - 4)$, namely $(2x\,dx - 0)$

$$\text{Then} \int (x^2 - 4)^{\frac{1}{2}}\ 2x\,dx = \frac{(x^2 - 4)^{\frac{1}{2}+1}}{\frac{1}{2}+1} + C$$

$$= \frac{(x^2 - 4)^{\frac{3}{2}}}{\frac{3}{2}} + C$$

$$= \frac{2}{3}\ (x^2 - 4)^{\frac{3}{2}} + C$$

We generally solve problems of this nature in the following manner, using the general form involving u, as shown in equation I-1.

$$\int u^n du = \frac{u^{n+1}}{n+1} + C$$

Let $u = x^2 - 4$

$n = \frac{1}{2}$

$\frac{du}{dx} = 2x$

$du = 2x\,dx$

By substituting these values for u and n, we will arrive at the final equation shown above.

4. $\int (1 + 3x)^3 3dx$

Let $u = (1 + 3x)$

Using I-1

$du = 3dx$

$n = 3$

$$\int (1 + 3x)^3 3dx = \frac{(1 + 3x)^4}{4} + C$$

Problems

Integrate and check the following indefinite integrals:

1. $\int x\,dx$
2. $\int x^3\,dx$
3. $\int \frac{dx}{\sqrt{x}}$
4. $\int (x + 2)\,dx$
5. $\int \frac{dx}{(x + 3)^2}$
6. $\int (x^2 - 2)\,2x\,dx$
7. $\int (ax^2 + b)\,2ax\,dx$
8. $\int (ax + b)^3\,a\,dx$
9. $\int \sqrt{x^3 - 6}\;3x^2 dx$
10. $\int \frac{2x\,dx}{\sqrt{x^2 - a}}$

Try to integrate the following problem: $\int (x^2 - 4)^{\frac{1}{2}}\,x\,dx$. In the previous examples the du term was always exact. If it is not, we may correct it with any number provided we multiply the integral itself by the reciprocal of the correction factor. This results in multiplying the integral by one, which does not change it in any way. (Caution: Never use a correcting factor for du which uses any of the unknowns.)

The correct du term for the above problem is 2xdx rather than x dx. We will therefore call it 2xdx and compensate for this by multiplying the integral by $\frac{1}{2}$.

$$\boxed{\frac{1}{2}} \int (x^2 - 4)^{\frac{1}{2}} \boxed{2}x\,dx$$

Now this problem may be integrated.

$$= \frac{1}{2}\,\frac{(x^2 - 4)^{\frac{3}{2}}}{\frac{3}{2}} + C$$

$$= \frac{1}{3}\,(x^2 - 4)^{\frac{3}{2}} + C$$

The integral of any differential of a function (u) is u plus a constant.

$$\boxed{\int du = u + C}$$

The differential of u = du. Since integrating is the inverse process, then $\int du = u + C$.

A constant multiplying factor when integrating is handled the same way as when differentiating. It remains a constant multiplying factor on the performed operation.

$$\boxed{\int a\,du = a\int du = au + C} \qquad \text{(I-3)}$$

When integrating a sum or difference, integrate each term separately, as was done in differentiation.

$$\int (du \pm dy \pm dz) = \int du \pm \int dy \pm \int dz$$

$$\boxed{\int (du \pm dy \pm dz) = u \pm y \pm z + C} \qquad \text{(I-4)}$$

Example 1: $\int 4x^2 dx = ?$

$$4\int x^2 dx = \frac{4x^3}{3} + C$$

Example 2: $\int (x^4 - 3x^2 + 1)\, dx = ?$

$$= \int x^4 dx - 3\int x^2 dx + 1\int dx$$

$$= \frac{x^5}{5} - \frac{3x^3}{3} + x + C$$

$$= \frac{1}{5}x^5 - x^3 + x + C$$

Example 3: $\int \left(\frac{1}{x^2} + \frac{x^3}{3} - 7\right) dx$

$$= \int x^{-2} dx + \frac{1}{3}\int x^3 dx - 7\int dx$$

$$= \frac{x^{-1}}{-1} + C_1 + \frac{1}{3}\,\frac{x^4}{4} + C_2 - 7x + C_3$$

$$= -\frac{1}{x} + \frac{x^4}{12} - 7x + C_1 + C_2 + C_3$$

$$= -\frac{1}{x} + \frac{x^4}{12} - 7x + C_{total}$$

Example 4: $\int x\,(1 + x^2)^4\,dx$

Let $u = (1 + x^2)$

$du = 2x\,dx$

$n = 4$

Since the correct du term is not in the problem, and since only an integer is required, it may be supplied — provided the whole integral is multiplied by the reciprocal of the supplied number. (The total result of making two such changes should always result in multiplying the integral by a plus 1, which really is no change at all.)

We obtain $\frac{1}{2}\int 2x\,(1 + x^2)^4 dx = \frac{1}{2}\frac{(1 + x^2)^5}{5} + C$

Therefore $\int x\,(1 + x^2)^4 dx = \frac{(1 + x^2)^5}{10} + C$

Example 5: $\int \frac{y^2}{\sqrt{1 - y^3}}\,dy$

$u = (1 - y^3)$

$n = -\frac{1}{2}$

$du = -3y^2 dy$

$$\int \frac{y^2}{\sqrt{1 - y^3}}\,dy = -\frac{1}{3}\int (1 - y^3)^{-\frac{1}{2}}(-3y^2)dy$$

$$= -\frac{1}{3}\,\frac{(1 - y^3)^{+\frac{1}{2}}}{\frac{1}{2}} + C = -\frac{2}{3}(1 - y^3)^{\frac{1}{2}} + C$$

Example 6: $\int (1 + x^2)^3\,dx$

Let $u = (1 + x^2)$

$du = 2x\,dx$

Note: The $\underline{x}$ of the du term is missing; therefore this power rule cannot be used.

Solution: Expand and integrate by parts.

$$\int (1 + x^2)^3\,dx = \int (1 + 3x^2 + 3x^4 + x^6)\,dx$$

$$= x + x^3 + \frac{3}{5}x^5 + \frac{x^7}{7} + C$$

Problems

Integrate and check the following indefinite integrals:

1. $\int x^5 dx$
2. $\int 5x^3 dx$
3. $\int 3x^2 (x^3 + 2)^3 dx$
4. $\int (x^4 + 7)\, x^3 dx$
5. $\int 6\, dx$
6. $\int (x + 2)\sqrt{x} dx$
7. $\int \frac{x + 2}{x^3}\, dx$
8. $\int (x^3 - 2)^2\, x^2 dx$
9. $\int \frac{3x^2 - 2}{\sqrt{x^3 - 2x}}\, dx$
10. $\int (\sqrt[3]{x} - \sqrt[5]{x}) dx$
11. $\int (v_i - gt)\, dt$
12. $\int \frac{1 + x}{\sqrt[3]{x}}\, dx$
13. $\int (3x^3 - 2x^2 + 1)\, dx$
14. $\int \frac{6y}{(5 - 3y^2)^2}\, dy$
15. $\int \frac{4x^2 - 2(x)^{\frac{1}{2}}}{x}\, dx$
16. $\int \left(\frac{x^2}{3} - \frac{4}{x^3}\right) dx$

(5-2) The Integration Constant

Whenever an integration is performed, the constant of integration must be added. The function obtained by integrating an expression actually represents a series of equations and hence a series of curves that could be located within the coordinate system. To determine this constant, some specific facts must be known about the problem.

Example 1:

Problem: The slope of a curve equals 2x. Find the equation of the curve which passes through (3, 4).

Note: The general integral with constant (C) gives an infinite series of curves. When this curve must pass through a specific point, then only one curve and hence one equation satisfies the conditions. (See diagram on next page.)

Step 1: Given: $\frac{dy}{dx} = 2x = \text{slope}$

Step 2: Solve: $dy = 2xdx$ (differential equation)

$$\int dy = \int 2xdx$$

$$y = x^2 + C \quad \text{(general equation)}$$

Step 3: Substitution of the specific facts of this problem: The curve passes through (3, 4).

$$y = x^2 + C \quad \text{(general equation)}$$

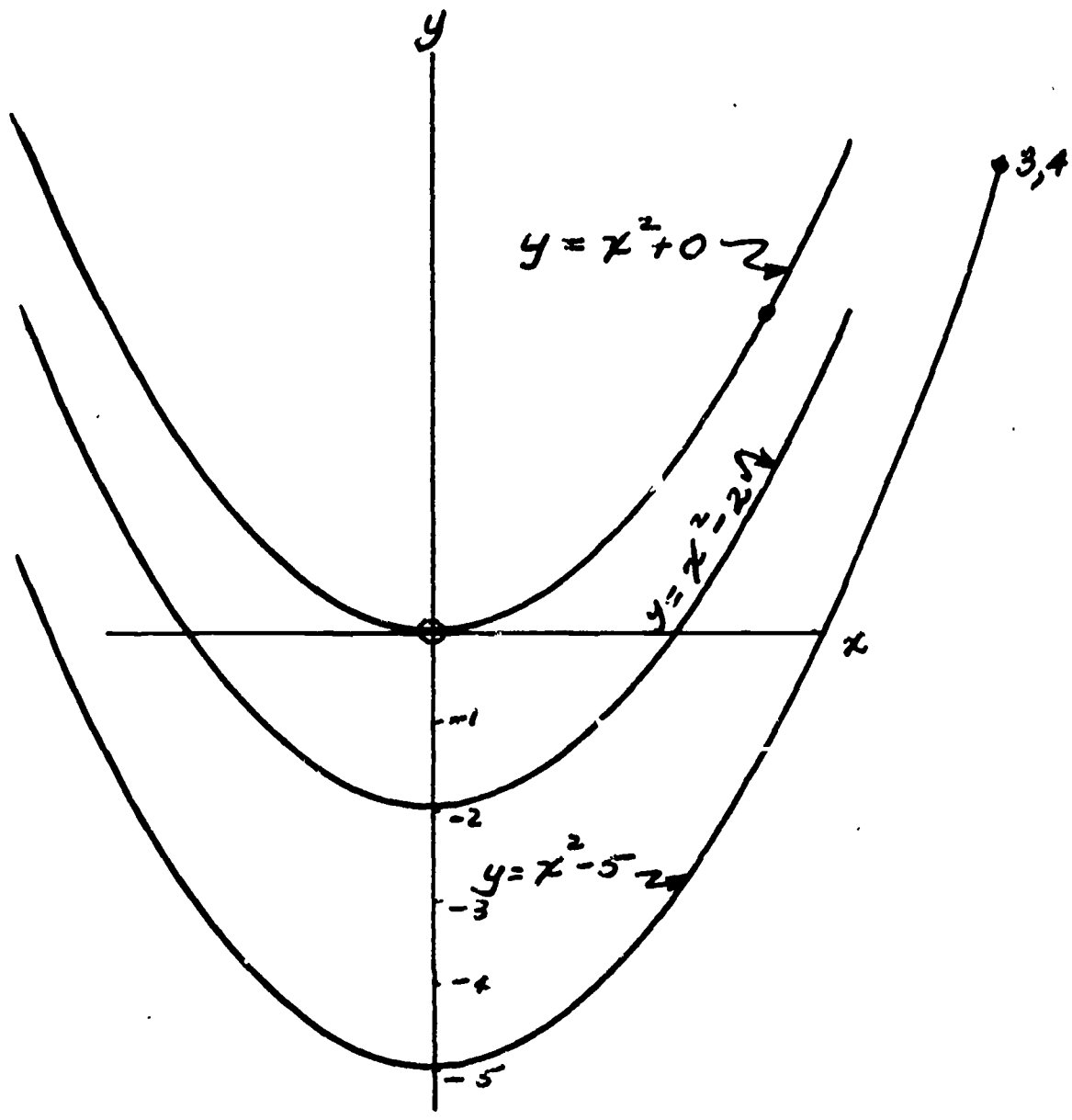
$$4 = 3^2 + C$$

$$-5 = C$$

Step 4: Substitute for C to get specific equation

$$y = x^2 - 5 \quad \text{(specific equation)}$$

Note that this equation actually represents a curve with a slope of 2x, and the point (3, 4) satisfies the equation.


y
x
3,4
y = x² + 0
y = x² - 2,5
-1
-2
y = x² - 5
-3
-4
-5

Example 2: Find the equation of a line with a slope of 2 which passes through (3, 4).

Step 1: $\frac{dy}{dx} = 2$

Step 2: Solve: $dy = 2dx$

$$\int dy = 2\int dx$$

$$y = 2x + C \qquad \text{(general equation)}$$

Step 3: At (3, 4), $x = 3$, $y = 4$

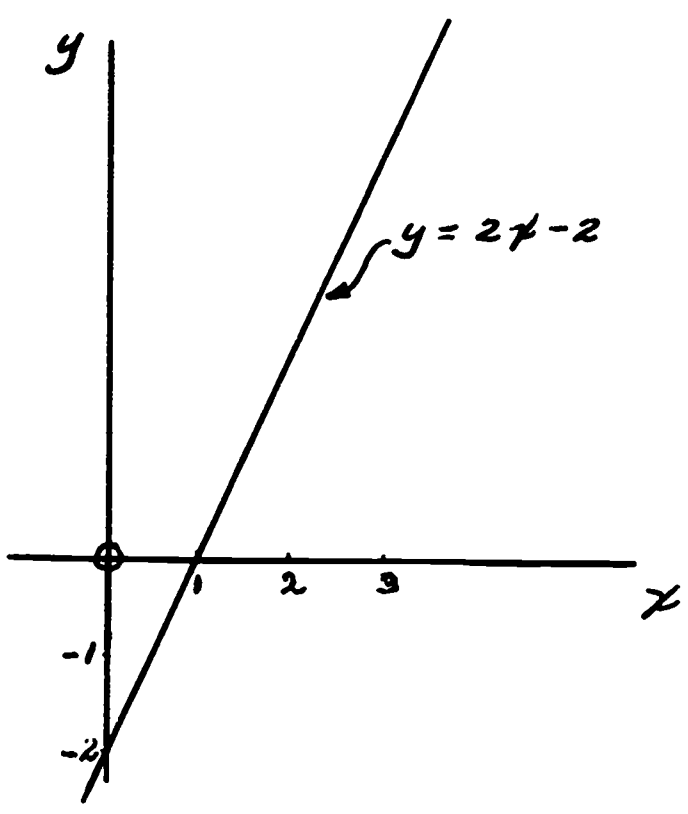
$$4 = 2(3) + C \qquad \text{substitution}$$

$$4 - 6 = C; \; C = -2$$

Step 4: $y = 2x + C$

$$y = 2x - 2 \qquad \text{(specific equation)}$$

Note that the equation found actually represents a line with a slope of 2, and the point (3, 4) satisfies the equation.



Example 3: Assume that the velocity of an object is directly proportional to the time. If the distance traveled is $4\frac{1}{2}$ feet at time 1 second, find the distance traveled at the end of the 4th second if the proportionality constant is 1.

Step 1: $v \sim t$

Therefore $v = kt = (1)t$

$v = t$

Step 2: $v = \frac{ds}{dt} = t$

$ds = tdt$

$\int ds = \int tdt$

$s = \frac{t^2}{2} + C$

Step 3: $4\frac{1}{2} = \frac{(1)^2}{2} + C$ Substitution

$C = 4$

Step 4: $s = \frac{t^2}{2} + 4$

$= \frac{(4)^2}{2} + 4$

$s = 12$ feet

Example 4: A tank which is 1 foot in radius has water in it which is 3 feet deep. How long would it take the tank to empty through a 1"-diameter hole?

1.

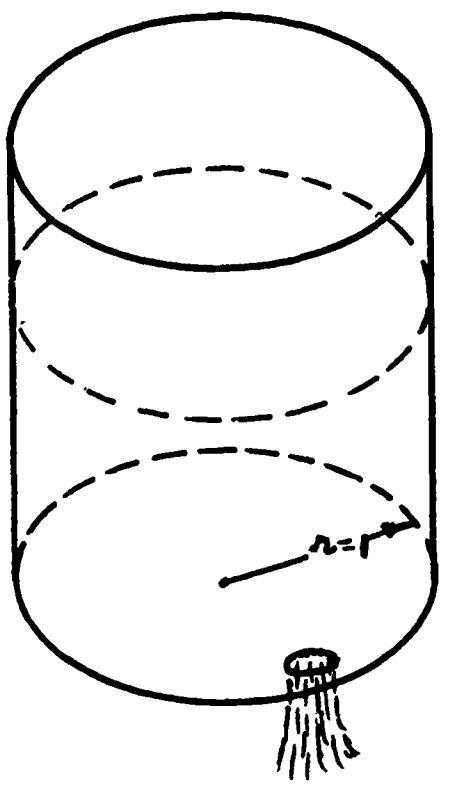
Given information:

r = 1 foot

h = 3 feet

hole dia. = 1 in.

Find: time (t)



This seems like a simple arithmetic problem but it isn't, since the velocity of flow from the opening is directly proportional to the square root of the height. Obviously, as the height changes, the rate of flow changes.

2. Write the equations which describe the problem:

$$V = A_{(Base)}h$$

$$V = \pi(1)^2 h = \pi h$$

The above equation expresses volume (V) as a function of height.

Now the rate of change of volume is the derivative of the equation for volume with respect to time.

$$\frac{dV}{dt} = \frac{d(\pi h)}{dt} = \pi\frac{dh}{dt}$$

The rate of flow through the hole in the bottom equals the effective area of discharge times the velocity of efflux. (We will assume that the entire opening is effective, although this is not actually the case.)

Area $= \pi r^2 = \pi(\frac{1}{24})^2$ Since $r = \frac{1}{2}$ inch or $\frac{1}{24}$ foot.

Velocity of efflux $= \sqrt{2gh}$ (where $g = 32$ ft. /sec^2)

The product of these gives the rate of flow.

Rate $= \pi(\frac{1}{24})^2\sqrt{2gh} = \frac{1}{24}\sqrt{h}$ Letting $\pi = 3$ (approximate)

Since the change in volume must always be equal to the rate of flow, the above two expressions are equated. The negative sign of the right side indicates that the volume is decreasing.

$$\frac{dv}{dt} = \pi\frac{dh}{dt} = -\frac{1}{24}\sqrt{h}$$ Rate of flow

$$\frac{dh}{dt} = -\frac{1}{75}\sqrt{h}$$ Divide both sides by π

$$dh = -\frac{1}{75}\sqrt{h}\ dt$$ Multiply both sides by dt

3. Manipulate or transform the equation so that it is possible to integrate.

In the above equation it is necessary to bring like terms to one side. This is done by dividing both sides by $\sqrt{h}$, which results in

$$\frac{dh}{\sqrt{h}} = -\frac{1}{75}\ dt$$

$$h^{-\frac{1}{2}}\ dh = -\frac{1}{75}\ dt$$

$$\int h^{-\frac{1}{2}}\ dh = -\frac{1}{75}\int dt$$ Integrate both sides

$$\frac{h^{\frac{1}{2}}}{\frac{1}{2}} = -\frac{1}{75}\ t + C$$ (C represents a combination of a C on the left and a C on the right.)

$$\sqrt{h} = -\frac{1}{150}\ t + C$$

4. Evaluate the value of the constant of integration.

From the statement of the problem, it is known that the height (h) = 3 at time (t) = 0.

$$\sqrt{3} = -\frac{1}{150}\ (0) + C$$

$$C = 1.73$$

5. Solve by substitution.

$$\sqrt{h} = -\frac{1}{150}t + 1.73$$

Now since there are 2 unknowns, one must be supplied before a solution is possible.

What is known? Well, when the tank is empty, h must be 0. Knowing this it will be possible to solve for t.

$$0 = -\frac{1}{150}t + 1.73$$

$$t = 260 \text{ seconds approx.}$$

The object of this problem was to explain the logical method of approach. The simplification of the arithmetic by rounding π to 3 was done so the student would not get lost in the calculus.

Problems:

Determine the integration constant and the specific equations:

1. $\frac{dy}{dx} = 1.$ Curve passes through point (2, 3).

2. $\frac{dy}{dx} = 2x.$ Curve passes through point (3, 4).

3. $\frac{dy}{dx} = x^2.$ Curve passes through point (1, 2).

4. $ydy = dx.$ Curve passes through point (1, 4).

5. Find the equation of a curve which has a slope of 2 and passes through the point (2, 3).

6. An object is dropped from rest, attains a velocity of 64 ft./sec. after 2 seconds. Find the total displacement of the object at the end of 3 seconds if g = 32 ft./sec. Hint: $\frac{ds}{dt} = gt$. What is the value of the integration constant?

7. The velocity of a ball ejected vertically is given by $v = 100 - 32t$. Find the height (s) of the ball after 4 sec.

(5-3) Successive Integration

In the previous sections, we saw that it was possible to use successive differentiation, depending on the statement of the problem. It would therefore be logical to assume that a similar process would be possible for the inverse operation of integration. Take for example the following problem:

Example 1:

Differentiation

Given: $y = x^3 + x^2 + x$

$$y' = \frac{dy}{dx} = 3x^2 + 2x + 1$$

$$y'' = \frac{d^2y}{dx^2} = 6x + 2$$

Integration

Given $\frac{d^2y}{dx^2} = 6x + 2$, find y.

$$y'' = \frac{d^2y}{dx^2} = 6x + 2.$$

$$y'' = \frac{d(y')}{dx} = 6x+2 \quad \left(\frac{d(y')}{dx} \text{ means the derivative of } y'\right)$$

$$\int dy' = \int (6x+2)dx$$

$$y' = \frac{6x^2}{2} + 2x + C$$

$$y' = \frac{dy}{dx} = 3x^2 + 2x + C$$

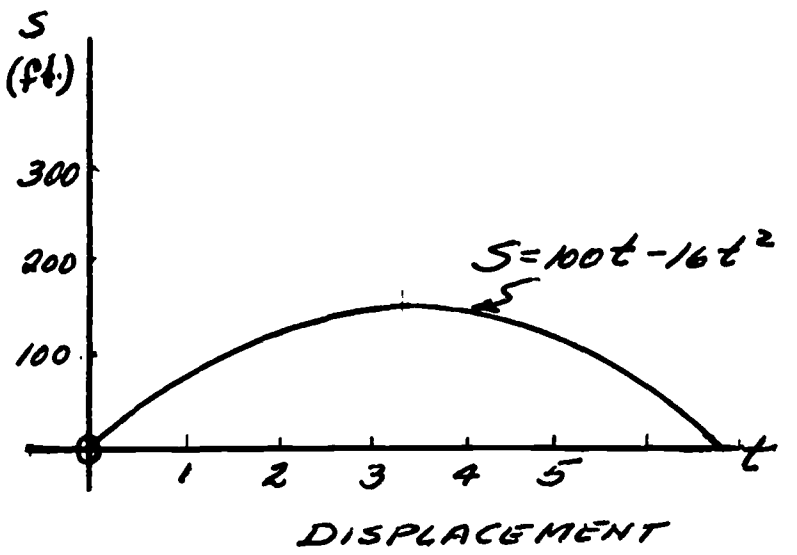
$$\int dy = \int (3x^2 + 2x + C)\, dx$$

$$y = \frac{3x^3}{3} + \frac{2x^2}{2} + Cx + C_1$$

$$y = x^3 + x^2 + Cx + C_1$$

Example 2: An object is shot into the air so that $s = 100t - 16t^2$. Determine the formulas for its velocity and acceleration.

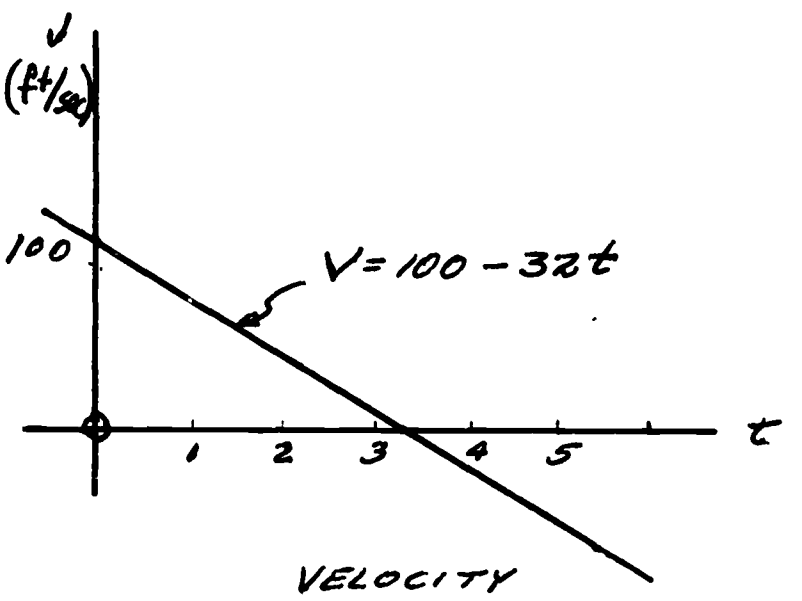
$s = 100t - 16t^2$



First derivative:

$V = \frac{ds}{dt}$

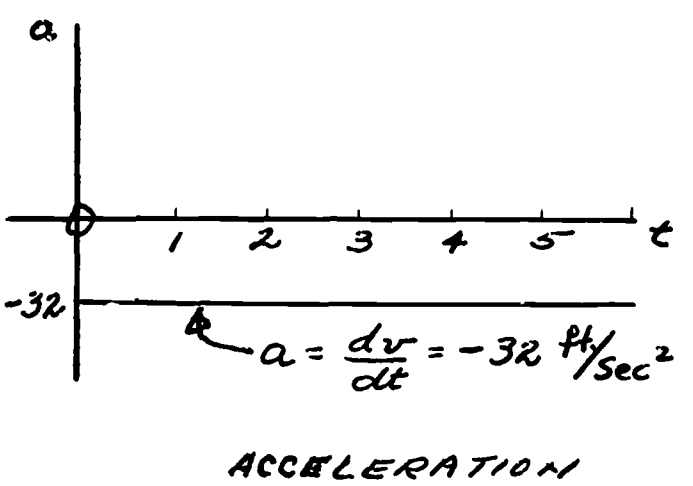
$V = 100 - 32t$



Second derivative:

$a = \frac{dv}{dt} = \frac{d^2s}{dt^2}$

$a = -32$



You will note that, given a distance-time relationship, by successive differentiation it is possible to determine velocity and acceleration. Any further differentiation is meaningless.

Now let's perform the inverse operation, that is, integration.

Example 3: The statement of the problem is as follows: The acceleration of an object is - 32 ft. / sec^2. If its velocity is 100 ft. / sec at t = 0, find the distance-time equation.

$a = \frac{dv}{dt} = -32$ (Given)

$dv = -32dt$ Multiply both sides by dt.

$\int dv = -32 \int dt$ Integration

$v = -32t + C$

$100 = -32\ (0) + C$ (Substitute v = 100 when t = 0)

$C = 100$

$v = -32t + 100$ (specific equation)

$v = \frac{ds}{dt} = -32t + 100$

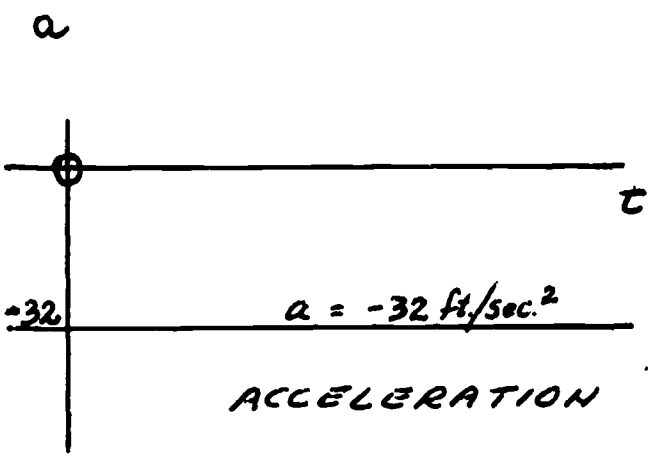
$\int ds = \int (-32t + 100)dt$

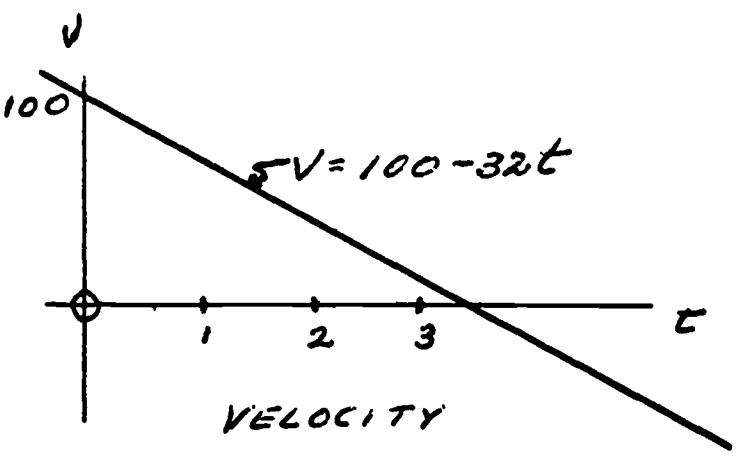
$s = -\frac{32t^2}{2} + 100t + C_1$

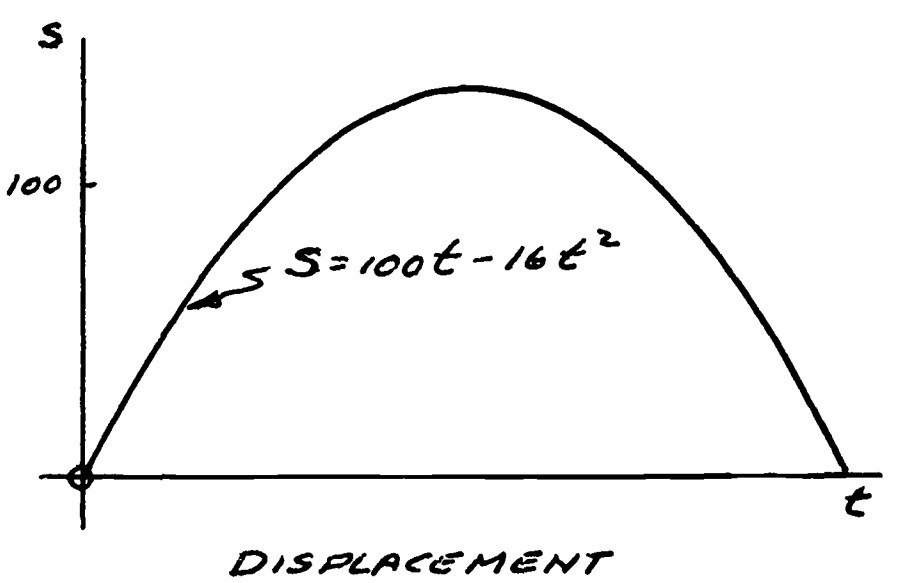
At t = 0, s = 0

$C_1 = 0$

$s = 100t - 16t^2$







Note how examples 2 and 3 are worked in both differentiating and integrating. The integration curves are obviously in reverse order from the differentiating curves. When integrating to obtain a specific equation, enough facts must be given to obtain specific constants.

Example 4: The acceleration of a free-falling body is g. Find the distance-time equation.

$$a = \frac{d^2s}{dt^2} = \frac{dv}{dt} = g$$

First integration: $\int dv = \int g dt = g \int dt$

$$v = gt + C$$

$$v = \frac{ds}{dt} = gt + C$$

When $t = 0$, $C = v_1$ (initial vel.)

$$ds = gt\, dt + v_i dt$$

Second integration: $\int ds = g \int t\, dt + v_i \int dt$

$$s = \frac{gt^2}{2} + v_i t + C_1$$

When $t = 0$, $C_1 = s_i$ (initial distance)

$$s = v_i t + \tfrac{1}{2} gt^2 + s_i$$

Example 5: A stone is dropped from rest and its speed was found to be $v = 32t$. Determine the distance it fell in 3 seconds.

$$v = 32t$$

$$\frac{ds}{dt} = v = 32t$$

$$\int ds = \int 32t\ dt$$

$$s = \frac{32t^2}{2} + C$$

$$0 = 16(0)^2 + C \qquad \left\{ \begin{array}{l} s = 0 \text{ when } t = 0 \\ \text{Therefore } C = 0 \end{array} \right.$$

$$s = 16t^2$$

$$s = 16(3)^2 = 144 \text{ feet}$$

Problems

1. $y''' = \frac{d^3y}{dx^3} = x.$ Find y.

2. $y'' = \frac{d^2y}{dx^2} = 4.$ Find y.

3. $y' = \frac{dy}{dx} = x^3 - \frac{1}{x^2} + 3.$ Find y.

4. $y'' = \frac{d^2y}{dx^2} = \sqrt{x}.$ Find y.

5. The acceleration of an object equals 32 ft. /sec^2. Find the general equation or indefinite integral for velocity and distance.

6. The final velocity of an object in free fall is $v = \sqrt{2gs}.$ Determine and plot the distance-time curve.

(5-4) Definite Integral

Most of the applications of integration use the definite rather than the indefinite integral. The definite integral gives a definite solution to a problem as a result of its limits. Take for example $\frac{dy}{dx} = x^2$

$$dy = x^2 dx \qquad \text{Multiply both sides by } dx$$

$$\int dy = \int x^2 dx \qquad \text{Integrate}$$

$$y = \frac{x^3}{3} + C$$

Even when a value is assigned to C, y varies according to the values assigned to x.

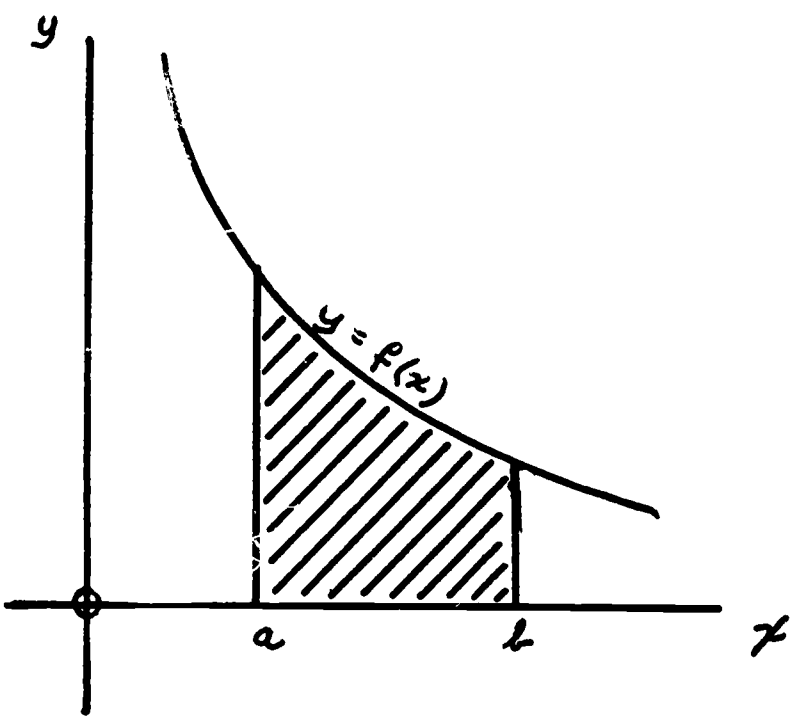
In solving definite integral problems, upper and lower limits for x are designated, which makes it a problem in definite integrals.

$y = f(x)$

$$\int_a^b f(x)dx$$

b ← (upper limit)

a ← (lower limit)



When integrating a definite integral, we first get the value of the resulting equation when the upper limit is substituted for x and subtract from this the value of the equation with the lower limit substituted for x. As you will see, we can drop the constant of integration, because if constants were used in each of the limits, they would cancel each other in the subtraction.

If $\frac{dy}{dx} = x^2$, find y between the limits of 2 and 3 for x.

$$dy = x^2 dx$$

$$\int dy = \int x^2 dx$$

$$y = \frac{x^3}{3} + C \Big]_2^3$$

Assume C = 5 and substitute the values of x, which are 3 and 2.

$$y = \left[\frac{(3)^3}{3} + 5\right] - \left[\frac{(2)^3}{3} + 5\right]$$

$$= (9 + 5) - (\frac{8}{3} + 5)$$

$$y = 9 + 5 - \frac{4}{3} - 5 \qquad = \frac{19}{3}$$

Now let's check the solution by dropping the C.

$$y = \frac{y^3}{3}\Big]_2^3 = \frac{(3)^3}{3} - \frac{(2)^3}{3} = \frac{19}{3} \qquad \text{(same result)}$$

Therefore, in the definite integral only, because the lower limit value is subtracted from the upper limit value, the constant of integration is neglected in the solution.

Note: <u>Always subtract the lower limit from the upper limit for the definite integral.</u>

Example 1: Current is defined as the time-rate of charge flow at any instant.

$$i = \frac{dq}{dt}$$

Find the charge in coulombs transmitted per second if $i = t^2 - t$ amperes and the time is t = 1 to t = 3 seconds.

$$dq = i\ dt \qquad \text{(Differential equation form)}$$

$$\int dq = \int i dt \qquad \text{(Integrate both sides)}$$

$$\int dq = \int (t^2 - t)\ dt \qquad \text{Substitute for i in terms of t}$$

$$q = \frac{t^3}{3} - \frac{t^2}{2}\Big]_1^3$$

$$q = \left[\frac{(3)^3}{3} - \frac{(3)^2}{2}\right] - \left[\frac{(1)^3}{3} - \frac{(1)^2}{2}\right]$$

$$= \frac{14}{3} \text{ coulombs}$$

Example 2: The charge of a capacitor (q) in coulombs is directly proportional to its capacity (C) in farads and its impressed voltage (v_c) in volts. If a 1-microfarad condenser is connected to a circuit in which the current $i = t^3$ amperes, determine the voltage across the condenser 0.1 seconds after making the connection.

$$q = Cv_c$$

$$dq = i\ dt \qquad \text{(Example 1)}$$

$$q = \int i\ dt = Cv_c$$

$$v_c = \frac{1}{C}\int i\ dt \quad (\div \text{ both sides by } C)$$

$$V_c = \frac{1}{10^{-6}}\int t^3 dt \qquad \text{(subst. conditions)}$$

$$V_c = 10^6 \left[\frac{t^4}{4}\right]_0^{0.1}$$

$$= 10^6(.25)(10^{-4}) - 0$$

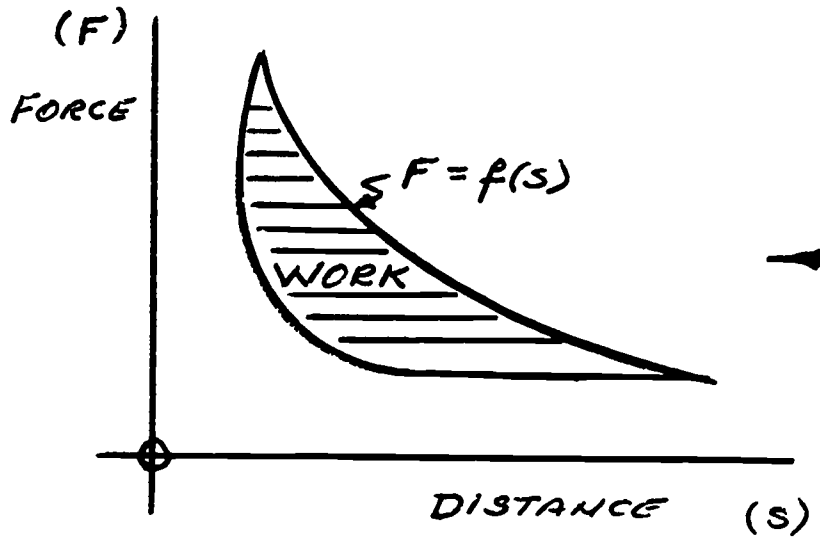
$$= 25 \text{ volts}$$

Problems

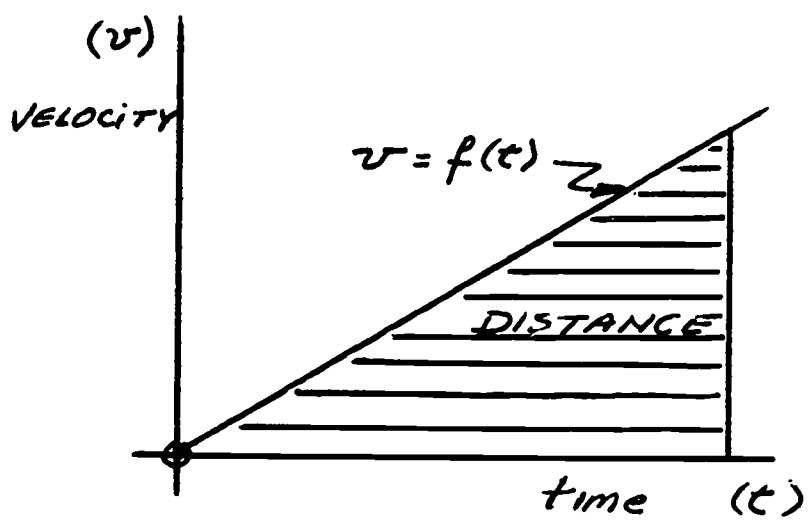
Find the values of the following definite integrals:

1. $\int_3^6 x^2\,dx$
2. $\int_1^4 \sqrt{2x}\,dx$
3. $\int_0^9 x^{\frac{1}{2}}\,dx$
4. $\int_{-1}^3 (3x^2 + 4x - 5)\,dx$
5. $\int_{-2}^2 (x - 3)(x + 2)\,dx$
6. $\int_{-2}^4 (2x - 3\sqrt{x})\,dx$
7. $\int_1^3 \frac{1}{2}(3x - 5)\,dx$
8. $\int_1^2 \frac{1}{2}(x^3)\,dx$
9. $\int_{\frac{1}{2}}^4 (2y)^{\frac{1}{3}}\,dy$
10. $\int_3^6 \pi y^2\,dy$
11. $\int_0^2 (x^2 - 4)\,dx$
12. $\int_0^1 x^2(x^3 - 3)^2\,dx$
13. $\int_{-2}^{+2} 4x^3\,dx$
14. $\int_1^3 \frac{1}{(5 - 3y)^2}\,dy$

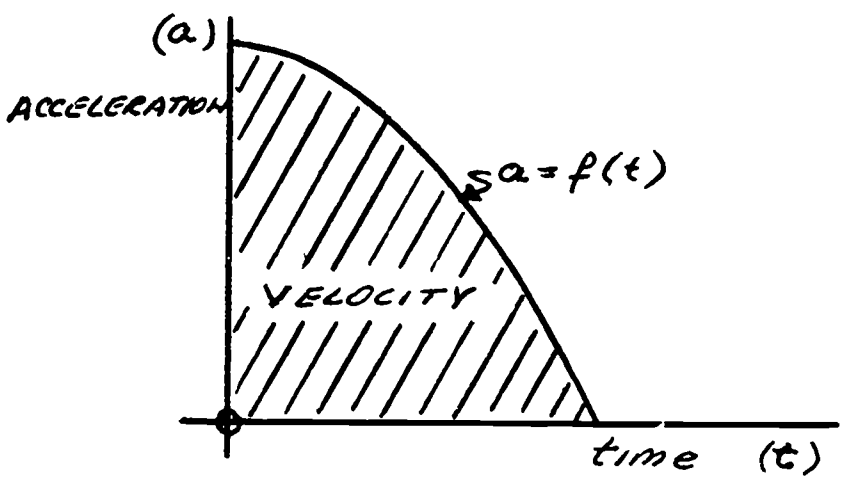
(5-5) Useful Applications of the Definite Integral



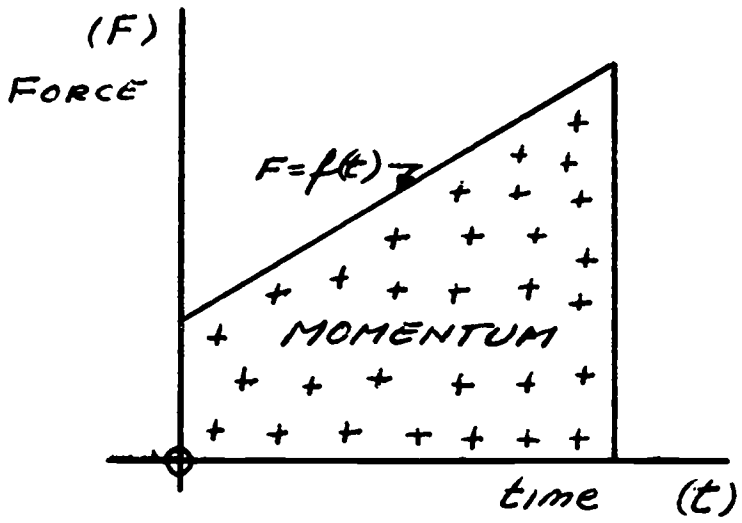
$$\text{WORK} = \int F\,ds$$



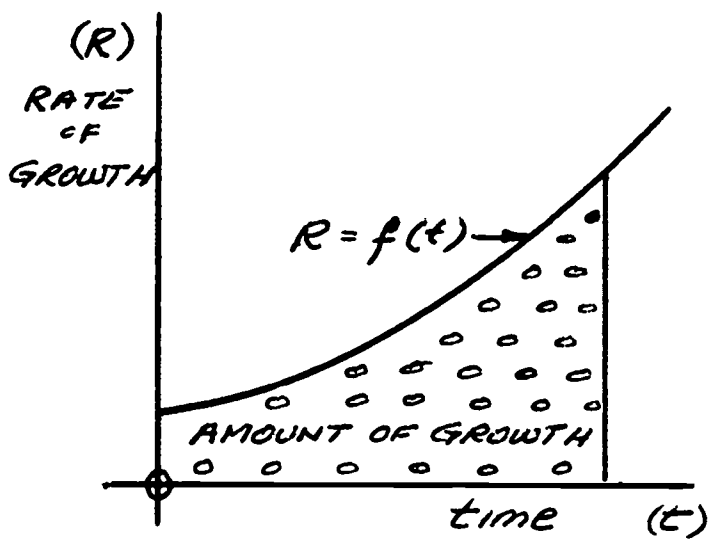
$$\text{DISTANCE} = \int v\,dt$$



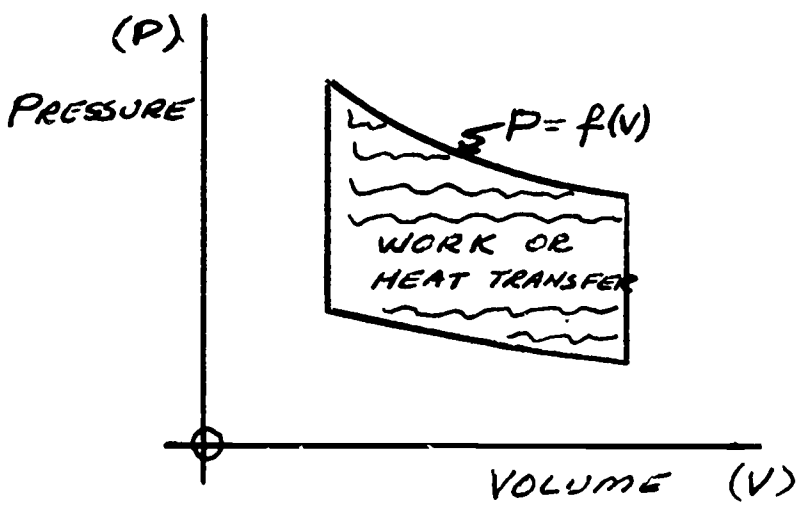
$$\text{VELOCITY} = \int a\,dt$$



$$\text{MOMENTUM} = \int F\,dt$$



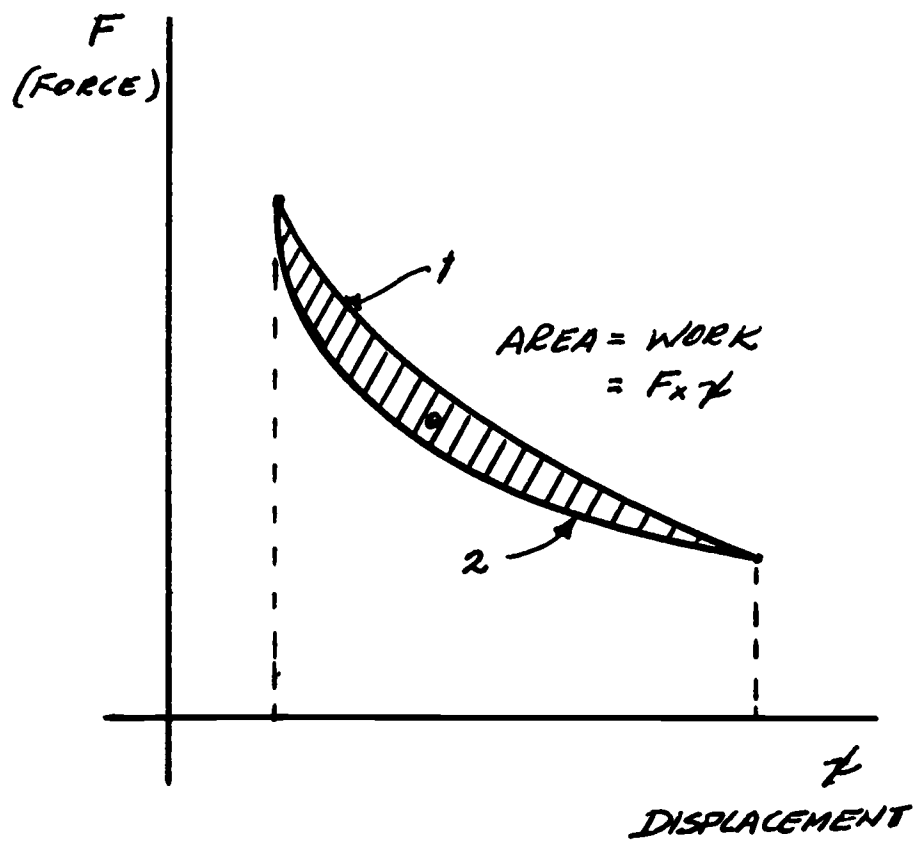
$$\text{AMOUNT OF GROWTH} = \int R\,dt$$



$$\text{WORK} = \int P\,dv$$

(5-6) Definite Integral - Area and Work Applications

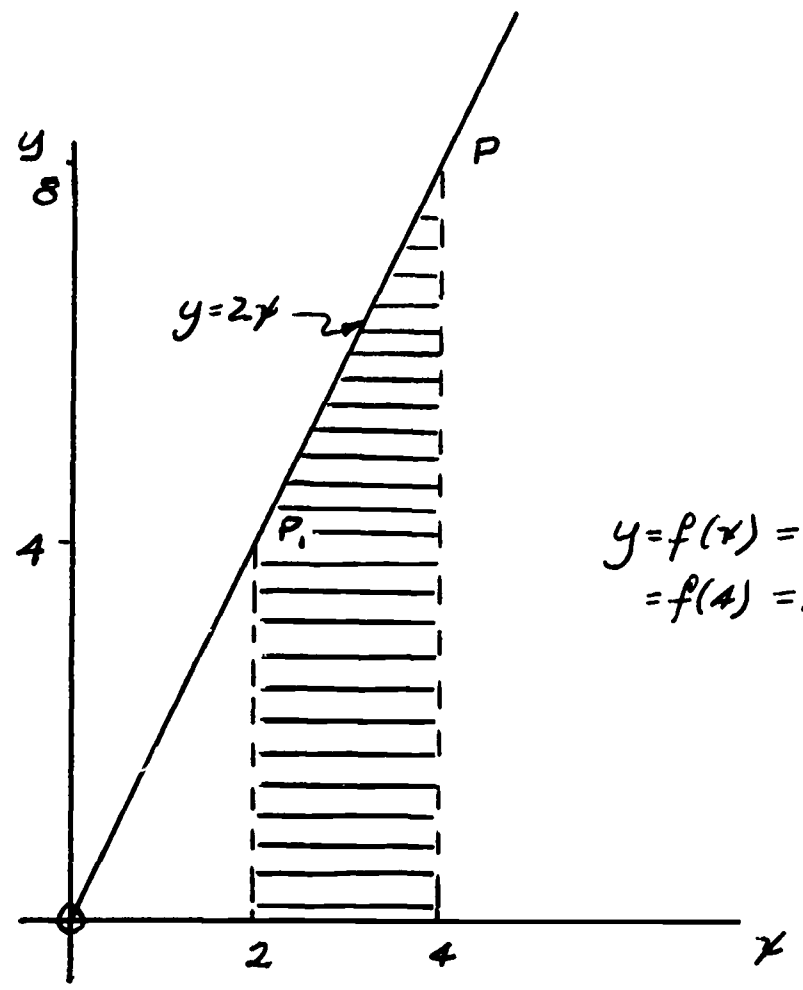
To determine the work produced by a cylinder, the pressure on the piston must be plotted against displacement. The net area between the curves (below) gives the work produced.



Now how is the area formed between the curves obtained? If the equations of the curves are known, first find the area under curve 1, between the upper and lower limits and the x-axis, and from it subtract the area under curve 2, between the upper and lower limits and the x-axis.

Now let's develop the mechanics of finding areas by the definite integral.

For the relationship y = 2x, find the area between the limits 2 and 4.



$y = f(x) = 2x$
$= f(4) = 2(4) = 8$

A. For point P, when x = 4, y = 8

$$A_{OP4} = \tfrac{1}{2}bh$$

$$= \tfrac{1}{2}(4)(8)$$

= 16 square units for triangle (OP4)

For triangle $(OP_1 2)$,

$$A = \tfrac{1}{2}bh$$

$$= \tfrac{1}{2}(2)(4) = 4 \text{ square units}$$

Now to get the net area (hatched) $(P_1P,\ 4,\ 2)$:

Area of whole - area of lower limit = net area

$16 - 4 \qquad = 12$ sq. units

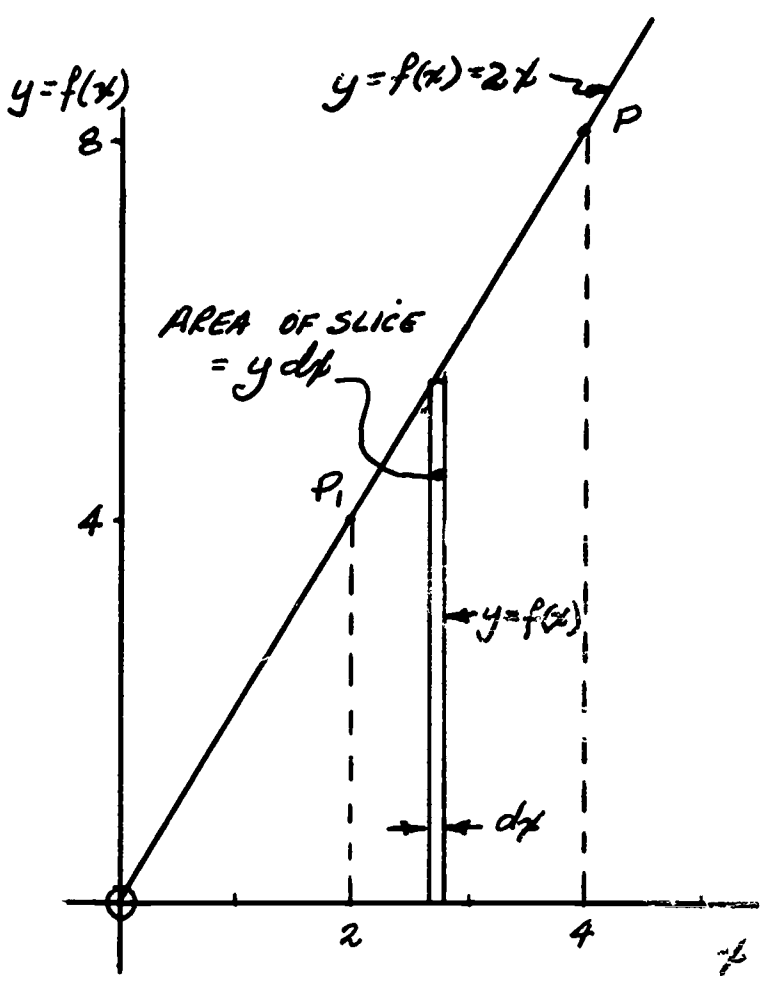
B. This area could also have been obtained by the rectangular method, if we first obtained the mean (average) height. This height $= \frac{4+8}{2} = 6$

$$\text{Area of rectangle} = b \times \bar{h}$$

$$= 2 \times 6 = 12 \text{ sq. units}$$

C. Now let's try a third method, with calculus.

Note that the area (P_1P42) consists of an infinite number of small "slices," each with an area of ydx. We will not go into the proof here, but it should seem reasonable to you that the sum of all the slices with an area ydx is the integral of ydx between the limits 2 and 4.



$$A = \int y\,dx \longrightarrow \text{summation of small areas}$$

Since $y = 2x$, $$A = \int_2^4 (2x)dx \longrightarrow \text{substitution and limits}$$

$$A = \left.\frac{2x^2}{2}\right]_2^4$$

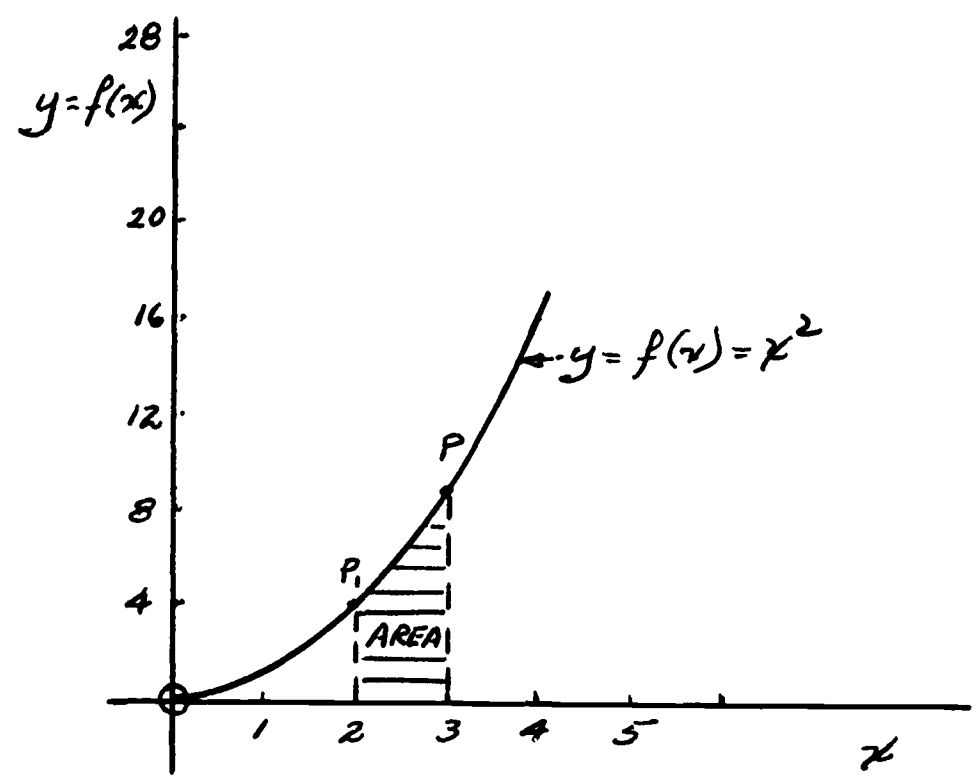
$$= (4)^2 - (2)^2 = 16 - 4 = 12 \text{ sq. units}$$

The definite integral method of solution is not the easiest for this particular problem. The intent here was to demonstrate the simplicity of this method and to check the result with the arithmetic solutions. Of course, the definite integral is the <u>only</u> exact method for determining areas under curves that are not straight lines.

Example 1:

Determine the <u>exact</u> area under the curve

$y = f(x) = x^2$ between $x = 2$ and $x = 3$.



$$A = \int y\,dx \text{ or } \int f(x)dx \qquad \text{(General area integral)}$$

$$A = \int_2^3 x^2 dx \qquad \text{Since } y = f(x) = x^2$$

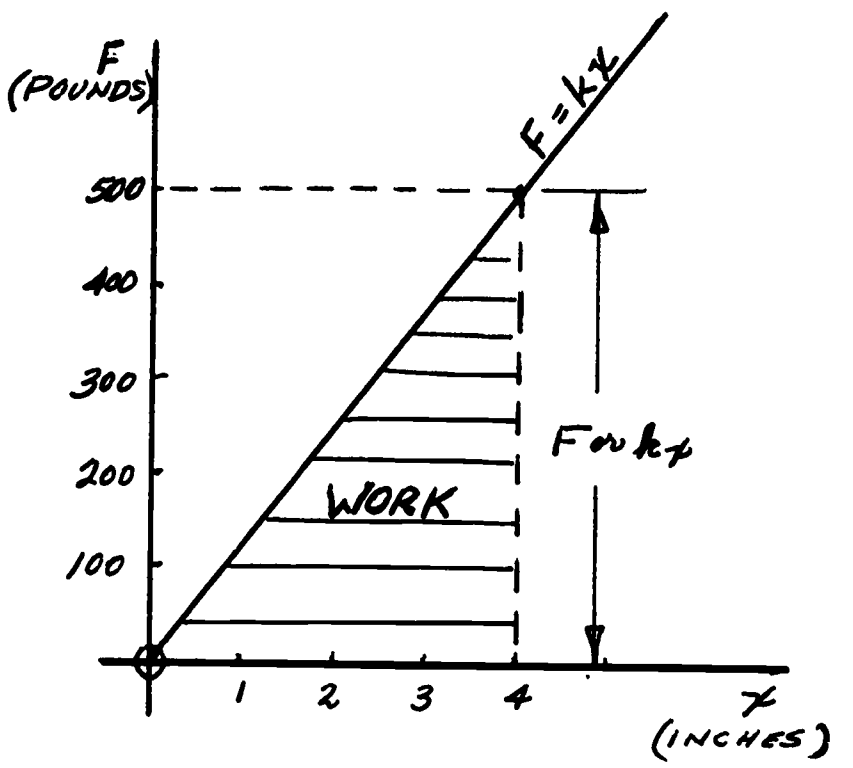
$$A = \left.\frac{x^3}{3}\right]_2^3$$

$$A = \underbrace{\frac{(3)^3}{3}}_{\substack{\text{Total}\\ \text{area (OP3)}}} - \underbrace{\frac{(2)^3}{3}}_{\substack{\text{Area}\\ (OP_1 2)}} = \underbrace{\frac{19}{3}}_{\substack{\text{Net area between}\\ \text{limits 2 and 3}}}$$

Example 2:

How much work is done in stretching a spring 4 inches if it takes 500 pounds of force to produce that amount of stretch?

The constant k symbolizes the spring constant and represents the number of pounds required to either stretch or compress the spring one inch, providing the material of the spring remains within its elastic range.



FORCE - DISTANCE

$$k = \frac{\text{total load on spring}}{\text{change in length}}$$

$$= \frac{500 \text{ lbs.}}{4 \text{ in.}} = 125 \text{ lb./in.}$$

Work is defined as the product of the force and distance when the force is in the direction of motion or displacement (x). $W = F \cdot x$ Since $F \cdot x$ equals work, then the area under the curve represents work.

$$A = \tfrac{1}{2}\, b\, h$$

$$A = \tfrac{1}{2}(x)kx = \tfrac{1}{2}kx^2$$

$$\text{Work } A = \tfrac{1}{2}(125)(4)^2 = 1000 \text{ inch-pounds}$$

Now the above problem will be solved with the definite integral. We know that the area under a curve can be found by taking an integral.

$$\text{Work} = A = \int_a^b F\, dx$$

$$= \int_a^b f(x)\, dx$$

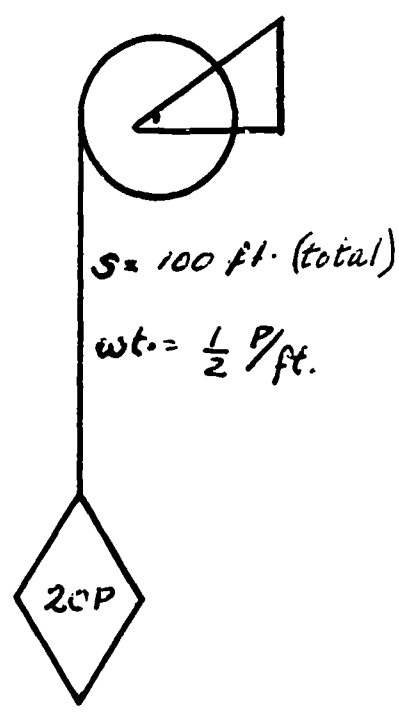
$$= \int_0^4 kx\, dx$$

$$= k\left[\frac{x^2}{2}\right]_0^4 \qquad k = 125 \text{ pound/inch}$$

$$\text{Work} = 125\,\frac{(4)^2}{2} = 1000 \text{ inch-pounds}$$

Example 3: A 20-pound weight is being raised by a 100-foot rope which weighs $\frac{1}{2}$ pound per foot. Determine the work needed to raise the weight 50 feet.

Work = Force x distance (s)
F = $20 + (100-s)\frac{1}{2}$ where s = distance moved
dW = F ds (differential equation of work)



$$dW = \left[20 + (100 - s)\tfrac{1}{2}\right] ds$$

$$dW = (70 - \tfrac{s}{2})ds$$

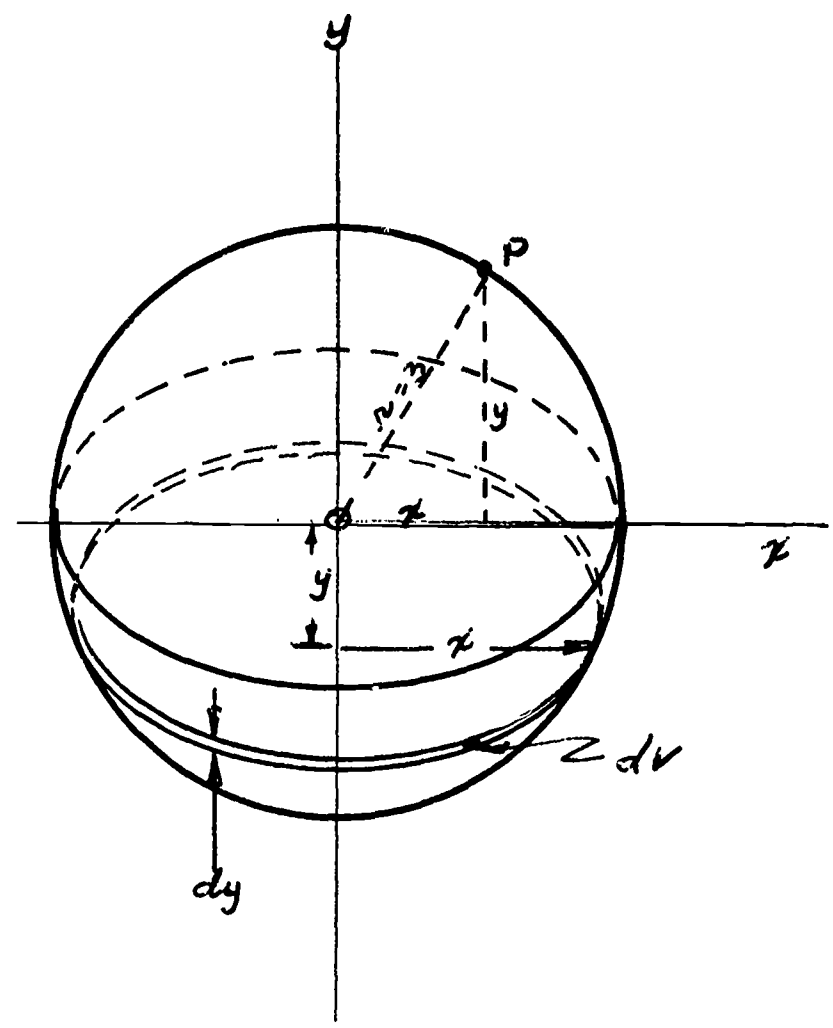
$$\int dW = \int (70 - \tfrac{s}{2})ds$$

$$W = \int_0^{50} (70 - \tfrac{s}{2})ds = 70s - \frac{s^2}{4}\Big]_0^{50}$$

$$W = 2875 \text{ foot-pounds}$$

Example 4:

Determine the amount of work which is needed to pump the water out through the top of a 3-foot-radius sphere which is half filled. The density of water (δ) = 62 pounds/ foot^3.



1. $x^2 + y^2 = r^2$ Equation of a circle.

2. $9 - y^2 = x^2$ Solve for x as a function of y.

3. $dV = \pi x^2 dy$ Volume of a slice (cylinder with height dy)

4. $dF = 62\pi x^2 dy$ Weight of slice

5. Work = Force x distance (s)

   $W = F\,(3 + y)$ (3 + y) equals distance from water level to the top of the sphere

6. $dW = (3 + y)\, dF$

$dW = (3 + y)\, 62\pi x^2\, dy$

7. $\int dW = 62\pi \int_0^3 x^2 (3 + y)\, dy$

8. $W = 62\pi \int_0^3 (9 - y^2)(3 + y)\, dy$ Substitution to make integral in terms of y. (See Step #2)

$= 62\pi \int_0^3 (27 - 3y^2 + 9y - y^3) dy$ Obtain product so integration by parts may be obtained

$= 62\pi \left[27y - y^3 + \frac{9y^2}{2} - \frac{y^4}{4} \right]_0^3$

9. $W = 14,462$ foot -pounds

Problems

1. The spring constant (k) = 1200 pounds/inch. Determine the amount of work done in compressing the spring from 4 to 2 inches. Draw the graph.

2. Find the area under the curve $y = \frac{1}{2}x^2 + 4$ between $x = -1$, $x = 3$, and the x-axis.

3. Find the area bounded by $y = x^2 + 2$, and $y = \frac{3}{2}x + 3$. Hint: The roots are the limits.

4. A crane with a 60-foot cable which weighs 2 pounds per foot lifts a 2000-pound Volkswagon 40 feet. Draw the force-distance diagram and calculate the work done by the crane.

5. A spring has a neutral length of 6 inches. A 16-pound force is used to stretch it to 7 inches. Find the work necessary to stretch the spring from 6 to 8 inches.

6. A 6-foot diameter cylindrical oil tank which is 10 feet long is full of oil ($\delta = 50$ pounds per cubic foot). Determine the work done in removing $\frac{1}{2}$ of the oil and pumping it to a height of 6 feet above the top of the tank.

7. An object which rests on the surface of the earth at a distance (r_e) from the center is held by a gravitational force.

$$F = \frac{GM_e m}{(r_e)^2}$$

G = gravitation constant

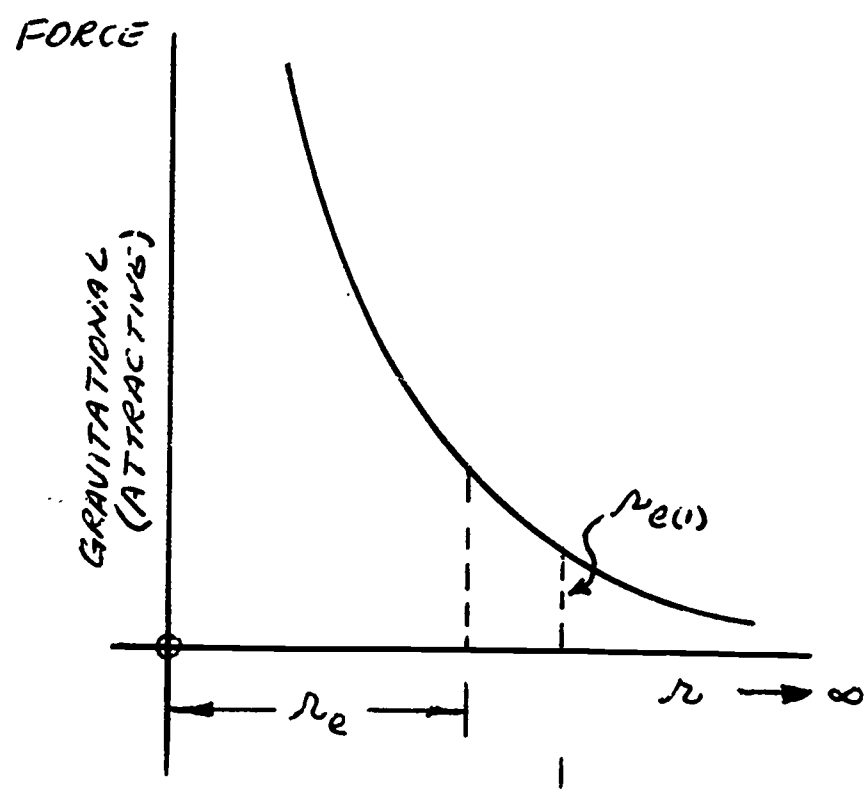
M_e = mass of earth

m = mass of object

r_e = radius of earth

The potential energy (U) of an object is equal to the force times distance. At a large distance from the earth, the earth's attractive force approaches zero, making the potential energy at that point zero.

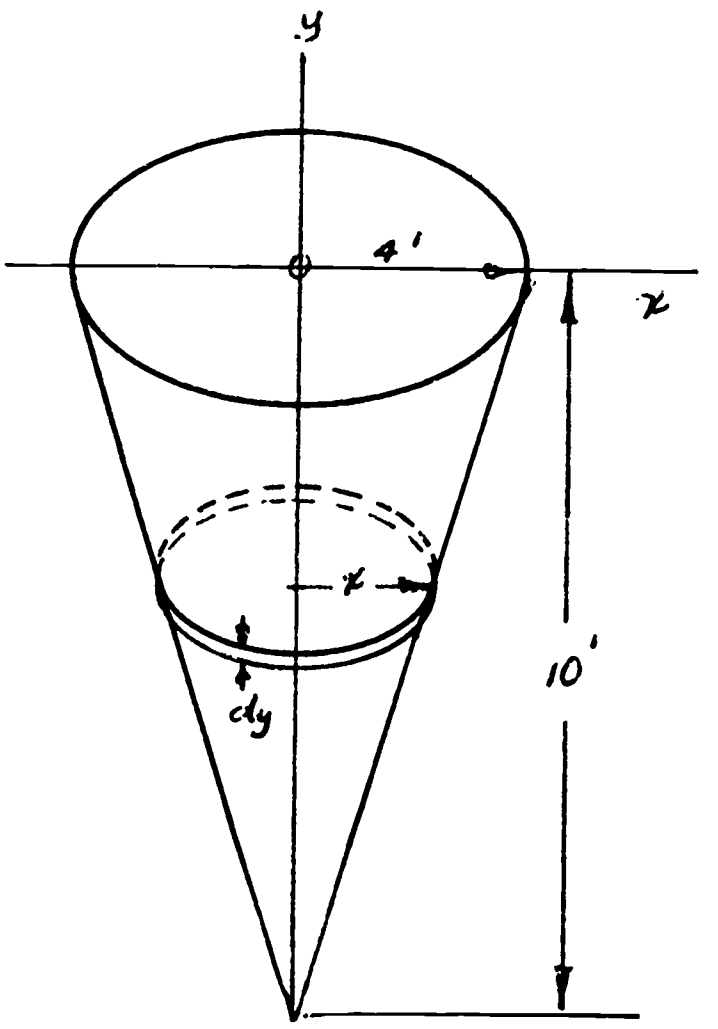
$$\text{Work} = \text{Potential energy} = \int_{\infty}^{r} F\,dr$$



A. Find the potential energy (U) of an object at an infinite distance (∞).

B. Compare this (U) with the potential energy required to just move the object from the surface of the earth to $r_{e(1)}$. Remember, the area under the F-r graph is equal to work or P. E. (U).

8. The illustrated tank is full of oil with a density (δ) of 60 pounds/ft^3. Calculate the work needed to pump the oil out of the top of the cone-shaped tank.



9. Do Problem 8 by setting the coordinate axis at the apex of the cone.

10. Find the area under the parabola $y = x^2 + x - 12$ between the limits $x = -4$ and $x = 3$.

(5-7) Summation: Symbol $\sum$

Before going on to the next topic, let us examine a new symbol, $\sum$ (sigma). We have seen that the integral represents a summation of an infinite number of infinitely small sections; sigma represents a summation of a finite number of parts of distinct size.

These numbers which are summed must be of the same type, or all be developed from the same law of formation.

Every time any numbers are added, a summation is obtained.

$$1 + 2 + 3 + 4 + 5 = 15$$

The above arithmetic sum could be indicated by sigma notation as follows:

$$\sum_{i=1}^{5} x_i = x_1 + x_2 + x_3 + x_4 + x_5$$

$$= 1 + 2 + 3 + 4 + 5 = 15$$

The left member is just a shorthand technique of writing the sum on the right. Verbally we read "the sum, from i = 1 to i = 5, of x-sub-i."

Other examples are:

$$\sum_{i=1}^{3} i^2 = 1^2 + 2^2 + 3^2 = 14$$

$$\sum_{x=1}^{4} (x^2+1) = (1^2+1) + (2^2+1) + (3^2+1) + (4^2+1) = 34$$

In general terms, the expression is written as follows:

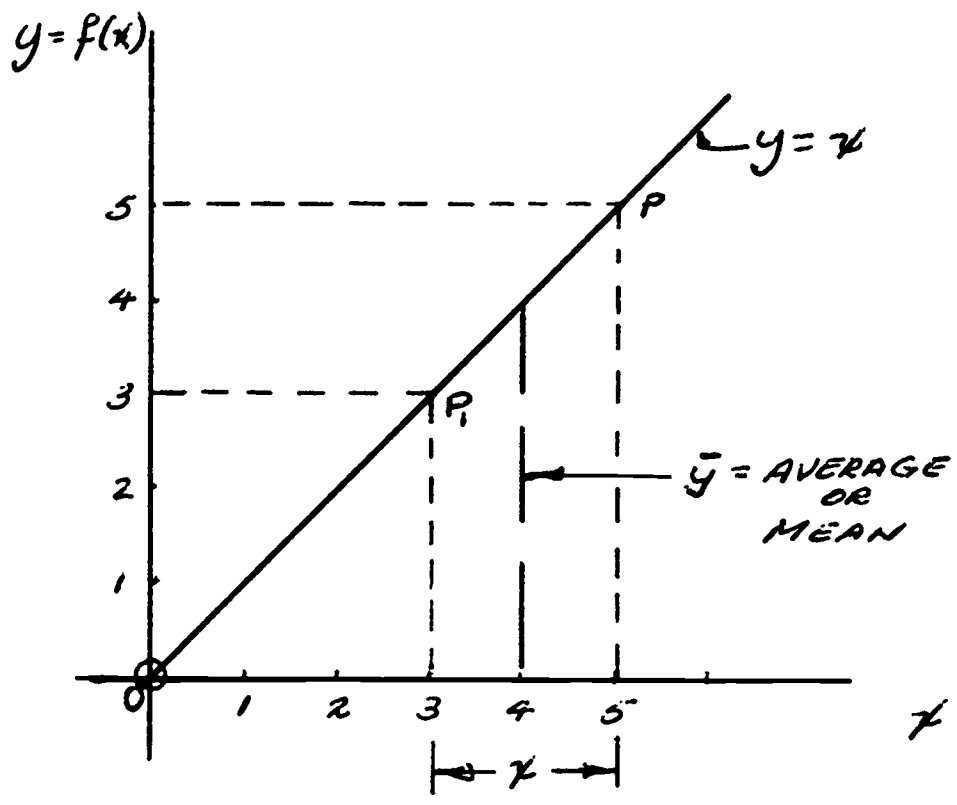
$$\sum_{i=1}^{n} a_i = a_1 + a_2 + a_3 + \ldots + a_n$$

(5-8) The Average or Mean Value

Phenomena that occur in nature do not remain constant - everything changes. To solve problems involving change requires the use of calculus. Average or constant-value problems were solved in arithmetic, algebra, and trigonometry. This is a simplification of the concept of change.

When a person drives a car in the city and covers a distance of 4 miles in 15 minutes, the velocity of the car is usually calculated by $v = \frac{s}{t}$ or $\frac{4}{\frac{1}{4}}$ = 16 miles/hr. This is the average velocity ($\bar{v}$). The bar over the letter means average. Occasionally it is designed as v_{av}. Obviously, in traveling in the city the car stops, accelerates, or changes velocity practically all the time—in fact, it seldom maintains its average velocity.

(5-9) The Average Height (Ordinate) of a Straight Line



Area = base x height

$$A = x\bar{y}$$

$$\bar{y} = \frac{A}{x}$$

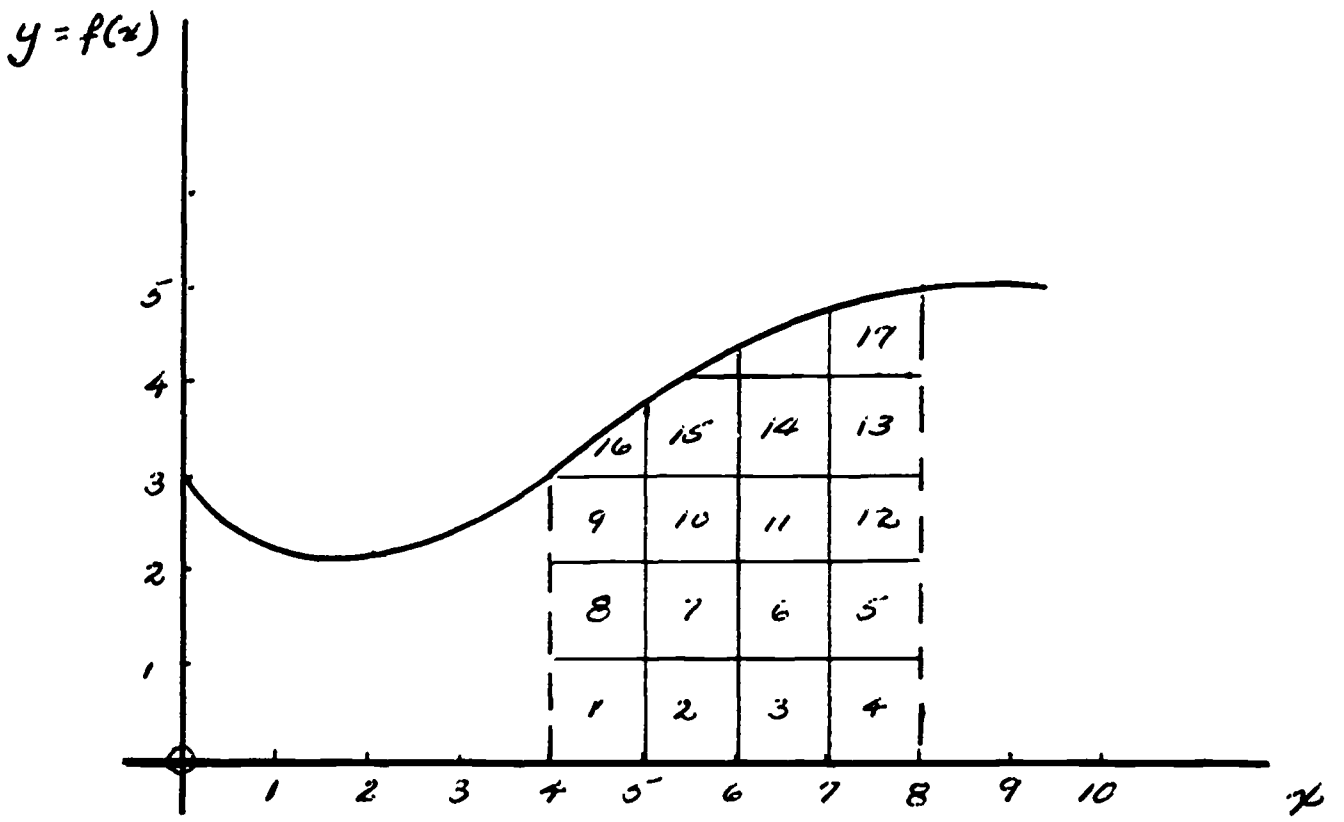
$$\bar{y} = \frac{\text{Area } OP5 - \text{Area } OP_1 3}{5 - 3}$$

$$= \frac{\frac{1}{2}(5)(5) - \frac{1}{2}(3)(3)}{5 - 3}$$

$\bar{y}$ = 4 units (average or mean)

An easier method would be to take $\frac{1}{2}$ of the sum of the ordinates or $\bar{y} = \frac{3+5}{2} = 4$. This method, however, will work for a straight line only.

Now let's take as an example a curve for which the equation is unknown. Because of the unknown functional relationship, we cannot use the definite integral.

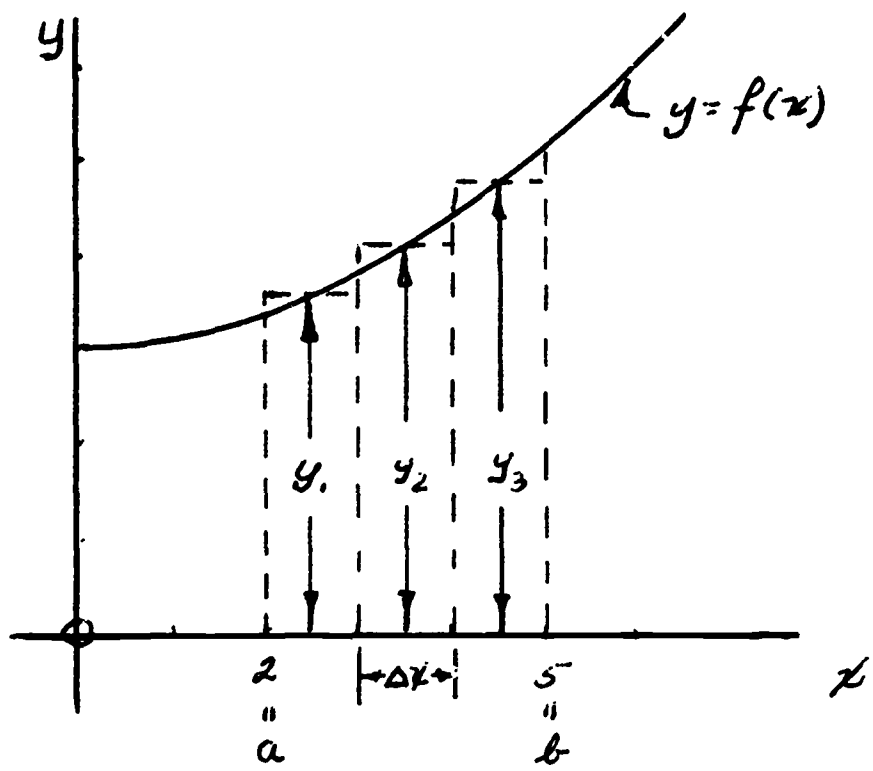


In this case, count the square units under the curve between the limits to obtain the area.

$$\bar{y} \text{ (average)} = \frac{\text{Area}}{x_8 - x_4} = \frac{17}{4}$$

$$\bar{y} = 4.25 \quad \text{(approx.)}$$

(5-10) Average or Mean Ordinate of a Function Which Is Not a Straight Line



$$\bar{y} = y_1 + y_2 + y_3 \cdots y_n$$

Let n = number of rectangles formed between the limits with Δx as the base. That is, $n\Delta x = b - a$

$$\bar{y} = \frac{A}{b-a} = \frac{\sum_{y=2}^{n} y\Delta x}{b - a}$$

Taking the limit as $n \rightarrow \infty$ gives

$$\bar{y} = \frac{\int_a^b f(x)\,dx}{b - a}$$

This equation simply states that $\bar{y}$ equals the definite integral or exact area under the curve divided by the length along the x-axis for the section.

Example 1: Find the mean or average value of the ordinate of $y = x^2 + 2$ between the limits $x = 2$ and $x = 5$.

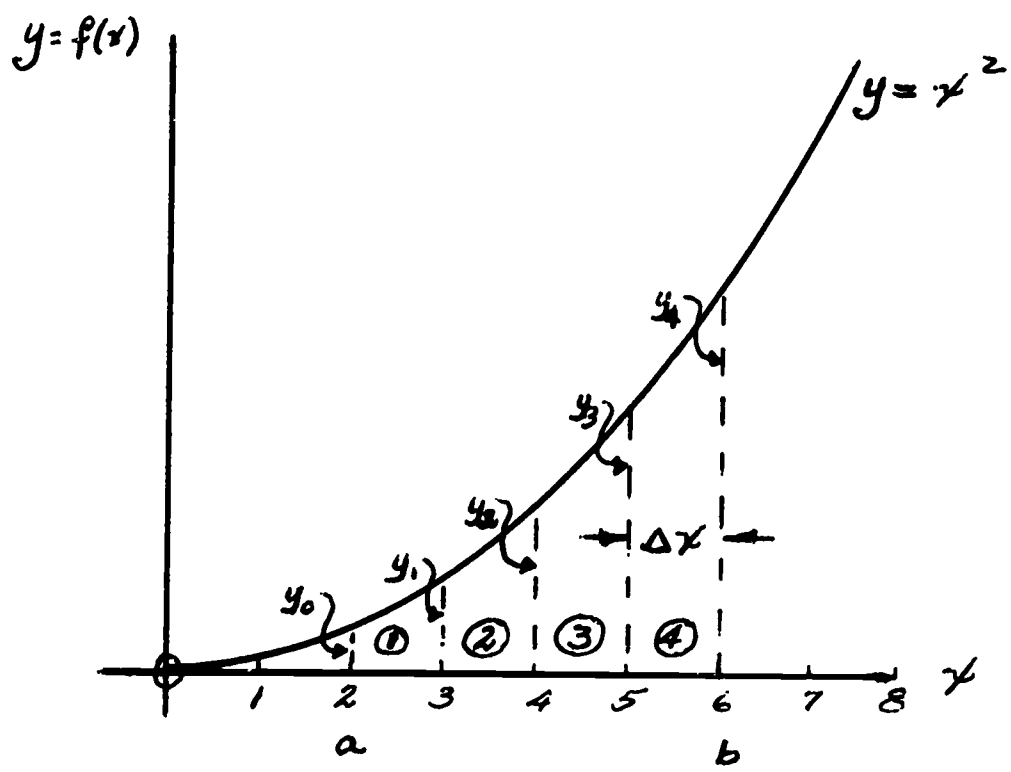
$$\bar{y} = \frac{\int_a^b f(x)dx}{b - a}$$

$$= \frac{\int_2^5 (x^2 + 2)dx}{5 - 2} = \frac{\left.\frac{x^3}{3} + 2x\right]_2^5}{3}$$

$$= 15$$

(5-11) Trapezoidal Method of Finding Areas

This method is not as exact as the definite integral method, depending as it does on the summation of finite parts ($\sum$). It is explained here primarily to develop a technique for determining an area when it is awkward or impossible to express the curve in terms of $y = f(x)$, or if the equation is unknown.



$y_0 = f(x) = x^2 = (2)^2 = 4$

$y_1 = f(3) = (3)^2 = 9$

$y_2 = f(4) = (4)^2 = 16$

$y_3 = f(5) = (5)^2 = 25$

$y_4 = f(6) = (6)^2 = 36$

The accuracy of this method depends on the number of trapezoids (n). As n increases, the area under the curve approaches the exact area obtained by integration.

Method

1. You select n (number of trapezoids). Here n = 4.

2. Determine $\Delta x = \frac{\text{upper limit (b) - lower limit (a)}}{n} = \frac{6-2}{4} = 1$

3. Area of each trapezoid

$$A_1 = \tfrac{1}{2}(y_0 + y_1)\Delta x = \tfrac{1}{2}(4 + 9)(1) = 6.5$$

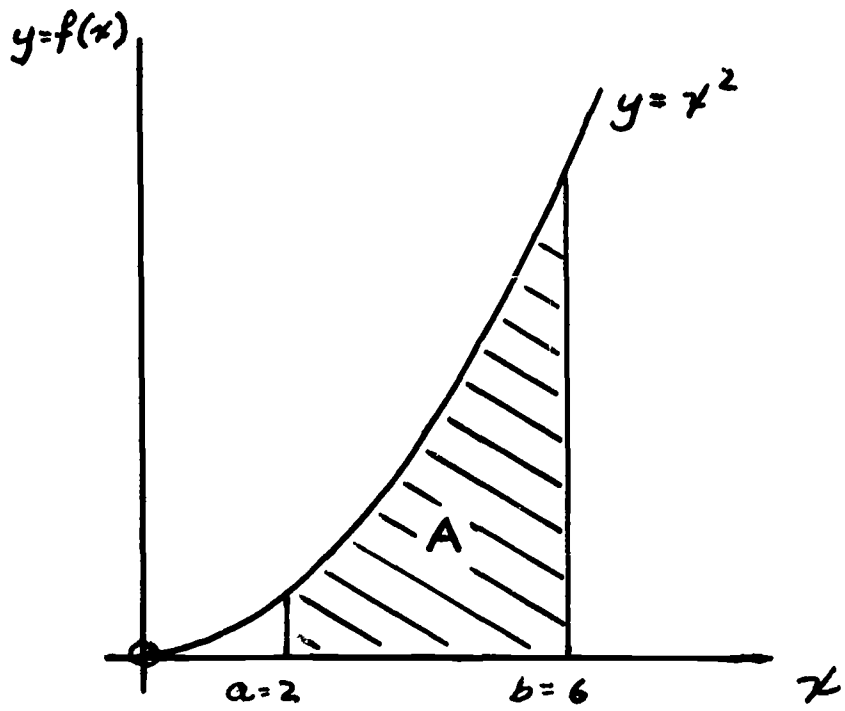
$$A_2 = \tfrac{1}{2}(y_1 + y_2)\Delta x = \tfrac{1}{2}(9 + 16)(1) = 12.5$$

$$A_3 = \tfrac{1}{2}(y_2 + y_3)\Delta x = \tfrac{1}{2}(16 + 25)(1) = 20.5$$

$$A_4 = \tfrac{1}{2}(y_3 + y_4)\Delta x = \tfrac{1}{2}(25 + 36)(1) = \underline{30.5}$$

4. Summation of trapezoids $\sum =$ 70.0

This answer is approximate. The accuracy depends on how much the secant lines vary from the curve between the selected points (y_0 and y_1, etc.). The greater the number n, the more accurate the results.



Now let us solve for the <u>exact area</u> in the above problem by calculus.

$$A = \int_a^b (y)dx = \int_a^b f(x)dx$$

$$A = \int_2^6 x^2 dx$$

$$= \frac{x^3}{3}\Big]_2^6 = \left[\frac{6^3}{3} - \frac{2^3}{3}\right] = (72 - 2.6) = \underline{69.4}$$

The difference between the two methods is only 0.6 square units of area. Using the trapezoid method, if n were large, the approximate value for the area would approach 69.4 as a limit.

Problems

1. $\sum_{x=1}^{4}(2^x + 1)$

2. $\sum_{x=2}^{5}\frac{x}{2^{x-1}}$

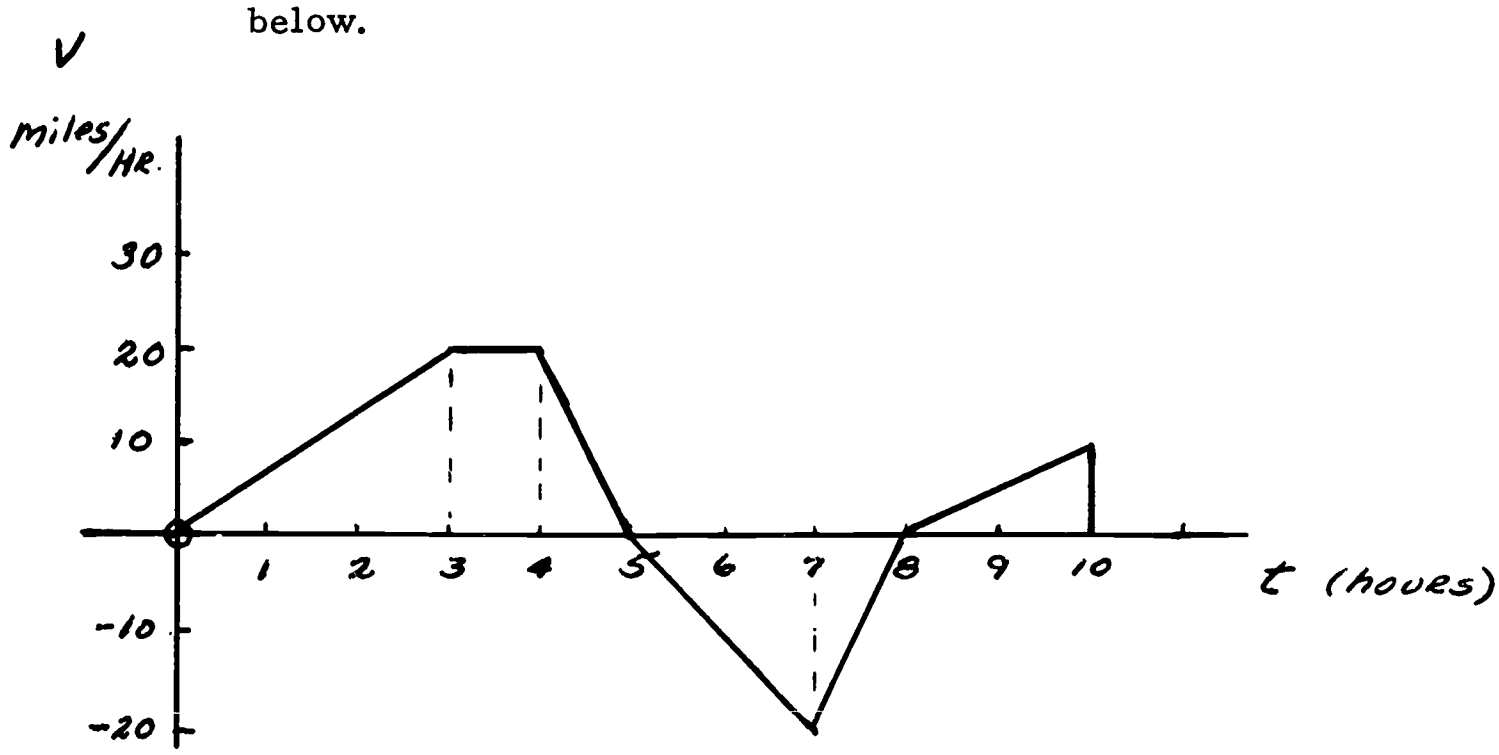
3. $\sum_{n=-3}^{3}(n^2 - 3)$

4. $\sum_{y=-2}^{3}\frac{1}{2^y}$

5. $\sum_{y=-3}^{1}3^{y-1}$

6. Find $\bar{y}$ of the function $y = \frac{x^2}{2} + 2x$ between the limits $x = -1$ and $x = 3$.

7. Find the average velocity from the velocity-time diagram below.



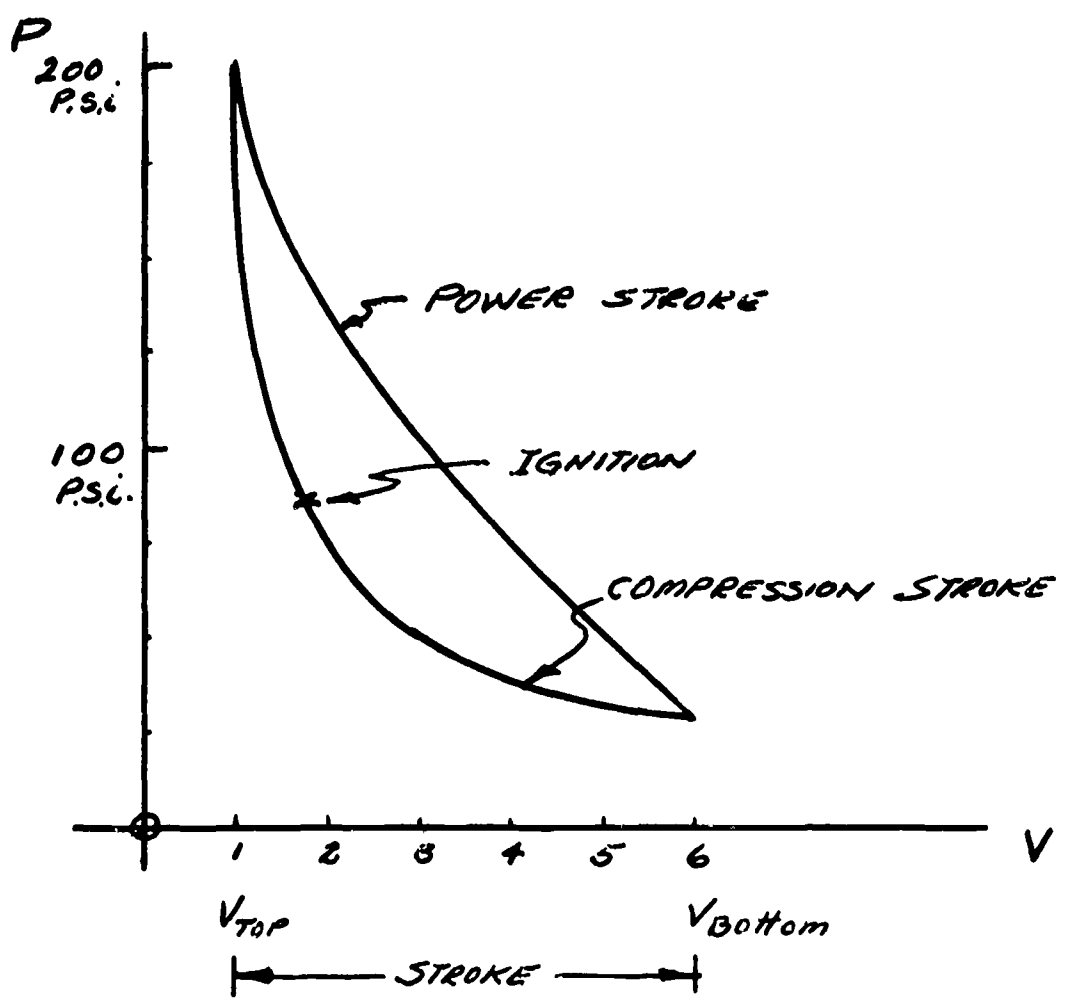
8. The distance-time relation due to gravitation in free fall is $s = \frac{1}{2}gt^2$ where $g = 32$ ft. /sec. ^{2}.

   a. Find the velocity at the end of the 3rd second and the 5th second.

   b. Find the distance between these times.

   c. Find the average velocity between $t = 3$ and $t = 5$ seconds.

9. In determining the indicated horsepower of an engine, the indicator card shows the following curve:



Determine approximately the mean or average pressure throughout the stroke. (This is called the indicated mean effective pressure in power calculations.)

10.

$$F = ma$$

$$a = \frac{\Delta v}{\Delta t}$$

$$F\Delta t = m\Delta v$$

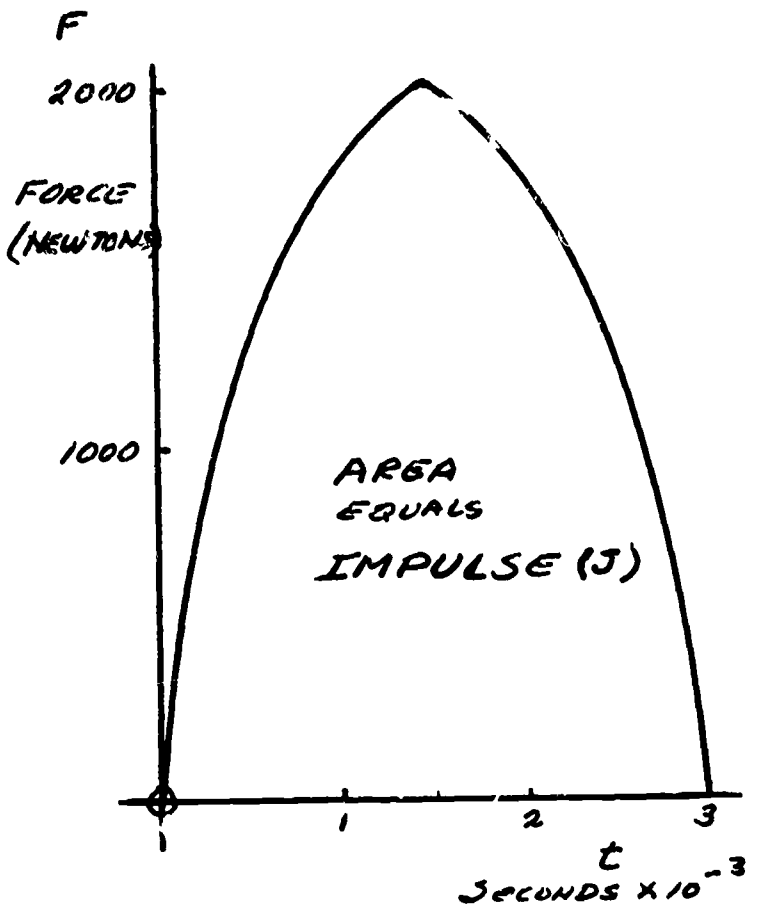
(J) Impulse = Momentum (P)

$$\text{Force} = \frac{dP}{dt}$$

Force equals time rate of change of momentum.

$$J(\text{Impulse}) = Fdt$$

$$= \bar{F}\Delta t$$



A bat hitting a ball may be represented by the force-time diagram indicated above. If the ball has a mass of 0.25 kg., what is the average force ($\bar{y}$)? Determine its velocity at the instant it leaves the bat.

Solve the following by the trapezoidal method:

11. $y = x^3$, $n = 5$, between $x = 2$ and $x = 6$.

12. $y = \sqrt{25 - x^2}$, $n = 5$, between $x = 0$ and $x = 3$.

13. Solve the above problem between $x = 3$ and $x = 5$.

14. Compute the approximate value of $\int_0^2 \sqrt{4 + x^3}\, dx$ using $n = 4$.

15. Find the $\bar{y}$ or mean value of $y = \sin x$ between $x = 0$ and $x = 90^\circ$ if the integral of the $\sin x$ equals $-\cos x$.

16. Find the mean height between $y = x - x^2$ and the x-axis.

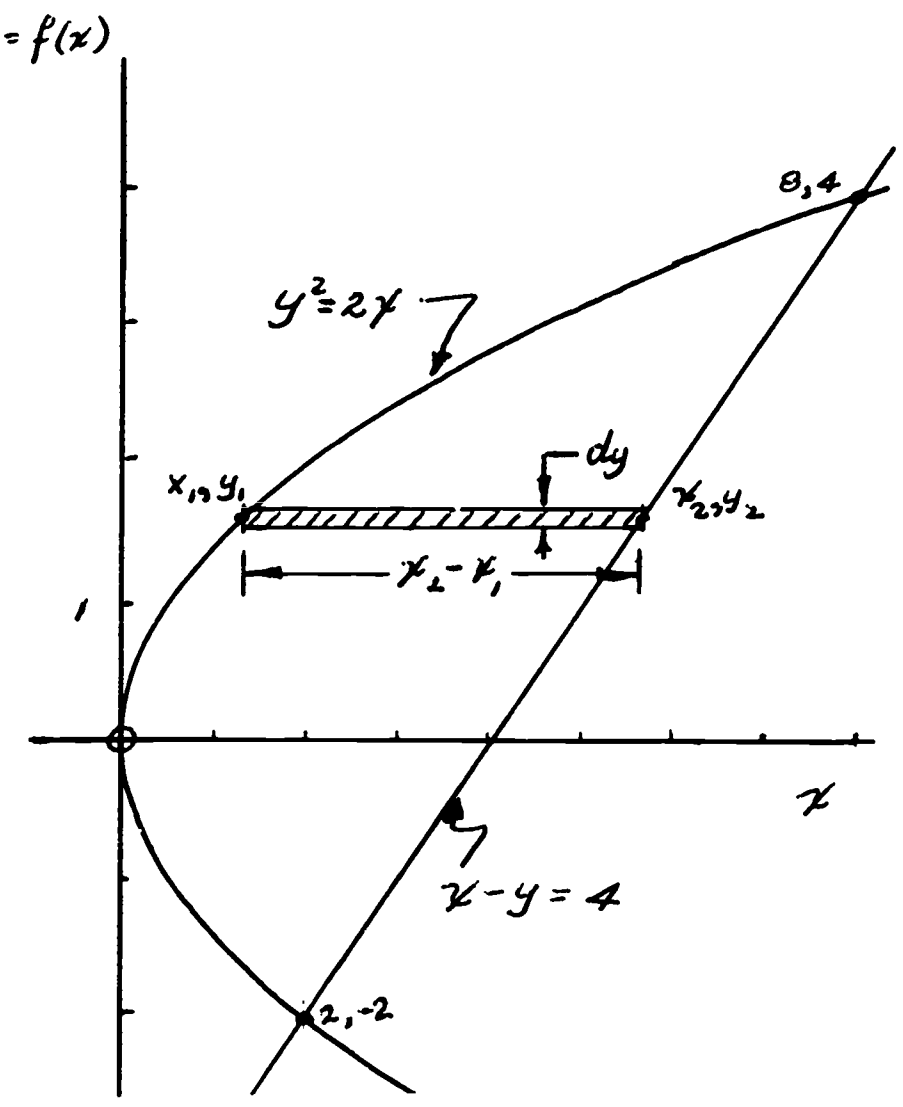
(5-12) Area Formed by the Curves of Two Equations

To solve this type of problem, it is advisable to make a sketch first, then analytically solve for the roots or intersection points between the equations. An intelligent selection of increments or slices is important to obtain the easiest solution.

Note: Always select the rectangular slices in such a direction that the slices are summed between the limits or roots of the equations.

Example 1:

Find the area formed by the intersection of the parabola $y^2 = 2x$ and the straight line $x - y = 4$.



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Method

1. Solve for the roots of the equation.

2. Selection of a horizontal slice - only 2 limits.
(Here vertical slices would start at (0, 0) go to (2, -2) and then to (8, 4), giving 3 limits.)

3. $$\underset{\text{Increment of area}}{dA} = \underset{\text{length}}{(x_2 - x_1)} \cdot \underset{\text{increment of width}}{dy} \qquad \text{(for a slice)}$$

4. $$dA = \left[(4 + y) - \frac{y^2}{2}\right]dy \qquad \text{Substituting for } x_2 \text{ and } x_1$$

$$\int dA = \int_{-2}^{4} (4 + y - \frac{y^2}{2}\ dy$$

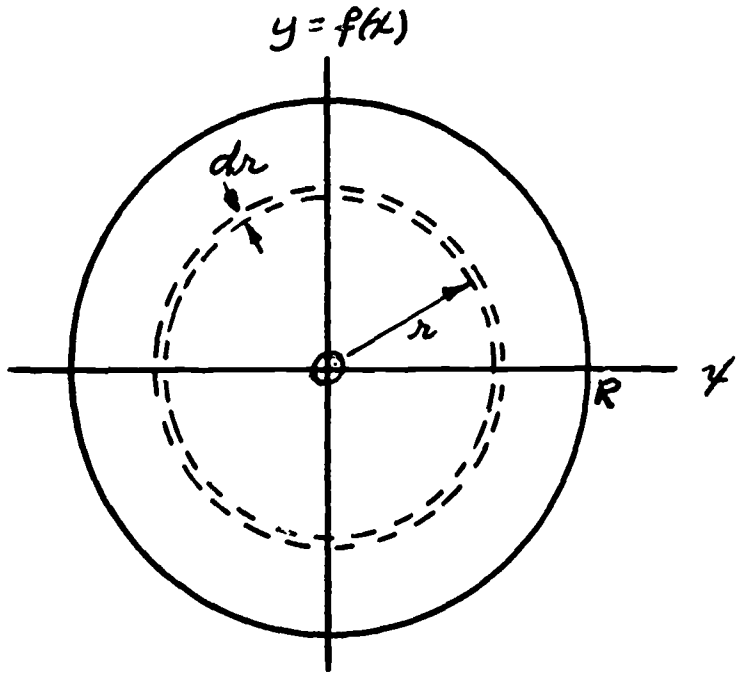
The limits are the roots of the differential variable (y) in the above example.

$$A = 4y + \frac{y^2}{2} - \frac{y^3}{6}\Big]_{-2}^{4}$$

$$A = \left[16 + 8 - \frac{64}{6}\right] - \left[-8 + 2 + \frac{8}{6}\right]$$

$$A = 18$$

Example 2: Derive the equation for the area of a circle.



Take an annulus or ring of the whole.

Circumference $= 2\pi r$

$$dA = 2\pi r dr \quad \text{(Area of dotted ring)}$$

$$\int dA = \int_0^R 2\pi r dr$$

$$A = 2\pi \int_0^R r dr$$

$$A = 2\pi \left[\frac{r^2}{2}\right]_0^R$$

$$A = 2\pi \left[\frac{R^2}{2} - \frac{0^2}{2}\right]$$

$$A = \pi R^2$$

Problems

1. Draw the figure and find the area bounded by $y^2 = 6x$ and $x^2 = 6y$.

2. Draw and find the area bounded by $x - \frac{y}{4} = 4$ and $\frac{y^2}{4} = 5$.

3. Find the area bounded by $x = y^3$ and $x = y^2 + 2y$.

4. Draw and find the bounded area of $y = 2\sqrt{x}$ and $x^2 = 4y$ by using horizontal elements and by vertical elements.

5. Find the area bounded by the parabola $y = x^2 + x - 12$ and the x-axis between the limits $x = -4$ and $x = 3$.

6. Find the area bounded by the curve $y = 4x + 5 - x^2$ and the x-axis.

7. Find the area of the hyperbola $xy = 10$ between the limits of $x = 2$ to $x = 8$ and the x-axis.

8. Calculate the area formed between the parabolas $y^2 = x$ and $y^2 = 6x$ and $x = 6$.

9. Calculate the distance traveled (by integration) of a falling body from 3 sec. to 6 sec. after it starts, if $v = gt$, where g is the constant of acceleration, v is the velocity, and t is the time.

(5-13) Volume by Integration

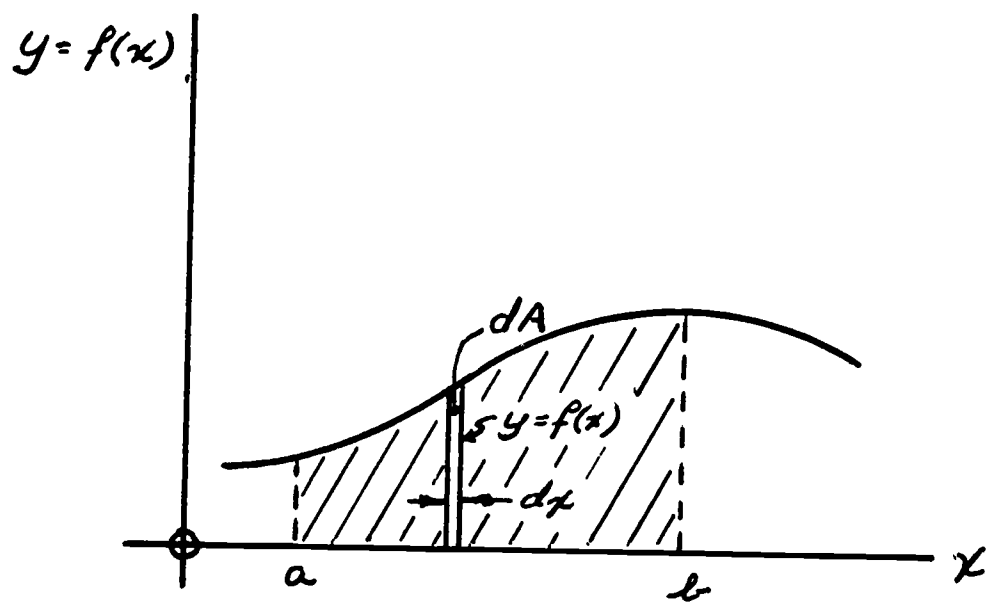
To determine areas formed between curves, a slice increment of the area was taken and then all these small elements were summed up or integrated between some boundaries or limits which were designated.

Volumes are found by a similar method of integrating an area between limits, or by revolving an area about some axis.

An important notion to remember is that the element or increment may represent any quantity which is assigned to it in order to solve the problem at hand, such as a plane area, volume, force, pressure, work, power, energy, etc.

To review: in finding the area under a curve, an increment is taken, which is

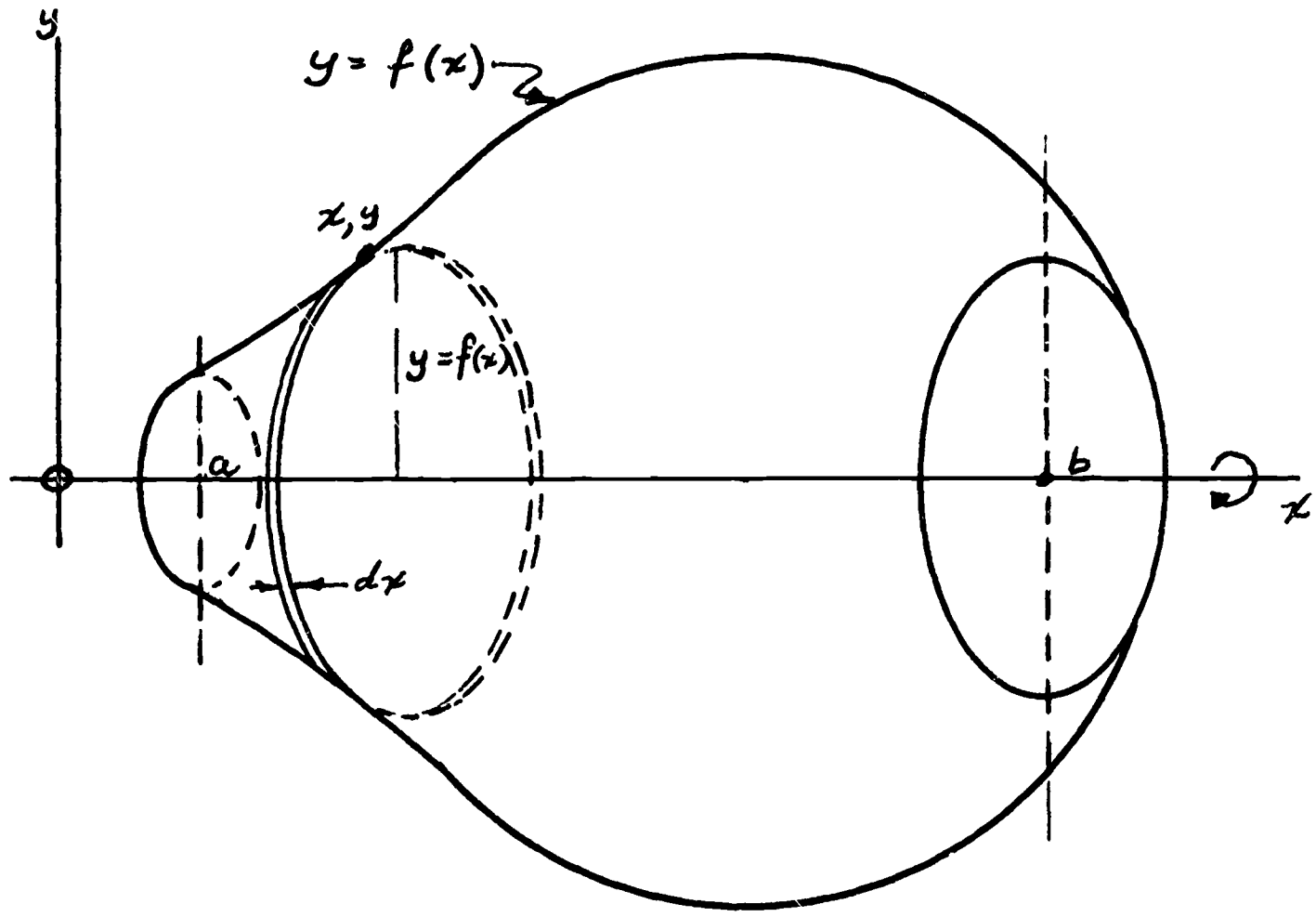
$$dA = y\,dx$$



Summing the increments and taking the limit gives

$$A = \int_a^b y\,dx$$

$$\text{or} \quad A = \int_a^b f(x)dx$$



(1) The Disc Method

Now let us determine the volume generated by the above curve if f(x) is rotated about the x-axis.

For an increment of the volume, let y = f(x) for some point x, where y is the radius of the revolving point; the volume then becomes, by summation of elements,

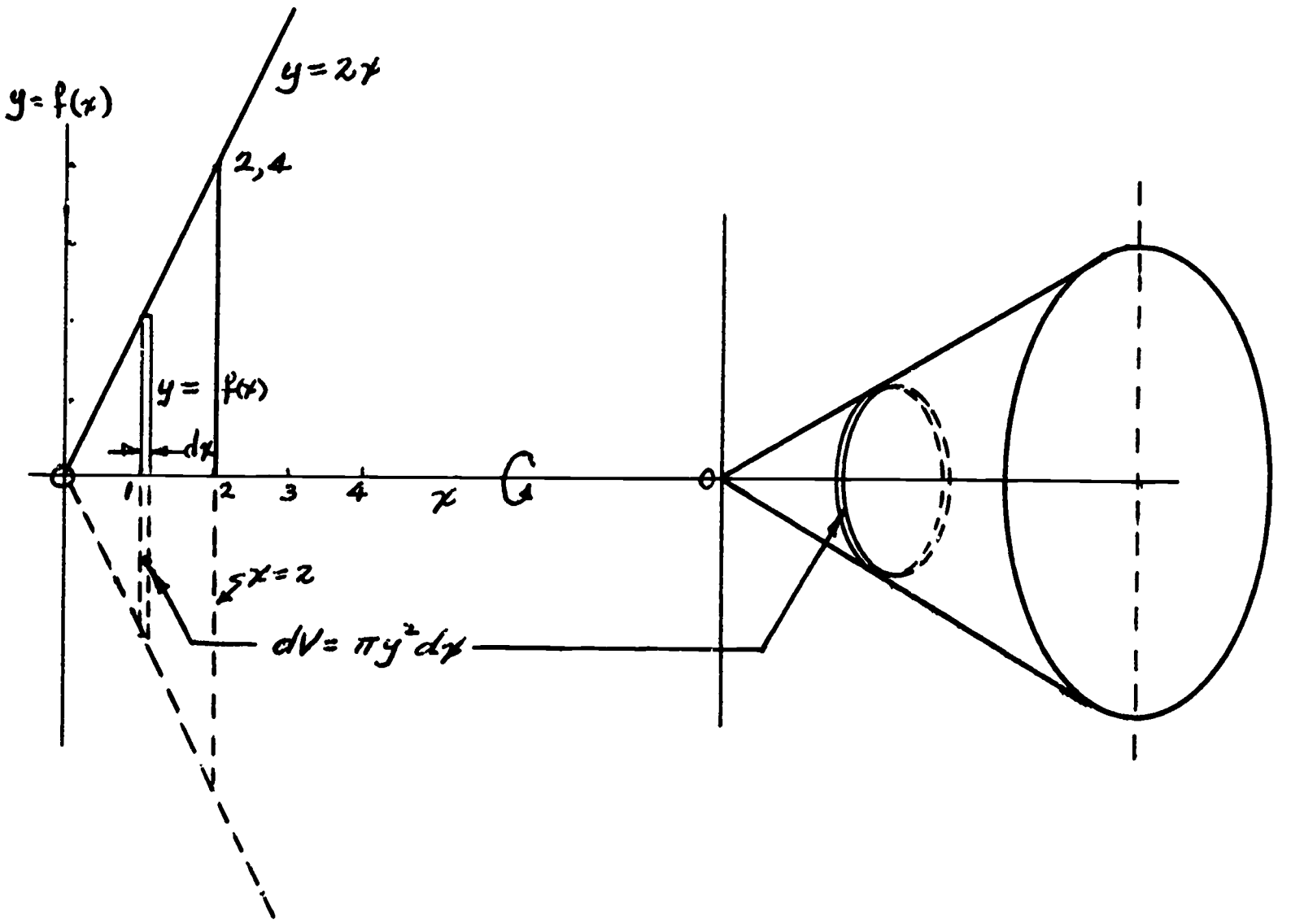
$$dV = \pi R^2 dx = \pi y^2 dx$$

$$\int dV = \pi \int y^2 dx$$

$$V = \pi \int_a^b y^2 dx$$

This is the general equation for volume. The important point to remember is that $\pi R^2 dx$ is the area times the thickness, that is, the volume of the increment, which is integrated between the required limits to get the total volume of revolution.

Example 1: Find the volume of y = f(x) = 2x when rotated about the x-axis and bounded by x = 2.

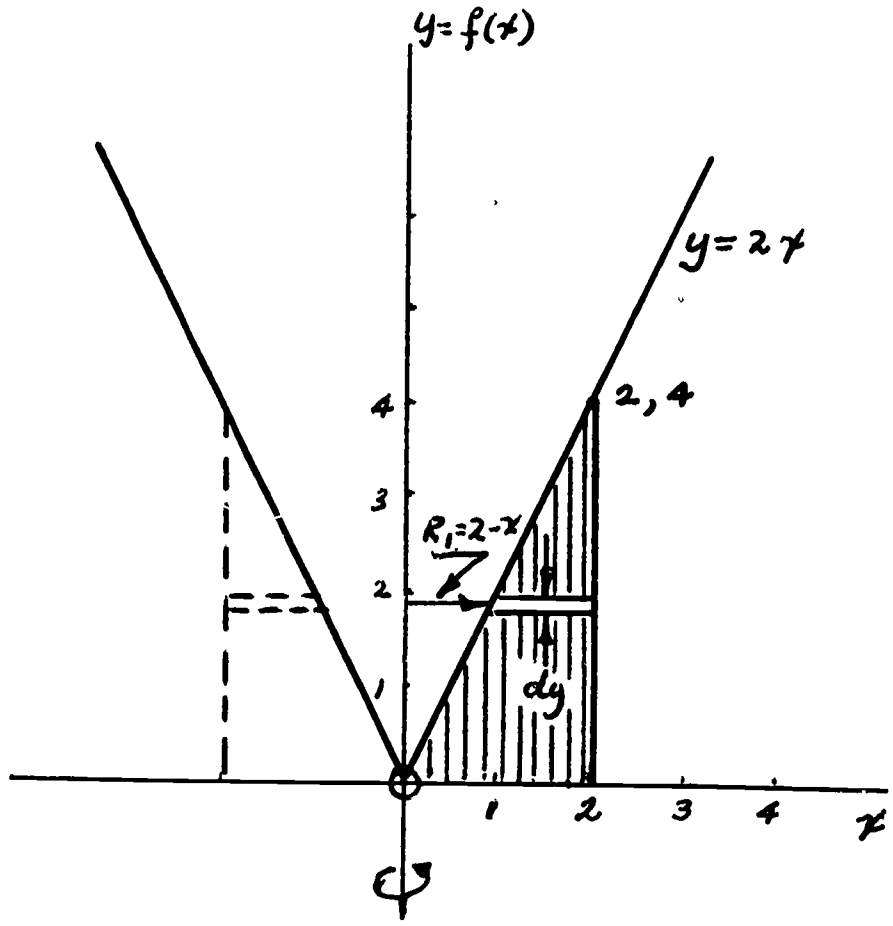


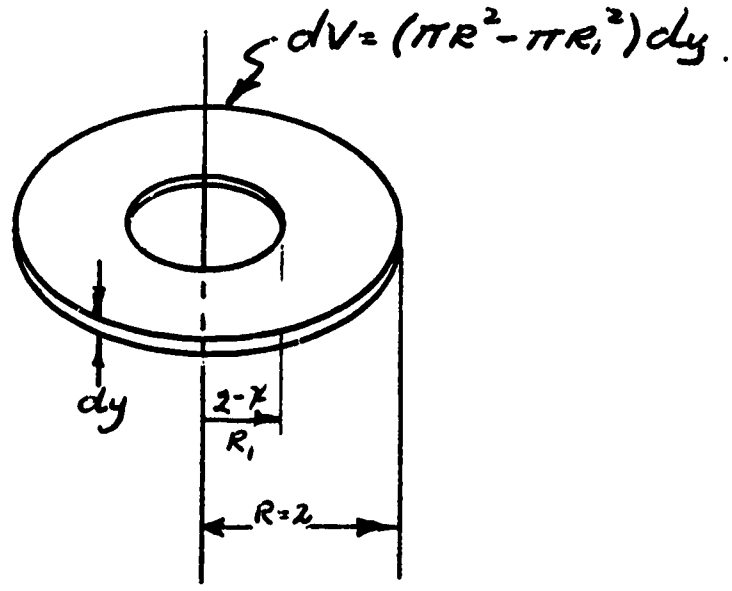
$$
\begin{aligned}
V &= \int_a^b (\pi y^2)dx \\
&= \pi\int_0^2 (2x)^2 dx \\
&= 4\pi\int_0^2 x^2 dx \\
&= 4\pi\frac{x^3}{3}\Big]_0^2 \quad = \frac{32\pi}{3}
\end{aligned}
$$

Since an increment of volume is a disc, this is called the <u>DISC</u> <u>METHOD.</u>

Example 2 (The Washer Method)

Rotate the same curve about the y-axis and determine the volume produced by the rotation of the shaded portion.





$$V = \int_a^b \left[\pi R^2 - \pi R_1{}^2\right] dy$$

$$= \int_a^b \left[\pi(2)^2 - \pi(2 - x)^2\right] dy$$

$$= \pi \int_0^4 4 - (4 - 4x + x^2)\, dy$$

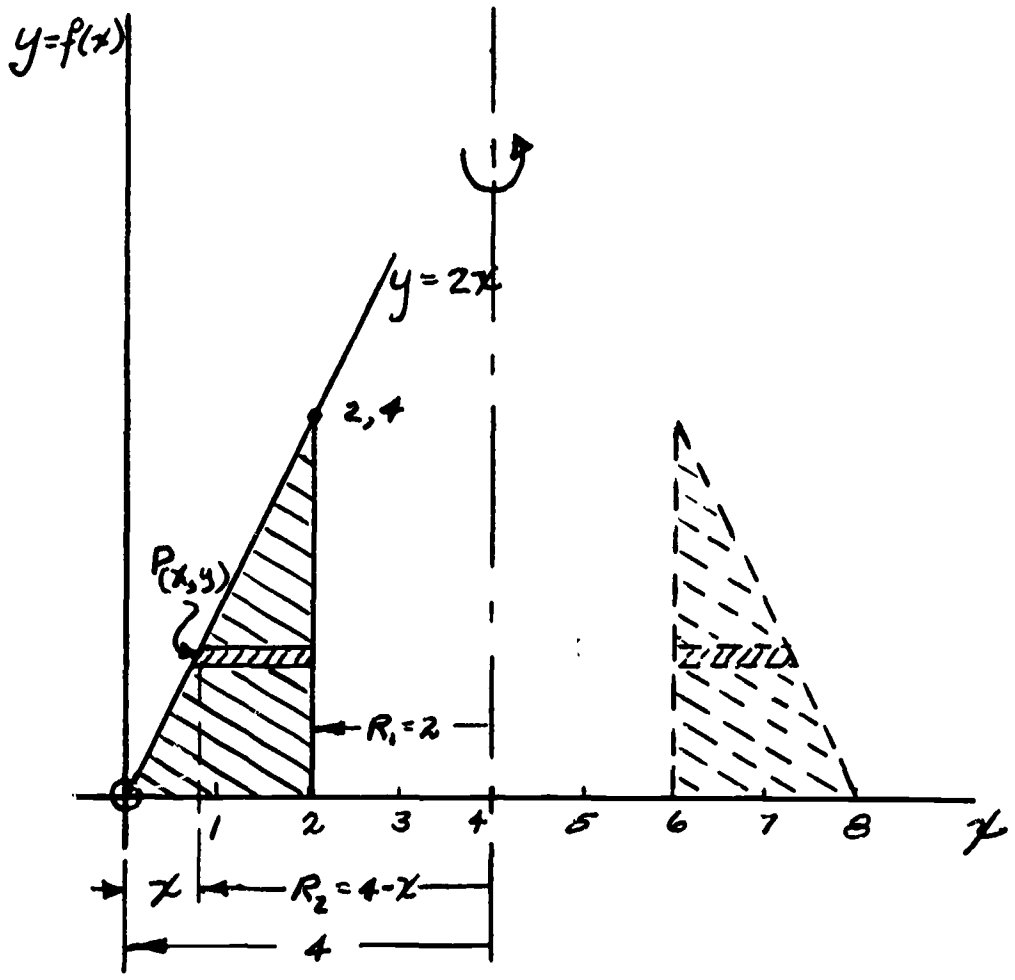
$$= \pi \int_0^4 \left[4\left(\frac{y}{2}\right) - \frac{y^2}{4}\right] dy$$ Substituting the value of y for x from the original equation

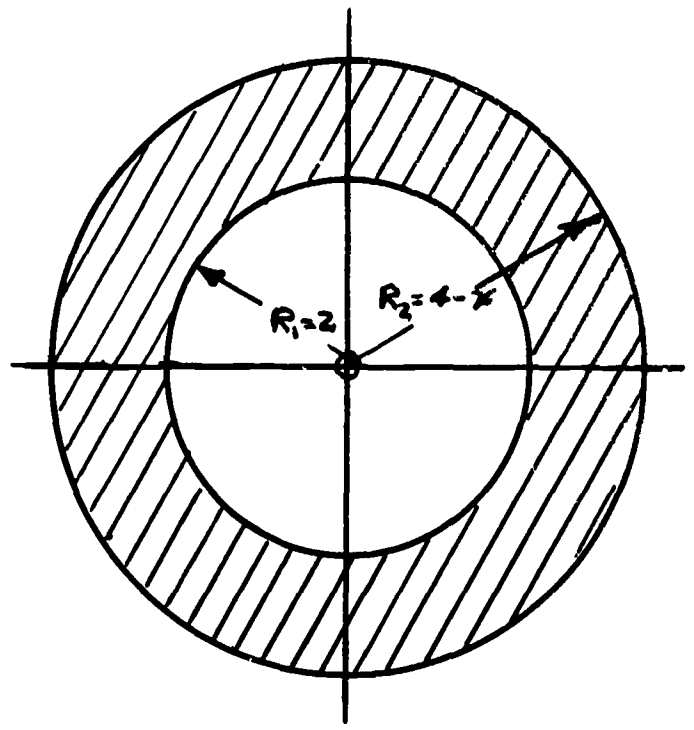
$$= \pi \left[y^2 - \frac{y^3}{4 \cdot 3}\right]_0^4$$

$$= \pi\left(16 - \frac{16}{3}\right) = \frac{32\pi}{3}$$

Since the increment of this volume is a "washer", this is called the <u>WASHER METHOD</u>.

Example 3: Rotate the same curve about the line x = 4 and find the volume produced by the rotation of the shaded portion.





Area of washer $= \pi(R_2^2 - R_1^2)$

Increment of volume $dV = \pi(R_2^2 - R_1^2)dy$

$$V = \int_a^b \pi(R_2^2 - R_1^2)dy$$

$$= \int_0^4 \pi\left[(4-x)^2 - 2^2\right] dy$$

$$= \int_0^4 \pi(16-8x + x^2 - 4)dy$$

$$= \pi\int_0^4 (12-8x + x^2)dy$$

But the x terms must be in terms of y because of dy. $x = \frac{y}{2}$ from the equation of the curve. Substituting:

$$V = \pi\int_0^4 (12 - 4y + \frac{y^2}{4})\, dy$$

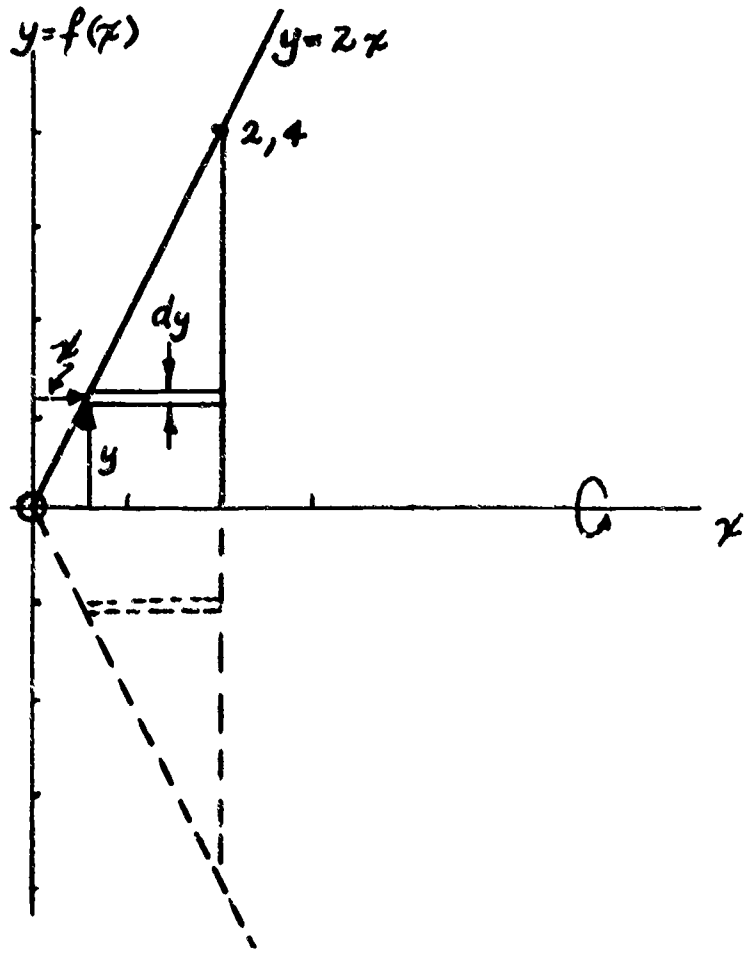
$$= \pi\left[12y - \frac{4y^2}{2} + \frac{y^3}{12}\right]_0^4$$

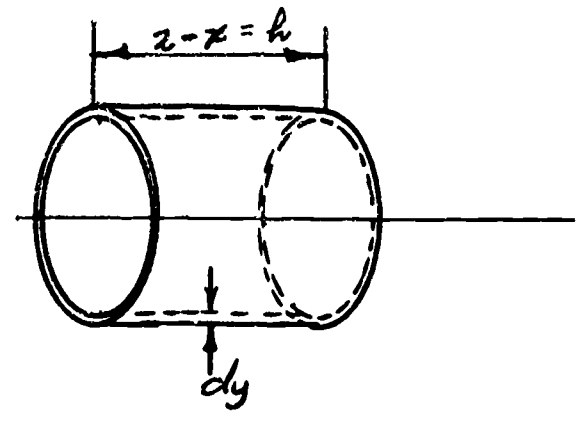
$$= \pi(48 - 32 + \frac{16}{3})$$

$$= \frac{64\pi}{3}$$

This is again the washer method. The important point to remember is to obtain the radii from the <u>center</u> line of rotation.

Example 4: (The Shell Method) Solve Ex. 1 using horizontal elements of volume.





ELEMENT OF VOLUME IS SHELL

This volume might be conceived of as a constantly expanding cylindrical shell whose radius (y) increases from 0 to 4 and whose height (x-value) varies from 2 down to 0.

The element of volume is obtained by taking the

circumference x height x differential of thickness

$$dV = 2\pi r \times h \times dy$$

$$dV = 2\pi y \quad (2 - x)dy$$

All the unknowns in the dV expression must be in terms of y, since the differential term is dy. Therefore we will substitute $\frac{y}{2}$ for x (from the original equation).

$$dV = 2\pi y(2 - \frac{y}{2})dy$$

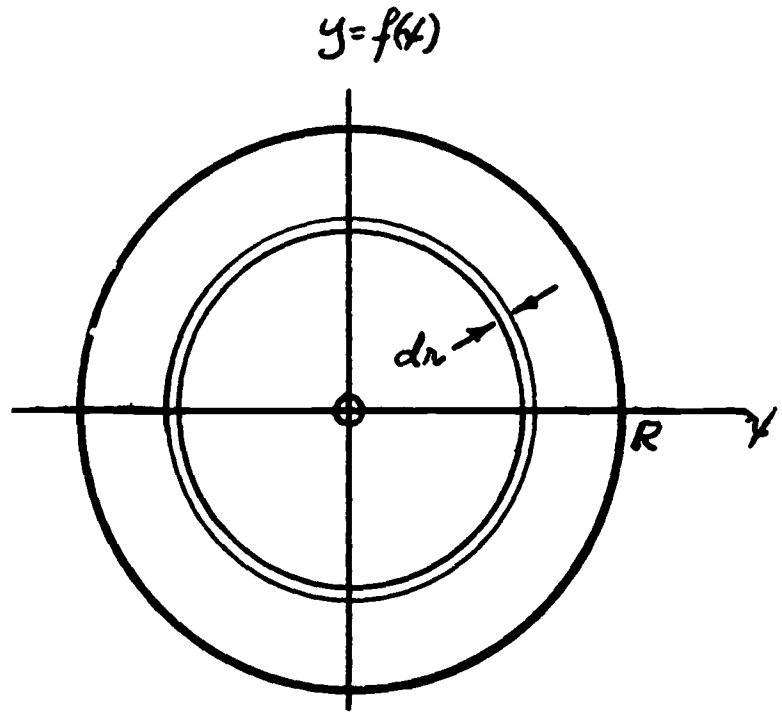
$$\int dV = 2\pi\int_0^4 (2y - \frac{y^2}{2})dy$$

$$V = \left[2\pi\ y^2 - \frac{y^3}{6}\right]_0^4$$

$$V = \frac{32\pi}{3}$$

The solution of this problem by this method is more work than the disc method of Example 1. It is, however, a convenient method to use when integration by another method becomes too complex.

Example 5: Derive the formula for the volume of a sphere.



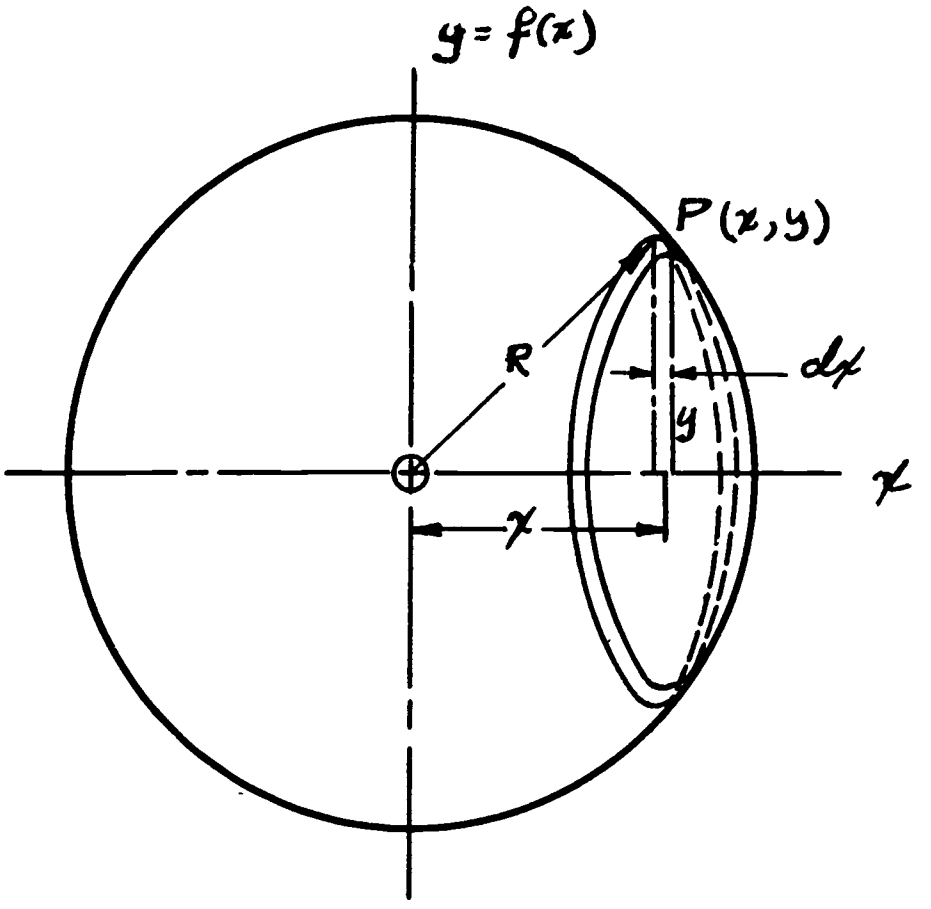
Method 1 (Shell Method).

Area of sphere $= 4\pi R^2$

$$V = \int_0^R 4\pi r^2 dr$$

$$V = \left.\frac{4\pi r^3}{3}\right]_0^R$$

$$V = \frac{4\pi R^3}{3}$$



Method 2 (Disc Method).

(for $\frac{1}{2}$ sphere)

$$V = \int_0^R \pi y^2 dx$$

General equation for a circle:

$$x^2 + y^2 = R^2$$

$$V = \pi \int_0^R (R^2 - x^2) dx$$

$$V = \pi \left[R^2 x - \frac{x^3}{3} \right]_0^R$$

$$V = \pi (R^3 - \frac{R^3}{3})$$

$$= \frac{2\pi R^3}{3}$$

This represented $\frac{1}{2}$ sphere. Therefore, for the whole sphere,

$$V = \frac{4\pi R^3}{3}$$

Problems

1. Find the volume which results from rotating the line $y = 2x$ about the x-axis when it is bounded by $x = 3$.

2. Referring to Problem #1, rotate the same triangle about the y-axis to determine the volume of the cone.

3. Rotate the same triangle about the axis $y = -1$ to find the volume of the figure.

4. Find the volume bounded by the parabola $y = x^2$ and the line $x = 3$ when the figure is rotated about the y-axis.

5. Find the volume bounded by the same two curves when the figure is rotated around the x-axis.

6. Find the volume above the x-axis generated by revolution of the curves $y = x^3$ and $x = 2$ when rotated around $x = 4$.

7. A 10-inch solid sphere is to have a segment 3 inches deep sliced off it. Determine the volume of the segment cut off.

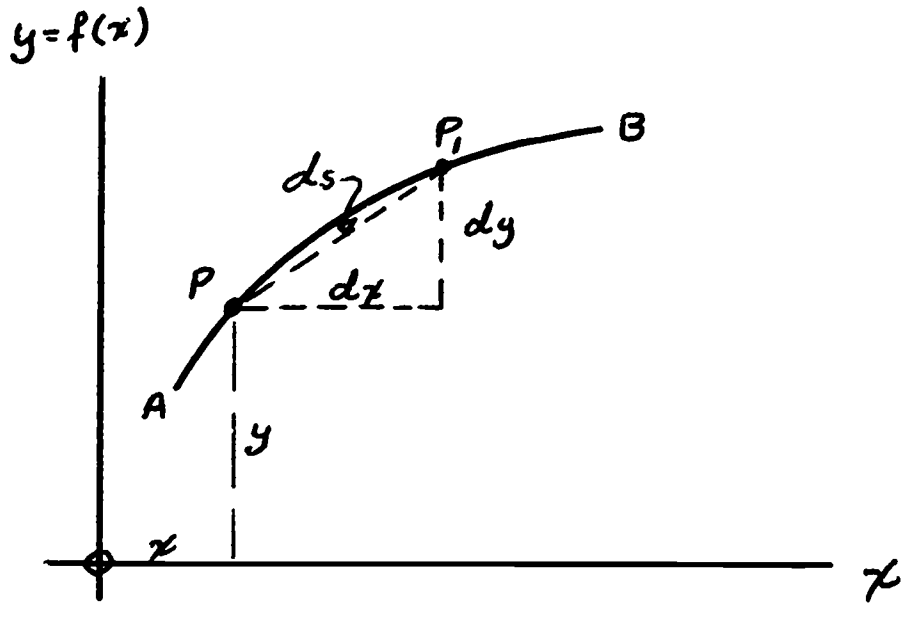
8. Rotating a right triangle generates a right cone. Derive the equation $V = \frac{1}{3}\pi R^2 h$, by this technique.

9. Find the volume of $y = 2x - 4x^2$ rotated around the y-axis and bounded by $y = -12$.

10. Rotate the above curve around $y = -2$.

(5-14) Length of Curves

You will recall from trigonometry that angles may be measured in radians. An angle of 1 radian is an angle subtended by an arc equal to the radius. This measurement of angles is important in determining the surface area of curves of revolution.



In the above diagram, ds is the infinititesimally small measure of the chord or slant length between two points on a curve. By the Pythagorean theorem we obtain

$$(ds)^2 = (dx)^2 + (dy)^2 \qquad (1)$$

$$ds = \sqrt{(dx)^2 + (dy)^2} \qquad (2)$$

Divide by dx: $\frac{ds}{dx} = \sqrt{1 + (\frac{dy}{dx})^2}$ or $ds = \sqrt{1 + (\frac{dy}{dx})^2}\, dx$

$$\boxed{s = \int_a^b \sqrt{1 + (\frac{dy}{dx})^2}\, dx}$$ Length of arc

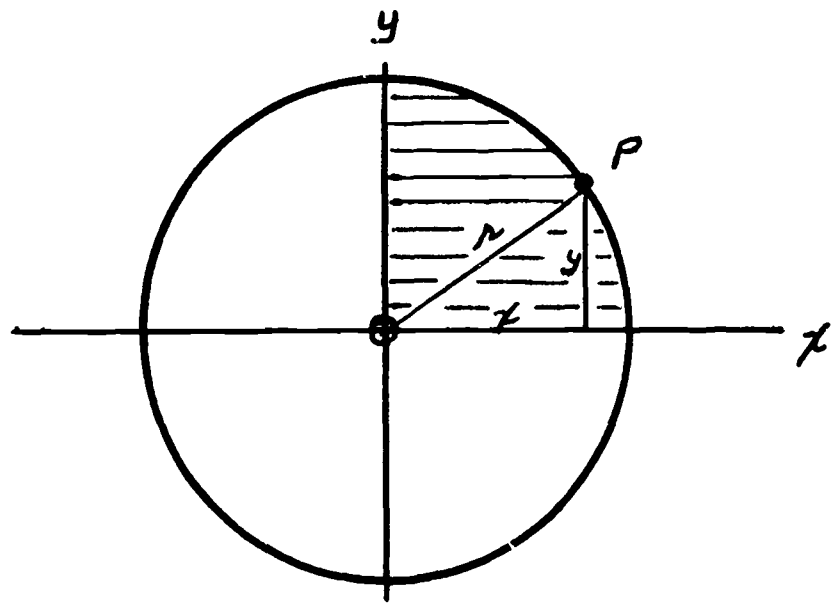
If the radical in equation 2 is divided by dy,

$$\boxed{s = \int_c^d \sqrt{(\frac{dx}{dy})^2 + 1}\, dy}$$ Length of arc

Sometimes this equation is easier to use than the other.

Length of an Arc

Example 1: Find the length of the circumference of $x^2 + y^2 = r^2$



To use the formula for the length of an arc, we will need to find $\frac{dy}{dx}$.

$$y = \sqrt{r^2 - x^2} = (r^2 - x^2)^{\frac{1}{2}}$$

$$\frac{dy}{dx} = \frac{1}{2}(r^2 - x^2)^{-\frac{1}{2}} \quad (-2x) \qquad (u^n = nu^{n-1}\,du)$$

$$= \frac{-x}{(r^2 - x^2)^{\frac{1}{2}}}$$

$$\left(\frac{dy}{dx}\right)^2 = \frac{x^2}{r^2 - x^2}$$

$$s = \int_a^b \sqrt{1 + \left(\frac{dy}{dx}\right)^2}\, dx = \int_o^r \sqrt{1 + \frac{x^2}{r^2 - x^2}}\, dx = \int_o^r \sqrt{\frac{r^2}{r^2 - x^2}}\, dx$$

$$= r\int_o^r \frac{dx}{\sqrt{r^2 - x^2}}$$

$$= r\left[\text{arc sin } \frac{x}{r}\right]_o^r \qquad \text{(Use integrating formula I-21)}$$

$$= r\left(\frac{\pi}{2} - 0\right)$$

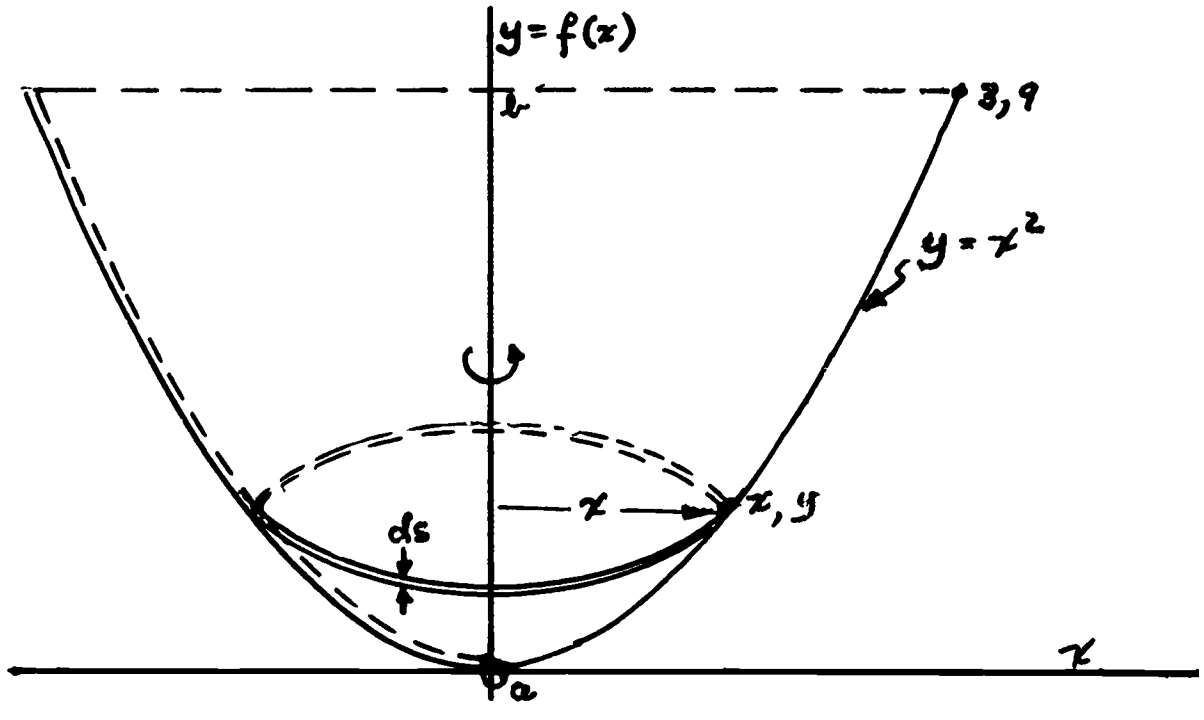
$$= \frac{\pi r}{2} \qquad \text{Length of arc in first quadrant}$$

Circumference $= 4\left(\frac{\pi r}{2}\right) = 2\pi r$

Note: To solve problems of this type, it will be necessary to consult the formulas on the back cover.

(5-15) Area of a Surface

Example 2: Find the surface area of the parabola of revolution $y = x^2$ about the y-axis, bounded by $y = 9$



$$ds = \sqrt{(dx)^2 + (dy)^2} \qquad (s = \text{slant length})$$

$$dS = 2\pi R\, ds \qquad (S = \text{surface area})$$

Since $y = x^2$

$$\frac{dy}{dx} = 2x$$

$$ds = \sqrt{1 + \left(\frac{dy}{dx}\right)^2}\, dx = \sqrt{1 + (2x)^2}\, dx = \sqrt{1 + 4x^2}\, dx$$

Therefore $dS = 2\pi R \sqrt{1 + 4x^2}\, dx$ (surface area)

Since $R = x$ in this problem,

$$dS = 2\pi x \sqrt{1 + 4x^2}\, dx$$

$$S = 2\pi \int_0^3 x \sqrt{1 + 4x^2}\, dx$$

This integral is in the form $u^n du$ where $u = 1 + 4x^2$.

Since $du = 8x$, we will require a correcting factor of 8.

$$S = \frac{2\pi}{8}\int_0^3 \sqrt{1 + 4x^2} \quad 8x\,dx$$

$$= \frac{\pi}{4}\left[\frac{(1 + 4x^2)^{\frac{3}{2}}}{\frac{3}{2}}\right]_0^3 \qquad \text{(By I-1)}$$

$$= \frac{2}{3} \cdot \frac{\pi}{4}\left[(1 + 36)^{\frac{3}{2}} - (1 - 0)^{\frac{3}{2}}\right]$$

$$= \frac{\pi}{6}\ (223.96)$$

$$= 37.33\ \pi \text{ square units}$$

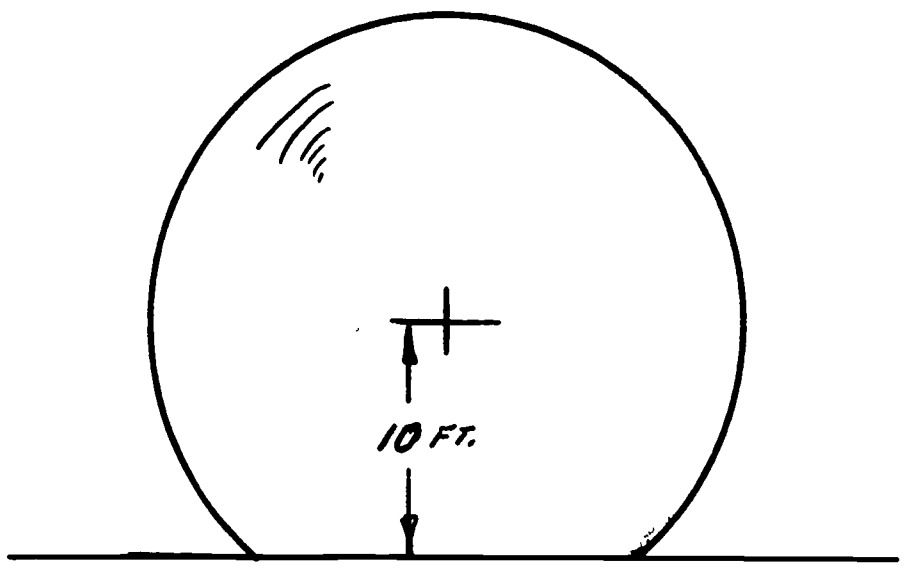
Problems

1. From the equation of a circle $x^2 + y^2 = r^2$, derive the equation for the circumference ($C = 2\pi r$).

2. Find the length of the arc of parabola $y = x^2$ between $x = 1$ and $x = 2$.

3. Find the surface area of a hemisphere cut off by the plane $y = 2$ if the equation for the circle is $x^2 + y^2 = 25$.

4. A radar antenna is to be covered with a polyethylene sphere of 30-foot diameter. Find the area of this sphere if it is mounted as indicated in the diagram.



CHAPTER VI

CALCULUS OF LOGARITHMIC AND EXPONENTIAL FUNCTIONS

The study of logarithms and exponents is extremely important because many of the phenomena of nature seem to fit this mathematical relationship. Many quantities in physics, electronics, engineering, biology, vibrations, economics, and statistics - to name a few - have rates of growth or decay which vary in proportion to their instantaneous magnitudes. Perhaps the most widely used phenomenon exhibiting a logarithmic relation is the half-life equation for radioactive decay.

(6-1) Review of Exponents and Logarithms

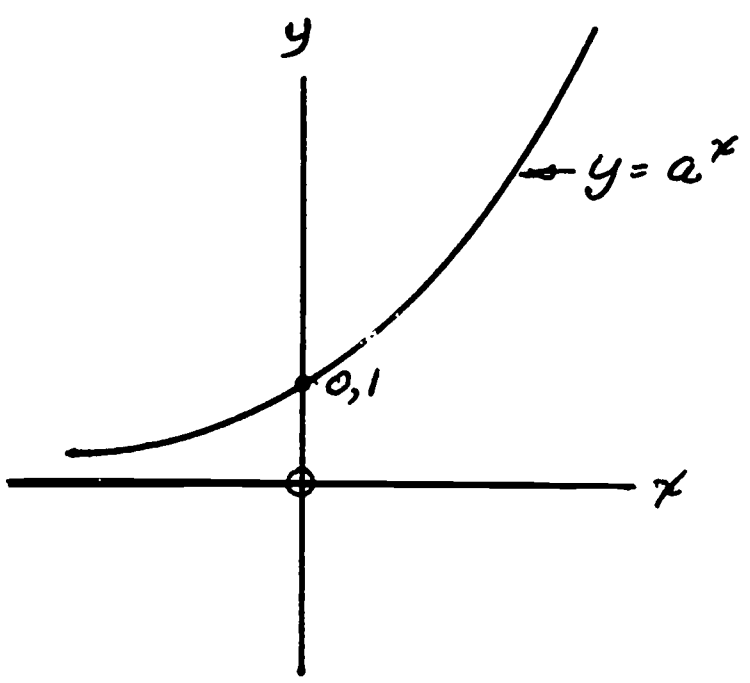
An exponential equation is one with a fixed base and a variable exponent

$$y = a^x \qquad \text{(exponential equation)}$$

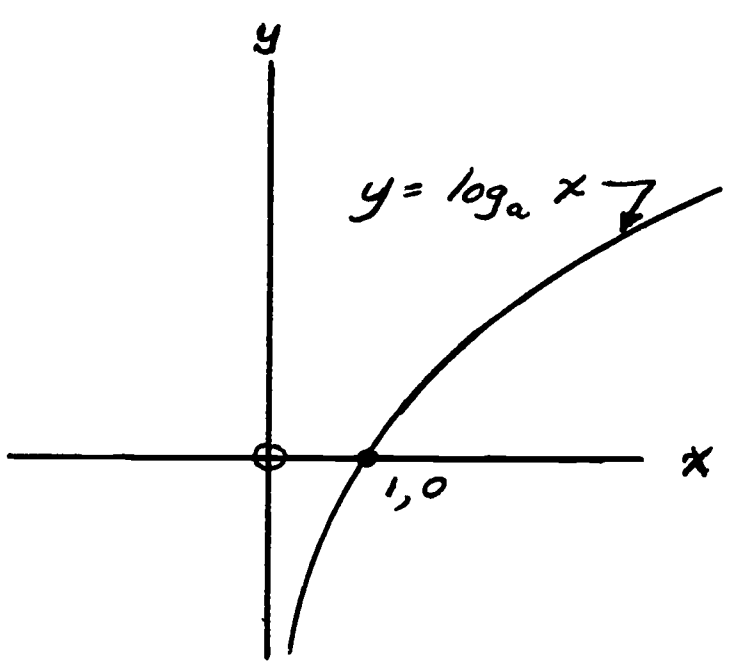
The logarithm of a number is defined as the exponent or power to which a base is raised to give the number.

$$\underset{\text{exponent}}{x} = \log_{\underset{\text{base}}{a}} \underset{\text{number}}{y} \qquad \text{(logarithmic equation)}$$

Logarithmic functions are the inverse of the exponential functions. They are a "mirror reflection" of each other.



EXPONENTIAL



LOGARITHMIC

Numerically the exponential function is written as follows:

$$y = a^x$$

$$1000 = 10^3$$

Logarithmically, the same function is

$$x = \log_a y$$

$$3 = \log_{10} 1000$$

The logarithm of a number is the exponent of the base which gives the number. Because of the inverse relationship between exponential and logarithm functions, a brief review of the laws of exponents and logarithms will be given.

1. Any number raised to the 0 power equals 1; therefore the log of 1 is always 0.

Exp.	Log.
$a^0 = 1$	$\log_a 1 = 0$
$100^0 = 1$	$\log_{100} 1 = 0$

2. Any number raised to the power 1 is the number itself; therefore the log of any number to itself as a base is one.

Exp.	Log.
$a^1 = a$	$\log_a a = 1$
$10^1 = 10$	$\log_{10} 10 = 1$

3. The logarithm of a product is equal to the sum of the logarithms of its parts, if the same base is used.

$$\log_a(MN) = \log_a M + \log_a N$$

4. The logarithm of a quotient is equal to the logarithm of the denominator subtracted from the logarithm of the numerator, using the same base.

$$\log_a \frac{M}{N} = \log_a M - \log_a N$$

5. The logarithm of a power or root (fractional exponent) is equal to the logarithm of the number multiplied by the power or root.

(power) $\log_a M^P = P \log_a M$

(root) $\log_a M^{\frac{1}{P}} = \frac{1}{P} \log_a M$

6. To change a logarithm from base a into logarithm to base b, multiply it by $\log_b a$

$$\log_b N = \log_a N \log_b a$$

Since

$\log_{10} e = .4343$
$\log_e 10 = 2.303$

$$\log_{10} N = .4343 \log_e N = .4343 \ln N$$

$$\log_e N = \ln N = 2.303 \log_{10} N$$

(6-2) Base of Logarithm

Logarithmic calculations can be made from tables with any number as the base. The oldest and perhaps the most widely used for science and engineering computations are the natural logarithms with a base e which equals 2.718.... $\text{Log}_e N$ is generally written $\ln N$.

The common logarithm has a base of 10, which simplifies comprehension and arithmetic computations, especially with scientific notation.

(6-3) Number e - Epsilon

Simple interest on one dollar taken at 5% over a period of twenty years results in doubling the original investment. Mathematically this arithmetic sum would be written as follows:

$1 + 20\ (.05) = 2$ specific equation

$1 + 20\ (\frac{1}{20}) = 2$

$y_o + x\ (\frac{y_o}{x}) = 2y_o$ general equation

At compound interest, the rate of interest is calculated on the original amount plus the accumulated interest. Mathematically this relation is represented by

$$y = y_o (1 + \frac{1}{x})^x$$

where $(1 + \frac{1}{x})^x$ does the compounding annually.

Let's invest a dollar at 5% and compound the interest once a year for twenty years. This gives:

$$y = 1 (1 + \frac{1}{20})^{20}$$

$$y = 2.65$$

If over the same twenty-year period the money was compounded 10,000 times, the result would be

$$y = 1 (1 + \frac{1}{10,000})^{10,000}$$

$$y = 2.711$$

It is easy to see that the money value increases according to the value of x, or the number of operations. If x is taken to infinity then

$$\boxed{\lim_{x \to \infty} (1 + \frac{1}{x})^x = 2.71828 = e}$$

This number (e) is the original and most widely used base for logarithms because problems in calculus with the base e are greatly simplified. The term e^x may be differentiated many times and the result is always e^x.

You will recall the binomial expansion theorem:

$$(a + b)^n = a^n + n \frac{a^{n-1}b}{1!} + n(n-1)\frac{a^{n-2}b^2}{2!} + n(n-1)(n-2)\frac{a^{n-3}b^3}{3!} + \ldots$$

Substituting $a = 1$, $b = \frac{1}{x}$, and $n = x$ gives the expansion of $(1 + \frac{1}{x})^x$:

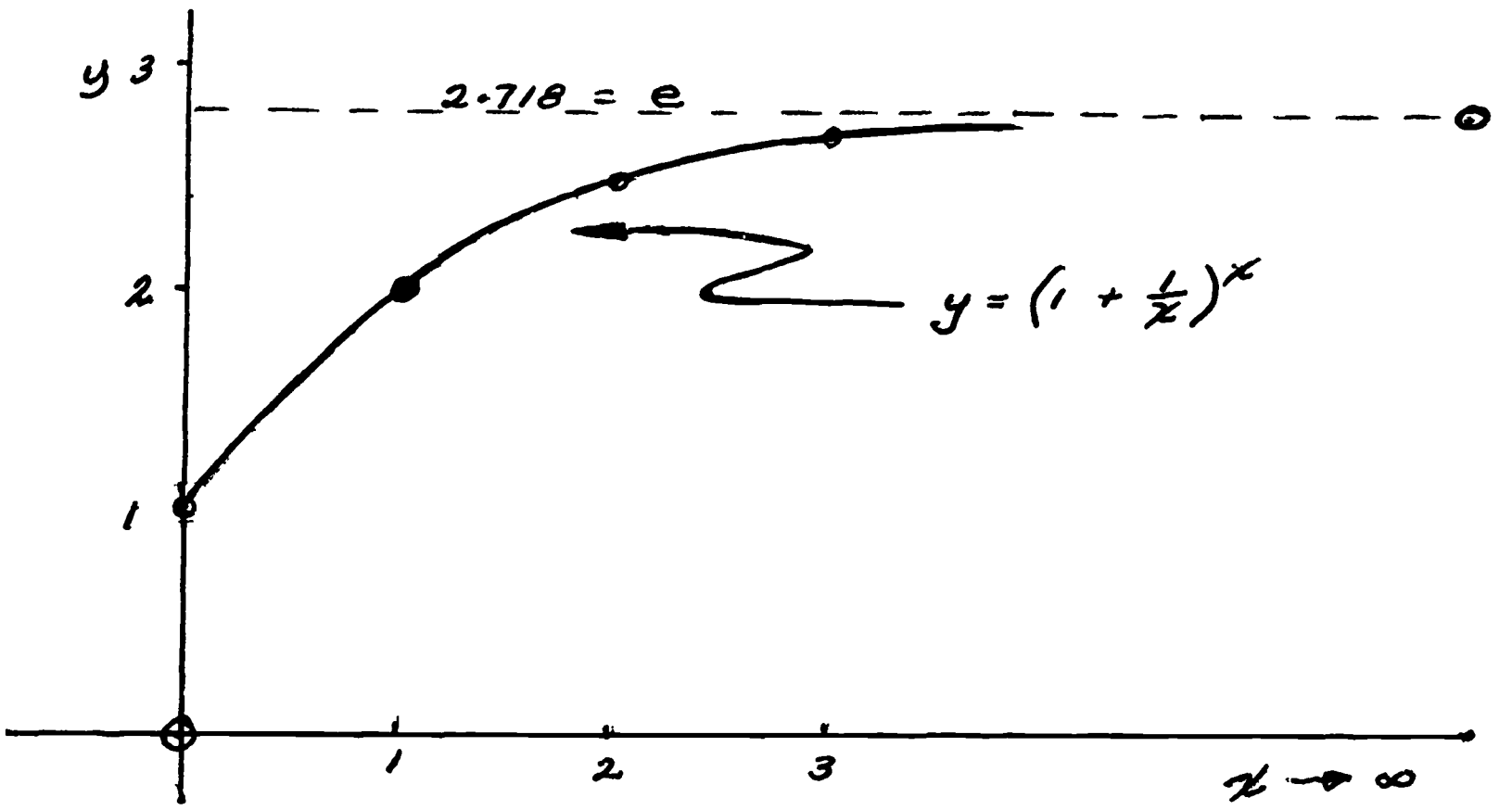
$$(1+\frac{1}{x})^x = 1^x + \frac{x(1)^{x-1}(\frac{1}{x})}{1!} + \frac{x(x-1)\,1^{x-2}(\frac{1}{x})^2}{2!} + \frac{x(x-1)(x-2)\,1^{x-3}(\frac{1}{x})^3}{3!} + \ldots$$

Now as x approaches infinity, the expansion becomes:

$$(1 + \frac{1}{x})^x = 1 + 1 + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} + \frac{1}{5!} + \frac{1}{6!} + \ldots$$

Summing the terms:

$$\begin{array}{r} 1.0000 \\ 1.0000 \\ .5000 \\ .1666 \\ .0416 \\ .0083 \\ .0014 \\ \hline 2.7179 \end{array}$$ = e to the accuracy we solved for.



A plot of $y = (1 + \frac{1}{x})^x$ as $x \to \infty$ is illustrated above. It is important to note that the rate of change of each increment is a function of the ordinate at that increment.

Example 1: The intensity level of a sound wave is given by

$$B = 10 \log \frac{I}{I_o} \qquad \text{(log is to the base 10)}$$

where B is in decibels

I_o = lowest level of power for human hearing = $10^{-16} \frac{\text{watts}}{\text{cm.}^2}$

I = measured intensity of power in $\frac{\text{watts}}{\text{cm}^2}$

Find the intensity level in decibels if $I = 10^{-11} \frac{\text{watts}}{\text{cm.}^2}$

$$B = 10 \log \frac{10^{-11}}{10^{-16}}$$

$$= 10 \log 10^5$$

$$= 10 \times 5$$

$$B = 50 \text{ decibels}$$

If the intensity level in decibels is 50, what is the intensity of the sound (I)? We know the answer, but the important thing is how we get it.

$$B = 10 \log \frac{I}{10^{-16}}$$

$$50 = 10 \log \frac{I}{10^{-16}}$$

$$5 = \log I - \log 10^{-16}$$ Divide by 10 and use log quotient rule

$$5 = \log I - (-16)$$

$$5 - 16 = \log I$$

$$-11 = \log I$$

By definition, the log of a number is the power to which the base is raised to give the number. The base is 10; therefore the power or log is -11.

Therefore $10^{-11} = I$

Problems

Solve the following or rewrite into a difference form. Use slide rule where necessary.

1. $e^x = 4$

2. $\log_e 2.718 = y$

3. $\log_{10} (42 \times 20)$

4. $\log_e \frac{50}{20}$

5. $\sqrt[10]{\frac{4.73}{2.5 \times 10^{-4}}}$

6. Write in log form: $2^3 = 8$

7. $\log_{10} 50$; find $\ln 50$

8. $\ln 50$; find $\log_{10} 50$

9. $y = \lim_{x \to 0} (1 + x)^{\frac{1}{x}}$. Plot the curve for 10 values of x.

10. $6.21\ e^{-1.35}$

11. e^{1}

12. e^{-1}

13. $2.4e^{.5}$

14. $e.^{-.3}$

15. $e^{-5} = \log_{10} x$

16. The air pressure (p) in pounds/square foot at height h in feet is given by

$$p = 2100\ e^{-3.7\ (10^{-5})\ h}.$$

Find the pressure at 16,000 feet.

17. The work done by a gas expanding in a cylinder is

$$W = p_o\ (.20)\ \ln\ (\frac{v}{v_o})$$

Find the work when $p_o = 300$, $v_o = .30$ and $v = .15$

18. Write this equation of the relationship of pressure to altitude in logarithmic form.

$$P = P_o e^{kx}$$

(6-4) Differentiation of Logarithmic and Exponential Functions

Exponential: $y = a^x$	Logarithmic: $x = \log_a y$
(D-12) $\boxed{\frac{d}{dx}(e^u) = e^u \frac{du}{dx}}$	(D-10) $\boxed{\frac{d}{dx}(\ln u) = \frac{1}{u}\frac{du}{dx}}$
(D-13) $\boxed{\frac{d}{dx}(e^x) = e^x}$	(D-11) $\boxed{\frac{d}{dx}(\ln x) = \frac{1}{x}}$
$\frac{d}{dx}(a^u) = a^u \ln a \frac{du}{dx}$	$\frac{d}{dx}(\log_a u) = \frac{1}{u}\frac{du}{dx}\log_a e$
$\frac{d}{dx}(a^x) = a^x \ln a$	$\frac{d}{dx}(\log_{10} u) = \frac{.434}{u}\frac{du}{dx}$

The most important derivatives are boxed. These are obtained by the delta method and taking the limit as $\Delta x \to 0$, by the same method as the algebraic derivatives were obtained. The simplicity of using natural logarithms will become clear to you as you work out problems.

Example 1: $y = \ln(3 + 4x)$; find $\frac{dy}{dx}$

Let $u = 3 + 4x$

$$\frac{d(\ln u)}{dx} = \frac{1}{u}\frac{du}{dx} \qquad \text{(D-10)}$$

$$\frac{dy}{dx} = \frac{1}{(3 + 4x)}(4) = \frac{4}{3 + 4x}$$

Example 2: $y = e^{\sqrt{x}}$; find $\frac{dy}{dx}$

$$\frac{d(e^u)}{dx} = e^u \frac{du}{dx} \qquad \text{(D-12)}$$

$$\frac{dy}{dx} = e^{\sqrt{x}} \frac{d(\sqrt{x})}{dx}$$

$$\frac{d\sqrt{x}}{dx} = \frac{d(x)^{\frac{1}{2}}}{dx} = \frac{1}{2}x^{-\frac{1}{2}}$$

$$\frac{dy}{dx} = \frac{e^{\sqrt{x}}}{2\sqrt{x}}$$

Example 3: $\frac{d}{dx}(e^{3x}) = ?$

$$= 3\ell^{3x} \qquad \text{(D-13)}$$

Example 4: Differentiate $y = \left(\frac{x^2 + 2}{x^2 - 1}\right)^{\frac{1}{2}}$

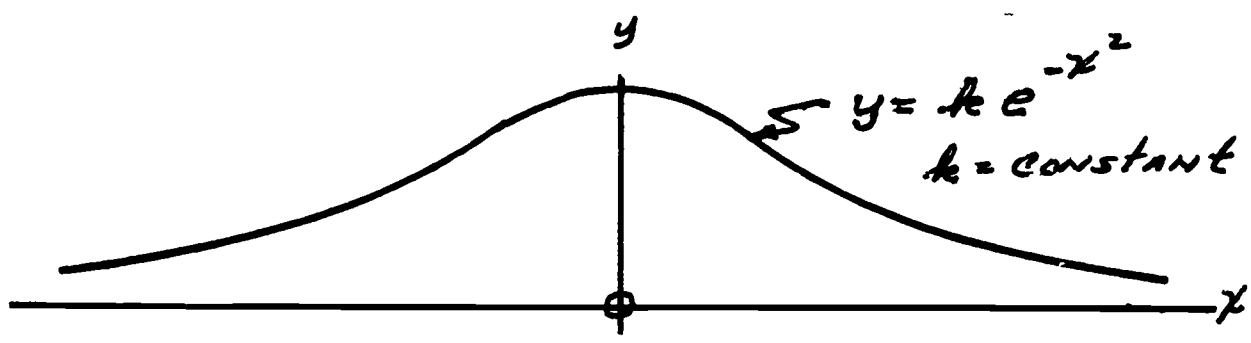
$\ln y = \frac{1}{2} \ln (x^2 + 2) - \frac{1}{2} \ln (x^2 - 1)$ (Put into logarithmic form)

$$\frac{d(\ln u)}{dx} = \frac{1}{u} \frac{du}{dx} \qquad \text{(D-10)}$$

$$\frac{d \ln y}{dx} = \frac{1}{2(x^2 + 2)} (2x) - \frac{1}{2(x^2 - 1)} (2x)$$

$$= \frac{(x^2 - 1)\ 2x - (x^2 + 2)\ 2x}{2(x^2 + 2)\ (x^2 - 1)} = -\frac{3x}{(x^2 + 2)\ (x^2 - 1)}$$

Example 5: The normal probability curve in statistics has an exponential equation $y = ke^{-x^2}$, where k is a constant.



Determine the instantaneous rate of change of this curve.

$$y = ke^{-x^2}$$

$$\frac{dy}{dx} = ke^{-x^2} (-2x) \qquad \text{(D-12)}$$

$$\frac{dy}{dx} = -2xke^{-x^2}$$

Problems

Find the derivatives:

1. $y = \ln x$

2. $y = \ln (x^3 - 2x^2 + 1)$

3. $y = x^{x^2}$ Hint: Take the logarithm of both sides and then differentiate both sides.

4. $y = x^{5x}$

5. $y = \dfrac{\sqrt[3]{x^2 - 25}\sqrt{x + 5}}{\sqrt[4]{x - 5}}$ Hint: Use logarithmic form with multiplication and division of logs.

6. The voltage build-up of a generator with respect to time was

$$V = 10\, e^{0.2t}$$

Find the instantaneous rate of change of voltage with respect to time.

7. In a series circuit made up of resistance R and capacitance C, the current (I) = $(\frac{V}{R})e^{-\frac{t}{RC}}$. Find the general equation of charge $q = \frac{dI}{dt}$.

8. The discharge current of a particular capacitor is $i = 0.04e^{-60t}$. Find the time when the current $i = .001$ amp.

9. The terminal voltage of a discharging capacitor is $V_c = 225e^{-200t}$. Find the voltage of the capacitor at $t = .004$ seconds.

10. Find $\frac{d(v_c)}{dt}$ of Problem 9.

11. The gun-barrel pressure is given by

$$P = xe^{-mx}$$

Find the value of x for a maximum pressure.
(Hint: Use the product method.)

(6-5) Integration of Logarithmic and Exponential Functions

Logarithmic $\boxed{\int \frac{1}{u}\, du = \ln u + C}$ I-2

Exponential $\boxed{\int e^u du = e^u + C}$ I-5

$\boxed{\int a^u du = \frac{a^u}{\ln a} + C}$ I-6

Example 1: $\int \frac{3x^2}{1 + x^3}\, dx$ Let $u = (1 + x^3)$, $du = 3x^2\, dx$

$$= \int \frac{1}{u}\, du = \ln u + C = \ln (1 + x^3) + C$$

Example 2: Convert $x = \ln (2 + y)$ to exponential form

$$e^x = 2 + y$$

Example 3: $\int \frac{x^3 - 6x + 2}{x}\, dx = \int x^2 dx - 6\int dx + 2\int \frac{1}{x}\, dx$

$$= \frac{x^3}{3} - 6x + 2 \ln x + C$$

Example 4: $\int \frac{dx}{3 + 2x} = \frac{1}{2} \ln (3 + 2x) + C$ I-2)

Example 5: $\int e^{\frac{t}{2}}\, dt$

$= 2\int e^{\frac{t}{2}} \frac{1}{2}\, dt$ Let $u = \frac{t}{2}$; $\frac{du}{dt} = \frac{1}{2}$; $du = \frac{1}{2}\, dt$

$= 2e^{\frac{t}{2}} + C$

The derivative $\frac{dy}{dx}$ of a logarithmic function is proportional to the ordinate (y).

$$\frac{dy}{dx} \sim y$$

$$\frac{dy}{dx} = ky$$ A proportional always becomes an equality when a constant (k) is used.

$$\frac{dy}{y} = kdx$$ Divide by y and multiply by dx.

$$\log_e y = kx + C$$ Integrate

$$y = e^{kx + C}$$ Exponential form

$$= e^{kx} \cdot e^{c}$$

$$y = Ce^{kx}$$ e^{C} = constant

The above equation is known as the Law of Organic Growth when the exponent of the natural base is positive (k = +). When the exponent is negative (k = -), it is called the Law of Decay.

The Law of Organic Growth is analogous to a snowball rolling down a hill.

The Law of Organic Decay may be compared to a snowball rolling up the hill, losing snow on its way.

In the compound-interest equation:

$$\Delta y = iy\Delta t$$

$$\text{Interest} = \text{rate x investment x time}$$

$$\frac{\Delta y}{\Delta t} = iy$$

$$\lim_{\Delta t \to 0} \frac{\Delta y}{\Delta t} = \boxed{\frac{dy}{dt} = iy}$$

This differential equation states that the change in y with respect to time is proportional to y, or $\frac{dy}{dt} \sim y$.

$$\frac{dy}{dt} = ky$$ k = i or interest

To integrate or obtain a summation relationship in the above (boxed) equation, multiply both sides by dt and divide by y.

$$\frac{dy}{y} = i\,dt$$

$$\ln y = it + C \qquad \text{(Integrate by I-2)}$$

Let $y = y_o$ = the initial investment at $t = 0$ and substitute.

$$\ln y_o = 0 + C \qquad \therefore C = \ln y_o$$

$$\ln y = it + \ln y_o$$

$$\ln y = \ln y_o = it$$

$$\ln \frac{y}{y_o} = it$$

Converting the logarithmic form to exponential form:

$$\frac{y}{y_o} = e^{it}$$

$$\boxed{y = y_o e^{it}}$$

This equation may be used only when the interest accumulates continuously. Go over the method of obtaining this equation, because the technique is applicable to many problems.

When interest is compounded annually, the equation is

$$y = y_o (1 + i)^t$$

The half-life of iodine 131 is 8 days. This means that in 8 days only $\frac{1}{2}$ of the original amount of radioactivity remains. In another 8 days, $\frac{1}{2}$ of this amount is left; that is, $(\frac{1}{2})(\frac{1}{2}) = \frac{1}{4}$ remains, etc. The exponential equation for radioactive decay is

$$A = A_o \left(\frac{1}{2}\right)^{\frac{t}{\lambda}}$$

where λ (lambda) is the half-life, A_o is the amount at $t = 0$, and A is the amount left at time t.

Example 1: Find the amount of radioactive iodine 131 remaining from 5 grams after 16 days. The half-life (λ) is 8 days.

$$A = A_o\left(\frac{1}{2}\right)^{\frac{t}{\lambda}}$$

$$A = 5\left(\frac{1}{2}\right)^{\frac{16}{8}}$$

$$A = 5\left(\frac{1}{4}\right)$$

$$A = 1\frac{1}{4} \text{ grams}$$

Example 2: Same problem, after 40 days

$$A = 5\left(\frac{1}{2}\right)^{\frac{40}{8}}$$

$$A = \frac{5}{32} \text{ gram}$$

Problems

Solve the following:

1. $\int \frac{x + 2}{x^2 + 4x + 3}\, dx$

2. $\int \frac{x^2}{x^3 + 1}\, dx$

3. $\int e^{-kx}\, dx$

4. $\int e^{-\frac{t}{RC}}\, dt$ (R and C are constants)

5. $\int 5^{2x^2}\, x\, dx$

6. $\int_o^2 e^{\frac{x}{3}}\, dx$

7. $\int \frac{x^2 + 4x + 3}{x + 2}\, dx$ Hint: Always divide first when degree of denominator is less than that of numerator.

8. $\int 3e^{2x}\, dx$

9. $\int 5e^{5x}\, dx$

10. If \$1000 is compounded annually at 4 percent, determine the amount of money in the bank account after 20 years.

11. Solve the above problem if the interest is compounded continuously.

12. The derivative of a function is proportional to three times the ordinate. Write the exponential equation for this relationship.

13. A piece of steel at 1500°C loses temperature with respect to time in proportion to its temperature. If $k = -3 \times 10^{-3}$, determine the time needed to cool to room temperature (20°C).

14. Twenty grams of phosphorus 32 with a half-life of 14 days results in how many grams of radioactive material in 7 days?

15. After 22 days of radioactivity, sulphur 35, with a half-life of 87 days, had 6 grams of its mass remaining. Calculate the original mass of sulphur 35.

16. The number of bacteria in a culture grows at a rate which is proportional to the number (N). In 100 seconds the bacteria tripled. Find the proportionality constant and the equation for N.

17. Find the area of the function $y = \frac{3}{x}$ between the limits of -1 and -4.

18. The amount of money earned by the investment of a given principle is given by the equation

$$A = Pe^{\frac{rt}{100}}$$

where P equals the principle, r equals the annual rate, and t equals the time in years.
Solve for the amount of money in the account when r = .04, t = 10 years, and P = \$500.

CHAPTER VII

CALCULUS OF TRIGONOMETRIC FUNCTIONS

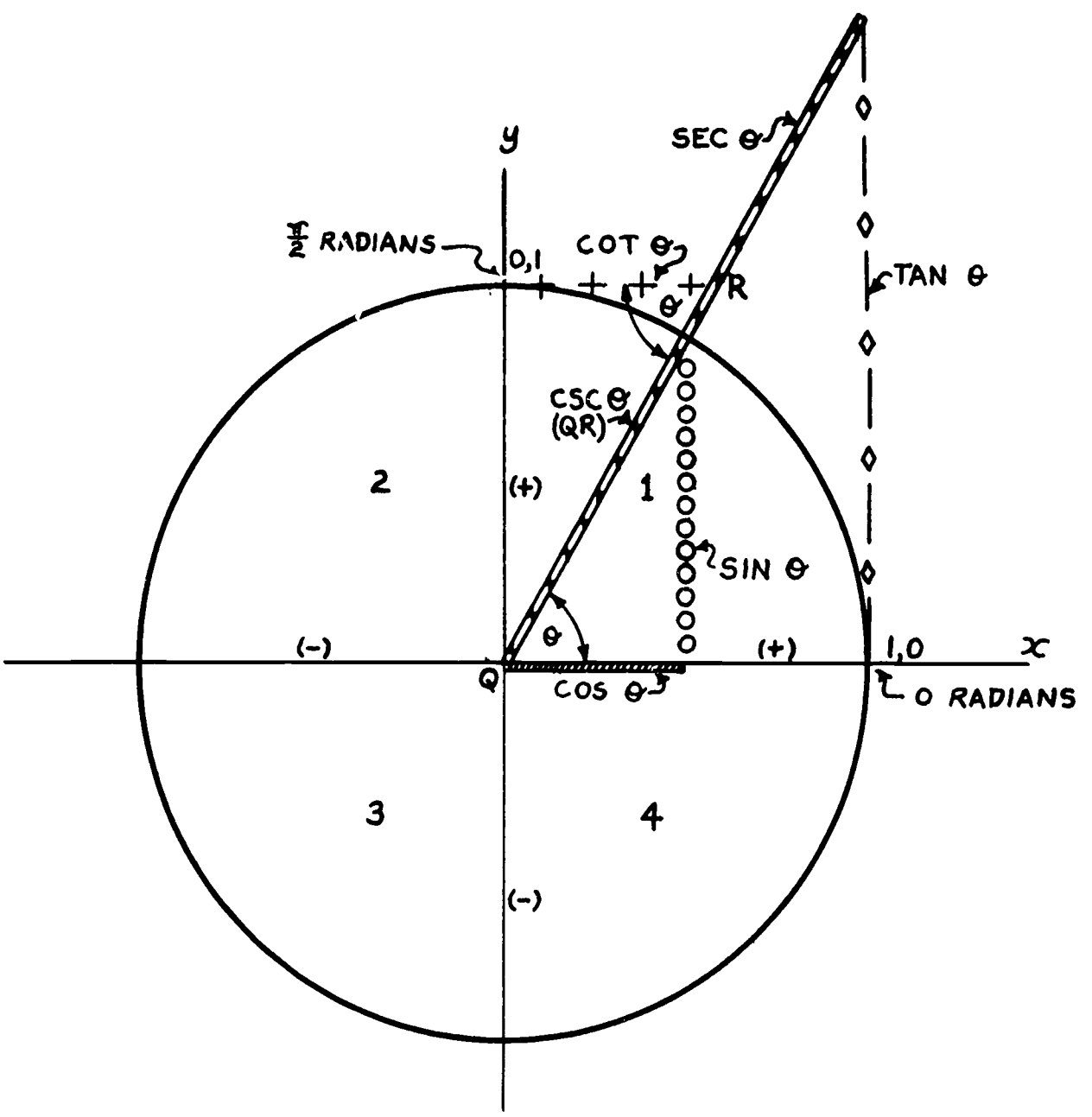
(7-1) Review of Trigonometric Functions

A brief review of the basic trigonometric functions may be obtained by studying the diagram. The important concept here is how the functions (ratios) vary as point P rotates around the complete circumference: the limits, signs, and pictorial representation are the things to understand.

For example, as the "ladder" moves counterclockwise from 0 to $\frac{\pi}{2}$ radians - the sine varies from 0 to 1,

the cosine varies from 1 to 0
the tangent varies from 0 to ∞
the cotangent varies from ∞ to 0
the secant varies from 1 to ∞
the cosecant varies from ∞ to 1

As a review, move the ladder into quadrants 2, 3, and 4. Determine the limits and signs of all six functions.

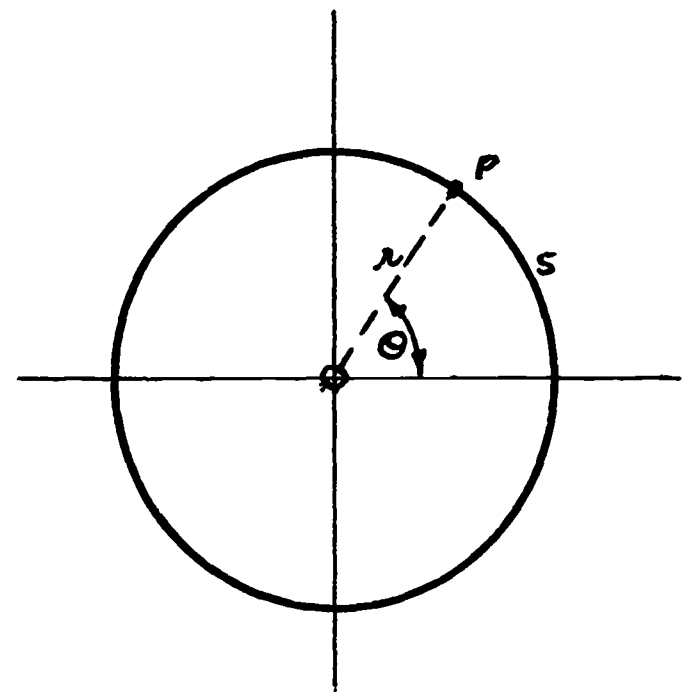


(7-2) Trigonometric Functions

The major uses of trigonometric functions in calculus are the areas of science which involve angular rotation - mechanics, vibrations, celestial motions, and especially a. c. electricity. The study of these functions thus broadens the scope of problem solving.

Radian. - The angular measurement for calculus is the radian. Degrees are not used because radian measurements give simpler solutions to calculus problems.

A radian is an angle which, when it is a central angle of a circle, intercepts an arc on the circumference which is equal to the radius. $(r = s)$



In general $\theta = \frac{s}{r}$ (θ is measured in radians)

There are 2π radians in the full 360° central angle of a circle. That this is so is readily apparent from the formula for the circumference of a circle:

$c = 2\pi r$ where c = full measure of arc s around the circle

$\frac{c}{r} = 2\pi$

To find the number of degrees in one radian:

$$2\pi \text{ radians} = 360^\circ$$

$$\pi \text{ radians} = 180^\circ$$

$$1 \text{ radian} = 57.3^\circ \text{ approx.}$$

To find the number of radians in one degree:

$$180^\circ = \pi \text{ radians}$$

$$1^\circ = \frac{\pi}{180} \text{ radians} = .0175 \text{ radian, approx.}$$

For making conversions of radians to degrees or degrees to radians, any of the above expressions may be used. The basic one from which all are derived is

$$\pi \text{ radians} = 180^\circ$$

Example 1: Change 120° to radians

$$120 \times \frac{\pi}{180} = \frac{2}{3} \text{ radians}$$

Example 2: How many degrees in 5.2 radians?

$$5.2 \times \frac{180}{\pi} = \frac{9360}{\pi} \text{ degrees}$$

or $5.2 \times 57.3 = 297.96^{\circ}$

Note: In future work, you may encounter expressions such as "an angle of $\frac{\pi}{2}$", or "tan $\frac{3\pi}{4}$". In each case, the word radian is understood.

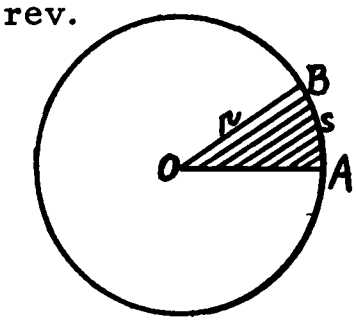
(7-3) <u>Area of a Sector Using Radians</u>

$S = r\,\theta$

By proportionality relations:

$$\frac{s}{2\pi r} = \frac{\text{arc}}{\text{circumference}} = \frac{\theta}{2\pi} \qquad \frac{\text{central angle}}{\text{radians in one rev.}}$$

Similarly, $\dfrac{\text{Area of sector (AOB)}}{\pi r^2} \quad \dfrac{\theta}{2\pi} = \dfrac{1}{2}\,\dfrac{\pi r^2 \theta}{\pi}$



$$\text{Area}_{\text{(sector)}} = \frac{1}{2}\, r^2 \theta$$

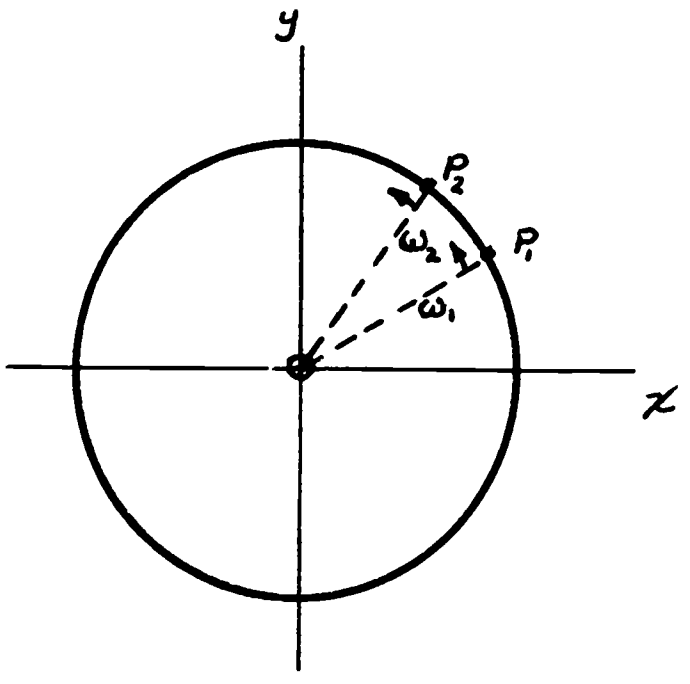
This equation indicates that the area of a sector is obtained by taking $\frac{1}{2}$ the product of the radius squared and the sector angle in radians.

Note how similar this equation is to that for the area of a circle. If we replace θ by 2π (the measure of the whole central angle), we get back to $A = \pi r^2$

The above derivation is one example of the usefulness of using radians instead of angles in degrees.

(7-4) Velocity and Acceleration - Linear and Angular

Velocity may be defined as the change of distance or displacement (linear or angular) with respect to time.



Linear: $v = \frac{ds}{dt}$ (in feet/sec.)

Angular: $\omega = \frac{d\theta}{dt}$ (in radians/sec.) (ω is the Greek letter omega)

Acceleration is defined as the change of velocity (linear or angular) with respect to time.

Linear: $a = \frac{dv}{dt} = \frac{d^2s}{dt^2}$ (in ft./sec.^{2})

Angular: $\alpha = \frac{d\omega}{dt} = \frac{d^2\theta}{dt^2}$ (in radians/sec.^{2}) (α is the Greek letter alpha)

Occasionally it is necessary to change angular units to linear units. This is done very simply as follows:

$$\text{(angular velocity)}\,\omega = \frac{v}{r} \quad \frac{\text{(linear velocity)}}{\text{(radius)}}$$

$$\text{or } \omega r = v$$

To change any angular motion to linear units, multiply the angular motion by the radius.

To change any linear motion to angular units, divide the linear motion by the radius.

Let us see why this is so.

Linear Velocity	Angular Velocity
$v = \frac{ds}{dt} \quad \left(\frac{\text{feet}}{\text{second}}\right)$	$\omega = \frac{d\theta}{dt} \quad \frac{(\text{radians})}{(\text{second})}$
ds = change of distance	$d\theta$ = change of angle

By the definition of radian measure

$$s = r\theta$$

Differentiating to obtain the instantaneous rate of change,

$$\frac{ds}{dt} = r\frac{d\theta}{dt}$$

But $v = \frac{ds}{dt}$ and $\omega = \frac{d\theta}{dt}$

Therefore $v = r\omega$

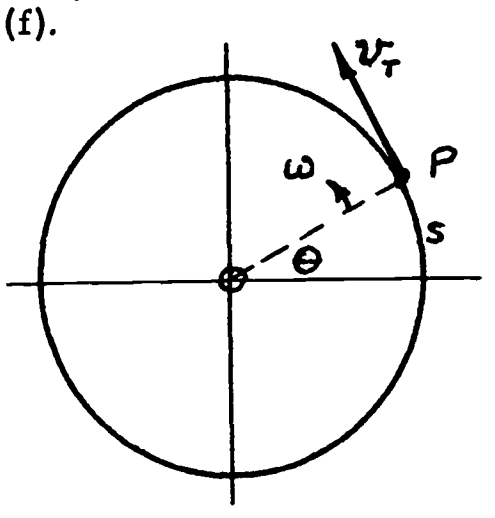
Differentiating again for acceleration:

$$\frac{dv}{dt} = r\frac{d\omega}{dt}$$

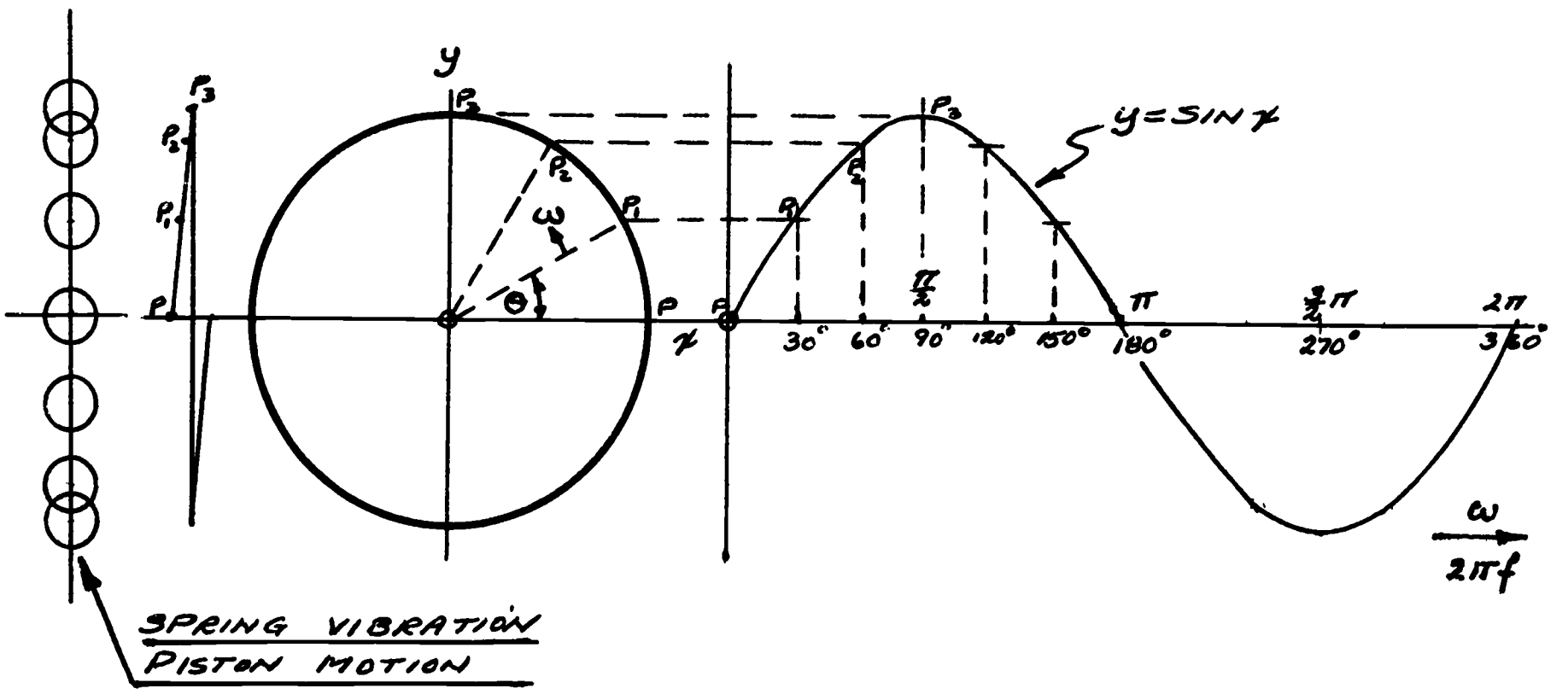
or $a = r\alpha$

The tangential velocity of a point on a circle (v_t) = circumference x the number of revolutions/second, or frequency (f).

$\omega = \frac{v_t}{r} = \frac{2\pi rf}{r} = 2\pi f$ = angular velocity in radians/sec.



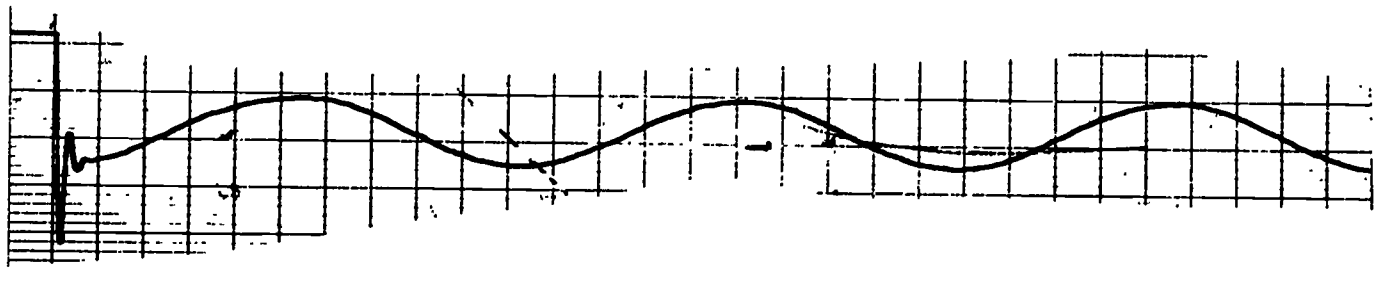
(7-5) Simple Harmonic Motion

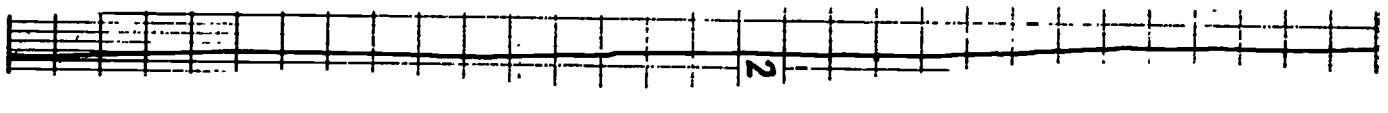


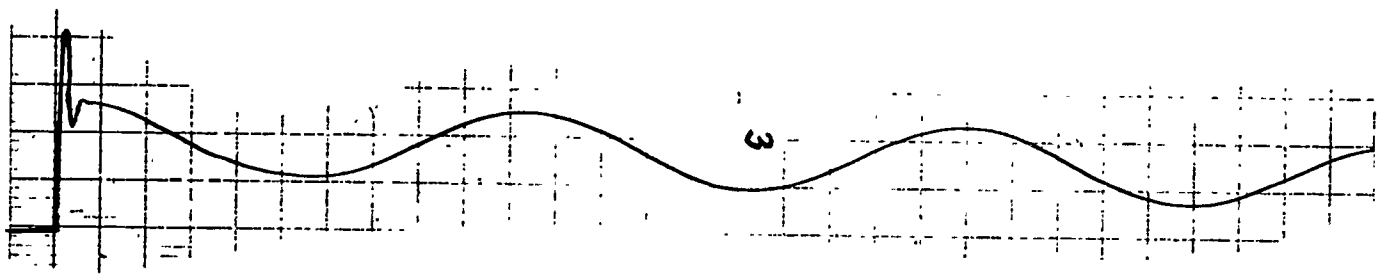
The vibration of a spring and the rotation of a wheel,when a spot is viewed from the end at the same frequency, develop the same type of motion. In fact, the AC-voltage of a generator produces a "sine wave" which varies with time in the same way as the spring or a point on the wheel.

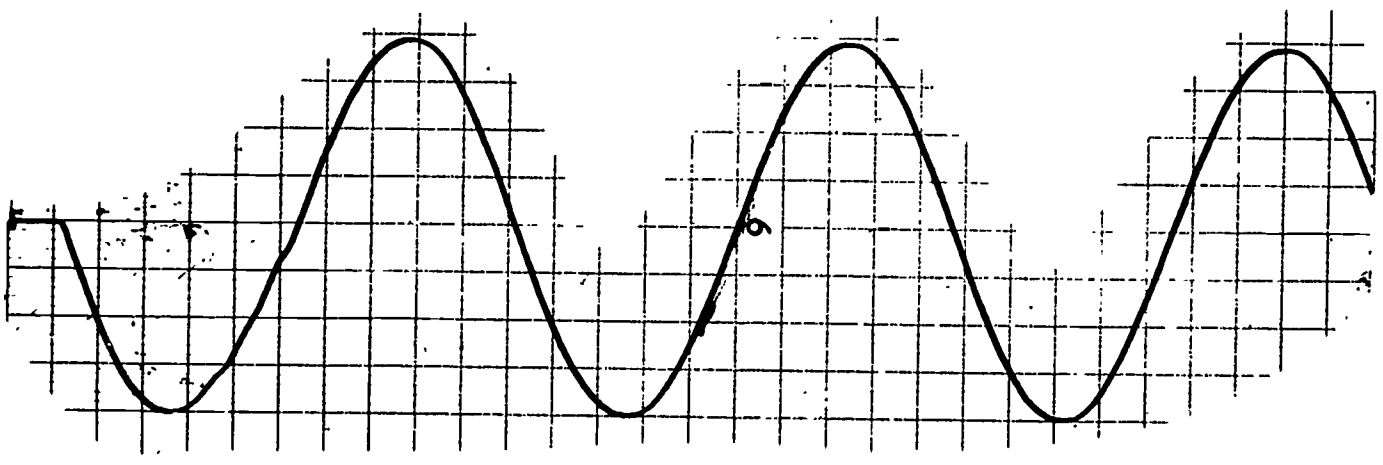
Every phenomenon in nature that is cyclic or repetitive, such as oscillatory or circular motion, is considered simple harmonic motion. Because of the importance of this type of motion, a further development is desired.

Below are curves taken from the read-out sheet of a scientific anologue computer. Notice the type of motion of each curve.









(7-6) Equations of Simple Harmonic Motion

Simple harmonic motion is the motion of a point in a straight line such that the acceleration of the point is proportional to the distance(x) from the center and is always directed toward the center.

When a body moves with a uniform speed (ω) in a circle, the projection of its motion on the diameter is called simple harmonic motion. The projection could be on the x or y diameters, as indicated by the diagram. Imagine point P_1 when it crosses the x-axis. Its v_t would be parallel to the y-axis; along the y-axis it would have a maximum value while along the x-axis it would be zero. As the point moves in the first quadrant its velocity along the y-axis decreases to zero and it increases along the x-axis to a maximum.

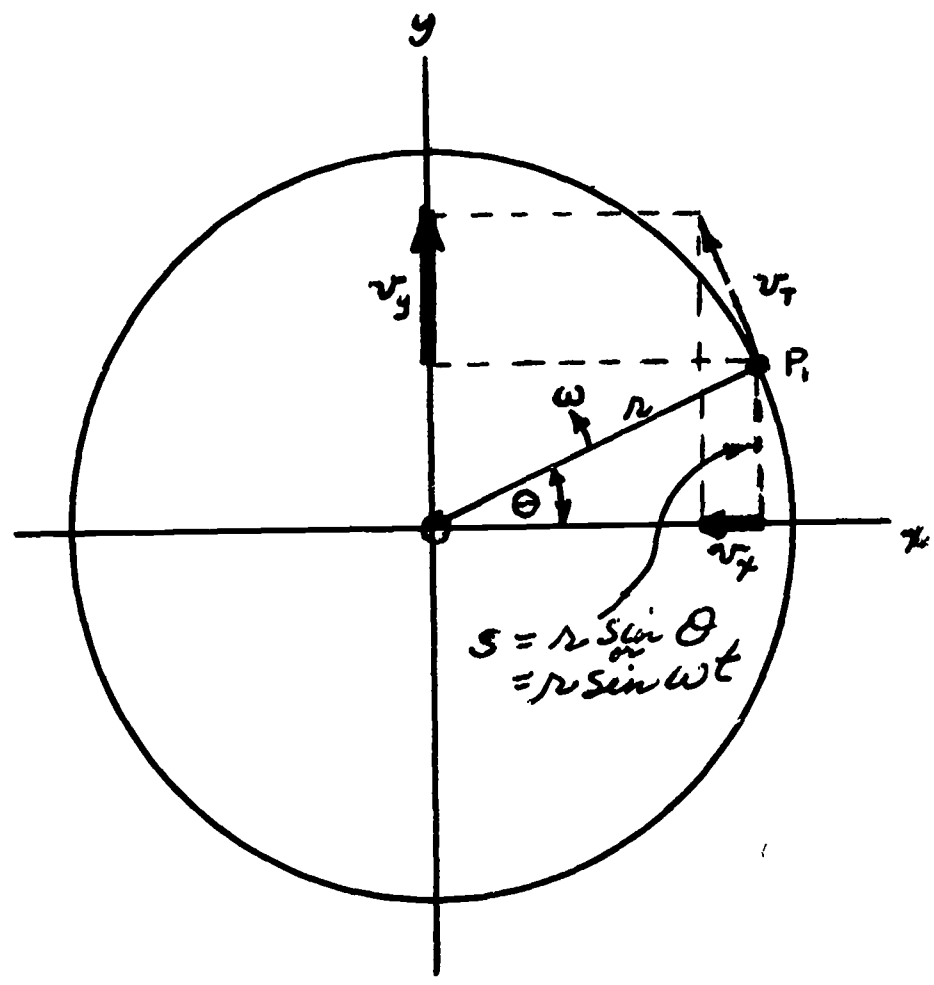
The displacement of P_1 as it moves past the x-axis is zero, and it increases according to the function of the sin θ. It attains a maximum value when P_1 is passing the y-axis.

The velocity of v_t along the y-axis is simply the component of v_t.

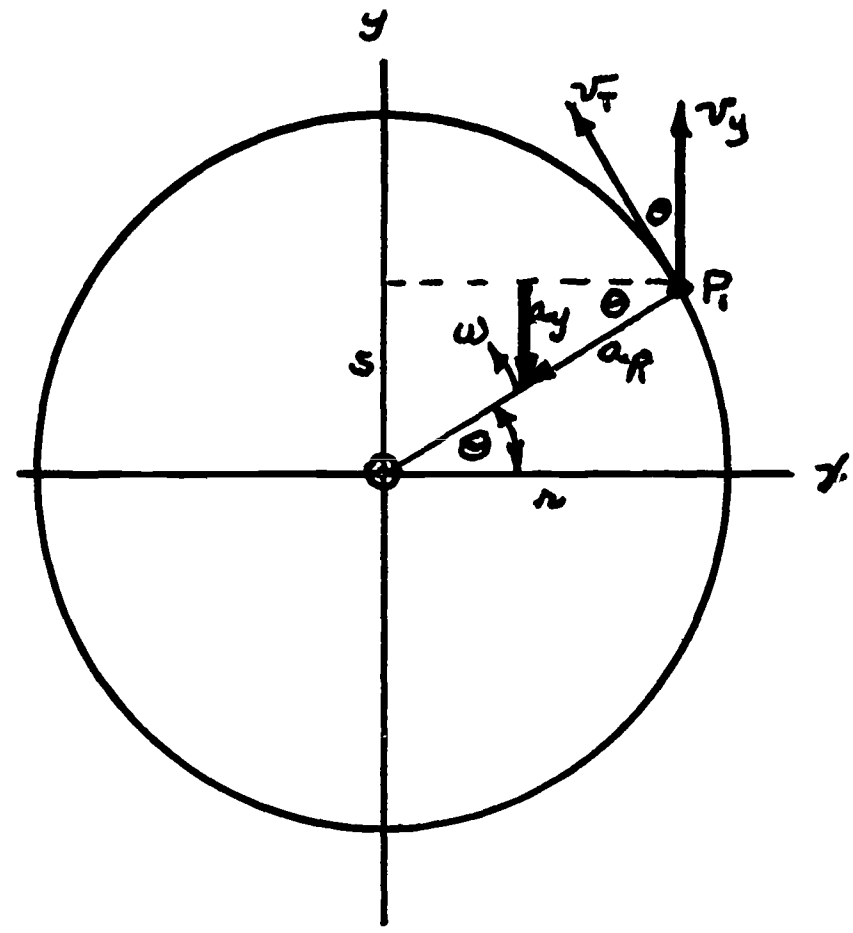
$$v_y = \quad \cos\theta$$

But since $v_t = r\omega$ and $\theta = \omega t$

$$v_y = r\omega \cos \omega t$$



As the velocity vector of P_1 moves on the circumference of a circle at a constant speed, its vector changes direction, since it must always be perpendicular to the radius. In a rotating body this is caused by the centripetal acceleration, which is always toward the center from the point. The magnitude of the acceleration a_{P_1} obviously depends on the radius and the angular velocity ω.



$$a_{P_1} = -r\omega^2$$

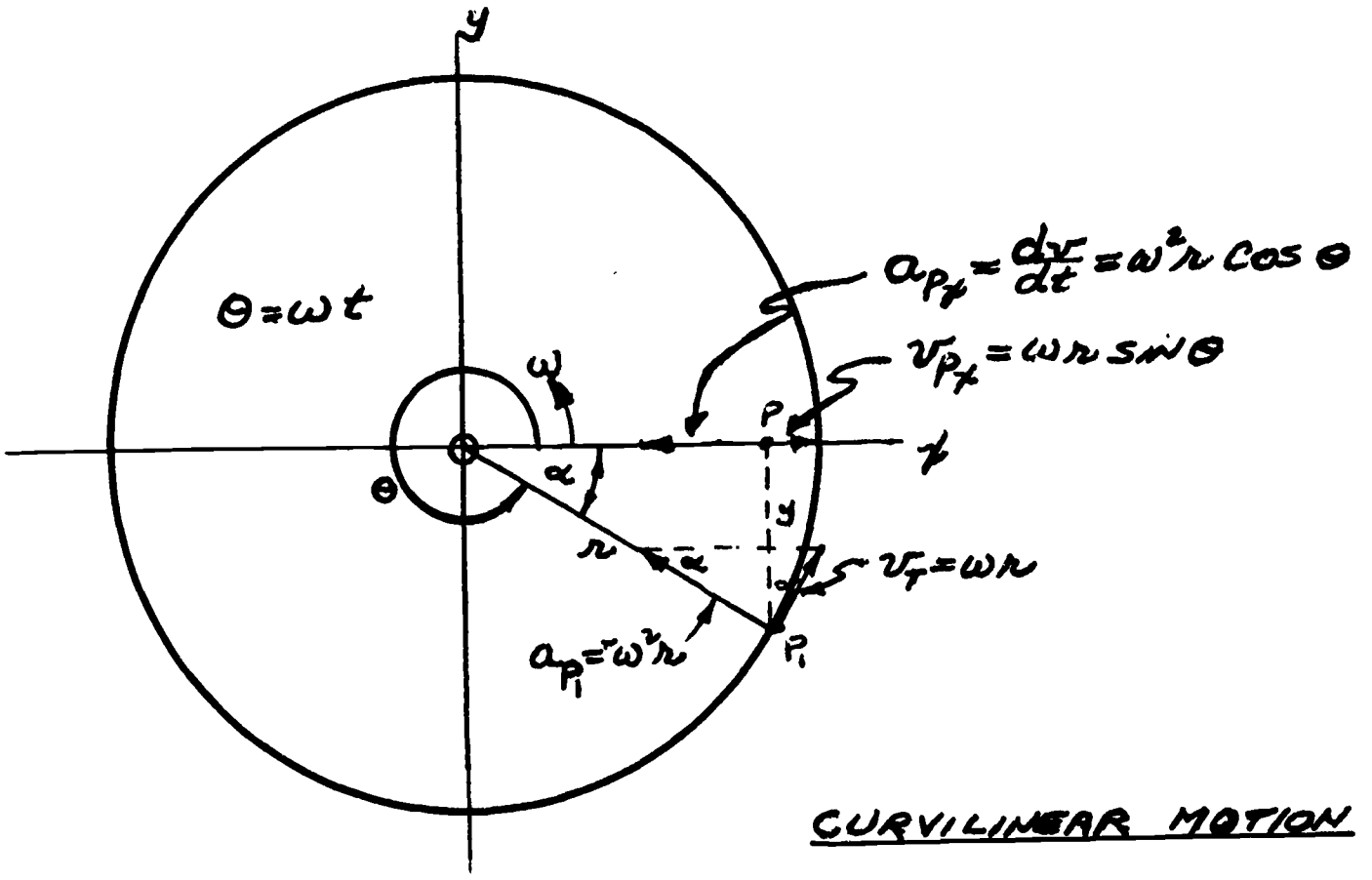
The minus sign simply indicates that the direction of the acceleration is opposite from the positive displacement s which is directed upwards.

The value of a_y of point P_1 can be written in many ways by making substitutions.

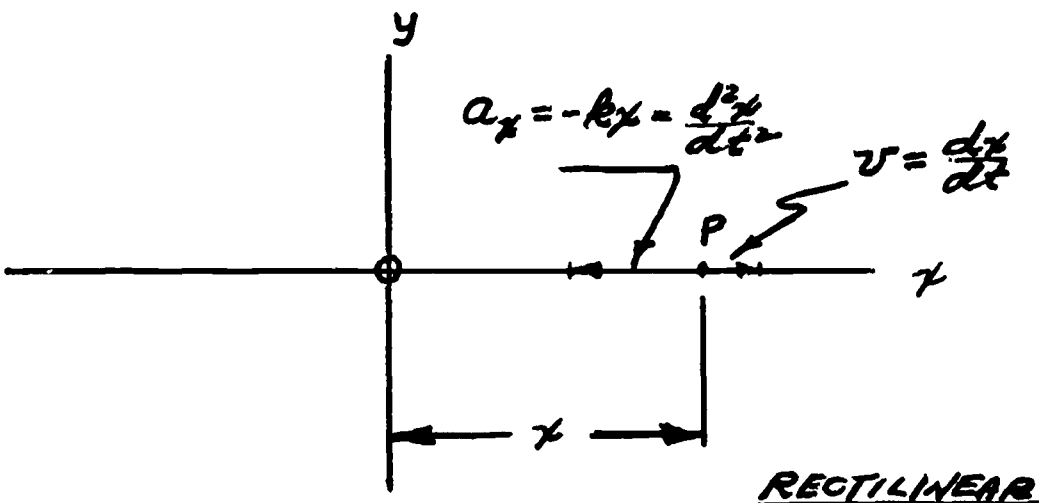
$$\begin{aligned} a_y &= -a_{P_1} \sin\theta \\ &= -a_{P_1} \frac{s}{r} \quad \text{since } \sin\theta = \frac{s}{r} \\ &= -r\omega^2 \sin\omega t \\ &= -\omega^2 s \end{aligned}$$

The projection of a point on one of its axes gives a vibrating motion in a straight line (rectilinear) which is similar to a vibrating blade or pendulum. This is called simple harmonic motion.

The following diagram will show the relationship between curvilinear and rectilinear motion. In this case the point is projected on the x-axis.



CURVILINEAR MOTION



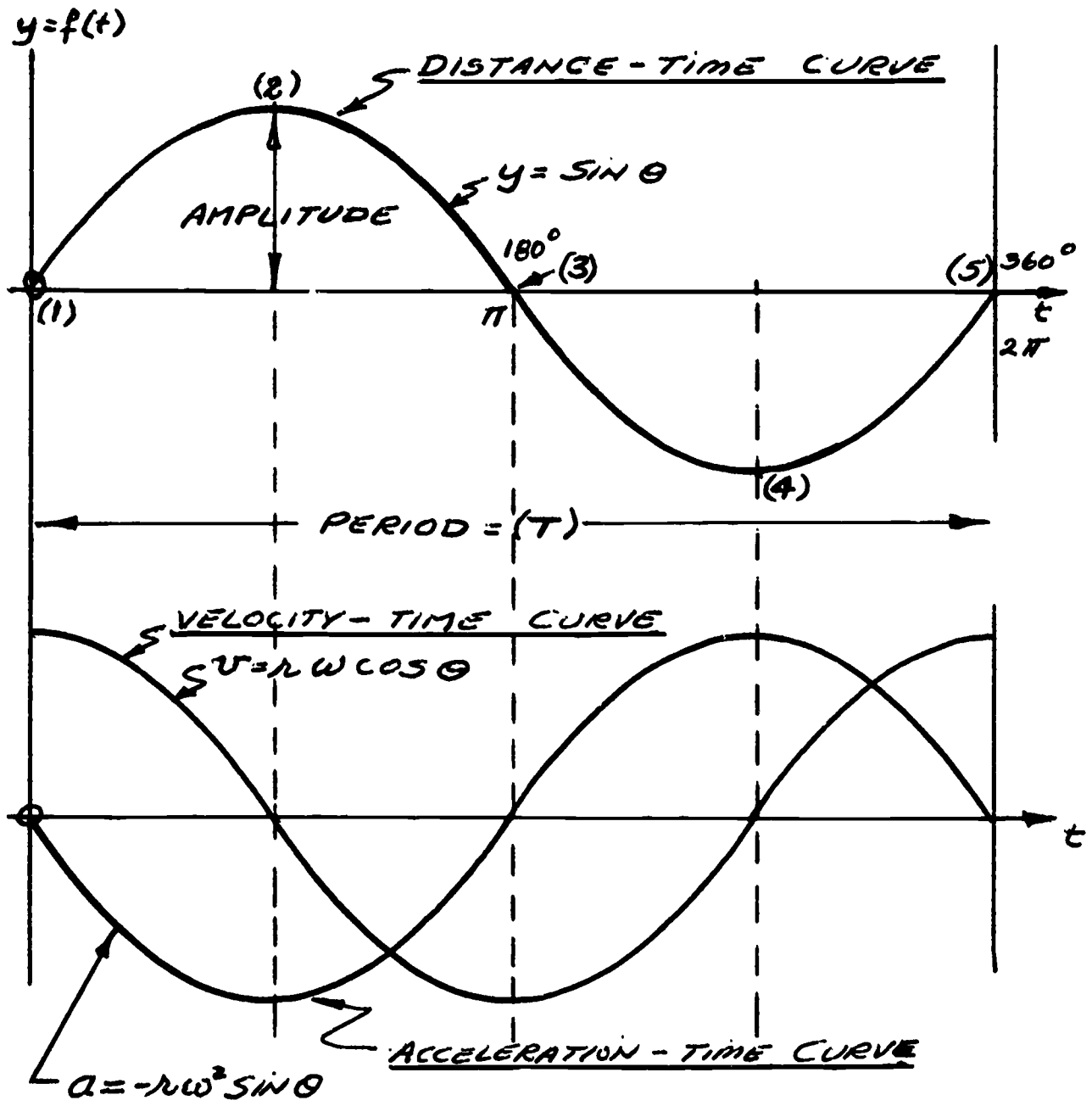
RECTILINEAR MOTION
(STRAIGHT-LINE)

The time to complete one cycle is called the period (T), and one complete cycle is called an oscillation. The frequency (f) is the number of cycles per second.

$$T = \frac{2\pi}{\omega} \qquad \text{(in seconds/cycle)}$$

$$f = \frac{1}{T} = \frac{\omega}{2\pi} \qquad \text{(in cycles/sec.)}$$

(7-7) Distance-Velocity-Acceleration Relationship



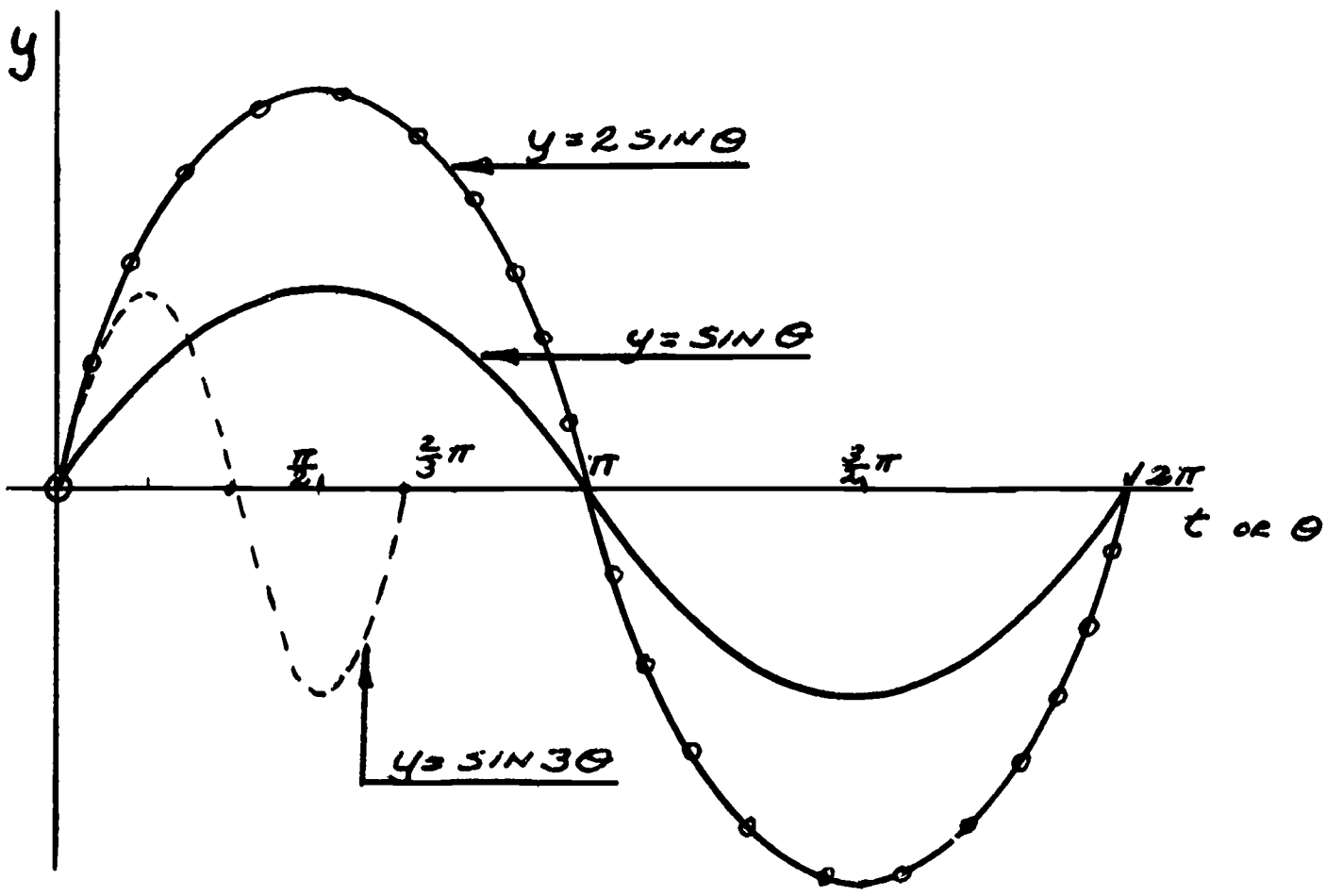
A check of the above diagram at point 1 shows zero displacement, maximum velocity and zero acceleration. At point 2, $\frac{1}{4}$ cycle or 90° later, displacement is maximum, velocity is zero, acceleration is maximum in a negative direction relative to di splacement. Follow the rest of the points and try to relate this motion to something you are familiar with.

The velocity curve is $\frac{\pi}{2}$ radians or 90° behind the displacement, and the acceleration is 90° behind the velocity.

(7-8) Periodic Functions

Actions which repeat at regular time intervals are periodic.

For a function y = 1 sin θ or y = sin θ, the amplitude of the function is 1 and θ is the corresponding angle.



The number which is the coefficient of the trigonometric function is the amplitude. To complete one cycle for all functions except tangent and cotangent requires 2π radians. Tangent and cotangent functions require only π radians for a full cycle.

The number 3 in front of the independent variable in the diagram above (y = sin 3 θ) indicates that 3 cycles are fitted into 2π radians of time, that is, the period is $\frac{2\pi}{3}$ radians per cycle.

Example: Sketch the curve $y = 2 \sin (3x + \frac{\pi}{2})$

For the equation:

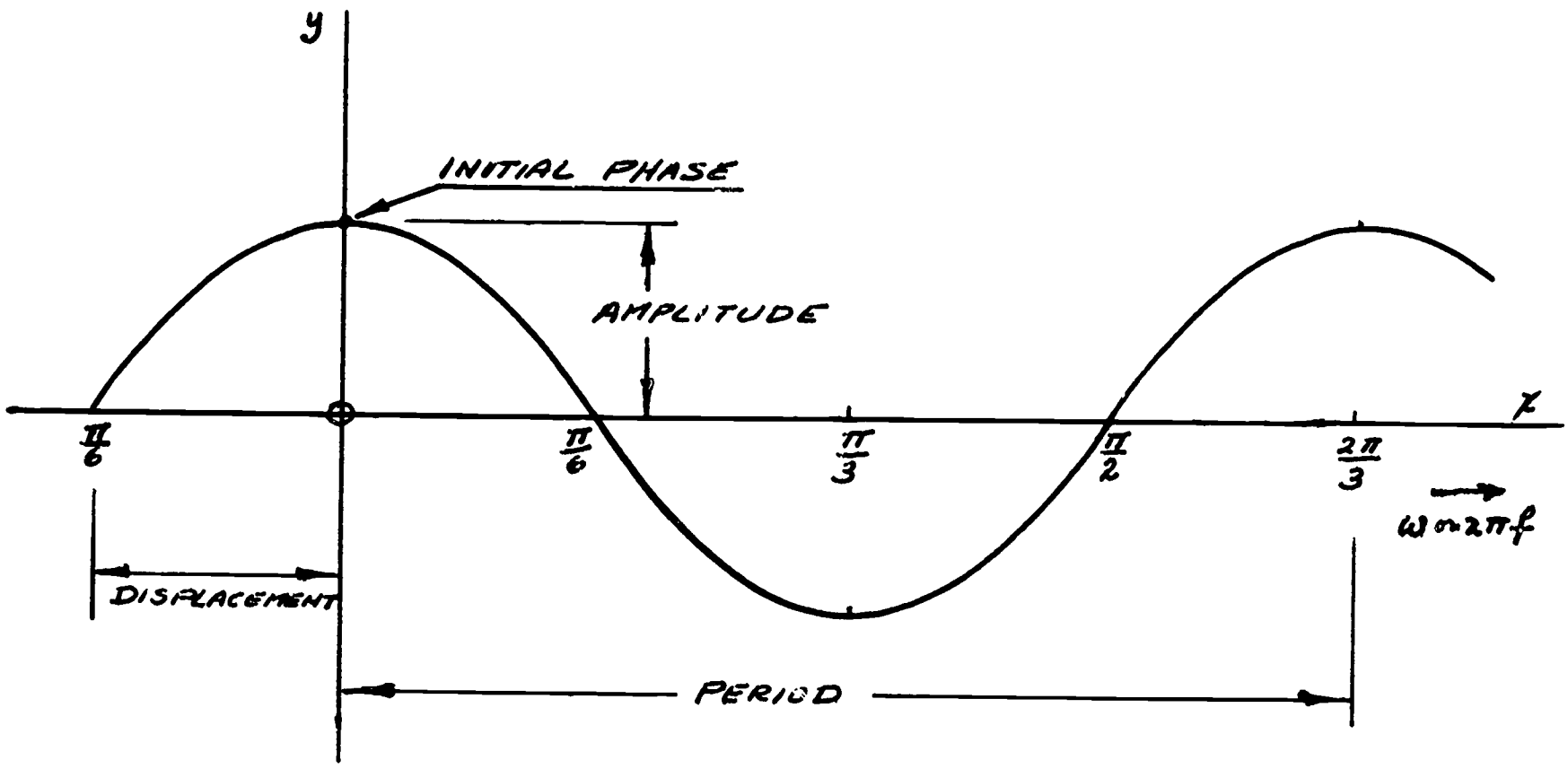
Amplitude = 2

Period = $\frac{2\pi}{\omega} = \frac{2\pi}{3}$ = 3 cycles completed in one revolution

Initial phase = $\frac{\pi}{2}$
(time of start)

Displacement = $\frac{\frac{\pi}{2}}{\omega} = \frac{\pi}{6}$

(Displacement = location of zero point to the right or left of the zero point of the coordinate axis)



Problems (All answers may be left in π notation.)

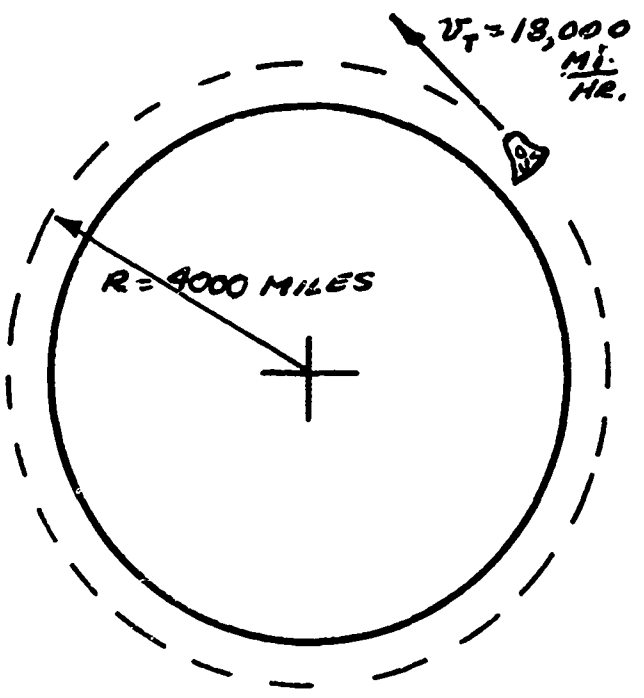
1. Change 6 revolutions to radians; 20 revolutions; 1000 revolutions.

2. Change the following degrees to radians: 30, 45, 60, 90, 120, 185, 180, 270, 300.

3. Determine the maximum velocity and maximum acceleration of a point in simple harmonic motion if its amplitude is 10 and its period is equal to 2 seconds.

4. The acceleration is $a = -60y$ for a spring with a weight on it. If the amplitude is 4 inches, find the period (T), maximum velocity, acceleration, and the frequency.

5. A satellite orbits the earth 100 miles above the surface in a period of 90 minutes. Determine its angular velocity (ω) and its acceleration toward the earth in $\frac{ft}{sec^2}$. Is the astronaut weightless in this capsule?



6. Sketch the following functions:

$$y = \sin\left(3x + \frac{\pi}{2}\right)$$

$$y = 3\sin(2x - \pi)$$

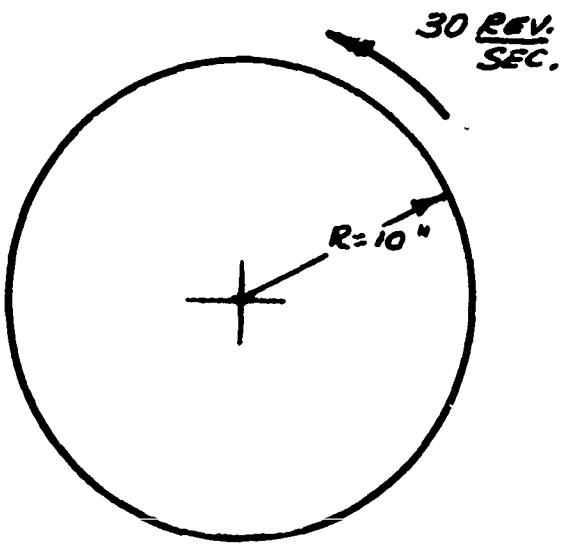
$$y = 2\cos\left(2x + \frac{\pi}{2}\right)$$

$$y = \frac{3}{2}\sin\frac{1}{2}x$$

7. Plot the following wave:

$e = E_m \sin(\omega t + 45)$, where $E = 110$ volts and $\omega = 157$ radians per second.

8. Determine the angular velocity (ω), the tangential velocity, the distance from the center at $(2\pi + \frac{\pi}{6})$ radians and the velocity of the projection of this point on the x-axis.



9. A gasoline engine is rotating at 2000 R. P. M. Assuming the piston moves with approximate harmonic motion, find the acceleration at the top of a 6-inch stroke.

(7-9) Derivative of Trigonometric Functions

In calculus the trigonometric angle is expressed in radians.

The derivative of a sine function is the instantaneous rate of change of the angle (in radians) with respect to the ordinate. It is important for the student to comprehend this definition to understand what is being done when functions are differentiated or integrated. The derivative of the sine and cosine function will be obtained by the delta (Δ) method. From these derivatives all the other function derivatives are obtained by algebraic and trigonometric manipulation.

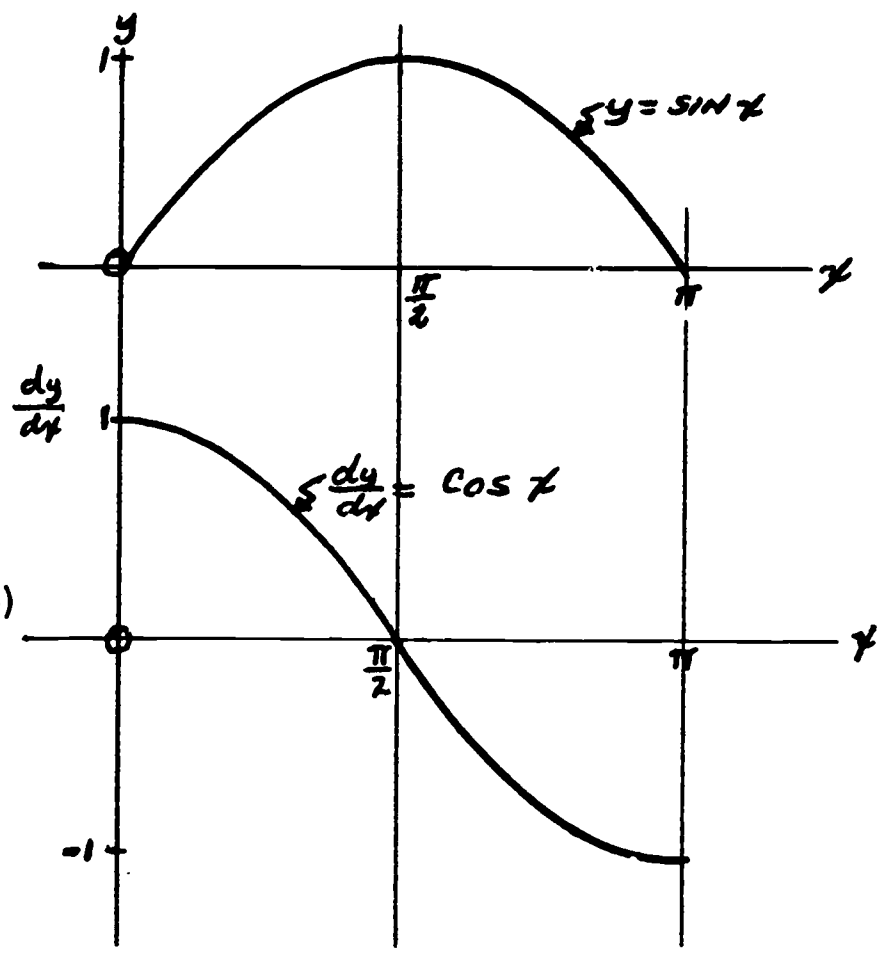
1. Derivative of the Sine Function

$$y = \sin x$$

$$y + \Delta y = \sin(x + \Delta x)$$

Subtract $y \quad = \sin x$

$$\Delta y = \sin(x + \Delta x) - \sin x$$



The trigonometric formula for the difference between the sines of two angles (formula T-9) is

$$\sin A - \sin B = 2\cos\tfrac{1}{2}(A + B)\sin\tfrac{1}{2}(A - B)$$

Let $A = (x + \Delta x)$

$B = x$

Then $\Delta y = \sin A - \sin B$

$$\frac{\Delta y}{\Delta x} = \frac{2\cos\frac{[(x + \Delta x) + x]}{2}\sin\frac{[(x + \Delta x) - x]}{2}}{\Delta x}$$

$$\frac{\Delta y}{\Delta x} = 2 \cos \left(x + \frac{\Delta x}{2}\right) \frac{\sin \frac{\Delta x}{2}}{\Delta x}$$

$$\frac{\Delta y}{\Delta x} = \cos \left(x + \frac{\Delta x}{2}\right) \frac{\sin \frac{\Delta x}{2}}{\frac{\Delta x}{2}}$$

As Δx approaches 0, $\frac{\Delta x}{2}$ approaches zero, and the sine factor in the above product approaches 1.

$$\lim_{\Delta x \to 0} \frac{\sin \frac{\Delta x}{2}}{\frac{\Delta x}{2}} = 1 \qquad \lim_{\theta \to 0} \frac{\sin \theta}{\theta} = 1$$

Taking the limit:

$$\lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x} = \cos \left(x + \frac{\Delta x}{2}\right) (1)$$

$$\lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x} = \frac{dy}{dx} = \cos x$$

In general terms:

$$\boxed{\frac{d}{dx} \sin u = \cos u \frac{du}{dx}} \qquad \text{(D-15)}$$

2. Derivative of the Cosine Function

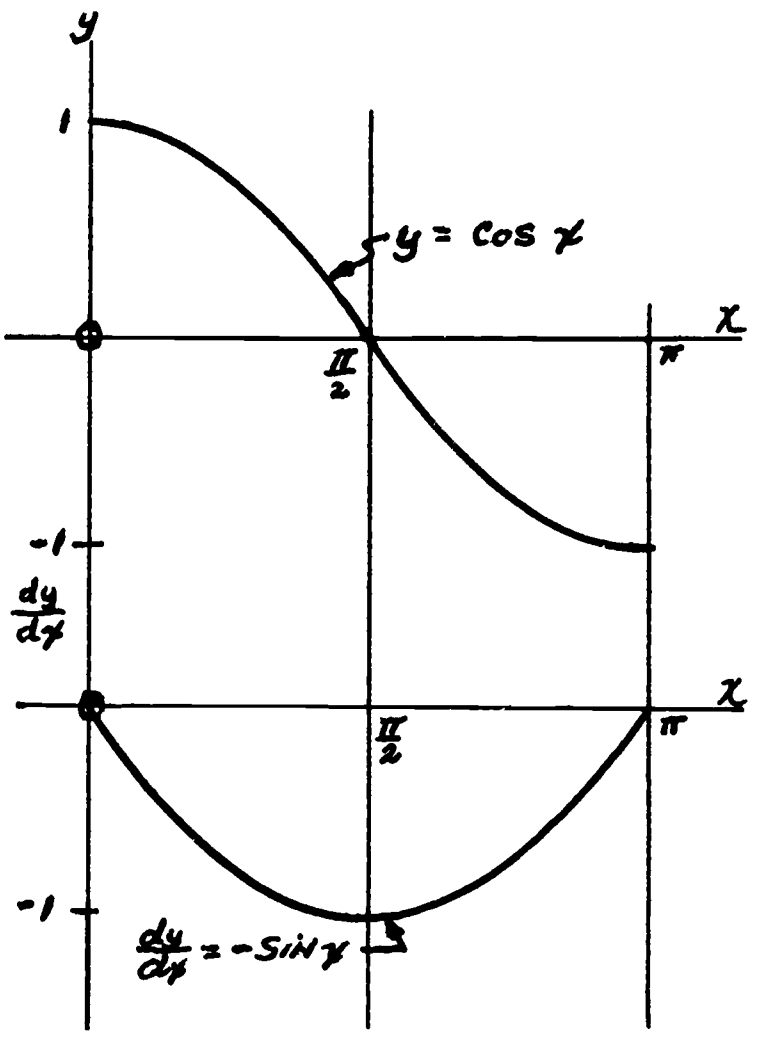
By the same method as was used for the sine function:

$$y = \cos x$$

$$y + \Delta y = \cos (x + \Delta x)$$

$$\underline{y \qquad = \cos x}$$

$$\Delta y = \cos (x + \Delta x) - \cos x$$



The trigonometric formula for the difference between the cosines of two angles is:

$$\cos A - \cos B = -2 \sin \frac{A + B}{2} \sin \frac{A - B}{2}$$

(Formula T-10)

Let $A = (x + \Delta x)$

$B = x$

$$\Delta y = \cos A - \cos B$$

$$\Delta y = -2 \sin \left(x + \frac{\Delta x}{2}\right) \sin \frac{\Delta x}{2} \qquad \text{(Substituting)}$$

Division by x gives

$$\frac{\Delta y}{\Delta x} = - \sin \left(x + \frac{\Delta x}{2}\right) \frac{\sin \frac{\Delta x}{2}}{\frac{\Delta x}{2}}$$

But as $\Delta x \rightarrow 0$, the right-hand factor, as before, approaches 1.

Taking the limit:

$$\lim_{\Delta x \rightarrow 0} \frac{\Delta y}{\Delta x} = \frac{dy}{dx} = - \sin x$$

In general terms:

$$\boxed{\frac{d}{dx} (\cos u) = - \sin u \frac{du}{dx}} \qquad \text{(D-16)}$$

3. <u>Derivative of the Tangent Function</u>

From the derivatives of the sine and cosine functions, the tangent derivative may be obtained easily, since $y = \tan x = \frac{\sin x}{\cos x}$

By the quotient method (Formula D-9):

$$\frac{dy}{dx} = \frac{(\cos x \cos x) - (\sin x)(-\sin x)}{\cos^2 x}$$

$$= \frac{\cos^2 x + \sin^2 x}{\cos^2 x}$$

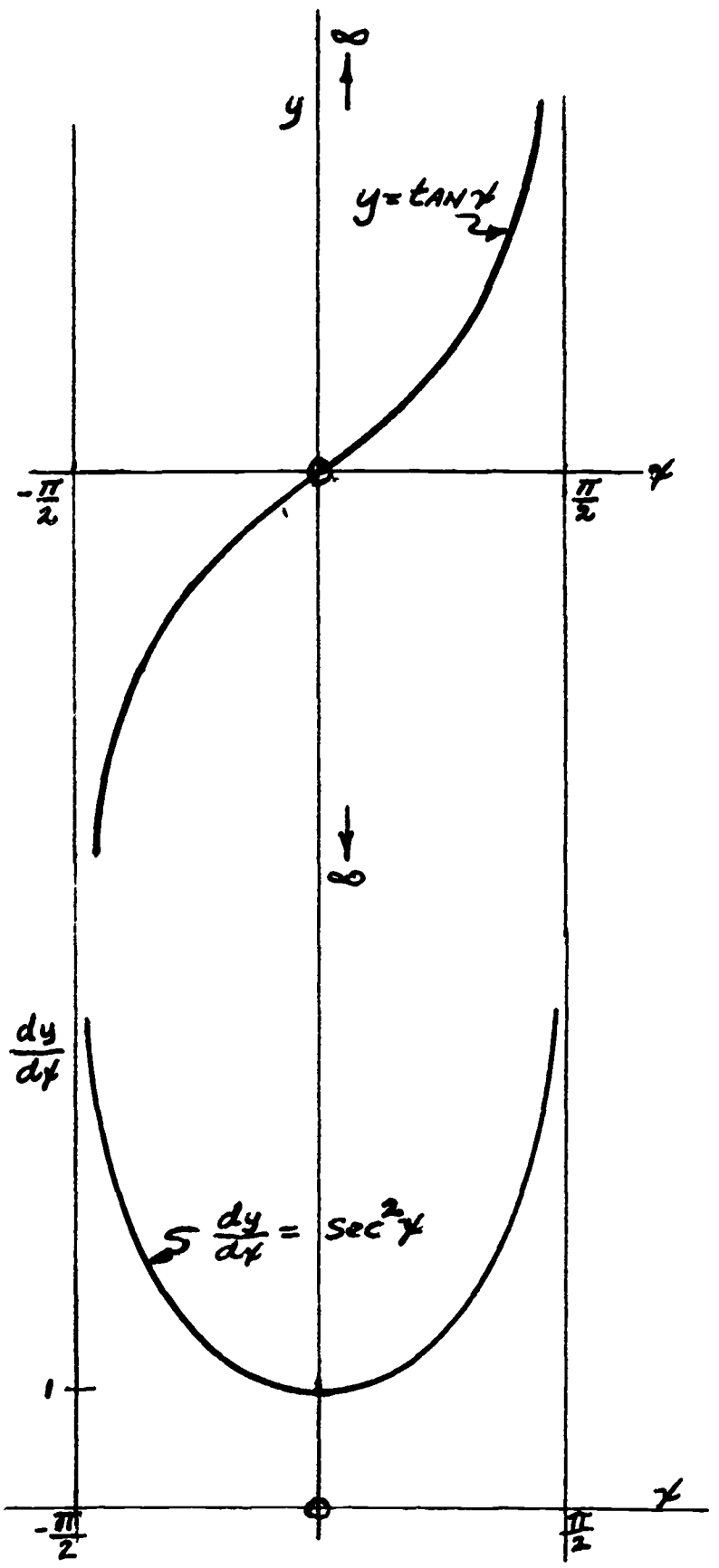
But $\sin^2 x + \cos^2 x = 1$

and $\frac{1}{\cos x} = \sec x$

$$\frac{dy}{dx} = \frac{1}{\cos^2 x} = \sec^2 x$$

In general terms:

$$\boxed{\frac{d}{dx}(\tan u) = \sec^2 u \frac{du}{dx}} \quad \text{(D-17)}$$



The remaining three trigonometric derivatives are obtained by simple differential techniques. A complete list is given below for ready reference in following the solutions of the illustrative examples.

(7-10) Application and Solution of Trigonometric Derivatives

Table of Trigonometric Derivatives

(D-15) $$\frac{d}{dx}(\sin u) = \cos u \frac{du}{dx}$$

(D-16) $$\frac{d}{dx}(\cos u) = -\sin u \frac{du}{dx}$$

(D-17) $$\frac{d}{dx}(\tan u) = \sec^2 u \frac{du}{dx}$$

(D-18) $$\frac{d}{dx}(\text{ctn } u) = -\csc^2 u \frac{du}{dx}$$

(D-19) $$\frac{d}{dx}(\sec u) = \sec u \tan u \frac{du}{dx}$$

(D-20) $$\frac{d}{dx}(\csc u) = -\csc u \text{ ctn } u \frac{du}{dx}$$

Example 1: Find $\frac{dy}{d\theta}$ if $y = \sin^2\theta$

$\sin^2\theta$ is the same as $(\sin \theta)^2$. This means the function and not the angle is squared. Obviously, this is a power function.

$$\frac{d}{dx}(u)^n = n\, u^{n-1} \frac{du}{dx} \qquad \text{(D-6)}$$

Substituting

$$\frac{dy}{d\theta} = 2 \sin \theta \cos \theta$$

Example 2: $y = \sqrt[4]{\tan x}$. Find $\frac{dy}{dx}$.

$$y = (\tan x)^{\frac{1}{4}}$$

Use $\frac{d(u^n)}{dx} = n\,u^{n-1}\,\frac{du}{dx}$ (D-6)

$$y = \tfrac{1}{4}\,(\tan x)^{-\frac{3}{4}}\,\frac{d}{dx}(\tan x)$$

But $\frac{d}{dx}(\tan x) = \sec^2 x$ (D-17)

$$y = \tfrac{1}{4}\,\frac{\sec^2 x}{(\tan x)^{3/4}}$$

Example 3: $y = u \tan u$. Find $\frac{dy}{du}$. (The independent variable is a product.)

Use $\frac{d(uv)}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$ (D-8)

$$\frac{dy}{du} = u\frac{d}{dx}(\tan u) + \tan u\,\frac{du}{du}$$

$$= u \sec^2 u + \tan u$$

Example 4: $y = \frac{\sin x}{x}$. Find $\frac{dy}{dx}$.

Use the quotient method (D-9)

$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$$

$$\frac{dy}{dx} = \frac{x\,\frac{d}{dx}(\sin x) - \sin x\left(\frac{dx}{dx}\right)}{x^2}$$

$$= \frac{x \cos x - \sin x}{x^2} \qquad \text{(D-15)}$$

Example 5: $y = \csc x - (\text{ctn } x)^2$. Find $\frac{dy}{dx}$.

$$\frac{dy}{dx} = -\csc x \text{ ctn } x - 2(\text{ctn } x)\frac{d}{dx}(\text{ctn } x) \qquad \text{(D-20), (D-6)}$$

$$= -\csc x \text{ ctn } x + 2 \text{ ctn } x \csc^2 x \qquad \text{(D-18)}$$

Example 6: The power (P) in an A. C. circuit is to remain constant as the impedance angle (θ) changes. Find $\frac{dP_a}{d\theta}$ if

$$P_a = P \text{ Sec } \theta$$

Since P is a constant multiplying factor, it remains a multiplying factor when differentiating or integrating.

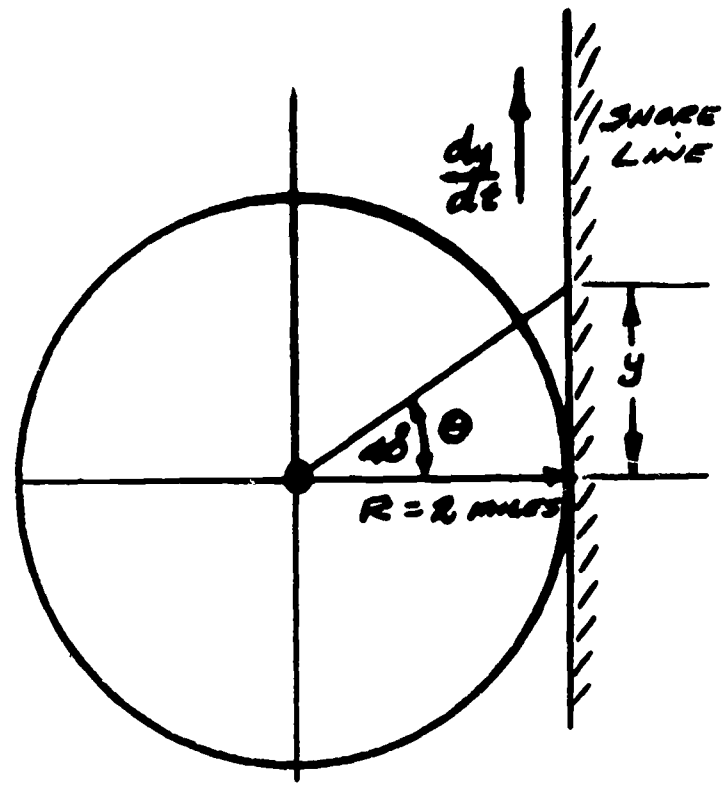
$$\frac{dP_a}{d\theta} = P\,(\text{Sec } \theta \text{ Tan } \theta) \qquad \text{(D-19)}$$

Example 7: Find $\frac{dy}{d\theta}$ if $y = \cos \frac{\theta}{2}$

$$\frac{dy}{d\theta} = -\tfrac{1}{2} \sin \frac{\theta}{2}$$

Example 8:

A destroyer escort is rotating a light at 20 revolutions/minute, when it is 2 miles from a straight shore line. How fast is the light beam moving along the shore line when the light beam is 50° with respect to the shore?



What do we know?

$$\omega = \frac{d\theta}{dt} = 2\pi f = 2\pi\frac{20}{60} = \frac{2}{3}\pi \ \frac{\text{radians}}{\text{second}}$$

$$\frac{y}{2} = \tan\theta \qquad \text{(Trig. relationship)}$$

$$y = 2\tan\theta$$

$$\frac{dy}{d\theta} = 2\sec^2\theta\ \frac{d\theta}{d\theta}$$

Therefore $\frac{dy}{d\theta} = 2\sec^2\theta$ (since $\frac{d\theta}{d\theta} = 1$)

But $\frac{d\theta}{dt} = \frac{2}{3}\pi$

Equations can be multiplied together, since the products of equals are equals.

Therefore $\frac{d\theta}{dt} \times \frac{dy}{d\theta} = \frac{2}{3}\pi(2\sec^2\theta)$

$$v = \frac{dy}{dt} = \frac{4\pi}{3}\sec^2\theta$$

$$\sec 40^\circ = 1.305$$

$$v = \frac{4\pi}{3}(1.305)^2$$

$$v = 2.27\pi \text{ miles/second}$$

Problems

Differentiate:

1. $y = 3 \cot x$

2. $x = \sin 3\theta$

3. $xy = \sin x$

4. $x = \ln \sin y$

5. $y = x \sin x$

6. $y = e^t \sin t$

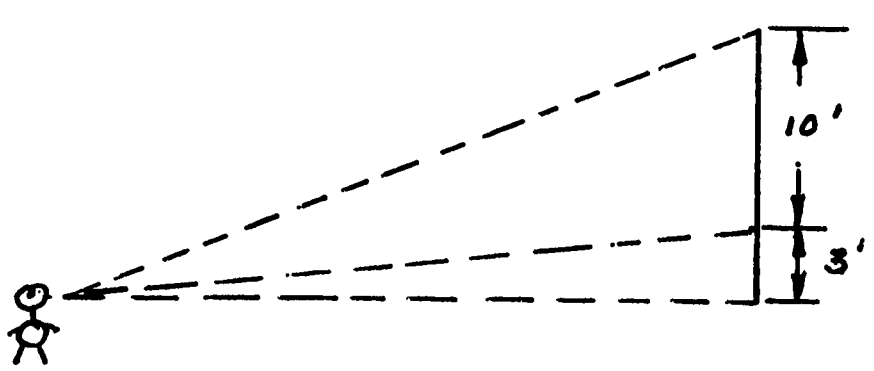
7. An object moves according to the equation $S = 2 \sin\frac{1}{2}\pi t$. Find the position, velocity, and acceleration at $t = 0, 1, 2, 3, 4$.

8. If $S = \frac{2}{3} t + \cos\frac{1}{3}\pi t$, find the equations for velocity and acceleration.

9. The general equation for simple harmonic motion or vibration is $S = A \cos kt$. From this equation derive velocity and acceleration.

10. A gas turbine which is 2 feet in diameter is rotating at 12,000 R. P. M. With what tangential velocity will it move? If the blade broke off at 0 degrees, find the rate of angle change with respect to the blade motion at $\frac{\pi}{6}$ radians.

11. A sign 10 feet in height has a base 3 feet above a boy's eye level. How far from the sign must he be to observe the sign with a maximum angle?

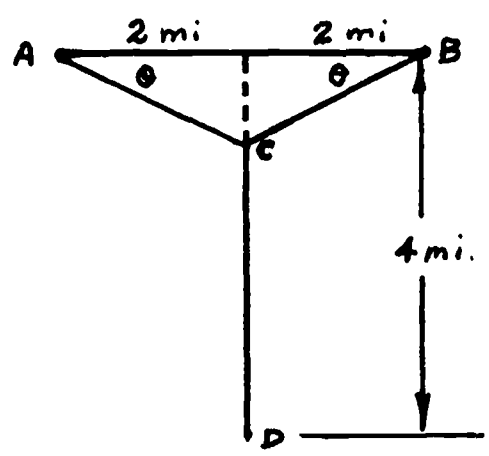


12. The angular velocity (ω) is 1 radian per second. Determine the velocity of the projection of the point on the x-axis if $r = 1$, for the following angles: $0, \frac{\pi}{2}, \pi, \frac{3\pi}{2}$.

13. Using trigonometric differentiation, find the volume of the largest right circular cylinder which can be inscribed in a sphere of radius 8 inches.

14. Using trigonometric differentiation, find the altitude of a right circular cone of least lateral area which can be circumscribed about a sphere of radius 8 inches.

15. Three towns (A, B, D) are located as shown in the diagram.



Find the length of road CD such that the total length of the roads will be a minimum.

(7-11) Integration of Trigonometric Forms

In listing the differentials for trigonometric functions, there were only six -- one for each function. For integration, however, there are many more, since these forms are used primarily to facilitate problem solving. There are approximately 250 standard forms which may be used. Only a small portion of these, which have more common applications, will be listed.

Elementary Integration Forms

(I-7) $\int \sin u \, du = -\cos u + C$

(I-8) $\int \cos u \, du = \sin u + C$

(I-9) $\int \tan u \, du = \ln \sec u + C$

(I-10) $\int \csc u \, du = \ln (\csc u - \operatorname{ctn} u) + C$

(I-11) $\int \sec u \, du = \ln (\sec u + \tan u) + C$

(I-12) $\int \operatorname{ctn} u \, du = \ln \sin u + C$

(I-13) $\int \sec^2 u \, du = \tan u + C$

(I-14) $\int \csc^2 u \, du = -\operatorname{ctn} u + C$

(I-15) $\int \sec u \tan u \, du = \sec u + C$

(I-16) $\int \csc u \operatorname{ctn} u \, du = -\csc u + C$

Example 1: $\int 3 \cos 3\theta d\theta$

Let $u = 3\theta$

$$\frac{du}{d\theta} = 3$$

$$du = 3d\theta$$

$$= \sin 3\theta + C$$

Example 2: $\int \sin x \cos x \, dx$

Let $u = \sin x$

$$\frac{du}{dx} = \frac{d}{dx}(\sin x) = \cos x \qquad du = \cos x \, dx$$

Use $\int u^n du$

$$\int \sin x \cos x \, dx = \frac{\sin^2 x}{2} + C$$

Example 3: $\int \cos 2\theta d\theta$

Let $2\theta = u$

$du = 2d\theta$

$= \frac{1}{2}\int \cos 2\theta \cdot 2d\theta = \frac{1}{2}(\sin 2\theta) + C$

($\frac{1}{2}$ is correcting factor for the correct du term)

Example 4: $\int \tan 3\theta d\theta = \frac{1}{3} \ln \sec 3\theta + C$

Example 5: $\int \frac{dx}{\sin^2 x}$

No form type: change to inverse function

$= \int \csc^2 x \, dx$

$= -\text{ctn } x + C$

Example 6: $\int \text{ctn} \frac{x}{2} \, dx$

Let $u = \frac{x}{2}$

$\frac{du}{dx} = \frac{1}{2}$

$du = \frac{dx}{2}$

Correcting factor = 2

$= 2\int \text{ctn} \left(\frac{x}{2}\right) \frac{1}{2} \quad dx$

$= 2 \ln \sin \frac{x}{2} + C$

Example 7: $\int x^2 \sin x^3 \, dx$

Let $u = x^3$

$\frac{du}{dx} = 3x^2$

$du = 3x^2 \, dx$

Correcting factor = $\frac{1}{3}$

$= \frac{1}{3}\int \sin x^3 \, 3x^2 \, dx$

$= -\frac{1}{3} \cos x^3 + C$

Example 8: $\int (\frac{3}{2} - x) \text{ ctn } (3x - x^2)\, dx$

Let $u = 3x - x^2$

$\frac{du}{dx} = 3 - 2x$

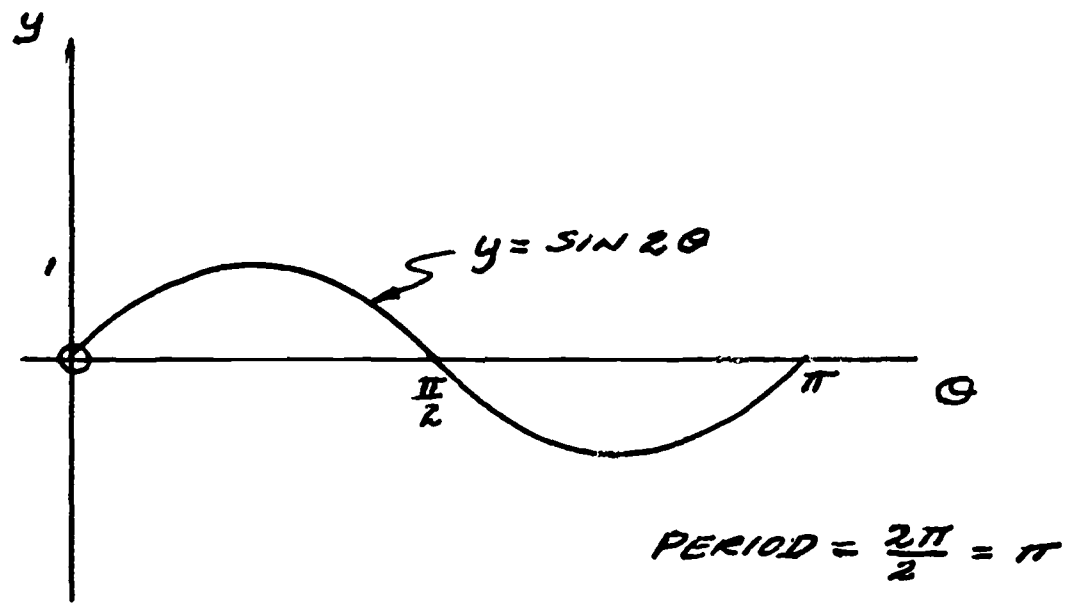
$du = (3 - 2x)\, dx$

Correcting factor $= \frac{1}{2}$

$= \frac{1}{2} \int \text{ctn } (3x - x^2)\, 2\, (\frac{3}{2} - x)\, dx$

$= \frac{1}{2} \ln \sin (3x - x^2) + C$

Example 9:



$y = \sin 2\theta$. Find the area between $\frac{\pi}{6}$ and $\frac{\pi}{4}$.

$y = f(x) = \sin 2\theta$

$$\text{Area} = \int y\, d\theta$$

$$= \int_{\frac{\pi}{6}}^{\frac{\pi}{4}} \sin 2\theta d\theta$$

Let $u = 2\theta$

$\frac{du}{d\theta} = 2$

$du = 2d\theta$

$$= \frac{1}{2} \int_{\frac{\pi}{6}}^{\frac{\pi}{4}} \sin (2\theta)\, 2\, d\theta$$

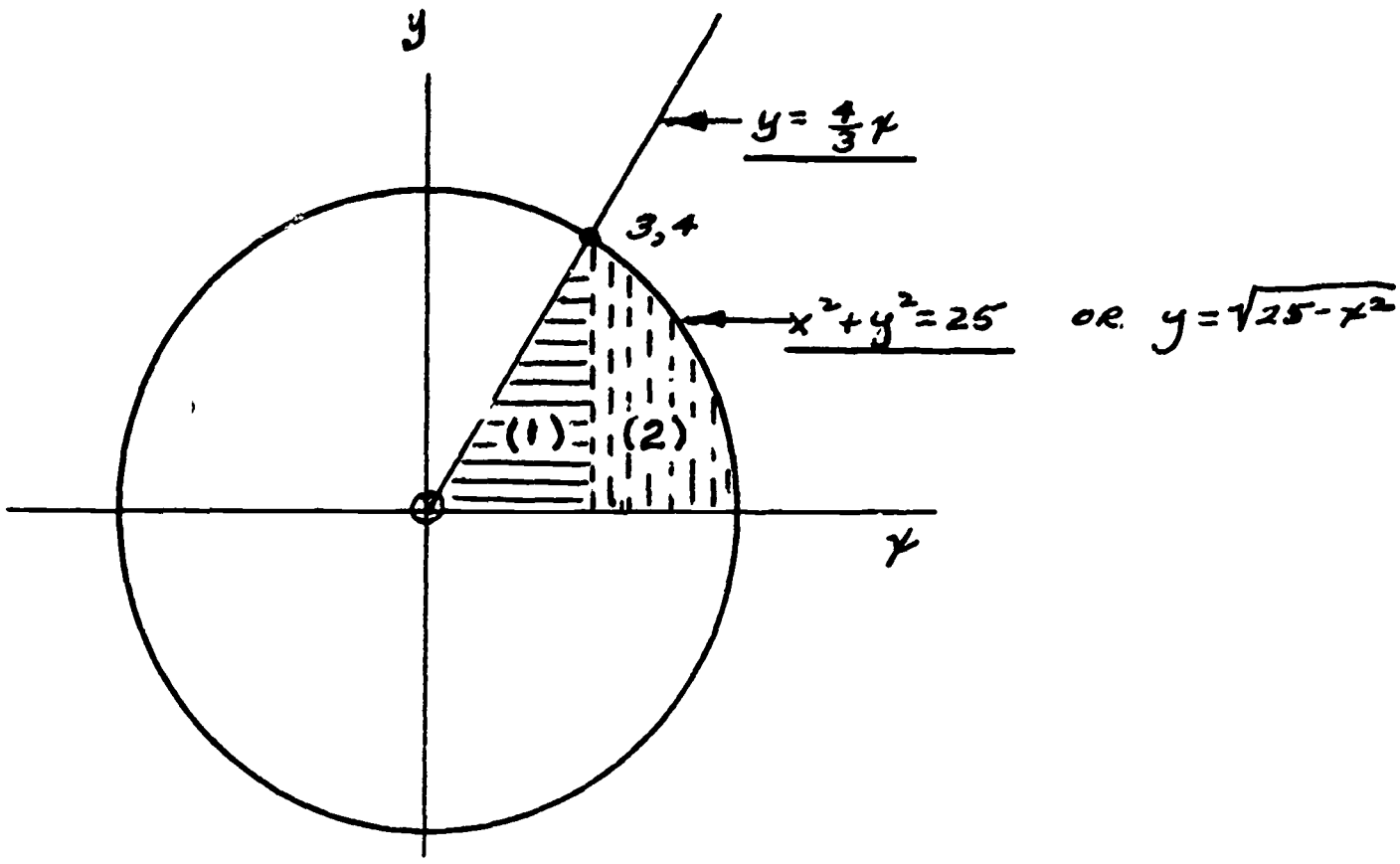
$$= -\left[\frac{1}{2} \cos 2\theta\right]_{\frac{\pi}{6}}^{\frac{\pi}{4}}$$

$$= -\left[\frac{1}{2} \cos \frac{\pi}{2}\right] + \left[\frac{1}{2} \cos \frac{\pi}{3}\right]$$

$$= -\frac{1}{2}(0) + \frac{1}{2} \times \frac{1}{2}$$

$$= \frac{1}{4}$$

Example 10: Given the equations indicated in the diagram, find the area bounded by the two curves and the x-axis.



$$x^2 + y^2 = 25$$

$$y = \frac{4}{3}x$$

Solving by substitution

$$x^2 + \left(\frac{4}{3}x\right)^2 = 25$$

$$x = 3$$

$$y = 4$$

$$A_1 = \int_0^3 \frac{4x}{3}\,dx$$

$$= \frac{4}{3}\,\frac{x^2}{2}\Big]_0^3 = 6$$

$$A_2 = \int_3^5 \left(\sqrt{25 - x^2}\right)\,dx$$

By using (I-20) from the table of integrals, we get

$$= \frac{x}{2}\sqrt{25 - x^2} + \frac{25}{2}\arcsin\frac{x}{5}\Big]_3^5$$

$$= \left[\frac{5}{2}\sqrt{0} + \frac{25}{2}\arcsin 1\right] - \left[\frac{3}{2}\sqrt{25 - 9} + \frac{25}{2}\arcsin\frac{3}{5}\right]$$

But, arc sin 1 is the same as

$$\sin\theta = 1$$

$$\therefore \theta = \frac{\pi}{2}$$

Also, arc sin $\frac{3}{5}$ means

$$\sin\theta = \frac{3}{5} \quad \text{(in radians)}$$

$$\theta = 36.8^{\circ} \times \frac{\pi}{180}$$

$$= .64 \text{ radian}$$

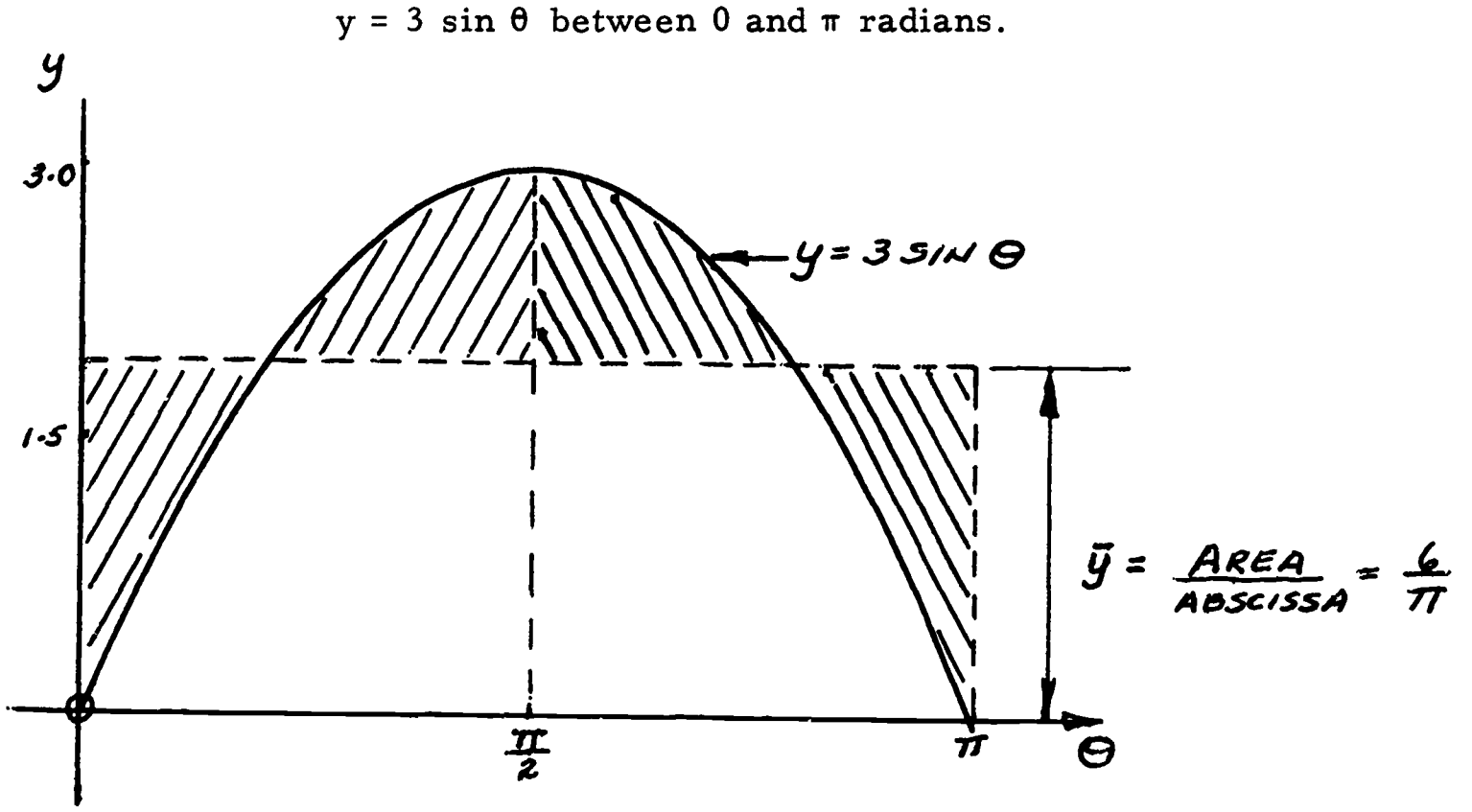
Making these substitutions above gives

$$= \left[0 + \frac{25\pi}{4}\right] - \left[\frac{3}{2}(4) + \frac{25}{2}(.64)\right]$$

$$A_2 = 5.6$$

$$A_1 + A_2 = 6 + 5.6 = \underline{11.6} \quad \text{Answer}$$

Example 11: Determine the average value of the ordinate of the function $y = 3 \sin\theta$ between 0 and π radians.



$$\text{Area} = \int_0^{\pi} y \, d\theta = \int_0^{\pi} 3 \sin\theta d\theta$$

$$= 3(-\cos\theta)\Big]_0^{\pi}$$

$$= 3\left[(-\cos\pi) - (-\cos 0)\right]$$

$$= 3\ (-[-1]) - (-[1])$$

$$= 6 \text{ square units}$$

$$\bar{y} = \frac{\text{area}}{\text{abscissa}} = \frac{6}{\pi}$$

Problems

1. $\int \sin^3 x \cos x \, dx$

2. $\int (\sin x)^3 \cos x \, dx$

3. $\int \sin bx \cos bx \, dx$

4. $\int \frac{x3}{1 + x^4} \, dx$

5. $\int \frac{\sin x}{1 - \cos x} \, dx$

6. $\int 2 e^{2x} \, dx$

7. $\int s \, 3^{s^2} \, ds$

8. $\int \frac{dx}{\sqrt{x^2 - 25}}$

9. $\int \frac{dy}{4 - 9y^2}$

10. $\int \frac{dx}{\sqrt{9 - (y + 2)^2}}$

11. $\int \sqrt{25 - 16y^2} \, dy$

12. $\int \frac{dy}{(y + 1)^{\frac{3}{2}}}$

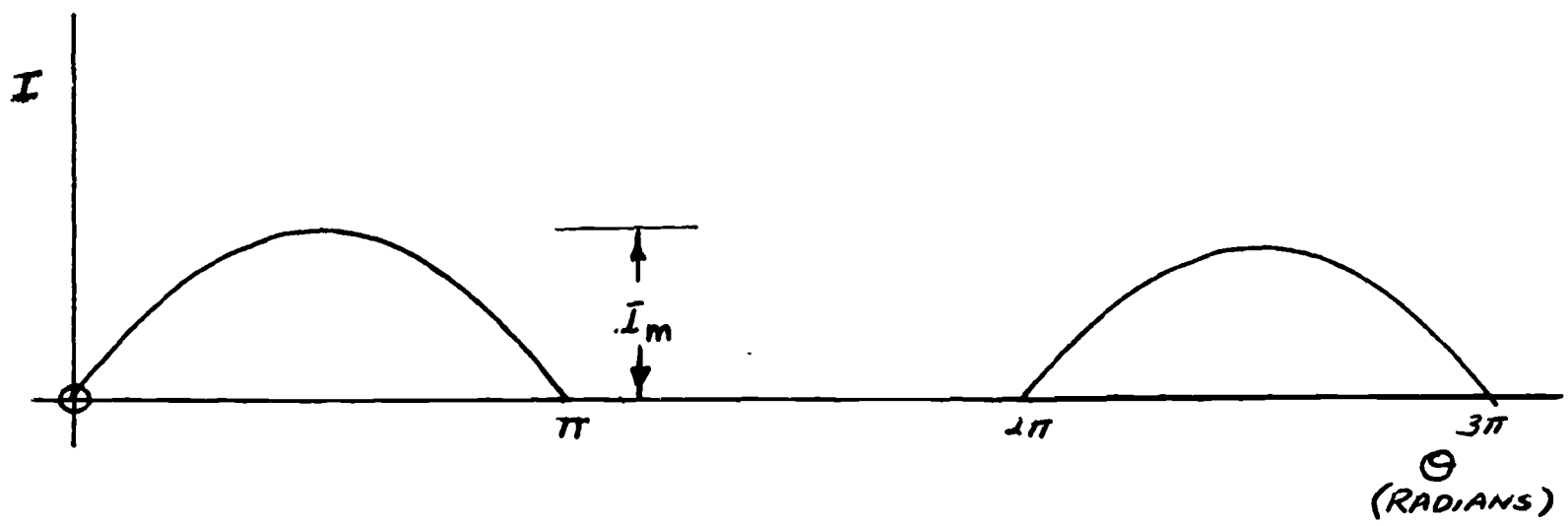
13. Find the area of the graph of $x^2 + y^2 = 25$ by using the definite integral.

14. For the above curve, find the area bounded between $x = -2$ and $x = 3$.

15. $\int_4^2 \frac{dx}{2x + 1}$

16. $\int_{\frac{\pi}{3}}^{-\frac{\pi}{6}} \sec u \tan u \, du$

17.



Half-wave rectifier wave form

If $I_{av} = \frac{1}{2\pi}\int_{o}^{\pi} I_m \sin\theta d\theta$

Determine the I_{av} in terms of I_m.

18. Compare the areas formed by the two equations $y = 2 \sin \theta$ and $y = 2 \sin 2\theta$, between the limits of 0 and π radians.

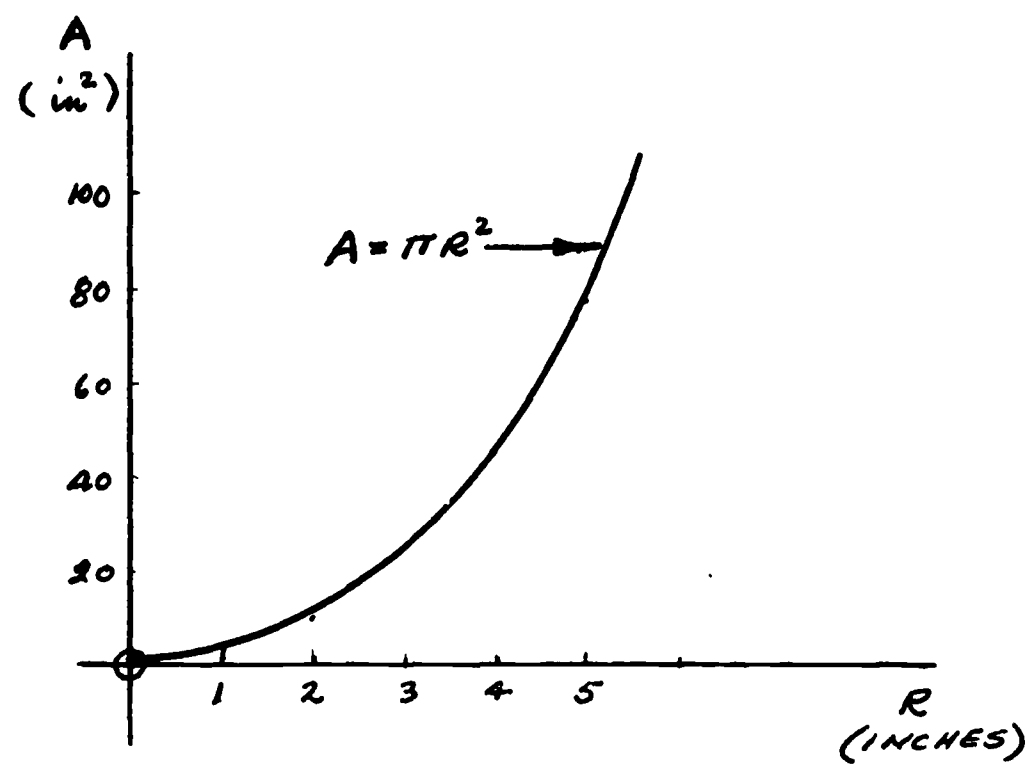
(7-12) Plotting Power Functions

The equation for the area of a circle is a common example of a power function.

$$\text{(dependent variable)} \rightarrow A = \underset{\text{(constant)}}{\pi} R^2 \leftarrow \text{(independent variable)}$$

To plot the area as a function of the radius, it is necessary to assign some arbitrary values to R in the equation in order to obtain corresponding values for the area (A).

R	A
0	0
1	3.14
2	12.56
3	28.26
4	50.24
5	78.50



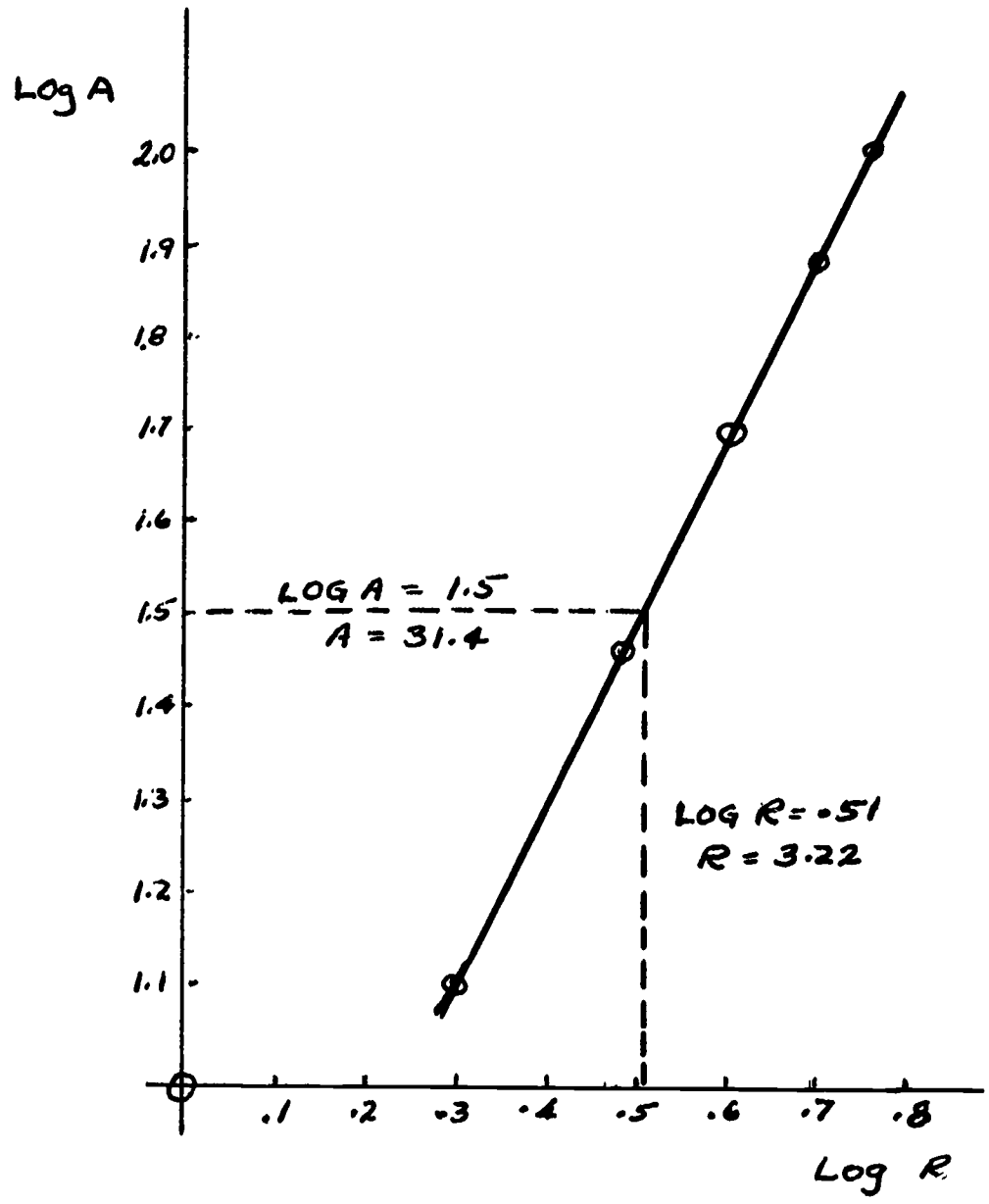
The sample plot shows that a power function plots as a curve on coordinate paper.

It is difficult to determine functional relations from curves, so we shall try another method.

Write the power function $A = \pi R^2$ in logarithmic form.

$$\text{Log } A = \text{Log } \pi + 2 \text{ Log } R$$

A	Log A	R	Log R
12.6	1.10	2	.301
28.3	1.45	3	.477
50.2	1.70	4	.602
78.5	1.89	5	.699
113.0	2.05	6	.778



You will note that plotting a power function gives a straight line when the variables are plotted as logs. When choosing some intermediate points, the dependent variable is obtained in log form. To obtain the answer in numeral form, antilogs must be taken, which involves extra work and indirect answers.

A method of plotting a power function so that the answers may be read directly from the plot is by using log-log paper. This paper has the abscissa and ordinate scaled like the "L" scale of the slide rule.

Note: For a given radius (R) of 3.22 on the bottom scale, the area is read directly on the ordinate as 3.1×10^2 or 310 in^2.

Now suppose certain data had been plotted as indicated, and it was necessary to write an equation relationship or formula for the plotted data.

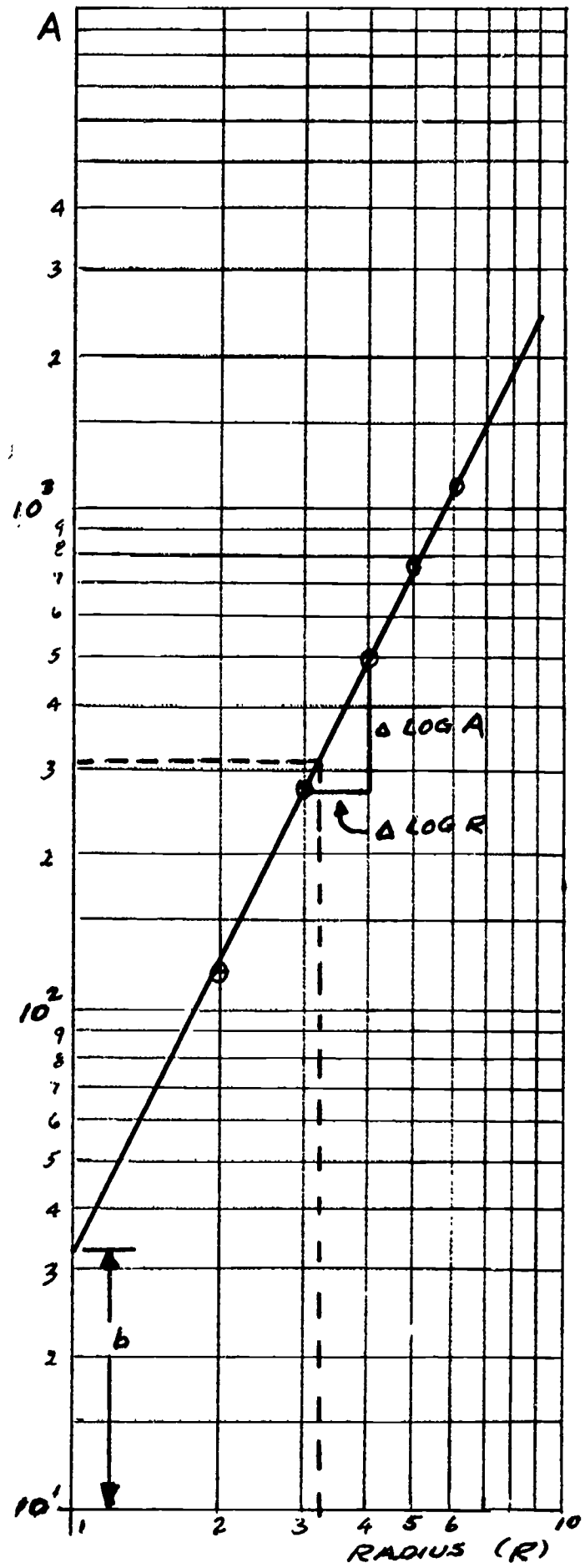
1. Determine the slope of the straight line (m). To do this simply measure $\frac{\text{rise}}{\text{sun}}$ in any unit.

$$m = \frac{\Delta y}{\Delta x} = \frac{\Delta \log A}{\Delta \log R} = \frac{1.6 \text{ cm.}}{.8 \text{ cm.}} = 2$$

2. The general linear equation is $y = mx + b$. In this problem $\log A = 2 \log R + \log b$

Since b — or in this problem log b — is the point where the curve cuts the ordinate (at R = 1),

$\log b = 3.14$



Taking the antilog of the above equation

$$\log A = 2 \log R + 3.14$$

we obtain $A = \pi R^2$, which is the equation of the line on log-log paper.

Generally, any power function, such as $A = \pi R^2$, can be plotted on log-log paper to give a straight line. Then by using the slope-intercept form for a straight line ($y = mx + b$) the equation may be obtained from the plotted data.

(7-13) Plotting Exponential Functions

Many functional relations in nature follow this pattern. The general expression is

$$\text{(dependent variable)} \rightarrow y = a\, e^{x}$$

independent variable

natural logarithm base (2.718)

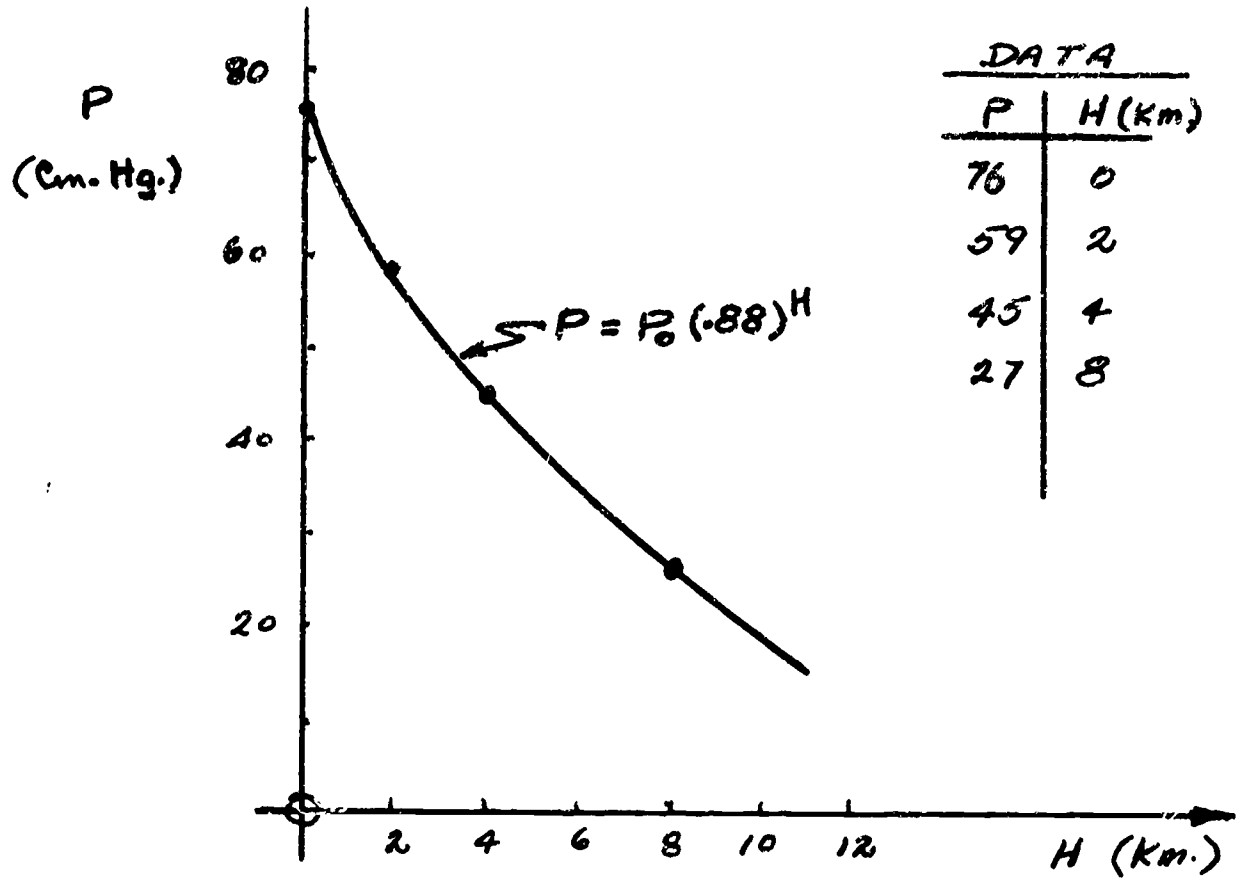
constant

A typical problem of this type is the variation of pressure with respect to height.

$$P = P_o\ (.88)^H$$

P is the pressure at a particular height and P_o is sea level pressure. The equation indicates that for every kilometer of elevation the pressure decreases to 88% of the value at the previous level. (This equation is true only if H is in kilometers.)

Now we shall determine the plot of this function on both regular coordinate paper and on log-log paper, as was done previously for the power function. (We shall take the value of P_o as 76 cm. of mercury, the standard atmospheric pressure at sea level.)

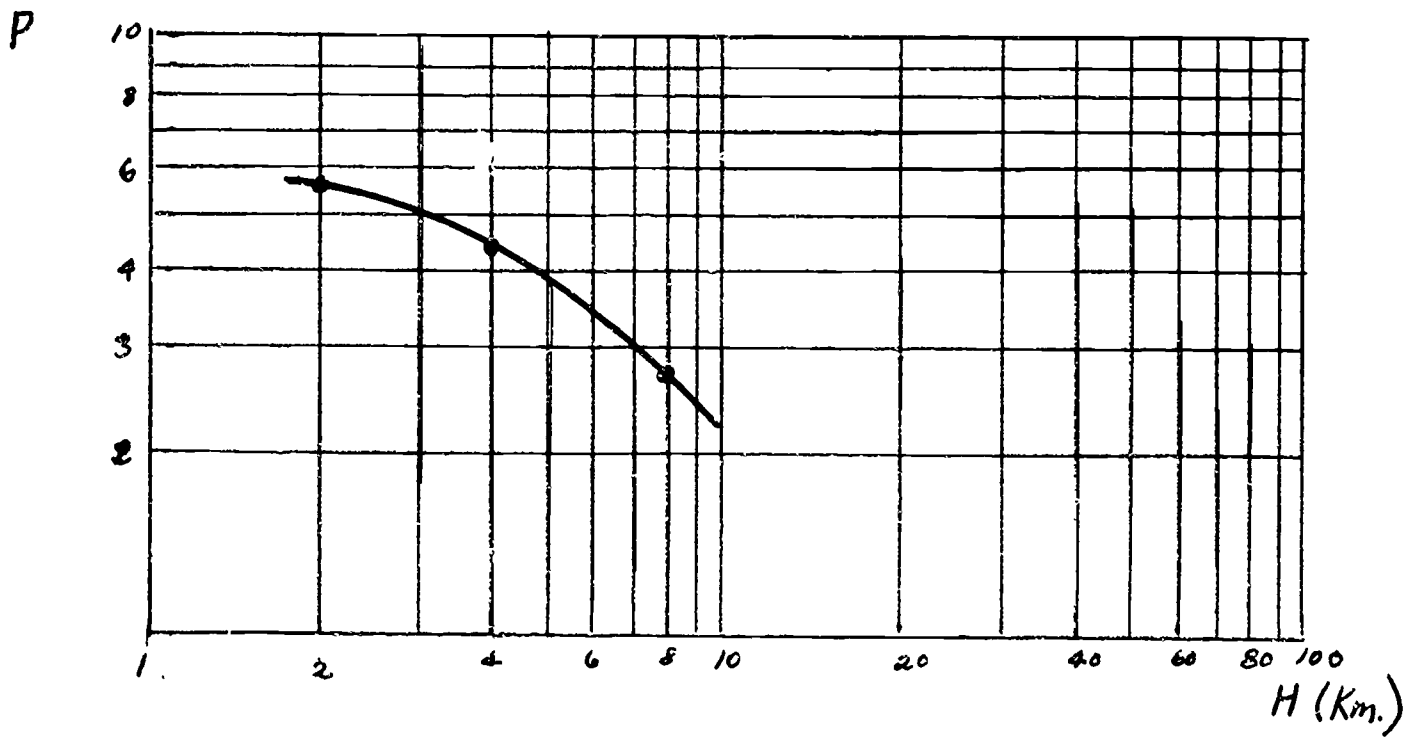


DATA

P	H (Km)
76	0
59	2
45	4
27	8

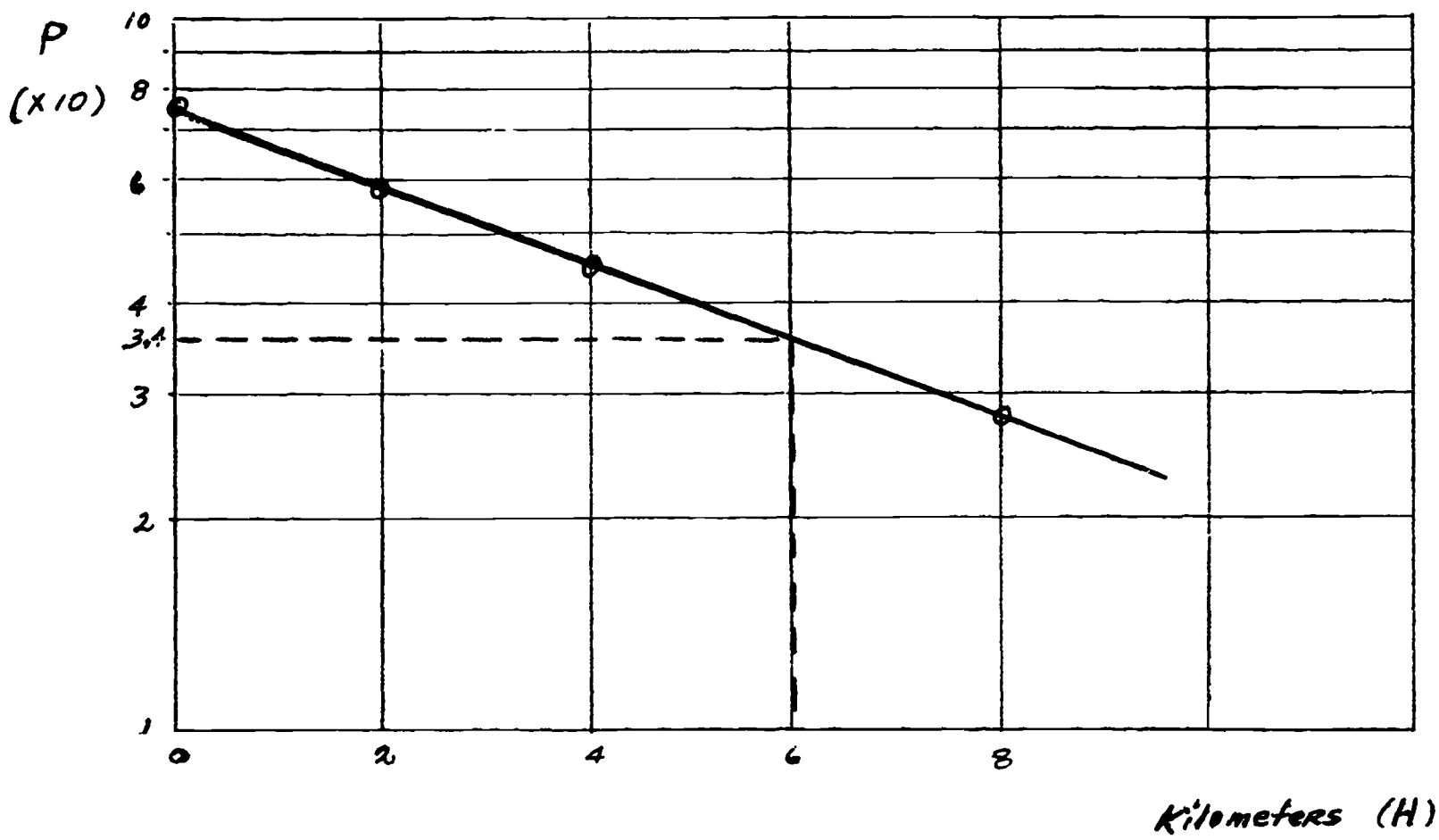
The exponential equation plots as a curve on regular coordinate paper.

Plotted on log-log paper, it still plots as a curve.



Note that the exponential function does not plot as a straight line in either of the two tries.

Now try plotting the relations on semilog paper.



Again, because the exponential equation plots as a straight line on semilog paper, it is easier to make direct readings from the graph than it was from the two previous plots. For example, for 6 Kms. in height, the pressure is 34 cms. of mercury.

Now suppose certain data had been plotted and it was necessary to write an equation from it - a problem which occurs quite frequently in the modern-day technology.

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How would this be done? Well, as before, try the plots on different paper until one is found that gives a straight-line plot, for example, the one shown above.

If the straight-line plot is on semilog paper, we know our equation will be of the form

$$y = ak^x$$

We shall call it

$$P = P_o k^H$$

When H is zero, then $k^H = k^o = 1$ and $P = P_o$. We determine P_o from our plot to be 76, and our equation now reads

$$P = 76 k^H$$

Now to find the constant k. From the plot we see that, when H = 1, P = 67. We may now write the equation as

$$67 = 76 k^1$$

$$\text{or } 67 = 76 k$$

From this we find that k = .88.

Now that both constants have been found, it is possible to write the equation $P = 76 (.88)^H$ where H equals the height in kilometers and P is the pressure in cms. of mercury.

Problems

1. Kepler's third law of astronomy states that the period of a planet squared equals the distance of the planet from the sum cubed. Or $T^2 = D^3$.
   Plot this relationship on log-log paper.

2. If $i = \frac{E}{R} e^{-\frac{Rt}{L}}$ in an A. C. circuit at any time, plot i against t on standard coordinate paper when E = 110 volts, R = 11 ohms, and L = .02 henry.

3. Plot the above relationship on semilog paper.

4. Newton's law of cooling is

$$\theta = 40\, e^{-0.95t}$$

   where θ is the difference in temperature between the body and the cooling air. If an object is heated to 1500° F. and is put into an oven at 100°F., find the time required to cool the metal to the oven temperature.

5. Plot the cooling curve and from the plot determine how long it takes for the metal to drop to a temperature of 1000°F.

6. A body at 0° is placed in a room at 70°F. The following data was recorded:

Temp. °F	Time (Min.)
45	30
60	60
67	90
69	120
69.5	150

   Plot this data on standard coordinate paper; on semilog paper; on log-log paper.

7. Write an empirical equation for the relationship of the data in Problem 6.

INTEGRAL TABLE

Algebraic

(I-1) $\int u^n du = \frac{u^{n+1}}{n+1} + C \ (n \neq -1)$

(I-2) $\int \frac{1}{u} du = \ln u + C$

(I-3) $\int a \, du = a \int du = au + C$

(I-4) $\int (du + dv) = u + v + C$

Logarithmic

(I-5) $\int e^u \, du = e^u + C$

(I-6) $\int a^u du = \frac{a^u}{\ln a} + C$

(I-6a) $\int \ln u \, du = u \ln u - u + C$

Trigonometric

(I-7) $\int \sin u \, du = -\cos u + C$

(I-8) $\int \cos u \, du = \sin u + C$

(I-9) $\int \tan u \, du = \ln \sec u + C$

(I-10) $\int \csc u \, du = \ln (\csc u - \cot u) + C$

(I-11) $\int \sec u \, du = \ln (\sec u + \tan u) + C$

(I-12) $\int \cot u \, du = \ln \sin u + C$

(I-13) $\int \sec^2 u \, du = \tan u + C$

(I-14) $\int \csc^2 u \, du = -\cot u + C$

(I-15) $\int \sec u \tan u \, du = \sec u + C$

(I-16) $\int \csc u \cot u \, du = -\csc u + C$

(I-17) $\int \frac{du}{a^2 + u^2} = \frac{1}{a} \arctan \frac{u}{a} + C$

(I-18) $\int \frac{du}{a^2 - u^2} = \frac{1}{2a} \ln \frac{a+u}{a-u} + C$

(I-19) $\int \frac{du}{u^2 - a^2} = \frac{1}{2a} \ln \frac{u-a}{u+a} + C$

(I-20) $\int \sqrt{a^2 - u^2} \, du = \frac{u}{2} \sqrt{a^2 - u^2} + \frac{a^2}{2} \arcsin \frac{u}{a} + C$

(I-21) $\int \frac{du}{\sqrt{a^2 - u^2}} = \arcsin \frac{u}{a} + C$

(I-22) $\int \frac{du}{\sqrt{a^2 + u^2}} = \ln (u + \sqrt{a^2 + u^2}) + C$

(I-23) $\int \frac{du}{\sqrt{u^2 - a^2}} = \ln (u + \sqrt{u^2 - a^2}) + C$

VT 010 409
Student Selection.

Ohio State Dept. of Education, Columbus. Materials Lab.
MF AVAILABLE IN VT-ERIC SET.
Distributive Education Materials Laboratory, The Ohio State University, 124 West 17th Avenue, Columbus, Ohio 43210 ($1.50).
PUB DATE - 1Feb67 74p.

DESCRIPTORS - *MANUALS; *RESOURCE MATERIALS; *DISTRIBUTIVE EDUCATION; *SELECTION; COOPERATIVE EDUCATION; CLASSROOM MATERIALS; *DISTRIBUTIVE EDUCATION TEACHERS

ABSTRACT - The teacher coordinator will find this handbook useful in selecting students for his distributive education program, while the teacher educator will find the material useful in preparing teacher coordinators for the task of student selection. The handbook is divided into three color-coded sections with the first section presenting ideas for (1) the initial contact, (2) handouts to be used in the second contact, (3) evaluation procedures, and (4) program agreements. Section two is a collection of readings on student selection, and section three is a collection of sample promotional aids. (JS)

VT 010 409

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STUDENT SELECTION

VT 010 409

2/1/67

Prepared by

State Department of Education
Division of Vocational Education
Distributive Education Services
Materials Laboratory

READER'S INDEX TO STUDENT SELECTION .....

The entire handbook has been color-coded two ways. Paper color and ink color combinations have been used to distinguish between areas of interest. There are no page numbers.

The sequence of information runs thusly:

SECTION I

A Guide to Selection of Students (Pink paper, Black ink)

Describes the five major areas of concentration in student selection. This in effect is a recapitulation of information to come.

Major Area I (Blue paper, Black ink)

These are the forms and information used in the initial student contact -"What Is D.E.?" (see "Guide")

Major Area II (Yellow paper, Black ink)

Includes forms and handouts used in the second contact. "Is Distributive Education for Me?" (See "Guide")

Major Area III (Pink paper, Black ink)

Illustrates forms and techniques used in the third student contact. "D.E. is for Me, If I Am Accepted." (See "Guide")

Major Area IV (Green paper, Black ink)

Basic evaluative procedures used in the fourth area of selection - "Time and Decisions" (See "Guide")

Major Area V (White paper, Black ink)

Forms used in the final area of student selection, "The Personal Interview." (See "Guide")

Reader's Index
(cont.)

Area VI (White paper, Black ink)

Other considerations - Program Agreements, Code of Ethics

SECTION II

Some Readings On Systems for Selection of Students (Blue ink, White paper)

A brief collection of articles and papers written in the area of "Student Selection." These are designed to familiarize the reader with the many different techniques and approaches to the subject. We are grateful to the authors and publishers for permission to include these in our manual.

SECTION III

Promotional Aids for Selection of Students

The initial page (Pink paper, Blue ink) outlines promotional areas to be detailed. These areas include:

1. Suggested Posters (Multi-colored paper, Black ink)

2. Newspaper Release (Red ink, Blue paper)

3. Suggestions for Assembly Programs (Green ink, Yellow paper)

   f. transparencies - separate supplement (Black ink, White paper)

4. Other Devices (Green ink, Yellow paper)

SECTION I

A GUIDE TO SELECTION OF STUDENTS

A GUIDE TO SELECTION OF STUDENTS

I. WHAT IS DISTRIBUTIVE EDUCATION? INITIAL CONTACT.

Four passouts are enclosed:

1. The traditional definition, purpose, objectives, means, evaluation

2. An original one made up for this mailing intended possibly as a handout to first-time student contacts

3. The DECA Sheet to supplement (1 and 2)

4. A "return" sheet can be used in any first contact gathering with any of the enclosed materials. This sheet will indicate only that the student may be interested and wants to talk about Distributive Education. This should be explained as such and they would be gathered up at the <u>conclusion</u> of the meeting. Don't let them return them later or you will never see them.

Our standard pictorial pamphlets are available and enclosed.

1. D.E. FOR ME???...COULD BE — $ .01 each
   Designed for first time contact - this has a coupon to indicate follow-up interest.

2. OHIO'S HIGH SCHOOL PROGRAM OF DISTRIBUTIVE EDUCATION — 10/$.25 or 50/$1.00
   Could be used for parents or the interested student making his second contact. You may also choose to use these for first contact.

(Both of these are available in any quantity from the Materials Lab)

II. IS DISTRIBUTIVE EDUCATION FOR ME? SECOND CONTACT

Application Form

1. Here are two for your evaluation.
   Some of our people prefer a short one, getting the other facts in an interview -- several have a place for the parent to sign indicating the student has discussed and obtained parental permission to take Distributive Education.

Letter to Parents

1. This is different -- perhaps a letter might be written to the parents at the same time the application is being filled in -- inviting their interest and securing their approval.

2. Course Descriptions (3)
   A course of study or complete topic outline may be given to the student at this time to better help him make up his mind and to aid him in explaining the program to his parents. Here are three examples made up for three different programs. They are not meant to be "state standards" or anything like that.

III. DISTRIBUTIVE EDUCATION IS FOR ME (IF I AM ACCEPTED!). THIRD CONTACT

This step should take place when the student returns the completed application and has indicated parental permission has been obtained. (Some coordinators prefer written parental permission while others will accept the student's verbal O.K.) You may want to call the parents or visit them, which is also done.

Now, if the initial contact was good, you have got to have time to do your own evaluating -- It may take this pattern:

1. Student School Schedule -- have the student fill in a school schedule and await his interview.

2. Student School Record -- have the student fill the sheet in at this point. You now have the names of his past teachers for your teacher evaluations. You also have his version of grades, absences, etc. to quickly check against his permanent record, which may indicate his honesty. You can also get some idea of his strong points and weaknesses by the A's and F's he has indicated.

IV. TIME AND DECISIONS

This step really doesn't involve the student. You must now pick and choose, weigh factors, sift prejudices and come up with what you hope will be a winner. Here are some possible "helps" --

1. Teacher Evaluation
   A new form is enclosed -- These are difficult to make up. You can't begin to judge a person on the basis of 8 or 10 ambiguous questions. But maybe this will help. Mr. Nichols also has what is probably the "standard" evaluation form (see "Acknowledgements") or you may choose to make your own. Anyway --

a. Ask the teachers to help you by evaluating -- They get to know you and the program. It indicates to them that you are sincere and interested in the student.

b. Try to personally talk with the teachers in addition to their filling out the form. Many times they won't put down in writing what they really think.

c. Don't load one teacher down with all the evaluation sheets. Try to spread them out so each faculty member has no more than 6 or 8.

d. Don't waste them on critics -- they won't return them and if they do they may not be accurate.

2. Statistics Sheets

a. Keep all facts and figures on one sheet -- if you choose to write down extremely confidential figures like test scores, use a retail pricing code or something similar.

b. Keep all the information on one sheet and don't lose it. Destroy it after the class is selected or take it home where it can't be lost.

3. School Records

Check school records for influencing factors such as:

a. Absences - cross check with student form
b. Other schools attended -- may indicate insecurity
c. Disciplinary actions
d. Health problems
e. A sudden rise or drop in grades over the years
f. School activities
g. Parents both living? (Step? Guardians?)
h. Parents' occupations
i. Location of home
j. Work record
k. Teacher evaluation slips and comments
l. Courses taken and grades

4. Testing

This is sometimes best picked up from the Guidance Office or school records. There are several testing devices available. You may choose to test all prospective applicants or make up a test in one specific area, i.e. math. The Kudar Preference

Test has an area on Persuasiveness. See also attached studies on selection regarding testing devices. Kroger Co. and others have been known to administer their tests to groups of prospective students with the cooperation of the school.

5. Other contacts

a. Check attendance officer
b. Check discipline officer (may be a)
c. Call previous employers from application
d. Some coordinators have asked their present Distributive Education class to take an unmarked sheet of paper (without their name) and number from 1 - ? indicating a + or - or 0 beside each prospective students name as it is read (hurriedly). + indicating likeable, - indicating not likeable and 0 indicating that they don't know them. The only thing close to a conclusion that can be drawn from this exercise is that a solid show of +'s may indicate the prospective student is popular with his classmates and -'s may not be popular. Any discussion or other evaluation by the entire class would be futile and probably in bad taste.
e. Check school nurse
She can quickly tell whether any of your students have serious health problems
f. You may want to check local juvenile officer -- sometimes in rare instances, students have good school records but not so good in the community

V. THE PERSONAL INTERVIEW -- FOURTH CONTACT

Two approaches here:

1. A one page Interview
Toledo has developed what appears to be a good one. You may choose to use this if you have a number of prospective students.

2. A depth interview
This was developed to learn as much about the student as possible if time is not too great a factor.

Some coordinators ask their prospective students to fill in an interview form and then base their questions on the written answers.

Some do not use any form but base their questions on the program application.

VI. At this point you probably have things pretty well lined up. One other factor which sometimes is brought into play here is the "Program Agreement" or "Code of Ethics." Two "Codes" and one "Agreement" are attached for your evaluation. This kind of wraps up the whole package and indicates acceptance.

Some schools distinguish between a "Program Agreement" as being a requirement for admission (in the Spring) and a "Code of Ethics" as an agreement after employment in the Fall. Both are invaluable because they spell out responsibilities clearly to all. One last variation is a "Code" or "Agreement" that is formulated by the class. Since they make their own rules, this sometimes is thought of as having some merit. THE CHOICE IS YOURS!

ACKNOWLEDGEMENT OF SELECTION PROCESS MATERIALS

USED IN COMPILATION

1. SELECTION, PLACEMENT AND EVALUATION
by Daryl E. Nichols -- Available from:

Daryl E. Nichols
2416 Isabella Street
Evanston, Illinois 60201 Price: $1.50

This, of course, is the classic collection of some 17 forms available for the entire evaluative process continuing through job evaluation. Very well done, it should be (and is in many cases) a part of every Distributive Education coordinator's library. A 41 page (workbook/like) publication -- this is the manual that appears to have spawned most evaluative processes for student selection.

2. Most of your large school systems now have standardized in this area -- some even for the entire vocational program. Special thanks to

Ken MacLaren, Toledo Public Schools
Bruce Summa, Ashland
Pat Canini, Columbus
Jack Strietelmeier, Southwestern
Dale Tippet, Hamilton Township
Bob Petrie, Penta County JVS
(for Stow's Selection Process)

for providing information and advice in preparing this mailing.

DISTRIBUTIVE EDUCATION

DISTRIBUTIVE EDUCATION - "Distributive occupations are those followed by proprietors, managers, or employees engaged primarily in marketing or merchandising goods or services. Such occupations may be found in various business establishments, including, without being limited to, retailing, wholesaling, manufacturing, storing, transporting, financing, and risk bearing."

PURPOSE - Distributive Education is designed to -

a) Train each student as an individual according to his interests, abilities, and needs.
b) Present the fundamental principles and practices of merchandising that should be understood by those who wish to enter the fields of service, retailing, and wholesaling, as a possible vocation.
c) Offer vocational guidance either within the area of distribution or to other areas is individual interests indicate otherwise.

OBJECTIVES or GOALS - Distributive Education is designed to -

a) Develop in each student a business attitude toward his job and customers so as to enable him to more adequately cope with everyday business decisions or problems.
b) Develop more efficient service to society and the economy through more effecient and more effective salespeople (advisors to American consumers).
c) Provide the student with a basic knowledge of selling and of customers so he can better understand and benefit each individual customer. It is assumed that better understanding and a proper philosophy will result in better customer satisfaction which will also tend to increase business and personal returns (profits).
d) Provide a valuable practical background for those who will go on to further formal schooling as well as giving basic training to people who will go immediately into the business world.

MEANS - Distributive Education is conducted primarily as a laboratory class, i.e. teaching methods used stress "learning by doing." This is accomplished by -

a) Providing practice of the principles learned through cooperative and coordinated part-time work.
b) Assigning projects individually to acquaint the student with methods of research as well as subject matter.
c) Use of text books to provide realistic business problems and situations for solution common to most types of businesses.
d) Organizing the class as a part of the regular school organization (with credit toward graduation) to enable the student to participate in regular school activities.

EVALUATION

a) Students are graded from results of objective as well as essay tests given on principles common to most distributive occupations.
b) Individual projects are evaluated each on its own merit.
c) Each student's work experience (performance) is rated by a superior responsible for him on the job.

WHAT IS DECA?

WHAT IS DECA?

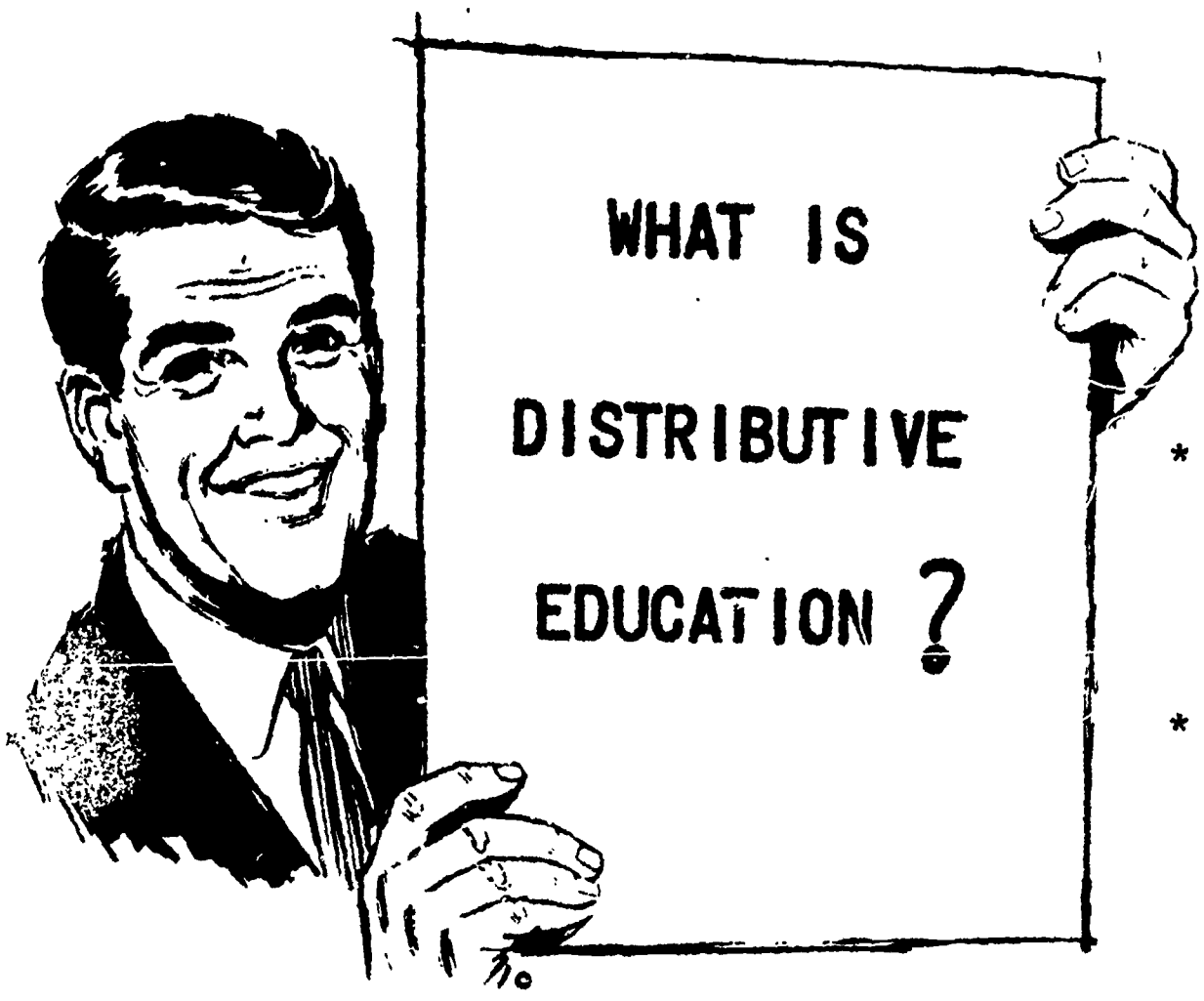
DECA stands for the Distributive Education Clubs of America. It is the youth organization specifically designed for all students taking Distributive Education.

HOW DOES DECA HELP ME?

All Distributive Education students have common interests. You share these interests and develop poise and confidence through the many activities of the DECA organization. It also provides a social outlet for many activities shared by the group.

DECA Chapters are to Distributive Education class members what a civic or professional organization is to a group of businessmen.

DECA contests enable Distributive Education students to compete with other Distributive Education students in areas of study common to Distributive Education. These contests are held at the district, state, and national level each year.



It is a course of instruction dealing with all things necessary for a business to sell a product.

* It is offered for students who plan to work in retail stores, wholesale outlets or businesses selling services (dry cleaners, restaurants, etc.)

* D.E. students attend school in the morning and work on the job in a training station in the afternoon practicing on the job what they have been taught in the morning.

* Distributive Education students work an average of 15 hours per week and are paid for their work experience.

WHAT JOBS CAN DISTRIBUTIVE EDUCATION LEAD TO:

* Generally, any job that deals with the complex process of marketing or selling goods. Some of these might be:

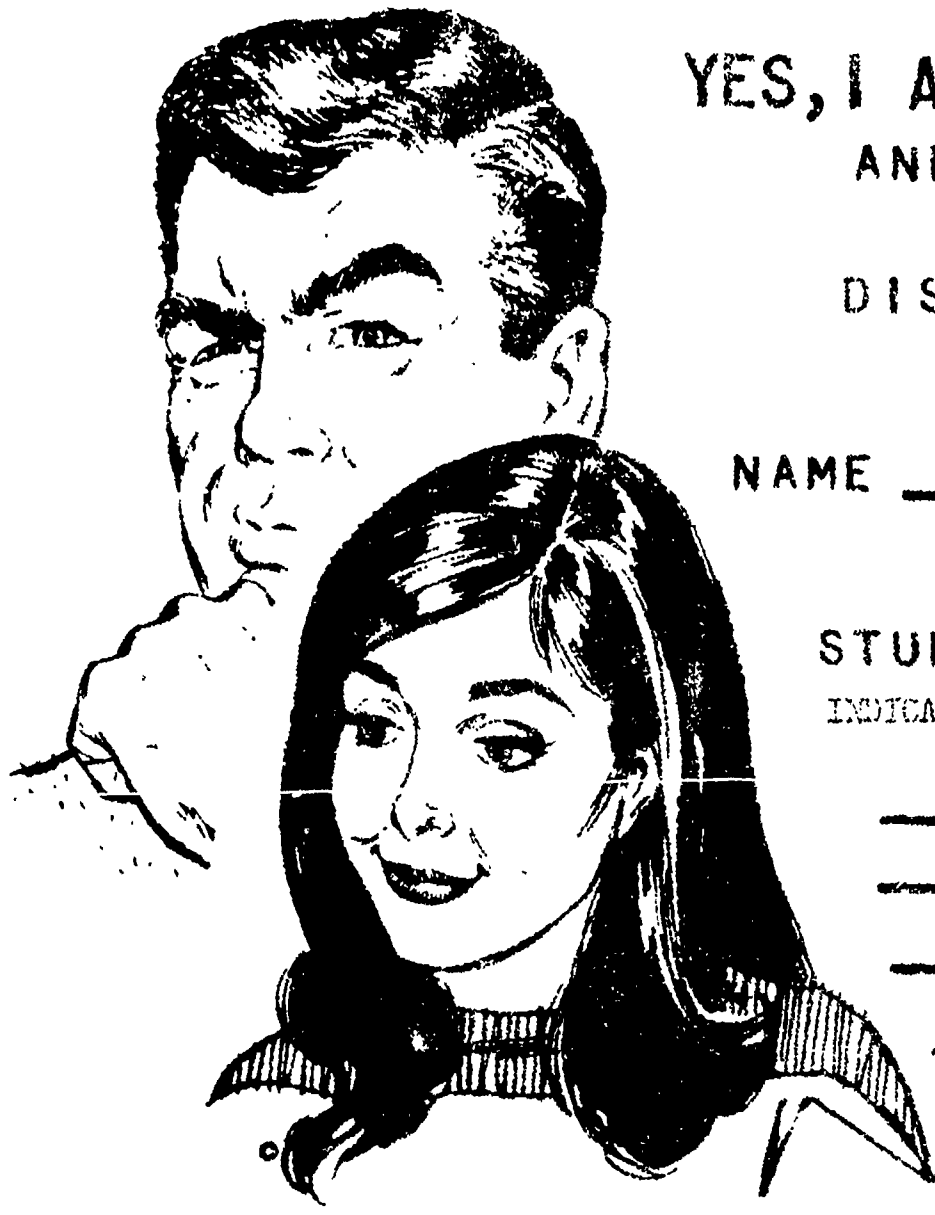
1. All types of salespeople
2. Advertising
3. Store Management
4. Personnel Manager
5. Credit Manager
6. Merchandise Buyer
7. Display Director
8. Fashion Coordinator
9. Ownership and Management of a small business
10. Supermarket Cashier

WHAT SUBJECTS DOES A DISTRIBUTIVE EDUCATION STUDENT STUDY?

* A wide variety of subjects necessary to business operations and geared to individual needs may include --

Selling	Preparation for job assignments
Pricing	Advertising
Buying	Display
Product Knowledge	Social Skills

Your Distributive Education Coordinator can elaborate and define more clearly the complete course of study offered.



YES, I AM INTERESTED

AND WOULD LIKE TO KNOW
MORE ABOUT
DISTRIBUTIVE EDUCATION

NAME _____

PLEASE PRINT

STUDY HALLS

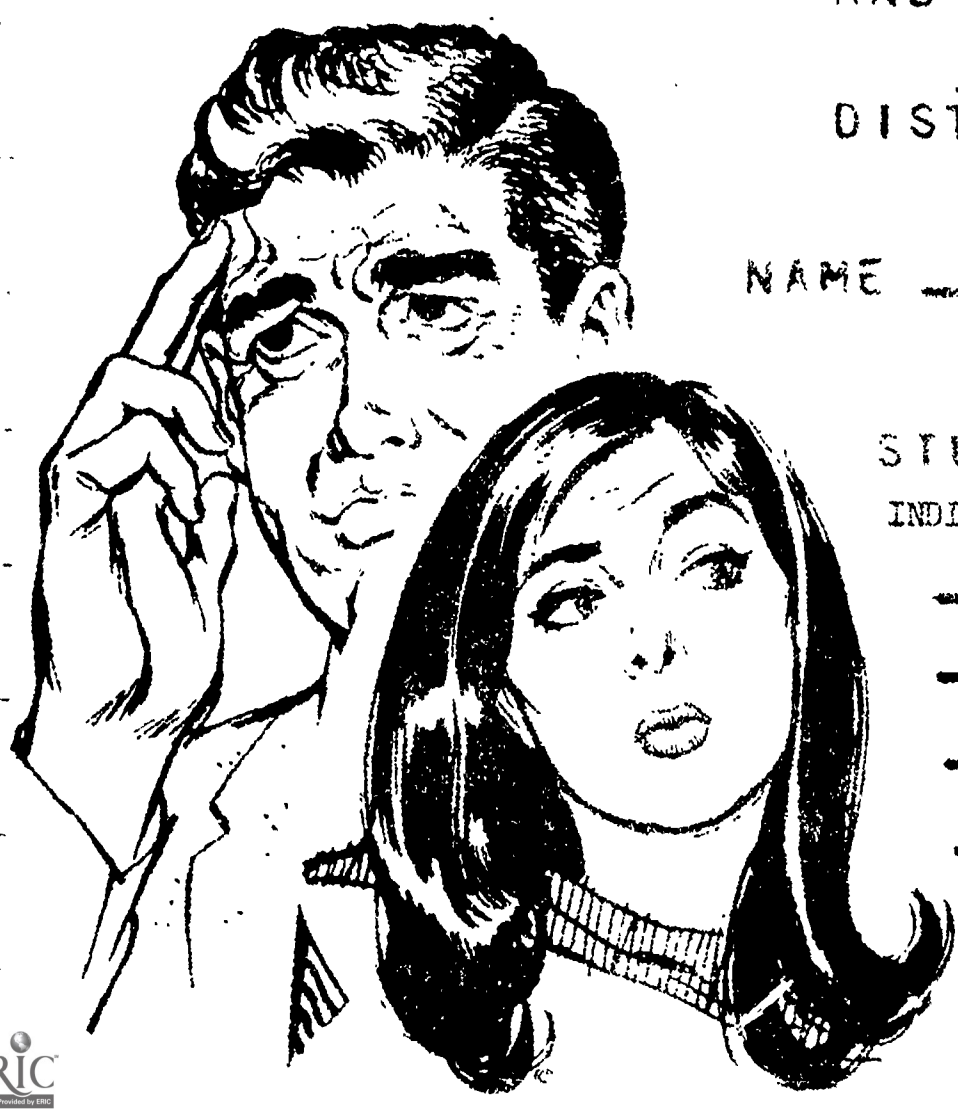
INDICATE ROOM NUMBERS

1. _____ _____
2. _____ _____
3. _____ _____
4. _____ _____
5. _____ _____

THIS SHEET OF PAPER DOES NOT
SIGN YOU UP FOR DE

YES, I AM INTERESTED

AND WOULD LIKE TO KNOW
MORE ABOUT
DISTRIBUTIVE EDUCATION



NAME _____

PLEASE PRINT

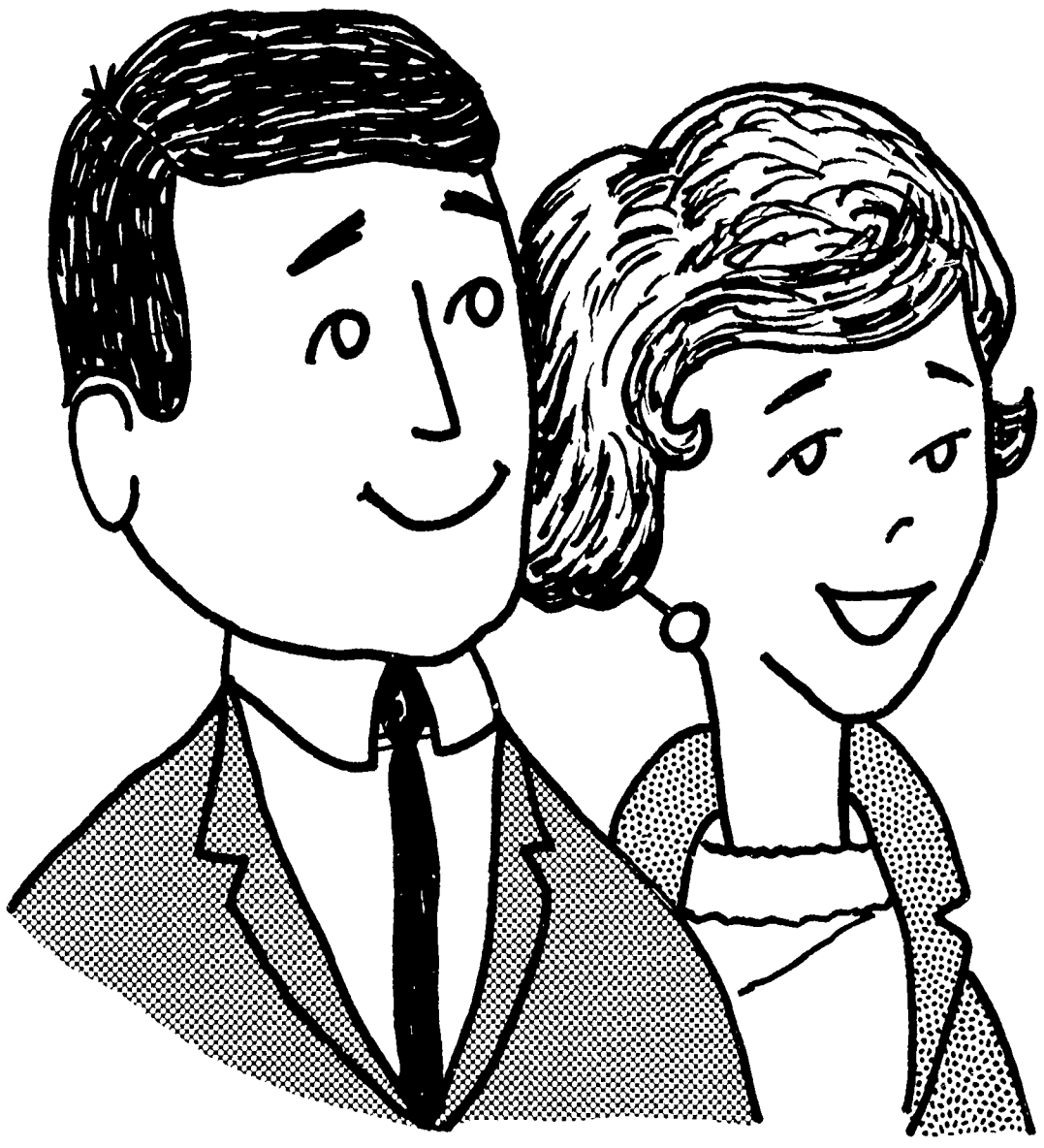
STUDY HALLS

INDICATE ROOM NUMBERS

1. _____ _____
2. _____ _____
3. _____ _____
4. _____ _____
5. _____ _____

THIS SHEET OF PAPER DOES NOT
SIGN YOU UP FOR DE

D.E.???

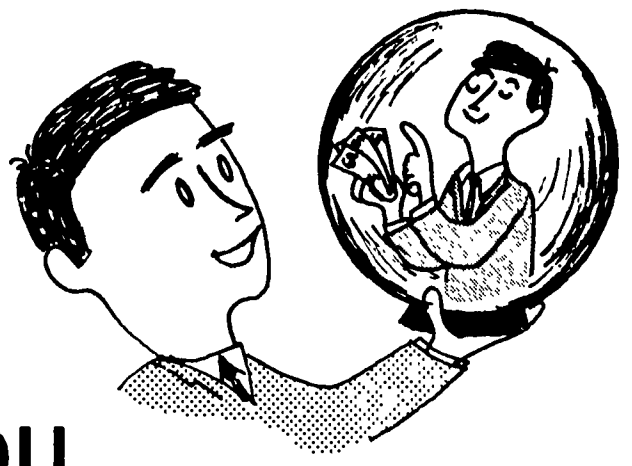


FOR ME??

Could be . . .

ARE YOU . . .

LOOKING FOR A CAREER
THAT IS INTERESTING,
SECURE AND CAN LEAD TO
ABOVE AVERAGE EARNINGS?



DO YOU . . .

- ENJOY WORKING WITH PEOPLE?
- WANT A CAREER IN WORK THAT HAS BOTH VARIETY AND OPPORTUNITY?

WOULD YOU . . .

- LIKE TO GET A HEADSTART ON GRADUATION BY STARTING YOUR CAREER NOW?

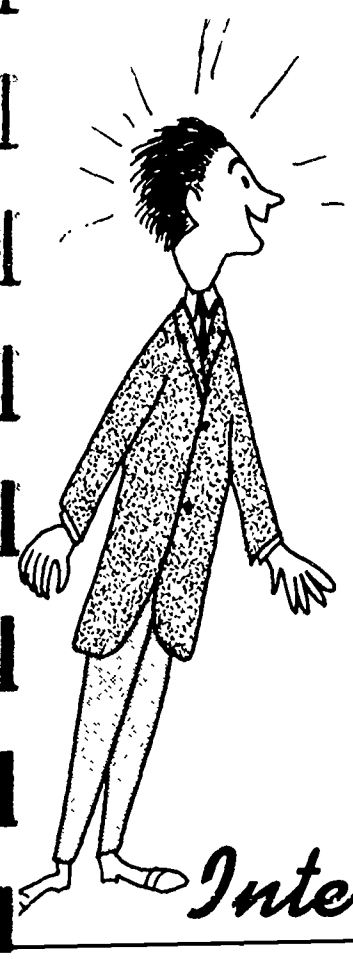
WILL YOU . . .

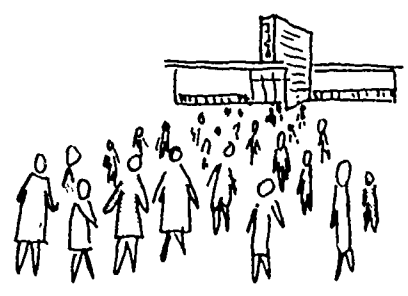
- WORK AT A PART-TIME JOB TRAINING STATION AT LEAST FIFTEEN HOURS A WEEK?
- UPHOLD THE STANDARDS AND ACCEPT THE RESPONSIBILITIES REQUIRED OF A D.E. STUDENT?

DID YOU -

Know that Distributive Education offers these advantages to a student -

- Develops personality and poise.
- Builds self confidence.
- Teaches responsibility
- Gives direction to education.
- Learns good work habits.
- Gives job knowledge and skills.
- Earns while learning.
- Leads to full-time employment.





Interested .....

Then,

D.E. COULD BE *For* YOU.

Distributive Education is a national program preparing students for either -

★ *Immediate employment* .

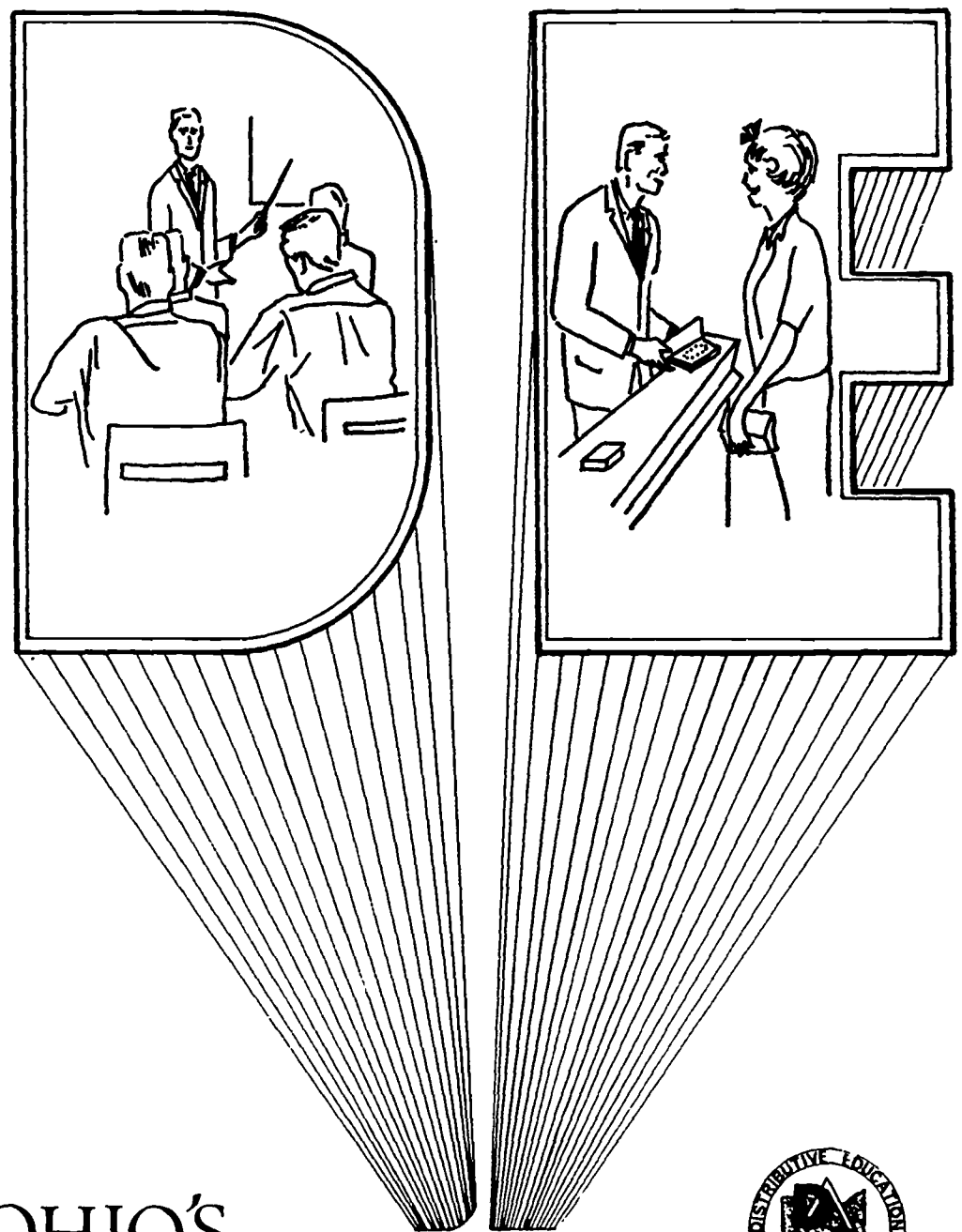
★ *Continuing Education in*

- *Post High School Technical* .
- *College* -
  - *-Business Administration* .
  - *-Business Education* .
  - *-Distributive Education* .

If you would like more information about your opportunities in the Distributive Education Program , complete this form and return it to _____

_____

Name _____ **Grade** _____



OHIO'S HIGH SCHOOL PROGRAM of *DISTRIBUTIVE EDUCATION*

THE OHIO STATE COUNCIL OF *Retail Merchants*

71 EAST STATE STREET
COLUMBUS, OHIO 43215
PHONE 221-7833

OFFICERS
PRESIDENT—CHARLES Y. LAZARUS
The F. & R. Lazarus & Company, Columbus
VICE PRESIDENT—CARLYLE W. EVANS
Gray Drug Stores, Inc., Cleveland
VICE PRESIDENT—HAROLD FREEDLANDER
H. Freedlander Company, Worcester
TREASURER—RALPH A. PENDERY
Hahn Brothers Co., Cleveland
SECRETARY—W. G. WALTERS
S. S. Kresge Company, Detroit
EXECUTIVE STAFF
GEORGE B. HAMMOND
Executive Director
JOHN C. MAHANEY, JR.
Associate Director
KARL M. KAHLER
Executive Assistant
JAMES E. HENRY
Public Relations Secretary

To: Future Leaders in Distribution

What will you be doing ten years from now? Of course, you have thought about the career you want to follow after leaving school, but how many of the vocations that look good today though will be promising in the future? One thing is certain - change. Change will affect the job opportunities and careers of many young men and women in public schools who are thinking about their careers.

Let's take a look at distribution. The experts who have studied manpower needs and job opportunities tell us that by 1975 there will be many more white collar jobs and less need for factory and production workers. Among the faster growing occupations will be those of a professional nature with white collar clerical and sales occupations near the top of the list. This is where the real manpower shortage will be in the next ten years.

Distributive Education in high school can provide you with the technical background and practical experience for entering positions in retail, wholesale, and service occupations. Through D. E. skills can be learned while you are a student and provide you with some income. You will have a good fundamental background for positions that provide a good standard of living. These are the executive and managerial positions.

There is a higher percentage of executive and managerial positions in retailing, wholesaling, and service fields than in other occupations. Ten per cent or nearly 8-1/2 million jobs in retailing in the United States are in this category. These are interesting, satisfying, well paid positions. But first, you must be trained. Take a good look at Distributive Education. Maybe your best opportunity for the future is in the distributive field.

Karl M. Kahler
Karl M. Kahler
Executive Assistant

WHAT YOU SHOULD KNOW ABOUT

DE

Distributive Education is a one or two year cooperative program of instruction and training for boys and girls interested in careers in marketing and distribution.

The term cooperative is used to identify the relationship which exists between the public school and the business community to achieve the basic objective of preparing young people for careers in the field of distribution.

Students must be 16 years of age before entering the distributive education program.

Students study in school those subjects directly related to their work experience plus other high school subjects.

Students must be employed an average of 15 hours per week under a "training plan" that serves as a set of ground rules for the school, the business, the student, the instructor, and the training sponsor.

For the student, this beginning job initiates him in the field of distribution, provides the opportunity to acquire job competency, to advance to subsequent positions of greater responsibility, to observe our free enterprise system in operation, and to become a contributing member of our society.

Distributive Education is not an employment service for students merely seeking part-time or after school jobs. It is an integral part of the total school program and has specific educational objectives. Though the primary objective of the program is to prepare youth for full-time employment in distributive occupations, it also serves as a background for those who plan advanced training at the college level in business administration, marketing, and related fields.

DISTRIBUTIVE EDUCATION

A TYPICAL STU
DISTRIBUTIVE

IN SCHOOL

Morning-theory

Selling techniques Wholesaling

Merchandising Market research

Retailing Government regulations

Business communications Buying

Economics Customer services

Visual merchandising Pricing

Marketing Sales promotion

in addition to english, civics, etc.

In most high school cooperative programs the student spends his mornings in classroom studies increasing his store of useful knowledge. Studies in the distributive education classes are practical in nature and vocationally oriented to occupations in the field of distribution. Students must also complete all subjects required for high school graduation. Because a student has established tentative career goals and is able to put his learnings to immediate use, high school becomes a more meaningful experience.

DENT'S DAY IN
DUCATION

ON THE JOB

Afternoon-practical

Receiving Stocking Selling

Credit control Window trimming

Ordering merchandise Pricing

Miscellaneous duties Cashiering

Housekeeping Checking invoices

Display merchandise Inventory

Understock Gift wrapping

Students are required to work a minimum of 15 hrs./wk. on an approved job training station with a distributive business. They are released from school afternoons for this purpose. The D.E. students receive regular wages from their employers and credit from their school. The job provides a laboratory where classroom learning is put to practical use. The Distributive Education teacher-coordinator works closely with the job training station employer to insure maximum personal growth and development of the student. Many of these students remain with their employers after graduation. Others find their experience to be a valuable asset either in seeking other employment or continuing their education.

Some SUCCESS Stories that began in OHIO

A 1955 graduate of Springfield South High School, Springfield, Ohio. Mr. Mercer is vice-president of the Martindale Marketing Service in Springfield. His training station while in distributive education was the Edward Wren Store. He continued with this company after graduation and worked up to Sales Promotion Director before going with the Martindale Marketing Service.

Mr. Mercer says, "The classroom study of Business Theory combined with the practical working experience gained through my distributive education training, gave me a head start in my career over my contemporaries. The distributive education training plus hard work and a desire to succeed will provide any student a golden opportunity in business."

A 1961 graduate from Springfield North high school, Springfield, Ohio. Mr. Wiseman is manager of the Schiff Shoe Store, Park Shopping Center in Springfield and employs five full-time salespeople.

Mr. Wiseman comments, "I feel distributive education has taught me many important things about salesmanship, store operation, and getting along with people. This knowledge has been extremely helpful to me in my work."

Graduated from Elyria High School in 1952. Mr. Feher was named manager of F. W. Woolworth store in 1958 and is presently manager of the Woolworth Store in the Great Eastern Shopping Center in Columbus. Mr. Feher now employs distributive education students from the Whitehall and Reynoldsburg programs.

Mr. Feher says, "The distributive education program exposed me to sales and distribution which in turn created a deep interest in the field. Distributive education offered me the opportunity to discuss job activities and problems correlated with classroom study and supervision. Because of distributive education, learning was accelerated and progress was more rapid."

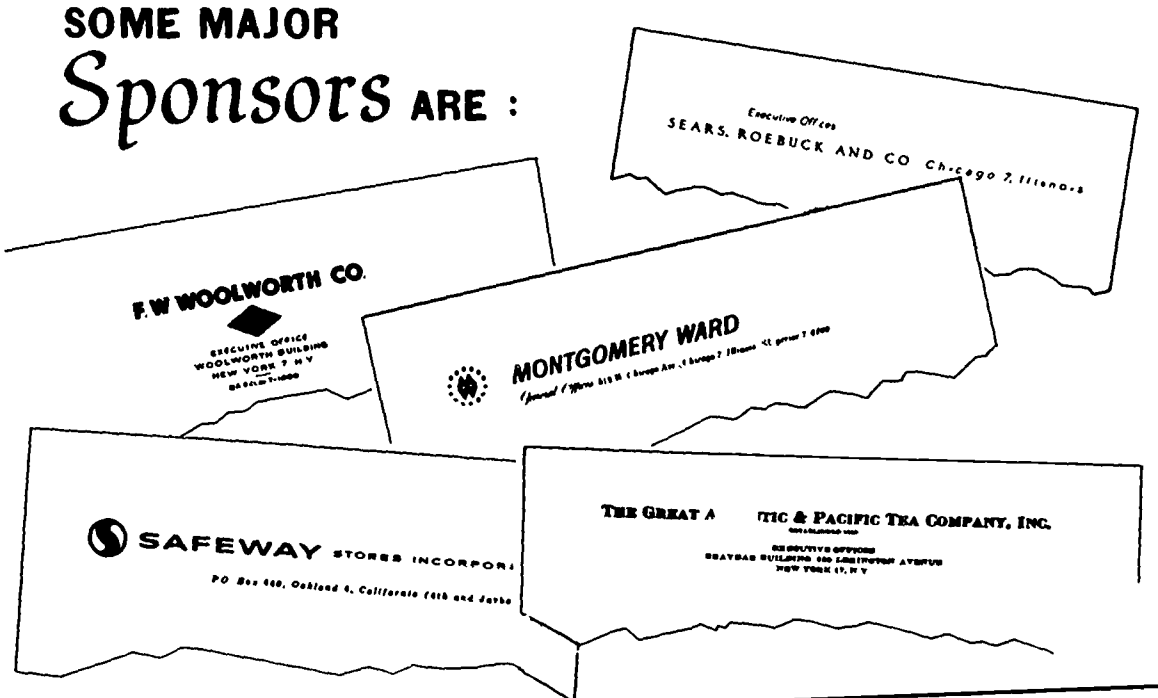
Graduated from Springfield Twp. Senior High School, Akron, Ohio, in 1956. Mr. Humiston established his own business in 1959 (Quality Appliance) and employs five salespeople.

Mr. Huminston comments, "Like most seniors, I was undecided about my future. Distributive education helped me make that decision by giving me the opportunity to work in an appliance business on a part-time basis while studying about business methods in school. I was sure that I wanted to continue in the appliance business and have a business of my own."

Career OPPORTUNITIES ARE UNLIMITED

Advertising copywriter
Assistant manager
Buyer
Commercial artist
Credit manager
Department head
Display manager
Fashion coordinator
Interior decorator
Merchandise manager
Personnel director
Professional model
Professional salesperson
Research specialist
Sales engineer
Speciality salesman
Stock control clerk
Store manager

SOME MAJOR Sponsors ARE :



DISTRIBUTIVE EDUCATION CLUBS OF AMERICA

What is DECA ?

DECA identifies the program of youth activity relating to distributive education--Distributive Education Clubs of America--and is designed to develop future leaders for marketing and distribution.

Purposes of DECA

1. To develop a respect for education in marketing and distribution which will contribute to vocational competence, and

2. to promote understanding and appreciation for the responsibilities of citizenship in our free, competitive enterprise system.

DECA is the only national youth organization operating through the public schools to attract young people to careers in marketing and distribution.

Importance of DECA

DECA chapter activities are always school-centered, thus contributing to the school's purpose of preparing well adjusted, employable citizens. Chapter activities serve the teacher-coordinator as a teaching tool by creating interest in all phases of marketing and distribution study, and serve as an avenue of expression for individual talent.

Vocational understanding

Civic consciousness

Social intelligence

Leadership development

Developing Future Leaders for Marketing and Distribution

Part II

APPLICATION FORM FOR
PROSPECTIVE DISTRIBUTIVE EDUCATION STUDENTS

(Please Print)

Present Date_____

1. Name_____
(Last) (First) (Middle)

2. Address_____ 3. Home Phone_____

4. Birth Date_____ Present Age_____ Birth Place_____

*Mother	*Father
7. Name_____	Name_____
Address_____	Address_____
Telephone_____	Telephone_____
Employed by_____	Employed by_____
Job Title_____	Job Title_____

*Please indicate if either parent is a step-parent or guardian.

8. Condition of Health:_____

Do you have <u>any</u> physical condition (past or present) that may effect your working (please describe) _____

9. Do you have a work permit?_____ Date issued_____

10. Are you currently working?_____

How long have you worked there?_____

Employer's Name_____

Address_____

Telephone_____

Immediate Superior_____

Describe the nature of work for your present employer_____

_____

_____

11. List all previous employers (Include baby sitting, lawn mowing, etc.)

a. Name_____
Address_____
Telephone_____
Job Title_____
Work
Performed_____

b. Name_____
Address_____
Telephone_____
Job Title_____
Work
Performed_____

c. Name_____
Address_____
Telephone_____
Job Title_____
Work
Performed_____

12. Last grade in school completed_____

13. Number of credits you will have at the start of school next year (check with the Guidance Department to be sure you will be eligible to take D.E.)_____

14. What course of study are you now following?_____

15. Do you plan to continue education after high school? (Describe)_____

_____

_____

16. If accepted for Distributive Education, what type of work would you prefer?_____

_____

_____

17. Where do you want to work after high school?_____

_____

_____

18. List all extra curricular activities_____

_____

_____

19. Would any of these conflict with a work schedule? _____

Please explain: _____

_____

_____

20. Number of absences last year _____

If more than 10 days, please explain _____

_____

_____

21. Do you now have a valid driver's license? _____

How would you get to work each day? _____

_____

I hereby certify that all the above information is factually correct and that any error in the information I have given could disqualify me from admission to the Distributive Education program.

Please sign _____

ERIC

TOLEDO PUBLIC SCHOOLS

APPLICATION BLANK FOR DISTRIBUTIVE EDUCATION

DATE_____

NAME_____ MALE_____ FEMALE_____
(Last) (First) (Middle)

ADDRESS_____ TELEPHONE NO._____
(Number) (Street) (Zone)

AGE_____ DATE OF BIRTH_____ HEIGHT_____ WEIGHT_____
(Month) (Day) (Year)

MOTHER OR GUARDIAN	FATHER OR GUARDIAN
NAME_____	NAME_____
ADDRESS_____	ADDRESS_____
TELEPHONE_____	TELEPHONE_____
OCCUPATION_____	OCCUPATION_____
EMPLOYED BY_____	EMPLOYED BY_____

Do you have a Work Permit? Yes__ No__ Do you have a Social Security Card? Yes__No_

Are you currently working? Yes__ No__ If Yes, what is the name and address of your employer?_____

Have you ever worked? Yes__ No__ If Yes, list employers:
(1)_____
(2)_____

What course of study are you now taking? College Prep_____ General_____
Vocational_____ Business_____

What is your occupational choice for a career?_____ Undecided_____
(Check here)

Do you plan to continue your education after high school? Yes___ No____

Are there any hours, days, or times of the year that you will be unable to work nex year? Yes__ No__ If Yes, when?_____

If accepted for this course, in what type of job would you prefer for your Cooperative Work Experience?_____

If accepted for this course, what classes do you plan to take in addition to Distributive Education? (need not be in order)

_____ _____

_____ _____

In what extra-curricular activities do you participate?

_____ _____

_____ _____

Dear _____:

At this time of year we are given the very large responsibility of selecting our students who will participate in the Distributive Education program. Your son/daughter has indicated an interest in our program.

Distributive Education is a unique experience for any young person. It is offered to those students who plan careers in the field of business -- particularly sales, retailing, wholesaling or any of the number of jobs that have to do with small business operation.

Some quick facts about our program of Distributive Education --

1. Students work in the afternoon (or evening possibly) after attending school in the morning.

2. Distributive Education students can and do attend college after graduation if they so desire -- Distributive Education does not disqualify them for entrance to college or further education.

3. Students work an average of 15 hours per week during the school year at the going rate of pay for a beginning employee in a distributive occupation.

4. Every effort is made between the school and the cooperating employer to provide an interesting, meaningful working experience tied in with the school work.

5. As you can see, our students must have good health, a good school record, an occupational objective or career goal in Distributive work and above all, a desire to cooperate and reap the benefits of this unique learning experience.

We sincerely hope that we have given you some idea of how our program functions. If you should desire more information about Distributive Education, please feel free to call me either here at school or at my home.

Sincerely,

_____

School Phone:_____

Home Phone:_____

(Alternate Plan)

Yes, I have read your letter regarding Distributive Education and feel that I would like to see my son/daughter enrolled.

Please sign_____

DISTRIBUTIVE EDUCATION

COURSE OF STUDY

Distributive Education is a program of instruction in Marketing, Merchandising and Management.

"D.E." is carried on under the supervision of the school board and the school administration with the help and cooperation of the local business community.

Distributive Education offers cooperative (school in morning; on-the-job training in the afternoon) training in marketing and merchandising goods and services leading to occupations in:

Retailing	Financing	Transportation
Risk Bearing	Wholesaling	Manufacturing
Advertising	Storing	

The Distributive Education program works thusly: qualified high school students work part-time and receive on-the-job instruction in an approved distribution occupation - a minimum of 15 hours per week - the major portion of which is during the afternoon - at beginners pay.

Classroom subjects covered in a typical Distributive Education classroom include:

Marketing Functions
- Selling
- Pricing
- Buying

Factors affecting marketing:
- Advertising
- Visual Merchandising
- Customer Services
- Personnel

Financing Marketing
- Capital
- Credit
- Records

Economics

Organization of Distributive Functions

Product Knowledge

Business Procedures

Preparation for job assignments

Social Skills

DISTRIBUTIVE EDUCATION

COURSE OUTLINE

Textbook: Retailing, Principles & Practices by Richert, Meyer, & Haines

Weeks		
2 - 3	Unit 1:	Orientation securing employment - Retailing (Parts 7, 8, 9, 10, 12, & 13)
1 - 2 (Continuous)	Unit 2:	Retail Arithmetic - Supplementary Materials
2 - 3	Unit 3:	Channel of Distribution - Retailing (Parts 3, 4, 5, 6, 53, 54, & 55)
4 - 6	Unit 4:	Selling Techniques - Retailing (Parts 14, 15, 16, 17, 18, 31, 32, 33, 34, 35, 36, & 37)
2 - 3	Unit 5:	Merchandise Information - Retailing (Parts 19, 20, 21, 22, 23, 24, & 25)
2 - 3	Unit 6:	Display - Retailing (Parts 38, 39, 40, 41, & 42)
1 - 2	Unit 7:	Investments - Supplemental materials
2 - 3	Unit 8:	Advertising - Retailing (Parts 43, 44, 45, 46)
3 - 5	Unit 9:	Planned Purchases - Retailing (Parts 50, 51, 52, 60, 61, 62, 63, & 64)
1 - 2	Unit 10:	Customer Services - Retailing (Parts 47 & 49)
2 - 3	Unit 11:	Store Location & Layout - Retailing (Parts 56, 57, 58, & 59)
1 - 2	Unit 12:	Credits & Collections - Retailing (Part 48)
2 - 3	Unit 13:	Financial Statements - Retailing (Parts 65, 66, & 67)
1 - 2	Unit 14:	Careers - Retailing (Parts 68, 69 & 70)

DISTRIBUTIVE EDUCATION

COURSE TOPIC OUTLINE

September

I. DE Objectives, Rules, and Regulations

a. grading, course credit
b. expectations of the D. E. student
c. responsibilities of the D.E. student

II. Pre-employment Orientation

a. job hunting
b. resume, profile sheet, interview forms, references
c. personal grooming and social skills
d. interviewing

III. Beginning Work

a. rules and regulations of employer
b. job duties analysis
c. familiarization with company
d. business ethics
e. meeting the public

October

IV. Introduction to Retailing

a. defined, types of retail outlets
b. history and evolution
c. chain of distribution
d. organizational structures of retail outlets

V. Retail Salesmanship

a. retail salesperson's role
b. sales steps and procedures
c. customer relations
d. telephone sales
e. suggestive selling
f. sales psychology

VI. Mechanics of Salesmanship

a. operating a cash register
b. filling out cash slips, receipts, return slips, etc.
c. handling money, making change
d. writing checks, banking and postal procedures
e. wrapping packages, layaways, etc.

November VII. Business Math

a. discounts
b. "supermarket math"
c. making change
d. tallying
e. check procedure

VIII. Product Knowledge

a. sources
b. relation to salesmanship
c. merchandise manual
d. economic geography
e. textiles as an example
f. warranties and guarantees

December IX. Buying

a. chain of distribution
b. competitive factors
c. location and populus influence
d. timing; "open to buy"
e. supply and demand
f. fashions, fads, and styles

X. Transportation of Goods

a. types of transportation
b. rates
c. interstate and intrastate regulations
d. liability of goods in transit
e. shipping terms and datings

January XI. Receiving and Marking Merchandise

a. cost analysis
b. profits (gross and net)
c. markups and markdowns
d. overhead and expenses
e. competitive pricing
f. loss leaders, sales, etc.

XII. Inventories

a. care of stock
b. importance to profits
c. types and objectives
d. shortages and overages
e. legal requirements
f. inventory forms

February XIII. Customer Services

a. shipping and delivery
b. credit
   1. extending
   2. "rules of credit"
   3. credit terms
   4. credit agencies
c. trading stamps
d. parking facilities
e. mail order service

XIV. Advertising

a. importance to retailer and economy
b. choosing media
c. budgeting for advertising
d. tieing in with sales
e. mechanics of advertising
   1. parts of an ad
   2. writing copy, layout and design
   3. figuring cost per capita
f. legislation of advertising

March XV. Display and Fixtures

a. types of displays and fixtures
b. function to retailer
c. elements of a good display
d. importance of color, line, design and balance

XVI. Location and Layout

a. type of store and market area
b. competitive factors
c. other influencing factors

April

XVII. Business Law

a. concerning employees
b. operation of business
c. buying and selling
d. insurance procedures and necessities
e. bankruptcy and receivership
f. proprietorship, partnership, and corporations

XVIII. Business English

a. business letters
b. business reports
c. comprehension of general terminology
d. conducting meetings
e. writing promotion releases, etc.

XIX. Business Machines

a. a general knowledge of use and function to the retail outlet - not a mastering of the actual manual operation or skill necessary for operation.
b. to include:
    1. typewriter
    2. calculating machines
    3. comptometers
    4. duplicating machines
    5. IBM equipment
    6. addressograph machines

May

XX. Personal Finance

a. budgeting
b. credit buying and personal loans
c. real estate knowledge
d. salary schedules (types of payment plans)
e. investments

XXI. Social Skills

a. personality development
b. planning "Employer-Employee Banquet"
c. attitudes important to success

XXII. Future Plans

a. business, retailing
b. university training
c. business college
d. review of mechanics of job hunting
e. going into business for yourself

NOTE: Any topic may be extended or shortened as the student needs are found. Topics not mentioned will be included as the need presents itself. English, speech, and arithmetic will be included throughout the course. Audio-visual aids, including outside speakers and field trips will be utilized whenever possible.
Every effort will be made to encourage individual learning in a specific field of interest while maintaining standards in following the course outline.
The textbook in use will be Retailing Principles and Practices, 1962 edition, Gregg Publishing Company.

STUDENT SCHOOL SCHEDULE

_____Student's Name

My present school schedule, or where I may be located in case you may want to talk to me, is as follows:

Period	Room Number	Teacher	Subject

Any variations or reasons why this schedule may not be accurate for the next 60 days?_____ (Describe:)_____

_____

_____

STUDENT SCHOOL RECORD

_____ Student Name

11th Year

Subject	Teacher	Grade Received	Additional Comment
Extra-Curricular Activities			Number of Days Absent:_____

10 th Year

Subject	Teacher	Grade Received	Additional Comment
Extra-Curricular Activities			Number of Days Absent:_____

List

Subjects Received A' in ------
Subjects Received F' in -----

TO:_____

_____ has indicated an interest in Distributive Education for next year. His/her schedule has indicated that he/she has had school work under your guidance. Would you be kind enough to take a few minutes of your time to give us an appraisal of the potential that this student might have in Distributive Education, based on your experiences with him or her.

I. Is he/she --

1) dependable and sincere 2) sincere but not dependable
3) completely untrustworthy

Comment:

II. His/Her basic personality seemed to indicate --

1) well-adjusted, outgoing 2) mature, but introvert
3) problems (please describe)

Comment:

III. School work was --

1) Thorough with follow through 2) average - could have been better
3) shoddy and unreliable

Comment:

IV. A general evaluation of intelligence based only on observation --

1) Quick, grasping, learns readily 2) average, works hard to comprehend
3) slow/but works hard 4) slow/doesn't care

Comment:

V. Socially this student is --

1) well-adjusted for age 2) average, with reservation
3) has problems

Comment:

VI. In your opinion, do you feel that this student could handle the huge responsibility of working in addition to school?

1) Yes 2) Possibly, depends 3) No, it would be a mistake

Comment:

VII. Could this student be counted on to represent the school favorably in a community job station?

1) Yes 2) Possibly 3) No

Comment:

VIII. How do you feel overall regarding this student's future in Distributive Education?

1) He/She needs a "break."
2) He/She would definitely benefit from such a program.
3) He/She would "use" the program for immature goals.

Comment:

Recap and additional comment:

You may return this to my mailbox or if you care to talk about it, I will be happy to make myself available at your convenience. Thank you for your cooperation.

Distributive Education Coordinator

ERIC

TOLEDO PUBLIC SCHOOLS

INTERVIEW EVALUATION FORM - DISTRIBUTIVE EDUCATION

STUDENT'S NAME_____

	EXCELLENT	GOOD	FAIR	POOR
APPEARANCE	_____	_____	_____	_____
PERSONALITY	_____	_____	_____	_____
DESIRE	_____	_____	_____	_____
ATTENDANCE	_____	_____	_____	_____

DAYS MISSED THIS YEAR_____

GRADE AVERAGE A____ A-____ B+____ B____ B-____ C+____ C____ C-____ D____

TRANSPORTATION: Do you have a valid operator's license? Yes____ No____
Do you own an automobile? Yes____ No____
Do you have transportation available for travel to and from the place of employment? Yes____ No____
Do you plan on using public transportation? Yes____ No____

SCHEDULE CONFLICTS:_____

VOCATIONAL OBJECTIVE:_____

WORK EXPERIENCE:_____

QUESTION: Why do you think you would like to take Distributive Education?
ANSWER: EXCELLENT_____ APPROPRIATE_____ INADEQUATE_____
REASON:_____

QUESTION: What plans do you have for the money you will earn?
ANSWER: EXCELLENT_____ APPROPRIATE_____ INADEQUATE_____
REASON:_____

QUESTION: What type of work would you like to be doing ten years from now?
ANSWER: OPTIMISTIC_____ REALISTIC_____ UNREALISTIC_____ VAGUE_____
REASON:_____

OVERALL EVALUATION BY COORDINATOR:
ACCEPTABLE_____ SHOULD BE CONSIDERED AS AN ALTERNATE_____
PASSABLE_____ WEAK_____ UNACCEPTABLE_____

****

COUNSELOR'S COMMENTS:_____

_____

_____

_____

TEST RESULTS:_____

****

DECISION: ENTER IN D.E._____ ALTERNATE_____ DO NOT ENTER IN D.E._____

PERSONAL INTERVIEW

1. Describe any recent illness you have had and the general condition of your health.

2. Describe your family -- number of brothers, sisters, their ages and your relationships with your family.

3. Describe briefly the times that you have performed work for pay.

4. Do you have a bank account? For what purpose?

5. What is your grade average in school? Explain briefly your feeling toward "grades."

6. What, above all else, do you expect to get out of your schooling?

7. How would you define trust? respect? maturity?

8. What would you do with any money that you might earn while in D.E.?

9. Give three names of teachers who know you well that might act as references for you.

10. Briefly describe the purpose of Distributive Education here at our school.

11. Would you be available to work at any time? Describe any conflict you might have.

12. What do you expect to be doing five years from now?

13. What do you do for relaxation? Why do you want to work?

14. Are you now going steady? engaged? married or planning marriage?

15. Give five events, situations, or circumstances that annoy you greatly and tell why they annoy you.

DISTRIBUTIVE EDUCATION TRAINING AGREEMENT

The Distributive Education Program is designed to provide a student with the opportunity to obtain a minimum average of 15 hours per week of supervised employment in addition to related classroom instruction in the field of marketing and distribution. To accomplish this end, the student will be required to meet definite requirements and accept certain responsibilities.

As a condition for acceptance into the Distributive Education Program, the student agrees:

1. To notify the teacher-coordinator and the employer by 10:00 A.M. on any day that it is impossible to work because of illness.

2. To secure the teacher-coordinator's permission to work any day when absent from the morning session of school.

3. To maintain all required class records related to employment.

4. To perform all duties in a manner which will reflect credit on himself, his teacher-coordinator, his employer, and his school.

5. To live up to all rules and regulations as outlined by the employer.

6. To keep matters of business in strict confidence.

7. Not to sever connections with the employer without consent of the teacher-coordinator, and then only after the coordinator has made the necessary arrangements with the employer.

8. To secure a job in an approved training station.

9. To provide transportation to and from the job training station.

10. To discuss controversial job problems with the teacher-coordinator prior to any discussion of same with the employer.

11. To be honest at all times. Any evidence of dishonesty with money, merchandise, time, or effort that results in dismissal from the job will automatically dismiss the student from the Distributive Education program with complete loss of credits.

_____
(Student's Signature)

_____
(Parent's Signature)

DISTRIBUTIVE EDUCATION PROGRAM CODE OF ETHICS

1. Distributive Education is a part of the school curriculum; therefore, I will not accept a training job unless I intend to keep it.

2. I will report for work at the scheduled time. If I find that I am unavoidably detained, ill, or unable to report for work, I will always inform my coordinator and employer promptly.

3. I will be honest with money, merchandise, time and effort.

4. I will perform an honest days work and will strive at all times to do the best job possible.

5. I will not receive visitors on the job, neither will I make or receive unnecessary personal telephone calls.

6. When I am on the job, my work will always come first.

7. If I feel that my studies, physical health, or moral well-being are jeopardized because of my job, I will consult with my parents, my coordinator and my employer before making a decision to resign. If I quit my job or change jobs without consulting my coordinator, I know that I will automatically be dropped from Distributive Education. This will result in a loss of Distributive Education credits.

8. I realize that to be dishonest or to fail on my job reflects not only on me, but on my school and my coordinator. I, therefore, agree to uphold this Code of Ethics in order to maintain the reputation of myself and my school.

9. I agree to keep matters of business in strict confidence, if told to do so by my employer.

Signature of student_____

Signature of Parent_____

Signature of Coordinator_____

DISTRIBUTIVE EDUCATION

CODE OF ETHICS

1. I will act accordingly on the job as in school. I will follow rules set by my employer.

2. If told to keep matters of business in confidence, I will do so.

3. If any circumstances requires absence, I will call my employer and coordinator.

4. I will be honest with my employer's money, merchandise, time and effort.

5. I will represent the Distributive Education class through my character to the best of my ability.

6. I will not quit my job without first consulting with my coordinator and parents. If I fail to do so I will be automatically dropped from the Distributive Education program with loss of credit.

7. I will keep up my school work to the best of my ability.

_____	_____
Student's Signature	Teacher's Signature

CONFIDENTIAL: STATISTICS FOR STUDENT SELECTION

Name	Days Absent	Grade Average	Teacher Evaluation	Work Experience	Guidance Evaluation	Personal Interview	Testing Results	Course of Study	Other

SECTION II

SOME READINGS

ON SYSTEMS

FOR SELECTION

OF STUDENTS

ERIC

SELECTION OF STUDENTS

1. What selection is:

   a. Student selection for Distributive Education is a systematic method of counseling students into the program which will do them the most good.
   b. It is a cooperative guidance function carried on by the coordinator, the faculty, and the guidance counselors.
   c. Consideration is given to such factors about the student as:

      (1) Age
      (2) Scholastic standing
      (3) Test results
      (4) Aptitude
      (5) Health
      (6) Attendance record and punctuality
      (7) Character
      (8) Personality
      (9) Appearance
      (10) Vocational Interest
      (11) Disciplinary record
      (12) Needs of the Community

   d. The most important consideration in student selection is whether or not the individual student will benefit from distributive education.

2. What selection is <u>not</u>:

   a. It is <u>not</u> a substitute for good classroom management and discipline; hence, it is <u>not</u> a method for the pre-elimination of discipline problems.
   b. It is <u>not</u> a method of forming a class composed primarily of high-ability "honor" students.
   c. It is <u>not</u> a method for directing low-ability students into a "work-experience" program.

3. Reasons for student selection:

   a. Certain students, due to their interests, abilities and temperament, will achieve greatest satisfaction and success in the field of distribution. These students should be guided into D.E. Others, possessing different qualities, characteristics and plans should be counseled into areas of endeavor better suited to their individual attributes.
   b. The distributive occupations require certain mental, social, and personal attributes that are the result of heredity and long-term environmental influences. Students not possessing these at the age of 16 or 17 will have extreme difficulty in successfully meeting the requirements of a distributive occupation.

c. Because he is under school supervision and sponsorship in the business community, the actions of the D.E. student will reflect on the entire school system -- either positively or negatively.

d. On-the-job training -- the laboratory phase where principles are put into practice -- is an integral part of the program.

(1) In any course where laboratory work is essential, admittance would be refused a person who would not do the lab work; or whose parents would not grant permission; or who was not physically or mentally capable of the responsibility; or whose temperament indicated that it would be dangerous to the school.

(2) It is the accepted practice to expect each student to participate in all phases of each course he takes, rather than only those parts that suit his fancy.

4. Student selection will exist in every program; only the mechanics and the degree will differ.

a. If the coordinator, his program, and his standards are respected throughout the school and community:

(1) Parents will want him as a teacher for their children.
(2) The business community will recommend his course to young people and their parents.
(3) The business community will cooperate by making good training stations available.
(4) The administration will allow him freedom to strengthen his program.
(5) The guidance counselors and other faculty members will counsel eager, enthusiastic, interested students into D.E.
(6) Students from all ability levels who are interested in distribution, who want to learn, and are willing to work at it will request permission to enroll in D.E.

b. If the coordinator has not earned this respect, no amount of freedom of selection will help him develop a good distributive education course because he will have no choice of students from which to make a selection.

Talk given by Joseph J. Grande, Director of District Education, Reading Senior High School, Reading, Pennsylvania.

SELECTION OF STUDENTS

The selection of students is a function of the coordinator, the faculty members, and the guidance department. If the students prove to be satisfactory and desirable workers, the merchants will want to cooperate with the school each year. In order to create and maintain a close tie-up between school and business, it is important that the coordinator be familiar with the requirements of the merchants with whom he works.

Guiding people is a very serious matter. We at Reading High School are not satisfied with the system employed; we seek constantly to improve it. But, since it is the system we use, I will endeavor to enlighten you on some of our methods.

I could quote many statistics showing great attrition in retailing on high school and college level. This is a real problem that must be solved because retailing is no longer in the 50¢ an hour category. Wages, fringe benefits, etc., make it very costly.

The Merchants Division of the Chamber of Commerce of Reading and Berks County, through its "Careers in Retailing Week," makes an effort to enlighten the area school principals, guidance people, and teachers of the school system of the advantages of retailing as a career. The merchants are encouraged to familiarize themselves with the program because they should be the best outside source of encouraging students to enter the program. Many part-time employees at Christmas are eleventh year high school students. Those who show promise in retailing should be encouraged to enroll in the Distributive Education program.

When selecting students for this program, the following factors should be considered:

1. PHYSICAL REQUIREMENTS
2. EDUCATIONAL REQUIREMENTS
3. CHARACTER AND PERSONALITY REQUIREMENTS
4. STUDENT'S PERMANENT SCHOOL RECORD FOLDER

I. PHYSICAL REQUIREMENTS

A. Minimum Age -- All enrollees must be sixteen (16) or older.

B. General condition of health must be normal as evidenced by their physical examination in grade 11, and by regular school attendance in former years.

C. Physical Appearance - Must be very neat and attractive. At least of average weight and size. Good grooming and clear skin. Free from noticeable defects.

II. EDUCATIONAL REQUIREMENTS

A. Completion of eleventh grade with at least EIGHT prerequisite credits toward high school graduation.

B. Must have passed all prerequisite subjects required for graduation.

C. Enrollees should have at least a "C" average or above in grades 10-11.

III. CHARACTER AND PERSONALITY REQUIREMENTS

A. Satisfactory character references. (Principals and teachers should not recommend for admission to this course any students they can not recommend to employers whose money and property trainees will handle.)

B. The applicant should have a pleasing personality of the employable type for retailing, and should also have vocational interest in this field.

C. All students should have a personal interview withthe coordinator of Distributive Education.

STUDENTS PERMANENT RECORD CARD

Completed Required Scholastic Work: English, Science, Math, History

The most important record that the coordinator can rely on for an overall picture of the student is the student's permanent record folder which is on file in the general office. From the permanent record folder the following information can be gained about the student:

Attitude Toward School

In most comprehensive high schools, when the student is sent to the office for disciplinary measures, a record is made and it is recorded in the student's folder. If a student's folder has a great number of these forms, it indicates he cannot adhere to the school rules and naturally, if a student cannot adhere and live up to the school rules, it is more than likely he will not be able to live up to the rules of the employer and school during his senior year if he should be selected as a Distributive Education student. The Bell-Adjustment Inventory Test should be considered; this is offered in the 10th year and any guidance interview reports made on the student.

Iowa Test of Educational Development

From this test you can get an overall picture of the student's ability. Important items to check are total score and vocabulary score.

Reading Score

The student's reading score and arithmetic score achieved on the Stanford Reading and Arithmetic Test given in junior high school.

I. Q.

The California Mental Maturity Test-Short form or the Henmon-Nelson I.Q. test is given. Ninety-five to one hundred five is an average score in the test. Keep in mind that this is only an indication of the student's ability.

Kuder Preference Test

The Kuder Preference Test which is given in the 10th year is a test that indicates the student's interests. From this test you should be able to get the student's interest in: Clerical ability, Mathematics, Art and Music, Persuasiveness and Social Service.

Test "Ability to Sell"

From the test "Ability to Sell," George Washington University, and from a Mathematics entrance examination, the applicant may be evaluated through a common medium.

Attendance and Appearance

The student's attendance in the regular program is very important. The average absence per year in our school system is six days. Should a student exceed this number, then the coordinator should check more carefully the reasons for possible chronic illnesses from the absentee record. Affixed to each permanent record is a photograph of the student; this should be noted.

Report Card

The student's scholastic record as of the 4th marking period of his eleventh year should be evaluated for achievement with their eleventh grade program. It will also indicate possible failures in required courses. The coordinator will also be able to check the number of units the student will possibly have at the end of his eleventh year.

Application Blank

From the completed application blank and the personal interview, the coordinator can evaluate the student's neatness, goals, hobbies, parental reaction, personality, grooming, interest, and get an overall impression.

Motivations -- Need money? ? Why? Positive or Negative? ?

The interviewer should seek out hidden activities, for example: Newspaper experience, money raising projects in school or scouts, magazine subscriptions. In general these activities indicate an interest for our field at an early age. Negative reaction -- student's interest in program to get money to buy a car. This type of student has seldom succeeded.

All of these factors are important and should carry equal weight. In the final analysis the judgment of the teacher-coordinator should be the determining factor. He is the real guide; he has traveled the path. Many times a student with a poor attendance record or low scholastic standing has been helped by the distributive education program. If a student is interested in the course, his attendance and scholastic standing generally improve.

Copies of tests referred to are available for examination.

PROCEDURE USED IN THE SELECTION
OF DISTRIBUTIVE EDUCATION STUDENTS
AT STOW HIGH SCHOOL

Set up a target date for initial recruitment meeting with all junior students. Arrange this date carefully with the administration.

a. At Stow, we called in two junior homerooms at a time. An announcement was made and these students were excused from their regular classes.

b. It is important that you be extremely well prepared for this meeting, everything has to be worked out ahead of time. I cannot emphasize this point too much as the success of your program is somewhat dependent upon it. You have a real selling job to do in a short time, you get only one crack at the entire junior class - make it a good one.

The forms used in recruiting at Stow High School are listed below:

1. Survey Form - This brief form is used at the first meeting to give you an idea of how many and which students show an interest in your program. A good check on your selling job. It is important to inform the students that by filling out this form they are not signing up for your program, they are merely indicating an interest in it.

2. D.E. Booklet - This booklet explains the Distributive Education program in brief. Booklets are handed out to all juniors at the first meeting with the instructions that they are to read it over carefully with their parents. In the booklet we have an information page to be filled out by the student and signed by the parent. This page returned by the student indicates a more sincere interest in your program.

3. Application Form - This is the official application form for Distributive Education. When the student returns the information page from his booklet he is given an application form to be filled out in his own handwriting. This form is to be studied carefully by the coordinator in his preliminary screening of students.

4. Student Rating Form - This form is used to rate the students on various areas other than grades. From the information given on the application form we list the student's teachers on this form. I have found that you learn much more about the student if you take this form around to the teachers personally and listen to their comments. Besides, it gives you a chance to sell your program to that teacher personally. Further screening.

5. Personal Interest Form - This form is used to uncover different sides and elements of the student's personality and interests. Demand that it be complete and that you will not accept it without a recent photograph attached. I had one employer hire a student sight unseen by looking over this form with the photograph attached.

6. Personal Interview Form - Use this form during a personal interview with a student. Try to study the personal interest form immediately before the student arrives for the interview. Here is where I suggest you add a question about the student's credits. He must have sufficient credits to enter your program and be made aware of it personally. It is a good idea to talk about the demands made on the students - the sacrifices that have to be made and also the rewards. Further screening.

7. Test - We gave an interest test at Stow, the Ohio State Employment Service has a good test to use if available. You have the student's grades and I.Q. in his permanent file - I have found that they have to be good in simple arithmetic in order to pass the tests given by many stores. I plan to emphasize arithmetic in our next testing effort.

8. Letter to the parent. This letter is sent out to the parent in hopes of making them more aware of the responsibilities envolved for both the student and the parent.

9. Composite Information Form - Here is where we gather together all the information available on a student and make our final selections. If you are assigned the entire responsibility of selecting students as I was it is good to get others opinions.

10. Letter of Congratulations - This letter is sent out during the summer months. It is signed by the administration and you.

It is suggested that at the top of all forms given to the student there be printed a deadline date by which this form must be returned to the coordinator. Screening takes long enough without waiting for students to return forms.

SELECTION AND PLACEMENT OF STUDENTS

1. Vocational Education and Guidance: Professional guidance personnel, administrators and all staff members should be made aware of the vocational opportunities available in the field of distribution. Although Distributive Education is a terminal program, participation by a student does not preclude his college attendance. In many areas of distribution, a college education is essential.

2. Guidance of Students: Distributive Education is a program designed for students who want, need, and can use the training given in retail, wholesale, and service jobs. Students whose interests lie in other fields should be guided into other school activities. It is desirable to make a number of the following contacts concerning each individual:

   Check with guidance counselors.

   Investigate student's grades in other subjects.

   Talk with other teachers about interests.

   Check with any former employers.

3. Individual Interview: Personal interviews between the teacher and prospective applicants are necessary. Preferably this interview should stem from an application blank which the student completes and can serve as a basis for other questions asked by the teacher. It is desirable that parents should be invited to accompany students to the interview.

4. Placement on Appropriate Jobs: Distributive Education students receive better training and show more interest in the program when the coordinator is responsible for finding the training station and for placing the student in the proper job.

   a. Some system of giving the student training in "how to apply for a job" and in principles of good grooming should be developed and used by the coordinator before referring any student for placement.

   b. Applying for a job is recognized as a training experience, and it is desirable for students to be directed to apply to several employers upon entering the program.

   c. The student should go alone when applying for the job, perhaps carrying a note from the coordinator or some type of introduction card.

   d. The coordinator should assume responsibility for arranging interview dates with the employer and for following up on the results of interviews. Preferably, the coordinator should be the one to inform students that they have been chosen for a job.

ATTRACTING STUDENTS

The following are ideas for attracting students to the Distributive Education program. Some of these ideas are considered musts for the coordinator. Others may be used depending on the local situation.

1. An educational program for the students throughout the year. A series of posters and the Inter-Communication System for spot announcements could be used.

2. A letter from the Chamber of Commerce to members of the Junior Class.

3. A positive attitude, a nice appearance, and friendliness in the halls on the part of the coordinator is important in attracting students.

4. Standards for the course which would include rules and procedures to be followed. This information should be made available to the teachers and administration.

5. Develop a friendship with the guidance counselor.

6. Appearance before service clubs, ladies' organizations, radio, T.V., etc. is very helpful in promoting Distributive Education

7. A coordinator should be helpful in placing other students on jobs. These students would have been referred by the guidance counselor.

8. Invite faculty members to the D. E. classroom to see displays. Displays which are outstanding can be placed in the faculty room.

9. Use other teachers in the school system as customers for sales demonstrations and judges in contests.

10. Exchange teaching units with other teachers when possible.

11. Invite critics in the school, guidance counselors, and other teachers to the Employer-Employee Banquet to promote public relations.

12. Coordinator whould attend faculty meetings, become part of the faculty, and accept his share of responsibility.

Attracting Students
(cont.)

13. Perform tasks for other departments in the school system.

14. Use top students to talk with Junior homerooms and students in lower grades.

15. Present D. E. C. A. and S. M. E. awards at assemblies.

16. Open house and initiation of D. E. C. A. members are effective ways to contact parents, other students, and friends.

17. Screening of students is very important -- must be selective by grades and attitude.

18. Interviewing by Advisory Committee can be used in selection of students.

19. Brochures should be available for Library and for handout material.

20. Employer-Employee Banquet.

21. Certificates of Appreciation for employers, letters of appreciation for guest speakers, other teachers, and principals are effective public relation devices.

22. Invitation to prospective students to Employer-Employee Banquet on pay basis.

23. Breakfast for prospective students.

24. News letter to parents and prospective students.

25. Appreciation Certificates to cooperating merchants -- 1 year, 5 year, 10 year, etc.

PRE-TESTING DISTRIBUTIVE EDUCATION STUDENTS

LIST OF TESTS AND PUBLISHERS

Intelligence Tests

Tests already in use by the schools will be acceptable as a general level of ability. We could find no intelligence tests that were applicable as an indicator of retailing-salesmanship ability by themselves.

Special Abilities

Advanced Occupational Inventory, California Test Bureau, 5916 Hollywood Boulevard, Los Angeles 28, California

Brainard Occupational Preference Inventory, The Psychological Corporation, 304 East 45th Street, New York 17, New York

Strong Vocational Interest Blank, Stanford University Press, Stanford University, Stanford, California

Aptitude Tests for Occupations, California Test Bureau

Aptitudes Associates Test of Sales Aptitude, Western Psychological Services, 12035 Wilshire Boulevard, Los Angeles, California 90025

Sales Motivation Inventory, Western Psychological Services

Thurstone Interest Schedule, The Psychological Corporation

Minnesota High School Achievement Examination-Business Relations and Occupations, Bobbs-Merrill, 4300 West 62nd Street, Indianapolis 6, Indiana

Detroit Retail Selling Inventory, Bobbs-Merrill

Vocational Interest Analysis, California Test Bureau

Gordon Occupational Check List, Harcourt, Brace & World, 757 Third Avenue, New York 17, New York

National Business Entrance Tests-Business Fundamentals and General Information Test, United Business Education Association, 1201 Sixteenth Street N.W. Washington 6, D.C.

SUMMARY

The general aptitude test battery, such as the GATB given by the Ohio State Employment Service, will also give information relative to occupational pre-selection. This service is offered on a ten student per test basis and can be quite time consuming. Some guidance counselors are qualified to give this test. A specific test for super-market cashiers is available from the National Cash Register Company, Dayton, Ohio. The newest test in the field is the Gordon Occupational Check List. An excellent list is available published by the American Textbook Publishers Institute, 432 Park Avenue South, New York 16, New York. This list can be used in connection with the National Defense Education Act of 1958.

SECTION III

PROMOTIONAL AIDS FOR SELECTION OF STUDENTS

WHAT'S ALL THE SHOUTING ABOUT?

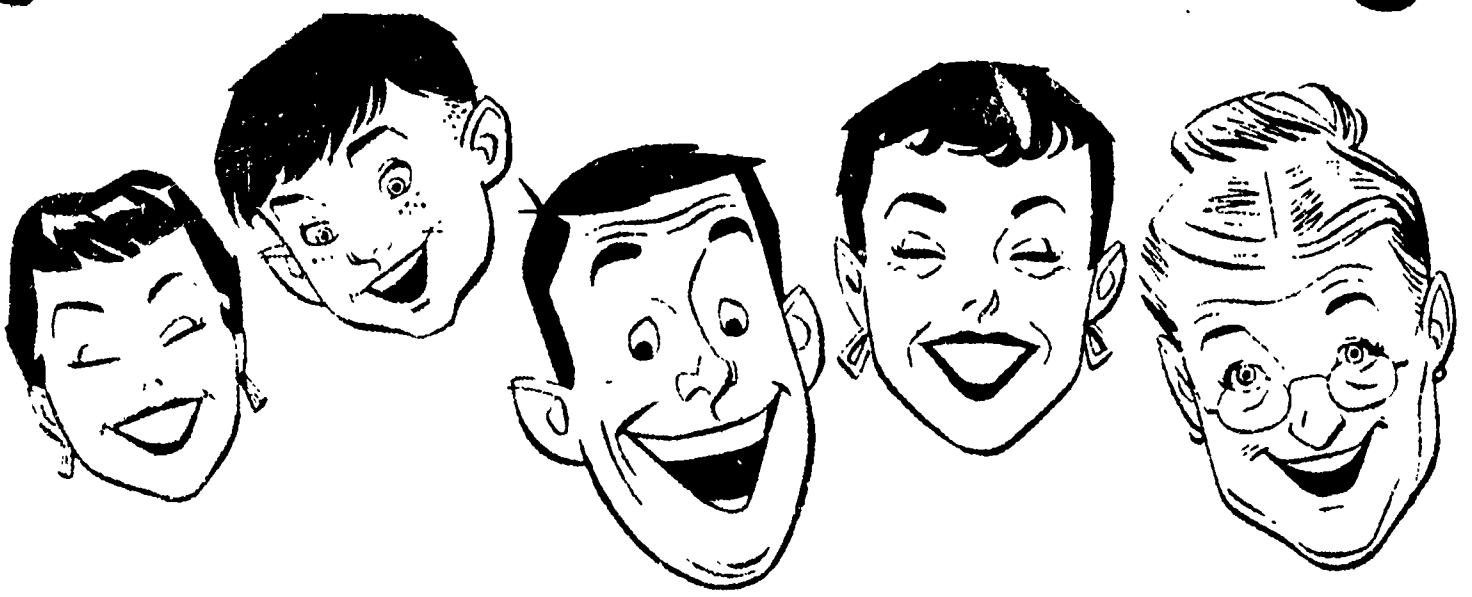
NEXT YEARS DE CLASS IS BEING SELECTED NOW!

IF YOU ARE...

* INTERESTED IN A BUSINESS CAREER IN SALES DISPLAY BUYING ETC
* PLANNING TO GO TO WORK AFTER GRADUATION IN A RETAIL STORE
* SINCERELY INTERESTED IN PEOPLE AND LIKE TO WORK WITH CUSTOMERS

THEN DE MAY BE THE OPPORTUNITY YOUVE BEEN LOOKING FOR!

LIKE PEOPLE ?



MAYBE YOU'LL LIKE DISTRIBUTIVE EDUCATION

"DE" IS A . . .

★ WORK STUDY PROGRAM FOR STUDENTS WITH A SINCERE INTEREST IN BUSINESS OPERATION

★ SCHOOL PROGRAM OPEN ONLY TO QUALIFIED STUDENTS WITH AN EYE TO THE FUTURE

★ PROGRAM TAILORED TO INDIVIDUAL GOALS HELPING YOU GET VALUABLE JOB EXPERIENCE WHILE COMPLETING YOUR HIGH SCHOOL EDUCATION

NEXT YEARS CLASS IS BEING SELECTED NOW

CHECK INTO IT !

"DE" IS "EXCITING!

YOU CAN EXPERIENCE THE SATISFACTION OF WORKING WHILE ATTENDING SCHOOL

"DE" TRAINS STUDENTS
FOR CAREERS

IN SALES
AND MARKETING

CHECK INTO
IT TODAY!

115

NEWS RELEASE (FOR THE SCHOOL NEWSPAPER)

For Immediate Release: DISTRIBUTIVE EDUCATION STUDENTS NOW BEING SELECTED FOR NEXT YEAR

Distributive Education Coordinator _____

announced today that students are being selected for next year's D.E. class.

Distributive Education is a program designed for those students who are interested in careers in the business areas of selling, small store management and personal contact with people in service-type businesses. Students prepare for their future careers by studying marketing and selling methods in school in the morning and working under supervised job stations in the afternoon or evenings.

Next year's class will be selected from interested students who are planning careers in selling and distribution, are good school citizens with few absences, and who are judged by the Distributive Education coordinator to be qualified for Distributive Education.

_____, the Distributive Education Coordinator, urges all students who are interested to contact (him or her) at the Distributive Education classroom (number) (room) to receive more information about this unique program.

3. Suggestions for Assembly Programs

a. DE/DECA, Slide-Tape Presentation

Two slide presentations are offered for sale from the Ohio Materials Lab. The first set with audio tape accompaniment explains Distributive Education using 40, 35 MM color slides. This set sells for $10.00 including the tape.

The second companion set explains the DECA program and consists of 50, 35 MM color slides and accompanying tape. This slide set sells for $10.00 including the tape. Both sets can be ordered from the Ohio Materials Lab. They were designed specifically for promotional use.

b. Use of Distributive Education Students

Your present Distributive Education students may be used in a number of different ways to add "believability" and identification to your promotional efforts. Some of these might be:

(1) A panel describing their classroom and job experiences
(2) Goodwill Ambassadors to describe the program and answer questions perhaps at the homeroom level -- frequently a boy-girl team works well here.
(3) Students can be used to distribute literature and speak as "candid" observers in any type of assembly gathering.
(4) Present students may want to wear badges "Ask Me About DE" or perhaps recommend (be careful here) an outstanding student for your next class.

c. A Localized Presentation -- Slide Tape

The use of 35mm slides with taped student narrative works thusly:

(1) Take 35mm slides of your students working (this can be done with a $15 Kodak Instamatic and flash "cubes"). Get their bosses in the picture with them. Use as many different retail backgrounds as possible to give your presentation variety.

(2) Ask each student to write down his name, who he works for - where he works and briefly what his duties are. This can be done on a half sheet of paper. Don't attempt to edit them unless they are real bad! Now put your slides in the order you want to show them and have each student record his written message on tape. As each student

finishes, use a Halloween "cricket" or click a spoon against a glass or a similar signal so that when the tape is complete and played -- you will have a signal to go on to the next picture.

You'll probably find it easier to tape a student, stop the recorder, get the next one into position, etc., rather than trying to go straight through the whole process.

(3) This type of presentation is exciting to the students because they see what could be themselves, the different voices and semi-professional approach adds a great deal of local flavor. It has been highly successful in actual use.

d. 16 MM Films

There are a few films developed by some states for Distributive Education promotion. These are to this writer's knowledge now dated.

The newest film and perhaps the best is -- "Tell It Like It Is". It is available from:

Audio/Visual Department
The Sears Roebuck Foundation
7435 Skokie Boulevard
Skokie, Illinois 60076

It is a free loan film and should be scheduled as far in advance of your anticipated use as possible. It is a very popular film.

e. A Panel of "Experts"

This is another approach to the assembly program wherein you develop a panel of people representing the most important facets of Distributive Education, i.e. --

(1) The Principal (or Guidance Counselor) represents the school and describes the school's function.
(2) A businessman (possibly Advisory Committee member) tells the function of the job supervisor.
(3) An outstanding student relates experiences connected with the program.
(4) You can chairman the panel and structure it to get the desired results.

Other variations may include a former Distributive Education student who "made good," important local people, the mayor, etc.

f. Transparencies

A set of transparency masters is enclosed to enable you to make your own overhead presentation. You can add to this localized transparencies to give it flavor.

4. Other Devices

a. Take advantage of all empty bulletin boards. Let your students practice their "Display" principles.

b. Check any local radio or TV time that may be available for public service.

c. Go after students you want -- Why not? The football coach does, and the choir director, etc. Don't push too hard or they may think they are privileged, but let them know you are interested in them, if they are interested in Distributive Education.

Check the office to see who keeps track of the work permits - go through these. These students sometimes are "naturals" -- and they may already have a Distributive Education job station!

Also check Advisory Committee for student recommendations and your present Distributive Education employers. Sometimes they have excellent suggestions on someone who worked at Christmas for them, etc.

d. Utilize the school P.A. system for form deadline announcements, etc., always including "Distributive Education, Room 103, Mr. Smith," etc.

You may choose to make up "teasers" for the P.A. each day (if the administration doesn't object), i.e.:

"Are you interested in working with people?"
"Are you planning a future as a cashier, small store manager, salesman?" If you are, why not investigate the opportunities in Distributive Education. Contact Mr. Jones, Distributive Education, Room 104, today!

e. Local Service Clubs

This may be an excellent time to take that speaking engagement at the local Rotary, Kiwanis, Chamber of Commerce, etc., explaining the program and the fact that you are presently selecting your students for next year, etc.

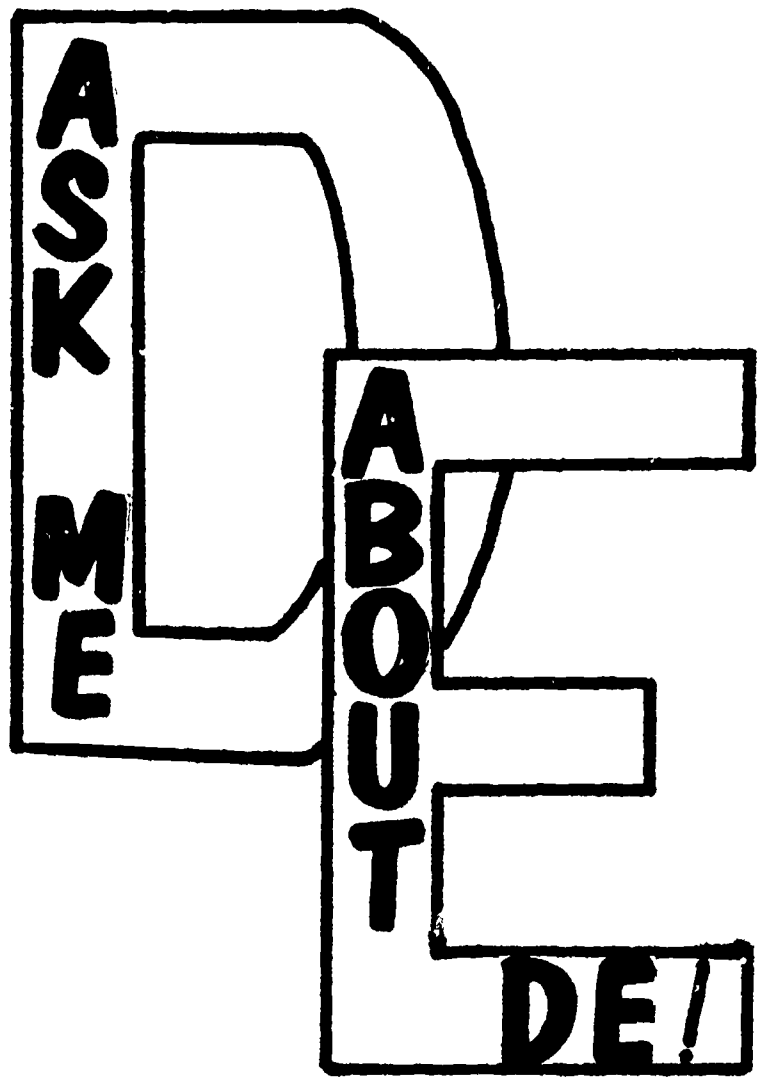
f. Classroom Open-House

This is a technique that has been used successfully by many coordinators. The juniors and seniors or either set up an "Open House For All Students Interested in Distributive Education." A structured program is set up by the coordinator so it doesn't become just a big party, but plenty of time is allowed for questions and answers both in group form and on an individual basis. Refreshments may be an added incentive and timing is up to you, perhaps after school, evening, or whatever can be worked out. You can work a visual presentation in here if you wish.

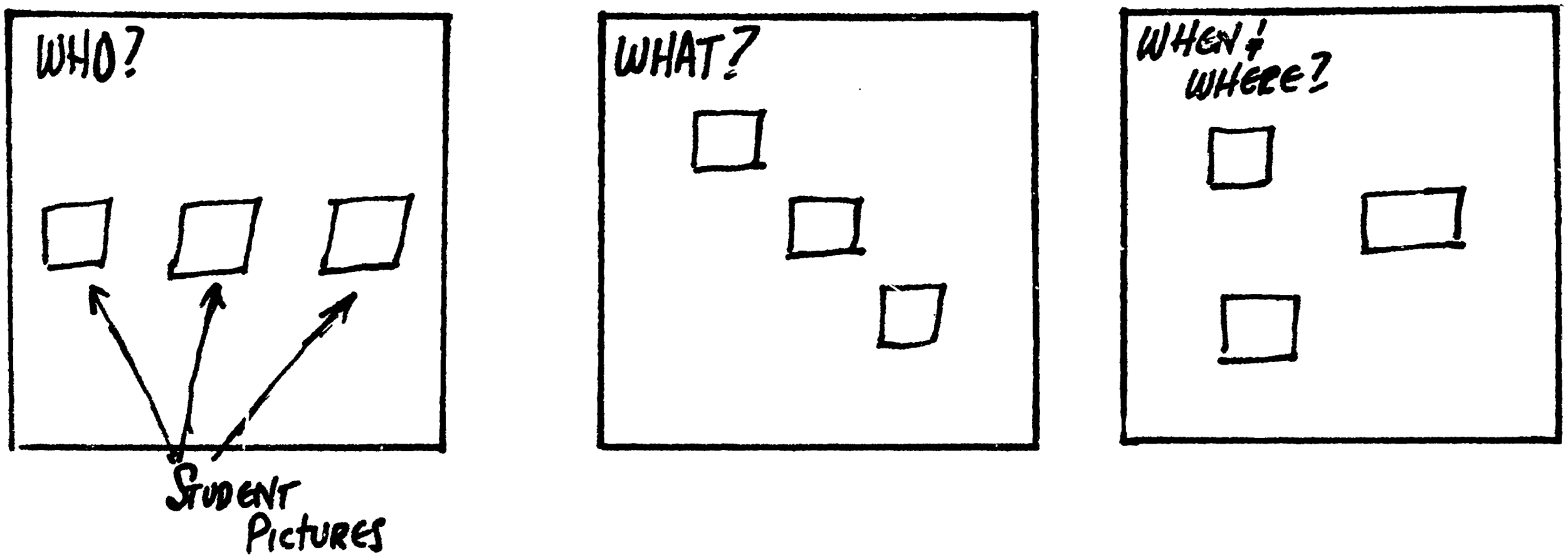
Finally:

Don't forget to follow through after the job is complete. This follow-up may include:

(1) A reception for new members.
(2) School newspaper release.
(3) Local news release.
(4) Any type of approach which will indicate to the student that he was very fortunate to have been selected!
(5) A special thanks to all the people who took their time to help you in the process of selection.



A "badge" secured by a straight pin that might be worn by your present class to amplify promotion --



SUGGESTED LARGE SELECTION DISPLAY
(CAN BE HINGED TOGETHER TO FORM A 'V')

1. "Who" can explain who is eligible for D.E., qualifications, etc.

2. "What" can be a thorough explanation of D.E. describing job stations.

3. "When" can tell when they can take it -- Juniors, Seniors, etc. and "Where" may list job stations, give the D.E. classroom number, etc.

You may choose to tie in DECA with two mannequins and DECA jackets in the background for an effective window display -- or improvise in any number of different ways --

VT 010 411
Display Made Easy.

Ohio State Dept. of Education, Columbus. Materials Lab.
MF AVAILABLE IN VT-ERIC SET.
Distributive Education Materials Laboratory, The Ohio State University, 124 West 17th Avenue, Columbus, Ohio 43210 ($2.00).
PUB DATE - ND 74p.

DESCRIPTORS - *DISTRIBUTIVE EDUCATION; *RESOURCE MATERIALS; *AUDIOVISUAL AIDS; *MERCHANDISING; DESIGN; *DISPLAY PANELS; DESIGN PRINCIPLES

ABSTRACT - Resource materials, prepared by the Ohio State Department of Education and emphasizing the basic concepts of displays, are included in these sections: (1) Why Study Display, (2) What is Display, (3) Display Function, (4) Display Types, (5) Display Concepts, (6) Elements of Display, (7) Principles of Arrangement and Design, (8) Arrangements, (9) Planning Displays, and (10) Observe, Practice, Study. The 53 illustrations accompanying the text are designed to be reproduced for use with overhead projector, opaque projector, bulletin board, flannel board, flash cards, or posters. A bibliography is also included. (SB)

VT 010 411

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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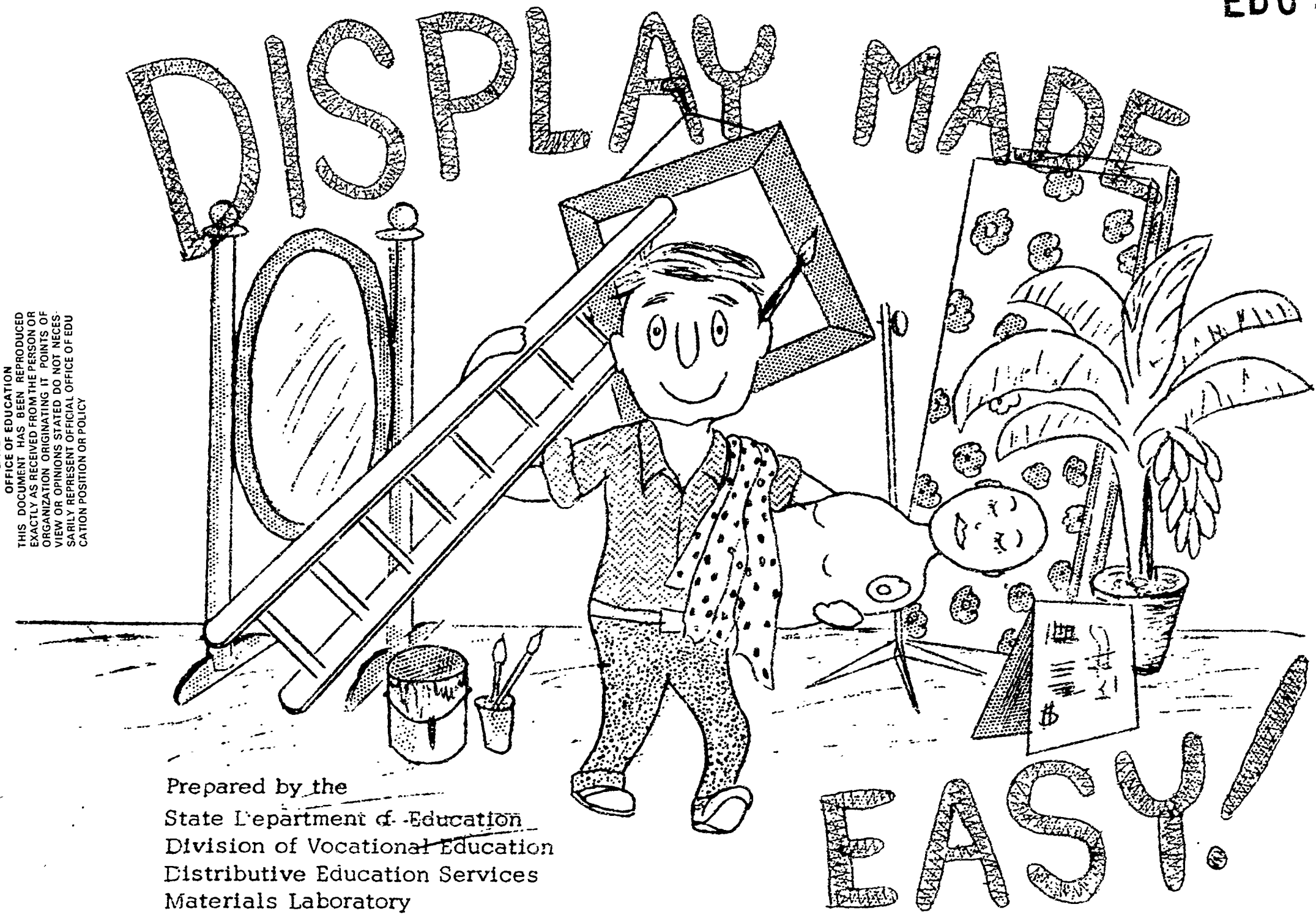
EDO 45856

DISPLAY MADE EASY!



Prepared by the
State Department of Education
Division of Vocational Education
Distributive Education Services
Materials Laboratory

VT 010 411

TEACHER SUGGESTIONS

This manual for teaching display has been prepared in its loose-leaf form to better serve the needs of individual teachers. The pages of illustrations can be removed and duplicated easily for use on overhead projectors by running them through a Thermo-Fax copier. There are 53 pages in this manual that lend themselves well to overhead projection use.

Many teachers will wish to copy individual pages on mimeograph stencils and use them for passouts to students. Illustrated pages can be reproduced by use of the squared method or an opaque projector so that the teacher may use them as flannel board presentations, bulletin board displays, or flash cards. You may have some of your more artistic students develop posters based on these ideas. The opaque projector will work well to project the illustrations for effective viewing by the entire class.

This material will prove useful as a self-teaching unit for individual students who are particularly interested in this subject. It is simply programed to lead the student point by point through the basic concepts.

Your use of the material in this manual will be limited only to your own imagination and resourcefulness as a teacher. It will serve well to be embellished and expanded from the wealth of your own background and experience. It is our hope that you will find this manual a useful tool and we would welcome sharing ideas with you on ways to use it most effectively.

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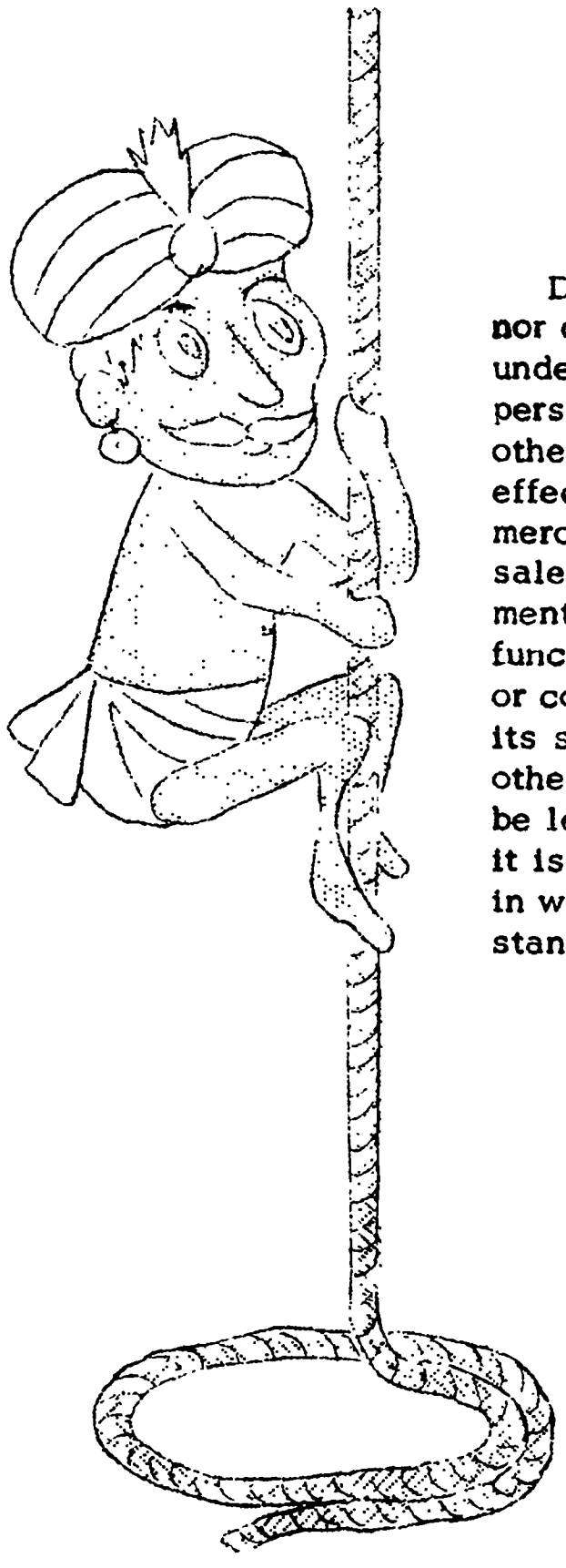
This manual was written and illustrated by Gerald E. Patterson, Consultant of the Distributive Education Materials Laboratory, State Department of Education. It is the hope of the author that Distributive Education coordinators and students will find it a helpful guide to stimulate the further study of display as a selling tool.

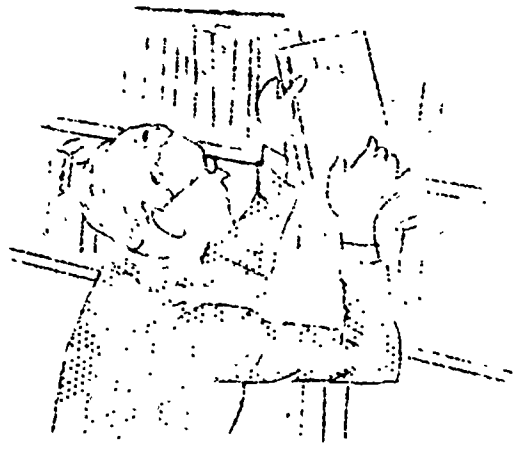


THE EASY WAY TO GOOD DISPLAY

PREFACE

Display is not a mysterious nor complex subject beyond the understanding of the average person. Display is simply another tool that can be used effectively to sell ideas or merchandise. It ranks with salesmanship and advertisement and serves a similar function. It can stand alone or compliment the efforts of its sister crafts. Like any other new activity it can be learned and fortunately it is not a difficult subject in which to acquire understandings and skills.

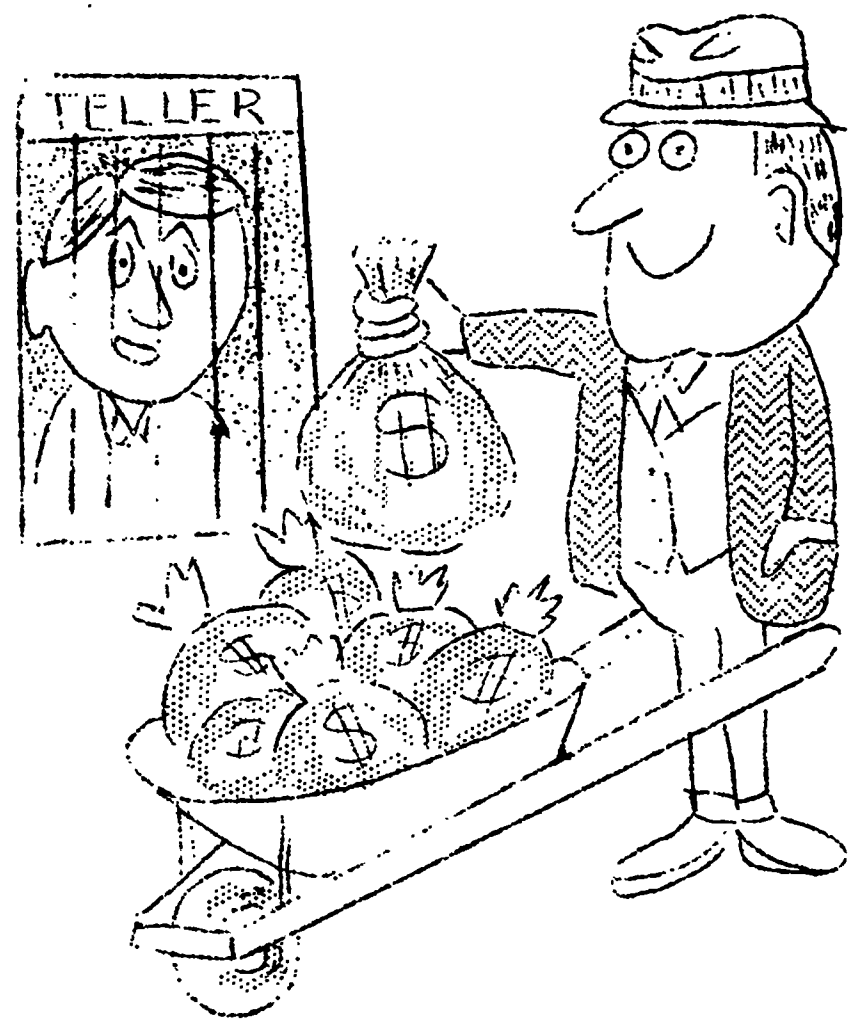
It is the purpose of this manual to present the basic concepts of display in a concise and understandable manner. The student who gives careful consideration to the information herein presented should thereafter be able to both evaluate and construct displays in an intelligent and useful manner.



This presentation is elementary and thus cannot be detailed nor all inclusive. The serious, or career minded, student will want to delve much deeper into the subject and a bibliography is provided to guide such efforts.

WHY STUDY DISPLAY?

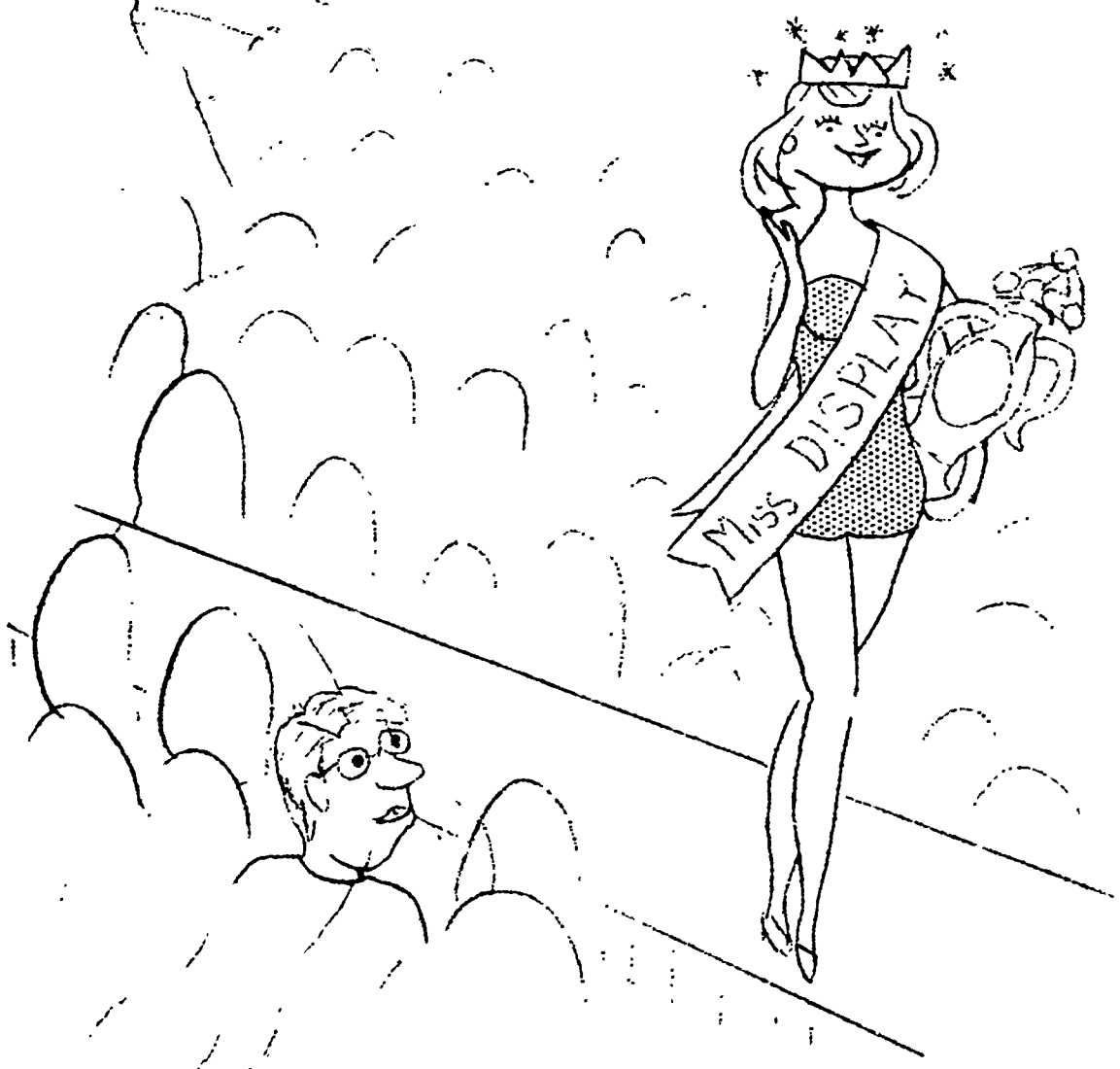
Display is an effective tool to promote ideas and sell merchandise. It can be a powerful tool if properly used and can serve the person who understands it in many ways. While our primary purpose in this study is to develop an understanding of its use in the business world, it can also be useful in enhancing the social and cultural development of the learner. Not only will this knowledge have a dollar value to the student but will provide him with more pleasure and enjoyment from his environment. Having learned the basic principles used in display, the student will be surprised to find them in use all around him.



Stated briefly, the major benefits that will accure to the students from learning about display are these:

* Marketable job skill
* Job understanding
* Job satisfaction
* Personal enjoyment

WHAT IS DISPLAY?



Our knowledge of the world around us comes to us primarily from our senses of seeing, hearing, smelling, tasting, feeling. Eighty per cent of our knowledge comes to us from sight alone. Display uses our sense of sight to implant its message. DISPLAY IS VISUAL.

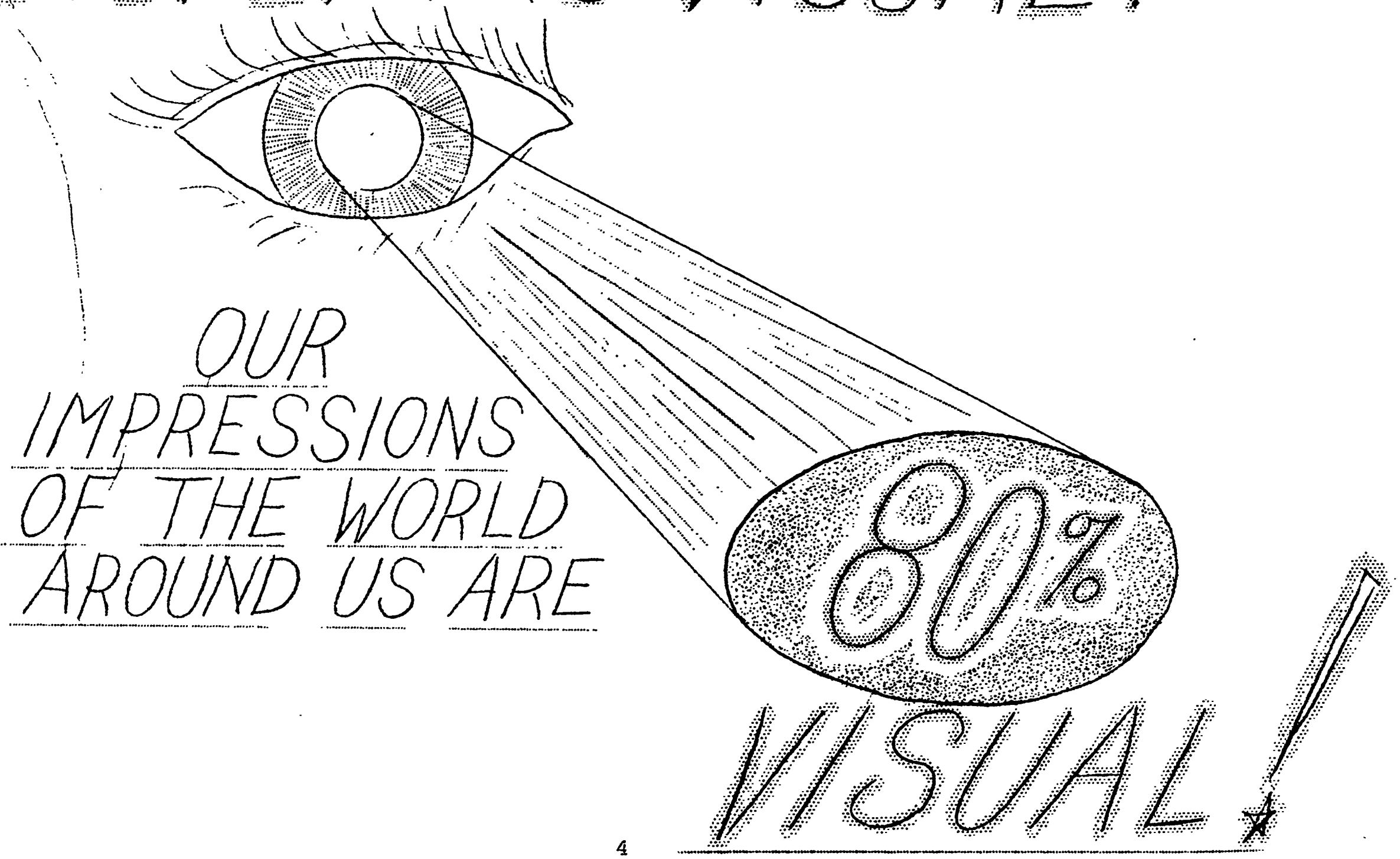
Display, as we shall consider it, is a visual tool used by stores to serve these two purposes:

1. PROMOTIONAL - to sell merchandise.

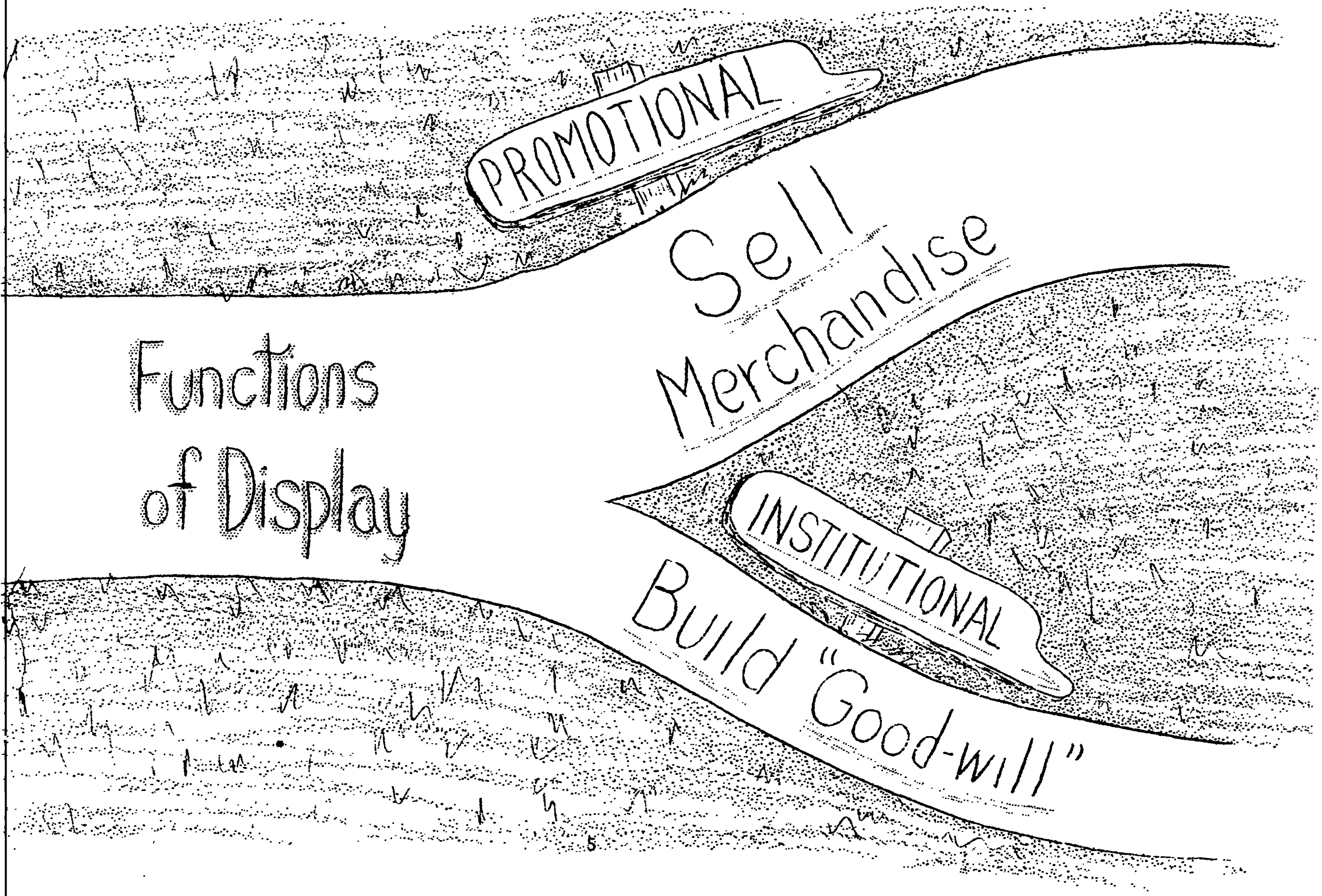
2. INSTITUTIONAL - to build "goodwill."

Display uses various elements placed according to certain principles of arrangement and design to present a visual impression.

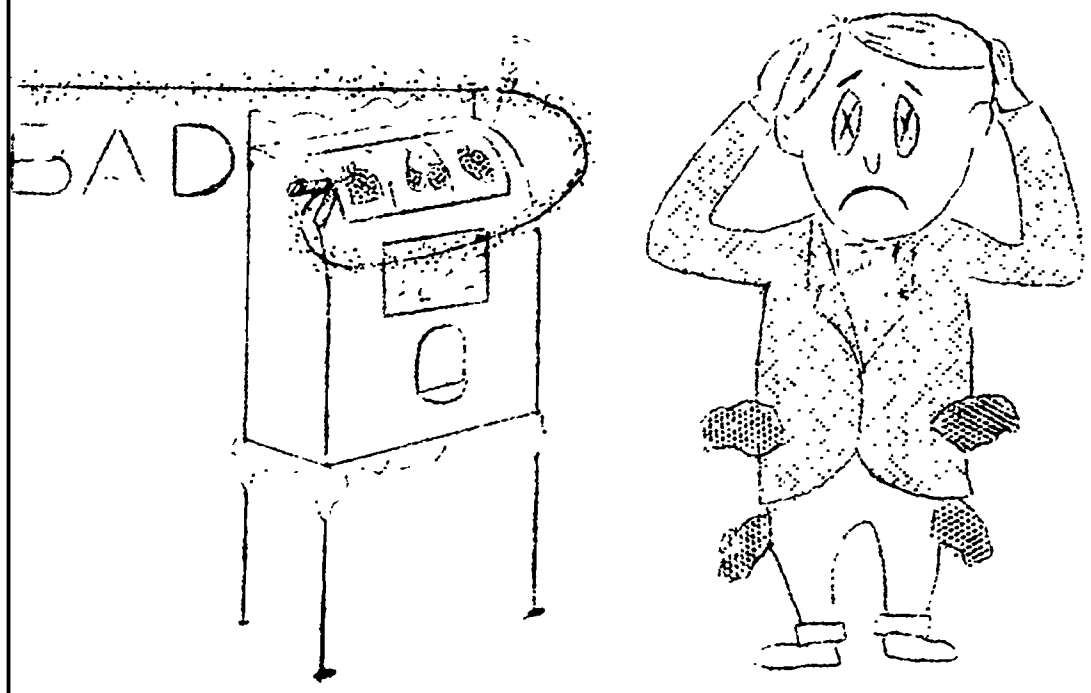
DISPLAY IS VISUAL.



Functions of Display



Displays are said to be effective (good) or ineffective (bad) to the degree that they serve the purpose for which they were made.



A display must carry the viewer through the same physiological steps that are involved in successful advertising and salesmanship. These steps are:

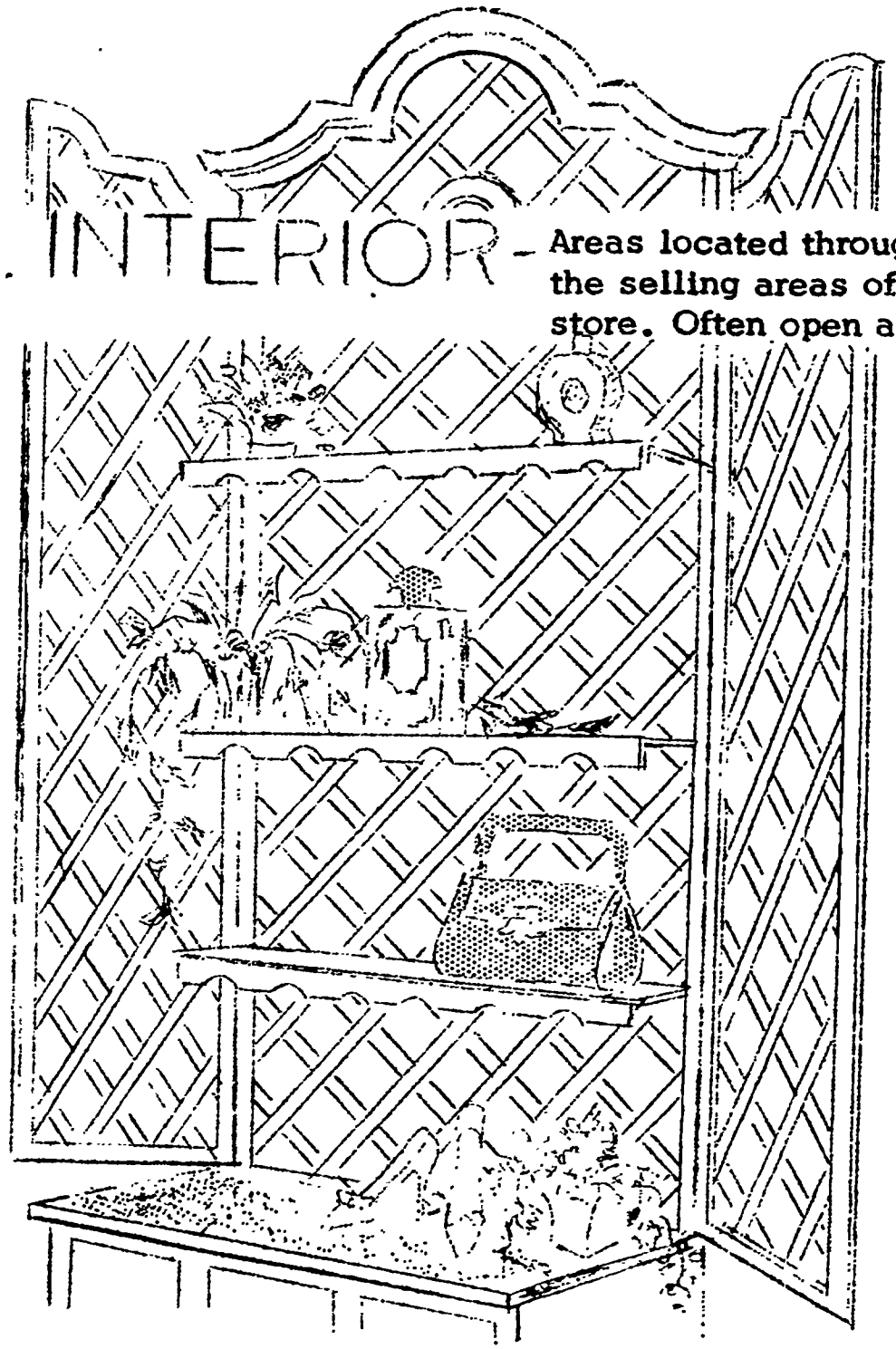
1. Attention - The viewer must be attracted to look at the display.
2. Interest - The viewer must look at the display long enough to understand what its purpose is.
3. Desire - The viewer must develop a feeling of wanting to own or do what the display suggests.
4. Action - The viewer must react to the display in the way intended. He should buy the merchandise or mentally accept the idea presented.

SUCCESSFUL DISPLAYS ACCOMPLISH:

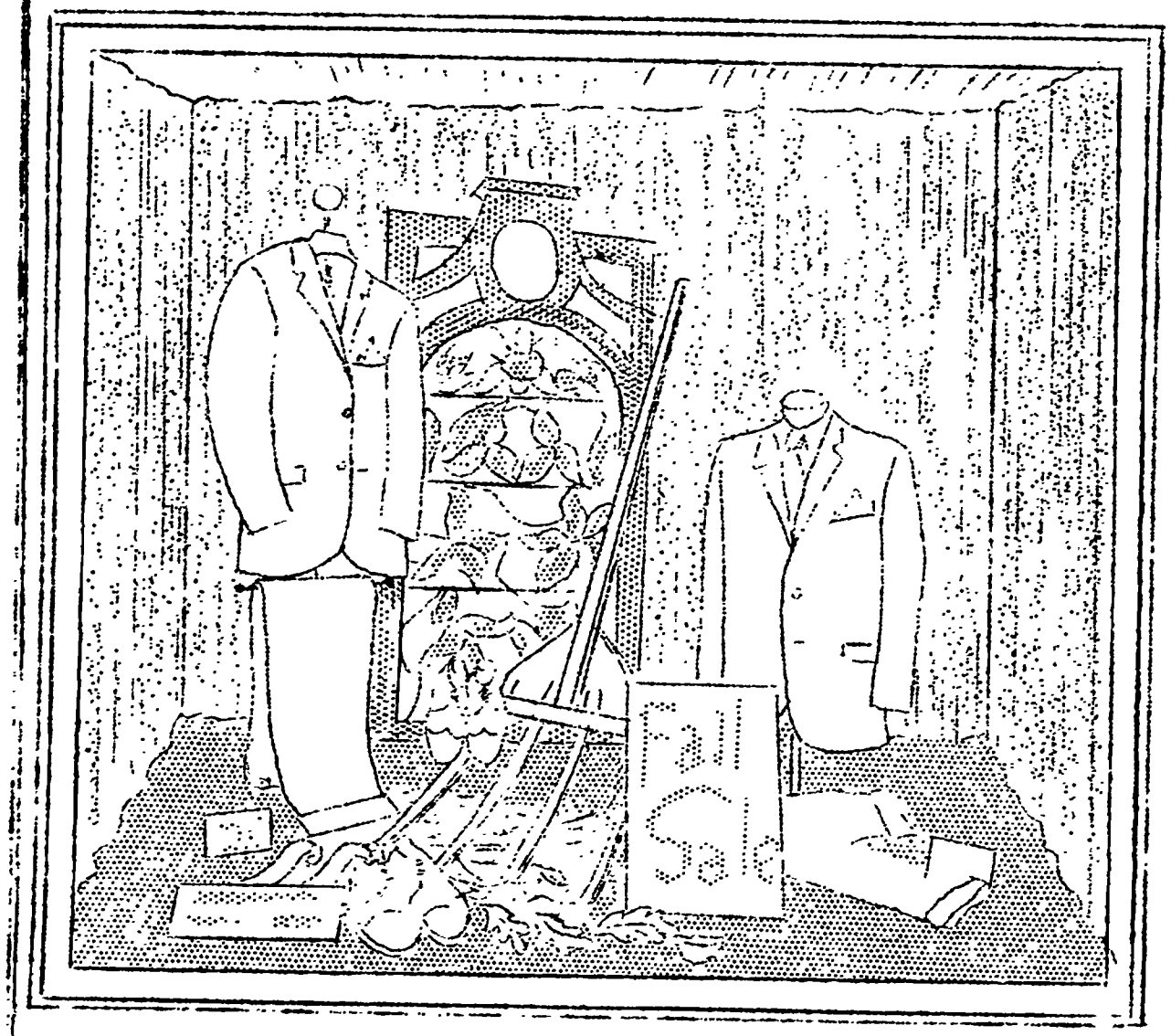
1. ATTENTION
2. INTEREST
3. DESIRE
4. ACTION

DISPLAY TYPES

Displays are used by stores in many ways but are generally grouped into the following two types:



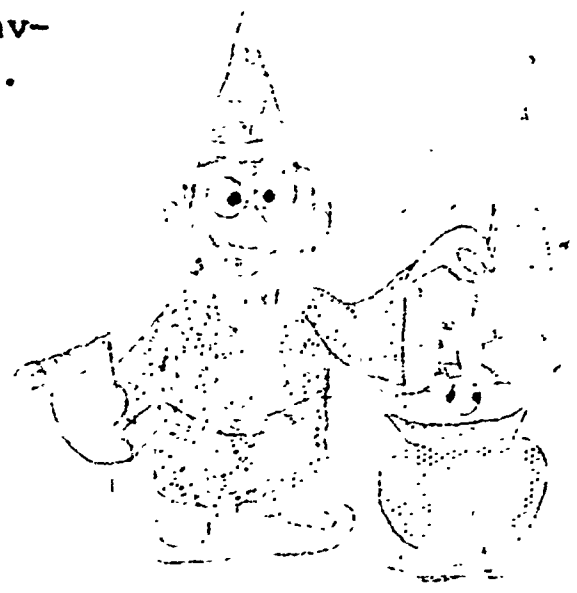
1. INTERIOR - Areas located throughout the selling areas of the store. Often open areas.



2. WINDOW - Glassed areas facing outward to streets and sidewalks. Usually are enclosed areas.

DISPLAY CONCEPTS

Display is considered by many as a distinct art form and therefore difficult to either understand or do. While an art background or aptitude is undoubtedly an asset in the study of display, it is by no means essential. A student who approaches this study with an open mind and a desire to learn will soon discover that display is not a mysterious rite to be practiced by the specially talented. Its basic principles can be easily grasped, understood and practiced by anyone having the desire to do so. This study should be a great source of personal satisfaction and enjoyment to students who take the small effort required to absorb it.



Display has sometimes appeared to be difficult because it is not a subject in which one can memorize sets of hard and fast rules that apply to all situations. It is possible, however, to study some basic guides and acquire a feeling for what is pleasing and what is not. A general display rule is: "If it looks good to you, it probably is good." Surprisingly, the human eye is pleased by certain things and displeased by others without our being personally aware of the reasons. This sense of what seems visually right and wrong can be developed and understood by studying what it was that you did not like about your observations. The guidelines and principles presented here have grown out of the numerous studies that have tried to determine what does and what does NOT appeal to the eye.

An analysis of a display reveals that it is made up of a number of elements (things) and that these are arranged (designed) according to various principles of what looks right. A study of display, then, must start with consideration of:

1. ELEMENTS.

2. PRINCIPLES of Design and Arrangement.

ELEMENTS OF DISPLAY

Every display starts out as an empty space. This space may be bounded on all sides by walls and windows, or it might be an open, unrestricted area in the store. What goes into that space depends on the idea of the display man as he has determined the purpose of the display. In order to carry out his idea, the display man must use merchandise, fixtures, props, materials, signs, etc. of his choosing to construct the display.

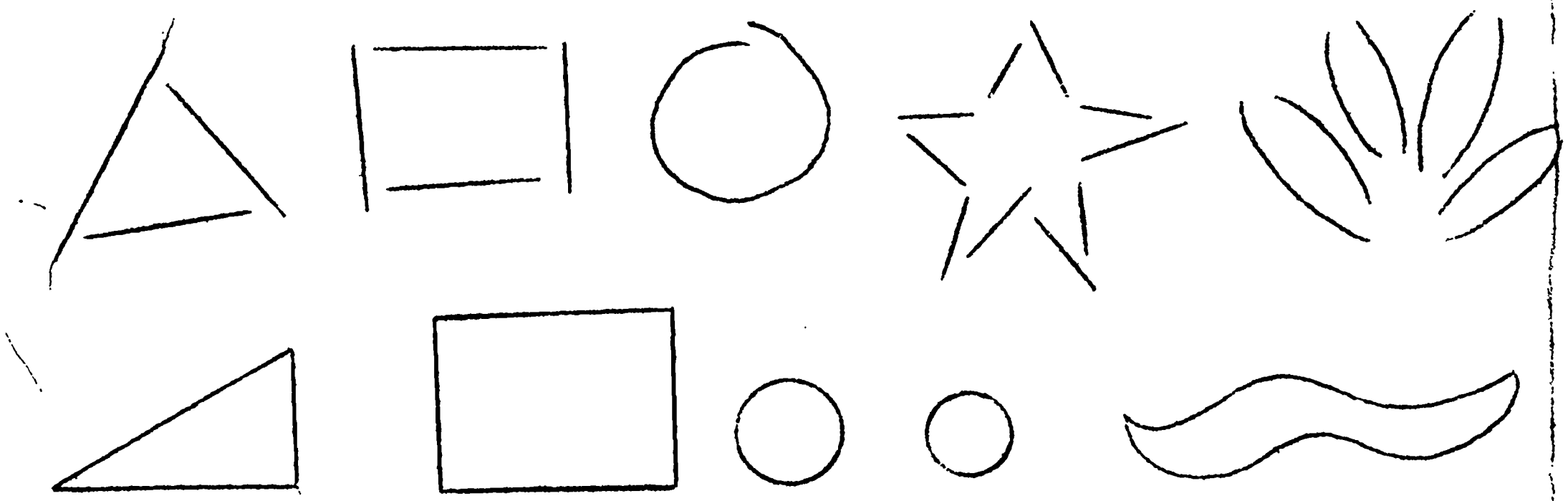
It is an important starting place in the study of display to realize that all displays begin as empty space. Fortunately this space is usually limited to a certain area and bounded so that it has shape. Space is turned into a usuable shape by surrounding it with lines. Restricting space to a recognizable shape is necessary in display since you must have a specifically defined area in which to limit your display efforts. Observe an empty display window and you get the impression of seeing the inside of a box. The walls, floor, and ceiling (lines) are restricting space into a shape you can see. This shaped space is recognizable and can be measured since it has height, width, and depth.

You will need to understand that one of the most important elements to consider in making a display is the shape of your display space. Will it be a cube, cylinder, a rectangular box, or what?

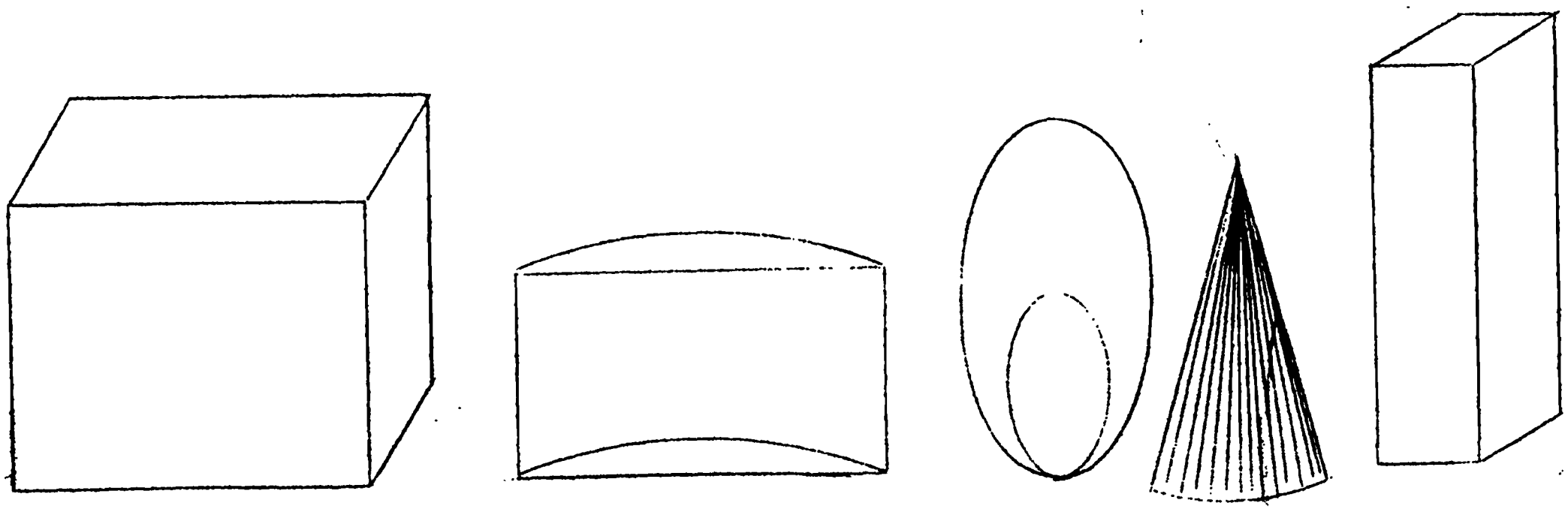
Stop here for a minute and use your pencil to construct some shapes by drawing lines on a blank piece of paper. Notice that you can quickly fill the blank space with shapes by drawing lines. Three straight lines can make a triangle, four straight lines can make a square, a single line curved around to meet itself becomes a circle or oval, etc. You have just proven that lines can create shape out of empty space.

If you will go one step further in your observation and look around you, you will find that every object in your sight has a shape. Look closely and you will discover that all shape results from a combination of lines. Without lines you would be living in a limitless, shapless, unending space. Such a concept is very difficult for us to imagine because we have always lived in a world of objects, and all objects have shapes which are defined by lines.

Another interesting fact about lines is their ability to create a feeling of direction or movement. Lines and the shapes formed by them impart various emotions and moods. They are able to lead the eye in intriguing ways. Some line arrangements please the eye while others displease. Practice line arrangements similar to those shown in the illustrations and become familiar with their visual effects. Learn to observe the actions of lines and shapes in the world around you.

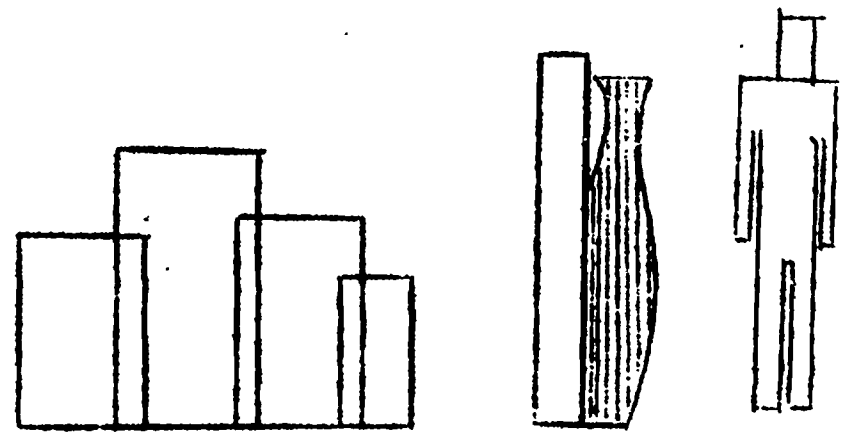


LINES MAKE SHAPES



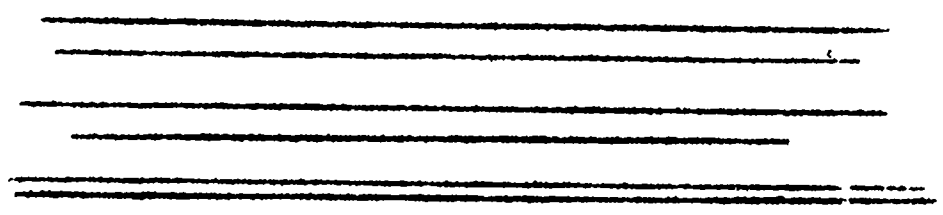
LINES

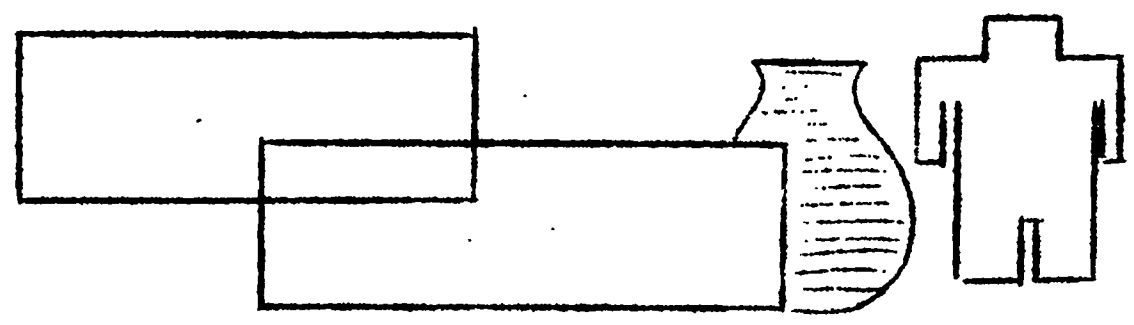
VERTICAL-



-forceful -masculine -impresson of height -slenderness
-elegance -suggest mountains & skyscrapers.

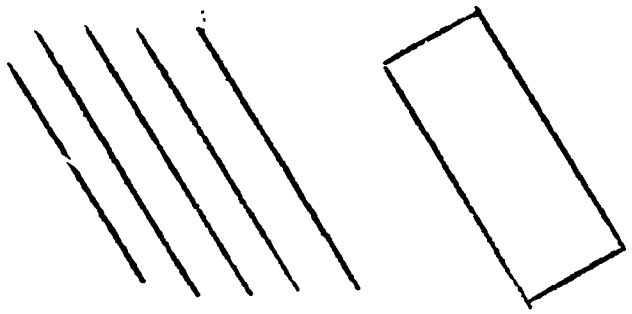
HORIZONTAL-



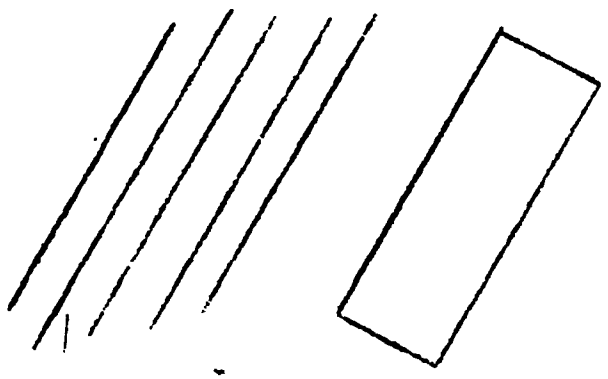


-restful -unifying -impression of width suggest
calm -steadiness - solid foundations

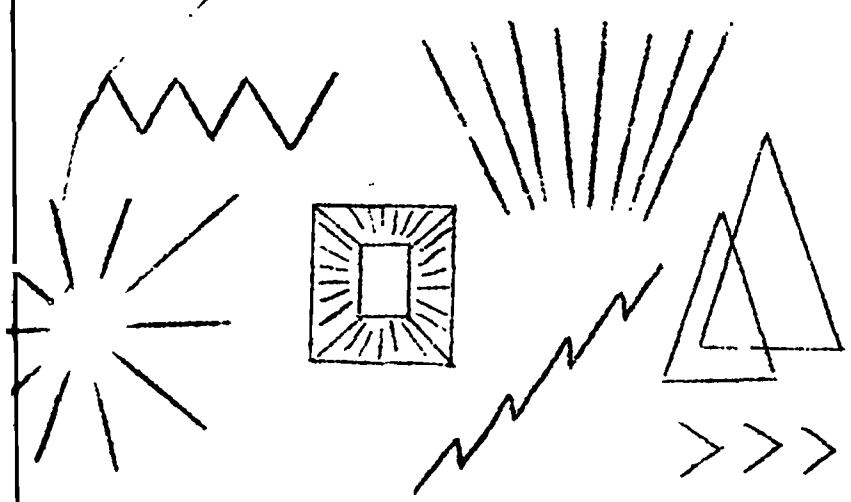
DIAGONALS-



LEFT to RIGHT- feeling of action leads eye from top left to bottom right- exciting - something happening.



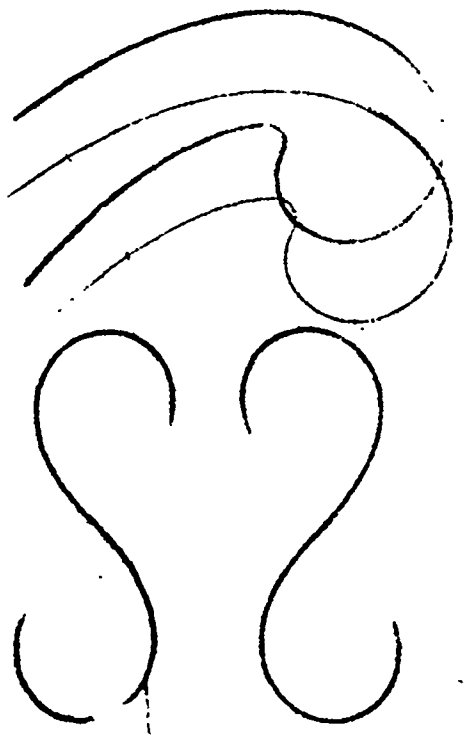
RIGHT to LEFT- feeling of instability- leads eye in unnatural movement. -lack of confidence-about to tip over.



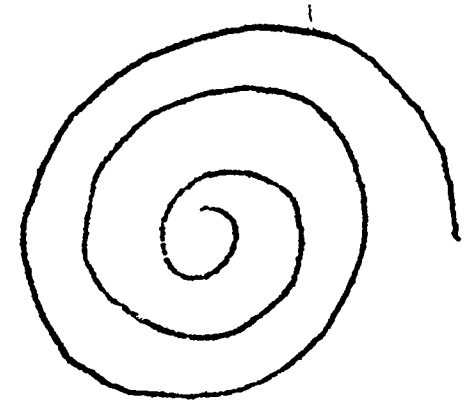
VARIED- interest added by combinations- many moods.

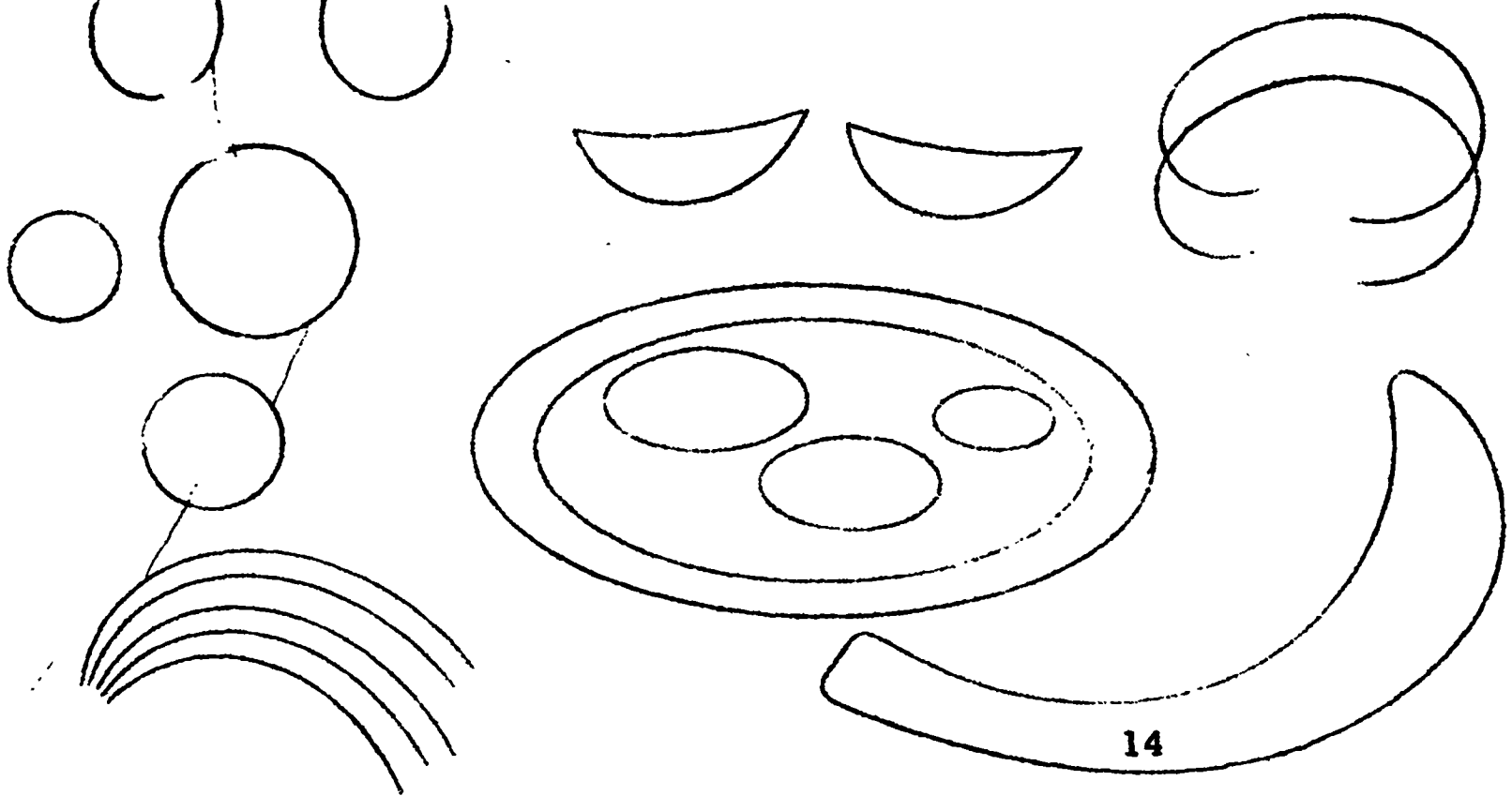
>>>>

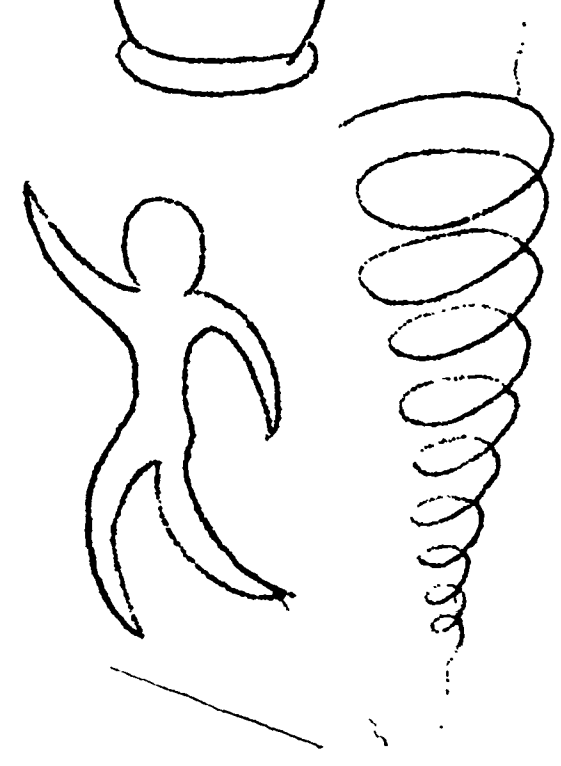
CURVES -

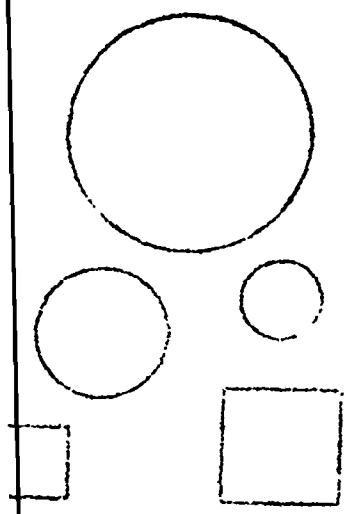


- softness - flowing - pleasing
- graceful - fluid motion
- beautiful - eye follows
- naturally - great interest









In addition to the element of the shape of the space for the display, the display man needs to know its size: How large or small it is. Size, then, is another element that demands our consideration. It is important to know not only that your space is shaped like a cube but that it is a seven foot cube as opposed to a one foot cube. The size of the area will greatly affect the size of objects that can logically be used in arranging the display.

We have thus far discussed line, shape, and size as three elements of display. A listing of some of the major elements involved in display would include:

- LINE
- SHAPE
- SIZE
- TEXTURE
- WEIGHT
- COLOR

The element of texture refers to the look or feel of the surface of the object under observation. Is it rough or smooth, shiny or dull, hard or soft.

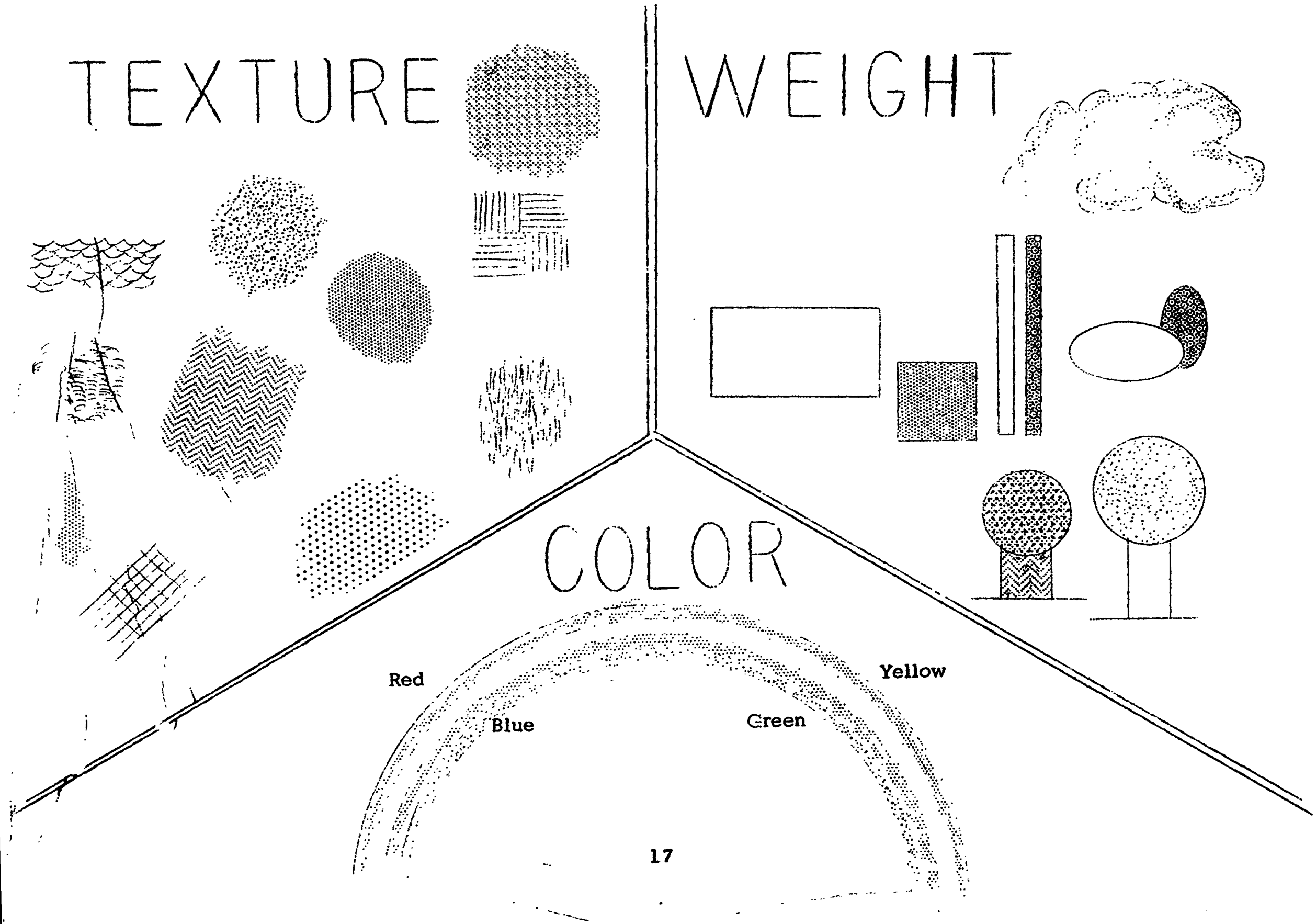
The element of weight refers to actual as well as the optical weight of an object. Does it appear heavy and bulky or light and airy?

The element of color includes not only reference to the hue of the object but the shading of light or dark. Here it includes white or black and the gradations between them.

These elements are examples of some of the physical characteristics of objects that will lend themselves to application under the principles of design and arrangement.

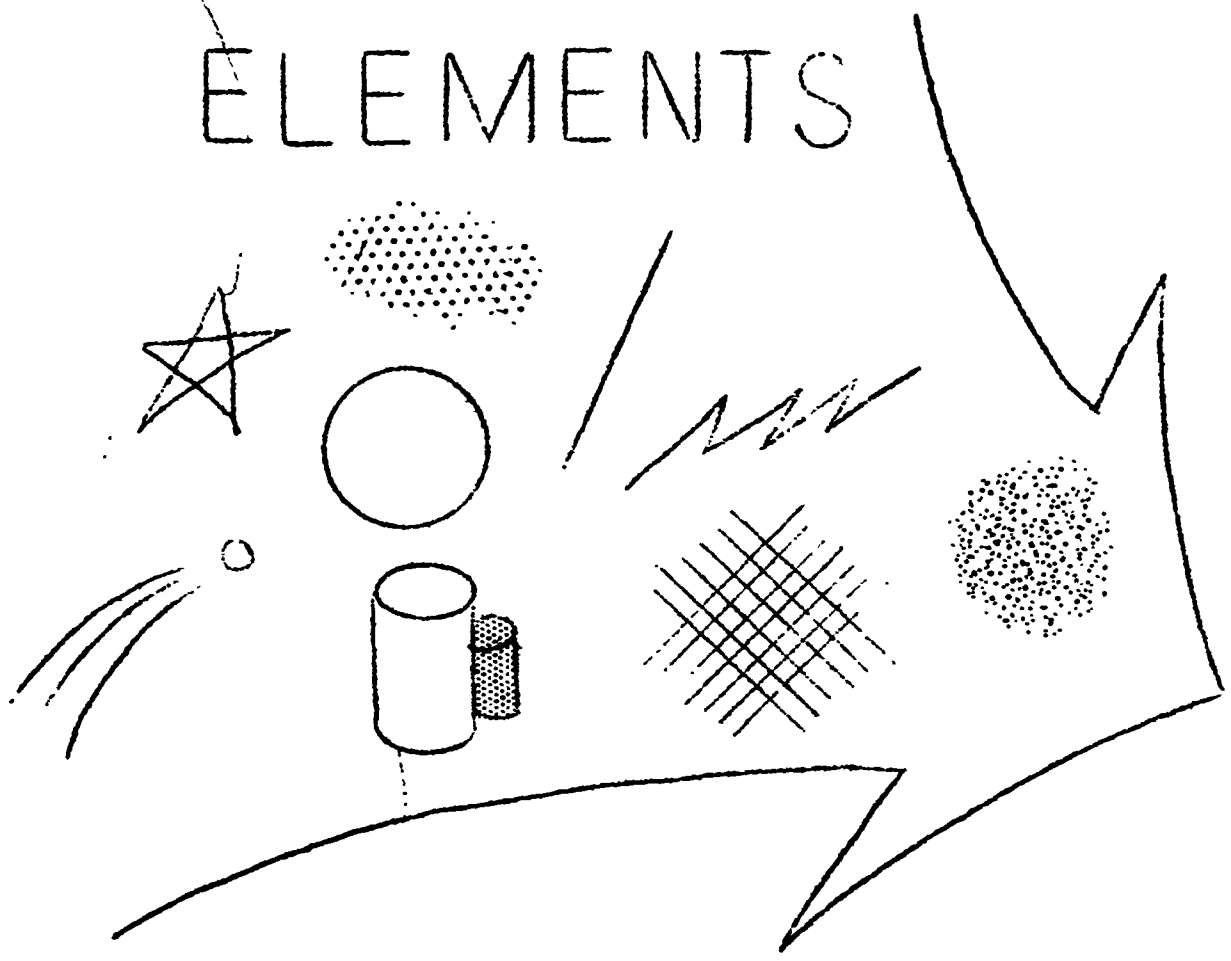
ELEMENTS
of Display

- LINE
- SHAPE
- SIZE
- TEXTURE
- WEIGHT
- COLOR

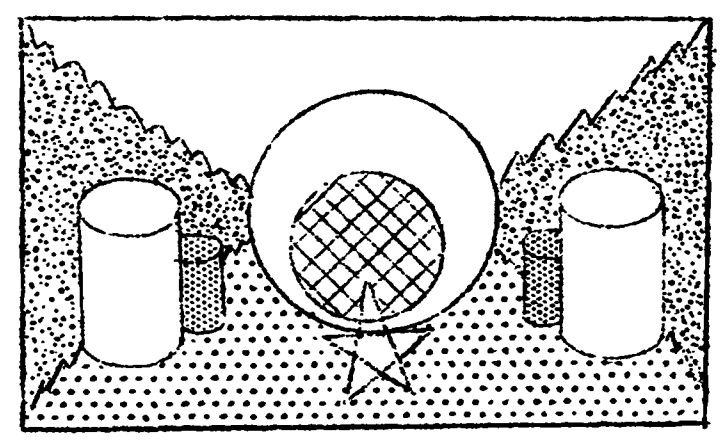

TEXTURE
WEIGHT
COLOR
Red
Yellow
Blue
Green

LINE
SIZE
SHAPE

A DISPLAY HAS ELEMENTS



ARRANGED into a

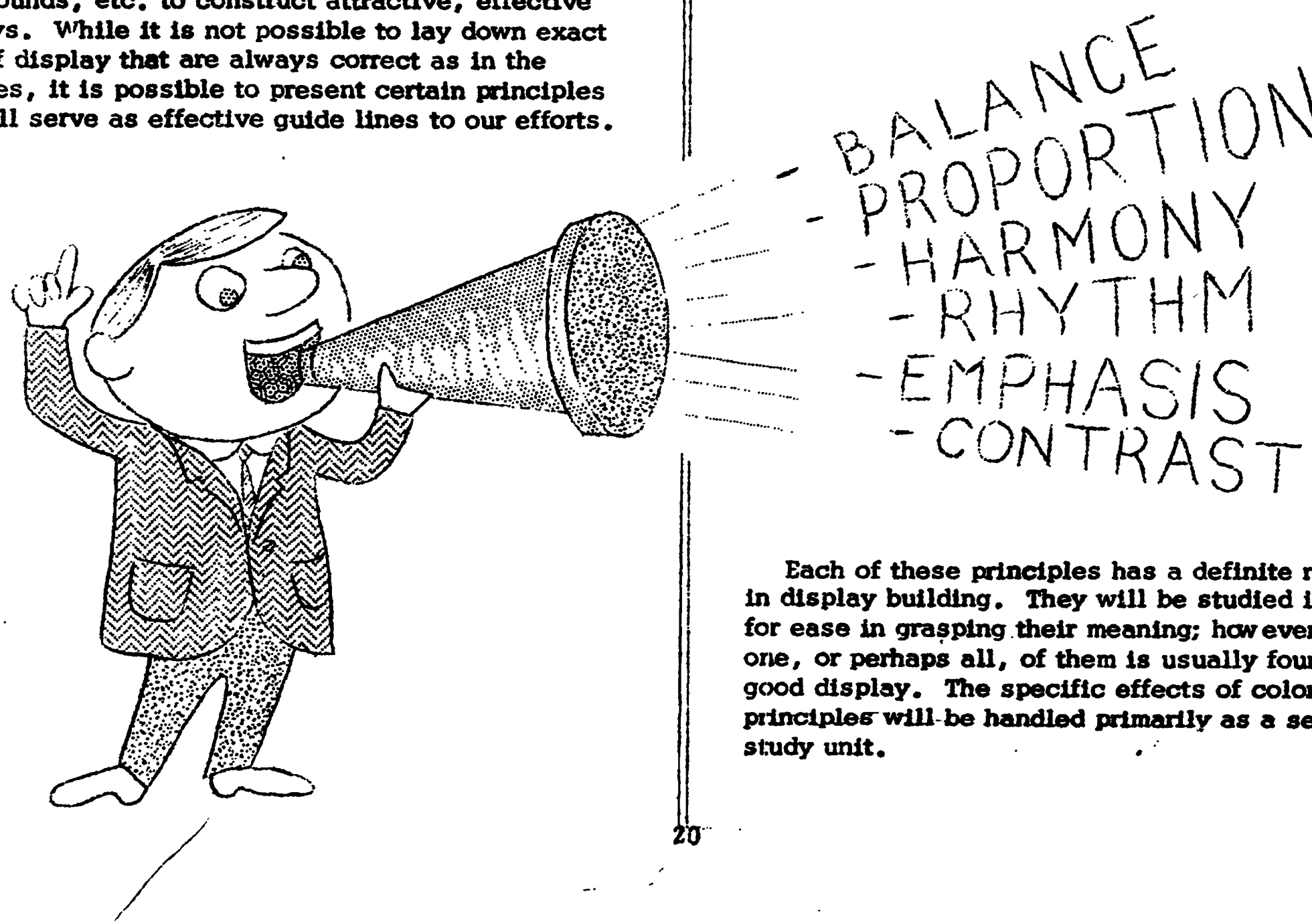


DESIGN.

PRINCIPLES OF ARRANGEMENT AND DESIGN

In this section we will consider the uses made of the elements discussed in the previous section. We will develop understandings of ways to utilize the best characteristics of merchandise, fixtures, backgrounds, etc. to construct attractive, effective displays. While it is not possible to lay down exact laws of display that are always correct as in the sciences, it is possible to present certain principles that will serve as effective guide lines to our efforts.

There is general agreement that an adequate understanding of display design can be gained by studying the application of the following principles:



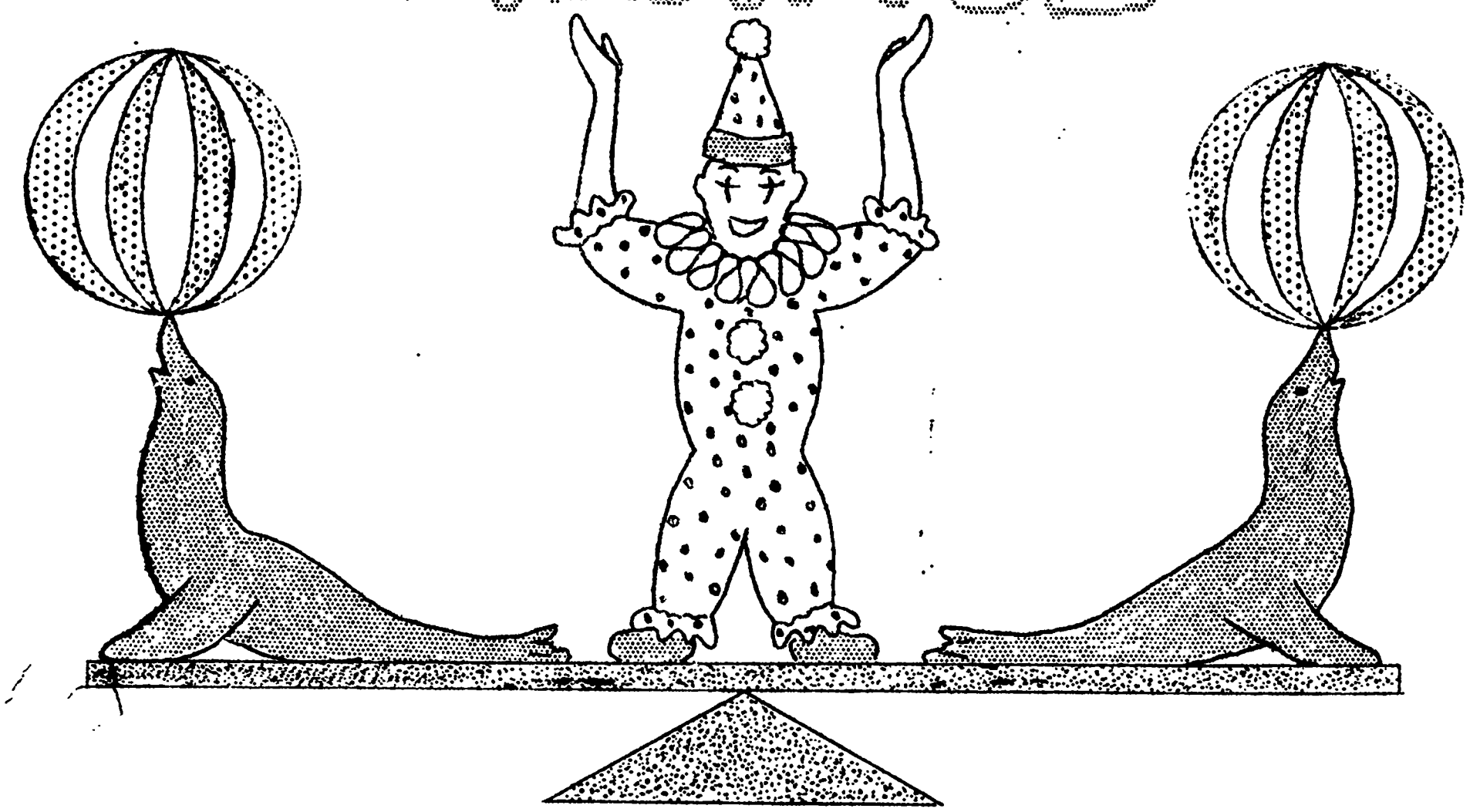
Each of these principles has a definite role to play in display building. They will be studied individually for ease in grasping their meaning; however, more than one, or perhaps all, of them is usually found in every good display. The specific effects of color on these principles will be handled primarily as a separate study unit.

PRINCIPLES

of DISPLAY

- BALANCE
- PROPORTION
- HARMONY
- RHYTHM
- EMPHASIS
- CONTRAST

BALANCE



When one thinks of balance with regard to display we are dealing with the optical weight of objects rather than their actual weight. Optical weight deals with the appearance of objects and pertains to the fact that some items look heavier and other lighter regardless of what a scales might indicate. In optical weight the size, shape and color of an object gives an impression of weight to the eye which can be compared to the other objects around it. This optical feeling of weight is an important consideration in determining how to place objects in displays.

BALANCE types:

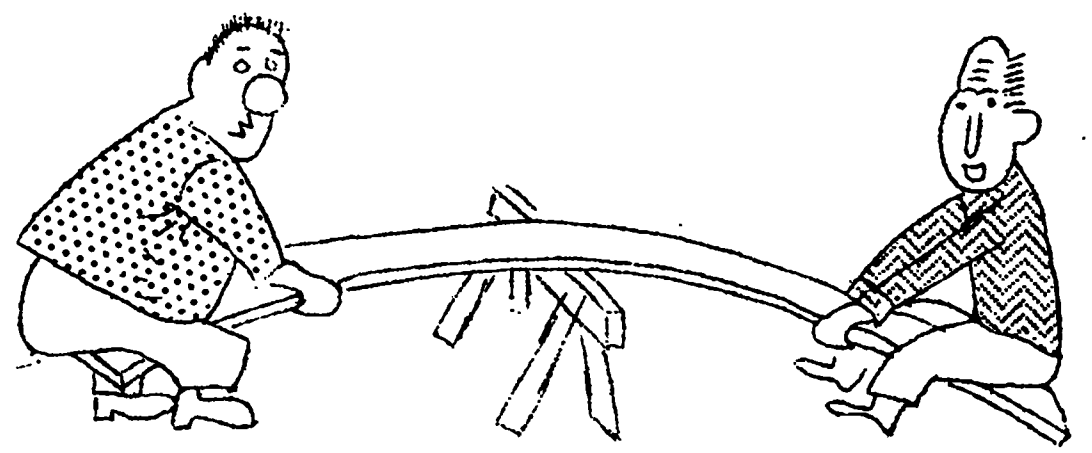
1. FORMAL
2. INFORMAL

FORMAL BALANCE

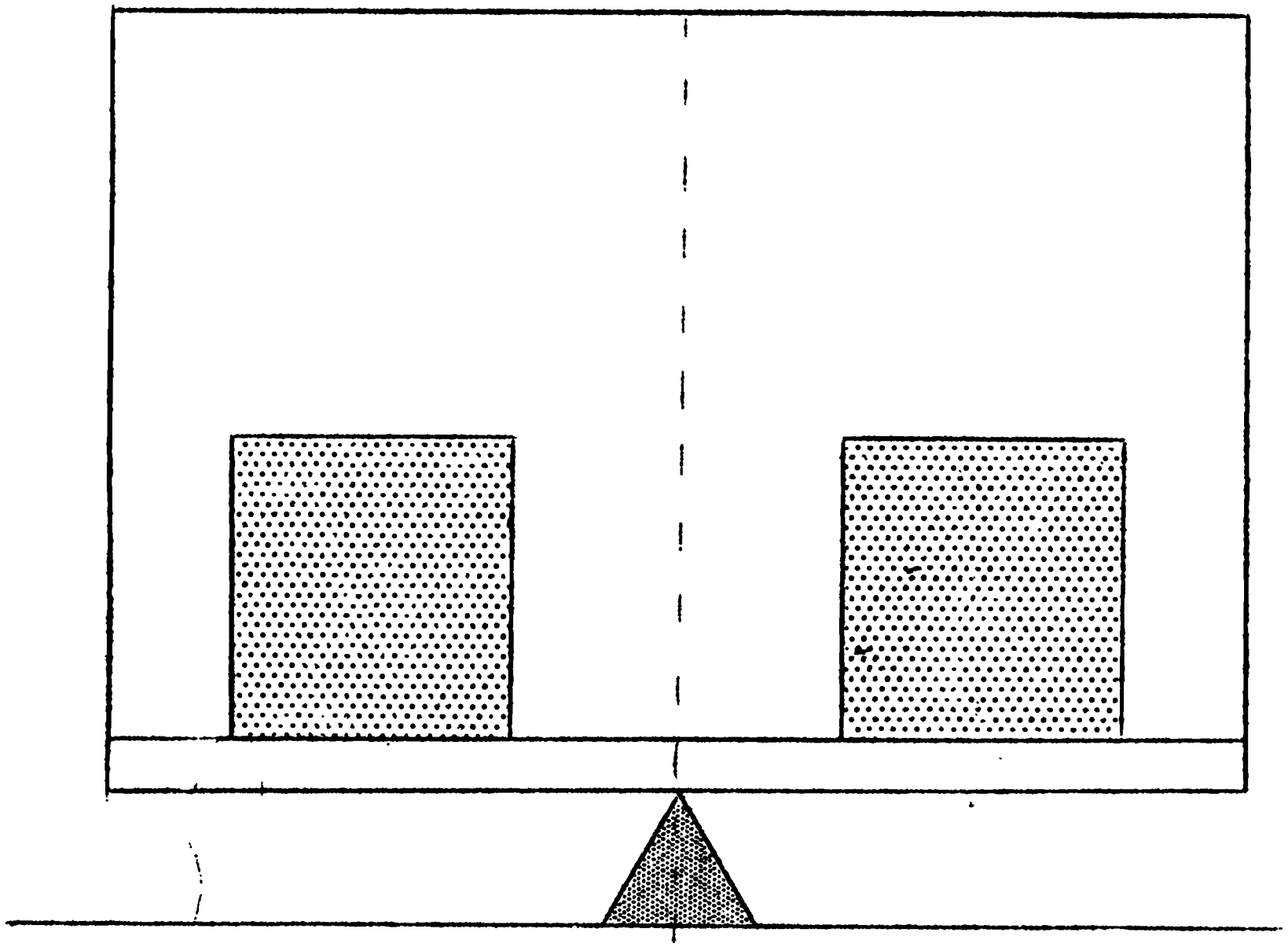
The first step in planning balance in a display is to draw an imaginary line down the center of the display area. Then let the imagination go one step further and envision that each side of the display area is sitting on a see-saw. With this concept of the display space delicately balanced on a central pivot point, one can proceed to place objects in the display space, being careful that the optical weight is not heavier on one side than the other. The secret of achieving a balanced look is the ability of the display man to optically weigh each object that is placed in the display. This knack is easily gained by close observation of the objects to be used.

Formal display is just what the name implies. It is a stiff, formal arrangement with every object placed on one side of the display area offset by a similar object placed on the other side of the display. It is the easiest type of display to make because one knows that everything that is done to one side of the display must be repeated on the other side. Often a large important item is placed exactly on the center pivot of the display and equal items are arranged on each side of this central dominate object. Formal displays are easy to make. They are dignified, proper and present a neat, well-ordered picture to the eye.

They have the disadvantage of being stiff and less dramatic or interesting than is achieved by informal balance. Study the illustrations and practice them with your own pencil until you have mastered the idea of formal balance.



FORMAL BALANCE

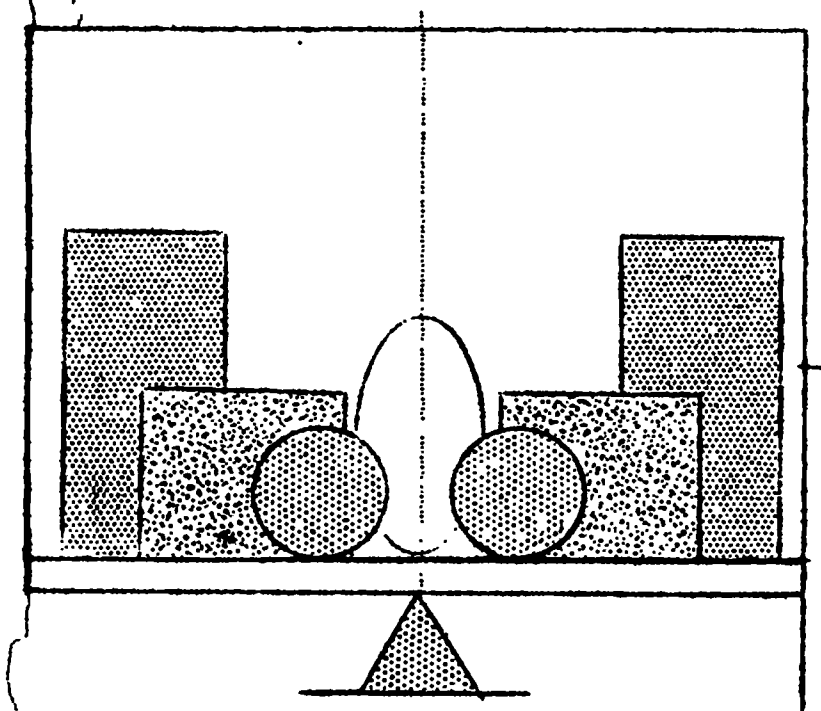


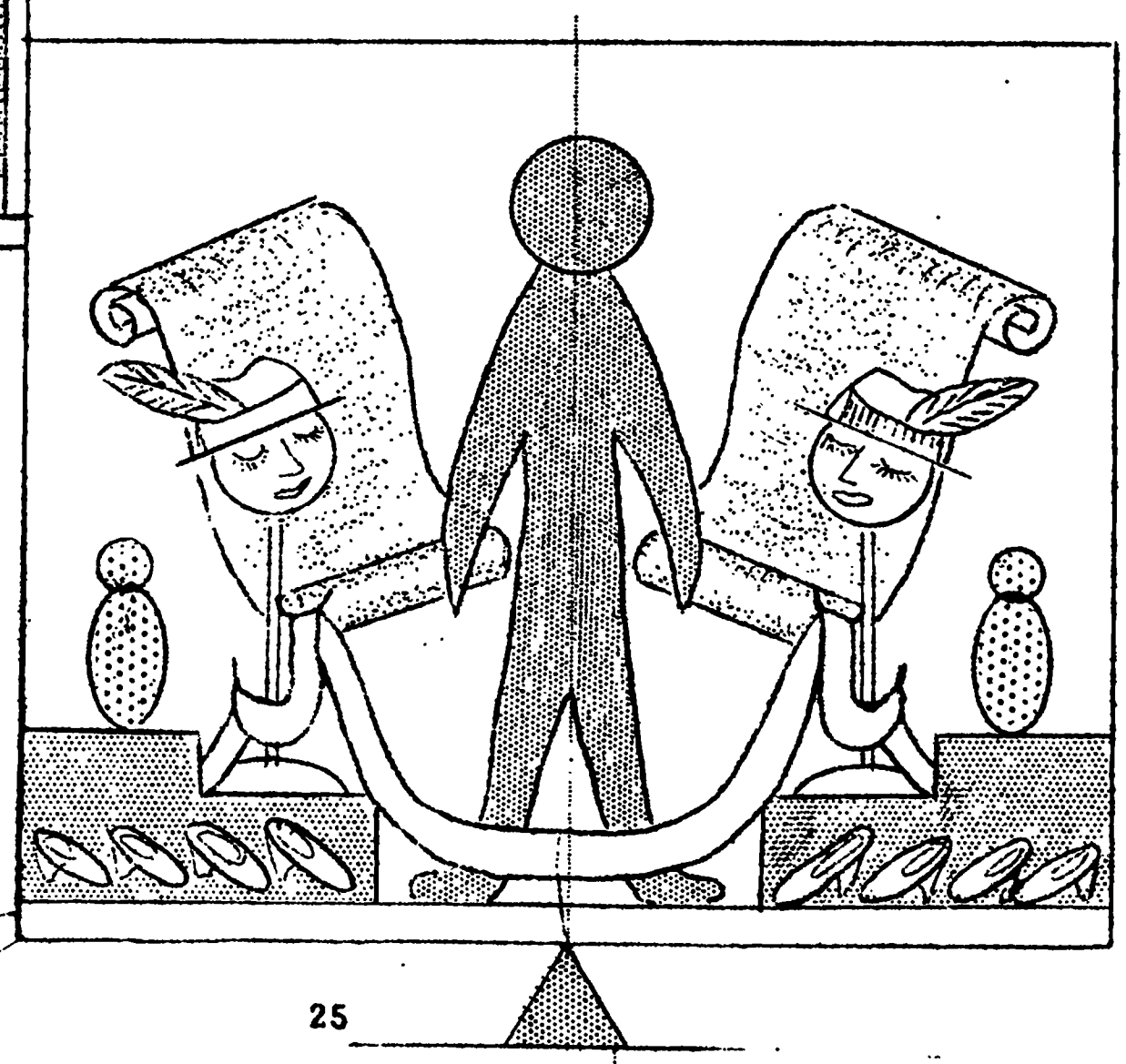
EACH SIDE IS ALIKE.

ERIC

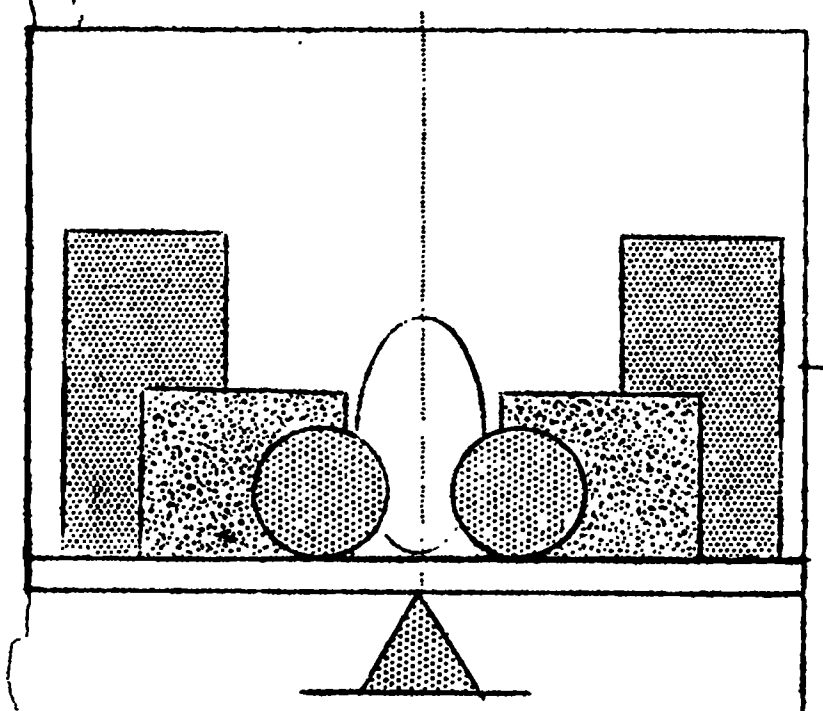
116

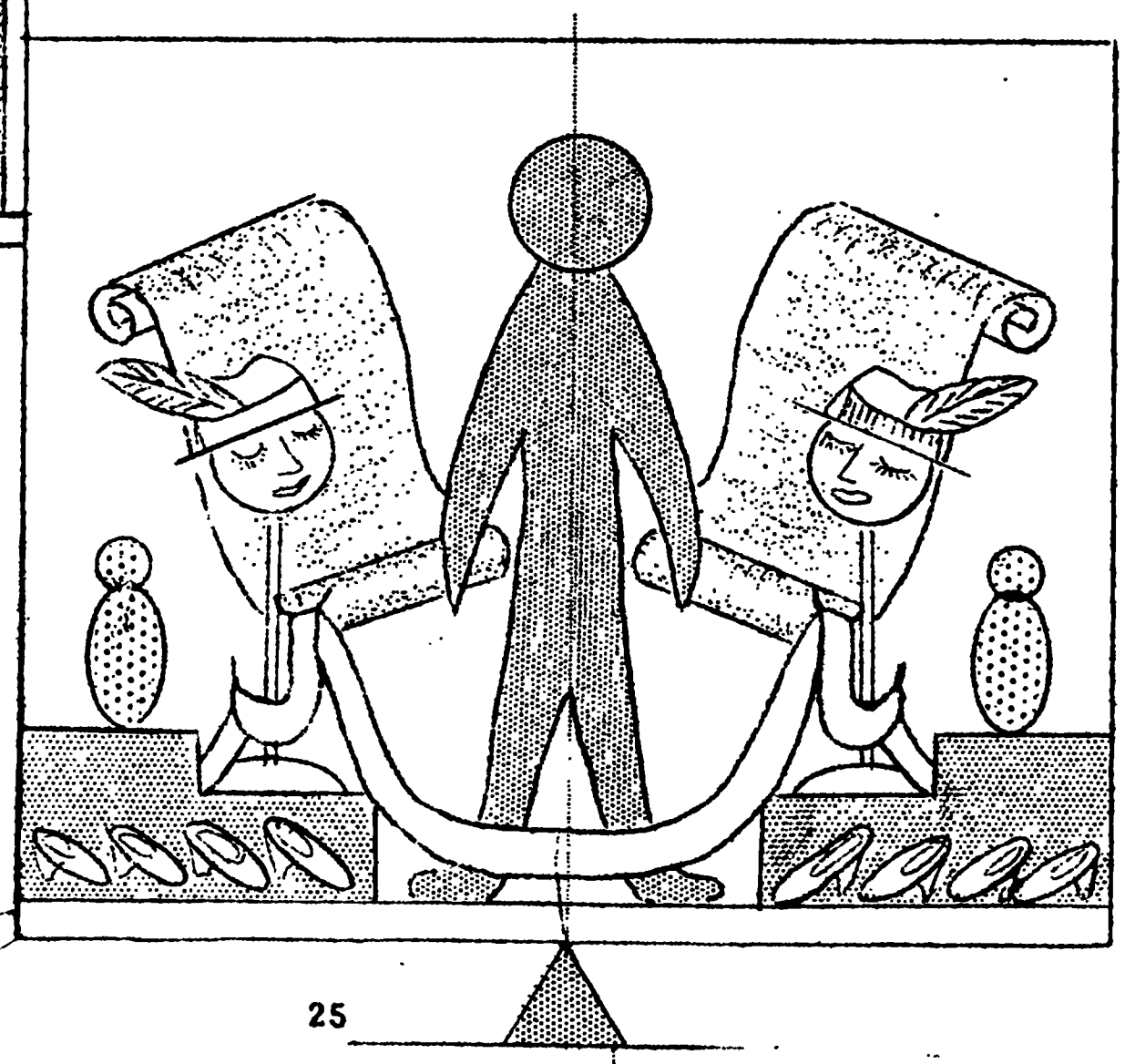
FORMAL BALANCE



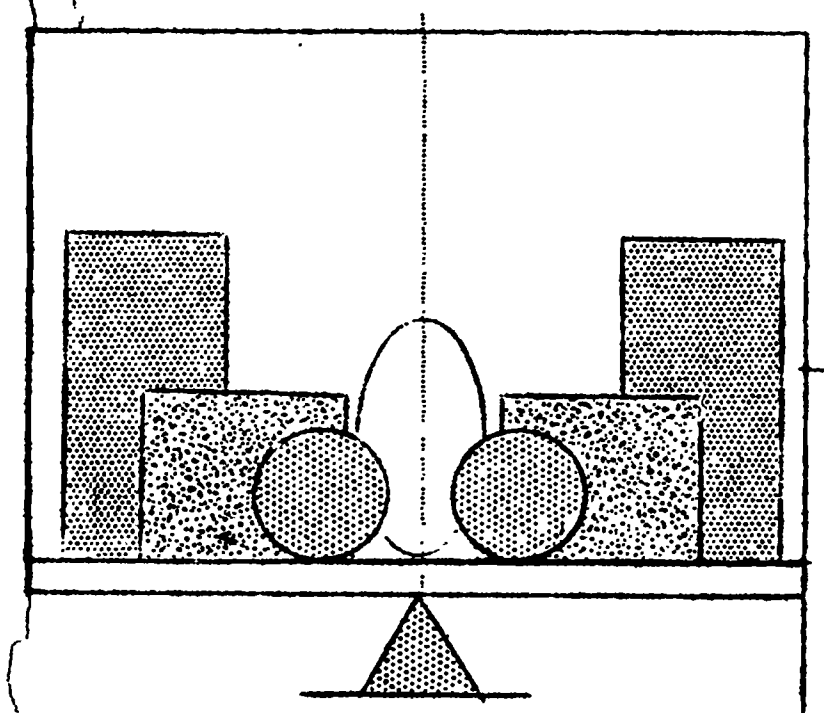


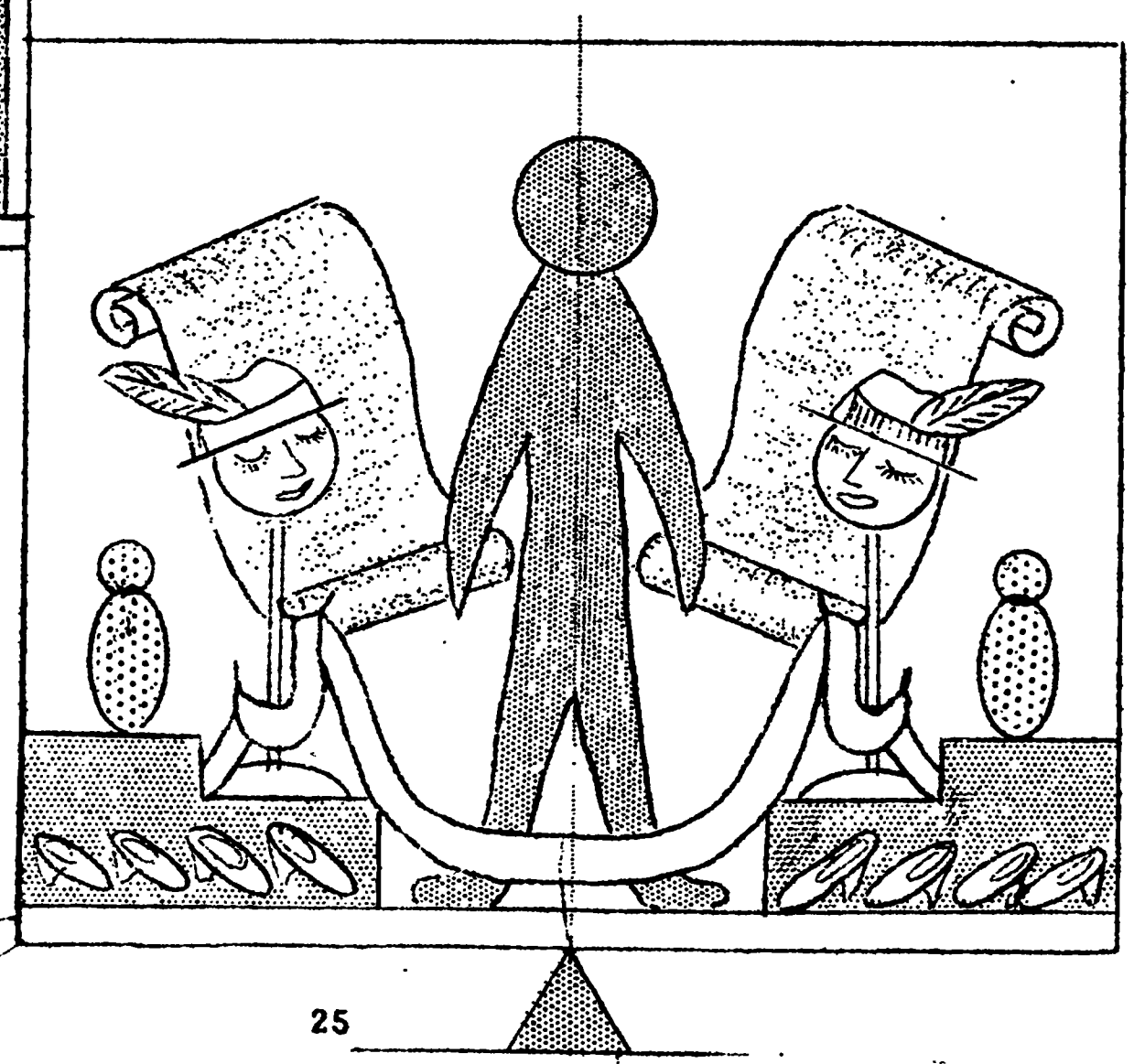
FORMAL BALANCE



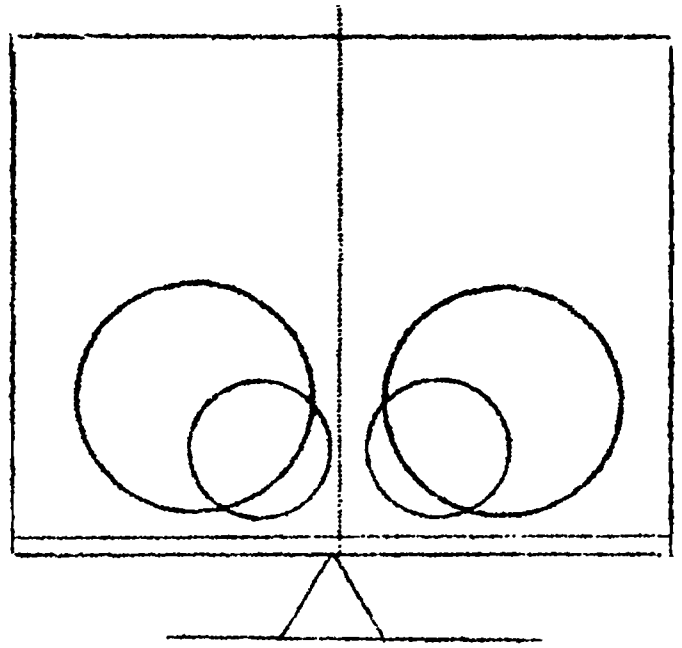


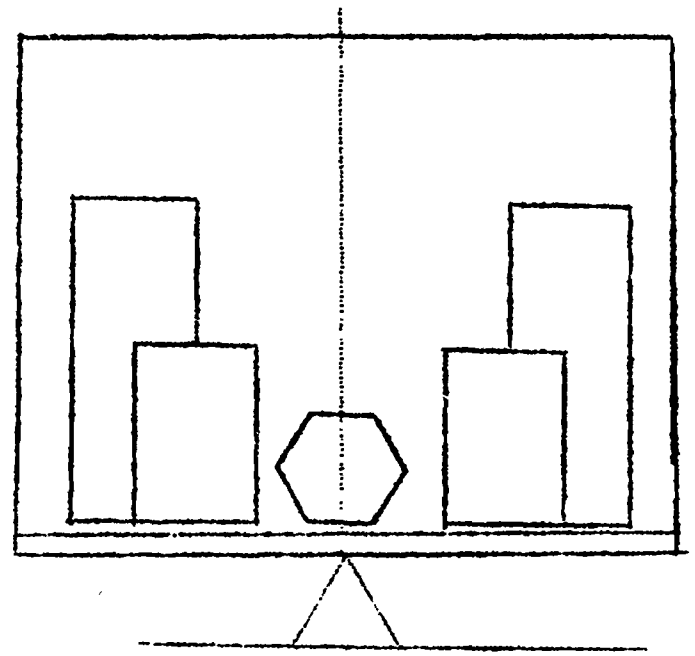
FORMAL BALANCE

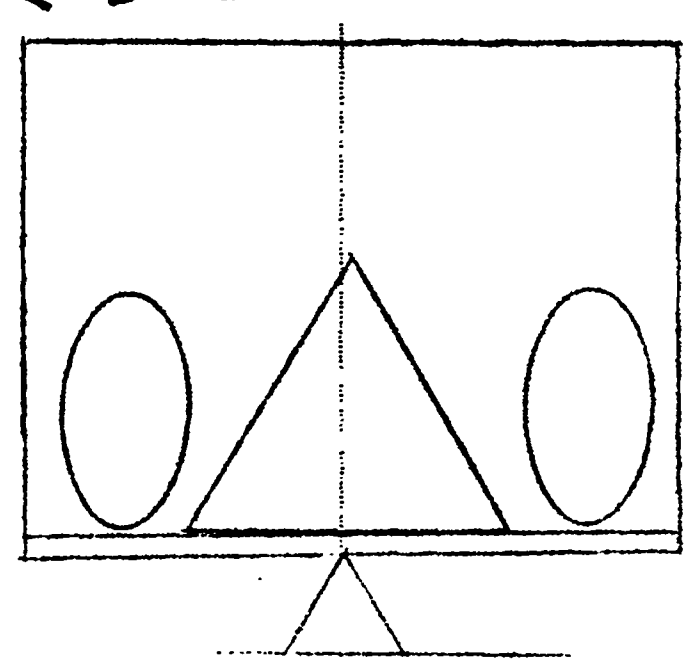


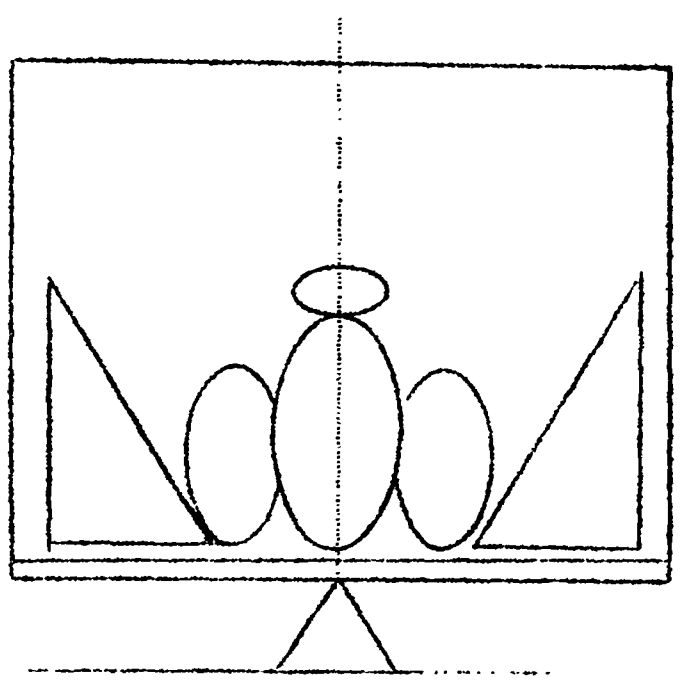


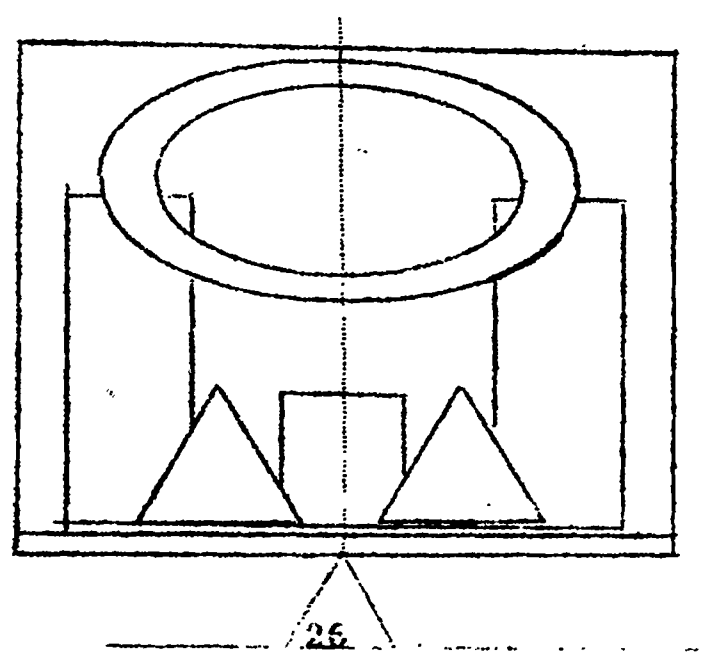
FORMAL "DOODLES"

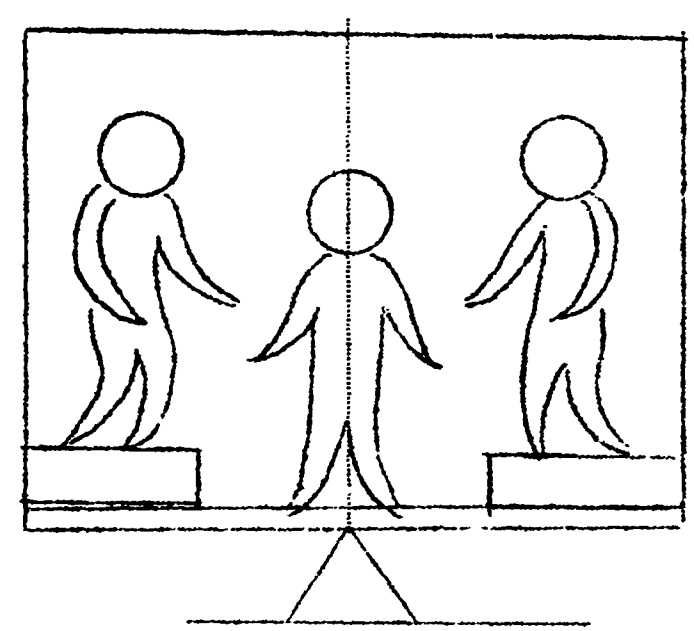


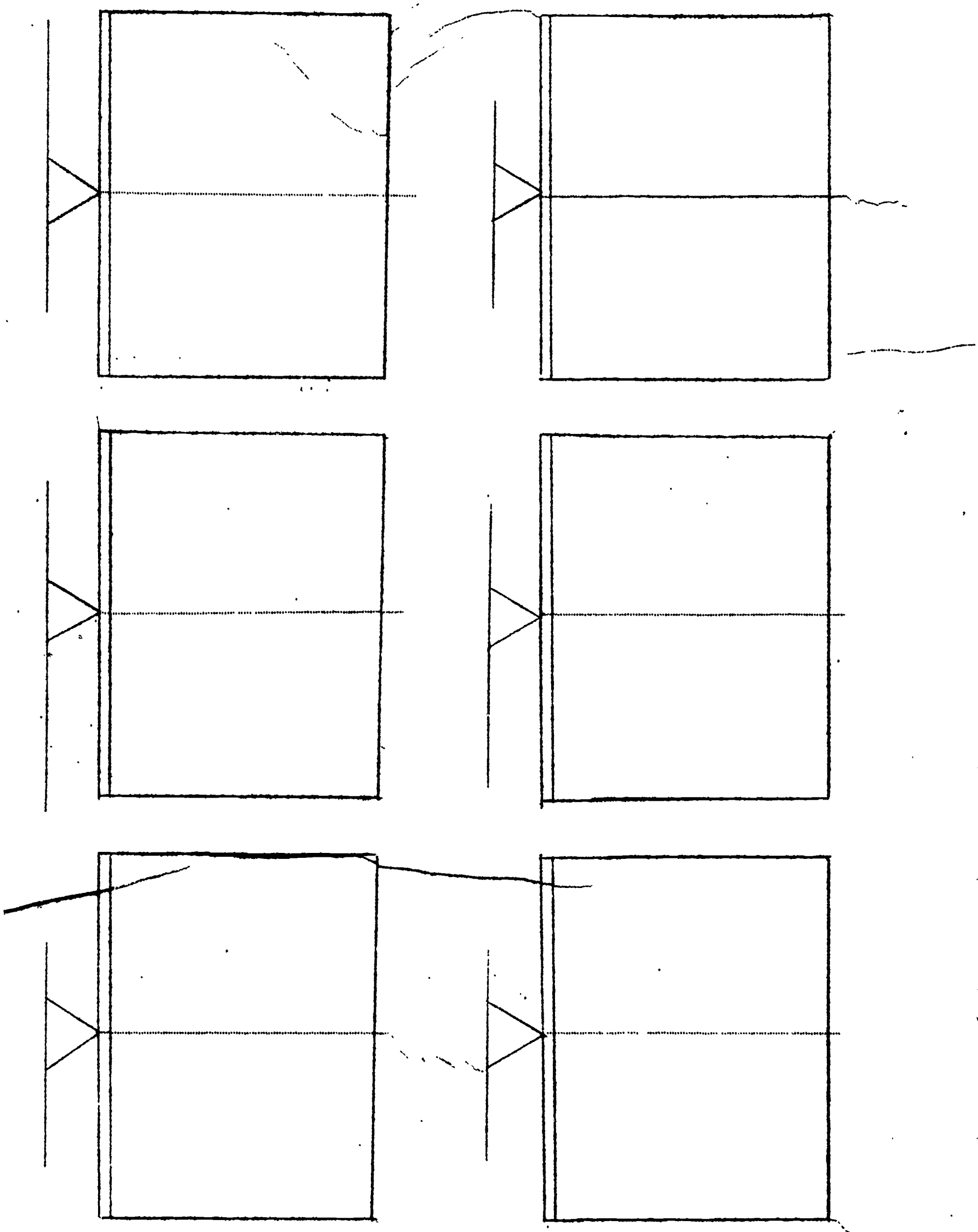


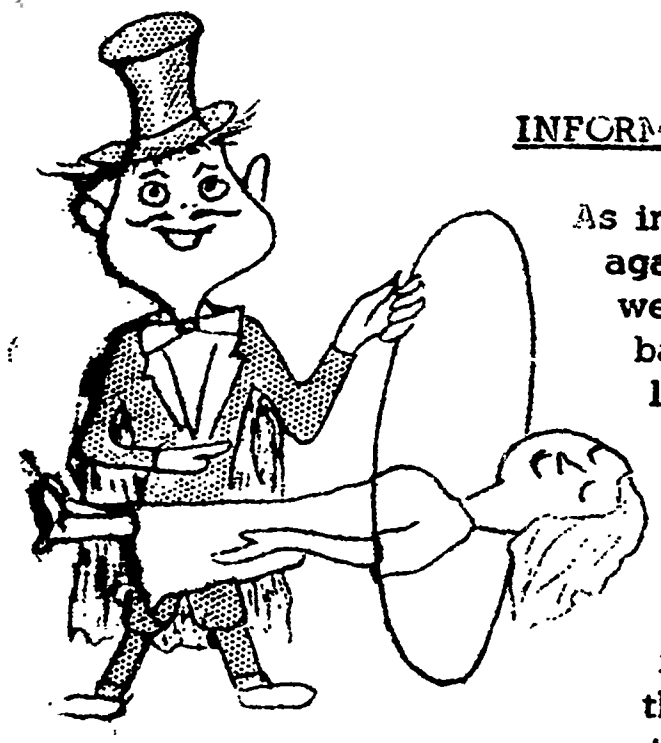












INFORMAL BALANCE

As in formal balance we are again dealing with the optical weight of objects. In informal balance, however, we are no longer limited to a stiff object for object type of display. It is possible to arrive at a more unusual and interesting display with this technique. The planning of the display is again started by imagining the display space to be pivoted at the center just as it was in formal balance. Now, though, by applying the principle of the see-saw, we will still be able to maintain a look of balance using different items because of the way we place them with regard to the center. As you probably remember, it is possible to balance a heavy object on one side of a see-saw with a light object on the other by moving the heavy object close to the central pivot and the light object away from the center. This same principle applies optically as can be seen in the illustrations.

One learns to optically weigh the objects to be used in the display and it becomes a habit to place them so that they give a feeling of equal weight on each side of the center point. Practice looking at objects around you and judge their optical weight in relation to other items near them. Study the illustrations closely and practice sketching samples with your pencil until you think you have the feel of informal balance.

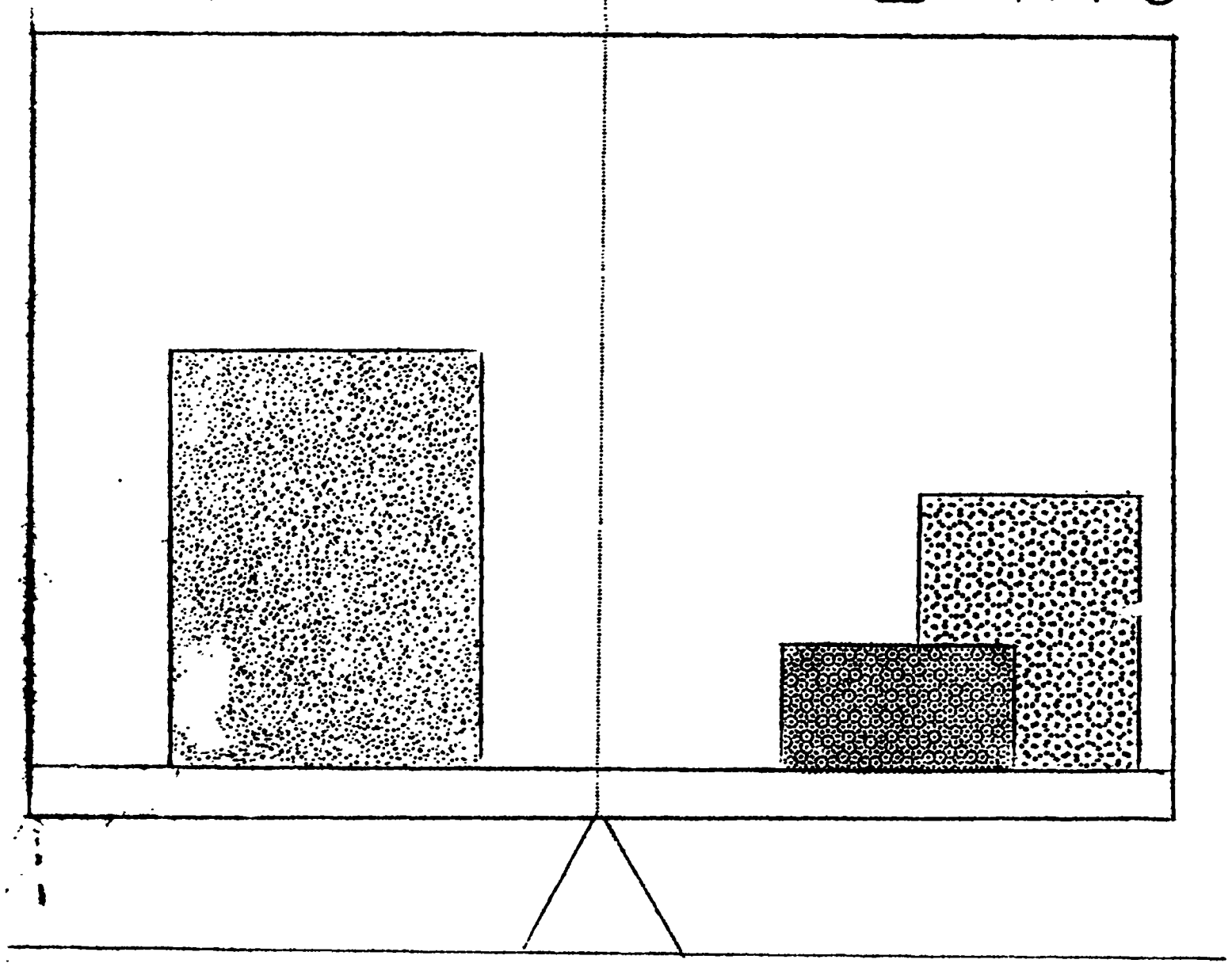
Informal balance lends itself to a great number of interesting, unusual, attention-getting displays. Variations of size, color, texture and shape all have an influence in the optical weight of objects and lend themselves to visually balancing informal displays. Well done informal displays have more flare, drama, and style than formal ones.

Observation of how stores use display will make it apparant to the student that the type of merchandise sold often dictates whether displays are primarily formal or informal in balance.

BALANCE IS THREE DIMENSIONAL

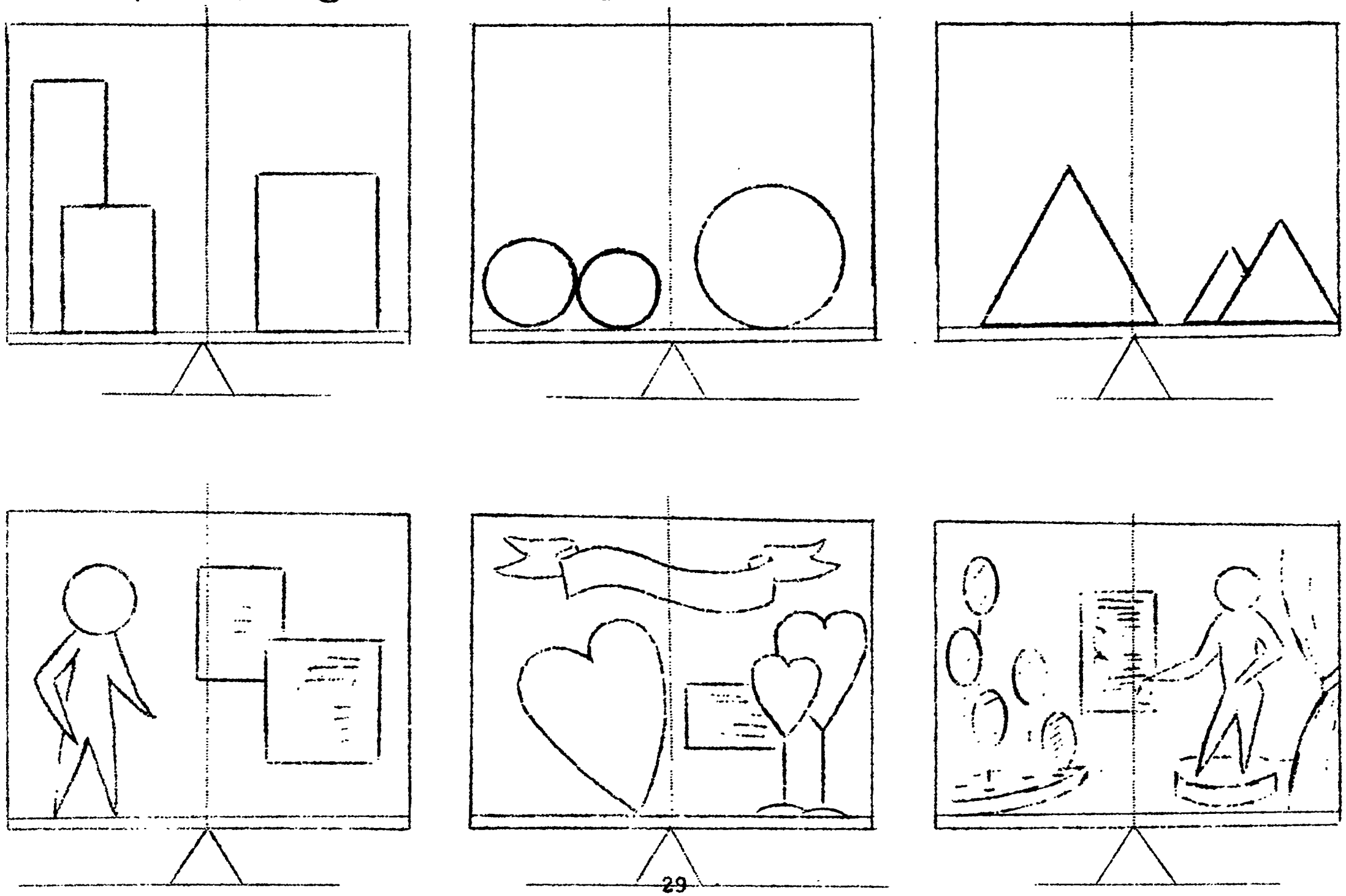
In actual practice the student will discover that displays are not flat like a picture, but have a depth to them in addition to height and width. It does not change the principles of balance discussed with regard to placement of objects on either side of the center. It should be kept in mind, however, that the merchandise is usually not set in a straight line but is placed at varying distances from the front to the back of the display area so as to be interesting and lead the eye into the display. As a general rule large or high items would be toward the rear of the area and small or low objects toward the front. Merchandise should be shown to advantage so it is visible but does not block other merchandise in the display.

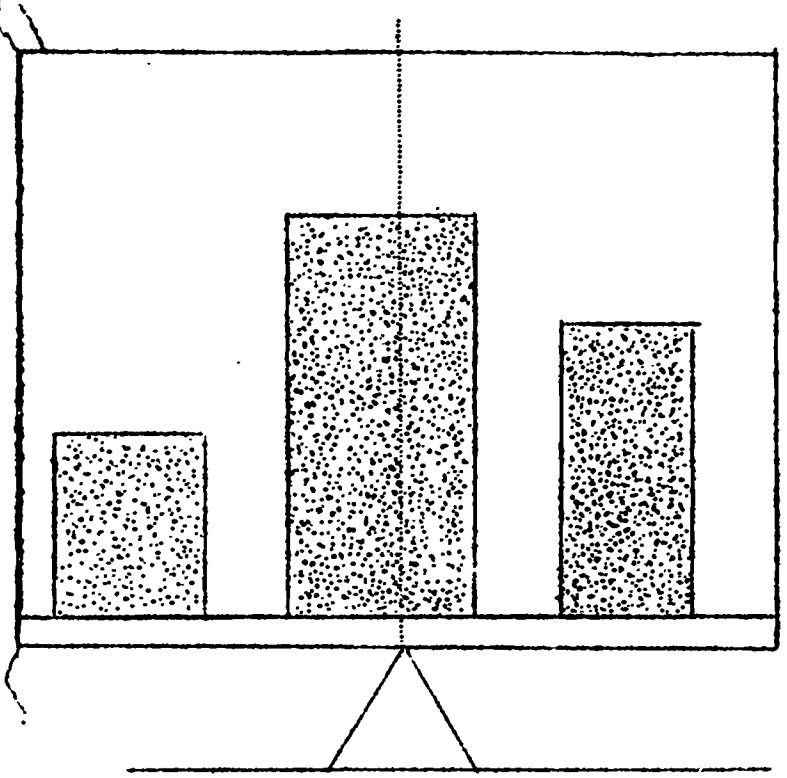
INFORMAL BALANCE



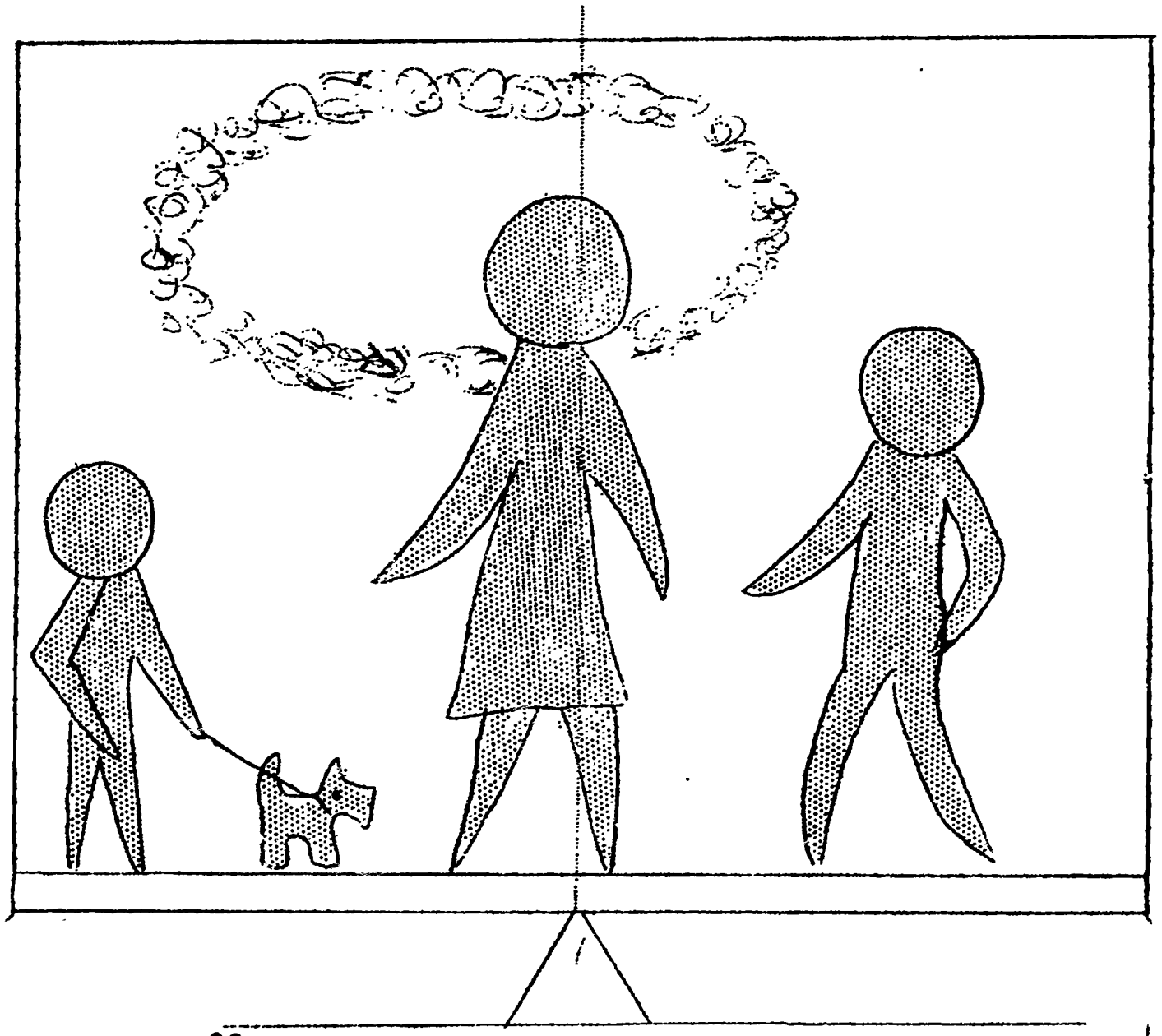
SIDES ARE OPTICALLY EQUAL

INFORMAL "DOODLES"

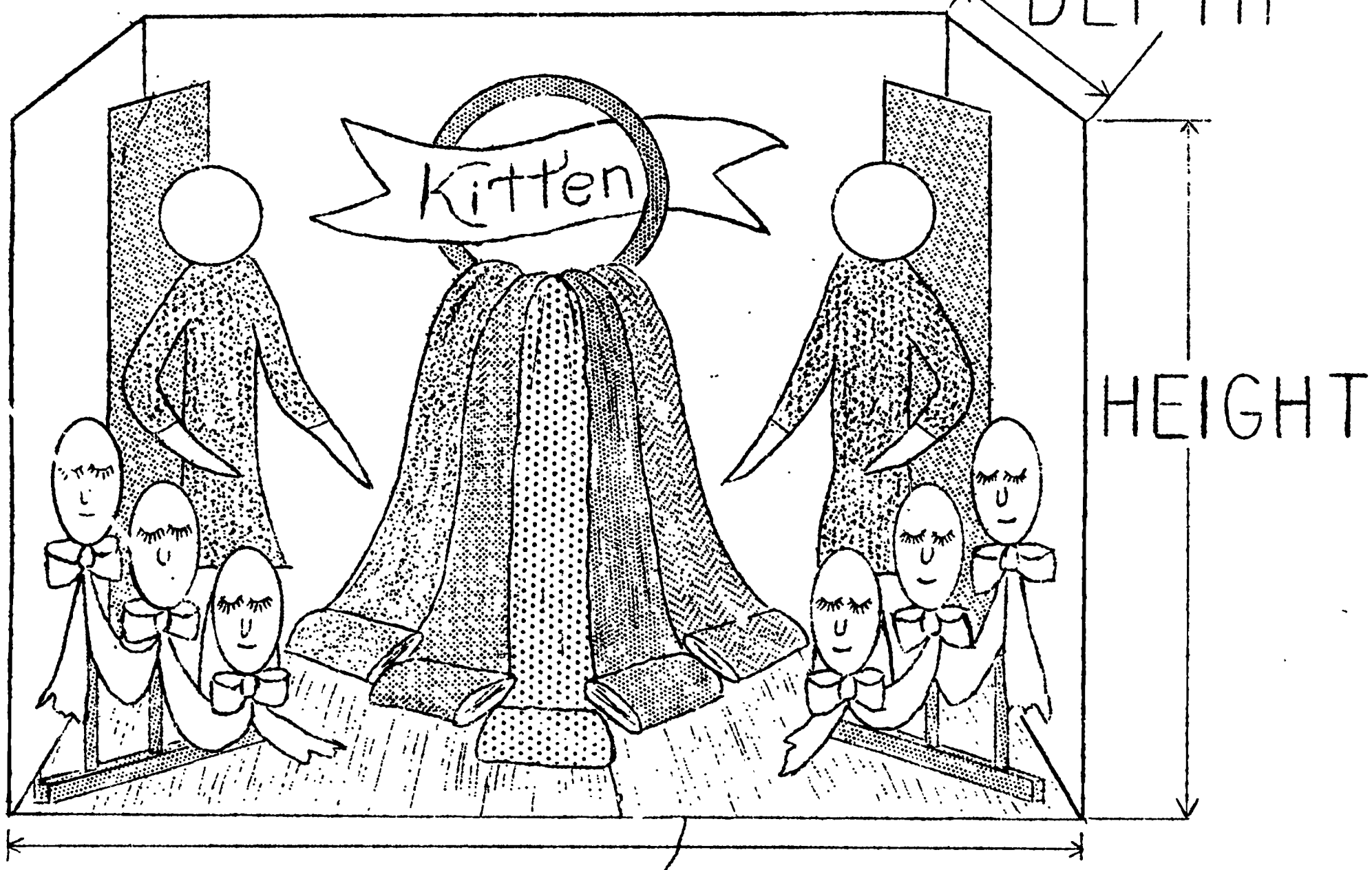


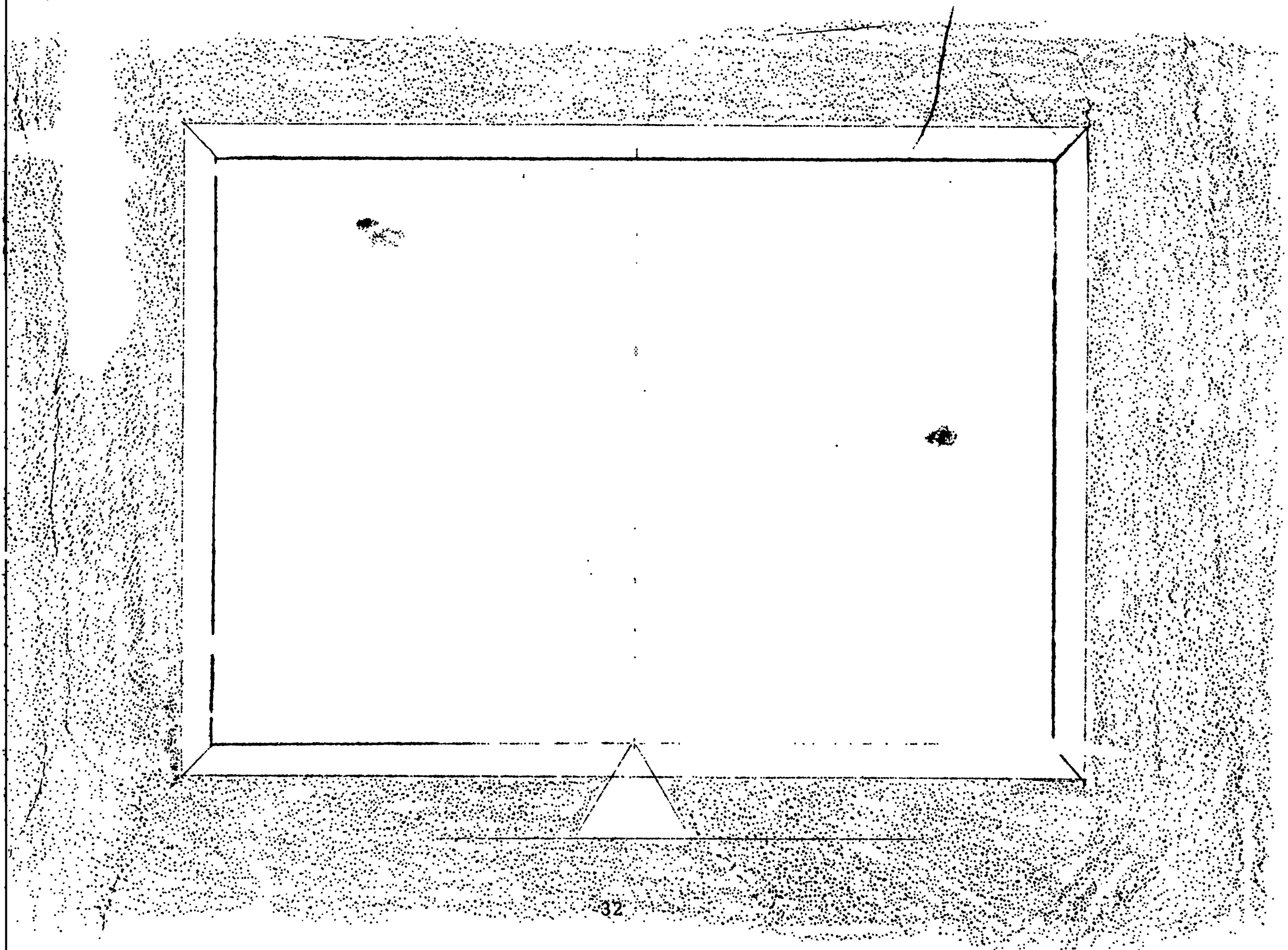


INFORMAL

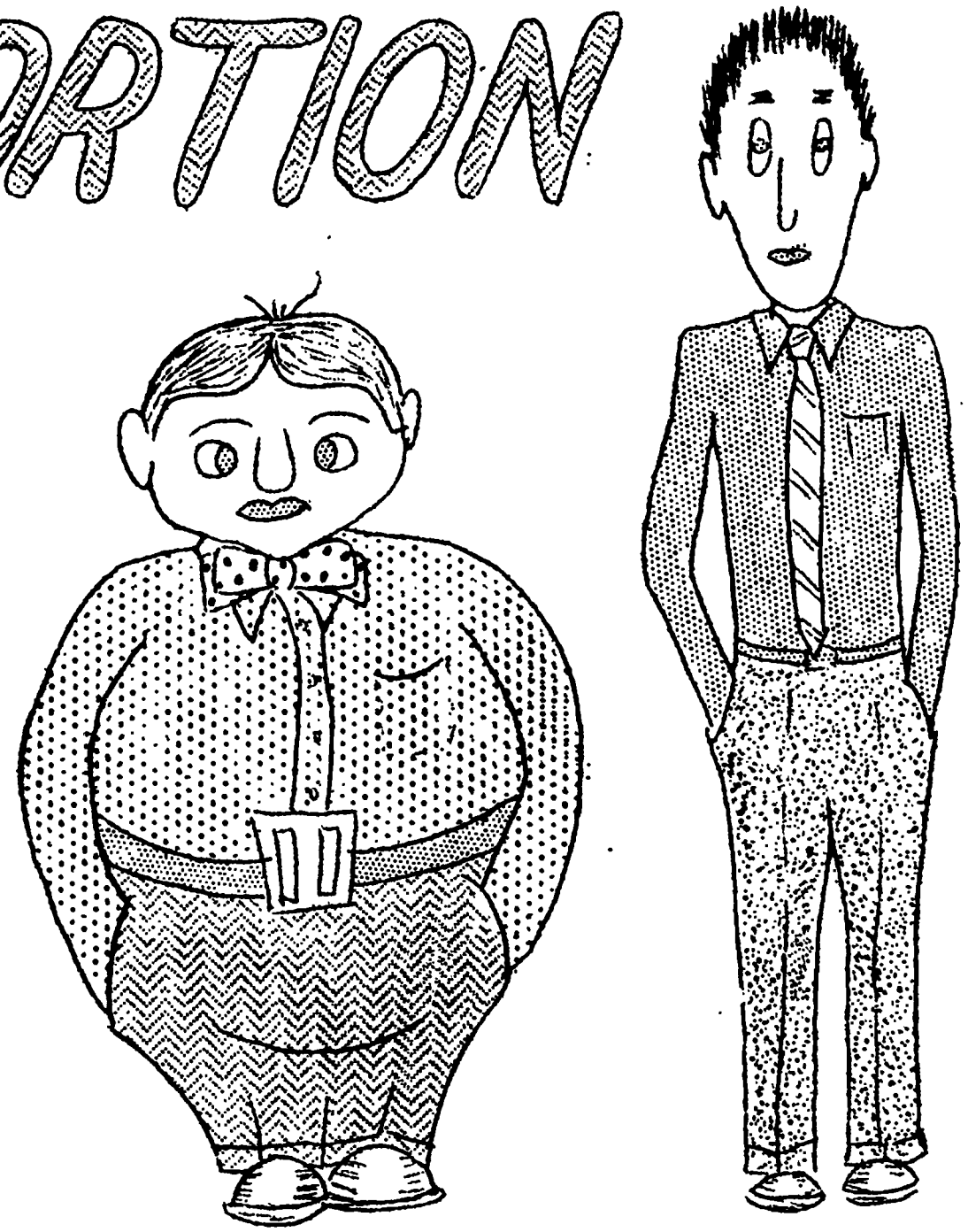


DISPLAY IS 3 DIMENIONAL



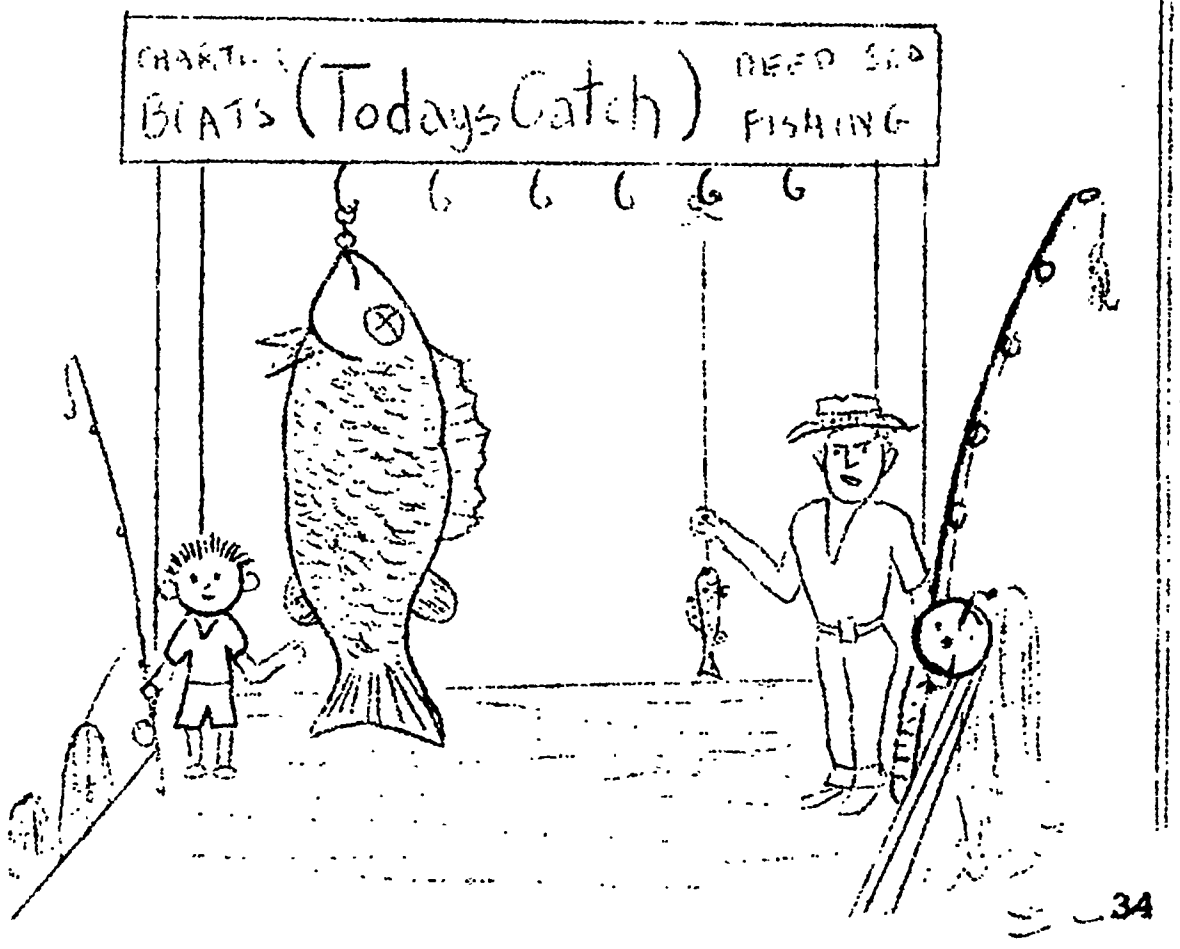


PROPORTION

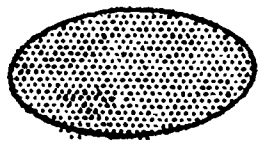


PROPORTION

The eye expects the objects it sees to bear a pleasing relationship in size and shape to the other objects around it. When the various objects viewed by the eye do not seem to belong together or fit properly into the space assigned to them we state that they seem out of proportion. Proportion then refers to what is generally accepted as being a proper relationship between objects and spaces. For example, a mouse would seem to be out of proportion standing next to an elephant. The size difference is too great to be pleasing to the eye.



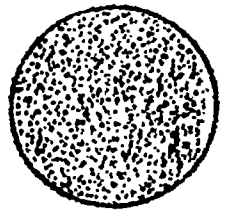
Large objects crowded into small display space often appear out of proportion, as do small items seem lost in a large display space. A display can be balanced and still appear out of proportion. The principle of proportion can apply to a single object and the relationship of its parts to the whole. For example, we have an idea of what a horse should look like. If we should see a horse with huge feet and a head far to large for the body, we would know that it had some parts out of proportion to what a normal horse should look like.



It is interesting to note that the eye is generally pleased more by some shapes than others. This fact was recognized by the Greeks in speaking of the golden oblong. They believed that the most pleasing shape to the eye was an oblong shape with a relationship of 3 parts to 2.

The application of this principle is evident in the fact that display windows are usually about one-third wider than they are high.

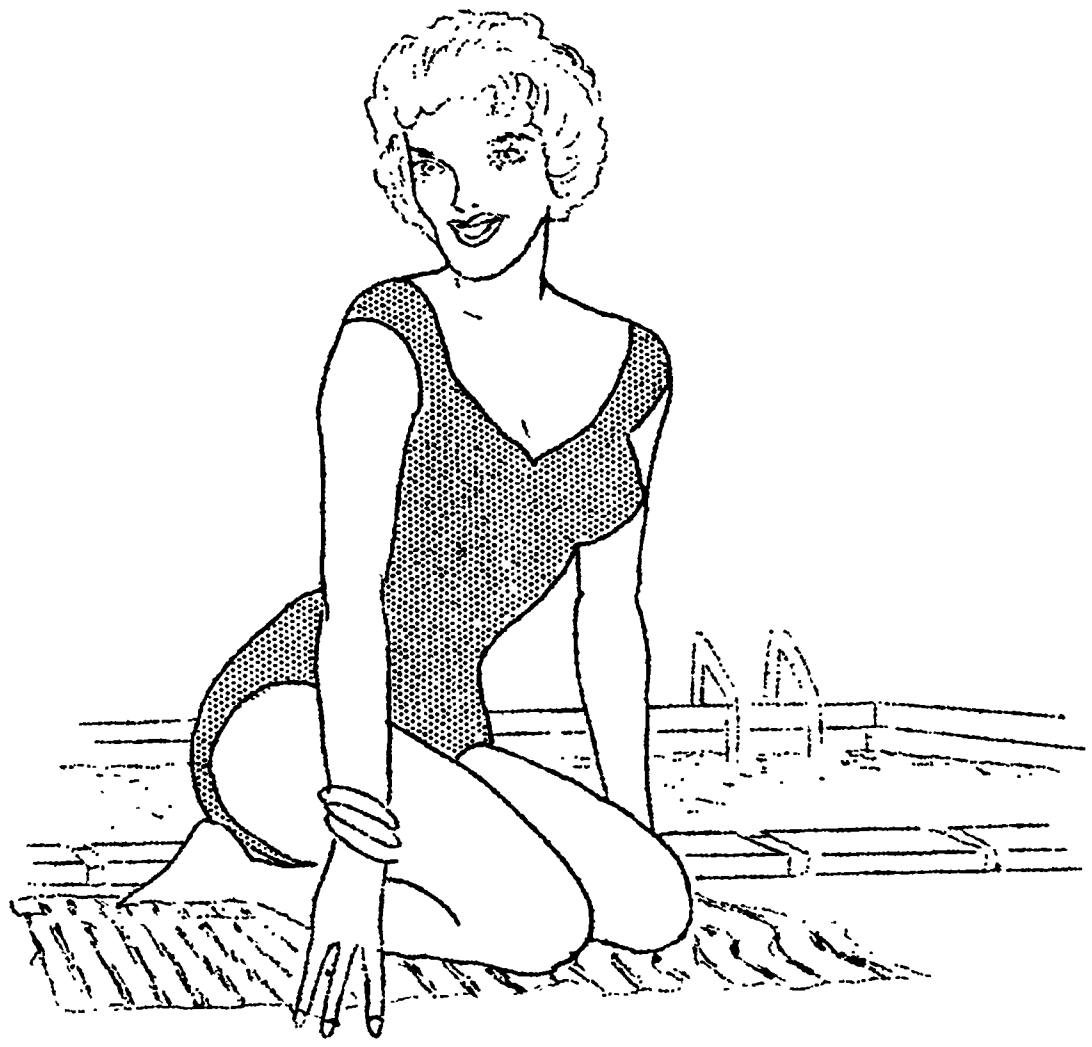
A circle is often considered to be nature's beauty line because it duplicates the sun and the full moon. It is a continuous line, never ending and has no sharp corners to distract the eye. A circle that has been elongated into an oval shape that is three parts wide and two parts high is believed to be even more pleasing and interesting to the eye.



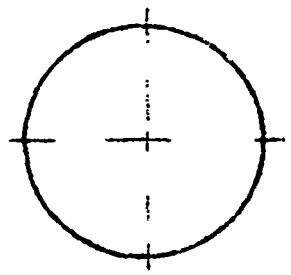
By the same token a square is not as interesting as a rectangle that is three parts wide and two parts high.

GOOD
PROPORTION

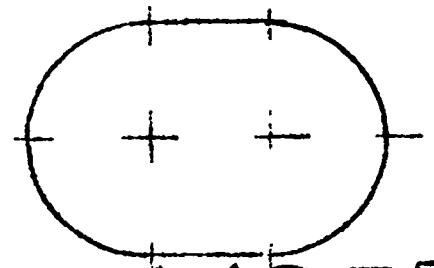
A PLEASING
RELATIONSHIP
of the
ELEMENTS.



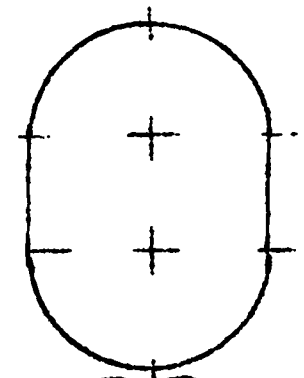
PROPORTION



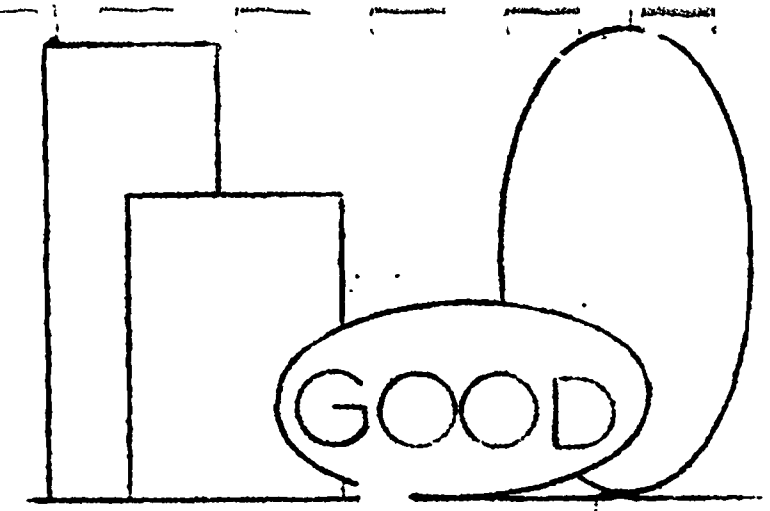
PLEASING

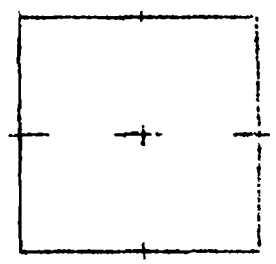


MORE

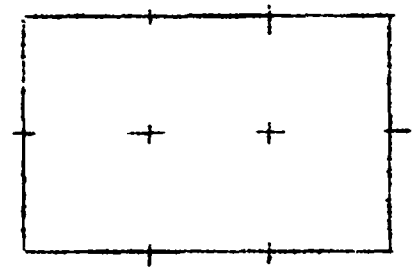


SO

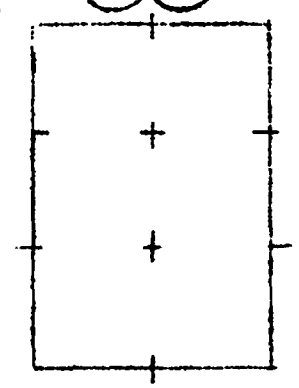


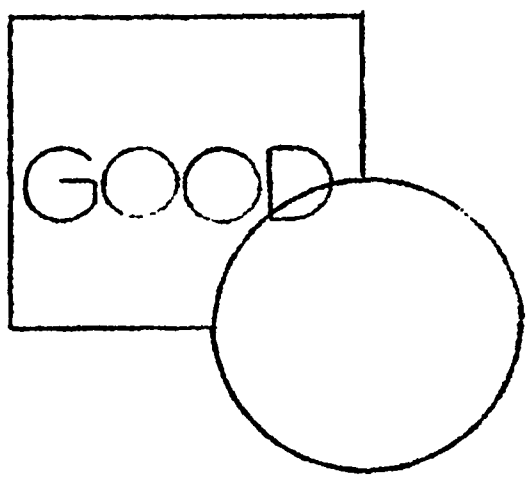


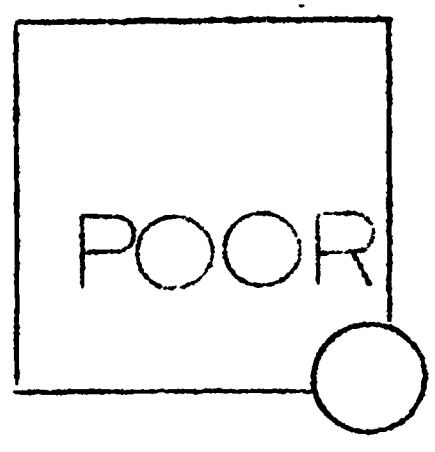
ACCEPTABLE

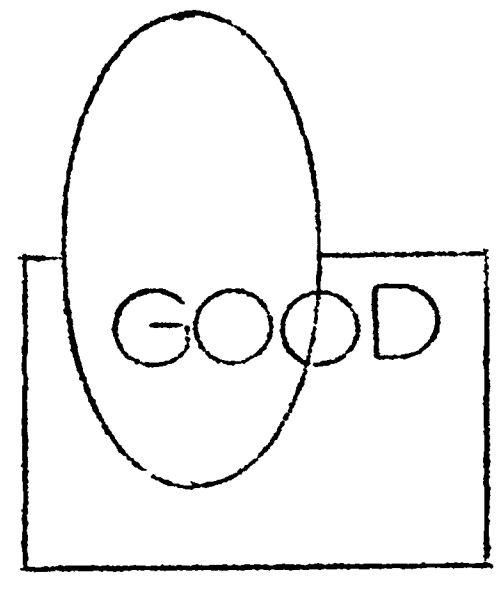


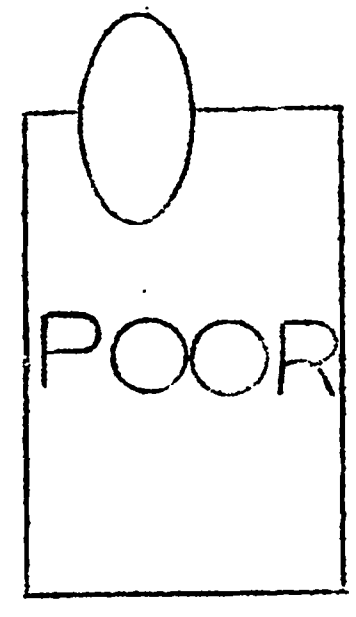
BETTER

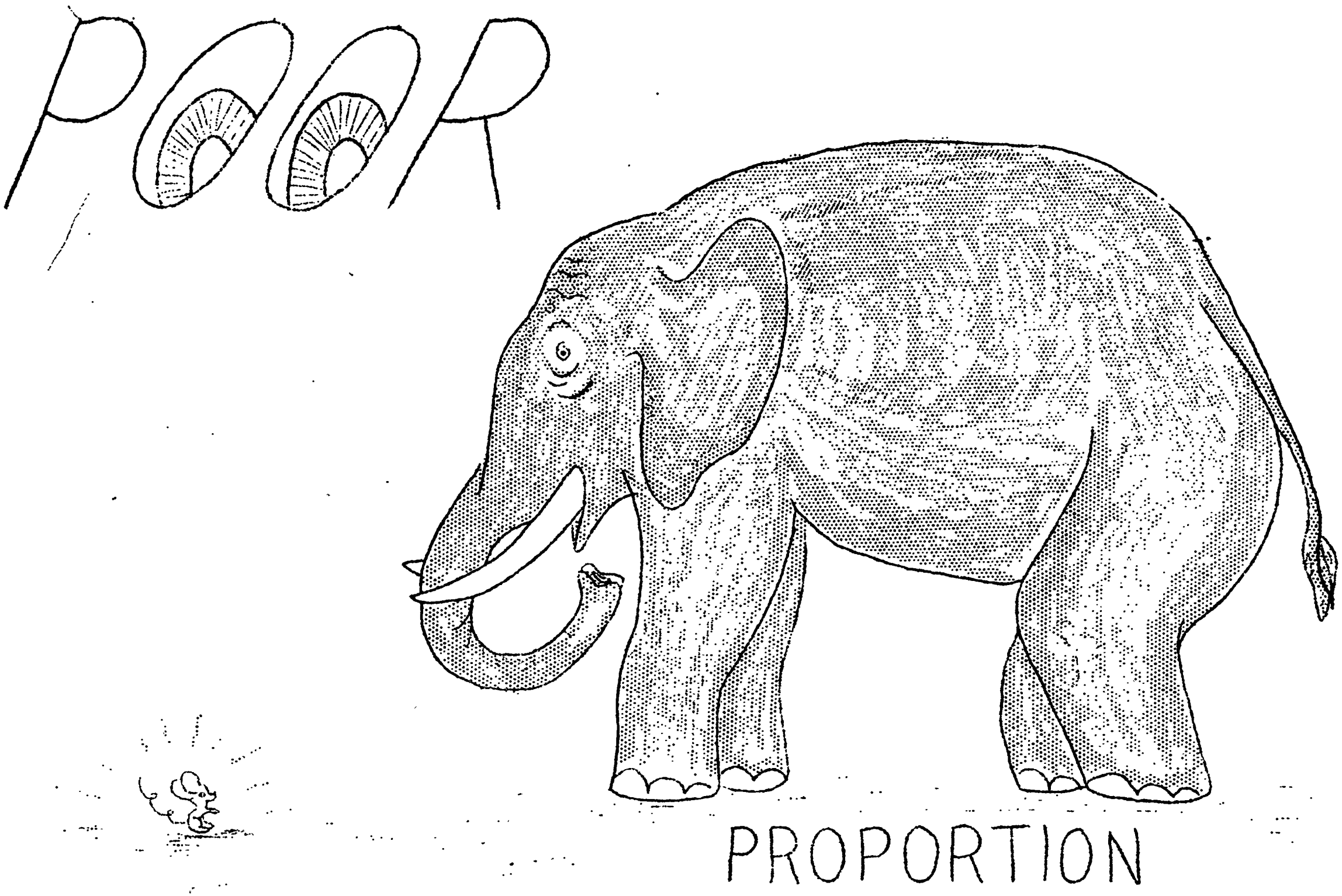




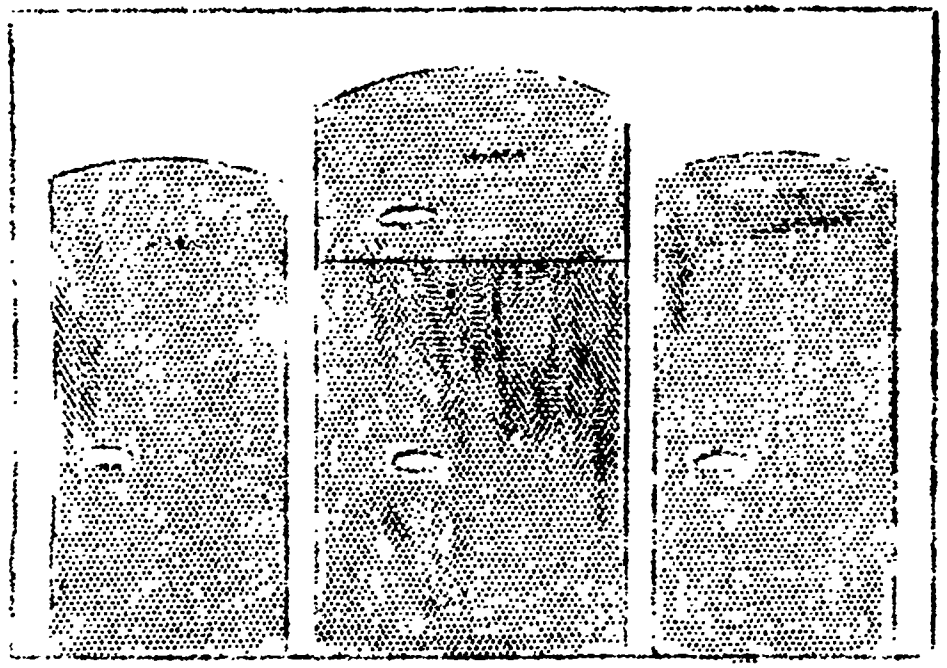




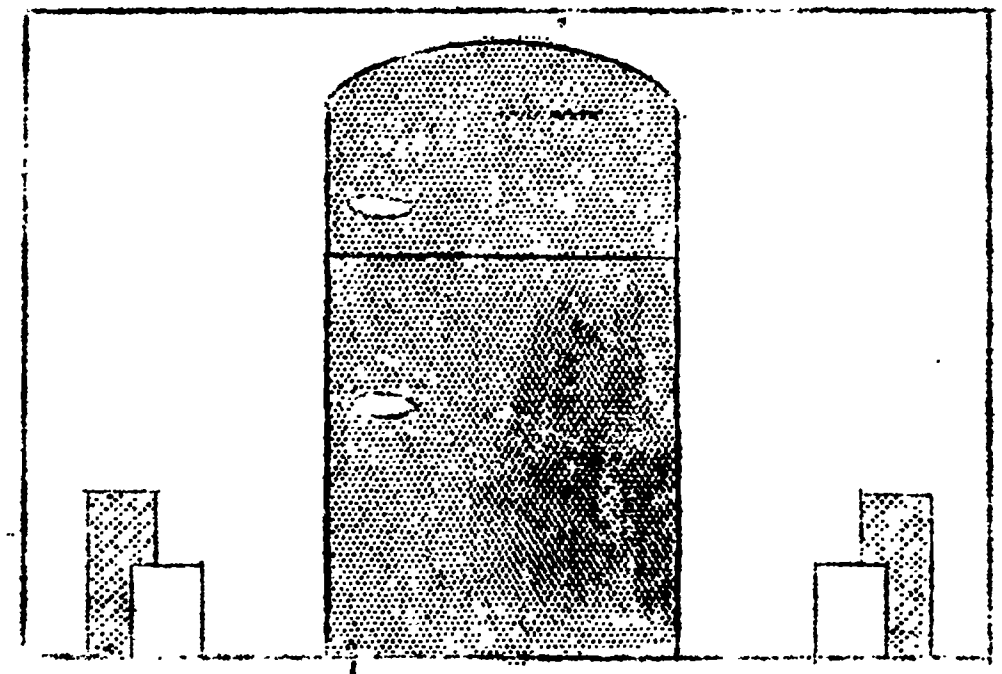



POOR
PROPORTION

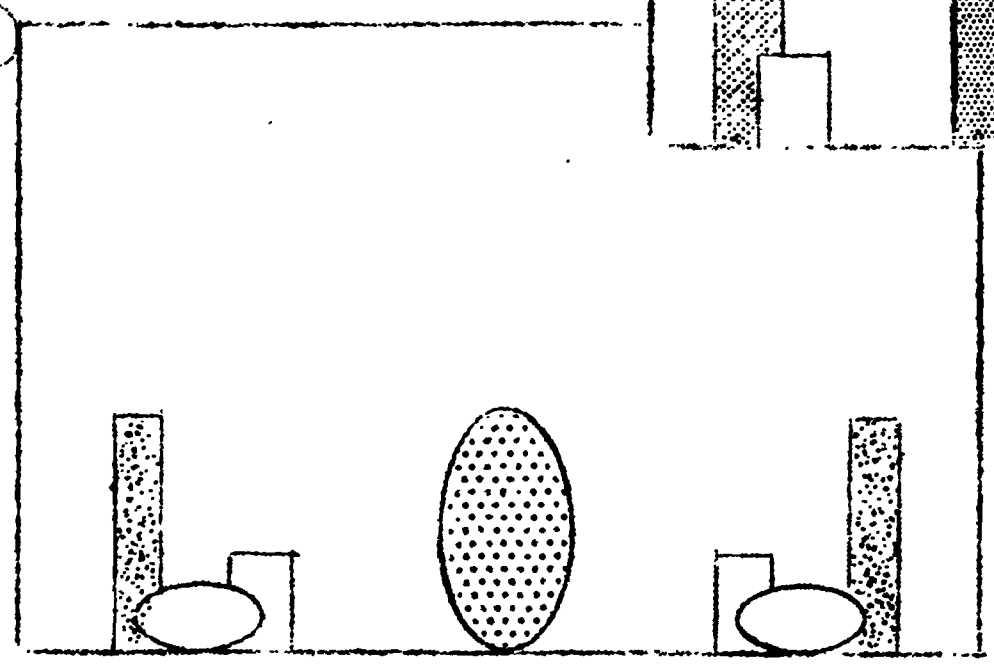
POOR PROPORTION



CROWDED SPACE

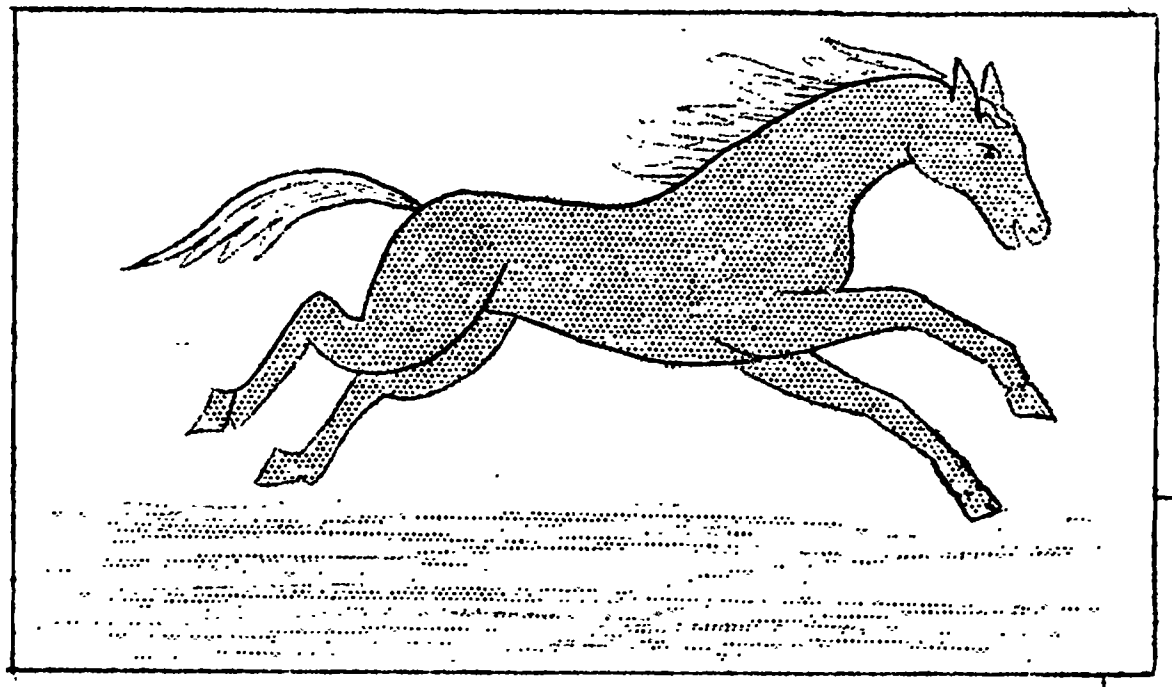


RELATIONS OF OBJECTS & SPACE POOR.

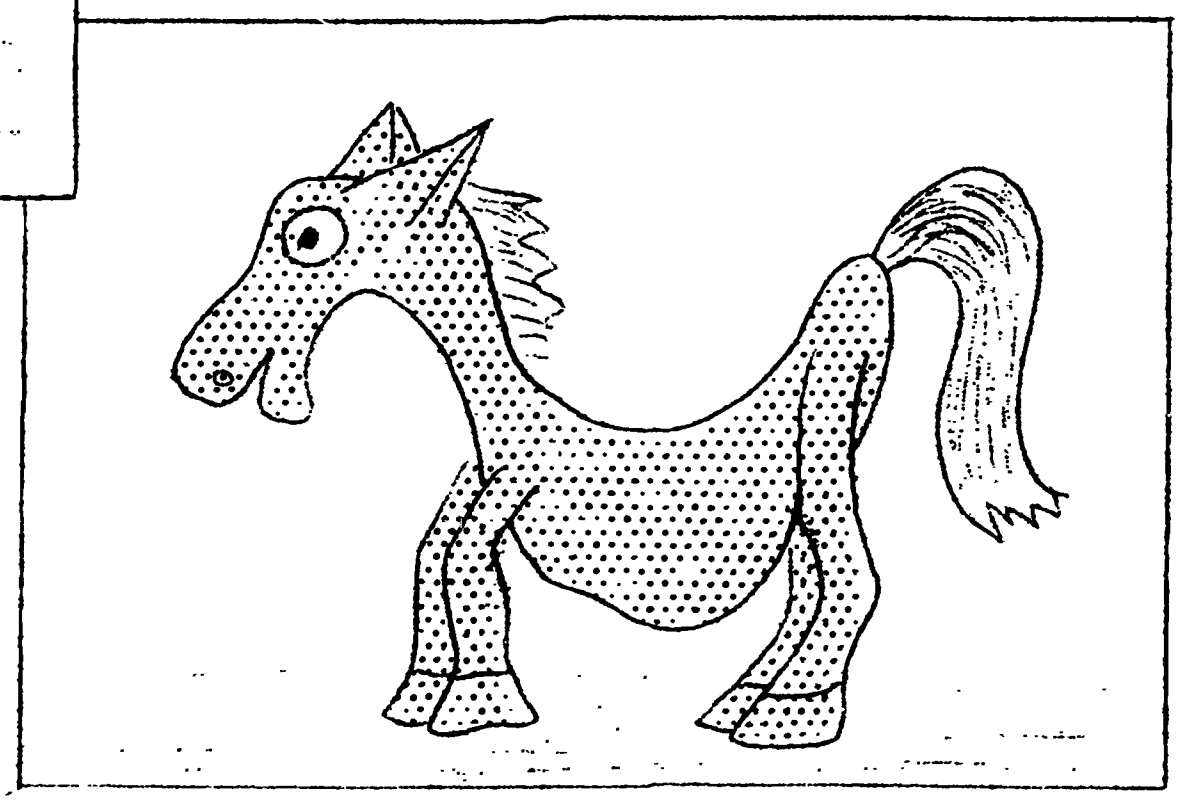


POORLY FILLED SPACE.

SINGLE OBJECT PROPORTION



GOOD



BAD

HARMONY

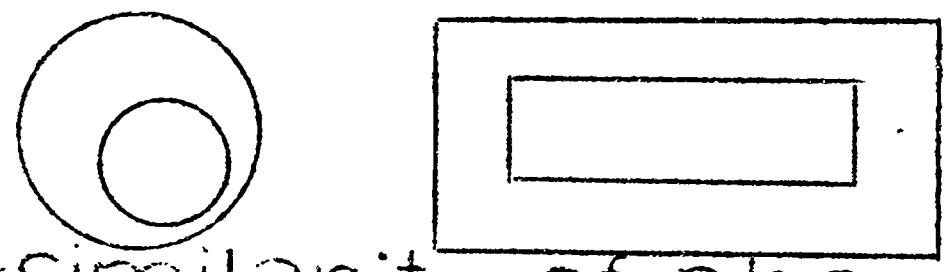
HARMONY

Harmony as it is understood in display serves much the same purpose as harmony does in music. A barbershop quartett with the correct blending of voices is pleasant to the ear. When a display is harmonious, there is a pleasant unity of objects and ideas in it. Similarity of merchandise, color, size, and shapes tend to blend into a pleasing composition. As a sour note in music is displeasing to the ear, so can an out-of-place object in a display be displeasing to the eye.

Synonyms of Harmony are:

-SIMILARITY

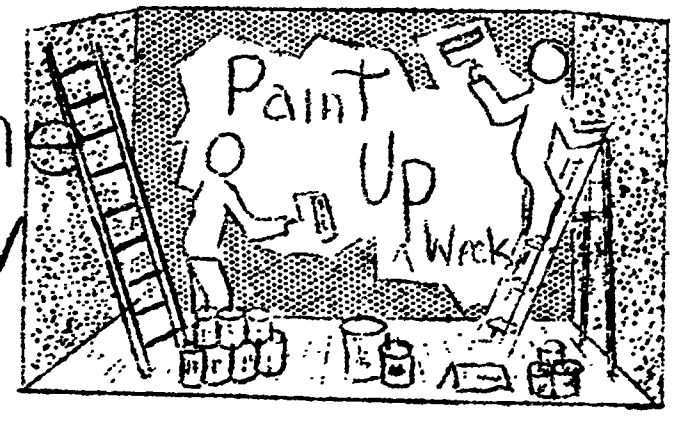
-UNITY

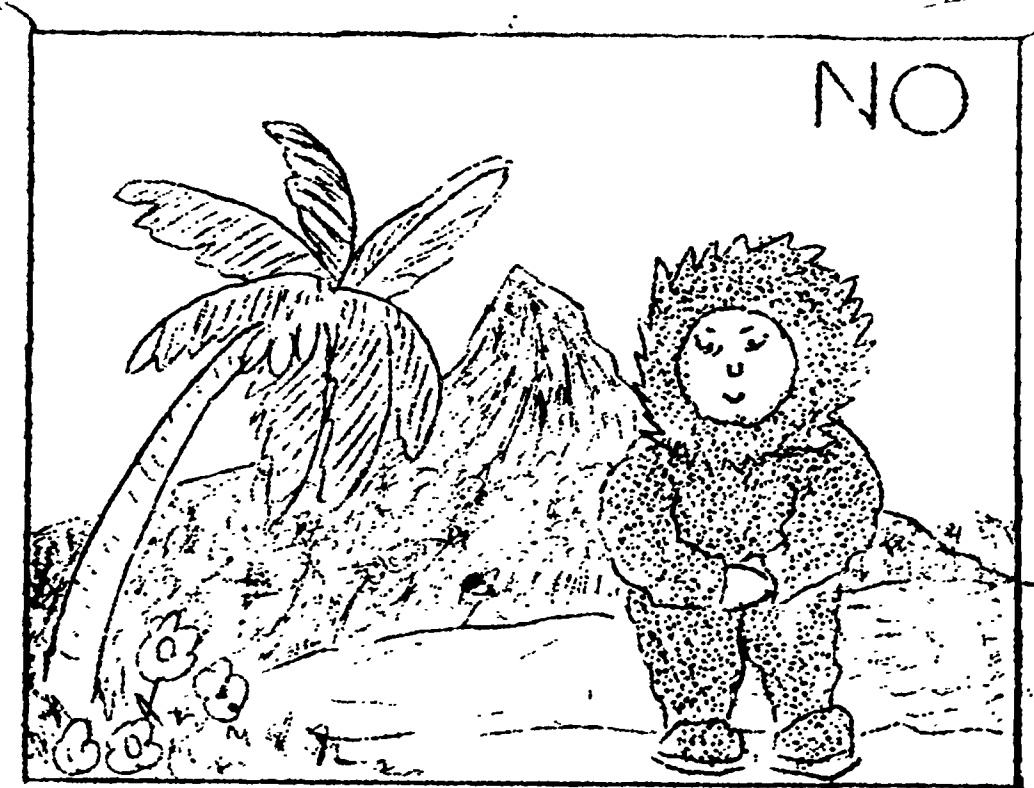


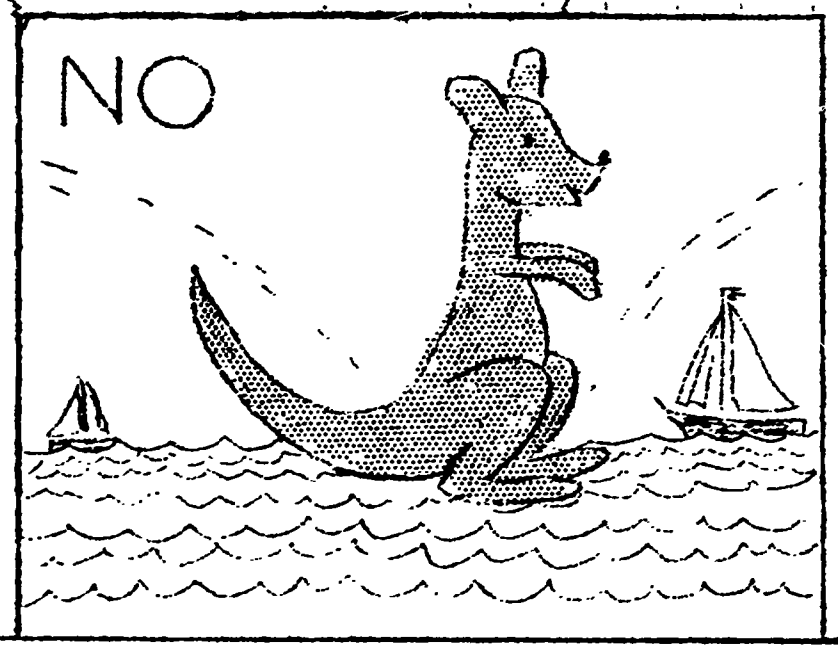
*similarity of shape

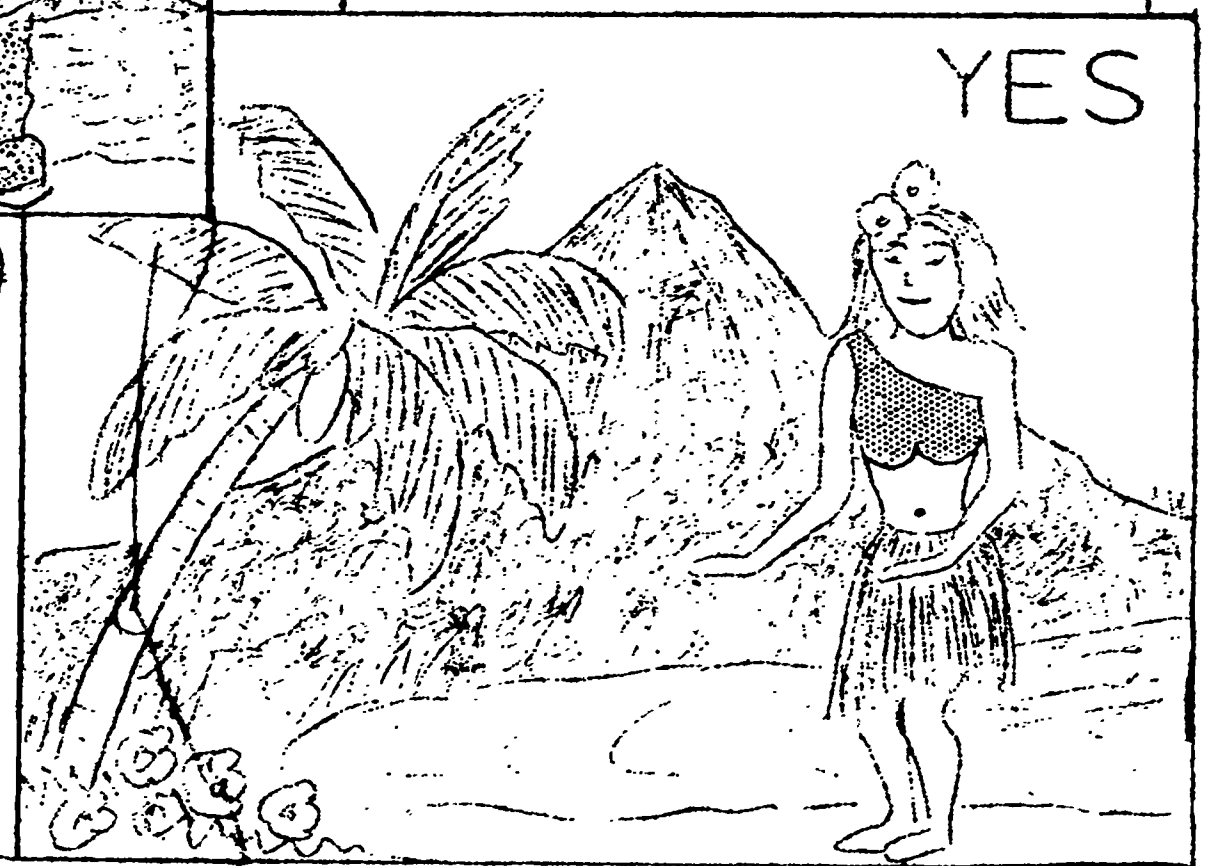
Proper use of the principles of balance and proportion are essential to making a display tie together in a harmonious manner. Harmony is easy to achieve and to recognize because of the similarity of the elements that are used.

*theme unity

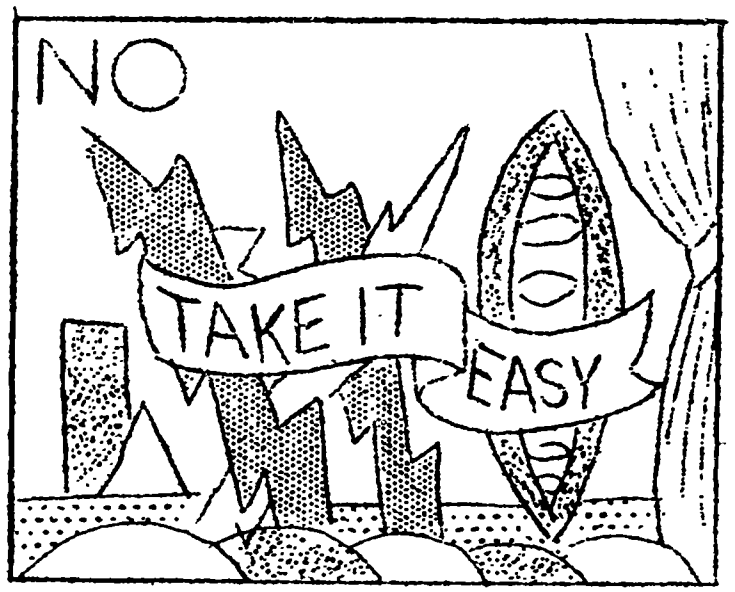


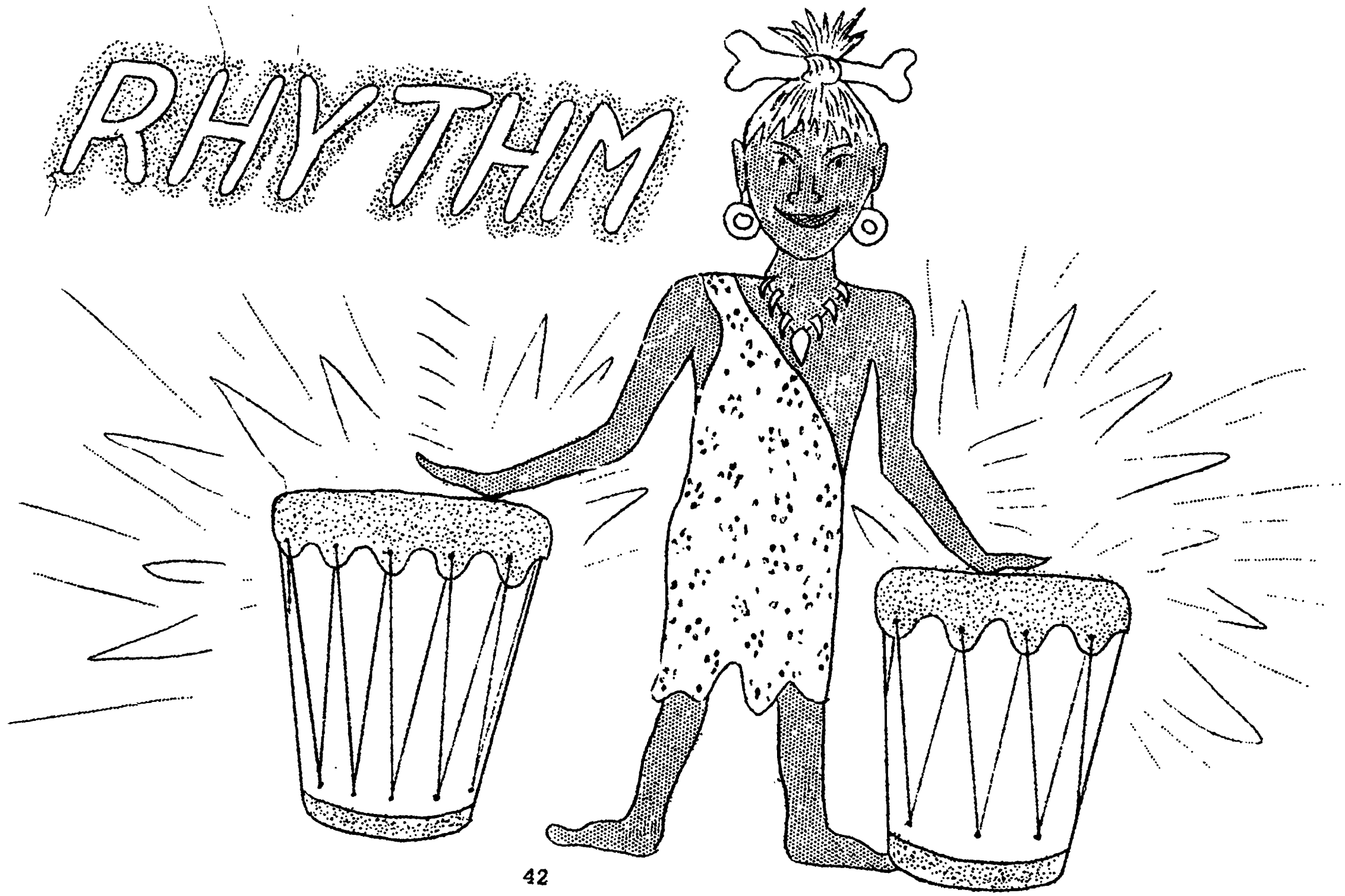






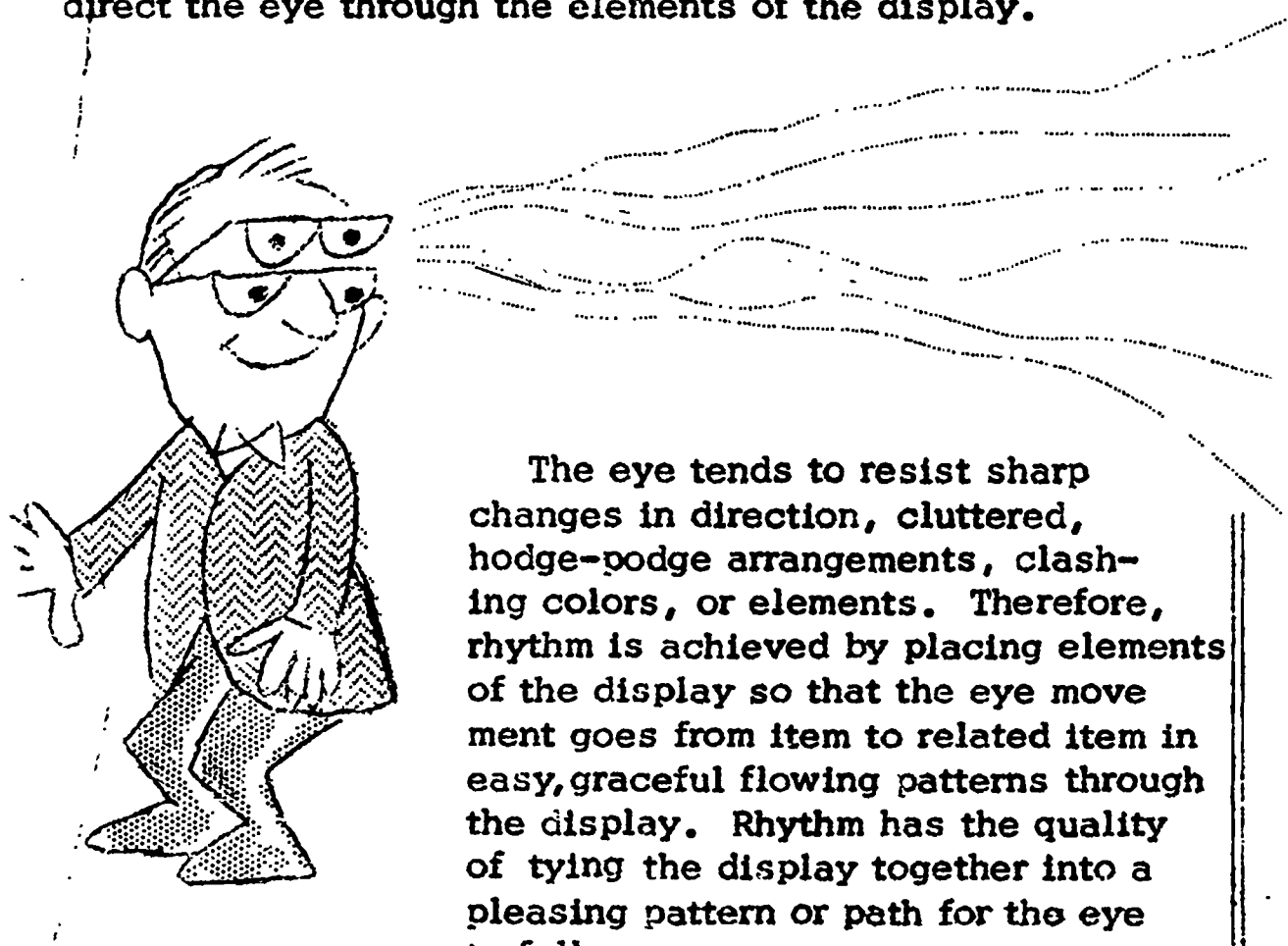
HARMONIOUS?




RHYTHM

In music, rhythm is described as the regular measured flow of heavy and light accents. Each piece of music has a particular accent pattern that rises and falls with regularity of movement. Poetry, too, has patterns of accent that are recognized by the rise and fall of stress on certain syllables. In display the principle of accent and flow of the eye over the pattern of the display is described as rhythm.

Once the eye is attracted to a display the attention and interest can be maintained by the use of rhythm to direct the eye through the elements of the display.



The eye tends to resist sharp changes in direction, cluttered, hodge-podge arrangements, clashing colors, or elements. Therefore, rhythm is achieved by placing elements of the display so that the eye move ment goes from item to related item in easy, graceful flowing patterns through the display. Rhythm has the quality of tying the display together into a pleasing pattern or path for the eye to follow.

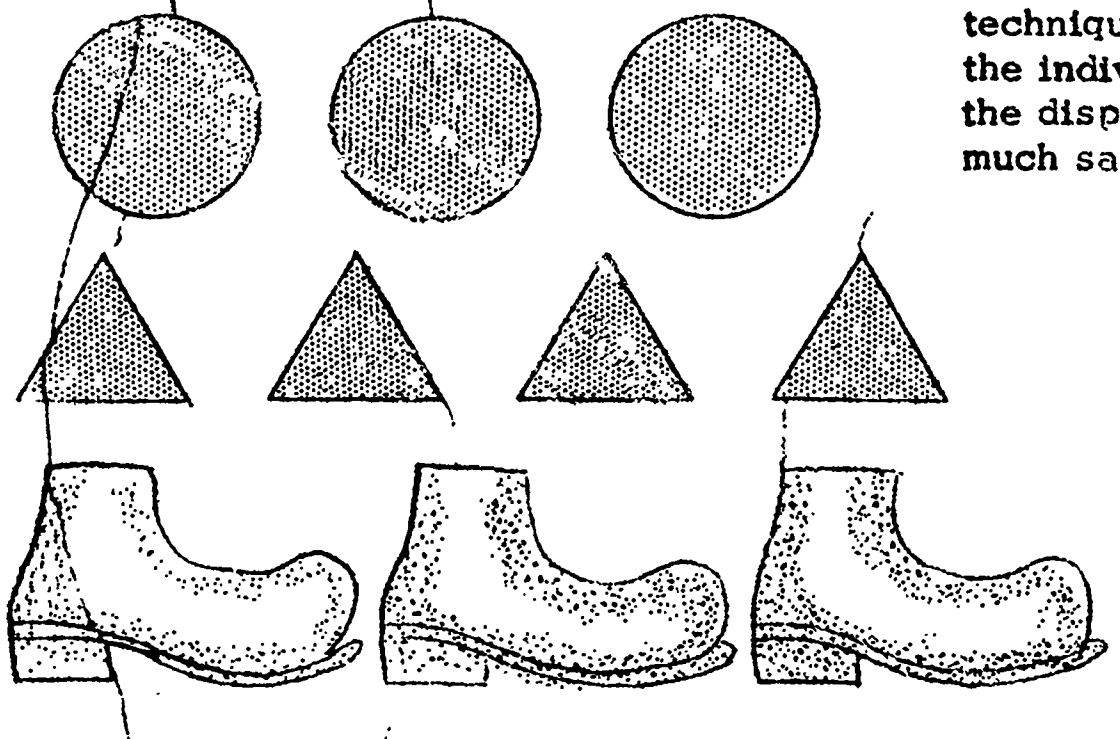
There are several methods used to obtain this rhythmic eye flow in a display and they are easier to accomplish than to explain. All of the elements of display such as line, shape, size, etc. may be employed to attain rhythm.

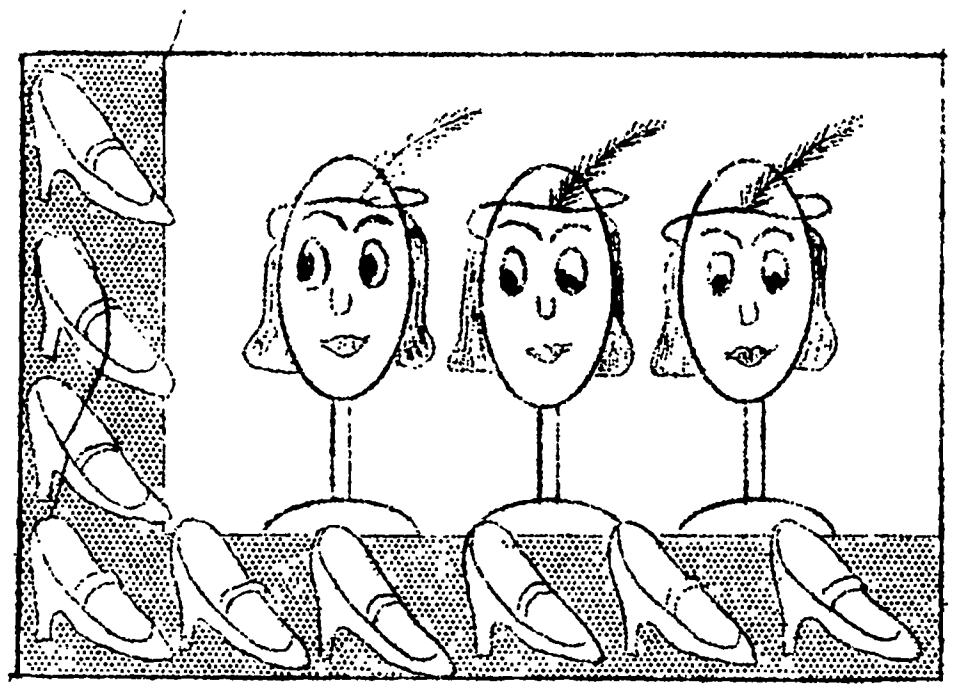
Ways to achieve RHYTHM:

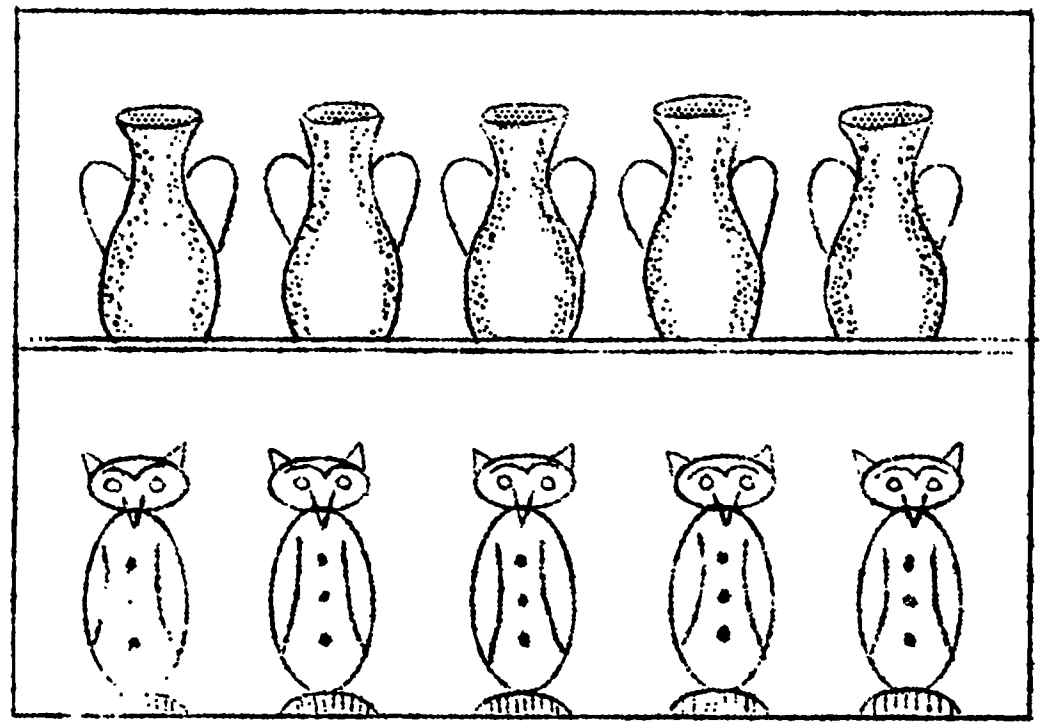
- REPETITION
- ALTERNATION
- PROGRESSION
- VARIED
- LINE MOVEMENT

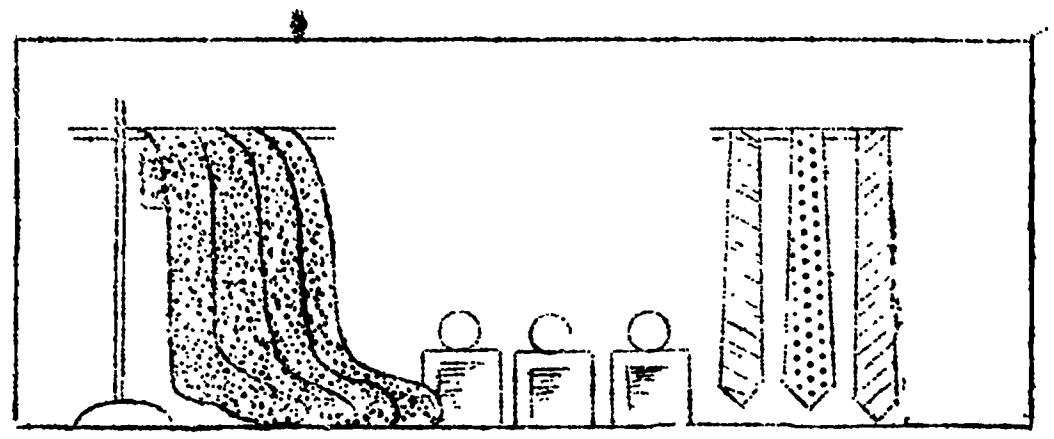
REPETITION:

When an element, or object, is repeated in a regular pattern through the display, the principle of repetition is being used and the eye flows smoothly without any distracting interruptions. It is an easily accomplished technique for tying a display together. With this technique the individual items tend to blend into a solid pattern and the display is sometimes lacking in interest because of too much sameness.



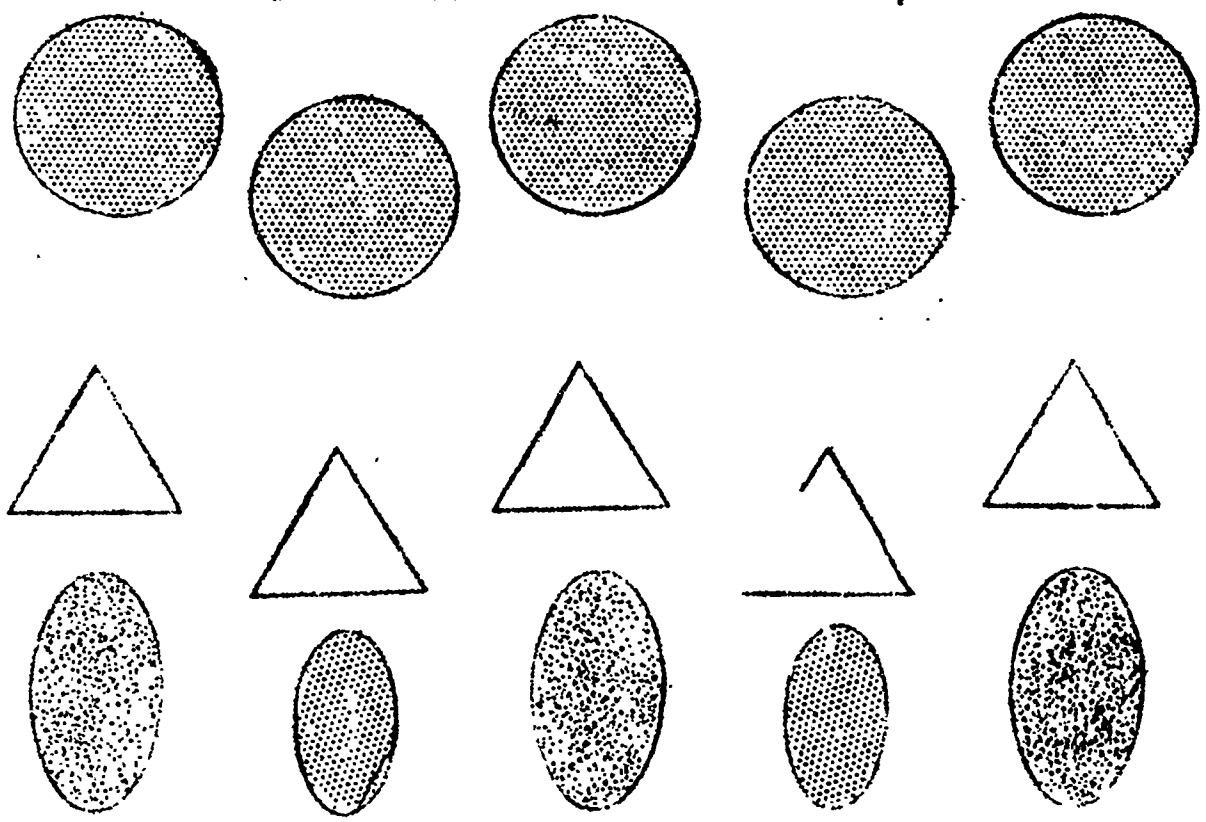


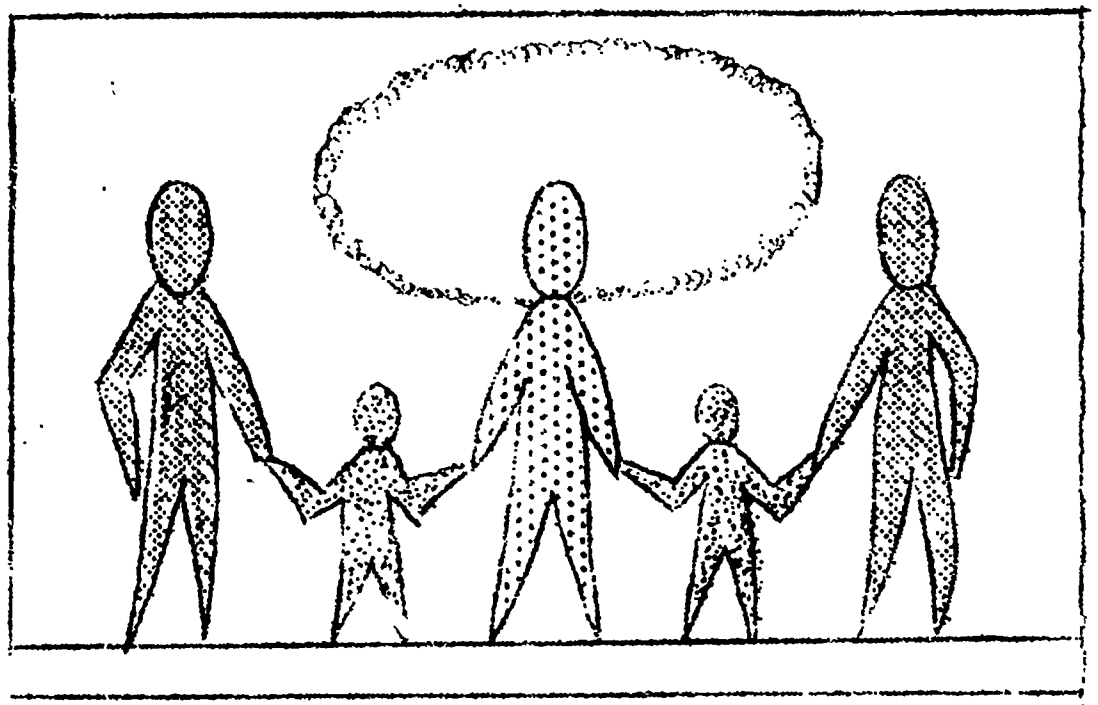


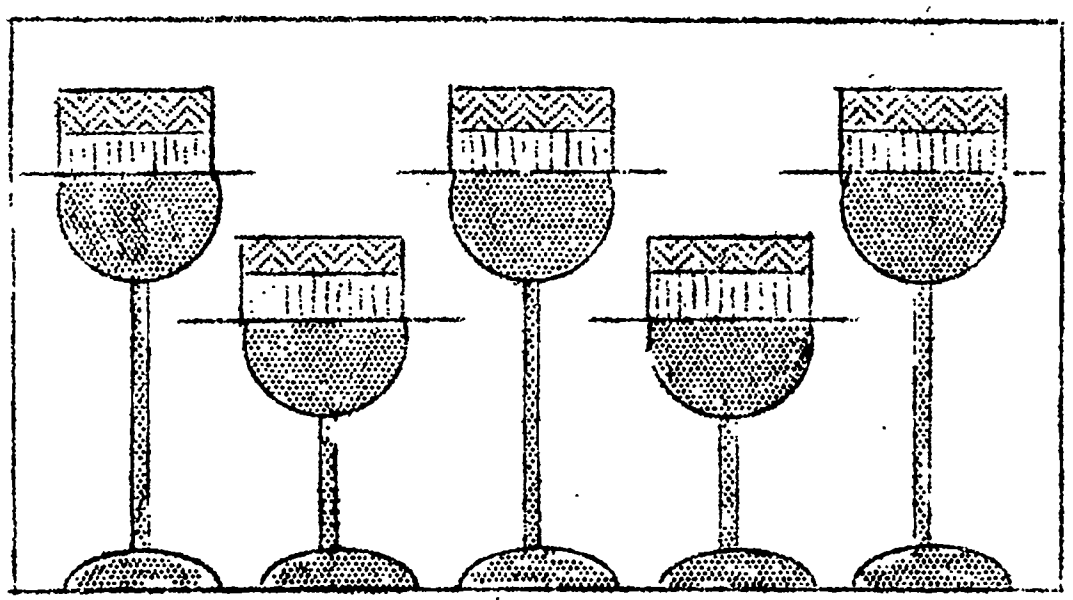


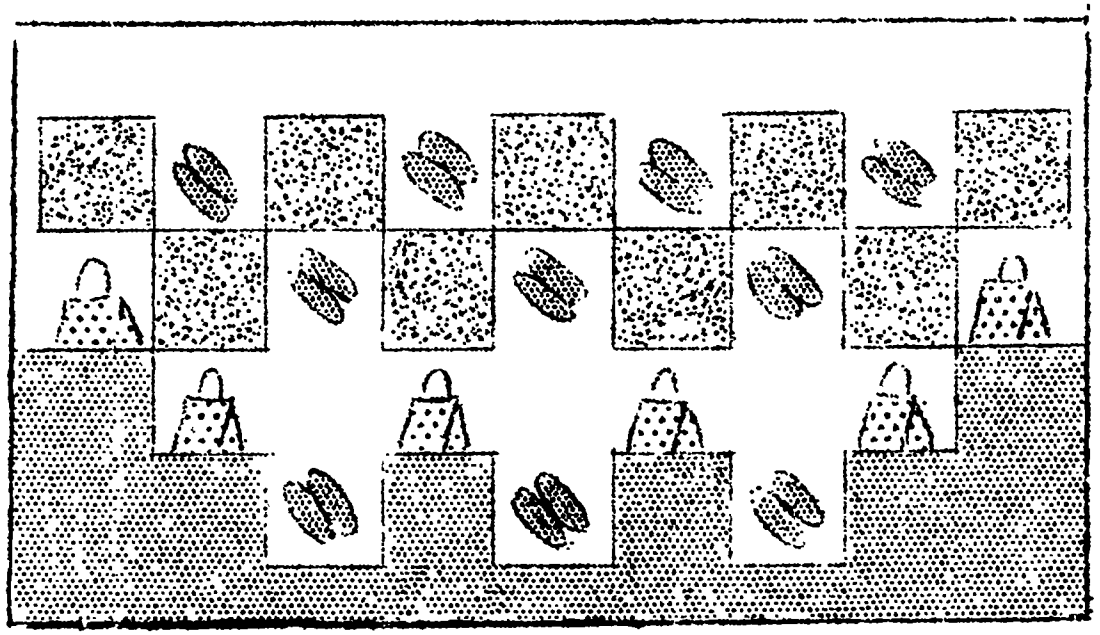
ALTERNATION:

Alternation is a principle similar to repetition except that monotony is reduced by varying the positioning, spacing, or color of the like objects used. The rhythm of the display is made more interesting by being varied and less regular.



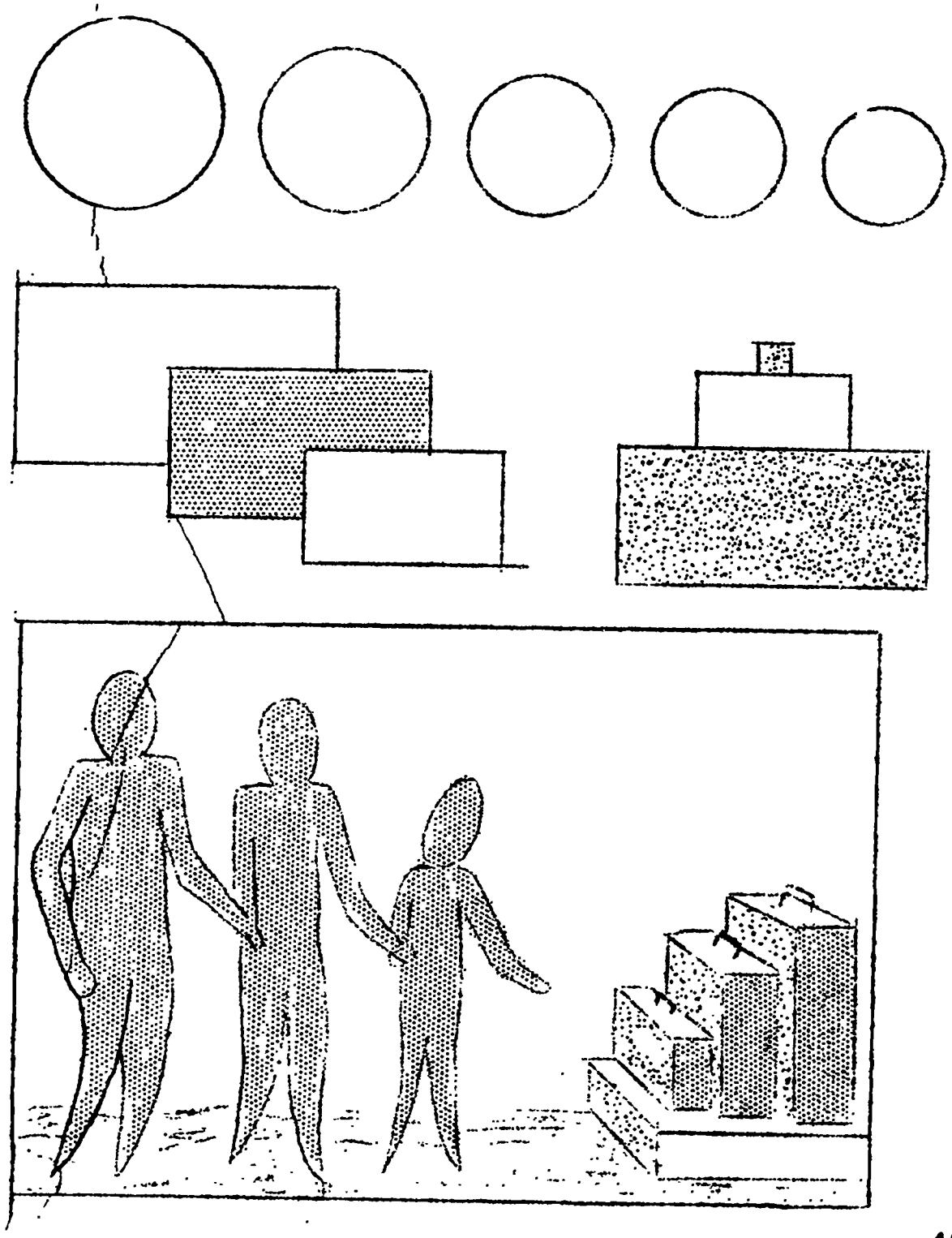


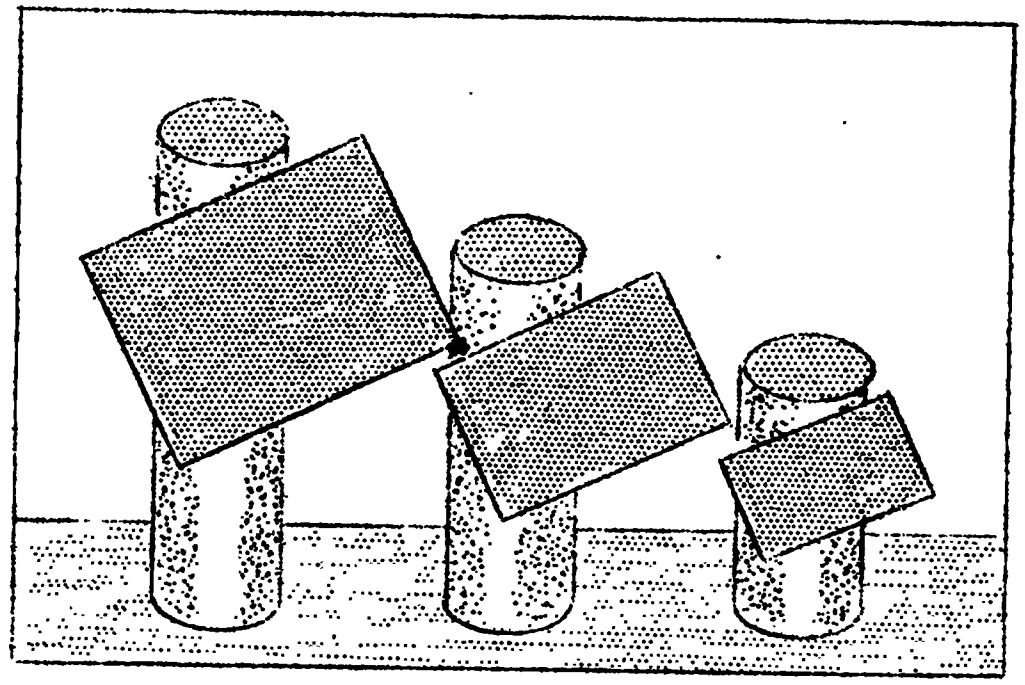


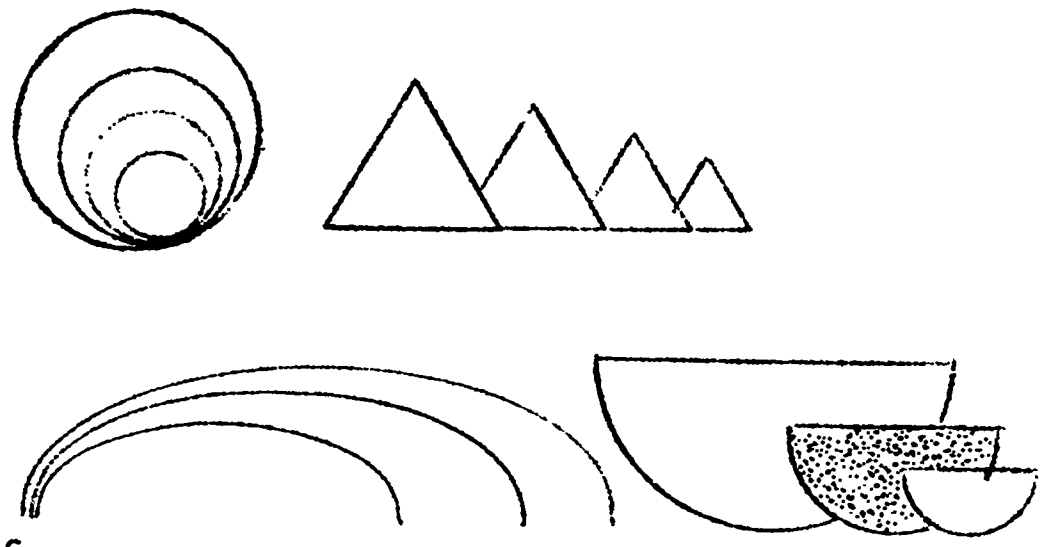


PROGRESSION:

The principle of progression involves the apparent growth or reduction of lines, shapes, merchandise, etc. in the display. Items are basically alike but they vary in their relation to each other. A simple example of this principle would be a three sized mixing bowl set arranged in order of size.

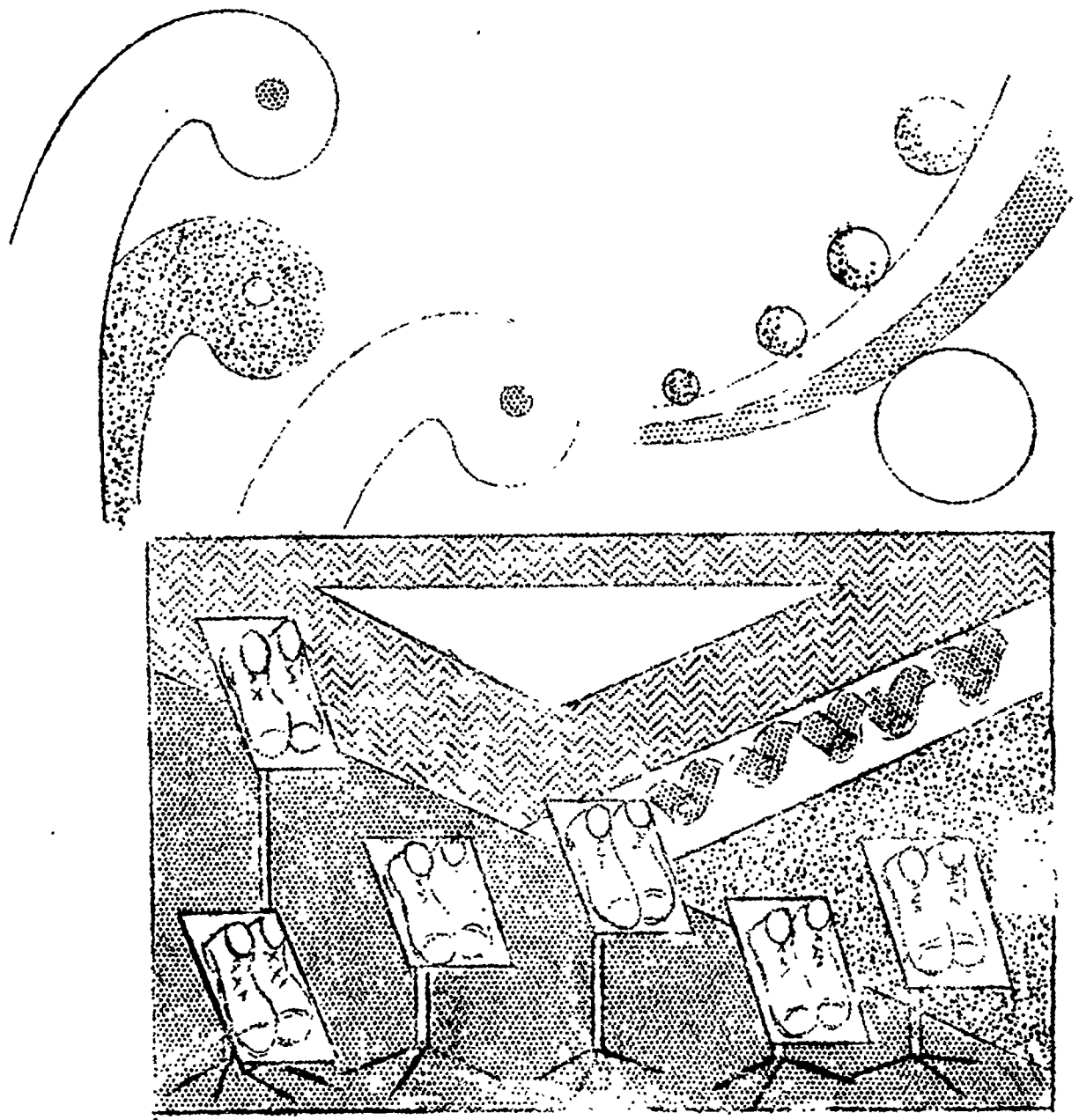


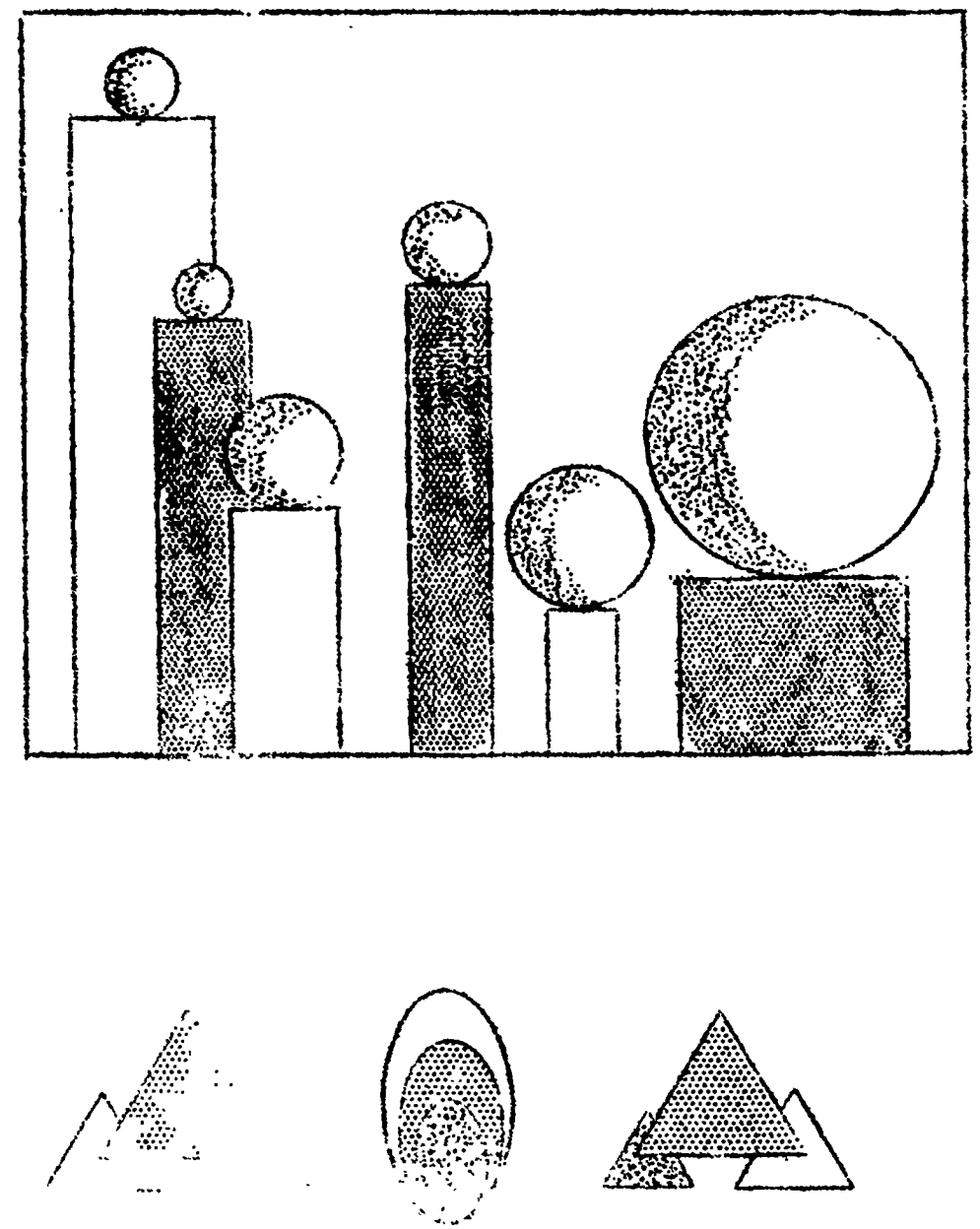




VARIED:

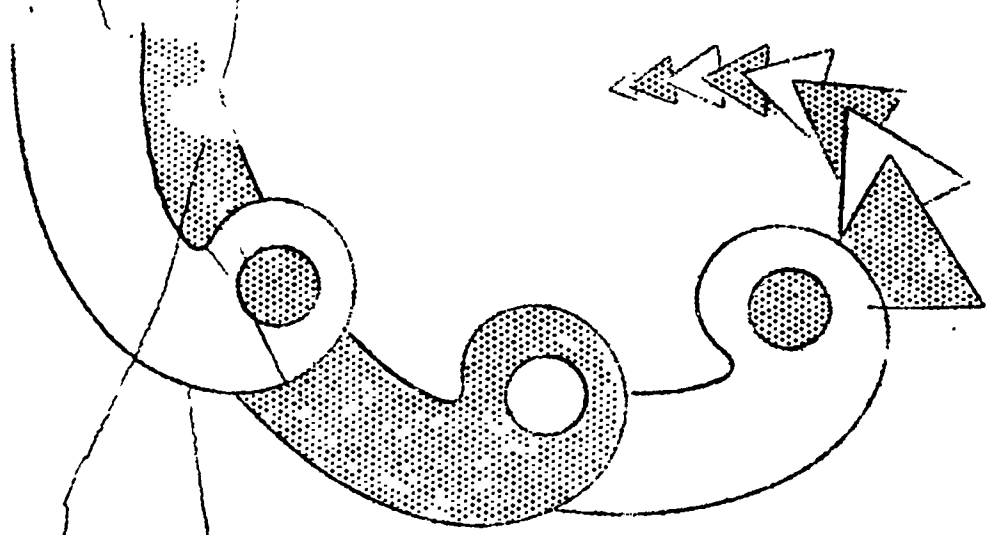
A great variety of moods and eye movements can be achieved by combining and adapting previously discussed rhythm principles. The possibilities are almost unlimited.

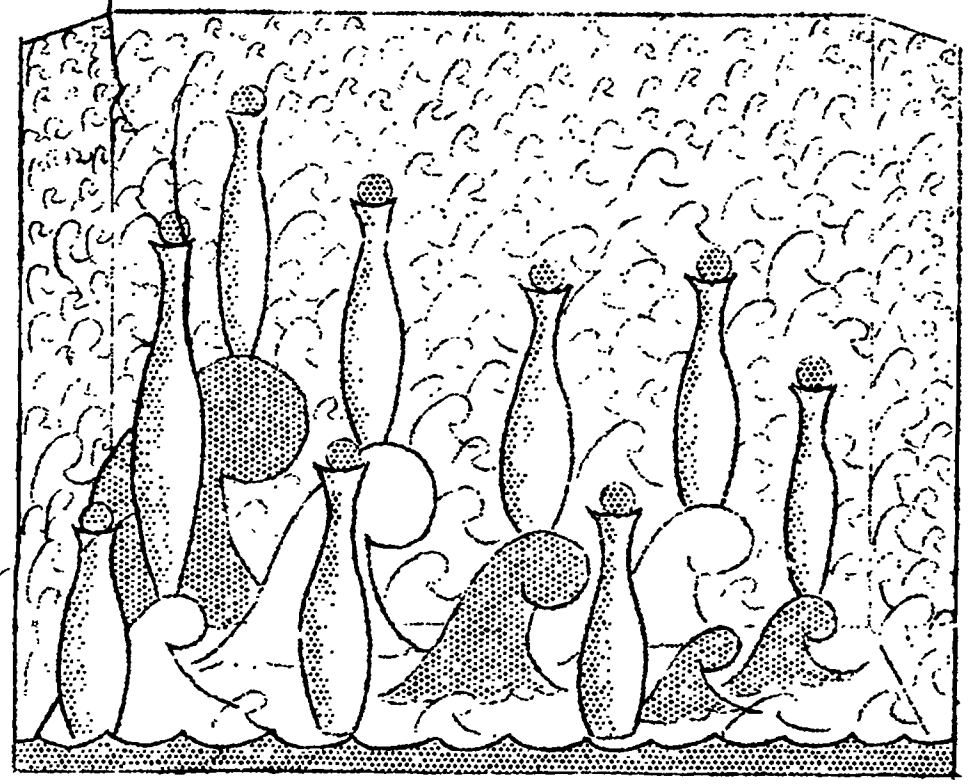


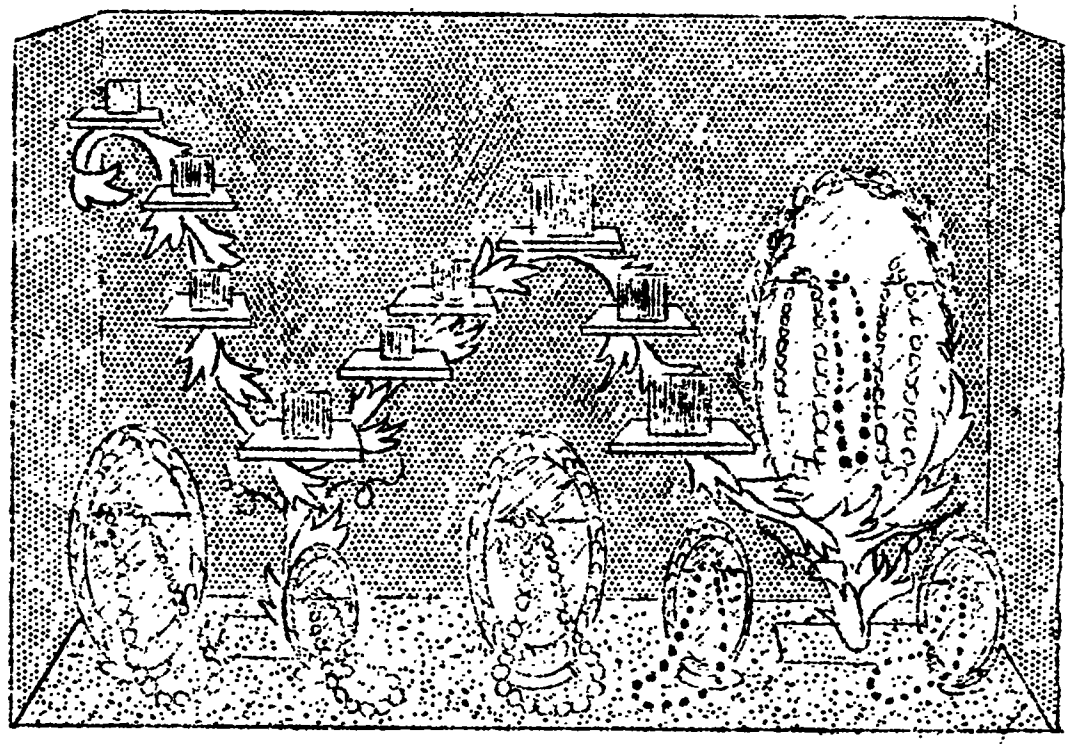


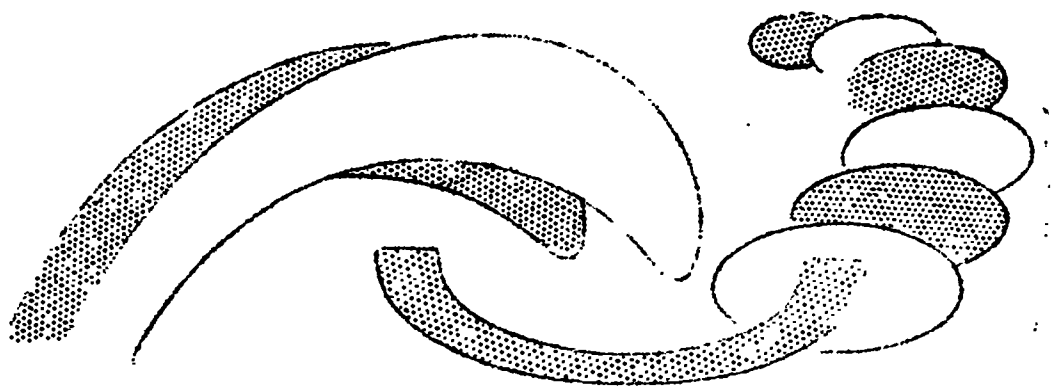
LINE MOVEMENT:

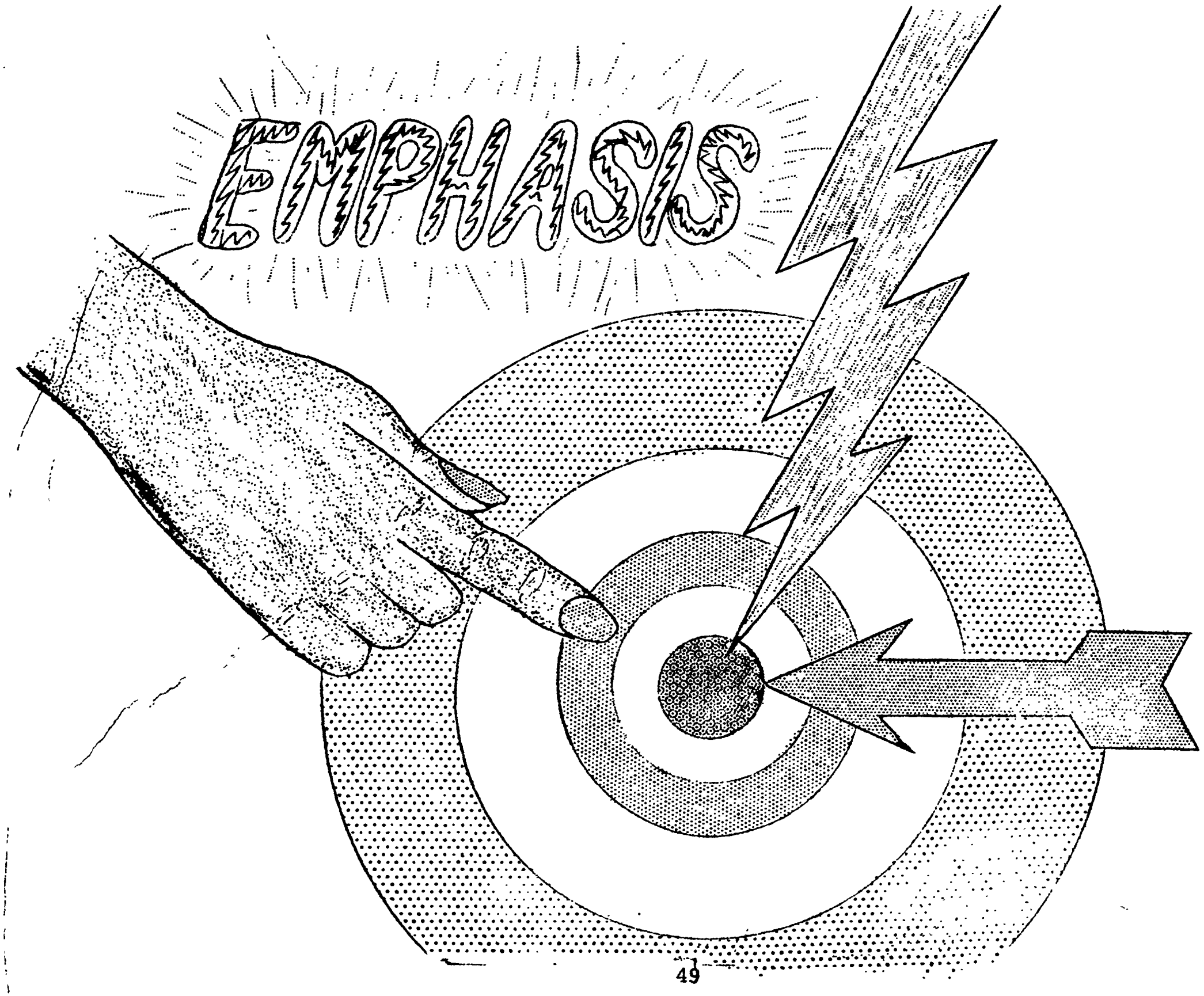
Eye movement through the display can be enhanced by placing objects in graceful sweeping curves. Rhythm is achieved by the use of flowing lines. Such curves can be formed by placing the merchandise to lead the eye through a gentle undulating pattern. Curves are much more pleasing to the eye than angular, abruptly changing patterns. Displays that require the eye to make sharp changes of direction are usually lacking in the quality of rhythm.







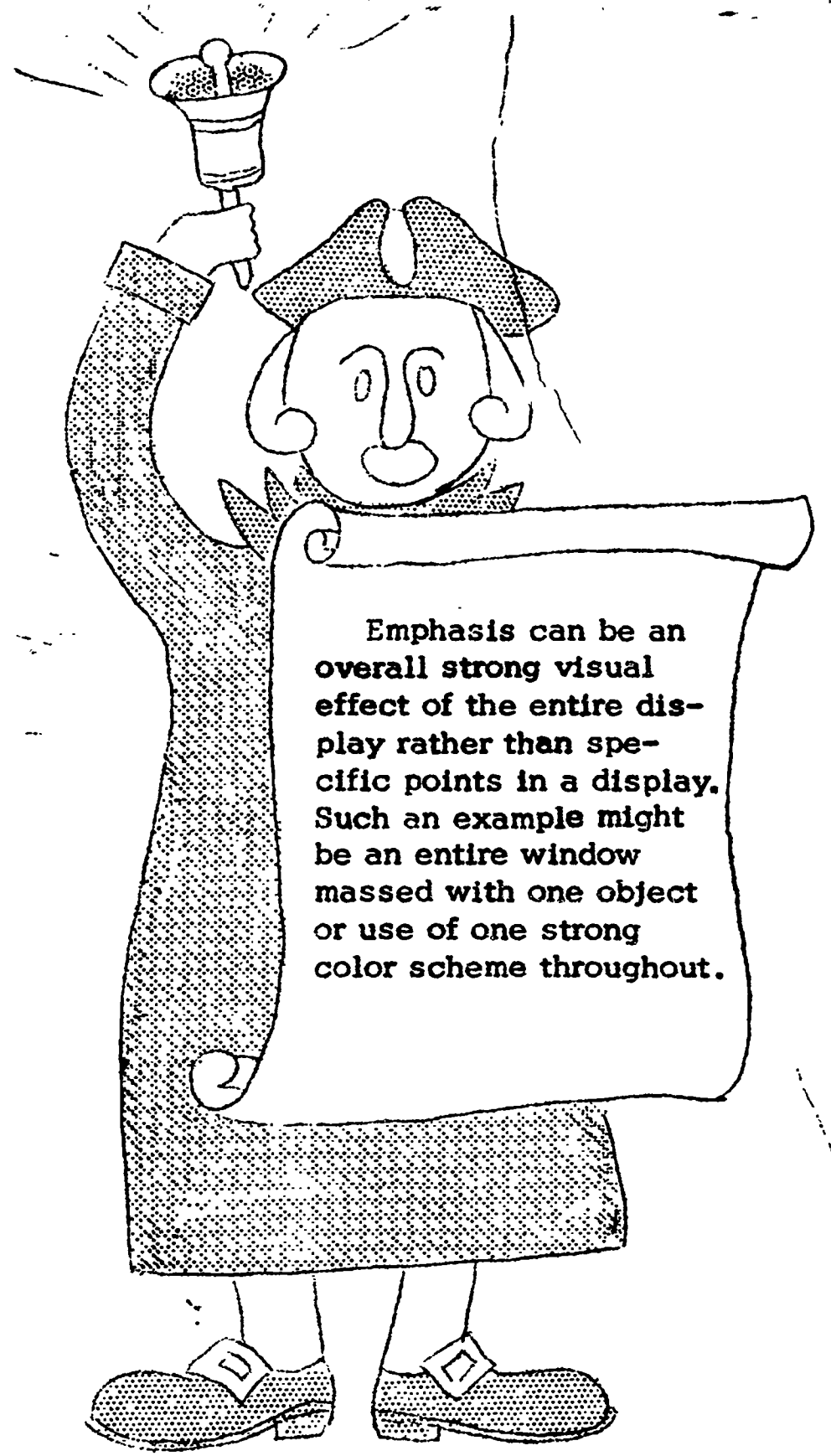



EMPHASIS

EMPHASIS

The principle of emphasis is used in display to call attention or give optical stress to certain features of the display. It is often used to call the customer's eye to a place of particular interest in the display. It can be a focal point, a dominant object or idea. The central purpose of the display should be at once evident to the viewer if emphasis is properly carried out. The other principles of design are combined and used to advantage to place the visual impact where it is desired.

Emphasis is most easily understood by looking at displays where the use of lines, shapes, colors, etc. lead the eye to a specific center of interest in the display. This center may be in item of merchandise or a show card with important information on it. Most displays have at least one center of emphasis. If there is more than one center of interest these should be limited to not more than three.



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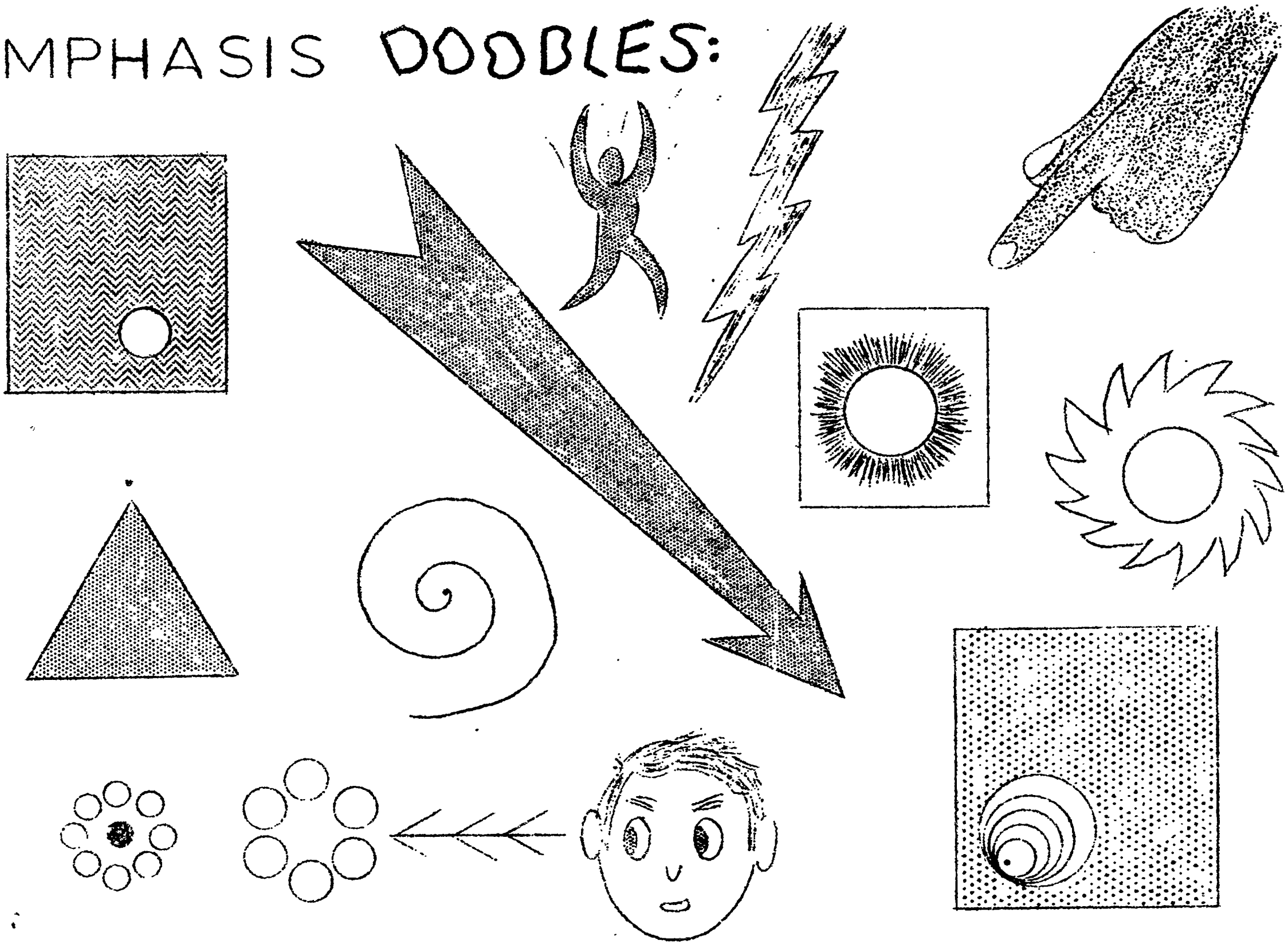
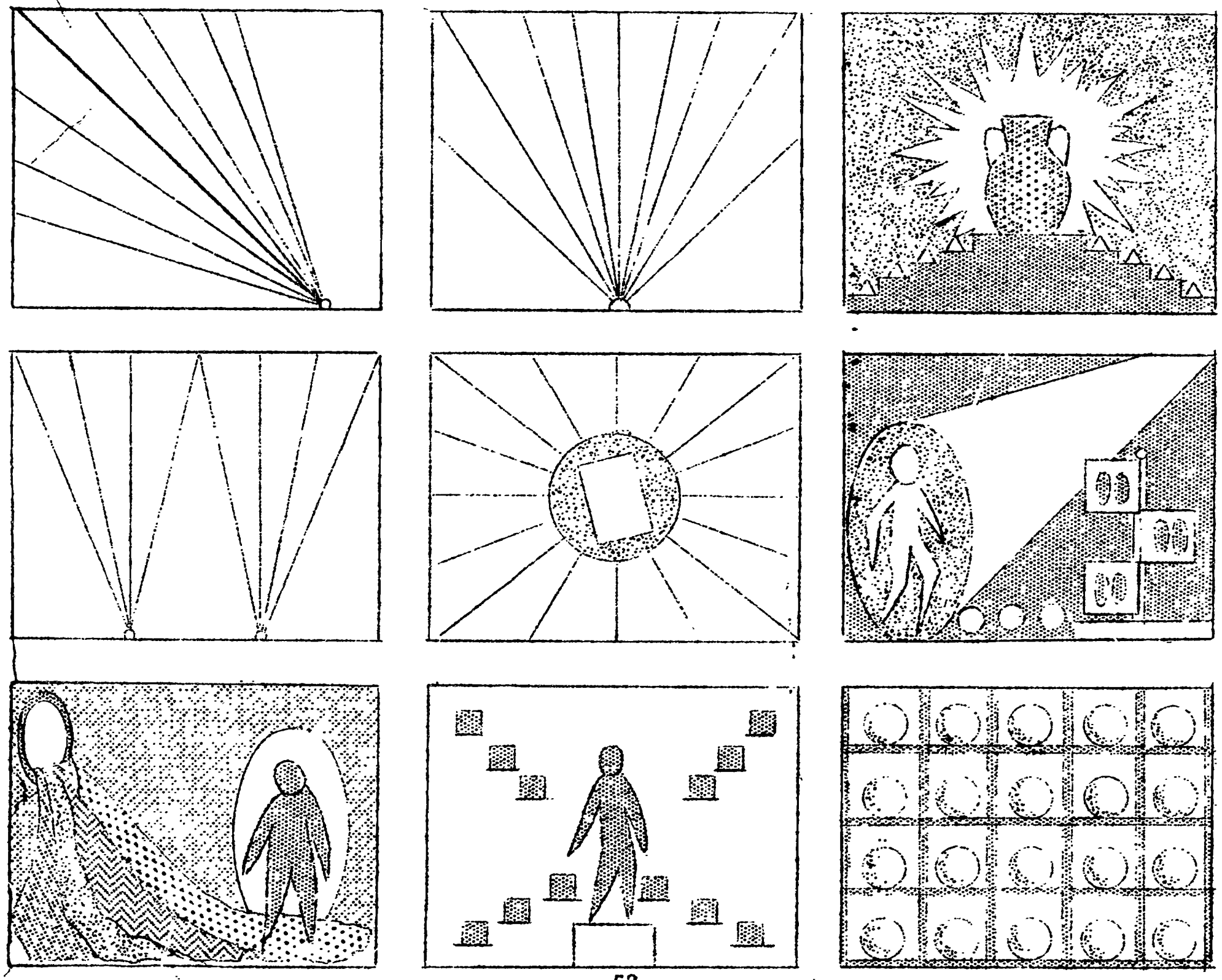
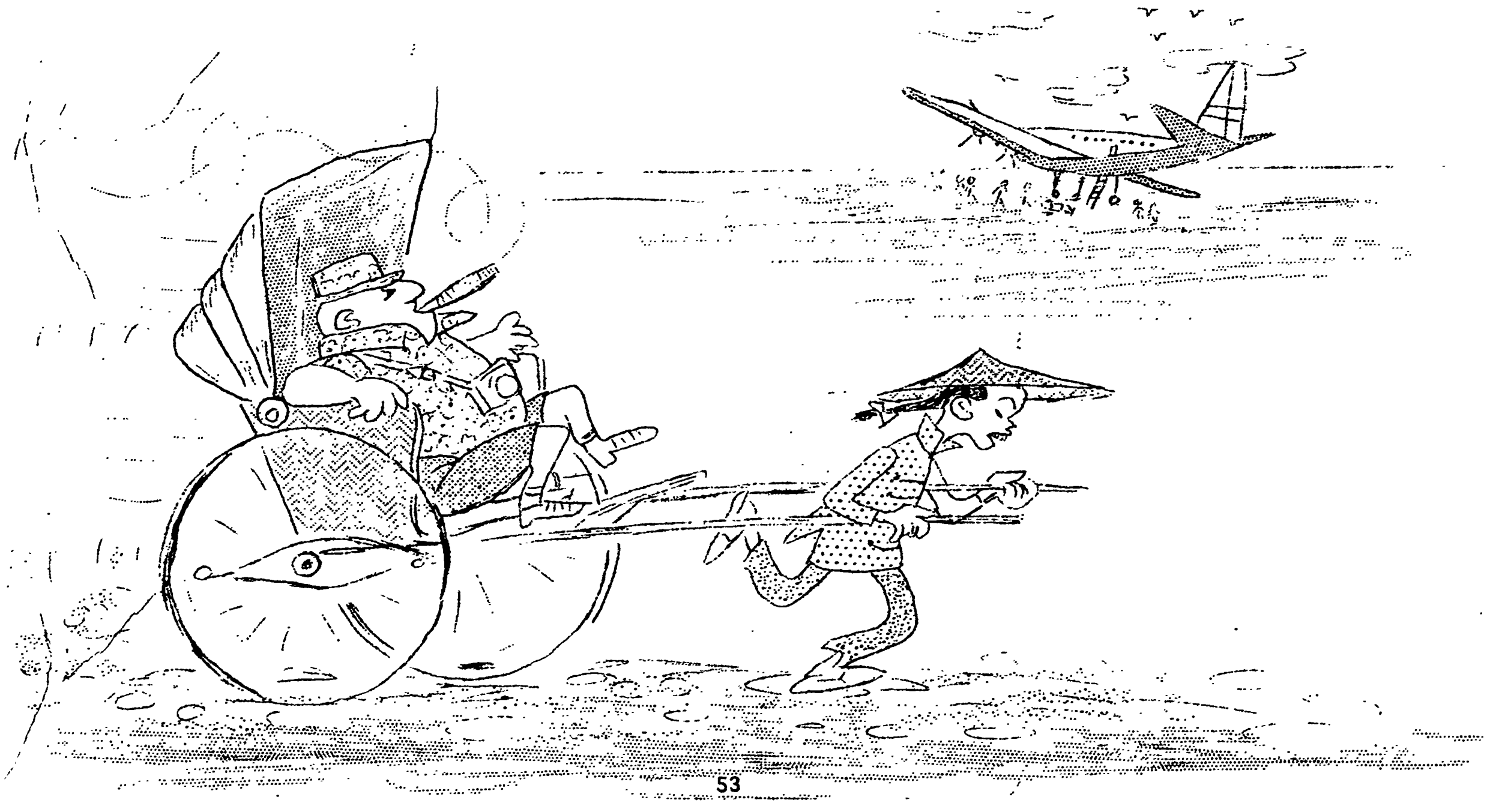


EMPHASIS



CONTRAST



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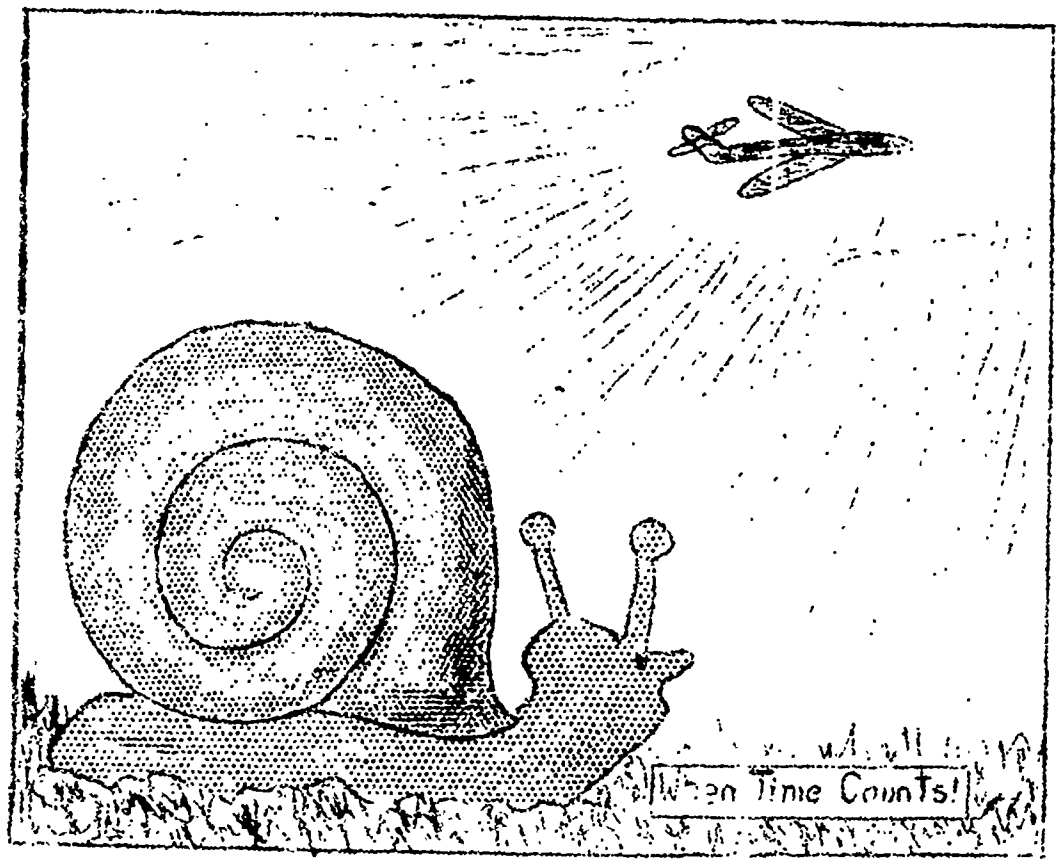
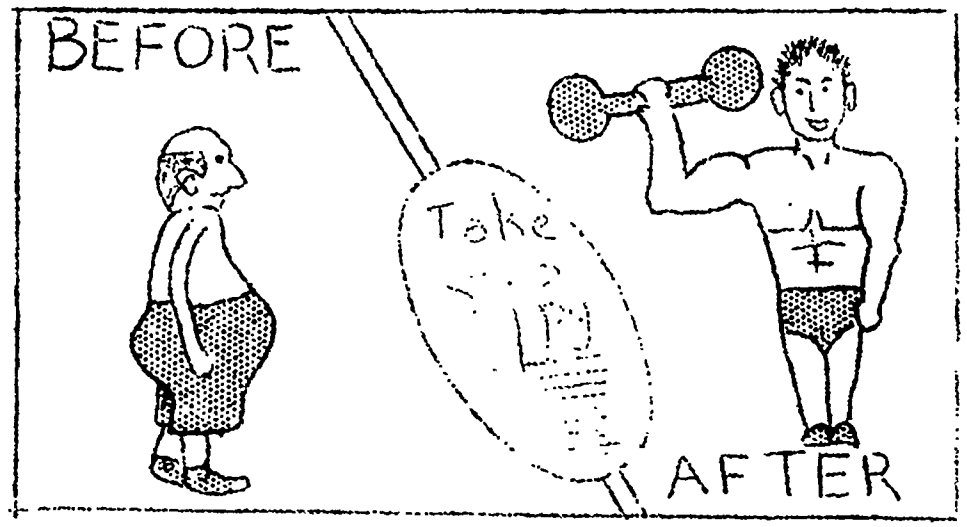
CONTRAST

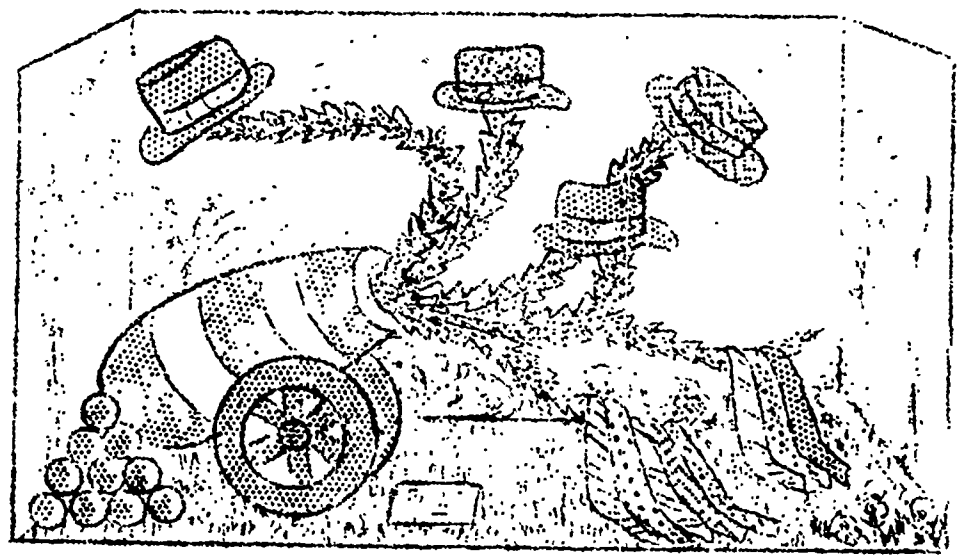
The principle of contrast is evident when unlike objects are grouped so that attention is called to their differences. Properly used, contrast is very effective in adding interest to the display. It is perhaps more difficult to use than the other principles of display because there is a danger of disrupting balance, harmony or rhythm. With practice, however, the student will soon be able to trust his judgement as to what enhances and blends with the display rather than clashing. Contrasts may point up differences in shape, texture, weight, color or proportion.



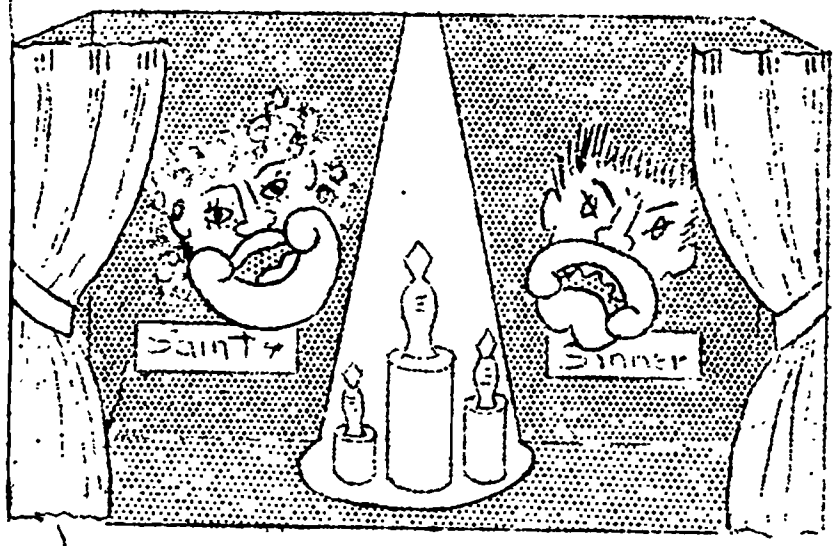
Before and after contrasts demonstrate results from various products.

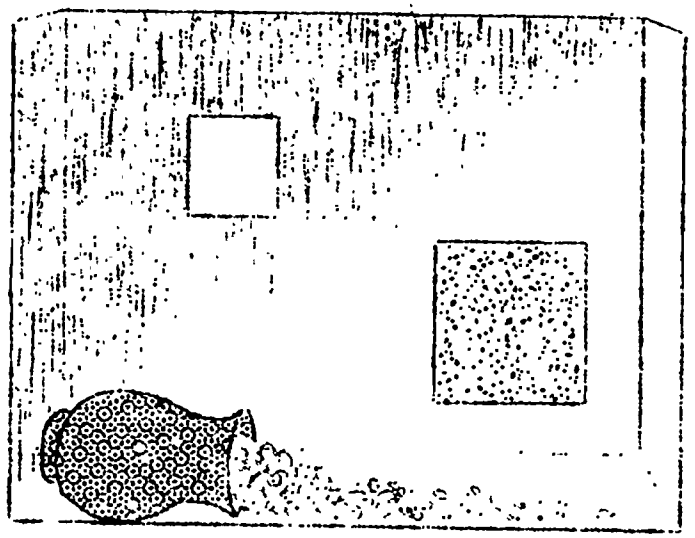


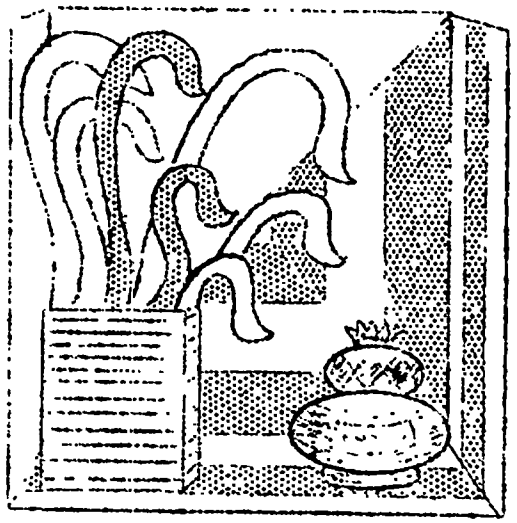
Unexpected or clever elements are often combined to call attention to the display. Contrast can add excitment and a chance to fully exercise one's imagination in display.

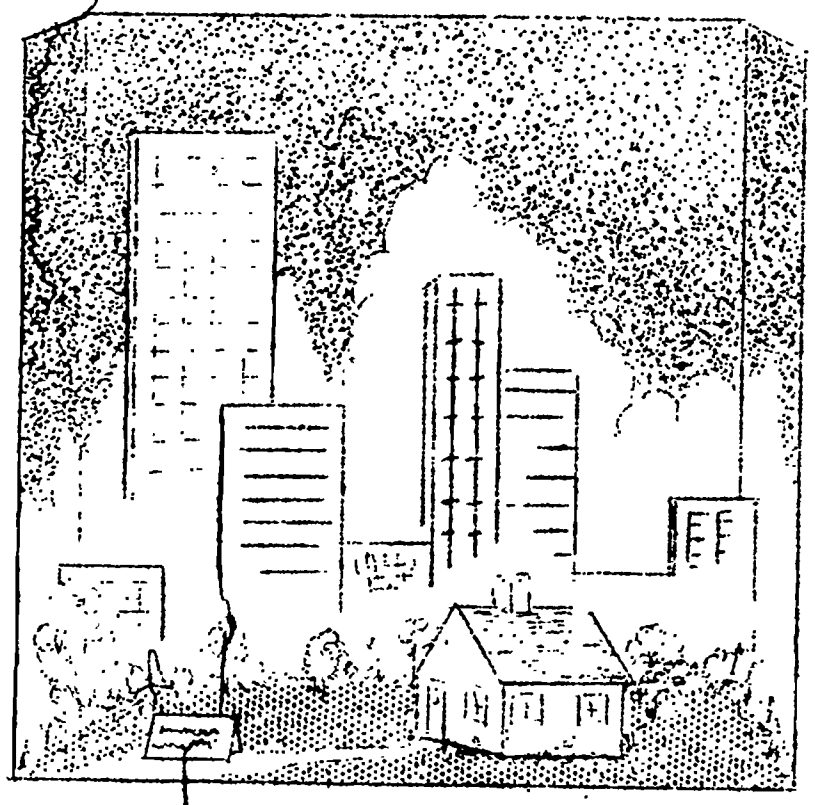


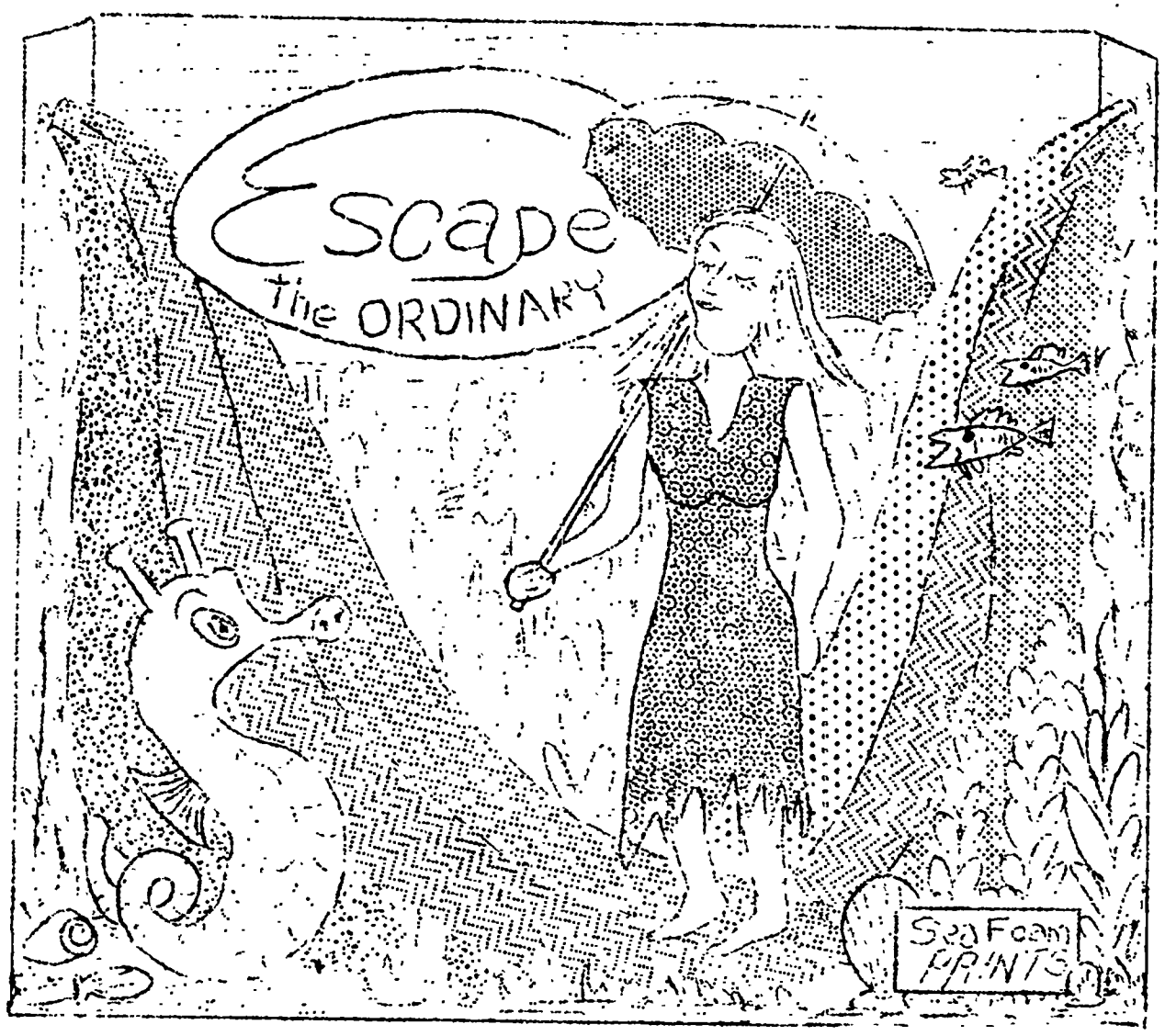
CONTRAST:











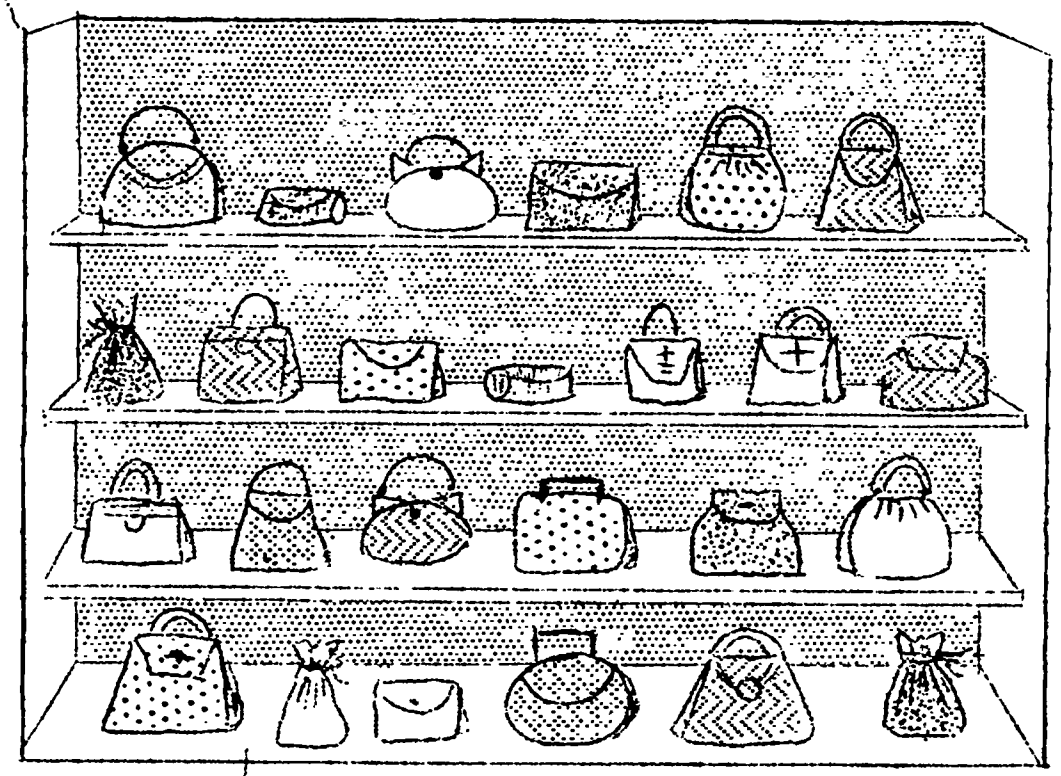
COMMON ARRANGEMENTS:

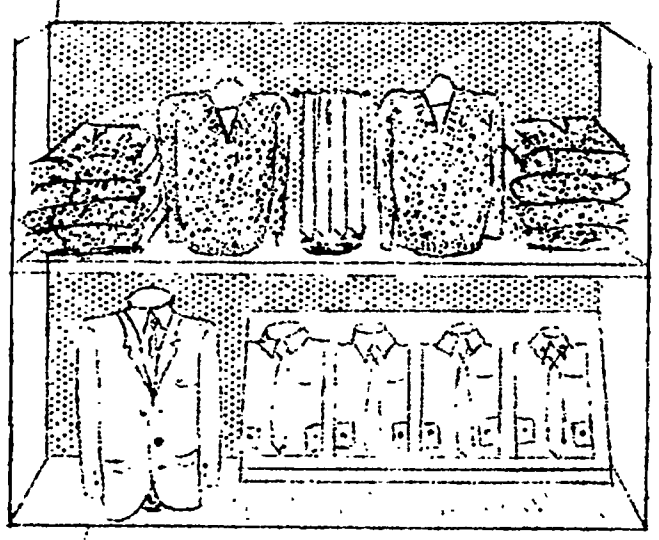
The beginner in display will find it helpful to recognize some of the more basic arrangements. These basic arrangements can serve as a starting point from which to develop more complex displays. Two general types of displays which are easily recognized are mass display and unit display. The type of merchandise and store policy usually dictate which type will be used.

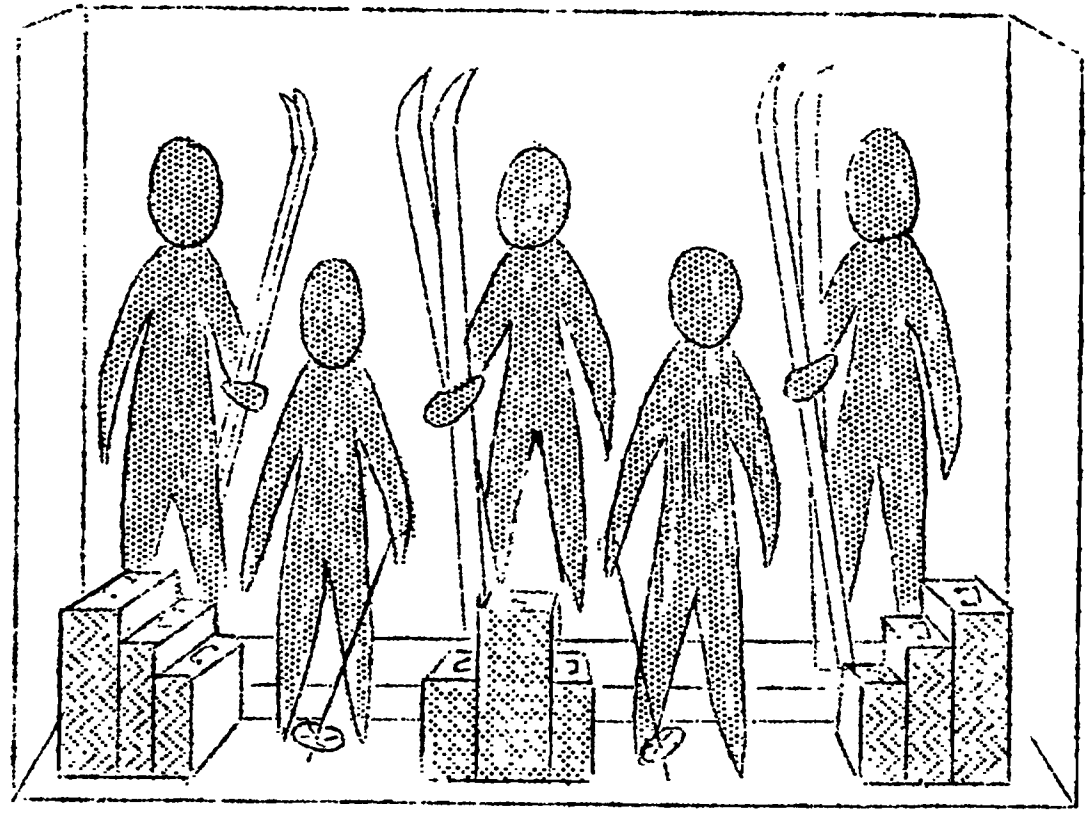
- MASS
- UNIT
- PYRAMID
- STEP
- ZIG-ZAG

MASS DISPLAY:

A mass display is recognized as a display area crowded with merchandise in which there is no effort to separate or space the items for individual viewing. The objects in the display are <u>massed</u> for an overall visual impact. It may feature repetition of one type of merchandise -- or a mixture in a cluttered "Bargain Basement" look. In mass displays one must look closely to separate individual details or merchandise from the total effect. Such displays serve a definite purpose but are rather unimaginative and little challange to the display artist.

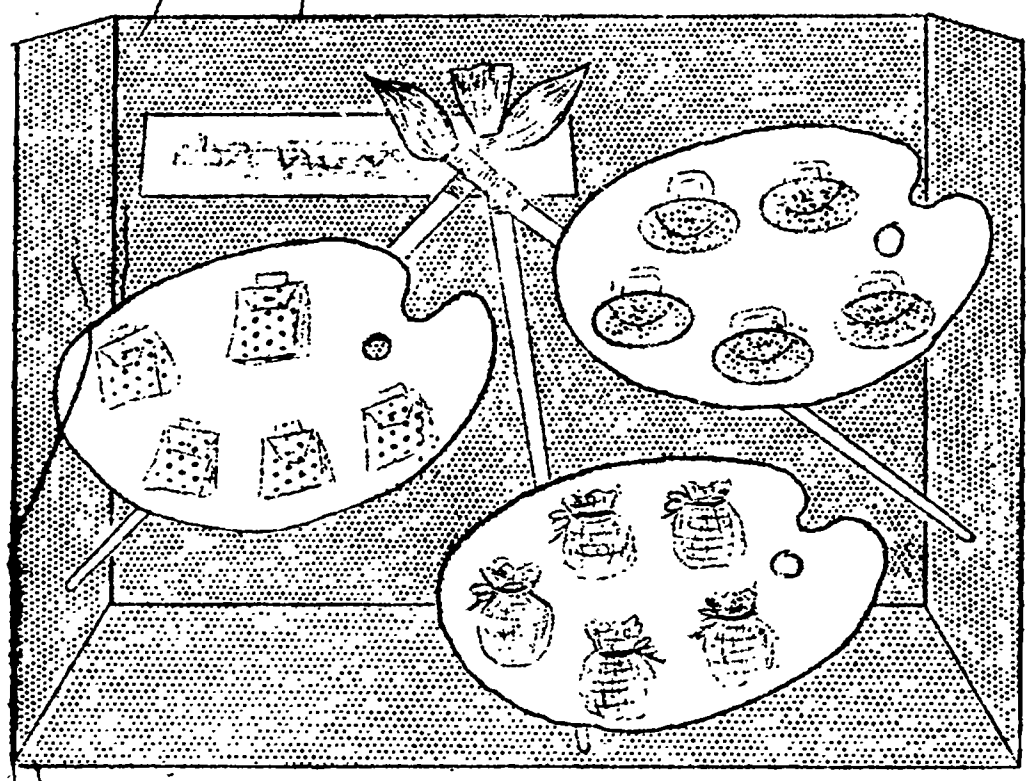


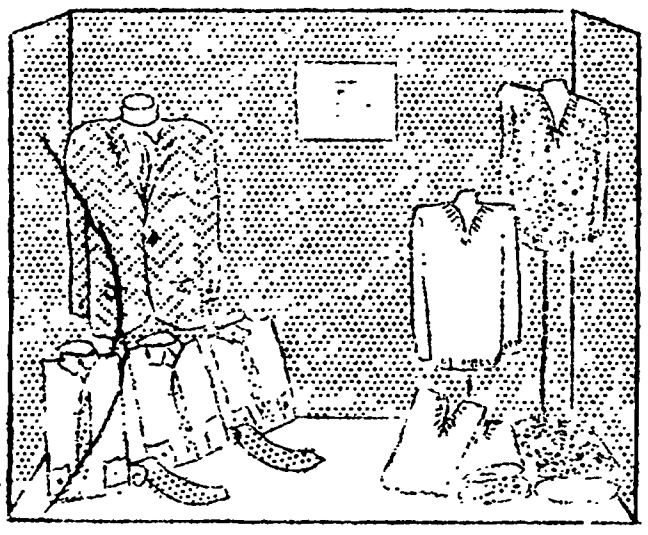


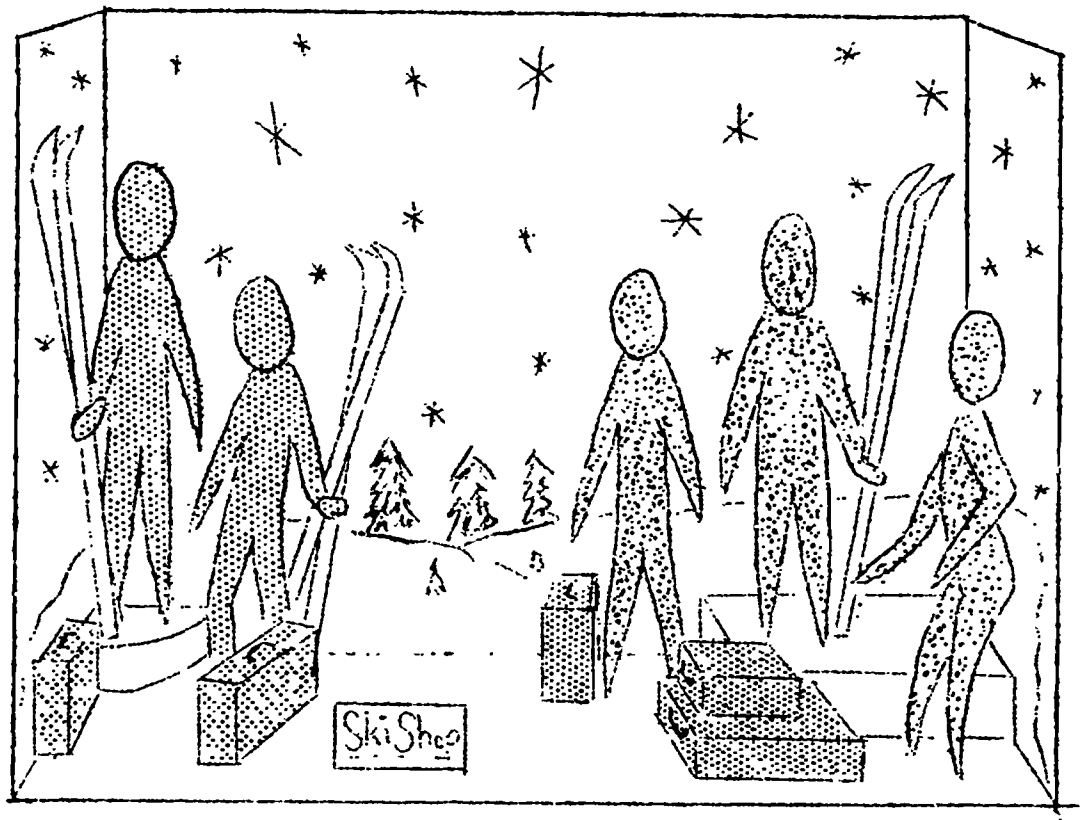


UNIT DISPLAY:

As opposed to mass display, the merchandise in unit displays is put into well defined groups. The features of the merchandise are more easily seen. A unit may be one item or several items grouped within the display. Grouping is accomplished by the use of space between units. Grouping normally is determined by the similar nature or relationships of the merchandise.

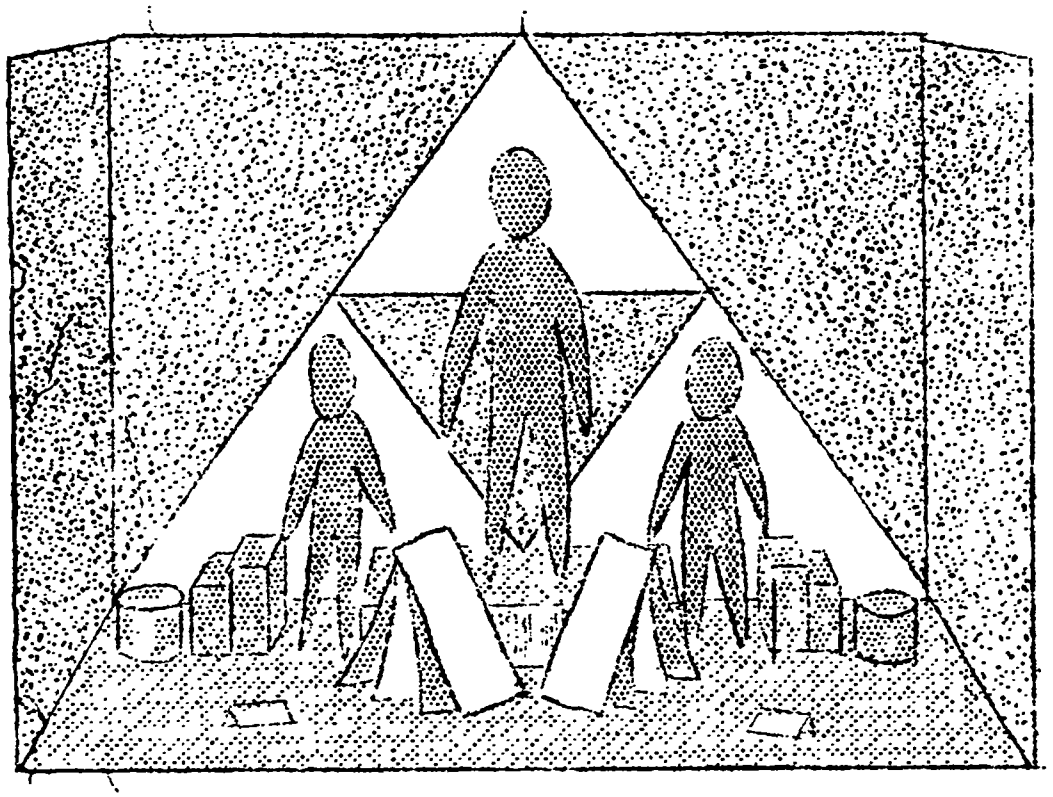


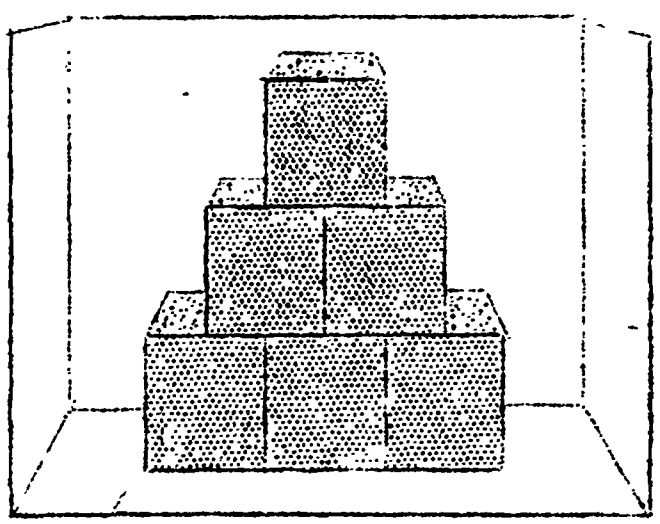


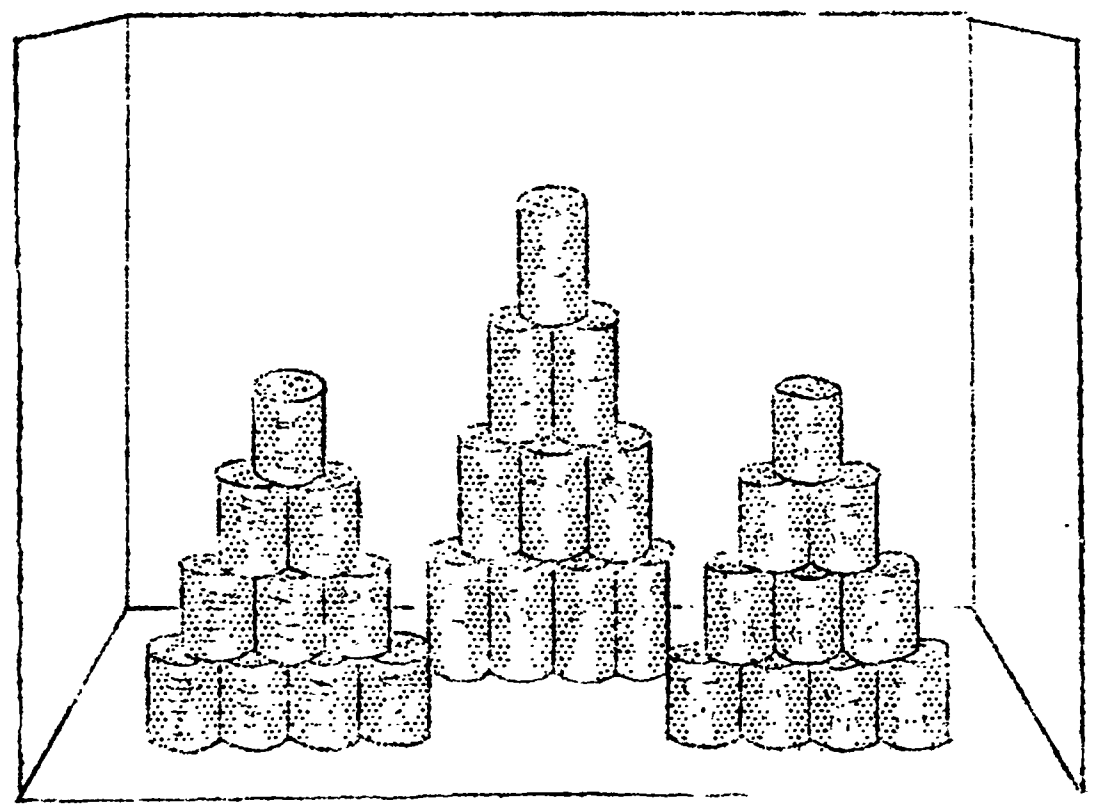


PYRAMID DISPLAY:

The easiest and perhaps most used arrangement is that of a pyramid. If only one pyramid of merchandise is centrally located in a display, perfect formal balance is present. More than one pyramid may be used -- or they can be combined with other shapes effectively.

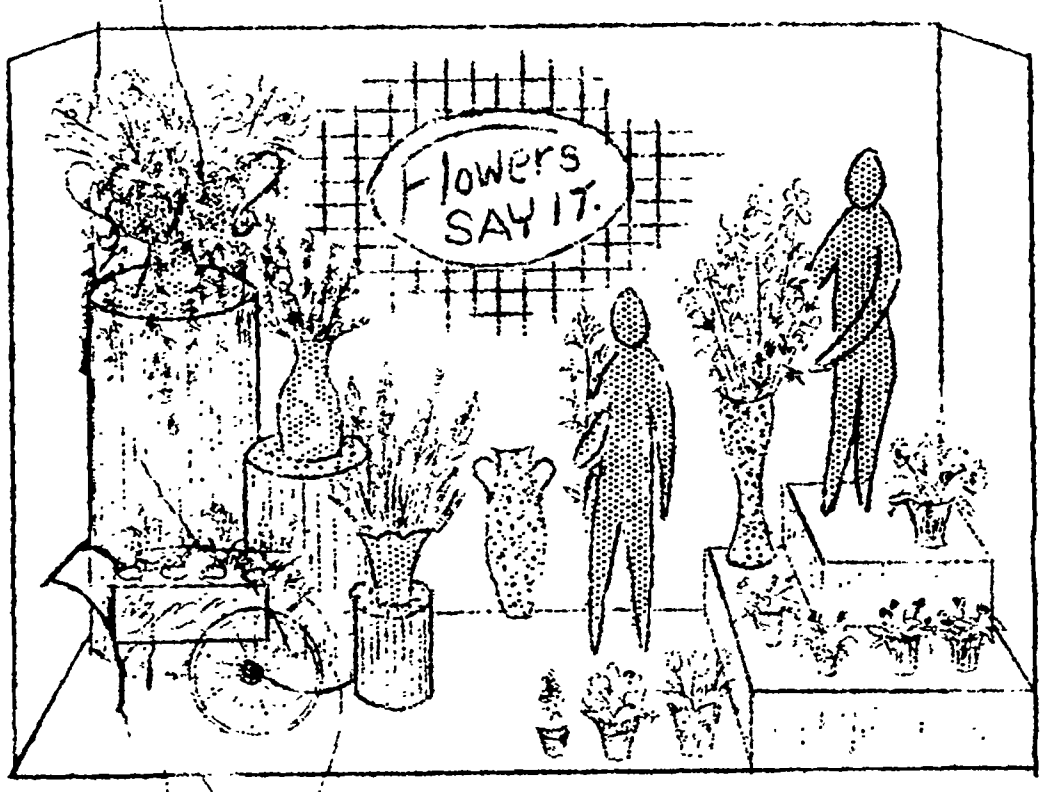


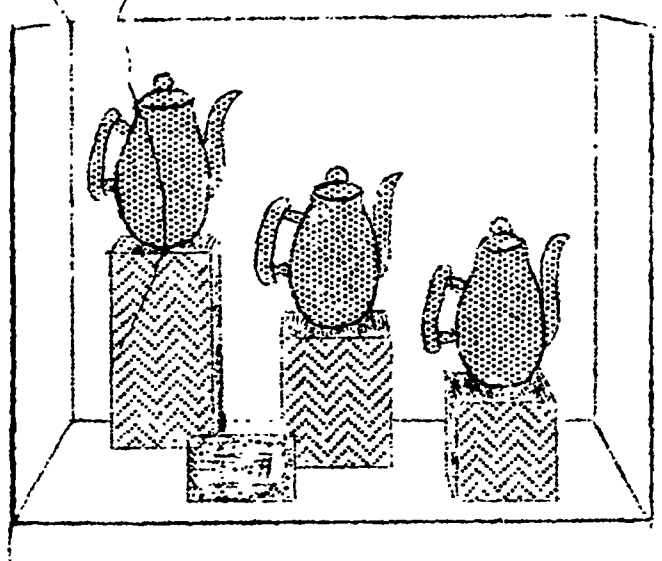


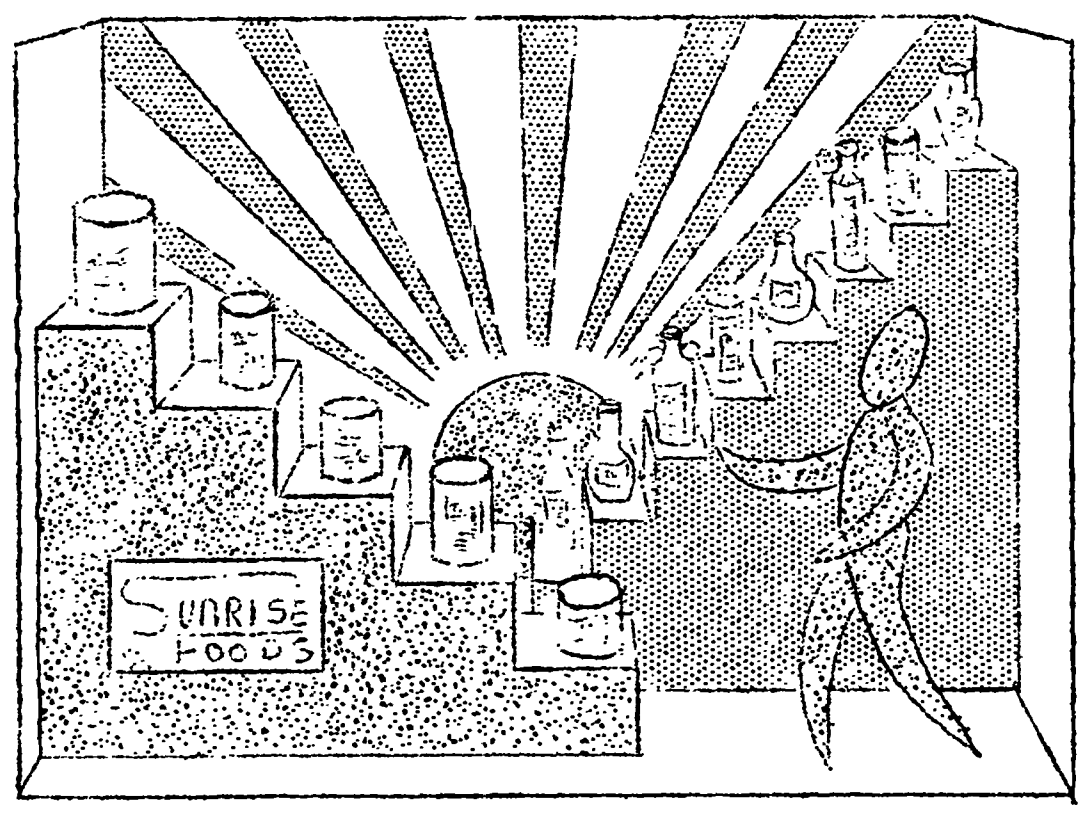


STEP DISPLAY:

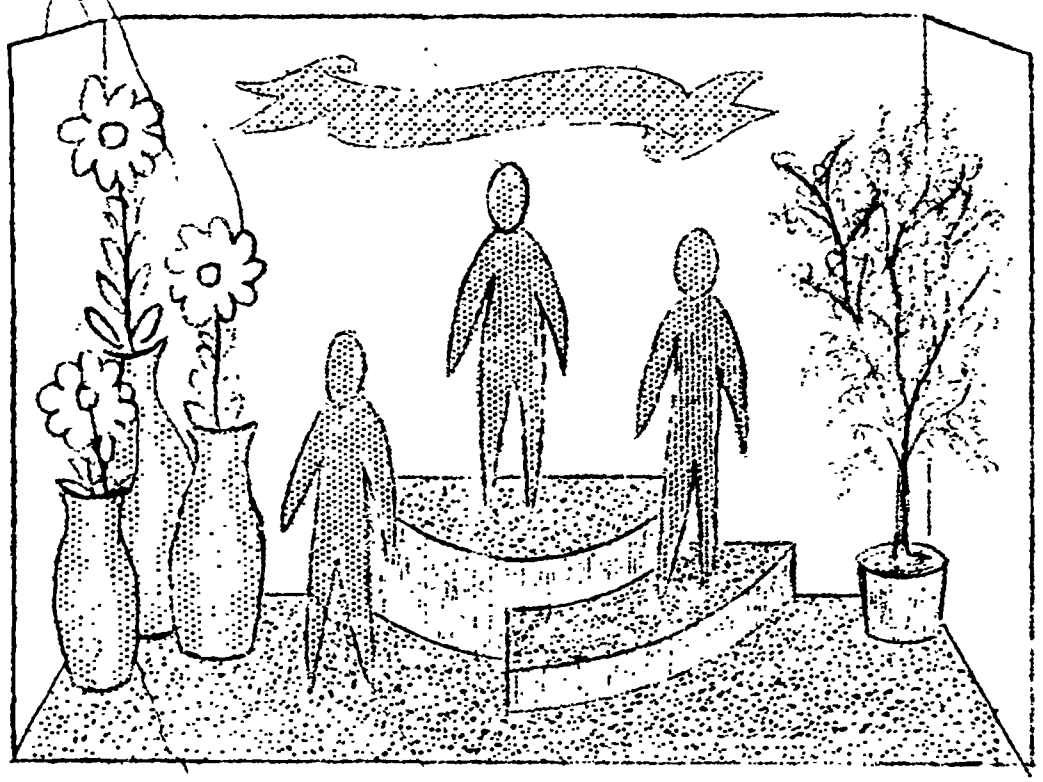
As the name indicates, objects are placed at equally distant heights to give an effect of stairs. This arrangement is an especially interesting placement of three items. It is sometimes effective as the central unit in a small display space -- or as side units in larger displays.



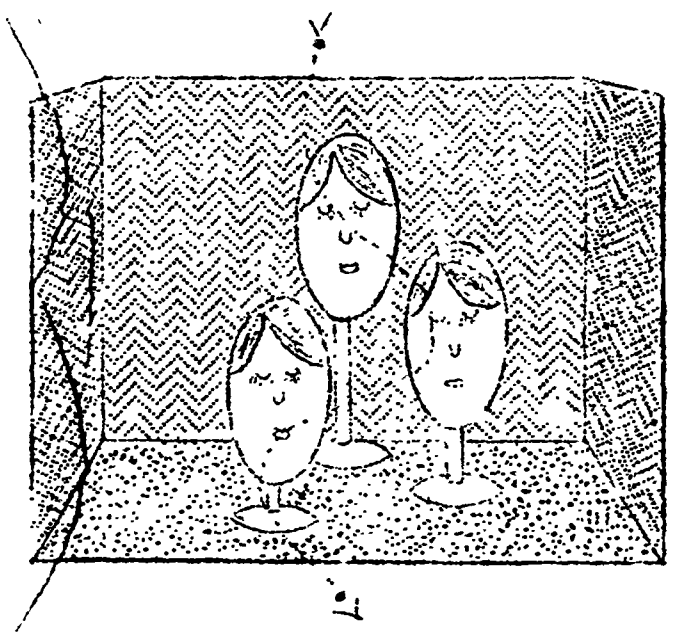


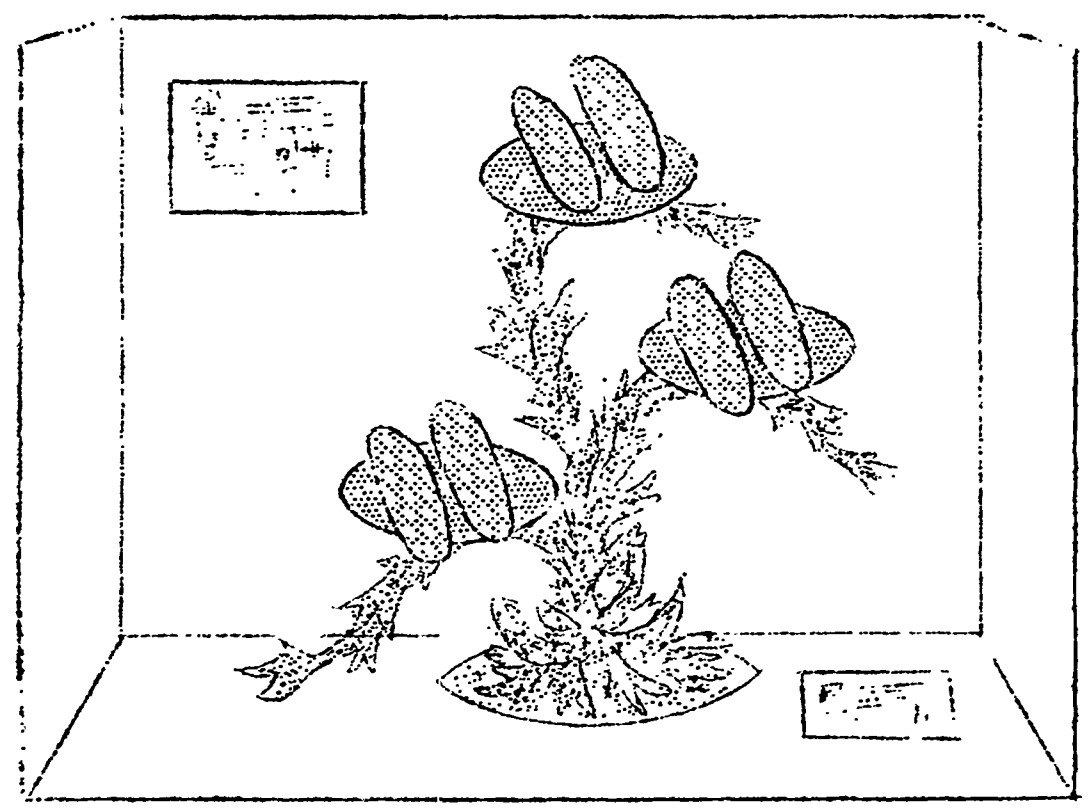


ZIG-ZIG DISPLAY:



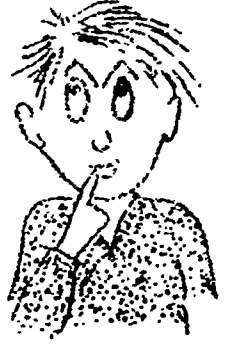
This arrangement is generally considered as the most interesting of those discussed. It is actually a variation on the step arrangement but is more graceful because it leads the eye in graceful curves rather than a straight line. The varied height of the objects must still be equal. The middle object is placed to the right or left of the highest item.





IDEAS

A display starts as an idea. The idea is a good one if it helps the display accomplish the purpose for which it is constructed. A display must serve as a selling tool rather than just being clever or artistic. It must present the merchandise or theme in a clear, easily recognizable manner. It must carry the viewer through the psychological selling steps to induce action.



The first step in planning a display is to determine the purpose for making it. Then a search for display ideas to accomplish this purpose must be made. Display ideas are not difficult to find. They come from observation and adaptation. The prime source of ideas will grow out of knowledge of the merchandise. The display man will ask: How is it used? Where is it used? Where does the raw materials come from? How is it made? What are the selling features and the benefits to the customer? Who are the potential customers? The answers to these questions will suggest a wealth of ideas for ways to effectively display the merchandise.

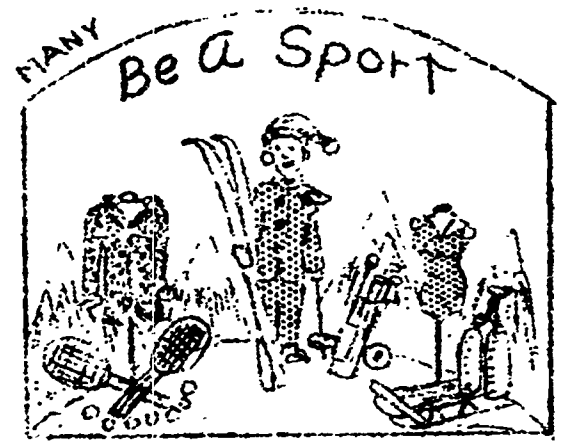
Other idea sources are found in the seasons, holidays, special events, store-wide promotions, or displays by others. Many display people collect and maintain files of display ideas for ready reference when needed.

It should be re-emphasized that whatever the display idea is, it should serve to call attention to and build interest in the merchandise itself. Merchandise must never be given a secondary place to elaborate or artistic fixtures, props, or backgrounds.

THEME - LIMIT TO ONE

A display should generally be limited to one theme or idea. To have more than this often confuses the viewer and renders the display ineffective.

For example, a display featuring winter sportswear would not include bathing suits or baseball gloves. Such a display might, however, feature ski equipment, sleds, ice skates, or perhaps luggage. Closely related items can add realism, interest and cohesiveness to the display. Unrelated items cause confusion, clutter, and unbelievability in the arrangement.



If it is necessary to present a number of unrelated types of merchandise in a display area the various types of merchandise that are related should be grouped and separated into distinct display units. Space should be used between unrelated groups so that the viewer can easily distinguish the groupings.

CALENDAR OF EVENTS

Displays should be timely. The months, seasons and holidays provide many display themes. Some obvious suggestions are these:

January: Mid-winter, New Years, White sales, Florida vacations (Father Time, baby, hourglass, palm trees, beaches).

February: Lincoln's birthday, Valentine's Day, Washington's birthday (log cabins, hearts - cupids, hatchets - cherries, flags - eagles).

March: St. Patrick's Day, Spring (Shamrocks, clay pipes, birds, flowers, butterflies).

April: April Fool's, Easter (Jesters, rabbits, chickens, eggs, lilies).

May: May Day, Mother's Day, Memorial Day (May baskets, flowers, May pole, carnations, flags, Red, White and Blue bunting).

June: Brides, summer vacations, Father's Day, Graduations (Bells, flowers, stained glass windows, caps and gowns).

July: Independence Day, summer vacations, (Flags, eagles, shields, stars and stripes -- sun, sports, travel, seashore, mountains).

August: Summer sale, start-back-to-school, continue summer fun (sports equipment, luggage, school supplies and clothes, apples).

September: Labor Day, School opening, Fall (School pennants, emblems, blackboards, books, apples, fall leaves, acorns, squirrels).

October: Fall, Football, Harvest, Halloween (Football stadiums, leaves, rakes, pumpkins, corn shocks, owls, brooms, cats, witches, skeletons).

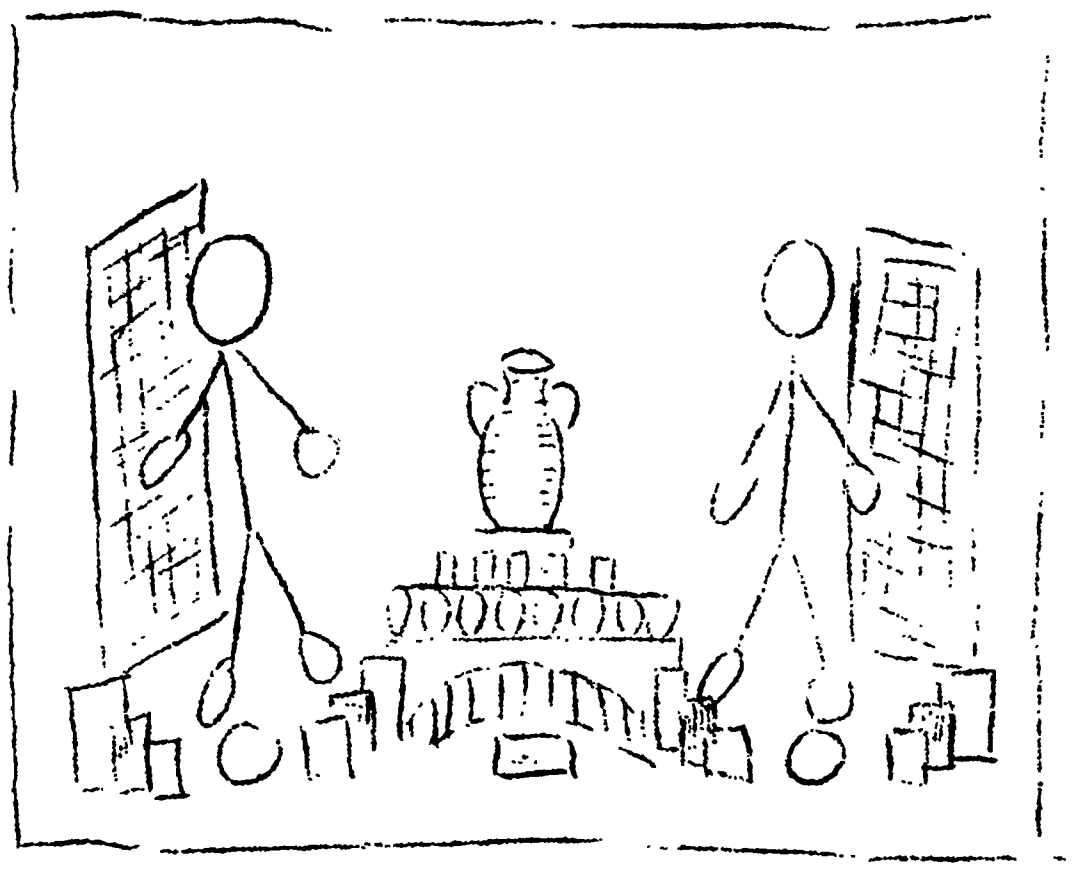
November: Winter, Thanksgiving, prepare for Christmas (snowflakes, turkeys, Pilgrims, Horn of Plenty).

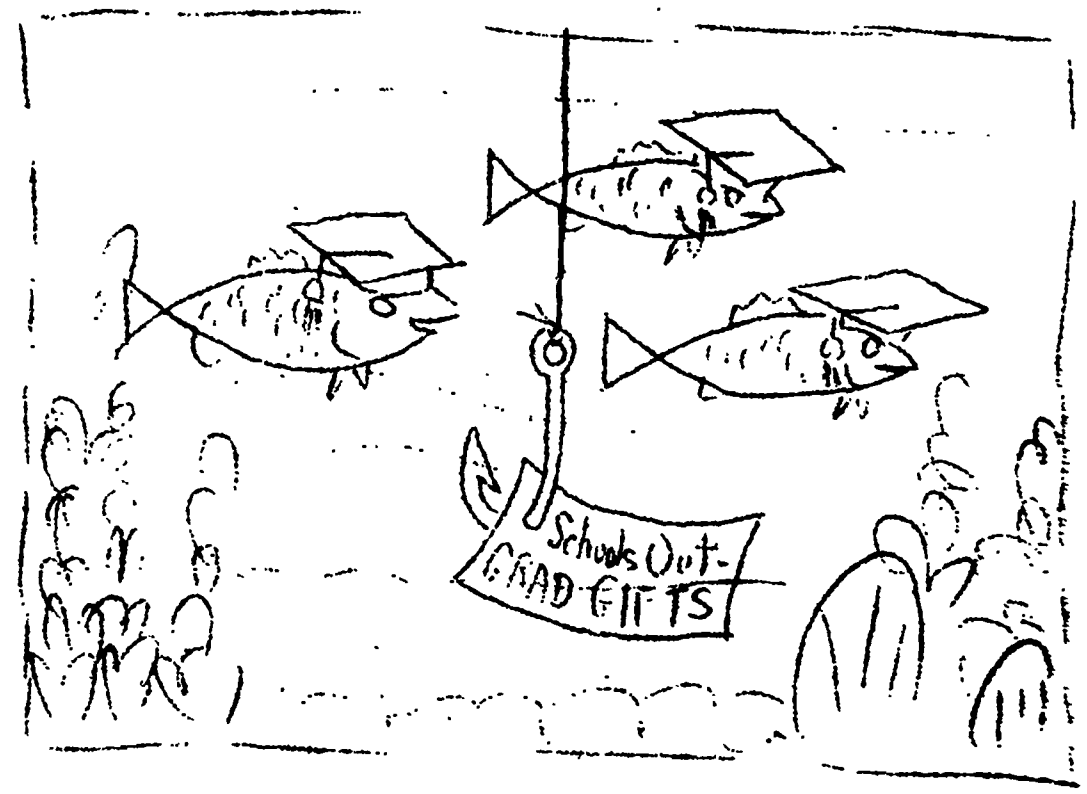
December: Christmas (Stars, snowman, angels, Santa, chimneys, reindeers).

SKETCH IDEA

After the purpose of the display is determined and several themes - or ideas - to accomplish this purpose are considered, it is desirable to draw rough sketches of the possible display.

Putting your ideas on paper before actually starting to construct displays will save time and result in more effective displays. The sketches do not need to be artistic nor detailed. Even a few lines or shapes will give a basic visualization of your display ideas. From these elementary drawings it is possible to choose the one which has the most appeal.





Making a sketch will force you to give advance attention to the principles of display -- How does it balance? Where is the emphasis? -- etc. In putting the idea on paper you must deal with the space relationships, shapes, sizes and the visual weight of objects. The sketch will help you determine how merchandise should be placed and corrections can be made more easily on paper than in working with the actual display.

ASSEMBLE MERCHANDISE AND FIXTURES

The rough layout or sketch of your display idea now becomes a valuable tool in making the actual display. The sketch will serve as a plan from which to determine in advance what essential elements and details will be needed to accomplish the display. From the sketch you can readily list the types, sizes, colors, styles, etc. of the merchandise you wish to include in the display.

The need for signs, price tags, and show cards will be obvious from the sketch and these items can be prepared ready for immediate use. Fixtures requirements to properly display the merchandise, to elevate it, form it, drape it, etc. will be readily seen in the sketch and can be assembled.

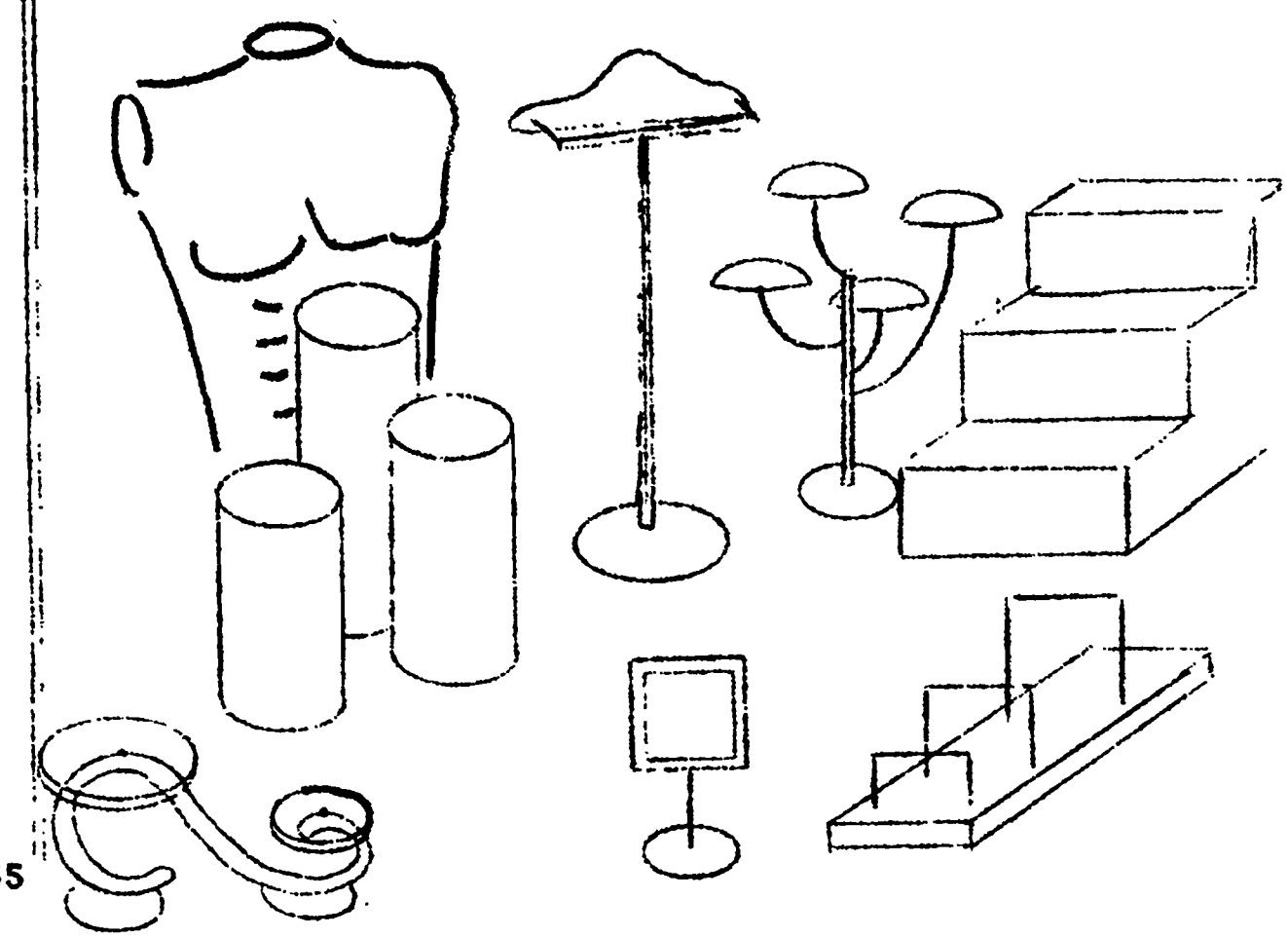
Background materials, floor coverings, special effects, properties, artistic decorations and accessories can be selected on the basis of the needs revealed in the sketch. Necessary art work can be completed well ahead of the deadline.

Proper lighting to achieve the desired effect can be visualized in the sketch and the problems anticipated.

The value of the advance layout sketch of the display idea will be proven at the time of actually making the display. All the preplanned elements can be brought together and the construction of the display will go smoothly. The disorganized last minute hustle and frustration resulting from forgotten details will be avoided. An attractive, effective display will most likely result where such planning is used.

A Word on Fixtures:

It will be a valuable asset to the student of display to become very familiar with the great variety of display fixtures available and their functions. Good arrangement and design often depends on knowing how to use the various fixtures to advantage.



OBSERVE, PRACTICE, STUDY

This manual has sought to present some basic concepts of display in very general and easily understandable terms. Because of its general nature, many details and refinements of display art have been omitted. It is believed, however, that the student who has given proper study to this manual will be well enough grounded in principles to accomplish attractive and useful displays.

The serious or career-minded student will want to read in much greater depth and some excellent sources of information are found in the bibliography.

Knowledge and understanding of display is greatly enhanced through practice in display making and careful observation of the displays by others. A feeling of what is and is not effective display can be developed by anyone interested enough to read, observe, analyze and practice. Through these efforts will come solidly based understandings and knowledge.

Some examples of the learnings that come with experience are these:

A student will discover that cleanliness and neatness are absolute musts in constructing displays. No amount of clever designing will make shoddy merchandise attractive -- nor a dirty plate glass window or floor acceptable.

Displays are often most effective when displayed in such a manner that the viewer can visualize himself owning and using the merchandise.

Simple, uncluttered displays are often more effective than elaborate ones.

Motion will attract attention to a display but it must serve some useful purpose to retain interest.

Generally speaking a plain background will serve better than a detailed one.

Color must be used carefully and the use of color is well worth spending time to study.

Good displays result from good planning.

Displays ARE a powerful sales tool when properly used. A store should be well stocked on items featured in displays.

Etc., etc.

END

It is our sincere wish that this manual has been helpful and some new doorways of learning have been opened to those who have avoided the study of display in the past because they thought it could be understood only by especially talented and artistic persons.

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Ohio State Dept. of Education, Columbus. Materials Lab.
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PUB DATE - ND 34p.

DESCRIPTORS - *DISTRIBUTIVE EDUCATION; *STUDY GUIDES; *RESOURCE MATERIALS; *PUBLICIZE; *TRANSPARENCIES; MERCHANDISING
IDENTIFIERS - *ADVERTISING LAYOUT

ABSTRACT - The 32 charts of rough layout illustrations are designed to acquaint students with the elements of an advertisement and to show that an advertisement may take many different forms by rearranging the elements. The illustrations can also be used for transparencies. (SB)

VT 010 412

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& WELFARE
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The following series of rough layout illustrations serves to illustrate the many different variations of form that a layout may take. It is meant to show the students the elements of an advertisement and how many different forms an "ad" may take by simply rearranging these basic elements. These can be made into transparencies to facilitate illustration.

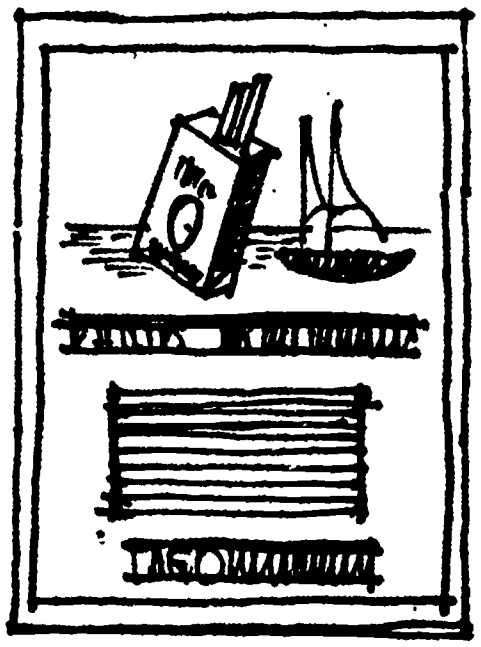
This set of illustrations was originally conceived by:

The Division of Vocational, Technical & Adult Education
Dade County Public Schools
1410 Northeast Second Avenue
Miami, Florida 33132

It was given to us with permission to reproduce by our old friend, G. E. (Pat) Patterson. We are extremely grateful to Pat and the Dade County System for passing it on for our classroom use.

ERIC

CHART 1



NORMAL PATTERN LAYOUTS

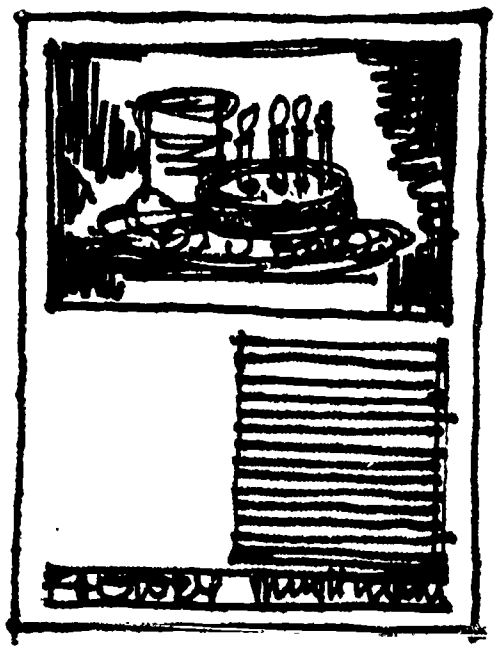


Illustration at top of area.
Heading Next
Copy Next
Logotype last.

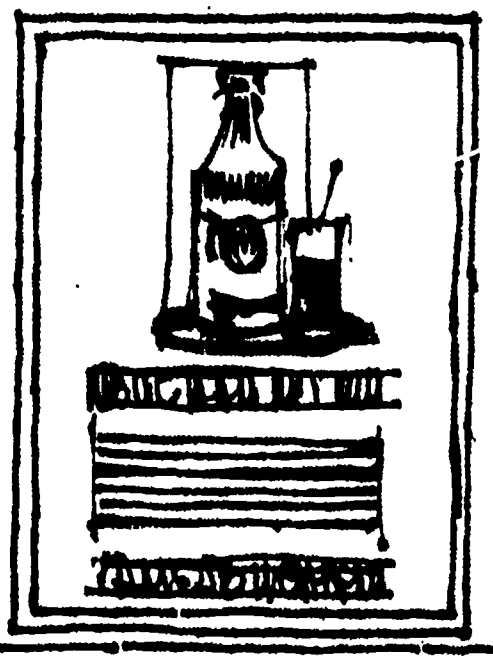


CHART 2

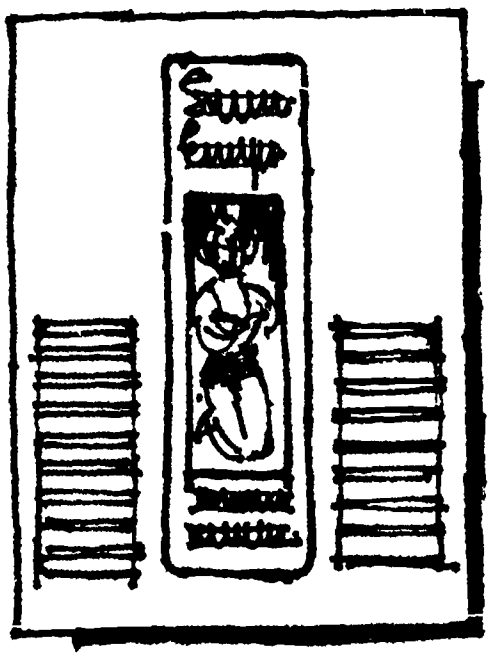
HEADING NORMAL
LAYOUT

HEADING FIRST

ILLUSTRATION

COPY

LOGOTYPE



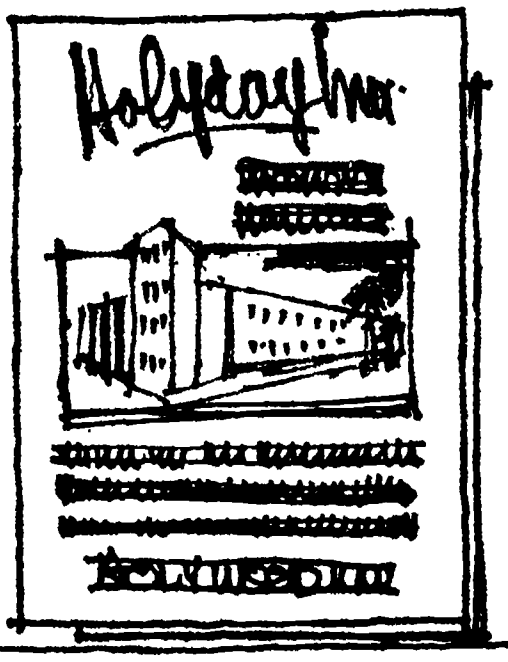
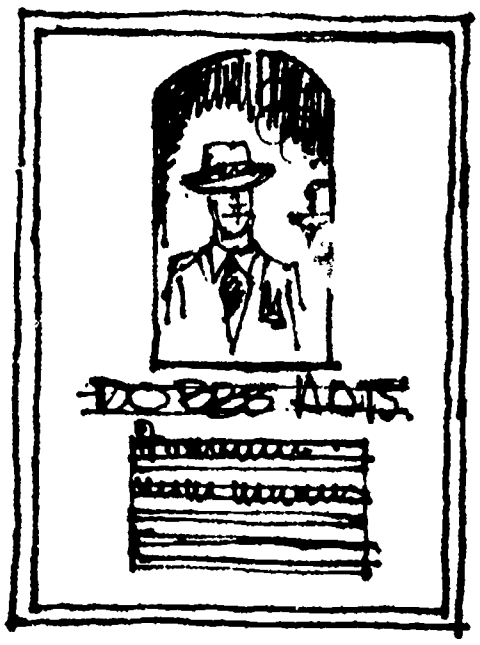
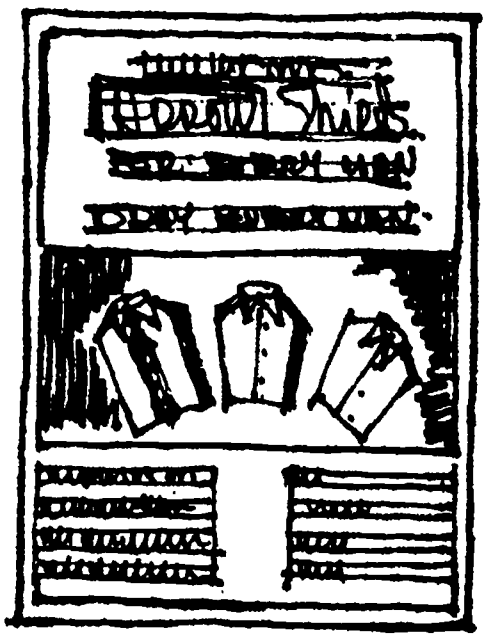


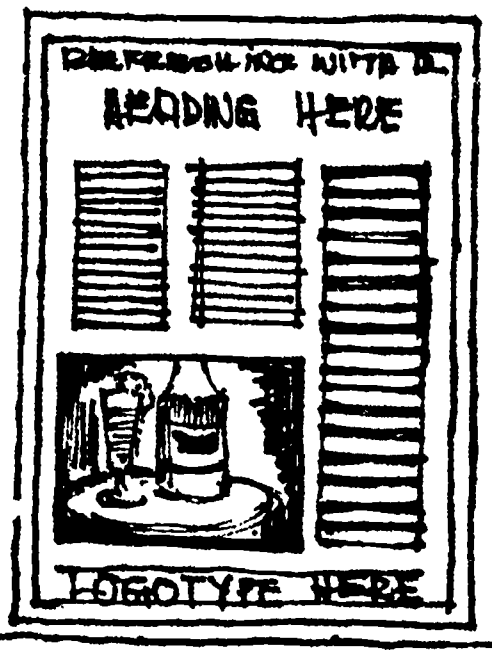
CHART 3

REVERSE NORMAL LAYOUTS

THE ORDER OF THE NORMAL PATTERN OF ELEMENTS IS REVERSED.







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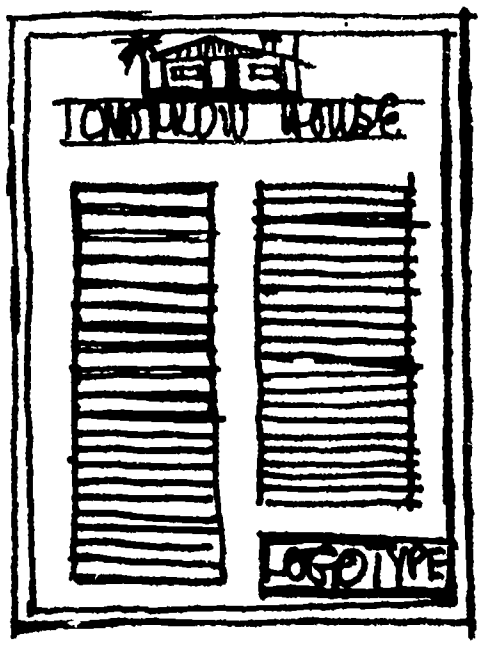

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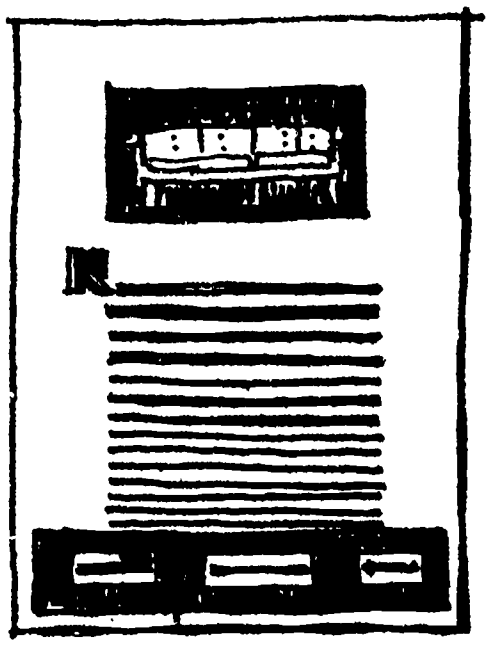


TYPE PREDOMINANT, ILLUSTRATION USED ONLY AS COLOR SPOT.

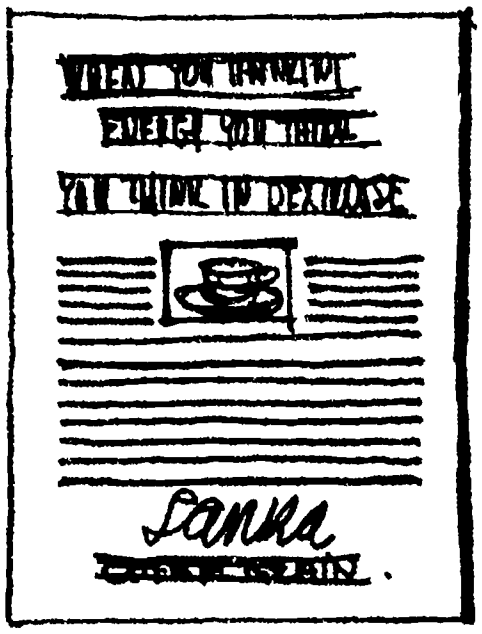
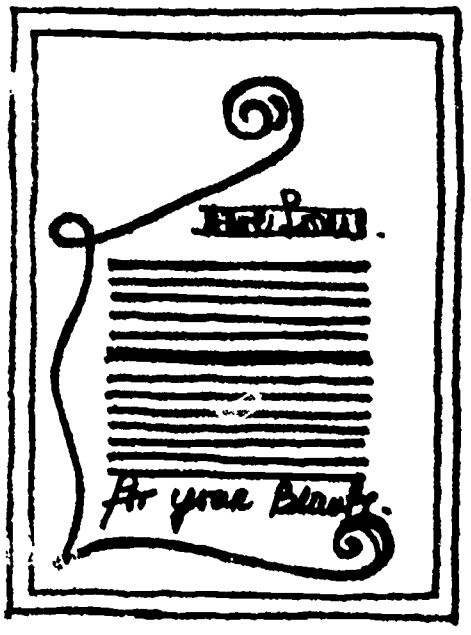


CHART 5

VARIATIONS

THE NORMAL PATTERN WITH VARIATIONS IN TREATMENT.



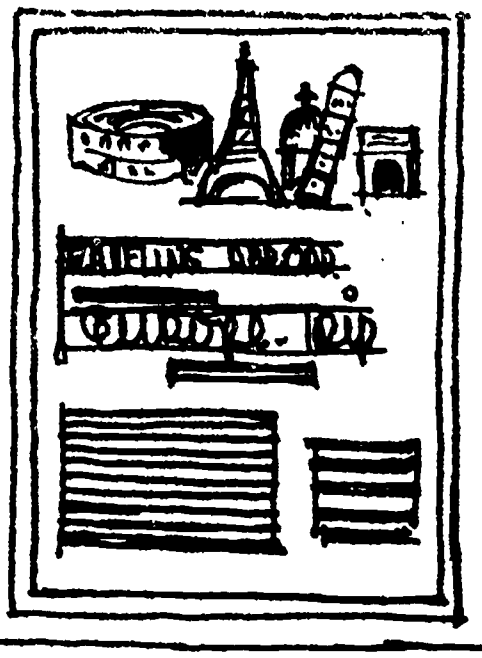
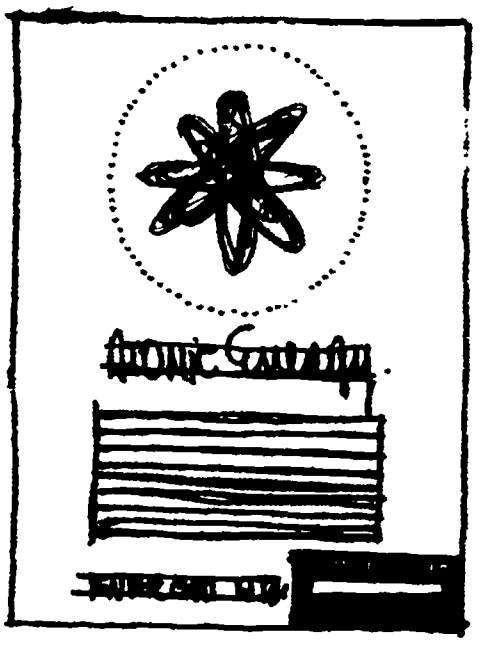
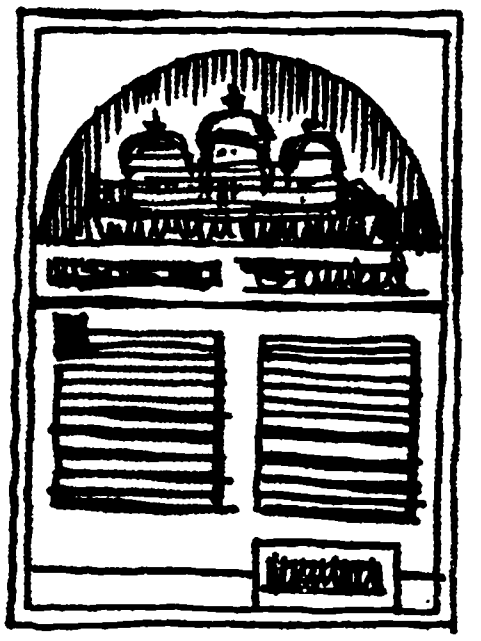


CHART 6



CIRCLE LAYOUT



THE ORDER OF NORMAL PATTERN WITH ILLUSTRATION IN A CIRCLE.

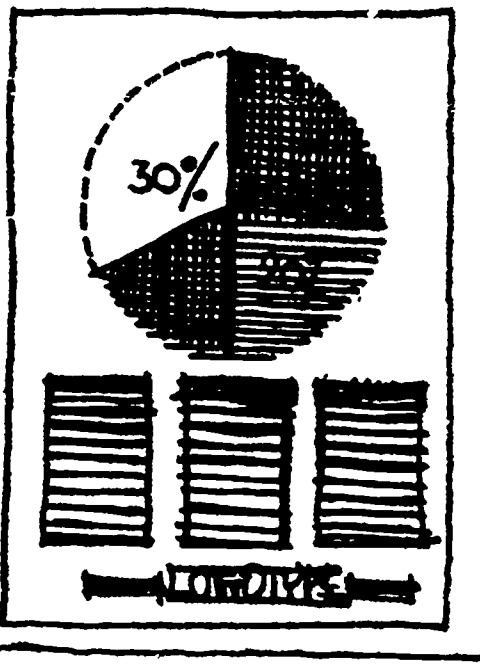


CHART 7

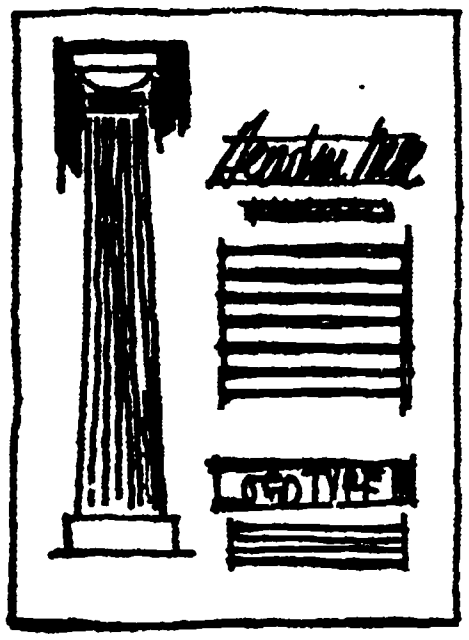
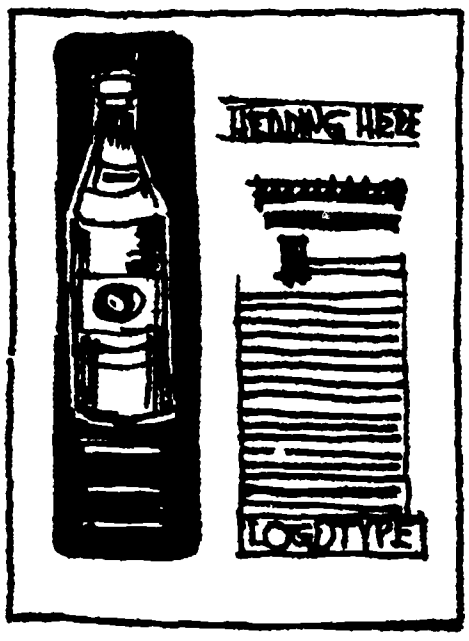
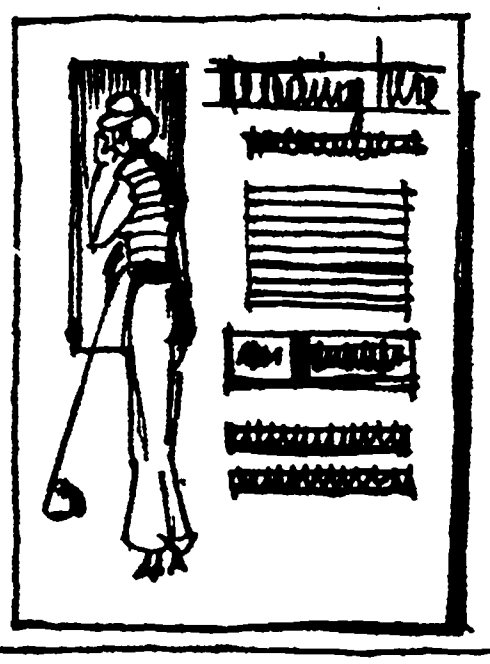


ILLUSTRATION LEFT

THE ILLUSTRATION VERTICAL ON LEFT, HEADING AND COPY RIGHT.





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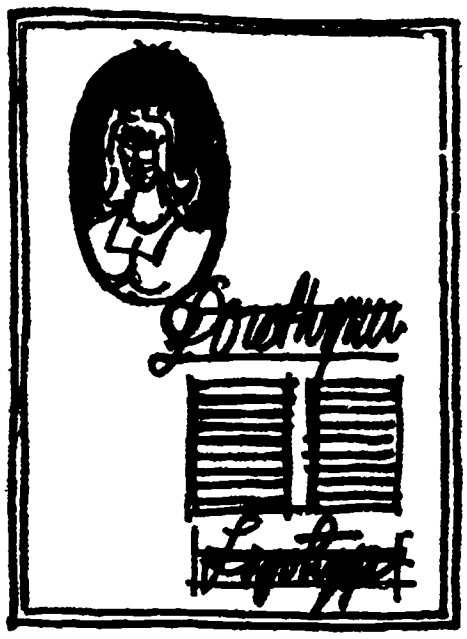
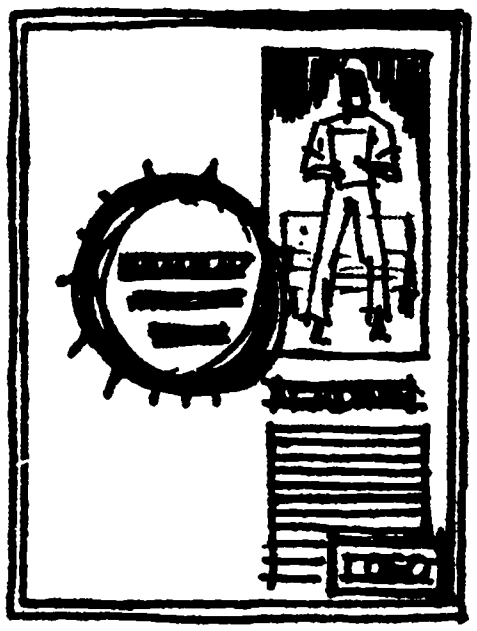
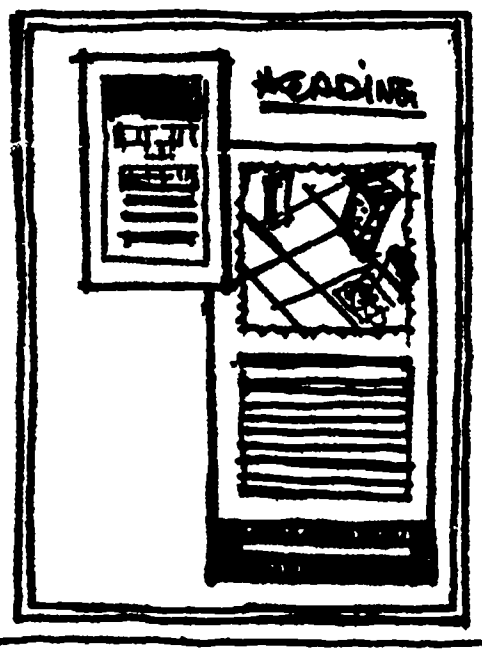


RIGHT
OR
LEFT
LAYOUTS



THE ILLUSTRATION
EITHER ON THE
RIGHT OR LEFT.



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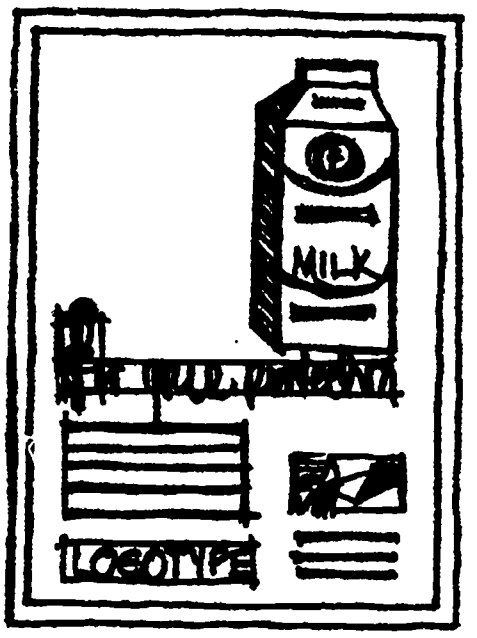


VARIATIONS

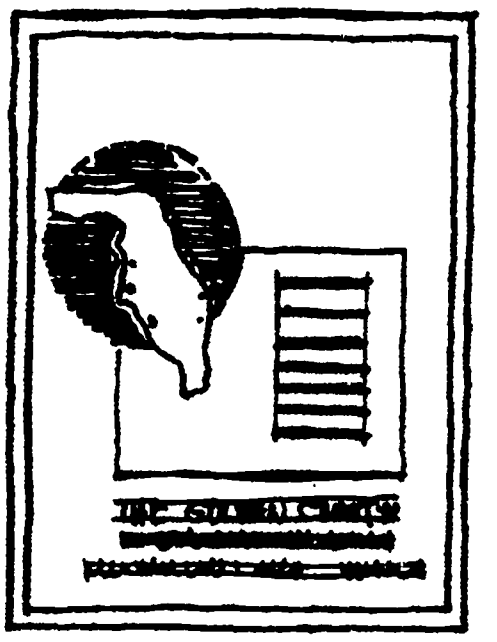


ILLUSTRATION TO
RIGHT OR LEFT WITH
VARIATIONS IN TREATMENT.

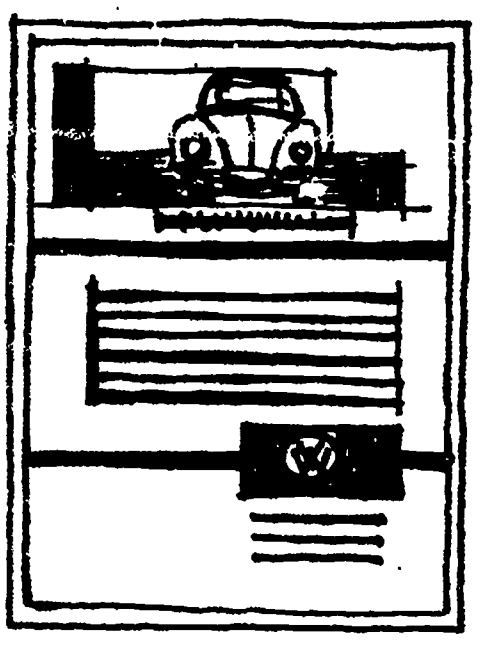
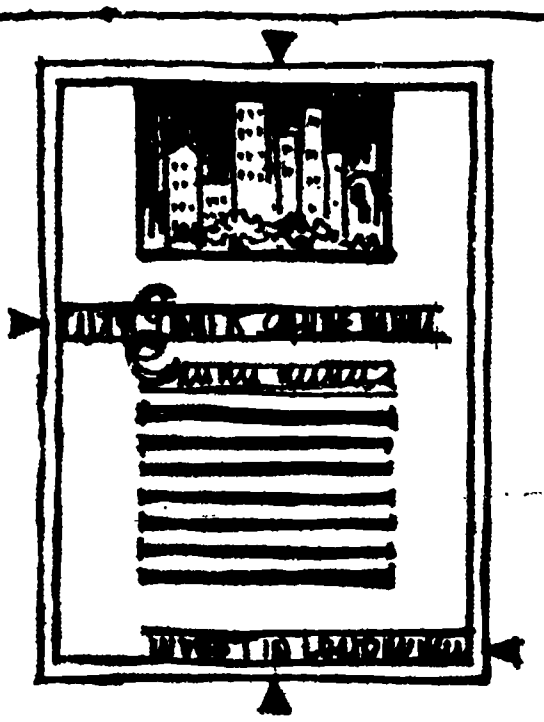
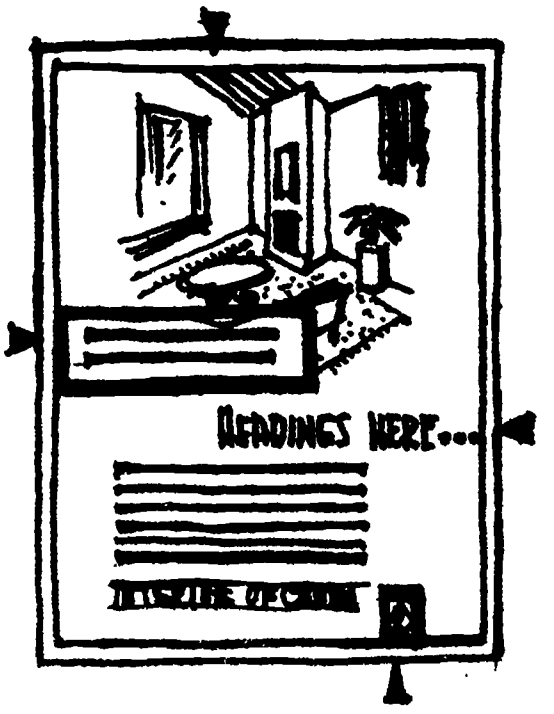


CHART 10

4 POINT LAYOUTS

THE LAYOUT TOUCHES ALL FOUR SIDES OF THE SPACE ONCE AND ONLY ONCE





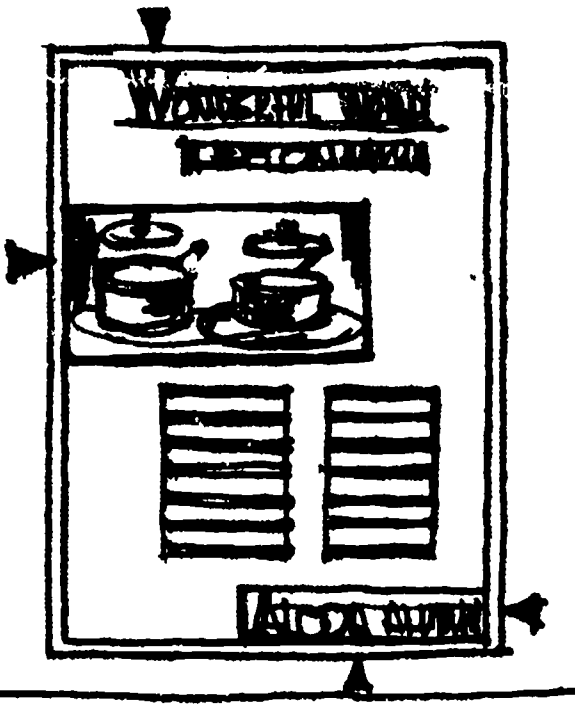
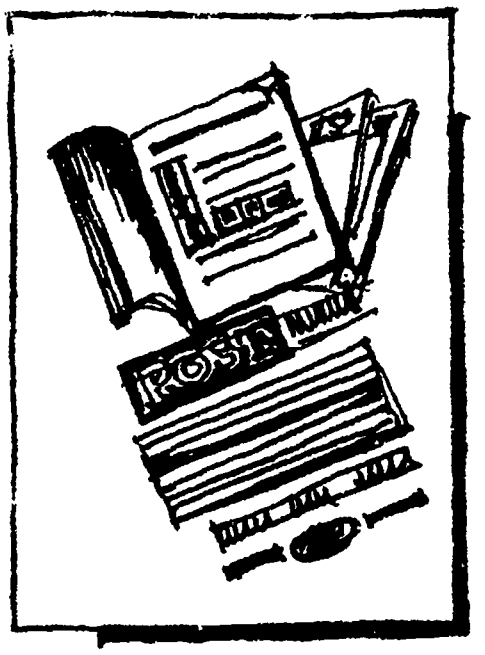
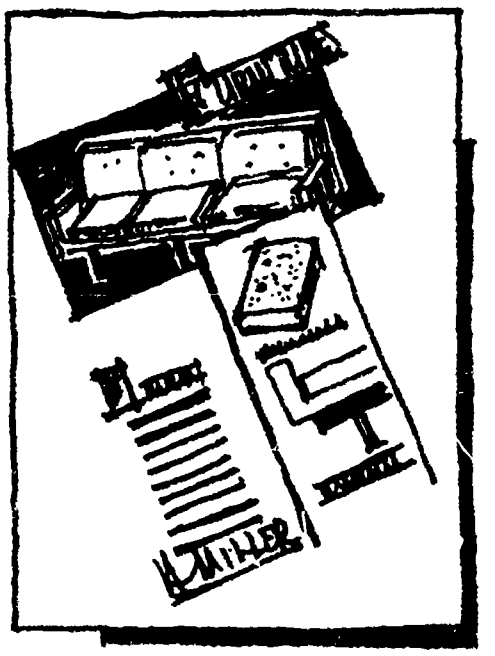


CHART II



OBLIQUE AXIS

THE LAYOUT OR THE MAJOR PORTION OF THE LAYOUT TIPS TO RIGHT OR LEFT.



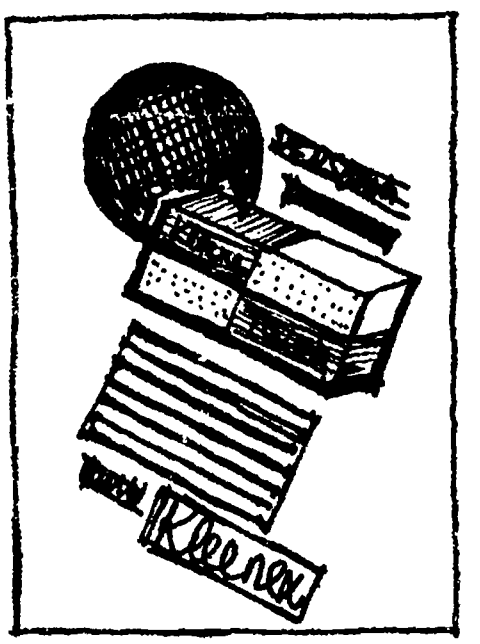
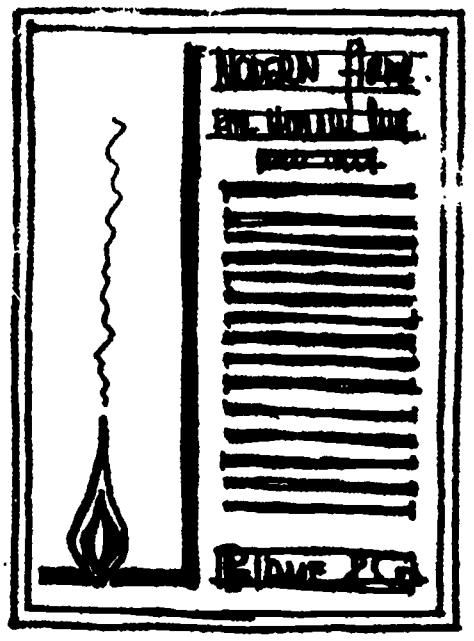
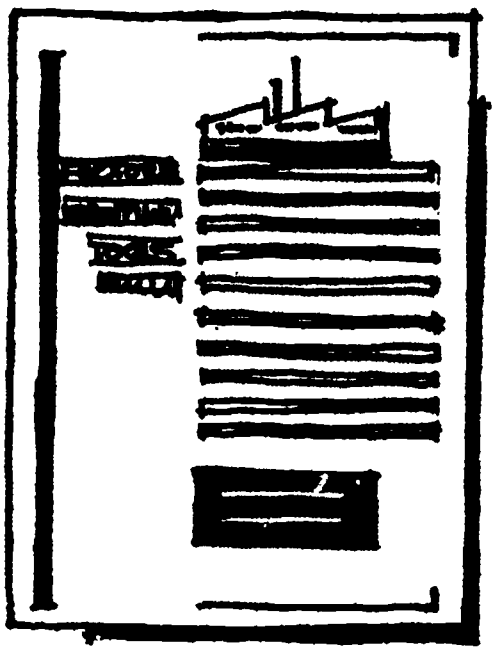


CHART 12



VERTICAL AXIS

UNITS RUN FLUSH TO ONE SIDE OF AN ACTUAL OR IMPLIED AXIS



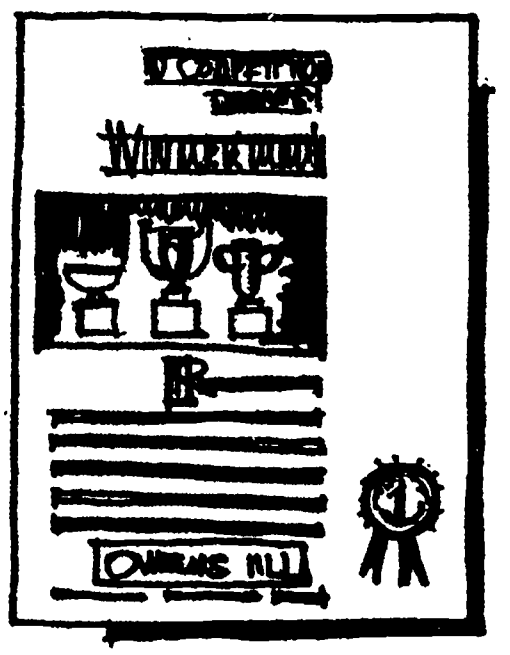
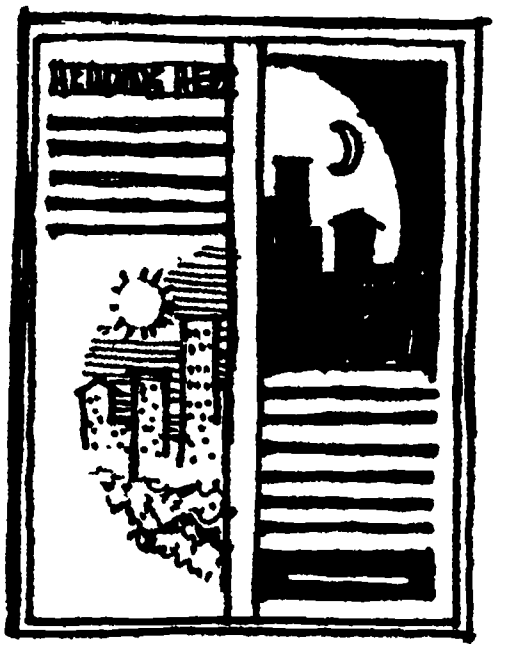


CHART 13

CENTER AXIS TYPE LAYOUT.



THE HEADING, COPY, ILLUSTRATION, LOGOTYPE FLUSH ON ALTERNATE SIDE OF AXIS

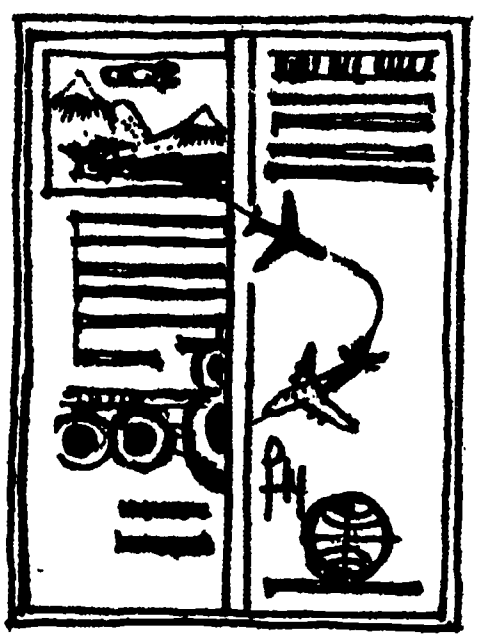
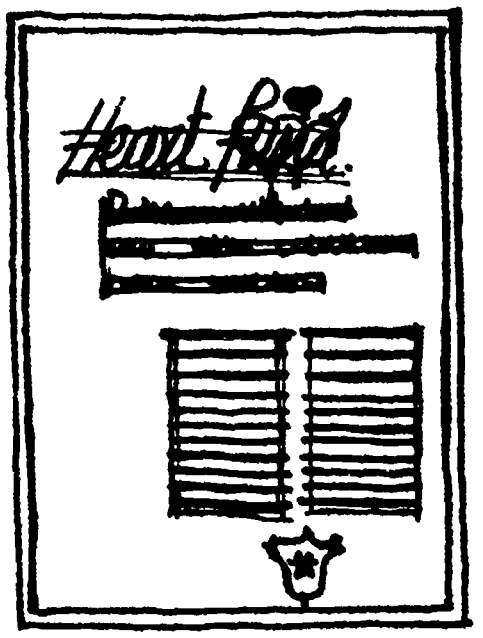


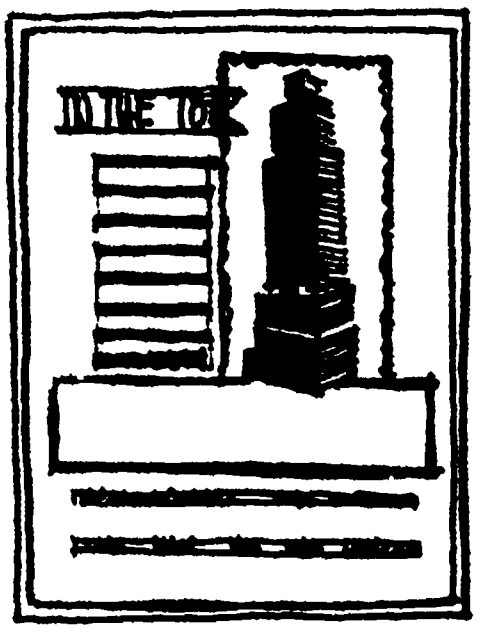
CHART 14



OVER

DOWN

ACROSS



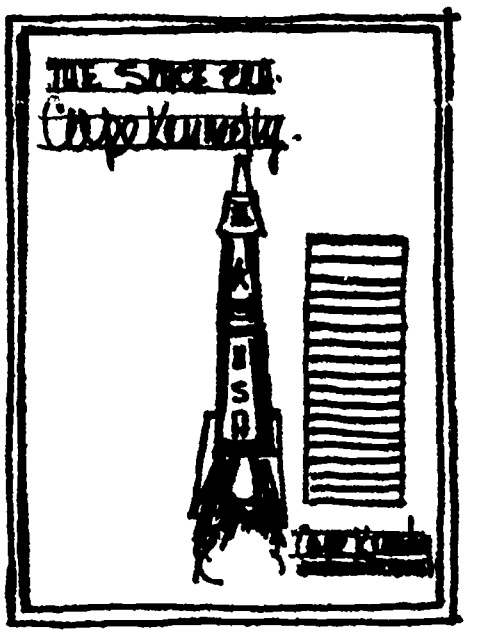
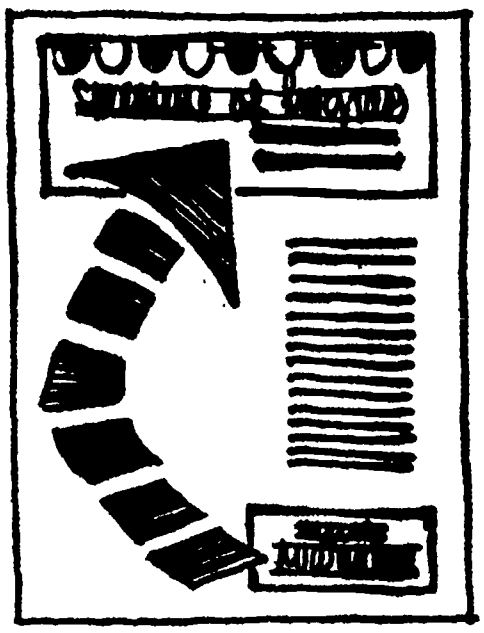


CHART 15

EYE DIRECTOR

HEADING OR ILLUSTRATION MOVES TOWARD THE READING MATTER.



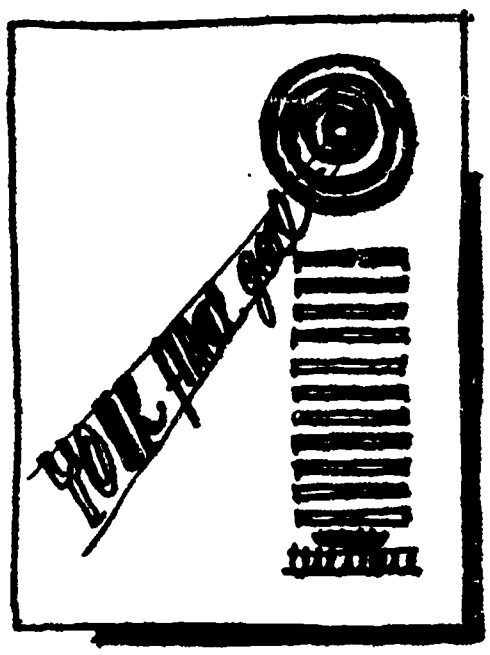
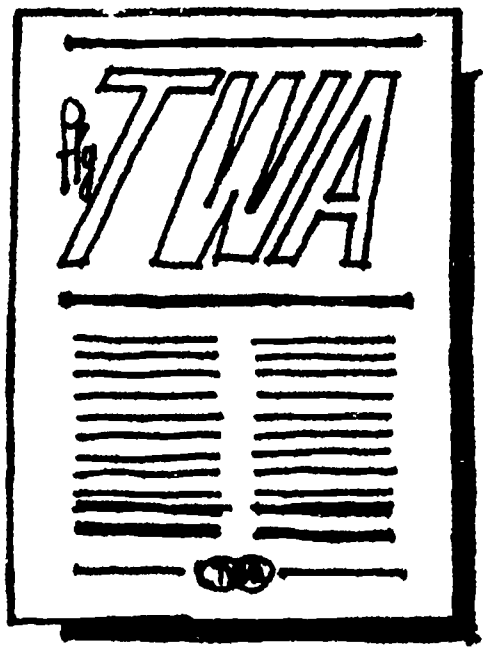
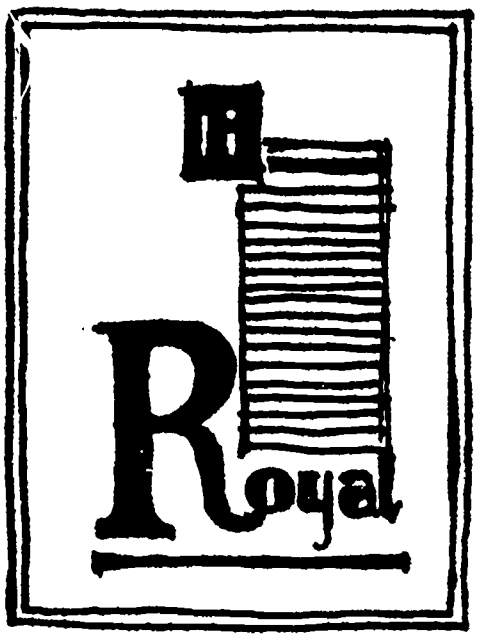


CHART 16



LETTERING ILLUSTRATIVE

THE HEADING OR THE LOGOTYPE MADE ILLUSTRATIVE.



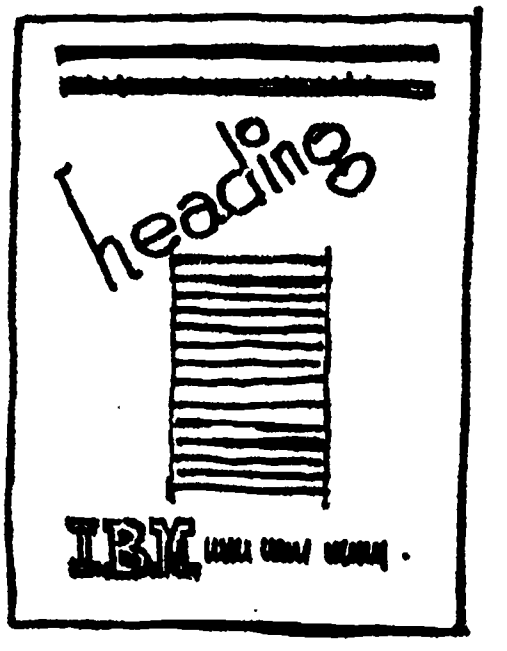
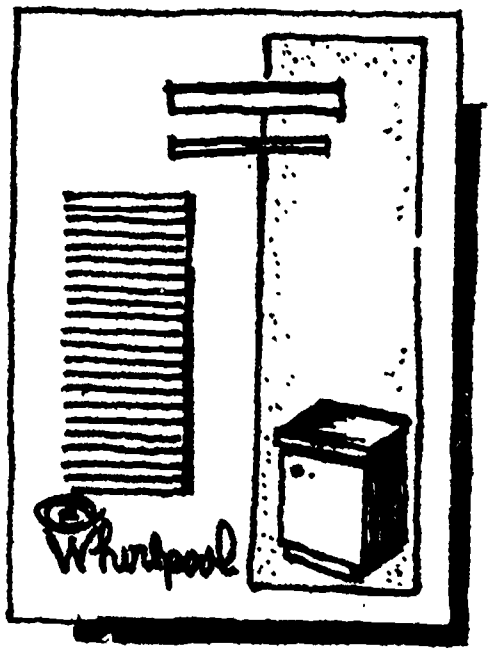
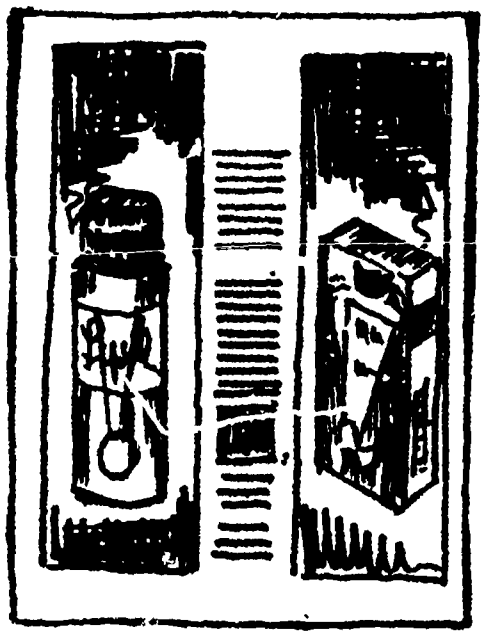


CHART 17



VERTICAL PANEL LAYOUT

THE AREA IS DIVIDED INTO VERTICAL PANELS OF COLOR.



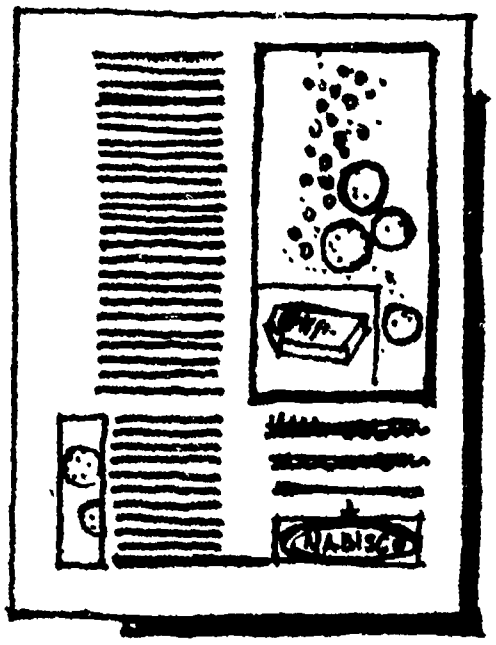
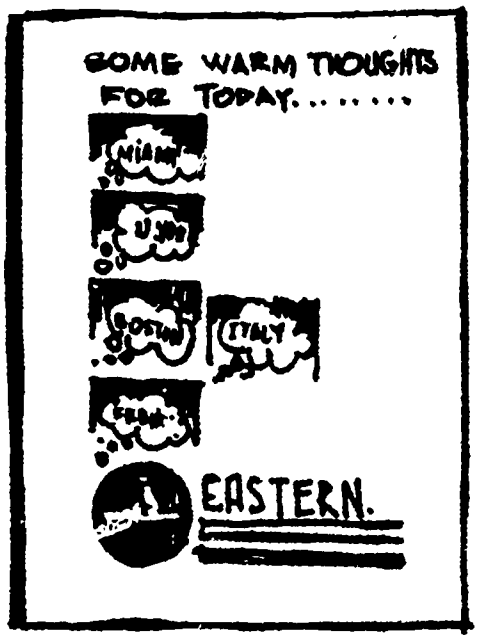
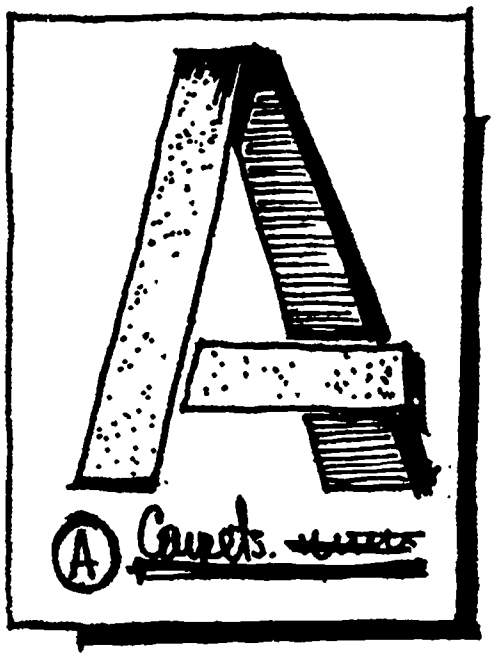


CHART 18



LETTER LAYOUTS

PATTERN TAKES THE SHAPE OF A LETTER IN THE ALPHABET



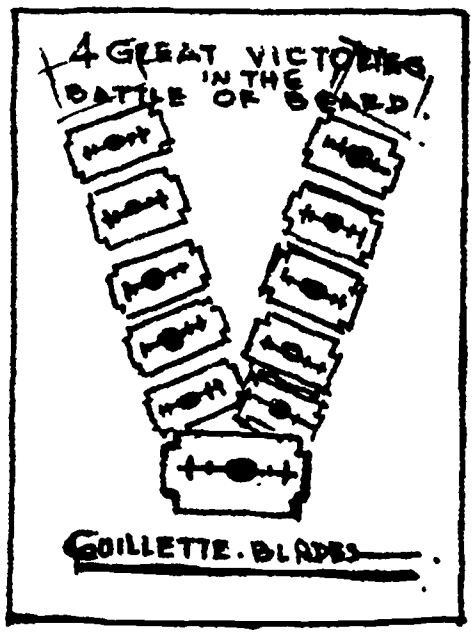
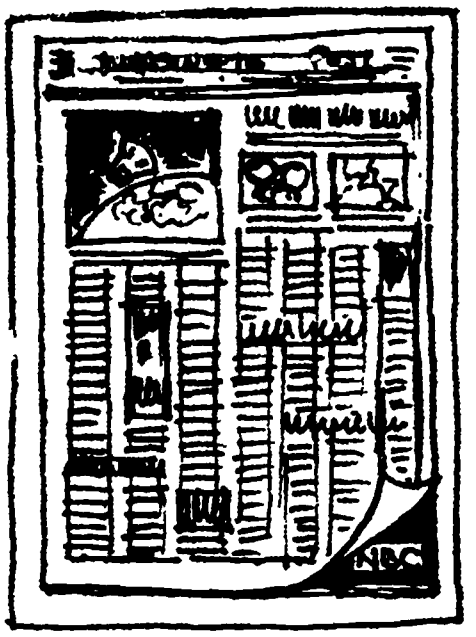


CHART 19



COMMON FORMS LAYOUT

AD APPEARS AS A NEWSPAPER PAGE, CARTOON STRIP, OR MAGAZINE ARTICLE.

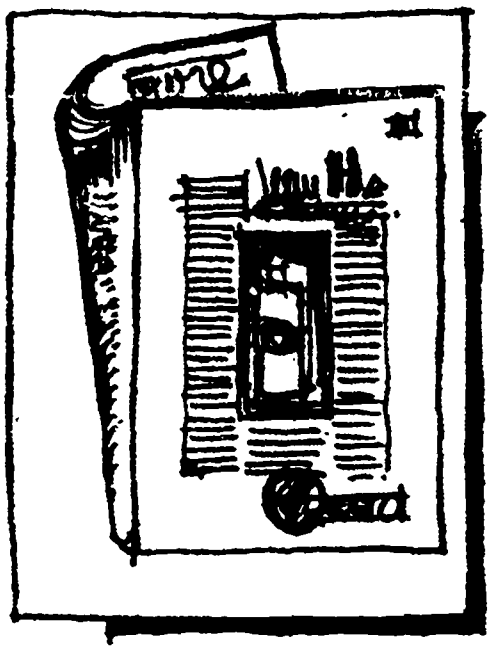
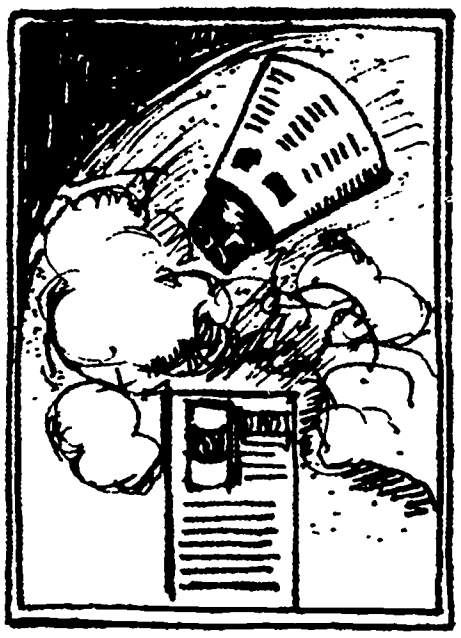
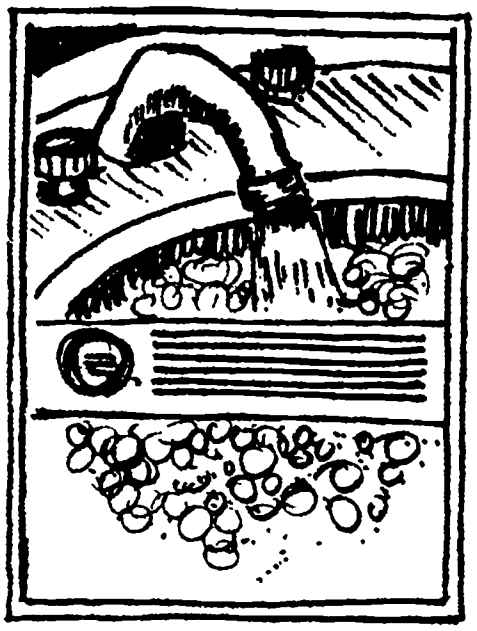


CHART-20



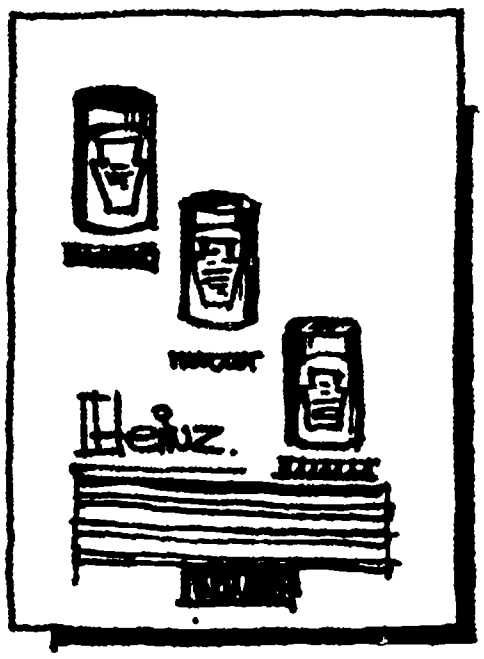
FULL ILLUSTRATION

LAYOUT.



THE ILLUSTRATION COVERS ENTIRE AREA, COPY BOXED OVER IT.

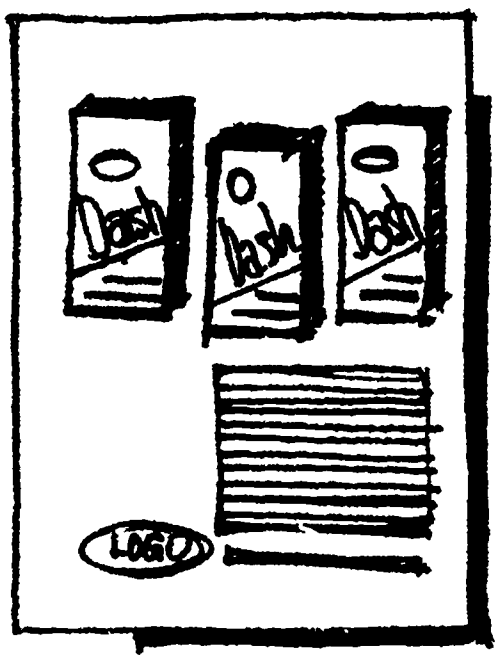
CHART 21



FRENCH

SINGLE STYLE

LAYOUT



A SINGLE UNIT IS REPEATED THREE OR MORE TIMES IN THE SAME MANNER.

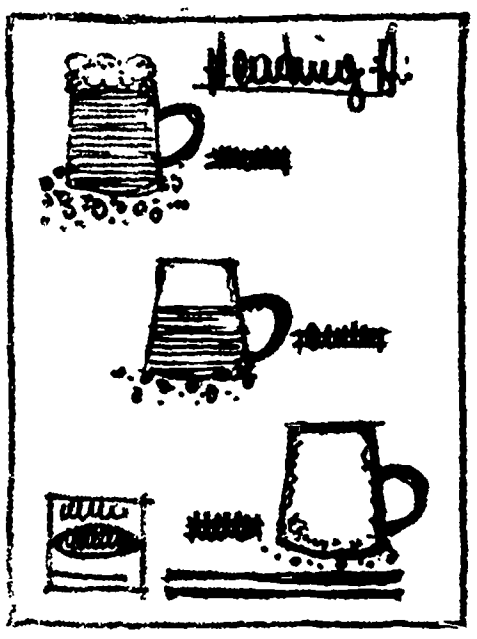
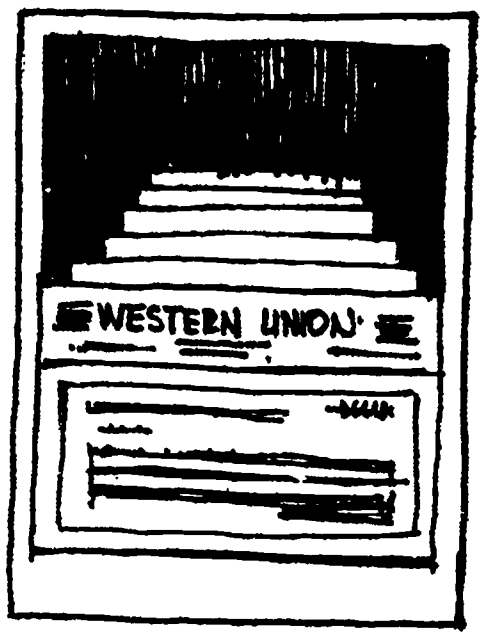


CHART 22

OPEN AND CLOSED

LAYOUT



COPY, HEADING, AND LOGO,
BOXED.— ILLUSTRATION.
OPEN.-.

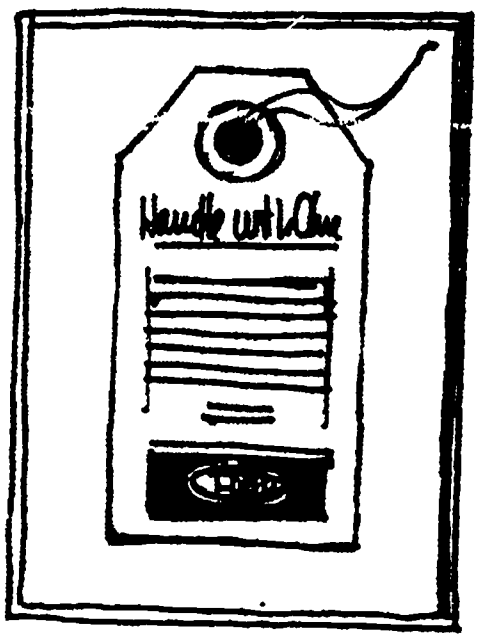
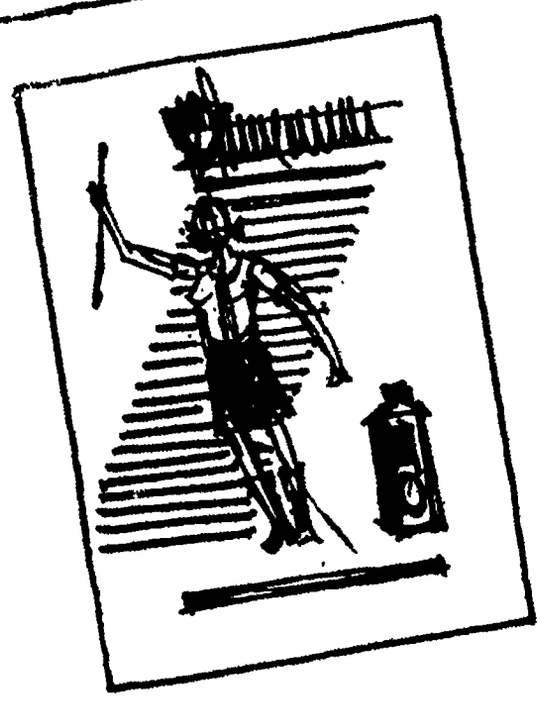


CHART 23



CRISS CROSS

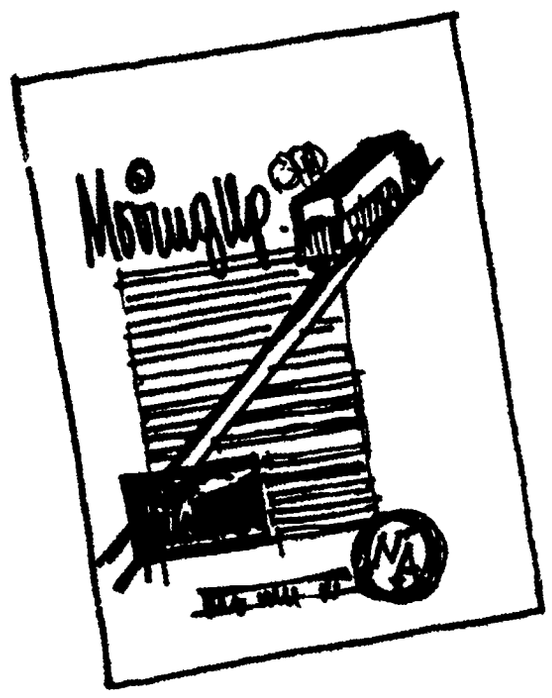


ILLUSTRATION RUNS IN ONE DIRECTION, COPY CROSSES IT IN OPPOSITE

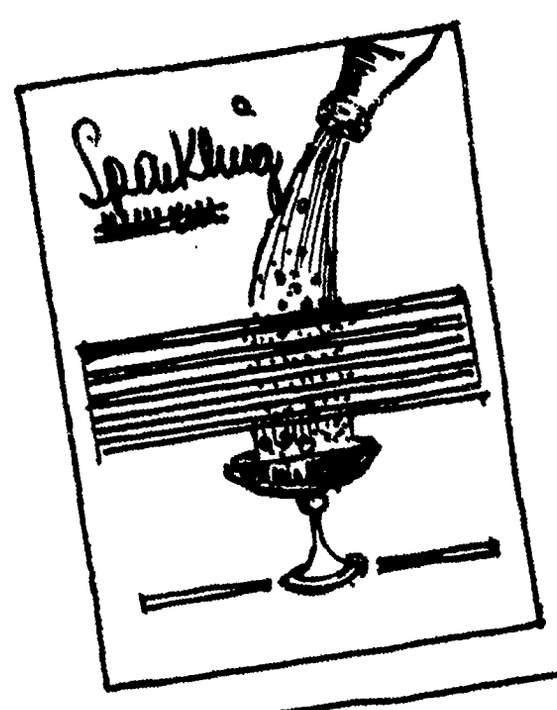


CHART 24

OVER PRINT LAYOUT.

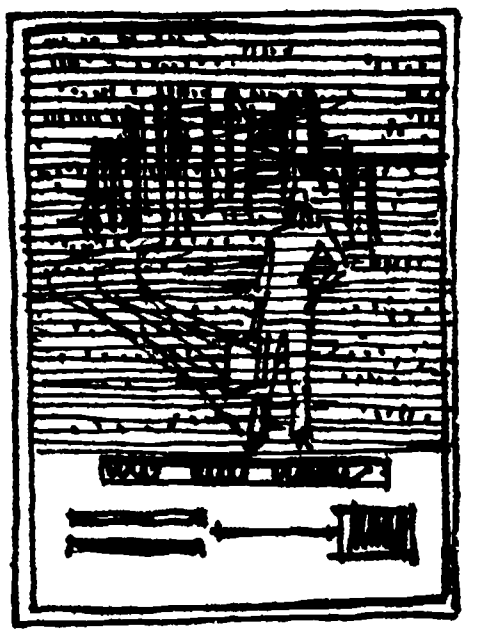


ILLUSTRATION SET IN BACKGROUND.
WITH THE COPY PRINTED OVER IT

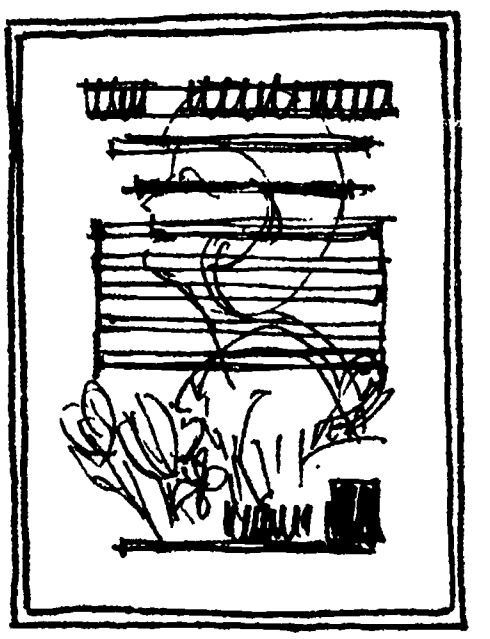
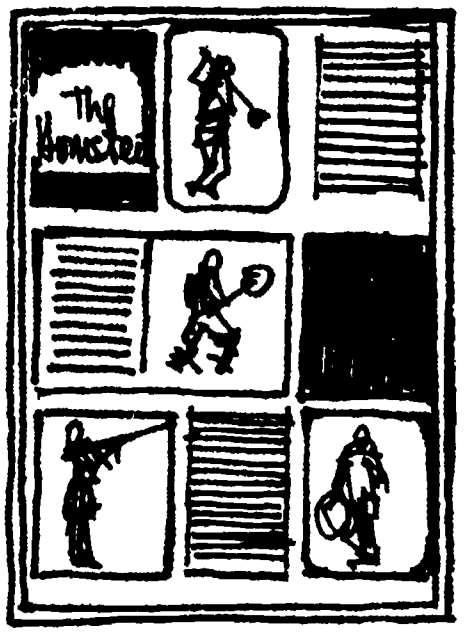


CHART 25



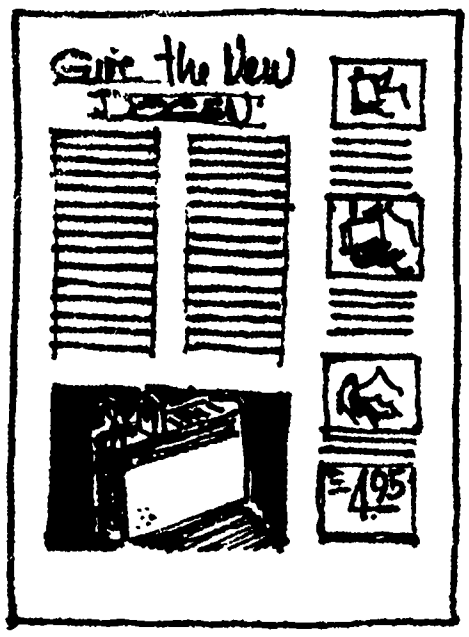
CHECKERBOARD.

LAYOUT ASSUMES THE PATTERN.

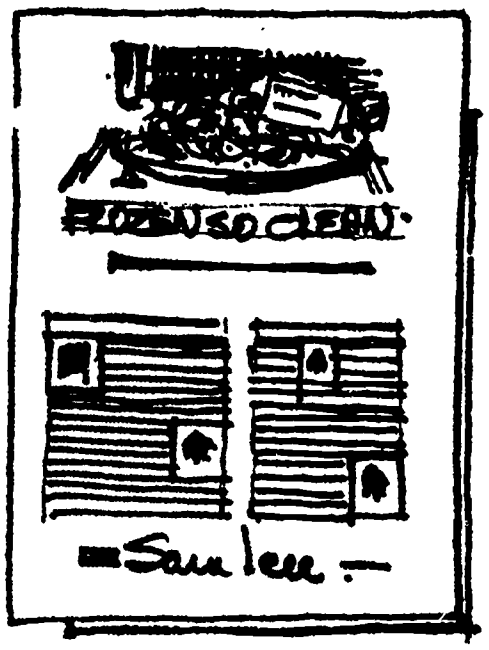
IN WHOLE, OR PART OF A.

CHECKERBOARD.

CHART 26



FAMILY LAYOUT



MAJOR ILLUSTRATION AND COPY, SET PATTERN FOR MINOR ILLUSTRATION AND. COPY.

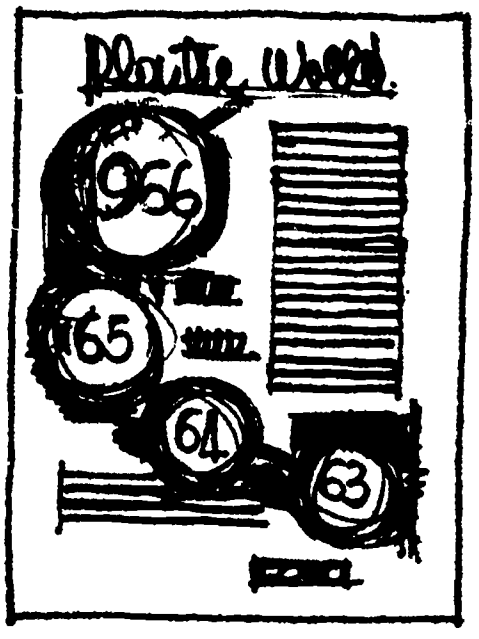
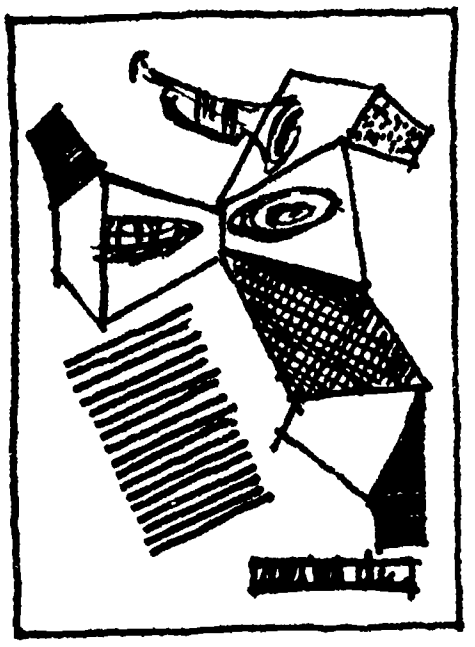


CHART 27



STAGGER.

THE UNITS OF THE AD ARE STAGGERED ACROSS AND BACK OVER THE AREA.

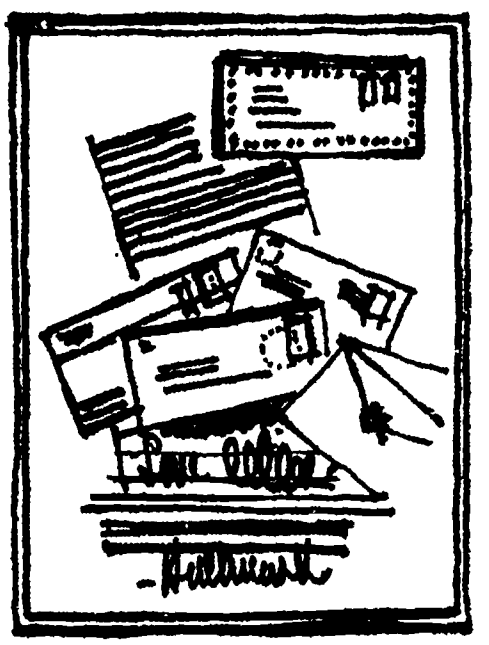
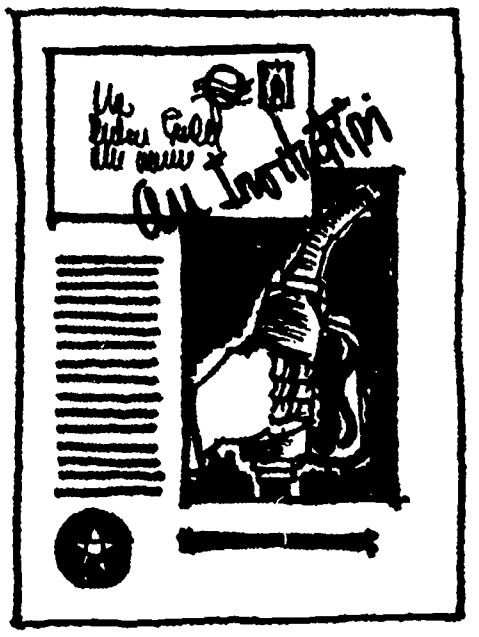
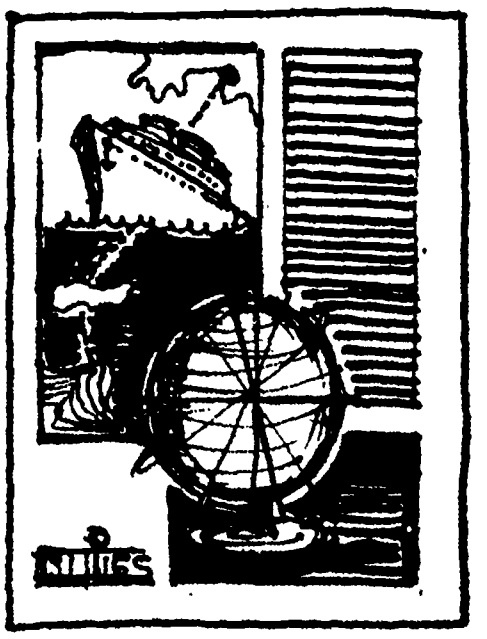


CHART 28



OVERLAP LAYOUTS



ILLUSTRATIVE UNITS PLACED WITHIN SHAPES THAT LAP OVER EACH OTHER.

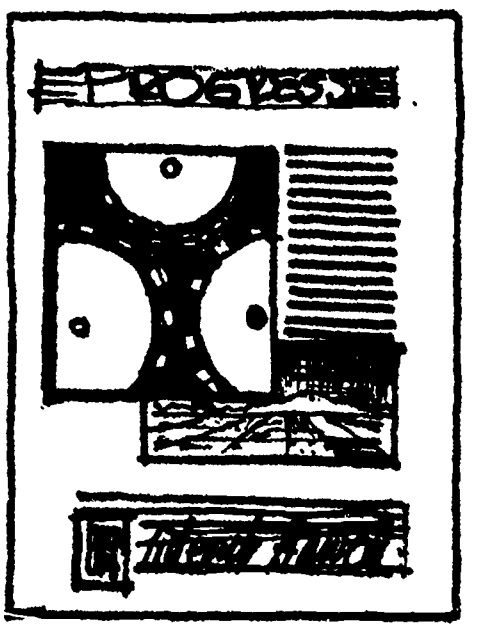
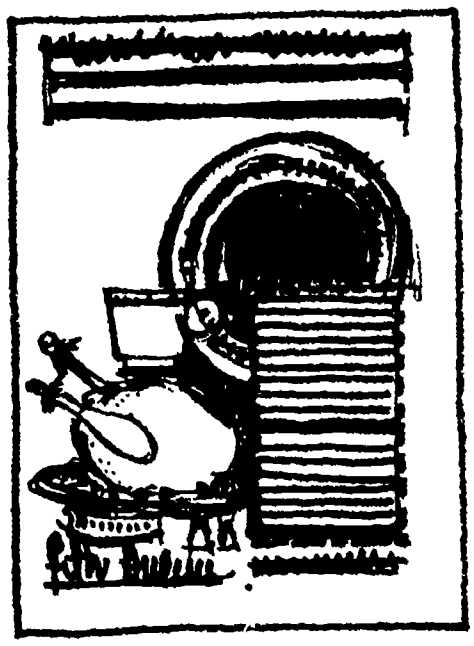


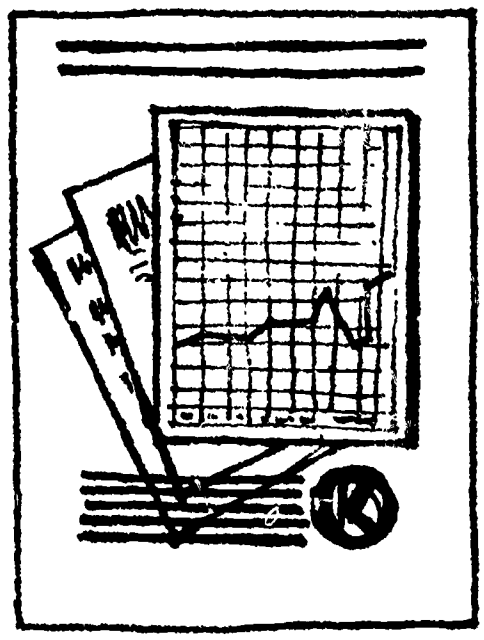
CHART 29



ECLIPSE

TYPE

LAYOUT



THE COPY IS PLACED OVER A PORTION OF THE. ILLUSTRATION.

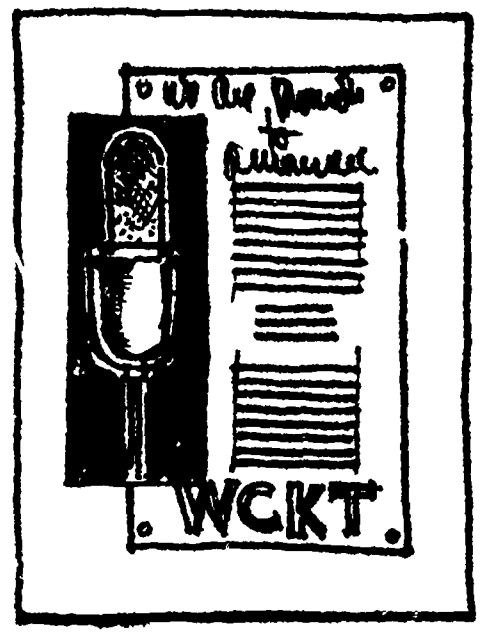
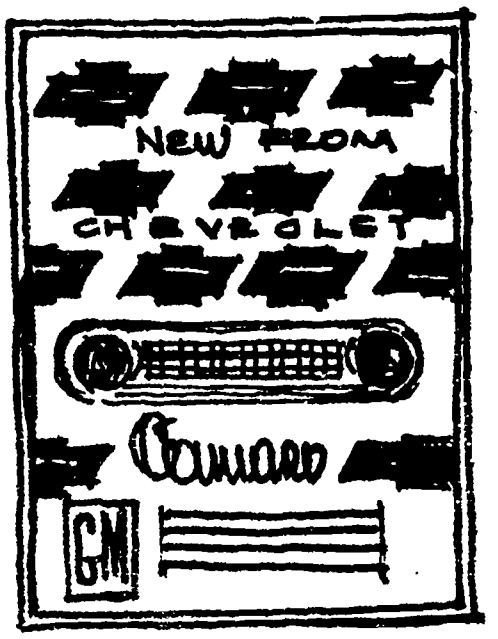


CHART 30

BACKGROUND

TYPE OF

LAYOUT.



PATTERN FORMS BACKGROUND, COPY SET IN SHAPE OVER IT.

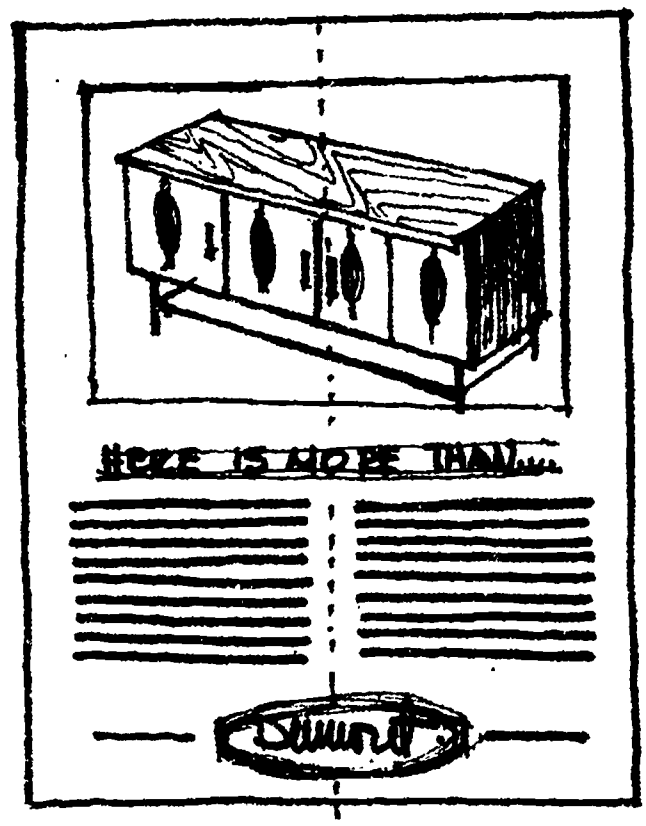
CHART 31

SYMMETRIC

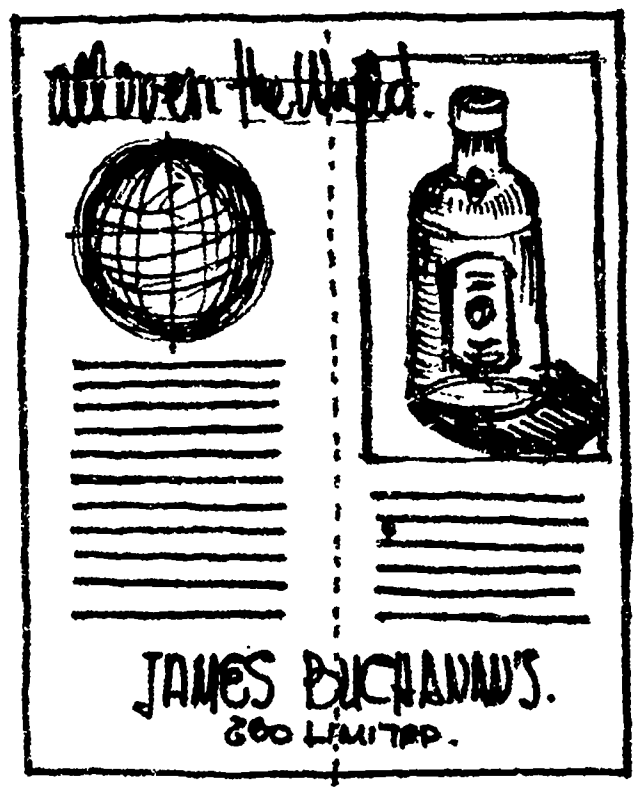
LAYOUT.

TOTAL AREA IS DIVIDED
AND SUB-DIVIDED INTO
EQUAL DIVISIONS

CHART 32



FORMAL.



INFORMAL.

VT 010 418
Livestock (Overhead Transparency Masters).

California State Polytechnic Coll., San Luis Obispo. Vocational Education Productions
California State Dept. of Education, Sacramento. Vocational Education Section
MF AVAILABLE IN VT-ERIC SET.
Vocational Education Productions, California State Polytechnic College, San Luis Obispo, California 93401 ($1.65).
PUB DATE - ND 18p.

DESCRIPTORS - *TRANSPARENCIES; *VOCATIONAL AGRICULTURE; *ANIMAL SCIENCE; *LIVESTOCK; INSTRUCTIONAL AIDS; CATTLE; SWINE; HORSES

ABSTRACT - Vocational agriculture teachers may use instructional aids produced from these transparency masters in teaching classes in animal science. Seventeen masters are included, covering body parts and wholesale cuts of beef, swine, lamb, and body parts of dairy cows and horses, as well as means of using teeth to determine the age of sheep and horses. (AW)

VT 010 418

LIVESTOCK

OVERHEAD TRANSPARENCY MASTERS

Research and development of these materials was assisted by
VOCATIONAL EDUCATION ACT
funds, administered through the Vocational Education Section
of the California Department of Education.

ED0 45856

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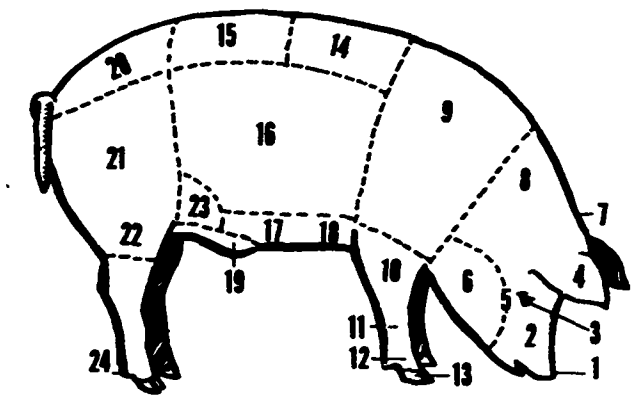

SWINE PARTS

1. Snout	9. Shoulder	17. Belly
2. Face	10. Foreleg	18. Fore Flank
3. Eye	11. Knee	19. Sheath
4. Ear	12. Pastern	20. Rump
5. Lower Jaw	13. Foot-toe	21. Ham
6. Jowl	14. Back	22. Hock
7. Poll	15. Loin	23. Rear Flank
8. Neck	16. Side	24. Dew Claw

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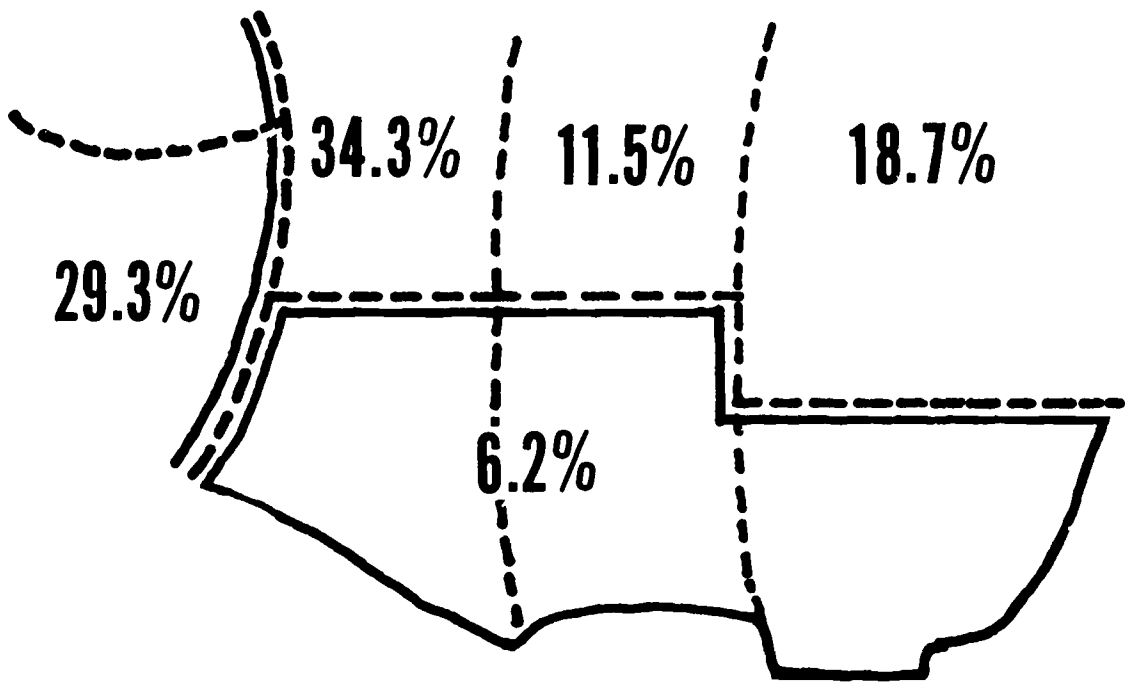
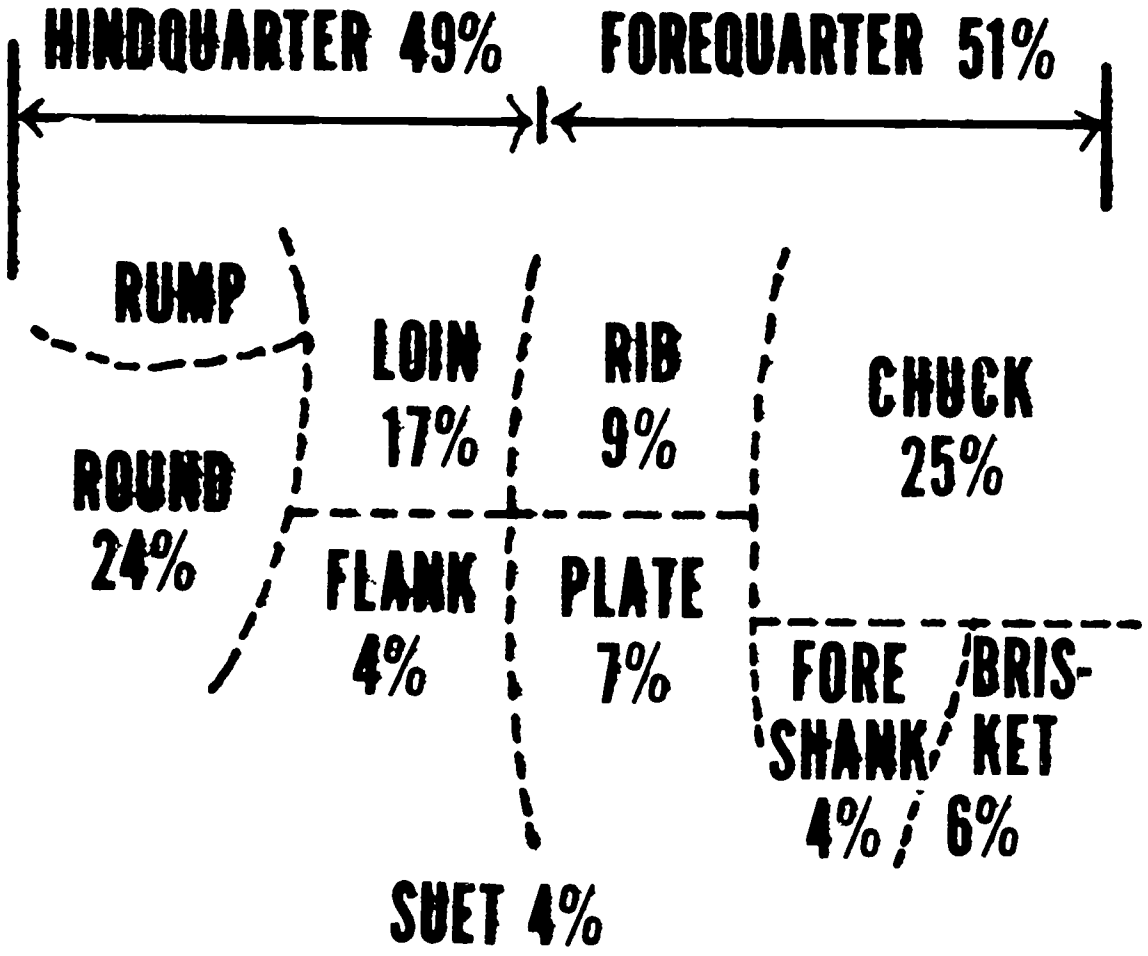
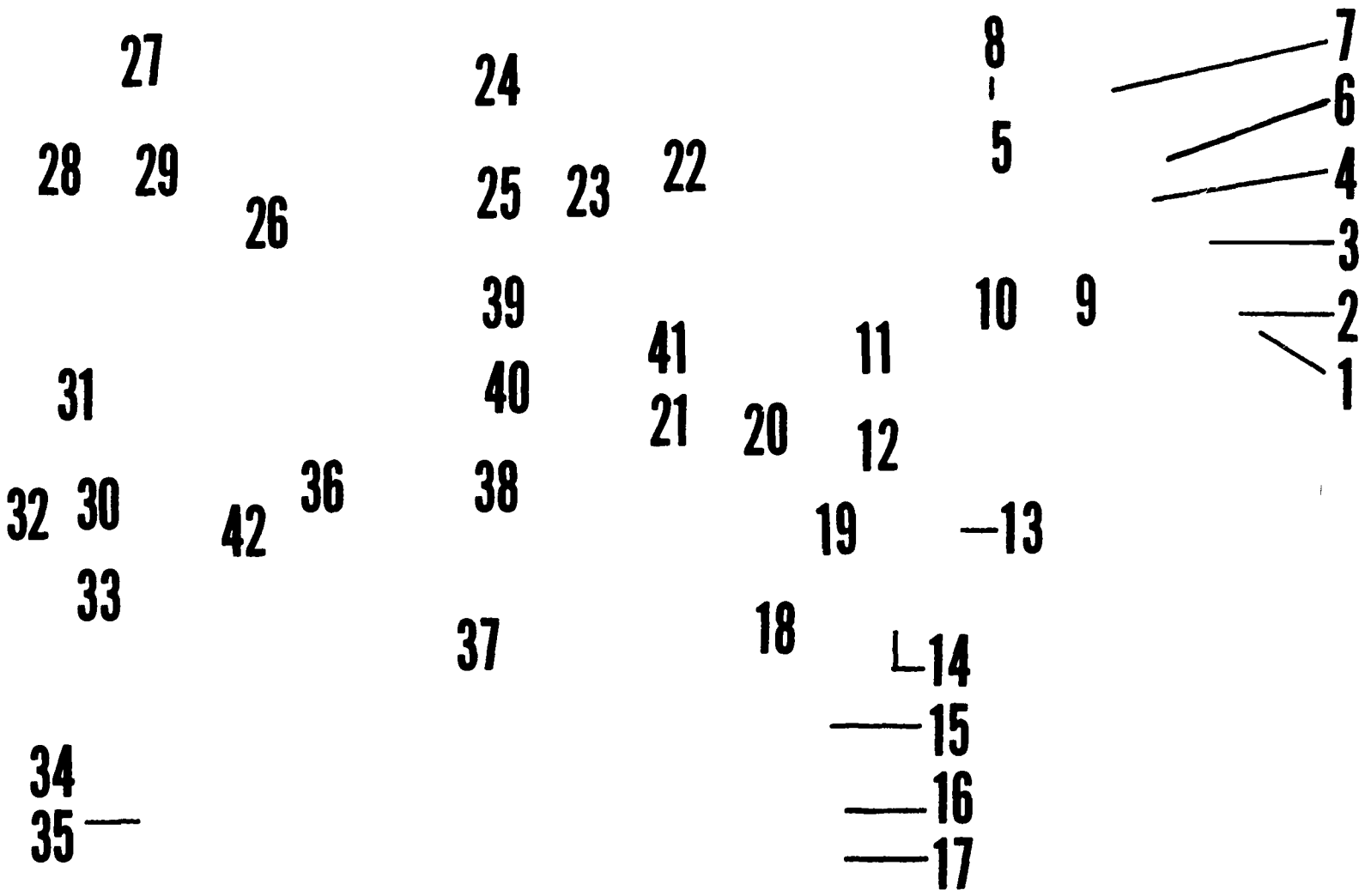
CALIFORNIA STATE POLYTECHNIC COLLEGE SAN LUIS OBISPO, CALIFORNIA 93401



PERCENTAGES BY VALUE OF CUTS

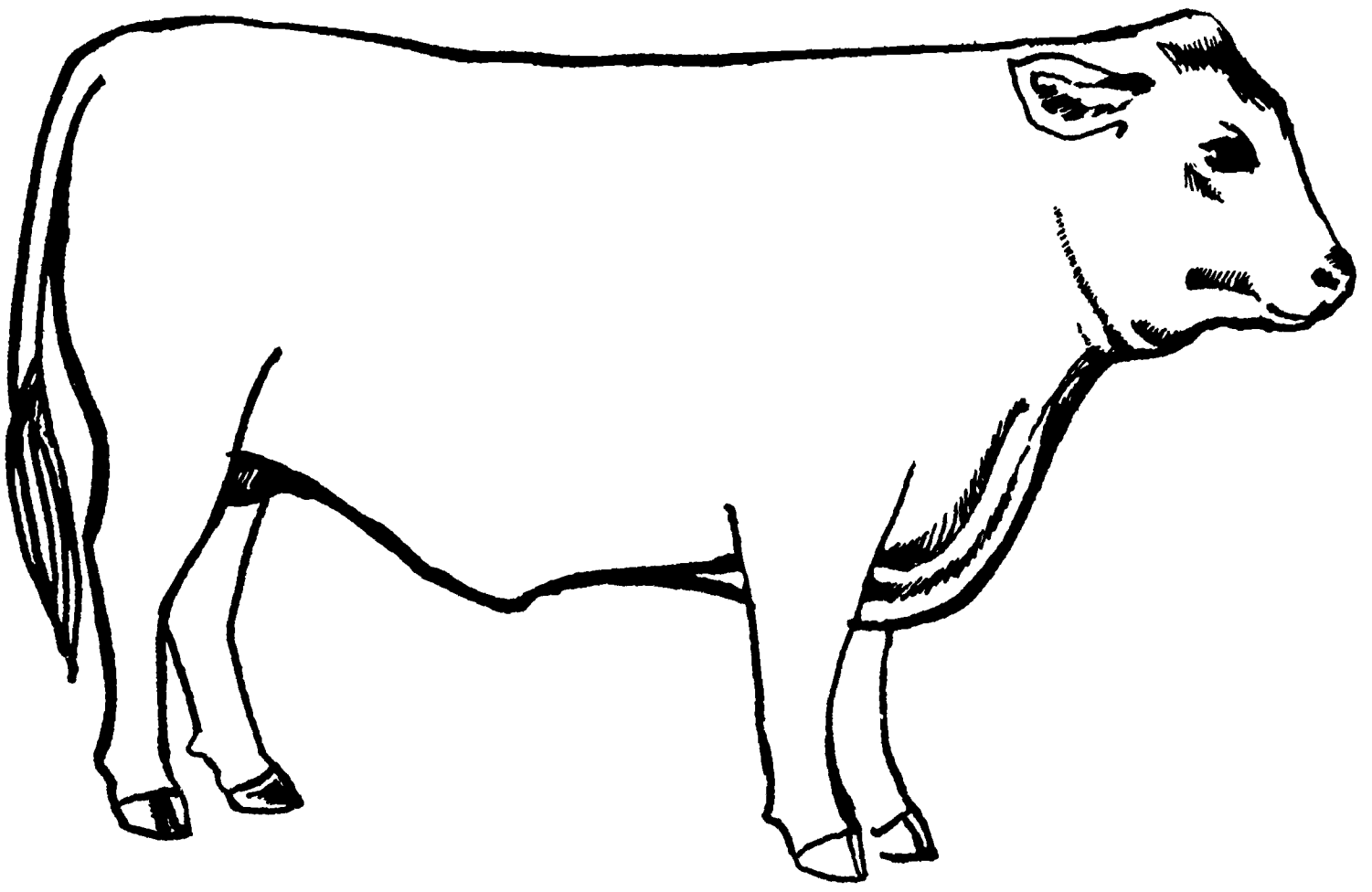


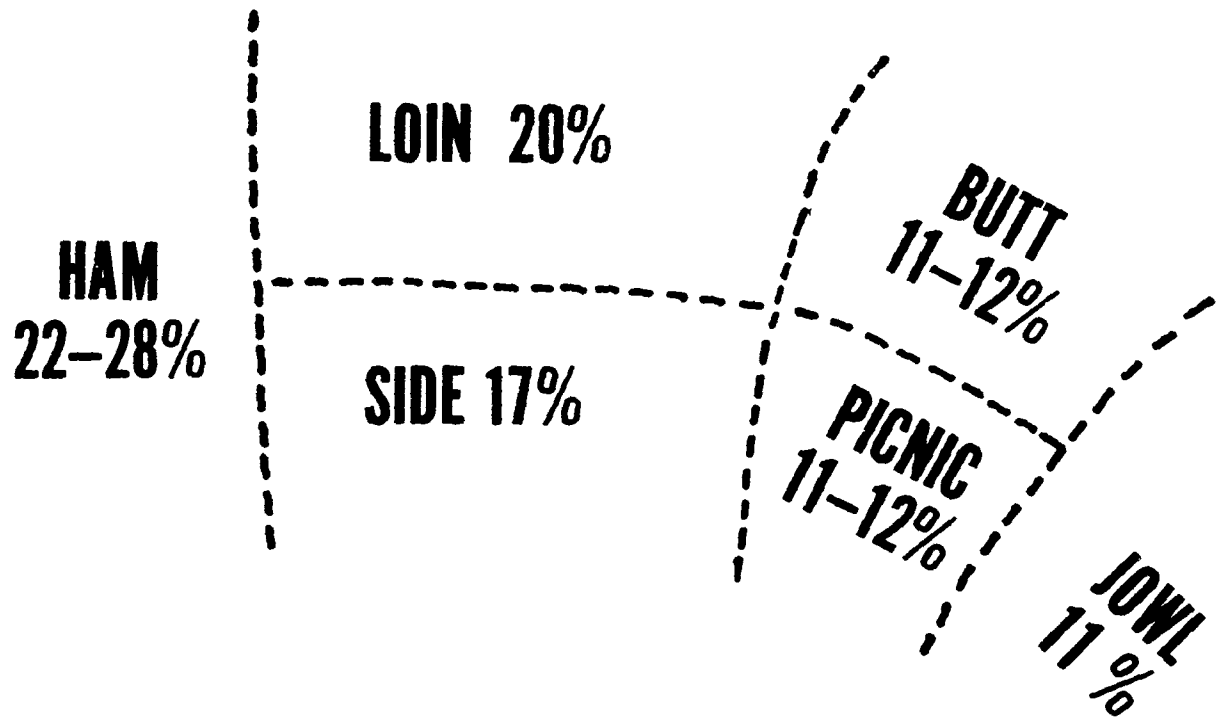
STANDARD WHOLESALE CUTS
PERCENTAGES BY WEIGHT



BEEF PARTS

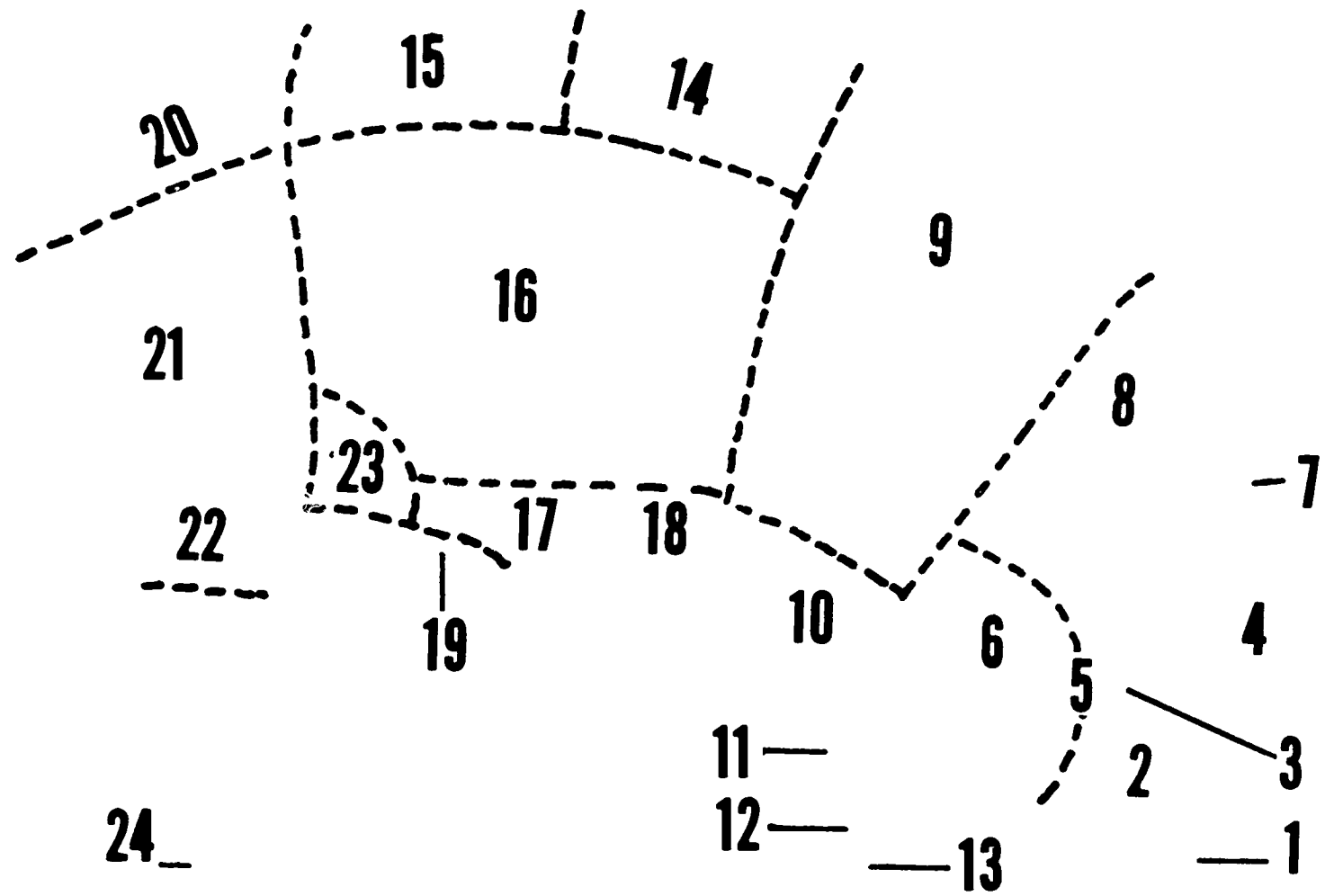
1. Muzzle
2. Nostril
3. Face
4. Eye
5. Ear
6. Forehead
7. Poll
8. Crest
9. Jaw
10. Neck
11. Shoulder vein
12. Point of shoulder
13. Dewlap
14. Brisket
15. Knee
16. Shank
17. Foot
18. Forearm
19. Arm
20. Shoulder
21. Heart Girth
22. Top of shoulder
23. Crop
24. Back
25. Loin
26. Hook
27. Rump
28. Tail head
29. Pin
30. Twist
31. Quarter
32. Switch
33. Hock
34. Dewclaw
35. Pastern
36. Flank
37. Sheath
38. Paunch or Middle
39. Loin edge
40. Rib
41. Forerib
42. Cod





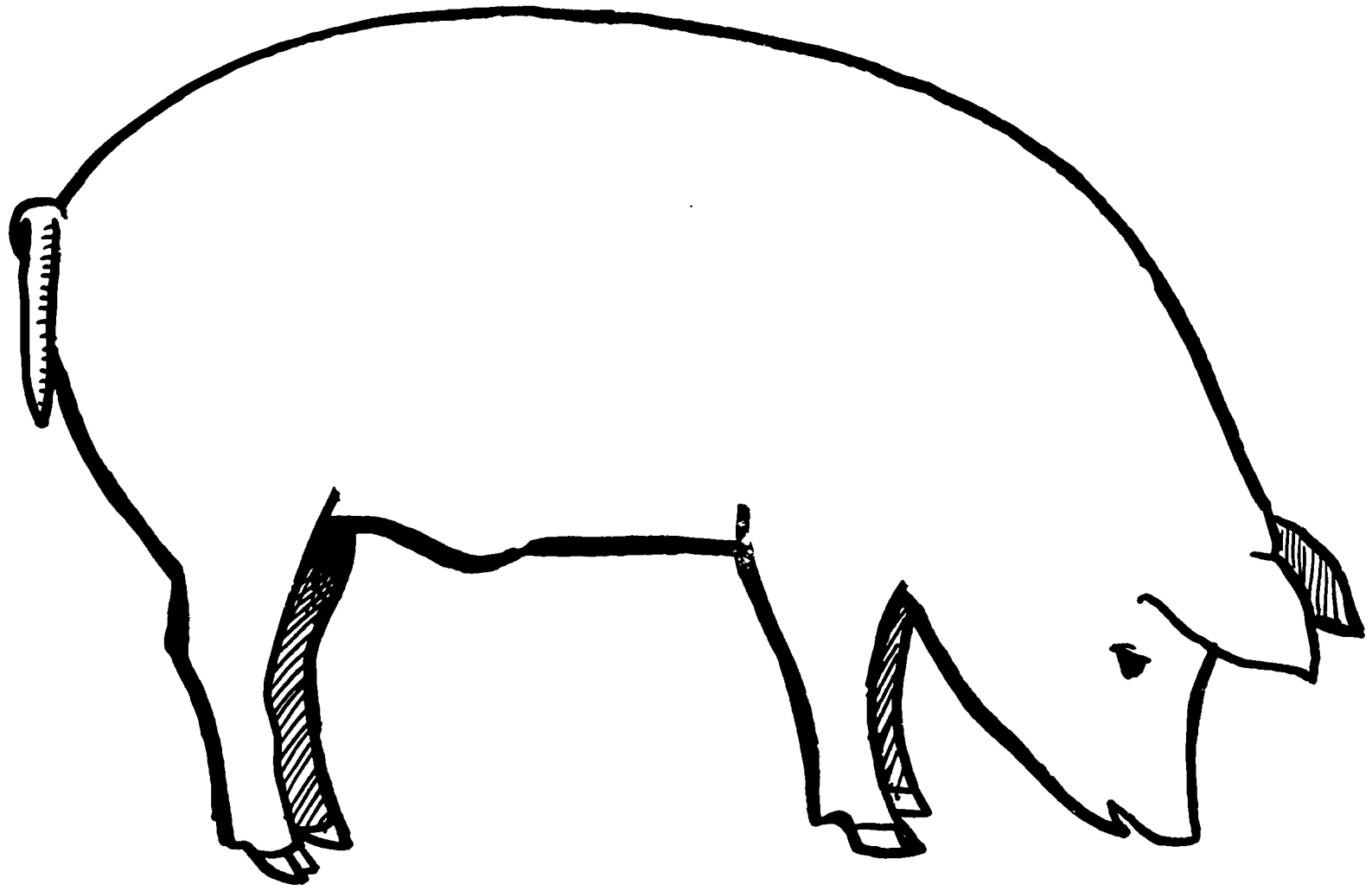
STANDARD WHOLESALE CUTS

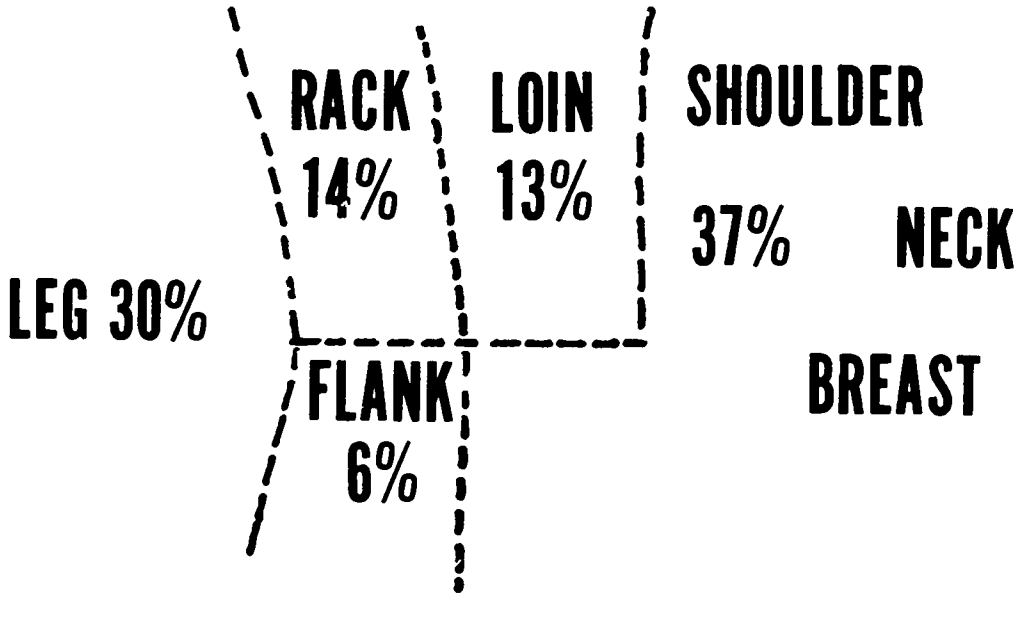
PERCENTAGES BY WEIGHT



SWINE PARTS

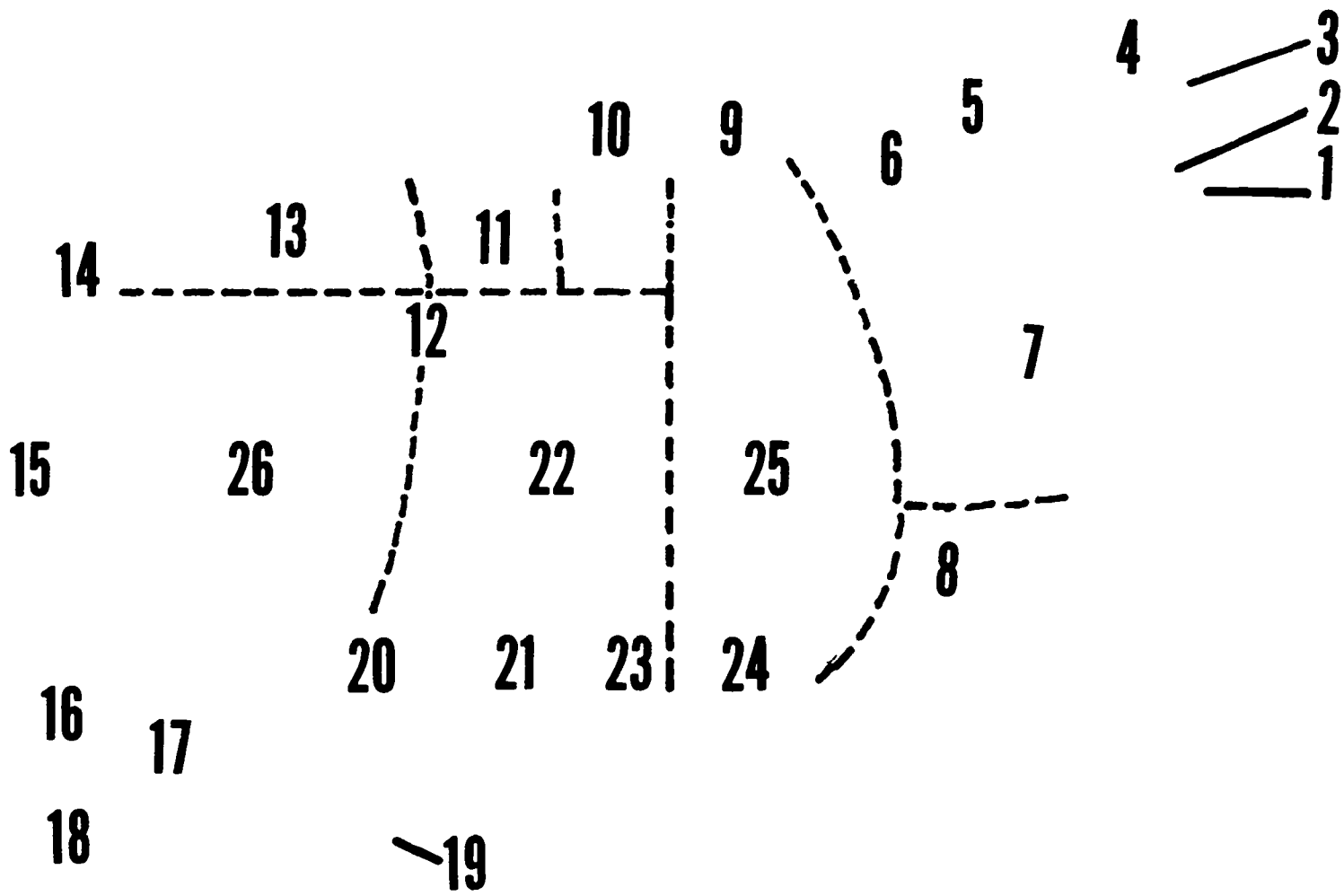
1. Snout
2. Face
3. Eye
4. Ear
5. Lower Jaw
6. Jowl
7. Poll
8. Neck
9. Shoulder
10. Foreleg
11. Knee
12. Pastern
13. Foot-toe
14. Back
15. Loin
16. Side
17. Belly
18. Fore Flank
19. Sheath
20. Rump
21. Ham
22. Hock
23. Rear Flank
24. Dew Claw





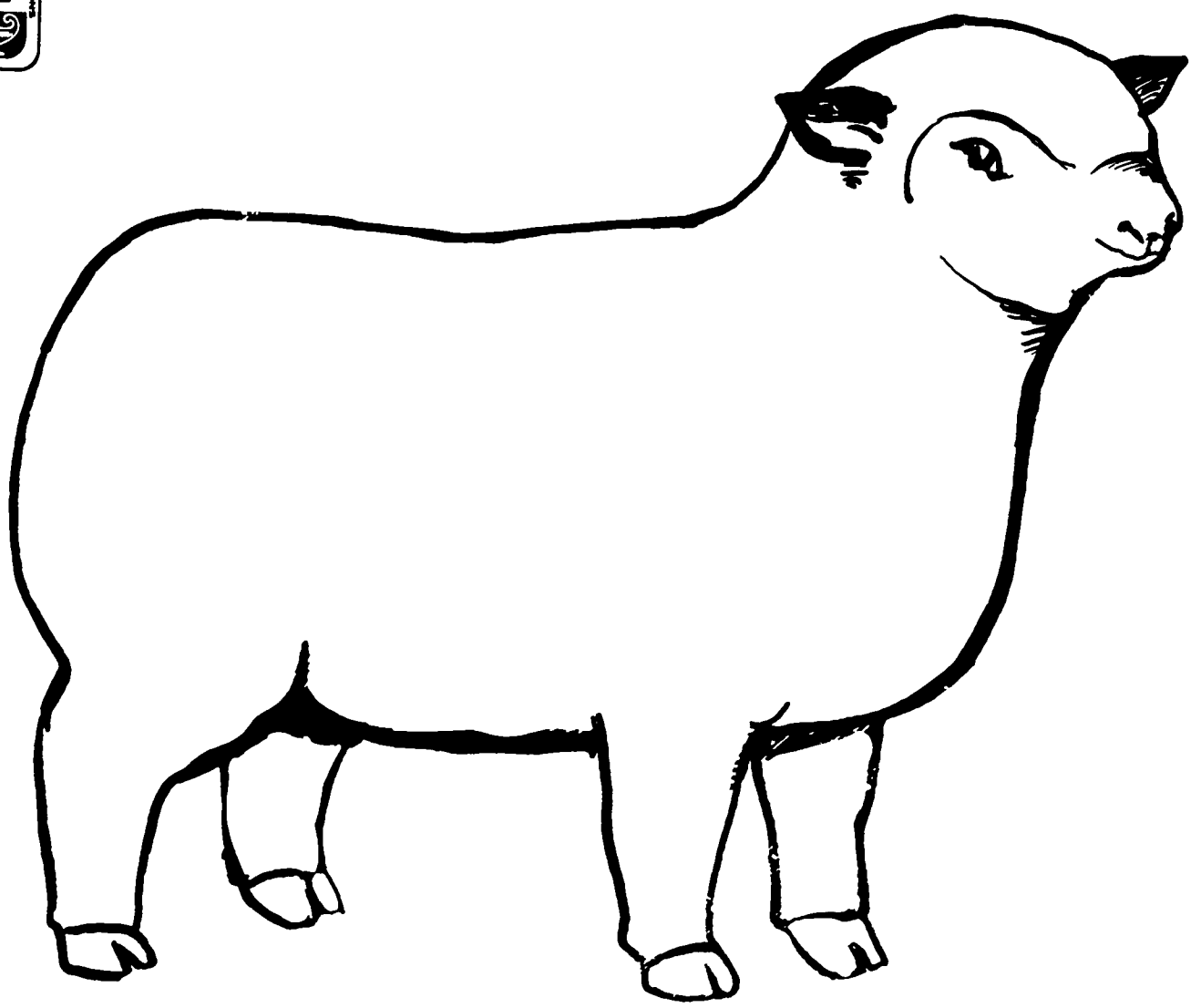
STANDARD WHOLESALE CUTS

PERCENTAGES BY WEIGHT

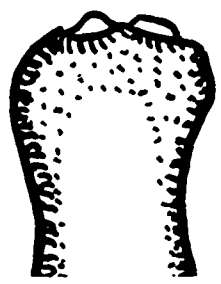


LAMB PARTS

1. Mouth
2. Nostril
3. Face
4. Forehead
5. Eye
6. Ear
7. Neck
8. Breast
9. Top of Shoulder
10. Back
11. Loin
12. Hip
13. Rump
14. Dock
15. Thigh
16. Hind leg
17. Dew Claw
18. Pastern
19. Foot
20. Hind Flank
21. Belly
22. Ribs
23. Fore Flank
24. Fore leg
25. Shoulder
26. Leg of Lamb



DETERMINING THE AGE OF SHEEP BY THE TEETH



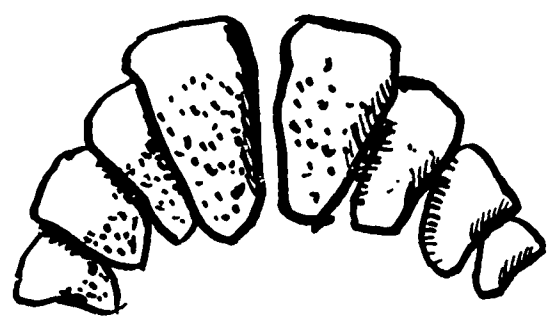
New-born lamb

3 months

12 to 15 months

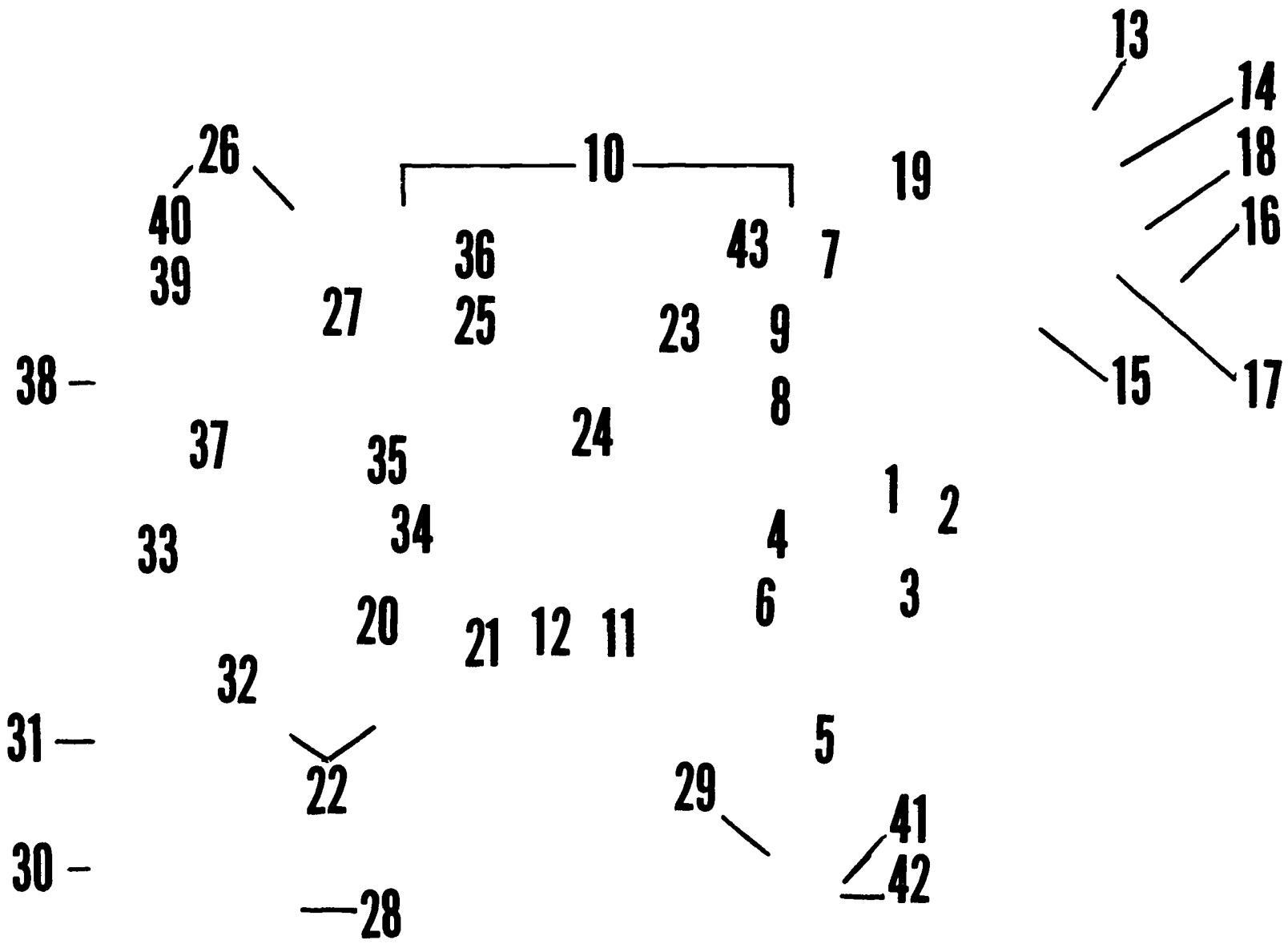
2 years

3 years



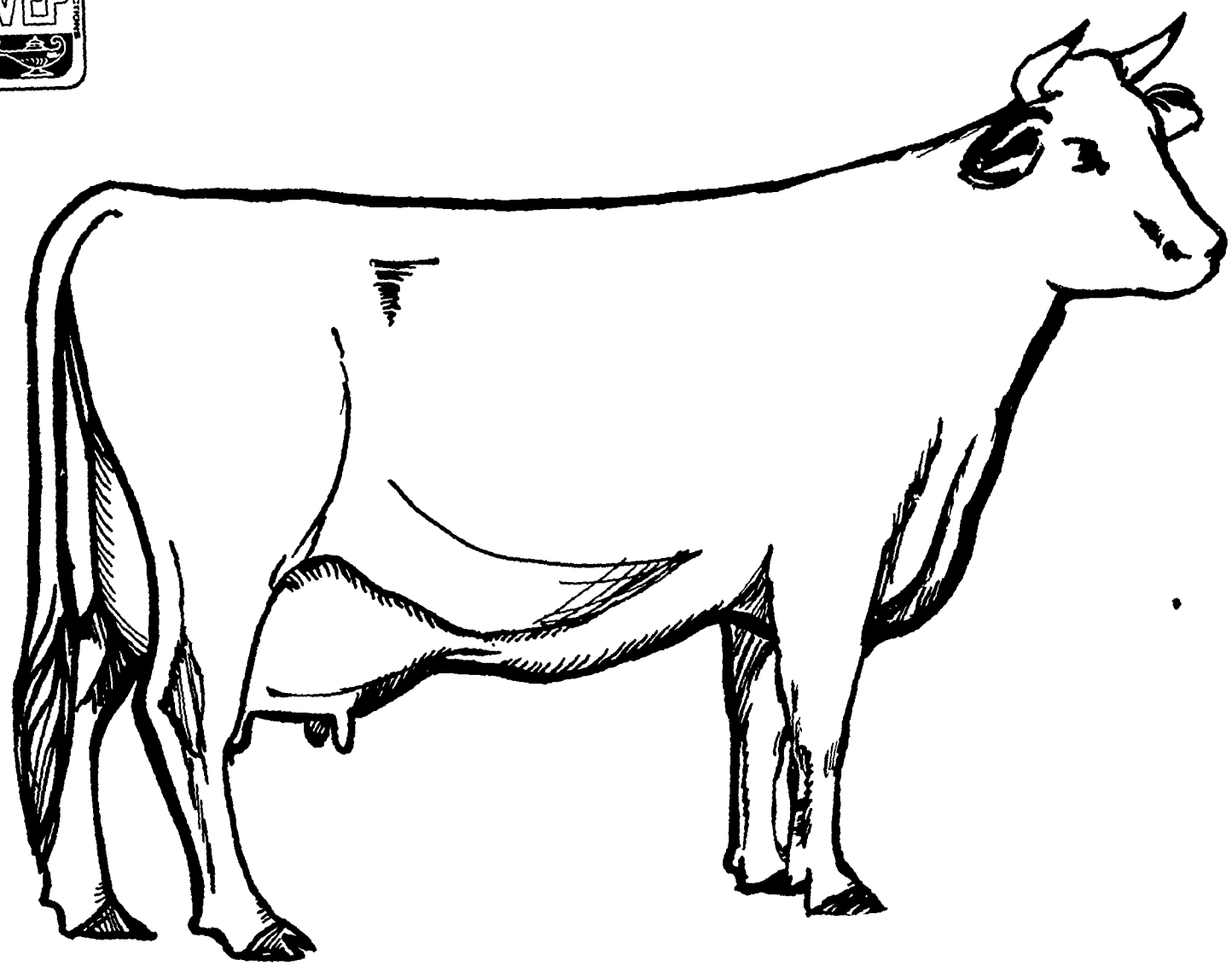
4 years

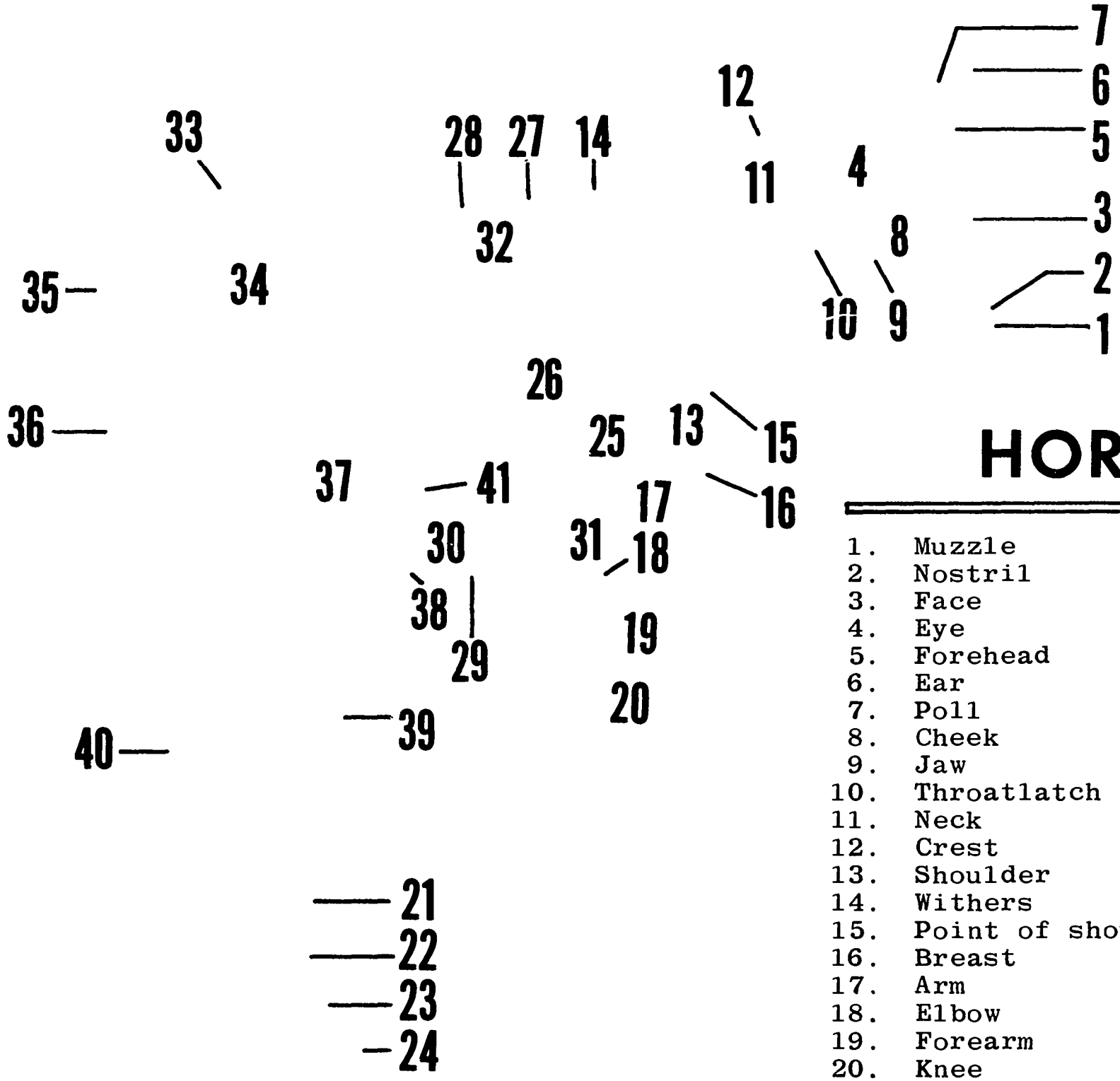
after
4 years



DAIRY COW PARTS

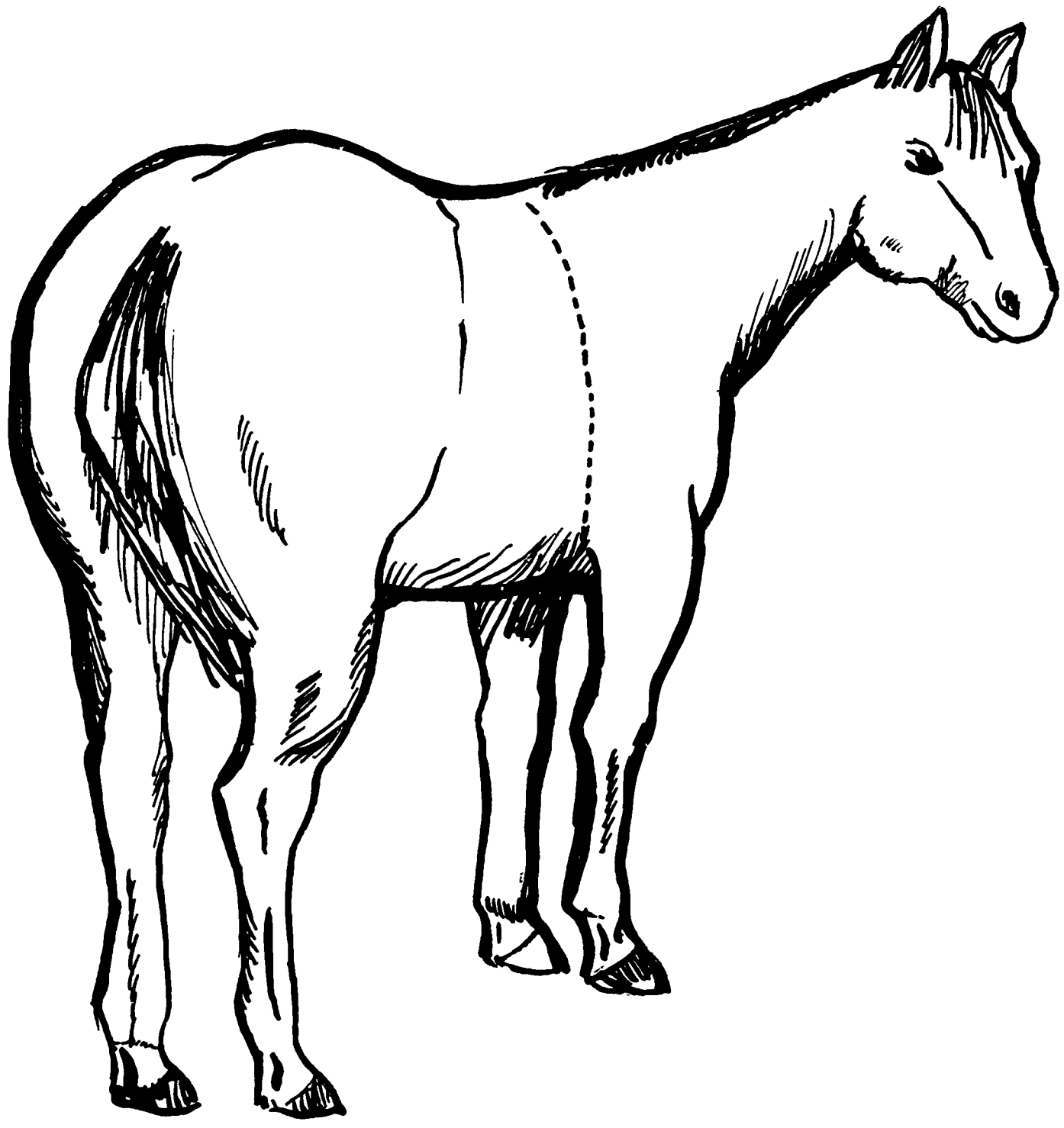
1. Point of Shoulder
2. Dewlap
3. Brisket
4. Point of Elbow
5. Knee
6. Chest Floor
7. Withers
8. Heart Girth
9. Crop
10. Back
11. Milk Wells
12. Mammary Veins
13. Poll
14. Forehead
15. Throat
16. Muzzle
17. Jaw
18. Bridge of Nose
19. Neck
20. Fore Udder
21. Fore Udder Attachment
22. Teats
23. Barrel
24. Ribs
25. Hip or Hook
26. Rump
27. Thurl
28. Hoof
29. Pastern
30. Dew Claw
31. Switch
32. Hock
33. Rear Udder
34. Flank
35. Stifle
36. Loin
37. Thigh
38. Tail
39. Pin Bones
40. Tail Head
41. Heel
42. Sole
43. Chine



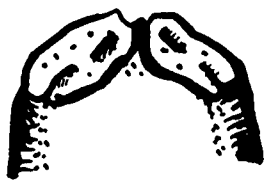


HORSE PARTS

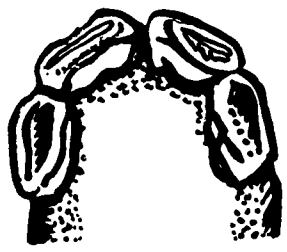
1. Muzzle
2. Nostril
3. Face
4. Eye
5. Forehead
6. Ear
7. Poll
8. Cheek
9. Jaw
10. Throatlatch
11. Neck
12. Crest
13. Shoulder
14. Withers
15. Point of shoulder
16. Breast
17. Arm
18. Elbow
19. Forearm
20. Knee
21. Cannon
22. Fetlock joint
23. Pastern
24. Foot
25. Heart girth
26. Ribs
27. Back
28. Loin
29. Underline
30. Rear flank
31. Fore flank
32. Coupling
33. Croup
34. Tail
35. Point of buttock
36. Quarter
37. Thigh
38. Sheath
39. Gaskin
40. Hock
41. Stifle



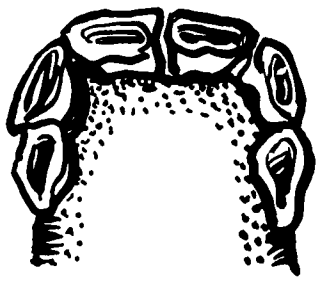
DETERMINING THE AGE OF HORSES BY THE TEETH



At birth or before ten days of age

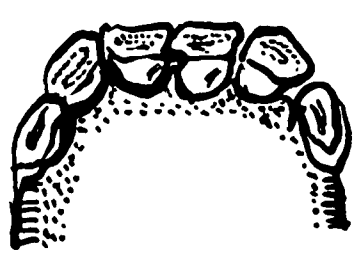


4 to 6 weeks of age

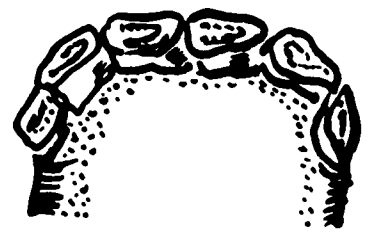


6 to 10 months

1 year of age

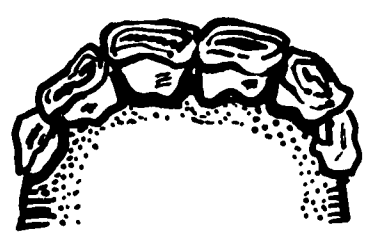


1 ½ years of age

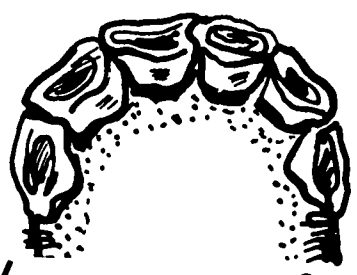


2 years of age

2½ years of age



3½ years of age

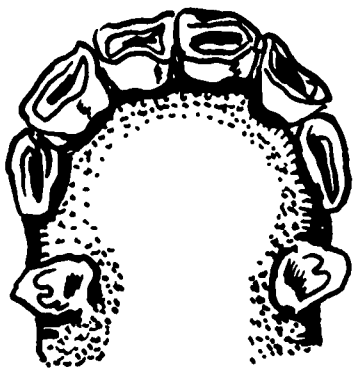


4½ years of age

(in male)

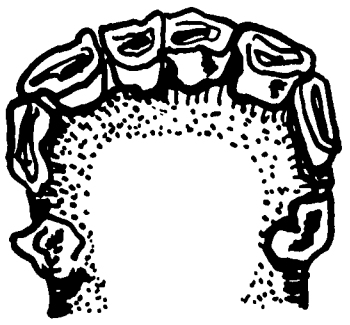
4 to 5 years of age

DETERMINING THE AGE OF HORSES BY THE TEETH



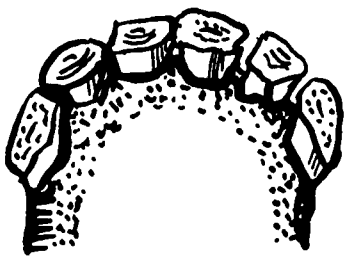
5 years of age

6 years of age

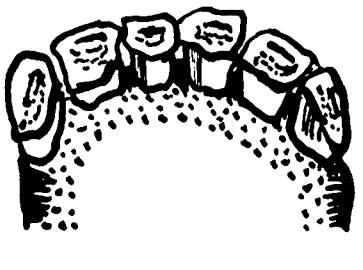


7 years of age

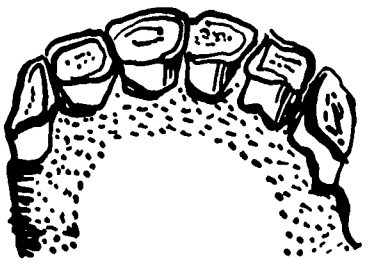
8 years of age



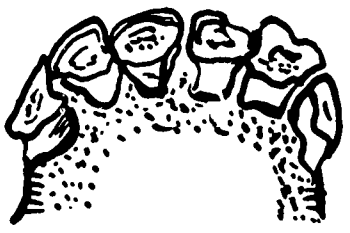
9 years of age



10 years of age



11 years of age



12 years of age

VT 010 421
Morphology of Grasses (Overhead Transparency Masters).

California State Polytechnic Coll., San Luis Obispo. Vocational Education Productions
California State Dept. of Education, Sacramento. Vocational Education Section
MF AVAILABLE IN VT-ERIC SET.
Vocational Education Productions, California State Polytechnic College, San Luis Obispo, California 93401 ($3.25).
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DESCRIPTORS - *TRANSPARENCIES; *VOCATIONAL AGRICULTURE; *PLANT SCIENCE; *BOTANY; INSTRUCTIONAL AIDS

ABSTRACT - Vocational agriculture teachers may use instructional aids produced from these 22 transparency masters in teaching plant science. Some representative titles are: (1) Bean Seedlings, (2) Mature Corn Plant, (3) Schematic Grass Plant, (4) Male and Female Grass Flower Parts, (5) Roots of Wheat, (6) Wheat Spikelet, (7) Oats Panicle, (8) Grass Identification, (9) Legume Flower, and (10) Reproduction Parts of Cotton. Teaching guidelines, a key to the plates, and a glossary are included in the package. (AW)

VT 010 42

MORPHOLOGY OF GRASSES

OVERHEAD TRANSPARENCY MASTERS

Research and development of these materials was assisted by VOCATIONAL EDUCATION ACT funds, administered through the Vocational Education Section of the California Department of Education

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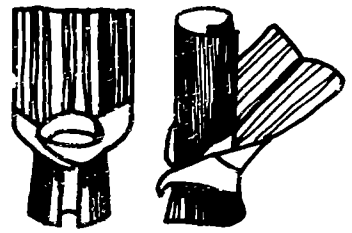
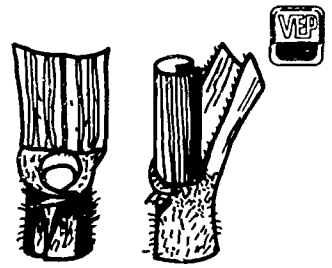
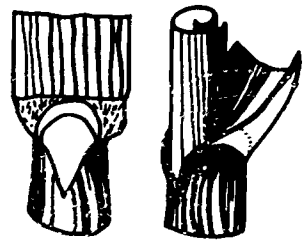


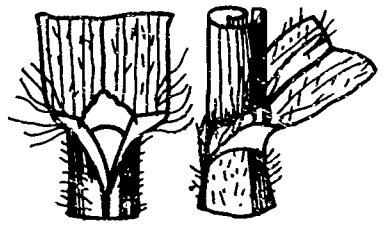
ANNUAL RYE-GRASS



QUACK GRASS



SMOOTH BROME-GRASS



LARGE CRAB-GRASS

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MORPHOLOGY OF GRASSES

OVERHEAD TRANSPARENCY MASTERS

- GUIDELINES
- PLATE KEY
- GLOSSARY

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PREFACE

Several approaches were used in developing the plates for the "Morphology of Grasses" overhead transparency set. There are plates without overlays, plates with overlays, overlays with parts named, overlays that use numbers and letters, and plates with spaces provided for writing information during a class presentation. Teachers are encouraged to experiment with the various modes, and to send their reactions to Vocational Education Productions.

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November, 1968.

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MORPHOLOGY OF GRASSES
Guidelines

Plate 1: BEAN SEEDLING

Bean seedlings in the various stages of development are interesting plants for study because they have many characteristics typical of most dicotyledonous plants. In addition, Beans are legumes and exhibit nodule formation on the root system and are capable of extracting nitrogen from the air and fixing it in a form which is available for use by higher plants. The nodules are actually colonies of symbiotic bacteria which are supplied food and housing by the legume which, in turn, benefits by receiving nitrogen for growth.

Typical dictyledonous features:

1. Two cotyledons (embryo or seed leaves) are a principal source of food (carbohydrates) during the germination period and until the plant emerges into the light and can begin manufacturing its own carbohydrate food. (See Plate items 2, 5, and 10.) The cotyledons are generally dropped from the plant after the seedling food-source function has been served.

2. The hypocotyl is a section of stem below the cotyledons and extending to the root system. In germination, it is a particularly active meristematic (growing) area which ultimately causes the cotyledons to emerge and permits the first true leaves to develop in the presence of light. (See Plate items 1 and 6.)

3. The first true leaves (Plate item 4), and those that follow, function in the manufacture of carbohydrate food materials during periods of active photosynthesis. Leaves of this type of plant are typically the broadleaf type and the veination is netted (not parallel as in grasses).

4. The radicle (Plate item 9) is the embryonic root and later develops into the tap root with its appended branches.

5. The tap root system has an enlarged central root (Plate item 3) which has numerous smaller branches. The top root tends to elongate and usually will penetrate to a depth of 3 or more feet in a porous soil provided moisture is present to that depth. In the event that the tap root is broken (such as in pulling tomatoes for transplanting) the replacement roots are smaller and fibrous since the branch rootlets are responsible for the regrowth. Transplanted broadleaf crops generally have a "fibrous" type of root system which does not penetrate as deeply as the original tap root system and may require more frequent irrigation.

Plate 2: CORN SEEDLING

Corn seedlings are often used for initial comparisons between grasses and dicotyledons, such as beans, since most of the typical structures are found and are large enough to see with the naked eye. Three successive stages in the development of a grass seedling are shown in Plate 2. Since grasses are monocotyledons, many of the characteristics of corn are typical of other monocotyledon families.

Plate items 1 and 2 show the initial development of the coleoptile and the radicle at the time of seed germination. Both structures emerge from the germ area of the seed. The radicle later develops into the primary (first) root system (Plate item 7) which functions in absorption of water and soil nutrients until it is replaced by the secondary (permanent) root system (Plate item 9). In order for a strong, healthy, permanent (secondary) root system to develop near the soil surface it is essential that rain or irrigation occur at the time the secondary roots are forming. The secondary roots become the principal root system of grasses as the plant progresses towards maturity.

Between the primary root system and the secondary root system is a slender stem-like structure called the mesocotyl which connects the two systems. The mesocotyl (Plate items 5 and 10) is sometimes called a subcrown internode due to its stemlike character which resembles the above-ground internodes.

The coleoptile (Plate item 1 and 8) is a membranous modified leaf which surrounds the first true leaves as the seedling foliage emerges from the soil. It is thought that the coleoptile protects the true leaves from injury as they push through the soil in emergence.

The crown (Plate item 4) is a transition point between the root system and the shoot system. The initial shoot system is termed the plumule (Plate item 3).

True grass leaves tend to be long and narrow and the grasses are sometimes termed narrowleaf plants. Leaves typically have a parallel veination much like a group of railroad tracks laid side by side.

Plate 3: MATURE CORN PLANT.

Examination of a mature corn plant reveals additional features that are typical of most grass plants, and several characteristics that are not generally exhibited.

Plate item 1 demonstrates the more advanced

development of the secondary root system (permanent root system) which originated near the soil surface and then enlarged greatly, becoming fibrous in appearance. This root system is typical of grass plants.

Above the secondary root system are brace roots (Plate item 2) which sometimes start as aerial roots and by elongation extend to the soil surface. Their large diameter and location has lead to the theory that a principal function is to prevent the plant from "lodging" or "falling over". Culturally, corn is sometimes listed or bedded-up at the time of the last cultivation; and the soil, thus thrown into the row, assists the brace roots in performance of their function. Brace roots are not typically found in grasses. Modern day field corn varieties have been bred to have a single stem or "tiller" per plant. This permits the farmer to exercise great control over the plant population per acre and to adjust the number of plants to his specific soil or climatic conditions. Sometimes, however, additional small tillers arising from the crown area are found on a few plants in a field. These smaller tillers are often called "suckers" (Plate item 9). They probably do little good or little harm under irrigated culture but may transpire and use critical moisture when corn is grown under non-irrigated, low rainfall conditions. A "sucker tiller" rarely develops as well as the main tiller and seldom develops ears.

Corn, like other grasses, has a series of swollen joints along the stem (Plate item 3) which are called nodes. The area between two nodes (Plate item 4) is called an internode and, during growth, accounts for most of the tallness of the plant. In most grasses, the internodes are hollow and the nodes are solid but in corn both tend to be filled with pithy material and are thus solid in nature. Nodes of grass plants give rise to suckers and leaves as well as to flowering structures.

A typical grass leaf and leaf arrangement is exhibited by corn. The leaves arise at the nodes and are arranged alternately along the stem. Two principal leaf parts are identifiable; the leaf sheath (Plate item 5) and the leaf blade (Plate item 6). The leaf blade is typical of grass leaves and has the parallel veination with the middle vein slightly predominant. The middle vein is sometimes called the midrib vein (Plate item 10).

A corn plant is normally monoecious, i.e., with male flowers and female flowers in separate locations on the same plant. Most grasses have the male parts and the female parts contained in the same flower; and corn is, in this respect, atypical. Because of the monoecious characteristic, cross-pollination tends to be the rule but this is rather nicely permitted by the male (staminate) flowers being borne in the tassel (Plate item 8) with the female (pistillate) flowers in the ear below (Plate item 7). However, inbreeding by collecting pollen in a bag over the tassel and applying it to the ear of the same plant is relatively easy to do. By recombining unlike inbreds the characteristic of hybrid vigor can be exploited. Most commercial corn varieties are hybrids to some degree.

Plate 4: SCHEMATIC GRASS PLANT

In the study of grass plants it is sometimes helpful to use an artist's concept, such as a schematic plant, to point out some of the characteristics used for positive identification of a species.

Plate 4 clearly demonstrates many of the structures shown by corn, including fibrous roots, crown, suckers, node, internode, culm(tiller), leaf blade, leaf sheath, and inflorescence.

In addition, some grasses exhibit stolons which are above-ground reproductive stems sometimes called "runners" which root at the nodes where they contact the soil surface. Other grasses possess underground reproductive stems called rhizomes which send forth new shoots from the nodes. Bermuda grass is a classic example of a grass that has both stolons and rhizomes in addition to the typical sexual reproduction by flowers and seed.

Plate 4 also brings a new term, "collar", into use in connection with leaves. The "collar" occurs at the outside junction of the blade and the sheath. The characteristics of the collar such as color and pubescence are useful in identification of grass species.

Opposite the collar, adjacent to the stem, is a leaf appendage called the ligule. The size, shape and color of the ligule are also used in species identification. It is thought that the ligule may serve a useful purpose by preventing rain and dew from seeping into the sheath, which undoubtedly would create plant disease problems.

Some grass leaves have finger-like appendages called auricles that extend fully or partially around the stem. When present, the auricles undoubtedly help prevent the sheath from separating from the stem. Size, color, and condition of the auricle are used in species identification.

The flowering structure of many grasses is shown by the uppermost insert. The spikelet consists of two pieces of chaff called glumes which enclose or subtend one or more florets. Hairy appendages or beards are usually called awns.

Plate 5: MATURE WHEAT AND BARLEY

Grasses that have fully headed are most easily identified in most cases.

If, for example, mature wheat heads and mature 6-row barley heads are available for study it will be noted that they appear to be similar in many respects. Some varieties of wheat are awnless and some varieties of barley are awnless. Other varieties of both crops are bearded; i.e., they have awns which in both cases are attached to the tip of the lemma.

In wheat, a single spikelet occurs at a rachis node. The spikelet consists of two glumes (fairly large and boat-shaped) with a number of fertile or sterile florets growing between them. A floret consists of the lemma, palea, and male/female flowering parts (usually the grain in mature plants).

A close examination of barley reveals that three

spikelets occur at each rachis node. At the base of each kernal are two hair-like glumes, so in a six-row barley, each grain is a functional part of a single spikelet. With two-row barley, the lateral spikelets (and florets) are sterile, which explains the two-row appearance.

Plate 6: A GRASS FLOWER

Although not bright and colorful, grasses have "flowers" which function in sexual reproduction in the same manner as those of other seed-bearing plants. The absence of color for attracting pollinating insects may account for the condition of "self-pollination" that so frequently occurs in grasses.

If a grass "flower" is tweezed open, prior to seed development, the lemma and palea may contain the sexual organs. Three male parts known as stamens are usually in evidence. A stamen consists of an anther (pollen sack) and a stalk that supports it called the filament. The stamens more or less surround the female organs, presumably to facilitate easy pollination.

The female flower part is, in total, called the pistil. The pistil has a feather-like stigma which receives the pollen. Below the stigma is the style which supports it. The basal portion of the pistil is the ovary which ultimately becomes the kernel when pollination is complete.

Plate 7: MALE AND FEMALE GRASS FLOWER PARTS

Under magnification, the male and female grass flower parts are more clearly visible.

In addition to the stamens and pistil, the lodicules (two) are sometimes evident. These two spherical bodies swell at the time of anthesis and force the lemma and palea to open and extend the anthers. Shortly thereafter, pollen is shed. The open condition of the flowers accounts for a small percentage of cross-pollination even in mostly self-pollinated grasses such as wheat or barley.

Plate 8: WHEAT KERNEL

A kernel of wheat has two sides. One side has a definite longitudinal crease and is known as the crease side. Visible are the "cheeks" and the "crease". A tuft of hairs occurs at the "brush end". The extent of the brush development is sometimes used in identification of varieties.

When the kernel is laying with the crease down, the back side is exposed. The ridge along the back is called the peak. Opposite the brush end is the embryo (germ) end which gives rise to the seedling plant upon seed germination.

Plate 9: ROOTS OF WHEAT (as depicted)

Plate 10: WHEAT PLANT

A comparison of a wheat plant with a corn plant (Plate 3) reveals that grasses of widely divergent growth characteristics are nevertheless similar in many respects.

Both species exhibit the fibrous root system; and the primary (first) root system develops as the seed first germinates but is largely replaced by the secondary root system as the plant approaches maturity.

Nodes and internodes are found along the tillers (sometimes called culms in wheat) but the internodes of wheat are normally hollow at maturity as contrasted with the normal solid internodes of corn. Plant breeders have incorporated solid characteristics to the lower internodes of some wheat varieties, which provides some genetic resistance to such pests as wheat stem saw-fly.

Leaves of both grasses are of the parallel-veined type and consist of a lower portion called the sheath and the aerial portion called the blade. Also similar in location and function are the coleoptile, mesocotyl, and crown.

Wheat plants tend to have more than one tiller per plant, and each tiller is capable of producing a fully-developed flowering structure called a head or "spike". The number of tillers per plant is somewhat greater when soil moisture for growth is good at the "tillering" stage which occurs before heading. This variable tillering effect permits the plant to self-compensate for seasonal variance in rainfall which is so unpredictable in most wheat-growing regions. Sometimes early rains are followed by inadequate moisture when the grain heads are forming, so the early tillering is detrimental to grain yields due to the tiller population being too great. Some plant breeders believe that wheat varieties producing a single stem per plant (like corn) would be better for the farmer since he could control the plant (tiller) population to suit his own conditions by adjusting the seeding rate. No single-stemmed varieties have yet been developed for wheat, however.

An area of major difference between corn and wheat is the flowers. It is recalled that corn has male flowers in the tassel and female flowers in the ear. On the other hand, both male and female parts occur in the same flowers in the case of wheat and most other grasses.

Another difference is the typical absence of brace roots with wheat, but presumably there is little need for them due to the shorter size of plants. Corn sometimes appears to be partially uprooted when lodging occurs but this uprooted effect seldom, if ever, exists with wheat. Lodging does occur in wheat, however, usually by bending or breaking of the stem.

Plate 11: WHEAT SPIKELET

A short comparison of a wheat spikelet with barley spikelets was presented in Plate 5. Plate 11 shows the wheat spikelet in greater detail.

Several wheat spikelets are borne in a wheat spike (head). The central stem of a spike inflorescence is called the rachis and is composed of rachis nodes (Plate item 1) and internodes (Plate item 2). Each rachis node bears one spikelet.

A spikelet is represented by two glumes (Plate items 15 and 19) and fertile or sterile florets which

they contain between them. A wheat spikelet seldom has more than three fertile (grain-bearing) florets due to maturation and ripening prior to full development of other florets.

The fertile florets each consist of a lemma, a palea, and a caryopsis or kernel when mature. The lowermost floret is called the first fertile floret with the next higher the second fertile floret, and so on until the sterile floret is reached. Florets are attached to a small stem-like structure (Plate item 9) called the rachilla or "little rachis."

Awns, when present (they are absent on some varieties), arise from the tip of the lemma.

The glumes are usually rather brittle and boat-shaped which accounts for the central nerve being called a keel (Plate item 14). Other nerves (Plate item 13), the beak length (Plate item 3), and the glume shoulder (Plate item 4) are used in varietal identification.

Plate 12: OATS PANICLE

Except for the loose branched panicle inflorescence, oats are typically similar to wheat in the vegetative stage.

The terminology of the panicle is somewhat different from a spike, however. For some reason, the central stem of a panicle has been called a peduncle; but functionally it is similar to a rachis. It will be noted that the peduncle has "peduncle nodes" and "peduncle internodes." The peduncle nodes each give rise to several branches called "peduncle rays." In turn, the peduncle ray is branched and the tip of each branch has a swollen area called the pedicel which supports a single spikelet.

The Oat spikelet is composed of two glumes (large, papery structures). Between them, several florets may develop attached to a small stemlike rachilla.

Plate 13:GRASS LEAF AND STEM

Barley plants are excellent for study of grass leaves and stems. Plate 13 could well be a schematic of a barley leaf and stem. The leaf blade and the parallel veination are easily apparent. Nodes and internodes are easily distinguishable. The ligule characteristics are useful in varietal identification. Barley auricles are prominent and well developed, encircling the stem.

Leaves, of course, arise from the nodes; and the basal part of the leaf sheath is a meristematic (growing tissue) region. The location of meristematic tissue accounts for the ability of grasses to regrow after grazing or mowing.

Plates 14 – 20: GRASS IDENTIFICATION

As previously stated, identification of grass species requires careful scrutiny of the vegetative characteristics and the root system. Mature, headed specimens are more easily identified than immature plants. Since thousands of grass species are known to exist it is impossible to state the species in a positive manner using vegetative characters alone.

If it is known that the vegetative plant can only be one of a few species, it is sometimes possible to identify it correctly. In any event, the shape of the ligule, the presence or absence of auricles, the presence of rhizomes or stolons are all helpful in this regard. If a grass creeps underground it may form a "sod"; or, when no creeping exists, the grass may grow in a clump and be called a "bunchgrass". Leaf shape and texture (coarse, medium, fine) as well as color are used in vegetative identification. Identification in the vegetative condition is complicated, to say the least.

Plate 14 shows that leaves may be folded or rolled "in the bud". Leaf shapes and other characteristics are used to identify certain grasses as presented in Plates 15, 16, 17, and 19.

If seedlings of cereals are examined it is usually possible to distinguish between oats, barley, corn, wheat, and rye (Plate 18). It is interesting to examine known seedlings to see if you can match them with the drawings. "A" is oats; "B" is barley; "C" is corn; "D" is wheat; and, "E" is rye. Structures used in identification are the ligule (1, 3, 9), auricles (4 and 7), collar (5), culm (8), midrib (2), and sheath (10).

Vegetative characteristics of four cereals are presented in Plate 20. Can you identify the cereals and label the parts indicated? Could you determine whether wild oats were present in a seedling barley field prior to using Carbyne for wild oat control?

Plate 21: LEGUME FLOWER

Legume flowers are similar to each other whether the legume is peas, beans, clover, or alfalfa. Bean flowers and pea flowers are good for study due to the large size. Plate 21 shows the complete legume flower and several levels of dissection.

The perianth is a floral envelope of parts not essential to reproduction which is visible on the complete flower. It consists of the "standard" petal (A), two "wing" petals (B), two "keel" petals joined together (C), and the calyx (D). The pedicel (E) is the stalk that bears the flower.

If the flower is partially dissected, the inner part of the perianth (composed of petals) known as the corolla can be more clearly seen. Petals include the standard, the wings, and the keel (A, B, and C).

If the corolla is removed, the remaining inner sexual organs known as stamens and pistil are exposed.

Legumes usually have nine stamens, eight of which are united into a "staminal column" at the base of the filaments. The remaining stamen has the typical anther (A) and filament (B). The staminal column of "united filaments" is indicated by "C" in the drawing. Stamens are male sexual parts.

The female sexual organ, known as the pistil, exhibits a typical structure. The stigma (A) receives the pollen grains. The style (B) lies between the stigma and the ovaries (D). In the development of the ovaries into "seeds" they are encased in a "legume" pod (C).

Plate 22: REPRODUCTION PARTS OF COTTON

Cotton flowers, like legume flowers, consist of some non-essential parts and some parts essential for reproduction.

Figure 1 of Plate 22 represents what is commonly called a cotton boll in the center of the drawing. Subtending the boll are the united calyx leaves and they are subtended by leaf bracts. The boll and flower parts are borne on a stemlike pedicel.

Before pollination, the flower petals may be stripped back to expose the sexual parts. The pistil is readily distinguishable due to the typical shape and the location of the stigma, style, and ovary. The stamens, composed of anthers and filaments, appear to be part of the pistil on casual observation due to the fact that the filaments are attached to the female organ.

After pollination, the dry petals are shed by the cotton plant. As the fruiting body (boll) develops, the leaf bracts enfold tightly about it and at this time the crop is said to have "squares." Acqually a square, created by three tight leaf bracts, is more like a "triangle" than a "square." With continued growth the boll emerges from the square and is clearly evident prior to maturity.

KEY TO PLATES

Plate 2: Corn Seedlings

1. Coleoptile
2. Radicle
3. Plumule
4. Crown
5. Mesocotyl
6. Seed Remnant
7. Primary Root
8. Coleoptile
9. Secondary Roots
10. Mesocotyl

Plate 5: Mature Spikelets

WHEAT (one spikelet)	BARLEY (three spikelets)
Awn	Awn
Sterile Floret	
Palea	
Lemma	Lemma
Glume	Glume
Rachis	Rachis

Plate 6: A Grass Flower

	Lemma
	Anther
	Stigma
Style	Filament
	Ovary
	Palea

Plate 7: Male and Female Grass Flower Parts

A. Filament
B. Ovary
C. Style
D. Anther
E. Stigma
F. Lodicule

Plate 8: Wheat Kernel

BACK SIDE	CREASE SIDE
Brush End	Brush End
Peak	Cheek
Embryo End	Crease

Plate 13: Grass Leaf and Stem

	Midrib
	Blade
	Node
Internode	Ligule
	Auricle
	Sheath
	Meristematic Region

Plate 18: Vegetative Characteristics of Cereals

A. OATS B. BARLEY C. CORN D. WHEAT E. RYE

1. Ligule	6. Blade
2. Midrib	7. Auricles
3. Ligule	8. Culm
4. Auricle	9. Ligule
5. Collar	10. Sheath

Plate 20: Small Grass Leaves

1. BARLEY	2. WHEAT	3. RYE	4. OATS
A. Blade	A. Blade	A. Blade	A. Blade
B. Ligule	B. Ligule	B. Ligule	B. Ligule
C. Auricle	C. Auricle	C. Auricle	C. Sheath
D. Sheath	D. Sheath	D. Sheath	

Plate 21: Legume Flower

PERIANTH	COROLLA	STAMENS	PISTIL
A. Standard Petal	A. Standard	A. Anther	A. Stigma
B. Wing Petals	B. Wings	B. Filament	B. Style
C. Keel Petals	C. Keel	C. United Filaments	C. Pod
D. Calyx			D. Ovaries
E. Stalk			

Plate 22: Reproductive Parts of Cotton

1. COTTON BOLL	2. FLOWERS		3. SQUARE
Calyx	Anther	Stigma	Fruit (Boll)
Leaf Bracts	Filament	Style	Leaf Bracts
Pedicel		Ovary	Pedicel

GLOSSARY

ADVENTITIOUS ROOTS--secondary roots; roots that have developed other than from seed.

ANTHER--pollen-bearing male part.

AURICLE--ear-like lobes which grow downward on each side at the junction of blade and sheath.

AWN--beard found on the lemma.

BEAK--structure at the tip of the glume.

BEARD--terminal appendages found on the end of the lemma; sometimes called "awn."

BLADE--flat, expanded, tapering part of a leaf, with a definite midrib and smaller parallel veins.

BOLL--capsule enclosing the fertilized seed.

BRACE ROOTS--specialized roots arising from nodes above the ground.

BRACT--leaf subtending a flower.

BUSH--short hairs on the caryopsis; also called "pubescence."

CALYX--modified leaves consisting of sepals.

CARYOPSIS--kernel or grain.

CHEEK--a rounded portion of a kernel that borders the crease.

COLEOPTILE--membranous modified leaf of grasses which surrounds the first true leaves and serves as a protective covering prior to emergence.

COLLAR--line or zone on the outer side of the leaf at the junction of the blade and sheath that is distinguished by texture, color, or pubescence.

COTTON BOLL--same as boll; contains seed and fibers.

COTYLEDON--embryo or seed leaves.

CREASE--depressed area running from one end to the other on a wheat kernel.

CROWN--point of transition from the root system to the shoot system.

CULM--monocotyledonous stem.

EMBRYO--rudimentary plant in seed.

ENDOSPERM--storage tissue in interior of a grain kernel.

FACE--portion of the glume which is visible as the spike is held in one's hand.

FIBROUS ROOTS--slender thread-like roots typical in grasses; develop if original tap root is destroyed.

FILAMENT--small thread-like structures that support the anther.

FLORET--lemma and palea with enclosed sexual parts.

FOLIAGE LEAF--develops in the axil of the cotyledons; usually is unifoliate.

GERM--embryo; spongy, oily, and living portion of the grain located at the base of the kernel adjacent to the concave side.

GLUMES--pair of basal bracts subtending a spikelet.

HYPOCOTYL--stem of the young seedling below the cotyledons and extending to the root.

INFLORESCENCE--flowering portion of a plant.

INTERNODE--portion of a stem between any two adjacent nodes.

KEEL--edge of glume formed by union of face and back.

LATERAL ROOTS--smaller branches of a tap root system.

LEAF BLADE--flattened, parallel-veined portion of the true leaves of grasses.

LEAF SHEATH--basal part of the true leaf of grasses.

LEMMA--lower of the two bracts enclosing the flower in the spikelet.

LIGULE--membranous or cartilaginous fringe at the junction of the sheath and the blade on the side of the leaf next to the culm.

LODICULES--two spherical bodies at the base of the pistil.

MERISTEM--growing portion of the bud of grasses.

MESOCOTYL--slender, stem-like structure connecting the primary root system with the secondary root system of grasses.

MIDRIB VEIN--prominent vein on the leaf blade.

NERVE--leaf, glume, or lemma vein.

NODE--enlarged joint of a grass stem from which true leaves arise.

NODULES--small, irregular knots or lumps found on the roots of legumes, usually the result of colonies of nitrogen-fixing bacteria living in a symbiotic relationship with the legume.

OVARY--enlarged base of the pistil which contains the ovule and is referred to as the fruit.

PALEA--thin papery structure covering the inner surface of a grass seed.

PANICLE--type of grass inflorescence where the spikelets are borne on branches such as in oats.

PEDICEL--spikelet bearing portion of the peduncle ray.

PEDUNCLE--central stem of a panicle bearing peduncle rays; sometimes called a "rachis."

PEDUNCLE RAY--branch originating from the peduncle.

PERIANTH--non-essential external part of a flower.

PISTILLATE INFLORESCENCE--flower containing only female sexual parts.

PLUMULE--primary bud of a plant embryo.

PRIMARY ROOT SYSTEM--roots originating from the seed.

RACHILLA--central stem of the spikelet.

RACHIS--central stem of a spike or raceme inflorescence.

RACHIS INTERNODE--internode between two rachis nodes or joints.

RACHIS NODE--joint of a spike inflorescence

RADICLE--portion of plant embryo which becomes the primary root system.

RHIZOME--modified stems of plants which develop horizontally below the soil and are capable of producing new culms and roots at each node; sometimes called "rootstocks."

SECONDARY ROOT SYSTEM--principal permanent organ of absorption that grows above the primary root system of grasses; sometimes referred to as the "fibrous root system."

SEED POD--dry dehiscent seed vessel or fruit.

SEMINAL ROOT--branches of the radicle near its origin.

SHOOT--all of those parts appearing above ground; sometimes called "plumule."

SHOULDER--inner edge of the face which slopes away from the beak.

SPIKE--flowering part of a grass plant called the head.

SPIKELET--flowering portion of the spike which is found between and includes the two glumes.

SQUARE--unopened cotton flower bud with its subtending bracts.

STAMINATE FLOWER--flower that contains only male sex organs.

STANDARD--broad upper petal of a legume flower.

STERILE FLORET--damaged or genetically incapable of reproduction.

STIGMA--feathery or plume-like structures on the style floret.

STOLON--modified plant stem developing horizontally from the plant above the ground that is capable of producing roots at each node; sometimes called "runner."

STYLE--neck-like elongation of the ovary tip which bears the stigma.

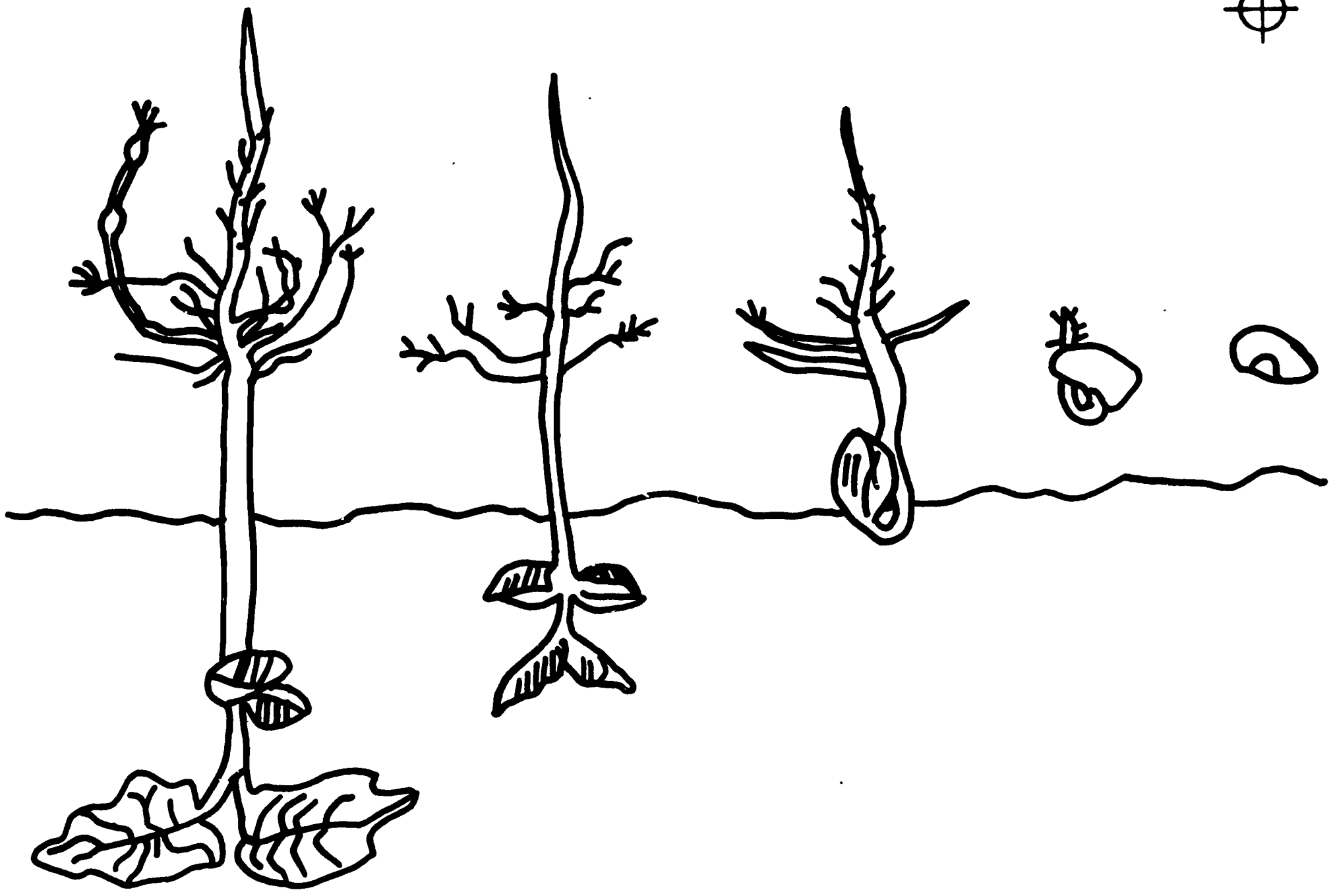
SUCKER--tillers of corn plants.

TAP ROOT--single well-developed central root of plants such as cotton or beans.

TILLER--sprout or stalk.

TRUE LEAF--originates from the base of each node of a culm; to be differentiated from cotyledon leaves or modified leaves such as calyx or bracts.

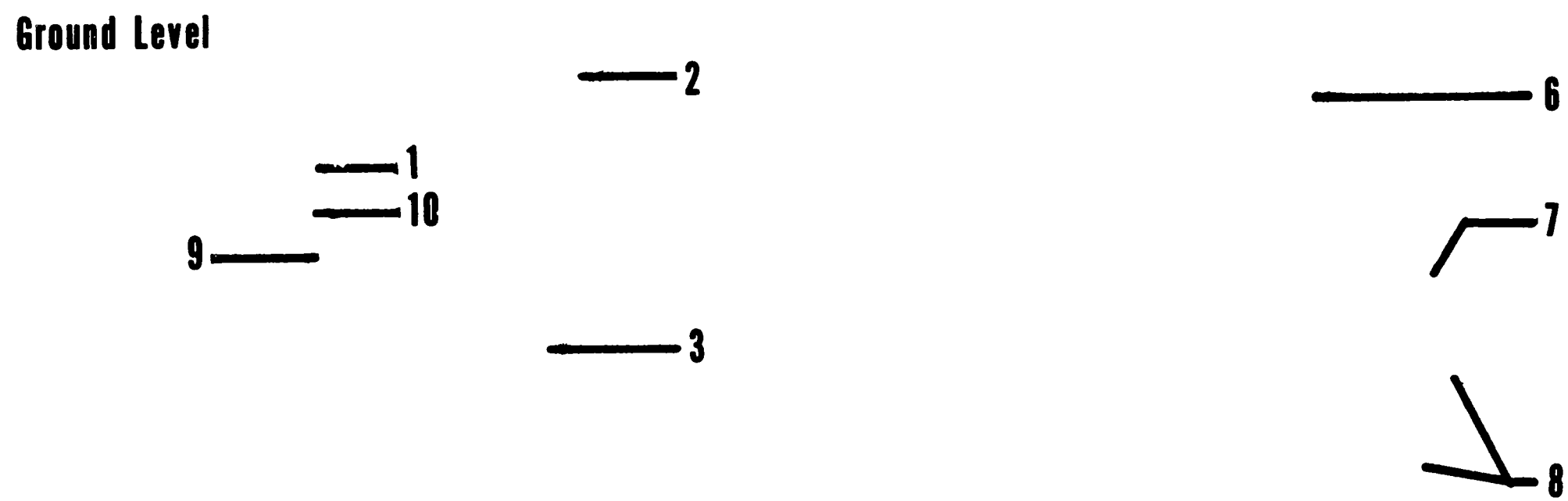
WING--two lateral petals of a legume flower.

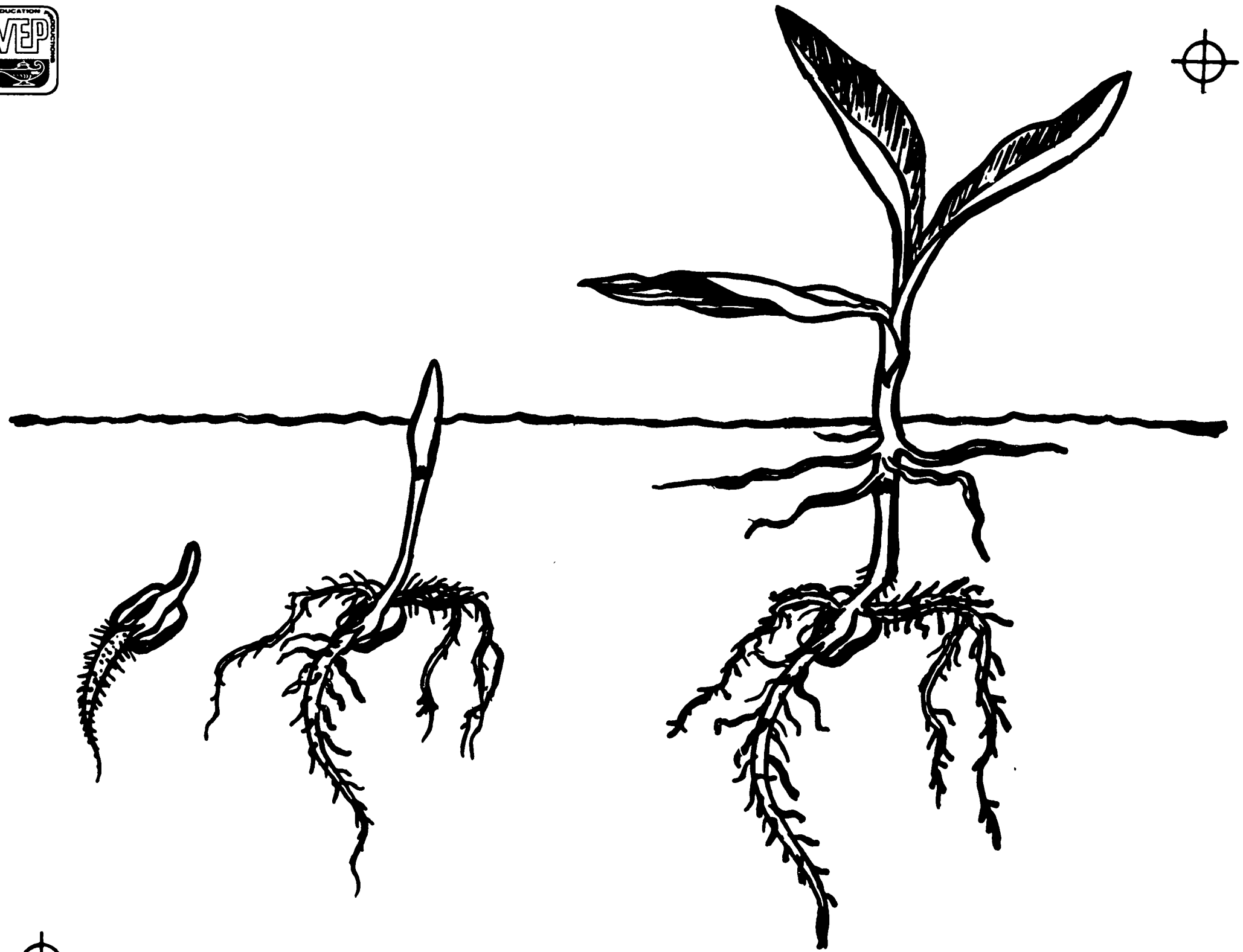


BEAN SEEDLINGS

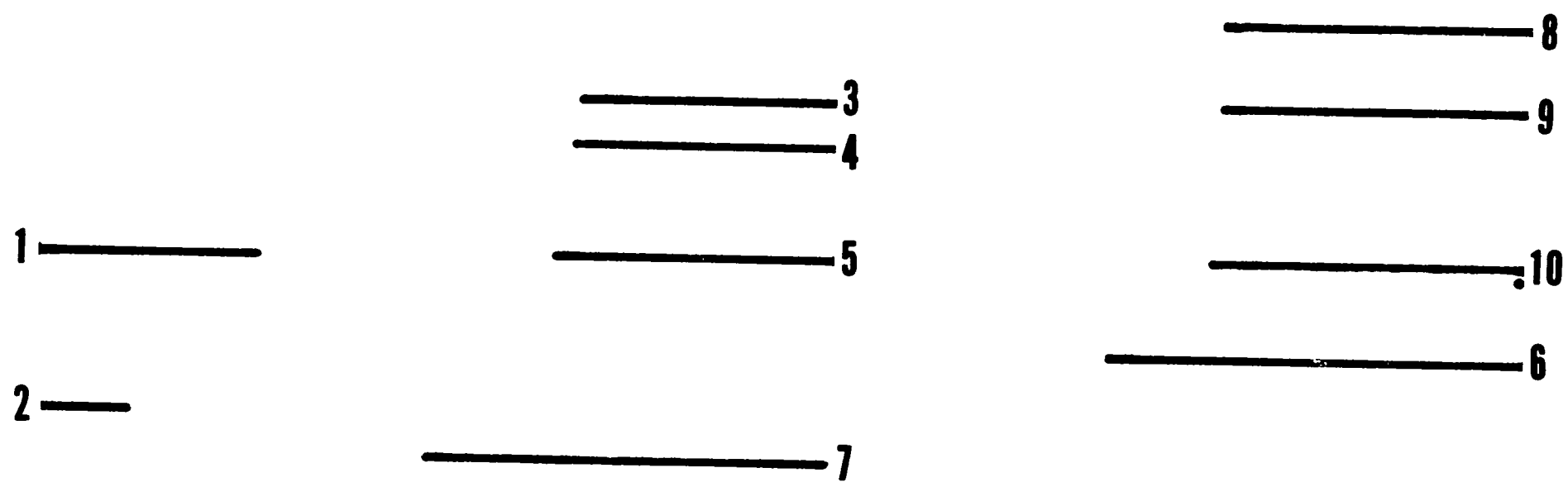
Name of Numbered Structures

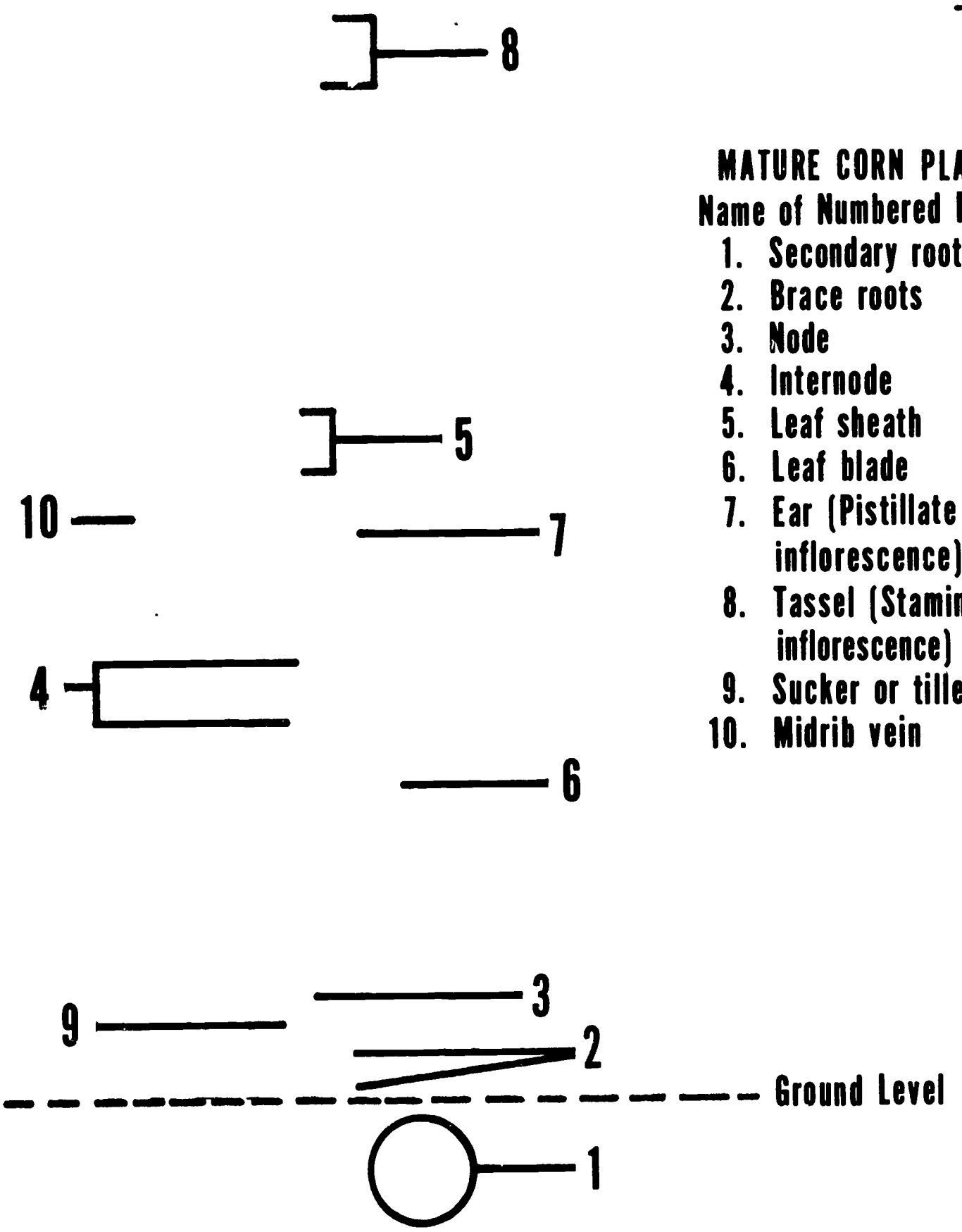
1. Hypocotyl
2. Cotyledons
3. Tap root
4. True leaf
5. Cotyledon
6. Hypocotyl
7. Lateral (Branch) root
8. Nodules
9. Radicle
10. Cotyledons





CORN SEEDLING

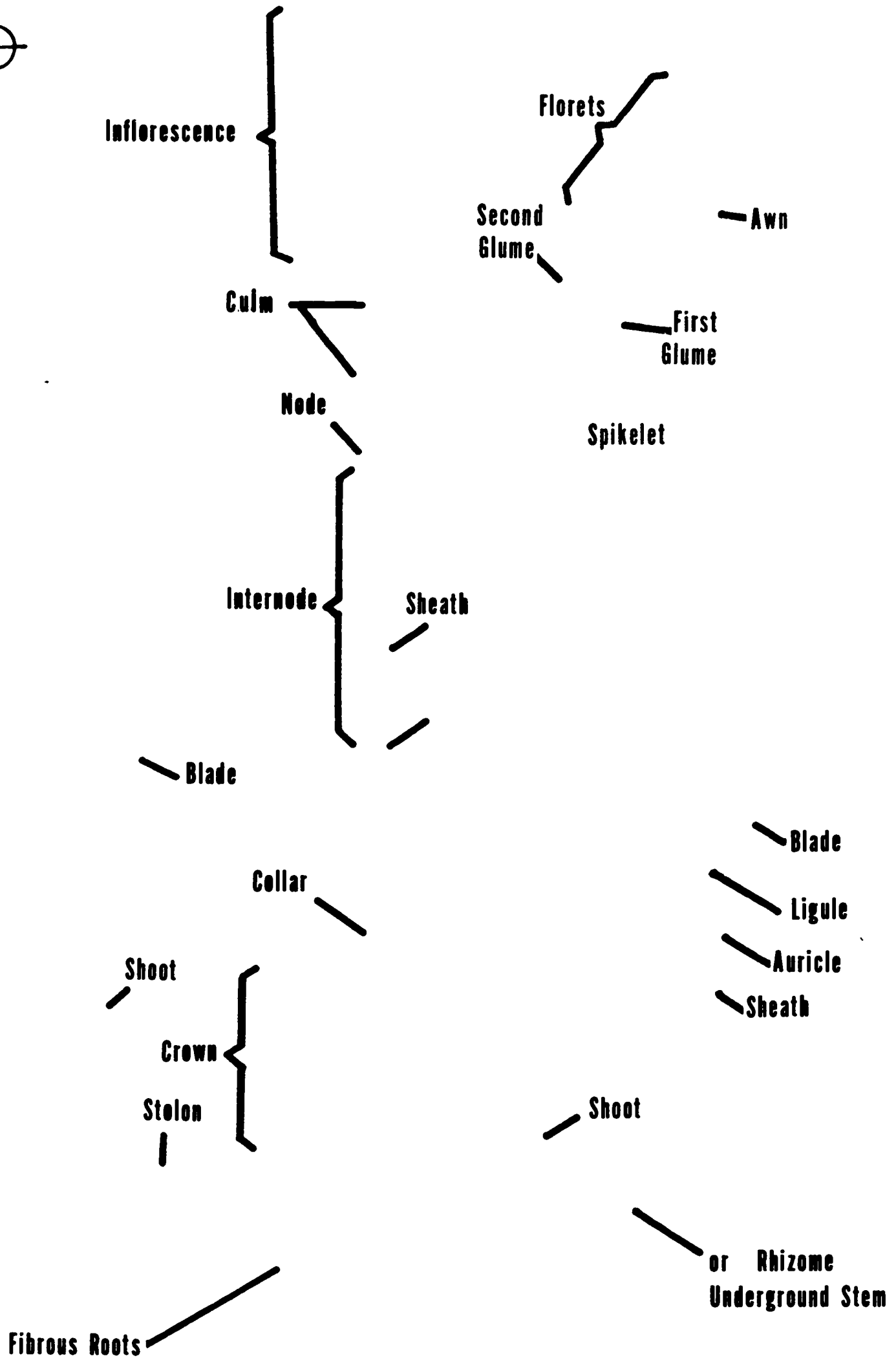


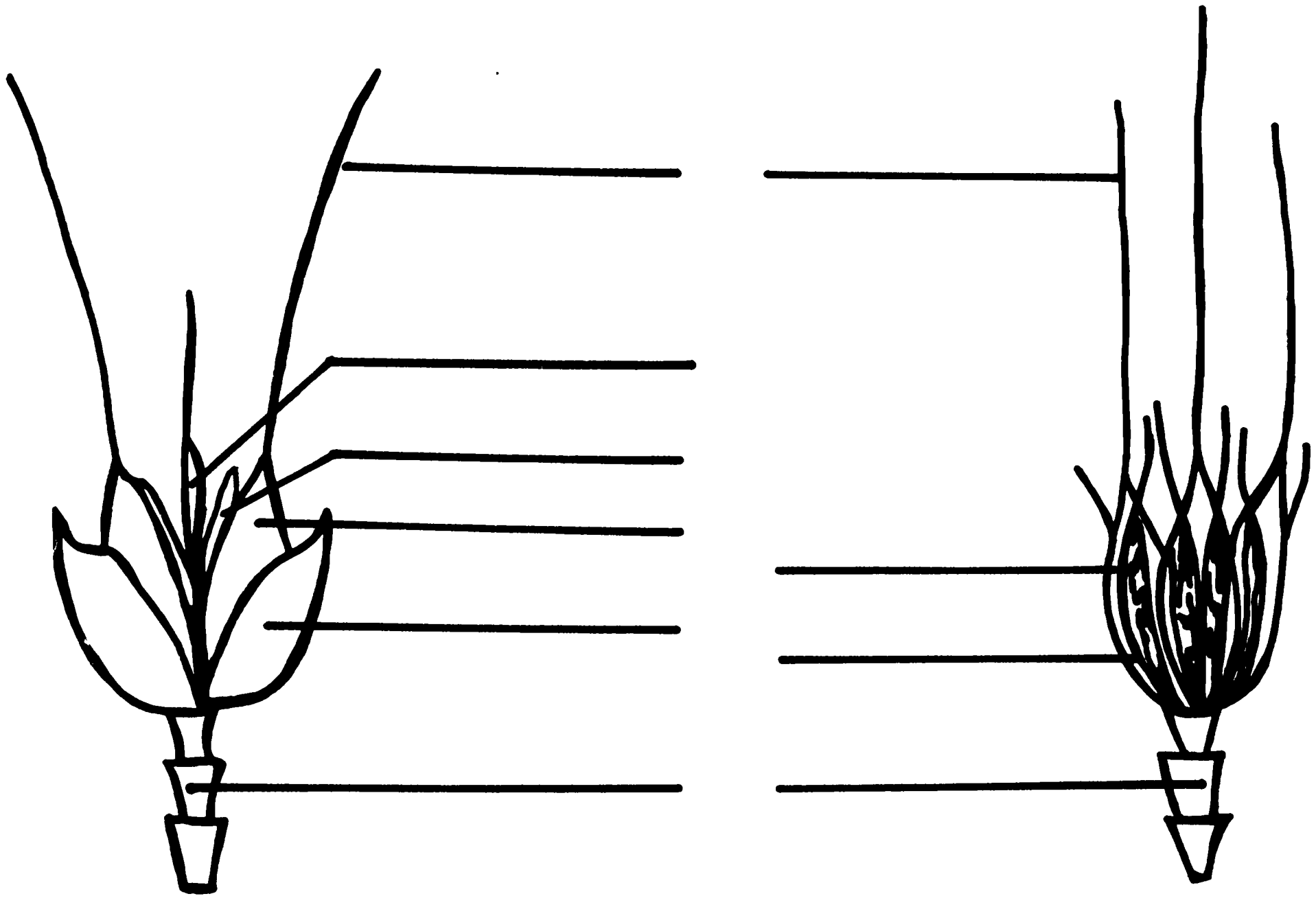


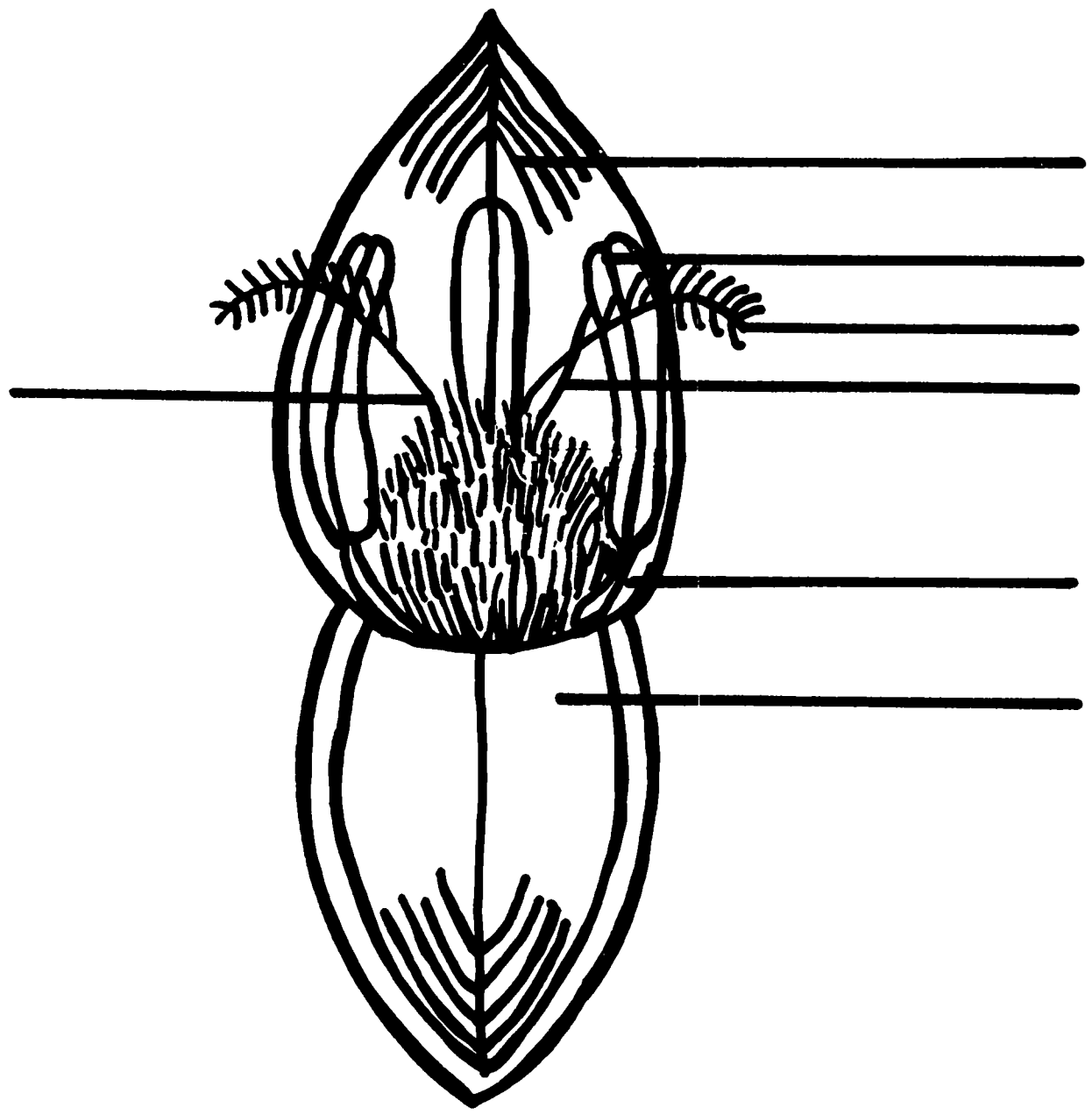
MATURE CORN PLANT

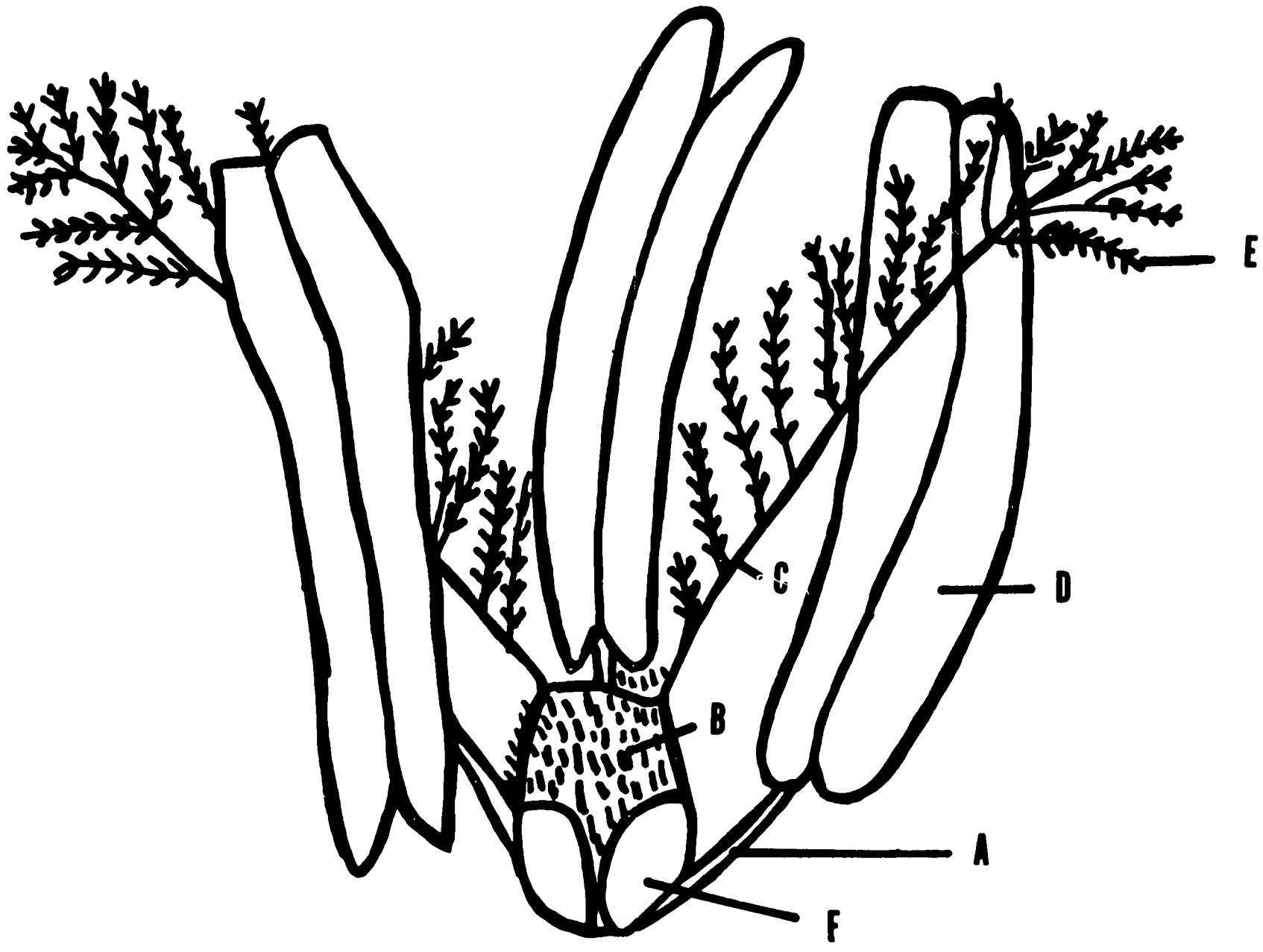
Name of Numbered Parts

1. Secondary roots
2. Brace roots
3. Node
4. Internode
5. Leaf sheath
6. Leaf blade
7. Ear (Pistillate inflorescence)
8. Tassel (Staminate inflorescence)
9. Sucker or tiller
10. Midrib vein


Inflorescence
Florets
Second Glume
Awn
Culm
First Glume
Node
Spikelet
Internode
Sheath
Blade
Blade
Collar
Ligule
Auricle
Shoot
Sheath
Crown
Stolon
Shoot
or Rhizome
Underground Stem
Fibrous Roots



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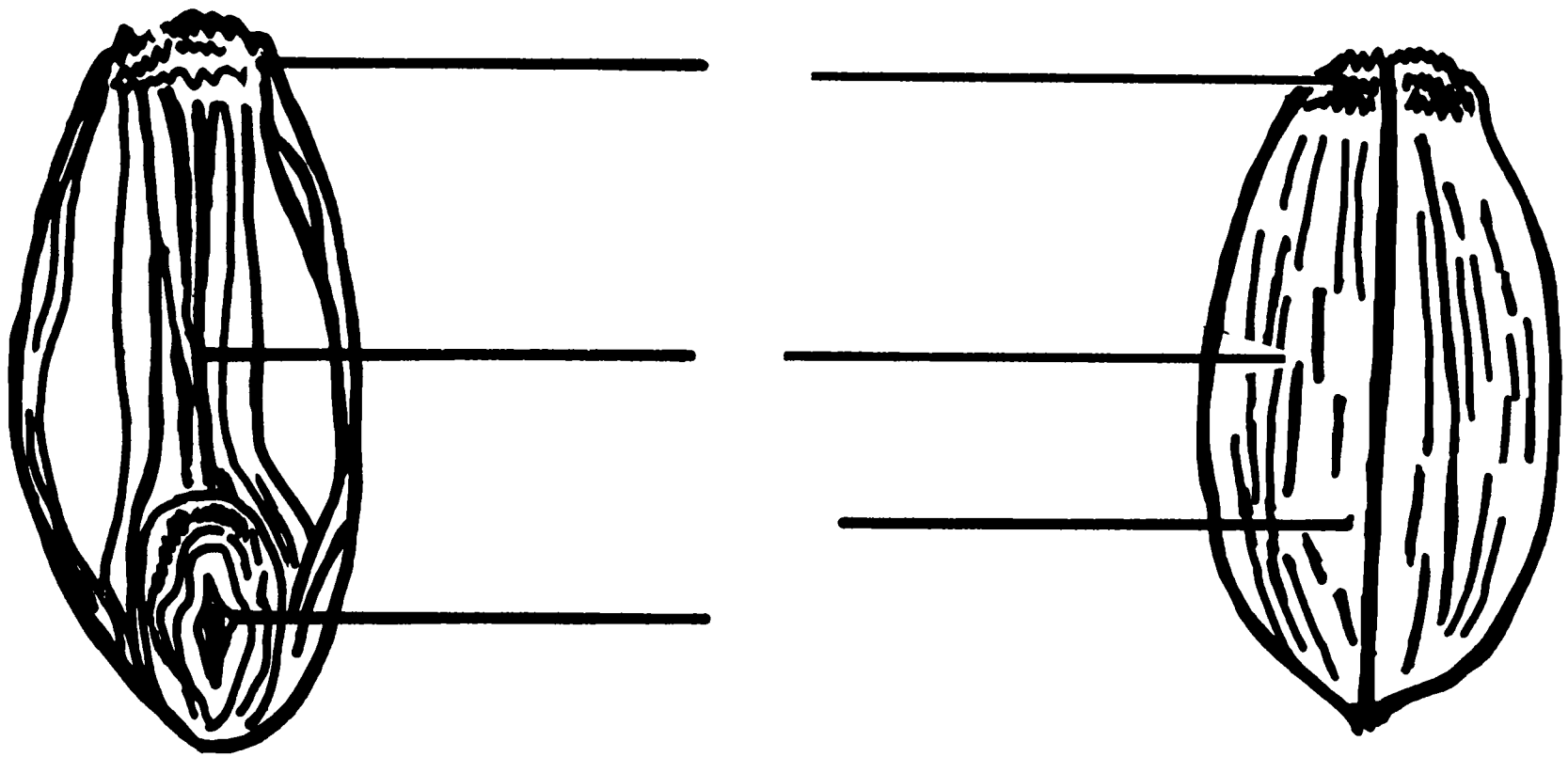
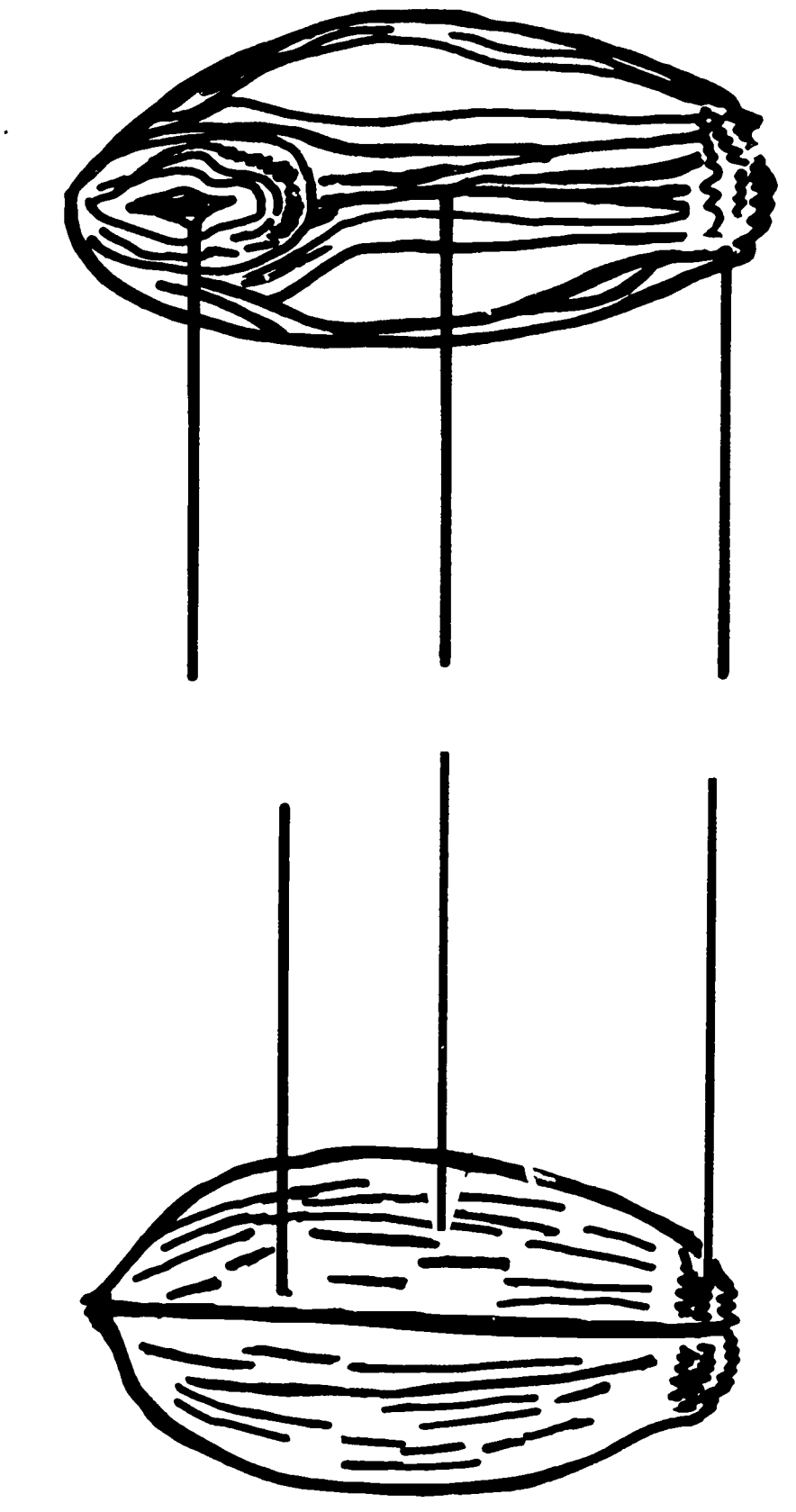
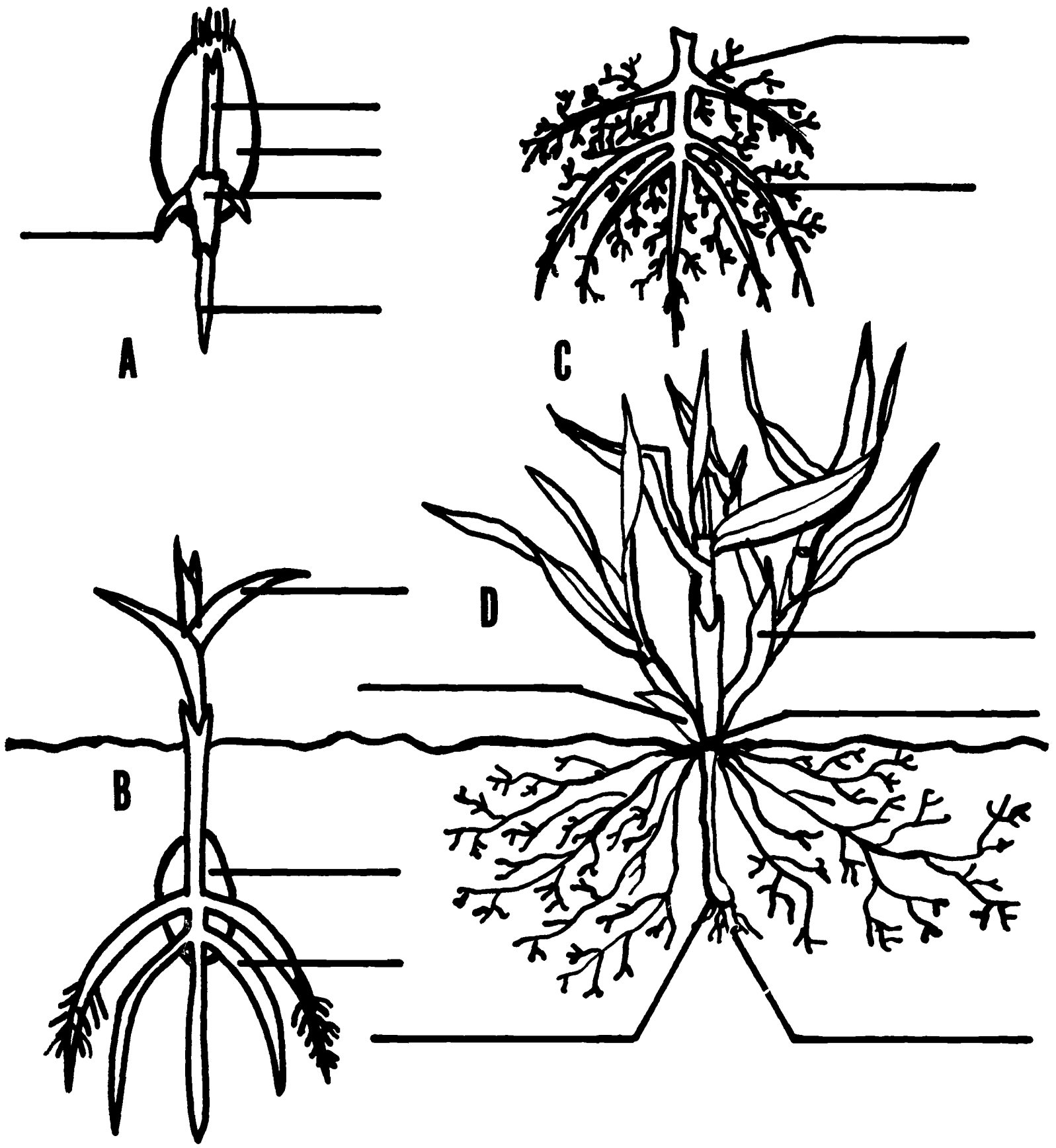
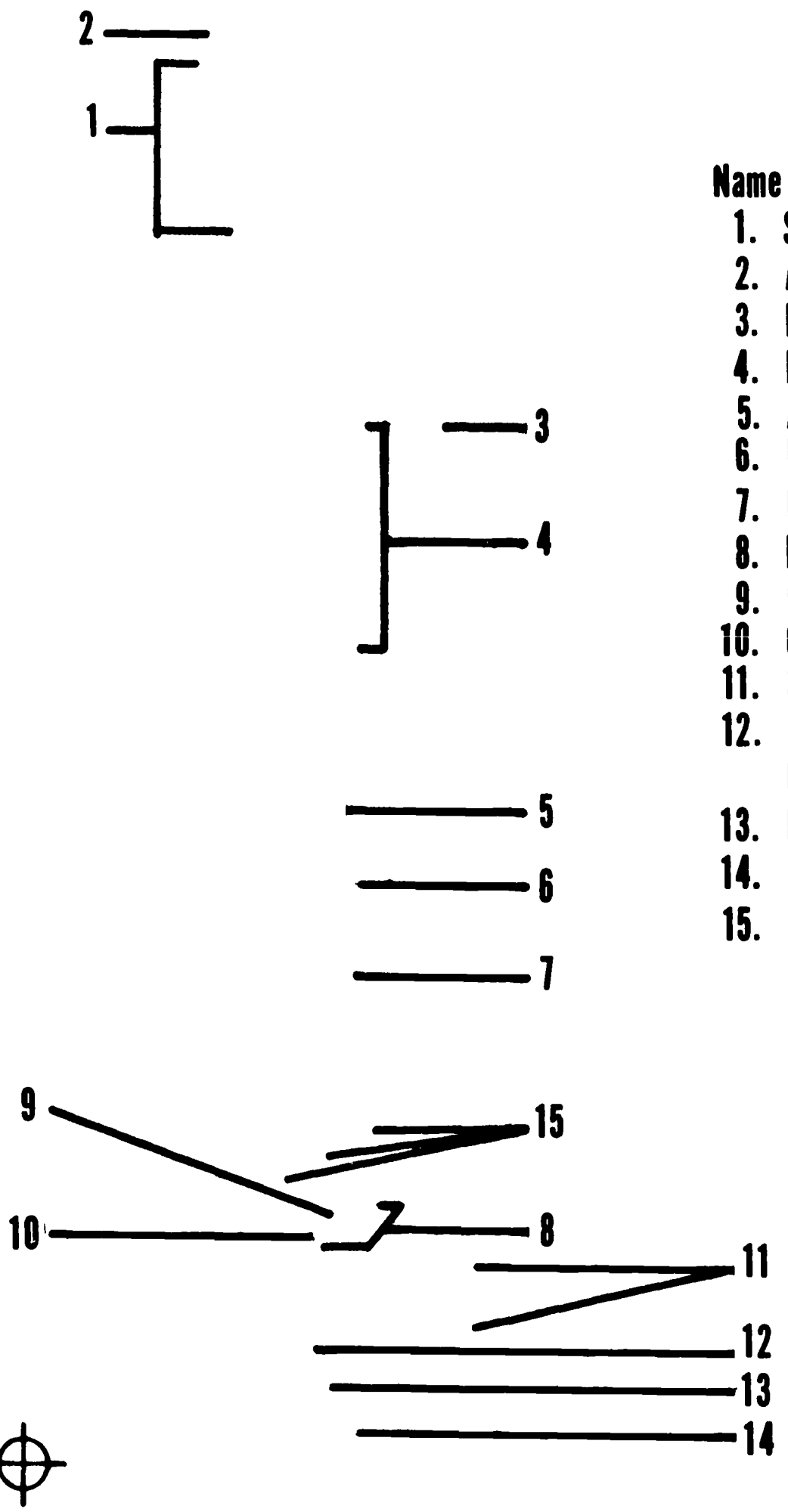




ROOTS OF WHEAT

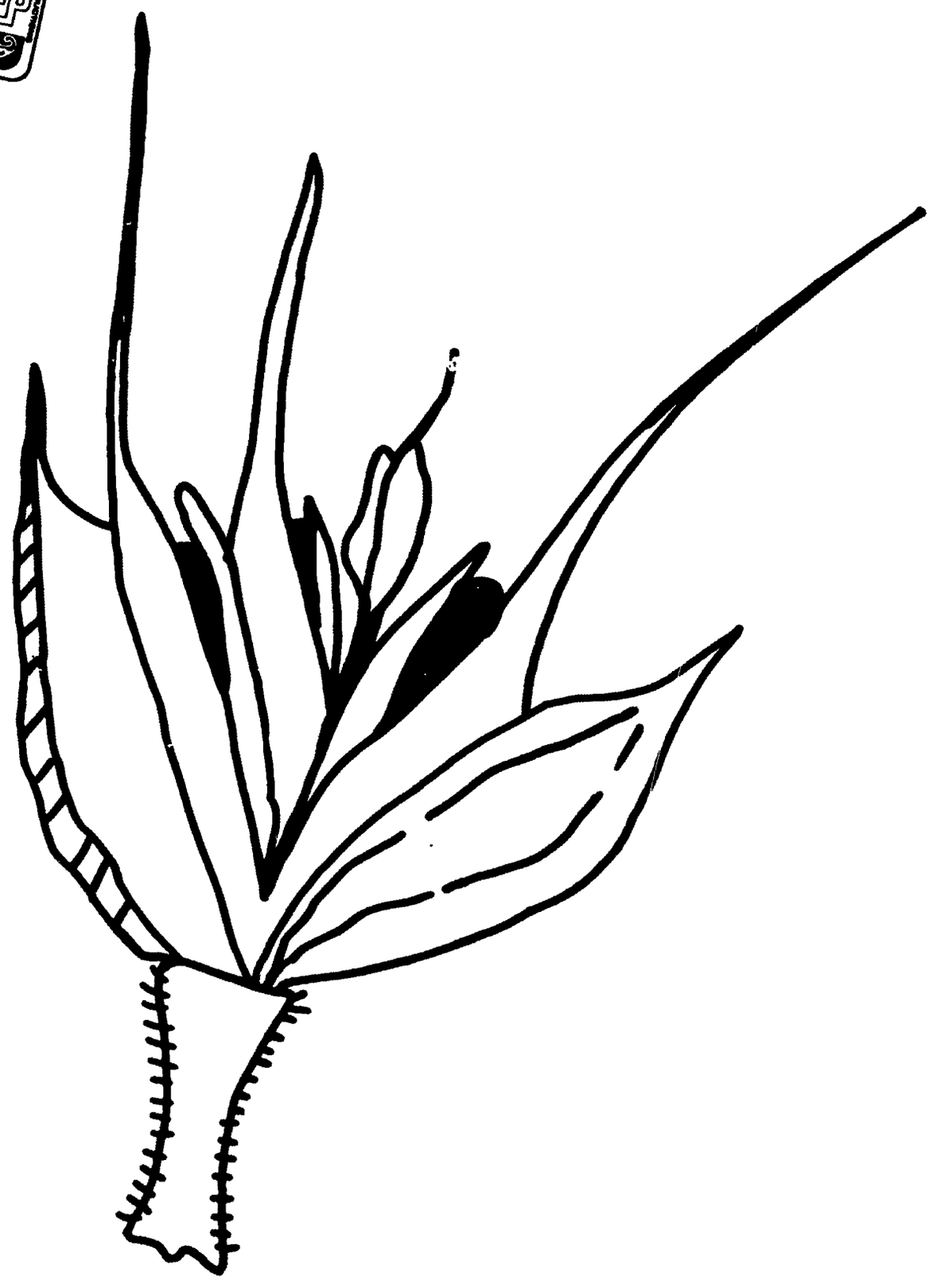


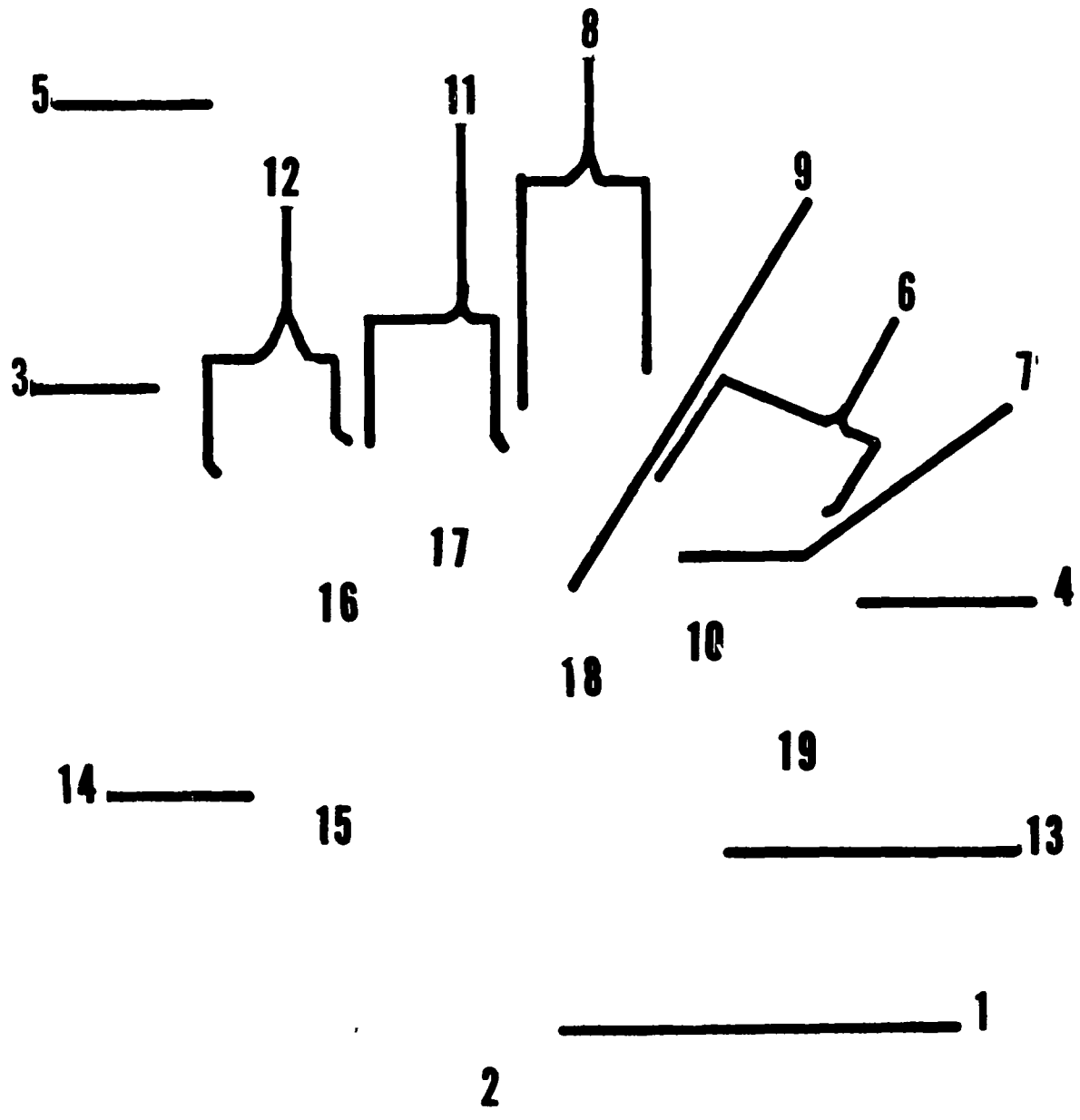


WHEAT PLANT

Name of Numbered Structures

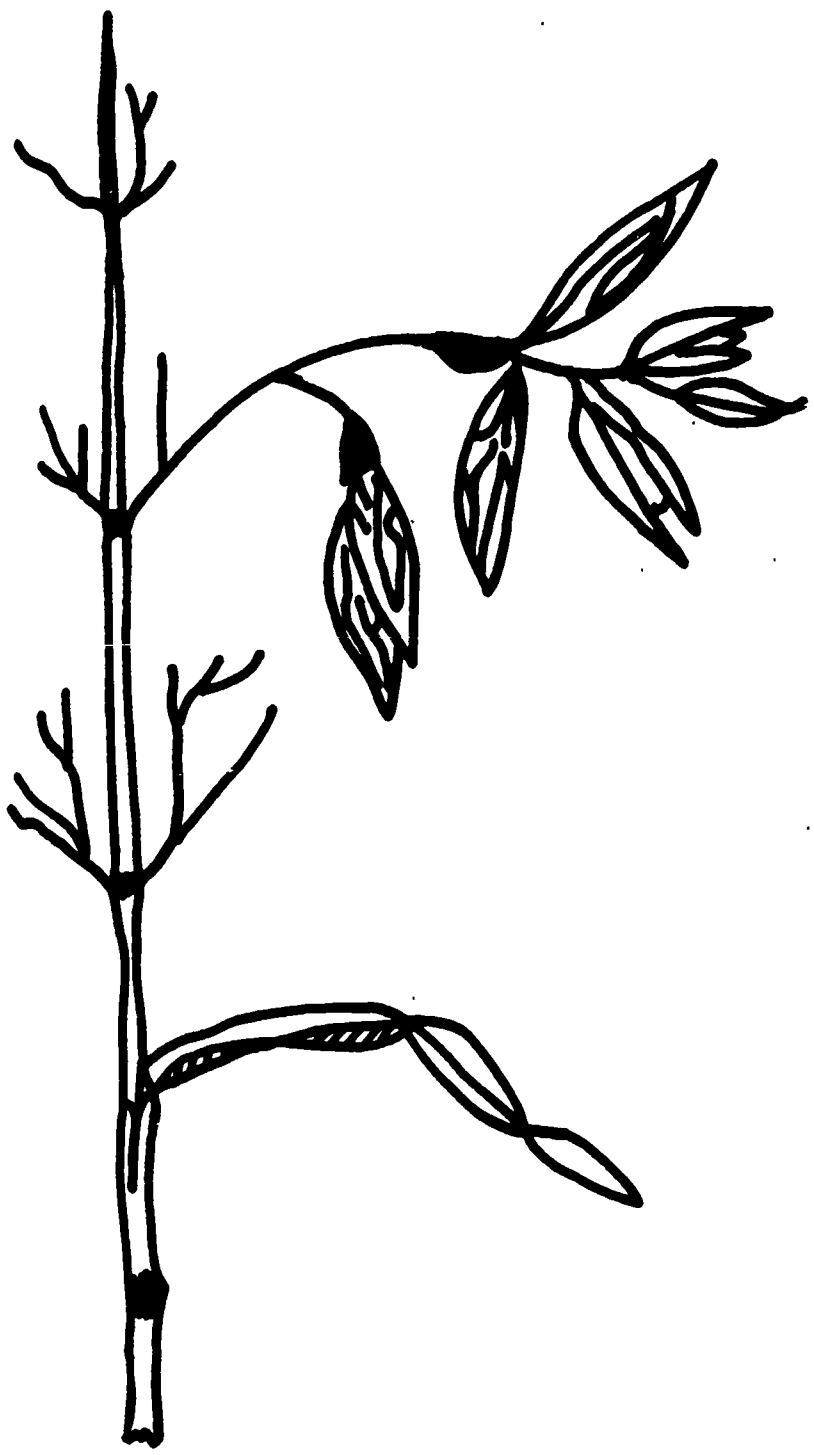
1. Spike
2. Awn or beard
3. Leaf blade
4. Leaf sheath
5. Auricle
6. Ligule
7. Node
8. Internode
9. Coleoptile
10. Crown
11. Secondary root system
12. Mesocotyl (subcrown internode)
13. Remains of seed
14. Primary roots
15. Culms, stems or tillers



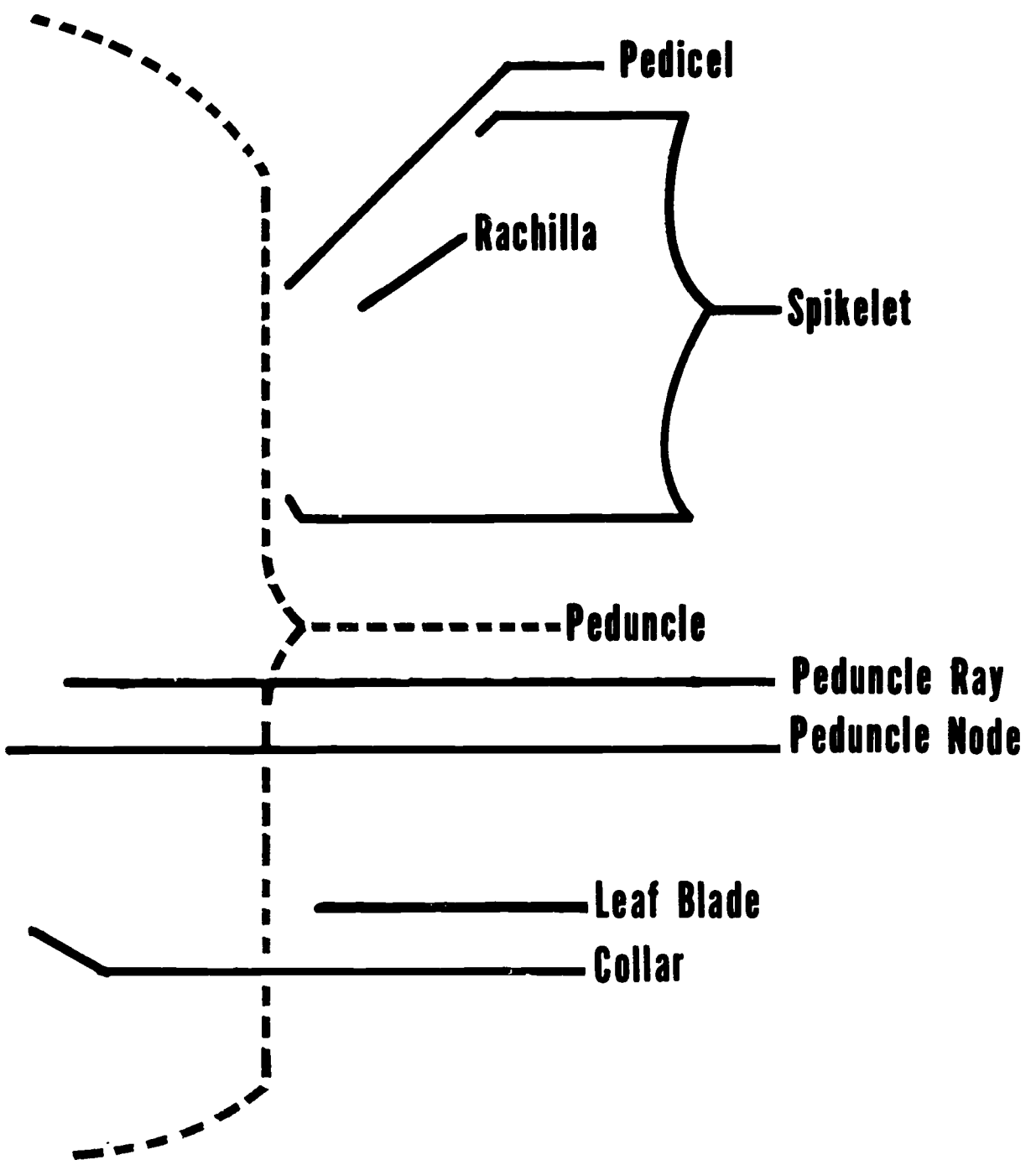


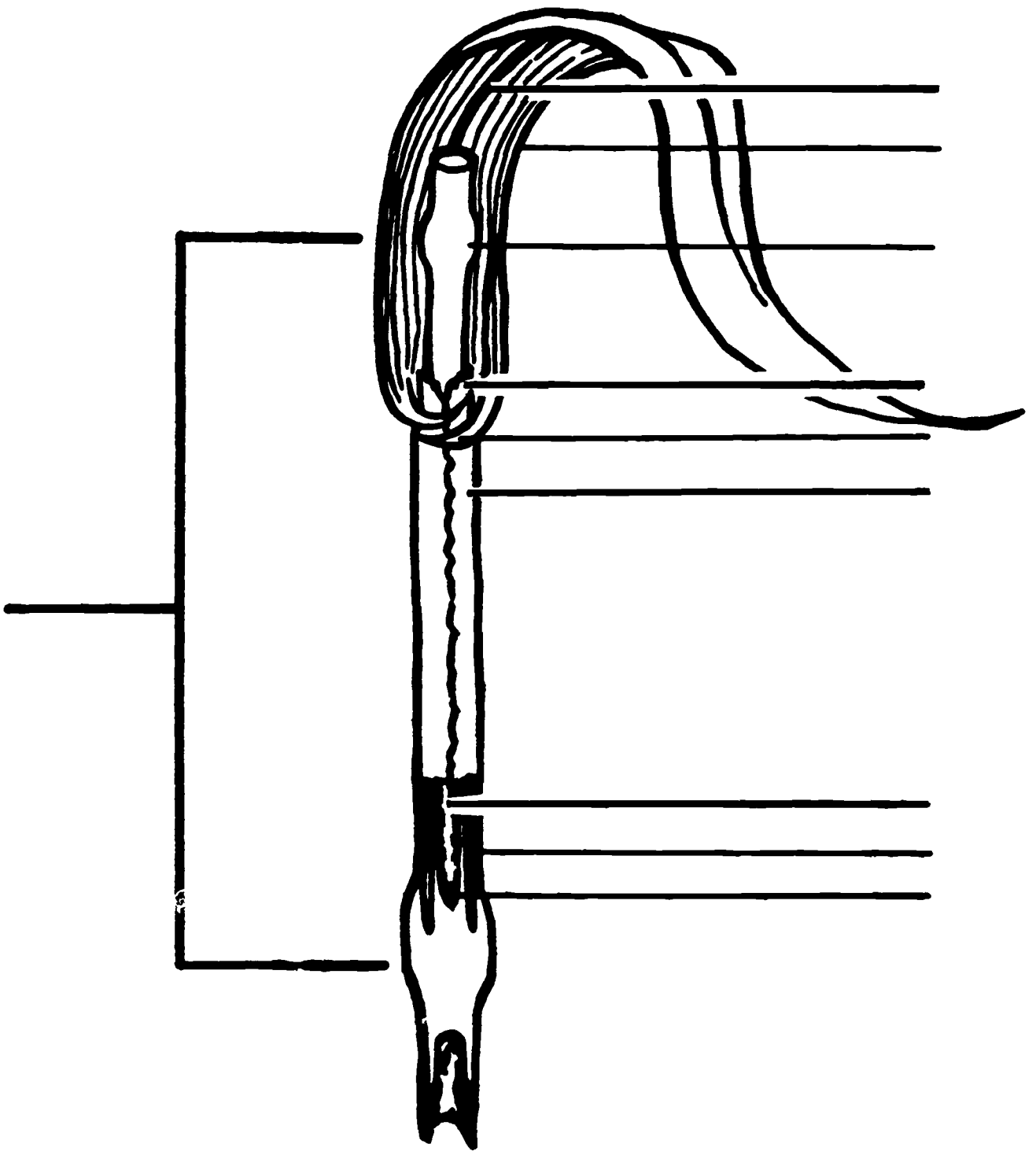
WHEAT SPIKELET
Name of Numbered Structures

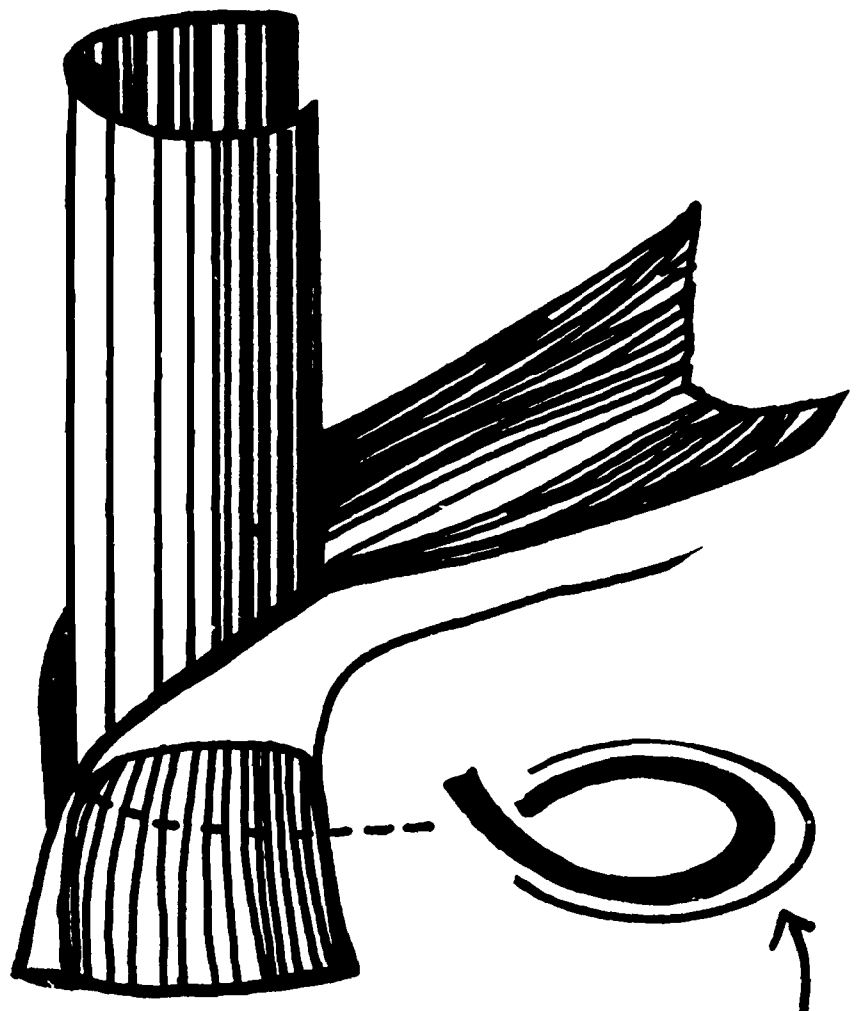
1. Rachis node
2. Rachis internode
3. Beak
4. Shoulder
5. Awn (Beard)
6. 3rd Fertile floret
7. Caryopsis (Kernel)
8. Sterile Floret
9. Rachilla
10. Lemma
11. 2nd Fertile floret
12. 1st Fertile floret
13. Nerve
14. Keel
15. 1st Glume
16. Lemma
17. Lemma
18. Palea
19. 2nd Glume



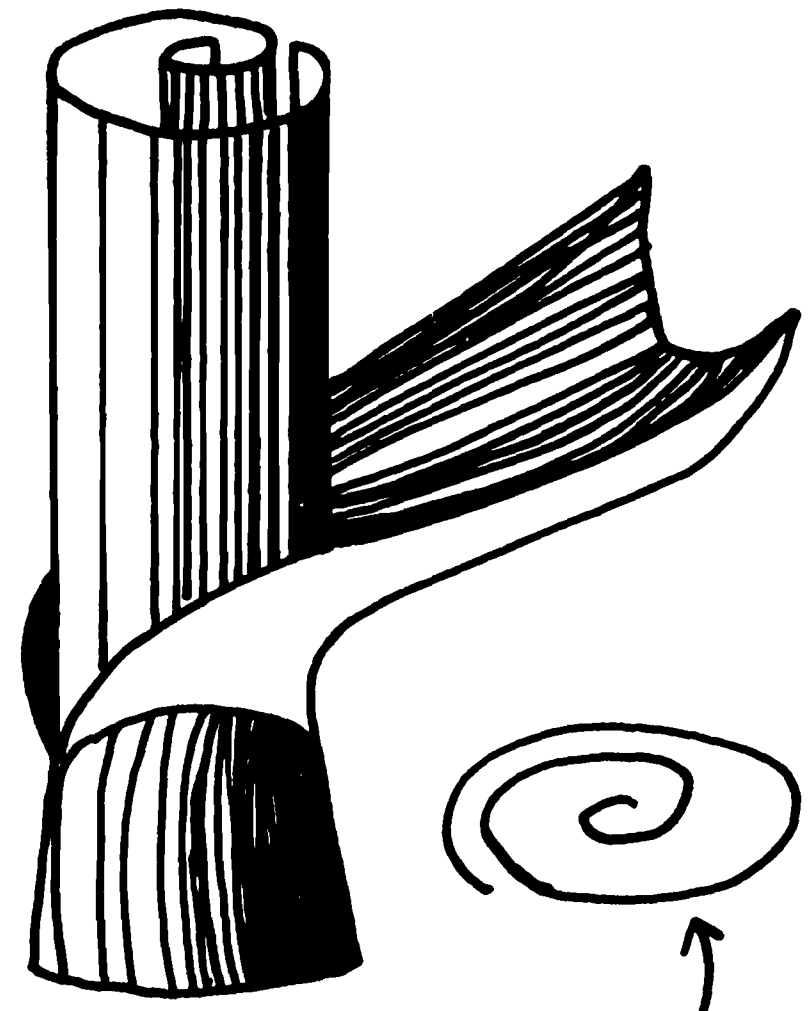
OATS—PANICLE







leaves folded in bud



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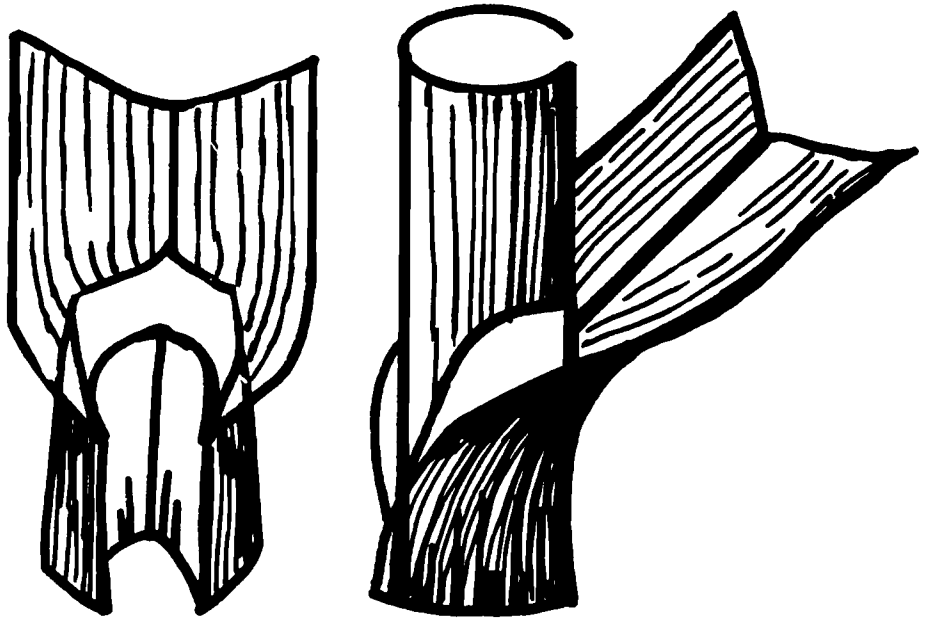

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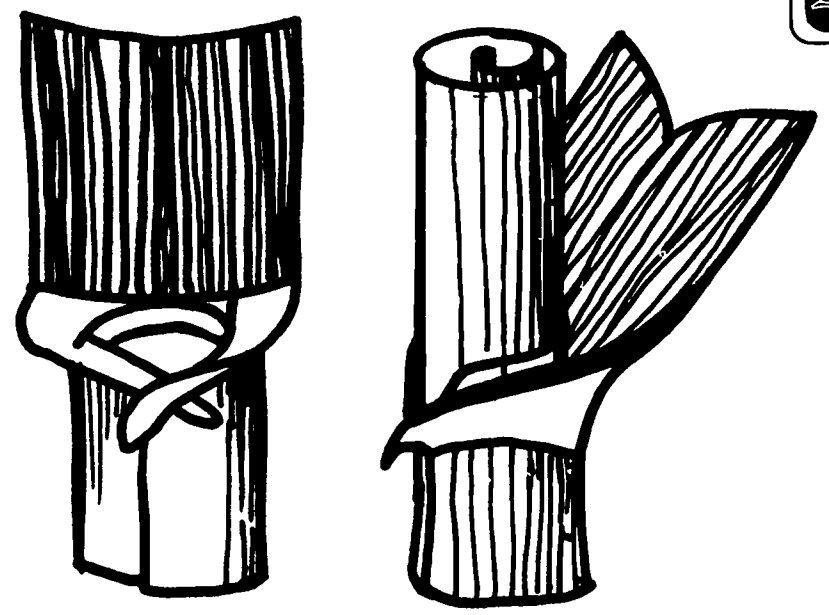

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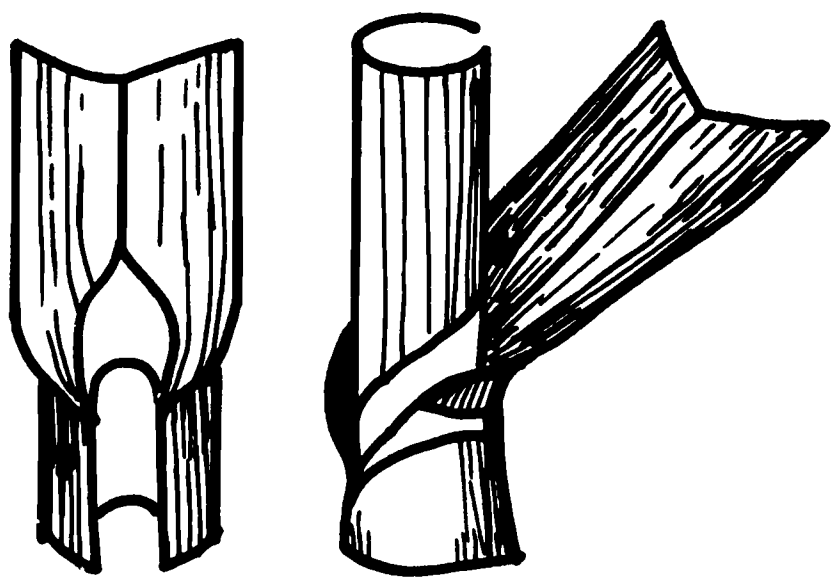

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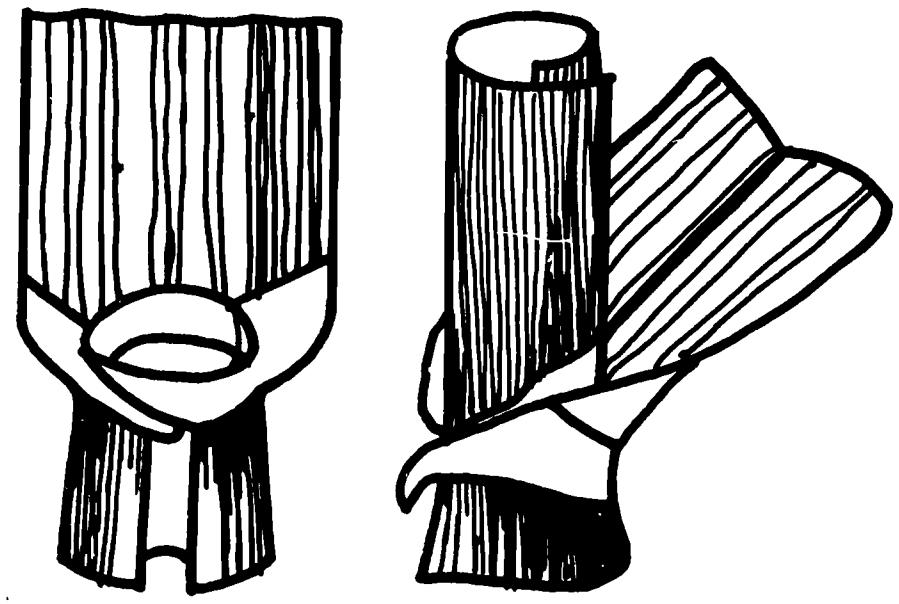

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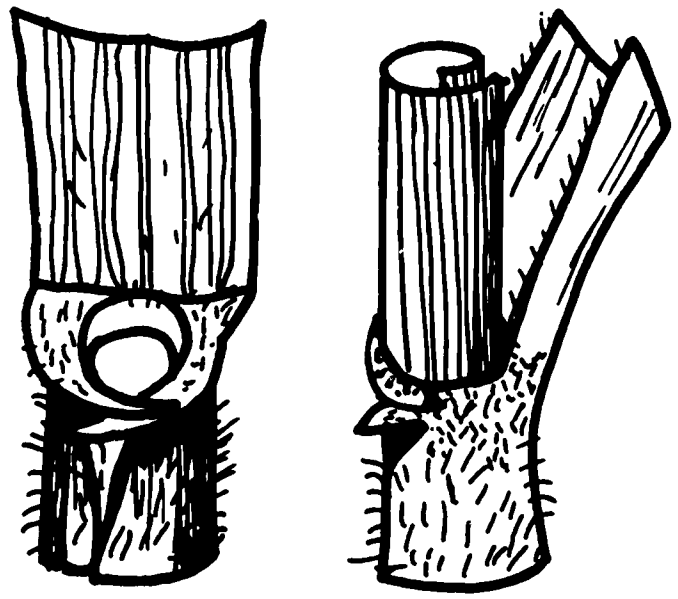

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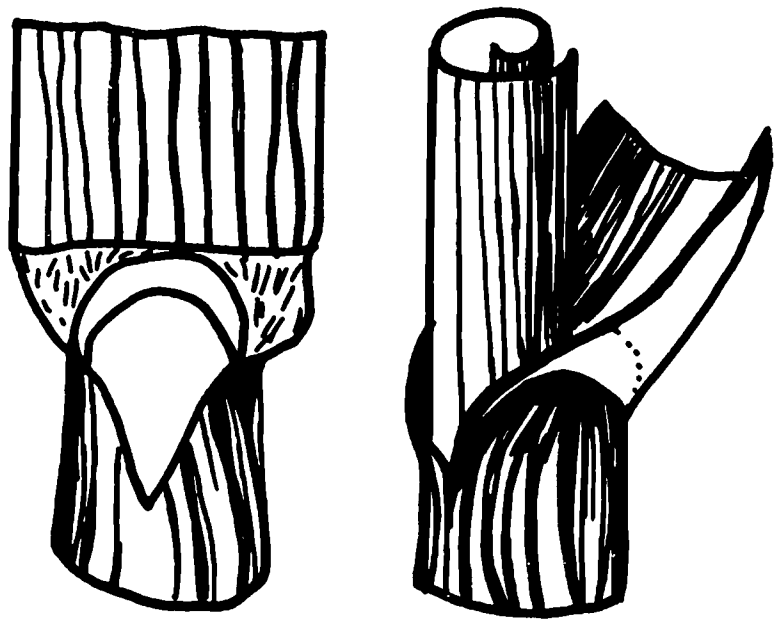

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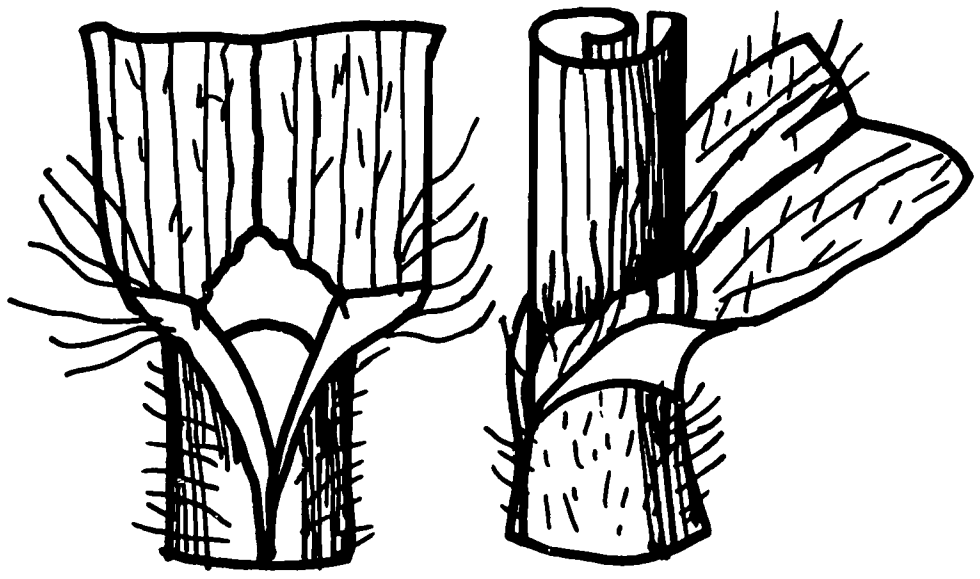
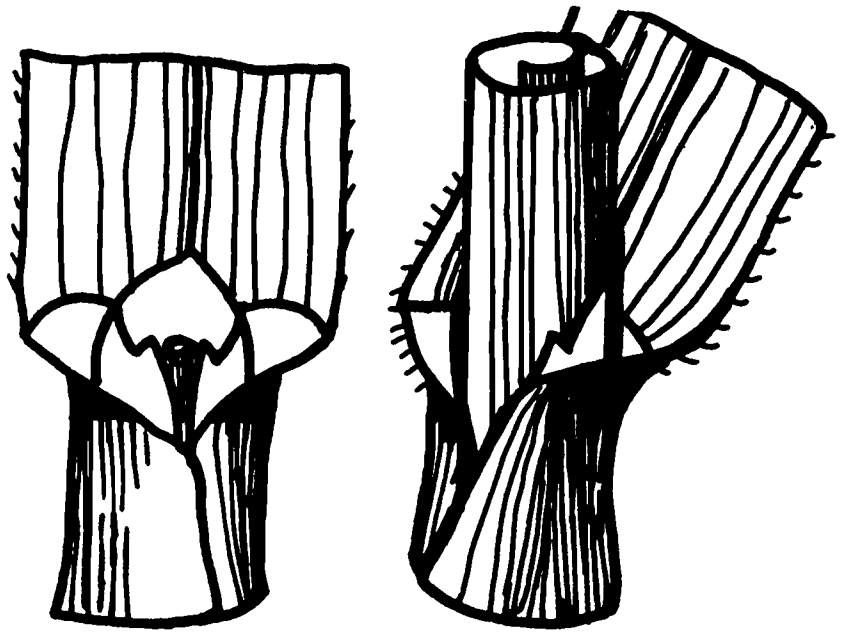
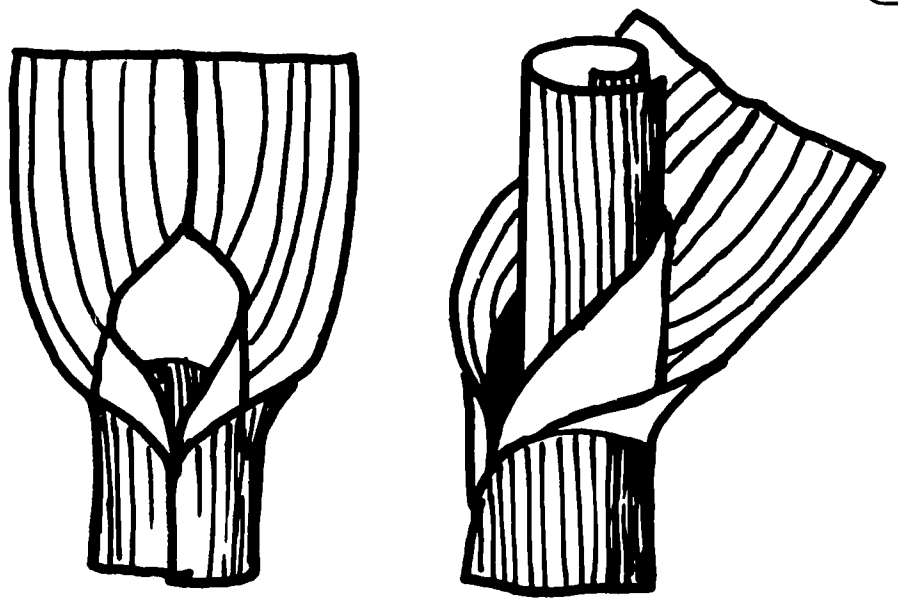


LARGE CRAB-GRASS



TIMOTHY



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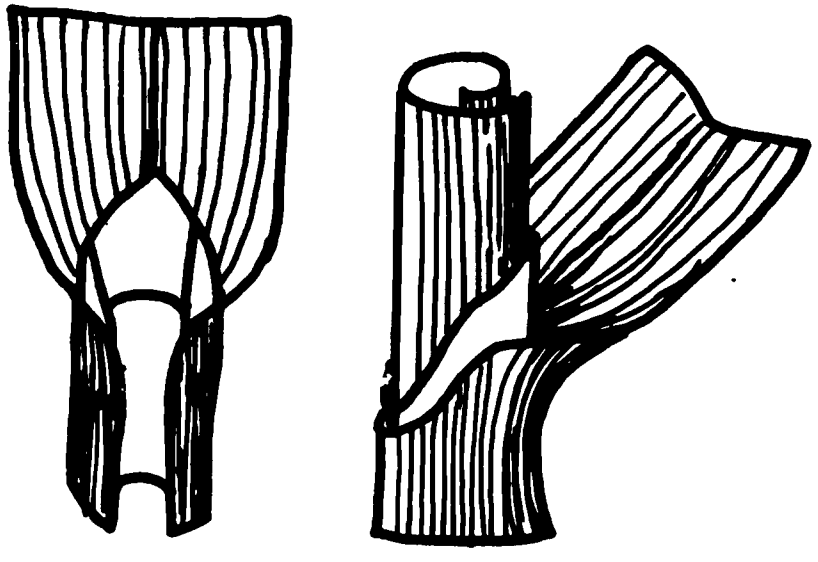
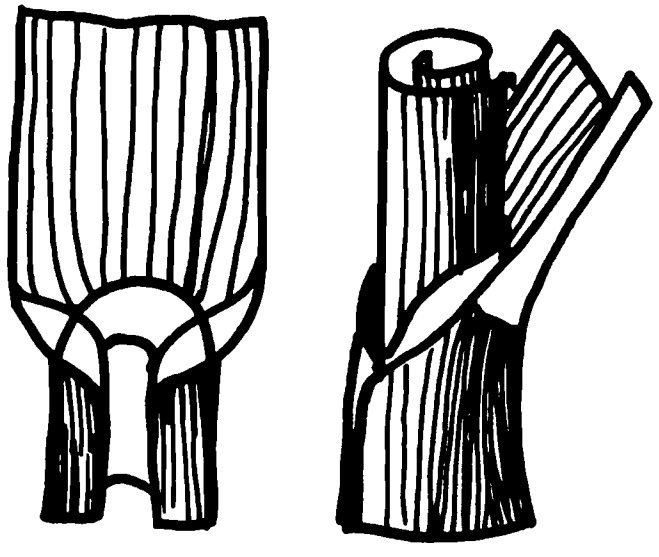
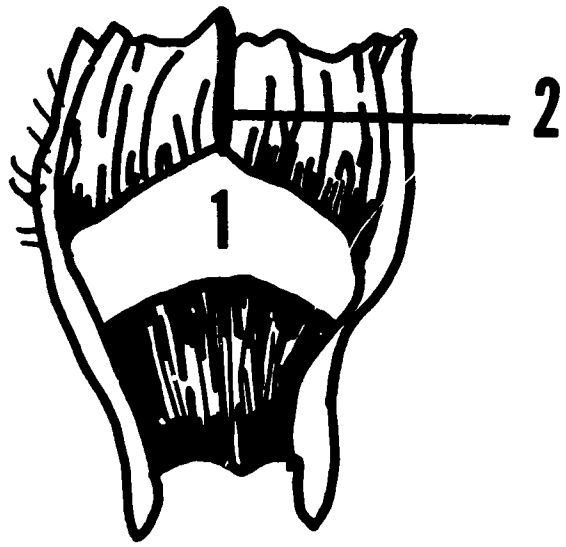


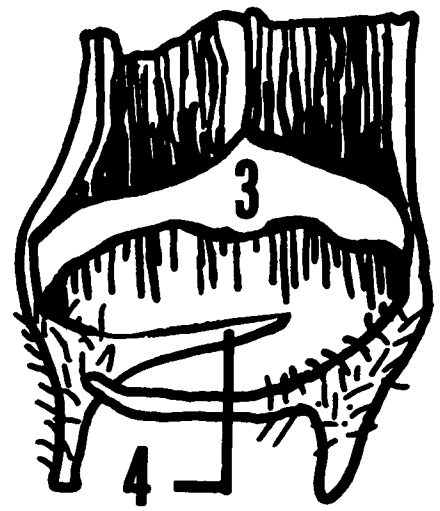
RED-TOP

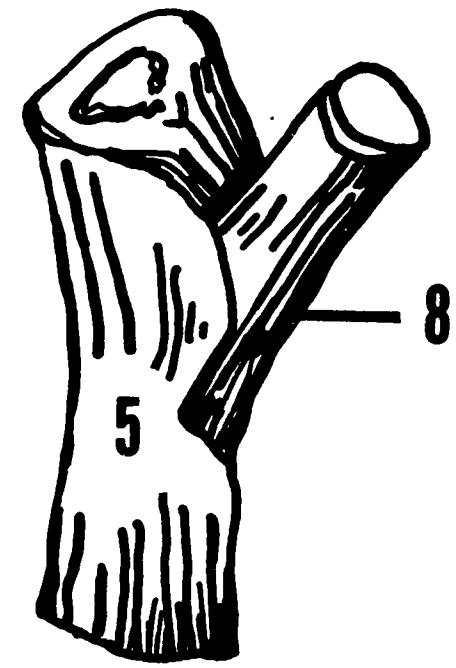


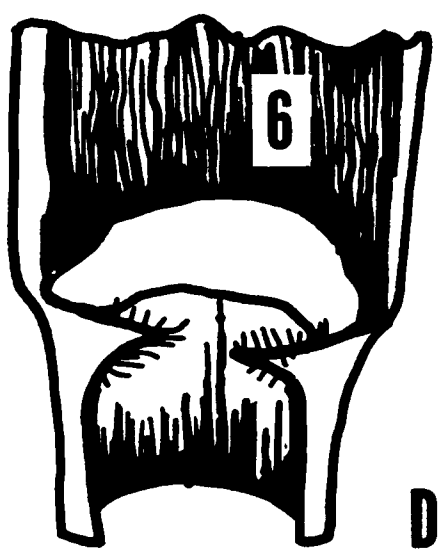
RHODE ISLAND BENT-GRASS

A _____ B _____ C _____

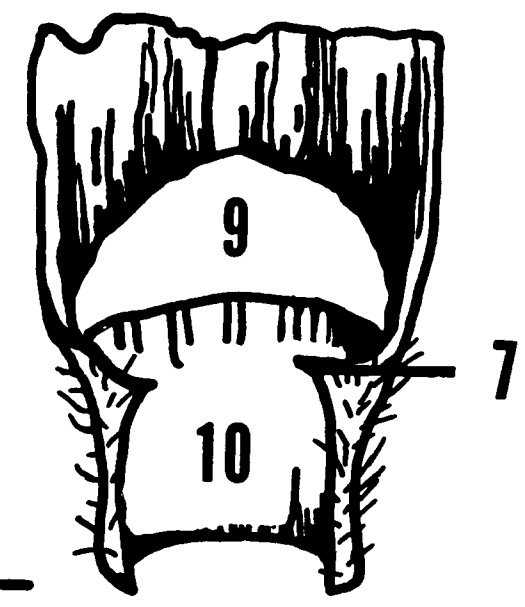








VEGETATIVE CHARACTERISTICS OF CEREALS



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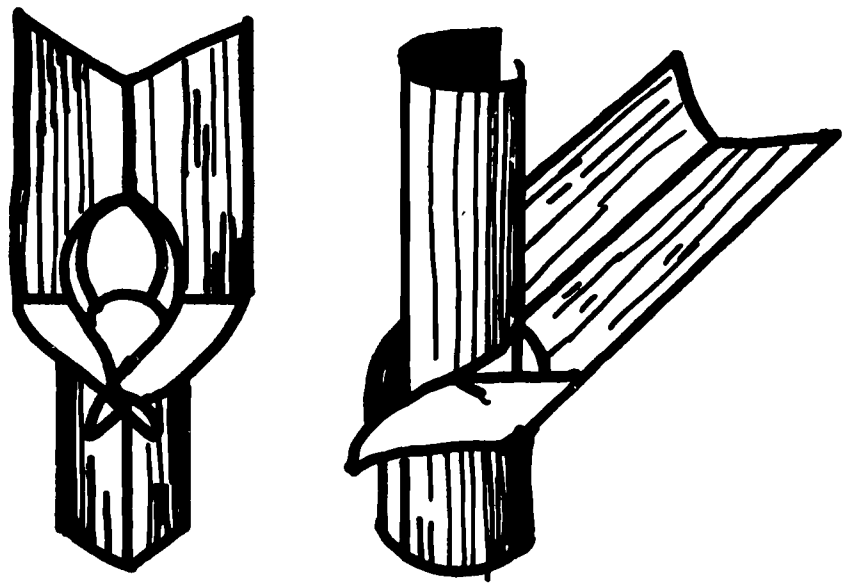
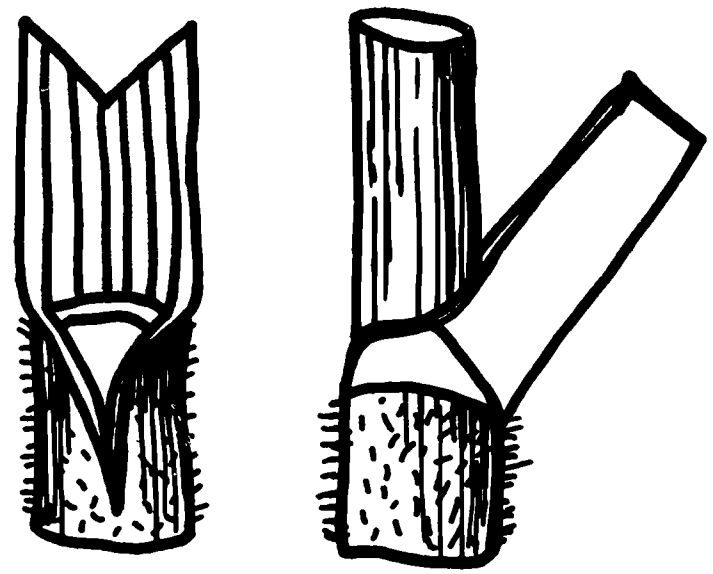


PERENNIAL RYE GRASS



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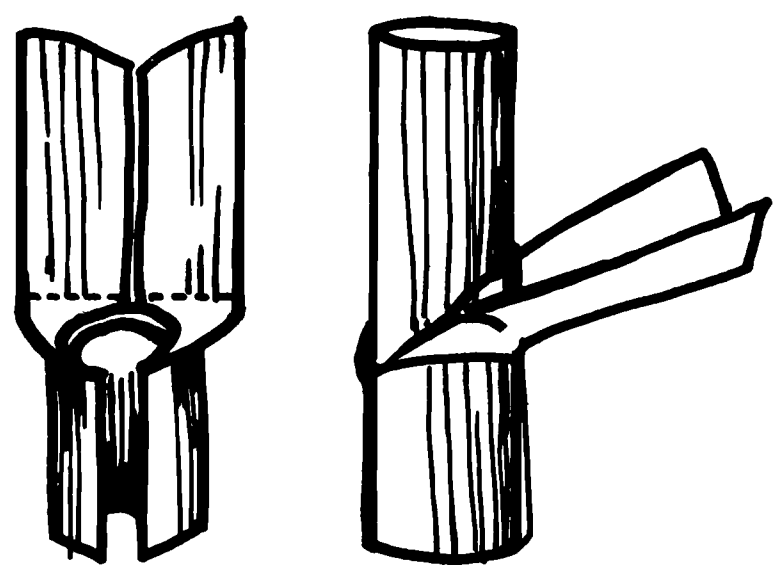

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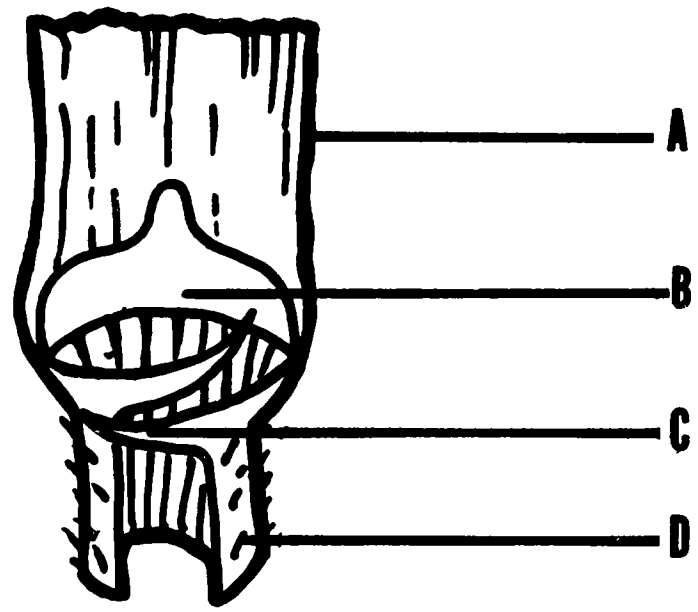

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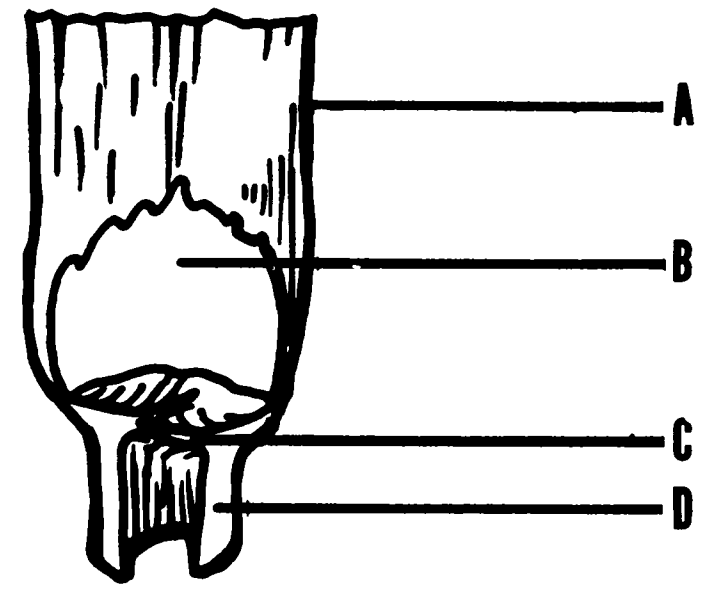

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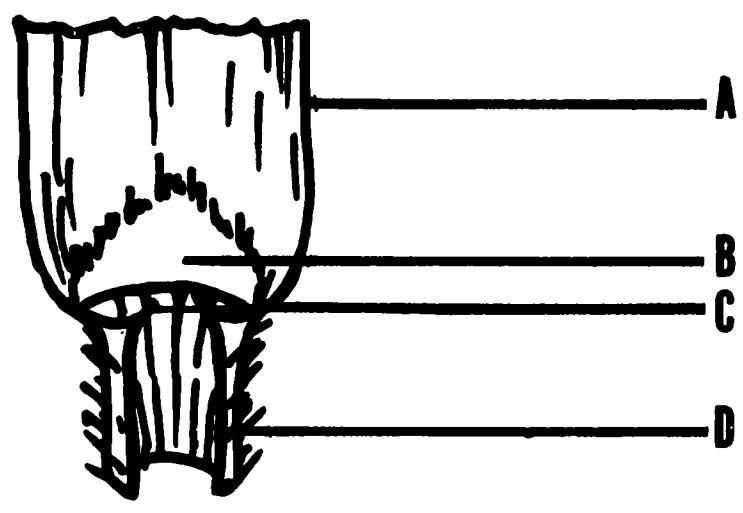

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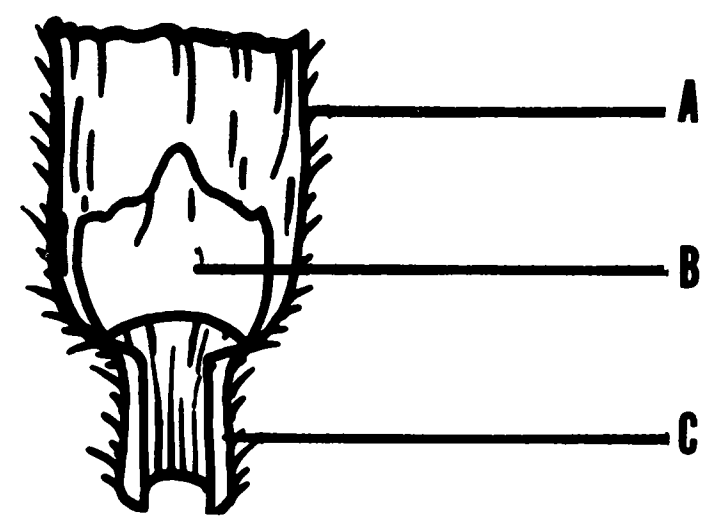

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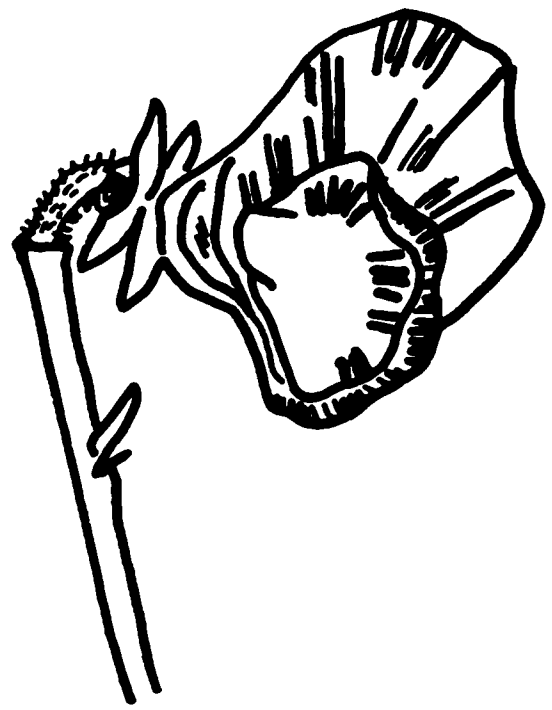

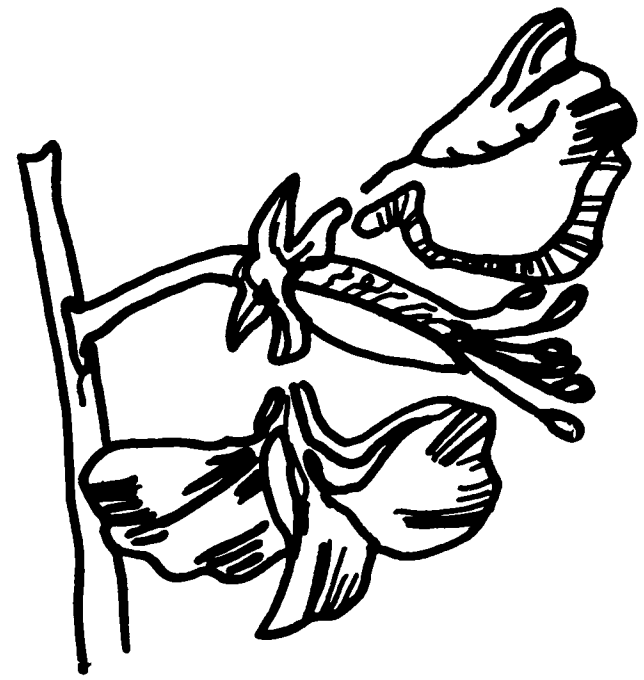

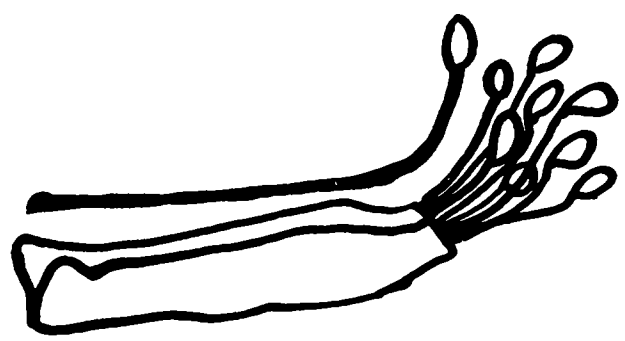

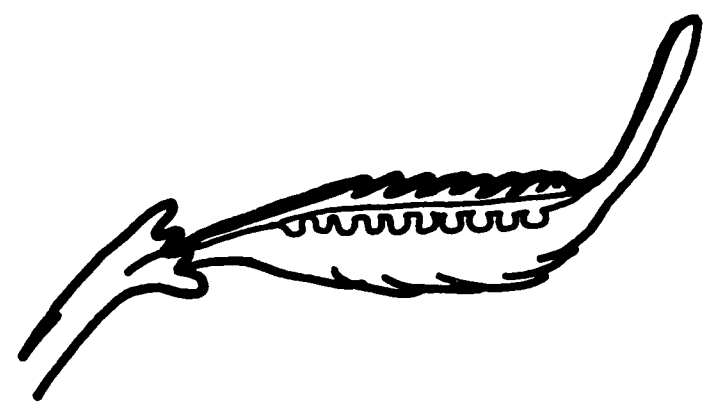

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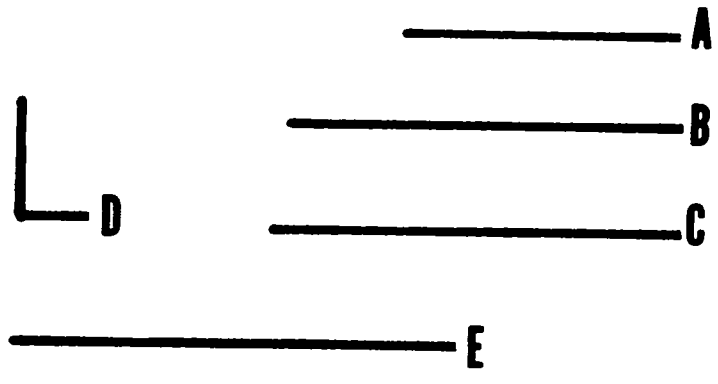

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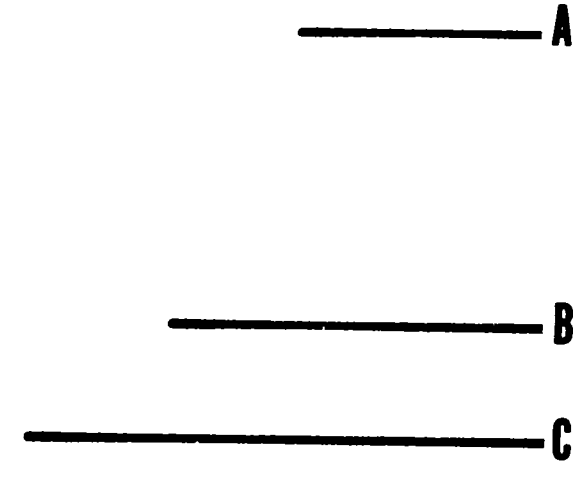

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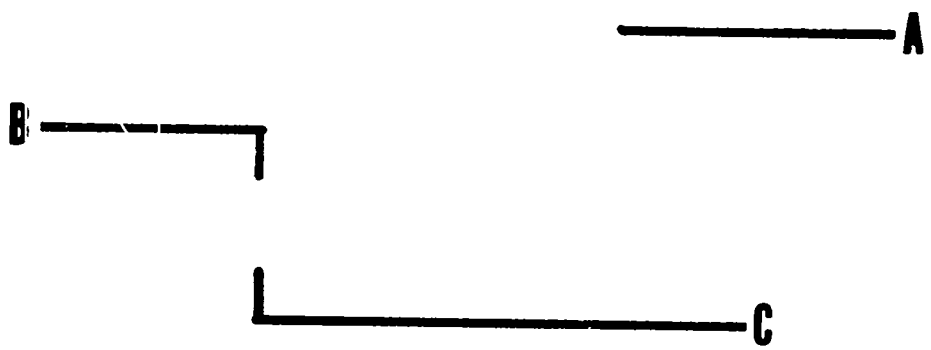

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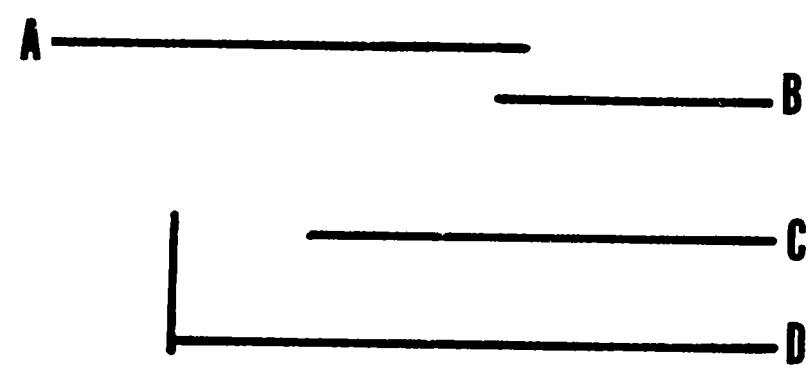

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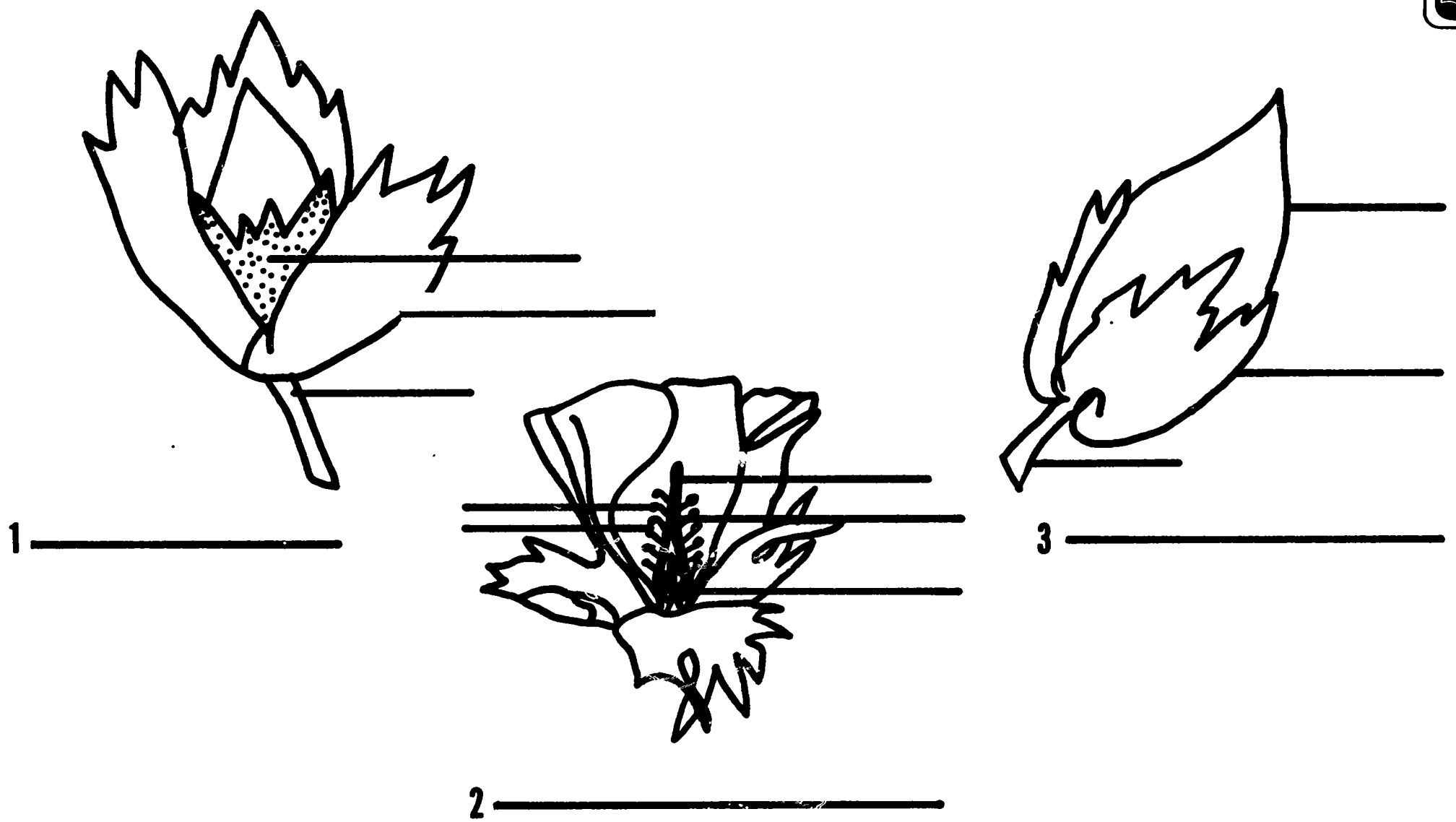

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VT 010 422
Genetics (Overhead Transparency Masters).

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DESCRIPTORS - *TRANSPARENCIES; *VOCATIONAL AGRICULTURE; *GENETICS; *HEREDITY; INSTRUCTIONAL AIDS

ABSTRACT - Instructional aids produced from these 16 transparency masters may be used by vocational agricultural teachers in teaching principles of genetics and heredity. Titles include: (1) Genetics and Heredity Terms, (2) Single Mendelian Inheretance, F1 and F2, (3) Mitosis, (4) Crossing Involving Two Pairs of Genes, (5) Modified Two Pair Ratios (Shorthorns), (6) Modified Two Pair Ratios (Radishes), (7) Sexlinked, (8) Lethal Genes, and (9) Sex-Influenced Characters, F1 and F2. (AW)

VT 010 422

GENETICS

G 103

OVERHEAD TRANSPARENCY MASTERS

Research and development of these materials was assisted by VOCATIONAL EDUCATION ACT funds, administered through the Vocational Education Section of the California Department of Education.

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MODIFIED TWO PAIR RATIOS, F_1 & F_2 (SHORTHORNS)

PARENTS PPRR (polled red) × pprr (horned white)

GAMETES PR × pr

F_1 PRpr (polled roan)

PRpr × PRpr

GAMETES PR Pr pR pr PR Pr pR pr

F_2	PR	Pr	pR	pr
PR	PRPR polled red	PRPr polled roan	PRpR polled red	PRpr polled roan
Pr	PrPR polled roan	PrPr polled white	PrpR polled roan	Prpr polled white
pR	pRPR polled red	pRPr polled roan	pRpR horned red	pRpr horned roan
pr	prPR polled roan	prPr polled white	prpR horned roan	prpr horned white

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GENETICS LESSON GUIDE

Plate 1

GENETICS AND HEREDITY

Definitions are phrased in terms of agricultural applications.

Plate 2

SIMPLE MENDELIAN INHERITANCE, F_1 AND F_2

Complete Dominance: D for Tall; d for Dwarf

Homozygous parents are "DD" and "dd"; thus the gametes are "D" and "D", and "d" and "d".

In the F_1 generation, a cross would give "Dd" or heterozygous for tall. This in turn would give "D" and "d" gametes.

In the F_2 generation, a cross would give, with random choice, the following offspring: DD, Dd, Dd, (all tall); and dd (dwarf), as stated in the "checkerboard."

Use of the checkerboard method helps in finding the various combinations of gene pairs which produce such characteristics as tallness and dwarfism.

The possible gametes of one parent, usually the female, are listed at the tops of the vertical columns in the checkerboard. The possible gametes of the other (male) parent are listed at the left of the horizontal rows of the checkerboard. Each square is filled with a combination of the letters of its vertical column and its horizontal row, with the male gamete letters always being written first in the combination. The filled-in squares represent all of the possible gene combinations in the offspring of the two parents. It is then relatively simple to predict the probable characteristics of the offspring.

With a little practice, the student should be able to complete a checkerboard correctly. In similar plates that follow, less filled-in information will be shown on the basic transparency, giving the student a chance to calculate the missing answers before he sees them on the transparency overlay.

Plate 3

MITOSIS

To illustrate what takes place in ordinary cell division, two pairs of chromosomes are used. The number of chromosomes per cell varies with the animal or plant.

The transparency shows the process a body cell goes through during mitosis, which produces two new daughter cells. Each daughter cell will be the same size as the original cell when the process is complete.

The overlay names the different steps. Transparencies for meiosis of the sex cells, oogenesis, and spermatogenesis can be found in the "Artificial Insemination" overhead transparency series produced by Vocational Education Productions (#171-1)

Plate 4

CROSSING INVOLVING TWO PAIRS OF GENES, F_1 AND F_2

"D" and "d" when paired as "DD" or "Dd" will produce blue blossoms. When paired as "dd" they will produce white blossoms.

"T" and "t" when paired as "TT" or "Tt" will result in tall plants. When paired as "tt" they will produce dwarf plants.

Homozygous parents ("DDTT" and "ddtt") produce the gametes "DT" and "dt". In the F_1 generation the offspring will be "DdTt"--that is, heterozygous tall plants with blue blossoms. A cross of two such parents for the F_2 generation starts with "DT", "Dt", "dT", and "dt" as possible gametes. With random choice the end result will be 9 tall blue-blossomed plants, 3 dwarf blue-blossomed plants, 3 tall white-blossomed plants, 3 dwarf blue-blossomed plants and 1 dwarf white-blossomed plant; or a 9:3:3:1 ratio.

Can your students complete the checkerboard and then use it to get the answer as given above?

Plate 5

MODIFIED TWO PAIR RATIOS, F_1 AND F_2 (SHORTHORNS)

With shorthorn cattle as an example, two pairs of genes are used that show dominance in one pair and blending inheritance in the other. Crossing a polled red (PPRR) male on a horned white (pprr) female in the F_1 results in a polled roan offspring (PRpr) of either sex.

When individuals of the F_1 generation are crossed, both parents provide "PR", "pR" and "pr" gametes. Before using the overlay, see if the students can work out the missing answers and complete the checkerboard.

Plate 6

MODIFIED TWO PAIR RATIOS, F_1 AND F_2 (RADISHES)

In this example, both characteristics show blending inheritance. "RR" results in round radishes, "Rr" results in oval, "rr" results in long, "WW" in white, "Ww" in purple, and "ww" in red. Using

homozygous parents that are round and white (RRWW) and long and red (rwrw) in the F_1 generations produces oval purple offspring. The students should be able to fill out the checkerboard that shows the results of crossing two of the F_1 generation.

Plate 7

SEXLINKED, F_1 AND F_2

Previous plates have shown simple modified ratios. This plate shows that not all characteristics are inherited in that way. Some genes are more restricted. In the first example of Plate 7, the sex-linked genes of the fruit fly are used. The second example uses sex-linked genes of Barred Plymouth Rock chickens.

With fruit flies, eye color seems to be related to a gene located on the female (X) chromosome. In the male fruit fly, "W" results in red while "w" results in white. With the female, two genes must be present because the female is homozygous for sex chromosomes and the male is heterozygous. Therefore, in the female "WW" and "Ww" result in red eyes and "ww" in white eyes.

"Y" is used to indicate the male chromosome and "W" or "w" in white eyes to indicate the female "X" chromosome. A cross of a white-eyed male and a homozygous red-eyed female results in a red-eyed male or a red-eyed female from the possible gametes of the two parents ("w" and "Y" in the male and "W" in the female) as is shown. Crossing of this F_1 generation will in the end give "WW" and "Ww" females and "WY" and "wY" males. In this case the characteristic was linked to the female sex chromosome. Can the students complete the checkerboard?

In the second example of Barred Plymouth Rock chickens, the gene is linked with the male (Y) chromosome. "BB" and "Bb" result in a barred male while "bb" results in a non-barred. "BX" results in a barred female and "bX" results in a non-barred female. "X" is used to designate the female chromosome, and "B" and "b" to designate the male or "Y" chromosome. In birds the female is the heterogametic sex. The F_1 and F_2 generations are similar to those in the fruit fly example except that the character is determined by the male chromosome. Can the students complete the checkerboard?

Plate 8

LETHAL GENES, F_1 AND F_2

A lethal gene is one that kills. Since it is lethal only in the homozygous state, with little or no indication of its presence in the heterozygous state, a breeding program must be established to eliminate the trait.

Using the fruit flies again, let's locate a lethal gene on the female which will be designated "L1". Take a normal male (LY) and

cross it with an "L1" carrier female. In the cross, you get one homozygous female (L1), one carrier female (L1), one "LY" male, and one "1Y" male. The "1Y" male would die, showing that the lethal gene is sex-linked and located on the female chromosome.

Plate 9

SEX-INFLUENCED CHARACTERS, F_1 AND F_2

The sex-influenced character, whether dominant or recessive, in the heterozygous state depends on the sex of the animal. For example, in Ayrshire cattle the gene for color in the homozygous state gives the same color in the male and female. However, in the heterozygous state the male shows mahogany with white and the female red with white. Using "M" for mahogany and "m" for red, the transparency shows what takes place. "MM" is mahogany and white for both male and female, and "mm" is red and white for both male and female. However, "Mm" in the male is mahogany and white, while in the female it is red and white.

The transparency shows a homozygous mahogany and white male (MM) crossed with a homozygous red and white female (mm). In the F_1 generation the male will be mahogany and white while the female is red and white. Thus, the offspring regardless of sex will be "Mm". Gametes from parents of this type will unite to form different colors in the offspring depending on sex. Can the students complete the two checkerboards?

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GENETICS AND HEREDITY

CHROMATIN MATERIAL: Threadlike material in the nucleus

CHROMOSOMES: Bearers of hereditary characters (occur in pairs)

GENES: Complex protein molecules that are hereditary factors, located at definite points on the chromosomes

MITOSIS: Division of body cells -- diploid cells - 2n

MEIOSIS: Division of sex cells or reduction division -- haploid cells - n
Sperm: Male sex cell formed in the testicle
Ovum: Female sex cell formed in the ovary

MATURATION: The entire process of the formation of the gametes

GAMETES: Mature germ cells

OÖGENESIS: Process by which the female sex cell is developed

SPERMATOGENESIS: Process by which the male sex cell is developed

DOMINANT GENES (D): The gene that produces its effect in the F_1 Generation

RECESSIVE GENES (d): Gene shadowed (hidden) by dominant gene in the F_1 Generation

ALLELES: Pair of genes that are contrasting, and together give the unit character

ZYGOTE: The result of the union of two gametes

HOMOZYGOUS: Genes are the same: DD or dd

HETEROZYGOUS: Genes are different: Dd or dD

PHENOTYPE: Classification determined by senses (tall, dwarf)

GENOTYPE: Classification from genetic formula (Dd, Tt, tt)

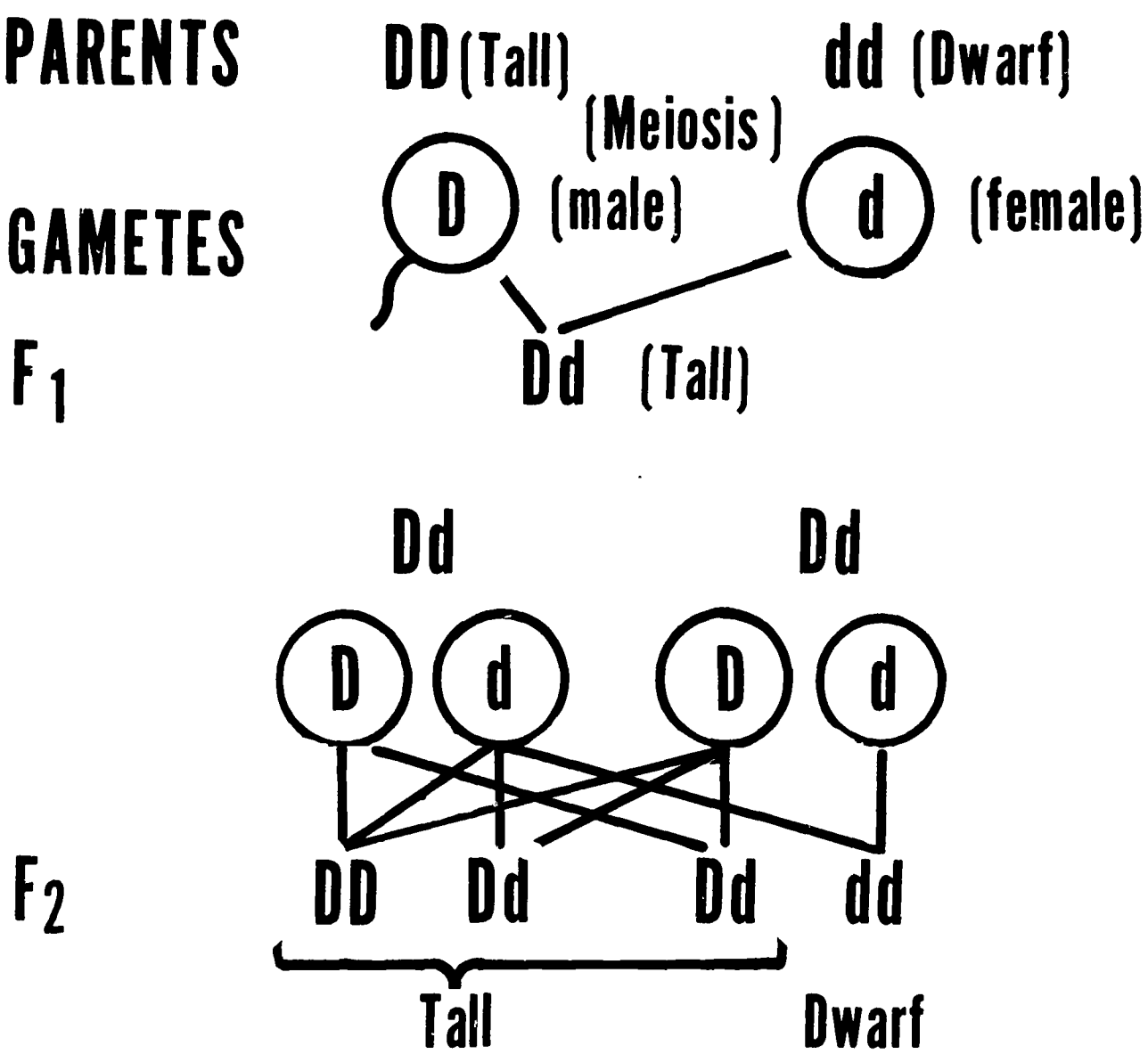
FERTILIZATION (Conception): Union of two unlike gametes, forming a zygote

BLENDING OR INCOMPLETE DOMINANCE: Neither gene in the allele is dominant (shorthorns)

MUTATION: Changes that take place in a gene

LETHAL GENES: Cause death when homozygous

SIMPLE MENDELIAN INHERITANCE F_1 & F_2

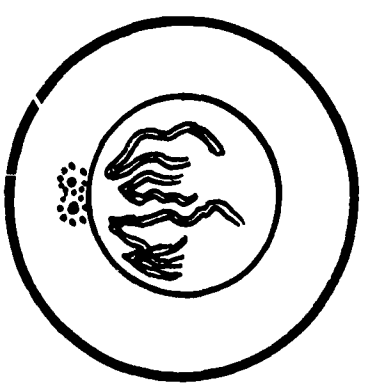


OR

F_2	D	d
D	DD tall	Dd tall
d	Dd tall	dd dwarf

MITOSIS

A



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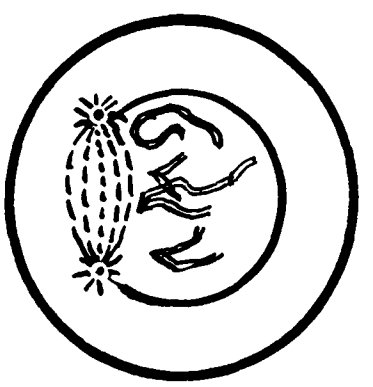
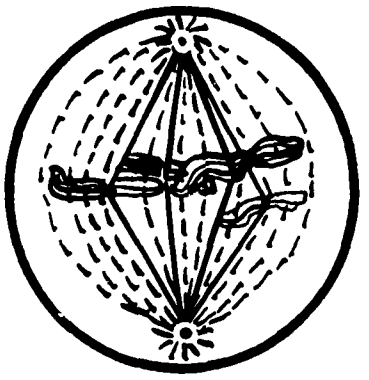


C

D



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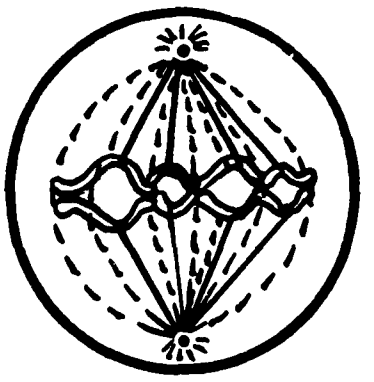
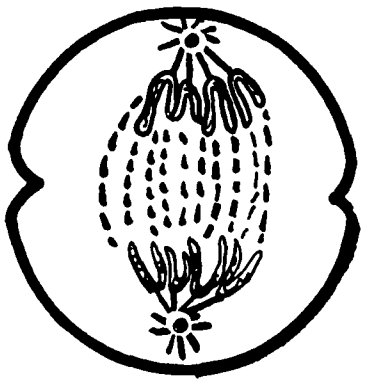
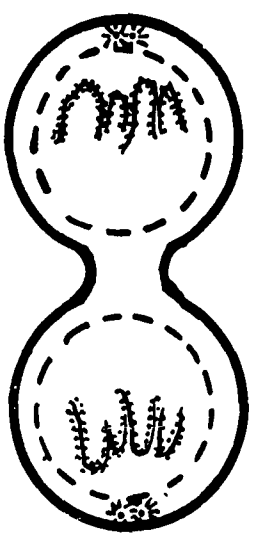


F



G



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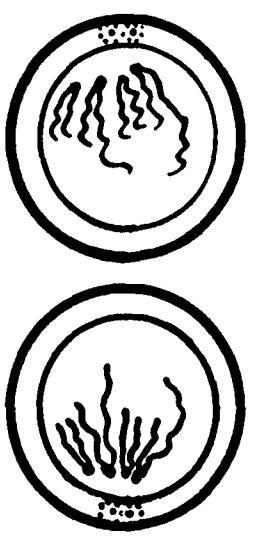


A. ..... INTERPHASE
B-C.... PROPHASE
D..... METAPHASE
E..... ANAPHASE
F-G.... TELOPHASE
H..... TWO DAUGHTER CELLS

CROSSING INVOLVING TWO PAIRS OF GENES, F_1 & F_2

PARENTS DDTT ddtt

GAMETES DT dt

F_1

PARENTS DdTt × DdTt

POSSIBLE GAMETES IN F_2 { DT Dt dT dt / DT Dt dT dt

RANDOM ASSORTMENT

FEMALE

MALE

DdTt

	DT	Dt	dT	dt
DT	DTDT	DTDt	DTdT	DTdt
Dt	DtDT	DtDt	DtdT	Dtdt
dT	dTDT	dTDt	dTdT	dTdt
dt	dtDT	dtDt	dtdT	dtdt

MODIFIED TWO PAIR RATIOS, F_1 & F_2 (SHORTHORNS)

PARENTS PPRR × pprr

(polled red) (horned white)

GAMETES PR × pr

F_1 (polled roan)

PRpr × PRpr

GAMETES

F_2	PR	Pr	pR	pr
PR				
Pr				
pR				
pr				

MODIFIED TWO PAIR RATIOS, F_1 & F_2 (SHORTHORNS)

PARENTS	PPRR (polled red)	×	pprr (horned white)
GAMETES	PR	×	pr
F_1			(polled roan)
	PRpr	×	PRpr

GAMETES

F_2	PR	Pr	pR	pr
PR				
Pr				
pR				
pr				

PRpr

PR Pr pR pr PR Pr pR pr

PRPR polled red	PRPr polled roan	PRpR polled red	PRpr polled roan
PrPR polled roan	PrPr polled white	PrpR polled roan	Prpr polled white
pRPR polled red	pRPr polled roan	pRpR horned red	pRpr horned roan
prPR polled roan	prPr polled white	prpR horned roan	prpr horned white

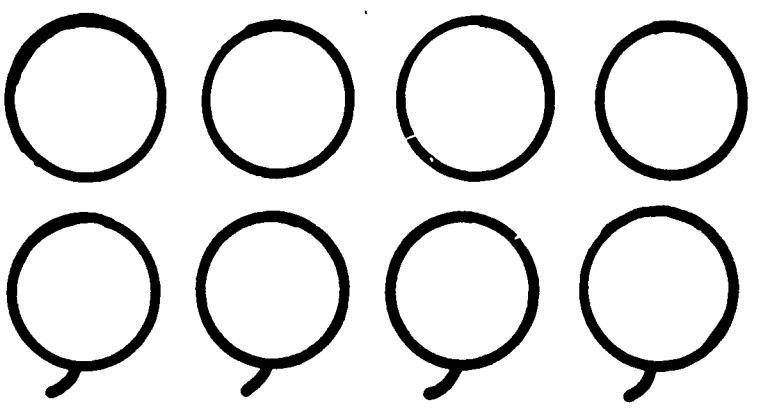
MODIFIED TWO PAIR RATIOS, F_1 & F_2 (RADISHES)

PARENTS RWRW (Round White) × rwrw (Long Red)

F_1

×

GAMETES



F_2

RWrw

RWrw RWrw

RW Rw rW rw

RW Rw rW rw

	RW	Rw	rW	rw
RW	RWRW round white	RWRw round purple	RWrW oval white	RWrw oval purple
Rw	RwRW round purple	Rw Rw round red	RwrW oval purple	Rwrw oval red
rW	rWRW oval white	rWRw oval purple	rWrW long white	rWrw long purple
rw	rwRW oval purple	rwRw oval red	rwrW long purple	rwrw long red

PARENTS wY × WW
(White-eyed male) (Red-eyed female)

GAMETES (w) (Y) (W)

F_1 WY Ww
(red-eyed male) (red-eyed female)

GAMETES (W) (Y) (W) (w)

F_2

	W	w
W	WW red-eyed female	Ww red-eyed female
Y	WY red-eyed male	wY white-eyed male

PARENTS (barred male) BB × bX (non-barred female)

GAMETES (B) (b) (X)

F_1 (barred male) Bb BX (barred female)

GAMETES ( ) ( ) ( ) ( )

B b B X

	B	X
B	BB	BX
b	bB	bX

LETHAL GENES, F_1 & F_2

PARENTS (Normal Male) **LY** × **LI** (Carrier Female)

GAMETES L Y L I

L I

L LL LI

Y LY IY

SEX-INFLUENCED CHARACTERS, F_1 & F_2

PARENTS MM × mm

(Mahogany-and-white Male) (Red-and-white Female)

GAMETES M m

F_1

GAMETES

F_2 MALES

F_2 FEMALES

Mm

Mm × Mm

	M	m
	M	m
M	MM mahog. & white	Mm mahog. & white
m	mM mahog. & white	mm red & white

	M	m
M	MM mahog. & white	Mm red & white
m	mM red & white	mm red & white

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ABSTRACT - Instructional aids produced from these 14 transparency masters may be used by vocational agriculture teachers in presenting guidelines for land measurement to farm management classes. Titles include: (1) Layout of Towns or Tiers, (2) Layout and Designation of Townships, (3) Subdivision of a Section, (4) Measurement of a Rectangular Field, (5) Measuring Triangular Fields, (6) Trapezium Measurements for Area, and (7) Problem. (AW)

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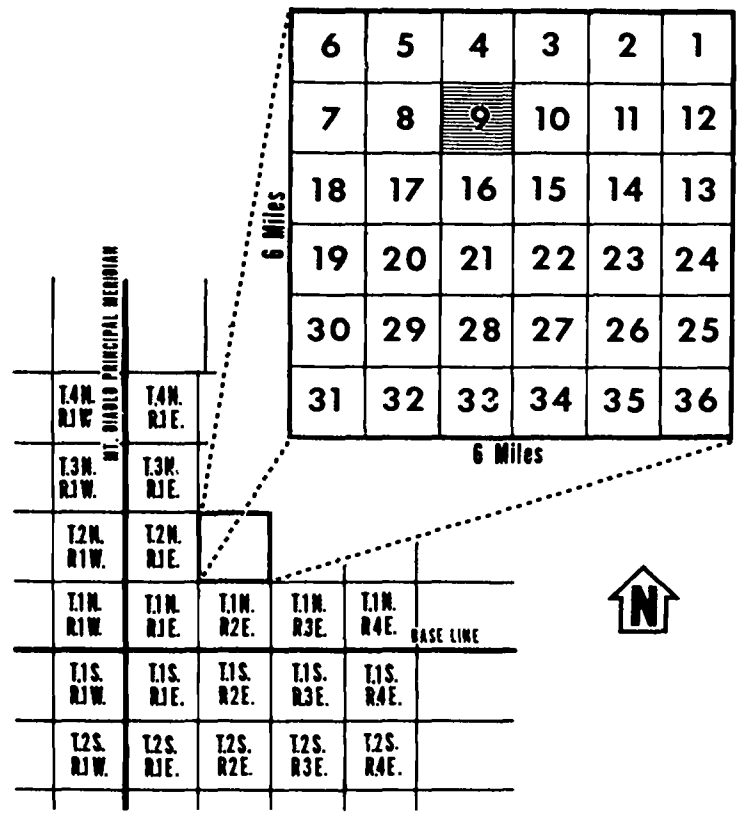
PLATE 4 Layout and Designation of Townships

Section Numbers of Township T.2N., R.2E.



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GUIDELINES FOR LAND MEASUREMENT

An understanding of legal land descriptions and their meaning is essential when buying, selling, or renting land. Description and measurement is required in virtually all governmental programs involving land use and, agriculturally, in farm management.

Land Description

The basic unit of land description in the Western United States is the "section." Most people believe that a "section" is an area of land one mile long by one mile wide containing 640 acres. This is not necessarily so, although that was the intention at the time that the U.S. General Land Office originally surveyed such states as California, Nevada, and Oregon. Some sections of certain townships contain barely half of 640 acres. These are often sections 31, 32, 33, 34, 35, and 36 although not limited to these particular ones. A few sections contain more than 640 acres but they are more rare than sections which have been short-changed in the number of acres.

Lest we be too critical of the survey crews in laying out "sections" of variable sizes, we should recall that the surveys were often made under hostile conditions with instruments not as refined as those of today. In addition, the surveys were made over rough terrain by several teams starting at different points. That the teams failed to meet at the exact proper position where they were supposed to meet is no surprise, and it was necessary to adjust or correct their maps to compensate.

In many parts of the country, county roads were built on the section lines with half of the right-of-way taken from each of two adjoining sections. A section completely bounded by county roads would be reduced in useful acres by 10 to 30 acres as a rule.

Persons involved in land purchase or rental are well advised to have a survey made to determine the exact acreage contained within the stated boundaries. This is particularly true when descriptions use the wording: "X acres, more or less."

In California. and most of the United States, the "rectangular survey" system was originally used. The survey starting point was at the intersection of a line running east and west called a "base line" and another running north and south called a "principal meridian." California has three such intersections, called "coordinates," and is typical of the survey system used. (Plate 1).

Since it is easier to remember a coordinate by name than by longitude and latitude, names are generally used in reference to the base lines and principal meridians. For example: Mt. Diablo Meridian or, if abbreviated, M.D.M.

Starting from a base line, lines were surveyed parallel to it every six miles, both north and south. Such parallel strips are called "towns" (Plate 2) or, in California, may be called "tiers."

In a similar fashion, north-south lines were laid out at approximately six-mile intervals from the principal meridians and are called "ranges." Range lines are not parallel to the principal meridian since the meridians meet at the poles. "Square" townships could not result without an occasional jog to preserve that character. (Plate 3).

When both the "town" lines and the "range" lines are shown on a land description map, such as can be obtained from title insurance companies, the resulting "squares" (generally six miles by six miles) are called "townships." Townships are designated numerically by both the town and the range in which they lie, such as "town 2 north and range 2 east." A township is further subdivided into 36 sections with each section containing 640 acres, more or less. (Plates 4 and 5).

Sections in each township are numbered beginning in the northeast corner and proceeding in a snake-like fashion to the southeast corner of the township which is section 36. (See insert of township T.2N., R.2E. in Plate 4). If section 9 is examined alone, further sub-divisions of the section into halves, quarters, eighths and smaller units can be illustrated (Plate 6). An overlay of section 9 of our example township has been shaded to indicate a parcel of land to be legally described. Such a description might read as follows:

> "The S.W. $\frac{1}{4}$ and the N. $\frac{1}{2}$ of the S.E. $\frac{1}{4}$ and the S.W. $\frac{1}{4}$ of the S.E. $\frac{1}{4}$ of Section 9, T.2N., R.2E., M.D.M., situated in the county of _____, State of California."

The acreage contained would be 280 acres if the section is a "standard section" of 640 acres.

Land Measurement

Many farm management decisions require fairly accurate determination of the acreage in a given field. Purchases of supplies such as seed, fertilizer, herbicides, and insecticides are dependent upon field measurement and acreage determination.

If extremely accurate measurement is required it is best to have the fields surveyed. For most purposes, reasonably level fields can be measured by anyone with a basic knowledge of mathematics and plane geometry. The equipment required is not complicated and the mathematics is fairly simple.

Some basic units of land measurement are:

1 Foot equals 12 inches
1 Arch* equals 6.6 feet
1 Yard equals 3 feet equals a standard pace
1 Rod equals 16½ feet
1 Chain equals 10 arches equals 4 rods equals 22 yards equals 66 feet
A square acre is approximately 208.7 feet on each side
1 Acre equals 43,560 square feet regardless of the shape
1 Acre equals 43,560 square feet equals 4,840 square yards equals 1000 square arches equals 160 square rods equals 10 square chains

No matter what measuring equipment is used (rule, tape, arch, rod-tape or chain), some basic mathematics must be applied to determine acreage. The basis of measurement is that right angles must be used at the proper points on a field map. Squares, rectangles, right triangles, parallelograms and trapezoids are then measured individually and the contained acreage added together for a field total. It is not necessary to convert measurements to feet so long as the proper factor is used as a divisor.

For example, if the area is given in:

Square feet, then divide by 43,560
Square yards, then divide by 4,840
Square arches, then divide by 1,000
Square rods, then divide by 160
Square chains, then divide by 10

Square and rectangular fields are the easiest to measure and determine acreages for. In this case, length times width divided by the correct factor gives the acreage contained. Plate 7 is an example of such a field showing the acreage computation using both "feet" and "chains" for measurement. It is obvious that units such as the "chain" and the "arch" are particularly desirable since the division factor is so easily applied.

Other field shapes can also be measured, but the area and acreage determinations are generally a little more complicated.

In the case of parallelograms, area equals length times width (taken at a perpendicular point). (See Plate 8). One can imagine that the right triangle formed by the perpendicular (width) could be moved so that, in effect, the measurements and computations are the same as those for a rectangle.

The rectangle is also used as the basis for computing area and acreage of right triangles. A right triangle is simply one-half of a rectangle divided by a diagonal line. (Plate 9).

When no angle of a triangular field is a right angle (Plate 10), it is necessary to divide the field into two right triangles and compute the area of each. The total area is then derived by

*Available from Great Western Sugar Co., Denver, Colorado

adding the two areas together. Acreage is computed by dividing by the correct factor for the measurement used. The standard formula, Area = $\frac{\text{base x height}}{2}$, may also be used.

Trapezoid fields (four angles and only two parallel sides) are treated in a fashion similar to, but not exactly like, a parallelogram. It is possible to imagine that this kind of configuration (Plate 11) could be re-arranged into a rectangle for computation purposes.

Trapeziums, four-sided fields with irregular shapes, are more difficult. However, if a little imagination is used, a layout of two right triangles and a trapezoid will result. The area is computed for each of the sub-divisions and added to give the total. (Plates 12 and 13).

How would you divide a field shaped like the one in Plate 14 for measuring? Assign some value to the measured sides and bases and compute the acreage contained.

Howard Rhoads
Associate Professor
Crops Department
California State Polytechnic College
San Luis Obispo, California

April, 1969

PLATE 1 California Base Lines and Principal Meridians

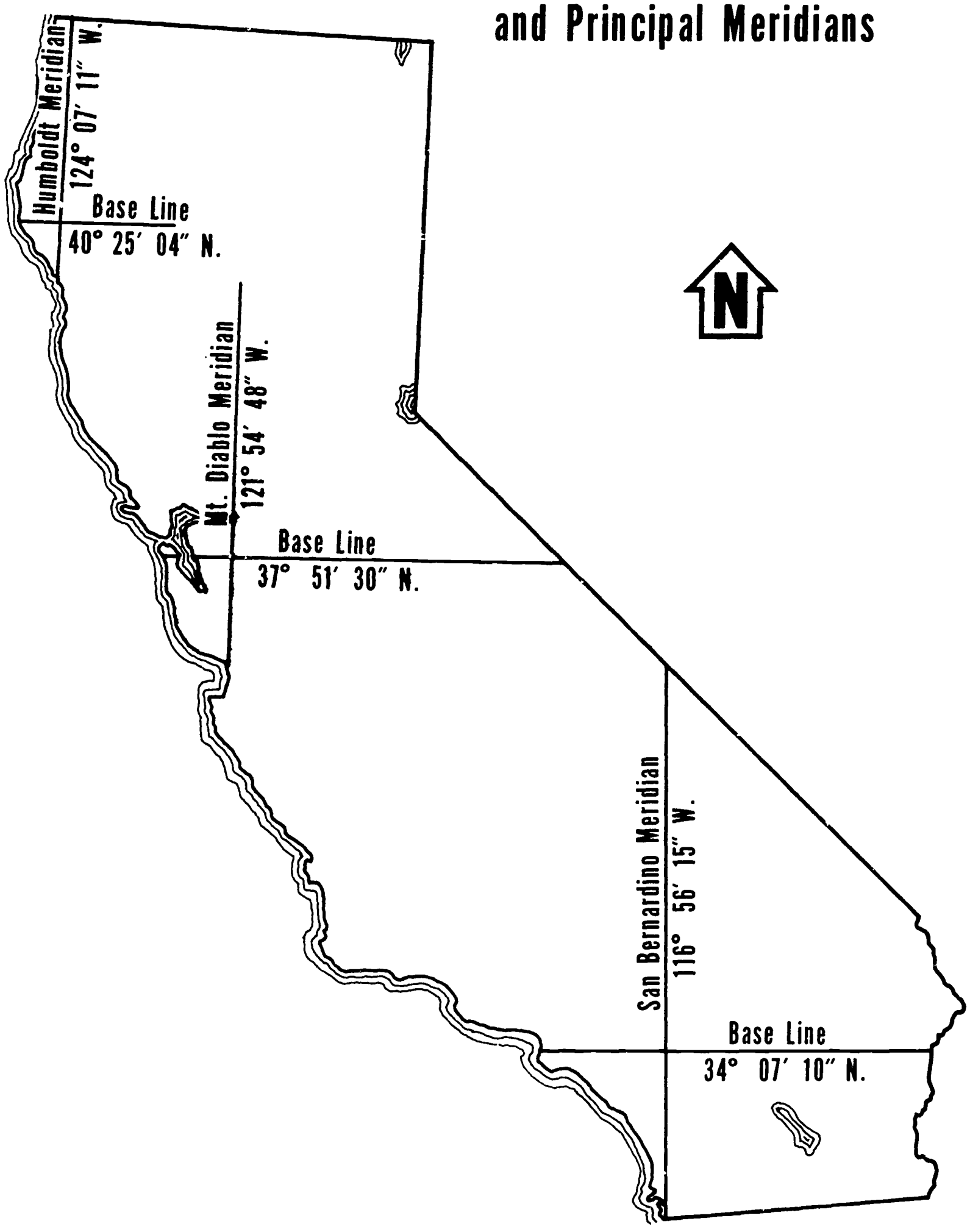

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PLATE 2 Layout of Towns or Tiers

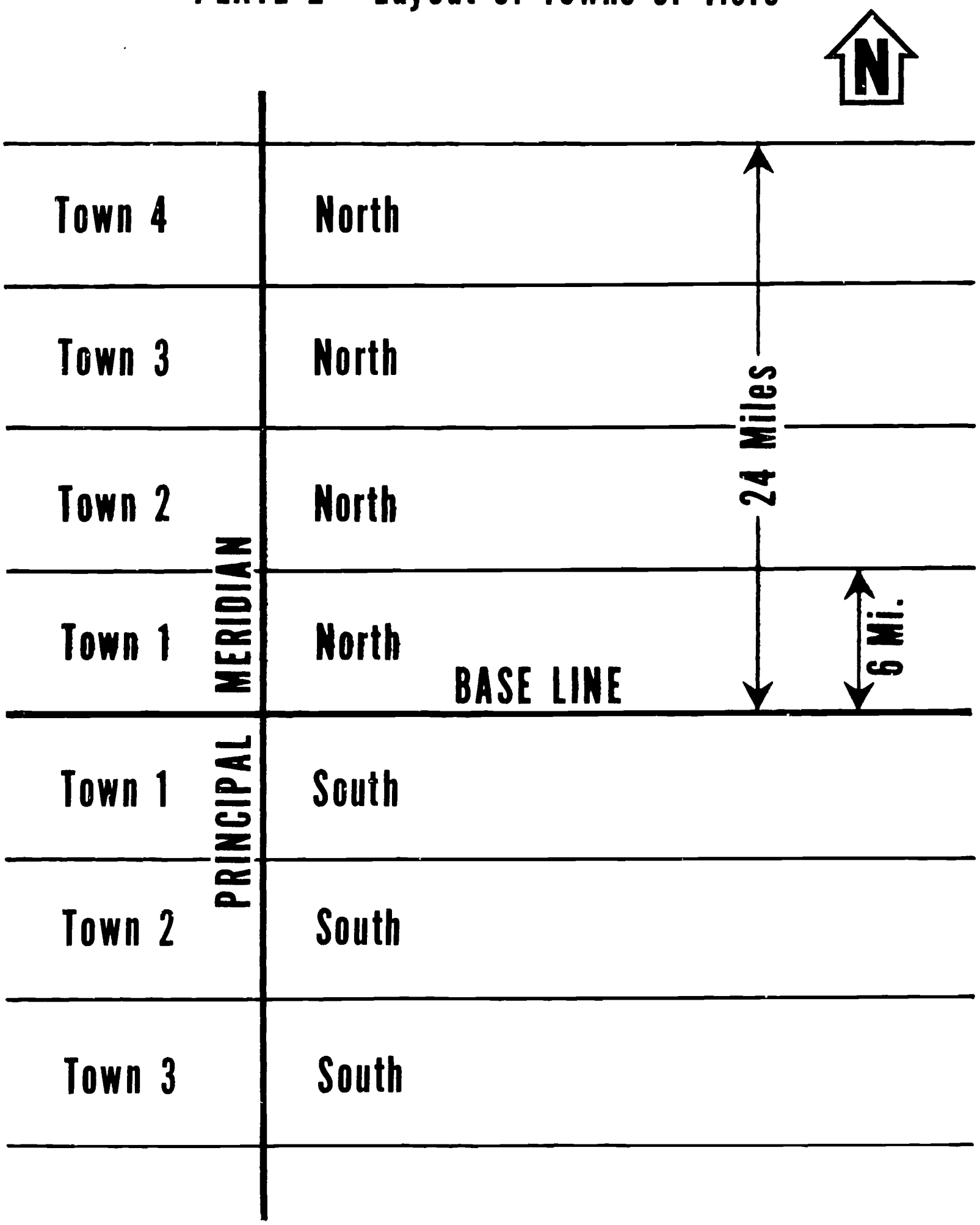

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PLATE 3 Layout of Ranges

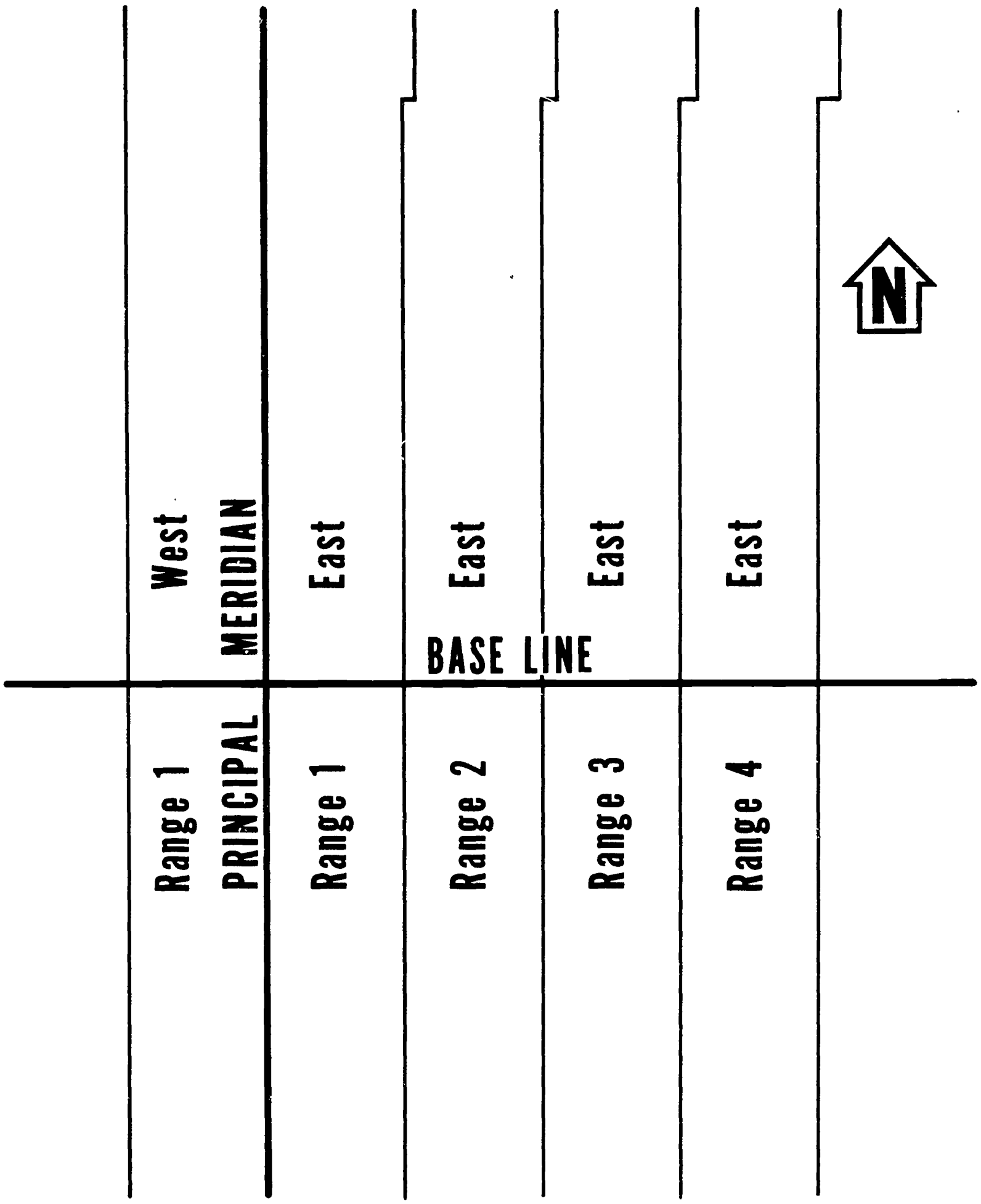

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PLATE 4 Layout and Designation of Townships

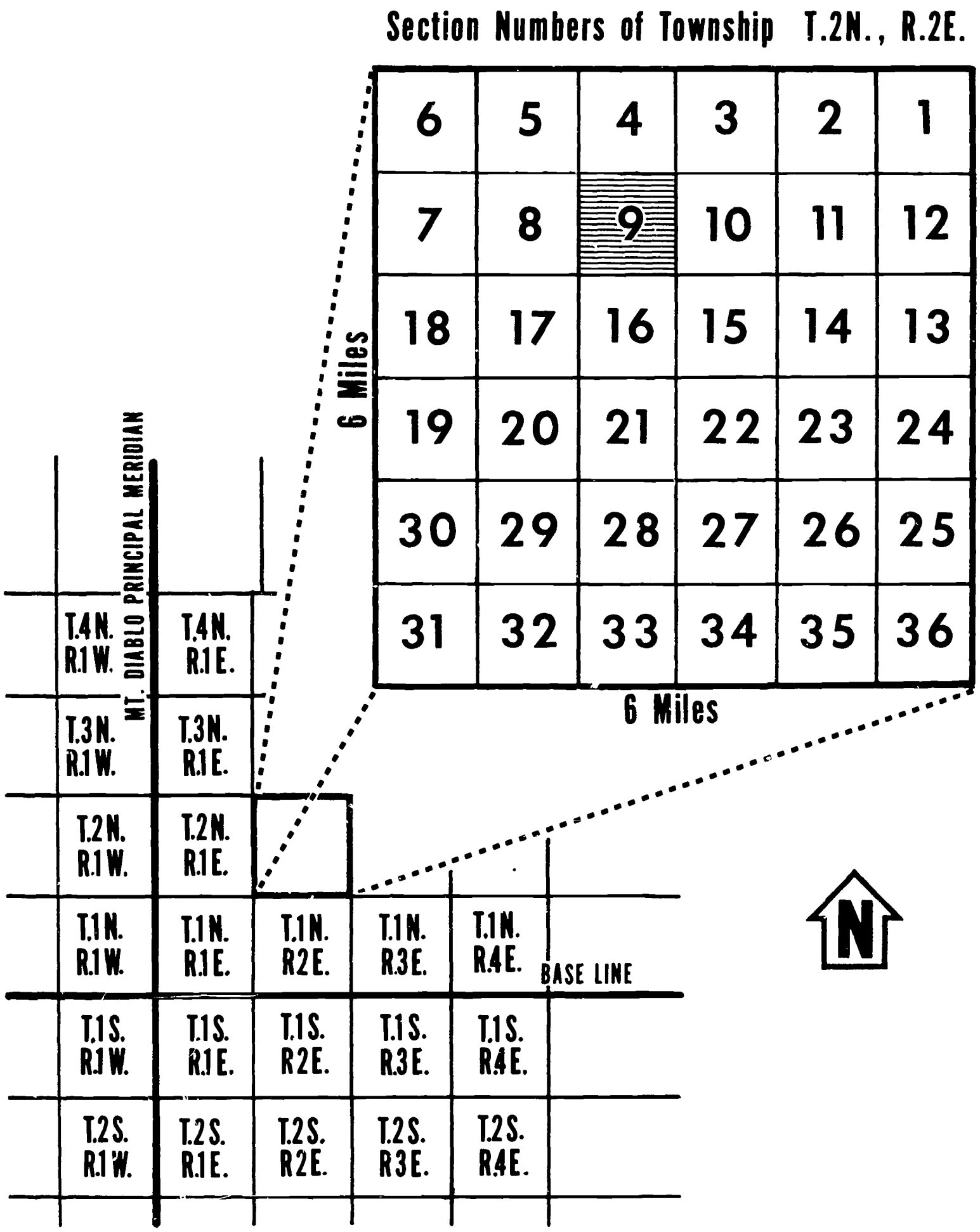

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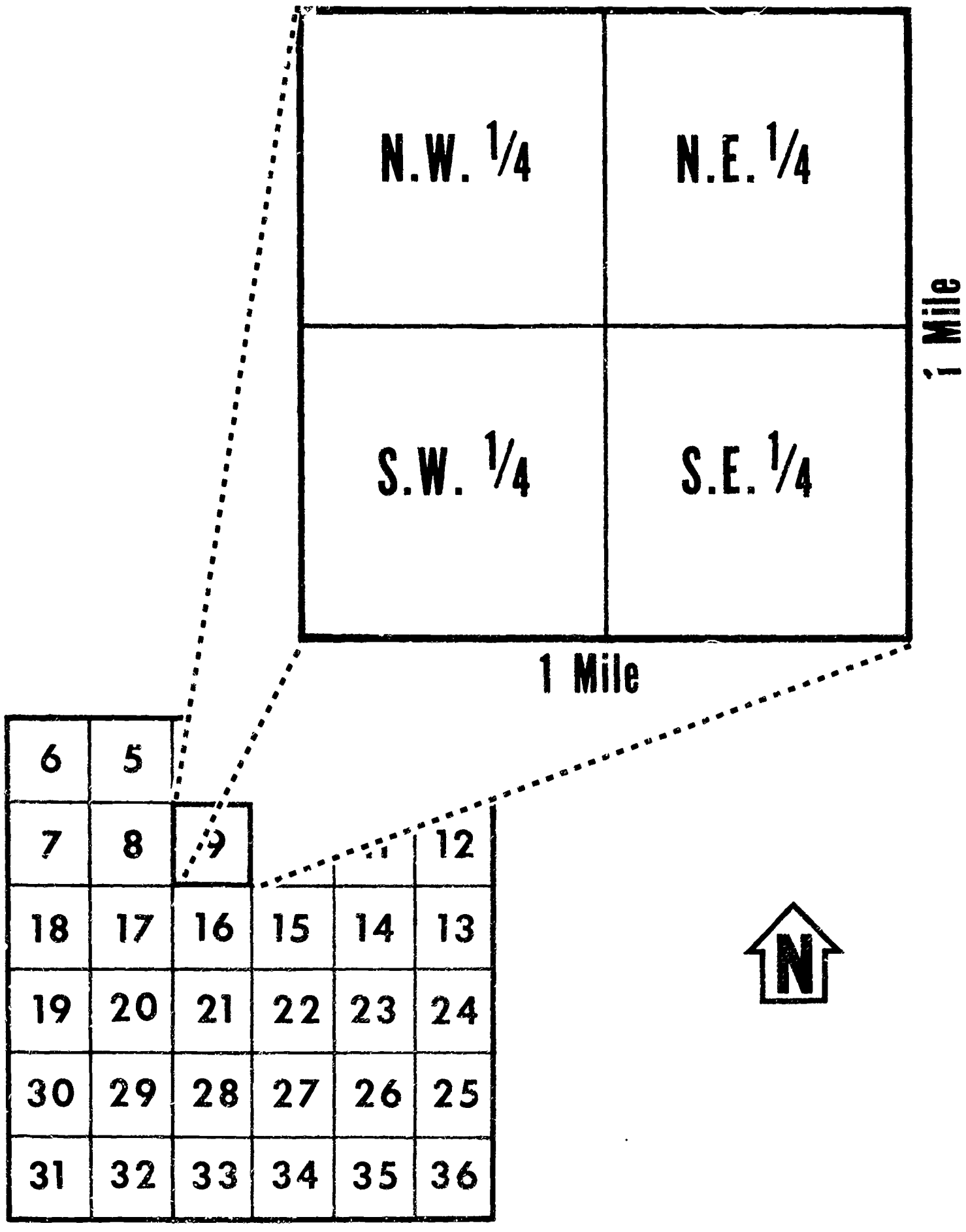
PLATE 5 Section 9 of Township T.2N., R.2E.



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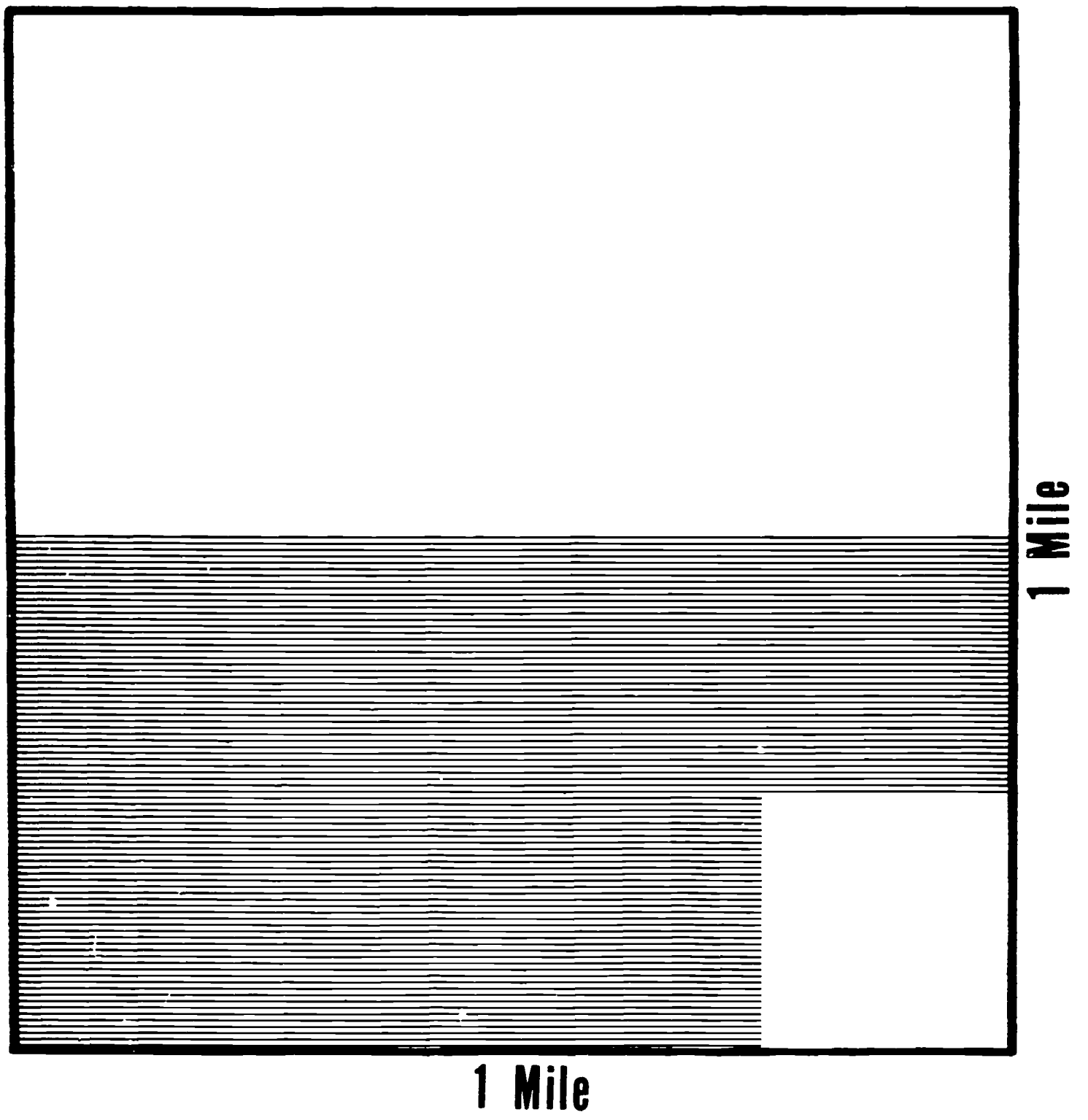
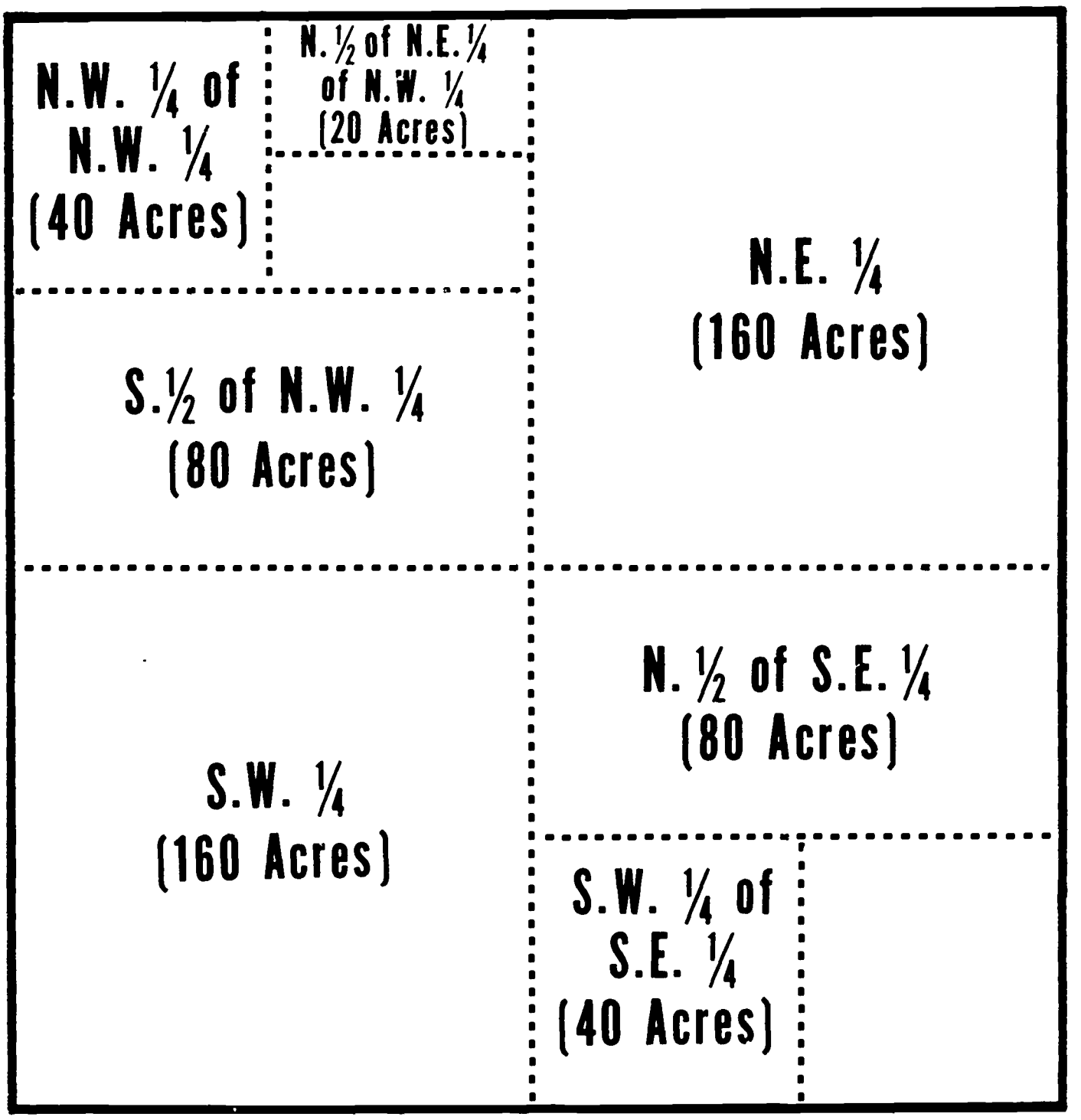


PLATE 6 OVERLAY

PLATE 6 Subdivision of a Section



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$$\text{Acres} = \frac{\text{Area}}{\text{Correct Factor}}$$

$$\text{Acres} = \frac{\text{12 Chains x 10 Chains}}{\text{10 Sq. Chains}}$$

$$= \frac{\text{120 Sq. Chains}}{\text{10 Sq. Chains}}$$

$$= 12$$

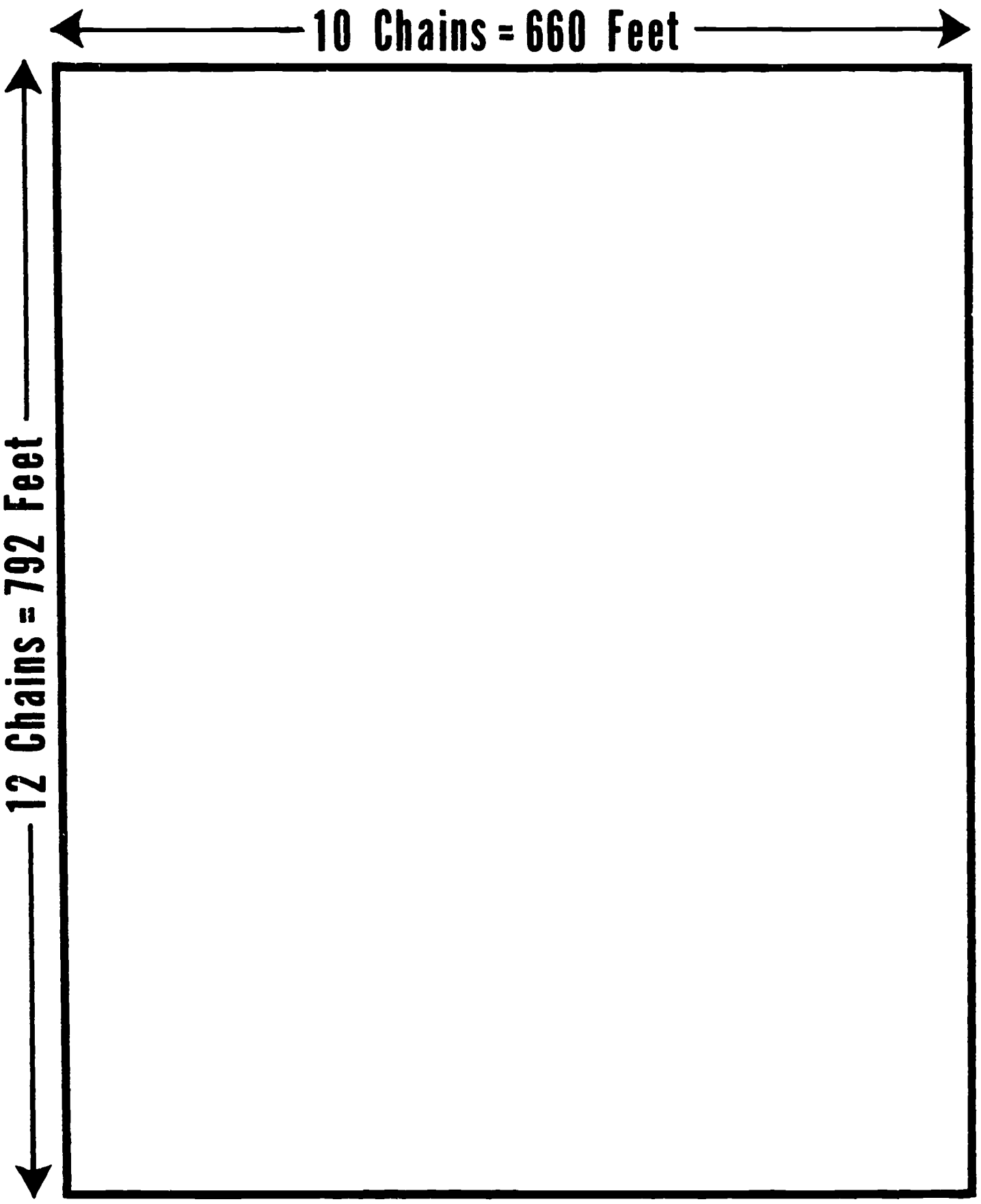
$$\text{Acres} = \frac{\text{792 Feet x 660 Feet}}{\text{43,560 Sq. Feet}}$$

$$= \frac{\text{522,720 Sq. Feet}}{\text{43,560 Sq. Feet}}$$

$$= 12$$

PLATE 7 OVERLAY

PLATE 7 Measurement of a Rectangular Field



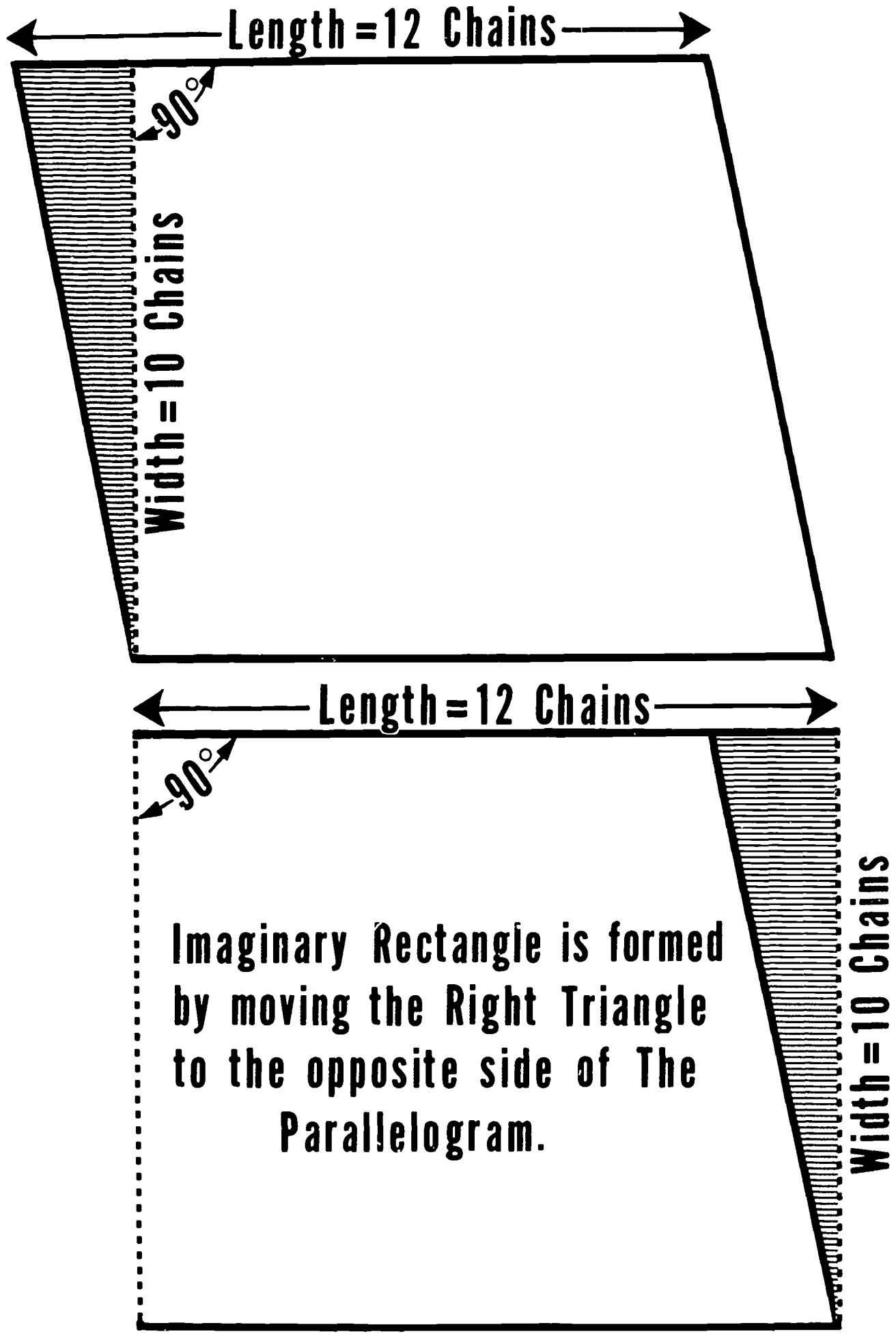
$$\text{Area} = 12 \text{ Chains} \times 10 \text{ Chains}$$
$$= 120 \text{ Sq. Chains}$$

$$\text{Acres} = \frac{120 \text{ Sq. Chains}}{10 \text{ Sq. Chains}} = 12$$

$$\text{Acres} = \frac{12 \text{ Chains} \times 10 \text{ Chains}}{10 \text{ Sq. Chains}} = 12$$

PLATE 8 OVERLAY

PLATE 8 Measurement of a "Parallelogram" Field



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$$\Delta \text{ Area} = (\tfrac{1}{2})\ (\text{L.})\ (\text{W.})$$

$$= \frac{12 \text{ Chains} \times 10 \text{ Chains}}{2}$$

$$= 60 \text{ Sq. Chains}$$

$$\Delta \text{Acres} = \frac{60 \text{ Sq. Chains}}{10 \text{ Sq. Chains}}$$

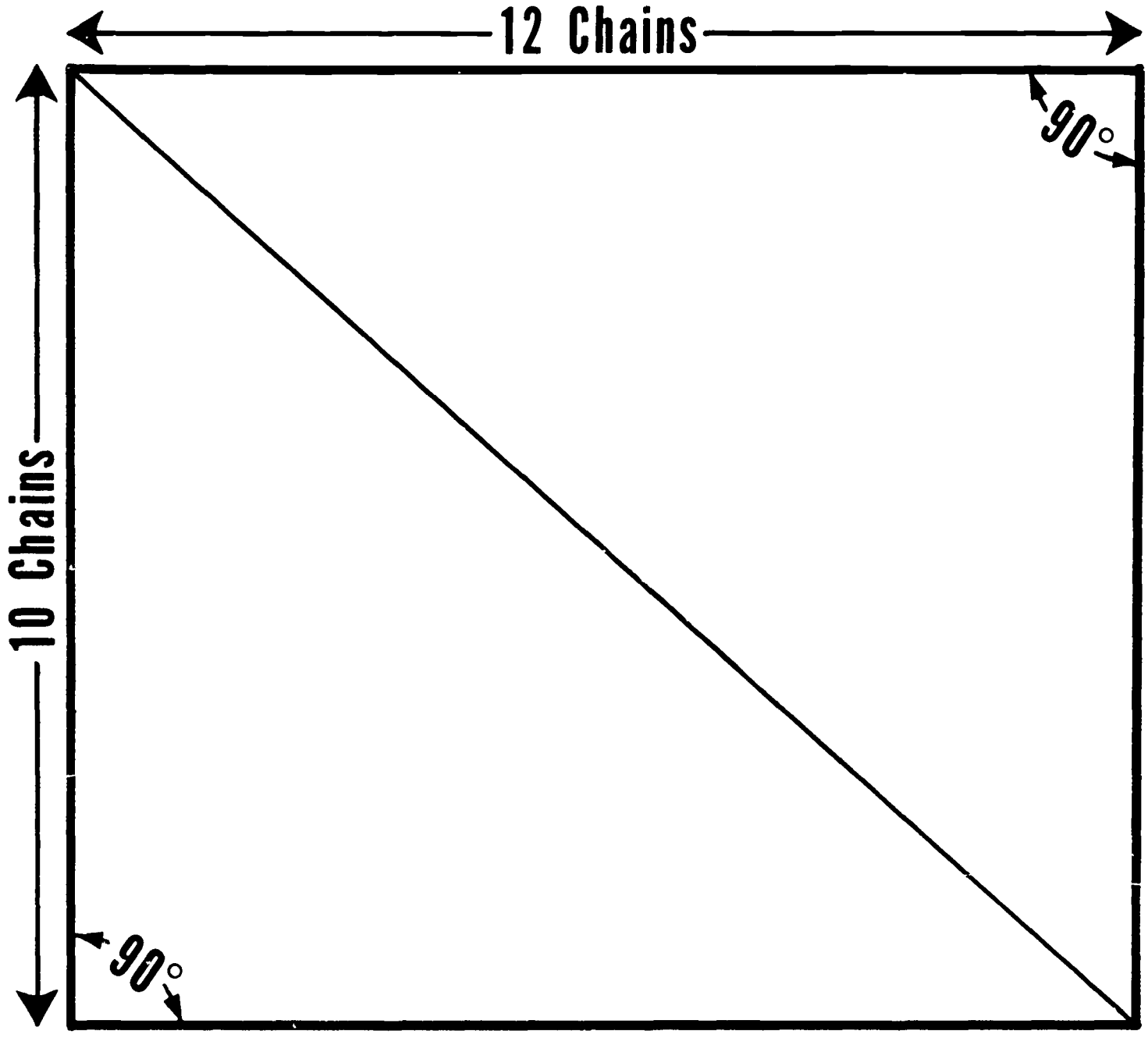
$$= 6$$

$$\Delta \text{ Area} = (\tfrac{1}{2})\ (\text{L.})\ (\text{W.})$$

$$\Delta \text{ Acres} = 6$$

PLATE 9 OVERLAY

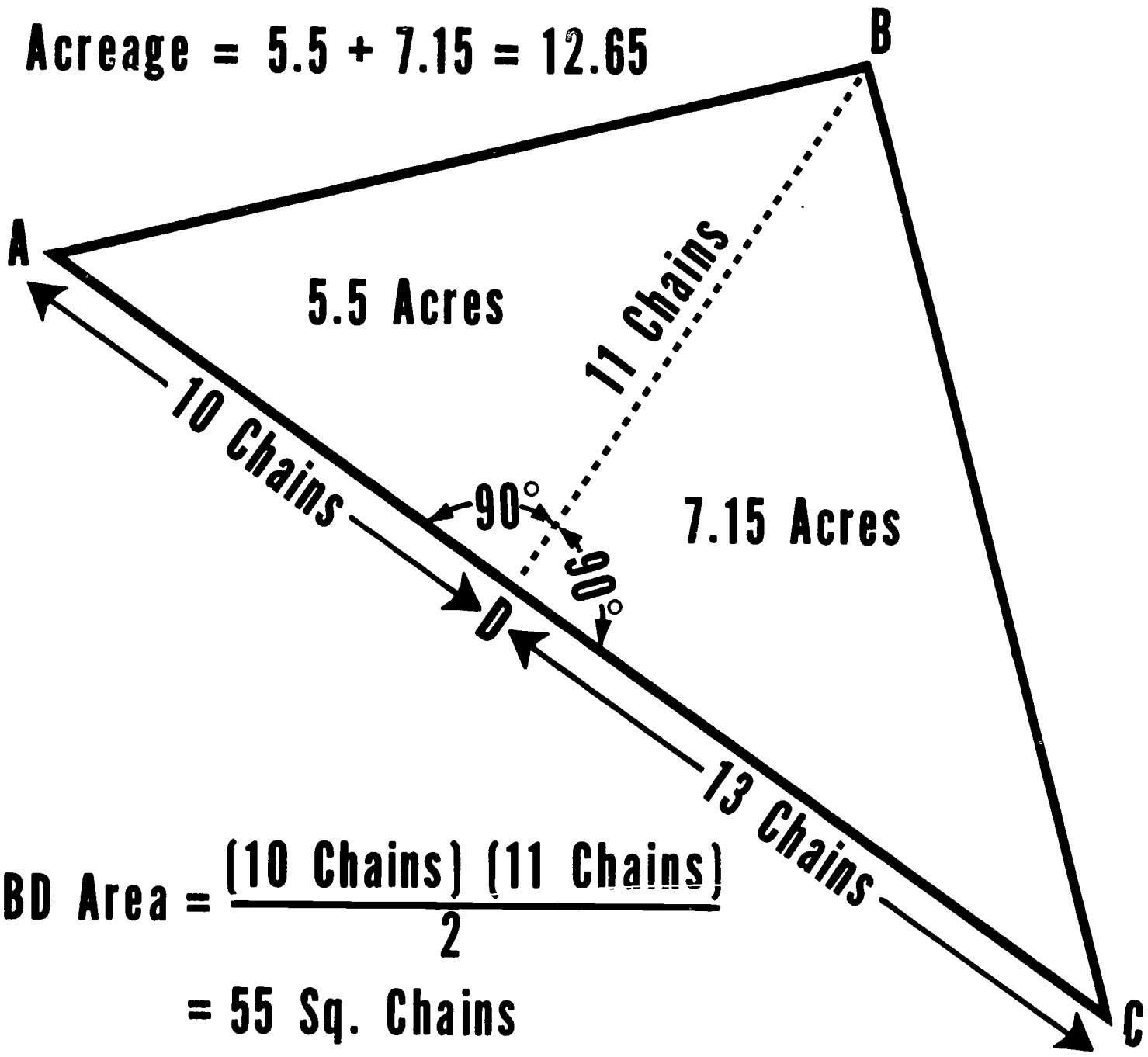
PLATE 9 How 2 Right Triangles are Derived



Area of Rectangle = Length x Width

PLATE 10 Measuring Triangular Fields

Acreage = 5.5 + 7.15 = 12.65



$$\triangle ABD \text{ Area} = \frac{(10 \text{ Chains})\,(11 \text{ Chains})}{2}$$

$$= 55 \text{ Sq. Chains}$$

$$\triangle BCD \text{ Area} = \frac{(13 \text{ Chains})\,(11 \text{ Chains})}{2}$$

$$= 71.5 \text{ Sq. Chains}$$

Alternate Procedure: $\text{Area} = \left(\frac{23}{2}\right)(11) = 126.5$ Sq. Chains

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$$\text{Area} = \frac{(8 \text{ Chains} + 16 \text{ Chains})}{2} (10 \text{ Chains})$$

$$= 12 \text{ Chains} \times 10 \text{ Chains}$$

$$= 120 \text{ Sq. Chains}$$

PLATE 11 OVERLAY

Plate 11 Measuring Fields with Two Right Angles and 4 Sides (Trapezoids)

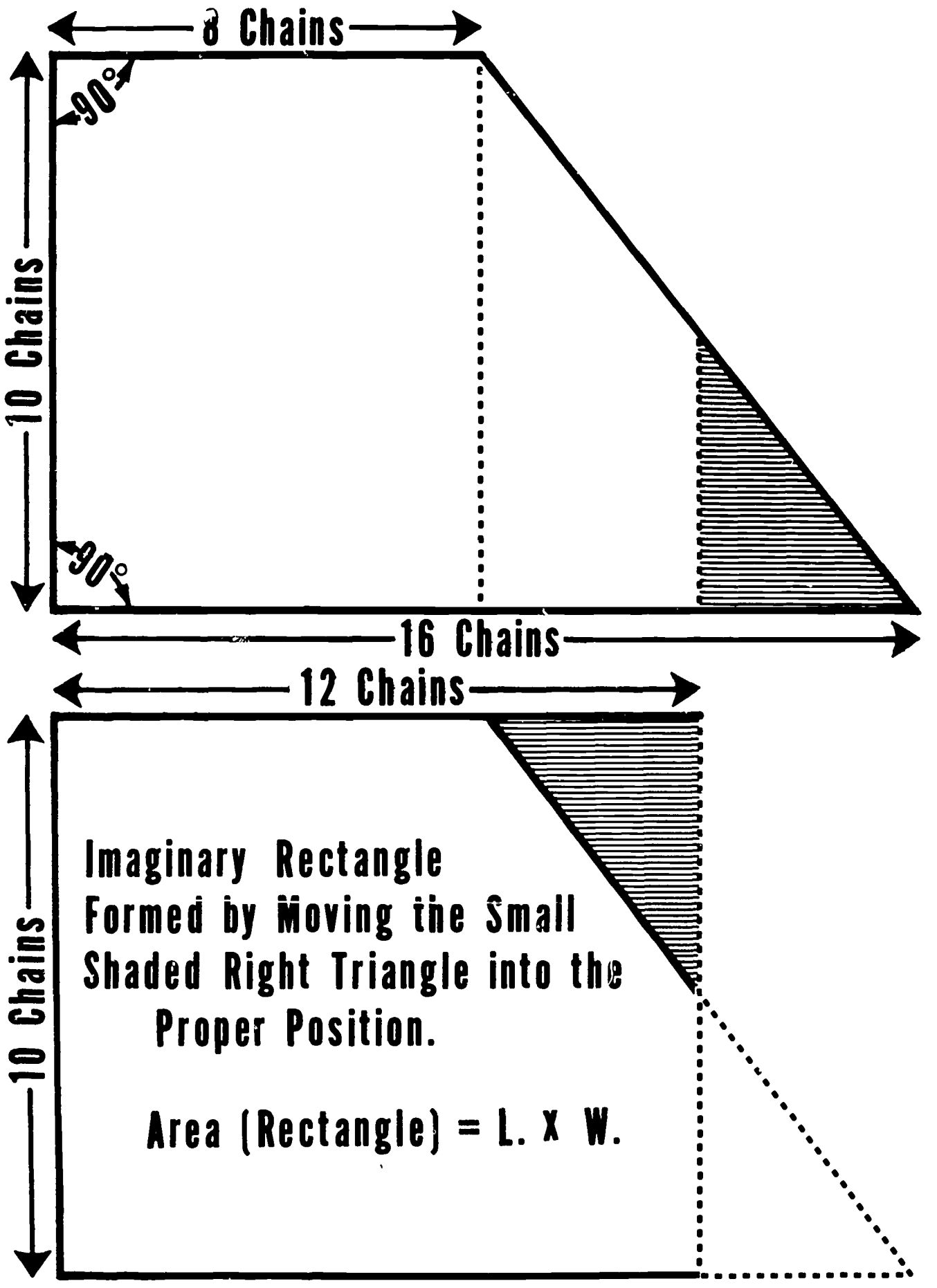

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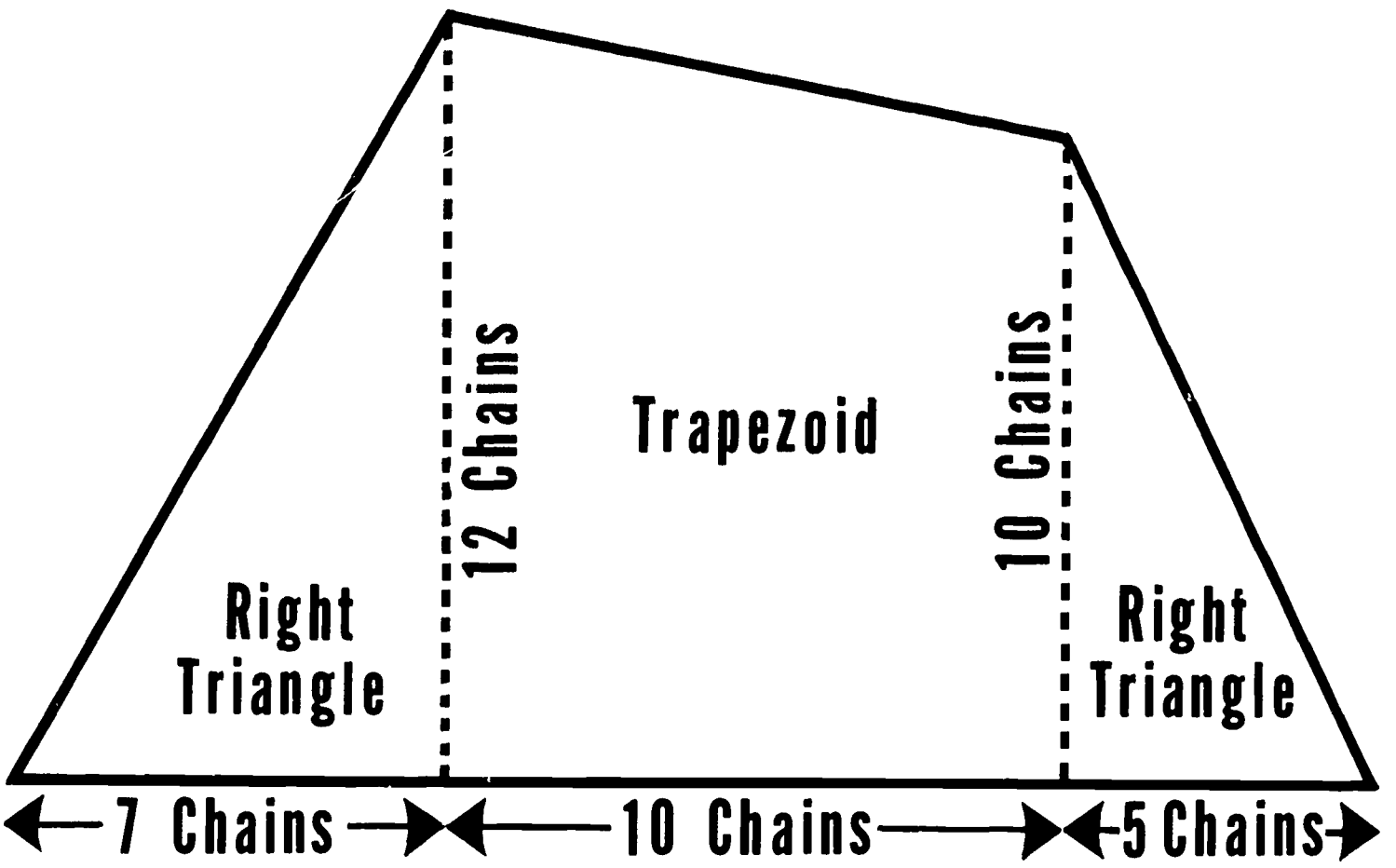
Plate 12 Trapezium Measurements for Area



$$\text{Area} = \left[\frac{(7)\ (12)}{2}\right] + \left[\left(\frac{10 + 12}{2}\right)(10)\right] + \left[\frac{(5)\ (10)}{2}\right]$$

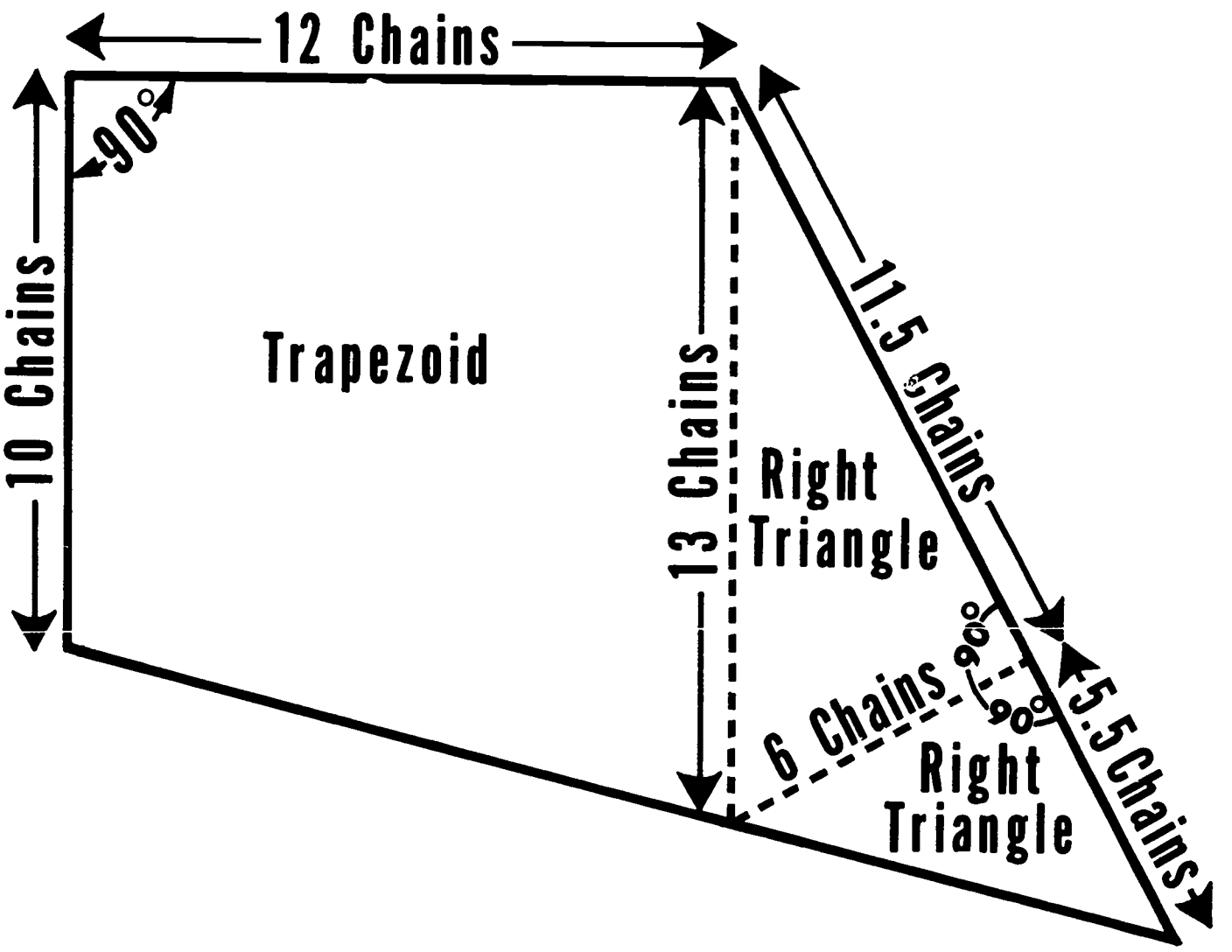
$$= \left[\frac{84}{2}\right] + \left[\left(\frac{22}{2}\right)(10)\right] + \left[\frac{50}{2}\right]$$

$$= 42 + 110 + 25$$

$$= 177 \text{ Sq. Chains}$$

Acreage = 17.7 for Total

Plate 13 Measurements for Area of a Trapezium with one Right Angle



$$\text{Area} = \left[\left(\frac{13+10}{2}\right)(12)\right] + \left[\frac{(6)(11.5)}{2}\right] + \left[\frac{(6)(5.5)}{2}\right]$$

$$= \left[\left(\frac{23}{2}\right)(12)\right] + \left[\frac{69.0}{2}\right] + \left[\frac{33.0}{2}\right]$$

$$= 138 + 34.5 + 16.5 = 189 \text{ Sq. Chains}$$

$$\text{Acreage} = 18.9 \text{ for Total } \left(\frac{189}{10}\right)$$

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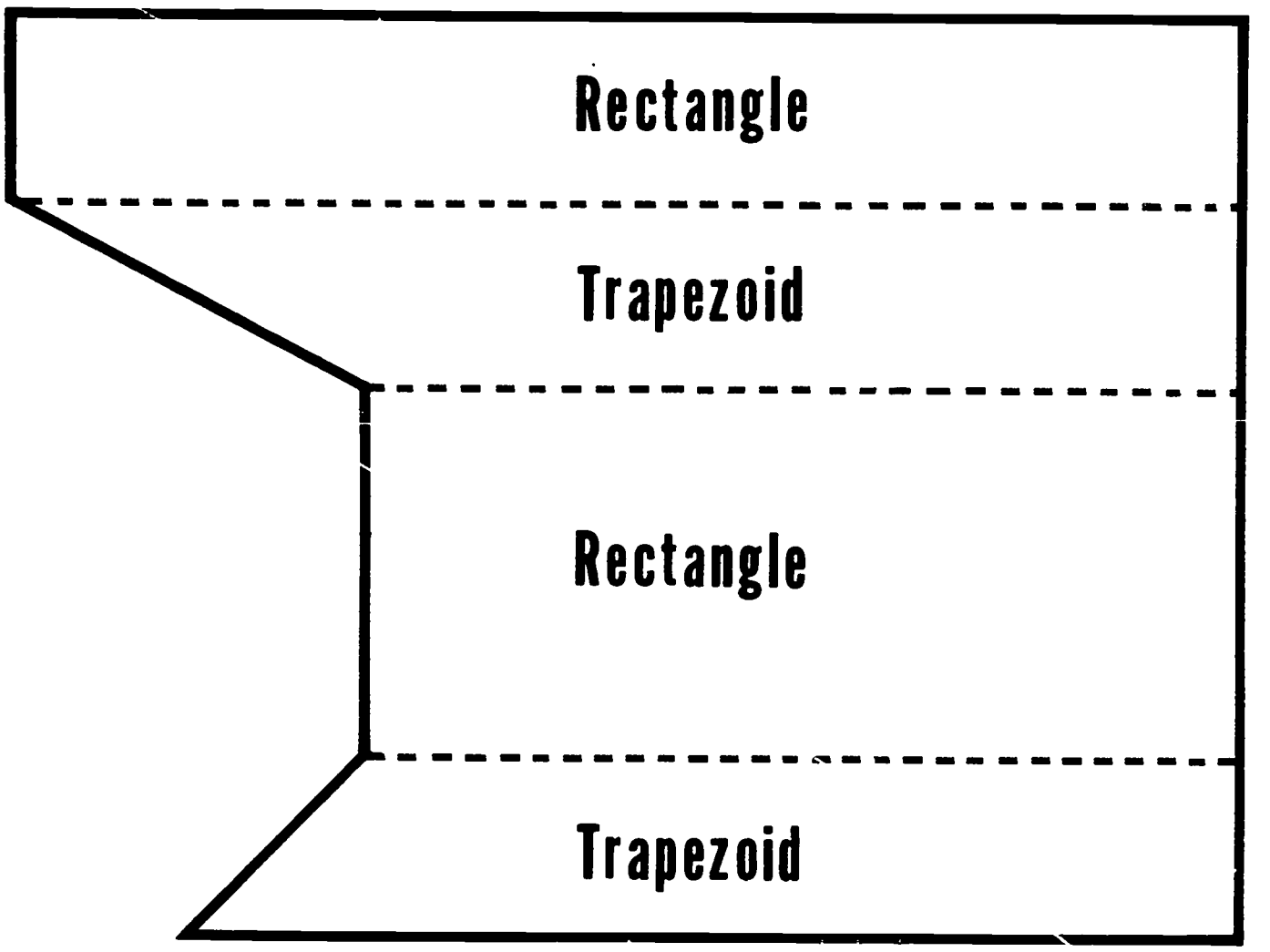
PLATE 14 OVERLAY

PLATE 14 Problem



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VT 010 425
Artificial Insemination (Overhead Transparency Masters).

California State Polytechnic Coll., San Luis Obispo. Vocational Education Productions
California State Dept. of Education, Sacramento. Vocational Education Section
MF AVAILABLE IN VT-ERIC SET.
Vocational Education Productions, California State Polytechnic College, San Luis Obispo, California 93401 ($2.25).
PUB DATE - ND 26p.

DESCRIPTORS - *TRANSPARENCIES; *VOCATIONAL AGRICULTURE; *ANIMAL SCIENCE; *LIVESTOCK; *INSTRUCTIONAL AIDS; ANATOMY

ABSTRACT - Vocational agriculture teachers may use instructional aids produced from these 17 transparency masters in teaching classes in animal science. Some titles included are: (1) Organs of Reproduction of the Cow, (2) Sex Determination at Fertilization, (3) Circulatory Routes in the Young Mammalian Embryo, (4) Position of the Calf in the Uterus After It Has Been Oriented for Normal Delivery, (5) Abnormal Presentations of the Calf for Delivery, (6) Reproductive Tract of the Bull, (7) Spermatogenesis, (8) Speculum Method of Inseminating the Cow, and (9) Rectovaginal Technique of Inseminating the Cow. (AW)

VT 010 425

ARTIFICIAL INSEMINATION

OVERHEAD TRANSPARENCY MASTERS

Research and development of these materials was assisted by VOCATIONAL EDUCATION ACT funds, administered through the Vocational Education Section of the California Department of Education.

EDO 45856

171-1

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Sex Determination at Fertilization	4
Circulatory Routes in the Young Mammalian Embryo	5
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Growth and Formation of the Extraembryonic Membranes in Mammals	6
Parts Nomenclature (overlay)	6
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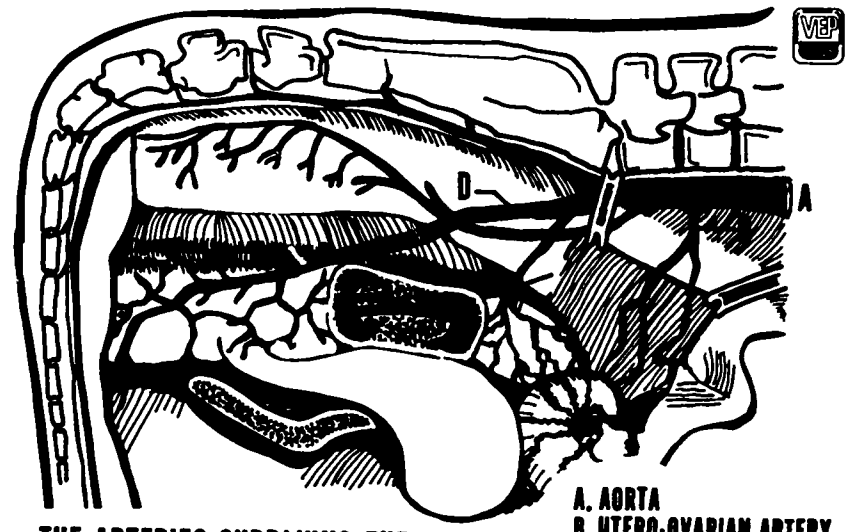

THE ARTERIES SUPPLYING THE REPRODUCTIVE TRACT OF THE COW

A. AORTA
B. UTERO-OVARIAN ARTERY
C. MID-UTERINE ARTERY
D. HYPOGASTRIC ARTERY

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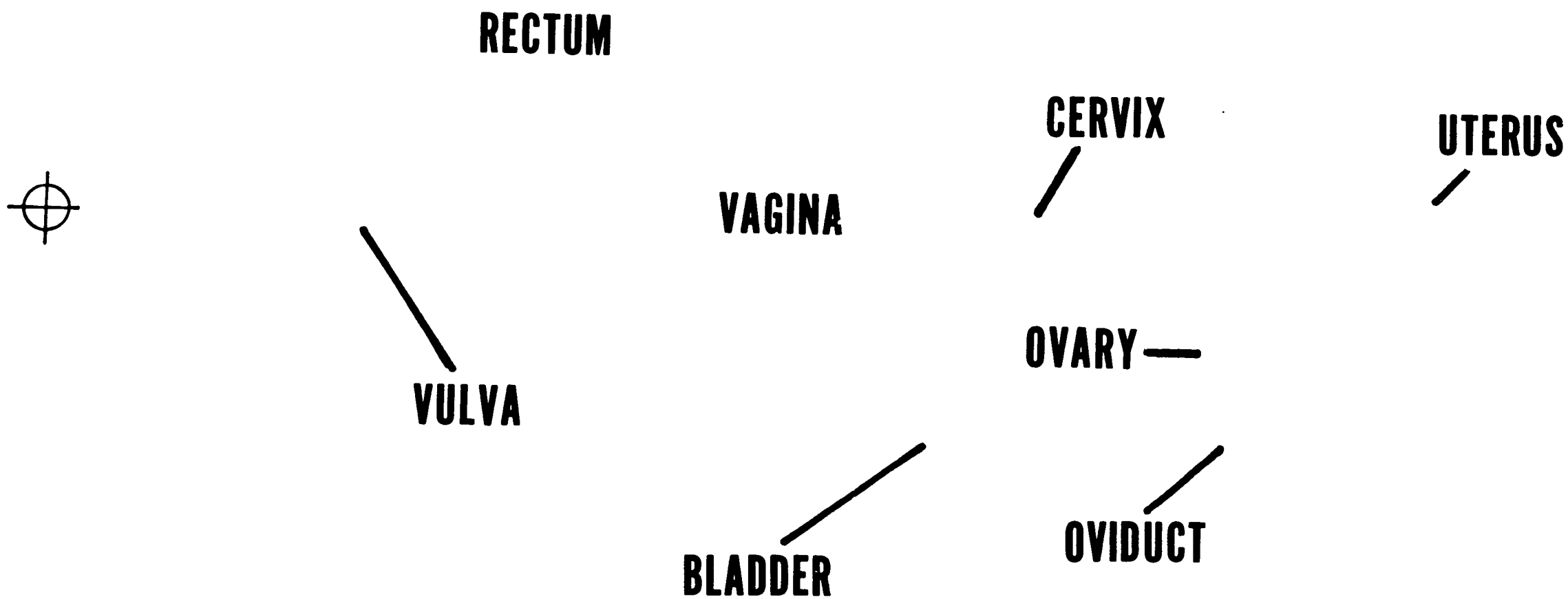
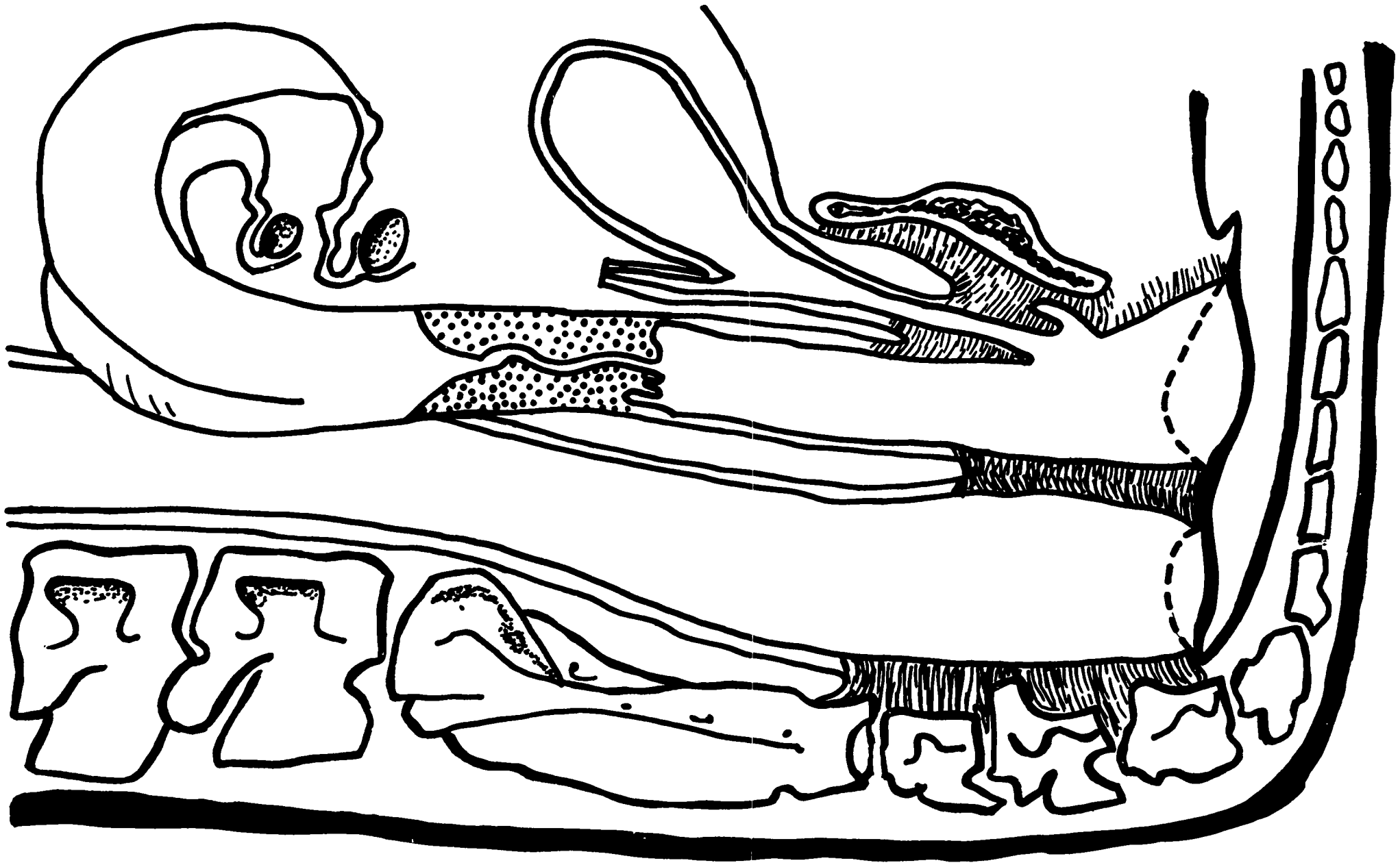


THE ORGANS OF REPRODUCTION OF THE COW



OOGENESIS USING ONLY ONE PAIR OF CHROMOSOMES

OOGONIUM

GROWTH

PRIMARY OOCYTE

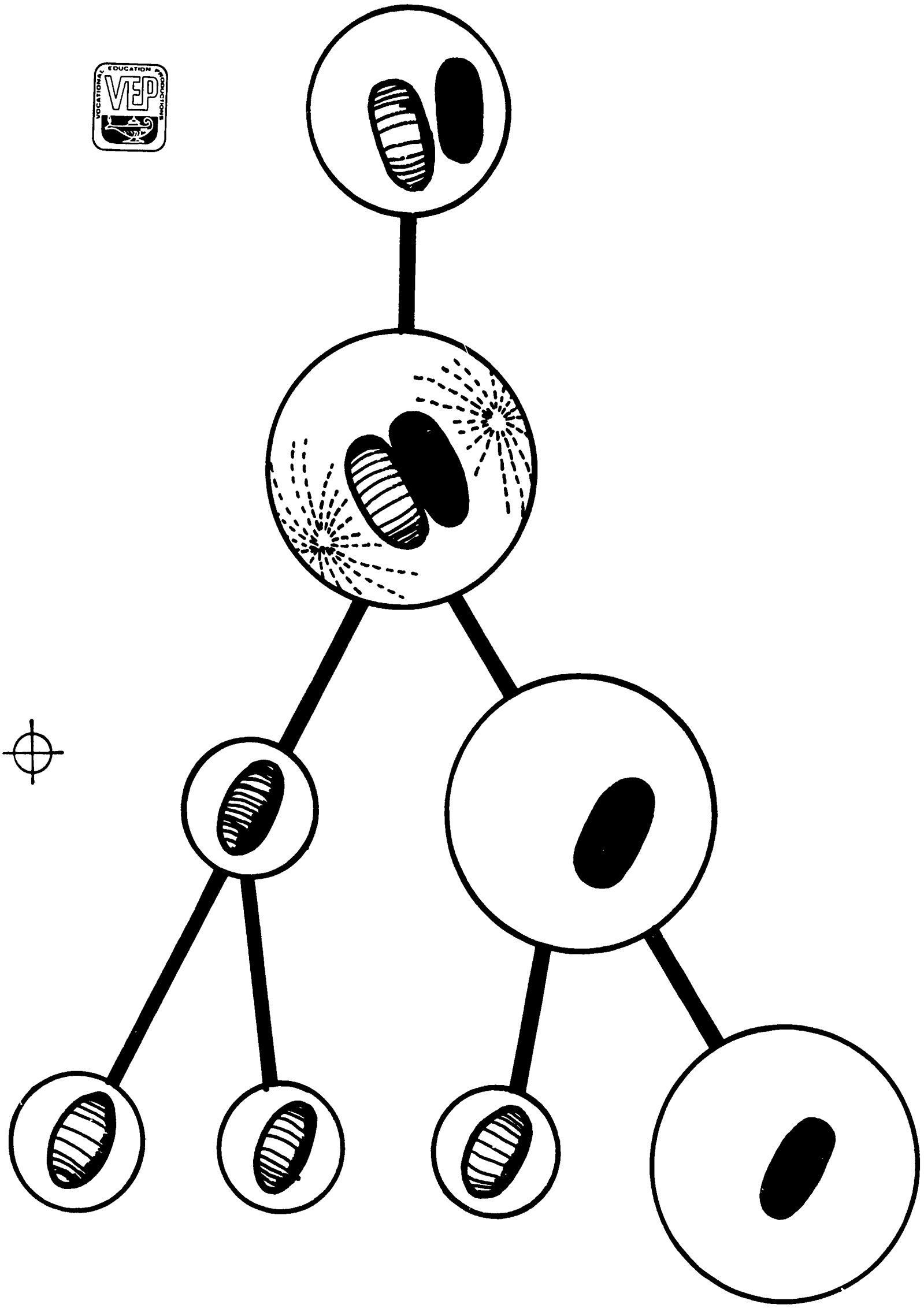
MEIOSIS

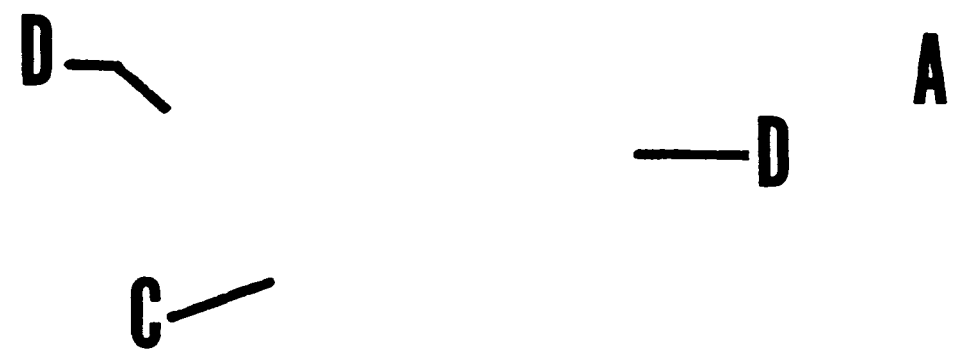
SECONDARY OOCYTE

MITOSIS

OVUM

POLAR BODIES





THE ARTERIES SUPPLYING THE REPRODUCTIVE TRACT OF THE COW

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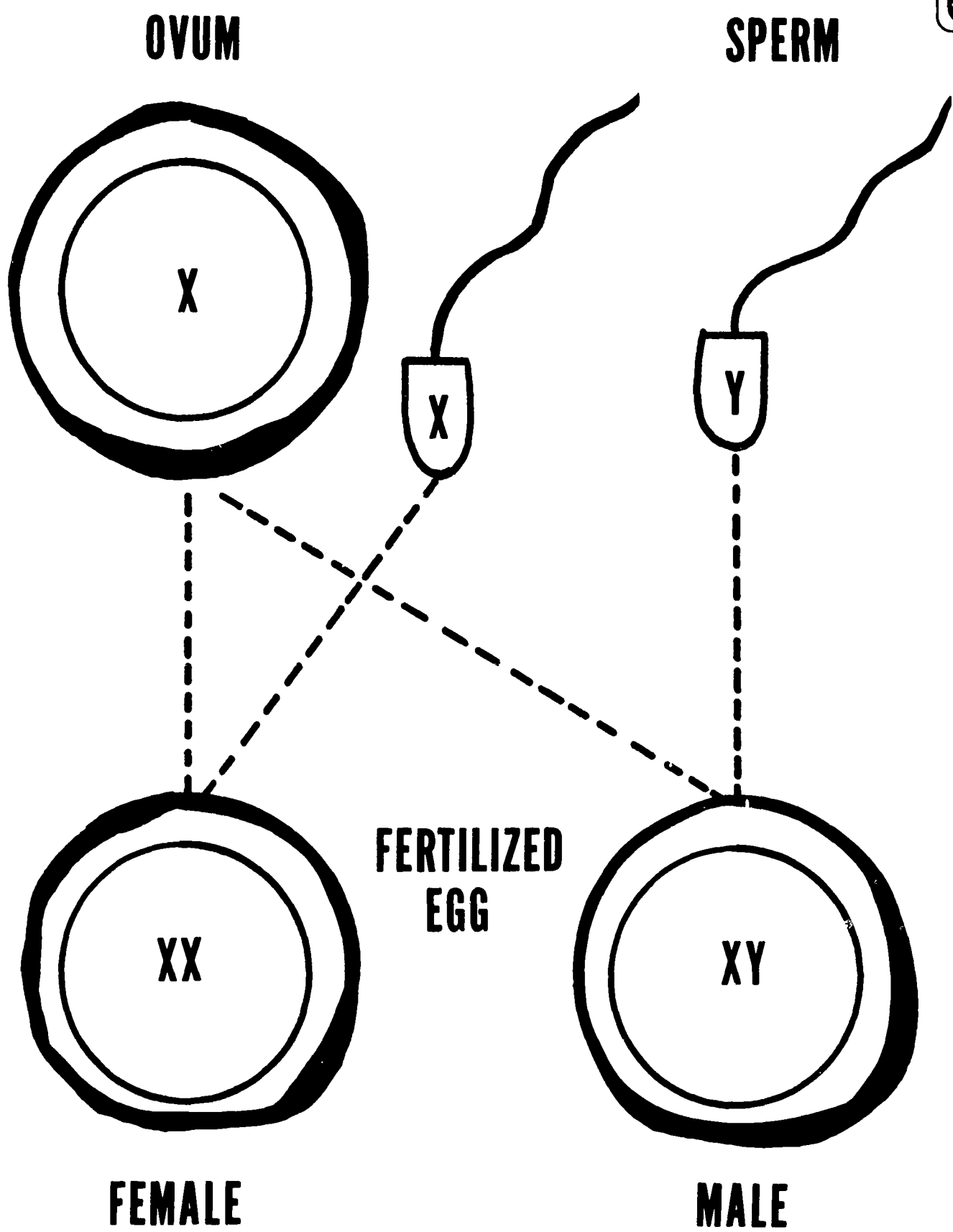
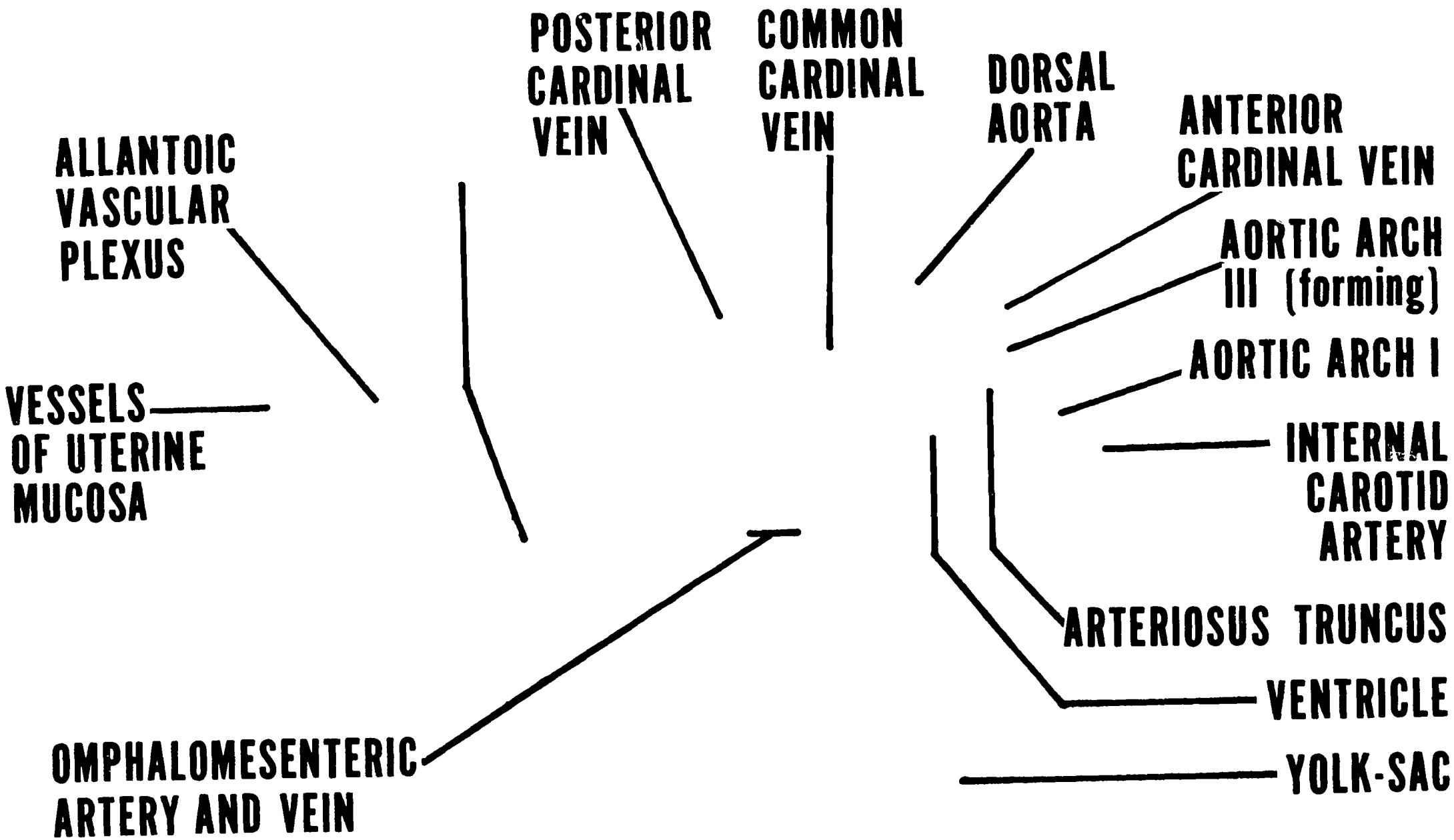
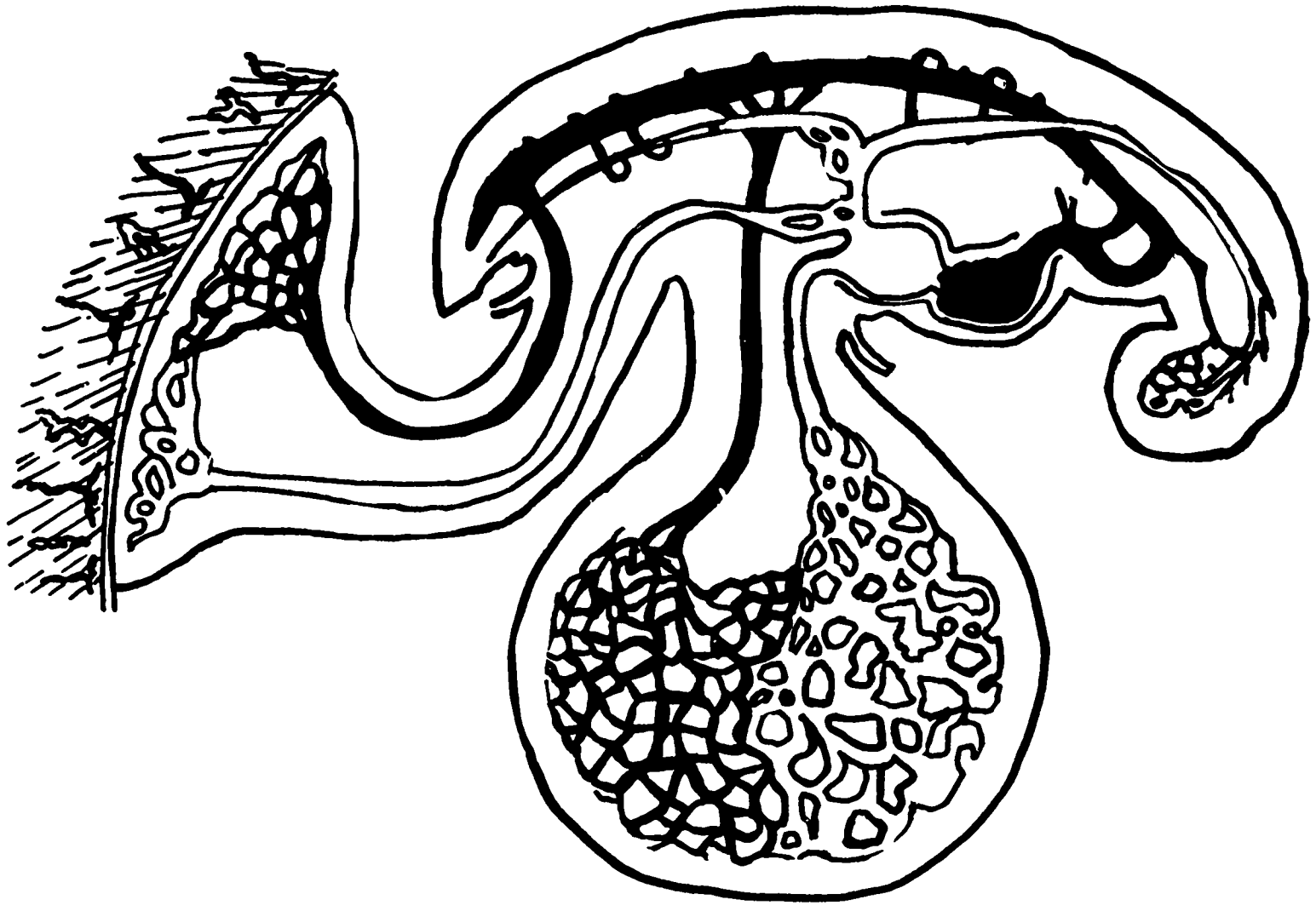
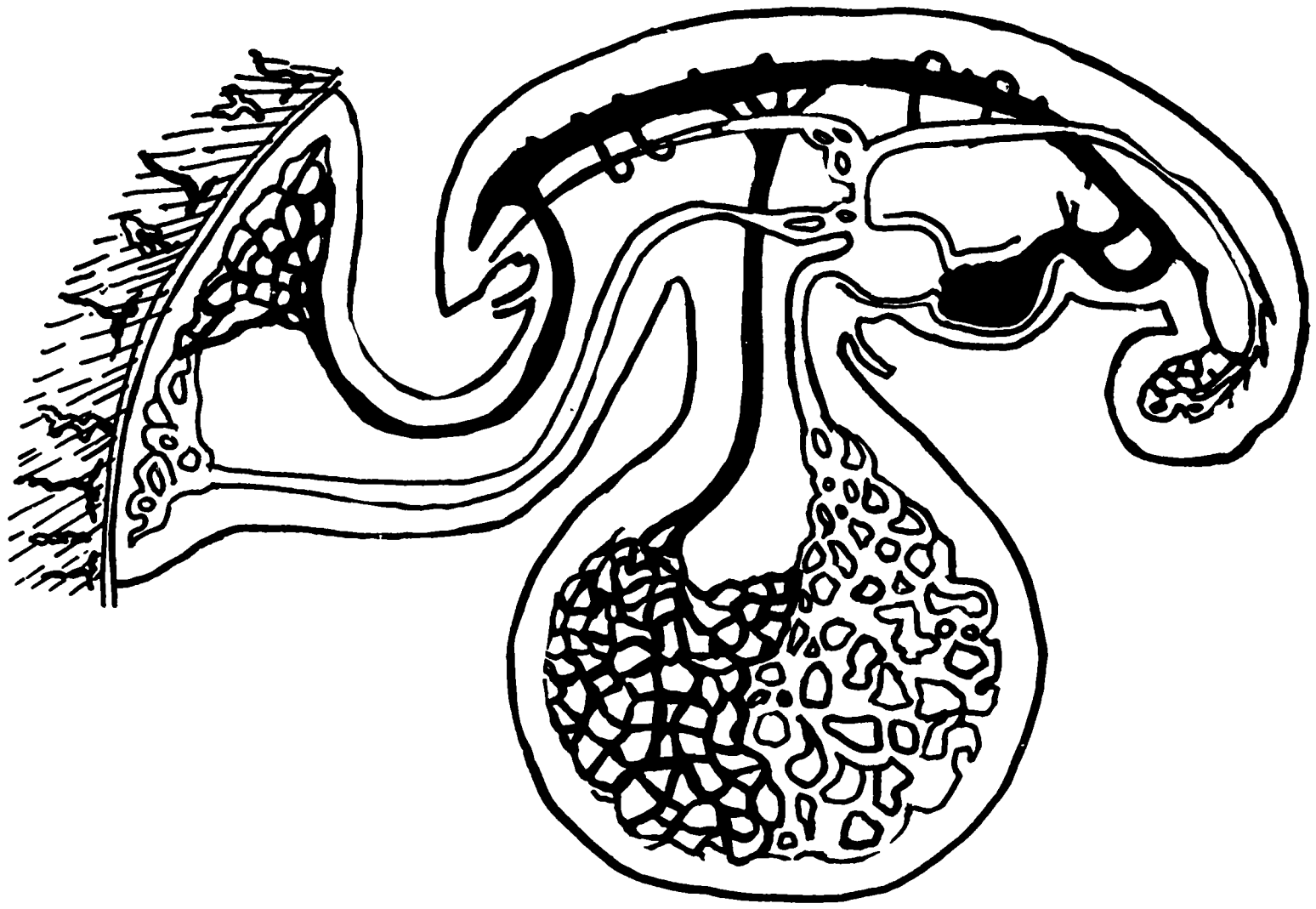


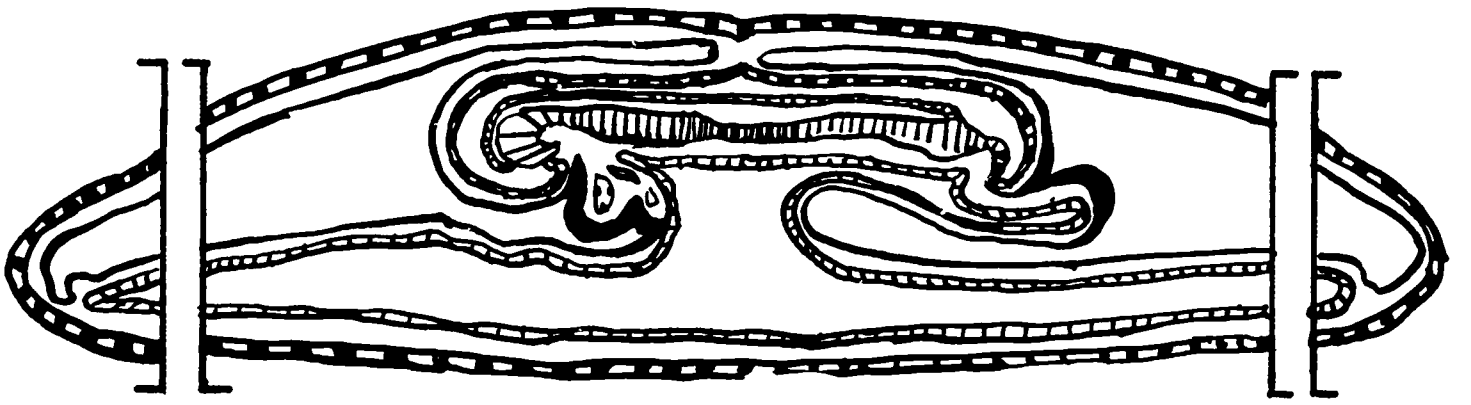
SEX DETERMINATION AT FERTILIZATION

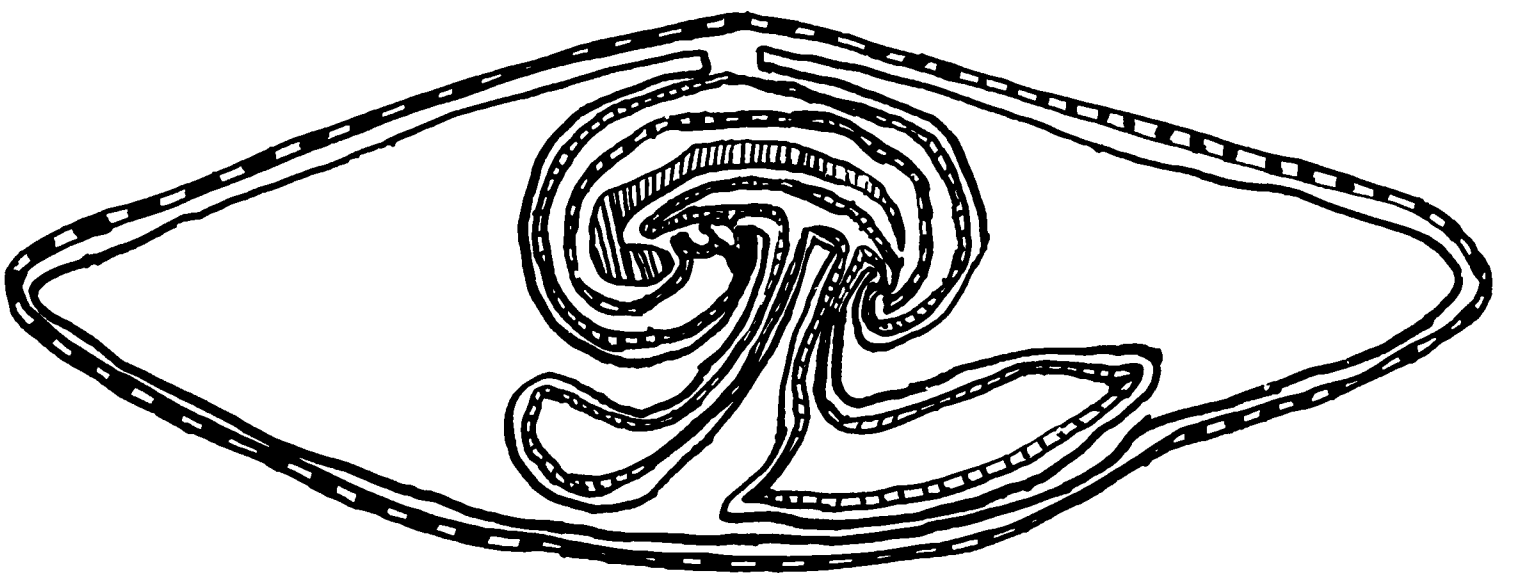


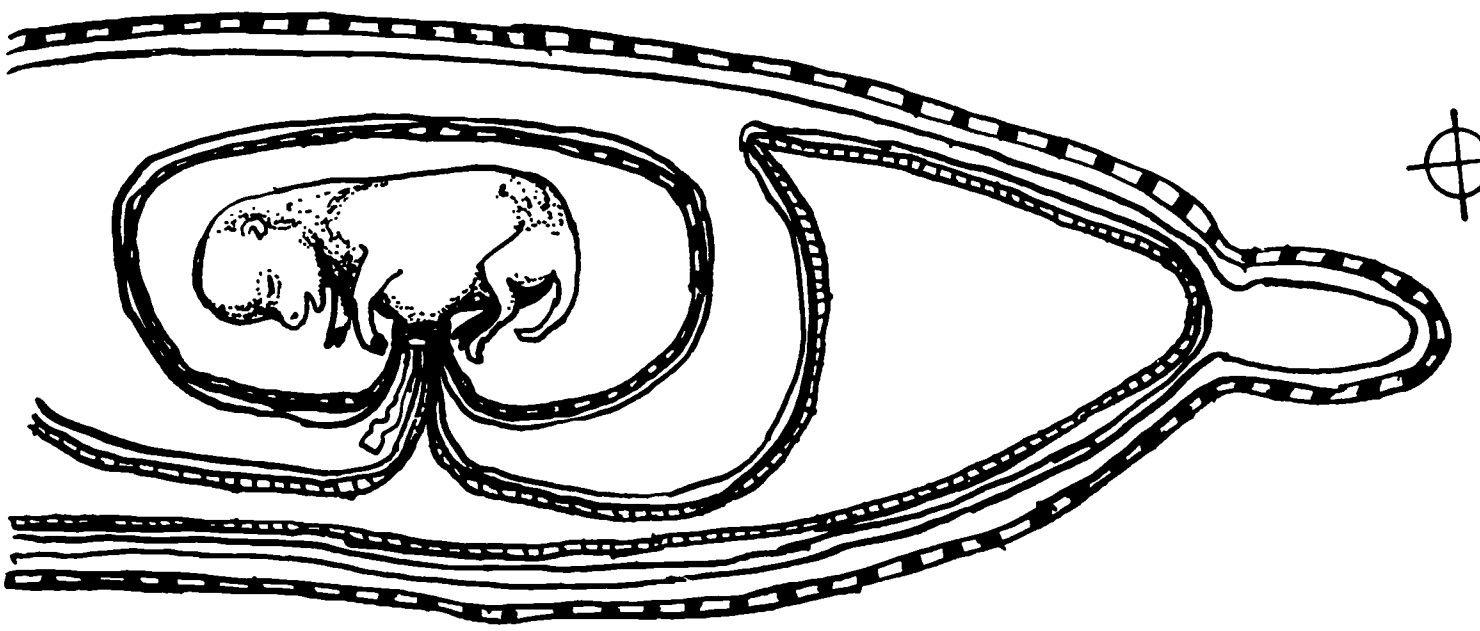
THE CIRCULATORY ROUTES IN THE YOUNG MAMMALIAN EMBRYO

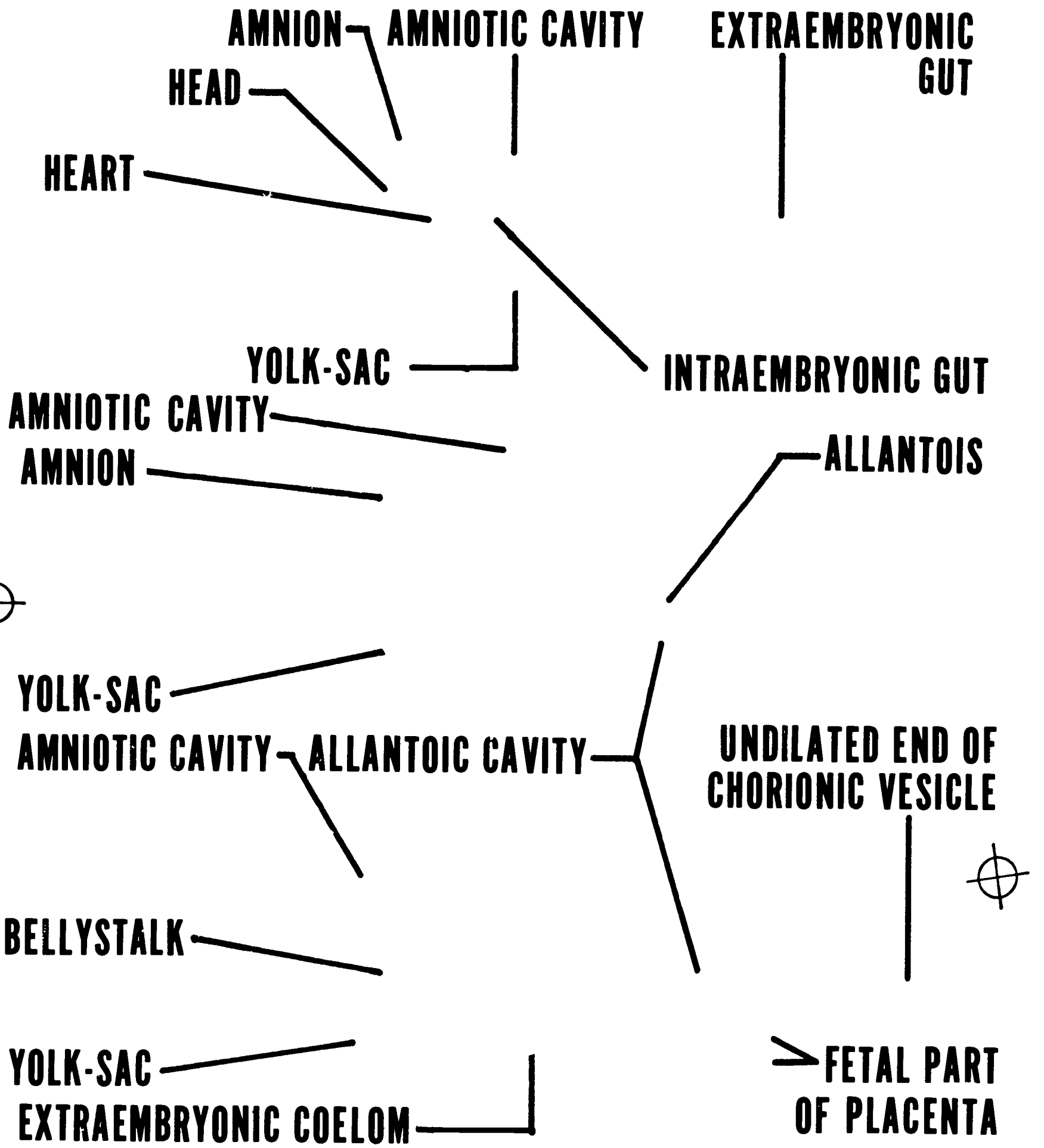




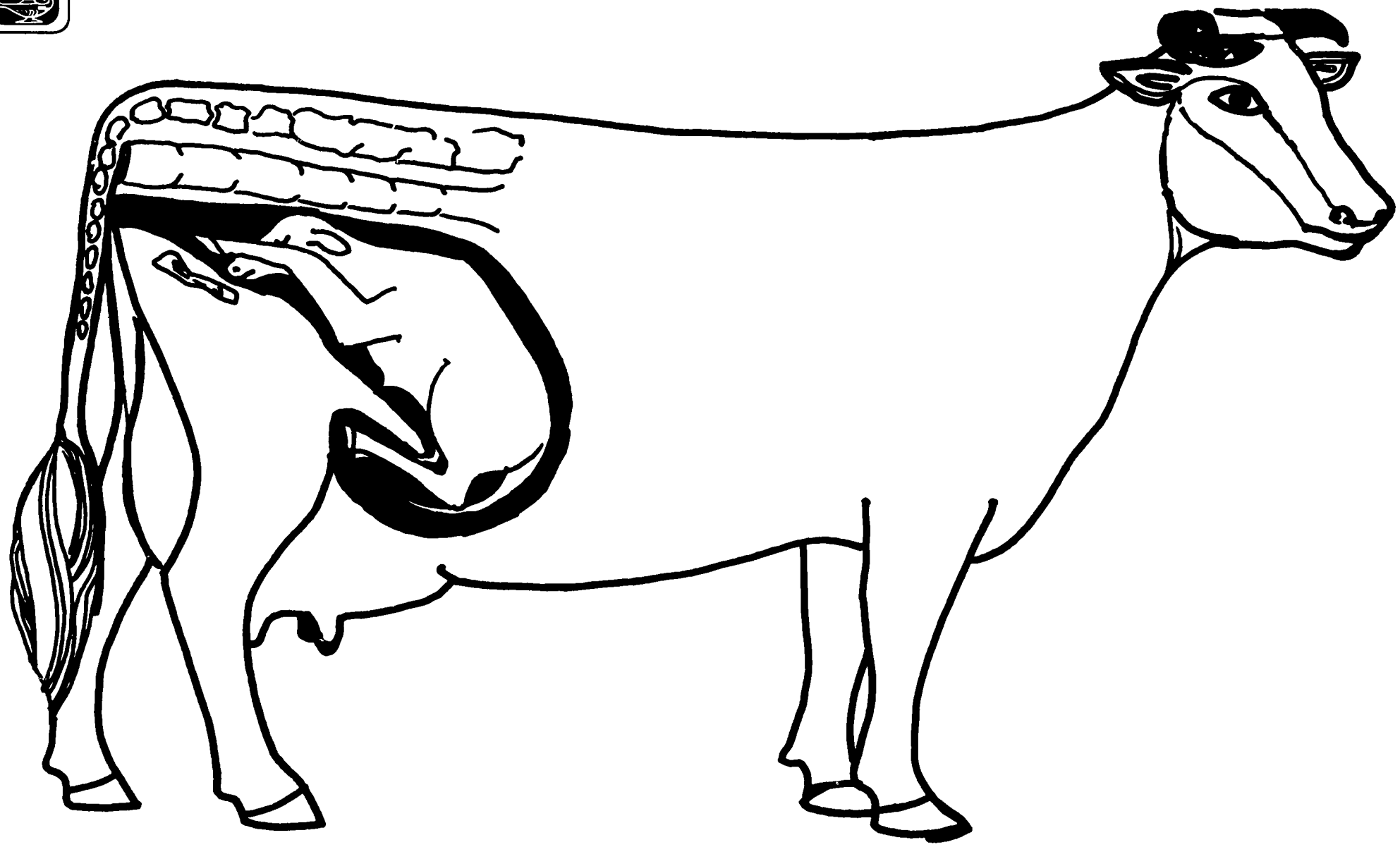




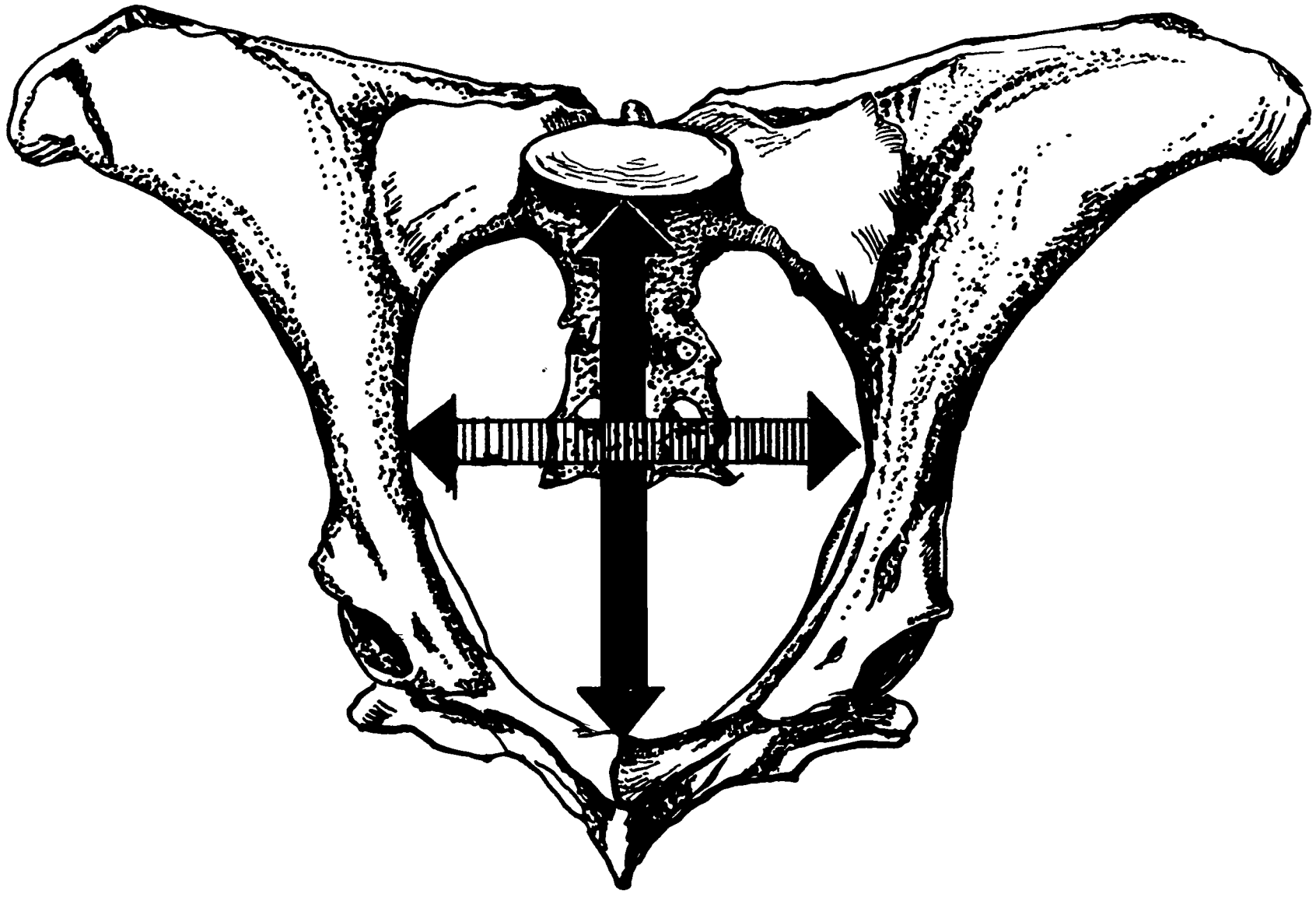




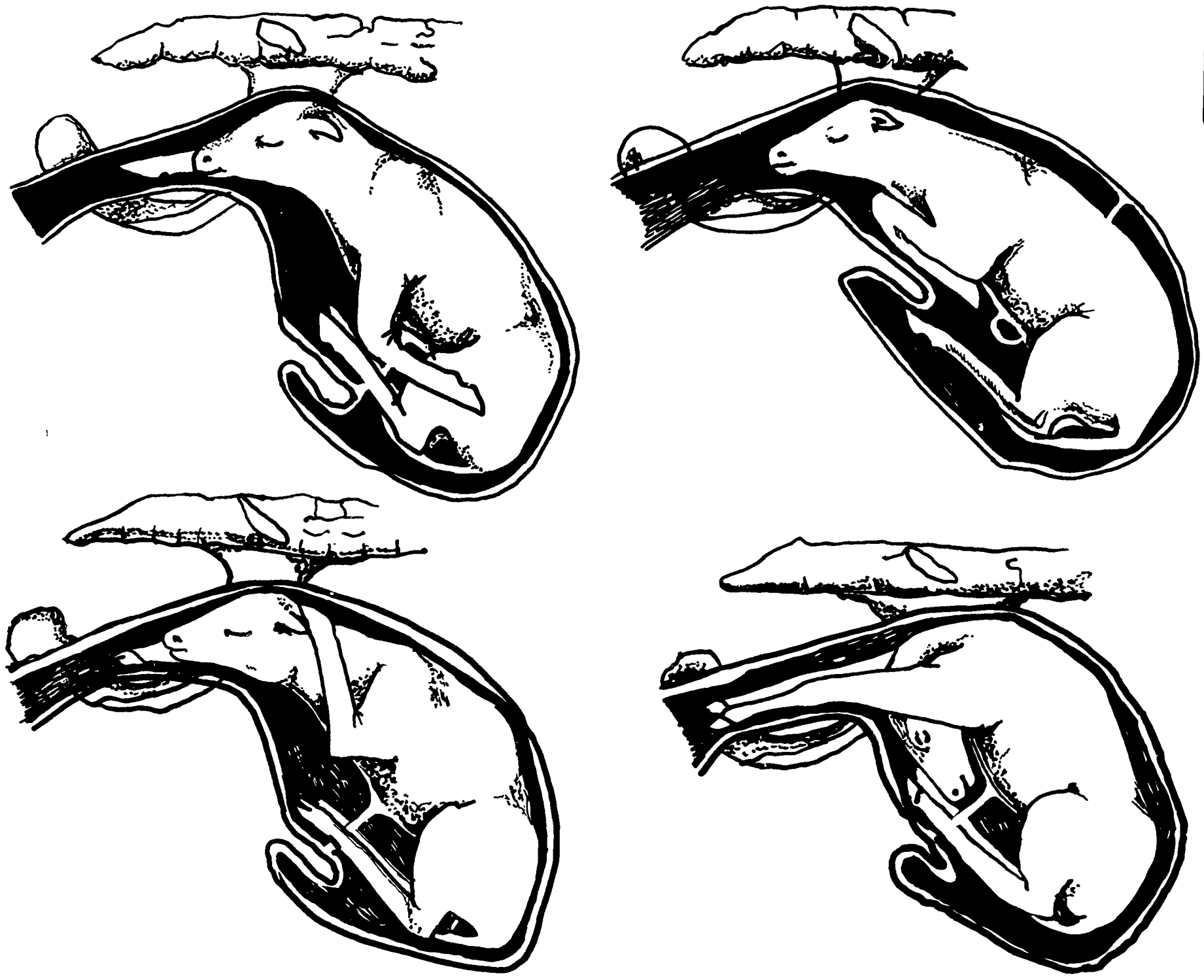
GROWTH AND FORMATION OF THE EXTRAEMBRYONIC MEMBRANES IN MAMMALS



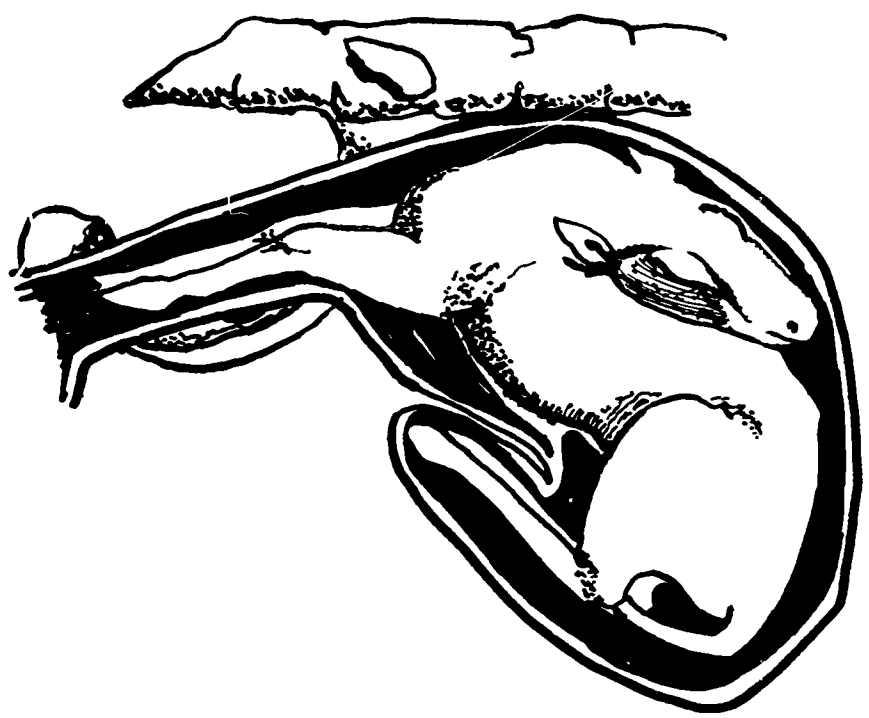
POSITION OF THE CALF IN THE UTERUS AFTER IT HAS BEEN ORIENTED FOR NORMAL DELIVERY

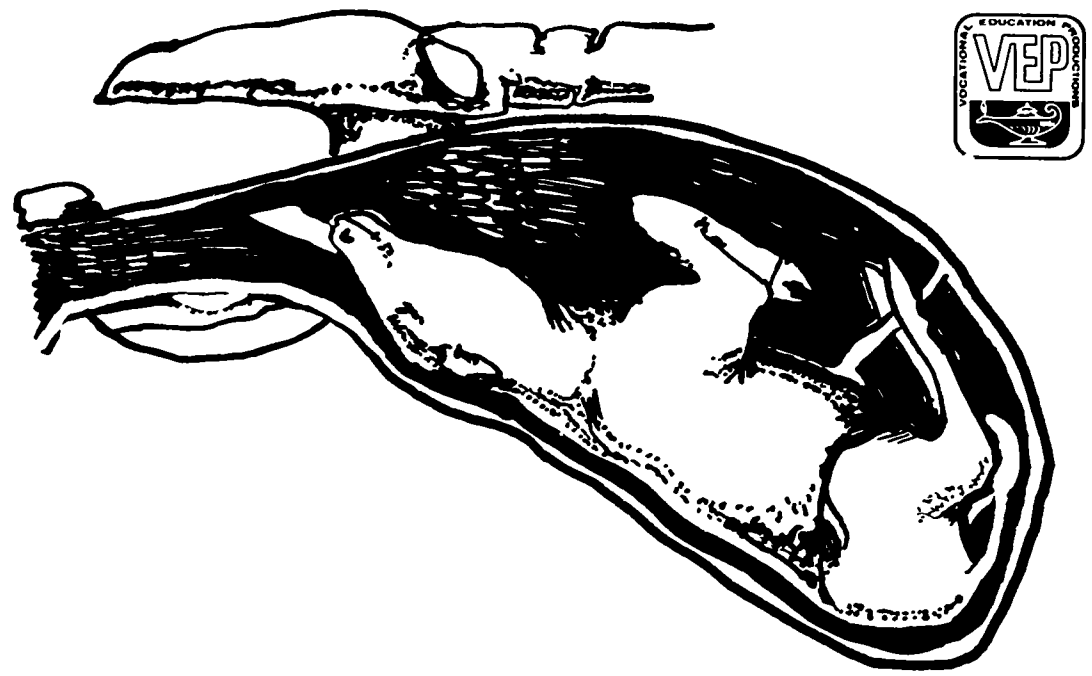


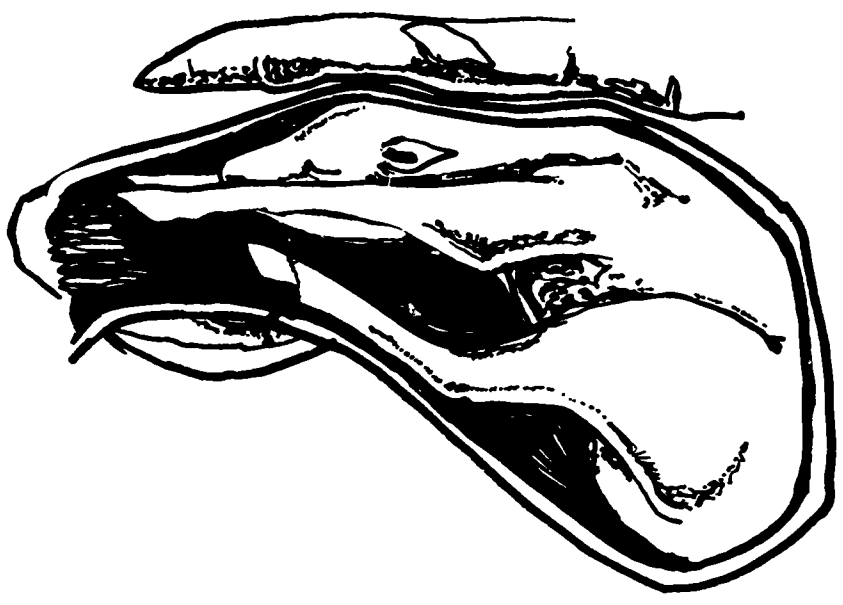
THE PELVIC BONES OF THE COW THROUGH WHICH THE CALF MUST PASS AT BIRTH

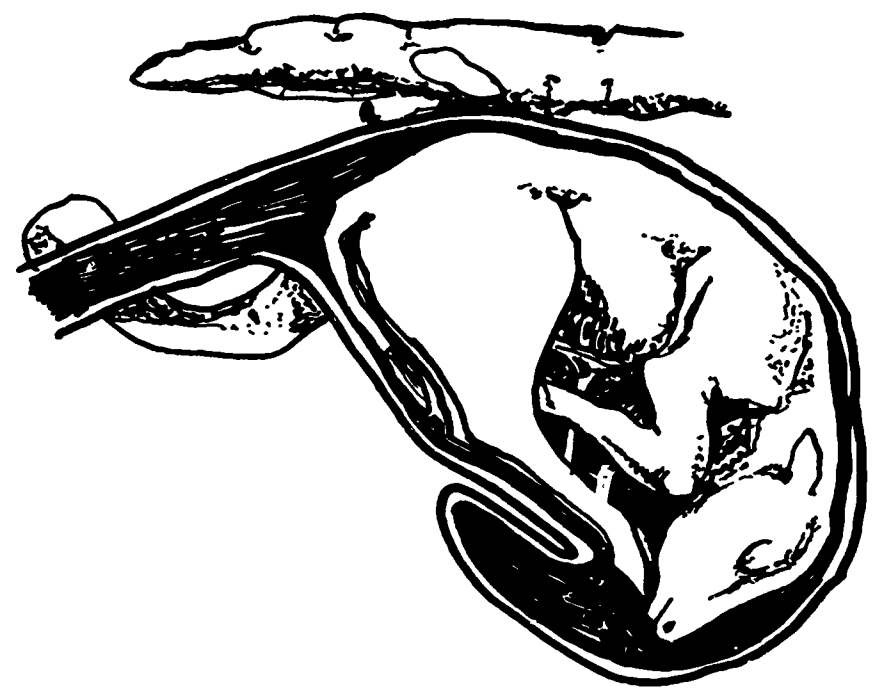


ABNORMAL PRESENTATIONS OF THE CALF FOR DELIVERY

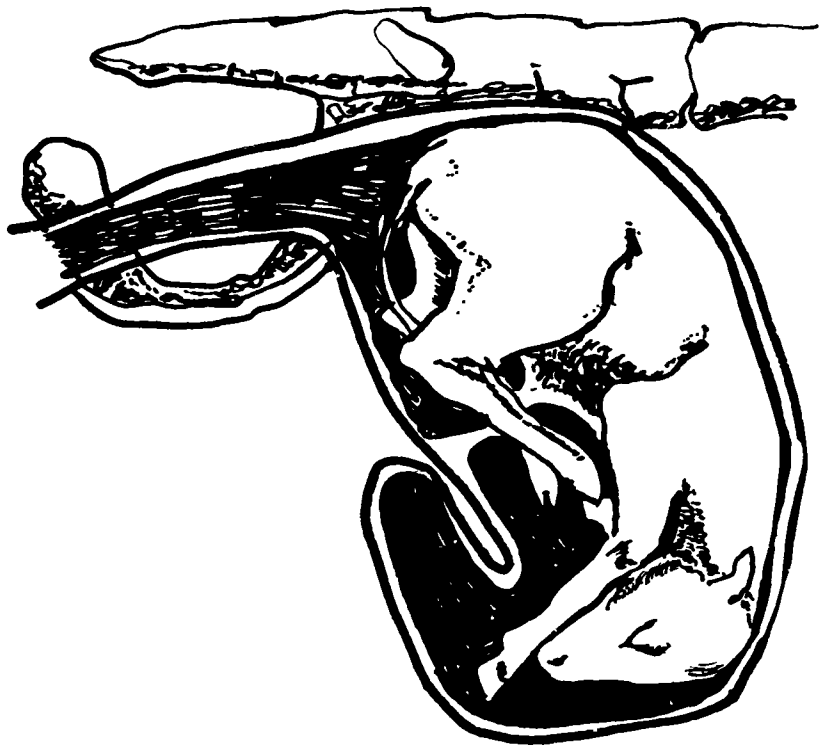


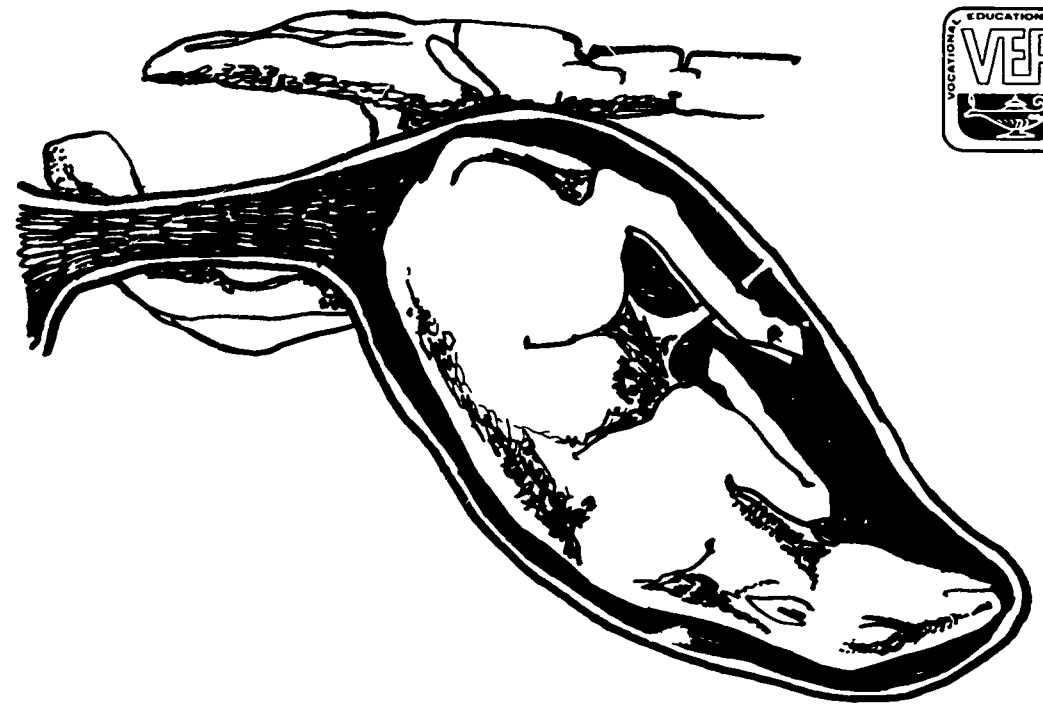


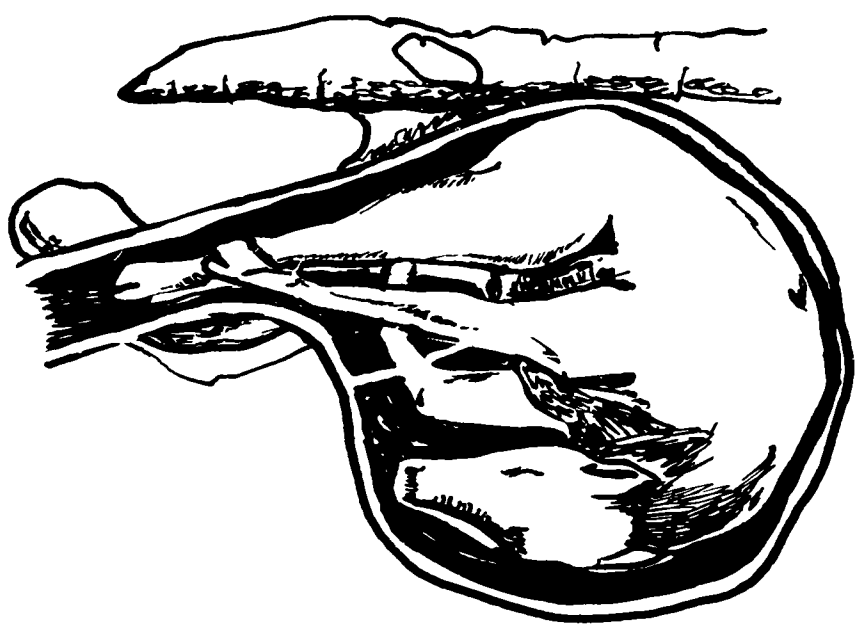


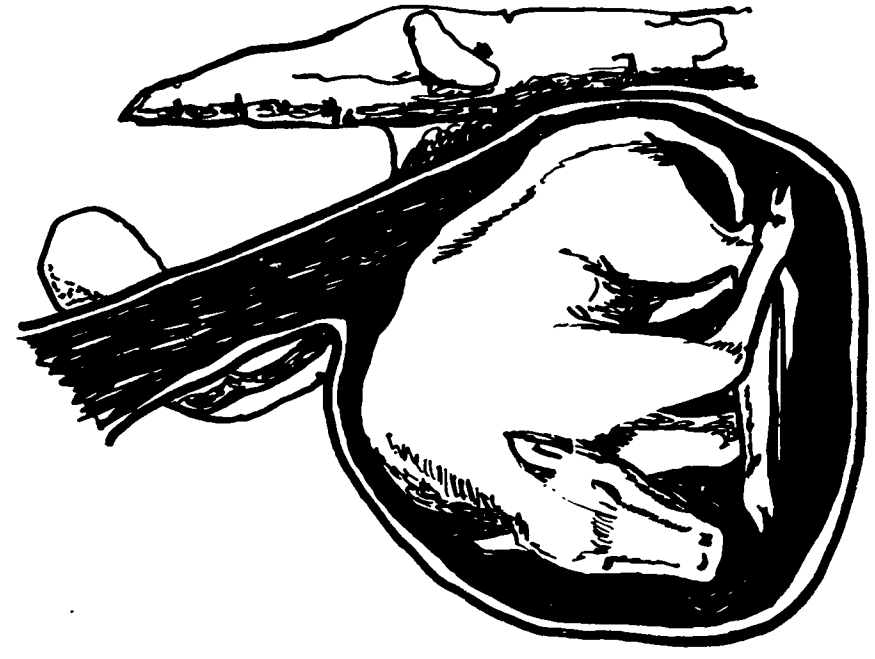


ABNORMAL PRESENTATIONS OF THE CALF FOR DELIVERY









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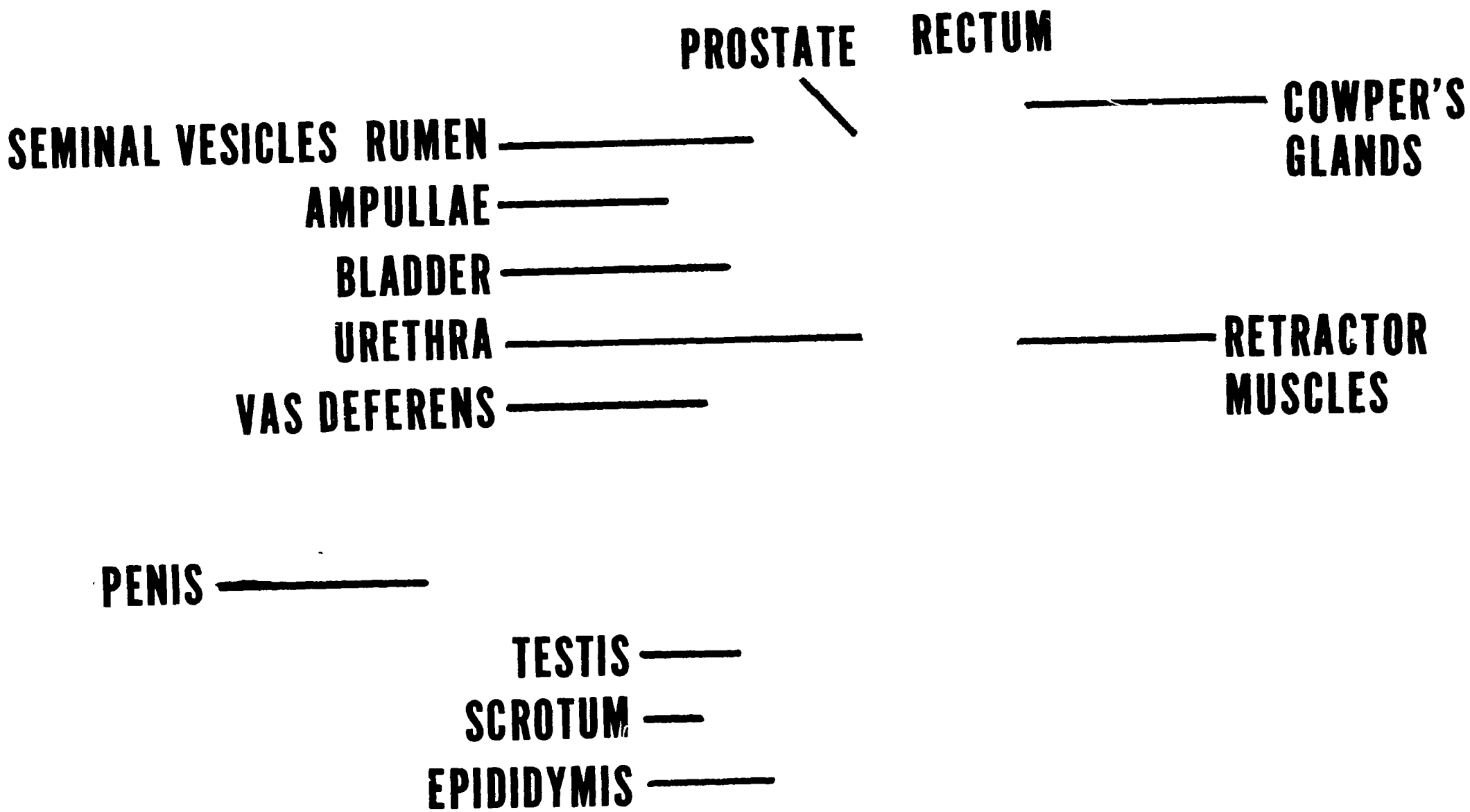
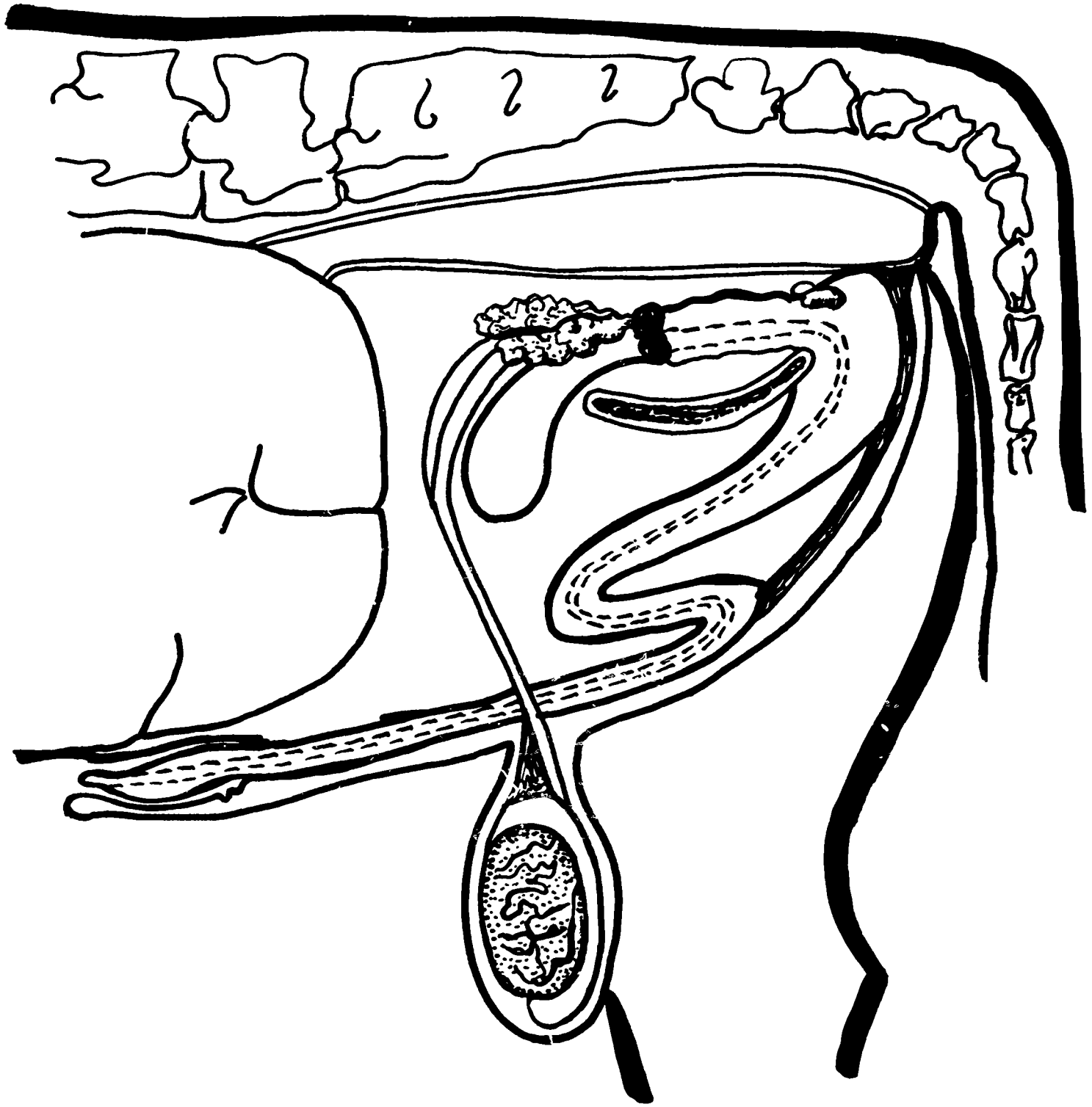
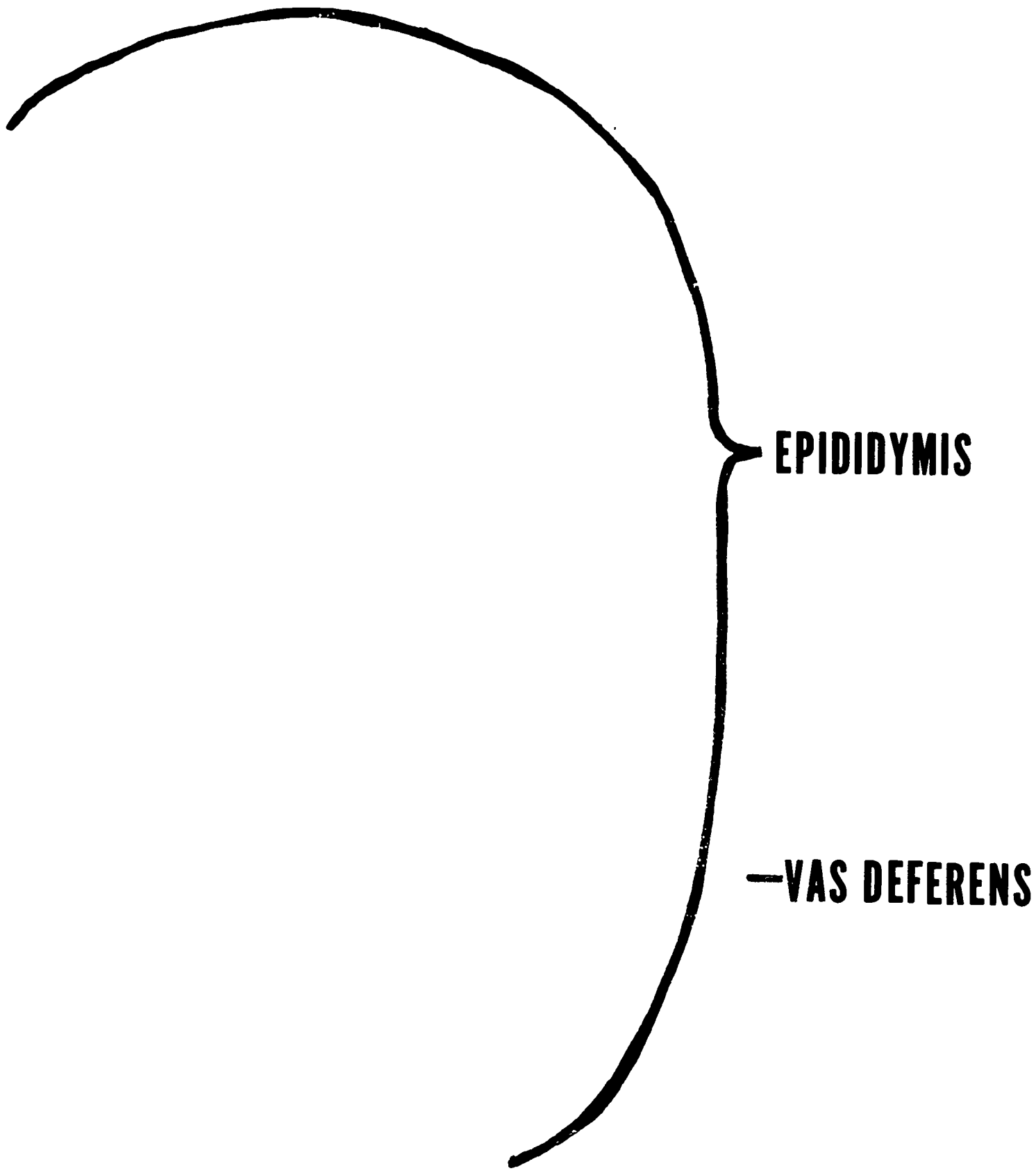
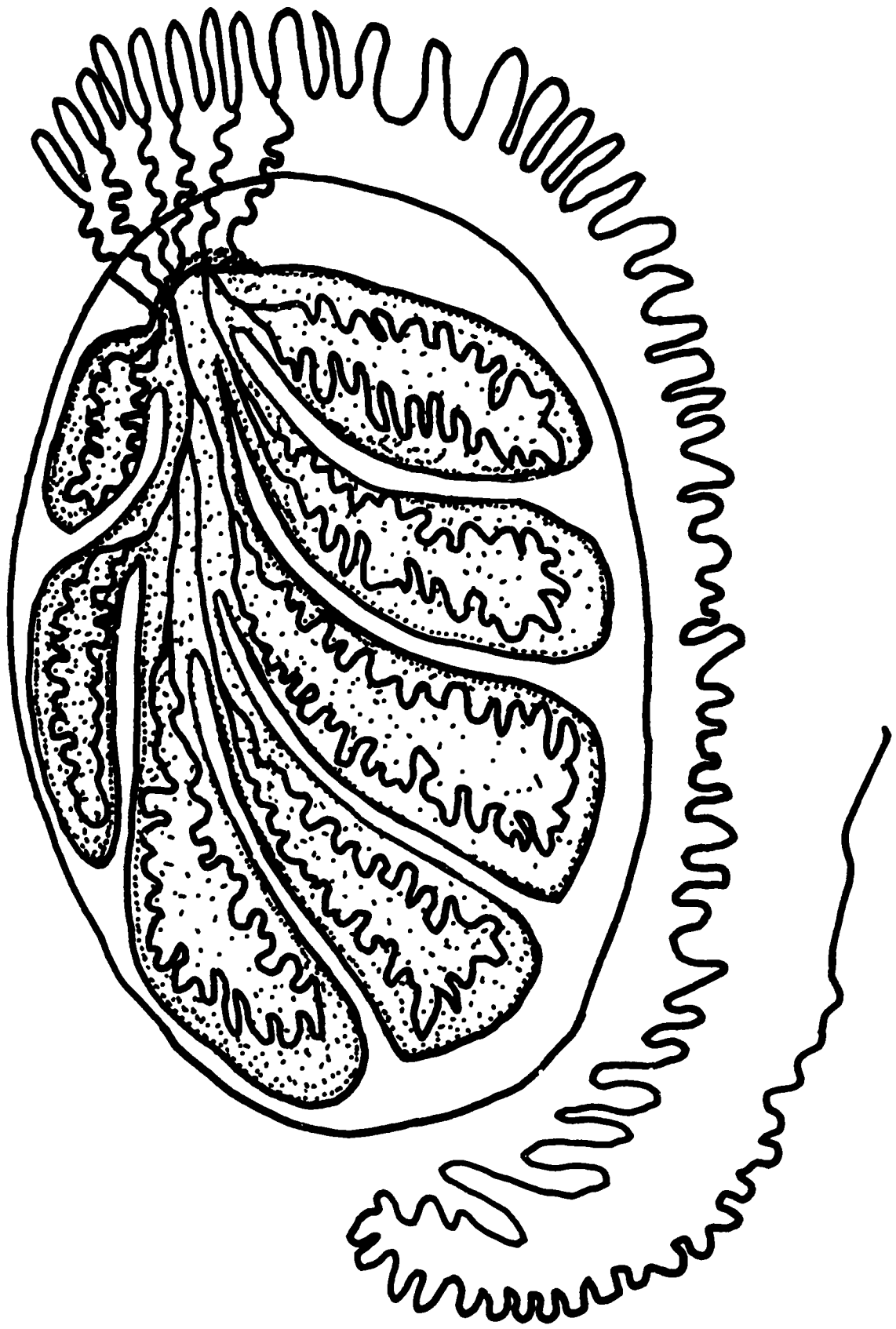


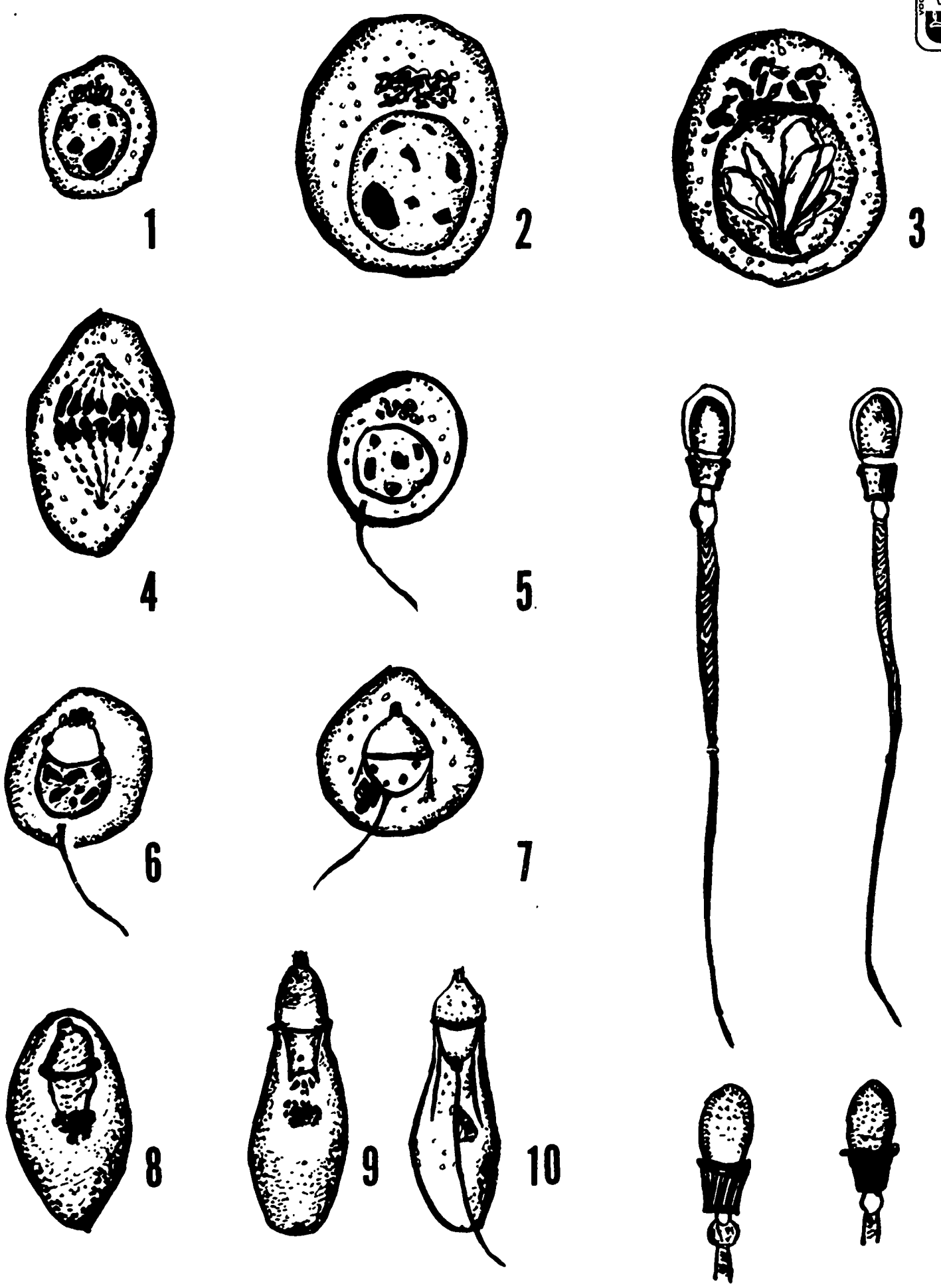
THE REPRODUCTIVE TRACT OF THE BULL



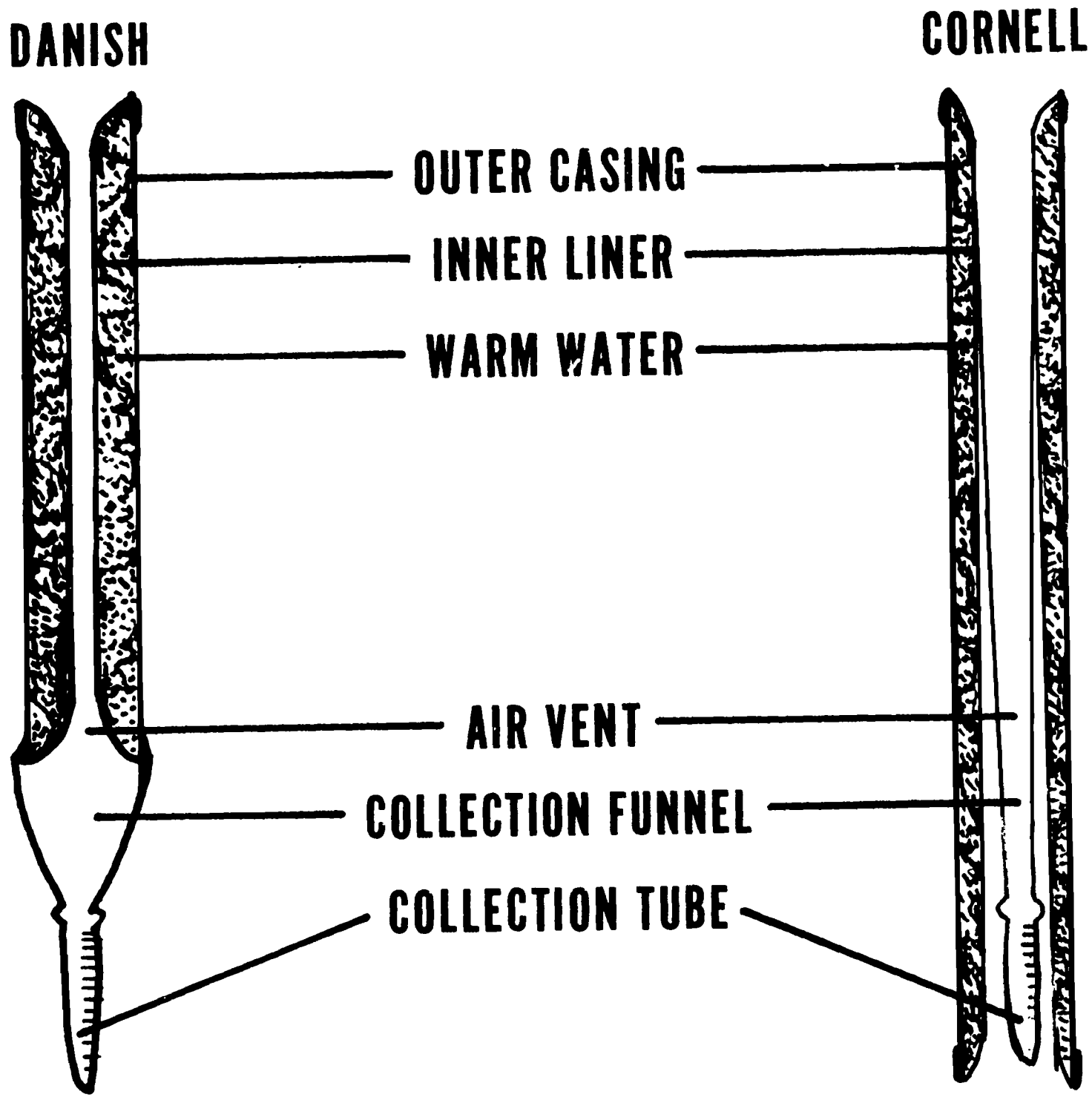


A BULL TESTIS, SHOWING THE EFFERENT PASSAGEWAY FOR SPERMATOZOA

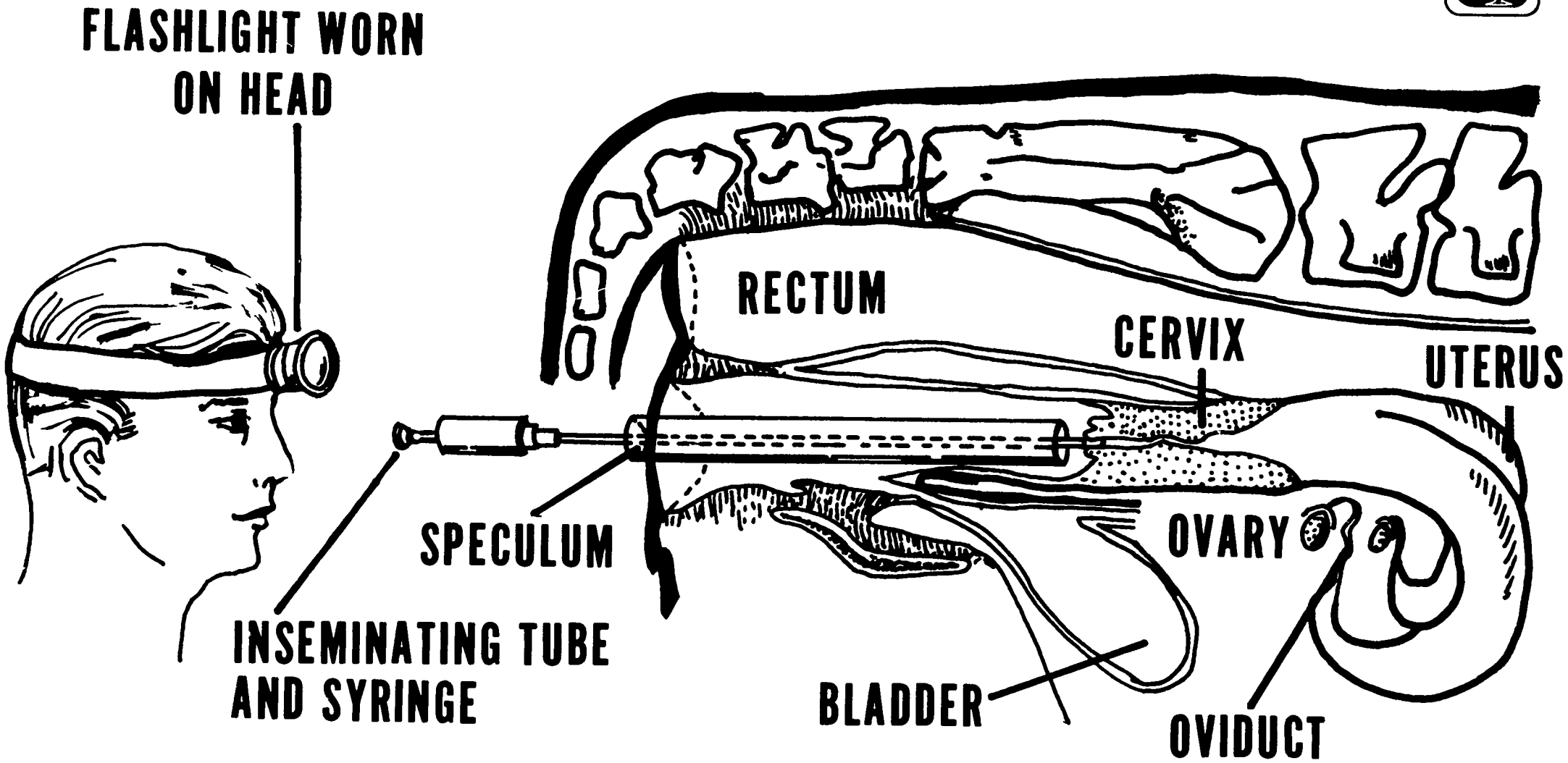




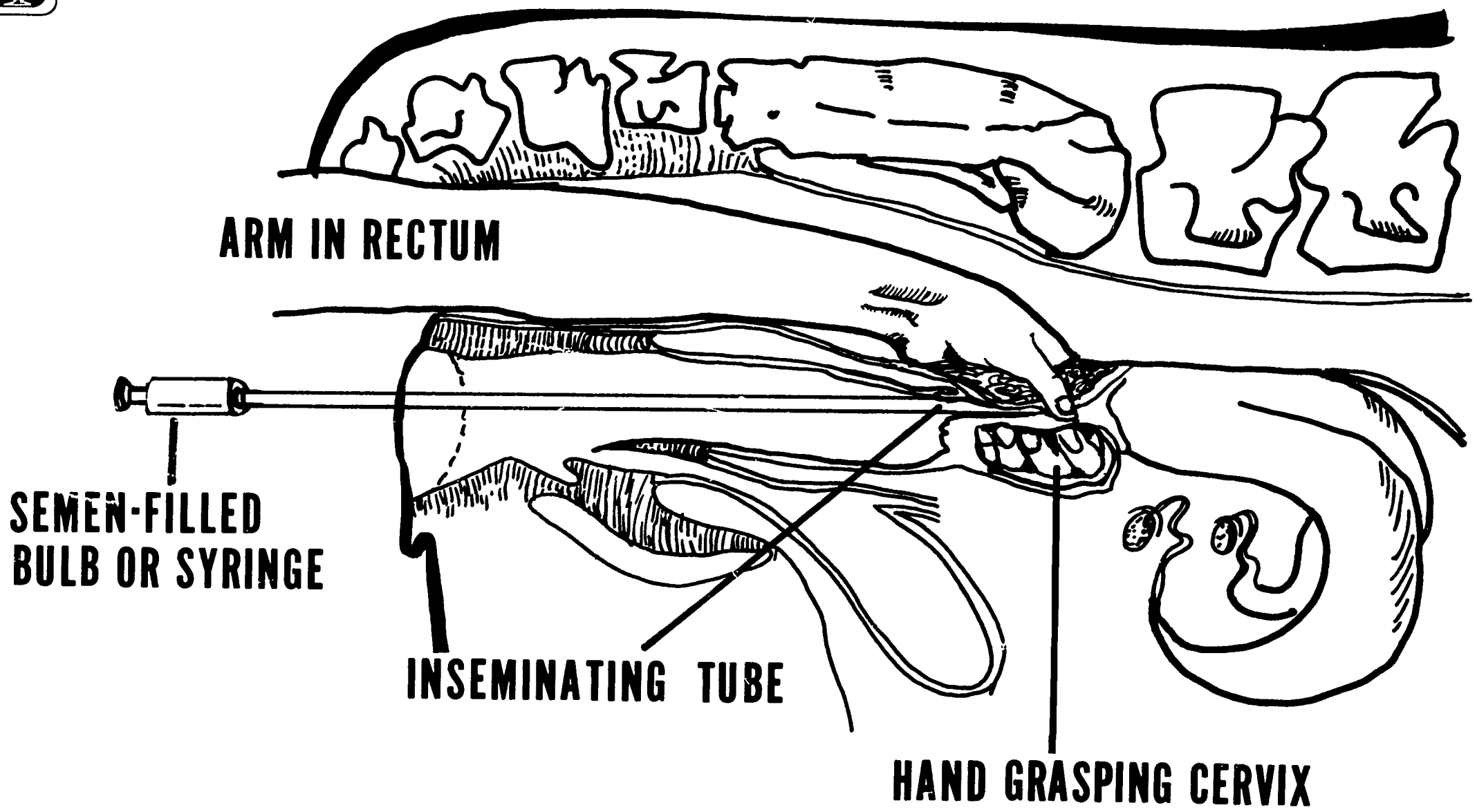
SPERMATOGENESIS



TWO COMMONLY USED MODELS OF ARTIFICIAL VAGINAS FOR BULLS



THE SPECULUM METHOD OF INSEMINATING THE COW



THE RECTOVAGINAL TECHNIQUE OF INSEMINATING THE COW

VT 010 439
Junior High School Curriculum Guide for Industrial Arts.

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IDENTIFIERS - *ALBERTA; CANADA

ABSTRACT - This curriculum guide is for use by industrial arts teachers of junior high school programs. It was developed by a committee of teachers, supervisors, and teacher educators for the Province of Alberta, Canada. Major topics are: (1) contemporary thought in industrial arts education, (2) functions of the junior high school, (3) objectives of the industrial arts programs, (4) definitions of terms, (5) the multiple-activity program and organization, (6) how to use the guide, (7) safety education, (8) general information, and (9) course content outlines for power, materials, electricity, electronics-computer, visual communications, graphic communications, industrial crafts, and development and research. The guide also contains methods of developing concepts, suggestions for the use of teaching aids and additional reference books. This curriculum guide is a revision of VT 007 934 (AIM Fall 1969). (GR)

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A C K N O W L E D G M E N T S

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NOTE

This Curriculum Guide is a service publication only. The official statement concerning the course is contained in the Junior High School Program of Studies. The information contained in the Guide is prescriptive insofar as it duplicates that contained in the Program of Studies. The Guide, however, contains as well as content, methods of developing the concepts, suggestions for the use of teaching aids and additional reference books.

I. INTRODUCTION

Technology is one of the major forces influencing society today. It has revolutionized industry and is now breaking down the walls of the schools through the introduction of television, video tapes and tape recorders. Everyone is affected to some extent by changes in technology.

It is imperative, therefore, that man learn to understand the changes and the forces at work in order that he might be better able to channel them to his advantage. Industrial arts provides ways for the student through its content, organizational pattern and activities to confront some of the technological problems inherent to our productive society.

II CONTEMPORARY THOUGHT IN INDUSTRIAL ARTS EDUCATION

Bonsor and Mossman indicated the purpose of industrial arts when they formulated a definition of this subject area over forty years ago. Their definition has been the most widely quoted one in the history of industrial arts.

> "The industrial arts are those occupations by which changes are made in the forms of materials to increase their values for human usage. As a subject for educative purposes, industrial arts is a study of the changes made by man in the forms of materials to increase their values and of the problems of life related to these changes."[1]

In 1957, Hornbake made the following statement:

> "The acceptance of industrial arts into the family of school disciplines assumes that the world of work, particularly the phenomena of industry, constitutes a legitimate area of study. Can a person who lives in an industrial democracy lay claim to being an educated person if he has not become aware of the basic processes by which society maintains itselt."[2]

Hostetler and Young, Professors of Industrial Ar at North Carolina State College stated:

> "If we over simplify the total task of education and agree that the central purpose of education is to enable the student to solve all of his problems (emotional, social, communicative, vocational, etc.) we would then say that the purpose of industrial

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[1]F. Bonsor and L. Mossman, *Industrial Arts for Elementary Schools* (New York: Macmillan Co., 1924), pp. 3-18.

[2]L. Hornbake, "Philosophical Viewpoints", Americ Council on Industrial Arts Teacher Education, *A Sourc book of Readings on Education*, 6th Yearbook (Bloomin Illinois: McKnight & McKnight Publ. Co., 1957), pp. 15.

arts is to provide experiences which will enable the student to solve the technical problems of living in a highly industrial age. The experiences provided should give the student an opportunity to apply science, mathematics, and other facets of his general education to the solution of practical problems in the industrial arts shop. Industrial arts is the general education aspect of the industrial education complex. It is general education in that it is not specialized. These experiences are not those which prepare for a trade or vocation, but are designed to familiarize the student not only with materials, processes and tools of industry but also with industry as science and invention - as a means of producing goods and services - and as a unique pattern of human relationships. Industrial arts is designed to provide general orientation and basic skills and experiences which may become a basis for making vocational decisions and for further study in the industrial-technical complex."[3]

Feirer, editor of the Industrial Arts and Vocational Education Magazine, made the following statements with regard to the purpose of industrial arts:

"A good industrial arts program affords students an insight into American Industry, the source of raw materials, how basic materials are processed, how products are designed and produced, and how people earn a living."

A summary of the few statements quoted above and of industrial arts literature in general illustrates that there appears to be consensus on the following points:

a) Industrial arts education is a part of general education.

b) Industrial arts education is concerned with interpreting the world of work, with industry a salient component, to all youth.

III. FUNCTIONS OF THE JUNIOR HIGH SCHOOL

The Department of Education in Alberta has stated specific functions for the junior high school which are in addition to the functional objectives of secondary education. It is important, therefore, that teachers of industrial arts interpret the junior high school industrial arts program to the achievement of the functions of the junior high school. For this reason they are included below:

1. To provide a setting in which the adolescent is understood and one in which he might experience success. This contributes to a positive concept of self and others.

2. To continue the development in the basic skills and knowledge begun in the elementary school and to broaden the educational program to include more opportunities for students to think critically and to draw generalizations.

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[3] I. Hostetler and T. B. Young, *A Guide to Curriculum Study - Industrial Arts* (Raleigh, North Carolina: State Board of Education, 1959), p. 3.

3. To provide a breadth of curricular offerings suited to the interests and needs of twelve- to fifteen-year-old youth and to permit, wherever feasible, student selection of educational experiences.

4. To provide for the mental, physical and aesthetic needs of students and to develop talents in these areas.

5. To provide opportunities within the curriculum and extra-curricularly for the development of acceptable social, moral and spiritual values.

6. To help pupils discover special interests and abilities that will enable them to set realistic educational and vocational goals.

7. To prepare the student to live successfully in a changing world.

IV. OBJECTIVES OF THE INDUSTRIAL ARTS PROGRAM

Industrial arts has a unique place to fill in an education program that has as its objective the development of an informed citizenry in a highly industrialized society - a society that must learn to use and control the technologies. Schools must help prepare people to manage an industrial complex unknown before and to work in vocations not yet described. Industrial arts is a subject area the scope of which introduces students, both boys and girls, to all aspects of productive society and has the following objectives:

1. To provide exploratory experiences in various technologies prevalent in a productive society.

2. To provide a synthesizing evnironment for students to apply their academic knowledge in the solution of practical problems.

3. To provide a supplementary guidance function by introducing the students to the multiplicity and interrelationship of educational and occupational opportunities.

4. To provide an environment which stimulates the individuals to discover and develop their interest and talents.

5. To develop attitudes of safety with a respect for safe working habits and practices in the use of tools, equipment and materials.

6. To develop attitudes of personal and social responsibility.

7. To have students develop an organized conceptual frame of reference interrelating the knowledge of the various technologies prevalent in a productive society.

V. DEFINITION OF TERMS

The following is a definition of terms used with the industrial arts program:

1. Multiple-Activity Laboratory - A laboratory where three or more activities are in progress at the same time.

2. Field of Study - Field is the general title given to the basic technologies represented, e.g., materials, electronics.

3. Unit - A unit consists of from nine to twelve weeks of work in a field. There may be several units to complete a field, e.g., woods, metals, plastics, earths in the materials field.

4. Predesigned Products - Students at the junior high school level may not have the background or knowledge of tools and materials to design their own products. The teacher should exercise care in the designing of projects to best meet the objectives of the course.

5. Instruction Sheets - These are supplemental teaching materials which contain organized material for the use of individual students. There are four common types:

   a) Operation Sheet - gives directions on how to perform a single manipulative task. This would include the directions on how to operate a machine.

   b) Job Sheet - gives directions on how to do, completely and in proper sequence, a number of operations. The procedure for making a product or doing an experiment would consitiute a job sheet.

   c) Information Sheet - contains everything necessary for the understanding of an instructional unit which is largely informational in nature.

   d) Assignment Sheet - directs the study to be done by the student on a lesson topic, and may include questions to determine how well a lesson has been learned.

6. Student Manual - The manual outlines in detail specific activities and assignments students are to do. This is a "guide" for the student to follow. It includes instructions to read specified pages in reference books, to view a filmstrip, to work out given problems and/or to outline the procedure for an activity.

7. Sequential Pictorial Instruction Books - S.P.I. books provide a sequence of pictures that illustrate the sequential procedures to be followed in performing a specific operation or process.

VI. THE MULTIPLE-ACTIVITY PROGRAM

The multiple-activity program is an organizational device by means of which a variety of exploratory experiences can be presented with a minimum of room and equipment. The laboratory is organized into a number of different sections representing the fields of study. Each section or bay is large enough to accommodate 4 to 6 students. These bays are as self-contained as possible with provisions made for the storage of tools, products and stock within them. The class is divided into three or more groups with each group working through the course unit in the assigned bay. After the completion of the unit in from nine to twelve weeks the groups rotate, each proceeding to another bay and new experiences.

As the units consist of from nine to twelve weeks of work, depending on the number of areas in operation, there will be several weeks unaccounted for. This time, two to four weeks, could be used at the beginning of the year to organize the activities of the groups, plan the first product for an area, teach the beginning

lessons of each unit, give demonstrations, and provide the information required to get each group started efficiently in their assigned unit.

Poor management and lack of planning are bound to result in confusion. Therefore, the teacher must have a well-devised plan before attempting to operate a multiple-activity laboratory.

1. Fields of Study

To provide for a breadth of exploratory experiences the junior high school industrial arts program is divided into six fields of study. These fields are further subdivided into thirteen units. Each unit represents nine to twelve weeks of study. The minimum number of units studied in one year is three. During the junior high school years it is recommended that a student study a minimum of three different units each year. In junior high schools where industrial arts is taught only two years, it is recommended that four different units per year should be studied.

Fields of Study	Units
a) Power	one
b) Materials	
(1) Woods	one
(2) Metals	one
(3) Plastics	one
(4) Earths	one
c) Electronics	
(1) Electricity	one
(2) Electronics-Computer	one
d) Graphics	
(1) Visual Communications	one
(2) Graphic Communications	one
e) Industrial Crafts (choose one only in Junior High)	
(1) Leather	one
(2) Lapidary	one
(3) Art Metal	one
f) Developmental Research (see page 97)	one

In addition to the six fields outlined, the junior high school industrial arts program includes a testing area and an instructional materials center. The testing area utilizes the materials and some of the products made in the other areas. The instructional materials center is used as a students' resource room, conference room and research area. The Developmental Research Unit is to be used for teacher research into new content only. The teacher must define the content of this unit and obtain the approval of the Provincial Supervisor of Industrial Arts and his principal before introducing it to the students.

2. Length of Program

The recommended time is from 4800 - 7000 minutes per year or 120-175 minutes per week in two blocks of time.

3. Organization of Industrial Arts Laboratories

The industrial arts area is designed as a multiple-activity laboratory. Each school should have all the fields of instruction represented, either in one or more facilities.

Each of the work stations should be self-contained with regard to tools, machines and materials. Enough floor area should be provided to accommodate from four to six students per station.

As the laboratory work proceeds, small groups of four to six students would be found pursuing activities at three or four of the stations. Following the completion of the outlined learning experiences in a unit, the group proceeds to the next station and engages in study and activities related to it.

This system of rotation insures each student an introduction to all the components of the program.

A multiple-activity laboratory affords each student the opportunity to observe the interdependence of technologies and to visualize the basic tools, machines, and processes in each of the technologies.

4. Approach

The use of the product in industrial arts has merit. It is to be considered a vehicle for learning. When the product becomes the focal point and ceases to be a media for this learning experience it should be reevaluated. Carefully selected products are recommended for some of the units included in this program. The woods, metals and plastics units lend themselves well to the product method. The products, however, should be predesigned and permit a measure of successful achievement for all levels of learning. Units such as electricity, electronics, computer technology, and power mechanics, lend themselves well to an experimental approach. Predesigned and programmed laboratory exercises will assist in the degree of student understandings. The teacher should have available instructional materials of all types such as workbooks, S.P.I.'s, films, slides, and manuals. These would help him and the students organize their time efficiently. Test-stand experiments will assist both in the understanding of these areas and in developing an appreciation for the scientific method.

5. Suggested Organization of Teaching Units

a) Three-Year Program

Grade VI	Grade VIII	Grade IX
Electricity	Visual Comm.	Electronics - Computer
Plastics	Woods	Power
Earths	Metals	Graphic Comm.

b) Two-Year Program

First Year	Second Year
Woods	Electricity-Electronics-Computer
Metals	Visual Comm.
Plastics	Graphic Comm.
Earths	

(A Developmental Research and/or craft unit may be used as a "floater" for enrichment.)

6. Scope of Program

The scope of the industrial arts program includes all the major technologies and all students, both boys

and girls should have the opportunity to explore the fields.

VII. HOW TO USE THE GUIDE

This guide is written so that teachers can more specifically relate the content to be taught to the major concepts of industrial arts. Each topic is followed by a concept that the students should understand at the completion of their activities.

The concept is further subdivided into statements which help define the content, the processes and/or the activities in which the students will engage.

Useful instructional media suggestions are listed in the last column.

The procedure for teaching the units may vary with the teacher. However, the following guidelines will be useful to ascertain adequate coverage of the topics.

1. The unit is divided into a number of topics. The amount of time spent on each will vary with the content to be studied. The order in which the topics are covered may also vary.

2. Each topic is circumscribed by one or two concepts. The material to be studied is selected on the basis that it will help the student understand the concept.

3. Conceptual statements are used to define specific points related to the concept. These statements are inserted in the column that lists the systems or processes.

4. The activities are suggestive and provide direction as to types of things in which students may engage. The following are categories of activities students should experience:

Adjusting	Describing	Operating
Analyzing	Designing	Organizing
Computing	Developing	Planning
Constructing	Displaying	Processing
Controlling	Examining	Reading
Cooperating	Installing	Researching
Creating	Interpreting	Scheduling
Defining	Inventing	Studying
Demonstrating	Judging	Testing
Depicting	Observing	

5. The guide will provide a logical sequence of progression in the development of the concepts listed. The teacher will need instructional materials for student use. These include:

   a) Manuals - outlining assignments of experiments, reading, products
   b) Tapes - describing use of specific instruments, experiments or procedures
   c) Loop films
   d) Slides
   e) Filmstrips
   f) Charts
   g) Models
   h) Films
   i) Programmed instructions.

6. The testing and guidance topics or portions thereof should be developed under the topics in which the subjects may be appropriately handled.

7. Information topics could be covered by

-Reading
-Researching
-Films
-Tapes
-Seminars
-Discussions
-Resource people
-Tours
-Assignments
-Writing for information

- A plan for the year should be prepared. In it the units to be taught each grade should be listed and a time schedule developed.

- The teacher should have a master plan book that outlines his program for each unit. It should include:

a) An outline of how each topic is to be presented

-demonstrations
-student assignments •reading
•experiments
•products
•films to view
•tapes to hear

-evaluation procedures
-criteria for marking practical work such as products and experiments
-tests and quizzes given.

b) All the instruction materials given to students should be in the master book.

10. A student personnel system under the direction of the teacher should be planned to allow students to make decisions and assume responsibility.

11. A daily plan is necessary. It outlines specifically the materials to be taught to each class in advance of the lesson period. Follow-up of the period should also be noted.

VIII. THE SAFETY PROGRAM

Every industrial arts laboratory must have an effective safety program. This does not mean that the promulgation of a set of rules and regulations will satisfy this end. Students must be taught in each and every subject studied within the industrial arts framework, the "hows and whys" inherent in the safety program. It is the responsibility of the teacher to supply continuous and vigilant supervision and to ensure that all students engage in only safe laboratory practices. A good safety program would include:

1. Machine guards and operating procedures approved or recommended by the Workmen's Compensation Board.

2. Regular and thorough instruction and revision.

3. Constant vigilance.

4. Checking and evaluating of student safety habits by the teacher.

5. Complete first aid equipment kept in first-class condition.

6. Non-skid material and clearly marked working areas around all machinery.

7. Proper clothing with particular attention to eye protection.

8. Machines and tools in good working condition.

9. Routine reporting and recording of all accidents.

10. Good housekeeping.

The following are samples of safety regulations which the teacher might be expected to enforce:

1. No power machines shall be used by any student before specific instruction has been given with regard to safe operation and safety precautions.

2. No power machine shall be used while the instructor is absent from the laboratory.

3. A student shall not use a machine unless it is equipped with approved guards.

4. Approved eye protection must be worn for certain operations.

NOTE: A good safety slogan which should be put into practice at all times - a place for everything and everything in its place.

There are six basic steps in safety education:

1. Be familiar with Workmen's Compensation Regulations.

2. Set a good safety example for students.

3. Instruct each student thoroughly in the safety precautions of his job.

4. Keep all tools sharp and in good condition.

5. Keep all safety devices in proper use.

6. Follow up safety instructions constantly. The laboratory will be as safe as the teacher makes it.

Dress and deportment play an important part in the operation of a safe program. Students and teacher should be neatly dressed at all times and the teacher should take care to ensure that no loose and dangerous clothing is worn. Safety aprons, goggles, gloves and face shields should be used wherever necessary.

Each school should receive the excellent publications and bulletins dealing with accident prevention and safety procedures distributed by the Workmen's Compensation Board, Edmonton, Alberta.

NOTE: Accidents must be promptly reported to some senior school authority. If no other person is designated, this authority is the Principal.

IX. GENERAL INFORMATION

1. Records

Every teacher should keep the following records.

a) Attendance

b) Daily plan (activities, demonstrations, follow-up.

c) Phase plan for the year

d) Record of student achievement (test marks, product rating, etc.)

e) Inventory of equipment and supplies

f) Student personnel system

g) Any other records that are deemed desirable

2. Student Evaluation

As the industrial arts courses are exploratory it is not logical to have students repeat units. A profile chart should be part of the student's report to show his standing in the various units he has studied.

3. Size of Classes

Courses and accommodation are prepared on the basis of a maximum class size of sixteen to twenty pupils per teacher.

4. Laboratory Accommodation and Equipment

An Industrial Arts Laboratory Planning Manual is available from the Department of Education, Stationery and Supplies Branch, Room 712, Administration Building, Edmonton. (Price: $1.00)

An Industrial Arts Equipment List is available from the Supervisor of Industrial Arts, Dept. of Education, Room 808, Adminstration Building, Edmonton. (No Charge)

5. School Opening

Several days to a week should be spent at the school preparing the program prior to opening day. The following points should be checked:

a) Examine the inventory - all tools should be repaired, sharpened, and properly stored.

b) Go over materials on hand - there should be material on hand to provide for the first rotation.

c) Plan your year's program - prepare a broad outline of the year's work in each grade. Have dates set for the time of rotation, when the groups change their activities.

d) Have the lessons in each area outlined with information, job sheets, etc., available to get started.

e) Have the products selected for each area in which they are required.

f) Have a record system prepared.

g) Survey product storage space and have lockers assigned by classes. Specific lockers can be given to students later.

h) Have a general information sheet prepared for each student, outlining general laboratory procedures and rules, fees required, evaluation criteria, and other information you find pertinent.

i) If your system has a book rental scheme, make arrangements to have the initial laboratory fee collected by the book rental secretary.

j) Have the laboratory thoroughly cleaned, painting done where needed, and laboratory coats and aprons clean.

k) Examine fire prevention equipment to see that it is functional.

l) Develop a complete and comprehensive safety program (charts, regulations, safety zones, etc.)

6. Laboratory Closing

At the end of the school year the teacher must ensure that:

a) The inventory is checked and reported to the Principal or Secretary-Treasurer.

b) The students' accounts are audited by a responsible authority, usually the Principal.

c) The tools are sharpened and needed repairs are ordered.

d) The tools are either oiled or waxed and put in a secure location.

e) The laboratory is thoroughly cleaned and left in creditable condition.

f) The materials that will be needed in the first quarter of the next term are ordered.

g) An inventory of instructional materials is taken and sufficient preparation is made to get started in the fall.

h) Rag bins and paint room supplies are checked. (Discard all soiled rags.)

i) Batteries are removed from electronic equipment, meters, etc.

j) Student lockers are cleaned out.

7. Provision for Custodial Services

Daily complete caretaking services are required to keep an industrial arts laboratory functional and allow maximum time for instructional purposes.

FORMAT EXPLANATION

Topic -Major topic to be developed
Concept -Major concept to be developed

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
Major Systems and Processes to be studied. -Sub-systems and processes to be studied. -Sub-concepts The systems or processes as outlined are to be considered required content.	This area should be completed by the teacher as guidance in laying out the unit of instruction.	Suggestions of what the student can do to develop an understanding of the topic, concept, system or process, sub-system or process, and sub-concepts. This area should be continually updated and added to by the teacher as better ways for teaching the systems and processes become apparent.	Suggestions of media to be used to assist the student in developing an understanding of topic, concept, system or process, sub-system or process, and sub-concepts. This area should be continually added to and updated by the teacher. Code for Media: ▶< Films B Filmstrips [] Transparencies or Slides o—o Tapes ▶<ˢ Film Loop

P O W E R

INTRODUCTION

This course is an introduction to the study of the sources, transmission, operation, control, and application of power. A concept of work, energy, and power should emerge through the reading and activities in which the student will engage as he progresses through the area.

Testing and analysis make up the core of the program. Facilities and equipment must be provided so that the program can achieve the expected results.

SPECIFIC OBJECTIVES

1. To help the student understand the many basic concepts and principles of science at work in power and relate these concepts to the vast area of power technology.

2. To gain knowledge of the utilization, transmission, and control of power.

3. To familiarize the student with the basic construction, operation, application, care, and control of machines that convert power to useful work.

4. To develop problem-solving techniques related to machines and their operation, control, analysis, and application.

5. To learn safe practices in the power area.

SUGGESTED APPROACH

The general approach in the course is that a student studies the total system, e.g., two- and four-stroke cycle gasoline engines, simple mechanical transmission systems, and simple hydraulic and/or pneumatic systems. The emphasis in the junior high school program should be at the systems level, with the units and components introduced on where and when necessary for clarification purposes.

The study should revolve around three basic topics:

a) Principles of operation
b) Control and analysis
c) Application.

When a, b, and c are applied to study of a total system, an organized and systematic program can be present

The power area should focus on the application of scientific concepts in technology. Parallels of the utilization of scientific concepts should be drawn between their use in power technology and other technologies whenever possible. Terms and practices used should be explain scientifically and also as they apply to other technologie

COURSE CONTENT

.c A. -Power Sources
:ept: -The conversion and application of energy is basic to a productive society.

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
Direct Mechanical Converters -Muscular, water, wind		It is suggested that all the systems under Topic A be studied on a comparative basis under the headings: a) Principles of Operation b) Control and Analysis c) Application d) Safety	
External Combustion Converters			
-Steam Engine			Model of a steam engine
-Steam Turbines			Job sheet on constructing a steam turbine
-Fossil Fuel Generators			
-Atomic Fuel Steam Generators			Atomic Energy of Canada Limited, Pinawa, Manitoba
Internal Combustion Converters (Heat Engines) -Piston or Reciprocating			Films: ▸< *Introduction to the Heat Engine*, (Shell Oil) ▸< *ABC of the Automobile Engine* ▸< *ABC of Internal Combustion* ▸< *ABC of the Diesel* (General Motors Corporation) ▸< *Diesel Story* ▸< *The Engine* ▸< *The Two-Stroke Cycle Engine* (Shell Oil)

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
			Models: -Two-stroke cycle Internal Combustion Gasoline Engi -Four-stroke cycle Internal Combustion Gasoline Eng. -Four-stroke cycle Internal Combustion Diesel Engin
-Rotary Combustion			Models: Wankel Rotary Combustion Engine
-Turbine			Model of turbine. Films: ▶< *The Gas Turbine*, (Sh ▶< *Gas Turbine*, (Gen. Motors Co
-Airstream Reaction			Model of jet. Film: ▶< *Introduction of Jet Engin* (National Film Board)
-Rocket			Estes Industries Inc., Box 227, Penrose, Colo. 81 Rocket Models from: Edmund's Scientific, Barringto N. J. 08007 Other Media: Jim Handy Filmstrips & Transparencies from: McGraw-Hill Co. of Can. by Sheppard and from Delmar Publishers - Dickson
4. <u>Electrical Converters</u> -Conventional, e.g., AC generators, DC generators, motors, transformers -Exotic, e.g., direct converters, fuel cells, magnetohydrodynamic generators, photovoltaic converters, therionic converters, thermoelectric generators, AC from DC direct converters		-Review or introduce (Electricity Section). -Understand the tie-in with the other power sources. -Review or introduce (Electricity Section). -Understand the tie-in with other power sources.	

Topic B. -Power Systems
Concept: -How energy is applied in various power systems.

Systems or Processes	Time	Student Experiences and Activities			Instructional Media
		Operation	Control and Analysis	Application	
1. Two-Stroke Cycle Internal Combustion Engine		-Study a cutaway model, noting design, and major systems.		-Investigate design and application.	-Two-stroke cycle internal combustion model.
		-Locate and analyze the operation of the major systems.	-Analyze the controls built into each system.	-Examine the interrelationship of the systems.	-Charts of major systems - fuel, cooling, lubricating, ignition.
		-Read the operating instructions on the assigned engine. Note maintenance; how to start, how to stop.	-Read the instructions on the assigned engine, noting how to control the engine and how the controls operate.	-Discuss the necessity of proper preventive maintenance of power equipment.	-Operating instruction booklet on the assigned engines.
		-Start the assigned engine	-Adjust the controls such as the throttle and air-fuel needle, and see how they affect engine operation		-Operating instruction manual

Systems or Processes	Time	Student Experiences and Activities			Instructional Media
		Operation	Control and Analysis	Application	
Two-Stroke Cycle Internal Combustion Engine (Cont'd.)			-Using a small engine test stand, perform tests such as: •effect of air-fuel ratio on power •effect of plug selection •effect or plug gap •effect of humidity, pressure and temperature •effects of various types of fuels •effects of oil-fuel ratio •torque •R.P.M. under various conditions	-Discuss necessity of proper adjustments in order to obtain best resulty from your car •plug selection depends on use of the engine.	-Test unit instructional manual
			-Develop concept of work, energy and power		
		-Stop the assigned engine.			

Systems or Processes	Time	Student Experiences and Activities			Instructional Media
		Operation	Control and Analysis	Application	
Two-Stroke Cycle Internal Combustion Engine (Cont'd.)		-Proper storage procedures		-Importance of following specific procedures when storing lawn mower, etc., for a long time.	
		-Know safety precautions, e.g., fuel and fuel storage •backfire •order of starting •order of stopping •heat areas •moving parts •carbon monoxide.		-Discuss proper storage of fuel at home •importance of fueling and/or running an engine in a well-ventilated area -Importance of guards.	
Four-Stroke Cycle Internal Combustion Engine		-Study a cutaway model, noting design and major systems.		-Investigate design and application.	-Four-stroke cycle internal combustion model.
		-Locate and analyze operation of the major systems.	-Analyze the controls built into each system.	-Examine the interrelationship of the systems.	-Charts or major systems fuel, cooling, lubricating, ingition

Systems or Processes	Time	Student Experiences and Activities			Instructional Media
		Operation	Control and Analysis	Application	
Four-Stroke Cycle Internal Combustion Engine (Cont'd.)		-Read the operating instructions on the assigned engine, noting maintenance; how to start, how to stop.	-Read the instructions on the assigned engine, noting how to control the engine and how the controls operate.	-Discuss the necessity of proper preventive maintenance of power equipment.	-Operating instructior booklet on the assigned engines
		-Start the assigned engine.	-Adjust the controls, such as the throttle and air-fuel needle, and see how they affect engine operation.		-Operating instructior manual
			-Using a small engine test stand, perform tests such as: •effect of air-fuel ratio on power •effect of plug selection •effect of plug gaps •effect of humidity, pressure and tempera-ture •effects of various typ types of fuels •effect of oil-fuel ratio •torque •R.P.M. under various conditions	-Discuss necessity of proper adjustments in order to obtain best results from your car. •plug selection depends on use of the engine	-Test unit instruction al manual

Systems or Processes	Time	Student Experiences and Activities			Instructional Media
		Operation	Control and Analysis	Application	
Four-Stroke Cycle Internal Combustion Engine (Cont'd.)			-Develop concept of work, energy and power.		
		-Stop the assigned engine.			
		-Proper storage procedures		-Importance of following specific procedures when storing lawn mower, etc., for a long time.	
		-Know safety precautions e.g., fuel and fuel storage backfire order of starting order of stopping heat areas moving parts carbon monoxide		-Discuss proper storage of fuel at home -Importance of fueling and/or running an engine in a well-ventilated area. -Importance of guards.	
3. <u>Comparative test Two-Stroke Cycle and Four-Stroke Cycle Engines</u>			-Do comparative tests using two- and four-stroke cycle internal combustion engines. Graph results of H.P., R.P.M., etc.	-Know where engines are used and the reasons.	-Test unit instructional manual.

Systems or Processes	Time	Student Experiences and Activities			Instructional Media
		Operation	Control and Analysis	Application	
4. Electric Motors (Optional)		-Analyze the operation of an electric motor.	-Do comparative tests using the two- and/or four-stroke cycle internal combustion engine and an AC electric motor.	-Know application of engines and motors.	-Test stand operatic instructional booklet.

Topic C. -Transmission
Concept: -Energy output can not be greater than energy input.

1. Mechanical Systems		-Use Mock-ups or cutaways to study methods of transmission, e.g., gears, belts and pulleys, chains and sprockets, shafts, fluid coupling, air-stream reaction.		-Study a car •gearbox •differential •steering mechanism -Investigate other mechanical systems found in the laboratory.	-Films: Jam Handy
		-Trace power through various mechanical systems.	-Analyze and graph where possible •mechanical advantage •efficiency.		
			-Understand directional changes and control.		

Systems or Processes	Time	Student Experiences and Activities			Instructional Media
		Operation	Control and Analysis	Application	
Mechanical Systems (Cont'd.)			-Compare ratio of input to output of several mechanical systems, e.g., gearbox train.	-Operate lathe gear system and compare ratio of input to output.	
			-Compare mechanical transmission with other types of transmissions.	-Develop concepts of leverage, piston action, etc.	
• <u>Pneumatic</u>		-Investigate a closed pneumatic system to ascertain how it operates.	-Understand principles of pneumatic circuits •concept of pressure and vacuum •problems in area •flow	-Analyze the vacuum, e.g., distributor model from a car or vacuum windshield wiper motor.	-Instructional manual
				-Apply concept to the vacuum-forming press	
And/Or		-Set up several circuits.		-Design and create a simple circuit using a lab machine, e.g., drill press.	

Systems or Processes	Time	Student Experiences and Activities			Instructional Media
		Operation	Control and Analysis	Application	
Pneumatic (Cont'd.)			-Compare with other types of transmissions.	-Uses of pneumatics in a productive society, e.g., climate control.	
3. <u>Hydraulics</u>		-Inspect a closed hydraulic system to ascertain how it operates.	-Understand principles of hydraulic circuits •concept of pressure •problems in area •flow.		-Instructional manual
		-Set up several circuits.		-Design and create a simple circuit for a lab machine, e.g., shear, press	
			-Compare with other types of transmissions.	-Uses of hydraulics in a productive society.	
4. <u>Fluidics Systems</u>		-Treat as an information topic until such time as equipment becomes available. -Relate to the electricity-electronics-computer units.			

Systems or Processes	Time	Student Experiences and Activities			Instructional Media
		Operation	Control and Analysis	Application	
5. Electrical Transmission Systems		-Treat as an information topic until such time as equipment becomes available. -Relate to the electricity unit.			

Topic D -Educational and Occupational Projections
Concept: -A productive society must prepare its youth to make realistic vocational choices.

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
1. Guidance			
-There are many job opportunities for highly-skilled persons.		-Investigate job opportunities in power-oriented fields. -Visit Vocational Education or technical Institute laboratories in your area.	-Pamphlets: Check with the Counselling and Guidance Office.
-Our society depends on highly-skilled labor and division of labor.		-See a film on occupations in power.	

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
Guidance (Cont'd.) -Technologists require training beyond the high school level. -The organization and management of business enterprises is an important element in a productive society.		-Tape an interview with a mechanic and play the tape back to the class. -Prepare a job qualification list for three different occupations related to power.	

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Shalka, Martin B., *Power Mechanics Students Workbook*, Commercial Printers, 1966.

Stephenson, George E., *Power Mechanics*, Delmar Publishers (Canada) Ltd., 1963. (With Instructor's Guide)

Worthington, Robert M., M. Margules, and Wm. H. Crouse, *General Power Mechanics*, McGraw-Hill, 1968.

M A T E R I A L S

INTRODUCTION

Woods, metals, plastics and earths are all extremely important materials. The student should be made aware of these by being involved in materials testing, and fabrication. This field should bring the student into contact with the more common materials, tools, equipment and processes as used by industry. Through this exposure it is hoped that the student will better understand the world in which he finds himself. A study of occupations related to the materials units will reveal the wide scope of this industrial field. There are careers in this field which have not yet been defined but which are certain to evolve in the very near future.

SPECIFIC OBJECTIVES

1. To provide the student with an opportunity to discover special aptitudes in the kinesthetic area.

2. To provide the student with an opportunity to learn to use tools safely and correctly.

3. To give the student an insight into the occupational opportunities related to materials.

4. To instill in the student an appreciation of high standards and pride in workmanship.

5. To familiarize the student with some of the fundamental material processes.

SUGGESTED APPROACH

Due to the complexity and variety of the materials field a student can not have experiences in all of the basic processes and operations involved. Therefore, much of the emphasis in materials must be on testing and on developing an understanding of the major concepts that are prevalent in industry.

While the product is still an important vehicle for student motivation and process development, more emphasis should be placed on testing and evaluating materials for th purposes to which they can be adapted.

The pattern of course development should be such that the student develops a comprehension of the concepts of materials and their place in our industrial society. How far one can develop these ideas depends upon the materials, tools, equipment, laboratory space available and the imagination and initiative of the teacher.

SAFETY

The laboratory organized for multiple activity must ha an effective safety program. Machines must have adequate guards; students must be properly clothed for their work anc thorough instruction in the use of ALL hand and power tools is of utmost importance. No machine should be student operated until complete instructions and demonstrations have been presented by the teacher.

COURSE CONTENT

Topic A. -The Material and Testing
Concept: -The development, testing and effective utilization of a nation'a natural and synthetic resources is necessary for a productive society.

Systems or Processes	Time	Student Experiences and Activities in *WOODS*	Instructional Media	Student Experiences and Activities in *METALS*
1. <u>Development of natural and man-made materials</u>.				
-Raw materials are refined, processed and restructured to make new substances useful to man.		-Interpret tree growth charts.	-Fyfe Smith Charts	-Know the main raw materials used in the metals industry.
-Man depends on many materials to meet the needs of a productive society.		-Investigate developments of restructured products, e.g., plywood manufacturing, process and advantages. Particle board-types, processes, uses.		-Understand reasons and desirability of alloying.
-Product research and development is important in a productive society.		-Know the chemical derivatives of wood.	-Fyfe Smith Charts	-Describe significant developments in the industry.
		-Know the significance of the pulp and paper industry.		
		-Procure information on substitutes for paper and their significance.		
2. <u>Sources</u>				
-Everyone should help to conserve out natural resources for future generations.		-Discuss: -conservation -cause of forest fires -reforestation -tree nurseries -legislation		-Discuss conservation

Instructional Media	Student Experiences and Activities in *PLASTICS*	Instructional Media	Student Experiences and Activities in *EARTHS*	Instructional Media
-Examples of raw materials	-Know the raw materials and understand basic principles in the production of some plastics such as polystyrene, vinyls and polyethelene. -Make some acrylic plastic. -Know and relate the plastic families. -Study significant developments in the industry.	-Film: *Perspect for Plastics* (Shell Oil) -Booklet: *ABC's of Modern Plastics* -Film: *Plastics* (Imperial Oil)	-Know about the materials used in the earths industries, e.g., cement and concrete, gypsom, clays, glass, glazes, porcelain enamels, abrasives -Study: structural clay products whiteware insulating materials	
	-Discuss conservation		-Discuss conservation	

Systems or Processes	Time	Student Experiences and Activities in *WOODS*	Instructional Media	Student Experiences and Activities in *METALS*
Sources (Cont'd.) -Availability of raw materials affects technological development. -Sources of raw materials are widely scattered.		-Using a prepared map of Canada that outlines the raw material areas and the related manufacturing areas: a) note the location of raw materials and related manufacturing areas b) interpret the significance of: 1) their relative position to each other 2) transportation and raw materials 3) manufacturing and population 4) manufacturing and transportation 5) available occupations		-Using a prepared map of Canada that outlines the raw material areas and the related manufacturing areas: a) note the location of raw materials and related manufacturing areas b) interpret the significance of: 1) their relative position to each other 2) transportation and raw materials 3) manufacturing and population 4) manufacturing and transportation 5) available occupations
• <u>Identification</u> -All materials can be classified under natural fibres, natural ores or synthetics.		-View cell structure of hardwoods and softwoods under a microscope. (Relate to hardness and weight.) -Note characteristics such as color, odor, texture	-Wall Charts and Samples	-View the crystal structure of metals. (Relate to hardness and weight.) -Classify metals as to ferrous and nonferrous.

Instructional Media	Student Experiences and Activities in *PLASTICS*	Instructional Media	Student Experiences and Activities in *EARTHS*	Instructional Media
	-Using a prepared map of Canada that outlines the raw material areas and the related manufacturing areas: a) note the location of raw materials and related manufacturing areas b) interpret the significance of: 1) their relative position to each other 2) transportation and raw materials 3) manufacturing and population 4) manufacturing and transportation 5) available occupations	-Pamphlet: *Nature and Uses* Canadian Industries Limited	-Using a prepared map of Canada that outlines the raw material areas and the related manufacturing area: a) note the location of raw materials and related manufacturing areas b) interpret the significance of: 1) their relative position to each other 2) transportation and raw materials 3) manufacturing and population 4) manufacturing and transportation 5) available occupations	
-Wall Charts and Samples	-Refer to a list of the general properties of the following plastics. <u>Thermoplastics</u> - acetols, acrylics, cellulosics, nylons, flurocarbons, polycarbonates, polyolefins, polystyrenes, vinyls.	Film: ▶< *Kingdom of Plastics*, (General Electric)	-Characteristics, properties, and uses of common materials such as clays, cements, abrasives, glass, glazes.	Wall Charts and Samples

Systems or Processes	Time	Student Experiences and Activities in *WOODS*	Instructional Media	Student Experiences and Activities in *METALS*
Identification (Cont'd.) -Materials have distinguishing properties and characteristics that dictate the uses to which they can be adapted.		-Identify common woods and compare their properties, uses, prices.		-Note characteristics, properties, common uses, sizes, shapes of readily available metals.
• <u>Testing</u> -Testing of materials is an important function of manufacturing. -Properties of materials can be changed chemically and/or physically.		-Compare wood to other natural and synthetic materials. -Comparative test wood samples for properties such as weight, strength, hardness, elasticity. -Relate the structure of the material to its workability. -Note the effect of chemicals on wood, e.g., bleaching.		-Spark test for carbon content. -Comparative test metal samples for hardness, malleability, ductility, elasticity, fatique resistance. -Investigate the process, principle and reason for tempering, annealing and case hardening. -Heat treat a project and test results.

pic B -Measurement and Layout
ncept: -Accuracy in measurement for layout is imperative in the production of most products.

<u>Measurement and Layout</u> -There are two basic systems of measurement - English and Metric.		-Use the basic systems of English and Metric measurement.		-Use the basic systems of English and Metric measurement.

Instructional Media	Student Experiences and Activities in *PLASTICS*	Instructional Media	Student Experiences and Activities in *EARTHS*	Instructional Media
-Wall Charts and Samples	Thermoset - aminos, epoxies, phenolics polyesters, silicones, urethanes. -View structure through a microscope. (Relate to hardness and weight.) -Refer to samples of common plastics.	-Wall Charts and Samples	-View structure when possible. (Relate to hardness and weight.)	-Wall Charts an Samples
	-Comparative test plastic samples for strength, elasticity, texture, odor, effects of flame, ability to transmit light, solubility, feel, etc. -Compare thermoset and thermoplastics. -Perform comparative tests of plastics, using a fluoroscope.	Pamphlets: -*Properties of Perspects* C.I.L. -*How to Work with Plexiglass* Cadillac Plastic	-Perform comparative tests such as elasticity, ductility, malleability, hardness, weight, color, and abrasive qualities on earth products.	
-Decimal Equivalent Chart	-Use the basic systems of English and Metric measurement.		-Use the basic systems of English and Metric measurement, i.e. lineal, volume, proportions.	

Systems or Processes	Time	Student Experiences and Activities in *WOODS*	Instructional Media	Student Experiences and Activities in *METALS*
Measurement and Layout (Cont'd.) -Layout and measuring tools provide man with a means of setting down, organizing, and communicating ideas in an industrial society.		-Learn the proper identification and use of tools related to the woods area.		-Learn the proper identification and use of tools used in the metals area.
		-Become familiar with design and layout procedures.		-Become familiar with design and procedures.
-The successful completion of a product depends on the choice of materilas and accurate layout and measurement.				-Use layout die. -Be able to interpret a chart of fractions and decimal equivalents.

pic C. -Shaping
ncept: -Man manipulates materials, tools and equipment to shape and form products of his environment.

Cutting -Most cutting tools employ the wedge to separate materials. -Machines have relieved man of toilsome work, and speeded up production.		-Examine all the cutting tools and machines in the area to determine the cutting principle that is most common.	-Stanley Charts -Workmen's Compensation Safety Charts	-Examine all the cutting tools and machines in the area to determine the cutting principle that is most common.

Instructional Media	Student Experiences and Activities in *PLASTICS*	Instructional Media	Student Experiences and Activities in *EARTHS*	Instructional Media
-Starrett Wall Charts	-Learn the proper identification and use of tools related to the plastics area.		-Learn the proper identification and use of tools related to the earths area.	
	-Become familiar with design and layout procedures.		-Become familiar with design and layout procedures.	
-Disston Tool Wall Charts 1. Files 2. Hacksaws -Workmen's Compensation Safety Charts	-Examine all the cutting tools and machines used in the area to determine the cutting principle that is most common.	-Pamphlets: *Machining Perspects* *Shaping Perspects* C.I.L.	-Examine all the cutting tools and machines used in the area to determine the cutting principle that is most common.	

Systems or Processes	Time	Student Experiences and Activities in *WOODS*	Instructional Media	Student Experiences and Activities in *METALS*
Cutting (Cont'd.) -Tools are an extension of man's faculties. Cutting tools provide man with mechanical advantage and control.		-Be familiar with the adjustable parts and the way in which adjustments, speed, pressure, direction, sharpness and support affect the cutting process.		-Be familiar with the adjustable parts and the way in which adjustments, speed, pressure, direction, sharpness and support affect the cutting process.
-Cutting can be accomplished by mechanical, abrasive, thermal, chemical, (etching) electrical (EDM) and optical (laser) means.		-Comparative test the operation of hand and machine tools (e.g., speed, efficiency, effort and quality of workmanship).		-Comparative test the operation of hand and machine tools (e.g., speed, efficiency, effort and quality of workmanship).
-Decreasing the area of the apex of the cutting edge proportionally reduces the power required to drive the edge into the material.		-Use as many of the cutting tools as possible. Be sure to know their proper use and safety precautions, e.g., ripsaw, crosscut saw, planes, chisels, files, drills, boring tools, and abrasives.		-Electro-chemically etch a metal product. -Use as many of the cutting tools as possible. Be sure to know their proper use and safety precautions, e.g., hacksaw, chisel, files, drills, taps and dies.
-A cutting edge must be of a harder material than the material being cut by that edge.		-Use as many of the cutting machines as possible. Be sure to know their proper use and safety precautions, e.g., lathe drill press, sander, portable drill, circular saw, jointer. -Sharpen one type or cutting tool.		-Use as many of the cutting machines as possible, e.g., engine lathe, sharper, mill, drill press, grinder, shear, portable drill. Be sure to know their proper safety precautions. -Sharpen one type of cutting tool.

Instructional Media	Student Experiences and Activities in *PLASTICS*	Instructional Media	Student Experiences and Activities in *EARTHS*	Instructional Media
-RPM and Cutting Speed Charts (Prepared by teacher)	-Be familiar with the adjustable parts and the way in which adjustments, speed, pressure, direction, sharpness and support affect the cutting process.		-Be familiar with the adjustable parts and the way in which adjustments, speed, pressure, direction, sharpness and support affect the cutting process.	
	-Comparative test the operation of hand and machine tools (e.g., speed, efficiency, effort and quality of workmanship).		-Comparative test the operation of hand and machine tools (e.g., speed, efficiency, effort and quality of workmanship).	
-Popular Science November 1968 -South Bend Wall Charts 1. Lathe 2. Tap and Drill Sizes -Stanley Safety Charts	-Use as many of the cutting tools as possible. Be sure to know their proper use and safety precautions, e.g., saws, planes, files, drills, taps and dies, snips, shears, scraper, abrasives.			
-Audio-Visuals Branch 1. Lathe work 2. Drill Press 3. Chuckwork	-Use as many of the cutting machines as possible. Be sure to know their proper use and safety precautions, e.g., machine lathe, drill press, portable drill, band saw, metal shaper, mill, sander, polisher.		-Use as many of the cutting machines as possible, e.g., jiggering. -Be sure to know the proper use and the safety precautions for cutting tools and equipment. -Drill a hole in glass. -Cut glass (optional).	-Simple Machine Lever

Systems or Processes	Time	Students Experiences and Activities in *WOODS*	Instructional Media	Student Experiences and Activities in *METALS*
2. <u>Shaping</u> -Removing Material The removal of materials for the purpose of shaping can be accomplished by applying the principle of the wedge.		-Use the cutting tools and machines that remove material, e.g., lathe, lathe tools, saws.		-Use the cutting tools and machines that remove material, e.g., metal lathe, hacksaw, lathe tools, milling machine.
3. <u>Molding</u>		-Discuss extrusion molding of particle board.		-Know how metal can be formed by the explosive process. -Discuss extrusion molding of metals.

Instructional Media	Student Experiences and Activities in *PLASTICS*	Instructional Media	Student Experiences and Activities in *EARTHS*	Instructional Media
	-Know the principles of mechanical shaping and make a product using this method. -Use the cutting tools and machines that remove material.		-Use a potter's wheel for simple jiggering. -Use a potter's wheel for simple throwing. (Optional)	
	-Know what kind of porducts can be used in the molding process. -Know how and what kind of products can be molded by foaming styrene beads, extrusion injection, transfer. -Make products using as many of the molding processes as possible. -Procedure for preparing molds for production. -Make a fibre glass product with hand layup. -Make a fibre glass product using matched molds. -Compression mold with thermoset plastic.		-Use a mold to make a concrete product. -Make a clay product using a mold. -Discuss extrusion molding of glass. -Dry press steatite to form ferrites for electrical insulators. -Dry press silicon carbide abrasives.	

Systems or Processes	Time	Student Experiences and Activities in *WOODS*	Instructional Media	Student Experiences and Activities in *METALS*
4. **Forming** -Materials may be readily formed or shaped after the application of heat and/or pressure. -Methods of forming materials permanently have extended the usefulness of the material.		-Bend wood for laminating. -Read about another method of of forming materials permanently. Compare the two methods, e.g., soak bending, steam bending.		-Understand the process and application of stamping. -Understand the process and application of forging. -Stretch form copper by hammering it over a die or sand bag. -Use jigs and blocks for bending -Use the bending equipment available in the lab, e.g., box and pan break, metal former. -Twist bar stock. -Know the factors involved in bending, e.g., thickness, type of material, degree of bend, type of bend.
• **Casting** -Shape of material can be changed. -Materials, when in a liquid form, can be shaped without the use of force.				-Be familiar with foundry procedures. -Understand the process and application of casting. -Cast a product using a material such as cerebond, aluminum, lead.

Instructional Media	Student Experiences and Activities in *PLASTICS*	Instructional Media	Student Experiences and Activities in *EARTHS*	Instructional Media
Di-Acro Charts	-Know the principles of free forming and make a product using this method. -Know the principles of vacuum forming and make a product using this method. -Know the principles of blow forming and make a product using this method. -Know how to use all thermoforming equipment safely. -Know the heats required to bend thermoform plastics. -Use the strip bender. -Use a bending jig.	-Film: *Forming Plastic Sheet Materials* Robert Morse Corporation	-Understand how glass can be shaped. -Bend glass tubing. -Anneal glass.	
	-Know what kind of plastics can be cast. -Know how and what kind of products can be made by casting. -Cast a product. -Do rotational and/or slush casting.		-Use a slip mold to cast a product. -Cast concrete in a mold.	

Topic D. -Fabrication
Concept: -Materials of similar or different properties and composition can be fastened by various methods.

Systems or Processes	Time	Student Experiences and Activities in *WOODS*	Instructional Media	Student Experiences and Activities in *METALS*
1. Mechanical		-Know how and when to use mechanical fasteners properly such as nails, screws. -Know types and uses of clamps.		-Know how and when to use mechanical fasteners, e.g., rivets, bolts, self-tapping screws.
2. Adhesion		-Discuss types of glues. -Know proper gluing procedure. -Use laminating process.		-Soldering procedure. -Brazing procedure.
3. Cohesion				-Spot welding procedure. -Forging procedure.
4. Comparative Testing		-Compare the above fastening methods by such criteria as speed, holding power, cost, appearance and permanence.		-Compare the above fastening methods by such criteria as speed, holding power, cost, appearance and permanence.

Instructional Media	Student Experiences and Activities in *PLASTICS*	Instructional Media	Student Experiences and Activities in *EARTHS*	Instructional Media
-Audio-Visuals Branch 8 *Fastening Devices* TK2161	-Know how to use mechanical fasteners in plastics. Use at least one method in a product. -Test the holding power of various mechanical fasteners in plastics.		-Know how concrete can be strengthened e.g., bolts, reinforcing steel, etc.	
	-Use epoxy cement as a bonding agent. -Test holding power of epoxy cement. -Laminate using solvents.	-Pamphlet: *Cementing Perspects* C.I.L.	-Be familiar with types of porcelain enamels. -Know porcelain enameling procedure and apply it to a product. -Study a grinding wheel and see how the abrasive is bonded.	
	-Know how to use solvents as a bonding agent. -Know how to weld plastics. (Test joints used. Laminate using heat and pressure. (plastic fussion) -Coat paper with plastic.		-Know the various types of glazes. -Know glazing procedure. -Apply a glaze. -Compare glazing process to refactory process. -Apply porcelain enamel to a blank.	
	-Compare the above fastening methods by such criteria as speed, holding power, cost appearance and permanence.		-Compare the above fastening methods by such criteria as speed, holding power, cost, appearance and permanence.	

Topic E. -Finishing
Concept: -Finishes are applied for the purpose of beauty, protection and sanitation.

Systems or Processes	Time	Student Experiences and Activities in *WOODS*	Instructional Media	Student Experiences and Activities in *METALS*
1. Natural				
2. Coatings -The value of a product is enhanced by the quality of its finish. -The appearance and durability of materials can be changed by the application of finishes.		-Discuss reasons for finishing. -Know safety precautions. -Understand the factors involved in finishing, e.g., cleanliness, temperature, humidity. -Discuss preparation for finishing.	-Information Sheet -C.I.L. Filmstrips 8	-Discuss reasons for finishing. -Know safety precautions. -Understand the factors involved in finishing, e.g., cleanliness, temperature, humidity. -Discuss preparation for finishing
-Hand Finishing		-Paint, using a brush. -Apply oil finish with a cloth. -Discuss primers, fillers, waxes.		-Discuss brush-painting procedure. -Discuss use of primer coat.
-Spray Finishing				-Spray paint, using spray cans.
3. Mechanical Finishing		-Know finishing procedures such as sanding, polishing, buffing. -Study types of abrasives.		-Know finishing procedures such as sanding, polishing, buffing. -Study types of abrasives.

Instructional Media	Student Experiences and Activities in *PLASTICS*	Instructional Media	Student Experiences and Activities in *EARTHS*	Instructional Media
	-Discuss reasons for finishing. -Know safety precautions. -Understand the factors involved in finishing, e.g., cleanliness, temperature, humidity. -Discuss preparation for finishing.		-Discuss reasons for finishing. -Know safety precautions. -Understand the factors involved in finishing, e.g., cleanliness, temperature, humidity. -Discuss preparation for finishing. -Study ways of sufface decorating using porcelain enamels.	
	-Know finishing procedures such as sanding, polishing, buffing. -Study types of abrasives.		-Know finishing procedures such as sanding, polishing, buffing. -Study types of abrasives.	

Systems or Processes	Time	Student Experiences and Activities in *WOODS*	Instructional Media	Student Experiences and Activities in *METALS*
Mechanical Finishing (Cont.'d)		-Know when to use the various types of abrasives.		-Know when to use the various types of abrasives. -Peen a surface.
4. <u>Chemical Finishing</u>		-Surface decorate by using chemicals, such as a bleach.		-Color metal by chemical action, e.g., potassium sulphide for antique work. -Surface decorate metal by chemical action, e.g., etching.
5. <u>Heat Finishing</u>				-Surface decorate metal by heat.
<u>Comparative Testing</u>		-Examine some of the prefinished wood materials available. -Finish wood by several methods and compare the results of finishes by criteria such as appearance, durability, resistance to strain or acid, ease of application, cost.		-Compare the results of finishes by criteria such as appearance, durability, resistance to strain or acid, ease of application, cost.

Topic F. -Educational and Occupational Projections
Concept: -A productive society must prepare its youth to make realistic vocational choices.

1. <u>Guidance</u>

- -There are many job opportunities for highly skilled persons.		-Study and prepare a report on: -lumbering - logging, sawing, seasoning processes, conservation.		-Write a report on senior and post high school programs in the metals field.

Instructional Media	Student Experiences and Activities in *PLASTICS*	Instructional Media	Student Experiences and Activities in *EARTHS*	Instructional Media
	-Know when to use the various types of types of abrasives.		-Know when to use the various types of abrasives. -Smooth glass edges.	
			-Project a picture onto a product. (Optional)	-Kodak
			-Fire polish edges of glass tubing.	
	-Compare the results of finishes by criteria such as appearance, durability, resistance to stain or acid, ease of application, cost.		-Compare the results of finishes by criteria such as appearance, durability, resistance to stain or acid, ease of application, cost.	
	-Write a report on high school or post high school training programs for plastic technology.		-Study development of occupations related to the earths' industries.	

Systems or Processes	Time	Student Experiences and Activities in *WOODS*	Instructional Media	Student Experiences and Activities in *METALS*
Guidance (Cont.'d) -Our society depends on highly skilled labor and division of labor. -Technologists require training beyond the high school level. -The organization and management of business enterprises is an important element in a productive society.		-List occupational areas related to woods. -Take a field trip. -Select one occupation in woodworking and list its job specifications, e.g., education required, vocational training, experience.	-Pamphlets: Check with Counselling and Guidance Office	-Study and prepare a report on: •One industry •Job opportunities within that industry •The specifications of one specific job within the chosen industry. •List occupational areas related to metals area. -Take a field trip

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Instructional Media	Student Experiences and Activities in *PLASTICS*	Instructional Media	Student Experiences and Activities in *EARTHS*	Instructional Media
-Pamphlets: Check with Counselling and Guidance Office	-Find out what jobs are available in the plastics industry and know the educational requirements for these jobs.	-Pamphlets: Check with Counselling and Guidance Office	-Learn about occupational opportunities in earths' industries. -Take a field trip. (If possible at beginning of unit). -Prepare a report on a topic suggested by the teacher.	-Pamphlets: Check with Counselling and Guidance Office

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E L E C T R I C I T Y

INTRODUCTION

Space exploration, which satisfies man's thirst for probing the unknown, and automation, which is producing more leisure time as well as a high standard of living, would not be possible were it not for the extensive use of electrical energy. Automation is becoming more apparent in all parts of the economy, urban as well as rural. It is playing an increasing role in industry, and therefore some knowledge of electricity will be necessary in all occupations. Students in the junior high school should be exposed to exploratory experiences in electricity which will help them interpret a productive society, reinforce and synthesize the academic disciplines, and serve in some cases as a measure of guidance to them in planning for their future.

As much activity and experimentation as possible should be provided in each unit. Construction of products which require a great deal of time but illustrate possibly only one electrical principle should be avoided. Rather, the activities should be such that an optimal number of electrical concepts are involved.

SPECIFIC OBJECTIVES

1. To develop an interest in and to recognize the importance of electrical systems used in a productive society.

2. To develop an understanding of the basic electrical principles of these systems and of the individual sections within these systems.

3. To acquaint students with electrical and electronic test equipment, symbols and diagrams.

4. To develop safety habits and attitudes while working with electrical and electronic equipment and material

SUGGESTED APPROACH

In a multiple-activity program the student must be abl to do a considerable amount of work by following written or printed instructions. It is essential that related informa tion, experiments, and instruction sheets which are given to the student be clearly written. It is also essential th suitable check points be written into the program so that t student's progress can be quickly evaluated before he proceeds from one job to another.

The basic prodecure will be the same as that suggested for all units. Some specific suggestions for this unit include the following:

1. Careful demonstrations on the use of meters are essent

2. Beginning experiments should use one-function meters o the proper range.

3. Limit the variables tested in a circuit, e.g., in a fixed circuit, test variable sources; using a fixed source, change the controls and/or loads.

4. Use the V.T.V.M. and the oscilloscope if time permits.

5. The use of a product, whether individually produced, mass-produced or co-operatively developed, creates strong motivation for learning the concepts introduced.

COURSE CONTENT

Topic A. -Uses of Electricity
Concept. -The conversion, application and control of energy is basic to the development and perpetuation of a technological society.

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
1. **Heating**			
-Heat is produced when the speed of molecular movement is increased.		-Experiment with a heating element. -Investigate use of electricity for producing heat in: •the home •manufacturing •construction •medicine	
-Induction heating (discharge tubes and electric arcs).		-Learn to use the ohmmeter to measure resistance. -Make a small induction heater. -Use the spot welder to make an arc. -Read about conization.	-Page 46, *The Silent Energy* -Pages 51-57, *The Silent Energy*
2. **Lighting**			
-Rapid molecular movement in solids, (liquids) or gases produces light.		-Identify parts and circuit of a light bulb. -Describe how a flourescent tube works. -Measure intensity of light with a light meter. -Suggest examples of the use of light in the home, construction, medicine, transportation. -Read a biography of Edison.	-Pages 49-51, *The Silent Energy*

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
3. <u>Motor</u> (magnetic induction) -Electron movement resulting from induction produces mechanical energy.		-Do experiment with induction coils and galvanometer. -Do experiment with loop of wire and magnets to show principle of motor. -Identify parts and function of the electric motor. -Run simple motor. -List uses of electric motors in: •home •transportation •construction •communication •medicine •manufacturing	
-Servo-Mechanisms		-Explain how a servo-mechanism is used to keep a ship or plane on course.	-Pages 43-46, *The Silent Energy*.

Topic B. -Safety
Concept: -Safe attitudes and knowledge of proper procedures in the use of equipment and materials is vital to man's survival.

1. <u>Machines</u> -Most current-run machines can be dangerous unless adequately grounded.		-Check motor run equipment for adequate grounds. -See film on electrical safety. -Make list of safety rules for working with electrical equipment.	

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
<u>Clothing</u> -Protective clothing or shielding devices are necessary for certain operations.		-Use of insulated clothing, gloves or boots when working with current. -Use eye protection when working with intense light.	

pic C. -Sources of Electricity
ncepts: -1. Electrical energy can neither be created nor destroyed but can be changed in form.
-2. Variables governing electron movement can be detected and/or measured.

<u>Friction Machine</u> -Electrical energy can be produced by friction.		-Do experiment with comb and paper bits. -Do experiment with glass rod and pitch ball. -Produce electric charge with static machine or electroscope.	
<u>Generator</u> -Electrical energy can be produced by magnetic induction.		-Run the generator and measure the current produced. -Identify the parts and study the difference between the generator and the motor. -Learn to use the ammeter.	

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
3. <u>Crystal Cartridge</u> -Electrical energy can be produced by pressure.		-Do experiment with phono cartridge to evaluate increase in strength of signal. -Study operation of crystal microphone. -Make crystal set.	
4. <u>Solar Cell</u> -Electrical energy can be produced by light.		-Measure current produced by photo cell. -Draw diagram of a photo-voltaic cell and describe how it works. -List examples of the uses of photo-voltaic cells. -Design a circuit, using a photo-voltaic device.	
5. <u>Thermocouple</u> -Electrical energy can be produced by heating two dissimilar metals in contact with each other.		-Make a thermocouple by twisting together two wires of different metal, e.g., iron stove wire and copper wire -Measure current produced by a thermocouple. -Study the circuit of a thermostat on a house furnace.	

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
6. Batteries -Electrical energy can be produced by chemical reactions.		-Make a battery. -Learn the parts and materials required in a dry cell battery. -Wire batteries in series and parallel and compare voltages. -Learn to use the voltmeter.	
7. Thermo-Electric Generator		-Study the production of electricity with semi-conductors.	-Page 102, *The Silent Energy*
8. Fuel Cells		-Explain the production of electricity with the fuel cell.	-Page 113, *The Silent Energy*

Topic D. -Controlling Electric Energy
Concept: -Electron movement can be controlled and manipulated.

1. The Circuit -Electron current can be directed in predetermined circuits.		-Make a simple series circuit. -Study control devices that may be used to stop or start electron flow: • switches • breakers • relays • fuses • photo cells.	-Pages 22-29, *The Silent Energy.*

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
The Circuit (Cont'd.)		-Control devices that decrease or increase electron flow: •resistors - rheostat •capacitors •coils. -Control devices that change the value of current in relation to voltage: •transformers •coils. -Study a complete transmission and generation system from dam or plant to the home.	
2. Series Circuits		-Experiment with various series circuits. -Develop experiments to illustrate Ohm's Law. -Use measuring instruments to compare values.	
3. Parallel Circuits		-Experiment with various parallel circuits.	
4. Telephone Circuit		-Set up a telephone circuit. -Identify units and functions.	-Page 91-96, *The Silent Energy*
5. Telegraph Circuit		-Make a morse code sender. -Identify parts and type of circuit.	
6. Teletype Circuit		-Compare with telegraph circuit. -List advantages.	

Topic E. -Educational and Occupational Projections
Concept: -A productive society must prepare its youth to make realistic vocational choices.

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
1. <u>Guidance</u> -Industrial Arts courses provide a student with a background of many experiences which can be helpful in selecting a more realistic high school program.		-Investigate job opportunities in electrically oriented fields. -See a film on occupations in electricity. -Tape an interview with an electrician and play back to the class. -Prepare a job qualification list for three different occupations related to electricity.	-Pamphlets: Check with the Counselling and Guidance Office

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E L E C T R O N I C S

INTRODUCTION

Because of automation, the increased use of computers, space exploration, and improved communication systems, electronics has become more and more important to our society. In an exploratory course such as this, it would be impossible to cover all phases of electronics in detail or to make an in-depth study of the circuitry and components involved. To study only some of these, however, would defeat the purpose of the course which should be in keeping with the general objectives of the industrial arts program. Therefore, the purpose is to give the students as much breadth of scope as possible. A broad selection of systems should be examined and their applications in our society emphasized. To do this the student should be given the overall story of the operation of each system first, and then should study the various units that comprise the system. Study of components and detailed circuitry should be done only as time permits.

SPECIFIC OBJECTIVES

1. To develop an interest in and to recognize the importance of electronic systems in a productive society.

2. To develop an understanding of the operating principles of these systems and the functions of the sections comprising them.

3. To acquaint students with the proper use of test equipment.

4. To develop safety habits and attitudes while working with electronic equipment and materials.

SUGGESTED APPROACH

The method of teaching the electronic systems will depend to some extent upon the equipment used. In some cases, systems such as radio receivers and amplifiers can be bought in units which can be put together in various combinations. The approach in such cases would be the assembly of the units into a system. After the assembly, the function of various units would be taught by the teacher or read about by the student. Various experiments should also be performed on this equipment. For example, the power supply filter could be removed to show what its purpose is in the system. In other cases the systems would be complete so that no assembly would be possible and an analytical approach to experimentation would have to be taken. The related information given to the students, should point out commercial and/or other applications of all the systems studied.

The Superhetrodyne radio is to be used as the major teaching system. Other systems may be used as supplementary or evaluative systems.

One product representative of a system may be produced as an individual of class activity.

C O U R S E C O N T E N T

Topic A. -Electronic Systems for Reception and Transmission
Concepts: -1. Intelligence can be converted to and/or obtained from controlled electron impulses.
-2. Electrical energy can be changed to electromagnetic waves that can carry signals through space at the speed of light.

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
Overview and comparison of function of the following systems: •radio •transmitter •phonograph •P. A. system •computer •video (Optional)		-Use of electronics in our society. -Define the function and purpose of each system. Comparisons should be based on: •power requirements •methods of control •type and method of input, voice, tape, record •type of output.	
1. <u>Superhetrodyne Radio</u> -Intelligence from radio waves can be converted to audible sound.		-Operate a radio by selecting a signal and controlling volume. Teacher demonstrates use of oscilloscope to show value and pattern of input signal and output signal. -Students make a block diagram of the units in the receiver: •power supply •amplifier •oscillator •detector.	
-Units in an electronic system are dependent on the integrated components within them.		-Recognize symbols used for components.	

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
Superhetrodyne Radio (Cont'd.)		-Identify and test components: •resistors •capacitors •inductance coils •tubes •transistors. -Practice using test equipment to measure resistance and voltage in teacher approved circuits. Use instruments available.	
2. <u>Transmitters</u> -Audio signals can be converted to radio waves and transmitted.		-Study the operation of a transmitter. -Identify the main sections of a transmitter and draw a block diagram; power supply, oscillator, radio frequency amplifier. -Use low power transmitters to transmit signals.	-Department of Transport pamphlet low power transmiss

Topic B. -Electronic Systems for Amplification
Concept. -Energy can neither be created nor destroyed, but has the ability to produce action or effect.

1. <u>Phonograph</u> -Audio waves can be converted to a permanent record and reproduced on demand.		-Identify the major parts of the system. -Draw a block diagram, labelling the units: power supply, audio, amplifier, etc. -Trace the reproduction of the sound from the record to audio sound.	

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
Phonograph (Cont'd.)		-Understand the piezoelectric effect. -Build a small amplifier, using printed board, integrated circuit or breadboard. -Test the power of the amplifier. (Calculate the power in watts.)	
2. <u>Public Address System</u> -The sound waves produced by human voices can be amplified by means of electronic circuitry.		-Identify the major units of a P.A. system. -Draw a block diagram and label the parts. -Determine the power rating of the amplifier. -Suggest uses for amplifiers in the home, industry and recreation.	
3. Video Systems (Optional)			

Topic C. -Electronic Systems for Calculators
Concept: -Electronic impulses can be manipulated to perform problem-solving tasks.

1. <u>Computer</u>		-Basic understanding of the operation of simple computers. -Study use and application of binary and octal number systems to computer. Use of number for •data •instruction code.	-Manuals that fit equipment.

Systems or Processes	Time	Student Experiences and Activities	Instructional Medi
Computer (Cont'd.)		-Study methods of "feeding" computer languages assembler, computer, interpreter (APL). -Identify uses of computers in industry and education. -Solve simple arithmetic problems on the computer.	

Topic D. -Educational and Occupational Projections
Concept: -A productive society must stimulate its youth to make realistic vocational choices.

1. <u>Guidance</u> -Industrial Arts courses provide a student with a background of many experiences which can be helpful in selecting a realistic high school program.		-Study job opportunities in fields requiring an electronics background. -Write a paragraph on the educational requirements of an electronics engineer (or other, student's choice).	-Pamphlets: Check with Counselling and Guidance Offic

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V I S U A L C O M M U N I C A T I O N S

INTRODUCTION

The segments of Visual Communications as outlined in the content of this unit refer to that type of communication which is drawn, duplicated or photographed. These include experiences in drafting, duplicating methods and the study of light-sensitive materials.

The importance of graphics in the complex world of today cannot be over-emphasized. Whatever segment of our society we examine: the planning of our homes, the automation and computerization of our industries, the achievements in communications ranging from the local newspaper industry to the satellite Alouette, the beckoning of whatever deeper knowledge may lie outside the circumference of our own planet as we venture out into space, all require some form of graphics in their production.

SPECIFIC OBJECTIVES

1. To develop in the student an appreciation of the importance of graphics in all aspects of a productive society.

2. To develop an appreciation for the many applications of light-sensitive materials in a productive society.

3. To impress upon the student, through practical experiences, the importance of technical design and illustration in a complex technological society.

SUGGESTED APPROACH

The object of this unit is to provide an opportunity for the student to obtain an overall view of Technical Design and Illustration and Light Sensitive Materials. Th methods and processes are such that the student can be assigned activities which will heighten his interest and give him a keener insight and better understanding of the concepts involved.

In the section on light-sensitive materials the students start with reporducing their drawings by the suggested copying methods.

Students are introduced to the complete process, from the taking of the picture to its final development. It is hoped that the students' work will include composition and darkroom procedures.

In the technical design and illustration section the stress is on expressing ideas by sketching. Partially completed drawings and exercises can be used to teach concept Reading of drawings is important and students should have practice to help them understand and recognize common symbols.

COURSE CONTENT

opic A. -Graphics
oncept: -All graphic representation is either by continuous tone or dicotomous process.

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
. History and Overview of Graphics		-Investigate the development of light-sensitive materials. -Discuss the growing importance of light-sensitive materials. -Discuss the development and importance of technical design and illustration.	
Materials		-Investigate the wide range of light-sensitive materials. -Investigate the production of paper and ink. -Make paper if equipment available.	

pic B. -Light-Sensitive Materials
ncept: -Light-Sensitive Materials provide the means by which the reporduction of printed and pictorial materials can be efficiently performed.

Copying Process		-Students learn the principles and operation of: •Diazo method (ammonia developed) •Intermediates, e.g., Van Dyke •Overhead transparencies •Wet and dry copies (Optional).	-Kodak Publications and Ansco Publications

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
Copying Process (Cont'd.)		-Students should produce copy, using at least two of the aforementioned methods. -Learn use of camera. -Study camera accessories. -Apply composition to photography.	
2. <u>Photographic Process</u>		-Do contact printing •composition and design of Xmas cards, masks, etc. -Do simple enlarging •exposure tests •darkroom procedures •basic projection controls -Do photo drawing. (Optional)	-Ideas for Xmas card slides from Kodak. [
3. <u>Film Processing</u>		-Simulate microfilming. -Study film characteristics -Follow correct darkroom procedures.	-Slides: (Kodak) •*Choosing Your Black and White Film.* [] •*How Film is Made for Your Camera.* [] •*How to Develop Your Film.* []

Topic C. -Technical Design and Illustration
Concept: -Production depends on man's ability to express his ideas in the form of drawings and symbols.

1. <u>Pictorial Representation</u> -Ideas presented pictorially are easy to understand.		-Students should have practice in sketching objects in •isometric •two-point perspective	-Industrial Arts [] Transparencies (Walk

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
?. Multi-View -Ideas expressed through multi-view drawings can provide more detailed information.		-Students sketch objects in multi-view projection.	
. Drawing Interpretation -Reading and accurate interpretation of drawings is a necessary function of many activities in society.		-Students learn to read: •dimensions •sectional views •mechanical symbols •architectural symbols •electrical symbols •topographical views.	
. Instrument Manipulation -Through the use of instruments, drawings can be made quickly and accurately.		-Students use drafting instruments: •the drafting machine •templates •scales, etc., to make simple drawings.	
. Composition -Good design and composition depend upon: function interest simplicity honesty (FISH)		-Students study methods of composition and principles of design related to: •advertising layout •poster design •photography -The principles of product design above should be used in the practical work as it applies to the topics in this unit.	-Locate newspaper

Topic D. -Educational and Occupational Projections
Concept: -A productive society must prepare its youth to make realistic vocational choices.

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
1. Guidance Information -There are many job opportunities for highly skilled persons. -Our society depends on highly skilled labor and division of labor. -Technologists require training beyond the high school level. -The organization and management of business enterprises is an important element in a productive society.		-List the occupations in your town, district or city that require the knowledge studied in this unit.	-Pamphlets: Check with Counselling and Guidance Office

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G R A P H I C C O M M U N I C A T I O N S

INTRODUCTION

For thousands of years man has been preserving his thoughts in pictures and words; today newspapers, magazines and books provide this kind of communication. In fact, pulp and paper is one of the major products of Canada. Since printing and publishing materials is a leading industry in Canada the graphics section of industrial arts is of considerable importance to students. In this course they should become acquainted with the operations connected with printing and publishing.

OBJECTIVES

1. To develop in the student an appreciation of the importance of graphics in all aspects of a productive society.

2. To develop an appreciation for the many applications of light-sensitive materials in a productive society.

3. To develop an understanding of the relationships and the interdependency of the various divisions of labor in the areas of graphic design, process photography, platemaking, reproduction and bindery.

SUGGESTED APPROACH

This is a unit of instruction where there is an oppo tunity to dramatize the "systems" approach used in the printing industry. To introduce students to the activiti of the unit, they are provided with a preprinted master. They print this and then are challenged to produce one of their own.

A simple project such as a personalized letterhead m be chosen as the first individual activity. To do this t student uses one of the methods suggested in the guide to set the type, take a photograph of it, reduce the size, m it, make the plate and run the master.

Having gone through these processes the student woul continue with further detailed printing. The product cou be synchronized with the work of other students to produc a brochure or booklet.

ION A

c A. -Graphics
ept: -All graphic representation is either by continuous tone or dicotomous process.

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
History and Overview of Graphics -There has been a continuous development and improvement of materials and processes for graphic presentation.		-Study methods of printing: •rebel •intaglio •lithography •silk screen -Trace development of printing on a chronological chart starting with Gutenberg. -The following relationships should be understood: •composition •camera •platemaking •press run •bindery -Students should have a basic idea of the total procedure required to produce a printed article before going on to the individual processes.	
Materials -Basic graphic materials are continuously being improved to produce better graphic reproductions.		-Study the production and uses of: •aniline dye •inks •paper •stencils •carbon paper •pencils -Students may experiment with the production of a product using one of the above, view a film or make a report.	

Topic B. -Offset Lithography
Concept: -The fact that oil and water do not mix is the basic principle used in offset lithography.

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
1. Offset Reproduction -The offset process has become the most commonly used industrial method of producing printed materials.		-Have students run a preprinted master (memo pads). -Pad the memos. -Examine the offset press and the wall charts. Be able to explain the 'oil and water' concept in terms of equipment,	1. 35 mm. film str and audio tape- B *"Operation of the Multilith 85"*. 2. Single Concept I 3. Sequential Pictorial Instructic "Preparation" *Graphic Arts Trainin Schools* - A.M. A-M Wall Chart "Offs Principle"
2. Master Preparation		-Prepare direct-image masters, using several methods: •sign press •lettering machine •typewriter •pencil, pen and crayon •letraset	-*Making a Good Impression on Your Master* - Instructic Sheets -Letraset Instructic Sheets
3. Design		-Design and run direct-image masters for: •posters •club activities •sports activities	-A-M Idea Sheets Clipper Service

ɔic C: -The Photo-Offset Process
cept: -The total system of photo-offset lithography is dependent on the inter-relationship of diversified divisions of work.

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
The Photo-Offset Process		-Trace the production flow of a book. Relate activities in I.A. to those in Industry. The inter-relationship of the following areas should be understood: composition camera platemaking reproduction bindery -Students should have a basic idea of the total procedure required to produce a printed article before going on to the individual processes.	-Meeta Video-Tape *"Offset Printing"* -Congoli -Unions -*Graphic Arts Training in Schools* - A.M. -*Preparing Copy for Camera* - A.M.
Composition		-Compose a personalized letterhead, using any of the following processes: sign press letraset lettering machine stencil idea sheets	-Instruction Sheet Clipper Service A-M Idea Sheets
Process Camera Simulation		-Set up a camera. -Characteristics of Ortho film. -Darkroom Procedures. -Film processing.	-Instruction Sheets

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
4. Masking and Stripping		-Laying out a flat. -Stripping-in the negatives. -Corrections and deletions. -Brownline proofs.	-Cogoli
5. Platemaking		-Fastening goldenrod to plate. -Exposure procedures. -Developing and desensitizing. -Preserving the master.	-Instruction Sheets
6. Reproduction		-Preparing the offset press. -Run the letterhead.	1. 35 mm. filmstrip and tape *"Preparation of the Multilith 85"* 2. Single Concept Super 8 Loop *"Preparation"* 3. SPI - *Multilith Preparation*
7. Bindery		-Use approved bindery methods to assemble material produced. -Study methods of fastening material into books, pamphlets, etc.	

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
Bindery (Cont'd.)		-Understand the meaning of: •trimming •stiching •jogging •perforating •collating •creasing •padding •mechanical binding	
8. <u>Guidance</u> -The student should understand interrelationship of the diversified Divisions of Work.		-The student should: 1. Know the interrelationship of the five areas in the photo-offset process. 2. Relate the industrial arts activities to those found in industry. 3. Know the divisions of labor within the printing industry. 4. Research local job opportunities, comparative salary and training required. 5. Be familiar with related technical vocabulary.	-*Graphic Arts Training Schools* - A.M. -Meeta Video Tape -Cogoli -A.M. *Graphic Arts Training In Schools* -A.M. *Putting Your School Paper to Bed.* -Cogoli - *Photo Offset Fundamentals*

Topic D. -Light-Sensitive Materials
Concept: -Exploiting varied characteristics of Light-Sensitive Material increases the versatility of the offset process.

1. <u>Composition Through Paste Make-Up</u>		-Simulate paste make-up on translucent paper. -Composition methods.	-A-M Idea Sheets Clipper Service

Systems or Processes	Time	Student Experiences and Activitive	Instructional Media
Composition Through Paste Make-Up (Cont'd.)		-Block out for half-tones. -Design methods using prepared translucent sheets.	
2. Positive Masters		-Positive Master characteristics. -Exposing and developing positive plates. -Use translucents for master preparation. -Run the designed product offset.	-A-M Translucents
3. Reversal Film		-Characteristics. -Exposure and developing methods. -Expose translucent paste make-up onto reversal film. -Plate make and press run.	-Instruction Sheet
4. Orthochromatic Film		-Characteristics. -Contact expose student designed translucent copy onto ortho film. -Plate make and press run. -Contact print greeting cards. -Drop out techniques. -Reversals for silk screening	

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
. <u>Line Color Separation</u>		-Produce suitable copy for line separation. -Composition methods. -Negative registration. -Masking procedure. -Plate making procedure -Transparent inks. -Two-color press run.	-Translucent Separations - 33 mm. Film and Audio Tape ▶< *"Clean-Up of the Multilith 85"* Single Concept Loop SPI *"Clean-Up"* ▶<[8]
. <u>Projection Control In Enlarging</u>		-Production of prints suitable for half-tones. -Filters. -Control methods.	-Kodak series McCoy-*Practical Photography* -Cogoli - *Photo-Offset Fundamentals*
<u>Half-tones</u>		-Introduction to half-tones. -Half-tone theory. -Autoscreen film. -Contact Screens. -Darkroom procedures. -Stripping half-tones for platemaking.	-Kodak Series

Topic E. -Educational and Occupational Projections
Concept: -A productive society must prepare its youth to make realistic vocational choices.

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
1. Guidance -There are many job opportunities for highly skilled persons. -Our society depends on highly skilled labor and division of labor. -Technologists require training beyond the high school level. -The organization and management of business enterprises is an important element in a productive society.		-Investigate opportunities in one of the following: printing photography duplicating -Investigate Vocational Education training opportunities.	-Pamphlets: Check with Counselling and Guidance Office.

B I B L I O G R A P H Y

GRAPHIC COMMUNICATIONS:

Addressograph Multigraph Company, *Teacher's Package*, Edmonton or Calgary.
Cogoli, John E., *Photo Offset Fundamentals*, General Publishing, Toronto, 1967.
Creative Art Service, *The Clipper*, Dynamic Grafts Incorporated, Peoria, Ill.

SECTION B (For use by those schools that have not as yet made the transition to offset equipment).

Topic A. -Topography

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
1. Printing Methods		-Know basic printing methods: •rebel •intaglio •lithography •silk-screen.	
2. Materials - Manufacture		-How paper and ink are produced. -Make paper if equipment available. -Draw map of sources of pulp for paper.	
3. The Printing Process		-Study the layout of California Job Case. -Learn the common terms used in printing. -Use a composing stick. -Learn to read a line of type. -Justify a line. -Tie form in galley. -Make a proof.	

Topic B. Rubber Stamp

1. Rubber Stamp Production		-Make a matrix for a rubber stamp.	

Systems or Processes	Time	Student Experiences and Activities	Instructional Media
Rubber Stamp Production (Cont'd.)		-Know the materials used and why. -Make a rubber stamp.	

Topic C. -Show Card Printer

1. <u>Show Card Production</u>		-Set up letters on show card printer. -Ink plate. -Print show card. -Clean type, brayer and plate. -Simulated embossing.	-Virkotype-Sears Ltd. 10301 - 109 Street Edmonton, Alberta

Topic D. -Educational and Occupational Projections
Concept: -A productive society must prepare its youth to make realistic vocational choices.

1. <u>Guidance</u>		-Prepare a report, using the proper format, on one area within the graphics field: •nature of the work •size and distribution •future •personal requirements •preparation •working conditions •economic returns •occupational relationships •entry into occupation •advantages and disadvantages •sources of further information •opportunities in related fields.	

B I B L I O G R A P H Y

GRAPHIC COMMUNICATIONS:

Hildegrandt, C. W., *Graphic Arts Students Workbook*, Commercial Printers, Edmonton, 1967.

Kagy, F. D., *Graphic Arts*, Goodheart-Wilcox, Ill., 1965.

INDUSTRIAL CRAFTS

INTRODUCTION

As our society becomes more productive more leisure time is available to people. In order to use this leisure time most effectively areas of interest can be established early in life. The units outlines under industrial crafts might well spark a student's interest in the selection of an avocational interest.

SUGGESTED APPROACH

An industrial crafts unit could be used as a fourth area for those teachers with large classes. It could also be used to provide enrichment for the industrial arts program. This can be done by tying leather to the materials units, lapidary to the earths unit, or art metal to the metals and earths units.

The industrial crafts should be taught as are the materials units and not as isolated craft units. The emphasis then will be on tools, materials and processes.

SPECIFIC OBJECTIVES (in addition to those found in Materials)

1. To provide an opportunity for the expression of originality and individual initiative.

COURSE CONTENT

Topic A. -The Material and Testing
Concept: -The development, testing and effective utilization of a nation's natural and synthetic resources is necessary for a productive society.

Systems or Processes	Time	Student Experiences and Activities in *LEATHER*	Instructional Media
1. Development -Raw materials are refined, processed and reconstructed to make new substances useful to man. -Man depends on many materials to meet the needs of a productive society		-Discuss the processing of hides. -Significant developments in the leather industry.	
2. Sources -Sources of raw materials are widely scattered. -Everyone should help conserve our natural resources for future generations.		-Be familiar with the more common types of leather and their sources. -Discuss conservation of materials.	
3. Identification -All materials can be classified under natural ores, natural fibres or synthetics. -Materials have distinguishing properties and characteristics that dictate the uses to which they can be adapted.		-View structure of various leathers under a microscope. -Compare composition of genuine and synthetic leathers. -Compare various leathers as to prices, uses, appearance, etc.	

Student Experiences and Activities in *LAPIDARY*	Instructional Media	Student Experiences and Activities in *ART METAL*	Instructional Media
-Discuss significant developments in this area.		Discuss significant developments in this area.	
-Discuss conservation of materials. -Mark on a map the sources of the more common stones.	-*Rocks and Minerals* by Zim and Shaffer	-Discuss conservation of materials. •sources of non-ferrous metals •sources of enamels.	
-Note characteristics, properties, texture, color, etc., of the more common types of rocks.		-Identify the more common metals used in art metal.	

Systems or Processes	Time	Student Experiences and Activities in *LEATHER*	Instructional Media
4. <u>Testing</u>			
-Product research and development is important in a productive society.		-Compare genuine and synthetic leathers as to flexibility, wearability, workability.	
-Testing materials is an important function of manufacturing.		-Compare various leathers as to workability, color, feel, etc.	

Topic B. -Measurement and Layout
Concept: -Accuracy of measurement for layout is imperative in a productive society.

1. <u>Measurement and Layout</u>			
-There are two basic systems of measurement, i.e., English and metric.		-Illustrate the two basic systems of measurement, i.e., English and metric.	
-Layout and measuring tools provide man with a means of setting down, organizing and communicating ideas in an industrial society.		-Learn the proper identification and use of tools in the area.	
		-Be familiar with design and layout procedures.	
-The successful completion of a product depends on the choice of materials and accurate layout and measurement.		-Illustrate use and development of templates.	
		-Transfer designs to the material being used.	

Topic C. -Shaping and Fabrication
Concept: -Man manipulates materials, tools and equipment to shape and form products of his environment.

1. <u>Cutting</u>			
-Most cutting tools employ the wedge to separate materials		-Examine all the cutting tools and machines in the area to determine the cutting principles that are most common.	

Student Experiences and Activities in *LAPIDARY*	Instructional Media	Student Experiences and Activities in *ART METAL*	Instructic Media
-Test rocks for hardness. -Discuss what types of rocks are suitable for polishing and cutting, e.g., hardness, color, pattern, fracture.	-Moh's scale of hardness.		
-Use the two basic systems of measurement, i.e., English and metric. -Learn the proper identification and use of tools in the area. -Be familiar with design and layout procedures. -Illustrate use and development of templates. -Transfer designs to the material being used.		-Use the two basic systems of measurement, i.e., English and metric. -Learn the proper identification and use of tools in the area. -Be familiar with design and layout procedures. -Illustrate use and development of templates. -Transfer designs to the material being used.	
-Examine all the cutting tools and machines in the area to determine the cutting principles that are most common.		-Examine all the cutting tools and machines in the area to determine the cutting principles that are most common.	

Systems or Processes	Time	Student Experiences and Activities in *LEATHER*	Instructional Media
Cutting (Cont'd.) -Tools are an extension of man's faculties. -Cutting tools provide man with mechanical advantage and control. -A cutting edge must be of a harder material than the material being cut by that edge.		-Note the adjustable parts and the way in which adjustments, speed, pressure, direction, sharpness and support affect the cutting process. -Use as many of the cutting tools and machines as possible. Be sure to know their proper use and safety precautions.	
• <u>Shaping</u> -Removing materials or separating -The removal of materials for the purpose of shaping can be accomplished by applying the principle of the wedge.		-Discuss the procedure for changing a hide into useable leather of different thicknesses. -Use the cutting tools and machines that remove or separate materials, e.g., bevel point knife, revolving punch, round drive punch, common edger, skife rampart gouger, saddler's awl, thonging chisel, scissors. -Prepare leather for carving and tooling.	
<u>Molding</u>		-Discuss how parts of leather shoes are molded.	
<u>Forming</u>		-Surface decorate leather by stamping, flat modeling, embossing, stippling, veining, seeding. -Discuss stretch forming of leather, using a die.	

Student Experiences and Activities in *LAPIDARY*	Instructional Media	Student Experiences and Activities in *ART METAL*	Instructional Media
-Note the adjustable parts and the way in which adjustments, speed, pressure, direction, sharpness and support affect the cutting process. -Use as many of the cutting tools and machines as possible. Be sure to know their proper use and safety precautions.		-Note the adjustable parts and the way in which adjustments, speed, pressure, direction, sharpness and support affect the cutting process. -Use as many of the cutting tools and machines as possible. Be sure to know their proper use and safety precautions.	
-Use the cutting tools and machines that remove material, e.g., diamond saw, grinders. -Use a dop stick.		-Use the cutting tools and machines that remove material, e.g., saws, grinders.	
		-Procedure of annealing and pickling metals. -Know the procedure and the tools used to beat down metal into a form. -Know the procedure and the tools needed to form metal by raising. -Know the procedure for metal-spinning.	

Systems or Processes	Time	Student Experiences and Activities in *LEATHER*	Instructional Media
Forming (Cont'd.)			
5. Casting			

Topic D. -Fabrication
Concept: -Materials of similar or different properties and composition can be fastened by various methods.

1. Mechanical		-Know how and when to use mechanical fasteners properly, e.g., snap buttons, rivets, eyelets. -Know most common methods of lacing and their procedure. -Know when and how to stitch.	
2. Adhesion		-Be familiar with types of cements. -Know proper cementing procedure.	

Student Experiences and Activities in *LAPIDARY*	Instructional Media	Student Experiences and Activities in *ART METAL*	Instructional Media
		-Surface decorate metal by planishing, fluting, doming, spotting, stamping. -Illustrate the use of jigs for bending materials.	
		-Cast a project, using metal of a low melting point, e.g., cerebond.	
-Anchor stones by mechanical means, e.g., tabs.		-Know how and when to use mechanical fasteners such as rivets, screws.	
-Use epoxy cement as a bonding agent.		-Know cements to use on metals. -Know soldering procedures. -Silver solder a product. -Study types of porcelain enamel. -Know porcelain enameling procedure and apply it to a product.	

Systems or Processes	Time	Student Experiences and Activities in *LEATHER*	Instructional Media
3. Cohesion			
. Comparative Testing		-Compare the above fastening methods by such criteria as speed, holding power, cost, appearance and performance.	

'opic E. -Finishing
Concept: -Finishes are applied for the purposes of beauty, protection and sanitation.

.. Natural			
2. Coatings -The value of a product is enhanced by the quality of the finish. -The appearance and durability of materials can be changed by the application of a finish.		-Discuss reasons for finishing. -Discuss Safety precautions. -Discuss preparation for finishing. -Understand the factors involved in finishing, e.g. cleanliness. -Dye leather. -Apply finish such as liquid wax, paste wax, oil. -Discuss proper care of leather articles.	
3. Chemical			

Student Experiences and Activities in *LAPIDARY*	Instructional Media	Student Experiences and Activities in *ART METAL*	Instruction Media
		-Spot weld a product.	
-Compare the above fastening methods by such criteria as speed, holding power, cost, appearance and performance.		-Compare the above fastening methods by such criteria as speed, holding power, cost, appearance and performance.	
-Discuss reasons for finishing. -Discuss safety precautions. -Discuss preparation for finishing. -Understand the factors involved in finishing, e.g., cleanliness.		-Discuss reasons for finishing. -Discuss safety precautions. -Discuss preparation for finishing. -Understand the factors involved in finishing, e.g., cleanliness. -Study ways of surface-decorating, using porcelain enamels. -Spray paint, using spray cans.	
		-Color metal by chemical action, e.g., antique.	

Systems or Processes	Time	Student Experiences and Activities in *LEATHER*	Instructional Media
• Mechanical		-Finish edges of leather project	
• Heat			
• Comparative Testing			

opic F. -Educational and Occupational Projections.
oncept. -A productive society must prepare its youth to make realistic vocational choices.

Guidance		-Leather industries in Alberta. -Occupational and leisure time. -Opportunities related to leather work.	

Student Experiences and Activities in *LAPIDARY*	Instructional Media	Student Experiences and Activities in *ART METAL*	Instructional Media
-Study types of abrasives. -Know when to use the various types of abrasives. -Know finishing procedures such as sanding, polishing, buffing.		-Study types of abrasives. -Know when to use the various types of abrasives. -Know finishing procedures such as sanding, polishing, buffing.	
		-Color metal by applying heat.	
-Compare the results of finishes by criteria such as appearance, durability, resistance to stain or acid, ease of application.		-Compare the results of finishes by criteria such as appearance, durability, resistance to stain or acid, ease of application.	
-Mainly of an avocational interest. -Application to geology, jewelry and field stone.		-Mainly of an avocational interest.	

D E V E L O P M E N T A L R E S E A R C H

INTRODUCTION

Industrial arts is a field of study that should be constantly changing if it is to be relevant for a productive society. This means then, that new content and curriculum materials need to be developed and tested on a continuing basis. To allow time for this type of activity, provision was made in the course for a nine-twelve week unit entitled "Developmental Research".

This time-block gives the teacher the opportunity to develop new and experimental materials following the approval of the Supervisor of Industrial Arts and the school principal.

SPECIFIC OBJECTIVE

To develop new curriculum content for junior high school industrial arts.

SUGGESTED APPROACH

The Research unit is not circumscribed by any formal content. The course is entirely developed by the teacher. However, it must be properly documented as a research unit and should be developed using the format of the present guide. THE TEACHER MUST SUBMIT AN OUTLINE OF HIS PROPOSAL TO BOTH THE SUPERVISOR OF INDUSTRIAL ARTS AND THE SCHOOL PRINCIPAL FOR THEIR APPROVAL BEFORE BEGINNING.

A record should be kept of activities done by the students so that an evaluation becomes meaningful.

An evaluation of the unit with possible implications for the curriculum should be submitted to the Supervisor of Industrial Arts at the end of the experimental period.

VT 010 457
Curry, Harold A.
Line Casting Keyboard Operation-1.

Marie Katzenbach School for the Deaf, West Trenton, N.J.
Rutgers, The State Univ., New Brunswick, N.J. Curriculum Lab.
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IDENTIFIERS - *LINECASTING KEYBOARD OPERATORS

ABSTRACT - Prepared by an instructor at the Marie Katzenbach School for the Deaf for deaf students interested in becoming operators of linecasting machines, the illustrated handbook contains the following units: (1) Keyboard Operation, (2) Operation of Keyboard, (3) The Fingering System, (4) Word Practice, (5) Keyboard Practice, (6) Sentence Practice, (7) Punctuation Marks, (8) Capital Letters, (9) Proofreading, (10) Italic and Bold-face Type, (11) Figures, (12) Division of Words, (13) Straight Matter, (14) Caps and Small Caps, and (15) Care of the Machine. Objectives, information, and assignments make up each lesson of the units. Also included are a glossary of terms and an achievement test for each unit. (SB)

VT 010 457

ED0 45856

Department of Vocational-Technical Education
Rutgers · The State University
Graduate School of Education

LINE CASTING KEYBOARD OPERATION - I

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INTRODUCTION AND ACKNOWLEDGEMENTS

The purpose of this book is to serve as a handbook for those students interested in becoming operators of linecasting machines. Prepared especially for the students at the Marie Katzenbach School for the Deaf, it is the first of two books designed to make it easier for a deaf person to learn the basic fundamentals of the trade. The glossary at the back of the book should prove quite helpful.

Grateful acknowledgement is given to Mr. Benjamin Shapiro for editorial work, Intertype Corporation, and to the Mergenthaler Linotype Company for permission to use the many illustrations that appear in the text, and to Dr. Charles M. Jochem, Superintendent of the Marie Katzenbach School for the Deaf, for making this book possible.

Harold A. Curry

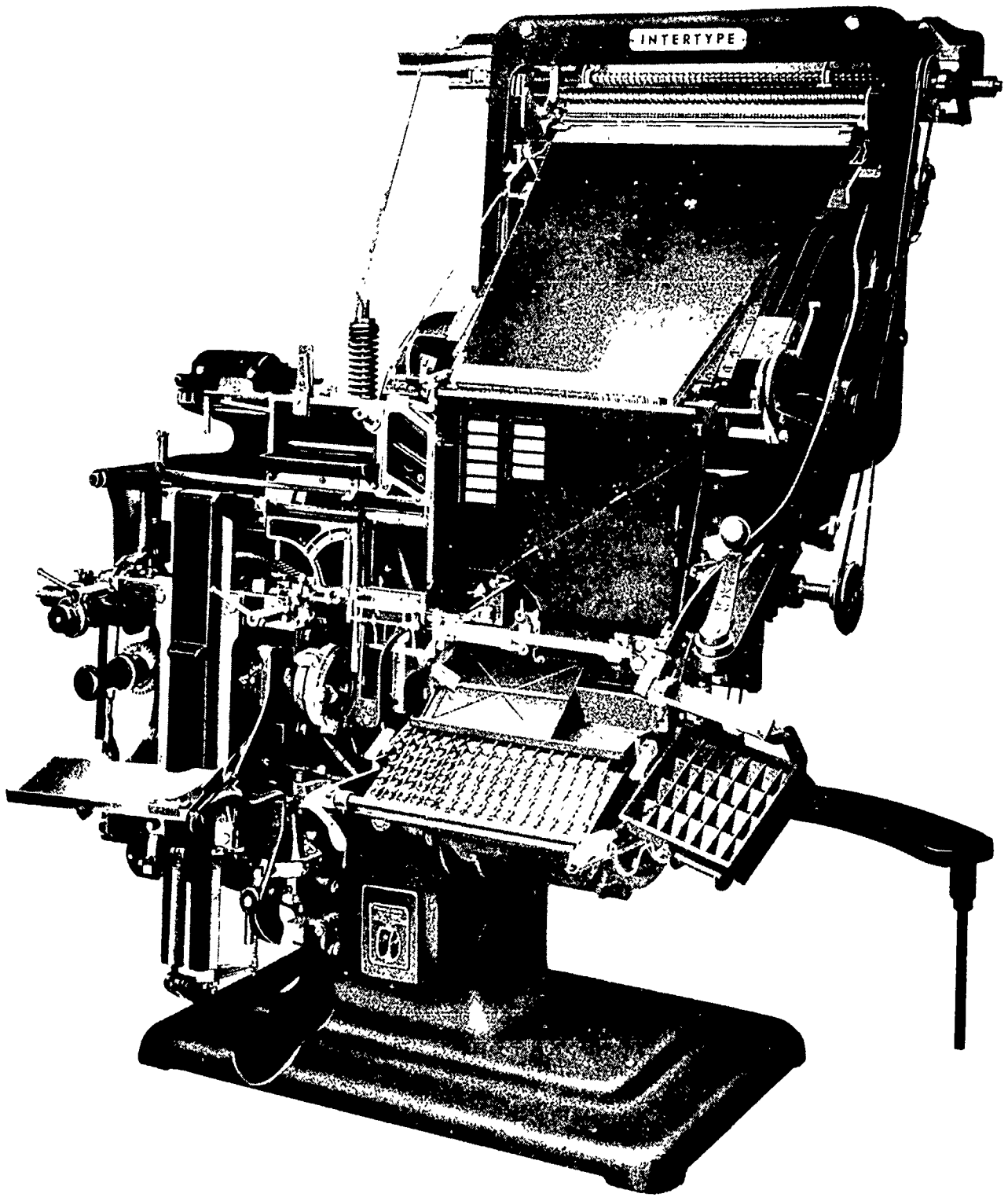
WHAT IS A LINECASTING MACHINE?

There are two types of linecasting machines. Each has its own trade name. One is called the Linotype Machine. The other is called the Intertype Machine. The work that they do is the same. They both have the same keyboard. They both use matrices and spacebands. Both machines eject their "line-of-type" or make lead "in-to-type," so, to avoid confusion, I will refer to these machines as linecasting machines. They both cast lines of type.

A linecasting machine has a keyboard with ninety keys on it. At the left of the keyboard is the spaceband key. When you push down on a key a matrix drops into the assembler. A matrix (usually called mat) is made of brass and has the letter stamped into it. When you push down the spaceband key you get a spaceband. (A spaceband is made of steel and is wedge shaped.) Spacebands are used to spread the line of mats. When you start to set type, you push down each key to assemble the letters to form the word you want. Then push down on the spaceband key to put the space between the words.

After you have enough words put together to make a line, you send it into the machine. The operation now becomes automatic. The line is next justified (spread to the right and left) by the wedge-shaped spacebands. Then the molten metal is pushed into the mold formed by the brass mats. The mats and spacebands are then separated and returned to where they belong. At the same time, the molten metal has become hard and is pushed out of the machine by the ejector. It has the words on its top and is a line of type. Meanwhile, the mats have been separated from the spacebands. The mats are returned to the magazine and the spacebands are returned to the spaceband box.

This explains the complete operation of a linecasting machine.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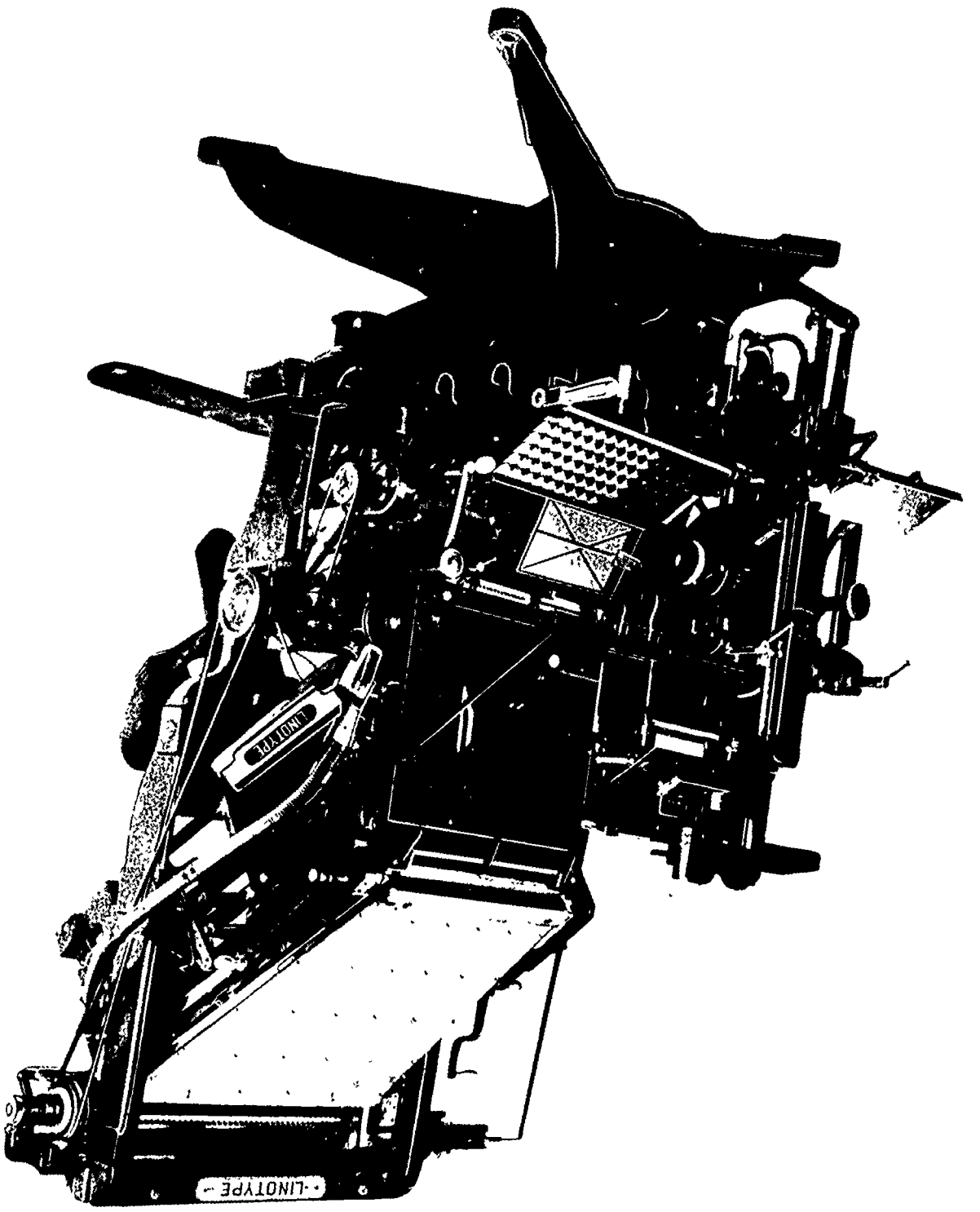
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LINOTYPE

UNIT I - KEYBOARD OPERATION

Education Lesson 1

OBJECTIVE:

To realize what education you need to become a successful linecasting machine operator.

INFORMATION:

You should have some knowledge of English grammar, sentence structure, spelling, punctuation, division of words, and pronunciation.

You must also have some understanding of addition, subtraction, multiplication, and division.

You must understand English to be able to recognize the mistakes in the copy that you are setting. You will find it difficult to divide words and to punctuate correctly if you do not understand the rules of the language.

You should know how to figure so that you can set different measures of type and divide the slugs when you are setting wide measures. You must also figure out how many lines of type you can set in a set amount of time.

ASSIGNMENT:

1. With what two subjects must you be familiar if you are to become a successful linecasting machine operator? Why?

2. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT I - KEYBOARD OPERATION

Knowledge of Printing — Lesson 2

OBJECTIVE:

To learn what you must know about printing before becoming a linecasting operator.

INFORMATION:

A student starting to learn how to operate a linecasting machine should have had a short course in printing. Then he will understand what type is and what its uses are. He will know how to read type. He will know how to space out type and why. He will know why he must be careful with the face of type. He will know how to follow a layout. If you do not understand any of the above printing terms, tell your instructor. It is very important that you understand the idea of printing before becoming a linecasting operator.

ASSIGNMENT:

1. Why should you understand printing before becoming a linecasting operator?

2. What is type?

3. Why must you be careful with the face of type?

4. There are some underlined words in this lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT I - KEYBOARD OPERATION

Proper Application — Lesson 3

OBJECTIVE:

To learn why hard work is necessary in becoming a linecasting machine operator.

INFORMATION:

Learning the keyboard of a linecasting machine can be monotonous to you, or it can be exciting. It depends on you.

You must remember to touch each key with the proper finger. You must get into a rhythm of the words. Soon you will find yourself going faster. That will mean that your fingers, eyes, and mind are all working together at the proper speed. Only when they are all working together can you acquire the proper rhythm so necessary to becoming a linecasting operator.

ASSIGNMENT:

1. Why must your fingers, eyes, and mind work together?
2. Why is there a certain key for each finger?
3. Is it easy to learn a linecasting machine keyboard?
4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

Speed Only One Factor — Lesson 4

OBJECTIVE:

To learn why speed is not the most important objective.

INFORMATION:

Do not try to be a fast operator. Learn the keyboard the right way. It will take you longer but try to remember that it is not how many lines of type you set, but how many correct lines you set. It takes twice as long to correct a mistake as it takes to set the line correctly the first time. Do not sacrifice good composition to gain speed.

An employer wants a person who can set type that is usable, not one that sets type that has to be corrected because of many mistakes. Re-setting takes time. Time is money to an employer, so learn to work accurately. Speed will come automatically after you practice enough.

ASSIGNMENT:

1. Should an operator try for speed first? Why?
2. How long does it take to re-set a line of type?
3. What do we mean when we say, "Time is Money?"
4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT I - KEYBOARD OPERATION

Errors Often Made by Operators — Lesson 5

OBJECTIVE:

To realize how "speed" can slow you down.

INFORMATION:

When you first start to set type, do not try to go fast. If you go too fast, you lose your rhythm and the work is not smooth. Try to set each word slowly at first, then a little faster. Build up your speed slowly. Be sure your lines are spaced evenly, or the finished work will look sloppy and may have to be re-set. This will make you lose time.

Remember accuracy and good spacing are the most important qualities.

Keep your eyes on the copy, not on the keyboard. Do not look at your fingers. Spell the words correctly and punctuate properly. It is better to produce quality type rather than a large quantity of incorrect type.

ASSIGNMENT:

1. What should you NOT DO when starting to set type?
2. Why should lines be spaced evenly?
3. Why shouldn't you go fast and then slow?
4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT I - KEYBOARD OPERATION

Speed of Fingers — Lesson 6

OBJECTIVE:

To train the fingers to touch the right key buttons.

INFORMATION:

It is very important that each finger touches the proper key button. Do not try to move the fingers faster than they can touch the right key buttons. If you try this it will confuse you and make you lose time. Start slowly and keep an even, steady motion. When you start to set type, wait for the assembling elevator to return to normal position before starting the next line.

Do not strike the keys with any other finger than the one assigned to it. It may seem as if it will take longer, but it will not. You must force yourself to use the proper keys. Only in this way can you expect to gain speed.

ASSIGNMENT:

1. Why is it important for the proper finger to strike the correct key?

2. Why should you start off slowly?

3. Is it practical to start off very quickly?

4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT I - KEYBOARD OPERATION

Speed Comes by Irregular Stages — Lesson 7

OBJECTIVE:

To learn why you cannot go faster when it seems you should be able to do so.

INFORMATION:

After you have been setting type for four or five weeks, you will find that you cannot go any faster. This means that you have reached your level of natural speed. To gain more speed you must force yourself. This means you must practice until you make your fingers more nimble.

Remember--do not become sloppy in your work to gain more speed. Accuracy is most important. Speed does not come to the beginner. He must go after it and get it.

ASSIGNMENT:

1. What is meant by natural speed?
2. Why is it important to strive for accuracy?
3. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT II - OPERATION OF KEYBOARD

How the Keyboard Works — Lesson 1

OBJECTIVE:

To learn how the keyboard operates.

INFORMATION:

The keyboard of a linecasting machine has keys, levers, cams, and many other parts.

When you push down a key, the lever in back moves the cam, the cam pushes up a rod that releases a matrix. The mat then drops onto a belt which carries it to the assembler. It is the touching of the key that starts the operation.

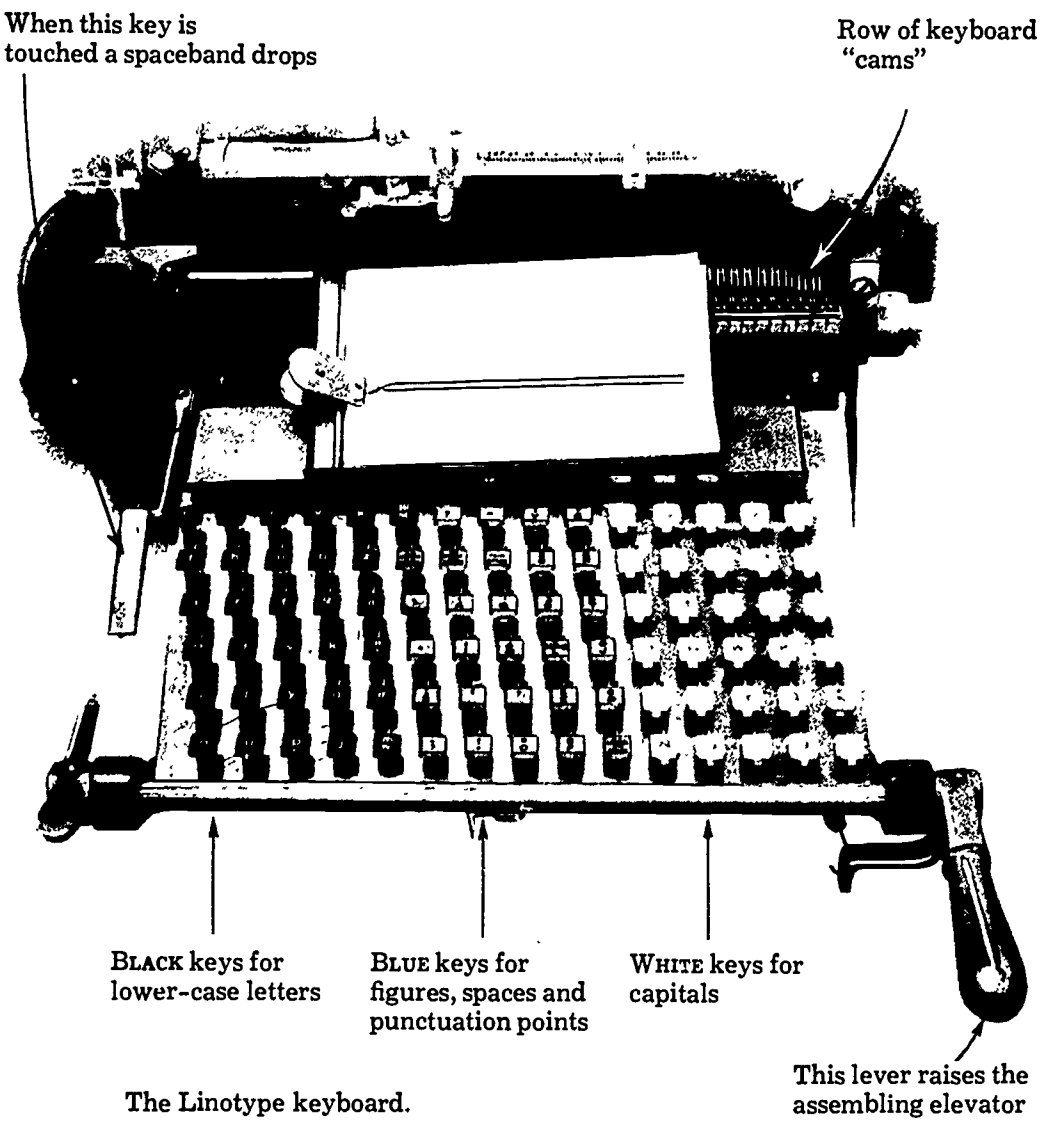
In this first year, you will learn how to operate a keyboard. Later, you will learn the simple repairs that can be made by the operators.

Many shops have a machinist or one man that is in charge of the machines. If you have trouble with the machine, call the machinist.

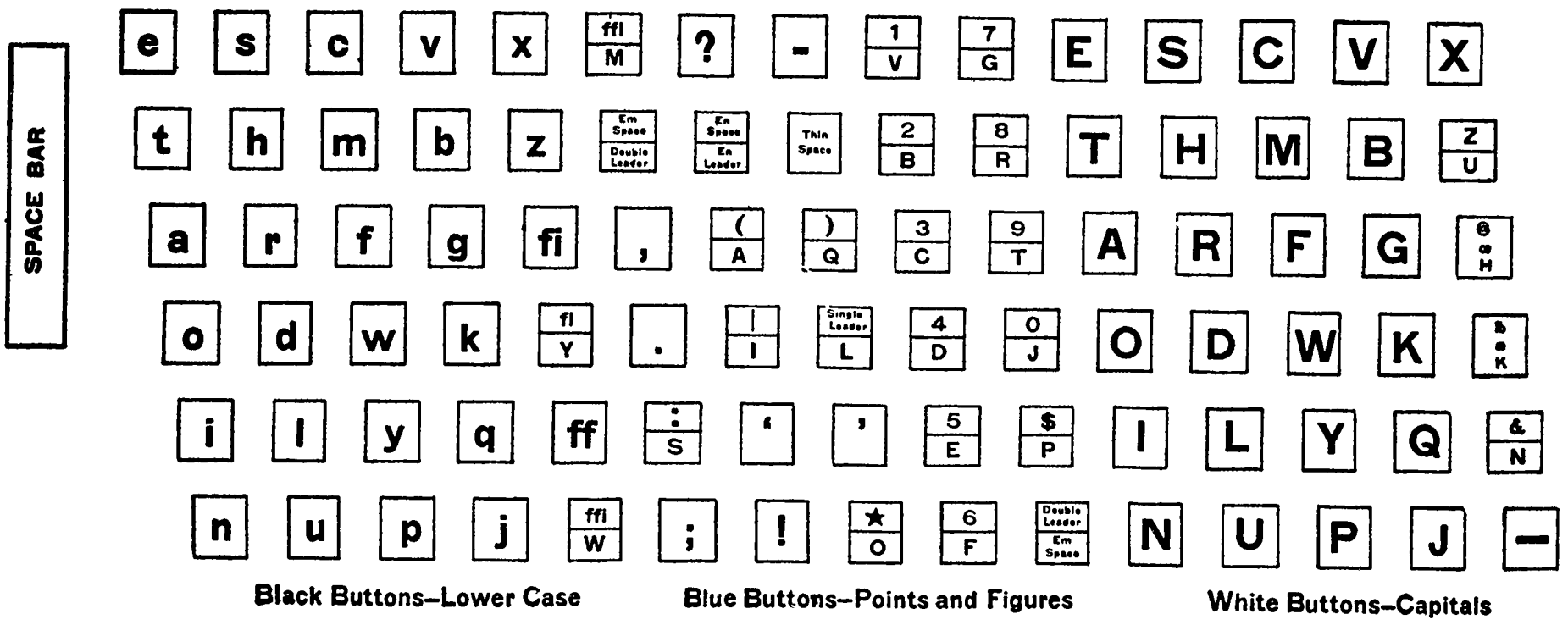
Here at school the instructor acts as the machinist. If you have trouble with the machine, tell the instructor.

ASSIGNMENT:

1. Explain the keyboard.
2. Who is to repair the machine?
3. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.



The Linotype keyboard.



UNIT II - OPERATION OF KEYBOARD

Standard Keyboard Arrangement — Lesson 2

OBJECTIVE:

To learn that the keyboard is divided into three different sections.

INFORMATION:

The standard keyboard consists of ninety keys arranged in six horizontal rows of fifteen keys each. In addition to the keys, the space-band is located at the left of the keyboard.

Three sections will be noticed on the keyboard (see illustration). Each group is set apart by colored buttons. The black buttons are the lower case. White buttons are the capitals. Blue buttons are the figures, marks of punctuation and other miscellaneous characters.

This keyboard should be memorized so that you can operate it without looking directly at the fingers or the keys. Your eyes will then be free to follow the copy and to watch the matrix or mats assemble.

ASSIGNMENT:

1. How many keys are there on a standard keyboard?
2. What colors are the three divisions of the keyboard?
3. Explain what keys each color represents.
4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT II - OPERATION OF KEYBOARD

Position at Keyboard — Lesson 3

OBJECTIVE:

To learn how to sit correctly at the machine.

INFORMATION:

In order to operate all day with a minimum of tiredness, you must sit properly. Use a comfortable chair. Do not sit bent over. Sit straight and tall and breathe in a normal way. Put both feet firmly on the floor. Your arms should not be held away from your body. They should hang naturally by the sides.

The palm of each hand should be close to the keyboard. You should be in front of the first two rows of key buttons on the left side of the keyboard. The letters e t a i o n and s h r d l u should come to the center of the body.

ASSIGNMENT:

1. What kind of chair should you sit in?
2. What two rows of keys should come to the center of your body?
3. Why should you avoid becoming tired?
4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT III - THE FINGERING SYSTEM

Basic Position of Hands — Lesson 1

OBJECTIVE:

To know where to place your hands before starting to operate.

INFORMATION:

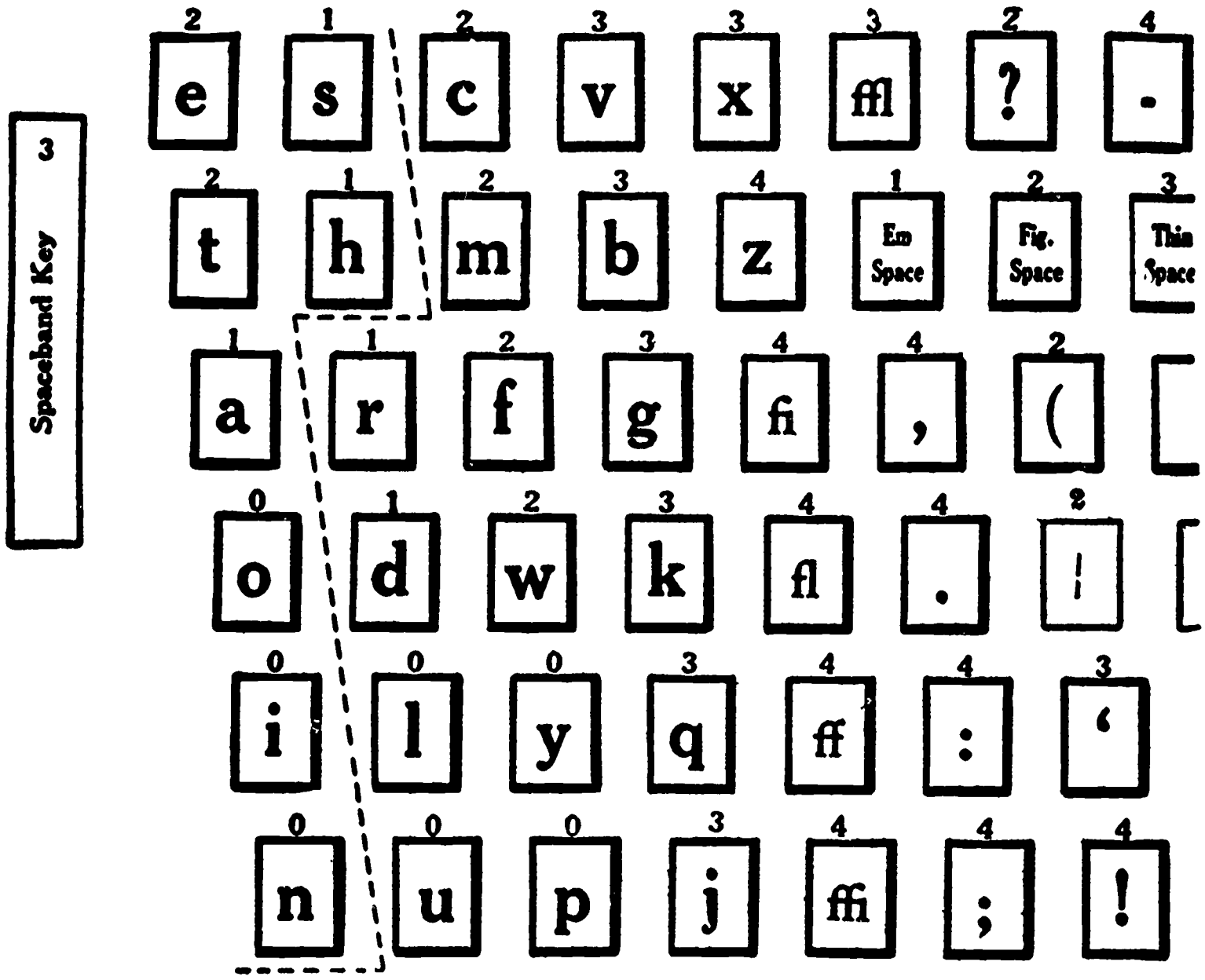
In order to operate the keys without looking at them, the hands must always take a fixed position at the keyboard.

Place the left hand over the keyboard so that the second finger rests over the "t" button and the thumb over the "i" button. This will bring the first finger over "a". Place the right hand so that the thumb comes over "l" and the first finger over "r". The second finger is over the "m" and the third is over the "b". This is the basic position for the hands. The left hand will never have to travel away from this position for operating key buttons.

ASSIGNMENT:

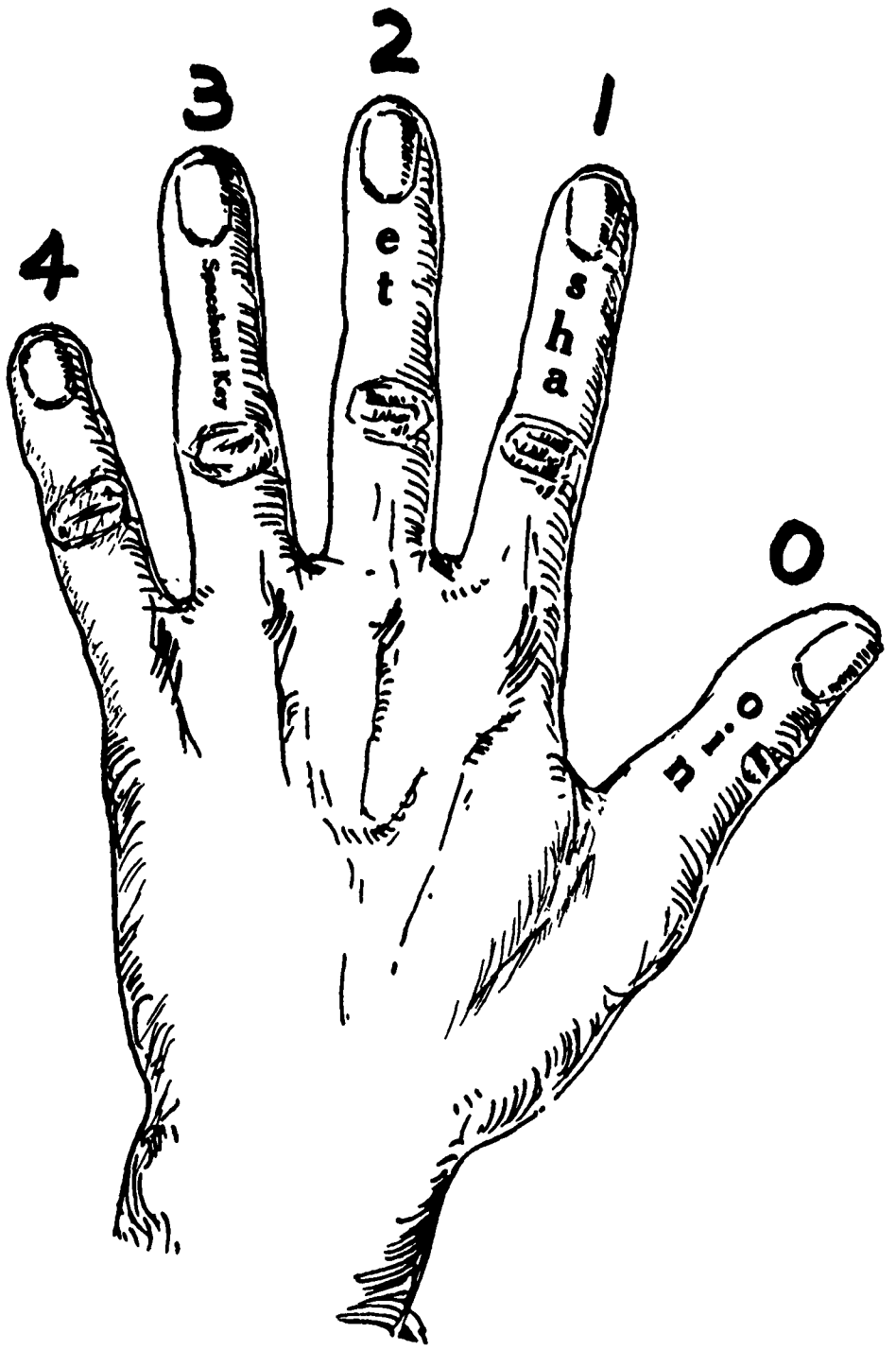
1. What is meant by fixed position at the keyboard?
2. What three letters do the fingers of the left hand rest upon?
3. What letters do the fingers of the right hand rest upon?
4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

ASSIGNMENT OF FINGERS TO THE KEYS



—Courtesy Mergenthaler Linotype Co.

Keys to the left of dotted line are to be operated by the left hand; the right hand manipulates the rest of the keyboard. "O" means the thumb.


4
3
Speaker Key
2
e
t
1
s
h
a
0

UNIT III - THE FINGERING SYSTEM

Use of Left Hand — Lesson 2

OBJECTIVE:

To learn how to place the fingers of the left hand on the proper keys.

INFORMATION:

The linecasting machine has ninety keys. You have ten fingers. Five on each hand. The thumb and three fingers of the left hand are responsible for touching eight key buttons and the spaceband key. The right hand is responsible for touching the other eighty-two keys. The fingers of the left hand are numbered.

0 - thumb
1 - index finger
2 - second finger
3 - third finger
4 - fourth finger

These are the key buttons each finger of the left hand should touch:

s, h, and a	-	first finger
e and t	-	second finger
o, i, and n	-	thumb
spaceband key	-	third finger

The fourth finger is not used.

Never touch a key button unless you use the proper finger.

ASSIGNMENT:

1. How many key buttons are there on the linecasting machine keyboard?

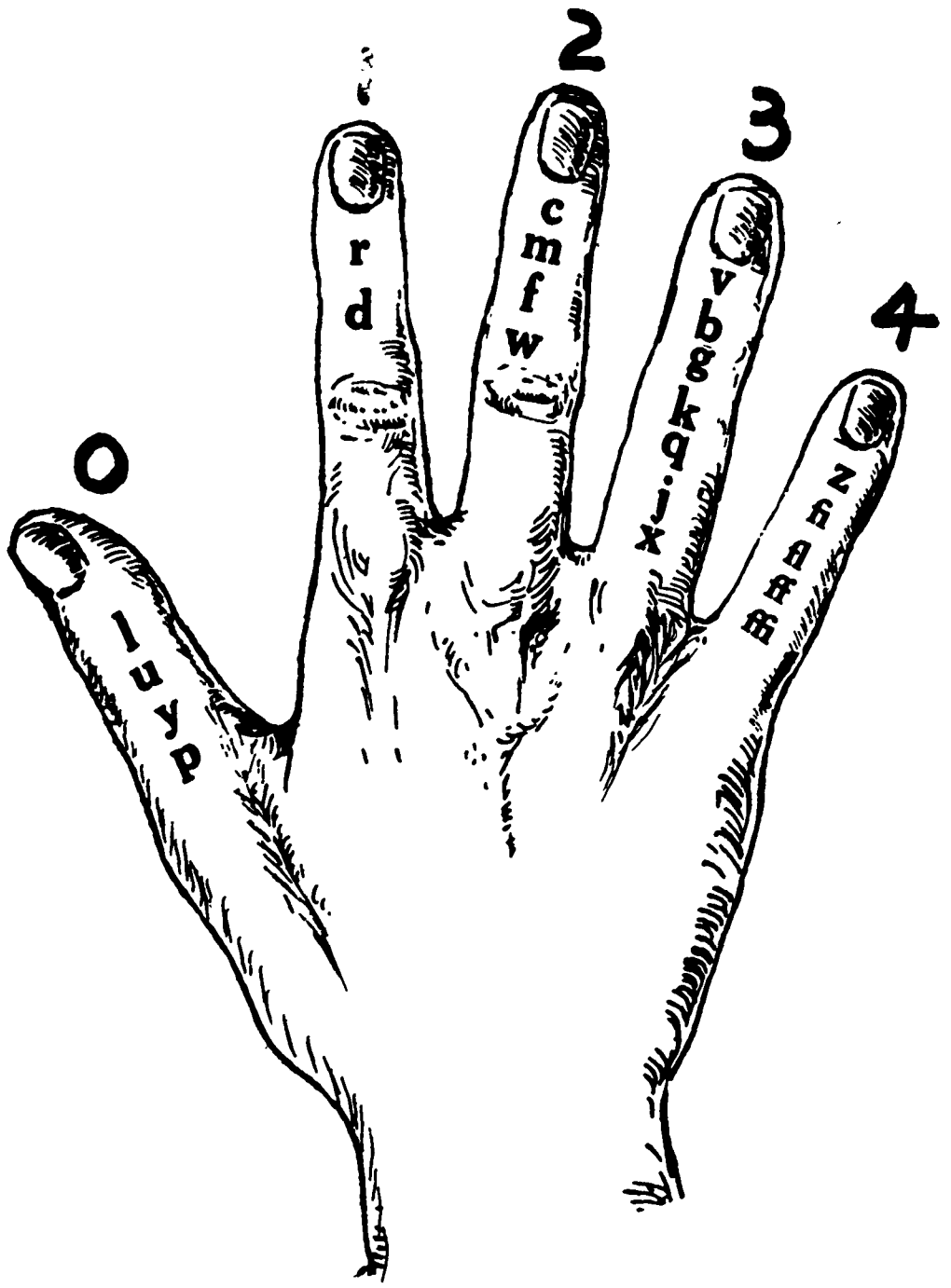
2. What letters are struck with the thumb of the left hand?

3. What letters are struck with the left index finger?

4. What letters are struck with the third finger of the left hand?

5. What letters are struck with the fourth finger of the left hand?

6. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.


0
1
2
3
4
r
d
c
m
f
w
v
b
g
k
q
j
x
z
s
h
n

UNIT III - THE FINGERING SYSTEM

Use of Right Hand — Lesson 3

OBJECTIVE:

To learn how to place the fingers of the right hand on the proper keys.

INFORMATION:

In the lesson before this you learned that the right hand was responsible for eighty-two keys. The fingers of the right hand are numbered in the same manner as those on the left.

0 - thumb
1 - index finger
2 - second finger
3 - third finger
4 - fourth finger

These are the key buttons for the fingers of the right hand:

r, d, and em space	-	first finger
c, m, f, and w	-	second finger
v, b, g, k, q, j, x, and ffl	-	third finger
z, fi, fl, ff, and ffi	-	fourth finger
l, u, y, and p	-	thumb

The comma, period, colon, and semicolon are struck with the fourth finger.

ASSIGNMENT:

1. How many keys is the right hand responsible for?
2. What letters are to be struck with the first finger?
3. What letters are to be struck with the thumb?
4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT III - THE FINGERING SYSTEM

Finger Practice — Lesson 4

OBJECTIVE:

To learn how the fingers should strike the keys.

INFORMATION:

When you sit down to start your word practice, assume the proper position at the keyboard. The fingers of the hand should not be widely stretched apart nor rigid. They should be slightly curved. The striking motion should be from the knuckle and not from the wrist. Depressing the key lever should be a finger not a hand motion. Remember, the keys have a hair-trigger touch and the slightest movement of the button will cause the release of a mat.

ASSIGNMENT:

1. What type of motion should you use in striking the keys?
2. Should the fingers be stretched far apart? Explain why.
3. What causes the mats to fall quickly?
4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT IV - WORD PRACTICE

Use of First and Second Fingers — Lesson 1

OBJECTIVE:

To learn how to use the first and second fingers on the linecasting machine keyboard without looking at the keys.

INFORMATION:

When you push down a key always use the same finger. That way you learn which finger pushes which key. In this lesson practice the words using the same fingers on the keys. Practice each word for two minutes without looking at the keyboard. Lock the matrices in the magazine before starting your word practice. After each word strike the space-band key with the third finger of the left hand.

at	her	farm
are	that	what
the	fact	harm
set	scarf	march
hat	see	tram

ASSIGNMENT:

1. Which key buttons do the fingers of the right hand strike?

2. Which key buttons do the fingers of the left hand strike?

3. Which finger strikes the spaceband key?

4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT IV - WORD PRACTICE

Use of Third Fingers — Lesson 2

OBJECTIVE:

To learn the use of the third fingers on the linecasting machine keyboard without looking at the keys.

INFORMATION:

It is very important that you use the finger on the right key button. Below are a list of words that you should practice. Practice each word for two minutes. Do not look at the keyboard. Lock the matrices in the magazine before starting your word practice. After each word, strike the spaceband key with the third finger of the left hand.

rage	extra
dark	grave
back	severe

ASSIGNMENT:

1. What do you strike with the third finger of the left hand?

2. What key buttons do you strike with the third finger of the right hand?

3. Which finger did you use to strike the spaceband key?

4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT IV - WORD PRACTICE

Use of Thumbs — Lesson 3

OBJECTIVE:

To learn the use of the thumbs on a linecasting machine keyboard.

INFORMATION:

In this lesson you find the use for the thumbs. Do not try to go fast but use a smooth, flowing rhythm. After each word strike the space-band key, Practice each word for two minutes. Lock the matrices in the magazine before starting your word practice. Do not look at the keyboard. After each word strike the spaceband key with the third finger of the left hand.

your	quick	liquor	merely
thing	wrong	delving	unjustly
world	jump	personal	mutual

ASSIGNMENT:

1. What key buttons do you strike with the thumb of the left hand?

2. What key buttons do you strike with the thumb of the right hand?

3. There is an underlined word in the lesson. Find it and give its meaning. Use this word in a sentence.

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UNIT IV - WORD PRACTICE

Use of Fourth Finger — Lesson 4

OBJECTIVE:

To learn the correct use of the fourth finger.

INFORMATION:

In this lesson you will use the fourth finger of the right hand. Go slow. Do not worry about speed. Lock the matrices in the magazine before starting the word practice. After each word strike the spaceband key with the third finger of the left hand. Practice the following words for two minutes for each word.

five	zebra	affluent
fling	suffer	puzzled
prize	official	efficient

extra fine flavor.
when you realize,
suffer severe pain!

ASSIGNMENT:

1. What key button did you strike with the fourth finger of the right hand?

2. What key do you strike with the third finger of the left hand?

3. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT IV - WORD PRACTICE

Double Letters — Lesson 5

OBJECTIVE:

To learn how to set a word with two letters the same next to each other.

INFORMATION:

To make a letter drop two times, push the key down two times. Do not hold the key down. If you do, you will get more than two letters. Do not be careless in touching the keys or you will get the letter next to the one you want. Push down only the key that you want to push. Go slowly and be careful. Do not try to go fast. Lock the matrices in the magazine before you start your word practice. Practice each word two minutes.

Strike the spaceband with the third finger of the left hand after each word.

been	flood
dragging	pulley
occur	dimmer
arrest	oppose

accident happens
getting his lesson
with good feeling
calling at this address

ASSIGNMENT:

1. How do you make two letters drop together?

2. Explain why you cannot hold down a key button to get two letters.

3. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT IV - WORD PRACTICE

Jumping of Fingers — Lesson 6

OBJECTIVE:

To train the fingers to jump from one key to the next for letters that use the same finger.

INFORMATION:

In this lesson you will practice setting words that use the same finger to push down the keys. In the word join you will see that the fingers that push down the keys are the third finger and the thumb. The third finger pushes down the j and the thumb pushes down the o, i, and n. That means that the thumb jumps from the o to the i to the n.

Lock the matrices in the magazine and practice the words following this paragraph. Strike the spaceband key after each word. Practice each word for two minutes. Do not push down a key unless you use the correct finger.

join	session	punishment
jump	question	at the annual session
luring	luminous	should anybody question
should	lubricate	draw the first prize

ASSIGNMENT:

1. Which finger do you use on the w?

2. Which finger do you use on the e?

3. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT IV - WORD PRACTICE

Widely Separated Letters — Lesson 7

OBJECTIVE:

To train the fingers to reach for letters that are far apart.

INFORMATION:

In this lesson the words have letters that are separated on the keyboard. That means that in the six rows of keys you will have letters from the top and bottom rows. Or, you may have letters that are two or three rows apart. Practice each word for two minutes. Do not look at the keyboard. Try to move your fingers smoothly. Lock the matrices in the magazine before starting the practice words. Strike the spaceband key after each word with the third finger of the left hand.

next	acknowledge
page	cancel
envy	poverty
dizzy	advance

luxury and extravagance
illuminate the park at night
print a special page next week
a lively time at the last session

ASSIGNMENT:

1. Why should you move your fingers smoothly?
2. Which finger do you use on x?
3. Which finger do you use on l?
4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT IV - WORD PRACTICE

Ligatures Lesson 8

OBJECTIVE:

To learn how to use letters that are together. These are called ligatures.

INFORMATION:

A ligature is two or three letters that are formed to make one. If they were separate there would be too much space between them. This way they look better. The ligatures are fi, fl, ff, ffi, and ffl. In the practice lesson you will find words that contain ligatures.

Set each word five times. Strike the spaceband key after each word.

Lock the magazine before you start.

find	flirt	offer	affix	raffle
first	flush	differ	office	scuffle
fitted	fling	offend	affirm	affluent
fiscal	fluent	affront	suffice	muffled
finish	flourish	diffuse	affiliate	baffled

ASSIGNMENT:

1. What is a ligature?
2. Which finger do you use on the ligature ffi?
3. Which finger do you use on the ligature ffl?
4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT V - KEYBOARD PRACTICE

Assembler | Lesson 1

OBJECTIVE:

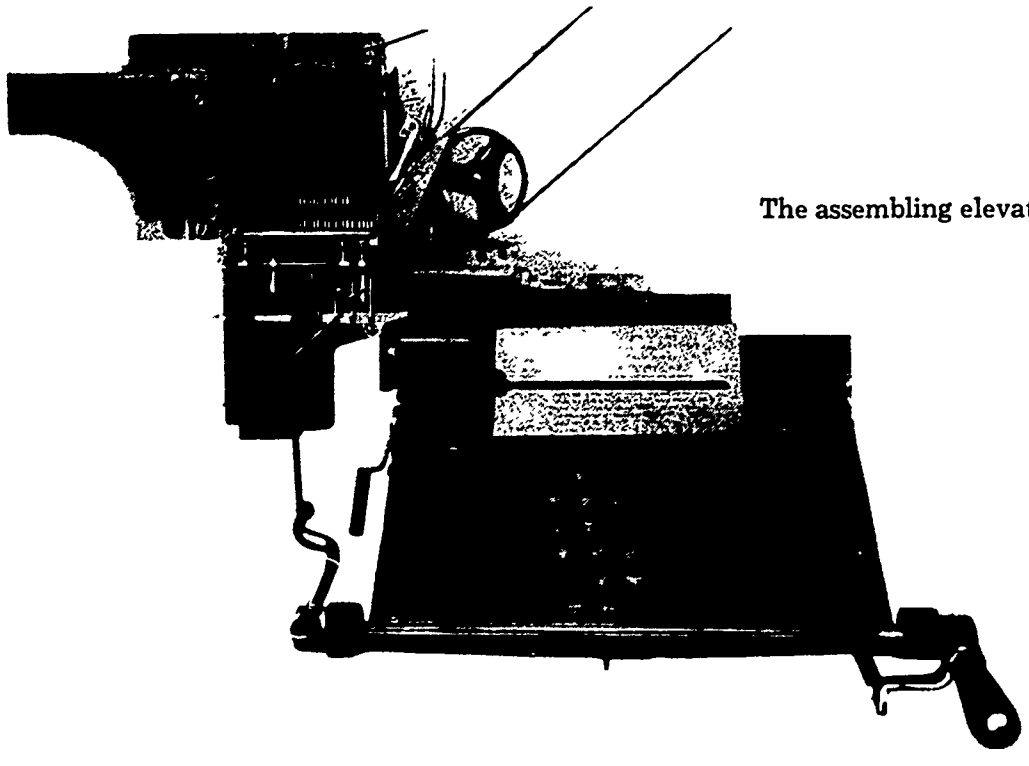
To become familiar with the assembler of the linecasting machine.

INFORMATION:

In the lessons before this you learned to memorize the keyboard. You did not see the mats or the spacebands fall into the assembler. They were locked in the magazine.

In this lesson you will learn how the assembler puts the mats together to make words and puts the space between them. Have the instructor remove the pot plunger pin. Now you can assemble a line of type but the machine will not cast a slug. Push down the keys e a t. Now push down on the spaceband key. If you will look at the assembler you will see that the letters e a t have formed the word eat. The spaceband is next to the t. Now repeat the word eat with the spaceband after it until the line is full. DO NOT PUT A SPACEBAND AFTER THE LAST WORD. Do you see the star wheel (the wheel that pushed the mat) turning? If it has stopped, the line is too tight. A TIGHT LINE SHOULD NOT BE SENT INTO THE MACHINE. Take out a mat and start the wheel turning again. Now raise the assembling elevator and send the line of mats into the machine.

You have just finished the hand operating part of the linecasting machine. The rest of the operation is automatic.



The assembling elevator.

ASSIGNMENT:

1. What is the assembler used for?

2. What does it mean if the star wheel stops turning?

3. How do you start the star wheel again?

4. There are some words underlined in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT V - KEYBOARD PRACTICE

Practice Exercise One — Lesson 2

OBJECTIVE:

To practice setting and spacing words while not looking at the keyboard.

INFORMATION:

By this time you should have memorized the keyboard. That means your fingers know where each key is without looking at it. There is a group of words at the end of this lesson. Set each word and repeat it until it makes a full line. You should practice each word until you can set it without looking at the keyboard or assembler. Just look at the copy. Use the same fingers each time you set the word. Have the instructor remove the <u>pot plunger pin</u> before starting the lesson.

eat eaten ate are ore arena tea tear tare art rat tart

tar ear rare earn tore tare rate tan ran ant ten

tent rent net tenor enter ante tenant neat treat retreat

entreat near nearer tartar trot rare none note tone neat

ASSIGNMENT:

1. Why should you be able to touch the keys without looking at them?

2. When setting type, what should you keep your eyes on?

3. There are some words underlined in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT V - KEYBOARD PRACTICE

Practice Exercise Two — Lesson 3

OBJECTIVE:

To train the fingers to set letter combinations used in different words.

INFORMATION:

This lesson is almost the same as the one before. You will ask the instructor to remove the plunger pin. Then start to practice the group of words which follows this paragraph. You should practice each word until you can set it without looking at the keyboard or assembler. Just look at the copy. Use the same fingers each time you set the word. Go slow. DO NOT TRY FOR SPEED.

tune retinue inaugurate unitarian returning untiring flung

fortunate unfortunate untrue enroute guarantee outgoing

tenure grunting refute gauge gouge ruining refuting fount

turnout touring fortune tuning grout argue turner again

nougat urging never fruitage infuriate automobile ragout

ASSIGNMENT:

1. What should you watch when operating a linecasting keyboard?
2. Why should you ask the instructor to remove the plunger pin?
3. There are some words underlined in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT V - KEYBOARD PRACTICE

Practice Exercise Three — Lesson 4

OBJECTIVE:

To train the fingers, eyes, and mind to work together.

INFORMATION:

This is a practice lesson. Have the instructor remove the plunger pin as in the other lesson. Practice setting each word until you can set it without looking at the keyboard or assembler. Remember, by learning a little more each day you can become a good linecasting operator. GO SLOW. DO NOT try for speed.

wave factor active event eventually never comfort recent

advance give given voice effect advent mouse convent

advice move dove affect court count care rice mice curb

card conduct cord vacate crown revenge cork croak vain

beacon picnic become between decade frantic river twice

wave country factor active recent event eventually never

comfort ocean once doctor native crane cigar evening view

UNIT V - KEYBOARD PRACTICE

Practice Excercise Four — Lesson 5

OBJECTIVE:

To train the fingers to gain rhythm.

INFORMATION:

Practice the lesson that follows this paragraph. Have the instructor remove the plunger pin before you start.

time miner team mount mountain before begin beginning

affront afford affect offend shuffle ruffling effluence souffle

bargain number member beyond uniform garden toward

reward town winter writing flower giraffe buffet rebuff

scuffle mosquito ruffling efflorescence adequate eloquent

equator quietly masquerade index exact index sextet fixture

sixth extort extract frozen amazing horizon zenith hazard

UNIT V - KEYBOARD PRACTICE

Practice Exercise Five — Lesson 6

OBJECTIVE:

To train the fingers to move smoothly.

INFORMATION:

Practice the lesson which follows this paragraph. Have the instructor remove the plunger pin before you start.

the there their them then thence theirs therefore these they

that this those than thin thing think third three than

though thought through thorough thoroughly throughout

and over under into out after before about from for forth

who what when where whose whenever whatever was

whether weather while which wish whole whom why went

UNIT VI - SENTENCE PRACTICE

How to Set a Sentence — Lesson 1

OBJECTIVE:

To actually set a complete line of type and have it cast on the machine.

INFORMATION:

Up to now you have been practicing setting words. You pushed down the keys and the mats would fall. The machine would go through its motions but the slug or line of type would not come out because the pot plunger pin had been removed. Now you will set type and be able to see the result. After the line of mats has been assembled, you raise the assembling elevator. This puts the machine into casting position. Before it will start you must release the clutch. The clutch allows the casting part of the machine to start working. If the line of type that you have assembled is correct, it will go through the machine in a smooth operation. If the line is too loose (not enough mats or spaces to make a full line), the line will not cast. If the line is too tight (too many mats or spaces), the machine will stop.

Each line must be set with the proper amount of mats and spacebands. No one cal tell you how many mats and spacebands are enough. You must find this out for yourself.

DO NOT START THIS LESSON WITHOUT THE INSTRUCTOR.

Set the line--

The quick brown fox jumped over the lazy dog.

Add enough spaces to make a full line. The star wheel should move freely. The instructor will show you how to make sure you have it right. Send the line into the machine and have it complete the full casting operation.

ASSIGNMENT:

1. How many mats should you put in a line?
2. How can you tell if a line is too tight? too loose?
3. There are some words underlined in the lesson. Find them and give their meaning. Use each of these words in a sentence.

ERIC

UNIT VI - SENTENCE PRACTICE

Short Sentences — Lesson 2

OBJECTIVE:

To learn how to set a short sentence or groups of words.

INFORMATION:

In the lessons before this you have just set words. In this lesson you will set groups of words and short sentences. At the end of this paragraph there is a list of short sentences and groups of words. Set each sentence and group and keep repeating it until you can set it without looking at the keyboard. Then go on to the next sentence or group.

Be sure that you are spacing your lines correctly. Do not put a space-band at the end of the line. Do not put two spacebands together. DO NOT SET the lines too tightly.

ASSIGNMENT: Set the following:

The iron gate. An old goat. The cold weather. Air raid signal.

Nine inning game. The editor was drafted. A good friend.

The girl is ironing. He earned some money. He had no intention.

She ignored him. Eight and nine are seventeen. He is grading the garden. They found a gold ring. Read the copy carefully.

A gelding is a horse. She ran to the tent. Do not forget this lesson.

Practice makes perfect. The fate of the nation. Come to my home. some day. It rained all day. The end of the lesson.

The quick brown fox jumps over the lazy dog.

UNIT VI - SENTENCE PRACTICE

Alphabetic Sentences — Lesson 3

OBJECTIVE:

To train the eyes, mind, and fingers to remember larger groups of words.

INFORMATION:

You should now be ready to set longer sentences.

ASSIGNMENT:

Set the following:

He that hath a trade hath an estate.

Diligence is the mother of good luck.

The tortoise was the first efficiency expert.

Concentration is the first condition of success.

A good worker is worth more than a poor manager.

If you want a thing to succeed, get behind it and push.

Raise your own seed corn and be sure of a crop that is worth tilling.

Sloth makes all things difficult, but industry all easy.

If the text and the initial are in one color, should they harmonize?

The man at the top is the one who has been in the habit of going to the bottom of things.

UNIT VI - KEYBOARD PRACTICE

Finger Gymnastics — Lesson 4

OBJECTIVE:

To set perfect work by reading letters in copy.

ASSIGNMENT:

Set each line five times. Set each group of letters by looking only at the copy--not the keys or your fingers. Work slowly on this.

etao nrfgfl etao nrfgfl etao nrfgfl etao nrfgfl etao nrfgfl etao

oate flgfrn oate flgfrn oate flgfrn oate flgfrn oate flgfrn oate

nertf agofl nertf agofl nertf agofl nertf agofl nertf agofl nertf

floga ftren floga ftren flogt ftren flogt ftren floga ftren floga

nert flogaf nert flogaf nert flogaf nert flogaf nert flogaf nert

PUNCTUATION MARKS

.	'	,	-	:	;	!	?
PERIOD	APOSTROPHE	COMMA	HYPHEN	COLON	SEMI-COLON	EXCLAMATION	QUESTION

( )	“ ”
PARENTHESES	QUOTATION MARKS

UNIT VII - PUNCTUATION MARKS

Explanation Lesson 1

OBJECTIVE:

To explain why we need punctuation marks.

INFORMATION:

Punctuation marks are signals. They are used in writing and printing. If you want to, you can call them road signs. The copy that you set can be the road and the signs tell you what to do.

The period is the same as a stop sign.

.	Period	When you see it, you stop reading and
,	Comma	take a big breath. A comma means slow down
-	Hyphen	and take a short breath. A hyphen means
:	Colon	that you are breaking a word in half.
;	Semi-colon	One half stays on the top line and the second
!	Exclamation point	half goes on the next line.
?	Question mark	There is a list of the punctuation marks at
'	Apostrophe	the left of this page. Each one of them has
"	"Quotation marks	has a special meaning.
( )	Parenthesis	

You are probably familiar with most of these marks. It will be good for you to review them. Learn the ones you do not know and their uses. The lessons that follow will explain each one separately.

UNIT VII - PUNCTUATION MARKS

The Period . Lesson 2

OBJECTIVE:

To learn the use of the period.

INFORMATION:

The period is a round mark. It looks like this . The period marks the end of a sentence.

Example: Tommy can set type.

It is used after abbreviations. That means when you take a long word and shorten it.

Examples:	West Trenton	W. Trenton
	Number	No.
	Dozen	Doz.
	New Jersey School for the Deaf	N. J. S. D.

It is used as a decimal point. That means when you separate dollars from cents in the use of money.

Examples: $ 1 00

$25.00

$25.50

It is used after initials.

Examples: T. H. C.

H. A. C.

ASSIGNMENT:

1. Where do you use a period?

2. Make up a sentence and use a period.

3. Put in periods where they are needed.

   a. It is raining hard I must go home

   b. The Jones Co makes pencils they are not very good, however

   c. The steak is $125 a pound

   d. A lb is 16 oz I learned this in school

   e. Gen U S Grant later became president

   f. Our school is in W Trenton, N J

   g. Dr C M Jochem is our superintendent Mr H Wyks is the boys' principal Mrs M Pieslak is the girls' principal

   h. My seat is No 5 Bill's seat is No 7

   i. I saved $250 this week from my allowance

   j. I bought 3 doz eggs for $2 10

4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT VII - PUNCTUATION MARKS

The Comma , Lesson 3

OBJECTIVE:

To learn the use of the comma.

INFORMATION:

The comma is a round mark with a tail on its bottom ,. It is used to separate parts of dates.

Example: July 4, 1965

It is used to separate groups of three figures in large numbers.

Example: Light travels 186,427 miles a second.

It is used after yes or no when it is part of an answer.

Example: Yes, I wrote the letter. No, I do not understand.

It is used after each word or phrase in a series, except the last.

Example: Brains, type, presses, paper, ink and power are used by printers.

There are other uses you will learn as you progress. They are too numerous for this one lesson.

ASSIGNMENT:

1. Where do you use a comma?

2. Make up a sentence using a comma.

3. Put in commas and periods where they are needed.

   a. My birthday is April 10 1950

   b. The new school cost $3 4 6 9 5 0 0

   c. He earns $10000 a year that's a good salary

   d. Yes I know the answer

   e. I have paper pencil eraser and ink

   f. I live at 19 Main St Elmville N J

   g. John's birthday is May 5 1951 Mary's is August 16 1952 Joe's is Nov 2 1950

   h. The house cost $7999

   i. No I can't go

   j. We had orange juice toast fried egg and milk for breakfast

4. If you know any other uses for the comma, write them down.

5. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT VII - PUNCTUATION MARKS

The Hyphen - Lesson 4

OBJECTIVE:

To learn how to use the hyphen.

INFORMATION:

The hyphen is a short line - . It is used to divide words. It can also be used to join two words. Most of the time it is used to divide a word. The hyphen is used at the end of the line where a word is broken.

All words cannot be divided. It is up to you to know where to divide a word. Common words you should know. Words that you do not use every day, you can look up in the dictionary. A dictionary tells you how to spell a word, how to pronounce it, and what it means. It also tells you how to divide a word. If you do not understand a word, look it up in the dictionary. It is good training.

Words are divided between the syllables. A syllable is a group of letters that show a sound. Do not divide a word of one syllable. Do not divide a word that has only four or five letters.

USE YOUR DICTIONARY TO HELP YOU DIVIDE WORDS.

ASSIGNMENT:

1. Where do you use a hyphen?
2. Divide the following words:

election	committee	horse	presentable	composing
punctuation	hippopotamus	fight	considerable	drumming

3. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT VII - PUNCTUATION MARKS

The Colon : Lesson 5

OBJECTIVE:

To learn how to use a colon.

INFORMATION:

A colon looks like two periods. One is on top of the other : . A colon is used to start a list.

Example: Some of the objects used in a print shop are:

type
chases
presses

You can also use a colon to show that two parts of a sentence are really the same.

Example: The scores were: N.F.S.D. 24 - P.S.D. 18

A colon shows the difference between hours and minutes.

Example: 10:30 a.m. 3:30 p.m.

Wherever you list anything, use a colon first.

ASSIGNMENT:

1. Where do you use a colon?

2. Write a paragraph and use a colon in it.

3. Put in colons where needed.

   a. It is 330 I will be late

   b. Here is my list ink solution plates and pads

c. At the end of the half the scores are Trenton 10, Newark 7; New Brunswick 3, South River 0.

d. I will arrive at 4 10 in the afternoon.

e. Buy the following 60 lb. paper aluminum plates and etch.

4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT VII - PUNCTUATION MARKS

Semi-colon ; Lesson 6

OBJECTIVE:

To learn how to use a semi-colon.

INFORMATION:

A semi-colon looks like a period and a comma. The period is on top of the comma like this ; . It is used to show the break in two sentences that are joined together.

Example: You heard the answer; you were there.

ASSIGNMENT:

1. Where do you use a semi-colon?
2. Make up a sentence using a semi-colon.
3. Put in semi-colons where needed.
   a. It is cold close the window
   b. Everyone knows that we had it yesterday
   c. He is tall he is thin
   d. Write me a letter send me a telegram do something
   e. I respect my teacher he respects me
4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT VII - PUNCTUATION MARKS

Exclamation Point ! Lesson 7

OBJECTIVE:

To learn how to use an exclamation point.

INFORMATION:

The exclamation point looks like a period with a vertical line on top of it ! . It is used to show surprise or other strong feeling. It is usually used at the end of a sentence. It can also be used at the end of a word.

Example: Stop! Stop thief!

Oh, what a lovely surprise!

ASSIGNMENT:

1. Where do you use an exclamation point?

2. Make up and write two sentences using an exclamation point.

3. Put in an exclamation point where needed:

   a. Hurrah we win

   b. Help

   c. Help me move this table

   d. Wow that was close

   e. Stop Stop

4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT VII - PUNCTUATION MARKS

Question Mark ? Lesson 8

OBJECTIVE:

To learn how to use a question mark.

INFORMATION:

The question mark looks like this ? . It is used after a sentence that asks a question.

Example: What is a linecasting machine?

Are you looking at the keyboard?

ASSIGNMENT:

1. Where do you use a question mark?

2. Make up and write two sentences using question marks.

3. Add a question mark where needed.

   a. What time is it

   b. It is 335

   c. Are you hurt

   d. No I am fine

   e. What are you doing

4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT VII - PUNCTUATION MARKS

Apostrophe ' Lesson 9

OBJECTIVE:

To learn how to use an apostrophe.

INFORMATION:

An apostrophe looks the same as a comma, only it is used at the top of a letter ' not at the bottom. It is used to show possession. That means it tells who owns something.

Examples: That book belongs to John. That is John's book.

It is also used when you shorten words or abbreviate them. It is used in the place where you leave letters out.

Examples:		
	should not	shouldn't
	will not	won't
	she is	she's

ASSIGNMENT:

1. Where do you use an apostrophe?

2. Make up five words using an apostrophe.

3. Make up a sentence showing the use of an apostrophe showing possession.

4. Abbreviate the following:

a.	can not	f.	it is
b.	I am	g.	would not
c.	You are	h.	I will
d.	I have	i.	they are
e.	She is	j.	has not

5. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT VII - PUNCTUATION MARKS

Quotation Marks " " Lesson 10

OBJECTIVE:

To learn how to use quotation marks.

INFORMATION:

Quotation marks look like this " " . They are regular quotation marks. There are also single quotation marks. They look like this ' ' .

Quotation marks are used to show that a person has said something.

Example: "I will go," said Bill, "if I can."

If you have a quotation within a quotation, you use the regular and single quotation marks.

Example: Jim said "I heard the coach shout, 'Hit that ball over the fence!' and then I saw a long fly."

ASSIGNMENT:

1. Where do you use quotation marks?
2. Make up a sentence using regular quotation marks.
3. Make up a sentence using regular and single quotation marks.
4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT VII - PUNCTUATION MARKS

Parenthesis ( ) Lesson 11

OBJECTIVE: To learn how to use parentheses.

INFORMATION:

Parentheses look like this ( ). They are used to set off words or ideas in sentences. The sentence would be complete without the part in parentheses.

Example: If you can learn to operate a keyboard without looking at the keys (this is the correct way to learn) you will become a fast operator.

ASSIGNMENT:

1. Where do you use parentheses?

2. Make up a sentence using parentheses.

3. Put in parentheses where needed.

   a. I got really dressed up surprise for the party.

   b. Don't run you'll get too tired to the field.

   c. I'm going to the movies do you want to come to see the new show.

4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT VIII - CAPITAL LETTERS

Keyboard Location — Lesson 1

OBJECTIVE:

To explain the location of the capital letters on the keyboard.

INFORMATION:

The capital letters are located on the right hand side of the keyboard. This is the section of keys that are all white. They are laid out the same as the lower case section. The lower case keys are all black. You memorized the lower case keys. That means you know where all the keys are without looking.

You already know the location of the capital letters. They are the same as the lower case letters. If you know where one is, you know where the others are.

To operate the keys in the cap section of the keyboard, use the fingers on the right hand.

The fourth finger should push down or operate the letters in the two bottom rows.

The third finger should operate the letters of the center two rows.

The second finger should operate the letters of the two upper rows.

You should be able to strike the keys without looking at them.

In the lessons that follow you will practice setting without looking at the keyboard.

ASSIGNMENT:

1. Where are the capital letters located on the keyboard?

2. What color are the buttons?

3. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT VIII - CAPITAL LETTERS

Keyboard Practice of Capital Letters — Lesson 2

OBJECTIVE:

To have the fingers of the right hand become familiar with the cap section of the keyboard.

INFORMATION:

Set each of the following words in capitals, using the right hand for letters and the third finger of the left hand on the space bar between words. Do not watch your fingers or the keys any more than necessary. Use a smooth regular motion. Practice each word at least twenty-five times.

TAXI	LONG	SHOULDER	INTEND
HAZE	JURY	TANGENT	QUERRIES
KNOT	TWINE	WRAPPED	PULLED

UNIT VIII - CAPITAL LETTERS

Keyboard Practice--Caps and Lower Case Letters Lesson 3

OBJECTIVE:

To have both hands work together.

INFORMATION:

Practice setting the following lines. Set each one until you can set it without looking at the keys. Make full lines. Hyphenate if necessary. Do not set the lines too tightly.

Indianapolis, Indiana

Buenos Aires, Argentina

Trenton, New Jersey

Washington, D. C.

Kalamazoo, Michigan

New Jersey School for the Deaf

Madison, Wisconsin

New York, New York

Miami, Florida

Niagara Falls, New York

Sacramento, California

Atlanta, Georgia

UNIT IX - PROOFREADING

Explanation Lesson 1

OBJECTIVE:

To explain proofreading.

INFORMATION:

After you have set your lesson and the type has been cast, you must take a proof of it. That means that you print a copy of the type. Then you can see what you have set on the linecasting machine.

In most print shops and newspapers there are proofreaders. Here at school you will do your own proofreading. There are rules and marks. You will use them in proofreading. If you use them, you will get to know them. When you know them, it will be easy for you to follow them.

The reason your proof must be read is this: everyone makes mistakes. When you use the keys on the keyboard you will sometimes touch the wrong key. When you touch the wrong key, the wrong letter will fall. That means there will be a mistake in the type that you set.

Now before that can be printed, the proof must be checked for mistakes. This is called proofreading.

After the proof has been read you will re-set the lines that have mistakes in them. You will then change the lines that are wrong. You will then pull another proof. Check this one with the one before. This new proof is called a revised proof.

ASSIGNMENT:

1. Why is it necessary to know proofreading?

2. Who makes mistakes?

3. What should be proofread?

4. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

OBJECTIVE:

To show what the proofreaders' marks look like.

INFORMATION:

This is a chart of the proofreaders' marks. You should look them over and get to know them. The copy you set will have the same marks to show if it should be changed.

Proofreaders' Marks

⊙	Period	¶	Paragraph
⸵	Comma	no ¶	No paragraph
⸗	Hyphen	wf	Wrong font
:	Colon	eq #	Equalize spacing
;	Semicolon	≡	Capitals
⸲	Apostrophe	=	Small capitals
?	Interrogation	—	Italic
!	Exclamation	l.c.	Lower case
⸌⸍	Quotations	///	Straighten
□	Em quadrate	bf	Bold face type
1/m 2/m 3/m	One, two, three em dash	?	Words missing—verify
⌣	Push down space	2/ or /2	Superior or inferior
⁀	Close up	rom	Roman
✓ or ⌣	Less space	[ ]	Brackets
∧	Caret—insert	( )	Parentheses
⁀	Turn to proper position	}	Brace
#	Insert space	xxx or	Ellipsis
[or]	Move to left or right	*	Asterisk
⌣ or ⌐	Move up or move down	†	Dagger
tr	Transpose	‡	Double dagger
stet	Do not change	§	Section
⁀	Dele—take out	‖	Parallels
x	Broken letter	☞	Index

Size and Style of Type

wf// Wrong font (size or style of type)
Repeat stop mark for each additional identical error in same line

lc // Lower Case Letter

lc Set in LOWER.CASE or LOWER CASE

L Capital letter

caps SET IN capitals

caps+lc Lower Case with Initial Caps u+lc

sm. caps SET IN small capitals

caps+s.c. SMALL CAPITALS WITH INITIAL CAPS

rom. Set in roman (or regular) type

ital Set in italic (or oblique) type

L.F. Set in lightface type

bf Set in boldface type

bf ital **Bold italic**

b Superior letter or figure^{b}

2 Inferior letter or figure$_{2}$

A marginal correction of lower case matter should NOT be written in CAPITALS

Position

Move to right — Ragged margin

Move to left

center Put in center of line or page ctr

Lower (letters or words)

Elevate (letters or words)

Straighten line (horizontally)

fl L or // Align type (vertically) — Square up — justify — flush right and left

tr # Transpose space (transfer)

tr Transpose enclosed in ring matter

tr // Transpose (order letters of or words)

tr Rearrange words of order numbers in (3 2 4 1)

Miscellaneous

e/ Correct letter or word marked

e/⊗ k/⊗ or X Replace broken or imperfect type

Reverse (upside-down type or cut)

⊥ or ⊥ Push down space or lead that prints

SP Spell out (20 gr) (Also used conversely)

G? Question of grammar

F? Question of fact

Qy au: or ? Query to author Qu?

Qy Ed Query to editor Qu Ed

A ring around a marginal correction indicates that it is not the typesetter's error. All queries should be ringed

OK w/c or OK a/c OK "with corrections" or "as corrected" — Correct and print; no revised proof wanted

Mark-off or break; start new line

End End of copy: # or 30 or End.

Spacing

solid Means "not leaded" (Pron. "ledded")

leaded Additional space between lines

lead Insert lead between lines

ld Take out lead or tr lead

Close up entirely; take out space

Close up partly; leave some space

or Less space between words

eq # Equalize space between words

thin # Thin space where indicated hair #

l/s LETTER-SPACE

Insert space (or more space)

space out More space between words

en quad ½-em (nut) space or indention

Em quad (mutton) space or indention

Insert number of em quadrats shown

Insertion and Deletion

OUT see copy Insert matter omitted; refer to copy (Mark copy Out, see proof, galley 0)

the/l Insert marginal additions

or Dele—take out ~~(delete)~~ (Orig. δ)

Delete and close up

stet Let it stand—(all ~~matter~~ above dots)

Punctuation

Period or "full point."
Periods and commas ALWAYS go inside quotes

or ,/ Comma — or :/ Colon

;/ Semicolon

or Apostrophe or 'single quote' "pos"

or Quotation marks "quotes"

?/ Question mark or "query"

!/ Exclamation point or "bang!"

-/ or =/ Hyphen — 1/en — 1/em En dash

1/em or 1/em — 2/em Two-em dash

(/) Parentheses (parens; curves; fingernails)

[/] Brackets (crotchets) — Brace

Paragraphing

¶ Begin a paragraph

no ¶ No paragraph.

run in Run in or run on

2 ¶ Indent the number of em quads shown

flush ¶ No paragraph indention

hang in Hanging indention. This style should have all lines after the first marked for the desired indention

1

ASSIGNMENT:

1. What does it means when one straight line is drawn under a word?

2. What does it means when three straight lines are drawn under a letter?

3. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT X - ITALIC AND BOLD-FACE TYPE

Explanation Lesson 1

OBJECTIVE:

To learn about the various fonts and mats.

INFORMATION:

In the beginning of this book the term brass matrix was used. That is the mold that the type is made from on a linecasting machine. When you push down a key you get a matrix or mat.

Push down the "k" key. The mat with the letter "k" will fall into the assembler. Take it out of the assembler. Turn it over and look at the back of it. Do you see the two letters "k" cut into it? They will both be the same kind of type. The difference will be that one is Roman. That means the face of the type will be straight up and down. The other will be italic or bold-face. Italic means that it slants or leans to the right. Bold-face means that it will print blacker or heavier than the Roman style type. Some fonts of type have Roman or italic on the same mat. Others have Roman and bold-face. It depends on what type face and the kind of font that you are using. Be sure and check the mats before you start. Then you will know what kind of type is on the machine.

ASSIGNMENT:

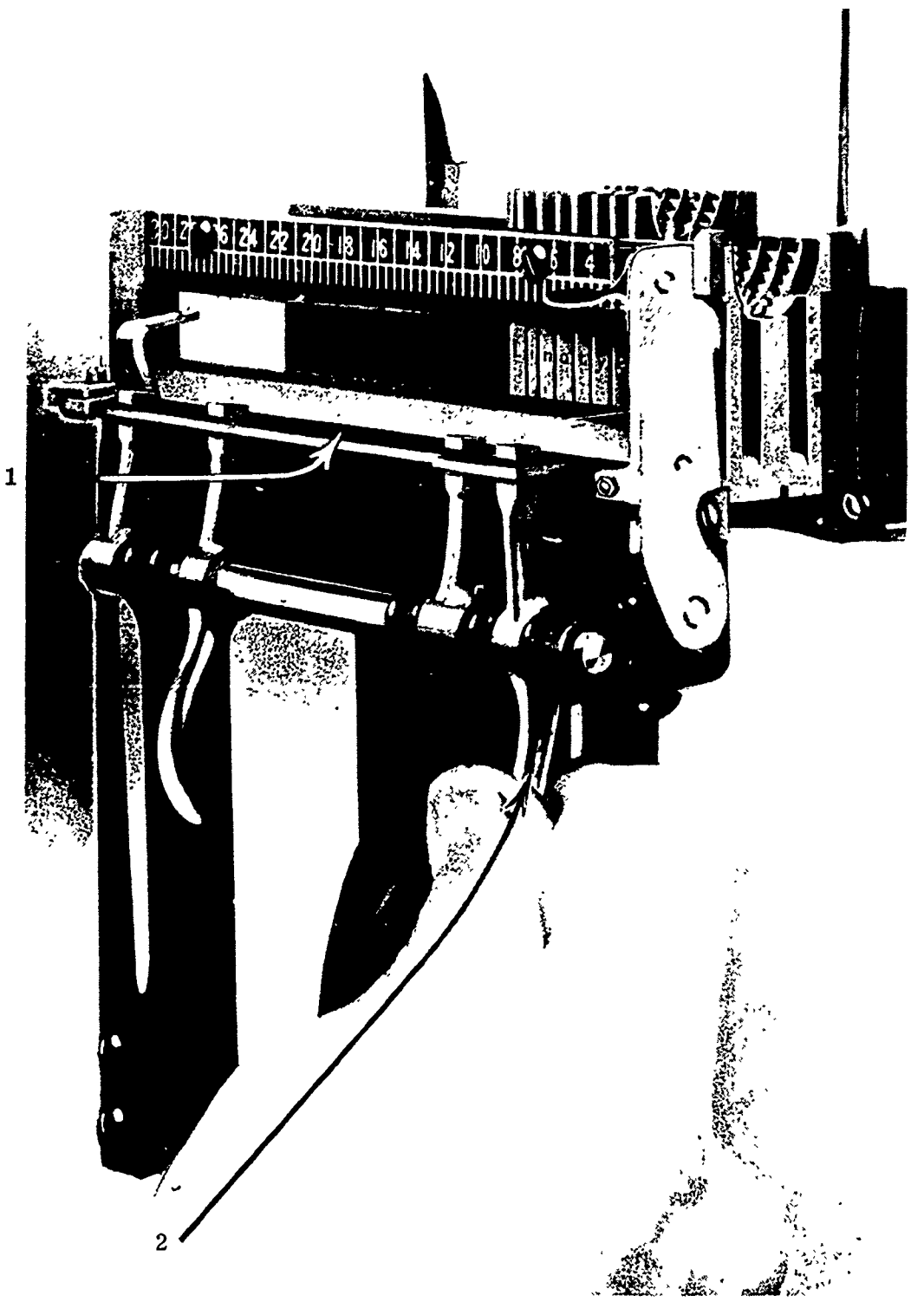
1. Describe italic type.
2. When is bold-face used?
3. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT X - ITALIC AND BOLD-FACE TYPE

The Duplex Rail Lesson 2

OBJECTIVE:

To learn how to set Roman and italic or bold-face type using the duplex rail.



INFORMATION:

You are now familiar with the setting of type. You have pushed down the keys. The mats and spacebands have assembled. The machine went through its casting operation and a line of type was formed.

Look at the picture. It is an assembler. The levers control the duplex rail. Number 1 shows the duplex rail. Number 2 shows the lever that moves the first half inch of the rail in or out. That means you can push in or out a rail for holding a mat.

The mat sits in a regular position without the rail. This casts Roman type.

The mat sits on the rail when it is pushed in. This casts italic or bold-face type.

You can also have some mats in the regular position and some on the rail. This is a mixed line. It will cast Roman and italic or bold-face at the same time.

ASSIGNMENT:

1. What is a duplex rail used for?

2. What is meant by a mixed line?

3. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT X - ITALIC AND BOLD-FACE TYPE

Setting an Italic Line of Type — Lesson 3

OBJECTIVE:

To learn how to set a line of italic type using the duplex rail.

INFORMATION:

Set the machine up as if you were going to set a regular line of type.

Now push in the first lever to use the duplex rail.

Set the line: The quick brown fox jumped over the lazy dog. Repeat this until the line is full. Ask the instructor to check this line.

DO NOT SEND THIS LINE INTO THE MACHINE UNTIL THE INSTRUCTOR HAS CHECKED IT.

If the line is satisfactory, send it into the machine.

Check the line as it is ejected to see if it has cast italic.

ASSIGNMENT:

1. Set this sentence five times using the duplex rail: The quick brown fox jumped over the lazy dog.

2. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT X - ITALIC AND BOLD-FACE TYPE

Setting a Line of Mixed Type — Lesson 4

OBJECTIVE:

To learn how to set a line of Roman and italic type.

INFORMATION:

Set the machine up as if you were going to set a regular line of type.

Now set the words -- The quick brown fox -- now push in the duplex rail. Now set the words -- jumped over the lazy dog.

The first part of the sentence should be in the regular position. The second half of the sentence should be on the duplex rail. Use em and en spaces and spacebands to fill out the lines. The em and en spaces will have to be dropped to regular position before sending the lines into the machine. When you have finished setting the line, have the instructor check the line.

DO NOT SEND THIS LINE INTO THE MACHINE UNTIL THE INSTRUCTOR HAS CHECKED IT.

If it is all right, send the line into the machine. When it is ejected from the machine you will see that the words -- The quick brown fox -- are in Roman type and the words -- jumped over the lazy dog -- are in italics.

ASSIGNMENT:

1. Why should the machine be set as if to set regular type?
2. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT X - ITALIC AND BOLD-FACE TYPE

Setting a Line of Bold-face Type — Lesson 5

OBJECTIVE:

To learn how to set a line of bold-face type.

INFORMATION:

There is no difference in setting bold-face and italic type.

They are both set the same way. The bold-face is cut into the mat the same as the italic. There are only two positions on a mat. The regular position and the italic or bold-face position.

Before starting to set type, check the font of mats that you are using. See if they are cut italic or bold-face. If you need italic and the mats have bold-face, then the mats must be changed.

ASSIGNMENT:

1. What position do you use for bold-face type?
2. What position do you use for Roman type?
3. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT X - ITALIC AND BOLD-FACE TYPE

Practice Exercise - Mixed Type — Lesson 6

OBJECTIVE:

To practice setting mixed type.

INFORMATION:

Set the following on the linecasting machine. Set the following copy in Roman type. The words that are underlined, set in italics.

Do not put a spaceband at the beginning of a line or at the end of a line.

Never touch the keybuttons when the power is off.

Turn off power when machine is not in use.

UNIT XI - FIGURES

Keyboard Location — Lesson 1

OBJECTIVE:

To explain where the figures are on the keyboard.

INFORMATION:

Figures are numbers. The numbers are 1, 2, 3, 4, 5, 6, 7, 8, 9, 0. By putting these numbers together you can make a large or small number. The numbers are located in the blue section of the keyboard. They are in two rows. (See diagram on page 9.) They are next to the capital letters ETAOIN.

You must practice to learn how to set numbers quickly. The numbers are set with the fingers of the right hand.

When setting numbers, start slowly. It is better to be accurate than fast when setting numbers.

ASSIGNMENT:

1. Which hand is used to set numbers?
2. Where are the numbers located?
3. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT XI - FIGURES

Practice Exercise — Lesson 2

OBJECTIVE:

To train the fingers, mind and eye to work together in setting figures.

INFORMATION:

Practice the figures that follow this paragraph. Set each line five times. Remember it is better to be right than fast. After you finish, proofread it for mistakes. Set the lines over those that have mistakes in them. Replace the lines in the galley of type, and pull a revised proof. Give both proofs to the instructor.

23 23 23 23 23 23 23 23 23 23 23 23 23 23 23 23 23

138 138 138 138 138 138 138 138 138 138 138 138 138 138 138

156 156 156 156 156 156 156 156 156 156 156 156 156 156 156

1,340 1,340 1,340 1,340 1,340 1,340 1,340 1,340 1,340 1,340

(6,289) (6,289) (6,289) (6,289) (6,289) (6,289) (6,289)

UNIT XII - DIVISION OF WORDS

Explanation Lesson 1

OBJECTIVE:

To learn about the division of words.

INFORMATION:

When you set type, the margins are usually flush left and flush right. To do this you must set full lines. They must not be too loose and they must not be too tight. They must be spaced evenly so they are pleasing to the eye. To be able to space evenly, some words must be divided. It is very important to know how to divide a word or hyphenate it.

Division of a word means to divide a word into syllables. A word must be divided at certain spots, not just any place. There are rules or guides to use when dividing a simple word. If you do not understand how to pronounce a word or to divide it, look it up in the dictionary. It will tell you where to divide the word, how to pronounce it and what it means. Do not hesitate to look for the word in the dictionary. It is good practice, and will mean that the line will not have to be reset because of a bad division. The lessons on the following pages will give you some rules for dividing words. Memorize them. If you are in doubt, use the dictionary.

A word that is divided wrong, shows that the machine operator is careless. If you do not know how to divide a word, use your dictionary and look it up. That is the best way.

There are also some simple rules to follow that will help you to divide words. When you come to words that you know, go ahead and divide them. If you are in doubt - USE THE DICTIONARY.

UNIT XII - DIVISION OF WORDS

Where to Hyphenate — Lesson 2

OBJECTIVE:

To show some simple rules of hyphenation.

INFORMATION:

Below are some rules to guide you in dividing words.

1. DO NOT divide words of one syllable. Examples:

aisle	jump	through
book	knife	use
charge	league	voice
draft	marsh	wrench
eye	numb	young
fence	ounce	zone
ghost	paste	scratch
house	quick	rhyme
ice		

A good rule to follow is NOT to divide words of four or five letters.

2. DO NOT divide words so that one letter is left by itself. Examples:

a-bout	i-dle	mold-y	e-clipse
a-bove	jump-y	eas-y	cop-y
rust-y	ech-o		

3. Usually divide a word after a prefix or before a suffix. Examples:

inter-change	un-common
care-taker	un-break-able
trans-action	communica-tion

4. Usually divide between double consonants. Examples:

com-munity	mum-my	profes-sor
trod-den	op-pose	sad-dle
ket-tle	fel-low	tomor-row

If the whole word has a double consonant at the end, do not split them. Divide before the ending.

kill-ing	kill-er
spell-ing	ill-ness

5. Usually divide between compound words. Examples:

price-less	left-over	milk-man
moon-light	leap-frog	neck-tie
eye-strain	mile-stone	

If a compound word has a hyphen already in it, divide on the hyphen.

first-class	four-poster	Chateau-Thierry
rock-bottom	frame-up	pay-off
chuck-full		

When in doubt remember to USE THE DICTIONARY.

UNIT XIII - STRAIGHT MATTER

Explanation | Lesson 1

OBJECTIVE:

To explain what is meant by straight matter.

INFORMATION:

Straight matter is type that is set and does not contain italics, boldface or small caps. It is all set on the same measure. A good example of straight matter is the columns of type used in a newspaper. Also the type set for a book is referred to as straight matter.

In setting straight matter, spacing is very important. There should be approximately the same space between each word. If a line is too tight, hyphenate the last word in the line. If the word cannot be broken, use thin spaces to make the spacing uniform.

To become a fast linecasting machine operator, you should practice setting straight matter.

Do not look at the keyboard. Keep your eyes on the copy. Start slowly and gradually you will gain speed and become a proficient operator.

ASSIGNMENT:

1. What is meant by straight matter?
2. What should you do to become a fast linecasting machine operator?
3. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT XIII - STRAIGHT MATTER

Practice Exercise | Lesson 2

OBJECTIVE:

To develop speed through practice with straight matter copy.

INFORMATION:

You must practice and practice and practice to make your fingers nimble. To keep from becoming bored while practicing, use live copy. Live copy is copy that will be used when you are finished.

When you come to this lesson, the instructor will provide you with live copy instead of practice lessons.

Do not look at the keyboard.

Keep your eyes on the copy.

ASSIGNMENT:

1. Get some live copy from your teacher. Practice setting it.

2. There are some underlined words in the lesson. Find them and give their meaning. Use each of these words in a sentence.

UNIT XIV - CAPS AND SMALL CAPS

Explanation Lesson 1

OBJECTIVE:

To explain the location and use of caps and small caps.

INFORMATION:

Small caps are just what the words say. They are small capital letters. The keyboard has a capital letter section which is white. It also has a lower-case section, which is black. The section that is blue contains most of the small capital letters or small caps.

Look at the keyboard. You will see that most of the small caps are in the blue section. Four letters are in the white section. They are U, H, K and N. Two letters are in the black section. They are Y and W. Two letters are not on the keyboard. They are X and Z. These letters run Pi. The other letters are all in the blue section.

The small caps are scattered over the keyboard because they had to use letters of the right size for the small capital letters. They are not used as much as regular capital letters. They are used in programs, menus, texts of plays, table of contents, etc.

ASSIGNMENT:

1. What are small caps?
2. Where will you find the small cap X and Z?
3. Where are small cap U, H, K and N?
4. Where are small cap Y and W?
5. There are some underlined words in the lesson. Find them and give their meaning. Use each word in a sentence.

UNIT XIV - CAPS AND SMALL CAPS

Setting Small Caps — Lesson 2

OBJECTIVE:

To learn how to set small caps.

INFORMATION:

Small caps are small capital letters cut into a mat with another letter. They are usually found only on italic fonts of mats. If you will strike the small cap "B" key, you will see that it has the figure "2" also cut into it. That means that the figure "2" and the small cap "B" both use the same mat.

Small caps are cast the same as you would cast italic or bold-face type. You must use the duplex rail. When you want to set small caps, push in the lever that controls the duplex rail. Strike the keys that you want. The mats will fall into the assembler and be held in the auxiliary position. The capital letters you must drop by hand into the regular position or they will cast italic. The punctuation marks must also be dropped to the regular position or they will cast italic.

When you space out the line, use em spaces and spacebands. Do not use the en leaders. In the auxiliary position they have the small cap "L" and not a blank space.

ASSIGNMENT:

1. Why can't you use en leaders to space out a small cap line?
2. Why must you use the duplex rail when setting small caps?
3. There are some underlined words in the lesson. Find them and give their meaning. Use them in a sentence.

UNIT XIV - CAPS AND SMALL CAPS

Practice Exercise One — Lesson 3

OBJECTIVE:

To train the fingers, eyes and mind to set caps and small caps.

INFORMATION:

Set the following sentences in caps and small caps. When finished, proof it and then proofread the type. Give proof to the instructor.

He that hath a trade hath an estate.

Diligence is the mother of good luck.

The tortoise was the first efficiency expert.

Concentration is the first condition of success.

A good worker is worth more than a poor manager.

If you want a thing to succeed, get behind it and push.

Raise your own seed corn and be sure of a crop that is worth tilling.

Sloth makes all things difficult, but industry all easy.

If the text and the initial are in one color, should they harmonize?

The man at the top is the one who has been in the habit of going to the bottom of things.

UNIT XIV - CAPS AND SMALL CAPS

Practice Exercise Two — Lesson 4

OBJECTIVE:

To practice setting caps and small caps.

INFORMATION:

Set the following paragraph. When finished, proof it and then proofread the type. Give the proof to the instructor.

The following people appear on the University faculty for the coming term of summer school: HANS H. DALAKER, Ph.D., Associate Professor of Mathematics and Mechanics; JAMES DAVIES, Ph.D., Assistant Professor of German; FRANCES DEL PLAIN, M.A., Instructor in English; HAL DOWNEY, Ph.D., Professor of Histology; RALPH S. DUGALF, B.A., LL.B., Special Lecturer in Americanization; RICHARD M. ELLIOT, Ph.D., Associate Professor of Psychology; MANUEL C. ELMER, Ph.D., Associate Professor of Sociology; HENRY A. ERICKSON, Ph.D., Professor of Physics; GEORGE H. FAIRCLOUGH, F.A.G.O., M.Mus., Instructor in Organ; DONALD N. FERGUSON, Professor of Psychology; WILLIAM L. HART, Ph.D., Associate Professor of Mathematics; LOIS B. HESSLER, Ph.D., Professor of English; BERTHA HINSHOW, M.A., Assistant in History; WILLIAM W. HODSON, B.A., LL.B. (Chief of the Division of Child Welfare Legislation, Russell Sage Foundation) Lecturer in Sociology; C. RUSSELL HOFFER, M.S., Instructor in Sociology; GERTRUDE R. HULL, Instructor in Music; ELIZABETH JACKSON, Ph.D., Assistant Professor of English.

UNIT XIV - CAPS AND SMALL CAPS

Practice Exercise Three — Lesson 5

OBJECTIVE:

To practice setting caps, small caps and italic type.

INFORMATION:

Set the following lesson. When finished, proof it and then proof-read the type. Give proof to the instructor.

MRS. GREENWOOD

Yes, mine if you will, but not yours! Not yours! (*Wanly*) Perchance there may be another respite.

BARROW

(Who has been walking up and down) Nay, no more respites. Last month they had struck off our chains and stood ready to bind us to the cart to take us to our deaths. A reprieve. Another day they took us to the place of execution and tied the nooses around our necks to the gallows. Again a reprieve. Enough of reprieves! What our words, what our lives could not do, our deaths will. Men pass; ideas abide.

MRS. GREENWOOD

JOHN HENRY, pray! I cannot. Pray that God give me strength.

As her husband comforts her, BARROW *begins praying. Distantly, a bell strikes ten.*

MRS. GREENWOOD

Only seven hours to daybreak! Only seven.

She clings to GREENWOOD, *sobbing hysterically. To the sound of* BARROW'S *half-audible praying, the lights close in.*

UNIT XV - CARE OF THE MACHINE

Explanation Lesson 1

OBJECTIVE:

To learn how to take care of the machines.

INFORMATION:

The Linotype and Intertype Machines are complicated pieces of equipment. They must be treated with care or they will not work properly.

The greatest cause of trouble on these machines is dirt.

Have your hands clean at all times.

There are some simple operations that must be done to keep the machines in good working condition. Some should be done every day. Others should be done every week and some on a monthly basis. The ones covered in this book are the simple operations. The more complicated ones will be taught to you later. Learn these first.

ASSIGNMENT:

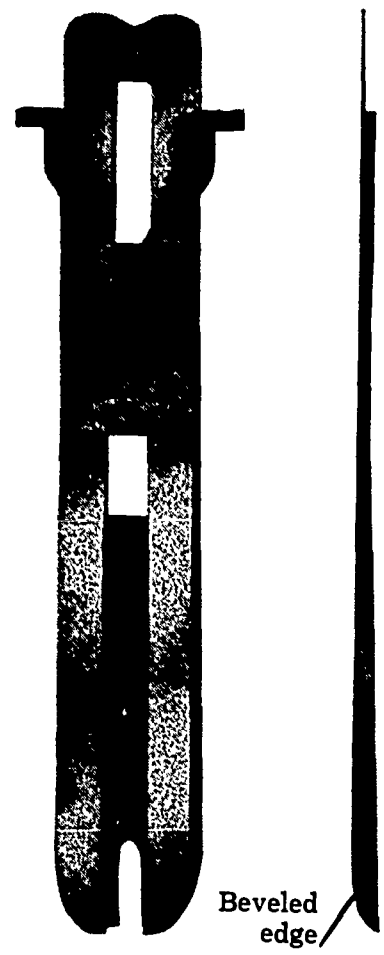
1. How can you help keep your typecasting machine in good order?
2. In this lesson there are some underlined words. Give their meaning. Use each word in a sentence.

OBJECTIVE:

To explain and how to use and how to clean a spaceband.

INFORMATION:

The spaceband is the adjustable space used between the words when you set type. They are made of steel and are in two parts (see illustration). The bottom part is wedge-shaped and the top part is tapered so that they are straight down when they are justified.



Front and side views of the Linotype spaceband.

Some shops have spaceband cleaners. Some small shops still clean them by hand. To clean a spaceband by hand you need a soft pine board and graphite powder. Lay the band flat on its back and rub briskly backward and forward the long way of the band. Then turn it over and rub the other side. Do not rub in a circle as it will round the edges. If the edges become rounded, metal will cast between the spaceband and matrix and show in print. These are called hairlines. If metal is sticking to the side of the spaceband, clean it off with a piece of brass rule. Do not handle the spacebands with dirty or greasy hands. If you do, the spaceband will transfer the dirt and grease to the mats and they will stick in the magazines.

When you have finished cleaning the bands, tap them gently on the board to remove the excess graphite. Then replace them in the machines.

ASSIGNMENT:

1. Why is a spaceband wedge-shaped?

2. Why do you rub spacebands backwards and forwards?

3. Why should you keep grease away from spacebands?

4. There are some underlined words in the lesson. Find them and give their meaning. Use them in a sentence.

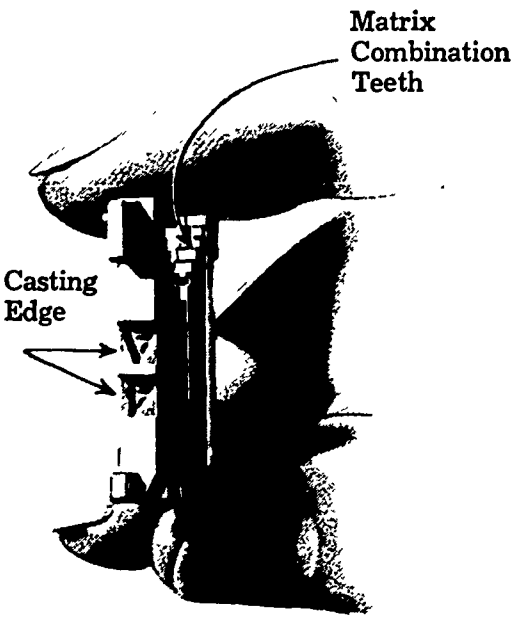
UNIT XV - CARE OF THE MACHINE

Matrices Lesson 3

OBJECTIVE:

To explain how to care for matrices.

INFORMATION:



The Linotype matrix.

A matrix is a brass mold that type is cast from. It is one of the most important parts of the machine. Without it you would not be able to cast type.

It is very important that the matrices stay clean. Always have clean hands before touching them. If they become dirty they will not slide through the magazine. Never touch a mat if you have oil on your hands. Always wipe a mat off before putting it back into a machine. Never step on a mat. If you drop a mat, pick it up immediately. Mats are very expensive. If a mat has a bent lug, give it to the instructor to straighten. A bent mat will cause trouble in the magazine by not dropping easily. If a mat is stuck in the magazine, ask the instructor to get it out. You can ruin a magazine if you do not know how to get a bent mat from the magazine.

ASSIGNMENT:

1. What is a mat made of?

2. Why shouldn't you get oil on a mat?

3. What should you do with a bent mat?

4. There are some underlined words in the lesson. Find them and give their meaning. Use each of them in a sentence.

UNIT XV - CARE OF THE MACHINE

Daily Operations — Lesson 4

OBJECTIVE:

To explain the simply daily operations.

INFORMATION:

The following operations should be performed daily before starting to operate the machine.

CLEAN THE MOLD DISK. Use a brass rule and rag. Remove all metal from the face and back of the mold. Scrape the metal loose with the brass rule and wipe with a rag. Remove all metal from behind the mold disk.

WIPE THE MOUTHPIECE with a rag. Scratch out the cross vents with a brass rule if they are filled or corroded.

LUBRICATE LOCKING STUDS. Put a small amount of oil on the mold-disk locking studs.

CLEAN THE PLUNGER AND METAL POT. Clean the plunger in the cleaning box. Use a well brush in the well. Open the holes on the side of the well, using the hook of the pot-mouth wiper. Skim the dross from the pot.

INSPECT THE KNIFE WIPER. See that it works freely up and down.

INSPECT THE PUMP-STOP LEVER. See that it is working.

CLEAN THE SPACEBANDS. Once each day the spacebands must be taken from the machine and polished with graphite on a soft pine board.

ASSIGNMENT:

1. Why do you use a brass rule when cleaning metal from the mold?
2. Why is it important that the pump-stop lever is working?
3. Why must the spacebands be cleaned daily?
4. There are some underlined words in the lesson. Find them and give their meaning. Use each of them in a sentence.

UNIT XV - CARE OF THE MACHINE

"Don'ts" Worth Knowing — Lesson 5

OBJECTIVE:

To explain a few simple don'ts for a linecasting machine.

INFORMATION:

Don't force anything on a Linotype machine.

Don't oil the escapements. The oil will surely get on to the matrices.

Don't put oil in the magazine. In other words, don't be foolish.

Don't slam the channel entrance when closing it. It may injure the parts of the automatic stop.

Don't pound the magazine to make the matrices drop. You are liable to bend the plates and make a bad matter worse.

Don't forget, when pulling down the channel entrance, to do so quickly, as opening it slowly is liable to cause a matrix to fall into the magazine flatwise.

Don't keep pulling on the starting and stopping lever when machine "stalls."

Don't force the first elevator when a tight line prevents its dropping far enough to release the vise automatic. Ruined matrices will result, and a "squirt" is bound to follow if you do.

Don't strike the keybutton impatiently and repeatedly if a matrix fails to respond. Locate the difficulty and correct it.

Don't forget that time spent in keeping the machine clean, oiled where oil is necessary, and free from rust, is time well spent. This is a case where "an ounce of prevention is worth a pound of cure."

ASSIGNMENT:

1. Why not put oil in a magazine?

2. What will happen if you force something on a linecasting machine?

3. Explain briefly, "An ounce of prevention is worth a pound of cure."

4. There are some underlined words in the lesson. Find them and give their meaning. Use each of them in a sentence.

TRADE NAMES

abbreviate	ə brē′vi āt	to shorten a word
accurate	ak′ū rit	right, correct
always	ôl′ wiz	every time
answer	an′ sər	reply to a question
apostrophe	ə pos′trə fi	punctuation mark (′); shows that a letter was left out of a word - also shows ownership
approximately	ə prox′sə mit li	almost, nearly, about
assembler	ə sem′blər	part of the machine that holds the matrix that forms words
assume	ə sūm′	take for granted, suppose
automatic	ô tə mat′ik	moving by itself
auxiliary	ôg zil′yə ri	additional - helping
basic	bā′sik	something you must learn first
beginner	bi gin′ər	person who starts something for the first time
below	bi lō′	in a lower place
between	bi twēn′	in the middle of
blank	blangk	nothing
bold face type	bōld′ fās′ tīp	a style of print that has thick or heavy lines
break	brāk	to destroy

careful	kär′ fəl	watchful, cautious
cast	kast	become a line of type
certain	sėr′ tən	to be sure of
change	chānj	become different
chart	chärt	drawing - picture
check	chek	look over - make sure correct
colon	kō′ lən	punctuation mark (:) introduces a list, sets them off from rest of sentence
comma	kom′ə	punctuation mark (,) indicates small interruptions in sentences
complete	kəm plēt′	all - whole - all the parts
complicated	kom′ plə kāt′ id	difficult to understand, made up of many parts
compound	kom′ pound	having more than one part
confuse	kən fūz′	mistake for another - mix up
copy	kop′ i	matter to be set up for printing
correct	kə rekt′	right - make it right
develop	di vel′ əp	get - grow - come into
dictionary	dik′ shən er′ i	reference book containing words in alphabetical order and their meanings
difference	dif′ r əns	not the same - to make different
discourage	dis kėr′ ij	lose hope - does not seem worth-while
distinct	dis tingkt′	clear - easily seen

divide	də vīd′	to separate into sections or groups
drop	drop	to let fall
dropped	dropped	fall or fallen
dross	drŏs	scum on top of molten metal
duplex rail	dū′pleks rāl	plate that matrices sits on for casting, italic, bold-face or small caps
ejector	i jek′tər	one that ejects
employer	em ploi′ər	the company or man you work for
example	eg zam′pəl	to show a particular item
excess	ek ses′	more than usual
exclamation point	eks′klə mā′shən point	punctuation mark (!) used to show surprise
explain	eks plān′	to tell how it should be done
face	fās	part of type which makes the impression
familiar	fə mil′yər	have a knowledge of - well known
far	fär	distant - out of reach
flowing	flō′ing	to proceed smoothly and easily
following	fol′ō ing	coming after
font	font	a complete set of type of one size and one style
force	fôrs	push hard enough to break
full	fu̇l	enough

gaining	gān′ ing	to move ahead
galley	gal′ i	narrow tray that holds type - part of machine that slug comes out on
greatest	grāt′ est	largest
group	grüp	number of things together
guide	gīd	to show how
horizontal	hôr′ ə zon′ təl	flat - level - parallel to horizon
hyphen	hī′ fən	punctuation mark (-) used to divide words
idea	ī dē′ ə	thought - belief in mind
illustration	il′ əs trā′ shən	picture or drawing
immediately	i mē′ di it li	right away
important	im pôr′ tənt	much meaning - worth noticing
instructor	in struk′ tər	teacher
italic type	i tal′ ik tīp	a style of printing that slants to the right
join	join	put together
jump	jump	sudden start - cross over - leap
justified	jus′ tə fied	a line that has been pushed tight so that it will cast
keyboard	kē′ bôrd′	part of machine that has the buttons which control the mats
knowledge	nol′ ij	what one knows

learn	lėrn	find out how to do something
letter	let′ər	mark - sign - A B C - alphabet
lever	lev′ ər	handle
list	list	items - series of names, numbers, etc.
located	lō′kāt ed	found
location	lō kā′shən	place - position
lock	lok	way of holding or fastening
longer	lông′gər	more than usual
magazine	mag′ ə zen′	the part that holds the matrices
manner	man′ ər	habit - way of doing something
matrices	mā trə sēz	more than one matrix
matrix	mā′ triks	brass mold for casting type
mat	mat	slang for matrix
mean	mēn	have in mind - indicate - intend
memorize	mem′ ə rīze	learn by heart
minimum	min′ ə m m	smallest amount
mistake	mis tāk′	error, misunderstanding
mixed	mikst	jumbled, different things put together
molten	mōl tən	changed to a liquid by heat
naturally	nach′ ə ral i	easily - by nature
necessary	nes′ ə ser′ i	that must be - can't do without

nimble	nim′bəl	flexible - quick moving
normal	nôr′məl	average - regular - usual
number	num′bər	figure - symbol used in counting
operate	op′ə rāt	work the machine
paragraph	par′ə graf	group of sentences that belong together
parenthesis	pə ren′th ə sis	two curved lines used to separate a certain word or sentence ( )
perfect	pėr′fikt	correct - no mistakes - not spoiled
period	pēr′i əd	punctuation mark (.) used to end a sentence
pi	pī	mixed up type
plunger	plun′jər	the part that pushes lead out of the metal pot
plunger pin	plun′jər pin	pin that holds plunger in position
polished	pol′ish ed	smooth and shiny
position	pə zish′ n	place where a thing is
practice	prak′tis	to do the same thing over and over again
prevent	pri ven′t	to keep from - to stop
proficient	prə fish′ nt	expert - skilled
proof	prüf	the first copy of printed material used for checking for mistakes
proofreader	prüf rēd′ər	one who reads copy and checks for errors

proper	prop′ər	correct - right
push	pu̇sh	pull in other direction - move something away
qualification	kwol′əfə kā′ shən	the proper training and know how
question mark	kwes′chən mär̈k	punctuation mark (?) ends a sentence when a question has been asked - it means that you want information
quotation mark	kwō tā′shən mär̈k	punctuation mark(") used at the beginning and end of a quotation - repeating what someone has said
quality	kwol′ə ti	something special, good
quantity	kwan′tə ti	amount - how much
reading	rēd′ing	study of books
reason	rē′zən	good sense - right thinking
regular	reg′ū lər	normal - usual
release	ri lēs′	let go - let loose
remember	ri mem′bər	think back - recall something to mind
remove	ri mü̇v′	take away - move from
repeat	ri pēt′	do again - make over
responsible	ri spon′səbəl	deserving credit or blame
return	ri tėrn′	come back - go back
rhythm	riTH′əm	regular even movement
Roman type	rō′mən tīp	a style of printing that is straight up and down

round	round	curved edges
row	rō	a line of something
ruin	rü′ən	spoil - destroy
rust	rust	red brown covering on metal, comes from being exposed to air and water
sacrifice	sak′rə fīs	give up something
scratch	skrach	mark up - cut slightly
section	sek′ shən	part of - slice
semi-colon	sem′i kō′lən	punctuation mark (;) shows a separation
sentence	sen′təns	group of words expressing a complete thought
separate	sep′ə rāt	keep apart
setting	set′ing	placing
shorten	shôr′tən	mark shorter
simple	sim′pəl	easy to do or understand
single	sing gəl	only one - alone
size	sīz	how large or small
sloppy	slop′i	not careful
slow	slō	taking a long time
slug	slug	line of type cast on linecasting machine
something	sum′thing	particular thing not known
start	stärt	begin
strike	strīk	touch - hit

thief	thēf	one who steals
thin	thin	not thick
tight	tīt	firm - spread snug
together	tə geTH′ ər	next to each other
travel	trav′ əl	go from one place to another
type	tīp	metal or wood having a letter or symbol on its surface that can be printed from
until	ən til′	up to the time of
used	ūzd	not new
vertical	vėr′ tə kəl	straight up and down
vocabulary	vō kab′ ū ler′ i	words and their meanings
wedge	wej	a piece of metal or wood with a tapered edge
where	hwâr	at what place
without	wiTH out′	not having
worry	wėr′ i	be anxious - be troubled
wrong	rông	not right - unlawful

UNIT I - KEYBOARD OPERATION

ACHIEVEMENT TEST

1. Explain the education that you must have to become a student in this class.

2. Explain what parts of the body must work together in operating a linecasting machine.

3. What will happen if you use the wrong fingers to strike the keys?

4. What is meant by a successful linecasting machine operator?

UNIT II - OPERATION OF KEYBOARD

ACHIEVEMENT TEST

1. In operating a linecasting keyboard, what should you keep your eyes on?

2. Is it important to memorize the keyboard? Explain your answer in writing.

3. Write a brief explanation of the sitting position at the keyboard.

ERIC

UNIT III - THE FINGERING SYSTEM

ACHIEVEMENT TEST

1. Explain what is meant by basic position of the hands.

2. Which letters is the second finger of the right hand responsible for?

3. Which letters is the third finger of the right hand responsible for?

4. Which letters is the fourth finger of the right hand responsible for?

5. Explain how the fingers should strike the keys.

UNIT IV - WORD PRACTICE

ACHIEVEMENT TEST

1. What is meant by word practice?

2. Why must you learn to operate a linecasting machine without looking at the keyboard?

3. Explain why you must always use the same finger when pushing down a key.

4. Why should you learn the correct use of ligatures?

5. Why are you told to go slow when beginning to learn they keyboard?

UNIT V - KEYBOARD PRACTICE

ACHIEVEMENT TEST

1. Explain why the plunger pin is removed from the machine for these lessons.

2. What will happen if you send a tight line into a machine?

3. Explain which part of the machine is hand-operated.

4. Explain which part of the machine is automatically operated.

UNIT VI - SENTENCE PRACTICE

ACHIEVEMENT TEST

1. What will happen if a line does not have enough mats in it?

2. What will happen if a line is too tight?

3. How should the star wheel be when a line is correctly set?

4. What do you do after a line has been completely assembled?

5. In Lessons 2, 3, and 4 there are some underlined words. Find them and give their meaning. Use each of these words in a sentence.

UNIT VII - PUNCTUATION MARKS

ACHIEVEMENT TEST

Set the following sentence on your machine. When finished, proof and proof read. Show the finished proof to the instructor.

Look, my lord! It comes!

Ha, ha, ha! That's a good joke.

St. Paul said, "Bear ye one another's burdens."

Read the following: "Matt. i:5, 7, 9; v:1-10; xiv:3, 8, 27."

The American flag has three colors: red, white, and blue.

He said: "I heard him say, 'Put down the gun,' and then I heard a shot."

Write a short essay on the following topic: "What is wrong with our industrial system"?

Farm for sale, rent or exchange; 400 acres, improved. 24 West Michigan Street, Circle 5930.

Dost thou love life? Then do not squander time for that is the stuff life is made of!—Franklin.

Franklin, like many others, was a printer; but unlike the others, he was a student, statesman and publicist as well.

"Breathes there a man with a soul so dead,
Who never to himself hath said:
'This is my own, my native land'?"

If we can reduce the labor turnover from 50 per cent (an accomplishment quite possible by means of group insurance) we shall have a consequent reduction of overhead from $25 to $12.50 per capita.

UNIT VIII - CAPITAL LETTERS

ACHIEVEMENT TEST

1. Why does the right hand set the capital letters?

2. Why is the capital section of the keyboard laid out the same as the lower case section of the keyboard?

3. Explain what is meant by a smooth, regular motion.

4. In Lessons 2 and 3 there are some underlined words. Find them and give their meaning. Use each of these words in a sentence.

UNIT IX - PROOFREADING

ACHIEVEMENT TEST

Fill in the correct proofreaders' mark in the proper space.

MARKS	MEANING	MARKS	MEANING
___	Push down space	___	Two-em dash
___	Turn over	___	Em quad space
___	Insert at this point	___	Take out
___	Space evenly	___	Make paragraph
___	Insert space	___	No paragraph
___	Close up entirely	___	Wrong font
___	Period	___	Let it stand
___	Comma	___	Transpose
___	Colon	___	Capitals
___	Semi-colon	___	Small caps
___	Apostrophe	___	Lowercase
___	Quotation	___	Italic
___	Move to the left	___	Roman
___	Move to the right	___	Verify
___	Move up	___	Superior
___	Move down	___	Inferior
___	Exclamation mark	___	Broken letters
___	Parenthesis	___	One em dash

UNIT X - ITALIC AND BOLD-FACE TYPE

ACHIEVEMENT TEST

Set the following lessons on the machine

SECTIONAL ADVERTISING FIGURES

Sectional advertising figures are used in the same manner as *ordinary matrices,* and require no special equipment on the machine. The *one-letter matrices carry only* one-half a character on each matrix; consequently, *two matrices* must be used to produce a *complete character*— one for the upper half and one for the lower half. *The two-letter matrices* carry a complete character on *each matrix,* the upper half in the *auxiliary position* and the *lower half* in the regular *or normal position.* In order to obtain the complete character, *two slugs* must be cast. When the *two slugs* are placed together, they form the *two-line character* which makes the whole figure.

The ten-point figures must be cast on *two five-point slugs; the twelve-point figures* must be cast on *two six-point slugs; the eighteen-point figures* must be cast on *two eight-point slugs; and the twenty-four point figures* must be cast on *two ten-point slugs.*

UNIT XI - FIGURES

ACHIEVEMENT TEST

Set the following on the machine.

Practice each of the following lines five times, touching the spaceband key with the third or little finger of the left hand at the end of each group of figures or characters corresponding to a word.

138 138 138 138 138 138 138 138 138 138 138
(6,289) (6,289) (6,289) (6,289) (6,289) (6,289)
$82.50 $82.50 $82.50 $82.50 $82.50 $82.50 $82.50
7,239 7,239 7,239 7,239 7,239 7,239 7,239 7,239 7,239
8:30 8:30 8:30 8:30 8:30 8:30 8:30 8:30 8:30 8:30
91-72 91-72 91-72 91-72 91-72 91-72 91-72 91-72
(?) $9.45 (?) $9.45 (?) $9.45 (?) $9.45 (?) $9.45
378,992 378,992 378,992 378,992 378,992 378,992
|846| |9,478| |12,462| |37| |201|
739,823 (!) 739,823 (!) 739,823 (!) 739,823 (!)

UNIT XII - RULES OF HYPHENATION

ACHIEVEMENT TEST

Set the following list of words on your machine and insert a hyphen as if the words were at the end of a line. When finished pull a proof and give to your instructor.

athletic	important	rabbit
awkward	island	refined
branch	judgment	school
buckle	jungle	secretary
command	kitchen	thread
curious	kidney	Tennessee
dramatic	ladder	umbrella
dynamite	Louisiana	upholstery
efficient	mantel	veterinarian
expert	nerve	vocation
faggot	nicotine	wallet
February	opportunity	warning
geyser	overcast	xylophone
gland	parachute	yellow
harpoon	quarter	yesterday
health	question	zipper

UNIT XIII - STRAIGHT MATTER

ACHIEVEMENT TEST

The copy that follows this paragraph is to see if you have made progress. The instructor will time you to see how fast you can go with a limited number of mistakes. This copy should be set with no more than five mistakes. Use this to judge how fast you can go.

ABRAHAM LINCOLN'S GETTYSBURG ADDRESS

"Fourscore and seven years ago our fathers brought forth on this continent a new nation, conceived in liberty, and dedicated to the proposition that all men are created equal. Now we are engaged in a great civil war, testing whether that nation, or any nation so conceived and so dedicated, can long endure. We are met on a great battlefield of that war. We have come to dedicate a portion of that field, as a final resting place for those who here gave their lives that that nation might live. It is altogether fitting and proper that we should do this. But, in a larger sense, we cannot dedicate—we cannot consecrate—we cannot hallow—this ground. The brave men, living and dead, who struggled here, have consecrated it far above our poor power to add or detract. The world will little note, nor long remember, what we say here, but it can never forget what they did here. It is for us the living, rather, to be dedicated here to the unfinished work which they who fought here have thus far so nobly advanced. It is rather for us to be here dedicated to the great task remaining before us,—that from these honored dead we take increased devotion to that cause for which they gave the last full measure of devotion—that we here highly resolve that these dead shall not have died in vain—that this nation, under God, shall have a new birth of freedom—and that government of the people, by the people, for the people, shall not perish from the earth."

VT 010 461
Ruth, William B.
A Teaching Outline for Conducting A Short Course on Methods to Detect Shoplifters.

Ohio State Dept. of Education, Columbus. Materials Lab.
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ABSTRACT - This outline was prepared by a coordinator of distributive education for teacher use in planning and conducting short courses in shoplifting detection and prevention for both in-school and adult programs in Ohio. Designed to permit flexibility in presenting the material, the course may be taught in four 2-hour sessions for a total of 8 hours, or in a shorter period of time on an emergency basis by the use of handouts. Emphasizing fundamental concerns of the businessman, the law enforcement agency, and the public, the course is divided into four sessions, each set up in outline form and providing content, teaching methods, and learning activities. Session I deals with the purpose and objectives of the course, with Session II expanding on the ideas developed in the first session by using qualified resource persons or related films. The third session deals with the tools of the shoplifter, conditions inducing shoplifting, and Ohio shoplifting laws, while the fourth outlines a survey concerning shoplifting in local stores that may be conducted by the class. A bibliography and supplementary material including suggestions for preventing burglaries and shoplifting are provided. (AW)

VT 010 461

ED0 45856

A TEACHING OUTLINE FOR CONDUCTING A SHORT COURSE ON METHODS TO DETECT SHOPLIFTERS

Prepared by

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Whitehall Yearling High School

Reproduced by

Ohio Department of Education
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PREFACE

There has been a great demand by Ohio's Distributive Education Coordinators to conduct short courses for both their in-school programs and adult classes concerning shoplifting. This demand stems from the increasing concern of businessmen and law enforcement officers about store losses due to shoplifting.

This teaching outline has been prepared by William B. Ruth, Distributive Education Coordinator at the Whitehall Yearling High School under the supervision of the State Staff of the Distributive Education Services, Division of Vocational Education and Mr. Bernard Nye, State Supervisor of Distributive Education. A special note of thanks to Mr. Karl M. Kahler, Executive Assistant, Ohio State Council of Retail Merchants, for his counsel and advice.

This outline has been developed so that the teacher can use flexibility in the presentation of the material. It can be taught in four sessions of approximately two hours each for a total of eight hours; or it can be taught in a shorter period of time on an emergency basis by the use of handouts. The number of sessions can be determined by the instructor and his advisory group. The introduction is a result of many hours of research and interviewing by the author and it can be used by the teacher as he sees fit. It can be referred to throughout the course, and can also be used to emphasize the increasing problem of shoplifting.

The course has been designed to follow a specific pattern that will take the class through the basic and fundamental concerns of the businessman, the law enforcement agency and the public.

The first session deals with the purpose and objectives of the course. It should get the class to thinking about the significance of the problem, and to examine the psychology and types of shoplifters.

The second session will expand on ideas developed in the first session. After the group has explored the problem of shoplifting, they are ready to listen to a qualified resource person and to view a film on the subject.

The third session deals with the tools of the shoplifter, factors that induce shoplifting and Ohio's up-to-dade laws on shoplifting. This knowledge will better enable store employees to curb the shoplifting problem.

The fourth and final session is a wrap-up of the course. It is the application of what the class has learned in the form of a survey. This survey may become interesting enough to the group that they may want to extend the course for another session. This survey can be used in several different ways as the instructor sees the need.

The adult participant is now ready to take this information and present it to his own organization in the form of training sessions.

INTRODUCTION

Much has been said about shoplifting. We read about it in the newspapers, we hear about it over the radio, and we learn about it at our training stations. We distributive education students hear about the light-fingered customers stealing more than a half-billion dollars a year from retail stores and supermarkets. We learn at our sales meetings that one out of every fifty-two emerging customers has stolen something. We read that the FBI recently revealed that in the first three quarters of 1964, shoplifting reported to 4,836 police agencies were up 21% nationally compared to 1963. Shoplifting has become so widespread and expensive that in the past eight years, forty-six states have enacted laws specifically designed to help merchants fight shoplifting.

This upsurge in shoplifting, the newspapers tell us, is attributed in the main to three developments:

1. The advent and expansion of self-service stores. When variety stores began to switch to self-service, the managers thought that thefts would decrease through the reduction of clerks handling cash. The decrease was more than offset by the increased number of customers who shoplifted. A merchant made this reply, "In self-service, we ask the customers to help themselves. They sure do!"

2. The removal of most barriers between goods and customers in stores. Open displays make shoplifting easier. As an old proverb states, "Opportunity makes the thief."

3. Improved display techniques psychologically designed to increase impulsive buying. The manager of a chain store said, "We try to tempt people into buying and we tempt them into stealing."

Of 6,500 confessed shoplifters in the stores of Alexandria, New York, 3,500 were teen-agers, most of them girls. The women's division of the Detroit police department reports that among female shoplifters, fourteen-year-olds outnumber all ages. In Cincinnati, where records of all cases are listed on IBM cards, the statistics show that seventy-eight out of one hundred shoplifters are under eighteen, forty-five of these are girls and thirty-three are boys.

Between ten and twenty percent of shoplifters are professionals who make a living by converting the merchandise into cash. The other eighty to ninety percent are so-called "amateurs."

In the July 21, 1963, issue of the New York Times, Samuel Withers states that even PTA's are trying to make parents aware and take notice of their children and help them see their "romantic game" as a moral issue.

In the Columbus area it is noted by Chief Ralph Walker of Whitehall that the startling increase in shoplifting is due particularly to the absence of salespersons. Chief Walker reports that potential shoplifters are induced to commit their acts when they gaze around the crowded stores and see nothing but customers. Chief Walker, whose jurisdiction includes three large shopping centers, also reports that his officers on some occasions have observed shoplifters in the act and have made arrests. In most instances, the actual arrests and filing of complaints are left up to the stores' security force. Chief Walker states that the stores themselves have provided better cooperation in the prevention of shoplifting and the apprehension of offenders in recent years.

Shoplifting has had a marked increase around the nation. Just prior to the 1965 Christmas season, an FBI report stated that shoplifting, the fastest form of larceny, had increased ninety-three percent in the last five years.

Lt. Harry Berkemer of the Columbus Police Department's Detective Bureau said, "Real smart ones, whether they be women or kids in gangs, make sure not to take anything worth more than sixty dollars." Then if they are caught, the charge can only be petit larceny.

SHOPLIFTING IN THE COLUMBUS AREA

Today, ninety per cent of the shoplifting in the Columbus area is done by amateur thieves whose shoplifting apparently has little relationship to their economic need. The other ten per cent is made up of professionals, kleptomaniacs and the desperately poor.

Captain Thomas Sawyer of the Columbus Police Department reported that several thousand adult shoplifters were apprehended in Columbus last year. These adult shoplifters probably account for a mere two per cent of the offenders. Captain Sawyer estimated that of every fifty offenders, only one was caught.

Sergeant Richard Griffith, Columbus Police Department, said that 588 children were charged with petit larceny in Columbus last year. The majority of the cases were for shoplifting. This number only accounts for a small per cent of the offenders, for many merchants call the parents of the children instead of the police.

The casual pilferer steals for any one of a number of reasons:

1. Not being able to pass up the chance to take something for nothing.
2. Desire for attention.
3. Actual need.
4. Fun of taking something without being caught.
5. Psychological reasons.

Most of these casual pilferers are women and children who definitely do not look like criminals. They may be housewives, mothers, career girls, businessmen, children or teen-agers.

Children and teen-agers often become shoplifters to be accepted by their friends. Pre-teen and teen-age girls who shoplift usually take merchandise they can use or wear.

Professional shoplifters usually travel in rings and have headquarters in one of the metropolitan areas. A few of these professional outfits have made Columbus their headquarters and worked in other cities.

The Ohio State Council of Retail Merchants suggests that their are six types of persons to watch as possible shoplifters:

1. Persons wearing loose, baggy clothes,
2. Persons carrying loosely folded umbrellas, shopping bags, folded newspapers,
3. Women with open handbags dangling from one arm with change purses held in plain view,
4. Tipsy customers,
5. Customers wheeling baby carriages through the store, and
6. Customers who attempt to engage a clerk in conversation to divert his interest. Such customers as this usually have a partner who will pilfer while the clerk's attention is on the other person.

Many retail organizations use one per cent of the estimated sales as a budget figure for shrinkage. A store's shrinkage includes clerical errors, marking mistakes, inaccurate cash handling procedures, breakage, and employee pilferage, in addition to shoplifting.

Twenty-five per cent of the total annual dollar shrinkage can be connected with shoplifting. A minimum of $382,500 worth of merchandise was lifted in 1963, a dollar amount that makes shoplifting a major problem for retailers.

One Columbus discount store recently found it necessary to increase its staff of special police to cope with the increasing problem of shoplifting. In one eight-day period 47 shoplifters were apprehended at this store with stolen merchandise worth more than $400.

SESSION I

OUTLINE	METHODS
I. INTRODUCTION	
A. Introduce Instructor	A. Name - Position
B. Explain Course Content 1. Number of sessions. 2. Time and place of meeting. 3. Tell of any guest speakers.	B. Relate the basic areas to be covered.
II. PURPOSE OF SHOPLIFTING COURSE 1. To define shoplifting. 2. To determine effect shoplifting has on the business community. 3. To learn how to identify shoplifters. 4. To get to know Ohio's laws on shoplifting. 5. To examine proper training procedures concerning store personnel. 6. To examine types of stores in which shoplifting is most prevalent. 7. To learn the correct procedures in apprehending a shoplifter. 8. Determine effect that the proper or improper displaying of merchandise has on shoplifting.	II. Attempt to draw out from the group these pointers. When there is a lull, the instructor can steer the class into some of the pointers, REMEMBER: DON'T ALLOW THE GROUP TO DRAG. List on the blackboard as points are brought out. 1. Websters' definition: a. Shoplifter is a person who steals articles exposed for sale in a store. 8. Discuss briefly why jewelry always found in a glass case. The effect of high stacks in corners.

Outline	Methods
III. OBJECTIVES OF THE STUDY OF SHOPLIFTING 1. To help businessmen reduce inventory losses. 2. To make employees aware of the problem. 3. To help prevent people from getting into trouble. 4. To know your rights and responsibilities as an employer or employee. 5. To learn to understand the policeman's problem. 6. To recognize key items of merchandise that are frequently stolen. 7. To find out what role age, sex, seasons of year, size of store, and attitudes play in shoplifting.	III. Again you have the opportunity to draw these pointers from the group. They may not recognize the ones listed at left; be sure you bring them out. They may have other points to discuss. NOTE: YOU WILL FIND AN OVER-LAPPING BETWEEN PURPOSE AND OBJECTIVES.
IV. PSYCHOLOGY OF SHOPLIFTING	
A. Why people shoplift	
1. Need 2. For "fun or kicks." 3. On a dare or impulse. 4. Just to see if they can get away with it. 5. Can't pass up the chance. 6. Desire for attention.	1. Draw out from group who they think would fall in this category. Example: Fathers who do not have money to buy groceries. --Teenagers preparing for a date but have no money to buy cosmetics.
V. TYPES OF SHOPLIFTERS	
A. Professionals	
B. Amateurs	
C. Kleptomaniacs	C. A sleptomaniac is one who has an abnormal, persistent impulse or tendency to steal.

Outline	Methods
1. Persons wearing loose, baggy clothing. 2. Persons carrying loosely folded umbrellas, shopping bags and folded newspapers. 3. Women with open handbags dangling from one arm, while holding change purses in plain view. 4. Intoxicated customers. 5. Baby carriages wheeled through the store. 6. Customers who engage you in conversation to divert your interest. Such people are often accompanied by partners who will steal while your attention is diverted. 7. Persons wearing unseasonable clothing such as heavy coats on warm days or raincoats on sunny days. 8. Persons carrying unwrapped merchandise in unrelated areas. 9. People who hang around but make no attempt to buy anything. 10. People who hang around the restrooms. 11. People who act nervous. 12. People who hang around the displays that are hidden from the clerks. 13. Teenagers grouped around a display. 14. Customers pretending to be waiting on someone. 15. A customer who always sends the clerk away on the pretense that he wants another size, color, etc. 16. People who go into receiving or stock rooms who have no business there.	The above three categories can be separated and broken down further by listing on backboard in this manner: PROFESSIONAL AMATEUR KLEPTOMANIAC Then draw out and ask group to separate the three groups. They should be able to pick out most of the types that are listed on the left. NOTE: IF INSTRUCTOR WISHES, HE MAY LIST TYPES RATHER THAN TAKING TIME IN DRAWING OUT FROM CLASS.

END OF SESSION ONE

SESSION II

The first session dealt with the introduction, purpose, importance, psychology, and types of shoplifters. This session should follow up the thinking and brainstorming that the group did last week by showing a film or having a resource person lead the discussion. Below are some suggestions and ideas that have worked.

Outline	Method and Source
1. Show film: THE MILLION DOLLAR CUSTOMER -- 22 min.	1. The Ohio Council of Retail Merchants, 71 East State Street Columbus, Ohio Attention: Mr. Karl Kahler or Mr. George Hammond
2. Discuss film.	2. Relate what class saw on film with what they discussed in class last session.
3. Guest speaker: a. Local store detective. b. Local police chief or member of his staff. c. Member of local security agency.	3. Any of these people are familiar with this film and could lead an excellent discussion.

END OF SESSION II

SESSION III

OUTLINE	METHODS
VI. TOOLS USED BY SHOPLIFTERS	
A. Some tools are:	
1. Boxes tied or wrapped like a regular suit box or other parcel but with a hinged top, bottom or end.	1. Arrange with police department to loan you a display of tools that they have confiscated from shoplifters.
2. Belts or harnesses to be worn under coats.	2. Have display ready before class so that they can be examined at beginning of meeting.
3. Work clothing bundled in a package.	3. Have general discussion with group concerning these tools.
4. Pants or bloomers with full pockets.	
5. Large wristed gloves.	
6. Musical instrument cases.	
7. Helper coats with large pockets.	
8. Pockets running the full length of the sleeve or large sleeves with cuff pockets.	
9. Newspapers or magazines that are folded to hold phonograph records.	
10. Umbrellas that are fitted with elastic bands that are attached to the ribs of the umbrella.	
11. Cases that look like those carried by doctors.	
12. Baby carriages, some have false bottoms and others are filled with blankets to cover articles that are stolen.	

Outline	Methods
13. Purses that are in baskets in self-service stores, also shoulder bags. 14. Maternity clothes -- Some-the bulge is false and holds a lot of merchandise. 15. Books that are hollowed out to hold small items. 16. Dresses with pockets in the back of the neck so small articles can be dropped in while the hair is being fixed 17. Bandaged arms with false plaster casts. 18. Toilet tissue or paper toweling with one end open so that small articles can be put in the broken end. 19. Coats carried on the arm or laid on the counter that may be laid over the merchandise to be stolen.	
VII. FACTORS THAT INDUCE SHOPLIFTING 1. Display 2. Advertising 3. Store hours 4. Crowds 5. Non-alert store personnel 6. Self-service 7. Too few employees 8. Lax police discipline 9. Store policy too lax 10. Not enough security 11. Shoplifting laws not understood 12. Teenage gangs and groups	VII. Have this sheet duplicated and pass out to group to discuss. Go over each item and relate how this has a bearing on inducing people to shoplift. Example: Display -- Highly stacked displays gives opportunity to hide. Open stock -- makes items easy to get. Self-service -- invites people to pick up items and conceal. Advertising: Exposes items available and brings large crowds.

WE HAVE NOW EXAMINED THIS SHOPLIFTING PROBLEM AND EXPLORED ITS PURPOSE, IMPORTANCE, PSYCHOLOGY OF SHOPLIFTING, AND TYPES OF SHOPLIFTERS. IN ADDITION, WE HAVE EXAMINED THE TOOLS OF THE SHOPLIFTING TRADE AND FACTORS THAT INDUCE SHOPLIFTING.

IT IS TIME NOW TO EXAMINE OHIO'S SHOPLIFTING LAW SO THAT WE MAY BECOME BETTER ACQUAINTED WITH THE HANDLING OF SHOPLIFTERS.

Outline	Methods
VIII. OHIO'S SHOPLIFTING LAW	
A. What merchants should know	A. Pass out booklet and go over the entire law
1. The new law effective September 15, 1965. 2. Summary of the new law. a. Who is covered? b. What can the merchant or his employee do? c. What are the ground rules for such detention d. Where can such detention take place? e. What can a police officer do? 3. Basic suggestions 4. With any power are conditions. 5. Who may use the power to detain? 6. Probable cause for believing 7. Purpose of detainment. 8. Within the merchantile establishment or its immediate vicinity. 9. Without search. 10. Reasonable time and manner. 11. Conclusion	Title: What Merchants Should Know About OHIO'S SHOPLIFTING LAW Source: Ohio State Council of Retail Merchants -- 71 East State Street, Columbus, Ohio 43215 It would be a good idea to have a store detective, police officer or other competent person discuss this law. NOTE: Law can be found in State Statute, Section 1. Section 2935.041 of the revised code. Author of the law is Representative Walter L. White.

END OF SESSION III

SESSION IV

OUTLINE	METHODS
IX. USE OF THE SURVEY FOR GROUP TO CONDUCT IN THEIR OWN COMMUNITY Things to know: 1. Name of store. 2. Number of employees. 3. Locally owned? Chain store? 4. Type of store: a. Department store b. Variety store c. Mail-order house d. Specialty store e. Neighborhood store f. Supermarket g. Other 5. Shoplifting a great, moderate or no problem? 6. Is shoplifting a seasonal problem 7. Average number of times a shoplifter is apprehended in the store monthly. 8. How many repeaters are caught monthly? 9. Approximate annual loss of merchandise due to shoplifting. 10. Three reasons why store has a shoplifting problem. 11. Are employees trained to spot a shoplifter?	IX. This survey can be used in many ways It was developed by the WHITEHALL YEARLING DISTRIBUTIVE EDUCATION CLASS* UNDER THE DIRECTION AND SUPERVISION OF CHIEF OF POLICE RALPH WALKER, AND A LOCAL STORE DETECTIVE. Survey can be used as follows: 1. At the termination of course. Now that the group has all the basic fundamentals of shoplifting, they can complete the course by means of this project. 2. If the class is large enough, it can answer the survey and compare results. 3. Some of the members may belong to the Jay-cees, Kiwanis, Lions or Rotary and may want to conduct this as a community project. 4. This survey could be used at the very beginning of the course. The questions could be motivation for the group to get started. 5. Regardless how you wish to use it, it is a most effective tool. *Courtesy of the WHITEHALL YEARLING HIGH SCHOOL, DISTRIBUTIVE EDUCATIO DEPARTMENT.

Outline	Methods
12. Method of training used: a. Literature b. Announcements c. Bulletins d. Sales meetings e. First several weeks of pre-employment f. Adult short courses g. Other methods 13. Does store carry liability insurance to protect employees-employer against law suits for false arrests? 14. Do you have a store detective? 15. Estimate of annual savings due to store detective. 16. Percentage of shoplifters: a. males b. females 17. Approximate age of shoplifters. 18, In handling a shoplifter, how do you handle the situation? a. Call the police. b. Make the person pay for the items. c. Make the person return the item and ask him to leave? 19. Store policy concerning internal theft. 20. Reasons why shoplifting is no problem.	

QUESTIONNAIRE ON SHOPLIFTING
Prepared by Professional Committee
Conducted by the Distributive Education Class
Whitehall Yearling High School

1. Name of Organization_____ _____

2. Number of Employees_____

3. Locally owned? YES_____ NO_____

4. If not locally owned, do you consider your organization a chain store?
YES_____ NO_____

5. Type of store:
Department_____ Variety_____ Specialty_____ Supermarket_____
Discount_____ Mail-Order____ Neighborhood____ Other_____

6. Is shoplifting a problem in your store?
Great problem_____ Moderate problem_____ No problem_____

7. Do you consider shoplifting a seasonal problem? YES_____ NO_____

8. If a seasonal problem, which season is shoplifting the greatest?_____

9. What is the average number of times you apprehend a shoplifter in a month?____

10. In the course of a year, how often do you apprehend a person that has shoplifted previously? _____

11. Have these repeaters in question 10 been ones that have been caught before but not prosecuted? _____

12. What is your approximate annual loss of merchandise due to shoplifting?$____

13. Would you list three reasons why you have a shoplifting problem?

1._____
2._____
3._____

14. Do you train your employees on how to spot a shoplifter? YES_____ NO_____

15. If you train your employees, please give the method of training used.(Please check)
Literature_____ Sales meetings_____
Announcements_____ In First Several Weeks of Employment____
Bulletin Board_____ Others_____

ERIC

16. Which method do you feel is the most effective?_____
Why?

17. Does your store carry liability insurance protecting your employees or you against law suits for false arrest? YES_____ NO_____

18. If so, what is the amount?_____

19. Do you have a store dective or any other type of security personnel?
YES_____ NO_____

20. If you have a store dective, please estimate your annual savings due to less theft. _____

21. What per cent of your shoplifters are males?_____ females?_____

22. What is the approximate age of these shoplifters? (Please give percentage)

0 - 12_____	30 - 40_____
12 - 18_____	40 - 65_____
18 - 22_____	65 - up_____
22 - 30_____	

23. If you apprehend a shoplifter, how do you handle the situation?

24. Do you ever prosecute shoplifters? YES_____ NO_____

25. If you do prosecute, what do the circumstances have to be before you do?

26. Do you feel our present law concerning shoplifting are strong enough?
YES_____ NO_____ If no, why?

27. Do you feel that the Whitehall police department plays an important part in handling your shoplifting cases? YES_____ NO_____ If no, why?

28. How could the Whitehall police be of better service to you concerning the problem of shoplifting?

ERIC

29. What would you estimate your annual loss of merchandise due to internal theft?
Annual loss $_____

30. What is your store policy concerning internal theft?

31. On the average, how many employees do you discharge in a year because of stealing merchandise? _____

32. Give three reasons why you do not have a shoplifting problem?
1. _____
2. _____
3. _____

33. Would you like a copy of our completed report? YES_____ NO_____

34. Do you have any comments that may help us in our study?

ERIC

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SUPPLEMENTAL MATERIAL

ERIC

BELOW ARE A LIST OF REASONS THAT WERE GIVEN TO THE WHITEHALL DISTRIBUTIVE EDUCATION CLASS OF 1965-66 IN A SURVEY THEY CONDUCTED ON SHOPLIFTING.

Out of 105 Businessmen they interviewed, 45 said they had no shoplifting problem or it was of minor significance. These are the reasons why:

1. Being small.
2. All merchandise sold over a counter. No self-service.
3. Watchful eye of employees.
4. Type of store.
5. Merchandise located properly.
6. Merchandise too heavy for shoplifter to carry.
7. Store layout. All aisles can be watched. No hidden corners.
8. Only one entrance. Customers must come and leave from same door.
9. Only display one item of a pair.
10. Keep help circulating.
11. Employees trained to spot shoplifters.
12. Lack of opportunity.
13. Follow up on any small incident. Word gets around. "People know I mean business."
14. Have a well lighted store.

SUGGESTIONS FOR PREVENTING BURGLARIES OF BUSINESS ESTABLISHMENTS

1. Keep only the minimum amount of cash on hand that is needed to operate your business.

2. Maintain complete personnel files and make security checks on all employees.

3. Instruct your employees not to discuss company business regarding valuable merchandise or large sums of money while they are off the job.

4. Keep your place of business well lighted at night. Place exterior lights in all alleyways and dark spots around the outside of your building.

5. Inspect your building for means of possible entry such as: coal chutes, fire escapes, ventilators, rear doors, loading docks, and windows and see that they are all properly secured.

6. If you have a safe or a vault, place it so it can be seen from outside and keep the area in this vicinity well lighted.

7. Do not place advertising displays in windows or doors which will block the view of officers and shield the actions of a burglar.

8. Do not stack materials close to fences or buildings, this makes it easy for a burglar to climb the fence or get on the roof of your building. Leave an aisleway between stacked materials and your fence so officer is able to observe what is going on.

9. Do not leave surplus materials, waste or debris piled next to your building. This gives burglars a place to duck and hide when officers come by, and also this may assist them in gaining access to your roof.

10. See that all doors and windows, particularly the ones in isolated places, are equipped with good substantial locks and all hinge pins on doors should be inside the building.

11. Place heavy screening or bars over doors and windows in remote areas.

12. Make a periodic security check of your building to see that all company rules and regulations are being carried out and everything is secure.

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ABSTRACT - Developed by a high school data processing teacher, this guide is designed to help teachers implement a course in processing data by means of mechanical and/or electronic equipment to train students for entry level jobs in data processing. Topics of the content outline are: (1) definition of data processing, (2) data processing cycle, (3) history and early development, (4) evaluation of data processing equipment, (5) input media for processing data, (6) processing data by unit record punch card equipment, (7) unit record punch card equipment machine operations, (8) elements of an electronic data processing system, (9) businesses employing data processing systems, (10) general application areas of data processing, and (11) employment opportunities. Objectives, a sample unit, suggested teaching techniques and aids, enrichment activities, evaluation, textbook list, equipment and supplies, and bibliography are included. The teacher for this course should be a business teacher with an extensive commercial orientation. (SB)

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State of New Jersey
Department of Education
Vocational Division

DATA PROCESSING

A Course of Study

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William J. Wolf

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I. Introduction

Among the many objectives of the comprehensive high school is the preparing of youth for economic and social competency. In order to succeed in this effort, the lag between what is happening in the real work and what is taught in the classroom must be immediately resolved. In some areas of the curriculum the delay has become too serious to remain tolerated, particularly in the field of data processing.

Automatic data processing has been with us on an ever-increasing scale since mid-century, yet it still largely remains for teachers to integrate such topics into their curricula. This process, one that is slow and difficult, is only now beginning. The time, then, is not inappropriate to present a course of study in which every part has been planned to provide the teacher with sufficient background and example to prepare his own instructional material. Therefore, the simple aim of this manual is to help teachers to learn about and then to plan and prepare their own course of study. This manual was not intended to be all-inclusive, but rather

to be a basic guide for those who are given the responsibility of implementing such a program in their school.

This entire area of instruction will remain fluid for many years and thus require a great deal of attention be given to curriculum development. Just as no publication in the technical field of automation remains static, the curriculum should continue to undergo day-by-day change and improvement. Without exception, any plan for curriculum change should be guided by an awareness of job skills and industry needs. If feasible, the method of cooperative education between school and industry is an area of possibility which should be considered.

The curriculum contained herein is designed to provide students with an understanding of the principles and techniques involved in the processing of data in business organizations, an understanding and knowledge of modern techniques of handling information, a basic competence in the application of data processing systems, and the operating and programming of punched card mechanical and electronic data processing equipment.

The emphasis throughout is upon the processing of data by the use of mechanical and/or electronic equipment. This includes familiarity with the use of a wide range of data processing equipment and an understanding of data processing applications. Sufficient instructional time on data processing equipment involving actual hands-on experience working with live problems will provide the student with a broad range of substantial experiences.

This particular course includes the necessary instruction for the student to acquire an understanding of the coding of source data and transcription to punched cards and magnetic or paper tape; operation and wiring of the more complex sorter, interpreters, reproducers, collators, and tabulators; and the operation and programming of electronic computers to produce personnel, inventory, fiscal, and other reports; and the planning, organizing, directing, and coordinating of a data processing installation. The student should be made aware of the employment duties of a data processor which require reasoning and verbal ability, clerical aptitude, finger and manual dexterity, and eye-hand coordination.

Qualified graduates of this course should be in the position to accept employment in one of a number of entry jobs available in the field of data processing. Their basic understanding of the principles involved in data processing will not only make them capable of immediate productivity in most business organizations but will also enable them to advance rapidly from entry jobs to positions of greater responsibility. Because all data processing systems, regardless of size, type, or basic use, have certain common fundamental concepts and operational principles, the graduate's proficiency with one complete data processing system should enable him to adapt to other systems quite easily.

Meeting the challenge of data processing instruction is not only reasonable, but is an intense responsibility. Our secondary students can function and succeed in this important training area. It follows then that we have an opportunity to provide a sound vocational skill for our youngsters while we help to meet a national shortage of personnel in this vital and dynamic field.

II. Objectives

A. To introduce the student to the concept of and the need for data processing.

B. To acquaint the student with the basic elements of a data processing cycle--input, processing, and output.

C. To provide the student with an understanding of the history and development of data processing equipment and technology.

D. To survey the various input media and their codes.

E. To introduce the student to the principles and characteristics of unit record punch card equipment data processing.

F. To develop skill in the operation of unit record punch card equipment, particularly with the card punch, sorter, and accounting machine.

G. To develop a comprehensive understanding of the elements of an electronic data processing system.

H. To introduce the student to the fundamentals and principles of computer operation and programming.

I. To acquaint the student with the various types of equipment that are manufactured to process data.

J. To acquaint the student with the types of businesses employing data processing systems.

K. To enlarge the student's understanding of the types of commercial and industrial problems that can be dealt with by automated data processing equipment.

L. To familiarize the student with the employment opportunities and the job activities in the area of data processing.

M. To provide basic job information needed by those who wish to obtain employment in the field of data processing.

N. To increase the student's awareness of the personal traits and work habits essential for desirable employability in the various career areas of data processing.

O. To provide basic information needed by those who wish to take advanced courses in data processing and computer technology.

III. Outline of Basic Content

A. Definition of Data Processing . . . Information Handling

B. The Data Processing Cycle

1. Input--the gathering and introduction of information to be analyzed

2. Processing--the manipulation of this data according to plan

3. Output--the production of results in a usable form

C. History and Early Development of Data Processing Computing Equipment

1. Abacus--simple type of digital computer (circa 2000 BC)

2. Pascal's Adding Machine--first adding machine (circa 1642)

3. Babbage's Analytical Engine--machine used for "store" of data (circa 1833)

4. Scheutz Difference Engine--computational machine (circa 1853)

5. Dr. Herman Hollerith--used cards with rectangular punches in 1890 census; machines included a punch, pin-press (first tabulating machine), electro-magnetic counters, and a sorting box.

6. Powers, in 1911, designed round hole punching, later formed Sperry Rand Company.

7. Howard Aiken, 1944, designed the Automatic Sequence Controlled Calculator. Input was by means of punched paper tape, cards, etc.; output by means of cards, tapes, or typewriters.

8. Electronic Numerical Integrator and Calculator (Eniac) 1942...the first electronic computer.

9. Electronic Discrete Variable Automatic Computers (Edvac) 1952...first machine to use an internally stored program (memory).

10. Univac (Universal Automatic Computer) 1949... first computer to be mass produced.

11. IBM 701--First truly electronic computer 1952

D. Evolution of Data Processing Equipment

1. Mechanical--adding machines, calculators, etc.

2. Electro-mechanical--unit record punch card equipment.

3. Electronic Computer
   a. Digital--manipulates data expressed in separate units
   b. Analog--reflects data in relative terms
4. Common language machines--flex-o-writer, teletype, etc.

E. Input Media for Processing Data

1. Punched Card
   a. Hollerith Code
   b. Powers Code

2. Tapes
   a. Punched paper tape using 5, 6, 7, and 8 channels
   b. Magnetic tape

3. MICR (Magnetic Ink Character Recognition)

4. Magnetic Disks

5. Mark-Sensing

6. Optical Scanning

7. Edge-Punched Cards

F. Processing Data by Unit Record Punch Card Equipment

1. Introduction to IBM Punched Card Data Processing
   a. History
   b. Fundamentals of IBM Accounting
   c. The IBM Card
      (1) Physical Characteristics
      (2) Columns

(3) Positions--zone and digit
(4) fields

d. Coding data
e. Punching and Verifying Data
f. Principles of IBM Machine Processing
g. Sorting Data
(1) Sequencing
(2) Grouping
(3) Selecting
h. The Accounting Machine
(1) Prints Alphabetic and Numerical Data
(2) Totals data by proper classification
(3) The Control Panel
i. Accounting Controls
j. Other Punched Card Machines
(1) Collators
(2) Calculators
(3) Interpreters
(4) Reproducers
(5) Summary Punching
k. Use of Prepunched Data

G. Unit Record Punch Card Equipment Machine Operations

1. Card Punching
a. Introduction
b. Operating Features
(1) Machine Parts
(2) Program Card
(3) Program Drum
c. Operations
(1) Inserting Cards Manually
(2) Numeric Punching with Program Control
(3) Alphabetic and Numeric Punching with Program Control
(4) Duplicating the Card
(5) Error Correction
(6) Error Correction--partially prepunched cards
(7) Prepunched Master Card Insertion
d. Printing Features
e. Program Card Preparation
(1) Field Definition coding
(2) Automatic skipping
(3) Automatic duplication
(4) Alphabetic coding

f. Operating Suggestions

2. 082 Sorter
   a. Operating Features
      (1) Machine Controls
         (a) Main-line switch
         (b) Start key
         (c) Stop key
      (2) Sort Brush and Column Indicator
      (3) Selection Switches
      (4) Pockets and Pocket Stops
      (5) Hand Feed Wheel
      (6) Chute Blades
   b. Machine Operation
      (1) Numerical Sorting
         (a) Sorting more than one field
         (b) Block Sorting
         (c) Sequence of Sorting for Reports
      (2) Alphabetic Sorting
      (3) Single Column Selection
   c. Operating Suggestions
      (1) Handling Cards
      (2) Protection against card jams
      (3) Timing the brush
      (4) Checking and stacking needle
         (a) Sight checking
         (b) Using a sorting needle
         (c) Stacking cards temporarily

3. 402 Accounting Machine
   a. Introduction
   b. Control Panel
      (1) Entry Hubs
      (2) Exit Hubs
      (3) Common Hubs
      (4) Switches
   c. Operating Switches and Signals
      (1) Main Line Switch
      (2) Start Key
      (3) Stop Key
      (4) Final Total Key
      (5) Light (Unlabeled)
      (6) Stop Light
      (7) Fuse Light
      (8) Form Light
      (9) Card Feed Stop Light

d. Print Unit
   (1) Detail Printing
   (2) Group Printing
   (3) Alphabetic Type Bars
   (4) Numeric Type Bars
   (5) Special Characters
   (6) Ribbon
   (7) Typebar Operation
e. Detail Printing: Numerical Information
   (1) Reading Brushes
   (2) Normal Alphamerical Print Entry (43 Type Bars)
   (3) Numerical Print Entry (45 Type Bars)
   (4) All Cycles
   (5) List
f. Detail Printing: Alphabetic Information
g. Zero Printing
   (1) Zero Suppression
   (2) Zero Carry Clip
h. Addition
   (1) Counter Postions
   (2) Counter Entry
   (3) Counter Control Plus
   (4) Counter Read-out and reset (Counter Total)
   (5) Counter Exit to Type Bars
   (6) Final Totals
i. Program Control
   (1) Comparing Unit
      (a) Entry
      (b) Exit
   (2) Program Start
      (a) Minor
      (b) Intermediate
      (c) Major
   (3) Total Program
j. Subtraction
   (1) Net Balance Subtraction
   (2) Method of Subtraction
   (3) Method of Net Balance Conversion
   (4) Non-Net Balance Subtraction
k. X Selection
l. Digit Selection
m. Selective Printing
n. Offset Total Printing
o. Hammerlock Control

p. Group Indication
q. Set Up Change
r. Summary Punching
s. Tape-Controlled Carriage
   (1) Control Tape
   (2) Operating Features
   (3) Form Control

H. Elements of an Electronic Data Processing System

1. Data Presentation
   a. Computer Data Representation
      (1) Binary Mode
      (2) Binary Number System
   b. Computer Codes
      (1) Code Checking
      (2) Seven-Bit Alphameric Code
      (3) Two out-of-five fixed count Code
      (4) Bi-quinary Code
      (5) Six-Bit Numeric Code
      (6) Binary System
   c. Data Recording Media
      (1) IBM Cards
      (2) Paper Tape
      (3) Magnetic Tape
      (4) Magnetic Ink Characters

2. Storage Devices
   a. Core Store
   b. Magnetic Drum Storage
   c. Magnetic Disk Storage
   d. Storage and Data Processing Methods

3. Central Processing Unit
   a. Functional Units
      (1) Register
      (2) Counter
      (3) Adder
   b. Machine Cycles
      (1) Instruction Cycle
      (2) Execution Cycle
   c. Serial and Parallel Operation
   d. Fixed and Variable Word Length

4. Input-Output Devices
   a. Card Readers
   b. Card Punches
   c. Magnetic Tape Units--Input and Output
      (1) Writing and Reading Magnetic Tape
      (2) Checking Binary Tape
      (3) Photosensing Markers
      (4) File Protection
   d. Paper Tape Readers
   e. Paper Tape Punch
   f. Printers
   g. Cathode Ray Tube
   h. Consoles

5. Store Program Concepts
   a. Instructions
   b. Developing a Program
      (1) Flow Charts
      (2) Block Diagrams
   c. Reading Data
   d. Calculating
   e. Logical Operations
   f. Comparing
   g. Instruction Modification
   h. Address Modification
   i. Indexing
   j. Indirect Addresses

6. Programming Systems
   a. Machine Coding
   b. The Programming System
      (1) The Programming Language
      (2) The Processor
   c. Automatic Coding System
   d. Macro-Instructions
   e. Program Compilers
   f. Program Package
   g. Fortran
   h. Sort Programs
   i. Utility Programs

7. Procedure Control
   a. Control Groups

(1) Control of Payroll Data
(2) Control of Sales Data

b. System Checks
(1) Record Count
(2) Control Total
(3) Proof Figures
(4) Limit Check
(5) Crossfooting Checks
(6) Tape Label
(7) Housekeeping Checks
(8) Check Point and Restart

c. Machine Checking

I. Types of Businesses Employing Data Processing Systems

1. Utilities

2. Institutions

3. Financial Organization

4. Insurance

5. Manufacturing

6. Construction

7. Transportation

8. Distribution

9. Textile and Clothing Industries

10. Local, State, and Federal Governments

11. Agriculture

12. Entertainment

13. Publications

14. Advertising

15. Retail

J. General Application Areas of Data Processing

1. Sales
   a. Comparative Sales
   b. Commission Statements
   c. Returns by Product
   d. Cost of Sales
   e. Sales Forecasts

2. Billing

3. Accounts Receivable
   a. Balance Forward
   b. Open Item

4. Inventory and Material Code

5. Accounts Payable
   a. Vendor Information
   b. Items due for payment
   c. Payables distribution summary breakdown

6. Payroll and Labor
   a. Payroll registers
   b. Statement and checks
   c. Payroll distribution reports

7. Manufacturing Control
   a. Forecasting of machine and labor loads
   b. Scheduling products and machine processing

K. Employment Opportunities in Data Processing

1. CODING CLERK. Converts routine items of information obtained from records and reports into codes for processing by data-typing or card-punch units, using predetermined coding systems.

2. TAPE LIBRARIAN. Classifies, catalogs, and maintains library of reels of magnetic or punched paper tape or decks of magnetic or punched cards used for electronic data processing purposes.

3. PROGRAMMER, DETAIL. Selects symbols from coding system peculiar to make or model of digital computer and applies them to successive steps of completed program for conversion to machine-processable instructions.

4. CARD-PUNCH OPERATOR. Operates alphabetic and numeric card-punch machine, similar in operation to electric typewriter, to transcribe data from source material onto punch cards and produce prepunched data.

5. CARD-TAPE-CONVERTER OPERATOR. Operates machines that automatically transcribe data from punched cards to reels of tape, or from tape to punched cards, for use in automatic data processing equipment.

6. DATA TYPIST. Converts alphabetic, numeric, and symbolic data into coded form on punch cards or tapes, loads decks of punch cards or reels of magnetic or paper tape into machine.

7. HIGH-SPEED-PRINTER OPERATOR. Operates high-speed printing machine to convert scientific, engineering, or business information previously recorded on reels of tape into printed records.

8. TABULATING-MACHINE OPERATOR. Operates machine that processes data from tabulating cards into printed records.

9. VERIFIER OPERATOR. Verifies accuracy of data punches on tabulating cards, using keyboard-type machine that rejects incorrectly punched cards.

10. COMPUTER-PERIPHERAL-EQUIPMENT OPERATOR. Operates on-line or off-line peripheral machines, according to instructions; to transfer data from one form to another, print output, and read data into and out of digital computer.

11. DIGITAL-COMPUTER OPERATOR. Monitors and controls electronic digital computer to process business, scientific engineering, or other data, according to operating instruction.

12. SUPERVISOR, COMPUTER OPERATIONS. Supervises and coordinates activities of workers who operate electronic data processing machines.

13. PROGRAMMER, BUSINESS. Converts symbolic statement of business problems to detailed logical flow charts for coding into computer language and solution by means of automatic data processing equipment.

14. PROGRAMMER, CHIEF, BUSINESS. Plans, schedules, and directs preparation of programs to process business data by electronic data processing equipment.

15. SYSTEMS ANALYST, BUSINESS ELECTRONIC DATA PROCESSING. Analyzes electronic data processing problems, such as development of integrated-production, inventory-control and cost-analysis system, to refine its formulation and convert it to programmable form.

16. PROJECT DIRECTOR, BUSINESS DATA PROCESSING. Plans, directs, and reviews business electronic data processing project.

17. MANAGER, ELECTRONIC DATA PROCESSING. Directs and coordinates planning and production activities of electronic data processing division.

IV. Sample Unit - Card Punching

A. Objectives

1. To learn the basic function of the card punch machine

2. To learn the machine parts

3. To learn how to insert cards manually and automatically

4. To learn how to do alphabetic and numeric punching with and without program controls

5. To learn how to correct errors

6. To learn how to punch cards from a prepunched master card

7. To learn how to prepare program cards

8. To learn how to insert and remove cards from the program drum

9. To learn how to remove damaged cards from the machine

10. To learn how to repunch damaged cards

B. Content

1. Introduction
   a. Description of machine functions and capabilities
   b. Description of keyboard setup
   c. Types of card punch machines

2. Card Description
   a. 80 Columns
   b. Punching positions
      (1) zones
      (2) digits
   c. Fields

3. Machine Parts
   a. Card hopper
   b. Punching station
   c. Reading station
   d. Card stacker
   e. Mainline switch
   f. Reading board

g. Backspace key
h. Program unit
i. Program control lever
j. Column indicator
k. Pressure-roll release lever
l. Chip box and fuses
m. Printing mechanism
n. Keyboards
o. Function Control Switches
   (1) Auto Feed
   (2) Auto Skip and Auto Duplication
   (3) Print

4. Program Card
   a. Field definition
   b. Automatic skip
   c. Automatic duplication
   d. Alphabetic shift
   e. Program card codes

5. Program drum
   a. Aligning pin
   b. Alignment check holes
   c. Clamping strip handle
   d. Clamping strip

6. Inserting Cards Manually
   a. Register key
   b. Release key
   c. Feed key

7. Numeric Punching with Program Control

8. Alphabetic and Numeric Punching with Program Control

9. Error Correction

10. Error Correction-Partially Prepunched Cards

11. Prepunched Master Card Insertion

12. Program Card Preparation
    a. Field-definition coding
    b. Automatic skipping

ERIC 123

c. Automatic duplication
d. Alphabetic coding

13. Operating Suggestions
    a. Engaging the program reading mechanism
    b. Stopping a punching operation
    c. Clearing the card bed
    d. Removing a card from the center of the card bed
    e. Removing a card from the left of the card bed
    f. Removing a card from the punching or reading station
    g. Spacing over columns
    h. Multiple-punched columns
    i. X-punching and skipping
    j. Corner cuts
    k. Single-card feeding
    l. Keyboard locking
    m. Suspending Automatic Duplication on first card

C. Activities

1. Collect various examples of IBM punched cards from community sources

2. Collect various examples of business documents used in IBM accounting

3. Code names on an IBM card

4. Punch alphabetic and numeric information from source documents

5. Duplicate information from one card into another

6. Insert cards manually and automatically

7. Punch cards using program control

8. Prepare program cards

9. Correct errors made in punching operations

10. X-Punching and skipping

11. Clear machine or jams

12. Insertion and removal of program cards

13. Punching payroll cards and invoice cards

14. Repunching damaged cards

D. Vocabulary

1. It will facilitate the teaching of this unit to develop pupil understanding of the following words and terms

Coding	Print Suppression
Column	Printing
Data	Program Control
Digit	Programming
Duplicating	Punching
Feeding	Reading
Field	Skipping
Keyboard	Source Document
Positions	Stacking
Prepunched	Zone

E. Evaluation

1. Does the student know the machine parts and the function of the machine?

2. Does the student know how to insert and remove cards from the machine?

3. Does the student know how to do alphabetic and numeric punching with or without program controls?

4. Does the student know how to prepare, insert, remove, and utilize a program card?

5. Does the student know how to remove and repunch damaged cards?

6. Does the student comprehend the function of the machine in relationship to the other elements of unit card accounting?

V. Suggested Teaching Techniques

A. Lecture when material comes from a supplementary source and when the textbook material is difficult to comprehend.

B. Discuss material that can l est be learned and understood through a give-and-take exchange of ideas and thoughts.

C. Individual assignments dealing with program card preparation, wiring control panels, and carriage tape preparation.

D. Group problem solving techniques dealing with key-punching and accounting machine operations.

E. Use of charts, bulletin board displays, and posters that deal with data processing concepts and practices.

F. Individual reports on news items dealing with data processing.

G. Individual and group projects dealing with implementing the accounting machines to solve business accounting problems.

VI. Suggested Teaching Aids

A. Audio Visual Material

There is an immeasurable number of filmstrips, slides, and films that are available from manufacturers of data processing equipment, various professional associations, and several independent organizations. Most of these audio-visual materials are obtainable on a loan or a rental basis. The following is a partial list of distributors who provide such materials for classroom use:

Association Films, Inc. (See Local Office)

American Management Association
1515 Broadway
New York, New York

Business Education Films
4607 Sixteen Avenue
Brooklyn, New York

Bell Telephone Free Loan Library
27 S. 17th Street
Philadelphia, Pennsylvania

Burroughs Corporation (See Local Office)

Data Processing Management Association
International Administration Headquarters
524 Busse Highway
Park Ridge, Illinois

Frieden, Inc. (See Local Office)

G. E. Film Library Service
3 Penn Center Plaza
Philadelphia, Pennsylvania

Honeywell EDP (See Local Office)

IBM Film Activities
590 Madison Avenue
New York, New York

Moore Business Forms, Inc. (See Local Office)

Modern Talking Picture Service, Inc.
(See Local Office)

National Cash Register Company
(See Local Office)

Project on Information Processing
Box 201
Montclair State College
Upper Montclair, New Jersey

Radio Corporation of America
(See Local Office)

Society for the Advancement of Management
74 Fifth Avenue
New York, New York

System Development Corporation
2500 Colorado Avenue
Santa Monica, California

Univac Division of Sperry Rand Corporation
(See Local Office)

B. Supplementary Reading Materials

1. Newspapers and magazines reporting on data processing
2. Business Education Periodicals
   a. Business Education World
   b. U. B. E. A. Forum
   c. The Balance Sheet
3. Professional Business Periodicals
4. Data Processing Periodicals and Journals
5. Automation Association Periodicals and Journals
6. Pamphlets, Booklets, and Bulletins from miscellaneous sources.

C. Demonstration Devices
   1. Control Panel Chalkboards
   2. Sample Cards (Blank and Punched) from various commercial companies
   3. Sample Forms (Blank and Printed) from various commercial companies
   4. Procedures and flow charts from various commercial companies
   5. Multiple card layout forms printing layout forms
   6. Pictures of equipment used in data processing functions.
   7. Educational Computer and Automation Kits.

D. Reference Materials
   1. IBM Programmed Instruction Books
   2. IBM 24-26 Card Punch Education Guide
   3. IBM 402 Accounting Machine Education Guide
   4. IBM Reference Manual--Functional Wiring Principles
   5. Various publications from selected bibliographies dealing with Automation and Data Processing

E. Training Aids
   1. Punch Card Chalkboard (Model #V25 6913)
   2. Accounting Machine Control Panel Chalkboard (Model #V25 6903)

F. The following examinations, problems, and training aids are available from the IBM Education Department:

Functional Wiring Tests
Punched Card Final Examination
Final Examination Principles, Punched Cards
Principles of Programming Quiz Booklet
Basic Machine Operators Examination
024 Final
Card Punch Aptitude
082 Final
402 Final
Functional Wiring Problems
Basic Machine Payroll Problem
Phase 1 Workbook Punched Card
Phase 2 Workbook Punched Card
Phase 3 Workbook Punched Card

024 Exercises
082 Problems
402 Problems
Functional Wiring Transparencies
Keyboard Chart
Sample Invoice Forms
Sets 082 Transparencies

VII. Enrichment Activities

A. Collect and start a file of newspaper and magazine articles on the impact of automation in office occupations, equipment, and techniques of handling data in various businesses.

B. Prepare posters or charts illustrating the history and development of data processing.

C. Construct bulletin board displays which illustrate current development of data processing.

D. Encourage and inspire students to participate in class discussions or in giving individual reports on news items, student visits to data processing installations, or with personal interviews with individuals directly connected with data processing.

E. Arrange field trips to local businesses using data processing equipment.

F. Construct and use flannel boards to introduce new equipment and for demonstrating flow charting techniques with movable symbols.

G. Organize a "Career Day" on Data Processing career patterns and future careers that are developing.

H. Develop a notebook of vocabulary words, crossword puzzles, math problems, sample source documents, scrambled letter puzzles, on Data Processing.

I. Guest speakers from business and industry who work in Data Processing.

J. Prepare transparencies for use with the overhead projector in illustrating flow charting, kinds of equipment, punch card codes, parts of machines, wiring diagrams, etc.

K. Prepare classroom library of books, magazines, manufacturer's manuals and descriptive literature on data processing.

VIII. Evaluation and Testing

A. Objective Test on Material
   1. Completion
   2. Multiple-Choice
   3. True or False
   4. Matching

B. Essay

C. Analysis of Written and Oral Work

D. Functional Wiring Tests

E. Punched Card Examination

F. Test on Principles of Punched Card Accounting

G. Basic Machine Operators Examination

H. Functional Wiring Problems

IX. Correlation of Data Processing to Total School Curriculum

A. Development of typing skills through related keypunching exercises

B. Development of bookkeeping knowledge and skill through the implementing of accounting machines to solve basic business accounting problems

C. Development of mathematical skills through data handling and summarizing

D. Development of communication skills through the writing of procedural and programming instructions.

X. Textbooks Used in the Course

A. IBM Reference Manual . . . 024 Card Punch and 026 Printing Card Punch

This test is basically a reference manual that presents information on the techniques and manner of operating the 024 Card Punch and the 026 Printing Card Punch. The operational and printing features of the machine are illustrated and explained in detail. Program card preparation is also illustrated.

B. IBM Reference Manual . . . 082, 083, and 084 Sorters

This text is basically a reference manual that presents information on the techniques and manner of operating the 082 sorting machine. The operational features are illustrated and explained in detail. Several operational suggestions are provided to maximize the operator's efficiency in running this machine and to facilitate the completion of work assignments.

C. IBM Manual of Operations . . . 402, 403, and 419 Accounting Machine

This book will serve to introduce the students to the operational techniques essential in running the machine and to a knowledge of the machines many functions and capabilities. The pictures and diagrams illustrate wiring procedures and methods of data handling. Specific attention is given to detail and group printing of alphabetic and numeric information, addition and subtraction, program control, and the fundamentals of the tape-controlled carriage.

D. IBM Basic Accounting Concepts and Introduction to Punched Card Accounting Application

This text will serve to introduce the students to the basic principles of accounting and the steps in the accounting cycle. Particular attention is given to a study of the common forms and papers used in accounting

activity and the related vocabulary of the trade. Moreover, a basic introduction to punched card application is presented. Some of the more common accounting applications are illustrated and explained.

E. IBM General Information Manual . . . Introduction to IBM Data Processing Systems, 1960, International Business Machines Corporation

This manual presents those fundamental concepts and operational principles which are basic to developing a knowledge of computers. The manual is designed for use in training programs where a basic knowledge of computers is the end objective or as a prerequisite to the detailed study of a particular IBM System. The subject matter in the manual deals with storage devices, input-output devices, stored program concepts, and programming systems.

F. Introduction to Data Processing, Haskins and Sells, 1957.

The objective of the text is to convey to the reader a grasp of the basic concepts in the processing of data. The field of data processing is broadly covered in its entirety with attention being focused upon the fundamental principles and practices. The author attempts to correlate the principal methods and devices with the basic operations they serve to perform. Principles and problems dealing with the concepts of integrated data processing and the subject of organization and control of data processing activities is also covered.

G. Principles of Automatic Data Processing, by the Data Processing Management Association, 1965.

This text amply covers the major principles of data processing which are basic to an awareness of the usefulness of automatic data processing equipment in combatting the "paperwork explosion." The subject areas include: the development of data processing methods, punched card systems, EDP systems, number systems, the basics of computer operations, and computer application in business.

H. Basic Machine Accounting . . . The Theory, Programming and Operation of Electric Accounting Machines, by the Machine Accountants Training Association, 1963.

The purpose of this text is to aid the student in achieving a thorough knowledge of the theory and operation of the basic IBM Data Processing equipment. The text provides for practical training in the functions and applications of the IBM Card Punch Machine, Collator, Reproducer, Interpreter, and Tabulator.

I. Automation Office Practice, by Wanous & Wanous, South-Western Publishing Company, 1964.

Automation Office Practice Set, by Wanous & Wanous, South-Western Publishing Company, 1964.

The basic purpose of this text is to introduce the student to the modern innovations in automating office work and activity. As a means of a background, the beginning and development of office automation is presented. Next the methods of processing data is introduced with limited attention being given to the tabulating and the electronic-computer system.

The practice set that accompanies this text provides the student with the opportunity to observe and handle some of the materials used in processing data, namely, punched cards, paper tapes, sales invoices, etc.

J. Key-Punch Training Course, by William E. Bux, South-Western Publishing Company, 1966.

This text is basically an instructional manual which provides specific information about the operation of the IBM 026 Card Punch. In addition, general instructions are provided for the completion of specific key-punching jobs or assignments involving labor distribution, payroll, accounts receivable, and accounts payable.

K. Business Data Processing . . . basic principles and applications, by Gilbert Kahn, Gregg Division McGraw-Hill Book Company, 1966.

As the title of this text suggests, this book is primarily an introduction to the basic principles and applications of business data processing. The material is presented in simple, graphic form. The student is initially introduced to the needs for data processing and how this processing of data has been accomplished in the past using mechanical methods. The author then proceeds to acquaint the student with the more modern methods of processing data through the use of punched-card and computer equipment.

XI. Equipment and Supplies

A. Unit Record Equipment

1. An 026 Printing Card Punch
2. An 082 Sorter
3. An 402 Accounting Machine
4. Accounting Machine Panels
5. IBM Selectric Typewriter with the attached "Simulator Device."
6. IBM Selectric Typewriter "Alphameric" typing elements
7. Two adjoining rooms . . . one to be used as a machine laboratory and the other for lectures

B. Supplementary Tabulating or Unit Record Equipment

1. Carriage Tape Punch
2. Key Punch Desk
3. Card Punch Posture Chairs
4. Multiple-drawer Punch Card File
5. Sorter Rack
6. Boxes and trays for the storage of wires and plugs
7. Control Panel Storage Units
8. Control Panel Charts and Blackboards

C. General Classroom and Miscellaneous Equipment

1. Chairs, Flat Top Desks, and Tables
2. Chalkboards, Chalk, and Erasers
3. Bulletin Board Facilities
4. Audio-Visual Aids . . . 16mm. Projectors, Slide Projector, Screen, Overhead and Opaque Projector
5. Book Rack or Book Case for the storage and display of reference books and periodicals

D. Supplies

1. Textbooks, Practice Sets, Machine Manuals, Templates, and Transparencies
2. Blank Accounting Machine Control Panel Diagrams, Multiple Card Layout Forms, and Spacing Chart Forms
3. Blank 5081 Cards and assorted cards representing specific types of business applications (Sales Cards, Payroll Cards, and Inventory Cards)

4. Colored pencils, pens, rulers, erasers, grease pencils, and cleaning fluid for transparencies
5. Programmed Instruction Books and Tapes
6. Standard Stock Paper for the print out of assigned 402 Accounting Machine Problems
7. Carriage Tapes for the 402 Accounting Machine
8. Musilage for the pasting of Carriage Tapes

XII. Instructional Staff

Essential to the success of any instructional program is a well qualified staff. This becomes a matter of extreme difficulty in the area of data processing where the qualifications include technical competence, information processing experience, and teaching skill.

Generally speaking, business teachers with an extensive commercial orientation are usually the best candidates for this instructional area. Even though they may lack the practical data processing experience and be completely devoid of machine knowledge, these deficiencies can be overcome by attending appropriate classes at IBM education centers and by spending a considerable amount of time in an industrial installation.

Further preparation, can be obtained through enrollment in various college or technical courses related to data processing. Certain teachers have been selected to attend the annual Summer Institutes on Business Data Processing sponsored by the U. S. Office of Education. Attendance at these institutes, six of which are held annually, is open to experienced teachers who are available for assignment in National Defense Education Act,

Title VIII, Business Data Processing Programs. Application for the course is made through the state director of vocational education.

If at all possible, the data processing instructor should attempt to obtain some work experience in a business or an industrial firm. This can be accomplished during the summer recess or on a part-time basis throughout the school year. Many companies would be most agreeable to employing a teacher for several evenings a week or every Saturday.

Most definitely, the business teacher of data processing should engage in a considerable amount of professional reading. Due to the newness of the program and the great expanse of instructional material that is being continually developed and published, extensive effort has to be exerted so as to remain informed and knowledgeable about the many ramifications of the subject. There are countless books, pamphlets, periodicals, and manuals which will greatly aid the teacher in acquiring understanding and competence in this explosive technological area where what is studied today becomes obsolescent as of tomorrow.

Finally, the data processing teacher can supplement and improve his instructional program by enlisting the aid of college professors, personnel from data processing installations, and IBM or other manufacturer representatives.

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Wanous, S. J. and Edward E. Wanous, Automation Office Practice. New Rochelle, New York: South-Western Publishing Company, 1964.

VT 010 470
Introduction to Advertising.

Ohio State Dept. of Education, Columbus. Distributive Education Materials Lab.
MF AVAILABLE IN VT-ERIC SET.
Distributive Education Materials Laboratory, The Ohio State University, 124 West 17th Avenue, Columbus, Ohio 43210 ($1.50).
PUB DATE - 66 63p.

DESCRIPTORS - *DISTRIBUTIVE EDUCATION; *TEACHING GUIDES; *PUBLICIZE; MASS MEDIA; *MERCHANDISING; UNITS OF STUDY (SUBJECT FIELDS)

ABSTRACT - Developed by teacher-coordinators during a workshop, the curriculum materials are designed to aid the teacher in preparing a unit on advertising. Technical material, suggested activities, and references are provided for these topics: (1) Pros and Cons of Advertising, (2) Regulation of Advertising, (3) Psychology of Advertising, (4) Advertising Agencies, (5) Printed Advertising Media, (6) Broadcast Media, (7) Effect of Ratings on Television Advertising, (8) Position Media, (9) Layout and Copywriting, (10) Advertising Campaign, and (11) Creativity in Advertising. (SB)

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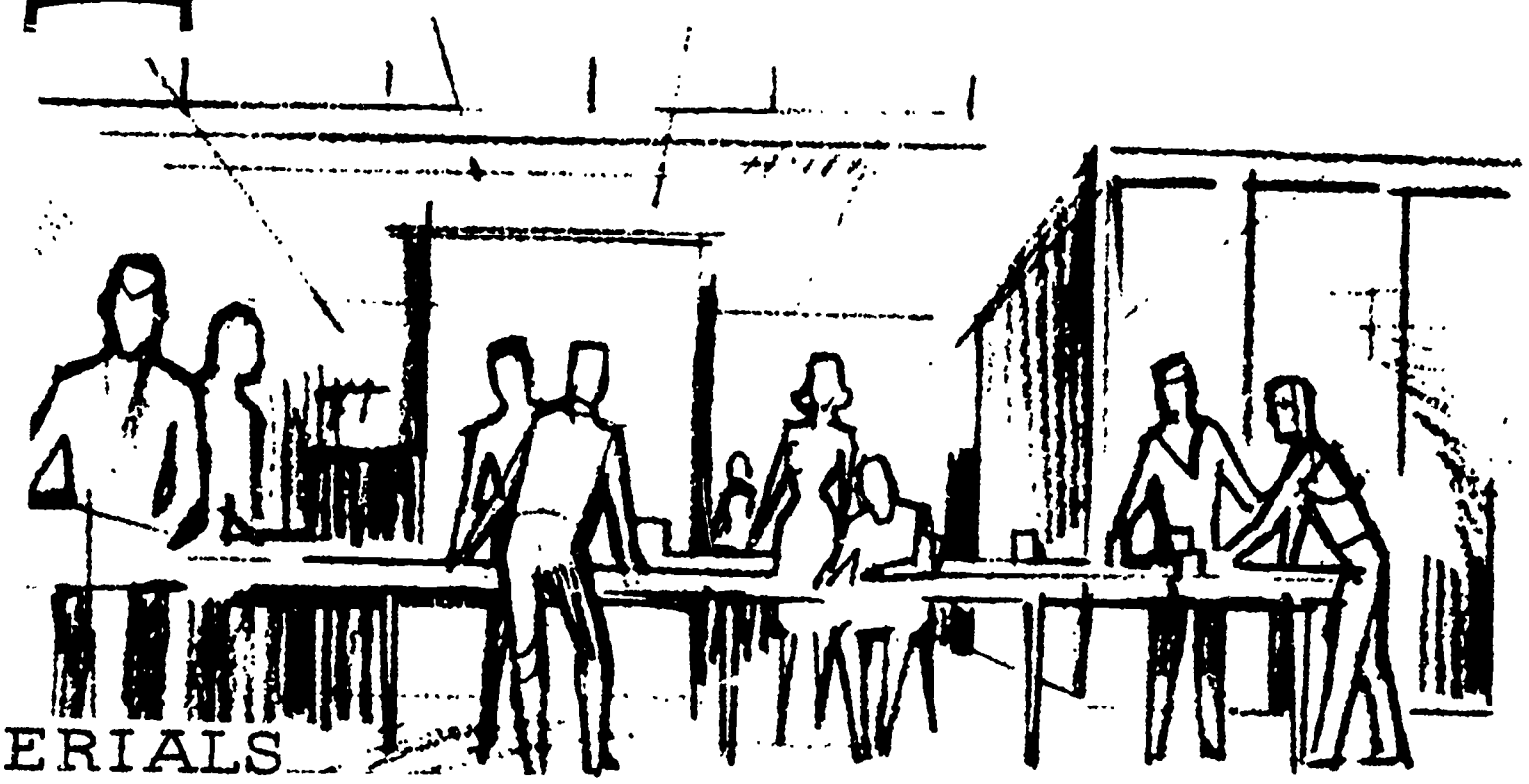
INTRODUCTION TO ADVERTISING



MATERIALS

OHIO
distributive
education

LABORATORY

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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TEACHER-COORDINATORS

MEMBERS OF THE ADVERTISING WORKSHOP

Bowling Green State University, 1966

William Bishop	Wooster High School
Ruth Liskai Blair	Toledo Woodward High School
Larry Casterline	Medina High School
Harold Caylor	Euclid Senior High School
Pamela Floyd Dudley (deceased)	Toledo Bowsher High School
Vincent Hainen	North Baltimore
James Henry	Penta County Joint Vocational School
John Holup	Toledo Waite High School
David Rankin	Toledo Rogers High School
Edward Savel	Chofflin Vocational High School
Bruce Summa	Ashland High School
Donald Taylor	Eaton High School
Gordon Williams	Lakota High School

INTRODUCTION

Distributive education teacher-coordinators composed the workshop to develop the information presented in this handbook.

The handbook is designed to provide technical material and activities to assist a teacher in preparing a teaching unit on advertising.

The activities listed in this handbook are intended to be suggestions to teachers that will reinforce learning and provide for the practical application of advertising. These suggested techniques are only teaching aids and do not intend to offset the individual creativity of the instructor.

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"PROS AND CONS" OF ADVERTISING

Most marketing people feel advertising plays an important role in our society, but advertising is constantly being analyzed and examined by economists, sociologists and moralists. Advertising is under a constant bombardment of criticism. Some of its own leaders are critical of techniques used in advertisements and uncertain as to the value of advertising in our economy.

"Cons" of Advertising

Criticisms concerning the value of advertising come from economists who claim advertising is wasteful. According to these economists, advertising shifts production into the wrong segments and denies consumers the right to express their preferences.

To further define their position on advertising, economists have divided advertising into two categories: constructive (informative) and combative (competitive). The first economist to distinguish between the wasteful and the acceptable forms of advertising was Alfred Marshall. His constructive category of advertising provides necessary information about products and services available to the consumer. Alfred Oxenfeldt in his book, Economics for the Citizen, describes informative advertising as "indicating the availability of goods that consumers would otherwise not know about". He states that competitive advertising "rarely tells the consumer anything that is new, but simply tries to shift the patronage of buyers from one source to another by whatever wiles the advertiser can employ".

Some economists feel that competitive advertising merely diverts demand from one manufacturer to another, and the competitive advertising of one firm merely

cancels out that of another. They believe this is a force toward monopoly and toward commercial stalemate which manipulates demand contrary to the interest of the consumer. Advertising is said to create a monopoly because industrial giants can afford to launch a new product supported by advertising, while the smaller manufacturer is limited and cannot compete.

Some critics claim that advertising gives the public the most superficial information and entertainment. It encourages what is popular rather than what is good.

Advertising is criticized for appealing to the public's emotions causing them to buy things they cannot afford and do not need.

Advertising is said to control the press. Critics claim that mass media are at the mercy of advertisers. Advertising is said to dictate editorial policy and determine what articles will or will not be published. Newspapers, magazines, radio and television depend on advertising as their main source of revenue. The criticism is especially strong against television network programing because the advertiser pays for the time his commercials are on the air as well as the cost of the entertainment between the commercials. The viewing public only sees the programs which the advertisers want to sponsor.

Advertising is criticized for the use of sex as an attention-getting device.

"Pros" of Advertising

Increased production brought about by technological invention and expansion has allowed man to reach wealth and a standard of living never thought possible. Continued production in a free enterprise economy must depend upon continued consumption or demand. Advertising is one method of creating such a demand.

One criticism of advertising is that it causes people to buy things they do not want or need. Advertising does influence the choices of buyers, but underlying physical and psychological conditions must be favorable if the demand for a product is to expand. People must have discretionary income before they will become concerned over satisfaction of anything except basic biological needs. A society such as the United States where the individual is free to better himself without strong class restrictions is also necessary for advertising to have a substantial influence on demand. The advertising not only creates product awareness and interest, but spreads wants among consumers of all economic levels.

Advertising increases sales and cuts down on the cost of selling by pre-selling the product. Advertising does not replace personal selling, but it is an effective means of creating product awareness and interest.

Advertising helps build customer loyalty against similar products and pure competition.

Advertising supports many forms of mass communication such as radio, television, newspapers and magazines. It would be impossible for a newspaper to charge the consumer a price high enough to cover the cost of gathering the news, writing, editing, printing and distributing the papers without advertising. Radio and television stations could not support themselves without advertising, and consumers would not be able to enjoy these media as they do today.

Advertising helps to level off seasonal fluctuations in demand.

Suggested Activities

1. Assign written report on Vance Packard's The Hidden Persuaders, New York, 1957; or Martin Mayer's Madison Avenue, U.S.A., New York, 1958.
2. For discussion purposes use The A.A.A.A. Study on Consumer Judgment of Advertising, An Analysis of the Principal Findings by Members of the Research Team which conducted the study for the American Association of Advertising Agencies. May 1965.
3. Appoint a panel to discuss the topic: Advertising As An Economic Waste.

REGULATION OF ADVERTISING

In 1911 the publishers of Printers' Ink launched a campaign for truth in advertising and printed its Model Statute for Truth in Advertising. This statute, in some cases modified, has been adopted by some forty-four states and the District of Columbia as the law governing advertising. At the same time the Associated Advertising Clubs of America established one of the first methods of self-regulation for the industry in the formation of vigilance committees. These committees, made up of and supported by advertisers, were to receive complaints by consumers, conduct investigations, and then either try to persuade the advertiser to cease the type of advertising or present evidence to district attorneys for action.

These actions, taken by the advertising industry itself, were the first forms of regulation of advertising. Today, the public actually has three forms of protection against misleading or fraudulent advertising. First, there is self-regulation, which is imposed on advertising by people in the industry. The second form is provided by state laws and the federal government. The actual nature of advertising as a communication process furnishes the third form of regulation.

Through the years the means and machinery of self-regulation have been established. All major associations of advertisers and agencies have developed codes of ethics, and all major media have standards of copy acceptance.

Two organizations within the industry which have been instrumental in promoting truthful advertising and good codes of ethics are the American Association of Advertising Agencies, Inc. and the National Association of Broadcasters. The AAAA established a voluntary interchange to enable agencies to stop any advertising they considered objectionable to the public. Their Creative Code points out what they

considered objectionable. The National Association of Broadcasters in their code covering both television and radio set up certain standards of good taste pertaining to commercials and the content of programs. The code covers such things as contests, advertising medical products, religious programs and sponsor identification.

The primary purpose of Better Business Bureau offices is to help business achieve effective self-regulation. Among their many duties is the shopping of retail stores to make sure their advertisements are honest. They keep a file of schemes and tricks used in all parts of the country to make them aware in case such acts are ever tried in their own locality.

The second form of regulation is that provided by state laws and the federal government. The Printers' Ink Model Statute of 1911 was the first form of law governing advertising to be passed. It was state law and had no effect across state lines. The Federal Trade Commission became the Federal policeman of advertising. The Federal Trade Commission Act of 1914 was strengthened by the passing of the Wheeler-Lea Amendment in 1938. These two acts were directed against false and misleading advertising of all types other than labeling.

Other federal attempts at regulating advertising are:

1. The Food, Drug and Cosmetic Act of 1938. This act specifies the information to be included on labels, packages and package inserts.

2. The Robinson-Patman Act of 1936. This act was intended to protect small retailers against unfair competition. It included the giving of advertising allowances and discounts.

3. The Lanham Act of 1946. This act set up procedures to be followed by persons and business firms wishing to protect their rights to certain trademarks.

Numerous other phases of advertising are policed by the Federal Government through such agencies as the Post Office Department, Securities and Exchange Commission, Federal Communications Commission and the Federal Alcohol Commission. At least twenty-one different federal agencies exercise some control over advertising.

The very nature of advertising as a communication process is the third form of regulation. This differs from self-regulation in that once an advertisement is processed and then seen or read by the consumer it is too late to be changed by anyone within the industry. Be it good, bad, false, misleading or of bad taste, it is now exposed for all to see and hear.

This form of regulation places the burden of exposure of false or misleading advertising in the hands of the consumer himself. He is the final judge of all advertising, and he expresses his regulatory powers in many ways. He may expose the dishonest advertiser by reporting him to the proper federal or state agency, or he may simply ignore the advertisement and then speak disapprovingly about the product.

Suggested Activities

1. Appoint a panel discussion committee to review the report entitled Self-Regulation in Advertising. The committee may divide its discussion into the following topics:

   (a) Self-regulation by individual advertisers, companies and corporations

   (b) Self-regulation by individual industries and industry groups

   (c) Self-regulation by advertising trade associations, clubs, bureaus and related organizations

   (d) Self-regulation by advertising media and by publishers and broadcasters acting both independently and through their own media associations

   Self-Regulation in Advertising, prepared by the advertising advisory committee to the Secretary of Commerce, is a 105-page report summarizing the many types of self-regulation activities operating in our society to upgrade American advertising and is available for 60¢ by writing the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

2. Assign reports on the local, state and national laws which affect the advertising practices in students' training stations.

3. Invite a representative of the Better Business Bureau to explain the operation of the bureau in discovering and weeding out fraudulent advertising.

4. Assign reports on factual cases involving advertising standards.

5. Assign students to bring to class several advertisements from newspapers or magazines which display the seal of approval of Parents' Magazine or of Good Housekeeping. Discuss the value of these seals to both the advertiser and the consumer.

6. Assign students to consult standard reference materials for information concerning Federal Trade Commission rules, Better Business Bureau codes and other regulations. (e.g., A Guide for Retail Advertising and Selling, Association of Better Business Bureaus, 405 Lexington Avenue, New York, New York 10017. This reference contains 268 fact-filled pages, listing 50 different products and services.

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PSYCHOLOGY OF ADVERTISING

Basic Concepts of Human Behavior

The objective of advertising is to influence human behavior. In order to accomplish this goal, the advertiser must understand some of the basic influences that shape human behavior, including the communicative process itself.

Three basic elements necessary to an understanding of human behavior are motivation, perception, and learning. Motivation can be defined as a state of tension or disequilibrium within the individual which activates or moves his behavior toward an objective or goal. Motivation, of course, can be conscious or subconscious. Individuals are not always aware of the motives that channel their behavior, but the behavior is always purposive or goal-directed.

All knowledge is derived through sensory stimulation, or the response of sense organs to light, sound, or similar stimuli. The complex process of selection, organization, and interpretation of these stimuli into a coherent picture of the individual's world is called perception.

Basically the learning process involves an association between a stimulus and a response, or between two stimuli, and most associations are formed when the individual is motivated in some way.

Human actions are affected by a number of needs, or motives--some innate, some learned, or acquired--which people seek to satisfy. The intensity of these motives and the directions taken in satisfying them are not fixed, but are modified by environment, especially by social standards of the group with which peer groups associate themselves.

No list of buying motives should be considered complete or absolute, but a working check list of the most common needs is a practical aid to the advertiser, provided he keeps in mind that they may not be so rigidly defined as the list indicates and that in any given situation there may be a number of different needs interacting determining the consumer's decision to buy or not to buy.

Besides being concerned with motivational patterns, the advertiser must be concerned with learning, reinforcement, and habit. Learning is the effect of either direct physical experience or symbolic experience on subsequent behavior. Perhaps even more important to the advertiser than the learning process is the individual's capacity to unlearn or forget. Studies indicate that people can forget as much as sixty per cent of what they have learned within an hour and seventy-five per cent in a day.

Reinforcement and habit are phases of the learning process. When achievement of a goal results in satisfaction or gratification of the motive, the result is reinforcement; and when the identical need is aroused later, the individual will tend to repeat the same process to achieve the same goal. Continued reinforcement tends to reduce the importance of thinking in behavior patterns until ultimately the connection between the stimulus and the response becomes automatic. The result is habit.

No motive to buy is stimulated by one stimulus but rather by a combination of different motives. Despite the universal nature of certain motives, their relative strengths within the total complex of motivation vary, not only among groups of people but even within the same individual at different times and under different circumstances.

The Image and the Brand

What the modern consumer really buys is not a product made to certain specifications but his image of a product--an image which he may or may not be able to describe with any accuracy--representing not only the inherent qualities of the product but also all the ideas he has about it.

Most advertisers are concerned with the brand image of their product. Their basic problem is not to increase the sales of a generic product, but to sell the particular brand.

Psychology and the Communicative Process

In its simplest concept the process of communication includes three elements: a source, a message, and a destination.

In advertising communication the message becomes a stimulus designed to obtain a certain consumer response--the purchase of a product or the acceptance of an idea.

One of the primary problems in the creation of advertising is the translation of news and information about the product from the language of the advertiser into the language of the consumer.

Feedback presents another problem in communication. Without feedback the advertiser does not know if the receiver understands the message or has any questions about it.

Interference from outside sources may cause the advertiser not to get the message to the consumer. External causes may be events which happen to the reader or viewer through no fault of the advertiser. Internal interference may be

due to the message's briefness, surrounding advertisements, the competition of entertainment with the advertisement, or other material.

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Suggested Activities

1. For discussion purposes assign selection of advertisements which illustrate different buying appeals.
2. Assign motivational study of a particular television commercial, selected by the student, describing commercial's personal appeal.
3. Designate a panel to debate the topic: Communications Best Describes Advertising's Role.
4. Assign the collection of two good and two poor advertisements. Each student's oral presentation should explain his reasons for classifying the advertisements as good or poor.
5. Assign visits to several community retail stores for observation of the various products that would be most adaptable to each of these buying motives: efficiency, style, beauty, dependability, convenience, pleasure, pride of ownership, bargains, cleanliness, curiosity and quality of construction. Students should be ready to discuss and, if necessary, defend their choice of product and the buying motive selected.

   Sample:

Buying Motive Used	(1) Product Selected	(2) Product Selected	(3) Product Selected	(4) Product Selected	(5) Product Selected

6. Develop an assignment sheet directing the students to examine the buying motives contained in several selling statements. After students have selected the motives, require explanation of various reasons for their choices.

7. Prepare an assignment sheet listing ten different consumer needs. Require students to complete the remainder of the table by making the different buying decisions.

Sample:

NEED	THING	SOURCE	PRICE	TIME
The gasoline tank is almost empty	Regular Gasoline	Service Station on Elm Street	31.9¢ per/gal.	Soon as possible

ADVERTISING AGENCIES

The agency is independent of both the media and its advertising clients. Because of this independence, the agency can offer an outside, objective point of view. It can recommend the most effective media and the most appropriate advertising campaign.

The agency must have a staff of creative and business people. Creative personnel prepare advertising copy, prepare art illustrations, conduct research, analyze media and provide other creative services designed to help their clients grow and prosper. At the same time, the advertising agency must apply business principles and practices designed to promote the agency itself.

Most agencies provide a number of marketing services. Regardless of the extent of these services, however, the primary function of an agency is to prepare and place advertising in advertising media. The agency analyzes the market before preparing an advertising campaign and evaluates its effectiveness after the campaign is completed.

The goal of the advertising agency is identical to the goal of advertising itself. The function of the agency is to prepare advertising that will motivate customers to buy the sellers' goods and services. The advertising agency performs services needed by advertisers when the agency employs media as intermediaries for communicating the selling message.

Although the Department of Justice and the AAAA agreed to refrain from activity in the area of agency recognition, individual advertising media still chose the agencies with which they would do business; therefore, the recognition system continues much as it did before 1956.

Advertising agencies still receive approximately two-thirds of their income in the form of commissions offered by the advertising media. The other one-third of their income is paid by clients in the form of service charges and service fees. The customary commission allowed by advertising media to advertising agencies has been 15 per cent. Both the media and the advertising agencies have resisted various attempts that have been made to modify this system of commissions.

A cash discount of 2 per cent is also given by the advertising medium if payment is made within 10 days.

The client pays for the costs incurred in preparing materials for the mechanical reproduction of advertisements plus a service charge of 17 2/3 per cent less 2 per cent discount.

Although an advertising agency does a large volume of business, it only makes about one per cent net profit.

Suggested Activities

1. Designate committees to plan a visit to an advertising agency and to evaluate their findings. Require preparation of questions to be answered by agency personnel. Following the trip, have students participate in a panel discussion to evaluate the economic role of the agency in the community.
2. Students should inquire whether their training stations use the services of an advertising agency. If so, assign students to determine why and to explain the services the agency provides. Students should also report whether the agency is paid by the media, by their firm, or by both. Then require explanation of the payment method.

PRINTED ADVERTISING MEDIA

Printed advertising media is divided into two subtypes, publication advertising and direct advertising.

Publication Advertising

Publication advertising makes use of newspapers and magazines to deliver the advertiser's message of measurable groups of readers in a package consisting of other advertisements combined with news, entertainment, or similar non-commercial content. The audience is pre-selected for the advertiser by the editorial content and policy of the magazine or newspaper, and in a sense, his advertising message is invited into the home or place of business of the reader.

Newspapers. With few exceptions, the newspaper is a local advertising medium and offers the advertiser intensive coverage of a restricted geographical area at a relatively low cost. Newspapers are edited to attract all kinds of people, and the advertiser benefits from reader acceptance of the paper within the community.

Most newspapers quote different rates for local and national advertisers and base their rates on different units of space. The basic unit of space for local advertising is the column inch, an area one column wide by one inch deep. The national advertising rate is quoted in terms of agate lines, one line, one column wide. There are 14 lines per inch. Both the local and national advertiser can reduce his cost by volume discounts.

The newspaper advertiser may purchase preferred position at extra expense. Preferred locations may be specific pages or sections within the paper or a particular position on the page itself, or both.

Most advertising by newspaper is done in black and white. Advertisements in color are available and increase the cost of the advertising space.

Newspaper advertising has two big disadvantages. The life of a newspaper is very short, a matter of hours, and the quality of reproduction is limited depending upon facilities of the publisher.

Magazines. Magazines are edited to appeal to the special interests of certain types of people and are traditionally a national advertising media.

A magazine advertisement continues to "live" and produce results for a week, a month, or perhaps longer. Nearly all magazines are excellently printed, and the better magazines are examples of the finest reproduction in printed media.

Many magazines now offer regional or sectional editions to the advertiser who advertises different brands in different geographic areas or whose marketing efforts are limited to certain regions or sections of the country.

A single rate structure is employed for all magazine advertisers. The rates are quoted in units of pages, fractional pages and by the agate line. Color reproduction is available in almost all magazines at additional rates. Also available to magazine advertisers is the preferred position.

The deadline for insertion of a newspaper advertisement is usually one or two days in advance of publication for a national advertiser and a matter of hours for the local advertiser. This speed of action is impossible for magazine advertisements. Magazine deadlines may be as short as three weeks or as much as two months in advance.

Another disadvantage to advertising by magazine is the cost.

Direct Advertising

Direct advertising is delivered to the receiver without the aid of established interest and editorial support and includes all forms of printed advertising delivered directly to the reader instead of indirectly as part of a newspaper or magazine.

The important advantage of direct advertising is its flexibility in format, in size, in color and, consequently, in cost. Direct advertising may be as simple in form as a leaflet or postal card or as impressive as a Sears, Roebuck catalogue.

Common forms of direct advertising are letters, leaflets, folders, broadsides, booklets, brochures, catalogues and house organs or company publications. Letters are perhaps the most widely used of all direct advertising forms; they offer the advertiser an opportunity to personalize a message and are frequently used in conjunction with other kinds of direct advertising material.

The major disadvantages of direct advertising are its high "throwaway" factor and a high cost per reader when compared with publication advertising.

Suggested Activities

1. For introduction to newspaper advertising, assign selection of advertisements from a typical metropolitan newspaper such as the New York Times. Later, for comparative purposes assign typical advertisements from local newspapers.
2. For practical working aspects of newspaper industry, show available films from newspaper offices and assign class discussion or written report on film content.
3. Designate a planning committee for a field trip to a newspaper plant.
4. For insight into newspaper advertising, arrange the showing of the color motion picture, Newspaper Retail Advertising, 1963.

   This 10-minute 16mm film shows the career opportunities available in the newspaper field and the skills required of the men and women working in the retail advertising department. The film also points out how merchants rely on retail advertising because it provides the best and most economical way of reaching potential buyers, speeding up sales and creating valuable goodwill for a store.

   The film is available for showing to schools without charge from the Copley Production distribution center, 434 Downer Place, Aurora, Illinois 60506.
5. Assign the examination of national manufacturers' advertisements for their relationship to a local store's newspaper advertising campaign. After the students have examined and determined the relationship and/or differences between advertising on national and local levels, for the same product, assign creation of their own advertisements which should be written with local tie-in flavor.

6. Arrange showing of the color motion picture, What Is a Magazine Made Of. This 20-minute film is a very honest and literal depiction of how the Family Circle magazine comes into being each month. Behind the scenes activities show how the editorial features are created and how the magazine is assembled. The film may be rented for $3.50 for one day's use from The City College, Bernard M. Baruch School of Business and Public Administration, Audio-Visual Center, 17 Lexington Avenue, New York, New York 10010.
7. Assign collection of different types of magazines for discussing appeal effectiveness for various products and services, and for selected audiences.
8. Assign collection and evaluation of direct-mail advertising samples.
9. Require creation of direct-mail advertising design for students' training stations. Advertising forms may be displayed on bulletin boards. The class may also vote upon these to award a prize, based upon two or three criteria such as ingenuity, neatness, or other categories.
10. For expanded printed material advertising examples, the instructor may obtain copies of The Yellow Pages As an Advertising Medium. Written or oral participation may be arranged on this booklet's content for insight into one of the nation's best known forms of advertising. Copies are available from the American Telephone and Telegraph Company.

BROADCAST MEDIA

Broadcasting media are divided into two basic types: radio and television. From a production standpoint the advertising message is received instantaneously; there is no delay between transmission and receipt of the message as is the case in printed matter.

As entertainment, the broadcaster must take positive steps to make sure that the home receivers are turned on and turned to a particular station. People listen to broadcasting stations primarily for two purposes: (1) to be entertained and (2) to be informed. The broadcaster attempts to build his programs in such a way that his station will be able to tap a segment of the market. If he can assure the potential advertiser that he is reaching a portion of the population, the advertiser may buy his services. A distinct advantage broadcast media have over printed media is that radio and television programs can be received without direct cost to the listener.

From an advertising standpoint, only the ability to hear is mandatory; even an illiterate person can be reached by broadcast media. This is not true of printed media. Television attracts through sight and sound and has the additional impact of motion. This part is very important when demonstration is needed to make a sales point.

Printed media require a literate population while broadcast media do not. Printed media operate in a framework of space while broadcast media are restricted by time. Both printed and broadcast media have the concept of preferred position. In radio and television, time is divided into class AA, A, B, C and D. In broadcasting, the term coverage is the potential audience while circulation is the

number of actual listeners or viewers that are tuned in with any regularity over a period of time. In printed media, potential audience is given very little, if any, consideration. Here circulation consists of the number of homes which receive the publication or the number of copies sold. Broadcast media are not expansible. Stations are limited by the number of hours which they may broadcast, and they must maintain an acceptable ratio of advertising to programing. A station can increase its income by increasing its rates but cannot expand the volume of advertising broadcasts.

Broadcasting as an industry has a very complex organizational structure. The station is at the heart of broadcasting. In the mind of the audience, radio and television are the local stations.

Another important institution found in the structure of broadcasting is the network. Networks help stations solve one of their most serious problems -- furnishing programs. Because of the local station's limited potential listenership, time rates are comparatively low; and the station is financially unable to present a steady stream of high-priced programs. Talent is expensive, and most of it is concentrated in New York City and Hollywood. The problem of presenting good entertainment which would bring sufficient listenership for use by a national advertiser was solved by network broadcasting.

Functionally, radio and television networks are organized in much the same way as broadcasting stations. The most common type of network is the national network. When the advertiser wishes to expose his advertising message to all parts of the country, he will buy the entire network, and his advertisements will be broadcast over all the network's affiliated stations. Regional networks are basically

miniature national networks which concentrate on one area. By doing this they provide a means of catering to regional tastes and preferences. The time differential between the Eastern and Western coasts of the country is another reason for the existence of regional networks. The third network classification is the tailor-made network in which a few or many stations join temporarily for a special program. For an advertiser it means he can pinpoint his message directly to the market he is trying to reach.

As a general rule, the local television station that is a network affiliate will receive approximately 40 per cent of its regular time charge for broadcasting a network program; the remaining 60 per cent will go to the network for payment of programing, promotion and the costs of getting the program to the affiliate. The affiliate makes its money because the cost of airing a network program is very low since only minimum staff is needed. Secondly, the real income for the station comes from the sale of time between network programs. Network programs have high listenership ratings generally, and an advertiser is willing to pay a premium price for a spot which is next to a highly rated program.

The advertiser of a broadcast nature is faced with a host of choices. His first choice is between the use of the program or the announcement. To sponsor a program gives a certain amount of prestige to the advertiser. Another advantage is that the program can be designed to fit the sponsor and his product.

With printed matter, if the copy proves ineffective after a period of time, the advertiser can change it. The broadcast advertiser must be sure that the commercials are good pieces of advertising since there is no second chance. Printed media can guarantee a given circulation; broadcast media cannot.

The first consideration in the selection process is to choose a program with appeal to potential customers. An almost equally important principle is that the program must be appropriate to the product since the tone of the program influences the public image of the product being sold. Two important limiting factors guide the choice of programs. First is the availability of funds. As the costs of program sponsorship rise, advertisers can take several alternatives. One is the use of alternate-week sponsorship. A second alternative is to divide advertising time equally, by two advertisers sharing the same program at the same time. One serious shortcoming is finding a compatible co-sponsor. Another problem is the identification of the sponsors of the program because it is difficult to keep commercials of equal length and to run them at equally advantageous spots during the broadcast.

The second limiting factor which guides choice of the program is time availability. A broadcaster has no way to expand or contract its "space". During the broadcasting hours only so many programs can be scheduled, and during the prime time between 7 and 10 p.m. the supply of available time is soon exhausted.

In addition to deciding the program format, the advertiser must decide what method of program to adopt--the filmed or taped program, the studio production or "live show", or the remote pickup for a special event. Studio production and remote pickup are more expensive because of higher production costs. The performance may have many mistakes in handling of commercial announcements. Therefore, the transcribed program is far more popular, not only because it is less expensive but because the end product is closer to perfection.

As for the type of program, the advertiser has one other choice--whether to sponsor a regular show or confine his advertising to one spectacular. A series

gives the advertiser an opportunity to build a regular audience. The spectacular, on the other hand, will usually attract a larger audience.

If a sponsor decides he wants to advertise by radio or television, where does he get good programs? There are three possibilities: (1) the network or station, (2) the outside packager and (3) the advertising agency. The outside packager is an independent organization having no ties with any station or network. They produce program ideas on a free-lance basis and maintain their own studios and the equipment needed to film, tape or record broadcast programs.

The announcement campaign is similar in form to a sponsored program; however, commercials are aired between the regularly sponsored shows at the station break. Some stations and networks design and produce special programs in which the station uses the advertising time on the show to present a series of short announcements for a number of advertisers. These shows are called participating shows and enable an advertiser to give his message to an established radio or television audience without taking on the responsibility of a regular program.

Why use an announcement program instead of sponsoring? The most important advantage is flexibility. If an advertiser wishes to intensify advertising pressure in a specific geographical area, he can purchase time for his announcements covering that specific area. It also gives an advertiser flexibility in a certain season for advertising for his product. The quantity of advertising is also flexible in the announcement campaign type of advertising.

If an advertiser wishes to advertise in a geographical location, he may desire spot advertising. Spot advertising is nonnetwork broadcast advertising.

In broadcast advertising there are three forms of sponsorship: (1) local, (2) network and (3) the spot. In spot advertising an advertiser is not committed to a program approach but can select unaffiliated stations as well as network affiliated stations. He makes arrangements with stations located in markets where he wishes to broadcast his message. Often the commercial is filmed or recorded, and the advertiser can pick times he wishes his spot to be aired. This flexibility then becomes a big advantage for spot advertising. Along with this advantage comes the disadvantage of the tremendous detail work involved in securing the time availabilities for programs and the adjacencies for announcements.

Special problems are evident in creating commercials for radio and television. Both are limited by a strict dimension in time. Simplicity is of utmost importance in delivering broadcast commercials.

Six basic radio commercial formats which may be used singly or in combination are: (1) the straight sell, (2) the educational, (3) the testimonial, (4) the humorous, (5) the musical and (6) the dramatization. These six radio commercial formats might be applied as well to television. Two commercial formats peculiar to television are the song and dance and the demonstration technique. Song and dance productions are actually a combination of sight, sound and motion and usually possible only for advertisers with mass budgets aiming at mass audiences. The demonstration format best presents television's unusual potentialities. Only television can describe <u>how</u> a product is used, <u>show</u> its benefits in use, and <u>illustrate</u> the use and benefits at the same time.

Suggested Activities

1. Assign collective student observation of commercial activity presented either visually or orally by classroom television or radio.
2. Arrange for a field trip to a local radio or television station. Assign student preparation of questions to ask during the field trip. These questions should pertain to programing, audience structure, commercial style, and the production costs of commercials.
3. Assign preparation of either a radio or a television commercial which could be used for students' training stations.

THE EFFECT OF RATINGS ON TELEVISION ADVERTISING

When radio and television came into being as a new advertising medium, advertisers asked the question, "Who is listening and watching?" This question brought about the establishment of the Audience Rating Services of which Crossley, Hooper and Nielsen were the first.

Since it is impossible to count all the millions of families who watch nationally televised programs, the advertiser must rely on one or more of the rating service organizations whose job it is to measure television audiences on a continuing basis. The ratings are determined by discovering the viewing habits of a small segment of the total audience.

Several rating services are offered to the advertiser, and each uses a different system to gather data. Each gives a unique interpretation of the information in a different way. Consequently, an advertiser must know which rating figures he must use in order to obtain the most productive results.

Several examples of the established rating services and their methods are listed.

A. C. Nielsen Company. Nielsen arrives at rating figures by studying the T.V. viewing habits of 1,000 homes throughout the United States by means of an audimeter, an automatic electronic instrument which is attached to each television set in a panel of homes. This instrument measures the viewing habits on a continuously moving photographic film indicating whether the set is "on" or "off" and the station to which it is tuned.

American Research Bureau. This rating service bases its ratings on viewers' diaries placed for one week in 2,200 homes throughout the United States. The

families are asked to keep a record of their viewing schedule and of the number of persons watching any given program.

Trendex. This rating service gathers information on T.V. viewing habits by coincidental interviewing in twenty cities, all of which are served by three or more television networks. Information is gathered by making telephone calls to homes where numbers are picked at random from the telephone directories at the time the program is on the air.

Pulse. This rating service uses the home visitation method. Interviewers pick homes at random and interview families during the first week of a month. They ask questions regarding the families' viewing habits over a specific period of viewing hours.

The reliability of the rating systems leaves much to be desired, and each has its shortcomings.

Today advertising often shows up as the second largest item in a corporate budget. While profits as a whole have stayed the same after taxes for the past 10 years, advertising expenditures have nearly doubled. More and more large companies are asking, "Yes, it is fine that so many have remembered my ad, but just how does this affect sales?"

The T.V. audience ratings have a great effect on advertisers changing their accounts from one agency to another and also develop mistrust of agencies. Once an advertiser finds he has been misled by the agency about the authoratativeness of T.V. audience ratings, he loses faith in the agency thus giving cause for change.

Although many advertisers and agencies are sophisticated enough to understand the limitations of ratings, others place a great importance on the statistical

differences. Even though most advertisers realize the limitations of ratings, all of them need some kind of audience measurement, so they use the ones available. At best, ratings are only the approximation of the opinions of the consumer.

Recently because of a new line of programs, ABC television has made substantial gains in the A. C. Nielsen ratings. With NBC and CBS either remaining at the same level or dropping slightly, this has put the three networks in a three-way tie with only a slight variation in their ratings. This tie has a dual effect. First, each network must work harder to produce programs that will appeal to a significant number of viewers in order to compete with the other two networks. And second, this will create greater competition for advertisers in sponsoring the programs.

This competition should result in better television programing, and the ultimate beneficiary should be the television viewer.

T.V. networks must show that they have a long-range plan to produce the kind of programs which have had high ratings in the past, or the type of programs that would appeal to the trend of the viewers. This is the selling point that the agencies use to sell an advertiser on a particular network.

The question as to the emphasis that advertising men place upon ratings and whether they use them as effectively as they might was answered by executives of top advertising agencies. These men attempt to convey one main idea concerning the effect of program ratings on television advertising. If the advertising agencies and the advertiser use the available ratings properly, taking into consideration the variables involved, they can use these ratings effectively as a yardstick to partially indicate the consumer reaction toward television programs and television

advertising. Thus an advertiser will be better able to plan his advertising program in order to best utilize his advertising budget.

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Suggested Activities

1. Invite a local television station representative to present a talk concerning the effect of program ratings on television advertising.
2. Assign an investigative report on the different techniques employed in judging the size and composition of television audiences.

   Students should consult dialogues of various incidents between organizations such as A. C. Nielsen Company; American Research Bureau; Pulse, Incorporated; Trendex, Incorporated; Videodex, Incorporated and federal regulatory agencies such as the Federal Trade Commission and the Federal Communications Commission.

POSITION MEDIA

Many advertising forms are sent to the consumer. Printed messages reach him through magazines, newspapers, and the postal system. Broadcast messages are transmitted by radio and television. One broad classification of advertising--position media--deviates from this pattern, for the prospect goes to the advertising message. By this method the message is placed where prospects will be exposed to the advertising story while engaged in their normal activities.

Outdoor Advertising

Among the position media, the dominant subtype is outdoor advertising. The basic types of outdoor advertising are: (1) posters, (2) painted bulletins, (3) electric spectaculars, and (4) multi-vision signs.

Posters or billborads have a standard size of 8' 8" high and 19' 6" wide. The advertisement is usually printed in large sections and pasted on the billboard.

Painted bulletins vary in size from 12 feet by 42 feet to 18 feet by 72 feet. These can be found on low roofs, on the side of buildings, and at ground levels where they can be seen from the highway or streets. Much greater costs are incurred in reproducing the advertising copy of the painted bulletin than that of the poster; therefore, painted bulletins are seldom changed more than every three, four or six months.

The electric spectacular is nonstandardized in shape and form. It is usually large enough to dominate the area where it is placed; the site is nearly always a spot where heavy traffic passes.

A recent innovation in the outdoor advertising field is the multi-vision (or tri-vision) sign. Similar in format to the painted bulletin, the display features 16 vertical three-sided louvers which are turned simultaneously by electric motors every 8 seconds. In other words, three individual messages about the advertiser's products are each shown three different times in approximately one minute.

Advertisers can select from firms which own or control a great many billboards the number and size of billboards desired. The firms will select the most prominent location and erect the billboards. The placement of billboards is not a matter of guesswork. The Traffic Audit Bureau does a massive amount of work in selecting the proper placement.

Outdoor advertising is used generally to tie in with other advertising media. The advantages of outdoor advertising include: (1) repetition, (2) concentration, (3) flexibility, (4) attractiveness and (5) visibility.

Nonstandardized Signs

Nonstandardized signs fall into two broad groups, roadside signs and on-premise signs.

Roadside signs are similar in function to regular posters and displays, but there are two important differences. First, roadside signs lack uniform design; and second, they are frequently placed in a careless, hit-or-miss fashion. Burma-Shave provided one of the best illustrations of roadside sign advertising. For several decades Burma-Shave was advertised by means of serialized bits of humor placed upon a sequence of several bright red signs erected along the principal highways of the nation.

Hardly any business fails to inform potential customers of its existence by means of on-premise signs. Movie theaters have their huge, brilliant marquees. Department stores blaze their name upon the skyline with multi-story, neon-lighted signs. Filling stations inform the approaching motorist that a particular brand of gasoline is sold at their pumps.

Transportation Advertising

The third type of position media to be considered is transportation advertising. Similar in function and method of operation to standardized outdoor advertising, this method is also called transit advertising. The three types of transportation advertising are car cards, traveling displays, and station posters.

Car cards are the small advertising messages found in the overhead racks and in other interior locations of buses, streetcars, subways and trains.

Traveling displays are really hybrids between the car card and the outdoor poster. This form of transportation advertising is an advertising message placed on the exterior of a bus or streetcar.

Station posters are the same as the 1-, 2-, or 3-sheet outdoor poster except that they are located in subways or elevated railroad stations.

Suggested Activities

1. Assign a survey of different forms of position media.

2. Arrange for the showing of the motion picture entitled Story of Outdoor Advertising.

   This 13-minute color film demonstrates the effectiveness of outdoor advertising on today's consumers. The automobile--the connective link between household and market place--has become the recognized basis for evaluation of consumer markets.

   The film may be rented for $2 for one day's use from The City College, Bernard M. Baruch School of Business and Public Administration, Audio-Visual Center, 17 Lexington Avenue, New York, New York 10010.

3. Assign panel discussion or debate on the topic: Most Outdoor Advertising Is a Public Nuisance and Should Be Greatly Restricted Through Legal Action.

LAYOUT

An advertising layout is developed through a series of three stages. The first stage consists of the preparation of a rough draft. A comprehensive layout which shows the location of each element comprises the second stage. The final layout, or third stage, is then ready for the printer.

The rough draft is simply an outline with a few lines and shapes to show placement of the headline, copy, illustration and logotype. A miniature layout sometimes called a "thumbnail" is developed to try out ideas on how an advertisement might be laid out. In making a thumbnail the first step consists of proportioning space. Layout men generally use one of four types of layout plans in determining space allocation.

Formal Plan. The headline is placed at the top of the layout. The illustration, the text, the trademark and the signature follow in that order.

Poster Form. Under this plan the aim is to construct the advertisement so that it can be completely comprehended by a sweeping glance. A significant picture is usually the most conspicuous part of the advertisement, with two or three descriptive adjectives and the name of the product prominent.

Editorial Form. In this plan of layout the text is the dominant part of the advertisement, usually preceded by the headline and followed by the signature.

Picture and Caption Series. A series of pictures and captions take the reader through a sequence of experiences, such as the uses of the article, the satisfactions derived from its use, selling points, other products by the same manufacturer, and the history and operations of the company.

The following elements are common to most newspaper layouts.

1. Headline. Headlines must have attention-getting power if they are to attract the reader's attention. The headline should be friendly in tone, should carry information of interest to a customer and should make him want to read more. The headline must be sincere, and it must be truthful.

2. Body Copy. The body copy contains the selling message of the advertisement. Good copy keeps to the point, stresses customer benefits, provides facts about the merchandise or service and asks the customer to come in, look and buy. Copy should be simply stated, using words customers can understand. Trite phrases and unusual words should be avoided in most business advertising.

3. Illustration. The retail advertiser generally uses the product or service as the subject of the illustration. The following list of things which might be illustrated could be used by an advertiser in arriving at a decision on what is to be used in an illustration: the product itself, a special feature of the product, how the product works, advantages of owning the product, quality of safety of the product, the product in use, needs for the product and image of those owning the product.

4. Logotype. The logotype or signature (sig cut) is a distinctive treatment of the brand or firm name and usually appears at the bottom of the advertisement.

5. White Space. The white space is the balnk area not occupied by any other element of the layout. It gives the advertisement attention value, legibility, individuality and refinement.

6. Border. The border brings the various parts of the advertisement together.

In addition, layouts may include coupons. Price is usually included in a prominent place so it stands out in a newspaper advertisement.

Suggested steps for creating a quarter-page newspaper advertisement follow.

1. Gather all selling points or features (e.g., colors, sizes, styles, etc.) and convert them into buyer benefits. You may want to use a feature-benefit analysis form.

2. Gather incidental information such as signature cut, store name, department, address, telephone number, store hours and days, delivery services, credit terms, guarantee and price.

3. Locate headline, illustration, copy, and logotype. The optical center, which is about five per cent above exact center and a little to the left of this point, is a very important location for some outstanding feature of an advertisement. It should be considered when the advertising space is broken up by headlines or pictures.

4. Write body copy.

5. Put finishing touches on illustration.

COPYWRITING

The first sentence of the copy should repeat the main benefits in the headline and back them up. The opening may be a striking claim for the quality or advantage of the article, an offer of an exceptional value, or refer to some unusual event. The copy should include full information about sizes, colors, construction, style, etc. It should show the prospective buyer where, how and when he can purchase the product. The copy should mention price after repeating the main benefits.

The copywriter should observe the following principles:

1. Be brief and to the point.

2. Write in the present tense as much as possible.

3. Use verbs of action.

4. Appeal to the appropriate buying motives.

5. Subordinate the pronouns I, we, ours, my and mine, displacing them as much as possible with you, your and yours.

6. Assume the consumer's viewpoint and remember that of the three--the manufacturer, the article and the consumer--the consumer is most important.

7. Test the advertisement for clearness by submitting it to friends for interpretation.

8. Be a model for clean-cut expression.

9. Inspire with honest statements.

10. Learn to select the specific words that will drive home the sales message and that require the least amount of attention from a reader.

11. Try to cultivate an affirmative attitude. "Holds its edge" is a stronger statement than "Will not dull soon".

Following are the various kinds of advertising copy:

1. Reason-why, or argumentative, copy: appeals chiefly to the customer's reason or intellect and is likely to be full of description and logical reasons why the customer should use the particular commodity.

2. Human-interest or suggestion copy: appeals to the customer's interests or emotions.

3. Sense-appeal copy: an advertisement that makes an appeal to one or more of the five senses.

4. Story-form copy: a narrative that gives an account of incidents or events pertaining to the product or services advertised.

5. Conversational or monolog copy: like story-form copy, but reproduces a conversation between two customers or may quote the statements of a user of the product or of someone in a position to give advice regarding the use of the product.

6. Educational copy: designed to increase the public knowledge of a particular product, an organization or a service.

7. Testimonial copy: a recommendation or testimonial on the acceptability of a product by an individual who is widely known.

8. Institutional copy: advertising that aims to develop goodwill rather than to sell any merchandise.

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Suggested Activities

1. Assign compilation of illustrated notebook depicting the various layout schemes. Brief paragraphs explaining the plan of layout used and emphasis area should be incorporated within notebook.
2. Assign the creation of a bulletin board display which highlights the composition of one advertisement. The various parts of the advertisement are to be appropriately labeled with regard to technical aspects.
3. Invite a local advertising manager to discuss the elements and the importance of an effective advertising layout. Student teams should design layouts for a specific item and ask the speaker to evaluate the effectiveness of their work.
4. Assign a critical analysis based upon one magazine advertisement using the following form.

	What	Who	Where	When	How
Attention					
Interest					
Desire					
Action					

5. Instructor should select pictures of familiar products from catalogues and require students to create advertisements using these materials.
6. Appoint committees to select a new product to advertise, and assign preparation of three different newspaper or magazine advertisements, two radio commercials and one television commercial.

7. Assign collection of advertisements illustrating different styles of copy. Require explanation of rationale for when and why each style should be used. Discuss style effectiveness.

8. Require preparation of booklets containing sales message samples. Advertisement's genre should be labeled. Display booklets and have class select the best advertisement fitting a particular style of copy and containing the most effective sales message.

9. Assign selection of a product or service associated with students' training stations and their particular work for which they are to prepare a slogan. Display slogans in the classroom, and have students try to identify the company associated with the slogan. Score five points for each slogan. The students who receive the top five scores should have a "slogandown". Other students should quiz these individuals until a winner is found. Students should make brief presentations pertaining to how the slogan could be used in conjunction with their work at the training stations. Students may judge displayed slogans based on creativity, effectiveness of the slogan and the student's presentation.

10. Appoint committees to design a trademark for a product of their choice. After the designs have been completed, the instructor may prepare a plastic overlay of the trademark for the overhead projector. As a committee, students should present their trademark to the class, explaining why they chose the trademark, how it will increase brand recognition, and whether or not it will help to create sales.

11. For demonstration purposes obtain examples of rough layouts and finished advertisements from an advertising agency.

12. Require preparation of advertisements for the school newspaper and yearbook.

13. Assign creation of posters advertising school functions.

14. Assign collection of advertisements from students' training stations or ones from a business they are interested in. After they have examined them, they should create their own advertisement.

15. Request English department personnel to cooperate with distributive education department in the integration of a minor newspaper unit in English classes.

16. Designate certain students to bring in advertising slogans for use in a question and answer period.

17. Prepare passout from Changing Times Magazine's "News Behind Ads," which explains the origins of slogans.

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THE ADVERTISING CAMPAIGN

The advertising campaign may be thought of as a group or series of related advertising messages distributed by one or more types of media. The continuity of such a series is both physical and psychological. Individual advertisements in a campaign are designed to have a family resemblance to one another, visually or orally. All of the series advance the same essential idea, and all have the same objective.

The basic steps in an advertising campaign for the national advertiser can be grouped into the following areas.

Analysis of the Marketing Situation. The advertiser's over-all marketing plan forms a basis for a current analysis of the marketing situation and a projection of what the situation will be when the campaign actually appears. The factors to be considered when analyzing the marketing situation are almost infinite, but the following are some of the more important:

1. What has been the total volume of the industry, and what is the advertiser's share of this total?

2. What laws, imports and patents are pertinent to the situation?

3. What is the advertiser's present image in the industry?

4. What does the competition look like?

5. What is the attitude of dealers toward the product and toward competitor's products?

6. How is the advertiser's sales department organized?

7. What is the seasonal sales curve for the product?

8. What amount of space is the product given by the retailer?

9. In what location does the retailer display the product?

The Determination of Advertising Objectives. The purpose of planning a campaign is not to classify objectives but to describe them as specifically as possible.

If a campaign has more than one objective, it should be made clear what is the most important one.

Advertising Budget and Control. The only true budget approach to the advertising expenditures is to let the needs of the advertiser dictate the amount of the advertising fund.

Selection of Advertising Media. The primary responsibility for media selection lies in the advertising agency rather than with the advertiser. Some of the more important variables that must be considered by the agency when considering media selection are: cost, availability of desirable time or space, promotional possibilities offered by the medium, the nature of the message, the medium's flexibility and duplication in coverage with other media.

Creation of the Message or Copy. An advertising campaign should have a basic theme which reflects the campaign objectives and appears in every advertisement. The campaign theme is an idea--like a headline idea.

Coordination of Advertising With Other Marketing Efforts. The seeking of active support in the channels of distribution and other nonadvertising elements of the marketing mix is the responsibility of the advertiser. From the retailer, the advertiser seeks cooperative or supplementary advertising and good display of the product.

Evaluation of Advertising Results. Copy testing, or pretesting, attempts to

eliminate errors or weaknesses in design before a considerable sum of money is invested.

An advertiser should watch the results of a campaign while it is in progress. Frequently weaknesses will appear soon after the campaign gets under way.

The final evaluation of an advertising campaign attempts to measure results not in terms of marketing goals but in terms of communication goals. What is actually measured is not sales productivity but the advertising efficiency of the campaign--how many people heard or read or saw the advertisements, changes in levels of awareness and attitude toward the product or the advertiser, the relative efficiency of different media in communicating the advertising message, etc.

Suggested Activities

1. Arrange for the showing of the film entitled Now We Know, 1949.

   This 20-minute film describes the history and explains the functions of the Audit Bureau of Circulations. It shows the chaotic conditions in the early days of the advertising and publishing industry as compared with the present and tells how the Bureau's reports make it possible for our advertisers and publishers to buy and sell advertising space on the basis of facts.

   The film is available on a free-loan basis from Modern Talking Picture Service, 1212 Avenue of the Americas, New York, New York 10036, or the Modern Film Library in your area.

2. Assign preparation of a sales-promotion campaign that could be used at the students' training stations.

3. The entire class could review the advertising campaign presented in Chapter 21, Part 2 of Marketing, Sales-Promotion and Advertising by Nolan and Wantke.

   The campaign depicts the step-by-step process that is necessary to organize an effective sales-promotion campaign. The class is to develop a similar campaign for the business outlined below.

   Each student should read the assumptions carefully. The problems of all sections should be considered while preparing the work of the student's specific area.

   Assumption No. 1. The class, as a unit, shall be known as Ace Public Relations, Inc.

   Assumption No. 2. Ace Public Relations, Inc. has bid for and received confirmation that it is to set up the complete sales-promotion and advertising

campaign for the distribution and sales of a new spray wax for cars. The new product will last six years at an average cost of $25 per application per car. Distribution will be accomplished by direct sales from manufacturer to retail dealer.

Assumption No. 3. The class shall be arranged in five sections: (1) Product Analysis, (2) Media Analysis, (3) Dealer Analysis, (4) Dealer Promotion and (5) Factory Salesmen Assistance.

The work of each section shall be defined as follows: Section 1. Analyze what is to be said and to whom? Section 2. What media of communication should be used and how? Section 3. How can dealers be persuaded to sell the new product? Section 4. What can be done to persuade dealers to continue to sell the product? Section 5. What can be done to keep factory salesmen enthusiastic about selling the product to dealers?

Assumption No. 4. Each section shall have a chairman who will be a member of the Advisory Staff. The Advisory Staff shall coordinate all work and shall keep the entire class informed of what each section is doing, to eliminate duplication of work.

CREATIVITY IN ADVERTISING

Today, as never before, advertising men are concentrating on fresh, unique ways of involving customers in their messages. The reason for this stems from the fact that the average American family is being exposed to 1,500 advertising messages every day. Also the increasing number of products flooding the market has caused an increase in competition among businessmen and a push for greater sales.

These stimulants have moved executives to give creativity considerable attention, for people buy ideas, not things. Creative advertising is the only solution for gaining the attention of a public exposed to so many ideas at the same time. One advertisement has to do the work of ten.

The creative man is definitely on the rise in agencies. Many of the fastest growing agencies with a reputation for creativity are headed by creative people. These agencies combine creative judgment with creative preparation of advertising.

In the past, advertising men confined themselves to libraries, research studies, sales experience, and other experiences for developing a creative idea. There is now a strong movement toward "brainstorming sessions" or panel discussions. It has been found that when a panel member spouts an idea, he almost automatically stirs his own imagination toward another idea. At the same time, his ideas stimulate the associate power of all other panel members.

Since the need for creative advertisements is on the upgrade, so is the demand for the creative man. Here are some of his qualifications:

1. Highly intuitive

2. Especially interested in the meanings, implications, and symbolic equivalents of things and ideas

3. Not a conformist

4. Emotionally stable and neat: not of the Bohemian set

5. Independent

6. Likes to work alone and think independently

The development of a creative advertisement plan is an adventure. It starts with an idea, an idea that may be as simple as recognition of the obvious. It may be the combining of several factors in a new way or an entirely new concept.

The idea can be developed only if the advertiser and the agency are willing to depart from the safe and established order of doing things. Creativity appears in one or more of these various areas: the main idea, a phrase or slogan, a graphic design, the layout, the illustration, the headline, the typography and engraving, color, motion, sound effects, planning campaigns, inventing strategies.

In the area of outdoor advertising, the need for creative and imaginative work is acute. Because of the nature of the posters, the limited amount of space for words and illustrations, the need for short, terse copy, and the refinement of production identification, creativity is a must. The objective of poster advertising is to serve as a buying reminder or to create an impulse sale. Creativity plays such an important role in this type of advertising because people buy ideas, not things.

There is a risk in originality that attention may be drawn to the idea and its novelty, rather than to the product or sales point demonstrated. People tend to accept the familiar and in the mass may resist accepting the completely new.

Novelty may arouse interest, but the tried and true may hold stronger conviction even where the new presentation is truly creative.

Any neophyte just out of college can put together a description of the product which even the naked eye can see is superior in value and quality. No talent is necessary for a specifications diagram. But the market place is characterized by products which are not notably different in price and function. Their sales advantage can only come from more appealing psychological attributes.

Principles for Developing Creative Thinking

1. Value creative thinking--recognize and appreciate a child's creative production or ideas.
2. Encourage new ideas.
3. Develop a tolerance of new ideas--this is also being tolerant of a creative personality.
4. Develop a creative classroom atmosphere.
5. Teach the student to value his creative thinking.

   Have him form an idea bank.

   We forget ideas, so record them, even if far-fetched. The idea can be criticized, modified, or rejected at a later time.
6. Give information about the creative process.
   a. All have creative abilities, but not in all areas.
   b. Even though someone may have done it before, it may still be creative to you.
   c. When blocked in the solution of a problem, maybe we need new techniques.
   d. Not all solutions come in a flash; some take more time.
   e. Above all, don't be afraid to express all the thoughts that come to you, no matter how unusual they may be.
7. Provide for active and quiet periods to produce an idea.
   a. Have brainstorming sessions.
   b. Give take-home problems.

8. Develop constructive criticism.

   a. Don't say an idea is bad, but maybe the idea is weak.

   b. Teach the student to work out the full implication of ideas.

9. Encourage acquisition of knowledge in a variety of fields--students tend to be specialists.

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Madson, John H.
Related Guide..Job Employment, Distributive Education.

Nevada State Dept. of Education, Carson City. Distributive Education
MF AVAILABLE IN VT-ERIC SET.
PUB DATE - Sep65 20p.

DESCRIPTORS - *DISTRIBUTIVE EDUCATION; *TEACHING GUIDES; UNITS OF STUDY (SUBJECT FIELDS); *JOB APPLICATION; *EMPLOYMENT INTERVIEWS; CAREER CHOICE

ABSTRACT - Job application techniques are emphasized in this teaching guide, developed by a state distributive education supervisor. Part one, "Selecting the Job You Want," describes such techniques needed for getting a job as: (1) questions to ask about yourself and the job, (2) ways to locate job openings, (3) how to write a letter of application, and (4) how to prepare a personal data sheet. Part two, "How to Prepare for the Interview," contains information needed before and during the interview which includes: (1) knowledge of the company, (2) personal appearance, and (3) awareness of possible interview questions. Suggested activities, a list of do's and don't's in job hunting, and a glossary are included. (SB)

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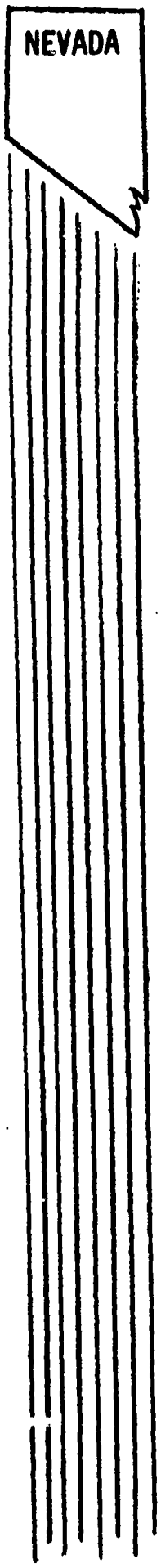
Related Guide..Job Employment Distributive Education



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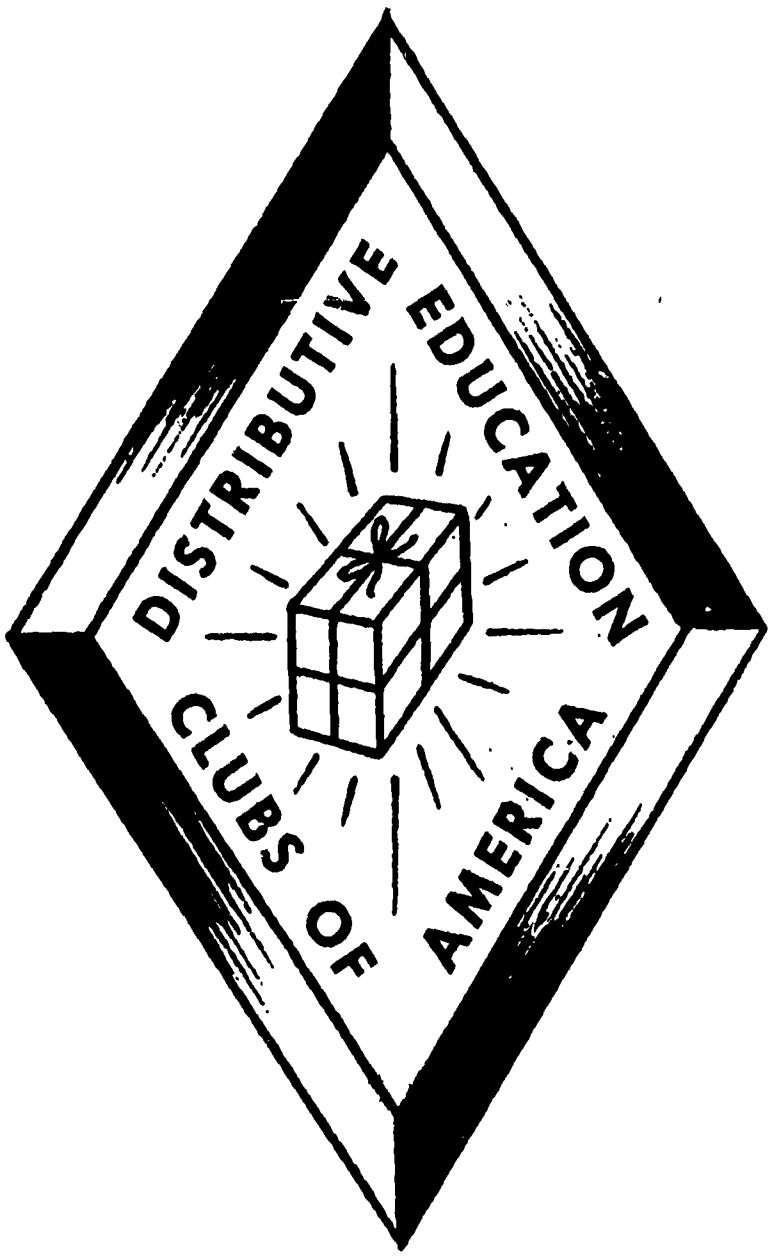

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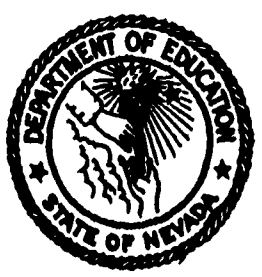

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Assistant Superintendent
Vocational-Technical and
Adult Education

Carson City, Nevada
September 1965

INSTRUCTIONAL PROGRAM

APPLYING FOR A JOB

OBJECTIVES:

To teach the essential techniques used in getting and holding a job.

To teach the value of a personal data sheet.

To provide experience in completing the necessary forms, writing letters of application, and interviews.

To develop an appreciation of the value of the year's supervised work experience.

INTRODUCTION:

Most people are never satisfied with the status quo. An individual desires to do better work than he presently does or he is interested in preparing for advancement. One of the purposes of distributive education is to bridge the gap between the classroom and the job and to accelerate promotion to more advanced positions.

A well-organized plan is essential to secure entrance into one's chosen vocation. If the potential employee understands the processes which enable him to secure employment, he will be able to convey his thoughts to those of the employer as they progress through the steps to his employment. A knowledge of what the employer expects gives the potential employee just a feeling of poise and well-being which contributes to his ability to secure employment just as does appropriate dress and a knowledge of good etiquette.

SUGGESTED APPROACH:

An introduction to this unit could be an activity in committee work: one committee could be in charge of organizing an application form for a specific sales job; another group could decide what traits would be desirable for an

employee to possess who is applying for the sales job; another group could prepare to apply for the sales position. Students could select a job opportunity from the Want Ad section of the local newspaper and write letters of application. A local personnel manager could be invited to talk to the class and explain how his firm decides if an applicant would be an acceptable employee or what his firm looks for when it is considering an applicant. A former D. E. student could be invited to talk to the class about the value of D. E. to him in terms of his present job success.

PART ONE

Selecting The Job You Want

Now that you are acquainted with so many different kinds of Distributive Jobs, it is time to choose the job that you would like to have. Naturally it is a big decision, and a very important one, but here are some ideas that might help you to make up your mind.

WHAT DO YOU LIKE TO DO?

Everyone has different likes and dislikes. Pick the job that has the greatest appeal to you. In the long run, you will be happier and will do your best work in an assignment that you like.

CAN YOU QUALIFY?

The businessman knows what he wants and isn't going to accept an inferior substitute. Have you planned your school training to meet his expectations? Can you produce a business-like performance?

WHAT DOES THE JOB OFFER FOR THE FUTURE:

Money isn't everything. Don't let the size of the first pay check blind you to other important considerations. Any young, ambitious person hopes to move up the ladder to better jobs.

ARE THE WORKING CONDITIONS GOOD?

You will be spending half of your waking hours every day in your employer's business. Is the place neat, clean, and attractive enough to keep you happy?

AREA

Beginning jobs are available in your own locality, in cities all over the country, and even abroad. You may discover just the job for you within walking distance from your own home, or if you wish a specialized job, you may commute to

another area within your own city or move to that section of the country which meets your specific desires. This, again, is your decision.

HOW TO LOCATE OPENINGS

Everyone is searching for that "really good job." There are a fair number of such positions--but they do take some finding. Every high school graduate you know will be looking for a job on the day after graduation. Why not start your search early and get ahead of the rush with some advance planning?

COVER ALL SOURCES

Businessmen use different sources and methods to find each type of help. Beginning office workers are usually located through school placement offices, co-operative business-training programs, employment agencies, newspaper want ads, recommendations of present employees, and waiting lists.

Knowing the right sources or channels is only the first step. Next you must get them to know you.

SCHOOL PLACEMENT OFFICE

Do not just assume that the school placement officer will know all about you and what kind of a job you want. Go to his office and register early. Give him a specific description of your job objective. Keep in touch with the placement officer and be prompt about reporting when you are summoned or when you return from an interview.

CO-OPERATIVE PART TIME EMPLOYERS

Be equally alert about possible opportunities in the business if you are working on a cooperative training plan or on a part-time schedule. Let your employer know in plenty of time if you are interested in full time employment. Then, if your past performance record is good, you can be certain you will receive every consideration.

PUBLIC EMPLOYMENT AGENCIES

Private employment agencies have served job seekers for many years. As specialists who are well acquainted with the locality, they have developed valuable contacts for finding positions. Since a fee is generally charged for this type of service, investigate the costs before you register.

NEWSPAPER LEADS

Start right now to watch the classified advertisements in your newspaper to see what distributive positions are available. Also as graduation day nears, you should reply to these ads. Businessmen will sometimes hold a job for you if they can and if you have what they need. Or there may be something else available later on which you would receive first consideration.

CIVIL SERVICE ANNOUNCEMENTS

If you are interested in a position in a government office, you can secure information regarding the dates of civil service examinations from announcements that are posted in public buildings and usually reported in the daily newspapers. Your name may be placed on a mailing list for notification of federal tests if you send such a request to the United States Civil Service Commission.

PERSONAL CONTACTS

Finally, use your spare time for personal visits to friends and to local businesses. In the course of their daily business, your friends may hear of openings that would interest you. Getting your name on waiting lists early is another good piece of strategy.

USE OF LETTERS OF APPLICATION

If there are more places than you have time to visit or if the distance is too great, a letter of application will bridge the gap for you.

Your letter will be effective if it is original and distinctive. It should reflect you and what you are like just as surely as a telephone call or a personal visit might do.

The content of the letter should include:

1. An attention-getting or informative opening.
2. A description of the kind of work for which you are applying.
3. A statement showing why you are sure that you are qualified for the job.
4. A polite request for an interview, indicating when you are available.
5. A data sheet giving details about your personal history, education, experience, and achievements.

The letter should reflect your command of grammar, punctuation, and spelling. Make sure to use the complete and correct name and address of the official to whom you are sending your letter.

THE DATA SHEET

First consider the preparation of a data sheet. It gives the prospective employer a quick picture of your personal characteristics, your training, and your work experience. You should include:

NAME	WEIGHT
ADDRESS	HEIGHT
TELEPHONE NUMBER	PHYSICAL CONDITION

EDUCATIONAL BACKGROUND

Schools -- Dates of Attendance

Courses completed

Special skills (mention any certificates or awards you may have earned.)

Machines operated

EXTRA-CURRICULAR ACTIVITIES IN SCHOOL:

Include memberships in clubs, offices held and when, committees on which you served, hobbies, sports activities, etc.

BUSINESS EXPERIENCE:

Names of employers, dates of employment, positions.

(Show any employment after school or during vacations.)

REFERENCES:

(The full name, title, and address of three to five people who can give information about you. Most firms prefer that you do not include relatives. Be sure that you obtain permission to use their names from the people you want to give as references.)

A data sheet and its contents will make an impression on the interviewer long before he sees you. Therefore, you cannot be too careful. A smudge, a careless erasure, or an error would be unpardonable. Each data sheet that you send out should be an original copy.

PART TWO

How to Prepare for The Interview

FIND OUT ABOUT THE COMPANY

If you go for an interview without knowing anything about the firm, how can you decide whether to say, "Yes" or "No" should a positon be offered to you? Knowing something about the firm is an advantage at the interview in still another way. Suppose you were the interviewer. Would you pick Joe, who is obviously just looking for "a job", or Bill, who sincerely convinces you that he has been waiting for "this job" in "your firm"? You can't blame the employer for selecting enthusiastic people. His whole life's work and the welfare of his company depend on good workers.

1. Ask friends about the firm.
2. Check at the library.
3. Chamber of Commerce.
4. Ask some present employees if you know any.
5. Customers of the firm can offer important facts.

MAKE THE MOST OF YOUR APPEARANCE

The first impression you make has to be good--because if it isn't, you will not get another chance.

Check off the following as you complete your preparation:

1. Your Personal Hygiene -- Your bath, deodorant, clean teeth, hair cut or hairdo, shave, manicure, and make-up.
2. Your clothing -- Your best suit or dress, freshly cleaned and pressed -- spotless and appropriate accessories, such as shirt, tie, hose, blouse, handkerchief, and gloves; polished shoes in good repair.
3. Your Equipment -- Filled pen, a couple of sharpened pencils, a small memo pad or notebook; your letter of introduction, notation of the time

and place of your appointment; your credentials, social security card, work permit, and references.

4. Your Posture and Carriage -- Stand and sit erect; walk gracefully; look alert; react promptly; follow instructions carefully.

BE READY WITH THE ANSWERS

Questions are a necessary part of the interview. They help the employer to know about you so that he can make a fair appraisal of your qualifications.

Obviously, if you spend some time thinking in advance about the kinds of questions you might be asked, you will be able to provide more accurate facts without confusion. Each interviewer has his own favorite questions. However, the following list includes most of those commonly asked of beginners.

1. Where did you go to school?
2. In what field did you specialize while in school?
3. What business courses did you take?
4. What courses did you especially like?
5. What parts of these courses did you enjoy the most?
6. Have you ever applied any of this training to school activities or at home?
7. What activities did you participate in most while in school?
8. Did you hold any offices in connection with these activities?
9. What do you know about our line of business?
10. How did you find out about this job?
11. For what type of job assignment do you think you are best qualified? Why?
12. What position do you regard as your job objective in life?

Some of these questions verify or elaborate information furnished in the application. Others are designed to identify your special interests and to

pinpoint the kind of work that would be most suitable for you. Each of the questions is an opportunity for you to sell and resell yourself -- if you make the most of your chances through advance planning.

PERSONAL REQUIREMENT FOR JOB SUCCESS

1. List and develop on blackboard, not just words, but, through sketches, illustrations, examples, make the following terms live: (Avoid being personal.)
   a. Physical
   b. Mental
   c. Social
   d. Character
2. Use oral reports such as:
   "As an employer, what traits would I look for in an applicant?"
   "What traits are most valuable in the following types of jobs?"
   Salesman, Manager, Store Owner
   "What do I say if the interviewer simply says, 'Tell me about yourself'?"
3. Discuss type of clothing worn by a young man or woman applying for a job in retailing.
4. List undesirable traits.

JOB SELECTION FOR THE INDIVIDUAL

1. Evaluate your results from the following tests given in most high schools: O. S. P. E. Tests, Kuder Preference Tests, Personality Tests, etc.
2. Learn all about yourself.
   a. Your abilities
   b. Your interests.
   c. Your personality.
   d. Your aptitudes.

THE APPLICATION

Things to do in class

1. Preliminary Preparation

   a. Obtain Social Security card and understand meaning and purpose.

   b. Discuss work permits (vary in different schools.)

   c. Review labor laws for minors.

      1. Secure charts from Department of Industrial Relations.

      2. Refer to business law textbooks.

   d. Use Recommendations

      1. Secure premission of reference.

      2. Know reference's complete name, address, and position.

   e. Study application blanks. (Emphasize completeness.)

   f. Explain techniques of filling in blanks.

      1. Give all information accurately, neatly, and clearly.

      2. Be brief and concise.

      3. Be honest -- don't exaggerate.

   g. Practice filling in blanks.

   h. Prepare letter of application and personal data sheet.

   i. Discuss interviewing techniques.

      1. Introduce yourself, telling briefly who you are and for what job you are applying.

      2. After the introduction, let the interviewer take the lead in the conversation. (Supply only the information requested.)

      3. Be seated only after interviewer suggests or motions you to be seated.

      4. The interviewer will ask a number of questions:

         (a) Answer directly and truthfully.

(b) Use good English.

(c) Look at your interviewer while he questions you.

5. The interviewer will give you a chance to ask questions. Do not ask about salaries, hours, etc., immediately. This is your chance to learn more about the nature and the requirements of the job.

6. Be your most agreeable self during the interview.

(a) Do not be familiar.

(b) Do not try to read the papers on the interviewer's desk.

(c) Do not fidget with your ring, tie, etc.

7. The interviewer will take the initiative in terminating the interview by word or action.

8. Thank the interviewer.

9. If possible, leave way open for future contact, but leave.

J. Guide students relative to the following essential information:

Be sure he knows:

1. To whom to go and where to find the employing agent.

2. When to go. (Time.)

3. That he must go alone. (No family or friends.)

4. That answers to questions should be positive. Avoid, "It doesn't make me any differences."

5. How to introduce himself. (Exact words.)

6. What to do if employer is busy.

7. What to say about salary if not mentioned, and if mentioned.

K. Practice interviewing. (Important)

L. Select a guest interviewer.

1. Personnel director of local store, etc.

2. Security Employment.

3. Job Interv.

(a) Arrange definite time for the appointment.

(b) Sell yourself to the prospective employer.

(1) By the references you give.

(2) By the letters of application.

(3) By your dress, poise, self confidence, businesslike manner, interests in the company and in the job specifically, courtesy, alertness, and attentiveness.

SUGGESTED ACTIVITIES

1. Have the students gather information on employment possibilities for persons of their age and experience -- in their community -- in other areas. This could be used as a panel.
2. List personal qualifications on the board. Students should be able to list many and define them.
3. Ask class to give examples of the importance of these personal qualificatior
4. Discuss clothing that should be worn by a boy or girl when applying for a job.
5. Choose specific jobs and ask students to report on the personal qualificatic necessary to succeed on those jobs.
6. Have students analyze the jobs according to their stated occupational objectives. Have them list the job requirements and check their ability to match or fulfill these requirements and decide if they have made realisti choices.
7. Have a student prepare a personal data sheet.
8. Have the students tell how they have previously obtained jobs. Discuss the best source for young people with limited experiences.

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9. Have each student prepare a letter of application for a specific job. Business English textbooks have examples of application letters. The letters should include:

   a. The job for which the student is making application.

   b. The applicant's personal qualifications on an attached personal data sheet.

   c. References.

   d. Availability for personal interview.

   e. Telephone number.

10. Secure copies of application blanks used by several firms. Go over these in detail with the students and explain why each question is asked and why it must be answered completely.

11. Ask each student to fill out application blanks. These may be mimeographed copies of sample application forms from various employers. Evaluate these according to points brought out during class discussion.

12. Role Playing could be used. Designate one person as the personnel manager and another as an applicant. At the conclusion of the role playing, a discussion could be held on the good and bad points of the interview. This may be taped.

13. Through class discussion, bring out reasons why some workers are successful and others unsuccessful. List points on chalk board.

IF YOU EXPECT TO GET A JOB

DO'S AND DON'T'S FOR THE JOB HUNTER

DO'S

(Women) Do wear moderate, becoming make-up, costume jewelry if it is a suitable accompaniment to the costume, and a business-like hat, suit or coat, shoes and gloves. Be sure that the seams of your stockings are straight. Arrange your hair in an attractive fashion. No long loose hair - put it up if it is not short.

(Men) Do be sure that your suit is well-pressed and clean, your shirt spotless, and your shoes shined. Wear a tie - not too loud or unusual - becoming.

* * *

Do be sure that each item of your personal apprearance shows care and good taste.

* * *

Do apply during employment office hours. Apply preferably on Tuesday, Wednesday, or Thursday; never on Saturday, unless otherwise instructed to do so.

* * *

Do look people in the eye, speak quietly and naturally, volunteering information about your training and experience which will show the employment manager that you will be valuable in his organization.

* * *

Do smile. (If you can do so naturally--an automatic smile is nauseating.) Remember that your greatest asset is your ability to please -- during the interview as well as on the job.

* * *

DON'T'S

(Women) Don't wear excessive make-up, unbusiness-like clothers, or too much jewelry.

(Men) Don't forget to SHAVE, don't allow socks to sag, and don't wear conspicuous colors or styles. Don't forget to wear a coat.

* * *

Don't neglect to have your teeth white, your hair neatly and becomingly combed, your fingernails well manicured and clean. Be certain that polish is not chipped.

* * *

Don't try to make an application outside of employment hours.

* * *

Don't act shy, nervous or embarrassed. Don't use such nervous gestures as continuously moving the hands, blinking the eyes, putting hands on face, shifting position in the chair, standing with weight on one foot, etc.

* * *

Don't be too serious.

* * *

DO'S	DON'T'S
Do say: "May I apply for a position as a salesperson, stock clerk, etc.?" Apply for one specific job.	Don't say: "There aren't any jobs open, are there?"
* * *	* * *
Do introduce yourself clearly and distinctly. Use a card or write your name on a slip of paper. If possible, learn the name of the employment manager before you go in. Telephone in advance to get his name.	Don't mumble your name.
* * *	* * *
Do answer each question on the application blank in LEGIBLE printing. Do not write unless directed to do so.	Don't leave the application blank incompletely filled out.
* * *	* * *
Do let the application blank show that you are a neat, systematic, dependable person. Make a rough draft of your answers if time permits.	Don't fill out the application blank so hastily that it is necessary to make changes or corrections.
* * *	* * *
Do answer questions clearly with yes or no, and add a statement if necessary to make your reply complete.	Don't say: "Yes, ma'm," "Yeah," or "Uh-huh."
* * *	* * *
Do tell specifically what skills and experience you have. Suggest that the employer give you a practical test.	Don't answer the question, "What can you do?" by writing or replying, "Anything."
* * *	* * *
Do sit or stand erectly and at ease. Walk as if you know where you are going, and are on your way.	Don't slouch or slump as you wait your turn or as you are interviewed.
* * *	* * *
Do be prepared to write or give names (with initials) and addresses of people who have agreed to recommend you.	Don't give names of people as references unless you have their permission to do so.
* * *	* * *

DO'S	DON'T'S
Do have confidence in yourself. If you don't have, why should anyone employ you?	Don't express doubt as to your ability.
* * *	* * *
Do tell the truth about your age, experience and training.	Don't misrepresent any facts in making your application.
* * *	* * *
Do leave cigarettes at home. Many employers do not approve. Very few think it is smart.	Don't have cigarette stains on your fingers or tobacco breath.
* * *	* * *
Do sit or stand quietly without tapping your pencil on the desk or your feet on the floor.	Don't chew gum when making application for employment, or on the job.
* * *	* * *
Do be sure of personal cleanliness.	Don't wear perfume. It is offensive to some people.
* * *	* * *
Do tell about yourself concisely and promptly, but do not discuss general subjects unless the employment manager asks you questions.	Don't gossip with personnel managers or discuss what you have learned form conversations with other men or women.
* * *	* * *
Do be natural.	Don't try too hard to make an impression.
* * *	* * *
Do keep articles in your hands, or if necessary lay them on the floor beside your chair.	Don't lay your hat, handbag, or other articles on the employer's desk.
* * *	* * *
Do say "Thank you" if you are asked to sit down, then be seated.	Don't sit down until you are asked to do so.
* * *	* * *
Do show your prospective employer that he will profit by employing you.	Don't plead that you need work.
* * *	* * *

DO'S

Do suggest that you call again at a specified date.

* * *

There is a technique to obtaining a good position. Learn it. Practice it. Discuss it with others.

* * *

Do learn something about the organization to which you are applying. What are its functions and its services. By doing this you can talk more intelligently about the organization and yourself.

* * *

DON'T'S

Don't remove a prospective employer from your list until you have applied several times.

* * *

Don't think that because you do not obtain a job after several trials that you are a failure.

* * *

* * *

GLOSSARY

APPLICANT - One who makes a request to a firm to become one of its employees.

APPLICATION FORM - A form used by most businesses to secure pertinent information about potential employees.

APTITUDE - A natural or potential capacity or ability to perform certain tasks. Talent.

CHARACTER - Moral qualities, ethical standards, principles, etc.

INITIATIVE - Heading action.

INTEGRITY - Honesty or uprightness in mutual dealings.

INTERVIEWER - The employer or a representative of the employer who asks an applicant questions concerning prospective employment.

JOB REQUIREMENTS - Necessary qualities that a person must possess in order to do a job adequately.

PERSONAL DATA SHEET - A paper containing general information about an individual that would be needed by an employing firm.

PERSONNEL MANAGER - The individual in a firm or business in charge of the problems of the organization's employees.

REFERENCES - A letter or statement from friends, acquaintances, employers as to behavior habits or competency to be used by an applicant in secruing a job.

SITUATIONS WANTED AD - A classified advertisement placed in a newspaper by an individual seeking employment. It usually states the individuals qualifications and experiences.

VT 010 480
Malone, Charles A.
Source Unit in Animal Breeding.

Colorado State Univ., Ft. Collins. Agricultural Education Section
Colorado State Board for Community Colleges and Occupational Education, Denver
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ABSTRACT - This source unit was prepared by a graduate student in agricultural education to be used by Colorado vocational agriculture teachers as a guide for planning and teaching a unit in animal breeding. Objectives, motivation techniques, study guides, references, and teaching suggestions are given for the following 11 sub-units of animal breedings: (1) different breeding systems, (2) male and female reproductive organs, (3) function of hormones in animal breeding, (4) reproductive characteristics of farm animals, (5) reproductive diseases, (6) fundamentals of heredity, (7) influence of genes, (8) transmission of characteristics from parent to offspring, (9) mutations and abnormal gene action, (10) rate of progress to be made through selection, and (11) different methods of selecting livestock. Seven transparency masters are included in the sub-unit on male and female reproductive organs. (AW)

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SOURCE UNIT

IN

ANIMAL BREEDING

Developed By

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Colorado State University

In Cooperation With

Colorado State University
Department of Vocational Education
Agricultural Education Section

and

The Colorado State Board for
Community Colleges
and
Occupational Education

1969

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The following source unit in animal breeding was prepared as a guide for vocational agriculture teachers in Colorado.

Suggested objectives, motivation techniques, study guides, and plans of action are presented in the following source unit for use in teaching a unit in animal breeding to vocational agriculture students.

The purpose of this guide is to help teachers of vocational agriculture analyze the area of animal breeding and to organize lesson units for instruction. It is not intended that this guide will be used either as a course of study or as an outline for instruction in any local vocational agriculture department. Strictly speaking, this guide is intended to serve as a source unit for course construction and instructional planning. It is considered sound that course outlines and instructional plans will be based on local conditions and needs. The thought that a course outline in vocational agriculture for a local community should be planned by any person not familiar with the local community has never been accepted in the past and is not accepted in the present-day thinking.

This source unit was prepared in cooperation with Dr. Irving C. Cross, Head of the Agricultural Education Section of the Department of Vocational Education at Colorado State University.

The following references were used in preparing this unit on animal breeding:

1. Livestock and Poultry Production, Bundy and Diggins
2. Sheep Production, Bundy and Diggins
3. Animal Science, Ensminger
4. Beef Cattle Science, Ensminger
5. Beef Production, Ensminger
6. Stockman's Handbook, Ensminger
7. Dairy Cattle Sterility, Hoard's Dairyman
8. Approved Practices in Cattle, Sheep and Swine Production, Juergenson
9. Livestock Breeding, Ohio Ag. Ed. Curriculum Services

AREA - ANIMAL BREEDING

Job 1. Understanding the Different Systems of Breeding

Job 2. Becoming Familiar with the Reproductive Organs of the Male and Female

Job 3. Understanding the Function of Hormones in Animal Reproduction

Job 4. Understanding the Reproductive Characteristics of Farm Animals

Job 5. Becoming Acquainted with Reproductive Diseases

Job 6. Understanding the Fundamentals of Heredity

Job 7. Understanding the Influence of Genes

Job 8. Understanding the Transmission of Characteristics from Parent to Offspring

Job 9. Understanding Mutations and Abnormal Gene Action

Job 10. Determining the Rate of Progress One Can Make Through Selection

Job 11. Understanding the Different Methods of Selecting Livestock

ERIC

I. ENTERPRISE: Animal Breeding

JOB: Understanding the different systems of breeding

II. SITUATION:

III. OBJECTIVES:

1. To create an understanding of different systems of breeding.
2. To create an interest in improving livestock.
3. To develop an understanding as to how one should select a system of breeding.

IV. MOTIVATION:

1. Ask a member of the class how Santa Gertrudis cattle were developed. (Crossbred 5/8 Shorthorn, 3/8 Brahman)
2. Start a class discussion by asking a member of the class why he feeds purebred animals, and another why he likes to feed crossbred animals.

V. STUDY GUIDES:

1. What are the three main systems of animal breeding? Explain
2. What is inbreeding? List the advantages and disadvantages
3. Explain the two methods of inbreeding and why each is used.
4. Define outcrossing and explain why most breeders of purebred animals use this method.
5. Explain the system of breeding used to improve a herd of grade females.
6. Define brossbreeding.
7. What are the advantages of a crossbreeding program?
8. Explain the two methods of crossbreeding.

VI. REFERENCE: Animal Science, Ensminger
Stockman's Handbook, Ensminger
Beef Production, Ensminger
Livestock and Poultry Production, Bundy and Diggins
Livestock Breeding, Ohio Ag. Ed. Curriculum Services

VII. ANALYSIS

1. Systems of animal breeding

   a. Purebred
   b. Grading up
   c. Crossbred

2. Inbreeding
   a. Definition - Mating of animals more closely related than the average of the population from which they came.
   b. Advantages
      (1) Increases the degree of homozygosity
      (2) Brings out desirable recessive genes
      (3) Tends to create a uniform group
      (4) It makes for greater prepotency
   c. Disadvantages
      (1) Increases the proportion of worthless breeding animals
      (2) Reduction in size, fertility, and vigor
      (3) Brings out unwanted recessive genes
      (4) Should only be used on above average groups

3. Inbreeding (methods)
   a. Closebreeding - Mating of closely related animals
      Has a stabilizing effect on good traits
   b. Linebreeding-Mating of animals with common ancestors but not closely related.
      Used to conserve and perpetuate the good traits of a certain outstanding sire or dam.

4. Outcrossing
   a. Is the mating of animals that are members of the breed but which show no relationship close up in the pedigree.
   b. It is a relatively safe system of breeding, for it is unlikely that two such unrelated animals will carry the same "undesirable" genes and pass them on to their offspring.

5. Grading up
   Mate purebred sires of a given pure breed with native or grade females

6. Crossbreeding - Is the mating of two animals both of which are purebreds but members of different breeds.

7. Crossbreeding (Advantages)
   a. Gain more heterozygosity and therefore hybrid vigor
   b. Covers up most undesirable characteristics

8. Crossbreeding (Methods)
   a. The maintenance of purebred females that are mated to purebred sires of a different breed
   b. The maintenance of crossbred females generation after generation with matings to purebred sires of different breeds being on a rotation basis
   c. Development of new breeds through crossbreeding. Example -- Santa Gertrudis, Brangus

I. ENTERPRISE: Animal Breeding

JOB: Becoming familiar with the reproductive organs of the male and female

II. SITUATION:

III. OBJECTIVES:

1. To develop interest in the students so they will want to learn the importance of this job.
2. To develop the students ability to recognize the various parts of the male and female reproductive tract and know where they are located.
3. To develop an understanding in the students as to the function of the male and female reproductive system.

IV. MOTIVATION:

1. Show a reproductive tract of a cow and bull to the class
2. Ask a member of the class what a freemartin is. (A female born a twin to a male which in most cases, due to the male hormone, does not let the reproductive tract develop.)

V. STUDY GUIDES:

1. What is the function of the female in the development of an offspring?
2. What is the function of the male in the development of an offspring?
3. List the parts and their function of the female reproductive tract.
4. List the parts and their function of the male reproductive tract.
5. Trace the route of the egg from development until fertilization.
6. Trace the route of the sperm from development until fertilization.

VI. REFERENCE: Beef Cattle Science, Ensminger
Livestock and Poultry Production, Bundy and Diggins
Dairy Cattle Sterility, Hoard's Dairyman
Livestock Breeding, Ohio Ag. Ed. Curriculum Services

VII. PLAN OF ACTION: Secure reproductive tract of male and female

VIII. ANALYSIS:

1. Function of the female

   a. Supply one-half of the genetic makeup (egg)
   b. Supply location for fertilization and development of offspring
   c. Nourish the developing offspring until parturition
   d. Nourish and care for offspring after birth until the young can take care of themselves.

2. Function of the male

   a. Supply one-half of the genetic makeup (sperm)
   b. Deposition of the sperm into the female tract

3. Parts and function of the female reproductive tract

   a. Vulva-entrance into the vagnia
   b. Vagina - organ of copulation, sperm deposited here (most cases)
   c. Cervix - structure in tract that prevents foreign bodies from entering uterus
   d. Uterus - structure where fetus develops
   e. Oviduct - passageway between ovary and uterus, site of fertilization
   f. Ovary - produces the egg and female horomones estrogen and progestrone

4. Parts and function of the male reproductive tract

   a. Testis - produces sperm and male sex hormone, testosterone
   b. Epididymis - storage and maturation of sperm
   c. Scrotum - temperature regulator for the testis
   d. Vas deferens - Duct that carries sperm from epididymis to penis
   e. Seminal vesicles)
      Prostate gland) acessory glands that add fluid to ejaculate
      Cowper's gland)
   f. Penis - Male organ of copulation, common passageway for urine

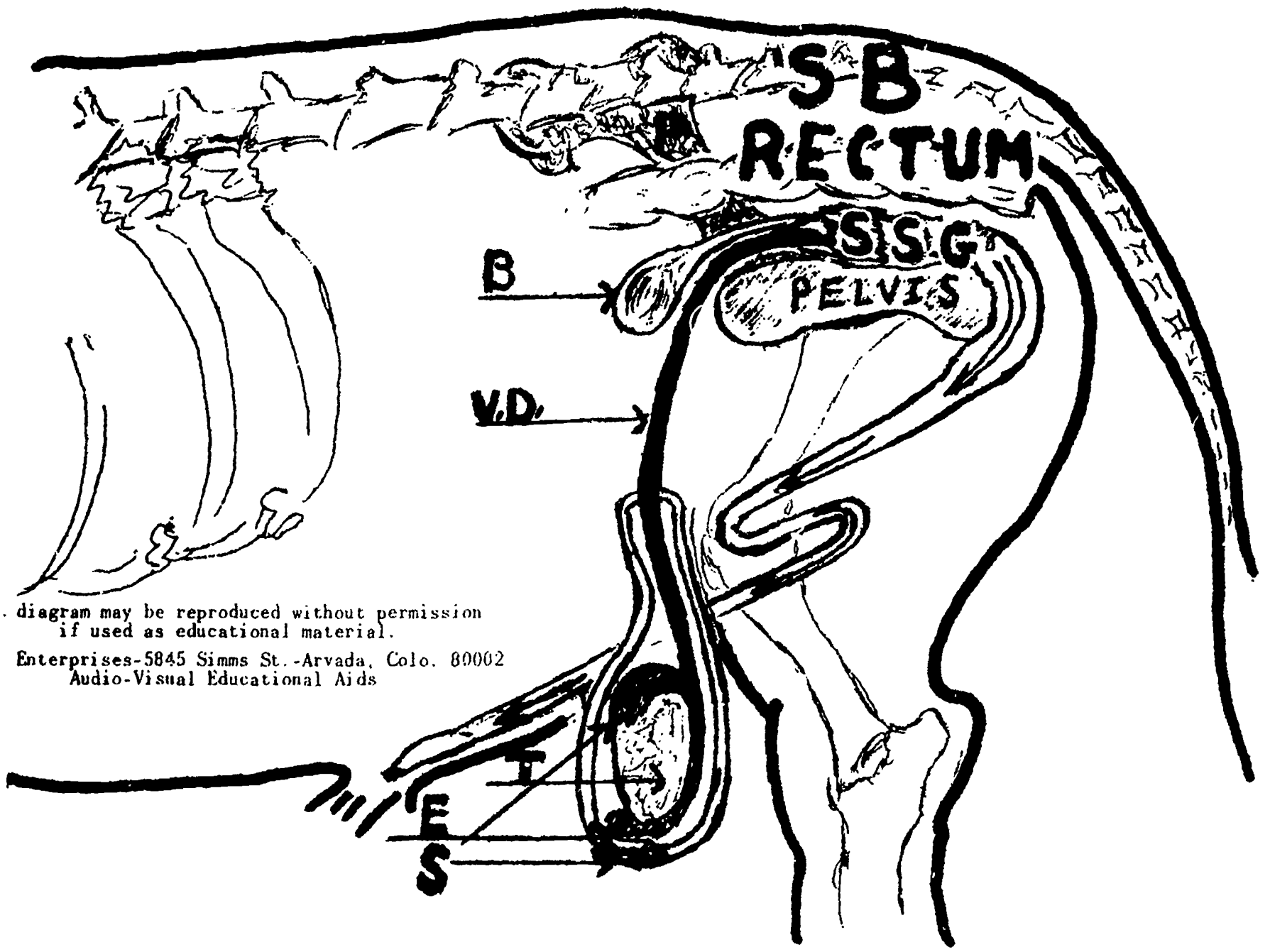
5. Route of egg

   a. Ovary
   b. Infundibulum
   c. Oviduct (fertilization)
   d. Uterus (fetus develops)

6. Route of sperm

   a. Testis
   b. Epididymis
   c. Vas deferens
   d. Penis
   e. vagina (female)
   f. Cervix (female)
   g. Uterus (female)
   h. Oviduct (female) (fertilization)

STUDENT WORK-SHEET --- REPRODUCTION IN THE BULL



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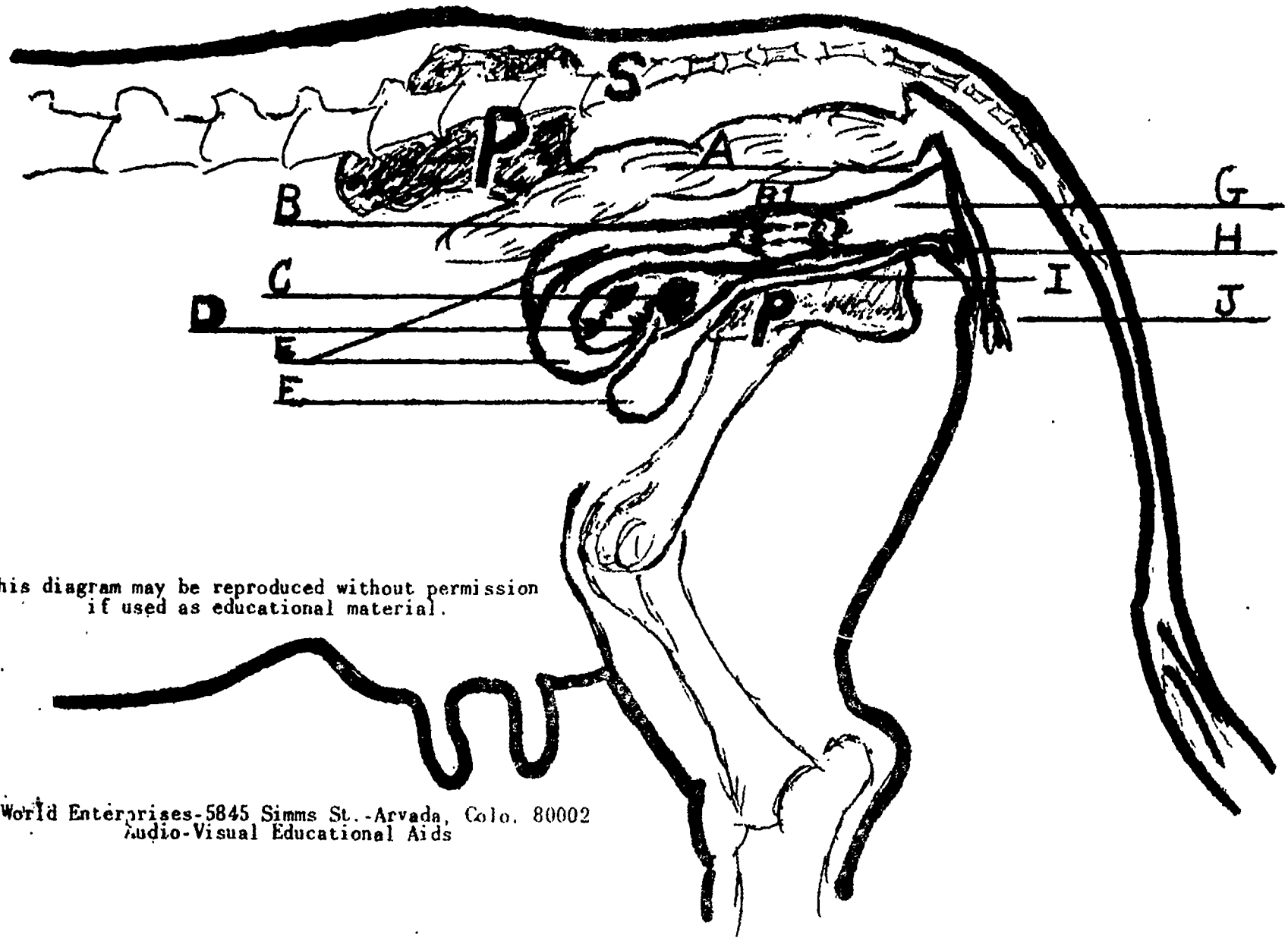
STUDENT WORK-SHEET --- REPRODUCTION IN THE COW



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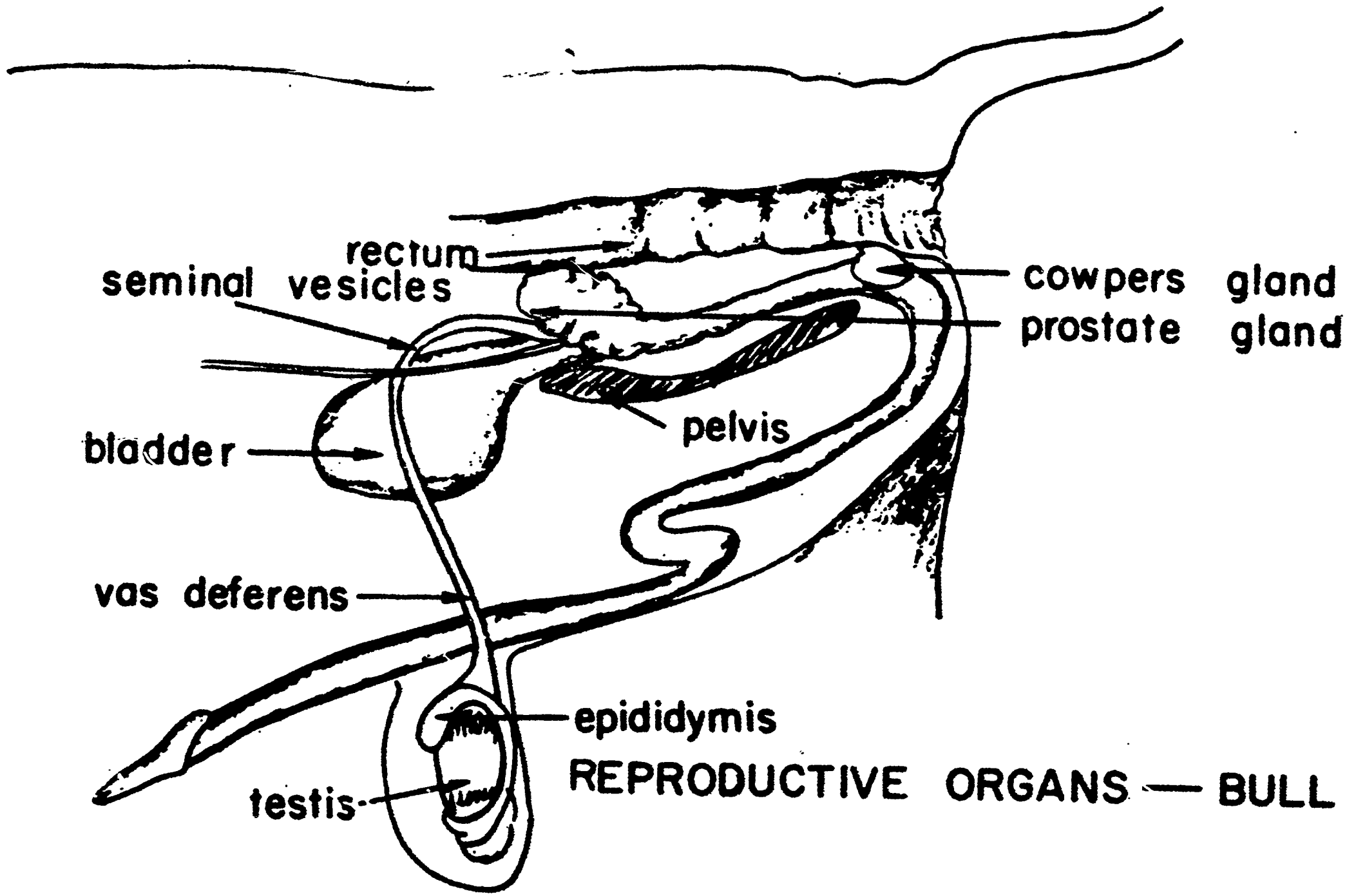
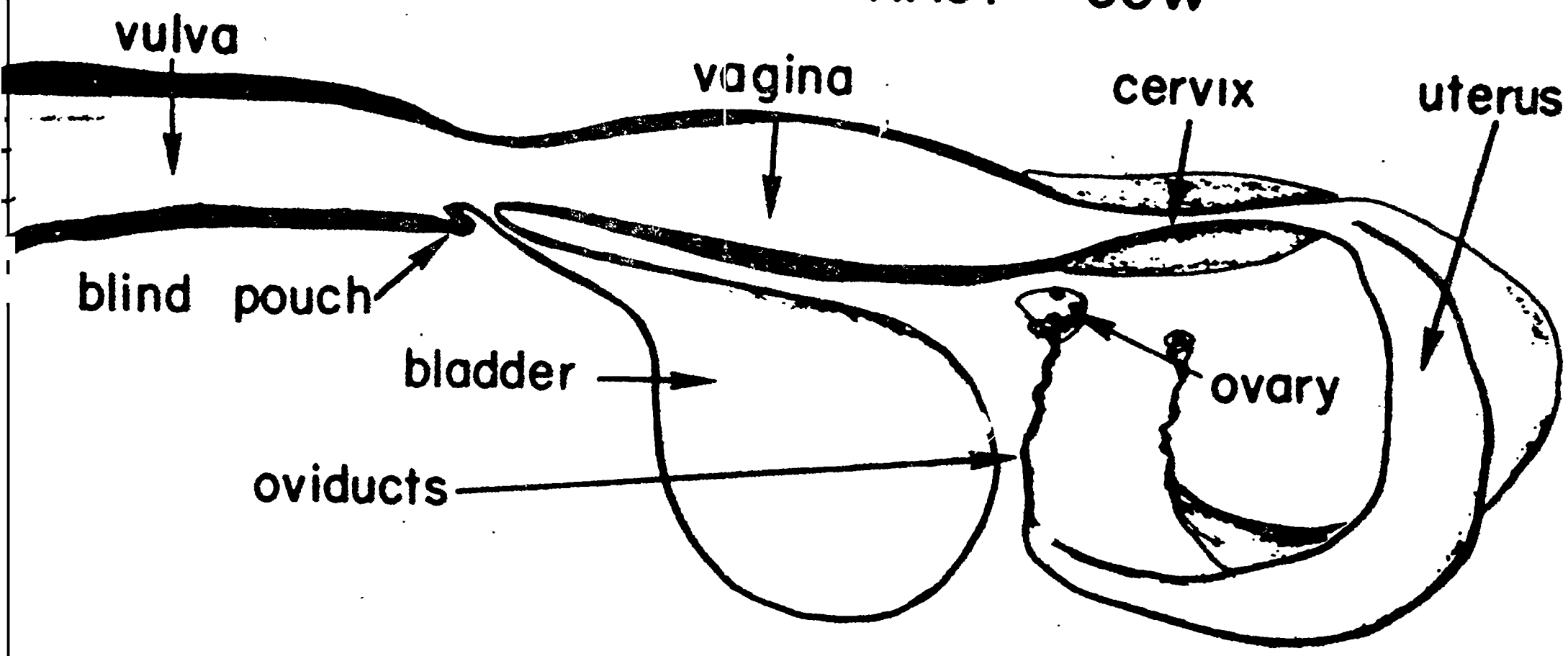
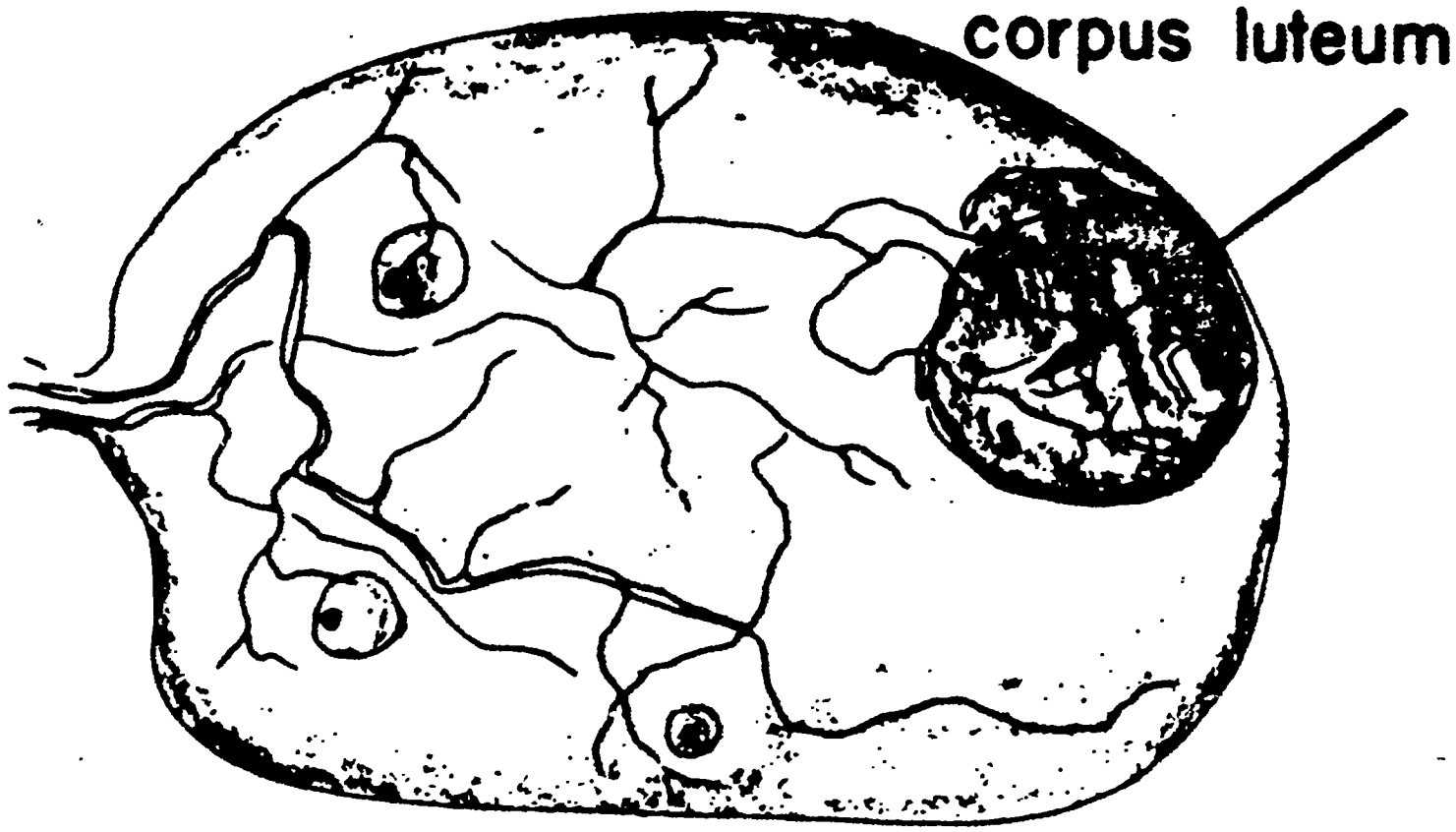


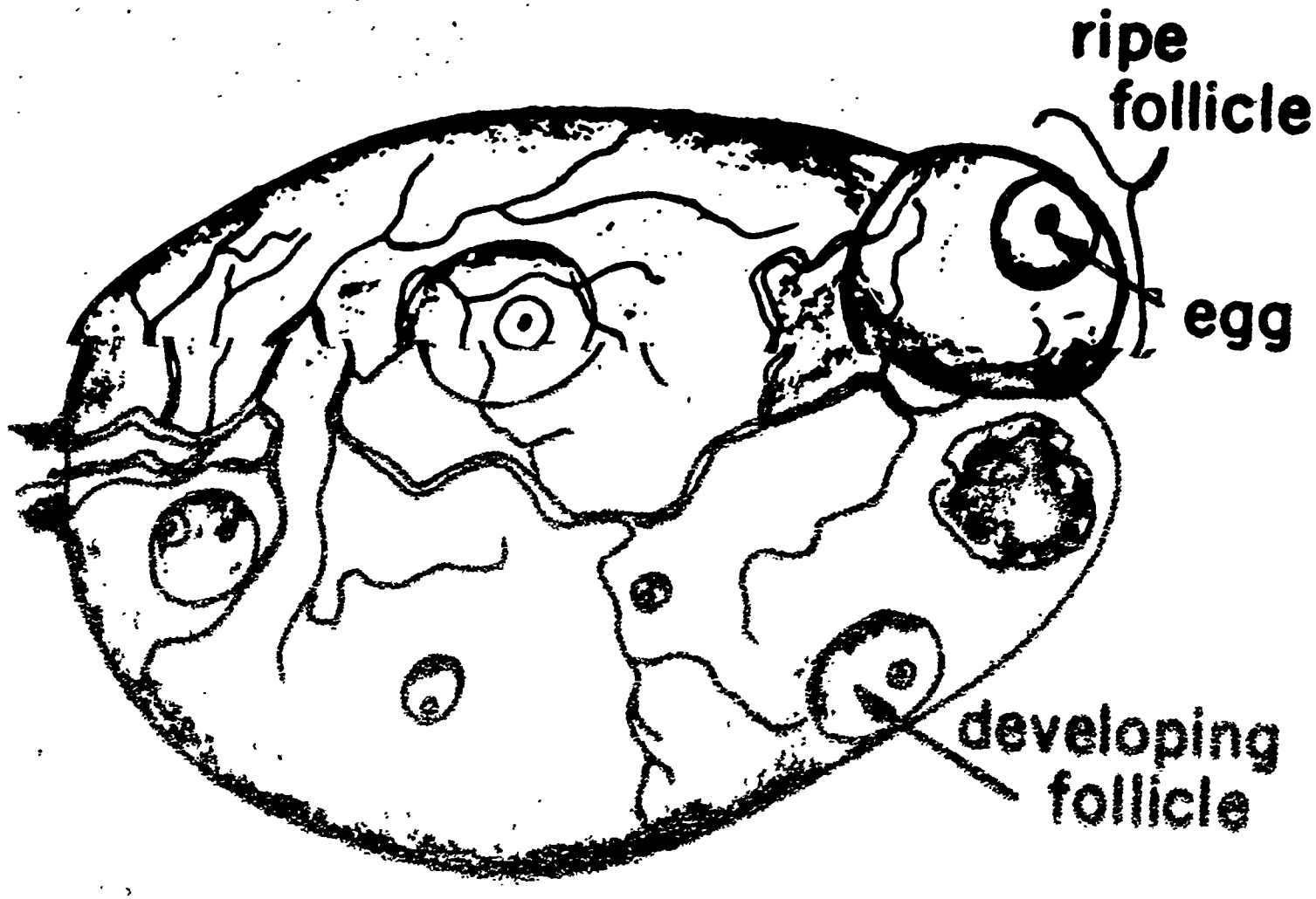
REPRODUCTIVE ORGANS — BULL

REPRODUCTIVE TRACT – COW

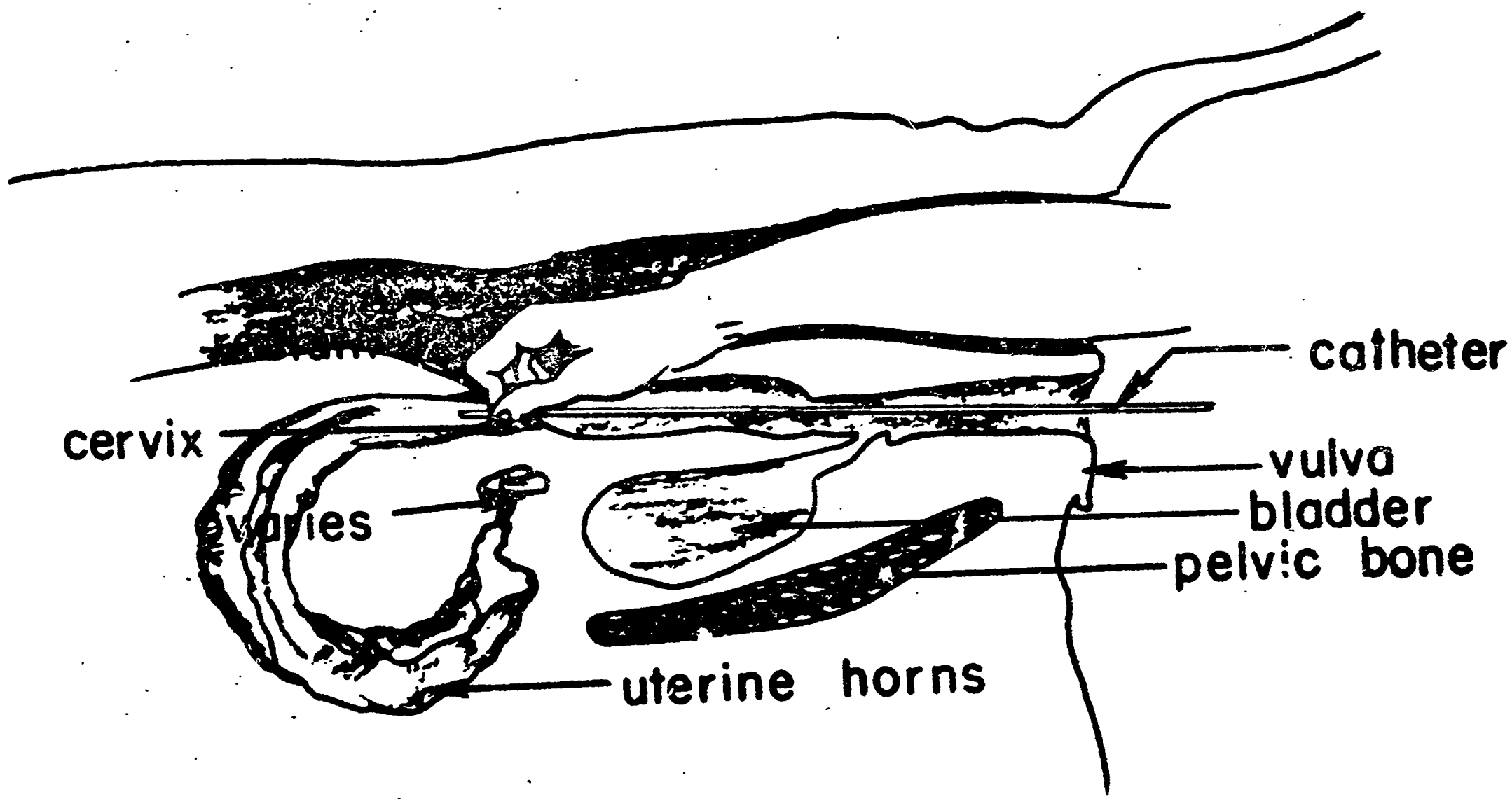




COW OVARY NOT DURING HEAT



COW OVARY DURING HEAT



DEEP UTERINE INSEMINATION OF THE COW

I. ENTERPRISE: Animal Breeding

JOB: Understanding the function of hormones in animal reproduction.

II. SITUATION:

III. OBJECTIVES:

1. To develop an understanding of the function of hormones in animal reproduction.

2. To create an interest in using hormones to further increase income from livestock production.

3. To create a desire to study and understand the new uses of hormones.

IV. MOTIVATION:

1. Discuss with the class members the reason ewes generally will not come into heat except during late summer and fall. (The pituitary gland will not trigger the reproductive mechanism until day length starts getting shorter.)

2. Ask a class member what a chronic buller is. (Due to a cystic ovary or follicle it continues to secrete high levels of estrogen, keeping the animal in heat.)

V. STUDY GUIDES:

1. Discuss the function of the endocrine glands.
2. Describe hormones and explain their function.
3. What is considered the master gland of the body? Explain. What part does it play in reproduction?
4. List five female reproductive hormones. Discuss which gland secretes each and the functions of each hormone.
5. What are the movements of hormones during the heat cycle?
6. What is the male sex hormone? Explain its function.

VI. REFERENCES: Dairy Cattle Sterility, Hoard's Dairyman
Livestock Breeding, Ohio Ag. Ed. Curriculum Services

VII: ANALYSIS

1. Endocrine Gland
   Small organs that secrete fluids that control some of the body functions.

2. Hormones
   a. Chemical messengers
   b. Secreted by an endocrine gland at one location and moves into the bloodstream where the blood carries the hormone to an organ at another location where it delivers it's message by affecting the organ in some way.

3. Pituitary Gland
   a. Considered the master gland of the body. (Secretes several different hormones.)
   b. Located at the base of the brain. 3/4 of an inch in size.
   c. Secretes gonadotropins (reproductive hormones). They control the gonads. (Ovaries of the female and the testes of the male.)

4. Female Reproduction Hormones
   a. FSH -- Follicle stimulating hormone
      (1) Secreted by the pituitary gland
      (2) Function is to stimulate the ovaries and cause the ovary to develop a follicle or follicles.
      (3) Its effect lasts for 10 to 11 days.
   b. ESTROGEN -- Female sex hormone
      (1) Secreted by the follicle. (The larger the follicle, the more estrogen.)
      (2) Function is to ready the reproductive tract for breeding, brings on the heat period, stops the production of FSH, develops mammary systems.
   c. LH---Luteinizing hormone
      (1) Secreted by the pituitary gland. (After a buildup of estrogen.)
      (2) Function is to cause the follicle to rupture and release the egg. Causes the development of the corpus luteum. (yellow bodies)
      (3) Usually lasts for 10-12 days.

   d. Progesterone
      (1) Secreted by the corpus luteum.
      (2) Function is to help ready the reproductive tract for pregnancy, if the animal is bred, progesterone maintains pregnancy by keeping estrus from occuring.
      (3) The corpus luteum remains in contact during pregnancy secreting progesterone.
   e. Oxytocin
      (1) Secreted by the pituitary gland.
      (2) Function is to cause contraction of the uterus, and to help carry the sperm. It also causes milk letdown.

5. Hormone movement in heat cycle.
   a. Pituitary gives off FSH causing follicle to grow in ovary.
   b. Ovary (follicle) gives off estrogen bringing on heat, and stops FSH.
   c. Pituitary gives off LH causing follicle to rupture, releasing egg.
   d. Ovary (corpus luteum) gives off progesterone preparing female for pregnancy.

6. Male sex hormones
   a. Given off by the testes.
   b. Function is to cause sex drive in the male and to cause male characteristics to develop.

I. ENTERPRISE: Animal Breeding

JOB: Understanding the reproductive characteristics of farm animals.

II. SITUATION:

III. OBJECTIVES:

1. To develop an understanding of the reproductive characteristics of farm animals.

2. To develop an understanding of the reproductive cycles of livestock.

3. To create the desire to further study the complexity of the reproductive systems and their functions.

IV. MOTIVATION:

1. Ask a class member what the production possibility of a pair of house flies could be. (A pair of flies and their progeny, starting in June, could produce enough flies by August to cover the earth four feet in depth.)

2. Ask a class member why most lambs are born in winter and spring.

V. STUDY GUIDES:

1. Define - puberty, gestation, estrus, ovulation, heat.

2. At what age is puberty reached in the different classes of livestock?

3. At what age should animals of each class be bred?

4. How long do farm animals of each class stay in heat?

5. How can you tell if an animal is in heat?

6. How many days are there between heat periods in the various classes of farm livestock?

7. Give the gestation periods of the different farm animals.

8. Describe the breeding habits of: cattle, sheep and swine.

VI. REFERENCES: Stockman's Handbook, Ensminger
Animal Science, Ensminger
Livestock Breeding, Ohio Ag. Ed. Curriculum Services
Approved Practices in Cattle, Sheep, Swine, Juergenson

VII. Analysis

Class of Livestock	Puberty	Age to Breed	Duration of Heat	Signs of Heat	Estrus Cycle (Days)	(Days) Gestation	Breeding Habits
Cattle	12 Mo. 1/3 adult size	15 to 20 mo. depending on growth	12-18 hrs. Ovulate at end of standing heat	Nervousness Mounting others Others mount her Swelling of vulva Frequent urination Swelling of udder	19-23	278-288	Breed anytime during the year.
Sheep	4 to 7 mo.	19 mo. Lamb as 2 year old.	3 to 70 hrs. Average 28	None Teaser ram acceptance of ram	14-19	144-152 Average 148	Most breeds will breed only in late summer and fall.
Swine	5 to 6 mo.	8 mo. or 250 lbs.	3 days	Same as for cattle	20-21	112-116 average 114	Breed anytime during the year.

I. ENTERPRISE: Animal Breeding

JOB: Becoming acquainted with reproductive diseases.

II: SITUATION:

III: OBJECTIVES:

1. To develop an understanding of the reproductive diseases of farm animals.

2. To develop an understanding of the importance of controlling these diseases for success in the livestock business.

3. To create the ability to recognize and control these diseases.

IV. MOTIVATION:

1. Ask the members of the class how many had a 100% calf crop. Why not?

2. Ask members of the class if they have a Brucellosis free herd.

3. Discuss: (a) What it costs to carry a cow for one year. (Varies - approximately$100.00) (b) Income from a cow that doesn't produce a calf. (Zero if no change in market price for cows.)

V. STUDY GUIDES:

1. What are the four main diseases affecting reproduction of farm animals?

2. Which animals do each of the diseases affect?

3. Give the cause of each disease and describe how each is spread.

4. Describe the symptoms of each disease, and explain how positive identification of each disease is made.

5. Describe the prevention of each disease.

6. Discuss the treatment available for the diseases.

7. List the diseases that can be contacted by man from infected animals.

VI. REFERENCES:

Stockman's Handbook, Ensminger
Sheep Production, Bundy and Diggens
Approved Practices in Cattle, Sheep, Swine Production, Juergenson
Livestock Breeding, Ohio Ag. Ed. Curriculum Services
Dairy Cattle Sterility, Hoard's Dairyman

VII: ANALYSIS

Disease	Species Affected	Cause and How Spread	Symptoms
Brucellosis	All farm animals	Aborted fetus, afterbirth, or fluid. Feed and water contaminated by infected animals. Contact with infected animals. Consumption of milk from infected animal.	Abortion or birth of dead or weak animal. Animal may fail to clean or expel afterbirth. Abortion usually in last third of pregnancy. Blood test is necessary for positive identification.
Trichomoniasis	Cattle	Caused by a protozoan Generally transmitted by infected animals at the time of natural mating. Bull usually the cause of the disease being spread.	Abortion in first third of pregnancy Uterine infections. Irregular heat periods. Poor conception at breeding. Positive diagnosis is made by microscopic study of the fluid from an aborted fetus, vagina of a cow, prepuce of the bull or seman.
Vibriosis	Sheep and cattle	Caused by a microorganism. Usually transmitted by natural mating. Direct contact with infected animals.	Abortion in cattle during middle third of pregnancy Abortion in sheep during last part of pregnancy. Irregular heat periods. Return to heat 2-4 mo. after breeding. A culture of the vaginal mucus is necessary for positive identification.
Leptospirosis	All farm animals	Caused by a cork-screw shaped organism of the spirochete group. Transmitted by urine of infected animals. Mating of infected animals. Wild animals which are infected.	Abortion anytime of pregnancy High Fever, poor appetite. Bloody urine, anemia, ropy milk. Young may be born weak or dead. Blood and/or urine tests are necessary for positive diagnosis.

DISEASE	PREVENTION	TREATMENT	REMARKS
Brucellosis	Buy disease-free animals. Isolate and test new animals before adding to herd. Avoid bringing disease onto farm; shoes, clothing, visitors, feed, etc., from infected areas. Divert drainage from infected areas. Annual blood test, removing animals showing a positive reaction. Vaccination of young animals (heifers)	No successful treatment. All infected animals should be sold for slaughter.	Man can contact the disease from infected animals. With proper testing one can receive a Brucellosis free herd certificate
Trichomoniasis	Buy disease free animals. Use disease free bulls or A.I. Test bulls regularly.	No reliable treatment. Animals that have aborted usually develop an immunity.	Will cause a large drop in calving percentage the first year.
Vibriosis	Avoid contact with diseased animals and contaminated feed, water and materials. Use disease-free bulls or A.I. Buy disease-free animals.	No reliable treatment. Sexual rest of three months usually will let animals develop an immunity.	Same as Trichomoniasis
Leptospirosis	Blood test animals prior to purchase. Isolate animals for 30 days and test. Avoid contact with contaminated feed, water or urine. Vaccinate if disease is present in the areas.	Antibiotics give fairly good results if treated promptly.	Vaccine is cheap and should be used if any chance of the disease.

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I. ENTERPRISE: Animal Breeding

JOB: Understanding the fundamentals of heredity.

II. SITUATION:

III: OBJECTIVES:

1. To develop an understanding of how characteristics are transmitted from parent to offspring.

2. To create an interest in using genetics to improve livestock.

3. To help develop an understanding of animal reproduction.

IV: MOTIVATION:

1. Ask a class member why he has black hair while another member has brown hair.

2. Thaw an ampule of frozen semen. Examine under a microscope to show the class sperm in a live situation.

3. Have the class list characteristics that may vary between individuals. (Will vary up to 50,000 or more.)

V. STUDY GUIDES:

1. Explain what is meant by heredity.

2. Describe a cell and explain the part it plays in the make-up of an animal.

3. What is a nucleus? Define chromosomes and genes.

4. Explain the two types of cell division. Describe their function.

5. Describe the male and female sex cell. Explain how characteristics are transmitted by the sex cells.

6. Describe what takes place during fertilization.

7. How is sex determined?

VI. REFERENCES: Beef Production, Ensminger
Animal Science, Ensminger
Livestock Breeding, Ohio Ag. Ed. Curriculum Services
Livestock and Poultry Production, Bundy and Diggins

VII. PLAN OF ACTION: Secure an ampule of frozen semen from A.I. technician.
Microscope

VIII. ANALYSIS

1. Heredity - The transmission of characteristics from parent to offspring. One-half of the genetic make-up of an individual comes from the male and one-half comes from the female.

2. Cell
   a. The smallest unit of living matter.
   b. Building blocks of livestock.
   c. Masses of cells form tissues -- groups of tissues form body organs -- organs work together as a system -- systems form an animal.

3. Nucleus - Rather round, dense material located near the center of the cell. The nucleus contains the chromosomes.
   a. Chromosomes - long structures which will always be found in pairs and carry genes.
   b. Genes - Minute particles on the chromosomes which determine heredity characteristics.

4. Cell Division

   a. Mitosis - Process of cell division where a cell splits, forming two identical cells. Each chromosome splits from end to end to keep all chromosomes paired in the nucleus (Animal growth)
   b. Mejosis - Process of cell reduction where a cell divides placing one chromosome of the pair in each cell. (Animal reproduction)

5. Sex Cells
   a. Sperm - The male sex cell containing a nucleus in which the chromosomes are haploid in number.
   b. Egg - The female sex cell containing a nucleus in which the chromosomes are haploid in number.

6. Fertilization - the uniting of the male and female sex cells. (sperm and egg). When fertilization occurs, the single chromosomes from the sex cell of each parent unite to form new pairs, and the genes are again present in duplicate in the body cells of the embryo.

7. Sex Determination
   a. Of all the chromosomes present in a cell, there is a pair of chromosomes called sex chromosomes.
   b. Female has a pair of similar chromosomes (Called XX)
   c. Male has a pair of unlike chromosomes (called XY)
   d. These separate out when the germ cells are formed - female X and X, male X and Y.
   e. When a Y bearing sperm fertilizes an egg a male is formed.
   f. When an X bearing sperm fertilizes an egg a female if formed.

I. ENTERPRISE: Animal Breeding

JOB: Understanding the influence of genes.

II. SITUATION:

III. OBJECTIVES:

1. To develop an understanding of the influence which a gene has on the characteristic of an animal.

2. To develop an understanding of the different ways genes interact.

3. To create interest in using genetic principles to improve livestock.

IV. MOTIVATION:

1. Ask a class member why two dark headed parents may have a red headed son.

2. Discuss the color of an offspring from an Angus-Hereford cross. (Black-whiteface, due to the white of the Hereford's head being dominant over black and the black being dominant over the red.)

3. Ask a member why there are usually a few black sheep in most flocks. (A recessive characteristic which is present in most flocks will show up when a female carrier and a male carrier of the genes are mated.)

V. STUDY GUIDES:

1. Explain the difference between genotype and phenotype.

2. Give the definition of homozygous and heterozygous.

3. Explain the difference between simple gene inheritance and multiple gene inheritance.

4. Define dominant and recessive and give an example of each.

5. What happens when two genes have equal power to express themselves?

6. Discuss the additive action of genes. Explain.

7. Explain the epistasis action of a pair of genes.

8. What is heterosis? Explain.

VI. REFERENCES: Beef Cattle Science, Ensminger.
Livestock Breeding, Ohio Ag. Ed. Curriculum Services
Animal Science, Ensminger

VII: ANALYSIS

1. a. Genotype
   The genes present or possible in an animal that determines specific characteristics. (PP, Pp, pp)
   b. Phenotype
   The specific characteristics of an animal. (The animal is polled)
2. a. Homozygous
   The gene on both chromosomes for a specific characteristic is the same. (Example PP both genes call for a polled animal)
   b. Heterozygous
   The gene for a specific characteristic is different on each chromosome. (Example - Pp- one gene is calling for a polled animal, the other for a horned animal.)
3. a. Simple Gene Inheritance
   The most simple type of inheritance, where only one pair of genes is involved for a characteristic. (Example - polled cattle)
   b. Multiple Gene Inheritance
   Where several pairs of genes are responsible for one characteristic. (Example - Growth rate in cattle -- due to appetite, efficiency of assimilation, the use of nutrients, etc.)

4. a. Dominant
   This gene has the ability to mask another (example - polled gene -- when the gene for polled and the gene for horns occur together the animal will be polled.) The polled gene is dominant.
   b. Recessive
   The gene or its effects is masked or hidden by another gene. (Example - polled cattle -- the horned gene will always be masked when in the presence of a gene for polled.)

5. Partial Dominance or Blending Gene Action
   Where neither gene has the ability to mask another but both genes have an effect on the characteristics. (Example - color of shorthorn cattle. RR=red, RW-roan, WW=white.)

6. Additive Action
   Where a specific trait is determined by the combined action of several genes, and each gene has an added effect to the trait. (Example - milk production in cattle A=4000#, a=2000#, B=3000#, b-1000#, C=2000# - C=1000# total production of 13,000 of milk. A different combination would give a different total amount of milk.)

7. Epistasis
   Where one gene or pair of genes has the ability to cover up the action of another pair of genes or several pairs of genes. (Example - Albino animal, the genes for color in their recessive homozygous form will not permit the other color genes functioning. This will therefore blot out all color in an animal.)

8. Heterosis or Hybrid Vigor
   Where genes in a heterozygous form will out perform genes in a homozygous form. (Example - crossbred pigs due to having more genes in the heterozygous form, will outgrow, have better feed efficiency, larger litters, etc., than purebred animals.)

I. ENTERPRISE: Animal Breeding

JOB: Understanding the transmission of characteristics from parent to offspring.

II. SITUATION:

III. OBJECTIVES:

1. To develop an understanding as to why offspring will not always look like their parents.

2. To develop the ability to predict the outcome of certain characteristics from different animals.

IV. MOTIVATION:

1. Ask members of the class why they try to buy outstanding stock for their breeding herds. (To produce a like animal.) Ask them if this always happens. (No, very seldom).

2. Ask different class members if they resemble their parents in physical characteristics.

3. Discuss the ways in which class members differ from their brothers and sisters.

V. STUDY GUIDES:

1. Explain the influence the sire and dam have upon their offspring.

2. Define prepotency and explain how prepotency can be increased in animals.

3. Explain what is meant by "nicking" when certain animals are mated.

4. Draw the form to use when predicting traits of offspring from certain matings. List the steps in using this form.

5. Using the square method, determine the genotypes possible from a mating of sheep which are heterozygous for black wool.

VI. REFERENCES: Livestock Breeding, Ohio Ag. Ed. Curriculum Service
Animal Science, Ensminger

VII. ANALYSIS:

1. Influence of sire and dam.

   a. Both are of equal importance so far as the concern of one offspring.
   b. Because of the larger number of offspring the sire is a more important individual from a hereditary standpoint.
   c. A breeder can afford to pay more for an outstanding sire than an outstanding dam.

2. Prepotency the ability of an animal to stamp its own characteristics on its offspring.

   a. Due to dominant characteristics and homozygosity of genes.

   b. Inbreeding increases the amount of homozygosity.

   c. The only way to test prepotency is to inspect or test the get.

3. Nicking - when offspring from a particular mating are generally better than their parents.

   a. Due to the fact that the right combination of genes for good characteristics are contributed by both parents.

   b. Outstanding animals, derived from mating of average animals, will generally not breed true due to their heterozygosity.

4. Predicting traits of offspring

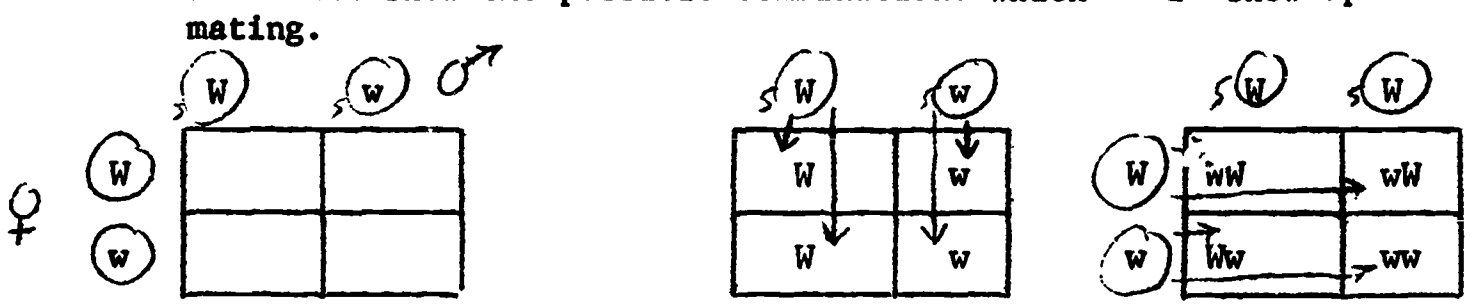
   a. Draw a checkboard --- 4 squares for 1 trait --- 16 for two traits, etc.

   b. Place the possible genes from one parent on the left side, and the possible genes from the other parent across the top.

   c. Place the genes along the top in the blocks below it.

   d. Then place the genes along the left side in the blocks beside it.

   e. This will show the possible combinations which could show up in a mating.



5. Possible offspring from mating sheep, heterozygous for black wool.

	W	w
W	WW	Ww
w	Ww	ww

25% - 1 - WW homozygous white
50% - 2 - Ww heterozygous white
25% - 1 - ww Black
4 = 100%

I. ENTERPRISE: Animal Breeding

JOB: Understanding Mutations and Abnormal Gene Action

II. SITUATION:

III. OBJECTIVES:

1. To develop an understanding of mutations and abnormal gene actions that may occur in livestock.

2. To develop an interest in developing livestock free of undesirable characteristics.

3. To develop an understanding of how livestock can be freed of undesirable characteristics.

IV. MOTIVATION:

1. Discuss why the European royal families of the past had a high percentage of abnormal children. (Due to a high percentage of inbreeding, undesirable recessive characteristics were unmasked.)

2. Discuss abnormal animals that the class members have seen. Show the class pictures or stuffed abnormal animals.

3. Discuss the effect of the atom bomb on the Japanese people during World War II. (The large amount of radiation caused a high percentage of mutations and abnormalities.)

V. STUDY GUIDES:

1. Discuss abnormal gene actions in livestock. Give some examples.

2. What is the effect of lethal genes?

3. Discuss dwarfism and the effect it has on beef production in the United States.

4. What percentages of dwarfs are likely to occur when mating two animals which carry the dwarf gene?

5. List two methods for testing males for a recessive characteristic.

6. What is a mutation? Explain the chances of a mutation occuring.

7. Explain how a mutation may be useful.

8. Discuss the causes of mutations.

VI. REFERENCES: Animal Science, Ensminger
Stockman's Handbook, Ensminger
Livestock Breeding, Ohio Ag. Ed. Curriculum Services

VII. PLAN OF ACTION: Secure stuffed abnormal animals and pictures of abnormal animals.

VIII. ANALYSIS:

1. Abnormal Gene Action
   a. Definition - A combination of gene codes which does not let the animal develop normally.
   b. Usually harmful.
   c. Usually caused by recessive genes.
   d. Example - Dwarfism in cattle.

2. Lethal Genes
   a. Abnormal gene action which causes an animal to be born dead or die soon after birth.
   b. Example - Bulldog condition in cattle.

3. Dwarfism
   a. A characteristic which shows up in beef cattle in which the animal does not develop to normal size.
   b. Causes an economical loss to the beef producer.
   c. Caused by a recessive characteristic and the recessive gene must be present in both the male and the female.
   d. Dwarf free bulls should be used and all known female carriers should be removed from the herd.

4. Dwarf carriers mated with dwarf carriers

N	NN	Nn
n	Nn	nn

- 25% non carriers Normal
- 50% Carriers Normal
- 25% Dwarf

   N - normal gene
   n - dwarf gene

5. Test for recessive characteristics
   a. Tests are usually done on males.
   b. Methods of testing.
      (1) Breed the male to 15 females that are known carriers of the recessive characteristic (produced animals with the characteristic.) There would be one chance in 75 that the animal is a carrier if characteristic does not show.
      (2) Breed the male to 30 of his own daughters. If the recessive characteristics do not show, you are relatively sure he does not carry the gene.

6. Mutations
   a. Definition - A sudden variation in genes which is later passed on to their offspring.
   b. Mutations are rare (One in each 100,000 to 1,000,000 animals)
   c. Most mutations are harmful and will cause death.

7. Useful effect of mutations.
   a. Once in a great while a mutation will occur which is a benefit to livestock breeders.
   b. Example - polled characteristics in hereford and shorthorn breeds were developed from animals with a genetic change.

8. Cause of mutations
   a. A change in the genetic make-up of an animal (genes may be lost or chromosomes may break and unite in a different location.)
   b. The chance of mutation can be increased with the use of X-ray radium, and ultraviolet light.

I. ENTERPRISE: Animal Breeding

JOB: Determining the rate of progress one can make through selection.

II. SITUATION:

III. OBJECTIVES:

1. To develop an understanding of the different methods of proper livestock selection.

2. To create an interest in improving livestock through proper selection.

3. To develop a broad understanding of the traits that are high and low in heritability.

IV. MOTIVATION:

1. Discuss Hitler's plan for creating a super race of people and why it failed. (Selecting a few males that were outstanding in physique and intelligence and mating with the female population. The principle was sound but the generation intervals (20 years) was too long for great improvement to be noted in a short time.)

2. Ask class members how they select replacement stock in the livestock operation.

V. STUDY GUIDES:

1. Explain the difference between heredity and environment.

2. Explain what is meant by high, medium and low heritability and list traits in each area.

3. What are the factors influencing the rate of progress one can make through selection?

4. What determines the amount of emphasis that should be placed on each characteristic?

5. Discuss positive and negative relationships between genetic characteristics.

6. List the steps necessary to determine the amount of improvement the offspring of selected individuals should exceed the group average.

7. Determine the improvement that can be expected the next generation;

Average weaning weight	400
Selected males	475
Selected females	425

8. Explain the three different systems of selection.

VI. REFERENCES: Stockman's Handbook, Ensminger
Livestock Breeding, Ohio Ag. Ed. Curriculum Services
Animal Science, Ensminger

VII. ANALYSIS:

1. a. Heredity - The transmission of characteristics from parent to offspring.
   b. Environment - The conditions and influences which affect the life and development of the animal. (Feed, management, type of birth, age, diseases, etc.)

2. Heritability of characteristics (Varies in different books)

   a. High -- when a trait is 50 percent or more heritable.
      (1) Conformation and carcass traits usually improve quite rapidly.
      (2)

SWINE	BEEF	SHEEP
Carcass length	Carcass ribeye	Face covering
Percent ham	Tenderness	Staple length
Backfat thickness	Feedlot weight	
Loin eye area		

   b. Medium -- When a trait is 25-50 percent heritable.
      (1) Production traits, such as rate and efficiency of gains are usually in this range.
      (2)

SWINE	BEEF	SHEEP
Rate of gain	Birth Weight	Birth weight
Feed efficiency	Feed efficiency	Body weight
Type score	Carcass grade	Daily gain

   c. Low -- When a trait is less than 25 percent heritable.
      (1) Reproductive traits are usually low heritable characteristics.
      (2)

SWINE	BEEF	SHEEP
Weaning weight	Calving interval	Prolificacy of ewes
Litter size	Percent calving	Type at weaning
Litter size at weaning		Finish at weaning

3. Factors influencing rate of progress.
   a. Heritability of the character.
   b. Number of characters selected for at the same time.
   c. Genotypic and phenotypic correlation between traits.
   d. Amount of heritable variation measure in such specific units as pounds, inches, numbers, etc.
   e. Accuracy of records and adherence to an ideal.
   f. Number of available animals.
   g. Age at which selection is made.
   h. Generation interval.

4. Emphasis to place on each character.
   a. Economic importance of the character to the producer.
   b. Heritability of the character.
   c. Genetic correlation between traits.
   d. Amount of variation in each character.
   e. Level of performance already attained.

5. a. Positive relationship--Where selecting for one characteristic will cause an improvement in another characteristic. (Average daily grain and feed efficiency.)
   b. Negative relationship--Where selecting for one characteristic has a detrimental or negative affect on another. (Backfat thickness and daily gain.)

6. a. Find the average of the amount the selected male and female exceeds the group.
   b. Find the heritability of the characteristics. (Books, etc.)
   c. Multiply the improvement (a) by percent heritability (b) to find the amount of superiority due to genetics. (c)
   d. Add the genetic superiority (c) to the group average if the improvement is an increase or Subtract the genetic superiority (c) from the group average if the improvement is a decrease. This will give you the expected performance of the next generation.

7. a. $\frac{425 + 475}{2} = 450$ $\quad$ $450 - 400 = 50$

   b. Approximately 30%

   c. 50 lbs. x 30% = 15 lbs.

   d. 400 lbs. + 15 lbs. = 415 lbs.

8. Systems of Selection

   a. Tandem selection - selecting for one trait until the desired improvement is reached, then select for another trait.
      (1) Usually it is not possible to select for one trait only.
      (2) Generally income is dependent on several traits.
      (3) Recommended only in rare herds where only one character needs improvement.
   b. Establishing minimum standards for each character, and selecting simultaneously but independently for each character.
      (1) Most common system of selection.
      (2) Minimum standards may have to vary from year to year because of environment.
      (3) Disadvantage - An individual may be culled because of being faulty in one character only, even though he is almost ideal otherwise.
   c. Selection index (setting a value in all important characteristics and selecting high score.)
      (1) Gives emphasis to the different traits in keeping with their relative importance.
      (2) Accuracy is dependent upon:
         (a) Correct evaluation of the net worth of economic traits.
         (b) Correct estimate of heritability of the traits.
         (c) Genetic correlation between traits.
      (3) Must be supplemented with careful observation in order to eliminate animals with severe defects.

I. ENTERPRISE: Animal Breeding

JOB: Understanding the different methods of selecting livestock.

II. SITUATION:

III. OBJECTIVES:

1. To develop an understanding of the different methods used for livestock selection.

2. To develop an understanding of new methods used to make selection more reliable.

3. To develop an understanding of the importance of proper selection for the greatest improvement of livestock.

IV. MOTIVATION:

1. Discuss with the class the use of sonaray to determine the meatiness of animals.

2. Ask a class member how the thickness of backfat on swine can be determined without killing the animal.

3. Ask the class members how much they resemble their grandparents.

4. Show the class pedigrees on different animals.

V. STUDY GUIDES:

1. Why is it important for livestock producers to make proper selection of animals for replacement?

2. What are the four different methods used to select animals for herd replacement?

3. What are the different methods used to select animals on individual performance? List some examples of each.

4. Draw a pedigree chart showing the names of the ancestors and the percent influence they have on the animal.

5. When is it beneficial to use pedigrees to select replacement animals?

6. List the type of information needed on a pedigree before it will be of value to the breeder.

7. When is it beneficial to use information from progeny testing to select animals?

8. Discuss the factors needed to make progeny testing reliable.

VI. REFERENCES: Livestock Breeding, Ohio Ag. Ed.Curriculum Services
Animal Science, Ensminger

VII. PLAN OF ACTION: Secure 5 or 6 good pedigrees and 1 or 2 poor pedigrees

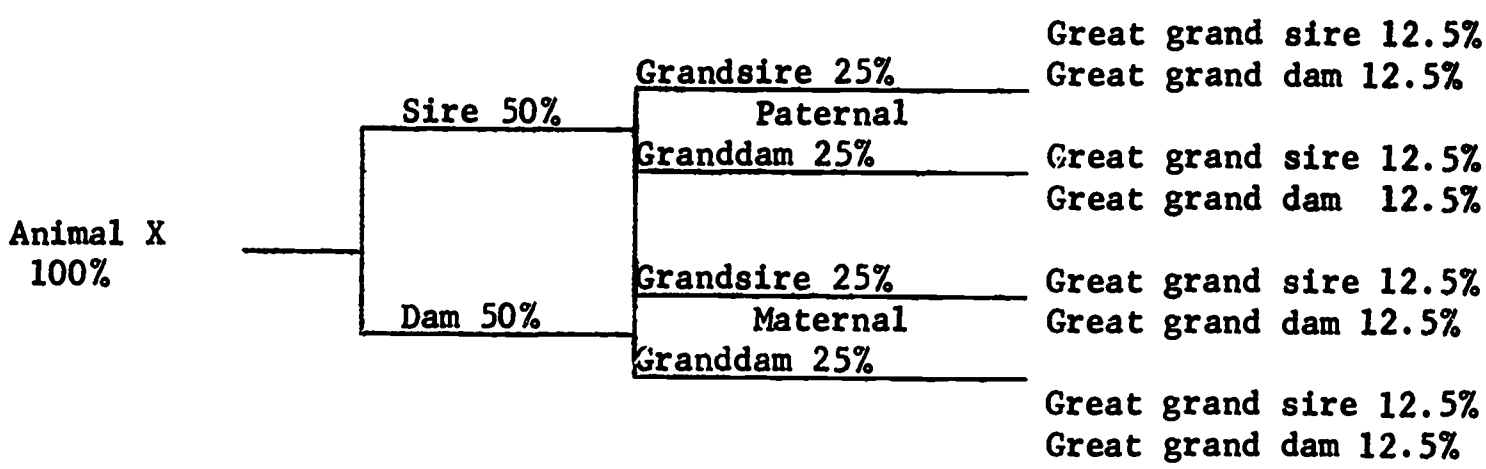
VIII. ANALYSIS

1. Selection
   a. Choosing animals which we want to be parents or producers of our livestock products.
   b. We select livestock to find those which will produce our food and fiber most satisfactorily and efficiently.
   c. Selected animals must be genetically superior, not superior due to some other factor.

2. Methods of selection
   a. Individual performance (study the animal's own conformation and performance). Oldest and most generally practiced method.
   b. Pedigree - Studying the animal's ancestry.
   c. Progeny - Studying the animal's offspring. Increase in use due to A.I.
   d. Combination of the first three.

3. Methods to determine individual performance.
   a. Visual methods - Selection by eye and feel.
      1. Judging contests
      2. County and State Fairs
      3. Market grading
      4. Breed exhibits
      5. Dairy type scoring
      6. Beef type scoring
   b. Mechanical aids
      1. Ultrasonic sound waves - helps give a picture of size of loin eye area, fat thickness over rib, size of ham or leg of lamb.
      2. Backfat probe - check backfat, etc.
   c. Performance records
      1. Feed efficiency
      2. Rate of gain
      3. Mothering ability
      4. Milk production
      5. Fertility
      6. Others
   d. Testing - Brothers and sisters
      1. Test stations
      2. Carcass contests

4. Animal pedigree and percent influence on animal.



5. Pedigree usefulness
   a. Selecting young animals before their own performance or other offspring's performance is known.
   b. Selecting for characteristics that are measured late in life. (Cancer eye, longevity)
   c. Selecting for traits expressed only in one sex.
   d. Selecting against inherited defects.

6. Pedigree information
   To have value -
   a. It must have records
   b. It must be accurate
   c. It must be complete with evidence of the poor as well as the good performance traits.
   d. The closest relatives must be of high quality.

7. Use of progeny testing
   a. Selecting for carcass traits which can't be identified in live animals.
   b. To determine transmitting ability of sex limited traits - such as mothering ability transmitted by males.
   c. For traits where percent heritability is small.

8. Reliability of progeny testing
   a. Large number of progeny are needed.
   b. When sires are compared, their progeny records need to be standardized.
   c. A sire should be used in many herds to establish his value.
   d. Breed averages need to be used to find changes a sire can make.

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ABSTRACT - Prepared by a graduate assistant in agricultural education, this source unit may be used by vocational agriculture teachers in planning and presenting a unit in feeds and feeding. The 13 sub-units, providing objectives, motivation techniques, study guides, references, and suggested teaching plans, cover: (1) nutrients necessary for livestock, (2) chemical composition and classification of feeds, (3) digestive systems of ruminants and non-ruminants, (4) digestion and adsorption of feeds by livestock, (5) feed preparation techniques, (6) role of proteins, carbohydrates, fats, minerals, and vitamins in livestock feeding, (7) feed additives, (8) balancing rations, and (9) computing lowest-cost balanced rations. (AW)

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SOURCE UNIT

IN

FEEDS AND FEEDING

Developed By
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In Cooperation With

Colorado State University
Department of Vocational Education
Agricultural Education Section

and

The Colorado State Board for
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1969

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The following source unit in feeds and feeding was prepared as a guide for vocational agriculture teachers in Colorado.

Suggested objectives, motivation techniques, study guides, and plans of action are presented in the following source unit for use in teaching a unit in feeds and feeding to vocational agriculture students.

The purpose of this guide is to help teachers of vocational agriculture analyze the area of feeds and feeding and to organize lesson units for instruction. It is not intended that this guide will be used either as a course of study or as an outline for instruction in any local vocational agriculture department. Strictly speaking, this guide is intended to serve as a source unit for course construction and instructional planning. It is considered sound that course outlines and instructional plans will be based on local conditions and needs. The thought that a course outline in vocational agriculture for a local community should be planned by any person not familiar with the local community has never been accepted in the past and is not accepted in the present-day thinking.

This source unit was prepared in cooperation with Dr. Irving C. Cross, Dr. Harold Anderson, and Professor Stanley Richardson of Colorado State University.

The following references were used in preparing this unit on feeds and feeding:

1. Livestock and Poultry Production, Bundy and Diggins, 2nd Edition.
2. Feeds and Feeding, Morrison, 9th Edition.
3. Animal Nutrition Handbook, Ralston Purina Company.
4. Animal Science, Ensminger, 5th Edition.
5. Approved Practices in Feeds and Feeding, Cassard and Juergenson, 3rd Edition.

AREA: Feeds and Feeding

Job:

I. Getting acquainted with the nutrients needed by livestock and their functions.

II. Getting acquainted with the chemical composition and classification of feeds.

III. Understanding the digestive systems in ruminants and non-ruminants.

IV. Understanding the digestion and absorption of feeds by livestock.

V. Becoming acquainted with feed preparation techniques.

VI. Getting acquainted with the amount and kind of protein needed in feeding livestock.

VII. Getting acquainted with the classes and sources of carbohydrates needed in feeding livestock.

VIII. Getting acquainted with the use of fats in livestock feeding.

IX. Getting acquainted with the minerals and their functions in livestock feeding.

X. Getting acquainted with the vitamins and their functions in feeding livestock.

XI. Getting acquainted with feed additives used in livestock feeding.

XII. Balancing a ration for livestock.

XIII. Computing least-cost balanced rations.

AREA: Feeds and Feeding

JOB: 1. Getting acquainted with the nutrients needed by livestock and their functions

SITUATION:

OBJECTIVE:
a. To develop an understanding of the nutrients needed by livestock and their functions.
b. To develop an interest in feeding livestock.
c. To develop a better attitude toward the subject of feeds and feeding.

MOTIVATION:
a. Have samples of items such as water, salt, grain, legume hay, and pellets. Ask the students what nutrient or nutrients each is composed of.
b. Have reports on feeders who made or lost money.

STUDY GUIDES:

1. What is a nutrient?
2. What is a digestible nutrient?
3. What are the seven nutrients needed by livestock?
4. Which nutrient is the largest single constituent of all living plant or animal tissues?
5. What are the functions water performs in plants and animals?
6. What are the functions of carbohydrates in animals?
7. What are the functions of fats in animals?
8. What are the functions of proteins in animals?
9. What are the functions of minerals in animals?
10. What are the functions of vitamins in animals?

REFERENCES:
a. Livestock and Poultry Production, Bundy and Diggins, 2nd Edition, pages 1-10.
b. Feeds and Feeding, Morrison, 9th Edition, pages 1-15.
c. Animal Nutrition Handbook, Ralston Purina Company, pages 13-21.
d. Animal Science, Ensminger, 5th Edition, pages 99-141.

AREA: Feeds and Feeding

JOB: Getting acquainted with the nutrients needed by livestock and their functions.

ANALYSIS:

1. Define nutrient:
   a. Any single class of food or group of like foods that aids in the support of life and makes it possible for animals to produce the things we expect of them.
   b. Any food constituent or group of food constituents of the same general chemical composition that aids in the support of life.

2. Define digestible nutrient:
   a. That portion of a nutrient which may be digested and taken into the body.

3. Seven nutrients:
   a. Proteins
   b. Carbohydrates
   c. Fats
   d. Minerals
   e. Vitamins
   f. Water
   g. Air

4. Largest constituent of plants and animals:
   a. Water
      1. Most active parts of plant and animals contain 70% or more water.

5. Functions of water:
   a. Controls body temperature
   b. Enables living plants and animals to hold their shape.
   c. Transports nutrients
   d. Helps in the digestion of feeds.
   e. Serves as a carrier for waste-products from body functions.

6. Functions of carbohydrates:
   a. Carbohydrates furnish heat and energy for animals and provide materials necessary for fattening.

7. Functions of fats:
   a. Fats furnish 2.25 times as much heat and energy as do carbohydrates.
   b. One pound of fat will equal 2.25 pounds of carbohydrates in heat, energy, and fattening value.

8. Functions of proteins:
   a. Proteins are essential in livestock feeding because they help to form the greater part of muscles, interal organs, skin, hair, wool, feathers, hoofs and horns.

AREA: Feeds and feeding

JOB: Getting acquainted with the nutrients needed by livestock and their functions.

ANALYSIS:

9. Functions of minerals:
   a. Minerals are needed in nearly all parts of the body but used primarily for the bones and in the teeth.
   b. Minerals make up an important part of the blood.
   c. Heartbeat depends upon mineral balance to maintain its regular beating.

10. Functions of vitamins:
   a. The purpose or function is not clear but we do know that serious results occur when feeds are given which do not provide the necessary vitamins.
   b. Vitamins provide a defense against disease, promote growth and reproduction, and contribute to the general health of the animal.

AREA: Feeds and Feeding

JOB II. Getting acquainted with the chemical composition and classification of feeds.

SITUATION:

OBJECTIVE: a. To develop an understanding of the chemical composition and classification of feeds.

MOTIVATION: a. Demonstrate what weak sulfuric acid will do to a piece of cotton cloth.
b. Put a glass of water in front of the room; ask the students what it is and list all the things they know about it. Stress the composition of it (hydrogen and oxygen).

STUDY GUIDES:

1. Into what six groups or classes are feeds grouped according to chemical analyses?

2. How is the percentage of dry matter of a feed determined?

3. How is the protein content of a feed determined?

4. How is the fat content of a feed determined?

5. How is the fiber content of a feed determined and why is it important to know the fiber content of various feeds?

6. How is the mineral content of a feed determined and why are roughages higher than grains in mineral content?

7. How is the percentage of nitrogen free extract in a feed determined?

8. Into what two classes are feeds divided? Distinguish between the two classes.

9. Does the amount of protein in a feed determine its classification as a concentrate or a roughage? Why or why not?

10. What are the differences in plants and animals in (a) animal cells and plant cells, (b) the storage of food, and (c) their sources of energy?

11. What are the changes in chemical composition of animals as they grow and as they fatten? Discuss the percentage of water, protein, fat, and mineral matter.

REFERENCES: a. Feeds and Feeding, Morrison, 9th Edition, pages 9-15.
b. Livestock and Poultry Production, Bundy and Diggins, 2nd Edition page: 13.

AREA: Feeds and Feeding

JOB: Getting acquainted with the chemical composition and classification of feeds.

ANALYSIS:

1. Six groups, feeds are classified according to chemical analyses:
   a. Water
   b. Mineral matter or ash
   c. Protein
   d. Fiber
   e. Fat
   f. Nitrogen-free extract

2. How dry matter is determined:
   a. It is found by determining the percentage of water and subtracting the water content from 100%
   b. To find the amount of water in a feed, the chemist weighs a finely ground sample before and after drying it until no more water is given off.

3. How protein content is determined:
   a. Process of determination is very difficult. Best method is to find the nitrogen content and then multiply the result by 6.25 to give the protein content, since about 16% of proteins is nitrogen.

4. How fat content is determined?
   a. The fat (ether extract) is determined by extracting a finely ground sample of feed with ether continuously for some hours in a suitable apparatus and then evaporating the ether and weighing the fatty residue.

5. How fiber is determined and importance of fiber content in feeds:
   a. The percentage of fiber is found by boiling a sample of feed successively in weak acid and in weak alkali, and washing out the dissolved material.
   b. It is important to know the fiber content because feeds that are high in fiber are less digestible and therefore less nutritious than those lower in fiber.

6. How mineral content is determined and percentage in roughages and concentrates:
   a. The percentage of mineral matter is determined by burning a sample of feed until the ash is free from carbon.
   b. Roughages are higher in mineral matter because of the accumulation of minerals in the leaves during growth, soil washed upon the growing plants by rain, and dust settling on the roughage before it is stored.

7. How nitrogen-free extract is determined?
   a. The percentage of N.F.E. is found by difference and not by actual analysis. The percentages of water, ash, protein, fiber, and fat are added together and the sum subtracted from 100%.

8. Class feeds are divided into and definition:
   a. Concentrates
      1. Feeds that are low in fiber and high in total digestible nutrients.
         a. Grains

AREA: Feeds and Feeding

JOB: Getting acquainted with the chemical composition and classification of feeds.

ANALYSIS:

8. (cont).
   b. Roughages
      1. Feeds that are high in fiber and low in total digestible nutrients.
         a. Hay and silage

9. Does protein determine a feed's classification:
   a. No, a concentrate may be either low in protein or rich in protein.

10. Composition of plants and animals:
   a. Walls of the body cells of animals are made chiefly of protein and the walls of plant cells are composed of cellulose and other carbohydrates.
   b. In plants, the reserve food is stored as starch and in animals, the reserve is stored in the form of fat.
   c. Plants can use energy supplied by the sun to build inorganic matter taken from the earth and air into organic compounds. Animals cannot secure directly from the sun, the energy necessary for their life, but must live on the organic energy-rich compounds built by plants.

11. Changes in chemical composition of animals:
   a. The percentage of water decreases as the animal grows and fattens.
   b. The percentage of protein remains fairly constant during growth but decreases as the animal fattens.
   c. The percentage of fat increases gradually during growth and more rapidly during fattening.
   d. The percentage of mineral decreases as the animal fattens.
   e. The changes in composition are due chiefly to the accumulation of fat in the body.

AREA: Feeds and Feeding

JOB III: Understanding the digestive systems in ruminants and non-ruminants.

SITUATION:

OBJECTIVE: a. To develop an understanding of the digestive systems in ruminants and non-ruminants.

MOTIVATION: a. Ask the students if when they chew gum they are doing the same thing as a cow chewing its cud.
b. Ask a student why he doesn't feed a lot of roughage to his swine.
c. Make arrangements with a student to come to class and tell you that his pig bloated last night and he wants you to visit his project. Observe how long it takes the class to discover that swine can't bloat.

STUDY GUIDES:

1. What is meant by a ruminant? Give some examples of ruminants.
2. What is meant by a non-ruminant? Give some examples of non-ruminants.
3. What are the four compartments of a ruminant's stomach?
4. What are the functions of each of these compartments?
5. Why do ruminants regurgitate their feed or chew their cud?
6. How does the digestive process in non-ruminants differ from ruminants?
7. Why is it possible for a horse to consume large quantities of roughage?

REFERENCES:
a. Approved Practices in Feeds and Feeding, Cassard and Juergenson, 3rd Edition, pages 64-73.
b. Livestock and Poultry Production, Bundy and Diggins, 2nd Edition, pages 31-35.
c. Feeds and Feeding, Morrison, 9th Edition, 18-19.
d. Animal Nutrition Handbook, Ralston Purina Company, pages 27-29.

AREA: Feeds and Feeding

JOB: Understanding the digestive systems in ruminants and non-ruminants.

ANALYSIS:

1. Define ruminant: examples
   a. An animal which has four distinct compartments in its stomach.
   b. Cattle, sheep, goats, deer, elk

2. Define non-ruminant: examples
   a. An animal which has a single compartment in its stomach.
   b. swine, horse

3. Four compartments:
   a. Rumen - first stomach
   b. Reticulum - honeycomb
   c. Omasum - manyplies
   d. Abomasum - true stomach

4. Functions of compartments:

   a. Rumen
      1. Largest compartment, capacity of 40-60 gallons in mature cattle.
      2. Serves as a storage area for feed.
      3. Millions of bacteria and other micro-organisms work on the feed to develop amino acids and vitamins to be used by the body.
      4. Bacterial action is reason why ruminants can digest large quantities of roughage.
      5. In young ruminants, the rumen is not developed.

   b. Reticulum
      1. To furnish additional storage space and to sort out and hold foreign materials such as nails and wire which may cause serious damage to the other body organs.

   c. Omasum
      1. Squeezes out the water from the feed before it enters the abomasum.

   d. Abomasum
      1. Digestive juices cause chemical changes to break down the proteins, carbohydrates, and fats into simpler substances which can pass through the walls in the small intestines into the blood stream.

5. Regurgitation:
   a. During the process of eating, ruminants chew their feed just enough to make swallowing possible. After the ruminants have consumed their feed, the feed is brought up from the rumen and chewing is completed.

6. Non-ruminant digestion:
   a. The food is swallowed directly into the single compartment stomach, where it is mixed with the digestive juices. Very little bacterial action takes place and there is no conversion from low-quality protein to high quality protein.

AREA: Feeds and Feeding

JOB: Understanding the digestive systems in ruminants and non-ruminants.

ANALYSIS:

6. (cont.)
   b. Are unable to digest large quantities of fiber unless they have large caecums.
   c. Similar to digestive process of ruminants after the food enters the abomasum.

7. Horse roughage consumption:
   a. Because of a blind gut called a caecum. It is there that the main work of fermenting the parts of the feeds which the digestive juices of the horse are not able to digest takes place.

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AREA: Feeds and Feeding

JOB IV. Understanding the digestion and absorption of feeds by livestock.

SITUATION:

OBJECTIVE: a. To develop an understanding how feeds are digested and absorbed in the animal's body.

MOTIVATION: a. Put barley into a beaker and add sulfuric acid to it. Ask the students what is happening. Explain that this is what happens to a feed being digested.

b. Put a small amount of sugar into a beaker of water. Ask the students what is happening. Explain that this is what happens to feed in the digestion process.

STUDY GUIDES:

1. What is meant by the term digestion?

2. Why are enzymes important in the digestion and absorption of feeds?

3. What is the purpose of the villi in the small intestine?

4. How is it possible for a whole kernel of corn to be found in the manure of fattening cattle?

5. What must occur before carbohydrates can be absorbed?

6. How is cellulose digested and absorbed by the animal's body?

7. What causes bloat in a ruminant during digestion of feed?

8. What happens to proteins before they can be digested and absorbed?

9. Where do fats undergo digestion before they are absorbed?

10. How are the absorbed nutrients distributed to the body tissues?

REFERENCES: a. Feeds and Feeding, Morrison, 9th Edition, pages 17-25.

AREA: Feeds and Feeding

JOB: Understanding the digestion and absorption of feeds by livestock.

ANALYSIS:

1. Define digestion:
   a. Includes all the changes which food undergoes within the digestive tract to prepare it for absorption and use in the body.

2. Importance of enzymes:
   a. Are organic compounds which bring about changes in other organic compounds without themselves being changed or broken down.
   b. Help in breaking down complex feeds into simpler forms.

3. Purpose of villi:
   a. To provide a larger surface area in the lining of the small intestine so that the nutrients may be more completely absorbed.

4. Kernel of corn:
   a. If a kernal of corn escaped chewing when first eaten and was not brought back up during rumination, the kernal may pass through the entire digestive tract in an unbroken condition.

5. Digestion of carbohydrates:
   a. Carbohydrates must first be broken down into starches and sugars before they can be absorbed by the villi into the small intestine.
   b. Carbohydrate digestion begins in the mouth with those animals whose saliva contains ptyalin.

6. Digestion of cellulose:
   a. Bacteria in the rumen break down cellulose into organic acids (acetic acid) which serve as food to the animal, the same as do the sugars.
   b. No enzymes in the digestive tract are able to digest cullulose.
   c. Cellulose is digested in the caecum of a horse.

7. Bloat
   a. It occurs when the gases produced in the rumen by fermentation do not escape normally, chiefly by belching. They consequently accumulate, causing great distension of the rumen.

8. Protein digestion:
   a. Proteins need to be broken down into amino acids before they can be absorbed by the villi.
   b. This begins in the stomach with pepsin, an enzyme, in the gastric juices.

9. Fat digestion:
   a. Fats do not undergo digestion until they reach the small intestine.
   . Bile helps in the breaking down of the fats so they can be absorbed.
   b. Lipase, an enzyme, splits the fats into fatty acids and glycerol.

10. Distribution of nutrients:
    a. The nutrients are absorbed by the villi of the small intestine and enter the blood circulation. The blood, containing these nutrients, reaches the capillaries in all the body tissues. Here the nutrients pass through the capillary wall into the lymph that surrounds the body cells. The nutrients then enter the cells, providing nourishment and energy for the various life processes.

AREA: Feeds and Feeding

JOB V: Becoming acquainted with feed preparation techniques.

SITUATION:

OBJECTIVE: To develop an understanding of different feed preparation techniques.

MOTIVATION: Show class a variety of feeds in different forms (whole corn, ground corn, flaked corn, and pellets). Ask the students which preparation of feed is the best.

STUDY GUIDES:

1. When is it profitable to grind, crush, or soak grain before feeding it to livestock?

2. What degree of fineness should grain be ground for livestock feeding? Why?

3. Why is rolling or crushing grain preferred by some livestock feeders instead of grinding?

4. What are some advantages of pelleting feeds for livestock?

5. Why is it advantageous to chop or grind hay or other roughage before feeding it to livestock?

6. Should a 100% concentrate ration be fed to livestock? Why or why not?

7. Is there an advantage of cooking or steaming feed before it is fed to livestock? Why or why not?

8. Is there an advantage in soaking feed before being fed to livestock? Why or why not?

9. Is there an advantage of fermenting, pre-digesting, malting, or sprouting feeds before being fed to livestock? Why or why not?

REFERENCES:
a. Feeds and Feeding, Morrison, 9th Edition, pages 38-43.
b. Animal Science, Ensminger, 5th Edition, pages 153-155.

AREA: Feeds and Feeding

JOB: Becoming acquainted with feed preparation techniques

ANALYSIS:

1. Profitable to grind, crush, or soak feed:
   a. Only when animals fail to chew the grain thoroughly and thus lose the nutritive value of the feed.

2. Fineness of grain - Why:
   a. It should be ground to medium fine.
   b. Extremely fine grinding takes more power and time and makes grain less palatable.

3. Rolling vs. grinding grain:
   a. Rolling is more palatable and bulky and may be less likely to cause digestive disturbances in heavy feeding.

4. Advantage of pellets:
   a. Less wastage from wind and weather
   b. Less space to store
   c. Animals may eat more feed in pelleted form. (Antibiotics)

5. Advantage of chopped or ground hay:
   a. It is usually advisable only if it induces animals to eat coarse, stemmy portions that would be otherwise wasted.
   b. If animals will consume a greater total amount of the roughage than when fed without the preparation.

6. 100% concentrate ration:
   a. Not advisable because of digestive troubles in animals.

7. Advantages of cooking feed:
   a. Only when feeding potatoes, field beans, and soybeans.
   b. Cooking does not increase the digestibility or feeding value of other feeds.

8. Advantage of soaking feeds:
   a. Only when grain with small or hard kernels cannot be ground or crushed.
   b. Soaking too long causes grain to become stale and fermentation may take place.

9. Advantages of fermenting etc., of feeds:
   a. Experiments show these methods of feed preparation do not cause any saving in feed or result in greater production.

PLAN OF ACTION: Visit a local elevator or feed store and observe the different preparations of feeds being fed to livestock.

AREA: Feeds and Feeding

JOB VI. Getting acquainted with the amount and kind of protein needed in feeding livestock.

SITUATION:

OBJECTIVE: To develop an understanding of the amount and kind of protein needed in feeding livestock.

MOTIVATION: Show pictures of protein deficient animals to the students. Ask the students which nutrient is being dealt with when they go to the barber shop for a hair cut.

STUDY GUIDES:

1. What two factors are important in feeding protein to livestock?

2. Discuss the effect of feeding an excess of protein in a ration.

3. What is meant by essential amino acids?

4. How many amino acids are essential for growth of all livestock?

5. Why is there a difference in amino acid requirements for different types of livestock?

6. Why does less attention need to be given to the quality of protein in a ration for ruminants compared to non-ruminants?

7. What part of grain kernels furnish protein of higher quality?

8. What manufactured feed is being used as a protein substitute in rations?

9. Is the above manufactured feed used in non-ruminant or ruminant rations? Why or why not?

10. What is meant by animal protein? Give some examples of animal protein supplements.

11. What is meant by vegetable protein? Give some examples of vegetable protein supplements.

12. Why do young animals require more protein in their ration than mature animals?

REFERENCES:

a. Feeds and Feeding, Morrison, 9th Edition, pages 48-57.
b. Livestock and Poultry Production, Bundy and Diggins, 2nd Edition, pages 18-20.
c. Animal Nutrition Handbook, Ralston Purina Company, 16-17.
d. Animal Science, Ensminger, 5th Edition, pages 99-103.

AREA: Feeds and Feeding

JOB: Getting acquainted with the amount and kind of protein needed in feeding livestock.

ANALYSIS:

1. Two factors important in feeding protein:
   a. Amount of protein
   b. Quality or kind of protein

2. Excess protein:
   a. No danger in feeding a larger amount than animals require.

3. Essential amino acids:
   a. Those which cannot be made in the body from other substances, or which cannot be made in sufficient amounts.

4. Number of amino acids:
   a. Ten

5. Difference in amino acid requirements:
   a. Depends on the kind of animal.
   b. Depends on body functions.
   c. Certain amino acids necessary for growth are not essential for merely maintaining an animal.

6. Protein in ration of ruminants and non-ruminants:
   a. All ten essential amino acids can be made in ruminants by the rumen bacteria from simple forms of nitrogen in the food. Therefore the bacterial protein may provide all of the essential amino acids, even though they are lacking in the feed which the ruminant eats.

7. Part of grain kernel:
   a. Germ

8. Feed substitute:
   a. Urea

9. Urea in rations:
   a. Urea is used only in ruminant rations.
   b. Ruminants have bacteria in the rumen to convert the urea into protein.

10. Animal protein:
    a. Proteins of animal origin.
    b. Fish meal, meat and bone meal, dried milk products, blood meal, tankage.

11. Vegetable protein:
    a. Proteins of vegetable seeds and legume roughages.
    b. Soybean oil meal, soybeans, cotton seed meal, linseed meal, legumes.

12. Young vs. mature animals:
    a. Young animals are building new tissue while growing.

AREA: Feeds and Feeding

JOB VII. Getting acquainted with the classes and sources of carbohydrates needed in livestock feeding.

SITUATION:

OBJECTIVE: a. To develop an understanding of the classes and sources of carbohydrates needed by livestock.

MOTIVATION: a. Establish a hypothetical race between two boy's horses. Have one win by a good margin. Ask the boys which nutrient furnished the energy for the two horses to run the race.
b. Review the nutrients which have previously been discussed.

STUDY GUIDES:

1. What are carbohydrates?

2. What are the three main classes of carbohydrates?

3. In what form is starch stored in animals?

4. Why does cellulose have a low feeding value for livestock?

5. What is meant by crude fiber?

6. What is meant by nitrogen free extract?

7. What are some common sources of carbohydrates in livestock feeding?

REFERENCES:
a. Animal Nutrition Handbook, Ralston Purina Company, pages 14-15.
b. Feeds and Feeding, Morrison, 9th Edition, pages 3-5.
c. Livestock and Poultry Production, Bundy and Diggins, 2nd Edition, pages 15-17.
d. Animal Science, Ensminger, 5th Edition, pages 103-105.

AREA: Feeds and Feeding

JOB: Getting acquainted with the classes and sources of carbohydrates needed in livestock feeding.

ANALYSIS:

1. Define carbohydrates:
   a. A compound composed of carbon, hydrogen, and oxygen including starches and sugars.
   b. They form about 75% of all dry matter in plants.
   c. Chief source of energy and heat in feed of animals.

2. Three classes of carbohydrates:
   a. Sugars
   b. Starches
   c. Crude fiber (cellulose)

3. Animal starch:
   a. Glycogen

4. Feeding value of cellulose:
   a. It is hard to digest - can be digested only through the action of bacteria in the rumen or caecum.

5. Crude fiber:
   a. Includes the relatively insoluble carbohydrates such as cellulose.

6. N.F.E.
   a. Includes starch, the sugars, and the more soluble portions of carbohydrates.

7. Sources of carbohydrates:
   a. Grains - provide the best source of energy
      1. Corn
      2. Oats
      3. Barley
      4. Wheat
      5. Grain sorghums
   b. Roughages
      1. Legume hay
      2. Corn silage
   c. Molasses

AREA: Feeds and Feeding

JOB VII: Getting acquainted with the use of fats in livestock feeding.

SITUATION:

OBJECTIVE: a. To develop an understanding of the use of fats in livestock feeding.

MOTIVATION: a. Ask the boys what factor their girl will probably worry about after she is married and has a few children? Have them relate their answers to nutrition. Bring out the subject about becoming fat as age increases. Tell the boys this is the nutrient they are going to be studying, even though the implication of the example is another type of fat.

STUDY GUIDES:

1. Why do fats have a higher energy value per pound than carbohydrates?
2. What is the difference between fats and oils?
3. What values or functions besides a source of energy do fats have?
4. What are some disadvantages of feeding rancid fats to livestock?
5. What is the maximum amount of fats needed in animal rations?
6. What is the effect of an animal's ration high in fat?
7. What are some common sources of fats used in livestock rations?

REFERENCES:
a. Animal Nutrition Handbook, Ralston Purina Company, page 15.
b. Feeds and Feeding, 9th Edition, pages 5-6, 58-59, Morrison
c. Livestock and Poultry Production, Bundy and Diggins, 2nd Edition, page 17.
d. Animal Science, Ensminger, 5th Edition, pages 105-109.

AREA: Feeds and Feeding

JOB: Getting acquainted with the use of fats in livestock feeding.

ANALYSIS:

1. Fats vs. Carbohydrates:
   a. Fats furnish 2.25 times as much energy per pound as carbohydrates.

2. Fats and oils:
   a. Fats are solid at ordinary temperatures while oils are liquid.

3. Fat values or functions:
   a. Aid in the absorption from the food of vitamin A and especially of carotene.
   b. Helps in the absorption of calcium.
   c. Increases the palatability of a ration.
   d. Decreases the dustiness and dryness of a ration.
   e. Increases the production energy of the ration.

4. Disadvantages of rancid fats:
   a. Have a tendency to decrease the palatability of a ration causing it to have a stale and unpleasant odor.
   b. Have a tendency to destroy certain fat soluble vitamins.
   c. Produce soft lard in hogs.
   d. Decrease milk production.
   e. Causes white muscle disease in sheep.
   f. Causes vitamin E deficiency in chicks.

5. Requirement of fat:
   a. Maximum amount of fat is 3%.

6. High fat content in rations:
   a. When rations are high in fat it is necessary to increase the protein and water soluble vitamin content because animals limit their feed intake by satisfying their caloric requirement.
   b. There is a danger that young growing animals on high fat rations may not get sufficient protein for maximum growth unless the protein is increased to a higher level or greater attention is given to protein quality.

7. Sources of fats:
   a. Lard
   b. Tallow
   c. Vegetable oils
   d. Soybean and peanut oil
   e. Feed grains

AREA: Feeds and Feeding

JOB IX. Getting acquainted with the minerals and their functions in livestock feeding.

SITUATION:

OBJECTIVE: a. To develop an understanding of the minerals needed by animals and their functions.

MOTIVATION: a. Show pictures of mineral deficient animals to boys.
b. Review the other nutrients previously mentioned or relate to a boy's project with a mineral deficiency.
c. Have two boys come up to the front of the classroom. Put some salt in two different containers, give each boy a sample and have them taste it. Ask them what it is and tell why they think so. Relate the salt to the job on minerals.

STUDY GUIDES:

1. How many minerals may be required by animals in their ration?

2. What two minerals are of greatest importance in an animal's ration? Why?

3. Discuss the function, deficiency symptoms, and sources of each of the required minerals needed by livestock.

4. What are some sources of mineral supplements?

5. What type of roughages provide the best source of minerals?

REFERENCES:
a. Animal Nutrition Handbook, Ralston Purina Company, pages 17-21
b. Livestock and Poultry Production, Bundy and Diggins, 2nd Edition, pages 23-24.
c. Feeds and Feeding, Morrison, 9th Edition, pages 61-79.
d. Animal Science, Ensminger, 5th Edition, pages 109-126.

AREA: Feeds and Feeding

JOB: Getting acquainted with the minerals and their functions in livestock feeding.

ANALYSIS:

1. Required minerals:
   a. As many as twenty minerals may be required by the animal body.

2. Two minerals needed most: Why?
   a. Calcium and phosphorus
   b. Because the skeleton of an animal's body is composed chiefly of these two minerals.

3. Function, deficiency symptoms, and sources of minerals:
   a. Calcium
      1. Function - major component of bones and teeth and essential in blood coagulation.
      2. Def. Symptoms - Retarded growth, deformed bones, (rickets) soft-shelled eggs.
      3. Sources - Milk, oyster shells, limestone.

   b. Phosphorus
      1. Function - Essential for the formation of bones, teeth, and body fluids. Required for metabolism, cell respiration, and normal reproduction.
      2. Def. Symptoms - Similar to calcium deficiency, lack of appetite, poor reproduction, and unthrifty appearance.
      3. Sources - Dicalcium phosphate, bone meal, and low fluorine phosphates.

   c. Sodium - Chloride - Potassium (Salt)
      1. Function - Required for the formation and retention of body fluids, such as protoplasm, blood and digestive juices.
      2. Def. Symptoms - Poor condition, appetite depression.
      3. Sources - Salts

   d. Iron
      1. Function - Essential for the function of every organ and tissue of the body. (Hemoglobin)
      2. Def. Symptoms - Nutritional anemia.
      3. Sources - Salt supplements, injectable products.

   e. Copper
      1. Function - Should be present in animal tissues for iron to be properly utilized.
      2. Def. Symptoms - Poor pigmentation of feathers, stringy wool, sway back lambs, lack of muscle coordination, anemia.
      3. Sources - Forages, copper salts.

AREA: Feeds and Feeding

JOB: Getting acquainted with the minerals and their functions in livestock feeding.

ANALYSIS:

f. Cobalt
   1. Function - Required as a nutrient for the microrganisms in ruminants.
   2. Def. Symptoms - Lack of appetite, loss of weight, rough hair coat, weakness, anemia, and death in extreme cases.
   3. Sources - Legume forages, salt containing cobalt.

g. Magnesium
   1. Function - Similar to calcium and phosphorus
   2. Def. Symptoms - Animals are irritable, their heart action is irregular and there is severe kidney damage.
   3. Sources - Mineral supplements, ordinary feeds.

h. Manganese
   1. Function - Affects growth and reproduction
   2. Def. Symptoms - Rabbits develop small crooked legs, chicks display a deformity of leg bones, causes sterility, and ovulation is irregular.
   3. Sources - Salt supplements, ordinary feeds.

i. Sulphur
   1. Function - Necessary in organic form of the essential amino acids, cystine and methionine.
   2. Def. Symptoms - None, very little sulphur is needed in rations
   3. Sources - Legume forages, occurs in the amino acid building units of proteins.

j. Zinc
   1. Function - Necessary for good growth and for normal hair development, serves as an activator of other enzyme systems.
   2. Def. Symptoms - Growth is reduced and hair development is retarded.
   3. Sources - Vegetable kingdom.

k. Iodine
   1. Function - Essential for the formation of the hormone, thyroxine.
   2. Def. Symptoms - Nutritional goiter.
   3. Sources - Iodized or mineralized salt.

l. Fluorine
   1. Function - Difficult to assign any function but is found in bones, teeth and skin
   2. Def. Symptoms - Tooth decay, rations could be toxic.
   3. Sources - Calcium phosphates and mineral supplements.

AREA: Feeds and Feeding

JOB: Getting acquainted with the minerals and their functions in livestock feeding.

ANALYSIS:

3. (cont.)
   m. Molybdenum
      1. Function - Has a role in enzyme systems.
      2. Def. Symptoms - Extreme diarrhea with constant loss in weight and production.
      3. Sources - Forages

   n. Selenium
      1. Function - Can replace sulphur in the amino acids, cystine and methionine.
      2. Def. Symptoms - Loss of hair from the mane and tail in horses, loss of hair from the tail in cattle, and loss of hair in swine, hoofs slough off, lameness occurs, food consumption decreases.
      3. Sources - Legume forages - same as sulphur

4. Sources of mineral supplements:
   a. High-quality ground limestone.
   b. Steamed bonemeal.
   c. Salt
   d. Trace mineral mixture.

5. Type of roughage:
   a. Legume

AREA: Feeds and Feeding

JOB X. Getting acquainted with the vitamins and their functions in livestock feeding.

SITUATION:

OBJECTIVE: a. To develop an understanding of the different vitamins and their functions needed in feeding livestock.

MOTIVATION: a. Show pictures of vitamin deficient animals to boys.
b. Put the letters A, A, C, D, I, I, M, N, O, S, on the board and tell the boys to arrange these letters into two words that pertain to animal nutrition. Give the boys enough time to spell the words, amino acids.

STUDY GUIDES:

1. What is meant by the term vitamin?

2. Which vitamin ranks first in importance in livestock feeding?

3. How do vitamins differ from other nutrients?

4. Distinguish between a fat soluble vitamin and a water soluble vitamin.

5. Discuss the function, deficiency symptoms, and sources of each of the vitamins needed by livestock.

REFERENCES:
a. Animal Nutrition Handbook, Ralston Purina Company, pages 21-26.
b. Feeds and Feeding, Morrison, 9th Edition, pages 82-102.
c. Livestock and Poultry Production, Bundy and Diggins, 2nd Edition, pages 20-23.
d. Animal Science, Ensminger, 5th Edition, pages 126-140.

AREA: Feeds and Feeding

JOB: Getting acquainted with the vitamins and their functions in livestock feeding.

ANALYSIS:

1. Define vitamin:
   a. An organic nutritive essential which is required in only a very minute amount.
   b. Are pure chemical compounds required in very small amounts for growth, maintenance, reproduction, and lactation.

2. Important vitamin:
   a. Vitamin A

3. Vitamins vs. other nutrients:
   a. They do not build body tissue.
   b. They are components of certain enzyme and hormone systems and are thus essential for the normal life processes.

4. Fat soluble and water soluble vitamins:
   a. Fat soluble vitamins can be stored and accumulated in the liver and other parts of the body whereas only very limited amount of water soluble vitamins are stored.
   b. Important that water soluble vitamins be consumed regularly in the ration in adequate amounts. Water soluble vitamin deficiencies develop in a short period of time.
   c. Fat soluble vitamins include: A, D, E, and K.

5. Function, deficiency symptoms, and sources of vitamins:
   a. Vitamin A
      1. Function - Development of normal, healthy, epithelial tissue or skin and nerve tissue which aids in building up resistance to infection. Important in ration of a female in gestation.
      2. Def. Symptoms - Retarded growth in the young and the development of a peculiar condition around the eyes known as Xerophthalmia. Night blindness, affects reproduction.
      3. Sources - Carotene, animal body oils (codfish and tuna), Legume forages, synthetically.

   b. Vitamin E
      1. Function - Normal reproduction, serves as the protector of vitamin A in the diet of poultry and cattle.
      2. Def. Symptoms - Crazy chick disease, white muscle disease in ruminants, stiff lamb disease.
      3. Sources - Synthetic tocopherol for poultry, cereal grains, wheat germ oil, forages,protein concentrates, alpha tocopherol.

AREA: Feeds and Feeding

JOB: Getting acquainted with the vitamins and their functions in livestock feeding.

ANALYSIS:

5. (cont.)

c. Vitamin D.
   1. Function - Is essential for the proper utilization of calcium and phosphorus to produce normal, healthy bones.
   2. Def. Symptoms - (Rickets) Retarded growth, misshapen bones, lameness and fractures, weak skeleton.
   3. Sources - Forage crops, fish liver oils, irradiated yeast, Chemical forms: activating ergosterol - Vit D_2, irradicating cholesterol - Vit D_3

d. Vitamin K
   1. Function - Necessary for the maintenance of normal blood coagulation.
   2. Def. Symptoms - Blood loses its power to clot and serious hemorrhages will result from slight wounds or bruises.
   3. Sources - Leafy forages, fish meal, liver, soybeans, synthetic compound - menadione.

e. Vitamin C (Ascorbic Acid)
   1. Function - Has an effect on the metabolism of calcium in the body. (Not required in ration of farm animals)
   2. Def. Symptoms - Scurvy (swollen and painful joints and bleeding gums) Brittleness of bones.
   3. Sources - Citrus fruits, tomatoes, leafy vegetables, potatoes.

f. Vitamin B_1 (Thiamin)
   1. Function - Required for the normal metabolism of carbohydrates.
   2. Def. Symptoms - Loss of appetite, muscular weakness, severe nervous disorders, general weakness, (Beri Beri)
   3. Sources - Raw, whole grains and especially their seed coats and embryos, fresh green forage, yeast.

g. Vitamin B_2 (Riboflavin)
   1. Function - Necessary for normal embryo development, important in the metabolism of amino acids and carbohydrates.
   2. Def. Symptoms - Poor reproduction characterized by small litters and deformed young (harelip, cleft palate,and club-footedness), Curled toe paralysis in chicks, Digestive disturbances, general weakness, eye trouble.
   3. Sources - Milk and dairy by-products, yeast, green forages, well cured hay, whole grains, wheat bran, synthetic riboflavin.

h. Vitamin B_6 (Pyridoxine)
   1. Function - Deals with fat metabolism and seems to be associated with the transportation and synthesis of unsaturated fatty acids.
   2. Def. Symptoms - Specific dermatitis (acrodynia), convulsions.
   3. Sources - Cereal grains, milk, cane molasses, yeast, rice polish. (No danger of a deficiency of this vitamin in animal rations)

AREA: Feeds and Feeding

JOB: Getting acquainted with the vitamins and their functions in livestock feeding.

ANALYSIS:

5. (cont.)

i. Niacin (Nicotinic Acid)
   1. Function - Recognized and designed as the pellagra preventing vitamin or black tongue factor. (Ruminants do not need niacin in their food because sufficient amounts are produced through bacterial synthesis in the rumen)
   2. Def. Symptoms - Reddening of the skin and development of sores in the mouth and intestinal tract resulting in bloody diarrhea. Fowl - slipped tendons or perosis, poor feathering.
   3. Sources - Dried yeast, rice bran, wheat bran, peanut oil meal, green forage, barley grain, sorghum grains, fish meal, meat scrap, and amino acid tryptophan.

j. Pantothenic Acid (Panacid)
   1. Function - plays an essential role in many basic biochemical reactions. (It is synthesized by bacterial action in the rumen)
   2. Def. Symptoms - abnormal skin condition about the face and eyes, retards growth, ragged feather development. Swine - poor appetite, slow growth, coughing, diarrhea, dermatitis, and stilted gait.
   3. Sources - fresh small grains, alfalfa hay, green pasture, wheat bran, peanut oil, dairy by-products, yeast.

k. Vitamin B_{12}
   1. Function - Essential for normal growth, reproduction and blood formation.
   2. Def. Symptoms - poor growth and reproduction.
   3. Sources - chemically pure substance B_{12}, fish meal, liver meal, and dried milk products.

l. Choline
   1. Function - helps with the transportation and utilization of fatty acids.
   2. Def. Symptoms - Kidney and liver damage, slipped tendons or perosis in chicks, development of fatty livers.
   3. Sources - Choline chloride in ration, liver meal, brewer's dried yeast, fish meal, cottonseed meal, soybean oil meal.

m. Biotin
   1. Function - in chicks, prevents slipped tendons and reduces the hatchability of eggs. (A deficiency of biotin does not occur in rations of farm animals)
   2. Def. Symptoms - Slipped tendons in chicks, reduces the hatchability of eggs in hens.
   3. Sources - Ordinary feeds.

AREA: Feeds and Feeding

JOB: Getting acquainted with the vitamins and their functions in livestock feeding.

ANALYSIS:

5. (cont.)

   n. Folic acid (Folacin)
      1. Function - Required for normal blood cell development.
      2. Def. Symptoms - Megaloblastic anemia, retarded growth, poor feathering, bleaching of feather, poor hatchability of eggs.
      3. Sources - Forages, oil meals, cereal grains.
         (Folic acid is not deficient in the usual rations fed to livestock)

PLAN OF ACTION: Do the chicken feeding demonstration which was performed by Dick Welton and Dr. Keinholz at Colorado State University. (Information for this demonstration can be obtained from the Avian Science Department at Colorado State University)

AREA: Feeds and Feeding

JOB XI. Getting acquainted with feed additives.

SITUATION:

OBJECTIVE: a. To develop an understanding of the feed additives used in livestock feeding.

MOTIVATION: a. Ask the boys what stilbestrol is? Ask them what would happen if they ate it? (They would induce sterility)
b. Ask the students to list all the feed additives they know on the board.

STUDY GUIDES:

1. What is the difference between a feed additive and a food nutrient?

2. What is the function of feed additives?

3. What are some common feed additives used in livestock feeding?

4. From what sources do we obtain feed additives?

REFERENCES:
a. Livestock and Poultry Production, Bundy and Diggins, 2nd Edition, pages 6-8, 132-134, 235, 257, 259-261, 499, 24
b. Feeds and Feeding, Morrison, 9th Edition, pages 375, 416-417, 442, 485-486.
c. Animal Nutrition Handbook, Ralston Purina Company, page 26.
d. Animal Science, 5th Edition, Ensminger, pages 142-144.

AREA: Feeds and Feeding

JOB: Getting acquainted with feed additives.

ANALYSIS:

1. Feed additive vs. food nutrient:
   a. A feed additive does not become a part of the animal body.
   b. A food nutrient becomes a part of the body cells and is necessary for the proper function of these cells.

2. Function of feed additives:
   a. Important for promoting growth.
   b. Improve feed efficiency.
   c. Prevention and treatment of internal parasites and diseases.
   d. Increase milk production.
   e. Increase bacterial rumen stimulation.

3. Common feed additives:
   a. Antibiotics
      1. Aureomycin (Reduces liver abcesses)
      2. Terramycin (reduces liver abcesses)
      3. Penicillin
      4. Zinc Bacitracin (Stimulates growth and improves feed efficiency)
      5. Hygromycin B
      6. Streptomycin
   b. Hormones
      1. Stilbestrol
      2. Iodinated casein
   c. Arsenicals
      1. Arsenilic acid
      2. Sodium arsanilate
      3. Hydroxyphenyl arsonic acid
   d. Dynafac (Minimizes bloat and founder)
   e. Dry Rumen Bacteria (bacterial rumen stimulation)
   f. Detergents or surfactants
   g. Others Matsushima recommended for cattle
      1. Erythromycin (Improves growth) - antibiotic
      2. Neomycin (Prevents scours) - antibiotic
      3. Ethylene diamine dihydroidide (Prevent foot rot and lumpy jaw)
      4. Poloxalene (bloat guard)
      5. Ammonia chloride (Urinary calculi)
      6. Ronnel (control grubs)
      7. Thibenzole (Control internal parasites)
      8. MGA (Melengestrol Acetate) (Depression of heat of heifers)

4. Sources of feed additives:
   a. Commercial sources - no farm-produced feeds contain additives.

PLAN OF ACTION: a. Visit a local elevator or feed store to observe the different feed additives fed to livestock.

AREA: Feeds and Feeding

JOB XII. Balancing a ration for livestock.

SITUATION:

OBJECTIVE: a. To develop an understanding of how to balance a ration.
b. To develop each boy's ability to balance his own ration.

MOTIVATION: a. Write two rations on the board (one balanced and one not balanced) Ask the students which ration they think is the best?
b. Take a sample of a ration, hand out a small amount to each boy, Have them separate the grains and have them determine the amount of each grain in the mixture.
c. Relate your discussion to a ration of a boy's project.

STUDY GUIDES:

1. What is a ration?

2. What is a balanced ration?

3. What are the methods of balancing a ration?

4. What is meant by feeding standards?

5. What feeds should you use to balance a ration?

6. What information do you need before you balance a ration?

7. How do you balance a ration? (Use both methods)

REFERENCE: a. Feeds and Feeding, Morrison, 9th Edition, pages 136-143, 15.

AREA: Feeds and Feeding

JOB: Balancing a ration for livestock.

ANALYSIS:

1. Define a ration:
   a. A ration is the feed allowed for a given animal during a day of 24 hours, whether it is fed at one time or in portions at different times

2. Define a balanced ration:
   a. A balanced ration generally contains more than one feed to provide essential nutrients in proper quantities so that they will properly nourish an animal for a 24 hour period.
   b. A balanced ration is one which furnishes the several nutrients in such proportion and amount as will properly nourish a given animal for 24 hours.

3. Two methods:
   a. Square method
   b. Feeding standards

4. Feeding standards:
   a. Tables stating the amounts of nutrients which should be provided in rations for farm animals of various ages and classes in order to secure the best results.

5. Feeds used:
   a. Use the feeds that you have available.

6. Information needed:
   a. Class of animal
   b. Requirements of that animal
   c. Percentage of digestible protein, dry matter, total digestible nutrien and net energy of each feed used.

7. Square method:
   a. Step I:
      1. Compute protein content of feeds available to use in the ration.
   b. Step II:
      1. Construct a square.
      2. Put desired protein percentage in the center of the square.
      3. Put protein percentages of feed on left side of square.
         a. Supplement, upper left
         b. Grain, lower left
      4. Subtract diagonally and place the differences at the right corners
         a. Upper right gives parts of supplement
         b. Lower right gives parts of grain
      5. Add the differences
   c. Step III:
      1. Compute the amount of feed required to make ? pounds of mixture.

         a. $\frac{\text{Parts of supplement}}{\text{Sum of differences}}$ X ? Pounds = Pounds of supplement

AREA: Feeds and Feeding

JOB: Balancing a ration for livestock

ANALYSIS:

7. (cont.)

b. $\frac{\text{Parts of grain}}{\text{Sum of differences}}$ X ? Pounds = Pounds of grain

2. Example: Prepare a 20% protein mixture using 1 part corn (7.0% protein), 1 part oats (12% protein), and cottonseed meal (40.0% protein). Prepare a one ton mixture.

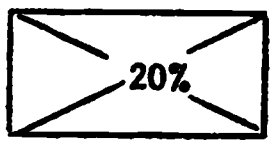
corn 7.0%
Oats 12.0%
19.0%

19 divided by 2 equals

9.5 or 10%

CSM 40

Grain 10



10 parts of CSM

20 parts of grain

30

$\frac{10}{30}$ X 2000 = $\frac{20000}{30}$ = 666 pounds of supplement

$\frac{20}{30}$ X 2000 = $\frac{40000}{30}$ = 1334 pounds of grain

or
667 pounds of corn
667 pounds of oats

Feeding Standards Method:

a. Step I
   1. Determine type and class of animal being fed.
   2. What feeds are available to feed

b. Step II.
   1. Make a chart such as the following

Feeds	Dry Matter	Dig. Protein	Total Dig. Nut.	Net Energy
(Requirements)				
TOTAL				

AREA: Feeds and Feeding

JOB: Balancing a ration for livestock

ANALYSIS:

7. (cont.)
   c. Step III
      1. Find the requirements of dry matter, digestible protein, total digestible nutrients, and net energy for the class of livestock.
   d. Step IV.
      1. Look in appendix table VII for example rations for certain classes of livestock
   e. Step V.
      1. Find the percentages of dry matter, digestible protein, total digestible nutrients, and net energy(therms) for each feed.
   f. Step VI.
      1. Multiply the pounds of feed times the percentages of dry matter, digestible protein, total digestible nutrients, and net energy.
   g. Step VII.
      1. Add the results and observe if the totals are within the range required for the animal.
   h. Step VIII.
      1. If the requirements are within the range, you have a balanced ration.

Example: Compute the following ration for wintering a 110 pound ewe until 4 to 6 weeks before lambing. Use the following feeds: Prairie hay (western, cut mid-season), corn silage (recent analysis) and cottonseed meal (solvent, 43%.)

Feeds	Dry Matter		Dig. Protein		T.D.N.		Net Energy	
(requirements)	2.5 - 3.2		.12-.17		1.4-1.8		1.1-1.4	
2.5 lbs. Prairie hay	(91.3)	2.28	(2.0)	.05	(45.1)	1.1	(33.8)	.8
2.5 lbs. Corn silage	(27.6)	.69	(1.2)	.03	(18.3)	.5	(15.2)	.4
.25 lbs. Cottonseed meal	(91.0)	.23	(33.3)	.08	(65.2)	.2	(69.0)	.2
TOTAL		3.20		.16		1.8		1.4

PLAN OF ACTION:
a. Provide other ration problems for the boys to figure.
b. Have the boys determine if the ration they are feeding to their livestock is balanced.

AREA: Feeds and Feeding

JOB XIII. Computing least - cost balanced rations.

SITUATION:

OBJECTIVE: a. To develop an understanding between a balanced ration and an economical balanced ration for livestock.
b. To develop the ability to compute a least-cost ration for the boy's projects.

MOTIVATION: a. Put the rations of two boys with the same project on the board. Ask which ration is the cheapest to feed?
b. Ask the boys which deal they would like the best? To buy three pieces of candy for a dime each or three pieces of candy for a quarter. Relate this example to buying something for a lesser cost.

STUDY GUIDES:

1. What is the best way to decide if substituting one feed for another in a balanced ration will make the ration more economical to the livestock feeder?

2. What are some "rules of thumb" used in substituting one feed for another in a ration?

3. What are some guides in swine, beef cattle, dairy cattle, and sheep rations as to the proportions and amounts of concentrates and roughages used?

4. How do you compute the cost of a ration?

5. Why shouldn't feeds be changed abruptly in a ration?

6. Discuss the difference between a balanced ration and a least-cost balanced ration.

REFERENCES:

a. Feeds and Feeding, Morrison, 9th Edition, pages 621-622.
b. Livestock and Poultry Production, Bundy and Diggins, 2nd Edition, pages 266-267, 330-331, 503.
c. Approved Practices in Feeds and Feeding, Cassard and Juergenson, 3rd Edition, pages 286-293.
d. Animal Science, Ensminger, 5th Edition, pages 147-150, 519-524, 687-692, 884-892.

AREA: Feeds and Feeding

JOB: Computing least-cost balanced rations

ANALYSIS:

1. Substitution of feeds:
   a. Make up a new balanced ration using the substituted feed.
   b. Compare the cost of the new ration with the old one.
   c. Determine if the substitution pays or not.

2. Rules of thumb:
   a. Silage can be substituted for hay at the rate of 3 pounds of silage for 1 pound of hay.
   b. Start cattle on feed with 2 lb./head the first day, increase the ration ½ - 1 lb. daily until they reach approximately halfway and then increase the ration by 1 lb. every third day until full feed is obtained.
   c. Lambs started on grain: Feed ¼ lb. per head per day. Gradually increasing so they are getting 2 lb. per head per day when on full feed four weeks later.
   d. Other feeds which can be substituted for alfalfa in a ration.
      1. Clover
      2. Lespedeza
      3. Timothy hay
      4. Prairie hay
   e. Feeds which can be substituted for corn in rations.
      1. Barley
      2. Milo
      3. Sorghum
      4. Oats
      5. Rye
      6. Wheat
   f. Protein supplements.
      1. Linseed meal, soybean meal, and cottonseed meal may be used almost interchangeably according to which is more economical.
      2. Tankage and meat scraps
      3. Soybeans
      4. Wheat bran

3. Guides for concrntrates and roughages:
   a. Swine
      1. Fattening pigs in drylot: 5 - 15% legume hay in ration
      2. Pregnant sows in drylot: 10-15% legume hay in ration
      3. Pregnant sow: 1 - 1.5 lb. of concentrates per 100 lb. body weight.
      4. Pregnant gilts: 1.5-2.0 lb. of concentrates per 100 lb. body weight.
      5. Fattening swine will consume 5 lb. of feed (mostly concentrates) per 100 lb. of body weight.
   b. Beef cattle
      1. Fattening cattle: 2.1 lbs. or more of concentrates and dry roughages daily per 100 lbs. of body weight. The allowance of concentrates ranges from less than 1.1b. to 1.7 lbs. or more daily per 100 lbs. of live weight.
         <u>full feed</u>: Cattle will consume 1 3/4 - 2 1/2 lbs. of concentrates and 3/4 - 2.0 lbs. of hay per 100 lbs. of live weight daily.

AREA: Feeds and Feeding

JOB: Computing least-cost balanced rations.

ANALYSIS:

3. (cont).
   2. Breeding cows: If roughage is low in protein, 1 lb. per head daily of protein supplement should be fed and a small amount of grain.

c. Dairy cattle
   1. Dairy cows in milk: 2.0 lb. of dry roughage daily per 100 lbs. of live weight. For concentrates - use tables VIIIa and VIIIb on page 672 in Feeds and Feeding book.
   2. Dairy heifers: Up to 6 months - 2 to 3 pounds of concentrates per head per day on good roughage. 4 to 5 pounds of grain on poor roughage.
      Over a year old - 2 - 4 lbs. of concentrates on fair roughage.

d. Sheep
   1. Breeding ewes: Good roughage up to 4-6 weeks before lambing. During 4-6 weeks, .5 to .75 lb. of concentrates per head per day.
   2. Nursing ewes: Ewes not on pasture, need 1 lb. or more per head per day of concentrates in addition to good roughage.
   3. Fattening lambs: 70 to 75 lb. lambs, 1.4 lb. of roughage per head per day and all the grain they will eat. 2.3 lb. or more of hay per head per day when grain is restricted.
      Full feed: Lambs will consume about 2 lb. of grain and about 2lb. of roughage per head per day.

4. Compute the cost of a ration:
   a. Figure the cost of feed to price per pound.
      1. Take ton price and divide by 2000 to get price per pound.
   b. Then multiply this amount by the pounds of feed used per day in the ration.
   c. Add together the figures for all the feeds used and divide by the numbers of animals fed to get the cost of feed per animal per day.

5. Sudden feed change:
   a. Digestive disturbances will result and animals go off feed.

6. Least-cost balanced ration vs. balanced ration:
   a. A ration will not be economical unless the animals like it, it keeps them in good health, and they grow, fatten, or produce well on it.
   b. A ration can be balanced but not necessarily the most economical ration to be fed to the livestock.

AREA: Feeds and Feeding

JOB: Computing least-cost balanced rations.

ANALYSIS:

6. (cont.)

c. Least-cost balanced rations should include the following factors:
   1. Use the feeds you have available at the lowest cost.
   2. Meet the minimum requirements of dry matter, digestible protein, total digestible nutrients, and net energy in balancing your ration.
   3. Use the proper proportions of concentrates and roughages in your ration.

PLAN OF ACTION:

a. Develop a problem for the boys to figure the lowest cost ration. Have all the boys use the same feeds and costs and see who can figure the lowest cost ration.
b. Visit a local feedlot to observe the rations and different types of feeds being fed.

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ABSTRACT - Developed by participants of an Education Professional Development Act (EPDA) Institute, this manual is for teacher use in conjunction with a slide presentation in metalworking technology. Units include: (1) Gas Metal Arc (MIG), (2) Gas Tungsten Arc (TIG), (3) Plasma Arc, (4) Electron Beam Welding, (5) Electrical Discharge Machining, (6) Electro Chemical Grinding, (7) Electro Chemical Machining, (8) Powdered Metallurgy, (9) Free Abrasive Machining, (10) Urethane Forming, and (11) Metal Finishing. Each unit contains a title slide, introduction, equipment, processes, advantages, and disadvantages. A bibliography, review questions, and a glossary are included with each section. (GR)

VT 010 505

ED0 45856

EPDA

INSTITUTE

MANUAL

MODERN METALWORKING TECHNOLOGY

*GAS METAL ARC (MIG)

*GAS TUNGSTEN ARC (TIG)

*PLASMA ARC

*ELECTRON BEAM WELDING

*ELECTRICAL DISCHARGE MACHINING

*ELECTRO CHEMICAL GRINDING

*ELECTRO CHEMICAL MACHINING

*POWDERED METALLURGY

*FREE ABRASIVE MACHINING

*URETHANE FORMING

*METAL FINISHING

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ED0 45856

GAS METAL ARC (MIG)

E.P.D.A. INSTITUTE IN MODERN

METALWORKING TECHNOLOGY

WESTERN MICHIGAN UNIVERSITY

KALAMAZOO, MICHIGAN

SUMMER - 1969

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the participants listed above

Slide
GMA - 1 Title Slide

Slide
GMA - 2 Introduction

The Gas Metal-Arc welding process is achieved by striking an electric arc between the workpiece and a consumable wire electrode, which is fed through a gun at controlled speeds.

Originally this process used only inert shielding gases and was called "MIG" or metallic-inert gas welding. With the advent of using CO_2 as a shielding gas, which is not inert, the AWS has since changed the name to "GMA" or gas metal-arc welding.

This slide shows the basic GMA system and will be discussed in detail later. For the present it is enough to say that GMA welding is an automatic or semi-automatic wire feed process, using a gas to shield the arc.

The next group of slides will discuss the types of welding currents as they apply to all welding processes, with emphasis placed on GMA.

Slide
GMA - 3 Welding Currents

Current flow in welding is classified as one of the

following, with the difference being the direction of electron flow in the welding circuit.

Direct Current Straight Polarity	DCSP
Direct Current Reverse Polarity	DCRP
Alternating Current	AC

Slide
GMA - 4

In DCSP the electron flow is from the electrode to the workpiece or from Negative to Positive.

Electron flow is always from Negative (-) to Positive (+).

With this condition about 2/3 of the total heat is at the workpiece and 1/3 at the electrode.

Slide
GMA - 5

In DCRP the electron flow is reversed from that of straight polarity. The electron flow is still from negative to positive but a switch has been turned to change the terminals on the welding machine.

With this condition 2/3 of the heat is liberated at the electrode and 1/3 at the workpiece.

Slide
GMA - 6

In AC welding, the electron flow changes direction 120 times a second from DCSP to DCRP.

Electric current as it comes from the power company

is called 60 cycle current because it requires 1/60 of a second to complete a full cycle. 1/120 of a second in DCSP and 1/120 of a second in DCRP.

With this condition about 1/2 of the total heat is liberated at the electrode and 1/2 at the workpiece.

Slide
GMA - 7

Laboratory Experiment

DCSP

A simple laboratory experiment to prove where the heat is liberated can be performed by striking an arc between two carbon electrodes of approximate equal length.

The carbon electrode being brittle, should carefully be inserted; one in the ground clamp and the other in the electrode holder.

Set the machine at about 125 amps. on DCSP.

As explained before, electron flow is from Negative to Positive and with DCSP the electrode is negative and the ground clamp positive.

When an arc is struck between the carbons, the one in the ground clamp becomes visibly hotter proving more heat is carried on the positive side.

DCRP

To prove the opposite is true in reverse polarity, allow the electrodes to cool and change the polarity switch from DCSP to DCRP.

DO NOT CHANGE THE AMPERAGE SETTING.

The current flow is still from negative to positive but now the electrode holder is positive and is receiving the electron flow. (DCRP)

When an arc is struck between the carbon electrodes, the one in the electrode is visibly hotter.

AC

Next, if you are using an AC/DC power supply, switch it to AC and again do not change the amperage setting.

With this condition, electron flow is equal in both directions and when an arc is struck, both carbons appear to be equally as hot.

Slide
GMA - 8

Welding Currents in GMA

HOWEVER, as you know with every set of rules it is possible to find an exception.

Everything we have said about heat distribution

holds true in DCSP and in AC and is true in DCRP when using non-consumable electrodes, as in the GTA (TIG) process.

The only problem is with DCRP under certain conditions with consumable electrodes. (usually in spray transfer)

With GMA the most common polarity is DCRP, therefore we should understand why there seems to be a contradiction in heat transfer.

Slide
GMA - 9

When welding with GMA in DCRP we find ourselves confronted with a phenomena called "PLASMA".

By definition "plasma" is the fourth state of matter following solids, liquids, and gases.

An example of plasma in nature is the ionization of the atmosphere during a thunderstorm where negative and positive charges collide causing <u>Lightning</u>.

Slide
GMA - 10

As we have already learned, in DCRP most of the total heat is liberated at the electrode in a simple arc.

However, with the intense heat of the arc concen-

trated on the tip of the consumable electrode, the molten metal becomes partially ionized.

These ionized particles of metal vapor and shielding gas then form the plasma stream in the center of the arc.

Slide
GMA - 11

The "Plasma" then, is a Gas that has been heated to such a high temperature (11,000° F.) that it is Ionized and can carry an electric current.

An ion is described as an atom that has lost one or more electrons and therefore behaves like a positive charged particle.

In Stick and GMA welding the amount of plasma formed is very small but is sufficient to cause expansion of ionized metal atoms. This expansion causes the molten metal at the electrode tip to be propelled across the arc with considerable force causing deep penetration.

In addition to the expansion, the metal atoms that are plasmaized will absorb latent heat during the change from metal vapor to plasma. This latent heat is carried by the ion flow back to the workpiece aiding in penetration.

Slide
GMA - 12 Therefore, it can be seen that initially most of the heat is at the electrode in DCRP, as is true in GTA welding, but due to the super-heating effect on the tip of the consumable electrode, the plasma carries the heat back to the workpiece.

Slide
GMA - 13 It can then be seen that the ionic bombardment, aided by the plasma stream, produces the deep penetration and breaks up the surface oxides. Removing the oxides is especially important for materials that have an oxide that melts at a high temperature, such as aluminum and magnesium (3900° F.).

Slide
GMA 14 <u>Shielding Gases</u>

I. Shielding gases are utilized for preventing contact of the surrounding air with the molten weld metal; during the welding operation. The gas metal arc welding process consists of performing a weld in which the arc is surrounded by an inert gas.

II. Common Shielding Gases

a) Helium

b) Argon

c) Carbon dioxide

d) Variety of combinations

III. Monotomic gases

a) Argon

b) Helium

IV. Other monotomic gases are not recommended for commercial use because they are very expensive

a) Neon

b) Krypton

c) Xenon

d) Radon

Slide
GMA - 15 <u>Argon</u>

a) It is colorless, odorless and tasteless.

b) availability

1) manufacturers of oxygen

c) will dissolve in water at a ratio of 4 volumes to 100 volumes

d) It is heavier than the air.

e) Diffuse more slowly

f) Offers less resistance than Helium

g) Has been used during many years for incandescent light bulb

h) Must be 99.8% pure

Advantages of Argon Gas

a) Useful for gas metal arc welding

b) Requires less temperature for welding

c) Less gas is used for most welding applications

d) Has the ability to carry a stable arc

e) Is a by-product from liquification of air

f) Will not burn or explode

g) Will not react chemically with any other element or compound

h) It is stored in different sizes of cylinders

Disadvantages of Argon Gas

a) It evaporates at normal temperature

b) More expensive per cubic foot than other common inert gas arc welding

Slide
GMA - 16 Helium

a) First shielding gas used with satisfactory results

b) Floats away rapidly when heated by the arc

c) Permits fast welding

d) Used very extensively

1) During World War II

a) manufacturing aircraft parts

b) in welding aluminum

Advantages of Helium Gas

a) Fast voltage change as the arc changes

b) Is used to operate electronic controls

c) works very well in automatic machines

d) Has deep penetration when welding

e) Is a by-product of natural gases

f) It is the second lightest gas

Disadvantages of Helium Gas

a) More cubic feet per hour are required to maintain an inert atmosphere around the arc

b) Requires higher voltage than argon (40% more) because of its higher resistance

c) More expensive than CO_2

Slide
GMA - 17 Carbon Dioxide (CO_2)

a) Mostly used in gas arc welding of mild steels

b) Need a higher current causing more agitation of the puddle reducing porosity

c) Caution has to be taken when moisture is present

d) Usable in automatic machines

e) Has the ability to shield the arc

Advantages of Carbon Dioxide (CO_2)

a) low cost

1) 1/10 the cost of argon

b) very successful for the manual use

c) DCRP is generally used

Disadvantages of Carbon Dioxide

a) needs a higher current

b) good ventilation has to be provided because of the toxic gases liberated

c) it may condense and freeze the regulator when moisture is present

d) it is heavier than other gases

Slide
GMA - 18 Gas Mixtures

a) used in a variety of metals because of successful results in gas-arc welding such as:

1) nickel

2) stainless steel

3) monel, etc.

b) recommended for automatic welding because of a very intense arc

c) mixture of 1 to 5% of oxygen to argon helps to produce arc stability

Slide
GMA - 19

d) Argon and Helium mixtures are an excellent balance

Slide
GMA - 20

Advantages of the Mixtures

a) they can be balanced better by mixing two different gases for every specific job

b) by mixing the gases we can reduce the cost of the job

Disadvantages of Mixtures

a) they are different for every kind of work

b) special care has to be taken when mixing gases, to have the right balance

Types of Metal Transfer

Slide
GMA - 21

Globular type transfer transfers across the arc in large irregular shaped drops or "globs". This type of metal transfer is indicative of CO_2 shielded welding of steel; it also can exist because of low arc voltage or low amperage when using other shielding gases.

Spray type metal transfer is accomplished by the movement of a stream of tiny droplets across the

arc from the electrode to the weldment. The arc has a characteristic sizzling sound or in some cases a buzzing sound. Spray transfer employs a relatively high voltage and current. Shielding gases that are used with this type of metal transfer include argon, helium, argon-helium mixtures, argon-oxygen mixtures and helium-oxygen mixtures. The typical load voltage ranges would be 26 to 35 volts.

Short Circuiting method of metal transfer is unique, in that, no metal transfers across the arc. Metal transfer occurs when the electrode wire makes contact with the parent metal. The number of shortcircuits per second will vary according to the welding condition set on the equipment. With short circuiting, with constant potential welding machines, amperage is controlled by the rate of wire feed speed. The faster the wire feed speed the higher the amperage. In this method the wire feed speed is slower than spray methods. The process is a relatively low amperage, low voltage technique. Machines used with this method are constant potential types with slope, or reactance, either built in as a fixed setting or variable through a range. The slope is a

fairly low value. Typical load voltage ranges are 15-22 volts depending on the shielding gas and other variables. Shielding gases used with this process are: welding grade (moisture free) CO_2, argon - CO_2 mixtures, argon-oxygen mixtures, helium-oxygen mixtures and helium-argon-oxygen mixtures.

Slide
GMA - 22

Globular Transfer

Illustrated is an example of globular type transfer. Note the irregular shaped "globs" and the distance between the workpiece and the electrode wire, indicating that the electrode wire does not touch the metal, but is transferred through the arc. The transition chart indicates the globular transfer, the lower left area with current (amps), along the bottom. Wire speed - inches per minute is shown along the left side of the chart. The label "low" is an indication of the amperage needed for globular transfer.

Slide
GMA - 23

Spray Transfer

Directly related to globular transfer metal is spray transfer. Again as in the previous slide note the droplets; however, much smaller in size to the "globs" of globular transfer. Also as

in globular and again in spray transfer the electrode wire does not touch the workpiece but passes through the arc. The label "high" is an indication of the amperage needed for spray transfer.

Slide
GMA - 24

<u>Pinch Area #1</u>

The high amperage (indicated in the previous slide) causes the pinching effect. This pinch area is caused by high current densities (amps) creating a magnetic field.

Slide
GMA - 25

<u>Pinch Area #2</u>

This pinch area narrows the molten electrode wire to a needle shaped point creating very small droplets.

Slide
GMA - 26

<u>Transition Chart</u>

Globular and Spray transfer are very similar. The difference is the current in amps in relationship to the wire speed. The transition line shows the transition point where metal transfer changes from globular to spray. Globular transfer is indicated in the pink area. Spray transfer is the blue area of the chart. This chart is set up by the trial and error method: the transition will differ with various diameters of electrode wire as indicated

by the black lines. The transition will also vary with the type of electrode wire used, e.g., stainless steel or mild steel.

Slide
GMA - 27

Spray and Dip

With respect to the third method of metal transfer one can compare the short circuit transfer method and spray transfer method. Note that again the droplets in spray transfer pass through the arc, however, in the Dip or Short Circuit transfer, the electrode wire touches the work. Our third method, Short Circuiting transfer, differs from spray and globular in that the electrode wire touches the workpiece to start the arc.

Slide
GMA - 28

Short Circuiting Transfer (arc off)

Short circuiting transfer of electrode metal to the workpiece is achieved by a combination of arc-melting and resistance heating. During arc off, the electrode wire feeds from the gun torch to the workpiece and resistance heating is caused by the high current (amps).

Slide
GMA - 29

Short Circuiting Transfer (Arc Established)

After the high current surge the electrode wire is melted to establish the arc.

Slide
GMA - 30

Short Circuiting Transfer (Arc Off)

This slide again shows the electrode wire feeding in, touching the work, and repeating the cycle. This cycle repeats itself 20 to 200 times per second depending upon voltage and amperage settings of the equipment.

Slide
GMA 31

"Stubbing or Roping"

Several problems may occur concerning the wire feed speed. If excessive wire feed speed is used, the welder cannot put out enough current to melt the wire fast enough and "stubbing" or "roping" of the wire occurs.

Slide
GMA - 32

Burn Back

If excessive current is used for too slow a wire feed speed, the wire melts off too fast and "burn back" occurs.

Slide
GMA - 33

Spray Arc Light Gauge Metal

Spray arc on light gauge metal cannot be successfully accomplished because the current cannot be lowered below the spray-transfer transition density. The result is burning through the metal.

Slide
GMA - 34 <u>Basic System</u>

Shows basic GMA welding systems blacked out.

Slide
GMA - 35 This slide shows the welding gun which provides the electrical contact for the welding wire and directs the wire toward the workpiece. The trigger on the gun actuates the wire feed and shielding gas.

Slide
GMA - 36 This slide shows the wire drive system. On most GMA machines a variety of wire sizes are available depending on the capacity of the power supply.

Slide
GMA - 37 Shows the shielding gas supply. The shielding gas is used to control the atmosphere around the welding arc and serves the same purpose as the flux coating on stick electrodes.

The common gases used are Carbon Dioxide, Argon, and a variety of mixtures.

Slide
GMA - 38 This slide shows the flowmeter which regulates the proper amount of shielding gas and is adjustable for varying welding conditions and different shielding gases.

Slide
GMA - 39 This slide shows the power source which will be

described in detail later. It is usually of the D.C. rectified type.

The power supply provides the necessary voltage and amperage to perform the welding.

Slide GMA - 40 This slide shows the controls for regulating the shielding gas and wire feed speed.

Slide GMA - 41 This slide shows the complete GMA welding system.

Slide GMA - 42 <u>Power Supply</u>

The power supply for GMA welding is a constant voltage type. This type of machine maintains a constant voltage which has a lower open circuit voltage than a machine suited to shielded metal arc or GTA welding. This machine has a different design electrically, and should not be confused with the conventional drooper type machine.

Slide GMA - 43 In the Constant Voltage power supply the voltage control is directly related to the arc length.

The higher the voltage, the longer the arc.

Slide GMA - 44 The conventional welding machine with a drooping volt-amp curve, can <u>not</u> be used to best advantage in the GMA welding techniques. In the Drooper

machine very small changes in arc length (which affects voltage) will result in varying amperage.

With the Constant Voltage machine the amperage can be run through a wide range without varying the voltage (arc length). Therefore, when the arc is started, the machine very quickly reaches welding voltage and remains nearly the same as the set open circuit voltage. This gives short circuiting currents of up to 3000 amps to burn off the wire.

Slide
GMA - 45

There are some GMA welding techniques where this extremely high amperage is not needed (such as short circuiting transfer). The high amperage as the arc is started would burn the wire back into the tip.

Therefore, most C V power supplies also have a means to control the shape of the volt-amp curve. This is done by either a tapped slope or a variable slope control.

It must be understood however, that the term SLOPE simply refers to the shape of the volt-amp curve as shown on a graph.

Slide
GMA - 46 The control of slope is obtained by adding a reactor in series with the electrode cable in a CV power supply.

Slide
GMA - 47 This reactor changes the power source's inductive reactance. The reactor opposes a change of current flow by inducing a choking effect.

Due to the constant voltage in this type of machine, the response rate is very high, and high currents produce instant melting at the electrode tip. This rapid response rate is necessary in the spray type of transfer but must be controlled in short circuiting transfer.

To control this rapid power response we add this reactor which produces a choking effect and acts like a flywheel in a gas engine.

The more turns of reactance that we put into the machine has the same effect as putting a larger flywheel on an engine. The reactance (choking effect) then simply slows the response rate of the machine by absorbing the initial power surge and releases it slowly.

Slide
GMA - 48 This slide shows a tapped slope control, which

is used to either increase or decrease the choking effect.

Slide
GMA - 49

When the slope control is set to "0" turns of slope, the machine will produce a constant voltage as it was designed to do.

*The more turns of slope that are added to the CV machine, the more it will behave like a conventional drooper.

For most welding with GMA we find the best results are somewhere between the "0" slope and maximum slope, depending on the type of transfer required.

*Fewer turns for spray transfer
More turns for short circuiting transfer

Slide
GMA - 50

This slide shows the relationship between voltage and amperage and the effects of slope.

Slide
GMA - 51

<u>Welding Techniques</u>

Leading Angle 2° - 15° (forehand) - The arc stream plays ahead on the cold metal and results in wide bead with shallow penetration.

Usually applied on thin gage metals and provides a better view of the weld puddle.

Slide
GMA - 52 Lagging Angle 2° - 15° (backhand) - The gas shield is over the weld zone and the arc is directed into the molten puddle which results in good penetration.

Usually applied on heavy plate.

Slide
GMA - 53 When voltage is set too high or when the wire feed is too slow, a long arc will result which causes spatter and undercutting.

When voltage is too low or when the wire feed is too fast, there is an excess buildup and shallow penetration.

Slide
GMA - 54 The position of the gun when making a fillet weld is another important variable.

If the arc is held too high on the workpiece, undercutting will occur.

The arc should be directed slightly toward the bottom plate, as this is where the heat is needed. The molten metal will then wash up upon the upright piece, preventing undercut.

Slide
GMA - 55 <u>Wires for GMA</u>

Wire can be purchased in many different diameters

and spool weights. Common wire sizes are .020 to 1/8" and larger. The standard spools have from 1 pound up to 600 pounds of wire.

Slide GMA - 56 The welding gun shown contains a spool of wire inside, which is an indication of how the wire can be fed.

Slide GMA - 57 <u>Flux Cored Welding - GMA</u>

This slide shows the manufacture of fluxed cored arc welding wire. The wire is made from a flat strip stock, flux added and the wire then closed and drawn into correct size using extrusion dies. Common diameters are 3/32 and 5/64.

Slide GMA - 58 Alloying materials to produce high strength, ductility, and toughness.

Slag to protect weld from cooling too fast and collect impurities.

Deoxidizers to purge the deposit of gas and slag.

Ionizers to stabilize the arc.

Slide GMA - 59 Indicates the amount of flux used and how the incorrect angle of the electrode will produce slag inclusions in the weld. For this reason weaving of any type cannot be tolerated.

Slide
GMA - 60 Comparison of stick welding with flux cored wire welding. Indicates more metal deposition and more penetration.

Slide
GMA - 61 Actual picture of flux cored welding indicates dip transfer, splatter, and large amount of slag.

Slide
GMA - 62 <u>Pulsed Arc Welding</u>

Pulsed arc welding is a method of welding in a non-continuous spray transfer by using a low background, three phase current, and a higher single phase current. The pulsed action enables the weld to stay cool as the spray transfer occurs only on one-half of a normal sine wave and the background current helps to maintain a stable arc.

Slide
GMA - 63 This indicates a normal sine wave and two sine waves that have been altered to produce certain characteristics in power sources. The half wave rectification shows a wave in which the lower part of the sine wave has not been allowed to flow, e.g. using a diode. The fully rectified wave indicates the lower half of the wave has been flipped up to the upper side of the wave by forcing the wave up and not allowing it to flow down.

Slide
GMA - 64 The spray transfer occurs in a very small area. (above the dotted line)

Slide
GMA - 65 Shows the high single phase current used to enable a spray transfer. Occurs every 1/60 of a second.

Slide
GMA - 66 Shows the low three phase background current, which maintains a stable arc and allows the metal to stay hot but not melted.

Slide
GMA - 67 The non-continuous spray transfer gives the advantage of a spray transfer without the continuous high current range. Thus enabling welding out of position and welding of thin materials.

The low background current enables one to maintain an arc much similar to the Gas Tungsten Arc process. The arc force is less and the splatter is largely eliminated.

Due to the constant heat output characterized by the background current uniform root penetration is obtained.

Slide
GMA - 68 A pulsed arc machine appears similar to the normal gas metal arc machine. The main difference is the control the operator has over the background current and the high current.

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for

Unit II Gas Metal Arc Welding (MIG)

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GMA Review Questions

1. What mainly differentiates GMA welding from GSA welding?

- -

Primarily high current density.

---

2. Why is a small percent of oxygen used with Argon for spray transfer?

- -

Wetting action (O_2 combining deoxidizers)

Prevention of undercutting

---

3. What conditions are associated with globular transfer?

- -

Low current density

Erratic transfer

Shallow penetration

Non directional

---

4. What are the disadvantages of spray transfer in GMA welding?

- -

Not suitable for all position welding

Not suitable for thin material

---

5. What popular shielding gas is used for dip transfer or short arc GMA welding?

- -

CO_2

---

6. What parameters control or affect the drop-spray transition?

- -

Electrode material

Electrode diameter

High current density

Kind of current (DCRP)

---

7. What are the advantages of the pulsed arc GMA machine over spray transfer without pulsed arc?

- -

Can spray transfer on thinner metal

Can do position welds

---

8. What distinguishes a pulsed arc GMA machine from other DCRP - GMA machines?

- -

Two machines in one: a 3 phase rectified background voltage and a single phase pulsed peak voltage.

---

9. What are advantages of spray transfer of metal in GMA?

- -

Directional properties in the form of fine metal droplets

Deep penetration

High deposition rates

Smooth metal transfer

---

10. What determines arc length for GMA welding?

- -

Voltage

---

11. What is the effect of increasing electrode feed rate when GMA welding?

- -

Increase current

---

12. What causes the pinching effect of droplets for spray transfer GMA welding? Can this pinch effect be obtained with CO_2 gas?

- -

Axially magnetic field around electrode (funnel shaped with large end toward work)

No.

---

13. What are the 3 types of metal transfer in GMA welding?

- -

1. Dip transfer
2. Globular transfer
3. Spray transfer

---

14. Why are CV machine characteristics desirable for GMA welding?

- -

A CV machine is sensitive to changes in arc length.

---

15. For stable welding conditions, with GMA welding, melt off rate must equal arrival rate. What if arrival is (1) too fast, (2) too slow?

- -

1. Stubbing
2. Burnback

---

16. What conditions must exist for spray transfer GMA welding?

- -

Argon as a shielding gas or a mixture of argon and a small amount of oxygen. High enough current density for the type of electrode material and electrode diameter to cause spray transfer. (Above transition level)

GAS TUNGSTEN ARC (TIG)

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the participants listed above

GAS TUNGSTEN ARC (GTA)

GTA - 1 Cover slide

GTA - 2 Gas tungsten arc is a welding process that has been referred to in the past as heliarc and later as TIG welding. In the past few years the American Welding Society has officially called this process gas tungsten arc welding.

GTA - 3 Here are a few common items that may be welded with the GTA process.

GTA - 4 GTA welding is used to weld some of our harder to weld metals. This list includes aluminum, aluminum alloys, stainless steel, magnesium, copper and its alloys, plain carbon and low carbon steel, nickel, monel and inconel. This process is also used for hard facing and surfacing applications.

GTA - 5 This slide shows a typical GTA welding station. At this point it might be well to define this process. This definition is taken from <u>The Welding Handbook</u>, Sec. 2, Welding Processes, American Welding Society.

Gas tungsten arc welding is an arc welding process wherein coalesence is produced by heating with an arc between a single tungsten electrode (non-consumable) and the work, shielding is obtained from a gas or gas mixture. Pressure may or may not be used and filler metal may or may not be used.

GTA - 6 Pictured here is the power source and components needed for GTA welding. At present the most desirable power source is a machine with drooping voltage. This would be a combination A.C. and D.C. machine with a high frequency unit built in. This power source would also incorporate a saturable reactor which would allow easy current control as the weld was in progress, made possible by a foot operated remote control unit. The power source should also incorporate the gas and water solenoids, timers for pre and post flow of gas and water. In the near future this power source may be replaced, in part, by a pulsed arc machine. This pulsed arc power source would call for a greater investment, but may have features not found in a standard drooping machine.

GTA - 7 Current selection is very important in GTA welding.

Our machine will allow us to select direct current straight polarity, D.C.S.P., or direct current reverse polarity, D.C.R.P., or alternating current, A.C. This slide shows us the D.C.S.P., sometimes called electrode negative or electrode cathode. GTA welding with straight polarity produces deep penetration because it concentrates the heat on the work.

GTA - 8 This slide shows the gas ion flow and electron flow. Straight polarity is used on stainless steel, cast iron and all the carbon steels as well as brass alloys, silicon, copper and silver.

GTA - 9 Here we see the direct current reverse polarity. The electrode is positive. D.C.R.P. produces good cleaning action as the heavy argon ions flow to the work, striking with sufficient force to break up oxide and soil on the surface of the metal. Weld penetration is shallow however, since the heating effect of the electron stream occurs at the tungsten electrode.

GTA - 10 This slide shows the electron and gas ion flow. D.C.R.P. welding in gas tungsten arc requires a larger tungsten electrode than would equal amperage

on straight polarity. There are very few cases, if any, where reverse polarity would be used in gas tungsten arc welding.

GTA - 11 Alternating current, as shown in this slide, is used for welding aluminum and its alloys plus many other non-ferrous metals. Gas tungsten arc welding with high frequency combines the desired cleaning action on the positive half of each cycle, with the heating required for good penetration, on the negative swing. The high frequency component re-establishes the arc which breaks each time the power alternates.

GTA - 12 This slide shows us a cross sectional view of the penetration received by using the three types of current.

GTA - 13 The sine wave of alternating current at 60 cycles may be viewed in this manner. At points A and B the voltage value is zero. These two zero values which occur in each cycle (every 1/60 of a second) make it difficult to strike and maintain an arc at small current values. This is true because a certain voltage is required to overcome electron inertia. In a circuit there is usually a small

lag or lead between the E.M.F. (voltage) and current (amperage). The E.M.F. usually leads the amperage.

GTA - 14 The three current waves are shown here visually. As shown here half of each complete A.C. cycle is D.C.S.P. and the other half is D.C.R.P. Keeping in mind then, that A.C. current is actually a combination of D.C.S.P. and D.C.R.P., we get the desired results from A.C. welding. It must be kept in mind however, that we have the zero value in A.C. current. To prevent any problems from the zero values and to prevent any rectification from taking place, it is common practice to introduce into the welding current a high voltage, high-frequency, low power additional current. This high frequency current jumps the gap between electrode and the workpiece, and pierces the oxide film thereby forming a path for welding current to flow. Superimposing this high voltage, high frequency current on the welding current gives the following advantages:

1. The arc may be started without touching the workpiece.

2. Better arc stability is obtained.

3. A longer arc is possible.

4. Welding electrodes last longer.

5. The use of a wider current range for a specific diameter electrode is possible.

GTA - 15 Here we see the control panel on a typical gas tungsten arc power source. It shows the selector for D.C.S.P., D.C.R.P., and A.C. current. It also shows the switch for start and continuous high frequency. The on and off power switch is on the lower right hand side. The two receptacles shown are for the remote control and gas solenoid switch.

GTA - 16 This slide shows the necessary equipment for shielding gas and its control that is needed in GTA welding. The high pressure argon cylinder and a regulator to control that high pressure. A flowmeter which will allow a certain number of cubic feet of gas to flow per hour. It also shows the hoses and torch.

GTA - 17 Accurate regulation and flow control are essential for high quality, economical GTA welding. A good flowmeter will give a constant, pre-set flow of shielding gas. A low flow rate may cause inferior

welds and high rates may cause poor economy. The flowmeter reads in cubic feet per hour of operation.

GTA - 18 GTA torches come in a wide variety of sizes and types. The torch holds a non-consumable tungsten electrode in the middle of a stream of shielding gas. The electrode is held in place by a collet and the collet body screws into the body of the torch. A variety of collet sizes are available and will fit into the same torch up to its rated capacity. The gas cup is threaded onto the torch head and provides directional and distributive control of shielding gas.

GTA - 19 Tungsten electrodes for GTA come in a variety of types and sizes from .020 up to 1/4 inch in diameter. The most common sizes are 1/16, 3/32, and 1/8 diameter. Five types are available for general usage. They are:

1. EWP - Pure Tungsten
2. EWTH Tungsten and 1% Thorium
3. EWTH Tungsten and 2% Thorium
4. EWTH Tungsten and 3% Thorium
5. EWZR Tungsten Zirconium

Pure tungsten is recommended for contamination free aluminum welding.

GTA - 20 The main function of the tungsten electrode is to carry the arc, with good stability, direction and without adding any of its particles to the weld zone. (Hence - non-consumable) End preparation is very important. This slide shows a good clean break in figure A, upon usage at the proper amperage the end will ball up as shown in figure B. Figure C shows an electrode in use at low amperage, an uneven arc like this will develop an undesirable end on the electrode. Figure D shows an electrode which has become contaminated because of contact with the filler metal or the base metal.

GTA - 21 What influence does the shielding gas have on the welding process? Which gas is the best to use? The shielding gas does influence arc stability, current transfer, penetration and cleaning action. Argon is the most important shielding gas used in GTA welding. It is used in a near pure state (99.9+). It gives good control of arc and good cleaning action. Helium is not economical to use. Flow rates must be doubled to give equal coverage as argon. It is used as an additive in some applications. It is also used in some high speed, high heat automatic applications. A mixture of

argon and helium are sometimes used for combined effects of the two gases. Most often for extra heat. Hydrogen and Nitrogen are used as additives, the latter is used for GTA welding of copper and bronze.

GTA - 22 The shielding gas does influence the voltage as can be seen in this slide.

GTA - 23 The manipulative technique used in GTA welding is very similar to that used in oxy-acetylene welding. In this slide we see the essential parts of the process. The ceramic cup surrounding the tungsten electrode, the shielding gas, the arc and the filler rod being added to the base metal. There are a few important functions that one should keep in mind to prevent contamination of the metal or the electrode. In striking the arc, it is not desirable to touch the electrode to the base metal. It should be avoided. The high frequency makes this method of establishing an arc without direct contact. It is also equally important that you do not make contact between filler rod and electrode. It is important that the filler rod remain inside the envelope of shielding gas. The arc then may be

established by bringing the electrode within 1/4" of the base metal, once the arc is started it should be maintained at about 1/8" arc length.

GTA - 24 Once you have the arc established and can maintain a stable arc of 1/8" you should use a circular motion. This circular motion is for preheating and may be 1/4" to 1/2" in diameter, and should be continued until a molten pool is established. Notice the torch angle of, 75°. Move the torch back to the rear of the pool and insert the filler rod to the leading edge of the pool. Notice the low angle of the filler rod, 15°. Once you have adequate filler added, retract filler rod and move the torch forward. This sequence should be continued until the bead is complete. Keep in mind that you should always maintain a stable arc. Do not touch electrode to base metal or filler rod to electrode. It is very important that you do not attempt to add filler until the pool is well established. Keep the filler rod inside the gas envelope because it will contaminate very easy when it is hot and exposed to the atmosphere.

GTA - 25 This slide shows three beads run at different current levels. The center bead was run at the

proper amperage and rate of travel. The bead to the left was run at a higher amperage and you can see the results, wider, flatter and excess penetration. The example to the right was run at low amperage and you can see the high crown and lack of good blending at the side.

GTA - 26 This slide shows a remote current control unit that is operated by the foot as the welding progresses. Heat loss is great at the start of the weld and a higher amperage is required, but as the weld progresses the heat loss becomes less, and less current is required to make a weldment of equal contour and penetration. This unit will allow the operator to decrease amperage as needed. This feature becomes very important on small weldments of aluminum or other high conductivity metals.

GTA - 27 This slide shows a fully automatic set-up for GTA welding. You see the needed components, the torch, the power source, the filler rod being fed in automatically and a way to move the torch over the work or move the work under the torch.

GTA - 28 Here is a little different application of automatic GTA. A round weldment is being rotated under the torch and the filler rod being fed in automatically

In these applications much higher heats and speeds may be used.

GTA - 29 This slide shows gas tungsten arc spot weld. We have the essential components, the tungsten electrode, gas cup, gas and arc. The cup is in direct contact with the base metal and the electrode is recessed back into the cup.

GTA - 30 The End.

As you can see GTA has its place in the world of welding, primarily in the welding of our hard-to-weld metals, which include many of the exotic space-age metals. This is true of the hand process, automatic or spot welding.

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for

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GTA Review Questions

1. Why does Helium exhibit higher arc voltages and arc energy input than Argon?

- -

Higher ionization potential and greater thermal conductivity.

---

2. What is the effect of adding series capacitors or DC current to an AC - GTA welding machine?

- -

To balance the wave and eliminate rectification or partial rectification of current.

---

3. Why cannot DCRP be used for welding single pass heavy sections with GTA welding?

- -

Excessive heating of electrode 2/3 of heat at electrode. No cathodic cleaning for Al. or Mg.

---

4. Why does GTA welding with AC have a tendency to rectify current? (half wave)

- -

Current can flow more readily from one direction than the other. (Good flow when electrode negative)

---

5. Why are thoriated electrodes used for GTA welding?

- -

Higher electron emissivity.

Better current carrying capacity.

Longer life.

Low resistance to contamination.

---

6. Why is superimposed HF used on AC welders for GTA welding?

- -

To maintain an arc through the zero position of the AC sine wave. The high frequency maintains an ionized path for the arc to prevent having to start a cold arc 120 times per second.

---

7. Why is ACHF current better for GTA welding Al. and Mg.?

- -

Gain effect of cathodic cleaning. (Breaking up and dissipation of oxide film)

---

8. Why must the flow rate for Helium be greater than for Argon for doing the same job? (All other conditions equal)

- -

Helium is lighter than air and rises away from the weld puddle.

---

9. Why cannot some of the gas mixtures used in GMA welding be used for GTA welding?

- -

No electrode protection required for GMA.

---

10. What is the purpose of shielding gas for GTA welding?

- -

To shield the heated zone.

To shield the molten metal.

To shield the electrode.

PLASMA ARC

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INTRODUCTION

PA-1 Title Slide

PA-2 The plasma arc technology became an important process of cutting, welding, metal surfacing, spherodizing and machining after 1955. The primary reason for the development of plasma arc, however, was the cutting of nonferrous metals, then it branched into the other areas after the primary developments took place.

PA-2-OH The plasma torch is sometimes referred to as a "mini atomic bomb". The temperature produced ranges between 20,000° F. to 60,000°F. and is probably around 40,000°F., while the voltage at the torch is up to 400 volts. The high voltages makes manual operation and adjustment dangerous.

WHAT IS PLASMA? HOW DOES IT WORK?

PA-3 The explanation of plasma will be discussed in several segments. The term plasma is sometimes referred to as the fourth state of matter. Plasma is not a gas, liquid or solid. Plasma theory therefore occurs in lightning, in arc welding and devices as carbon arc lights.

PA-3-OH Plasma is associated with a flow of pressurized

PA-4 whirling gas passing through a high voltage arc between two electrodes causing superheating and the ionization of the gas.

PA-5 Ionization refers to the disassociation of gas atoms into electrons and positively charged ions.

PA-6 When the electrons leave the cathode and accelerate toward the anode, they collide with other gas molecules in their path causing some of these to become ionized and thus releasing more electrons and ions. Each collision gives up kinetic energy. As the gas is ionized and superheated, it expands greatly in volume. The gas must pass through a constricting nozzle, thus forcing the gas to travel at a high velocity. The speed of the gas becomes supersonic and approaches speeds of 7000 feet per second. The pressurized and heated gas leaving the nozzle at this high velocity stretches the arc beyond the nozzle. The gas flame is now in a state of plasma.

The gas primarily used is nitrogen, but hydrogen, argon, and other gases are also used. The use of other gases and gas mixtures is determined by the work and the manufacture of the particular machine -- some even use air.

PA-7 There are two versions of plasma arc torches. They are the "transferred" arc and the "non-transferred" arc. In the transferred method both the arc and plasma travel from the torch to the work. This method is employed for welding, cutting, machining and weld surfacing because it transfers the heat more efficiently.

In the non-transferred method only the plasma reaches the work piece. Plasma arc spraying is a good example of this application.

PLASMA CUTTING

PA-7-OH There are several labels that have been attached to the plasma cutting operation by industry and the American Welding Society. AWS refers to it as plasma-arc cutting, while industry uses tungsten arc cutting, constricted tungsten arc cutting and plasma arc cutting. The most commonly accepted name today is plasma arc cutting.

Plasma and gas tungsten arc (GTA or TIG) both use a tungsten electrode, and the two processes are sometimes confused. The chief difference between the two processes is the constricting orifice of the plasma torch.

PA-8 In order to start the plasma torch, a high frequency

circuit is used to initiate the arc. After the ionization begins, the primary power source is used and the high frequency circuit is disengaged.

PA-9 In the cutting operation, the plasma flame contacts the work with a tremendously hot, high velocity, pencil-thin stream. The heat causes instantaneous melting of anything that conducts electricity, while the high velocity stream washes the molten metal through the kerf.

Due to the velocity of the plasma flame and the momentum of the torch, the metal becomes molten and is blown through the kerf so that almost no droplets of partially-melted metal remain at the kerf; the cut is clean and smooth while being cut at a high speed. One-fourth inch stainless is cut at 200 inches per minute. The plasma torch is cooled by means of a circulating water supply.

PLASMA WELDING

PA-10 In some respects plasma welding may be considered as an extension of conventional gas tungsten arc welding. The main difference is that in plasma welding the arc is constricted, and it is this constriction that produces a collimated plasma needle arc which is less

affected by variation in arc length than the conical shape of the gas tungsten arc.

PA-11 As the plasma strikes the metal, it cuts or "keyholes" entirely through the piece producing a small hole which is carried along the weld seam. During this cutting action, the melted metal in front of the arc flows around the arc column, then is drawn together immediately behind the hole by the surface tension forces and reforms in a weld bead. This process is used to weld most of the "hard to weld" metals. The typical shape of a cross-sectional of a plasma weld is in the shape of a wine glass. The thickness capabilities varies with different machines up to ¼" and down to .001" with the needle arc.

SPHERODIZING

PA-11-OH Spherodizing is the process of making ball shaped particles so small it is referred to as metal powder. The plasma stream spherodizes any conductive material including tungsten. The powder is processed from sheet, rod or wire in any desired atmosphere. The molten particles are quenched through a cooling gas then collected in a bin. This process is inexpensive to run, and can be completely automated.

PLASMA SPRAYING

PA-12 Plasma spraying or metalizing is the process of applying metal coating to various types of substrate via a plasma stream.

PA-12-OH It is used to coat new work, and is used with increasing frequency in salvage work. The type of bonding between coating and substrate may be mechanical, metallurgical (diffusion) or chemical. This depends on the substrate and coating materials. The same type of torch is used with two important changes. First the arc is non-transferred. Second, metal is introduced into the plasma stream.

MACHINING

PA-13 Plasma arc torches can also be used for machining.

PA-13-OH A torch is mounted on a lathe carriage in such a way that the jet impinges tangently on the workpiece. The rate of removal is extremely high - approximately 5 to 10 times those obtainable with tungsten carbide cutting tools. Plasma arc turning is limited to the roughing operation although finishes of 25 rms have been obtained.

POWER SUPPLY

PA-14 All plasma torches use a direct current straight polarity power source. There is, however, a great difference in the components due to the type of torch. For a needle arc torch, the amperage can vary from .1 to 10 amps with 110/220 volt input.

PA-14-OH For some larger plasma cutting, the amperage runs up to 1000 amps with the open circuit voltage of 400 volts.

CONTROL CONSOLE

The Control Console houses components that automacitally control power, gas and cooling water to the torch. It has adjustable pressure switches for automatic shut-off should some failure occur in one of the supply lines.

Remote Control

PA-15 The remote control is located conveniently giving the operator good visibility for starting and controlling the torch.

With the high voltage (around 400 v.) at the torch, most manufacturers advise including in the remote control unit a device to adjust the torch to work

height without manually adjusting it and exposing him to unnecessary danger.

Ventilation System

PA-15-OH The tremendous heat of the cutting process forms a great amount of smoke and fine dust. In the interest of the health of the operator and shop cleanliness, it is essential that a good, positive ventilation system be installed. Even with a ventilation system, the power supply, especially, should be periodically blown out with air pressure, clearing the metallic dust out of the unit to prevent possible short circiting and ineffective cooling by its own cooling fans.

PA-16 The plasma torch has such a capacity for speed that though there are some "hard held" models available, the efficiency and precision is lost with hand operation. There is danger to the operator from the high voltage and spatter from cutting, so the plasma torch can only be really effective and economical when mounted on a cutting machine. The machine must provide a method of smoothly and rapidly following a line on the drawing of the part being cut.

PA-17 The cutting machine will have a photo-electric cell in its sensing unit that will focus on and

PA-18 follow the edge of a line and transmit the direction of travel through a control mechanism carrying the torch.

PA-19 A problem on the cutting machine, that at this time has not been solved, is a lag in the mechanical reactions of the machine due chiefly to inertion forces.

PA-20 The problem manufacturers face is to have the machine transverse a tight corner rapidly and accurately without swinging wide and slightly deforming the part.

ADVANTAGES OVER OXY FUEL

Plasma cutting has a number of distinct advantages over oxy fuel where one torch only can be used.

PA-21 Where multiple oxy-fuel torches are used to duplicate parts, the plasma cannot compete economically or well; first, because of investment in additional equipment and second, because an operator cannot adequately handle more than one, or at the very most, two plasma torches.

The plasma torch will cut costs for a company by cutting at 10 times the rate of an oxy-fuel torch and by cutting materials that are difficult or

impossible to cut by oxy-fuel methods.

PA-22 The plasma torch will not lose the cut when it crosses a previously made kerf as will oxy-fuel equipment. This will save material and further machining operations otherwise necessary to finish the part.

PA-23 Material can be stacked in multiple layers, and the cut will not be lost if an air gap occurs between some of the pieces. The stack of pieces will not be welded together as in oxy-fuel cutting, which can be costly and time consuming for a manufacturer to separate and clean the individual parts.

PA-24 In some applications a problem may arise with plasma cutting in that the cut is slightly wider at the top than at the bottom giving a small taper to the sides

PA-25 of the cut. Other than this, the cut is very clean, and the bottom of the cut is clean and dross free.

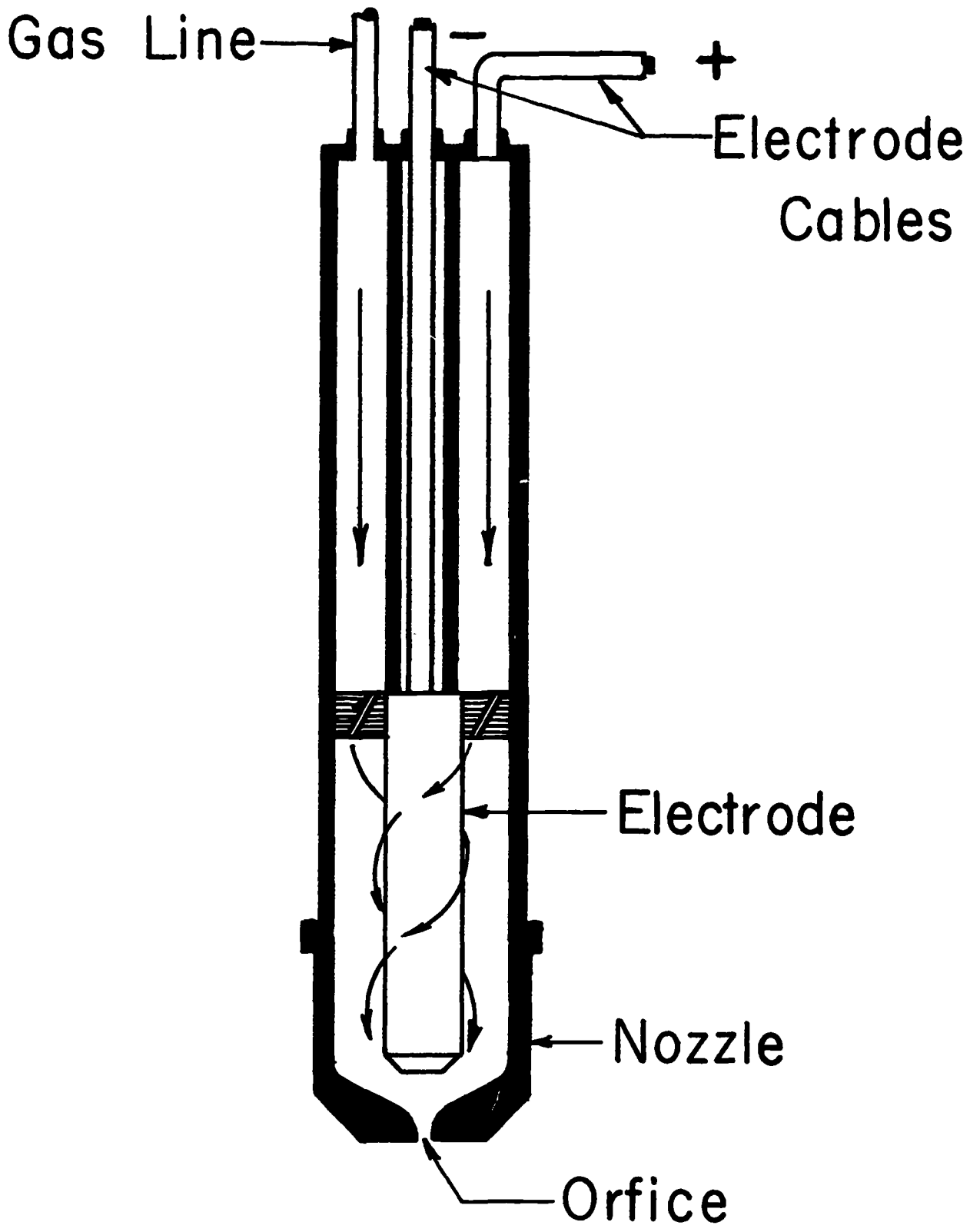
PA-26 Piercing can be done with plasma but is not recommended on thicknesses greater than 2 inches. The molten material rising into the torch or thicker stock can cause damage and greatly shorten the life of the nozzle and electrode.

PA-27 Science has, in the last fifty years, revealed many new processes to the industrial society, and one

PA-28 of these with a bright future is the use of plasma.

CUTTING SPEED COMPARISONS

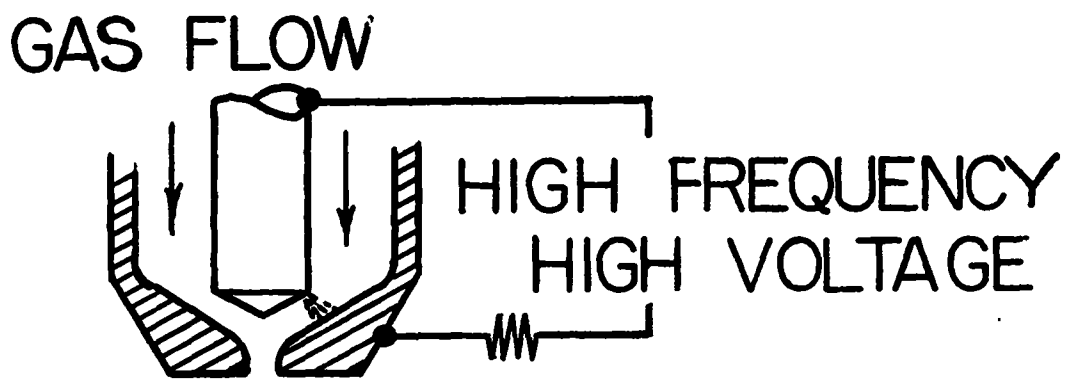
Metal	Thickness	Plasma	Oxy-Fuel
Carbon steel	1/4"	300 (ipm)	25 (ipm)
	1/2	100	24
	1	50	22
Stainless steel	1/4	200	20 *
	1/2	120	14 *
	1	60	12 *
* with powder	3	16	7 *
Aluminum	1/	300	not used
	1/2	200	
	1	90	
	3	15	
	5	10	

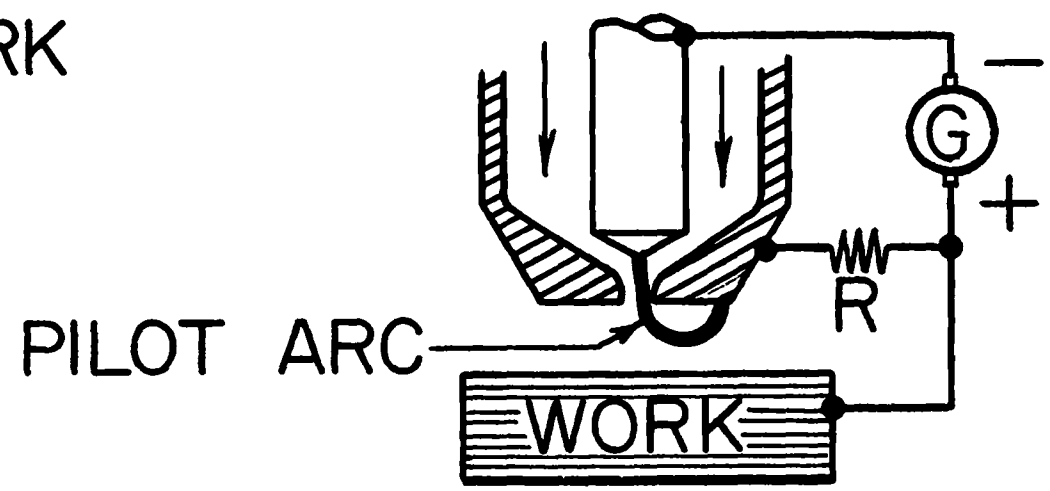


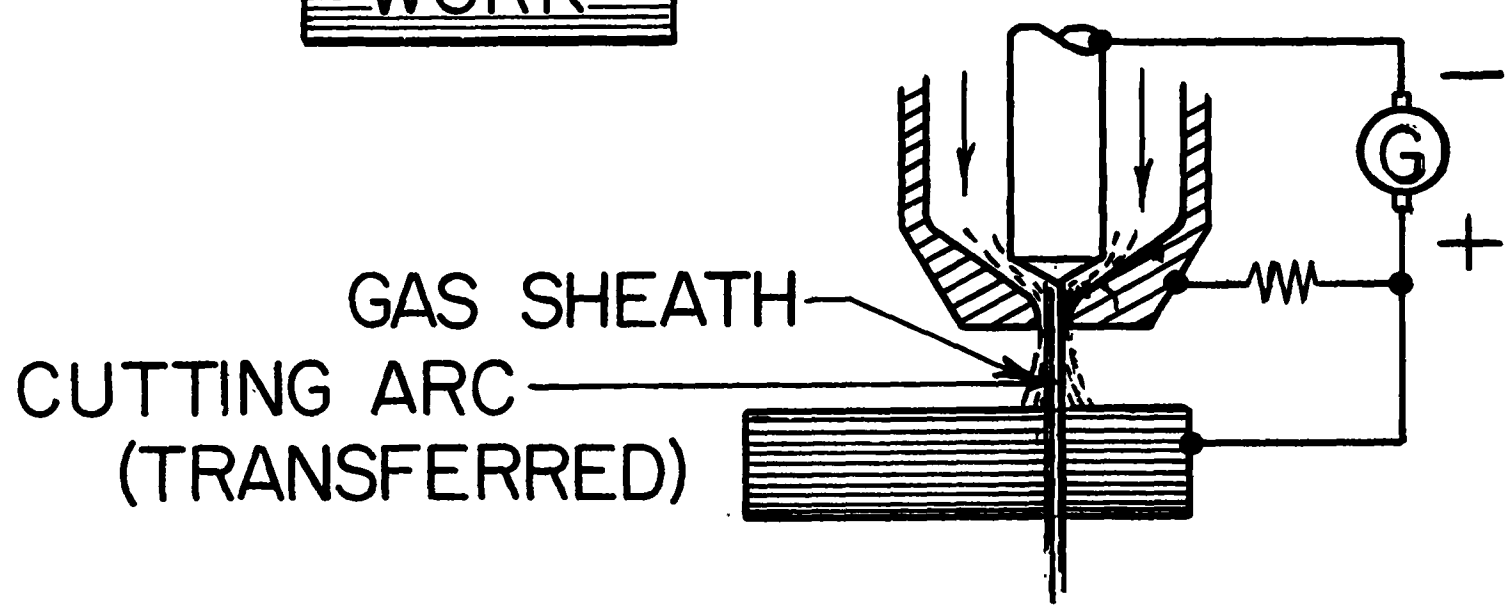
PLASMA TORCH

P1-3-OH

STARTING THE PLASMA TORCH







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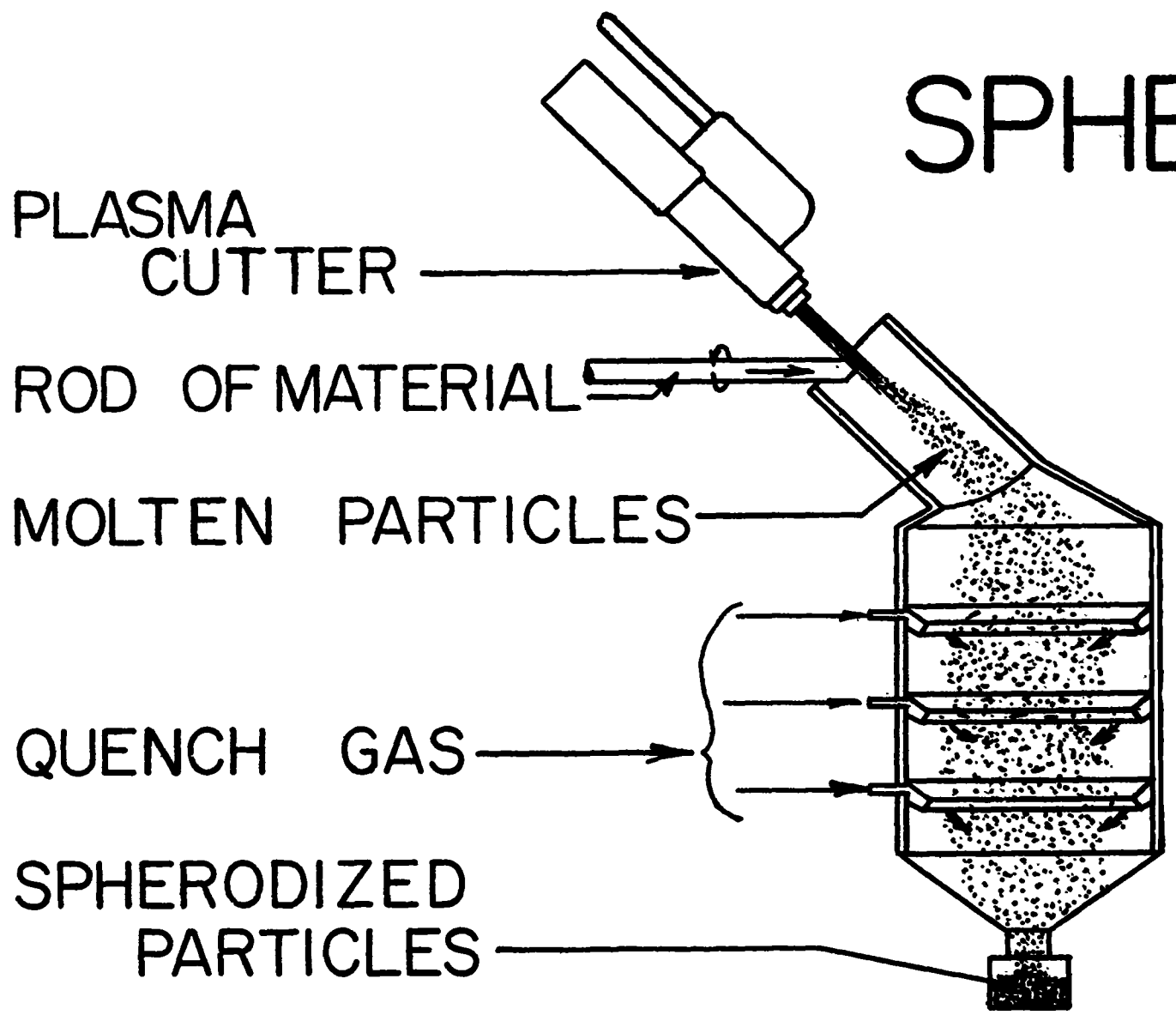
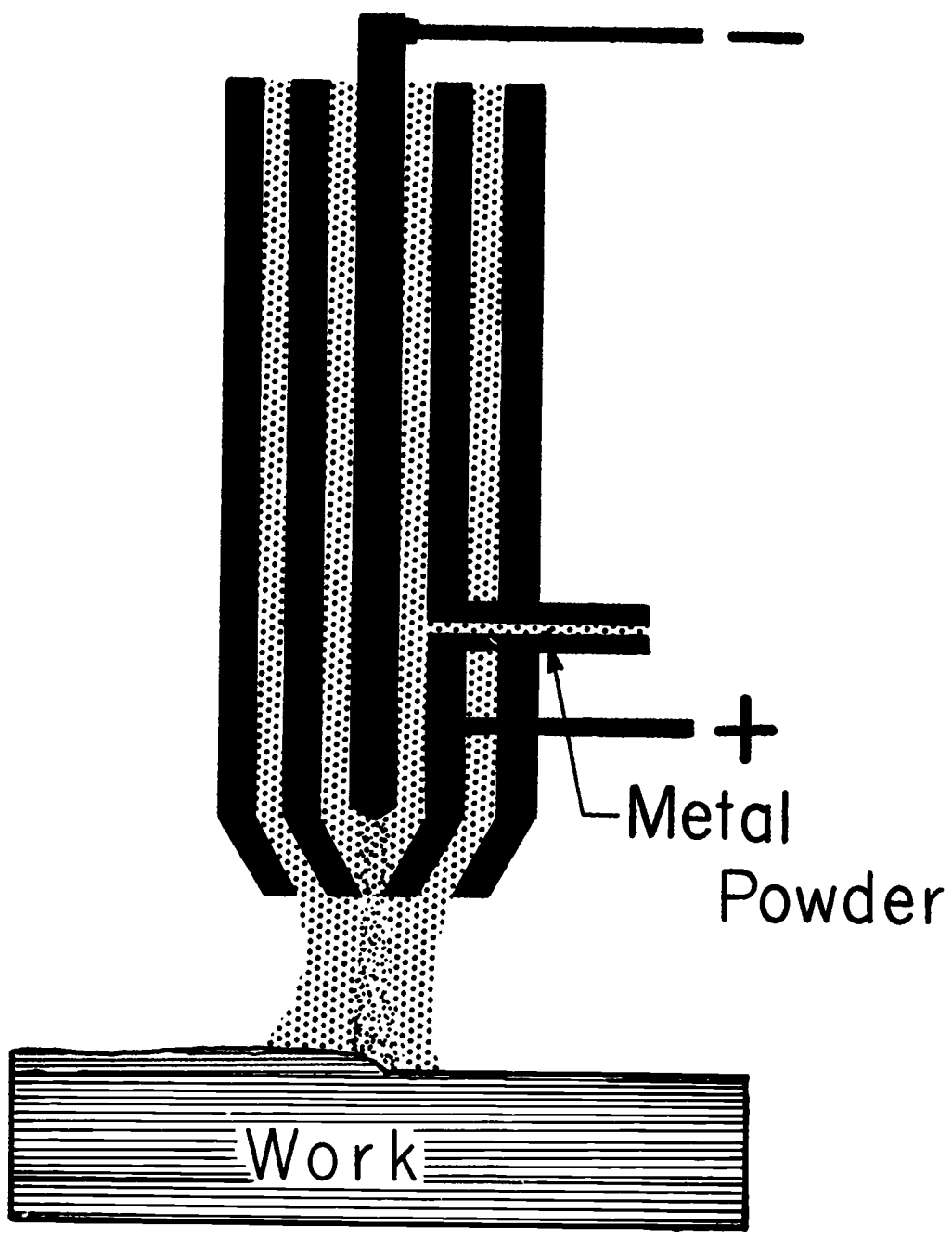
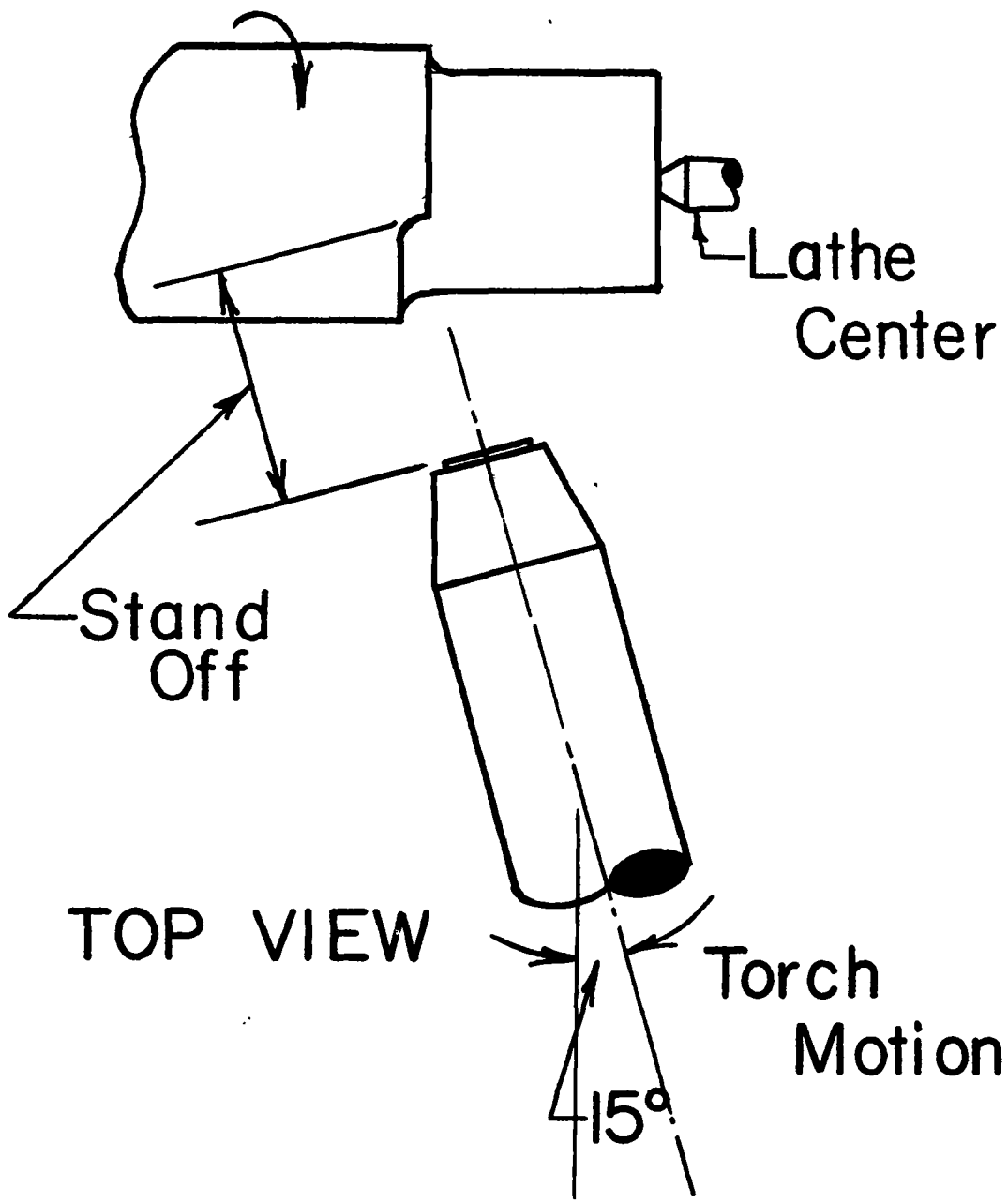
PARTICLE SPHEROIDIZING

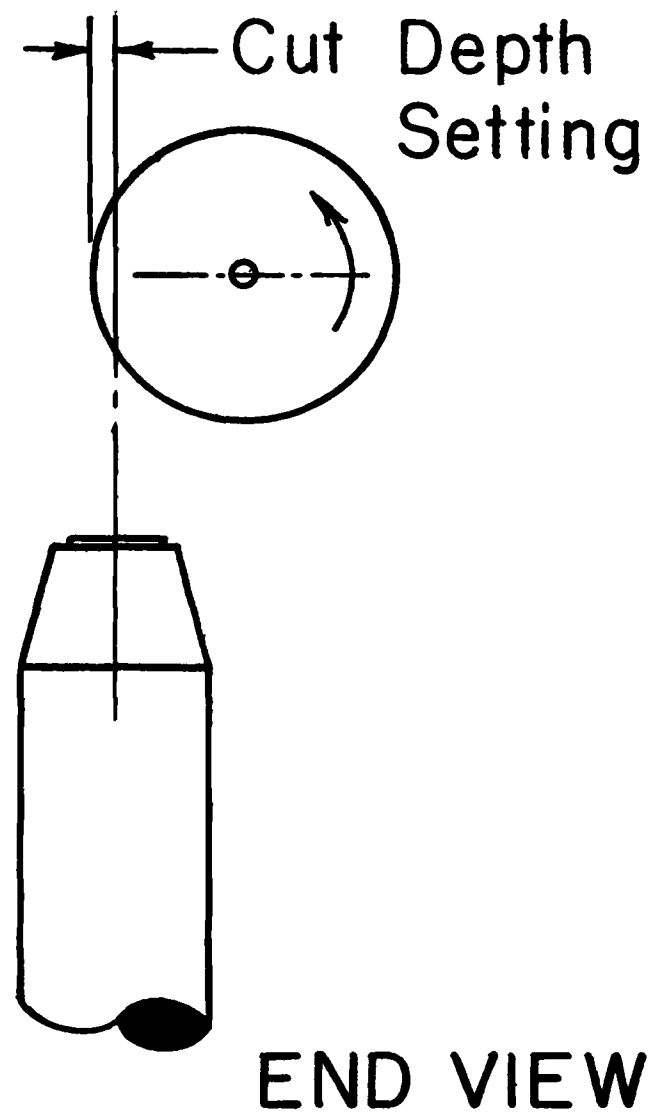


PLASMA SPRAYING



PLASMA MACHINING





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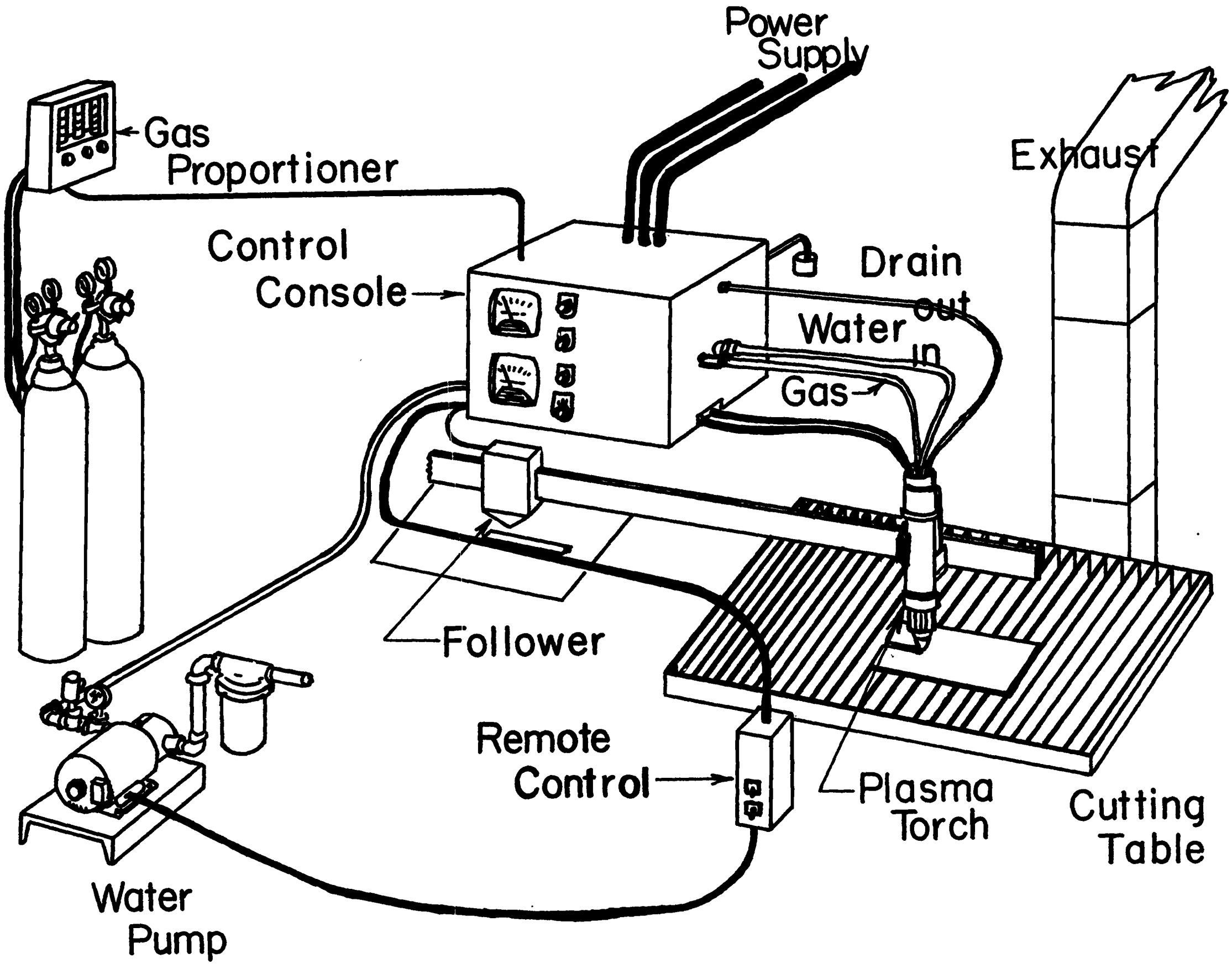
Power
Supply
Gas
Proportioner
Exhaust
Control
Console
Drain
out
Water
in
Gas
Follower
Remote
Control
Plasma
Torch
Cutting
Table
Water
Pump

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PA Review Questions

1. What is the limiting factor in shape cutting with plasma?

- -

Ability of a machine to negotiate a corner at a given speed.

---

2. Where does oxy-gas outshine plasma cutting?

- -

Close tolerance fine intricate detail

Where multiple oxy-gas torches can be used for duplicate work

---

3. What does the term autogenous plasma welding mean? What thicknesses can it be used on?

- -

Keyhole welding

.090" - .300" and for the root passes of thicker workpieces

---

4. What kind of finishes can be expected from plasma cutting? (compared to other metal cutting)

- -

Somewhere between sawing and oxygas cutting

---

5. What is the typical cross sectional shape of a plasma weld?

- -

Wine glass shape

6. What is the advantage of Plasma welding using the keyhole effect?

- -

No edge preparation or filler metal required.

---

7. What type of metal or alloy of that metal should <u>never</u> be cut with plasma? Why?

- -

Berilium - particles atomized as dust and breathed are toxic to people.

---

8. What are some significant advantages of plasma welding?

- -

1. Ability to produce consistent weld beads without mechanical backup.
2. Ability to weld at higher speeds.
3. Relative insensitivity to process variables.
4. "Keyhole" effect ... complete penetration.

---

9. What health hazard exists around plasma cutting?

- -

Noxious dust and fumes

---

10. What are three commonly used gases in plasma cutting and welding either pure or as a mix?

- -

N_2 Cutting

H_2 Sweetner

A_2 Welding

---

11. What initiates or starts the plasma arc process?

- -

H.F. at 30 to 40 amp

---

12. What danger to the operator exists when changing replaceables in a plasma torch?

- -

400 OC.V. of torch

---

13. Where are the transferred and non-transferred plasma arcs used?

- -

Transferred - Cutting Spheroidizing

Non-Transferred - Welding

---

14. What are the three most important factors for plasma cutting? (to produce good quality cuts)

- -

Arc length

Gas flow

Travel speed

---

15. What capacities (metal thicknesses) can be welded with the needle arc plasma welder?

- -

Up to .020" thick

---

16. What results if a plasma cutting torch nozzle contacts the workpiece?

- -

Double arcing occurs and damage to the replaceables of the torch results.

---

17. What is the normal arc length for Plasma cutting?

- -

1/2" - 5/8"

---

18. What are the two arc types for plasma?

- -

Transferred arc in which plasma and arc both reach the workpiece. Non transferred arc - in which only the plasma reaches the workpiece.

19. What is the basic difference between the GTA and the plasma arc as we know it?

- -

The plasma arc is in a constrictive orifice which gives it greater stability, direction properties, force, velocity, and high temperature.

---

20. What is the fourth state of matter? Does it exist in nature as opposed to being artificially produced?

- -

Plasma is an ionized gas that exists in the presence of the high temperature of an arc between two electrodes. YES--When lightning strikes, the path of lightning flash is in the plasma state.

---

21. What are some uses of the plasma technology as it now exists?

- -

1. Plasma cutting
2. Plasma machining
3. Plasma Welding
4. Plasma overlaying
5. Plasma Spheroidizing
6. Plasma metalizing

---

22. Although there are many advantages of plasma cutting, there are several that are quite significant.

- - - - - - - - - - - - - - - - - - - -

1. Dross free cuts on all conductive engineering materials.
2. Clean cuts on most metals up to 5" thick.
3. Precision cuts and narrow kerfs.
4. Cutting speeds up to 300 IPM or 10 times faster than oxy-gas.
5. Minimum heat affected zone.
6. High quality cuts that eliminate or minimize machining.

ERIC

ELECTRON BEAM WELDING

E.P.D.A. INSTITUTE IN MODERN

METALWORKING TECHNOLOGY

WESTERN MICHIGAN UNIVERSITY

KALAMAZOO, MICHIGAN

SUMMER - 1969

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The following unit was prepared by
the participants listed above

ELECTRON BEAM WELDING

INTRODUCTION

An electron beam is a controlled stream of electrons accelerated by a very high (20,000 - 150,000) voltage. As these infintestimally small electrically charged particles traveling at speeds as great as 108,000 miles per second (389 million miles per hour) strike objects in their path, kinetic energy (energy of movement) is transformed into heat energy. The electron beam's initial speed and energy may be fantastically high, but each particle of matter the electrons collide with slows them and absorbs a portion of their original energy. The air we breathe or any other gas that we may substitute at atmospheric pressure has, according to Avogadro's hypothesis, 27 million million million molecules per cubic centimeter. A beam of electrons attempting to force its way through such a mass of gas would reduce its strength to an ineffective source of heat for the melting of solids.

For many years it was known that a beam of electrons would be capable, because of its high concentration of energy and speed of penetration, of performing welding operations impossible to do by conventional methods. It has been only in recent years that effective methods have been developed for isolation of the electron beam producing device (gun) and parts to be welded in an

almost perfect vacuum. The technological breakthrough that made electron beam welding possible was the development of highly efficient vacuum pumping systems. These systems can remove 999,999 of every 1,000,000 particles of air that was in the chamber at atmospheric pressure in as little as five minutes.

The concentrated power of the electron beam can now be used to cut, drill, or weld virtually any material, including diamonds.

Advantages of electron beam welding include:

1. The welding of refractory or reactive materials whose properties are detrimentally affected by gaseous contamination.
2. Welds that are essentially straight-sided and narrow. Distortion, as a result of welding, is greatly reduced and metals that require preheat in other fusion processes may be welded without preheat.
3. Weld thermal cycles are so rapid that weld heat-affected zones are very narrow.
4. It is possible to obtain welds with a depth to width ratio exceeding 20 to 1 in some metals. Heavy sections up to 6 inches in thickness have been welded in one pass.
5. Grain size, both in the weld and heat-affected zone, is smaller than in welds made by other fusion processes; the metallurgical properties are frequently better.

6. Multiple welds may be made in a single pass. Honeycomb sections, for example, having skins as widely separated as 3 inches vertically have been butt welded successfully on both sides in a single pass.
7. Components may be sealed to retain an internal vacuum.
8. Dissimilar metals may be welded with very satisfactory results in all but a very few combinations such as aluminum and bronze.
9. The quality, strength, and other weld characteristics are repeatable.

Some of the disadvantages of electron beam welding include:

1. Electron beam welding equipment costs may run between $20,000.00 and $200,000.00.
2. Because filler metal is seldom used except for imparting some special metallurgical qualities to the welded joint, a very close fit up is required.
3. Because of the low vapor pressure of some metals, vapor formed during welding will "arc-out" or else require extensive cleaning of chamber after welding.
4. Operators must have considerable knowledge of metal machining processes and some electrical and welding training prior to learning the operation of this equipment.

5. Additional time required to set up work and create vacuum slows production.

6. Limit to size of parts that can be welded due to maximum size of chamber.

ELECTRON BEAM WELDING

Slide Narration

EBW 1 The electron beam. The electron beam is a controlled stream of electrons accelerated by a very high voltage. As these infinitesimally small electrical charged particles traveling at speeds as great as 108,000 miles per second strike objects in their path, kinetic energy is transformed into heat energy. Because of the collision of electrons in the beam with molecules in the air, welding with this equipment has been most successful in a vacuum chamber. The electron beam is invisible, however, in a partial vacuum the beam's collision with molecules will produce ions which will produce a visable beam.

EBW 2 This slide shows regelation of ice after the application of pressure and heat. The ice melts, then flows and fuses together. The electron beam penetrates through the work causing it to melt and form a hole. After the beam passes it flows together and solidifies.

EBW 3 The electron beam welder is shown with control panel, a viewing port of the vacuum chamber and the gun itself inside the chamber. The viewing port is leaded glass to protect the operator from harmful X-rays. The steel vacuum chamber also protects the operator.

EBW 4 EB Welder 54" x 50" x 54" Chamber size -- A typical small job shop type electron beam welder with controls on the front and the electrical power supply in the back. Note: The vacuum system is not shown.

EBW 5 Power Supply and Chamber -- A smaller laboratory type electron beam welder with power supply. Note: Vacuum pumping system is not shown.

EBW 6 The operation of the electron beam gun is similar in operation to the television picture tube, except that the power and therefore the heat generated is greatly increased. In these devices electrons are emitted when a tungsten filament is heated to approximately 3500° F. This heated filament gives off electrons which tend to swirl around the surface of the wire. If a positive voltage is impressed the electrons are pulled from the wire, to the workpiece, or the television tube screen. When accelerated and focused by a magnetic coil on to the target, which is the face of the television picture tube and the workpiece in the case of welding, this is the electron beam.

EBW 7 Theoretical Schematic of Electron Beam Gun --
Filament - heats the cathode - AC voltage
Cathode - emits the electrons - DC negative voltage

Anode - attracts the electrons at velocities depending on voltage. DC positive voltage from 20,000 to 150,000 are applied

Focusing Coil - an electro magnet - by varying the current flowing through the coil the focal point of the beam may be varied.

EBW 8 Electron Beam Gun and Associated Parts Schematic -

Current adjustment (Quantity of electrons flowing)- by adjusting filament rheostat

Electron Beam Velocity - by adjusting the high voltage rheostat on line to anode

Beam alignment - To cause beam to move and to be directed at various points on workpiece by adjusting beam alignment rheostat

Beam focus - to focus beam, adjust focusing rheostat

EBW 9 The focal length can be varied from 1" to approximately 20". The optimum focal lengths are between 1" and 15". The electron beam depth of focus or focal depth (the distance over which the focal spot or beam diameter remains essentially the same) increases appreciably at longer focal lengths.

EBW 10 The basic component parts of the Electron beam welder

are, high voltage transformer with controls, welding vacuum chamber, electron beam gun, work holding devices and vacuum pumping system.

EBW 11 The vacuum system has a roughing pump which brings down the vacuum chamber to a soft vacuum. The line valve then closes and the diffusion pump pumps down to a hard vacuum. A small holding pump pumps from the diffusion pump to atmosphere. In the diffusion pump oil is heated and vaporized so it rises up in the pump chamber until it reaches some cooling coils where it is condensed thus creating a vacuum. The vacuum draws off ions from the chamber and the holding pump pumps these to atmosphere.

EBW 12 EB Welder with Vacuum Pumping System --

Roughing Pump - Removes the greatest quantity of air. Reduces the chamber to a soft vacuum.

Diffusion Pump - The cylindrical device with tubes running around the outside. It stands upright just to the right of the welding chamber. It will reduce the chamber to a hard vacuum.

Holding Pump - A small pump located between the diffusion pump and the roughing pump.

EBW 13 Penetration with Varying Atmospheric Pressures --

Stainless steel is shown at the top of the slide, carbon steel in the center and aluminum at the bottom. There is little noticeable effect on beam width or penetration until the atmospheric pressure approaches 100 microns (the beginning of what is considered to be a soft vacuum).

EBW 14 The soft vacuum welding system uses a soft vacuum pumped down by a mechanical pump at the work chamber. The electron beam gun is in a hard vacuum maintained by a mechanical pump and a diffusion pump. A valve located between the chambers opens when the weld is made and then closes immediately.

EBW 15 Welding 9" thick aluminum in One Pass -- The capabilities of electron beam welding are dynamically shown. There is no other process that could penetrate such thickness and provide for such a narrow fusion and heat affected zone.

EBW 16 This weld also shows the characteristically narrow width. The material at the top of weld and bottom is caused by a minor increase in grain growth and contraction of parts as weld solidifies.

EBW 17 The narrow fusion zone of the electron beam weld is contrasted with the wide fusion zone of the gas metallic arc (GMA) weld.

EBW 18 Some interesting things about electron beam welding are evident. The high voltage input in comparison with GMA. The low current input in milliampere compared to the high current in amperes in the GMA. The high welding speed of electron beam in comparison to GMA. The energy input is much less in electron beam and this gives us fewer problems caused by heat.

EBW 19 Gun Flat Welding Position -- Gun may be stationary and work moved or work held stationary and gun moved. Since it is necessary to have a close fit up in a butt weld, careful machining must be observed. If a sheet or plate is sheared the edges must meet squarely and any oily substances on the edge removed with a solvent prior to welding.

EBW 20 Some of the capabilitites of the electron beam welder are shown by this slide. Vertical and horizontal movement of the gun.

EBW 21 With proper work holding fixtures and work movement capabilities annular horizontal and vertical welds may be made.

EBW 22 Rotating Round Objects - Gun Stationary - This method is satisfactory for welding short sections of round stock or tubing.

EBW 23 In pipe line welding the work may be stationary and the gun moved about the work. A large clam shell vacuum chamber has been devised for this purpose.

EBW 24 Flywheel and Ring Gear Welds - An example of welding a stamping to a gear. Because of the rapid travel with little change in the crystalline structure, no post heat treatment is needed, thus a considerable saving is realized.

EBW 25 This is an example of a blind butt weld of two different steels with electron beam. The reason for this weldment is the ease with which they can be machined separately.

EBW 26 This shows the welding of the axle flange with two electron beam welds. One is a lap weld and the other a lap butt weld. These welds show the fusion zone and the heat affected zone.

EBW 27 Carbide Teeth Welded to Band Saw Blade - An example of economy through automation. Yet the most important point shown is that two very dissimilar metals can be welded and the resulting weld will hold up under the extreme loads imposed on saw blades in use.

EBW 28 This is an annular weld on a turbine engine stator. The work is rotated and the gun is inclined at a slight angle. This method of welding is very useful on space age materials.

EBW 29 Landing Gear Forging - This landing gear strut is being made for a Boeing 727 jet aircraft. It was forged in two pieces and welded while secured to a rotary table. Utilizing EBW eliminated the forging from one solid piece with a resulting saving in weight and cost of production.

EBW 30 Landing Gear Strut Forging in EBW Chamber - This shows strut in previous slide in vacuum chamber before the sides were closed and vacuum formed prior to welding.

EBW 31 This torque converter housing has a fillet weld around its circumference joining the two halves together in which a stainless steel filler rod has been used. The filler rod was needed to impart metallurgical qualities to the weld.

EBW 32 Universal Joint - These parts were formed and machined as separate units and then welded by an electron beam circumferential weld. This was a much easier method of producing this assembly.

EBW 33 Repair of Magnesium Casting - This is an example of how an expensive part may be saved by EBW. A portion of the casting was machined away and replacing that portion with a EB Welded insert.

EBW 34 Valve body - This is a pipe line valve unit which was fabricated in parts and then welded together with electron beam welding.

EBW 35 Valve body - The cut away shows where the electron beam welds will be made on the pipeline valve assembly.

EBW 36 Valve body - The pipeline valve assembly in a section showing the electron beam welds which are circumferential. The valve was successfully welded with seals in place because of the narrow heat affected zone.

EBW 37 Contour Control of Gun Movement - The part being welded is a slot track for the USAF C-5A jet -- the world's largest aircraft. Two welds are made, one on each side of the contoured butt joint to provide a boxed aircraft structure of high strength-to-weight ratio.

EBW 38 Numerical Control - An example of 2 axis movements of an EB gun using point to point or contour welding using numerical control.

EBW 39 Large EB Welder - This large electron beam welder has a rotary table so this type of tooling can be accomplished in a hard vacuum. Large parts may be welded in the hard vacuum, an example would be a turbine stator with annular weld. The rotary table can be removed and other fixtures used in the chamber.

EBW 40 Distributor Rotor for Ford Motor Co. - An example of a part welded by an EBW. It is shown before welding and after welding. Note: 4 more slides will show the automatic welding equipment for the welding of this part.

EBW 41 A Soft Vacuum EB Welding Machine - This machine is an automatic EB welder utilizing a soft vacuum chamber for welding. It has automatic feeding devices. Instead of the part turning or gun moving, the electron beam is caused to move in the small circle to complete the weld on the distributor rotor.

EBW 42 Feed Hopper for Automatic EB Welding - One of the two hoppers used to feed the parts to the automatic EB welder.

EBW 43 Rotary Table Chucking Device for Automatic EBW - This shows parts held in place about to move into position for welding.

EBW 44 Schematic of Automatic EBW of Distributor Rotor - An example of the various stations on the rotary table for automatic welding. Note the following:

1. Hoppers for part placement.
2. Automatic sensing device - if a part fails to position properly the beam will not operate when

that station arrives under the gun. This prevents beam from damaging table.

3. The broken line indicating hard vacuum area for the gun and the soft vacuum for the welding area.

EBW 45 Clam Shell EB Welder - This super size clam shell vacuum chamber is being built for Grumman Aircraft Engineering Corp. The chambers will be able to pump down to welding vacuum in twenty minutes. It will provide for multiple electron beam guns. This size chamber has become necessary to satisfy the requirements of aerospace and aircraft industries. The chamber size is 302" long and has a rectangular cross section 108" wide by 132" high. The gantry mechanisms provide for 5 degrees of freedom for the electron beam gun: X, Y, Z. A and B motions: A is rotary motion around the X axis, B is rotary motion around the Y axis.

ELECTRON BEAM WELDING

GLOSSARY

ANODE - A circular plate with a hole in the center located at a variable distance from the cathode. A very high direct current positive voltage is applied in order to attract and expell electrons through the hole at velocities approaching 2/3 the speed of light.

ARC OUT - A short circuit between the anode and the workpiece caused by unintentional boiling off of metallic particles from the workpiece.

ACCELERATING VOLTAGE - A voltage applied to the anode usually calibrated in kilovolts.

BEAM CURRENT - The number of electrons flowing to the workpiece usually calibrated in milliamperes.

BLIPPING - Is a surge of beam current that does not cause as dramatic an effect as the arc out, yet there is some surface damage to the weld -- by proper gun cleaning procedure blipping has been greatly reduced.

CATHODE - The emitter of electrons in the electron beam, may be self heated (as a filament), or for greater efficiency a separate device heated by a filament.

COSMETIC PASS - A weld pass made over a previous weld to improve appearance, repair a defect or change bead contour, power is usually less than or equal to original pass.

DIODE TYPE - Electron beam producing device using a cathode and anode in a vacuum chamber.

ELECTRON BEAM - A controlled stream of electrons (that is an electric current) accelerated across a space by means of an accelerating voltage.

ELECTRON BEAM GUN - A device which generates, accelerates and focuses a beam of electrons.

EMISSION - The process by which a metal is able to give up electrons by heating.

FILAMENT - A device used to heat and emit electrons.

FOCUS CURRENT - A variable current applied to magnetic coils to provide for expansion or contraction of the beam diameter.

FUSION ZONE - The part that became molten due to the passage of the electron beam.

GRID - (bias grid cup) -- located immediately below the cathode in a Hamilton Standard gun, it causes electrons to form into a concentrated beam.

HARD VACUUM - (10^{-3} torr, .1 micron) The vacuum obtained by a use of a mechanical pump and a diffusion pump.

HEAT AFFECTED ZONE - A very limited area measured in thousandths of an inch adjacent to the fusion zone.

MICRON - A unit of length, the thousandth part of one millimeter or the millionth of a meter or 0.000039 inch. The symbol for the micron is μ.

NECKING - Short, intermittent pinched stretches along the weld bead. The name was given to the defect because of its physical appearance. It was found that necking was a function of focal point change caused by faulty focus power supply.

OSCILLATOR - An electrically controlled device to provide movement of the beam by magnetic deflection to provide for welds of repeating patterns.

OPTICAL SYSTEM - A method of locating the electron beam on the workpiece using lenses, prisms and a beam of light.

POWER DENSITY - Electrical force on a unit of area. The amount of electrical energy applied to the weld area at the point of impingement.

SOFT VACUUM - (atmospheric vacuum in the range of 100 to 500 microns) The vacuum created by a mechanical pump.

TACKING - A method of locating point of initial contact on work of the electron beam by using low voltage so work is not damaged.

TRIODE TYPE - Electron beam producing device using a cathode, anode, and grid located between those two components in a vacuum chamber.

WATTS - The unit of measurement of electrical power using the following relationship. Voltage times amperes. E x I = W

150 KV x 250 MA = 37,500 Watts

or

150,000 Volts x .250 Amperes = 37,500 Watts

WELD PARAMETERS - Information developed about a particular welding process to enable the operator to produce satisfactory welds with predictable and repeatable results.

WELD REPEATABILITY - The ability of a machine and operator to perform consistently, quality welds utilizing the same settings and materials.

WELD SCHEDULE - A work sheet prepared by engineers or technicians for use by weld operators based on information computed from weld parameters.

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EBW Review Questions

1. Explain the operation of a: A. roughing pump, B. diffusion pump, C. holding pump.

- -

A. Roughing pump evacuates to zero atmospheric pressure.

B. Diffusion pump - Oil vapor attaches to stray gas molecules then recondenses.

C. Holding pump - holds and maintains vacuum.

---

2. EBW Disadvantages:

- -

High cost

High maintenance

Good fit up of workpiece required

Limited kinds of metals that can be welded (rimmed steel - no; killed steel - yes, etc.)

X-rays - psychological implications for operator

Costly special operator training required

---

3. What 3 systems are essential for EBW?

- -

1. Electric & Electronic (High voltage and control)
2. Vacuum
3. EB Gun

---

4. What creates the heating of the workpiece in EBW?

- -

Kinetic energy of electron bombardment changes into heat energy.

---

5. What is the difference between a hard vacuum and soft vacuum?

- -

Soft vacuum zero atmospheric pressure

Hard vacuum zero atmospheric pressure but still further reduction in concentration of gas molecules by the use of a diffusion pump.

---

6. What are advantages of EBW?

- -

Welds without distortion

Deep penetration - High depth to width ratio

Dissimilar metals can be welded

Three thicknesses can be welded

Only method of doing some jobs

High quality welds are produced

Repeatability is excellent

---

7. What is a cosmetic pass?

- -

Smooth out previous EBW eliminate notch or depression or minimize notch effect.

---

8. Why is the Hamilton Standard gun (EB) permanently mounted and not positionable?

- -

Higher voltages than Sciaky up to 200 KV as opposed to 60 KV, thus creating insulating problems.

---

9. Three methods of beam alignment:

- -

Stylus - Mechanical tracking with stylus

Optical - View through optics of beam track

Tack - Track at low power level on tacking cycle to zero in on seam

---

10. How may an electron beam be broadened in order to weld parts with poor fit up? (.015" gap)

- -

1. Defocus beam
2. Pulse deflection magnets to give a pattern
3. Lower voltage - raise amp. to level required. Preferred over defocus because of repeatability

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(Designed to be used as a handout to students)

ELECTRICAL DISCHARGE MACHINING

Advanced technology continuously develops new ideas, materials, processes, and manufacturing techniques that did not previously exist. One of the new machining and shaping techniques is that of Electrical Discharge Machining (E.D.M.).

There are indications that a great portion of machining may be done by electrical discharge machining. The big advantage of electro-machining is that mechanical forces have no influence on the process. Material is not removed by brute force as with conventional machining processes. Electrical energy is applied directly to the removal of metal and is not just a source of power for the motor that drives the cutting tool.

Electrical discharge machining is a method for producing holes, slots or other cavities in electrically conductive material by means of a controlled removal of material through vaporization by high-frequency electrical sparks. The spark discharge is produced by controlled pulsing of direct current between the workpiece (positively charged) and the tool, or electrode (the negative electrode). The end of the electrode and the workpiece are separated by a spark gap of 0.0005 to 0.020 inch and are immersed in a dielectric fluid. The dielectric fluid in the gap is partially ionized under the pulsed application of high voltage, thus enabling a spark

discharge to pass between tool and workpiece. Each spark produces enough heat to melt or vaporize a small quantity of the workpiece, leaving a tiny pit or crater in the surface of the workpiece.

Application

Application of EDM depends on many factors; material, shape and accuracy required.

The widest use of EDM today is for the machining of dies and molds either before or after heat-treating. This process is used also for machining carbide, tungsten, honeycomb structures and other fragile materials, deep holes, odd-shaped holes and slots as narrow as 0.001 inch.

Because of low tool life and the high cost of accurate tools, ordinary EDM techniques are seldom competitive at present for parts that are readily produced by regular machining methods. With the introduction of "No Wear" EDM Machining, roughing with graphite electrodes has a cost advantage in the sinking of large contoured cavities in hardened tool steel dies for forging, casting or plastic molding, as the hardness of the material machined has little effect on the cutting operation.

Electrodes (Tools)

The productivity, results and cost of EDM, depends greatly on the material used for the electrode.

Machined electrodes are made from copper, brass, copper-tungsten alloys, silver-tungsten alloys and graphite using standard machining methods.

Graphite electrodes are used more often than metal electrodes (except when the finish must be smoother than 40 micro-inches). Graphite generally costs less than metal, wears exceptionally well, machines easily and has a very high melting point.

Electrodes are used at negative polarity for most EDM operations. An exception to this is "No Wear" EDM for roughing which uses graphite electrodes at reverse (positive) polarity. Wear ratio, a measure of electrode life, is important in EDM because electrodes are often expensive. Rapid consumption of electrodes increases the difficulty and cost of producing the accurate dimensions and the sharp corners needed in many kinds of workpieces.

Wear ratio is expressed in terms of corner wear, end wear, side wear and volume wear. Wear is always greatest at the corners of an electrode. When accuracy is important, corner wear controls the choice of electrode material.

Machines

Most machines for EDM are ram-type, in which the workhead is moved by a hydraulic cylinder. Quill-type machines are used mostly for smaller work. The quill usually is driven by a hydraulic motor.

Both ram and quill machines have servo control for tool advance, to keep the spark gap constant. The servo gets its signal from the difference between a selected reference voltage and the actual voltage across the gap.

Coolant

Electrical Discharge Machining by definition is the process of removing metal by means of electrical sparks in the presence of a dielectric. This dielectric is more commonly called a coolant since this is one of the functions it serves. There are three functions that a coolant serves:

1. it forms a dielectric barrier between the electrode and the workpiece at the arc gap
2. the coolant "cools" the workpiece and chip
3. the coolant flushes the eroded workpiece particles out of the arc gap.

One factor over which there is the least control in EDM is the workpiece material. The end product, or use of the part, normally dictates what materials can be used. The one requirement of the workpiece for EDM is that it must be a conductor of electricity.

Conclusion:

The EDM method of metal removal has a number of advantages which are responsible for its rapid increase in importance. The

EDM method is applicable to all metals, alloys, carbides and any material which is a sufficiently good conductor of electricity. Melting point, hardness, composition, toughness or brittleness are not limitations for EDM. Numerous geometrics designs are possible by the EDM method.

(For Slide Presentation)

ELECTRICAL DISCHARGE MACHINING

"E.D.M."

Electrical Discharge Machining (EDM) has graduated from the "unconventional" ranks. It has moved from being a machine used for specialty jobs in laboratories to one that is being used a great deal in industry, from space age industry to the automotive industry.

What is "EDM"? The following slides together with the accompanying commentary will give an insight concerning the process.

1. This name tag is a sample of EDM. The holes in the two lower corners were put there with the EDM Electrodes shown. Look carefully at the fine webbs in the hole. This would have been very difficult to do with a standard die punch.
2. This stamped gear is an example of a part that can be made from a die produced by either conventional machining or by EDM. The next two slides will show the two dies and the advantages of EDM over the conventional method.
3. This is a conventional die which involves numerous expensive operations to make.
4. The die shown here shows the simplicity of the EDM produced die. In addition to being simple to produce the cavity can be cut into hardened tool steel or

carbide, thereby increasing the life of the die.

5. This slide shows an emblem die and the EDM Electrode used to make the die. One can easily see the difficulty of machining such a die by conventional methods.

6. To know how the pieces were made one needs to have an understanding of EDM. This slide gives a picture of how EDM basically works.

7. This slide shows a commercial EDM machine in operation with the electrical discharge (spark) zone visible beneath the surface of the dielectric liquid.

8. This is a basic EDM system showing the relationship of various parts. It follows the electrical circuit from the power supply, through the electrode, the spark through the dielectric liquid, to the work and back to the power source.

9. This is a more complete pictoral schematic showing the EDM with all the basic components of a commercial unit.

10. Here we have the first commercial EDM to be manufactured by the "Elox" Company. It has jokingly been called the "Goldelox".

11. This is one of the current models of ELOX's EDM Machines that are manufactured for industry.

12. To understand how EDM works, one must understand how amperage, volts, and frequency relate to one another.

This slide shows how varying the amperage in the power supply affects the cutting.

13. With voltage and amperage remaining constant we can see by varying the frequency that the surface finish can be controlled.

14. In this view we see that the speed of the cut can be increased and the finish unchanged by increasing both the amperage and frequency.

15. We see in the picture an example of two finishes that can be obtained with EDM. The top surface would have been machined at a much higher frequency than the lower surface - providing the voltage and amperage of the machine remained the same.

16. Remember the basic relationship of amps and frequency to speed and surface finish.

17. This is a view of commercial EDM in actual operation.

18. Here we show the completed hole that was being machined in the previous slide. Note how, to speed the EDM work, the square holes to be EDM'd have been drilled to dimensions slightly smaller than the finished size.

19. This slide shows the electronic envelope which enables the EDM to function and to maintain uniform tolerances on cavities.

20. We see here the electronic envelope maintaining uniform tolerance on irregular cavities.

21. Here are electrodes of various shapes and sizes that have been used in EDM work. Notice that there seems to be no limit to the shape or size of the electrodes.

22. Electrode wear is a factor that must be considered in EDM. When the spark removes a piece of metal from the workpiece it also removes a smaller portion of the electrode. This (electrode wear) must be considered when designing electrodes for EDM.

23. It will be recalled that the dielectric liquid cools and cleans the eroded particles from the cavity. This can be done by pumping the dielectric liquid through the cavity in various ways as you see in this slide.

24. This chart gives you an idea of why industry is going the EDM way. The savings shown here are typical. It must be remembered that EDM does not always result in this kind of economy. The economy depends on the operation performed.

25. The slide shows a part that was made with a mold produced by an EDM machine.

26. This is the finished mold that was used to make the nylon impeller that you saw in the previous slide.

27. Here we can see the advantage of producing the mold by EDM rather than conventional methods. The EDM mold is done in a single piece which eliminates flash and takes less time to make than the section formed mold. This one-piece construction also makes a mold which

lasts longer - thereby saving money.

28. EDG is a new process using the basic system of EDM except that the electrode is rotating. EDG promises to have a bright future in the metals industry. This slide shows an EDG machine.

29. Here we see the EDG machine ready to grind a piece of carbide to be used in a cutting tool.

30. The EDG machine in operation is essentially the same as EDM except the electrode revolves. This gives a faster cut and a smoother surface than is obtainable with regular EDM.

31. This is the part that you saw being machined.

ELECTRICAL DISCHARGE MACHINING

GLOSSARY

AMMETER - A meter located on the front panel of the CINTROJET power supply measuring the current flow in the machining gap.

AMPLIFIER - A circuit device which magnifies or increases the signal so that the output is of a higher value than the input.

BLOCKING VALVE - A solenoid operated valve which prevents movement of the ram head while machine is in stand by.

BUS - Any rigid, heavy current carrying conductor used to distribute current to several branches - usually made of copper.

CENTERFLOW - Dielectric fluid flowing through the electrode to the machining gap.

CENTERFLOW ADJUSTMENT - A needle valve used for vernier adjustment of the centerflow pressure.

CENTERFLOW PRESSURE - A control of dielectric flow stated in pounds per square inch (psi).

CLIPPER - A circuit for preventing the peak amplitude of a signal from exceeding a predetermined level.

COLLET - Device used to hold the round shank electrodes in place.

CUT-TO-WEAR - The ratio of the amount of workpiece material removed to the amount of electrode material removed.

DIELECTRIC - A fluid which flows between the workpiece and electrode. Its purpose is to act as a coolant and to flush debris from the gap so as to insure proper machining of the workpiece.

DISCHARGE - The spark that occurs between the electrode and workpiece.

DRIVER - A circuit or device that amplifies a signal and controls current to another amplifier.

EDM - Abbreviation for Electrical Discharge Machining.

ELECTRODE - A term used to refer to the tool used in an EDM operation. Electrodes can be made of graphite, brass, copper, etc.

FILL TANK - Refers to either a lever or button (depending on the type of EDM machine) which when activated causes dielectric to enter the work tank.

FILTER PRESSURE - A measure of dielectric pressure ahead of the filter, stated in pounds per square inch.

FINISH - Refers to the measurement of the surface roughness of a workpiece after machining. Usually measured in microinches RMS.

FINISH CUT - A term used to refer to the last machining operation and usually involves the removal of a small amount of material.

FREQUENCY - The rate of electrical discharges - the number of discharges per second between the electrode and workpiece. Low frequencies are usually associated with rough machining operations, while higher frequencies are used for finish operations.

GAP - The space between the electrode and workpiece.

GAP VOLTAGE CONTROL - A variable control located on the machine control panel. It enables the operator to set the proper gap distance between the workpiece and electrode.

GAP CURRENT - The current flowing in the machining gap.

GAP LEADS - The wires which conduct the power supply output to the gap.

HEAD - That part of the machine tool providing vertical movement and housing the vertical drive mechanism.

LIMIT SWITCHES - Micro-switch stops provided on the machine to turn off the cutting power at a predetermined depth.

"MACHINE" POSITION - The position of the "Machine Functions" switch which activates the power supply for machining operation. (Sometimes referred to as "AUTO" position).

MASTER START - A push button located on the machine control panel, that starts the machine pumps, servo amplifier, and CINTROJET power supply.

MASTER STOP - A push button located on the machine control panel which de-energizes the machine pumps, servo amplifier, and CINTROJET power supply.

MFD - MICROFARADS - The unit in which capacitance is measured.

MISS - Term used to refer to the lack of a discharge due to an improper gap setting.

MODULAR - Refers to being constructed with standardized units. An example is the CINTROJET 2400 printed circuit boards.

MULTIVIBRATOR - A relaxation oscillator used to obtain various square wave voltage patterns. It is used to determine the pulse frequency and pulse width.

NO-WEAR - An electrode wear-saving process by which molten workpiece material from the cut builds up on the electrode as the electrode material erodes. When these two conditions

are in equilibrium, electrode wear is eliminated. No-Wear takes place during a low frequency, high amperage condition, with polarity reversed. No-Wear machining occurs only in roughing operations with graphite electrodes.

OVERCUT - Refers to the difference in physical size between the electrode and workpiece after the machining operation is complete. Usually measured in thousandths of an inch per side.

PEAK CURRENT - The maximum instantaneous current that flows through the gap.

PLATEN - That portion of the machine head upon which the electrode is mounted.

PRE-DRILLED - A pre-machined hole in a workpiece. It reduces the area to be machined, and may be used as a centerflow hole when a solid electrode is used.

PROFILOMETER - Instrument used to measure surface finish. Usually calibrated in microinches.

PULSE - A variation of a quantity (as in voltage or current) whose value is normally constant: this variation is characterized by a rise and decay, and has a finite duration.

PULSE WIDTH - More correctly called PULSE DURATION, is the time interval of the pulse or on-time.

PULSER - An optional attachment which provides a periodic withdrawal of the electrode. Used on deep holes and/or with poor flow conditions to provide better flushing action.

RATE - Refers to the amount of workpiece material removed. Usually stated in cubic inches per hour.

REVERSE FLOW - The flow of dielectric through a hole in the workpiece rather than through the electrode.

REVERSE POLARITY - Positive gap lead connected to the electrode and the negative gap lead connected to the workpiece.

ROUGH CUT - A machining operation where high metal removal rate is desirable and finish is secondary.

SENSITIVITY CONTROL - A variable control located on the machine control center. Its function is to adjust the gain of the servo amplifier, which in turn will determine the speed with which the head moves at short circuit or open circuit.

SOLID ELECTRODE - An electrode with no centerflow hole.

SPLIT ELECTRODE - Two or more electrodes on the same machine insulated from each other. A separate gap cable is connected to each electrode.

STANDARD POLARITY - The negative gap lead connected to the electrode and the positive gap lead connected to the workpiece.

STANDBY - The position of the "Machine Functions" switch on the machine control center which deactivates machining voltage.

STEPPED ELECTRODE - An electrode which has a reduced portion for a rough cut, and then is increased to a larger size for a finish cut.

STUTTER CIRCUIT - A circuit which interrupts output current if a gap short occurs. This prevents possible damage to the electrode and/or workpiece.

TOOL - See ELECTRODE.

VACUUM FLOW - Dielectric fluid drawn from the work tank through the electrode or workpiece by means of vacuum.

VIBRATOR - An optional attachment mounted on the machine head which vibrates the electrode improving cuts having little or no centerflow.

VOLTMETER - A meter on the CINTROJET power supply to indicate the voltage at the gap during machining.

WAVE-SHAPE - (Also called WAVE-FORM) A current or voltage considered as a function of time in a rectangular coordinate system. An example is a "SQUARE WAVE-FORM".

WORKPIECE - Term used to refer to the material to be machined. Usually some form of hardened steel, but may be carbide, alloys, or any conductive material.

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EDM Review Questions

1. What is meant by rate of stock removal?

- -

Volume of metal removed per unit of time.

IN^3/MIN CM^3/SEC

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2. As amperage increases for a particular frequency, what happens to rate of stock removal? Finish?

- -

Metal removal rate increases.

Finish deteriorates but not linearly.

---

3. If the amperage is doubled with the frequency also being doubled, what happens to rate of stock removal? Finish?

- -

Rate of stock removal doubles.

Finish remains the same.

---

4. As the frequency increases for a particular amperage, what happens to rate of stock removal? Finish?

- -

Rate of stock removal remains the same.

Finish improves but not linearly.

5. What factors determine overcut (actual practice) other than current?

- -

Dielectric strength of coolant and chip size. If .001 overcut is desired dielectric strength 170 volts/mil. then V would be 170 volts for clean coolant. If .0005 overcut then 85 volts. If chips for .001 overcut are .0005 diameter, then Voltage is reduced to 85 volts.

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6. What three purposes for coolant in EDM?

- -

Offers dielectric strength

Cool electrode and workpiece (metal vapors otherwise)

Flush away chips

---

7. After overcut is determined how is electrode size determined? (rectangular for .0015 overcut)

- -

Subtract .003 from L & W dimensions of required hole.

---

8. The clearance or overcut between the electrode and workpiece varies with the shape of the electrode. True or False.

- -

False. The overcut is constant regardless of the shape, number of electrodes, size of electrode.

9. What term defines the surface quality that will be obtained with EDM?

- -

Spark Energy

---

10. EDM requires the understanding of some six fundamental principles which are:

- -

A. Rate (amps)

B. Frequency

C. Electronic Envelope

D. Coolant

E. Electrode material

F. Work material

---

11. Compare the wheel pressure for EDG and conventional grinding. (same form, same work material)

- -

EDG wheel pressure near zero psi because wheel is always a spark away (only hydraulic pressure of coolant between wheel and workpiece).

---

12. What are two classifications of EDM?

- -

Three hole machining.

Cavity Machining.

---

13. What dictates the selection of electrode material?

- -

Each machining application

Electrode material

Machinability

Price

Wear Rate

Finish obtained

Castability

Workpiece material

---

14. Advantages of EDM:

- -

Burr Free machining

Light clamp pressure (no distortion)

Material full hard homogenious (no HT stresses)

No residual machining stresses

No tool pressure

All conductive material machineable

ELECTRO CHEMICAL GRINDING

E.P.D.A. INSTITUTE IN MODERN

METALWORKING TECHNOLOGY

WESTERN MICHIGAN UNIVERSITY

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INTRODUCTION

This report is basically a set of slides and narration concerning the ECG metal machining process. For additional technical information the narrator should refer to the enclosed publication No. EM-118D on electrolytic grinding, which has been supplied through the courtesy of the Cincinnati Milling Machine Co.

ELECTROCHEMICAL GRINDING

GLOSSARY OF TERMS

(Student Handout)

ABRASIVE - A substance which removes material from a workpiece through a mechanical grinding action.

ANODE - The electrode positive in polarity. In electrolytic grinding the workpiece is the anode.

ARC (ELECTRIC) - Spark between the anode (workpiece) and the cathode (grinding wheel), usually resulting in damage to both.

CATHODE - The electrode negative in polarity. In electrolytic grinding the metal bonded grinding wheel is the cathode.

CONTACT AREA - The surface area of an electrical conductor that contacts another conductor for the passage of current.

DEPLATING - The controlled reversal of the machining process to remove (deplate) a portion of the metal bond from the grinding wheel. This controlled "deplating" exposes the proper amount of abrasive to provide the required working gap.

ELECTROLYTE - In electrolytic grinding a solution of water and a commercial salt.

ELECTROLYSIS - The process of chemical decomposition of metals, encouraged by the passage of current through an electrolyte.

ELECTROLYZING CURRENT - The current from the workpiece to the grinding wheel through the electrolyte which causes the electrochemical decomposition of the material being machined.

FLOW LINES - Narrow grooves or fine lines on the machined surface of a workpiece caused by turbulent, inadequate, nonuniform electrolyte flow between the grinding wheel and the workpiece.

GAP - Is determined by the thickness of the abrasive which separates the work from the metal bond of the wheel.

INTERFACE - The contact area between the grinding wheel and the workpiece which is filled with electrolyte.

IONIZATION - The formation of ions at the machining gap. The electrolyte reacts with the positively charged workpiece causing the formation of metallic ions. In a simple electroplating process these metallic ions would plate on the cathode.

MACHINING CURRENT - Current drawn through the machining area in amps.

MACHINING GAP - The distance between the wheel and the workpiece

established by the protrusion of the abrasive particles while machining.

MACHINING VOLTAGE - The DC voltage applied to the actual machining operation measured from the workpiece to the grinding wheel.

OVERCUT - A phenomenon of electrolytic grinding caused by electrochemical machining beyond the area of contact and at the sides of the grinding wheel.

Definition of ECG Process

Electrochemical Grinding (ECG) is a process of stock removal in which DC current passes through an electrolyte which is between an abrasive wheel serving as a cathode (-) and the workpiece serving as the anode (+). The current passing through the electrolyte, electrochemically decomposes the surface of the workpiece. This decomposed material is then wiped from the workpiece by the abrasive wheel and is flushed away by the electrolyte.

ECG - 1 EPDA Title Slide

ECG - 2 An introduction illustrating the three principle elements of ECG being that of electricity, chemicals and a metal bonded abrasive wheel.

ECG - 3 The electrolytic cell in electrochemical grinding is similar to that employed in electroplating. The essential parts of an electroplating system are: (1) the electrolyte, which is a liquid containing a compound of the metal to be deposited; (2) a source of direct current; (3) the object to be coated which must be a conductor; and (4) a sheet or bar of plating metal. The negative terminal of the D.C. source is connected to the object (the cathode), while the positive terminal is connected to the plating metal (the anode). When both electrodes are lowered into the plating bath, the following reactions occur: (1) the metal ions (positively charged particles produced by the metal salt in the plating bath) migrate to the cathode surface (under the influence of the electric current) and are there transformed to the metallic state and attached to that surface; (2) the anode metal is dissolved by the action of

the current, forming new metal ions (which replace those removed at the cathode). Thus, the combination of these two electrode processes results in the transfer of the plating metal from the anode to the cathode.

ECG - 4 <u>The ECG Process</u>

The purpose of this slide is to present the basic parts and process involved.

I. The basic parts are as follows:

A. The wheel - which is charged just as the cathode (-) in electroplating

B. The work - which is charged the same as the anode (+) in electroplating

C. The electrolyte - which allows current to flow between the work and the wheel. The electrolyte is pumped through a tube and directed on to the face of the wheel.

D. The power source - uses low voltage (5-7 volts) and amperage varying from 50-10,000 amps

II. The basic process is as follows:

The current flow (ions*) goes through the work to the wheel. The electrolyte is sprayed on the abrasive grains which are bonded on the face of the wheel.

*It should be noted that the arrow in the workpiece shows the direction of ion flow rather than electron flow.

ECG - 5 **Metal Removal with ECG**

This enlargement serves to illustrate the action the electrolyte and abrasive play in the ECG process. The main functions of the electrolyte are as follows:

1. Carry the electrical current
2. To chemically combine and decompose workpiece
3. Flush away the decomposed material wiped from the workpiece by the abrasive wheel.

The process of flushing away of the decomposed material is important in that if allowed to stay in the area of the wheel an electroplating process would develop, thereby clogging the abrasive wheel. The two basic functions of the abrasive are as follows:

1. Help maintain working gap
2. Remove decomposed material from work face.

The working gap is necessary in order that the ECG process may operate rather than a dead short develop. The decomposed material is non-conductive and thus must be removed in order that the ECG process may continue.

At this point it should be explained that in the

ECG process stock removal is approximately 90% electrochemical and 10% conventional grinding, thus creating advantages such as low heat production and fast stock removal.

ECG - 6 Electrochemical machining is essentially a reverse plating process. To prevent the metal from plating the tool, electrolyte is passed between the work and tool at high pressure and velocity.

The primary difference between ECM and ECG is that in ECG a grinding wheel is used to assist in removing the decomposed metal.

EDM is a process of metal removal by means of an electric spark in the presence of a dielectric, and is entirely different in concept.

ECG - 7 <u>Parts of ECG Machine</u>

The grinder shown is a typical ECG machine. The major components have been identified.

1. Machine - Includes that portion of the equipment where the grinding is done.

2. Electrolyte System - The pumping system is used to deliver the electrolyte to the wheel surface and also recirculate the electrolyte.

3. Power Supply - Available with an output amperage range from 50-10,000 Amps.

Voltage delivered to the machine is low. The range is from 5 to 10 volts. Note: The power supply must be capable of maintaining a constant voltage.

ECG - 8 A close up of an ECG grinding head illustrating the electrical hook-up. The head must be insulated from the rest of the machine and also from the working parts of an ECG grinder.

ECG - 9 The cover of the ECG machine has been raised allowing a veiw of how the electrical current is introduced into ECG grinding head.

ECG - 10 <u>Advantages of ECG</u>

1. Accuracy

Tolerance is readily held to plus or minus .001".

The once exception to above statement is with respect to corners.

A final pass can be taken conventionally, with the same wheel, by turning off the power supply.

2. Burr Free

On many applications ECG pays for itself because it eliminates the secondary operation of de-burring. (One example of Burr Free grinding which could be mentioned would be a hypodermic needle, and the reason why such an item <u>must</u> be burr free.)

3. Cool Cutting

It is common to get cracks on carbide cutters due to the heat generated in conventional grinding. ECG does not generate such damaging heat.

4. Freedom from Distortion

Grinding pressures in conventional grinding often distort fragile workpieces. This problem is eliminated with ECG.

5. Reduce Wheel Cost

Grinding wheels for ECG last about ten times as long as do conventional wheels.

6. Material Hardness is of little significance

This is due to chemical rather than mechanical removal. 90% is removed electrochemically. 10% is removed mechanically.

ECG - 11 <u>Disadvantages of Electrochemical Grinding</u>

1. Cost

Since the cost of an ECG unit is between $12,000 and $50,000, many jobs might be run more economically on conventional equipment. Under such conditions it is pointless to consider ECG.

2. Trained Personnel

Unlike conventional tool grinders, which many different employees might use, the complexity of the ECG equipment requires that all work be performed by a specially trained operator.

3. Wheel contact area

The wheel contact area has two influences:

a. Wheel contour limits the shape of the part

b. Machining rate is controlled by the wheel contact area.

ECG - 12 Hand grinding of a single point tool. This cuts down setup time, while allowing greater flexability. Nose radii on single point tools are frequently done in this manner.

ECG - 13 Close-up of a large cemented carbide tool being ECG ground. The back rake is set by the swivel of the grinding fixture and the side rake is fixed by the tilting table.

ECG - 14 A Hammond CBE-77 tool grinder is shown grinding a chip breaker on a single point tool. An angular vise and table permit accurate tool positioning.

ECG - 15 <u>Regrinding Throw-away Carbide Inserts</u>

The indexing rotary fixture is loaded on the

operators side while a workpiece is being ground on the other side. It is quickly retractable and can be rotated 180° to grind the pieces just loaded. The parts are held by magnets and matching size frames. This piece of equipment makes possible low cost regrinding of throw-away carbide inserts. Note: A throw-away carbide tool should be shown and discussed. This is especially important if the students have not used inserts previously.

ECG - 16 This is a fixture for grinding on-end inserts. Adapter blocks are available for different sizes and shapes of inserts. To increase production the fixture can be indexed.

ECG - 17 <u>Face Mill Grinder</u>

The ECG grinder shown is a specially designed grinder used to sharpen carbide insert face milling cutters. Also shown is a mounted cutter which is to be ground.

ECG - 18 <u>Close-up of Operation</u>

The close-up shows the grinding of carbide inserts. The machine is entirely automatic. After the initial set-up and adjustment, the machine advances to grind the insert angle. It then backs out, indexes to the next insert and advances the edge to the wheel for grinding. A cutter of the size shown requires about

5 minutes to complete one angle on the cutter.

ECG - 19 A special purpose plunge type ECG grinder under construction at the Anocut Engineering Corp.

The following slides show various examples of applications of ECG. It is not intended that all of them be used. Rather, it is suggested that the instructor go through the slides and select those which might be best understood in the particular section of the country where they are being shown.

ECG - 20 Rifle part (Sear Release)

Material: mile steel casting

Operation: removing gate

Stock Removed: .045"

Finish: 6-8 rms

Grinding time: 16 sec.

Amps: up to 180

ECG - 21 Part: investment-casting

Material: 420 Stainless steel

Operation: remove gate

Stock removed: .275"

Grinding contact Time: 83 sec.

Amps: up to 400

ECG - 22 Part: Jet turbine blade

Material: Udimet - 700

Operation: Removal of the flash from each edge of blade

Stock Removed: 475"

Grinding contact Time: 85 sec.

ECG - 23 Part: Jet engine snout assembly

Material: Stainless Steel

Operation: Grinding the surface flat within .002"

Grinding Time: 45 sec.

ECG - 24 Part: Relay core for a telephone

Material: 1010 Steel

Operation: Grinding the two bevels

ECG - 25 Part: Cutting tip

Material: Copper

Operation: Grinding end

burr free orifice

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for

Unit VI Electro Chemical Grinding (ECG)

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ECG Review Questions

1. What determines the machineability of a workpiece in ECG?

   -

   Electro chemical properties or chemical make up

---

2. What is a passive layer? Why must it be removed in ECG?

   -

   Passive layer is the decomposed metal or oxides that form on metal during ECG. It is important that it be removed because this layer becomes non-conductive and current flow would stop.

---

3. In an ECG system, there are 5 variables, 3 of which are independent and 2 dependent. List these variables.

   -

Independent	Dependent
Voltage	Amperage
Feed Force	Spindle Power
Contact area	

---

4. What kind of power source is required for ECG machine?

   -

   AC rectified to DC or straight DC. Power source must be of the CV type.

5. What polarity is the workpiece? the wheel? in ECG.

- -

Workpiece - Anode (+)

Wheel - Cathode (-)

---

6. Why are very close tolerances difficult to hold with ECG?

- -

The overcut is somewhat uncontrollable when tolerances to tenths of a thousandth are required.

---

7. Compare wheel wear of a diamond wheel with convention grinding VS ECG.

- -

Conventional Grinding	ECG
.006"/cu.in. of stock removed	.0003"/cu.in. of stock removed

---

8. What are some characteristics of an ECG grinding wheel?

- -

The wheel is a uniformly conductive metal bonded diamond wheel on a uniformly conductive aluminum oxide wheel for steel.

---

9. Why is there no plating of workpiece material onto grinding wheel?

- -

Abrasive scavenges the ionic work material from the interface and decomposed material carried away in solution.

---

10. What prevents intimate contact of the workpiece with the wheel for ECG thus preventing a dead short?

- -

Abrasive particles act as an insulating stand off.

ELECTRO CHEMICAL MACHINING

E.P.D.A. INSTITUTE IN MODERN

METALWORKING TECHNOLOGY

WESTERN MICHIGAN UNIVERSITY

KALAMAZOO, MICHIGAN

SUMMER - 1969

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ELECTROCHEMICAL MACHINING

INTRODUCTION

Electrochemical machining (ECM) is industry's answer to high speed metal removal from space age materials. Other materials used in everyday industry are affected at even greater rates.

ECM is a combination of two different systems of metal removal combined into one system that is more efficient in its combined form than either process.

There is an electrochemical process which is in essence a reverse plating system. The system takes metal off rather than put it on as is found in the usual electro-plating process. The other process is accomplished by electrical spark discharge which erodes the metal away. The combination of these two processes results in approximately 90% of the metal being removed by the electrochemical process and approximately 10% being removed by the spark erosion method.

The electrochemical action is accomplished by pumping an electrolyte under pressure past the work piece which carries away the removed particles before they can be plated to the part. This residue is carried into a tank where it is filtered out of the solution and trapped. This method results in machining times from three to five times faster than conventional machining on similar materials.

THE PROCESS

Electrochemical machining is performed by treating the workpiece anodically in an electrolyte. Metal is removed by the formation of an anodic film composed of soluble oxides. These oxides and other salts dissolve as fast as they are formed. Work is accomplished by reverse plating, and no spark is required. The metal removal rate is directly proportional to the amount of current that passes between the work (anode) and the tool (cathode).

The metal removed is carried away by a very high-pressure flow of electrolyte solution. The metal removal or deplating is accomplished by the flow of D-C current between the anode (+) (work), through the electrolyte and the electrode (-) (tool). As the current flows, the anode metal is deplated and deposited by the current into the electrolyte solution. This deposit (sludge) must be continually and effectively removed from the deplating area and from the electrolytic solution. This requires fast and extremely high pressurized and positive flow of the electrolyte solution away from the action area.

Other critical elements of consideration in the process are current control, arcing control, very high-pressure requirements and highly precise controlled forward movement of the tool or electrode.

ELECTROLYTE

Electrochemical machining by definition is the process of removing metal by deplating in the presence of an electrolyte. This electrolyte is more commonly called a coolant since this is one of the functions it serves. There are three functions that the coolant serves in the complete ECM process.

1. The coolant carries the current between the tool and the workpiece.
2. The coolant "cools" the workpiece by carrying away heat developed during the machining.
3. The coolant flushes the deplated particles away from the workpiece and into the sludge tank before they can plate to the tool.

An electrolyte should have the following:

1. High electric conductivity
2. Low toxicity and corrosivity
3. Chemical and Electrochemical stability
4. Absence of passivating effects

(To be used as an overhead transparency for classroom discussion)

ADVANTAGES

1. Most metallic materials may be machined.
2. Results in an essentially stress free surface.
3. Metal removal rates of 3 - 5 times greater than conventional machining.
4. Tool forces are absent and machining deflections can be held at minimal levels.
5. Little or no tool wear once a controlled process is established.
6. Material mechanical properties have little influence on the machining characteristics.
7. Burring, edge radiusing and surface finish are minimal problems.
8. Repetitive and closely spaced hole patterns are readily accomplished.
9. Compared to conventional machining ECM develops added economy with increasing machining surface area.
10. Blind areas can be machined with a minimum of tool access area.
11. Roughing cuts are not needed and in most cases are undesirable.
12. Blind machining applications are an excellent use for this process.

(To be used as an overhead transparency for classroom discussion)

DISADVANTAGES

1. ECM technology is new-- therefore few people understand the machining and tooling principles and little developed theory.

2. Machining facilities involve major capital expenditures.

3. Most ECM installations are not adaptable to normal machine shop environments.

4. Liquid handling and waste disposal are major considerations.

5. Care must be taken of electrode since any nicks or scratches will be reproduced.

6. Shorting out of electrode when electrolyte pressure is lost at break-through.

7. Must maintain a critical electrolyte flow rate.

8. Damage to machine parts by electrolyte corrosion.

9. Present uses center around unique requirements when it is impractical to use conventional methods.

10. Machining tolerances are still considered to be inferior to those developed mechanically (due primarily to the relative states of development of the types of metal removal)

    a. The accuracy of the finished dimensions is not limited so much by the process as it is by the ability to measure the parts in process.

ECM BASIC SYSTEM

1) STORAGE OF ELECTROLYTE, READY TO "START FLOW".

2) SOURCE OF REQUIRED EXTREME PRESSURE FOR ELECTROLYTE FLOW.

3) ELECTROLYTE FLOW TO THE ELECTRODE.

4) ADEQUATE POWER SUPPLY.

5) THE ECM OPERATION (TOOL AND WORK).

6) REMOVAL AND FLOW OF CONTAMINATED ELECTROLYTE AWAY FROM MACHINING.

7) REMOVE SLUDGE FROM THE ELECTROLYTE.

8) ADEQUATE RESERVOIR OF "READY TO GO" ELECTROLYTE - READY TO REPEAT THE FOREGOING CYCLE, ON A REPETITIVE BASIS.

E.C.M.

1. The principle of ECM has been known since Farraday's invention of electroplating. ECM is a process of reverse electroplating in a system of high amperage, low voltage, a non-metallic electrolytic salt, a preformed tool (cathode), and a workpiece (anode).

2. World's first ECM machine invented by Mr. Kellerick in conjunction with Mr. Lynn Williams. Mr. Williams, the president of Anocut Corporation, perfected the power supply unit which is the secret to Electrochemical Machining.

3. A New ECM machine as seen on a tour through the Anocut plant during the summer of 1969 while attending the E.P.D.A. Institute.

4. Comparison of Four Systems:

   ECM: Electrochemical Machining utilizes electricity, chemistry and basic mechanical components. The tool (cathode) is shaped to provide the form desired in the workpiece (anode). A low voltage (5-20 v) D.C. is supplied from the power unit. The metal removed is carried away by a very high-pressure flow of electrolyte solution. The metal removal or deplating is accomplished by the flow of D.C. current from the tool, through the electrolyte and

the workpiece. As the current flows, the anode metal is deplated and deposited by the current into the electrolyte solution.

EDM: In Electrical Discharge Machining a pulsating D.C. current sends small sparks through a non-conductive (dielectric) oil. These high-frequency intermittent sparks erode and vaporize small portions of the metal from the workpiece. The work acts as the anode and the tool as the cathode.

CM: In Chemical Milling the part to be processed is immersed in a tank of chemical solution (acid or alkali) and the chemical etches or dissolves the metal uniformly over its entire surface. No shaped tools are used. Where pockets or reliefs are to be made, the part is coated or masked around these areas prior to immersion. The removal rate is slow.

ECG: In Electrochemical Grinding an electrolyte is used as the conducting medium. The workpiece which must be metallic, is the anode, and the metal-bonded wheel is the cathode. As the electrolyte flows across the surface of the wheel it passes current from the work to the wheel causing the workpiece to dissolve. The electrochemical action forms an oxide of the material being machined and the wheel wipes away this oxide leaving a new surface to be acted upon.

5. The principle of the ECM machine showing the shaped tool (cathode), workpiece (anode), power supply, and high pressure electrolyte supply.

6. This schematic shows a more detailed flow chart of the ECM system. The many features of this complex system are combined to perform great rates of metal removal of space aged materials as well as everyday materials used in industry.

7. This drawing shows the method used in deep hole deburring. This is a related application of ECM developed by the Anocut Corporation. The electrode is covered by an insulator down to the point of contact with the burr. The burr is then deplated leaving a small radius at the point of intersection.

8. View of a shaped electrode for machining a hole in carbide steel. The domed end retains the electrolyte pressure until the electrode has broken through the material being cut. The cross slots are for emission of the electrolyte under 200 psi of pressure.

9. This oval electrode has two smaller forms which will form deeper cavities in the bottom of the die being machined.

10. Difficulty in machining a radial engine cylinder for aircraft resulted in the manufacture of this back up block which

stops the workpiece from machining too far by use of the red plastic plugs. Through the use of ECM a difficult job has been made relatively simple.

11. New machine as seen during E.P.D.A. Institute incorporates all the latest features of the Anocut Corporation. This machine is the result of close tolerance machining, a high pressure electrolyte system, and a power supply unit recognized as the finest in industry.

12. Electrolyte tank - Electrolyte is stored in this large tank (note relationship of tank to man's size), where the metal particles carried away from the workpiece can settle to bottom and be removed from the system. Clean electrolyte is pumped at 200 psi from the tank to the workpiece.

13. This picture shows a large power supply (low voltage but high amperage 10,000 amps.) Because this unit is so large it requires a cooling unit (located on its top.) Note the size relationship to cement block wall and vending machine in background.

14. This picture shows a typical control panel for an electro-chemical machine. All controls are centrally located on this panel and within view and easy reach of the operator.

15. This Buss bar on the power supply has 1" diameter connector lug holes. One inch cables then carry power to workpiece on machine.

16. This is a picture of the interior of a power supply. Notice the large amount of circuits and connections and the size in relationship to the man.

17. This picture shows a micro bar short circuiting device. This micro bar is a protective device which protects the costly dies and workpieces from welding together in case the anode and cathode accidentally touch. This device will operate within 20 microseconds.

18. This slide shows a machinist using a precision surface gauge to check the accuracy of machine base. Basic machine shop skills are being used to build in the accuracy of Anocut machine. The machine base is placed on 1-2-3-set up blocks which are accurately ground. The machinist is making measurements from a micro flat black granite surface plate approximately 4' x 8' size. Note size in relationship to man making measurements.

19. This slide shows the full machine base on the granite surface plate. The machinist was checking the parallelism of the top surface to within .0004 to .0006 inch. At right side, a machine column is set up for accurate checking.

20. This automobile front spindle forging die was made by electrochemical machining. Once the ECM tool is made a number of forging dies can be made. Conventionally these forging dies had to be made by complicated machining processes which are very costly. Because of poor wear life of die, large amounts of dies need to be made and ECM has cut the cost tremendously.

21. This slide shows a forging die for universal joints (on left). The two red parts are universal joints that were made from this forging die.

22. Shot gun receiver -- The decorative pattern on this shot gun receiver was electrochemically etched to a .010 inch depth.

23. Titanium turbine wheel -- This titanium turbine wheel was electrochemically machined from a solid forging. Because of the sharp curvature of the blades on this wheel and the extreme hardness of titanium, this part could not have been made by conventional means without a special machine set up and extremely high cost.

24. Zirconium grid -- In this picture we see a Zirconium grid which has been electrochemically machined from a solid blank. Again because of the irregular shapes conventional machining would have been most difficult and extremely costly.

25. The thin wall sections in this picture would have been extremely difficult to machine by conventional methods. Because of the thin wall section in this picture, the pressure and the heat generated by the milling cutter would have made this part almost impossible to make. A metal washer was laid on the top of the part prior to machining to allow for any under cutting which might occur at the beginning of the operation.

26. Note the fish tailed slots in this clutch part. They would have been extremely difficult to machine by conventional methods.

27. The deep pockets cut in this airfoil section are irregular in shape and taper toward the end to make this an example of a complex machining operation made simple by the use of ECM.

28. This is the mating part to the previous slide. Note the area that was not completely machined through.

29. This cavity in the end of this airfoil was accomplished by ECM.

30. Mr. Lynn Williams, president of Anocut Corporation and Dr. John L. Bendix, Director of the E.P.D.A. Institute.

31. Group picture including Lindsey Williams, incharge of Electrochemical Grinding at Anocut Corporation.

32. Group picture at luncheon hosted by Mr. Lynn Williams of Anocut Corporation held at Plentywood Farms, Bensonville, Illinois, a suburb of Chicago.

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ECM Review Questions

1. What metallurgical change on the surface of a workpiece results from ECM?

- -

There is absolutely no metallurgical damage to the surface of a workpiece as a result of ECM.

---

2. Why does a 10 RMS ground finish have greater fatigue strength than a 10 RMS ECM finish?

- -

Because grinding induces compressive surface stresses which in turn add to the fatigue strength.

---

3. What happens if ECM electrodes contact each other?

- -

Then a welding machine is developed.

---

4. What determines the metal removal rate for ECM?

- -

Metal removal rates are directly proportional to the machining current and the electro-chemical equivalent of the material being machined.

5. When ECM competes with conventional machining, under what conditions does ECM shine?

- -

It looks very good with hard and difficult to machine materials or difficult shapes.

---

6. Why is an extremely rigid machine required for ECM?

- -

To prevent the machine from yawning under the high pressures of the electrolyte between the workpiece and the cathode.

---

7. How long have the principles for ECM been known?

- -

Since Faraday's experiments in electro-plating.

---

8. Why is high pressure on the electrolyte necessary to ECM?

- -

To produce close tolerances and fine finishes and to wash away decomposed material to increase metal removal rate.

---

9. What are the basic requirements for electro-chemical machining?

- -

1. A cathode
2. An anode
3. An electrolyte @ 200 p.s.i.
4. A power supply - variable c.v.

10. What is the basic difference between plating and ECM?

- -

1. High metal removal rate.
2. High current density - plating uses a few amperes per foot^2. ECM uses a few <u>thousand</u> amperes per inch^2
3. Metallic electrolyte

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Powder Metallurgy

At first glance, the powder metallurgy process seems very simple. On the surface it is: powder fed into a die, pressed, and then heated in a furnace. A simple method for making strong parts with complex shapes at minimum costs. However, the techniques are sophisticated and technical competence is required to produce a high quality powder metallurgy part.

Iron powder was probably first introduced about 1,000 A.D., when high quality swords were made out of sponge iron.

In 1829, Wollaston succeeded in press-bonding metals, a process very similar to present day methods. In the early 1920's, nonferrous bushings were mass produced by powder metallurgy techniques. During the 1960's powder metallurgy became less of an art and more of a proven technique. Also during this period, knowledge and acceptance of powder metallurgy became more widespread. Many parts used in our everyday life, particularly in the automotive and appliance industries, are made of powder metallurgy techniques.

The success of powder metallurgy can be directly related to industrie's need for a simple process by which strong, complex parts may be made to extremely close tolerances at a high rate of production - with a minimum of machining, and attractive cost savings.

No one knows for sure what benefits remain hidden in the

future for powder metals. New types of iron, steel, stainless steel, superalloy, and other metal powders are continually in development. Iron powder parts may soon be made by closed die, hot forging at very reasonable high rates.

Other new techniques are being developed: isostatic and hydrostatic pressing, spark sintering, and high-energy-rate compacting.

The future holds much promise in the metalworking industry through powder metal technology.

DEFINITION

Powder Metallurgy is the process of blending pure metals or alloy powders with a die lubricant, such as zinc stearate, compacting the cold mixture in a die to the desired contour, and sintering or heating the part in a controlled atmosphere to bond the particles and obtain the required properties.

PROCESS DESCRIPTION

The manufacture of parts by the powder-metallurgy process usually involves a series of steps, as follows: the manufacture of metal powders, blending, compacting (briquetting), and sintering. Secondary operations including sizing, coining, machining, impregnation, infiltration, plating, and heat treatment. The secondary operations are only performed as needed for the particular parts.

POWDER METALLURGY

GLOSSARY OF TERMS

P/M - Powder metallurgy

POWDER METALLURGY - A process whereby parts are made by compacting metal powders in a precision die.

LOW DENSITY - For self-lubricating bearings and parts. Will hold a large amount of oil. For parts carrying no severe load and when costs must be kept to a minimum.

MEDIUM DENSITY - For most structural parts, will hold some oil. Can be hardened (in case of iron).

HIGH DENSITY - For ultimate strength. Usually forged electrolytic. Can be hardened. Can be very ductile. Best magnetic properties for pole pieces, etc.

PRESS - Basic machine which holds and operates tools.

TOOLS - Punches, dies, etc. made up for customer's part.

COMPACT - To form the shaped part from powder in the tools. A compact - the part. (Briquet.) GREEN COMPACT - Unsintered part.

COMPRESSION RATIO - The ratio of the volume of the loose powder to the volume of the compact made from it.

SINTER - To pass the parts through high heat in a protective atmosphere. Imparts strength to the compact by bonding particles.

SIZE - Repress for dimensional control.

COIN - Repress to change surface profile.

FORGE - Repress to increase density. In some cases a change in shape also.

IMPREGNATE - To fill the pores with oil or other substance.

INFILTRATE - To cause the pores of an iron part to become saturated with copper. Virtually eliminates porosity. Improves physical properties.

*METHODS OF MANUFACTURING METAL POWDERS

ATOMIZATION. In the atomization process, molten metal is forced through a nozzle into a stream of air or water. Upon contact with the stream, the molten metal is solidified into particles of a wide range of sizes. The size is controlled by varying the nozzle size, metal flow rate, and the temperature and pressure of the stream. This process is used mostly for low-melting-point metals because of the corrosive action of the metal on the nozzle at high temperatures.

ELECTROLYSIS. The electrolytic process is similar to electroplating. In this process the metal plates are placed in a tank of electrolyte. The plates act as anodes, while other metal plates are placed into the electrolyte to act as cathodes. High amperage produces a powdery deposit on the cathodes. After a period of time the cathode plates are removed from the tank and rinsed to remove the electrolyte. After a drying period, the deposit is scraped off and pulverized to produce powder of the

*Methods Most Commonly Used

desired grain size. An annealing process follows pulverization to remove work-hardening effects.

REDUCTION. The reduction process reduces metal oxides in powder from by contact with a gas at temperatures below the melting point. The largest volume of metallurgical powder is made by the process of oxide reduction. Mill scale or chemically produced oxides are reduced with carbon monoxide or hydrogen, and the reduced powder is then ground. If the oxide powder is graded before reduction, a high degree of size uniformity can be obtained in the reduced powder. The particles produced by oxide reduction are spongelike in structure and are ideal for molding. The shape is generally jagged and irregular and the particles are porous.

MILLING. The milling process utilizes various types of crushers, rotary mills, and stamping mills, breaking down the metals by impact and crushing. Brittle materials may be reduced to irregular shapes of almost any fineness by this method. The process is also used in pigment manufacturing of ductile materials, where flake particles are obtained. An oil is used in the process to keep them from sticking together.

CHARACTERISTICS OF METAL POWDERS

In all cases, the performance of the material during processing as well as the properties of the finished product

depends to a large extent upon the basic characteristics of the powder material. Aside from the chemical composition and purity, the basic characteristics of a metal powder are:

SHAPE	PARTICLE-SIZE DISTRIBUTION
FINENESS	COMPRESSABILITY
FLOWABILITY	APPARENT DENSITY

CHARACTERISTICS DEFINED

SHAPE - The powder particle shape, depending largely on how it was produced, may be spherical, ragged, flat, or angular. The shape is important in influencing the packing and flow characteristics of powders. Spherical shaped particles have excellent sintering qualities and result in uniform physical characteristics of the end product; however, irregular-shaped particles have been found superior for practical molding. NOTE: The mechanism of packing involves three processes: the filling of gaps between layer particles by smaller ones, breakdown of bridges or arches, and mutual sliding and rotation of particles. These processes are important in loading die cavities with metal powders.

FINENESS - Is determined by passing the powder through a standard sieve or by microscopic measurement. Metal powders may be divided into sieve and subsieve size ranges. Those in the sieve-size class are usually designated according to the

finest mesh through which all the powder will pass. If all the powder passes through a 200-mesh screen, it is designated as a minus 200-mesh powder, etc. The subsieve-size powders all pass through a 325-mesh sieve used in practice.

FLOWABILITY - Is that characteristic of a powder which permits it to flow readily and conform to the mold cavity. It can be described as the rate of flow through a definite orifice.

PARTICLE-SIZE DISTRIBUTION - Is important in the packing of the powder and will influence its behavior during molding and sintering. It also determines the flowability and apparent density, as well as the final porosity, of the product. Once it is established for a product, it cannot be varied appreciably without affecting the size of the compact. Particle-size deistribution is specified in terms of a sieve analysis, that is, the amount of powder passing through 100-, 200-, etc., mesh sieves.

COMPRESSIBILITY - Of powders, which varies considerably, is influenced by the particle-size distribution and shape. Dependent on this characteristic is the green strength of the powders which must be sufficient to hold the compressed forms together in the manufacturing operations. Compressibility is the ratio of the volume of initial powder to the volume of the compressed piece.

APPARENT DENSITY - Or specific gravity may be defined as the weight of an un-packed quantity of powder necessary to fill a given die cavity completely. As the apparent density decreases, it is necessary to use more powder to produce a part. It should therefore be kept constant so that the same amount of powder can be fed into the die each time. Also with low apparent density, a longer compression stroke and deeper cavities are needed to produce a briquette of given size and density. The tendency of the briquette to shrink during sintering seems to decrease with increasing apparent density.

BLENDING (Mixing)

Proper blending and mixing of the powders is essential for uniformity of the finished part. Particle-size distribution is used by blending in advance the different types of powders available. Alloying powders, lubricants, and volatilizing agents to give a desired amound of porosity are added to the blending powders during mixing. The time for mixing may vary from a few minutes to several days, depending upon results desired. Metal powders used include copper, iron, tin, lead, nickel, silver and stainless as well as a number of steel alloys.

Mixtures of copper, tin, iron, lead, graphite, and silica to make friction materials.

Copper combined with carbon, as in electrical brushes.

Ceramics and metals to form cermets.

Carbides and other materials too hard or too brittle to permit any other method of shaping.

Lubricants are added to reduce friction during pressing operations. This both reduces die wear and lowers the pressure required for pressing.

The mixing may be done either wet or dry. Wet mixing has the advantage of reducing dust and the danger of explosion which is present with some finely divided posters.

COMPACTING

One of the most important operations in powder metallurgy is the compacting, or pressing operation. There are generally three steps involved.

1. Filling the die cavity with powder. Since the powder is compressed about 2½ times, the cavity must be large enough to hold the amount of powder required for a given size part.
2. Pressing the powder by moving the upper and lower punches toward each other. Internal shapes, such as holes are produced by core rods.
3. Pushing the compacted part out with the lower punch. (A variation of this procedure permits part removal by lowering the die.)

The part is called a "green" compact after it has been pressed from the loose powder into the die shape. It is also known as a briquette. The part is compacted enough so that it can be handled, but since it is still fragile it must be handled with care.

The dies and punches used for the compacting operation are constructed from a very high quality heat-treated steel. The dies are slightly harder than the punches to insure that the punches will not damage the dies. Clearance between the die, punches and core rods must be held close to maintain alignment. Sufficient clearance to permit free movement under all operating conditions, particularly in removing the part from the die, must also be provided.

Most compacting is done with the powder in a cold condition. However, hot pressing is used to a limited extent in the production of very hard parts. The temperature and pressure are applied at the same time, and the part is compacted and sintered in one operation. The parts can be done faster, and have a higher density. Additional advantages are a reduction in gas content and shrinkage effects, and higher strength and hardness. The main disadvantage is that dies constructed to handle the higher temperatures are more expensive.

The compacting operation can be done either with a mechanical or hydraulic press, with applied pressures ranging from 20 to 100 tons pre square inch. Mechanical presses have the following

advantages over hydraulic presses.

1. Higher production rate.

2. Flexibility in design.

3. Simple and economical operation.

4. Relative low investment and maintenance cost.

Hydraulic presses are built with higher pressure ratings, and are used when more complicated, higher pressure powder metal parts are required.

SINTERING

Sintering is a solid state phenomenon in which powder particles become metallurgically bonded below the melting point of the metal. This metallurgical bonding develops the desired mechanical properties - without adhesives or cements.

In powder metallurgy processing, sintering is another important step in consolidating a mass of powder into a coherent body of specific density, strength and other desired properties.

During sintering, a material movement takes place which results first in the formation of a bond between the powder particles and later in the densification of the powder mass and the formation of a finer grain structure.

The sintering process is usually carried out at a temperature that is somewhat below the melting point of the parent material. In most cases, no melting of the materials takes place.

The sintering process varies in time from thirty minutes

up to several hours. Sintering may be carried out in either the batch or continuous type oven.

Sintering furnaces may be either the electric-resistance type or gas or oil-fired type. Close control of temperature is necessary to minimize variations in final dimensions. The very uniform and accurate temperature of the electric furnace makes it most suitable for this type of work.

Another feature of the furnace is that of the controlled protective atmosphere to eliminate the formation of oxides on the workpiece. The elevated temperatures tend to favor the sintering process. The longer the time of heating or the higher the temperature, the greater will be the bonding between the particles and the higher the tensile strength.

IMPREGNATION

Impregnation is the process of filling the pores of a powder metal part with a lubricant or other non-metallic material such as plastic resin. It may be accomplished by soaking or by means of a vacuum.

Sintered metal parts are quite absorbent, depending on density, because of their built-in porosity. Bearings as well as many structural parts are oil impregnated for lubricating purposes, greater wear resistance or for corrosion resistance. Powder metal parts that are to be plated are usually plastic resin impregnated to avoid plating-salt

entrapment. Pressure tightness may be assured through plastic impregnation.

INFILTRATION

Infiltration is a process of filling the pores of a powder metal part with a lower melting point metal such as a copper base alloy. It is useful in increasing the density, strength, hardness, ductility and impact resistance of powder metallurgy parts.

On sintering, the infiltrant material melts and penetrates into the pores of the powder metal part by capillary action. Mechanical properties, such as tensile strength, hardness, wear-resistance and toughness, are enhanced considerably and a fully dense structure is produced by infiltration.

SIZING AND COINING

These operations are simply a repressing of the part to achieve very close tolerances or increased density or both. Repressing usually improves the surface finish of the parts.

Sizing and coining are similar insofar as they both involve a plastic deformation of structural parts or bushings after sintering. The difference between them could be defined as follows:

SIZING - Sizing is used to obtain high dimensional accuracy, thus compensating for warpage or other dimensional defects

occuring in the sintering operation. In this, the sintered part is placed in a die, which is designed to meet the required tolerances, and is repressed. Only a slight plastic deformation is necessary, so the pressures required for the sizing operation are normally quite moderate.

COINING - Coining has a double purpose. Not only is dimensional accuracy improved, as in sizing, but by the use of higher pressures the density of the part is increased. Again, the sintered part is re-pressed in the die to reduce the void space and impart the required density. Oftentimes, the sizing and coining operations are combined in the same die.

ADVANTAGES AND DISADVANTAGES

Powder metallurgy, like most other manufacturing processes, has some distinct advantages and disadvantages. One should be aware of these so as to use the process most economically.

Advantages:

1. Elimination of Machining:

For a large proportion of the applications for which it is used, the dimensional accuracy and surface finish obtained by the powder metallurgy process are such that no machining or other finishing are required.

2. High Production Rates:

All the steps of the process are very simple and high rates of production can be achieved. Labor requirements are simple and labor costs are low. In many cases the process can be automated. The uniformity among pieces is excellent.

3. Scrap is Eliminated:

Powder metallurgy is one of the only common production processes wherein very little if any material is wasted.

4. Complex shapes can be produced:

Complex shapes, with some limitations, can be produced readily.

5. Porosity and Density control

Porous parts and controlled density can be produced which could not be made in any other way.

6. Controlled Composition:

Parts of very high purity can be produced, or entirely different materials, such as metals and non-metals can be combined.

7. No high temperature melting furnaces needed.

8. Precise tolerances can be accurately maintained.

9. Self lubrication of parts.

Disadvantages:

1. Low Strength Properties:

In most cases for a given material, powder metallurgy parts do not have as good physical properties as wrought parts or most cast structures.

2. Relatively High Die Costs:

Because of the high pressures and severe abrasion which are involved in the process, the dies must be made of expensive materials. The extremely close tolerances required by the tooling causes tooling costs to be expensive.

3. High Material Costs:

Powdered metals are considerably more expensive than the cost of wrought forms.

4. Design Limitations:

The powdered metallurgy process simply is not feasible for some shapes. Many configurations are not adaptable and the length to diameter ratio is limited.

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for

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SLIDE PRESENTATION FOR POWDER METALLURGY

Slide
PM - 1 Title slide

Slide
PM - 2 Typical flow chart for P.M. process

Color code

Movements of parts in powder metal press

Blue - upper and lower punches

Yellow - upper platen-die

Buff - outer lower punch

Black - part or briquette

Red - core rod

Gray - lower platen

Slide
PM - 3 This shows a simplified view of the compacting process.

The powder is ejected into the die.

The powder is compressed.

Part being ejected from die.

The following series of slides illustrates a step by step procedure of compacting a flanged part.

Slide
PM - 4 (Operations 1 & 2)

The core rod is withdrawn completing the part.

The fill shoe shuttles the completed part across the top of the die and is in position to load the die cavity.

Slide
PM - 5 (Operation 3)

The die and outer lower punch rise to allow the proper amount of powder to fill the die.

Slide
PM - 6 (Operation 4)

The core rod moves into position (up).

Slide
PM - 7 (Operation 5)

The fill shoe has been removed; striking off the excess powder. The upper punch moves down to close the die cavity.

Slide
PM - 8 (Operation 6)

Simultaneously the upper punch, die, and outer lower punch move down. Note the compression taking place on the outer surfaces of the cavity.

Slide
PM - 9 (Operation 7)

The same movements are continued as in the 6th step, increasing the part density.

Analogy - Snow ball

Slide
PM - 10 (Operation 8)

The compression cycle has been completed.

Slide
PM - 11 (Operation 9)

The upper punch and die are separated.

Slide
PM - 12 (Operation 10)

The part is stripped out by lowering the die assembly.

Slide
PM - 13 (Operations 10 & 1)

The core rod is removed completing the cycle.

The following series of slides gives the six basic rules for P.M. part design.

Slide
PM - 14 The shape of the part must permit ejection from the mold.

Slide
PM - 15 The shape of the part should be such that the powder is not required to flow into thin walls, narrow splines, or sharp corners.

Slide
PM - 16 The shape of the part should permit construction of strong tooling.

Slide
PM - 17 The shape of the part should make allowance for the length to which thin wall parts can be compacted.

Slide
PM - 18 The part should be designed with as few levels (diameters) and axial variations as possible.

Slide
PM - 19 Take advantage of the fact that certain forms can be produced by powder metallurgy which are impossible, impractical, or uneconomical to obtain by any other

method.

The following slides show examples of parts which were produced by P.M. process.

Slide
PM - 20 A gear used to raise and lower the dolly legs on a tractor trailer. The gear is a single piece gear and could not be machined by conventional methods.

Slide
PM - 21 Ball joints for the front end suspension of an automobile.

Slide
PM - 22 A compressor housing.

Slide
PM - 23 Paw and sleeve for locking a transmission in park. Both parts bonded together during sintering.

Slide
PM - 24 A pole piece for an electric motor. This is used to wrap the coil on.

Slide
PM - 25 A hydraulic pump and housing.

Slide
PM - 26 A gear for a milk separator.

Slide
PM - 27 A splined gear.

PM Review Questions

1. What are the purposes of sizing and coining?

- -

To reduce the variations in sizes. Increase the density.

---

2. Five major points to consider in powdered metallurgy parts.

- -

1. Material
2. Pressing
3. Sintering
4. Sizing and Coining
5. Tooling

---

3. What variables must be controlled during the sintering process?

- -

1. Preheat temperature
2. Hydrocarbon content of the flame curtain.
3. Sintering temperature
4. Control of the carbon atmosphere
5. Control of the dew point
6. Control of the cooling rate

---

4. What 3 major advantages are obtainable only in powdered metallurgy process and not obtainable by any other process?

- -

1. We can combine dissimilar metals in any combination
2. We can control the density
3. We can control the porosity

---

5. How does the shape of metal particles influence the green strength of a compact?

- -

Irregular particles give the greatest amount of mechanical interlocking, thus the greatest amount of green strength. Spherical shaped particles give minimum mechanical interlocking.

---

6. Why are parts produced using dissimilar metals?

- -

Parts can be produced to take advantage of the best properties of several metals combined.

---

7. What is the relationship of porosity to density (a generalized statement)?

- -

High porosity / low density.

8. Why are powders of the same composition, but of varying shape and size blended?

- -

To obtain "tailor made" specific or unusual properties.

---

9. What is considered the 3rd dimension of powdered metallurgy?

- -

Controlled density.

---

10. What is the limit of length to width ratio for powdered metal parts?

- -

2½ to 1 for thin walled parts and up to 4 to 1 for thicker parts.

---

11. What are the effects of soft powders vs. hard powders in powdered metallurgy?

- -

Softer powders are less abrasive on tools and give higher density at lower tonnage.

---

12. What is considered the European method for compact ejection?

- -

Where the die lowers off of the compact.

13. What basic difference in molding is required for multi-level parts as opposed to single level parts?

- -

Multi-level parts must be pressed from 2 directions.

---

14. What is meant by the term infiltration?

- -

Filling the porous voids with copper or similar material by capillary action to increase its tensile strength, density, wear resistance, and to make it impervious.

---

15. The powdered metallurgy industry requires the most accurate tooling of any industry engaged in mass production. Useful life of these tools is dependent upon what 3 factors?

- -

A. Material used

B. Tonnage used

C. Tolerance required

---

16. What is meant by the term "spring-up" in the powdered metal industry?

- -

The expansion of the part as it comes out of the die.

FREE ABRASIVE MACHINING

E.P.D.A. INSTITUTE IN MODERN

METALWORKING TECHNOLOGY

WESTERN MICHIGAN UNIVERSITY

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FREE ABRASIVE MACHINING

INTRODUCTION

Free Abrasive Machining (FAM) utilizes a hardened steel alloy back-up wheel (60-62Rc), which prevents impregnation of the abrasive, and thus produces a rolling-cutting-abrasive action in the slurry film between the wheel and the workpiece. As the abrasive grain rolls, all of the cutting edges of the grain are available for stock removal. This is an advantage over bonded grains which provide only one cutting edge before being discarded.

Other advantages of FAM include:

1. A temperature controlling system - usually water circulating under the steel alloy back-up wheel. This prevents microscopic cracking in parts being ground.
2. A wheel dressing system that corrects the back-up wheel geometry during production by changing the direction of rotation of the truing and retaining ring. With very little training an unskilled operator can operate these machines so that the back up wheel can maintain relative flatness or where necessary, curvatures to specified radii.
3. Parts handling facilities, large capacity truing and retaining rings provide for rapid production of

small and medium size parts while still maintaining high accuracies.

4. An ability to grind parts containing two or more materials of varying hardness. The abrasive will act equally on the entire surface - being regulated in the cutting action by the harder material.

5. The ability to grind most materials with relatively cheap abrasives such as Silicon Carbide. These include metals as hard as tungsten carbide and non metals from rubber to glass and ceramics.

6. The absence of chucking devices eliminates distortions caused by spring back.

7. It provides an economical method of obtaining a true reference surface for further machining by numerical controlled machines.

8. It provides the close tolerances obtained by hand scraping and lapping but with mass production economics.

FREE ABRASIVE MACHINING

GLOSSARY

FREE ABRASIVE MACHINING - A flat machining process which combines rapid stock removal with precision size, parallel, flatness and surface finish on any solid material at high production rates, utilizing loose abrasive grain.

FIXED ABRASIVE - Grain bonded into or on a surface such as a wheel, belt, polish buff, etc.

FLATNESS - Refers to a single surface or plane being between three points and the variation from that plane.

PARALLEL - Plane equally distant from another plane at all points.

SIZE - Relationship of thickness of two or more parts

SURFACE FINISH - Numerical value given to a surface in terms of RMS, CLA, AA, etc.

LAY - Character of a surface such as cross or multi-directional hatch, circular, matte, etc.

MATTE FINISH - Dull grey, non directional finish generated by FAM.

POLISH - A reflective surface normally generated by a "fixed" abrasive.

VEHICLE - The liquid used as a carrier for abrasive grains usually petroleum based, may be water with additives.

SLURRY - The mixture of abrasive and vehicle.

FREE ABRASIVE MACHINING

SLIDE NARRATION

FAM 0 Title Slide

FAM 1 Machine Nomenclature

This particular machine is a Speed FAM 32 BTAW. The 32 BTAW refers to the size and accessories for the machine. The number "32" refers to the diameter of the back-up plate or rotating diameter in inches. The "B" refers to basic machine. The "T" refers to the parts handling table. The "A" refers to an air pressure system. The "W" refers to a water cooled table.

FAM 2 Free Abrasive Machining is unique when compared to grinding or lapping which has the abrasive attached to a plate or wheel. The free abrasive allows exposure of every sharp edge of each individual abrasive grain as it is carried or rolled along in the slurry.

The hardened steel alloy of the back-up wheel prevents impregnation by the abrasive and produces a rolling and cutting action on the piece parts.

FAM 3 The back-up wheel is of sturdy construction with attached hard steel segments that provide a flat, moving surface. The power applied to the rotation must be

sufficient to accomodate the high load factors of the air cylinders. The pressure from the air cylinder is applied to the piece parts via the pressure plate through a shaft and a self aligning bearing. The piece parts are confined beneath the pressure plate by a truing and retaining ring.

FAM 4 Loading - Piece parts loaded in truing retaining ring. Pieces are loaded to produce one flat surface.

FAM 5 The felt pad has been placed in the truing retainer ring over the piece parts in preparation for the first machining operation.

FAM 6 Flatness - piece parts loaded in truing retaining ring with felt pad mounted under universally mounted pressure plate. The felt pad is used to take up the irregularities in the piece parts in this first operation.

FAM 7 Flatness - piece parts loaded with felt pad under pressure plate after the machining operation is completed. One surface is now machined flat. The flatness can be made slightly concave or convex by controlling the shape of the steel alloy back-up wheel.

FAM 8 Reloading (side two) - the piece parts are loaded with flat side up. Turning boards may be used for rapid turning of the piece parts for reloading.

FAM 9 Hardplating - The piece parts are riding with flat side (first side machined) bearing against the pressure plate. The expression "hard plating the parts" is used in the trade when parts are held in this manner. The universally mounted pressure plate will conform to the piece parts because of its self aligning bearing.

FAM 10 Flatness (side two) - Piece parts after second side is machined. The sides are not parallel. To make the sides parallel parts must be transposed.

FAM 11 Non-transposed - Piece parts shown as they were loaded in the truing retaining ring. Piece part surfaces are not parallel but must be rearranged in the ring (transposed) to be machined parallel.

FAM 12 Transposed locations as loaded - The piece parts reloaded so three high pieces have been loaded at locations 120° apart. The three points will hold the plate parallel to the back-up wheel. These higher piece parts will be machined down until all piece parts are being machined. The piece parts will now be parallel when the machining operation is completed.

FAM 13 Transposed - The piece parts are now "hard plated" ready for machining in the truing retaining ring. This operation will produce parts flat and parallel.

FAM 14 Parallel - Piece parts have now been machined parallel and flat as shown in this illustration. The machining action was accomplished on a free abrasive in a slurry.

FAM 15 Wheel flatness - The wear of the back-up wheel normally is from flatness to concavity with the truing retaining ring revolving in counterclockwise direction the same as the back-up wheel. A straight edge is used to measure concavity with a thickness gage.

FAM 61 Checking concavity - The slide shows the machine operator checking the back-up wheel for concavity.

FAM 17 The wheel dressing gear has been raised to engage with the truing retaining ring. The ring will now revolve in a clockwise direction. This will increase the relative speeds of the back-up wheel and the truing ring on the outer surface of back-up wheel. The action of the abrasive slurry will result in a convex shape on the back-up wheel. This shape can be developed as the machine is in production.

FAM 18 Back-up wheel flatness - This slide shows relative wheel motion with wheel dressing gear engaged. The lower part of the picture illustrates wheel in convex shape.

FAM 19 <u>Machining Difficulty Graph</u>

All machine tools in use today have characteristics that make them excell in certain functions and range from acceptable in some to poor in performance in others. When industry uses a machine it must be capable of producing the desired qualities in competitive quantities. Although Free Abrasive Machining is adaptable in many machining operations, it excells in some but provides fair or unacceptable results in others. The vertical arrow in this graph indicates the degree of difficulty in performing various surfacing functions. The space within the broken line circle indicates operations that can be done competitively (in most cases) by FAM. The space within the red triangle represents surfacing operations in which no other machine can compete with FAM economically.

FAM 20 <u>FAM Finishing Capabilities</u>

Surface finish is a function not only of the abrasive grain, but also of the piece part material. In FAM there is a constant cutting rate with a given abrasive. There is no variation in finish due to tool dulling, wheel loading, or operator error.

FAM can control parallelism to .0001, thickness to .0001, flatness to .000002 per inch. Squareness or perpendicularity must be obtained with fixtures. A

matte type finish to 1-2 RMS can be obtained. Secondary polishing is also possible.

FAM 21 Parts Handling Table Movement, Unloading

One of the features that allows for high production rates in FAM is that an operator may load small parts in a truing and retaining ring on the parts handling tabling while the machine is operating. When the parts in one of the rings are finished, the machine is stopped, the pressure plate raised, the parts handling table lowered as shown in slide and the retaining ring with parts is slid off back-up wheel without disturbing position of part. (The next slide also shows a similar operation)

FAM 22 Parts Handling Table Movement, Loading

When parts in truing and retaining ring are to be moved to the back-up wheel the handling table is raised to a level slightly higher than the back-up wheel and the retaining ring moved onto the wheel without disturbing the position of the individual parts in the ring.

FAM 23 Cutting Rate Chart

In laboratory experiments it has been determined that the maximum effective cutting pressure ranges from 3 to 5 pounds per square inch.

In operation, the amount of stock removal is governed by

a combination of three variables inter-acting. These three are pressure, size of the abrasive and the duration of time. The operator must check the first run to arrive at the running time.

FAM 24 This is a small free abrasive machine made by the SpeedFAM Corporation. Note the simple control panel. The panel has an air pressure gage, a cycle timer, start, stop and reset button.

The simple controls enable operators to be trained with ease.

FAM 25 This is a large free abrasive machine showing the large capacity of the truing retaining rings and the back-up wheel.

FAM 26 Machine Base

The base for these machines are weldments. This machine works on a geometrical principle so that extreme accuracy need not be built into the machine.

FAM 27 Driving Motor

The motor to drive the rotary table is a heavy duty type. The formula for determining the motor size is one horsepower per 90 square inches.

FAM 28 Water Cooled Table

The rotating diameter governs the size of the machine. The machines are available in 12, 18, 24, 32, 48, 64 and 84 inch sizes. The 24" size and larger machines have a water cooled table to dissipate the heat generated by the process. The water enters at the center of a cast iron base, flows around a rib and exits at the center. This feature is essential for constant fast stock removal. Water cooling also assists in extreme flatness and size control on ultra-precision work.

FAM 29 Slurry

The slurry is a mix of abrasive and a vehicle. The abrasive covers a broad spectrum of particle sizes and materials. Generally speaking, only four grades of silicon carbide are needed for most production operations. The vehicle may be reclaimed and reused but the abrasive is used only once.

FAM 30 Slurry Pump

The slurry pump provides material flow to the work and at the same time provides agitation in the tank to keep the abrasive in suspension.

FAM 31 Slurry to Work

Only a relatively small amount of slurry reaches the work

area. The used slurry drains down through the slits in the back-up table and travels to a storage tank.

FAM 32 Surfacing of Large Casting

One of the most difficult aspects of numerical control machining is to obtain a perfectly flat reference surface. This is an example of a rough casting receiving FAM surfacing for further work on a numerical control milling machine.

FAM 33 Distributor Points, To be Finished to Size

An example of the use of a fixture for holding of small parts or controlling size from a given point. The parts shown are contact points for an ignition distributor. The bottom is in the form of a tube to be swedged or riveted onto a bracket for final assembly in the distributor. The tubular portion requires no machining. The upper or lower portion must be machined by FAM to a specified thickness and surface finish. (The next two slides also show these parts)

FAM 34 Use of Turning Board

This is an example of the use of a turning board for rapid turning of multiple parts in a fixture as shown or larger parts without a fixture. A similar board is placed on top and the parts are held securely as

they are turned to present the other face to the steel alloy back up wheel for machining.

FAM 35 Distributor Points, Prepared for Machining

The distributor points in their fixture in the truing retaining ring have been moved off the turning board and are in position for machining.

FAM 36 Ferrite Type Atomic Pile Control Material

The material shown is a very brittle ferrite material used in atomic energy electrical plants as a means of controlling the heat output of the atomic pile. They are of a cast material and must be machined on six sides by FAM. The flat surfaces are machined by conventional methods. The parts are placed in a truing retaining ring with pressure plate until they have been machined to correct thickness and parallel dimensions.

(The next slide also shows this part)

FAM 37 Ferrite Control Material in Fixture for Squaring

This is an example of a fixture in which flat parts may be clamped for machining to specified width and squareness dimensions. These are the ferrite plates that have received flat surface machining by FAM as explained in previous slide.

FAM 38 Examples of Carbide Cutter Inserts

Tungsten carbide cutter inserts for machine cutting tools are rapidly ground by FAM. The advantages other than speed are: no cracking from heat due to grinding and a matte or non-directional surface finish.

FAM 39 Non-Metallic Parts for FAM

Many non-metallic materials may be machined by FAM. This slide shows in addition to metallic parts, some of these are rubber, plastic and ceramic materials.

FAM 40 IBM Start-Stop Clutch Plate

This is a start-stop IBM print out clutch plate. It must be capable of engaging as often as 1400 times per minute. It must have a perfectly flat surface for consistent torque. Previous methods of machining retained distortions caused from assembling. FAM gave an almost 100% quality control acceptance.

FAM 41 Explosive Proof Micro-Switch Box

This is an explosive proof micro-switch box of aluminum. The mating surfaces for the cover and box must be such that no vapors may enter. FAM proved to be the most economical method.

FAM 42 Rotary Table Base Plate, Checking with Autocollimator

This is a base plate for a rotary table being manufactured for the Atomic Energy Commission. It must be within .000050 in parallel and flatness. FAM was used to obtain these close dimensions. This view shows the plate being inspected by an autocollimator. (The next slide also shows this part)

FAM 43 Rotary Table Base Plate, Checking With Electronic Mike

This is another view of the rotary table baseplate shown in previous slide. It is shown being measured in thickness with an electronic micrometer.

FAM 44 FAM Compared to Conventional Machining

This is an example of the relative efficiency between FAM and conventional methods of machining.

FAM 45 Seals for Bogey Wheels

These seals are made of stellite and are used to seal out the mud on the shafts for bogey wheels on track type vehicles. They must be ground to a specified curve in one operation by FAM. In another FAM operation a small flat was put on it.

FAM 46 Prisms for Psychedelic Lighting

These are plastic prisms used in psychedelic lighting fixtures. They were ground by FAM.

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for

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FAM Review Questions

1. Since the workpiece takes a complimentary shape to a spherically convex or concave wheel, how is flatness to any degree of accuracy achieved?

- -

Relative flatness is dependent upon piece part diameter, backing wheel diameter, and degree of concavity or convexity of the backing wheel.

---

2. How is the backing wheel converted from a concave to a convex surface?

- -

By reversing the direction of rotation of the truing rings.

---

3. Explain the difference between parallelism and flatness.

- -

Two surfaces equidistant apart are parallel - example, inside and outside surface of a spherical hollow ball. Flatness has all points of its surface in a single plane.

---

4. What are the advantages of FAM?

- -

1. No clamp distortion
2. No chuck distortion

3. No fixturing or waxing required.

4. Good for first surface referencing

5. Good for short or long runs

6. Good for brittle parts (gentle action - no thermal or mechanical shocks).

7. Good for short or long runs

8. No thermal or mechanical distortion

9. Good for thin parts

10. Replaces hand scraping

11. Close tolerance work lapping tolerances at grinding production rate

12. Good for magnetic and non magnetic parts (lead to silicon carbide; rubber to sapphire)

13. Dissimilar materials - cuts uniformly at the rate of the slowest cutting material

---

5. How does Free Abrasive Machining differ from lapping?

- -

The abrasive is not embedded in the backing plate but is contained as a free abrasive layer between the workpiece and plate.

Higher pressures 3-5 lbs. for FAM, 1/2 - 2 lbs. for lapping.

Water cooled to provide stable operating temperatures.

FAM is not always a finishing operation because of the high rate of stock removal.

6. What determines the type and quality of a FAM surface?

- -

1. Abrasive size
2. Hardness of the workpiece
3. The type of finish is matte

---

7. What is the difference between a geometric machine and a mechanical machine?

- -

A mechanical machine depends upon its inherent accuracy.

A geometric machine is dependent upon generation (relative motion) to produce accurate parts.

---

8. Is the backing wheel of a FAM consistently flat?

- -

No.

---

9. When is the backing wheel dead flat?

- -

The wheel going from spherically convex to spherically concave or vice-versa is for one moment in time, dead flat.

URETHANE FORMING

E.P.D.A. INSTITUTE IN MODERN

METALWORKING TECHNOLOGY

WESTERN MICHIGAN UNIVERSITY

KALAMAZOO, MICHIGAN

SUMMER - 1969

Dr. John Bendix, Director

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INTRODUCTION

URETHANE FORMING

Urethane Forming began back in the 30's with the use of rubber as the die. This was very crude, and development was slow in this process until the development of plastics.

Urethane is a rubber-like material that is able to change shape under pressure and then return to its original shape. It is tough, can withstand repeated deflection and is easily machined and cast.

The working action of urethane can best be described by comparing its action with that of hydraulic fluid. It can change its shape but cannot be compressed.

The basic distinction over conventional steel press brake work is that all metal forming is done by the pressure exerted by the urethane against the upper die rather than air forming the metal into the lower die. In most cases the lower die is simply a square length of urethane into which the upper die forces the metal. Due to its versatility and inexpensive tooling, urethane has been adopted for use as wipe down dies, punch and blanking die springs and strippers, pressure pads, embossing dies, clamping fixtures and also single pass rolling.

ADVANTAGES OF URETHANE FORMING

1. The urethane pad will not mar the work surface during forming. Prefinished and embossed metals can also be formed.

2. The time required for urethane die manufacture is considerably less than that of conventional dies.

3. Critical die alignment is not necessary as it is in the use of regular dies. Urethane forming usually calls for much less set up time.

4. Urethane forming makes it possible to do jobs that would otherwise be very difficult or impossible to do with regular dies.

5. Urethane forming creates much less distortion and spring-back than usually occurs with standard forming.

6. Stock material of various thickness and surface irregularities can be used with urethane forming.

DISADVANTAGES OF URETHANE FORMING

1. The replacement cost of urethane for large volume production sometimes makes regular die forming operations the most economical.

2. Urethane starts to break down in temperatures in excess of 200° F.

ADVANTAGES OF URETHANE FORMING

1.) THE URETHANE PAD WILL NOT MAR SURFACES DURING FORMING.

2.) THE TIME REQUIRED FOR URETHANE DIE MANUFACTURE IS CONSIDERABLY LESS THAN THAT OF CONVENTIONAL ALL-STEEL DIES.

3.) THE URETHANE PAD CAN BE USED WITH ANY NUMBER OF DIES.

4.) DIE ALIGNMENT HAS BEEN ALMOST ENTIRELY ELIMINATED.

5.) DIES FOR URETHANE FORMING CAN BE SET UP IN 10 MINUTES VS. 1½ HOURS FOR CONVENTIONAL STEEL DIES.

6.) URETHANE FORMING IS ADAPTABLE TO LONG RUN FORMING BECAUSE OF ITS DEFLECTION AND RESILIENT PROPERTIES.

SLIDE SCRIPT

FOR

URETHANE FORMING

Slide
#1 - UF Title slide

Slide
#2 - UF Urethane is a elastomer type plastic not to be confused with urethane foam. Urethane has the same basic action as rubber; that is it can return to its original shape after being squeezed to another shape or size. One could say urethane has a memory, it always returns to its original shape. Unlike rubber urethane cannot be compressed because it has no air spaces. Urethane reacts somewhat like liquid under pressure (such as, hydraulic fluid) being noncompressable it must displace itself. Urethane is also oil and air resistant therefore lasting longer than rubber.

Slide
#3 - UF In this slide urethane is being used as a simple holding device which will not mar or damage the work surface. This application can be used in a variety of ways such as chucking, fixtures, the common bench vice, etc.

Slide
#4 - UF Here we see a urethane embossing die - which is a process by which an impression of a letter, insignia, or other design is pressed in light gage metal. In

the case of urethane forming only the female die is necessary as the urethane follows the metal into the die as the pressure is applied. In this case the left half of the press is open and the right half is at the bottom of the stroke showing how the metal flows into the die.

Slide #5 - UF In this slide we see the three parts of the preceeding slide. At the top is the aluminum workpiece, in the center is the female die and below is shown the urethane pad which because of its long usage still retains some of the impression of the die. It should be noted that this process is similar to hydroforming.

Slide #6 - UF Shown here is a simple hand operated draw die which utilizes a hard type urethane for the die form, and a soft urethane for the punch.

Slide #7 - UF Title slide for Urethane Bulging

Slide #8 - UF This is a diagram illustrating how a bulging die operates to expand inside cavities. In this case the alignment plate positions the workpiece, and the die restricts the action of the urethane to the desired shape as the pressure is applied.

Slide #9 - UF In this slide we see two pieces of brass tubing and

bulging die. One of the brass tubes has been bulged by the urethane process. This die was operated in a common bench vice.

Slide #10 - UF This is an example of a standard shape extruded aluminum alloy die retainer, showing individual blocks of urethane inserted in the retainer cavity. The urethane blocks which get the most wear can either be replaced or turned to a new wear surface.

Slide #11 - UF This is an end view of the die retainer and the punch showing the relationship of the urethane pad.

Slide #12 - UF In this diagram the punch and workpiece are fully pushed into the urethane. Notice the urethane displacing itself into the cavity in the bottom of the die retainer. No matter how much harder the punch is pushed the workpiece cannot be formed any more.

Slide #13 - UF In this case the urethane is under high pressure in order that the flow characteristics of the urethane can be seen.

Slide #14 - UF This slide shows a conventional "V" shape punch using a steel die. One can see that to complete the bend the metal must be pulled and stretched over the edges of the die which causes marring of the work-

piece and uneven wall thicknesses. There will also be considerable springback of the workpiece.

Slide #15 - UF Shown here is an end view of a 90° tool at about one-half the stroke. This illustrates the urethane pushing the metal up against the die and thus forming the desired shape. One of the advantages of the urethane process is that it starts the bend at the point of contact rather than air forming the metal as in the previous slide. This type tooling will eliminate most metal distortion and springback, which is important to consider when using difficult to form materials.

Slide #16 - UF This shows a radius punch starting to form a metal sheet. Urethane forming on radius dies has the same advantages of little springback or distortion as has been previously noted.

Slide #17 - UF This slide shows the radius fully formed. If the punch were depressed into the die further the metal could bend up and touch the sides of the punch, but damage may occur to the urethane if the punch were depressed excessively. Therefore, the design of the die plays an important role in each special metal forming application. This type of die should be used for light or simple bending and forming operations.

Slide #18 - UF Shown here are examples of typical bends on the

urethane die pad.

Slide
#19 - UF Kaufmann Engineering Corporation engineered the application of urethane forming as we know it today.

Slide
#20 - UF The Di-Acro Company is a licencee of the Kaufmann Urethane products. This is a common arrangement in industry.

Slide
#21 - UF Title slide for urethane "wide-down" dies.

Slide
#22 - UF This is a standard aluminum alloy extruded wipe-down die. The die utilizes a wiping pad and a heal support pad both of urethane. The die is adjustable for various gages of metal by means of the gib and adjustment screws shown in the bottom left portion of the assembly.

Slide
#23 - UF In this diagram the left half shows the urethane die in the up stroke position. The right half shows the same die in the full-down position. Notice how the pressure pad acts as a spring.

Slide
#24 - UF Here the die is shown putting a joggle offset in a piece of sheet metal.

Slide
#25 - UF In this picture we see a cut-away section of a punch stripper. The steel punch in the center blanks the

workpiece while the urethane acts as a spring to strip the metal from the punch.

Slide #26 - UF This diagram shows the operation of the preceeding slide. Notice the urethane acts both as a pressure pad and a stripper.

Slide #27 - UF In some cases a urethane rod can be placed in the die retainer cavity to support the urethane pad.

Slide #28 - UF This slide shows a form being stamped in a textured piece of aluminum. Urethane will not destroy the textured workpiece. Fully painted work can also be formed without damaging the painted surface.

Slide #29 - UF This is a sample die to show the feasibility of a special bend. The sides of the workpiece must be bent past 90° and be removed from the punch by sliding off one end.

Slide #30 - UF This is the same part starting to be formed.

Slide #31 - UF In this application the workpiece will be formed to the shape of the punch with the sides of the work bending over the sides of the punch.

Slide #32 - UF Here the punch is starting to form the workpiece.

Slide #33 - UF Notice how the urethane formed the work completely

over the punch in the absence of a female die. Here as before the workpiece could have been fully painted beforehand.

Slide #34 - UF Urethane Pressure Roll Forming - Roll forming is an excellent application for urethane because of its direct forming against the roll rather than air forming over a 3rd roll. This characteristic results in single pass rolling with positive duplication each time.

Slide #35 - UF We see in this slide the many diverse types of parts that can be successfully rolled. Urethane has the advantage of rolling a part with a cut-out without kinking at the edges of the cutout. Material that has been embossed, painted, or engraved can be rolled without damage to the finished surfaces.

Slide #36 - UF This schematic shows the typical urethane roll forming process. Unlike conventional rolling, which uses three adjustable steel rolls, urethane utilizes only two rolls. The diameter of the workpiece is controlled by the use of a "slip on tube" over the upper steel roll. These "slip on" tubes will produce repeatable parts each time because each tube will produce only one diameter on a workpiece, providing the pressure of the urethane roll is constant.

Slide
#37 - UF Here a urethane rolling machine is starting to form a cylinder which will be used as a missile component.

Slide
#38 - UF Here the cylinder is shown completed. Notice the large holes and the leading edges of the cylinder are not kinked, as often happens in conventional rolling.

Slide
#39 - UF This slide represents a production application of urethane roll forming. In this case we see the half rolled sheet metal housing for a G.E. garbage disposal unit.

Slide
#40 - UF Here we see a completed housing and also one just coming out of the rolls. Notice that the pre-painted surface is undamaged by the rolling process.

Slide
#41 - UF This machine is rolling 3/16" hot rolled steel into a cylinder for welding. The application of rolling tubes of this type is cheaper than buying standard lengths of pipe. The accuracy of the rolled part is also greater.

Slide
#42 - UF Here the same part is shown about half way through the rolling process. Notice the leading edge is fully formed into the proper radius. In this case the heavy steel plate had to have the leading edges

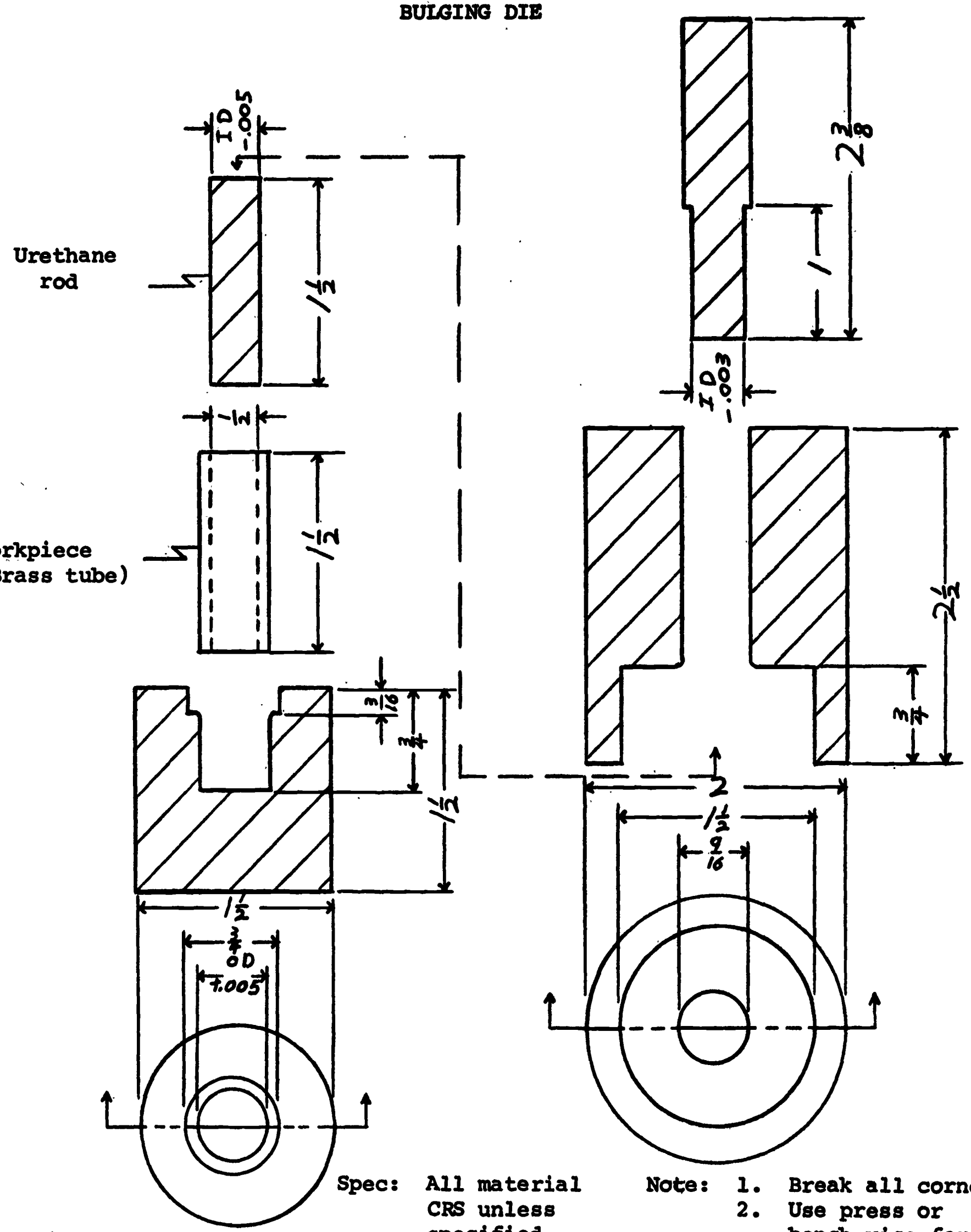
preformed in a brake press.

Slide
#43 - UF This last slide shows the finished part. The gap shown at the top cannot be closed further by additional forming. If you wanted it closed further, you would have to use a smaller slip on tube.

ERIC

URETHANE DEMONSTRATOR

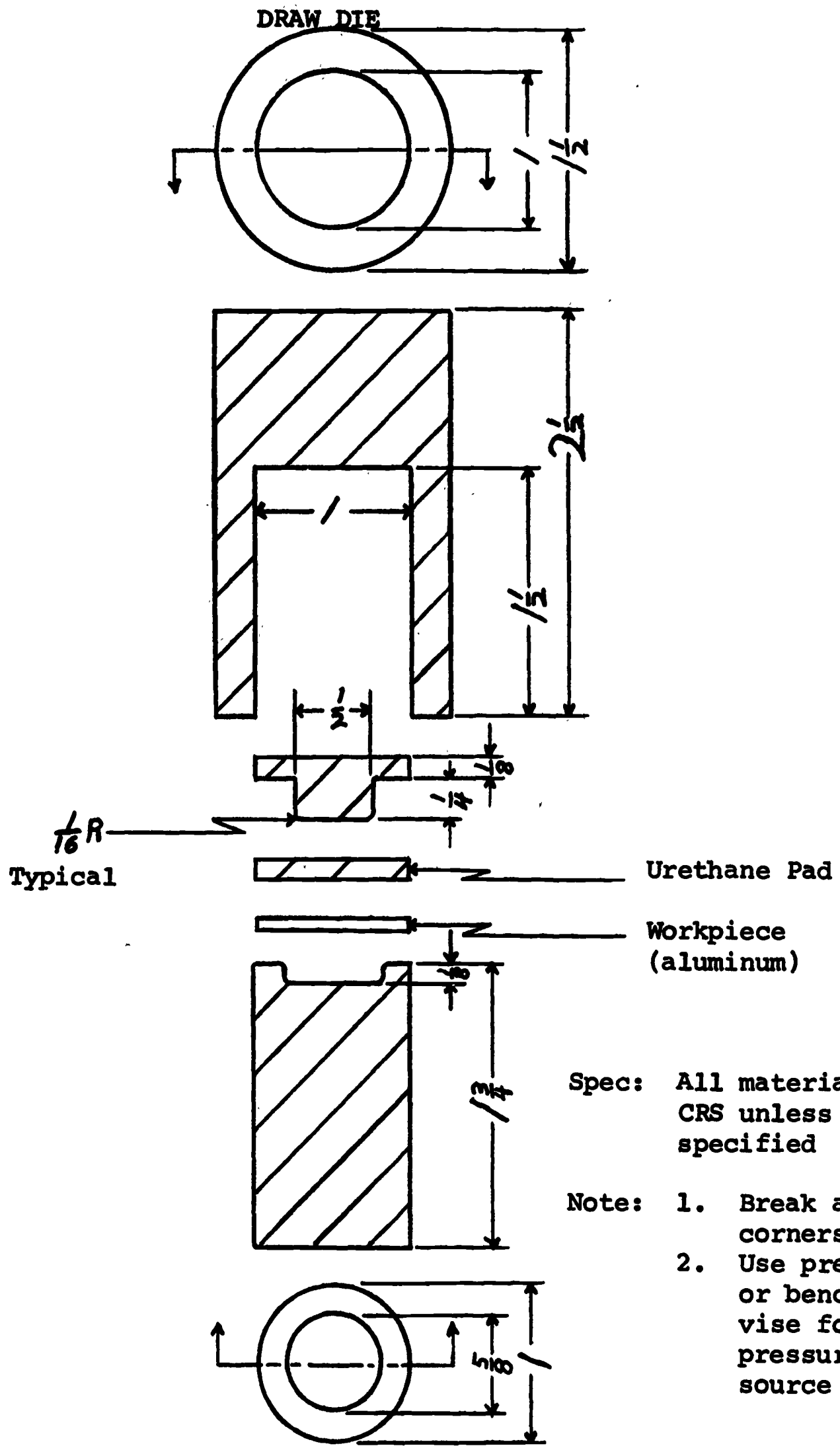
BULGING DIE



Spec: All material CRS unless specified

Note: 1. Break all corners
2. Use press or bench vise for pressure source

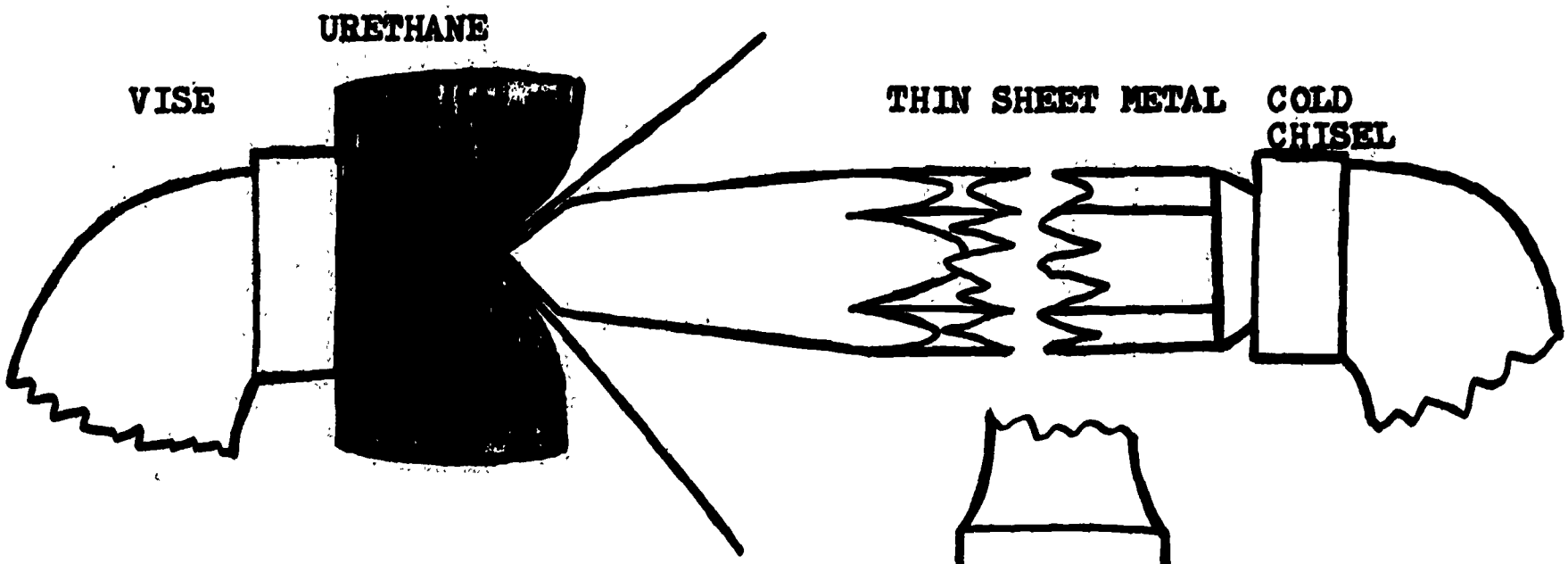
URETHANE DEMONSTRATOR

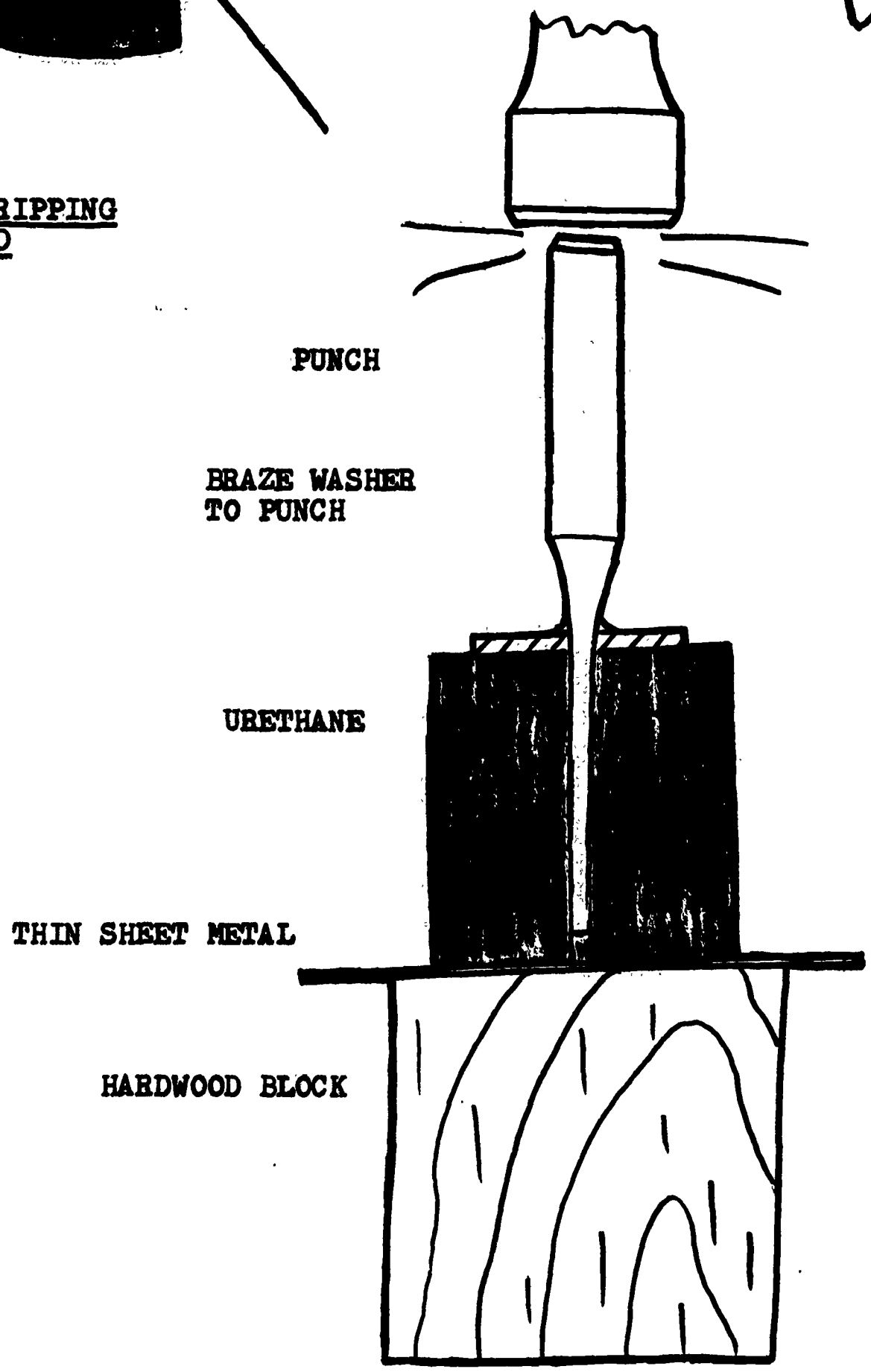


Spec: All material CRS unless specified

Note:
1. Break all corners
2. Use press or bench vise for pressure source

V-FORMING


URETHANE
VISE
THIN SHEET METAL
COLD CHISEL


STRIPPING PAD
PUNCH
BRAZE WASHER TO PUNCH
URETHANE
THIN SHEET METAL
HARDWOOD BLOCK

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for

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Designing the New Urethane Press Brake Tooling, ASTME MF68-187.

UF Review Questions

1. Why cannot an absolutely perfect cylinder be formed on a urethane rolling machine?

- -

Because there is a slight moment arm required for bending the metal even though the forming roll is deeply embedded in the urethane roll. This moment arm will be from 1 - 4 times metal thickness in length.

---

2. How does the clamping pressure of urethane springs compare with steel springs?

- - - - - - - - - - - - - - - - - - - -

5. What are design considerations for urethane dies?

- -

A. control pressure

B. control deflection

C. avoid undue strain

D. avoid cutting

---

6. What are some of the uses of urethane in metal forming processes?

- -

A. Female die

B, Male die

C. Wiping

D. Spring

E. Bulging

F. Hydro-forming

G. Shrinking

H. Drawing

I. Rolls

---

7. What are some of the most outstanding features in the use of urethane? in the forming processes?

- -

A. Non-marring

B. Can accomodate varying thickness of material without changing set up.

METAL FINISHING

E.P.D.A. INSTITUTE IN MODERN

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The following unit was prepared by
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METAL FINISHING

M.F. - 1 Title Slide

"Loose Finishing" is a term often applied to methods involving barrel and vibratory machines. These machines have two things in common. They accomplish their work through collision of non-fixtured abrasive particles with workpiece surfaces, and both are used for the same type of work. Usually work is within the areas of deburring, descaling, radii forming, burnishing or surface improving.

This presentation will deal mainly with the vibratory type machine with a brief description of its basic components. All such systems have: 1) A work chamber called a bowl or tub, 2) A work media such abrasive nuggets, 3) A solution for cooling, cleaning, chemically attacking (e.g. acid descaling) or lubricating the media and workpieces and 4) A power source for applying motion to the media and workpieces.

Vib bowls are presently built in either straight-line or circular shapes. Sombe bowls are made with curved outerwalls and are especially useful for processing light parts that tend to float on

the media and resist blending into the mass. Bowls are usually lined with an elastomeric material such as rubber, neoprene or polyurethane.

Work media can vary from extremely abrasive silicon carbide to essentially non-abrasive hardened steel. Media shapes range from completely random, e.g. crushed granite, to triangular ceramic extrusions, and pyramidal plastic castings. There seems no limit to the shapes possible with modern extrusion, molding and pressing equipment. Common sizes of media particles vary from 1/6 inch diameter nuggets to large extruded triangles 2 inches on each edge.

Solutions used in vibratory systems are usually aqueous and are applied through a spray header above the bowl. The solution, percolating through the mass, passes through drain patches in the bottom of the bowl and from there to the sewer or a recirculation reservoir. A few of the older vibratory units are closed to solution flow, and a measured amount of solution must be added for each batch cycle.

Motion is generally applied to media in a vibratory bowl by revolution of an eccentric shaft which is

attached to the bowl. The eccentric shaft is ordinarily, a conventional shaft, with eccentric weights attached to the ends of the shaft. The shaft can be linked by gears or belts to a drive motor, or weights can be attached to a motor shaft and the motor mounted on the bowl.

M.F. - 2 Three types of loose finishing methods to be viewed are: vibratory, as shown here, barrel and spindle.

M.F. - 3 This is the ordinary barrel type finishing, many times referred to as tumbling. Parts, media and solution are loaded into the barrel and rotated until desired finish is obtained.

M.F. - 4 Spindle finishing is accomplished using a machine of this type. The workpiece is attached to the spindle and lowered into the tub. The tub is loaded with the abrasive particles and rotated in the opposite direction of the spindle.

M.F. - 5 This straight-line vibrator, is one of the batch type. The loose finishing takes part in the tub at the upper left. When the desired finish is obtained, the charge is unloaded onto the separating belt.

M.F. - 6 Vibratory action in the straight-line bowl is caused by rotation of the eccentric weights as shown. The entire unit is mounted on springs so that it is free to vibrate due to the eccentric action.

M.F. - 7 A comparison is made between barrel action and vibratory action. The work zone, in the barrel, is from upper left to lower right on the top of the media. This is called the slide zone. The material below the slide zone merely rotates with the barrel, until it reaches the top and then slides down.

In the vibratory tub on the right, work is being done throughout the mass. This is caused by the orbiting of the entire mass (the macro orbit) as shown by the arrows.

M.F. -8 In addition to the macro orbit mentioned on the previous slide, we also have a micro orbit of each particle in the mass. Each particle is making a very small orbit within the macro orbit, thus one can see each particle is subject to constant abrasive action.

M.F. - 9 Shown is a cross-sectional view of a bowl filled with media. Energy distribution is very high at the bottom due to the high vibration and the weight of the mass. Energy is high along the outside edge

of the mass, due to the movement along the edges. Energy is low at the center of the mass due to absorption of vibration.

M.F. - 10 A solution is used in most vibratory machines for: cooling, cleaning, chemical attacking (acid descaling) and lubricating of the media and workpiece.

The yellow area indicates a typical solution flow.

M.F. - 11 Straight-line units may be linked together to form an infinitely long unit.

M.F. - 12 Five units are linked together to accomodate long workpieces. The workpiece here is an aircraft wing spar.

M.F. - 13 Vibratory finishing can be accomplished in a circular bowl of this type. The entire media rotates in a counter-clockwise direction, along with the macro and micro orbital movement, until the desired finish is obtained. At this time the gate is dropped down and separates the workpiece from the abrasive particles.

M.F. - 14 Shown, are the top and front view of a circular bowl vibrator. The eccentric weights and springs cause the vibrating action. The bowl is spiral in

design and the media moves around and over the screen for part removal.

M.F. - 15 The essential components of a circular bowl vibrator are shown. This machine uses the same principle as the straight-line vibrator as is shown by the similar parts.

M.F. - 16 Vibration is created by the eccentric weights of this type.

M.F. - 17 Here is a typical settling tank and circulating pump. Its function is to separate the undesirable particles and re-circulate the solution.

M.F. - 18 The urethane lining is shown in this tub that is under construction.

M.F. - 19 A variety of sizes and shapes of abrasive particles are used to obtain the desired results. The abrasives are made from ceramics, plastics, porcelain and granite. The plastic and ceramic particles may be charged with abrasive material such as silicon carbide.

M.F. - 20 Steel balls (essentially non-abrasive) of various sizes are used in the burnishing operation to obtain the desired surface finish.

M.F. - 21 Here is an example of fishing spoons, before and after burnishing.

M.F. - 22 Abrasive particles are used to remove excessive ink or paint from plastic parts.

M.F. - 23 Zinc die castings are often burnished for the finish desired. The steel balls peen the surface to blend in any surface irregularities.

M.F. - 24 This is another example of the same burnishing process.

M.F. - 25 In conclusion, the vibratory machine has proved to be more economical than other methods of surface finishing. Vibratory systems are easy to automate and require short work cycles. Normally a separate finishing department is required where workpieces are handled individually. It is now possible to handle large quantities of parts right in the production line.

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for

Unit XI Metal Finishing

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VT 010 527
Tree Identification: Western Pines.

California State Polytechnic Coll., San Luis Obispo. Vocational Education Productions
California State Dept. of Education, Sacramento. Vocational Education Section
MF AVAILABLE IN VT-ERIC SET.
Vocational Education Productions, California State Polytechnic College, San Luis Obispo, California 93401 ($2.00, Manual and 20 slides available for $6.50).
PUB DATE - 69 21p.

DESCRIPTORS - *GUIDES; *AGRICULTURAL EDUCATION; *IDENTIFICATION; *TREES; *FORESTRY; NATURAL RESOURCES; CLASSIFICATION; TAXONOMY

ABSTRACT - This multi-media kit, for use in agricultural education classes studying tree identification, consists of the following: (1) 10 slides of pines of commercial significance in the West, with the common and Latin names of the tree superimposed on a combined view of a typical specimen and a close-up view of the trunk and needles or leaves, (2) 10 slides identical to the ones identified, but without the names, to be used for testing purposes, (3) 10 transparency masters, one for each of the 10 species pictured on the slides, for use in producing overhead transparencies or other instructional materials, (4) short descriptions of the 10 pictured species, and (5) suggested identification procedures. The 10 Species of western pines covered are: (1) Douglas Fir, (2) Engelmann Spruce, (3) Idaho White Pine, (4) Incense Cedar, (5) Larch, (6) Lodgepole Pine, (7) Ponderosa Pine, (8) Sugar Pine, (9) Western Red Cedar, and (10) White Fir. The slide set may be obtained from the source of availability indicated for this document. (AW)

VT 010 527

ED0 45856

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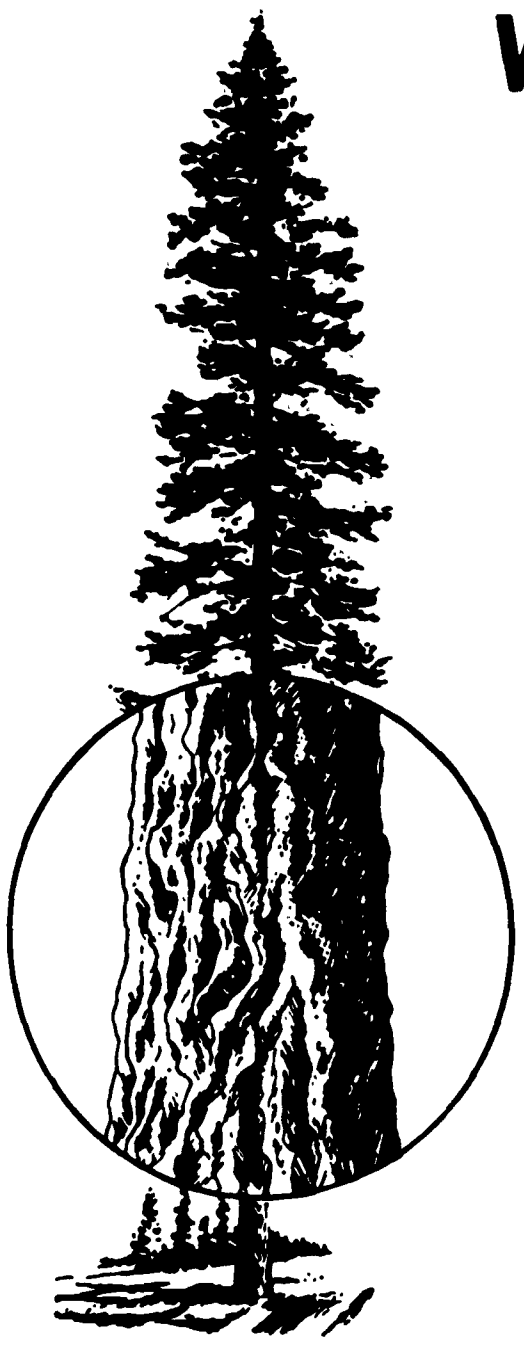
TREE IDENTIFICATION:

WESTERN PINES



DOUGLAS FIR

ENGELMANN SPRUCE

IDAHO WHITE PINE

INCENSE CEDAR

LARCH

LODGEPOLE PINE

PONDEROSA PINE

SUGAR PINE

WESTERN RED CEDAR

WHITE FIR

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VT010527

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TREE IDENTIFICATION:

Western Pines

Principles of Tree Identification

A. Learn to recognize various tree species in the forest by learning the overall look of big examples of the tree as pointed out by a forester, teacher, guide or guide book (What a big one looks like from middle-distance). Practice in this will have to be done on good specimens which are somewhat separated from the mass of the forest.

B. Look for specifics like size; straightness, thickness and taper of mature trunk; color and texture of mature bark; how high the limbs start, their shape and sense of organization; shape of needle sprays as they appear on the branches, visibility of cones if any, etc.

C. Notice young saplings and intermediate size trees of the same species which are usually growing nearby. Young "reproduction," as it is called, often looks quite different from the parent trees—always in size, sometimes in leaf or needle, particularly in density of limbs and texture of bark, and sometimes in general shape and appearance.

D. Come closer for a close-up examination of bark (color, thickness, texture — grooves, scraggliness, etc.); needles (shape, length, color, how many to a bunch, how they grow on the twig); cones (size, shape, scale design, "feel," how attached to the branch). Old cones are usually on the ground beneath the tree if none are visible on the tree itself. While you are close up, give the squeeze-the-needles test to a sprig of the foliage. In learning the difference between Engelmann Spruce and Blue Spruce, foresters sometimes say that if your reaction is "Ouch!" the tree is Engelmann Spruce. If it is "#%$—&*!," it is Blue Spruce.

E. Finally, back off and view the tree from a distance again, reviewing all the aspects you have learned, while memorizing its overall look, large or small. Expect major variations in general form to appear under extremely different conditions of altitude, sunlight, water, soil, and competition.

For a more thorough study, get a book like *The Best Loved American Trees* by Robert Lemmon or *North American Trees* by Richard Preston, and really get into the vast and technical study of tree identification. Who knows, it might start you on a career in forestry.

This multi-media kit, "Tree Identification: Western Pines," consists of the following:

—10 slides of pines that are of commercial significance in the West, with the common and Latin name of the tree superimposed on a combined view of a typical specimen and a close-up view of the trunk and needles or leaves.

—10 slides identical to the above 10, except that the name of the tree does not appear. (These can be used for testing students.)

—10 overhead transparency masters, one for each of the 10 species pictured on the slides, which can be used with a Thermofax machine or other similar office duplicating equipment to produce overhead transparencies. (The masters may also be used to produce ditto masters for distributing copies to all class members for study and review.)

—Short descriptions of each of the 10 species pictured, and an accompanying small copy of each of the overhead transparency masters.

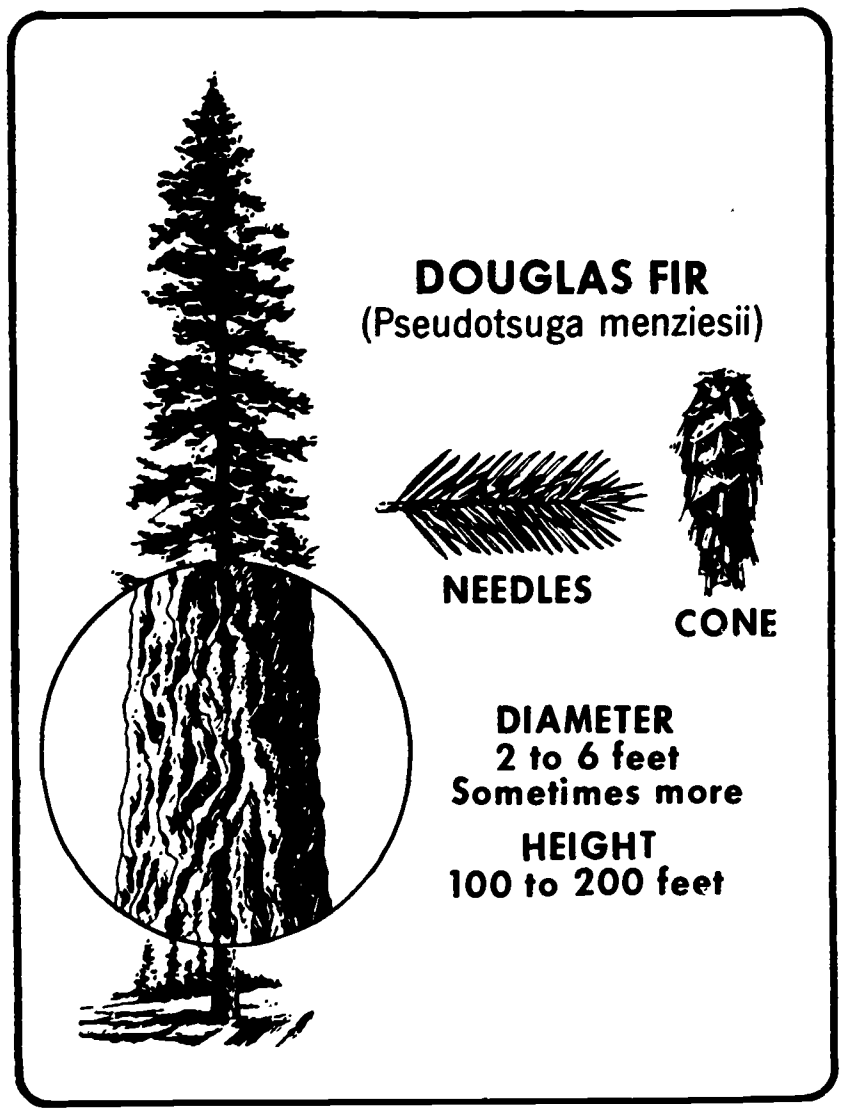
—Suggestions for identification procedures.

The overhead transparency masters may be easily removed from this manual by bending back the single staple which holds them. The ten sheets can then be quickly separated along the perforations.

This multi-media kit is intended not only for students planning a career in forestry. It is designed also to help all students to better identify an important agricultural "crop" that is a vital natural resource as well.

Special thanks should go to the Western Wood Products Association, which provided the photographs and basic drawings from which the slides and overhead transparencies were made; and to the American Forest Institute and the Forest Service of the U. S. Department of Agriculture, for their cooperation in providing background information.

—*The Editors*



DOUGLAS FIR is the king of lumber trees because of its high volume supply and outstanding construction qualities. Its strength makes it the nation's first line wood for structural purposes, though for some jobs it is too hard and difficult to work compared to softer woods. This stately giant grows in wetter areas — the Pacific Coast rain forest or, inland, in the forests receiving 28 to 40 or more inches of moisture annually (generally in the mountains from 4000 feet in the Northwest to 11,000 feet in the Southwest, though Douglas Fir grows its largest near sea level in British Columbia).

The "Doug-fir," as it is called, is named for David Douglas, the great Scottish plant hunter who discovered it in 1826. Botanically it is between the firs and the spruces with some characteristics of each — a species distinct in itself called *Pseudotsuga taxifolia*, or "false hemlock with a yew-like leaf." A most symmetrical and graceful tree radiating a dark aspect, it frequently grows in close-packed pure stands; yet almost as often occurs intermingled with all the other major western conifers — Ponderosa, Sugar Pine, Lodgepole, Larch, White Fir, Engelmann Spruce, etc. (This mixed conifer type of forest indicates rain or snowmelt heavier than that which will support Ponderosa alone.)

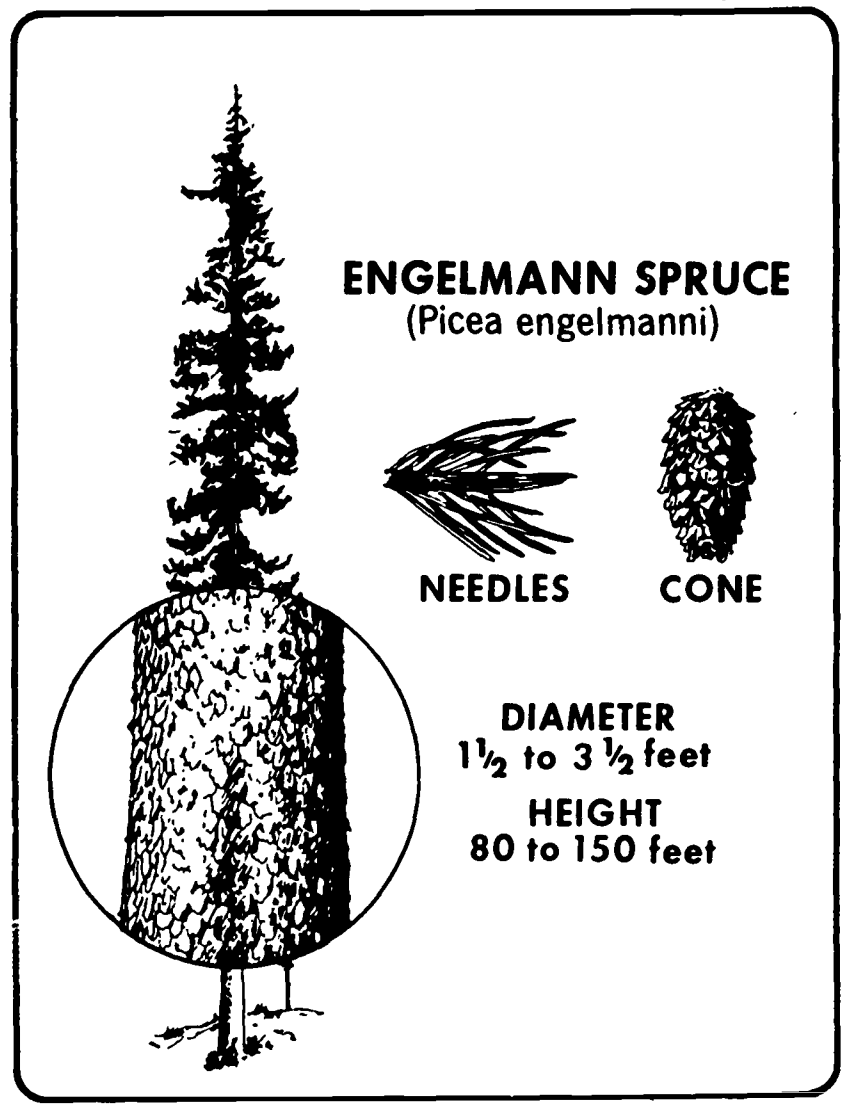
Mature Douglas Firs frequently reach 200 feet in height and 7 feet in diameter in Pacific Coast forests (130 feet with three-foot diameters in the Rockies) with moss hanging from the medium-green boughs. The needles, much shorter than those of the pines, are about an inch long, bright green above and blue-white beneath. Doug-fir needles occur *all around the twig* (thus distinguishing them from White Fir and other true firs) and are *soft to the touch* (thus distinguishing them from the stiffer, more pointed Engelmann and other spruces).

Doug-firs also do not radiate the trim bristly appearance of the Spruces or Red Fir, or the graceful flatter-branched limbs of the White Fir.

The nation has some 600 billion board feet of Doug-fir standing, and harvests about 8 billion feet a year. When the logger yells "Timmmmberrrrrrrr!" and seventeen tons of valuable wood sway and crack and come sailing down, the limbs break off due to air resistance and sail down after the trunk, making a second, softer "whump!" on the earth.

Yet the Doug-fir is a prolific seed bearer. And its growing habits — thousands of little trees growing up together in pure even-age stands — make clear-cutting of blocks best in pure Doug-fir areas. As long as sufficient uncut trees surround the cleared block, it will quickly seed in with a new, fast-growing forest.

ENGELMANN SPRUCE (*Picea engelmanni*) is a



snow-country tree, a tall graceful spire of darker needles not quite so narrow, dark and spiry as the Alpine Fir, but the next thing to it.

Engelmann Spruce grows at elevations of from 1500 to 5000 feet in the Canadian Rockies, somewhat higher in the Bitterroots of northern Idaho and western Montana, higher still in the central Rockies of Colorado, Utah and Wyoming, and from 10,000 to 12,000 feet in the southern Rockies of Arizona and New Mexico. It is also frequent in the Cascades of Oregon and Washington.

At timberline it will appear dwarfed and struggling; but in its true home — the flanks of the mountains, surrounding lush alpine meadows — it will appear stately and full, rich and strong, yet with an air of composed reserve perhaps left by its survival of centuries of Arctic winters.

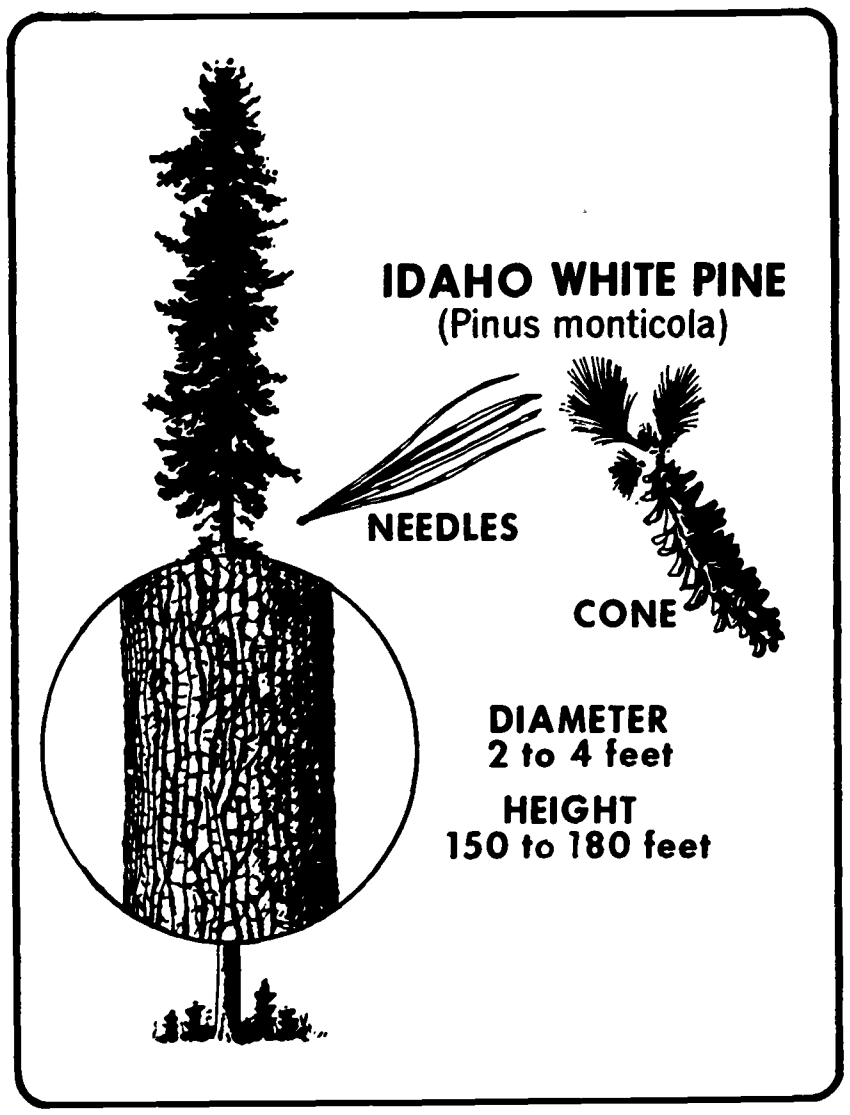
The Engelmann Spruce grows from 80 to 150 feet tall, with a 1½ to 3 foot diameter. Like all Spruces, the Engelmann has four-sided short needles which grow separately (not in bundles like the pines), bristling out from the twig in all directions (though curving around to the upper side), not just on the two sides or top of the twig as do the firs. These Engelmann needles are blue-green, flexible, an inch or so long, with tips sharp but not thorny to the touch, yet with a disagreeable odor when crushed.

Engelmann cones, two inches long and narrow in proportion to width, are light brown. They have a loose-plated look when mature, as though someone had just made them up by hand-glueing a hundred flexible woody scales together. The bark of the Engelmann Spruce is also distinctively scaly, thin gray to russet-red bark made up of loosely attached scales overlapping downward, yet many of them curled loose from the tree on the downward side like old sunburn.

Engelmann is an important sawtimber tree in the Rocky Mountain area, though much of its range is not particularly accessible country. The wood is nearly white, odorless, light yet strong for its weight; it has a wide range of uses from rough construction to fine interior finish work, paneling, crates, poles, ties and furniture.

About 85 billion board feet remain in the twelve continental western states, from which about 400 million board feet of lumber products are produced annually. The species sometimes is found in pure stands but more often grows intermingled with Alpine Fir, Doug-fir, Lodgepole, White Fir and Limber Pine.

IDAHO WHITE PINE (*Pinus monticola*), also called the Western White Pine, is a graceful, narrow-crowned, symmetrical tree of the northern Rockies and mountains of the Pacific States. A five-needle pine with slender cones 5 to 15 inches in length, this important softwood has bark which is dark, almost purplish, gray or silver gray, broken into a distinctive pattern: a cylindrical grid of vertical oblong blocks.



Idaho White Pine generally grows 90 to 180 feet high with a 2½ to 5 foot diameter. The wood is straight-grained, soft, light and easily worked, popular for woodwork, cabinet making and knotty pine paneling.

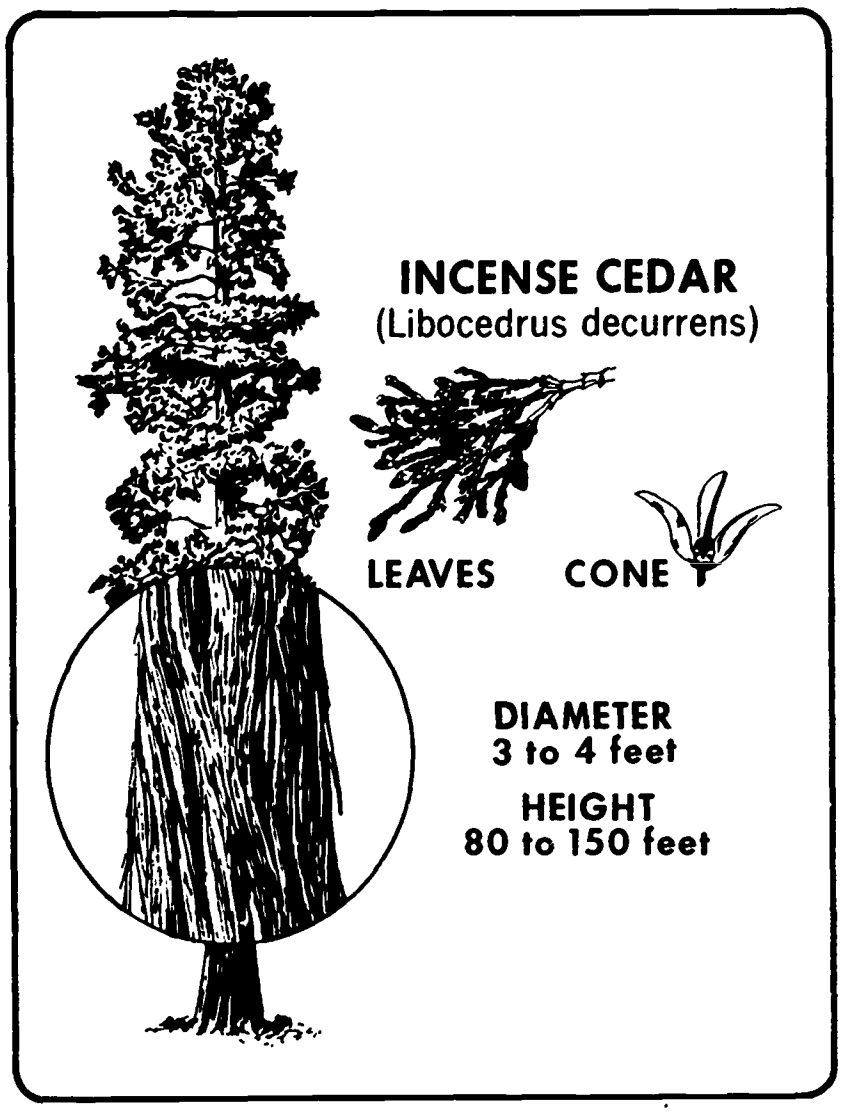
The Idaho White Pine is a western cousin of the famed Eastern White Pine, now largely logged away, and as such shares in the latter's great reputation of excellence for woodworking. A close relative of the Sugar Pine, the Idaho White Pine is similarly much less plentiful than other lumber trees (like Doug-fir and Ponderosa).

About 27 billion board feet of Western White Pine grow in the U.S.; most of this supply is in northern Idaho, and about 1% a year is turned into boards and matches and other wood products.

Growth range is 2000 to 7000 feet (Canadian Zone) in the northern Rockies, from sea level in the Olympics to 7500 feet in the Cascades, from 4500 in the northern Coast Ranges of California to 11,500 feet in the Sierra Nevadas. The Western White Pine even grows in southern California in the mountains above 8600 feet.

The needles, 2 to 4 inches long and five to a cluster, stick out from the twig in sharp sprays of many clusters each, like bottle-brushes or little whisk brooms. Frequently the Western White Pine is difficult to distinguish from the other conifers it is mixed with because the denseness of the forest forces the foliage to be all at the top, 100 or more feet from the ground, locked in the "crown" of interlacing competing conifers. Hence we may have to identify this tree by its distinctive bark or its cones.

The cones, long, slender and flexible, give rise to another of the Idaho White Pine's common names, the Fingercone Pine. These cones are erect and green when young, later becoming purple and dangling on long curved stalks. The scales are thin and flexible without spines. The seeds, shed in September and October soon after the cones ripen, may be carried several hundred feet from the parent tree. After big fire years like 1889 and 1910, large stands of young White Pine sprout up to renew the forest once more.



INCENSE CEDAR (*Libocedrus decurrens*), source of pungent-smelling red-to-cream cedar wood for paneling, posts, and pencils, is another handsome forest monarch from the mountains of California and Oregon.

The mature tree is easily recognized by its thick red-brown trunk and scraggly bark of deep vertical furrows. George R. Stewart described these distinctive trunks as "fluted columns"; Collingwood called them "shreddy . . . deeply grooved and ridged."

Those familiar with the giant Sequoia will find the Incense Cedar roughly resembling on a modest scale her larger neighbor. Similar appearances include: thick reddish-brown bark with deep vertical furrows; a trunk fat in proportion to the height of the tree, with corresponding fast taper; a similar rounded clumpy appearance to the crown of foliage (unlike the spiky tops of so many other conifers); and a crown which generally clears the lower third to one-half of the trunk for a stately rise from the forest floor.

Thus to the casual observer in the Sequoia region of the Sierras, the Incense Cedar in middle distance may be mistaken for a Big Tree in its youth. Yet upon closer examination the two can be readily distinguished by size, by more roundedness to the foliage of the Sequoias, and by more scraggliness to the bark in the Incense Cedar.

The foliage of the Incense Cedar, like that of other cedars and junipers, does not consist of needles; the tiny leaves are small scales of green overlapping each other along the ends of the twigs to form compound fronds 4 to 9 inches long. Incense Cedar foliage is also distinctive in that it looks as though someone took each frond of tiny light-green leaves, pressed them flat, and gave them a shiny coat of shellac.

The Incense Cedar flowers with male and female blooms surprisingly in January or February, like a touch of the goldenrod of summer above the snow. The cones, unlike the intricate designs of those of the pines and spruces, are small, drooping, light-brown pods about 1¼ inches long containing only a pair of winged seeds. When these pods mature, they curl open into a three pronged husk, releasing the seeds; the husk remains open on the tree like a small frozen flower or a tiny exploded banana-peel.

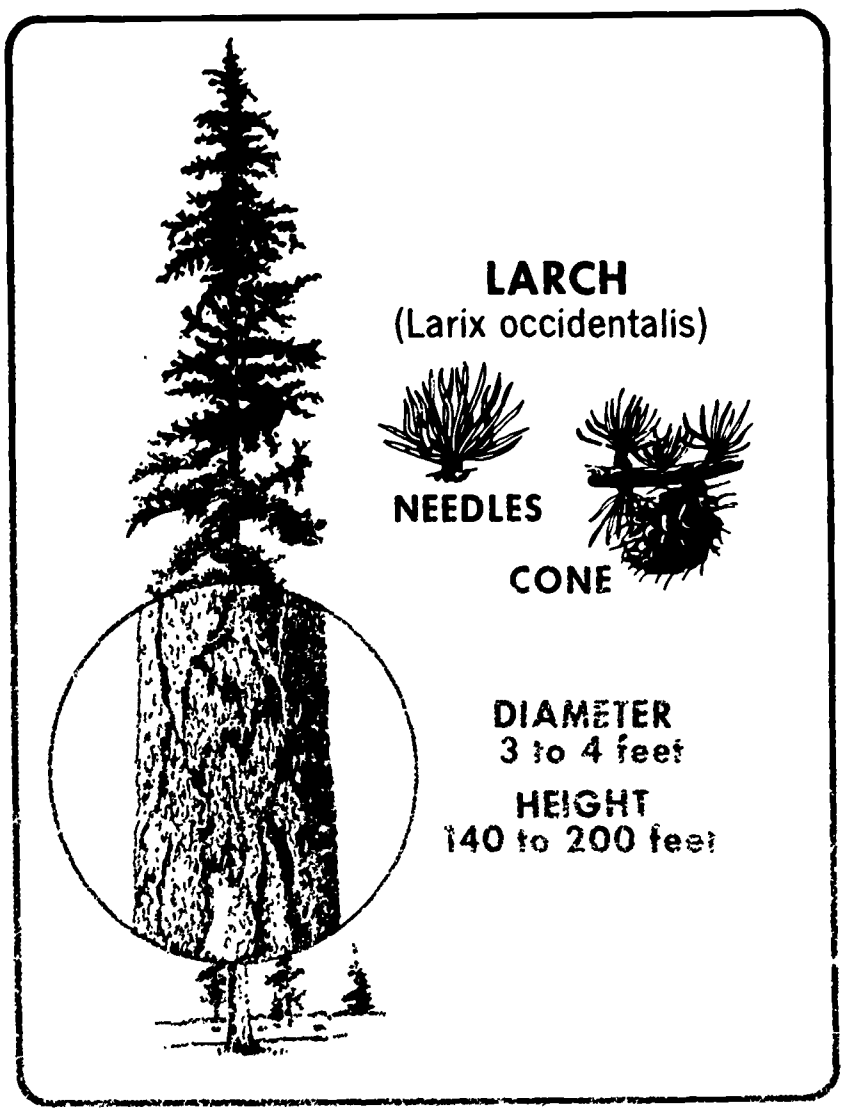
Range of these beautiful trees is along the middle altitude-temperature-wetness zone of the mountains, from the Cascades in Oregon through the Coast and Sierra Nevada ranges of California to the San Pedro Martir Mountains in Baja California, from about 1000 feet in the wet north to 9000 feet in the warmer south.

Though 2500 to 7500 feet is the tree's general habitat, Incense Cedars reach their best development on the west slope of the Sierras at 5000 to 6000 feet. Large specimens reach 150 feet in height, and a diameter of 3 to 4 feet, though the average will be 80 to 90 feet with a two-foot thickness.

Incense Cedar is rarely found in pure stands: it grows intermingled with Sugar Pine, Ponderosa, Doug Fir, and White Fir. Standing Incense Cedar

left is about 13 billion board feet. Average annual wood production is 70 million board feet or about one-half percent. Such figures do not tell the whole story, however, because the standing timber figure usually includes park forest not open to lumber production.

The light, non-resinous wood of the Incense Cedar is soft, workable, fragrant, yet durable and strong. It would be important for many uses except for the prevalence of pecky rot which attacks the heartwood of the standing tree.



The LARCH (*Larix occidentalis*), also called Western Larch or Tamarack, is a tall straight-growing conifer of northern Idaho and surrounding states.

The Western Larch is a rarity among western forest species, being a cone-bearing tree which is deciduous, shedding its needles every fall (as an oak drops its leaves) and growing a new set each spring. Yet the casual observer in the summertime would never know he was not looking at an evergreen, since the Larch from a distance closely resembles the Doug-fir and Idaho White Pine with which it is often intermingled.

The chief difference noticeable is that the needles have a thinner, flimsier look and are a lighter green, becoming yellow toward late summer — and of course they are gone from the tree entirely in early autumn. These needles, 1 to 1¾ inches long, come in rather wilted-looking globular sprays of twenty or so each, growing out of little nubs along each twig. The cones (1½ inches long) grow right on the twigs like little armadillos crawling along the limbs.

The Larch grows to be 140 to 200 feet in height, up to 3 or 4 feet in diameter, frequently with a swollen butt. The bark at the base of mature trees is reddish cinnamon-brown, 3 to 6 inches thick with deep fissures between plates; 20 feet or so up the tree the bark is much thinner and less furrowed.

Though subject to a number of wood destroying fungi and sometimes to breakage along the growth rings, Larch in good condition furnishes remarkably strong, straight-grained lumber in large sizes and is widely used for residential and heavy construction. It frequently grows and is logged with Doug-fir and is cut and sold as a mixed product, Fir-and-Larch, because of its similar qualities. Larch is also much used in the northern Rockies for mine timbers, railroad construction, and telephone poles. Estimated supply of Larch timber standing is 43 billion board feet, from which about 200 million feet are produced annually.

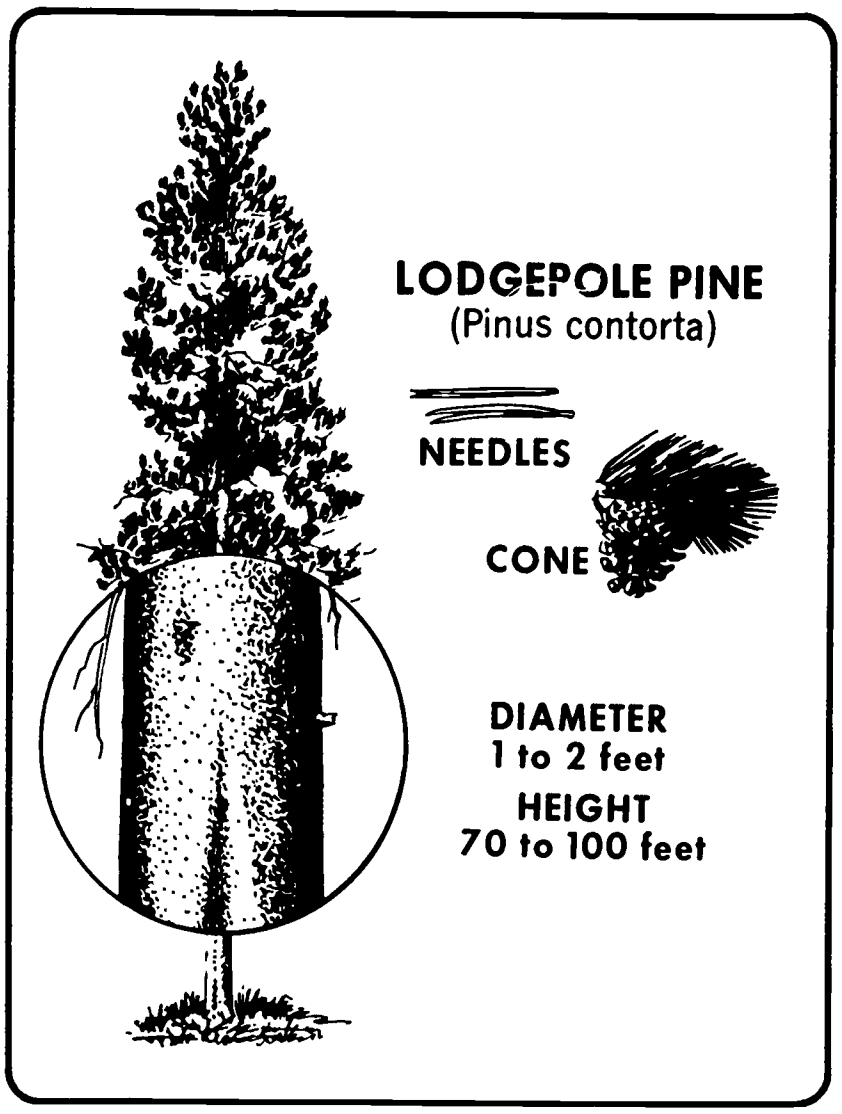
Though the Western Larch is not really the same as its relative, the Tamarack or Eastern Larch (*Larix laricina*), the sprigs of needles are sufficiently similar (and likewise shed in the fall) so that Idaho and Montana folks frequently call the Larch simply the Tamarack.

These tall, lighter green forests come in after severe fires, competing with Lodgepole Pine to get established in the burnt-over areas. Larch grow from 2000 to 7000 feet in their Northern Rockies home, sometimes in pure stands, sometimes mingled with the other principal sawtimber species.

The smokejumpers who fly over these forests on summer fire-fighting missions recognize the Larch as swatches of lighter green. To the trail-crew man on the ground, sawing through a downed log across the trail, the higher amount of pitch which binds his saw may identify the Larch.

LODGEPOLE PINE (*Pinus contorta*) is the most common conifer of the Rocky Mountains north of Arizona and New Mexico. It grows from sea level to 11,500 feet. It is a smaller tree among sawtimber species, at maturity 70 to 80 feet tall. 1 to 2 feet in diameter with a thin, loosely-scaly bark.

In the Rockies it grows in dense straight stands which produce up to 10,000 board feet per acre (though no single tree may be as large as a Ponderosa). Growing thus competitively in the high country, Lodgepole develops in its young trees the slim, straight, branch-riddled shafts 5 inches in diameter at the base which were a natural for the Indians to



use in construction of their teepees or lodges; hence the name, Lodgepole Pine.

Farther north as far as the Yukon and at lower elevation along the Pacific, the tree is frequently stunted and gnarled; hence the Latin name of "contorted pine" or the local names, Screw Pine or Scrub Pine. Though no different in flower, cone, or leaves from the dense-stand Lodgepole, these contorted examples (often at timberline or where there is ample room for the single tree to develop) appear from their general shape to be an entirely different tree.

The inland variety, however, is quite straight enough and productive enough to be important commercially for lumber, chiefly in Idaho, Montana, Wyoming, Colorado, Oregon and Washington.

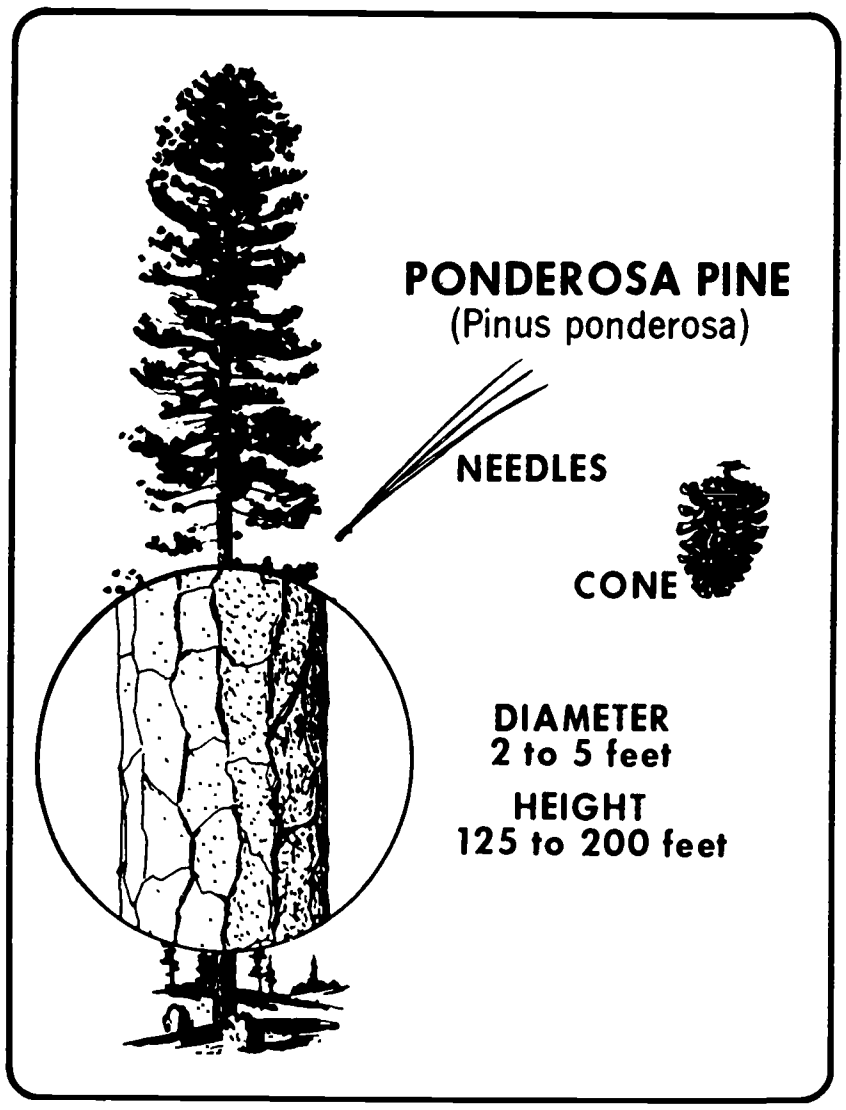
The total stand of Lodgepole sawtimber in the twelve western states is estimated at 47 billion board feet, from which some 140 million feet of lumber are produced annually. The wood makes substantial poles, mine-timbers, ties, siding, knotty pine paneling and subflooring.

The bark of Lodgepole is never very thick. It has a black crusty appearance on the young tree, taking on a pale reddish-brown scaly look in the larger trees.

To recognize Lodgepole, look for a smaller pine than the Ponderosa but one with a similar but smaller ball-spray effect to the clumps of needles. On closer examination these clumps will not resemble the ball shape but will be elongated tufts of one-to-three-inch needles, coming in bundles of two, with numerous small cones, 1 to 2 inches long, clinging to the branches. These lopsided prickly cones may hang unopened on the tree for many years until fire comes through, destroying the forest but roasting billions of cones to release trillions of seeds.

Thus the thick, impassable forest of Lodgepole, while forming a massive tangle of fuel for fire hazard, also contains its own secret missile system for counter-attacking the flaming enemy.

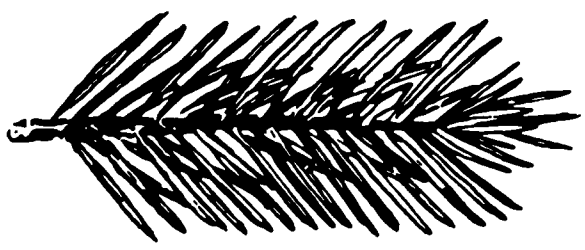
There is tremendous germination of Lodgepole seeds after a fire. And though millions of little seedlings crowd each other out, millions more survive to form the dense, even-aged Lodgepole stands aggressively fighting cold and snow for a place in the summer sun.



PONDEROSA PINE (*Pinus ponderosa*), also called the Western Yellow Pine, is the most widespread conifer in the inland West. It grows at elevations from 2000 to 7000 feet in the Northwest and from 5000 to 8000 feet in the Southwest, in the drier sites supporting sawtimber.

Ponderosa is the friendliest tree, because it is the most easily recognized and generally the first "real forest" tree encountered as you enter the mountains.

DOUGLAS FIR
(Pseudotsuga menziesii)



NEEDLES

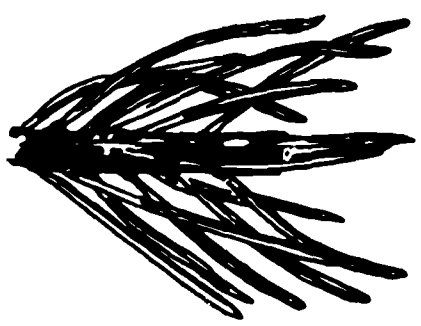
CONE

DIAMETER
2 to 6 feet
Sometimes more

HEIGHT
100 to 200 feet

COURTESY OF THE WESTERN WOOD PRODUCTS ASSN.

ENGELMANN SPRUCE
(Picea engelmanni)



NEEDLES

CONE

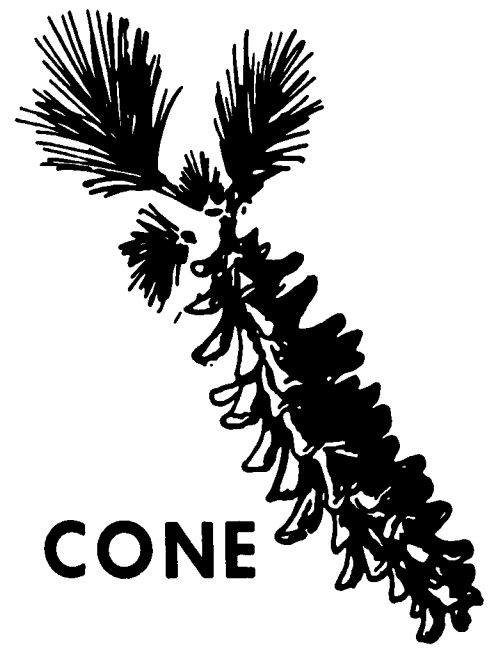
DIAMETER
1½ to 3½ feet

HEIGHT
80 to 150 feet

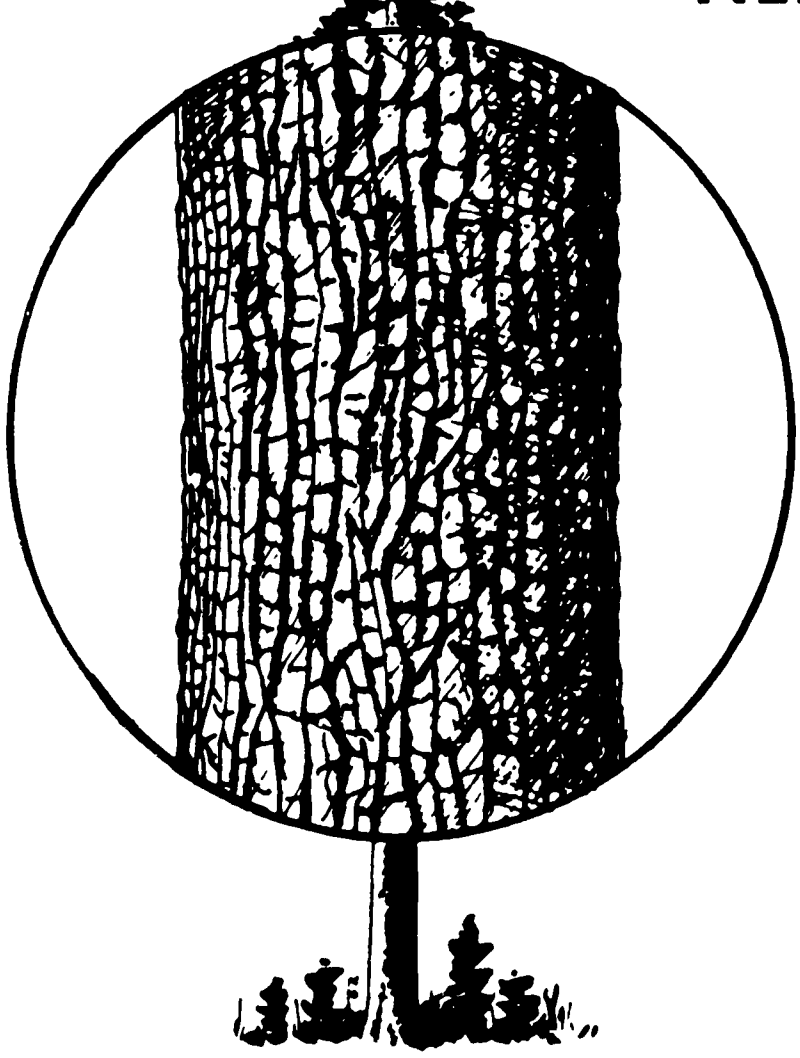
COURTESY OF THE WESTERN WOOD PRODUCTS ASSN.

IDAHO WHITE PINE
(Pinus monticola)

NEEDLES



CONE



DIAMETER
2 to 4 feet

HEIGHT
150 to 180 feet

COURTESY OF THE WESTERN WOOD PRODUCTS ASSN.

INCENSE CEDAR
(Libocedrus decurrens)

LEAVES

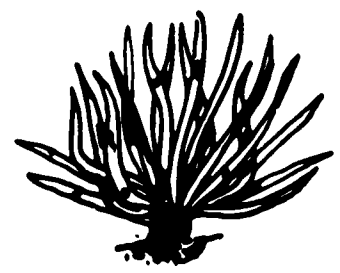
CONE

DIAMETER
3 to 4 feet

HEIGHT
80 to 150 feet

COURTESY OF THE WESTERN WOOD PRODUCTS ASSN.

LARCH
(Larix occidentalis)



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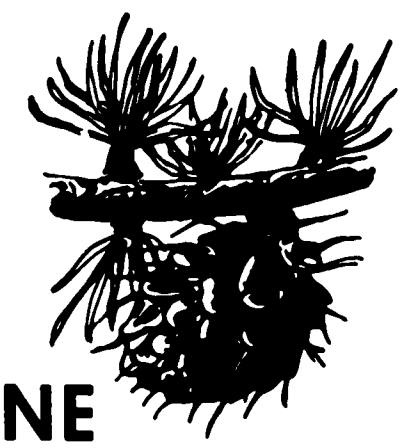
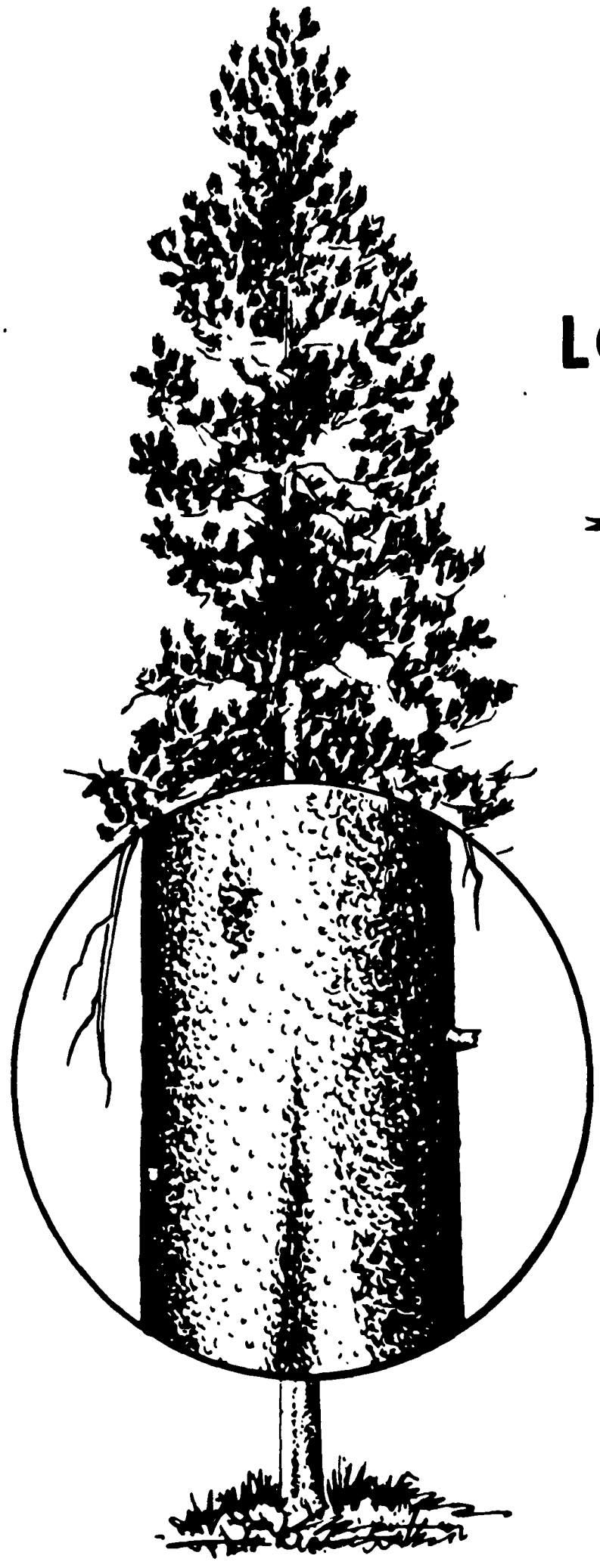


CONE

DIAMETER
3 to 4 feet

HEIGHT
140 to 200 feet

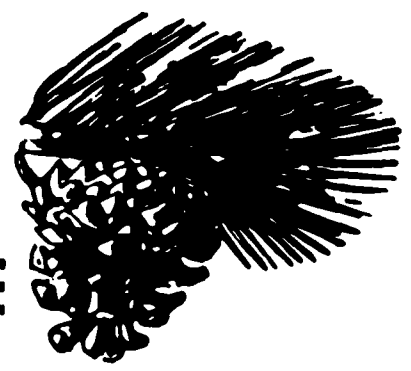
COURTESY OF THE WESTERN WOOD PRODUCTS ASSN.



LODGEPOLE PINE
(Pinus contorta)

NEEDLES

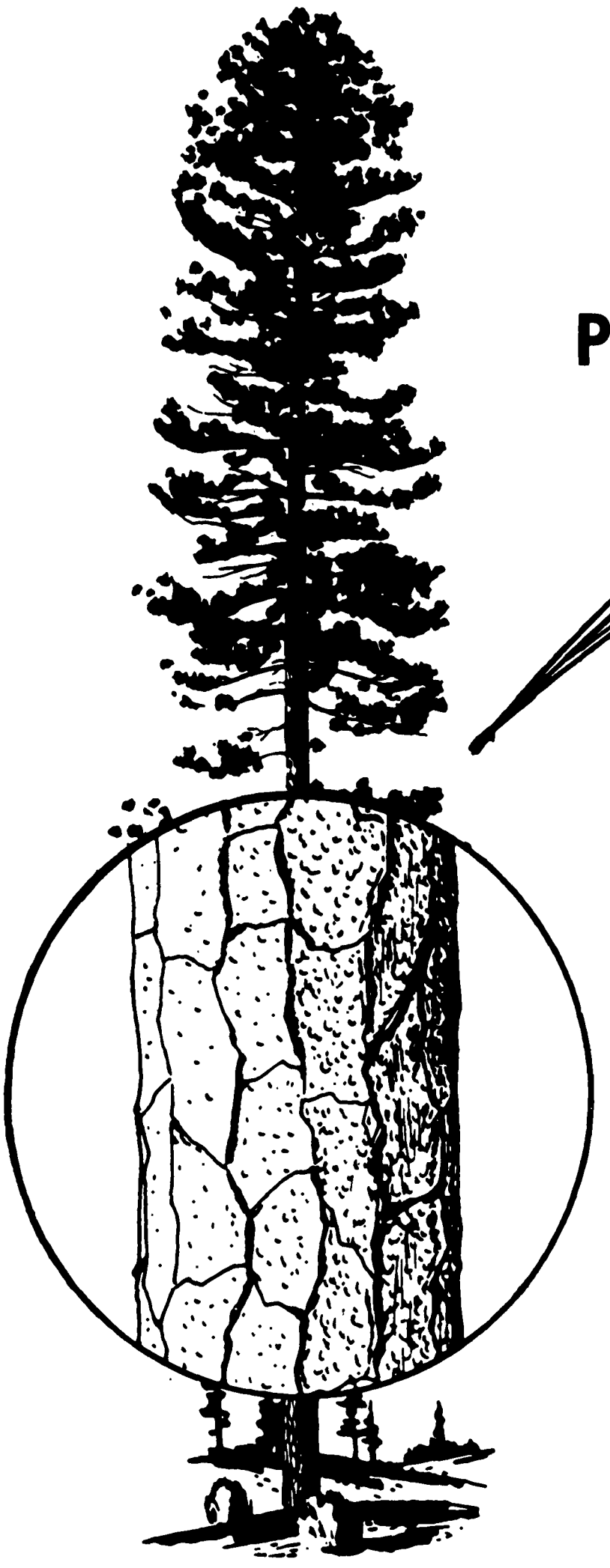
CONE



DIAMETER
1 to 2 feet

HEIGHT
70 to 100 feet

COURTESY OF THE WESTERN WOOD PRODUCTS ASSN.



PONDEROSA PINE
(Pinus ponderosa)

NEEDLES

CONE

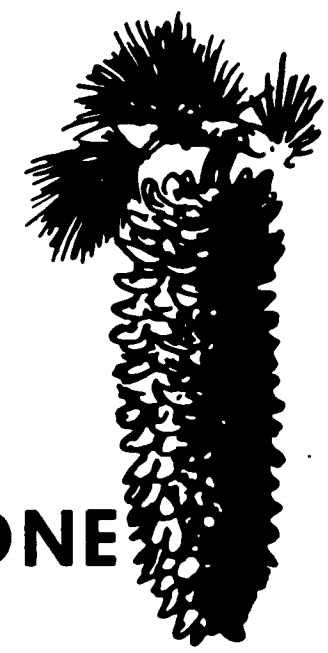
DIAMETER
2 to 5 feet

HEIGHT
125 to 200 feet

COURTESY OF THE WESTERN WOOD PRODUCTS ASSN.

SUGAR PINE
(Pinus lambertiana)

NEEDLES

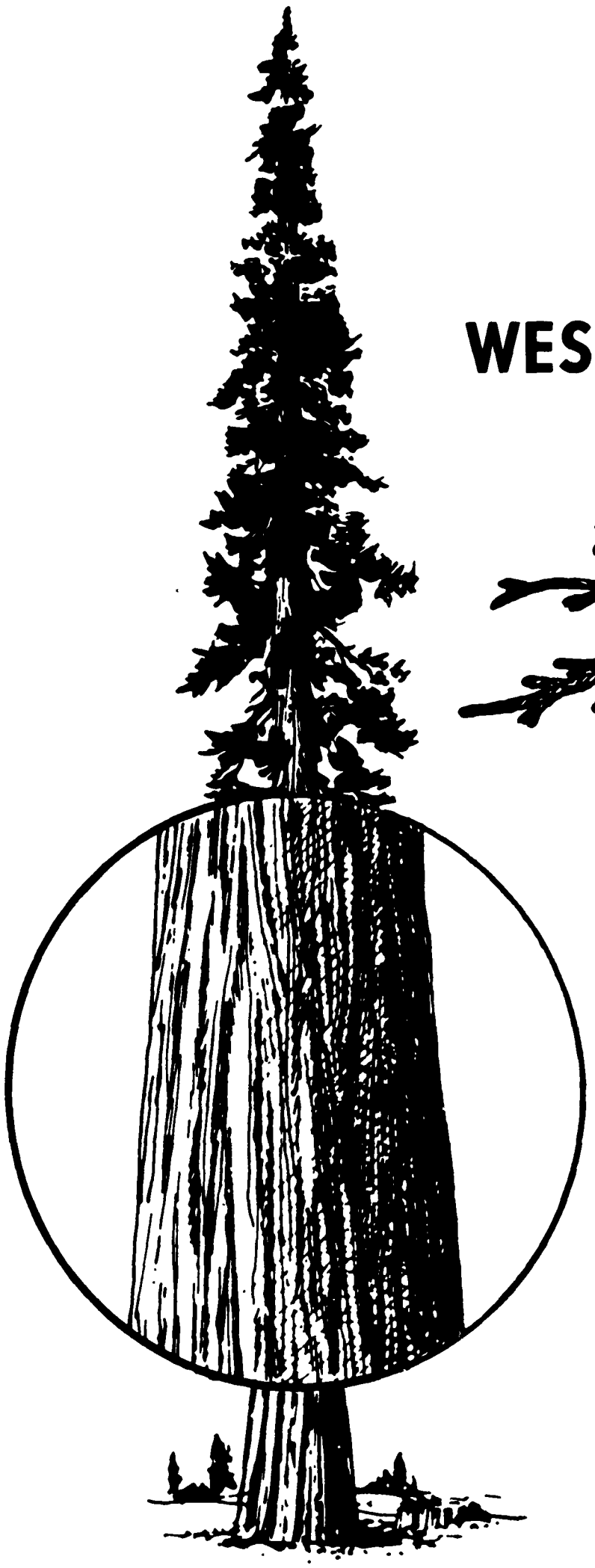


CONE

DIAMETER
2 to 7 feet

HEIGHT
160 to 200 feet

COURTESY OF THE WESTERN WOOD PRODUCTS ASSN.



WESTERN RED CEDAR
(Thuja plicata)

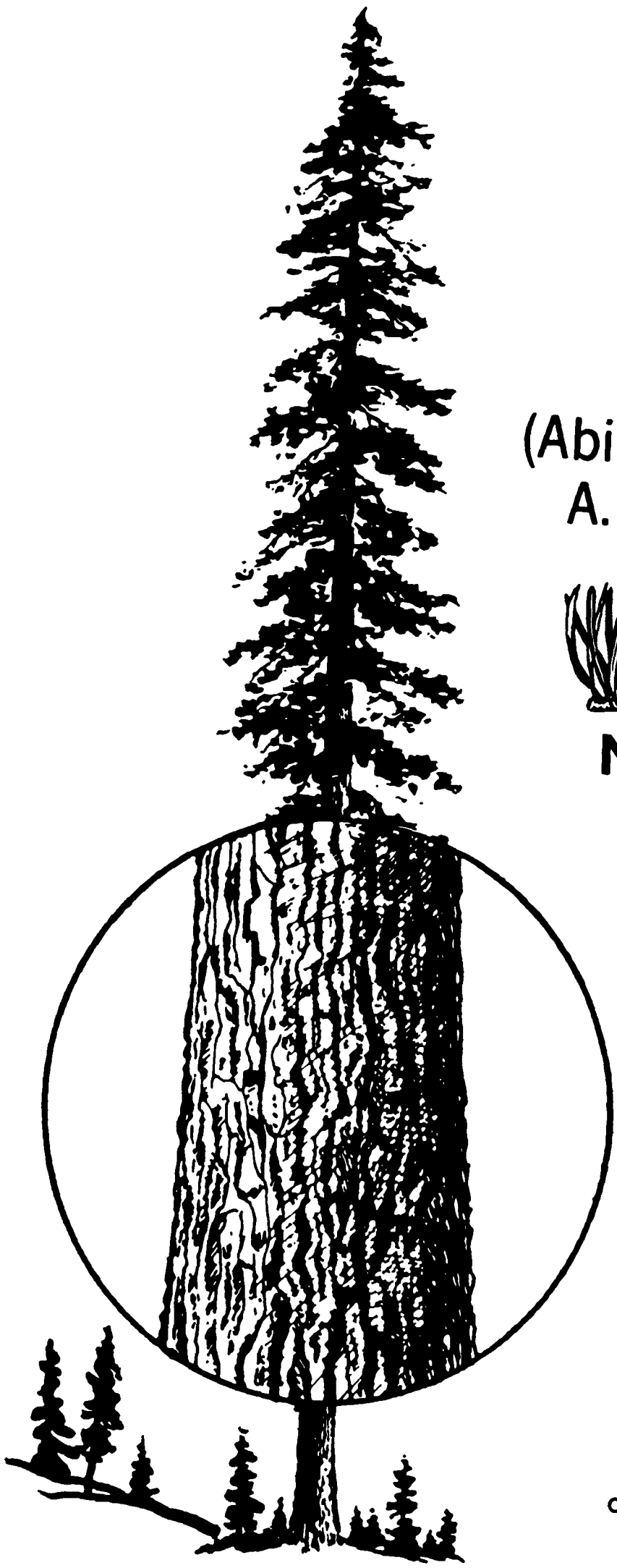
LEAVES

CONE

DIAMETER
2 to 5 feet

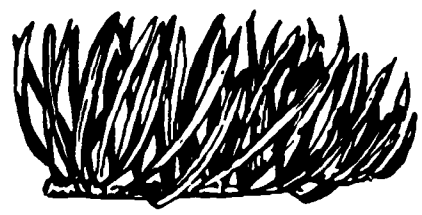
HEIGHT
80 to 150 feet

COURTESY OF THE WESTERN WOOD PRODUCTS ASSN.

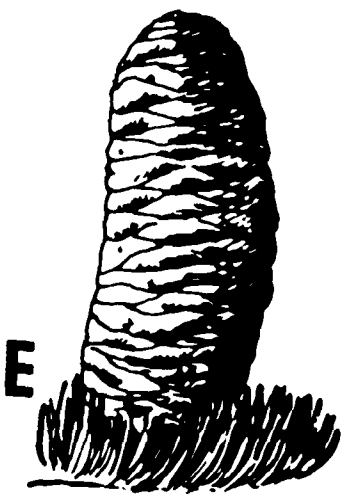


WHITE FIR

(Abies amabilis, A. concolor, A. grandis, A. magnifica)



NEEDLES



CONE

DIAMETER
1½ to 4 feet

HEIGHT
100 to 200 feet

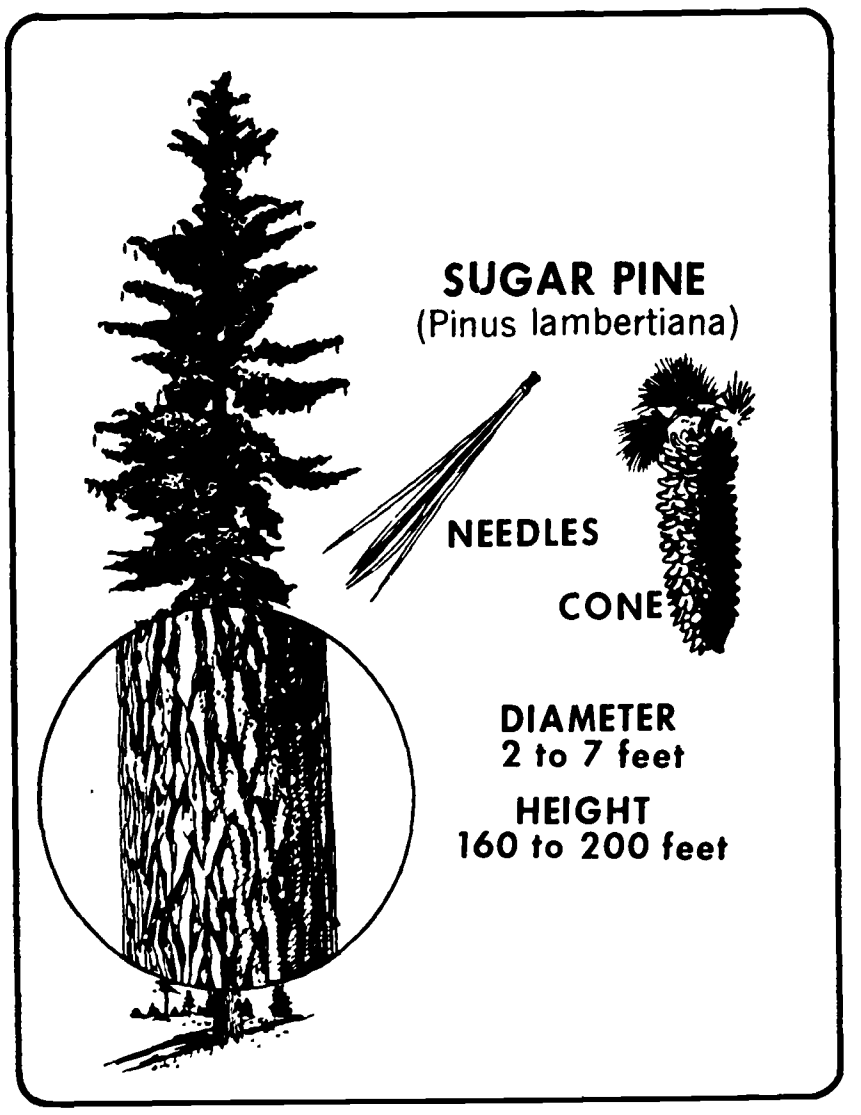
COURTESY OF THE WESTERN WOOD PRODUCTS ASSN.

You can tell it from a distance because it is tall, sturdy, straight-trunked pine whose needles splay out in balls at the ends of the branches. Closer up you will see that on the larger trees the trunk is limbless for a long way up and the yellow-brown bark cracks into distinctive plates that look like alligator-hide. No other western pine has this unmistakable bark.

The full-grown tree is 150 to 180 feet tall and 2 to 5 feet thick at the base. In warm, wet valleys Ponderosas sometimes grow over 200 feet with an eight-foot diameter, but most of these great trees have been long since logged away. The needles are long, 5 to 10 inches in bundles of three, and they shed all year, carpeting the ground with a soft layer. The cones are 3 to 5 inches long; when new are hard and pitchy; when old are dry and flaky, with scales spreading outward-pointed spines (if squirrels haven't chewed them off for the seeds). When the wind blows through tall Ponderosas, they sway and roar like the sea.

Ponderosas when small grow in dense thickets because millions of seeds sprout at once in the rare good germination years. Later these thickets thin themselves through competition (or are thinned by fire, logging, or intensive forestry) resulting in beautiful park-like forests of large all-the-same-age trees. Usually two or three such even-age stands of Ponderosas are growing in the same forest simultaneously, assuring — with proper forest protection and management — continuous crops of sawtimber and other forest benefits.

Ponderosa Pine is a great lumber tree, furnishing some 4 billion board feet of construction material annually out of a standing supply sixty times that size. This versatile softwood is useful for siding, sheathing, light framing, furniture, and many other uses. Its forest lands, getting 22 to 28 inches or more of moisture a year, form some of the pleasantest recreation areas in the West.



The SUGAR PINE (*Pinus lambertiana*), the largest and most beautiful of all the pines, also has some of the finest wood — and a tree-design which seems to be made to inspire man as well as to serve him.

Growing 175 to 240 feet tall in the mountains of California and southern Oregon, the mature Sugar Pine generally has a magnificent straight trunk 3 to 7 feet thick, 50 to 80 feet up to the first limb, topped by a disconcerted array of tufted branches flung out in all directions.

The bark of these great columns of wood is somewhat like that of their neighbors the Ponderosas, but more gray-brown to red-brown (rather than the yellow-brown of Ponderosa) and with a finer grain of vertical-furrow plating, resulting in a pink mottled effect.

When a Sugar Pine is wounded, it exudes whitish globules of resin with a sweetish taste; hence the name.

Not only do the Sugar Pines tower over their usual Ponderosa companions, but they have the hugest pine cones in the world, 10 to 20 inches in length — purple-brown, pitchy, and erect when young; a six-inch-wide football of yellow-brown flakes dangling from the limb-ends when mature.

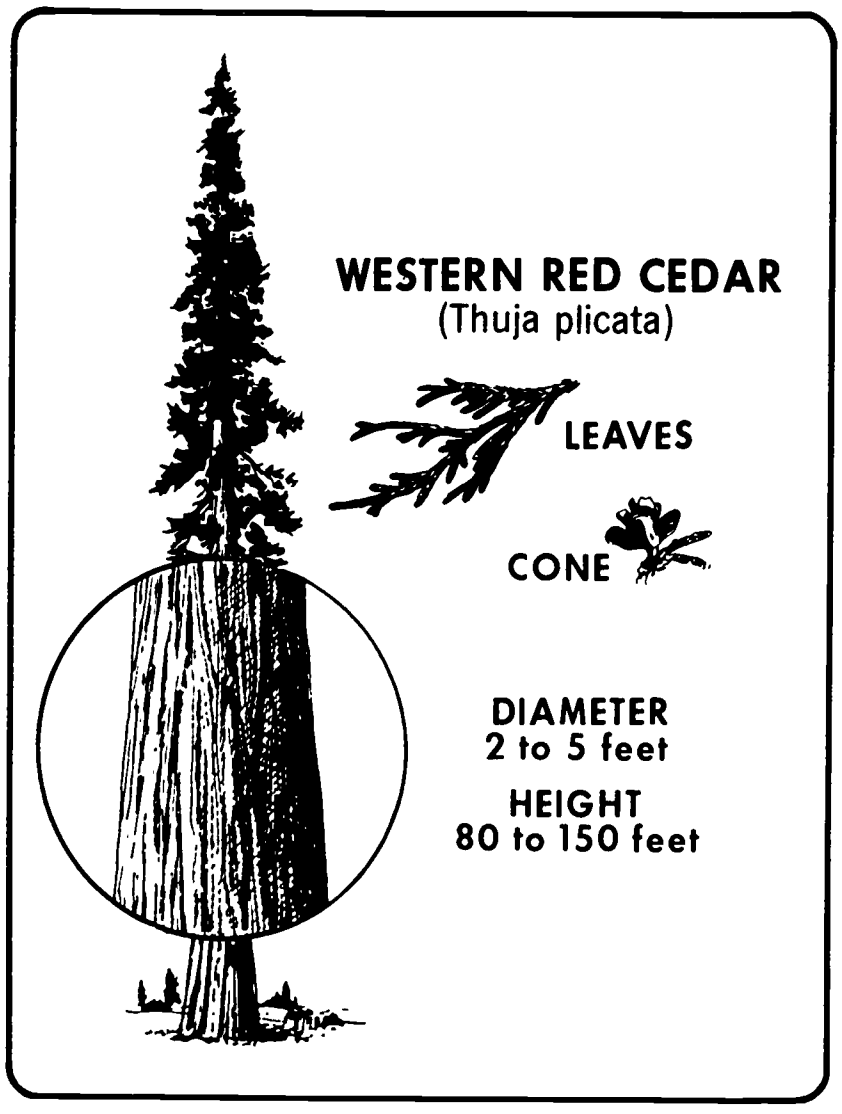
The trees grow in the 3000 to 10,000 foot range but do best on the western slopes of the Sierra Nevadas at 5000 to 6000 feet. Here, with precipitation over 40 inches of snow-melt a year, they attain the great stature which is only surpassed by their near-neighbors the giant Sequoias.

Often called "the king of the pines," the Sugar Pine is a true white pine, and as such is one of the five-needle pines with highly desirable wood (clear, straight-grained, light, strong, exceptionally resistant to splitting, perfect for jobs where carving or wood-pattern-making is to be done). Since it is so good for special purposes, it is not used for general construction.

John Muir gives a beautiful description of Sugar Pine in his book, *The Yosemite*. Within it he says:

No tree lover will ever forget his first meeting with the sugar pine. In most pine trees there is the sameness of expression which to most people is apt to become monotonous, for the typical spiral form of conifers, however beautiful, affords little scope for appreciable individual character. The sugar pine is as free from conventionalities as the most picturesque oaks. No two are alike, and though they toss out their immense arms in what might seem extravagant gestures, they never lose their expression of serene majesty. They are the priests of pines and seem ever to be addressing the surrounding forest.

Though limited in range (supply estimated at 30 billion board feet, annual production about 1% of that) and threatened by man, fire, and blister rust, the Sugar Pine is likely to be preserved if man really conserves his heritage.



WESTERN RED CEDAR (*Thuja plicata*), also called the Canoe Cedar, is one of the giant conifers of the Pacific Coast. It ranges from southern Alaska through maritime British Columbia, Vancouver Island, the Olympics and Puget Sound, and the Cascades to northern California — and inland to eastern British Columbia, Alberta, northern Idaho and western Montana — on sites below 7000 feet where the soil is very wet.

This is the tree from which Lewis and Clark carved their Pacific-bound canoes after crossing the mountains on Shoshone horses in 1805. This is the tree that the Indians before them used to carve totem poles and whaling canoes and to split into great plank communal houses and all kinds of wooden tools and necessaries.

Western Red Cedar commonly reaches 150 to 200 feet and a diameter of 5 to 8 feet, although few this large now remain after much cutting. The largest specimens reach 250 feet with a 16-foot diameter, although such giants are usually hollow from a center-destroying heart-rot.

Inland this same species is often called the Inland Red Cedar, and there it ranges from 80 to 150 feet tall with diameters from 2 to 5 feet. The stumps of the cedars cut by Lewis and Clark near present-day Orofino, Idaho — pointed out there until 1900 — were of these inland sizes.

Western Red Cedar trees are easily distinguished in the forest by their stringy fibrous bark and buttressed bases. Like other cedars, the Western Red Cedar does not have needles for foliage but flattened fern-like fronds of tiny scalelike leaves which look a bit like needles until closely examined. Their color is a dark yellow-green with a shiny finish.

Seed pods are tiny slabby things hardly recognizable as cones, near branch tips. The bark of the Western Red Cedar is less than an inch thick, cinnamon-red, shreddy in vertical strips — somewhat reminiscent of that of the Incense Cedar although not as deeply grooved or as thick.

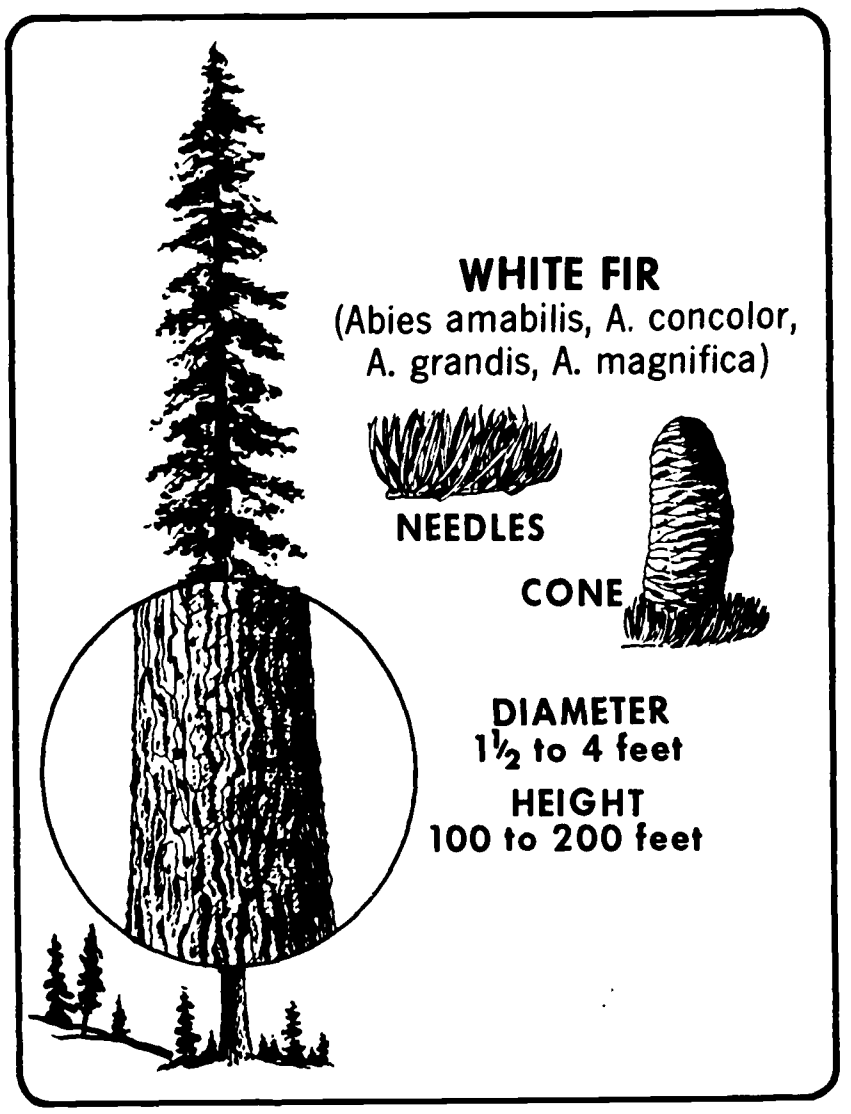
Western Red Cedar wood is widely used where durability rather than strength is required. The sapwood is white, the heartwood reddish. Soft and fragrant — one of the most decay-resistant of woods — it is widely used for shingles, siding, interior trim, boats, poles, nursery flats — or anything where resistance to water is a prime concern.

In the Pacific Northwest, where the rains come so perennially and the fog-shrouded forests march down to the sea, the Western Red Cedar is a grand competitor among the dense growth of Hemlock, Spruce, Fir and Cypress. Inland the tree, not quite so large but still stately and imposing, is found from 2000 to 7000 feet intermingled with White Pine, Ponderosa, Doug-fir, White Fir and Larch.

WHITE FIR is the name loosely given by the lumber industry to four closely related fir species which group into lowland and highland varieties.

The lowland types:

Grand Fir (*Abies grandis*), also called Lowland, White, Silver or Yellow. It grows on the Pacific Coast from San Francisco to the north end of Vancouver Island, inland through the Cascades to northern Idaho and Montana, at 5000 feet and below. Truly the grandest of firs, these graceful giants rise to 250 feet in the coast forests. Inland, though not so tall, they present a striking majesty.



Pacific Silver Fir (*Abies amabilis*), also called White, Red, Amabilis or Lovely Fir. It grows from the Cascades of Oregon north along the coast through Washington below 6000 feet, and on the coasts of British Columbia below 4000 feet, to the southeast tip of Alaska below 1000 feet. A noble tree of the tree-crowded Olympics, up to 200 feet tall, it often is seen shining with a silvery aura in proper light.

The highland types:

California Red Fir (*Abies magnifica*), also called Silvertip Fir. It grows from 4000 to 9000 feet in the mountains of California from the latitude of Bakersfield north to mid-Oregon. It is the largest of the firs in bulk of wood produced, with heights from 150 to 230 feet, and diameters from 4 to 10 feet. On old trees there is distinctively reddish-brown bark 4 to 6 inches thick with mottled furrows, almost like those of an oak; on younger trees the bark is smooth and chalky gray. The color effect of Red Fir needles is a rich green, not as blue-white-green as White Fir.

The White Fir proper (*Abies concolor*). The most widespread fir in the inland West, it grows at 6000 to 11,000 feet in the mixed conifer zone which first appears on the cooler, wetter north slopes of mountain ranges rising from the dry deserts. These trees have the flat spreading-hand of fir branches with a blue-white tinge to their green which usually distinguishes them from the Doug-fir or Ponderosa growing nearby. At higher altitudes they form dense pure stands (after growing up through the aspen) which, when opened for ski runs or power lines, may be seriously decimated by wind-throw and insects.

Taken together the four species span the entire western forest region, usually inland in the next wetter zone above the pure Ponderosa Pine country on up almost to timberline (White and Red varieties), or on the Northwest Coast and "Inland Empire" (north Idaho and vicinity) from sea-level to 5000 or 6000 feet (Grand or Silver varieties).

All four have the flattened frond-like limbs of firs, short needles ¾ to 1¼ inches long (a bit longer in the Grand), needles generally pointed up and out from the twig (not down), and down-drooping branches that start curving upward at the tips.

The cones, 4 to 8 inches high, are neat egg-shaped cylinders rising upward from the upper branches. Each cone has a clean, solid look like a miniature hornet's nest growing upright, built out of many smoothly-sculptured wedges — totally unlike the spiny pendulous effects of the cones of pines.

The wood of all four firs has similar characteristics: a disagreeable pungent odor when cut (one nickname: Stinking Fir); light, soft, brittle, fairly strong for its weight but not tough enough or resistant enough to decay for quality construction; and used for crates, pulp, lumber on jobs where strength and durability are not required.

Donald Culross Peattie in his *A Natural History of Western Trees* says of the true White Fir:

> Of all the western Firs, the White Fir is the most widespread. You see it abundantly on the mountain slopes just above the floor of Yosemite Valley, its beautiful, light gray and smooth bark shining between its tier on tier of regularly whorled branches, its deep green or almost silvery gray needles cheerfully matching the clear mountain sunlight. In Colorado it lines the exciting mountain drives, and crowds into the canyons where the streams come seething down . . . Always the springing boughs, the symmetrical broad cone of the outline, have a look of strength and health and the ability to grow almost anywhere in the drier mountains of the West, and endure all that the Rockies and Sierra Nevada can bring of snow and storms, and long dry summers.

— STARR JENKINS

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ABSTRACT - Developed in a fire training officers' workshop, this instructional guide contains material about sprinkler systems. The unit, including stated objectives in the form of questions that students might ask, and study assignments when appropriate, are: (1) History and Development of Sprinkler Systems, (2) Design and Installation of Sprinkler Systems, (3) Water Supplies for Sprinkler Systems, (4) Sprinkler Heads, (5) Sprinkler Alarms, (6) Types of Sprinkler Systems, (7) Economics of Sprinkler Protection, (8) Inspection and Testing of Sprinkler Systems, (9) Use of Sprinkler Systems During a Fire, and (10) Operating Procedure Following a Fire. (GR)

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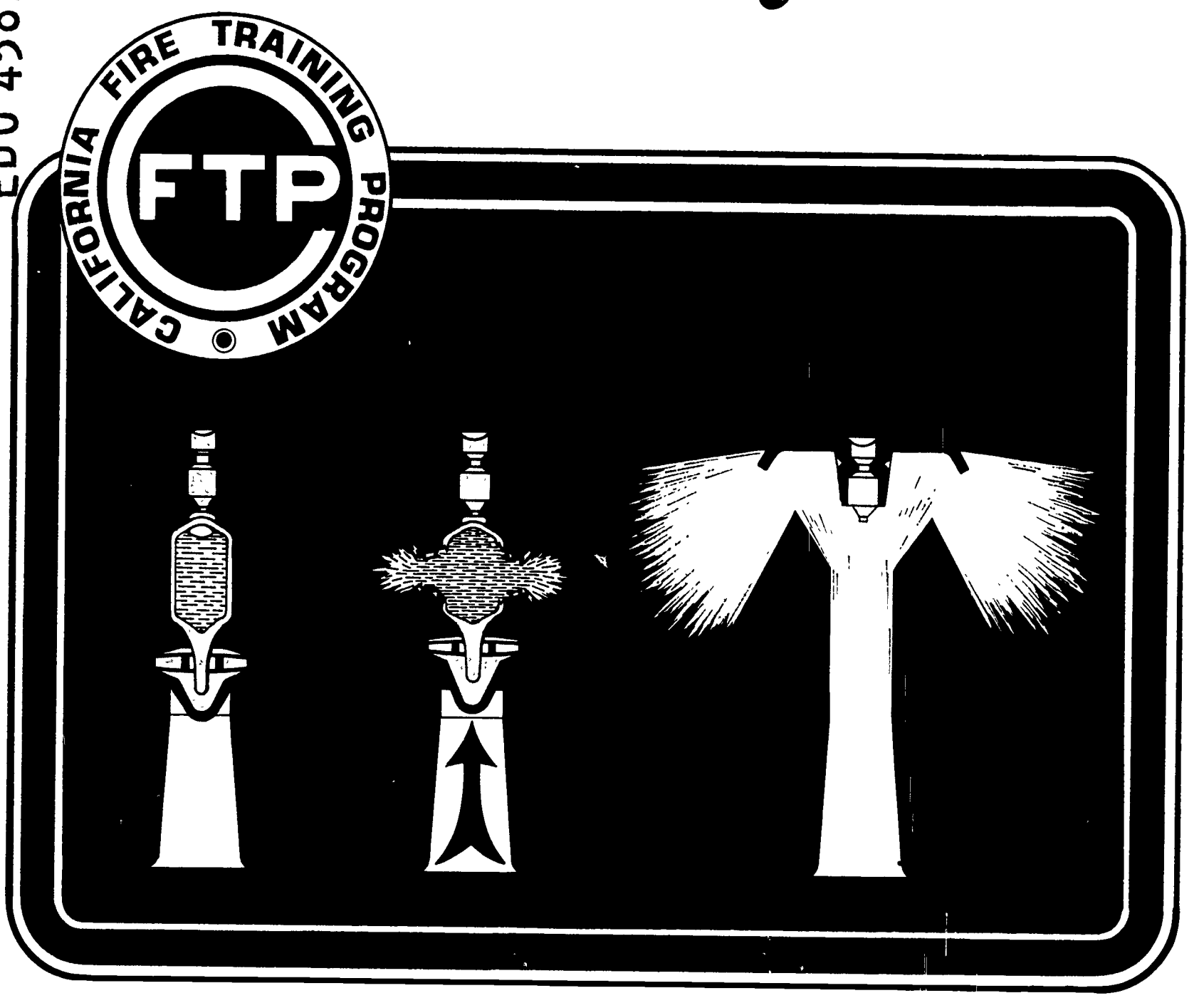
Sprinkler Systems



What a Fireman Should Know About Sprinkler Systems

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CALIFORNIA STATE DEPARTMENT OF EDUCATION
Max Rafferty—Superintendent of Public Instruction
Sacramento 1968

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Sprinkler Systems

What a Fireman Should Know About Sprinkler Systems

Instructional Materials Developed by
Group V, Fire Training Officers' Workshop
held at Fresno, California
May, 1967

for the
Bureau of Industrial Education
Division of Instruction
California State Department of Education

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Foreword

The efficiency with which any agency of government functions depends to a very large extent upon how well the personnel of the agency are prepared to meet their responsibilities. Therefore, every agency of government must select personnel who are qualified to do their respective job assignments well, and the agency must also provide such inservice training as may be needed to keep each member of its staff well prepared to meet job assignments promptly and efficiently.

Fire departments are agencies of government whose efforts are largely devoted to the prevention and control of unwanted fires. Therefore, these departments must make certain that the members of their staffs are prepared to act intelligently and promptly in every situation.

The Bureau of Industrial Education, California State Department of Education, develops and makes available instructional materials to those responsible for providing fire training programs. These materials have been planned and developed by people who know the responsibilities of firemen, have the knowledge and ability to meet each of the responsibilities, and are determined to provide for each fireman opportunity to acquire the knowledge and skill he needs to meet his responsibilities as a member of the fire department he serves. It is my hope that this publication will be a valuable addition to the instructional materials that have already been developed for the fire training program in California.

Max Rafferty

Superintendent of Public Instruction

Preface

What a Fireman Should Know About Sprinkler Systems is one of a planned series of publications containing instructional and informational materials that are being developed by groups of Fire Training Officers under the direction of the State Fire Training Program staff.

The California Fire Service members that developed this material were selected because of their interest, knowledge, and experience in the subject. They are the following:

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LeRoy Frye	Hawthorne Fire Department
Danny Hooten	Fairfield Fire Department
Jerry Jones	Rialto Fire Department
John Petruzziello	Millbrae Fire Department
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The Education and Training Committee of the California Fire Chief's Association has reviewed and approved the materials.

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I. History and Development of Sprinkler Systems

This unit, "History and Development of Sprinkler Systems," is planned to help the student find answers to the following questions:

- Of what real value is a sprinkler system in the prevention of fire loss?
- How did early sprinkler designs compare with approved types of today?
- What are the fundamentals of sprinkler protection?

Need for Effective Fire Protection

A marked increase in fire hazards and the cost of fire losses in manufacturing plants emphasizes the need for more adequate protection against fire. Although this need has been recognized, the difficulty in reaching the source of the fire with effective water protection has often been demonstrated, and simple fire protection afforded by water pails, standpipes, and hoses has proved inadequate. The members of a municipal fire department frequently take considerable punishment and are not always assured that their streams are actually reaching the fire, since partitions and other obstructions may be deflecting the water.

Fire's Destructive Capacity

Statistics show that although 70 percent of all fires cause individual losses of one hundred dollars or less, these fires account for only 5 percent of the total destruction caused by fire in the United States. What, then, is the major difference between this large number of fires that cause small losses and the remainder, which account for 95 percent of the total loss? The difference lies largely in the early discovery of the fire, when a small quantity of water applied directly onto the fire will extinguish it while it is still in the incipient stage.

Automatic Sprinklers

Someone cannot always be present where fire may occur, so it is obvious that some other means must be used to detect and extinguish fires -- some mechanical device is needed to perform those functions. One such device, which incorporates an alarm and a means of extinguishing fires, is the automatic sprinkler system. This method has proven to be highly efficient and dependable. In 96 percent of the fires in areas protected by sprinkler systems during the past 41 years, the fires have been extinguished completely or were held in check until personnel arrived with fire-fighting equipment.

Reducing Hazards by Sprinklers

The American Insurance Association engineers believe that the installation of automatic sprinklers constitutes the best and most practical means of reducing the hazards in buildings of poor fire-resistive construction, especially those located in the high-value districts. Automatic sprinklers should be installed in all buildings that, by reason of their size, construction, or occupancy, constitute a serious life hazard or that might be conflagration breeders.

Combatting Objections

An enforcing authority who requests installation of an automatic sprinkler system for the protection of life and property frequently encounters objections from the building owner, the architect, or the engineer, but these objections often stem from erroneous ideas, such as: (1) when the sprinklers are in operation excessive water damage will result; (2) the accumulated smoke will obscure exits and persons will be trapped in the building and suffocated; (3) the water discharge will drown some of the building's occupants; and (4) others will be scalded by steam. Each of these points should be examined for validity:

Water damage. A comparison of water damage between buildings equipped with sprinkler systems and those without such systems will disclose the following points:

1. In sprinkler-equipped buildings a sprinkler system detects an incipient fire and applies about 20 gallons of water per minute onto the fire. Since the system is also equipped with a water-flow alarm or other similar device, there is indication that water is flowing.

2. In a building that does not have a sprinkler system, someone must discover the fire and call the fire department. During this emergency, the fire increases in intensity. When the firemen arrive, they will attack the fire with either a 1-1/2 inch hose line (100 gpm or five times the amount of water from a sprinkler head) or a 2-1/2 inch hose line (250 gpm or ten times the amount of water from a sprinkler head).

Smoke damage. The amount of smoke generated by a fire depends primarily upon how long the fire burns before it is extinguished. Because sprinkler systems are automatic, a fire extinguished by sprinklers will generate less smoke than the same fire in an unprotected building where extinguishment is delayed until the hose stream can be put into operation.

Drowning. A person standing under a sprinkler in operation is in no greater danger of drowning than if he were standing in a heavy rainfall.

Steam. The amount of steam generated in putting out a fire would ordinarily be the same whether the water came from a sprinkler or from a hose

nozzle. However, there usually will be a lesser amount of steam when sprinklers extinguish a fire because the fire in a building without a sprinkler will be much larger by the time water is applied; thus, larger amounts of steam will be generated.

History and Development

Since man first used fire for his own benefit, it has escaped control occasionally and caused serious losses. Man has continually sought better methods of controlling and extinguishing fires. The search for fire protection finally led to the development of the automatic sprinkler system, which is now the most effective of all fire-fighting devices.

A sprinkler system may be likened to a tree. The roots correspond to the underground piping which carries water from the main supply to the risers. In a tree trunk, a "riser" carries similar feed mains, and smaller tree branches correspond to the branch lines in the sprinkler system. The sprinkler heads are located along the branch lines, and the sprinkler head is the heart of the sprinkler system.

Early Sprinkler Devices

One of the first sprinkler devices was developed by Ambrose Godfrey in 1723. It consisted of a barrel of water in which was placed a charge of gunpowder in a waterproof container. When fire occurred, a fuse leading to the gunpowder was lit, exploding the powder and rupturing the barrel. The resultant water spray was supposed to extinguish the fire. A successful extinguishment was performed by this device in November, 1729.

The first development of an automatic device similar to those used today consisted of a piping system with attached rosettes, which resembled salt shakers. A normally closed valve in the water supply tank was controlled by an arrangement of cords and weights. The tank was elevated to supply pressure. When a fire occurred, the cord in the fire area was supposed to burn through, releasing the weight and opening the valve. This sytem introduced problems, however, with cords stretching and valves sticking.

The first perforated pipe system in the United States was installed in the Locks and Canals Company building in Lowell, Massachusetts, in 1852. This system was acceptable, and many similar systems were subsequently installed, mostly in New England. The system was manually operated and was usually equipped with separate riser and control valves on each floor to conserve water and reduce water damage. This installation was similar to a deluge system, and the water damage was usually excessive.

A Major Harrison of London invented an automatic sprinkler system in 1864. The device was never patented, and no record exists of its having been used except experimentally. The head consisted of a rubber seal, a brass ball, and a solder fuse. However, sediment clogged the holes and the

rubber seal wore rapidly. Even so, the Harrison head was superior to many of the heads that were developed later.

Prototype of Modern Sprinklers

Between 1874 and 1878, the experiments of Henry S. Parmalee of New Haven, Connecticut, led to development of the prototype of the modern automatic sprinkler. From 1878 until 1882, the Providence Steam and Gas Pipe Company sold and installed the Parmalee head. Although the head was crude, its performance was satisfactory, and more than 200,000 of these heads were installed.

Frederick Grinnell, an associate of the Providence Steam and Gas Pipe Company, which later bore his name, developed the Grinnell head in 1882.

From 1872 until 1914 more than 450 sprinkler head patents were applied for. Many others were probably not patented because only 17 types of sprinkler heads are listed and approved today by national testing laboratories.

Study Assignment

Fire Protection Handbook (Twelfth edition). Edited by George H. Tryon. Boston: National Fire Protection Association (NFPA), 1962, pp. 16-4 through 16-11.

II. Design and Installation of Sprinkler Systems

This unit, "Design and Installation of Sprinkler Systems," is planned to help the student find answers to the following questions:

- What are the various classifications of sprinkler systems?
- What factors must be given major consideration in the layout and design of a sprinkler system?
- What sprinkler pipe requirements must be considered in the design of a sprinkler system?

Familiarity with Systems

The fire department should be informed when automatic sprinkler equipment is to be installed, and department personnel should become familiar with the layout of each system. Department members should know how much protection is available, the location and arrangement of the control valves, and where to reach the fire department connection. Failure to act on this knowledge may lead to excessive property losses and fire-caused deaths.

Sprinkler systems should be installed in accordance with accepted standards and commensurate with the hazards involved. These standards may be found in the National Fire Protection Association Standards (NFPA), Standard No. 13, "Installation of Sprinkler Systems."

Preparation of the Building

All obstructions that might limit the effectiveness of a sprinkler system, such as needless ceiling sheathing, hollow siding, tops of shelving, or decks, should be removed. Flooring should be tight enough to be waterproof. Floor or wall openings that could cause drafts or other building conditions that could delay the prompt operation of the automatic sprinklers by preventing the "banking up" of the heated air from the fire should be stopped to permit the fire to be controlled anywhere by local sprinklers. The entire building should be sprinkler-equipped if possible, and protection should be provided wherever danger from fire exists in buildings that have a sprinkler system.

Water Supplies

Every automatic sprinkler installation must have at least one automatic water supply of adequate pressure, capacity, and reliability. While in theory a single water supply is all that may be necessary for satisfactory protection,

such a supply may be temporarily out of service or disabled before or during the fire. Adequate secondary or additional supplies may therefore be advisable. Several means are used to supply water to sprinkler systems; they are public and private water supplies, gravity tanks and pressure tanks, pumps, and fire department connections.

Fire Department Connections, Piping, Valves, Fittings, and Hangers

Fire Department connections are used for secondary water supplies. The arrangement usually consists of at least two 2-1/2 inch diameter hose inlets, a check valve, and interior piping not less than 4 inches in diameter. The inlets should be capped and labeled "AUTO-SPKR."

The piping throughout the building should be fastened securely with the correct hangers and hardware. Sprinkler piping should be designed to withstand a working pressure of not less than 170 psi. The system should be pitched for the purpose of draining -- 1/4 inch to 10 feet for wet-pipe systems and 1/2 inch in 10 feet for dry-pipe systems. (Standards for piping and valves can be found in National Fire Protection Association Standards (NFPA), Standard No. 13, "Installation of Sprinkler Systems.")

Location and Spacing of Sprinklers

The fundamentals for providing protection by sprinklers are as follows:

1. Definite maximum protection area per sprinkler
2. Minimum interference to discharge pattern by beams, bracing, girders, trusses, piping, lighting fixtures, and air-conditioning ducts
3. Correct location of sprinklers with respect to ceilings or beams and wood joists to obtain suitable sensitivity

Study Assignment

Fire Protection Handbook, pp. 16-38 through 16-61.

References

National Fire Protection Association Standards (NFPA), Standard No. 13, "Installation of Sprinkler Systems;" Standard No. 20, "Fire Pumps;" and Standard No. 24, "Underground."

III. Water Supplies for Sprinkler Systems

This unit, "Water Supplies for Sprinkler Systems," is planned to help the student find answers to the following questions:

- How is the total amount of water required by a sprinkler system determined?
- What sources are usually considered for water supplies in a normal sprinkler installation?
- How does the occupancy classification of a structure influence the water-flow requirement of its sprinkler system?

Effectiveness of Automatic Sprinklers

The main principle in the control of fire using automatic sprinklers, especially where ordinary materials are involved, is to detect the fire in its incipient stage and to drench the immediate fire area so as to limit fire spread and damage to property. If the sprinklers can provide a cooling effect greater than the heat generated by the fire, then the sprinklers can gain control. The successful application of this principle depends mainly on an adequate water supply.

Number and Type

An automatic water supply of adequate pressure, capacity, and reliability is vital for every automatic sprinkler system. Not only must the rate of flow and total volume required by the system be considered but the choice of supply will also be influenced by the area, height, and value of the property; the type of occupany; construction features that allow the fire to spread; quality and availability of public fire department response; and, in some cases, by the hazards the building is exposed to.

Water Supply

One source, or a combination of sources, such as street mains, gravity tanks, reservoirs, fire pumps, pressure tanks, wells, rivers, and lakes may be used to supply sprinkler systems. The necessity for a supplemental supply will depend on various factors such as those mentioned in the preceding paragraph.

The authority having jurisdiction should be consulted in every case as to the water supplies required for any given system. The water supply needed

for various structures must be determined by a study of the conditions involved, with consideration being given to the number of sprinklers that may be expected to operate from a fire in any one area.

In determining the water supply needed for extra hazardous structures, special consideration must be given to the following:

1. Number of sprinklers that may operate
2. Amount or rate of discharge needed from each sprinkler
3. Required time of sprinkler discharge
4. Amount of water needed simultaneously for hose streams

Advisability of Additional Sources

Intense fires in certain types of buildings may require an extra heavy sprinkler discharge, which is usually obtained by increasing the pressure and volume of the water supply, by closer spacing of sprinklers, or by a combination of those two methods.

Connections to a Waterworks System

A connection to a reliable waterworks system of adequate capacity and pressure is preferable as a single or primary supply. However, a greater volume may be required if the system must supply hose streams in addition to sprinklers.

When connections are made to street mains, the mains should not be less than 6 inches in diameter, nor should the connections be made to dead-end mains. The size and arrangement of mains are very important.

In determining the adequacy of a waterworks system, the normal capacities and pressures available and the probable minimum pressures and flows available should be considered during the summer months when the demand on the system is heavy or during unfavorable winter or flooding conditions.

Determining Amount of Public Water Available

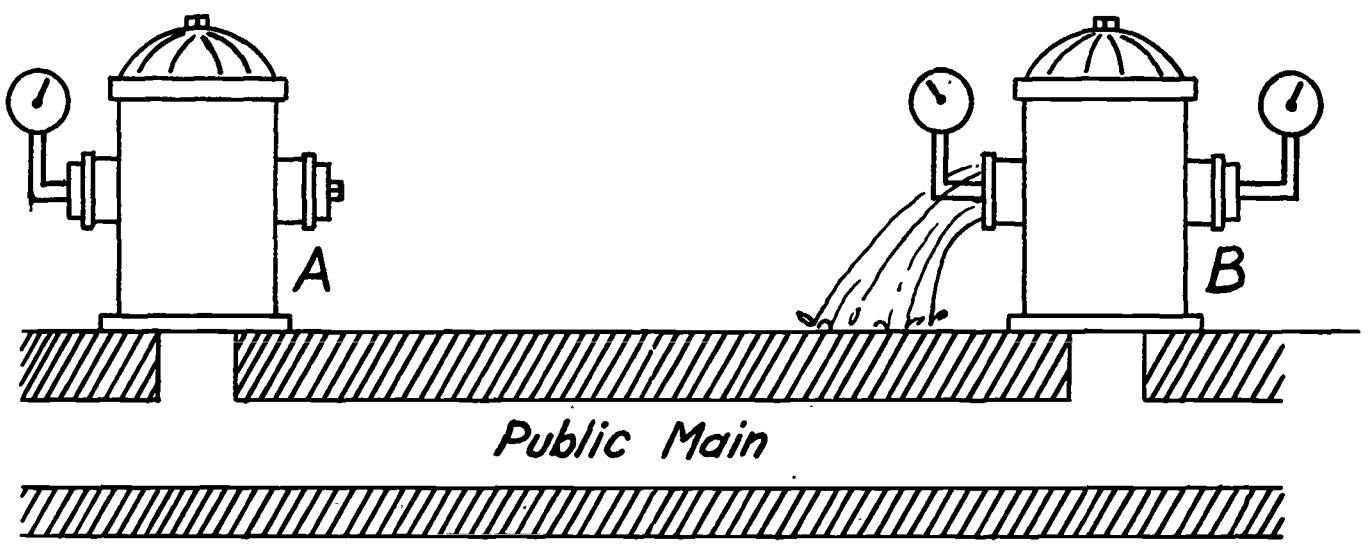
To determine the amount of public water available for automatic sprinkler systems, a flow test is generally necessary. The following are the methods recommended by the NFPA to make such a test.

1. Select two hydrants in the vicinity of the property.
2. Measure the static pressure on the hydrant in front of the property, and allow the water to flow from the hydrant next in distance from the

property -- preferably the one farthest from the source of supply if the main is fed only one way.

3. Indicate the residual pressure at the hydrant where water is not flowing.

Referring to the illustration below, the method of conducting the flow test is as follows:



1. Attach gauge to hydrant (A), and obtain static pressure.

2. Either attach second gauge to hydrant (B), or use a pitot tube at outlet. Have hydrant (B) opened fully, and read pressure at both hydrants.

3. Use the pressure at hydrant (B) to compute the gallons flowing, and read the gauge on hydrant (A) to determine the residual pressure or that which will be available on the top line of sprinklers in the property. (Water pressure in pounds for a given height in feet = Height X 0.434.)

Cross Connections Between Public and Private Supplies

A water supply supplemented by private or other sources of public water is sometimes necessary to feed into a single system. These secondary supplies are commonly referred to as "cross-connected" systems. When a system is cross connected, certain precautions are necessary; the installation of check valves or similar devices may be needed to prevent a backflow into the water system. This backflow might endanger public health.

Other Supply Sources

Gravity tanks. When a gravity tank is used to supply a sprinkler system, the same considerations that should be given to this type of system would apply to any other system. These considerations include the size or capacity of the gravity tank, the number and type of sprinklers that are expected to operate, kind of occupancy, and the possibility of spread of fire because of construction features.

Fire pumps. In general, the main purpose of the fire pump is to maintain a higher pressure for an extended period in certain installations that do not have the desired pressures. If the fire pump has a reliable source of power and is connected to an adequate water supply, it usually provides a good secondary supply to automatic sprinkler systems. However, certain limitations -- such as high water demand or nonautomatic pumps that require a pump operator -- could restrict the effectiveness of this type of system.

Pressure tanks. Although pressure tanks have possible uses -- in tall buildings, for instance, where water pressure is inadequate -- these tanks usually require specific approval and sometimes are classified as "limited supply systems" because of the small volume of water that can be stored in the tanks.

Study Assignment

Fire Protection Handbook, pp. 16-89 through 16-98.

IV. Sprinkler Heads

This unit, "Sprinkler Heads," is planned to help the student find answers to the following questions:

- What is the "standard" automatic sprinkler, and how does it compare with the "old-style" head?
- What is the operating principle of an automatic sprinkler?
- Why are special sprinkler heads required to meet certain service conditions?

Modified Deflector Design

The present standard automatic sprinkler incorporates design improvements made on the older model sprinkler heads. During 1952 and 1953, water distribution methods were greatly improved with the adoption of redesigned systems, and modification of the deflector was the principal reason for this improvement. As a result of these changes, the water is discharged in all directions below the plane of the deflector.

Head Exchange

The pattern of standard sprinklers is more uniform than was the case with the older type sprinkler heads. The spray at a point 4 feet below the deflector covers a circular area having a diameter of approximately 16 feet at a discharge rate of 15 gallons per minute. The redesigned sprinkler is known as the standard sprinkler, and the conventional or regular sprinkler is known as the old-style sprinkler head. The standard head may be used to replace the old style, but the old style cannot be used to replace standard sprinklers until the system has undergone a complete engineering review.

Study Assignment

Fire Protection Handbook, pp. 16-99 through 16-127.

V. Sprinkler Alarms

This unit, "Sprinkler Alarms," is planned to help the student find answers to the following questions:

- What are the chief advantages of the water-flow alarm?
- What purpose is served by the use of supervisory switches?
- What are "retard chambers," and how do they work?

Variety of Alarm Systems

Some kind of warning device should be incorporated into all sprinkler systems to indicate water flow. Whether the flow is caused by a malfunction, a broken line or head, or a fire, some means of alarm should be activated at once. The warning device may be an audible alarm, such as gong, bell, or horn; or it may be visible, such as a flashing light at a local or remote station. Although some alarms are triggered by heat-detecting devices (indicating the presence of fire), a water-flow alarm usually indicates the presence of fire and the flow of water.

Alarm Valves for Wet-Pipe Systems

Water-flow valves are so designed that any appreciable flow of water in the sprinkler system will lift a clapper from its valve seat. This actuates the alarm, although the means of giving the alarm may vary. The alarm signal can work electrically, by water-driven motor, or by both. Retarding chambers may be included in the system to prevent the alarm from being actuated by sudden fluctuations of pressure in the water supply.

Water-Flow Indicators

Many large wet-pipe sprinkler systems use water-flow indicators to pinpoint the location of water flow in the system. In some relatively small systems, these indicators can also be used to activate electrically operated bells or other alarm devices to signal the water flow at local or remote stations. (See Fig. 16-215A, Fire Protection Handbook.)

Alarm and Supervisory Pressure-Actuated Switches

Sprinkler systems sometimes use pressure-actuated electrical switches to activate alarms when water flow occurs. The circuit may be connected

to central, proprietary, or remote station signal systems. These switches can also be used to control other electrically operated units, such as air conditioners, fans, conveyor belts, ventilators, and fire doors. (See Figs. 16-212, 213A, 213B, 214A, and 214B in the Fire Protection Handbook.)

Retarding Chambers

Retarding chambers consist basically of relatively small reservoirs or tanks placed in the water line between the alarm valve and the water-motor gong. Any brief water flow accumulates in the chamber, which must fill with water before the flow can reach the alarm. The size of the chamber and the water inlet is determined by the manufacturer so as to allow enough delay to prevent actuation of an alarm as a result of minor fluctuations in the water pressure or limited water flows.

Water-Motor Gongs

Sprinkler system installations usually include a mechanically activated water-motor gong, which is generally mounted on an outside wall close to the alarm check valve or dry-type valve. This alarm operates mechanically; the flow of water from the alarm valve is diverted to a small impulse water-wheel or turbine that turns a shaft which has a knocker-arm assembly inside the gong. The water that drives this device flows through a drain to the outside.

Study Assignment

Fire Protection Handbook, pp. 16-187 through 16-220.

VI. Types of Sprinkler Systems

This unit, "Types of Sprinkler Systems," is planned to help the student find answers to the following questions:

- What are the differences between the two main types of sprinkler systems, and what are the relative merits of each?
- What is a "pre-action system," and how does it work to reduce "delay time" in a sprinkler system?

Purpose of Sprinkler Systems

Automatic sprinklers, regardless of type, are designed to distribute water upon a fire automatically and in sufficient quantity to extinguish or control the fire until fire-fighting units arrive. Many different systems are in use, each having its advantages and disadvantages.

Wet-Pipe Systems

The main characteristic of the wet-pipe system -- and the reason for its name -- is that it is always charged with water. Fewer controls are needed in wet-pipe systems than with some others; however, one disadvantage is the possibility that the system will freeze during cold weather.

Dry-Pipe Systems

As its name implies, a dry-pipe system is one in which no water passes the valve in the riser. Instead, air is pressurized in the system. Such a system can be supervised; that is, any loss of air pressure can be detected and indicated by an appropriate alarm device.

Pre-Action Systems

The typical pre-action system is basically dry-pipe and uses a heat-detecting device that opens the water supply valve, sending water into the system and to the sprinkler heads, whether they are open or closed. Two advantages are inherent in the system: (1) this action protects property from damage that would otherwise be caused by a broken pipe or sprinkler head; and (2) the action allows water to flow into the piping system before the heads open, thereby reducing the "delay time" normally associated with dry-type systems. Pre-action systems, like the dry-pipe, may be supervised by an appropriate tripping alarm.

Combined Systems

Combined dry-pipe and pre-action systems are those in which a heat-responsive device operates a dry-pipe valve before any sprinklers are open. These systems have many advantages, particularly where long feed lines are necessary.

Deluge Systems

A deluge system is normally used only where large amounts of water are required immediately -- in areas, for example, where flammables are stored. In these systems, only sprinkler heads of the open-orifice type are used.

Limited Water Supply Systems

Where the water supply is limited, special systems that are quite similar to a normal wet-pipe system may be used, except that the amount of water available is minimal.

Partial Systems

Sometimes only certain areas in a building require protection -- stairways and corridors, for example -- to allow rapid evacuation from apartment buildings, schools, offices, or hospitals. These are considered to be partial installations and are normally connected to a domestic water supply, although they may have a separate or supplemental fire department connection.

Study Assignment

1. Fire Protection Handbook, pp. 16-62 through 16-75.

2. National Fire Protection Association Standards (NFPA), Standard No. 13, "Installation of Sprinkler Systems," Section 4030.

VII. Economics of Sprinkler Protection

This unit, "Economics of Sprinkler Protection," is planned to help the student find answers to the following questions:

- What savings can be realized when a building is protected by a sprinkler system?
- How can the initial cost of a sprinkler system be amortized over a period of years?
- What is a "sprinkler system investment graph," and what does it show?

Sprinkler System Economies

When considering the primary function of a sprinkler system -- that of controlling fires -- one must think of the costs involved. For example, can the purchase of an effective sprinkler system be justified over a long period considering the payment of reduced insurance premiums? All indications favor such an investment.

Although a large premium reduction will not occur in all cases, sprinkler protection still enables the property owner to buy more insurance for less money. For example, in 1957 a sprinkler system was installed in a building at a cost of approximately $22,000. The building was insured for $868,000 and the contents for $56,000. The listed insurance rates per $1,000 of coverage for this type of building and contents were as follows:

Without sprinkler	Building 0.153	Contents 0.202
With sprinkler	Building 0.073	Contents 0.122

The rates on the sprinkler-equipped building and contents show a premium saving of about 0.08 cents each over rates for the unprotected building, or an annual saving of $739. This means that the cost of the sprinkler system could be paid for from insurance savings in 30 years.

The cost of buying insurance is based on the factors that contribute to the chance of a fire and to the extent of potential damage. These factors include the type of building, nature of occupancy, environmental conditions, water supply, location of the fire department, and the classification of the city involved. The following examples of buildings and contents further illustrate how much money may be saved by having a sprinkler installation. The rates quoted are tentative one-year fire rates. The 100-percent average clause and rate adjustment credits have been given:

Cereal Manufacturing Building

Without sprinkler	Building 0.082	Contents 0.233
With sprinkler	Building 0.042	Contents 0.111

Mattress Manufacturing Building

Without sprinkler	Building 1.18	Contents 2.02
With sprinkler	Building 0.173	Contents 0.337

Automatic sprinkler protection obviously provides safeguards against fire losses and loss of life and ensures that the interruption of business activity will be minimal following a fire.

Study Assignment

Fire Protection Handbook, pp. 16-11 through 16-15.

VIII. Inspection and Testing of Sprinkler Systems

This unit, "Inspection and Testing of Sprinkler Systems," is planned to help the student find answers to the following questions:

- Of what value is a definite schedule of inspection and testing of sprinkler systems?
- Why is it essential that the fire department be familiar with valve locations?
- What is the accepted procedure for inspecting control valves and piping?

Firemen's Additional Responsibility

Fire department personnel should have a thorough knowledge of automatic sprinkler protection systems. Firemen must be familiar with the sources of water, details of piping and valve arrangements, and available hydrants. Sprinkler systems should be studied as part of the company inspection program and a definite fire-fighting procedure developed for each sprinkler-equipped building. The difference in plant layouts, construction, nature of occupancy, and fire-protection systems requires the preparation of specific operational procedures.

During an inspection, the individual responsible for maintenance should be asked to explain the complete operation of the system, the method of testing, and the nature of the repair facilities.

The following points should be checked during sprinkler system inspections:

1. Control valves
2. Piping
3. Sprinkler heads
4. Fire department connections
5. Storage of building contents

Control Valves

Control valves should be inspected carefully. The advantage of prompt automatic operation of sprinkler systems is lost when the valves are closed; the failure to ensure that the valves are open has resulted in many disastrous

fires in sprinkler-protected buildings -- fires that would otherwise have been extinguished quickly at the incipient stage.

The location of all control valves should be noted during an inspection of sprinkler systems. This knowledge has occasionally proven valuable in sprinkler-equipped buildings, particularly when sprinklers are operating and control valves are situated in a different section of the building or in another building. When valves are placed in enclosures or at out-of-the-way places, their location should be prominently indicated by signs.

In general, a valve inspection should show that each valve is:

1. Open or closed, as required

2. Properly secured or sealed

3. In good operative condition, with glass sights intact

4. Readily accessible, and with protective guards in place where required

5. Supplied with the correct wrench in the right place

6. Provided with a sign or metal tag to indicate the building and system controlled

7. Rigged for quick closing in an emergency

The post indicator valve. The post indicator valve is usually located outside of a building to control water flow to sprinkler and yard hydrant mains. The position of the indicator valve is determined by observing a target that is attached to the stem of the valve and set in a glass-protected sight. The target shows "OPEN" or "SHUT" as the valve is operated.

The outside screw and yoke valve. The outside screw and yoke valve is the most commonly used control valve in sprinkler systems and is employed within the buildings and valve pits. Inspection of the valve should include observation of the following:

1. When the stem is "OUT", the valve is "OPEN".

2. When the stem is "IN", the valve is "CLOSED".

3. The valve stem should be checked to ensure that it is clean.

The dry-pipe valve. The dry-pipe valve is employed in a dry-pipe sprinkler system. The air pressure in the system should be checked during the inspection. Instruction charts for the maintenance of dry-pipe valves should be provided by the company installing the sprinkler system and should be posted at or near these valves.

Piping

The piping cross-mains should be traced and the following conditions observed:

1. Inspect pipe supports for corroded or broken hangers.

2. Make certain that piping is not being used to support ladders, stock, or other materials.

3. Determine whether sprinkler protection has been extended through newly constructed partitions or curtailed by building alterations.

Sprinkler Heads

The cabinet containing extra sprinkler heads and wrenches should be located. The cabinet should be placed where it will not be exposed to moisture, dust, or temperatures exceeding 100 degrees. The supply of extra sprinkler heads should include heads of different temperature ratings for replacement purposes. (Where sprinkler heads are exposed to corrosive atmospheres, wax-coated heads should be used to retard or prevent corrosion.)

Fire Department Connection

The fire department connection is used by fire departments to supplement the water supply to the sprinkler systems. Inspection should cover the following:

1. Location of the connection should not be obstructed or hidden.

2. Caps should be in place, threads in good condition, and check valve in good repair.

Storage of Building Contents

The storage of stock should be checked to see that the distribution of water from the sprinkler heads is not impeded. Water discharge from sprinklers cannot reach the seat of the fire in combustible materials that are piled high. A fire may spread through such a pile, generate heat, and open sprinklers over a considerable area. Water from sprinklers will be hampered by high-piled stock in furniture plants, department-store warehouses, wholesale grocery outlets, wooden-pattern storage departments of foundries, barrel-storage rooms of cooperage plants, lumber and box-storage areas, and lumber kilns.

Arrangements should be made to keep all stock piles, racks, and other possible obstructions a safe distance below sprinklers. The height of merchandise stacked on floors must be restricted to provide 18 inches of clearance

between the merchandise and the sprinklers. In some structures a 36-inch clearance is acceptable.

Study Assignment

1. Fire Protection Handbook, pp. 16-226 through 16-254.

2. National Fire Protection Association Standards (NFPA), Standard No. 13, "Installation of Sprinkler Systems," Section 3660.

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IX. Use of Sprinkler Systems During a Fire

This unit, "Use of Sprinkler Systems During a Fire," is planned to help the student find answers to the following questions:

- Why is prefire planning essential to a successful fire-fighting operation in a sprinkler-equipped building?
- What initial steps are usually taken at a fire when sprinkler systems are involved?
- What are some of the inherent limitations of a sprinkler system?

Discretionary Role in Fire Fighting

Automatic sprinkler systems have been increasingly appreciated in recent years. Most fire departments in major cities have some prearranged plan for the operation of sprinkler systems.

The correct procedure to follow in buildings that are burning and that have sprinkler systems operating is often in question. In many departments the officer in charge of fire operations decides whether hose lines will be connected to sprinkler systems.

When a fire occurs in a sprinkler-equipped building, fire-fighting procedures must be based upon a thorough knowledge of the property, knowledge that was gained from prior inspections and some prefire planning. The officer in charge at the fire site must see that these procedures are followed as promptly and efficiently as possible. For best results, the standard operating procedures should be guidelines of good practice, not hard and fast rules that rob the duty officer of responsibility and initiative.

Operations

Some practical suggestions for the guidance of officers in charge of fire department operations in sprinkler-equipped buildings are as follows:

1. A fire fighter should be sent immediately to the proper control valve to:

   a. Determine that the valve is fully open. (Valves are designed to show "OPEN" or "CLOSED" positions.)

   b. Open the valve if it has been closed except where the valve is "tagged" for repairs.

c. Close the valve only when ordered to do so by the officer in charge.

d. Remain at the valve so that it can be reopened immediately if the fire rekindles and begins to spread.

2. On arrival at the fire, one of the first alarm engine companies should immediately connect two lines to the correct sprinkler connection and maintain a prescribed pressure and volume. (Keep in mind that a 2-1/2 inch hose line can effectively supply 20 to 25 sprinkler heads.)

3. The officer in charge should immediately size up the fire and determine its location and extent. He should ensure that the sprinklers have extinguished the fire or are controlling it. He should look for any extension of the fire, being particularly watchful of concealed places. The officer should have portable radio communications so that he may deploy his men and equipment as needed.

4. Hose lines of workable size (usually 1-1/2 inches in diameter, with combination spray nozzle) should be taken into the building to extinguish the fire in areas that are concealed or otherwise inaccessible to sprinklers.

5. The officer in charge should order ventilation and other equipment as needed to complete extinguishment without endangering fire personnel.

6. When extinguishment is complete, pumper operations at the system should be discontinued. Temporary repairs to the system should be made using tongs, wooden plugs, and other equipment or devices until the system can again become operable.

7. Salvage operations should be started as soon as possible. (Refer to Salvage Operations, Block VI, California Fire Training Program Manual.)

8. When overhauling is completed so that rekindling is no longer possible, pumpers and equipment should be returned to service.

Limitations

The officers and men must recognize certain limitations and failure possibilities when dealing with fires in sprinkler-equipped buildings. These defects can be summarized as follows:

1. In planning strategy for fires in sprinkler-protected buildings, firemen should be aware that the system piping is usually of such size that the fusing of a large number of heads may overtax the system and diminish the flow from individual heads.

2. Fire department pumping operations in the neighborhood may reduce the water pressure and prevent a building system from receiving the needed supply.

3. The fire department siamese connection is usually located above the shutoff, which generally makes it possible to supply a system even if the main valve is closed.

Special Conditions

Visible steam indicates that the sprinklers are operating and probably have the fire under control or in check. If large billows of black smoke and flames are visible, this may indicate that the sprinklers are not fully effective, perhaps because of an inadequate water supply; e.g., closed, or partially closed, valves.

X. Operating Procedure Following a Fire

This unit, "Operating Procedure Following a Fire," is planned to help the student find answers to the following questions:

- What actions regarding a sprinkler system should be taken immediately following a fire?
- What is the purpose of draining a system after a fire?
- How should sprinkler heads be removed and replaced?

Restoration Procedure

Many large losses in sprinkler-equipped buildings have been caused by subsequent fires occurring before sprinkler systems have been restored. Restoration should follow as soon as possible and preferably before the department leaves the scene. Company officers should always make immediate inspections to ensure that the system has been restored to normalcy. The officer in charge should complete a report of the fire department operations, and he should include all pertinent information on the operation of the sprinkler systems.

Shut Off Valve

No valve should be shut off unless ordered by the officer in charge, nor should sprinkler-system control valves be shut off until the fire is positively out and has not involved another part of the building.

Draining System

The system should be drained immediately to minimize water damage. If the drain valve is not opened at this time, the water above the open sprinkler heads will continue to drain through the sprinklers, causing unnecessary water damage.

Repairing Heads

New sprinkler heads of the correct type and rating should be installed. A special sprinkler wrench should always be used when removing or installing sprinkler heads; other kinds of wrenches may damage the sprinkler. Adjacent sprinklers should be inspected for weakened links.

Restoring Valves

Valves should be turned on immediately to minimize danger in case of a rekindle. When a wet sprinkler system is restored, the test valve should be used to draw the air out of the system.

Inspecting Water Mains

Immediately after any fire, all water mains to sprinkler valves should be carefully examined to ensure that no valve has been closed in error. An inspection should also be made for leaks.

Detailed Report

A detailed report should include the following information:

1. Orders received
2. Hose lines connected to sprinkler system connections
3. Water supply used
4. Pressure maintained
5. Length of time sprinklers were supplied

NOTE: The above procedures may not always be followed. However, it is recommended that a fireman be stationed in the building to ensure that the system is promptly restored to operational order either by the owner or the tenant.

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VT 010 544

Fire Department Driver Training Manual of Instruction, Course Outline, and Trade Technical Information Sheets. California Fire Service Training Program.

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ABSTRACT - This driver training manual, developed by participants of a fire training officers' workshop, outlines practice demonstrations for the drill ground and the classroom, as well as related information regarding safe driving practices. Major topics are: (1) Driver Responsibility and Qualifications, (2) Vehicle Operational Practices, (3) Standard Driving Practices, (4) The Tillerman, (5) Collision and Accident Prevention, (6) Field Training, and (7) Inspection and Maintenance Schedule. A glossary of technical terms and a list of reference materials are appended. (GR)

VT 010 544

ED0 45856

Driver Training

Fire Department Driver Training Manual of Instruction, Course Outline, and Trade Technical Information Sheets

Instructional Materials Developed by
Group V, Fire Training Officers' Workshop
held at Fresno, California
May, 1966

for the
Bureau of Industrial Education
Division of Instruction
California State Department of Education

VT010544

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Foreword

The efficiency with which any agency of government functions depends to a very large extent upon how well the personnel of the agency are prepared to meet their responsibilities. Therefore, every agency of government must select personnel who are qualified to do their respective job assignments well, and the agency must also provide such inservice training as may be needed to keep each member of its staff well prepared to meet job assignments promptly and efficiently.

Fire departments are agencies of government whose efforts are largely devoted to the prevention and control of unwanted fires. Therefore, these departments must make certain that the members of their staffs are prepared to act intelligently and promptly in every situation.

The Bureau of Industrial Education, California State Department of Education, develops and makes available instructional materials to those responsible for providing fire training programs. These materials have been planned and developed by people who know the responsibilities of firemen, have the knowledge and ability to meet each of the responsibilities, and are determined to provide for each fireman opportunity to acquire the knowledge and skill he needs to meet his responsibilities as a member of the fire department he serves. It is my hope that this publication will be a valuable addition to the instructional materials that have already been developed for the fire training program in California.

Max Rafferty

Superintendent of Public Instruction

Preface

Members of any fire department who drive emergency apparatus must be properly trained to meet their responsibilities. However, proper training for drivers of emergency apparatus is not easily accomplished because of the rapid growth of fire departments and the new developments in emergency apparatus. The training, therefore, must be a continuous process to keep the experienced driver abreast of new developments, as well as to teach the new men just starting.

At the request of the California Fire Chiefs' Association, the Fire Training Program within the Bureau of Industrial Education initiated the project of developing this training manual for drivers of fire department apparatus. A committee of training officers was formed to compile and evaluate existing material and information on this subject and to write the manual. Members of the committee included the following representatives of various fire departments:

Battalion Chief William Wood	Hayward
Captain LeRoy Frye	Hawthorne
Assistant Chief James Thompson	Escondido
Assistant Chief Robert Miraglio	Orinda
Captain James Heywood	Los Angeles County
Battalion Chief James Orsborn	La Mesa

One of the greatest problems in training drivers of emergency apparatus is providing adequate experience for them. This manual outlines practice demonstrations for the drill ground and the classroom. It also contains related information regarding safe driving practices. It should be most useful in planning, developing, and maintaining a training program for emergency apparatus drivers.

This manual has been reviewed and approved by the professional standards and the training and education committees of the California Fire Chiefs' Association, and the Bureau of Industrial Education of the State Department of Education is pleased to have been able to assist in the development of the publication.

EUGENE GONZALES
Associate Superintendent
of Public Instruction; and
Chief, Division of Instruction

RICHARD S. NELSON
Chief, Bureau of
Industrial Education

EDWARD W. BENT
Supervisor of Fire Service Training

Introduction

A defensive driver is one who makes allowances for the lack of skill and knowledge on the part of the other driver and one who recognizes that he has no control over the unpredictable actions of other drivers and pedestrians nor over conditions of weather and road.

In the days of the horse-drawn fire apparatus, drivers were proud of their ability to handle two or three galloping horses in response to a fire alarm. An experienced driver realized that he and his steeds must act as one unit. He gave his team a workout every day, not only to exercise the horses but to acquire the "feel" of the power of his horses and to become aware of the constant vigilance necessary to control the weight of the apparatus when responding to an alarm through traffic.

Today, with the power of hundreds of horses under the hood of his automotive fire apparatus and with the greatly increased congestion of modern traffic, far greater attention must be given to the training of fire apparatus drivers and tillermen. These drivers and their officers are responsible for the safety of the apparatus and its personnel. Drivers must recognize that while they may know what they are doing, the drivers of other vehicles -- and pedestrians as well -- may not. Therefore, the officer, driver, and tillerman must always be prepared for the unexpected.

Speed

Speed is not of prime importance when responding to alarms. Speed often results in a serious and unnecessary accident which not only prevents the apparatus from reaching the fire but may cause death or injury to firemen and civilians.

Of even greater importance is the psychological effect which speed has on men. The natural result of speeding to a fire is that it induces a lack of logical judgment when the fire is reached. The most effective approach to the control of fire often goes unrecognized, and windows and doors are unnecessarily smashed in the effort to apply fire streams speedily. Speed in providing ventilation to a fire before hose lines are in position has proven disastrous in many fires. Speed in discharging hose streams before the fire is located, or before salvage covers are spread, has caused thousands of dollars of unnecessary water damage. The officer who makes certain of an alarm location and responds with sane and safe driving will arrive with a company prepared for action. Of major importance during a response is that the driver of the apparatus keep his vehicle under control at all times, and especially at street intersections. The normal excitement induced by dangerous speed will then be lacking, and the officer and his men will be in a state of mind conducive to proper control of the fire.

Driver Training

The most promising way of improving traffic safety is through the effective use of a formal and authoritative driver training program. Many high schools and colleges offer formal driver education as a means of developing better drivers. Private industry and government agencies are also improving today's commercial drivers by formally training their truck and passenger car operators. That success is being attained in these programs is demonstrated by the improved ratios of accidents to miles driven.

The driver of fire department emergency apparatus plays an important and intimate part in the safety program. Driving a heavy truck, loaded with men and fire equipment, through congested traffic leaves no room for error. To qualify for his position, the driver must be thoroughly trained in the skills necessary for emergency driving operations. In addition, he must have knowledge of basic mechanical information pertaining to fire apparatus, understand all pertinent traffic regulations, establish good traffic habits, and develop proper attitudes toward traffic responsibilities.

Hazards

Every portion of the fire department vehicle, including its load, should enter into the driver's thinking. The very weight and balance of the apparatus are important. The engine with its high power; the transmission with its intricate mechanism; the brakes, which must always be effective for the safety of all concerned; the tires that provide the frictional surface for traction and for stopping or turning; the steering mechanism; the starter; and the various switches are all under the sole control of the driver. He must be trained to a high degree of skill in their proper use.

Modern fire trucks are equipped with several performance features comparable to the better passenger cars and commercial trucks. The modern fire truck is a machine of great horsepower, equipped with powerful brakes and designed for ease of operation. But its very ease of performance may conceal the fact that the tons of weight under the driver's control respond only to his efforts, and efficiency and safety will result only if these controls are operated properly. If improperly handled, there will be many tons of uncontrolled weight loosed upon the streets. This may be more apparent when one considers that when a fire truck running at 20 mph is involved in a collision, it will have the same force as though the truck were dropped from a height of 14 feet. At 40 mph, the equivalent falling distance is four times as great, or 56 feet -- about the height of a four-story building.

To the driver of a fire truck responding to an alarm, any street intersection brings the hazard of cross traffic that is seldom controlled for his benefit by a signal light or a stop sign; in fact, quite the opposite is true. These signal controls are often a hazard to him. However, the driver has his own "traffic control" with him on his vehicle in the form of a warning red light and siren. Unfortunately, these devices do not always control traffic instantly, and the driver must be skilled enough to avoid a dangerous situation by suitable actions.

Emergency right-of-way does not permit a driver to lose sight of his responsibility for the safety of all users of the streets. Although the law allows certain exemptions to emergency vehicle drivers when responding to a call with the lawful use of a red light and siren, it does not give any valid recognition to the arbitrary use of these emergency rights that may endanger life or property.

Note: Trained and qualified instructors must be available prior to the offering of this course of instruction. An untrained instructor can do more harm than would the absence of this course from the training curriculum.

Within the boundaries of every fire jurisdiction, or in nearby locations, will be found a chapter of the National Safety Council (NSC), which has the necessary facilities and personnel available to train instructors for teaching this course.

The NSC course requires two full days of application and the payment of a small fee. Any fire department should find this course well worth the expenditure of both the time and money required, and the overall quality of the Driver Training Course should be substantially improved.

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I. Driver Responsibility and Qualifications

A fireman wishing to qualify as a driver of fire department apparatus must first be licensed by the Department of Motor Vehicles and then successfully complete a driver training course offered by his department or other authorized agency.

Apparatus drivers, tillermen, and chiefs' drivers should have a thorough knowledge of the material in this manual. They must also be thoroughly familiar with the rules and regulations of their own department and must possess a valid California vehicle operator's license.

Modern traffic conditions necessitate that fire truck drivers be skillful, mature, and responsible men, if accidents are to be avoided. Good drivers are made, not born, and they attain the required skills largely through a training program that includes initial instruction, driving training, the development of proper attitudes and driving habits, and training in the exercise of restraint and good judgment. Some of the factors that govern skillful driving are:

- The condition and limitations of the vehicle
- The physical features of roads, streets, and terrain
- The attitudes, behavior, and reactions of other highway users
- Varying light and weather conditions
- The personality and makeup of the driver himself

Driver Characteristics

Despite all the mechanical improvements and automotive safety advances, the driver is still the key to traffic safety. He must keep himself in good physical condition, have sound driving skills and habits, and develop and maintain proper attitudes. The chief attributes of a good driver are related directly to his attitude, skills, knowledge, judgment, habits, and his physical and mental fitness.

Attitude

A good attitude is possibly the most important requirement of being a good driver. A driver's attitude is reflected in his mental or emotional regard for himself, for others, for his vehicle, and for surrounding conditions. A driver with a poor attitude usually has some excuse for any adverse occurrence -- the other fellow was wrong, the street was poor, the intersection was blind, and so on. Attitudes are not inborn; they are learned and, therefore,

can be improved. Unfortunately, the driver who is a nice fellow and a perfect gentleman until he gets behind the wheel is not rare. We have all known the fellow who, climbing on the rig and acquiring the authority of red lights, siren, and several tons of fire apparatus, is suddenly a big shot and loses all consideration for safety and courtesy. His attitude, of course, is wrong. To be a good driver, this attitude must change. Recent tests conducted by the Fire Service have indicated that the self-styled "expert driver" usually has an attitude of indifference which may tend to cloud his judgment. This attitude often results in an excessive number of accidents that the alert driver probably would have avoided. This lack of attention to responsibility on the part of a driver indicates a need for retraining, or the curtailment of driving assignments, until his attitude has been improved. Some of the contributing factors to a bad attitude of a driver are:

- Overconfidence: Taking too much for granted -- having a serene confidence that his vehicle will always perform as he wills it; counting on other people to do the right thing at all times; feeling that red lights and siren provide an impenetrable barrier through which nothing can pass to do him harm

- Pride in past record: Getting puffed up about an accident-free record. Such a driver may be due for a rude awakening. The cemeteries are crowded with people who had only one accident.

- Faith in experience: Believing that long experience as a driver will see him through. Experience alone is not enough. It must be supplemented by comprehensive and continuing training and constant self-analysis of one's capabilities, attitudes, and skills. Experience develops bad habits as well as good ones.

- False ideas: Relying on guesses, estimates, legends, and hearsay, instead of facts. A quiz of hundreds of drivers revealed that when estimating stopping distances at a given speed, 90 percent of those tested were short by more than 40 feet -- a possibly fatal underestimation. The average driver, driving at 20 mph, will travel 45 feet before braking to a stop; at 30 mph, the total stopping distance will average 78 feet.

- Impatience: Taking needless chances, suppressing good judgment and violating safe-driving practices, just to save a little time. This causes accidents.

Skills

Skill in driving does not necessarily mean safe-driving performance. Records show that some drivers of exceptional skill are repeatedly involved in accidents, while other drivers, who are less adept, have good safety records. Skill is ability plus training. And good driving performance is skill plus (or minus) attitude. It is not how much skill has been developed that is important, but rather the extent to which the skill is applied.

Knowledge

Good knowledge of apparatus capabilities and limitations, response routes, hydrants, and rules and regulations is essential if one is to be a skillful driver. A driver who does not have this knowledge is apt to be distracted and confused to such an extent that he becomes an accident looking for some place to happen.

Judgment

Good judgment is based on proper attitudes, mental fitness, knowledge, and experience.

Good Habits

Habits are acquired and learned through training and self discipline. It has long been recognized that it is more difficult to break a bad habit than it is to develop new and acceptable ones. This is true throughout all fire service operations and is of maximum importance in driver training.

Physical Fitness

Any driver who is assigned as a vehicle operator should refrain from driving and ask for a relief driver when he feels there is any impairment of his physical well being, however slight or temporary. The reasons for such an action might be illness, fatigue, drowsiness, or the effect of medication. This does not relieve the company officer of his responsibility to replace those drivers who he feels are not physically fit or those who might be reluctant to ask for relief.

Mental Fitness

Mental fitness will change from day to day, hour to hour, and minute to minute. Mental fitness is affected by, and affects, attitude. A driver who is worried over financial difficulties, domestic problems, department discipline, and the like may not be mentally fit to drive. If a driver cannot clear his mind of such distractions and concentrate on the job of driving, he is not mentally fit to drive and should remove himself or be removed from driving status.

THE BEST SAFETY DEVICE IS A CAREFUL DRIVER.

II. Vehicle Operational Practices

All members of the Fire Service should have a thorough knowledge and understanding of the provisions found in section 21055 of the California Vehicle Code. This section exempts a driver of an authorized emergency vehicle from compliance with certain nonemergency sections of the code.

It is particularly important to note that section 21055 of the Vehicle Code does not:

- Grant any exemptions when a fire department vehicle is returning from an alarm of fire or from any other emergency call
- Relieve the driver of a fire department vehicle from his responsibility to drive with due regard for the safety of all persons using the highway when responding to an alarm of fire or other emergency call
- Protect the driver of a fire department vehicle from the consequences of an arbitrary exercise of the privileges granted in that section

It is of paramount importance that all fire department officers and drivers responsible for the operations of department vehicles exercise sound judgment in the application of the privileges accorded in Section 21055 of the California State Vehicle Code. Any action which could be interpreted as an "arbitrary exercise of privilege" must be avoided. The following sections are the applicable Vehicle Code Sections for Emergency Vehicles:

Section	
30	- Legislative Policy: Red Lights and Sirens
165	- Authorized Emergency Vehicle: Defined
2416	- Issuance of Permit
2417	- Suspension or Revocation of Permit
2418	- Regulations Governing Ambulance Services
4001	- Registration Exempt Vehicles
4015	- Firefighting Vehicle (exemption from registration)
9104	- Fire Vehicles (exemption from registration fees)
16050	- Exemptions (financial responsibility law)
16051	- Publicly Owned Vehicles (financial responsibility law)
17001	- Liability of a Public Entity

Section	
17002	- Extent of Liability (of a public entity)
17004	- Authorized Emergency Vehicles (liability of driver)
17004.5	- Liability of Private Fire Department
21052	- Public Officers and Employees (application of code)
21055	- Exemption of Authorized Emergency Vehicles
21056	- Effect of Exemption
21706	- Following Emergency Vehicles
21707	- Fire Areas
21708	- Fire Hoses
21714	- Ambulance, Operate with Advanced First Aid Certificate
21806	- Authorized Emergency Vehicles (right-of-way)
21807	- Effect of Exemption (responsibility of driver)
22514	- Fire Hydrants (blocking of)
25251	- Permitted Flashing Lights
25252	- Warning Lamps on Authorized Emergency Vehicles
25259	- Additional Warning Lights on Authorized Emergency Vehicles
26506	- Warning Device (airbrakes)
26700	- Windshields
27002	- Sirens
27305	- Firefighting Vehicles (seat belts required)
27905	- Fire Departments (display of fire department signs)
35002	- Authorized Emergency Vehicles (size, weight, and load limits)

Predetermined Response Routes

Drivers must follow their response routes of travel as closely as possible. These routes should be predetermined by a comprehensive prefire planning program. Officers and drivers must always be on the alert for other responding emergency vehicles, particularly at street intersections, and make necessary allowance for them.

Normally, all fire department vehicles responding from a multiple-company station shall take the same route to an alarm. If more than one vehicle is using the same street when responding to or returning from an alarm, they shall proceed in single file, and no vehicle should pass another unless the latter is disabled.

When approaching an intersection that may be used by other emergency vehicles, a driver should use his radio to inform other vehicles of his approach; he should not rely on the fact that he is "well ahead" of the other responding apparatus at intersections. And he should always remember -- "expect the unexpected."

Alternate Routes

Personnel making a response should recognize the need for developing alternate routes of travel which may be necessitated by traffic conditions, street blockage, or other conditions that may require companies to respond from locations other than regularly assigned quarters. Developing alternate routes should be a part of preplanning.

Response on One-Way Streets

Whether to respond against traffic on one-way streets is a decision left to the judgment of the officer and driver of the vehicle. Conditions are too variable to set hard and fast rules. Normally, a response distance longer than half a city block on a one-way street should receive special consideration of the time of day, traffic conditions, type of emergency, and the like. Travel against traffic on a one-way street should in all cases be practiced only as a last resort. Obviously, extreme caution must be exercised, and any extended such travel should be avoided whenever possible.

Section 21055 of the State Vehicle Code authorizes responding emergency vehicles to proceed against traffic on a one-way street. Such response, however, can be made only under the provisions of the subsections (a) and (b) of that section and is not permitted when returning from an alarm.

Warning Devices and Other Safety Factors

To guard against accidents when responding to alarms, the bells, sirens, and air horns (or other approved audible warning device on department vehicles) must be sounded as may be reasonably necessary. Company officers and drivers must be especially careful during cold or rainy weather, as car windows are usually rolled up tight during these times, which makes it very difficult for other drivers to hear the approach of emergency vehicles. With the advent of more closed cabs on fire apparatus, a factor which cuts down on the ability of the fire truck driver to hear other emergency vehicles approaching, special thought must be given to windows during inclement weather. With the windows rolled up, and with the noise of radio traffic too, it is very unlikely that any approaching emergency apparatus could be heard. However, warning devices should not be sounded, when consistent with safety, in the immediate vicinity of hospitals, schools, theaters, churches, or other places of assembly during the time that people are, or are likely to be, in attendance.

Use of Warning Lights

The red lights and headlights on all emergency equipment shall be kept lighted at all hours of the day or night while responding to emergency calls. When returning from such calls, only the headlights shall be left on. When fire apparatus is out for district inspection or other nonemergency assignment, the headlights shall be turned on to warn citizens that emergency equipment is rolling.

All fire department vehicles double-parked on the street at night should have all red lights (front and rear), and directional signals turned on as a warning of their presence to approaching traffic. Discretion shall be used, however, so that battery power is not needlessly expended. For example, when a series of department vehicles is double-parked in close proximity to each other, it should be necessary for only the first and last vehicles to keep their warning lights on. Such double-parked vehicles should be moved to a safer position as soon as conditions permit.

Speed of Apparatus

Drivers should govern their own choice of speed according to a "Basic Speed Rule," which can be stated in a very simple way: "Never exceed a speed which is reasonable and proper for existing conditions, even where the law permits a speed higher than that at which you are driving." Safe, prudent speeds vary with such factors as driver reaction time, driver condition, brake efficiency, condition of pavement, weather, and traffic congestion. A speed which is reasonable when there are few persons or vehicles on the street may be excessive in heavy traffic or at hours when school children must cross the streets. Over the same stretch of roadway, speeds that are safe at certain times are unsafe at other times.

Under all circumstances, the speed of fire department vehicles turning at any street intersection shall be reduced to a minimum consistent with safety and with due consideration of traffic conditions.

On return from an emergency call, and in all other nonemergency driving, all traffic laws shall be observed by drivers of fire department vehicles.

Whenever any department vehicle is required to respond to a still alarm which does not involve fire service or immediate danger to human life, the driver shall proceed in a safe and cautious manner, observing all traffic laws and rules. He shall not use the siren or red lights during the response.

Crossing Controlled Intersections

Whenever a traffic control red light is against a fire department vehicle responding to an alarm, the vehicle shall be slowed down -- and stopped if necessary -- until all drivers and pedestrians proceeding on the green light realize that the fire department vehicle is signaling for the right-of-way and

all traffic has stopped to let the department vehicle proceed through the intersection. Upon approaching a stop sign, a fire department vehicle shall slow down and shall not proceed until all other vehicles yield the right-of-way. If opposing traffic does not yield to the siren and red light, the right-of-way shall not be taken arbitrarily.

Wet Streets

During damp or wet weather, department vehicles shall avoid graded streets whenever possible. If necessary to use such streets, the vehicle must be driven with the utmost caution, at reduced speed, under control of lower transmission gear ratios, and with the vehicle kept as close as possible to the sidewalk or curb to prevent skidding.

Use of Turn Signals

Turn signals should be used before starting to turn, not while turning. They are intended to inform other drivers what you are going to do before you do it, so as to give them time to provide ample clearance for your vehicle. The law requires that the signal be given at least 100 feet before reaching the turning point.

Courteous Driving Habits

Fire Department drivers should make every effort to develop courteous driving habits. Public opinion of the fire service can be greatly influenced by the personnel behind the steering wheel of department vehicles.

All of the aforementioned points emphasize a need for "defensive driving tactics" on the part of the driver of fire trucks, particularly at peak traffic hours, at intersections, and during inclement weather.

Entering Area of Emergency

The command officer should avoid the concentration of large numbers of emergency apparatus in one location. Normally, drivers do not control these situations and must look for direction. When faced with the potential of response commitments without adequate direction, the driver must then take the initiative on deciding his deployment.

Positioning Vehicles at Fires

Drivers must use good judgment in parking their vehicles so as not to interfere with the positioning of other fire department apparatus. Particular attention must be given to the positioning of triple combination pumpers for the use of hose reel lines, ready lines, or when acting as a manifold, so as not to obstruct aerial-ladder operation. (Aerial ladders usually operate from a position directly in front of the fire scene.)

Unless otherwise ordered, a "first in" vehicle should be placed in a position where it will least interfere with incoming companies, but still spotted in an area where its mission can be satisfactorily accomplished. This may be the responsibility of the driver if direction is not available from command positions.

Operators of fire department cars and pickups must at all times exercise good judgment in parking their vehicles so as not to interfere with the operations of responding companies. Particularly, they should avoid blocking the removal of ladders from the rear of truck company vehicles.

Apparatus not in use. All apparatus not needed at the fire scene should be parked in a safe location with lights and motor turned off, and only one unit should be manned for radio contact with communications.

Pumper apparatus. The driver of a pumper that has responded to the fire scene should remain with the apparatus until it is obvious that the immediate necessity of movement and operation is over. Thereafter, he should report to his immediate superior, who will direct his future movements.

Aerial truck and elevating platform driver. The driver of an aerial ladder or elevating platform truck shall remain with his vehicle until it is obvious that the immediate necessity of movement and operation of the vehicle or aerial ladder has passed. Thereafter, he should report to the officer in charge at the scene, who will direct his further movements.

Idling of motors. The driver of a vehicle standing by for future assignment should idle his truck motor at about 750 rpm to keep the battery charged.

Backing up at fires. The practice of engine companies backing into position, or to hydrant locations at fires, is a necessary maneuver. However, unnecessary backing, such as backing to pick up hose, should be curtailed as much as possible. If it is found necessary to back up while maneuvering at the fire scene, the driver should be assisted by guides. The guide should stand or walk at one side of the apparatus and signal the driver, rather than call to him. The guide should never stand or walk behind the apparatus in a position where the driver cannot see him.

In addition to necessary guides, it is recommended that an audible warning device be used whenever apparatus is to be backed.

Post-Emergency Operations

Certain post-emergency practices should be followed to ensure adequate training of personnel, to ensure that the vehicle and equipment are correctly cleaned and serviced, and to ensure correct safety procedures.

Relief Driver Practice

Each company officer shall require one of the relief drivers assigned to his company to drive the apparatus when returning from alarms, drills, tests, and at other times whenever practicable. This same requirement shall also apply in the case of truck companies. This practice is essential in order that such personnel may acquire proficiency in the duties of a driver.

Cleaning of Vehicle After Run

If any fire department vehicle has become wet due to weather conditions, or due to conditions at the fire, all parts, and particularly those subject to rust, should be thoroughly wiped dry. Any dirt, grit, mud, salt, or dirty water should be thoroughly washed off with clean fresh water. Equal attention should be paid to the underside of fenders and the undercarriage of the apparatus. (Care must be exercised not to flush water on hot brake drums, as the water may cause the drums to crack.) Salt water has a particularly corrosive action on exposed metal parts and body finish and must be promptly washed off.

Backing into Stations

Whenever apparatus is being backed into stations, the officer in charge shall station men strategically to control traffic and to guide the apparatus into the station house.

III. Standard Driving Practices

The main difference between driving a car and driving a truck lies not so much in construction of the vehicle as in the technique required to operate it.

Actually, there is very little difference in the basic principles of driving a truck or a car with manual shift transmission. Each must be shifted, steered, propelled, slowed, and stopped -- the objective being to move the vehicle from one location to another, preferably smoothly and safely.

In the driving of a truck, however, certain professional techniques are required to properly manipulate the controls, whereas the absence of these techniques might go unnoticed in automobile operation.

A truck driver frequently utilizes the gears and the engine to control the vehicle. To make a smooth, safe gear change, he must coordinate shift lever, throttle, and clutch. To coordinate these, he must recognize minimum and maximum engine speeds and should understand their application when selecting gears while traveling at various road speeds.

Awareness

"Awareness" is an important aid to safe driving. A good driver must learn to be aware of many of the functions of his vehicle. He should be subconsciously aware of engine speed, road speed, and the terrain that affects these speeds. He should also have the "feel" of the throttle, clutch, and brakes.

A driver should never become so engrossed in the operation of controls of his vehicle that he neglects to pay attention to traffic or road conditions.

A driver who has to concentrate on "how to do this" or "what to do next" may not be a safe driver.

Proper Throttle Use

The secret of proper throttle application is to use a sensitive, relaxed foot on the gas pedal. This is generally referred to as "featherfooting."

The sooner a driver is able to apply "just a little more" or "just a little less" throttle pressure when he desires, the sooner he will be able to shift smoothly. Too much or too little throttle pressure during a shift will result in roughness. The degree of roughness will depend largely on the degree of error in throttle use.

Probably the most significant sign of a really good driver is his judgment of how much throttle he should apply and his ability to apply just that amount. (This ability is especially noticeable in shifting, but applies to all driving situations.)

Although it is basically true that the throttle is pushed down for power and speed, and "off" throttle is used for slowing and stopping, a driver can improve his performance by considering his throttle as a precision instrument. Used properly, it can correct many conditions that result in sloppy operation. A driver who can "featherfoot" his throttle is a good driver.

How to "Feel" the Throttle

Some engines have more "pep" than others, and this influences throttle pressure. Some throttle pedals are so located that the driver's shoe will sometimes contact other parts of the vehicle. (In such a situation, throttle pressure will be affected, so the driver must be sure his foot is properly positioned on the pedal. Some throttles have stronger springs than others, and are therefore harder to push.)

After the driver has started the engine, but before he moves the vehicle, he should get the "feel" of the throttle while the transmission is in neutral. To do this, he should apply a slight amount of pressure to determine how much pressure is necessary to obtain the amount of engine speed desired. He should then apply just a little more or just a little less pressure, which will change the engine speed slightly. This enables the driver to "feel" the throttle and to know just how much pressure is needed for smooth operation.

Proper Clutch Operation

It is highly desirable to avoid clutch abuse. A clutch is a rugged device, but it is not indestructible. Proper use will improve its efficiency, prolong its useful life, and reduce strain on other connected components.

Excessive clutch wear is the result of excessive friction caused by improper engine speed at the time the clutch is released. (A clutch pedal is released to engage the clutch; consequently, the terms "release" and "engage" in respect to clutch operation are used interchangeably.) To avoid excessive clutch wear, the driver must match the engine speed to the road speed in relation to the selected gear, and maintain that engine speed as the clutch is released.

For example, picture two electric fans facing each other with the blades turning in the same direction at the same speed. If one fan is moved forward until its blade is against the blade of the other fan, there will be little reaction providing they are still turning at the same speed.

However, if the procedure were repeated with one blade turning slower than the other, the result could be serious damage to both blades. In a way, this is similar to clutch action as the clutch pedal is released.

Even though the clutch is engineered to withstand some friction, excessive abuse shortens its service. Every driver should remember that proper clutch care can be achieved by the correct use of the throttle.

How to "Feel" the Clutch

Although most clutch pedals are depressed and released in the same manner, they are not always adjusted identically. Some clutches begin to function just as the clutch pedal is moved downward; some do not function until the pedal is depressed two or three inches. But usually, a clutch pedal has approximately one and one-half inches of free travel before it affects the clutch action. As the pedal continues downward, the clutch is completely uncoupled in about one more inch of travel. The pedal still has approximately three inches more of travel before it contacts the floorboard.

Conversely, when released, the pedal will travel approximately three inches from the floorboard before affecting the clutch action. Another inch of travel will complete the coupling, and the last one and one-half inches will be free travel. The distance of pedal travel may not be the same on every vehicle, but the principle is the same.

A driver should know just where this "point of contact" occurs in his vehicle if he is to use the clutch properly, and he should always get the feel of it before departing on his trip. When he is ready to move the vehicle, he should push the clutch pedal gently downward and feel how far it travels freely before it encounters resistance. This free travel is comparable to the free play in a steering wheel -- a sort of built-in safety feature. The resistance felt in the clutch is the start of the actual clutch action.

The driver should then depress the pedal all the way down, put the stick in gear, and slowly release the pedal. He will find that the pedal travels upward a certain distance before the vehicle attempts to move. This distance is important to remember, because the pedal must always come up just this far before it begins to perform its function.

If the driver is unsure of just where this contact area is, he will be too slow in releasing the clutch pedal, which probably will affect throttle regulation -- or he will release it too far too quickly, resulting in either a stalled engine or a lurching start.

The driver who tries out the clutch pedal first, as outlined, should continue to be able to "feel" his clutch. If he can, he will certainly be a better, smoother driver.

Double-Clutching

Double-clutching is probably the easiest maneuver of driving operations, but it has a very important function. It simply involves releasing and depressing the clutch during shifting while the transmission is in neutral.

Even though the truck gears are synchromeshed, the driver should double-clutch when upshifting. And if the driver will make it a habit to always double-clutch when shifting, even his down-shifting will be accomplished easier.

The length of time the clutch is "out" during the double-clutch operation depends on the driver's ability to regulate the engine speed to match the next gear speed. A driver who can quickly regulate the engine speed has only to let the clutch out and right back in again to complete a fast shift. A driver who is unsure of the throttle and has difficulty attaining proper engine speed must keep the clutch out until he does get it properly regulated; then he can depress the clutch to complete the shift. Obviously, it would take this driver longer to shift. In any case, the clutch should be out while the transmission is in neutral and as the engine speed is regulated for the next gear.

Proper Brake Operation

Too little thought is usually given to brake use. It is assumed that brakes will always slow and stop the vehicle at the driver's discretion, but little attempt is made to conserve them. A driver should give considerable thought to saving his brakes by utilizing the gears and should also improve his method of brake application.

Some vehicles are equipped with hydraulic brakes, some have vacuum boosters, and others have airbrakes. The degree of brake pedal pressure required varies from a very light touch to a rather hard application. The pressure needed also varies in relation to the load of the vehicle -- the heavier the load, the more pedal pressure is needed for the desired deceleration.

In normal stopping, more pedal pressure is needed as the brakes are first applied than is needed as the vehicle stops. A driver should apply considerable pressure at the start of the application, ease off as the vehicle slows, and release the brakes almost entirely at the end of the stop, then apply more pressure to hold the vehicle. This method provides a smooth stop and eliminates the lurch or jerk so often noticed as a vehicle ceases its forward motion.

In the event a long-term application of brakes is necessary (due to some circumstance other than routine), the proper application of brakes can spell the difference between safety and disaster. Although opinions differ as to methods of application, it stands to reason that if a steady, prolonged brake pressure is applied, the brake linings will heat, and the more they heat, the less effective they are. On the other hand, if a slow pumping action is used a vehicle equipped with air or vacuum brakes will soon use its air reserve and "lose" its brakes.

This in no way suggests that one should not use a heavy braking action with a long, hard application if the occasion demands it. By all means, brakes must be used as necessary to stop short of any collision.

The point is that if the driver conserves his brakes as much as is reasonable and practicable in normal driving situations, the brakes will prove to be more efficient in cases of emergency.

How to "Feel" the Brakes

As soon as the vehicle is in motion, the driver should gently apply the brakes to determine how much brake pedal pressure is required. If the brakes are functioning properly, he should then increase the road speed in the next higher gear and repeat the procedure.

Assuming the driver has paid close attention to the reaction of the vehicle as he conducted this brake test, he should have the "feel" of the brakes and from that point on can avoid rough and jerky brake application when slowing or stopping.

Airbrakes

Operating the brakes of airbraked vehicles differs very little from operating the brakes of a passenger car. Because operation of the brake pedal requires very little physical effort, proper control of the brakes may be easily accomplished. The distance the brake pedal is depressed determines the amount of air pressure delivered to the brake chambers, and the brake chamber pressure determines the braking force. Thus, the driver should keep in mind that he is operating a brake valve capable of giving finely graduated brake control, and he should make full use of this feature.

An airbraked vehicle, one not equipped with MGM or Maxi-Brake systems, should not be moved unless the air gauge shows at least 60 lbs. of air pressure in the brake system because the brakes are not fully effective at lower pressures. While operating the vehicle, the driver should periodically observe the air pressure registered by the dash gauge to be sure that pressure is being maintained properly. If the air pressure drops to a low point, or if the warning buzzer or light signifies that the pressure is low, the vehicle should be stopped and the trouble corrected. (Section 26506, Vehicle Code, requires all vehicles equipped with airbrakes to be equipped with a low air-pressure warning device.)

The best stop results when the brake is applied firmly enough to correspond with the speed and condition of the road. As the vehicle speed decreases, the brake pedal may be released slightly as necessary to assure a smooth stop. As the stop is completed, there should be only sufficient air pressure in the brake chambers to hold the vehicle stationary. The brakes must never be applied lightly at first and the braking pressure increased as the speed decreases; this will result in a rough stop.

The brake pedal should not be "fanned," as this merely wastes compressed air and does not effect a desirable stop. Neither should the brake pedal be fully depressed, except in cases of emergency, as this causes full braking force to be delivered to the wheels. This should not be necessary in ordinary service.

Normally, the driver should use the engine to assist the brakes. He does this by not disengaging the clutch until the last few feet of travel. Some airbrake systems also provide a "secondary brake locking device." Control

for this device is usually a small toggle installed on the instrument panel of the driver's cab. (Note: this is not to be confused with the toggle control for Maxi- or MGM Brakes.) The toggle switch has two positions. With the switch in the "ON" position, the air is locked in the braking system and the brake shoes will remain in contact with the brake drums. When the switch is in the "OFF" position, the brake shoes are retracted from the brake drums. The escutcheon plate on the switch is marked: "Do not use this lever to park." This means that the toggle switch should not be engaged while the truck is in quarters or parked on the street for other than fire duty. It also means that the "ON" position should never be used if the normal air pressure is not being maintained. DO NOT USE THIS TOGGLE SWITCH AT ANY TIME WHILE THE VEHICLE IS MOVING.

The switch may be placed in the "ON" position when the apparatus is stopped and the motor is running, such as at a fire or other emergency. It may, in addition, be used with the motor shut off, providing the driver is sure that adequate air pressure is being maintained. Airbrakes will assist the parking brake in holding the vehicle on a hill or in position for fire duty. Since this air-lock system provides assistance only, it must be considered as a secondary system and used as such. THE PARKING BRAKE MUST ALWAYS BE APPLIED FIRST AND THE CHOCKS PLACED BEFORE APPLYING THE SECONDARY AIRBRAKE SYSTEM.

(Note: Like the hydraulic system, leaks may develop in an airbrake system while under pressure over a long period of time. For this reason, the parking brake must be engaged fully and chocks placed under the rear wheels.)

Downhill Driving

In considering this phase of driving, only general situations can be examined. Exceptional circumstances or a combination of specific conditions may necessitate actions other than outlined here.

The procedure to follow when going downgrade is to "gear down." The accepted procedure is to drive downgrade in a gear low enough to permit the engine speed to be in the medium range and still hold the vehicle at a safe, steady road speed. If in the proper gear, the vehicle will slow when the driver eases off the throttle, and will gain speed with more throttle. This is as it should be and is the proper way to drive downhill. This method gives the driver more control of his vehicle and reduces the necessity of excessive brake use.

Brakes are certainly intended to be used to slow or stop a vehicle, and a driver should use them any time the situation demands. But a good driver will utilize the gears and engine to help hold or slow the road speed during much of his driving, thereby saving his brakes.

CAUTION: Downshifting while traveling downgrade is not recommended.

If the downgrade is not steep, if the driver is very good at shifting, and if his judgment of engine speed versus gear speed versus road speed is excellent, downshifting can be done successfully, but the risk is great, and it is strongly recommended that the proper gear be selected and the shift made before starting down the grade. In the event an error in judgment results in selecting a gear too high for the grade, the driver should use brakes to slow the vehicle -- stopping if necessary -- and put it in the proper gear. Many serious accidents were the result of the driver failing to downshift at the proper time, confident he could shift later, and brakes alone were inadequate to stop the vehicle.

Shifting a Stick-Shift Vehicle

Gear shifting is seldom a problem for the average automobile driver. A peppy engine, a lightweight vehicle, and synchromeshed gears offer very little challenge to shifting ability. Generally speaking, gears are shifted only to gain higher speed, and brakes are used for slowing and stopping.

However, in the operation of a heavier vehicle, with a heavier, slower motor, a more professional technique is required. Shifting to a higher gear is still used to increase momentum or to control motor speed. However, shifting to a lower gear is a standard operation to regain momentum after a reduction of road speed, to maintain momentum on upgrades, to conserve brakes, to hold vehicle speed control approaching a downgrade, and usually to keep the motor speed in its proper range.

If gears are synchromeshed, getting into gear presents no problem, but clutch abuse must be avoided when the clutch is engaged after the shift.

The motor must not be abused by prolonged running over or under normal tach range. When upshifting, the motor must not be revved up over tach range before the shift to a higher gear, but must be near its top speed before the shift to avoid being "under tach" when in the higher gear at the completion of the shift. If a speed either over or under the tach range seems likely to occur, the shift should be delayed until the situation is suitable for the change.

When shifting into any gear, it is necessary to understand that some engine speed is needed as the clutch is released after the shift has been completed.

Therefore, that "some" motor speed should be determined by the driver when the shift is to be made. This "some" amount of throttle varies considerably, depending on the road speed of the vehicle while the shift is executed and on which gear is being selected. Shifting to a higher gear will require less throttle. Shifting to lower gear will require more throttle.

The position of the gear lever before the shift has no bearing on the amount of throttle needed during the shift into the selected gear, nor on the amount needed when the clutch is released at the completion of the shift.

The three items that determine how much throttle is needed during a shift are:

1. Which gear is being selected?

2. How fast is the vehicle traveling?

3. How fast will the motor be running in that gear at that speed?

The main point is that the driver must determine how much motor speed will be needed in that gear to match the road speed of the vehicle after the clutch is released at the completion of the shift. He must determine, then regulate and hold the proper amount of throttle during the entire shift, and still hold that amount of throttle until the clutch is released.

If the driver's judgment has been reasonably correct, a smooth entry into the selected gear will be accomplished, and equally important, this will result in a smooth clutch release.

If a shift is made smoothly with no noticeable change of motor or road speed when the clutch is released, no vehicle abuse has occurred.

How to Upshift

When shifting from a lower to a higher gear, observe the following procedure:

- Rev the tach up to near maximum before starting to shift, so that the engine will not drop under tach after the shift is completed.

- Depress the clutch and move the stick to neutral as you ease off on the throttle.

- Double clutch, move the stick to the next highest gear, and release the clutch.

- After the shift is completed, regulate the throttle as the situation requires.

- If you regulate the throttle properly (less than in the lower gear, but still "some"), there will be no gear clash or grind; and if you hold that proper amount of throttle as you release the clutch, there will be no noticeable change of motor or road speed, indicating that you executed a smooth shift.

How to Downshift

When downshifting, it is most important to realize that the motor must turn considerably faster in a lower gear than it would in a higher gear at the same road speed. Therefore, the driver must be alert to the minimum

and maximum engine speeds (indicated by the tachometer) and understand that unless the engine speed is lowered to near its minimum range in the higher gear before the shift, it will very likely be above the maximum range after the shift to the lower gear is completed.

A shift to a lower gear should never be attempted if the vehicle is going faster than the engine can make the vehicle move in the lower gear. For example, if a vehicle can go only 10 mph in second gear at maximum motor speed, a shift into second gear at a road speed of more than 10 mph should never be attempted -- it may result in stripped gears, a ruined motor, a twisted driveshaft, or a broken axle.

The driver who understands the relationship of motor speed to road speed and the variations incurred in changing gears will have little difficulty in executing smooth, safe downshifts.

When shifting from a higher to a lower gear, observe the following procedure:

- Be sure the tach is near its minimum range before the start of the shift, so it will not be above maximum after the shift is completed.
- Depress the clutch and put the stick in neutral as you press down on the throttle (hold it down until the shift is completed).
- Double clutch, move the stick into the next lower gear, and release the clutch.
- With the shift completed, regulate the throttle as the situation requires.
- If you hold the throttle down the correct amount (not too much motor speed) all during the shift and clutching, it will result in a smooth, safe gear change.
- If you don't make a smooth shift, determine what is wrong and correct it next shift. If you do make a smooth shift, be proud of it and remember how you did it.

Exception. Less Throttle is used for more motor speed. This might seem ridiculous until the exception is understood. The throttle can be far down even though the tach is at minimum range (such as when pulling upgrade). As soon as the clutch is depressed, the strain on the engine is removed, and if the throttle is held in its down position, excessive motor speed will probably result before the clutch is released. Use of either one of the two following techniques can solve the problem:

- Let the clutch out quickly before the motor can rev over tach.
- Ease off on the throttle to regulate it for the amount of motor speed needed for downshift. By using this technique, the driver eases off on the throttle, but still gains more motor speed as the clutch is depressed.

This exception refers only to downshifting under the given situation and applies to either a stock transmission or a two-speed rear axle.

The effect of terrain on shifting. Since it is necessary to keep the motor speed in its proper range, it is necessary when contemplating a shift to consider the immediate terrain and the momentum of the vehicle.

It should be remembered that as soon as the clutch is depressed at the start of a shift, the momentum of the vehicle changes according to the immediate topography.

As soon as the clutch is depressed, the road speed will:

- Change very little on a level roadway
- Decrease on an upgrade
- Increase on a downgrade

How much the road speed will change during the shift depends on:

- The momentum at the start of the shift (the greater the momentum, the less noticeable the change)
- The steepness of the grade where the shift is made (the steeper the grade, the more the speed is affected)
- How long it takes to make the shift (the longer it takes the driver to complete the shift, the longer the drive train is uncoupled and the more the momentum changes)

A knowledge of proper throttle regulation is necessary to be able to adjust motor speeds to match road speeds under these varying road conditions. When a driver understands how much terrain conditions affect shifting, he should be able to change gears with little difficulty.

The Two-Speed Rear Axle

Many trucks have an extra cluster of gears located in the rear axle. This is commonly referred to as a "two-speed" axle. Some drivers are bewildered when first confronted with this device, but understanding and application of its features develop an appreciation of its value. Its purpose is to change the gear ratio in the rear axle to either a high or low range, allowing a choice of two speeds in any transmission gear. (A truck having a four-speed forward transmission has a possible eight speeds forward if equipped with a two-speed rear axle.)

The gears in the two-speed axle are moved by a vacuum or electric motor. The motor is controlled by a switch, lever, or button. Most common is a "button" mounted near the top of the gear shift lever, which moves up or down approximately one inch.

If the button is pushed down to the "low side," the motor changes the range to "low" in the rear axle in much the same manner as the stick is moved to drop the transmission into a lower gear. If the button is lifted "up," the motor changes the range to "high" in the rear axle.

Whenever a driver prepares to shift gears with the stick, his judgment governs his actions. He automatically waits until conditions are right for the shift, or he corrects the conditions that are not right by adding more throttle, reducing road speed, or whatever is called for. If he forced the stick into gear at the wrong road or engine speed, for example, damage could result or, at the very least, the shift would be noisy and probably unsmooth.

This same principle applies to the shifting of a two-speed axle. The motor that operates the gears cannot think and will try to shift the gears just as soon as the driver moves the shift button, whether or not conditions are right. And again, if engine or road speed are not correct at the time, damage can occur.

The driver must apply correct throttle regulation and clutch operation to get the most satisfactory results from the two-speed axle. If he understands the two-speed, it won't be confusing to him and will prove to be of great help in maintaining momentum -- whether traveling uphill or on level, and whether the vehicle is loaded or empty. But the main purpose of the two-speed axle is often overlooked; it is of great value because it allows the driver to keep the tach closer within its range, with less variation of road speed. For example, the tach range between transmission gears is usually 1,000 rpm, whereas the tach range between the high side and the low side of the two-speed axle is approximately 500 rpm. Since this type of axle offers two speeds in each transmission gear, a two-speed change can be considered a "half gear," and this is why the motor speed varies only half as much on a two-speed change as in relation to the standard transmission. If the driver will train himself to remember that pushing the button down is downshifting (just like downshifting the stick) and raising the button is upshifting, he should be able to grasp the techniques of two-speed operation very quickly.

When the stick is downshifted, more throttle is applied during the shift and should continue to be applied until the clutch is released. When the button is pushed down, the throttle is applied in the same manner, but the two-speed is only a half-gear change, so the throttle should be adjusted only half as much as would be needed for a stick change. The same technique is used when raising the button to the high side. The throttle is eased off for less engine speed, but changed only half as much as for a stick change.

While the principle of the two-speed and the stick operations are very similar, there is one slight variation of technique -- clutch timing. In the two-speed operations, the button and throttle are moved at the same time in the same direction and the clutch is depressed a split second afterward. The clutch must not be depressed until the button is moved, but should be depressed immediately afterwards.

To avoid confusion on this point, one might remember that B comes before C in the alphabet. Button starts with a B and clutch starts with a C. So always move the button before the clutch, then immediately depress the clutch -- approximately one-quarter second after the button is moved.

Most two-speeds can be shifted without the use of the clutch and some instructions suggest not using it. But too often a roughness is incurred as the shift is made with the clutch out; sometimes it does not complete the shift (leaving the rear uncoupled), and if the button is raised to the high side going downgrade, it often will not shift unless the clutch is depressed.

The best procedure is to press the clutch in before the two-speed tries to shift. Always depress the clutch about one-quarter second after the button is moved so the shift will occur while the clutch is in.

How to Operate the Two-Speed Button

Down -- from high side to low side:

- Reach for the button with the right hand and "reach" for the clutch with the left foot.
- When the motor speed and road speed are suitable for the shift, push the button down (as you push the throttle down), and immediately depress the clutch and let it right back out.

If throttle regulation is correct, and if clutch follows the button immediately (and is released immediately), a good downshift will be completed.

Up -- from low side to high side:

- Reach for the button with the right hand and "reach" for the clutch with the left foot.
- When the engine speed (rpm) and road speed (mph) are suitable for the shift, lift the button (as you raise your throttle foot) and immediately depress the clutch. Pause to allow the two-speed to shift, then release clutch.

Splitshifting

Splitshifting is the term usually used to describe the combination of a change of the stick and a change of the button in one operation to permit a half gear change. For example, shifting from high 2nd to low 3rd would be upshifting one-half gear.

Splitshifting has many advantages, but its main purpose is to allow the driver to keep the rpm within tach without sacrificing momentum. Although usually considered most helpful during upgrade travel, it is quite helpful to the motor when traveling on the level and aids the driver in attaining the most practical road speed.

How to Splitshift

Regardless of how a splitshift is made, the objective is to execute a safe, smooth, fast, and simple change of gears. Although there are several ways to accomplish a splitshift, only one technique is presented here as the safest, most dependable, and easiest to perform.

The operation requires moving the stick to shift the transmission and moving the button to shift the rear axle. Any time a shift is made to a higher gear (stick or button), less throttle is required. Whenever a shift is made to a lower gear (shift or button), more throttle is required. When the clutch is released, "some" throttle pressure must be used. Therefore, when splitshifting, always shift to the higher gear first (with less throttle) rather than to the lower gear (with more throttle), so the foot is on the throttle with "some" pressure as the clutch is released at the completion of the shift.

For example, to change from high 2nd to low 3rd (upshifting):

Shift from 2nd to low 3rd in the usual manner, but just before the clutch is released, push the button down in the usual manner. As you can see, there is less throttle while changing from 2nd to 3rd; then as the button is moved to the low side, throttle is applied and the clutch is released with "some" throttle. This results in a smooth, safe splitshift.

Changing from low 3rd to high 2nd (downshifting):

Lift the button to the high side in the usual manner, but just before the clutch is released, shift the stick from 3rd to 2nd. As you can see, there is less throttle as the button is raised, and then more throttle is applied while changing from 3rd to 2nd and as the clutch is released.

When both the stick and the button are to be moved as noted in these two examples, just one is moved, then the other, but the actions are combined into one operation as previously explained.

If this procedure is followed, splitshifting will prove very effective, and the many advantages it offers will be readily seen.

Steering Control

Most drivers would claim that they are able to retain good control of a vehicle regardless of hand position. Yet it is a fact that many drivers often drive with their hands improperly placed on the steering wheel -- a condition which may tend to limit their reactions under emergency conditions.

If any unusual situation were to develop (tire blowout, wheel encountering obstruction, and the like), the driver could not recover control soon enough.

It is hard to improve upon the standard recommendation of "10 and 2" -- left hand at 10 o'clock position on the wheel and the right hand at 2 o'clock. (This applies to straight-ahead driving.) When a curve in the road ahead

necessitates a turn of the wheel, the good driver will prepare for the turn before reaching it. If the curve is to the right, the driver should hold the wheel firmly with his right hand and slide his left hand down to 8 o'clock, then hold the wheel firmly with his left hand and slide his right hand up to 12 o'clock. Now, as the curve is entered, the hands will move clockwise and approach the 10-2 position as the curve is traveled. In this way, control is maintained while approaching and during the turn. Obviously, the sharpness of the curve will govern the hand position needed. The procedure outlined should, of course, be reversed for a left curve maneuver.

Another point to consider in turning is the position of the thumb. Many drivers grip the wheel with the thumbs curved around the wheel, and some of these drivers have received sprained thumbs when the wheel suddenly slipped as a front wheel unexpectedly hit something.

To eliminate this danger, the hands should be placed on the wheel with the thumbs resting on the wheel or forefinger -- not around the wheel. You can hold the wheel with just as firm a grip, and if the wheel is spun through your hands, they are still at the wheel and in a position to regrasp it with no injury.

Always be in command of the vehicle -- never let it control you.

Engine Speed Control

It should be thoroughly understood that the engine speed must generally be kept within a certain range -- not too fast (racing the engine) and not too slow (lugging). It should be recognized, too, that major variations in the road speed of a vehicle are controlled more by gear selection than by engine speed. Since the engine speed is limited to proper minimum and maximum, the desired road speed is obtained by selecting an appropriate gear.

If the engine speed reaches maximum, a shift to a higher gear will lower the engine speed in relation to road speed. If the engine speed reaches the practical minimum, a shift to a lower gear will raise the relative engine speed.

A driver not experienced in recognizing minimum and maximum engine speeds may have difficulty in judging the proper time to shift. A tachometer installed in a vehicle makes the correct control of your engine speed comparatively simple. If no tachometer is installed, the driver must learn to "play it by ear" -- to get the "feel" of it.

It might help the driver to devise some mental method to promote awareness of engine speed. For example, he might visualize a horse hitched to the front of the vehicle and compare the efforts of the horse pulling the vehicle to the efforts of the engine. If the horse is laboring, this is sapping his strength -- this would represent the engine running too slow.

If the horse is trotting easily as the vehicle rolls along freely, he is under very little strain, and this would represent the engine running in its proper range.

If the horse is running fast and hard, he will soon become winded, overheated, and possibly permanently damaged -- this would represent excessive engine speed.

To avoid unnecessary engine abuse because of lugging or racing, the horse should be kept "trotting"; engine speed should be kept above a laboring strain, but below a vibrating roar. This applies to any driving condition in any gear. Engine speed can be controlled by shifting to a gear that will allow the correct speed. Only experience will teach a driver this kind of control.

Helpful Hints for Truck Driving

The following driving hints, if consistently applied to actual driving situations, will not only make driving of trucks safer but will also make it considerably easier.

Shifting Before a Turn

When approaching a turn where a shift of gears will be advisable, the driver should always shift before the turn so that both his hands will be at the wheel throughout the maneuver. Also, throttle can be applied when leaving the turn, because the truck will already be in the proper gear. Avoid shifting in a turn.

Remembering the wheel base. When turning a corner, the driver should know approximately where the rear wheels are located in relation to the rear of the truck. On some trucks, the wheelbase is quite long, and this distance must be allowed for in a turn.

Preparing for a turn. When a change of direction is required after a complete stop, the wheel should be turned just before the stop is completed. The vehicle will then be ready to turn in the desired direction the instant motion is resumed. This applies to forward stopping before backing or to a backing stop before moving forward. Avoid turning the wheel while the vehicle is stationary.

Steering During Backup

The location of the wheels in relation to the ends of the vehicle should be noted before backing. The overhang (the distance the rear end protrudes beyond the rear wheels) varies quite a bit between vehicles. A driver must be aware of this overhang and govern his steering accordingly. He should never become so involved in maneuvering the rear end of the vehicle that the position of the rear wheels is forgotten.

A factor in backing, too often overlooked, is that the back wheels are leading and the front end is following. To change the direction of travel when backing,

the front end must swing to the side in order to point the rear of the vehicle toward its goal. The sharper the turn, the more the front end must swing. While looking in the backing direction, the driver should not forget this factor because it will determine the success of the maneuver.

Motor compression can be used to help the brakes slow the vehicle when stopping. The clutch pedal should not be depressed as long as it is helping hold back the vehicle, but it should be depressed when it ceases to help. The practice of depressing the clutch and "coasting" up to a stop should be avoided -- this requires excessive brake use.

Riding the clutch. Due to the numerous clutch applications that are necessary during a run, the driver often has his foot ready at the pedal, anticipating its use. This is proper, but it also leads to a fault found in many drivers -- one which they often do not realize.

While being held "at the ready," the foot is depressing the pedal slightly, which causes a small, unnoticeable amount of slippage. This is known as "riding the clutch," and is often very damaging to the clutch plate. When not actually using the clutch, the driver should keep his foot off the pedal -- not resting on it. **Avoid riding the clutch.**

Gear Selection

What gear to use to start a truck in motion is a debatable subject. The physical make-up of the gears is considerably different from one vehicle to another. Some vehicles are designed to start in the lowest gear; in others, the lowest gear is to be used only for an extremely hard pull. Terrain and load also have a strong effect upon proper gear selection.

To select the proper gear for starting, the general principles of motor and clutch use may be applied. If the vehicle can move with a minimum of clutch slippage and no motor strain in a particular gear, that gear is obviously satisfactory. The driver will soon discover whether the lowest or the next to lowest gear is best for starting.

Extended Stop With Clutch Out

The mechanics of a clutch are such that the pedal should not be depressed for extended periods when the motor is running. This rule does not apply to shifting, but to stops, such as waiting at railroad crossing, standing at a stop signal, stopping for a line of cross traffic, and the like.

Any time it is evident that a pause will be prolonged, the driver should place the stick in neutral and release the clutch pedal. He should anticipate the moment safe progress can be resumed and place the stick in gear just before that time, so the move can be made without delay.

- Avoid holding the clutch in for extended periods.
- Avoid waiting so long in preparing to move that traffic behind is unnecessarily delayed or the opportunity to proceed is lost. Anticipate your move and prepare.

Grinding of gears. Quite often the gears will grind when the driver attempts to shift into the starting gear after stopping. This problem is more pronounced in some vehicles than in others, and there are three possible solutions:

- Be sure the clutch is fully depressed.
- Be sure the motor is idling, and pause before the shift is attempted to allow time for the gears to stop turning.
- Select another, higher gear; then try the starting gear again.

Securing the Vehicle

When securing a vehicle, a driver should always place the stick in a low gear. Sometimes the parking brake may be worn, or defective, or not properly adjusted, and, therefore, not fully effective. To play it safe, the vehicle should be left in a low gear (1st gear, or reverse), and the parking brake set.

Chocks placed when securing. Too often a parked vehicle has moved while unattended, yet the driver in charge insisted he had the vehicle in gear with the parking brake on. So that the driver may avoid any possibility of a "roll-away" from a secured position on a grade, he should place one chock against a left rear tire and one against a right rear tire -- in front of the wheels if headed downgrade, in back if headed upgrade. If on level terrain, he should place one chock in front of a rear tire and one chock in back of the same tire. Some vehicles are equipped with special type chocks and only one is used. **It is the driver's responsibility to check his chocks before departure, and always use them when securing the vehicle.**

Button down when securing vehicle. Due to the construction of the two-speed rear axle, it is possible for it to be "caught" between its high and low side if the control is incorrectly operated when the vehicle is standing. A driver should be aware of this possibility and use the following procedure to avoid it:

> Before the motor is turned off, have the button on the low side with the stick in gear, and slowly release the clutch until the vehicle attempts to move. When it does attempt to move, this proves that the two-speed axle has shifted, and you can then secure the vehicle properly.

Instruments and Gauges

The instruments and gauges on the instrument panel of the driver's compartment must be considered by the driver as devices necessary to the operation of the vehicle. The most important of these are:

The ammeter. This ammeter indicates the current output of the generator or alternator, not the condition of the battery. During operation, other ammeters can be used to indicate the condition of the battery.

Air-pressure gauges. It is unsafe to operate vehicles equipped with air brakes at an air pressure of less than 60 psi. There are generally two of these gauges on a fire truck; one indicates the reservoir pressure, and the other indicates the brake application pressure.

Air-pressure warning devices. These instruments may be in the form of a warning light, a buzzer, a flag, or any combination of these. When the air pressure drops below 60 psi, these devices will operate. (Most air compressors will operate until the air pressure in the reservoir reaches about 110 to 120 psi.)

The fuel gauge. The fuel gauge should always read full before starting.

The motor oil-pressure gauge. Lower than normal oil pressure can be caused by any one of the following:

a. Low oil level in crankcase
b. Broken oil line
c. Oil pump not operating properly
d. Badly worn bearings or cylinder walls

The motor temperature gauge. An undue rise in motor temperature, as reflected in the gauge reading, is an indication of probable trouble. The following items should be checked at once:

a. Fan and fan belt
b. Radiator and water level
c. Oil pressure and oil level in crankcase

The speedometer. The speedometer should be calibrated accurately and checked periodically.

The tachometer. The "tach" serves as a check on motor speeds and as an aid in determining when a transmission shift is necessary.

The vacuum gauge. The amount of vacuum an engine is drawing is shown by the vacuum gauge. This can also be used as a driving aid in place of, or to supplement, the tachometer.

Ready to Move Out

If the foregoing is understood, the driver is now qualified to put the techniques to practical use. He has completed the preliminary vehicle check and is ready to depart.

He is in the driver's seat, has adjusted his seat and the mirrors, has made sure the hand brake is set and the seat belt is adjusted and fastened, and is ready to start the motor. If he is to perform correctly and safely he should:

- Depress the clutch, place the stick in neutral, still holding the clutch in, and start the motor. Maintain a medium-low rpm, and when the engine is running smooth and steady, release the clutch. Check the gauges during a short motor warmup period and, when warmup is completed, get the feel of the throttle. Next, get the feel of the clutch. Now prepare to move out.

- Depress the clutch and place the stick in the correct gear. Release the clutch to contact point, regulate the throttle, and slowly ease out the clutch as you ease down on the throttle and ease off on the hand brake.

If these motions are properly coordinated, the result will be a smooth, gentle movement.

If, on the other hand, it is a rough start, it is probably because of too much throttle, a rapid clutch release, a late release of the brake, or a combination of these errors. If the engine stalls, it is probably because of too little throttle. (If this technique is followed on a stop where there is the slightest chance the vehicle might roll backwards, no rollback can occur.)

Too much throttle, too slow a clutch release, and too slow a handbrake release will cause excessive clutch friction, which can be harmful. This is known as "slipping the clutch," and it can burn the clutch facing. (A poor driver sometimes slips the clutch so much that a burning odor can be detected.) Proper coordination is necessary to eliminate clutch slipping.

When ready, the driver should move out in the following manner:

- While moving forward in the starting gear, bring the tach up to medium range, depress the clutch, "feel" the brakes, and then proceed.

- After shifting to the next higher gear, again increase the tach to medium and repeat the brake procedure.

- If throttle, clutch, and brakes feel all right, all gauges are functioning properly, and the entire vehicle operation is satisfactory, proceed to your destination.

Ideal Motor Speeds

The ideal operation of a gasoline motor, from the standpoint of motor efficiency, economy, and long, trouble-free mileage, is attained at speeds ranging from about two-thirds of top motor rpm to within about 200 rpm under top. The accelerator must also be in a position corresponding to about

two-thirds to three-quarters torque. For a motor with a top rpm of 2,600, the range as described above would be 1,700 to 2,400 rpm. Within this range the motor would be more responsive to the accelerator, and its proper torque would be achieved more readily with the opening of the throttle. With the use of these motor speeds and the correct transmission gears, the desired results will be achieved.

If a tachometer is provided in the driver's compartment, it is a simple matter to control motor speeds simply by knowing the engine operating limits and watching the tachometer to keep within those limits.

Where a tachometer is not provided in the driver's compartment, motor speeds are indicated by correlation to the speedometer in terms of allowable speeds in each gear.

IV. The Tillerman

The responsibility of driving a tractor trailer ladder truck apparatus is divided between its driver and tillerman. The driver is assigned to the operation of the tractor, and the tillerman has the responsibility for lateral control of the trailer. There is, perhaps, no other activity in the fire service which catches the interest of an observer more quickly than the work of a tillerman when a ladder truck responds to an alarm. The public is always thrilled by the sight of a ladder truck weaving in and out of traffic with the tillerman negotiating turns that appear impossible. There is, however, much more to the tillerman's job than steering and maneuvering the trailer of a ladder truck.

The tillerman must be thoroughly competent in his duties as set forth in the department rules and regulations, as well as in his tiller-driving assignment. His driving assignment includes not only straightaway driving, turning, and backing, but also the proper placement of the trailer at fires, so as to ensure ready removal of ladders from the trailer, and safe operation of the aerial ladder of trucks so equipped. The tillerman of an aerial truck must be particularly aware of such factors as the distance of the trailer from the base of the building involved; the angle of the trailer placement in regard to the position of the tractor; the proper clearance from overhead, side, and rear obstructions; and the grades and slopes of the working area. Tillermen assigned to aerial trucks must also be qualified in the operation of the aerial ladder, as well as in the duties assigned to all truck company firemen. They share the same responsibility as that of the driver in regard to the safety of the public and of other vehicles when responding to or returning from alarms. A thorough knowledge of the prescribed routes to first alarm assignments, and of the traffic conditions to be anticipated, are also essential to efficient tillerman operation. Finally, the tillerman has the responsibility for the proper care and maintenance of the trailer apparatus and the ladders, tools, and equipment carried on the trailer.

Tillerman Qualifications

Members of the firefighting service who desire to be qualified as tillermen must inform the company commander of their desire for tillerman instruction. If the company commander is satisfied that the candidate is capable of becoming a qualified tillerman, he will place him under the supervision of an experienced tillerman for training and instruction. Handling the tiller wheel will involve considerable practice by the candidate. This instruction will take place on returning from alarm response and at such other convenient times as the company officer may direct. When practicing tillering, the instructor will station himself close to the student and in such a position as to be able to assume immediate control of the tiller if necessary.

Candidates for qualification as tillermen must be recommended by the company commander of the company to which each candidate is assigned. The recommendation must also be approved by the battalion chief of the district in which the company is located. Final qualification is made by the Division of Training.

Tillerman Training

When selecting a firemen for assignment as a tillerman, the company officer must exercise care to recommend a man capable of fulfilling a tillerman's responsibilities and must give him sufficient training to produce good tillerman performance. Tillering, like any other specialized operation, requires considerable practice and training under skilled supervision.

When giving instruction in tillering, the instructor should stress the following points in particular:

- Maneuvering the direction of the tiller wheels correctly
- Proper driver-tillerman signalling
- Keeping the trailer in line with the tractor on straight roadway
- Bringing the trailer back into line as soon as turns are completed
- Avoiding rough and over-tillering
- Continuous awareness of the trailer overhang when making turns

Awareness of the overhang of the trailer is very important because this is a definite factor in good negotiation of turns with proper clearance distance, and in the placement of the apparatus at fires. Such distances and the placement involved should be practiced under varying conditions to develop good tillering skills.

It is of utmost importance that the duties and precautions involved in tiller operations are reviewed many times with prospective tillermen in order to prevent injury to themselves or others and to prevent unnecessary property damage to the apparatus or to private property. It is equally important that company officers afford their relief tillerman every opportunity to practice tillering on return from alarms so that he can develop and maintain his skills.

Driver-Tillerman Teamwork

The driver and the tillerman of a tractor-trailer ladder truck have a dual responsibility unique among fire department apparatus drivers. The driver is responsible for proper maneuvering of the tractor, and the tillerman for proper lateral control of the trailer. However, both must work together as a team and coordinate their actions to ensure the safe and efficient operation of the tractor and trailer as a unit.

Truck company officers should realize that the driver and tillerman who work together will soon learn each other's operating techniques and thereby develop into an efficient driver-tillerman team. In this respect, company officers must exercise good judgment in the light of personality differences that are bound to exist. They must enforce strict adherence to good driving practices and observance of traffic laws. It is equally important that company officers provide relief drivers and tillermen with driving practice, whenever possible, so that these men can maintain their driving and tillering skills and learn the techniques of other drivers and tillermen. It is also good practice for the regular driver of truck company apparatus to practice tillering in order to become more familiar with joint driver-tillerman responsibilities. Any combination of driver and tillerman should be capable of handling the apparatus efficiently and working together as a team.

Driver-Tillerman Signals

A system of signals between the driver and tillerman is essential to safe operation of a tractor-trailer ladder truck. Either a horn or a buzzer is provided for signalling purposes. Use of the following signal code by the driver and tillerman is mandatory:

1 Blast -- Stop immediately

2 Blasts -- Forward

3 Blasts -- Back up

Signals should be given distinctly and may originate with either the driver or the tillerman. The signal for "go forward" or "back up" must be acknowledged before action is taken by the driver.

The "stop" signal is intended primarily for use by the tillerman to signal an emergency stop or a necessary stop during a backing operation.

The "go forward" signal is used primarily by the tillerman to signal that he is in proper position and that the tiller end of the truck is ready to proceed forward. It is the company officer's responsiblity to see that the crew is safely positioned on the truck before directing the driver to "roll;" however, he should not give this order until the tillerman has signaled that he is properly secured and ready to go. There is no excuse for an accident caused by a truck leaving the station or proceeding forward before the tillerman is properly seated and ready for the move.

The "back up" signal signifies that a backing operation is necessary. When given by the tillerman, it signals that he has determined the way is clear for backing, andhe is prepared to maneuver the trailer backward.

The driver of a ladder truck can always aid the tillerman by clearly indicating his turns ahead of time. This can be done by giving the standard arm signals well in advance of legal requirements so that the tillerman has ample

time to anticipate tractor movement. Duplication of this signal by the tillerman will also warn other vehicles and pedestrians of the truck's direction of travel. Because of his elevated position, the tillerman may often find it advantageous in the prevention of accidents to supplement the standard arm signals by additional arm movement to attract necessary attention.

Tiller Control

Tiller control is particularly important when the tractor-trailer ladder truck is being driven from the station, when making turns at intersections, and when backing up.

Leaving Station

When preparing to drive a tractor-trailer ladder truck from the station, the tillerman has several items to check before giving or returning the signal to proceed forward. On approaching the truck, he should check the position of the trailer wheels for alignment with the tractor. If they are not in line, he must be prepared to bring them into line as soon as the tractor starts to move. The elevated seat position of the tillerman provides him with ample view to check the readiness and safety of the crew and the proper security of the ladders and equipment. The tillerman must be secured to his bucket seat by the safety belt provided before giving the signal to proceed.

As the truck leaves the station, the tillerman must keep the trailer centered in the station doorway. It may be necessary for the tractor to make a sharp turn because of vehicular congestion in front of the station. If the driver is required to make a sharp turn, it may be necessary to turn the tiller wheel slightly to the left to keep the trailer centered in the station doorway. In this maneuver, the right side of the trailer ahead of the tillerman is the point where clearance must first be maintained. As the trailer wheels clear the doorway, the trailer will pivot and move the ladder overhang toward the left side of the doorway. The tillerman will then be required to steer to the right in order to keep the ladder overhang centered in the doorway.

The tillerman must not "over-tiller" on any turn. He should avoid making a sudden swing-out that will require a sharp counter swing-in, unless it is necessary to avoid an accident. After any turn the tillerman must bring the trailer in line with the tractor in a smooth maneuver.

Traveling Forward

When traveling in a forward direction, the tillerman should, whenever possible, keep the trailer wheels parallel to the frame of the trailer and in direct line with the tractor. This is especially important when streets are wet and the danger of skidding is high. When the tractor and trailer are not in line, the effective width of the apparatus is greatly increased, which also increases the chance of an accident.

When traveling in a forward direction, turning the tiller wheel counter-clockwise turns the trailer wheels to the left and moves the rear of the

trailer to the left. Turning the tiller wheel clockwise moves the trailer wheels and the rear of the trailer to the right. When the tractor and trailer are in line and traveling forward, little movement of the wheel will be necessary. Under this condition it normally is necessary for the tillerman to control only the "drift" of the trailer to one side or the other, similar to the drift which occurs when driving a passenger car forward. When making a turn, or when required to weave in and out of traffic on an emergency response, the tillerman should keep the trailer in line with the tractor as much as possible, turning the trailer wheels only enough to maintain adequate clearances. For most turns where traffic is congested by stopped or parked vehicles, or where narrow streets are involved, the tillerman may have to turn the trailer wheels directly opposite to the travel of the tractor wheels in order to keep the trailer in alignment with the tractor and to maintain adequate clearance for the trailer and ladder overhang. This particular maneuver must be followed by a smooth recovery turn of the trailer wheels to maintain proper tractor-trailer alignment.

It is essential that the tillerman be alert to conditions on the street ahead whenever the apparatus is traveling. Particular attention should be given to trucks, buses, and streetcars because their height usually presents an added hazard to the overhang of a ladder truck and may require the tillerman to take precautionary actions. The tillerman who is alert and anticipates situations that may develop can plan compensating measures sufficiently in advance to prevent an accident. It is the duty of all members of a truck company, as well as that of the driver and tillerman, to keep a sharp lookout for any overhead obstructions that could injure the tillerman or damage the apparatus.

At Intersections

Particular care and alertness must be exercised by the driver and the tillerman at intersections. If the intersection is clear and the streets are wide, a right or left turn should not be difficult if the driver steers the tractor into a wide turn. If the traffic is heavy or the streets are narrow, extra precaution and good judgment must be used, and the tillerman must keep constantly aware of vehicles on each side and to the rear of the apparatus. Even after starting into a turn, developments may occur which will require the tillerman to maneuver the overhang of the trailer into the clear.

On most intersectional turns, the trailer will track and follow the tractor without an excessive amount of tillering. When approaching a turn at an intersection, the tillerman should anticipate whether additional traffic-lane space will be required to make the turn. If necessary, he can partially block a line of traffic from the rear by steering the trailer slightly into whichever lane it is necessary to keep clear. When it is necessary to move out wide with the trailer on making a turn at an intersection, the tillerman should start turning away from the corner about the time the front tractor wheels first enter the intersection. This maneuver will prevent overrunning the in-line position of the tractor and trailer and will compensate for the centrifugal force of the turn. It is necessary for the tillerman to judge and

maintain proper side clearance on any turn, sufficient to permit safe passage of the rear overhang of the trailer. If at any time he is in doubt regarding safe clearance, he should immediately signal the driver to stop.

The proper positioning or parking of a ladder truck is the responsibility of the company officer in charge of the apparatus. If the apparatus is an aerial truck, he shall position it as required by the officer in charge of the fire. First alarm city service ladder trucks and aerial trucks, on which the aerial ladder is not to be used, are normally positioned on the opposite side of the street just beyond the fire building, so that the ladders and other truck equipment may be readily available. Trucks responding on greater alarms should be positioned as close to the fire area as possible. In no case should any truck be parked so it obstructs access to the fire area by other apparatus. This precaution is especially important in the case of narrow alleys, where the truck should be parked near the street and alley intersection closest to the fire, unless otherwise ordered by the officer in charge of the fire.

When parking a ladder truck, it is the responsiblity of the tillerman to make certain that the area directly to the rear of the trailer is clear so that the truck bed ladders can be removed easily. If the truck company is ordered to work, the tillerman should maneuver the tiller wheels to facilitate the operation and removal of ladders. When it is necessary to park a ladder truck on a grade, the truck should be placed with the tractor in the downhill position whenever possible. This precaution is essential, particularly in the case of ladder trucks on which the removal of the tiller shaft will free all bed ladders.

If the ladder truck is equipped with an aerial ladder, the tillerman should be alerted immediately if the aerial is to be raised. Because of the height of his position at the rear of the trailer, he can be of considerable assistance to the driver in spotting conditions which may affect the placement of the apparatus and the operation of the aerial ladder, such as overhead obstructions, street clearances, distance out from building, and the like. In the absence of the truck company officer, the responsibility for the proper placement of an aerial truck, in compliance with the orders of the officer in charge of the fire, is delegated to the driver and the tillerman. In order to carry out this duty in an efficient manner, all aerial truck company drivers and tillermen must have a thorough understanding of aerial ladder placement and operation.

Backing Ladder Trucks

In any backing-up maneuver of a tractor-trailer ladder truck, close coordination must be maintained between the driver and tillerman, particularly in the use of signals. It is very easy to inadvertently jackknife the apparatus when backing if close cooperation of the driver and tillerman is not maintained. It is also essential that firemen be stationed as guides to warn the driver and tillerman of any inadequate clearance and to control traffic while the apparatus is backed up.

In backing operations, the driver must control the movement of the truck at a low, smooth speed. He must be in position to stop the truck immediately and to steer the tractor so that it tracks the trailer in proper alignment. The

tillerman must pay special attention to the position of the tractor, as well as to clearance on both sides and to the rear of the trailer. He must guide the trailer wheels to the parking spot and align the wheels with the trailer frame when the apparatus is stopped. Steering the trailer wheels of a tractor-trailer apparatus, when backing, requires the opposite control from that used to steer a single unit apparatus. For example, if the tiller wheel is turned to the right, the trailer will travel sideways to the left; if the tiller wheel is turned to the left, the trailer will move to the right. This deviation from normal control is another of the many reasons why company officers should give every opportunity to their relief tillermen to practice tillering.

Backing into station. The procedure for backing a tractor-trailer into a company station will vary with the width of the street in front of the station, the setback of the station doors, and traffic conditions. The normally required maneuvers are as follows:

- When approaching the station preparatory to backing in, the tractor should be driven to the side of the street opposite the station. The tillerman should steer the trailer wheels so that the rear of the trailer is drawn over to about the center of the street. The apparatus should be stopped when the rear of the trailer is a few feet past the door to be entered.

- As soon as the apparatus starts to back up, the tillerman should reverse the direction of the trailer wheels and steer into the quarters. He must pay particular attention to maintaining adequate clearance on both sides and to the rear of the trailer to avoid striking the door frame with the running board of the trailer or with the overhang of the ladders.

- As the truck enters the apparatus floor, the tillerman must align the trailer with the center of the doorway. He may use such aids as the centerline lights on the ceiling to determine correct alignment.

- When the entire apparatus is parked in the station, it is of utmost importance that the trailer be directly in line with the tractor, and that the trailer wheels be lined up with the trailer frame and not turned to one side or the other.

- The driver must back the tractor in the same arc as that used by the trailer to prevent any possiblity of jackknifing. He must pay particular attention to maintaining adequate clearance on either side of the tractor and at the front of the trailer as the apparatus enters the doorway. He must properly align the tractor with the trailer as the apparatus enters the doorway. He must properly align the tractor with the trailer as the apparatus is parked, and he must immediately obey any signal to stop when given by the company officer, the tillerman, or the firemen stationed as guides.

V. Collision and Accident Prevention

The majority of motor vehicle accidents might better be called collisions, and the remaining number called accidents. The latter group would include those quite accidental in nature and considered unavoidable.

If preventive measures were to be effected that would tend to eliminate "avoidable" accidents, a small number that could be referred to as "incidents" might be left. Incidents would be those accidents considered unavoidable, and, as such, there is little that can insure against repetition of them under similar circumstances.

Accident Board of Review

An accident review board should meet a minimum of once per quarter (or when required) and should be composed of both line and staff officers, including one mechanic qualified on fire apparatus. Their major responsibility should be to conduct interviews to determine the facts surrounding accidents, place responsibility, and look for preventive measures. The results of such examination would determine what measures should become policy.

The main criterion that a Board of Review should use is best illustrated in the following example:

> Many collisions first go through a stage of being avoidable, and then pass through a time element to a stage where they are unavoidable. For example, if a driver 200 feet away from an intersection drives toward the intersection at moderate speed, and sees a vehicle approaching on a cross street, he has time to take in the situation and slow down or stop. However, if he fails to heed the other vehicle until both are in the intersection, then the impending situation has passed into the stage where a collision has become unavoidable. To call such a collision an "unavoidable accident" would be wrong because it disregards the initial failure of the driver, and the direct relation of his failure to the cause of the collision. It should be more properly called an "avoidable collision."

The preventive measures to be taken, or recommended, are obvious in this case, and the decision of the board of review has been well charted. Action and followup would complete the picture and keep the board a functional body.

Causes of Apparatus Accidents

The majority of accidents involving fire department vehicles are the result of four principal causes:

1. Improper backing
2. Reckless driving on the part of the public
3. Excessive speed of fire department vehicles
4. Lack of driving skills

Backing accidents account for 85 percent of the incidents involving fire department apparatus. Although they seldom result in serious personal injury, such accidents do require repairs and account for a great deal of "out of service" time.

Reckless driving on the part of the public includes unlawful speed, failure to obey traffic signals, failure to heed apparatus warning signals, illegal parking, and a general disregard of traffic laws.

The majority of accidents involving excessive speed of fire department vehicles have occurred when the vehicle was traveling straightway, entering "through streets" or other intersections, or turning into cross streets.

Misjudgment of distance or of the condition of roadway when moving through narrow streets congested with traffic, as well as through wide streets so congested, and carelessness on the part of fire department drivers have also contributed to the cause of fire department vehicle accidents.

Prevention of Apparatus Accidents

The selection of fire department drivers is the first of many important factors to be considered in the prevention of accidents. The candidate should be in excellent health, have vision commensurate with the requirements of the licensing laws, be mentally alert, well coordinated, and possess an attitude of maturity and responsibility. The recommendations of his company officer and training officer should be secured prior to his admittance to driver training.

The driver of a fire department vehicle must always do everything he can to protect other drivers or pedestrians. Even when the actions of another motorist are foolish or illegal, no fire department driver has the right to let such actions result in an accident which he has a clear chance to prevent. Under some circumstances, a fire department driver may be held accountable for an accident which he did not directly cause, but which he could have helped avoid.

When it is necessary to safeguard the pedestrian, the driver is subject to an additional principle of attitude, namely, the person who has the power to inflict injury also has the responsibility to avoid it. For example, the

motorist can injure the pedestrian; therefore, the motorist must safeguard the pedestrian whenever possible, even from the consequences of a foolish pedestrian act. All pedestrians have the right to use the streets, and the law places the responsibility of protection on the motorist. A recent traffic injury study showed that of every four pedestrians killed in traffic accidents, three had never driven a car. This study strongly indicates that these pedestrians did not understand the danger of walking in front of a fast-moving vehicle; that they were not aware of a car's limitations and of the time and distance necessary to stop a vehicle.

A professional driver should govern his choice of speed according to a "Basic Speed Rule," which can be stated in a very simple way: "Never exceed a speed which is reasonable and prudent for existing conditions, even when the law permits a speed higher than that at which you are driving." Safe, prudent speeds vary with such factors as driver reaction time, driver condition, brake efficiency, condition of pavement, weather, and traffic congestion. A speed which is reasonable when there are few persons or vehicles on the street may be excessive in heavy traffic, or at hours when school children must cross the streets. Even on the same stretch of roadway, speeds that are safe at certain times are unsafe at other times.

Procedure Following an Accident

Although the procedure outlined here is only recommended, it will probably fit into most existing programs with some modifications.

The procedure recommended to fire department members when an accident involves fire apparatus is as follows:

1. Alert communications (response cover).
2. Provide first aid if needed (rescue).
3. Place apparatus out of service, if required.
4. Call for ambulance if needed.
5. Notify the:
   a. Police department accident bureau
   b. Duty chief
   c. Agent for city attorney
6. Have witness cards filled out and signed.
7. Provide name, address, and driver's license number.
8. Offer no opinions or statements to unauthorized personnel.
9. Do not move involved vehicles except for reasons of safety or unless authorized to do so. Mark original scene of accident with chalk.

All of these requirements are quite necessary to maintain peak efficiency as a unit, to ensure that investigation procedures are accurate, and to reduce any adverse public opinions.

The preparation of written reports will be governed by the policy of the individual department. However, the elapsed time period should never exceed 12 hours.

Minor Accidents While Responding to an Alarm

When in the officer's (or acting officer's) opinion an accident is of minor consequence and it is not necessary that the unit go "out of service," he may leave the driver at the scene of the accident to comply with existing requirements and proceed to the alarm with the apparatus driven by the relief driver. **Under no conditions should this practice be authorized if injuries are involved. In all such cases department policy must be followed, and department regulations complied with.**

Departments should require the company officer, as well as the driver, to submit full reports on all accidents, regardless of how minor, through the normal chain of command. This procedure will be an invaluable aid should the case be tried in court and will demonstrate the proficiency of the department.

Use of the telegraph key. This section may apply only to a few departments. However, it should be given some thought by all. It is entirely possible that the use of the telegraph may be the only means to alert interested parties as to the condition of a unit within a reasonable period of time. The following policies are suggested:

- All members should be able to relay the required code.
- Code should be preceded by the box number to indicate location.

Safety Devices and Practices

Most department personnel seem to resist safety measures unless they relate to some recent unfortunate experience that directly or indirectly affects the department. But personnel are slowly becoming aware that any preventive measures which will materially reduce injury from motor vehicle accidents are worth consideration. It is well to remember, however, that "the best safety device is a careful driver."

Safety Belts

A safety device that has been installed on all chiefs' cars and is now being installed on other fire department vehicles is the seat belt. Although a seat belt will not save one's life in all types of accidents, it has been adequately demonstrated that the seat belt is effective in minimizing injury and in reducing the number of deaths of vehicle occupants in the majority of accidents. This fact has been well documented by research of crash injuries conducted by the National Safety Council. Excellent reasons

why seat belts are so important to safe driving are as follows:

- You are five times more likely to be severely injured or killed if thrown out of a car. A seat belt will keep you in the car.
- A seat belt will keep you behind the steering wheel in an accident situation, where you may be able to guide the vehicle and avoid going off the roadway or avoid colliding with other vehicles, buildings, or fixed objects.
- Without a seat belt you may be thrown to the officer's side of the front seat by the initial impact, where you are powerless to control the movement of the vehicle.
- Without a seat belt, your chances of being rendered unconscious by the initial impact are greatly increased.
- It takes approximately ten seconds to strap on a seat belt and less than two seconds to remove it.

Safety Straps

On the recommendation of the San Francisco Chapter of the National Safety Council, safety straps for the protection of members riding on fire apparatus have been given serious consideration by the fire service. They should be used by all members who are required to stand on apparatus when seating is not available; this includes tailboards, running boards, turntables, jump seat areas, or other such areas.

The use of straps is required both in response to and returning from alarms and at all other times when the apparatus is moving on public thoroughfares. The safety strap should be secured before the apparatus is in motion and should remain secured until the destination has been reached. Company officers are responsible for the safety of personnel under their command and should require compliance with these safety regulations.

Members are cautioned not to place sole reliance upon the safety strap; they should also maintain a firm hold on handrails or other parts of the apparatus which may be used for this purpose.

Wheel Chocks

The San Francisco Fire Department Safety Committee recently concluded a series of tests designed to measure the efficiency of wheel chocks. The committee found that the proper placing of wheel chocks is all important.

- Chocks must be placed square and snug against the tires to be effective.
- Improperly placed chocks that were off only a slight degree failed the job for which they were designed.
- If four chocks are available (such as on an aerial truck), placement of

two chocks under trailer wheels as well as two under the tractor wheels added to the safety factor.

- Wheel chocks placed under the front tractor wheels did not afford the same degree of protection as when placed under the trailer wheels.

Flares

It cannot be overemphasized that flares are useful safety devices that can be extremely dangerous if misused in the presence of flammable liquids or explosive compounds. Flares should not be used to leeward if dangerous conditions exist. In fact, it would be well to delete their use altogether in such situations, and resort to battery-operated lights or safety lights for traffic control.

Since flares are used mostly by companies of departments stationed near freeways, many members of other companies may be unfamiliar with their proper use. Companies responding from areas near freeways should carry ten flares; other companies should carry four. Each flare burns for approximately thirty minutes.

The proper procedure to ignite a flare is as follows:

- Pull tape up to release the cap of the flare, and twist the cap off.
- Remove the tape from the cap to expose the scratch surface on outside of the cap.
- Grasp the flare near its base and rub the scratch surface of the cap sharply against the flare head until ignition occurs.
- **Always point the flare away from the face and body while igniting and when ignited.**
- After ignition, hold the flare for at least six seconds (but less than ten seconds) before placing it on the roadway.

When fire department vehicles respond to an emergency on a freeway or other busy thoroughfare, they should attempt to park directly behind or ahead of cars involved in the emergency. This position will minimize interruption to traffic flow and reduce exposure of men and apparatus to danger from collision. Avoid, as much as possible, directing lighted headlights and spotlights into flowing traffic. Revolving warning lights, tail lights, and emergency red lights should be kept on. Department vehicles equipped with turn-light indicators should have these lights turned on and flashing on the side of the vehicle next to the traffic flow. A series of three to four flares should be placed around the scene of the emergency, starting from a position at least one hundred feet back of the emergency and extending up to the immediate side of the emergency scene. If the emergency occurs on a curve, or at night, or during the early morning hours when traffic often flows much faster, the flares should be spotted from a point several hundred feet to the rear of the emergency. Needless to say, the man spotting the flares should use extreme care in anticipating the action of oncoming cars.

Safety When Driving in Fog

Visibility is at its worst in fog. In dense fog, a person should drive slowly, with headlights on low beam, which will throw the light down on the road where it is needed, rather than out into the fog where it will be reflected back.

Sudden stops should be avoided. Stops should be signalled by tapping on the brake pedal to make the stoplights blink. A person should never assume a clear road lies ahead when driving in fog, except for the distance he can actually see. He should drive as though he has to make an emergency stop within the distance he can see, no matter how short it is.

A person should remember that he is driving an emergency vehicle when responding to an alarm, but also that it is better to drive safely under these conditions and to reach the scene of the emergency than to be involved in an accident which may result in possible death or serious injuries.

Windshield wipers of department vehicles should be kept in good working condition. They are bad-weather safety devices. Driving without efficient windshield wipers so increases the danger of accident that a driver may be guilty of contributory negligence if an accident is caused by such a defect.

Stopping Distances

It is essential that all drivers have a thorough understanding of speed in relation to "reaction distance," "braking distance," and "total stopping distance."

- Reaction distance can be described as the "thinking distance" of the driver. It is the distance a vehicle will travel during the split second interval when a driver is transferring his foot from the accelerator to the brake pedal after he perceives danger. The average reaction distance of a driver when traveling at 20 mph is 22 feet. Converted to time, this distance represents 3/4 of a second.

- Braking distance is the distance a vehicle will travel from the place where the first application of the brake is made to the place where the vehicle stops.

- Total stopping distance is the sum of the reaction distance plus the braking distance.

These distances will vary with the physical and mental alertness of the driver; the speed, type, and condition of the vehicle; the number, type, and condition of the brakes; the tire sizes; the weight of the vehicle when fully equipped; and the type and condition of the road surface. For example, at 35 mph (the maximum speed permitted by fire department rules for fire department vehicles) an average distance of 40 feet (reaction distance) will be required for the average alert driver to react and apply the brakes. In most cases the vehicle will have traveled another 60 feet (braking distance) before it stops. This adds up to a total of 100 feet (total stopping distance), which is the approximate total number of feet required to halt the vehicle.

With these figures in mind, a driver should assume that he is driving a fire department vehicle at 35 mph and a child darts out from behind a parked car into the path of travel 90 feet ahead of the vehicle. He is not going to be able to stop in time to avoid hitting that child! It should be obvious, therefore, that at speeds lower than 35 mph, it is possible to control a vehicle with a far greater degree of safety. At speeds in excess of the stated limit, the stopping distance increases; for example, at 60 mph the stopping distance is approximately 270 feet.

Minimum Safe Following Distances

Following too closely is one of the most dangerous driving practices and one of the most frequent causes of traffic accidents. If a driver uses poor judgment and follows too closely, a sudden turn or an unsignaled stop by the driver ahead is almost sure to involve him in an accident. A safe rule is this: A driver should stay at least the length of the vehicle he is driving behind the vehicle he is following, for each 10 mph of speed. For a chief's car traveling at 10 mph, this distance should be at least 20 feet; for an engine company apparatus at least 30 feet; and for truck company apparatus at least 50 feet for each 10 mph.

Safe Driving Reminders

- Skid marks on the pavement are an indication that the vehicle was not under proper control.
- The lives and welfare of your fellow firemen depend upon the driver and the officer in charge every time a department vehicle leaves the station.
- Officers should operate the siren so as to produce a regular high-and low-pitched sound. **Caution: Never ride the siren button.**
- A good driver takes his foot off the gas pedal and places it on the brake pedal at each intersection. This practice reduces reaction time when a stop must be made.
- More time can be made up by getting out of the station quickly than can ever be made up by speeding to alarms.
- The best piece of equipment in the world is useless unless it arrives at a fire safely.
- Traffic lights and signs are an aid to safe driving, but they are no guarantee that safe driving conditions actually exist.
- Inspect your vehicle often -- and keep it in safe operating condition.
- Good drivers are never reckless.

- Accidents never "just happen" -- they are caused.
- If you are a truck company driver, you have a tillerman. He has a tough or an easy job, depending on you.
- Car windows of other motorists may be closed, and the drivers may not hear sirens or bells.
- A heavy piece of equipment may not stop as easily as a passenger car.
- It is not a good practice to accept an "off shift" driver's report that the vehicle is in proper condition to drive.
- Don't <u>think</u> you are a good driver -- <u>prove</u> it.
- Don't depend on having the right-of-way -- you may not get it.
- Don't permit the promiscuous use of sirens. Don't use sirens when converging with other fire department vehicles at the scene of fire or other emergency. And don't fail to reduce speed and proceed cautiously, as this is one of the most dangerous areas of response.
- Don't back up apparatus without a man in the rear to signal, or when it is not absolutely essential to back. Never back at more than 5 mph.
- Don't drive with your hands on top of the steering wheel; get a good grip on the wheel, with your knuckles down.
- If you should skid, turn your steering wheel the same way as the skid -- don't throw out the clutch. Apply the brakes off and on, letting the wheels revolve.
- When descending a hill, don't ride a clutch or throw it out and coast.

If your driver's license is revoked or expires, notify your superior immediately!

VI. Field Training

Each student should be required to meet established standards of vision, reaction time, color perception, and depth perception.

Predriving Essentials

Tests should be accomplished prior to students being allowed to go into the practical application of Driver Training. These tests indicate to the instructor whether the student possesses the physical qualities to learn safe driving and defensive driving practices. Any weakness in these areas should result in the rejection of the driver candidate.

Emergency Vehicle Operation Course

The course should be located in an area where distractions are at a minimum and obstructions are nonexistent. At least five acres should be available for use. When this is not possible, several smaller sites may be employed. In any event, instructors will have to use their own imagination and base their decisions on the topography of the area. The California Highway Patrol can furnish help and suggestions as to course locations and requirements.

Backing, braking, and skid control courses shall make up the bulk of the ground facilities. At least 12 stanchions will be needed for course layout. These may be constructed economically by filling the bottom half of a plastic bleach bottle with mortar and inserting a 6-foot section of rigid plastic tubing. The tubing should be painted chrome yellow or other bright color for emphasis.

Backing

The backing course should be laid out with six stanchions in a straight line, and the stanchions should be placed as follows:

1. On 22-ft. centers for passenger cars
2. On 23-ft. centers for station wagons
3. Distances for different rigs must be adjusted according to the vehicle wheel base to provide a fair test.

No minimum width should be established for the course; the student who swings too wide while running the slalom-type course will have problems and will not be successful. This course must be run without toppling one stanchion. This can be accomplished only after some practice. Time and speed limitations should not be required in this evolution.

Braking

The braking course should be made with six stanchions forming an aisle which allows 6 feet of clearance on either side of the vehicle to be used. One set of stanchions will mark the point where the student would remove his foot from the gas pedal. His approach should be made at 20 mph. The second set of stanchions will be 10 feet from the first set and indicate where the student will apply his brakes, evenly and smoothly. The third and final set of stanchions will be 40 feet from the second set, and at this point the student should complete his stop with the front bumper even with this third set of stanchions. A decelerometer will be mounted on the floor board of the tested vehicle, facing forward. This controlled stop, if properly carried out, should not cause any of the tumblers of the decelerometer to fall. A minimum score of 80 percent should be required on this evolution.

Skid Control

The "skid pan" is constructed as an oval which "snakes" around an orbital track, forming both right and left turns. At the points where vehicles enter curves, a liberal quantity of water is applied. On this wet surface is floated just enough oil (or similar petroleum product of high flashpoint) to form a slippery surface. Curves should be rather wide and paved with macadam. Roadways should be 20 feet wide with 4 foot paved shoulders. (Until his solo, a student must always be accompanied by a qualified instructor whenever this course is run.)

When driving the skid pan, the student learns to control skids by starting them, and then practices controlling the vehicle as it skids. He finds that if he applies the brakes while turning, the front wheels will not steer, and that if the back end of the vehicle is allowed to get too far around, he cannot prevent it from "spinning out." He finds out, too, that if he travels too fast while turning, the vehicle will slide sideways off the roadway. If he goes into turns too fast while turning, the vehicle will not turn. Sudden rough movements cause the vehicle to go out of control and he learns that smooth and positive use of acceleration, deceleration, braking, and steering enable him to drive faster and negotiate turns safer than if he uses rough techniques.

Smoothness is one of the most important factors in safe vehicle operation. Speed on the skid pan rarely exceeds 25 mph, yet it provides the student with an abundance of opportunity to practice skid control, applying the same principle that would be involved in any emergency speed run on regular pavement.

Practice should continue until the student is correcting for skids automatically by reflex action. At this point the student is ready for his solo run of the entire course. His evaluation, made by the instructor, should be rated "satisfactory," "improvement needed," or "unsatisfactory."

It is recommended that extinguishers and pumping apparatus be standing by while the course is in use.

In summary, the instructor should watch for the following items for grading:

- Cornering ability
- Smoothness
- Skid control
- Use of brakes
- Use of transmission
- Use of body momentum
- Degree of caution
- Degree of tension
- Degree of fatigue
- Care of equipment

Tests should be conducted annually, after an accident, or on the request of the company officer or training officer.

ERIC

VII. Inspection and Maintenance Schedule

The driver of any type of fire department vehicle must be conscious of the necessity for a basic preventive maintenance program relating to driver responsibility and must be familiar with the workings of components of motor vehicles. Such a program is a necessity, regardless of the size of department, and all personnel should be instructed in the following material in preparation for becoming a driver or tillerman.

Inspection and Maintenance Responsibility

All department vehicles must be regularly inspected and properly maintained to assure immediate response to alarms, as well as to provide safety to those persons required to ride the vehicle, to the drivers of other vehicles, and to pedestrians. Department regulations usually specify that this responsibility is assigned to the driver and the tillerman. Their immediate superior officer is, in turn, responsible for the proper performance of these duties by the driver or the tillerman.

The driver and the tillerman should normally devote two hours each morning, following the roll call, to the inspection and care of the vehicle to which they are assigned. This period may, of course, be exceeded or shortened at the discretion of the company officer, when necessitated by extended fire service or other department duty. It is not expected that a detailed and complete inspection can be made of each vehicle assigned to company stations during this two-hour period. The work is, therefore, divided into mandatory daily and weekly inspection and maintenance programs, as outlined on the following pages.

Daily Inspection and Maintenance Schedule

The inspection and maintenance duties required to be performed by drivers and tillermen each day include the following checks:

- Storage batteries
- Lighting System
- Fuel, oil, and water
- Brakes
- Steering system
- Tires
- Springs
- Motor
- Chassis, body, tools, and equipment

Storage Batteries

Each morning, immediately after roll call, the storage batteries should be checked to determine whether they are sufficiently charged, in need of recharging, or in need of replacement. Hydrometers are provided for the purpose of testing the specific gravity of the battery electrolyte (which must be kept about 1/2 inch above the top of the battery plates). The specific gravity reading must be taken before any water is added to the battery. After the specific gravity reading has been taken, distilled water may be added to bring the electrolyte up to proper level. If it is necessary to recharge a battery, drivers must ascertain that the electrolyte is at proper level before connecting the battery to the charger. (The specific gravity reading of the electrolyte should not be taken on a recharged battery until at least thirty minutes after the battery charger has been disconnected.)

For a lead-acid battery, a hydrometer reading of 1.260 indicates a fully charged battery cell. When the specific gravity drops to 1.225, the battery must be recharged. If the specific gravity of the electrolyte does not rise above 1.225 after a twelve hour period of continuous charging, a battery replacement should be ordered. Caution: Do not overcharge batteries. They should be left on charge just long enough to bring the specific gravity up to 1.260. Continued charging, after this point has been reached, will damage the battery.

Battery terminals and cable connections must be kept clean and tight. When necessary to clean them, both cables should be disconnected to prevent arcing. The connections and terminals should be washed in a solution of bicarbonate of soda and water, then replaced, tightened, and smeared with a thin coating of petroleum jelly or grease. Terminal connections should be tightened carefully to avoid breakage. Whenever there is a spillage of electrolyte in the battery box, or when an excessive amount of corrosion has occurred, the battery should be removed and the box washed out with a solution of bicarbonate of soda and water. The outside of the battery may be washed with the same solution, care being taken not to allow any of the solution to enter the filler holes of the battery cells.

When the charger is connected to the battery, the charger wires should be looped around the spoke of the steering wheel whenever possible, to remind the driver to disconnect the charger before leaving quarters. When receiving replacement batteries, the driver shall immediately check each battery to determine that the specific gravity of each cell is above 1.225 and the electrolyte is at the proper level.

When the motor of a vehicle is difficult to start, the cause may be loose or dirty battery terminal connections, an abnormal battery discharge, or a defective starter switch. The battery and starter system may be given a quick inspection by the following method:

- Turn on the vehicle lights and press the starter button momentarily.
- If the lights go out, loose battery connections are indicated.

- If the lights go dim, dirty battery connections or defective wiring (causing an abnormal discharge) are indicated.
- If the lights remain bright, a defective starter switch (or relay) is indicated.

Lighting System

The lighting system must be inspected regularly each day. All the lights of the vehicle should be turned on. If any light is inoperative or defective, the driver should inspect the wiring for defects, check to see that lamp connections are tight and clean, and examine the fuses. If it is found that a lamp is defective, a replacement must be installed. Be certain to specify the type stamped on the face of the lamp, the number stamped on the base of the lamp, and the candlepower and voltage of the lamp. It is extremely important that the red lights and other warning lights required by the Vehicle Code be kept operative.

When inspecting the wiring of the lighting system, the driver should be particularly observant for any breaks in the wiring, tightness of connections, and cleanliness of connections (absence of corrosion). The fuse holder spring clamps must be clean and tight. Blown fuses must be replaced at once. (On ladder trucks, the driver is responsible for checking all lights on the trailer as well as the tractor.)

Fuel, Oil, and Water

Gasoline and oil levels, including crankcases or separate containers, should be measured at the beginning of each watch and upon return to quarters from an alarm, drill, or test. Proper water level in the radiator must also be maintained. The gasoline fuel tank should be kept full to within one inch of the tank top (to allow air space for expansion), and the fuel level should be brought back up to this point after every run.

At working fires, the driver must use particular caution not to permit the supply of gasoline or oil to reach dangerously low levels before making this fact known to the chief officer in charge of the fire.

Brakes

The various types of brakes in use on apparatus and vehicles consist of the following:

Mechanical brakes. Operating pressure for this type brake is applied by the driver to the brake foot pedal, which is connected by a series of rods or cables (or a combination of both) to the brake shoes located inside the brake drums of the wheels. The brake shoes are forced outward on application of the brake pedal and are brought into contact with the inside of the brake drum to diminish the speed of the vehicle. This is an entirely mechanical means of braking, and all stopping energy is applied by the driver.

Vacuum brakes. The operating energy of this type brake is supplied by a vacuum cylinder operated from the intake manifold of the engine. When applying these brakes, the driver applies foot pressure on a brake pedal which actuates a two-way valve. This valve is connected by means of piping to the vacuum cylinder, within which is a piston. The piston is connected mechanically to the brake shoes. When air pressure is admitted into the vacuum cylinder, the piston is moved to the opposite end of the cylinder and creates the braking effect. When the brake pedal is released, the two-way valve closes off the air inlet and opens the vacuum line, thereby permitting the air which had been admitted into the cylinder to be exhausted through the intake manifold of the engine.

Hydraulic brakes. This system consists of a master cylinder, containing a piston and a quantity of brake fluid, connected by tubing to smaller cylinders located in each wheel. Each of these wheel cylinders contains two pistons, facing each other, with a space between them. The outside face of each piston contacts the brake shoe when the pistons are forced to the outer ends of the wheel cylinder. When the brake pedal is applied, the piston in the master cylinder forces brake fluid through the tubing to each wheel cylinder. The fluid forces the two wheel cylinder pistons to opposite ends of the cylinder and this action causes the brake shoes to contact the brake drum of each wheel.

Maintenance note: The master cylinder must always be checked for sufficient fluid; a low fluid level admits air into the tubing. A spongy brake pedal indicates that air is in the tubing (check tubing for leaks). The brake pedal should have a "solid" feel when depressed.

Compressed air brakes. Proper maintenance of a compressed air brake system requires that air reservoirs be drained regularly, as required. Local conditions govern frequency; in dry areas, for example, once a month may be sufficient, while in humid areas it may be necessary to drain reservoirs daily.

The drain is a petcock on the bottom of the air reservoir. With the engine shut off, the petcock should be opened and kept open until the moisture is drained from the reservoir. Then the valve should be closed and tested by starting the engine. The petcock may be checked while the compressor is running to make absolutely certain that it is completely closed.

Parking brakes. The "parking brake" (also commonly called emergency brake or hand brake) provides a secondary means of stopping a vehicle. Should the normal foot brake fail, the parking brake can be used to bring the vehicle to a safe stop; but an understanding of the braking system will point out the disadvantages of using the parking brake indiscriminately.

The parking brake on most modern heavy fire apparatus is on the final drive shaft and is separate and distinct from the foot brake. This is necessary to provide two separate systems for stopping the vehicle. Some vehicles have a double-face brake on the drive shaft, while others have a single-face brake. In both cases, direct pressure is applied to the facing by cable, rod,

or a combination of both. A ratchet is provided to allow the brake handle to remain in the "on" position.

Normally, the parking brake should be applied only when the vehicle has been brought to a full stop. Engaging the parking brake while the apparatus is underway will cause:

- Glazed surfaces to build up on the lining surface, resulting in brake failure
- Burning of the brake surface due to friction
- Terrific stresses to be placed upon the drive, as well as on the rear-end assemblies
- Stretching of cables, rods, and linkages

The foot brake should be used to stop the vehicle, and then the parking brake should be applied (followed by the placing of chocks under the rear wheels). Should the foot brake fail and no immediate danger exists, the driver should attempt to shift downward by double-clutching, thereby slowing his vehicle to a stop. Where a serious emergency exists during a brake failure, the parking brake may be pulled on rapidly, but the driver should realize he is submitting the running gear to severe strain. Whenever possible, the application of the parking brake while the vehicle is underway should be avoided.

(Note: Apparatus equipped with the MGM Safety Brake or the Maxi-brake are not provided with a hand parking brake.)

MGM Safety Brake. The MGM Safety Brake is a combination air pressure-coil spring system that provides automatic braking should a failure occur in the service airbrake system. The system also provides a manual control for application of a positive parking brake. Automatic brake application occurs when there is abnormal leakage of air or complete failure in the service brake system. Additionally, there is an automatic application of the MGM brakes when normal leakage or decrease in pressure occurs in the air system of the service brakes.

MGM brakes are individual units installed in pairs on the rear axle of the vehicle; the cylinders may be readily seen under the vehicle body. Encased in each cylinder is a diaphragm and a large coil spring. A pull rod extends from the diaphragm, through the center of the spring, and through one end of the cylinder housing, where it is connected to the service brake shaft control mechanism. At the opposite end of the cylinder is a connection to the air line of the service brake system. It is the air pressure from this air line, applied against the diaphragm in the cylinder, which compresses the spring and prevents application of MGM brake pressure. Should pressure in the service brake system be reduced by leakage or by failure, the cylinder spring automatically expands to apply pressure to the service brakes on the rear wheels.

The manual control feature of the MGM braking system permits its use as a parking brake. Located on the driver's instrument panel is a control switch which activates a valve to release or retain air in the MGM cylinders. To apply brake pressure, the switch is depressed. This action releases air in the cylinders and allows the spring to expand. To release the brake, the switch must be raised to close the discharge valve and open the line from the air tanks. This action returns air pressure to the cylinders, causing the springs to compress, and thus releases the brakes. It is necessary to hold the switch in the raised position for a matter of several seconds, or until there is sufficient air pressure in the cylinders, for the springs to remain fully compressed. This time may be determined by the cessation of the audible flow of air. Additionally, it will be found that if there is insufficient air pressure in the service brake system, the manual control will drop automatically from the "off" position to the "on" position when air pressure drops to approximately 50 psi. on the air pressure gauge. Activating the air compressor will increase pressure in the system to the point where the manual control will remain in the "off" position, usually at about 90 psi. With a partial reduction in the pressure and in spring expansion, it may be necessary to "fan" the service brake pedal, so the valve in the air line from the tank to the MGM cylinders will open.

Should an unexpected emergency application of the MGM brakes occur, the stop will not be too abrupt because application of the MGM brakes is approximately 70 percent that of the force of the service air brake system. At any given speed, the service brakes would be capable of stopping a vehicle in a shorter distance than would the MGM brake application. The effectiveness of the MGM system as parking brakes is adequate. Tests have shown that single-axle application (as on the 900 series LaFrance) is capable of holding weights in excess of 100,000 pounds on grades of 23 percent. The MGM brakes should be applied as a parking brake by using the manual control whenever the vehicle is parked. Normally, the MGM brake is not used manually to bring a moving vehicle to a stop, although it is possible to do so.

Safety Maxi-brake. The Maxi-brake is an automatic spring-applied safety brake similar in principle and operation to the MGM Safety Brake. The design of the Maxi-brake and the hardware necessary for its installation, however, are different from that of the MGM brake. The Maxi-brake is used on the trailer wheel brake system of aerial trucks and on other apparatus where the installation of the MGM brake is impractical.

Emergency air reserve tank. All department apparatus equipped with MGM or Maxi-brake systems should be outfitted with an emergency air reserve tank. The purpose of this tank is to comply with the Vehicle Code of the State of California, which requires an emergency air supply be provided to release the spring-loaded tension on the brake diaphragms once the normal air brake system has failed and the "fail-safe" feature of the MGM or Maxi-brake system has activated. The objective is to provide an emergency means of releasing the brakes so that a disabled vehicle can be moved out of the path of traffic.

This emergency air reserve system is controlled by a push-pull button which is mounted on the instrument panel of the cab. (On aerial ladders an

additional push-pull button is mounted at the rear of the trailer.) Such buttons may be identified by the operating plates, which read: "Push In To Release Brakes" or "Williams Valve."

Caution: Do not confuse this switch with the normal operating push-pull button of the MGM or Maxi-brake.

Utilization of this emergency system is a delicate manipulative operation, requiring a thorough technical knowledge of the installation and the correlation of the air line, air valve, and air tank complex between the normal air brake system and the emergency air brake system.

To avoid damage or accident to the apparatus, the following policy should be adhered to:

Malfunction or failure of MGM or Maxi-airbrake systems, wherein the spring-loaded fail-safe has been activated, will result in inability to move the apparatus. No attempt by officers or drivers should be made either to move the apparatus or to utilize the emergency air reserve system. The brake failure shall be properly reported, and only trained personnel from the Equipment and Maintenance Division are authorized to effect emergency movement of the apparatus when required.

Maintenance: All brakes must be checked frequently for proper adjustment, missing cotter pins, loose bolts, defective tubing, and defective cables. The clevis pins, cross shaft bearings, rods, and cams must be lubricated more often than the rest of the chassis because of their exposure to mud and water. The importance of adequate brakes cannot be overemphasized. Any deficiency should be reported immediately.

Steering System

The principal parts of the steering system are the steering wheel, steering column, steering gear, and an ingenious group of linked rods and arms. When the steering wheel is turned, a worm gear causes motion of the Pitman arm. The Pitman arm is connected by means of tie rods and steering arms to the front axles, and its motion causes the front wheels to turn to the right or left. The steering system, like the braking system, is a very critical part of the vehicle. It must always be in good working order.

The steering gear links, tie rods, and arms should be examined daily for loose nuts or bent parts. Although these parts are sturdy and are designed to stay tight, they should not be overlooked when checking the steering apparatus. The steering wheel should be tested daily for excessive play. As with brakes, any deficiency should be reported at once.

Tires

All tires must be kept properly inflated. An underinflated tire, when rolling, may ignite by friction because flexing of the walls of underinflated tires generates heat. The softer the tire, the more violent the flexing, and the higher the temperature generated. If a rock or chuck is hit while a car is traveling at a good speed with underinflated tires, the fabric wall of the tire is almost sure to rupture, which can easily lead to a blowout.

The four major causes of tire trouble are underinflation, bruises, front wheel misalignment, and overinflation. It should be remembered that although brakes stop the wheels, the tires stop the car. Tires should be checked daily for uneven tread wear, rim bruises, and cuts.

Motor

The motor should be checked daily for any signs of leaks, looseness, chafing, or defective units. All linkage and levers should have free action; they must be kept clean and properly lubricated. The motor block should be wiped clean. Equal attention should be given to the underside of the hood, the fire wall, the undercarriage, and the mechanical parts below the motor. There is no excuse for allowing mud, dirt, grease, or oil to accumulate on these parts; they may conceal defects that could be a source of future failure. Failure to keep these parts clean indicates inefficiency and a lack of interest on the part of the driver, as well as a lack of supervision on the part of the company officer.

The motor, the gear cases, and other parts of the vehicle subject to grease and oil deposits may be cleaned with kerosene and a good motor brush. The brush must not have any metal part in its base because of the danger of causing a short circuit when it is used to clean parts near electrical equipment. **The use of gasoline is strictly prohibited for cleaning any of these parts.**

Chassis, Body, Tools, and Equipment

The body of all fire department vehicles must be kept clean and polished. When necessary to wash a vehicle body, it should be washed with clear, cool water and a sponge. It should be dried with a clean chamois, with care being taken to rinse the chamois frequently to flush away any grit that may scratch the body paint.

If any mud or dirt has accumulated on the vehicle during a run, or if a run has been made in a rain, the body should be promptly washed off on return to quarters. If mud has dried on the vehicle, ample water should be used to soak it off; no attempt should be made to rub it off. If the vehicle has been sprayed with salt water, it must be thoroughly washed with fresh water before drying.

All tools, equipment, and appliances carried on the vehicle must be inspected daily to make certain that everything is in its proper place, securely fastened to whatever mounting is provided, and in condition for service. Any accumulation of rust, dirt, or corrosion must be removed by washing or polishing as required. Any missing or defective equipment must be reported promptly.

Weekly Inspection and Maintenance Schedule

The weekly inspection and maintenance duties required to be performed Monday through Friday by drivers and tillermen are as follows:

Monday -- Fuel system

Tuesday -- Electrical system

Wednesday -- Cooling and exhaust systems

Thursday -- Transmission, differential, and motor oil systems

Friday -- Chassis and body

Fuel System

The fuel system consists of a gasoline tank, filter, pump, carburetor, manifold, and appurtenant tubing, control wires, and rods. This entire system must be checked thoroughly. The tubing connections must be checked for leaks, and the control rods and choke wire connections to the carburetor must be checked for looseness and proper lubrication.

The intake manifold operates under a partial vacuum during the time the engine is running. The bolts or nuts which hold this manifold in place must be kept tight because any leakage of air into the manifold changes the ratio of fuel to air. This fuel-to-air ratio is very critical, and the smallest air leak will cause the engine to operate inefficiently.

The gasoline filter is located in the fuel supply line between the gasoline tank and the fuel pump and is usually a part of the pump. Some engines may have filters installed at the carburetor. Most gasoline filters are placed in the suction side of the fuel pump where even the smallest air leak will break the vacuum; for this reason, when cleaning of the gasoline filter is found necessary, this should be reported to the maintenance division for proper service.

Electrical System

The electrical system is the "nerve center of any automotive unit. It operates the starter, the lights, and all other electrical equipment, such as fuel pumps, windshield wipers, radios, etc. It includes the motor ignition system, the battery system, and the alternator (or generator). The entire system is connected by various size wires to form many complex electrical circuits.

In order to reduce the possibility of failure, modern fire trucks are equipped with two sets of batteries, with each set consisting of two 6-volt batteries connected in series. Each set of batteries provides a 12-volt system. Practically all fire vehicles are equipped with dual ignition system.

On vehicles equipped with a dual battery system, a battery selector switch permits the starter motor to be operated from either or both sets of batteries. The battery selector switch also permits the alternator (or generator), the lights, and other electrical systems to be switched to either set of batteries. In no case, however, should the position of the battery selector switch be changed when the engine is running above idling speed, because of the high voltage surge thereby created, which could damage the alternator or regulator. Separate connections are usually provided for charging each set of batteries.

All the wiring used to connect component parts of the electrical system must be kept free from oil and grease. All electric circuit connections, including fuses and fuse holders, must be kept clean and tight to ensure good contact.

Cooling and Exhaust Systems

The power output of a gasoline motor is derived from the explosive force which results from burning a mixture of gasoline and air in the cylinder chambers. The expansion of the ignited gases in the cylinder pushes the piston downward on the power stroke. The temperature of the burning mixture in the combustion chamber of the cylinder often reaches 4,500 degrees Fahrenheit, which is about twice the melting point of iron. The gasoline engine is able to convert about 25 percent of this heat into power; the remainder is dissipated. Part of this dissipated heat is discharged in the form of hot gases through the exhaust system, and part of it is absorbed by the cooling system.

There are two general classes of automotive cooling systems: air and water. Fire department vehicles normally employ only the water type. Actually, the water-cooled motor is indirectly aided by air-cooling. The water is circulated by means of water pumps through passages that are integral parts of the motor block and head castings. The water which flows through these passages (jackets) around the cylinders and combustion chambers absorbs heat and is carried to the top of the radiator. It then flows downward through the radiator coils where the water temperature is reduced by the action of air circulating around the radiator coil surfaces. The cooled water is then picked up by action of the water pump and recirculated through the cooling system. Air is also forced through the radiator coils by a motor-driven suction fan placed back of the radiator. The amount of air forced past the radiator coils is determined by the speed of the motor and the speed of the vehicle while in motion. (This explains why motor vehicles have a tendency to overheat while the engine is idling.)

The normal cooling system, built as an integral part of the gasoline engine, may be inadequate to keep the motor of a pumper operating within

the proper temperature range when working under a heavy load. Pumpers are, therefore, equipped with an auxiliary cooling system to augment the normal motor cooling system.

The driver should inspect the cooling system of his vehicle for leaks, especially around the hose connections and around the water pump shaft, tightening the hose clamps when necessary. If the packing gland on the water pump shaft is leaking, and it is of the type that may be reached without the use of special tools, the driver may tighten this gland just enough to stop the leak. This may be followed with a shot of grease from a Zerk gun or by a tightening up of the grease cup, depending upon the type of lubricant connection.

The pumper auxiliary cooling system must be checked for leaks while the pump is connected to a hydrant. The fan belt should be checked for proper adjustment -- it is properly adjusted when the fan belt can be depressed about 1/2 inch between the pulleys.

Every 30 days the radiator should be flushed as follows:

Allow the engine to run at a speed of about 700 rpm, open the radiator drain; place a garden hose in the radiator filler opening; and turn on just enough water to keep the radiator full during the flushing process. Continue the flushing until water runs clear from the radiator overflow.

The exhaust system consists of the exhaust manifold, exhaust pipe, muffler, and tail pipe. The manifold should be checked for defects and loose studs, and the exhaust pipe and other components for holes or looseness of mounting brackets.

Transmission, Differential, and Engine Oil Systems

Power is transmitted from the motor to the rear wheels by the clutch, transmission, and differential. The transmission and differential gears are housed in their respective gear cases along with a quantity of gear oil which lubricates the entire assembly. (Some pumpers have an additional gear case which houses the pump transmission.)

Frequently (at least once a week), the clutch pedal should be tested for proper clearance. As the clutch lining wears, the position of the clutch release and clutch pedal changes. It is, therefore, necessary to readjust this clearance periodically during the life of the clutch lining. The adjustment is made so that there is always 3/4 inch to 1 inch of free travel before the release action takes place. This clearance can be felt easily by depressing the clutch pedal lightly. As the lining wears, this clearance becomes less if not adjusted; if no clearance exists, the effect is the same as riding the clutch with the foot, which eventually results in clutch slippage. When less than 3/4-inch clearance is determined, the maintenance division should be notified.

Oil leaks from the transmission, universal joints, axle differential, and wheel hubs are revealed by pools of oil or grease that have dripped therefrom.

Loose flange bolts or defective oil seals or gaskets will cause such leaks. Detection of these faults before serious damage can be done, particularly in the case of pumpers which may have to work for hours at a fire, is the mark of a good driver. Heat and friction will build up pressure inside these gear cases if they are not properly cared for. Axles and gear cases are provided with "breathers" to relieve this pressure and to prevent oil from being forced through gaskets and seals. The breathers must be kept clean. The driver should tighten any loose bolts or nuts found during this inspection and report to his immediate superior any defects that are beyond his ability to correct. Every 30 days (or more often if leaks are found), the driver must remove the filler plugs from these gear cases and check the oil level. If contents are below required levels, such facts should be reported immediately, and necessary corrections made.

Motor oil system. The motor oil system consists of the crank case, the oil pump, oil filters, oil gauge, and the copper tubing that connects the various units into a system. Most of the oil channels are cast as an integral part of the motor block, but a few run on the outside of the block. The oil pressure gauge and the oil filters are connected with copper tubing. Oil leaks may develop because of a loose gland nut on the tubing, or because a crank case bolt may have loosened up through vibration. All oil pools caused by dripping and all excessive oil accumulations around the engine block should be checked to determine the source and cause. The conditions should be corrected if possible or reported if necessary. Crank case bolts and packing gland nuts may be tightened to stop oil leaks. After tightening the nuts, the engine should be started to make certain the leak has been controlled.

Oil changes for vehicles in service should be made in accordance with approved schedules. Drivers of vehicles in service for fire response should have their immediate superiors place the company or unit out of service only long enough to drain the vehicle crankcase, replace the crankcase plug, and refill the crankcase. All advance preparations, including a supply of the proper kind and amount of oil, should be made before placing the vehicle or unit out of service. Oil in relief vehicles should be changed as determined by the amount of use for drill, in service, or for other contributing reasons. All normal lubrication of other parts of the vehicles is handled under a schedule adopted by the maintenance division.

Body and Chassis

Inspection should be made of all bolts and rivets on the body, sides, panels, steps, running boards, floor boards, tool and equipment brackets, and mounting pegs. Any bolts found to be loose should be tightened, and any deficiences that are beyond the ability of the driver or tillerman to correct should be reported.

Springs. If the vehicle sags to one side, this may be an indication of faulty shock absorbers, a damaged front end suspension, or broken, damaged, or weakened springs. All these items should be checked.

Summary of Apparatus Maintenance and Inspections

Both the driver and the tillerman must be constantly alert to any changes in the handling of the vehicle, or to any strange noises that may develop, such as gear hum, motor knocks, rattles, steering difficulty, and the like. If, after a thorough check, the cause of the deficiency encountered has not been found, this should be reported immediately to the superior officer who, in turn, will notify the maintenance division. Drivers are empowered to make minor repairs, such as tightening body bolts and battery terminals, correction of water leaks and oil leaks where possible, and so on. Drivers are cautioned not to attempt to tighten stud bolts on the motor, to make adjustments on carburetors, or to clean fouled spark plugs. In other words, they must not engage in duties which are clearly the responsibility of authorized mechanics.

Drivers and tillermen must bear in mind that the apparatus they are charged with maintaining is worth many thousands of dollars. It should be accorded no less respect and attention than one's personal property.

Glossary of Technical Terms

Accelerator	A device used to control the speed of an engine. Also called a gas pedal or throttle.
Button (2-speed axle)	A button, switch, or lever, usually attached to the gearshift lever, used to select high- or low-range gear in rear axle. Sometimes called a range selector.
Clutch	That part of the drive train which connects the motor to the transmission. The term is also used in place of clutch pedal (i. e., "push in the clutch.")
Clutch pedal	A foot pedal on the floor of a vehicle with standard transmission (straight stick) used to engage or disengage the clutch.
Downshift	Moving gearshift lever (or button) to lower gear ratio. Opposite of upshift.
Drive train	Those components which together comprise the mechanical linkage between the engine and the drive wheels.
Engage (clutch)	To release, let up (or out) the clutch pedal, thereby engaging the clutch facings. This results in the engine being coupled to the transmission.
Engine speed	The speed at which the engine is turning, measured in rpm. Not to be confused with road speed.
Feather	Used to describe the smooth use of the accelerator when increasing or decreasing engine speed. A gentle, easy operation of the gas pedal.
Gas pedal	See Accelerator.
Gear (transmission)	Used to describe the driving range selection; ratio between the engine speed and drive wheels.

High range (2-speed axle)	High ratio of drive wheel rpm to motor speed.
In gear (transmission)	Indicates that the transmission gears are in such position that the drive train is connected up to the clutch (any position other than neutral).
Low range (2-speed axle)	Low ratio of drive wheel rpm to motor speed.
Mph	Abbreviation for miles per hour, used to indicate road speed of a vehicle.
Neutral (transmission)	Gearshift lever in neutral position; engine uncoupled from drive train.
Range, tach	That area between minimum and maximum engine speed, indicated by the tachometer in rpm.
Range (2-speed axle)	Either of the two available gear ratios.
Regulate (throttle)	To control the amount of motor speed with the gas pedal.
Released (clutch)	Clutch pedal out (or up); transmission engaged with motor through the clutch facings.
Rev (motor)	Used to describe a sudden increase in engine speed.
Rpm (motor)	Revolutions per minute of motor; used to indicate how fast an engine is running (e.g., 1,500 rpm).
Selected gear (transmission)	A particular gear chosen by a driver; presumably one that corresponds in ratio to the work load imposed on the motor.
Speedometer	A calibrated dial and pointer which indicates vehicle speed (road speed).
Splitshift	A half shift executed when transmission is shifted from one gear to another and the 2-speed rear axle is shifted simultaneously to a gear of opposite ratio (e.g., transmission is shifted from first to second gear, and rear axle is shifted down to low range).

Stick (transmission)	Gear shift lever; used to select desired gear.
Tach	Abbreviation for tachometer; used to indicate motor speed (i. e., "increase or decrease the tach").
Tachometer	A calibrated dial, usually located on vehicle dashboard, with a pointer that indicates speed of motor in rpm.
Tach range	See Range, tach.
Throttle	See Accelerator.
Transmission	A cluster of gears located between the clutch and the remaining drive train, usually operated by gearshift lever and used to vary road speed while maintaining proper "tach" or desired engine speed.
Two-speed axle	A cluster of gears in rear axle, similar to those in the transmission, but operated separately from, or in conjunction with, transmission gears.
Upshift (transmission)	To move the gearshift lever to a higher gear. Opposite of downshift.

Reference Materials

Books and Pamphlets

Defensive Driver Training Outline. Sacramento: California State Personnel Board, n.d.

Facts and Facets -- Five Steps to Safer Driving. Dearborn, Mich.: Education Affairs Department, Ford Motor Co., n.d.

How to Train Fire Department Drivers. Boston, Mass.: National Fire Protection Association, n.d.

Laws Relating to Fires and Firemen. Sacramento: State of California Documents Section, n.d.

Tests for Use of Sportsmanlike Driving (Fifth edition). New York: McGraw-Hill Book Co., n.d.

Vehicle Code. Sacramento: California Department of Motor Vehicles, 1965.

Training Films

The following films may be obtained on loan from the California State Department of Education, Bureau of Industrial Education, Fire Training Program, 721 Capitol Mall, Sacramento, California, 95814:

Fire Apparatus -- Emergency Response. 15 min., 16 mm sound.

Responding to an alarm -- Hazards encountered while enroute -- Safe driving habits and things to be avoided -- Necessity of preplanning response routes

Fire Apparatus -- Gear Shifting. 15 min., 16 mm sound.

Operation of clutch, transmission, and differential -- Relationship to engine in transmitting power to drive wheels -- Method of shifting gears smoothly to maintain proper road speed without injury to engine

Fire Apparatus -- Preparation. 15 min., 16 mm sound.

Driver's responsibility for apparatus that he drives -- Inspection and checking of apparatus and equipment -- Those things which should be done before the alarm

Fire Apparatus -- Steering. 15 min., 16 mm. sound.

Today's apparatus compared to the old -- Construction of steering mechanisms -- Those things that make for hard or easy steering -- Checking the steering gear -- The mechanics of steering heavy apparatus -- Signaling -- Different driving conditions encountered

Give Us a Brake. 11 min., 16 mm sound.

Points and problems that arise, or are created, by the failure of the motorist to abide by regulations governing emergency vehicles, particularly fire apparatus (Los Angeles Fire Department)

It may be possible to rent the five films in the "Expert Seeing Series" from the San Francisco Bay Area Safety Council or the Los Angeles Area Safety Council. This series is also available for purchase from the National Safety Council, 425 North Michigan Avenue, Chicago, Illinois, 60611. (The price for black and white is $400; for color, $720. Each film has a running time of about ten minutes, and all are 16 mm.) The five films are titled as follows:

1. Aim High in Steering
2. Get the Big Picture
3. Keep Your Eyes Moving
4. Leave Yourself an Out
5. Make Sure They See You

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IDENTIFIERS - *SALVAGE OPERATIONS; FIRE SERVICE; FIRE DEPARTMENT TRAINING

ABSTRACT - Prepared by the State Fire Service Training Program staff, this salvage operations manual may be used as a fire department training manual, a reference for students enrolled in fire service training and fire science courses, or a source of information for individual study toward career advancement. Major topics include: (1) Fire Department Salvage Work, (2) Care and Handling of Salvage Covers, (3) Use of Salvage Covers, (4) Protecting Property and Removing Excess Water, (5) Salvage Operations in Sprinklered Risks, (6) Overhauling Premises, (7) Controlling Utilities and Other Services, and (8) Salvage Equipment. This document is illustrated with line drawings and photographs. (GR)

VT 010 545

Salvage Operations

Manual of Salvage Operations

Prepared for the
BUREAU OF INDUSTRIAL EDUCATION
by

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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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VT 010 545

Foreword

The efficiency with which any agency of government functions depends to a very large extent upon how well the personnel of the agency are prepared to meet their responsibilities. Therefore, every agency of government must select personnel who are qualified to do their respective job assignments well, and the agency must also provide such inservice training as may be needed to keep each member of its staff well prepared to meet job assignments promptly and efficiently.

Fire departments are agencies of government whose efforts are largely devoted to the prevention and control of unwanted fires. Therefore, these departments must make certain that the members of their staffs are prepared to act intelligently and promptly in every emergency.

The Bureau of Industrial Education, California State Department of Education, develops and makes available instructional materials to those responsible for providing fire service training programs. These materials have been planned and developed by people who know the responsibilities of firemen, have the knowledge and ability to meet each of the responsibilities, and are determined to provide for each fireman opportunity to acquire the knowledge and skill he needs to meet his responsibilities as a member of the fire department he serves. It is my hope that this publication will be a valuable addition to the instructional materials that have already been developed for the fire service training program in California.

Max Rafferty

Superintendent of Public Instruction

Preface

The Manual of Salvage Operations, prepared by the State Fire Service Training Program staff, is designed for use as (1) a fire department training manual; (2) a reference for students enrolled in fire service training and fire science courses; and (3) a source of information for individual study toward career advancement in the fire service.

William Cox and Frank Manwarren of the Los Angeles City Fire Department and Donald L. Palmer of the Buena Park Fire Department provided the photographs used in this manual. The California Fire Chiefs' Association, Training Officers' Section, Northern and Southern Divisions; the Fire Training Officers' Workshop, Group V, Fresno, May 8-12, 1967; and the Buena Park and Los Angeles City fire departments rendered valuable assistance by providing recommendations and suggestions regarding the technical phases of the material presented.

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A Fire Department Salvage Work

TOPIC 1 -- SALVAGE: A FIRE DEPARTMENT FUNCTION

This topic, "Salvage: A Fire Department Function," is planned to provide answers to the following questions:

- How were early attempts at protecting property carried out?
- What developments in the early 1800s prompted more organized salvage efforts?
- What was the forerunner of modern fire service salvage operations?
- Why did salvage become a fire department function?

Early Salvage Efforts

The problem of protecting property from unnecessary damage during fires has existed since man began accumulating possessions. Early attempts to save property exposed to fire were at best unorganized, crude, and sometimes almost as destructive as fire itself. Usually friends, neighbors, and bystanders rushed into burning buildings and attempted to remove everything movable. Because of the need to remove items quickly, no system or organization could be developed. Little effort was made to coordinate activities, to select the most valuable items, to avoid breakage, or to choose a safe storage area. The results were (1) that items of little value were sometimes removed while valuable items were overlooked; (2) that property was needlessly broken or damaged during removal; and (3) that items removed were later exposed to the fire; to the effects of weather, and to theft or vandalism.

During the bucket-brigade days such salvage efforts were probably effective to a small degree. In most cases possessions not removed were destroyed by fire anyway. Fire-fighting tools and techniques were so ineffective that buildings usually burned until they and their contents were a total loss.

Significant Developments

As the nineteenth century dawned, two significant developments were leading to more organized salvage efforts. First, buildings were becoming larger, and second, fire-fighting tools and techniques were improving. More and more bucket brigades were being replaced with pumping apparatus, hose, and nozzles; thus the ability of fire departments to control fires before the fires caused total losses was increasing. However, since larger buildings were housing more property, losses created by applying more water were also

increasing. Damage by flame and heat was no longer the prime cause of total fire loss; damage by water applied to control a fire became significant.

During this period insurance underwriters became increasingly concerned over losses caused by the following:

1. Larger concentrations of values

2. Fire-fighting methods characterized by primitive tactics, open-butt nozzles, and the need to attack a fire with numerous streams to prevent it from extending to other structures

3. Attempts by unorganized groups of citizens to save property, resulting in unnecessary damage

Salvage Corps

Boards of fire underwriters therefore established salvage corps in the larger cities of the United States. The first corps was organized in New York in 1829 and was called the New York Fire Patrol. These corps or patrols were staffed with men trained in salvage work, equipped with salvage covers and other tools to reduce water damage, furnished with apparatus and stations, and in most instances provided with connections to the municipal fire alarm system. Since the function of the patrols was to protect property from damage by fire, water, and weather and from loss by theft, the patrols saved an untold amount of property and money. More importantly, they demonstrated the benefits of organized salvage operations.

The corps and patrols were supported financially by insurance companies that were members of various boards of fire underwriters. All insurance companies were not board members, nor was all property insured; thus board member companies were furnishing a service that benefited the entire community. All property owners, uninsured as well as insured, were receiving salvage services, but only insured property owners were contributing funds for services.

Ultimate Responsibility

Board company members therefore recommended that fire departments were the logical agencies to provide salvage services. Municipal and other fire departments agreed to provide these salvage services, and so today no underwriters' salvage corps or patrols exist.

Since the 1920s, fire departments have constantly emphasized their salvage efforts and increased their effectiveness. Modern fire departments are accepting the challenge to provide complete fire protection, a concept that establishes salvage as a vital fire department function. Constant efforts are being directed toward reducing (1) losses from water, heat, and smoke damage; (2) losses from fire-fighting operations; and (3) the effects of theft and adverse weather following fires.

A -- FIRE DEPARTMENT SALVAGE WORK

TOPIC 2 -- SALVAGE OPERATIONS IN GENERAL

This topic, "Salvage Operations in General," is planned to provide answers to the following questions:

- What are the four categories of salvage operations?
- What training is necessary before effective salvage work can be accomplished?
- How does prefire planning affect salvage tactics and strategy?
- What are the results of indiscriminate use of water during extinguishment?
- Of what value are postfire critiques?

Categories of Salvage Work

Salvage work performed by a fire department may be divided into four categories. They include operations (1) before a fire; (2) during a fire; (3) after a fire is under control; and (4) following a fire.

Operations Before a Fire

A fire department cannot begin to fulfill its obligation of saving property (and lives) without performing two major functions. These are training and planning, each of which will be examined in detail.

Training

Probably the most important consideration in operations before a fire is the matter of training personnel, who must be trained in the use and care of salvage equipment and in correct fire-control techniques. These techniques include forcible entry, ventilation, use of water, and the operation of sprinkler systems. Training should be a continuous process in all fire departments.

Forcible entry. All fire service personnel should be proficient in forcible entry so that they know where and how to gain access to a structure with a minimum of damage. The ideal of simply turning a knob is not present in all situations; frequently the entry is locked or otherwise obstructed, and the fireman must use special tools.

Ventilation. As a salvage operation, ventilation is essential if damage from fire, smoke, and heat is to be prevented. Rapid removal of smoke, heat, and gases during the early stages of a fire pinpoints the area involved, allows firemen to get closer to the source of the fire, and provides a cleaner atmosphere in which to work. Ventilation also minimizes the use of indiscriminate streams of water in areas where contents can be damaged or broken.

Use of water. The most significant of all salvage principles may be the accurate application of water. Applying water at the wrong time, from the wrong place, with the wrong nozzle pattern, and in unnecessary amounts causes a great deal of preventable damage. Water should not be applied in smoke-filled areas until ventilation has been accomplished and the seat of the fire can be found. The wrong place may be either inside or outside of structures. Although high-velocity, variable-pattern fog nozzles provide a means of using water with the greatest degree of efficiency, these nozzles can contribute to unnecessary losses when used incorrectly. Water is delivered not only at a high velocity, but in fine droplets that readily convert to steam.

These factors can result in great volumes of flame, heat, and smoke being forced away from the point of application. Therefore, nozzlemen must be trained in the correct use of fire streams. Applying water from the outside of a structure should be avoided in every possible instance. This may also force flame, heat, and smoke into uninvolved sections of the structure, sections that could contain articles highly susceptible to heat and smoke damage.

A similar situation may occur where water is applied incorrectly within a structure. Ideally, water should be applied from a position that will force fire gases and heat to the exterior through windows, doors, or other openings. Application of water from the correct location will not only reduce unnecessary damage, but will also control a fire more quickly and serve to ventilate the fire area.

Indiscriminate application of large quantities of water on stocks of paper goods, baled paper or fabric, grain, and other bulk or porous materials will cause excessive water damage and could cause overloading of floors with a subsequent collapse. This in turn could result in injury or death to personnel or unnecessary damage to the building and other contents.

Sprinkler systems. Fire service personnel should be thoroughly familiar with the sprinklered buildings in their district. Firemen should receive extensive training in the operation of sprinkler systems and in correct water control techniques during fires where automatic sprinkler systems are involved. Salvage operations in sprinklered buildings is the subject of a separate section in this manual.

Planning

Prefire planning provides the answers to questions such as the following: How susceptible are various materials to damage from heat, smoke, and water? What are the potential salvage problems within the department's response district?

Building inspection is the key to prefire planning; a good planning program will give the fire officer valuable information on the contents of a building. This knowledge gathered before a fire starts can result in the saving of thousands of dollars in unnecessary damage as well as the prevention of loss of life. Some building contents such as expensive fabrics, carpets, draperies, upholstered furniture, and clothing are highly susceptible to smoke damage. Rapid ventilation is a necessity in such occupancies. Also, care must be taken to prevent the forcing of heat and smoke into uninvolved areas during extinguishment.

Conditions that could cause a more serious loss should a fire occur will be evident during a building survey. These include incorrectly piled stock, inadequate or clogged floor drains, inoperative sump pumps, and extremely valuable stock in one area. These adverse conditions should be eliminated, if possible.

A thorough knowledge of the building and its contents will determine the procedure to be used to keep heat, smoke, and water damage at a minimum. Developing this knowledge of potential salvage problems within a response district is a matter of training that can be accomplished only through an organized, comprehensive, prefire planning program. No fire department--paid or volunteer--can fulfill its obligation to the people it serves without prefire planning.

Operations During a Fire

Those salvage operations conducted during a fire will be performed efficiently only if they are well planned and well supervised. Responsibility should be established by designating a salvage officer at every fire where salvage is necessary. When fires are small, a company officer can handle this task, but larger fires may require that a chief officer fulfill the responsibility. Regardless of the size of a fire, the responsibility for supervising and coordinating salvage operations must be established.

Operations during a fire involve the use of sound fire-fighting strategy and correct fire-control methods to limit unnecessary damage. Contents must be protected from fire and water damage, theft, and breakage by covering them, removing them when necessary, and guarding them. Floors may have to be bagged, and water may have to be removed from the building.

Operations After a Fire is Under Control

Specific salvage operations after a fire is under control are also performed more efficiently when they are well planned and well supervised. Circumstances and the particular situation will determine which of the following operations are necessary and in what sequence they should be performed:

1. Stopping the water flow from open sprinkler heads
2. Ventilating the building to remove any remaining heat and smoke
3. Drying the building and contents
4. Drying and oiling contents susceptible to rusting
5. Removing debris from the building
6. Deodorizing the building and contents
7. Shutting down and draining water systems where such systems may be exposed to freezing temperatures
8. Covering openings in walls and roofs to prevent weather damage and theft
9. Locating and protecting valuables
10. Restoring sprinkler systems to service

Operations Following a Fire

Following a fire, the effectiveness of salvage and fire-control techniques must be determined. A postfire critique is necessary if the practical experience gained is to be used to deal with future fires more competently, for efficient operations in any endeavor require constant evaluation. Such an evaluation cannot be made unless fires requiring salvage work are subject to a follow-up. Questions such as the following should be asked:

1. What unnecessary damage was caused?
2. How did the damage occur?
3. What was the condition of the building and its contents after all department operations were completed?

The answers to these questions may lead to a reevaluation of the department's equipment and methods and may determine training needs in certain fire-control techniques.

Manpower for Salvage Operations

Salvage work requires manpower. Fire departments that do not have sufficient manpower to assign men to salvage during the initial stages of a fire should not neglect salvage. Procedures whereby men can be assigned as they become available are relatively simple to develop. The majority of structure fires are brought under control rapidly; as these fires come under control, men can be relieved of other duties and directed to report to the salvage officer.

A -- FIRE DEPARTMENT SALVAGE WORK

TOPIC 3 -- RESPONSIBILITIES OF SALVAGE OFFICERS

This topic, "Responsibilities of Salvage Officers," is planned to provide answers to the following questions:

- What steps are involved in an effective size-up system?
- What probabilities must a salvage officer consider in making fireground decisions?
- How does a salvage officer solve manpower problems?
- What part should communications play in a size-up system?

The Size-up System

Efficient fire department operations are based upon certain definite principles, and one of the principles of fire service work is that a size-up must be made to determine what to do and how to do it. Officers responsible for salvage operations should develop a system for such operations. One effective system of size-up includes the following five steps: (1) facts; (2) probabilities; (3) resources available; (4) decision; and (5) plan of operation. While this system is designed for overall fireground operations, it can readily be adapted to salvage.

Facts

Facts to be determined include the size of the fire and its location within the structure, the type of construction in the involved building, the type of contents exposed, the fire protection features of the building, and anything else regarding the building and its contents that could aid or hinder salvage operations. The majority of these facts must be gathered through prefire planning surveys.

Probabilities

Probabilities must include an estimate of where the fire may travel, the quantity of water required to control the fire, possible hazards to personnel engaged in salvage, effects of possible weather changes upon the operations under consideration, and any other probability relating to operations.

Resources Available

Resources available to deal with the emergency are such items as apparatus, equipment, and manpower. Salvage officers must be adaptable. They must have the ability to adapt their apparatus and equipment to various unusual situations, and they must be able to utilize equipment and facilities that may be available on the fire premises or available from other sources.

Manpower is always a problem. A good salvage officer will develop an organization that will be effective at the outset with a minimum number of personnel. His nucleus will be readily expandable in order to use additional manpower that becomes available (1) as the fire is brought under control; (2) through greater alarms or special calls; or (3) through the use of the civilians employed at the occupancy where a fire occurs.

Decision

Decision is essentially what to do and how to do it based upon the facts, probabilities, and resources available -- considerations developed during the first three steps of the size-up process. Fireground activities are not static; fireground situations change, sometimes very rapidly. Therefore, a great number of decisions are required, and the officer in charge of salvage must be ready to make those decisions. He must be available to receive information and to communicate his decisions, which means that his subordinates must be able to locate him. A modified command-post operation may be required for large salvage operations.

Plan of Operation

Plan of operation is a mental diagram of the processes necessary to achieve the objectives. The plan should be as simple as possible to be readily communicated and easily understood. After the plan is activated, constant supervision is required so that the plan will be consistently directed toward the objectives.

Summary

The foregoing is only a brief description of the factors involved in sizing up salvage operations. Officers who use this or any other type of system to evaluate and to contend with salvage situations must consider all necessary factors in their estimates, and then deal positively with the problem.

A -- FIRE DEPARTMENT SALVAGE WORK

TOPIC 4 -- TYPICAL SALVAGE OPERATIONS DURING FIRES

This topic, "Typical Salvage Operations During Fires," is planned to provide answers to the following questions:

- What are the primary objectives of salvage officers when water is being applied to a fire?
- How is excess water removed from basements?
- How are salvage covers used during fires?
- How is overhaul related to salvage?

Primary Objectives

During the time that water is being applied to a fire, the salvage officer has the following primary objectives:

1. To protect exposed contents on the fire floor

2. To protect exposed contents on the floor below the fire

3. To hold water to the fire floor or the floor below the fire

4. To divert water to the exterior of the building as necessary

Exposed building contents can be protected by moving them to safety, by covering them, or both. Water in a particular area may be contained by bagging attics or floors and by constructing catch basins or drip tubs. Where the quantity of water being used exceeds the capacity of these devices, the water must be diverted to the exterior of the building through the use of elevator shafts or by the construction of stairway drains or window drains as explained in this manual. Water in basements may be removed by clearing floor drains, activating sump pumps, removing toilet bowls, breaching or removing cleanout plugs from exposed toilet drains, using siphons or eductors, or pumping with apparatus or portable pumps.

Salvage Cover Work

Effective salvage cover work depends to a great degree upon training (Fig. A-1). Of course, covers must be clean and well maintained. They should not be dragged over materials, but should be carefully draped over breakable items or delicate stock. Where glass showcases are covered, some object must be placed on top of the cover to warn personnel against

climbing on the showcases. Where large items or groups of items must be covered and more than one cover is required, the first cover should be drawn up from the floor. The second cover should be lapped with the first, and so forth, to prevent water from reaching the covered material. Frequently contents can be grouped so that one cover will be enough. Water following vertical pipes may be caught by wrapping a cover around the pipe and securing it with twine. When water is being swept through aisles, exposed contents must be protected with covers.

Safety During Salvage

Salvage operations during a fire can be hazardous to personnel. If possible, work areas should be well lighted. Men engaged in salvage should use extreme care in climbing on shelving, counters, show cases, or other fixtures, for falls are a leading cause of accidents in the fire service. Adequate equipment and protective clothing are necessary safety factors.

Salvage and Overhaul

Salvage operations conducted after a fire is brought under control are generally associated with overhaul, an operation performed to prevent rekindling of a fire. Salvage and overhaul are so closely related that a clear distinction cannot be made between them. Overhaul is also a kindred function of extinguishment. The chief difference between overhaul and salvage is that overhaul is performed to prevent the rekindling of a fire, and salvage work is performed to save property from damage by fire, water, smoke, heat, and fire-control activities.

Fig. A-1. Typical use of salvage covers

B Care and Handling of Salvage Covers

TOPIC 1 -- TYPES OF SALVAGE COVERS

This topic, "Types of Salvage Covers," is planned to provide answers to the following questions:

- What types of salvage covers are in common use by fire departments?
- How are grommets used on salvage covers?
- What records should be kept concerning salvage covers?

Sizes of Salvage Covers

Salvage covers are made in several sizes and of various combinations of materials, although a cover 12 x 18 feet is probably best suited for most purposes. A smaller size may be good for some particular work but too small for other work. Larger covers, on the other hand, are better for covering large areas but are too cumbersome to be handled efficiently.

Covers in General Use

The following five types of covers are used by fire departments:

1. The rubber-coated cover, rubberized on both sides, generally is limited to larger departments where considerable salvage work is necessary and covers are used frequently.

2. The "greenback" cover is specially treated on one side, with a green fabric on the other side. This cover should be used treated-side up.

3. The duck cover is treated with a linseed-oil compound. Duck will shed water, but is sticky in the summer and stiff in the winter and therefore is hard to handle. Additionally, it tends to soil objects with which it comes in contact.

4. The regular canvas cover is made of specially treated woven canvas. This cover is probably the most generally used in small departments and quite extensively used in some larger departments. It has the advantage of being lightweight, can be easily handled, and is sufficiently waterproof for practically all types of service.

5. The plastic salvage cover is usually made of a synthetic fabric such as nylon coated on both sides with a vinyl material. Plastic covers are lightweight, waterproof, shrinkproof, and flame, chemical, and tear resistant. They will not rot or mildew.

Grommets in salvage covers provide a means of hanging covers over shelves and on walls. Two grommets should be on each corner, and grommets on the ends and sides should be 16 inches center-to-center to correspond with the standard spacing of studs and joists. This permits hanging a cover on nails driven into studs rather than into plaster or plasterboard.

Salvage Cover Records

Salvage cover records should be kept in a card filing system and should contain such information as the type and size of the cover, purchase date, cost, manufacturer, vendor, repair data, and "out of service" and "survey" dates. Fire department administrators usually develop a method for recording such information on the basis of their particular needs.

B -- CARE AND HANDLING OF SALVAGE COVERS

TOPIC 2 -- MAINTAINING, REPAIRING, AND WASHING COVERS

This topic, "Maintaining, Repairing, and Washing Covers," is planned to provide answers to the following questions:

- What are the specific care commandments for maintaining salvage covers in a state of readiness?
- How are repairs made on salvage covers?
- What procedures are used in washing salvage covers?

Maintaining Salvage Covers

Because salvage covers are expensive, officers should practice strict economy in their use, make careful repairs, and keep adequate records to ensure maximum service. Covers should be thoroughly washed and dried after each drill or other use; officers are generally held responsible for mildewed or unclean covers. When they are removed from drying racks, covers must be carefully examined for cuts and tears. Officers should instruct their men in making correct repairs, and the work should be closely checked before the repaired covers are returned to service.

Care is the byword in maintaining salvage covers in a state of readiness; care must be taken when using them at fires or in training. Among the specific care commandments are the following:

1. Do not drag or walk on covers unnecessarily, as this will cause dirt and grit to grind into covers. Remove them from floors and stairways as soon as possible.

2. Do not pull covers over sharp projections or spread them over broken glass or other sharp objects. In covering roofs, materials likely to perforate or tear covers should be removed first.

3. Do not throw covers down elevator shafts or from windows when removing them from buildings.

4. Do not drive nails through covers, except in grommet holes. Covers must be securely fastened to prevent them from flapping, particularly when roofs are covered.

Salvage covers should not be allowed to remain in apparatus compartments indefinitely without being aired and refolded. Rubber-coated covers should be refolded after two weeks on the apparatus or one month in stationary storage. The ideal care procedures are to hose them down with clear water, hang

until completely dry, dust with talcum powder, and refold. Other types of covers should be refolded periodically with an interval of hanging before refolding if the supply permits taking them out of service.

Repairing Canvas Salvage Covers

Salvage covers with holes or rips should be removed from service and repaired immediately, because perforated and torn covers allow water and debris to damage merchandise. Although canvas salvage covers may be repaired in a number of ways, the following method is recommended:

1. Use canvas patches and contact cement.

2. Extend the patch at least 2 inches beyond the hole or rip to ensure a strong, waterproof repair (Fig. B-1).

3. Patch only one side of a simple puncture or a small rip.

4. Patch both sides of the cover for larger holes (up to 3 inches in diameter) and longer rips. Holes more than 3 inches in diameter and very long rips are difficult to repair; they usually require the service of professional repairmen.

5. Place tape over any stitching to ensure a waterproof seal before returning the cover to service.

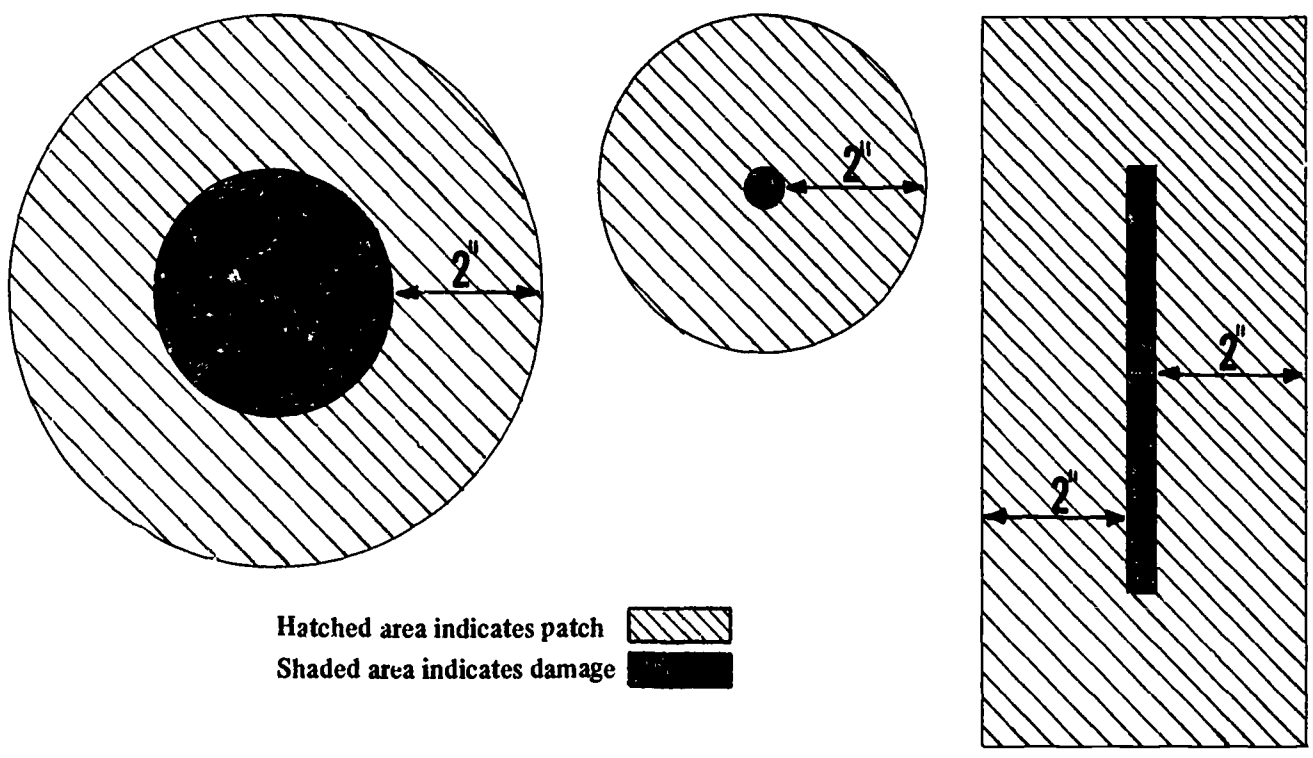
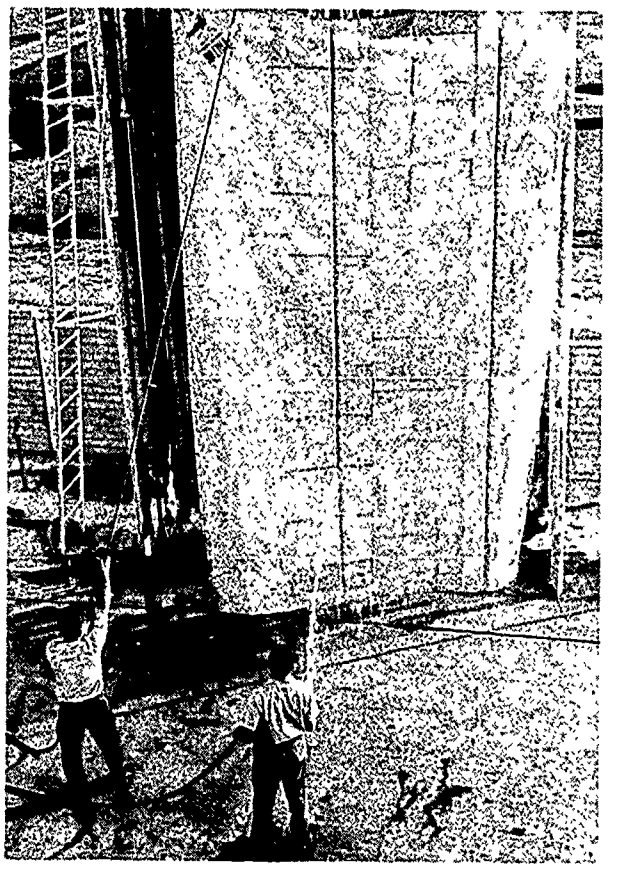


Fig. B-1. Repairs on canvas covers

Rinsing and scrubbing



Final rinse and drain

Fig. B-2. Washing salvage covers

Washing Salvage Covers

Salvage covers must be washed after each use to remove materials harmful to the covers or to objects to be covered at subsequent fires. Dirty covers used on expensive fabrics, for example, could cause more damage than if the fabrics had not been covered.

In cleaning cotton duck covers, harsh soaps or detergents should not be used. They cause deterioration of the cotton fibers and, in some cases, reduce the ability of the fabric to shed water. When a cover is particularly dirty, a mild soap or 5 percent detergent solution may be used if clean, clear water will not do the job.

The following procedures are recommended for washing salvage covers (Fig. B-2):

1. Select a clean, well-drained concrete surface, and spread the cover completely.

2. Rinse the cover with cold water from a garden hose or booster line. Scrub the cover with deck brushes while rinsing if the cover is not clean after the first rinse.

3. Reverse the cover and repeat step two.

4. Hang the cover to dry, and give it a final rinse if drainage is available in the drying area.

B -- CARE AND HANDLING OF SALVAGE COVERS

TOPIC 3 -- FOLDING AND CARRYING SALVAGE COVERS

This topic, "Folding and Carrying Salvage Covers," is planned to provide answers to the following questions:

- What are the standard procedures for folding salvage covers?
- Why is the Palo Alto fold better than the standard accordion fold?
- How are covers best removed from apparatus?

Typical Folds

Not only must salvage covers be carefully maintained, but they must be folded correctly to ensure their successful use in emergencies. Four standard folds are used by the fire service: (1) the accordion fold; (2) the Palo Alto accordion fold; (3) the one-man roll; and (4) the "donut" roll. Covers folded correctly are easy to stow on apparatus, to remove quickly, and to spread efficiently.

Accordion Fold

In making the accordion fold, the cover is placed on a clean surface with the finished (weather) side up. The cover is inspected for condition and cleanliness and, if prescribed, is dusted with powder. The following procedures are then used by two men to make the fold (Fig. B-3):

1. Turn all corners in about 10". Then, kneeling as shown in Step 1, place the outside hands on the end of the cover 3' from the edge, reach over with the inside hands, and grasp the turned-in corners. (The corners are turned in only to provide a handhold; they are flat in the final fold.)

2. Working together, bring the outside edge to the center.

3. Repeat this procedure with the other half of the cover, turn in the first-fold corners about 10" to provide a handhold, and lap one half of the cover over the other.

4. Remove air from the cover with push brooms.

5. At one end of the cover, measure in about 9" (the span of the outside hand) to determine the width of the fold.

6. Place thumbs of outside hands under the cover and, with the inside hands spaced about 18" in, bring the first fold even with the end of the cover.

7. Continue making accordion pleats until the cover is completely folded.

8. Secure the bundle to protect it while in storage on apparatus (optional). Place rubber bands or twine around the folded cover or place plywood boards (3/8" x 9" x 35") on the top and bottom under rubber bands made of old inner tubes.

Palo Alto Method

Although similar to the standard accordion fold, the Palo Alto method has certain advantages over the standard fold. Covers folded by the Palo Alto method are easier to spread by either one or two men. Also, the center of the cover may be placed more precisely over objects, a distinct advantage when the object to be protected is a narrow counter or a similar article. Since the finished side of the cover is always visible, the cover is easy to place correctly.

The procedures are the same as for the standard accordion fold shown in Fig. B-3 with the following exceptions (Fig. B-4):

1. Instead of lapping one half of the cover over the other as in Step 3, fold each half toward the center.

2. Use three men to pleat the cover. The third man holds the center of the cover to keep it from wrinkling.

One-Man Roll

An alternate method of folding a salvage cover is to roll it for one-man spreading. An advantage is that the cover need not be "thrown" when spread, but may be simply placed upon articles to be protected, unrolled, and opened. This is a relatively easy, one-man operation.

The initial folds are as described for the Palo Alto method, except that the folded cover is not pleated. Rather, each end is folded in 12"; then the cover is rolled tightly from each end. Accumulated slack is tucked in as necessary, and the finished roll is secured with twine or an inner-tube rubber band (Fig. B-5).

Donut Roll

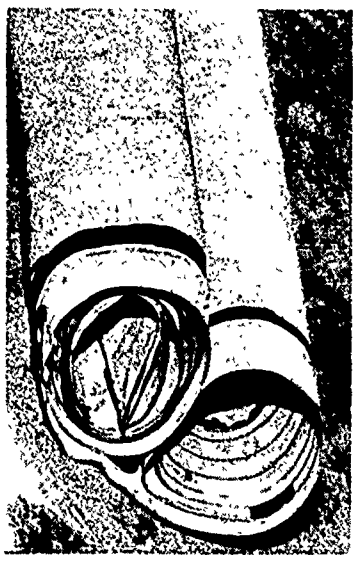
The donut roll is useful for a number of purposes, among them the easy covering of floors, stairways, and roofs. Covers rolled in this manner are also easily spread under beds to protect floors during mattress fires.

Again, as in each of these operations, the cover is spread on a clean surface, finished side up, and inspected for condition and cleanliness. Powder may be dusted on the cover, particularly if it is rubberized. Then two or three men roll one edge of the cover's long side toward the center and repeat the operation on the other side. One man now rolls the cover tightly, lengthwise, while the second man keeps the side rolls firm and straight. The completed roll is secured with a strap, short rope, or rubber band (Fig. B-6).

Removing and Carrying Folded Covers

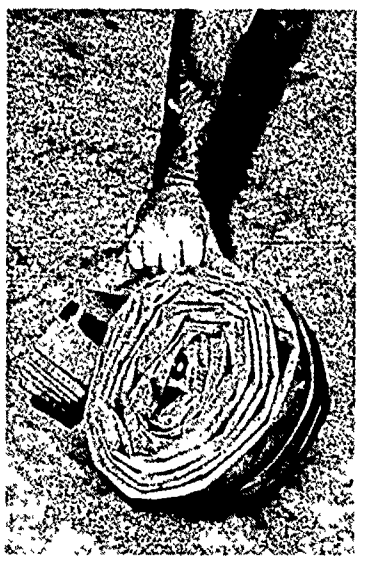
Care in removing covers from apparatus is important. They should be removed and carried in a certain manner because of their weight and the way in which they are folded. Covers must arrive at their point of use with their folds intact so that they may be spread quickly and correctly.

In removing and carrying an accordion-folded cover, it should be grasped from its compartment with the right hand. The left hand is slipped under the center of the cover, and the cover is draped over the left shoulder by using the left hand as a pivot. A second cover is removed and carried on the right arm at the hip. More than two covers may be carried if they are lightweight.



Rolling sides to center

Rolling tightly lengthwise



Securing for storage

Fig. B-6. Donut roll

C Use of Salvage Covers

TOPIC 1 -- SPREADING AND HANGING SALVAGE COVERS

This topic, "Spreading and Hanging Salvage Covers," is planned to provide answers to the following questions:

- What methods are used to spread salvage covers?
- What are the fundamentals of hanging salvage covers?
- How is a leakproof fold made?
- What purpose is served by the use of "S" hooks?

Spreading Covers

Four methods, each having its advantages, are used to spread salvage covers over articles to be protected during fires: (1) the one-man throw; (2) the one-man roll; (3) the counter payoff; and (4) the two-man balloon.

One-Man Throw

The one-man throw should be used only when covering unbreakable materials. It is a rapid method for spreading covers, is particularily advantageous when manpower is limited, and works well when spreading accordion-folded covers. However, the standard accordion-folded cover will not be centered on the article unless the center of the cover is determined beforehand and the cover spread accordingly. When using the Palo Alto fold, the center of the cover is easily centered on the object. The following procedures are used in making the one-man throw (Fig. C-1):

1. Hold the cover as follows:

   a. Center the folded cover on the forearm with the open edges toward the body.

   b. Lock in the two bottom folds with the ring and little fingers, and hold the index and middle fingers tightly pressed against the remaining folded edges.

   c. Grip the three top folds nearest the body with the thumb and fingers of the throwing hand.

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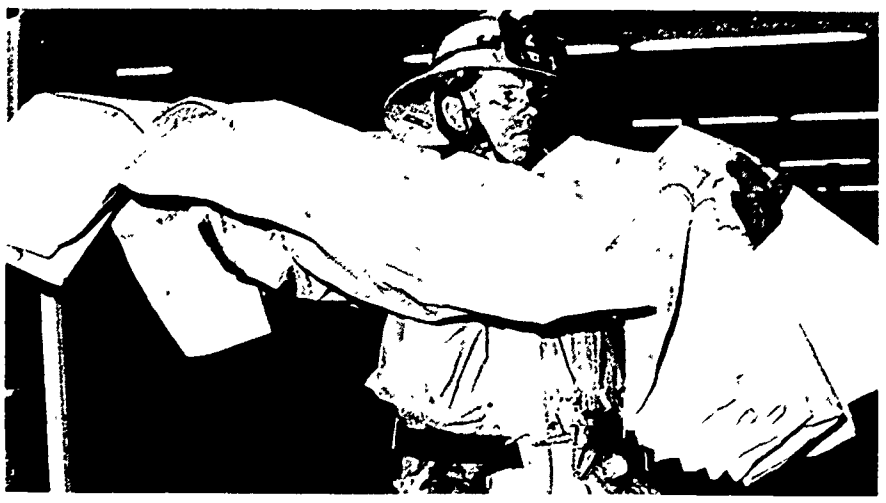
2. Hold the cover firmly, and flip the three top folds over the back of the hand and wrist as the arm is moved into a throwing position. Use the index and middle fingers of the opposite hand as a brake.

3. Throw the top folds directly overhand. Retain the grip on the bottom folds, and apply pressure with the index and middle fingers as necessary to control the speed of the throw.

4. Open the cover so that it envelops the material, and tuck in all loose edges at the bottom.

Step 1



Step 2

Step 3

Step 4

Fig. C-1. One-man throw

One-Man Roll

A salvage cover prepared for a one-man roll can be spread without throwing. Before the cover is opened, it can be positioned to ensure its correct placement. The following procedures are used in spreading the one-man roll (Fig. C-2):

1. Place the cover at the top center of the object to be protected.

2. Unroll the cover.

3. Unfold each side of the cover, and tuck in the edges at the bottom.

Step 1 Step 2 Step 3

Fig. C-2. One-man roll

Counter Payoff

The counter payoff, a two-man method of spreading a salvage cover, allows the cover to be placed exactly where it is needed on counters or tables. The cover may also be placed gently on fragile articles. The procedures are as follows (Fig. C-3):

1. Hold the cover on the forearms, with the fingers gripping the two bottom folds, while the second man grasps the top layer with both hands.

2. Extend the cover and hold the arms high as the second man walks backward.

3. Position the extended cover gently over the object.

4. Open the cover, and tuck in the edges around the base.

Two-Man Balloon

The two-man balloon method of spreading a salvage cover can be used to advantage where the object to be covered is fairly open and unobstructed. The top of the object must be within easy reach, or difficulty will be encountered in placing the cover correctly. The procedures for making this spread are as follows (Fig. C-4):

1. Hold and extend the cover as shown in Fig. C-3. Both men grasp one double fold with each hand and let the center of the cover hang.

2. Snap the cover upward, and spread the arms to trap the air and balloon the cover; then release the outside hands and float the cover into position with the inside hands.

Making a Leakproof Fold

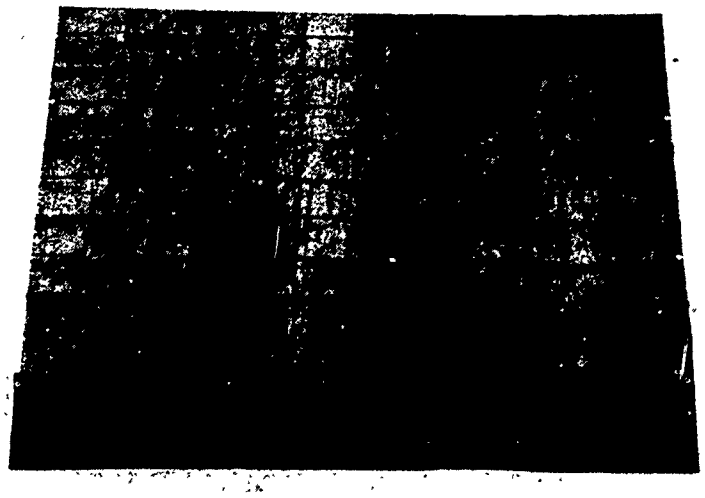
When salvage covers are laid side by side or end to end to protect an area larger than one cover, the covers must be joined together in a manner to prevent water from leaking between the covers. This provision must also be made when flooring or floor coverings are to be protected or when water is to be channeled down a long hall or stairway. The following procedures are used by two men in making this leakproof fold (Fig. C-5):

1. Take positions on opposite sides of the first cover, and fold the cover back on itself from 12 to 18 inches.

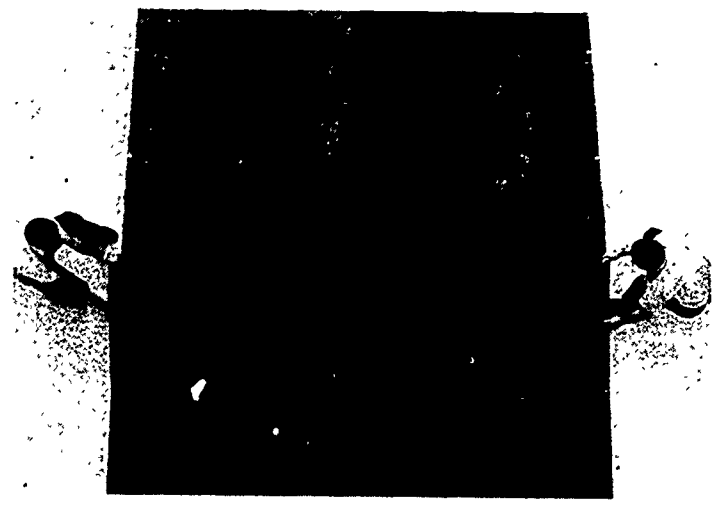
2. Spread the second cover so that its end overlaps the folded end of the first cover. When possible, kneel on the first cover; if not possible, work from the sides.

3. Grasp ends of both covers, palms down, fold over from 4 to 6 inches, and roll until the slack is taken up.

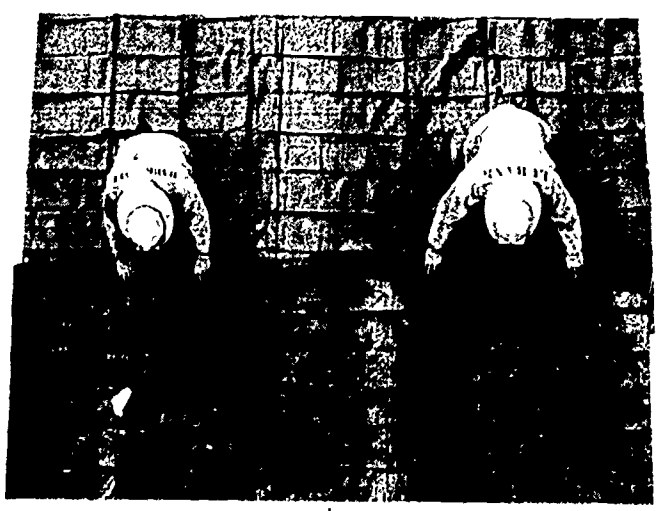
Any number of covers may be joined in this manner, either at the ends or along the sides.



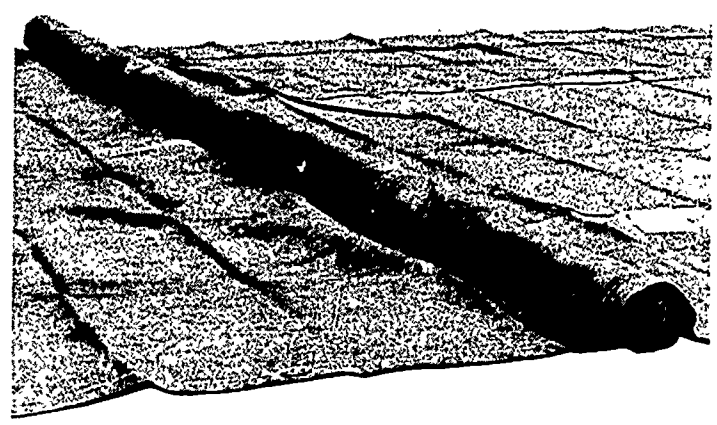
First cover folded



Second cover lapped



Ends rolled



Operation completed

Fig. C-5. Leakproof fold

Hanging Salvage Covers

Permanent fixtures on walls, as well as merchandise stored on shelves or racks, can also be protected with salvage covers. These may be hung in two ways: (1) by securing them to the wall with "S" hooks, salvage cord, or battens and nails; and (2) by draping them down from the tops of shelves and using articles of sufficient weight found on the premises to hold the covers in place.

In hanging salvage covers from walls, either a stepladder or a baby extension, an attic, or a roof ladder is used. One man climbs the ladder with the cover and, at the desired height, secures himself with a leg lock. He holds the bottom folds of the cover in the manner prescribed for the counter payoff. Then the following procedures are used (Fig. C-6):

1. Pay out the cover to the man on the floor.

2. Hang the cover, assisted by the man on the floor, using the most suitable method and equipment.

3. Lap the second cover, if more than one is used, over the first by at least 1 foot.

These procedures can also be used to cover a fireplace opening when extinguishing chimney fires. However, an old salvage cover should be used, and constant attention should be given it to prevent sparks from burning the cover.

Step 1

Step 2

Fig. C-6. Hanging salvage covers

Salvage Cover "S" Hooks

Salvage cover "S" hooks resemble meat hooks. In fact, they may be purchased from meat-handling equipment suppliers as well as made in fire department shops (Fig. C-7). "S" hooks should be correctly shaped and sturdy enough to be driven into any type of wall, including masonry. Fire department-made "S" hooks are usually constructed from 1/4" or 5/16" cold-rolled steel. The larger size is recommended because it is more durable. Stock is cut into 8-inch lengths, shaped on an anvil, sharpened on both ends, and hardened.

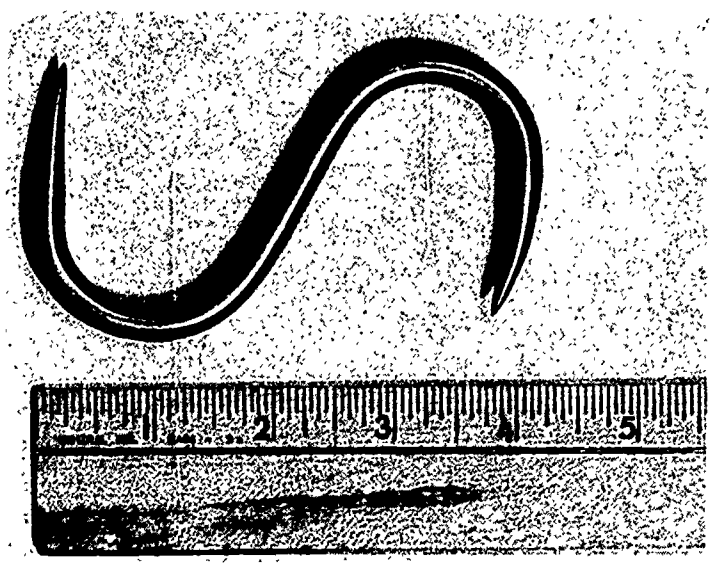


Fig. C-7. Salvage cover "S" hooks

C -- USE OF SALVAGE COVERS

TOPIC 2 -- IMPROVISING WITH SALVAGE COVERS

This topic, "Improvising with Salvage Covers," is planned to provide answers to the following questions:

- How are water and debris controlled by salvage covers during a fire?
- What improvisations are possible with salvage covers other than for controlling water and debris?
- What procedures are used in removing soiled covers from buildings?

Controlling and Removing Water

Salvage covers have a number of applications beyond spreading and hanging to protect furnishings, fixtures, and merchandise. For example, to control and remove water, covers are utilized in the construction of such devices as sumps, drains, and basins.

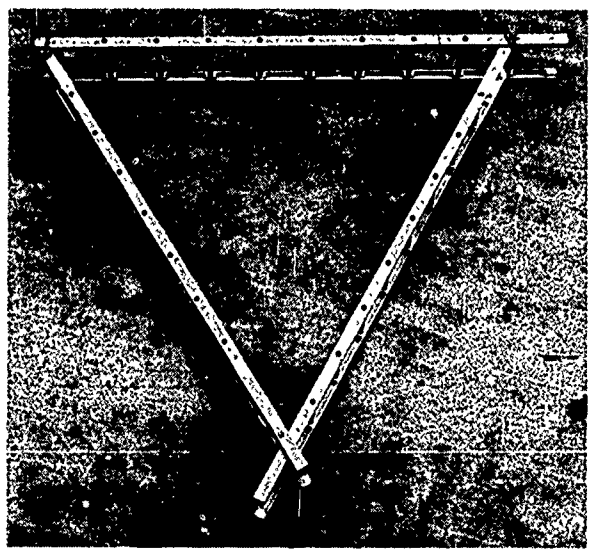
Improvised Sumps

The improvised sump is designed to serve a variety of purposes. It may be used to supply water to a pumper when threads are damaged or fittings are not available to make hydrant connections. The sump is an aid in supplying water to tankers in rural areas where discharge is limited and water has to be transported to the fire. The sump also can serve to trap and hold water in salvage operations.

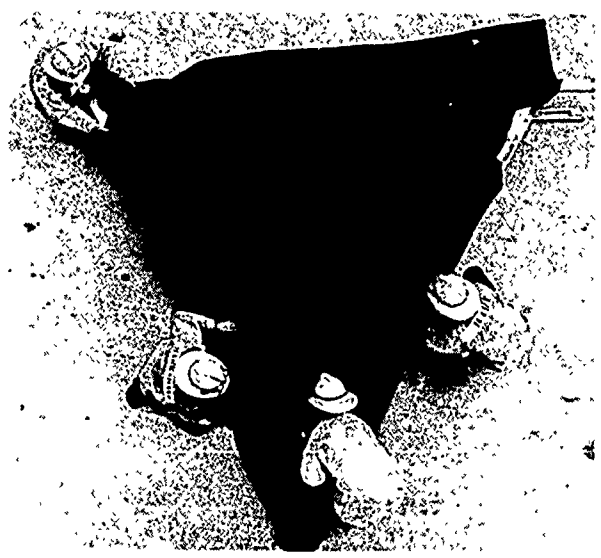
Materials required in improvising a sump are a salvage cover, ladders, and rope or cord. Three ladders may be used, although a better procedure is to select a short (20' to 24') extension ladder and a matching roof ladder so that sections will nest between the beams of other sections. A pike pole may be used if a roof ladder is not available. The following procedures are used in making the sump (Fig. C-8):

1. Place the ladders in a triangle, and lash the rungs and beams together tightly with rope or cord.

2. Center the salvage cover on this framework, position the cover on the inside so that it fits snugly against the framework and the ground, and tuck the excess underneath. Use two covers and a leakproof seal if the framework is too large for a single cover.



Step 1



Step 2

Fig. C-8. Improvised sump

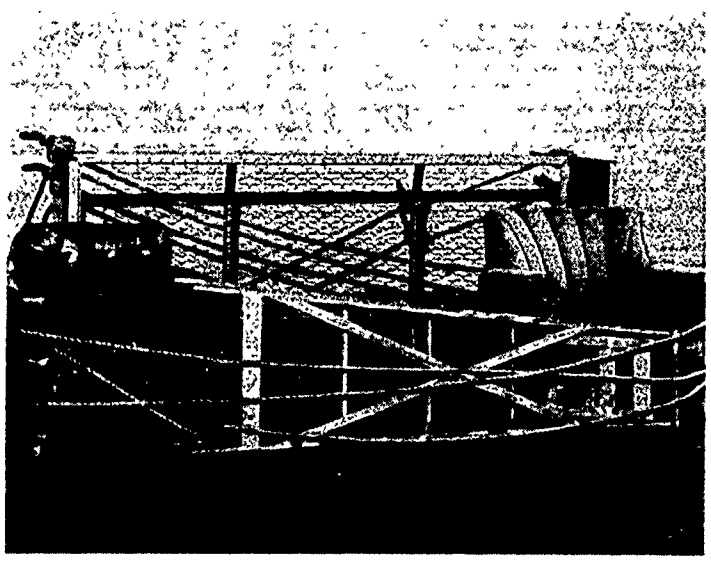
Catch Basins

Salvage operations sometimes require the hurried construction of devices to trap a considerable amount of water. The catch basin can be used for this purpose, although a suitable method for draining the basin must be considered. The fastest and usually the easiest way to improvise catch basins is to use the following procedures (Fig. C-9):

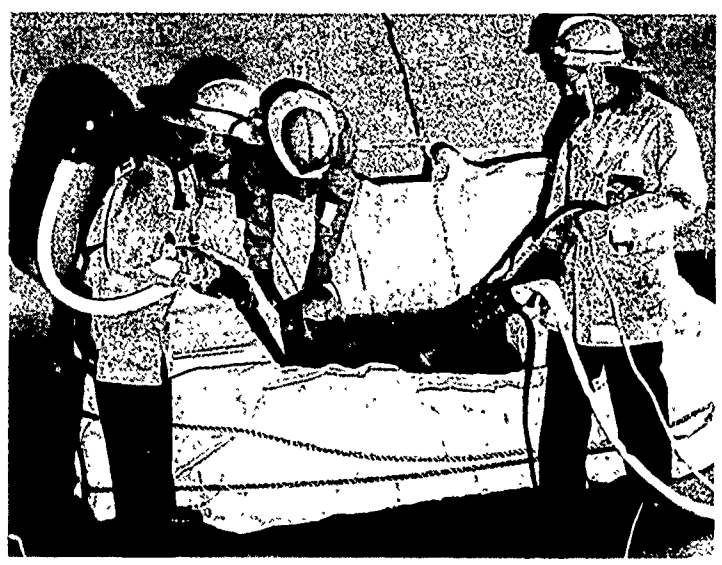
1. Obtain suitable materials from the building contents--chairs, tables, bedsprings, stepladders, or stock--to form a framework large enough to contain the anticipated amount of water.

2. Spread a salvage cover to form the basin, tuck the loose edges underneath, and lash the components together to prevent spreading.

3. Arrange for a suitable method of removing the water as the basin fills.



Basin framework



Removing water

Fig. C-9. Catch basin

Catchalls and Drip Tubs

Catchalls and drip tubs are made by rolling the edges of salvage covers to form rectangular containers to catch and hold either debris or water. The catchall is the larger of the two. It is recommended for catching debris during fire fighting and overhaul operations and can be placed near walls or under ceilings or roofs where operations are being conducted. A drip tub is somewhat smaller and is recommended for catching and holding water because its corners are more secure than those of a catchall. A drip tub made with a standard salvage cover (12' x 18') will hold approximately 50 to 100 gallons of water, which may be removed with a water vacuum, a submersible pump, or a scoop shovel. Where space within a structure is limited, catchalls and drip tubs may be constructed outside and carried to the desired location.

The initial procedures in making a catchall and a drip tub are similar. Covers are spread on a flat surface, and the sides are rolled in about 18 inches. Then the following steps are taken:

1. With catchalls, roll the ends, and tuck the corners in as shown in Fig. C-10.

2. With drip tubs, make a miter fold at each corner, and place the ends of the rolled sides at the center of the cover. Then make two or three folds in the ends, and tuck them under the rolled edges to make an envelope fold (Fig. C-11).

Fig. C-10. Catchall fold

Fig. C-11. Drip tub fold

Stairway Drains

Large amounts of water can be removed from the upper floors of a building by diverting the water down a stairway. When water may damage stairway treads, risers, or covering or the area beneath the stairway, a drain made of salvage covers should be used. If a stairway has a handrail, two men use the following procedures to make the drain (Fig. C-12):

1. One man carries a cover to the top of the stairway, leaves it on the landing, and returns halfway down the stairs.

2. The second man, at the foot of the stairs, makes a one-man throw of a second cover to the top man.

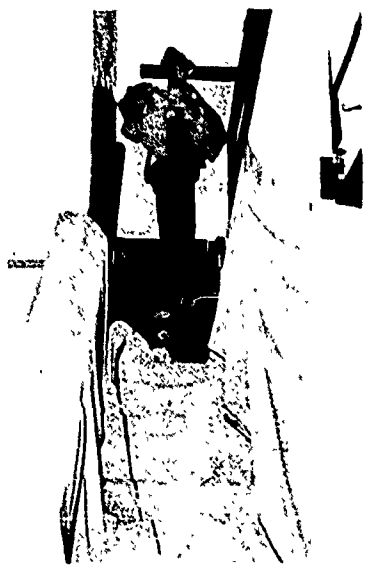
3. One side of the second cover is draped over the handrail, and the other side is hung or tied to the opposite handrail with "S" hooks or twine.

4. The men advance up the stairway and repeat this operation with the top cover, which should overlap the lower cover at least two feet.

5. So that water will not run under the improvised drain, a seal is made by placing sawdust under the cover on the two top steps, then wedging a lath over the cover against the top riser.

If the stairway does not have a handrail, the covers may be rolled as shown in Fig. C-13.

One-man throw



First cover draped

Second cover lapped

Fig. C-12. Stairway drain

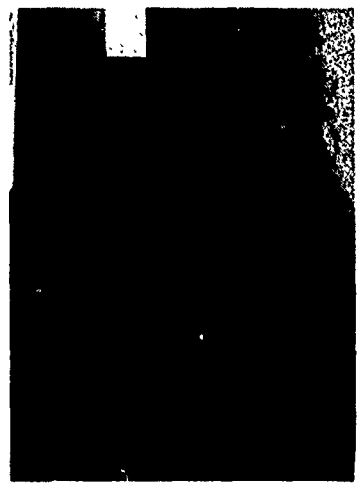


Fig. C-13.

Side-rolled drain

Window Drains and Chutes

One of the objectives of salvage work is to remove excess water to the exterior of a structure. Sometimes this can be accomplished by the use of sewer pipes, catch basins or drip tubs, stairway drains, or other means. But if none of these methods is practical during a particular instance, the most effective method then involves cutting holes in upper floors and diverting water through window drains or chutes.

Cutting holes in floors. Before a hole is cut in a floor, merchandise or furnishings should be covered and window drains or chutes constructed in the area below. The hole should be placed so that the water will flow onto a chute that extends through an exterior window or door. The hole in the ceiling above the chute should be cut first, and it should be somewhat larger than the hole in the floor above so that water will not accumulate between the floor and the ceiling (Fig. C-14).

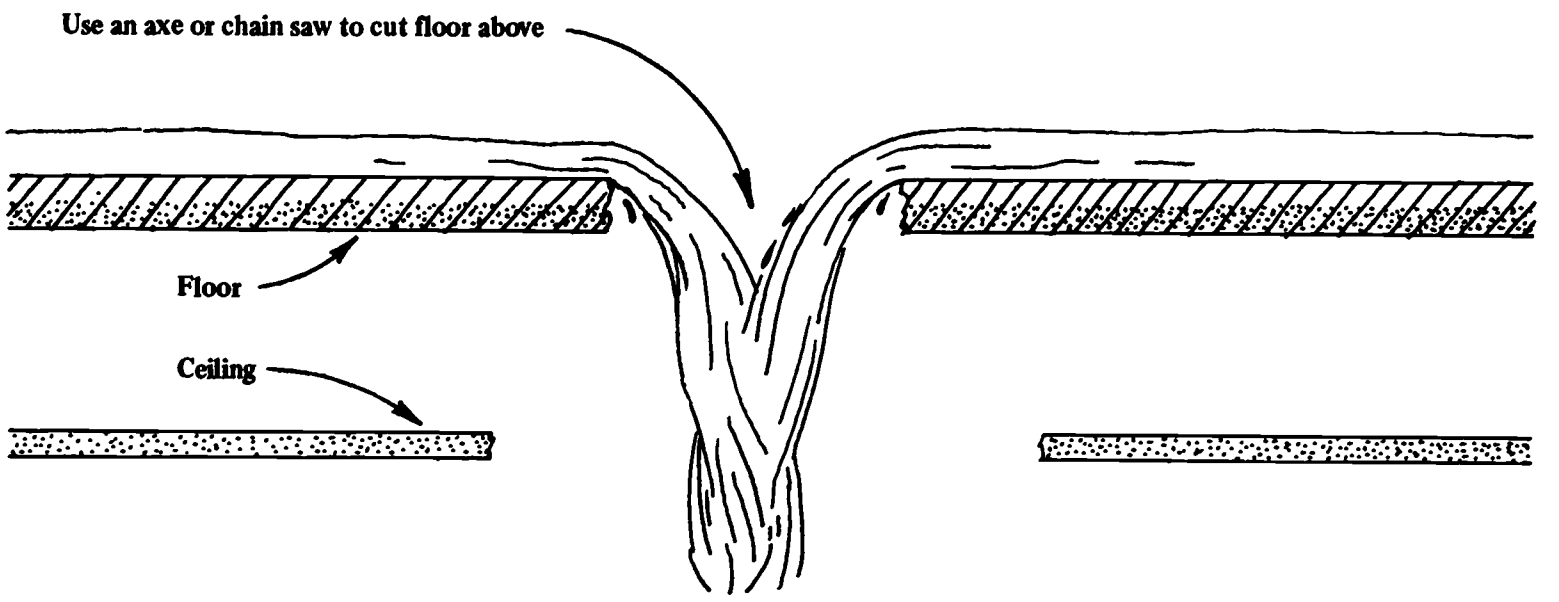
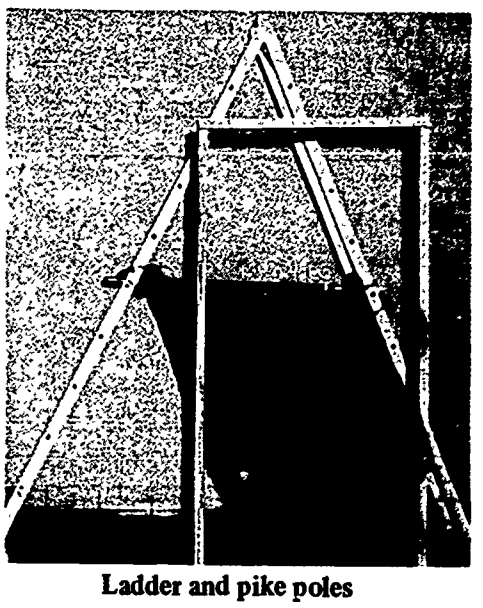
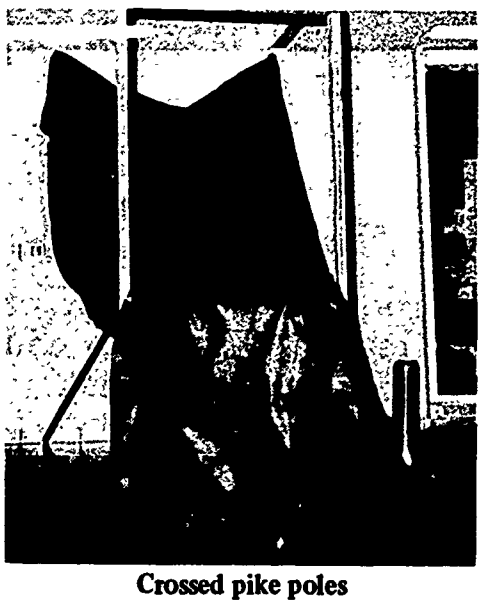


Fig. C-14. Draining excess water

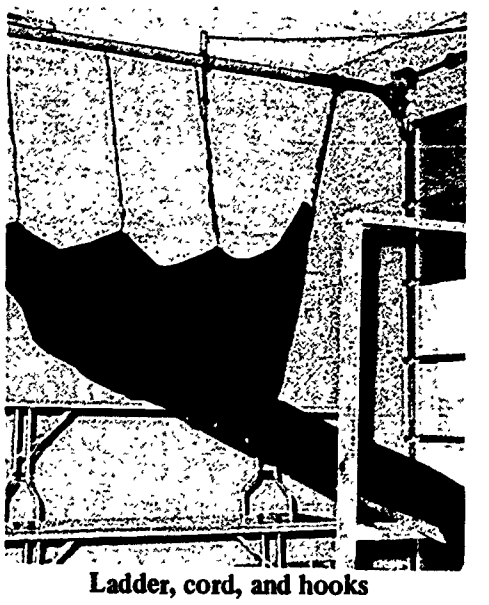
Constructing Window Drains. The salvage cover is the basic component of the drain or chute and can be formed with pike poles, ladders, salvage cord and "S" hooks, or a combination of these. The ladder and pike poles, or even material found on the premises, can be used to position the chute and ensure correct drainage. Step-by-step procedures for constructing various types of drains and chutes are not provided in this manual; salvage work requires ingenuity (Fig. C-15).



Ladder and pike poles



Crossed pike poles



Ladder, cord, and hooks

Fig. C-15. Window drains and chutes

Controlling Smoke and Debris

Salvage covers can be used effectively as smoke curtains during ventilation operations, as debris curtains during chimney fires, and as debris carriers.

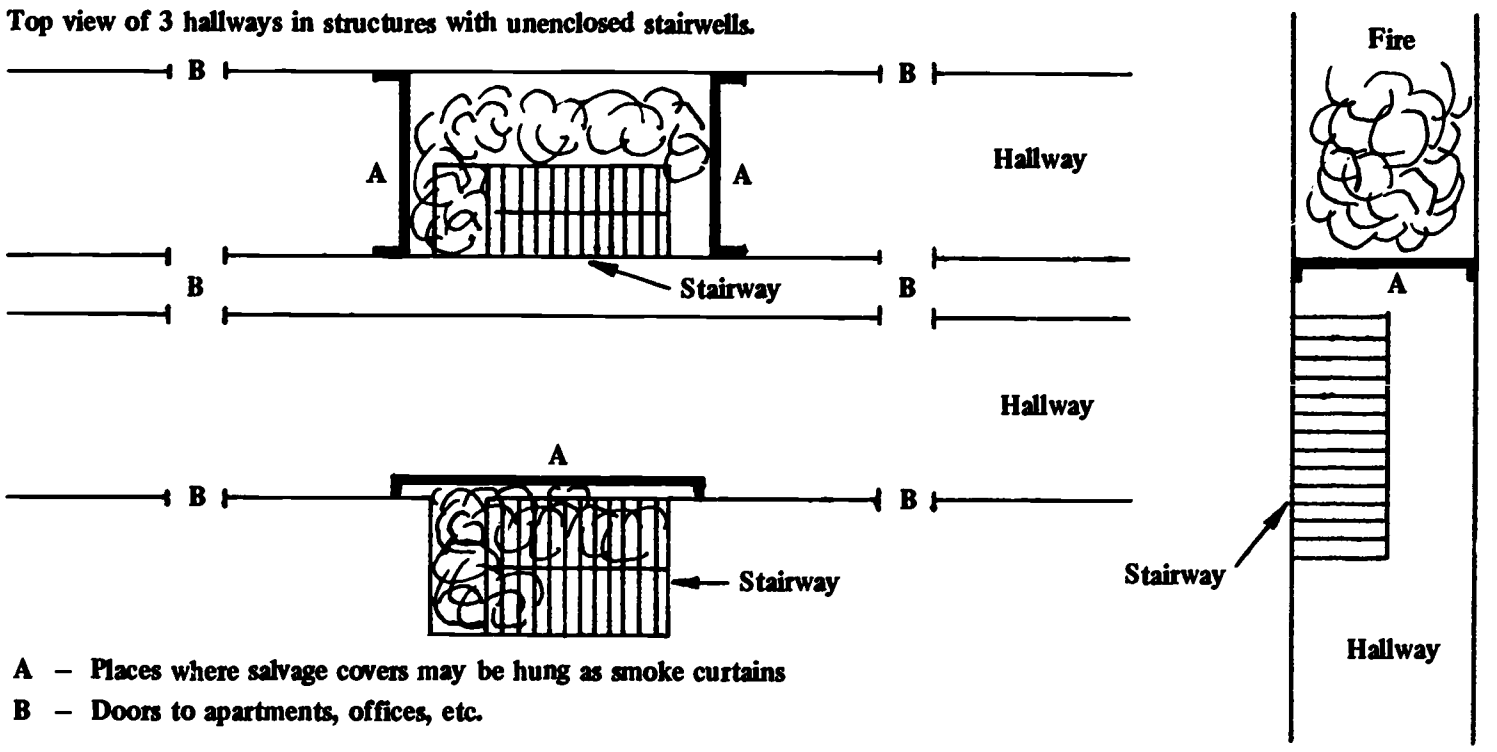


Fig. C-16. Smoke curtains

Smoke Curtains

Smoke can be controlled in most open stairways by using one or two salvage covers as curtains at each landing. This method makes smoke removal possible through windows or other vents, or through openings made above the stairway, without allowing smoke to enter other floor levels. Curtains may also be used to prevent smoke from entering exit stairways or to block smoke from passing into uninvolved sections of the building. All of the basic principles of ventilation should apply when smoke curtains are used (Fig. C-16).

Protection During Chimney Fires

At times the interior of a room must be protected from the ashes and debris found in a fireplace. Usually this will occur when men are controlling a chimney fire from the roof or chimney top.

One method of chimney fire control requiring the use of a canvas to cover the fireplace opening involves reducing the flames in the fireplace with a minimum of water spray and then applying a water spray down from the top of the chimney. After the flames in the fireplace have been extinguished, but before water is applied from the top, a canvas should be hung or supported over the fireplace opening to prevent ashes from drifting into the room. Many fire departments carry a "chimney-fire canvas," 6' to 8' square, for this purpose.

When a mantelpiece is present, the canvas can be hung in front of the fireplace by placing weights such as books on the part of the canvas laid on the mantel. In the absence of a mantel, the canvas will have to be held or propped against the face of the fireplace.

Other Improvisations

A salvage cover can be used as an improvised stretcher, to remove a smoldering mattress, and as a floor runner.

Improvising a Stretcher

An improvised stretcher affords a method of transporting injury victims when other means are not available. It serves well to support back, arm, or leg injuries, and the victim can be lowered or raised without difficulty. The procedures for improvising the stretcher are as follows (Fig. C-17):

1. Place one salvage cover, doubled crosswise, on the floor or ground. Lay a roof ladder alongside the cover, and extend the hooks; tie a pulling rope to the ladder, if necessary, with a bowline. Roll a second cover lengthwise, and double it between the beams of the ladder.

2. Place the victim on the ladder with his head resting on the fold of the cover, and secure him with triangular bandages. Be careful to immobilize any back, arm, or leg injuries. Center the ladder and the victim on the flat cover so that the victim's shoulders are 1 foot below the top edge of the cover, and fold the cover accordion fashion over the victim.

3. Lash the cover, victim, and ladder with rope. So that the victim will be supported when vertical, start just below his feet with an eye and loop or a running bowline, and place half hitches at his knees, wrists, and shoulders.

4. Attach a guide rope to the bottom of the ladder if the victim is to be lowered from a height such as a building or raised from a depth such as a pit.

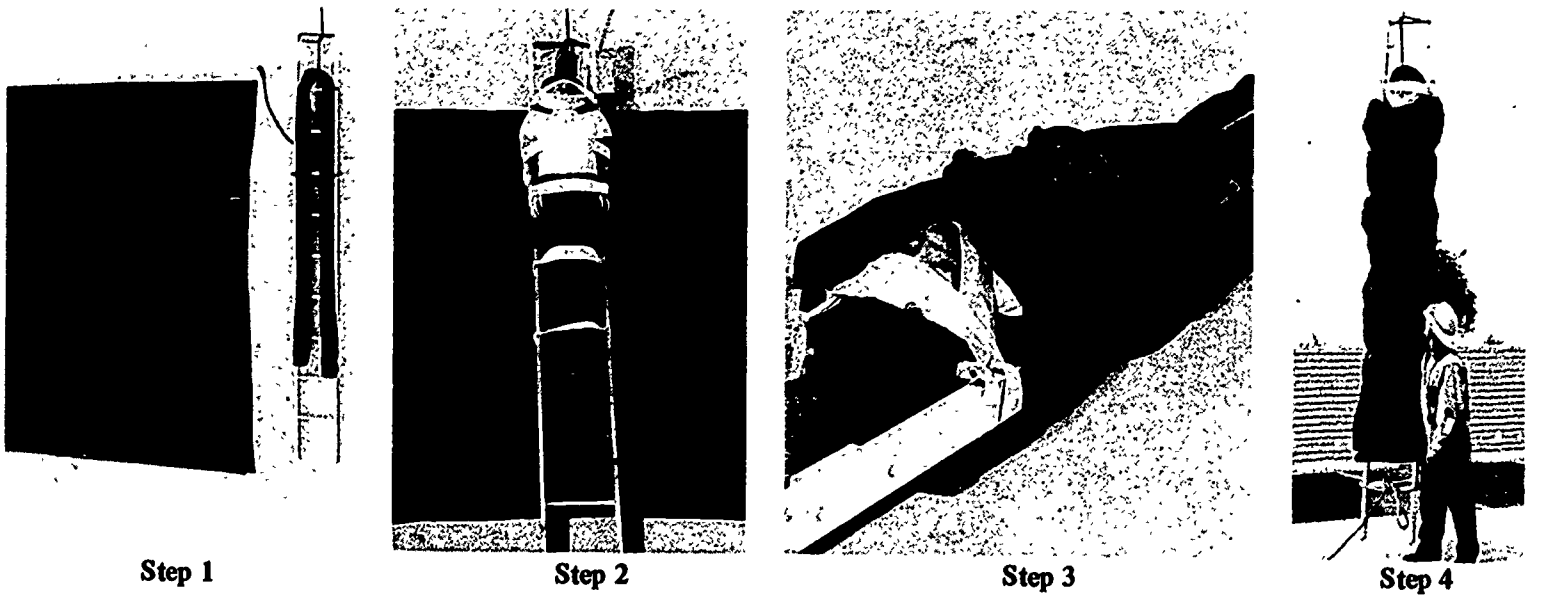


Fig. C-17. Improvised stretcher

Removing a Smoldering Mattress

A burning mattress can cause considerable unnecessary damage from heat, smoke, or excess water if complete extinguishment is attempted inside a building. Much of this damage can be prevented, after flames have been reduced, by removing the mattress to the outside with the help of a "donut-rolled" salvage cover. The procedures are as follows (Fig. C-18):

1. Move the bed to the center of the room, roll out the cover underneath, and moisten the cover with a partially opened nozzle.

2. Disassemble the bed and remove the springs from under the mattress unless the springs are box type and also burning or smoldering.

3. Lower the mattress onto the moistened salvage cover, wrap the mattress, and remove it to the outside for complete extinguishment. (An old cover should be used for this operation, since some scorching and burning may result.)

Protecting Floors and Floor Coverings

In fire premises, areas not involved with fire, smoke, or water can be protected by the use of salvage covers as floor runners. The placing of floor runners by the first men entering a structure will protect floors and floor coverings from the mud, water, and debris usually tracked in by subsequent firefighters. The procedure also helps to develop good public relations (Fig. C-19).

Floor runners are usually made from old salvage covers, although canvas can be bought for this purpose. Runners should be 3' to 6' wide and 12' to 18' long. They should be rolled and tied with a quick-release knot and carried in a convenient location on the apparatus.

Step 1

Step 2

Step 3

Fig. C-18. Removing a smoldering mattress

Rolling the runner

Positioning the runner

Fig. C-19. Floor runner

When floor runners are removed after operations are completed, care must be taken that debris is not dropped. The runners should be folded lengthwise about 8" or 10" in from the sides and then loose folded or rolled from each end toward the middle.

Removing Soiled Covers

After a fire, wet and soiled salvage covers must be removed from the objects they protected, taken to the outside, and prepared for storage on apparatus.

Removing Catchalls and Drip Tubs

As much debris as possible should be removed from catchalls and drip tubs, placed in rubbish carriers or waste cans, and carried out of the building. Excess water may be removed with a water vacuum, submersible pump, or scoop shovel. The procedures for removing the improvised catchalls and drip tubs are as follows:

1. Fold the ends and one side of the cover in about 2 feet.

2. Fold the other side to the opposite folded edge so that remaining debris and water will be trapped within the cover, and remove the cover to the outside.

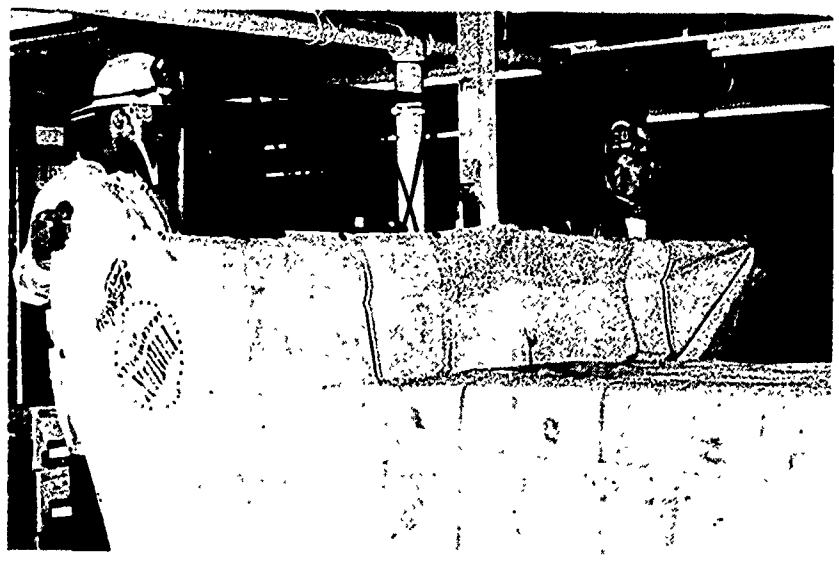
Removing Covers from Objects

When a salvage cover is picked up after a fire, small amounts of debris and water usually remain on the cover. This debris and water should be contained within the cover while it is being carried outside so that parts of the building unaffected by the fire will not be soiled. The procedure is accomplished by two men as follows (Fig. C-20):

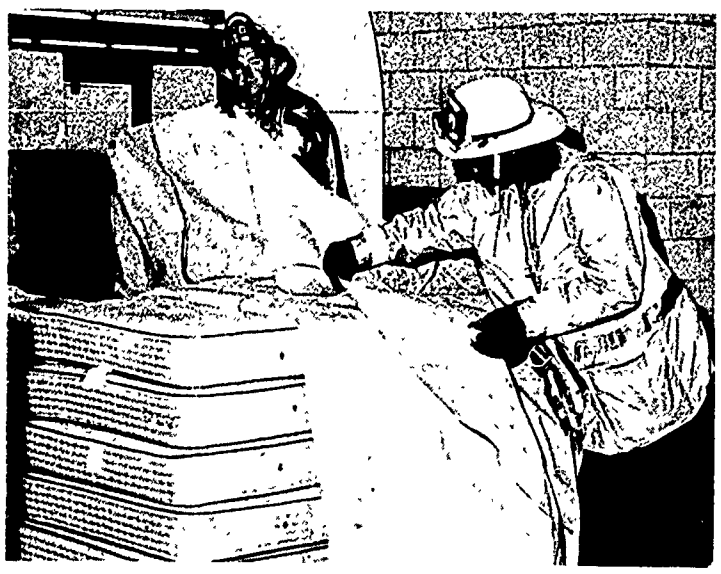
1. Each man grasps a corner at one end of the cover and lifts it clear of the object covered.

2. The men carry this end of the cover to the opposite end, taking care to contain the debris within the cover. The ends of the cover are now lifted and carried over to the fold.

3. The sides are then folded to make a compact bundle, which is placed on the shoulder of one man and carried to the outside.



Step 1



Step 2

Step 3

Fig. C-20. Removing soiled covers

Making the Loose Fold and Roll

After wet and soiled salvage covers are removed from a building, a method known as the loose fold and roll is used to dispose of excess water, debris, and sharp or solid objects that might damage the cover. The method, which also provides a convenient package for easy handling, is accomplished by two men as follows (Fig. C-21):

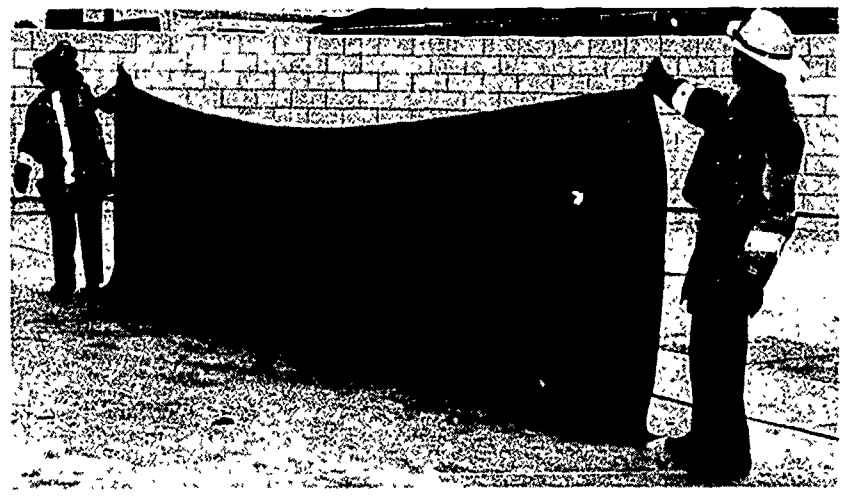
1. In an open and preferably clean area, the men pick up the cover by the center grommets (which should be marked) and walk backward.

2. The cover is extended with the folded edge up and shaken vigorously to dislodge the foreign matter.

3. The cover is then laid flat on a clean surface, folded lengthwise twice, and one end is folded to within 6 feet of the opposite end.

4. The cover is then rolled loosely from the fold to the open edges.

Step 1



Step 2

Step 3

Step 4

Fig. C-21. Loose fold and roll

D Protecting Property and Removing Excess Water

TOPIC 1 -- PROTECTING BUILDINGS AND CONTENTS

This topic, "Protecting Buildings and Contents," is planned to provide answers to the following questions:

- What is the importance of protecting business records?
- How does water affect flooring and floor coverings?
- What measures are recommended for the protection of buildings and their contents?
- How are room furnishings grouped and covered for maximum protection?

The Major Objective

The protection of buildings and their contents is the major objective of salvage work, and most salvage operations are performed toward that end. Because of the high values usually involved, the necessity of performing these operations rapidly and efficiently cannot be overemphasized.

Records

Where fire involves a business or a manufacturing concern, a sincere effort must be made to protect the records of the occupant. The important point is to save insurance policies, stocks and bonds, orders, inventories, and other records of business transactions. American Insurance Association reports show that only a small percent of businesses are able to reopen after their records have been destroyed by fire; therefore, the importance of this phase of salvage work must be stressed repeatedly in training sessions.

Floors and Walls

When water collects in a building, most of it will obviously be on the floor. This fact alone indicates the need for a consideration of the effects of water accumulation on floors or floor coverings. Although damage to the finish of wood floors is a concern, a greater concern is that wood floors react to severe or prolonged dampness by warping, swelling, and buckling. Various types of composition and tile coverings will often separate from the floor when water seeps under the coverings. Other damage to floors and floor coverings can result from burning particles dropping from ceilings and walls and from firefighters tracking debris across floors.

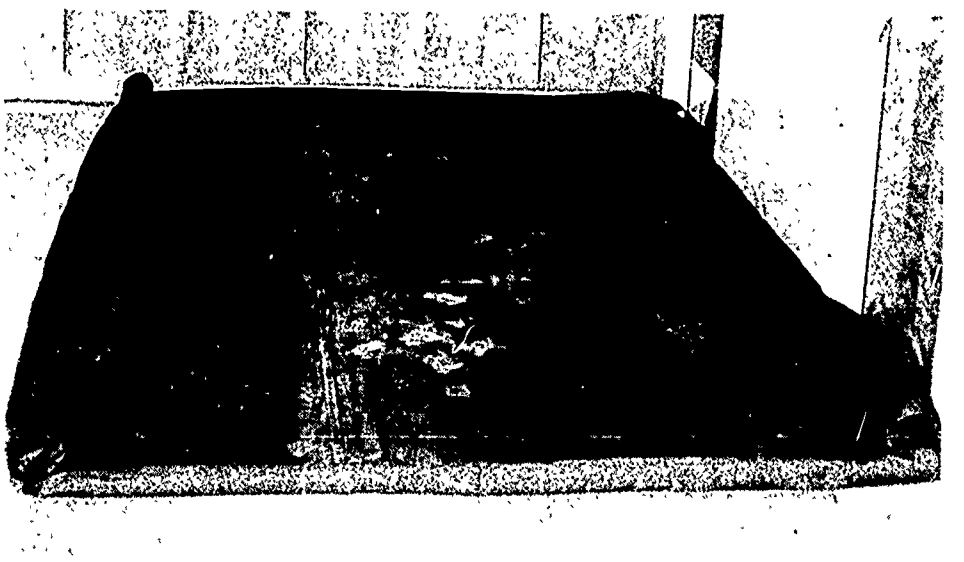


Fig. D-1. "Bagging" a floor

All of these conditions can be minimized by taking immediate protective measures. One is to cover and "bag" the floors to collect runoff water (Fig. D-1). Another is to use floor runners to protect against the foreign material carried on the soles of shoes. When water does collect on floors, it should be removed as quickly as possible with squeegees, brooms, mops, or water vacuums.

Carpeting absorbs water quickly. When it is saturated, carpeting can sometimes be "dewatered" and dried in place with special equipment designed for that purpose. Unless the carpeting can be dried after dewatering, it should be taken up if it and the wood floor are to be salvaged. Professional maintenance and salvage firms in some cities can be called on a 24-hour basis for the specialized work of dewatering and drying carpets.

Although water does not collect on walls as it does on floors, protection for walls, wall coverings, and wall fixtures is sometimes necessary. Water collecting above the ceiling will eventually break through to the room below unless controlled by (1) bagging; (2) laying sawdust above the ceiling; or (3) piercing the ceiling. This latter procedure also requires the collecting or channeling of the resultant flow to prevent damage to floors.

Walls and wall coverings can be protected from water, heat, and smoke damage by hanging salvage covers with "S" hooks or salvage cord and nails. Covers must also be hung when wall fixtures and stock cannot be moved away from the wall enough to allow covers to be drawn over them.

Care should be taken that water does not run down the wall in back of the fixture and damage stock on the shelves. Where a salvage cover is used to divert water running down a wall, the top of the cover must be sealed. One sealing method is to fasten the top of a 9-inch strip of 30-pound roofing felt tightly to the wall, about 4 inches above the cover, with battens and nails. The bottom edge of the felt then overlaps the top of the salvage cover.

Residential Furnishings

Contents of residences can be protected by one or two men well trained in salvage work. This operation begins in the room directly under or adjacent to the fire area and involves grouping the contents so that a minimum number of covers will be required. The salvage personnel should observe the following rules:

1. Do not overlook the contents of closets.

2. Check the tops of bureaus, dressers, and tables, and place small valuables found on these pieces in drawers for safekeeping.

3. Use the largest and heaviest pieces of furniture as the base for the grouping. Before other articles are piled on them, protect fabric coverings and wood finishes with rugs, blankets, cushions, or pillows.

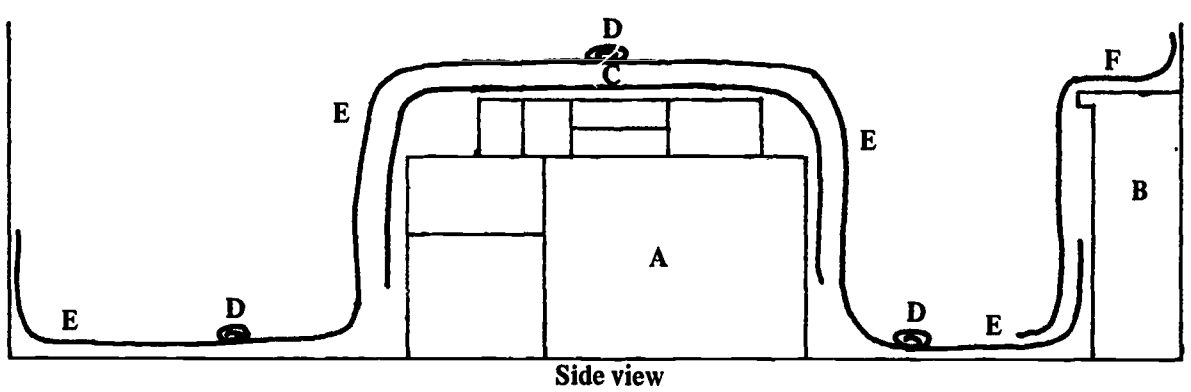
4. Do not build the pile too close to a wall where spreading covers will be difficult.

5. Roll up any rugs, if possible, and place them on top of the grouping. If a rug cannot be removed, try to roll it from both ends toward the pile.

6. Do not overlook paintings or wall tapestries, which may be placed on the pile after the larger and heavier pieces of furniture have been grouped.

7. After salvage covers have been placed, tuck the edges around the base of the grouping and the rolled-up rug.

Where the floor or floor covering should be protected in addition to the grouped furnishings, covers can be placed in the order shown in Fig. D-2.



Side view

A – Grouped furnishings
B – Bookcases
C – First salvage cover thrown over merchandise
D – Salvage seals
E – Salvage covers used to bag floor
F – Last salvage cover thrown over bookcases

Fig. D-2. Protecting grouped furnishings

Merchandise and Other Contents

Salvage work in mercantile occupancies can require many men and much salvage equipment. A great deal of water may collect because of the large amounts being used, and the quantity of the contents and the area to be protected can be vast. Good, rapid salvage work under these conditions is necessary if all the work is to be completed.

In addition to covering merchandise and other building contents, firefighters must consider water accumulation. Ideally, stock should be on pallets or skids with a clearance of about 4 inches from the floor. If the stock is piled on the floor, or if the clearance is insufficient, sawdust dikes can be constructed. Action must be taken immediately to prevent excessive water accumulation. Methods of water removal are described in Topic D-2.

Machinery

Some machinery is highly susceptible to damage by water, heat, and smoke. When a representative of the tenant is present, he may be able to tell the salvage men which machinery should receive protection priority. Prefire planning inspections provide an excellent opportunity for firemen to note this and other points on the storage of stock, floor drain locations, and the like.

As with stored stock, sawdust may be used to build dikes around machinery and motors. Where machinery may be damaged by smoke or heat, ventilating procedures must be carried out as quickly as possible. Also, this equipment must be covered.

If machinery becomes wet during fire fighting, the responsibility of the salvage men is to see that it is dried and cared for. Sometimes this will be done by the fire department, sometimes by the tenant, and sometimes as a joint effort. As in all salvage work, the responsibility of the fire department is to leave the premises after a fire in as clean a condition as possible.

D -- PROTECTING PROPERTY AND REMOVING EXCESS WATER

TOPIC 2 -- REMOVING EXCESS WATER

This topic, "Removing Excess Water," is planned to provide answers to the following questions:

- Why is the concern over excess water important in salvage operations?
- How is excess water collected and channeled from upper floors?
- How is excess water pumped and drained from basements?

The Concern Over Water

After the protection of building contents, the concern over excess water is normally the next most important salvage function. Not only is water a concern because of its weight and its natural tendency to work downward in a building, but it is a concern as it accumulates or is absorbed in areas that are without adequate drainage. This accumulation of water can damage stored goods, machinery, and utilities as well as the floor.

A basic premise of fire fighting is that all personnel should be aware of the additional weight placed in a building by water. An idealistic hope is that all water applied on a fire will be converted to steam; on large fires this is not the case. Where none of the water is being vaporized because it is not being applied on or in an area of sufficient heat, and the application is from a 240-gpm nozzle, simple mathematics indicates that just short of a ton of water per minute is being added to the building. Obviously, continued application of a number of streams into a building, with most of the water remaining in liquid form, will rapidly increase the weight.

In most buildings accumulated water will work its way to the lowest level, which may be one of the basements or the ground floor. Water in a basement could well endanger machinery or utilities as well as stored merchandise and heating, ventilating, and elevator equipment.

Methods of Removal

Methods of removing water from basements or shafts involve either draining or pumping. Drains in basements are often clogged or covered with stored merchandise or debris. If drains are controlled by valves or if the basement has a switch for manually activating a pump, these should be indicated by signs suspended from the ceiling. The drains should also be indicated so that they may be cleaned as they become clogged.

Fire department pumping equipment -- either eductors, portable pumps, or apparatus pumps -- are frequently used to dewater basements. However, eductors or portable pumps should be used whenever possible so that dirty water will not cause excessive wear in first-line apparatus pumps.

Excess water on upper floors must be collected and removed in a way that will do as little damage as possible. Here the ability, knowledge, and ingenuity of salvage men may be taxed to the utmost because of the many different conditions found in this area of salvage work. A complete knowledge of all tools and equipment and the techniques of using them is essential. The basic equipment available includes salvage covers, squeegees, brooms, mops, sawdust, water vacuums, and portable pumps.

When feasible, drip tubs or catchalls should be constructed to contain the water. However, if the amount of water is large or the flow is continuous, the water will have to be channeled out of the building with drains or dikes. Drains may be constructed of salvage covers and a framework either of ladders, stairways, or contents of the building. Dikes may be made of covers and sawdust. Sawdust is also used to absorb standing water that cannot be channeled to a drain.

Another method of draining water is through the soil pipes installed in a building. This can be done either by removing a toilet bowl or a cleanout plug, or by breaking a vertical soil pipe at floor level. Toilet bowls can easily be lifted after using a crescent wrench or an open-end or box-end wrench to remove the nuts and wood bolts holding the base to the floor. By rocking the bowl after the hold-down nuts and bolts have been removed, the wax or putty seal can be broken and the bowl lifted out of place, revealing the flush soil-pipe opening.

A wrench will be needed to remove cleanout plugs in soil pipes (Fig. D-3). Tapping the edge of the bell may help if the plugs are hard to start. If these methods fail, a soil pipe extending from the floor can be broken off at floor level to drain the water (Fig. D-4). When any of these procedures is followed, screens or drain guards should be used to prevent large pieces of debris from entering the drain pipes.

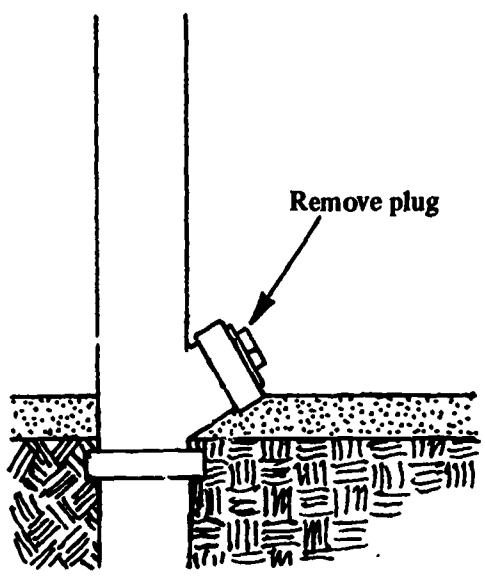


Fig. D-3.
Soil pipe cleanout

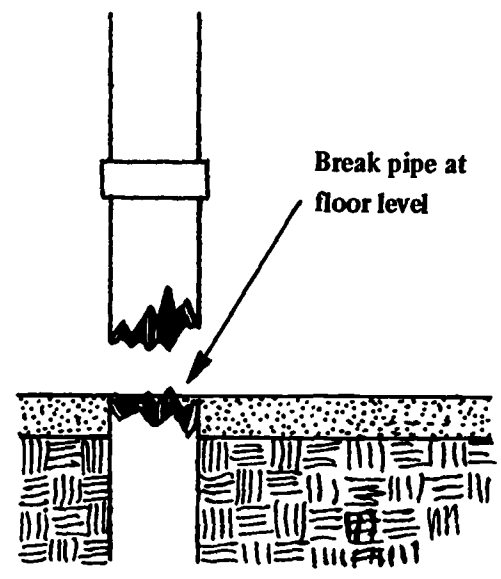


Fig. D-4.
Breaking a pipe

D -- PROTECTING PROPERTY AND REMOVING EXCESS WATER

TOPIC 3 -- TOOLS AND EQUIPMENT

This topic, "Tools and Equipment," is planned to provide answers to the following questions:

- How is sawdust used to control excess water?
- What equipment is used to remove large volumes of water from basements?
- What equipment is used extensively to remove water from floors and rugs?
- How do siphons differ from pumps?

Sweeping and Drying

Tools and equipment used to remove excess water from buildings include brooms and squeegees; buckets, mops, and shovels; and sawdust.

Brooms and Squeegees

Brooms and squeegees are used to sweep water to doorways, scuppers, stairs, or other points of drainage. Care must be taken when sweeping water to prevent damage to buildings and contents. Where necessary, objects that may be damaged should be protected with salvage covers or removed from the area of operation. Brooms are also used to sweep debris during overhaul operations.

Buckets, Mops, and Shovels

Buckets are used to catch water dripping from upper floors and ceilings, to bail catch basins, and to carry water and debris from buildings. Some departments use standard custodian mop buckets with attached wringers to facilitate mopping operations. Mops are used to absorb water and to clean and dry floors, and scoop shovels are used to pick up water, sawdust, and debris.

Sawdust

Sawdust is used to absorb water and to form dams and dikes. Some departments purchase sawdust in paper bags and carry a number of these on ladder and salvage trucks. The bags hold 2 cubic feet of sawdust, are easy to handle,

and do not leak unless they are punctured. Five cubic feet of Grade No. 2 dustless sawdust will absorb about 15 gallons of water. Water that has collected on floors or on the upper side of ceilings may be removed by spreading sawdust, allowing it to absorb the water, and then removing the water-laden sawdust with shovels, brooms, and buckets. Sawdust dams and dikes may be used to control flowing water or to direct it to a drainage point. Sawdust is also used to form seals between salvage covers and floors.

Grade No. 2 dustless sawdust will hold water for about 10 to 15 minutes. Therefore, sawdust should be removed before it begins to release the absorbed water. Sawdust dams and dikes should be checked frequently for leaks.

Dewatering

Equipment for removing large volumes of water includes water siphons, submersible pumps, and portable pumps. Water vacuums are used to remove small quantities of water from floors and rugs.

Siphons and Pumps

Siphons and pumps, both submersible and portable, are used to dewater basements, elevator shafts, and similar below-ground areas without diverting the dirty water through fire apparatus pumps.

Siphons. Water siphons are available in sizes from 100 to 300 gpm (Fig. D-5). They operate on the principle that for every gallon of water pumped into them, a gallon of water is picked up and therefore two gallons are pumped out. This means that either a 1-1/2" or 2-1/2" hose feeds the siphon from a pump or hydrant, and a 2-1/2" or 4" hose removes the accumulated water.

Submersible pumps. Submersible pumps, available in 3/4- and 1-horsepower sizes, remove from 90 to 120 gpm where the water must be raised 10 feet, and they remove correspondingly reduced amounts to 50 gpm for a 30-foot lift (Fig. D-6). These pumps weigh about 20 pounds, are electrically operated from a 1,500-watt minimum power source, are self-priming, and will remove water to within 1/4" of the floor on which they rest. A strainer that is part of the pump shell prevents drawing debris into the pump mechanism. The discharge outlet is normally 1-1/2" in diameter, so to use a 2-1/2" discharge hose to decrease friction loss, a 1-1/2" to 2-1/2" increaser must be installed.

Portable pumps. Portable gasoline-fueled pumps are useful for removing accumulated water where the pump can be placed within 25 feet of the water to be moved. The pump shown in Fig. D-7 weighs about 50 pounds and pumps 90 gpm when the suction lift is 5 feet, with reduced gpm for greater suction lifts.

Water Vacuums

For removing water from floors and carpeting, an electrically powered device called a water vacuum is carried and operated by a fireman. The receiving tank, with a capacity of almost 5 gallons, is worn as a backpack by the operator, who uses a wand similar to that attached to a tank-type vacuum cleaner to pick up the water (Fig. D-8). The contents of the receiving tank can be emptied into a toilet bowl or out a window without the tank being removed from the operator's back.

Water vacuums are also used extensively in salvage operations to pick up water from drip tubs, catch basins, floor depressions, or the upper side of ceilings. The vacuums will pick up small particles of debris as well as water from floors, both bare and carpeted. Water vacuums are also capable of drying carpets that have not been completely soaked.

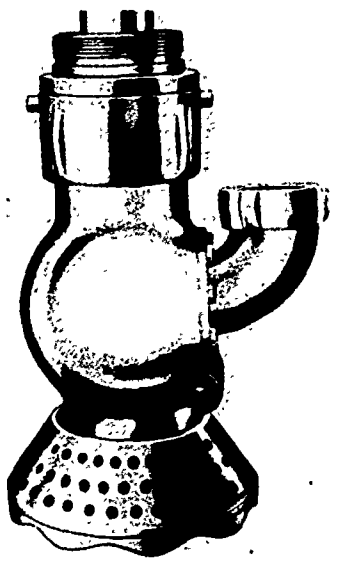


Fig. D-5. Water siphon

Fig. D-6. Submersible pump

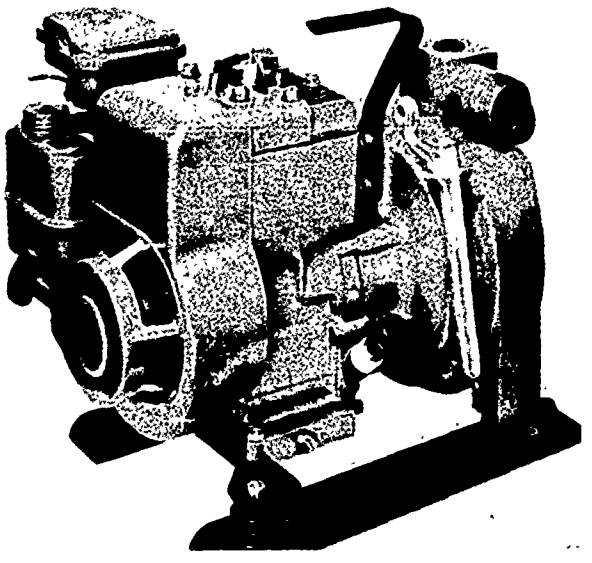


Fig. D-7. Portable pump

Fig. D-8. Water vacuum

E Salvage Operations in Sprinklered Risks

TOPIC 1 -- PREFIRE PLANNING

This topic, "Prefire Planning," is planned to provide answers to the following questions:

- How does prefire planning in sprinklered risks help salvage operations?
- What information must be gathered in a prefire planning survey?
- What relationship does the storing of stock in a building have with the location of sprinkler heads?
- What are the disadvantages of piling stock directly on the floor?

The Necessity for Prefire Planning

For fire departments to fulfill their responsibility of reducing fire losses to an absolute minimum, firemen must have a complete knowledge of sprinkler systems, how to use them to control fire, and how to prevent unnecessary water damage during fires in sprinklered buildings. This knowledge can only be developed through a sound prefire planning program and through constant training. Prefire planning is necessary to determine the location of sprinklered buildings within the district; the types of sprinkler systems in use; and the location of valves, drains, scuppers, sump pumps, and other accessories for controlling water. Constant training will help firefighters develop an ability to utilize the equipment necessary to deal with salvage problems.

When a prefire planning survey is conducted in a sprinklered risk, certain salvage information must be gathered. Basically, this information is included in the answers to three questions: What is the type of system? Where are the control and drain valves? What can be done to remove water from the building? A simple checklist such as the following could be developed to determine the answers:

1. Type of system
2. Location of main risers
3. Location and type of main riser valves
4. Location of post indicator and floor or sectional control valves
5. Location of main sprinkler-system drain valves

6. Accessibility of sprinkler heads

7. Location and condition of floor drains

8. Location and condition of sump pumps and methods of activating them

9. Location of auxiliary means of dewatering the structure

A prefire planning survey may also be used to teach occupants how to prevent excessive water damage. For example, where stocks are piled too close to sprinkler heads, the possibility exists that a number of heads may fuse during a fire that could easily be controlled by only one head. Stocks should be piled to provide a minimum of 18 inches of clear area below sprinkler heads. Control valves and drain valves should be marked and must be easily accessible. Floor drains must not be covered with stock, and sump pumps should be tested periodically to ensure that they are in working order. Any stock stored directly on floors should be on pallets or skids. An example of the importance of some of these factors can be seen in the following case study.

A Case Study

During the Christmas season a fire occurred in the basement stockroom of a large store. Because of the season, stocks were piled practically to the ceiling. The fire, which should have been controlled by one or two heads, therefore caused the fusing of six heads. Smoke made the seat of the fire difficult to locate, and approximately 20 minutes elapsed from the time of the alarm until the fire department could determine that the fire was under control and that the system could be shut off. At a conservative estimate, 6,000 gallons of water flowed from the six open heads.

Again because of the season, a great deal of stock was piled directly on the floor. Approximately 60 men worked for more than four hours to remove all of the water from the basement. Sump pumps, which were located in elevator wells, were not used because no one, not even the building engineer, knew they existed. Water damage to stock was excessive because unnecessary heads fused and because stock rested directly on the floor. Efforts to remove water took excessive time because of the lack of information regarding the building; a sound educational program could prevent such occurrences in sprinklered buildings.

E -- SALVAGE OPERATIONS IN SPRINKLERED RISKS

TOPIC 2 -- TYPES OF SPRINKLER SYSTEMS

This topic, "Types of Sprinkler Systems," is planned to provide answers to the following questions:

- What are the advantages and disadvantages of the various types of sprinkler systems to salvage personnel?
- Which sprinkler system is best for areas where explosive or highly combustible materials are stored?
- What features do substandard systems lack?

Purpose of Sprinkler Systems

Without question, the automatic sprinkler system is the most effective means of protecting buildings and their contents from serious fire losses. The sprinkler system, on duty around the clock every day of the year, has the capability not only of detecting and controlling a fire but also of notifying occupants, bystanders, and the fire department that a fire is in progress.

Sprinkler Systems in Use

Many different sprinkler systems are in use, each with its advantages and disadvantages. The systems are classified as follows:

1. Wet-pipe systems
2. Dry-pipe systems
3. Pre-action systems
4. Deluge systems
5. Combined dry-pipe and pre-action systems
6. Limited water-supply systems
7. Substandard or junior systems

Wet-Pipe Systems

A wet-pipe system employs automatic sprinkler heads attached to a piping system and a water supply so that water discharges immediately from sprinklers opened by a fire. These systems are in extensive use in California and

are generally installed to provide protection for structures and occupancies where the fire problem is not considered unique.

Dry-Pipe Systems

A dry-pipe system employs automatic sprinkler heads attached to a piping system containing air under pressure. Heads open automatically under fire conditions, and air in the piping system is released, triggering a dry pipe valve that allows water to flow into the system and on to the fire through the fused heads. Dry-pipe systems are installed where extremely low temperatures may occur: in structures exposed to freezing temperatures, in cold storage plants, and in space-simulation areas.

Pre-Action Systems

A pre-action system employs automatic sprinkler heads attached to a piping system that may or may not contain air under pressure. Additionally, a heat-responsive device opens a valve to supply water to the piping system and to fused heads. Usually installed in areas that may be subject to freezing temperatures, pre-action systems protect risks that exceed the capabilities of standard dry-pipe systems. Basically the pre-action system is more sensitive and can provide water for fire control more quickly than the dry-pipe system.

Deluge Systems

A deluge system employs open sprinkler heads attached to a piping system normally dry and supplied with water after the activation of a valve by a heat-responsive system. Deluge systems, because of their open-head feature, are able to deliver water immediately in large amounts throughout areas where explosive or highly combustible materials are handled or stored. Deluge systems may be located in flammable-liquid mixing and handling plants, paint manufacturing plants, nitrocellulose handling and storage plants, and similar extra-hazard occupancies.

Combined Systems

A combined dry-pipe and pre-action system is usually installed in structures where wet-pipe systems are impractical and where a number of dry-pipe valves would be required because of the possibility of extremely low temperatures. The automatic sprinkler heads are attached to a piping system containing air under pressure, and a heat-responsive device is employed to open both the water supply valve and air exhaust valves. Water is therefore supplied to heads more quickly than where air must be exhausted only through fused heads.

Limited Systems

A limited water-supply system is an automatic sprinkler system not connected to a standard water system, but supplied with water by a pressure tank of limited capacity.

Substandard or Junior Systems

A substandard or junior system is installed to protect moderately hazardous areas in nonsprinklered buildings. One or more automatic sprinkler heads connected to the domestic water system may be installed in waste-storage rooms, janitors' closets, small basements, heater rooms, and other similar areas. These systems are classified as substandard because they do not incorporate water-flow alarms, fire department connections, a separate water supply, and other standard requirements. The systems do, however, provide necessary fire protection in nonsprinklered buildings. From a salvage standpoint, on the other hand, excessive water damage may occur through the lack of an audible warning device. Therefore, water may flow from a fused head or heads for quite some time before discovery and may cause extensive damage.

E -- SALVAGE OPERATIONS IN SPRINKLERED RISKS

TOPIC 3 -- SPRINKLER HEADS AND VALVES

This topic, "Sprinkler Heads and Valves," is planned to provide answers to the following questions:

- What are the basic types of sprinkler heads?
- How are color codings used in the replacement of heads?
- How is the rate of flow from a head determined?
- What are the differences between the two types of sprinkler-system control valves?
- How are inspector's test drains installed?

Sprinkler Heads

Since the designs of sprinkler heads are numerous, they will not be discussed at length in this manual. Complete information regarding them is contained in the Fire Protection Handbook, published by the National Fire Protection Association (NFPA).[1]

Basic Types

Two basic types of sprinkler heads are the upright and the pendant -- so named for the way they are installed. Most sprinkler heads are marked, although their differences are easily recognized. An upright head usually has a large deflector curved at its circumference toward the sprinkler yoke. A pendant head has a small, flat deflector. An important consideration during salvage operations is that the correct type of head must always be used during replacement.

Replacing Heads

Heads of the correct temperature rating must also be used during replacement. Fusing temperatures are denoted by color as shown in Table 1. Color markings may appear as dots on top of the deflectors, or the yokes or frame arms may be painted. Where heads are coated to resist corrosion, the coating may be colored.

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[1] Fire Protection Handbook (Thirteenth edition). Edited by George H. Tryon. Boston: National Fire Protection Association, 1969.

TABLE 1

Temperature Ratings, Classifications, and Color Codings

Maximum ceiling temperature in °F.	Temperature rating in °F.	Temperature classification	Color code
100	135 to 170	Ordinary	Uncolored
150	175 to 225	Intermediate	White
225	250 to 300	High	Blue
300	325 to 375	Extra high	Red
375	400 to 475	Very extra high	Green
475	500 to 575	Ultra high	Orange

The quantity and the pressure of water flowing from a sprinkler head is an important salvage consideration. The formula for determining approximate flow from a head with a 1/2 inch orifice is 1/2 P + 15, where P is residual pressure. Table 2 contains average flow rates from a standard head.

TABLE 2

Average Rates of Flow From a Standard Head

Pressure at the head in psi	Approximate flow in gpm
10	18
15	22
20	25
25	28
35	34
50	40
75	50
100	75

Sprinkler Valves

A knowledge of the location and operation of sprinkler control and drain valves is important to the fireman, for these can be used to reduce excessive water damage. Two types of control valves are the outside screw and yoke and the post indicator. Both have a means of indicating whether they are open or closed. Drain valves are ordinary globe, gate, or angle valves.

Outside Screw and Yoke Valve

The outside screw and yoke valve is installed in a valve pit, on a main riser, or on auxiliary lines. Pit and main riser valves control the entire system; valves on auxiliary lines may be used to control water flow to various floors or building sections. As its name implies, this valve has an outside screw indicating the position of the gate. When the screw is extended beyond the valve wheel, the gate is open (Fig. E-1).

Post Indicator Valve

The post indicator valve is located outside of the building and has a sign that indicates whether the gate is open or closed (Fig. E-2). The valve also has a wrench usually sealed to a hasp on the post. In operating the valve, the seal must be broken and the wrench removed, turned over, and placed on the valve stem. An adjustable spanner wrench may be used if the post wrench is missing. Although the post wrench should not be padlocked to the hasp, sometimes this is the case. Firemen should not hesitate to break such a lock, for the valve must be closed. A very few gallons of water can cause a great deal of damage -- much more than the value of any padlock.

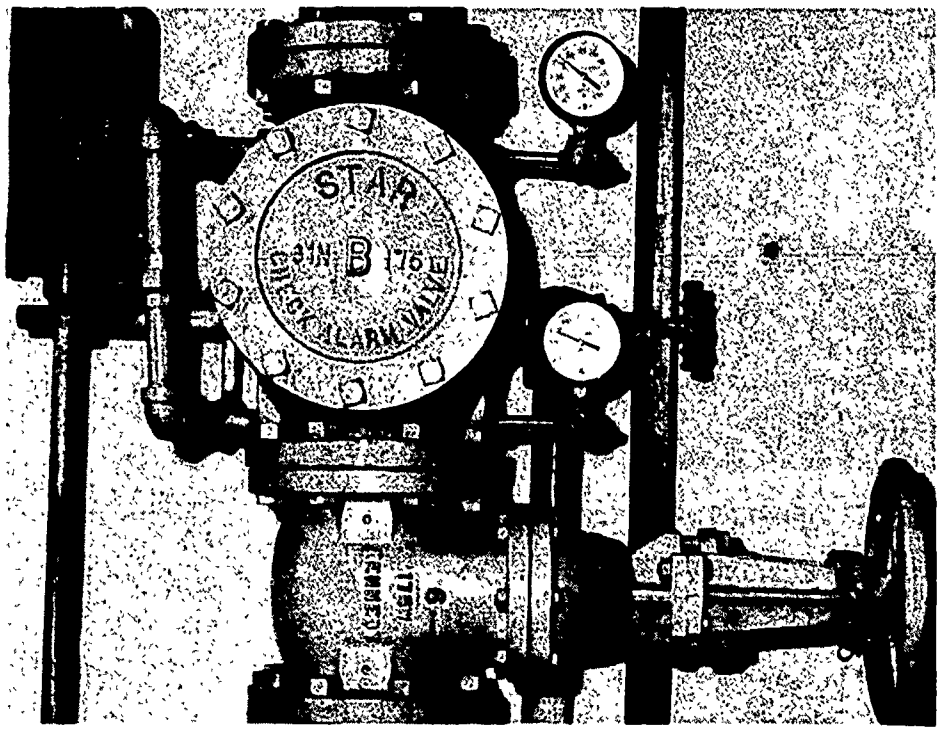


Fig. E-1. Outside screw and yoke valve

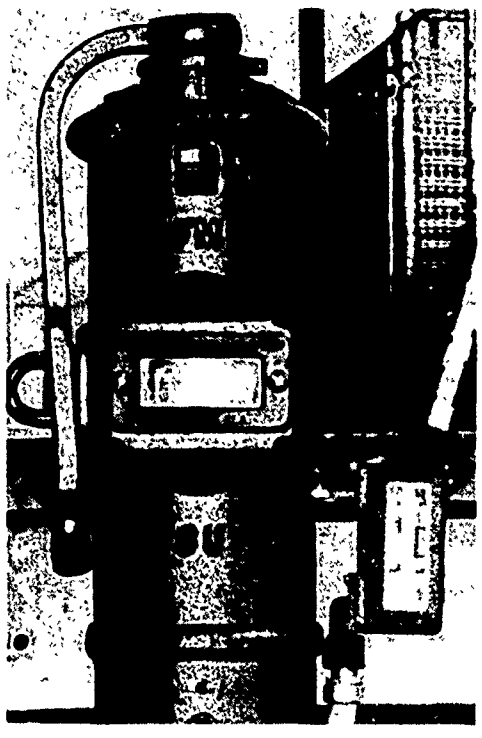


Fig. E-2. Post indicator valve

Drain and Test Valves

The main drain, required on main risers, should be equipped with a sign reading MAIN DRAIN or SPRINKLER DRAIN (Fig. E-3). A drain adjacent to sectional control valves is also required and should be equipped with a sign reading AUXILIARY DRAIN. Inspector's test valves are also ordinary globe, gate, or angle valves. They are installed in piping that taps into the sprinkler system and leads to an outlet equivalent to the flow of one sprinkler head. These valves are used to test alarm systems and dry-pipe valves and are equipped with signs reading INSPECTOR'S TEST.

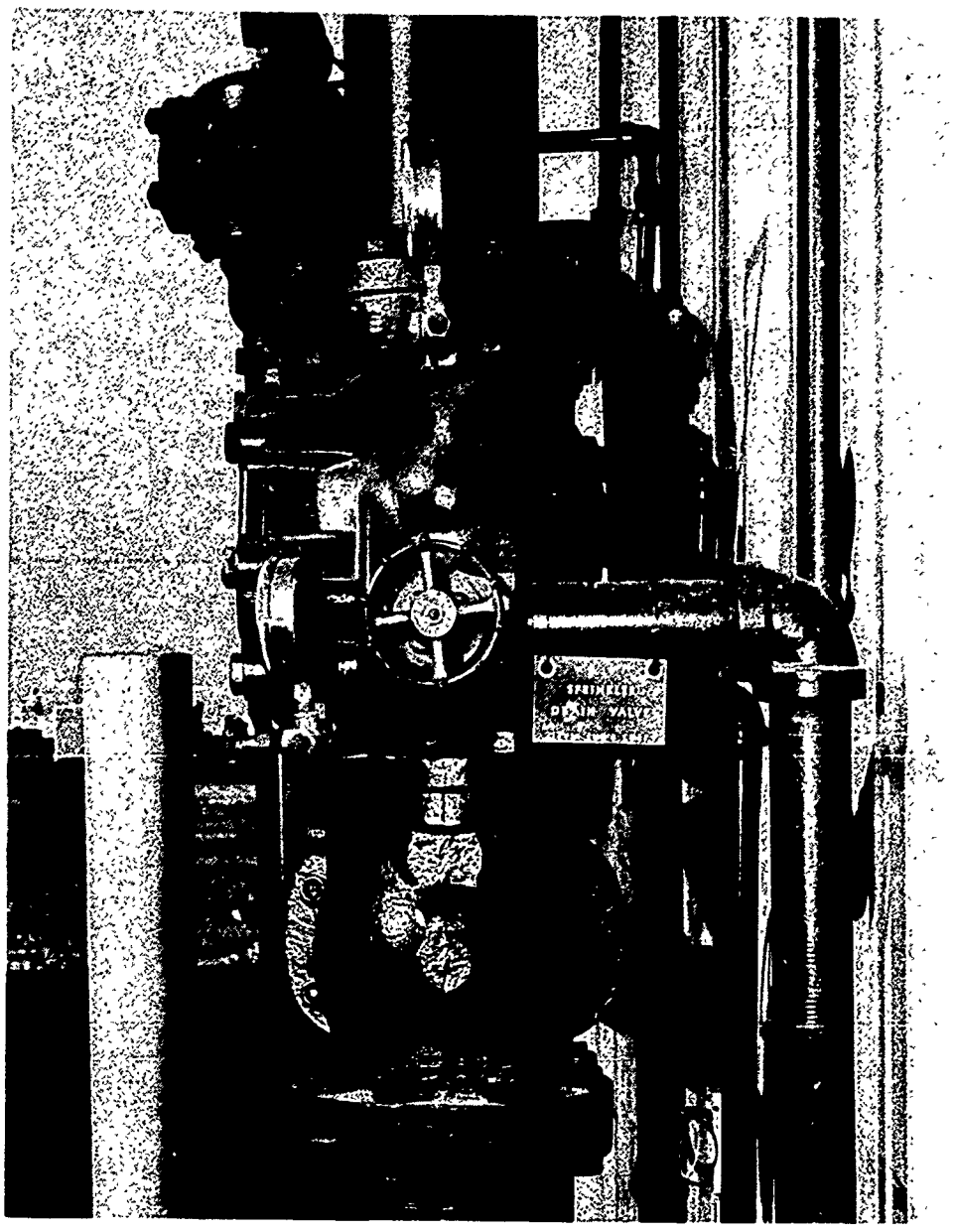


Fig. E-3. Sprinkler drain valve

E -- SALVAGE OPERATIONS IN SPRINKLERED RISKS

TOPIC 4 -- CONTROL AND RESTORATION

This topic, "Control and Restoration," is planned to provide answers to the following questions:

- When should sprinkler systems be shut off?
- What devices are used to shut off certain sprinkler heads without interrupting water supplies to other heads?
- What is the responsibility of the fire department in restoring sprinkler systems to service?
- What procedures are used in restoring wet systems to service?

Controlling Sprinkler Systems

Stopping water flow from fused sprinkler heads immediately after determining that a fire is under control is a goal of modern fire departments. But this does not imply that sprinkler control valves should be indiscriminately closed. The first steps to be taken by the officer in charge on arrival at a fire in a sprinkler-equipped building are (1) to determine that all sprinkler valves are open by assigning a man to check and stand by each valve and (2) to supply pumper lines to fire department connections. The fire should then be located and necessary steps taken to ensure that it is under control. Only then should sprinklers be shut off.

Sprinkler heads can be shut off as necessary without interrupting water supplies to the balance of the system by using sprinkler shutoffs, wooden wedges, or plugs (Fig. E-4). This procedure provides protection against the possibility of more serious situations developing, situations that could occur because a fire had traveled into concealed areas or because a fire apparently under control had regenerated suddenly and uncontrollably. Where individual heads are closed, the balance of the system remains in service.

Sometimes, however, closing the valves is the only method of stopping water flow. Examples include the following:

1. When individual heads are inaccessible because of their height, concealment, or obstruction

2. When major parts of the sprinkler system have been ruptured or destroyed by explosion, roof or floor collapse, or other causes

3. When a deluge system is involved

Under normal conditions valves should never be closed unless the fire is definitely under control. When the sprinkler system must be shut down to control water flow, the man already detailed to the appropriate valve is notified. Floor or sectional valves should be used to control flow if possible. Immediately after the correct valve has been closed, drains (main or auxiliary) must be opened. This allows water remaining in the system to flow harmlessly to the exterior of the building rather than into the building through open heads. The man assigned to close a sprinkler valve must remain at the valve so that it may be quickly reopened if necessary.

Restoring Sprinkler Systems to Service

Sprinkler protection must be restored as soon as possible after a fire. Most fire departments restore wet systems to service before leaving the premises, but other types of systems require special attention. Restoring dry-pipe, pre-action, deluge, and limited water-supply systems to service is usually the responsibility of the building owner or occupant, although most systems incorporating automatic sprinkler heads may be restored to temporary service by the fire department. Sound fire-protection principles, however, dictate that a fire department should never leave the premises of a sprinklered building unattended while the system is out of service. Posting a watch until the premises can be turned over to the correct authority is good practice. Should a fire rekindle or should another fire occur, the watchman will be responsible for notifying the fire department and reopening valves as necessary to control the fire.

Where water flow has been controlled by sprinkler shutoffs or wedges, the following procedures are used to restore a wet system to service:

1. Close the post indicator, main riser, or floor or sectional control valve.

2. Open the main and auxiliary drain valves.

3. Allow the system to drain sufficiently so that water will not flow from fused heads.

4. Remove stoppers or wedges from fused heads.

5. Replace fused heads with new heads of correct type and temperature ratings. These may be obtained from the supply on the premises or from stock carried on apparatus.

6. Close drain valves as necessary.

7. Open the control valve.

8. Open the inspector's test valve to bleed air from the system, and test the alarm device.

Where water flow has been controlled by closing the valves, the following procedures are used to restore a wet system to service:

1. Remove fused heads.

2. Replace fused heads with new heads of correct type and temperature rating.

3. Close drain valves as necessary.

4. Open control valves.

5. Open the inspector's test valve to bleed air from the system, and test the alarm device.

Additional information on sprinkler systems can be found in Sprinkler Systems, published in 1968 by the California State Department of Education.

F Overhauling Premises

TOPIC 1 -- THE ROLE OF OVERHAUL

This topic, "The Role of Overhaul," is planned to provide answers to the following questions:

- What is meant by "overhaul"?
- How are salvage and overhaul related?
- What are the purposes of overhaul?

Salvage and Overhaul

Although salvage and overhaul have distinctly separate functions during fire control operations, the two are closely related because (1) salvage and overhaul are conducted simultaneously in many instances and (2) most of the objectives of overhaul contribute to the accomplishment of the primary purpose of salvage.

Since salvage and overhaul operations are frequently conducted simultaneously, personnel engaged in this work should understand completely the purposes of these operations and their relationship to each other. Firefighters should remember that the primary purpose of salvage is to limit property damage to an absolute minimum. Significantly, overhaul operations that are well-organized, complete, and carefully executed will assist materially in accomplishing this purpose of salvage. For these reasons a discussion of overhaul is necessary in this manual.

The Purposes of Overhaul

The purposes of overhaul, which will be examined in detail in subsequent topics, are the following:

1. To establish safe conditions in the fire area
2. To completely extinguish all remaining fire
3. To determine the cause of the fire
4. To protect property from theft and adverse weather conditions
5. To prepare the fire premises for release to owners or occupants

F -- OVERHAULING PREMISES

TOPIC 2 -- ESTABLISHING SAFE CONDITIONS

This topic, "Establishing Safe Conditions," is planned to provide answers to the following questions:

- What steps are required in establishing safe conditions?
- How are premises inspected and evaluated?
- How are hazards eliminated?

The Safety of Firefighters

The primary objective of overhaul has long been considered to be the extinguishment of remaining fire and the prevention of rekindle, but actually the first step in overhaul should be to provide safety in the fire area. Hazards to personnel during overhaul are sometimes extreme. Firefighters may be injured from falls or by falling objects or tools. They are susceptible to cuts, puncture wounds, eye injuries, strains, sprains, and broken bones. The only logical reason for exposing firefighters to hazards is to save human life, but human life is not at stake during overhaul operations. Once a fire has been brought under control, time is available to plan and organize the overhaul phase in such a way as to provide the highest possible degree of safety. The steps required to establish safe conditions include: (1) inspecting the premises; (2) developing a sound organization; (3) providing suitable equipment; and (4) eliminating hazards.

Inspecting the Premises

If the fire occurred outside a structure, the entire working area should be inspected for potential hazards. If the fire occurred within a structure, the following procedures should be used:

1. Inspect and evaluate the integrity and stability of the structure to determine whether roof and ceiling trusses, walls, floors, and stairways are subject to collapse.

2. Inspect and evaluate the condition of structural components to determine whether ceilings, chimneys, and signs or other hanging objects are subject to collapse and to determine the hazard potential of utilities, broken windows, and so forth.

3. Inspect and evaluate the hazards that may be created by any other factor, such as sharp objects, holes in floors or stairways, high piles of stock, and pits and vats.

Developing a Sound Organization

Efficient fireground operations require planning and organization, and overhaul is no exception. In fact, since time is available, this phase of fire fighting can be planned and organized to a high degree. Developing a sound organization includes the following procedures:

1. Establish and define objectives -- what is to be done; how, when, and where it will be done; and who will do it.

2. Provide adequate supervision.

3. Instruct personnel as to objectives, hazards, and expectations.

Providing Suitable Equipment

Establishing safe conditions requires that suitable equipment be used. For example, adequate lighting is absolutely essential. Suitable equipment also includes standard fire department tools and apparatus and other equipment that may be necessary. The important consideration is to obtain and use the equipment that will assist personnel in doing their job efficiently and safely.

Eliminating Hazards

As many hazards as possible should be eliminated in establishing safe conditions. The procedures for establishing safe conditions include the following:

1. Shore up weakened roof or ceiling trusses, walls, floors, and stairways.

2. Pull down loose-hanging objects, water-laden ceilings, and unsafe chimneys and walls.

3. Remove excess water from floors.

4. Discontinue electric and fuel services if necessary because of damage to fixtures or equipment.

5. Remove broken glass from windows, and clear other sharp objects from the work area.

6. Reduce the size of stock piles if necessary.

7. Place barricades around hazards that cannot be eliminated, and post guards.

The Safety of Others

The foregoing purpose of overhaul is primarily directed toward providing safety for firefighters. Other persons may also be on the premises, however -- representatives of the press, public utility personnel, insurance agents and adjusters, investigators, and owners and occupants. The fire department is obligated to protect them as well as its own personnel. Providing safety for all persons who may have access to the fire premises should be the goal of this phase of overhaul.

F -- OVERHAULING PREMISES

TOPIC 3 -- EXTINGUISHING ALL REMAINING FIRE

This topic, "Extinguishing All Remaining Fire," is planned to provide answers to the following questions:

- What procedures are used to ensure that all remaining fire is extinguished and to prevent rekindle?
- What equipment is used in handling debris?

Relation to Salvage

After establishing safe conditions, those operations necessary to extinguish any remaining fire can begin. This phase of overhaul is closely related to salvage. Incorrect, disorganized, and careless overhaul techniques could result in unnecessary damage to structures, contents, or materials. A rekindle could result in additional fire loss. Incorrect handling of debris could result in unnecessary damage or the loss of valuable articles. The objective of salvage is to reduce property damage to an absolute minimum; careless overhaul will not assist in reaching this objective.

Required Procedures

The steps required to perform this phase of overhaul include the following:

1. Check all avenues of potential fire spread. Any horizontal or vertical opening or channel through which fire or heat may have traveled must be closely examined.

2. Check all concealed areas that may have been exposed to excessive heat. These areas may be examined by sight, touch, hearing, and smell. Open any concealed spaces in which fire is suspected; have a charged line ready, and use debris carriers or salvage covers to catch debris caused by these activities.

3. Carefully examine all items and areas in which burning took place.

4. Remove severely damaged and potentially dangerous materials to a safe location.

5. Employ a systematic method for handling debris, and select a suitable location for it. The area selected should provide (1) room to work at a distance safe from combustible materials in case of a possible rekindle and (2) easy access for final disposal of the debris.

Examining and Overhauling Debris

A system must be established and responsibility determined for examining debris. Bulky objects susceptible to deep-seated burning usually must be opened, and hot particles may have to be completely soaked or submerged in water. In addition, materials of possible value should be recovered from the debris, and care must be taken that materials susceptible to smoldering or spontaneous heating are not covered with other materials.

A safe, efficient method must be provided for transporting materials to the overhaul location. The method of transporting can vary from hand carrying to the use of skip-loaders and other mechanical devices. Debris may be placed in debris carriers or old salvage covers to protect the areas through which it is transported. Valuable articles should be removed from the path of transport, and other items should be protected with floor runners and salvage covers.

Debris Handling Equipment

Pike poles, rubbish hooks, manure forks, scoop shovels, hay hooks, and similar standard tools are readily adaptable to debris handling operations. Two pieces of equipment especially designed for debris handling are rubbish carriers and mattress chains.

Rubbish Carriers

Rubbish carriers are usually 8 feet square (Fig. F-1). They can be purchased or may be constructed from salvage covers. Rope is hemmed into the perimeter of the carrier and exposed at the four corners, where short sections of garden hose or booster-line hose are slipped over the rope to provide handles. Filled rubbish carriers can be carried by two or four men, depending on the weight of the debris. Doorways and narrow halls through which debris may be carried will sometimes limit the quantity of materials to be placed into carriers. Rubbish carriers may also be used for catchalls where a section of the wall or ceiling is to be pulled. Catchalls may be made from old salvage covers such as those reserved for covering roofs.

Mattress Chains

A partially burned mattress can be difficult to handle without the correct equipment. In residential occupancies mattresses frequently must be removed to the outside for complete extinguishment. Mattress chains are a great assistance in the removal process.

Mattress chains may be purchased from equipment dealers or made in departmental shops, usually of light chain or flexible cable. They are approximately 8 feet in length and have hooks or similar locking devices to keep them tight around a rolled mattress.

Mattresses should first be wrapped in old salvage covers or similar materials to prevent damage to floors, carpets, and other furnishings during removal. A mattress with a chain at each end is easier to handle than one wrapped with a single chain (Fig. F-2).

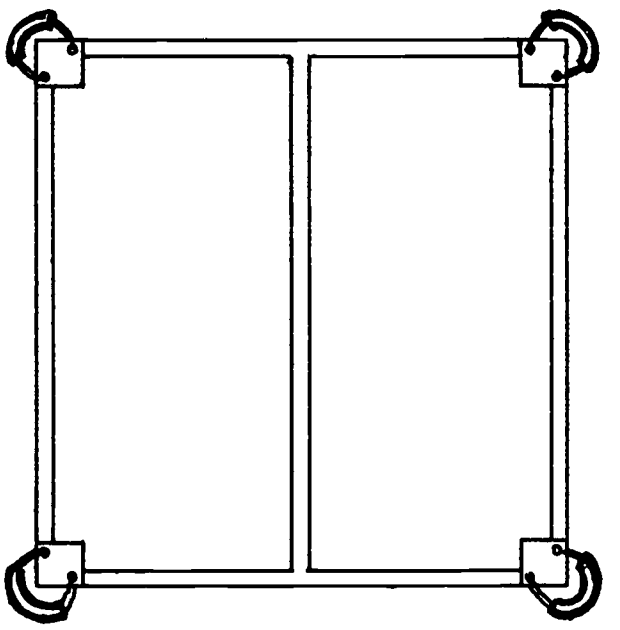
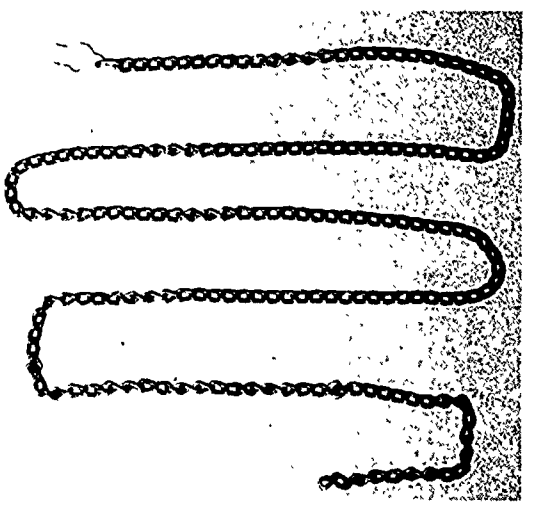


Fig. F-1. Rubbish carrier



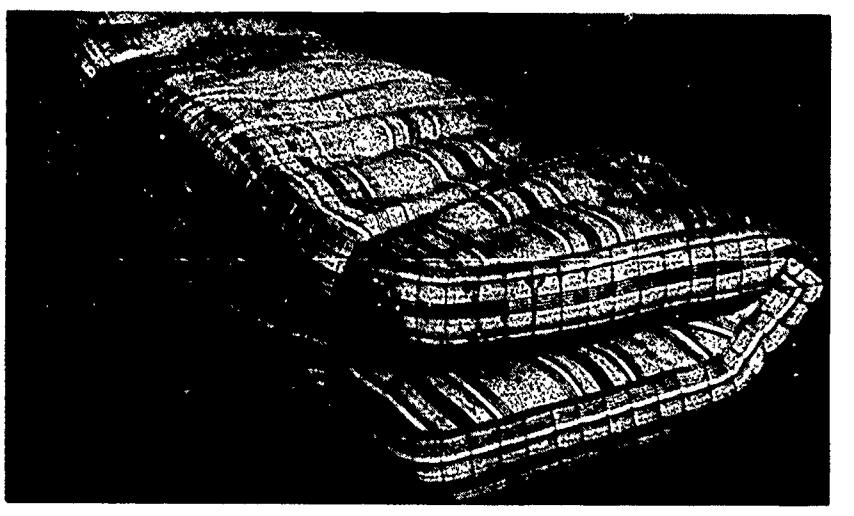


Fig. F-2. Mattress chain

F -- OVERHAULING PREMISES

TOPIC 4 -- DETERMINING THE CAUSE OF THE FIRE

This topic, "Determining the Cause of the Fire," is planned to provide answers to the following questions:

- What procedures are used in assisting investigators?
- What procedures are used when investigators are not available?

A Cause for Every Fire

Every fire has a cause. Determining why a fire started and why it spread are important objectives of overhaul -- objectives that are also related to salvage operations. A study of fire causes provides information that can help in preventing future fires. A prevented fire cannot damage property; the purpose of salvage is achieved without effort.

Required Procedures

The point of origin of a fire should be determined before overhaul operations begin. All necessary steps should be taken to protect the point of origin, including the placing of guards, the constructing of barricades, and the posting of signs to prevent anyone from disturbing the area. A careful evaluation of the point of origin may help to determine the cause of the fire.

If the cause cannot be established, or if incendiarism is suspected, a formal investigation should be requested. The following procedures will assist the investigators:

1. Isolate the point of origin so that possible evidence will not be disturbed.

2. Determine the condition of the premises before the fire. Were they secure? Is there evidence of forced entry? Were fire protective devices or other systems tampered with?

3. Search out possible witnesses, and record their names and addresses.

4. Prepare an inventory of damaged and destroyed items.

5. Guard the premises while waiting for the investigator to arrive.

If an investigator is not available, the following procedures should be taken:

1. Photograph the point of origin and other potential evidence before moving anything.

2. Carefully sift the debris at the point of origin to determine the fire cause and the materials that burned initially.

3. Photograph, identify, and safeguard any evidence.

4. Gather and record pertinent statements from witnesses.

5. Prepare a concise, accurate report.

F -- OVERHAULING PREMISES

TOPIC 5 -- PROTECTING PROPERTY FROM THEFT AND WEATHER

This topic, "Protecting Property from Theft and Weather," is planned to provide answers to the following questions:

- What is the responsibility of the fire department in protecting property from theft after fires?
- How are window and roof openings covered to prevent weather damage?

Relation to Salvage

The overhaul objective of protecting property from theft and adverse weather is also closely related to salvage. Efforts to save property from fire will be nullified if the property is subsequently stolen or is damaged by weather. Since the objective of this phase of overhaul is to reduce property losses to a minimum, it also accomplishes the purpose of salvage.

Protecting Property from Theft

Protecting property from theft can range from simply requesting police assistance to completely securing the premises. The latter procedure usually requires boarding all openings or otherwise securing areas through which persons could enter the premises illegally.

In some communities the protection of property from theft is the responsibility of police and property owners. The police will guard the premises for only a limited time while the owner arranges either to secure the premises himself or to engage the services of a private security agency. In other communities the fire department does everything possible to secure the premises. Owners are usually responsible for furnishing necessary materials (lumber, fencing, padlocks, and so forth), and the fire department installs these as a public service. Regardless of the local policy concerning protection from theft, the fire department is usually responsible for notifying property owners and for remaining at the fire scene until owners or their agents arrive.

Protecting Property from Weather

An essential function of salvage operations is to ensure that additional damage does not occur to a structure from rain, snow, sleet, wind, or dust passing through openings caused by fire or extinguishing and ventilating operations. The responsibility of the fire department is to see that any openings are closed in the best possible way so as to prevent damage.

Window and roof openings are generally closed with salvage covers, rolled roofing, or industrial polyethylene film. If salvage covers are used, almost certainly some damage will result to the cover because of the wind snapping the cover against nails, sharp edges of a shingle roof, or other abrasive material. Therefore, only the oldest covers should be used, but preferably 30-pound felt paper or industrial polyethylene film because these two items are expendable.

If a salvage cover is used, care should be taken to reduce the possibility of damage to it. Nails should be pulled or driven and any other possible source of damage removed. The cover should be securely fastened to prevent it from being blown away. Nails securing the cover should be driven through the grommet holes and bent over to hold the cover in place. If the opening is too large for a single cover, two covers may be used with the top one lapped over the bottom in shingle fashion. Where large openings are covered with two or more covers, they should be supported underneath to prevent sagging. On pitched roofs the top of the cover should lap the ridge or be sealed to prevent water from getting underneath (Fig. F-3). The weather edge of roofing may be raised and the cover slid underneath and secured to prevent water from entering.

When holes in flat roofs are to be covered, all debris should first be removed; then the roofing around the opening should be carefully raised and wedged 3 to 6 inches above the roof level. This will prevent runoff water from entering the opening.

A temporary support for a cover may be constructed by nailing an upright board to the rafter at each end of the opening and then nailing a horizontal piece between the two uprights. Additional pieces may be nailed diagonally from the horizontal piece to the roof to form a framework resembling a skylight. The salvage cover should then be drawn tightly over the frame and secured by nailing through the grommets or by placing heavy objects on the edges of the cover to hold it in position (Fig. F-4).

Small openings may be covered with roofing paper or polyethylene film by nailing several strips of wood across the opening to support the covering material in a tent-like fashion. Nails, staples, or mastic may be used to secure the material. If this method is used on a flat roof, the roofing edges around the hole should be raised and wedged as previously described; if on a pitched roof, the upper edge of the material should be lapped under the old roof covering.

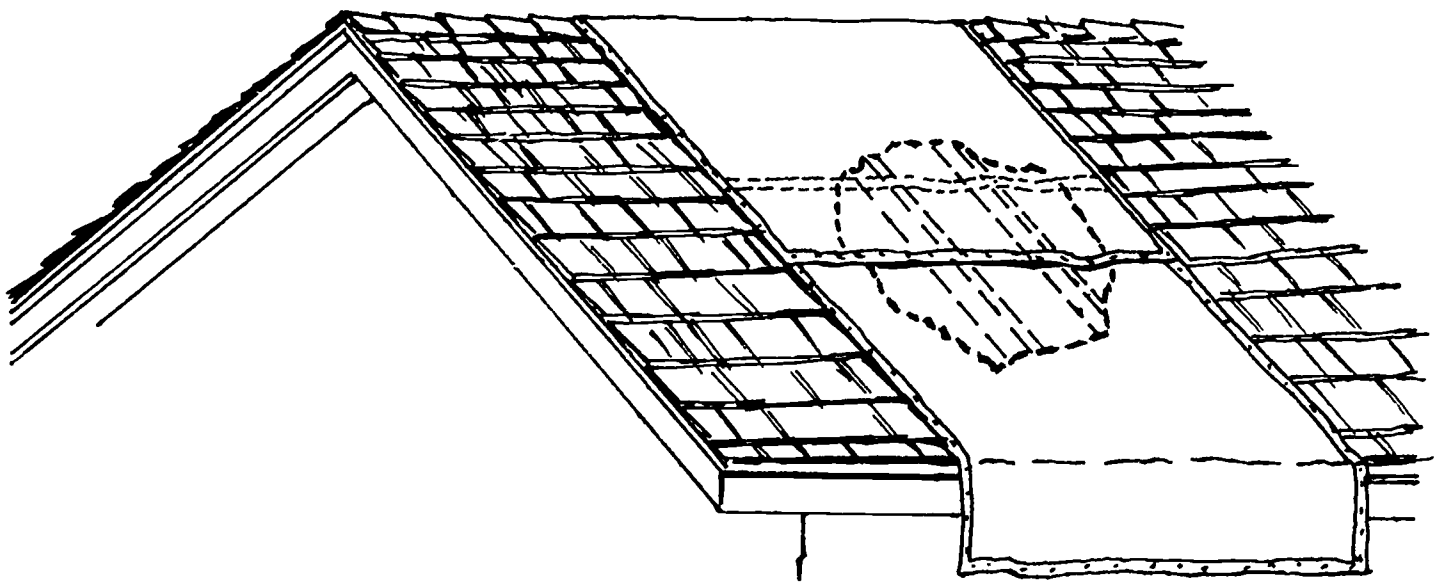


Fig. F-3. Covering a peaked roof

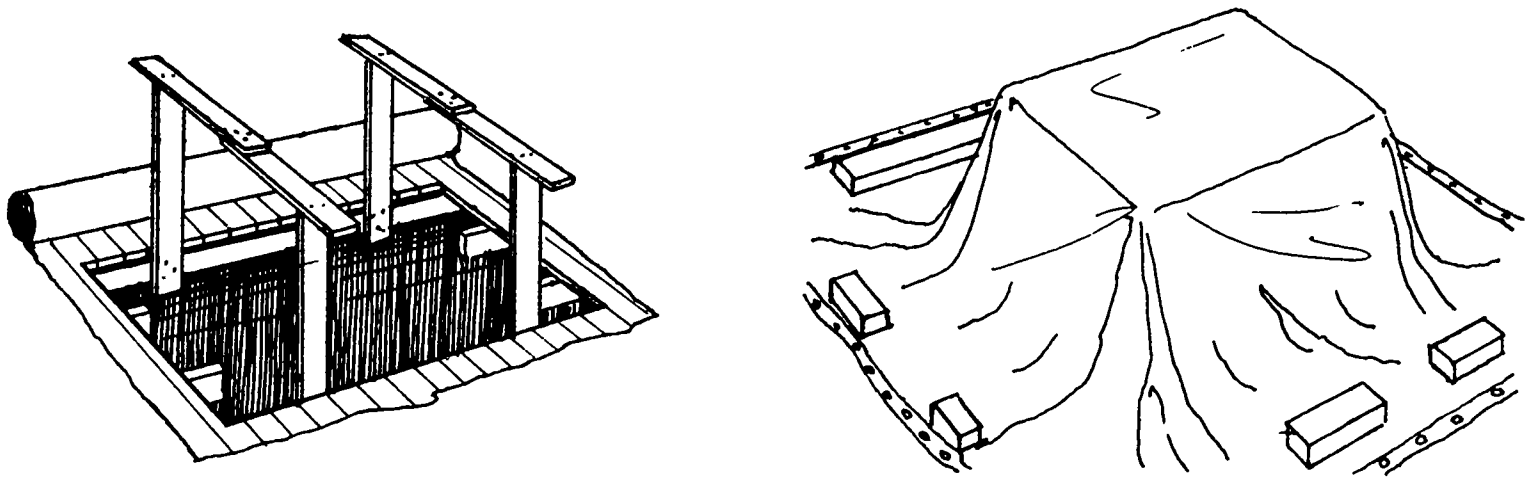


Fig. F-4. Covering a flat roof

F -- OVERHAULING PREMISES

TOPIC 6 -- PREPARING PREMISES FOR RELEASE

This topic, "Preparing Premises for Release," is planned to provide answers to the following questions:

- When should fire premises be released to owners or occupants?
- What procedures are followed before the premises are released?

Avoiding Premature Release

The final phase of overhaul involves those operations that are required before the fire premises can be released to responsible representatives of the owners or occupants. Although premises are usually released upon the completion of all necessary fire department functions, an immediate release can sometimes be premature. If the fire conditions are suspicious, most fire departments retain control over the premises until an investigation can be conducted. And, where the danger of rekindle exists, a watch is usually maintained until all danger has passed.

Recommended Procedures

Before the premises are released, the following steps should be taken:

1. Restore the premises to a habitable condition. Remove all debris; ventilate, dry, and clean the structure and its contents as much as possible. Barricade or seal off hazardous or uninhabitable areas.

2. Restore fire protection systems to service if possible.

3. Take action to restore heating systems to service, particularly in cold weather. Where fuel is supplied by a public utility or by a private contractor, notify the supplier. Most agencies will dispatch a qualified person or crew to inspect the heating facilities and to restore the services wherever it is possible.

4. Notify the power utility. It will perform similar services with the electric equipment.

5. Request a representative of the owner or occupant to inspect the premises. Point out unusual or hazardous conditions, and discuss the status of power, fuel, fire protection, and other systems.

G Controlling Utilities and Other Services

TOPIC 1 -- PUBLIC UTILITIES

This topic, "Public Utilities," is planned to provide answers to the following questions:

- What are the advantages of prefire planning in the control of utilities?
- When should emergency service crews be called to control utilities?
- What can a fireman do to control utilities when service crews are not available?

An Important Salvage Function

The control of utilities, such as electricity, gas, and water, is generally considered a salvage function, although other fire department operations may also be concerned with controlling utilities. Failure to consider this function in the salvage size-up could result in thousands of dollars of unnecessary damage.

The locations of shutoffs and control valves will vary depending upon the area, local ordinances, and utility company policies governing their installation. Whenever possible, maintenance personnel should be consulted regarding the controlling of utilities and services in all types of occupancies. Many fire companies also maintain a portable record system that includes the locations of the utility control valves and shutoffs in the major buildings in their districts. Such a record system is usually developed as part of a prefire-planning survey and inspection program.

Controlling Electric Services

By far the most common utility problem is the control of the electrical system. When fire involves the structural elements of a building, the power usually must be disconnected. A good policy is to stop the flow of electricity into a building whenever the possibility exists that electrical equipment may be damaged. After an inspection of the equipment, service in most cases can be reactivated to supply power for light, tools, and other operations.

Arrangements should be made in advance with the company supplying power for the immediate response of an emergency service crew to all structure fires. The company should understand that its personnel must be under the

general supervision of the commanding fire officer, although technical supervision should come from the service crew leader. But even with the most complete planning for utility crew assistance, at times this help cannot be counted upon immediately. Stormy weather, floods, earthquakes, or other emergencies place unusually heavy workloads on these crews; then their immediate response should not be expected.

Fire departments should be prepared to cope with electrical emergencies if utility company crews are not available. Wire cutters, hot sticks, climbing spurs, and lineman's gloves and gauntlets should be provided for this purpose. All this equipment should be tested periodically to ensure its safety and dependability. Preferably, firemen with previous electrical experience and training should be assigned the responsibility of handling electrical hazards.

Among the emergency procedures involved in controlling electrical service are the following:

1. Cut wires, if necessary, at the drip-loop near the service head (Fig. G-1).

2. Do not climb power poles to cut fallen live wires. Cut them near the pole and high enough above the ground so that persons passing under them will not contact the ends. Cut the individual wires at different lengths to prevent the ends from contacting each other.

3. If twisted wire conductors (triplex) between a pole and a building must be cut, separate the wires sufficiently so that one of the conductors may be cut without contacting the neutral (bare cable). Bend the live ends with the cutter blades to prevent contact with the neutral, and leave the neutral intact, if possible, to support the other wires. If the entire wire assembly must be cut, cut the neutral last after ensuring that the assembly will make no contact with persons or conductive material such as clotheslines or fences. Then, at a point near the pole, cut the assembly again so that the live ends are above the level of possible contact with the ground (Fig. G-2). Note: Safety factors require an approved, tested cutter for electric wiring and every possible protection to avoid being grounded.

Controlling Gas Services

In controlling natural or liquified-petroleum gases, fire department members should be aware of the location of shutoff valves through prefire planning so that no delay will result. Natural gas controls are usually located at the meter of an individual occupancy. Master control valves are usually installed in multiple occupancies, but individual occupancy shutoffs should be used because utility emergency crews will then spend less time and effort in restoring service. Sometimes street shutoff valves are provided on gas mains. If

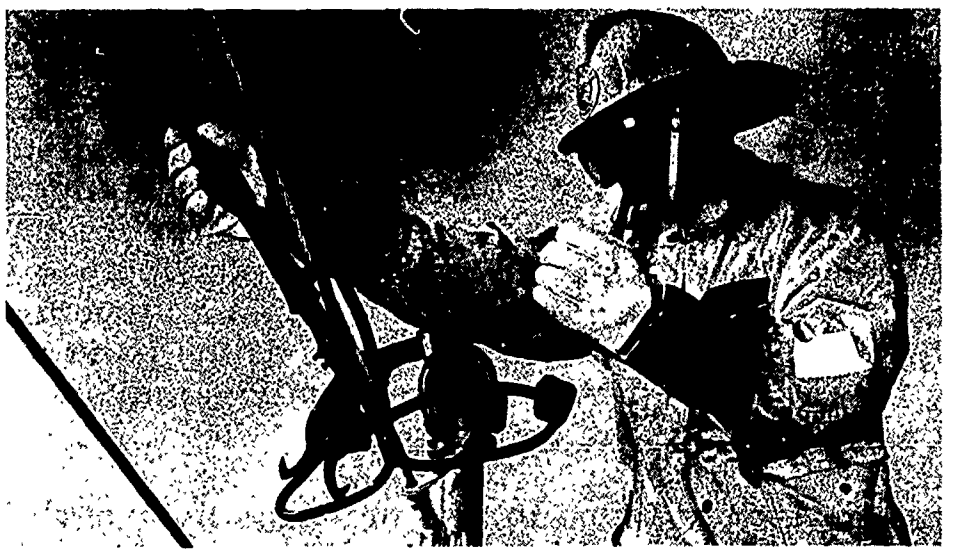


Fig. G-1. Cutting at the drip loop

Fig. G-2. Cutting twisted wire conductors

these have to be used for control, gas company emergency crews should handle the work under the general supervision of the commanding fire officer.

The same basic control factors apply to both natural and liquified-petroleum gases except for an important difference in the vapor density of the two gases. Under normal conditions natural gas is lighter than air and will rise and diffuse in the atmosphere. Liquified-petroleum gas is heavier than air, will hang at low levels, and will collect in basements, pits, or other depressions. Therefore, additional precautions will be necessary, including the ventilation of these areas and the elimination of potential ignition sources.

Controlling Water Services

Water damage, a major concern of fire departments, is usually associated with hose lines, sprinkler systems, and other fire-control devices. Yet water damage is sometimes the result of a failure of domestic water systems that may occur during a fire or from other causes. Control of water services therefore may be necessary to reduce water damage.

Although a number of ways may be found to stop the flow of water within or to a structure, generally the best practice is to close valves as near the leak as possible. Most plumbing fixtures -- sinks, lavatories, and toilets -- are supplied with water through wall-mounted valves installed under the fixtures. Water systems in large structures are usually equipped with valves that can be used to control leaks in affected sections or floors. Since sectional control valves are seldom labeled and often difficult to locate, maintenance personnel should be asked about them. Most structures, large and small, are equipped with master control valves at the point where the domestic water supply enters the structure. These valves may be installed aboveground or in a box or pit near the structure.

Water meters are usually found in pits or boxes near curb lines. Most meter installations incorporate a valve on the street side of the meter. Valves are installed at intervals in street mains; utility crews can isolate sections of street main systems to control water leaks that cannot be controlled by other methods.

Water flowing from an impaired domestic system can cause considerable damage. Since the objective of salvage is to reduce property loss regardless of its cause, water system control is therefore a salvage operation.

G -- CONTROLLING UTILITIES AND OTHER SERVICES

TOPIC 2 -- SPECIAL SERVICES

This topic, "Special Services," is planned to provide answers to the following questions:

- What special services will firemen be required to control?
- How are refrigerant leaks controlled?

Types of Special Services

In addition to utilities, salvage units are also concerned with the control of special services such as refrigerants, fuel oils and gases, and medicinal gases. Special services in various types of occupancies include any number of piped systems to store, handle, and dispense liquid and gaseous materials. For example, large cold-storage and air-conditioning systems use vast quantities of refrigerants. Modern hospitals are equipped with piped oxygen and anesthetic-gas systems. Industrial occupancies may have extensive piped systems that handle steam, fuel oil, welding gases, compressed air, paint, or other materials. The control of these special-service installations during fires is a salvage operation.

Controlling Refrigerant Leaks

Leaking refrigerants, particularly ammonia, can be hazardous to firefighters and bystanders. Such hazards can usually be reduced by the following methods:

1. Large commercial refrigeration systems usually have fire department connections that are plainly marked. When water is supplied to them in sufficient amounts at correct pressures and certain valves are manipulated, the refrigerant in the system is diluted and flushed into the sewer or other drainage system.

2. Some smaller refrigeration systems may be controlled by simply opening a valve marked FIRE DEPARTMENT USE ONLY, which diffuses the refrigerant into the atmosphere near roof level.

Controlling Other Services

Because of the wide variety of other special-service installations in use, specific recommendations for controlling such systems are impossible to make. Fire department personnel should be aware that numerous special-service facilities now exist and that additional facilities are being devised

and installed at an ever-increasing rate. Gathering information on the type and location of special systems should be a continuous process, and methods of control should be developed through consultation with responsible persons at the occupancies where installations exist. Records should be kept of the types of systems and the methods of controlling them. A program of prefire planning can accomplish these objectives.

H Salvage Equipment

TOPIC 1 -- FIRE DEPARTMENT APPARATUS AND EQUIPMENT

This topic, "Fire Department Apparatus and Equipment," is planned to provide answers to the following questions:

- What salvage equipment should be carried on pumpers and ladder trucks?
- What equipment should be carried on salvage trucks?

Local Equipment Needs

The quantity and type of salvage equipment required for efficient salvage operations will depend upon local needs. The National Fire Protection Association recommends that the equipment listed in this topic be provided for various types of apparatus.[1] These recommendations should be used as a guide in developing basic inventories of salvage equipment.

Pumpers

The following salvage equipment should be carried on pumpers:

2 salvage covers, 12' x 18'	2 brooms
3 sprinkler stoppers or wedges	1 scoop shovel
1 portable pump, gasoline driven	2 buckets, 12 quart

Ladder Trucks

The following salvage equipment should be carried on ladder trucks:

10 salvage covers, at least 12' x 18'	4 mops
4 squeegees with handles	4 brooms
2 mop wringers with buckets	4 buckets, 12 quart
6 sprinkler stoppers or wedges	1 heavy-duty stapler
4 assorted handsaws	4 scoop shovels
2 roof covers, at least 12' x 18'	2 hatchets, shingle
1 roll 2" heavy-duty cellophane tape	2 large sponges

[1] Motor Fire Apparatus, NFPA No. 19. Boston: National Fire Protection Association, 1968.

1 deodorizer unit, power operated
1 each gas and water shutoff wrench
1 water vacuum cleaner
2 floor runners, 3' x 18'
1 auger, hand or electric, at least 1-1/2"
1 canvas debris bag, 8' x 8', with handles
1 roll 15-pound tar paper or plastic sheeting (at least 8 mil)
12 standard sprinkler heads, assorted temperatures and types
1 set sprinkler-head wrenches for the types of heads carried
2 claw hammers, each with a kit of assorted nails
1 box of tools to include hacksaw and 3 blades, keyhole saw, stillson wrenches (12" and 24"), ball peen hammer, and tin snips
2 sacks sawdust
1 submersible pump
4 bale hooks
2 forks, 4 tine

Salvage Trucks

The following equipment is recommended for salvage trucks by the NFPA and the Fire Training Officers' Workshop:[2]

40 to 100 salvage covers, 12' x 18'
2 adjustable end wrenches, 8" and 12"
10 bags sawdust or similar absorbent material
2 mop wringers with buckets
1 Vernon bar (tar paper lifter)
4 buckets, 12 quart, or metal tubs
100 to 300 "S" hooks
6 floor runners, 3' x 18'
6 squeegees, 18", with handles
1 long-handled round-point shovel
1 pair bolt cutters, 36"
2 ladders, 10', with folding roof hooks
1 Hayward lock breaker or claw tool
2 pinch bars (wrecking bars)
2 padlocks, keys, hasps, and screws
1 power saw (chain or heavy-duty rotary)
2 smoke ejectors, at least 5,000 cfm
2 crosscut handsaws
1 first aid kit, 24 unit
4 self-contained breathing masks
1 deodorizer, power operated
1 roll 2" heavy-duty cellophane tape
2 electric hand lights, at least 6 volts
1 auger, hand or electric, at least 1-1/2"
125' manila rope, at least 1-1/2" diameter
125' manila rope, 3/8" diameter
100' sash cord or heavy twine
1 set wire cutters
1 set climber's spurs
1 set assorted pliers
1 bundle wood lath
1 water chute
4 brooms, corn
2 brooms, wire
4 mops
4 chamois
4 sponges
3 scoop shovels
1 submersible pump
1 soil-pipe strainer
2 pike poles, 8'
2 sledge hammers
2 axes, 6 pound
2 hatchets
1 crow bar, 36"
1 rubber mallet
1 heavy-duty stapler
1 hammerheaded pick
2 pruning saws
1 box assorted nails
6 bale or hay hooks
2 claw hammers
2 water vacuums
1 appliance dolly

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[2] Conference on Salvage Manual, Group V, Fire Training Officers' Workshop, Fresno, May 8-12, 1967.

2 rolls 15-pound tar paper or plastic sheeting (at least 8 mil)
1 canvas debris bag, 8' x 8', with handles (rubbish carrier)
1 pair lineman's rubber gloves with leather gauntlets
1 portable electric generator, 2,500-watt capacity, with:
  3 portable floodlights, 500 watt
  6 electric cables, 3 wire, 50' lengths
  3 electric cables, 3 wire, 100' lengths
  3 pigtail adapters, 2 wire to 3 wire
2 approved portable extinguishers, fire department type, suitable for class A, B, and C fires
1 box of sprinkler equipment containing:
  12 standard sprinkler heads, assorted temperatures and types
  6 sprinkler stoppers and 6 redwood wedges
  12 assorted redwood plugs
  1 set sprinkler head wrenches
  1 box assorted pipe plugs and caps
  3 pipe wrenches, 10", 14", and 16"
  2 monkey wrenches

H -- SALVAGE EQUIPMENT

TOPIC 2 -- UTILIZING INDUSTRIAL EQUIPMENT

This topic, "Utilizing Industrial Equipment," is planned to provide answers to the following questions:

- What are the varieties of specialized industrial equipment that may be utilized for salvage use?
- Where may this specialized equipment be obtained?
- What advance planning is necessary for the use of industrial equipment?

Obtaining Equipment on Short Notice

Occasionally salvage operations require the use of highly specialized industrial equipment. While this equipment is designed for other purposes, it may be utilized for salvage and overhaul. Some fire departments maintain a list of contractors, rental agencies, and other sources where necessary equipment can be obtained on short notice; for large fires or unusual circumstances may require the immediate use of industrial equipment to reduce property damage.

The purpose of this topic is to point out the availability of highly specialized equipment that could be employed for salvage and overhaul operations. Too often the advantage of using this equipment is overlooked, even when the equipment is readily available at the scene. Fire departments should not necessarily assume financial responsibility for procuring such special equipment. Fire officers do, however, have a responsiblity to know what is needed, where it can be obtained on short notice, and how it can be used to best advantage.

Varieties of Equipment

Specialized equipment may be utilized by salvage workers for moving materials or debris, for cleanup operations, for gaining entry to structures or inaccessible places, and for various other purposes.

Equipment for Moving Materials

Heavy materials and debris may be moved with forklifts, dump trucks, conveyor systems, or bulldozers.

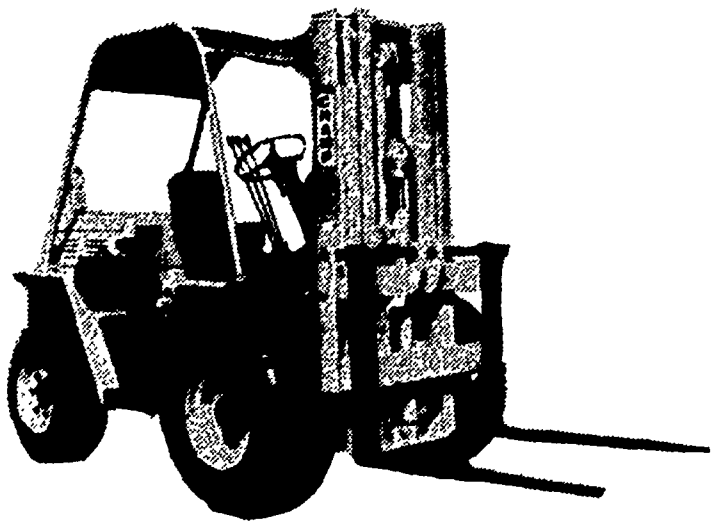


Fig. H-1. Forklift

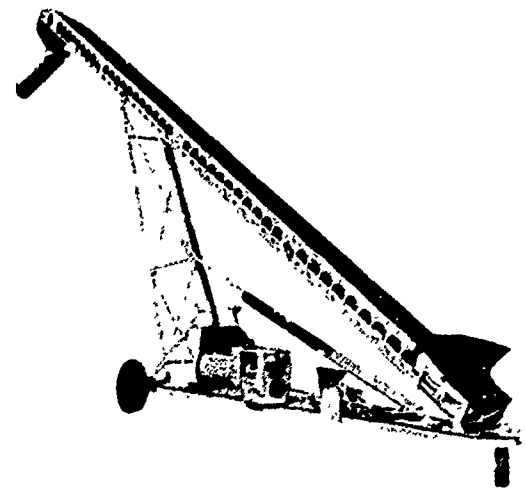


Fig. H-2. Conveyor

Forklifts. Often found on the premises where fires occur in industrial or storage occupancies, forklifts are used to move materials to a more protected or suitable location for overhaul. They may also be used by firemen as improvised scaffolding to place salvage covers on highly piled materials, to install sprinkler shutoffs, to replace sprinkler heads, and even to position hoselines during fire control and overhaul operations (Fig. H-1).

Dump trucks. Dump trucks are useful not only in removing debris but also in hauling large quantities of sand to form dikes and dams and to prevent damage where flooding exists.

Conveyor systems. Belt, screw, or bucket conveyor systems, either portable or fixed, are useful in moving packaged or bulk materials during or after a fire (Fig. H-2).

Bulldozers. Bulldozers or skiploaders are useful in clearing debris where extensive salvage operations are being conducted and in separating salvageable and nonsalvageable materials. Fires of baled hay or other stacked materials may require the use of this equipment to "cut a break" or to separate the involved and uninvolved materials. Garden tractors with suitable attachments may also be used to separate salvageable and nonsalvageable materials.

Equipment for Cleanup Operations

An important salvage function is to leave the fire premises in as clean and habitable a condition as possible. Among the specialized equipment are heaters, smoke ejectors, vacuum cleaners, and pumps.

Heaters. Portable space heaters suitable for cleanup operations range in output from 50,000 to 500,000 Btu per hour and are fired with kerosene, fuel oil, or liquified-petroleum or natural gas. They are useful where considerable dampness has resulted during the extinguishment of structure fires and where the premises must be dried quickly to prevent further damage to the structure or its contents (Fig. H-3).

Ejectors. Large, portable commercial air-moving equipment is available in some areas. This equipment is used for ventilation and to help reduce smoke and heat damage. Firemen should take care in using this equipment; unless the fire is fully controlled, it may intensify, spread, and cause a more serious loss because of incautious use of ejectors.

Vacuum cleaners. Large industrial or commercial wet-dry vacuum cleaners have proved useful during salvage operations. Manufacturers state that these units will pick up wood and metal chips, sludge, grindings, sand, plaster, stone, and other waste materials. The vacuums can lift water to 238 inches and can fill a 55-gallon drum in as little as 27 seconds. The intake can be equipped to handle 1-1/2", 2", or 3" suction hose. These machines can also be used to transfer bulk materials such as grain and sawdust and to recover reusable materials (Fig. H-4).

Pumps. Portable industrial pumps are available in a variety of sizes and types and may be driven by electric motors or by diesel, gasoline, or liquified-petroleum gas engines. Dewatering or other problems may require the use of one or more of these special pumps. One manufacturer states that his pump will handle sand, mud, and even rocks to 1-1/2" in diameter (Fig. H-5).

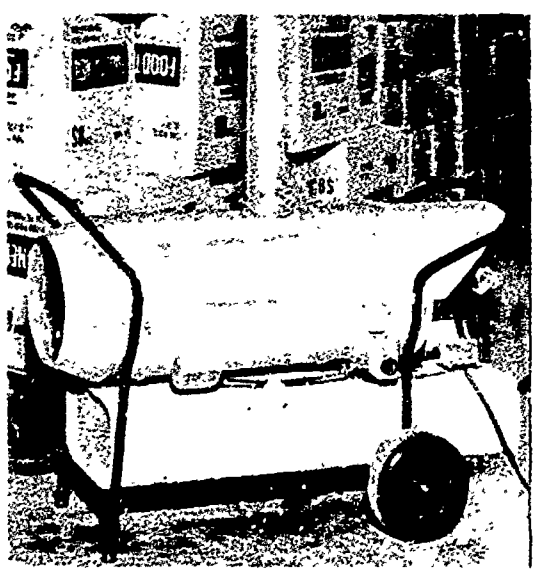
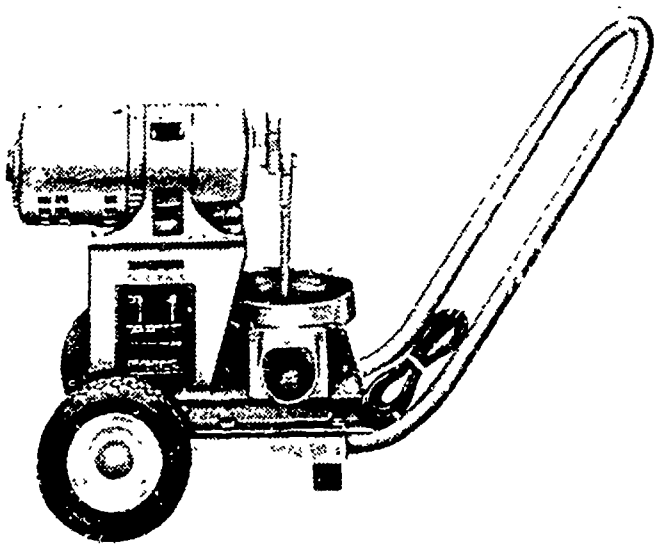


Fig. H-3. Heater

Fig. H-4. Vacuum cleaner



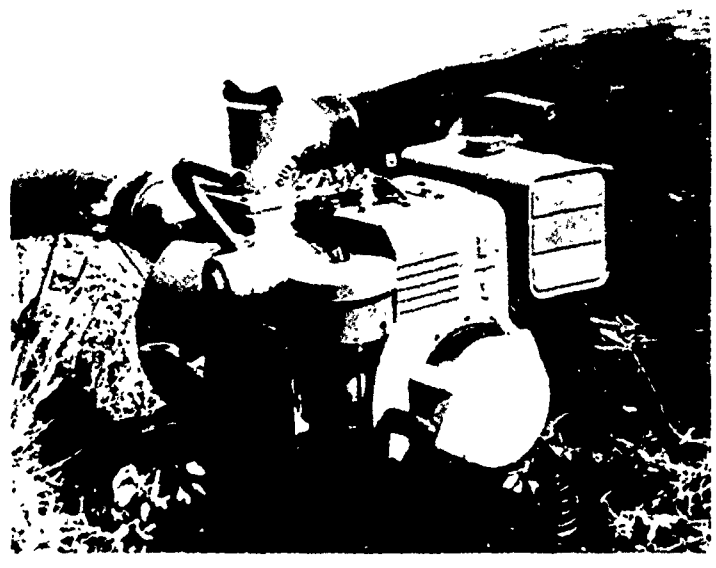


Fig. H-5. Typical pumps

Equipment for Gaining Access

Salvage operations occasionally need specialized equipment for gaining entry to structures or certain inaccessible places. Industrial tools and boom trucks are useful in these operations.

Industrial tools. Industrial drills, air hammers, concrete saws, and cutting torches are useful not only in forcible entry, but in extreme salvage and overhaul problems and for rescue, ventilation, extinguishment, and certain other operations.

Boom trucks. Power-operated boom trucks are useful where structure failure has occurred and parts of a building must be removed to gain access to valuable property.

Equipment for Miscellaneous Operations

Other equipment can be adapted to special salvage and overhaul problems involving extinguishment, safety, power, and so forth.

Excavating tools. Backhoes, trenchers, draglines, power shovels, or clamshells may be used to advantage in extreme drainage problems to construct holes or pits either to collect water for special extinguishing problems or to contain water. Such pits have been used to extinguish fire in large quantities of heavy, tightly baled rags or paper. The bales were handled by the clamshell, submerged in the water, and removed after they became thoroughly soaked. This eliminated the necessity of opening each bale individually. Pits may also be used to trap water contaminated with radioactive substances, acids, or similar hazardous materials.

Generators. Large-capacity power generators may be required where regular power sources have been interrupted by fires. Hospitals, hatcheries, cold-storage plants, and other places require a constant source of electrical power, and provisions for a temporary power supply may be necessary.

Jacks. Form and house-moving jacks can be used where shoring of weak floors, roofs, beams, or other parts of a building is necessary to prevent further damage or to provide safe working conditions.

Removal of Odors

In many areas commercial odor-removal companies maintain around-the-clock service. These companies state that their service will eliminate odors such as those caused by smoke, ammonia, stench bombs, tear gas, fuel-oil spillage, burner puff-backs, skunks and other animals, decomposition and mustiness, and flood and backed-up sewage. The service has been successfully used after fires in residences, storage vaults, banks, stores, factories, restaurants, hospitals, schools, trucks, autos, railroad cars, ships, libraries,

food plants, and hotels as well as in structures with other odor problems. Many of these companies publish directories that explain their services and list the locations and telephone numbers of their representatives (Fig. H-6).

Advance Planning Necessary

The equipment described in this topic is usually available on a rental basis in larger cities. In other areas it may be available through contractors, industrial establishments, other governmental agencies, utilities companies, and so forth. In any event, in the interest of saving time, an extremely important consideration is that arrangements for special equipment must be made before the need for its use arises. This emphasizes the importance of maintaining a departmental directory listing types of equipment that might be needed, where it can be obtained, whom to contact on a 24-hour basis, and any other pertinent information that will assist in expediting its procurement. If special equipment is needed and charges for its use are to be incurred, a written agreement with owners, insurance companies, or insurance adjusters may prevent problems of financial responsibility at a later date.

Fig. H-6. Removing odors

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VT 010 546

Recommendation 19: The Training of Power Station Operators Coal, Oil and Gas Fired Stations.

Electricity Supply Industry Training Board, London (England)
MF AVAILABLE IN VT-ERIC SET.
PUB DATE - Dec69 47p.

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ABSTRACT - Based on current training practice in electricity boards' generating stations, this training guide provides current training practices for power station operators by defining the program and providing a formal system of monitoring and control. Contents of this guide are: (1) Occupational Description, (2) Aims, (3) Sequence of Recruitment and Promotion, (4) Pattern of Training, (5) Induction Training, (6) Introductory Training, (7) Formal Training, (8) On-the-Job Training, (9) Facilities for and Location of Training, (10) Associated Theory, (11) Further Education, and (12) Monitoring of Training. Eight training program outlines and a glossary of terms are appended. (GR)

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Electricity
Supply Industry
Training Board

Recommendation 19: The Training of Power Station Operators Coal, Oil and Gas Fired Stations

ED0 45856

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foreword

In preparing this recommendation on the training of power station operators, it was recognised that the industry has been training operators for many years, both at junior and adult level, during which time it has evolved practices for recruitment, education and training, and for promotion which have worked well and have accommodated themselves to a wide range of station capacities and types of plant, and to variations in the backgrounds of entrants, in different parts of the country.

The recommendation has therefore been based on the best features of current training practice in electricity boards' generating stations. It aims to make these explicit, by defining the ground to be covered; and effective through a formal system of monitoring and control. It envisages that further improvement will arise from the increasing development and use of such training and control techniques as simulators, programmed instruction and attainment tests.

In addition to this recommendation, there will be a separate one for junior operators.

recommendation on the training of power station operators (coal, oil and gas fired stations)

occupational description

1. Operators in coal-fired, oil-fired and gas-fired power stations are employed in a variety of occupations the principal of which covered by this recommendation are:

a) *Unit stations*

Auxiliary plant attendant (A.P.A.)
—concerned with the servicing and operation of auxiliary plant.

Assistant unit operator (A.U.O.)
—concerned with assisting in the safe and efficient operation of one or more units comprising boiler, turbo-alternator and auxiliary plant.

Unit operator (U.O.)
—concerned with the safe, efficient and economic operation of one or more units comprising boiler, turbo-alternator and auxiliary plant, including other main services associated with the plant.

b) *Range stations*

Auxiliary plant attendant
—concerned with the servicing and operation of auxiliary plant.

Boiler operator
—concerned with the safe, efficient and economic operation of one or more boilers and other main services associated with the plant.

Turbine operator
—concerned with the safe, efficient and economic operation of one or more turbo-generators and other main services associated with the plant.

aims

2. The aims of operator training are:

a) to train operators at each level of appointment in the skills and knowledge necessary to operate plant in a safe and efficient manner;

b) to provide, at each level of appointment, a foundation of skill, knowledge and experience from which the more able operator may progress to a higher appointment, including that of foreman.

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sequence of recruitment and promotion

3. Recruitment to the occupation of auxiliary plant attendant may be from lower grades, from other types of power station work, from other parts of the industry, or from external sources, normally at an age of at least 21. It should be borne in mind in selection that whilst many entrants will remain as A.P.A.s after training, a number will be required for promotion to higher operator posts (see para. 4), and a corresponding range of abilities should be sought in recruits. As an aid in selection, consideration should be given to the development and use of aptitude tests.

4. A sequence of promotion exists from the occupation of A.P.A. to A.U.O. and from A.U.O. to U.O. in a unit station; or from A.P.A. to boiler or turbine operator in a range station. Recruitment to these occupations should normally occur through the A.P.A. level since successful experience in this appointment is a pre-requisite for the higher posts. A small number of recruits may join the industry with experience in attending to or operating power plant in the Merchant Navy, other Service or organisation. The training of such entrants should be covered on an individual basis. After making an assessment of the man's knowledge and skill, ad-hoc arrangements should be made to fill any gaps before an entrant is regarded as fully trained for the level of work to which he is appointed.

5. Newly recruited A.P.A.s are appointed to established posts which involve them, after introductory training, in the performance of specific duties. Further training must then be given to ensure that they are competent to carry out the full range of tasks associated with this grade. As preparation for work at a higher level, full advantage should be taken of opportunities for temporary up-grading.

6. In range stations it may be possible for boiler operators to extend their knowledge and skill by training in turbine operation (and vice versa) through the completion of a supplementary period of on-job training. Appointment from that stage to an A.U.O. post on a unit plant will depend on the availability of vacancies.

pattern of training

7. Training for all these posts will involve both formal and on-job training (see Glossary of Terms), arranged to occur at suitable times throughout the operator's appointment, which will reinforce the experience gained whilst performing his normal duties.

In unit stations

a) Auxiliary plant attendant: After induction and introductory training (appendices 1 and 2), one week's formal training shall be given within three months after appointment, and a further two weeks' approximately 33 months after appointment for potential A.U.O.'s, in conjunction with on-job training (appendices 3, 4 and 6).

b) Assistant unit operator: Two weeks' formal training given approximately 8 months after appointment, for potential U.O.'s, in conjunction with further on-job training (appendices 5 and 7).

c) Unit operator: Further on-job training as outlined in appendix 8.

In range stations

a) Auxiliary plant attendant: After induction and introductory training, one week's formal training given approximately three months after appointment, and a further two weeks' approximately 27 months after appointment for potential boiler or turbine operators, in conjunction with on-job training (appendices 3, 4 and 6).

b) Boiler operator or turbine operator: Further on-job training as outlined in appendix 7.

Note: The suggested training times in the appendices refer to an operator of average ability, and may therefore be subject to variation in individual cases.
The more detailed contents of the major components of this pattern of training are set out in paragraphs 10 to 16.

induction training

8. New entrants should be received by a member of the senior staff, and then introduced by a supervisor to their immediate working unit. This should be done on the first working day, and should cover an outline of the functions, organisation and rules of the station including safety rules, personnel matters such as salary arrangements, staff facilities, a brief introduction to the duties of A.P.A.s and arrangements for training and further education.

9. It is essential that the earliest opportunity is taken to introduce the safety aspects of the post and the individual's responsibilities towards accident prevention. It is therefore recommended that a session should be devoted on the first day to the duties and responsibilities of A.P.A.s with emphasis on safety and health matters and relevant regulations, fire-fighting and first-aid (see appendix 1).

introductory training

10. The induction should be followed by introductory training, given by a nominated supervisor, to prepare the entrant for his first job. This training should last for at least two weeks. In the first week a general introduction should be given to the overall duties of an A.P.A. and to power station plant, covering the ground set out in appendix 2; in the second, attention should be concentrated on the particular aspects of the total duties of an A.P.A. that the entrant will be required to undertake initially.
Instruction must continue until the supervisor is satisfied that the entrant can carry out his first job with competence. Throughout, particular emphasis must be given to safety.

11. Further background information about the industry as a whole, as well as elementary theory of power station work, are covered during the first stage of formal training (see paragraph 12 below and appendix 3). Introductory training therefore shades into the early sections of other phases of training.

formal training

12. Short formal courses at electricity boards' training schools, or other suitable locations, should be provided for operators under training, in three stages, at appropriate points in their development, as follows:

Stage 1
A one week course to be given within the first three months of appointment as A.P.A. with the objective of ensuring that the operator understands the principles of generating electricity.

Stage 2
A two-week course given towards the end of the A.P.A.'s on-job programme, i.e. approximately 30 to 36 months after appointment, and designed for potential A.U.O.s, boiler operators or turbine operators.

Stage 3
A two-week course given towards the end of an A.U.O.'s on-job programme, i.e. approximately 8 to 12 months after appointment as an A.U.O. and designed for potential U.O.s.

The topics to be covered in each stage are set out in appendices 3, 4 and 5.

13. The timings recommended in paragraph 12 should be adhered to as far as practicable, but some adjustment may be necessary to allow an optimum number of operators to be assembled, and to cater for any difference in the learning rates of individuals.

on-job training

14. On-job training should be spread throughout a period of 30 to 36 months for A.P.A.s; of 12 months for boiler operators, turbine operators and A.U.O.s; and of 12 months for U.O.s. These times are indicative of the period required to cover all the elements set out in the schedule, presuming no delays occur (e.g. due to shift working or the difficulty of forecasting the occurrence of infrequently performed operations) and bearing in mind that the operator will be required to perform normal duties at intervals during this overall period. If a backlog of uncompleted elements is seen to be accumulating then specific times should be allocated for training. The recommendation as a whole should be administered in a sufficiently flexible manner to meet varying local requirements.

15. The various tasks in which operators should be trained, together with an indication of the times suggested are set out in the appendices as follows:

appendix 6: on-job training for auxiliary plant attendants at unit and range stations,

appendix 7: on-job training for assistant unit operators at unit stations and boiler or turbine operators at range stations,

appendix 8: on-job training for unit operators at unit stations,

Some modification to the list of tasks will be necessary according to the plant in the generating station concerned. In the event of transfer to another station, or on the introduction of new equipment, supplementary training should be given as required.

16. At all stages of training it is important that emphasis is placed on instruction in safe working. The measures to be taken to prevent accidents must be an integral part of tuition.

facilities for and location of training

17. Formal training should be given off-the-job at suitably equipped locations which may include low merit stations, plant workshops or other places where adequate facilities such as classrooms, training aids, models, real plant or simulators are available for training. Programmed instruction may be one appropriate instructional method.

18. Simulators designed to reproduce running conditions in control room and main plant should be developed and used in training wherever possible; only in this way can realistic training in emergency procedures be effectively achieved. Simulators could do much to accelerate the completion of the on-job programme.

19. Normally the elements listed in the on-job training schedule, appendices 6, 7 and 8, will be covered by the operator in his own station, as opportunities arise during the performance of his normal duties; but maintenance programmes may provide unique opportunities for accelerated training, either at the operator's own station or a neighbouring station, through the use for instruction of plant which is not usually available.

associated theory

20. Stages 1, 2 and 3 of the formal training outlined in paragraph 12 and set out in more detail in appendices 3, 4 and 5, cover the theoretical knowledge required by operators to carry out their work effectively. These short courses will usually be most conveniently held in power station training schools from which visits to plant can readily be made as required. Instruction should always be given by staff who are technically competent and trained in instructional techniques.

further education

21. Every encouragement should be given to those employees who wish to add to their knowledge, and who have demonstrated the ability for further study, to prepare for the City and Guilds Certificate appropriate to their work either by attendance at a local technical college or by following one of the three correspondence courses provided by the C.E.G.B. Where an operator shows the ability to benefit from additional study, facilities can be provided under the Educational Incentives Scheme for him to follow suitable courses.

monitoring of training

22. Each electricity board should ensure that training programmes based on this recommendation and its appendices and appropriate to individual station requirements are drawn up for each grade of operator.

23. Overall responsibility for the training of his operator staff rests on the superintendent of the station at which the trainee is employed, but he will normally delegate this responsibility to a senior member of the station's engineering staff. This engineer will have available to him the advice of the training engineer on the staff of the region, where these have been appointed, and should work in close liaison with him. The responsible engineer in the station will ensure that training programmes for individual operators make effective use of the facilities both within and outside the station. His responsibilities will also include checking at the end of the training that the required standard has been attained, and carrying out an intermediate survey at least every three months, to ensure that the operators have progressed satisfactorily. Appropriate methods of checking will include observing the trainee at work, oral discussion and questioning;

but immediate attention should also be given to devising and implementing more formal attainment tests, to ascertain whether an appropriate standard of knowledge and skill has been reached.

24. The more detailed supervision of on-job training will be the responsibility of nominated supervisors, who should be given copies of each operator's programme and instructed as to any special features. The supervisors should be clearly briefed in the training aspects of their duties, including methods of instruction appropriate to on-job training.

25. Training check-books should be prepared from the appendices to this recommendation and used as a means of effectively monitoring progress and of highlighting training deficiencies. In addition, notes of guidance should be prepared for training supervisors and engineers, their main purpose being to emphasise points which it is especially important for operators to understand in undertaking or participating in the tasks listed in the check-book.

notes on appendices

In view of the change-over to metric units which, in common with British industry as a whole, will be taking place in electricity supply between the present time and 1975, electricity boards should ensure that all trainee operators are given training in the aspects of SI units which are applicable to their future work. Electricity boards should bear in mind that for many years to come, equipment manufactured to both Imperial and metric specifications will be in use, and that trainees must therefore be familiar with both systems and with appropriate methods of conversion.

induction training for A.P.A.s

appendix I

location At the A.P.A.'s station

duration One day

method On the first day of appointment, after being received by a member of the senior staff, the entrant should be introduced by a nominated supervisor to members of his working unit, and instructed in the items listed below.

content a) *Introduction and administration*

Entrants should be given:

An introduction to administration and wages staff, Local Advisory Committee and Works Committee representatives.

Copies of any station administrative instructions, and of N.J.I.C. agreement booklets.

A note of arrangements for training and further education.

Copies of station layout, organisation, staff trees, manning schedules, Local Advisory Committee and Works Committee information.

A general tour of the station.

b) *Duties*

Entrants should be briefly informed about the duties and responsibilities of A.P.A.s.

c) *Safety*

Aspects of the job with regard to safety and health matters and relevant regulations, fire-fighting, first-aid and the individual's role should be outlined.

introductory training for A.P.A.s

appendix II

location	At the A.P.A.'s station
duration	Nine days—immediately following induction training.
method	Instruction should be given by a supervisor trained in instructional techniques and should be closely related to the particular plant in the entrant's station. *Safe working methods must be an integral part of the instruction and accident prevention must be stressed at every stage.*
content week 1	a) *Introduction to station organisation* Entrants should be briefly instructed in the following: Plant functions and operations from receipt of fuel to electrical output at alternator. Line diagrams of main plant and auxiliary services. Main plant and station layout. b) *Plant and auxiliary services* Entrants should be briefly instructed in the purpose, type and operation of the following: Coal handling plant; oil fuel plant; boilers; turbines; alternators; ash and dust handling plant; auxiliary steam plant; water systems (circulating water, tower mains, soft water, condensate, etc.); other auxiliaries; instrumentation. Visits to the site should follow instruction in each main item of plant. c) *Alarms and protective devices* A simple explanation of the purpose, action and interpretation of alarms and protective devices, followed by visits to installations. d) *Review* Discussion on functions and operations of plant.

content week 2*

a) *Duties*

Training in the particular duties the entrant will be required to undertake initially.

b) *Conclusion*

Revision and final discussion.
Explanation of training programme, duties and rota for on-job training.

**Note*

The one week training period is flexible. Training must continue until the A.P.A. is competent to carry out his first job.

formal training—stage 1 for auxiliary plant attendants in unit and range stations

appendix III

location At a station training school or other suitable centre.

duration A minimum of one week within the three months following appointment.

content a) *Introduction*

Duties of A.P.A.s and their contribution to station efficiency; brief history and development of electricity generation; conversion of energy—heat—mechanical—electrical.

b) *Fuels*

Types, origins and properties of fuels (coal, oil and gas). Methods of handling and preparation.

c) *Steam raising*

Brief history of boiler plant and methods of firing. Drum, tubes, superheater, air heater, economiser. Draught. Elementary combustion. Simple treatment of boiler operation and control. Feed water.

d) *Steam utilisation*

Elementary ideas on turbines, turbine blading, glands. Cooling water system—condenser—unavoidable heat loss. Feed water system—feed heating—water purity. Oil system—lubrication—barring gear—jacking and oil pumps. Simple treatment of turbine operation and control.

e) *Electrical generation*

Generating electricity: the generator—rotor—stator—exciter—cooling systems.

f) *The waste products*

Clean Air Act—smoke. Ash and grit—grit arresters—ash handling and disposal. Effluents—river contamination.

g) *Safety of people and plant*

The part of the individual in accident prevention.
Personal safety—health risks—protective clothing—safety rules—permits to work.
Fire and explosion risks and fire-fighting—types and use of extinguishers.
Requirements of the Factories Act and associated regulations.

formal training—stage 2

for auxiliary plant attendants in unit stations

who are potential assistant unit operators;

for auxiliary plant attendants in range stations

who are potential boiler or turbine operators.

appendix IV

location At a station training school or other suitable centre.

duration A minimum of two weeks, given approximately 33 months after appointment as A.P.A. in unit stations; and approximately 27 months after appointment as A.P.A. in range stations.

content a) *Outline of power station cycle*

Conversion of heat to mechanical and electrical energy. Water—steam—condensate—make up. Order of merit—factors affecting efficiency—station cost per unit of loading.

b) *Heat, temperature and pressure*

Elementary treatment of the principles involved in heat transfer and steam raising. Radiation—conduction—convection.
Units of temperature and units of heat.
Unit of work. Pressure and boiling points.
Pressure—temperature—volume.

c) *Boilers and boiler house plant*

Brief history of the development of the boiler and description of types in use today. Water walls and circulation systems. Priming. Water alarms and regulators. Superheaters. Economisers—air heaters—draught fans—soot-blowers—types of steam and water valves.

d) *Fuels and fuel handling*

Origin and properties of coal, coke, fuel oils and gas. Calorific value—grindability—ash fusion temperature. Viscosity, flash point and ignition temperature. Hazards and safe practices when handling oil or pulverised fuel.

e) *Introduction to principles of combustion*

This session to deal very simply with the principles of combustion and their practical application in the boiler house. Composition of air—the combustion process. Time, temperature, turbulence—excess air—CO and CO_2—air pre-heating.

f) *Methods of firing*

Discussion of modern firing methods. Chain grate—pulverised fuel—cyclone furnace—oil fuel. Burner types. Mills and milling. Ignition. Ash and clinker formation. Boiler deposits. Unburnt losses; on- and off-load cleaning. Safety. Pulverised fuel code of practice. Importance of purging; explosion doors and blow-backs. Use of coloured glass for furnace inspection.

g) *Making and using steam*

Sensible heat. Latent heat. Superheat. Total heat. Superheating and re-heating. Heat exchangers. Use of steam tables.

h) *Turbines and condensers*

Brief history. Reasons for condensing. Impulse and reaction turbines. Pressure stages. Glands and gland sealing. Velocity changes. Steam bleeding as an aid to efficiency. Leaving losses and blade erosion. Thrusts. Couplings. Governors. Throttle and nozzle control. Oil pumps, various. Safety devices and procedures. Turbovisory equipment. Automatic de-loading.

i) *Feed water system*

Closed feed system. Feed heaters and automatic by-passing. De-aerators. Feed water storage and emergency arrangements. Control of air and cooling water leakage. Oxygen content. Oil contamination. Feed pump—leak-off—balance valve. Charging. Starting and shutting down. Extraction and de-aerator pumps. Operation procedures.

j) *Water purity*

Effects of impurities in feed water (gases, hardness, oil, etc.) Testing for purity.

k) *Circulating water system*

Conventional and dry cooling towers. Location of intake and outfall. Cooling water losses. Chlorination. Screening. Syphonic system.

l) *Boiler operation*

Duties of the operator; priming. Carry-over. Draining and use of steam traps. Checking and blowing down water gauge glasses. Testing water alarms. Correct pressure raising procedures, with reference to the effect of bad practices on superheaters, economisers and steam ranges. Bringing a boiler on and off load. Banking. Smoke prevention. Maintaining efficient combustion.

Operation in emergency: loss of water, loss of load. Water hammer. Loss of ignition. Loss of auxiliaries. Tube failures.

m) *Turbine operation*

Hot and cold starting procedures. Drainage. Critical speeds. Differential expansion. Causes and prevention of vibration. Loading and effects of load changes. Importance of gland sealing. Under-cooling and over-cooling of condensate. Interpretation of condenser readings—condensate and cooling water. Bearing oil temperatures. Shutting down procedure and idle running. Routine test of safety devices. Maintaining efficient operation.

Operating in emergency: loss of load, loss of vacuum. Loss of auxiliaries. Heater flooding.

n) *Generator*

Rotor, stator, and exciter. Cooling the windings—air fans, hydrogen cooling and sealing—water cooling. Explosion hazard of hydrogen. Pedestal insulation. Load control and despatching, with brief mention of grid control system.

o) *Accident prevention and safety rules*

Factories Act and Statutory Regulations as they affect the operator.

Preparation of plant for inspection and maintenance.

Requirements of Safety Rules including isolation of plant and the personal responsibility for prevention of accidents. Permits-to-work and other forms.

p) *Nuisance prevention*

Statutory requirements—how the operator can help. Requirements of the Clean Air Act. Effluents—cooling water—ash pond water—blow down—softening plant discharge. Avoiding river contamination. Noise abatement.

formal training—stage 3

for assistant unit operators

who are potential unit operators

appendix V

location At a station training school or other suitable centre.

duration A minimum of two weeks given approximately 8 months after appointment.

content a) *The duties and responsibilities of operators*

Importance of the team—supervisory aspects of the job*—communications.

b) *Economics*

Aspects of fuel costs. Station "order of merit" lists. Relative costs of station operation and maintenance. The importance of availability. Cost of outage of high merit plant.

c) *Plant*

Modern trends in plant design. Operation and maintenance. Advantages and disadvantages of high merit plant. The role of the operator—the need for knowledge, vigilance and care.

d) *Instrumentation*

Significance in operation. Pressure and temperature. Some practical aspects of temperature measurement. Steam and water blow. Pressure meters. Solid fuel and oil fuel measurement. Smoke density. Gas analysis. Oxygen meters. Automatic control systems.

e) *Steam*

More advanced work on steam production and utilisation. Use of steam tables. Examples in the calculation of cycle efficiency. Importance of superheat. Reheat cycles.

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f) *Condenser performance*

The importance of this aspect. Problems involved. River and cooling tower stations. Calculation of condenser efficiency. Inportance of continuous observation and checking on the log readings. The effect of vacuum on exhaust steam conditions.

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g) *Elementary electricity*

Resistance, voltage and current. Units. Ohm's Law. The unit of electrical energy. Energy conversion—coal, steam, electricity. Three phase generation.

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h) *Station auxiliary plant*

Points of special interest in the operation and protection of auxiliary plant, e.g. importance of transfer of electrical supplies between station auxiliary and unit boards. Starting up and shutting down. Boiler feed pumps. Pulverised fuel mills. Auxiliary extractors. Cooling water and extraction pumps. Forced and induced draught atmospheric valves. De-aerators and evaporators.

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i) *Efficient operation*

Factors affecting the station heat balance. Use of figures obtained from log sheets. Elementary calculation of station efficiency—loss method, etc. Boiler, turbine and condenser losses. Instruments.

j) *Safe operation*

Statutory requirements for pressure plant affecting operation. Increasing importance of correct boiler water level. Operational hazards and codes of practice to ensure safety. Safe operation—boilers, turbines, and condensers. Application of Safety Rules during operation and for maintenance. Responsibility for safety of others.

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k) *Interpretation of instrument readings*

The instrument panel. Inter-relation of instruments. Significance of instrument readings and actions to be taken.

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l) *System control*

System operation. The grid system. Grid control centres. Base load and two-shift operation.

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m) *Developments*

The nuclear power programme. Cross-channel link. Hydraulic transport of coal. Ash disposal and utilisation. Super-critical steam conditions.

**Note*
Further development of the operator in the supervisory aspects of the job might be necessary and consideration should be given to the use of formal courses to supplement the brief treatment given here.

on-job training for auxiliary plant attendants at unit and range stations

appendix VI

content a) The list of tasks shown opposite in which on-job training should be given applies to a typical unit station. It is not exhaustive and for larger or more complex stations it will be necessary to add further tasks. Conversely, for smaller stations some can be omitted.

b) The tasks relevant to range stations are marked opposite the headings as (B) for boiler A.P.A.s, (T) for turbine A.P.A.s and (B.T.) for both.

duration a) The suggested time shown against each group of tasks refers to the number of hours likely to be required by an operator of average ability, and may therefore be subject to variation in individual cases.

b) The addition of the suggested times gives a total of about 600 hours for a typical unit station, to be covered within a period of 30 to 36 months; and of about 450 hours for a typical range station, to be covered within a period of 24 to 30 months.

method a) The training will take place under the detailed supervision of nominated supervisors who will arrange for the instruction of the operator in those elements in the list below which are relevant to his work.

b) In some instances a whole shift may be devoted to training or, more usually, the supervisor and operator will cover individual tasks on an *ad hoc* basis during a normal shift.

Whenever operators are introduced to plant, processes and procedures, safe working methods must be an integral part of the instruction. Accident prevention must be stressed at every stage.

	task description		suggested time hours
1. boiler operation	*A 1) Fuel system*	(B)	40
	a) Check and operate—pumping and heating unit b) Clean—oil burners and test—oil filters c) Purge—oil burner system d) Assist with—lighting-up boiler e) Operate—trace heating system f) Operate—oil and condensate recovery systems		
	A 2) P.F. fired plant	(B)	80
	(Include an introduction to sections of the boiler house code of practice, referring to pulverised fuel) a) Appreciate—sequential operation of mill group and auxiliary oil system b) Check—mill group pre-start and normal conditions —mill group start-up conditions—mill group running conditions c) Clear—fuel blockages—mill rejects d) Check and operate—pumping and heating unit e) Clean—oil burners and test—oil filters f) Purge—oil burner system g) Assist with—lighting-up boiler		
	B) I.D. & F.D. gas and air circuits	(B)	40
	(Include an appreciation of damper function and control vanes) Operate—dampers—I.D., F.D., fans—air heaters —sootblowers—other on-load cleaning equipment—off-load superheater, reheater, economiser and air heater cleaning equipment.		

task description		suggested time hours
C) Feed water system	(B.T.)	40
(Particular attention to lubrication and function of leak-off mechanism. Give appreciation of plant alarm and necessary corrective action.) Operate and/or service—boiler feed pumps—feed water control valves—blowdown valves—boiler vents —boiler filling pumps—chemical injection pumps		
D) Steam system	(B)	24
Operate—steam auxiliary services for example: sootblowing—steam purging—steam atomising—steam tracing		
E) Ash handling	(B.T.)	80
(Include appreciation of safety mechanisms) a) Operate—ash and dust handling equipment, including: conveyors—pneumatic disposal systems—mixer conveyors—sluices—ash pumps—vacuum cleaning plant b) Sample—ash (as required)		
F) Routine testing	(B)	24
a) Check—gauge glasses b) Clean—smoke density indicators—plant c) Test (under supervision)—high/low water alarms—fuel/air temperature alarms—other scheduled plant		
G) Safe operation	(B.T.)	Time allowed in other headings
Understand—safe operating procedures and codes of practice —Board's Safety Rules and statutory requirements —P.F. explosion risks—need for good housekeeping		

	task description		suggested time hours
2. turbine operation	*A) Cooling water plant* a) Prime—c.w. plant b) Operate—c.w. pumps—chlorine injection plant or other treatment system c) Clean—screens or main strainers d) Regulate—make-up water system	(T)	24
	B) Condenser plant a) Prime—condensers b) Operate—on-load cleaning system c) Carry out—condenser tube cleaning d) Search for—leaks e) Operate—air exhauster plant	(T)	24
	C) Distilled water system and hydrogen cooling system (where applicable) a) Prime—distilled water system b) Operate—coolers—D.W. pumps c) Check—pump normal running conditions d) Operate—hydrogen drier—compressed air purge equipment (as directed) e) Monitor—equipment, including hydrogen pressure, temperature, purity levels f) Understand—risk of hydrogen explosion	(T)	16
	D) Lubricating and power oil systems a) Prime—oil systems b) Operate and clean—barring gear—strainers—oil coolers—oil centrifuge c) Check—standby plant availability—alarms	(T)	40
	E) Condensate and feed systems a) Operate—condensate dumping valves—system make-up valves—extraction pumps—feed pumps (see section 1C) b) Check—running condition of all pumps—standby plant availability—feed heater system—alarms	(T)	24

	task description		suggested time hours
	F) Evaporators Operate—evaporator	(T)	16
	G) Valves Instruction in correct operation and servicing of all valve types	(T)	24
	H) Routine tests Assist with—overspeed testing—vacuum trip testing—atmospheric valve testing—other scheduled tests	(B.T.)	12
	I) Normal duties Assist—during turbine run-up—during normal operation of auxiliary plant, including barring gear—gland sealing—ejector equipment—rotary air pumps—flange warming systems	(T)	24
	J) Lubrication (Specific instructions to be given in types of lubrication required in accordance with approved schedule.) Lubricate—main plant—auxiliary plant—gas turbine plant—automatic turbine lubrication system	(B.T.)	40
3. general duties	*A) Defects* Understand—significance of defects—detection and correction of minor defects—need to report to supervisor	(B.T.) Time allowed in general section on safety	
	B) Transformers a) Check—conservator, transformer and bushing oil levels—oil leaks b) Monitor and regulate—transformer oil temperatures—transformer winding temperatures c) Operate—oil pumps and coolers	(B.T.)	12

task description		suggested time hours
C) Instrumentation	(B.T.)	8
Understand—need for adequate instrumentation—care of instruments—interpretation of instrument readings		
D) Bulk chemical handling plant	(B.T.)	16
Operate—hydrogen, CO_2, nitrogen, caustic soda, sulphuric acid and other chemicals as instructed.		
E) Fire prevention	(B.T.)	24
a) Appreciate—standing orders for fire prevention b) Service and operate—fixed installations —other fire-fighting equipment—alarms		
F) Air system	(B.T.)	16
Operate and monitor—A.B.C. air system —G.P. compressed air system		
G) Station drainage	(B.T.)	16
(Draw attention to hazards of oil, acid and other pollution in station effluent) Operate—site drainage pumps—sewage pumps		
H) General service water	(B.T.)	8
a) Operate—G.S.W. pumps and strainers b) Service—tanks and reservoirs		

on-job training for assistant unit operators at unit stations and boiler or turbine operators at range stations

appendix VII

content a) The list of tasks shown opposite in which on-job training should be given applies to a typical unit station. It is not exhaustive and for larger or more complex stations it will be necessary to add further tasks. Conversely, for smaller stations some can be omitted.

b) The tasks relevant to range stations are marked opposite the headings as (B) for boiler A.P.A.s, (T) for turbine A.P.A.s and (B.T.) for both.

duration a) The suggested time shown against each group of tasks refers to the number of hours likely to be required by an operator of average ability, and may therefore be subject to variation in individual cases.

b) The addition of the suggested times gives a total of about 420 hours for a typical unit station, to be covered within a period of approximately 12 months; and of about 250 hours for a typical range station, also to be covered within a period of approximately 12 months.

method a) The training will take place under the detailed supervision of nominated supervisors who will arrange for the instruction of the operator in those elements in the list below which are relevant to his work.

b) In some instances a whole shift may be devoted to training or, more usually, the supervisor and operator will cover individual tasks on an *ad hoc* basis during a normal shift.

Whenever operators are introduced to plant, processes and procedures, safe working methods must be an integral part of the instruction. Accident prevention must be stressed at every stage.

	task description	suggested time hours
	(B)	
1. boiler operation	a) Operate—auxiliaries including boiler feed pumps—boiler fans—boiler circulation pumps	48
	b) Check—pre-start conditions on main and auxiliary plant	40
	c) Assist with—raising boiler pressure	24
	d) Set up—boiler feed water system	24
	e) Understand—boiler automatic control system and individual control loops f) Achieve—boiler performance targets	16
	(T)	
2. turbo-generator operation	a) Operate—turbines normally and for emergency shut down	40
	—auxiliary plant normally and for emergency shut down	16
	—ancillary equipment, *including* condensate and feed system in detail, hydrogen gas-seal system on load—gland seal equipment—flange warming equipment	40
	b) Test—for overspeed trips—for emergency valve checks (on and off-load)—vacuum pay-off—vacuum trip—pressure unloading gear	24
	c) Fill and discharge—gases from alternator	8
	d) Check—security and availability of stand-by plant	8
	e) Understand—requirements for two shift operation	8

task description	suggested time hours
	(B.T.)
3. general duties a) Operate—unit plant under normal conditions —unit control consoles (where applicable) b) Check—lubrication and cleaning of equipment —plant operating conditions c) Train and supervise—A.P.A.s d) Carry out—instructions from supervising staff	40
e) Understand—safe operating procedures and codes of practice—Board's Safety Rules and statutory requirements —methods of defect detection, correction and reporting —methods of instrumentation—unit auxiliary electrical system—emergency drills	24
f) Deal with—abnormal operating conditions and major emergencies on boilers	40
g) Deal with—abnormal operating conditions and major emergencies on turbo-generators	24

on-job training for unit operators at unit stations

appendix VIII

content The list of tasks in which on-job training should be given, set out below, applies to a typical unit station. It is not exhaustive and for larger or more complex stations it will be necessary to add further tasks. Conversely, for smaller stations some can be omitted.

duration a) The suggested time shown against each group of tasks refers to the number of hours likely to be required by an operator of average ability, and may therefore be subject to variation in individual cases.

b) The addition of the suggested times gives a total of about 180 hours for a typical unit station, to be covered within a period of approximately 12 months.

method a) The training will take place under the detailed supervision of nominated supervisors who will arrange for the instruction of the operator in those elements in the list below which are relevant to his work.

b) In some instances a whole shift may be devoted to training or, more usually, the supervisor and operator will cover individual tasks on an *ad hoc* basis during a normal shift.

Whenever operators are introduced to plant, processes and procedures, safe working methods must be an integral part of the instruction. Accident prevention must be stressed at every stage.

	task description	suggested time hours
1. boiler operation	a) Operate—main plant, including boiler feed pumps—	
	boiler fans—boiler circulating pumps	40
	—pulverising or oil-firing plant—dust precipitation plant	40
	b) Check—pre-start conditions on main and auxiliary plant	40
	c) Note—combustion chamber efficiency from instrument values	40
	d) Set up—feed water system	40
2. turbine operation	a) Operate—turbine normally and for emergency shut-down	32
	—auxiliary plant normally and for emergency shut-down	32
	b) Understand—requirements for maximum generation and emergency output	32
	—procedure for maintaining generation under conditions of system failure	32
3. general duties	a) Operate—unit plant under normal conditions	32
	b) Train and supervise—A.U.O's and A.P.A's	—
	c) Understand—safe operating procedure and codes of practice	16
	—Board's Safety Rules and statutory regulations	16
	—methods of defect detection, correction and reporting	16
	—methods of instrumentation	16
	—requirement for unit electrical stability	16
	—emergency drills	16
	d) Deal with—major emergencies and abnormal conditions on boilers	40
	e) Deal with—major emergencies and abnormal conditions on turbo-generators	24

glossary of terms

glossary of terms

training programmes	A descriptive outline of the training to be given to an operator indicating the tasks to be covered and the time to be spent on each component of training.
induction training	Training designed to inform the operator about the industry, its structure and functions, and his place within it with particular attention to his working unit.
introductory training	Training designed to prepare the operator for his first job. It will include instruction by his supervisor and may include a short course comprising talks and visits.
formal training	Training that is provided in an establishment designed or designated specifically for the purpose and staffed by persons trained in the techniques of instruction. It includes simulated training.
simulated training	Training provided in specially created conditions reproducing those of a working situation, where formal training methods can be followed and opportunity is given for practising and applying skills and operational procedures. It may include operations on plant and equipment that are out of service; on specially designed simulators; and in low-merit generating stations where training opportunities can be made available.
on-job training	Training provided on the location where the operator normally works. It will consist of periods of instruction either at or away from his normal work, by a supervisor competent to instruct; and practice in his work under training supervision. It will include those occasions when performance at his normal post is carried out under a supervisor, to confirm that instruction has been understood. Programmed instruction using teaching machines and programmed texts can be used as part of formal and on-job training.

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ABSTRACT - This course outline is for teacher use in conducting a course in franchise merchandising for adults in business and distributive education. The guide was developed by the State Department of Education in cooperation with representatives of franchise businesses. The content objectives are to acquaint the student with: (1) a review of franchise operations, (2) qualifications necessary for successful franchise operations, (3) the selection of a franchise, (4) pre-opening activities, and (5) ongoing operational activities. Each unit includes objectives, content outline, teaching points and techniques, and references to resource materials. A 1-hour final examination, suggestions for use of transparencies, and a selected bibliography are appended. (CH)

VT 010 570

A SUGGESTED ADULT COURSE OUTLINE

ED0 45856

FRANCHISE MERCHANDISING

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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BUSINESS AND DISTRIBUTIVE EDUCATION

VT010 570

B-E

THE UNIVERSITY OF THE STATE OF NEW YORK/THE STATE EDUCATION DEPARTMENT/BUREAU OF CONTINUING EDUCATION CURRICULUM DEVELOPMENT/ALBANY, NEW YORK/12224

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THE UNIVERSITY OF THE STATE OF NEW YORK

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Foreword

The franchising industry has expanded rapidly in recent years and is now one of the fastest growing methods of distribution in the country. Franchising is attractive to the individual desiring to own a business but who has limited experience and capital. Even though the franchise industry has a low failure rate, it is very important that prior to any decision every facet of the franchise opportunity be thoroughly investigated.

This publication is designed for teachers of adult business and distributive education courses. The guide provides methods, tips, and selected references that will assist the instructor to achieve effective teaching. The suggested outline identifies the content that a person should consider or understand before he signs a franchising agreement such as personal qualifications required, methods of selecting a franchise, and management techniques for opening and operating a franchise.

Appreciation is expressed to the following committee members who formulated the basic outline and provided the general content for each unit: Alexander A. Courtney, Manager, Manpower, Inc., Albany; George Magley, Vice President, Carrols Drive-In Restaurants, Syracuse; Frank R. Nostro, Neba-Mike's International, Inc., Albany; and William Rayburn, Branch Manager, Snap-On Tools Corp., Albany. The Bureau is grateful to Reno Knouse, Professor of Distributive Education, State University of New York at Albany, for his efforts in developing and writing the manuscript.

Assistance relating to the content was provided by John Brophy, Associate in the Bureau of Business and Distributive Education. Nelson S. Maurer, Associate in the Bureau of Continuing Education Curriculum Development, coordinated and supervised the preparation of the manuscript for publication.

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Message to the Instructor

The potential that franchising offers the small investor makes it an attractive opportunity for many. Before an individual invests his savings in such a venture, he should be sure that he understands the disadvantages and pitfalls as well as the advantages. This publication was developed to help you present information that will assist individuals to make a thorough study of a franchise prior to their investing in the opportunity.

The units are planned to be given in numerical order as adult or continuing education courses. Plan each unit before you present it to the class. You will need to plan classwork, discussion, and review. The left-hand column of each unit contains suggested topics to be covered. The right-hand column gives techniques, methods, and tips, as well as related information which should help you achieve effective teaching. Also, this column shows page references for selected books for which the complete citations and symbols are given on page 50. At the end of each unit, give a summary of the key points discussed.

Use the chalkboard, overhead projector, charts, diagrams, and other visual aids to clarify the material being presented. Duplicate for student use any important material. Give typical job situations as illustrations whenever possible. As the situations develop, consider the use of outside speakers to give additional and technical information on specific topics.

Franchising is expanding rapidly, so be alert for new books that might be available on the subject. Also be familiar with several financial and trade publications which will keep you up to date on the developments that are taking place in the franchising industry.

A suggested final examination is provided at the end of this guide. The questions are derived from the basic material and are in the form of matching, completion, and multiple choice. The correct answers given in each case are for the instructor only, and the spaces are to be left blank in presenting the questions to the students. It is suggested to make all the spaces the same length. The test should be completed in less than 1 hour.

As you gain experience with this outline, it is hoped you will send to the Bureau your suggestions for consideration in subsequent revisions.

HOBART H. CONOVER, *Chief*
Bureau of Business and Distributive Education

JOHN E. WHITCRAFT, *Director*
Division of Occupational Education

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Unit 1

A Look at Franchising

Objectives

- To become acquainted with class members
- To provide a general description of the course
- To become acquainted with the field of franchising
- To point out the advantages and disadvantages of franchising
- To present the historical development of franchising
- To indicate the importance of franchising in our current economy

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
I. Orientation	
A. Teacher introduction	Print the name of the course and your name on the chalkboard and give a brief description of your activities and experience.
B. Purpose of course	Explain that the course is being given to acquaint people with the opportunities, responsibilities, and pitfalls associated with franchising.
C. Group evaluation	Have each student introduce himself and volunteer such information as name, occupation, and where employed. Distribute cards with spaces for name, address, telephone number, occupation, place of employment, and previous experience in retailing and/or dealing with the public. Use this information to determine the background and individual needs of class members.
D. Course description	Explain briefly the subject matter covered in each unit.

A Look at Franchising

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
1. A look at franchising	Indicate that the advantages and disadvantages of franchising and a review of the development of the industry are given in Unit 1.
2. Qualifications required for success in franchising	Mention that the personal qualifications needed to operate a franchise successfully are explained in Unit 2.
3. Selecting a franchise	Point out that the procedures and methods for selecting a franchise are included in Unit 3.
4. Preopening activities	State that the preopening activities of a franchise operation are presented in Unit 4.
5. Ongoing activities	Indicate that suggested activities for the profitable operation of the franchise are set forth in Unit 5.
6. Final examination	Note that a final examination will be given at the end of the course to point out any weak areas. Indicate that a seminar will follow the examination for reviewing the test and any other questions that relate to the course.
II. Franchising	
A. Definition	Ask members of the class to give their interpretation of franchising. State that franchising is basically a system of distribution which is individually owned but operated as though it was part of a large chain. Franchising gives certain rights to a person to sell a product or a service in a prescribed way within a specific area. (Ref. B, pp. 10-11; Ref. E, pp. 4, 21-24; Ref. H, pp. 1, 4; Ref. I, p. 1; Ref. J, p. 7)†

†Reference citations are shown on page 50.

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
B. Characteristics	Discuss some of the characteristics of franchising such as (Ref. H, p. 3): • Product or service established • Continuing contractual agreement between franchisor and franchisee • Financial responsibility for both parties • Precise benefits and rights given to each party • Operational methods and procedures specified • Some of profits returned to franchisor
C. Advantages	
1. To the franchisee	Point out that some of the advantages of owning a franchise include (Ref. E, pp. 40-45; Ref. F, pp. 9-11; Ref. H, p. 2; Ref. I, pp. 2-3; Ref. J, p. 8): • Start in business with limited experience and capital • Lower risk • National advertising • Begin with established products and reputation • Managerial assistance and training available • Easier to secure capital • High personal motivation • Savings through bulk purchases
2. To the franchisor	Mention that some advantages of a franchise to the franchisor include

A Look at Franchising

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	(Ref. B, pp. 9-10, 107-119; Ref. H, p. 2): • Low cost for expansion • Uniform marketing procedures • Selective distribution • Savings through bulk purchases • Wide reputation • Low payroll and insurance costs • Selling expenses eliminated • Immediate community acceptance
D. Disadvantages	
1. To the franchisee	State that some of the disadvantages of owning a franchise include (Ref. D, pp. 45-46; Ref. F, p. 11): • Loss of personal identity • High assessment for fees, materials, and supplies • Inequitable and conflicting territories • High initial equipment costs • Dissimilar contracts within area • Difficult to cancel contract • Required to follow standard operating procedures • Too much dependence on parent company • Loss of some operating control
2. To the franchisor	State that some of the disadvantages of a franchise to the franchisor include:

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	• High supervisory costs • Disputes with franchisees • Loss of some operating control • Securing competent personnel • Lack of cooperation from franchisees
E. Historical development	Indicate that franchising is not new, is uniquely American, and has grown rapidly since 1945. (Ref. B, pp. 11-15; Ref. E, pp. 6-9; Ref. J, p. 7) Indicate that franchising began before the turn of the century when automobile manufacturers and petroleum refiners licensed dealers to sell their products in specific areas. Soon it included drugstores, variety stores, dance studios, soft drink bottlers, and auto parts stores. State that franchising flourished after World War II primarily in drive-in food and ice cream stands. Today some of the best known and oldest names in the American business world are franchising their products and services. (Ref. I, p. 2)
F. Importance	Point out that franchising is "big business", is rapidly approaching a $100 billion a year, involves approximately 5,000 companies with over 400,000 outlets, and accounts for one-fourth of all retail sales or more than 10 percent of the Gross National Product. (Ref. B, pp. 92-98) Note that the franchising industry is attracting over 40,000 new investors each year to enterprises ranging from simple operations to lavish establishments.

A Look at Francising

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
G. Types	Discuss the types of franchises available such as the conventional or over-the-counter operation, the mobile or "business on wheels" type, and the distributorship or "authorized dealer." (Ref. D, pp. 30-40)
H. Fraudulent offers	Indicate that the rapid expansion of the industry and the possibility of higher-than-average profits have attracted a few unethical operations. Emphasize the importance of a complete investigation of the franchisor before signing an agreement. Secure from a banker a Dun and Bradstreet rating for each franchisor being considered and check his standing with the Better Business Bureau and the International Franchise Association. (Ref. E, pp. 14-19, 126-131; Ref. J, pp. 8-10; Ref. K, pp. 36-38)
I. Failure rate	State that industry sources indicate that the failure rate for new franchises is less than 10 percent. This compares with over 30 percent for all new retail businesses. The causes of most of these failures were undercapitalization and lack of know-how and franchising tends to reduce these particular hazards. (Ref. B, p. 94; Ref. E, pp. 46-48; Ref. J, pp. 8-9)
J. Case histories	Relate a variety of franchise operations to illustrate the scope, possibilities, and pitfalls of the industry. (Ref. E, pp. 24-30, 52-60, 219-268) Point out that the basic ingredients for a successful franchise operation are long hours and hard work. Emphasize the importance of investigating the entire franchise offering before signing any agreement and turning over personal capital. (Ref. E, pp. 81-88; Ref. H, p. 8; Ref. J, pp. 10-11)

Unit 2

Qualifications Required for Success in Franchising

Objectives

- To determine the qualifications required for success in franchising
- To provide an opportunity for self-analysis prior to entering the franchising industry

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
I. Personal Goals	Emphasize the need for setting realistic goals and the importance of establishing short- and long-range plans before making a decision to enter the field of franchising. Indicate that the obligations of owning a franchise might well involve sacrifices relative to leisure time, hobbies, and time spent with family and friends. Caution that personal goals and satisfactions should be compatible with the demands and expectations of operating a franchise.
II. Approval and Cooperation of Family	Emphasize the need for the approval and willingness of the family to assist and/or make personal sacrifices and to cope with hardships during the transitional period and duration of the franchise agreement. Note that the lack of family cooperation could definitely affect the operation of the franchise.
III. Capital Requirements	Point out the necessity of determining the total investment required, including the down payment; cost of land, buildings, equipment, and supplies; and required operating cash. Also consider the methods of securing the capital, the interest rates, and re-

Qualifications Required for Success in Franchising

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	payment plans. (Ref. C, pp. 98-100; Ref. E, pp. 12-14, 52-60; Ref. F, pp. 13-15)†
IV. Personal Qualifications	Explain the importance of the following traits for those considering franchising: punctuality, independence, drive, energy, determination, friendliness, adventurousness, patience, perseverance, stamina, sincerity, and desire to serve others. (Ref. D, pp. 33-43; Ref. E, pp. 83-85)
	Point out that self-motivation affects the success of any enterprise. (Ref. B, pp. 23-33)
	State that individuals considering the operation of their own business should have the ability to analyze, to listen, to communicate, to administer, and to make decisions.
	Point out the importance of having some actual experience in the field before investing capital in a business of your own. Securing this experience might mean a delay in starting the business, but the time spent usually proves to be a valuable investment.
	Indicate the importance in franchising of being able to meet the public effectively. Reproduce and distribute the rating sheet found on page 10. Have each class member evaluate his qualifications for selling. Note that such a rating sheet points out areas of strengths and weaknesses.
V. Requirements of Specific Franchisors	Review a variety of promotional materials directed at securing franchisees and develop the personal characteristics and other requirements desired by the franchisors. (Ref. E, pp. 10-12, 76-77, 329-380)

†Reference citations are shown on page 50.

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
VI. Summary	State that the decision to go into franchising needs to be studied from many different viewpoints. Mention that checklists are available to aid a person to assess his qualifications for the franchising industry. (Ref. E, pp. 88-92; Ref. F, pp. 20-22) Reproduce and distribute the rating sheet found on pages 11 and 12. Have each class member evaluate his qualifications for success in the franchise industry. Compare the characteristics established in the rating sheet with those mentioned by franchisors in their promotional materials. Indicate that each individual has to really evaluate his ability to operate his own business successfully.

Qualifications Required for Success in Franchising

TRAITS NEEDED IN PERSONAL SELLING†

Directions: Rate yourself for each trait using 1 for *Hardly Ever*, 2 for *Sometimes*, and 3 for *Almost Always*. Write the appropriate number for each trait in the *Score* column and total. A score of 51 or above is good, 30 to 50 is average, and 29 or below is poor.

TRAIT	Hardly Ever (1)	Sometimes (2)	Almost Always (3)	Score
Objective	_____	_____	_____	_____
Well-groomed	_____	_____	_____	_____
Poised	_____	_____	_____	_____
Pleasant voice	_____	_____	_____	_____
Enthusiastic	_____	_____	_____	_____
Tactful	_____	_____	_____	_____
Loyal	_____	_____	_____	_____
Confident	_____	_____	_____	_____
Courteous	_____	_____	_____	_____
Friendly	_____	_____	_____	_____
Emotionally mature	_____	_____	_____	_____
Understanding	_____	_____	_____	_____
Industrious	_____	_____	_____	_____
Dependable	_____	_____	_____	_____
Good memory	_____	_____	_____	_____
Accurate	_____	_____	_____	_____
Imaginative	_____	_____	_____	_____
Knowledgeable	_____	_____	_____	_____
Interested in job	_____	_____	_____	_____
			Total	_____

†Adapted from *Revitalize Personal Selling in Your Store* by K. R. Gillespie, Small Business Administration, Washington D.C. May 1964.

Qualifications Required for Success in Franchising

SELF-ANALYSIS FOR FRANCHISING

Directions: Answer each question truthfully. Rate yourself by using 0 for *No*, 1 for *Maybe* or *Sometimes*, and 2 for *Yes*. Write the appropriate number for each question in the *Score* column and total. If you score 35 or above, you should probably continue your investigation of the franchise industry. If your score ranges from 25 to 34, you may wish to review again the requirements for operating a franchise before plunging into the industry. If you score 24 or below, it is doubtful if you should consider the field of franchising.

	No (0)	Maybe or Sometimes (1)	Yes (2)	Score
Am I self-motivated?				
1. Do I get to work on time without the need to punch a time clock?	___	___	___	___
2. Am I aware of things that need to be done and do them?	___	___	___	___
3. Do I work productively without supervision?	___	___	___	___
4. Do I complete things that I start?	___	___	___	___
5. Do I have lots of drive, energy, determination, perserverence, and an adventurous spirit?	___	___	___	___
6. Am I willing to work long hours at my place of business?	___	___	___	___
What are my goals?				
7. Am I prepared to make sacrifices for my business relative to hobbies, leisure time, and time with family and friends?	___	___	___	___
8. Do I have the ability to establish realistic goals?	___	___	___	___
9. Is my family aware of the part they will play in this business venture?	___	___	___	___
10. Is my family willing to make the personal sacrifices and give the necessary help?	___	___	___	___
11. Will my family be able to cope with the hardships during the transition period and until the franchise produces an adequate income?	___	___	___	___

Qualifications Required for Success in Franchising

	No (0)	Maybe or Sometimes (1)	Yes (2)	Score
Do I have the required capabilities and qualifications?				
12. Do I have the physical stamina required?	___	___	___	___
13. Have I had enough experience in the product line or service?	___	___	___	___
14. Do I have the physical and mental abilities and the business skills to go into business?	___	___	___	___
Can I secure the capital required?				
15. Can I finance the franchise from my own assets?	___	___	___	___
16. If not, can I get financing?	___	___	___	___
17. Is the payback plan and interest rate realistic?	___	___	___	___
18. Will I have sufficient reserve to tide me over during the transition period?	___	___	___	___
Would I make a good businessman?				
19. Am I as willing to listen as I am to talk?	___	___	___	___
20. Do I have an analytical mind?	___	___	___	___
21. Do I enjoy solving problems?	___	___	___	___
22. Do I have a sincere desire to serve my clientele?	___	___	___	___
23. Do I have the ability to make decisions without undue deliberation, based on fact and circumstances, with a minimum of adverse effect on all concerned?	___	___	___	___
24. Do I have the ability to successfully manage money?	___	___	___	___
25. Can I take suggestions from others about the operation of my business?	___	___	___	___

Unit 3

Selecting a Franchise

Objective

- To become acquainted with the procedures needed to analyze, evaluate, and select a franchise

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
I. Personal Considerations	Point out that the first things to consider in the selection of a franchise should relate to one's abilities, likes and dislikes, mental and physical condition, social status, and family attitude as discussed in Unit 2.
II. Business Considerations	
A. Sources of franchise opportunities	Discuss the different sources in which advertisements for franchise opportunities appear such as (Ref. E, pp. 72-76, 78-80, 292-348; Ref. F, pp. 162-186; Ref. J, p. 12):†

- Newspapers
  Local
  New York Times
  Wall Street Journal

- Magazines
  Drive-In Management
  Franchise Around the World
  Franchise Journal
  Income Opportunities
  Modern Franchising

- Trade Publications
  Coin-Op
  TV Technician

- Reports
  Franchise Company Media
  National Franchise Reports

†Reference citations are shown on page 50.

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	• Annuals *The Franchise Annual* *Directory of Franchising Organizations* Indicate that franchisor exhibits in universities and key cities also provide valuable information concerning franchise opportunities. Discuss the advantages and disadvantages of the various approaches franchisors use in their promotional materials to secure franchisees. These materials may be obtained locally or by writing to selected franchisors. (Ref. E, pp. 292-348; Ref. F, pp. 162-186)
B. Types of franchises	Note that franchises are available in practically every type of enterprise, including services, recreation, food, training, equipment, cleaning and maintenance, rentals, and vending operations. Mention that franchising has been called by some a "cradle to the grave" industry. (Ref. E, pp. 10, 30-40, 162-176, 271-291; Ref. F, pp. 159-161)
C. Population survey	Emphasize the importance of making a population survey to determine the trends and characteristic of the area in which the franchise is to operate. Recommend that the population ratio of the trading area to the franchise location should be at least 3 to 1. Therefore, if a city has a population of 30,000 people, the retail or marketing area should contain 90,000 people who come into the area to buy goods or services. (Ref. C, pp. 119-134)
D. Location survey	Point out the desirability for a complete location survey. Discuss the importance of the items included in location survey forms used by different

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	types of franchisors such as lot specifications and characteristics, owner, real estate agent, attorney, price, terms, traffic count, speed limit, proximity to shopping center, utilities, zoning regulations and competitors. (Ref. C, pp. 136-144; Ref. D, pp. 91-119; Ref. E, pp. 102-104; Ref. F, pp. 74-80, 192-194)
	Secure location survey forms from local franchisees or home offices for discussion purposes and ask students to find and rate a site for a specific franchise.
E. Real estate costs	Emphasize the importance of determining the costs for land, building, fixtures, and equipment.
	Note the difference in charges between real estate (land and building) that is purchased and real estate that is rented. (Ref. C, pp. 144-153)
	Indicate that the capital investment for real estate should be amortized by charging a rent factor to the business (a smaller percent on a long-term lease, a larger percent on a short-term lease).
	Point out the importance of obtaining information on the land and real estate costs of retail or service business in the location being considered.
	State the need to know if rent security is required.
F. Profit potential	Emphasize the importance of analyzing the income that can be expected from the investment of both capital and personal effort.
1. Estimated income	Show the method of determining the profit potential of a franchise based on gross income and estimated expenses as outlined in forms available from various franchisors.

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
2. Estimated return on investment	Explain the method of analyzing the potential rate of return on the investment. (Ref. G, pp. 42-48)
G. Capital requirements	Point out the importance of analyzing the capital required for the franchise for such items as fees, building, equipment, supplies, and operating cash. (Ref. E, pp. 12-14, 42) Indicate the need to know the amount of money that will be required for deposits on utilities, personnel benefits, insurance, and other related items.
1. Source	Emphasize the need to know the source of the capital required for starting and operating the franchise including loans from banks, friends, franchisor, and federal government. Consider inviting a local banker to discuss with the class the various types of financing available and methods of securing a loan. (Ref. C, pp. 100-106; Ref. E, pp. 60-67)
2. Types of financing	State the importance of investigating the different types of financing available for land and buildings, equipment, and materials and supplies. (Ref. D, pp. 67-70, 379-381; Ref. F, pp. 133-137) Point out the advantage of a quick turnover of inventory which will make money available for payment of the loan or reinvesting as compared with a slow turnover of inventory which will keep money tied up for a longer period of time. Discuss the policies of various franchisors for providing financial assistance to their franchisees.
H. Competition	State the importance of securing information about potential competitors.

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
1. Kind	Indicate that a survey should be made to determine the kind of competition that is in the area including type of business, company-operated or franchised, community acceptance, and nationally or locally based. (Ref. C, pp. 32-46, 131; Ref. D, pp. 99-100)
2. Number	Point out that it is necessary to know the number of competitors and their share of the potential business before a decision can be made to enter the field. Suggest that the absence of competition is not a true indicator for success in the area. With a new product there is always a hesitancy for acceptance without an educational program to show benefits. Review the sales problems encountered by the manufacturers of kerosene lamps, typewriters, phonographs, radio sets, television sets, and other new products.
I. Legal factors	
1. Contracts	Emphasize the importance of examining all contracts pertinent to the franchise such as purchases of land, equipment, supplies, and materials; financing; licenses and permits; corporation papers and/or partnership papers; and guarantees and/or warantees. (Ref. E, pp. 93-108; Ref. H, pp. 6-7) Indicate that other features of the contract which should be checked by the franchisee include: territories, fees, quotas, operating policies, franchisor responsibilities, personal restrictions, right to sell, and contract terminations. (Ref. E, pp. 101-108; Ref. F. pp. 28-32) Discuss several checklists that have been developed to help the franchisee

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	be sure all important contract items have been investigated. (Ref. E, pp. 95-101; Ref. H, pp. 9-10)
	Review the legal implications of various franchise contracts. Consider inviting a local lawyer to discuss with the class the legal aspects of a contract. (Ref. E, pp. 384-415; Ref. F, pp. 34-73)
	Recommend the selection of a well-respected lawyer who is experienced in the business contract field to review the franchise contract before signing.
	Indicate the need for basic business knowledge before getting involved with costly legal expenses. Discuss such sources of business information as the Small Business Administration, U.S. Department of Commerce, Government publications, trade associations, and educational institutions. (Ref. E, pp. 177-193, 349-378, 417-465)
2. Political and governmental considerations	Call attention to the need to investigate the political attitudes toward the prospective franchise at the local, state, and national levels.
	Point out the need to investigate zoning laws, health permits, and other governmental regulations.
J. Observation of existing operations	Indicate the advisability of visiting existing franchise operations and talking with the owners for first hand information about their problems and experiences.
1. Product or service reputation	Point out the need to investigate the acceptance of the franchise product or service in the community along with the reputation of the distributor.

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	Emphasize the importance of checking with actual franchisees concerning the fulfillment of promises made by the franchisor and the quality of services or products provided.
2. Profit and loss statement	Show the need to compare actual profit and loss statements of existing franchise operations with the estimated income statements supplied by the franchisor.
3. Failures	Point out the desirability of finding out the number and percent of failures connected with the franchisor.
	Mention the importance of studying the records of franchisees who failed to determine the reasons and causes for failure such as poor location, poor management of time and money, and lack of community acceptance. (Ref. E, pp. 49-51)
K. Public acceptance of prospective franchise	
1. Conformity	Discuss and illustrate with examples the advantages of operating a franchise that conforms with and is accepted in the community.
2. Nonconformity	Point out the problems involved in operating a franchise that does not conform to the community including costly sales promotion, lower profits, and higher risks. Indicate that the final results must justify the efforts to convert the public to the acceptance of the product or service.
III. Final Evaluation	Emphasize that prior to making a decision every facet of the franchise opportunity must be thoroughly investigated such as bank references and credit rating of the franchisor, the home office, other franchisees operating in the area, and the services expected from the franchisor. (Ref. E, pp.

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CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	76-77, 101-108, 126-134; Ref. F, pp. 20-27, 187-192; Ref. I, pp. 3-4; Ref. J, pp. 10-11)
	Mention the importance of seeking advice from the family, a lawyer, an accountant, close friends, and local businessmen before making a final decision. (Ref. E, pp. 202-212; Ref. F, pp. 16-19, 195-196)
	State the need to consider the demands that will be placed upon the family both socially and financially as well as their willingness to accept hardships without complaining and to cooperate by contributing time and effort to the business.
	Suggest the use of checklists for evaluating a franchise offer. (Ref. E, pp. 95-101, 132; Ref. H, pp. 4-10)
	Discuss typical questions that should be asked when considering a franchise opportunity such as those found on pages 21 and 22. (Ref. E, pp. 111-125; Ref. H, pp. 4-8)

QUESTIONS TO ASK WHEN CONSIDERING A FRANCHISE OPPORTUNITY

1. What is the reputation of the franchisor?
2. What is the financial rating of the franchisor?
3. What is the reputation of the product or service provided by the franchisor?
4. How much pre-training will be given by franchisor?
5. How much training and help will be provided by the franchisor after the opening?
6. How much capital is required for the initial investment of the franchise?
7. Is financing available from the franchisor?
8. What is the cost of good will?
9. What is the potential of the franchise?
10. What is the competition for the product or service?
11. How much help is needed to operate the franchise?
12. What is the company policy on guarantees, warrantees, repairs, etc?
13. What are the costs of advertising?
14. Who pays for special promotional discounts or premium giveaways?
15. What control or jurisdiction does the franchisor have over the franchisee?
16. Does the franchisor help finance receivables? If so, what are the costs?
17. Is floor planning available and necessary?
18. Does the franchisor recommend carrying open accounts? If so, how are they collected?
19. Who pays the freight costs on raw materials?
20. Are product knowledge and merchandising meetings conducted by the franchisor? If so, how often, where, and at who's expense?
21. Is the product line perishable? If so, who stands the loss?
22. Are there model changes? If so, how often and what is the disposal of the discontinued model?

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23. What are the business insurance costs?

24. How close to my franchise can the franchisor open another franchise?

25. What protection do I have with regard to a physical area or territory?

26. Do volume purchases qualify for longer discounts? If so, what are the amounts?

27. Are all new and salable materials returnable for full cash credit?

28. Does the franchisor set quotas and goals?

29. Why does the franchisor consider certain franchises successful?

30. Are reports and records of successful franchisees available for inspection?

31. What reasons does the franchisor give for the failure of some franchises?

32. Are reports and records of past franchisees who have failed available for inspection?

33. What is the franchise turnover rate?

34. How many business hours per week are required in a successful franchise?

35. How many hours per week are required for such things as bookkeeping, ordering, stocking, and correspondence?

36. How can a franchise be terminated and for what reasons?

37. Is the termination of a franchise effective upon a written notice?

38. Can the franchisee take on and operate a franchise of a competitive line or related line without jeopardizing his present franchise?

ERIC

Preopening Activities

Objective

- To provide guidelines for efficiently handling the preopening activities of a franchise

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
I. Training for Management	Emphasize the necessity for familiarization with available reference material on business management. Indicate that there is seldom time available for study after business operations have started. Point out the need for training not only in the mechanics of operating a business but also in any specific skills not now possessed.
A. Company publications	Describe the kind and scope of guidelines that are usually available from the franchisor such as procedure manuals, sales promotion, advertising, credit, accounting, employee selection and training, and legal requirements. (Ref. F, p. 82)†
B. Government and trade publications	Mention that pamphlets on business management are available from the Small Business Administration, the Internal Revenue Service, and trade associations. (Ref. E, pp. 354-378)
C. Company schools	Emphasize the value of attending a company training school to secure professional help and tested management techniques on the operation of the franchise. (Ref. F, pp. 23-24)
D. Local courses	Point out the opportunities that exist in adult education courses in area

†Reference citations are shown on page 50.

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	high schools on such subjects as marketing, accounting, and salesmanship.
E. Special consultants	Indicate that special franchise consultants are available for such services as hiring and training of personnel, managerial training, and market research. Mention that these services are costly and should be considered only after a careful study of the budget. Mention that since the quality of such services varies, a consultant should be carefully investigated before being engaged. (Ref. E, pp. 202-218)
II. Advertising and Publicity	Emphasize the importance of having a well-planned advertising program.
	Discuss the importance of becoming familiar with the local advertising media and the methods they use to promote business through publicity and paid advertisements.
	Describe the kinds of information that may have publicity value (at no cost) such as human interest features of the business, products, and customers; management's participation in community activities; tie-ins with current events and community developments; and unusual business promotions. (Ref. F, pp. 104-106)
A. Budget	Discuss methods of setting the advertising budget such as discretionary methods, formula methods, and objective-and-task method. (Ref. A, pp. 486-498)
	Point out that small businesses usually limit advertising budgets to 2 percent of the gross sales.
B. Newspaper advertising	Indicate that newspapers are the dominant medium in advertising, and that retailers and business establishments suffer when newspapers are closed because of strikes. (Ref. A, pp. 155-160)

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	Point out that the cost of contacting readers through newspaper advertising is less than 15 percent of the cost of third-class mail. (Ref. A, p. 160)
	Emphasize the importance of checking quantity, frequency, or earned discount rates with local newspapers. Point out that rate advantages are to be gained by "local" designation of business as opposed to "national." (Ref. A, 174-180)
	Explain that both display and classified advertising may be used effectively depending upon the product or service. (Ref. A, pp. 170-174)
	Indicate the importance when buying advertising of selecting the appropriate newspaper, the right class of advertisement, the best days, and the most desirable position on the page. Also emphasize the need of determining the special services rendered by the newspapers such as assistance in preparing the advertisements, point-of-sale aids, marketing data, and publicity. (Ref. A, pp. 160-170, 180-189)
C. Radio advertising	Emphasize the importance of radio as an advertising medium. Note that the radio is in the home, stores, restaurants, automobiles, and wherever man transports it. There are more than 150 million radio sets in the United States today. (Ref. A, pp. 254-261)
	Point out that the total coverage may not be as important as the "metro" coverage where potential customers are located. Describe the cost relationship to the size of this potential market. (Ref. A, pp. 263-269)
	Point out that radio listening can be measured by mail-questionnaires, mechanical or electronic recorders

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	(Nielson Radio Index, C. E. Hooper, Inc.), diaries, and personal interviews.
	Indicate the importance of selecting the right time segment and of obtaining tie-ins with the franchisor's regional or national advertisements. (Ref. A, pp. 261-263)
	Discuss the flexibility and low cost advantages of spot announcements.
	Emphasize that radio stations offer assistance in planning individual and long-range advertising programs. (Ref. A, pp. 270-273)
D. Television advertising	Point out the increasing popularity of television and its effectiveness as an advertising medium. (Ref. A, pp. 213-214)
	Emphasize the cost factor related to the realistic market for the franchisee's business. Point out that it is an expensive advertising medium in terms of immediate outlay, but that it may be relatively inexpensive in terms of effectiveness and number of potential customers reached. (Ref. A, 231-237)
	Discuss the various types of spot announcements such as station breaks, chain breaks, I.D's (station identifications), ROS (run-of-the-station packages), and in-program spots. (Ref. A, pp. 229-231)
	Describe "packaged" deals, and the meaning and significance of "preemptible" advertisements.
	Discuss prime and fringe time in relation to the business potential. (Ref. A, pp. 225-226)

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	Point out that television programs are measured quantitatively with the use of mechanical devices (A. C. Nielson Company and American Research Bureau), personal diaries (A. C. Nielson Company and American Research Bureau, Videodex), telephone inquiries (C. E. Hooper), and personal interviews (The Pulse, Inc.). Also indicate that a few organizations are attempting to measure television programs qualitatively. (Ref. A, pp. 241-246)
	Discuss the customer services provided by local television stations.
E. Other advertising media	Mention the importance of other advertising media such as direct-mail, outdoor, transportation, and specialty. (Ref. A, pp. 283-334; Ref. C, pp. 646-648)
F. Selecting a local advertising agency	Note that the advantages of using a local advertising agency include (Ref. A, pp. 468-470): • Knowledge of market and media • Awareness of best buys • Professional skill at minimum cost • Ability to put together "deals"
G. Opening promotion	Indicate the need to plan in detail the opening promotion and the techniques for followup activities. (Ref. C, pp. 623-643; Ref. D, pp. 521-532, 535)
	Point out that the parent company usually provides the franchisee with pretested advertising and promotional aids including a plan for the opening activities. Emphasize the importance of using those aids and plans as they are professionally designed and appropriate for the event. (Ref. F, pp. 24, 84-85)

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
III. Securing Capital and Credit	Point out the desirability of locating the commercial bank that offers the lowest charge for checking account services and one that will cooperate with short term loans on a favorable basis. (Ref. F, pp. 134-137) Note the advantages of a check reconciliation service for a business that writes many checks. Mention that the bank's potential as a customer of the franchisee may override any of the above considerations. Discuss the importance of establishing a credit standing by regularly submitting financial statements to the bank. Describe the corporate resolution procedure to institute an account. Discuss the limitations on check signatures. Explain the services offered by Dun and Bradstreet and local credit agencies including credit checks and collections. Describe collection procedures including followup letters, warning notices, and placement of accounts for collection with attorneys. (Ref. D, pp. 646-652)
IV. Arranging for Utilities	Point out that free consulting services are offered by utility companies for planning power and light requirements and a satisfactory system of communications. Discuss the lead time required when requesting the installation of utilities. Mention the possibility of reserving telephone numbers in sequence ahead of the actual need for the service.

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	Describe the policies of the power and telephone companies regarding deposits for service.
	Examine possible alternatives for intercommunication systems that are available through private firms.
V. Procuring Personnel	Indicate the importance of following the staffing recommendations made by the franchisor.
	Emphasize the need to allow sufficient lead time for: • Placement of recruiting advertising • Scheduling and conducting applicant interviews • Checking references suggested by applicants • Adequate notice for employment termination with other employers • Preliminary employee training
A. Employment agencies	Discuss employment agencies as a source of employees, methods of handling agency fees, and the necessity for giving accurate job information to permit the most effective selection of applicants.
B. Temporary help	Explain the cost advantages in using part-time help wherever possible in the early stages of the business. State that the use of such help also avoids precipitous permanent hiring decisions.
	Describe firms which specialize in supplying temporary help and point out how these agencies relieve the franchisee of many details at the very beginning.
C. Selection	Emphasize that the success of the operation is dependent upon the type of employees selected. (Ref. C, pp. 264-269; Ref. D, pp. 215-222)

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	Indicate how the application blank, the employment interview, conferences with references, and tests are used to determine if the individual possesses the required characteristics for the job. (Ref. D, pp. 222-230)
D. Training	Mention that plans must be made for employee training and personal followup at the site. (Ref. C, pp. 269-274; Ref. D, pp. 230-242)
E. Determination of the pay scale	Point out the availability of wage information from the Bureau of Labor Statistics, the Administrative Management Society, various agencies of the State, and local chambers of commerce. (Ref. C, pp. 278-285; Ref. D, pp. 244-255)
	Suggest that, even at the outset, competition for people may force the consideration of a comprehensive fringe benefit program for employees. (Ref. C, pp. 285-286)
VI. Acquiring Legal Assistance	Discuss the importance of selecting a lawyer with business and tax experience and one who will devote adequate time to a new businessman.
A. Form of organization	Examine and discuss the benefits and limitations of: • Corporations • Sub-chapter "S" corporations • Partnerships and limited partnerships • Proprietorships
B. Licenses and mandated requirements	Indicate that there is a need to obtain various types of permits and licenses. These are generally obtained by a lawyer and include: • Health permits

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	• Food permits • Local permits for signs • Employer's identification number • Employer's state unemployment number • Use of checks • Fair employment and minimum wage posters • Use of a name or title • DBA (doing business as) certificates
C. Federal and state labor laws	Review the state laws regarding women and children in industry, the employment of minors, and overtime provisions. (Ref. C, pp. 291-294)
D. Will	Emphasize the urgent necessity for an up-to-date will even though the business is new.
VII. Securing Insurance	Explain legally mandated insurances. Discuss the selection of a local broker to survey the franchisee's needs relative to such types of insurance as (Ref. D, pp. 734-755; Ref. F, pp. 138-143): • Workmen's compensation • Disability • General liability • Auto and nonowned auto • Primary commercial bond • Umbrella coverages • Key-man

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	• Mortgage or bank loan • Valuable papers • Fire, theft, wind, and water Point out the importance of having a local insurance claims representative for speedy service and rapid settling of cases. Explain the procedure for processing compensation and disability claims.
VIII. Accounting Procedures	Point out that proper record keeping procedures are essential to achieve adequate earnings and assure the successful operation of the business. (Ref. F, pp. 144-148) Explain the services available from a public accountant or a certified public accountant. Establish guidelines for the selection of an accountant and the factors which determine the frequency of financial reports.
A. Internal controls	Explain the purposes of the balance sheet and the profit and loss statement and how they are used to focus attention on the kinds of information which will permit or compel specific action. (Ref. C, pp. 752-758, Ref. D, pp. 655-670) Emphasize the importance of regular consultations with the accountant to analyze the financial statements of the business.
B. Systems	Mention the necessity of following the franchisor's recommendations of the following (Ref. C, pp. 833-837; Ref. D, pp. 716-731): • Payroll (hand, pegboard, or machine prepared)

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	• Invoicing forms and procedures • Cash receipt procedures • Accounts receivable including statement forms and procedures • Accounts payable including the importance of applicable discounts • Office records and filing procedures
IX. Summary	Emphasize the necessity of completing all plans as outlined above prior to the opening of the business. Point out the importance of total concentration on "business-getting" activities after the formal opening. Indicate the need for complete family cooperation and help during this crucial period.

Unit 5

Ongoing Activities

Objectives

- To provide guidelines for management activities that will aid in the efficient operation and expansion of a franchise
- To indicate safeguards against the vulnerabilities of a continuing franchise
- To indicate the ownership problems of a mature franchise

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
I. General Management Activities	Point out that sound business management practices must be followed throughout the entire life of the franchise. Indicate the necessity for continued personal motivation, study, discipline, and improvement. (Ref. F, p. 27)†
	Explain that the emphasis on specific management practices varies with the period of development of the franchise.
II. Management Activities During the Developmental Period	
A. Sales	Emphasize the importance of strict adherence to the franchisor's sales policies and practices during the developmental period of the business.
	Mention the importance of devising a workable plan for reaching prospective customers and the necessity of following the plan regularly. (Ref. F, pp. 92-99, 123-127)
	Discuss the various methods of increasing sales such as contests, seasonal promotions, "tip clubs," tie-ins with other events, and creative

†Reference citations are shown on page 50.

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	selling ideas. (Ref. F, pp. 86-115, 128-132)
	Note the importance of revising the sales budget as the business expands. (Ref. C, pp. 300, 406-417; Ref. F, pp. 144-147)
B. Public relations and promotion	Point out the necessity of using the franchisor's plan for public relations and promotion, since it is usually professionally developed and pretested. (Ref. C, pp. 546-567)
	Explain the importance of becoming acquainted with the area and getting involved in such activities as community improvement plans and fund raising programs for charitable, youth, and welfare organizations. (Ref. D, pp. 47-48; Ref. F, pp. 82-84, 105)
	Indicate the importance of creating and maintaining a good public image through service, integrity, thoughtfulness, patience, cheerfulness, and graciousness. (Ref. F, pp. 123-127)
	Ask the students to suggest other practices which would help to maintain a good public image.
C. Accounting	Discuss the importance of the regular services of an accountant for evaluation, advice, and assistance in budget planning. This service would point out where additional spending would be beneficial and where spending should be reduced.
	Emphasize the necessity of keeping within budget limitations during the developmental period of the franchise.
	Explain how to calculate the break-even point. (Ref. C, pp. 57-63; Ref. F, pp. 148-151; Ref. G, pp. 1-34;)

Ongoing Activities

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	Mention the necessity of being aware of all of the factors that may affect the earnings of the business.
	Indicate that ratios show the relationship between two items. Emphasize the importance of studying specific business ratios in order to have a continuing picture of the progress of the franchise. Explain the use of the following ratios: current, operating, gross earnings, unit cost, capital employed, and fixed property. (Ref. F, pp. 151-158)
	Discuss the importance of maintaining proper controls over credit and collections. (Ref. D, pp. 617-652; Ref. F, pp. 154-155)
	Emphasize the need to limit the personal withdrawal of funds during the developmental period of the franchise.
D. Quality control	Point out the need for quality control of goods or services sold so as to maintain customer satisfaction. (Ref. D, pp. 443-444)
E. Personnel	Call attention to the necessity for continued training and close supervision of personnel in order to maintain peak efficiency. (Ref. C, pp. 272-274, 286-289; Ref. D, pp. 231-242)
	Point out the need to consider the adoption of various fringe benefits for permanent employees such as medical and health services, group insurance, savings and loan plans, and recreational and educational activities. (Ref. C, pp. 285-286; Ref. D, pp. 262-267)
	Discuss the importance of hiring key staff to assist management. (Ref. C, pp. 274-276)
	Emphasize the importance of requiring key personnel to sign restrictive

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	covenants so that they cannot enter into competition after they have been trained and acquired experience in the business.
F. Legal	Call attention to the need to meet all legal requirements in the franchise contract including notice of intent to continue and provisions to extend or revise the agreement.
	Emphasize the necessity of being aware of developments that may affect profits such as misuse of workman's compensation provisions by former employees and proposed tax or minimum wage laws.
G. Financial	Explain the importance of reviewing the need for additional capital for expansion of the business including the possible acquisition of more land, buildings, and equipment.
H. Coordination	Discuss the need of coordinating all activities to meet the expanding needs of the business. (Ref. D, pp. 768-769, 779-782)
III. Management Activities in an Established and Continuing Business	
A. Vulnerabilities and necessary action	
1. Excessive expenses	Note that an acceptable gross with a low net indicates a need to review the costs of doing business. This might include a study of such items as the cost of extra personnel, the use of extra or inefficient equipment, and the practices involved in purchasing materials and supplies. (Ref. C, pp. 821-844)
2. Business, social, and political changes	Mention the importance of being aware of business, social, and political changes that may affect the franchise such as amount and distribution of

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
	personal income, increase in automation, economic conditions in the trading area, and new laws and restrictions. (Ref. D, pp. 12-26, 760-761; Ref. E, pp. 269-276)
3. Market changes	Emphasize the importance of a continuous study of the potential market and of keeping in contact with a changing clientele considering such items as population growth, changes in age groups, and changes in customer preferences. (Ref. D, pp. 9-12, 769-772)
4. Community changes	Point out the need to be alert to community changes that may affect the business and require a change in location.
5. Modernization of facilities	Discuss the advantages of modernizing the facilities before sales begin to decrease. (Ref. C, pp. 155-162; Ref. D, pp. 141-143)
6. Growth	Indicate the importance of being able to anticipate the need for expansion and of being in a position to take the appropriate action.
B. Personnel	Emphasize the advantages of selecting and keeping loyal, honest, and devoted employees.
	State the necessity of being able to train and inspire the employees to do their work in an acceptable manner.
	Indicate the importance of being willing to listen to employee problems, and at the same time being firm and following rules that enable the franchise to succeed.
	Emphasize the need to consider retirement and profit sharing plans for key personnel. (Ref. C, pp. 283-285)

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
C. Managerial assistance	Mention that as the business grows there comes a time when the owner cannot do everything himself, and needs to select an individual to share the responsibilities of managing the franchise. Point out the advantages and disadvantages of promoting from within the organization. Note the importance of outlining in detail the duties and financial obligations of a management assistant.
D. Retirement	Emphasize the need to recruit and train key personnel so that the owner can be released from major duties at time of retirement.
1. Succession	Point out the necessity to revise incentive plans including profit sharing, pension provisions, or part ownership for the successor upon the owner's retirement.
2. Estate planning	Call attention to the need for reviewing estate planning and the application of the federal estate and gift tax laws.
3. Retention of franchise	Discuss the various options that the owner or his heirs have for retention of the franchise.
IV. Summary	Indicate that franchising has been a tremendous boon to the small investor interested in operating his own business. Note that there are now more than a half million individual franchises offering a large variety of goods and services.
A. Advantages	State that an outstanding advantage of franchising is the reduced risk of failure because of management assistance available through the continuing relationship with the parent company.

Ongoing Activities

CONTENT OUTLINE	TEACHING POINTS AND TECHNIQUES
B. Personal qualifications	Mention that no one should enter franchising without analyzing his personal characteristics to make sure that he has the necessary qualifications to succeed. Motivation and enthusiasm are important requirements for success. Business "know-how" is an added asset, but ability and desire to learn are frequently given a higher priority by the parent company.
C. Selecting a franchise	State that in selecting a specific franchise, the likes and dislikes of a person should be prime considerations. The actual decision should be made only after every facet of the franchise has been thoroughly investigated including such items as a population and location survey, capital requirements and franchising, profit potential, and family acceptance. No contract should be signed without legal counsel to assure that all provisions are included.
D. Preopening activities	Indicate that the franchisee should be familiar with the management techniques involving employee selection and training, sales promotion, advertising, financing, accounting, and insurance. Emphasize the importance of making all necessary plans for the operation of the business prior to the formal opening.
E. Ongoing activities	Note the importance of using the proper management practices during the early stages of the franchise. As the business develops and grows, different management activities need to be emphasized in order to keep the business financially sound. Adequate provisions for management succession, retirement, and retention of the business must also be considered. Indicate that franchising offers many attractive rewards for those qualified individuals who choose the right opportunity carefully and who are willing to put a great amount of time and energy into the business.

Final Examination

Final Examination Part I — Fill-In Statements

Directions: For each statement, write the item or phrase that, when inserted in the blank, will correctly complete the statement.

1. Small businesses usually limit advertising budgets to approximately 2 percent of sales.

2. The most expensive medium of advertising from the standpoint of immediate outlay is TELEVISION.

3. The place, the piece of land, the street, or the store where the business is established is called the franchise LOCATION.

4. The franchisee should consider the adoption of pension and profit sharing plans for KEY employees.

5. The most flexible and low-cost type of advertising coverage on radio and television is referred to as SPOT advertising.

6. The operating ratio of a business compares net profits with NET SALES.

7. Employee medical and health services, financial benefit plans, and recreational and educational activities made available by the employer are referred to as FRINGE BENEFITS.

8. Up-to-date franchise facilities should be provided BEFORE sales begin to decrease.

9. Insurance that is required by all franchisees is referred to as legally MANDATED insurance.

10. The official organization representing the franchising industry is the INTERNATIONAL FRANCHISE ASSOCIATION.

11. The statement that shows the financial position of a business at the end of a period is called a (an) BALANCE SHEET.

12. Compared to other types of businesses, the risk of failing in franchising is LOWER.

13. Franchising offers the manufacturer an opportunity to expand rapidly without increasing the cost of MANAGEMENT.

14. Franchising had its greatest development since 1945.

Final Examination

15. Compared to other types of businesses, the profit ratio in franchising is HIGHER.

16. The key to success in franchising is SELF-MOTIVATION.

17. Franchising offers an opportunity for those with limited CAPITAL and EXPERIENCE.

18. The marketing area which is exclusively assigned to the franchisee is called the FRANCHISE TERRITORY.

19. Capital investment should be amortized by CHARGING RENT to the franchise business.

20. Net sales less the cost of goods sold is called GROSS PROFIT.

21. A social device for transferring certain risks to a second party upon payment of a fee is called INSURANCE.

22. Allowing for changes in competition and business conditions, estimated sales are usually based on past SALES.

23. In order to prevent a key employee from entering into competition with the franchisee, the employee should be required to sign a (an) RESTRICTIVE COVENANT.

24. In television advertising, ROS means RUN-OF-THE-STATION.

25. An organization of salesmen for the purpose of exchanging information that will result in added sales is referred to as a (an) TIP CLUB.

Final Examination Part II — Multiple Choice

Directions: For each statement place an X in the space to the left of the choice that most accurately completes the statement.

1. A true franchise will always include the use of a

   _____ (a) gentlemen's agreement
   _____ (b) pension plan
   __X__ (c) common name
   _____ (d) mandated location

2. It is important for the prospective investor to know

   _____ (a) who founded the franchising company
   __X__ (b) the franchisor's financial strength
   _____ (c) the franchisor's key employees
   _____ (d) who makes decisions in the parent company

3. Franchising has been described as a

_____ (a) "fast-buck" operation
_____ (b) limited income business
_____ (c) "fly-by-night" business
__X__ (d) "cradle to the grave" industry

4. The population ratio of the trading area to the franchise location. should be at least

_____ (a) 2:1
__X__ (b) 3:1
_____ (c) 4:1
_____ (d) 5:1

5. Franchising reduces business failure by eliminating the lack of

__X__ (a) know-how
_____ (b) vision
_____ (c) ambition
_____ (d) interest

6. Franchise agreements are usually

_____ (a) standardized
_____ (b) oral
_____ (c) average
__X__ (d) varied

7. The franchisor usually does *not* have the right to specify the

_____ (a) amount of inventory
_____ (b) accounting system used
__X__ (c) franchisee's work hours
_____ (d) maximum amount of profits withdrawn by the franchisee

8. The largest volume of business in franchising is in the field of

_____ (a) food industry
__X__ (b) automobiles and trucks
_____ (c) gasoline and automobile service
_____ (d) soft drink bottlers

9. During the early stages of the business, it is usually more economical to have a larger number of

__X__ (a) part-time employees
_____ (b) key employees
_____ (c) female employees
_____ (d) full-time employees

Final Examination

10. An up-to-date will should be drawn up during the

X (a) early stages of the business
____ (b) middle stages of the business
____ (c) advanced stages of the business
____ (d) failing stages of the business

11. Financial statements should be submitted to the bank

____ (a) when requested
____ (b) yearly
____ (c) before applying for a loan
X (d) regularly

12. The franchisee is usually individually responsible for

____ (a) employee training programs
____ (b) the design of the store layout
____ (c) the program for the store opening
X (d) franchise legal services

13. The franchisor is especially interested in the prospective franchisee's

____ (a) experience in franchising
X (b) character, personality, and ability
____ (c) social status
____ (d) present income

14. The prospective franchisee should

____ (a) have a lawyer make all contracts
____ (b) consult a banker
X (c) investigate before investing
____ (d) negotiate through an accountant

15. The franchisee is basically operating as a (an)

____ (a) leasee
____ (b) partner
____ (c) cosignee
X (d) owner

Final Examination Part III — Matching

Directions: In the space provided to the left of each item in Column I, write the letter of the word or phrase from Column II which best defines the item in Column I.

Column I	Column II
1. E Franchise marketing	A. Optional type of insurance
2. F Franchisor	B. Pioneer in franchising
3. G Nielsen	C. Charge in addition to investment in inventory and equipment
4. L Workmen's compensation	D. Flat charge paid by franchisor
5. J Restrictive covenant	E. Licensing system
6. H Continuing relationship	F. Parent company
7. C Franchise fee	G. Television rating service
8. I Advantage to franchisor	H. Distinguishing characteristic of a franchise
9. A Insurance on valuable papers	I. Rapid expansion
10. K Advantage to franchisee	J. Agreement not to engage in similar business
	K. Continuing guidance of experienced people
	L. Legally mandated insurance

Preparing and Using Transparencies

Visual aids are both a tool for teaching and an avenue for learning. They lend themselves well to bring about a high level of involvement. When working with adults, it is well to remember that much can be learned from each other. While no particular amount of time is recommended for using such materials, it is suggested that they be used with a variety of learning activities.

Materials for use on the overhead projector may be prepared by hand, the heat-transfer process, and the color-lift process. Each method is described briefly for those who might like to make original transparencies. Also included are procedures for the use of the overhead projector.

Handmade Process

Produces a simple and inexpensive transparency.

Materials Needed

Plastic sheet or roll - clear or frosted
Markers - grease pencil or pen
Ink - transparent or india

Suggested Procedures

- Select only content that is appropriate for an overhead transparency.
- Keep content of transparency simple.
- Organize the content of the transparency carefully.
- Use multiple overlays (one transparency over another) for the development of a concept or to show steps.
- Keep master and overlays in register with crosshair registration marks in opposite corners.
- Use color to make the transparency attractive but only enough color for emphasis. Color-toned sheets or colored ink may be used to identify parts of a drawing or picture.
- Plan transparency for horizontal projection.
- Mark directly on the plastic sheet. This may be done in front of the class as you are giving the lesson or may be prepared ahead of time.

- Use letters and symbols that are at least $\frac{1}{4}$-inch high. Use a lettering guide or dry-transfer letters and symbols to produce attractive titles or labels.

- Leave a $\frac{3}{4}$-inch clear margin on all sides of the transparency.

- Use a pointer to identify a specific part and then remove it quickly or lay pointer on transparency for a hand-held pointer cannot be kept steady, and therefore, becomes distracting.

- Use a sliding or hinged mask to control the rate of disclosure when more than one step is included on a transparency.

- Remove materials placed on a handmade transparency with a sponge or cloth moistened with water or a special cleaning fluid. Then the transparency is ready to be used again.

Heat-Transfer Process

Produces a transparency from almost any original that is flexible and no thicker than a sheet of paper.

Materials Needed

Plastic sheets
Item to be copied
Copying machine

Suggested Procedures

- Material to be copied can be opaque or transluscent but should have a carbon-type ink base *(black)*.

- Follow the directions for the specific copying machine and use the recommended type of plastic sheets.

Color-Lift Process — Drymount Press

Produces a transparency by transferring the ink of a printed picture to a sheet of transparent film. Only material printed on a clay-based paper may be used.

Materials Needed

Special film
Detergent
Flat tray
Drymount press
Pressure boards
Item to be transferred

Preparing and Using Transparencies

Suggested Procedures

- Select and test the picture to be lifted. Wet the fingertip and rub over an unprinted portion of the page. Clay-based papers will leave a white residue on fingertip.
- Dry the picture for 5 seconds in a drymount press set at 270° F.
- Put the picture on the coated side of the special film and place between pressure boards. Heat resulting sandwich for 2 - 3 minutes in a drymount press set for 270° F.
- Place picture and film in lukewarm water containing a liquid detergent. Soak for 2 minutes or until the paper pulls easily from the acetate.
- Wash clay coating from picture and dry film carefully.
- Spray ink surface with clear lacquer spray. Allow spray to dry then mount transparency.

Suggested Transparencies

A number of samples for overhead transparencies are presented below. They were selected from a series of projectuals used by the Small Business Administration for their Administrative Management Program. Instructors may wish to use the materials as presented or to develop and use their own visual aids.

ADVANTAGES of FRANCHISING

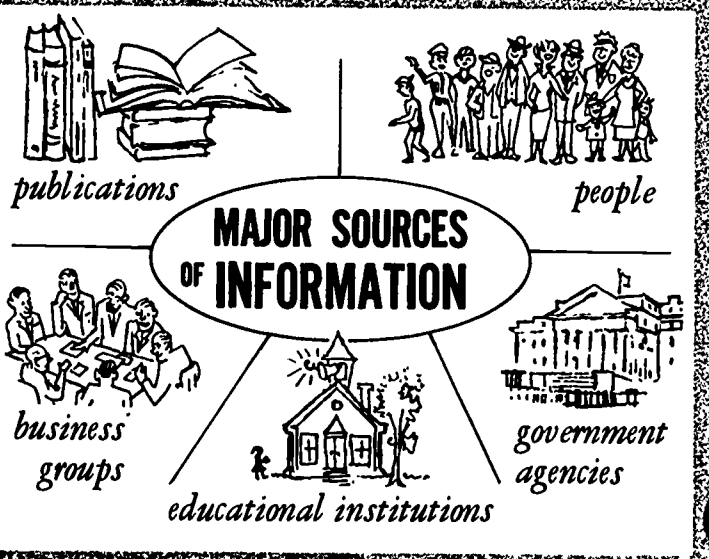
1 Smaller than usual capital investment
2 Less working capital than normally required
3 Product or service usually has prior public acceptance
4 Inexperience and limited education less of a handicap
5 Management assistance
6 Better than average profit margins are typical

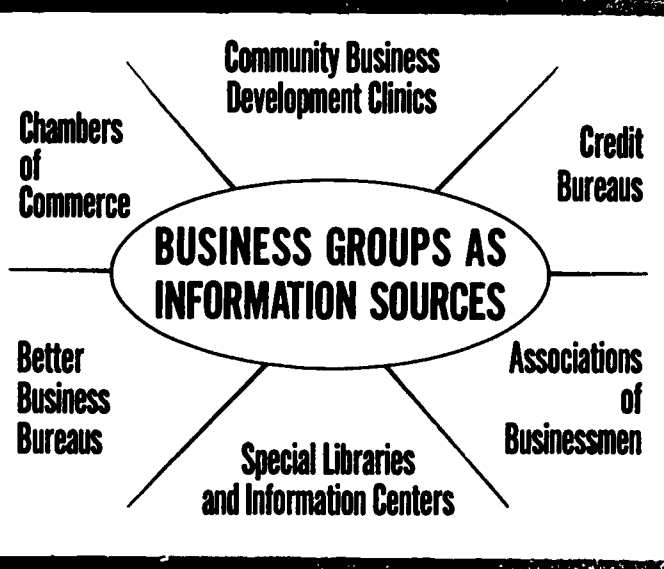
DISADVANTAGES of FRANCHISING

1 Franchisor fees, supplies, and charges may be high
2 Some loss of independence
3 Contract may be difficult to cancel
4 Possible problems working with franchisor agents

THE FIVE STEPS OF PROBLEM SOLVING

1 Define the problem
2 Define your expectations
3 Develop alternative solutions
4 Choose the solution
5 Provide a trial period

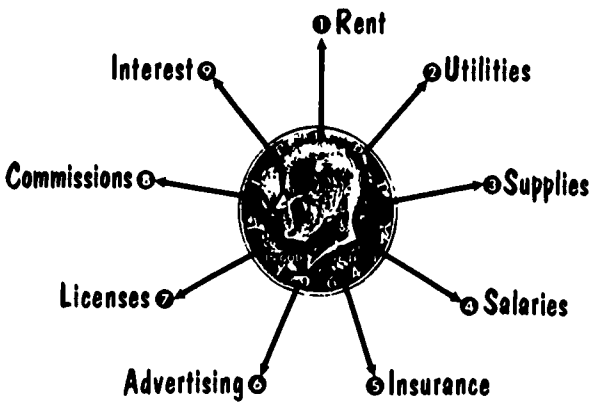




TIPS ON GOOD FINANCIAL MANAGEMENT

- Plan your capital requirements
- Balance equity and debt
- Avoid excessive fixed assets
- Maintain adequate working capital
- Avoid excessive inventories
- Study the capital market
- Develop banking connections
- Don't borrow more than you need

ORDINARY AND NECESSARY BUSINESS EXPENSES



THE IMAGE OF A BUSINESS

CHEAP ...VS... EXPENSIVE

NEAT ...VS... SLOPPY

THOUGHTFUL ...VS... INDIFFERENT

HIGH INTEGRITY ...VS... QUESTIONABLE METHODS

FRIENDLY ...VS... IMPERSONAL

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ABSTRACT - This guide is a continuation of Book 1 on the use of fire apparatus and equipment for training fire department personnel, available as VT 010 572 (also in this issue). The 26 individual units of instruction are arranged under the following four major headings: (1) Handling Hose--Street Level, (2) Ladders, (3) Hose and Ladders--Above Ground Level, and (4) Rescue Equipment. Specific objectives for each major unit are included. The document is profusely illustrated with photographs. (GR)

VT 010 571

ERIC

ED0 45856

CALIFORNIA FIRE TRAINING PROGRAM

Book 2

of

BLOCK III

USE OF FIRE APPARATUS AND EQUIPMENT

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1957

VT 010 571

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CALIFORNIA FIRE TRAINING PROGRAM

Unit E

HANDLING HOSE -- STREET LEVEL

31. SINGLE LINE OF HOSE
32. MULTIPLE LINES OF HOSE
33. CONNECTING HOSE LINES TO AUXILIARY APPLIANCES
34. OPERATING REFRIGERANT DIFFUSERS
35. OPERATING CELLAR NOZZLES
36. OPERATING HYDRANTS
37. BATTERIES, MONITORS, TURRET PIPES, LADDER PIPES, AND DELUGE SETS
38. OPERATING WATER TOWERS

OBJECTIVE:

To develop the ability to lay single and multiple lines of hose; connect hose to auxiliary appliances; with a knowledge of each function and the relation of one function to the others.

31: LAYING HOSE LINES GROUND LEVEL

INTRODUCTION:

Most departments use apparatus commonly called triple combination, having a hose bed capacity of 1000' or more of 2½" hose and a smaller amount of 1½" hose, a pump, and water tank.

This one piece of apparatus takes the place of the two-piece company which had one pumping engine and a hose tender or wagon, allowing the pumper to go directly to the hydrant while hose was being laid with the hose wagon.

Many times the hose compartments are split which allows for laying either single or multiple lines of hose. This in effect, makes the apparatus more flexible and speeds the laying of multiple lines.

Successful fire extinguishing operations depend largely upon the speed and efficiency of engine companies in laying lines of hose and getting hose into operation in the minimum amount of time. Hose should be loaded in such a manner as to take full advantage of water supply, type, and amount of apparatus and equipment. When laying from hydrant to fire, hose should be loaded with female on top of load and reversed for laying from fire to hydrant. On split bed arrangements, hose in one compartment may be loaded to lay in one direction while other compartment may be loaded in reverse direction.

31a: HOW TO LAY SINGLE LINE OF 2½ INCH HOSE AT STREET FROM HYDRANT TO FIRE WITH TRIPLE COMBINATION APPARATUS (Using Blake Four-Way)

INSTRUCTIONS:

1. Grasp sufficient slack hose in one hand to reach hydrant; grasp combination hydrant wrench and handle of Blake four-way valve in other hand. (Note: Blake four-way preconnected to hose line)
2. When driver stops apparatus at hydrant, hydrant man steps off rear running board.
3. Drops slack on ground, retains hold on combination hydrant wrench and four-way valve and place hose around the hydrant. (Fig. 1) NOTE: Signal driver to go; signal loud enough for driver to hear.

Fig. 1

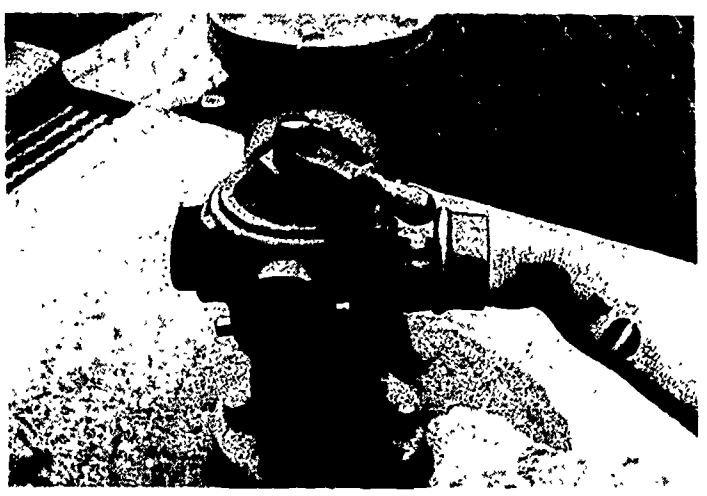

Fig. 2

4. Remove cap from hydrant and connect four-way valve. (Fig. 2) Place combination wrench on hydrant and open hydrant. NOTE: In opening hydrant this will depend largely on the amount of men and if a hose clamp is used at fire. If company is short-handed at fire and no hose clamp is available, the man at the hydrant should wait for a signal for water.
5. Take kinks out of hose at hydrant and lay hose next to curbing, to avoid running over hose when pumper returns to connect up to Blake four-way valve.
6. Driver continues 15 or 20 feet beyond fire, laying the hose line near curb. NOTE: Stay out from curb where apparatus stops, sufficiently to remove hose to side of apparatus toward fire.
7. If hose clamp is available, place clamp at first coupling at rear of apparatus. (Fig. 3)

Fig. 3

Fig. 4

8. Grasp the first double fold of hose that completely encircles the bed if horseshoe load, or second loop for accordion load. (Always behind the line being laid out.) Run back 20 to 25 feet, or until loops clear running board 4 to 6 feet, lay same down on side of main line toward fire. (Fig. 4) NOTE: Lay to one side of apparatus to provide clearance for apparatus to back to the hydrant. Laying the hose out straight makes it easy to calculate the amount of hose removed, avoids kinks and hose can be carried to desired location without tangles.

Fig. 5

Fig. 6

9. Repeat Operation No. 8 until sufficient hose is removed--lay out straight on side toward fire.
10. When sufficient hose is removed, break first coupling out of hose bed. Replace female coupling in hose bed. (Fig. 5)
11. Remove 2½ inch nozzle from holder and screw nozzle on male end of hose. Check to see if nozzle is closed. (Fig. 6)

Fig. 7

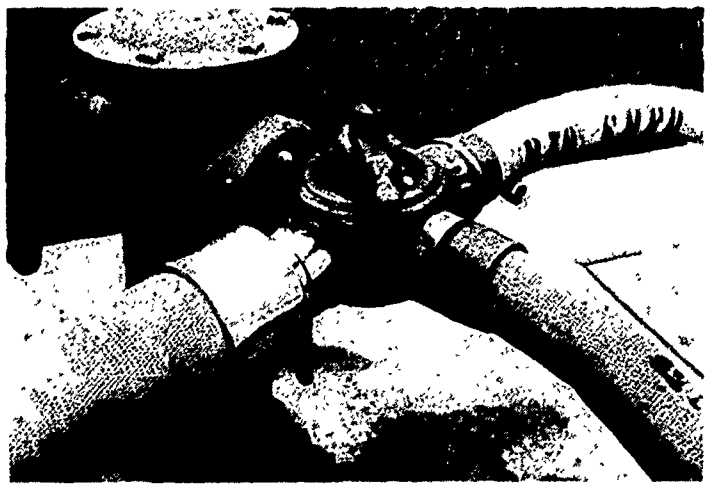

Fig. 8

12. Remove ladder and necessary equipment. (Fig. 7) NOTE: Not necessary to remove ladder, axe, or pike pole if truck company is on duty at fire.
13. Carry hose to desired location; one man at nozzle and, if available, one man at every 25 feet. All members on the same side of the hose. Remove hose clamp if clamp has been used or signal for water.
14. Driver backs apparatus to hydrant and spots pump if more pressure is needed.
15. Make proper connection, four-way valve. (Fig. 8)
16. Man at hydrant assists driver in making connections.
17. Man going from hydrant to fire follows hose line, removes kinks and tightens loose couplings. NOTE: If water pressure is sufficient, Blake fourway valve may not have to be used. In such cases, just hooking the 2½" female to the hydrant is all that is necessary. Apparatus will not have to return to hydrant.

31b: <u>HOW TO LAY A SINGLE LINE OF 2½ INCH HOSE FROM HYDRANT TO FIRE, USING DOUGHNUT ROLL ANCHOR</u>

INFORMATION:

The doughnut roll anchor is used where manpower is short when laying a line or where extra hose is required to do the job.

INSTRUCTIONS:

1. Driver slows apparatus at hydrant or, if alone, comes to a complete stop.
2. Grasp loop in rope sling and lay roll on ground.
3. Driver proceeds toward fire laying line.

4. When sufficient hose has been laid, grasp female coupling of roll and take to hydrant.
5. Remove cap from hydrant, connect hose. (Fig. 9)

Fig. 9

6. Turn on water when given order and then follow up line, straightening out kinks and tightening any couplings that may be leaking.
7. When driver reaches fire, immediately place clamp on hose.
8. Remove necessary amount of hose, break couplings, placing female coupling back in bed, and screw on nozzle. Close, and take to desired location.
9. Remove clamp from hose.

QUADRUPLE COMBINATION

INFORMATION:

Quadruple combination pumping and ladder apparatus give fire departments greater flexibility of operation.

Quadruple combinations or Quads, as they are most commonly called, combine four units of the fire department; hose wagon, pumper, ladder truck, and water wagon carrying equipment and appliances that are common to both pumpers and ladder trucks.

Hose beds on these units may be found either above or below ladder rack. They should be divided. Racks for $1\frac{1}{2}$ inch hose will usually be found behind the drivers seat, or on each side of apparatus on running board, permitting lines to be placed in operation on either side of apparatus. These lines are usually permanently connected to pump.

Ladders consist of a footage of not less than 240 feet, and sizes of ladders are governed by the height of buildings in the community in which apparatus is to be used.

Water tanks are of a size to hold between 100 and 200 gallons of water, and booster line reel is conveniently mounted.

Intakes of pump should have a gated $2\frac{1}{2}$ inch connection to permit the connecting of suction lines while pump is in operation.

One compartment of hose bed should be loaded with 3 inch hose, female end at the rear of bed. Loading of other compartment optional with department, depending on conditions to be met in service.

To receive full benefit of the Quad, lay a line of 3 inch hose from the hydrant to the fire, connect to pump, place 1½ inch lines and booster line in operation. Apparatus will be stationed in front of fire where ladders and other equipment that is needed may be obtained in a hurry, making the task of extinguishing the fire much quicker and increasing the efficiency of the department.

31c: HOW TO LAY A LINE FROM THE HYDRANT TO THE FIRE, USING QUADRUPLE COMBINATION

INSTRUCTIONS:

1. Driver slows down at hydrant or stops completely.
2. Grasp female coupling with one hand, fold of hose, combination hydrant wrench with other hand and take wrap on hydrant.
3. Driver will proceed to fire location.
4. Upon reaching fire location, place hose clamp on line leading from hydrant and remove sufficient hose from bed to reach pump inlet. Break coupling.
5. Open gate valve between water tank and pump and place pump in operation, charging booster line.
6. Grasp nozzles of 1½ inch hose and take to desired location.
7. Connect hydrant line to gated pump inlet, remove clamp from line, open gate valve, charge 1½ inch lines, close gate between pump and tank. NOTE: If engineer is careful, hydrant line of 2½ or 3 inch will furnish enough water to pump, for two good 1½ inch hose lines using small tips in addition to booster line. (Fig. 10)

Fig. 10

8. As soon as enough hose is laid so that couplings will not snag in bed, or line be pulled away from him, hydrant man shall connect female end to hydrant outlet, place wrench on hydrant valve stem, and turn on water as soon as clamp is placed on line, or signal is given.
9. Follow up line to straighten out kinks and tighten any loose couplings. NOTE: This last operation is very important.

31d: HOW TO LAY A SINGLE 2½" LINE FROM FIRE TO HYDRANT WITH TRIPLE COMBINATION APPARATUS.

INFORMATION:

An advantage in laying lines from the fire to the hydrant is that pumper can be connected up immediately and can supply the exact pressures needed as determined by the size of the nozzle and the length of the line.

Ladders and other tools should be taken off without delay and used if necessary before the line is laid.

INSTRUCTIONS:

1. Driver stops apparatus 15 to 20 feet beyond fire toward hydrant.
2. Removes ladders and other necessary equipment. NOTE: May not be necessary if another company is on duty at fire.
3. Estimate amount of hose needed. Grasp nozzle with one hand and the first double fold that completely encircles the bed in other hand, if horseshoe load, (Fig. 11) or second loop if accordion load. Run back 20 to 25 feet and lay double fold down, carry nozzle back to rear running board on side toward fire and lay it down. NOTE: Laying the hose out straight makes it easy to calculate amount of hose removed, avoid kinks, and hose can be carried to desired location without tangles.

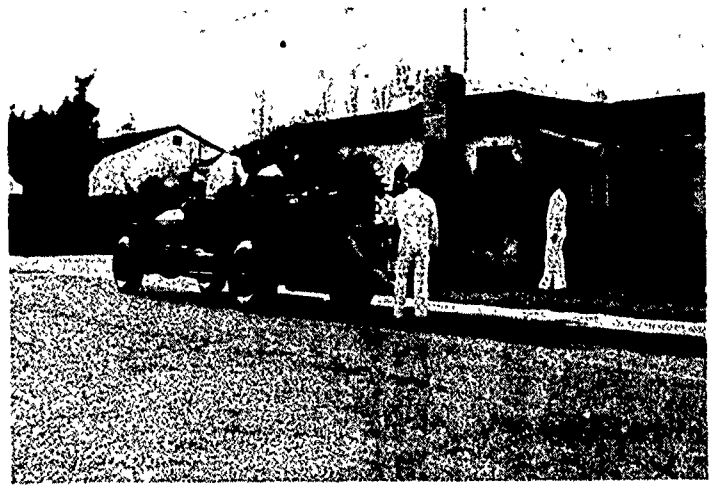

Fig. 11

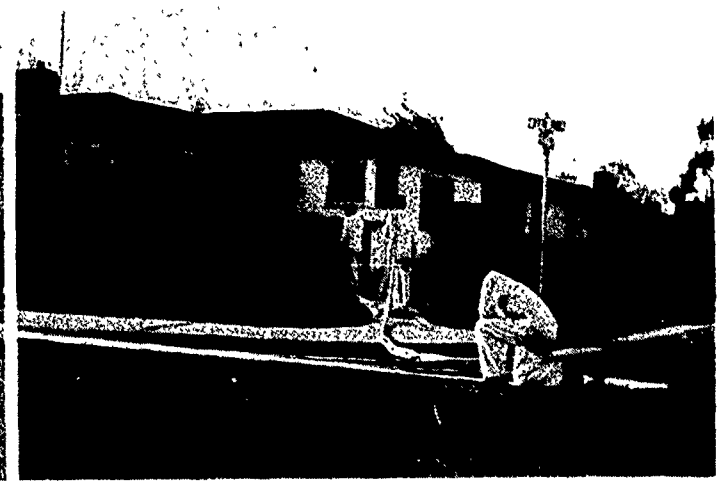

Fig. 12

4. Continue operation No. 3 by laying each fold out straight on side of hose away from fire until sufficient hose is removed.
5. One man leads in with hose under arm or over shoulder. NOTE: Place on shoulder on side hose is laid.
6. Second man lines up on hose 25 feet back of first man.
7. When sufficient hose is removed from bed, one man grasps hose being laid out on ground about three feet from rear running board, braces self, and gives driver signal to proceed to hydrant. (Fig. 12)
8. Driver and one man continues to hydrant with apparatus laying the line as close to the curb as possible and spots pump at hydrant.

9. When sufficient hose has been laid out to prevent dragging of hose, man holding hose will assist with working line. (Fig. 13)

Fig. 13

Fig. 14

10. When nozzle and sufficient slack hose are in position, second and third men will advance and assist man at nozzle.
11. Nozzleman opens and directs nozzle.
12. As apparatus arrives at hydrant, driver spots pump, man riding tail board assists driver in making connections to pump and hydrant, (Fig. 15) then pulls sufficient hose out of bed for coupling to reach discharge port of pump, (Fig. 16) breaks coupling, placing male end back in hose bed, and connects female end to pump discharge outlet.

Fig. 15

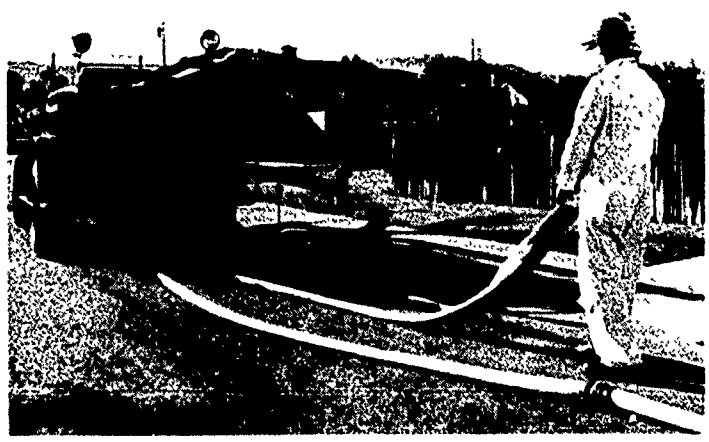

Fig. 16

13. Open hydrant, and pump at desired pressure.
14. Man assisting follows line checking for kinks and leaks, then assists at fire.

31e: <u>HOW TO LAY A SINGLE LINE OF 2½" HOSE AT STREET LEVEL, FROM FIRE TO HYDRANT (USING DOUGHNUT ROLL)</u>

INFORMATION:

Where a shortage of manpower exists and only a small amount of working line is usually required, the doughnut roll anchor may be used.

INSTRUCTIONS:
1. Driver stops apparatus at fire area.
2. Man grasps loop of rope sling and lays roll on ground. (Fig. 17)

Fig. 17

Fig. 18

3. Remove ladders and other necessary equipment.
4. Driver proceeds to hydrant laying line, spots pump.
5. Nozzleman slips rope loose from doughnut roll and takes nozzle to desired locations. (Fig. 18)
6. For proper method of hooking up pump, refer to job 31d, steps 12, and 13.

31f: <u>HOW TO LAY SINGLE LINE OF 2½ INCH HOSE AT STREET LEVEL FROM FIRE TO HYDRANT, USING SKID LOAD</u>.

INFORMATION:

Where single compartment hose beds are loaded for a fire to hydrant layout, the skid load provides an excellent method of carrying extra hose for the nozzleman. The skid load (Refer to Job 30e) provides the nozzleman with the hose he needs to reach the seat of the blaze; in most layouts, about 100 feet of free hose.

INSTRUCTIONS:
1. Driver stops apparatus upon reaching scene of fire.
2. Man grasps hand holds provided by the looped hose and pulls skid on to ground. (Fig. 19) NOTE: This serves as anchor for line. (Fig. 20)
3. Remove ladders and other equipment, if necessary.
4. Driver proceeds toward hydrant, laying line.
5. Man places hose over shoulder or under arm near nozzle, advancing toward fire. (Fig. 20)

6. For proper method of hooking up pump, refer to job 31d, steps 12, 13, and 14.

Fig. 19

Fig. 20

32: LAY MULTIPLE LINES OF HOSE

INTRODUCTION:

There are times when fighting fires that it becomes necessary to lay multiple hose lines. These include wyed 1½" lines from one 2½" line, which is very common. Also any other combination where two or more hose lines of any size are operating on a fire.

32a: HOW TO LAY SINGLE LINE OF HOSE FROM HYDRANT TO FIRE AND REDUCE TO TWO 1½ INCH LINES

INFORMATION:

1½ inch hose is employed in fire extinguishing operations where large streams are not practical, and to avoid unnecessary water damage. The same procedure is followed as in laying single 2½ inch lines. Some wyes have shut-offs or valves by which either line can be controlled.

INSTRUCTIONS:

1. Lay line from hydrant to fire. NOTE: Follow the same procedure as in laying 2½ inch lines as found in Job 31a, steps 1 through 7.
2. Remove ladders and other necessary equipment. NOTE: Where truck company, water tank, or other apparatus is at scene of fire, this is not necessary.
3. Remove 1½ inch hose either bundles or other loads. Place to one side and rear of apparatus. NOTE: Hose is placed on side of apparatus that hydrant is on. This is to avoid apparatus backing over hose on return to hydrant.
4. Remove amount of 2½ inch hose desired. NOTE: Same procedure is followed as in laying 2½ inch hose. (See Job 31a, Step 8)
5. Remove nozzle and connect wye. (Fig. 1)

6. Take 1½ inch hose and wye as near to fire as necessary to reach desired location.
7. Remove keepers from 1½ inch hose if bundled.
8. Grasp nozzles and take to locations desired.
9. If hose clamp is used, remove clamp or give signal for water.
10. Open wye. (Fig. 2)

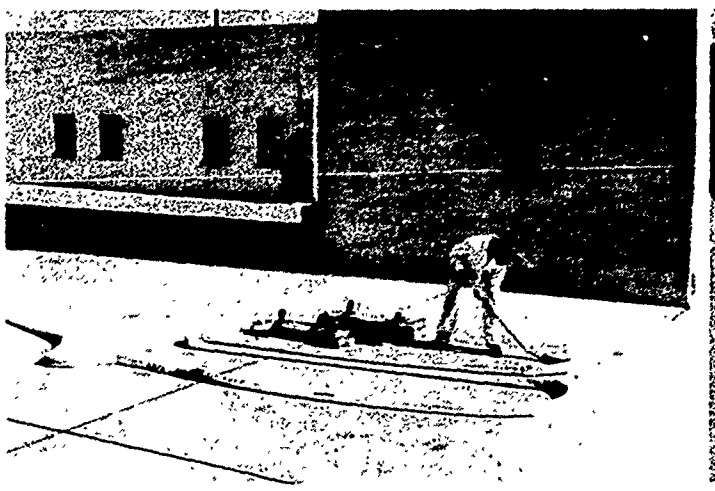

Fig. 1

Fig. 2

32b: HOW TO LAY SINGLE LINE OF 2½ INCH HOSE AND DIVIDE INTO TWO 2½ INCH LINES FROM HYDRANT TO FIRE

INFORMATION:

When carrying on this operation the same methods are used in connecting to hydrant as in laying single line of hose, depending on the type of hose load used.

INSTRUCTIONS:

1. Lay line from hydrant to fire. Refer to Job 31a, steps 1 through 7.
2. Remove amount of hose desired in lead line. NOTE: Method of removal will depend on type of hose load used. Lead line should be laid out directly behind apparatus.
3. Break coupling.
4. Remove amount of hose desired in one working line.
5. Break coupling. NOTE: This should be laid out on one side of lead line.
6. Connect wye to lead line.
7. Bring female ends to wye and connect.
8. Connect nozzles to working lines.
9. Take lines to desired location. (Fig. 3)
10. Remove hose clamp, or signal for water. NOTE: If pump is desired at hydrant, hook up will be same as Job 32c, Fig. 9, except no extra line connected to pump.

Fig. 3

32c: HOW TO LAY TWO LINES OF HOSE SIMULTANEOUSLY FROM THE HYDRANT TO THE FIRE WITH A COMBINATION APPARATUS, USING A DIVIDED HOSE BED

INFORMATION:

Practically the same procedure is followed in laying two lines of hose with a combination apparatus as is used when laying two lines simultaneously with two piece apparatus, except providing sufficient clearance for apparatus to back to hydrant, and removing equipment that may be needed. In laying lines to standpipes, always lay two lines simultaneously if possible.

INSTRUCTIONS:

1. Break coupling that connects hose to other compartment (providing hose is carried in this manner).
2. Grasp combination hydrant wrench and handle of Blake four-way valve attached to female hose in one hand, and female end of hose in other compartment with free hand.
3. Driver stops apparatus at hydrant, and man gets off apparatus with proper slack and places hose around hydrant. (Fig. 4) NOTE: Check to see if proper fittings are at hydrant. Gleeson valve to be used on high pressure hydrants.
4. Retain hold on hose around hydrant until sufficient hose has been laid so that weight of hose will hold line.
5. Connect Blake four-way valve to hydrant, place combination hydrant wrench on hydrant stem.
6. Pull hose in to curb sufficiently for driver to back apparatus to hydrant without running over hose.
7. Driver to keep apparatus as near the curb as possible while the hose is being laid out, and stops 15 to 20 feet beyond fire. NOTE: Stay out from curb where apparatus stops sufficiently to remove hose from one compartment to side of apparatus toward fire.

Fig. 4

Fig. 5

Fig. 6

8. Place hose clamp on hose line that Blake four-way valve is attached to (providing hose clamp is available).
9. Remove amount of hose necessary in each line directly behind apparatus. NOTE: Method of removing hose will depend on the type of hose load used. (Fig. 6)
10. Break couplings and place female ends in hose bed.
11. Remove nozzles from apparatus.
12. Attach nozzles to male ends and close. (Fig. 7)
13. Remove ladders, and other necessary equipment. NOTE: When truck company or other apparatus is at fire, it is not necessary to unload any other equipment.
14. Take lines to desired locations. (Fig. 8)
15. Remove hose clamp or give signal for water.
16. Driver back apparatus to hydrant and make proper connections. (Fig. 9)

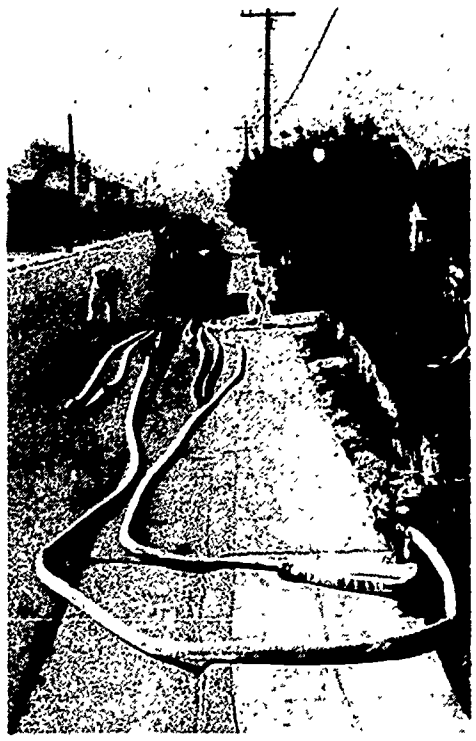

Fig. 7

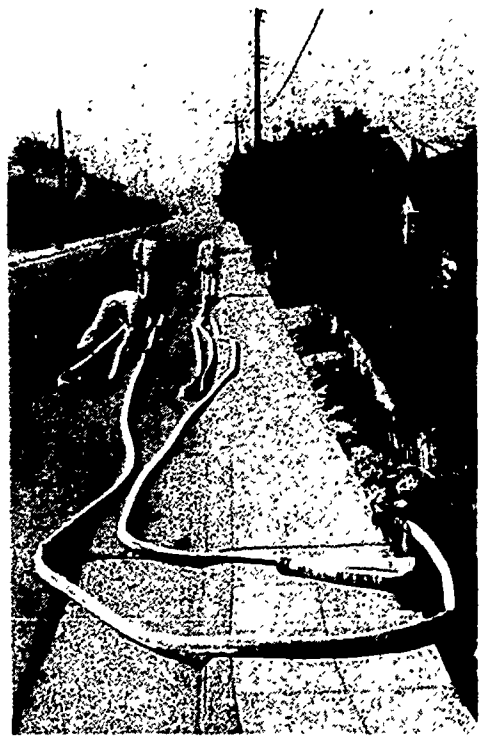

Fig. 8

Fig. 9

32d: HOW TO LAY A SINGLE LINE OF 2½ INCH HOSE FROM FIRE TO HYDRANT WYED INTO TWO 1½ INCH LINES (Preconnected)

INFORMATION:

In laying a line from fire to hydrant, the 1½" wyed extension is used when the extent of the fire does not justify larger streams.

The 1½" hose may be loaded in various ways, and sometimes is preconnected to 2½" hose. Regardless of type of hose load, there should be very little change necessary in the following procedures.

INSTRUCTIONS:

1. Driver will stop apparatus 15 to 20 feet beyond fire toward hydrant.
2. Remove ladders and necessary equipment.

3. Grasp $1\frac{1}{2}$" nozzles and wye (or rope sling if used) run back 20 to 25 feet and anchor lines. NOTE: If manpower is available, second man may anchor $2\frac{1}{2}$" line, also. (Fig. 10)
4. One man rides apparatus to hydrant, if available.
5. Driver lays line to hydrant.
6. Place $1\frac{1}{2}$" nozzles with hose over shoulder and lead in. (Fig. 11)
7. Other members of crew will assist first man in carrying hose to desired location. (Fig. 11)
8. When nozzles and sufficient slack are in position, men lay hose down, and with one man on each nozzle, put lines in operation when charged.
9. When apparatus stops at hydrant, follow Job 31d, steps 12 through 14 for hook up procedure.

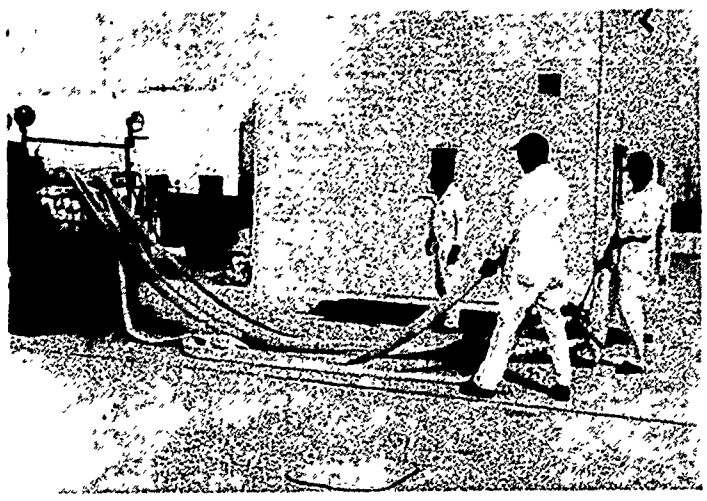

Fig. 10

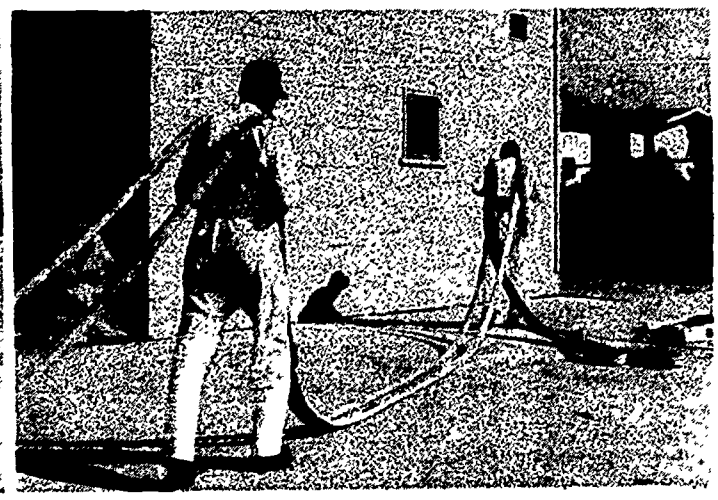

Fig. 11

32e: HOW TO LAY SINGLE LINE OF $2\frac{1}{2}$ INCH HOSE AND WYE INTO TWO $2\frac{1}{2}$ LINES FROM FIRE TO HYDRANT

INFORMATION:

Sometimes it is desirable to wye one $2\frac{1}{2}$" hose line into two $2\frac{1}{2}$" hose lines, used mainly when two areas need to be covered at one time.

INSTRUCTIONS:

1. Remove amount of hose desired in one line (working line). NOTE: The method used in this operation will depend on the type of hose load used.
2. Disconnect coupling nearest to hose bed.
3. Remove amount of hose desired in second line. Keep separate from first line.
4. Remove amount of hose desired in lead line.
5. Remove wye and nozzles and other necessary equipment.
6. Signal driver to proceed to hydrant.
7. Connect wye to lead line.
8. Bring both female couplings to wye.
9. Connect both lines to wye.

10. Connect nozzles to male couplings. (Fig. 12)
11. Take lines to desired location.

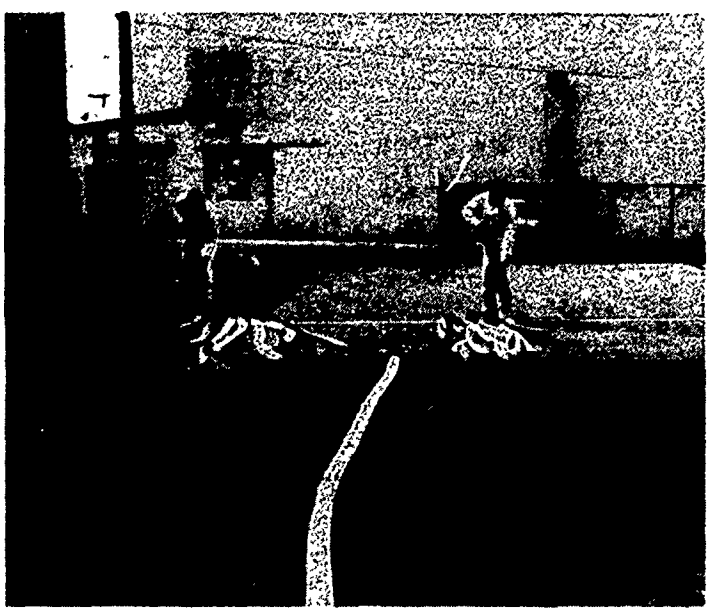

Fig. 12

32f: HOW TO LAY TWO LINES OF HOSE SIMULTANEOUSLY FROM THE FIRE TO THE HYDRANT USING COMBINATION APPARATUS

INFORMATION:

In extinguishing operations, it sometimes becomes necessary to lay two lines simultaneously from the fire to the hydrant. This is easily accomplished where divided hose beds are used, irrespective of the way that hose is placed in bed.

INSTRUCTIONS:

1. Driver stops apparatus at scene of fire.
2. Break coupling that connects hose to other compartment if necessary.
3. Grasp coupling in one hand, two double folds that completely encircles the bed with other hand, run back 20 to 25 feet, (Fig. 13) lay fold down and take coupling to rear of apparatus.

Fig. 13

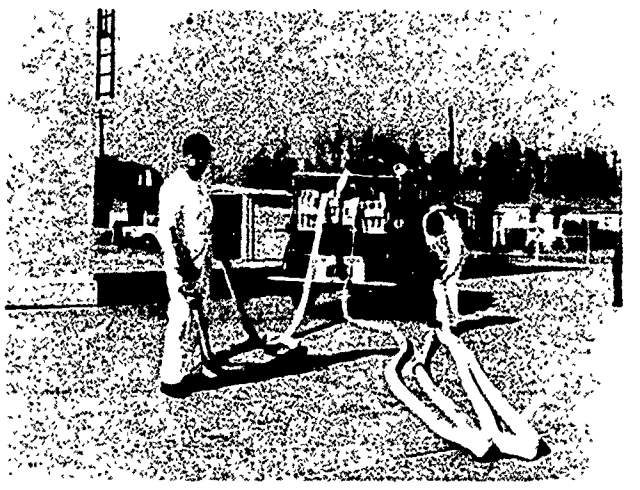

Fig. 14

4. Continue operation 3, laying folds alongside of first fold on side away from fire, until sufficient hose has been removed, and place nozzle on hose.
5. Repeat operations 3 and 4 for other compartment until sufficient hose has been removed for second working line. (Fig. 14)
6. Remove ladders and necessary equipment.
7. Give driver signal to proceed, holding hose about three feet back of apparatus with hands, feet well braced. (Fig. 15)
8. Driver proceeds toward hydrant, laying hose as close to curb as possible. Spot pump at hydrant.
9. Break first couplings out of bed, replacing male ends of hose in bed, or remove sufficient hose to reach pump discharge outlets and connect.
10. Connect pump to hydrant, turn on water when ordered, place pump in gear.
11. Follow up line of hose to tighten loose couplings, and remove kinks.

Fig. 15

32g: HOW TO LAY TWO LINES OF HOSE, AND SIAMESE TO ONE 2½ INCH LINE WITH DIVIDED HOSE BED, FROM FIRE TO HYDRANT

INFORMATION:

In carrying on extinguishing operations involving the use of water streams, it is sometimes found that pumpers are incapable of supplying water streams of suitable size and effective pressures, through single lines of hose because of the friction loss in long lines, where larger size nozzle tips are used.

To provide streams of suitable size and effective pressure, or to permit the use of larger tips, it becomes necessary to overcome the friction loss by means of two parallel lines laid to the fire, and siamesed into one line. Always place the siamese as near to fire as possible.

INSTRUCTIONS:

1. Remove amount of hose desired for working line. NOTE: This can be removed from either side of hose bed, but should be laid directly to the rear of apparatus.

2. Break coupling.
3. Remove siamese 2 into 1. NOTE: If nozzles are not attached to line, remove one nozzle from apparatus.
4. Pull desired amount of hose from each side of hose bed. (Fig. 16)
5. Anchor lines same as other hose lays, and give signal for driver to proceed to hydrant.
6. Connect lead lines to siamese. (Fig. 17)
7. Connect siamese to working line.
8. Take working line and siamese to desired location.
9. For hydrant hook up, see job 32f, steps 8 through 12.

Fig. 16

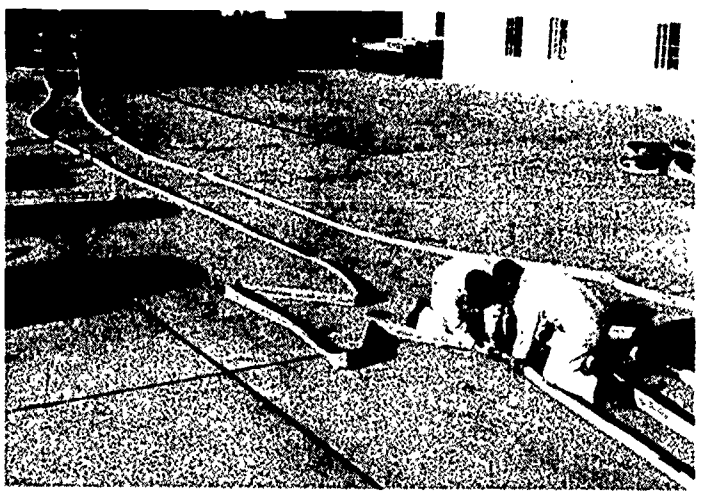

Fig. 17

33: CONNECT HOSE LINES TO AUXILIARY APPLIANCES

INTRODUCTION:

Practically the same procedure is followed in carrying on operations involving the laying of hose lines into all auxiliary appliances, such as exterior standpipe manifolds, upper floors, basement and dry sprinkler system manifold.

33a: HOW TO CONNECT HOSE LINES TO EXTERIOR STANDPIPE MANIFOLD

INFORMATION:

The number of standpipe outlets on each building so equipped may vary with the height of the building. Number of lines laid will vary with number of outlets and volume of water desired on fire floor. The equipment available on apparatus may vary details of hooking up procedures.

INSTRUCTIONS:

1. Lay lines, either hydrant to standpipe or reverse.
2. Connect nozzles (metropolitan type) to hose.
3. Remove tips from nozzles.
4. Unscrew protector plug from female manifold connection. NOTE: Remove center or lower plug first, check gasket and see if any foreign object is in the manifold.
5. Connect male thread of shut-off butt to female swivel manifold connection and tighten with spanner. NOTE: Center or lower connection first.

6. Turn shut-off indicator so top will be visible.
7. Remove all short kinks or bends in hose leading to manifold.
8. Open shut-off nozzles. (Fig. 1) NOTE: When line is disconnected, replace protector plugs.
   NOTE: Same procedure is followed for hooking up to sprinkler system manifold. Be sure to read name to see if upper story, basement, or dry sprinkler system is to be used.

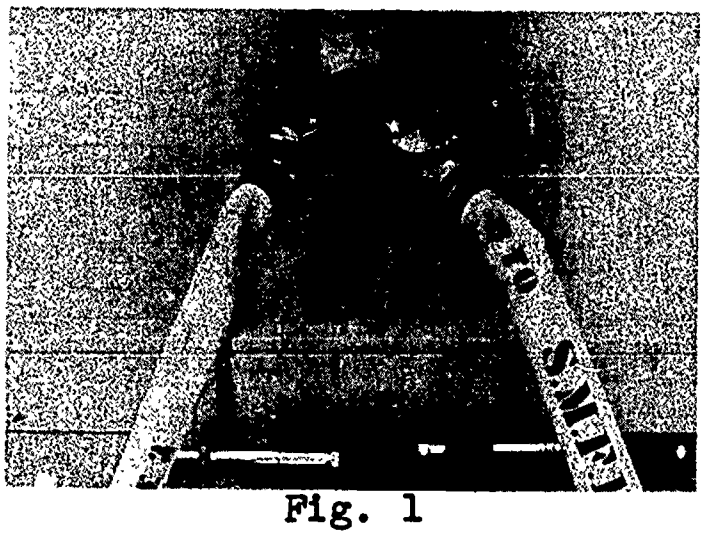

Fig. 1

34: OPERATE REFRIGERANT DIFFUSERS

INTRODUCTION:

Certain types of refrigeration plants of the older installations require a safety device to diffuse the refrigerants to the open air, and others require a diffuser to the sewer.

In the newer installations any refrigeration system operating at a pressure higher than atmospheric pressure and at a pressure not exceeding one hundred twenty-five (125) pounds on the low side and containing less than one hundred (100) pounds of refrigerant must automatically discharge to the the open air.

When these refrigeration systems contain more than one hundred (100) pounds of refrigerants, in connection with an automatic diffuser to the open air, they must also be equipped with a diffuser to the sewer.

This diffuser being provided with a two and one-half ($2\frac{1}{2}$) inch steamer connection extending to the exterior of a street wall of the building and directly under a Fire Department Service Box, which contains a high pressure and a low pressure valve for the control of the refrigerants being used.

34a: HOW TO OPERATE REFRIGERANT DIFFUSERS: (Water Type)

INSTRUCTIONS:

1. Connect $2\frac{1}{2}$ inch male nozzle butt to female swivel connection of diffuser.
2. Open shut-off on nozzle butt to start water flowing.
3. Unlock padlock on service box door and open same.
   NOTE: Every service box has the name of the refrigerant being used, also the words "For Fire Department Use Only" plainly marked on outside cover.

4. Open both high and low pressure valves. NOTE: On the inside cover appears a sign "Do not open valves until water is flowing". There also must be a brass sign within 12 inches of female connection reading "To refrigerant mixer".

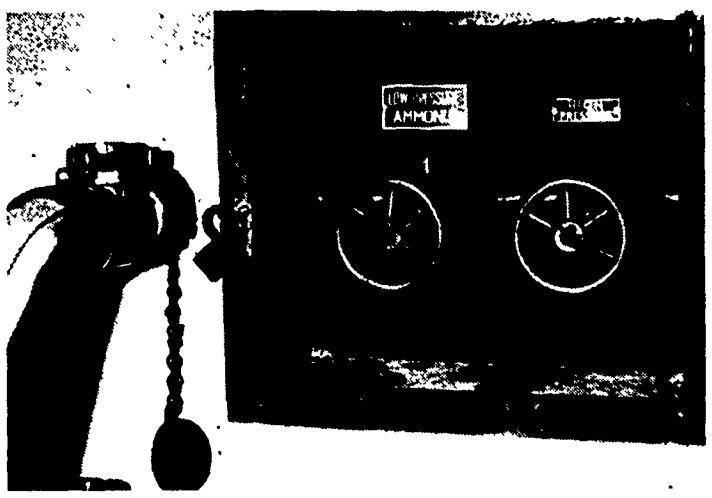

Fig. 1

34b: HOW TO OPERATE MANUAL DIFFUSER TO AIR

INFORMATION:

The small, older installations which are permitted to diffuse to the open air through a manual control valve are provided with a valve housed in a box placed on the outside of the building. The box is plainly marked "For Fire Department Use Only", and a pipe leads upward from the valve to the open air where it is properly capped with a diffuser head.

A very few installations have the valve in the pipe above roof.

There is also a valve within the building housing the system, which valve is marked "Fire Department Relief Valve."

INSTRUCTIONS:

1. Open "Fire Department Relief Valve" inside building or,
2. Unlock box on outside of building and open valve which is located inside box. NOTE: Opening either one of the valves will diffuse the high pressure side of the system.
   CAUTION: When operating either of the valves, care must be exercised to open the valve slowly and avoid permitting liquid refrigerant to discharge from diffuser head onto the human body.

35: OPERATE CELLAR NOZZLES

INTRODUCTION:

The chief object in the use of cellar nozzles is to get an effective stream at a point where men cannot operate because of smoke, heat, or obstructions. The Baker, Larkin and Invincible Cellar Nozzles operate in a like manner; that is, they are inserted in holes cut in floors, roofs, or other points where used.

The range of streams from cellar nozzles is less than that from a plain nozzle, due to the sudden change of direction of stream at the point where the stream enters the tip on the cellar nozzle.

The Baker, Larkin, or Invincible Cellar Nozzles can be used in a small passageway or room, and the stream manipulated in any direction by means of the handle on the nozzle.

In operating the cellar nozzles the stream should be directed at an angle upward so that the maximum range may be secured. Care must be taken, however, that the stream is not directed at so high an angle as to strike floor beams or other obstructions which would destroy it's effectiveness.

Then too, it should not be directed at too much of an angle downward, for in this case the stream would strike the floor and would not reach the burning materials as desired. The continual movement of the stream is essential if the greatest efficiency is to be secured from its use. The Bresnan, Porter, and Murray Distributors are called Cellar nozzles, but they are different in operation.

35a: <u>HOW TO OPERATE BAKER OR LARKIN CELLAR NOZZLE</u>

INSTRUCTIONS:

1. Get Baker (Fig. 1) or Larkin (Fig. 2) Cellar Nozzle from apparatus and axe if required.
2. Assemble cellar nozzle at apparatus, if not carried assembled. Connect male end of straight pipe into female swivel connection on cellar nozzle. Screw controlling handle in socket.
3. Connect charged line to cellar nozzle. NOTE: Shut-off is always used on end of line.
4. Adjust guide rod on cellar nozzle.
5. Insert tip end of nozzle into opening provided.
6. Open shut-off on discharge line. (NOTE: Shut off valve constructed in Larkin must also be opened.)
7. Operate control handle as desired. NOTE: Turning radius is 270 degrees. The Baker or Larkin are equipped with $1\frac{1}{4}$ inch tip and an extra 1 inch tip.

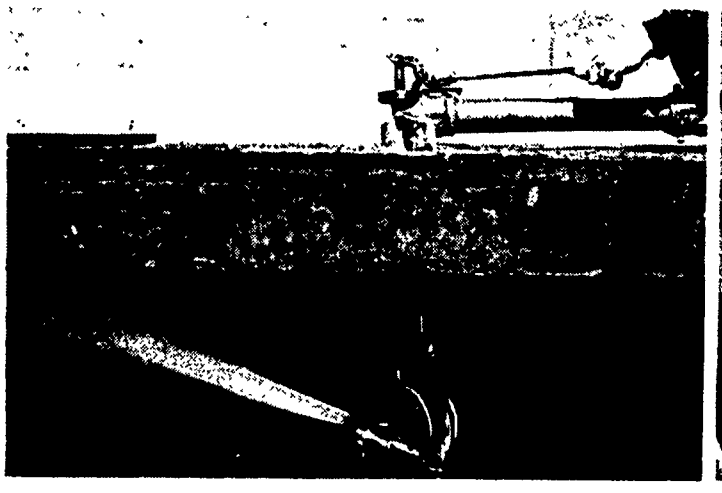

Fig. 1

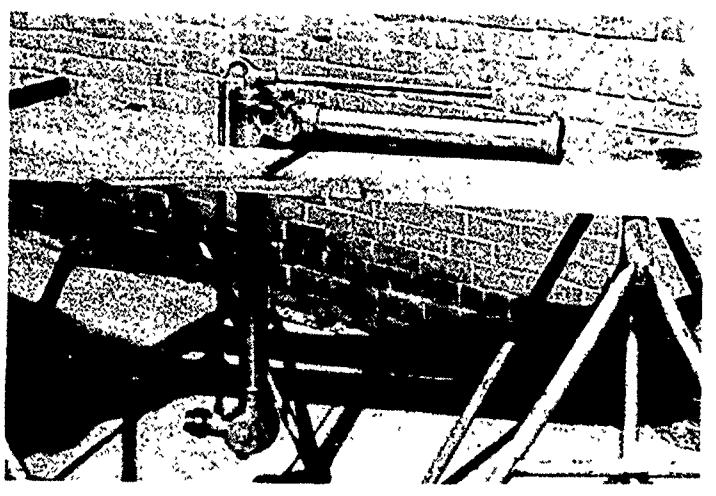

Fig. 2

35b: HOW TO OPERATE ROCKWOOD CELLAR NOZZLE

INSTRUCTIONS:

1. Get Rockwood Cellar Nozzle (Fig. 3) from apparatus, and an axe is required.
2. Raise collapsable arms to horizontal position.
3. Connect charged line to cellar nozzle. NOTE: Shut-off is always used on end of line.
4. Insert tip end of nozzle into opening provided and rest on nozzle arms.
5. Open shut-off on main line.

Fig. 3

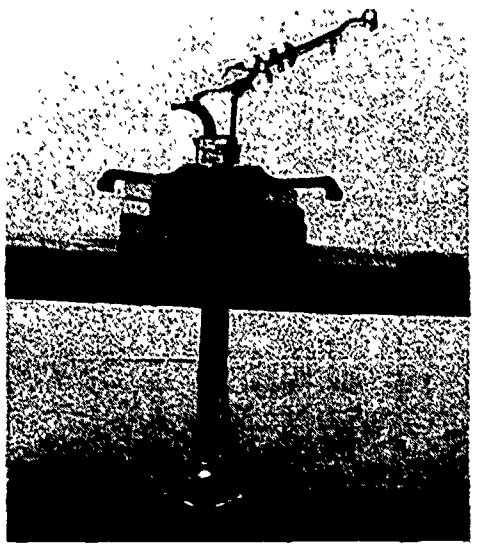

Fig. 4

35c: HOW TO OPERATE CORLEY BAKER CELLAR NOZZLE

INFORMATION:

The Corley Baker cellar nozzle is made of heavy brass tubing and castings and operates similar to the Larkin or Baker cellar nozzles. It has two discharge outlets instead of the normal one that others of this type have. Tip sizes range from 1/2" to 3/4" with some tips equipped with diffusers. One removable handle is used for both the shut-off valve and for turning the nozzle or adjusting angle. Nozzle will revolve the full 360°.

INSTRUCTIONS:

1. Get Corley Baker cellar nozzle (Fig. 4) from apparatus and an axe if required.
2. Carry to desired location.
3. Spread collapsable arms to operating position.
4. Connect 2½" water supply hose to female connection.
5. Insert tips through floor opening and allow nozzle to rest on spread arms.
6. Place removable wrench on shut-off valve and turn on water supply.
7. Remove wrench from shut off valve and place on turning and angle control handle.
8. Direct stream as desired.

35d: HOW TO OPERATE DISTRIBUTORS (BRESNAN AND GORTER)

INFORMATION:

The distributor nozzles are largely confined in their use to cellar fires, or to fires such as on shipboard where the department must operate through decks or flooring to fires below. They are occasionally used to good effect in attic fires.

The distributor may be classed as a very large sprinkler head, particularly in the method of throwing water and results obtained. The maximum range in any direction may be considered as fifteen (15) feet. Thus a distributor placed through a floor and operating into a cellar cannot be expected to wet down a space greater than a circle thirty (30) feet in diameter.

These two distributors are classed as circulating nozzles as they revolve while in action.

The Bresnan distributor, (Fig. 5) has nine (9) orifices ranging in size from 3/8" to 3/4" in diameter. The Bresnan distributor has an equivalent nozzle diameter varying from 1½ inches to 1 3/4 inches.

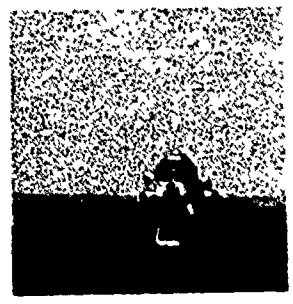

Fig. 5

Fig. 6

The Gorter distributor, (Fig. 6) has six (6) orifices. Two of these are 15/16 inch in diameter and four (4) of them 13/16 inch in diameter. The Gorter distributor diameters are equal to a 2 inch nozzle.

For effective results, a pressure of not less than thirty (30) pounds should be maintained at these distributors.

INSTRUCTIONS:

1. Get distributor and by-pass from apparatus, and axe if required. NOTE: A 10 foot length of hose is generally carried connected to distributor.
2. Shut off nozzle on end of charged line and remove tip. CAUTION: Place tip clear.
3. Connect distributor hose to male end of shutoff on main line.

4. Insert distributor into opening. NOTE: The method commonly employed in getting the distributor to operate at its proper height is to let the length of hose attached to the distributor down through the opening until the distributor touches the floor of the cellar, then it is withdrawn about five feet above the floor. (Fig. 7)
5. Open shut-off on main line.

35e: HOW TO OPERATE MURRAY DISTRIBUTOR

INFORMATION:

The Murray distributor commonly called the "Flower Pot" is a non-revolving type of distributor nozzle. (Fig. 8) The advantage of the Murray cellar nozzle is that it can be operated directly on a basement floor, allowing the deflected stream to go beneath skidded stock. Also, it can be used to good advantage in cocklofts as the largest portion of the stream is directed sideways and upwards instead of downwards.

The Murray distributor can be used in forming water curtains to protect crews while operating streams or getting into operation.

Murray distributors are made in two sizes, $2\frac{1}{2}$ inch and $1\frac{1}{2}$ inch. The $2\frac{1}{2}$ inch size being the one most commonly used.

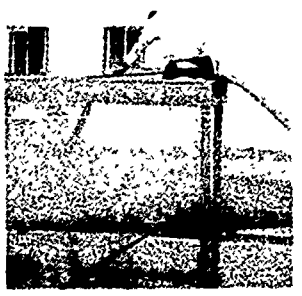

Fig. 8

INSTRUCTIONS:

1. Get Murray distributor and 10 foot length of hose from apparatus, and axe if required. NOTE: A 10 foot length of hose is generally carried connected to Murray distributor.
2. Shut down nozzle on main line and remove tip. NOTE: Place tip in clear to prevent loss or damage.
3. Connect female coupling of 10 foot section of hose attached to Murray Distributor to male end of shut-off on main line.
4. Insert and lower distributor into opening provided.
5. Open shut-off nozzle on main line, raise and lower distributor as desired, so as to cover the entire area.

36: OPERATE HYDRANTS

INTRODUCTION:

Various types of hydrants, capable of supplying sufficient water for the particular district served, are provided for fire department use in carrying on operations involving the use of water to protect property. The spacing, type, and size of hydrants are determined according to the requirements of district served.

California or wet barrel type hydrants (Fig. 1) are used extensively where there is no danger of freezing and where adequate gate valves are provided to stop the water flow in case of accidental breakage.

Fig. 1

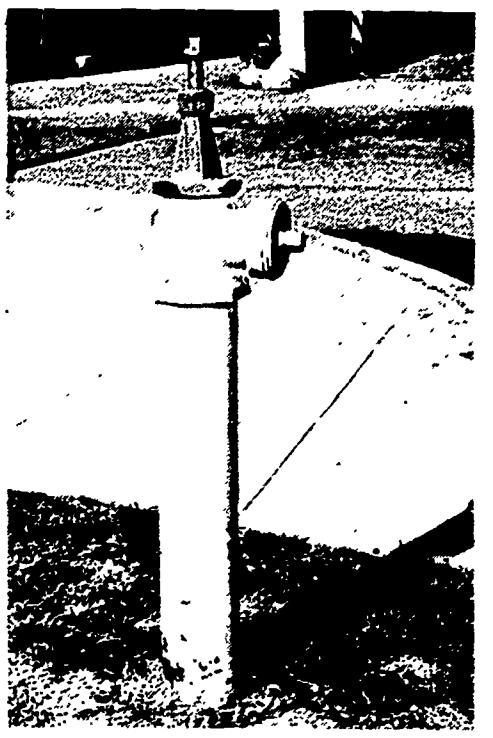

Fig. 2

Wharf type or substandard hydrants (Fig. 2) are provided by some water companies and municipalities for fire department use. They usually consist of a commercially manufactured brass gate valve located on 3" or 4" risers. All such installations should be gated. Glove Valves should never be permitted because of the restriction of the water flow.

Base valve, or dry barrel type hydrants (Fig. 3) are used wherever cold weather is experienced to prevent freezing, and are recommended by the Underwriters for all installations. Several base valve types of hydrants are provided with breakaway rings which will allow the hydrant to be broken off without causing a water flow. These hydrants should also be gated.

Fig. 3

NOTE: In all cases open and close hydrants slowly to prevent chattering of valves or damage to water mains.

36a: HOW TO OPERATE HYDRANTS

1. Remove protector cap from male hydrant outlet. NOTE: Use spanner to loosen cap.
   (a) Make necessary connections to hydrant.
2. To open all types of hydrants except Ludlow Hydrant.
   (a) Place hydrant wrench on valve stem, use right socket to fit stem, or adjust combination hydrant wrench to fit.
   (b) Turn valve in counter-clockwise direction.
   NOTE: Turn slowly to prevent chattering of valve or damage to water main. In case valve sticks, tap end of valve stem lightly with hammer.
   (c) Continue to turn spanner until hydrant is opened fully.
   NOTE: To open Ludlow Hydrant, follow same operations as other types of hydrants except valve opens by turning stem in clockwise direction.
3. To close hydrants
   (a) Place wrench on stem, turn in clockwise direction.
   (b) Turn wrench slowly until valve is completely seated. NOTE: Turn Ludlow valve stem in counter-clockwise direction to close.
   (c) Disconnect hose or suction, replace protector cap.
   (d) Replace equipment on apparatus.
4. Hydrants equipped with Eddy valve stem. (Fig. 4)
   (a) Place proper spanner on Eddy valve stem.
   (b) Turn spanner in counter-clockwise direction, open valve completely.
   NOTE: Check hydrant valve stem to see if completely open. Corey or other base valve hydrants require close attention of drain, in freezing weather, to see that it is open so that it will completely drain the hydrant barrel.

Fig. 4

INSPECT AND CARE FOR HYDRANTS

INFORMATION:

Hydrants, to be of value to the fire department, must be inspected regularly to assure their being in first class working condition.

Two types of hydrants are in use, the wet barrel and the dry barrel. In the wet barrel type, the operating valves are above the ground, and usually each outlet has an independently controlled valve. The main operating valve in the dry barrel

type is below the ground and outlets may or may not be independently gated.

When making an inspection of a fire hydrant, the following observations should be made: As to whether hydrant is obstructed by any poles, trees, lamp posts, brush, or high grass; that there is sufficient clearance between the hydrant butt and the ground so that quick and easy connections can be made. NOTE: Clearance between bottom of the butt and the ground should be at least 15 inches. Hydrant should not be set too close to the curb as to expose it unduly to vehicular traffic.

Tests for leaks should be made by tightening caps on outlets and opening hydrant wide. If stuffing box leaks, packing may be old and dry and should be replaced with new packing and oiled. Valve stem at stuffing box should be oiled every time hydrant is inspected. This test will also show whether the calking of the nipples is tight and any weakness above the valve.

After the leak test has been concluded, one or more caps shall be taken off hydrant, valve fully opened and flushed. After foul water has passed from hydrant, shut down and observe whether hydrant drains properly if dry barrel, if valves close properly on wet barrel, and that they do not chatter. If chattering develops due to a loose or worn valve, or if drain does not work properly on wet barrel type hydrants, notify water department immediately.

Before leaving hydrant, note if caps have gaskets in them, take a small brush and place thin coating of graphite and oil on threads of butts, replace caps and draw snug. NOTE: Mixture of graphite and oil is very good for lubricating stuffing box packing.

Note paint on hydrant, and if in poor condition, clean with wire brush and sandpaper. Use a good grade of aluminum paint for a prime coat, and if colors are used in marking hydrants, use the highest grade enamel obtainable.

These inspections should be made at least twice a year, and a complete record kept of each hydrant.

37: OPERATE BATTERIES, MONITORS, TURRET PIPES, LADDER PIPES, AND DELUGE SETS

INTRODUCTION:

On fires of major proportions, large streams are required for control. This can be accomplished in the fire service by the use of batteries, monitors, turret pipes, ladder pipes, or deluge sets. Each of these will provide a large volume of water through various tip sizes. They will vary in construction from having one to four inlets. Some will be portable and others mounted for use on apparatus.

37a: HOW TO OPERATE MORSE INVINCIBLE PORTABLE DELUGE MONITOR

INFORMATION:

The Morse invincible portable deluge monitor can be used where heavy streams are desired in locations that are not accessible with wagon battery or water tower.

It can be quickly carried from apparatus to the desired location, assembled, and placed in operation. It is possible to operate the stream at an angle of 40 degrees below the horizontal without tipping the monitor over.

The invincible monitor has either two or three 2½ inch inlet connections near the base. A worm and rack gear arrangement is controled by a wheel which changes the vertical direction of the stream. The horizontal direction is controled by turning the entire monitor which pivots on the base. A pin with a wire clip keeper holds the monitor to the base and platform while the assembly is being transported or operated.

There are three nozzle tips, sizes 1½ inch, 1 3/4 inch and 2 inch. One nozzle tip is carried on the male end of nozzle barrel and two are carried on wooden pegs or screw nozzle holders on the platform. The nozzle barrel is approximately 2½ inches in diameter and 21 inches long.

The platform is 34 by 40 inches and made in three sections hinged together with suitable latch to lock folds open. It has a socket in the center to fit the base of monitor, holding pin is secured by chain, two nozzle holders, two blocks for nozzle barrel, (on early models only) a handhold on each side and eight steel pins on under side to prevent slipping when in use.

INSTRUCTIONS:

1. Unscrew wing nuts that secure platform to apparatus.
2. Remove platform with complete monitor assembly attached and carry to the desired location.
3. Open up folds of platform, lock folds open with latch and set platform in position. NOTE: On smooth cement it is advisable to chip the cement with the point of an axe so the steel pins on bottom of platform will hold.
4. Remove protector cap from 2½ inch male opening at top of main monitor body.
5. Unfasten strap and remove nozzle barrel from platform.
6. Connect female end of nozzle barrel to 2½ inch male monitor opening. NOTE: Change nozzle tip if desired. NOTE: 4, 5, and 6 apply only to early models.
7. Shut nozzles off on two main working lines and remove tips. NOTE: Place tips in safe location.
8. Connect the nozzle butts with the shutoff indicators in upright position, to the two 2½ inch female inlet connections near base of the monitor body.

9. Direct the nozzle.
10. Stand on the platform and open nozzle butts on both lines.
11. Stand on the platform and operate hand wheel to raise or lower nozzle.
12. Grasp nozzle barrel and direct the nozzle to either side as desired. NOTE: The nozzle can be turned in a complete circle. (Fig. 1)

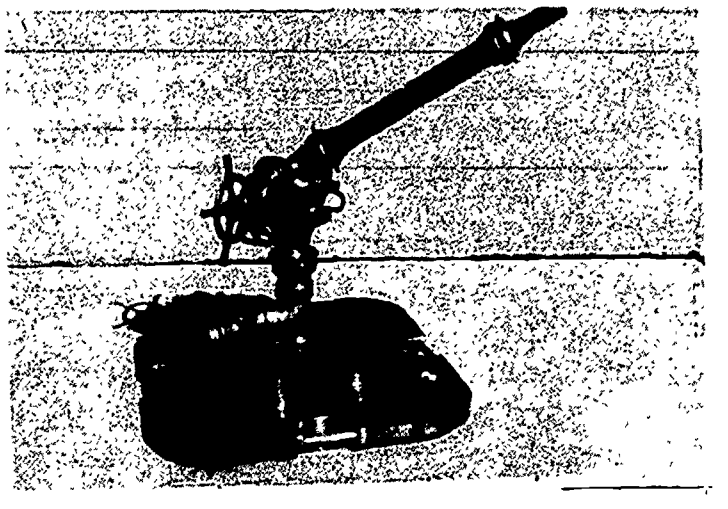

Fig. 1

HOW TO ASSEMBLE MONITOR WHEN MAIN BODY IS CARRIED TO DESIRED LOCATION DETACHED FROM PLATFORM

(a) Insert the base of monitor post into socket in center of platform.
(b) Adjust monitor base so that holding pin can be inserted in center of platform.
(c) Insert holding pin.
(d) Insert wire clip in grooved end of holding pin.

37b: HOW TO OPERATE MACGREGOR PORTABLE DELUGE MONITOR

INFORMATION:

The Macgregor portable deluge monitor can be used where heavy streams are desired similar to the way the Morse invincible portable deluge monitor is used. It is equipped with a 1 3/4 inch and 2 inch tip.

The main body is carried in a socket on the apparatus with platform, handle and extra tip in separate locations.

The lower section of the main body has three 2½ inch female inlet connections near the base with a cylindrical extension that is secured to a socket in center of platform or on apparatus by means of a removable holding pin that extends through the socket and base of the monitor. Above the inlet manifold is the lower swing joint (without packing) that allows the monitor to be turned in a horizontal plane a full 360 degrees. This movement is made by the same handle that directs the nozzle in a vertical plane, ten degrees below the horizontal and 65 degrees above the horizontal, thus giving all the required range for the stream.

The upper swing joint (also without packing) is at right angles to the lower swing joint, and consists of an inner cone turning within a floating cone; these two rotating with the outer body, which is a casing so constructed that both upper and lower joints function within this casing.

The inner cone of the upper joint carries the nozzle barrel or play pipe. The play pipe travels through a slot in the casing. A portion of the solid inner cone, opposite the end of the play pipe, is cut away to form a large unrestricted water way, no matter in what position the play pipe or nozzle barrel is directed. The handle is covered with rubber in case the stream from the monitor passes through high voltage wires.

INSTRUCTIONS:

1. Remove main body of Macgregor monitor from the apparatus.
   (a) Remove holding pin from socket.
   (b) Raise monitor from socket and lower same to ground.
2. Remove platform from apparatus and place on ground.
3. Remove control handle from apparatus and place in socket of nozzle, secure handle with lock pin.
4. Remove extra tip from apparatus and change tips if necessary.
5. Carry main monitor body and platform to desired location.
   NOTE: In some cases monitor can be assembled at apparatus.
6. Open up folds of platform, lock folds open with latch and set platform in position. NOTE: On smooth cement it is advisable to chip the cement with the pick of an axe so the steel pins on bottom of platform will hold.
7. Insert the base of monitor post into socket in center of platform.
8. Adjust monitor base so that holding pin can be inserted through socket and base of monitor.
9. Insert holding pin. (Fig. 2)
10. Shut nozzles off on working lines and remove tips.
    NOTE: Place tips in a safe location.
11. Connect female swivels of monitor inlet manifold to male nozzles butts, with shut-off indicators in upright position.
12. Direct monitor nozzle.
13. Stand on platform and open nozzle butts connected to inlet manifold.

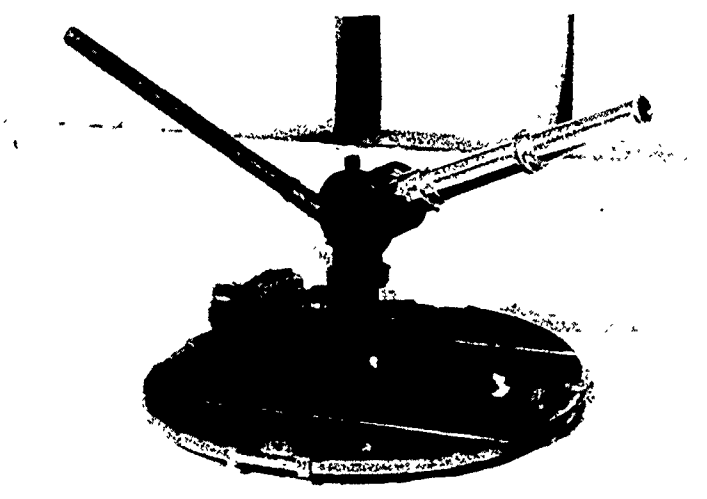

Fig. 2

14. Grasp the insulated handle and raise or lower to direct the nozzle in a vertical plane.
15. Turn handle to either side to direct nozzle in a horizontal plane. NOTE: The nozzle can be turned full 360 degrees.

37c: HOW TO OPERATE THE EASTMAN DELUGE SET

INFORMATION:

The Eastman deluge sets (Fig. 3) with a two, three, or four-way manifold are for use where heavy streams are desired. The set consists of a two, three, or four-way 2½ inch inlet manifold into a 3½ inch line; nozzle with 1½ inch, 1 5/8 inch, 1 3/4 inch, 2 inch, and 2 1/4 inch tips. It is usually carried on the apparatus assembled with the platform and extra tips detached.

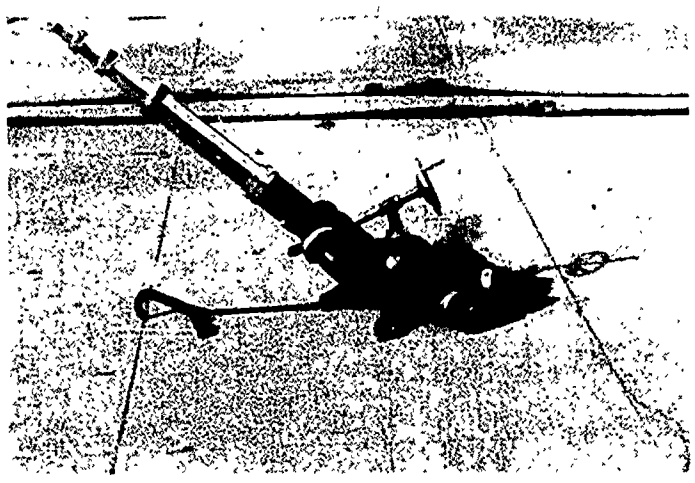

Fig. 3

When working from the ground level with portable deluge sets or monitors the third floor is considered the highest floor for an effective stream; in cases of emergency the stream can be directed to the fourth floor.

Monitors delivering heavy streams should be turnable and mobile to be effective. This is done by mounting the set on a platform of sufficient area to take care of the center of gravity.

The Eastman set when in operation develops two forces. A propelling force and a reactionary force.

In the Eastman set the lines of the center of gravity fall outside of the base, and the reactionary force of the stream is utilized to steady the set. For that reason the set, when in operation, must not be thrown out of balance.

INSTRUCTIONS:

1. Remove assembled set from apparatus and carry to desired location. NOTE: Change tip on nozzle if necessary. Place stars up on inlet manifold.

2. Open up folding legs and place in position. NOTE: On smooth cement it is advisable to chip the cement with the pick of an axe so the steel pins on bottom of the platform will hold.
3. Shut nozzles off on working lines and remove tips. NOTE: Place tips in a safe location.
4. Connect female swivels of inlet manifold to male nozzle butts with shut-off indicators in an upright position.
5. Open nozzle butts at inlet manifold.
6. Shut valves off at manifold when lines are to be moved.
7. After use, replace all equipment on apparatus.

37d: HOW TO OPERATE GRANT MULTIVERSAL PORTABLE MONITOR DELUGE SET

INFORMATION:

The Grant multiversal portable monitor deluge set can be used wherever heavy streams are desired similar to the Morse or Eastman deluge sets.

This set is carried in a special bracket on the apparatus, either with or without the nozzle connected to the body of the monitor. The body of the monitor is so constructed that the nozzle may be turned, in a horizontal plane, in a complete circle.

INSTRUCTIONS:

1. Remove nozzle from carrier and connect to body of monitor, if detached.
2. Give hand wheels on carrier one turn so as to release leg supports and lift from carrier. (Fig. 4)
3. Carry to desired location, loosen lock on elevation adjustment, set nozzle at desired elevation and lock. NOTE: Elevation adjustment has pins and catches on it so that nozzle cannot be operated below 10 degrees above the horizontal.
4. Loosen revolving positive lock so that body of monitor can be turned to any position wanted.
5. When setting on hard pavement, roughen pavement with suitable tool where legs set.
6. Connect hose lines, using the outer inlets of monitor first, whether on a three or four way inlet.

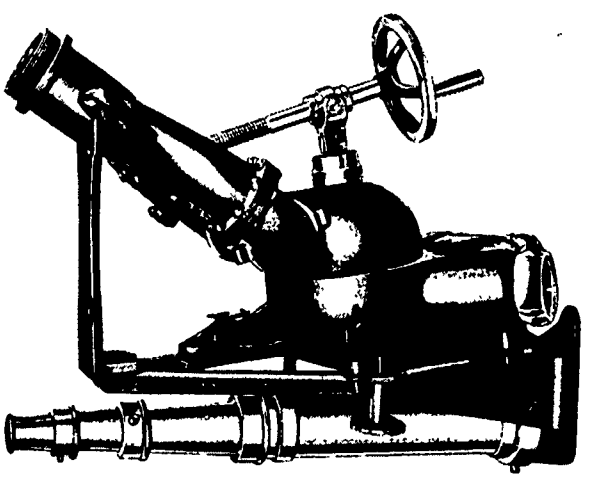

Fig. 4

Fig. 5

37e: HOW TO OPERATE JR. PORTABLE DELUGE NOZZLES

INFORMATION:

The junior multiversal deluge nozzles have several attachments, namely, a four leg ground attachment, window and coping attachment, and a ladder attachment. These deluge nozzles are primarily designed for use with one line, but may be used with two by using regular fire department siamese. (Fig. 5)

INSTRUCTIONS:

On the ground, procure ground attachment, unscrew locking wheel and drop body of nozzle over ground attachment and tighten locking wheel. Release lock on elevation adjustment, set in desired location and lock. Nozzle may be turned in complete circle and moved at any angle as well as 180 degrees perpendicular position.

To secure window and coping attachment to a window, unscrew lock wheel all the way out, release pin on single leg and adjust for thickness of wall. Tighten lock wheel so as to hold securely. Set nozzle on holder, tighten locking wheel, release elevation adjustment lock, and set nozzle at desired position. Tighten elevation adjustment lock.

To secure ladder attachment to a ladder, unscrew lock wheel all the way out, place single leg on one rung and double legs on to next rung and screw lock wheel up tight securing attachment to ladder. Set nozzle on attachment and lock securely. Release elevation adjustment lock, set nozzle at desired elevation and lock.

37f: HOW TO OPERATE WAGON BATTERY OR DECK PIPE

INFORMATION:

Wagon battery or wagon pipes are provided for fire boat tenders and some Engine Companies operating in high value districts, where heavy streams are desired.

The wagon battery possesses two advantages over the street streams; deluge sets, or monitors. First the nozzle is approximately nine feet above the street, and second the heavier calibre streams are easily manipulated by one man. The logical place to locate the wagon is at the opposite curb on medium or narrow streets. This gives the maximum distance from the building, which in turn means the maximum reach, provided the stream is not broken up before it strikes the building.

A thirty degree angle stream gives the most effective results. Above the third floor the effectiveness of the stream decreases.

The nozzle is operated by means of hand wheels, one directs the vertical plane and other permits the nozzle to be turned in a horizontal plane full 360 degrees.

When the battery is operated the wheels should be chocked and the wagon covered with salvage covers. NOTE: Fire boat tenders are equipped with stay chains to counteract back pressure.

Suitable spanners are provided to tighten the connections in case of leaks. Water should be run through the battery at regular intervals to prevent the packing from drying out.

INSTRUCTIONS:

1. Place the hose wagon containing the battery or wagon pipe in proper location.
2. Chock the wheels on hose wagon. On tenders, chock wheels and set chain.
3. Remove protector plugs in inlet manifolds for desired number of lines.
4. Lay desired number of lines and place in position.on.
5. Shut nozzles off on lines of hose and remove tips.
6. Connect the inlet female swivel connections to the male nozzle butts with the shut-off indicators in upright position. (Fig. 6)
7. Operate the control wheels to direct the stream at fire.
8. Open all shut-offs on supply lines. CAUTION: Notify crews operating within range of battery before turning on water.
9. Operate control wheels to direct streams as desired.

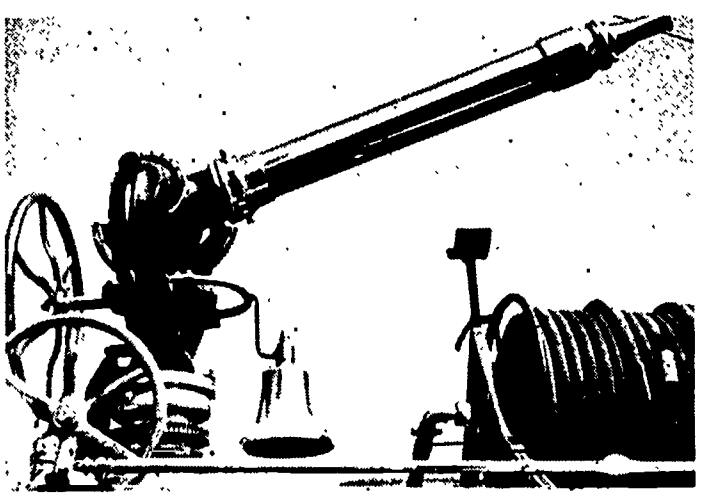

Fig. 6

38: HOW TO OPERATE WATER TOWER AND LADDER PIPE

INTRODUCTION:

The handling of water towers (Fig. 1) and ladder pipes from aerial ladders comes only from practice and use of same.

Water towers that are raised by water pressure, chemical pressure, springs, or by hand, etc., require knowledge in the operation of their mechanism and members detailed to these pieces of apparatus should be thoroughly drilled in the operation of same.

INFORMATION:

One of the most essential points to be considered in placing a water tower is the distance from the building to set the tower in order to get an effective stream. This depends upon the height of the building and the amount of pressure which is to be supplied.

After spotting apparatus at desired location, connect hose lines, raise tower, set spurs on the body of the tower and guy lines made fast on the side of tower in which direction the stream is to be played. This is to prevent the tipping over of the tower due to back pressure. The elevation of the nozzle is controlled by hand lines from the tower platform, as is also the horizontal direction of stream.

In using a ladder pipe from an aerial as a water tower, the ladder shall lean from the perpendicular in the direction in which the stream is to be played. Vertical range of stream is usually controlled by man working directly with ladder pipe at top of aerial ladder. Horizontal movement of stream is controlled by movement of the aerial ladder platform as desired. Ladder pipe (Fig. 2) is equipped with holders for fastening it to rungs of aerial ladder. On some equipment they are carried preconnected to ladder and extension hose.

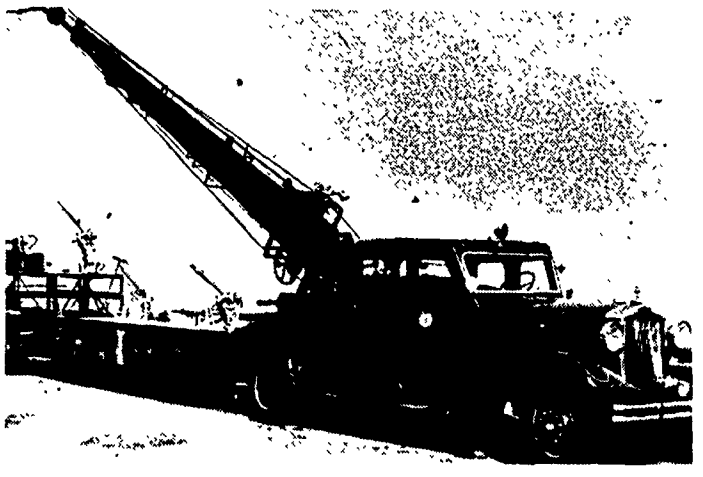

Fig. 1

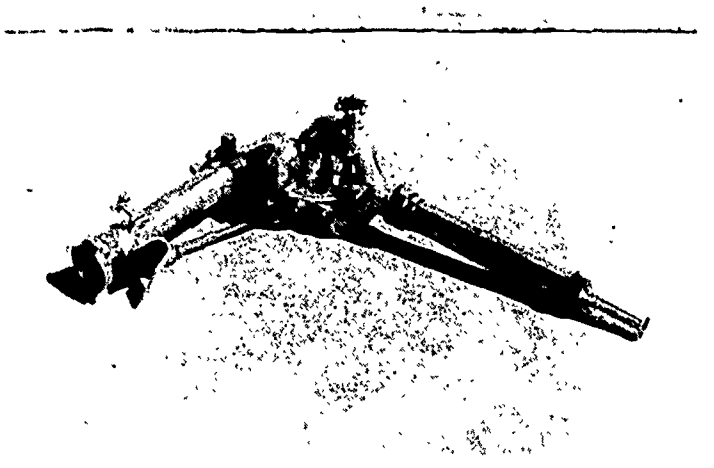

Fig. 2

SUGGESTED GROUND HOSE LINE DRILLS

In drilling, every effort should be made to gain precision before speed is attempted. Drills should be as practical as possible from the standpoint of man power available. If two men are all that will be available, drills should be built around that number.

1. Lay one line from hydrant to fire, unload ladders, pike pole, and axe. Return to hydrant.
2. Lay one line from hydrant to fire. Unload ladders, pike pole and axe, siamese to 1½, return to hydrant and connect pump.
3. Lay one line from hydrant to fire. Unload ladders, pike pole and axe, siamese to 1½, return to hydrant and connect pump.
4. Lay two lines from hydrant to fire, unload ladders, pike pole, and axe, and siamese one line, return apparatus to hydrant and connect. NOTE: This can only be used when hose bed is divided.
5. Lay one line from fire to hydrant, unload ladders, pike pole, and axe, connect pump to hydrant.
6. Lay one line from fire to hydrant, unload ladders, pike pole, and axe, reduce to two 1½ inch lines, connect hydrant.
7. Lay two lines from fire to hydrant, unload ladders, pike pole, and axe, reduce one line to two 1½ inch, connect to hydrant. NOTE: This can only be used when hose bed is divided.

8. (a) Replace damaged hose section.
   (b) Lay lines and connect to auxiliary appliances
   (c) Lay lines and connect to monitor sets. (Two, three, or four intakes)
   (d) Lay lines and connect to deluge set
   (e) Lay lines and connect to ladder pipe.

9. Pump engines in relay, to be used where fire is more than 1000 feet from hydrant, or where water may be drafted. Two or more engines can be used to provide hose to reach the fire. Care must be exercised by engineers pumping on relay line to avoid collapse of the hose line entering pump section. Tap-ins, if used on brush fires, etc., should be made near the discharge side of engines stationed on the relay.

   NOTE: In all drills proper hand signals should be practical. These signals will increase efficiency by better coordination, speeding up operations with less confusion, and less manpower required. (See California State Fire Training Manual "Pump Operations" pages 65 through 67 for standard hand signals)

CALIFORNIA FIRE TRAINING PROGRAM

Unit F

LADDERS

39. CARRY, RAISE AND LOWER STRAIGHT LADDERS
40. CARRY, RAISE, AND LOWER ROOF LADDERS
41. CARRY, RAISE AND LOWER EXTENSION LADDERS
42. CLIMB, LOCK-IN AND FOOT LADDERS
43. CARRY, RAISE AND LOWER POMPIER LADDERS
44. OPERATE AERIAL LADDERS
45. USE LADDERS AS IMPROVISED EQUIPMENT, BRIDGING, ETC.
46. RELEASE AND LOWER FIRE ESCAPE LADDERS

OBJECTIVE:

To develop the ability to carry, raise, and place ladders correctly; take hose lines aloft using various methods; estimate the correct distance the base of a ladder should be placed from a building in order to attain the proper angle for climbing; recognize the different makes and types of ladders, with a knowledge of their size, construction, and strength; number of men a ladder will support with safety; the importance of selecting proper ladder and equipment for the job.

CONSTRUCTION OF LADDERS

INTRODUCTION:

A large variety of ladders are employed in the fire service. A thorough knowledge of them is essential. In general, they may be classified as follows: aerial, extension, trussed type (some of the smaller extension ladders are of the solid beam type), straight (trussed type), roof or hook (this type is found in both trussed and solid beam) Pompier or scaling ladder, and the collapsible ladder.

INFORMATION:

There are three types of ladders from the standpoint of material used in the construction of ladders; wooden ladder, metal ladder, and wood and metal combined.

There is a variety of design of trussed ladders. Some are made with beams of equal size while others are built with one of the beam members larger than the other. Rungs may be set directly into the beam, while in other types, the rungs are set into blocks mounted between beam members.

The solid beam ladder is designed with both beams of solid material, either of wood or metal, with rungs set in center of beams. The metal ladder is constructed of a metal alloy, some of which have solid beams, while others are built similar to the wooden trussed ladder, with blocks of metal between the beams in which the rungs are set.

The beam of a pompier is made of second growth hickory with a steel band or bronze wire, which is imbedded and extends completely around the beam, while the rungs are made either of hickory or second growth ash. The hook is generally constructed of plow steel. The beams of a collapsible ladder are made of spruce with hickory rungs.

There are many recognized types of trussed ladders in use in the fire service at the present time: Pirsch, LaFrance (or Weston), Seagrave, and Duo Safety are among the most common. The LaFrance, Pirsch, and Duo Safety ladders have the rungs set in blocks that are mounted between the beams. The Seagrave ladders are all trussed, and the rungs are set in a beam of the truss. On these ladders, the rung side of truss is placed away from building when in use.

In using a solid beam extension ladder, some departmental rules require the fly to be away from the building, while others require the fly toward the building. This is a matter of opinion and has never been fully decided which side is proper, although there has been much discussion on this subject by the chiefs and engineers, either side being safe to climb, depending on the rule of that particular department which side is to be placed toward the building.

DEFINITIONS:

Base or Butt:	The bottom or ground end of a ladder.
Beam:	The principal structural member of a ladder in which rungs are supported. In case of trussed ladders, "beam" usually refers to the larger of the two members making up one side of the ladder, and in this case again, either the rungs are set into the beam or they are set in blocks attached to the beam.
Dog (Lock Pawl):	Device which locks fly ladder in place after hoisting same.
Extension Ladder:	A ladder built in two or more sections.
Fly Ladder (or Fly):	The upper sections of an extension ladder.
Guides:	Strips on the inner side of truss blocks on the beams between rungs which guide the fly ladder while being hoisted. In some types of trussed and metal ladders, guides run in a track in the truss blocks. Solid beam ladders generally have outside metal guides.
Halyard:	Rope used in hoisting the fly ladder.
Main Ladder:	The lower section of extension ladder.
Poles (tormentors):	Poles attached to upper end of beam of main ladder, used to raise, guide and steady the long ladder. Most tormentors are permanently attached to the main ladder.
Rollers:	Metal rods with rollers imbedded at the top of the main aerial ladder over which the fly ladder rolls when being hoisted and lowered.
Rungs:	Cross members between beams used in climbing ladder.
Steel Shoes:	Metal devices at the butt end of ladder.
Stops:	Devices which stop the fly ladder from being extended out of main ladder.
Tie Rods:	Metal rods which hold the entire ladder assembly together.
Truss Blocks (chairs)	Wooden blocks placed between the beams and trusses of a trussed ladder. In a metal ladder these are made of metal.

Trusses: The beam running parallel to the rung beam.

EXTENSION LADDERS

Ladders of the extension type are used in lengths from 14 to 55 feet, and the aerial ladders range from 65 to 150 feet. Solid beam extension ladders seldom run over 30 feet in length, except on aerials. The metal ladders, from 35 feet and over, mostly have two fly ladders or three sections. This is to make them compact for carrying on apparatus.

STRAIGHT TRUSSED LADDERS

Trussed ladders of the straight trussed type are used in lengths ranging from 16 to 35 feet. There are very few straight solid beam ladders in use, except roof or hook ladders. These seldom run over 24 feet.

ROOF OR HOOK LADDERS

Roof ladders of the hook type are used in lengths from 10 to 20 feet. These may be either the solid or trussed beam type.

POMPIER OR SCALING LADDERS

The parts of pompier ladders are known as follows:

Beam or Spar: Main structural member of ladder through which rungs are placed.

Rungs: Cross members used in climbing ladder.

Hook: The steel member which hooks over the window sill, generally made of plow steel.

Heel: Curved part of the hook immediately at the top of spar or beam (sometimes called goose neck).

Shields: Devices, two in number, which hold the ladder out from the wall at a sufficient distance to permit stepping on rungs, grasping the beams while climbing and snapping snap of life-belt to beam.

Straps: The metal band or cable which is usually a continuation of the hook, extending the full length of the spar or beam, and are imbedded in spar.

Braces: The metal braces under rungs.

Pompier ladders are used in lengths from 12 to 16 feet.

FOLDING OR COLLAPSIBLE LADDERS

As the name implies, this is a ladder with the rungs pivoted in such a manner that the beams will fold together and when folded occupies very little space on apparatus.

GENERAL DATA ON LADDERS:

The length of the ladder should be marked on beam near the ends. This entirely eliminates guesswork in the removal and replacement of ladders at fires.

The distance the base of a ladder should be placed away from a building is found by the simple formula: Divide estimated height to be reached by five and add two (1/5 of height plus 2). Example: What distance should base of 35 foot ladder be placed from building when fully extended? 35 ÷ 5 = 7 + 2 = 9' from the building. This will place the ladder on an angle at which it will give its best service, having maximum strength and, at the same time, not too steep for climbing with safety.

The number of men permitted on different sized ladders: One man is permitted on 14 and 16 foot, two on 18 to 24 foot, three men on 30 and 40 foot, four men on 45 to 55. Two are permitted on pompier ladder, and three men on roof or hook ladder when placed on pitched roofs. Men should be spaced approximately 10 to 15 feet apart at all times in climbing ladders.

Before climbing a ladder, the base must rest evenly: extension ladder pawls should be locked; on large extension ladders, halyard properly secured.

In ascending or decending, always face the ladder.

Ladders may be used for other purposes than climbing, for instance: As a battering ram; bracing extension ladders; used to bridge between buildings; salvage work, etc.

INSPECT AND CARE FOR LADDERS

INFORMATION:

Ladders in fire department service must receive constant care and attention if they are to be kept in dependable first class condition. They should be inspected regularly and be tested periodically.

One of the most important features of ladder care is in the care of the finish. Proper protection of wood ladders against deterioration, due to a poor finish, has been found to be of the utmost importance in prolonging the life of the ladder. As a means of preserving the strength and prolonging the life of a ladder, they should be revarnished (not painted). Before varnish is applied all blemishes, spots, and mars shall be removed

by scraping and sanding. Two coats of varnish shall be applied, the second coat only after the first coat has thoroughly dried.

Ladders shall be inspected carefully for cracked or splintered beams and trusses, cracked or marred rungs, especially those on extension ladders to which the fly ladder has been locked. Splintered or worn poles, particularly at the point where they are attached to ladder, justify replacement.

Other points to consider are spurs worn smooth from raising the ladder on pavement, halyards improperly adjusted for length, or frayed, worn, cut or otherwise damaged; breaks, splits, or weakening of the guides, braces, and other wooden members; ends of stops worn, permitting ends to pass, tie rods loosened or unbolted. Sharpen spurs by dressing down with a good file. Where wooden members of ladder are badly worn, replace with new parts.

Marred rungs and beams should be scraped down and two coats of varnish applied.

Pawls (locks, dogs) also pulley, shall be examined and oiled to keep in first class working condition.

Ladders shall be tested periodically, and when testing the following points must be taken into consideration: Were the ladders originally of a good make, are they of standard dimensions, to what use have they been subjected, have they ever been repaired?

The above all have a bearing on the severity of the tests to which they shall be subjected, but at the same time, it should be remembered that ladders, old or new, weak or strong, may be submitted to the same stress in an emergency. In view of this condition, it must be conceded that a ladder, if unable to stand up under a fair test, should be discarded. That is one of the objects of testing ladders--to determine which ones are unfit for further use.

In making tests the average weight of a man is taken at 175 pounds, and the usual method of testing is to take the total weight of the number of men permitted on the ladder under test and double this weight distributing it evenly on the ladder. To each rung on which a load is to be suspended attach a sturdy clothesline pulley. The pulley is secured to the rung by a piece of sash cord or quarter inch rope. Through each pulley is threaded a piece of sash cord or quarter inch rope of sufficient length to reach the ground at both ends. A number of bags of sand are provided, each weighing 87 pounds. One end of the rope through the pulley is attached to one sand bag. This bag is then drawn into the air and the free end of the rope is attached to another 87 pound bag of sand. This is then lifted clear of the ground until

the two sacks balance. This method makes it possible to add to the load gradually without endangering the men making the test. Weights should be attached in order from top of ladder to base.

The testing of ladders does not end with determining their ability to carry a load. Each rung should be tested to twice the weight of the average man, and an allowance of 100 pounds should be made as a safety factor, making the total load to which the rung is subjected to 450 pounds.

For this load, five bags of sand are used and securely tied together. (Fig. 1) The two ends of a rope about four feet long are tied securely together to form a loop. This loop, together with an "S" hook, comprise the method of supporting the load on the rung. The usual method employed to raise this load is by block and tackle, one having half inch rope preferred. The hook of one block is placed over the rung and the hook of the other block is fastened to the rope holding the bags of sand, then sandbags are hoisted clear of the ground. (Fig. 2)

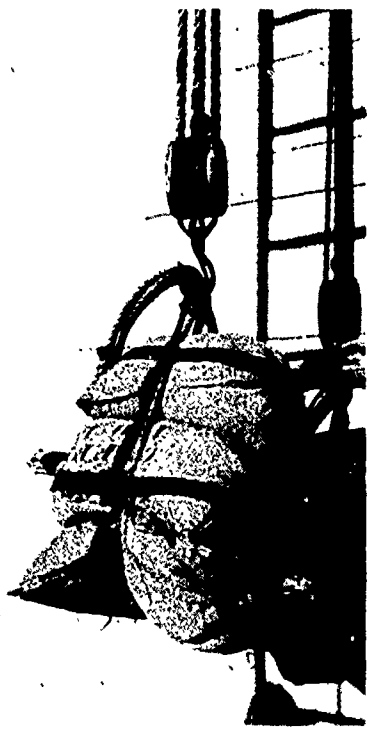

Fig. 1

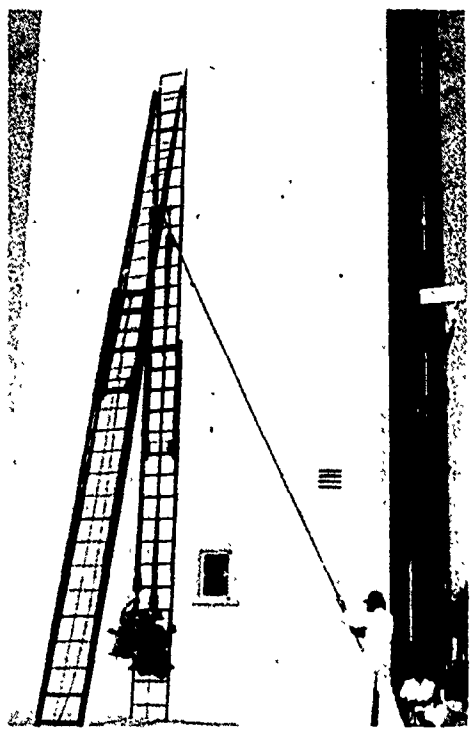

Fig. 2

To make the test a trifle more severe, swing load from side to side so that the ladder will receive the same strains that it gets in actual service. This method avoids any unnecessary risk to the men engaged in carrying out the test.

REMOVING DIFFERENT SIZES AND TYPES OF LADDERS

INFORMATION:

Owing to the different types and sizes of ladders and the many ways ladders are carried and fastened to the apparatus, it is nearly impossible to cover all means of removing ladders from apparatus.

On combination pumpers, they are generally carried on the side and in many instances, 20 or 24 foot extension and 10 or 12 foot roof ladders are carried on the same side, although some are carried separate, one on each side of apparatus. In some cases they are carried above the hose bed. They are all fastened with some sort of catch that must be released before ladder can be removed.

On service and ladder trucks, most generally, the short straight ladders are carried on racks provided on the sides, (Fig. 3) while the longer straight ladders and extension ladders are carried in a bed over center of apparatus. Where ladders are carried in bed, catch (Fig. 4) must be released and ladders removed by walking straight back from apparatus. (Fig. 5) Tiller post must be removed first on aerial truck before ladders can be removed from ladder bed.

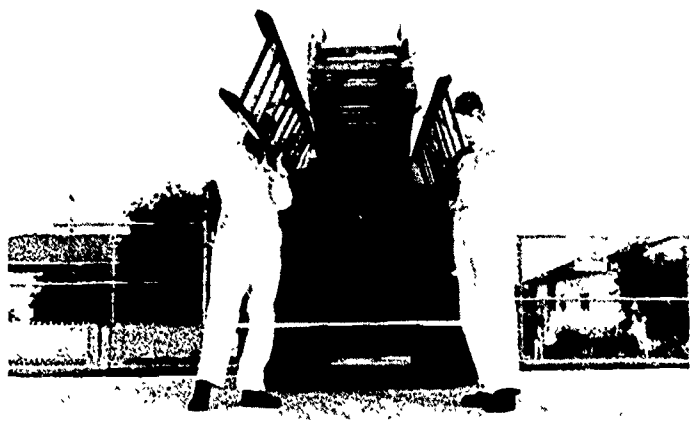

Fig. 3

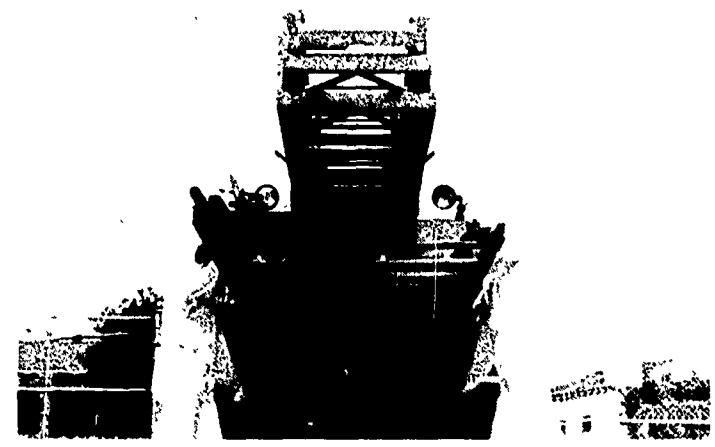

Fig. 4

Fig. 5

When ladders are removed from combination pumpers and not to be used immediately, they shall be placed on the ground, either next to apparatus or on sidewalk or curb, to keep space clear for apparatus to return to hydrant if necessary.

CARRYING, RAISING AND LOWERING LADDERS

INFORMATION:

When carrying any ladder, place the climbing side next to body. In laying ladders flat on ground, climbing side should always be down. This will place ladder into proper position for raising. When turning or picking up a ladder, men shall work together to avoid twisting, as this tends to loosen the rungs and consequently weakens the ladder. Ladders shall be carried with base or butt forward wherever possible. This will also bring the ladder into proper position for raising.

The raising and lowering of ladders for fire fighting and rescue operations require constant drill and team work. Some operations require only one man while others may require several men.

If possible, selection of ladder crews should be made up of men of uniform height and weight.

Obstructions such as overhead wires, tree limbs, etc. must be observed so as not to hinder ladder raising operations.

39a: HOW TO CARRY, RAISE AND LOWER STRAIGHT LADDERS (One Man)

INFORMATION:

Straight ladders from the shortest up to and including twenty feet in length are generally classified as one-man ladders.

INSTRUCTIONS:

1. Take position at balance point of ladder facing top.
2. Grasp beam next to body (Fig. 1) and raise on edge.
3. Lift ladder, pivoting body and placing other hand between rungs grasping lower beam and place top beam on shoulder. (Fig. 2)

Fig. 1

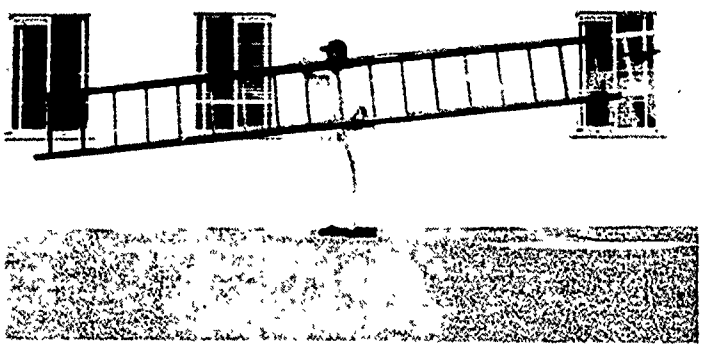

Fig. 2

4. Carry to desired location.
5. Turn ladder flat by lifting bottom beam and place butt of ladder against base of building. (Fig. 3)
6. Grasping center of each rung (hand over hand) walk forward raising ladder to vertical position against building (Fig. 4)
7. Grasp second rung either hand, palm up, and fifth rung with other hand, palm down. Position one foot in front of ladder and other to one side.
8. Lift ladder and step back using foot placed in front of ladder. Place ladder proper distance from building with both beams set firmly (Fig. 5).
9. To lower ladder, reverse operations.

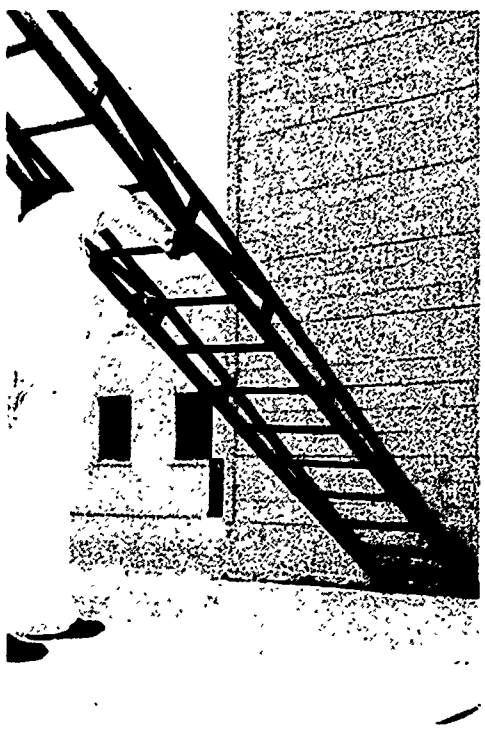

Fig. 3

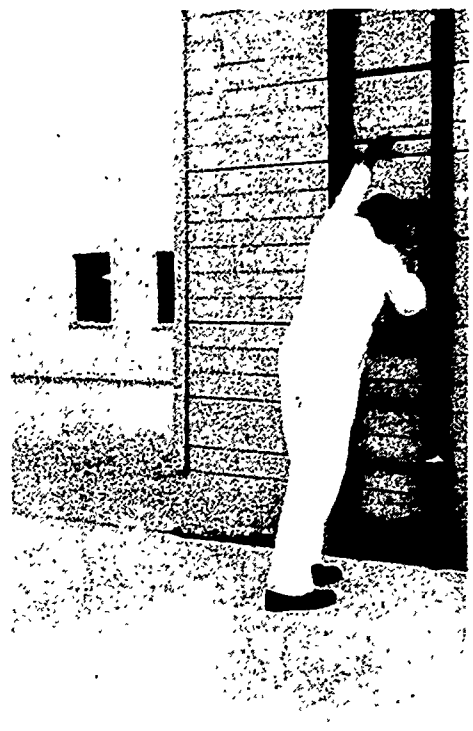

Fig. 4

Fig. 5

39b: <u>HOW TO CARRY, RAISE AND LOWER STRAIGHT LADDERS (two-men)</u>

INFORMATION:

For straight ladders of 20 ft. or more in length, two men are used. Butt man generally issues commands.

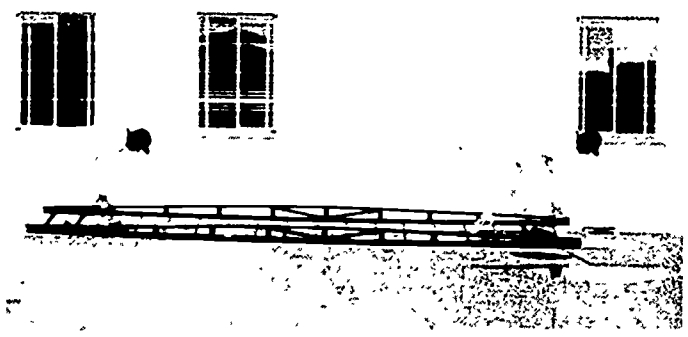

Fig. 6

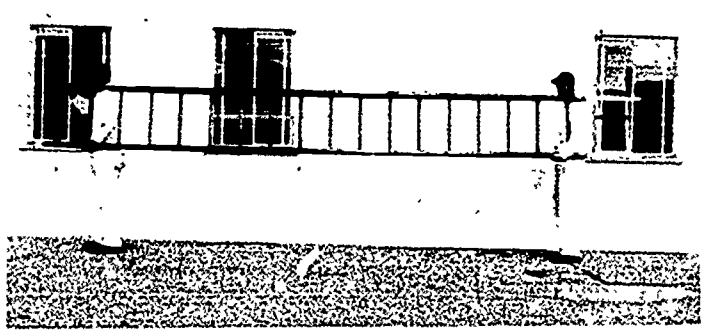

Fig. 7

INSTRUCTIONS:

1. Take positions at opposite ends of ladders between second and third rungs, facing top of ladder.
2. Grasp beam next to body, (Fig. 6) and raise on edge.
3. Lift ladder, pivoting body, and placing other hand between rungs grasping lower beam, and place top beam on shoulder. (Fig. 7)
4. Carry to desired location.
   NOTE: The ladder may be raised either parallel or at right angles to building, depending on the amount of space available.
5. Butt man lowers ladder, turning flat and spotting at proper location and distance from building.
6. Butt man foots ladder with both feet on bottom rung, grasp third rung and pull back. (Fig. 8) As ladder is raised, move hands up on rungs as in climbing ladder. NOTE: Alternate method of footing ladder (Fig. 9).

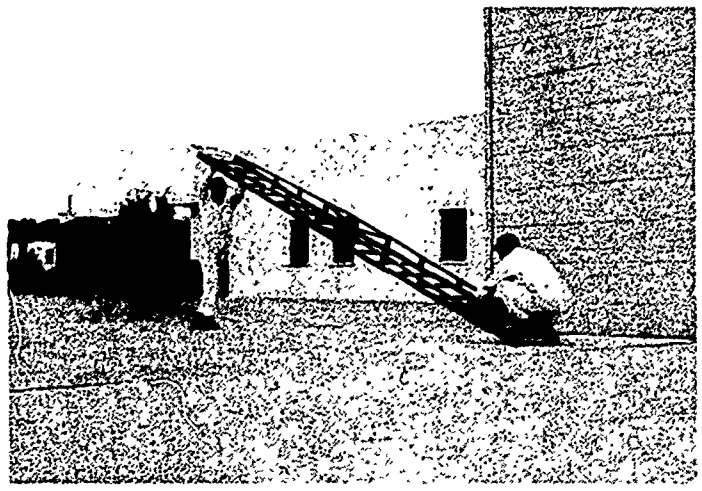

Fig. 8

Fig. 9

7. Top man grasps center of each rung (hand over hand) walking forward and raising ladder to vertical position.
8. Top man places foot on bottom rung next to pivot beam. Tilt ladder slightly on pivot beam (Fig. 10) and turn to let into building. NOTE: Butt man goes behind ladder.
9. Ladder is let into building, with butt man bracing ladder from rear and top man in front of ladder with one foot on bottom rung, and grasping the rung about shoulder high, near beams. (Fig. 11)
10. To adjust base of ladder for proper position, both men move to right, one on each side of ladder. Bottom hand of each man grasping second rung from bottom palm up; top hand grasping fifth rung from bottom, palm down. Lift and adjust base to proper position. (Both men watch top of ladder).
11. To lower ladder, reverse operations.

Fig. 10

Fig. 11

39c: HOW TO RAISE AND LOWER STRAIGHT LADDERS (Beam Method-2-men)

INFORMATION:

This method is employed when ladder has to be raised in close quarters or when necessary to avoid overhead obstructions etc. For picking up and carrying ladder the same method is used as shown in Job 39b, Fig. 6 and 7.

INSTRUCTIONS:

1. Butt man lowers ladder, spotting at proper location and distance from building.
2. Butt man foots ladder by placing ball of one foot on shoe of bottom beam, and grasps top beam with hands and assists in raising ladder.
3. Top man grasps top beam with free hand, (Fig. 12) raises ladder using lower beam, and walking toward base of ladder.

Fig. 12

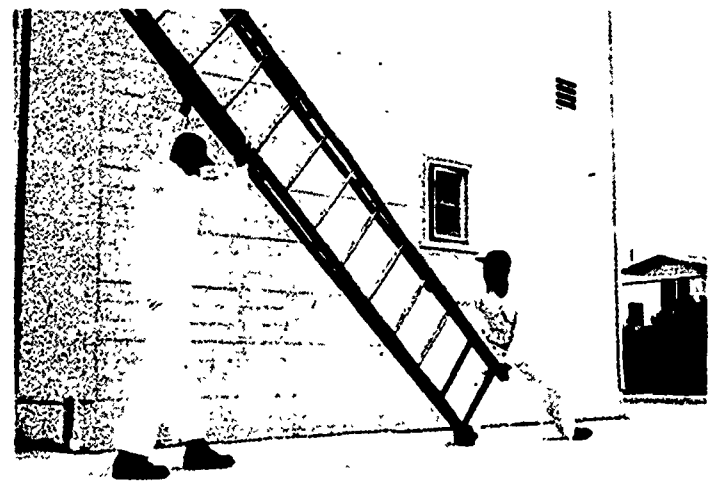

Fig. 13

39d: HOW TO CARRY, RAISE AND LOWER STRAIGHT LADDERS (28 feet or longer -- three men)

INFORMATION:

These longer ladders generally require three-men and may be raised either flat or beam raise.

There are some variation in carrying the ladders with three men, the flat carry on shoulders being the most common.

INSTRUCTIONS:

1. Position man at butt of ladder between second and third rungs, and two men one third distance from top on each side of ladder. All face top of ladder.
2. Each man grasps beam next to body. Lift ladder and pivot body underneath placing ladder beam on shoulder.
3. Carry ladder to desired location.
4. Butt man spots ladder properly and lowers base to ground, and foots ladder. (Fig. 14)
5. Top men raise ladder, by placing inside hands on rungs and outside hands on beams walking toward base of ladder. (Fig. 15)
6. When ladder reaches near-vertical position, if necessary to pivot front man on pivot beam side, places foot on bottom rung against pivot beam, and all men pivot ladder.
7. Both front men place inside feet near center of bottom rung, with butt man grasping beams at rear, ladder is lowered into building. (Fig. 16)

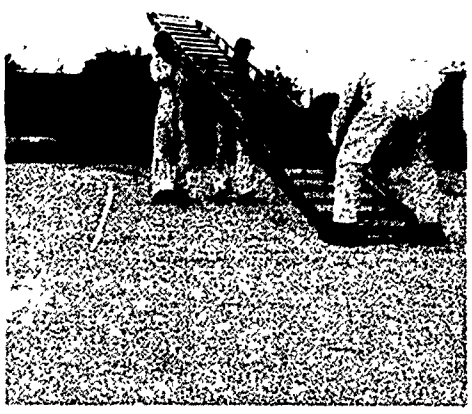

Fig. 14

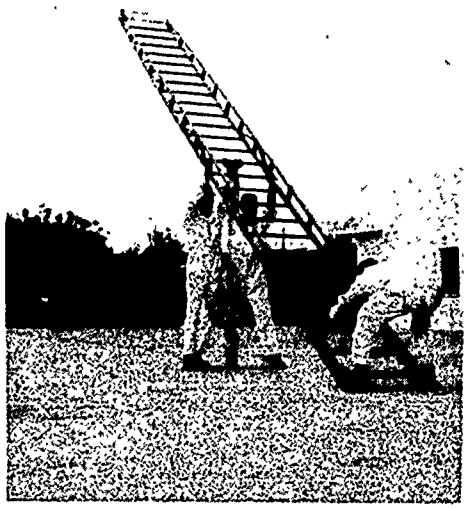

Fig. 15

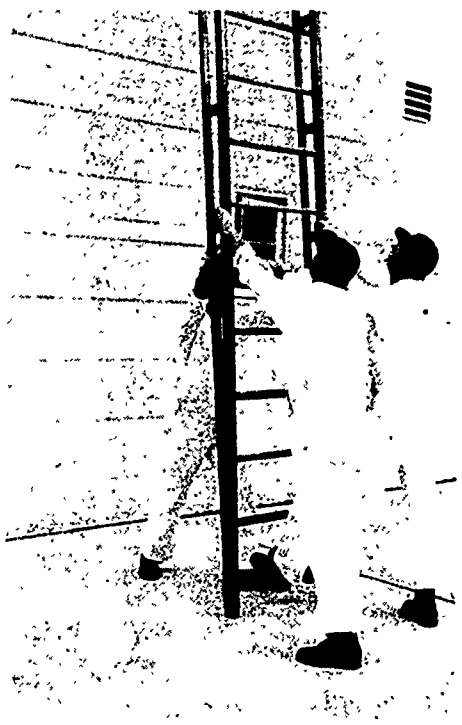

Fig. 16

8. To lower ladder, reverse operations.

NOTE: If beam raise is necessary, the ladder is generally carried on side with top beam on shoulders. Men are spaced between second and third rungs from each end and one at center. In raising men, take positions as shown in Fig. 17.

Fig. 17

39e: HOW TO CARRY, LOWER, AND RAISE "FOLDING" STRAIGHT LADDERS

INFORMATION:

These ladders are available in 8 to 12 foot lengths; 10 ft. being the most common. They are especially useful for inside work. They are easily carried up stairways and to places where the ordinary ladder would be cumbersome. They are carried in a folded position and can be carried in one hand. They generally have folding shoes with corrugated rubber base, for protection of floors and to prevent slipping.

INSTRUCTIONS:

1. Carry ladder to desired location.
2. Place ladder in vertical position (Fig. 18)

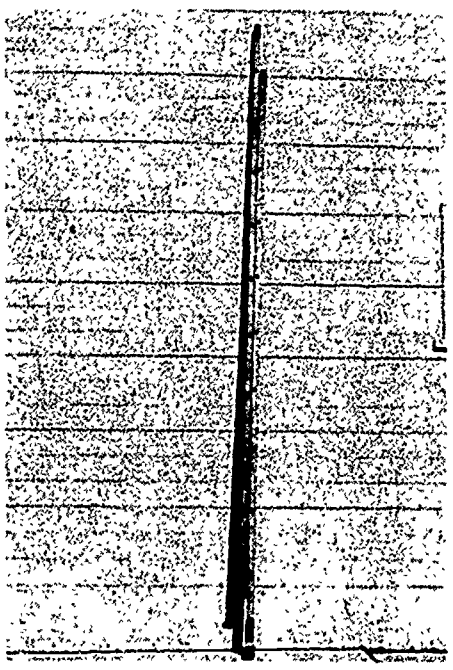

Fig. 18

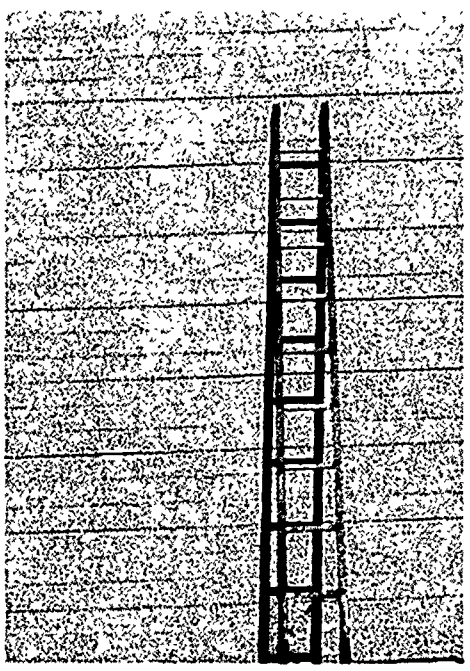

Fig. 19

NOTE: If inside, and unable to place upright, open with ladder on floor.

3. Pull beams apart and lock. (Fig. 19)
4. To lower ladder, release safety brace and fold together.

40a: HOW TO CARRY, RAISE, AND LOWER ROOF LADDERS (Used as Straight Ladder)

INFORMATION:

The roof ladders used in the Fire Department have the movable hooks mounted in stationary sockets which permit the hooks to open outwards when ladder is to be used, (Fig. 1) or turned inward when not in use.

The roof ladder possesses certain advantages over other types of ladders. It may be employed in getting to peaks of gabled roofs to facilitate removal of shingles, or to cut holes to ventilate, and can be used to good advantage in entering scuttle holes in ceilings or in holes cut through flooring or sidewalk openings.

The hooks of the ladder placed over roof peaks, sills, walls, or the coaming of any opening, make it safe and reliable, whether the butt rests upon a foundation or not.

Roof ladders of the hook type as used in the Fire Department range in lengths of 10 to 16 feet.

INSTRUCTIONS:

1. Carry to desired location with bottom beam on shoulder and base forward. (Fig. 2)
2. Rest base of ladder on ground and raise to vertical position.
3. Place either foot on bottom rung, grasp rung shoulder high with both hands and lower into building.
4. Adjust to proper climbing angle.

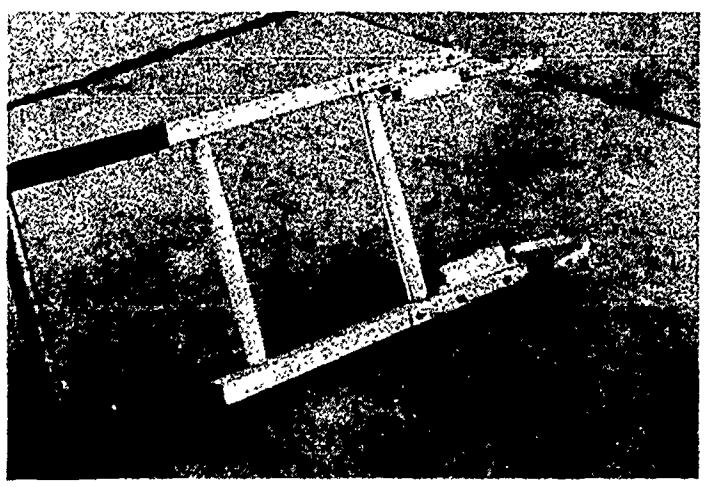

Fig. 1

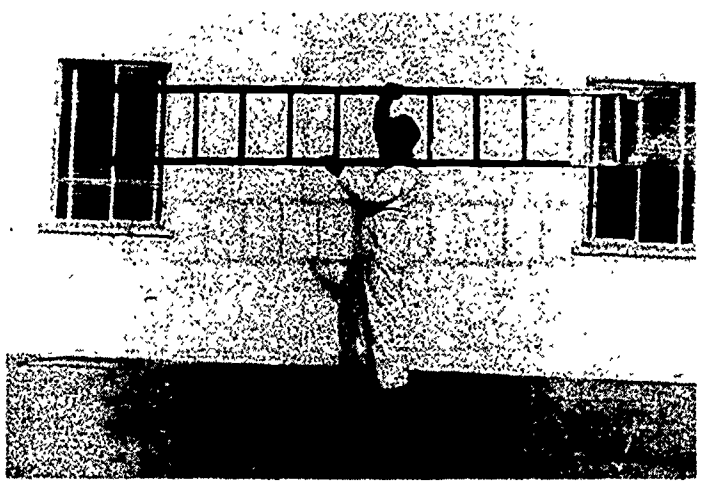

Fig. 2

5. To lower ladder, reverse operations. NOTE: If ladder is to be used inside, carry ladder with top beam on shoulder and hooks forward. (Fig. 3)

Fig. 3

40b: HOW TO CARRY, RAISE, AND LOWER ROOF LADDERS (ABOVE GROUND)

INFORMATION:

The primary purpose of the roof ladder is for use in ventilating operations on steep roofs

INSTRUCTIONS:

1. Carry to base of climbing ladder, with bottom beam on shoulder and base forward.
2. Lower base of roof ladder and place near climbing ladder.
3. Move back and open hooks by pushing downward to clear square shoulder on bottom of hook, turn outward. (If Seagrave, turn to straight side of ladder)
4. Raise ladder to vertical position and lean against climbing ladder, hooks out.
5. Proceed up climbing ladder to position where arm can be placed between second and third rungs of roof ladder.
6. Balance ladder on shoulder and climb using both hands. (Fig. 4)
7. When top of ladder is reached, lock-in and place roof ladder in position for use.
8. To lower, reverse operations.

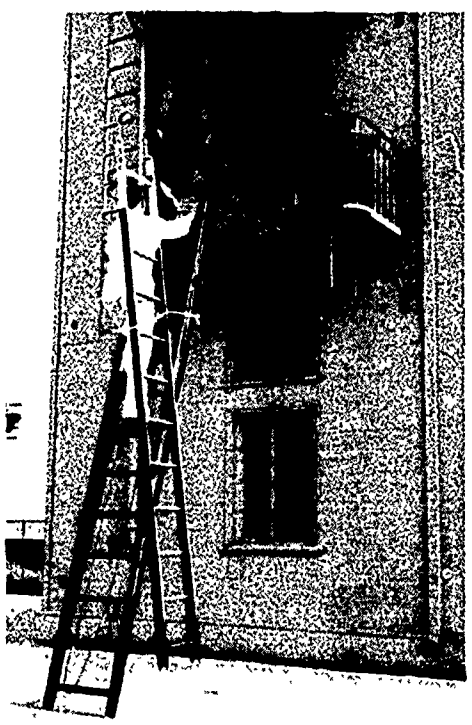

Fig. 4

41a: HOW TO CARRY, RAISE, AND LOWER 14 FOOT EXTENSION LADDER

INFORMATION:

This ladder is very useful for inside work, and can easily be taken up stairways and used to good advantage in removing scuttle hole covers and opening up ceilings. It can be readily taken apart and made into a step ladder permitting one man to operate from same. This ladder is made in two nine-foot sections.

A short pike pole is sometimes carried strapped to this ladder.

1. Carry to desired location with bottom beam on shoulder. (Fig. 1)

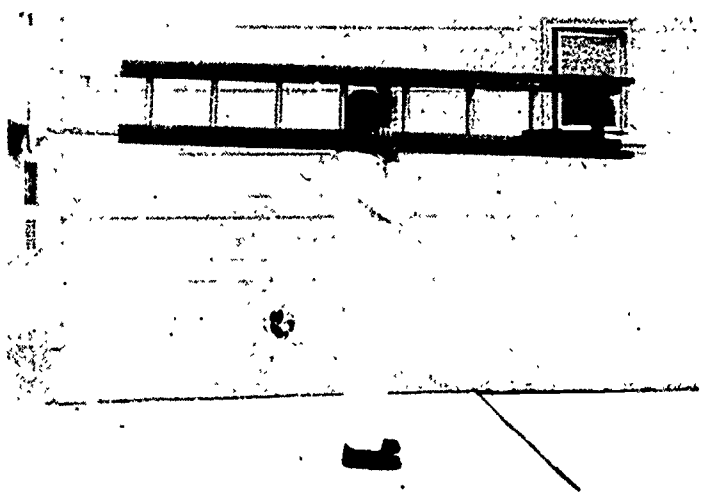

Fig. 1

2. Stand ladder in upright position in proper location and distance from building.
3. Steady ladder by grasping beam of main ladder and locking foot around same beam at ground. (Fig. 2)

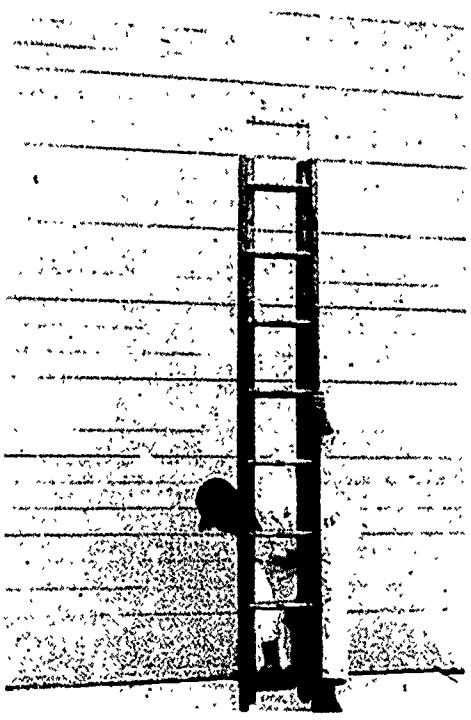

Fig. 2

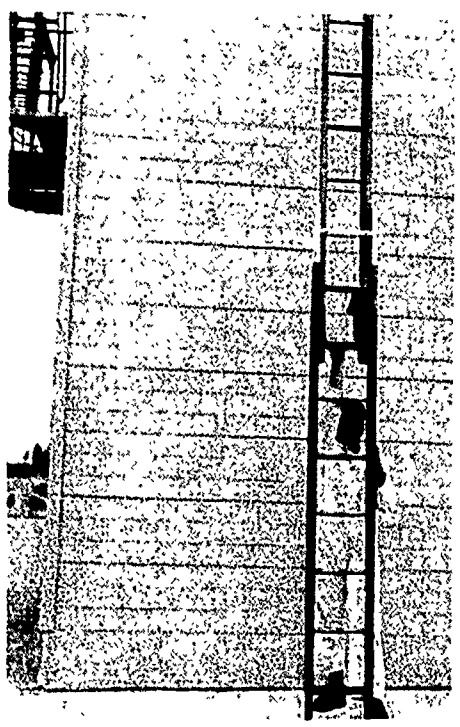

Fig. 3

4. Reach down in back of ladder and grasp bottom rung of fly, palm up. Raise fly to desired height and hook dogs over rung of main ladder. (Fig. 3)
5. Move to front of ladder, place either foot on bottom rung, grasp rung shoulder high with both hands and lower ladder into building.
6. To lower ladder, reverse operations.

41b: HOW TO CARRY, RAISE AND LOWER 16, 20, AND 24 FOOT EXTENSION LADDERS (One Man)

INFORMATION:

Sixteen, twenty, or twenty four foot extension ladders are usually carried on most fire apparatus, and are the longest ladders normally available before arrival of a ladder truck.

They are used for laddering fire escapes, reaching roofs and second floor windows, etc. These ladders are made in two, ten, twelve, or fourteen foot sections, making it possible to take them apart and use the sections as individual ladders.

INSTRUCTIONS:

1. Take position between second and third rung from top of ladder, facing top.
2. Grasp inside beam and lift ladder on edge. (Fig. 4)
3. Lift ladder, pivoting underneath and placing bottom beam on shoulder. (Fig. 5)
4. Walk forward until ladder is at balance point, bring up base of ladder level for carrying (Fig. 6)

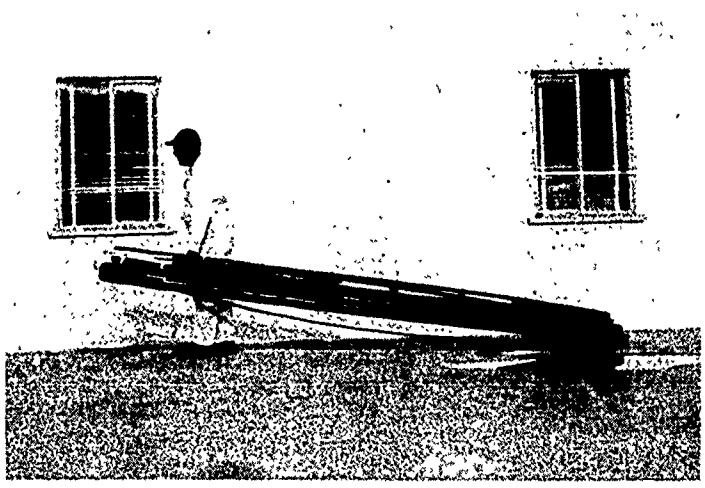

Fig. 4

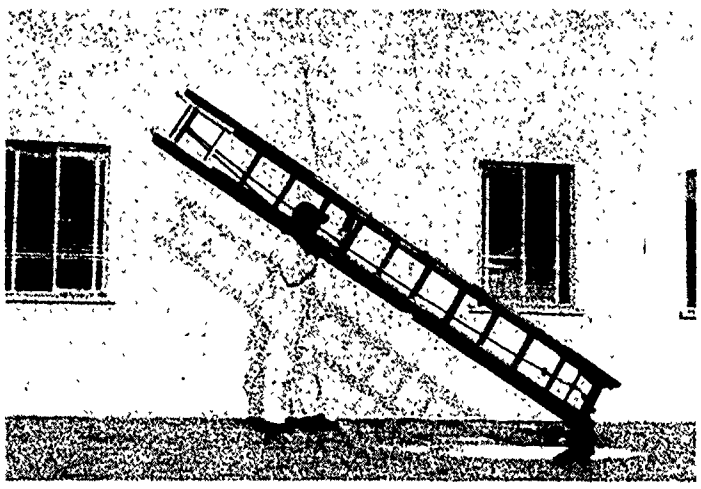

Fig. 5

NOTE: These steps can be eliminated if ladder is being removed from apparatus.

5. Carry to desired location.

6. Spot base of ladder at proper location and distance from building and raise to vertical position.

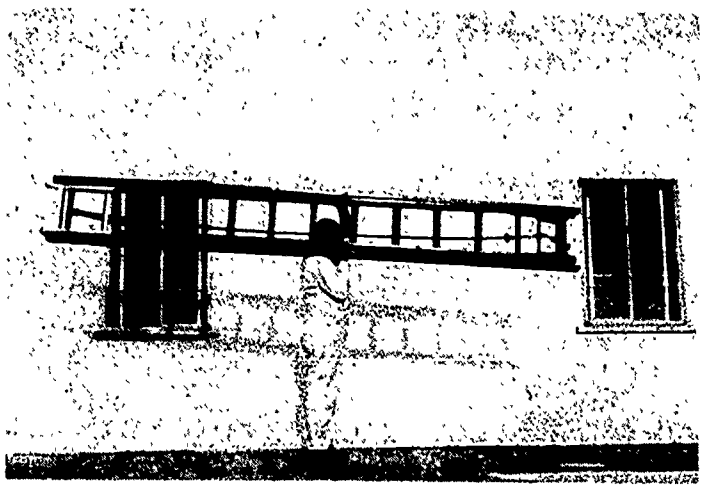

Fig. 6

7. Steady ladder by locking foot around beam, with knee against front of same beam. (Fig. 7)
8. Grasp halyard and pull extension to desired height. (Fig. 7)
9. Lock dogs on proper rung. NOTE: If balance type lock-pawls are used, reach around beam and pull on halyard to lock. (Fig. 8)

Fig. 7

Fig. 8

Fig. 9

10. Place either foot on bottom rung, grasp rung shoulder high with both hands and lower into building. (Fig. 9)
11. Grasp second and fifth rungs and adjust ladder to proper climbing angle. (If at fire escape, secure top of ladder)
12. To lower ladder, reverse operations.

41c: HOW TO CARRY, RAISE AND LOWER 24 THROUGH 30 FOOT EXTENSION LADDERS (TWO MEN)

INFORMATION:

Due to weight and length of these ladders it generally requires two men for proper and safe handling.

Where one man may handle a 24 foot in some makes of ladders, conditions such as wind, obstructions, etc. may warrant two men.

INSTRUCTIONS:

1. Take positions between second and third rung from each end of ladder, same side facing top.
2. Grasp beam next to body, and lift ladder on edge. (Fig. 10)
3. Lift ladder, pivoting body, and place top beam on shoulder. (Fig. 11)
4. Carry to desired location.
5. Butt man lowers ladder, turning flat and spotting proper location and distance from building.

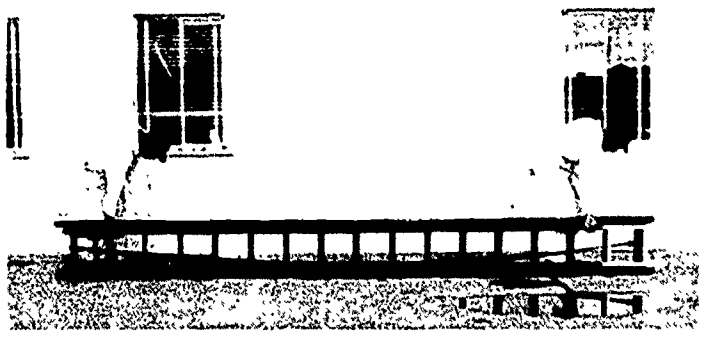

Fig. 10

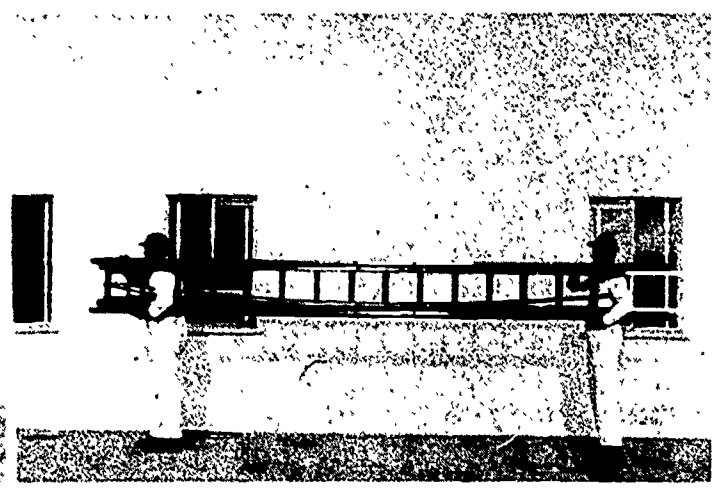

Fig. 11

6. Butt man foots ladder by placing balls of feet well up on shoes of ladder, keeping heels on ground. (Fig. 12)
7. Top man grasps center of each rung (hand over hand) walks forward and raises ladder to vertical position.
8. Front man places either foot against shoe of ladder in front, and butt man places foot against same shoe in rear. Butt man grasps beams, being sure to span if ladder trussed. NOTE: If ladder has movable guides, have one hand high and one low.
9. Front man pulls halyard to raise extension to desired height and locks. (Fig. 13)
10. Front man places either foot on bottom rung and grasps rung at shoulder height with both hands near beams, and with butt man grasping beams and bracing, lower ladder into building. (Fig. 14)

    NOTE: If raised to fire escape, secure ladder.

11. To lower ladder, reverse operations.

Fig. 12

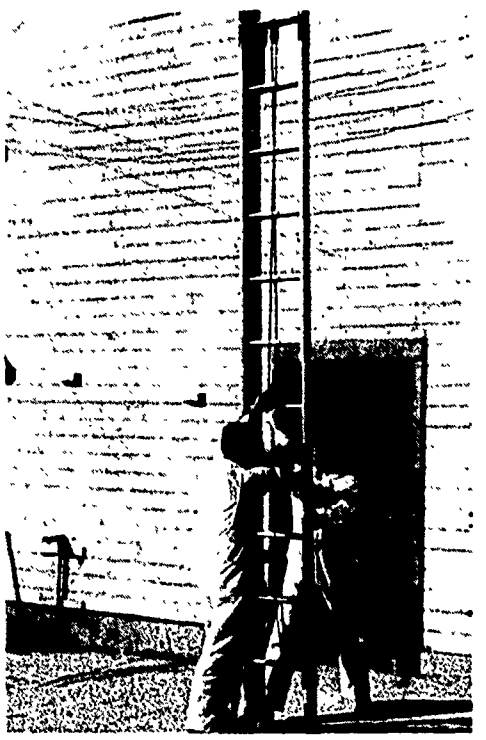

Fig. 13

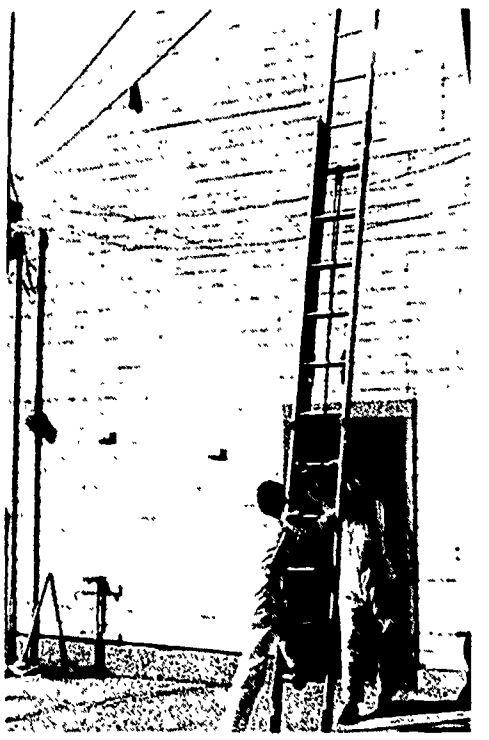

Fig. 14

NOTE: It is desirable at times to move a ladder a short distance in a vertical position, as from window to window etc. Care must be taken to maintain the balance of the ladder, by raising ladder only a short distance from ground and holding close to body. This may be a one or two-man job, depending on the length and weight of ladder. Details may vary according to rung spacing. See (Fig. 15) for one man. See (Fig. 16) for two man.

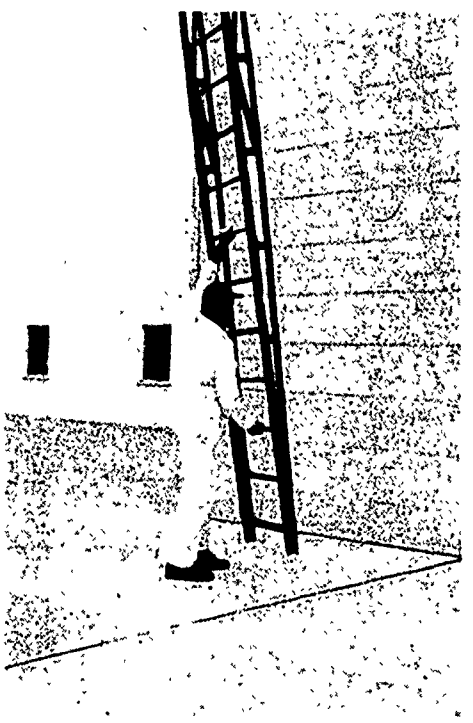

Fig. 15

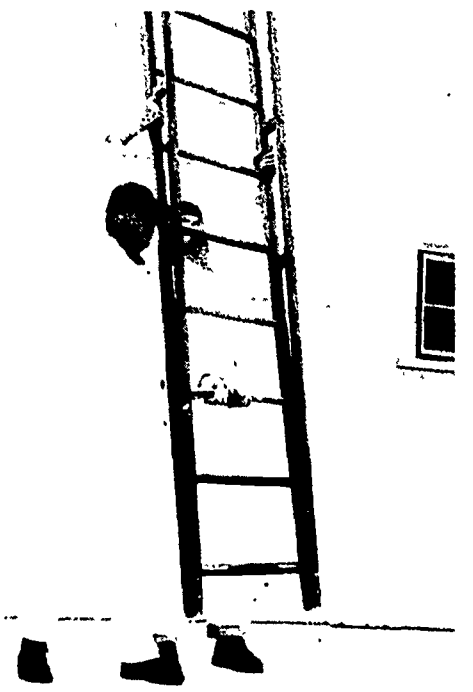

Fig. 16

41d: HOW TO CARRY, RAISE, AND LOWER A 35 FOOT EXTENSION LADDER (THREE MEN)

INFORMATION:

The 35 foot extension ladders are usually carried on ladder trucks, although with the general acceptance of the 3 section metal ladder, they are now carried on other apparatus.

These ladders are used for reaching roofs, second and third floor windows, and similar operations when this length ladder is sufficient to reach. Two men can raise the ladder in emergencies, but three men can handle and carry this ladder more efficiently.

INSTRUCTIONS:

1. Take positions, butt man between second and third rung from base and beam men 1/3 distance of ladder from top, all facing top of ladder. (Fig. 17)
2. Grasp beam or rung next to body and raise ladder, pivoting body and placing beam on shoulders. (Fig. 18)
   NOTE: (Fig. 19 shows stretcher carry and (Fig. 20) shows side carry.

Fig. 17

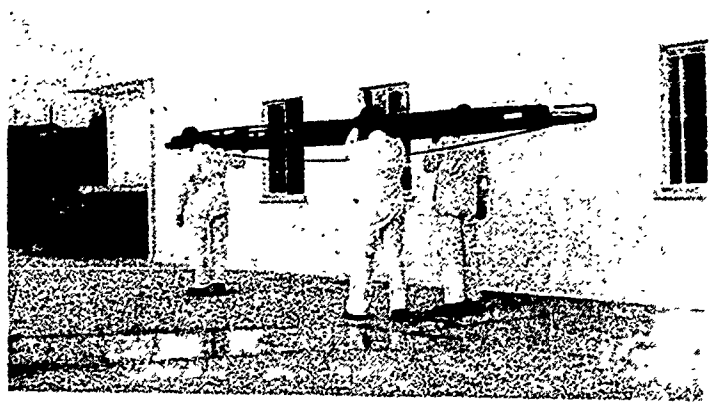

Fig. 18

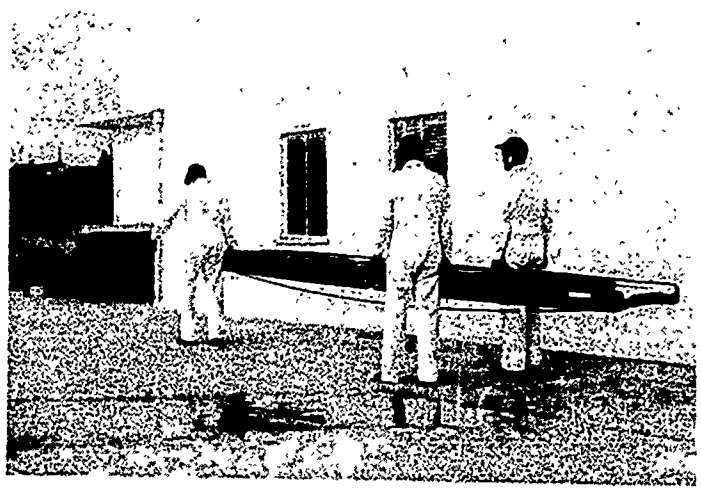

Fig. 19

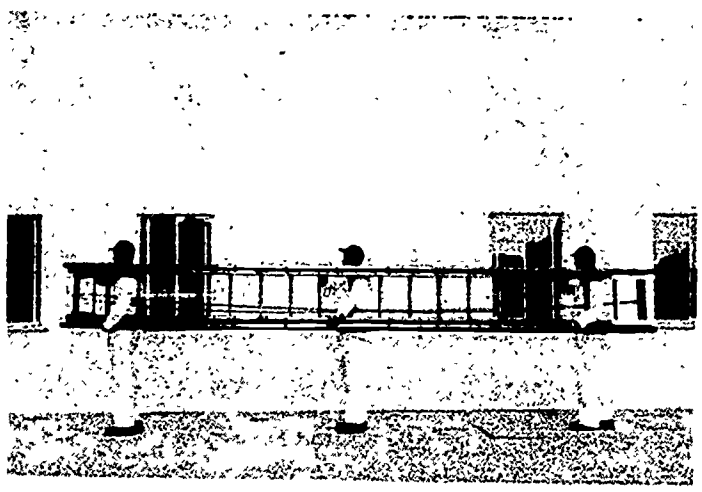

Fig. 20

3. Carry ladder to desired location.
4. Butt man lowers ladder, spotting proper location and distance from building.
5. Butt man foots ladder by placing balls of feet well up on shoes of ladder, keeping heels on ground. (Fig. 21)
6. Beam men place inside hand on rung and outside hand on beams, walking forward raise ladder to vertical position. If necessary, pivot ladder into position.
7. Butt man grasps both beams, spanning main beam, and placing foot against shoe of ladder on his right.
8. Beam men, each foot ladder, by placing outside foot against shoe. Man on left grasps both beams, placing right arm under halyard. Other man pulls on halyard and raises extension to desired height. (Fig. 22)
   NOTE: If balance type lock pawls are used, butt man pulls halyard downward to lock in place. (Fig. 23)
9. Beam men place outside feet on rung and grasping rung shoulder high with inside hand and beam with outside hand, lower ladder into building with butt man bracing.
10. To lower ladder, reverse operation.

Fig. 21

Fig. 22

Fig. 23

Title: HOW TO CARRY, RAISE, AND LOWER 50 FOOT EXTENSION LADDER (six men)

INFORMATION:

This ladder serves to enter the third, fourth and the fifth floor windows.

Before climbing the 50 foot extension ladder, the butt must rest evenly, poles properly set, pawls locked, the halyard secured, and the ladder set at the proper angle for climbing. The extended fly must rest upon a window sill or against a wall or object.

The ladder is made in two, three, or four sections, wood or metal, or a combination of both. Poles (tormentors) are usually fastened to the beam near top of main bed ladder, although some are not, but are carried resting on the ladder in the rack and must be fastened to beam before raising. NOTE: This is done for more compact racking.

This ladder may be raised with less than six men, but it is more difficult to handle.

INSTRUCTIONS:

1. Release ladder lock on apparatus and remove ladder. Two men at base, pull horizontally, two men at center, and two men at top as ladder comes off rack.
2. As soon as ladder is clear of apparatus, all men raise and place on inside shoulder and carry to location. (Fig. 24)
3. Men on butt of ladder spot same directly under where ladder is to be placed, proper distance out.
4. Each man raise outside hand up and grasp beam, (Fig. 25) turning body at same time while lowering ladder to ground.

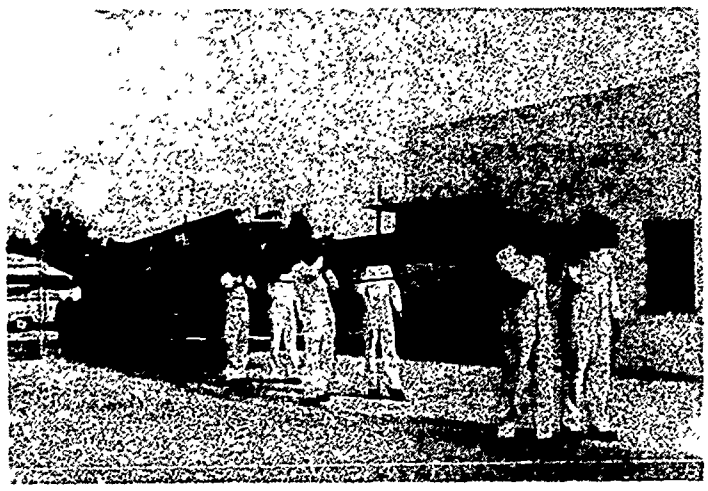

Fig. 24

Fig. 25

5. All men face base of ladder.
6. Men at base of ladder release the end of tormentor poles, raise the pole ends and pass to center men, (Fig. 26) who in turn, pass to men at top, who walk to end of poles. NOTE: Men at base designated as butt men; men in center, beam men; and men at top, pole men.
7. Pole men face toward ladder, grasping ends of each pole with inside hand, outside hand extended forward grasping pole; poles are to be kept slightly out from outside of beam. (Fig. 27)
8. Butt men foot the ladder by placing the ball of outside foot on end of beam with heel firmly on ground, the inside foot well back, bracing the body, both standing in an upright position until ladder is raised sufficiently high for them to grasp the beams, then swinging bodies well back in order to maintain balance. (Fig. 27)

9. Beam men proceed to about 1 foot of where poles join ladder, facing top of ladder; with the inside hand, reach down and grasp the beam, (Fig. 27) raise ladder turning body, while raising, to face foot of ladder. When ladder is raised sufficiently to get beneath, use the free hand to grasp the rung, both men walk toward foot, inside hand on rung and outside hand on beam, until ladder is raised to a vertical position.

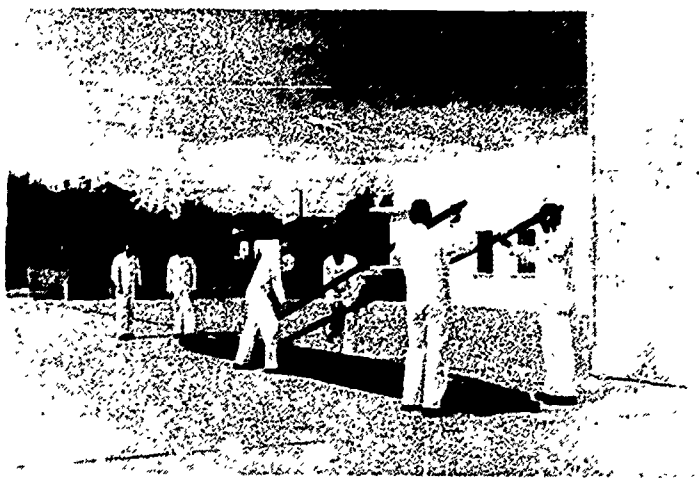

Fig. 26

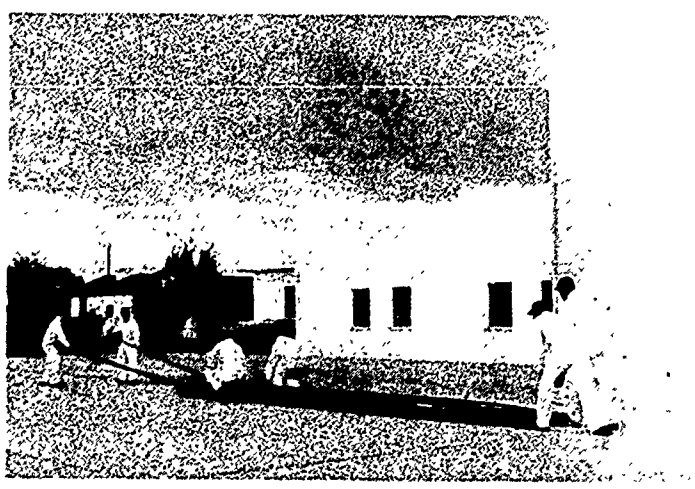

Fig. 27

10. Pole men lower poles and exert an upward pressure on the poles; walk in keeping abreast of each other, watching top of ladder. NOTE: Always watch top of ladder and do not push on poles until ladder reaches 45 degree angle.
11. After ladder is in vertical position, one pole man pivots to a point on beam side, always turning to walk forward with pole. Other pole man moves over directly in front of beam. (Fig. 28)
12. Butt men step back with inside foot, keeping the toe of outside foot against shoe of beam. Beam men place toe of outside foot against shoe of beam also.

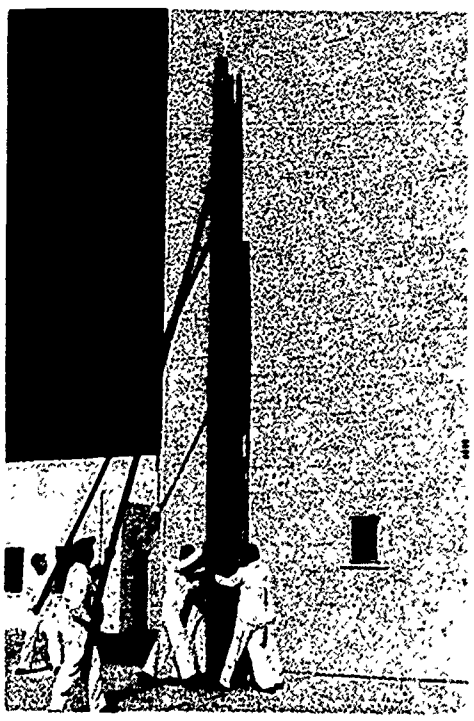

Fig. 28

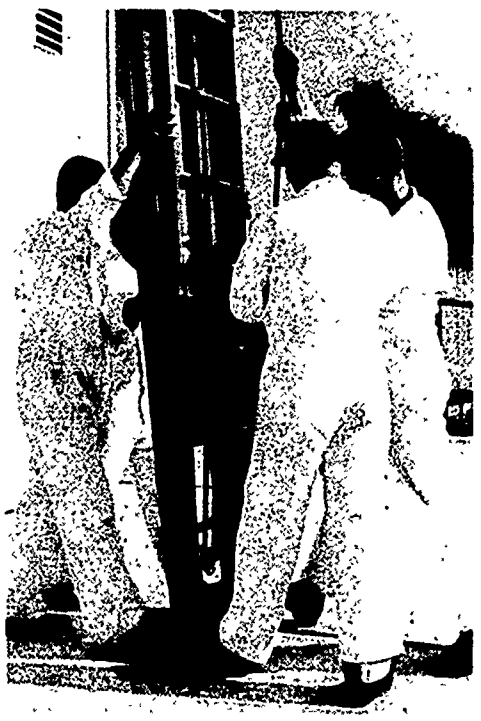

Fig. 29

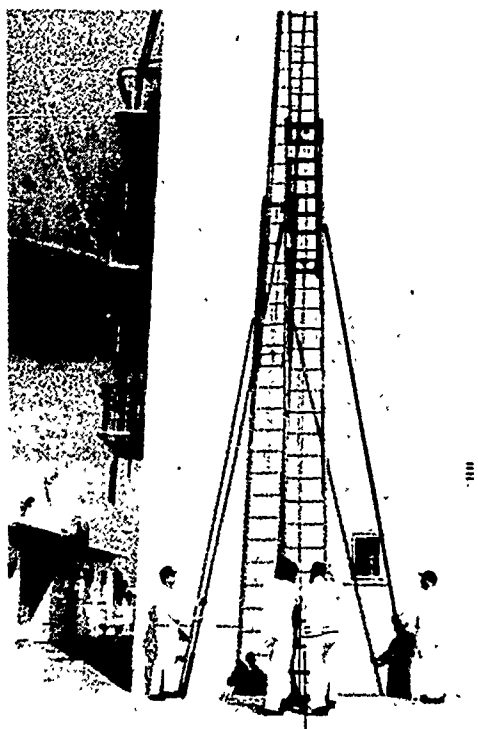

Fig. 30

13. Butt men span the beams with both hands, lending further support to ladder. (Fig. 29)
    NOTE: If ladder is raised parallel to building, outside pole man pushes on pole to lift outside beam slightly off ground. Beam men and butt men pivot ladder into proper position while pole men hold positions.
14. Beam men grasp the rope (halyard) and pull down, hand over hand, until the fly ladder has reached the desired height, lock pawls. NOTE: If rope is on back side of ladder, operations 13 and 14 are reversed.
15. Beam and butt men grasping rungs and beam of main ladder, lower top of ladder in to building; all members to watch top of ladder while lowering.
16. Pole men guide top of ladder and assist in lowering to building. NOTE: Ladder is to be placed to side of window set forth in department regulations.
17. Pull up slack in rope and make same secure to convenient rung by use of the bangor knot. (See Job 12s, Book 1)
18. Pole men place poles under ladder to relieve the strain, both side movement and the up and down movement. Do not force poles under ladder. (Fig. 30)
    NOTE: For proper setting, poles should be set so that they hang in natural position forming an approximate 45° angle between point of attachment and ground.
19. To lower ladder, reverse operations.

HOTEL RAISE

Where rescue is necessary on several floors simultaneously (such as in hotels) the hotel raise may be used. The raising operations follow the above procedures, with the exception that the base of the ladder is placed about 3 feet from building, top against building with ladder overlapping row of windows. All men hold positions while ladder is used. (Fig. 31) NOTE: Use both sides of ladder when descending, those on lower floors generally using inside.

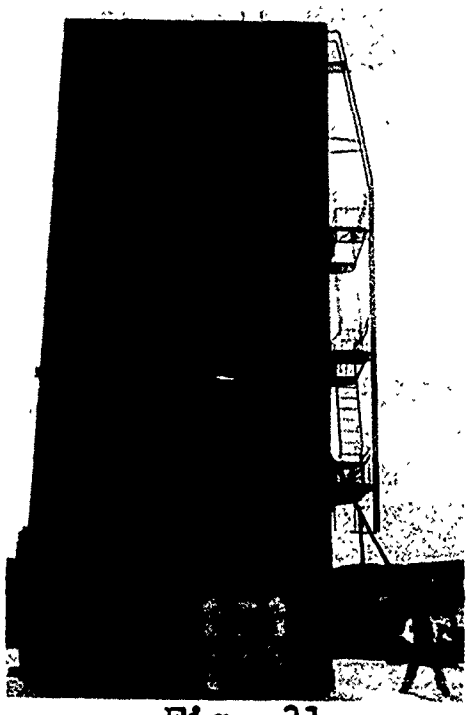

Fig. 31

41f: HOW TO RAISE 50 FOOT BANGOR (BEAM RAISE)

INFORMATION:
When necessary to raise ladder in narrow spaces, the beam raise is used.

INSTRUCTIONS:
1. Place ladder parallel to building, bottom pole extended on ground.
2. Butt men heel ladder; beam men take positions to raise. (Fig. 32)
3. Pole men take positions, one on end of pole on ground, other at butt end of ladder.
4. Beam men raise ladder and walk toward foot. Pole men at top of ladder walks toward ladder, exerting pressure. Pole man at butt of ladder walks away from ladder, pulling on pole. Butt men throw their weight onto butt of ladder and balance same. (Fig. 33)
5. When ladder has reached vertical position, proceed as outlined in operations 14 through 18 of 41e inclusive.

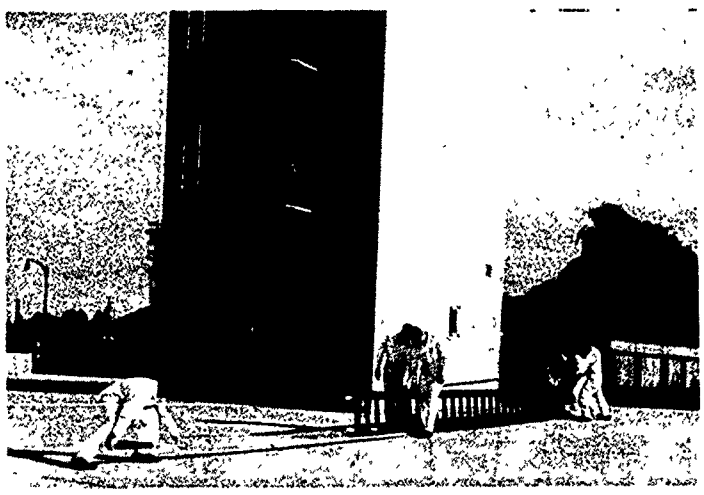

Fig. 32

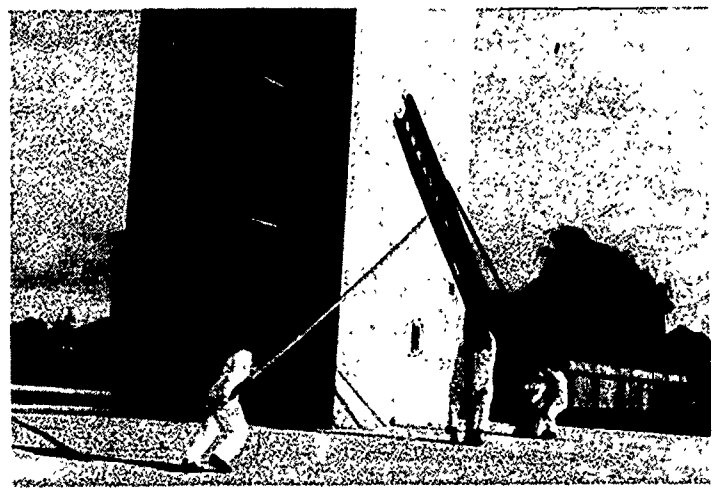

Fig. 33

41g: HOW TO RAISE 50 FOOT BANGOR (CHUTING)

INFORMATION:
When necessary to bring top of ladder up between obstructions and the building the Chuting raise is used.

INSTRUCTIONS:
1. Carry to position, with butt of ladder away from building and tormentor poles extended at an angle butting against building. NOTE: Climbing side up.
2. Position two men at butt, two men below point of pole attachment and two men holding poles firmly against building with feet. (Fig. 34)

3. Raise ladder with beam men raising top of ladder and butt men walking forward pulling butt of ladder close to ground. (Fig. 35)
4. When ladder has reached vertical position, proceed as outlined in operations 14 through 18 of 41e.

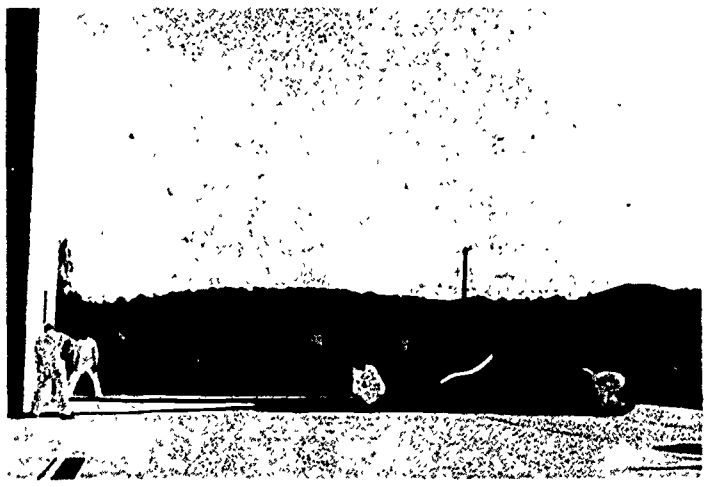

Fig. 34

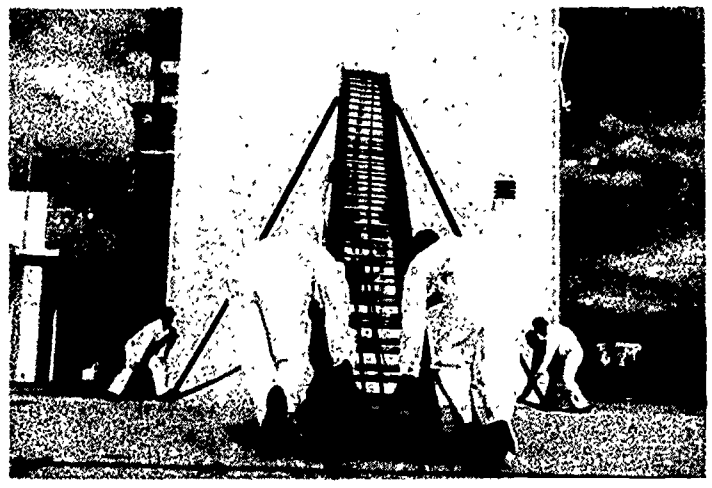

Fig. 35

41h: HOW TO RAISE 50 FOOT BANGOR (AUDITORIUM RAISE)

INFORMATION:

This raise is used when it is necessary to raise a ladder and there is nothing for the top of ladder to rest against.

INSTRUCTIONS:

1. Carry to desired location and place in position on ground.
2. Extend top fly sufficient distance to enable the securing of ropes around top rung and beams.
3. Secure ropes by grasping center bight and taking one complete wrap around rung and looping bight over end of beams. (Fig. 36)

   NOTE: At least one hundred feet of rope is necessary.
4. Raise ladder to a vertical position in the conventional manner, and raise fly to desired height, with ropes hanging free.

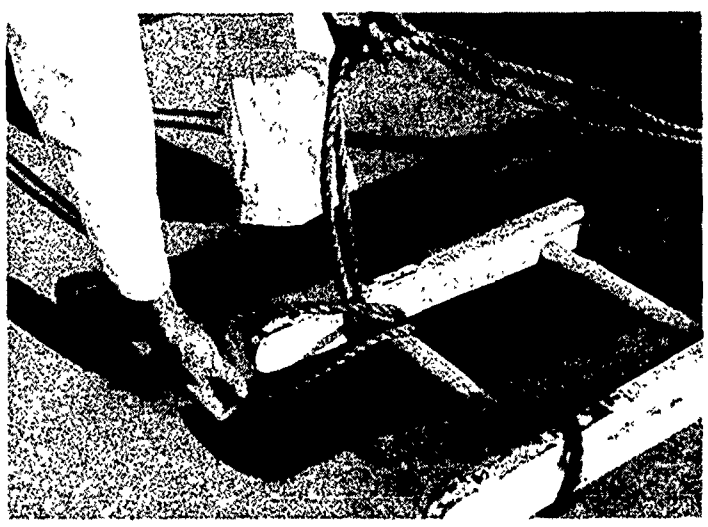

Fig. 36

5. Four anchor men take their positions, each controlling a guy line. (Fig. 37)
NOTE: Details of anchoring the guy line are shown in (Fig. 38)

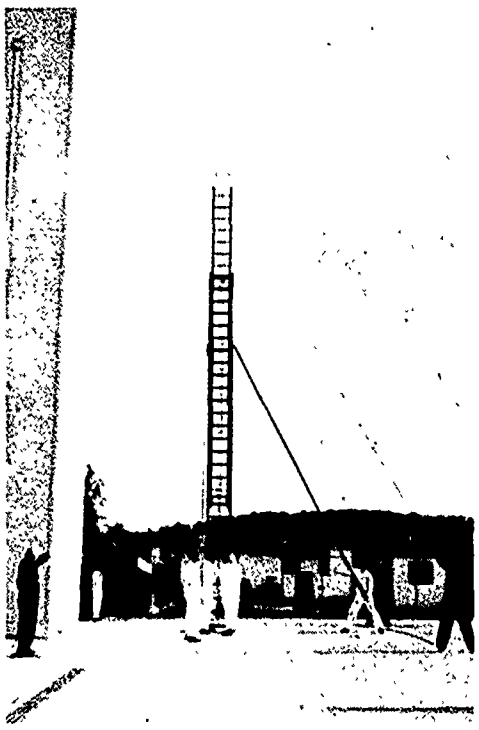

Fig. 37

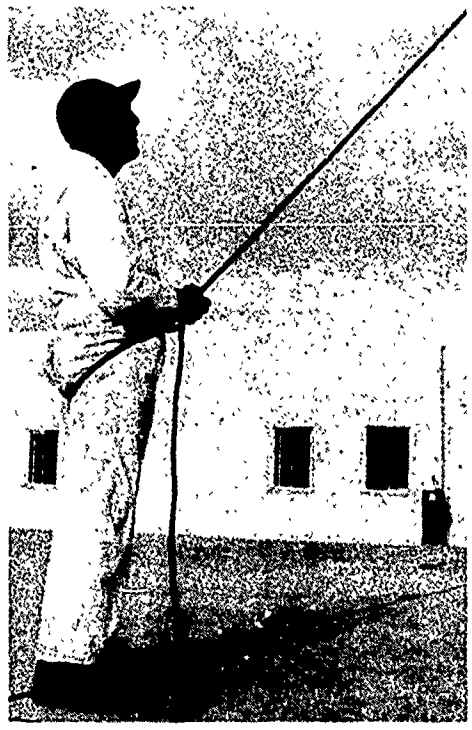

Fig. 38

42: CLIMBING, LOCKING-IN ON, AND FOOTING LADDERS

INTRODUCTION:

Ladder work in fire departments is of utmost importance, and to be able to climb ladders properly is one of the first requirements of a good fireman.

Good form is essential in climbing ladders, the same as it is in most sports. The man who climbs a ladder well has good form and a certain well-defined rhythm.

Good form consists of keeping the body erect and the arms straight but not tense. A good ladderman stays at arms length from the ladder. When a man holds himself rigid and hugs the ladder, he is in danger of falling because he does not have control of his body. Also, he cannot place his feet on the rungs properly as his knees will collide with the rungs.

The climber should not look down or watch his feet. Rather, he should look slightly upward in the direction the hands are going. In order to keep the ladder steady, it should be climbed near the center of the rungs. The hands should be moved on the rungs at a level between the waist and head. This method is considered the safest because a much firmer grip may be had on the rungs than on the beams, particularly if the climber's hands are

not large. The use of the rungs in climbing is advisable also because the hands test the rungs. A defective rung may be detected before placing a foot on it. The ball of the foot and not the arch should be placed on the rungs. They carry the weight of the body.

It is bad practice to run up or down a ladder. It is better to climb briskly but smoothly.

When working from ladders, it is frequently necessary to have both hands free to do such work as directing hose streams, handling roof ladders, or hauling up fire tools. No man working on a ladder shall let go his hold with both hands unless he has properly secured himself to the ladder so that he will not lose his balance and fall.

Life belts, ladder belts, rope tools, or other safety devices to hold a man on a ladder may not always be available, so that it is necessary to take a leg lock. The leg lock is made on the side of the ladder opposite the side on which the work is being done. The arch of the lower foot on which the weight is carried should be on the rung near the beam in a position from which it will not slide, should the ladder be wet or slippery.

42a: HOW TO CLIMB LADDERS

INSTRUCTIONS:

1. Place left foot on lower rung.
2. Grasp rung firmly with right hand about level with eyes, palm down, thumb around rung.
3. Place right foot on second rung. NOTE: Climb near center of rungs.
4. When right foot is moving to second rung, grasp rung above one that right hand is gripping with left hand firmly, palm down, thumb around rung. (Fig. 1)
5. Continue operations 1 and 4 until top of ladder or desired height is reached. NOTE: Using opposite hand and foot when climbing steadies the ladder, eliminates sway, and allows climber to keep a more perfect balance.

42b: HOW TO LOCK-IN ON LADDER

INSTRUCTIONS:

1. Climb ladder to desired height.
2. Stand on ladder, grasping rungs firmly with both hands.
3. Place one leg through ladder above second rung from the one feet are on.

4. When crotch touches rung, bend knee, bring foot back between first and second rungs, placing toe around beam. NOTE: It may be more convenient for short men to place toe under first rung and for taller men to step down one more rung for a more comfortable position. (Fig. 2)

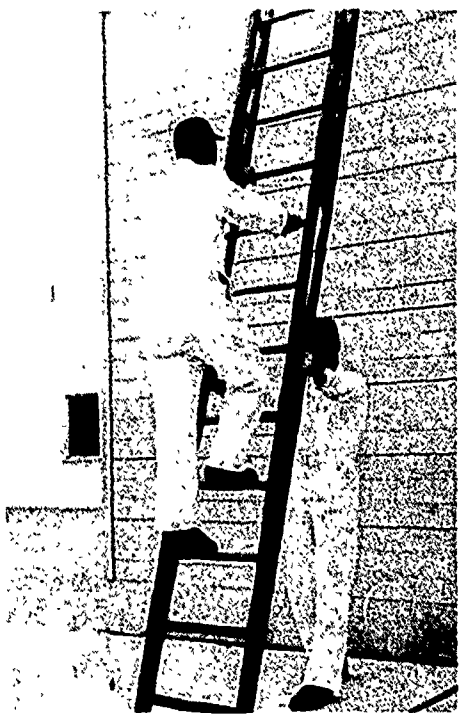

Fig. 1

Fig. 2

42c: HOW TO FOOT LADDERS

INFORMATION:

In using shorter ladders when not secured at top, and base rests on a hard surface where shoes may slip, it becomes necessary to foot ladder while in use.

INSTRUCTIONS:

1. Take position at rear of ladder with back to wall.
2. Grasp both beams at about shoulder height, feet spread for balance, allowing weight to anchor ladder. (See Job 42a, Fig. 1)

43: CARRY, RAISE, AND LOWER POMPIER LADDERS

INTRODUCTION:

The Pompier ladder is commonly employed for reaching points higher than the normal reach of other ladders. It is also used for mounting obstructions in an emergency, such as high walls, etc.

Pompier ladders used in the Fire Department range in length from 12 to 16 feet.

When working with the Pompier, or scaling ladder, a life belt is invariably worn. The snap on belt is hooked on the heel of hook of Pompier, also can be snapped around beam of ladder, permitting the wearer to stand up on rungs with security. Thus firmly braced upon the ladder, the man has free use of his hands and can maintain his balance to take another Pompier from the man below.

The Pompier ladder is occasionally employed for opening wire-glass windows. In the operation the Pompier is hoisted to the floor below the window, which is to be ventilated, and the ladder worked up hand over hand until the hook is opposite the point in the window which is to be opened. The hook is driven through the window, and the ladder thereupon pulled downward ripping out the wire-glass and providing the necessary ventilation.

NOTE: The Pompier may be operated from floor above or from roof for this purpose by reversing position of ladder.

43a: HOW TO RAISE, LOWER AND CLIMB POMPIER LADDER (ONE LADDER, ONE MAN)

TO RAISE

INSTRUCTIONS:

1. Procure life belt and put it on. Remove pompier ladder from apparatus.
2. Raise pompier and place beam on shoulder, balance same, hook forward and pointing down. (Fig. 1)
3. Carry ladder to desired location.
4. Place butt of ladder against building, or solid object, (man can be used to foot ladder) walk toward butt raising to vertical position. (Fig. 2)

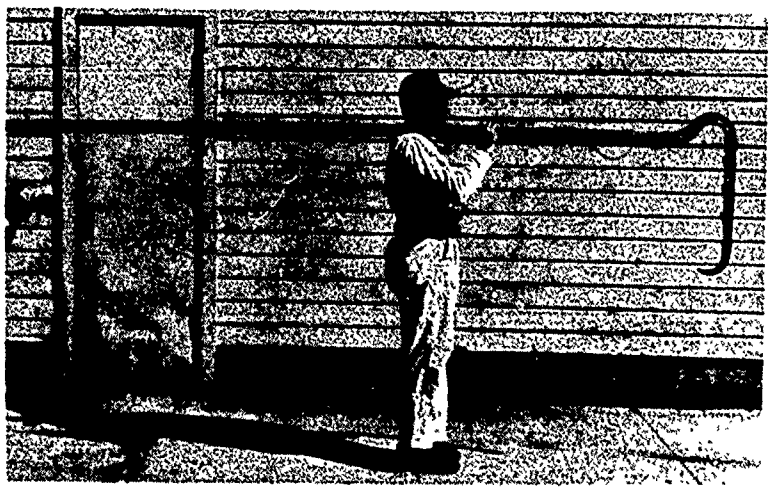

Fig. 1

Fig. 2

NOTE: 12 or 14 foot pompiers may be raised by grasping beam of the ladder with the right hand just above the third rung, fingers pointing to the ground. Lift the butt end above the waist, reach back with the left hand four feet from the right, grasp beam, palm of hand up with hook resting on ground, (Fig. 3) raise ladder and stand on butt by pulling up the left hand and pushing down the right.

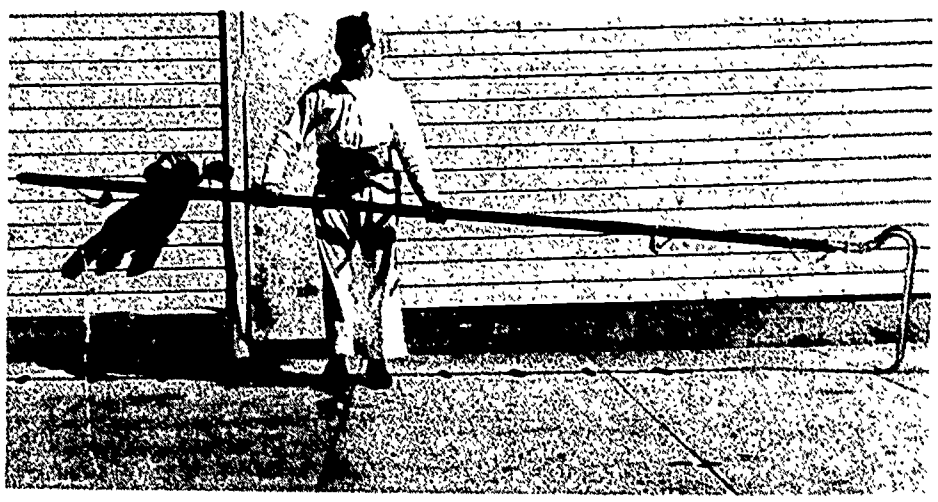

Fig. 3

5. When pompier is in vertical position, turn hook away from body and into window, placing hook to left side of window. Allow hook to come to rest on window sill and both shields resting against sides of building.
6. Grasp beam with both hands, place one foot on nearest rung, proceed to top of ladder, using both hands on beam while climbing. (Fig. 4)
7. After reaching top, grasp heel of hook with left hand, hook of gooseneck with right hand swinging the right leg in, and straddling sill facing ladder. (Fig. 5)

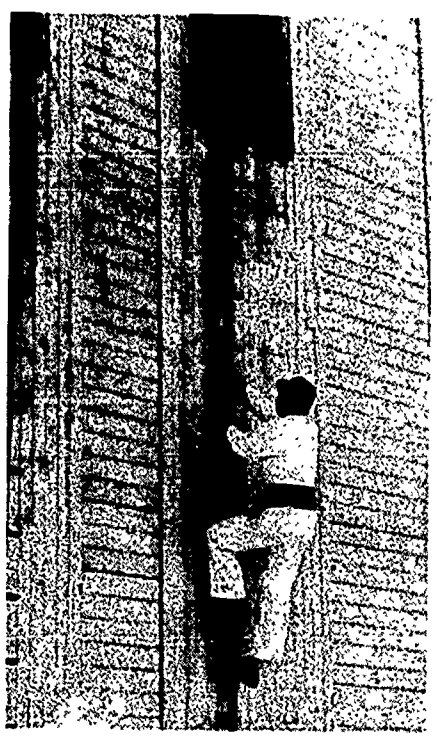

Fig. 4

Fig. 5

8. Grasp gooseneck with left hand and hook with right, raise high enough so that hook can be lifted over sill.
9. Grasp beam, turn hook away so heel rests against building, and work upwards hand over hand. NOTE: Keep eyes on hook at all times.
10. When hook clears sill above about 18 inches, turn in to window and lower on to sill.
11. Place left foot on nearest rung on opposite side of beam, grasp beam with both hands, swing out of window and climb.
12. Repeat operations 7, 8, 9, 10, 11 until top of building or desired height is reached.

TO LOWER

INSTRUCTIONS:
1. Straddle window sill facing ladder.
2. Grasp beam with both hands, raise ladder so hook will clear sill above.
3. Let ladder lean and turn hook out of window.
4. Lower hand over hand, heel of hook against building. When hook is opposite body, grasp with hands, turn hook toward building and into window, placing hook on sill.
5. Grasp heel of hook with one hand, hook with other hand, place outside foot on top rung on opposite beam of ladder, swing out of window and descend.
6. When feet are opposite window sill below, swing in window and straddle sill.
7. Repeat above operations until ground is reached.
8. Return ladder to apparatus.

43b: HOW TO SWING FROM WINDOW TO WINDOW, USING ONE POMPIER LADDER, ONE MAN

INFORMATION:
When scaling a building with a pompier ladder it is sometimes necessary to shift from one line of windows to another, owing to obstruction on building, in order to reach desired location.

INSTRUCTIONS:
1. Raise ladder and place over window sill of second story window with hook about six inches from the right hand corner.
2. Climb ladder and straddle sill.
3. Lift ladder out and raise to story above. Raise hook about 18 inches above sill, then with right hand down near the bottom and with left hand well up on ladder, allow top of ladder to drop toward the window in the opposite row, giving ladder a quarter turn to left. (Fig. 6)
4. Place hook over sill about 12 inches from the left hand corner.
5. Place butt of ladder in against building, holding ladder with right hand, placing right foot on the convenient rung. (right hand side of beam). (Fig. 7)

6. Reach up and grasp beam with both hands, lift leg over sill, and swing to opposite window, placing left foot on proper rung (left side) while swinging.
7. Climb ladder, grasp gooseneck and swing right leg over sill, straddling same.
8. Move ladder over near left hand corner at the same time moving close to ladder.
9. Lift ladder up and out of window, raise hand over hand until hook is about 18 inches above sill, then with left hand on lower part of beam, right hand well up allow ladder to drop toward window in opposite row, (Fig. 8) giving ladder a quarter turn to the right, place hook over sill about 12 inches from right hand corner.

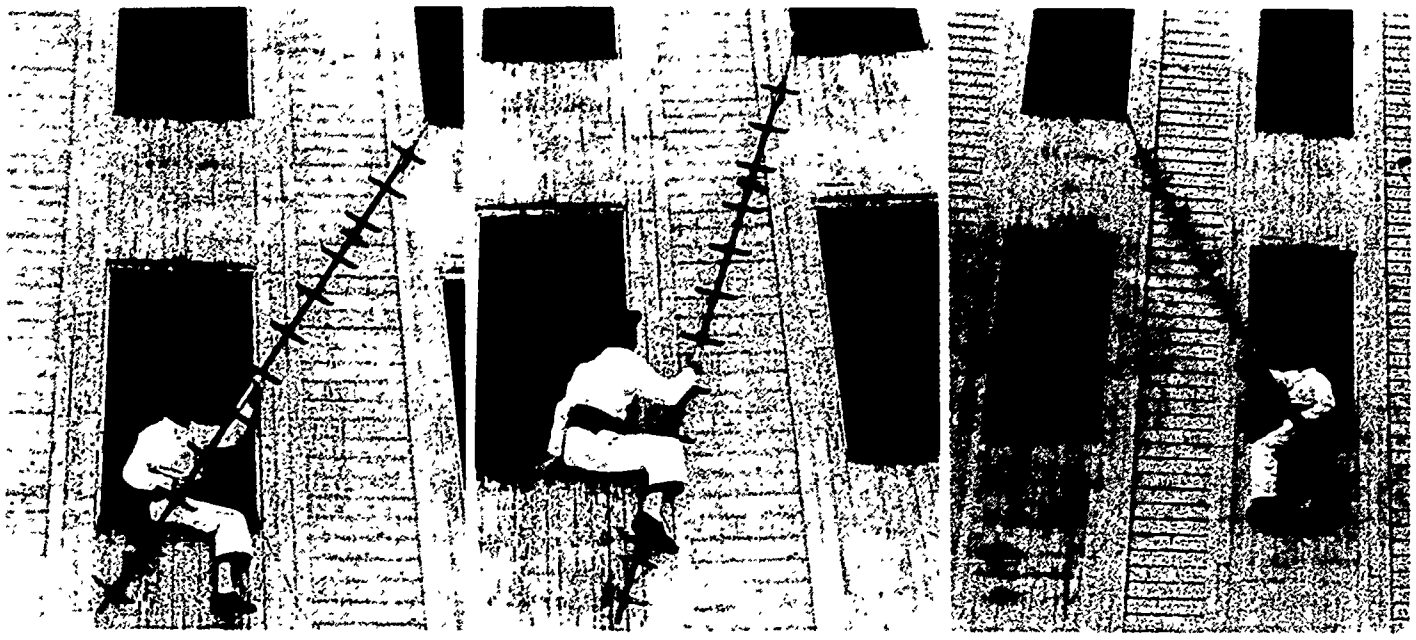

Fig. 6 Fig. 7 Fig. 8

10. Place butt of ladder against building, grasp beam of ladder with both hands, place left foot on convenient rung (left side).
11. Swing over to window in opposite row, lifting right leg clear of sill, placing foot on proper rung (right hand side) while swinging. (Fig. 9)
12. Climb ladder and repeat operations until desired location is reached.

43c: HOW TO SWING FROM WINDOW TO WINDOW, USING TWO SCALING LADDERS, (ONE MAN)

INSTRUCTIONS:

1. Raise and place hooks of two pompier ladders of equal length on sill of second story window, right hand ladder about 8 inches from upright of the frame.
2. Climb half way on right hand ladder (Fig. 10) and secure with hook of life-belt to beam of ladder.

3. Raise left hand ladder about two feet above window sill, hook brought over to the right sufficiently to give it room to swing out. (Fig. 11)

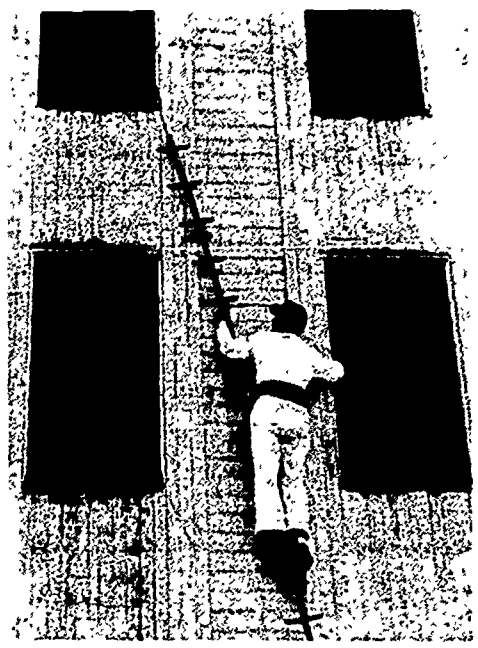

Fig. 9

Fig. 10

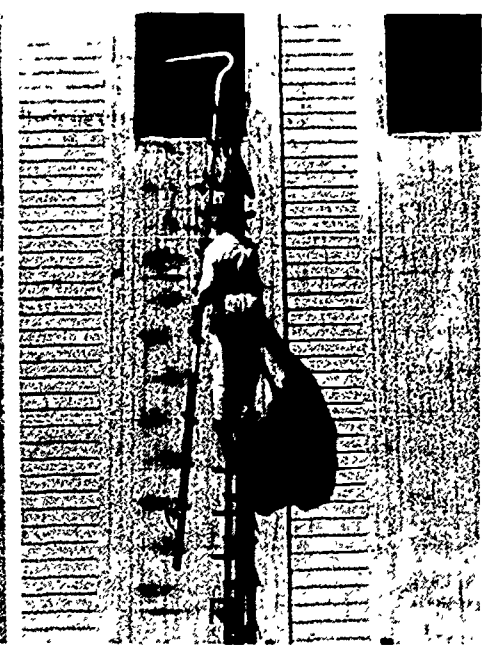

Fig. 11

4. Swing hook to right until it points toward right hand window, drop ladder down to the right, swing hook in window and place in left hand corner. (Fig. 12)
5. When hook is in window the butt of ladder is swung over back, right foot is lifted off rung allowing the butt to be placed, and held behind the left and in front of the right foot by placing right foot on same rung it was taken from. (Fig. 13)

Fig. 12

Fig. 13

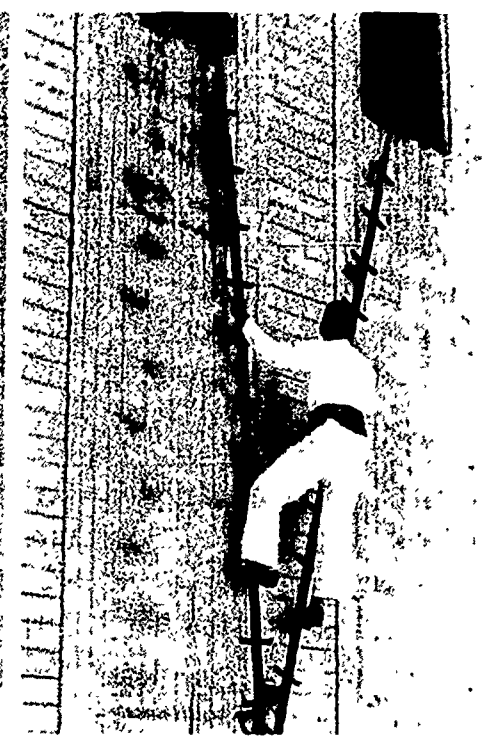

Fig. 14

6. Take hold of ladder that is between the two feet with right hand and swing it clear of the right foot.
7. Reach out as far as possible with the right arm, look down to see if butt is clear of obstructions, then step over with right foot, then the left hand and the left foot.
8. Swing over (Fig. 14) leaving the left hand ladder behind.
9. When returning to the window climb half way on the ladder.
10. Reach out with left hand and grasp ladder to left, bringing butt of ladder to the right.
11. Step over with the left foot, then the right, and swing over to the left bringing right ladder along.
12. The right hand ladder is held as before, secure hook of life belt to beam of ladder.
13. Lift ladder clear to right foot, swing over back, lift hook clear of window sill.
14. Swing hook toward left hand window and place hook on sill about 8 inches from the left hand corner.

43d: HOW TO CARRY, RAISE, AND LOWER POMPIER LADDERS (2-MEN)

INFORMATION:

If manpower is available, greater speed and safety may be obtained by using two men.

INSTRUCTIONS:

TO RAISE POMPIER LADDERS

1. Two men equip themselves with life-belts and remove two Pompiers from apparatus.
2. Each man raise a Pompier and place beam on shoulder, balance same, hook forward and pointing down.
3. Carry ladders to desired location.
4. Raise one Pompier ladder to window, by placing foot of ladder against base of building, keeping hook pointing downward, walk towards base of ladder raising same with hands on beam while walking, until ladder is against building.
5. Raise ladder up so that the hook will clear the sill, turn hook away from body and into window, placing hook to left side of window, allow the hook to come to rest on window sill and both shields resting against sides of building.
6. Repeat operation No. 5 placing second ladder into position about one foot to right of first ladder.
7. First man climbs ladder placed in left side of window, grasp the beam with both hands, place one foot on nearest rung, proceed up to top of ladder, using both hands on beam while climbing, stand on third rung from top, grasp the heel of hook with left hand supporting the weight of body, grasp the snap of life belt with right hand, snapping same to heel of hook.

8. Place heels of feet together with toes apart, knees rigid, lean weight of body out against life-belt, drop hands to side. (Fig. 15)
9. Raise ladder from right side of window, by grasping the heel of other ladder with right hand, lift ladder up to clear sill and turn hook out from building. Grasp the beam with left hand and continue raising by using both hands on beam, to window above, keep heel against building and foot of ladder out while raising, with one hand above the other, (Fig. 16) turning hook away from body and into center of window, so that the shield on top part of ladder rests against the building, allow the shield on base of ladder to rest against building. Drop both hands to side.

Fig. 15

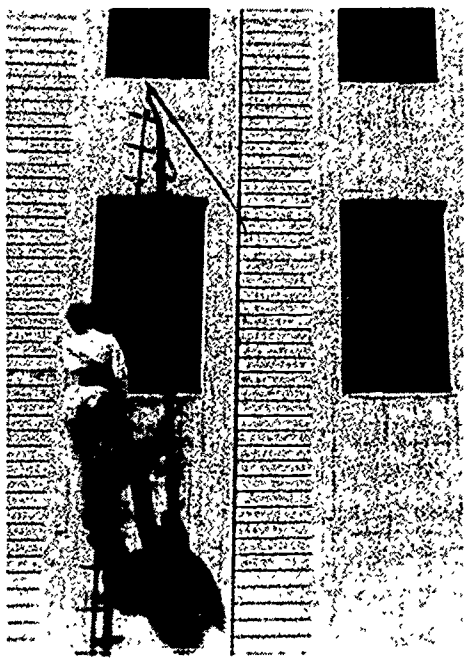

Fig. 16

10. First man then grasps heel of ladder he is standing on with left hand, with right hand he unsnaps hook on life-belt from heel of Pompier.
11. First man then grasps the beam of ladder to his right with right hand, placing his right foot on nearest rung on far side of beam and steps on to ladder and climbs to top, stopping with feet on third rung from top and snaps in on heel of hook as before.
12. As top man moves to second ladder, bottom man proceeds to climb ladder from ground, but does not snap in, he steps over on ladder to right standing on third rung from bottom, grasping beam with left hand, with right hand he snaps hook of life-belt around beam over rung nearest his snap. He then drops both hands to his side.

13. Second man raises lower ladder, grasps beam of ladder he is standing on with right hand, with left hand grasps the heel of hook and raises ladder, turning hook out of window and away from body, with both hands on beam of ladder passes ladder to first man, keeping heel of hook against building with base out, assist in raising until the ladder is out of reach.
14. First man continues to raise ladder to window above, turns hook away from him into window, adjusts in window, then adjust ladder so shield will rest against building. These operations are repeated until the desired height is reached.

To Lower Pompier Ladders

1. To lower Pompier ladder the two men change their positions; the first man up will be the first man down.
2. The first man starting down will stand in window, facing the hook of ladder, bend over and grasp the hook, the outside hand on the heel of hook and the inside hand on hook inside of sill, place outside foot on rung on far side of beam of ladder, stepping on first rung and his inside foot on the top rung near side of beam, proceed to climb down until feet reach the third rung from bottom, then grasp the heel of hook on lower ladder with nearest hand, steps over with nearest foot to far side of rung, he then steps over with other foot and climbs down second Pompier until feet are on third rung from bottom and then snaps in on beam over the most convenient rung.
3. The second man proceeds down in same manner until he gets to third rung from top of lower ladder, where he snaps in on heel of hook on lower ladder.
4. The top man grasps the beam of the upper ladder with both hands, raises same to clear the sill and then turns hook from him, out of window keeping heel of hook against building and foot of ladder out and lowers hand over hand. The lower man assisting when ladder is within his reach, the lower man continues to lower ladder until hands reach the hook.
5. The lower man now holds heel of hook with one hand and grasps the beam of ladder he is standing on with other hand, then turns hook of ladder into window.
6. Both men unsnap from their ladder and proceed down as in last operation, repeat same operations until ladders are in second floor window.

43e: HOW TO EXTEND A 35 FOOT EXTENSION LADDER, USING POMPIER LADDER

INFORMATION:

The pompier ladder is commonly employed for reaching points higher than the normal reach of other ladders. It is also used for mounting obstructions in an emergency, such as high walls, etc.

When working with the Pompier ladder, a life belt is invariably worn. The belt is hooked on the heel of the ladder or snapped around the ladder beam, permitting the wearer to lock himself in. Thus firmly braced upon the ladder, the man has free use of his hands and can maintain his balance to handle another Pompier or to effect a rescue. This evolution may be performed by any two men of a company.

INSTRUCTIONS:

1. Remove Pompier ladder, balance, and place beam on shoulder with hook down and in front, carry to base of extension ladder, place foot of Pompier against the base of the beam of extension ladder, hook away and Pompier parallel to building, raise vertical and rest hook on extension ladder.
2. Climbs extension ladder, and place arm around hook allowing the gooseneck to rest on arm at elbow with hook out, then proceed to climb extension ladder until about the fourth rung from sill is reached, then lock in on extension ladder.
3. Raises Pompier to window above, by keeping gooseneck of hook against building, hook out, hand over hand, until hook has cleared window, then turns hook away and into window, (Fig. 17) allowing the hook to rest on window sill, with shields against building. CAUTION: Make sure hook is firmly resting on window sill.
4. When Pompier ladder is in place in window above, unlock and proceed up Pompier. (Fig. 18)

   To Lower Pompier (Reverse of above evolutions)

Fig. 17

Fig. 18

44: OPERATE AERIAL LADDERS

INTRODUCTION:

The aerial ladder is commonly employed for reaching points higher than the normal reach of other ladders. It is, also, used for other operations involving walls, etc., that may be unsafe to lean ladders against, as this ladder supports its own weight if necessary.

Most of those in use are hydraulically controlled and vary in length from 65 foot to 150 foot. They are constructed in three or four sections and made of wood, steel, or aluminum alloy.

44a: HOW TO RAISE AND LOWER AERIAL LADDERS, HYDRAULIC CONTROL

INFORMATION:

No attempt will be made to give detailed operating procedures for all makes of aerials. For these detailed procedures, consult manufacturer's operating manual.

TO RAISE

INSTRUCTIONS:

1. Select most practical and level location. Check for overhead obstacles.
2. Set hand brake and shift the power take-off lever to engage the power take-off for driving the oil pump.
3. Proceed as follows;
   a. Depress clutch pedal.
   b. Shift power take-off control lever.
   c. Release clutch pedal.
   d. Pull throttle until tachometer registers 800-950 engine R.P.M., then lock hand throttle in position.

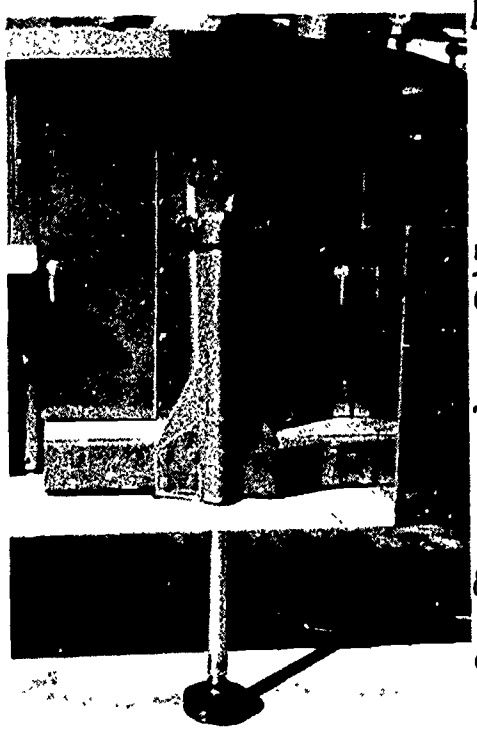

Fig. 1

4. Set aerial frame jacks. (Fig. 1) NOTE: Do not operate aerial ladder until the frame jacks have been placed in position and wheel chocks (wooden blocks) have been placed at front and rear of the two wheels nearest the turntable.
5. Release turntable lock.
6. Move the hoist control handle slowly and steadily in required direction. This will raise the nested ladder.
7. Revolve the turntable until ladder is square with the building by moving rotation control handle in the direction required.
8. Raise or lower nested ladder to the angle that appears necessary.
9. Extend the sections by moving the section control handle. This handle should be operated slowly and steadily. Stop sections when they have reached the desired height.

10. Lower the extended ladder to within approximately two inches of the roof edge, window, ledge, or the object on which it is to rest by moving the cylinder control handle. Avoid permitting the ladder to contact the building or any other object while the power is applied.
11. Ladder lock control handle should now be released and the second section allowed to drift slowly down on the locks.
12. Lock turntable securely in place with turntable lock.
    NOTE: The ladder is now ready for use by the crew.

TO LOWER

INSTRUCTIONS:

1. Raise the ladder a considerable distance from the building by moving proper control handle slowly and evenly.
2. Extend the sections a few inches by moving proper control handle.
3. Disengage ladder locks by moving ladder lock control handle and lock it in the lever bracket.
4. Lower sections until the second section contacts the main section stops.
5. Rotate the turntable by moving rotation control handle in the desired direction. The turntable should be stopped so marker is lined up with the pointer on the stationary portion of the truck.
6. Adjust the pulldown cable by moving control handle until the pulldown cable anchor is to the top end of its travel.
7. Return the nested ladder to its bedded position by moving proper control handle.
8. Observe ladder closely to make certain it is central with the arches and will bed between them without interference.
   NOTE: Do not slam the control levers from one position to another. That will cause rough, jerky operation which may result in damage to the ladder.
   Ladder operations will be accomplished smoothly and as rapidly if the handles are moved slowly and evenly.
   (Fig. 2) shows Seagrave, (Fig. 3) American La France and (Fig. 4) shows Pirsch Operating Panels.

Fig. 2

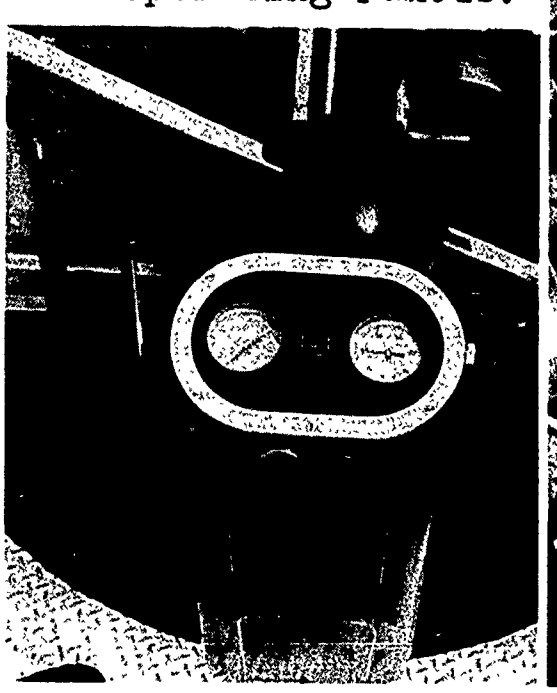

Fig. 3

Fig. 4

45: LADDERS AS IMPROVISED EQUIPMENT

INTRODUCTION:

Very frequently fire departments are called for service, other than the extinguishment of fires. Special equipment may be needed that is not carried by the department. Improvising this special equipment with the aid of ladders is necessary, as the making of a stretcher, sump or catch all, step ladder, church or flagpole raise or used as a crane or boom to lower an injured person from wires or out of buildings. The use of Pompier ladders in man holes is advocated as the hook makes securing easy and the ladder will only take up a small space to one side of hole. Sometimes it becomes necessary to bridge from building to building, and extend ladders that are too short to reach desired objectives.

45a: HOW TO HOIST AND LOWER LADDERS BY ROPE AND HOSE ROLLER

INFORMATION:

When hoisting ladders by ropes to roofs on the upper floors of buildings the hose roller is generally used. The rope and hose roller is carried to the roof or floor where ladder is desired, placed in position and made secure, then rope is dropped to ground where men attach same to ladder with proper knot.

INSTRUCTIONS:

Sending a Ladder to Roof:

1. Three men go to roof; carrying hose roller, and rope.
2. Men on ground remove ladder from apparatus and place same in position to be raised.
3. First men go to roof, place hose roller on edge of building, making same secure by means of regulation knot, drop hoisting rope to men on ground, and place over hose roller.
4. Men on ground make proper ladder hitch, give signal to hoist, steady and turn ladder so that rope is between building and ladder.
5. Continue to hoist ladder until convenient to break over hose roller.
6. One maintains tension on pulling rope, while other two men grasp ladder, one from each side and break-over hose roller and pull on to roof. (Fig. 1)

Fig. 1

7. Remove rope from ladder and carry to desired location.
8. To lower ladder, reverse operations.

45b: HOW TO MAKE EXTENSION TO 28 FOOT STRAIGHT LADDERS WHEN THEY ARE OF INSUFFICIENT LENGTH

INFORMATION:

When 28 foot straight ladders are too short to reach the desired point, the 20 foot straight ladder can be used in making an extension to reach a higher position. This 20 foot straight ladder, after being placed in position, is always held by a man locked in on bottom ladder. NOTE: If straight ladders of over 28 feet are being used, always place U (crotch) poles in position.

INSTRUCTIONS:

1. Place 28' straight ladder in position.
2. Two men remove 20 foot straight ladder from truck, turn same so that climbing side will be out from body.
3. Both men raise ladder and place upper beam on shoulder, man at top inserting arm between first and second rung; man at base inserts arm between last two rungs.
4. Both carry ladder to the ladder to be extended. Man at top starts up ladder followed by man at base.
5. As soon as top man reaches the sixth rung from the top of main ladder, he steps over fifth rung with left foot, turning body so that back will be against ladder rungs and both feet standing on sixth rung, turns ladder while getting into position assisted by man at base of ladder, allowing climbing side of 20 foot ladder to be out from building, grasps beams of 20 foot ladder.
6. Man at base of 20 foot ladder allows ladder to go into place and then grasps bottom rung in center with right hand, thumb out and works ladder upwards, man at top guiding ladder into position until desired height is reached. Man at base then places heels of ladder over proper rung. NOTE: Always try to place heels on rung, having tie rod underneath.
7. Top man then places arms through and around rung of main ladder, allowing rung to fit into arms at elbows, grasping beams of 20 foot ladder and holds same securely.
8. Man at base climbs to desired location. (Fig. 2)

45c: HOW TO MAKE EXTENSION WITH ROOF LADDER

INFORMATION:

When the longest ladder you have in the department is too short to reach windows or roof of building, an extension can be made by the use of a roof ladder. This evolution can be done by one or more men.

INSTRUCTIONS:

1. Remove roof ladder from apparatus and carry to ladder to be extended.
2. Raise roof ladder to vertical position and lean against beam of ladder to be extended.
3. Climb ladder until opposite hook on roof ladder; lock in on ladder and open hooks outward. Be sure that hooks line up with beam. NOTE: Hooks must be opened before ladder is raised.
4. Step down a bit and place roof ladder on shoulder at a point between second and third rungs.
5. Climb ladder until near top and lock in. Work roof ladder upwards. Beam against building, hands on rungs. (Fig. 3)

Fig. 2 Fig. 3 Fig. 4

6. When top of ladder reaches window or roof, place hooks on window sill or roof coping, pull down to set hooks. Roof ladder shall be on one side of ladder to be extended. Step onto roof ladder and climb. (Fig. 4)

45d: <u>BRIDGING WITH A 20 FOOT STRAIGHT LADDER</u>

INFORMATION:

In carrying on rescue and ventilating operations it sometimes becomes necessary to bridge between buildings. This can be done very efficiently if the distance between the buildings can be spanned by the straight ladders used in the fire department.

INSTRUCTIONS:

1. Nos. 3 and 5 go to roof. No. 3 carries hose roller and places same on edge of roof, directly over lower windows which are to be bridged. No. 5 carries rope and drops coil to street in regulation manner.

2. Nos. 4 and 6 go to window at desired height for bridging.
3. Nos. 1 and 2 remove 20 foot straight ladder and carry same to position to be raised, No. 2 takes proper ladder hitch with rope. Nos. 1 and 2 then steady and turn ladder so as to have the rope between the ladder and building while being hoisted.
4. Nos. 3 and 5 at given signal, hoist ladder up to where the foot of ladder reaches the sill of proper floor window.
5. Nos. 4 and 6 grasp the base of ladder with both hands, and turn ladder over, placing ladder between rope and building. Give signal to 3 and 5 to lower away, Nos. 4 and 6 pulling ladder in window as it is lowered. (Fig. 5)

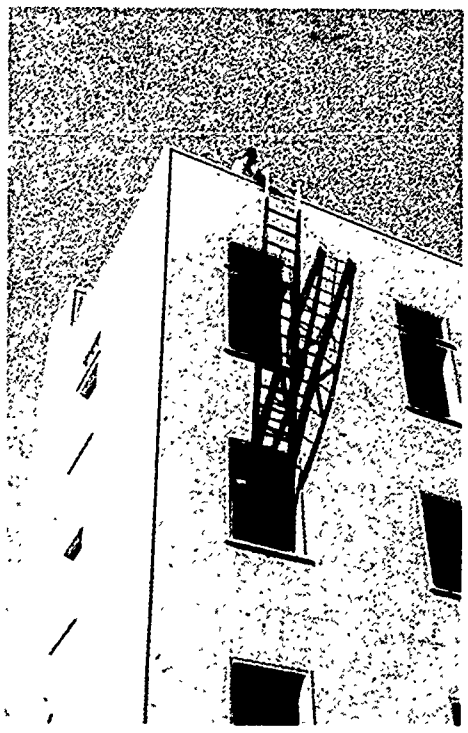

Fig. 5

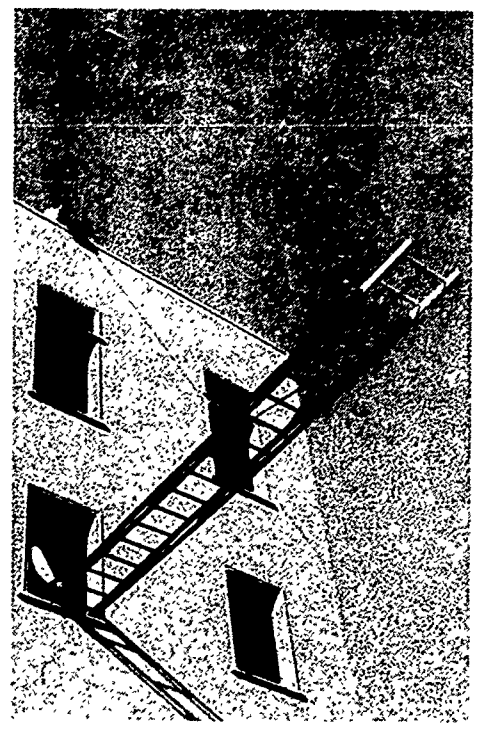

Fig. 6

6. Then Nos. 3 and 5 lower away as Nos. 4 and 6 take base of ladder in window, this throws pulling rope around top rung of ladder. (Fig. 6)
7. When ladder is in horizontal position Nos. 4 and 6 shove into window directly opposite.
8. Nos. 3 and 5 pull rope taut and secure, being careful not to raise ladder from window sill.
9. To lower, reverse operations.

45e: <u>HOW TO BRIDGE FROM LADDER TO WINDOW</u>

INFORMATION:

In carrying on rescue and extinguishing operations, it may be necessary to bridge between ladder already extended, and windows of various floors.

INSTRUCTIONS:

1. Bring bridging ladder to base of ladder previously raised.
2. Place butt of bridging ladder near base of raised ladder and raise in conventional manner, resting top against main ladder.
3. Proceed up main ladder to position where arm can be placed between 2nd and 3rd rungs from top of bridging ladder.
4. Place arm through and balance bridging ladder on shoulder and climb main ladder using both hands to desired height and lock-in.
5. Hoist bridging ladder hand over hand to balance point, and lower top end into window. (Fig. 7)
6. Push ladder in until butt end clears main ladder, and bring back through main ladder over rung at nearest level to sill, to first rung on bridging ladder.
7. Fasten rungs together with strap or rope. (Fig. 8).

Fig. 7

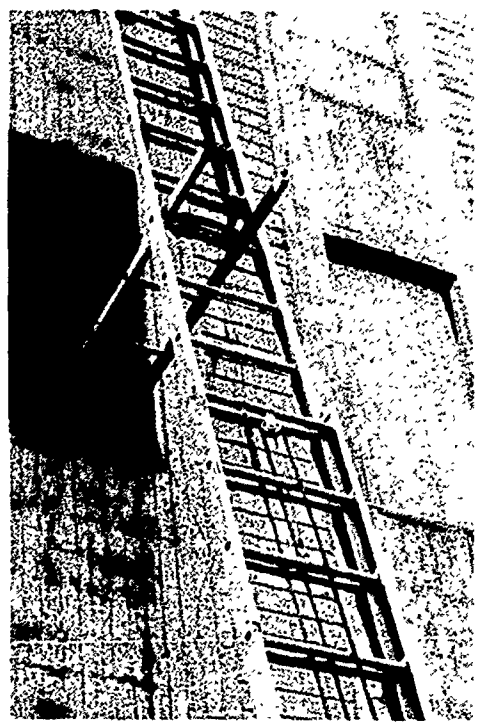

Fig. 8

Fig. 9

CAUTION: Butt end of bridging ladder protrudes through main ladder and must be avoided when climbing.
NOTE: In case rope is used to hoist bridging ladder, pull top into window (Fig. 9)

45f: <u>HOW TO MAKE A STEP LADDER, USING EXTENSION LADDER</u>

INFORMATION:

The improvised step ladder may be very useful in setting up drains during salvage operations or for general above ground work where a step ladder may be needed.

INSTRUCTIONS:

1. Lay ladder on ground with fly section on top.
2. Take extension apart and reverse ends of fly section.

3. Insert base of fly into upper end of main section, with pawls of fly section locked under top rung of main section.
4. Strap the rungs together at lock pawls.
5. Set ladder in upright position.
6. Secure with rope (Fig. 10) or hose strap (Fig. 11) at proper climbing angle.

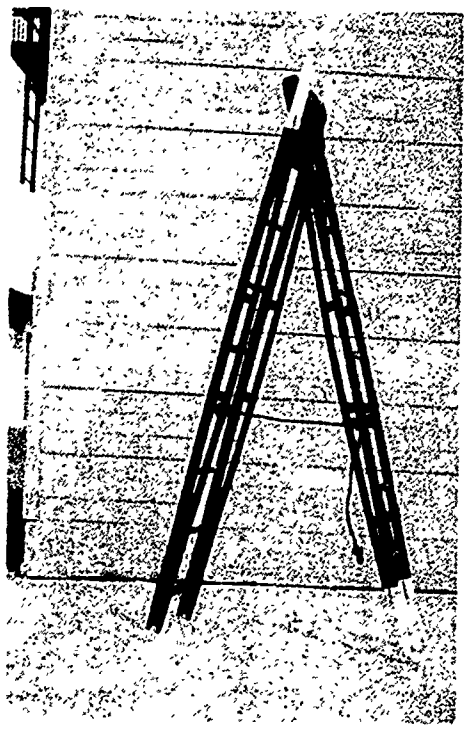

Fig. 10

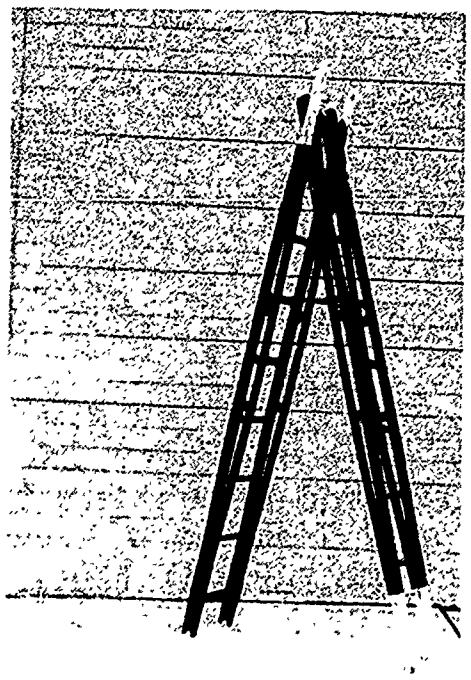

Fig. 11

NOTE: Two straight ladders may be lashed together in the same manner in the shape of an "A" and then raised.

45g: HOW TO MAKE IMPROVISED SUMP

INFORMATION:

Sometimes suction hose cannot be connected to water supply where threads are damaged or fittings are not available. Water may be transferred to an improvised sump and utilized for fire fighting purposes, by fire truck taking suction from sump. This sump may also be set up to hold run-off water during salvage operations. Standard ladders carried on most pumpers are used for this purpose (20 or 24 foot extension and 12 or 14 foot roof ladder)

INSTRUCTIONS:

1. Take extension ladder apart and with the use of a roof ladder, form a triangle. (Fig. 12) NOTE: The ends of the narrow sections are placed inside the wider sections and overlapped sufficiently to make sump desired size, lining up rungs where overlapped for ease in securing sections.

2. Fasten sections together with rope, cord or straps. NOTE: If halyard of extension ladder is removable, it may be used. (Fig. 13)

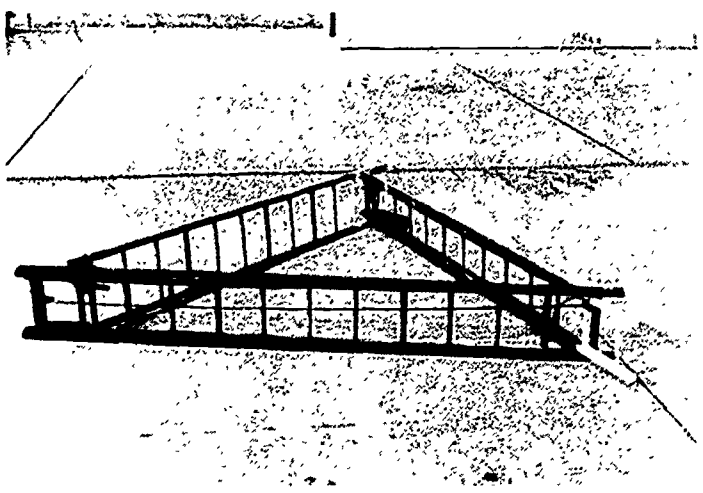

Fig. 12

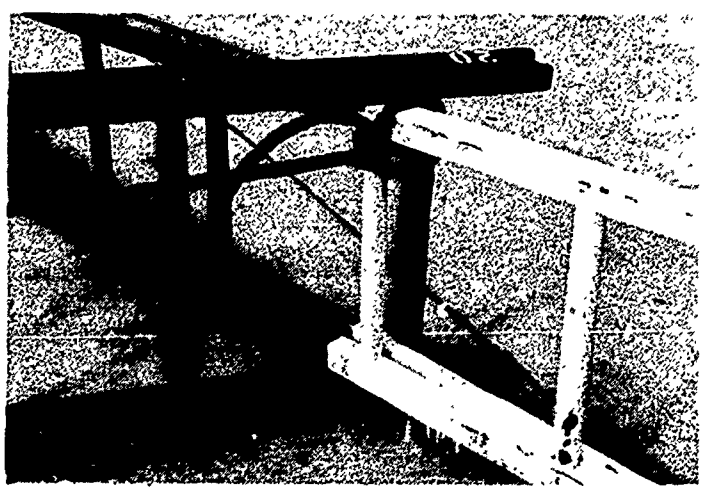

Fig. 13

3. Spread cover over ladders (Fig. 14) and form sump by taking slack and adjusting to all sides with corners and edges to ground level and tucked under lower beams of ladders.
4. Lift ladders at corners and place loose ends of cover underneath sump as far as possible, to complete sump. (Fig. 15)

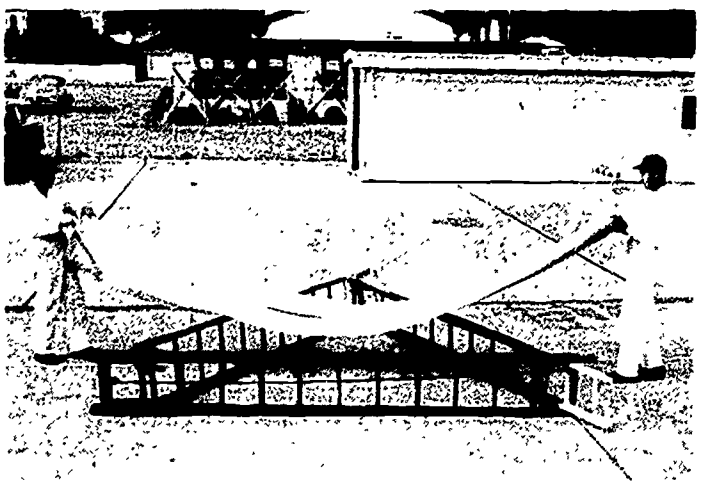

Fig. 14

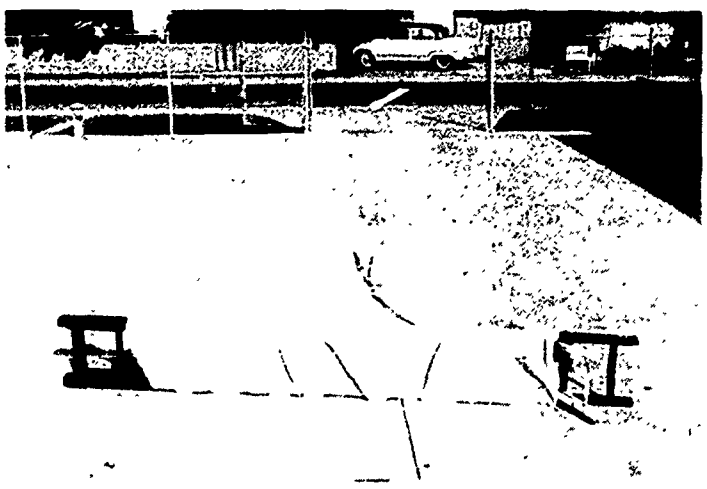

Fig. 15

CAUTION: Avoid pulling cover tightly at corner where sharp base shoe of main section of ladder extends, as it may rip cover. Cover may be tied around ladders at the corners if necessary.
NOTE: For large sumps, two covers are required and should be connected with a leakproof roll.

45h: HOW TO MAKE AN IMPROVISED CRANE OR BOOM (USING A 28 FOOT AND A 20 FOOT STRAIGHT LADDER)

INFORMATION:

Sometimes it becomes necessary to make an improvised crane or boom for lifting during rescue or fire fighting operations. Details will vary with the ladders available and the job to be done. Space will not permit all the variations herein.

INSTRUCTIONS:

1. Place 28 foot ladder flat on ground.
2. Secure end of a rope around each beam and top rung of ladder. NOTE: If rope is long enough, it may be doubled for this job.
3. Pass end of another rope under second rung from base, back up over 3rd rung and carry over top rung, leaving enough slack rope to reach ground when ladder is raised.
4. Place butt end of 20 ft. ladder between beams of 28 foot ladder and over bottom rung.
5. Align bottom rungs of the two ladders and strap or tie securely.
6. Raise 28 foot ladder to proper height to secure ropes from top beams of 28 foot ladder to the top rung and beams of the 20 foot ladder.
7. Lower sufficiently to secure load on single rope (Fig. 16)

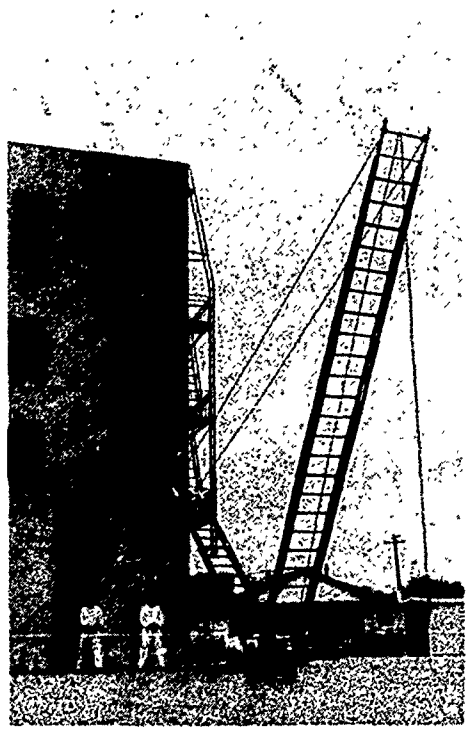

Fig. 16

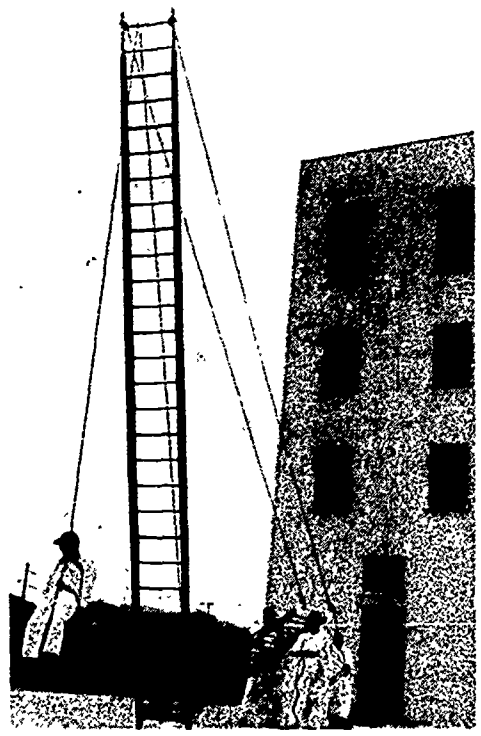

Fig. 17

8. Tie person or object to be lifted to end of single rope.
9. Take turn around convenient rung of 20 ft. ladder with single boom rope, pull taut and hold firmly.
10. Pull down on top of 20 foot ladder and elevate person or object to desired height. (Fig. 17)
11. To lower, reverse operations.

46: <u>RELEASE AND LOWER FIRE ESCAPE LADDERS</u>

INTRODUCTION:

Fire escapes are used to provide egress from a building in case stairway or elevator shafts are involved with heat and smoke. Also to allow firemen to ventilate or place lines where ladders are short or not present. They are placed on all classes of buildings three or more stories in height, except in buildings where life hazard is not a problem.

The lowest fire escape balcony should not be more than twenty-two (22) feet above the street, alley or ground level below the same. To the lowest balcony of any fire escape there should be attached a counterbalanced stairway, drop ladder, or permanent ladder or stairway extending from such balcony to the street, alley or ground.

Such counterbalanced stairway, drop ladder, or permanent ladder or stairway should be of similar construction of the same width as the "standard" fire escape stairway and should be designed to carry similar loads.

Every standard fire escape balcony should be not less than forty-four (44") inches in width and not less than nine (9') feet in length, inside measurements.

The opening of the floor in the balcony for stairways, should be not less than twenty-one inches by forty inches (21" x 40"). The lowest balcony should have no such opening therein, excepting where a ladder or stairway is attached thereto leading to the ground, sidewalk or alley level, and an opening therein shall be required.

46a: HOW TO RELEASE AND LOWER FIRE ESCAPE LADDERS

INSTRUCTIONS:

1. Counterbalanced drop ladders are operated by first releasing the pin or lock holding this type of ladder in a fixed position. Releasing the pin requires the operator to stand on fire escape balcony. After pin is released, ladder can be lowered by hand. CAUTION: Use care to prevent injury to hands or to persons below.
2. Fire escape drop ladders are held in a raised position by several different devices. Most all types of devices used at the present time must be operated by hand when standing on fire escape balcony, only a few can be tripped from the street by using a pike pole.
   EXTRA PRECAUTIONS must be exercised when tripping those drop ladders, as persons may be injured below, as well as the operator. (Fig. 1)

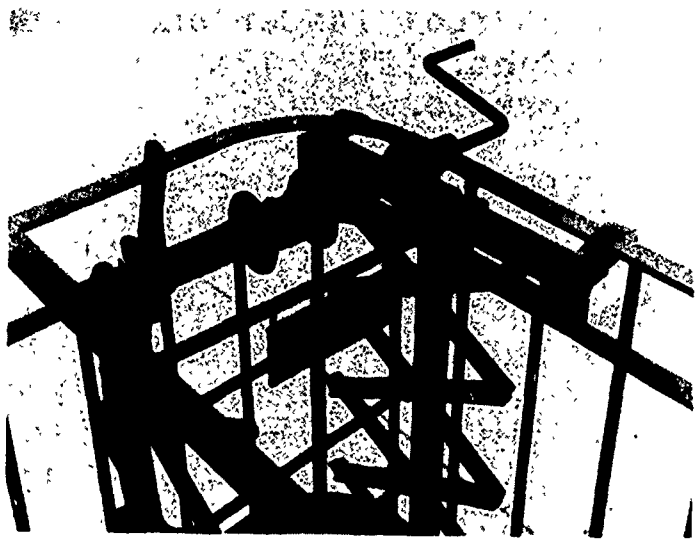

Fig. 1

3. Counter balanced stairways are provided on some fire escapes. These are so arranged that they will swing up and down automatically by counterbalancing weights. A person's weight will automatically lower them and they can be lowered by pulling them down with a pike pole.

CALIFORNIA FIRE TRAINING PROGRAM

Unit G

HOSE AND LADDERS -- ABOVE GROUND LEVEL

47. ELEVATORS
48. FIRE DOORS AND SHUTTERS
49. HOSE LINES ABOVE STREET LEVEL

OBJECTIVE:

To develop ability to operate elevators, fire doors, and shutters to lay hose lines above ground with a knowledge of the various devices and their relation to one another.

91/92/93

HANDLING HOSE AND LADDERS ABOVE GROUND LEVEL

INTRODUCTION:

When fighting fires in upper floors of buildings, it frequently becomes necessary to utilize equipment and devices within the involved and adjacent structures. This equipment includes elevators, fire doors and shutters, fire escapes, stairways, etc.

Elevators may be used for taking manpower and equipment aloft. Fire doors and shutters may be used to prevent the spread of fire. Elevators, fire escapes, and stairways are used to take hose lines aloft.

47a: HOW TO OPERATE AN ELEVATOR

INFORMATION:

There are many different kinds and types of elevators in service, but their operating principle remains the same. Where an elevator operator is not on duty, it will be necessary for a fireman to operate same. There are two types that will be commonly encountered; the manual control, and the automatic. Operation of manual control is obtained by use of a drum controller, automatic by a series of push buttons numbered to correspond with each floor.

INSTRUCTIONS:

Manual Control (Fig. 1)

1. Close shaft and elevator doors. NOTE: If either door is not closed, elevator will not run.
2. Push handle of drum controller to UP position.
   a. Hold handle in this position.
3. Release handle when nearly up to desired floor.
   a. Allow momentum to carry elevator up to floor.
   b. If you glide past, push handle to down position momentarily.

To bring elevator down

1. Close doors.
2. Push handle of drum controller to DOWN position.
3. Release handle when within a few feet of ground floor.
   NOTE: Newer elevator installations automatically adjust themselves to floor level when control handle is released.

Automatic Control (Fig. 2)

1. Close shaft and elevator doors.
2. Select button for desired floor and push.

To bring elevator down

1. Close shaft and elevator doors.
2. Push button for first floor.
3. Close doors when leaving elevator.

Fig. 1

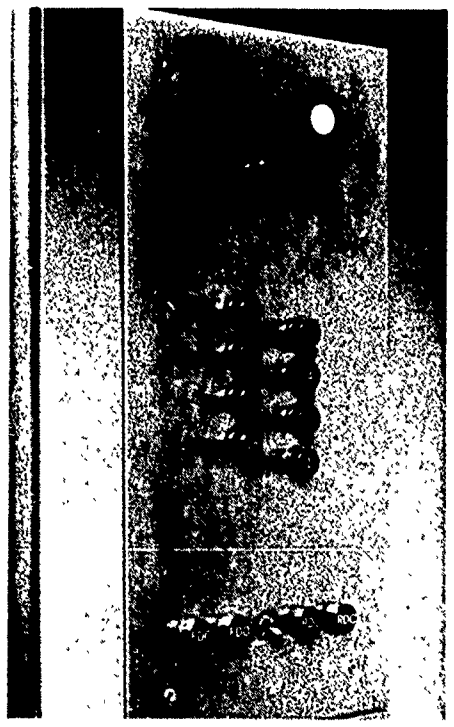

Fig. 2

48: FIRE DOORS AND FIRE SHUTTERS

INFORMATION:

Fire doors are designed for the protection of openings in walls and partitions against fire and are identified by the labels illustrated below.

The rating of 3, 1½, 1, or 3/4 hours indicates the duration of exposure to fire. The letters A, B, C, D., or E following the hourly rating designate the location for which the assembly is designed, which are intended to agree with the Standards of the National Board of Fire Underwriters for Protection of Openings in Walls and Partitions Against Fire. The temperature rise classifies the temperature developed on the unexposed face of the door at the end of 30 minutes of fire exposure. Those labels which do not show temperature rise are for doors which develop temperatures in excess of 650F. All doors with glass lights in excess of 100 sq. In. per opening are so rated. Doors with glass vision panels of 100 sq. In. or less per wall opening carry the same rating as similar doors without glass lights.

The protection of an opening depends not only upon the use of a labeled door of the proper type, but also upon the use of proper frames and other accessories, as specified under the respective types of doors and the installation. Prospective users should first ascertain from authorities having jurisdiction which type, mounting, hardware, frame, and closing mechanism are acceptable for any given location.

While doors exceeding the sizes recorded in the tabulations under the respective types have not been subjected to standard fire tests, the Laboratories are prepared to furnish a Certificate of Inspection for such oversize doors found to be in compliance,

otherwise, with all requirements for design, materials, and construction.

Fire Doors which have been produced under the Factory Inspection and Label Service Program of Underwriters' Laboratories, Inc. are identified by the labels illustrated. (Fig. 1 and Fig. 2) A label on a door indicates only that it has been considered from the fire protection viewpoint without reference to the electrical or accident hazard features which may be involved. The electrical and accident hazard features, if considered, are covered by separate listings.

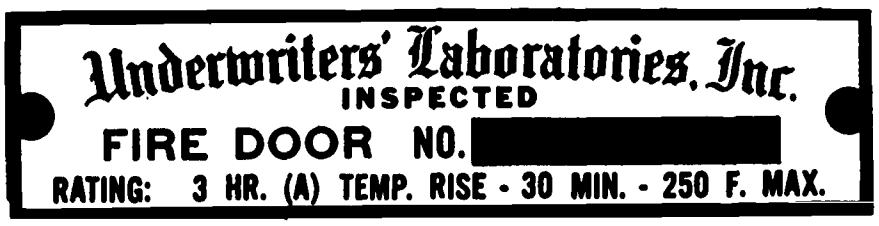

Fig. 1

Every Class A fire door shall be an automatic closing fire door and installed with the frames and hardware as specified in the ordinance.

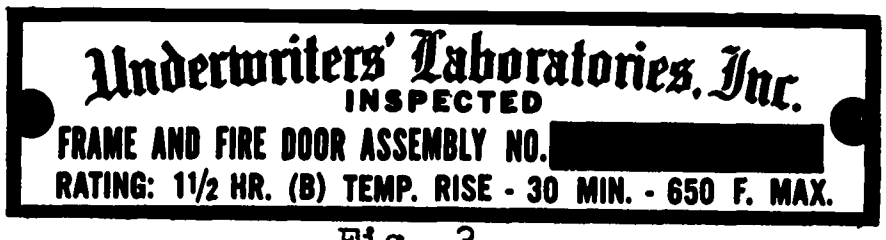

Fig. 2

Fire doors are of varied types namely: the hollow metal fire door; metal clad paneled fire door; plate steel fire door; sheet metal fire door; steel fire door (counterbalanced type); steel fire door (rolling and lift up types) and tin clad fire doors (with 3 ply and 2 ply cores). Automatic closing fire door shall mean any fire door which is arranged to close by the fusing of an approved fusible link at a specified temperature, or by other quick operating heat acutated door closing device or system.

"Self-closing fire door" shall mean any fire door which is arranged to close by gravity, approved door check, or other approved device, which will insure positive closing from an open position without becoming defective from reasonable use.

"Automatic closing devices," shall be so arranged and installed that the operation of any such device on either side of an opening will close all "Fire Doors" on such opening. Every "Fusible Link" or "Heat Actuated Device," shall be of an approved type which will release and operate at a temperature of not less than 155 degrees Farenheit.

Not less than two fusible links shall be installed on any door not more than 10 feet in width, and not less than four fusible links shall be installed on any door of greater width. One such link for each door shall be located within six inches of the ceiling of the room and one link shall be located in the door opening, or directly above the door opening when door is open. One link for each door shall be attached to an "S" hook for testing.

Where only one fire door is installed on an opening, the automatic closing device shall be extended through the wall or partition, and have an additional fusible link on the side thereof opposite the door and within six inches of the ceiling of the room.

All hardware or other equipment for any Class A fire door, shall bear the label of approval of the "Underwriters Laboratories, Inc.

All hardware and equipment for any class B, C, D, or E fire door shall be hardware and equipment listed and approved by the "Underwriters Laboratories, Inc.," or in either case may be other equivalent hardware and equipment approved by the Board of Building and Safety Comissioners.

Approved hardware for sliding or swinging Class A fire doors shall be provided with not less than ten labels for single doors and at least 20 labels for swinging doors in pairs.

Tin clad fire door, (Fig. 3) when used on both sides of walls furnish a high degree of resistance to fire and to the transmission of heat for long periods of exposure and resist fire streams well. The arrangement of automatic device provides two fusible links, one constantly in opening and exposed from both sides and one link near ceiling. If either link fuses, door is released and closes by gravity.

Fig. 3

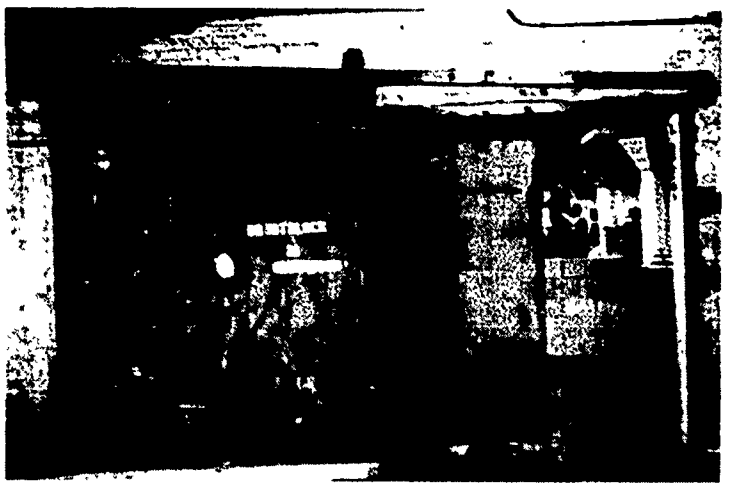

Fig. 4

If doors are used on both sides of wall, (Fig. 4) the cord can be made to pass through wall near ceiling, at points where it is shown attached to the wall, and same arrangement continued on other side, thus providing four links. The fusing of any one releases both doors.

Tin clad fire door, (Fig. 5) Level track, weight operated type fire doors can be counterbalanced so as to operate without great difficulty and can be made to close automatically without the use of complicated apparatus.

Fig. 5

Fig. 6

Tin clad fire doors in pairs, (Fig. 6). When fusible links in door opening fuse, both doors are released and close by gravity. Where level track is used, doors close by weights attached to chains as shown in Fig. 5.

Sliding fire doors can be mounted close to the wall, require only a small amount of floor space, and are less likely than many other types to be rendered inoperative by obstruction.

Tin clad vertical fire door--doors of this type may be employed where horizontally sliding or swinging doors cannot be used.

Rolling Steel fire door, (Fig. 7) may be employed where the transmission of heat through the door is not liable to result in the spread of fire and when the doors do not serve as exit doors.

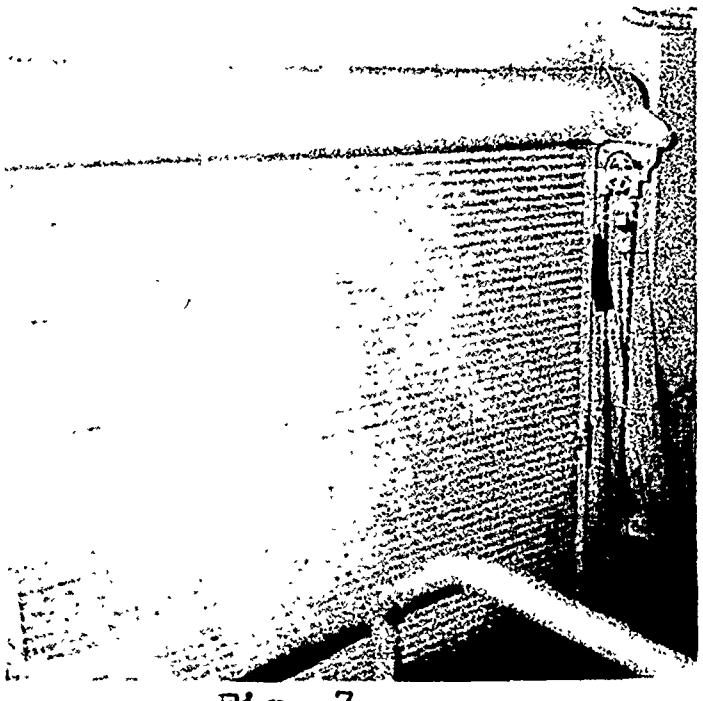

Fig. 7

Tin clad single swinging door (Fig. 8). Tin clad overhead fire door (Fig. 9)

Fire doors as shown in Figs. 3 to 9 represent some of the various types and installations found in or on buildings. All fire doors as indicated are designed to be automatic in operation or self-closing. These doors are sometimes found inoperative due to mechanical defects or goods and merchandise piled against doors. In such cases it becomes necessary to remove any obstruction or close such doors manually.

Fig. 8

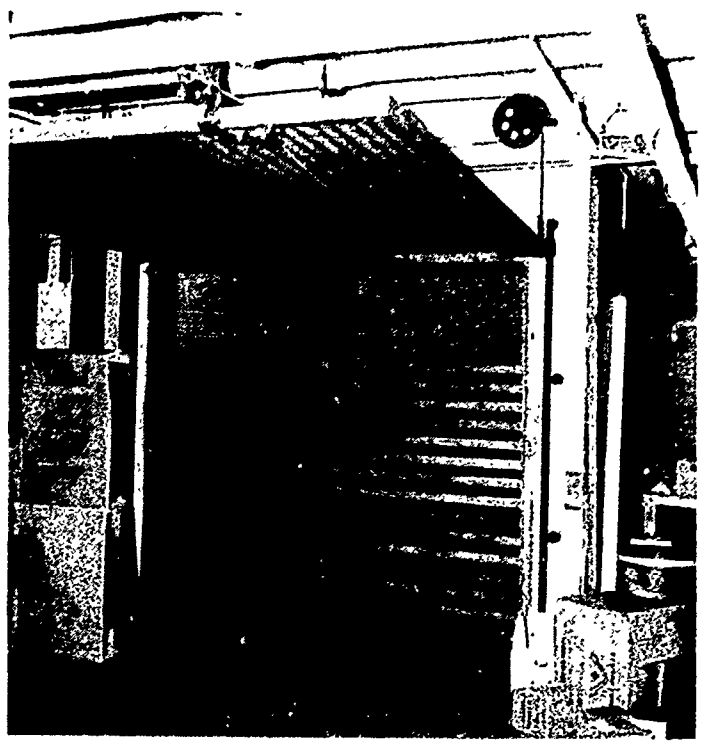

Fig. 9

49a: HOW TO CARRY HOSE LINES ALOFT VIA STAIRWAY (SHOULDER CARRY)

INFORMATION:

Where fires are encountered on floors above street level, it is sometimes necessary to take hose lines up stairways to get lines in position to combat fires. This method may be used to take lines to any floor above ground level, providing man power is available. It is good practice to have sufficient working line to be able to reach any part of the floor.

INSTRUCTIONS:

1. Lay hose line same as any ground lay with nozzle connected.
2. Stretch out in a straight line the amount of hose required to reach desired location.
3. Place one man on nozzle and the remaining men at required positions, (Book One, Unit D, Job 26c). Ordinarily, where stairway is near entrance of the building, three men are required to take line to the second floor, with 50 feet of working line on the second floor. One man is required for every additional floor line is to be raised.

Fig. 1 shows line being laid up stairway to second floor. Fig. 2 shows hose being adjusted around stairway railing post. NOTE: Alternate method (Under Arm Carry) may be used for this job.

Fig. 1

Fig. 2

49b: HOW TO CARRY A SINGLE EMPTY LINE OF $2\frac{1}{2}$ INCH HOSE UP A LADDER

INFORMATION:

Where fires are encountered on upper floors of buildings, involving the use of lines of hose, it sometimes becomes necessary to take the line of hose up a ladder to upper floor, due to inadequate fire escape or standpipe facilities.

INSTRUCTIONS:

1. All men line up on hose at about 25 foot intervals and place hose on same shoulder.
2. Nozzleman places line across chest with nozzle at back and starts climbing.
3. Other men on hose move up, forming loop of hose in front, until all are spaced ten to fifteen feet apart. Climb ladder as turn comes. NOTE: Be sure to keep distance while climbing so that hose will be kept in balance on shoulder. (Fig. 3) NOTE: An alternate method of carrying hose up ladder on shoulder, (See Fig. 4) loop is placed over shoulder to rear.
4. Nozzleman enters window of upper floor, walks in with slack and lays nozzle down; goes back to window and takes in slack hose until there is sufficient slack hose to reach desired location.
5. Other men lock in on ladder and feed slack hose to man above. (Fig. 5) When sufficient hose has been placed on floor, nozzleman will give signal and men on ladder will secure hose to ladder with hose strap (Fig. 6)
   NOTE: Place hose strap behind couplings to relieve strain.

6. Man nearest top of ladder advances and assists nozzleman direct stream.

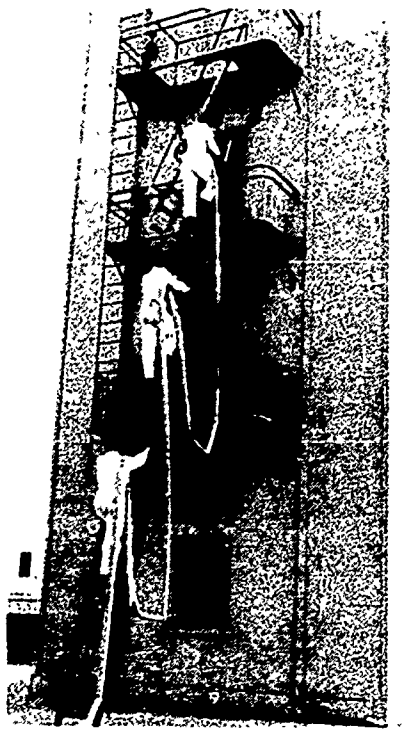

Fig. 3

Fig. 4

Fig. 5

49c: <u>TO REMOVE LINE FROM UPPER FLOOR</u>

INSTRUCTIONS:

1. Shut water off at hydrant or pump.
2. Break first coupling away from base of ladder, drain hose.
3. Men lock in on ladder, (Fig. 7) remove hose straps, let hose down ladder hand over hand.
4. Man at base of ladder lays hose in folds so that it will be easy to pick up.

Fig. 6

Fig. 7

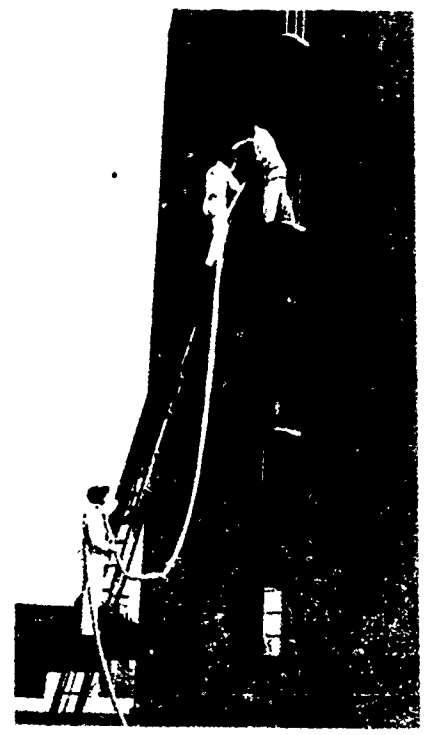

Fig. 8

5. Nozzleman places hose over shoulder of top man on ladder, under right arm and over left shoulder when line is on right side of ladder. (Fig. 8) Other men place hose on shoulders and start down, keeping proper distance. NOTE: Extreme care should be practiced when nozzle man is last man out of window with hose line.

49d: HOW TO TAKE A LOADED LINE OF HOSE UP A LADDER

INFORMATION:

When carrying on extinguishing operations involving the use of loaded lines of hose at fires, it sometimes becomes necessary to change the position of the line from the street level to the upper floor of a building via ladder. This procedure should never be used at the time line is laid because of the additional weight of hose when loaded, and the time involved to complete the operation.

INSTRUCTIONS:

1. All men line up on same side of hose, place hose under arm spacing in direction hose is laid, about 10 to 15 feet apart. Nozzle man places rope hose tool or combination hose strap on hose, (See book 1, Job 1x) proceeds to climb ladder.
2. Men follow nozzleman on ladder in same manner and same distance apart. NOTE: Maintain distance between men.
3. Nozzleman proceeds in window of upper floor, lays nozzle down with hose over sill to side of ladder and pulls in desired amount of hose.
4. Men on ladder lock in and feed hose upward until nozzleman signals that he has desired amount of hose. Secure hose to ladder with hose straps, or rope hose tools, unlock on ladder, advance and assist nozzleman.

49e: HOW TO TAKE LOADED LINE DOWN A LADDER

NOTE: The movement of loaded hose lines up or down ladders should not be attempted except when time is an important element.

INSTRUCTIONS:

1. Men proceed to ladder; take positions on ladder, lock in, and remove hose straps.
2. Nozzleman places nozzle near ladder.
3. Hose is passed down ladder. Safety to be practiced at all times.
4. When all hose has been let down except approximately two feet with nozzle, nozzleman should place hose on ladder and take his position.
5. Nozzleman gives order when ready for all hands to unlock from ladder and back down slowly.
6. Ground man should place hose in large circle to assist in its removal.

49f: HOW TO TAKE A LOADED LINE UP LADDER AND OPERATE STREAM IN UPPER FLOOR WINDOW

INFORMATION:

In carrying on extinguishing operations involving the use of loaded lines of hose at fires, it sometimes becomes necessary to operate the streams from ladders into windows of upper floors of buildings.

Where it is determined to operate a stream in this manner at the time the line is laid, the correct procedure is to take the empty line up the ladder before water is placed in the line.

Fig. 9

INSTRUCTIONS:

1. All men take positions on line and climb ladder.
2. When nozzleman reaches position opposite window, stream is to be operated in; all men lock in on ladder and secure hose to same.
3. Nozzleman places nozzle between rungs of ladder and secures hose strap in regulation manner.
4. Nozzleman opens nozzle and directs stream as desired. (Fig. 9)

49g: HOW TO HOIST A LOADED LINE TO THE UPPER FLOOR OF A BUILDING WITH HOSE ROLLER AND ROPE

INFORMATION:

When operating streams at fires, it may become necessary to hoist the loaded line to upper floors of buildings by use of hose roller and rope.

Avoid this method if possible, due to the difficulties encountered while hoisting a loaded line.

If conditions permit, time would be saved by shutting off and draining the line, then hoisting the empty line.

INSTRUCTIONS:

1. Upon receiving orders, men place hose in position at street under desired window.
2. One man obtains hose roller from apparatus, one man obtains rope from apparatus.
3. All but one man proceed to floor where line is to be used, via ladder, stairway, elevator, or fire escape to desired window. NOTE: Not advisable to use elevator when upper floors are involved with fire.

4. Place hose roller in window and secure same in regulation manner.
5. Drop coils of rope to ground.
6. Man on ground secures rope to the loaded line in regulation manner.
7. One man places rope over hose roller, and, upon signal from man on ground, all men hoist line. (Fig. 10)
8. When nozzle reaches window, one man grasps same and bends line over hose roller.
9. Other men assist in pulling in line until bowline or eye-splice loop is reached, then hold hose.
10. Remove half hitches, make coil of rope approximately 35 feet, and hold in one hand, enlarge loop with free hand; drop enlarged loop down hose line so that loop will be below coupling if possible. (Fig. 11)
11. Hoist more line by pulling on rope and hose together until bowline or eyesplice loop again reaches roller.
12. Continue operations 10 and 11 until sufficient hose is on floor.
13. When sufficient hose is on floor, drop rope as before in a manner so as to fall below coupling, tighten, and secure rope in regulation manner to relieve strain on hose.
14. Place hose strap on hose and secure to hose roller in regulation manner to relieve strain on hose. (Fig. 12)
15. Place hose in operation.
16. Man on ground provides slack hose at street until line is made secure, then proceeds to upper floor and assists men at nozzle.

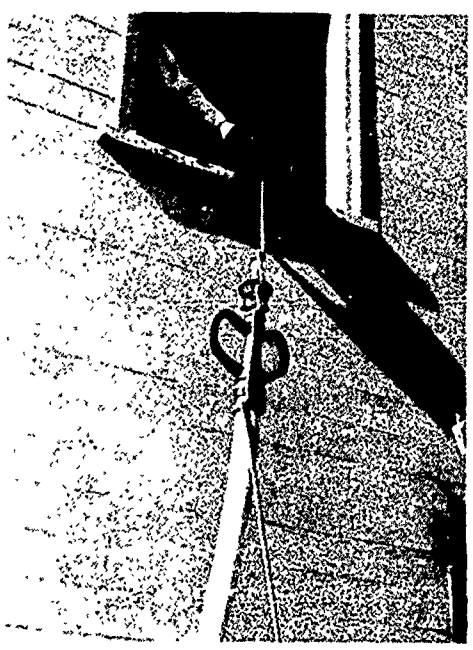

Fig. 10

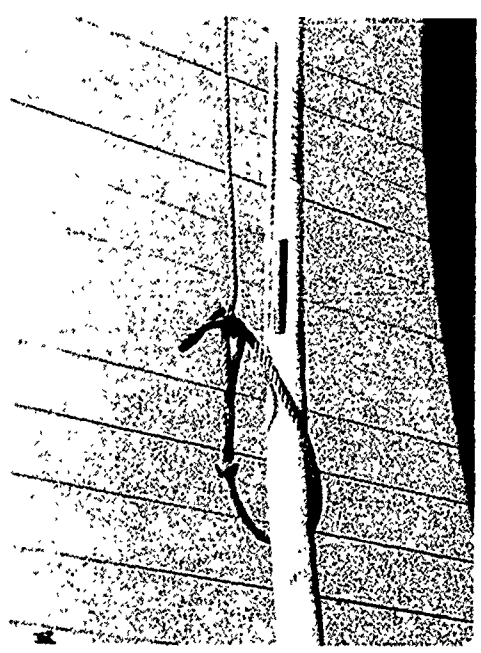

Fig. 11

Fig. 12

49h: <u>HOW TO LOWER LOADED LINE</u>

INFORMATION:

If time is not an important factor, place clamp behind coupling, break and drain line, and let empty line down.

INSTRUCTIONS:

1. One man proceeds to street level.
2. Hold line in position, untie rope and lower loop to man on ground by working rope over hose sufficiently for loop to slide down hose.
3. Man on ground enlarges loop and makes fast in regulation manner.
4. Man at window pulls up rope with enlarged loop to hose roller, removes half hitch, and places loop over hose roller.

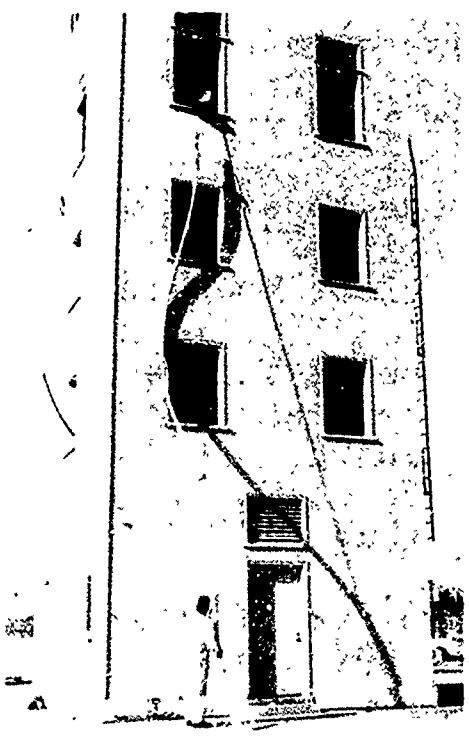

Fig. 13

5. Pull up on hose, remove hose strap at hose roller, lower the loaded line until approximately 15 feet of hose remains on floor; hold hose in this position.
6. Remove enlarged loop from over hose roller, tighten same on hose, then make regulation hitches to lower loaded line.
7. Grasp rope and lower lines to ground. NOTE: One man guides nozzle over roller. (Fig. 13)
8. Man on ground straightens out line as it is lowered and removes rope from hose.
9. Man in window on upper floor pulls rope back, secures hose roller rope to end of other rope, and lowers hose roller to ground, then drops rope.
10. Replace hose roller and rope on apparatus.

491: <u>HOW TO HOIST HOSE LINES ALOFT, USING PIKE POLE AND HOSE STRAP</u>

INFORMATION:

It is sometimes necessary to lay lines from street directly to the fire on floors above ground level, where standpipes are inoperative or all outlets are in use.

A very effective means of getting lines to the desired floor is by use of pike pole and hose strap, especially when other companies are operating on fire escapes.

Lines can be hoisted to any floor desired in this manner, providing man power is available. It is necessary to have one man on each fire escape landing. The same procedure can be used to take lines to upper floors and make connections to standpipe outlets. Where building is not equipped with fire escape, men take position at windows to each floor, reach out and pull line up in the same manner. Lines can also be hoisted in this manner on the inside of the building up an open stairwell. Men take position on each floor along stair railing, reach down and pull the line up in the same manner.

INSTRUCTIONS:

1. Lay line same as any ground lay; remove sufficient hose to reach desired location.
2. Remove hose strap and pike pole and ladder, if needed.
3. Place ladder to first fire escape balcony or second story window. NOTE: When other companies respond and are in position, it will not be necessary to remove ladders from apparatus.
4. Place pike pole and hose strap at foot of ladder.
5. Men take positions, one man on each floor until desired floor is reached. One man on the ground to secure hose to strap and pike pole, and pull up desired amount of hose to reach location. NOTE: Numbering position of men in this operation will avoid confusion. No. 1 ground man; 2 on the second floor; 3 on third floor, and so on until all men are placed.
6. No. 1 secures hose strap to hose and pike pole (See Book 1, Job 1) and passes pike pole to No. 2; pulls hose to provide slack. NOTE: When pike pole will not reach balcony or window, No. 1 gets on ladder sufficiently for No. 2 to reach end.
7. No. 2 passes pike pole to No. 3.
8. No. 3 passes pike pole to No. 4 (Fig. 14)
   NOTE: This is repeated until pole is at desired floor.
9. No. 4 or last man, continues to pull pole until nozzle reaches top edge of balcony, lets upper end of pike pole swing out, raises lower end of pike pole over railing sufficiently for nozzle to clear, pulls in sufficiently to grasp hose and pike pole together, guides nozzle and pike pole through window or door until length of pike pole is in on the floor. (Fig. 15)
10. No. 4 lays pike pole down and continues to pull up hose and place in on floor until sufficient hose is in on floor. (Fig. 16)

Fig. 14

Fig. 15

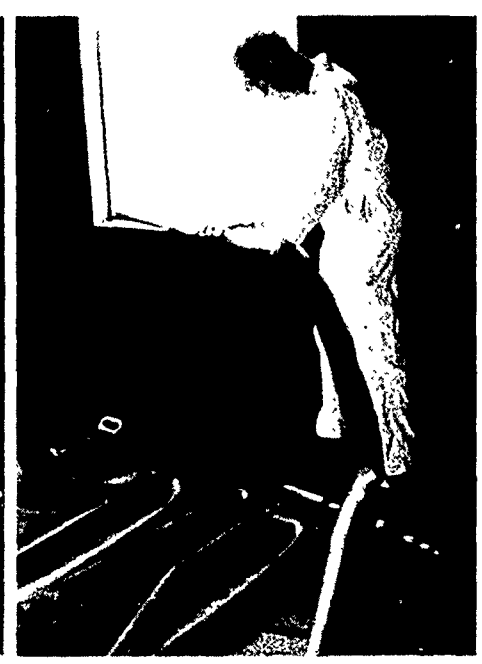

Fig. 16

11. No. 1, 2 and 3 work together and pull up hose sufficiently to take strain off man above until No. 4 gives signal that amount of hose desired is on floor.
12. Upon signal, 2 and 3 secure hose to end of balcony railing with hose strap and advance to upper floor and place nozzle in position to operate stream.
13. No. 4 removes strap from pike pole and hose.
14. Place hose strap behind coupling if possible after slack is passed up.
15. After hose is passed up, No. 1 proceeds to upper floor and assists with operation of nozzle.
16. Signal for water after hose is secured and nozzle is in position.

49j: HOW TO LOWER LINE WITH PIKE POLE AND HOSE STRAP

INFORMATION:

Lines are generally removed after fire is out or under control, after which water may be shut off and lines bled to remove water. This will make the job easier to do. If line is to be lowered and used, it will be much easier to place hose clamp on the ground and break coupling to remove water. Hose can then be lowered and connected, and water turned on by removing hose clamp.

INSTRUCTIONS:

1. All men get in their respective positions as when hoisting line.
2. Remove hose straps and lower extra line from top floor.
3. No. 4 secures hose strap to hose and pike pole.
4. Removes hose from floor over side of balcony railing, raises pike pole in vertical position as nozzle reaches railing, holds pike pole in one hand with point of hook against railing and top against upper floor balcony, guides nozzle over railing with other hand, than with both hands raises pike pole to clear railing and lowers to No. 3.
5. No. 3 passes pike pole down to men below. This is done until nozzle is on ground.
   NOTE: When line is being lowered, all men look up until nozzle reaches them. Always signal men below before letting go of pike pole.

49k: HOW TO CARRY LINE OF HOSE UP FIRE ESCAPE

INFORMATION:

It is sometimes necessary to carry lines of hose up fire escape when standpipe outlets are inoperative or in use.

The successful completion of this operation necessitates proper teamwork and spacing of crew on fire escape balconies. The operations given are for taking a line to the fourth floor. May be used with either 2-1/2 inch line, single 1½ inch line, or two 1½ inch lines. Positions are numbered. No. 1 on ground, No. 2 on the first fire escape balcony, and so on up.

INSTRUCTIONS:

1. Lay hose lines as in any ground lay.
2. Remove 20 foot extension ladder from apparatus and raise to fire escape balcony. NOTE: Not necessary to remove and raise ladder where truck company is at scene of fire.
3. When sufficient amount of hose is removed, men proceed to their positions on fire escape balconies. No. 1 on the ground, No. 2, on first fire escape balcony, No. 3 on second, No. 4 on third.
4. No. 1 places nozzle over shoulder in position to carry, and proceeds up ladder to fire escape balcony.
5. No. 2 removes hose and nozzle from shoulder of No. 1, (Fig. 17) places nozzle over shoulder to carry, and proceeds to third floor; No. 1 assists in pulling line up.
6. No. 3 on third floor balcony takes nozzle underneath railing from shoulder of No. 2, (Fig. 18) places nozzle over shoulder in position to carry, and proceeds to fourth floor balcony. No. 2 assists in pulling line up.
7. No. 4 on fourth floor balcony takes nozzle underneath railing from shoulder of No. 3 (Fig. 19) and proceeds to take line in on floor. No. 3 assists in pulling up line.

Fig. 17

Fig. 18

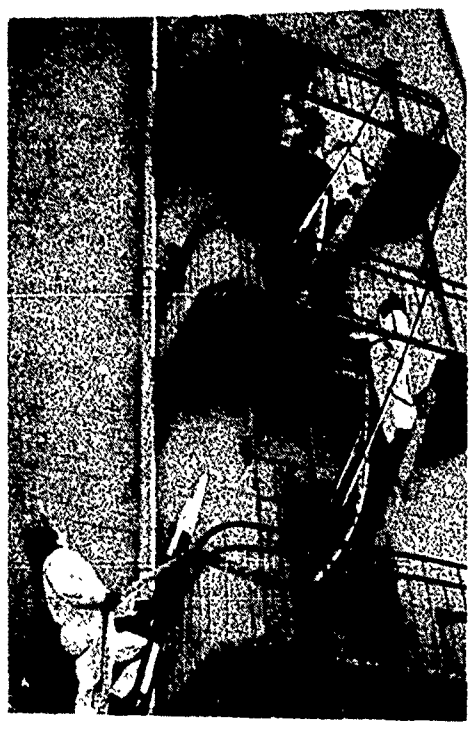

Fig. 19

8. At signal from No. 4 man on balcony, secure hose to balcony stairway railing with hose strap, No. 1 places line on ladder. (Fig. 20)
9. Men proceed to upper floor to assist with nozzle when No. 2 arrives at top floor and signals for water. No. 1 proceeds to fourth floor to assist.

NOTE: If this job must be done by two men, carry hose up ladder in regulation manner, (Fig. 21) as nozzleman continues up fire escape, second man stays on first landing and assists in pulling hose. Nozzleman proceeds to fourth floor, places nozzle in window, and pulls sufficient working line. (Fig. 22)

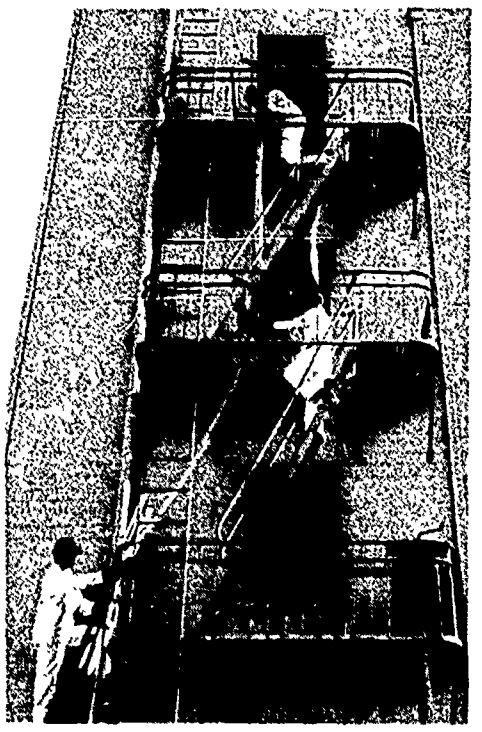

Fig. 20

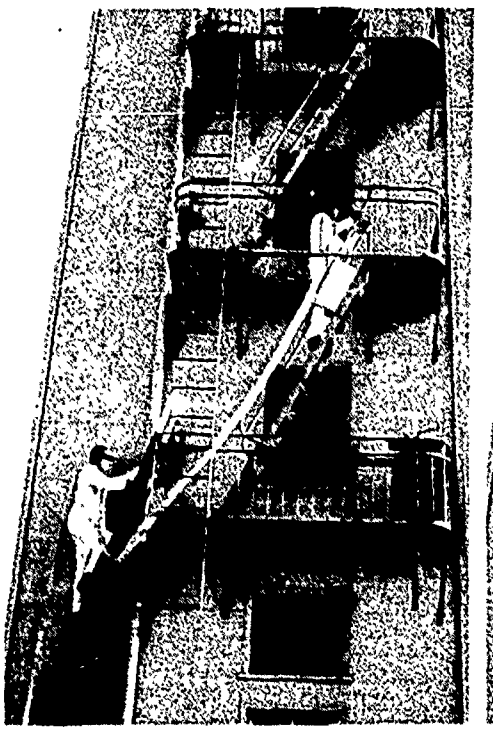

Fig. 21

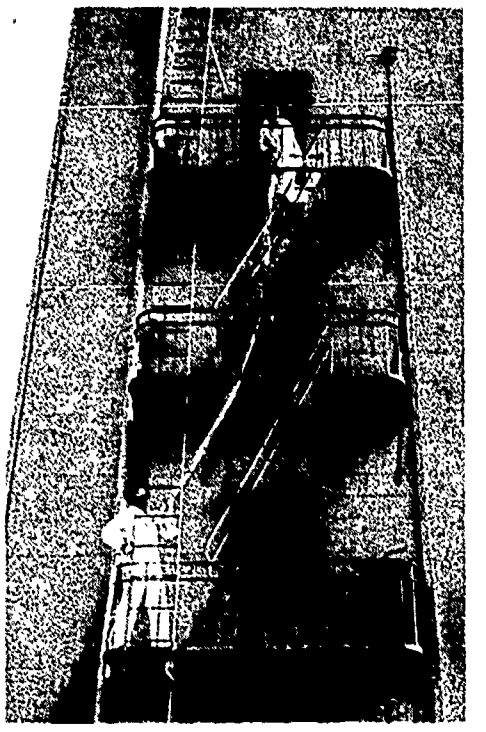

Fig. 22

491: HOW TO LOWER EMPTY LINE VIA FIRE ESCAPE

INSTRUCTIONS:

1. Men take positions on fire escape.
2. Remove hose straps.
3. Nozzle man places nozzle underneath railing and on shoulder of No. 3 man who in turn goes down fire escape to where he passes nozzle to No. 2 man.
4. No. 2 man goes down fire escape to where he passes nozzle to No. 1 man on ladder.

49m: HOW TO LAY TWO LINES OF HOSE TO STANDPIPE MANIFOLD, MAKE CONNECTIONS TO OUTLET ON FLOORS ABOVE

INFORMATION:

In carrying on extinguishing operations involving fires on upper floors of buildings, two or more lines of hose are generally laid to standpipe inlet manifold near ground level, and two or more sections of hose taken up fire escape to the desired floor and connected to standpipe outlet valve. These operations are generally used where lines are required on third floor or over. Lines can be taken off any floor standpipe outlet desired. For illustration: Fire is on the fourth floor. Connect one line to outlet on fourth floor to combat the fire, one line each to third and fifth floor to cover exposures.

These last two may be either 2½ inch lines or reduced to 1½ inch lines. Extra lines may be taken from standpipe outlets after standpipe is loaded and more manpower is available.

INSTRUCTIONS:

1. Lay two lines with sufficient hose to reach standpipe manifold intake.
2. Connect lines to standpipe manifold.
3. Take two sections of 2½ inch hose (that is rolled and provided with harness to carry) to the fourth floor, using fire escape ladder if no ladder has been placed to second floor balcony.
4. Take nozzle to fourth floor.
5. Unroll and connect sections together and place nozzle on male end, connect female end to standpipe outlet on fourth floor.
6. Open valve on standpipe outlet. (Fig. 23) NOTE: Four men are required in this operation; one man to carry each section of hose, and one man to carry nozzle. This will also bring enough men on the floor to operate nozzle. The man on the ground can be used to bring other tools that may be required, or assist in some other operation. If only three men are available, ground man shall bring nozzle up as soon as connections to standpipe are completed.

Alternate Method for Taking Lines Above to be Connected to Standpipe Outlet:

1. Remove amount of hose necessary from apparatus. Connect nozzle to male end.
2. Proceed to take line to desired floor as in Job 49k until female end is on desired floor. Connect female end to outlet. Open valve.

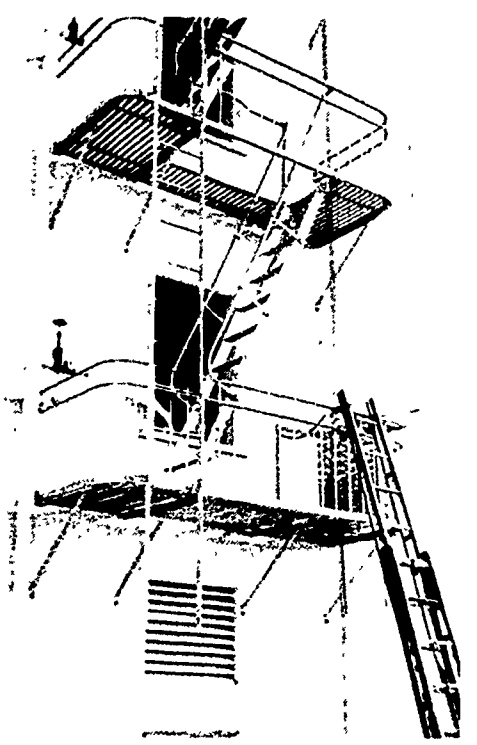

Fig. 23

49n: HOW TO LAY TWO LINES OF HOSE AND MAKE IMPROVISED STANDPIPE MANIFOLD CONNECTION ON SECOND FLOOR AND CONNECT LINE TO UPPER FLOOR

INFORMATION:

The improvised standpipe manifold connection is used when carrying on extinguishing operations involving the use of standpipes, where manifold is found inoperative due to damage or

corrosion. The lines are connected to second floor outlet by use of $2\frac{1}{2}$ inch double female and siamese two into one $2\frac{1}{2}$ inch.

INSTRUCTIONS:

1. Lay two lines with sufficient hose to reach second floor outlet on standpipe.
2. Remove double female connections, siamese two into one $2\frac{1}{2}$ inch, nozzle and standpipe hose rolls and 20 foot extension ladder. NOTE: If truck company is at scene of fire, it will not be necessary to remove ladder.
3. Place double female coupling on siamese.
4. Place one side of siamese on hose nearest standpipe.
5. Place coupling over shoulder same as nozzle, and proceed to second floor balcony.
6. Remove cap and connect double female end to standpipe outlet. (Fig. 24)
7. Proceed with second line to second floor balcony and connect hose to siamese. (Fig. 25)
8. Open valve.
9. Proceed as in Job 49k or m depending on the method to be used to take line aloft to make connections for working lines.

Fig. 24

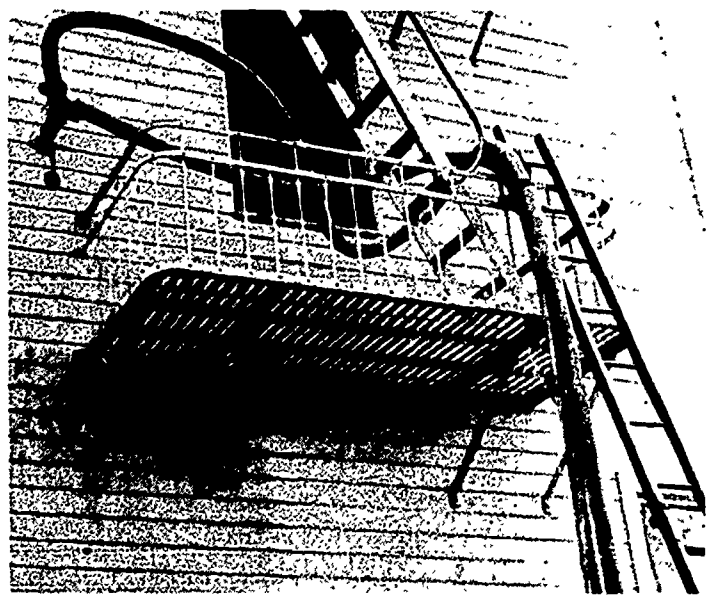

Fig. 25

SUGGESTION FOR DRILLS:

1. Lay hose line and carry to third floor using stairway.
2. Lay one line $2\frac{1}{2}$ inch hose, siamese to two $1\frac{1}{2}$ inch, one line to second floor by stairway, one on ground floor, bring siamese in building at foot of stairway.
3. Lay one line $2\frac{1}{2}$ inch hose, carry same to third floor using ladder.

4. Lay one line 2½ inch hose, siamese to two 1½ inch lines, one line to roof of one story building, one line on ground floor.
5. Lay one line 2½ inch hose, siamese to two 1½ inch lines, make extension from 20 foot ladder with roof ladder to third floor, one line to second floor, one line to third floor.
6. Lay one line 2½ inch hose, hoist to fourth floor, using hose strap and pike pole.
7. Lay one line 2½ inch hose, siamese to two 1½ inch lines, hoist lines with pike pole to third floor, secure 2½ inch hose below siamese with hose strap, one line on third floor, one line on fourth floor, either by stairway or fire escape.
8. Lay two lines 2½ inch hose, make improvised intake manifold on second floor, use pike pole to pass up all lines, and take two sections 2½ inch hose to fourth floor.
9. Lay one line 2½ inch hose, take up stairwell using pike pole, siamese to two 1½ inch lines on third floor.
10. Lay one line 2½ inch hose, hoist to fourth floor by rope, 100 feet of 2½ inch hose on fourth floor.
11. Lay two lines 2½ inch hose, one line to third floor, one line to fourth floor or roof, use rope and hose roller.
12. Lay one line 2½ inch hose, hoist to third floor, siamese to two 1½ inch lines on third floor, one line on third floor, one line on fourth floor by way of stairway.
13. Lay one line 2½ inch hose, hoist to fourth floor, make 50 foot extension on fourth floor, remove damaged section and replace with good section, (a) with break above third floor, (b) with break below third floor.
14. Lay two lines to standpipe manifold, 100 feet 2½ inch hose on fourth floor.
15. Lay two lines to standpipe manifold, 100 feet 2½ inch hose on third floor, 100 feet 1½ inch hose on second floor, 100 feet 1½ inch hose on third floor.
16. Explain the different types of ladders and their uses in the fire service.
17. Explain how they are removed and what is necessary before ladders can be removed from different types of apparatus.
18. Have all men remove and carry ladders.
19. Raise and lower pompier ladder, one man.
20. Raise and lower pompier ladder, two men, using one ladder.
21. Raise and lower pompier ladder, two men, using two ladders.
22. Raise pompier ladder and swing from window to window, lower same as two men with one ladder.
23. Raise and lower pompier ladders building a chain from the bottom to the top of the drill tower. Have men who assisted in this evolution climb ladders to the top. Last man up is last man down.
24. Raise and lower straight ladders, one man.
25. Climb and lock in, explain why it is necessary to lock in in ladder when working.
26. Raise and lower straight ladders, two men.
27. Raise and lower straight ladders, three men.

28. Raise and lower extension ladders (one man--two men--three men--four men, and six men).
29. Climb aerial ladder.
30. Raise roof ladder and make an extension.
31. Release and lower fire escape ladders.
32. Hoist and lower ladders by rope.
33. Explain the operation of fire doors.
34. Use ladders for bridging and proper way to cross ladders.

Have all men go through all of these operations, alternating at the different positions when raising and lowering ladders where more than one man is required.

CALIFORNIA FIRE TRAINING PROGRAM

Unit H

RESCUE EQUIPMENT

50. CANISTER TYPE GAS MASKS
51. HOSE MASKS
52. SELF-CONTAINED BREATHING APPARATUS
53. DRAGGING TOOLS
54. LIFE NET
55. LIFE GUN AND LIFE LINES
56. EVACUATOR

OBJECTIVE:

To develop an understanding of various types of dangerous gases that a fireman may be exposed to and their effect upon the human body, the ability to use gas masks, hose masks, self contained oxygen breathing apparatus and rubber clothing with a knowledge of their operating principles and limitations. Also, develop the ability to use and care for those tools and appliances used in rescue work and their operating characteristics.

RESCUE EQUIPMENT

INTRODUCTION:

Rescue is one of the most important phases of fire department operations. Practically all equipment carried on fire apparatus may be utilized for rescue purposes when necessary. However, there is some equipment designed primarily for this work. Some of this equipment is also used at times to facilitate fire fighting operations. Therefore, it is highly important that all firemen have a complete working knowledge of all equipment, its limitations, and the necessity for efficient teamwork during operations.

TYPES AND EFFECT OF GASES ENCOUNTERED AT FIRES

INFORMATION:

Gases encountered while fighting fires comes from such sources as combustion, vaporization, and chemical action. Gases produced by combustion may, because of their lower density and heat, rise and pass away, or, because of high density, may settle to the floor and become a hazard. Any gas may behave in just that manner because of different densities. Some gases are poisonous to man while others are not. Only the nature of the gas and its reaction upon the body determine the hazard.

The situations where these hazards may be encountered are too numerous to mention. Mechanical refrigeration has brought with it certain hazards to life because some refrigerants used are toxic; warehouses and stores contain many liquids, such as naptha, solvents, paints, and lacquers, which are readily vaporized to form irrespirable atmospheres; many manufacturing plants may be found with such compressed gasses as Ammonia, Chlorine, and Sulfur dioxide; street manholes frequently contain poisonous gases, and motion picture theaters and hospitals present a hazard from film storage.

In addition to these hazards frequently encountered by firemen during their regular line of duty, they are often called to give aid in emergencies for rescuing persons from underground tunnels, and persons overcome through the use of fumigating gases.

AIR:

Air is a mixture of gases, chiefly oxygen and nitrogen, with a small percentage of carbondioxide. Oxygen is necessary to sustain life and comprises approximately 21% of the air we breath. Nitrogen acts as a diluting agent for the very active oxygen and comprises about 79% of air. Carbon dioxide is always present in air in very small quantities, about .04%.

Under normal conditions, air is never absolutely dry because it always contains some water vapor.

In dealing with gases, the standard of comparison used is dry air, and the unit of measurement is Specific Gravity. Air equals 1.000.

If Specific Gravity of carbon dioxide is 1.5, a given volume of carbon dioxide is 1.5 times as heavy as the same volume of air at the same pressure and temperature. Therefore, carbon dioxide will not blend rapidly with air but will settle to low spaces. If the Specific Gravity of a gas is less than the air, then the gas is lighter and will rise to the upper parts of a building, and its rate of blending with the air will be slow. Gases having Specific Gravities near that of air will blend rapidly with air.

Oxygen-- Chemical Symbol O_2
Specific Gravity 1.103

Oxygen is non-inflammable and a non-poisonous gas. It is colorless, odorless, and tasteless; does not conduct an electric current; and is a poor conductor of heat. It is slightly soluble in water. It does not burn but supports combustion. Without oxygen there would be no fires.

When the oxygen content of air falls below the normal amount (about 21%), a man will breathe a little faster and a little deeper. If the oxygen content decreases to about 15 per cent, a man usually becomes dizzy, notices a buzzing in his ears, has a rapid heart beat, and often suffers from headache. When the oxygen content decreases below 15 percent, a man will become unconscious and death from suffocation will result. The greater physical activity a man engages in where air is deficient of oxygen, the quicker these symptoms appear. Flame safety lamps are used in mines to determine oxygen deficiency, and will only give about 1/3 the usual light when oxygen content of the air is depleted to 19%, and 16% or less will extinguish the flame. Oxygen is compressed and stored in cylinders for use with acetylene in welding.

Carbon Dioxide-- Chemical Symbol CO_2
Specific Gravity 1.5

Carbon Dioxide is the product of combustion, and is also given off by all animal life in the exhalation of the animal. It is non-flammable, non-poisonous, colorless, odorless, and may have an acid taste if present in large quantities.

Air contains about .04% of carbon dioxide, and a content higher than the normal amount in air will cause a man to breath deeper and faster. If it increases to 10% or more, a man will become unconscious and death may result after several hours exposure caused by suffocation from the deficiency of oxygen in the air.

The most practical way of detecting an excessive amount of carbon dioxide in the air is by the physical reaction to the person exposed.

Carbon dioxide is compressed to a liquid and placed in cylinders and is used in refrigerator units, soda fountains, and in bottling works. It is also used quite extensively in fire extinguishing operations because it is much heavier than air and will settle over a fire, excluding the oxygen.

Carbon Monoxide-- Chemical symbol CO
Specific Gravity .967

Carbon monoxide is a colorless, odorless, tasteless, flammable, and explosive gas of practically the same density as air, and is a product of incomplete combustion. It is insoluble in water, burns with a blue flame, and does not support combustion. It contains only half as much oxygen as carbon dioxide. Therefore, it can, by burning, combine with more oxygen and form CO_2. It may be catalyzed to CO_2 by Hopcalite, a commercial product.

Carbon monoxide is a very poisonous gas. In the red corpuscles of the blood is a substance called "Hemoglobin" which has 200 to 300 times the affinity for carbon monoxide that it has for oxygen. It combines in the lungs with oxygen, which it carries throughout the body, and gives oxygen to the tissues as needed. When carbon monoxide is inhaled, it forms a stable compound with the hemoglobin and destroys the oxygen carrying power of the blood.

If from 60% to 70% of the hemoglobin is used in this way, a sufficient amount of oxygen is not carried to the brain and degenerative processes set in and the nerve centers which control the breathing fail to respond. First symptom is a slight headache and discomfort, followed by a tendency to stagger, palpitation of the heart, confusion of mind, sickness of the stomach and vomiting. If exposure continues for half hour, unconsciousness and death will result. Where a large amount of Carbon Monoxide is present in the air, the effect may be so sudden that a man will have little or no warning before he lapses into unconsciousness.

Carbon monoxide is fatal when it becomes 1/2 of 1% or even 1/5 of 1%, if breathed for any time. The most common sources of carbon monoxide are fuel gases, instantaneous water heaters, detonation of explosives, explosion of methane, natural gas, and exhaust from automobiles. Antidotes used in severe cases of carbon monoxide poisoning are the transfusion of blood from a healthy person, Methylene Blue plus a heart stimulant and inhalation or resuscitation using oxygen or carbogen.

Phosgene-- Chemical symbol $COCl$
Specific Gravity 1.432

Phosgene is a colorless and tasteless gas and has a very disagreeable odor. It is formed by passing carbon monoxide and chlorine through hot charcoal. It is also produced when carbon tetrachloride from an extinguisher is played on a hot object. Phosgene is also formed when refrigerants, such as Freon, come in contact with flame. It acts as a strong lung irritant and is a poison in which the full poisonous effect is not evident for several hours. 25 parts per million parts of air are deadly.

When phosgene comes in contact with water it is decomposed. Since the lungs and bronchial tubes are always moist, phosgene, when inhaled, forms hydrochloric acid in the lungs.

Chlorine-- Chemical symbol Cl
Specific Gravity 2.45

Chlorine is a greenish-yellow gas that has a very unpleasant, suffocating odor. It is used in water works, paper mills and swimming pools quite extensively.

Chlorine is readily detected in the air before it is present in dangerous quantities because of its irritating action on the throat and lungs, and its stifling odor. However, in even the least quantity detected by odor, or about 4 parts per million, an exposure of one half hour would be dangerous.

Carbon tetrachloride fluid, when coming in contact with hot metal, produces chlorine. The effect of inhaling this gas is somewhat relieved by the inhalation of ammonia or alcohol vapor.

Remember that chlorine is heavier than air and will flow to the low levels. It will kill vegetation and animal life of any kind.

Sulphur Dioxide-- Chemical Symbol SO_2
Specific Gravity 2.264

Sulphur dioxide is a colorless gas with a suffocating irritating odor and a pronounced taste; does not burn or support combustion; is soluble in water, forming sulphurous acid without much heat being formed.

Sulphur dioxide is very poisonous and is used in bleaching, fumigation, and as a refrigerant in mechanical refrigerators. It is very irritating to the eyes and throat, hence it may be readily detected in mixtures of less than 20 parts per million of air by the coughing it causes. Sulphur dioxide, in dangerous percentages in air, is so irritating as to be unbearable without respiratory protection.

Ammonia-- Chemical symbol NH_3
Specific Gravity 0.597

Ammonia is a colorless gas with a sharp burning taste and a penetrating overpowering odor. It is used principally in ice plants, large refrigeration units, and in petroleum refineries. It is found in the air in small quantities, and is extremely soluble in water.

Ammonia gas, when highly concentrated, will attack the skin in tender places, especially the nose, throat, and lungs, causing tears, difficult respiration, strangulation, and suffocation. It will also attack the moist skin between the legs and under the arms. When shutting off an ammonia leak, an approved gas mask or self-contained breathing apparatus can be used to protect the tender skin between the legs and under the arms. Tie the trouser legs at the ankles and the coat sleeves at the wrists.

Nitrous Oxide-- Chemical symbol N_2O
Specific Gravity 1.53

Nitrous oxide is a colorless, transparent gas with a faintly sweetish taste and smell. It is somewhat soluble in water; is called laughing gas, and is used by dentists as a mild anaesthetic when extracting teeth.

This gas is formed by the action of nitric acid upon metals or organic material, or by the burning of articles made of nitrocellulose, such as movie films, X-ray films, or other pyroxlin products. In this group are included brushing lacquers and many articles such as combs and other toilet articles. Extreme care should be used around fumes emitted by the burning of such articles as it is possible to inhale sufficient amounts to be fatal without a great deal of discomfort at the time of inhaling. The gas may also be formed by the burning of cotton or rayon cloth in a deficient oxygen supply. If inhaled for a short time, it causes more or less nervous excitement, often manifested by laughter, and because of this the gas has been called laughing gas. If breathed in large quantities, it produces temporary unconsciousness and insensibility to pain. However, nitrous oxide fumes are seldom found by themselves as the result of combustion, but are usually found in combination with nitric oxide and nitrogen tetroxide. The mixture of these gases is deep orange and extremely poisonous.

Hydrogen Sulphide-- Chemical symbol H_2S
Specific gravity 1.2

Hydrogen Sulphide is a poisonous, colorless gas, with the characteristic odor of rotten eggs, and is always found near cesspools. This gas is so poisonous that one part of the gas in 200 parts of air may be fatal.

Hydrogen sulphide is formed to some extent when woolens and rubber materials are burned. However, the gas decomposes into hydrogen and sulphur and finally burns and forms water and sulphur dioxide.

Hydrogen Cyanide-- Chemical Symbol HCN
Specific gravity .697

Hydrogen Cyanide is the gas from Hydrocyanic Acid (Prussic Acid) and is extremely poisonous, having an odor of bitter almonds. It is very soluble in water.

This gas is used in fumigating houses, to exterminate weevils in mills, and to execute criminals in the lethal chamber. An inhalation of even a small amount is apt to be fatal. When used for fumigating, the fire department should be given notice of time and place.

Burning rubber gives off HCN fumes. Smoldering woolens may contain as much as 7% HCN gas, with silk giving off even greater concentration. Air containing .05 of 1% HCN gas is dangerous to breathe. Woolens are much more apt to smolder than to burn freely, and a blaze involving even a nominal quantity of this textile can play havoc with those who inhale its smoke. A concentration of only .003% in the air is fatal in 6 to 8 minutes.

Cyanide Aspyxia is one of the most rapid modes of death, for the reason that the use of oxygen by the tissues is prevented. In other words, the gaseious interchange between blood and tissue cells is stopped and "Tissue Asphyxia" is induced.

Methyl Chloride-- Chemical symbol CH_3Cl
Specific gravity .920

Methyl Chloride, sometimes called chloromethane, is a colorless gas with a faintly sweet odor, and is used quite extensively in mechanical refrigeration. Its lack of odor or irritating properties make it difficult to detect when leaks occur in a refrigerating system.

Poisoning with methyl chloride gas produces drowsiness, mental confusion, coma, nausea, vomiting, and, in severe cases, convulsions and death. It is decomposed by contact with flame or very hot surfaces, producing hydrochloric acid and phosgene.

SMOKE:

Smoke encountered ordinarily at a fire consists of a mixture of oxygen, nitrogen, carbon dioxide, some carbon monoxide, finely divided particles of soot and carbon, and a miscellaneious assortment of products from the combustion of wood and other materials. Its companions, Dusts and Mists, are composed of tiny bits of dirt and small drops of water respectively, floating in air. These can be classed as ordinarily not dangerous, although continued breathing of them may cause discomfort. They can be rather easily removed by filtering through a layer or two of cotton wool or some similar fine mesh, as a moistened handkerchief. The fact that these apparent particles can be so easily removed often gives a false sense of security to those who use cheap masks and respirators, in spite of the fact that they offer no protection whatever from dangerous gases that are often found mixed with smoke, hereinafter described.

Organic vapors are formed from such well-known products as Chloroform, gasoline, formaldehyde, and frequently a mixture given off by ordinary burning materials such as wood, paper, etc. Some of these are merely irritating, while others are very poisonous. They are readily absorbed by a good grade of activated charcoal.

Acid gases, such as chlorine, hydrogen sulphide, phosgene, etc., can only be controlled by being neutralized with a product such as a caustic soda preparation. This group covers an ever-widening field, as electrical and mechanical refrigeration is becoming more common in the homes. Many of the substances used therein, such as sulphur dioxide, fall within this group.

50: THE CANISTER ALL-SERVICE TYPE GAS MASK

INTRODUCTION:

There are several makes of the canister all-service type gas mask but all operate in the same manner. This type gas mask does not supply the oxygen needed to maintain life. It serves only to filter out relatively small portions of irrespirable gas from air containing the required amount of oxygen. Gas masks of this type should not be used where there is less than 16 per cent of oxygen present.

50a: HOW TO APPLY ALL-SERVICE GAS MASK

INFORMATION:

The all-service gas mask is provided with a face piece of the Kops type. Air enters through a check valve in the bottom of the canister and leaves at the top through a timer which records the amount of usage. The timer consists of a light metal disk over the opening of the canister which is lifted with each inhalation. This movement actuates a system of gears which causes the hand on the dial of the timer to slowly rotate in a clockwise direction. It takes about two hours for this hand to make a complete revolution.

Air is conducted from the timer to the face piece through a rubber tube, corrugated to increase flexibility and prevent collapse.

The inhaled dry air enters the face piece through two tubes called deflector tubes that discharge over the eye-glasses which prevents fogging.

The exhaled air passes out of the face piece through an exhalation valve.

The all-service gas mask canister is painted red and is labeled "All-Service Canister." The Canister contains various granular absorbents arranged in layers from top to bottom.

Metal screen separators are placed between the layers. A spring at the top presses the materials firmly in place. Poisonous gases, vapors, and smoke are removed or eliminated from the air passing through the canister.

The canister will deteriorate in regard to carbon monoxide protection when worn in air whether this gas is present or not.

The all-service mask is approved for respiratory protection in air containing acid gases, organic vapors, or carbon monoxide not exceeding 2 per cent by volume; ammonia not exceeding 3 per cent and in smoke, dust, and mists not exceeding 2 per cent of total poisonous gases when more than one class is present.

Weight of entire mask is approximately 5 3/4 pounds.

The case should be carried in an upright position whenever possible.

The entire gas mask must be inspected monthly.

Check harness for tears; see that tape is on bottom of canister; check head bands for elasticity; check eyeglasses and timer glass for breaks; check corrugated tube and face piece for holes; check timer glass connection, timer coupling to canister and exhalation valve guard for looseness; check exhalation valve for tears; and mask for air tightness.

A record must be kept on a chart which is attached to the inside lid of case. The "time left" column should be observed before applying and using mask.

Canisters should be changed after two hours use, or one year after tape is removed.

INSTRUCTIONS:

1. Remove mask from case.
2. Remove tape from bottom of canister. (Fig. 1)
   CAUTION: See that all connections are tight before wearing.
3. Suspend the mask on the chest by means of the neck strap. (Fig. 2)
4. Tighten the body strap so that the canister is drawn snugly against the chest, and check timer. (Fig. 3)
5. Grip the face piece where the head straps are connected, insert the chin well into the lower part of face piece (Fig. 4) and pull the head straps over back of the head.
6. Tighten neck bands first, (Fig. 5) side bands next, and top bands last.

7. Place the palm of the hand tightly over the opening in the bottom of the canister so as to completely seal the opening. (Fig. 6)
8. Inhale deeply. CAUTION: If face piece does not collapse, investigate source of leakage.
   NOTE: This test must be made every time mask is used.
9. Reset timer if new canister installed.

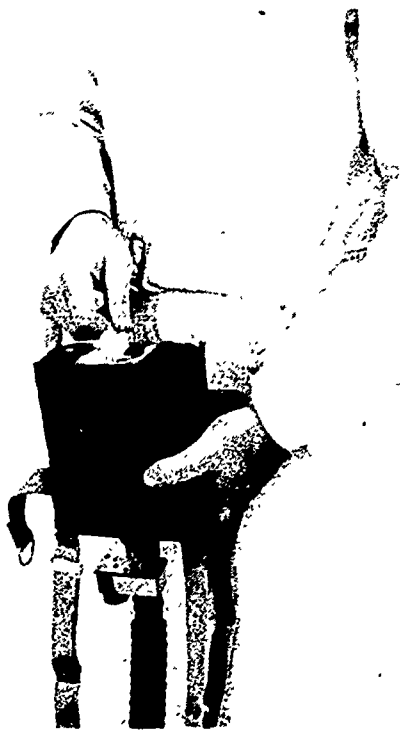

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

50b: HOW TO DISINFECT ALL-SERVICE GAS MASK FACE PIECE

INSTRUCTIONS:

1. Prepare solution of 1/2 ounce cresol to one quart of warm water or other accepted disinfectant. Exercise caution to prevent solution from entering eyes.
2. Place head bands over front of mask.
3. Wash face piece with cloth dipped and wrung out in disinfectant solution. NOTE: Exercise care not to omit exhalation valve and front of deflector tubes, and avoid use of excessive amount of solution.
4. Wipe entire face piece with clean cloth dipped and wrung out in clean warm water.
5. Wipe dry with clean cloth.
6. Allow face piece to thoroughly dry in air.
7. Properly replace mask in case.
   NOTE: Observe that new tape is properly placed on bottom of canister and that proper entry of time used has been made on time chart.

50c: HOW TO CHANGE CANISTER IN AN ALL-SERVICE GAS MASK

INFORMATION:

For safety of wearer, canister (Fig. 7) must be changed as follows:

1. After two hours use.
2. One year after red tape is removed.
3. If breathing becomes noticeably difficult.
4. If fumes are noticed coming through the canister.
   Timer must be reset when new canister is installed.

INSTRUCTIONS:

1. Disconnect coupling at top of canister.
2. Remove canister from holder.
3. Remove rubber protector cap from top of new canister. When canister is installed in a gas mask, the red tape should not be removed until occasion to use the mask in actual service arises. When tape is removed, date should be noted on canister and time chart, and such canister replaced with a new one a year from such date whether used or not.
4. Place new canister in holder.
5. Check gasket on coupling and connect to canister head hand tight. CAUTION: Replace gasket when needed.
6. Remove timer cap.
7. Loosen nut which holds hand on timer dial.
8. With small object move hand to zero position and tighten nut finger tight.
9. Replace timer cap finger tight.
10. Make record on chart.

READING THE ALL-SERVICE MASK TIMER

INFORMATION:

The timer (Fig. 8) indicates the service undergone by the canister. However, while we speak of time in referring to the reading of the Timer, it is not a clock and does not actually measure time. What the timer does do is to measure approximate time based on average number of respirations. We breathe normally about 15 times a minute. On this basis the dial is calibrated for approximately two hours or, in other words, 1800 respirations (15 x 120). For obvious reasons it is preferable to base the dial readings on time rather than number of respirations. Variation from the normal number of respirations is provided for by a wide margin of safety in the two hours established as the maximum use of a canister.

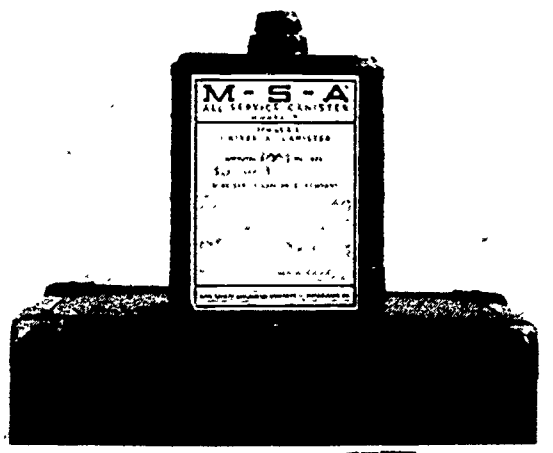

Fig. 7

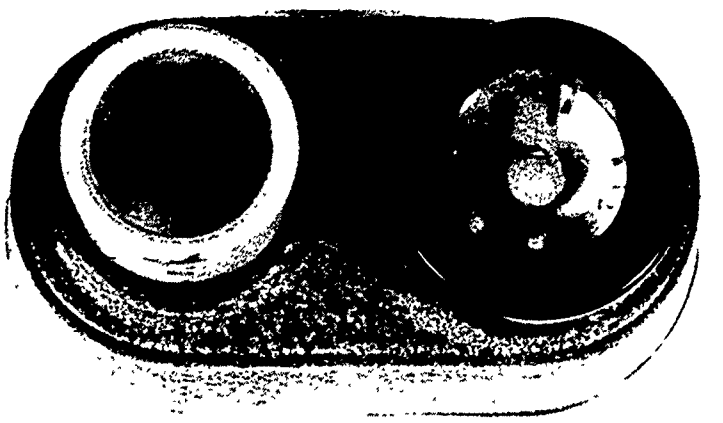

Fig. 8

The dial is divided into eight equal parts. Each mark indicates 1/8 of a two hours period, or 15 minutes. While the actual dial is not marked in this manner, this illustration serves to explain how the dial is read. It must be remembered that the time indicated means time <u>used</u>.

To determine how long the canister may still be used, the time indicated must be deducted from the two hours prescribed as maximum use. Example: If the dial indicates the canister has been used 45 minutes, the canister may be used 1 hour and 15 minutes (120 minus 45 equals 75).

TYPICAL SERVICE RECORD CHART FOR ALL SERVICE GAS MASKS

Date	Time left in minutes	INSPECTED		REMARKS
		Date	by	

51: THE M. S. A. COMBINATION HOSE MASK

INTRODUCTION:

The M. S. A. Combination Hose Mask (Fig. 1) is used as a method of supplying fresh air to the wearer by means of a blower, either hand operated or electrically operated, and is used wherever there is a low concentration of oxygen or a high concentration of gases such as oil tanks, gas holders, ship holds, tank cars, sewers, etc.

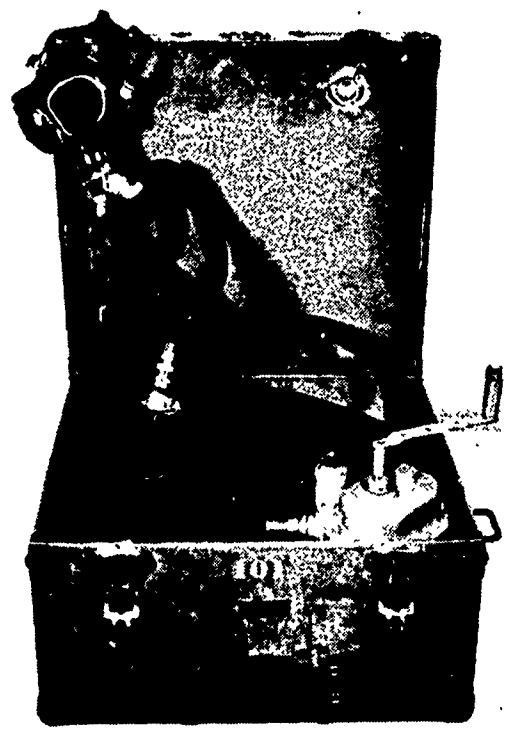

Fig. 1

51a: HOW TO APPLY AND OPERATE HOSE MASK

INFORMATION:

The face piece is of the Kops type and fastens to two flexible inhalation tubes, one over each shoulder joining a substantial metal Y connection in the back between the shoulders. This arrangement makes it impossible to twist the tubes or to cut off the wearer's air supply even though one of the tubes is pinched or squeezed.

The blower furnishes a steady stream of fresh cool air over the face of the wearer when cranked in either direction, making it possible for him to work for long periods with absolute safety and comfort. It will force an ample supply of cool fresh air through 150 feet of hose to the wearer. It is designed to eliminate resistance to breathing and in no case to furnish a heavy stream of air to the wearer. The intake opening is screened to keep out dust, etc. Should the man operating the blower be called away or forced to stop turning the crank, no appreciable resistance to the flow of air is added and the wearer may still draw fresh air through the hose.

Each hose mask contains four 25 foot sections of 1 inch oil proof hose.

INSTRUCTIONS:

1. Place hose mask in clear atmosphere.
2. Remove face piece and harness from case.
3. Test all connections and tighten hand tight.
4. Place crank on blower and clear of residual air.
5. Adjust harness to body and face piece to face.
6. Test mask for air tightness by kinking corrugated inhalation tubes. Inhale deeply and face piece should then collapse to the face and hold. CAUTION: If any leaks are detected, adjust the head band and reset.
7. When necessary attach life line securely to safety harness. and attach signal cord on arm. CAUTION: The blower must be operated continuously during the use of mask.
   CAUTION: Exercise care to prevent the hose and life line from becoming entangled or fouled.

51b: HOW TO INSPECT AND CARE FOR HOSE MASKS

INFORMATION:

Mask shall be inspected monthly. Check face piece and hose for leaks and breaks. Check head straps and buckles and oil moving parts of blower with a light oil. Avoid using too much oil. Check hose connections for damaged threads, swivels and gaskets.

Disinfect face piece.

INSTRUCTIONS:

1. Remove face piece from hose.
2. Prepare solution of 1/2 ounce cresol to one quart of warm water or use any other approved disinfectant.
   NOTE: Exercise caution to prevent solution from entering eyes.
3. Place bands over front of mask.
4. Wash face piece with cloth dipped and wrung out in disinfectant solution. NOTE: Exercise care not to omit exhalation valve and front of deflector tubes, and avoid use of excessive amount of solution.
5. Wipe entire face piece with clean cloth dipped and wrung out in clean warm water.
6. Wipe dry with clean cloth, and allow face piece to set in the sun for half an hour.
7. Properly place mask and hose in case.
8. Place case in proper place on apparatus.

52: SELF-CONTAINED OXYGEN BREATHING APPARATUS

INTRODUCTION:

Self-contained oxygen breathing apparatus will enable the wearer to live in poisonous or suffocating gases, or smoke filled rooms where air is depleted of the oxygen necessary to sustain life. Care must be taken where hydrocyanic acid gas is present

because this gas is absorbed through the unprotected skin of the body and will produce poisoning the same as when breathing. Wearer should have all exposed parts properly protected.

REGENERATING TYPE

INFORMATION:

Self-contained oxygen breathing apparatus are made in three different sizes--half hour, one hour, and two-hour duration. The construction, operation, and care for the different sizes is the same, with the exception of a few minor details. The half-hour type is carried in the front of body, while the hour and two-hour type are carried on the back, with a metal case to protect the breathing bag. The one-hour type is also made for front carry.

The normal capacity of the cylinder for the half-hour type is 38 cu. inches, which is equivalent to .63 liters, or approximately .62 quarts. When charged to 135 atmospheres, the cylinder holds approximately 84 liters of oxygen.

One-hour type: The normal capacity of the cylinder is 72 cu. inches, which is equivalent to .94 liters, or approximately .94 quarts. When charged to 135 atmospheres, the cylinder holds approximately 130 liters of oxygen.

Two-hour type: The normal capacity of the cylinder is 130 cu. inches, which is equivalent to 1.96 liters, or approximately 2 quarts. When charged to 135 atmospheres, the cylinder holds approximately 270 liters of oxygen.

There is also a slight difference in the capacity of the breathing bags. The half-hour and one-hour are the same: Six liters, or approximately six quarts, while the capacity of the two-hour is eight liters, or approximately eight quarts.

The amount of Cardoxide required to recharge the three different types depends on the type.

Half-hour type:	Requires 1 pound
One-hour type:	Requires 2 pounds
Two-hour type:	Requires 4 pounds

There are two types of mask used on the self-contained oxygen breathing apparatus: The Mouthpiece Type and the regular Facepiece, as used on the canister type mask.

THE GIBBS SELF-CONTAINED OXYGEN BREATHING APPARATUS

INFORMATION:

NEED OF OXYGEN:

Oxygen supports and is necessary to life. When drawn into the lungs it is taken up by the blood and carried to the tissues

of the body where it combines with substances given off by the tissues and forms carbon dioxide. This carbon dioxide from the tissues is carried by the blood to the lungs and given off by them in the breath.

Briefly, air contains about 20 per cent oxygen and 80 per cent nitrogen. The nitrogen in the air is not absorbed or changed in the lungs and may be breathed over and over again. Air exhaled from the lungs contains 2.6 per cent to 6.6 per cent carbon dioxide and some moisture. Air containing carbon dioxide in proportions over 5 per cent, if breathed for a long time, causes headaches and dizziness. The purpose of a self-contained oxygen breathing apparatus, therefore, is to replace as needed the oxygen absorbed or consumed by the lungs and to get rid of the waste products (carbon dioxide gas and water vapor given off in breathing).

OXYGEN BOTTLE:

The Gibbs oxygen bottle is of high grade carbon steel and is tested at 3750 pounds per square inch. The I. C. C. (Interstate Commerce Commission) stamp 2250 on bottle is the permissible filling pressure. The bottle is charged with oxygen to a pressure of 1,984.5 pounds per square inch (135 atmospheres) and holds about 275 liters (about 10 cubic feet) of oxygen at this pressure, enough to last the wearer at least two hours while he is working very hard.

The bottle valve consists of a by-pass valve, main bottle valve and a safety cap. The main bottle valve is controlled by a large wheel at the end of the valve. It should be opened two to four turns which will give a sufficient supply of oxygen to the apparatus. There is a metal tube projecting from the end of the main valve into the bottle in order to draw oxygen free from sediment.

A by-pass valve that is independent of the main bottle valve connects the oxygen bottle to the inhalation side of the cooler. If any other part of the apparatus fails to work properly, oxygen can be supplied directly to the wearer by momentary operation of the by-pass, giving him time to return to safety. The by-pass is not kept open, as the pressure is too great for the strength of the material used in the construction of the apparatus; the wearer could not inhale and exhale under such pressure, for it would be dangerous to his health.

When the by-pass valve is opened, oxygen has a free course to the lungs for all openings are large, as there is only the inhalation valve between the oxygen bottle and the lungs; moreover the valve opens towards the lungs. The by-pass valve is controlled by a smaller wheel at the lower part of the bottle valve.

A safety cap filled with Rose metal and containing a breakable or frangible copper disc is also attached to the bottle valve. A hard composition gasket is placed between the disc and connection to prevent leaks. The cap provides for the escape of oxygen without rupture of the bottle if exposed to fire or excessive pressure. The metal will fuse at about 94 degrees C., or 201 degrees F.

Bottles must be tested for pressure once a month. Whenever bottle valves have been opened they must be tested for valve stem and valve seat leaks before replacing Gibbs on apparatus. When minor leaks occur packing glands may be slightly tightened, but valves must not be repacked or repaired in quarters. Valves should work free enough to be operated by hand. If valve is in bad order, tag bottle and indicate what repairs are needed. The bottle should be changed at 50 atmospheres pressure or lower. This will insure sufficient pressure for average work. Do not empty partly filled bottle because it can be refilled without loss of contents.

A regenerator wrench may be used to open a tight main bottle valve. Never use a wrench to close any oxygen valve. Never permit oil or grease to come in contact with oxygen valves, regulators, gauges, and fittings. Do not handle oxygen bottles or apparatus with oily hands or gloves.

PRESSURE GAUGE:

A pressure gauge graduated in atmospheres and carried in a leather pocket permits the wearer to determine how much of his oxygen supply has been used. This gauge is joined by a flexible canvas covered coiled metal tube to the piece which connects the oxygen bottle to the reducing valve. The gauge valve, which is located just above and forward of the main bottle valve, controls the admission of oxygen to the gauge.

REDUCING VALVE:

The reducing valve works automatically and reduces the high pressure in the bottle to from 3 to 5 pounds per square inch.

REGENERATOR:

The regenerator is a rectangular cartridge of sheet metal containing wire gauze trays divided into two compartments into each of which is placed two pounds of Cardoxide (baked mixture of caustic soda and lime). Full charge is four pounds. A baffle plate in the center extends from the top of the canister to within two inches of the bottom separating the wire gauze into two compartments and insures air circulation through and over the trays thus avoiding possible short circuiting of the air. Air spaces are provided for freedom of air circulation and to lessen the resistance to breathing.

The cardoxide is the element for absorbing carbon dioxide and moisture in the exhaled air. A record is kept on a chart in the Gibbs case of the time Cardoxide has been used. This chemical is well adapted to intermittent and continuous work for a total period of two hours. It should be changed when below 20 minutes "Time left" on chart. This record is important and should be read before using a Gibbs because it is the only method by which the wearer can find out how long he can safely wear the apparatus. Do not fail to make a record on the chart after wearing Gibbs and when changing Cardoxide.

A clamp is placed on the top of the regenerator and under the frame to eliminate any vibration of regenerator.

SAFETY VALVE (Whistle):

On the oxygen supply tube just above the reducing valve is an automatic safety valve, which is set to release at about 7 pounds pressure and at the same time gives a whistle warning. This valve protects the wearer if the reducing valve fails to close at the desired pressure. If the whistle sounds, the wearer should close his main working valve and return to fresh air at once. During this return trip he should depend on oxygen supplied through the by-pass.

BREATHING BAG:

The breathing bag is of flexible airtight fabric, is rubberized inside, fastened by screws to the metal cooler, and is protected from injury by a metal cover. It has one compartment, with a capacity of 6½ to 7 liters (quarts) when fully inflated.

There is a metal plate or bumper fastened across the center of the bag on the inside and held by two screws. It is about 2 inches wide and 8 inches long.

Gasoline fumes are injurious to the bag. Should these fumes be detected by the wearer after working in them for some time, he should return to fresh air and obtain another Gibbs.

The breathing bag should be inspected monthly. Leaks are usually found at the seams and folds. The cover is detachable and is held in place by two screws at the bottom. These screws should only be tightened finger tight.

COOLER:

The cooler cools the purified air passing out of the regenerator, supports the bag, and with the breathing bag and its connecting tubes forms an air reservoir from which the wearer breathes. It is attached to the regenerator in such a manner as to form a continuous air passage.

A metal partition divides the cooler into inhalation and exhalation compartments to prevent the exhaled air from mixing with the purified air. The exhalation side is about 2½ inches in width from top to bottom. The exhalation tube is connected

to the top left side or exhalation side of the cooler and the inhalation tube is connected to the top right side or inhalation side.

ADMISSION VALVE:

In the lower part of the inhalation side of the cooler and extending up into the breathing bag is one of the most important parts of the Gibbs apparatus, the "bumper" valve or admission valve. Slight pressure on a metal pin opens this valve, and lets oxygen flow from the reducing valve to join the purified air on its way to the wearer's lungs. This needed pressure is supplied by the metal or bumper plate on the breathing bag.

When the flexible bag fabric is drawn nearly flat by the wearer's breathing, the bumper strikes the admission-valve pin and opens the valve. The oxygen flows from the reducing valve through a rubber tube into the lower right side of the cooler then through a metal tube inside the cooler to the admission valve. When the wearer exhales, the bag will inflate and release the bumper from the pin thereby stopping the flow of oxygen. The admission valve is tested for air tightness when making a simple test. This test should be made before Gibbs is worn.

MOUTHPIECE:

The wearer of a Gibbs apparatus breathes through his mouth alone, a steel-wire "wish-bone" clip closing the nostrils completely. This clip is located on the top right mouthpiece strap. A rubber mouthpiece fits snugly between the teeth and lips. This rubber mouthpiece fits in turn into a metal mouthpiece containing a mica-disc inhalation valve, a similar exhalation valve and a combination saliva trap and hand pressure release valve. The inhalation valve operates only when the wearer exhales. The saliva trap has a U-tube with a mica-disc valve and a finger-press release. These let the wearer release excess pressure and discharge the saliva accumulations outside, but do not allow any external air to be drawn into the apparatus. Fastened to the metal mouthpiece are flexible corrugated-rubber tubes with unions for attaching them to the cooler.

The oxygen sold by dealers for use in rescue apparatus is ususally about 99.5 per cent oxygen and traces of nitrogen and other gases. The nitrogen and other gases are fed with the oxygen into the breathing bag of a wearer's apparatus, and not being absorbed by the lungs will gather in the bag unless let out by a release valve or by other means. Consequently, if an apparatus wearer starts with normal air (containing 20 per cent of oxygen and 80 per cent nitrogen by volume) in his apparatus, and if he does not operate a release valve to get rid of the nitrogen, the percentage of oxygen in the air breathed will be lowered by inflowing nitrogen. Eventually the wearer will be overcome, often without warning, and will collapse because he is not getting enough oxygen. This is why the breathing bag and connections

should be cleared of residual air and filled with pure oxygen from the bottle of the apparatus. If this is done properly, the air breathed will contain over 75 per cent of oxygen. The relief valve should be used occasionally to get rid of accumulation of nitrogen and saliva.

The mouthpiece is fastened by straps to a Protective Hat which is made of insulating materials. It is absolutely sweat and moisture proof and will protect the head against any blow the neck can stand.

The mouthpiece and tubes must be disinfected after apparatus is worn. They must also be inspected monthly for tears, gaskets, holes, and proper working of pressure release valve.

CIRCULATION:

Oxygen from the bottle passes through the main bottle valve into the reducing valve, through a rubber tube into a metal tube and an admission valve inclosed in the cooler, and into the breathing bag through the space around the admission valve. The oxygen returns from the breathing bag to the inhalation side of of the cooler and passes through the inhalation tube and valve into the lungs. Air breathed out goes through the exhalation valve and tube into the exhalation side of the cooler and passes down into the regenerator through one compartment, around the baffle plate then up through the other compartment into the inhalation side of the cooler to repeat the same course.

A complete Gibbs consists of a case containing the apparatus, goggles, water, set of tools, one four pound can of Cardoxide and an extra bottle of oxygen.

REPAIRS:

Special tools are required to adjust and repair a Gibbs breathing apparatus. Repairs should not be attempted in quarters.

52a: HOW TO CHECK GIBBS SELF-CONTAINED OXYGEN BREATHING APPARATUS AND MAKE SIMPLE TEST BEFORE USING

INFORMATION:

For safety of wearer, a Gibbs should be checked and given a simple test before using.

INSTRUCTIONS:

1. Grasp by metal frame or frame and edge of cover, lift Gibbs from case and place on floor.
2. Remove goggles and water bottle from case and place by breathing apparatus.
3. Check saliva trap release, inhalation, and exhalation couplings for loose connections.

4. Check
   A. Shoulder straps
   B. Breast straps
   C. Waist Straps
   D. Mouthpiece straps
   E. Nose clip

5. Make simple test:
   A. Shoulder straps
   B. Tilt apparatus backward to a 45 degree angle from a verticle position.
   C. Open main working valve of oxygen bottle two to four turns.
   D. Open pressure gauge valve.
   E. Note pressure in oxygen bottle.
   F. Close main working valve.
   G. Observe pressure gauge to detect leaks
   H. Press bumper plate against admission valve through top hole in back of cover, then release. (Fig. 1) Gauge hand will drop to new position and should hold in this position. If it does not, there is a leak.
   I. Close pressure gauge valve.
   J. Open by-pass valve and close quickly by hand to test for free opening. CAUTION: By-pass valve controls high pressure from bottle and should only be opened slightly at any time.

Fig. 1

52b: HOW TO APPLY AND OPERATE GIBBS SELF-CONTAINED OXYGEN BREATHING APPARATUS

INFORMATION:

For uniformity, and safety of wearer, Gibbs should be properly applied and cleared of excess nitrogen before using.

INSTRUCTIONS:

1. Place tubes over back of cover.
2. Place chest straps in the clear.
3. Kneel with right knee in front of and next to Gibbs.
4. Grasp left shoulder strap buckle with left hand placing strap over back of neck. Place right hand through right shoulder strap, grasp frame on right side, (Fig. 2) lift apparatus and swing on back upon rising to a standing position.
5. Snap left shoulder strap buckle to left side of frame. Fasten first strap to buckle on right side, then waist strap to buckle on left side.
6. Place tubes overhead to front position.
7. Fill chamber of goggles with water and turn them to allow surplus water to drain out of eyepieces. Place goggles on eyes, adjust and clear glasses of moisture by nodding and shaking the head.
8. Place safety-helmet on head, insert mouthpiece and adjust.
9. To clear Gibbs of excess nitrogen;
   A. Inhale from apparatus and exhale to the outside air through the nose at least four times.
   B. Open main oxygen bottle valve two to four turns. Open pressure gauge valve.
   C. Inhale from apparatus and exhale to the outside air through the nose at least three times and adjust nose clip.
   D. Squeeze exhalation tube and inhale from apparatus and exhale through release valve two or three times. (Fig. 3)

Fig. 2

Fig. 3

52c: HOW TO DISINFECT A GIBBS BREATHING APPARATUS

INFORMATION:

For the purpose of cleanliness and sanitation the tubes, mouthpiece, spring, and cap should be disinfected after use.

INSTRUCTIONS:

1. Remove safety helmet from mouthpiece straps.
2. Disconnect tubes by turning connections to the left. CAUTION: Remove gaskets from tube connections and place on snap at side of apparatus taken off.
3. Pour two ounces of Cresol in bucket containing on gallon of warm water, or use any other approved disinfectant.
4. Remove cap and spring from saliva trap by turning to left.
5. Submerge mouthpiece, tubes, spring and cap in solution.
6. Remove articles from solution and wash in clear water. Shake to remove excess water.
7. Dry parts with clean cloth and dry tubes by hanging.
8. When thoroughly dry, replace spring and cap. Hold tubes so that saliva trap points upward and mouthpiece away from apparatus. Replace gaskets in tube connections. Connect and tighten hand tight.
9. To replace mouthpiece straps on safety helmet:
   A. Connect center buckle to single strap at back of helmet.
   B. Connect the two mouthpiece straps farthest from saliva trap to buckles at side of helmet.
   C. Connect the two mouthpiece straps nearest saliva trap to buckles on each side of back strap. CAUTION: Hold helmet in wearing position and observe if straps are properly connected.
10. Remove eyepiece glasses from goggles, wipe parts dry and replace.

52d: HOW TO CHANGE CARDOXIDE IN GIBBS SELF-CONTAINED OXYGEN BREATHING APPARATUS

INFORMATION:

A new cardoxide change is good for two hours use only. Cardoxide must be changed when below 20 minutes "TIME LEFT" on time chart.

INSTRUCTIONS:

1. Loosen screws on back of cover and remove cover by lifting upward.
2. Unscrew regenerator clamp and remove.
3. Remove regenerator screws with screwdriver or proper wrench until clear of regenerator.
4. Remove regenerator. (Fig. 4)
5. If necessary, place cartridge gaskets on left shoulder strap snap.
6. Remove screw caps on regenerator with proper wrench and place caps on floor top side down.

7. Empty contents of regenerator into bucket. Shake well to remove contents.
8. Remove plug on bottom of regenerator and shake out remaining cardoxide. CAUTION: Destroy old cardoxide.
9. Examine screens in regenerator for holes. Replace plug, then place regenerator on floor or bench in an upright position.
10. Remove cover from new cardoxide can. Place funnel in one side of regenerator opening.
11. Pour half of cardoxide into regenerator. Place funnel in other opening and pour balance into regenerator.
12. CAUTION: Use care to prevent cardoxide from entering eyes.
13. Replace regenerator screw caps and tighten.
    CAUTION: See that gaskets are in place.
14. Replace regenerator in apparatus with label out, connect and tighten connections. CAUTION: See that gaskets are in place.
15. Replace regenerator clamp and cover.
16. Make record on time chart.
17. Order new four pound can cardoxide.

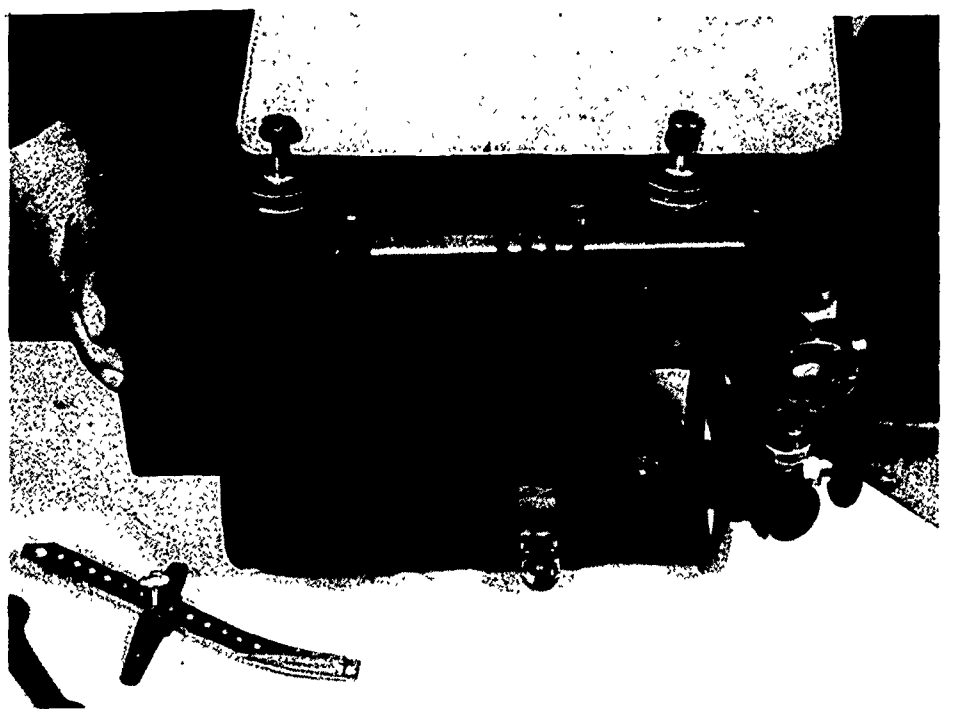

Fig. 4

52e: <u>HOW TO CHANGE THE OXYGEN BOTTLE IN A GIBBS SELF-CONTAINED BREATHING APPARATUS</u>

INFORMATION:

Oxygen bottle should be changed at 50 atmospheres pressure or lower and when in need of repairs.

INSTRUCTIONS:

1. Loosen back cover screws with screwdriver and remove cover by lifting upward.
2. Turn Gibbs on side with main oxygen bottle valve pointed upward.

3. Disconnect by-pass connection at oxygen bottle with proper wrench by turning to right. CAUTION: Always disconnect by-pass connection first.
4. Disconnect main oxygen bottle connection with proper wrench by turning to right.
5. Place Gibbs in an upright position and loosen bottle clamp with proper wrench sufficiently to remove oxygen bottle.
6. Grasp bottle on each end and turn quarter turn outward. Remove bottle by sliding to left while holding by-pass and main oxygen bottle connections with right hand to allow valve wheels on bottle to pass out freely. (Fig. 5)

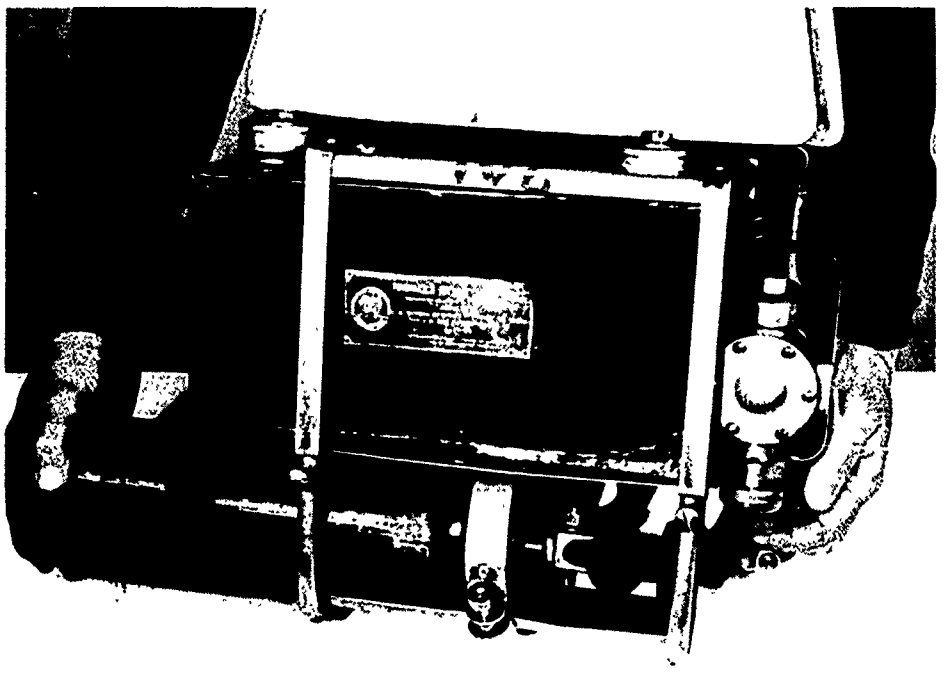

Fig. 5

7. Remove metal caps from by-pass and main outlet on replacement bottle and place on bottle taken out. NOTE: See Job 52i for testing bottles.
8. See that main bottle valve gasket is in proper position.
9. Slide bottle in container from left to right with fusible plug upward until main oxygen bottle valve is in line with coupling.
10. Turn bottle quarter turn outward, then connect and tighten main oxygen valve coupling with proper wrench. CAUTION: Always connect this coupling first.
11. Check by-pass for gasket.
12. Place Gibbs on left side. Connect and tighten by-pass connection with proper wrench.
13. Place Gibbs in an upright position and tighten clamp with proper wrench.
14. Replace cover and tighten screws snug.
15. Tag oxygen bottle when in need of repairs.

TYPICAL SERVICE RECORD CHART FOR REGENERATING TYPE GAS MASK

Date	Checked by	Oxygen pres-sure	CARDOXIDE	
			Time used in minutes	Time left in minutes

52f: HOW TO OPERATE THE CHEM-OX SELF-CONTAINED BREATHING APPARATUS

INFORMATION:

The Chem-ox self contained breathing apparatus is to be worn for the purpose of purifying and restocking, with oxygen, air exhaled from the lungs. Storing it as a reserve supply, cooling it, and directing it back to the lungs as needed, rendering the wearer independent of outside air. This result is achieved, in the main, by means of a canister of chemicals.

INSTRUCTIONS:

1. Put on apparatus and adjust harness, placing mask over shoulder.
2. Place canister in holder and screw to standby position. (Fig. 6)

Fig. 6

Fig. 7

3. Don mask and tighten straps--bottom to top. (Fig. 7)
4. Test face piece by squeezing both tubes and inhaling deeply (face piece will collapse against face if tight). (Fig. 8)
5. Screw canister up tight against main housing.
6. Squeeze both tubes, press starter button and inhale deeply (release starter button and tubes on exhale). (Fig. 9)

Fig. 8

Fig. 9

7. Repeat operation #6 until about 5 breaths have been taken. (If breathing bags become too full, relieve pressure by placing finger between ear and mask and press on bags until comfortable)
8. Set timing device at about 35 minutes and proceed to objective.

52g: HOW TO CARE FOR CHEM-OX SELF CONTAINED BREATHING APPARATUS

INFORMATION:

The Chem-ox self-contained breathing apparatus has proven its value over a period of years. However, there are certain precautions that should be heeded during and after using the equipment.

INSTRUCTIONS:

A. When using the equipment it is well to remember the following:
   1. Never touch starter valve when in toxic atmosphere as this allows toxic gases to enter the face piece.
   2. If bags become punctured, leave the toxic atmosphere at once.
   3. Never release canister while in toxic atmosphere (if oxygen in canister mixes with oil, grease, gasoline, etc., a violent explosion will result).
   4. No protection against heat.
   5. Not to be used under water.
B. After use and for cleaning and storing equipment.
   1. Do not dispose of canister in or near oils, grease, gasoline, etc. If these substances come in contact with oxygen in canister, a violent explosion will result. It is best to dispose of canister, after puncturing numerous holes in it, and then placing it in a bucket of clean water.
   2. Do not handle canister unless wearing gloves.
   3. Never use oil, grease, gasoline, alcohol, etc., in any part of apparatus or oxygen container.
   4. Inspect bags and breathing tubes after use for cuts, holes, etc.
   5. Check mica disc in speaking diaphagm before each use.
   6. Store in cool, dry place.

52h: HOW TO OPERATE SCOTT AIR PACK OR MINE SAFETY DEMAND TYPE SELF-CONTAINED BREATHING APPARATUS

INFORMATION:

The two pieces of equipment mentioned above are designed as self-contained breathing apparatus which delivers, to the user, through a demand type regulator, fresh-cool, breathing air. The Scott air pack uses compressed air only, whereas the Mine Safety apparatus can be used with either oxygen or compressed air.

No chemicals are used in either apparatus and the supply is carried in cylinders strapped to the back by a harness and both will supply air for about 10 minutes to 45 minutes.

INSTRUCTIONS:

1. Put on harness, cylinder at back, and hook harness snaps to rings.
   a. Adjust to fit. (Fig. 10)
2. Open cylinder valve full turn (counter-clockwise), (Fig. 11)
   a. Check pressure on gauge. (Full charge is 1800 lbs.)
3. Put on mask. (Tighten straps, bottom to top)
4. Check mask for leaks by placing palm of hand over bottom of tube and inhaling deeply, (Fig. 12) Mask will collapse against face if tight.)
5. Connect hose to main housing. Watch pressure gauge while using.

Fig. 10

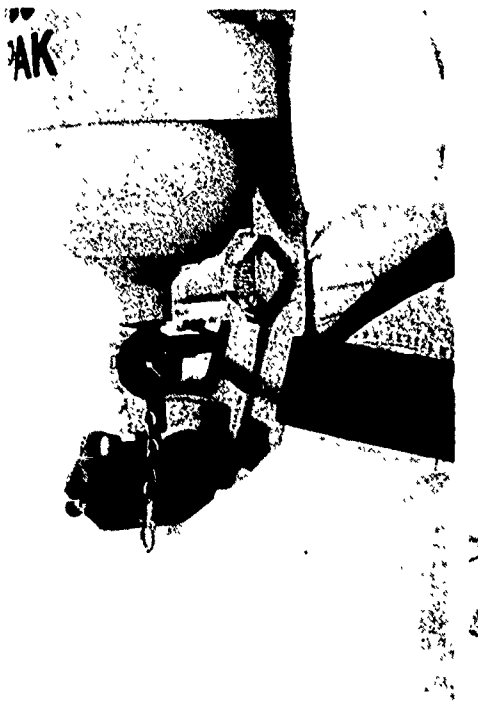

Fig. 11

Fig. 12

521: <u>HOW TO TEST OXYGEN BOTTLE VALVES AND VALVE STEMS FOR LEAKS AND FREE OPENING</u>

INFORMATION:

Whenever oxygen bottle valves have been opened the bottles <u>must</u> be removed and valves tested for leaks. All oxygen bottles <u>must</u> be tested for pressure and leaks once a month.

INSTRUCTIONS:

1. To test valve stems for leaks:
   A. Put metal caps on by-pass and main outlets. Tighten with proper wrench.
   B. Open by-pass and main valves two to four turns using hand or regenerator wrench.
   C. Submerge valves in bucket of clear water. Air bubbles, if present, indicate leaks. If no leaks are present, follow Operation No. 3. CAUTION: Never use oil on any oxygen equipment.

2. To tighten packing gland nuts to stop valve stem leaks:
   A. With caps tight and valves opened, back off lock nut, one half turn.
   B. Tighten packing gland nut about one sixth turn.
   C. Tighten by-pass packing gland nut one eighth turn if leaks are present.
   D. Test for leaks by submerging valves in water. If leaks are still present, repeat Operations No. 2-B, C, and D.
   E. When no leaks are present, work valves back and forth to test for free turning. Test again by submerging in water. If leaks are still present, repeat operations No. 2-B C, D, and E, until leaks have stopped. CAUTION: Valve stems must turn freely after leak is stopped. If difficulty is encountered, tag for repairs and obtain serviceable bottle. Do not repack stem in quarters.
   F. Close valves set up on main valve lock nut and remove caps. CAUTION: Never use wrench to close any oxygen bottle valve.
3. To test valve seats for leaks, remove caps and submerge closed valves in water. Air bubbles, if present, will indicate valve seat leaks.
4. To stop valve seat leaks:
   A. With valves closed and caps removed, hold bottle with main valve outlet pointed downward.
   B. Open and close main valve or by-pass valve by hand quickly. CAUTION: Never use a wrench to close any oxygen bottle valve.
   C. Test for leaks by submerging valves in water. If leaks are still present, repeat Operations No. 4-A, B, and C.
   D. When no leaks are present, dry the valves with cloth then replace on breathing apparatus or replace caps.

Fig. 13

Fig. 14

SAFETY CLOTHING FOR MEN WORKING IN DANGEROUS FUMES

INTRODUCTION:

In safeguarding men working in dangerous fumes it must be remembered that merely supplying the necessary breathing equipment is not enough. Many fumes will attack the skin through the pores and thus necessary protective clothing must be worn.

INFORMATION:

The wearing of a suitable mask or breathing apparatus will protect the lungs of firemen when necessary to enter where dangerous fumes are present. The protection of the man does not stop there, however, as the fumes of ammonia will attack the skin and mucous membrane and cause serious burns, while hydrocyanic acid gas is absorbed through the unprotected skin and will produce poisoning in this manner.

Ammonia, having an affinity for water, attacks first any moist, damp, or wet surface. The eyes, mouth, nose, armpits, and crotch are especially vulnerable. Any exposed skin surface covered with perspiration is also readily burned by ammonia fumes.

The best protection afforded men working in ammonia and hydrocyanic acid gas fumes consists of a light rubberized suit similar to coveralls which have feet and hood attached. Tie-downs are provided at the wrists and neck. Rubber gloves with tied gauntlets are worn. The exposed skin on neck, face, and head are thoroughly greased with burn ointment or salve.

When using self-contained breathing apparatus or gas mask not equipped with complete face protection, it is necessary to wear air tight goggles to protect the eyes while in the fumes.

Where rubberized suits are not available, good protection is afforded by the fireman's regular turn-out suit. The wrist of the coat and trouser legs are securely tied, the coat is full buttoned, the collar turned up, and rubber gloves are worn with gauntlets tied. The exposed skin is thoroughly greased. (Fig. 14) Thus equipped, a fireman stands little chance of being burned by ammonia fumes or poisoned by hydorcyanic acid gas.

After the mask is put on, a life line is tied to the ring of the safety belt. If the fireman becomes a casulty inside the building, the life line can be readily followed by a rescue crew, or, if no obstructions are present, he can be pulled to the outside. Whenever it is possible, two men should go together when mask or breathing apparatus is worn.

Hydrocyanic acid gas is lighter than air. Consequently it will rise to the highest point. It is deadly in small amounts in enclosed places, but in open air its dissipation is so rapid that it requires very large amounts to produce fatal results to human beings. Wherever possible, the building should be ventilated

before entering. This will eliminate some of the danger within the building and allow the gas to escape to the air and dissipate.

Under no circumstances should the mask be taken off while in the fumes. If difficulties are experienced in breathing, return to the outside air before removing mask. If an ammonia or all-service gas mask is being used, and the wearer can smell the gas coming through the cannister, it is a sign the cannister is no longer safe, or that the concentration is too high for that type of mask. No time should be lost in returning to the outside air, and either replace the canister or obtain self-contained breathing apparatus or hose mask if either of these is available.

Although there are some types of gases encountered that are odorless, the one most generally encountered by firemen is carbon monoxide gas which is present to some extent at all fires. In this case, a fireman should know the symptoms accompanying the breathing of carbon monoxide gas. When breathing carbon monoxide gas, the person becomes drowsy, sometimes accompanied by dizziness and a headache. At any of these symptoms, the wearer should return to the outside air as soon as possible to avoid being overcome entirely, and never remove the mask until in the clear, as the mask is affording a certain amount of protection.

CARE FOR RUBBER CLOTHING

The rubber suits used in the fire service are worn in conjunction with breathing apparatus to enter atmospheres that contain toxic fumes that are either irritating to, or absorbed by, the skin. Special care should be given these garments.

They shall be inspected monthly for any rips or breaks, and refolded to change the fold in the garment as they have a tendency to break if left in the same fold any length of time. They shall be kept well powdered with powdered soapstone or French talcum powder to avoid vulcanizing or sticking together.

They shall be washed with luke warm water to remove any grit or foreign matter. If soap is necessary, use only a mild soap with very little caustic, and no lye, as either of these will harm the rubber. Rinse off with clean water, dry thoroughly with clean dry cloth, hang up until well dried out, apply powdered soapstone or French talcum powder, fold, and place in canvas bag or compartment to avoid any dampness or undue heat from the sun.

SUGGESTIONS FOR DRILLS:

1. Have men put on gas mask and exercise with mask on. Use in a smoke room if possible.
2. Men to rescue man, using gas masks.
3. All men to use hose mask same as gas mask.
4. Use hose mask and locate fire. Use booster line to extinguish fire.
5. Replace cannister on gas mask and reset dial.
6. All men to wear self-contained breathing apparatus.
7. Make rescue with self-contained breathing apparatus.
8. Replace oxygen bottle and Cardoxide in breathing apparatus.
9. Clean and disinfect face piece.
10. Wear rubber clothing.
11. Guard men against ammonia fumes without the use of rubber clothing.

53a: HOW TO USE DRAGGING TOOLS

INTRODUCTION:

Dragging tools, usually called grappling hooks, are used in the fire department in dragging for bodies under water.

There are several different styles of dragging tools, and they are sometimes made in the fire department shop.

INFORMATION:

In Fig. 1, the hook has three barbless prongs made from steel and to which is attached 50 feet of 3/8 inch steel cable.

Other types of dragging tools are made by using a piece of iron pipe about four feet long, to which are attached by means of heavy fish cord or light cable small forged steel hooks, or extra large fish hooks with the barb removed, 3/8 inch cable is fastened on each end of the pipe and is run back about 6 or 8 feet where a loop is formed. Single rope or cable is fastened to this loop when dragging.

INSTRUCTIONS:

1. Remove straps or keepers from rope or cable.
2. Lower grappling hook into water from stern of boat.
3. When hook strikes bottom, begin to drag by moving the boat forward. NOTE: A body lying under water rises when merely disturbed by a hook.

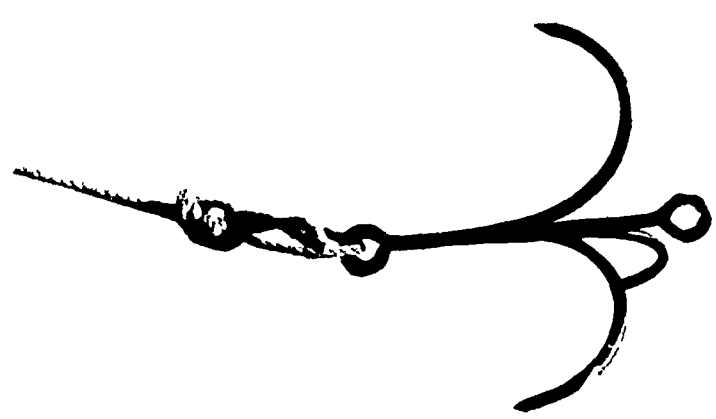

Fig. 1

54a: HOW TO OPERATE LIFE NET

INTRODUCTION:

The Browder and Atlas life nets have a nine foot six inch circular ring of metal tubing to which the landing mat is attached by thirty-two springs. The circular metal ring is divided and hinged so that it may be folded into quarter circle (Fig. 1) when carried on the apparatus.

When the net is put into operation, it is unfolded and locked in position by sliding ferrules which cover the hinged joints.

Springs provide elasticity or "give" to the landing mat. In other words, the landing mat is suspended by the series of springs connecting it to the inside of the metal ring; the mat is also equipped with a quilted pad.

When the net is open, it has a diameter of nine and one-half feet (9½ feet), (Fig. 2)

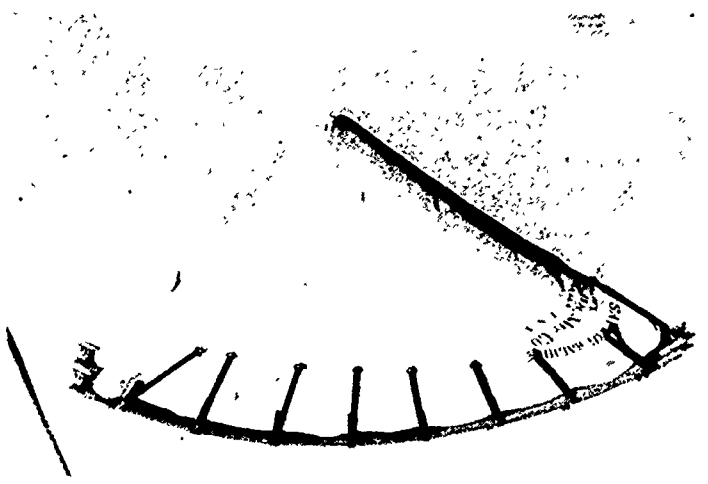

Fig. 1

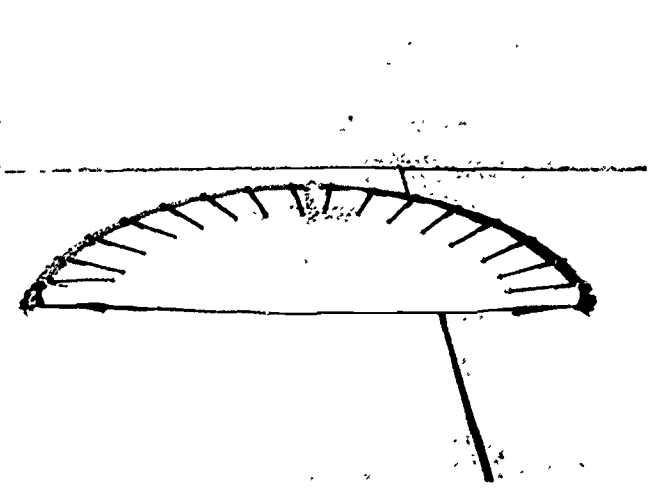

Fig. 2

INSTRUCTIONS:

1. The men hold the net, by grasping the hand holds on the ring with both hands, hand to be placed on every other handle, palms up with the thumbs in clear, using precaution so elbows will clear body. NOTE: Not less than ten or more than sixteen men should be used to properly handle a life net. Men to be spaced equal distance around net when net is held with the minimum number of men, do not span hinged joints.
2. The net is held so that the ring is about even with the necks of the holders, men stand with the left foot advanced in front of right. Do not allow net to give any more than possible when jumper lands. (Fig. 3)
3. The men holding net watch person who is to jump, and be ready to move net, so that person jumping will land in center of net NOTE: The person jumping should land on seat and back in center of the net.

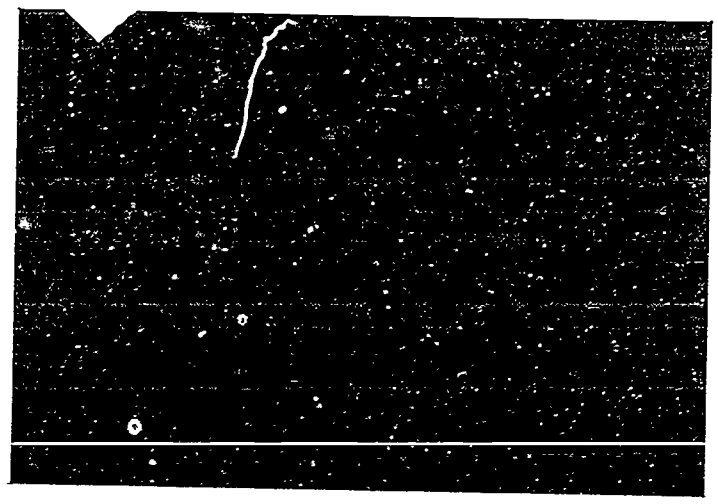

Fig. 3

55: USE OF LIFE LINES

INTROUDCTION:

During fires it is sometimes necessary for firemen to slide to safety when all other methods of escape are cut off, or lower persons from buildings in rescue work during fires. The life line and life belt are employed for this purpose. The life line and life belt are also employed at the drill tower for the purpose of building confidence in working above ground level.

55a: HOW TO USE LIFE BELT

INFORMATION:

Life belts are always used in connection with pompier ladders and sliding life lines.

Life belts used in the fire service are of two types, one having a large snap, which is more adaptable to pompier ladders than the other which has a lever arrangement attached to the snap that is known as a brake. The rope is passed beneath the lever and then up around and through the hook. Pressure on this lever produces a braking effect and slows down the rate of speed. It is not necessary to use this brake arrangement as it may be used the same as the other life belt.

The life belts are made of either leather or tightly woven material, and are from 4 to 6 inches in width. They come in different sizes. The narrow belts have two buckles. (Fig. 1) while the wider belts generally have three buckles.

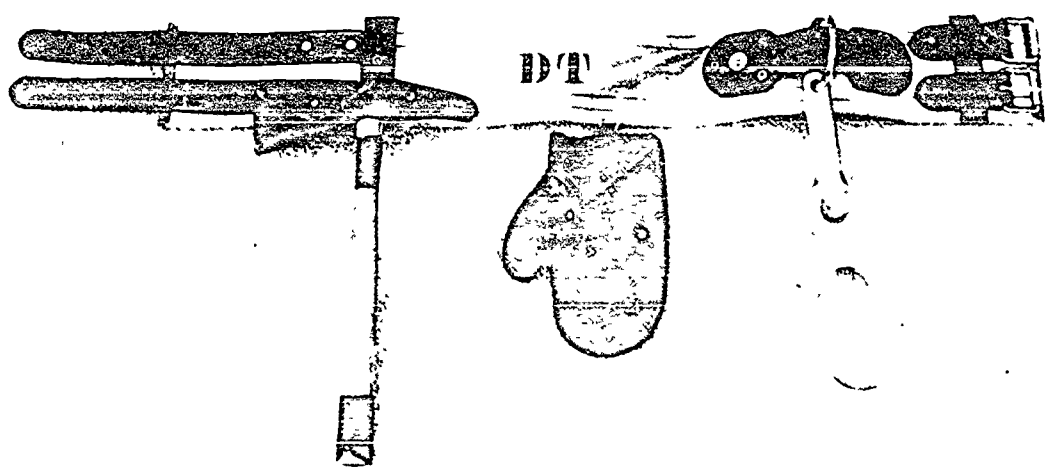

Fig. 1

Before putting on any life belt it shall be inspected to see that buckles, straps, and snaps are in good working order. Test the snap and see that spring is not weak. It is necessary to note which way snap is turned.

Life belts shall be put on with tongue of snap to the left at all times. When using snap to slide life line, rope is wrapped a certain way. If snap is to the right, rope will come unsnapped automatically. When using a life belt on pompier ladders, hook is held in right hand to snap hook to ladder. Where tongue of snap is toward buckles, grasp buckles in right hand. Where tongue of snap is toward straps, grasp buckles in left hand and throw around body. This will bring the snap in the correct position with the tongue of snap to the left.

INSTRUCTIONS:

1. Inspect belt and grasp buckles in proper hand.
2. Throw belt around body, grasp belt with free hand and fasten.
3. Buckle bottom strap first. Take equal tension on each strap and buckle. Place strap in keepers, then adjust belt so that snap is in front of body. NOTE: Check to see that open part of snap is to the left.

55b: <u>HOW TO SLIDE LIFE LINE, ONE MAN</u>

INFORMATION:

The life line used in the fire service is generally of 5/8, 3/4, or 1 inch manila hemp rope and is carried either on truck companies or squad companies in lengths from 75 to 200 feet, depending on the height of the buildings in the different cities.

The life line shall be done up in a neat compact bundle that is easily undone without kinks or knots, and shall be placed in a canvas bag or stored in some place on the apparatus to keep dry and marked life line. The life line shall not be used for any other purpose.

INSTRUCTIONS:

1. Obtain life belt and leather glove, put life belt on.
2. Fasten life line to some object with bowline knot.
   NOTE: When used at the drill tower, there is generally a ring provided on top of tower for this purpose. When used in actual rescue work, life line will either have to be taken up to desired location or life gun used to shoot cord to men to be rescued. In fastening life line under actual conditions, be sure object life line is fastened to will support the weight required on the line.
3. Grasp life line in left hand, face direction where life line is tied.
4. Grasp snap of life belt in right hand, snap hook around life line toward end where rope is fastened.
5. Pass life line to right hand under snap; hold both the snap and rope in right hand.
6. Reach away from you, with left hand grasp line, throw a full turn around hook.

7. Place right hand around side next to hip, holding on to rope. NOTE: It is necessary to wear a heavy leather glove or mitten on the right hand.
8. Place left hand on side of snap.
9. Take up slack in life line and straddle window or fire wall with right foot out.
10. Swing body out of window putting bight on life line, keep right foot against building to swing body away from building. As left leg comes over sill, place both feel against building until balanced.
11. Start down. (Fig. 2) As momentum is started, kick out clear of building and loosen tension slightly on rope with right hand. Gauge speed and tighten up with right hand when it is necessary.
12. After landing in net, come to sitting position, then raise yourself up. This will allow slack in life line to be able to remove turn in hook. NOTE: When sliding life line at drill tower, a stationary net shall be stretched to avoid men being injured. When in actual rescue work, use hand net if possible to stop any hard fall that may occur from misjudgment of distance.

Fig. 2

Fig. 3

Fig. 4

55c: <u>HOW TO SLIDE LIFE LINE AND PICK UP MAN FROM FLOOR BELOW</u>

INSTRUCTIONS:

1. Proceed as in single slide. Take two full turns around hook with life line in place of one.
2. Swing body out of window same as in previous operations. Keep legs apart, one on each side of window.
3. The man to be taken down puts on life belt, places himself in sitting position in center of window.
4. Top man swings in to window, straddling man sitting in the window. (Fig. 3)

5. Man to be taken down takes hold of hook of other man with left hand and hook on his own belt in his right hand, then secures his belt hook into the ring on the other belt.
6. Places his left hand on the shoulder of top man with right hand on belt hook. (Fig. 4)
7. When secured, they push themselves free from building. Top man keeps feet out to keep men from building, and regulates the descent by tightening or loosening his grasp on the rope with his right hand.
8. After men have descended to net, lower man unfastens hook from life belt. Top man rises and removes turns from snap.

55d: HOW TO LOWER PERSONS WITH LIFE LINE AND LIFE BELT

INSTRUCTIONS:

1. Fasten one end of rope to avoid rope slipping over side of building.
2. Place rescue tie (bowline on a bite) on person to be lowered.
3. Place snap on life line same as in 55b: operations 2-3-4-5-6- and 7.
4. Man to be lowered sits straddle of window.
5. Man doing the lowering kneels on right knee bracing self with left knee against wall.
6. The point of the life belt hook is placed against wall beneath window sill and held there with left hand.
7. The man being lowered slides out of window, keeping feet straight out from body and spread apart, holding on to rope with both hands.
8. Man lowering plays life line through gloved right hand held behind right hip, until receiving signal from below that the man is down.
9. Remove lifeline from snap on life belt.
   NOTE: This operation may require rope to slide over rough surfaces (window sills, cornices, etc.) and should be avoided except in an emergency.

55e: HOW TO OPERATE A LIFE GUN

INFORMATION:

Life guns (Fig. 5 and Fig. 6) are used to shoot projectiles, with cord attached, to persons in peril who cannot be reached in any other way. A life line made fast to the other end of the cord is then drawn up by the person in danger. The life gun may be employed for getting a line to firemen operating on roofs, and after the life line is drawn up, various pieces of equipment can be hoisted to roof, or a means of rescue or escape is provided.

Various Fire Departments use several types of projectiles; the sleeve type and the arrow type are the most common.

Life guns are equipped with different size charges, full loads, three quarter loads and half loads, giving a choice of charge to use according to height of building.

It is always best in firing the gun to work from the windward side of the building, if such is possible. This will make sure that the projectile goes over the building and reaches the people thereon.

The cord used in connection with a life gun is carried coiled in a canister which prevents it from becoming fouled.

INSTRUCTIONS:

1. Remove lid from cord canister, attach inside end of cord to projectile by regulation knot. (See Book 1, job 12, fig. 87)
2. Place life line in position and attach outer end of cord to eye on ring end of life line.
3. Load gun and then place projectile in or on gun barrel, depending on type of projectile.
4. To fire gun, stand firm on feet and hold gun tight to shoulder, aim at the cornice of building, then elevate the aim to a point 15 to 20 feet out from edge of building. NOTE: Building should not be more than 50 feet distant. BE SURE THAT projectile is clear down, canister cover is removed. The cord attached to projectile should be well cleaned and oiled after use; the sleeve type projectile must be cleaned on the inside and both types on the outside, the gun cleaned inside and outside so that the projectile will always fit freely inside and outside thereby eliminating recoil when gun is fired.

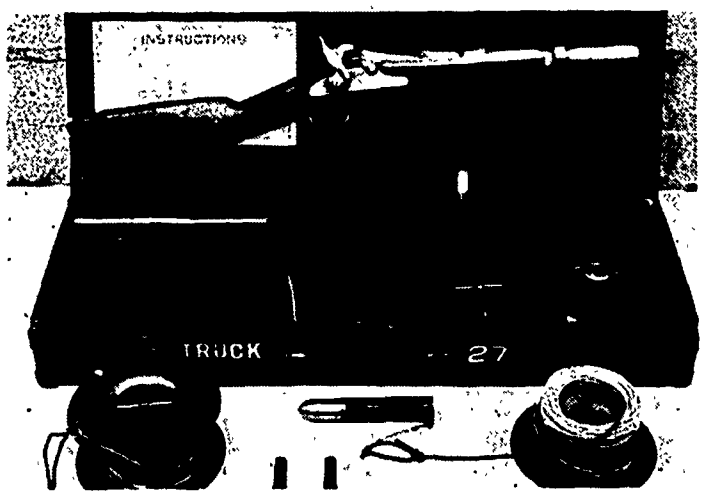

Fig. 5

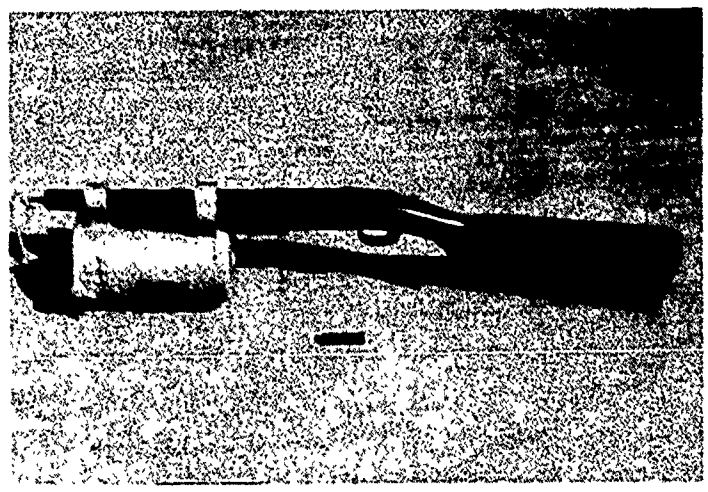

Fig. 6

INSPECT AND CARE FOR LIFE LINE

Life line shall be inspected every month and after use, and after runs during rainy weather, depending on where they are carried. Life lines are put to severe tests, and the lives of men depend upon their being in first class condition at all times. If rope becomes frayed, it shall be replaced with a new rope.

INFORMATION:

Life lines shall be of the best grade of rope, 5/8, 3/4, or 1", in lengths from 75 to 200 feet, depending on the height of the buildings in that particular city. They shall be done up in a neat and compact roll that will uncoil without snarling or tangling, and placed in a canvas bag marked life line. This is to avoid getting life line wet and it being used for other purposes

than its original intention. The ends shall be braided or a brass band placed around end to avoid ends from raveling.

The life line shall be tested annually, whether used or not. It shall be tested to 500 or 600 pounds by placing sacks of sand on the ground up to the amount of weights required. Place pulley at the top of drill tower or some high object, thread rope through pulley, attach one end to weight and hoist to bring all of the weight on the life line.

INSPECT AND CARE FOR LIFE BELTS

INFORMATION:

Life belts shall be inspected every month and after they have been used. Check snap, straps, ring holder, and buckles. Snaps shall be kept free from rust and some sort of light oil applied to spring. All leather parts shall be cleaned with saddle soap and lightly oiled with neatsfoot oil, rubbed well into the leather. Life belts shall be tested annually or when any parts become worn to any extent.

Test life belts by securing the belt around some object, place weight of 500 to 600 pounds on the belt. This may be done by filling sacks of sand to the desired weight, tying sacks together, placing block and tackle in hook of the belt, placing other end to weight and raising weight gradually. Place belts in proper place on apparatus.

Life belts shall be in first class condition at all times because of the type of work required of the life belt. A slight defect in any part of the belt may cause a man to fall and injure himself seriously.

INSPECT AND CARE FOR LIFE GUN

INFORMATION:

Life gun shall be inspected monthly. Keep clean and dry, away from all moisture to avoid rusting. Both gun and projectile should be well cleaned and oiled after use with oil that is provided for this purpose. The sleeve type projectile must be cleaned and oiled on the inside, and both types on the outside so that projectile will always fit freely, thereby eliminating recoil. Before placing life gun on apparatus after use or inspection, see that all parts are in their proper place and all empty shells replaced.

INSPECT AND CARE FOR LIFE NET

INFORMATION:

Life nets receive severe strain when in use, and should be inspected regularly to see that springs have proper tension, that steel ring and hand holds are in perfect condition, that rail locks work freely and lock securely, that cover of net is not

torn. Net shall never be put away before thoroughly dry. The life net shall be tested annually by having men hold net and throw sacks of grain or sand near human weight into net from height representing service conditions.

56: EVACUATOR, MODEL AA

INTRODUCTION:

The evacuator is used in life saving operations where many people have access to a certain point. They can be evacuated in absolute safety, utilizing a minimum of man power.

INFORMATION:

The evacuator with the sixty five foot chute weighs 100 pounds and can be carried by one man. It consists of a metal frame of tubular steel, equipped with two adjustable hooks that engage window-sills or roof parapets. The framework supports the chute made of heavy duck. This duck has been treated to make it fire proof, water and mildew proof. The sides of the chute have hand holds cut away every few feet, exposing the rope which supports the sides of the chute. The rope is loose in the seams, making it adjustable to any angle the chute might be held. The side ropes must be pulled taut to make a well shaped chute.

If the angle of the chute is too long, friction will stop the victim before they reach the end of the chute. But if the angle is too steep, the victims will slide off the end of the chute onto the street and possibly injure themselves. The angle of the chute for safe use is two feet horizontal for every three feet of vertical rise. The evacuator can be used as high as the fifth story window or the roof of a four story building (except those having mezzanine floors) and still have the proper sliding angle. It can be taken to the desired height by carrying it up a ladder or by pulling it up with a rope, depending upon which is the most practicable for the situation.

When the evacuator is taken to the third floor or higher, especially when the wind is blowing, one man of the ground crew should assist by taking some slack chute over his shoulder and follow up the ladder about fifteen feet behind the man carrying the evacuator. When the evacuator has been secured, the man who carried same up the ladder goes in the window and assists with the evacuation. The man who assisted with the slack returns to the ground crew and stretches the chute to the proper angle and prepares to receive victims.

Due to the difference in wall thickness of some buildings, the first man up the ladder must have a rope with him, so in case the hooks do not properly secure the framework to the building, he can secure same by tieing.

The man in the building who is in charge of the evacuation should have the victims remove their shoes as the friction of the heels on the canvas has a tendency to force the legs of the victim back up under him and pitch him forward. Also, the heels or the nails in them can puncture the canvas. When they are about to slide, they must be cautioned to keep their arms and hands away from the sides of the canvas, by no means must they try to hang on or they may receive friction burns from the canvas chute.

56a: HOW TO USE EVACUATOR

INSTRUCTIONS:

1. Place ladder against building just left of window.
2. Two men get evacuator and rope.
   a. Carry to right side of ladder.
   b. Place evacuator on ground with chute pack on top.
3. One man take rope and go to the floor to be evacuated.
   a. Get ready to receive and secure evacuator.
4. Second man unstrap evacuator.
   a. Lay chute over on the ground off the framework.
   b. Have pay-off on top.
5. Second man pick up framework by carrying strap
   a. Place on right shoulder (chute side next to body)
   b. Ascend ladder to proper window.
   c. Lock in with left leg and swing evacuator in to window.
6. Man inside of the building grasps the framework and brings it snugly in place against the building.
   a. Set securing hooks in place.
   b. Unfasten one side of carrying strap and place it on the outside of the chute.
7. Man on ladder assists in holding the framework in place, and after being properly secured he goes inside the building to assist in the evacuation.
8. The ground crew of at least two men and preferably four men stretch chute to proper angle.
   a. Two feet out from the building for every three feet of vertical rise.
   b. Unused portion of the chute can be doubled back underneath, thus keeping the area clear.
9. Two additional men should be at the foot of the chute to assist in the removal of victims that are unconscious, bed-ridden, injured, etc.
   NOTE: (Fig. 1) shows evacuator in place, ready for use.

56b: HOW TO FOLD CHUTE

INFORMATION:

The chute of the evacuator must be folded properly after use and replaced on the apparatus.

INSTRUCTIONS:

1. Stretch chute out its entire length.
2. Fold one side of the chute one third of the width over.

3. Fold other side the entire width over.
4. Fold the chute on framework in accordion folds.
5. Fasten straps.
6. Replace on apparatus.

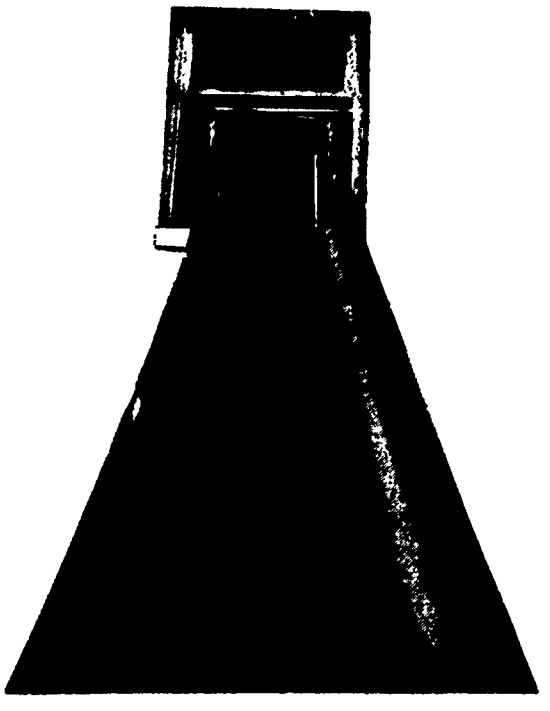

Fig. 1

SUGGESTIONS FOR DRILLS:

1. Take life line to top of drill tower and fasten with approved tie.
2. Slide life line from top of drill tower.
3. Slide life line, jumping from window to window.
4. Slide life line, pick up man from floor below; pick up man on the same floor.
5. Lower man with life line, using life belt on man to be lowered.
6. Lower man, use life belt and life line; use proper knots on man to be lowered; after he is lowered, slide life line.
7. Place man on roof of drill tower; use life gun to send up life line and life belt. Man fasten life line and slide to ground.
8. Have all men load life gun and fit projectile to gun and load. NOTE: Use empty cartridge for this drill.
9. Have three men bring life net from apparatus to location to be used, open net, all men get in position and hold net properly.
10. Have men jump from second story in life net.
11. Explain the many different methods used in rescue work.
12. Explain the use of dragging tools. Assume problems to be done with these tools, have men go through the operations.
13. Have men take evacuator to fourth floor and place in use. Each man to slide down evacuator.

VT 010 572
California Fire Training Program; Book 1 of Block III, Use of Fire Apparatus and Equipment.

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ABSTRACT - This program guide, describing the use of small tools and appliances in the training program of fire department personnel, divides 30 specific units of instruction into the following four major units: (1) Forcible Entry and Miscellaneous Tools, (2) Lifting and Hoisting Equipment, (3) Fire Extinguishers and Foam Generators, and (4) Hose, Nozzles and Fittings. Specific objectives for each major unit are included. The document is profusely illustrated with photographs. Book 2 is available as VT 010 571 (also in this issue). (GR)

VT 010 572

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CALIFORNIA FIRE TRAINING PROGRAM

Book I

of

BLOCK III

USE OF FIRE APPARATUS AND EQUIPMENT

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CALIFORNIA FIRE TRAINING PROGRAM

UNIT A

FORCIBLE ENTRY AND MISCELLANEOUS TOOLS

1. CARRYING TOOLS
2. DIGGING TOOLS
3. STRIKING TOOLS
4. BATTERING TOOLS
5. PRYING TOOLS
6. LIGHTING TOOLS
7. SAWING TOOLS
8. BORING AND DRILLING TOOLS
9. CUTTING TOOLS
10. ACETYLENE CUTTING TORCH

OBJECTIVE

Develop the ability to use the small tools and appliances in the fire department, with an understanding and knowledge of the limitations and characteristics of the different tools and what tool to use for any particular job to be done.

1: CARRYING TOOLS

INTRODUCTION:

Many different types of carrying tools are manufactured to remove water and materials, such as wet sawdust, debris, plaster, etc., while carrying on overhauling, salvage, and extinguishing operations.

INFORMATION:

1a: Scoop Shovels--are used in overhauling operations and salvage work, such as spreading and removing sawdust and in picking up water from floors, rugs, etc. (Fig. 1)

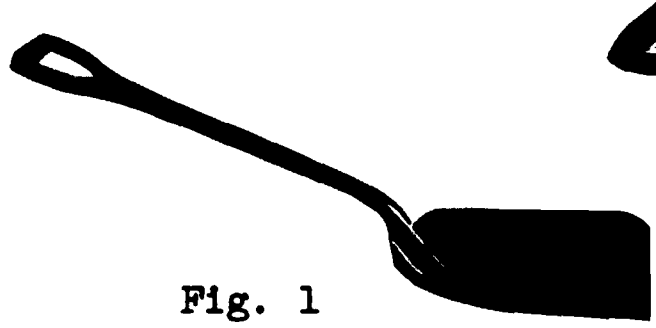


Fig. 1

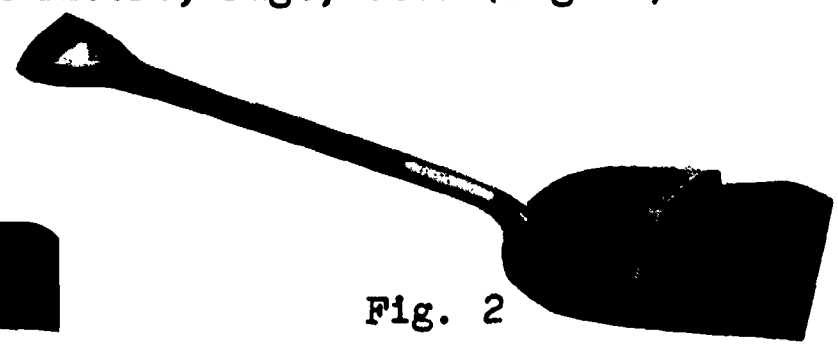


Fig. 2

1b: Covered Scoop Shovels--are used for bailing water and picking up wet materials. (Fig. 2)

1c: Water Buckets--usually of $3\frac{1}{2}$ gallon size, are used to catch and to remove water or wet materials, and for mopping up and extinguishing operations. (Fig. 3)

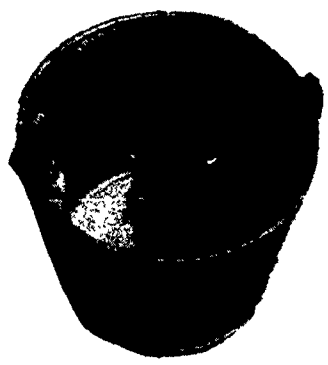


Fig. 3

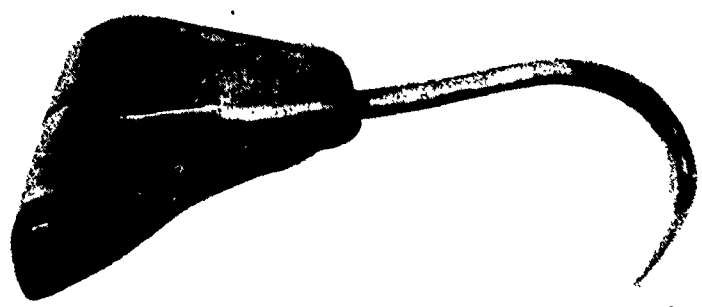


Fig. 4

1d: Hay or Longshore Hooks--are used for moving and carrying baled materials, packing cases, crates, pulling burning cushions out of cars, etc. (Fig. 4)

1e: Long-handle, Round-point Shovels--are carried for grass and brush fire extinguishment operations. (Fig. 5)

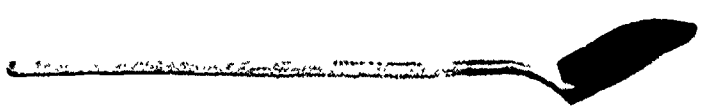


Fig. 5

Fig. 6

1f: Long-handle, Square-point Shovels--are used for overhauling operations. (Fig. 6)

1g: Short-handle, Square-point Shovels--are used for the same purposes as long-handle, square-point shovels. (Fig. 7)

Fig. 7

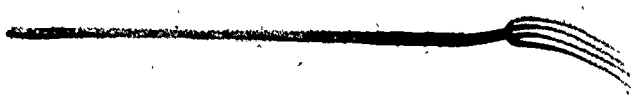


Fig. 8

1h: Long-handle, Four-tine Forks--are used in overhauling operations and in the construction of fire breaks. (Fig. 8)

1i: USE OF HOSE STRAPS

INTRODUCTION:

Many types of hose straps are manufactured for the use of fire departments. Some departments have them made up to their own specifications, and others use standard manufactured types of straps (Figs. 9 and 10)

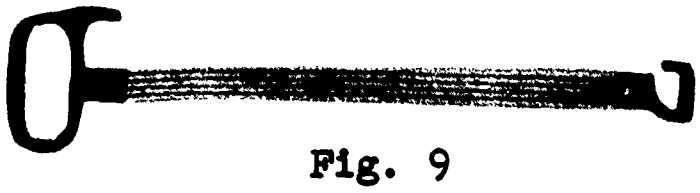


Fig. 9

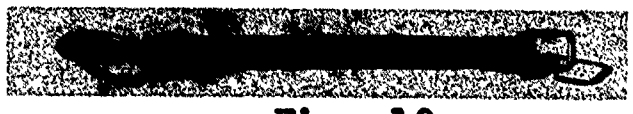


Fig. 10

Hose straps are used for securing hose to ladders, fire escapes, and for assisting in handling hose in other manners.

1j: HOW TO SECURE HOSE TO LADDER OR FIRE ESCAPE

INSTRUCTIONS:

Figs. 11 and 12 show both the old and new type hose strap securing hose to a ladder. With the hose strap, it is a simple matter to secure a line to a ladder or fire escape. It is only necessary to pass the strap around the hose and secure same, then place the handle hook over the rung of ladder or over the rail of a fire escape. NOTE: Hose straps are always placed below couplings if possible.

1k: HOW TO SECURE NOZZLE AND HOSE LINE WHEN OPERATING FROM A LADDER INTO A WINDOW

INSTRUCTIONS:

When man on nozzle gets opposite window he is to work into, he first locks in on ladder in regulation manner, then takes nozzle and inserts it through rung on level with window. After nozzle is placed between rungs, he then places hose strap around hose behind nozzle coupling and takes handle hook of hose strap and places same over second rung above hose line, as in Fig. 13.

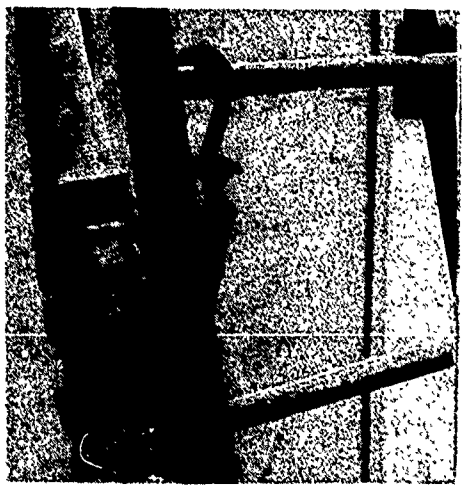


Fig. 11

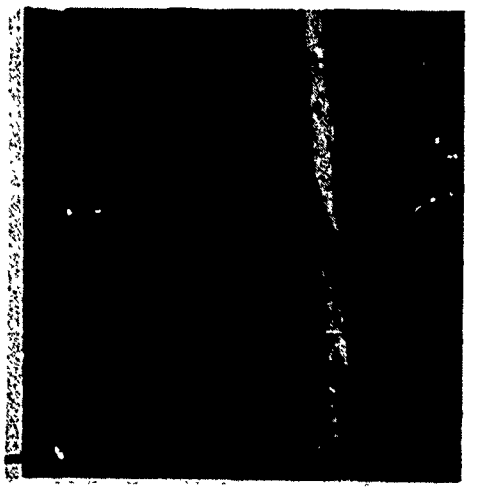


Fig. 12

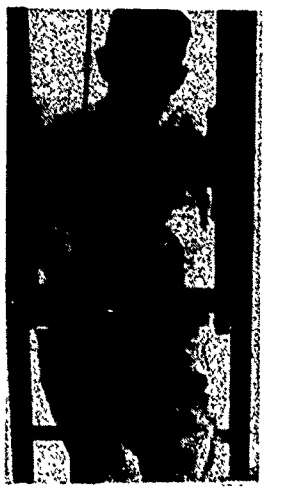


Fig. 13

11: HOW TO SEND A HOSE LINE ALOFT, WITH A HOSE STRAP AND PIKE POLE

INSTRUCTIONS:

This method is employed to send hose lines up the face of a building, usually by means of a fire escape or a ladder. To send an empty line up, the hose strap is placed 18 inches behind coupling. (Fig. 14) To send a loaded line up by the pike pole and hose strap, the strap is placed around the hose behind nozzle coupling by inserting the end of hose strap through the hose strap handle, then attaching the small end of strap around the shaft of pike pole behind hook. The handle of the pike pole is then handed to man on ladder or fire escape balcony, who then takes the pole and passes it up hand over hand to next man above and the performance is repeated.

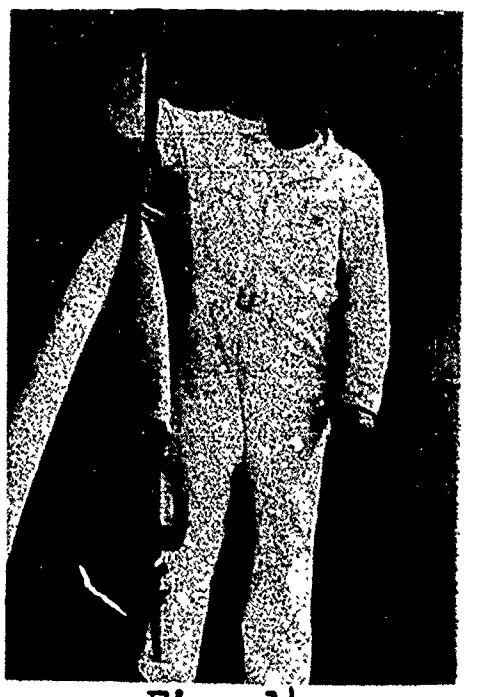


Fig. 14

Fig. 15

1m: HOW TO ATTACH A HOSE STRAP TO A LINE AND HOSE ROLLER

INSTRUCTIONS:

After a line is hoisted to the desired height, the hose is secured to hose roller by placing a hose strap around the hose, placing handle hook over the iron brace on bottom part of hose roller. (Fig. 15)

1n: ROPE HOSE TOOL

INTRODUCTION:

The rope hose tool (Fig. 16) is used in carrying hose aloft, in sending up hose or smaller equipment, with the pike pole. It is also used in holding lines on ladders, tying ladders to fire escapes and windows. It may be used in rescue operations, and as a safety belt when working on ladders. The rope used for this tool is 3/4" and the hook is made from 1/2" tool steel.

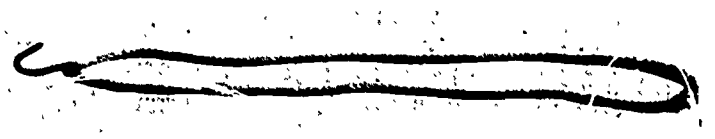


Fig. 16

1o: HOW TO CARRY HOSE AND NOZZLE UP A LADDER USING A ROPE HOSE TOOL

INSTRUCTIONS:

1. Attach rope hose tool to hose line 6" behind coupling.
   (a) Hook free and to top. (Fig. 17)

Fig. 17

Fig. 18

1p: HOW TO SECURE HOSE LINE TO LADDER

INSTRUCTIONS:
1. Attach rope hose tool to hose line at any desired location.
2. Place hook on rung of ladder. (Fig. 18)

1q: HOW TO SECURE NOZZLE AND HOSE LINE WHEN OPERATING FROM LADDER INTO A WINDOW

INSTRUCTIONS:
When man on nozzle gets opposite the window he is to work into, he first locks in on ladder in regulation manner, then he takes and inserts nozzle through rungs on level with window. After nozzle is placed between rungs, the man places hose rope around base behind nozzle coupling and places hook of hose rope over second rung above hose line. (Fig. 19)

Fig. 19

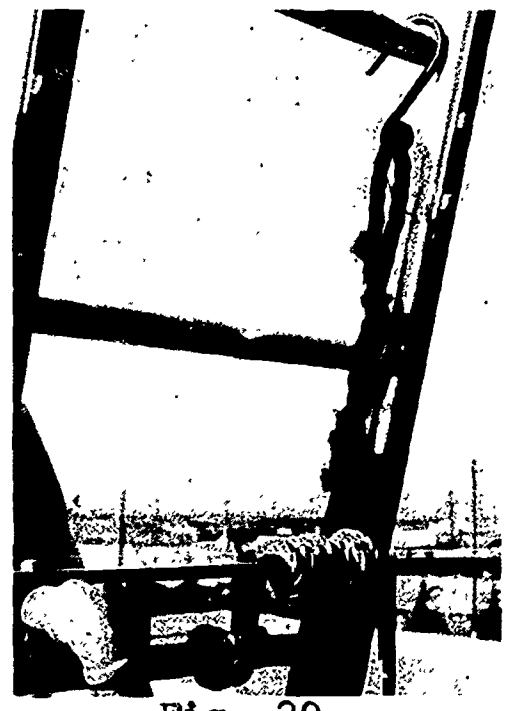


Fig. 20

1r: HOW TO SECURE LADDER TO A BALCONY

INSTRUCTIONS:
1. Attach rope hose tool to rung of ladder below balcony railing.
2. Pass hook end around balcony rail several turns.
3. Attach hook to most convenient rung of ladder above balcony railing. (Fig. 20)

1s: HOW TO SECURE LADDER TO WINDOW SILL

INSTRUCTIONS:
1. Secure hose rope to convenient rung below window sill.
2. Proceed--if necessary use up excess rope by wrapping around rung above. (Fig. 21)

3. Pass hose rope over rung and window sill and secure inside. NOTE: Pike Pole, bar, or other tools could be used to secure ladder. (Fig. 22)

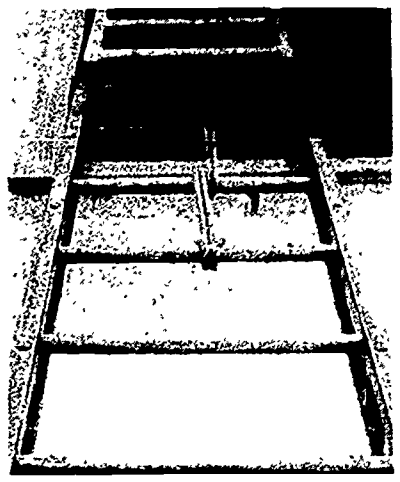


Fig. 21

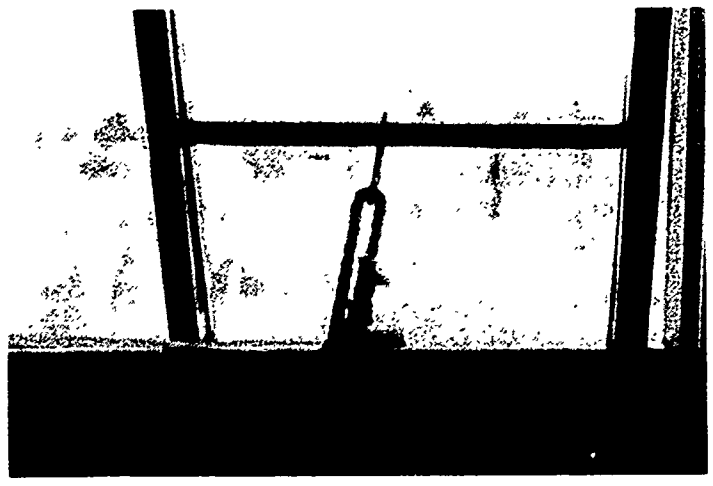


Fig. 22

lt: HOW TO USE ROPE HOSE TOOL TO SECURE SELF TO LADDER

INSTRUCTIONS:

1. Place fold of rope around waist.
2. Run hook through loop.
3. Secure hook to rung of ladder waist high. (Fig. 23)

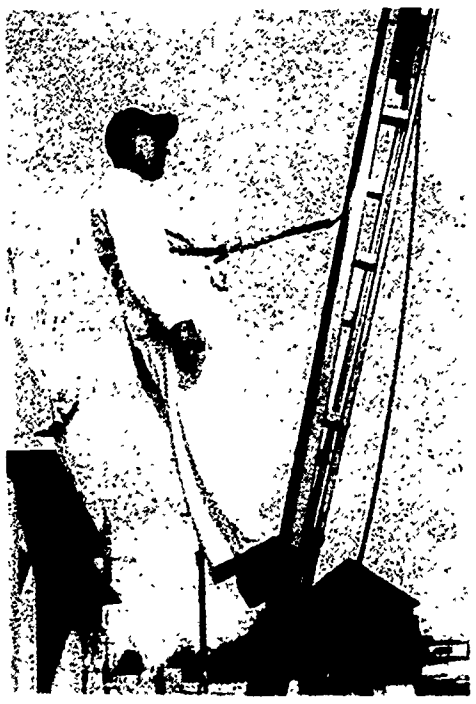


Fig. 23

Fig. 24

1u: HOW TO CARRY INJURED PERSON

INSTRUCTIONS:
1. Place hose tool around back of person to be carried.
2. Leave loop ends to front and about the same length.
3. Place your arms through loops with your back to person.
4. Stoop a little to lift person's feet from floor. (Fig. 24)

1v: HOW TO USE ROPE HOSE TOOL FOR FIREMEN'S DRAG

INSTRUCTIONS:
1. Place person on his back with palms of hands together.
2. Tie hands together with rope hose tool.
3. Straddle person to be dragged.
4. Place head through arms. (Fig. 25)

Fig. 25

Fig. 26

1w: HOW TO HEEL HOSE LINE USING ROPE HOSE TOOL

INSTRUCTIONS:
1. Make bight in rope tool and tighten loop around hose behind nozzle coupling.
2. Bring loop across back.
3. Place arm through loop letting rest on shoulder opposite hose line.
4. Alternate position may be used. (Fig. 26)

1x: COMBINATION HOSE AND LADDER STRAP

INTRODUCTION:

The combination hose and ladder strap is used for hoisting, pulling, and heeling lines.

This combination hose and ladder strap (Fig. 27) is constructed in two parts. The loop or upper portion, and the lower or tail portion which has a split link fastened to one end of a strap, a snap and hook on other end.

The loop is adjustable and has a ring to which the tail piece is hooked, and a snap to which the spanner is fastened.

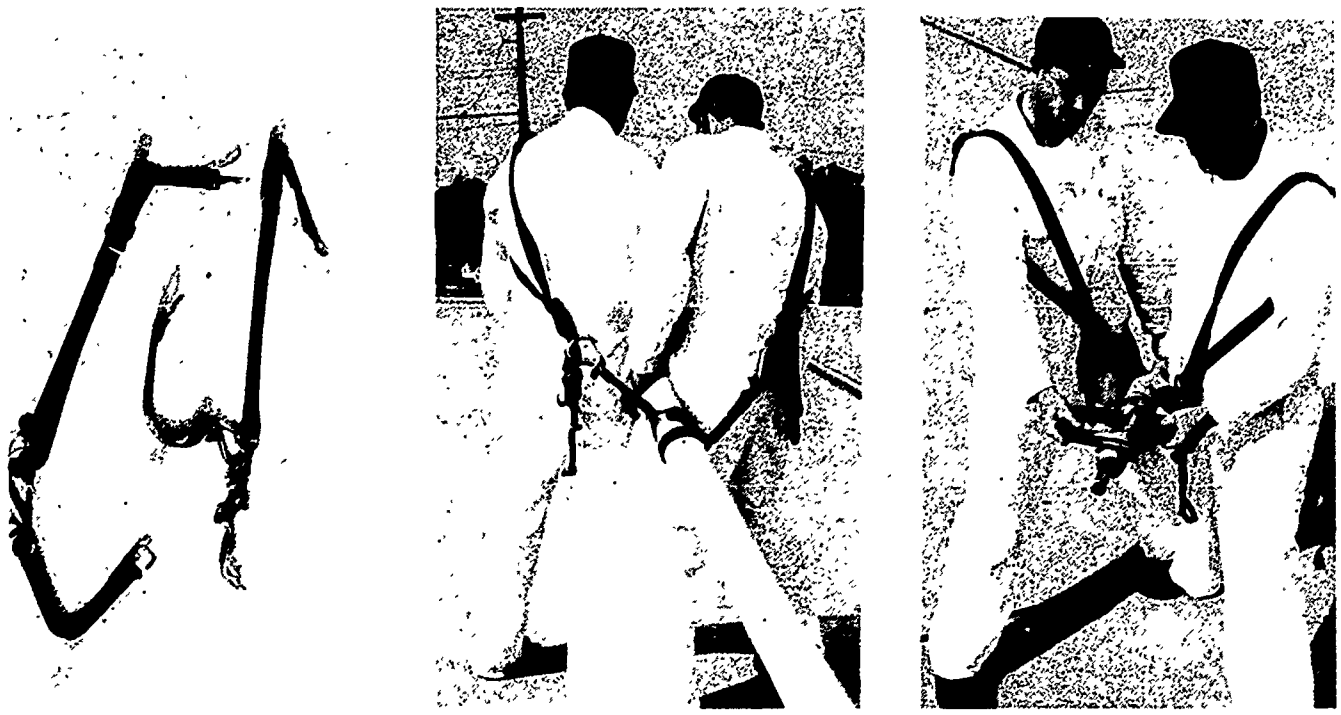


Fig. 27 Fig. 28 Fig. 29

ly: HOW TO HEEL A LINE WITH COMBINATION STRAP

INSTRUCTIONS:

1. Place tail piece around hose behind nozzle. Split in link away from nozzle.
2. Bring loop across back.
3. Place arm through loop, letting rest on shoulder opposite hose line. (Fig. 28)
4. Alternate position may be used. (Fig. 29)

lz: HOW TO ATTACH A HOSE BELT TO A NOZZLE FOR CARRYING THE NOZZLE OVER LADDERS

INFORMATION:

The difficulties encountered in carrying a nozzle over ladders, etc., can to a very large extent be eliminated by the use of a combination hose belt. This method can only be used when the nozzle is equipped with a shut-off or operating handle.

INSTRUCTIONS:

1. The hose strap position of the hose belt is placed under the hose and near the nozzle. (Note Fig. 30)
2. Closed side of keeper must be towards the nozzle. This eliminates any possibility of the strap slipping out of the keeper. (Note Fig. 30)
3. When hose strap has been placed in the keeper, arrange belt so the buckle and the loose snap will be on top.
4. Thread loose end of belt through shut-off handle.
5. Place over nozzle tip. (Note Fig. 30)

6. Pull back into place. NOTE: Be sure hook and snap are clear of clothing and other obstacles.
7. Face hose line with carrying shoulder in same direction as nozzle.
8. Lift nozzle and hose line with strap, and put hand of carrying shoulder through loop. Pivot body so nozzle rests on back. (Note Fig. 30)

Fig. 30

lzz: HOW TO USE THE FRESNO HOSE STRAP

INFORMATION:

The Fresno hose strap is a combination strap with spanner wrench and hook combined. The Fresno hose strap (Fig. 31) is used to carry hose aloft, to send up hose or smaller equipment, using the pike pole. It is also used in holding lines on ladders, securing ladders to fire escapes and windows. It may be used as a spanner in tightening or breaking couplings from 1" to 3½", either pin lug, rocker lug, or slot type couplings and opening or closing hydrants.

INSTRUCTIONS:

For use in carrying hose up a ladder, thread spanner end of strap through ring, and place on shoulder next to hose line. (Fig. 32) To fasten to ladder, place spanner or hook end under rung and hook over rung above.

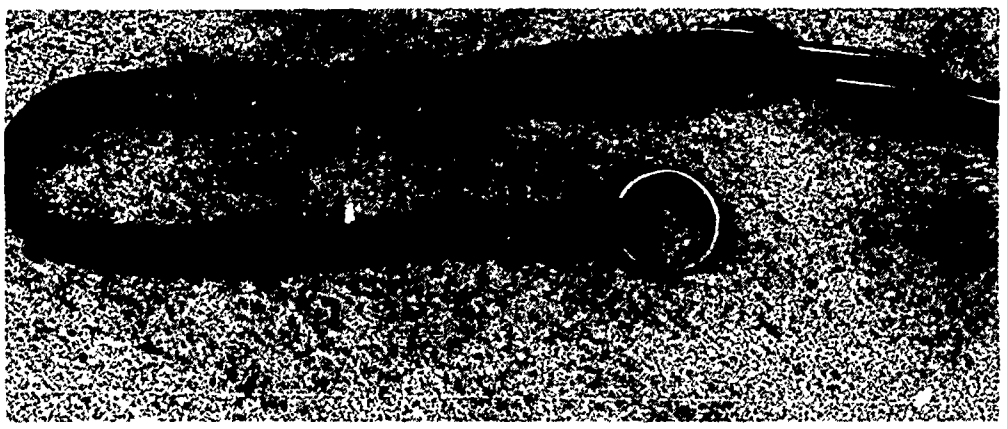


Fig. 31

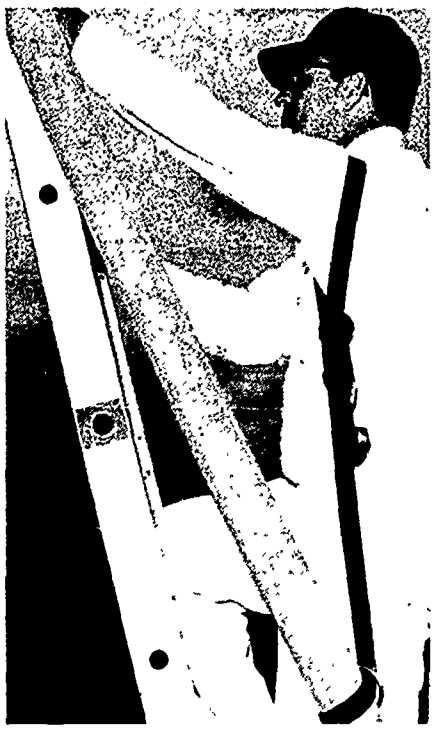


Fig. 32

2: DIGGING TOOLS

INTRODUCTION:

Different types of tools are manufactured for digging earth, concrete, debris, etc., while carrying on overhauling, ventilation, rescue, forcible entry, salvage, and extinguishment operations. They are also used to construct fire breaks, dikes, barriers, etc.

INFORMATION:

2a: Pickhead Axe--carried on most apparatus; pick end can be used for digging while carrying on overhauling, ventilating, rescue, forcible entry, salvage, and extinguishing operations. (Fig. 1)

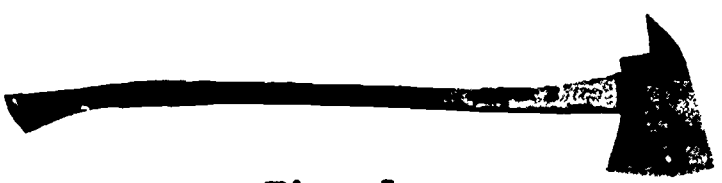


Fig. 1

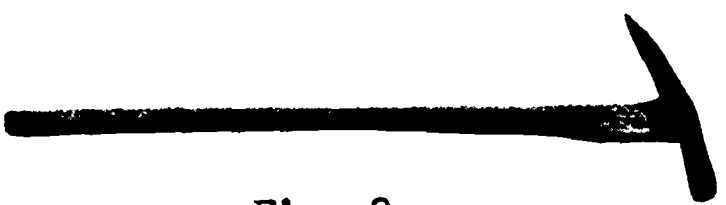


Fig. 2

2b: Hammerhead Pick--in addition to the pickhead axe, the hammerhead pick is the most generally used type of pick used by the fire department. It serves not only as a pick but as a hammer as well while carrying on overhauling, ventilation, rescue, forcible entry, salvage, and extinguishing operations. (Fig. 2)

2c: Rubbish Hook--carried for digging while carrying on overhauling and extinguishing operations. (Fig. 3)

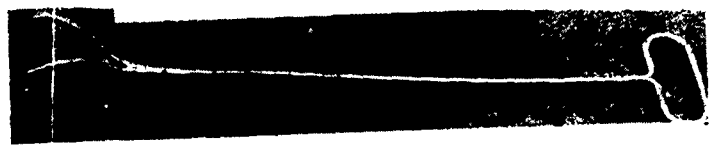


Fig. 3

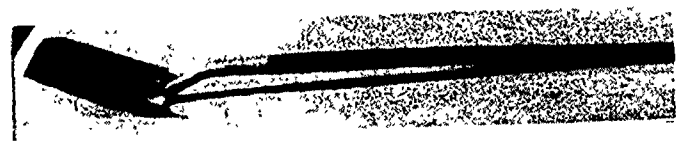


Fig. 4

2d: Long-handled, Square-point Shovel--carried for use while digging, overhauling, ventilating, rescue, salvage, and extinguishing operations. It is also used to construct dikes, barriers, etc. (Fig. 4)

2e: Short-handle, Square-point Shovel--carried for the same purpose as the long-handle, square-point shovel. (Fig. 5)

Fig. 5

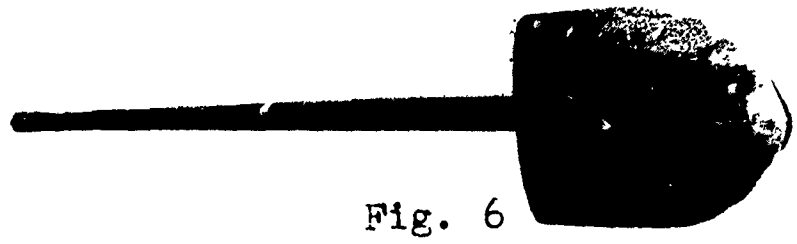


Fig. 6

2f: Long-handle, Round-point Shovel--carried by outlying companies and used for digging while extinguishing brush fires, and to construct fire breaks. (Fig. 6)

2g: Railroad Pick--carried for use where heavy digging is required. (Fig. 7)

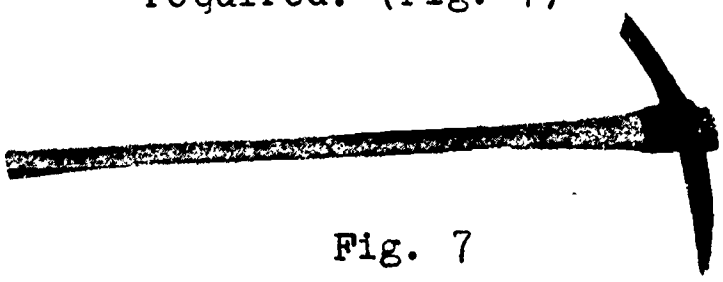


Fig. 7

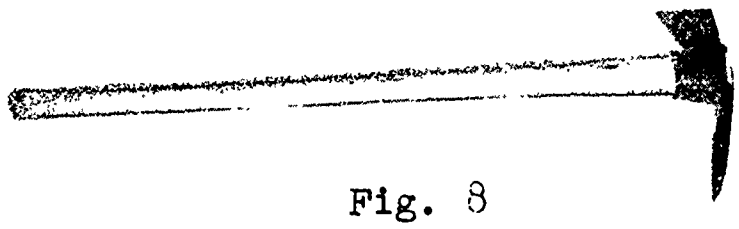


Fig. 8

2h: Mattock--serves not only as a digging tool but as a cutting tool as well. It is used in extinguishing grass and brush fires and to construct fire breaks. (Fig. 8)

2i: McLeod Tool--used for digging while extinguishing grass and brush fires and to construct fire breaks. (Fig. 9)

2j: California Tool--used the same as the plantation hoe.

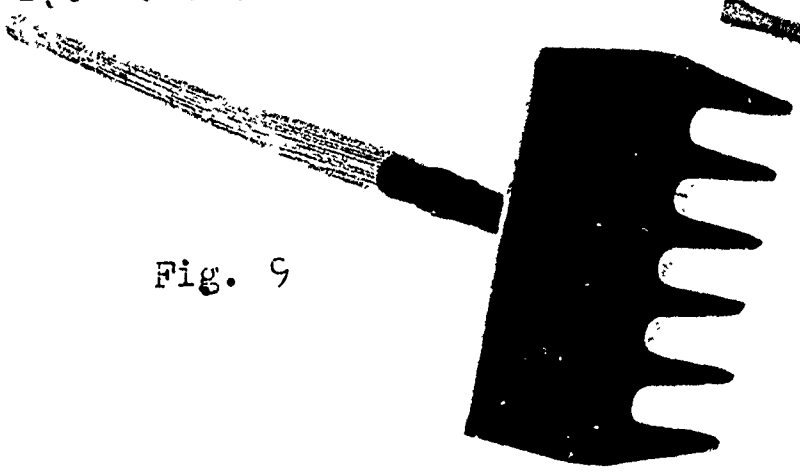


Fig. 9

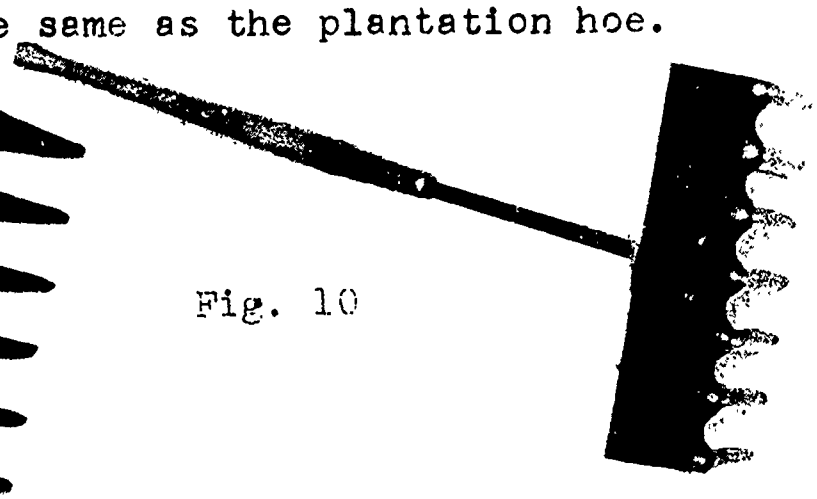


Fig. 10

2k: Road Rake--used for digging leaf mould and for cleaning off fire breaks. It is also used by investigators in combing debris for evidence. (Fig. 11)

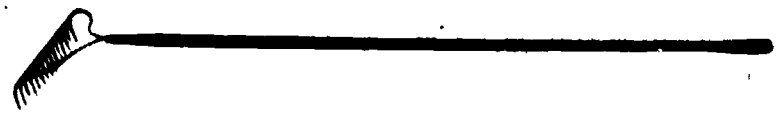


Fig. 11

3: STRIKING TOOLS

INTRODUCTION:

Different types of striking tools are manufactured for jobs that require weight and striking power, such as breaking glass, concrete, deadlights, tile, roofs, doors, walks, etc., while carrying on extinguishing, overhauling, salvage, ventilation, rescue, and forcible entry operations.

INFORMATION:

3a: Rubber Mallet--carried by some pumping engines to tighten suction connections when necessary to draft water. It is also carried by CO_2 companies to rupture disc on cylinders. (Fig. 1)

Fig. 1

3b: The Pick Head Axe--carried on most apparatus and used as a striking tool for breaking, ventilation, forcible entry, rescue, salvage, and overhauling operations. In breaking glass with the axe, stand to one side of the pane and strike the glass with the flat side of the axe. (Fig. 2) Most of the glass will follow the axe inward and very little glass will fall on the outside of the building. (Fig. 3) Men below should always be warned when windows are broken on upper floors.

Fig. 2

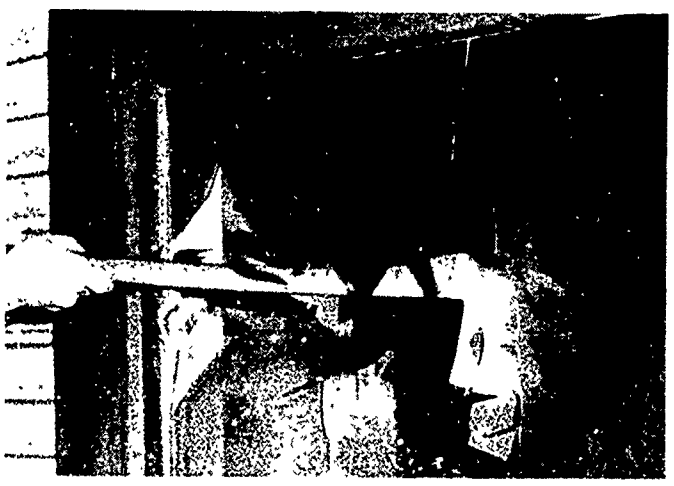


Fig. 3

After glass is broken, for safety and to eliminate any possibility of being cut by jagged glass, the side nearest you should be cleaned first, then top, (Fig. 4) opposite side, and bottom last. Cleaning bottom last will remove all fragments that may have fallen from top and sides.

Fig. 4

The pick, of the pick head axe, may be used for digging and for prying within the limits of the tool.
CAUTION: Precaution should be taken when breaking glass not to stand directly in front of the window as there is a possibility of the glass' sliding down along the axe handle and of cutting the hands of the operator.

3c: The Hammerhead Pick--the hammer end is used as a striking tool in the same manner as a sledge hammer. (Fig. 5)

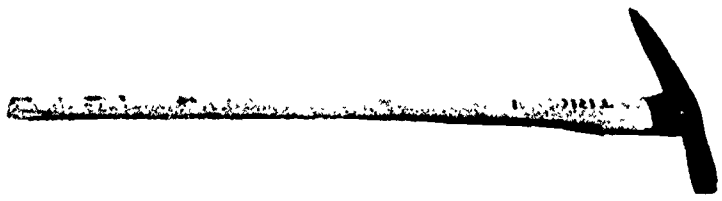


Fig. 5

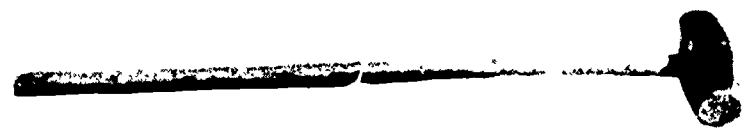


Fig. 6

3d: The Sledge Hammer

INFORMATION:
Carried on most apparatus and used on jobs that require considerable weight and striking power, such as breaking deadlights, concrete, tile, walls, floors, roofs, locks, or for bending iron bars in windows while carrying on extinguishing, overhauling, salvage, ventilation, rescue, and forcible entry operations. (Fig. 6) They generally weigh 6, 8, 10, 12, or 14 pounds. NOTE: When breaking deadlights, cement floors, or

other hard, flat surfaces, the sledge should be struck with the head at an angle. To strike squarely on the head under such circumstances may cause the head to break off and to injure persons nearby.

INSTRUCTIONS:

1. To free bars in masonry, strike the bar with sledge about 10" above the sill. (Fig. 7) As bar bends in, the end will sometimes pull free of the sill.

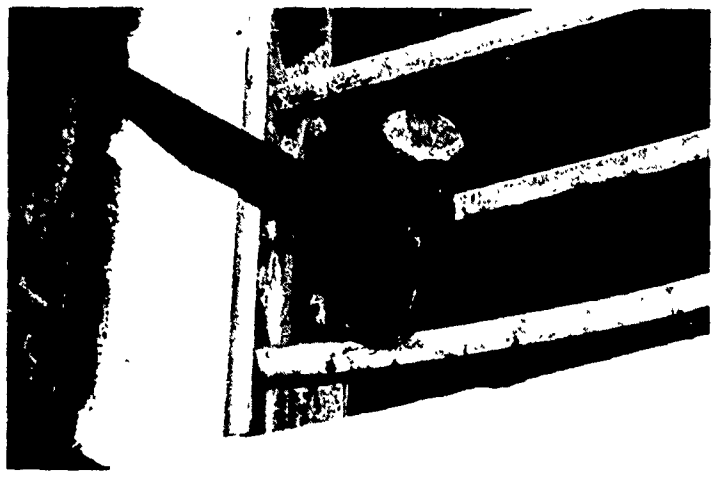


Fig. 7

Fig. 8

2. To free bars in masonry, strike sill with sledge at opposite end of bar. This will sometimes crack the masonry sufficiently to release end of bar.

3. To free bars in masonry, start hammerhead pick in masonry sill at edge of bar. Strike head of pick with sledge to crack masonry sufficiently to release end of bar. (Fig. 8)

4: BATTERING TOOLS

INTRODUCTION:

The Battering Ram and Jumbo Bar are provided for jobs that require considerable weight and force; such as breaching walls, opening elevator doors, fire doors, etc. The Sledge Hammer and Ball and Chain are also used as battering tools for jobs that cannot be reached, such as breaking holes in ceilings or breaking windows and doors above ground, while carrying on extinguishing, ventilation, rescue, overhauling, and forcible entry operations.

4a: HOW TO USE BATTERING RAM

INFORMATION:

Battering Ram (Fig. 1) carried for use when forcing heavy doors, or for breaching brick, tile, or other walls to provide drains for water, openings for hose lines, opening heavy doors, and occasionally in overhauling and rescue work.

Fig. 1

INSTRUCTIONS:

To breach brick walls, stand on roof or floor of adjoining building, remove first brick by means of hammer head pick, pick head axe, sledge hammer, star drills, etc.

After first brick is removed, two men on each side of ram grasp handles so that fork end of ram will be toward building, swing ram quickly toward building.

Just before point reaches building it should be raised so as to give lifting motion to the point where it strikes. Repeat operations until hole is of desired size. Sometimes a fifth man is placed at butt end of ram to assist in swinging it where a particularly tough job is encountered. For light work two men can operate ram. NOTE: Be sure that charged lines are in position before breaching walls at a fire.

When forcing a door, the butt end of ram is used. See that ram is driven against the door jam just below the lock on the solid portion of the door and not against the panel.(Fig. 2) If the panel is struck, it may merely be knocked out or broken.

Fig. 2

Fig. 3

4b: <u>BALL AND CHAIN</u>

INFORMATION:

Ball and Chain (Fig. 3) carried by all truck companies for use as a battering tool when breaking windows, skylights, doors, and ceilings where it is not possible to reach them by other means. It consists of a 12-pound iron ball attached to a chain with ring on end of chain. It can also be used for cleaning a chimney which is afire, the ball being lowered into chimney and worked up and down. A rope can be tied to ring in chain so that ball can be operated from any height.

INSTRUCTIONS:

To break windows with ball and chain, the man who is to operate the ball and chain goes to a window or roof above the fire and pays the chain with rope attached out window. Then the rope attached to chain is firmly grasped in one hand, or is made fast to building or contents. If rope is held in hand, he holds it at this point and withdraws ball. The ball is thrown outward and sweeps downward striking the window with considerable force. It not only breaks the glass, but drives the broken glass onto the floor. The same method would be used for doors above ground level. (Fig. 4)

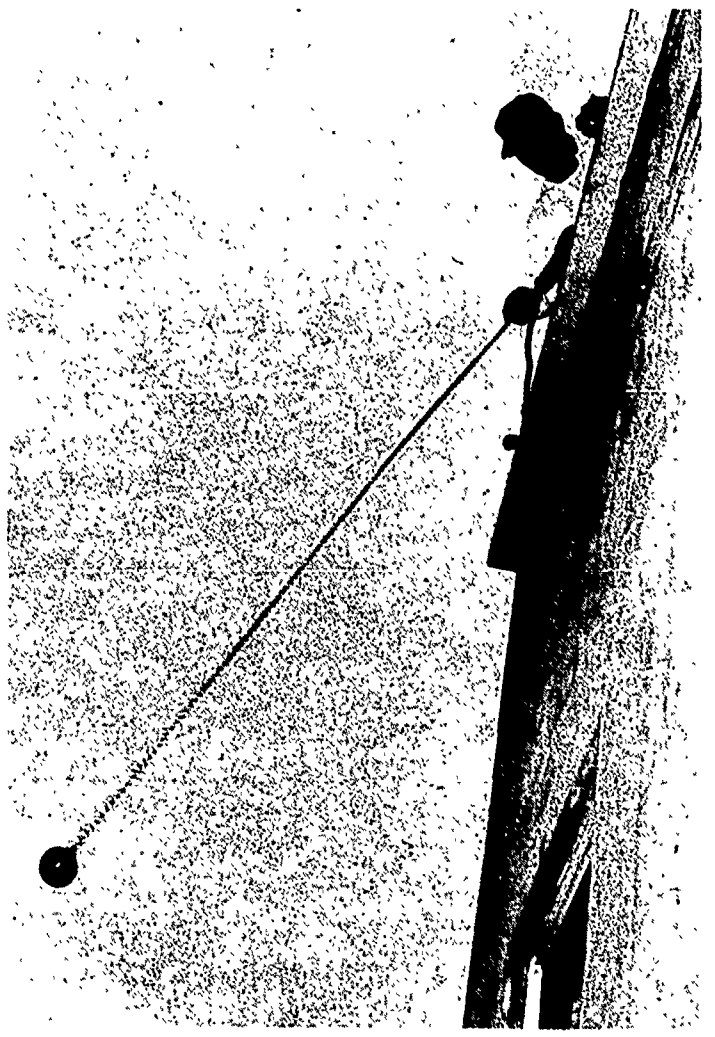


Fig. 4

Operate ball and chain with man on roof and man on ground. The man on roof drops rope to ground, man on ground secures end of rope to ring in chain, then attaches another rope to chain at ball. The man on roof raises ball, level with window to be broken, or is guided by signal of men on ground. The man on ground will take rope attached to ball to center or opposite side of street, pull ball straight out and let swing in to break glass. By holding rope he can prevent ball from swinging in window too far and wrapping around frame. This is the most effective means of breaking windows with ball and chain, as ball can be raised and lowered to different floors, or men can walk from one row of windows to another as per signals of men on ground who operate ball by means of rope attached thereto. (Fig. 5)

Fig. 5

Break skylights with ball and chain. To ventilate roofs it is sometimes necessary to go to adjoining roof or window above to break skylight. The ball and chain can be used for this purpose. Lower ball to roof, estimate distance from building line to skylight. Allow this amount of additional rope, that is attached to chain, in order to have sufficient rope to reach skylight. (Fig. 6) Make rope secure at this point to some part of structure. Withdraw ball and throw to skylight to break same.

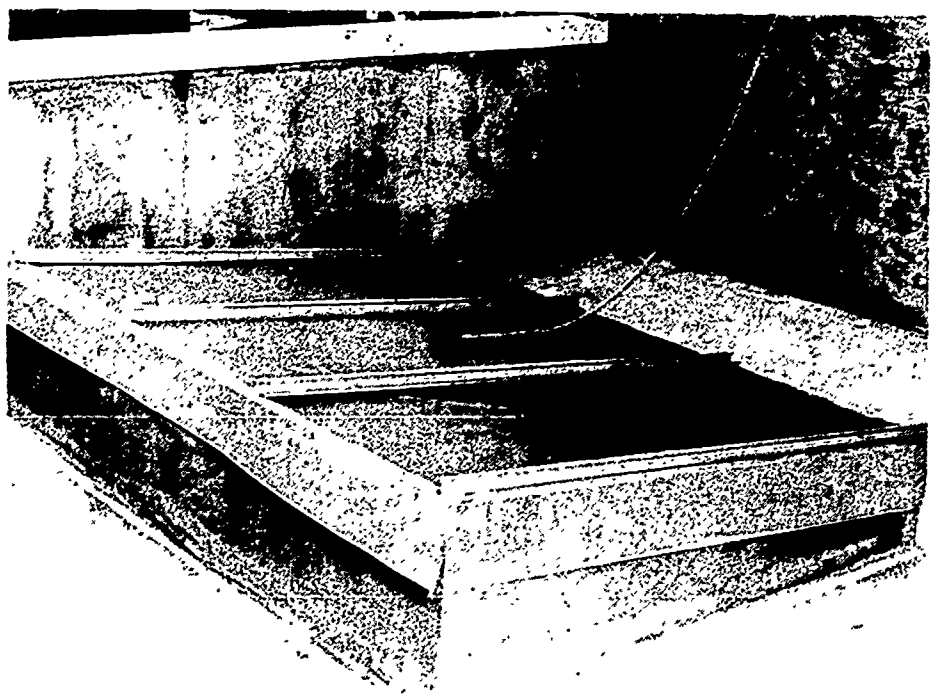


Fig. 6

Break hanging ceiling with ball and chain. To break holes in hanging ceiling where holes have been cut in the floor above, or the roof, or using scuttle opening, it is only necessary to estimate distance to ceiling, secure or retain hold of chain or rope at this point, and let drop to make opening in hanging ceiling. (Fig. 7)

Sledge hammer can be used as a battering tool when attached to rope to break windows. The man at roof lowers rope to man on ground, sledge can be made secure at any point in rope, or it can be tied at end, with another rope attached to loose end. The men will then operate it in same manner as the ball and chain, NOTE: It is not advisable to use if ball and chain can be obtained. (Fig. 8)

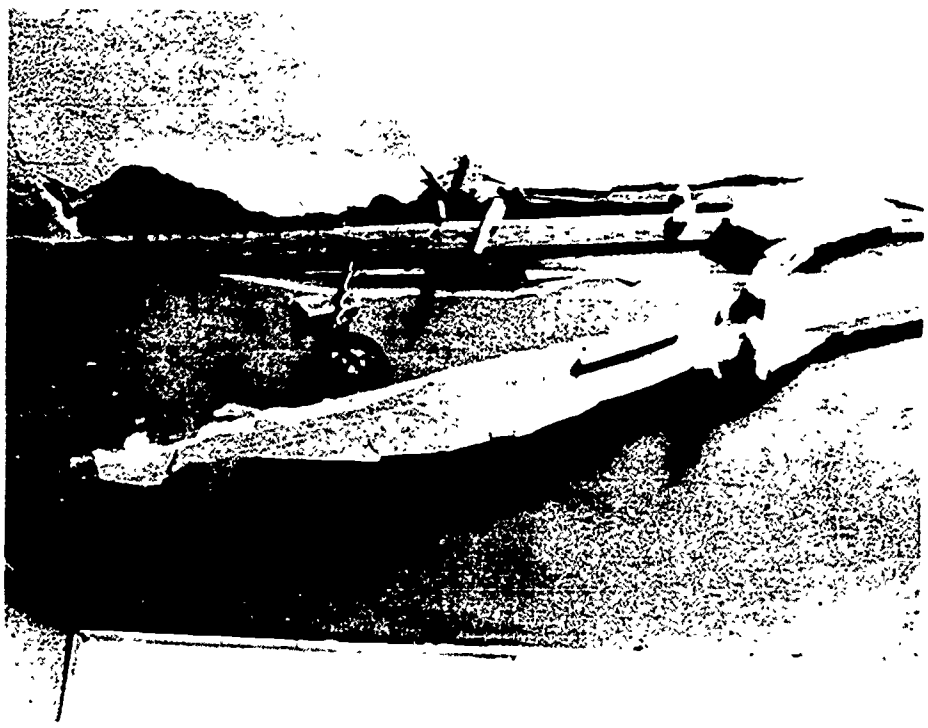


Fig. 7

Fig. 8

4c: HOW TO USE STRAIGHT LADDER AS IMPROVISED BATTERING RAM

INFORMATION:

It is sometimes necessary to break down large doors in gaining forcible entry. When regular battering ram is not available, a straight beam ladder may be used to perform this operation. Care must be exercised not to damage ladder. When properly used, the danger of damage to ladder is small.

INSTRUCTIONS:

1. Place ladder on one beam.
2. Men take positions--two men on each side of ladder, two men in front grasp third and fifth rung, one man next to top beam, other man next to bottom beam, other two men take positions in rear of first two men with hand in the same position. (Fig. 9)

Fig. 9

3. Place ladder with lock between beams.
4. First two men guide ladder, having both beams strike door at the same time. NOTE: If beams do not strike together, ladder is apt to be broken at rungs.
5. Bring ladder back and strike door. NOTE: This operation may be done with two men. Men then place themselves near center of ladder at best balance. It also may be done with three men. Third man at end of ladder to one side or other helping to swing ladder. This also may be done with five men, fifth man at end of ladder on one side helping to swing ladder. When using longer ladder, six to eight men may be used, two men opposite each other along ladder.

5: PRYING TOOLS

INTRODUCTION:

There are many tools of various types in the fire service used for prying. Most of these tools are also adaptable to other uses.

5a: HOW TO USE HAYWARD LOCK BREAKER AS A PRYING TOOL

INFORMATION:

The Hayward Lock Breaker is used for opening or removing hinges, locks, doors, windows, transoms, sidewalk elevator doors, sidewalk gratings, manhole covers, flooring, heavy planking, roof covering and sheathing while carrying on fire department operations.

The Hayward Lock Breaker, also called a claw tool, weighs 8 pounds, is 3½' long, and is a handy tool for general use in forcible entry work. (Fig. 1) So many are its uses that only a few can be enumerated here, but a few applications disclose many special uses to which it can be applied. It is particularly effective in breaking locks, opening doors, forcing windows, lifting shutters, and prying open overhead doors. It is equally effective for opening up for ventilating or for getting at fires in such a manner as prying up the boards on the roof after the covering has been cut away, opening up window frames to disclose interior, pulling metal ceiling, removing lath and plaster, opening wainscoting and baseboards, and when ripping off shingles.

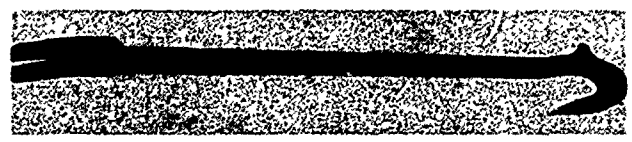


Fig. 1

INSTRUCTIONS:

Breaking a lock with a claw tool is a simple task if the lock is on the outside; the lock can either be twisted off with the claw tool by inserting the point of the tool in the staple or in the bow of the lock, and swinging the handle of the tool around, or by forcing the fork of the tool over the bow of the lock or staple (as shown in Fig. 2) and twisting it sidewise. For forcing doors outward, the fork of the claw tool is quite effective, being driven in between the door and jamb and the door pried outward. (Fig. 3)

Fig. 2

Fig. 3

In prying up flooring, or roofing, after the covering has been removed, the claw tool is used similarly to an axe. However, the handle of the claw tool has greater strength than the handle of an axe so that there is no danger of snapping off the handle when prying heavy planking.

In prying up flooring of any sort the fork end of the tool is driven in between the boards and the hook end of the tool is forced toward the floor, lifting the board up. This same operation is used on roofs.

In ripping the tin off metal roofs the point of the tool is driven into the tin roof and the tin thereon can be pulled back. This method can be used in removing metal ceilings (when used for shallow ceilings is very effective and requires but little space for operation, as a man can stand on table, chair, or ladder while working).

Opening Overhead doors becomes a difficult operation due to their being generally fastened on the inside. The usual method of opening them is to drive the forked end of the claw tool between sill and door, thus springing the door enough to get the feel of the lock. After fastening is struck, the claw end of lock breaker should be driven in at that point and pressure applied. (Fig. 4) If the door is securely locked and does not give to above treatment, the use of the claw tool gives sufficient clearance to insert the point of a Jumbo crow bar and a greater leverage can be applied.

Fig. 4

Removing hinge pins from doors and shutters. If the hinges on the outside are accessible, the pins may be removed (as shown in Fig. 5), or if the pins are not removable, the hinge may be removed by driving the fork end of the lock breaker in between the hinge and casement, and the hinge pried off the casement or door. Sometimes it is advisable to use a chisel and cut the screws or bolts holding them.

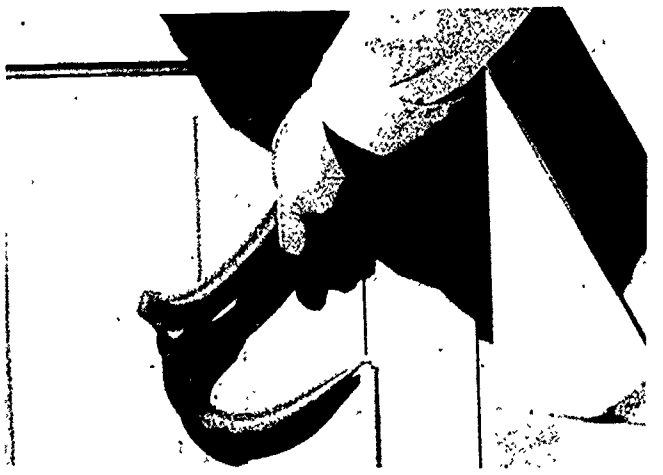


Fig. 5

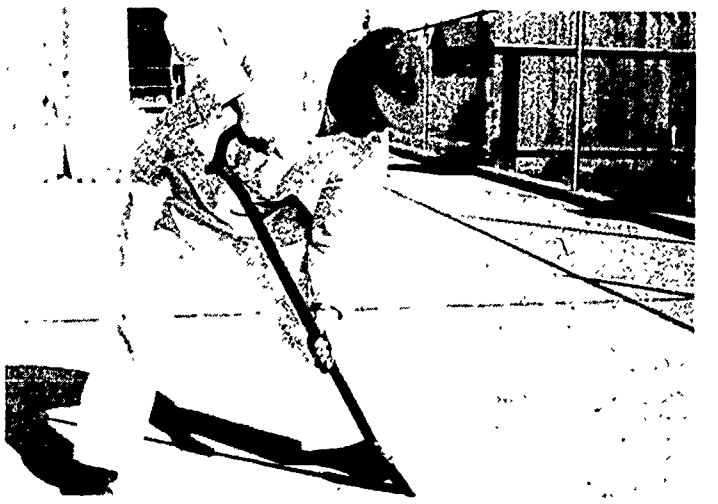


Fig. 6

Removing manhole covers and covers from street vaults sometimes becomes a very difficult job due to dirt, asphalt, and foreign material filling up the space between the casement and lid. A claw tool can be inserted in between the lid and casement and driven in if necessary, and leverage applied to start the cover, and then the handle can be used to remove cover (Fig. 6)

5b: HOW TO USE P AND Q DOOR OPENER AS PRYING TOOL

INFORMATION:

The P and Q door opener (Fig. 7) is made in two major parts known as the "Head" and the "Bar". (Fig. 8)

Fig. 7

Fig. 8

The Head is made of chrome vanadium steel, drop forged, and will stand a pressure of 350,000 pounds per square inch. The Bar, while not chrome vanadium, is specially treated and tempered so as to withstand extremely hard usage. The Head is attached to a specially hardened pin at the heavy end of the bar, and is held in place by friction ball springs.

INSTRUCTIONS:

The P and Q door opener is readily dismantled by merely pressing against the center of the pin with the thumb, while holding the sides of the head with both hands.

Single Door--Opening in--Insert the thin edge of head between door and jamb, opposite lock if possible, or just above or below the lock and lift on bar. NOTE: Head is removable to allow for doors that swing either left or right, also the bar can be used to drive the thin edge of head in between door and jamb.

Single Door--Opening out--Insert claw end of Bar between door and frame, opposite lock and use as lever. NOTE: Insert the claw end of the bar well into crack of door, in order to get sufficient bite before applying leverage.

Double Doors--In or Out, Sliding Doors--Single or Double--Insert claw end of Bar in crack between doors, opposite lock and use as a lever. NOTE: Claw end of Bar must be inserted well into crack between doors in order to get sufficient bite to spring lock.

Upon Doors Opening In which might be too heavily bolted for door opener to force, it is only necessary to insert the thin edge between the door and jamb, about opposite hinge location and apply leverage with Bar to snap hinges. NOTE: Head can be removed to insert in either right or left hand openers.

This Door Opener is very efficient for opening windows. When the claw end is inserted between the window sash and the sill, an enormous leverage can be applied by a straight downward pull.

5c: HOW TO USE HALLIGAN AS PRYING TOOL

INFORMATION:

The use to which a Halligan Tool can be put at fires are many. To an experienced firemen, its adaptability to special uses makes it particularly valuable for fire duty. Its one great advantage is the three (3) driving heads, one for each part; the hook, adz, and claw, which is crossforged from one piece of steel. (Fig. 9)

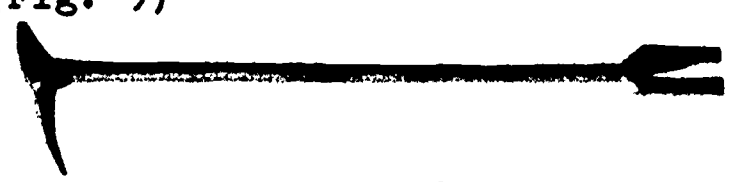


Fig. 9

INSTRUCTIONS:

Opens doors in or out and in confined space. Force the adz of Halligan Tool in between the jamb and door, either just above or below the latch or lock, and pry handle to one side away from the door. (See Fig. 10) Planking, trim, moulding, windows and frames, wainscoting, baseboards, shutters, and gratings are easily removed. It can also be used to break padlocks as shown in Fig. 11.

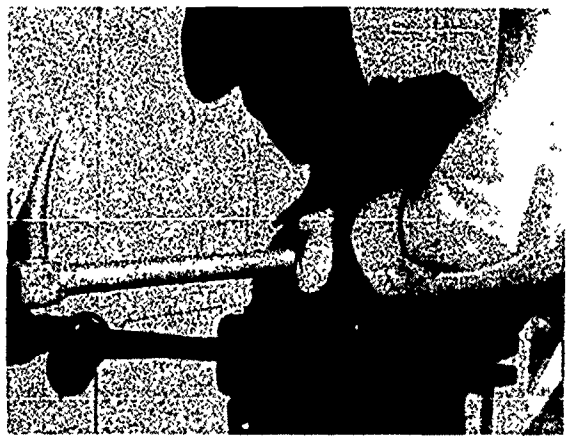


Fig. 10

Fig. 11

5d HOW TO USE PICK HEAD AXE AS A PRYING TOOL

INFORMATION:

The uses to which the pick head axe can be put at fires are many. To an experienced fireman, its adaptability to special uses makes it particularly valuable for fire duty. Its one great advantage is the pick on the back of the head, which is used for prying operations.

INSTRUCTIONS:

Opening swinging doors, hinged single. Force the blade of axe in between the jamb and door either just above or below the latch or lock. Pry handle to one side away from the door and thus spring the door sufficiently to let lock slip past catch, door thereupon opening. (Fig. 12)

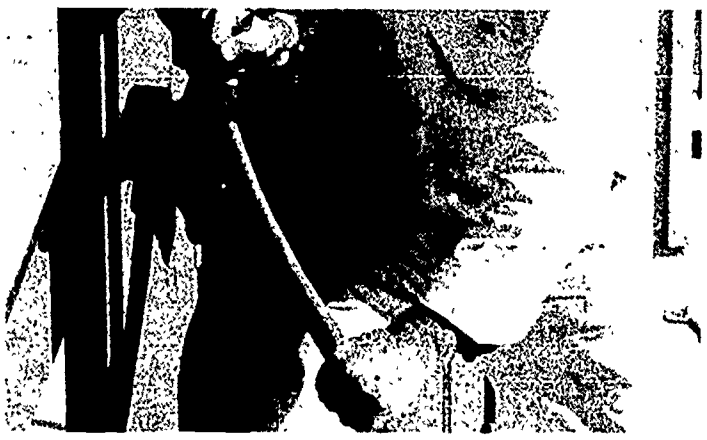


Fig. 12

Opening swinging doors, hinged double. These doors may or may not have windows in them. If they have, care must be exercised not to break the panes unnecessarily. In either case, one door is likely to be bolted both top and bottom while the door alongside operates as a hinged door single. First, notice which way the doors swing. If they swing in, then there will likely be found a small weather strip attached to one of the doors on the outside and covering the crack between the two doors. This must be removed before the axe can be inserted to force the door. When the doors open outward the strip is usually on the inside, though on some doors which open outward

the strip is not on the bolted door, but on the door which is most frequently used. To open double doors, wedge the blade of axe (or blade of the lock breaker) between them and pry them apart. A catch or lock will usually give without appreciable damage. If properly done, even the glass panes should they be present, will not be cracked.

Removing hinge pins. The axe may be used for removing hinge pins in order that doors may be lifted entirely out of the frame. In removing a pin from a hinge, make sure that there is not a nut on the lower end of the pin. After this has been determined, take the blade of the axe and force it between the head of the pin and the top of the hinge prying downward on the blade. The pin may stick. If it does, force another axe beneath the door and sill so as to remove the strain on the hinge while the pin is being taken out. (Fig. 13)

Fig. 13

Fig. 14

Removing iron gratings. Iron gratings may be fastened in several different ways. They may be merely held in position by the friction of the grating against the sill, or may be pivoted at the rear; also, set in masonry and locked in position with hasp and padlock. In the first case, they are opened by using pick end of the axe, forcing it between the sill and the grating, and prying (care being exercised not to break axe handle).

When they are pivoted at the rear, the operation is precisely the same, with the exception that the axe is inserted near the front edge of the grating so that, on prying upward, the greatest leverage is produced. If the grating does not respond to the above method, then the proper thing to do is to drive the claw tool between the sill and the grating with a sledge. When this is done, apply greater leverage as the claw tool has greater strength than the handle of an axe, and there is no danger of snapping the handle as there is when using the axe.

Opening windows. In opening locked windows of the sliding type; that is, where they slide vertically, an axe should be inserted beneath the sash at the bottom and pried upward. (Fig. 14) If the window is fastened with a lock or catch at the center, the screws holding these catches or locks will easily be pulled out without shattering the glass, provided the axe is inserted at the middle of the sash at the lower sill. If, on the other hand, the sash is fastened closed by spring pins which set in the side of framework, these will be bent and pulled out when sash is pried upward.

Opening swinging windows, hinged double. In opening these windows, care must be exercised not to break the glass unnecessarily. In most cases one half of the window is likely to be bolted both top and bottom while the window alongside operates as a hinged window single. First, notice which way the window swings. Sometimes there is a small weather strip attached to one of the windows. If so, that is the window which opens. In most cases the window jamb is recessed to make a weather strip; and in this case, by applying pressure after inserting the axe in the crack, or between the two windows at center and springing the window slightly, you can readily determine which way to apply pressure to open window.

Opening up window frames for inspection after fires. To open up a window frame it is only necessary to pry off the inside facing. It may be necessary to start the axe blade in under the facing by striking the axe with a hammer, but once the blade has been inserted it is an easy matter to pry off the facing. As soon as the facing is off the entire interior of the frame is exposed to view, and any remaining fire is accessible.

In prying up flooring or roofing, (after the tin has been removed, if tin roof) the pick end of the axe is used to pry up the sheathing or flooring, by striking with the pick end in the crack, next to the end or where the flooring or sheathing joins and by applying leverage the sheathing or flooring is started, then by following along board in a similar manner, the entire board is removed.

5e: HOW TO USE CROW AND JUMBO BARS AS PRYING TOOLS

INFORMATION:

The ways in which the crow and jumbo bars can be used are many in gaining entrances and in carrying on ventilation, extinguishing, overhauling, and rescue operations.

INSTRUCTIONS:

The Crow Bar (Fig. 15), used in this Department weighs _____ pounds, is _____ feet long, and is carried by _____ Companies. It is employed for prying up heavy planking, flooring, moving heavy obstructions, and for opening heavy or strongly bolted doors. A crow bar is very useful for moving freight cars short distances. In this operation, the point of the blade is jammed underneath the wheel next to rail, and bar is forced downwards. By working the bar upwards and downwards, the bar can be moved at a slow rate of speed until it reaches the desired point. [redacted]

Fig. 15 Fig. 16

The Jumbo Bar (Fig. 16) used in this Fire Department weighs _____ pounds, is _____ feet long, and is carried by _____ companies. It is employed for prying up heavy planking, flooring, heavy gratings, freight elevator doors, heavy obstructions, moving freight cars, and numerous other uses such as battering ram, breaking out deadlights in the sidewalks, etc.

5f: <u>HUXBAR AS A PRYING TOOL</u>

INFORMATION:

The huxbar is used in the same manner as the Hayward lock breaker. In addition, the huxbar can be used as a tin roof cutter and hydrant wrench. There are many other uses for this type of bar where leverage is necessary to remove obstacles. (Fig. 17)

Fig. 17

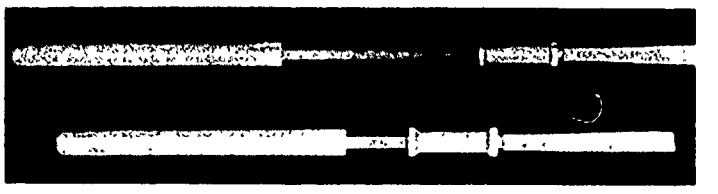


Fig. 18

5g: <u>HOW TO USE THE RAMBAR</u>

INFORMATION:

The Rambar (Fig. 18), which operates on the principle of an air hammer, is designed so that a heavy outer handle slides up and down on a shaft to which is attached a tool steel bit. At the lower end of the stroke a metal plug in the upper end of the outer handle strikes the head of the shaft (which is hardened to prevent battering in use) imparting inertia created during the downward journey of the outer handle to the tip of the Rambar forcing the tool steel bit into the material.

INSTRUCTIONS:

To remove flooring, the spade bit is inserted between the boards near a floor joist and preferably near the end of a board. Hold shaft handle in one hand while working outer handle with the other hand, driving bit between the boards. Use as any other prying tool, to lift up board.

To open doors, insert bit between the door and jamb just above or below the latch or lock. Work outer handle back and forth forcing the bit between the door and jamb, causing door jamb to spread far enough to release lock.

To breach walls insert bit in between bricks in mortar. Hold shaft handle in one hand while working outer handle with other hand. Work outer handle rapidly. Remove bricks. Do not set bit on foot as accidental dropping of the outer handle would cause personal injury.

5h: MASTER SPANNER AS A PRYING TOOL

INFORMATION:

The Master Spanner (Fig. 19) is one of the handier small tools in the fire department. They are usually carried by each member of the department and can be used for breaking padlocks, removing hinge pins, forcing windows, prying doors open, prying off staples and hasps, breaking small panes of glass, and many other prying operations.

The Master Spanner can be used on pin or rocker lug couplings from 1½ inch to 3 inches. Also, it can be used as a hydrant wrench. It is also fitted with hose bib key or hammer head, and is very useful in salvage work.

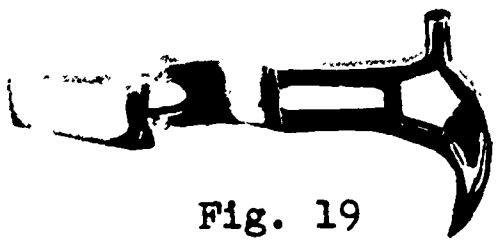


Fig. 19

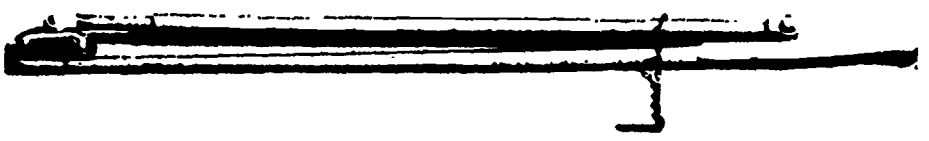


Fig. 20

5i: HOW TO USE DETROIT DOOR OPENER

INFORMATION:

The Detroit Door opener (Fig. 20) can be used for several purposes such as opening doors, removing hinges and padlocks, spreading door jambs, and can be used as a crow bar to move heavy objects. This door opener is carried by all Truck, Salvage, and Engine Companies.

INSTRUCTIONS:

The Detroit Door opener is effective in opening doors that swing inward. In operating the door opener, first measure the height of the door knob from the floor with the door opener, this being the correct distance to place the point of the bar or lever out from the door. (See Figs. 21 and 22) The length of the rod from the fulcrum to the compression piece may be adjusted by removing pin which is employed for locking the extension. Draw the extension out to desired point and replace pin. The rod should be extended until the compression piece is beneath the lock plate or lock at door knob. (See Fig. 23) When this is

done and the point of the lever is securely placed on floor then the handle of the lever or bar is raised, and the door thereby forced inward. (Fig. 24) NOTE: In placing the Detroit Door opener into operation an axe must be brought along with the Door opener in order to make a depression that will prevent the possibility of the point of the bar slipping when operating on such materials as concrete, etc.

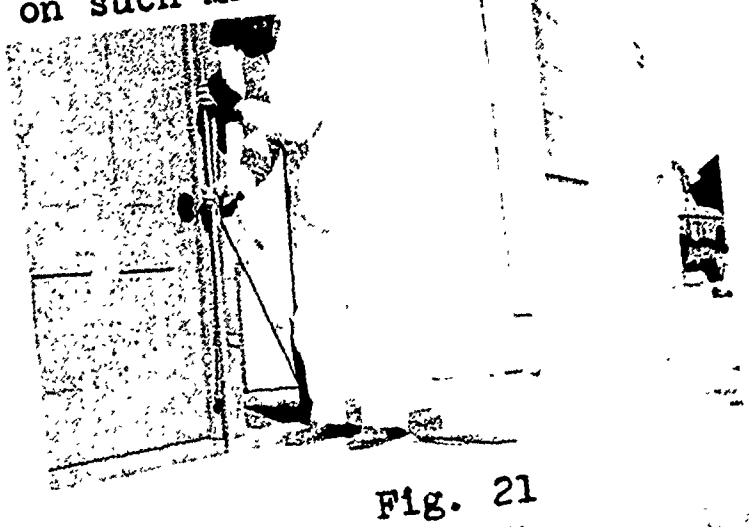


Fig. 21

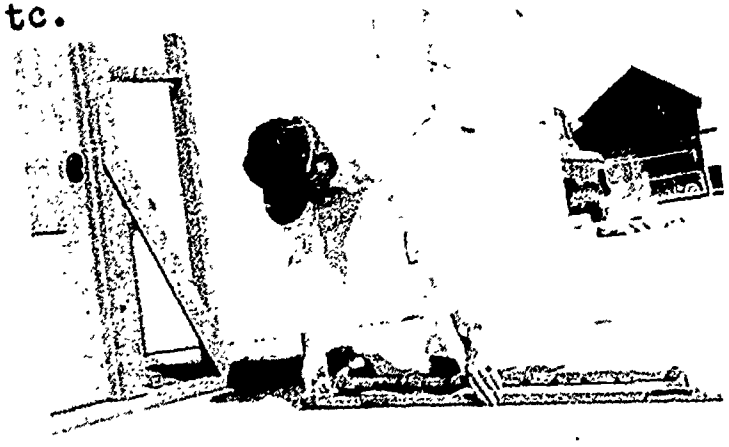


Fig. 22

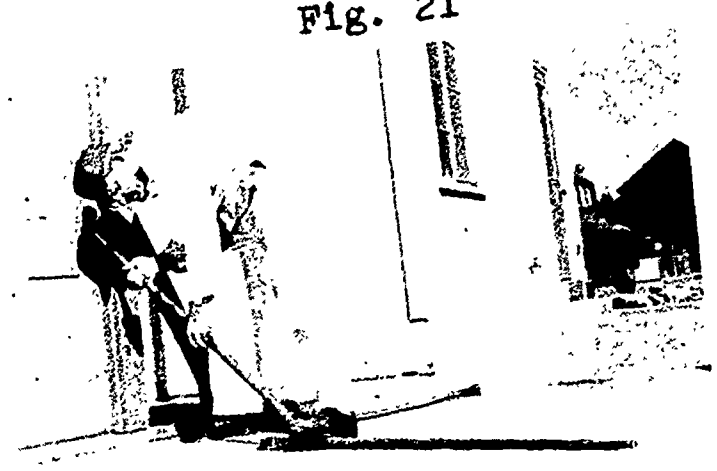


Fig. 23

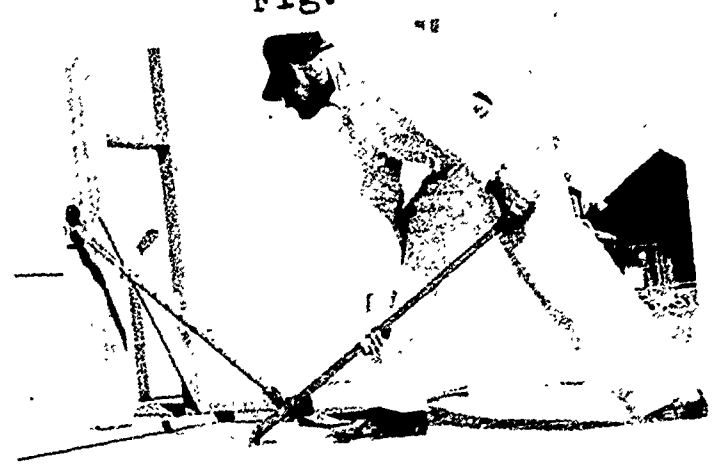


Fig. 24

It is sometimes possible in opening doors in frame buildings to spread the door jambs by inserting the Detroit door opener between the jambs, even with the lock, extending the extension arm to the required distance, and then applying pressure at end of leverage arm, thus springing the door jambs sufficiently to free the catch of lock (Fig. 25)

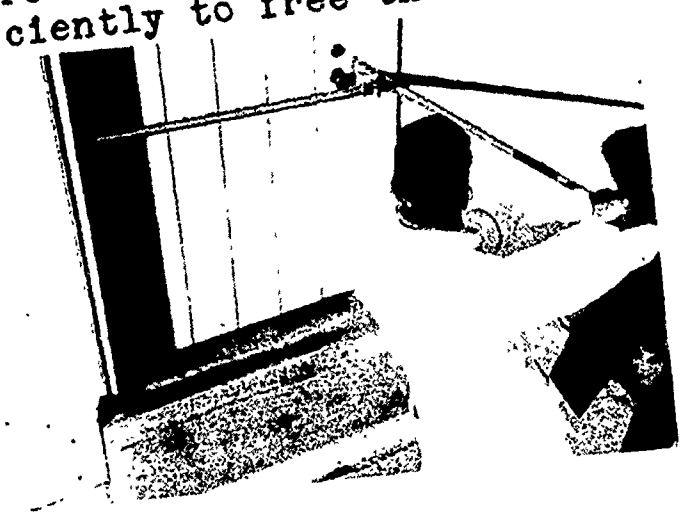


Fig. 25

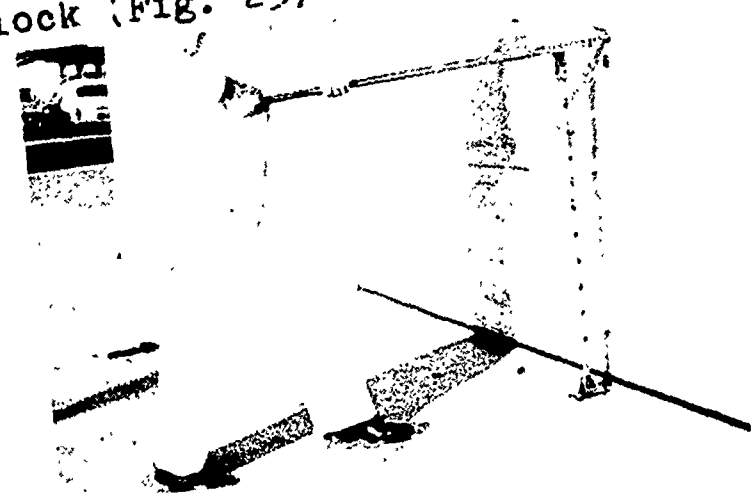


Fig. 26

In removing hinges, hasps, and padlocks by the use of the Detroit door opener the length of the rod from the fulcrum to the compression piece must be adjusted. Determine the distance from the hinge, hasp, padlock, or door handle to the floor, make proper adjustment of rod, and fasten with pin. Compression piece is placed on floor and the claw end of leverage arm or bar is placed beneath hinge, hasp, or padlock, and pressure applied by pulling down on bar, making it possible to snap screws, bolts, nails, or pull them from their seat. (Fig. 26)

Detroit door openers can be used for moving heavy objects away from doorways and in skidding stock during overhauling operations. They can also be used as a pry in various operations, and it is possible to use claw end of bar similarly to a crow bar.

6: LIGHTING EQUIPMENT

INTRODUCTION:

Many forms of portable lighting equipment are manufactured to supply light for operations where normal light is deficient. Portable lights are also valuable for signalling at night. Care in the selection of all electric lighting equipment should be exercised to provide lights that are safe for use in flammable vapors. Mine safety-approved, rubber-covered flashlights and non-sparking switches only are safe for fire department use. A brief description of some of the more common forms in general use follows:

INFORMATION:

6a: Five-cell Flashlight (Fig. 1)--generally carried by chief officers and investigators.

Fig. 1

Fig. 2

6b: Two-cell Flashlight (Fig. 2)--generally carried by company officers for general use.

6c: Two-cell Boy Scout Flashlight (Fig. 3)--generally carried by members of salvage companies. They are equipped with a spring clip with which the light may be fastened to the coat, belt, or helmet while working.

Fig. 3

6d: Pen Light (Fig. 4)--generally carried by members of rescue companies and are used for close examination of patients during rescue work.

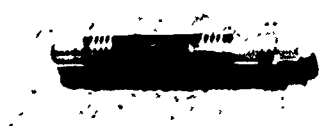


Fig. 4

6e: Kerosene Lanterns (Fig. 5)--carried on apparatus and used in the protection of hose lines, as danger signals for excavations, obstruction, lines laid across railroads, to block street intersections, and as an emergency light while operating at fires. Caution must be exercised in their use as the open flames of these lanterns are dangerous when used in gas or fumes. They must be extinguished after use. There are cases on record of explosions and fires occurring in the engine room of fire stations caused by the flame of lanterns which were not extinguished after returning to quarters, and they have ignited gasoline fumes from a leaking carburetor or caused other damage from overheating.

Fig. 5

Fig. 6

6f: Electric Hand Lantern (Fig. 6)--carried on some apparatus and by some chief officers and investigators. They are for general use and are usually provided with one or two standard or special dry cells.

6g: Portable Spot or Floodlight (Fig. 7)--generally carried by salvage squad and sometimes by other companies. For use in covering, overhauling, and extinguishing operations. They are generally equipped with a wet battery ranging in size from small lanterns to six-volt storage batteries which will last from 8 to 10 hours without recharging. Sometimes provided with jack to plug into electric system of apparatus on emergency cars.

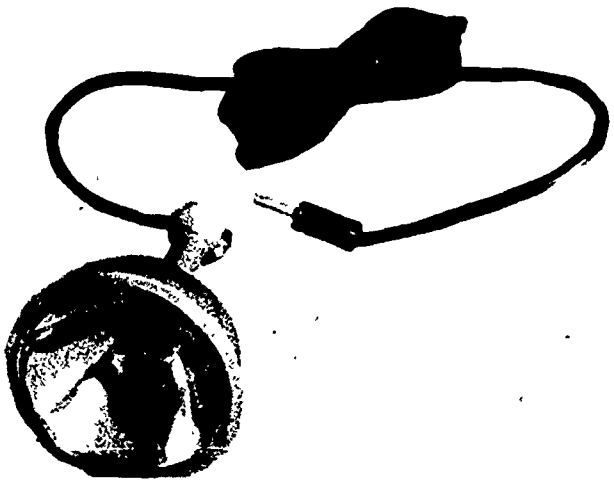


Fig. 7

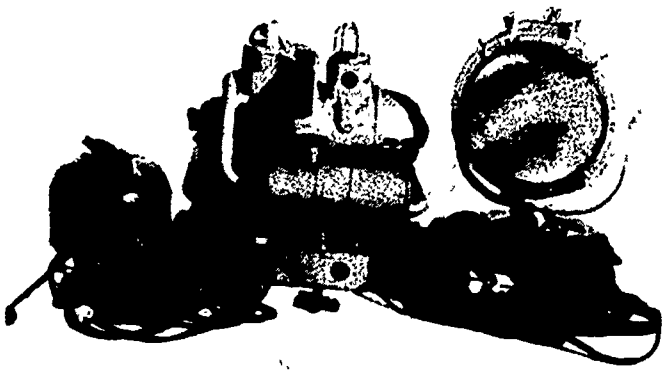


Fig. 8

6h: HOMELITE PORTABLE FLOODLIGHTING UNIT

INFORMATION:

Homelite portable floodlighting unit (Fig. 8) is coming into use in some departments and used in floodlighting night operations with resultant increase of efficiency and safety. The power plant weighs 89 pounds, complete with engine. It generates 1,250 watts and can operate several floodlights at one time. It is equipped with an air-cooled motor, and runs about four hours on a gallon of gasoline. Lubricating oil is included in the gasoline. The usual equipment consists of two 500-watt floodlights, one 250-watt spotlight, and 165 feet of rubber-covered extension cord with 2 and 3 lock-type outlets. Extension cord for transportable lights may also be provided.

INSTRUCTIONS:

1. See that gas tank is full.
2. Set motor in safe, convenient place.
3. Turn on gas.
4. Turn butterfly valve to choke position.
5. Wind starting rope on crank.
6. Pull starting rope. (Motor will generally start on the second pull)
7. Lock all line connections while using.

TO STOP MOTOR: Press "stop" button on top of motor.

CAUTION: When discontinuing operations shut off gasoline pet cock and allow carburetor to run dry.

NOTE: Motor and lights should be checked frequently to see that they are in working order. Extra bulbs, gasoline, oil, line and starting cord should be carried. Care in handling lights must be exercised as they are breakable.

7: SAWING TOOLS

INTRODUCTION:

Wood saws are used in connection with putting cellar pipes in operation, ventilating basements, cellars, rescue operations, etc., and for opening up heavy planked floors, or similar operations. Hack saws are used in forcible entry work and are especially useful for sawing bars of barred windows.

7a: RIP, CROSSCUT, AND FIREMEN'S HANDSAWS

INFORMATION:

Rip (Fig. 1), crosscut (Fig. 2), and firemen's saws (Fig. 3) are generally carried by truck, salvage squad and rescue companies. They should be placed in keepers in the equipment box. They are used in ventilating and for various other purposes. NOTE: The two-inch wood auger can be used to drill several holes in order to start rip or cross cut saws. The fireman's handsaw can often be used without boring holes on account of the curved cutting edge, smaller point, and adjustable handle.

Fig. 1

Fig. 2

Fig. 3

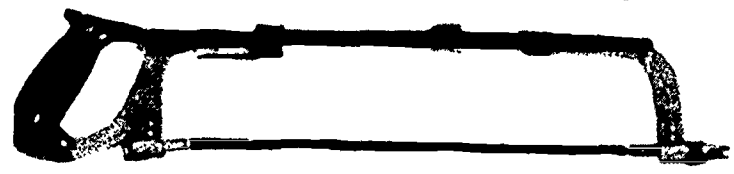


Fig. 4

7b: HACKSAWS

INFORMATION:

Hacksaws (Fig. 4) are carried for use in forcible entry and rescue work, such as the sawing of iron bars, etc. It is a good practice to tape three extra blades along the top part of saw frame. New blades should be installed with the point of teeth pointed forward.

7c: PORTABLE POWER SAWS

INFORMATION:

Portable power saws are generally carried by truck, salvage and rescue companies. They are of two types, the gasoline powered (Fig. 5), and the electric powered (Fig. 6). They are used for ventilating, falling unsafe structural members, cutting drainage holes etc.

Fig. 5

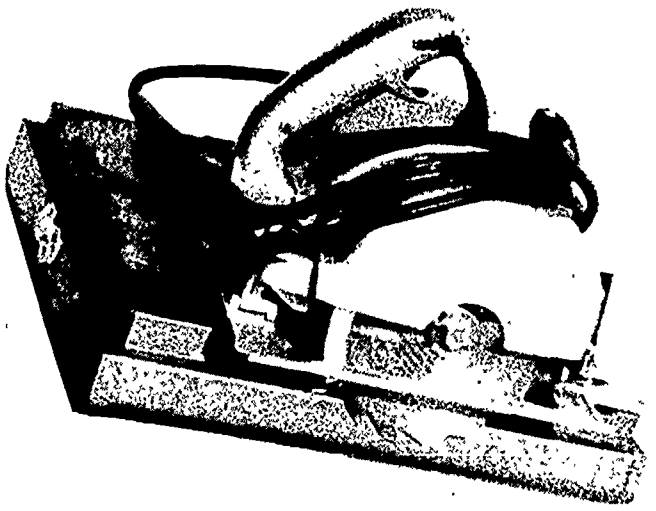


Fig. 6

8: BORING AND DRILLING TOOLS

INTRODUCTION:

Wood augers are used in connection with boring holes in flooring, roofs, etc. to start wood saws; also for draining operations in floors, tanks, etc. Star drills are used for drilling holes in cement or concrete, bricks, terra cotta, etc., for various purposes.

INFORMATION:

8a: Wood auger (Fig. 1) is approximately two feet long and has a bit two inches in diameter. In using the auger, care must be observed to keep the bit from striking nails or other metal. The safest method is to drill the hole away from joist, keeping the bit well in the center of the board. The main uses of the wood auger are: For providing drain holes in flooring to release water; to provide holes for starting saws; for draining wooden tanks in the event that valves are inoperative or inaccessible.

Precautions must be taken when boring holes in flooring to keep away from floor beams, for if sent through a beam, that beam is appreciably weakened and a hazard created. When boring a hole in the floor, as a starting point for the saw keep the hole near a beam. This will make sawing easier and subsequent repair of the floor firmer. Avoid cutting hole in center of aisle.

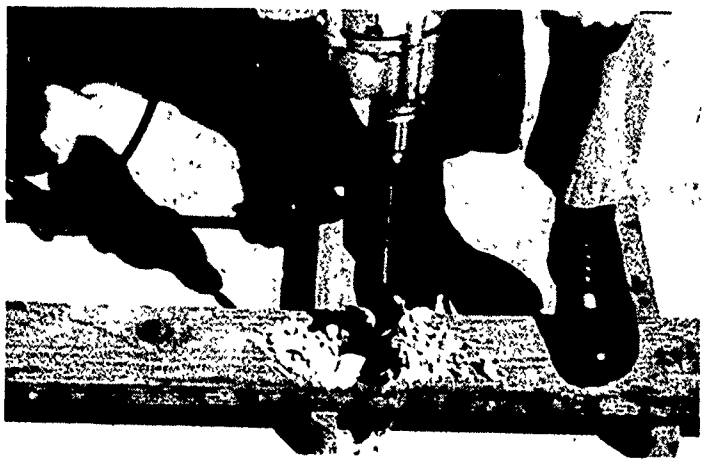


Fig. 1

8b: Star drills (Fig. 2) are carried in two sizes, 3/4 inch and 1 inch. These drills are used for drilling hole in cement or concrete, brick, etc. NOTE: While striking the drill with a hammer, the drill must be turned every few blows so that the cutting edge comes in contact with material at a different point.

Fig. 2

9: CUTTING TOOLS

INTRODUCTION:

Cutting tools of many kinds are carried by all companies for the purposes of ventialting, salvage, rescue, forcible entry, etc.

9a: PICK HEADED AXE

INFORMATION:

The fire axe (Fig. 1) is one of the most important pieces of equipment carried by all companies in the fire department, and it is one that is given less thought and care than most other tools.

The fire axe is carried by all truckmen in a belt provided with a proper shield to hold the blade and pick, which allows the free use of both hands to do other work or to climb ladders or fire escapes, eliminating the possibilities of dropping axe on those below, which might occur if the axe was carried in any other manner.

The pick head axe has several advantages over the flat head axe. It is easier to carry in a belt, can be used to pull up flooring and roof boards or to remove partitions, and for pulling lath and plaster in places inaccessible to pike poles.

If the fire axe were used exclusively for cutting wood free from materials harmful to the blade, a wood chopper's axe would be ideal. However, the many requirements and severe service expected of a fire axe, such as all kinds of prying as well as cutting, make it advisable to have a pick head axe.

Fig. 1

INSTRUCTIONS:

1. When cutting wood of any kind it should be done at an angle with the grain of the wood, instead of straight across it. About 45° to 60° is, in the opinion of authorities, the correct angle. (Fig. 2)

Fig. 2

2. When cutting diagonal sheeting, it should be done, wherever possible, in the direction towards which the sheeting runs. In this manner the chips have a tendency to split out, while if the cutting is done against the sheeting, the axe is apt to bind and cause extra effort to achieve results.

3. Wherever possible, the cutting should be done across the grain of the board instead of straight down, which will give a firmer object to cut against. Also, do the cutting as close to a joist or studding as possible for the same reason.

4. When cutting flooring or straight laid sheeting it may be necessary to cut at a greater slant from the perpendicular than in the case of a diagonal sheeting.

5. In cutting through a lath and plaster wall, follow the lath down center of studding to prevent excessive damage to plaster.

6. When cutting a hole in a roof for ventilating purposes, the pick headed axe can be used for scraping away the gravel and ripping up the tar paper (if a tin covered roof, the tin roof cutter is employed for this purpose). In cutting a hole in a roof, the opening should be made rectangular or square. This is easier to make than an oval or odd shaped opening. At the same time it is much easier to repair.

7. In cutting the boards, first stand on windward side of hole to be cut, sound with the axe the location of the roof beams or rafters. Then cut along edge of roof beams.

8. You will find there is little spring to the boards when they are chopped closely along side of beams.

9. In cutting up the roofing, do not remove any boards until you have cut all boards on both ends.

10. The object of this operation is to permit ripping up of all boards at one time, for if but one board were cut and then removed, the hot air and gases which come out make it very difficult for the men to finish the job.

11. After both ends of the boards are cut, then rip them up at one time with the pick head of axe (also claw tool can be used for this purpose). In ripping up the boards after they have been cut, stand with your back towards the wind. This will keep the smoke and heat away from you as the boards are being ripped up and after the first board has been removed. (After the section of roof has been removed, make sure that ceiling below is opened up)

    NOTE: A truckman should be able to cut right or left handed. Cutting in difficult corners and under obstructions can be done in a workmanlike manner by men who have been schooled in the proper way to use a fire axe. Good axes and good axmen are important to efficient fire operations.

    Precautions which should always be taken are to see if you have sufficient room to swing an axe, and that there is no overhead obstruction which you may strike.

12. Cut close to yourself as much as possible for the reason of possibilities of striking those working around you. Always cut at an angle with the grain of the wood, never straight across it, and remember to always be careful when using an axe as it is a very dangerous as well as a useful tool, and although wood is sometimes called soft, it takes considerable energy to cut through a piece of it, so hit it hard.

9b: <u>THE FLATHEADED AXE</u> (Fig. 3) is carried by many departments for use in clearing brush, shrubs, etc. Can also be used as a hammering instrument.

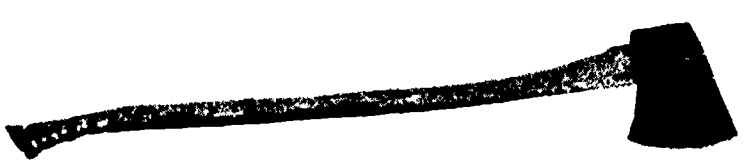
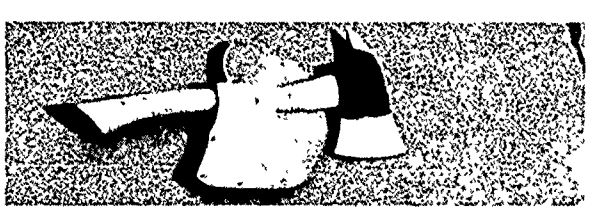


Fig. 3



9c: THE PICK HEADED HATCHET (Fig. 4) is very useful in working in tight places.

9d: THE HAMMER HEADED CHISEL

INFORMATION:

The hammer head chisel is used in forcible entry and rescue work. It can be used in cutting rivets, padlocks, bars, hinges, cement, and for splitting heavy planking.

INSTRUCTIONS:

In using the hammer headed chisel (Fig. 5), the person holding it keeps as far back as possible extending the arm in line with the cutter to provide as much distance as possible between the tool and the person holding it. The man swinging the sledge stands at a point at right angles to the handle. In other words, he does not stand in line with the man holding the chisel and tool itself, but stands to one side so that if the head of the sledge comes off, there will be no danger of striking the man holding the tool.

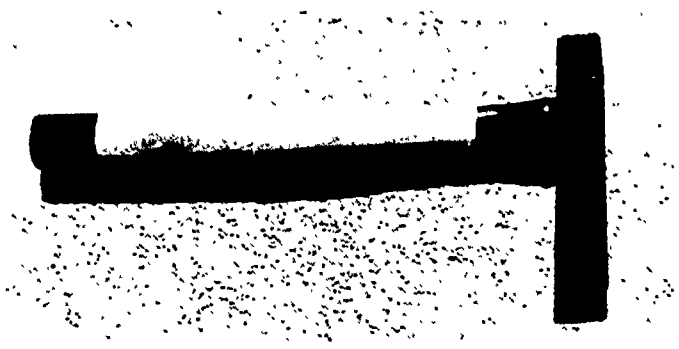


Fig. 5

9e: THE VOLESKE BOLT CUTTER NO. 15

INFORMATION:

The Voleske Bolt Cutter No. 15 (Fig. 6) weighs 9½ pounds, is 30 inches in length, cuts iron rods and steel cable up to 5/8 inch in diameter, and will cut to within 1/16 inch of nut, leaving a clean edge for removal of the nut. These cutters are not to be used on electric wires.

Fig. 6

Fig. 7

9f: HOW TO USE THE VOLESKE BOLT CUTTER NO. 17

INFORMATION:

The Voleske Bolt Cutter No. 17 (Fig. 7) weighs 19½ pounds, cuts cables and bars of all shapes and sizes up to 3/4 inch square. This is designed especially to meet the requirements of rescue squads. It can be quickly and easily operated by a single fireman standing on ladder or window ledge. The bar supports the shears while it is being cut off.

INSTRUCTIONS:

Open the jaws of shears by releasing cam on side of ratchet drum, place foot on lower shear shank, lift the top shank of shears until cable is entirely unrolled from drum. Place the cable or bar to be cut between jaws of shears and press down the retaining dog on side of shear jaw, so that the material to be cut is held in square alignment with shears jaw.

Now take up slack in cable of shears by engaging the pawls of side of ratchet drum and turning ratchet drum handle. Move the long ratchet handle up and down until the material in shears' jaws is completely cut.

9g: PORTER BOLT CUTTER (Fig. 8) are carried by many departments for use in cutting chain link fence, padlocks, hasps, etc.

Fig. 8

9h: WIRE CUTTERS

INFORMATION:

During fire department operations live wires are frequently encountered and occasionally obstruct the work of the department, making work of the men more hazardous. If the power cannot be shut off on live circuits, it sometimes becomes necessary to cut the wires.

The fireman's contact with and work around high tension wires often necessitates the use of some tool for cutting them with safety. Cutters manufactured for this purpose are shown herewith. Fig. 9 is called the Steck Wire cutter. A pertinent feature of this tool is the insulation of the handle which must be able to withstand high voltage for protection of the person using it. The cutter has hard rubber handles capable of withstanding, with a large factor of safety, voltages over all wires, cutting of which is permissible.

NOTE: If the overhead wires entering the property are bare, spaced 24 inches or more apart, and are attached to insulators more than 6 inches in height, the potential of such wires will be 15,000 volts or higher, and should not be cut while energized under any circumstances.

(Fig. 10) shows the Porter wire cutter, with finder hook and soft rubber handles, which is carried by a large number of departments.

The "Mechanical Axe" (Fig. 11) is equipped with a wooden handle divided into two sections, each of which is five feet long. It is used to reach overhead wires and allows the operator to keep a greater distance away from electric wires.

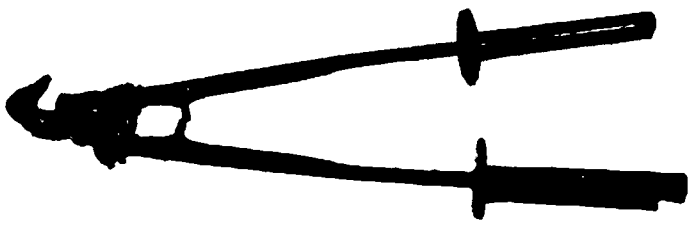


Fig. 9

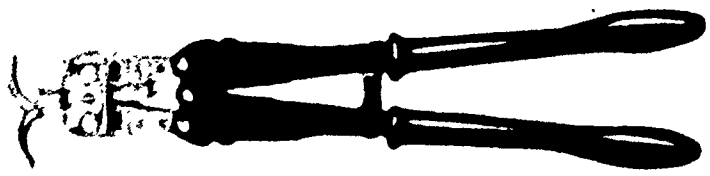


Fig. 10

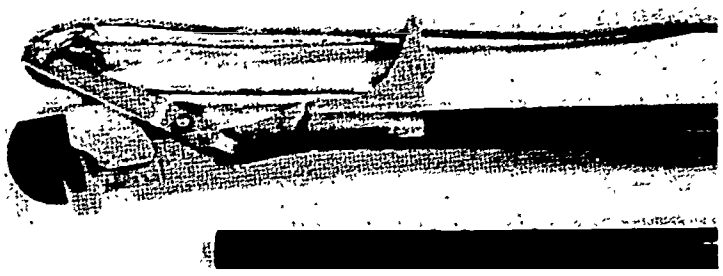


Fig. 11

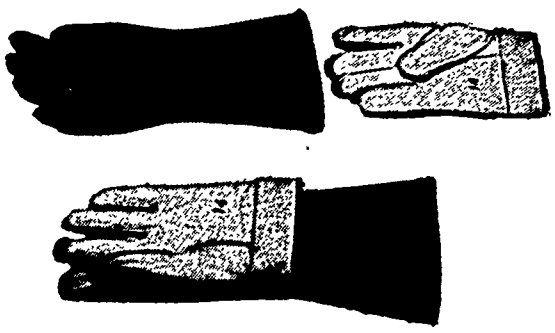


Fig. 12

NOTE: Steck, Porter Electric, and Mechanical Axe Wire Cutters are manufactured for the purpose of Cutting copper wire only and their use on iron or steel wire or bolts will ruin them.

Rubber gloves are employed in connection with electric wire cutters for severing live wires. They provide an additional safeguard in the event that the insulation on the handle of cutters is cracked or deteriorated. They are also effective in the rescue work of persons caught by live electrical apparatus.

NOTE: The rubber gloves used in fire departments are of the gauntlet type and should be tested every 60 days to withstand a voltage of 15,000. Wrist length leather gloves may be used with rubber gloves and are worn over rubber gloves to protect them. (Fig. 12)

91: PLASTER HOOK

INFORMATION:

The plaster hook penetrates plaster and lath easily. It is useful in removing metal ceilings, making openings in them and for removing plaster partitions or other obstructions to get to fire.

The plaster hook (Fig. 13) is made of tooled steel and the spear head and blade on each side have sharp knife edges. The blades close to permit entrance into the opening being made and open automatically when entered, carrying away the obstruction upon being withdrawn.

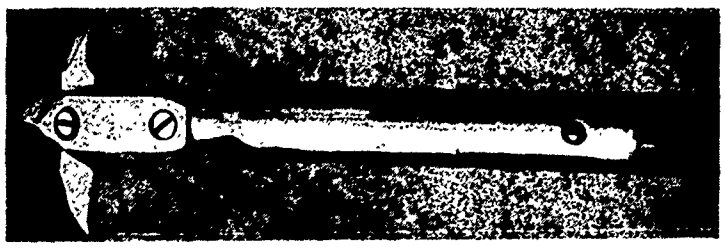


Fig. 13

9j: HOW TO OPERATE TIN ROOF CUTTERS

INFORMATION:

Rotary type--the function of this tool is to remove or cut the tin on roofs. Ordinarily the tin is placed over the roof and on top of the tin is a layer of tar and gravel. Before using the tin roof cutter, the gravel is usually scrapped off. The cutter shown in Fig. 14 employs a rotary cutter which rotates when the tool is drawn through the tin.

INSTRUCTIONS:

To operate, the chisel side of tool is driven into the tin, then cutter is turned over and the point of the cutter is inserted in hole beneath the tin. Then it is merely a question of drawing the tool along and the cutter does the work.

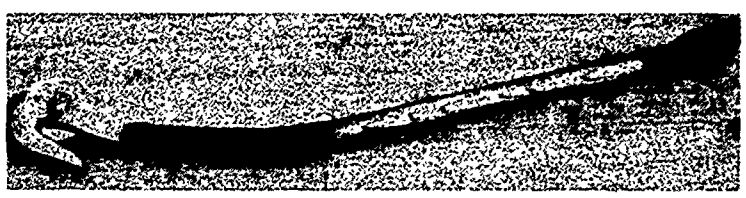


Fig. 14

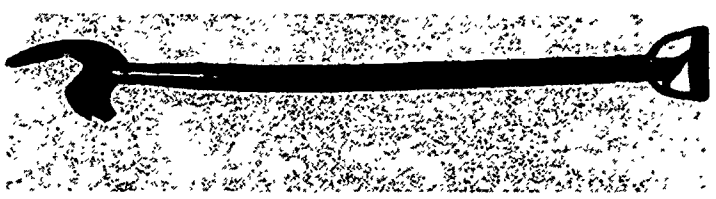


Fig. 15

"Can Opener" type--this type of tin roof cutter (Fig. 15) is operated by driving the point of the tool into the tin, and the tin pried up sufficiently to get the point beneath it. Then the cutter is forced along, in front of the operator, and the tin is cut on the knife edge of the cutter.

9k: BRUSH HOOK

INFORMATION:

The brush hook (Fig. 16) is carried on brush or grass fire apparatus, and is used for cutting brush, during fire extinguishing operations, and in constructing fire breaks.

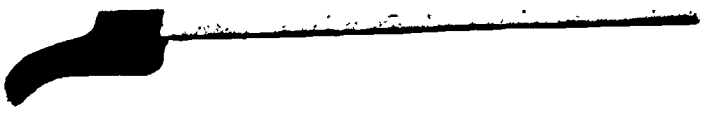


Fig. 16

Fig. 17

91: PULASKI

INFORMATION:

The Pulaski is used during extinguishing brush and grass fires and in constructing fire breaks. Roots, branches, and growth of various kinds encountered in constructing fire breaks or trenching can be cut with cutting edge. (Fig. 17)

10: HOW TO OPERATE ACETYLENE CUTTING TORCH

INTRODUCTION:

There are times in fire fighting when ordinary hand tools such as axe, bars, etc., will not do the job required.

It becomes necessary to use some other means of gaining entry, ventilating, or as a means of rescue. Some departments have installed acetylene cutting equipment for this purpose.

INFORMATION:

The equipment consists of two tanks, one of oxygen, the other acetylene, hose, gauges, cutting torch, and various sized tips. (Fig. 1)

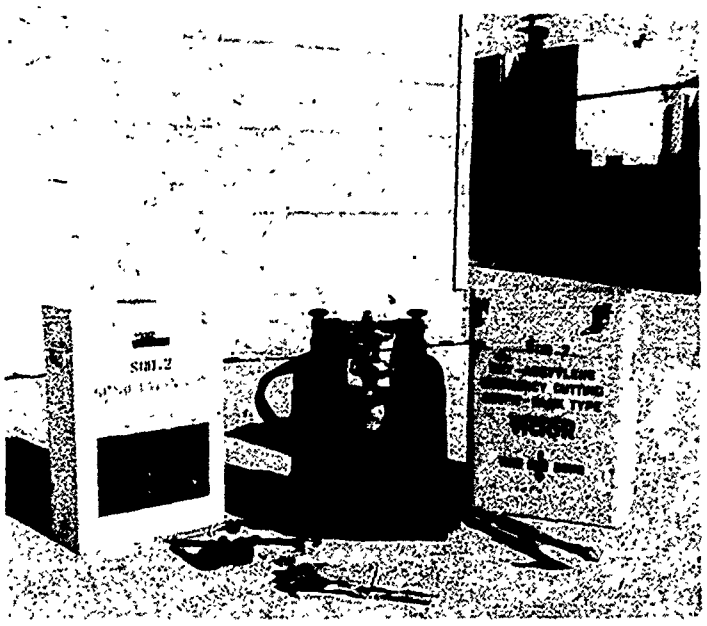


Fig. 1

The torch has two control valves: One for oxygen and one for the acetylene. An excess oxygen trigger is installed on torch so that when the metal glows a cherry red the oxygen trigger is pressed and the cutting operation proceeded with. When tanks of oxygen are exposed to a temperature greater than 70° F, they absorb heat and the pressure is increased 3.7 lb. per square inch for every degree in temperature over 70°.

Pressure gauge on oxygen tank is so arranged that if it bursts from any cause, the metal back blows out.

Working pressure should not exceed 75 lbs. per square inch on oxygen hose as it might burst and cause unnecessary delay. If at any time either hose bursts, it should be kinked between break and tank and repairs made.

The acetylene tank contains a liquid, an absorbent packing containing cells; packing absorbs liquid and turns it into gas, which burns readily. Gas from acetylene tanks has a smell similar to ether, and if hose leaks, it can readily be detected by the smell. The working pressure on acetylene hose should not exceed fifteen pounds. There is a great danger from leaking acetylene tanks in confined places.

INSTRUCTIONS:

To use torch, be sure that both outlets are shut off, open valves at tanks so that oxygen gage shows 75 pounds and acetylene gage shows 15 pounds. Open acetylene valve at torch and light tip. Open oxygen valve at torch enough to produce a good blue flame, heat metal to be cut a dull red, press oxygen trigger on torch and cut. Fig. 2 shows cutting equipment in operation. Note goggles and gloves used for safety purposes.

Fig. 2

CALIFORNIA FIRE TRAINING PROGRAM

Unit B

LIFTING AND HOISTING EQUIPMENT

11. LIFTING TOOLS
12. HOISTING AND PULLING EQUIPMENT
13. INSPECT AND CARE FOR TOOLS IN QUARTERS

OBJECTIVE

To develop the ability to care for and use the various tools for lifting and pulling with a maximum of safety and a knowledge of the value of one tool to another.

11: OPERATE LIFTING TOOLS

INTRODUCTION:

This information is intended to include only the operating principles of jacks commonly found in the fire department. All automotive equipment operated by fire departments should carry the jacks furnished by the manufacturer of that apparatus.

In addition to the purpose for which they are provided, jacks may be used to advantage in many operations that require considerable lifting power such as wrecking and rescue operations.

INFORMATION:

Care should be exercised not to overload jacks beyond their rated capacities and to always place under load so that they will not slip. Sufficient base or footing should always be provided. Screw jacks (Fig. 1) are carried on some apparatus and can be used in a comparatively small space beneath an axle, heavy timbers, etc. They work on a threaded screw principle on a stationary base turned by a lever inserted in holes near the top of the cap which works on a swivel.

Fig. 1

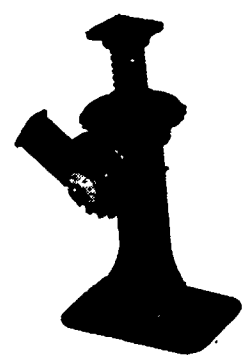


Fig. 2

Single ratchet handle types of jacks (Fig. 2) of various sizes are provided on some apparatus. The heaviest types can be used on operations that do not require a lifting capacity of more than five tons. They work by setting the pawl attached to the handle in the position desired. The handle is then worked up and down until the necessary height is obtained. To lower, it is necessary to reverse the position of the pawl.

Double worm gear type jacks (Fig. 3) are provided on some apparatus and are of various lifting capacities. They usually operate with a folding extension handle which is provided with a socket that is connected to an exposed gear shaft. The handle is turned in the desired direction to raise or lower the load. Some such jacks, usually of heavier capacities, are provided with a ratchet type handle provided with a pawl which is set in the desired position before the handle is inserted.

Hydraulic jacks (Fig. 4) are provided on some apparatus and are used on operations that require great lifting capacity. They are raised by turning the release valve to the right until closed. The handle is locked on pump lever and worked up and down to the desired height. To lower, turn release valve one full turn to the left and repeat action with handle. After use, the ram is pushed down and the release valve is closed. Heavier jacks are provided on wreckers and specialized equipment for certain purposes. All jacks with which the department is provided shall be regularly inspected, and the men should be familiar with their operation and possible use.

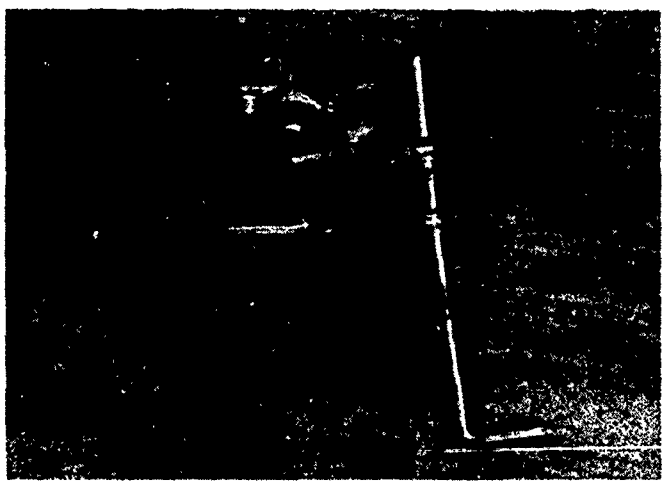


Fig. 3

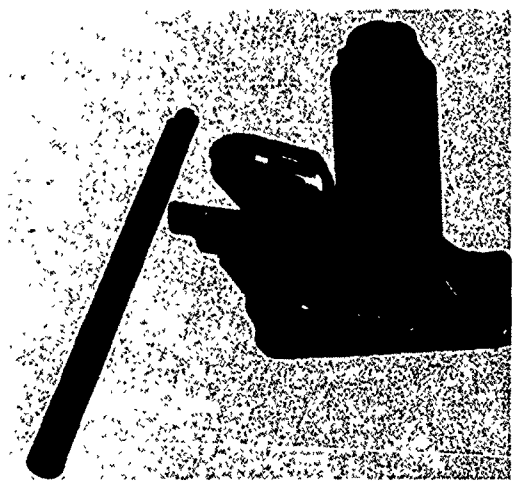


Fig. 4

12: HOISTING AND PULLING EQUIPMENT

INTRODUCTION:

The fire department uses hose roller, ropes, pike poles, plaster hooks, axe, hammer head pick, and the pull-down hook for use as hoisting and pulling equipment in carrying on extinguishing, overhauling, forcible entry, ventilation, salvage and rescue operations. NOTE: For heavy operations, a block and tackle should be employed.

Bird's Nest Coil (Fig. 1)--Manila rope, 1/2 and 3/4 inch, in lengths of 75 to 100 feet are carried for use in carrying on operations, such as raising and lowering equipment when operating above ground in buildings, pulling down unsafe walls, partitions, timbers, etc. NOTE: The fire department measures the diameter of rope. Seamen measure the circumference.

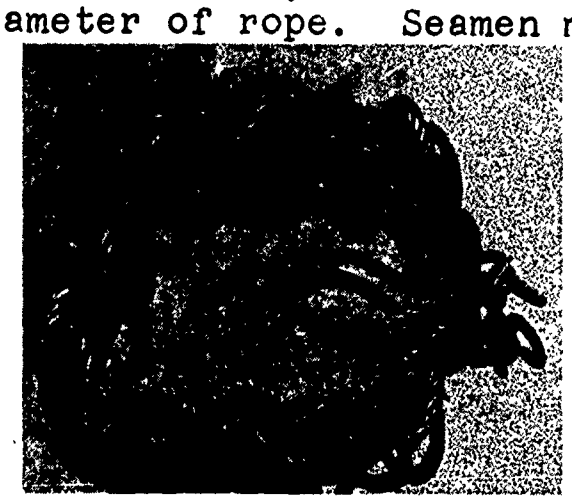


Fig. 1

Fig. 2

12a: HOW TO USE HOSE ROLLER TO HOIST EQUIPMENT ALOFT

INFORMATION:

Hose rollers (Fig. 2) are carried for use in hoisting or lowering equipment when operating in buildings above ground level. It consists of a metal frame so curved that it will fit over a window sill or edge of roof. It contains two rollers over which ropes may be drawn, thus eliminating the possibility of cutting rope on sharp edges of sills, cornices, roofs, etc., while raising or lowering hose, ladders, etc.

INSTRUCTIONS:

The roller is placed over window sill, cornice, or edge of roof and made secure by means of short rope attached to roof support or other projections. A newer type will fasten to any wall by means of a screw clamp.

12b: HOW TO USE PULL-DOWN HOOKS

INFORMATION:

Pull-down hooks are carried for use in extinguishing, ventilation, rescue, and over-hauling operations, such as pulling down unsafe walls, (Fig. 3) partitions, baled goods, boxes, timbers, supports, removing obstacles, etc.

It consists of a heavy forged steel hook which is attached to a 10-foot solid link chain with forged ring at end and a 16-foot wooden detachable handle.

Fig. 3

Fig. 4

INSTRUCTIONS:

1. To operate, stand back safe distance, attach rope to ring in end of chain, insert handle in end of hook, raise hook over object and remove handle. A sufficient number of men are lined up along rope, and at a command, all give a sudden tug to start the object. In some cases the rope can be attached to apparatus in order to provide sufficient power to pull down object. NOTE: Care must be exercised in placing hook to prevent injury to crew in carrying on above operations.

12c: HOW TO OPERATE PIKE POLES

INFORMATION:

Pike poles (Fig. 4) from 6 to 16 feet in length are carried by engine, truck, and some salvage companies for operations that involve the use of hoisting and pulling equipment, such as removing lath and plaster from walls and ceilings, pulling down metal ceilings, pulling and rolling up tin on roofs after the tin cutter has cut the tin in strips of a reasonable width, removing corrugated iron walls and roofs, overhauling piled up material, and is used in general where the pulling away of material that has been cut or pried loose is desired. It is also used for hoisting and lowering equipment, raising and lowering of windows, transoms, etc., in carrying on extinguishing, ventilation, rescue, salvage, forcible entry and overhauling operations.

INSTRUCTIONS:

1. In carrying on operations that require hoisting and lowering hose and equipment from upper floors of building, the pike pole is used to advantage due to its length. The object to be raised or lowered is made secure on hook end of pole by means of rope, rope sling, or hose strap. Men are placed on each fire escape balcony, or at window at each floor. The pole is passed to man on first landing and on to other man. (Fig. 5) By this means a man is in position on each floor to equalize weight as object is being raised or lowered.

Fig. 5

2. In pulling down lath and plaster ceilings and walls, do not stand directly beneath the hook after the point and hook have been driven through the plaster, but back from it. Point hook downward and from you; this precaution will prevent the lath and plaster falling upon you and blinding you with dirt. NOTE: The point of pick head axe and hammer head pick can be used for pulling off lath and plaster from walls.

3. For pulling metal ceilings, the pike pole is particularly effective. The point is driven through the ceiling with the hook pointing downward and the operator standing well away from beneath the portion of tin to be torn down. When removing tin from ceiling with hook, if the tin holds stubbornly, the hook part can be used as a fulcrum for prying the tin from ceiling. NOTE: The same principle can be applied in removing tin from roofs.

4. For forcing ceilings below cocklofts through scuttle or other openings in roof, or where hole is cut through floor to provide a drain for water, or to ventilate portions of structure, the point of pole is placed through such opening in ceiling below. Where auger is used to make drain, end of pike pole handle can be inserted in hole to force ceiling below. NOTE: For this use the pike pole is not considered as a hoisting and pulling tool.

5. For opening windows to provide ventilation on upper floors of building the pike pole can be used in forcing the upper window down, or for pulling the lower window up.

   The man employing the hook lies face downward on the roof, or leans out window on floor above, reaching over or out and applying the point of hook to window below. Windows can also be raised and lowered by operator standing on fire escape balcony. NOTE: The pike pole can be used as a striking tool in above operations to break glass window where window can not be raised or lowered.

   The plaster hook penetrates plaster and lath easily. It is useful in making openings in metal ceilings, and for removing hay or other obstructions to get at a fire.

   It is made of tool steel and the spear head and blade on each side have sharp knife edges. The blades close to permit entrance into the opening desired to be made, and open automatically when entered, carrying away the obstruction upon being withdrawn.

   While this tool can be used to advantage in removing lath and plaster, tin ceilings, etc., the pike pole is generally employed after the holes are started with plaster hook.

12d: HOW TO USE GRAPPLING HOOKS

INFORMATION:

Grappling hooks (Fig. 6) are carried for use in dragging for bodies under water. It can be used in extinguishing, ventilation, rescue and overhauling operations, in the same manner as the pull-down hook.

Fig. 6

It consists of three forged steel hooks attached to approximately 50 feet of 3/8 inch steel cable.

12e: SENDING EQUIPMENT ALOFT USING EYE SPLICE, LOOP, AND HALF HITCH

INTRODUCTION:

The use of the eye splice, loop, and half hitch to send small tools and equipment such as ladders, hose, etc., aloft has simplified hoisting operations and eliminated the use of many knots formerly used for this purpose. 5/8" Manila rope 100' long, has proven satisfactory for all ordinary purposes. It is also wise to attach a guide line to objects being lifted aloft to keep it clear of windows, etc., while hoisting.

INSTRUCTIONS:

How to make loop with eye splice

1. Place right hand through eye and grasp rope below splice with right hand (Fig. 7)

Fig. 7

Fig. 8

2. Pull rope through eye, looping eye over back of right hand, rolling eye with thumb and forefingers so that loop will be straight. (Fig. 8)

12f: HOW TO USE EYE LOOP AND HALF HITCH TO HOIST PICK HEAD AXE

INSTRUCTIONS:
1. Make Loop (as shown in Figs. 7 and 8).
2. Place eye over handle of axe with loop down, running line up. (Fig. 9)
3. Lower eye and loop to head of axe, and place loop over pick of axe. (Fig. 10)
4. Pull loop tight and throw half hitch near butt of handle. (Fig. 11)

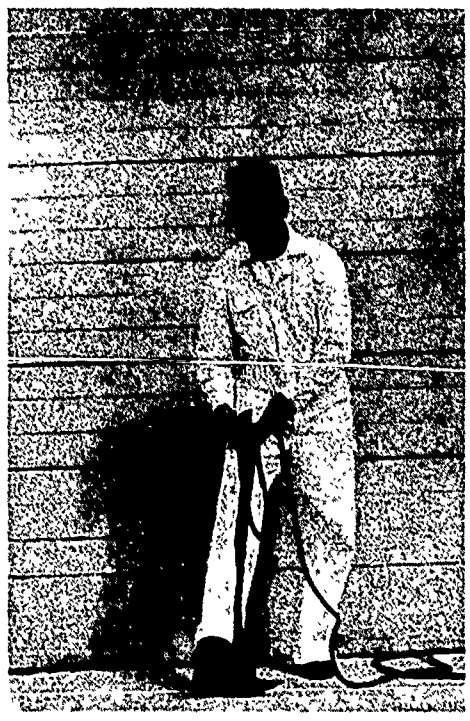


Fig. 9

Fig. 10

Fig. 11

NOTE: This method can be used for any piece of equipment having head such as: broom, shovel, pitchfork, crowbar, etc. (Figs. 12, 13, 14)

Fig. 12

Fig. 13

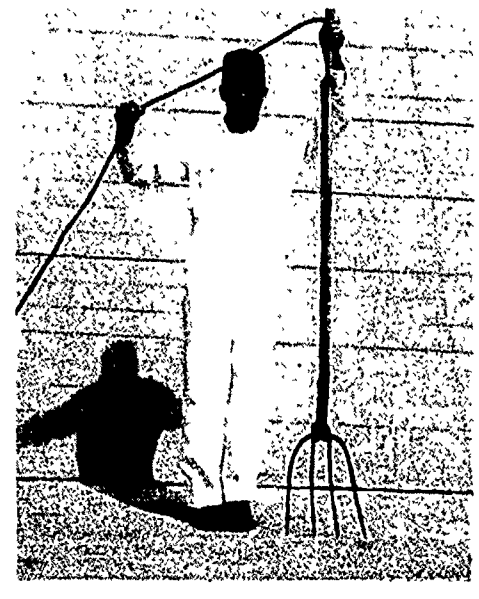


Fig. 14

12g: HOW TO USE EYE LOOP AND HALF HITCH TO HOIST FIRE EXTINGUISHER (RING TYPE)

INSTRUCTIONS:

1. Make loop. (as shown in Figs. 7 and 8)
2. Place loop over ring and around neck of extinguisher. (Fig. 15)
3. Pull loop tight and throw half hitch over loop. (Fig. 16)

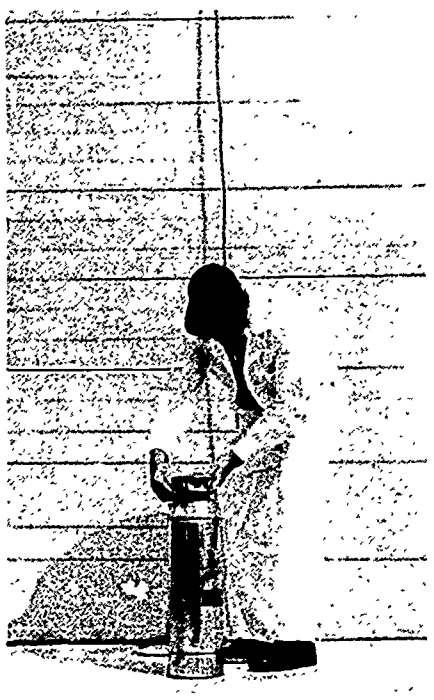


Fig. 15

Fig. 16

12h: HOW TO USE EYE LOOP AND HALF HITCH TO HOIST FIRE EXTINGUISHER (ALTERNATE METHOD)

INSTRUCTIONS:

1. Make loop (as shown in Figs. 7 and 8).
2. Place loop over top of extinguisher and slip down near bottom.
3. Pull loop tight and throw half hitch near top (Fig. 17)
   NOTE: This method can be used on all large extinguishers.

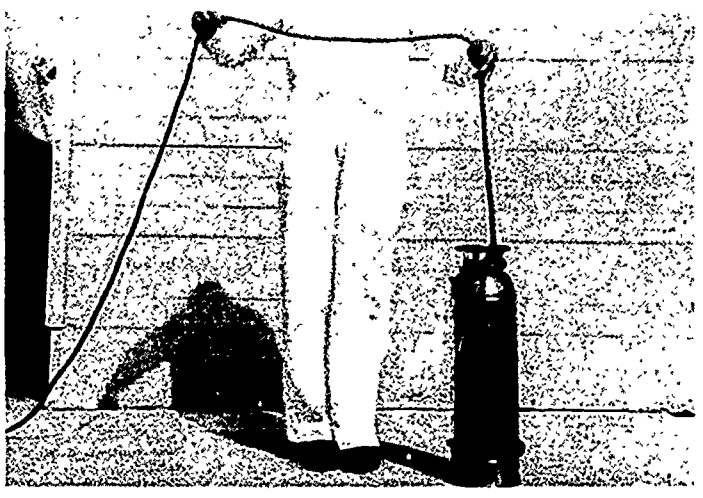


Fig. 17

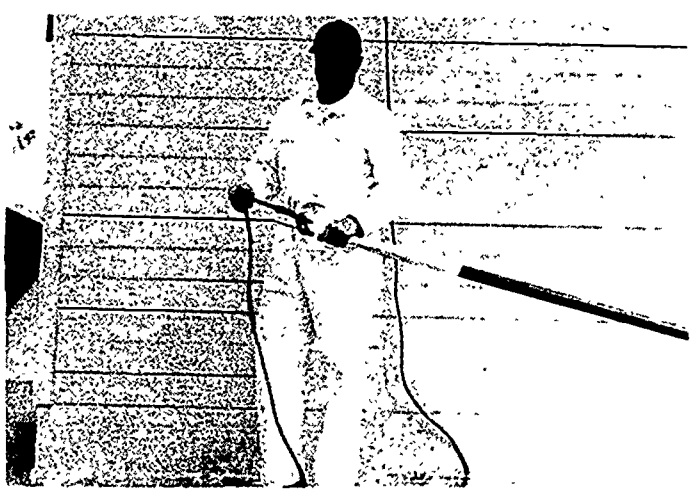


Fig. 18

12i: HOW TO USE EYE LOOP TO HOIST PIKE POLE

INSTRUCTIONS:
1. Make loop (as shown in Figs. 7 and 8).
2. Place loop over hook end of pike. (Fig. 18)
3. Pull loop tight.

12j: HOW TO USE EYE LOOP AND HALF HITCH TO HOIST CROW BAR

INSTRUCTIONS:
1. Make loop (as shown in Figs. 7 and 8).
2. Place loop over handle and tighten. (Fig. 19)
3. Make half hitch around shoulder and tighten (Fig. 20)
   NOTE: This method can be used on Jumbo bar, Detroit Door Opener, and other such tools.

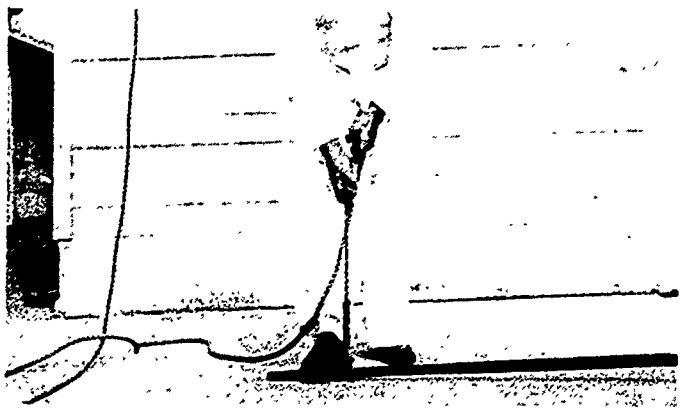


Fig. 19

Fig. 20

12k: HOW TO USE EYE LOOP TO HOIST GAS MASK

INSTRUCTIONS:
1. Pull rope through handle toward you. (Fig. 21)
2. Make loop (as shown in Figs. 7 and 8).
3. Enlarge loop to fit case. (Fig. 22)
4. Place loop around end of case and tighten.

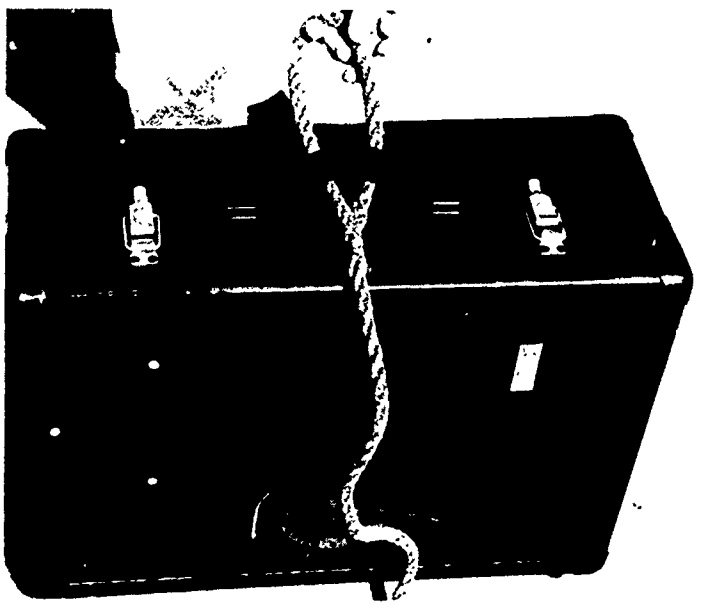


Fig. 21

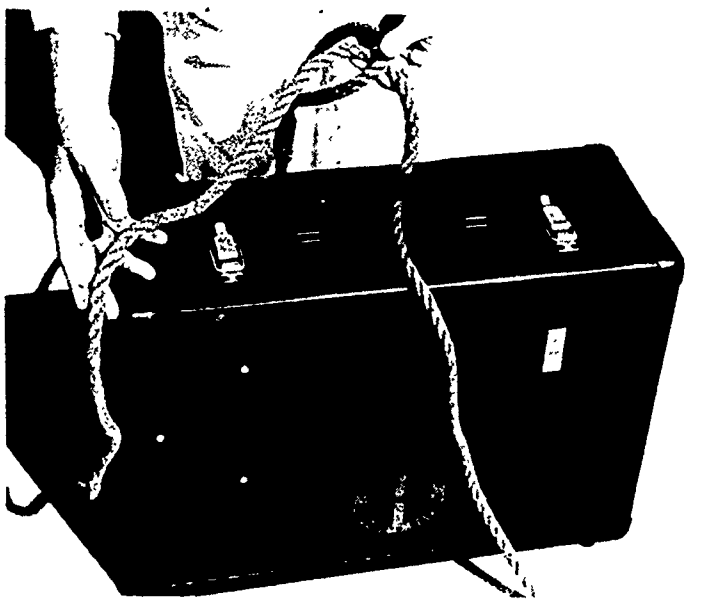


Fig. 22

121: HOW TO SEND 20 FOOT STRAIGHT LADDER ALOFT USING EYE IN ROPE

INSTRUCTIONS:

1. Place rope on ladder.
   (a) Measure for start using formula: 1/5 height x 2.
   Example: If ladder 20 feet:
   1/5 of 20 = 4. 4 x 2 = 8
   (b) Starting at top of ladder count down 8 rungs.
   (c) Place eye under 8th rung and bring up and over the remaining rungs to bottom of ladder.

2. Place eye on beam.
   (a) Either beam
   (b) Wrap end around bottom rung bending running line against beam (Fig. 23)
   (c) Place eye over end of beam (Fig. 24)

Fig. 23

Fig. 24

3. Turn ladder over before raising to place rope between building and ladder.
   CAUTION: Be sure eye is pulled tight against bottom rung and not just over end of beam.
   NOTE: This method can be used on all straight ladders and on extension ladders up to 24 feet if possible to place eye over both beams.

12m: HOW TO SEND 20 FOOT STRAIGHT LADDER ALOFT USING EYE IN ROPE (ALTERNATE METHOD)

INSTRUCTIONS:

1. Place rope on ladder.
   (a) Use same formula as 121.
   (b) Count down required number of rungs and place eye under that rung.
   (c) Bring eye to top of ladder and place on beam against top rung.
   (d) Turn ladder over before hoisting. (Fig. 25)
   NOTE: This method can be used on all straight ladders and extension ladders to 24 feet if possible to place eye over both beams.

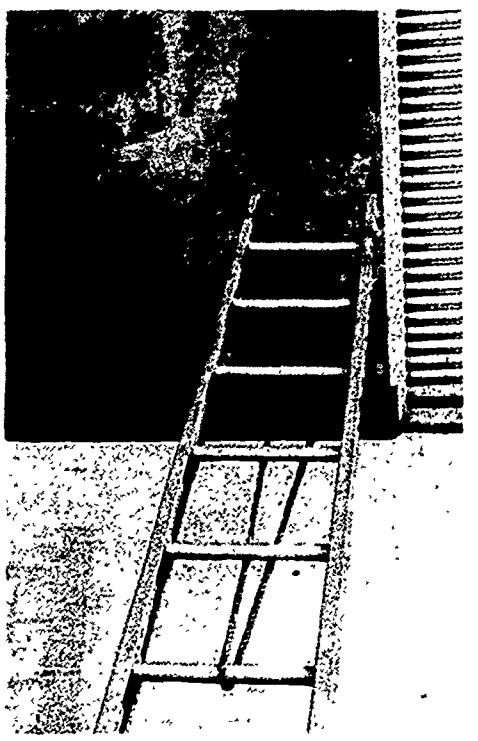


Fig. 25

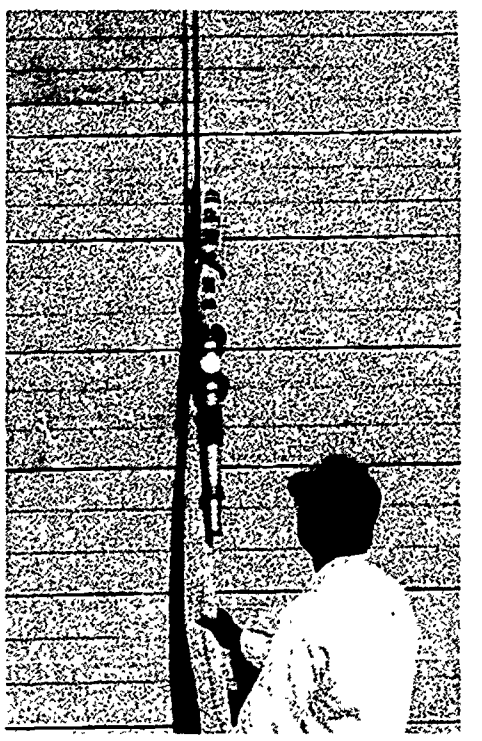


Fig. 26

12n: HOW TO SEND DRY LINE WITH NOZZLE ATTACHED ALOFT USING EYE, LOOP, AND HALF HITCHES

INSTRUCTIONS:

1. Prepare hose line:
   (a) Make sure nozzle is shut off.
   (b) Fold hose approximately 3' and lay on top of bottom hose with handle of shut off facing down. (Fig. 26)
2. Place tie on hose and nozzle.
   (a) Make loop (as shown in Figs. 7 and 8)
   (b) Place loop on nozzle and pull tight. (Fig. 26)
   (c) Throw half hitch on hose approximately 1 foot from bend. (Fig. 26)

12o: HOW TO SEND CHARGED LINE ALOFT USING EYE LOOP AND HALF HITCHES

INSTRUCTIONS:

1. Place loop on hose line 15 feet back of coupling (Fig. 27).
2. Make bend in hose line (Fig. 27)

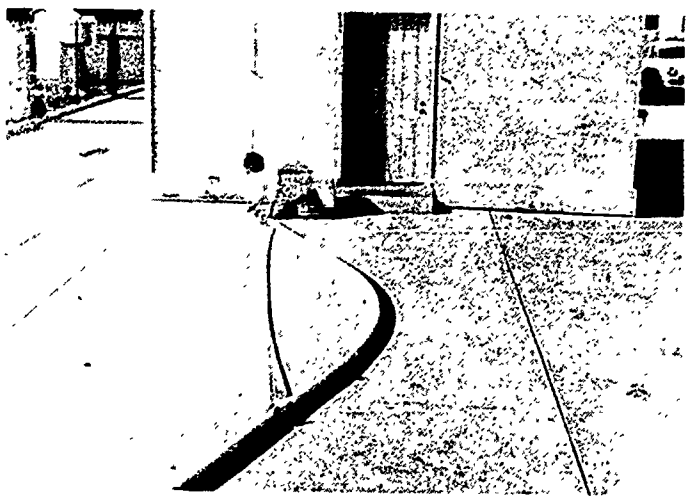


Fig. 27

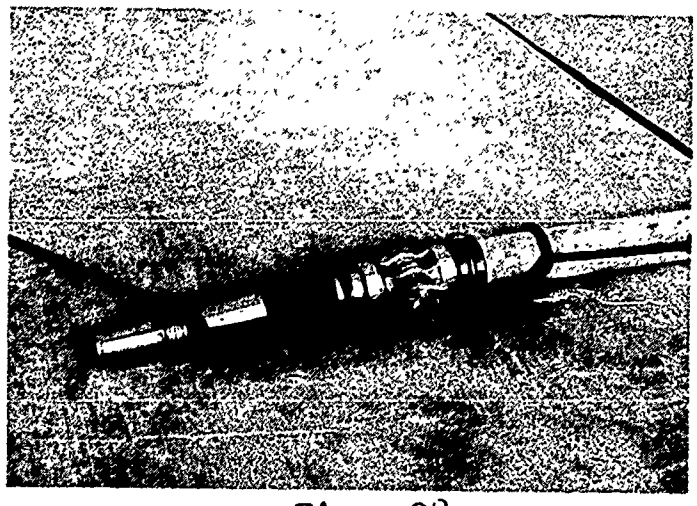


Fig. 28

3. Place half hitch 3 - 6 inches back of coupling and take up slack in rope (Fig. 27).
4. Place half hitch close to shut off nozzle (Fig. 28).
5. Place half hitch on nozzle tip (Fig. 28).

12p: HOW TO USE THE EYE SPLICE, LOOP, AND HALF HITCH AS A RESCUE TIE

INSTRUCTIONS:

1. Adjust eye and loop to proper size. (Fig. 29)
2. Place half hitch over eye side to form two seperate loops. (Fig. 30)
3. Tighten up half hitch. (Fig. 31)

Fig. 29

Fig. 30

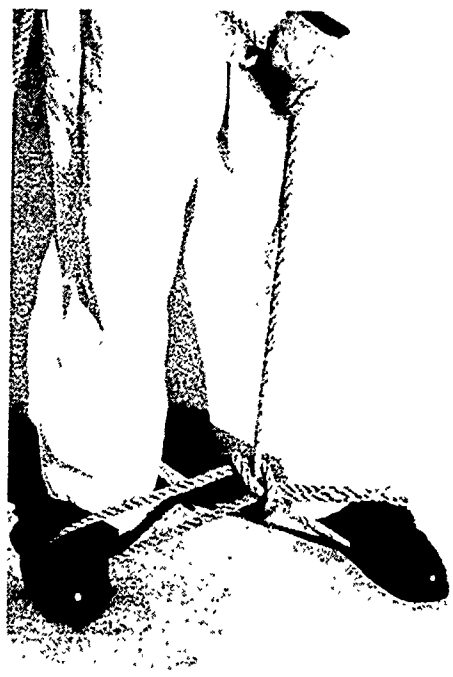


Fig. 31

4. Position loops on legs. (Fig. 32)
5. Take bight in line to form approximately 6' of double line.
6. Take half hitch around waist with double line. (Fig. 32)

Fig. 32

Fig. 33

Fig. 34

7. Place bight end under waist loop on bight side. (Fig. 33)
8. Bring bight end over half hitch. (Fig. 34)
9. Place under single line. (Fig. 34)
10. Bring up through loop formed. (Fig. 34)

INFORMATION ON KNOTS AND HITCHES USED IN THE FIRE SERVICE

In the fire department a knowledge of rope, knots and hitches, and their proper application is very essential. Many times an **improperly** tied knot or hitch may result in the failure of an evolution, the satisfactory completion of which is so necessary for saving lives or property.

The use of rope and lines in handling certain fire department equipment is so essential that firemen should devote sufficient time in perfecting themselves in the handling of rope and the tying of knots, bends, and hitches.

There are a few basic principles in the construction of knots, bends, and hitches, which, if well understood, make knot tying easy.

There are numerous kinds of knots and hitches of which various applications are made by sailors, mechanics, contractors, and construction companies. It is the purpose of this information to limit that number to the essential knots that are adaptable for use in the fire department.

Names and terms commonly used in connection with the use of rope in making knots as follows:

Fig. 35
Square Knot

Fig. 36
Bowline

Fig. 37
Slip Knot

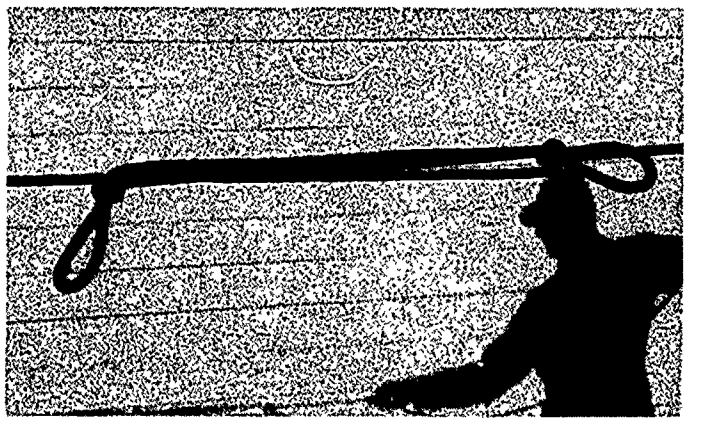


Fig. 38
Sheepshank

Fig. 39
Running bowline

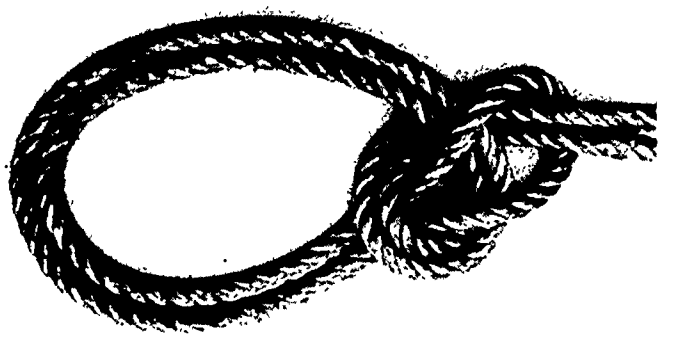


Fig. 40
Bowline on a bight

Fig. 41
Becket bend

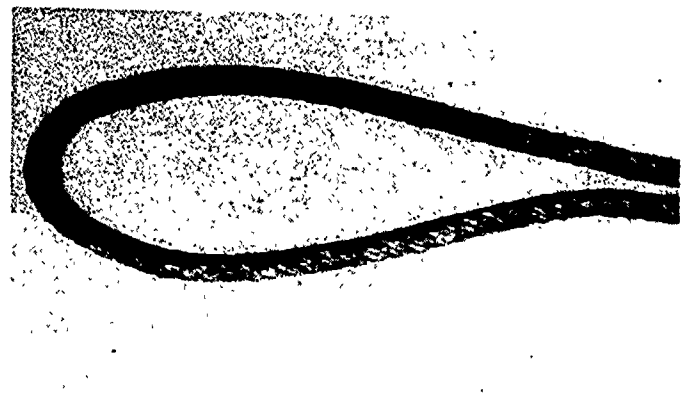


Fig. 42
Bight

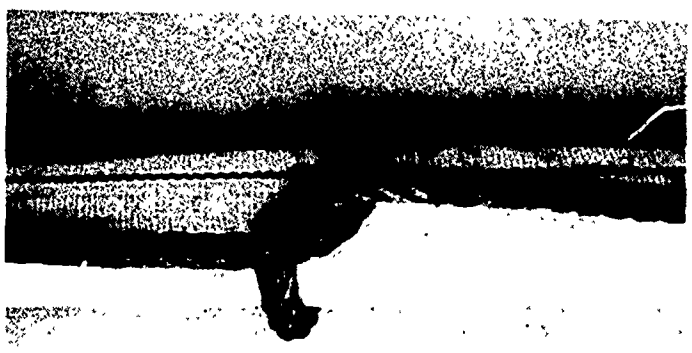


Fig. 43
Half hitch

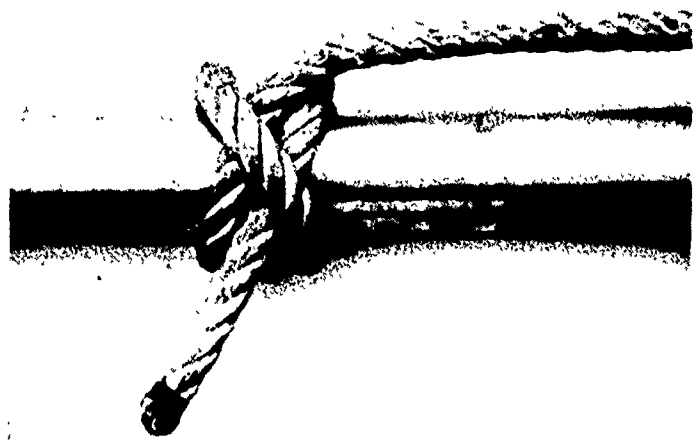


Fig. 44
Clove hitch

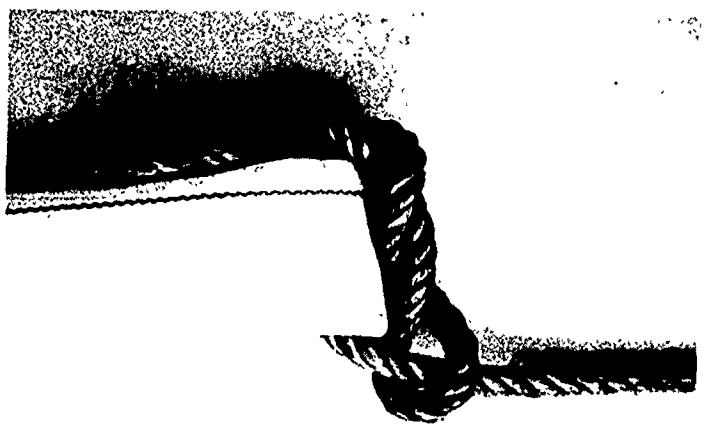


Fig. 45
Timber hitch

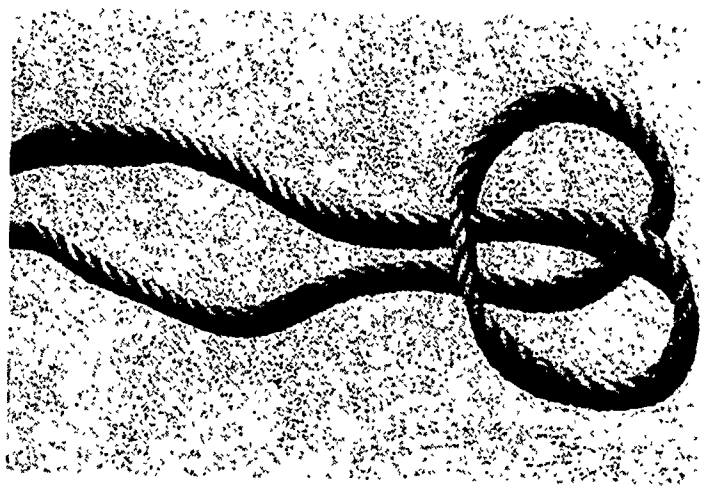


Fig. 46
Double loop
Crossed

A knot is defined as a lump or knob formed by interweaving the parts of a cord, rope, or other slender flexible body; or any tie or fastening formed with rope cord, etc., and is intended to be more or less permanent in nature.

A bend is a method of fastening one rope to another or to a ring, loop, etc., by passing the rope through a loop and fastening it back around itself.

A hitch is a temporary knot or noose by which one rope is fastened around another rope or post so as to be readily undone.

When necessary to stretch new rope, the two ends are rigidly secured between two supports to prevent unlaying of strands. Then a weight can be attached to the center and allowed to hang clear of ground for a period of seven to ten days, or instead of using a weight, pressure may be applied to center of rope to stretch it.

In the following information an effort will be made to show some of the practical uses of these knots, bends, and hitches.

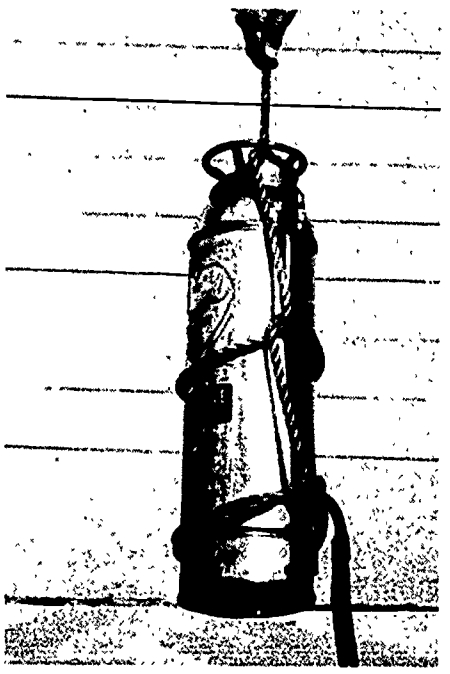


Fig. 47--Clove hitch and two half hitches used to send extinguishers aloft

Fig. 48--Clove hitch and one half hitch used to send nozzles, crow bars, Detroit Door Openers, pike poles, etc., aloft

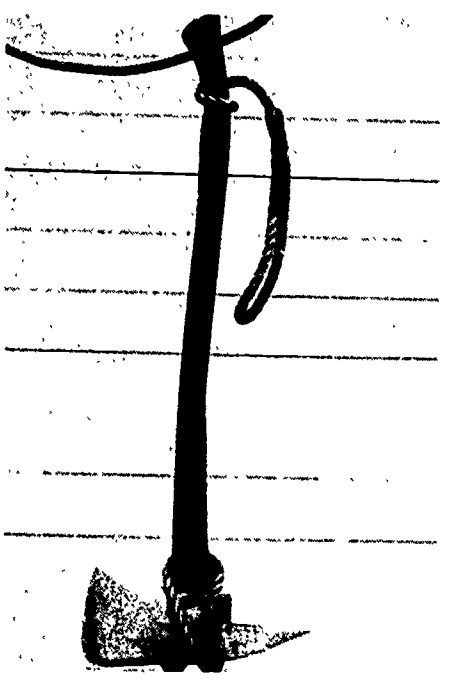


Fig. 49--Double loop crossed and half hitch used in sending axe and all other T shaped tools aloft

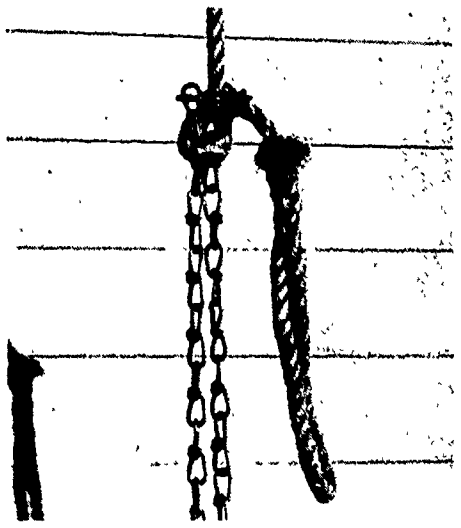


Fig. 50--Becket bend used to tie rope to chain or two pieces of rope together

Fig. 51--Square knot and half hitch used in cask or barrel sling.

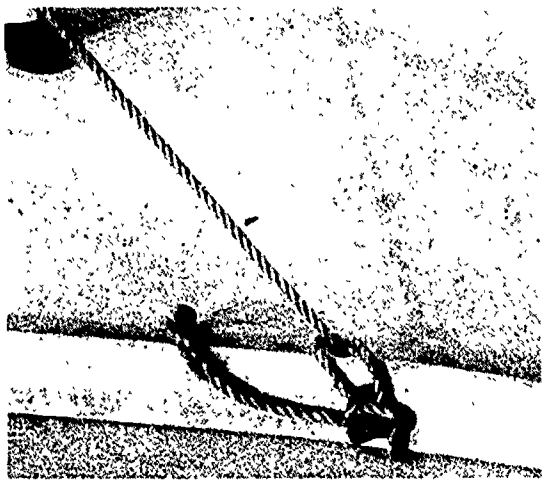


Fig. 52--Running bowline applied to hose for hoisting or lowering

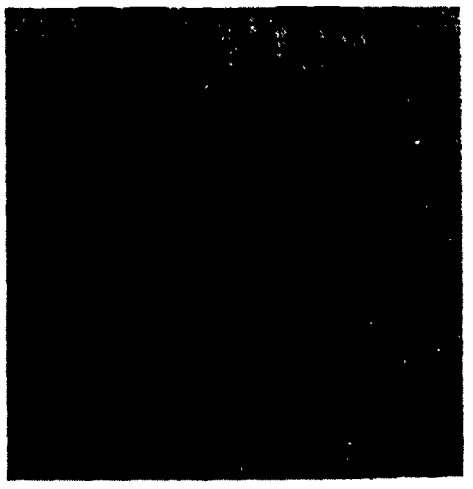


Fig. 53--Timber hitch and half hitches used in sending lines aloft or lowering

12c: HOW TO TIE THE BOWLINE

The Bowline is a knot that can neither slip nor jam, and is used for a variety of jobs in the Fire Service.

INSTRUCTIONS:

1. Position Rope
   a. End in one hand
   b. Other hand holding rope
      NOTE: Space between hands will determine size of bight. (Fig. 54)
2. Start Bowline
   a. Place end across lead rope on top, forming bight. (Fig. 55)
3. Form half hitch in running line. (Fig. 56)
   a. Around bitter end.

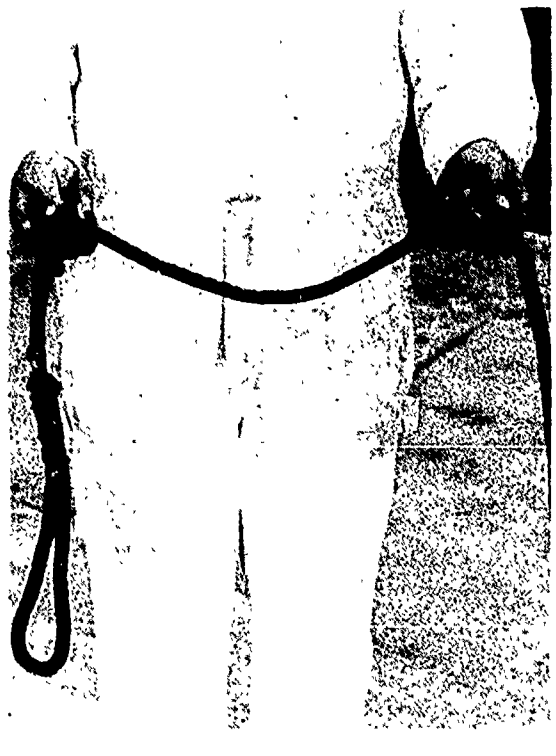


Fig. 54

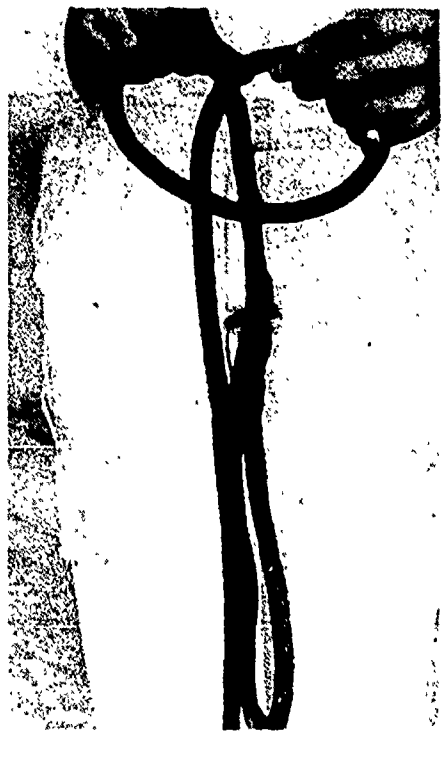


Fig. 55

Fig. 56

4. Place bitter end around running line. (Fig. 57)
5. Place bitter end through loop in running line, tighten. (Fig. 58)
6. Finished Bowline. (Fig. 59)

Fig. 57

Fig. 58

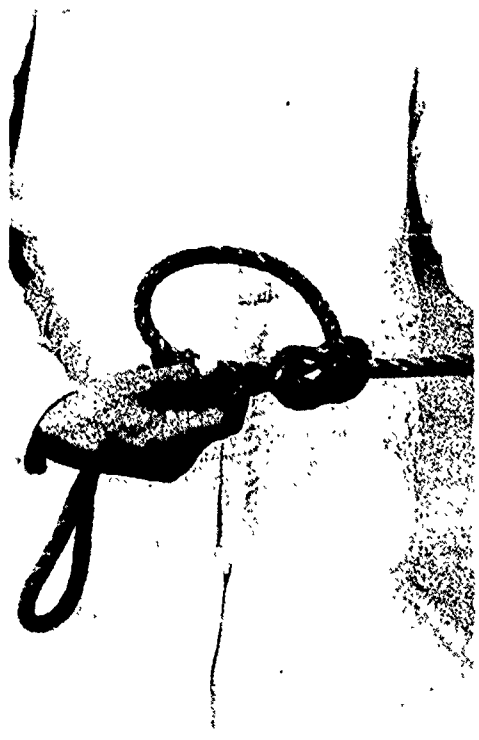


Fig. 59

12r: <u>HOW TO SEND LADDER ALOFT USING BOWLINE AND HALF HITCHES</u>

INSTRUCTIONS:

1. Position rope with running line coming from top of ladder.
2. Take position behind proper rung from top using formula 1/5 length of ladder multiplied by 2. (Fig. 60)

3. Run bitter end around beam behind rung.
   a. Bitter end to end up towards top of ladder. (Fig. 60)

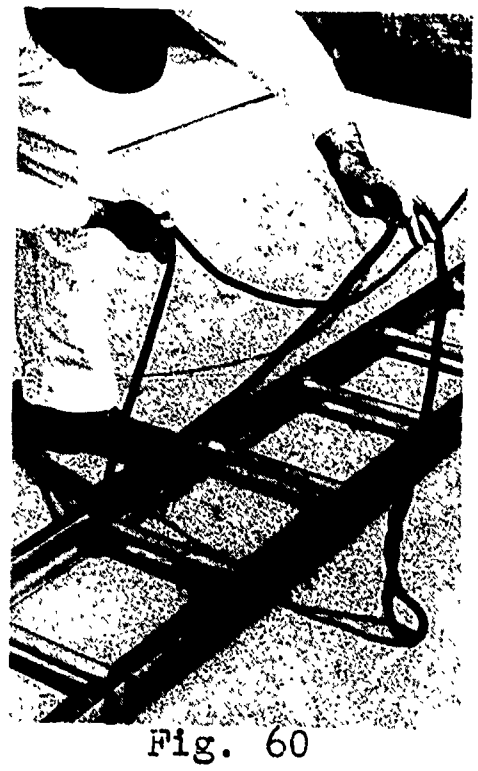


Fig. 60

Fig. 61

Fig. 62

4. Run bitter end around opposite beam behind same rung.
   a. Bitter end to end up towards bottom of ladder. (Fig. 61)
5. Use bitter end and form bowline in running line. (Fig. 62) (See Job 12c)
6. If roof ladder, throw half hitch around hooks. (Fig. 63)
7. If straight ladder, half hitch around top of ladder is optional. (Fig. 64)

Fig. 63

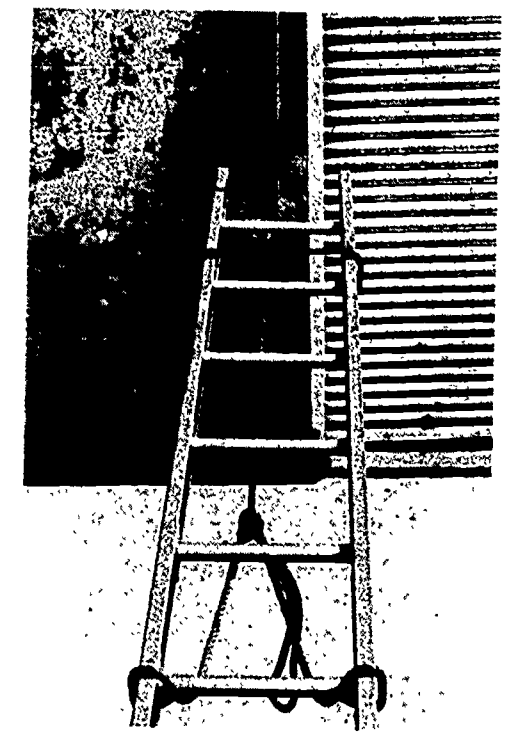


Fig. 64

12s: HOW TO TIE A BANGOR KNOT

INFORMATION:

This knot is used as a safety factor when tying off halyard of extension ladders. It insures keeping extension sections locked in position, as well as eliminating the hazard of excess halyard.

INSTRUCTIONS:

1. Take position behind ladder.
2. Coil surplus halyard. (Fig. 65)
3. Throw coil over rung at shoulder level.
4. Bring surplus under rung at knee level, and tighten. (Fig. 66)
5. Take bight around halyard above rung. (Fig. 67)

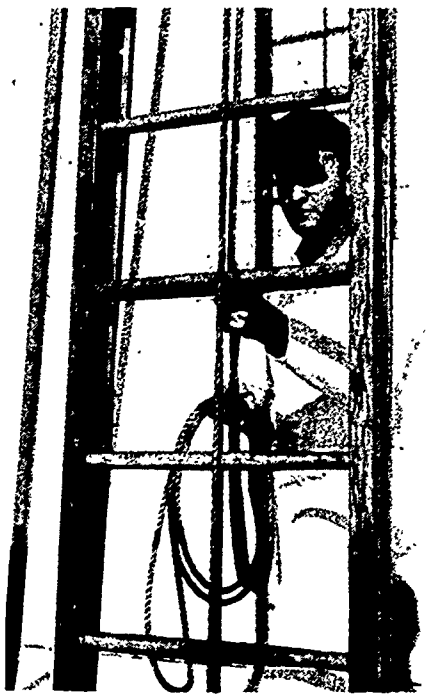


Fig. 65

Fig. 66

Fig. 67

Fig. 68

Fig. 69

6. Form half-hitch around rung and halyard.
   NOTE: Fig. 68 shows start and 69 completion of half-hitch.
7. Apply second half hitch over first. (Fig. 70)
8. Use up excess slack by wrapping around halyard to complete tie. (Fig. 71)

Fig. 70

Fig. 71

12t: HOW TO TIE A SLEDGE HAMMER TO GO ALOFT, USING DOUBLE LOOP AND HALF HITCH

INFORMATION:

This tie may also be used to tie other "T" handle type tools to go aloft.

INSTRUCTIONS:

1. Form bight in rope about 4 ft. in length.
2. Form double loop.
   a. By bringing bight back over double rope.
   b. Cross double rope lines below bight. (Fig. 72)
3. Place loops over head (Fig. 73) and tighten.
   NOTE: (Fig. 74) shows back side with ropes crossed.
4. Apply half-hitch on handle with running line.
5. Place bitter end through loop formed by half hitch. (Fig. 75)
6. Tighten for completed tie. (Fig. 76)

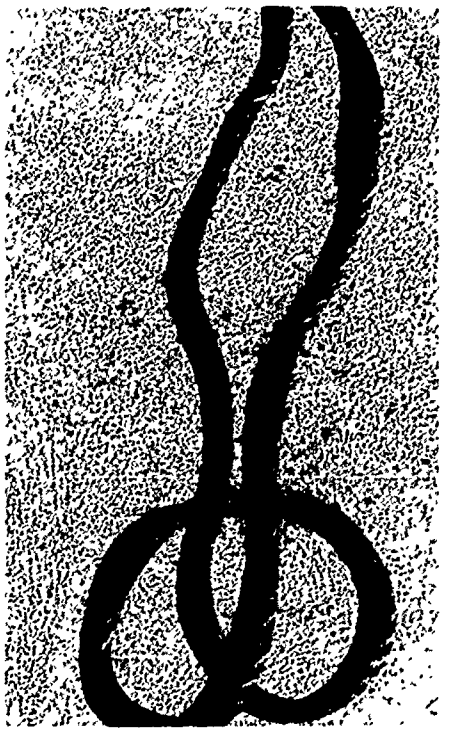


Fig. 72

Fig. 73

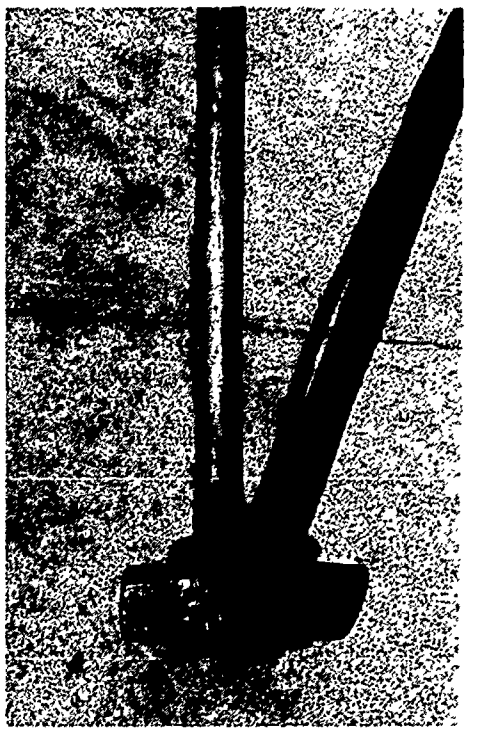


Fig. 74

12u: HOW TO TIE SLEDGE HAMMER TO BE USED AS A BATTERING TOOL

INFORMATION:

This may be used in place of the Ball and Chain in ventilation and overhaul work.

INSTRUCTIONS:

1. Form bight near center of line.
2. Form double loop (See Job 12t) and place over head of sledge hammer.
3. Apply half hitch on handle using upper rope.
4. Apply half hitch around handle above double loop using lower rope. (Fig. 77)

Fig. 75

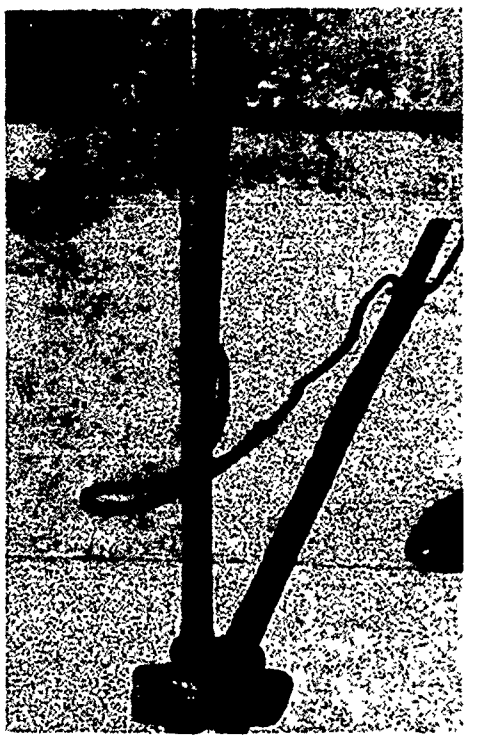


Fig. 76

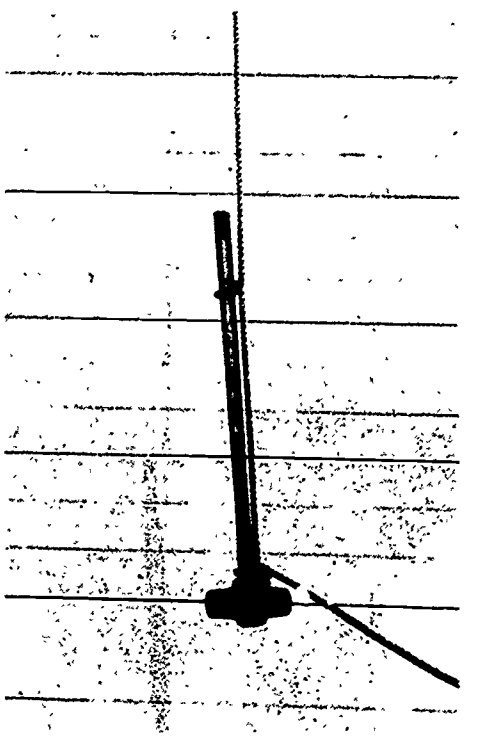


Fig. 77

12v: HOW TO TIE HALF A SHEEPSHANK OR A TRUCKMAN'S HITCH

INFORMATION:
Used for tying hose roller or other equipment where a taut line is necessary.

INSTRUCTIONS:
1. Place rope around anchor point.
2. Lay bitter end across running line. (Fig. 78)

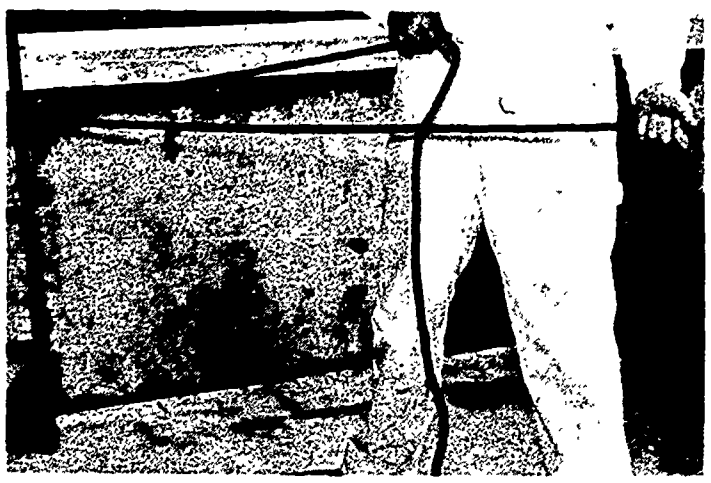


Fig. 78

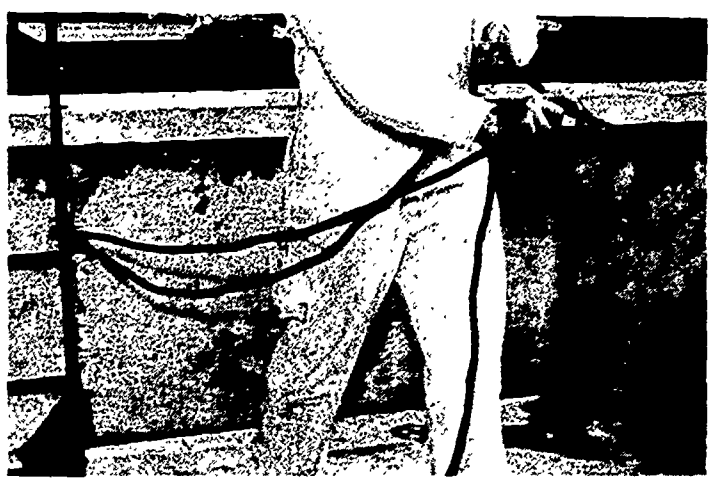


Fig. 79

3. Form bight in running line. (Fig. 79)
4. Position bight to form loop for bitter end. (Fig. 79)
5. Place two half-hitches on bight using running line.
6. Pull bitter end taut. (Fig. 80)
7. Secure with half hitch on bight on anchor side of loop. (Fig. 81)
8. Apply half-hitch over bight to complete tie. (Fig. 82)

Fig. 80

Fig. 81

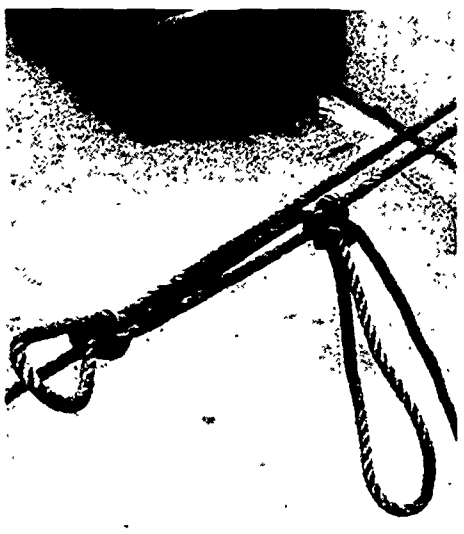


Fig. 82

Fig. 83 -- Knot and hitches used to send a loaded line aloft. A running bowline 15' back from coupling and half hitch 7½' back of coupling, another half hitch 6" back of coupling. NOTE: In lowering, place additional half hitch around tip.

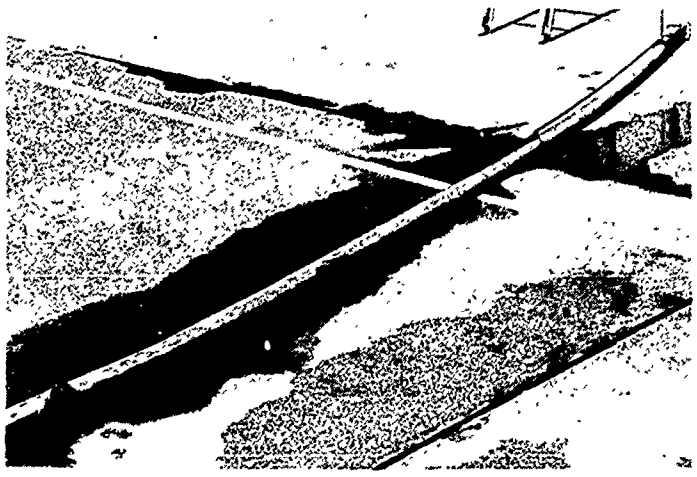


Fig. 83

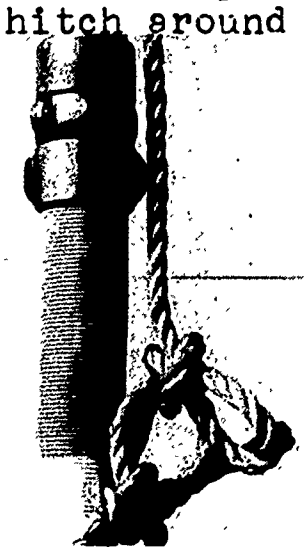


Fig. 84

Fig. 84 -- A running bowline tied open, used for raising a loaded hose line.

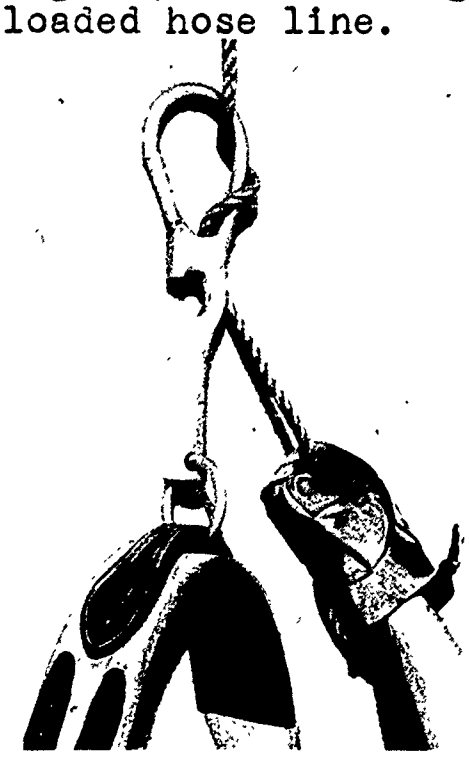


Fig. 85 -- Seagrave Life Belt showing one turn taken around hook.

Fig. 86 -- Atlas Lifebelt, shown with two turns taken around hook and rope placed beneath brake

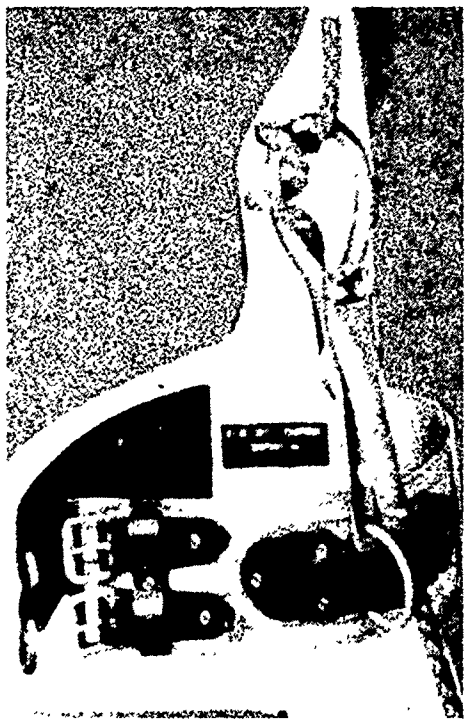


Fig. 86

Fig. 87 -- Tying Life Gun Cord. Loop inside end of cord through projectile and make a series of half hitches starting about 2 feet from eye of projectile. This will absorb part of recoil shock when gun is fired. Fasten other end to life line by slip knot.

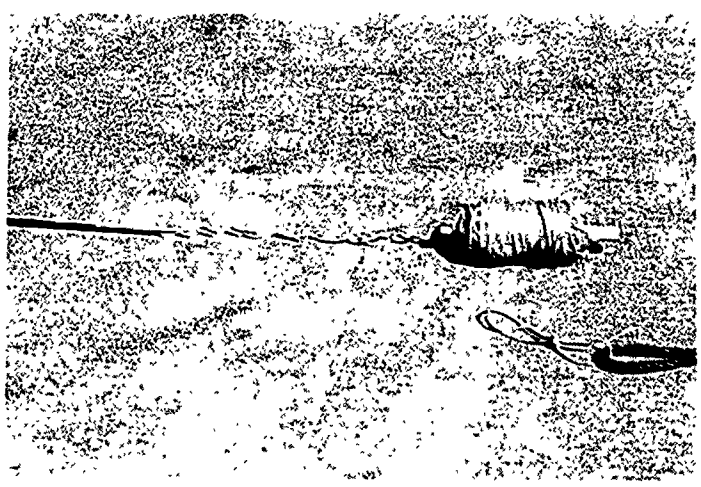


Fig. 87

12w: HOW TO TIE A BOWLINE ON A BIGHT

INFORMATION:

The bowline on a bight is one of the everyday knots used in the fire service and is used in many instances as part of a rescue tie. When tied for this purpose, the bowline is used as a chair for the injured to sit in when being lowered from a height.

INSTRUCTIONS:

1. Lay rope out full length.
   (a) To your left as you face rope.
2. Grasp rope, both hands.
   (a) End in right hand and left hand behind about 2'.
3. Measure rope to be used.
   (a) Two full arm lengths spreading arms wide from shoulder.
4. Bend line at second full arm length.
   (a) At left hand.
   (b) Double line by throwing right hand rope to left.
5. Grasp double rope in hands.
   (a) Right hand about 6" behind bend in line.
   (b) Left hand about 12" behind right hand.
6. Measure for size loops wanted.
   (a) Hold left hand in front of chest or front of right shoulder, depending on size loops needed.
   (b) Stretch right hand holding bend to full length.

NOTE: Size of loops depends on size of injured man's legs, measurement governed by length of operator's arms. Practice will perfect judgment.

7. Place both hands in front.
   (a) Belt high
   (b) Palms up (Fig. 88)

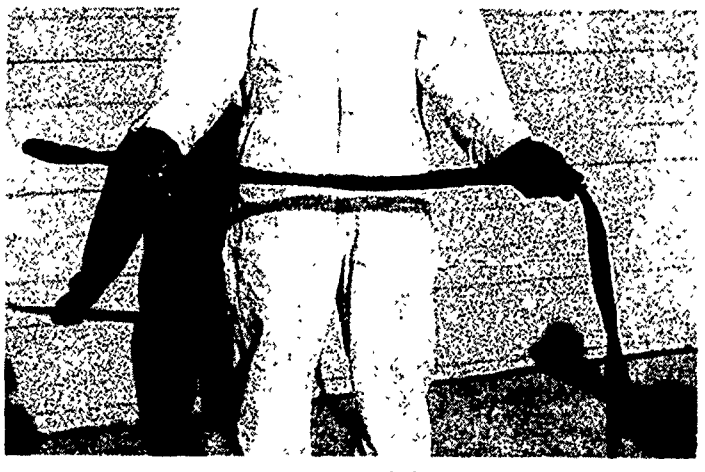


Fig. 88

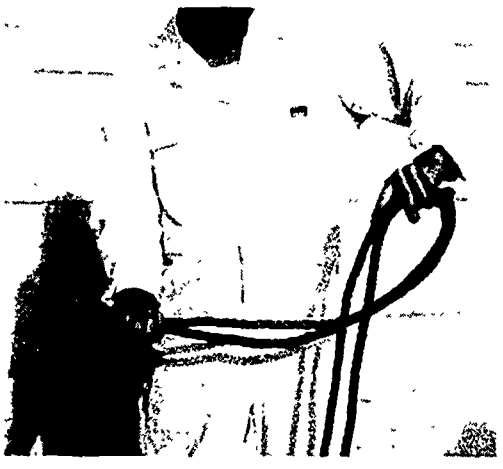


Fig. 89

8. Extend fingers of left hand.
   (a) Index and middle fingers to hold rope when tying knot.
9. Roll left hand.
   (a) To center of body.
   (b) Towards right hand. (Fig. 89)

10. Roll right and place bend in position
    (a) Towards left.
    (b) Outside of left hand.
    (c) Bend placed between index and middle fingers.
    (d) Hold bend firm with two fingers and let go with right hand.
11. Pull bend through fingers.
    (a) Grasp bend inside between belt and left hand.
    (b) Pull up tight to left hand forming simple overhand knot.
    (c) Hold on to rope being pulled through with two fingers at all times. (Fig. 90)

Fig. 90

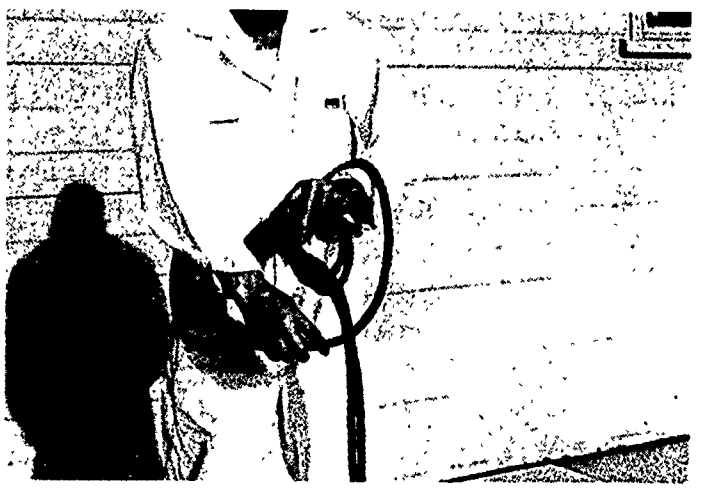


Fig. 91

12. Drop loop in right hand.
    (a) Over left hand and outside.
    (b) All the way down. (Fig. 91)
13. Pull large loop through index and middle fingers.
    (a) Grasp ropes between index and middle finger on outside of left hand.
    (b) Pull through until loop is at back of left hand. (Fig. 92)

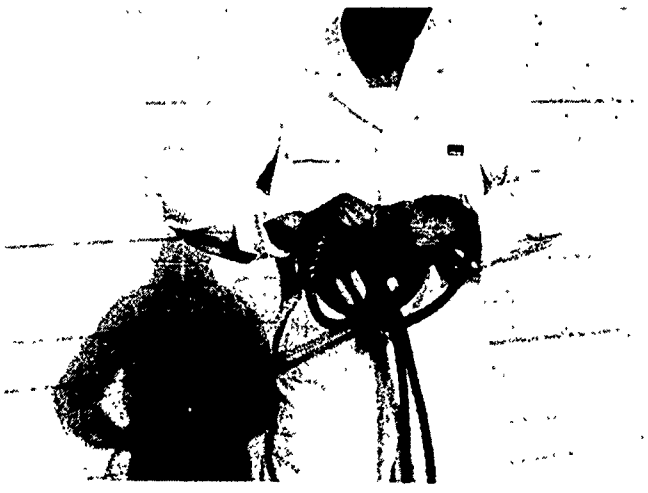


Fig. 92

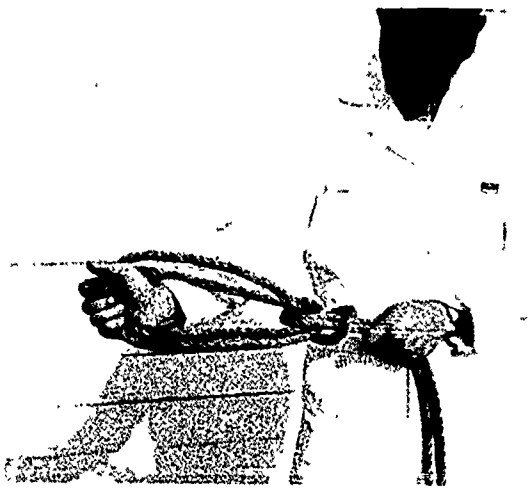


Fig. 93

CAUTION: Do not allow loop to slip over left hand or slipknot will develop. Hold firm with index and middle fingers until ready to slip left hand out.

14. Finish tying knot.
    (a) Hold on to loop with right hand.
    (b) Slip left hand out and down to loose line. (Fig. 93)

(c) Hold firm with left hand and pull knot tight with right.
NOTE: Adjustment may be made in size of loops after completed.

12x: HOW TO TIE RESCUE TIE USING BOWLINE ON A BIGHT:

INSTRUCTIONS:
1. Tie bowline on a bight. (See 12w)
2. Place loop on each leg. (Fig. 94)
3. Place pulling rope and bitter end in position. (Fig. 95)

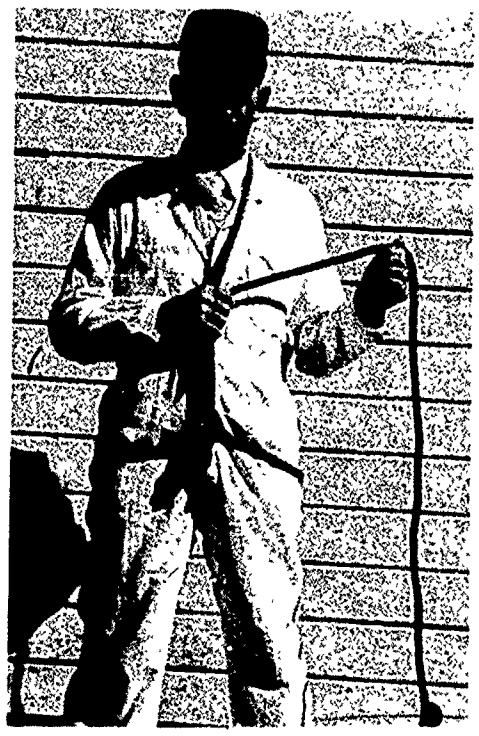


Fig. 94

Fig. 95

4. Wrap bitter end around body under arm pits.
5. Tie knot at chest.
   (a) Pass bitter end behind vertical ropes. (Fig. 96)

Fig. 96

Fig. 97

Fig. 98

(b) Bitter end returned to front and cross vertical lines.
(c) Continue bitter end upward behind line around body.
(d) Pass bitter end between vertical ropes and up through loop formed. (Fig. 97)

6. Place two half hitches on running line with bitter end to complete tie. (Fig. 98)

12y: HOW TO MAKE OPTIONAL RESCUE TIE

INFORMATION:

This method is sometimes preferred for an unconscious person, because it is applied with victim in lying position.

INSTRUCTIONS:

1. Position victim on back.
2. Position rope, running line leading from head of victim.
3. Position end of rope to tie knot.
   (a) Pass bitter end between legs slightly above knee nearest to you. (Fig. 99)
   (b) Return toward you underneath.
   (c) Pass bitter end over both legs.
   (d) Pass under leg away from you and up between legs, opposite running line. (Fig. 100)

Fig. 99

Fig. 100

Fig. 101

4. Tie square knot. (Fig. 101)
5. Position knees of victim against chest.

6. Position rope for tie at chest.
   (a) Take bight in running line about 6 feet from square knot.
   (b) Place bight around back under arm pits. (Fig. 102)

Fig. 102

Fig. 103

7. Tie knot at chest.
   (a) Keep rope between knees and chest tight.
   (b) Pass bight under both lines. (Fig. 103)
   (c) Pass bight over line around back, forming overhand knot.
   (d) Then tie square knot, using knee rope and bight.
   (e) Place two half hitches around bight with running line to complete tie. (Fig. 104)

Fig. 104

KNOTS AND HITCHES USED FOR HOISTING HEAVY DUTY APPLIANCES

INFORMATION:

MacGreger hoist knot (Fig. 105) consists of three half hitches on nozzle, clove hitch on intake manifold (allow 40 feet of rope behind clove hitch), run rope through handle of platform (platform to be placed 10 feet behind intake manifold). Place a half hitch around platform at center, insert a loop through bottom handle of platform, throw two half hitches over loop and place a bowline knot in end of rope, then place over nozzle tip.

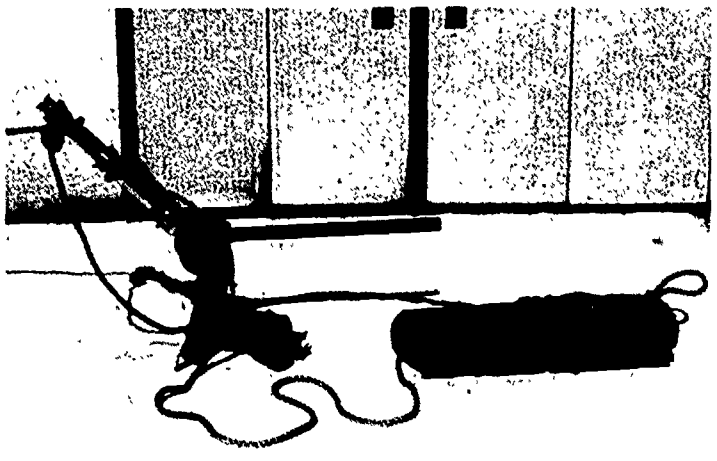


Fig. 105

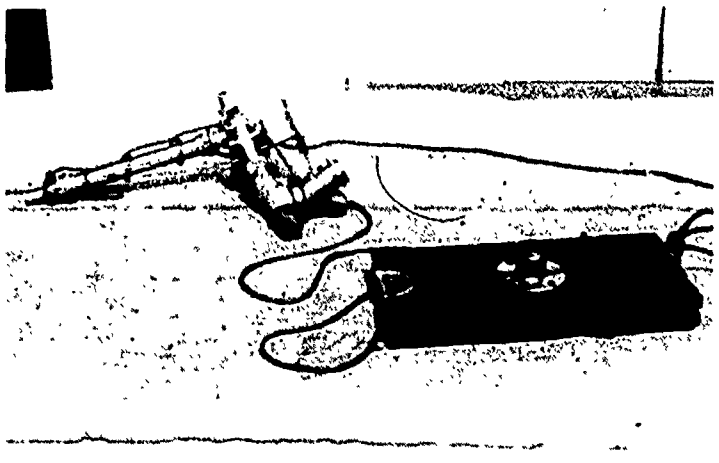
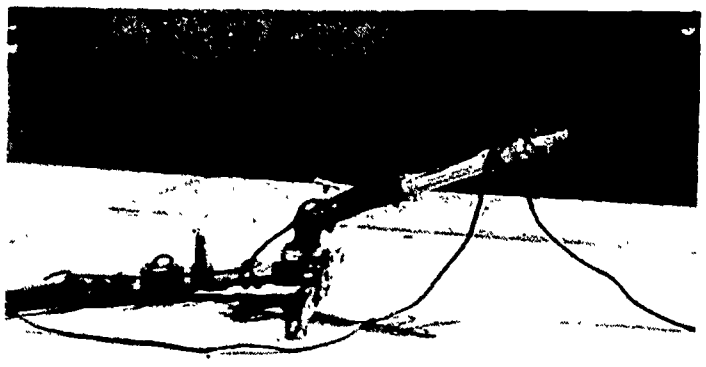


Fig. 106

Invincible hoist knot (Fig. 106) consists of three half hitches on nozzle, clove hitch on intake manifold (allow 40 feet of rope behind clove hitch), run rope through handle of platform (platform to be placed 10 feet behind intake manifold). Place a half hitch around platform at center, insert a loop through bottom handle of platform, throw two half hitches over loop, place a bowline knot at end of rope and place over nozzle tip.
NOTE: Extra nozzle tips must be removed from platform's pegs before sending deluge set up, leaving same on apparatus.



Eastman hoist knot (Fig. 107) consists of a half hitch six inches behind manifold on hose, clove hitch around intake manifold, two half hitches spaced on barrel. Place bowline knot at end of rope and place same over nozzle tip.

Fig. 107

12z: HOW TO TIE THE BARREL SLING:

INSTRUCTIONS:

1. Place barrel on rope
   (a) Length of bitter end to be twice the height of barrel.
2. Tie overhand knot. (Fig. 108)

Fig. 108

Fig. 109

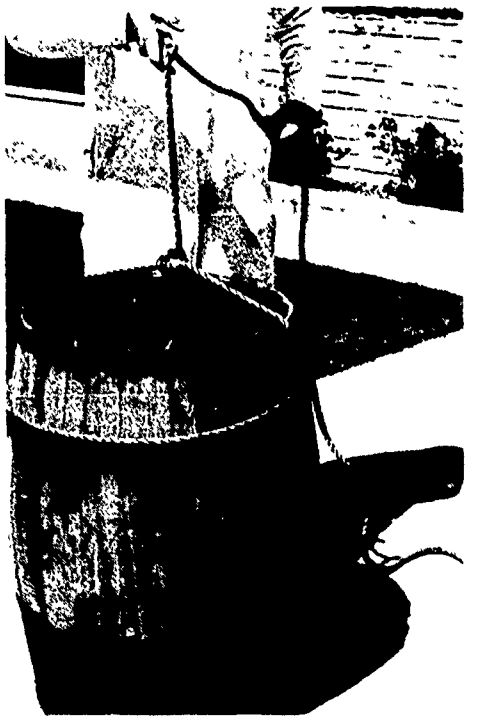


Fig. 110

3. Separate overhand knot and slip over sides, (Fig. 109) to one-third way down.
4. Pull tight, and bring both lines to top.
5. Tie bowline (square knot optional) to complete job. (Fig. 110)

12aa: HOW TO MAKE BIRDS NEST COIL

INFORMATION:

The birds nest coil is a method of coiling rope that will not snarl or tangle. Many departments now use this method for coiling all ropes because of its simplicity and the ease with which a rope can be uncoiled without fouling. NOTE: To avoid permanent kinks, it is necessary to stretch and recoil lines once a month.

INSTRUCTIONS:

1. Lay rope out straight to full length.
   (a) Free of all kinks and twists.
2. Grasp eye splice at end of rope and place top of loop in palm. (Fig. 111)
3. Grasp line and make loop under foot.
   (a) 30" coil between foot and hand. Coiling clockwise.
   (b) If 50' rope, use 2 coils; if 100' rope, use 4 coils, etc.

(c) Use left foot if left hand holding eye splice. Right if right hand holding eye. (Fig. 112)

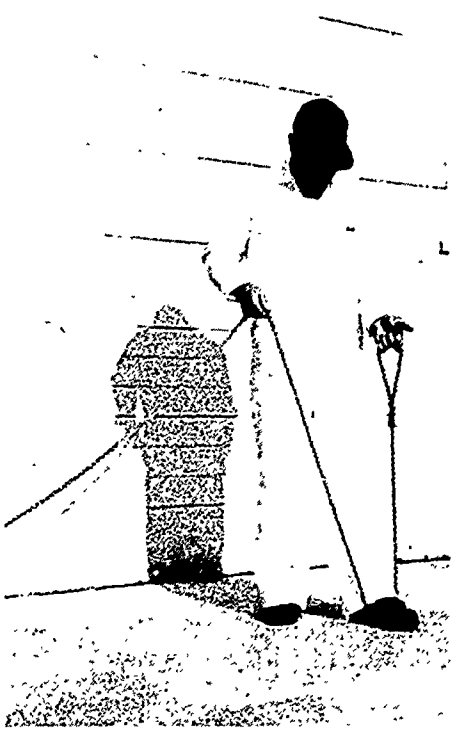


Fig. 111

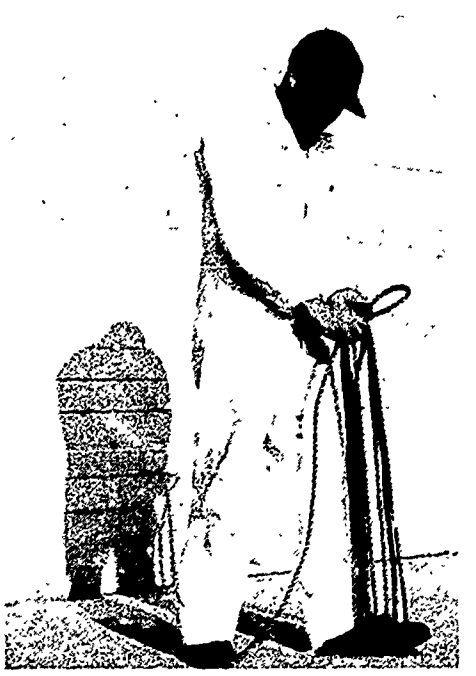


Fig. 112

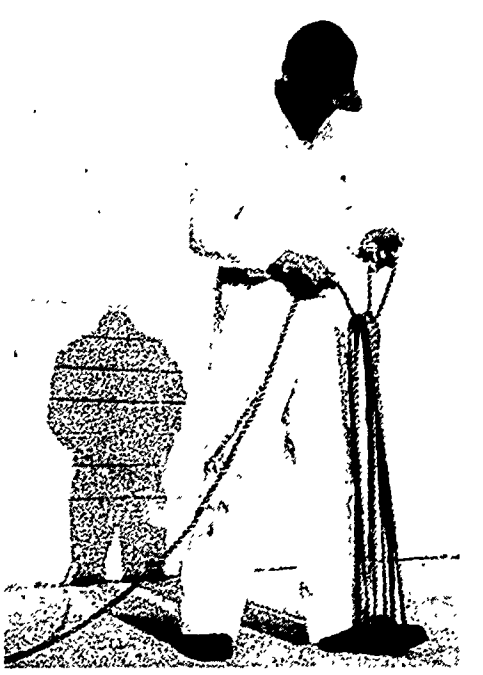


Fig. 113

4. To start chain knot, hold coiled rope firmly with hand and foot.
   (a) Push bight under coiled rope and through the eye to palm of hand holding coiled rope and eye splice. (Fig. 113)
   (b) Push next bight over the top of coil through first bight and pull up tight to tie off line. (Fig. 114)

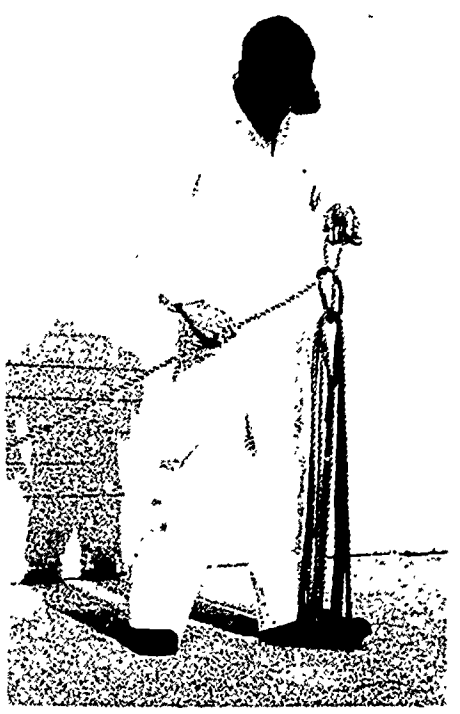


Fig. 114

Fig 115

Fig. 116

5. Remove coiled rope from beneath foot. (Fig. 115)
   (a) Turn half turn right or left according to hand and foot used.
   (b) Place between legs and hold firmly. (Fig. 116)
6. Place hand through top of open loop and place rope under coil to hand through loop, using free hand.
   (a) Pull up loop approximately 6". (Fig. 117)

Fig. 117

Fig. 118

Fig. 119

7. Place hand through bottom of loop and take loose rope over top of coil to hand through loop.
   (a) Pull through to approximately 6".
8. Continue to make chain by repeating steps 4 and 7 until all but 12" of rope is coiled.
   (a) Keep each loop open to avoid knot in line.
   (b) If loose rope is passed under coil, hand through loop is placed in loop from top.
   (c) If loose rope is passed over coil, hand through loop is placed in loop from bottom.
9. Tie off with half hitch around last loop.
   (a) Coil will not unravel. (Fig. 118)
   (b) Completed Coil (Fig. 119)

12bb: HOW TO THROW BIRDS NEST COIL

INSTRUCTIONS

1. Untie half hitch
   (a) Hold loose end in left hand and coil in right. (Reverse if left handed)

2. Fasten loose end securely.
   (a) Throw straight out.
   (b) Spin coil as thrown. (Fig. 120)

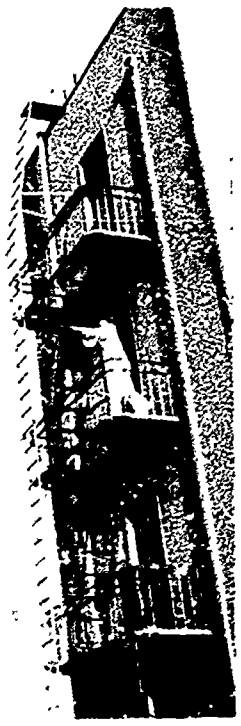


Fig. 120

Fig. 121

Fig. 122

12cc: <u>HOW TO MAKE LINEMAN'S COIL TO THROW</u>

INFORMATION:
Used for throwing one end of a rope to a given point.

INSTRUCTIONS:
1. Make several throwing coils about 18" in diameter in one end of rope. (Fig. 121)
2. With running line take complete turn around coils.
3. Take bight in running line and place it through coils. (Fig. 122)
4. Grasp running line and bight with throwing hand. NOTE: This part of rope is now ready to throw.
5. Form required number of loops (determined by distance to be thrown) NOTE: Loops to be formed in throwing hand and transferred to opposite hand before throwing. (Fig. 123)

Fig. 123

12dd: HOW TO COIL ROPE

INFORMATION:

In the fire service a knowledge of how to correctly coil a rope is very essential. Many times an improperly coiled rope may result in a failure of an evolution.

Companies in the fire department can be equipped with a standard rope coiler, which is used to coil all life lines and rope in a standardized manner. After once coiled in this manner, a rope can be carried easier and the danger of the rope fouling is eliminated.

Life lines vary from 125 feet to 200 feet in length. Engine and truck companies also carry rope in lengths of 74 and 100 feet, for hoisting equipment and fire line use.

INSTRUCTIONS:

1. Start the coil by eye over left post. (Fig. 124)

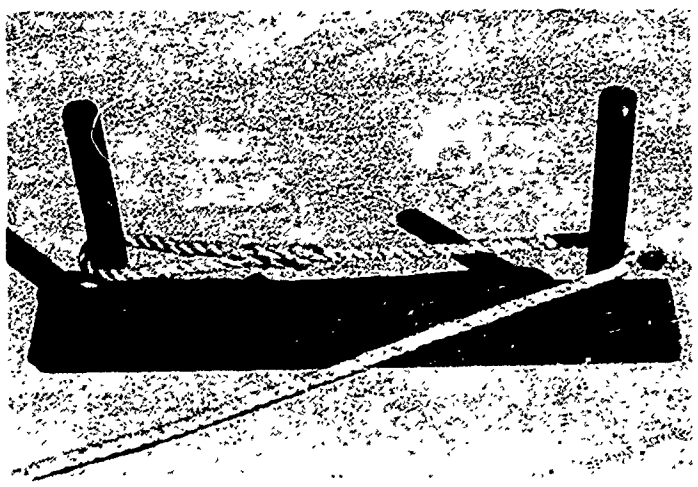


Fig. 124

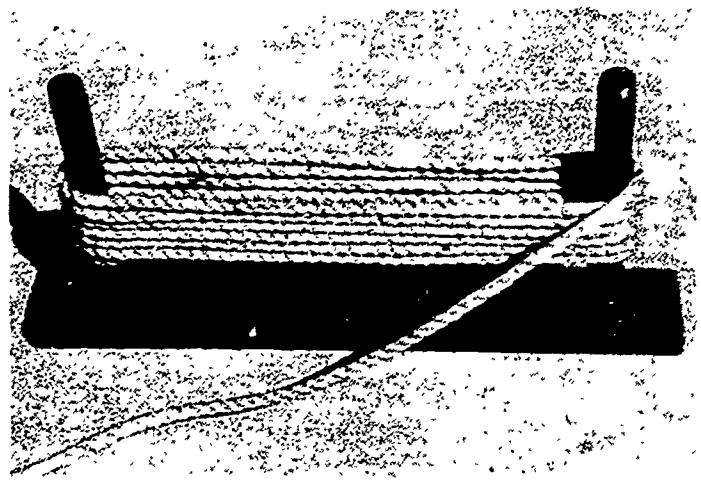


Fig. 125

2. Take six wraps horizontal and parallel to each other. (Fig. 125)

   NOTE: This job is based on 100' of 5/8 inch rope with rope coiler pipes spaced 25 inches apart. Number of wraps will vary with length and size of rope and space between coiler pipes.

3. Take five more wraps over first tier, starting at top and working downward. (Fig. 126)

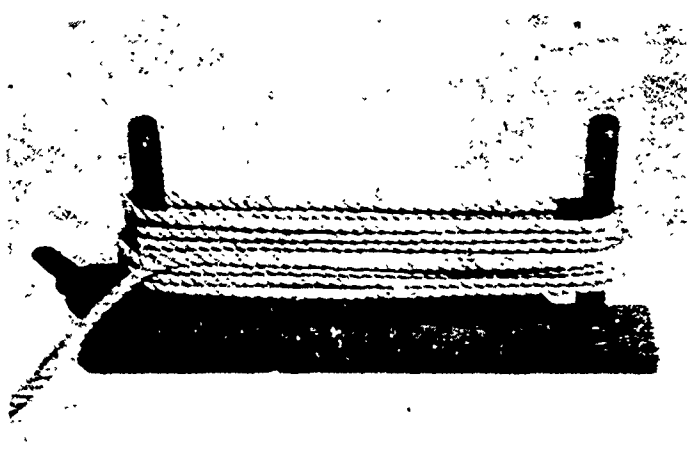


Fig. 126

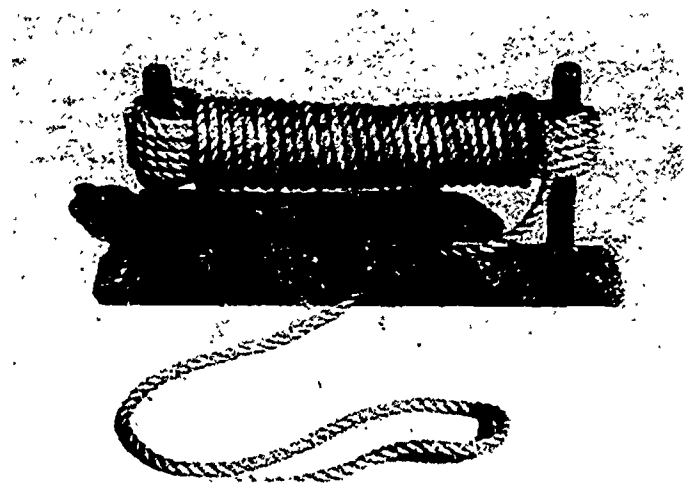


Fig. 127

4. Start third tier at bottom and continue upward until approximately 55' of rope remains.
5. Bring rope around starting post to a point about two inches from post and make breaking point. (Fig. 127)
6. Make vertical wraps around coil with second wrap binding first, until approximately 15 feet are left. (Fig. 127)
7. Remove rope from rack by lifting evenly.
8. Double remaining rope and pass bight end through opening on right side of coil. (Fig. 128)

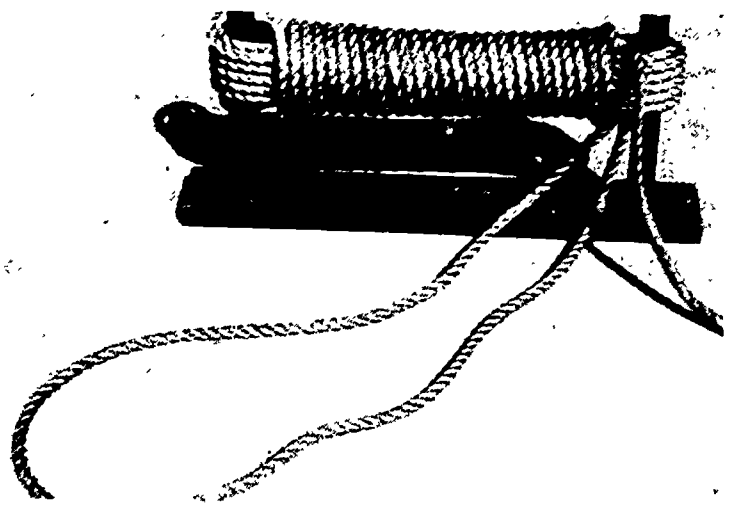


Fig. 128

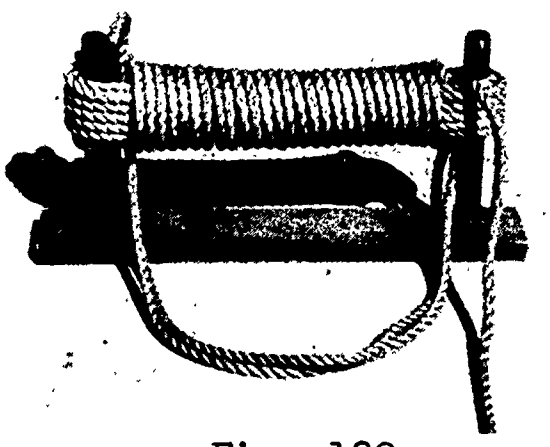


Fig. 129

9. Pass bight end through opening on left side. (Fig. 129)
10. Place bitter end through bight opening. (Fig. 129)
11. Pull double end tight to complete coil. (Fig. 130)
    NOTE: Coiled rope is carried in an upright position on back, loops may be adjusted to fit person.

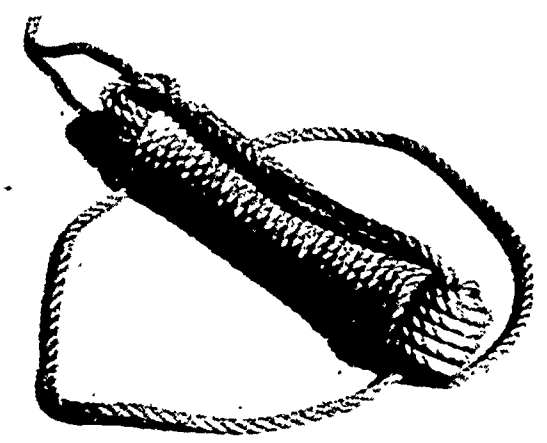


Fig. 130

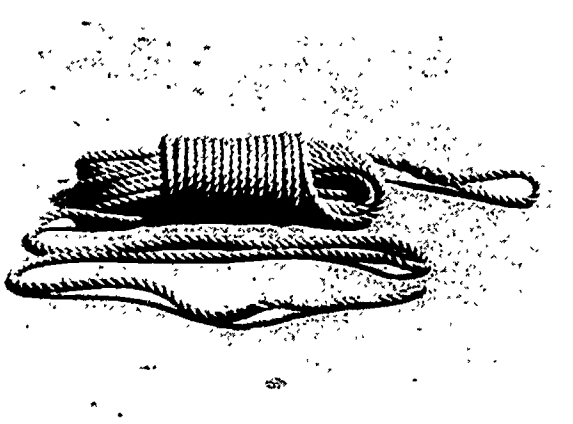


Fig. 131

12ee: HOW TO PLACE BARREL COIL INTO USE

INSTRUCTIONS:
1. Loosen bight end and pull bitter end free.
2. Pull bight end through each end of coil. (Fig. 131)
3. Pull eye free from center of coil (enough to secure).
   NOTE: This eye should always be located at end of coil where bitter end is tied off.

The body thickness recommended should be about 1/4 inch at 3/4 inches from the edge, 3/8 inch at 1-1/4 inch, and 1/2 inch at 2 inches from the edge, the measurements to be taken at the center of the blade, the axe weighing from 6 to 10 pounds.

Care must be used in grinding to prevent heating and the consequent softening of the steel. The axe should be ground to preserve the body thickness and not merely to sharpen the blade. After sharpening the blade, it should be rubbed slightly over the stone to take off keen edge and lessen the possibility of cutting firemen who may rub against the blade at fires. A keen edge is not necessary as it is removed after a few strokes at a fire, after which effective cutting depends upon the thickness of the blade.

The shoulder of the handle is left rather thick to prevent breaking, should the axe be driven through the floor unexpectedly. The grip is thin to provide elasticity and should be smoothed to a polish. Paint or varnish shall not be used on handle to exclude roughness and warping.

All paint and rust should be removed from blade with fine sandpaper or emery cloth to a polish. Rub over with cloth which has had some light oil on it, preferable 3-in-one oil, to keep from rusting during damp weather. Check head of axe to see that handle fits tight. To tighten, drive thin white or douglas fir wooden wedges into split end of handle.

Brush Hook

Grind both sides of the long portion of the cutting edge at least 1 inch. Care must be taken with the throat to keep its circular pattern. Carefully grind throat back 1 inch on an even bevel. Grind hock or point back on a bevel approximately 3/4 inch, the same care should be given the handle and blade after sharpening, as the axe.

McLeod Tool

Grind the hoe so there is a good cutting edge on the inside face; bevel to slope outward at an angle of approximately 45 degrees; bevel to be on outside of blade, away from handle. See that handle is tight. Care for handle same as the axe, keeping smooth, and treated with boiled linseed oil. Blade should be kept free of rust and oiled when not in use.

Pulaski

Grind both bits to a good cutting edge. Bevel of the mattock bit, to be approximately 1/2 inch at 5/8; grind on the inside (the side facing the handle). Bevel on the cutter to be 3/8 inch to 1/2 inch deep. Grind on both sides. Care for handle same as the axe, keeping smooth, and treated with boiled linseed oil. Blade should be kept free of rust and oiled when not in use.

4. Secure eye.
5. Drop main coil.

13: HOW TO INSPECT AND CARE FOR TOOLS IN QUARTERS

OBJECTIVE:

To develop the ability of a fireman to inspect, clean, take proper care of tools and equipment, and sharpen cutting tools with a knowledge of the methods and processes involved, and appreciate the value of having tools in first class working order.

13a: CARE FOR STRIKING TOOLS

INFORMATION:

Striking tools used in the fire department must be given good care and shall be inspected after every run when apparatus has returned to station.

The head of the axe shall be clean and free from rust. The handle shall be smooth and free from any checks, cracks, or imperfections, and never painted or varnished. Use metal or glass scraper to smooth handle, and make sure that handle is set into head securely and at right angle to the head. Apply boiled linseed oil to preserve wood.

The sledgehammer shall be kept clean and free from rust and dirt. Head of the hammerhead pick shall be smooth and free from any defects. Pick shall be sharp at all times and handle shall have same treatment as axe handle.

A film of light oil placed over metal parts will prevent rusting of metal and will make it easier to keep clean.

Rubber mallet. Mallet head shall be securely fastened to handle and shall be kept free from defects as much as possible. Keep free from grease and oil.

13b: CARE FOR AND SHARPEN CUTTING TOOLS USED IN THE FIRE SERVICE

INFORMATION:

Tools shall be inspected after fires, and kept in working order at all times.

Sharpen and care for axe

If the blade is extremely sharp, and the body is ground too thin, pieces of the blade will be broken out when cutting gravel roofs or striking nails and other material in flooring. If the body is too thick, regardless of the sharpness of the blade, the axe cannot be driven through ordinary flooring. Medium thickness of the body is necessary, the thickness dependent upon the grade of steel being used and the experience of the operator. The temper should be such that the blade will not bend or break off when nails, gravel, or other foreign matter is struck with the axe.

Garden Hoe

Should be filed to a good cutting edge on the outside; bevel to slope approximately 45 degrees. Run file over inside edge to remove rough edge. Inspect handle for tightness. Keep smooth and treated with linseed oil.

Steck, Porter, and Mechanical Axe Wire Cutters

Inspect insulated handles for cracks and breaks, test at not less than 10,000 volts and replace if insulation shows signs of weakness. When cutting blade on Steck is nicked or chipped, it must be removed to sharpen, depending on the size of the nick, whether it is possible to sharpen; if not, replace with a new blade. The same applies to the Porter Wire Cutter or bolt cutter and the "Mechanical Axe". Check for fraying of line in "Mechanical Axe".

Voleske Bolt Cutters

Inspect and keep clean, and keep working parts lubricated with a light oil.

Cold Chisels

Should be kept sharp and clean at all times when not in use. All metal parts of tools may be kept free from rust if some light oil or oronite priming solution or comparable material is applied. This may be done with a small brush or cloth, being careful to apply only a light coating.

13c: CARE FOR PRYING TOOLS

INFORMATION:

All prying tools, such as bar, hayward lock breaker, and door openers, shall be kept clean and free from rust. Points of bars and door opener shall be kept sharp and handles shall be smooth, with no slivers.

Particular emphasis shall be paid to the extension piece of Detroit door opener to be sure that extension bar will slide freely, and that pin works freely.

Those tools having wood handles shall be checked for cracks, mars, and pits. If cracked, replace with new one.

13d: CARE FOR SAWING TOOLS

INFORMATION:

Saws should be carried in a special bracket, preferably in jockey or tool box.

They shall be kept free from dirt, grit, and rust. A thin coat of oil placed on blade will protect and preserve the metal.

Saws should be sharp at all times, and teeth set at proper pitch, with handle securely fastened to blade.

Hack saw frames shall be kept straight by using the proper length blade for the frame and not keeping the blade too tight. Extra blades should be carried for replacement.

Electric driven saws must be kept clean, free from dirt and grit, and bearings shall be oiled according to manufacturer's instructions.

13e: CARE FOR BORING AND DRILLING TOOLS

INFORMATION:

Wood augers shall be kept clean and free from rust. Shank shall be set securely in handle, and handle should be smooth.

Cutting edge of auger shall be kept sharp by occasionally dressing down with a fine grained file. When bit becomes too badly worn, auger will have to be replaced with a new one.

Electric drills shall be kept clean and free from dirt or grit. Bearings and other movable parts shall be oiled according to manufacturer's directions.

Star drills shall be kept clean, free from rust, and cutting edge shall be sharp. Striking top shall be smooth and square, with no protruding edges.

Electric or air hammers shall be kept clean and free from dirt, grit, or rust, and movable parts shall be oiled according to manufacturer's instructions.

13f: CARE FOR BATTERING TOOLS

INFORMATION:

The Battering Ram shall be kept clean and painted at all times. Ball and chain shall be kept clean. The ball part shall be painted, chain shall be done up neat to keep from tangling, and ready for use at all times.

13g: CARE FOR DIGGING TOOLS

INFORMATION:

All shovels, hoes, and picks shall be inspected after use; kept in clean condition, and sharpened, handles kept smooth and free from slivers and treated with boiled linseed oil; metal parts kept free from rust; and replaced in proper place on apparatus.

13h: CARE FOR CARRYING TOOLS

INFORMATION:

Shovels shall be kept clean and free from rust, and handles shall be smooth, free from any defects.

Never paint or varnish handles, but give them a treatment of hot boiled linseed oil.

Points of shovels shall be kept smooth and free from pits, and turned edges.

Keep buckets clean, and inspect for any pin-hole leaks. If small hole develops in buckets, same may be repaired by soldering. Keep bails and handles securely fastened.

13i: CARE FOR LIFTING TOOLS

INFORMATION:

Inspect all jacks after use, keep in clean condition. Screw jack and Lever jacks should be oiled. Hydraulic jacks shall be inspected for leaks, and fluid replaced when necessary. They should always be replaced on apparatus in working condition.

13j: CARE FOR LIGHTING TOOLS

INFORMATION:

Electric hand lanterns are of three types, namely, dry, wet cell, and 110V plug in type. In inspecting dry cell type, be sure that terminals are clean and tight. When cells become weak, show corrosion and start to swell, remove and replace with new cells. Clean reflectors of lantern with a piece of absorbent cotton dipped in dry lamp black, starting at the center and working in a circular motion to the outside edge.

Inspect wet cell type to see that proper amount of electrolyte is present, clean and vaseline terminals and test for cell voltage. Check lamp and switch and be sure that reflector is clean. Wash lens with diluted solution of ammonia and water, using soft cloth, and dry with soft flannel cloth. Inspect 110V plug in type to see that connections are tight, and clean lens as for wet cell type. Inspect wire periodically and coil properly.

Lighting plants of the portable type shall be inspected regularly for proper performance. When not in use pet cock or gasoline line shall be closed and all surplus oil, gasoline, and dirt wiped off machine. Gasoline tank shall be full and with the proper mixture of oil. Spark plug checked, cleaned, and the proper clearance between points; all connections and terminals clean and tight; operating lamp good, and an extra amount of gasoline mixed with proper amount and kind of oil according to the manufacturer's instructions in an approved safety can carried alongside of machine. Floodlights and spotlights shall be checked to see that lamps are good, reflectors and lens clean, stand in good condition, cord not frayed or broken, plugs not broken, or wire pulled from terminal screws.

13k: CARE FOR FUSING TOOLS

INFORMATION:

Fusing tools shall be inspected after use, and all parts of equipment cleaned.

Tips of torches shall be clean and openings shall not be clogged. All parts of torch shall be tight and free from leaks.

Hose shall be inspected for snags or abrasions and, when found, shall be repaired. Also check for clogging or for water. If clogged, or there is water in the hose, it must be blown out. Hose shall be securely fastened to threaded socket connections.

Pressure regulating valves shall work freely, packing glands tight. Gauges shall be calibrated periodically at an authorized service station. Never oil gauges or threads as oxygen coming in contact with oil will cause explosion. All connections shall be tight.

Tank valves shall be checked for leaks and packing glands tightened when necessary. Tanks should always be kept in upright position.

131: CARE FOR HOSE JACKETS AND CLAMPS

INFORMATION:

Hose jackets and clamps shall be inspected regularly, and after each fire, to see that they are in working order. Hose jackets vary in type: The Cooper hose jacket or leak stop is the one most commonly used. The hinges shall be kept oiled and free from rust. If hinges are allowed to get rusty or corrode, it will hamper the operator in its use. When oiling, care shall be taken to avoid getting oil on the inside rubber jacket. The jacket shall be submerged in water periodically if not in use. This is to liven up the rubber and keep the rubber from cracking, after which it shall be thoroughly dried and hinges and lock oiled and replaced on apparatus.

Hose clamps vary in types and construction. They shall be kept clean and in working order, and movable parts oiled with a light lubricating oil. If clamps are painted, care shall be taken not to put too much paint around movable parts to hinder operation of clamp.

13m: CARE FOR HOISTING AND PULLING EQUIPMENT

INFORMATION:

Leather, when not given proper care, becomes stiff and cracks and, in this condition, presents a definite hazard to the user, whether he may be using a life belt, an axe belt, or any other tool, appliance, or holder as used in the fire department.

When dirty, leather should be cleaned with a soft cloth moistened with soap suds, then wiped thoroughly dry with a soft cloth. When dry, an application of neatsfoot oil (specially prepared for treatment of leather) should be rubbed into the leather and polished with a soft cloth to remove all surplus oil. This oil penetrates the pores of the leather and, besides keeping the leather soft and pliable, tends to waterproof it too.

Care for and test ropes.

Ropes in the fire service are of two kinds, manila hemp and cotton. Cotton rope of close weave is used for life lines and should be inspected for any tears or snags, and tested to twice the strain that it might have to withstand in service.

Rope commonly used in hoisting operations is three-strand manila hemp. The size and length, as used, varies from 1/2 inch to 3/4 inch, and from 50 to 125 feet. 5/8 inch diameter and 100 foot lengths have been found to be of most value. Rope should be hung from a tower with sufficient weight attached to stretch and should be stretched for not less than seven days. After stretching, rope should be placed around a block of wood or threaded through pulleys to remove all fuzz and assure a smooth rope. The ends should either be knotted or have eye-splices.

Block and tackle should be inspected after use or periodically. Ropes shall be inspected and tested. Blocks should be kept smooth and treated with boiled linseed oil and varnished. Pulleys should be oiled very lightly with a light oil; ropes done up in a neat and compact bundle to avoid tangling, and be ready for use at all times. Steel blocks may be painted to keep them free from rust.

Rope should be checked after being used and at least every three months. In view of the numerous conditions that may effect the strength of rope, and that only part of the rope may be effected, examination shall be made to determine the condition of the rope throughout its entire length as suggested below:

If any of the following conditions are found to exist, and if the condition of the rope is such that there is any doubt as to its being safe to use, it should be reported to superior officer.

<u>On surface of rope</u>

A. Abrasion (broken fibres)
B. Cuts
C. Extremely soft (badly worn rope is extremely soft and has lost its stretch)
D. Decayed, or burned by hot surface or chemical

<u>Inside rope</u>

Separate the strands at three-foot intervals and observe the inner parts for:

A. Broken fibres
B. Fine powder, which determines the presence of grit
C. Mildew or mold
D. Change in color of fibres

Rope should not be carried in a truck compartment containing sharp edged tools. Rope must always be carried coiled and ready for use and should be carried in a compartment that is dry. In fire work rope containing metal strand should never be used.

Determine the proper size of rope to handle the weight of the load. Don't overload it. Following is a list showing the strength of different sizes of Manila rope:

Size (inches)	Breaking Strength (New rope - pounds)	Safe Working Strength (New rope - pounds)
1/4	700	200
3/8	1450	400
1/2	2450	700
5/8	4000	1100
3/4	4900	1400
1	8200	2300
1-1/4	12500	3000
1-1/2	17500	5000

NOTE: New rope loses 1/3 to 1/2 of its strength in six months of ordinary use.

CALIFORNIA FIRE TRAINING PROGRAM

Unit C

FIRE EXTINGUISHERS AND FOAM GENERATORS

14. PRESSURE TYPE EXTINGUISHERS
15. CHEMICAL REACTION TYPE EXTINGUISHERS
16. PUMP TYPE EXTINGUISHERS
17. FOAM GENERATORS
18. FOAM PROPORTIONERS

OBJECTIVE

To develop the ability to use and care for portable fire extinguishers and foam generators, with an understanding of their functions and limitations, and a knowledge of the different types of fires each particular type of extinguisher is best adapted for.

FIRST-AID FIRE FIGHTING APPLIANCES

INTRODUCTION:

The term "first-aid fire fighting appliance" means a portable extinguishing device designed to provide a small quantity of water or other extinguishing agent to cope with fires in their incipiency. These appliances are designed for fires in their incipient stage and cannot be expected to be effective if not applied until after a fire has spread to involve a large amount of combustible material.

For centuries water has played a principal part in the extinguishment of fire. Because of its general plentifulness, low cost of handling throughout most of the inhabited world, it was in the past, still is, and probably will continue to be the most widely used extinguishing agent. However, modern science has brought about the development of certain substitutes for water as fire extinguishing agents, most of which are of a chemical nature. Most of these substitutes are equal to water in their extinguishing power, and some, under certain circumstances, are far superior to water in accomplishing their purpose.

While the use of these substitutes has not been extensively applied to fires of great consequence, they have found a useful field of their own in which they fit. This field is, namely, their use in connection with small portable fire extinguishing devices to use in combating small fires, and fires in their incipient stages. In some cases, these chemical agents even have a marked value, when properly applied through adequately designed equipment, in the extinguishment of severe fires, particularly those involving flammable liquids and greases.

Peculiarly enough, water still is an important factor in the adaption of most of these agents to fire extinguishment purposes. We are mainly interested in their application by medium of small portable extinguishing devices. However, in order that we may clearly understand their practical value, we must first have some conception of the characteristics of incipient fires in the field of which these portable extinguishers are to be used.

INFORMATION:

Combustion, or fire, is defined as, "A chemical process, accompanied by the evolution of heat."

Substances, when heated to a certain temperature known as the "ignition temperature", form a union with the oxygen of the atmosphere resulting in combustion or fire. Sufficient heat is usually liberated to raise the temperature of surrounding substances to the "ignition temperature." Proper temperature, an adequate supply of oxygen, and the presence of combustible material all are necessary to support combustion.

Combustion can be suppressed by cooling or lowering the temperature of the burning substance to below the "ignition temperature" by excluding the supply of oxygen from the atmosphere in contact with the burning substance, by removing the combustible material, or by a combination of these means. In the discussion of portable fire extinguishers or first-aid appliances, we are mainly interested in the cooling of the burning material and in the exclusion of the oxygen supply.

Classification of Fires

Accepted standard practices separate fires into three general classes, as follows:

Class A Fires are those in ordinary combustible materials where the "quenching" and "cooling" effects of quantities of water, or of solutions containing large quantities of water, is of first importance. Examples are fires in wood, textile fabrics, rubbish, etc.

Class B. Fires are those fires in flammable liquids, petroleum products, etc., where the "blanketing" or "smothering" effect of the extinguishing agent is of first importance. Examples are fires in gasoline, oils and greases in tanks or containers, open vats, or running freely on floors or ground.

Class C Fires are those involving electrical equipment, where the use of a "non-conductor" extinguishing agent is of first importance. Examples are fires involving electrical switchboards, motors, or wiring.

Classification of Methods of Propulsion:

To be of any practical value, these extinguishing agents must be provided with suitable means of expelling them from their storage compartments, and propelling streams to the seat of the fire in an effective manner. Methods employed in portable fire extinguishers for accomplishing this purpose are classified as follows:

1. Hand generated pressure (mechanical hand pumps) or pump type.
2. Internally generated pressure (pressure created as product of chemical reaction taking place within). Chemical reaction type.
3. Storage pressure (gas cartridge or confined air pressure). Pressure type.

14: CARBON DIOXIDE CO_2 EXTINGUISHERS

INFORMATION:

Portable quick opening valve type carbon dioxide (CO_2) extinguishers are provided for use in extinguishing operations where a combination of smothering effect and absorption of heat within limits of such extinguishers is desired.

When valve is opened the pressure of gas in top of cylinder forces liquid gas through pipe extending from bottom to top of cylinder, thence through valve and flexible hose to nozzle located at base of insulated rubber cone. The liquid gas at this point expands from a liquid to a gas with a ratio of expansion of from 1 to 450 times its stored volume. This expansion is so rapid that heat is absorbed with resultant freezing of the pure gas to a pure carbonic snow (110° below zero). As the gas forces the liquid down into the line, more gas is emitted from the top of liquid into cylinder. This provides a constant pressure until cylinder is practically empty.

Approximately 3/4 of gas content in cylinder is liquefied due to pressure (about 1000 pounds pressure per square inch is required to compress gas into a liquid state.)

Cylinder is of drawn seamless steel, tested to withstand pressure of 3000 pounds per square inch.

Valve is of a special design of pressed brass attached to top of cylinder. A small pipe extends from top to bottom of cylinder.

Safety release is provided if the extinguisher is subjected to a continuous temperature exceeding 135° F. The increased pressure of the gas in the extinguisher will rupture gold plated safety disc located in the safety nut, releasing gas to the atmosphere.

Valve outlet contains ball and check device that prevents recoil of extinguisher due to the rapid release of gas unless hose with reducing discharge orifice in nozzle is screwed to outlet of valve.

Hose is flexible metallic, and three feet long, tested to withstand a pressure of 2500 pounds per square inch.

Nozzle is designed to prevent freezing of the gas.

Cone is generally of hard rubber, bakelite, or plastic, and designed to withstand extreme and sudden temperature changes.

These extinguishers are effective on small surface fires of Class A, on moderate fires of Class B, and on electrical fires of Class C since the gas is a non-conductor. They are particularly effective on flammable liquid fires in alcohol, carbon bisulphide, and similar liquids which will not support foam. However, it is not effective on deep seated fires in ordinary combustible materials due to the lack of moisture. The gas and "snow" are non-injurious to materials. Duration of continuous discharge ranges from 1/2 to 1 minute depending upon size of extinguisher.

This type extinguisher has a maximum range of 8 feet, but best results are obtained by playing the discharge as close to the fire as possible and applying the discharge first at the edge of bottom of fire and gradually progressing forward or upward, moving the discharge cone very slowly from side to side. The discharge should continue to be directed on the burned substance or surface to deposit carbon dioxide snow even after the fire has been extinguished. This will tend to prevent possible reflash by cooling the hot surface and any glowing material present.

14a: HOW TO OPERATE PORTABLE QUICK OPENING VALVE TYPE CARBON DIOXIDE (CO_2) EXTINGUISHERS

INFORMATION:

Portable type CO_2 extinguishers are found in sizes running from 2½ to 20 lb. hand extinguishers and larger type wheel units.

INSTRUCTIONS:

1. Stand extinguisher in upright position. (Fig. 1)
   NOTE: Due to construction of cylinder, extinguisher should not be laid on side to operate.
2. Remove cone nozzle from holder.
3. Hold handle in one hand.
   NOTE: Static electricity is generated due to speed of gas through hose.
4. Remove Safety Lock pin from valve.
5. Squeeze to operate discharge valve.

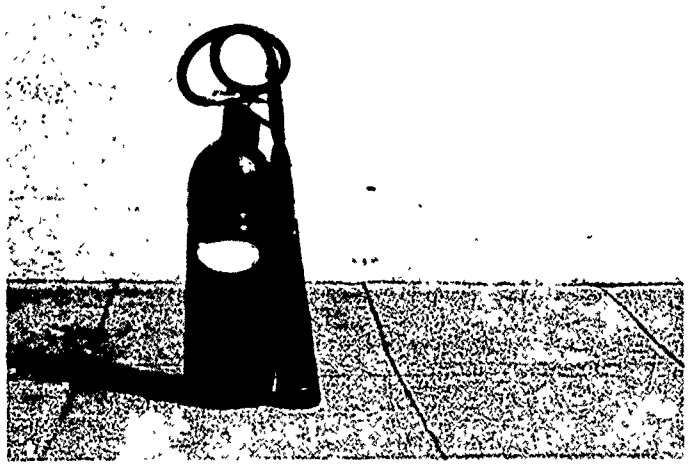


Fig. 1

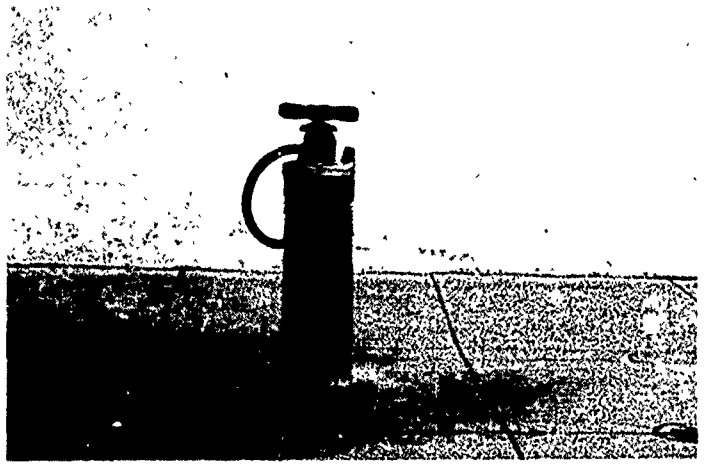


Fig. 2

6. Direct cone nozzle as desired. Care must be taken to prevent reflash.
7. Close nozzle as soon as conditions permit.
8. Continue to open and close valve as desired.
9. Replace Safety Lock pin.

14b: HOW TO OPERATE PHISTER PRESSURE TYPE EXTINGUISHER

INFORMATION:

The one-gallon Phister positive pressure type carbon tetrachloride (CCL_4) extinguisher (Fig. 2) is carried for use on electrical fires and fires where the blanketing effect is desired.

NOTE: CCL_4 is a non-conductor of electricity.

It is constructed entirely of brass and is equipped with liquid control valve, hand air pump, air pump valve, air gauge and liquid gauge. The outer chamber is tested to 200 pounds pressure and contains air under pressure which when released into the outer chamber, forces the liquid in a continuous stream out through a flexible discharge hose a distance of from 35 to 40 feet.

There are no working parts in liquid and liquid is not under pressures, except when in use.

This extinguisher requires no pumping to operate as 100 pounds air pressure is maintained to provide sufficient pressure to discharge entire contents with undiminishing force.

CAUTION: Do not operate in confined space. Carbon tetrachloride in contact with high temperature will break up, producing, in part, highly poisonous gases.

INSTRUCTIONS:

1. Read pressure gauge to see that 100 pounds pressure is indicated on gauge.
2. Remove discharge hose from holder and direct nozzle to base of flame.
3. Turn valve wheel (liquid control valve) one full turn to left.
4. Direct nozzle as desired until the contents are expelled or control valve is closed.
   NOTE: Make regular inspection of air pressure and see that liquid shows in glass gauge.

DRY CHEMICAL EXTINGUISHERS

INFORMATION:

Dry chemical extinguishers consist of a charge of specially prepared dry powdered sodium bicarbonate, with a cartridge of inert gas, such as carbon dioxide to provide the expelling force. Discharge is in the form of a cloud of powder together with gas. The range of the cloud may extend up to 25 feet horizontally, depending on size of extinguisher and type of nozzle. In contact with fire the powder gives off additional carbon dioxide gas with its smothering effect. Discharge should be directed at the base of the flames and should be continued to the burning surface after the flame has been extinguished. On flammable liquid fires, best results are obtained when the discharge is

directed with a sweeping motion, as with the carbon dioxide extinguisher. Dry chemical extinguishers are effective on small fires of Class B, on electrical fires of Class C, and may be effective on small surface fires of Class A.

Nominal capacity of extinguishers of this type is from 3 to 30 pound hand extinguishers giving a discharge duration of from 1/4 to 1/2 minute. Large wheel units are available. They do not have to be protected from freezing.

14c: HOW TO OPERATE 20# DRY CHEMICAL FIRE EXTINGUISHER

INFORMATION:

(Fig. 3) shows Cutaway

A. Nozzle
B. Fill Cap
C. Carrying Handle
D. Container
E. Gas Outlet Tube
F. Puncture lever
G. Gas Cartridge
H. Cartridge Guard
I. Puncture pin

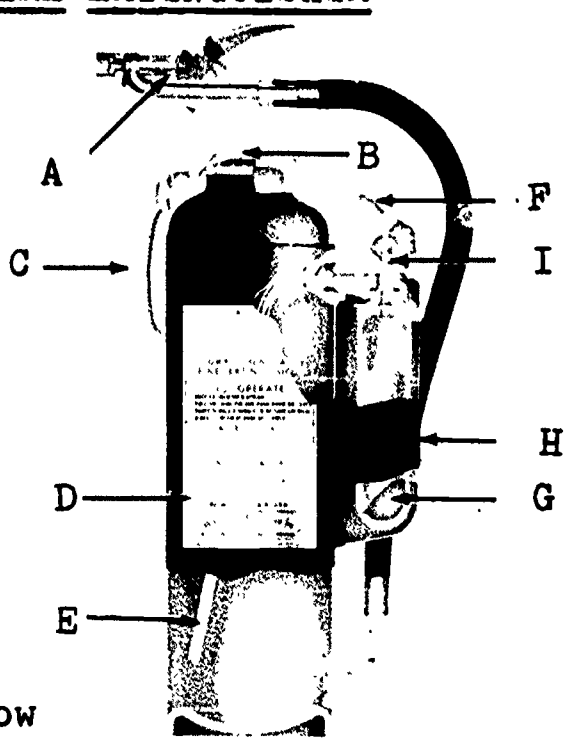


Fig. 3

INSTRUCTIONS:

1. Remove Safety Lock Pin
2. Push lever down to break seal in cartridge.
3. Squeeze nozzle handle. Direct flow of chemical to base of fire.

14d: HOW TO OPERATE STORED PRESSURE TYPE PORTABLE FIRE EXTINGUISHERS (Water Type)

INFORMATION:

The stored pressure (water type) extinguishers will be found in buildings for protection of ordinary combustibles, and are not generally carried on fire apparatus. Pressure for these extinguishers is supplied by two methods, either cartridge or stored air pressure. Sometimes liquids containing wetting agents, anti-freeze compounds or non-conducting agents, are used in this type of extinguisher.

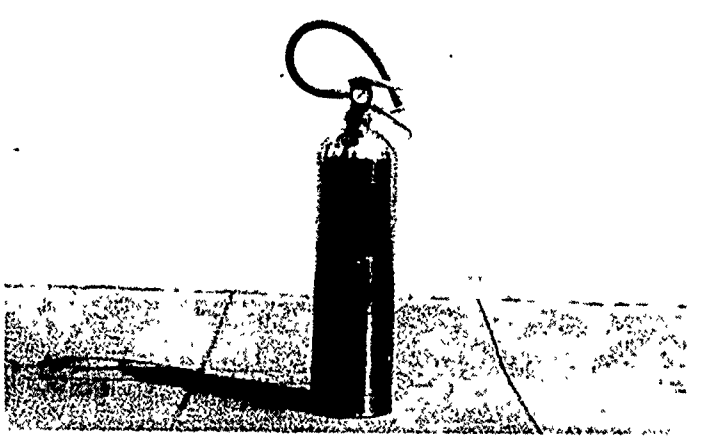


Fig. 4

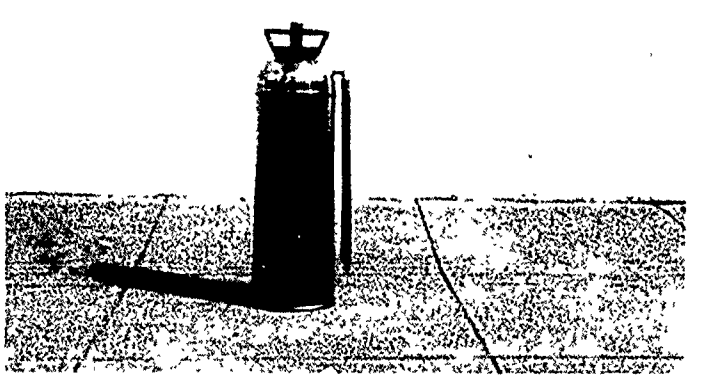


Fig. 5

INSTRUCTIONS:

(Stored Air Pressure Type) (Fig. 4)

1. Remove nozzle from keeper, and hold in either hand.
2. Pull safety lock pin.
3. Squeeze to operate discharge valve.
4. Direct stream to base of fire.

NOTE: If Cartridge type, (Fig. 5) make sure safety yoke is removed, then invert and puncture cartridge by striking against floor.

INSPECT AND RECHARGE PRESSURE TYPE EXTINGUISHERS

INFORMATION:

Carbon dioxide (CO_2) extinguishers shall be inspected and cleaned after use. Check valve and make sure that safety lock pin is in proper hole. If pin will not drop in hole in yoke, take screw driver and loosen set screw in yoke, turning yoke until pin sets, then tighten set screw. Weigh extinguishers, and if below 10% of its original weight, recharge. This must be done under the supervision of a factory representative, or send extinguisher to an authorized recharging plant.

Pressure type carbon tetrachloride (CCL_4) extinguishers must be inspected and cleaned after use. Refill with liquid approved by the manufacturer, to mark on extinguisher or on glass guage. Replace plug tightly. Make sure all valves are closed and pump up air pressure so that 100 pounds show on gauge. Frequent inspections must be made of this extinguisher to be sure that air pressure is maintained at 100 pounds.

Dry chemical extinguishers should be inspected and cleaned after use. If not completely emptied, invert extinguisher and blow out hose with remaining CO_2 pressure. Unscrew top of extinguisher, blow out hose from nozzle end toward extinguisher and replace used carbon dioxide cartridge with a charged one. Refill extinguisher to mark with chemical provided by the manufacturer. Replace top hand tight.

These extinguishers should be inspected periodically, kept full of powder, and checked for weight of gas cartridges. Check hose, nozzle, and elbow for packing of powder. Only those chemical powders as are furnished by the manufacturers should be used.

15: PORTABLE CHEMICAL REACTION TYPE EXTINGUISHERS

INTRODUCTION:

Soda and acid extinguishers are similar to water, in that the water content is the principal extinguishing agent. They contain a solution of sodium bicarbonate in water and a sealed vial of sulphuric acid. These two chemicals, when brought into contact, create a chemical reaction, producing carbon dioxide gas. The pressure of this gas expels the fluid from the extinguishers.

The fluid, as it emerges from the nozzle, contains a small amount of soda in solution and some small bubbles of carbon dioxide gas. However, under normal conditions, the percentage of these free chemicals is so small in comparison with the water content that they have no practical effect as fire extinguishing agents. A disadvantage of this type is that the discharged fluid may contain small percentages of diluted sulphuric acid which is injurious to materials with which it comes in contact.

Foam Type Extinguishers. These differ from soda and acid types in that they contain a solution of sodium bicarbonate in an outer chamber and a solution of powdered aluminum sulphate in water in inner chamber. In addition to the sodium bicarbonate, certain chemicals important to the formation and stablization of the foam are added to the outer chamber. Mixture of the contents of the two chambers is accomplished by inverting the extinguisher, or by releasing the cap of the inner chamber and inverting. The two chemicals which come in contact bring about a chemical reaction causing gas bubbles to rise, permeate the liquid, and form a tough leathery, and durable foam.

The average 2-1/2 gallon foam extinguisher will produce anywhere from 15 to 25 gallons of foam. This foam, when discharged, will pile up against a wall from four to six inches thick. Because of the gas bubbles, the foam is lighter than liquids and floats on the top, eventually covering the entire surface.

The foam extinguisher is most adaptable to gasoline and oil fires or Class B fires. Foam is soluble in some chemical liquids, such as alcohol, carbon bisulphide, acetone, some acids, etc., and should not be used on fires in such liquids. However, a special foam compound is available for fire involving these liquids. The value of foam extinguishers in connection with Class A fires, in ordinary combustible materials, is often overemphasized since the nature of the foam inclines it to stick to the first object it strikes, thus coating the outside surface and making saturation of piled materials difficult. The extinguishing effect of foam is almost entirely by smothering and blanketing.

15a: HOW TO OPERATE SODA AND ACID FIRE EXTINGUISHER

INSTRUCTIONS:

1. Carry to fire in upright position.
2. In screw stopple type (Fig. 1), turn wheel to left to raise stopple. NOTE: Unnecessary with loose stopple type. (Fig. 2)
3. Grasp nozzle and cap ring with same hand.
4. Invert extinguisher.
5. Direct stream to base of fire.
   CAUTION -- Do not direct stream on electrical equipment.
6. To stop discharge, invert to original position.

15b: HOW TO OPERATE FOAM TYPE EXTINGUISHERS

INSTRUCTIONS:

1. Operates in the same manner as Soda and Acid (See Job 15a).

Fig. 1

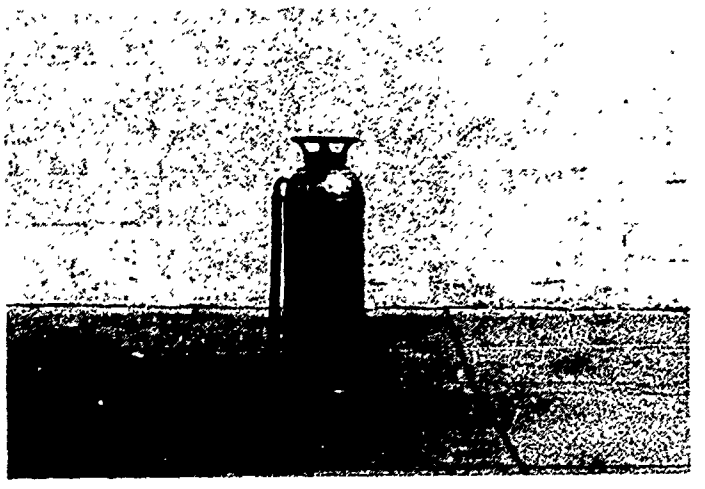


Fig. 2

INSPECT AND RECHARGE CHEMICAL REACTION TYPE EXTINGUISHERS

SODA AND ACID EXTINGUISHERS

INFORMATION:

Soda and acid type extinguishers shall be washed and cleaned out thoroughly after using, making sure that the hose is open and free from obstructions before recharging. Valve on nozzle shall work freely and easily.

Periodical inspections of these extinguishers are necessary and should be discharged and recharged at lease once a year. If hose shows cracks or signs of weakness, replace with new hose.

INSTRUCTIONS:

To recharge a 2-1/2 gallon soda and acid extinguisher, use 1-1/2 pounds of soda dissolved thoroughly in a bucket containing 2-1/2 gallons of fresh luke warm water. Pour thoroughly mixed soda and water into extinguisher. Pour sulphuric acid into bottle up to filling mark (four ounces), taking care not to spill any on the body or clothing. Place acid filled bottle, with stopple in position, in holder. Inspect gasket in top and renew if necessary. Screw top on extinguisher, first placing soap on threads (common laundry soap) so that top can be removed easily, and tighten hand tight. Never use tools to tighten tops of extinguishers. If screw stopple type, screw wheel valve tight.

FOAM EXTINGUISHERS

INFORMATION:

Foam extinguishers shall be thoroughly cleaned before recharging. Inspect all parts of extinguisher while cleaning. If hose is cracked or appears weak, discard and replace with a new one.

INSTRUCTIONS:

To recharge, take a clean bucket and place therein 1-3/4 gallons of water, temperature not to exceed 110° F. To this add contents (small amount at a time) of paper carton or can labeled "B" and stir thoroughly. When thoroughly dissolved, pour mixture into extinguisher. Wash bucket thoroughly and fill with 2-1/2 pints of hot water, temperature not to exceed 120° F. Dissolve contents of chemical solution labeled "A" in this water and stir until completely dissolved. Pour into small cylinder, place cylinder in extinguisher being careful not to spill any liquid. Check gasket in top, place soap on threads and replace top on extinguisher, hand tight. If screw stopple type, screw wheel valve.

16: HAND PUMP TYPE EXTINGUISHERS

INTRODUCTION:

The most commonly used hand pump type extinguishers are carbon tetrachloride (CCL_4) and water pump cans. There are various types and makes of each. Water pump tanks are all similar in their operation. This also applies to the different makes of carbon tetrachlorides (CCL_4).

Carbon tetrachloride extinguishers employ a specially treated non-conducting liquid having a carbon tetrachloride base, with important components added to depress the freezing point to about 50° below zero F. Carbon tetrachloride extinguishers are mainly a smothering type extinguisher since the liquid used is transformed to a vapor upon contact with fire or heat. Consequently, it is not very effective on Class A fires of any great extent, when cooling or penetration would be needed to extinguish the fire.

Caution should be used when using carbon tetrachloride in confined spaces. The gases formed by the vaporized liquid are injurious to inhale. There is a certain amount of phosgene gas created when it comes in contact with hot metals, such as fires on electric motors, combustion motors, grease on stoves, etc.

Carbon tetracholride is a non-conductor of electricity and may be used on electric motors and transformers.

16a: HOW TO OPERATE HAND PUMP TYPE CARBON TETRACHLORIDE (CCL_4) EXTINGUISHERS

INFORMATION:

One-quart hand pump type carbon tetrachloride (CCL_4) extinguishers (Fig. 1) are carried on some mobile equipment for incipient fires within limits of extinguisher.

A double acting pump operated by hand pump handle provides necessary pressure for forcing liquid (CCL_4) from the container.

INSTRUCTIONS:

1. Remove extinguisher from holder
2. Hold body of extinguisher in palm of either hand.
3. Unlock pump handle by turning to left.
4. Direct discharge stream to base of fire.
5. Operate pump.
6. After use, lock handle back into position.

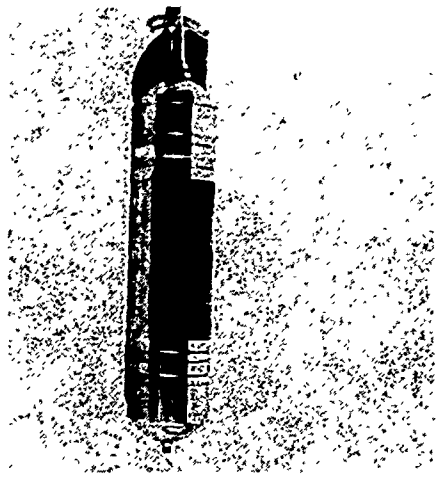


Fig. 1

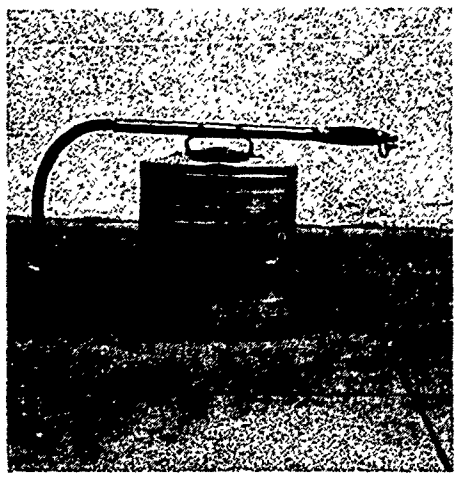


Fig. 2

16b: HOW TO OPERATE PUMP TANK (KNAPSACK TYPE)

INFORMATION:

Pump tanks (knapsack type) (Fig. 2) are carried for use on brush and grass and for some structural fire extinguishing operations.

These extinguishers hold five gallons of water and are provided with shoulder straps, filler cap, filler cap strainer, flexible hose attached to plunger type nozzle and different type discs to place in nozzle discharge orifice.

INSTRUCTIONS:

1. Place pump tank on running board or suitable location to get on back.
2. Release nozzle straps, lay nozzle to one side.
3. Turn back to pump tank, insert both arms in shoulder straps, place straps well up on shoulders.
4. Reach back with either hand, grasp barrel of nozzle, bringing under arm and carry to desired location.
5. Hold barrel of pump firm in hand.
6. Take nozzle in free hand and work plunger of pump in and out.
7. Direct stream and walk along as desired.
   NOTE: Different streams may be obtained by changing disc in nozzle discharge orifice if provided.

16c: HOW TO OPERATE PORTABLE WATER PUMP TANK EXTINGUISHER

INFORMATION:

Portable water pump tank extinguishers (Fig. 3) are carried on some apparatus for use in carrying on extinguishing operations within limits of such extinguishers. These extinguishers are equipped with a double acting hand pump capable of discharging a continuous stream of water from nozzle, a distance of from 30 to 40 feet.

For those locations where pump cannot be operated, the master adapter and garden hose can be used as an extension. The standard length of extinguisher hose is ten feet.

INSTRUCTIONS:

1. Carry extinguisher to desired location.
2. Release nozzle and remove hose from around extinguisher.
3. Hold and direct nozzle with one hand.
4. Take hold of pump handle with free hand, work plunger up and down. NOTE: With two men, one operates pump while one directs nozzle.

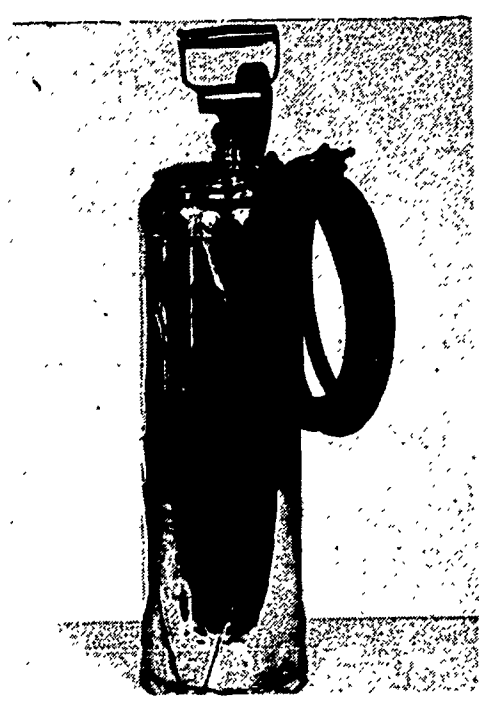


Fig. 3

INSPECT AND RECHARGE PUMP TYPE EXTINGUISHERS

PUMP TYPE -- CARBON TETRACHLORIDE TYPE

INFORMATION:

Pump type carbon tetrachloride extinguishers should be kept full at all times and be refilled immediately after use. No liquid other than that furnished by the manufacturer should be used either for washing or filling the extinguisher. This is very important as liquid other than that furnished by the manufacturer is liable to contain impurities which will render the extinguisher inoperative in a very short time.

When periodic inspection is made, the extinguishers should be tested by discharging a portion of the liquid with the stream directed alternately upward and downward. Sufficient liquid should then be poured in to replace that which was discharged. Wipe off pump rod with a clean cloth.

WATER PUMP TANK TYPE

INFORMATION:

Fresh water pump tank extinguishers should be kept filled with water at all times and frequently examined as to condition of operating parts for deterioration or injuries due to misuse.

If fresh water pump tank extinguisher container leaks due to small holes or sprung seams, this can be remedied by soldering. If hose leaks, replace with a new one, and in replacing be sure to use hose cement.

Nozzle should be examined to see that it is not clogged. Pump should be tested frequently to see that it works properly, and a drop of oil should be put on the piston rod packing.

In the case of a back pump that will not work, the plunger barrel may be gummed up. This can be remedied by using coal oil to clean. The packing gland nut may be screwed up too tight, which can be remedied by loosening. Should this cause the pump to leak, repack pump. If barrel or plunger is badly bent, replace with new one.

17a: HOW TO OPERATE FOAM GENERATOR

INFORMATION:

The foam generator is a device which may be transported from point to point and which generates a continuous stream of foam. (Fig. 1)

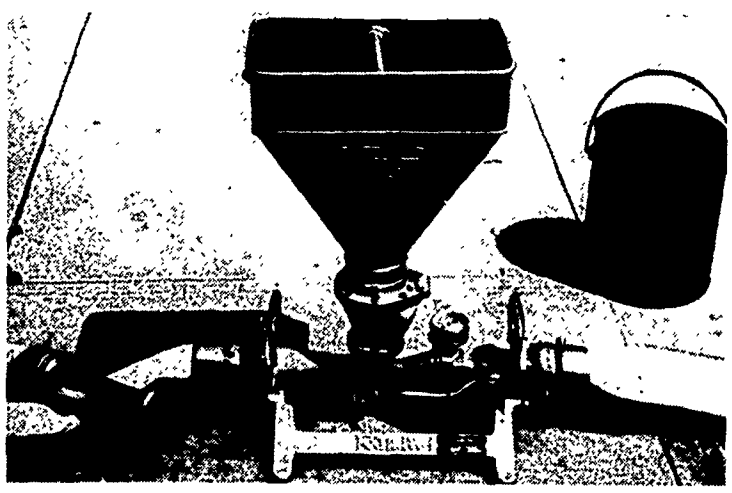


Fig. 1

Its operation consists of feeding powder into a hopper and forcing water under pressure from the fire engine or hydrants through an ejector type of device which draws the powder in and mixes it with water, producing foam as desired. As long as foam powder and water are supplied, foam will continue to be discharged from the outlet of the generator. One pound of foam powder makes about eight gallons of foam. Salt water is considered equally as effective as fresh water for use in foam generators.

The foam generator is employed for oil fires where permanent installations are not provided; it is also used for garage, cleaning plants, and other fires where considerable quantities of gasoline or other inflammable oils are present.

The generator weighs 70 pounds and can be easily carried by one man.

INSTRUCTIONS:

1. Locate the generator to the windward side of the fire about 100 feet distant.
2. Connect two or at the most three fifty-foot sections (100 to 150 feet) of 2-1/2 inch hose to the discharge end of generator (male outlet connection) and lay it on ground towards fire. NOTE: Care should be taken to see that there are no kinks or sharp bends in this discharge hose.
3. Place 1-3/4 inch nozzle tip or play pipe on end of discharge line. NOTE: The size of tips is very important and should always be of large dimensions.
4. Lay a line of 2-1/2 inch hose from the source of water supply, either hydrant or pumper, equip 2-1/2 inch hose with shut-off nozzle, remove tip and connect to generator inlet (female swivel connection). The length of the water line is immaterial so long as it permits sufficient pressure to be available at the generator (preferably 75 to 100 pounds).
5. Open hydrant or start pumper, open the shut-off which is at generator intake and inlet control valve on generator. The inlet control valve is in the open position when its handle is horizontal.
6. Immediately fill hopper with foam powder from the sealed cans. The suction created by the generator will automatically carry the powder into the moving column of water. NOTE: The generator is so designed that the proper quantity of powder will be drawn into the water irrespective of the pressure used. The powder should not therefore, be pushed down into the hopper except that the powder may be assisted by pushing it from the edges to center of hopper. Keep the hopper well filled during the entire discharge period. Fire foam will appear at the nozzle in 10 to 15 seconds after the generator is put into operation.
7. The pressure gauge provided at the generator enables the operator to make frequent check readings. Best results will be obtained when the operating pressure at the generator is maintained between 75 pounds and 100 pounds, never more than 125 pounds.
   NOTE: It is good to bear in mind the temperature of water being used, as cold water makes a much better foam than warm water, in case of using warm water, never use over 100 feet of hose in discharge side, preferably 50 feet if possible, while with cold water 150 feet can be used. Except in rare occasions, never use over 150 feet.

FOAM POWDER

Foam generator powder (also shown in Fig. 1) is a finely ground material resembling dry Portland cement in color and consistency. The powder is packed in sealed cans which contain 45 pounds of powder. The generator operating at 100 pounds pressure consumes approximately 2 cans per minute. The cans are equipped with a "strip" cover. A pull ring is attached to facilitate opening the cover. Each can is provided with a handle, attached to the can proper for carrying purposes.

NOTE: After use, the generator and hopper must be thoroughly washed, to be sure no powder is left in check valve housing.

17b: HOW TO OPERATE PHOMAIRE UNIT

INFORMATION:

The phomaire play pipe, employs phomaide solution and produces foam mechanically. The unit consists of one Phomaire play pipe with pick-up tube attached (Fig. 2) and one or more pails of phomaide solution (Fig. 3).

This unit will operate on any hose line 3/4" or larger, if the necessary adapters are provided.

A pail of phomaide solution contains 2 gallons and will produce between 600 and 700 gallons of foam. Unit uses about 20 gallons of water per minute.

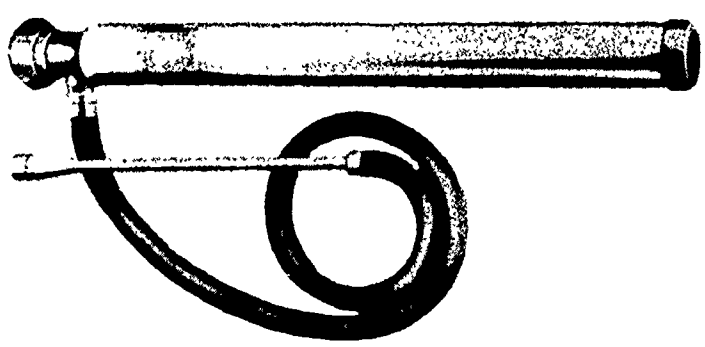


Fig. 2

Fig. 3

INSTRUCTIONS:

1. Remove tip from shut-off nozzle and screw on Phomaire play pipe.
2. Break seal on can of Phomaide solution.
3. Place Pick-up tube into solution.
4. Direct stream.
   NOTE: Nozzle pressure must be 75 pounds per square inch. If Knapsack or Hip pack is provided, only difference in operation would be to transfer solution into them.

INSPECT AND CARE FOR FOAM GENERATORS

INFORMATION:

Allow the hopper to empty itself of powder. When foam ceases to discharge from the play pipe and clear water appears, close the inlet control valve.

Shut the water off at the pump or hydrant, disconnect hose lines at generator, remove hopper, and thoroughly wash the generator inside and out with water. Be sure that no powder is left in the check-valve housing.

Dry all parts thoroughly, replace the hopper, and close hinged cover on pressure gauge. Inspect female coupling and gaskets. Replace on apparatus.

Phomaire unit shall be inspected and cleaned after use. Run clean water through phomaire play pipe and pick up tube to prevent same from becoming clogged. Wash thoroughly the hip pack and dry all parts of unit before replacing on apparatus.

18a: HOW TO OPERATE PROPORTIONERS

INFORMATION:

Most proportioners installed on fire apparatus are of the "around-the-pump" type, using either foam, wet water, or both. These units operate efficiently in the range from 3/4" booster lines to 2½" lines. The metering valves automatically feed the foam liquid or wetting agent into hose lines.

INSTRUCTIONS:

1. Check for supply of wetting agent or foam, water, and hose lay-out.
2. Supply water to discharge line.
3. Open valve of porportioner on pipe from pressure side of pump.
4. Set metering valve for desired mixture.
   NOTE: Maximum discharge approximately 200 GPM for foam.
   Maximum discharge approximately 100 GPM for wetting agent.

CALIFORNIA FIRE TRAINING PROGRAM

Unit D

HOSE, NOZZLES & FITTINGS

19. ADAPTERS, REDUCERS, AND HOSE FITTINGS
20. CONNECT NOZZLE
21. COUPLE AND UNCOUPLE HOSE
22. EXTEND AND REDUCE HOSE LINES
23. PLACE TAP IN
24. SIAMESE HOSE LINES
25. ROLL HOSE
26. FOLD AND CARRY HOSE
27. HOSE JACKET AND CLAMPS
28. REPLACE DAMAGED SECTION OF HOSE
29. REEL AND UNREEL HOSE
30. LOAD HOSE ON CARRIER

OBJECTIVES

To develop the ability to properly care for and operate hose, nozzles and fittings, and to use hose, nozzles and fittings to extend and reduce lines; roll, fold, and carry hose; operate hose jacket and clamps; replace damaged sections of hose; load hose on carriers; with a knowledge of each function and the relation of one function to the others.

INSPECT AND CARE FOR HOSE

INTRODUCTION:

It is deemed important to consider the proper inspection and care of hose at this point, because the entire unit involves the use of hose.

INFORMATION:

Hose, as used in the fire department, is usually of two classes: cotton or synthetic or cotton-synthetic with rubber lining, and rubber lined with rubber cover.

(1) Cotton rubber-lined hose consists of a single, double, or triple jacket of woven cotton synthetic or combination lined with rubber.
(2) Rubber lined with rubber cover hose is made of cotton canvas covered both on the inside and outside with rubber. There are two types: braided and woven. The ends of this type of hose are usually sealed with rubber to prevent cotton from being injured by moisture, acid, or acid vapors.

The most commonly used cotton rubber lined hose is double jacketed, and four sizes are common, namely: 1 inch, 1½ inch, 2½ inch, and 3 inch.

Good hose will last a long time if it is not abused and if given proper care. The principal sources of damage to hose are mechanical injury, heat, mildew and mold, acid, gasoline and oils. Tears, snags and abrasions from dragging hose over the ground or rough surfaces account for much damage to hose. Care in folding the hose and in its use at fires can do much to avoid failures due to mechanical injury. Hose can be injured mechanically even when it is not in use. Being built in 50 foot straight line units, when it is hung over racks for a considerable period, both the cotton and rubber are under certain stresses and strains which cause permanent kinks. When pressure is applied to the hose, it usually bursts. Frequent changing of the hose in hose beds, on reels and racks, helps to avoid these strains which cause permanent kinks. In storing hose not in use, a satisfactory method is to roll loosely and store horizontally. Care must be taken not to make a sharp kink next to the male coupling in the center of the roll. Store in a cool place because if stored in warm rooms for a considerable period, the rubber lining becomes hard, brittle, and lifeless.

Mildew, mold, and other forms of rotting are caused by improper drying of hose. These plants and organisms break down the fibre of the cotton jacket and are usually caused by coiling the hose while wet and storing in a damp place; stored on a damp floor; and the placing of wet hose in a hose bed after use at fires and leaving for a long period of time before replacing.

A very common and insidious cause of fire hose failure is damage by sulphuric acid. Minute amounts of this acid, and very dilute at that, char and burn the cotton jacket of hose to a powdery mass. At such acid-eaten spots the rubber lining is deprived of its support and will fail at relatively low water pressures. It is amazing how easy fire hose can come in contact with sulphuric acid. In use it may be dragged across parking spaces where acid has dripped from a car battery, or may be stored in a room with chemical extinguisher recharges and in dragging across the floor, pick up some acid. There is a certain amount of sulphur in rubber. When water is left lying in rubber hose for a period of time, minute amounts of sulphuric acid form, and when the hose is moved, this acid drips on this or some other length of hose, and the acid is strong enough to eat the jacket.

Fire hose can very easily be ruined by gasoline and oils coming in contact with the rubber lining. Rubber is soluble in gasoline, and oils have a tendency to soften the rubber lining. It is very easy for oil and gasoline to come in contact with the rubber lining of hose, as the cotton jacket picks it up and acts as a wick, and carries it to the rubber lining. This will dissolve the lining or the cement, holding the lining and jacket together.

Hose should be loaded in hose beds so that it will not be too tight and not rub or chafe on the sides of the bed. Hose should be removed from bed every thirty days and the folds changed. Every sixty days (in hot climates, every 30 days) water should be run through the hose, after which it should be hung in the tower to thoroughly drain. Hang by male coupling as hanging by female coupling may damage swivel. If tower is not available, hose should be placed on hose rack. Hose rack should be built with spaces between the slats for circulation of air, and one end should be a foot off the ground, and the other end about three feet.

WASHING, DRYING, AND TESTING

After hose has been in use at fires or has been subjected to test, all loose dirt should be thoroughly brushed off. If the dirt cannot be removed by brushing, the hose should be washed with plain water and scrubbed. When hose has been exposed to oil, the oil may be removed by washing with soap or a mild alkali and then thoroughly rinsed. The hose should then be hung up or placed on a rack to dry. The drying must be carefully done and hose should not be dried in the sun or on concrete roadways or sidewalks.

Hose should be tested regularly and at least once a year. New hose is tested at 400 to 800 pounds for double jacket and 300 to 600 pounds for single jacket. After the first year of service, the hose should be tested at not less than 200 pounds or

where unusually high pressures are used, make test 50 lbs. higher than the normal pressure used. This test may be made with the pumper, but a more convenient method is to hook up lengths one at a time to a small hand or power pump assembly with which the hose may be filled and quickly pumped up to any desired pressure. When making such a test, care should be taken to remove all the air from the hose. Any faulty or defective lengths, or even doubtful lengths, should be repaired by cutting out defective places and recoupling, or the entire length should be scrapped and replaced at once. Before removing hose from hose carrier, be sure that enough spare hose is at hand to replace, so that the required amount of hose will be available for fire fighting.

CARE IN HANDLING HOSE AT FIRES

Hose should not be dragged unnecessarily over pavements. Hose should not be exposed to traffic damage any more than necessary, and when it is necessary to run over hose, hose bridges should be provided. Less damage will be caused to hose when apparatus has to run over it if it has water under pressure, than when flat or under low pressure.

Chafing blocks should be provided for hose next to apparatus and for suction hose. When hoisting hose on roofs and into windows, wear on the jacket can be prevented by the use of hose rollers instead of dragging hose over the sharp edges of roofs and windows. Shutting off nozzles too abruptly may injure hose. This builds up pressure rapidly, and many failures of hose can be traced to this source.

All hose used at fires and drills should be replaced with dry hose upon return to quarters.

19: ADAPTERS, REDUCERS AND HOSE FITTINGS

INTRODUCTION:

Many fittings, such as double male, double female, adapter coupling, plain and gated wyes, plain and gated siameses, water thiefs and nozzles, are used in the fire department when making hose lays to accomplish desired results.

INFORMATION:

Double male couplings (Fig. 1) are used to connect two female couplings and to connect nozzles to female coupling.

Double female couplings (Fig. 2) are used to connect two male couplings. When double female couplings have only one swivel, solid end of coupling should be connected to male coupling of hose first.

Adapter couplings (Fig. 3) are used mainly to change from one type and size of thread to another. They are also used as reducers for like threads. Female end should be connected first.

Wyes, plain or gated (Fig. 4) are used to take two lines from one. Most common use is the laying of two $1\frac{1}{2}$ inch lines from one $2\frac{1}{2}$ inch line.

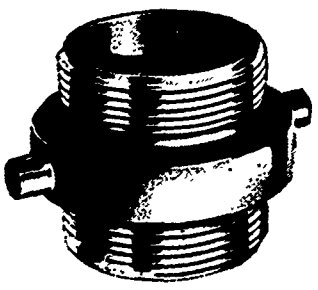


Fig. 1

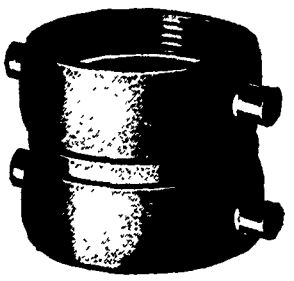


Fig. 2

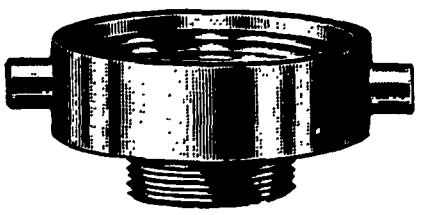


Fig. 3

Fig. 4

Siamese, plain (Fig. 5) or gated is used to connect two lines into one. Generally used when operating high pressure streams or heavy duty appliances.

Water thief is used to provide a number of small streams from one $2\frac{1}{2}$ inch line. Either connected in the line or at the end of a line, and permits the taking off of 3/4, 1, and $1\frac{1}{2}$ inch lines. Has $2\frac{1}{2}$ inch female thread on one side and $2\frac{1}{2}$ inch male thread on the other side, which is capped when using on the end of a line. (Fig. 6)

Shut-off nozzles (Fig. 7) are used as gate valves in a line where tip is threaded for $2\frac{1}{2}$ inch hose. Usually used to reduce $2\frac{1}{2}$ inch line to $1\frac{1}{2}$ inch by removing the tip. Some departments reduce $1\frac{1}{2}$ inch lines to 3/4 inch by removing tip, placing reducer on line and connecting garden hose.

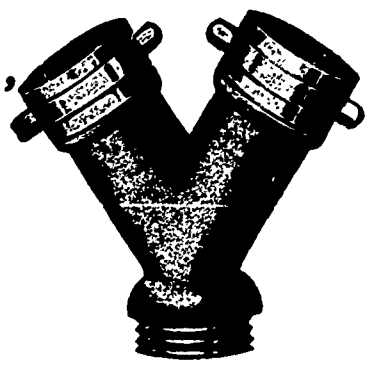


Fig. 5

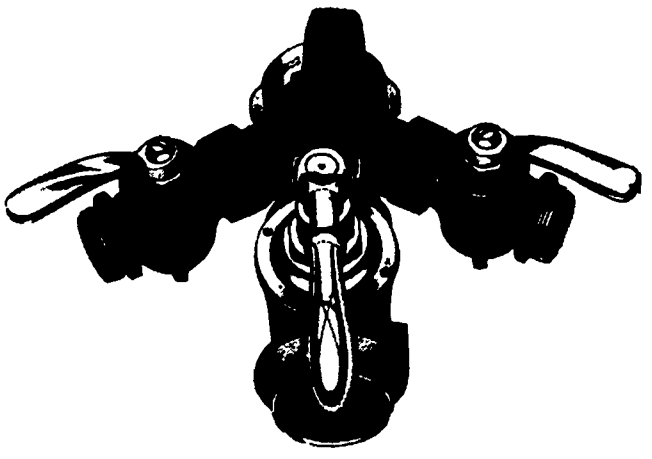


Fig. 6

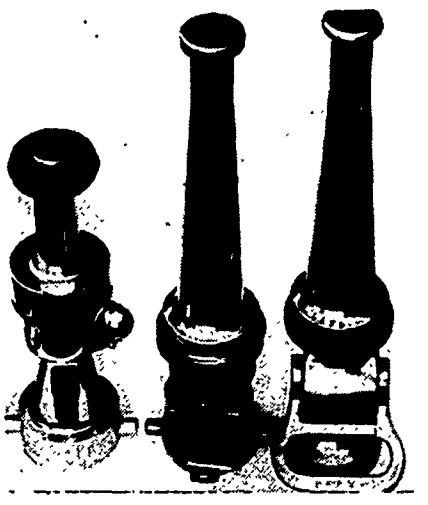


Fig. 7

19a: MAST-R ADAPTER

INFORMATION:

The Mast-r Adapter Unit consists of an adapter connection containing a combination washer and equipped with a safety chain, 50 feet 1/2 inch rubber hose and a special type shutoff

nozzle. The hose with adapter and nozzle attached is carried on apparatus, coiled and secured by means of three carrier straps.

This unit may be connected to any water outlet (Fig. 8) which does not exceed 1 inch outside diameter regardless of whether it is threaded or not. The adapter is threaded for standard garden hose thread and is so constructed that a connection can be made in case the threads are damaged.

The unit may be used upon incipient fire for which water is the proper extinguishing agent. The nozzle will discharge from 2 1/2 to 10 GPM.

There are many places where this unit may find practical use in fire service. Besides connection to domestic water service outlets it may be used for extending garden hose lines, house lines, chemical hose lines, and pump can hose lines.

The combination washer contained in the adapter is constructed of pure para gum and functions not only as a garden hose washer but also as a washer for any connection less in diameter than the regular garden hose coupling. Due to its resilience and shape the pressure of the water acting upon it causes it to more tightly grip a smooth surface. It therefore makes a tight connection when it is slipped over a threadless bib or smooth pipe. By wetting the washer it becomes easier to slip over a threadless bib and this does not affect its function as a washer.

When making a connection with the adapter the tightest possible connection should be made so as to eliminate any water damage from unnecessary leaks. For this purpose a safety chain is provided, the function of which is to hold the adapter in place when connected to damaged threads, threadless bibs, or nozzles. When using the safety chain for this purpose it should be tightened by wedging any convenient material or object under the chain in order to make the connection as tight as possible.

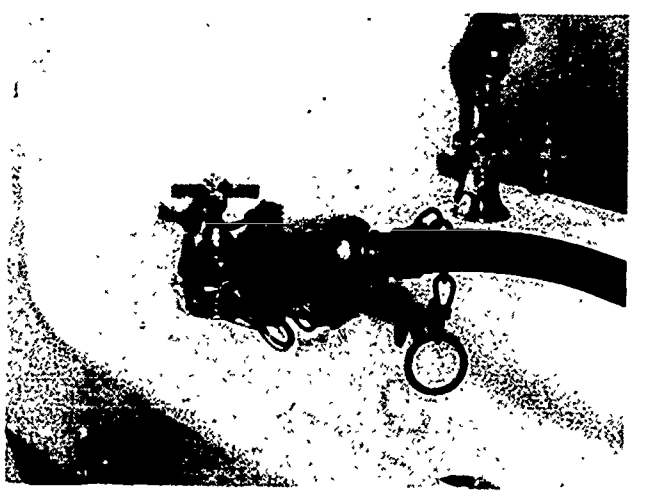


Fig. 8

Another function of the safety chain is to secure spring type faucets in an open position. This is necessary to insure a continuous and full flow of water. If insufficient chain remains to secure spring type faucet after fastening an adapter to connection, one or more of the carrier straps may be used for this purpose.

Another function of the carrier straps is to aid in fastening the adapter to the connection when the safety chain is of insufficient length to meet the situation.

When the adapter is used on domestic water faucets, it is necessary to locate and open full any valve which may be in the supply pipe leading to the fixture to insure a full flow of water. These valves are usually partly closed for the purpose of controlling the pressure of the water flowing into the fixture.

19b: HOW TO OPERATE FOUR-WAY VALVE

INFORMATION:

The object of a four-way valve is to provide a means for **changing from a direct hydrant stream to an engine stream without** shutting off the flow of water.

With this device, which is always used in connection with a triple combination apparatus, the hydrant stream is used on the fire until the pumper returns to hydrant, where connections are made from pumper to four-way valve, then by throwing valve handle over 90° pressure is sent out into line without interrupting the stream. This valve is made of aluminum and brass and is called the Blake four-way valve.

INSTRUCTIONS:

1. The four-way valve is connected to female end of hose. (Fig. 9)
2. When line is laid the four-way is attached to hydrant. (Fig. 9)
3. The valve lever is placed as shown in picture. (Fig. 9) NOTE: This picture shows the valve so turned as to permit the hydrant to deliver water directly into hose line.
4. When additional pressure is wanted at nozzle, the suction is attached to remaining male coupling and the discharge line from the pumper is attached to the other connection as shown. The valve handle is swung 90° as shown in Fig. 10. In this position water flows from the hydrant into suction, through the pumper, through discharge hose back into four-way valve, then out into line which was originally fed by hydrant.

5. Pump connections are made with ordinary suction hose from male outlet of four-way valve to suction intake of pumper. Generally a 25 foot by-pass is attached to discharge outlet of pumper to female intake of four-way valve.

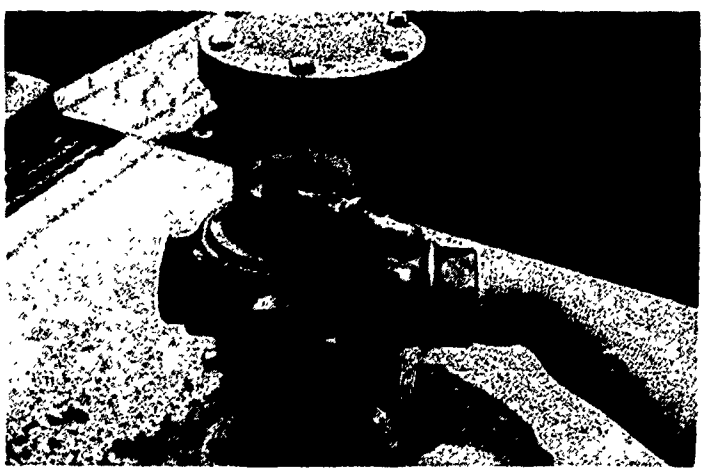


Fig. 9

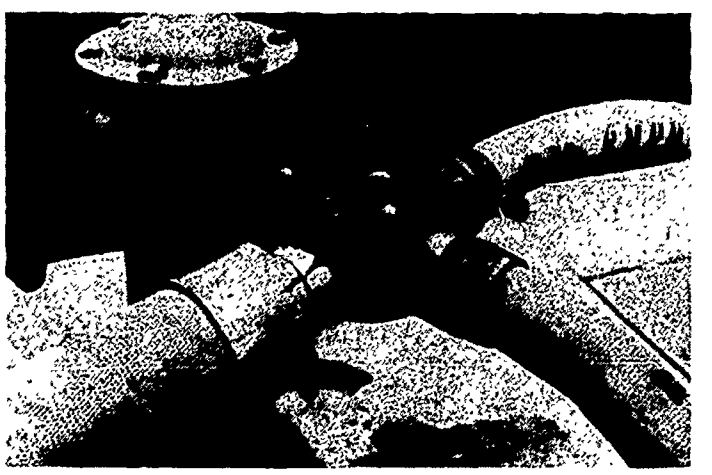


Fig. 10

19c: HOW TO OPERATE THE GLEESON REDUCING VALVE

INFORMATION:

This valve is adapted to all conditions where it is desired to reduce high pressure to a lower pressure, it will automatically operate to maintain the desired pressure at the discharge side, after indicator is set.

The Gleeson valve is used on hydrants which have a pressure greater than 120 pounds, it is also used by fire boats and in making tap-in's on high pressure lines.

The Gleeson valves used, are in two sizes, $2\frac{1}{2}$ and $3\frac{1}{2}$ inch, both operating exactly the same. The scale or indicator is graduated from zero to 300, which shows pounds pressure.

INSTRUCTIONS:

1. Couple reducing valve to hydrant (Fig. 11)
2. Couple hose to reducing valve. (Fig. 11)

Fig. 11

3. Set indicator at whatever pressure is desired.
4. Upon receiving orders for water, open hydrant wide open. NOTE: In case of emergency, the emergency pet cock can be opened to cause an immediate shut-down.
5. When given orders to shut down, first close hydrant, open drain cock to drain hose line, then screw indicator back to zero. NOTE: If salt water is used through valve, flush thoroughly with fresh water.

20: CONNECTING NOZZLES TO HOSE

INTRODUCTION:
There are many makes and types of nozzles used in the fire service varying in size and type of shut-off valve. Basically, all can be connected to the hose by using a standard procedure.

20a: HOW TO CONNECT NOZZLE TO HOSE (KNEE METHOD)

INSTRUCTIONS:
1. Pick up nozzle
   a. Either hand
   b. Check gasket, threads, and roundness (Fig. 1)
   c. Make sure shut-off is open
2. Pick up coupling
   a. Opposite hand
   b. Check threads and roundness
3. Position coupling (Fig. 2)
   a. Palm up.
   b. Back of hand on knee (same side as hand used)
4. Place nozzle on coupling
   a. Spread legs and bend knees
   b. Place nozzle against male coupling
5. Set threads
   a. Turn counter clockwise until threads set.
      NOTE: You will either hear or feel same.
6. Connect nozzle
   a. Turn clockwise hand tight
7. Shut off nozzle (Fig. 3)

Fig. 1

Fig. 2

Fig. 3

20b: HOW TO CONNECT NOZZLE TO HOSE (Foot Method)

INSTRUCTIONS:

1. Pick up nozzle
   a. Either hand
   b. Check gasket, threads and roundness (Fig. 1 -- Job 20a)
   c. Make sure shut-off open
2. Position foot
   a. Opposite foot to hand used to hold nozzle
   b. Close behind male coupling (Fig. 4)
      NOTE: Make sure body is in front of coupling with other leg spread.

Fig. 4

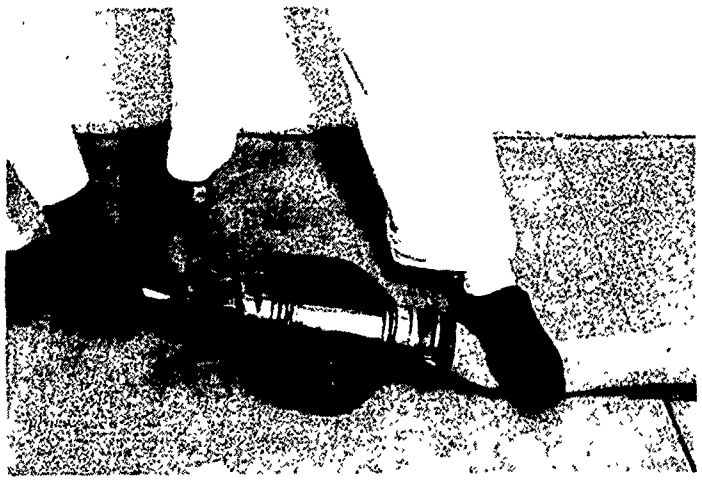


Fig. 5

3. Set Threads
   a. Place nozzle against male threads
   b. Turn counter clockwise until threads set.
      NOTE: You will either hear or feel same.
4. Connect nozzle (Fig. 4)
   a. Turn clockwise hand tight
5. Shut off nozzle (Fig. 5)

20c: HOW TO CONNECT NOZZLE TO HOSE (2 men)

INSTRUCTIONS:

1. Pick up nozzle
   a. Either man
   b. Check gasket, threads, and roundness (Fig. 1, Job 20a)
   c. Make sure shut-off open
2. Pick up male coupling
   a. Other man
   b. Check threads and roundness
3. Position coupling
   a. Hold with both hands firmly
   b. Between knees or across hip (Fig. 6)
4. Set threads
   a. Place nozzle against male threads
   b. Turn counter clockwise until threads set
      NOTE: You will either hear or feel same.

5. Connect nozzle (Fig. 6)
   a. Turn clockwise hand tight
6. Shut off nozzle

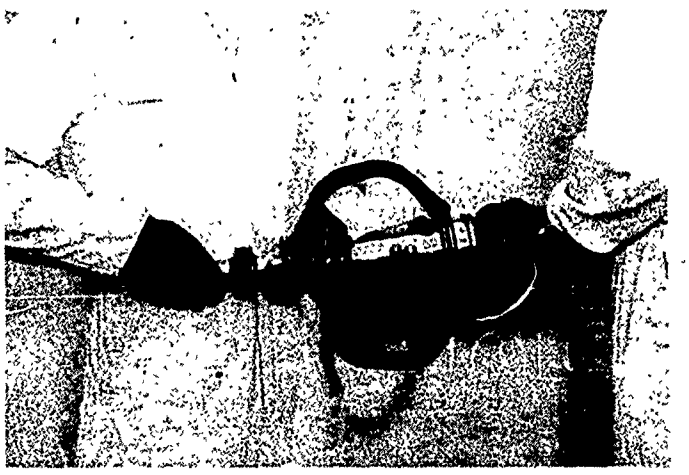


Fig. 6

INSPECT AND CARE FOR NOZZLES

INFORMATION:

Nozzles should be inspected periodically and after use. Nozzles or playpipes that are bent or battered in any way should be carefully repaired, if possible, or else replaced. Bent or battered nozzles should not be used as the effective reach and fire extinguishing capacity of the stream will be much impaired. Tips shall be examined for dents and nicks as the slightest roughness will sometimes cause the stream to break or spray and to become inefficient. Check gaskets for softness and proper size. Clean and check threads, check valve seats and apply powdered graphite (or rubber lubricant if rubber seated). Also, check valve packing and tighten or replace as necessary.

21: COUPLE AND UNCOUPLE HOSE

INTRODUCTION:

The coupling and uncoupling of hose is one of the most important jobs performed by all firemen. It must be done rapidly under all kinds of working conditions. Three one-man methods and the two-man method is shown in this manual. Stress should be placed in drilling on several methods so that all working conditions can be met.

21a: HOW TO COUPLE HOSE (Straddle method)

INSTRUCTIONS:

1. Straddle hose
   a. About one foot behind female coupling, facing coupling.
2. Pick up female coupling
   a. Right hand

b. Fingers inserted inside coupling, checking for gasket. (Fig. 1)

3. Pick up male coupling
   a. Left hand, half on coupling, half on hose. (Fig. 2)

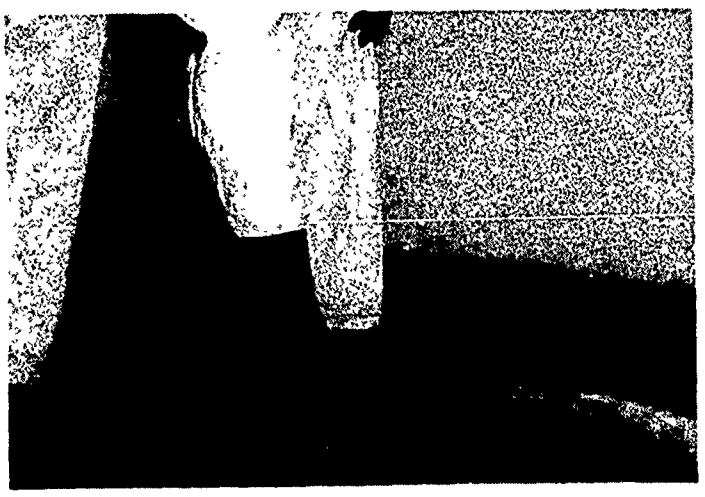


Fig. 1

Fig. 2

4. Set Threads
   a. Place male against female
   b. Turn counter clockwise until threads set
      NOTE: You will either hear or feel same.
5. Connect Couplings
   a. Turn clockwise, right hand, down motion.
   b. Align flat part of hose before making hand tight.
      NOTE: The above procedures may be adapted for left handed persons.

21b: <u>HOW TO COUPLE HOSE</u> (<u>Over Hip Method</u>)

INSTRUCTIONS:

1. Take position
   a. Left side, about two feet behind female coupling
2. Pick up female coupling
   a. Either hand
   b. Fingers inserted inside coupling, checking for gasket. (Fig. 1 -- Job 21a)
   c. Place hose over right hip, and hold with elbow.
3. Pick up male coupling
   a. Left hand, half on coupling, half on hose
   b. Palm up
4. Position male coupling
   a. Back of left forearm on left knee (Fig. 3)
5. Set Threads
   a. Place male against female
   b. Turn counter clockwise to set threads
      NOTE: You will hear or feel same.

6. Connect couplings
   a. Turn clockwise, right hand, down motion
   b. Align flat part of hose before making hand tight.
      NOTE: The above procedures may be adapted for left handed persons.

Fig. 3

Fig. 4

21c: HOW TO COUPLE HOSE (Foot Method)

INSTRUCTIONS:
1. Take position
   a. Left side of female, facing male coupling
2. Position left foot
   a. Directly behind male coupling, using ball of foot
3. Pick up female coupling
   a. Right hand
   b. Fingers inserted inside coupling, checking for gasket. (Fig. 1 -- Job 21a)
4. Set Threads
   a. Place female against male
   b. Turn counter-clockwise to set threads
      NOTE: You will hear or feel same.
5. Connect couplings (Fig. 4)
   a. Turn clockwise, right hand, down motion
   b. Align flat part of hose before making hand tight.
      NOTE: The above procedures may be adapted for left handed persons.

21d: HOW TO COUPLE HOSE (2 MEN)

INSTRUCTIONS:
1. Pick up female coupling
   a. Either man
   b. Fingers inserted inside coupling, checking for gasket. (Fig. 1, Job 21a)
2. Pick up male coupling
   a. Other man

3. Position couplings
   a. Between knees or across hip (Fig. 5)
   b. Man holding male look away, and holds coupling steady.
4. Set threads
   a. Place female against male
   b. Turn counter-clockwise to set threads
      NOTE: You will hear or feel same
5. Connect couplings
   a. Turn clockwise, right hand, down motion
   b. Align flat part of hose before making hand tight.
      NOTE: To uncouple using this method, man holding male will turn female swivel clockwise, downward motion.

21e: HOW TO UNCOUPLE HOSE (Straddle method)

INSTRUCTIONS:
1. Straddle hose
   a. About one foot behind male coupling, facing coupling.
2. Position couplings
   a. Place between knees (Fig. 6)
3. Disconnect Couplings
   a. Left hand holding female coupling just behind swivel.
   b. Right hand turning female swivel clockwise, downward motion.

NOTE: Lay couplings down gently.

Fig. 5

Fig. 6

21f: HOW TO UNCOUPLE HOSE (Hip Method)

INSTRUCTIONS:
1. Take position
   a. Left side about two feet behind male coupling.
2. Position couplings
   a. Over right hip and hold with elbow.

3. Disconnect coupling (Fig. 7)
   a. Left hand holding female coupling just behind swivel.
   b. Right hand turning female swivel clockwise, downward motion. NOTE: Lay couplings down gently.

Fig. 7

21g: HOW TO UNCOUPLE HOSE (Foot Method)

INSTRUCTIONS:

1. Take position
   a. Left side of male, facing female
2. Position left foot
   a. Behind female coupling, using ball of foot
3. Position hose
   a. Lift up with left hand to clear couplings of ground
4. Disconnect couplings (Fig. 8)
   a. Left hand grasping hose just behind male
   b. Right hand turning female swivel clockwise, downward motion.
      NOTE: If couplings are too tight to loosen by above method, (Fig. 9) shows a method that may be used.

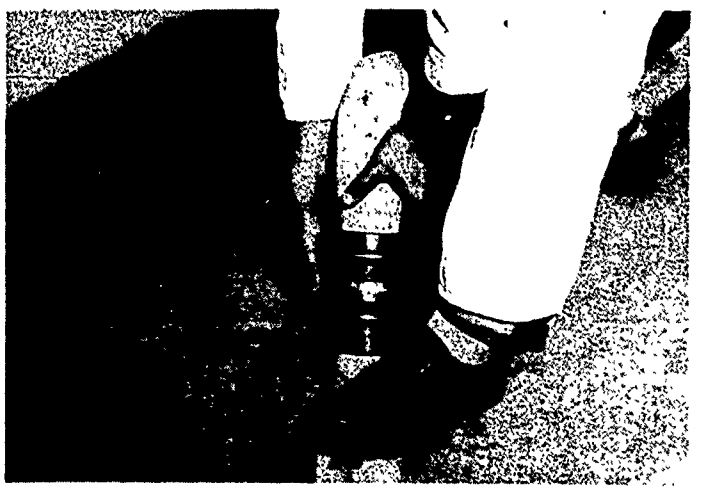


Fig. 8

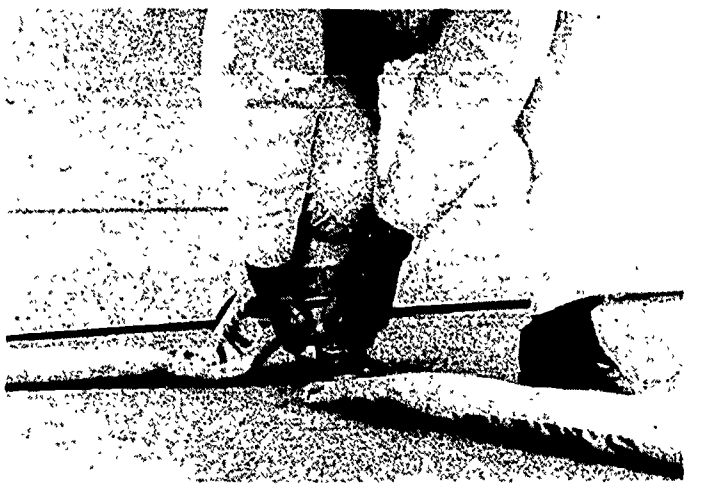


Fig. 9

INSPECTION AND CARE OF COUPLINGS

INFORMATION:

Couplings should never be dropped or dragged on the ground unnecessarily as this will result in bent or battered threads, swivels that may be dented or sprung so that they will not turn.

Inspection of couplings shall be made every time that hose is changed in hose bed, and shall consist of noting threads on both male and female couplings, whether swivels work freely and whether gasket is of correct size and in proper place.

If threads are damaged, they shall be rechased with tap and die provided for that purpose. Clean all dirt off threads using wire brush. If swivel is corroded, make solution of bicarbonate of soda and warm water in pan and place coupling in solution, taking care not to get solution on rubber lining. Work until free. When dry, lubricate swivel of female with powdered graphite. Never use oil.

The rubber washers in couplings shall be checked and renewed as needed, as they deteriorate and break away. Care should be taken that they do not protrude into water way as this will reduce the effectiveness of the stream.

22: EXTEND AND REDUCE LINES OF HOSE USING NOZZLES AND OTHER FITTINGS

INTRODUCTION:

In carrying on operations involving the use of hose lines, it sometimes becomes necessary to make extensions and reductions of lines of hose in order to reach desired locations, to use smaller lines for overhauling after fires and on smaller fires to eliminate excessive use of water to prevent unnecessary water damage.

In extending or reducing lines of hose, obtain all necessary equipment to do the job before shutting off the flow of water. The water may be shut off either with a hose clamp, at pump or hydrant, or by kinking the hose line.

22a: HOW TO EXTEND 2½ INCH LINE

INSTRUCTIONS:

1. Obtain desired number of lengths of 2½" hose and nozzle.
2. Connect nozzle to extension hose.
3. Shut off water. (Fig. 1)
4. Take off nozzle tip (Nozzle must be 2½" straight through)
5. Connect extension line.
6. Take nozzle to desired location.
7. Charge line

   NOTE: Order of sequence may have to be changed according to conditions.

22b: HOW TO EXTEND $2\frac{1}{2}$ INCH LINE (Using Hose Clamp)

INSTRUCTIONS:

1. Obtain desired number of lengths of $2\frac{1}{2}$ inch hose and hose clamp.
2. Place hose clamp on line about one foot behind coupling. (Fig. 2)

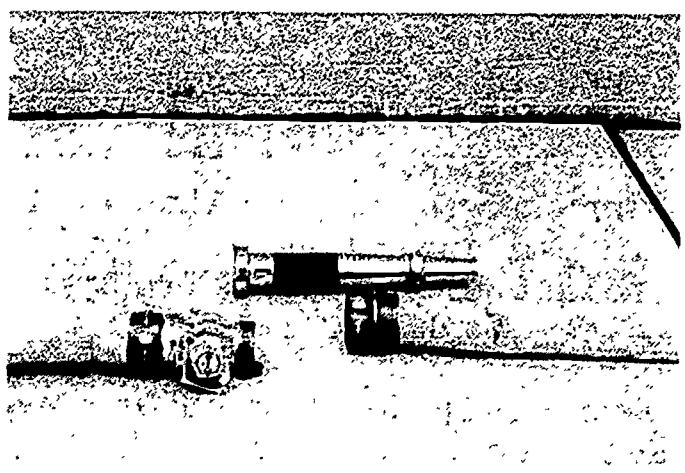


Fig. 1

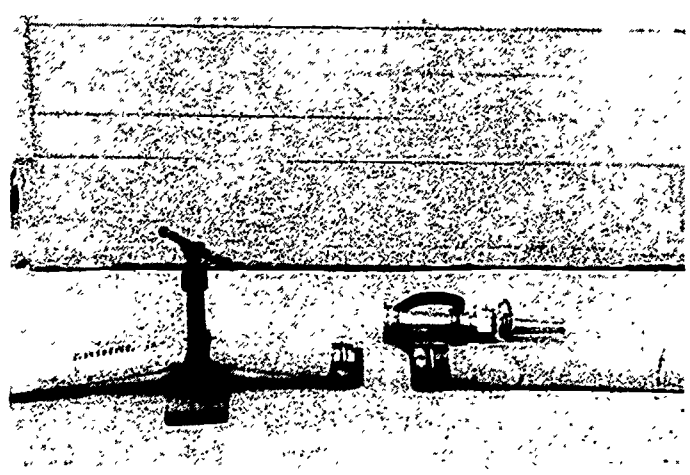


Fig. 2

3. Remove nozzle and attach to extension line.
4. Attach extension line to original line.
5. Take nozzle to desired location.
6. Remove hose clamp.

22c: HOW TO EXTEND AND REDUCE $2\frac{1}{2}$ INCH LINE TO $1\frac{1}{2}$ INCH LINE

INSTRUCTIONS:

1. Obtain desired number of lengths of $1\frac{1}{2}$" hose with nozzle connected.
2. Close nozzle on $2\frac{1}{2}$" line
3. Remove tip. (Fig. 3)
4. Connect $1\frac{1}{2}$" hose to $2\frac{1}{2}$" nozzle.
5. Open $2\frac{1}{2}$" nozzle.

   NOTE: A further breakdown to chemical hose or garden hose can be accomplished by using the proper reducers. (Fig. 4)

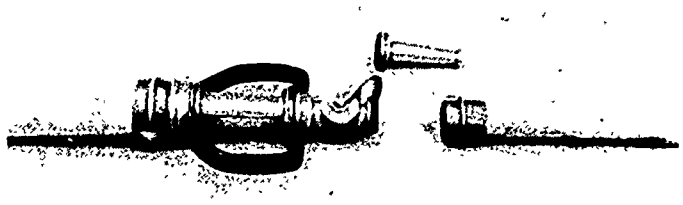


Fig. 3

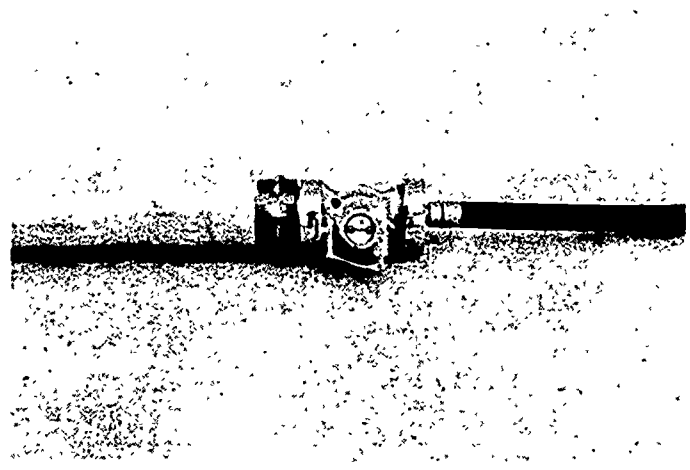


Fig. 4

22d: HOW TO EXTEND AND REDUCE $2\frac{1}{2}$ INCH LINE TO $1\frac{1}{2}$ INCH LINE (Using Hose Clamp)

INSTRUCTIONS:

1. Obtain desired number of lengths of $1\frac{1}{2}$" hose with nozzle attached, hose clamp, and $2\frac{1}{2}$" to $1\frac{1}{2}$" reducer.
2. Apply hose clamp about one foot behind $2\frac{1}{2}$" nozzle.
3. Remove $2\frac{1}{2}$" nozzle.
4. Attach $2\frac{1}{2}$" to $1\frac{1}{2}$" reducer.
5. Connect $1\frac{1}{2}$" line to reducer. (Fig. 5)
6. Take $1\frac{1}{2}$" nozzle to desired location.
7. Remove hose clamp.

   NOTE: Any additional breakdown to chemical hose or garden hose can be accomplished in the same manner with the use of the proper reducers.

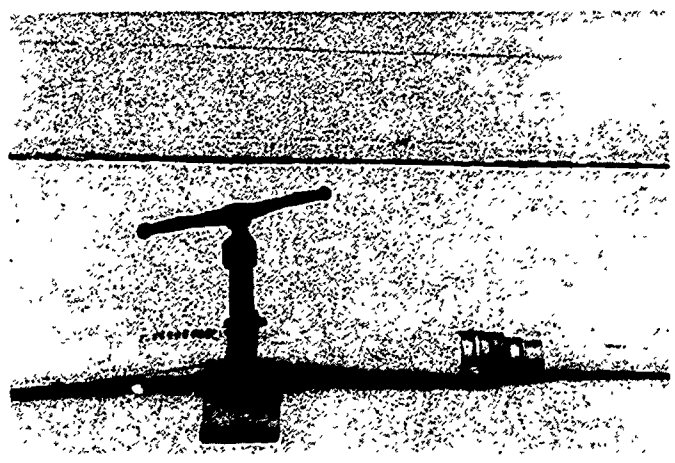


Fig. 5

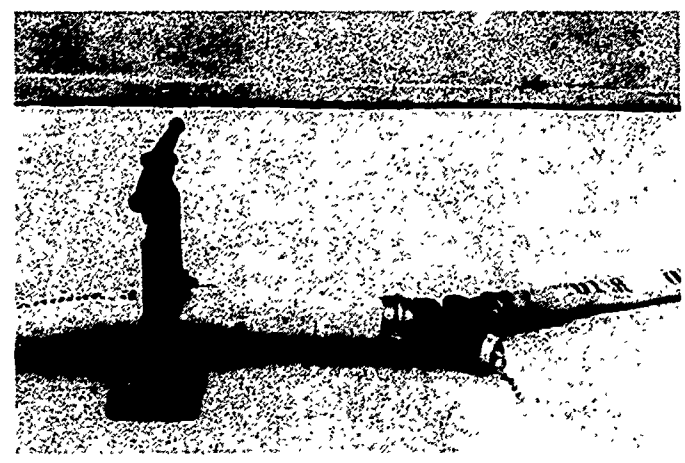


Fig. 6

22e: HOW TO EXTEND AND REDUCE $2\frac{1}{2}$ INCH LINE TO $1\frac{1}{2}$ INCH LINE USING WYE AND HOSE CLAMP

INSTRUCTIONS:

1. Obtain desired lengths of $1\frac{1}{2}$" hose with nozzle attached, $2\frac{1}{2}$" to $1\frac{1}{2}$" wye and hose clamp.
2. Apply hose clamp behind $2\frac{1}{2}$" nozzle.
3. Remove nozzle.
4. Apply $2\frac{1}{2}$" to $1\frac{1}{2}$" wye.
5. Attach $1\frac{1}{2}$" line to one outlet of wye.
6. Cap off or shut off (if gated) other side of wye (Fig. 6).
7. Take $1\frac{1}{2}$" nozzle to desired location.
8. Remove hose clamp.

   NOTE: This method can be used to reduce a 3" line to a $2\frac{1}{2}$" line by using the 3" to $2\frac{1}{2}$" wye.

23: PLACING A TAP-IN IN A LINE OF HOSE

INTRODUCTION:

In carrying on operations involving the use of hose lines it sometimes becomes necessary to place a tap-in in the line to extinguish spot and other fires or in some cases due to shortage of hose.

Before interfering with the original line, always have tap-in connection made up ready to insert in line so that time original line is out of service can be reduced to the minimum. When tap-in connection is ready, the flow of water in original line can be stopped by kinking line, by using a hose clamp, or by making a temporary shut down at pump or hydrant.

Where line is laid from high pressure hose lines, a reducing valve is sometimes necessary on the tap-in line.

The tap-in line can be of any size hose from 3" to garden hose, if proper adapters are available.

23a: HOW TO PLACE TAP-IN IN LINE USING WATER THIEF

INSTRUCTIONS:

1. Obtain desired amount and size of hose with proper nozzle attached, any necessary adapters and the water thief.
2. Shut off flow of water by kinking, using hose clamp or temporary shut down at pump.
3. Break coupling at desired location for tap-in in original line.
4. Connect plain wye to original line. (both male and female) Make sure tap-in outlets are closed.
5. Charge original line.
6. Make desired connections to either or both tap-in outlets using proper adapters for size of tap-in line to be used.
7. Take tap-in nozzle or nozzle to desired location.
8. Charge tap-in line or lines (Fig. 1)

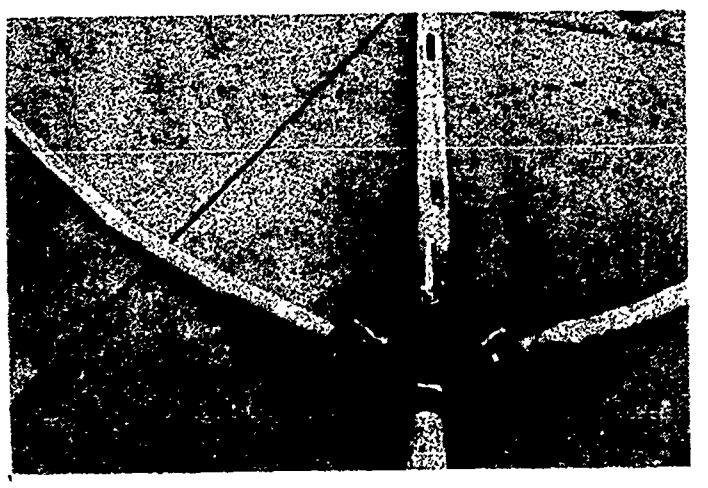


Fig. 1

23b: HOW TO MAKE A TAP-IN (Improvised Method)

INSTRUCTIONS:

1. Obtain desired amount and size of hose with proper nozzle attached, any necessary adapters, a plain wye, and a shut off valve.
2. Shut-off flow of water by kinking, using hose clamp or temporary shut down at pump.
3. Break coupling at desired location for tap-in original line.

4. Connect plain wye to original line. (both male and female)
5. Attach shut-off valve to other outlet of wye and make sure it is closed.
6. Charge original line. (Fig. 2)
7. Make desired connection to tap-in outlet using proper adapters for size of tap-in line to be used.
8. Take tap-in nozzle to desired location.
9. Charge tap-in line.
   NOTE: If original line is of high pressure, a reducing valve can be installed just ahead of tap-in shut off and pressure in tap-in line can be controlled at this point. (Fig. 3)

Fig. 2

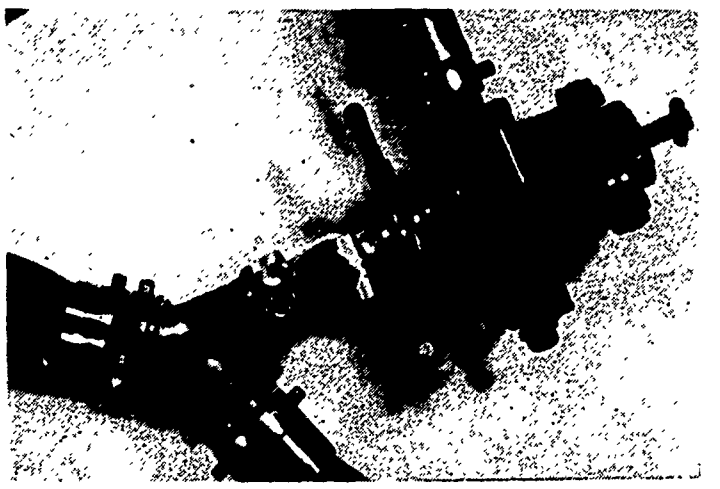


Fig. 3

24: WYED AND SIAMESED LINES OF HOSE

INTRODUCTION:

In carrying on extinguishing operations, single lines of hose are often wyed into two or more lines of the same size or smaller size hose, for use where heavy streams are not needed. In order to give better coverage and in overhauling operations etc., lines are wyed to facilitate the operations. The wyed lines should be made up before interfering with the original line.

In carrying on extinguishing operations involving the use of water streams, it is sometimes found that pumpers are incapable of supplying water streams of suitable size and effective pressures through single lines of hose, because of the friction loss in long lines of hose, or where larger size nozzles are used.

To overcome these problems, two or more parallel lines are laid from pump or pumpers and siamesed into a single line near the fire. Always place the siamese as near the fire as feasible.

24a: HOW TO WYE ONE 3 INCH LINE INTO TWO 2½ INCH LINES

INSTRUCTIONS:

1. Lay desired amount of 3" hose or use line previously laid.
2. Obtain desired amount of 2½" hose for each line and place in position with female ends near male end of 3" hose. (Fig. 1)
3. Obtain 3" to 2½" wye and two 2½" shut-off nozzles.
4. Connect 2½" nozzle to male end of each 2½" line and shut off.
5. Connect female ends of 2½" lines to male ends of wye.
6. Connect wye to 3" hose.
7. Take 2½" nozzles to desired locations.
8. Charge lines.
   NOTE: If 3" line has been in operation, use the shut-off valve to control flow of water, remove tip and attach wye at this point.

Fig. 1

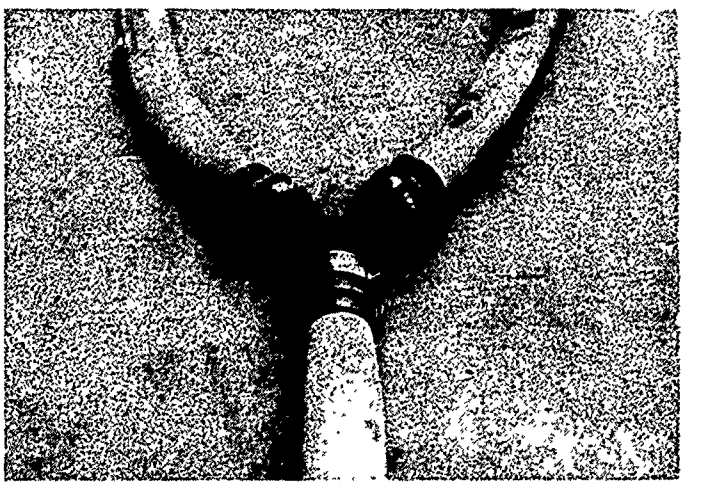


Fig. 2

24b: HOW TO WYE ONE 2½ INCH LINE INTO TWO 2½ INCH LINES

INSTRUCTIONS:

1. Lay desired amount of 2½ inch hose for single line, or use line previously laid.
2. Obtain desired amount of 2½" hose for the two lines and place female ends near male end of original line.
3. Obtain 2½" plain wye and two 2½" shut-off nozzles.
4. Connect 2½" nozzle to male end of each line and shut off.
5. Connect female ends of hose to male ends of wye.
6. Connect wye to original line. (Fig. 2)
7. Take 2½" nozzles to desired locations.
8. Charge lines.
   NOTE: If single 2½" line has been in operation, use the shut-off valve to control the flow of water, remove tip and attach wye at this point.

10. Open 2½" shut-off valve, and charge 1½" lines as desired. (Fig. 4 and Fig. 5)

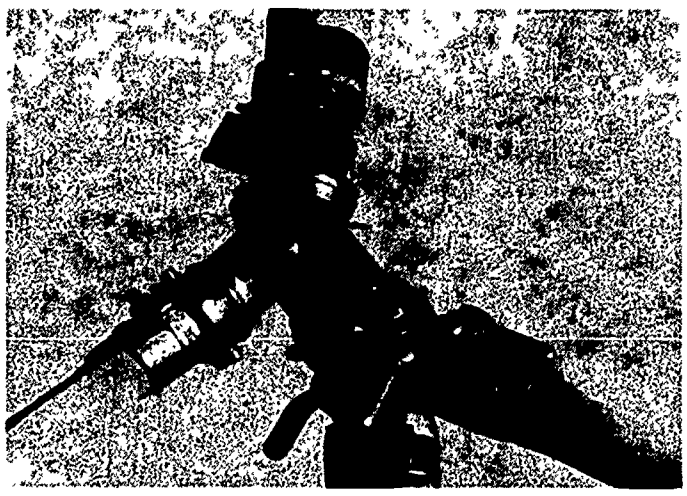


Fig. 4

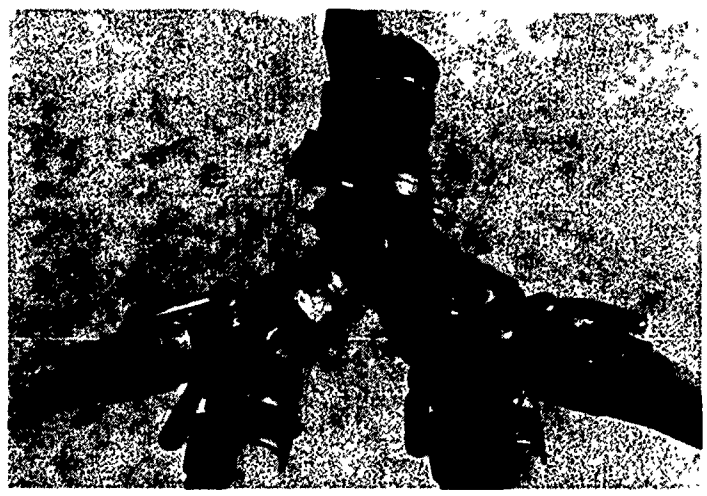


Fig. 5

24e: HOW TO SIAMESE TWO 2½ INCH HOSE LINES INTO ONE 2½ INCH HOSE LINE

INSTRUCTIONS:

1. Lay the desired amount of hose for two lines or use lines previously laid.
2. Obtain amount of 2½" hose for single line, and place female end near male end of 2½" lines.
3. Obtain one 2½" Siamese and a 2½" nozzle.
4. Connect 2½" nozzle to male end of single line and shut off.
5. Connect female end of single line to male end of siamese.
6. Connect female ends of 2½" siamese to male ends of original lines.
7. Take nozzle to desired location.
8. Charge line.

   NOTE: If siamese has control valves or clapper valve or valves, line may be charged as soon as the first feeder line is hooked up. (Fig. 6)

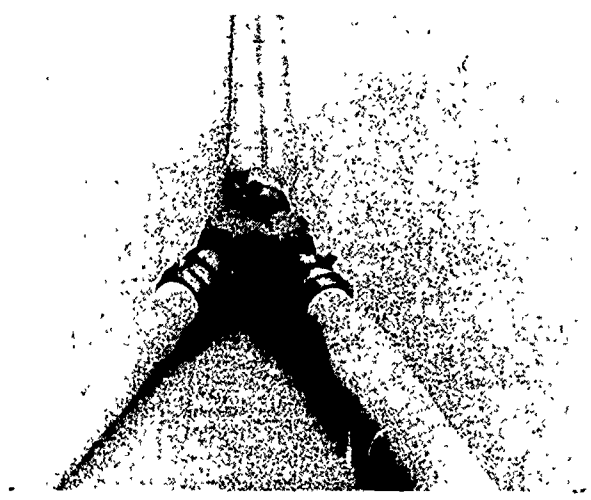


Fig. 6

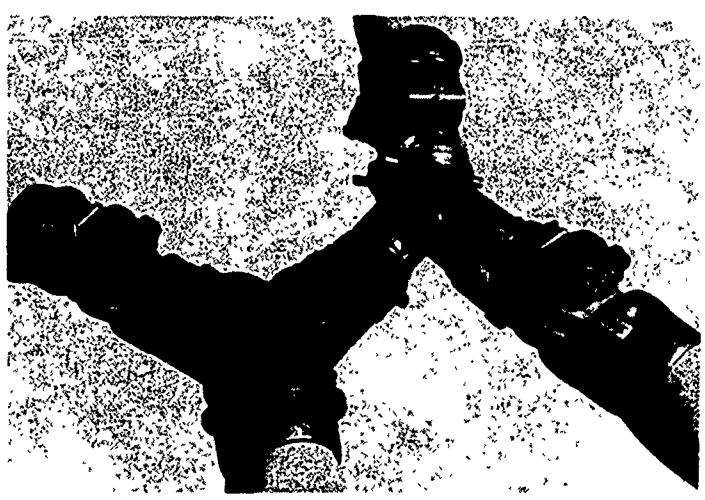


Fig. 7

24c: HOW TO WYE A 2½ INCH LINE INTO TWO 1½ INCH LINES

INSTRUCTIONS:

1. Lay desired amount of 2½" hose for single line or use line previously laid.
2. Obtain desired amount of 1½" hose for each line and lay female ends near male end of original line.
3. Obtain 2½" to 1½" gated wye and two 1½" nozzles.
4. Connect a nozzle to end of each 1½" line and shut off.
5. Connect female ends of 1½" hose to male ends of wye.
6. Connect wye to original line (Fig. 3)
7. Take nozzles to desired locations.
8. Charge lines as desired.

Fig. 3

24d: HOW TO WYE A 2½ INCH LINE INTO THREE OR FOUR 1½ INCH HOSE LINES USING NOZZLE SHUT-OFF

INSTRUCTIONS:

1. Lay desired amount of 2½" single line of hose or use line previously laid.
2. Obtain desired amount of 1½" hose for all lines to be put into operation and place female ends near 2½" nozzle.
3. Obtain a 2½" wye. Obtain 2½" to 1½" gated wye, plus a 2½" to 1½" reducer for three 1½" lines, or two 2½" to 1½" gated wyes for four lines.
4. Obtain required number of 1½" nozzles. Attach and shut off.
5. Connect female ends of 1½" hose to male ends of wye, and reducer or wyes.
6. Connect 2½" to 1½" wyes and reducer or wyes to male ends of 2½" wye.
7. Shut-off water in 2½" hose line at nozzle and remove tip.
8. Attach 2½" wye to shut-off valve.
9. Take 1½" nozzles to desired locations.

24f: HOW TO SIAMESE THREE CHARGED 2½ INCH LINES INTO ONE 2½ INCH LINE

INSTRUCTIONS:

1. Obtain the desired amount of 2½" hose for single line and place in position with female end near the three nozzles.
2. Obtain a 2½" nozzle, a 2½" wye, a 2½" siamese, and a 2½" double female.
3. Connect 2½" nozzle to male end of single line, and shut off.
4. Connect one female end of siamese to male end of wye.
5. Connect double female to male end of wye.
6. Connect single line to male end of siamese.
7. Shut off water in lines and remove nozzle tips.
8. Make connections to the three lines.
9. Take single line nozzle to desired location.
10. Charge line by opening all three shut-off valves. (Fig. 7)

25: ROLLING HOSE

INTRODUCTION:

It sometimes becomes necessary to roll sections of hose in carrying on operations involving the use of 1", 1½", 2½" and 3" hose. Some of these operations would include rolling for storage, preparing to return to quarters, or transporting sections of hose at fire scene. Type of roll used will vary to meet the working conditions.

25a: HOW TO ROLL HOSE (Single)

INSTRUCTIONS:

1. Lay out section of hose flat and straight.
2. Pick up male coupling and make bend to form core for roll. (Fig. 1)

   NOTE: Don't make bend too tight but leave hand hole opening.
3. Roll towards female coupling keeping edges of hose even until completed. (Fig. 2)

Fig. 1

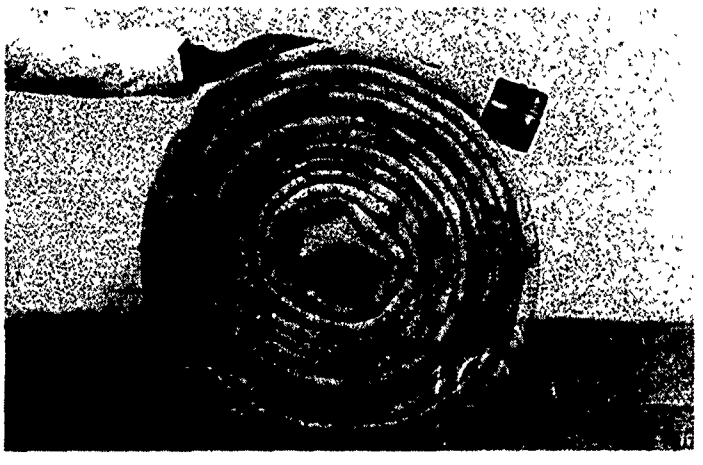


Fig. 2

4. Lay roll on side and press until all edges are even.
   NOTE: If rolling a damaged section of hose, reverse above procedure and place female coupling on inside of roll. Attach a string, rag, etc., to roll for identification purposes. (Fig. 3)

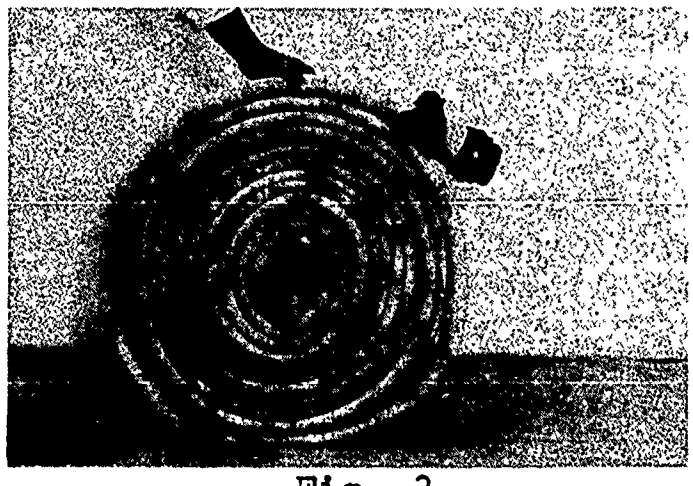


Fig. 3

25b: HOW TO ROLL HOSE (Donut-two Man)

INFORMATION:

Hose rolled in this manner may be used as a means of getting extra hose to hydrant or fire. It is also used when loading hose to expel the air from hose to avoid taking up extra space in the hose bed. Many departments use this method to store hose after drying. When stored in this manner, hose is ready to load on hose bed without unrolling.

INSTRUCTIONS:

1. Stretch hose out straight.
2. Bring male coupling back within 3 or 4 feet of female coupling placed on top of hose.
3. One man starts at fold and makes bend to form core. (Fig. 4)
   NOTE: Do not make too tight but leave a hand hole opening.
4. Other man face first man as shown in (Fig. 4).
5. Continue to roll with first man walking forward and second man backward keeping roll even and taking up slack until completed. (Fig. 5)

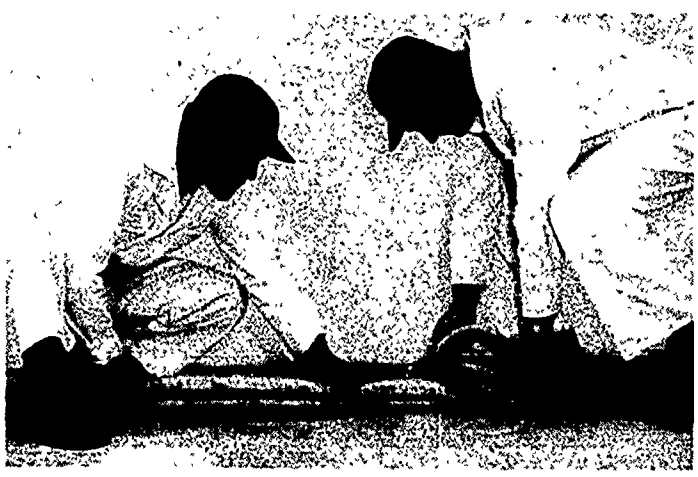


Fig. 4

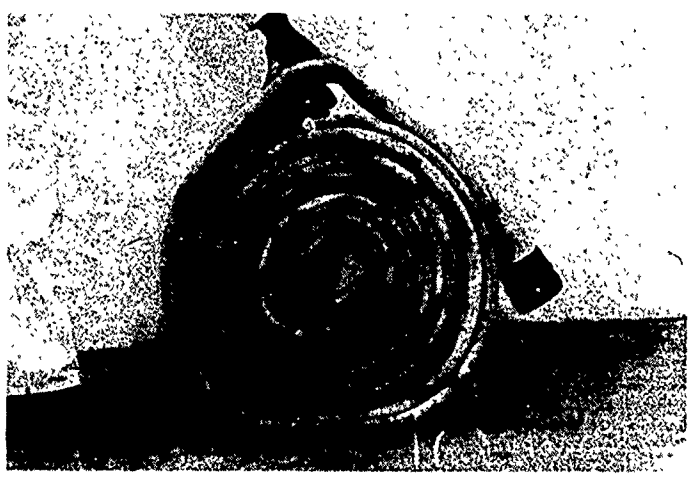


Fig. 5

25c: HOW TO ROLL HOSE (Donut--one man)

INSTRUCTIONS:
1. Stretch out straight.
2. Bring male coupling even with female (Fig. 6)

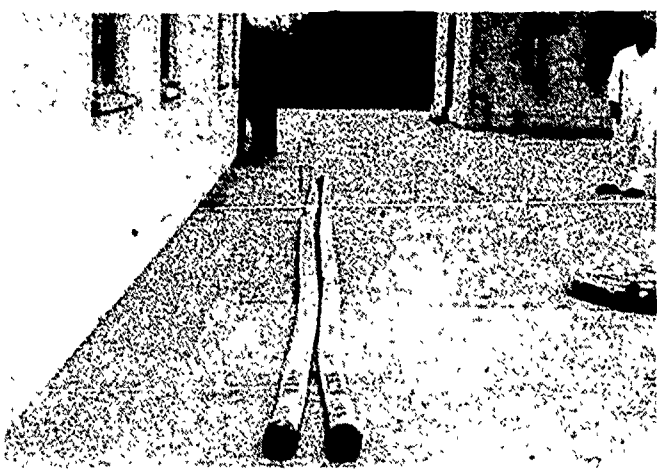


Fig. 6

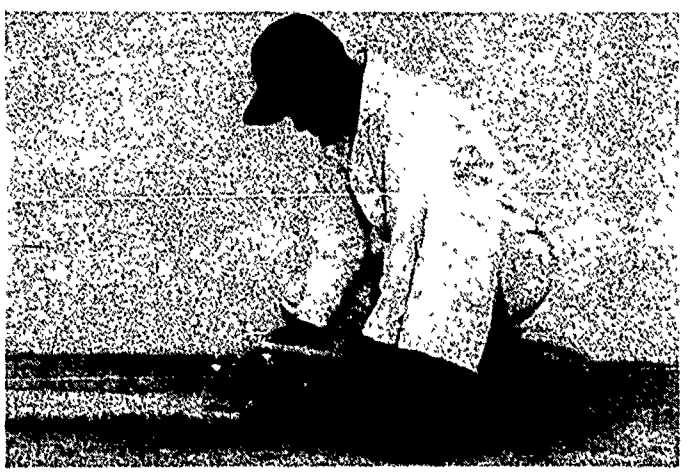


Fig. 7

3. Starting about 2½ feet from fold on male side of hose, make bend for core. (Fig. 7)
4. Continue rolling keeping side even until male coupling is reached.
5. Lay roll on side and press edges until even.
6. Wrap female end around male to complete roll. (Fig. 8)

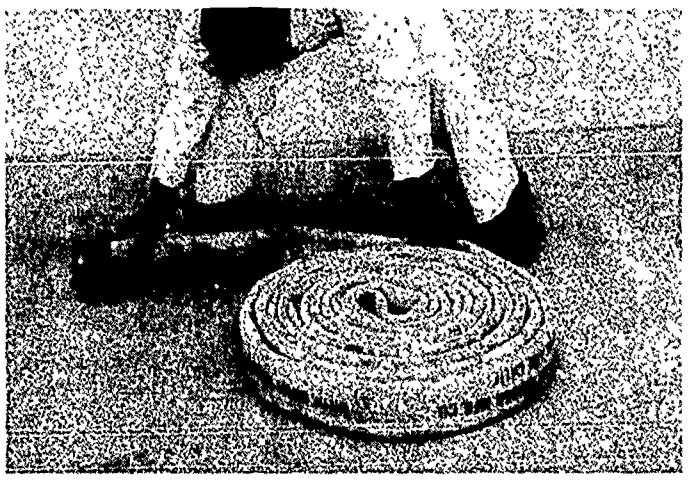


Fig. 8

25d: HOW TO MAKE 1½ INCH SELF-LOCKING HOSE ROLL

INFORMATION:
This roll can be carried as a spare roll. It is easy for one man to handle. When put in service it unrolls like the ordinary donut roll.

INSTRUCTIONS:
1. Stretch hose out straight.
2. Bring male coupling even with female forming fold in center.

3. Cross right side over left side about one step from bend. (Fig. 9)
4. Grasp cross with hand, throw loop forward toward couplings and bring forward part of loop back to cross. Both loops to be about same size. (Fig. 10)

Fig. 9

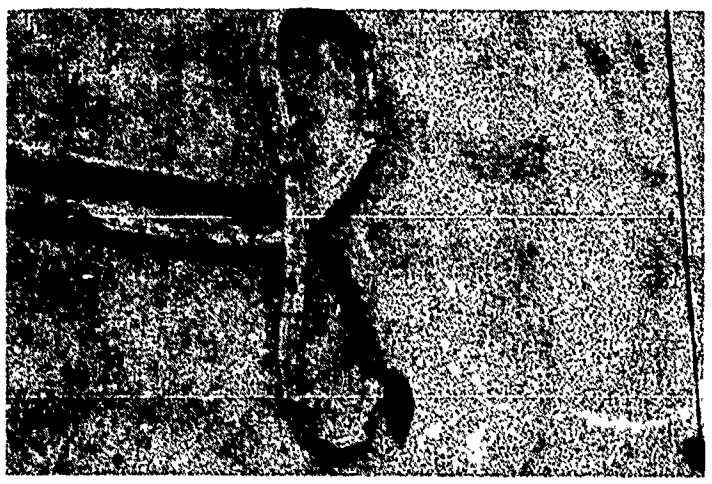


Fig. 10

5. Start roll by having forward part of loop tight against cross. (Fig. 11)
6. Roll until couplings are reached.
7. Adjust loops, one shorter than other, and pull long loop through short loop, just behind couplings and snug down. (Fig. 12)
8. Slip arm through long loop and adjust on shoulder for comfortable carry. (Fig. 13)

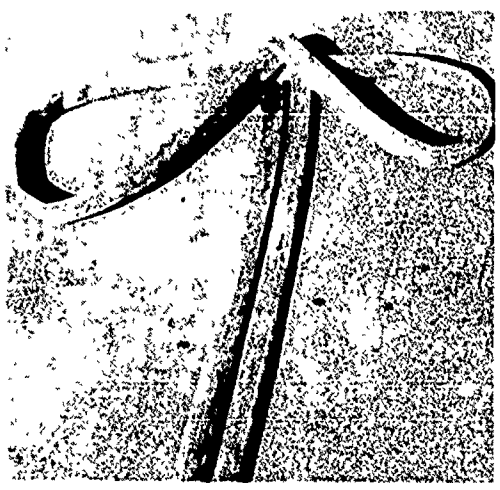


Fig. 11

Fig. 12

Fig. 13

26: <u>FOLD AND CARRY HOSE</u>

INTRODUCTION:

In carrying on operations involving the use of hose lines, it sometimes becomes necessary to fold a section of hose in order that it may be carried considerable distance or up stairways, ladders, and fire escapes. For carrying convenience, sometimes leather carrying straps are provided. By the proper folding and carrying of hose, dragging, with its resulting

damage to the hose, is eliminated. It also makes the manual job of laying hose much easier and speeds up the operation.

When it becomes necessary to make an extension on a hose line, the man sent for same would place shut-off nozzle on hose.

26a: HOW TO FOLD AND CARRY HOSE (One Man)

INSTRUCTIONS:

1. Stretch section of hose out straight.
2. Grasp coupling on either end and proceed to center of section making sure bend forms towards **operator.**
3. Grasp center of hose (Fig. 1) and proceed to other coupling.
4. Lay coupling and center fold on ground and adjust loops about even.
5. Pickup Couplings with center fold (Fig. 2) and make another full fold. (Fig. 3)

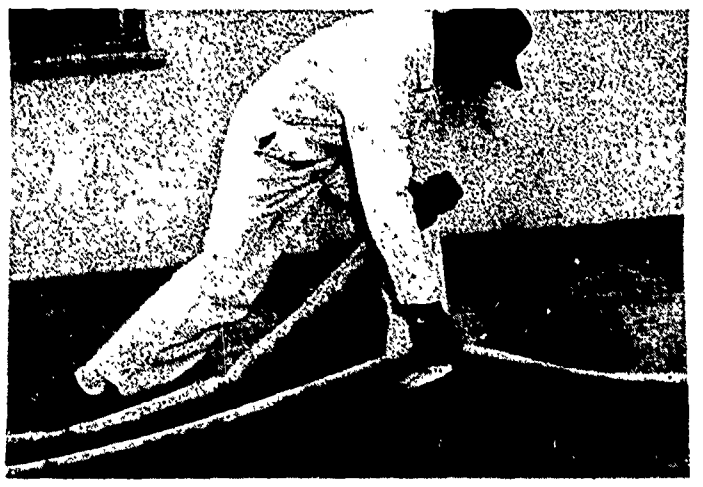


Fig. 1

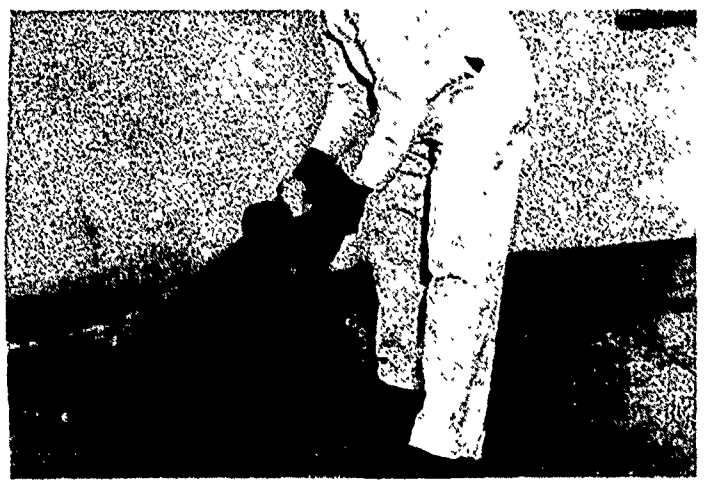


Fig. 2

6. Group tightly near center of final fold (Fig. 3)
7. Lift and place on shoulder, couplings to front. (Fig. 4)

TO UNLOAD:

1. Grasp both couplings and drop load from shoulder.

Fig. 3

Fig. 4

26b: HOW TO FOLD AND CARRY HOSE (One Man Shoulder Method)

INSTRUCTIONS:

1. Stretch section of hose out straight.
2. Pick up male coupling, walk toward female, allowing male to pass downward next to body until male reaches ground. Adjust loop formed to head height. (Fig. 5)
3. Grasp center of loop and place loop on shoulder.
4. Continue walking towards female coupling folding over shoulder in accordian style, with front and back loops adjusted to knee level. (Fig. 6)
5. Complete folds making sure female coupling ends up in front of body. (Fig. 7)

Fig. 5

Fig. 6

Fig. 7

TO UNLOAD

1. If working by self, grasp both couplings and **drop** from shoulder.
2. If help is available, pass female coupling back over shoulder and have helper hold.
3. Grasp male coupling with hand on same side load is carried.
4. With opposite hand grasp double fold and start walking away from helper. (Fig. 8)
5. As tug in line is felt, push each loop off shoulder until load is completely unloaded.

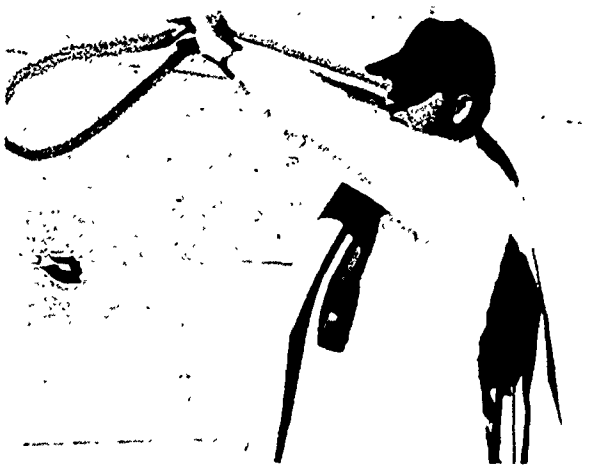


Fig. 8

26c: HOW TO FOLD AND CARRY HOSE (Two or more Men--Shoulder Method)

INSTRUCTIONS:

1. Lay out desired number of lengths, with nozzle attached to male end. NOTE: With this method, load may be made directly behind tail board of apparatus paying hose directly from hose bed.
2. Pickup nozzle, walk toward female end, allowing nozzle to pass downward next to body until nozzle reaches ground. Adjust loop formed to head height. (Fig. 5, Job 26b)
3. Grasp center of loop and place loop on shoulder. (Fig. 9)

Fig. 9

Fig. 10

4. Continue walking towards next coupling folding over shoulder in accordian style with front and back loops adjusted to knee level (Fig. 10)
5. Complete folds until within about 10 feet of next coupling.
6. Second man place hose on same shoulder with coupling to rear about waist height. (Fig. 10)
7. Second man continues to walk toward next coupling and repeats Step 4 with first man helping to adjust rear loops. (Fig. 11)
8. Second man completes folds until within about 10 feet of next coupling.
9. Third man would repeat second man's operations and any other men would, also, repeat until all hose is loaded. (Fig. 12)

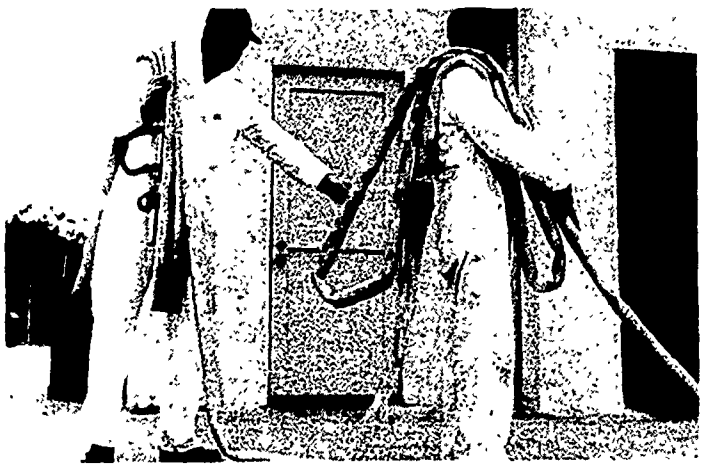


Fig. 11

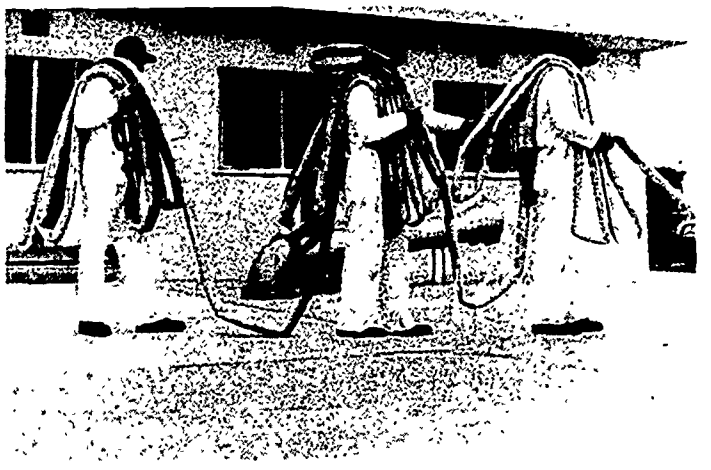


Fig. 12

NOTE: Connect female end of hose to water supply.

TO UNLOAD

1. All men pivot the opposite way from shoulder on which hose is loaded, grasping coupling as shown in (Fig. 13)
   NOTE: Any partial loops to be dropped so that hose pays from rear of men.
2. Man closest to water supply pays folds off shoulder first and when all folds are paid off, lays coupling down gently. (Fig. 14)

Fig. 13

Fig. 14

3. Each man in order repeats operation until nozzle is reached.
   NOTE: This same method is used for laying hose lines up stairways.

26d: HOW TO FOLD AND CARRY 1½ INCH HOSE (Using Leather Carrier Straps)

INSTRUCTIONS:

1. Stretch out two sections of 1½" hose connected.
2. Pick up coupling at either end and bring back to coupling at other end making a complete fold.
3. Lay straps out about 24" apart at bend in line.
4. Start fold either side of center bend and lay on straps. (Fig. 15)

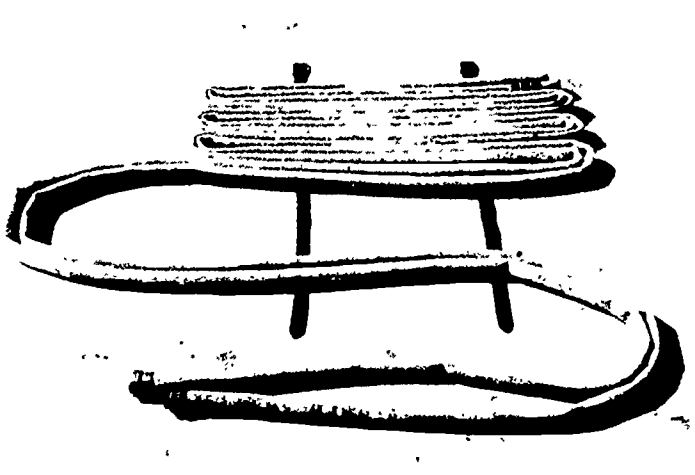


Fig. 15

Fig. 16

5. Make accordian folds across straps until approximately one half of hose is used up. (Fig. 15)
6. Start second tier and accordian fold in opposite direction until all hose is folded.
7. Apply nozzle.
8. Tighten up straps making sure nozzle is secured. (Fig. 16)

27: OPERATE HOSE JACKETS AND CLAMPS

INTRODUCTION:

Hose jackets are provided for most engine companies to place over leaks that develop when lines are in use, or to connect two sections of hose whose couplings are damaged. Hose clamps are provided to stop the flow of water in lines of hose, to remove sections or break couplings without shutting off at source of supply. An improvised hose clamp can be made with the Detroit door opener and hose strap.

COOPER HOSE JACKET

INFORMATION:

Cooper Hose Jacket (Fig. 1) is carried by some engine companies for use when small cuts or breaks occur in hose while in operation.

To stop the flow of water from such cut or break and keep the line in service, place hose so water will be shooting away from the operator and as nearly horizontal as possible, then the hose jacket is opened and one side slipped under the hose.

When ready the upper part of jacket is snapped together quickly preferably with the foot. It locks as it is snapped together.

NOTE: If the tear in hose were so placed that the stream issued vertically, there would be danger of the upper part of jacket being knocked upward, as it was being closed, and possibly injuring the operator.

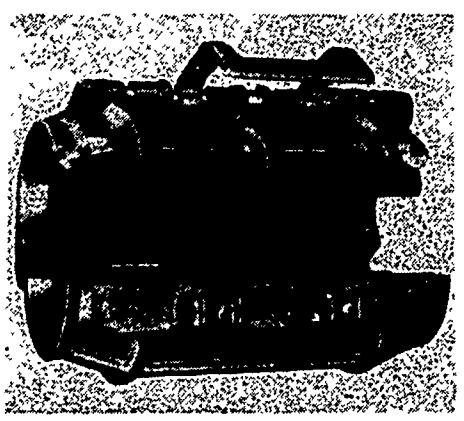


Fig. 1

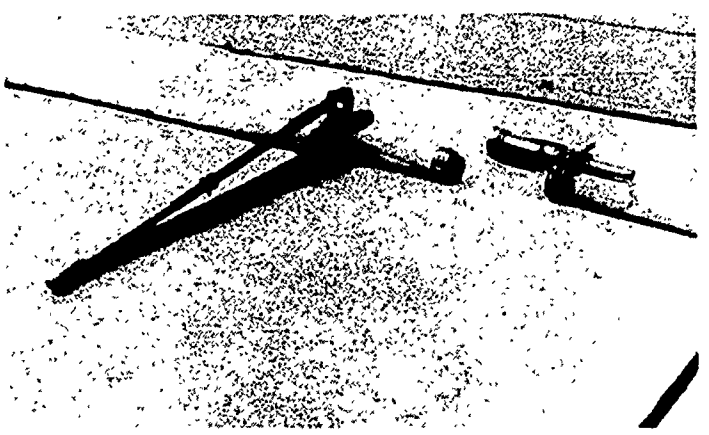


Fig. 2

Cooper hose jacket can be used where threads on hose are of different sizes, or where threads on hose are of different sizes, or where threads are damaged, as temporary means of coupling hose together. The two couplings of the hose to be joined are brought together within the jacket, and the jacket closed. As soon as the pressure is put in the hose, the hose will become inflated and properly seal the coupling.

HIRSCH HOSE CLAMP

INFORMATION:

The Hirsch hose clamp is carried for use in shutting off flow of water in lines of hose to replace bursted section, make tap-ins, extend lines, (Fig. 2) etc., without shutting off at source of supply. Another hose clamp of this type is the Peerless.

The clamp is placed on ground with jaws open. Then the hose is placed in open jaw about 8 to 10 inches from coupling. As the jaws clamp hose, the lock will roll in place making clamp secure at any point.

NOTE: Clamp should be placed 8 to 10 inches behind coupling because if hose is damaged by this tool, it can be repaired and only a foot of hose lost.

HEBERT HOSE CLAMP

INFORMATION:

The Hebert Hose Clamp (Fig. 3) is used in stopping the flow of water in hose lines from 1" cotton jacket hose to 3" cotton jacket hose. Its construction is similar to a pipe vise, with two jaws, upper and lower. The lower jaw is built on a flat platform of wood 8" x 12". The jaw is hollowed in the center with edges rounded off to avoid damaging hose. The upper jaw slides in a track which is constructed on both sides and fastened to the lower jaw, with a screwing device to bring the jaws together. The upper jaw is rounded so as to fit in the lower jaw. One side of the clamp is fastened with a spring catch by which it is released and bent over to allow the hose to be placed in the clamp.

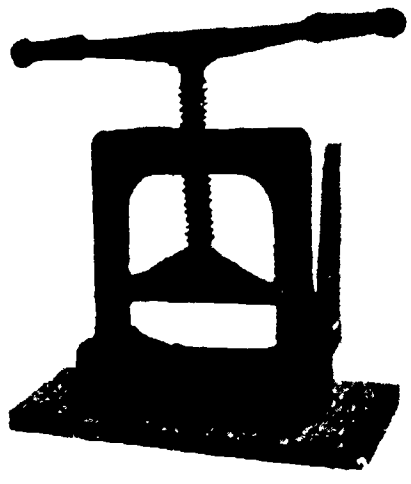


Fig. 3

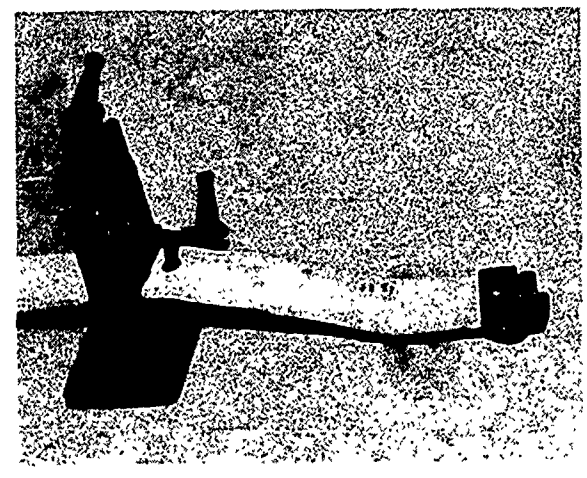


Fig. 4

INSTRUCTIONS:

To operate clamp: Screw clamp up, raising top jaw. Release spring catch on side of clamp and open with open side next to hose. Place hose in center of lower jaw, close clamp, with snap to allow spring catch to fasten, place one foot on either side of clamp and screw down until flow of water is shut off. (Fig. 4)

To release clamp: Get in same position as putting clamp on, unscrew clamp until clear of hose, release spring catch on side, remove hose, and place clamp in some protected place or return to apparatus.

DETROIT DOOR OPENER (Improvised for Hose Clamp)

INFORMATION:

The Detroit door opener can be used to clamp a line of hose. The bar or leverage arm is placed beneath the section of hose with the extension arm of door opener over hose, place the hose line well up to the fulcrum part of bar. Apply pressure downward on extension arm, the hose line is thus shut down sufficiently so that bursted sections may be removed, tap-ins placed, or hose line extended. (Fig. 5)

The door opener should be placed 8 to 10 inches behind the coupling so that if hose is damaged by the tool, it can be repaired with the loss of only a foot of hose.

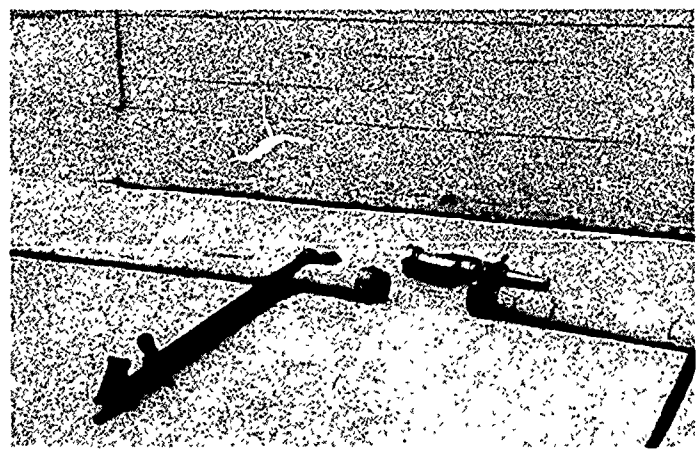


Fig. 5

After the hose line is shut down with the door opener, remove the pin in the extension arm. The compression piece is pulled free from the hollow part of the extension arm and the handle of a hose strap is slipped over the end of the bar and extension arm thereby relieving the man making shut-off to make any additional kink needed and to complete the shut-off.

In making a shut-off with the Detroit door opener it will usually be found that the water is not completely shut off. It therefore becomes necessary to either kink the line or to make the connection with some water flowing. If connections are attempted with water flowing, it will usually be found necessary to open nozzle to allow water to flow freely.

28: REPLACE DAMAGED SECTION OF HOSE WITH LINE CHARGED

INTRODUCTION:

In carrying on operations involving the use of hose lines, it sometimes becomes necessary to replace a damaged section of hose. This may be done by kinking or using the hose clamp to control the flow of water. This eliminates the necessity of shutting the line down at the pump or hydrant.

28a: HOW TO CONTROL FLOW OF WATER BY KINKING HOSE (5 Man)

INSTRUCTIONS:

1. Nos. 2 and 4 get required amount of hose for **replacement** in position.
2. Nos. 1 and 3 take position on section of hose to be kinked. No. 3 from opposite side grasps hose near coupling toward nozzle.
3. No. 1 and 3 pull hose back toward pump until an "S" turn approximately 12 feet long is made, with couplings approximately 3 feet beyond each bend. NOTE: On long lay Nos. 2 and 4 assist 1 and 3 to pull hose. (Fig. 1)

Fig. 1

Fig. 2

4. No. 5 opens nozzle.
5. After obtaining replacement hose, No. 2 lines up beside No. 1 on the side toward nozzle. No. 4 lines up on other side of hose beside No. 3 toward pump and assists in completing kinks.
   NOTE: This makes Nos. 1 and 3 on outside and Nos. 2 and 4 on inside.
6. Nos. 1 and 2 raise hose from outside at bend to upright position.
7. Nos. 3 and 4 release hold on hose near coupling, step back and grasp hose at 2nd bend and raise from outside on upright position.
   NOTE: Always work from outside, this permits making kinks against main hose leading from pump end to nozzle.
8. Nos. 1 and 2 make kink in line toward nozzle first by forcing hose straight down and against hose leading from pump.
   NOTE: Always make kink in line nearest nozzle first.

9. Nos. 3 and 4 make kink in line toward source of supply immediately after Nos. 1 and 2 make first kink by forcing hose straight down and against hose leading to nozzle. (Fig. 2)
10. Nos. 1 and 3 hold kinks in place with hands and knees.
11. Nos. 2 and 4 (inside men) leave kinks as soon as completed.
12. No. 2 breaks coupling nearest source of supply and connects female end of replacement hose to male end of original hose.
13. No. 4 breaks coupling nearest nozzle and connects female end of original hose to male end of replacement hose.
    NOTE: In case hose is laid from fire to hydrant Nos. 2 and 4 will reverse ends of replacement hose.
14. No. 5 shuts nozzle off as soon as couplings are broken.
15. When connections are completed by Nos. 2 and 4, Nos. 1 and 3 will raise and release kinks in hose.
16. Nos. 1, 2, and 4, line up on hose and assist No. 5 in carrying hose to original position.
    NOTE: Three men may be able to accomplish this job as shown in Fig. 3.

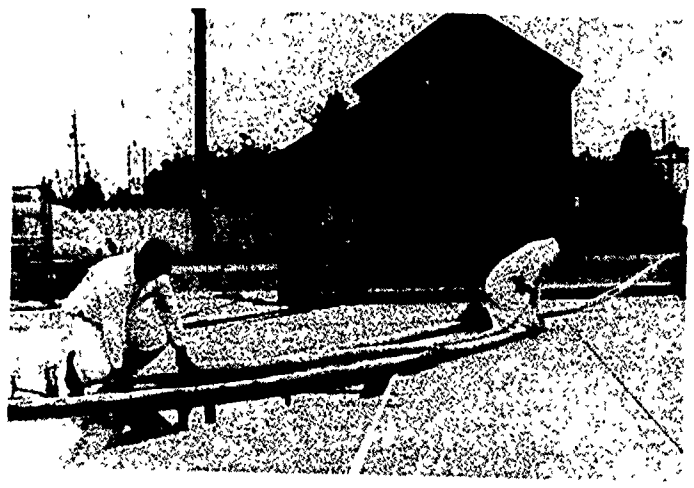


Fig. 3

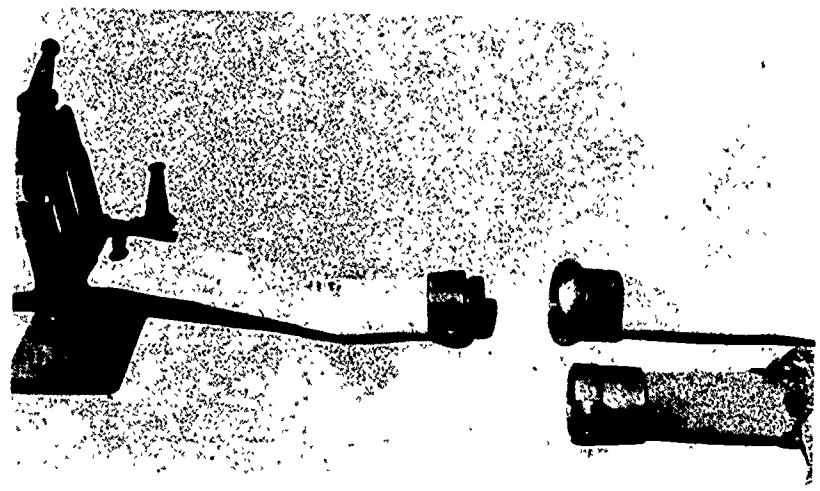


Fig. 4

28b: <u>HOW TO REPLACE DAMAGED SECTION OF HOSE USING CLAMP</u>

INSTRUCTIONS:

1. Procure a length of hose and hose clamp.
2. Place length of hose in desired position.
3. Place clamp on hose behind coupling of burst length, on side leading to pump or hydrant. (Fig. 4)
4. Make sure nozzle is open and close clamp slowly until water is shut off.
5. Break coupling toward nozzle end of hose first, then break other coupling, removing burst length.
6. Connect good length of hose, connecting coupling toward nozzle last.

28c: <u>HOW TO REPLACE DAMAGED SECTION OF HOSE ABOVE GROUND</u>

INTRODUCTION:

Damaged sections of hose that must be replaced above ground level require considerable speed and effort.

NOTE: Be sure to notify men at nozzle before shutting off line.

INSTRUCTIONS:

1. Obtain good section of hose and hose clamp.
2. Place hose clamp on line and shut off water.
3. Break first coupling on ground. (Fig. 5) It may be necessary to lower hose to reach the coupling to be broken.
4. Connect good section of hose.
5. Lower hose to next coupling.
6. Remove damaged section of hose.
7. Connect good section of hose. (Fig. 6)
8. Hoist hose line and fasten.
9. Remove hose clamp.

   NOTE: If damaged section is located on upper floor or roof area, it may not be necessary to lower damaged section. In this case, replacement section will be taken to area where work is to be done.

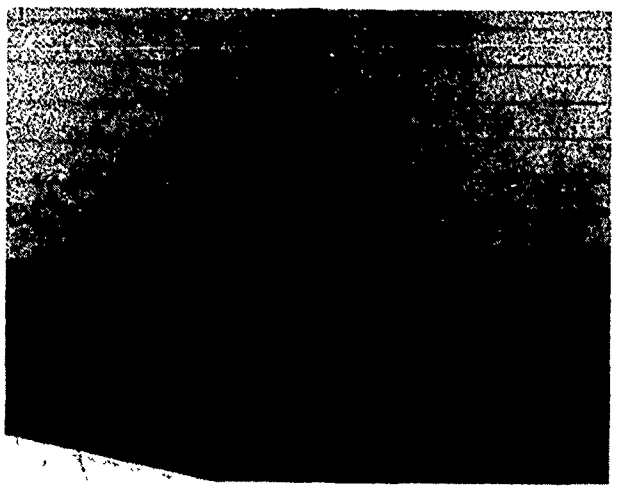


Fig. 5

Fig. 6

29a: HOW TO REEL AND UNREEL HOSE

INFORMATION:

All triple combination apparatus and hose wagons are equipped with a reel that holds 1 inch or 3/4 inch hose, usually in 50 and 100 foot lengths, with a total of 200 ft. to 300 ft. on the reel. The hose is attached to male connection that connects to pipe arrangement leading from water tank.

NOTE: See that packing nut is tight to prevent leaks. If not used, change position of hose on reel every 60 days.

INSTRUCTIONS:

To unreel Hose

1. Stand on running board or equipment box.
2. Release strap or reel clamp.
3. Grasp end of hose at nozzle, step down on ground.
4. Retain hold on hose, walk until required amount of hose is unreeled, or end of hose is reached.
5. Where hose is to be taken some distance, men will grasp hose at intervals as it is being unreeled.
6. Guide hose at reel as it is being unreeled to prevent tangle or damage to hose and apparatus.

   NOTE: To remove all hose from reel, unscrew female hose coupling from male reel connection with spanner.

To Reel Hose

1. Lay each section of hose out straight.
   NOTE: Does not apply at fires
2. Close valve leading from tank to reel.
3. Examine gasket in female coupling.
4. Screw female coupling on male reel connection, tighten with spanner.
   NOTE: Do not place hose on reel on same order in which sections were taken off.
5. Turn reel so male reel connection will pull against hose.
6. Maintain tension on hose as reel is being turned so as to guide folds as they are laid on drum.
7. As each layer is complete on reel, loosen hose sufficiently to relieve strain where connections are made at couplings, or to avoid flat hose.
8. Make next layer on reel in opposite direction.
9. As each section of hose is placed on reel, check gasket in female coupling, screw up tight with spanner.
10. Place nozzle on last section of hose, secure reel with strap or clamp when nozzle reaches center of reel.
11. Check all valves.

30: HOSE LOADS

INTRODUCTION:

In loading hose upon apparatus, whether designed with single or split hose bed, a basic principle is to place the hose in the bed so that it will pay out smoothly and without kinking. The hose must, therefore, be placed in the bed not too tightly, as too much friction between the lengths may cause the line to dump out all in one heap. On the other hand, it is necessary to load the hose snugly enough to prevent its shifting or falling and chafing against the sides and bottom of the bed when rolling over rough roads or streets. The points to consider in loading the hose bed, therefore, are to get the most hose in the space provided, to have a minimum number of short bends, and in general arrange the hose so that it can be removed in a smooth and speedy manner. Loads may be completed with either male or female end of line on top of load depending upon method of lay desired.

30a: HOW TO LOAD HOSE (U or Horseshoe)

INFORMATION:

The U or horseshoe load is one of the most common loads used in the fire service.

One chief advantage of this load is the reduction in the number of bends placed in the hose.

INSTRUCTIONS:

1. Place coupling in either front corner of hose bed. (Fig. 1)
2. Make bend at rear edge of bed.
3. Continue around front of hose bed to opposite side.
4. Make bend and return to other side.
5. Alternate bends should be 6 inches shorter (Fig. 1)
   (a) Makes bends less sharp.
   (b) Makes paying out easier.
6. Continue these operations until first layer is full.
7. Carry line from center diagonally over hose to either corner. (Fig. 2)

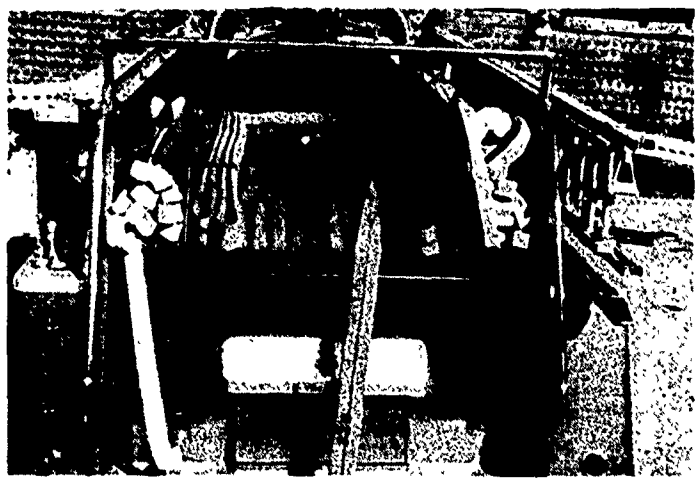


Fig. 1

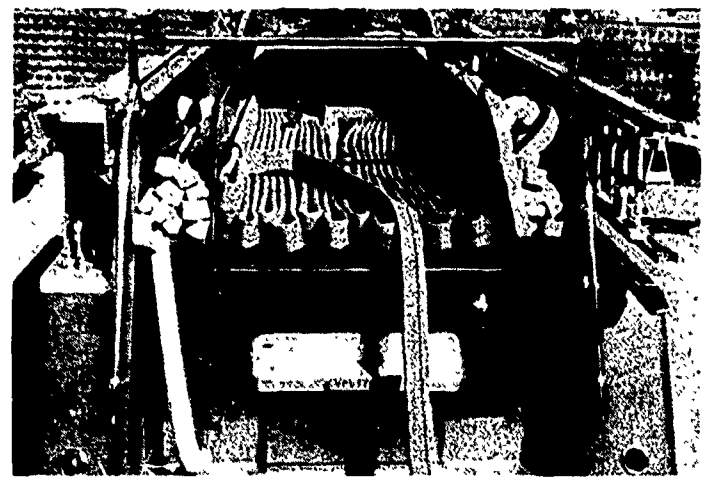


Fig. 2

   (a) Makes twists in hose long and flat.
   (b) Avoids tangling with next layer.
8. On finishing each layer, the diagonal goes to opposite corners until load is completed. (Fig. 3)
   NOTE: The use of a "Dutchman" may be necessary within the last twelve inches of each tier in order for the coupling to pay out without turning. See Job 30c for Instructions.

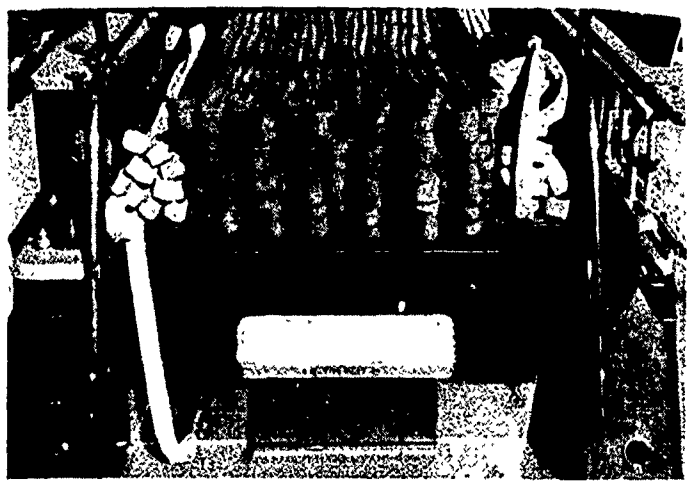


Fig. 3

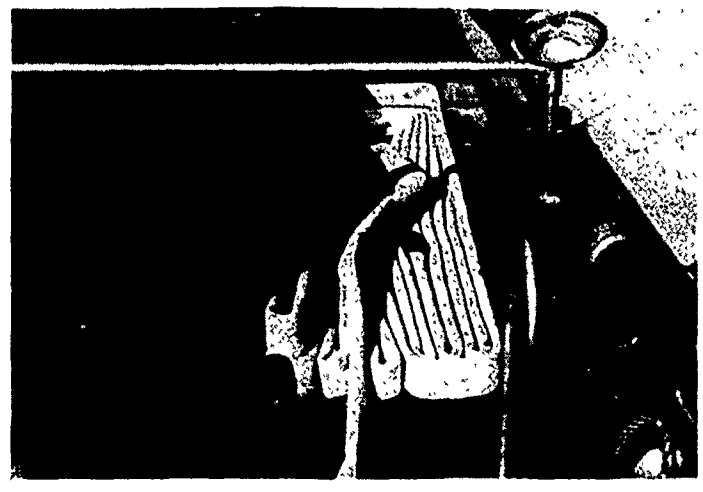


Fig. 4

30b: HOW TO LOAD HOSE (Alternate U or Horseshoe)

INSTRUCTIONS:

1. Start load as in Job 30, Fig. 1.
2. Rear bends on one side are two inches shorter than those on other side.
3. The end of the first layer is led from the center around ends of the shorted side.
4. Start second layer with hose tucked between hose and hose bed.
   (a) Raise hose gradually until reaching the front corner.
5. Repeat operations for second layer. (Fig. 4)
   (a) Rear bends on opposite side are made shorter to allow room for bringing end of the second layer around these ends to start the third layer.
6. On each succeeding layer alternate sides are made shorter.
7. Continue these operations until all hose is loaded in hose bed.

30c: HOW TO LOAD HOSE (Accordion)

INFORMATION:

The accordion load is particularly adaptable to those departments working under conditions that have to make long lays by hand. This load is much easier to remove from bed and place on shoulder than the horseshoe load, but requires more and sharper bends while in the hose bed.

INSTRUCTIONS:

1. Place coupling in either front corner.
   (a) Can be started to the rear of hose bed.
2. Fold hose back and forth making alternate bend on the opposite ends about 6 inches shorter. (Fig. 5)
3. As layer is completed, the last length is gradually raised from front to rear and the next layer is started. (Fig. 6)

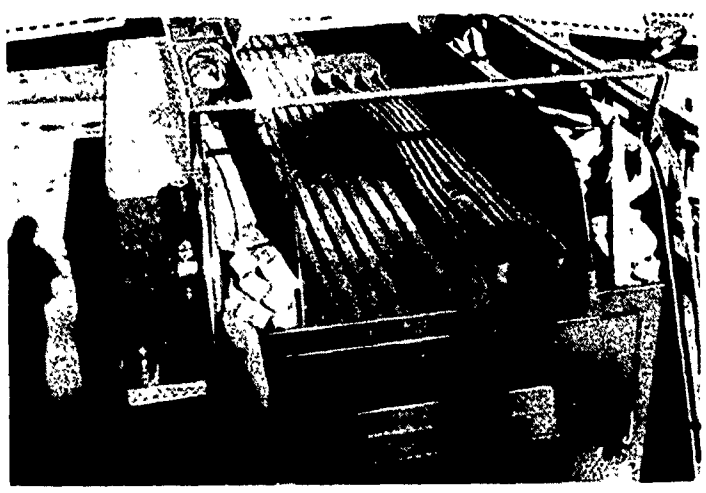


Fig. 5

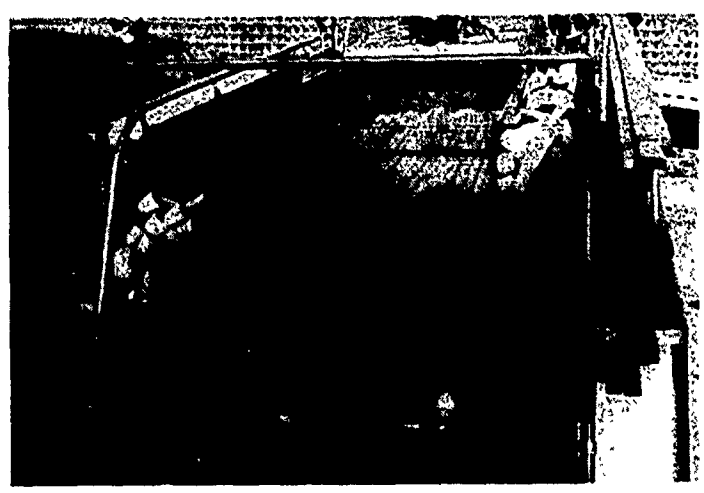


Fig. 6

4. Proceed with operations until all hose is loaded.
   NOTE: As each layer is completed, the remaining space becomes narrower than the length of the coupling, and if the hose is placed in this space in such a manner that the coupling will have to turn around when paying out, it will jam. To avoid this, a small reverse bend is made (commonly called "A dutchman"), so that the coupling will lie in place so that it does not have to turn around. This device may also be used at other couplings to avoid placing two couplings in different layers together, also allowing coupling to pay straight out. Otherwise, hose may wedge tightly. (Fig. 7)

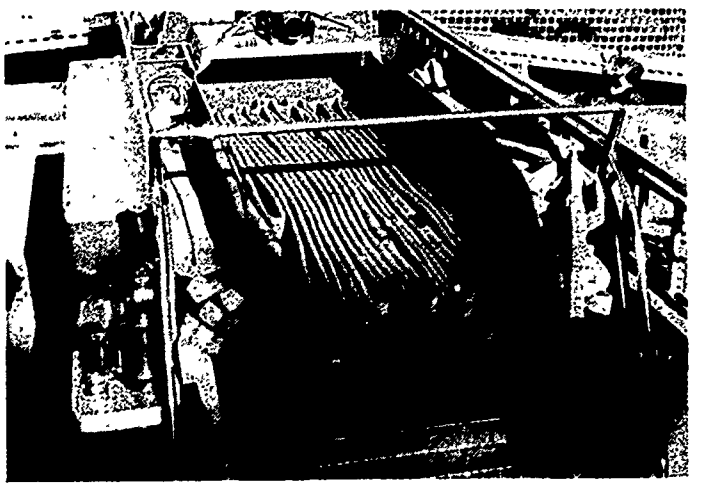


Fig. 7

30d: HOW TO LOAD HOSE (Flat Load)

INFORMATION:

The flat load is loaded in carrier in this method where hose lines are laid from fire to the hydrant. This is loaded in such a way as to unload extra 2½ hose at fire which is known as the anchor. There are several variations of the anchor arrangement.

INSTRUCTIONS:

1. Place female coupling a few inches out of rear end of hose bed at the right side when facing the front of the apparatus.
2. Fold hose to the front with hose laying flat.

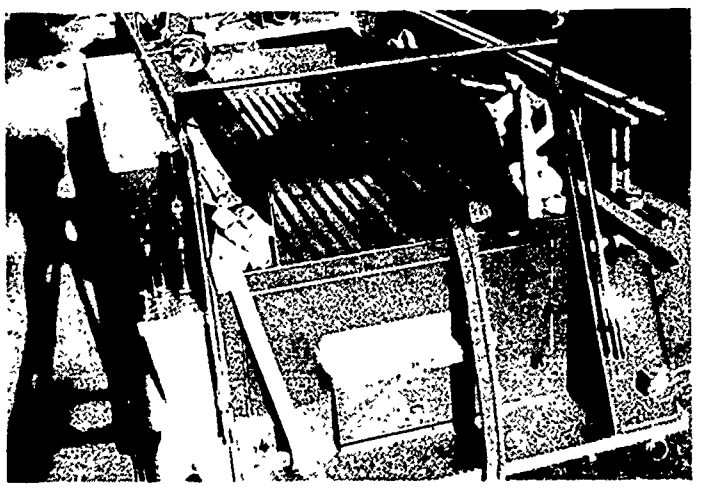


Fig. 8

Fig. 9

3. Fold hose double and bring to the left of first fold toward rear of hose bed. (Fig. 8)
4. Fold hose double and bring back on the same fold.
5. Repeat the operations until left side of hose bed is reached.
6. Fold next fold back on last fold of first tier. (Fig. 9)
7. Repeat these operations until hose load is completed, and attach nozzle. (Fig. 10)
   NOTE: Adjust long loop to pull as anchor. The exact location of long loop is determined by the amount of working hose line desired (usually 100 to 200 ft.)

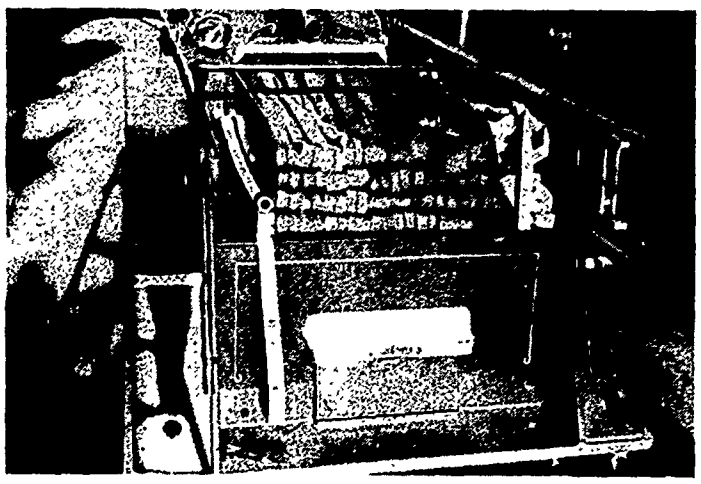


Fig. 10

30e: HOW TO MAKE SKID LOAD

INFORMATION:

In laying lines from the fire to the hydrant, usually not enough hose has been removed from the bed to effectively fight the fire.

To avoid this, and assure a working line without the necessity of estimating amount of hose needed, the skid load has been devised. This will give the nozzleman 100 feet of hose immediately.

INSTRUCTIONS:

1. First make sure that layer upon which skid is to be placed is level and free from protruding lugs.
2. Bring up end of hose from last layer and make several folds widthwise of bed.
3. The first skid is made by laying the hose flat toward the rear of bed.
4. At the rear of the hose bed a loop is made by bending the hose back on itself and giving it a half turn. This long loop is to provide a hand hold.
5. Next bring hose widthwise of bed at front and make flat layer to rear of bed on opposite side.
6. Bend hose back on itself, leaving loop for handhold.

7. Carry hose to front of bed and start making folds widthwise on top of skids. Couplings must ride on top of skids so that they will not become damaged or snag when skid load is pulled off. (Fig. 11)
8. Continue this operation until hose is all loaded, then lay nozzle down well back from rear of load. Making this load requires 125 feet or more of 2½ inch hose. (Fig. 12)

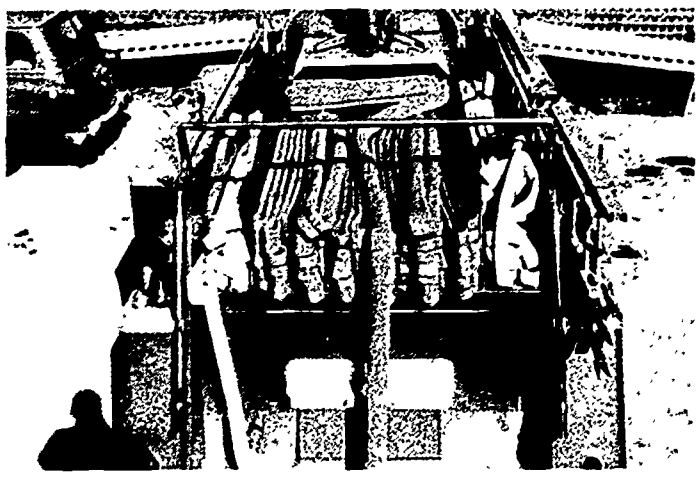


Fig. 11

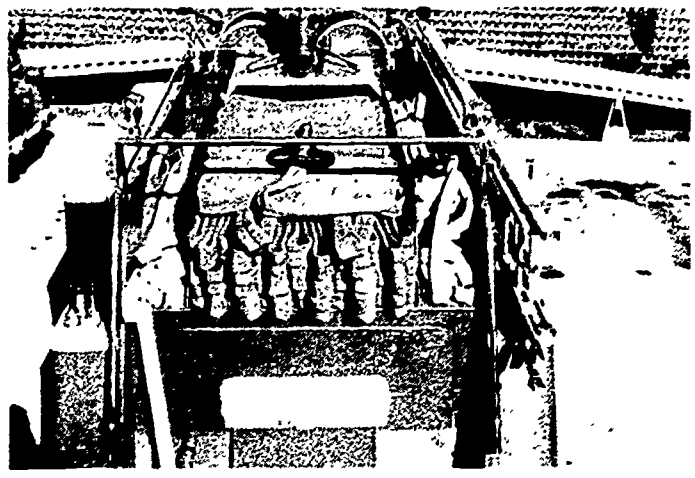


Fig. 12

30f: HOW TO MAKE DOUGHNUT ROLL ANCHOR

INFORMATION:

In order to eliminate the taking of a wrap around hydrant when laying from hydrant to fire, a method has been developed to provide an anchor with a roll of hose.

This can also be used when laying hose from fire to hydrant, single lines of 2½ inch or two lines of 1½ inch hose, where 1½ inch hose is placed in tray or on top of 2½ inch hose.

INSTRUCTIONS:

1. Make necessary number of folds on each side of hose bed. (either accordion or horse shoe).
   NOTE: Sufficient room must be left in center of hose bed for doughnut roll.
2. Then carry hose widthwise of bed between fold until last length of hose is reached.
3. Make doughnut roll with last length and place rope sling on roll to hold together and for handhold in pulling off.
4. Place roll between folds of first operation and connect to hose in bed. Roll should fit snugly between folds of hose so that it will not bounce off. (Fig. 13)
5. When used on hose lays from fire to hydrant nozzle or wye should be coupled to male coupling and laid across roll. Make sure that sling goes around these fittings.
6. To remove from bed, grasp loop in rope sling and lay roll in street. Weight of roll serves as anchor to hold same.

(a) When made in divided hose beds, folds on each side may not be necessary before starting cross folds with hose coming from lower layer.

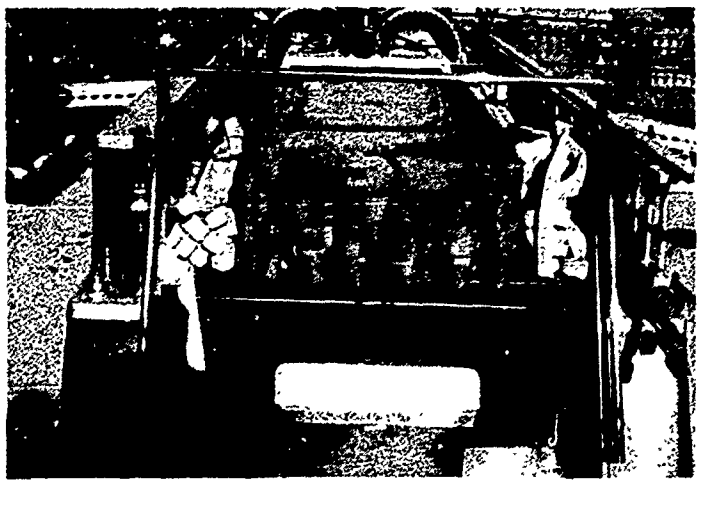


Fig. 13

Fig. 14

30g: HOW TO MAKE UP 1-1/2 INCH HOSE BUNDLES

INFORMATION:

In the majority of departments, 1½ inch hose is employed in extinguishment of small fires such as dwellings, garages, and out buildings, and overhauling after large fires. Hose should be loaded in such a manner that it is convenient to unload and avoid tangling or kinks in the hose line, which is apt to partly shut off the flow of water and hamper the work of the fireman.

INSTRUCTIONS:

1. Make two bundles following Job 26d with the exception that, when making first fold, female coupling is adjusted about 2 feet longer than male, and male end to start and end on outside of bundle.
2. When all folds are completed, attach nozzle to each line and wye to either line.
3. Tighten straps after female end is wrapped around to protect nozzle making sure wye is secured with strap. (Fig. 14) NOTE: After placing bundles on apparatus, other 1½" bundle and 2½" hose may be connected to wye, or the bundles may be left separate.

30h: HOW TO BUNDLE 100 FT. OF 1½" HOSE (Coupled Do-nut Rolls)

INSTRUCTIONS:

1. Stretch out both sections of 1½" hose.
2. Double each line, placing male on top of one and the female on top of the other (No twists) Couplings to be even.

3. Starting at center fold of each section, make do-nut roll, leaving hand hold in center of roll (Fig. 15)
4. Place section with long male on top of other section, connecting short female to short male.
5. Place nozzle on long male.
6. Strap tightly through center of rolls with rope (Fig. 16) NOTE: Leave sufficient hose free of bundle on female end to reach from pump discharge to ground, if carried preconnected.

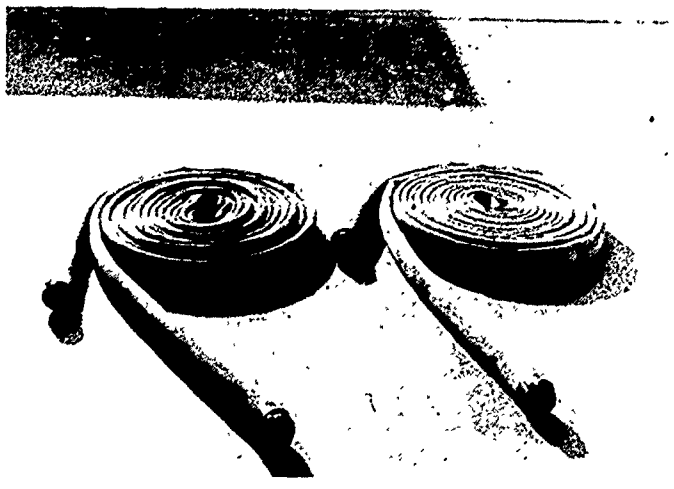


Fig. 15

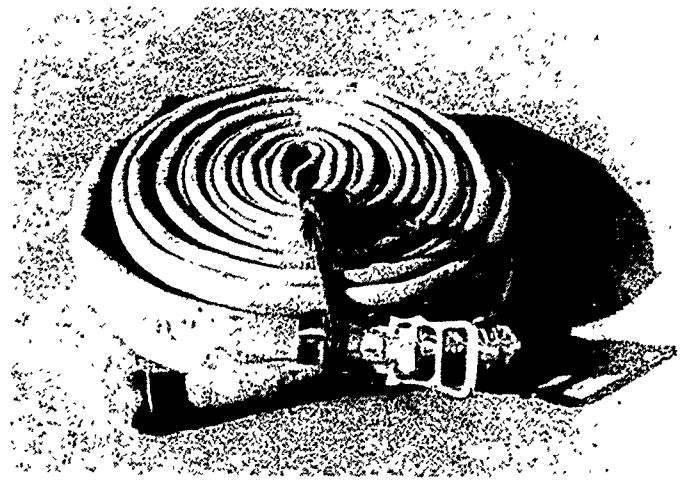


Fig. 16

301: HOW TO LOAD 1½" HOSE (Tray Load)

INFORMATION:

Where departments have trays on their apparatus, several methods of loading 1½ inch hose in trays have been developed, making it possible to combine a number of operations and speed up getting lines into operation. The method described below is for two 150 feet sections wyed to 2½" hose load.

INSTRUCTIONS:

1. Connect 6 lengths of 1½ inch hose into two lines of 150 feet each.
2. Fold each 150 Ft. line so that male is on outside and extending 6" longer than female. (Fig. 17)
3. Bring couplings of each line near rear of hose bed, and place on ground. (Fig. 18)

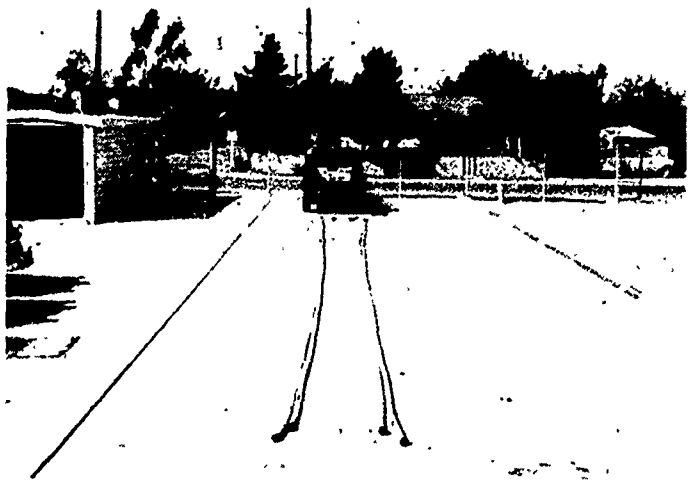


Fig. 17

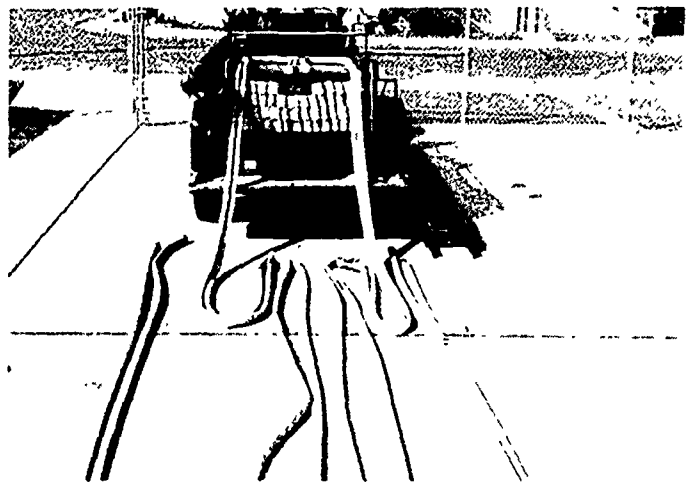


Fig. 18

4. Grasp center fold of either line and place next to center position at rear of tray. (Fig. 18)
5. Proceed with horseshoe load until all hose loaded in one side of tray (accordion load optional).
6. Repeat steps 4 and 5 for other side of tray.
7. Attach female connections to wye, after attaching wye to $2\frac{1}{2}$" hose in bed.
8. Attach $1\frac{1}{2}$ inch nozzles, and place along side of wye. Tying nozzles to wye with strap or rope is optional.
   NOTE: Where apparatus does not have tray, this method of loading $1\frac{1}{2}$" hose may be used directly on top of $2\frac{1}{2}$" hose. (Fig. 19)

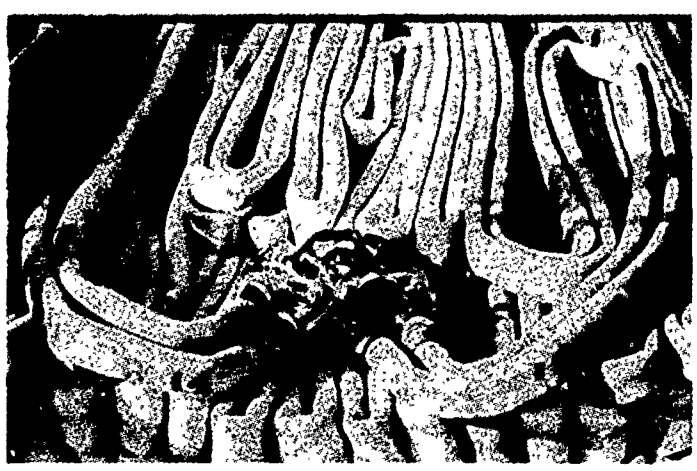


Fig. 19

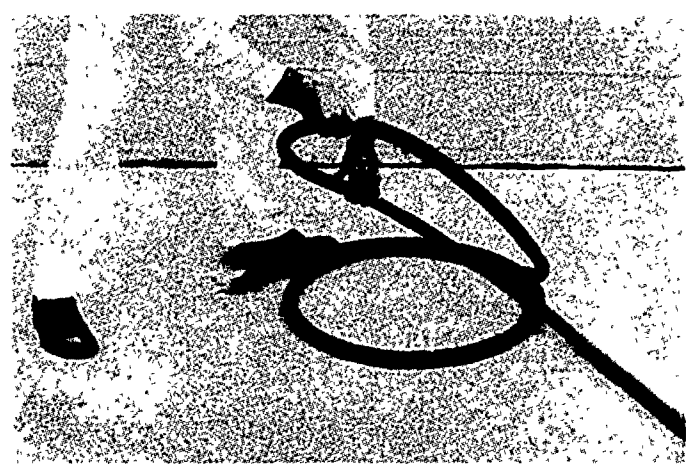


Fig. 20

30j: HOW TO COIL HOSE (Cable Method)

INFORMATION:

Extra hose of small size is sometimes carried on apparatus for various uses, and a proper method of coiling is important so that hose does not twist, kink, or snag when put into operation. The Cable Coil is generally recommended for this purpose.

INSTRUCTIONS:

1. Stand facing hose line with male end of left side and hose coming from right side.
2. Make first coil clockwise, size desired.
3. Reach down and pick up hose with right hand.
4. Reach back with left hand, crossing under right hand and pull hose forward to form coil, twisting in opposite direction of first coil. (Fig. 20)
5. Place second coil on top of first.
6. Place third coil on top of second and in same direction as first coil.
7. Place fourth coil on top of third in same direction as second coil.
8. Repeat above operations until all hose is coiled.
   NOTE: Hose may be strapped to hold in position.

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Small Gasoline Engines; Study Guide and Job Tests.

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ABSTRACT - Prepared by trade and industrial education instructors for student use in studying small gasoline engines, the study guide includes a bibliography, a progress record chart, and 77 job assignment and information lessons and questions. Units include: (1) General Fundamentals of Small Gasoline Engines, (2) Engine Maintenance and Repair, (3) Carburetors, (4) Electrical System, (5) Lawn Mowers, and (6) Outboard Motors. A separate booklet contains job tests related to each of the 77 job assignments. Related documents "Small Gasoline Engines, Answer Book" and "Small Gasoline Engines, Job Test Answers" may be obtained from the source of availability indicated for this document. (GR)

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SMALL GASOLINE ENGINES

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SMALL GASOLINE ENGINES

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This revision was made by Mr. Milton Mulder and instructors at J. F. Ingram Trade School.

The material was edited and prepared for reproduction by Mr. J. R. Thomas, Assistant State Supervisor, Trade and Industrial Education, and approved by Mr. H. F. Worthy, State Supervisor, Trade and Industrial Education.

SMALL GASOLINE ENGINES

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Code

SGE — All About Small Gas Engines, Jud Purvis - 1963 Edition, $3.38, Goodheart-Willcox Company, 18250 Harwood Avenue, Homewood, Illinois 60430

AGE — Audels Gas Engine Manual, 1967 Printing, $4.50, Howard W. Sams and Company, Inc., 4300 West 62nd Street, Indianapolis, Indiana 46268

AOM — Audels Outboard Motor and Boating Guide, 1967 Printing, $4.95, Howard W. Sams and Company, Inc., 4300 West 62nd Street, Indianapolis, Indiana 46268

ETM — Small Gasoline Engines Training Manual, Ted Piper, First Edition, $3.94, Howard W. Sams and Company, Inc., 4300 62nd Street, Indianapolis, Indiana 46268

OMS — Outboard Motor Service Manual, 4th Edition, Volume I, $3.71, ABOS Marine Division, Technical; Howard W. Sams and Company, Inc., 4300 62nd Street, Indianapolis, Indiana 46268

Supplementary

Small Engines - Care, Operation, Maintenance and Repair, Volumes I and II American Association for Agricultural, Engineering and Vocational Agriculture, Coordinators Office, Agricultural Engineering Center, Athens, Georgia

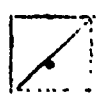
Motorcycle Service Manuals, Volumes I and II, Technical Publications Division, Intertec Publishing Corporation, 1014 Wyandotte Street, Kansas City, Missouri, 64105

HOW TO USE THIS STUDY GUIDE AND RECORD OF PROGRESS

The student's record of progress is kept on the Trade Analysis and Progress Record page. Progress "on-the-job" is kept in the column headed "Job Progress", and related study progress is kept in the adjoining column headed "Related Study".

The four step method of training is used in developing the skills of a trade or occuaption. A record of all these steps for each job is kept in the squares in the column below "Learning Status" (Steps), opposite a specific job.

A dot in the center of the square indicates a student is in the first step; that of observing the job being done. No other mark is made in this square as long as the student remains in this step.



A diagonal line across the same square indicates the student is in the second step; that of helping perform the job under instruction.

Two diagonal lines across the same square indicates that the student is in the third step; that of doing the job under supervision.

The square filled in solid indicates that the student has reached the fourth step; that of a satisfactory level of accomplishment. The date when this accomplishment has been reached is placed in the column "Date Objective Reached", opposite the specific job.

On the day the student has read all the references and has written the answers to all of the questions, for a specific job, the student places this date in the column headed "Date Completed", opposite this job. The grade made on the test on this job is entered in the adjoining square headed "Test Grade".

The word "Information" will be found in the "Job Progress" column for all information lessons. When all references have been read and all answers to the questions have been written, for a specific information lesson, the student places the date of completion in the "Date Completed" column, opposite this lesson number. The grade made on the test on this lesson is entered in the square headed "Test Grade".

The student should read all references before writing the answers to questions. The essay type of answers which are required for most questions have a very definite value as they will help the student form the habit of giving clear-cut, definite answers or explanations. Only a few references and a few questions have been listed on each job sheet to teach the student how to study the literature pertaining to his occupation.

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Revised May, 1966

TRADE ANALYSIS AND PROGRESS RECORD

SMALL GASOLINE ENGINES

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
	UNIT I GENERAL				
1.	Fundamentals of Small Gasoline				
	Engines	Information			
2.	Operate A Four-Cycle Engine				
3.	Operate A Two-Cycle Engine				
4.	Classification of Engines	Information			
5.	Determine The Horsepower of				
	Engines	Information			
6.	Determine The Efficiency of Small				
	Engines	Information			
	UNIT II ENGINES				
7.	The Combustion Chamber	Information			
8.	Alter The Compression Ratio				
9.	Replace Valves				
10.	Replace Cylinder Head				
11.	Control Valve Temperature				
12.	Install Valve Inserts				
13.	Replace Valve Springs and Guides				
14.	Adjust Valve Timing				
15.	Grind The Valves				
16.	Determine Cause of Engine Knock				
	or Ping				
17.	Inspect Small Gasoline Engines				
	For Repair				

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	UNIT II CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
18.	Remove and Replace Camshaft				
	Assembly				
19.	Remove and Replace Crankshaft				
20.	Adjust Crankshaft End Play and				
	Check For Wear				
21.	Remove, Replace, and Fit Main				
	Bearings or Inserts				
22.	Measure Piston Clearance				
23.	Replace Piston				
24.	Install Piston Pins				
25.	Install Piston Rings				
26.	Repair Cooling System				
27.	Remove and Replace the Flywheel				
28.	Lubricate the Engine				
29.	Adjust the Governor				
30.	Tune the Engine				
31.	Repair the Cylinder Block				
32.	Bore Cylinders Oversize				
33.	Recondition A Damaged Crankshaft				
	UNIT III CARBURETOR				
34.	Replace the Carburetor				
35.	Replace the Carburetor Float				
36.	Adjust Fuel and Air Mixture				
37.	Adjust the Carburetor				

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SMALL GASOLINE ENGINES

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	UNIT III CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
38.	Carburetor Trouble Shooting				
	UNIT IV ELECTRICAL				
39.	Fundamentals of Electricity	Information			
40.	Magnetism	Information			
41.	Replace the Generator				
42.	Test and Service the Generator				
43.	Adjust Generator Relays				
44.	Service the Starting Motor				
45.	Replace Ignition Coil				
46.	Replace Ignition Distributor				
47.	Service the Ignition Distributor				
48.	Replace the Condenser				
49.	Adjust Contact Points				
50.	Replace the Magneto				
51.	Replace A Rotating Magnet Magneto				
52.	Adjust Magneto Spark Advance				
53.	Install, Service and Adjust Spark Plugs				
	UNIT V LAWN MOWERS				
54.	Inspect and Repair Lawn Mower Cooling Systems				
55.	Lubricate A Lawn Mower				
56.	Service Lawn Mower Clutches				
	UNIT VI OUTBOARD MOTORS				
57.	Outboard Motor Fundamentals				

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SMALL GASOLINE ENGINES

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	UNIT VI CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
58.	General Maintenance and Salt Water				
	Care of Outboard Motors				
59.	Repair A Submerged Motor				
60.	Install Outboard Motor				
61.	Service Remote Control Steering System				
62.	Start Outboard Motors				
63.	Construction of the Outboard				
	Motor Power Head				
64.	Service the Power Head				
65.	Check the Cooling System Operation				
	on an Outboard Motor				
66.	Service the Lower Unit of				
	Outboard Motors				
67.	Service Outboard Propellers				
68.	Service Outboard Carburetor				
69.	Service Outboard Fuel Systems				
70.	Service Outboard Engine Valves				
71.	Adjust Fuel and Air Mixture				
72.	Service Outboard Electrical System				
73.	Service Outboard Starting System				
74.	Install Spark Plugs in Outboards				
75.	Minor Motor Tune-Up				
76.	Major Motor Tune-Up				
77.	Trouble Shooting on Outboard Motors				

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44.	Service the Starting Motor				
45.	Replace Ignition Coil				
46.	Replace Ignition Distributor				
47.	Service the Ignition Distributor				
48.	Replace the Condenser				
49.	Adjust Contact Points				
50.	Replace the Magneto				
51.	Replace A Rotating Magnet Magneto				
52.	Adjust Magneto Spark Advance				
53.	Install, Service and Adjust Spark Plugs				
	UNIT V LAWN MOWERS				
54.	Inspect and Repair Lawn Mower Cooling Systems				
55.	Lubricate A Lawn Mower				
56.	Service Lawn Mower Clutches				
	UNIT VI OUTBOARD MOTORS				
57.	Outboard Motor Fundamentals				

File No. 849-R
Revised May, 1966

TRADE ANALYSIS AND PROGRESS RECORD

SMALL GASOLINE ENGINES

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	UNIT VI CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
58.	General Maintenance and Salt Water				
	Care of Outboard Motors				
59.	Repair A Submerged Motor				
60.	Install Outboard Motor				
61.	Service Remote Control Steering System				
62.	Start Outboard Motors				
63.	Construction of the Outboard				
	Motor Power Head				
64.	Service the Power Head				
65.	Check the Cooling System Operation				
	on an Outboard Motor				
66.	Service the Lower Unit of				
	Outboard Motors				
67.	Service Outboard Propellers				
68.	Service Outboard Carburetor				
69.	Service Outboard Fuel Systems				
70.	Service Outboard Engine Valves				
71.	Adjust Fuel and Air Mixture				
72.	Service Outboard Electrical System				
73.	Service Outboard Starting System				
74.	Install Spark Plugs in Outboards				
75.	Minor Motor Tune-Up				
76.	Major Motor Tune-Up				
77.	Trouble Shooting on Outboard Motors				

NAME_____ OCCUPATION_____ AGENCY_____

STUDENT'S DAILY RECORD

Date	List the Job Numbers Performed the Previous afternoon	List the References Read in the Related Class by Symbols and Pages	List the Number of the Job Studied Today

JOB NO. 1

FUNDAMENTALS OF SMALL GASOLINE ENGINES AGE: 1-16

1. Explain fully what the gasoline engine is and how it operates.

2. Define cycle.

3. What types of valves are used in two-stroke engines?

4. How are the ports in a two-stroke cycle engine covered and uncovered?

5. What action controls the air-fuel ratio?

6. What are the fundamental differences between the operations of the four-stroke cycle and the two-stroke cycle engine?

7. What are the four strokes comprising the working cycle?

8. When should the admission valve open and close?

9. In general, why is the two-stroke cycle engine preferred over the four-stroke?

10. When is the four-stroke cycle engine preferred over the two-stroke?

JOB NO. 2

OPERATE A FOUR-CYCLE ENGINE

SGE: 12-15
AOM: 75-79
AGE: 7-13
OMS: 3- 4

1. Explain how the explosive mixture from the carburetor is drawn into the cylinder.

2. How is the explosive mixture regulated?

3. What happens at the peak of compression?

4. How are the intake and the exhaust valves controlled?

5. Why must the same sequence of admission, compression, expansion, and exhaust always occur in order?

6. When does a four-cycle engine ignite the charge?

7. Why does a four-cycle engine have an intake valve in each cylinder as well as an exhaust valve?

8. Define stroke.

9. At about what time does ignition occur?

JOB NO. 3

OPERATE A TWO-CYCLE ENGINE

OMS: 4-5
AOM: 71-74
AGE: 3-7
SGE: 15-16

1. Why does the piston take over part of the valve function in the two-cycle engine?

2. What happens when the piston reverses at the end of a stroke?

3. What happens when the piston reaches the end of its stroke?

4. What is the only time the inlet and exhaust ports are not reversed by the piston in a two-cycle engine?

5. Why is a deflector placed on top of the piston on the inlet side of the piston?

6. How can the alternate phases of vacuum and compression be avoided in the crankcase?

7. What are the engines called that are almost universally used in the outboard industry?

8. What is built in the crown of the piston on a two-cycle engine?

9. Where are the friction parts requiring lubrication located in the crankcase of a scavenged engine?

10. How does the three-port motor differ from that of a two-port?

JOB NO. 4

CLASSIFICATION OF ENGINES AGE: 17-

1. How are engines cooled on air cooled engines?

2. Where is the coolant located on liquid cooled engines?

3. Why do liquid cooled engines require a fan?

4. What is a common name for an L-head type engine?

5. Where are the two valves located on the L-head type engine?

6. List four disadvantages of the one or two-cylinder engines.

7. How much does the angle between the cylinders on V-type engines vary?

8. What is the usual cylinder arrangement in liquid cooled engines?

9. What is the cylinder arrangement in an air cooled engine?

10. How far apart are the cylinders placed on a horizontally opposed engine?

JOB NO. 5

DETERMINE THE HORSEPOWER OF ENGINES

AGE: 203-
SGE: 19

1. Define horsepower.

2. What is the simplest way to determine useable horsepower in a small engine?

3. Describe the operation of a prony brake.

4. What is the formula for rope brake?

5. Define torque.

6. What causes the torque to fall off after a short rise in the speed of an engine?

7. Describe the operation of a dynamometer.

8. What is meant by indicated horsepower?

9. What is the formula for indicated horsepower?

10. How is the mechanical efficiency of an engine determined?

JOB NO. 6

DETERMINE THE EFFICIENCY OF SMALL ENGINES

SGE: 19-26
AGE: 203-218

1. What is the formula for finding rated horsepower which has been with us since early days of inefficient engines?

2. What is meant by piston displacement?

3. How is the area of the piston head determined?

4. Define horsepower.

5. Of what does the dynamometer consist?

6. For what is the indicated horsepower useful? How is it determined?

7. What are supercharges?

8. What is torque?

9. What is the value of one Btu?

10. What factor has the greatest effect on the mechanical efficiency of an engine?

JOB NO. 7

THE COMBUSTION CHAMBER

ETM: 10-18
SGE: 26-30

1. Define and name the two types of combustion engines.

2. Give twelve (12) examples of typical elements.

3. What is an atom?

4. Who developed one of the modern combustion chamber designs?

5. Where is the combustion chamber located?

6. What ingredients have been added to gasoline to slow down the rate of combustion?

7. At what compression ratio did automobile engines operate in the early days?

8. What is the best material for making the combustion chamber?

9. What are the shapes of conventional pistons for internal combustion engines?

10. What is another name for the piston pin?

JOB NO. 8

ALTER THE COMPRESSION RATIO

SGE: 24-26
ETM: 24

1. Describe two ways that compression increases the force of combustion.

2. How were the earliest engines operated?

3. Why do engines today run on compressed charges and not on uncompressed charges as on earlier engines?

4. How can the compression ratio in a given size engine be changed?

5. How is it possible to change the stroke of compression ratio?

6. What is the easiest method of lowering the compression ratio of an engine?

7. How is the compression increased when installing a thicker cylinder head?

8. How is the air entering the engine controlled?

9. Give an explanation of the valve compression.

10. Why are modern engines being designed for higher and higher compression ratios?

JOB NO. 9

REPLACE VALVES

AGE: 93-104
ETM: 31-38

1. What two types of valves are no longer in demand?

2. Where do the valve seats of the poppet valves sit? How are they held in place?

3. What is the basic operating mechanism of any poppet valve?

4. What is another name for the "I" type cylinder head?

5. What is the shape of a poppet valve?

6. Of what is the poppet valve made?

7. Of what are the admission and exhaust valves made?

8. Of what are removable valve guides usually made?

9. What does the exhaust valve contain in an air-cooled type engine?

10. What is the purpose of the admission valve?

JOB NO. 10

REPLACE CYLINDER HEAD

AGE: 31-32
SGE: 39-46

1. What is the most commonly used material for engine blocks? Why?

2. Give three reasons why the cylinder block castings are made as nearly to the finished dimensions as possible.

3. What three things may cause cylinder block warping?

4. Why do cylinder walls wear regardless of how carefully they are designed or finished?

5. Why must there be some pressure on the piston rings?

6. What causes the cylinders to wear out-of-round?

7. What did the engineer Ricardo discover?

8. What causes detonation or knocking?

9. What will happen if a poorly made head gasket or an improper model gasket is used?

10. How can a cracked block or head be repaired?

JOB NO. 11

CONTROL VALVE TEMPERATURE SGE: 82-86

1. In what way does heat flow in small engines?

2. What is done when guides are not used to control valve temperature?

3. Why will temperatures vary around the rim of the valve?

4. What is the temperature of the stem adjacent to the head in normal operation?

5. What is the temperature of the valve head around the seating surface in normal operation?

6. At what angle with the stem is the valve face cut?

7. How hot does the central position of the valve head run?

8. Explain fully how a valve seat is cut if it is wider than 1/16 of an inch.

9. How close should the seat be concentric with the guide?

10. What is used to narrow the valve seat to its proper width?

JOB NO. 12

INSTALL VALVE INSERTS SGE: 86-87

1. How are valve seat inserts refaced when installing?

2. Of what are valve seats made?

3. What is done after the new insert is installed?

4. How are the pressed in or shrunk in inserts usually held in place?

5. What happens if the insert does not bottom fully in the hole or if it doesn't fit tightly all around the hole?

6. How much larger in diameter is the insert than the hole it is to be inserted into?

7. Explain what is done after the insert is installed.

8. What is the final step when installing valve inserts?

9. How should the inserts be handled when they have been frozen?

10. Name the three types of valve seats.

JOB NO. 13

REPLACE VALVE SPRINGS AND GUIDES

AGE: 95-96
SGE: 87-92

1. Explain fully the function of the valve stem guides.

2. Why are valve stems ground?

3. When is it customary to replace valves?

4. Why must valve springs be square on each end?

5. How are valves opened and how fast are they opened?

6. How is the valve stem measurement made?

7. When is heat dissipation best in an engine?

8. Of what are valve guides made?

9. What type of valve guides are preferable for small engines?

10. Why are some exhaust guides counterbored in the port end?

JOB NO. 14

ADJUST VALVE TIMING

AGE: 105-112
SGE: 93- 96

1. Explain fully how the proper clearance is obtained if the engine has no adjustment screws in the valve lifters.

2. What would happen if the valves were not timed to open and close at precisely the proper impact?

3. Define valve timing.

4. How is correct valve timing obtained?

5. Define valve overlap.

6. Why is valve overlap a necessity?

7. What indicates that valve timing is correctly set?

8. How is timing usually expressed?

9. How is the position of the valves determined and how is the correct valve timing obtained?

JOB NO. 15

GRIND THE VALVES

AGE: 101-104
SGE: 84-86, 92

1. What is one of the most frequently performed jobs when working on an engine?

2. What is the lapping procedure?

3. What aspect of the lapping procedure was never given much thought?

4. What is the first step in valve grinding?

5. When should valve guides be replaced?

6. What is the usual valve seat width?

7. What is the next step after a valve seat has been narrowed?

8. For what is a dial gauge used?

9. What is the purpose of a valve spring?

10. What is the function of the valve operating mechanism?

JOB NO. 16

DETERMINE CAUSE OF ENGINE KNOCK OR PING SGE: 118-121

1. What parts of an engine are a potential source of noise?

2. When will a rod in bad condition be heard?

3. How can a main bearing knock be located?

4. When is the noise of piston slap the loudest?

5. Why do piston rings that are loose in the groove usually not make noise?

6. Give two reasons why valves are a prolific source of noise?

7. What will usually stop the noise caused by wear between the valve lifter and lifter guide?

8. What is a common source of hard-to-find knocks?

JOB NO. 17

INSPECT SMALL GASOLINE ENGINES FOR REPAIR

AGE: 297-330
SGE: 115-122

1. On what is high oil consumption usually blamed?

2. In what two ways do overlapping and clogged water jackets cause the oil to be consumed?

3. Name six things that will cause the generation of excess heat?

4. What is one of the most difficult of all trouble-shooting jobs and one that occurs quite frequently?

5. When does the main bearing knock the loudest?

6. After the installation of new piston rings, what will most likely be the cause of the knock if it is heard?

7. What is a common cause of hard-to-find knocks?

8. If a motor doesn't start, what is the most common cause?

9. What are three possible causes of piston ring noises?

10. Name three possible causes for noisy valves.

JOB NO. 18

REMOVE AND REPLACE CAMSHAFT ASSEMBLY

SGE: 51-53
AGE: 96-104

1. How many cams are found on a multiple cylinder engine?

2. Of what are camshafts made?

3. Why should the ramps on cams be designed to open valves smoothly and gradually?

4. Where is the camshaft located on the overhead camshaft engine?

5. What is a camshaft in its simplest form?

6. What happens when the steel cam is altered in shape by wear?

7. How are steel cams designed?

8. How are cams shaped in racing engines where total efficiency is desired?

9. Why is the location of cams important?

10. What is necessary of the camshaft and camshaft journals?

JOB NO. 19

REMOVE AND REPLACE CRANKSHAFT

AGE: 28-30
377-382
SGE: 30,47-51
129

1. How is static balance in a crankshaft obtained?

2. What is meant by dynamic balance?

3. Explain how rotating balance in a crankshaft is obtained?

4. Why are the connecting rods and pistons balanced?

5. Why is it often more desirable to repair a damaged crankshaft than to replace it?

6. Why is it desirable to find out the size of bearings that are available before grinding the crankshaft journals?

7. If the shaft is badly damaged but a new shaft is high in cost, what can be done to restore the journal to operable condition?

8. When should oversized bearings be installed on the crankshaft?

9. What is the accepted method of clearance measurement?

10. Of what does the "plastigage" method of clearance measurement consist?

JOB NO. 20

ADJUST CRANKSHAFT END PLAY AND CHECK FOR WEAR

SGE: 47-51
30-34
AGE: 75-86

1. Explain fully the function of the crankshaft.

2. Why must crankshafts be correctly proportioned?

3. Of what are crankshafts made?

4. Non-bearing surfaces of the crankshaft are coated with what?

5. What is the engines crankshaft regarded as?

6. What is done to crankshafts when construction is completed?

7. Where is the flywheel located on most engines?

8. How is the crankshaft balanced when adjusting the end play?

9. Explain what is meant by dynamic balance.

10. Explain what is done to obtain rotating balance.

JOB NO. 21

REMOVE, REPLACE, AND FIT
MAIN BEARINGS OR INSERTS

SGE: 47-48
56-59
AGE: 85-86

1. How many main bearings will a one or two cylinder engine have?

2. In the case of poured or integral bearings, how is it possible to bore them?

3. Why do inserts or shell bearings not require fitting by hand?

4. If the crankshaft journal has been reduced in diameter, how is it possible to fill this added space?

5. Why must a bearing seat and shell be round and true?

6. If the bearing shell halves are not round and true what will happen?

7. What is meant by bearing "crush"?

8. Explain how the cap is dressed down, if the bearing cap is warped so that the faces are not flat and level, or if the bearing is not provided with shims.

9. If there is resistance toward the rotation of the shaft after the bearings are adjusted properly and the caps drawn up tight, what is the cause or causes?

JOB NO. 22

MEASURE PISTON CLEARANCE

AGE: 41-42
SGE: 66-68

1. What is the customary fit for cast iron pistons?

2. At what temperature are all piston clearance recommendations made?

3. What will happen to a piston if it becomes overheated or worn?

4. What happens if an excessive amount of oil passes up to the rings?

5. Give two causes for skirt expansion.

6. What is one way to avoid skirt expansion?

7. What is the purpose of the horizontal slot in the skirt?

8. How is the load on the piston head transferred directly to the wrist pin?

9. How is constant clearance obtained?

10. Why is the surface sometimes serrated or interrupted to retain the oil?

JOB NO. 23

REPLACE PISTON

AGE: 35-46
361-36
SGE: 62-66

1. What is the purpose of the piston in the engine?

2. Why must pistons be strong but light?

3. Why is cast iron used for pistons?

4. Why is a groove cut in the piston?

5. Why do alloy pistons have a split skirt?

6. What is the steel bell type of piston?

7. What is the common material used for making pistons?

8. What is the advantage of a cast iron piston?

9. What is the purpose of cam grinding?

10. What are the three stages of completion that pistons may come in when ordered from the factory?

JOB NO. 24

INSTALL PISTON PINS

SGE: 76-80
AGE: 67-70

1. Name three types of piston pins.

2. What is an ever present problem in piston pin design?

3. What is a very important point to remember when replacing a bushing in a piston pin?

4. Why must a film of oil always be around the piston pin?

5. How are piston pins constructed?

6. Name two ways that a piston pin is lubricated.

7. What is another name for the full-floating piston pin?

8. What is a piston pin?

9. Why are piston pins often chrome plated?

JOB NO. 25

INSTALL PISTON RINGS

AGE: 47-68
367-374
SGE: 68-76

1. Explain how the simple case iron piston ring was made.

2. What are the two distinct classifications of piston rings?

3. What are three possible causes for cylinder walls distorting out-of-round when at operating temperatures?

4. Name three problems that "oil pumping" can cause.

5. What is the purpose of the groove on the upper corner of the top compression ring?

6. In the absence of specific instructions, how much clearance should be allowed on the top ring? How much should be allowed on the others?

7. If the ring grooves are worn, bell-mouth, or tapered what are the two ways they can be repaired?

8. When installing piston rings, how are the gaps in the rings usually spaced around the piston?

9. What is a concentric piston ring?

10. What is the eccentric piston ring?

JOB NO. 26

REPAIR COOLING SYSTEM

AGE: 131-149
SGE: 97-101

1. How may heavy deposits of lime and scale be removed from the cooling system?

2. Why is it desirable to remove the water jacket cover from the cylinder block when lime and scale has been allowed to accumulate over a period of years?

3. For what purposes are air cooled engines used almost exclusively?

4. Explain how water cooling is obtained in an internal combustion engine.

5. What is the main objection to the use of water as a coolant for liquid cooled engines?

6. How is cooling of the engine parts accomplished?

7. Of what do water jackets in internal combustion engines consist?

8. What is the definition of a radiator?

9. Name the two general classes of radiators.

10. What is the function of the thermostat?

JOB NO. 27

REMOVE AND REPLACE THE FLYWHEEL

AGE: 87-92
SGE: 48-50

1. How does the flywheel allow the engine to idle smoothly?

2. What is the purpose of the flywheel?

3. Define torsional vibration.

4. Name the two classes of vibration dampers.

5. What is the purpose of the harmonic balancer?

6. Why are main bearings often channelled?

7. How is loss of engine lubrication prevented?

8. What type of flywheel acts as a housing for the magneto?

9. Of what are flywheels employed on small engines usually made?

JOB NO. 28

LUBRICATE THE ENGINE

AGE: 113-130
SGE: 101-104

1. Define lubricant.

2. Name three tasks that lubricating oil performs.

3. For what does S.A.E. stand?

4. How does the manufacturer decide which grade of oil to use in the engines?

5. Why does the manufacturer recommend the lightest grade of oil?

6. What is the splash system of supplying oil to moving parts?

7. How do the working parts of a two-cycle engine receive lubrication?

8. What is a "dispersive" additive?

9. What is an oil strainer and where is it located?

10. What are two different types of oil gauges?

JOB NO. 29

ADJUST THE GOVERNOR

AGE: 193-194
SGE: 113-114
ETM: 76- 81

1. What are the purposes of the governor?

2. What are the two types of governors?

3. What is the most common cause of surging or "hunting" by the governor?

4. What determines the r.p.m. which the flyballs will unfold? In what type of governors are flyballs used?

5. What instrument is used in "finding" the proper setting of the governor?

6. What are the effects of an improperly adjusted governor?

7. Who determines how and under what conditions adjustments are made on the governor?

JOB NO. 30

TUNE THE ENGINE

ETM: 204-216
SGE: 122-126
AGE: 332-352

1. Why are minor engine tuneups performed?

2. What does a major engine tuneup include?

3. What test should be run on the spark plugs during a minor engine tuneup?

4. What is the average condenser's capacity?

5. What parts make up the high tension distributor switch?

6. In which engines are magnetos used?

7. What is one way in which a magneto permanent magnet may lose its power?

8. Why is a compression test important?

9. What two engine tuning instruments are used in carburetor adjustment?

10. Why must the cooling system be kept clean?

JOB NO. 31

REPAIR THE CYLINDER BLOCK

SGE: 127-136
AGE: 353-360

1. Why do cylinders wear out of true?

2. What is the main indication of worn cylinders?

3. What is necessary when cylinders are scored too much for honing?

4. Why must pistons and rings be replaced after regrinding the cylinder oversize?

5. What are the various methods of reconditioning cylinders?

6. Why must the surface of the block be cleaned and filed of burrs before cylinder boring equipment is installed?

7. What would cause a piston to seize in a cylinder?

8. What is the purpose of the hone?

9. What should be done if scratches on a cylinder are too deep for a hone?

10. Name one way to repair a scored cylinder.

JOB NO. 32

BORE CYLINDERS OVERSIZE

AGE: 354-360
SGE: 128-129

1. What happens if the sleeves on the cylinder block fit too loose when boring cylinders oversize?

2. Why should sleeves be checked with a suitable cylinder gauge?

3. Why is it sometimes necessary to hone the sleeves?

4. Give five methods for reconditioning cylinders.

5. What is the first thing done before using the cylinder boring bar?

6. Where and how is the holding tool placed?

7. What is done immediately after determining the size of the hole to be bored?

8. Define reaming.

9. Define grinding.

10. Define honing.

JOB NO. 33

RECONDITION A DAMAGED CRANKSHAFT

SGE: 47-49
AGE: 75-86
AOM: 103-109
ETM: 18- 49

1. Define journal.

2. Define the word "throw" when used in mechanical operation.

3. What kind of crankshafts are used in West Bend engines?

4. What is an engine crankshaft regarded as?

5. Describe the function of a crankshaft.

6. How is the desired firing order of the engine cylinders regulated?

7. Why must crankshafts be correctly proportioned?

8. Of what are crankshafts generally made?

9. Define case-hardening.

10. What are the number of throws and their angular arrangement dependent upon?

JOB NO. 34

REPLACE THE CARBURETOR

SGE: 137-152
AGE: 393-408

1. What is a carburetor?

2. Who first designed a carburetor which utilized a float that maintained the level of fuel within the carburetor at substantially the same level?

3. For normal operating conditions, what proportion of gasoline and air mixture is the best economy?

4. What is a venturi?

5. Why do the rates of delivery of fuel and air differ?

6. Where do the two nozzles of the double nozzle principle of controlling the mixture of fuel and air receive their fuel?

7. Of what does the Zenith carburetor consist?

8. Describe the first type of carburetor to come into general use.

9. Name the four adjustments to the typical air valve carburetor.

10. How do thermostats affect carburetion?

JOB NO. 35

REPLACE THE CARBURETOR FLOAT

SGE: 140-141
AGE: 169-171
395
ETM: 92- 93

1. How is the fuel level in the float chamber maintained?

2. In recent designs, where is the float needle valve located and how is it operated?

3. What is the function of the carburetor float?

4. Explain the float feed method of maintaining a constant level of gasoline in the receiving chamber.

5. Explain the overflow method of maintaining gasoline at the necessary level.

6. Explain the downflow float feed system.

7. Explain the upflow float feed system.

8. What are the two types of float systems used?

9. Why is the carburetor bowl more often connected to carburetor air horn through a connecting passage than to the outside?

10. Why will the float type carburetor become inoperative if inverted?

JOB NO. 36

ADJUST FUEL AND AIR MIXTURE SGE: 139-144

1. What mixture of air and gasoline is economical for normal operating conditions?

2. What is the most suitable mixture for quick acceleration?

3. How are air and gas drawn through the carburetor?

4. What is used to measure suction created by the action of pistons?

5. What happens when the throttle is opened wide?

6. Why do the rates of fuel and air delivery differ?

JOB NO. 37

ADJUST THE CARBURETOR

AGE: 393-408
SGE: 146
ETM: 102, 106
108, 110

1. What are the major items in carburetor servicing?

2. What should be checked before servicing the carburetor?

3. Describe the method of using a white cloth in checking carburetor adjustment.

4. What are the four adjustments on the air valve carburetor?

5. Why should the liquid level in the float chamber be adjusted to the highest level without overflowing?

6. Name five of the nine factors which affect carburetion.

7. How is a vacuum gauge used in adjusting the carburetor?

8. At what speed are adjustments made with a vacuum gauge on the carburetor?

9. Why must manufacturers specifications be followed exactly on carburetor adjustment?

10. In what direction should a single needle valve be turned in order to have a lean mixture in the carburetor?

JOB NO. 38

CARBURETOR TROUBLE SHOOTING

AGE: 402-408
SGE: 149-150

1. When an engine does not start or operate efficiently where is it advisable to check first?

2. If the ignition and compression prove to be in good operating condition what should be done next?

3. If the carburetor or intake manifold is loose what is the result?

4. What may cause carburetor troubles?

5. How is the gum that is found on the inside and outside of the carburetor formed?

6. How is the carburetor cleaned?

7. What is the possible cause of poor carburetor performance?

8. What do mechanics usually find as the cause of poor carburetor idling?

9. What are the five possible causes of carburetor flooding?

10. How can a check be made to make sure that the fuel is reaching the carburetor?

JOB NO. 39

FUNDAMENTALS OF ELECTRICITY

AGE: 219-232
259
SGE: 152-156
AOM: 173-188

1. What is the theory that is now generally accepted by scientist as to the nature of electricity?

2. What is a proton?

3. In what kind of materials do the electrons never leave the protons and neutrons?

4. What is voltage?

5. What is an ampere?

6. What is an ohm?

7. What is Ohm's Law?

8. What are the three general types of circuits?

9. Define Joule.

10. What are the four different kinds of current?

11. What are four electrical systems employed on internal combustion engines?

12. What is a storage battery?

13. What is an insulator?

14. What is electrical resistance?

15. Name two kinds of wire conductors.

16. What are the four types of currents?

17. What is an insulated circuit?

18. What is a short circuit?

19. What is magnetism?

JOB NO. 40

MAGNETISM

AGE: 225-226
SGE: 157-164

1. What were the first effects of magnetism discovered?

2. What is one of the fundamental laws of magnetism?

3. Explain what happens when a non-magnetic substance is placed in a magnetic field.

4. How is electro-magnetism produced?

5. What is Residual Magnetism?

6. Define magnetism.

7. What is an electro-magnet?

8. What is a permanent magnet?

9. What is a solenoid?

10. What did Faraday discover?

JOB NO. 41

REPLACE THE GENERATOR

AGE: 273-282
SGE: 164-179

1. On what principle does the generator operate?

2. Of what does the armature of a generator consist?

3. What is armature reaction?

4. What is the output of the third brush generator dependent upon?

5. Define ampere turns.

6. Name two undesirable characteristics of third brush generators.

7. How is the field traced in the standard duty circuit?

8. In any standard duty circuit, what two elements are necessary for the proper working of the system?

9. What is the first step in generator inspection?

10. Why is the tension of the brush spring important?

JOB NO. 42

TEST AND SERVICE THE GENERATOR

ETM: 118-119
AGE: 342-343
SGE: 175-176

1. What should be checked when servicing the generator?

2. What is frequently the underlying cause of many electrical difficulties?

3. What equipment is required to check for resistance (voltage drop) in the starter and generator circuits?

4. How should the ammeter be connected when checking the starter and the generator circuits for resistance?

5. When checking for resistance in the starter and generator circuits, how should all checks be made?

6. If no readings can be obtained on the voltmeter when checking for resistance, what should be done?

7. How should a commutator be sanded?

8. What should be done to new brushes when they are installed in a generator?

9. Explain why the tension of the brush spring is important.

10. What can excessive oiling of the generator cause?

JOB NO. 43

ADJUST GENERATOR RELAYS

ETM: 118-119
AGE: 276-277
SGE: 176-179

1. Describe the cut-out relay.

2. Why is the shunt winding connected between the generator and ground?

3. What is the purpose of the fuse in the generator?

4. Define cut-out relay.

5. At what two times is the generator not charging?

6. What happens if the generator voltage drops below the battery voltage?

7. What is maintenance of the coil limited to?

8. What are the three cut-out relay checks and adjustments?

9. Explain what the air gap is and how it is measured and adjusted.

10. How is the point opening adjusted?

JOB NO. 44

SERVICE THE STARTING MOTOR

ETM: 180-182
AGE: 282-290
SGE: 179-181

1. Name the principal parts of an electric motor.

2. Define starter motor.

3. Why should the starter motor be used for a short time?

4. Upon what is the operation of a starter motor based?

5. Why are all starter motors of the series-wound type?

6. What is done to prevent the starter motor from overheating?

7. What will over-oiling of the motor bearings cause?

8. What should be done if the starter motor has been over-oiled?

9. What are the four main parts of the cranking system?

10. Define cranking system.

JOB NO. 45

REPLACE IGNITION COIL

ETM: 124
AGE: 235-236
SGE: 183-184

1. What is an ignition coil?

2. How is the ignition constructed?

3. What is the purpose of the core?

4. Why do coils have their windings immersed in oil?

5. Of what is the primary winding of the ignition coil made?

6. Of what is the secondary winding of the ignition coil made?

7. What are the primary contacts in the distributor?

8. What is the induced voltage ratio between the primary and secondary windings.

9. What is emf?

10. To how many volts may the secondary voltage be raised?

JOB NO. 46

REPLACE IGNITION DISTRIBUTOR

AGE: 236-238
409-411
ETM: 185-190
SGE: 185-190

1. What is the purpose of the ignition distributor?

2. On a four-cycle engine, at what speed does the distributor shaft revolve?

3. Name the main parts of the ignition distributor.

4. What are the advance cam and breaker cam assemblies?

5. At idle speed, when is the spark timed to occur?

6. What will a weak primary current cause?

7. What makes up the primary circuit?

8. Why does the adjustment of the contact points affect secondary current strength?

9. When does the current flow into the primary winding of the coil?

10. What happens if the cam angle is closed too long?

JOB NO. 47

SERVICE THE IGNITION DISTRIBUTOR

AGE: 409-411
SGE: 188-189
ETM: 128-131

1. What will happen if the points are set too close or too far apart?

2. What should be done if the points become pitted or burned during operation?

3. What can cause oxidized contact points?

4. What will weak or excessive contact point pressure cause?

5. What do most data tables specify for the breaker arm spring tension?

6. How must the contact points in a modern distributor be adjusted?

7. What is dwell angle?

8. What will cause variation of dwell angle?

9. Where are all distributor adjustments begun?

10. How is the contact gap usually adjusted?

JOB NO. 48

REPLACE THE CONDENSER

AGE: 232
240-241
SGE: 190-192

1. What is the double duty of the condenser as employed in batter ignition systems?

2. What would happen without the condenser action?

3. How is the capacity of the condenser measured?

4. How is the capacity of a condenser determined?

5. What is necessary besides the secondary coil in a jump spark ignition system? Why?

6. What is the voltage of the induced current in the secondary winding?

7. Upon what does the capacity of the condenser depend?

8. What is an indication of a condenser with improper capacity?

9. What are some remedies for excess condenser capacity?

10. What may cause high voltage in the condenser?

JOB NO. 49

ADJUST CONTACT POINTS

AGE: 409-411
SGE: 192-193

1. Why should the manufacturers specifications be followed when adjusting breaker points?

2. What will happen if the contact points are set too close?

3. What will result if the contact points are set too far apart?

4. What should be done if the points become pitted or burned in operation?

5. What are some causes for oxidized points?

6. What will too little spring tension at the contact breaker points cause?

7. What will too much spring tension at the contact breaker points cause?

8. What do most data tables specify for breaker arm spring tension?

9. How are contact points in a modern distributor adjusted?

10. What is dwell angle?

JOB NO. 50

REPLACE THE MAGNETO

AGE: 246-249
SGE: 193-197

1. What is a magneto?

2. What are some advantages of magneto ignition over battery ignition?

3. How is electrical energy in magneto ignition obtained?

4. What three things are necessary in order to generate electrici

5. What are the two types of magnetos in general use?

6. On what type of engines are magneto particularly popular?

7. How is the magnetic field produced in the magneto?

8. What alloys are used on the modern magnets?

9. Of what does a shuttle wound magneto consist?

10. Of what does the induction type magneto consist?

JOB NO. 51

REPLACE A ROTATING MAGNET MAGNETO SGE: 199-203

1. What made possible the design of magnetos in which the magnet was revolved?

2. What causes an alternating magnetic field in a Rotating Magnet Magneto?

3. What does the current in the primary windings produce?

4. When does the current in the secondary winding reach its maximum?

5. What causes the breaker points to open in the rotating magnet magneto?

6. What happens to the voltage produced in the primary windings?

JOB NO. 52

MAGNETO SPARK ADVANCE SGE: 197-205

1. Name the two ways of classifying magnetos.

2. Describe the low tension magneto.

3. How is the secondary winding in a high tension magneto protected from excessive voltage?

4. How is the current induced in the primary winding of a rotary inductor magneto?

5. What made possible the design of magneto in which the magnets revolve?

6. On what type engines are flywheel magnetos used?

7. How is the magneto spark advance obtained?

8. How is the degree of spark advance controlled?

JOB NO. 53

INSTALL, SERVICE, AND ADJUST SPARK PLUGS

AGE: 291-296
SGE: 205-210

1. Who made the first spark plugs?

2. Of what does the spark plug consist?

3. Of what were many spark plug insulators formally made?

4. What determines the size of the spark plug gap?

5. What are the five different thread sizes on spark plugs?

6. What may happen if spark plugs with a longer reach than the manufacturer's specifications are installed?

7. What determines the temperature of the spark plug insulator?

8. What is a hot plug?

9. What is carbon fouling or lead fouling?

10. What causes lead fouling?

JOB NO. 54

INSPECT AND REPAIR LAWN MOWER COOLING SYSTEMS

ETM: 171-172
AGE: 143-144
SGE: 99-101

1. From a production standpoint what is the most economical cooling system for small gas engines?

2. Name the two types of air cooling systems.

3. What is the most important maintenance to be performed on an air cooled engine?

4. Name some uses of air cooled engines.

5. What relation does the amount of heat generated have to the area of the surface on the fins?

6. Explain why an air cooled engine will run cooler when it is mounted on a steel plate.

7. What is the major difference between the two basic air cooling systems on small gas engines?

8. Which air cooling system uses air shrouds?

9. Where is the fan located on an engine which uses the forced draft air cooling system?

10. Do engines of high horsepower ratings incorporate an air cooling system?

JOB NO. 55

LUBRICATE A LAWN MOWER

ETM: 146-151
AGE: 113-130
SGE: 101-104

1. How many varieties of lubricants are there?

2. What is the principal difference between lubricants?

3. What is the first thing a lubricant must be able to withstand?

4. What, primarily, are motor oils and greases?

5. For what does S.A.E. stand?

6. What is the most important requirement or rating that is upheld by the S.A.E.?

7. What do grades of oil indicate?

8. What would excessive friction do to an engine?

9. In a 2-cycle engine, the engine does not have an oil pump. Why?

10. Why is a filter used in an oil pump and sump system?

JOB NO. 56

SERVICE LAWN MOWER CLUTCHES AGE: 195-202

1. Define Clutch.

2. What are the two clutch elements?

3. What makes up the drive members?

4. Of what is the clutch disk usually made?

5. How is the movement of the clutch pedal transmitted?

6. Of what do the two plate clutches consist?

7. What is the purpose of cushioning devices?

8. How is the transmission of power through the clutch accomplished?

JOB NO. 57

OUTBOARD MOTOR FUNDAMENTALS

AOM: 1-36
OMS: 3-15

1. What materials are used for making boat hulls?

2. What is the function of a carburetor?

3. Of what does a typical condenser consist?

4. What is an Ohm?

5. How are the terms; ampheres, Ohm, volt and watt related to one another?

6. Extremely high voltage of 10,000-25,000 is created by what part of an outboard motor engine?

7. Why is special care needed if an outboard motor is used in salt water?

8. What is negative polarity?

9. What happens to the spark plug if the wiring is of negative polarity?

JOB NO. 58

GENERAL MAINTENANCE AND SALT WATER CARE OF OUTBOARD MOTORS OMS: 15-25

1. What is the most common cause for carburetor malfunction on outboard motors other than an improper fuel mixture?

2. What happens when the speed control is moved to the fast position?

3. What will a mixture of fuel that is too lean cause?

4. What are the types of generators used on outboard motors?

5. What is the most common type of water pump?

6. What is the first step in removing or repairing damaged threads on outboard motors?

7. Where are the breaker points located?

8. Most carburetor service consists of what three things?

9. What causes carburetor flooding?

10. Before putting new rings into the piston, what must be done to the piston grooves?

JOB NO. 59

REPAIR A SUBMERGED MOTOR OMS: 25-26

1. Why is it dangerous to use a chain to assist in the recovery of large motors while it is alright to use the chain in the recovery of small outboard motors?

2. Why is the corrosion action greater when the motor that has been sumberged has been removed from the water?

3. Why will mechanical problems develop if an outboard motor has been dropped into the water?

4. Why will the outboard motor not start after it has been dropped into the water?

5. After removing the motor from the water why is it best to keep it in fresh water in a small tank until cleaning?

6. Why will the crank journals and main bearings most likely corrode after the motor has been dropped in water?

7. What may be the cause of no spark after the motor has submerged?

8. What type of damage will occur after a motor has been submerged and then used after recovery?

9. What will the result be if a motor has been submerged in cold weather and used immediately and not serviced?

10. After use in salt water what should be done to the motor to keep it in the best condition?

JOB NO. 60

INSTALL OUTBOARD MOTOR AOM: 37-50

1. What will cause a motor boat to plow or porpoise in water?

2. What weights must a clamp bracket support?

3. What are the steps for removing a motor from a boat?

4. What should be done before storing a motor that has been in salt water?

5. What should be done to any engine that is to be put in storage?

6. How is water removed from the engine after a motor has been dropped in water?

7. What may happen if a new motor is operated out of water?

8. What part of the engine should be checked if the engine loses power or overheats?

9. Why should a break in compound never be used on a new engine?

10. Why should an engine with an electric starter have its negative battery terminal disconnected while in storage or drydock?

JOB NO. 61

SERVICE REMOTE CONTROL STEERING SYSTEM AOM: 51-59

1. What are the three types of tiller steering?

2. What is the most simple method of tiller steering?

3. Give a simple definition of tiller.

4. What items other than extensions are used on tillers?

5. For best service where should the pulley be located?

6. What is meant by remote control?

7. What can the actuating source of remote control be?

8. What is the simpliest form of remote control on an outboard motor?

9. What does remote control steering have to do with the position of the boat driver?

JOB NO. 62

START OUTBOARD MOTORS AOM: 61-66

1. What is the principal disadvantage of an internal combustion engine?

2. In what ways may an outboard motor be started?

3. What are the present types of manual starters?

4. What are the two types of automatic rewind starters?

5. What causes the pawl to disengage after the engine has started?

6. What is the most common type of outboard starter?

7. How are the pawls attached to the equalizer cup?

8. Where was the hand crank located on older motors?

9. What happens when the starter cord is pulled on an engine?

10. Give the seven steps which should be followed in starting an outboard motor.

JOB NO. 63

CONSTRUCTION OF THE OUTBOARD MOTOR POWER HEAD AOM: 81-92

1. What are the four types of power head construction?

2. What determines the number of cylinders in an engine?

3. Name the parts of a two-stroke cycle single cylinder engine power head.

4. In what types are the power heads of two-stroke cycle four cylinder outboard motors designed?

5. In a four cylinder opposed firing outboard engine, at what interval does the power stroke occur?

6. Of what are modern cylinders made?

7. What methods of power head construction has reduced weight, but has improved the quality of the engine assembly as well?

8. Of what is the friction type bearing made?

9. How is the gravity type of carburetor attached to the engine?

10. How is fuel passed through a V-type crankcase?

JOB NO. 64

SERVICE THE POWER HEAD AOM: 93-116

1. What are the four moving parts which act to transform the energy contained in the incoming fuel mixture into useful power?

2. What are the three types of pistons?

3. What are the types of connecting rods?

4. Where does the crankshaft receive its motion?

5. What are the two types of bearings?

6. What is the function of the crankshaft bearing?

7. Where is the magneto located on most two cycle engines?

8. What are the principal parts of a connecting rod assembly?

9. What is the purpose of a connecting rod?

JOB NO. 65

CHECK THE COOLING SYSTEM OPERATION ON
AN OUTBOARD MOTOR AOM: 117-124

1. Why must an engine have a cooling system?

2. How much fuel energy is actually converted into useful power?

3. What are the two methods of cooling outboard motors?

4. Where are air cooled engine blades usually incorporated?

5. What type pumps are used in water cooled outboard motors?

6. Of what are typical rotor blades made?

7. At what temperature does a thermostat usually open?

8. In a circulating system, what happens to the water when its temperature reaches 145°?

9. What is the usual working temperature of pistons?

10. Where may a water pump be located?

JOB NO. 66

SERVICE THE LOWER UNIT OF OUTBOARD MOTORS AOM: 125-138

1. What are the three types of lower units?

2. What is necessary in order to have a forward, neutral, and reverse speed?

3. What is the purpose of the drive shaft housing?

4. What is water tubing?

5. What is contained in the gear case?

6. In what two demensions is the size of propeller given?

7. What is cavitation?

8. Why are shear pins used?

9. What is the pitch of a propeller?

JOB NO. 67

SERVICE OUTBOARD PROPELLERS

AOM: 133-138
OMS: 10- 12

1. What are the two general types of boats?

2. Will a two or a three blade propeller give greatest speed?

3. What will happen to the motor if there is too little propeller pitch?

4. What is the normal slippage on a racing hull?

5. What amount of slippage is there on a slow speed boat?

6. On what does the potential speed of a boat depend?

7. A displacement hull is used on what types of boats?

8. Of what are propellers made?

9. Where are the upper and lower shafts connected?

10. What is the usual number of blades on a propeller?

JOB NO. 68

SERVICE OUTBOARD CARBURETOR

AOM: 139-160
OMS: 19

1. What is the basic function of a carburetor?

2. Of what does the bulk of carburetor maintenance consist?

3. What is the ideal fuel mixture for outboard motors?

4. What is the first requirement of a carburetor?

5. What is the purpose of the automatic choke?

6. What are the three types of fuel transfer?

7. What controls air-fuel mixture?

8. Where are the rotary valves located?

9. What is the purpose of the fuel filter?

10. What is the usual type of carburetor used on smaller outboards?

JOB NO. 69

SERVICE OUTBOARD FUEL SYSTEMS

AGE: 145-160
AOM: 134-160
OMS: 5- 7

1. What are the two types of air filters?

2. What is the purpose of the intake manifold?

3. What is the purpose of the muffler?

4. How were early fuel gauges operated?

5. What are the two ways that gasoline can burn?

6. What does octane rating of gasoline indicate?

7. What is the most common compound added to gasoline?

8. What are the three types of fuel transfer?

9. Where are the rotary valves located?

10. What are the three types of valves?

JOB NO. 70

SERVICE OUTBOARD ENGINE VALVES AGE: 17-34
93-112

1. Of what are intake and exhaust valves made?

2. What is a valve seat?

3. What is a valve stem guide?

4. What is valve timing?

5. What are the eight parts of working valve train?

6. What are the two ways to cool an engine?

7. What is the most common cylinder head arrangement?

8. What are four disadvantages of 1-2 cylinder engines?

9. What are the four types of valve faces?

10. What is the purpose of the valve mechanism?

JOB NO. 71

ADJUST FUEL AND AIR MIXTURE AOM: 161-172

1. On what does the two stroke cycle outboard motor operate?

2. What system is used for classifying engine oils?

3. Why are M.L. oils not used in an oil-fuel mixture?

4. From what are oil and gasoline made?

5. What is the function of additives in motor oils?

6. What are the two ways in which gasoline burns?

7. How is the ability of a fuel to resist detonation measured?

8. The proper oil and gas mixture depends upon what factors?

9. What are the usual grades of oil?

10. During the breaking in period of the engine what is usually recommended in the fuel-oil mixture?

JOB NO. 72

SERVICE OUTBOARD ELECTRICAL SYSTEM AOM: 353-386

1. What two types of ignition systems are used on outboard motor boats?

2. What are the three possible failures of a coil if it has an irregular, weak or hesitating spark across the gap?

3. How does a battery ignition system differ from a magneto ignition system?

4. What are the parts of the battery ignition system?

5. What causes oxidized points in an ignition system?

6. What will happen to a set of points if they are set too close or too far apart?

7. What is the dwell angle?

8. What should the breaker arm spring tension be in ounces?

9. What is the relationship of the coil and condenser?

10. What is the voltage in the secondary coil?

JOB NO. 73

SERVICE THE OUTBOARD STARTING SYSTEM

AOM: 61-66
212-217
367-375
SEC: Vol. II
5-32

1. What does a 120 volt A.C. starting system primarily consist?

2. What is the purpose of the starter drive mechanism?

3. What are the three types of drive mechanisms on electric starters?

4. What is the function of a starter?

5. What are four ways of transmitting power from the source to the drive mechanism in a starter?

6. What is a starting motor?

7. What are the six most common causes of starters not operating?

8. What are the five most common causes of starter failure and the lights dimming?

9. What are the three most common causes of the starter not engaging?

10. What are the parts of the typical starter motor circuit?

JOB NO. 74

INSTALL SPARK PLUGS IN OUTBOARDS AOM: 233-248

1. What will happen if a cold plug is used in a low speed engine?

2. What will happen if a hot plug is used in a high speed engine?

3. What is a misfire?

4. What is the probable cause of trouble if plugs are found with oil on them?

5. What is the probable cause if engine is sluggish, lacks power, and overheats?

6. What is the probable cause if the engine is misfiring, or has weak or irregular spark?

7. What is the probable cause of engine misfiring or cutting out at high speeds or under loads?

8. What is the probable cause of plug fouling?

9. What is the probable cause of the engine missing at high speeds?

10. What is the possible cause of an arcing from terminal to ground?

JOB NO. 75

MINOR MOTOR TUNE-UP AOM: 271-278

1. What is meant by a tune-up?

2. What are the two types of tune-up?

3. What is a minor tune-up?

4. What are four minor tune-up test and servicing items?

5. What should be done to the points before testing a spark plug?

6. On a minor tune-up, what should be inspected for damage on magneto breaker points?

7. On a minor tune-up, what should be inspected for damage on the wiring circuit?

8. Why should the breaker arm spring be checked?

9. How many steps are there in remagnetizing a magneto?

10. What should be done to battery cells on a minor tune-up?

JOB NO. 76

MAJOR MOTOR TUNE-UP AOM: 278-284

1. What is a major motor tune-up?

2. What should be done to the battery on a major tune-up?

3. What should be done to the cylinder block on a major tune-up?

4. What should be done to the reed valves on a major tune-up?

5. What does the compression indicate?

6. How is an idle needle valve adjusted?

7. What is the purpose of the float in a carburetor?

8. What does the water pump impeller do?

9. What should be checked on the carburetor on a major overhaul?

10. What six items are checked on a major tune-up?

JOB NO. 77

TROUBLE SHOOTING ON OUTBOARD MOTORS AOM: 285-302

1. What are five causes of a motor not starting?

2. What are five causes of a motor stalling?

3. What are three causes of a motor skipping or misfiring?

4. What are three causes of a motor misfiring while idling?

5. What are three causes of a motor misfiring at high speeds?

6. What are three causes of reed valve failure?

7. What are three causes of connecting rod noises?

8. What are three causes of main bearing noises?

9. What are three causes of broken piston rings?

10. What are three causes of broken pistons?

JOB NO. 77

TROUBLE SHOOTING ON OUTBOARD MOTORS AOM: 285-302

1. What are five causes of a motor not starting?

2. What are five causes of a motor stalling?

3. What are three causes of a motor skipping or misfiring?

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5. What are three causes of a motor misfiring at high speeds?

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7. What are three causes of connecting rod noises?

8. What are three causes of main bearing noises?

9. What are three causes of broken piston rings?

10. What are three causes of broken pistons?

SMALL GASOLINE ENGINES

JOB TEST

VT010582

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NO. 1 TEST

FUNDAMENTALS OF SMALL GASOLINE ENGINES

TRUE - FALSE

T F 1. The two-stroke cycle engine has twice the power output of a four-stroke cycle engine of the same size.

T F 2. The admission valve should open the instant the piston starts upward in the cylinder on the compression stroke.

T F 3. The admission valve should close at the exact time the piston starts down in the cylinder.

T F 4. The two-stroke cycle engine is preferred because the fuel economy is an important factor.

T F 5. Admission means intake.

MULTIPLE CHOICE

6. The ports are covered and uncovered by the action of the _____. (a) piston (b) carburetor (c) cylinder

7. The air-fuel ratio is controlled by the _____ action. (a) fuel pump (b) cylinder (c) carburetor

8. The fuel most commonly used in internal combustion engines is _____. (a) natural gas (b) gasoline (c) propane

9. In a four-stroke cycle engine, the cycle is extended through _____. (a) two strokes (b) four strokes (c) eight strokes

10. In two-cycle engines the air-fuel mixture enters the crankcase through the fuel admission port opening which is equipped with a vacuum controlled _____. (a) valve (b) charge (c) plug

NO. 2 TEST

OPERATE A FOUR-CYCLE ENGINE

TRUE - FALSE

T F 1. The compression stroke in the four-cycle engine is the third step in the cycle.

T F 2. The exhaust stroke is the last stroke in the cycle.

T F 3. The intake is the first stroke in the cycle.

T F 4. The intake and exhaust valves are used in both two and four-cycle engines.

T F 5. The explosive mixture is regulated by the intake valves.

MULTIPLE CHOICE

6. The spark plug is found in the _____. (a) block (b) cam (c) head

7. Gas is drawn into the cylinder by a _____. (a) valve (b) tube (c) vacuum

8. Each movement of the piston is a _____. (a) cycle (b) stroke (c) intake

9. As the burning gases expand, they force the piston towards the _____. (a) crankshaft (b) camshaft (c) cylinder head

10. Ignition occurs about the time the piston reaches the _____ of the cylinder on the compression stroke. (a) top (b) bottom (c) middle

NO. 3 TEST

OPERATE A TWO-CYCLE ENGINE

TRUE - FALSE

T F 1. A deflector on the top of the piston inlet side is used to divert the fresh mixture up into the piston cylinder.

T F 2. When the piston reverses at the end of a stroke it creates a heavy pressure in the crankshaft while the piston is moving.

T F 3. The piston takes over some of the valve function in order to obtain a power stroke each revolution of the crankcase.

T F 4. When the piston reaches the end of its stroke it covers the port.

T F 5. A supercharger is used to push air into the cylinder.

MULTIPLE CHOICE

6. A _____ is built in the crown of the piston of a two-cycle engine. (a) lock (b) baffle (c) float

7. Crankcase _____ engines are used in most outboard motors. (a) scavenged (b) cycle (c) vented

8. The friction parts requiring lubrication are located in the _____. (a) cooling system (b) heating system (c) fuel intake system

9. The three-port motor differs from the two-port mainly in the _____. (a) fuel admission (b) cylinder (c) carburetor

NO. 4 TEST

CLASSIFICATION OF ENGINES

TRUE - FALSE

T F 1. Air cooled engines require a radiator and water jacket.

T F 2. The "V-type" engine is most commonly used.

T F 3. In a liquid cooled engine the cylinder arrangement is usually "in line."

T F 4. In an air cooled engine the cylinder arrangement is usually "in line."

T F 5. The coolant is held around the valve ports, combustion chambers, and cylinders by a water jacket.

MULTIPLE CHOICE

6. The angle of the cylinders vary on the "V-type" engine _____. (a) 90° to 45° (b) 30° to 60° (c) 45° to 60°

7. The cylinders on a horizontally opposed engine are placed in two rows _____ apart. (a) 180° (b) 120° (c) 160°

8. The I-head type engine is commonly termed _____. (a) longhead (b) valve in the head (c) underhead

9. The two valves are located on the _____ of the head on an L-type engine. (a) middle (b) opposite side (c) same side

10. The firing order for a four-cycle engine is _____ or _____. (a) 1 3 4 2 (b) 4 3 2 1 (c) 3 2 1 4 (d) 1 2 4 3

NO. 5 TEST

DETERMINE THE HORSEPOWER OF ENGINES

TRUE - FALSE

T F 1. One of the simplest ways to determine useable horsepower in a small engine is by means of the rope brake.

T F 2. The prony brake consists of two blocks of wood shaped to fit around the flywheel of a motor.

T F 3. Dynamometer is a method of connecting an electric generator to the main shaft of the engine to be tested.

T F 4. Mechanical efficiency means the relationship between the output and input measured in the same units.

MULTIPLE CHOICE

5. One "British" thermal unit equals _____ foot-pounds of work. (a) 578 (b) 678 (c) 778

6. One horsepower is a unit of power numerically equal to _____ foot-pounds of work per minute. (a) 3525 (b) 33,000 (c) 3650

7. The number of cubic inches of cylinder space displaced by the piston during a single stroke is termed _____. (a) volumetric efficiency (b) super charger (c) piston displacement

8. The formula for indicated horsepower is _____.
(a) $I.H.P. = \frac{PLAN}{33000} \times K.$ (b) $TT\ D^2 \times L \times N$
(c) $TT\ \frac{(4.125)}{4}\ 2 \times 3.4 \times 8$

9. In the rope brake formula N means _____.
(a) revolutions per minute (b) spring balance
(c) number of cylinders

NO. 6 TEST

DETERMINE THE EFFICIENCY OF SMALL ENGINES

TRUE - FALSE

T F 1. Rated horsepower is primarily used for licensing purposes.

T F 2. The cubic inch displacement is an unreliable figure for indicating the potential power output of the engine.

T F 3. The horsepower is measured by means of a dynamometer or prony brake.

T F 4. Indicated horsepower is a measurement of the force delivered by the expanding gas to the piston inside the cylinder.

T F 5. The mean effective pressure is a term used to describe the power producing pressures minus the opposing pressure.

MULTIPLE CHOICE

6. One horsepower is a unit of power numerically equal to a rate of 33,000 foot pounds of work per _____.
(a) second (b) hour (c) minute

7. The prony brake consists mainly of two blocks of wood shaped to fit around the _____ of the engine.
(a) block (b) flywheel (c) crankcase

8. _____ _____ is based upon the pressure exerted on the piston during the power stroke obtained from the indicator diagram, area of the piston head, length of the stroke, and the number of power strokes in a given period. (a) SAE horsepower (b) indicated horsepower (c) piston size

9. The overall _____ efficiency of a gas engine is the relationship between the fuel input and the power output.
(a) volumetric (b) thermal (c) mechanical

10. The _____ pressure is a peak immediately after the mixture is ignited in the cylinder. (a) expansion (b) mean effective (c) compression

NO. 7 TEST

THE COMBUSTION CHAMBER

TRUE - FALSE

T F 1. An external combustion engine uses kinetic energy for fuel.

T F 2. Pistons may be flat, concave, or convex on the outer surface of the closed end.

T F 3. Thermal type combustion engines are more in demand than internal type combustion engines.

T F 4. A combustion engine is defined as one that uses the heat energy of fuel.

T F 5. Atoms are the parts that form molecules.

MULTIPLE CHOICE

6. An engineer named _____ designed one type of combustion engine. (a) Ritzs (b) Rives (c) Ricardo

7. There are _____ natural atoms. (a) 92 (b) 98 (c) 88

8. Conventional type pistons for internal combustion engines are shaped like _____. (a) cones (b) cups (c) buckets

9. Another name for the piston pin is the _____. (a) wrist pin (b) elbow pin (c) arm pin

NO. 8 TEST

ALTER THE COMPRESSION RATIO

TRUE - FALSE

T F 1. The compression ratio in a given size engine can be changed by altering the length of the stroke or the volume of the combustion chamber.

T F 2. It is impossible to change the stroke by regrinding the crank throws off center.

T F 3. If metal were to be ground out of the cylinder head, the compression ratio would be raised.

T F 4. Almost every design feature and individual part of an engine has something to do with its efficiency.

T F 5. An engine will not run on uncompressed charges.

MULTIPLE CHOICE

6. The easiest method of lowering the compression ratio of an engine is to install a _____ cylinder head gasket. (a) thinner (b) thicker (c) wider

7. To _____ the compression, the cylinder head is often milled or "shaved" off on the gasket face to bring the cylinder head closer to the block. (a) eliminate (b) decrease (c) increase

8. The compression ratio of an engine can be changed by adding to or subtracting from the length of the piston _____ the piston pin. (a) below (b) at (c) above

9. The power output of the earliest engines was exceedingly _____. (a) low (b) high (c) inconsistent

10. The ability of the engine to utilize the burning and expansion of gas in creating power will depend upon the _____losses in the engine, the thermal losses and mechanical conditions, such as leakage from worn out or improperly fitted parts. (a) compression (b) power (c) friction

NO. 9 TEST

REPLACE VALVES

TRUE - FALSE

T F 1. Sometimes bronze is used to make removable valve guides.

T F 2. Rotary valves are commonly used in engines today.

T F 3. "Poppet" valves are commonly used in today's engines.

T F 4. Poppet valves consist of a coil spring and a rotating cam.

T F 5. The exhaust valve is made of chromium-nickel alloy.

MULTIPLE CHOICE

6. The tension of the valve spring should be _____.
(a) 5 lbs. (b) 20 lbs. (c) 40 lbs. or more

7. The poppet valve is shaped like a _____. (a) mushroom
(b) small piston (c) carrot

8. The poppet valve is made of special _____ steel.
(a) nickel (b) alloy (c) compound

9. The exhaust valve on an air-cooled engine usually contains
_____. (a) solvent (b) liquid air (c) sodium

10. Removable valve guides are made of _____ or _____.
(a) cast iron (b) wrought iron (c) soft iron (d) bronze

NO. 10 TEST

REPLACE CYLINDER HEAD

TRUE - FALSE

T F 1. Cast iron is not easily machined.

T F 2. Little has been done in the way of design to minimize the affects of warpage in cylinder blocks.

T F 3. There are no successful engines running without water jackets between adjacent cylinders.

T F 4. Most cylinder wear occurs in the area covered by the piston rings.

MULTIPLE CHOICE

5. Pressure exerted on the piston is much greater on the _____ stroke than on the other three strokes. (a) intake (b) exhaust (c) power

6. In the _____ head engine, the valve ports, and the gas passage are built in the detachable cylinder head. (a) L (b) I (c) T

7. Detonation is uncontrolled burning and _____. (a) expansion (b) explosion (c) detenting

8. The _____ in the cylinder is timed at or near top center and the burning fuel produces an expansive force on the descending piston. (a) pressure (b) spark (c) power

9. The cylinder head surface and the matching block surface should be flat and true within _____ inches. (a) .002 (b) .013 (c) .020

NO. 11 TEST

CONTROL VALVE TEMPERATURE

TRUE - FALSE

T F 1. A 30° cut is sometimes used when cutting the valve face.

T F 2. Heat flows in small engines from the valve stem to the valve guide and from the guide to the block.

T F 3. The temperature will vary around the rim of the valve head due to the difference in velocity.

T F 4. Use special grinders when cutting a valve seat to its proper width.

T F 5. Most valve faces are cut at a 90° angle with the stem.

MULTIPLE CHOICE

6. A valve seat is satisfactory if the width is _____ of an inch. (a) 7/16ths (b) 3/16ths (c) 1/16th

7. The central portion of a valve head operates at temperatures between _____° F. (a) 1200 to 1400 (b) 1400 to 1600 (c) 1300 to 1500

8. In normal operation the temperature of the stem adjacent to the head is _____° F. (a) 800 to 1000 (b) 1200 to 1400 (c) 1000 to 1200

9. In normal operation, the temperature of the valve head around the seating surface is _____° F. (a) 800 to 1000 (b) 1400 to 1600 (c) 1000 to 1200

10. The valve seat should be concentric with the guide within _____ inches. (a) 0.01 (b) .001 (c) .0001

NO. 12 TEST

INSTALL VALVE INSERTS

TRUE - FALSE

T F 1. Valve seat inserts are refaced by grinding with special grinders.

T F 2. Valve seat inserts are made of hard heat resisting metal.

T F 3. Valve seat inserts cannot be reamed like the integral seat on a cast iron block.

T F 4. If the insert does not bottom fully in the hole there will be poor heat transfer from the insert to the cylinder block.

T F 5. The final step when installing valve inserts is to grind the seat for the valve on the insert true with the valve grind.

MULTIPLE CHOICE

6. There are _____ types of valve seats. (a) 2 (b) 3 (c) 4

7. Valve inserts are handled _____ after they have been frozen. (a) rough (b) easily (c) carefully

8. A valve seat insert is _____ or _____ thousandths of an inch larger than the hole into which it will be inserted. (a) 1 2 (b) 2 3 (c) 6 7

9. The pressed-in type insert is usually held tightly in place by rolling or peening _____ of the insert after it has been installed. (a) under the botton (b) in the middle (c) over the top

10. After a new insert is installed the _____ surface is ground. (a) top (b) middle (c) seating

NO. 13 TEST

REPLACE VALVE SPRINGS AND GUIDES

TRUE - FALSE

T F 1. Some exhaust ports are cut short to reduce the tendency for carbon to accumulate on the guide.

T F 2. Most engines have separate valve guides of the press-in or slip-in type.

T F 3. Some engines are built with the valve stem in direct contact with a hole bored in the cylinder block.

T F 4. Valve springs do not receive the attention they deserve.

T F 5. "Keepers" is another name for valve spring locks.

MULTIPLE CHOICE

6. Valve spring locks are _____ shaped washers that fit into a slot cut near the end of the valve stem. (a) circle (b) C (c) moon

7. It is customary to fit the intake valve with _____ in clearance. (a) 0.01 to 0.03 (b) .001 to .003 (c) .0001 to .0003

8. It is customary to fit exhaust valves with _____ in clearance depending upon the size of the valve stem. (a) .002 to .004 (b) 0.02 to 0.04 (c) .0002 to .0004

9. Replace the valves when more than _____ in clearance exists between valve stem and guide. (a) 0.05 (b) .005 (c) .00005

10. There are _____ types of valve guides. (a) 4 (b) 3 (c) 2

NO. 14 TEST

ADJUST VALVE TIMING

TRUE - FALSE

T F 1. Valve timing refers to the exact times in the engine cycle at which the valves trap the gas mixture and then allows the burned gases to escape.

T F 2. Correct valve timing is obtained by the proper relationship between the camshaft and the crankshaft.

T F 3. The expression "timing the valves" of a gas engine applies to both the valves and the ignition.

T F 4. Timing marks by the manufacturer are on the fly wheel and the camshaft gear.

T F 5. The half-speed camshaft gear and the crankshaft gear are known as the timing gears.

MULTIPLE CHOICE

6. Timing is usually expressed in _____. (a) inches (b) degrees (c) pounds

7. When finding top dead center, stencil the letters _____ on the fly wheel rim. (a) T.D.G. (b) T.D.C. (c) T.T.D.

8. When determining the correct position of the camshaft, turn the fly wheel until the piston is at the _____ of the admission stroke. (a) middle (b) end (c) beginning

9. When the engine is in operation the top of the fly wheel rotates _____. (a) left to right (b) right to left (c) up and down

10. The instant of opening and closing of a valve is controlled by the position of the _____. (a) gear (b) cam (c) shaft

NO. 15 TEST

GRIND THE VALVES

TRUE - FALSE

T F 1. The hand lapping procedure has been modernized by the invention of machines.

T F 2. Valve stems are to be replaced if they are pitted or scored.

T F 3. Valve faces are cut at 45° angles with the stem.

T F 4. Modern grinding procedures are much faster and better than hand lapping.

T F 5. Valves that are too large will not dissipate enough heat to cool the engine.

MULTIPLE CHOICE

6. In the absence of factory specifications a valve seat _____ _____ of an inch in width is usually satisfactory. (a) one-sixteenth (b) one-sixth (c) one thirty-second

7. An _____ angle is cut under the valve seat if it is too wide. (a) right (b) acute (c) obtuse

8. The seat should be concentric with the guide within _____ of an inch. (a) .01 (b) .002 (c) .001

9. Valve faces usually have an angle of _____° with the stem. (a) 45 (b) 35 (c) 40

10. A camshaft turns _____ the speed of the crankshaft. (a) twice (b) half (c) equal

NO. 16 TEST

DETERMINE CAUSE OF ENGINE KNOCK OR PING

TRUE - FALSE

T F 1. Locating engine knock is not a difficult job.

T F 2. A rod in bad condition will be heard at all speeds.

T F 3. Slightly loose rods are sometimes confused with piston slap.

T F 4. A main bearing knock is loudest at idle speed.

T F 5. Crankshaft knock is sharper than fly wheel knock.

MULTIPLE CHOICE

6. A main bearing knock is loudest when the engine is _____.
(a) at idle speed (b) lugging (c) speeding

7. Loose fly wheel knock is similar to a _____ knock.
(a) piston ring (b) connecting rod (c) main bearing

8. One indication of piston slap is a _____ of the noise as the engine warms up. (a) picking-up (b) decrease (c) stopping

9. In piston ring noise the rings will click _____ times each revolution of the crankshaft. (a) 6 (b) 4 (c) 2

NO. 17 TEST

INSPECT SMALL GASOLINE ENGINES FOR REPAIRS

TRUE - FALSE

T F 1. Overheating is a cause for oil consumption.

T F 2. There is very little relation between oil consumption and overheating.

T F 3. A bad rod will make noises at all speeds.

T F 4. A main bearing knocks the loudest while the engine is idling.

T F 5. Excessive crankshaft play will make a noise that is duller than the sound of the fly wheel knock.

MULTIPLE CHOICE

6. If the fly wheel should be loose, the noise will be similar to the sound of a _____. (a) loose connecting rod (b) loose main bearing (c) loose piston pin

7. Excessive end crankshaft play will cause a noise that is _____ a loose main bearing or fly wheel. (a) duller than (b) more rapid than (c) sharper than

8. There is much confusion between the noise caused by a piston slap and _____. (a) loose connecting rod (b) loose main bearing (c) loose piston pin

9. One indication of piston slap is a _____ in the noise as the engine warms up. (a) decrease (b) clatter (c) increase

10. A common cause for hard to find engine knocks is _____ _____. (a) loose main bearings (b) improper alignment of connecting rods (c) worn timing gears

NO. 18 TEST

REMOVE AND REPLACE CAMSHAFT ASSEMBLY

TRUE - FALSE

T F 1. The location of the cams around the camshaft and the design of the camshaft determines the rotation of the engine.

T F 2. Cams are pinned to the camshaft.

T F 3. On a multiple cylinder engine there are as many cams as there are valves to be operated.

T F 4. The camshaft in its simplest form is a straight shaft with an eccentric lobe on it.

T F 5. The camshaft is located below the head on an overhead camshaft engine.

MULTIPLE CHOICE

6. A one cylinder, four-cycle, or poppet valve engine has ____ cams on it. (a) 1 (b) 4 (c) 2

7. Cams are located at different places around the _____ of the camshaft on a one cylinder engine of the four-cycle type with poppet valves. (a) area (b) meshed (c) perimeter

8. If there is an _____ gear interposed between the crankshaft gear and the camshaft gear then the camshaft will turn in the same direction as the crankshaft. (a) idler (b) elliptical (c) inclined

9. Camshafts are made of _____. (a) alloy (b) steel (c) zinc

10. The camshaft must be _____ and _____. (a) straight, true (b) hard, heavy (c) soft, oiled

NO. 19 TEST

REMOVE AND REPLACE THE CRANKSHAFT

TRUE - FALSE

T F 1. The crankshaft is often regarded as the backbone of an engine.

T F 2. Dynamic balance of the engine's crankshaft is obtained by centrifugal force.

T F 3. In order to obtain rotating balance the weight must be equal in all directions.

T F 4. A crankshaft is designed never to be rebuilt but to be replaced.

T F 5. Short crankshafts have more vibration than long ones.

MULTIPLE CHOICE

6. In order to obtain _____ balance the crankshaft must have counterweights. (a) static (b) rotating (c) dynamic

7. A connecting rod journal worn within _____ inches can be replaced without removing the crankshaft. (a) .015 (b) .0150 (c) .0015

8. Limits of the taper of the crankshaft journal should be held within _____ of an inch. (a) .010 (b) .001 (c) .020

9. If the shaft is badly worn but can be repaired it can be welded and then the journals/or journal can be _____ to the right size. (a) shimed (b) filed (c) machined or ground

10. _____ balance is attained when the rotation is equal in all directions. (a) Static (b) Dynamic (c) Rotating

NO. 20 TEST

ADJUST CRANKSHAFT END PLAY AND CHECK FOR WEAR

TRUE - FALSE

T F 1. The crankshaft is first balanced dynamically then balanced statically.

T F 2. Crankshafts are usually equipped with counterweights.

T F 3. Dynamic balance is obtained with the crankshaft rotating as it is being balanced.

T F 4. Crankshafts must be correctly proportioned.

T F 5. One bearing may operate with a smaller volume of oil than another.

MULTIPLE CHOICE

6. Non-bearing surfaces of the crankshaft are covered with a _____ coat of copper. (a) heavy (b) light (c) thin

7. Crankshafts are generally made of _____.
(a) alloy of steel (b) cast iron (c) hard steel

8. The engine crankshaft is called the _____ of the engine. (a) backbone (b) father (c) life

9. The crankshaft is mounted at the _____ of the engine.
(a) front right (b) left (c) rear

10. The function of the crankshaft is to convert the reciprocating motion of the _____ into rotary power. (a) valve (b) piston (c) crankshaft

NO. 21 TEST

REMOVE, REPLACE, AND FIT MAIN BEARINGS OR INSERTS

TRUE - FALSE

T F 1. A four cylinder engine has three main bearings.

T F 2. Modern boring equipment has insufficient accuracy to produce a 100% surface contact with each bearing in precise alignment with the other bearings.

T F 3. Inserts or shell type bearings require fitting by hand.

T F 4. If the crankshaft journal has been reduced in diameter so that standard undersize bearing will not fit, it is discarded.

T F 5. If true and intimate contact is not present between the inside of the bearing seat bore and the outside bearing shell, the heat will flow from the shell to the crankcase, or the connecting rod and bearing will melt.

MULTIPLE CHOICE

6. An adjustable bearing is usually provided with _____ shims on each side. (a) thick (b) two (c) thin

7. A skilled machinist can dress the bearing cap down with a _____. (a) mill (b) lathe (c) file

8. When all bearings are adjusted properly and the caps drawn tight, there should be _____ resistance toward the rotation of the crank. (a) little (b) no (c) some

9. One reason for bearing "crush" is to make sure that the bearing remains _____. (a) solid (b) round (c) elongated

NO. 22 TEST

MEASURE PISTON CLEARANCE

TRUE - FALSE

T F 1. There is only one way to resize pistons.

T F 2. There are two types of peening hammers.

T F 3. A piston will collapse if it is overheated.

T F 4. Oil pumping is a result of oil passing up through the rings.

T F 5. The piston is serrated sometimes to lessen the possibility of the piston scoring the cylinder wall.

MULTIPLE CHOICE

6. Constant clearing is obtained by cutting a _____ slot in the skirt of the piston. (a) horizontal (b) vertical (c) diagonal

7. All piston clearance recommendations are made for use with the temperature about _____°. (a) 70 (b) 80 (c) 90

8. It is customary to fit solid cast iron skirts to about _____ or _____ inch per inch of diameter. (a) .000075 - .001 (b) .00075 - .001 (c) .0000065 - .00001

9. A four inch piston will be about _____ inches smaller than the cylinder bore. (a) 0.04 - 0.03 (b) .0004 - .00003 (c) .004 - .003

NO. 23 TEST

REPLACE PISTONS

TRUE - FALSE

T F 1. Aluminum pistons are now often used in engines.

T F 2. A groove is cut into a piston skirt to reduce heat.

T F 3. Alloy pistons never have split skirts.

T F 4. The slots are cut on the thrust side of the piston.

T F 5. When installing a piston, never strike it in any way.

MULTIPLE CHOICE

6. The _____ thrust side of the piston is the side opposite the crank throw. (a) minor (b) power (c) major

7. _____ clearance must be given for heavy duty pistons than for light duty pistons. (a) Same (b) More (c) Less

8. The piston transforms heat energy into _____ energy. (a) chemical (b) mechanical

9. The advantage of _____ pistons is that they expand at the same speed as the cylinder thus allowing for minimum clearance. (a) cast iron (b) aluminum alloy (c) semi-steel

10. A weight moving up and down at high speed requires a very great force to stop it and a very great force to start it because of its _____. (a) weight (b) inertia (c) speed

NO. 24 TEST

INSTALL PISTON PINS

TRUE - FALSE

T F 1. The anchor piston pin is clamped in the rod with the pin oscillating in the piston.

T F 2. Piston pins are also known as gudgeon pins.

T F 3. One of the problems faced by the designers of the piston pins is its size.

T F 4. In order for the piston rod clamp hole to accept an oversized piston pin it must be enlarged.

T F 5. When replacing bushings in a piston it is extremely important to avoid hammering as the piston can be easily distorted by rough treatment.

MULTIPLE CHOICE

6. A _____ pin is anchored to the connecting rod and turns in the piston pin bosses. (a) anchored (b) full-floating (c) semi-floating

7. Piston pins are sometimes _____ _____ to increase their wearing ability. (a) chrome plated (b) nickel plated (c) zinc plated

8. Another name for the full floating pin is the _____ pin. (a) engine (b) plain (c) piston

9. There are _____ types of pistons. (a) two (b) three (c) four

NO. 25 TEST

INSTALL PISTON RINGS

TRUE - FALSE

T F 1. The compression pressure can go past the ring in several ways. This is known as blow-by.

T F 2. It is easier for oil to pass upward in some cases than it is for compression to leak down past the rings.

T F 3. The top piston ring will need less gap clearance than the other rings.

T F 4. In case specific clearance dimensions are not available it is customary to allow .004 in. on the top ring gap, and .0036 on the rest of the rings.

T F 5. The depth of the ring groove need not be checked when replacing rings.

MULTIPLE CHOICE

6. In the absence of specific instructions it is best to allow for _____ of an inch clearance for the top ring. (a) .025 (b) .002 (c) .0025

7. A four inch bore will require a _____ inch gap on the top ring. (a) .012 (b) .016 (c) .009

8. In bores that are out-of-round the _____ _____ should be used. (a) wide channeled oil rings (b) fitted oil rings (c) flexible rings

9. Great care should be given to the fitted rings as far as _____ is concerned. (a) end (b) sidewise (c) bore

10. Oil rings can _____ be mounted in the same position as they were while in the engine. (a) frequently (b) never (c) seldom

NO. 26 TEST

REPAIR COOLING SYSTEM

TRUE - FALSE

T F 1. Minor accumulations of scale and lime may be caused by prepared chemicals.

T F 2. The main objection to the use of water is that it has a high freezing characteristic.

T F 3. The water is pumped from the engine to the radiator bottom and up through the whole radiator.

T F 4. When the engine is cooled, the thermostat is closed and when it is hot the thermostat will open.

T F 5. Ethylene glycol has a low boiling point and it evaporates if it is heated.

MULTIPLE CHOICE

6. A _____ radiator consists of vertical water tubes with air fins. (a) circulating (b) tubular (c) cellular

7. The _____ regulates the engine temperature, and automatically controls the amount of water to pass through the radiator and engine. (a) hydrometer (b) volvometer (c) thermostat

8. _____ _____ has a high boiling point and is called antifreeze. (a) Glycerin (b) Ethylene glycol (c) Ethyl alcohol

9. The freezing point of antifreeze is shown by a _____. (a) hydrometer (b) volvometer (c) thermostat

10. After an inhibitor is placed in a vehicle the radiator should be flushed in about _____ _____. (a) one year (b) six weeks (c) six months

NO. 27 TEST

REMOVE AND REPLACE THE FLYWHEEL

TRUE - FALSE

T F 1. The flywheel in most small engines acts as a housing for the magneto.

T F 2. Flywheels employed on small engines are made of steel.

T F 3. Inertia forces are a cause of vibration.

T F 4. Oil seals are placed at the main bearings to prevent the loss of engine lubrication.

T F 5. Main bearings may be lubricated with the crankcase oil.

MULTIPLE CHOICE

6. Torsional vibration is a _____ rotation. (a) pulling (b) turning (c) twisting

7. Vibration dampers are divided into _____ classes. (a) 2 (b) 3 (c) 6

8. The harmonic balancer has a flywheel or inertia weight mounted with _____. (a) coil springs (b) leaf springs (c) bolts

9. _____ balance means balance while the engine or crankshaft is turning. (a) Static (b) Dynamic (c) Magneto

10. When number ____ cylinder fires, it has a tendency to turn the front end of the crankshaft very rapidly. (a) 1 (b) 2 (c) 3

NO. 28 TEST

LUBRICATE THE ENGINE

TRUE - FALSE

T F 1. S.A.E. has nothing to do with oil.

T F 2. S.A.E. 10-W will not have the fluidity of S.A.E. 10 at low temperatures.

T F 3. Manufacturers' recommendations of the oil to be used is based upon temperature and specifications.

T F 4. A "pour point depressant" additive is intended to retard deterioration of the oil.

T F 5. Most of the wear in an engine often occurs after it has been run a long period of time.

MULTIPLE CHOICE

6. _____ lubrication is used under direct pressure of the main bearings of the engine. (a) Splash (b) Combination (c) Forced

7. _____ type oil pumps force oil into the pump cavity and into oil passages. (a) Vane (b) Gear (c) Plunger

8. _____ additive is used to prevent oil sludge. (a) Inhibitor (b) Pour point depressant (c) Dispersive

9. Two stroke engines use the _____ type of lubrication. (a) oil feed with fuel (b) forced lubrication (c) splash lubrication

10. High temperatures promote _____ of lubricating oil. (a) consolidation (b) oxidation (c) evaporation

NO. 29 TEST

ADJUST THE GOVERNOR

TRUE - FALSE

T F 1. A governor is an automatic device linked to a throttle lever and actuated by the speed of the engine.

T F 2. There is no danger to engine parts from excessive speeds.

T F 3. The mechanical governor is operated by centrifugal force acting on rotating weights.

T F 4. Governors are used on two-cycle engines only.

T F 5. There are several ways to find the proper setting on the governor.

MULTIPLE CHOICE

6. A mechanical governor is sometimes called _____.
(a) centrifugal governor (b) vacuum (c) velocity governor

7. The purpose of the governor is to _____.
(a) keep engine clean (b) regulate speed (c) prevent engine from stalling

8. A vacuum governor is actuated by _____ _____.
(a) exhaust manifold pressure (b) engine temperature
(c) intake manifold pressure

9. There are ____ types of governors. (a) 3 (b) 2 (c) 4

10. Governors are classified by _____ _____ _____.
(a) year invented (b) rpm they allow (c) their method of operation

NO. 30 TEST

TUNE THE ENGINE

TRUE - FALSE

T F 1. A condenser of wrong capacity will cause pitting of contact points.

T F 2. When servicing spark plugs, examine firing ends of plugs for evidence of oil fouling, gas fouling, or over-heated condition.

T F 3. All engines sometimes develop trouble.

T F 4. Most failures in a new engine are because of the manufacturer.

T F 5. Most small gas engines have magnetos.

MULTIPLE CHOICE

6. The purpose of a "tachometer" is to _____.
(a) register torque (b) register rpm's (c) measure engine horsepower

7. Streamlining of exhaust manifolds is commonly called _____. (a) porting (b) boring (c) relieving

8. An over-rich mixture of fuel and air will cause _____ _____. (a) hard starting (b) popping back through carburetor (c) spark plugs to be fouled

9. When adjusting valves we must _____.
(a) adjust them with no clearance (b) follow our ears and how engine runs (c) use manufacturer's specs

NO. 31 TEST

REPAIR CYLINDER BLOCK

TRUE - FALSE

T F 1. The compression thrust acts on one side of the cylinder and the power thrust works on the other.

T F 2. Honing will remove all scratches or gouges in the cylinder.

T F 3. A cylinder will normally wear in a circle and will never need to be repaired.

T F 4. Compression thrust wear is usually more than power thrust wear.

T F 5. A cylinder can be elliptical if the piston is just as elliptical, as long as they will match.

MULTIPLE CHOICE

6. The main purpose of a hone is to _____. (a) remove all gouges and scratches (b) remove just the deepest scratches (c) remove small scratches and prepare the cylinder

7. Grinding can be done by _____. (a) anyone with an electric grinder (b) shops that have the proper tools and specifications (c) only factories

8. Before using boring bar the head or block surface must be _____. (a) filed to prepare the surface and cleaned (b) oiled (c) steam cleaned

9. A reamer has _____. (a) coarse sandpaper blades (b) a number of cutting blades (c) a number of grinding edges

10. A reamer is _____. (a) needed often (b) needed only for four-cycle engines (c) is self aligning

NO. 32 TEST

BORE CYLINDERS OVERSIZE

TRUE - FALSE

T F 1. A lathe cut is as smooth as a cut made by grinding the cylinder.

T F 2. A reamer consists of two cutting blades mounted radially in a substantial body.

T F 3. A very small amount of metal can be removed from the cylinder wall by lapping as the operation is very tedious.

T F 4. Sleeves should be checked to make sure of roundness, straightness, and smoothness.

T F 5. Honing is performed by a tool which consists of a cylindrical frame having mounted grinding stones.

MULTIPLE CHOICE

6. Lapping is a form of _____. (a) grinding (b) honing (c) reaming

7. There are _____ methods used for reconditioning cylinders. (a) 5 (b) 4 (c) 6

8. The holding tool is placed _____ into the cylinder bore next to the one that is going to be worked on. (a) endwise (b) crosswise (c) lengthwise

9. The _____ of the cylinder block should be filed off to remove any dirt. (a) bottom (b) middle (c) top

NO. 33 TEST

RECONDITION A DAMAGED CRANKSHAFT

TRUE - FALSE

T F 1. Counterweights are used on crankshafts to prevent vibration.

T F 2. Typical two cylinder crankshafts are used in West Bend engines.

T F 3. The crankshaft is often regarded as the backbone of the engine.

T F 4. The function of a crankshaft is to convert the reciprocating motion of the piston and connecting rod into rotary motion and to transmit the resulting torque to the flywheel and clutch.

T F 5. Case-hardening is done by putting the crankshaft in a carburizing oven.

NO. 34 TEST

REPLACE THE CARBURETOR

TRUE - FALSE

T F 1. When an internal combustion engine is started it is cold, and a fuel mixture containing a larger portion of fuel is required.

T F 2. For quick acceleration and maximum power a mixture of one part by weight of gasoline to between 16 to 17 parts of air is needed.

T F 3. In some carburetors, double or triple venturi tubes are used in order to get maximum suction on the fluid tube or jet.

T F 4. The standardized method of measuring or determining vapor pressure in the laboratory is known as the Reid Method.

T F 5. A disadvantage of the downdraft carburetor is that it must lift the fuel by air friction.

MULTIPLE CHOICE

6. The first type of carburetor to come into general use was the _____. (a) crossdraft (b) updraft (c) downdraft

7. To overcome the limitations of the _____ carburetor, the downdraft unit was developed. (a) crossdraft (b) Zenith (c) updraft

8. For normal operating conditions, the best economy is obtained by a mixture of one part by weight of gasoline to between _____ parts of air. (a) 15 to 16 (b) 16 to 17 (c) 17 to 18

9. There are _____ adjustments to the typical air valve carburetor. (a) 3 (b) 4 (c) 2

10. The recommended solvent for gum deposits is _____ alcohol. (a) ethyl (b) propyl (c) denatured

NO. 35 TEST

REPLACE THE CARBURETOR FLOAT

TRUE - FALSE

T F 1. The level of the fluid in the chamber which supplies the carburetor jet must remain substantially constant and in general slightly below the top or outlet of the jet.

T F 2. In recent designs the float needle valve is mounted on top the float with a conical seat directly above.

T F 3. In the float feed method of maintaining a constant level of gasoline in the receiving chamber, a cork or hollow metal float is placed in the float chamber.

T F 4. The upflow method is similar to the downflow method except that it is arranged to admit the gasoline at the bottom of the float chamber.

T F 5. The float level adjustment should be such that the liquid level will be as near the top of the nozzle as possible without overflowing.

MULTIPLE CHOICE

6. If the level of the fluid in the chamber which supplies fuel to the carburetor jet is too _____ the velocity of the air stream would have to be increased in order to draw a given amount of fuel. (a) slow (b) high (c) low

7. The bowl is always _____ to atmospheric pressure in both types of float systems. (a) immune (b) closed (c) open

8. The removable drain plug at the bowl bottom is provided for _____. (a) emergency (b) flushing (c) convenience

9. The fuel level must be properly maintained to keep the _____ correct for the calibrated operation of the other carburetor systems. (a) float (b) pressure (c) choke

10. All float type carburetors will become _____ if inverted. (a) inoperative (b) sluggish (c) hot

NO. 36 TEST

ADJUST FUEL AND AIR MIXTURE

TRUE - FALSE

T F 1. Air and fuel are drawn through the carburetor by suction.

T F 2. A venturi tube consists of three tubes.

T F 3. Suction is measured with a vacuum gauge.

T F 4. The rates of delivery of the fuel and air are the same.

T F 5. For idling, a simple carburetor will produce a too lean mixture.

MULTIPLE CHOICE

6. For normal operating conditions the best economy is obtained by a mixture of 1 part gasoline to _____ parts air. (a) 12-13 (b) 10-14 (c) 16-17

7. When starting a cold engine a _____ mixture is needed. (a) rich (b) lean (c) normal

8. As soon as the throttle is opened wide the suction above the throttle _____. (a) increases (b) decreases (c) remains the same

NO. 37 TEST

ADJUST THE CARBURETOR

TRUE - FALSE

T F 1. If the engine has an excessive amount of blow-by it will affect carburetor operation.

T F 2. Using a vacuum gauge in the carburetor test is the most accurate method.

T F 3. Backfiring in the engine will cause black carbon deposits in the venturi area of the carburetor.

T F 4. Manufacturers' specifications are not always used when adjusting the carburetor.

T F 5. Needle valves should never be closed extremely tight because too much pressure may cause damage to the tip.

MULTIPLE CHOICE

6. Adjustments made on the carburetor of an engine which has a gravity fuel tank should be made only with a _____ tank of fuel. (a) half (b) full (c) empty

7. When adjusting the carburetor the engine should be operating at _____ temperature. (a) high (b) low (c) normal

8. When adjusting the carburetor always have the choke _____. (a) closed (b) open (c) half open

9. When adjusting the carburetor always _____. (a) close everything (b) use proper specifications (c) use a knife

10. For properly adjusting the carburetor the engine should be in _____ shape. (a) poor (b) any (c) good

NO. 38 TEST

CARBURETOR TROUBLE SHOOTING

TRUE - FALSE

T F 1. Complete failure of the engine to operate originates in the carburetor.

T F 2. When the engine is hot the choke is closed.

T F 3. It is important to make sure that the nuts holding the carburetor to the manifold are tight.

T F 4. Possible causes of poor performance are all from incorrect float level.

T F 5. Defective gaskets in the carburetor can cause carburetor flooding.

MULTIPLE CHOICE

6. The gum found on the inside and outside of the carburetor is caused by _____ fuel. (a) hot (b) cold (c) dry

7. When the engine does not start or operate efficiently, it is advisable to check the _____. (a) fuel pump (b) ignition (c) carburetor

8. One of the remedies for _____ is to disassemble the carburetor and clean all parts. (a) flooding (b) too lean of an adjustment (c) worn valves

9. Loose jets in the carburetor can cause _____. (a) poor performance (b) carburetor flooding (c) poor idling (d) all of these

10. When the engine is performing poorly from a too rich mixture and you have to remove the air cleaner and clean it and replace the oil with _____. (a) SAE 30 (b) SAE 40 (c) SAE 50

NO. 39 TEST

FUNDAMENTALS OF ELECTRICITY

TRUE - FALSE

T F 1. A knowledge of the fundamentals of electricity and magnetism is not important in order to understand the operation and servicing of engines.

T F 2. The neutron is a small positive charge of electricity.

T F 3. Any one basic material is composed of one kind of atoms.

T F 4. An object with more than its normal number of electrons is described as being postively charged.

T F 5. The opposition to the flow of current is known as resistance and is measured in ohms.

MULTIPLE CHOICE

6. At present, there are ____ different known elements. (a) 107 (b) 98 (c) 83

7. An object with more than its normal number of protons is described as being _____ charged. (a) magnetically (b) negatively (c) positively

8. In the _____ circuit, the current flowing will be the same at all points throughout that circuit and the total resistance in the circuit will be the sum of the resistances of each individual part. (a) parallel (b) series parallel (c) series

9. The electrical unit for measuring work is known as the _____. (a) Joule (b) ohm (c) ampere

10. _____ electrical current is produced when the voltage and amperage of a primary current have been changed by an induction coil. (a) primary (b) alternating (c) secondary

NO. 40 TEST

MAGNETISM

TRUE - FALSE

T F 1. Without magnetism there would be no generators or motors.

T F 2. Unlike poles of a magnet repel each other.

T F 3. The magnetic lines of force will not penetrate through all non-magnetic materials and substances.

T F 4. It is believed that most substances do not show magnetic properties because the orbits of the various electrons are so arranged that magnetic fields cancel each other.

T F 5. Current carrying conductors will always move away from a strong magnetic field into a weaker field.

MULTIPLE CHOICE

6. In a _____ the movable core will have a south pole next to the north pole of the coil. (a) magnetic field (b) electro-magnet (c) solenoid

7. When a magnet is cut the ends _____ to the cut will have poles opposite to the poles at the other ends of the magnet. (a) opposite (b) adjacent (c) parallel

8. The _____ greatly increases the strength of the solenoid. (a) current (b) coil (c) core

9. A/an _____ is made up of an iron core over which is wound a number of turns of insulated wire. (a) solenoid (b) permanent magnet (c) electro-magnet

10. When current is flowing in the same direction in two _____ conductors the right hand rule of current flow will show that the current lines of force between the two conductors are in opposite directions. (a) parallel (b) adjacent (c) opposite

NO. 41 TEST

REPLACE THE GENERATOR

TRUE - FALSE

T F 1. The generator system is used to restore the supply of electrical energy used for the car.

T F 2. Most automotive generators are the shunt wound type with an outside means of regulating the voltage output.

T F 3. The voltage current regulator controls the amount of current the battery produces.

T F 4. Shorts or grounds occurring in the charging circuit or reverse polarity conditions of the generator can cause the output relay points to weld together.

T F 5. The current and voltage regulators both operate at the same time.

MULTIPLE CHOICE

6. The _____ regulator has a bi-metal armature hinge for the thermostatic temperature control. (a) current (b) voltage (c) cutout

7. All regulators have a _____ in the generator charging circuit. (a) thermostat (b) spring (c) fuse

8. In the _____ generator, it will be noted that instead of both terminals of the shunt field windings being connected directly to the brushes, one end of the field winding is connected to the third brush, while the other end of the field winding is connected to the (-) main brush in the usual manner. (a) shunt type (b) third brush (c) interpole

9. Because of the wide range of speeds under which a generator operates, a _____ generator would not have satisfactory voltage characteristics. (a) shunt type (b) third brush (c) interpole

10. When servicing the generator, if the brushes are worn down to _____ their original length they should be replaced. (a) one-third (b) one-half (c) two-thirds

NO. 42 TEST

TEST AND SERVICE THE GENERATOR

TRUE - FALSE

T F 1. High resistance is frequently the underlying cause of many electrical difficulties.

T F 2. All checks for electrical resistance should be made while the engine is not running.

T F 3. Whenever the starter, generator, or voltage regulator requires servicing, the wiring circuit should be checked for loose or defective connections and frayed or damaged wires.

T F 4. Emery cloth should never be used on a commutator.

T F 5. If the commutator is rough or pitted the generator should be replaced.

MULTIPLE CHOICE

6. The battery should be checked with a _____ to establish its specific gravity. (a) ammeter (b) voltmeter (c) hydrometer

7. The _____ should be connected with short leads between the B, terminal of the voltage regulator and its base ground screw. (a) ammeter (b) hydrometer (c) voltometer

8. If the commutator is rough and pitted the generator should be disassembled and the commutator turned on a lathe. In addition the mica should be undercut so that it is _____in. below the surface of the commutator bars. (a) 1/64 (b) 1/12 (c) 1/32

9. When checking for resistance an accurately calibrated voltmeter with 10 volt scale graduated in _____ volt division or a milli-volt meter of 500 M.V. range. (a) 1.0 (b) 0.1 (c) 10.0

10. When checking for resistance, if no reading can be obtained on the _____ clean and tighten all ground connections, especially the generator frame bracket where it is bolted to the engine and the battery ground strap. (a) hydrometer (b) voltmeter (c) ammeter

NO. 43 TEST

ADJUST GENERATOR RELAYS

TRUE - FALSE

T F 1. A voltmeter is needed to check the voltage when the points of the cut-out relay close.

T F 2. You can usually use your own judgement when making adjustments on the cut-out relay.

T F 3. The air gap on the generator is adjusted by bending the upper armature connection.

T F 4. The generator is always charging the battery.

T F 5. When resurfacing and leveling the contact points emery paper should never be used.

MULTIPLE CHOICE

6. The cut-out relay has a series of current windings of a few turns of _____ wire. (a) fine (b) bare (c) heavy

7. When the generator slows to engine idling speed or stops, current begins to flow from the battery back through the generator _____ the current flow through the series winding. (a) increasing (b) reversing (c) decreasing

8. When the generator begins to operate, voltage builds up and forces current through the _____ winding, thereby magnetizing the core. (a) series (b) armature (c) shunt

9. Cut-out relay has _____ windings assembled on a single core. (a) two (b) three (c) four

10. When the generator builds up sufficient voltage to charge the battery the current flowing through the windings of the cut-out relay will produce sufficient _____ to pull the armature toward the relay core. (a) current (b) voltage (c) magnetism

NO. 44 TEST

SERVICE THE STARTING MOTOR

TRUE - FALSE

T F 1. The cranking motor is a special type motor designed to operate under a light load.

T F 2. A starter motor should not be used more than 30 seconds at a time.

T F 3. The principle of operation of a starter motor is based on the fact that unlike magnetic fields tend to attract each other and magnetic fields of like polarity tend to repel each other.

T F 4. If the commutator is dirty it should be cleaned with a strip of No. 00 sandpaper, which is held against the commutator while the armature is rotating.

MULTIPLE CHOICE

5. A starting motor should not be used for more than _____ at a time. (a) 2 minutes (b) 30 seconds (c) 1 hour

6. Magnetic fields of the same polarity will _____ each other. (a) attract (b) magnetize (c) repel

7. Mica on starting motors should be undercut _____ inches. (a) 1/14 (b) 1/32 (c) 1/12

8. If brushes are worn more than _____their length, they should be replaced. (a) 2/3 (b) 1/2 (c) 1/4

9. Each time an open-circuited bar passes under a brush, severe arcing will occur so that the commutator bar will be badly _____. (a) distorted (b) burnt (c) pitted

NO. 45 TEST

REPLACE IGNITION COIL

TRUE - FALSE

T F 1. The primary winding of the coil is made up of approximately 200 turns of fine wire.

T F 2. The ignition coil has the secondary winding wound around the soft iron core and the primary winding around the secondary.

T F 3. Many coils have their windings immersed in oil.

T F 4. The purpose of the core is to generate emf.

T F 5. When the ignition switch is closed and the distributor contact points are closed, the current flows through the primary winding of the ignition coil.

MULTIPLE CHOICE

6. The secondary winding consists of _____ to _____ turns of fine wire. (a) 20,000 - 30,000 (b) 10,000 - 15,000 (c) 10,000 - 20,000

7. Sufficient voltage to jump a spark plug gap is _____ to _____ volts. (a) 8,000 - 12,000 (b) 6,000 - 8,000 (c) 5,000 - 8,000

8. A single snap-in fitting is provided for the _____ wire that carries current to the distributor. (a) secondary (b) core (c) primary

9. The primary winding of the ignition is made of several hundred turns of _____ wire. (a) heavy (b) fine (c) insulated

10. The secondary output approximately _____ the primary output. (a) doubles (b) equals (c) triples

NO. 46 TEST

REPLACE IGNITION DISTRIBUTOR

TRUE - FALSE

T F 1. On a two-cycle engine the distributor shaft will revolve at 1/2 the speed of the crankshaft.

T F 2. A semi-charged battery will have sufficient voltage for ignition purposes.

T F 3. Adjustment of the contact points has a definite effect on secondary current strength.

T F 4. The current flows in the coil primary winding only when the distributor points are opened.

T F 5. The cam angle has a direct bearing on the capacity of the condenser.

MULTIPLE CHOICE

6. The _____ is located on the distributor shaft and driven indirectly by the engine crankshaft. (a) breaker points (b) rotor (c) cam

7. Ordinarily the cam will have as many lobes as the engine has _____. (a) spark plugs (b) gears (c) cylinders

8. The second function of the distributor is to conduct the high voltage surges from the _____ winding of the ignition coil to the proper spark plug at the correct time. (a) primary (b) secondary (c) coil

9. The cam and the rotor must be driven by the _____ shaft to synchronize their operation. (a) crank (b) distributor (c) cam

10. Most data tables specify breaker arm spring tension as _____ ozs. (a) 15-20 (b) 25-30 (c) 17-20

NO. 47 TEST

SERVICE THE IGNITION DISTRIBUTOR

TRUE - FALSE

T F 1. Proper service of the distributor is impossible without the use of an ignition test stand.

T F 2. Contact gap must be correct to obtain desired cam dwell and coil saturation.

T F 3. The length of time that the current flows in the coil has a direct effect upon the value of the spark at the spark plugs.

T F 4. The manufacturer's specifications need not always be followed when adjusting contact points.

T F 5. If contact points do not appear to be smooth and bright they should be replaced.

MULTIPLE CHOICE

6. If the points become pitted or burned in operation, rub lightly with a dry _____. (a) chamois (b) oilstone (c) rag

7. With possible exception of the _____, the distributor is probably the one most difficult part of an engine to service properly. (a) pistons (b) valves (c) carburetor

8. Dwell angle is the angle of _____ rotation through which the distributor points remain closed. (a) crankshaft (b) point (c) cam

9. The _____ automatic spark advancement control is a two-flyweight governor with springs mounted on the shaft below the breaker plate. (a) centrifugal (b) vacuum brake (c) vacuum advance

10. A _____ control is usually adjusted, by altering spring tension with adjusting nut or by resetting spring anchor posts. (a) automatic (b) centrifugal (c) vacuum

NO. 48 TEST

REPLACE THE CONDENSER

TRUE - FALSE

T F 1. The induced current in the secondary winding does not exceed 20,000 volts.

T F 2. After the spark occurs at the spark plug the condenser discharges back into the primary circuit.

T F 3. Condenser capacity is measured in micro-farads.

T F 4. If metal transfers from the negative to the positive point it indicates a condenser of excess capacity.

T F 5. The capacity of the condenser depends entirely upon the area of the plates in the condenser.

MULTIPLE CHOICE

6. The condenser provides a quick exit for the induced high tension current in the low tension winding and provides a storage tank in which to hold this induced current momentarily while the _____ discharges to the spark plug. (a) secondary (b) primary (c) coil

7. After the spark occurs at the spark plug the condenser discharges back into the _____ circuit. (a) secondary (b) breaker (c) primary

8. If metal transfers from the negative to the positive contact it indicates a condenser with _____ capacity. (a) insufficient (b) excess (c) normal

9. Ignition condensers are usually manufactured in the range of _____ micro-farads. (a) 0.15-03.0 (b) 0.05-0.30 (c) 0.15-0.30

10. When measuring the capacity of a condenser, the _____ the insulation for a given area of foil the greater the capacity. (a) heavier (b) thinner (c) thicker

NO. 49 TEST

ADJUST CONTACT POINTS

TRUE - FALSE

T F 1. The only service the contact points perform is to open the primary circuit and cause a high voltage spark.

T F 2. The manufacturer's specifications should always be followed when adjusting breaker contacts.

T F 3. If contact points are set too close, it will cause ignition failure at high speeds.

T F 4. If contact points do not appear to be smooth and bright they should always be replaced.

T F 5. Points can be dressed with a clean ignition file without removing them from the distributor.

MULTIPLE CHOICE

6. If the points become pitted or burned in operation, they should be rubbed lightly with a dry _____. (a) rag (b) oilstone (c) file

7. Oxidized contact points may be caused by _____ resistance. (a) no (b) low (c) high

8. Most data tables specify breaker arm spring tension between _____ ozs. (a) 15-20 (b) 20-25 (c) 17-20

9. Dwell angle is the angle of _____ rotation through which the distributor points remain closed. (a) point (b) cam (c) crankshaft

10. The points must remain closed long enough to insure saturation and build-up of the _____ coil. (a) induction (b) secondary (c) ignition

NO. 50 TEST

REPLACE THE MAGNETO

TRUE - FALSE

T F 1. A magneto is a compact combination of a generator, ignition coil, and distributor.

T F 2. Magneto ignitions are used on internal combustion engines.

T F 3. Electrical energy in magneto ignition is obtained by a generator utilizing the principle of electro-magnet induction to produce electricity.

T F 4. The rotating magnet principle of magnetos is now most commonly used.

T F 5. Some engines have both magneto and battery ignition available.

MULTIPLE CHOICE

6. High tension magnetos produce voltage of _____ value to jump the spark plug gap without any external coil. (a) excessive (b) sufficient (c) insufficient

7. The recent development of permanent magnets of greatly increased strength has materially _____ their performance. (a) ruined (b) decreased (c) increased

8. In the magneto, the magnetic field is produced by _____. (a) generators (b) electricity (c) magnets

9. Magnetos which have the windings on an armature which is revolved in a magnetic field are known as _____ magnetos. (a) shuttle wound (b) inductor (c) revolving magnet

10. In the _____ type magneto, both the coil and the magnet are mounted in stationary positions. (a) shuttle wound (b) inductor (c) revolving magnet

NO. 51 TEST

REPLACE A ROTATING MAGNET MAGNETO

TRUE - FALSE

T F 1. The introduction of more powerful magnets made possible the design of the rotating magnet magneto.

T F 2. In the rotating magnet design, the coil, condenser, and the breaker points are stationary.

T F 3. The current induced in the secondary winding produces a magnetic field which surrounds the primary winding.

MULTIPLE : CHOICE

4. The self-induced voltage produced in the primary winding is absorbed by the _____. (a) magneto (b) condenser (c) coil windings

5. The American Bosch magneto ball bearings are packed in _____. (a) high temperature grease (b) insulation (c) oil

6. High tension current is produced in the _____. (a) primary winding (b) condenser (c) secondary winding

NO. 52 TEST

ADJUST MAGNETO SPARK ADVANCE

TRUE - FALSE

T F 1. Breaker points on a low tension magneto cannot be connected in series with the armature winding.

T F 2. High tension magnetos are provided with a safety gap.

T F 3. In the rotating magnet magneto the coil, breaker points and the condenser are stationary.

T F 4. The current induced in the secondary winding produces a magnetic field around the primary winding.

MULTIPLE CHOICE

5. No external ignition _____ is used on the high tension magneto. (a) switch (b) wire (c) coil

6. When one ____ of the magnetic circuit field is broken, the magnetic flux in the coil alternates from maximum to minimum. (a) wire (b) coil (c) leg

7. In the American Bosch magneto the _____ are rotated. (a) magnets (b) coil winding (c) bushings

8. Outward movement of the pawls is transferred by _____ t the breaker camshaft. (a) tubing (b) linkage (c) coil

NO. 53 TEST

INSTALL, SERVICE, AND ADJUST SPARK PLUGS

TRUE - FALSE

T F 1. The spark plug consists of a central electrode which is connected to the induction coil secondary through the distributor.

T F 2. Many spark plug insulators were formerly made of porcelain.

T F 3. Spark plug gaps must be set very carefully in accordance with the manufacturer's specifications.

T F 4. Spark plugs with short paths for the heat to travel are known as hot plugs.

T F 5. The tip of the spark plug is a good indicator of an engine's condition.

MULTIPLE CHOICE

6. Spark plugs come in a variety of _____. (a) gauges (b) sizes and lengths (c) colors

7. Spark plugs which have black carbon deposits on the insulators are _____. (a) only turning black from intense heat (b) black because they are cold (c) leaking and releasing engine compression

8. Many times a spark plug will fire at normal atmospheric pressure but will not fire when under _____. (a) water (b) a big strain (c) compression such as may be found in the engine

9. When a spark plug is replaced we should also replace the _____. (a) wire (b) gasket (c) insulator

10. Never use pliers to remove a _____. (a) spark plug (b) insulator (c) electrode

NO. 54 TEST

INSPECT AND REPAIR LAWN MOWER
COOLING SYSTEM

TRUE - FALSE

T F 1. All air cooled engines use fans.

T F 2. Most air cooled engines of the multiple cylinder type use fans.

T F 3. Fans are usually mounted on the flywheel.

T F 4. The fins on an air cooled engine help to dissipate heat.

T F 5. Both two and four stroke cycle engines can use air cooling.

MULTIPLE CHOICE

6. Air cooled engines use _____ to radiate heat.
(a) baffles (b) cowls (c) fins

7. The fins on an air cooled engine must be kept _____.
(a) oiled (b) clean (c) covered

8. One type of air cooling system is the _____.
(a) oiled air cleaner (b) open draft (c) water cooling

9. Any _____ will contribute to the convection cooling.
(a) breeze (b) lubricant (c) enclosure

10. Air cooled engines have large _____ cast integrally with the cylinder head or block. (a) water passages (b) fans (c) fins

NO. 55 TEST

LUBRICATE A LAWN MOWER

TRUE - FALSE

T F 1. Ice is a lubricant.

T F 2. S.A.E. stands for System of Automobile Engineers.

T F 3. Oil is not usually made to withstand heat.

T F 4. The quality of the oil is never indicated by a S.A.E. number.

T F 5. Lawn mowers can have either two or four-cycle engines.

MULTIPLE CHOICE

6. Four-cycle engines have a crankcase which holds _____.
(a) fuel (b) oil (c) water

7. Engine crankshafts sometimes _____ oil. (a) splash
(b) ruin (c) waste

8. The _____ is an important part of the oil system.
(a) oil filter (b) timing chain (c) valve lifters

9. Oil strainers are usually made of _____. (a) glass
(b) porcelain (c) screen wire

10. _____ of the oil in the crankcase is an indication of trouble. (a) burning (b) foaming (c) pumping

NO. 56 TEST

SERVICE LAWN MOWER CLUTCHES

TRUE - FALSE

T F 1. Friction clutches are a part of a gas engine.

T F 2. The drive member is not attached to the engine.

T F 3. Drive members are made of cast iron plates.

T F 4. When the clutch is disengaged, there is no connection between the engine and the drive shaft.

T F 5. The friction plate is sometimes called a disc.

MULTIPLE CHOICE

6. A clutch is a device for connecting and disconnecting two pieces of shafting in _____ lines. (a) vertical (b) the same (c) parallel

7. Any clutch construction contains _____ principal elements. (a) 2 (b) 3 (c) 5

8. The drive members usually consist of two _____ plates ground to a smooth finish. (a) steel (b) aluminum (c) cast iron

NO. 57 TEST

OUTBOARD MOTOR FUNDAMENTALS

TRUE - FALSE

T F 1. These four terms are interrelated: watt, volt, OHM, and ampere.

T F 2. All but the smaller motors use remote fuel tanks.

T F 3. The modern ignition system is a strong electric current.

T F 4. In a scavenged engine, parts requiring lubrication are located in the fuel exhaust system.

T F 5. The diesel cycle is the same as the Otto cycle.

MULTIPLE CHOICE

6. _____ is the unit of measurement used to designate the resistance of an electrical current. (a) OHM (b) watt (c) ampere

7. The function of the carburetor is to _____ the gas and mix it with the ingoing air. (a) carbonize (b) fluidize (c) atomize

8. A typical condenser consists of _____ metal conductors. (a) 4 (b) 3 (c) 2

9. The _____ changes 6-12 volts and 2-5 amps into a high charged electrical current. (a) condensor (b) ignition coil

10. One of the five types of material used on outboard motor hulls is _____. (a) plexiglass (b) fiberglass (c) plastics

NO. 58 TEST

GENERAL MAINTENANCE AND SALT WATER CARE OF OUTBOARD MOTORS

TRUE - FALSE

T F 1. The bulk of carburetor service is dismantling the carburetor.

T F 2. Breaker points are found under the cylinder head.

T F 3. Before adjusting the carburetor, close all adjusting needles and back them off to factory specifications.

T F 4. A bent or broken reed may not allow compression build-up in the crankcase.

T F 5. Using your memory and guesswork is usually best when finding out what type of generator is used.

MULTIPLE CHOICE

6. Refer to the _____ _____ for each motor for the recommended type and amount of lubrication used in engine and gears. (a) individual section (b) service manual (c) operator's manual

7. All outboard motors should have a covering of _____ for protection from corrosion. (a) paint (b) plastic (c) special chemicals

8. When adjusting carburetor valves, turn them all the way down and then turn open the number of times _____ _____. (a) until it sounds right (b) suggested in the service manual (c) until rpm are at their peak

9. To inspect breaker points _____ _____. (a) take them out (b) separate them (c) look at the taps

10. A bent or broken reed may not allow for _____ _____. (a) highest rpm (b) correct running (c) compression build-up

NO. 59 TEST

REPAIR A SUBMERGED MOTOR

TRUE - FALSE

T F 1. To flush out a motor means to wash and wipe it off.

T F 2. Use a safety chain only on outboard motors of 25 horsepower or more.

T F 3. All outboard motors come equipped with a bolt on transom.

T F 4. If an outboard motor is dropped in water but recovered quickly nothing will happen to the motor.

T F 5. There are only five types of danger after the motor has been dropped overboard.

MULTIPLE CHOICE

6. After a motor has been dropped overboard while running, _____ problems are apt to develop. (a) mechanical (b) corrosion (c) starting

7. Corrosion is more apt to occur when the motor is _____ _____. (a) out of the water (b) in fresh water (c) in salt water

8. If it is a long time before the motor is to be brought to the shop for repairing, it is best to keep it _____ _____. (a) in a dry area (b) in water (c) in the boat.

9. If you attempt to start the motor after it has been submerged, you should remove the _____. (a) spark plug (b) cowling (c) magneto

10. The most likely spot for corrosion after the motor has been submerged is the _____ _____. (a) engine (b) main bearings and crank journal (c) the propeller

NO. 60 TEST

INSTALL OUTBOARD MOTOR

TRUE - FALSE

T F 1. Never run a new motor more than one-fourth throttle for a period of six running hours.

T F 2. Never use a safety chain on a motor.

T F 3. Too much oil can be harmful to an engine that uses oil-gas mixture.

T F 4. If there is too much engine angle the boat will plow through the water.

T F 5. A hook in the hull of a boat will cause it to porpoise.

MULTIPLE CHOICE

6. If a boat motor is mounted on with a transom angle too small the thrust from the engine will be directed in a/an _____ position. (a) up (b) down (c) cross ways

7. The cause of a loss of power or overheating is _____. (a) water pump (b) too much oil in an oil-gas engine

8. The _____ should be disconnected on an electric engine if it is to be put up for a while. (a) positive terminal (b) negative terminal (c) both terminals

9. The average boat transom angle is _____. (a) 24° (b) 12° (c) 18°

NO. 61 TEST

SERVICE REMOTE CONTROL STEERING SYSTEM

TRUE - FALSE

T F 1. Remote control is the best way to drive a motor boat and in a way it is the safest.

T F 2. Steering ropes are attached to the tiller and wound around the drum.

T F 3. The simpliest form of remote control is the hand extension.

T F 4. For best steering passages the cables should be located as far inboard as possible.

T F 5. A tiller is a simple device or lever arm used to regulate the rudder.

MULTIPLE CHOICE

6. The actuating source of remote control can be _____. (a) push button (b) hand (c) hydraulic

7. The steering wheel should be located at the _____ of an outboard motor boat. (a) left (b) approximate center (c) right

8. Attachment strips are located on the engine with reference to the _____. (a) transom (b) service manual (c) steering wheel

9. Steering hand and hand rope extensions are examples of _____ control. (a) tiller (b) automatic (c) self

10. For best service, cable pulleys should be located as far _____ as possible. (a) inboard (b) outboard (c) in the center

NO. 62 TEST

START OUTBOARD MOTORS

TRUE - FALSE

T F 1. Early starters were of the pull cord type.

T F 2. Before starting a new motor check first with the service manual.

T F 3. The ratchet plate can only be mounted on the flywheel.

T F 4. The pawl retainer is located on the flywheel.

T F 5. Electric and manual engines are prepared for starting in the same manner.

MULTIPLE CHOICE

6. The pawl retainer is located on the _____.
(a) flywheel (b) retainer (c) pulley

7. The pawl spring is attached to the _____.
(a) equalizer (b) cup (c) retainer

8. There are _____ types of automatic rewind starters.
(a) 5 (b) 2 (c) 3

9. The _____disengage through centrifugal force on an outboard engine. (a) ratchets (b) pawls (c) equalizer

10. _____ causes the pawls on the cup to extend.
(a) frictional drag (b) centrifugal force (c) rotation of the flywheel

NO. 63 TEST

CONSTRUCTION OF OUTBOARD MOTOR POWER HEAD

TRUE - FALSE

T F 1. There are three types of power head construction.

T F 2. The number of cylinders depend upon the size and application of the engine.

T F 3. There are four types of power head construction for a two-cycle four cylinder engine.

T F 4. The old type of power heads were constructed of gray cast iron.

T F 5. An intake head is used to pass the fuel from the carburetor to the engine on a V-type engine.

MULTIPLE CHOICE

6. Today's method of power head construction makes the head _____. (a) lighter (b) heavier (c) about the same.

7. A prime mover or power unit is called a _____. (a) cylinder (b) power head (c) intake manifold

8. On a four cylinder V-type power head a power impulse is generated every _____°. (a) 90 (b) 60 (c) 180

NO. 64 TEST

SERVICE THE POWER HEAD

TRUE - FALSE

T F 1. The two types of bearings between crankshaft and connecting rod are friction and non-friction.

T F 2. The two types of connecting rods are offset and straight.

T F 3. The magneto ignition system is located in the flywheel on a four-cycle engine.

T F 4. Two thirty-seconds of an inch overlap is left when securing proper sealing of crankshaft bearings.

T F 5. The three types of pistons are the dome, crown, and flat.

MULTIPLE CHOICE

6. The crankshaft receives its power from the piston and _____. (a) rod (b) bearing (c) pinion

7. The purpose of the crankshaft bearing is to eliminate friction and support the _____. (a) rod (b) piston (c) crankshaft

8. The four moving parts that convert energy into power are the piston, connecting rod, flywheel, and _____. (a) crankcase (b) crankshaft (c) piston buttons

9. The _____ provides linkage between piston and crankshaft. (a) crankcase (b) connecting rod (c) retainer pin

NO. 65 TEST

CHECK THE COOLING SYSTEM OPERATION ON AN OUTBOARD MOTOR

TRUE - FALSE

T F 1. Air cooled engines have blades attached to the fly-wheel.

T F 2. About 1/4 of the heat energy in the fuel is changed into useful power.

T F 3. Typical water pump rotor blades are made of rubber.

T F 4. The water pump in the engine is necessary.

T F 5. Two methods of cooling the outboard engine are air and water.

MULTIPLE CHOICE

6. The thermostat is made to open at _____°.
(a) 130-135 (b) 135-140 (c) 140-145

7. Piston temperature ranges from _____ to _____° F.
(a) 330-550 (b) 230-450 (c) 130-450

8. Water pumps may be located in drive shaft housing above the driving gear, and lower gear housing directly ahead of the _____. (a) propeller (b) gear housing (c) gear shaft

NO. 66 TEST

SERVICE THE LOWER UNIT OF OUTBOARD MOTORS

TRUE - FALSE

T F 1. There are three types of lower units.

T F 2. The size of propellers is given in diameter and pitch.

T F 3. The gear case contains only the gears.

T F 4. Shear pins are used to protect the engine.

T F 5. Cavitation is caused when a propeller is forced to operate in calm water.

MULTIPLE CHOICE

6. _____ is used to conduct water to and from the water jackets. (a) Water tubing (b) Water jacket (c) Water pump

7. Outboard propellers are usually made of aluminum and _____. (a) bronze (b) copper (c) copper alloy

8. A drive shaft housing is usually made of _____. (a) iron (b) bronze (c) aluminum

9. A large propeller is used for low speed and _____. (a) thrust (b) power (c) torque

NO. 67 TEST

SERVICE OUTBOARD PROPELLERS

TRUE - FALSE

T F 1. The slippage on a racing boat is 10%.

T F 2. The normal slippage on a slow boat is 65-70%.

T F 3. Potential speed depends on the design of the boat and the power of the motor.

T F 4. Propellers are made of bronze and aluminum alloys.

T F 5. The two types of hulls are the planning and the displacement.

MULTIPLE CHOICE

6. Too _____ propeller pitch will cause the engine to overspeed. (a) little (b) much (c) large

7. The propeller pitch may be of the _____.
(a) constant and continual (b) constant and cupped
(c) continual and cupped

8. The usual number of propeller blades are _____.
(a) 2-3 (b) 2-4 (c) 3-4

9. The upper and lower drive units are connected at the _____ shock absorbers. (a) motor (b) propeller
(c) drive unit

NO. 68 TEST

SERVICE OUTBOARD CARBURETOR

TRUE - FALSE

T F 1. Three types of fuel transfer are vacuum, pressure and gravity.

T F 2. The ideal fuel mixture is 15 parts air to 1 part fuel.

T F 3. Check valve type carburetors are used most commonly on small outboard motors.

T F 4. Automotive type carburetors are used on larger outboard motors.

T F 5. Fuel enters the carburetor through the inlet valve.

MULTIPLE CHOICE

6. The _____ valves are built into the crankshaft. (a) leaf (b) reed (c) rotary

7. The _____ valve is a simplified version of the leaf valve. (a) rotary (b) reed (c) seal

8. The fuel _____ prevents foreign matter from entering the carburetor. (a) bowl (b) float (c) filter

9. In a vacuum fuel system a pump attached to the _____ produces the necessary pumping action. (a) piston (b) crankcase (c) crankshaft

10. The _____ system of the carburetor is separate from the high speed section. (a) idle (b) crankshaft (c) rotary valves

NO. 69 TEST

SERVICE OUTBOARD FUEL SYSTEM

TRUE - FALSE

T F 1. Combustion and detonation are the two ways of fuel ignition.

T F 2. Octane rating is measured fuel resistance to detonation.

T F 3. Early fuel gauges were electrically operated.

T F 4. Today fuel gauges are mechanically operated.

T F 5. An efficient muffler must offer minimum resistance to the gas escape.

MULTIPLE CHOICE

6. There are _____ types of fuel filters.
(a) three (b) two (c) four

7. The most common compound added to gasoline is _____ lead.
(a) tetraethyl (b) nickel (c) platinum

8. There are _____ types of valves.
(a) three (b) two (c) four

9. The rotary valve is located in the _____.
(a) piston (b) crankshaft (c) crank case

NO. 70 TEST

OUTBOARD ENGINE VALVES

TRUE - FALSE

T F 1. The most commonly used engine heads are L, T, and I.

T F 2. The valve mechanism operates the opening and closing of the valves.

T F 3. Water and air are the most common ways of cooling an engine.

T F 4. A valve seat is in the head assembly.

MULTIPLE CHOICE

5. Timing marks are located on the _____.
(a) cam shaft (b) flywheel (c) harmonic balancer

6. Valves must be _____ resistant.
(a) heat (b) water (c) air

7. _____ are used to guide the valve stems.
(a) valve retainers (b) valve guides (c) valve bands

8. _____ lift the rocker arm.
(a) valves (b) connecting rods (c) push rods

9. A _____ angle is correct for grinding a valve seat. (a) 45 degree (b) 44 degree (c) 50 degree

NO. 71 TEST

ADJUST FUEL AND AIR MIXTURE

TRUE - FALSE

T F 1. Do not use M M oil because of its low price.

T F 2. Additives reduce sludge and carbon deposits.

T F 3. A mixture of 50% more oil should be used during the break-in period of an engine.

T F 4. An oil-gas mixture should be measured carefully.

T F 5. The A.P.I. is a system of classifying oils.

MULTIPLE CHOICE

6. _____ stroke engines use an oil and gas mixture.
(a) single (b) four (c) two

7. Fuel burns in _____ different ways.
(a) 3 (b) 2 (c) 4

8. The grades of oil usually used are _____.
(a) S.A.E. 10-20 (b) 50-60 (c) S.A.E. 30-40

9. Lower case lubrication consists of oil or grease in the _____. (a) gear case (b) propeller (c) shifter

10. Oil is important to reduce _____.
(a) friction (b) horsepower (c) bottom end torque

NO. 72 TEST

SERVICE OUTBOARD ELECTRICAL SYSTEM

TRUE - FALSE

T F 1. The voltage on the secondary coil circuit exceeds 25,000 volts.

T F 2. The condenser controls the action of the coil.

T F 3. The specification of the breaker arm spring tension is 17-20 ounces.

T F 4. There are three types of ignition systems.

T F 5. Contact points set too close will burn and pit rapidly.

MULTIPLE CHOICE

6. Oxidized points are caused by _____ resistance.
(a) high (b) low (c) frequent

7. Points will _____ if they are set too close together. (a) oxidize (b) burn and pit (c) cause ignition failure

8. Points will _____ if they are set too far apart.
(a) burn and pit (b) oxidize (c) cause ignition failure

9. _____ is the speed at which the condenser performs its function. (a) 1/1200 of a second
(b) 1/120,000 of a second (c) 1/12,000 of a second

10. Dwell angle is the angle of cam rotation through which the distributor points remain _____.
(a) open (b) closed (c) stuck

NO. 73 TEST

SERVICE OUTBOARD STARTING SYSTEM

TRUE - FALSE

T F 1. A typical starting motor circuit consists of 4 parts.

T F 2. There are three types of drive mechanisms on a starter motor.

T F 3. There are 4 ways of transmitting power from the source to the drive mechanism in a starter.

T F 4. A solenoid is a plunger which moves and causes a complete circuit between the battery and the starter.

T F 5. A split-pulley type clutch starter is a direct current starter.

MULTIPLE CHOICE

6. The purpose of the starter is to _____ the bendix to the flywheel. (a) engage (b) disengage (c) start

7. A bendix starter is of the _____ type. (a) A.C. (b) Fluxuating (c) D.C.

8. An electric starter can be started by _____ current. (a) A.C. or D.C. (b) alternating (c) direct

NO. 74 TEST

INSTALL SPARK PLUGS IN OUTBOARDS

TRUE - FALSE

T F 1. There are hot, cold, and warm spark plugs.

T F 2. You check a spark plug gap with a ammeter.

T F 3. The failure of fuel to ignite is a misfire.

T F 4. Appearance of a plug removed from the cylinder block will indicate whether it is too hot or too cold.

T F 5. A spark plug center electrode is insulated from the plug shell by means of a molded insulator.

MULTIPLE CHOICE

6. All spark plug gaps range from _____.
(a) 15-.050 (b) .015-50 (c) .015-.050

7. Plugs that are fouled with oil indicates the _____ are loose. (a) piston rings (b) valves (c) head gasket

8. A _____ causes arcing from terminal to ground.
(a) close gap (b) wide gap (c) loose plug

9. _____ is the cause of engines missing at high speeds. (a) weak breaker point spring (b) loose breaker point spring (c) both a and b

NO. 75 TEST

MINOR MOTOR TUNE-UP

TRUE - FALSE

T F 1. A minor tune-up will help prevent a major tune-up.

T F 2. A battery is checked by a voltmeter.

T F 3. Breaker points are set on the open of the dwell.

T F 4. The magneto cannot be remagnetized after being dropped.

T F 5. A condenser cannot produce high voltage.

MULTIPLE CHOICE

6. A magneto remagnetizer is composed of a switch, magnetizer, and a _____. (a) rotor (b) fan (c) jaw

7. There are _____ steps to remagnetizing a magneto.
(a) 6 (b) 3 (c) 4

8. The ignition condenser provides a path for the primary current to flow instead of arcing across the _____.
(a) breaker points (b) ignition switch (c) breaker arm

9. Magneto breaker points should be checked for burning, frosting, and _____.
(a) oxidizing (b) pitting (c) carbonizing

10. An open circuit in the condenser will cause _____ trouble. (a) valve (b) carburetor (c) ignition

NO. 76 TEST

MAJOR MOTOR TUNE-UP

TRUE - FALSE

T F 1. A major tune-up comprises an overall check and service.

T F 2. A fuel gauge indicates the compression from one cylinder to the other.

T F 3. A cylinder block should be checked for scoring.

T F 4. If a piston is scored it should be replaced.

T F 5. A float is used to keep a constant amount of fuel level in a carburetor.

MULTIPLE CHOICE

6. A major tune-up consist of _____ main items.
(a) 2 (b) 4 (c) 6

7. A carburetor has _____ items to be checked.
(a) 3 (b) 4 (c) 6

8. Compression _____ from one cylinder to the next.
(a) varies (b) is constant (c) is the same

9. Turning the idle speed valve_____ gives a lean mixture.
(a) left (b) right (c) up and down

10. Battery water should be checked by the _____.
(a) voltmeter (b) gravity meter (c) hydrometer

NO. 77 TEST

TROUBLE SHOOTING ON OUTBOARD MOTORS

TRUE - FALSE

T F 1. Under sized pistons are the possible cause of broken piston rings.

T F 2. Over sized pistons are the possible cause of broken pistons.

T F 3. Cracked spark plug porcelain is the possible cause of a motor backfiring.

T F 4. Defective coil or condenser is the possible cause of a motor misfiring at high speeds.

T F 5. Leaks in ignition wiring is a possible cause of engine misfire.

MULTIPLE CHOICE

6. The torque specification of a flywheel is _____ pounds.
(a) 50-60 (b) 60-70 (c) 70-80

7. Remove carbon and clean _____ parts if there is a carbon path in the distributor gap.
(a) distributor cap (b) distributor (c) rotary

8. Piston pins should be put in at _____ degrees.
(a) normal room temperature (b) 60 (c) 70

9. For an out-of-round crank pin journal, the shaft should be replaced or _____ as necessary.
(a) reground (b) traded in (c) discarded

10. Service diagnosis consist of _____, possible causes, and remedies.
(a) adjustments (b) failure (c) conditions

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ABSTRACT - Prepared by Trade and Industrial Education coordinators for high school students in cooperative education studying building maintenance, the study guide includes a bibliography, a progress record chart, and 91 job assignments and information lessons and questions. Units are: (1) Blueprint Reading, (2) Electrical Work, (3) Heating, (4) Air Conditioning, (5) Plumbing, including Cold Water Supply, Drainage Systems, and Hot Water Supply, (6) Carpentry, (7) Machine Shop Practice, and (8) Glazing. An answer book "Answers, Building Maintenence" may be obtained from the source of availability indicated for this document. (GR)

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BUILDING MAINTENANCE

A study guide and progress record for high school cooperative students in the field of Building Maintenance. It is not intended for Janitorial Training.

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The material was edited and prepared for reproduction by Mr. J. R. Thomas, Assistant State Supervisor, and approved by Mr. H. F. Worthy, State Supervisor, Trade and Industrial Education.

BIBLIOGRAPHY

BUILDING MAINTENANCE

The bibliography for Building Maintenance is extensive due to the fact that this trade includes several occupational areas.

Most of the references below are a part of the bibliography listed in study guides for Electrical Wireman, Air Conditioning and Refrigeration, Home Appliance Servicing, Plumbing, and other standard trade and industrial occupations. Thus it is seen that many of the references are currently in use in the related study room and duplicate purchases need not be made.

PBM Audels Practical Guide to Building Maintenance ---- $3.71
Howard W. Sams & Company, Incorporated
4300 West 62nd Street
Indianapolis, Indiana 42206

RIP Related Information Plumbing 2 ---------- $2.46
Harry Slater
Delmar Publishers
Mountainview Avenue
Albany, New York 12205

FOC Fundamentals of Carpentry, Vol. I ---------- $4.40
Fourth Edition, Durbahn
American Technical Society
848 E. 58th Street
Chicago, Illinois 60637

BTB Building Trades Blueprint Reading ---------- $2.20
4th Edition, Part I Fundamentals
American Technical Society
848 E. 58th Street
Chicago, Illinois 60637

SRA Standard Refrigeration and Air Conditioning ------- $9.00
Elonka and Minich
McGraw-Hill Book Company
Manchester Road
Manchester, Missouri 63011

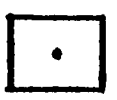
MSO Machine Shop Operations and Setups ---------- $5.52
Third Edition, Clyde A. Nelson
American Technical Society
848 E. 58th Street

AHA	Audels Home Appliance Service Guide ---------- Howard W. Sams & Co., Inc.-1967 Ed. 4300 West 62nd Street Indianapolis, Indiana 46206	$6.95
HSA	How To Repair Small Appliances Vol. I & II -------- Howard W. Sams & Co., Inc.-1967 Ed. 4300 West 62nd Street Indianapolis, Indiana 46206	$4.12
RMA	How To Repair Major Appliances ---------- Howard Sams & Co., Inc. - 1967 Ed. 4300 West 62nd Street Indianapolis, Indiana 46206	$2.96
EAE	Electricity and Electronics ---------- Goodheart-Willcox Company 18250 Harmond Avenue Homewood, Illinois 60430	$4.31
EMC	Electric Motor Controls ---------- Delmar Publishers Mountainview Avenue Albany, New York 12205	$3.27
PEW	Practical Electrical Wiring ---------- McGraw-Hill Book Company Manchester Road Manchester, Missouri 63011	$8.50
ICW	Industrial and Commercial Wiring ---------- American Technical Society 848 E. 58th Street Chicago, Illinois 60637	$5.95

HOW TO USE THIS STUDY GUIDE AND RECORD OF PROGRESS

The student's record of progress is kept on the Trade Analysis and Progress Record page. Progress "on-the-job" is kept in the column headed "Job Progress," and related study progress is kept in the adjoining column headed "Related Study."

The four step method of training is used in developing the skills of a trade or occupation. A record of all these steps for each job is kept in the squares in the column below "Learning Status" (Steps), opposite a specific job.



A dot in the center of the square indicates a student is in the first step; that of observing the job being done. No other mark is made in this square as long as the student remains in this step.

A diagonal line across the same square indicates the student is in the second step; that of helping perform the job under instruction.

Two diagonal lines across the same square indicates that the student is in the third step; that of doing the job under supervision.

The square filled in solid indicates that the student has reached the fourth step; that of a satisfactory level of accomplishment. The date when this accomplishment has been reached is placed in the column "Date Objective Reached," opposite the specific job.

On the day the student has read all the references and has written the answers to all of the questions, for a specific job, the student places this date in the column headed "Date Completed," opposite this job. The grade made on the test on this job is entered in the adjoining square headed "Test Grade."

The word "Information" will be found in the "Job Progress" column for all information lessons. When all references have been read and all answers to the questions have been written, for a specific information lesson, the student places the date of completion in the "Date Completed" column, opposite this lesson number. The grade made on the test on this lesson is entered in the square headed "Test Grade."

The student should read all references before writing the answers to questions. The essay type of answers which are required for most questions have a very definite value as they will help the student form the habit of giving clear-cut, definite answers or explanations. Only a few references and a few questions have been listed on each job sheet to teach the student how to study the literature pertaining to his occupation.

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Revised May, 1966

TRADE ANALYSIS AND PROGRESS RECORD

BUILDING MAINTENANCE

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
I--	BLUEPRINT READING				
1.	Read Working Drawings				
2.	Read Floor Plans				
3.	Learn Electrical Symbols				
4.	Determine Circuits Required				
5.	Determine Conductor Sizes and Types				
6.	Determine Location of Lighting Control				
	Switches				
7.	Read a Set of Blueprints				
II--	ELECTRICAL WORK				
8.	Fundamentals of Electricity	INFORMATION			
9.	Measurement of Electricity	INFORMATION			
10.	Ohms Law and Circuit Fundamentals	INFORMATION			
11.	Power and Energy	INFORMATION			
12.	Methods Used in Appliance Repair	INFORMATION			
13.	Install Electric Range				
14.	Use Hand Tools in Appliance Repair				
15.	Use Appliance Testing Instruments				
16.	Replace Switches on Electric Range				
17.	Service Oven Temperature Controls on				
	Electric Range				
18.	Test Surface Units and Controls on				
	Electric Range				
19.	Repair or Replace Oven Units on Electric				
	Range				

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TRADE ANALYSIS AND PROGRESS RECORD

BUILDING MAINTENANCE

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
II--ELECTRICAL WORK CONTINUED					
20.	Test Oven Units and Controls on Electric				
	Range				
21.	Service Electric Water Heater				
22.	Service Electric Food Mixer				
23.	Service Electric Fan				
24.	Service Vacuum Cleaner				
25.	Repair Line Cords and Plugs				
26.	Service Heating Elements and Thermostats				
27.	Service Electric Toaster				
28.	Service Electric Iron				
29.	Service Electric Dishwasher				
30.	Service Garbage Disposer				
31.	Service Automatic Coffee Maker				
32.	Types of Electric Motors -	INFORMATION			
33.	Install Electric Motor Starting Device				
34.	Repair and/or Install Motor Overload				
	Protectors				
35.	Repair and/or Install Motor Switches				
36.	Determine Circuit Requirements for Motors				
37.	Install Motor Controllers				
38.	Install Push-Button Station-Stop-Start-				
	Reversing				
39.	Wire Motors				

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NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
II--	ELECTRICAL WORK CONTINUED.....				
40.	Service Motor Controller				
III--	HEATING				
41.	Heating Terms	INFORMATION			
42.	Types of Heating Systems	INFORMATION			
43.	Check Low Pressure Fire Box Boiler				
44.	Check Hot Water Boilers				
45.	Service Boiler Water Controls				
46.	Maintain Boilers				
47.	Install and/or Service Steam Traps and Valves				
48.	Service Unit Heaters (Steam and Hot Water)				
49.	Replace Air Filters or Service Permanent Type Filters				
50.	Service Gas Fired Hot Water Heaters				
IV--	AIR CONDITIONING				
51.	Refrigeration Fundamentals	INFORMATION			
52.	Check High and Low Pressure Refrigerant Systems				
53.	Check Air Conditioning Safety Devices				
54.	Service Electrical Controls and Limit Switches				
55.	Maintain Air Conditioning System				
56.	Service Cooling Tower				

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BUILDING MAINTENANCE

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	IV--AIR CONDITIONING CONTINUED.....	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
57.	Service Evaporators				
58.	Service Condensers				
59.	Install Air cooled, Self Contained Unit				
V--PLUMBING					
	COLD WATER SUPPLY				
60.	Service Globe, Gate and Check Valves				
61.	Check Water Meters, Curb Boxes and				
	Strainers				
62.	Check Pressure Valves and Bypass				
63.	Check House Service Pipe-Basement Water				
	Mains				
	DRAINAGE SYSTEMS				
64.	Determine Maximum Fixture Unit Load				
65.	Check Waste and Vent Stacks				
66.	Check Loss of Trap Seals				
67.	Check Continuous Vent and Wet Vent				
68.	Replace Fixture and Grease Traps				
69.	Check Sumps and Cellar Drainers				
	HOT WATER SUPPLY				
70.	Conduction-Convection-Radiation	INFORMATION			
71.	The British Thermal Unit and the Expansion				
	of Water	INFORMATION			
72.	Replace Thermostats				
73.	Replace Relief Valves				

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NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
V--PLUMBING CONTINUED....					
74.	Install Electric Water Heaters				
VI--CARPENTRY					
75.	Use Measuring Tools				
76.	Use Edge Cutting Tools				
77.	Use Holding Tools				
78.	Use Fastening Tools				
79.	Use Boring Tools				
80.	Use Pounding Tools				
81.	Use Power Tools				
VII--MACHINE SHOP PRACTICE					
82.	Use Machine Shop Measuring Tools				
83.	Use Bench Tools				
84.	Use Hack Saws (Hand and Power)				
85.	Use Layout Tools				
86.	Use Chisels and Files				
87.	Use Hand Taps				
88.	Cut Threads with a Die				
89.	Use Drill Press and Accessories				
VIII--GLAZING					
90.	Replace Calking Material				
91.	Replace Broken Glass				

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BUILDING MAINTENANCE

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
I--	BLUEPRINT READING				
1.	Read Working Drawings				
2.	Read Floor Plans				
3.	Learn Electrical Symbols				
4.	Determine Circuits Required				
5.	Determine Conductor Sizes and Types				
6.	Determine Location of Lighting Control				
	Switches				
7.	Read a Set of Blueprints				
II--	ELECTRICAL WORK				
8.	Fundamentals of Electricity	INFORMATION			
9.	Measurement of Electricity	INFORMATION			
10.	Ohms Law and Circuit Fundamentals	INFORMATION			
11.	Power and Energy	INFORMATION			
12.	Methods Used in Appliance Repair	INFORMATION			
13.	Install Electric Range				
14.	Use Hand Tools in Appliance Repair				
15.	Use Appliance Testing Instruments				
16.	Replace Switches on Electric Range				
17.	Service Oven Temperature Controls on				
	Electric Range				
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85.	Use Layout Tools				
86.	Use Chisels and Files				
87.	Use Hand Taps				
88.	Cut Threads with a Die				
89.	Use Drill Press and Accessories				
	VIII--GLAZING				
90.	Replace Calking Material				
91.	Replace Broken Glass				

NAME_____ OCCUPATION_____ AGENCY_____

STUDENT'S DAILY RECORD

Date	List the Job Numbers Performed the Previous afternoon	List the References Read in the Related Class by Symbols and Pages	List the Number of the Job Studied Today

JOB 1

READING WORKING DRAWINGS BTB: 5-7

1. What is a blueprint?

2. Describe a true blueprint.

3. Describe a blueprint which has been reproduced.

4. Define "working drawings".

5. The working drawings consists of several different kinds of drawings usually assembled into a set, name these different kinds of drawings.

6. Define "plot plan".

7. Define "floor plan".

8. Define "section drawing".

9. Define "elevation drawing".

JOB 2

READ FLOOR PLANS BTB: 31-42

1. Why is it important for a building tradesman to learn to read blueprints of floor plans early in his job experience?

2. What are some things a tradesman must know about floor plans so that the work will progress smoothly?

3. Why is it sometimes necessary to trace over a complex blueprint showing only the walls, partitions and openings while leaving out all other information?

4. In learning to read blueprints, why should the greatest emphasis be placed on studying floor plans?

5. Summarize the five basic ideas in reading floor plans.

6. What considerations are important when locating windows in a house?

7. What should be a factor in determining which way a door should be swung?

8. Although kitchen equipment such as the range and refrigerator are not part of a building, why are they indicated on floor plans?

JOB 3

LEARN ELECTRICAL SYMBOLS

BTB: 49

1.

2.

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21.

JOB 3

WHAT DOES EACH OF THE FOLLOWING SYMBOLS REPRESENT? BTBR: 49

1. S
2. S_2
3. S_3
4. S_4
5. S_D
6. S_E
7. S_K
8. S_P
9. S_{CB}
10. S_{WCB}
11. S_{MC}
12. S_{RC}
13. S_{WP}
14. S_F
15. S_{WF}
16.
17.
18. ———
19. — — —
20. - - - - - -
21.
22.
23.
24. Ⓖ
25. Ⓜ

JOB 3

WHAT DOES EACH OF THE FOLLOWING SYMBOLS REPRESENT BTBR: 49

1.

2.

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JOB 4

DETERMINE CIRCUITS REQUIRED Information Sheet: 4A

1. For lighting, how many watts must be provided for every square foot of floor space?

2. How many amps does No. 14 wire carry?

3. The formula for finding the number of watts from the amps and volts is: amps times volts equals watts. (A x V= W) Find the number of watts when there are 15 amps and 115 volts.

4. If three watts are required for each square foot, how many square feet will the answer in question No. 3 serve?

5. Is the area figured from the inside or outside dimensions of the house?

6. What areas of a house are not figured in the dimensions for the lighting?

7. What happens when kitchen and laundry appliances are plugged into lighting circuits?

8. With what size wire must the special circuit for small appliances be wired?

9. Name the appliances which must have a circuit of their own.

JOB 4A

INFORMATION SHEET

The National Electrical Code has very definite requirements as to the minimum of circuits required. It requires that for lighting only, enough circuits be installed to provide three watts for every square foot of area. Since each circuit wired with the No. 14 wire usually used is able to carry 15 amps which at 115 volts is equivalent to 15 times 115 or 1,725 watts, then each circuit will serve 575 square feet.

The area is figured from the outside dimensions of the house, not including open porches, and not counting unfinished spaces and unused spaces unless adaptable for further use. Any space that can be finished at a later date, as for example, attic rooms, or space in a basement, must be included. Garages are not counted.

It has been the general experience in the past that when kitchen and laundry appliances are plugged into the lighting circuits, overloads quickly develop, leading to blown fuses, excessive voltage drop causing dim lights and so on. This became especially true during recent years in which the wattage consumed by flat-irons and toasters has increased from the former standard of 660 watts to a present figure of more than 1,000 watts; roasters became more available consuming as much as 1,650 watts, and the use of appliances in general multiplied greatly. Therefore, the code wisely requires that in addition to the minimum number of circuits for lighting when no lighting outlets are connected, the special circuit must serve only small appliances, loads in the kitchen, laundry, pantry, dining room, and the breakfast room.

This special circuit must be wired with No. 12 wire (instead of the usual No. 14) and then of course protected by 20 amp fuses or circuit breakers. While the code requires one such circuit, most new homes today deserve two; a single circuit will not permit an iron and a toaster to operate on the same circuit at the same time.

Note that the special appliance circuit is for appliances only; lighting outlets may not be connected to such circuits.

Most homes being wired today require special circuits over and above those mentioned. The electric range must have a circuit of its own; the electric water heater must have an individual circuit; other appliances like clothes dryers, oil burners, some air conditioners, each require a special circuit.

JOB 4A

INFORMATION SHEET

Bear in mind that the code requirements concern safety, not convenience. For a practical, livable home, you will want to go beyond the code requirement, and install more circuits than required.

JOB 5

DETERMINE CONDUCTOR SIZES AND TYPES Information Sheet 5A

1. What kind of wire is generally used to conduct electric power from one point to another?

2. In electrical terms, what word is used rather than the term "wire"?

3. What is the abbreviation AWG?

4. In terms of inches, how large is No. 14 wire?

5. Which is larger in diameter, No. 14 wire or No. 40?

6. Why are various colors used in building wires?

7. The grounded neutral wire is made of what color?

8. Describe "Type T" building wire.

9. What is the advantage of using a cable type wire where wiring in a building has already been completed?

10. From what source can information be found to determine the correct size wire to use in wiring various types of buildings?

JOB 5A

INFORMATION SHEET

Wires are used to conduct electric power from the point where it is generated to the point where it is used. Copper is the material used in practically all cases. The Code makes very little reference to "wire" but speaks frequently of the "conductor", which it defines as "wire or cable or other form of metal suitable for carrying current". All wires therefore are conductors, but not all conductors are wires. For example, copper bus bars are conductors but are not referred to as wires.

All wire has resistance that prevents an unlimited flow of current and causes voltage drop. For any given load, you must select a size of wire that causes only a reasonable voltage drop.

Current flowing through a wire causes heat; the heat varies as the square of the amperage. There is a limit to the degree of heat that various types of insulation will safely withstand, and even a bare wire must not be allowed to reach a temperature that might cause fire. The Code carefully and in great detail specifies the maximum amperage that is considered safe for wires of different sizes with different insulations and under different conditions.

Instead of referring to common sizes of wire by their areas, sizes or numbers have been assigned to them. The gauge commonly used is the American Wire Gauge, abbreviated AWG; it is the same as the Brown and Sharpe, or B & S gauge.

Number 14 wire, which is the size most commonly used for ordinary house wiring, has a copper conductor 0.064 in., or 64 mils, in diameter. Wires smaller than this are Nos. 16, 18, 20, and so on. Number 40 has a diameter of approximately 0.003 in., as small as a hair; many still finer sizes are made. Sizes larger than No. 14 are Nos. 12, 10, 8, etc. Note that the bigger the number, the smaller the diameter of the wire.

Building wires come in various colors, and there is, of course, a purpose in this. Only white wire may be used for the grounded neutral wire in wiring. Other wires may be any color except white. If there are two wires in a circuit, one is white, one black. If there are more than two wires, one is white, the others may be another color. Using varying colors makes it easy to trace circuits.

Building wire with thermoplastic insulation is called "Type T" by the National Electrical Code. This type of wire is the most common kind in use today. It consists of the copper conductor, tinned for easy soldering and covered with a layer of plastic insulating compound, the thickness of which depends on the size of the wire. The wire is clean and easy to handle and strips easily. Ordinary Type T wire may be used only in dry locations. A subtype known as Type TW may be used in either dry or wet locations.

JOB 5A

INFORMATION SHEET

For many purposes, especially in residential and farm wiring, it is desirable to have two or more wires grouped together in the form of a cable. This makes a compact assembly which is easy to install, especially when used to wire a building that was completed before the wiring was installed, for the cable lends itself well to being fished through wall spaces.

For the internal wiring of lighting fixtures, special wire known as "fixture" wire is used. There are many types of fixture wire, and the particular type used depends to a great extent on the temperature that exists in the wire in use. Those with rubber insulation may be used only if the temperature of the wire while carrying current does not exceed 140 degrees F., but the most common is the Type CF which employs no rubber in the insulation. It may be used at temperatures not exceeding 194 degrees F. At higher temperatures, type AF using asbestos for insulation must be used.

Bell wire consists of a copper conductor over which are two layers of cotton, the two wrapped in opposite directions, then parafined to give it some semblance of being moisture resistant. It is commonly known as "thermostat cable" because it is most frequently used in connection with furnaces and thermostats. Instead of fabric insulation, plastic material is becoming far more common.

In determining conductor sizes you must use a size of wire that is big enough to prevent the development of dangerous temperatures, and also big enough to avoid wasted power in the form of excessive voltage drop. Voltage drop is simply wasted electricity. If the drop is 5%, it means that 5% of the power is wasted as unwanted heat in the wires. Moreover, all electrical devices operate most efficiently on the voltage for which they are designed. The National Electrical Code contains a chart from which you may determine the smallest wire that may be used in various situations.

JOB 6

DETERMINE LOCATION OF RECEPTACLE OUTLETS
AND LIGHTING CONTROL SWITCHES

Information Sheet: 6A

1. Describe an adequately wired home.

2. Why should receptacle outlets be placed so that extension cords will not be needed?

3. What is the minimum requirements set up by the Code in locating receptacle outlets in a house?

4. Why is it practical to install more than the minimum number of receptacles in a house?

5. Where are the only locations in which pull chains should be used?

6. What is the general rule to follow in locating lighting control switches in rooms with more than one door?

7. What height should lighting control switches be placed from the floor?

8. What side of the door should lighting control switches be located?

JOB 6A

INFORMATION SHEET

An adequately wired home is one that has been so wired that the occupant will get the maximum of convenience and utility from the use of electric power, with a minimum of inconvenience.

He must have light available where needed, in the amount needed, from permanently installed fixtures or portable lamps. He must be able to plug in lamps, radio, and TV where he pleases, without resorting to extension cords, even after the furniture is moved around. He must be able to turn lights on and off in any room without stumbling through darkness to find a switch, to move from basement to attic with plenty of light but without leaving an unneeded light turned on behind him.

Sufficient receptacle or plug-in outlets do away with the need of extension cords, which are unsightly, inconvenient, and dangerous, both from the standpoint of possible injury caused by tripping over them and also from the standpoint of electrical and fire hazards caused by fraying and short circuits.

The National Electrical Code requires that "in every kitchen, dining room, breakfast room, living room, parlor, library, den, sunroom, recreation room, and bedroom, receptacle outlets shall be installed so that no point along the floor line in any wall space is more than 6 ft., measured horizontally, from an outlet in that space, including any wall space 2 ft. wide or greater and the wall space occupied by sliding panels in exterior walls. The receptacle outlets shall, in so far as practicable, be spaced equal distances apart".

This is the Code minimum, but remembering that floor lamps, radios, and other electrical devices are seldom equipped with cords 6 ft. long, you may want to reduce the 6 ft. to 5 ft. for a really adequate installation.

Lights that are controlled by a pull chain, or a similar switch on the fixture itself, are inexcusable today, except perhaps in closets or other rooms so small that it is impossible to miss the cord or pull chain. Outside this one exception, every light should be controlled by a wall switch.

If there is only a single door leading into a room, the logical location for the switch is near the door. If, however, there are two entrances, it is equally logical that there should be a switch at each so that the light can be controlled from either point; in other words, use a pair of 3-way switches. Should there be three entrances, a switch at each of the three entrances is a touch of luxury that the owner will appreciate. In a house that has been really adequately wired, you can enter by any entrance and move from basement to attic without ever being in darkness, yet without ever having to retrace your steps to turn off lights.

JOB 6A

INFORMATION SHEET

Boxes for switches should be mounted at a convenient height; the usual distance is about 48 in. above the floor. They should be placed on the same side of the door as the door knob is located.

JOB 7

READ A SET OF BLUEPRINTS

BTB: 110-120
Blueprint Sheets: 1-6

1. What are two purposes for a preliminary study of a set of blueprints?

2. Where is the kitchen usually placed in a home?

3. What does the longitudinal section of the plans show?

4. What is a dutch door?

5. Describe a parquet floor.

Refer to the door schedule on Sheet 6 (blueprints) to determine the size and type doors for the following locations. Doors are shown on Sheets 1 and 2.

6. Closet doors in No. 4 bedroom.

7. No. 3 bedroom door.

8. Door from Family room to Playcourt.

9. Door from Garage to Playcourt.

10. Living Room door to Patio.

11. Refer to Sheet 1 and determine the over-all length of the building from North to South.

12. Refer to Sheet 1 and determine the length and width of the basement.

13. Refer to Sheet 2 and determine the inside dimensions of the living room.

JOB 8

Fundamentals of Electricity AHA - 7-15

1. Name the two types of electric currents which must be considered when dealing with electrical appliances, and describe how they work.

2. What is the effect of free electrons in substances?

3. How does temperature effect the velocity or motion of the molecules or electrons?

4. What is the result if the random movements of electrons is controlled?

5. (a) What is atomic weight?
   (b) Name the simplest of atoms.

6. Compare protons, neutrons and electrons.

7. What is an atom?

8. Give the difference between a positively-charged body and a negatively-charged body.

9. What happens to the electrons when a piece of flannel and a stick of sealing wax are rubbed together?

10. Why is alternating current used universally in homes and factories?

JOB 9

Measurement of Electricity AHA - 16-29

1. Make the following temperature scale changes: (a) If the temperature of a certain element is 350°C. what is its corresponding temperature on the Fahrenheit scale? (b) Change 113°F. to read correspondingly on the Centigrade scale.

2. The expansion and contraction of metals and fluids is utilized in many ways; give an example of a liquid in expansion.

3. What is the most widely used conductor of electricity in electrical circuits?

4. What is the practical measurement unit of electron flow or electric current?

5. What is indicated by the term voltage?

6. Why does the resistance to an electric current vary?

7. What effect will the length of the wire have on the current passing through?

8. What effect does temperature have in the electrical circuit?

9. Name one type of thermostat employed in the home and describe the principle of its operation.

10. What would be the expansion of a steel joist 800 feet in length if the temperature applied to it was 350°F. above its normal temperature?

11. What is the effect if the electron flow in a conductor is greatly increased?

12. The resistance of a conductor or wire is measured in ohms. Define an ohm.

13. What is the meaning of linear coefficient of expansion?

14. In what ways may the electromotive force, e.m.f., be developed?

15. What is the procedure for finding the total resistance of wire in ohms?

16. How are the metals in the blade arranged in a simple bi-metallic thermostat?

JOB 9

Continued

17. What is the relation between an ampere and a milliampere?

18. What is the resistance of one mile of copper wire 1/8 inch in diameter?

19. What are the differences in divisions on a Fahrenheit and Centigrade thermometer?

20. What effect does the length of the conductor have upon the resistence of the conductor?

21. What is a volt?

22. If a copper conductor has a resistance of 5 ohms at 100° F., what will be its resistance at 200° F?

23. The ability of a conductor to carry an electric current depends upon what?

24. Why is it long structures must not be rigidly fixed at both ends?

JOB 10

Ohms Law and Circuit Fundamentals

AHA - 30-38

1. What is meant by a series circuit?

2. Define a series-parallel circuit or a parallel-series circuit.

3. State Ohms law and give the formula.

4. What are the three types of circuits usually found in most household appliances?

5. How can the circuit be checked while working with voltage?

6. Besides showing that the voltage of a circuit is equal to the current times the resistance, what else does Ohm's law indicate?

7. When working with series-parallel circuits what should be kept in mind?

8. What do I, E, & R represent in Ohm's law?

9. Define a parallel circuit.

10. When a circuit has a number of resistances how is the total resistance found?

11. In a circuit having a voltage of 30 volts and a current of 5 amps what will be the resistance?

12. What is the effective resistance of a parallel circuit when the individual resistances are 4 & 8 ohms, respectively?

13. What voltage must be furnished by the battery in a series circuit in order to force a current of 4 amperes through the circuit, if R_1, R_2, R_3, and R_4 are 5, 15, 20, and 30 ohms, respectively?

14. A parallel circuit consists of three branches in which the individual resistances are 4, 8, and 10 ohms, respectively. What is the effective resistance of the combination?

JOB 11

Power and Energy AHA - 38-45

1. Explain the term "efficiency" as used in electrical devices.

2. Show by the formula how electrical energy is determined.

3. What is power and how is it measured?

4. Why is 0.057 B.T.U. per minute used to represent one watt?

5. Define the term B.T.U.

6. Is electrical power usually turned into heat? Explain.

7. What is required to find the amount of heat necessary to raise a quantity of water to a certain temperature from an initial temperature?

8. Why is the formula $P = I^2 R$ used?

9. How are power and energy different?

10. If a 5 horsepower direct current motor takes 5 killowats at full load, what is its efficiency?

11. If a 100 watt incandescent lamp is connected to a 110 volt circuit, what will be the current flow?

12. How many heat units are generated in one hour by a heating element which carries 50 amperes and has 5 ohms resistance?

13. If the rate of electrical energy in a certain location is five cents per kilowatt-hour, and the monthly bill is $3.00 how many kilowatt-hours has been consumed?

14. If an electric soldering iron has a resistance of 440 ohms, a potential source of 220 volts, what will be the power consumption and energy requirements of the iron when connected to the circuit for one quarter of an hour?

15. A direct current motor draws a current of 20 amperes from a 220 volt main. The full load nameplate rating of the motor is 5 horsepower. What is the efficiency of the motor and cost of operation per 8 hour day when the cost of electrical energy is 5 cents per kilowatt-hour?

JOB 11
Continued

16. A resistance heating element of 150 ohms is placed in a container of water of one quart capacity. How long must a current of 5 amperes flow through the element in order to raise the temperature of the water from 72° F. to boiling (212°F). Assume the efficiency of the process 80%.

17. A three-quarter horsepower direct current motor takes four amperes when operating at full load, and connected to a 110 volt source. What is the efficiency of the motor?

JOB 12

Methods Used in Appliance Repair AHA - 73-84

1. What must often be done to electric cords and connections?

2. What is the process of removing insulation called?

3. What three tools can be used to remove the insulation?

4. What must be done to the wire after removing the insulation?

5. What are the essential conditions for successful soldering?

6. What must be done to the soldering iron before soldering?

7. Describe the process of tinning a soldering iron.

8. What must be done to a wire connection prior to applying solder to the joint?

9. Which type of flux is universally used in electrical work?

10. What is solder?

11. How long is the soldering iron held to the joint?

12. What should be done to the wire before soldering it in place?

13. Where is the solder applied?

14. What is done to the wire in order for it to be connected to a terminal?

15. Where is the wire inserted when attaching it to the screw terminal?

16. Why should a knot be tied in the cord after it has been passed through a plug?

17. What should be kept in mind when selecting a resistance cord?

18. What are mending sleeves?

19. For what are mending sleeves used?

20. What is the function of resistance wires?

JOB 13

Install Electric Range AHA - 195-203, 226

1. What is the advantage of a three-wire single-phase circuit for electric ranges?

2. Of what materials are most heating elements made?

3. What is the controlling factor as to the type of current on which the range can be operated?

4. Why cannot ranges, usually, be operated on direct current?

5. What code governs the wiring of any electric range?

6. Why should feeder lines from the main power supply to the range be three-wire circuits?

7. Why does the average range usually operate for many years without need of repair, once it has been properly installed?

8. Where may a serviceman receive complete instructions for installing any new range?

9. Why should an electric range be installed in a level position?

JOB NO. 14

USE TOOLS IN APPLIANCE REPAIR

RSA I: 113-121
RSA II: 10-13

1. In order to make a profitable business of appliance servicing, in what two things would it be best to invest?

2. List the essential tools needed in appliance repair.

3. Which type of screw driver is a great time saver in appliance work?

4. Name the two basic types of screw-holding screw drivers.

5. What is the advantage of the inside-grip screw driver?

6. List some special tools used to make the repair job easier.

7. Why is the strength of the nut holder an advantage?

8. Which type of power tool can be used most often in appliance repair jobs?

9. Which type of screw-holding screw driver is almost essential for phillips screws?

10. How does the inside-grip holder function?

11. Which attachment is needed with the ¼ inch electric drill?

12. Explain the difference between the standard hex-nut drivers, and the nut holders.

13. How does the nut holder function?

14. For what purpose is the three-way tap used?

15. List the standard equipment for repairing wiring.

16. How may riveted appliances be taken apart?

17. In cases where you cannot get to the inside of the appliance to put on a nut, what is used as a replacement?

18. Explain the use of the crimping tool, and its terminals.

JOB 14

Continued

19. Why are the small open-end and box-end wrenches often useful in appliance repair?

20. Explain the use of chemical products on appliance repairs.

21. Why are penetrating solvents and rust solvents especially useful?

22. What chemicals should not be used? Why?

JOB 15

Use Appliance Testing Instruments AHA - 46-72

1. The milliammeter is made up of what parts?

2. What is the function of shunts?

3. What is the difference between a voltmeter and a milliammeter?

4. How may a milliammeter be converted into a voltmeter?

5. Voltmeters suitable for electrical appliance work usually have what resistance?

6. What is an ohmmeter?

7. What is the advantage of a combination volt-ohm-milliammeter?

8. Why is a high degree of accuracy not necessary in testing instruments for appliances?

9. Why should inexpensive volt-ohm-milliammeter combination meters never be used for current measurement?

10. For what purpose is a wattmeter used?

11. What is the growler used to test?

JOB 16

Replace Switches on Electric Range

AHA - 195-233

1. What is the purpose of the three-wire load balancing switch for the surface unit?

2. What color is the neutral wire on high and medium heat?

3. What wire becomes neutral on the low position?

4. What is the advantage of the five heat load balancing switch over the three-heat switch?

5. How many watts is consumed on an 8 inch unit if the switch is turned to medium low?

6. Show with a drawing how the heat control switch changes connections to the elements when providing three heats.

JOB 17

Service Oven Temperature Control on Electric Range

AHA - 195-233
HSA - 133-144

1. Explain the difference in construction of the upper and lower unit heating elements in the oven.

2. How many units does the modern oven have? Where are they located?

3. In a two unit oven what switch position will give the highest temperature?

4. What is a thermostat?

5. Describe the principle upon which the thermostatic switch operates.

6. Name the two different types of thermostat switches employed in electric range ovens.

7. Why must care be taken in placing the liquid charge bulb in the oven?

8. Explain the operation of the sealed liquid charged bulb to control the oven heat.

9. What instrument is most reliable in checking the accuracy of oven temperatures?

10. What is a poor adjustment most servicemen make when a customer complains that the oven temperature is not right?

11. What special instruction does a serviceman need in order to replace an oven thermostat?

JOB 18

Test Surface Units and Controls on Electric Ranges

RSA 1 - 85-93
RMA - 126-138
AHA - 195-233

1. Name the two meters used in checking the surface units.

2. Why are lead wires checked on surface units?

3. With the surface unit switch in the low position, which ring will heat?

4. When you read no voltage in making a voltage check at the surface terminals, what is probably defective?

5. In what position on a five-heat switch is the green wire the neutral wire?

6. On a three-heat switch, in which position is the green wire the neutral wire?

7. On a three-heat switch, how much voltage is applied between the black and red wires when the switch is on the high position.

8. How much voltage is applied between the red and green wires when the switch is on the medium position on a three-heat switch.

9. The black wire is the neutral wire when the five-heat switch is in which position?

10. In a five-heat switch, in what position are the black and green wires both the neutral wires?

JOB 19

Repair or Replace Oven Units on an Electric Range

AHA - 195-233
RSA 1 - 85-93

1. How many heating elements does an oven normally have?

2. How is the heat normally controlled in an oven?

3. What is the primary purpose of an oven unit?

4. Which switch position provides the highest temperature? Why?

5. How is the temperature maintained and the time of starting and terminating the heat controlled?

6. Name one way to check a heating element.

7. Explain how to check oven units.

8. Is it possible to interchange the upper and lower units in an oven after removal for cleaning?

JOB 20

Test Oven Units and Controls on Electric Range

AHA - 195-233
RMA - 126-138

1. Why is measuring the high temperature in an oven difficult?

2. What two methods are used in checking oven temperature when a questionable control is encountered?

3. What is a thermostat?

4. How does a thermostat operate?

5. What are the three functions of an oven timer?

6. What are the two types of thermostatic switches employed in and electric range oven?

7. Explain the proper way to adjust a thermostat in an oven.

8. Electric timers are used on what type of circuits?

9. What is a timer?

10. Where may spring-powered timers be found and how do they work?

JOB 21

Service Electric Water Heater

AHA - 158-193
RMA - 194-203

1. What are the three most common troubles with hot water tanks?

2. Why do some electric heaters come equipped with a magnesium rod?

3. What is the formula for finding BTU?

4. A double-throw thermostatic switch controls what in an electric water heater?

5. What is meant by limited-demand type hook-up?

6. What are the two general classifications of thermostats?

7. What is the range of most thermostats in electric water heaters and at what temperature are they set?

8. Explain the two methods of heating water in electric hot water tanks?

9. Explain the function of the two thermostats found on hot water heaters?

10. What are the power requirements of electric water heaters?

JOB 22

Service Food Mixers

AHA - 282-299
HSA-I 34-36

1. Certain types of mixers are equipped with oil holes located on the top of the motor casing, how often do they require oiling?

2. What are some causes of food mixer trouble?

3. Why will it not often be necessary to completely disassemble and reassemble a mixer when making repairs?

4. When checking or repairing the electrical system, particular attention should be given to what item?

5. When reassembling the mixer, why should a definite procedure be followed?

6. In order for the serviceman to intelligently diagnose a defective food mixer, what must be familiar to him?

7. On a faulty food mixer, excessive grease leakage at the beater sockets may be a sign of what defect?

8. How can the speed-control switches of the tap-switch type be cleaned?

9. If an operator receives a shock when the mixer is touched while in use, what is usually the trouble?

10. If a mixer runs only on "high speed", what is possibly the defect?

JOB 23

Service Electric Fans

AHA - 305-321
HSA-I 55-57
HSA-II 25-37

1. What should be done when blades on a fan get out of balance and cause vibration?

2. Name two types of fans used in the home?

3. Where is the exhaust fan used and mounted?

4. Modern electrically operated household fans may be divided into several classes, depending on their operation and method of mounting, what are these classes?

5. What fans may be operated on either A.C. or D.C. current?

6. Of what does the oscillating mechanism consist?

7. Name the two varieties of window fans?

8. Before taking a fan apart, what is the first thing you should do?

9. A worn or damaged plug or cord should be replaced immediately, why?

10. Explain how to check the angle of the fan blades.

JOB 24

Service Electric Vacuum Cleaners

AHA - 322-337
HSA-II 95-103

1. List the five usual vacuum cleaner complaints.

2. Name four causes for motor overheating.

3. Name seven reasons for noisy motor.

4. Name five parts to check if vacuum cleaner will not pick up properly.

5. What may cause the operator of a vacuum cleaner to be shocked?

6. What type motors are used on vacuum cleaners?

7. In the absence of special laboratory equipment, how may a vacuum cleaner be ckecked?

8. Failure of cleaner motor to operate does not necessarily indicate motor trouble, but may be caused by what?

9. What is a very common, minor complaint?

10. What should be checked first if the vacuum cleaner motor will not run?

JOB 25

Repair Line Cords and Plugs

AHA - 73-84
HSA-I 65-83

1. Why is the replacement of line cords and plugs the most common service job on appliances?

2. What type is the heaviest of all line cords?

3. Describe POSJ cord.

4. Describe SV cord.

5. What type of cord should be used on an appliance whose heating elements draw more than 500 watts?

6. Which type of cord can be installed on any electrical appliance?

7. When should an appliance cord be replaced?

8. What is the most frequent trouble of a plug?

9. What is probably the best type plug to use for all around replacement?

10. What is the quickest insulation test for line cords?

11. What devices are sometimes used to produce a firm anchorage at the point where the line cord goes into the appliance to keep any strain off the electrical connections?

12. Name two appliances whose line cords require special protection, because of the high heat and frequent movement to which they are subjected?

13. Why are plugs used on appliances?

14. Which tools are best to use when stripping insulation from a wire?

15. What are the essential conditions for successful soldering?

16. What type of solder is used in electrical work?

17. What type of solder is most convenient for soldering light wire to terminal lugs?

Continued...

JOB 25

Continued

18. What is the function of resistance wire, as used in the heating elements of household appliances?

19. What is the first consideration when selecting a resistance wire for a heating element?

20. What is a mending sleeve?

21. In making any electrical repairs, especially appliance repairs, what should be the major objective?

JOB 26

Service Heating Elements and Thermostats

HSA -I-85-93

1. What is a heating element?

2. What were the disadvantages of early hot plates?

3. Describe the construction of a later type heating element.

4. What is a thermostat?

5. Explain the operation of a thermostat.

6. How may a thermostat be adjusted?

7. What must usually be done if a sealed heating element is open?

8. What is an ohmmeter?

9. Define the underwriter's code.

10. What special tape should be used when insulating an element?

JOB 27

Service Electric Toaster

AHA - 100-113
HSA-I 15-17

1. Why should the bimetal strip of the thermostat never be bent?

2. Automatic toasters are made to operate on what voltage?

3. Name five common causes for the toaster failing to heat.

4. Describe the operation of a pop-up type toaster.

5. When an automatic toaster fails to heat up after the bread carriage lever has been properly depressed, what is usually the cause?

6. What is used to clean the electrical contacts?

7. What causes a toaster to fail to pop-up?

8. What is the length of a toasting cycle?

9. How can a single element in a toaster be replaced?

JOB 28

Service Electric Irons

AHA - 85-99
HSA-I 24-31

1. Most service calls in connection with electric irons are caused by what three conditions?

2. What is the first thing to test, when an electric iron will not heat?

3. What are the two most important rules to observe in taking an iron apart?

4. Name the two classes of irons.

5. Of what do the heating elements in electric irons consist? Explain.

6. Why is it not desirable to use ordinary tap water in a steam iron?

7. Name two reasons why an iron fails to heat.

8. What is the standard voltage in most sections of the country, and most irons are rated at what volts?

9. If an iron is rated at 1 kilowatt and the tester shows it is only drawing 700 watts, what could be the trouble?

10. Name the two common methods used to generate steam in irons.

JOB 29

Service Electric Dishwasher

AHA - 462-475
RMA - 139-159

1. What may cause a need for service on the dishwasher?

2. The dishwasher should be run through several cycles in the customers presence. Why?

3. What may cause a bad reputation for the serviceman?

4. List possible causes machine fails to operate.

5. List possible causes and remedies if water does not remain in tank.

6. What three essentials are required for proper installation and operation of the dishwasher?

7. In addition to the three essential items necessary for a dishwasher, what two other things must we have for proper operation?

8. If the serviceman has any doubt concerning a repair job, what should he do?

9. Why should the dishes and cups be properly racked?

10. Why are bleach and vinegar used?

JOB 30

Service Garbage Disposer

AHA - 476-484
RMA - 160-165

1. What kind and size motors are used on garbage disposers?

2. Since jamming is common place in the functioning of a garbage disposer, most disposer are provided with what? Explain.

3. What is used to provide a watertight joint and absorb the vibration of the disposer?

4. What kinds of matter will the garbage disposer not dispose?

5. Name the two essential parts of the garbage disposer.

6. What is the function of the pulverizing device?

7. What mechanism prevents operation of the unit unless a sufficient amount of water is available to carry away food waste?

8. What should the serviceman look for in the older drainage systems?

9. What size drain pipes should be used?

10. What electrical connections are necessary for garbage disposers?

11. What are the most common troubles found with disposers?

12. Name some possible causes if the motor will not start?

13. Give four causes of abnormal noise and vibration?

JOB 31

Service Automatic Coffee Makers AHA - 143-149

1. Upon what are all automatic coffee makers dependent for their operating cycle?

2. What are some of the reasons that automatic coffee makers may not function properly?

3. What should be done after the appliance has been carefully checked and no defect is found?

4. On pilot-lamp equipped units, how does one know when the low-heat circuit is operating?

5. If a circuit is complete, what will happen when the reset switch is depressed and held down?

6. What may occur if the thermostat of the appliance is out of adjustment?

7. List the steps for adjusting the low-temperature control setting, on the automatic brewer-type coffee maker.

8. When is the high-temperature control setting made?

9. List steps for setting the high-temperature control.

10. List steps for checking the low-temperature control setting.

11. List steps for checking the high-temperature control setting.

12. What are two causes for the boiling over of automatic coffee makers?

JOB 32

TYPES OF ELECTRIC MOTORS EAE: 141-151

1. The Shunt D.C. motor is usually referred to as what kind of motor?

2. Why does the sum of the field and armature currents not give the output power of a Shunt D.C. motor?

3. How are the windings connected in the Series D. C. motor?

4. What is the main advantage of the Series motor?

5. What are the two kinds of compound D.C. motors?

6. Which kind of current is used to operate the Universal motor?

7. Why are the field poles and windings on an induction motor called the Stator?

8. What is represented by three-phase alternating current?

9. In what way does the Repulsion Induction motor differ from the D. C. motor?

10. Describe the Shaded pole motor.

JOB 33

INSTALL ELECTRIC MOTOR STARTING DEVICE

EMC: 2-10
EAE: 142-145

1. What is meant by "Starting Device"?

2. Are starting devices used for more than just starting motors? Explain.

3. What is the difference between manual and magnetic starters?

4. Name the four types of manual controllers.

5. Name some of the factors to be considered when starting and stopping a motor.

6. Discuss conditions to be considered in speed control with respect to: Varying speed; constant speed, adjustable speed, and multi-speed.

7. What protective features may be desired for a typical motor installation?

8. Automatic systems of starting and control can be divided into two general classifications. What are they?

9. Motors started with a toggle switch need some sort of overload protection. What is generally used?

JOB 34

REPAIR AND/OR INSTALL MOTOR OVER-LOAD PROTECTORS EMC: 12-13

1. What are the two most popular types of overload units used in motor starters?

2. How does a melting alloy overload work?

3. How many relays are required in the single-pole or double-pole types of starters?

4. Describe how you would change out a pair of overload units on a motor starter.

5. Does motor starting current cause the overload units to trip under normal conditions?

6. What is meant by "trip-free"?

7. Where are the overload units usually located?

8. Will a motor starter operate without overload units?

9. If the handle of an installed motor starter is in the center position, what condition does this indicate?

10. How may a manual starter be installed or used for an automatic operation?

JOB 35

REPAIR AND/OR INSTALL MOTOR SWITCHES

EMC: 11-14
EAE: 143-144

1. On motors of one horsepower or less there is a simple type of starter in common use. Name this starter and tell why it cannot be used on motors of larger size.

2. What do electrical codes require for small fractional horsepower motors when they are started by automatic or remote control?

3. What are some of the most usual applications of fractional horsepower starters?

4. What are some automatic control devices used in conjunction with fractional horsepower manual starters?

5. What are the limitations to be considered in using these control devices?

6. Sketch a schematic drawing of a manual starter for fractional h. p. motor without selector switch.

7. Draw a schematic for a manual starter for fractional h. p. motor using hand-off-automatic selector switch.

8. What size single-phase motors may be started with a manual push button type starter?

JOB 36

DETERMINE CIRUCIT REQUIREMENTS FOR MOTORS PEW: 502-518

1. What are the Code requirements regarding the size of wire used in connecting motors?

2. The Code specifies only the minimum size wires that may be used in a motor circuit. What about the voltage drop that always occurs?

3. Discuss the difference between straight wiring for a motor and "remote" control circuits.

4. What are the Code requirements for grounding motors operating in excess of 150 volts to ground?

5. What is the purpose of the disconnecting means in a motor circuit?

6. Discuss briefly the need for running protection for a motor.

7. According to the Code, what is the definition of a motor controller?

8. How high does the ratio of starting current to running current vary?

JOB 37

INSTALL MOTOR CONTROLLERS PEW: 511-518

1. Define a motor controller.

2. What is a remote-control type controller?

3. What comparative size is the wiring for the remote station as compared to regular motor leads?

4. What are the requirements for grounding controller cases?

5. Describe a "combination" or combined controller.

6. What is the advantage of using a remote station instead of a controller with the push buttons located in the controller itself?

7. Describe in your own words how a motor starter operates.

8. What purpose are overcurrent devices put in a starter?

9. Is it possible to control a motor from more than one place?

JOB 38

INSTALL PUSH BUTTON STATION-STOP-START-REVERSING EMC: 68-72

1. What are the three basic control circuits?

2. What may actuate the controlling contact on a two-wire circuit?

3. What type of starter is generally used with a two-wire control?

4. Draw a push button station using a three-wire control.

5. Why is a jumper required between the start button and the stop button on a three-wire circuit?

6. What is all that is necessary to stop a motor using a three-wire push button station?

7. By merely adding another three-wire control to the one already in use it can be seen that you can, by making the proper connections, operate a motor forward or reverse. Would more than one set of overloads be needed in this new total circuit?

8. Give some examples of a Hand-off-Automatic control.

9. Why must a selector switch and two-wire pilot device be used to control a magnetic starter rather than a large motor directly?

10. Would it be possible to operate the control circuit separate from the motor voltage?

JOB 39

WIRE MOTORS ICW: 98-101

1. What knowledge must an electrician have before he can wire, repair or otherwise work on motors?

2. Name some of the most popular kinds of motors in use today.

3. What is the usual current frequency in this country?

4. With what, according to the Code, must every motor be equipped?

5. Are all motors supposed to be marked in horsepower?

6. What are the most important notations on a motor for a wireman?

7. What does the term continuous duty mean on the motor nameplate?

8. What do the Code Letters show on the nameplate?

9. What does the term Ambient Temperature mean?

10. What percent of normal current do a large number of squirrel-cage motors draw on starting?

JOB 40

SERVICE MOTOR CONTROLLERS Information Sheet 40A

1. What are the basic parts of a motor controller?

2. In servicing controllers, which parts should be checked first?

3. If an overload is found to be tripped, how soon should an attempt be made to reset it?

4. In servicing a controller, if the contacts are found to be made of silver, how should they be cleaned?

5. How are the operating coil and the overloads connected?

6. What should be used to check continuity in the controller circuit?

7. How does the electrician determine if the operating coil is working?

8. If the overload keeps tripping, would the fault be in the controller?

9. What is another very important point to check when servicing a controller?

10. If a connection is discolored, what is this a sign of?

JOB 40A
INFORMATION SHEET

Motor controllers are made up of the following basic parts: stationary and movable contacts, operating coil, and overloads. The contacts are very important as the life of the controller depends on a good contact. The burning of one contact can cause a single- phase condition. If an overload is found to be tripped wait until it cools, usually about two minutes before attempting to reset it.

Some contacts are made of silver, these should never be dressed with a file. They should be wiped off and if found to be burned or beat down the contacts should be replaced.

The operating coil and the overloads are connected in series. An Ohmeter or a multimeter can be used to check the continuity of the controller circuit. To determine if an operating coil is working properly, disconnect one of the leads and test across the coil with an ohmeter. If the coil is open there will be no reading. If a very low resistance reading is obtained, the coil is probably shorted. The resistance should be checked against a new coil if possible.

Overload devices are placed on all motors to prevent them from taking too many amperes. The controller will not usually cause them to trip.

All terminal connections on controllers should be kept very tight. Loose wires will cause heat and eventually burn open, causing a discoloration around the connections.

JOB 41

HEATING TERMS PBM: 333-335

1. What are the classifications in which heating systems may be classified?

2. What is the difference in the types of heating systems?

3. Why does the term "BTU" affect any operation of a heating system?

4. What does the term "specific heat" mean?

5. Why is it said, that temperature is not heat, but the effect of heat?

6. What must be done in order to change water into steam after it has reached a boiling point?

7. What is the accepted rule for calculating boiler horsepower?

8. What are the methods by which heat transfer may be accomplished

9. What is the method of heat transfer when you feel heat from a radiator in a room?

10. What is the method of transfer when heat is transferred by motion or circulation of some substance?

11. When a common fireplace poker is placed in the fire, what method of heat transfer is this?

JOB 42

TYPES OF HEATING SYSTEMS PBM: 335-339

1. What are the types of heating systems in use today?

2. In which type system is water heated at a central source and then circulated by pipe to convectors, unit heaters, or radiators?

3. How does the forced-circulation system of hot water heating operate?

4. What is meant by the gravity system of water circulation?

5. What are the advantages of the hot-water type heating systems?

6. Which type system provides heat by air being circulated over heat transfer surfaces and then circulated to the location to be heated?

7. Which of the heating systems is said to be excellent, because it carries a maximum amount of heat in a small volume?

8. Why do systems operating with steam heat operate with different degrees of boiler pressures?

9. What actually happens during the burning of fuel which is used in heating systems?

10. What are the three conditions that must be met for efficient combustion?

JOB 43

CHECK LOW PRESSURE FIRE
BOX BOILER

PBM: 339-343

1. What do the Kewanee Boiler factory engineers emphasize for boilers to maintain efficient operations?

2. What are the rules to remember when operating a low pressure firebox boiler?

3. Why should the inside of a new boiler be completely washed out before operating?

4. What will the thin film of oil on the surface of the boiler tend to cause?

5. What is the procedure to follow in washing out the new boiler?

6. Why should a new boiler be fired at a low rate for at least one day?

7. How should the burner be adjusted for the breaking in period of the boiler?

8. At what temperature should the boiler be kept while washing?

9. Draw and label the Kewanee type "C" boiler as shown on page 342 (PBM).

JOB 44

CHECK HOT WATER BOILERS PBM: 344-351

1. What will indicate the amount of pressure required to fill the boiler and entire system with water?

2. Why should the outside of the boiler be covered with insulation?

3. How soon after installation of the boiler should it be insulated?

4. How much water should be put into the boiler before operating it?

5. When should the heat be applied to the water after it has been put into the boiler?

6. What should be the firing rate of the boiler for the first firing?

7. How should the burner be adjusted for the best results?

8. When a boiler is fired with either oil, gas, or combination oil and gas burner or stoker, and is equipped with all controls and safety devices, how should the burner be adjusted?

9. How should the boiler be fired if the boiler is to be fired by hand?

10. Which method of firing is most suitable for a high steaming rate?

JOB 45

SERVICE BOILER WATER CONTROLS PBM: 347-350

1. What should always be noticed upon entering the boiler room?

2. Why should the gauge cock and the drain valves on the water column and the water glass be operated daily?

3. What is the proper procedure to follow when making a complete test on the water control installations?

4. What is the purpose of the blowoff or drain valve on the boiler?

5. How does the treatment of the water affect the boiler?

6. How many times should the water be treated during the years operation?

7. How does the appearance of foaming and priming affect the boilers operations?

8. What are some of the conditions that could cause foaming or priming in the boiler?

9. What should be done in case of serious trouble due to foaming or priming?

10. What care should be given the boiler flues?

JOB 46

MAINTAIN BOILERS PBM: 350-357

1. How should all piping connections on the boiler be maintained?

2. What is the procedure to follow in replacing a new water glass on the boiler?

3. When placing a boiler out of service, what is the best procedure to follow?

4. How is the proper method to wash a boiler for more efficient service?

5. Who should always accompany the State or Municipal Inspector when inspecting the boiler?

6. What are the points to consider regarding "general" boiler maintenance?

7. What should be considered in daily maintenance of the boiler?

8. What are the items you should always check on the monthly maintenance of the boiler?

9. How should the boiler be prepared if it is to be left in "wet storage"?

10. What is the procedure to follow if the boiler is to be left in "dry storage"?

JOB 47

INSTALL AND/OR SERVICE STEAM
TRAPS AND VALVES

PBM: 360-364

1. How often should steam traps be checked or disassembled for good operation?

2. When inspecting the valve, how is it possible to look at it and determine if the valve is tight and not leaking?

3. Why should an old valve seat never be used with a new valve or vise versa?

4. What should not be done when installing new valve seats?

5. What other item usually needs replacing when making repairs on the steam trap, for it to perform like new?

6. What is the method for checking the alignment of the guide pins in the steam trap?

7. How may the buckets be checked for proper operation?

8. What should be done if dirt is found in the steam trap?

9. How should the bypass valve inspection be made?

10. What must be done when changing the pressure on any steam trap?

JOB 48

SERVICE UNIT HEATERS
(STEAM AND HOT WATER) PBM: 364-369

1. What are some of the advantages of unit heaters?

2. What must be done in order that unit heaters will produce the maximum heat for which they were designed?

3. What is the procedure to follow in installing a unit heater so that it will deliver its rated capacity?

4. What should be done in order to provide longer life and overall economical operation and efficiency of the unit heater?

5. What has experience shown that indicates the frequency of unit heater inspection?

6. How should the heaters be cared for to keep down internal corrosion?

7. How should the motors of the heaters be cared for to insure maximum operation?

8. Where motors of the type that need oiling are used, what kind of oil should be used?

9. How should the casings, and fans be cared for to insure good performance?

10. When using an air hose to clean the coils extreme care should be used where?

JOB 49

REPLACE AIR FILTERS OR SERVICE PERMANENT TYPE FILTERS

PBM: 369-371

1. What are the most common air filters in use today?

2. How does this type filter help to filter out the air?

3. Where is the renewable or throw away type filter used?

4. Which of the two types of filters is the most economical to use?

5. What type of filter is used where exceptionally high efficiency if required?

6. How does the water spray system of air filtering work?

7. How are the electrostatic precipitators used in the filtering of air?

8. What type of filtering system should be used where it is necessary to remove smoke or very fine particles of dust?

9. What is usually the result of dirty air filters in any situation?

10. What is the procedure to follow when cleaning the steel or aluminum mesh type filters?

11. What is the recommended schedule to follow when using the throwaway type filters?

JOB 50

SERVICE GAS FIRED HOT WATER HEATERS PBM: 80-81, 371-373

1. Where are the lighting instruction usually found on the gas hot water heater?

2. What temperature is the thermostat usually set for gas hot water heaters?

3. What is the maximum temperature that the hot water heater should be set?

4. Why should all hot water heaters be equipped with a safety valve?

5. How should the hot water heater be serviced for a long and trouble free life?

6. What are some items that should not be stored around or near the hot water heater?

7. When and in what cases should the hot water heaters thermostat be set above 140 degrees?

8. What actually provides the heat for the gas hot water heater?

9. Which of the types of hot water heaters is supposed to be the most economical?

10. Of what is the storage tank of the typical hot water heater made?

JOB 51

REFRIGERATION FUNDAMENTALS SRA: 1-10

1. What is refrigeration?

2. What is heat?

3. What is temperature?

4. What is the unit of quantity of heat?

5. Define the term B.T.U.

6. What is specific heat?

7. What is latent heat?

8. List some forms of energy.

9. Why is an understanding of the laws of energy important to those working with refrigeration?

10. What is the kinetic theory of heat?

11. What effect does pressure have on the boiling point of a liquid?

12. How is this effect of pressure used in refrigeration?

13. What are critical pressure and critical temperature?

JOB 52

CHECK HIGH AND LOW PRESSURE REFRIGERANT SYSTEMS PBM: 296-299

1. What is meant by the terms "high side" and "low side" of the unit?

2. What parts of the unit are found on the "high side"?

3. What parts of the unit are found on the "low side"?

4. The condensing unit is made up of what parts of the system?

5. What is the function of the expansion valve?

6. Refer to figure 1, page 296, PBM, diagram of a refrigeration cycle, and give the state or condition of the refrigerant as it is found in each of the following parts of a refrigeration unit:

   a. Liquid line

   b. Suction line

   c. Evaporator

   d. Compressor

   e. Receiver

JOB 53

CHECK AIR CONDITIONING SAFETY DEVICES SRA: 221-232

1. Name the major hazards encountered with refrigeration.

2. What are some of the main causes of explosions in the crankcase of a refrigeration compressor?

3. What safety rule must every maintenance and repair man observe before working on machinery?

4. Explain ways to prevent machinery from being set in motion.

5. What precaution should be taken before opening a system for repair?

6. Are refrigerants toxic? Explain.

7. What should every operator know about the dangers of carbon dioxide?

8. Is it dangerous to smoke while drawing oil from an oil trap?

9. Why should gasoline never be used as a cleaning solvent?

10. Why should oxygen never be used to test a refrigeration system for leaks?

JOB 54

SERVICE ELECTRIC CONTROLS AND LIMIT SWITCHES SRA: 84-91

1. What are electric controls?

2. What are the various functions of electric controls in refrigerant systems?

3. Name and describe the three types of pressure controllers.

4. In what way are thermostats similar to pressure controllers?

5. What is a bimetal thermostat?

6. What is meant by the range and differential of a pressure or temperature controller?

7. What is a low oil-pressure switch, and how is it used in a refrigeration system?

8. What is a high-pressure cutout, and what is its function in a refrigeration system?

9. What is a low-pressure cutout and what is its function?

10. What precautions should be observed in the installation and operation of any type of electric controls?

JOB 55

MAINTAIN AIR CONDITIONING SYSTEM SRA: 192-210

1. What is complete air conditioning?

2. What factors affect the conditioning load?

3. How can solar radiation be reduced?

4. What effect does infiltration or ventilation have on the conditioning load?

5. What is air?

6. How are air temperature and humidity related?

7. How is water vapor superheated?

8. Sketch a compression cycle, and explain how it works.

9. How are dust particles removed from conditioned air?

10. What are packaged air-conditioning units?

11. What is a central air-conditioning system?

12. What are some advantages of a central air-conditioning system?

JOB 56

SERVICE COOLING TOWER SRA: 175-191

1. How does a cooling tower dissipate heat?

2. Name several reasons for re-using cooling water.

3. Why is transferring heat from water to air important?

4. What is meant by wet and dry-blub temperature?

5. Why is it important to know the dry-and-wet-blub temperatures?

6. Which is better for cooling towers, cool or warm air? Explain.

7. List ways in which the cooling effect can be increased in a cooling tower.

8. What is meant by the cooling range?

9. What is meant by the term "drift"?

10. What is meant by blowdown?

11. What is meant by make-up?

12. What is a cooling tower?

13. Of what material is the filling for cooling towers made?

14. What are the three classifications of cooling towers?

15. In a natural-draft tower, on what does the air circulation depend?

16. Sketch a typical cooling-tower system.

17. What are some precautions to take when installing cooling towers indoors?

18. What are some causes of spotty performance in a new cooling tower?

19. What factors can upset cooling-tower performance?

20. How long is it safe to run a cooling-tower fan in reverse?

JOB 56 CONTINUED

21. What mechanical maintenance does a cooling tower need?

22. What structural maintenance does a cooling tower require?

23. What should be done when shutting down a cooling tower?

24. What six steps are needed in determining the correct size pump and pipe for a cooling tower installation?

25. How is the amount of water in gallons per minute to be circulated through a cooling tower determined?

JOB 57

SERVICE EVAPORATORS SRA: 57-62

1. What part of the refrigeration system is the evaporator, and what is its importance?

2. What are the two main types of evaporators?

3. What is the difference between the two types of evaporators?

4. What is meant by prime-surface and extended-surface evaporators?

5. What are the advantages of extended-surface evaporators?

6. What is a plate coil?

7. Where is a plate coil most often used?

8. What is a headered coil?

9. What is a direct-expansion evaporator?

10. What is the difference between flooded and dry-expansion shell-and tube brine or water coolers?

JOB 58

SERVICE CONDENSERS SRA: 46-56

1. What is the purpose of the condenser in a refrigeration system?

2. How much heat does the condenser handle in relation to the heat absorbed in the evaporator?

3. Name six common types of condensers used in refrigeration systems.

4. Where are air cooled condensers usually used?

5. What is meant by the term "gallon-degrees per minute per ton"?

6. What are the disadvantages of a vertical shell and tube condenser?

7. How do shell and coil condensers differ from shell and tube condensers?

8. What is the principal advantage of the evaporative condenser?

9. What determines the capacity of an evaporative condenser?

10. What maintenance is required on evaporative condensers?

JOB 59

INSTALL AIR-COOLED, SELF-CONTAINED UNIT Info. Sheet: 59A

1. For what purpose are air cooled, self-contained units becoming popular?

2. What features do they have that make them desirable for these purposes?

3. What checks should be made on the evaporator and condenser fans before installing the unit?

4. What should be done to the compressor motor after uncrating the unit?

5. When installing the unit inside the building, what steps should be taken to insure adequate condenser air?

6. Where should the unit, which is being installed inside the building, be located to assure adequate support?

7. Of what should the drip pan be constructed for a unit which is located inside the building?

8. What should be done to prevent vibration?

9. How much clearance should there be for a unit that projects through a wall?

10. What should be done if the electrical power at the unit is not up to the rated voltage that is recommended by the manufacturer?

JOB 59A
INFORMATION SHEET
INSTALL AIR-COOLED, SELF-CONTAINED UNIT

Air-cooled package units are proving to be quite popular for central residential and small commercial units. They are compact and eliminate the need for cooling towers and water piping. They are very popular in areas which have hard water and the resulting condenser scaling problems.

Air-cooled package units are designed to meet many different residential and commercial installation requirements. For example, the units can be installed in the attic or crawl space, through the wall or transom, suspended from the ceiling, placed on a roof, or on a concrete base next to the basement wall. They can be connected to an existing warm air duct system or to a specially designed duct system of their own. Plenums are available for "free blow" distribution into the conditioned space.

Most units supply cool air to the conditioned space through the top section of the front face and remove warm air through the bottom section. The condenser intake is through the sides, and discharge is through the rear face of the unit.

They are completely weatherproofed for outside or roof installations.

PREPARING THE UNIT FOR INSTALLATION

Uncrate the unit and check the clearance and rotation of the evaporator and condenser fans. Be sure all fans are properly adjusted.

The hermetic motor compressor is spring-mounted, but during shipment it is held rigid by hex-head, hold-down bolts which are usually located at the four corners of the compressor. Remove the compressor hold-down bolts with a 9/16" wrench. Place the bolts in a cloth bag and tie the bag inside the unit so they are available for future use. The compressor must be bolted whenever the unit is moved.

INSTALLING THE BASE UNIT INSIDE THE BUILDING

The following steps are recommended to insure adequate condenser air:

1. Locate air intake remote from unit.
2. Remove condenser side panels if rotating fan parts are not an injury hazard.
3. If intake must be located next to the unit, take the following steps:
   a. Box in and seal intakes.
   b. Remove condenser side panels to decrease air restriction.
   c. Make provisions to minimize recirculation.

The above recommendations must be followed to prevent excessive losses in capacity.

The location of the opening for condenser supply and discharge air is usually determined in the preliminary survey. An existing window, vent, transom or other opening can be used if it is adequate in size and strength. The gap around the unit must be closed to assure a good weatherseal.

The weight of the unit requires substantial support when installed. In attic installations, place the unit directly over, or as near as possible, to points at which the center partition or other walls meet the side walls of the building. The unit can be placed directly on the joists or on a constructed platform. The joists or platform must provide a level base for the unit.

Use an auxiliary drip pan on all inside installations. Do this even though FHA and local codes do not require it. The drip pan must be constructed of corrosive resistant material such as galvanized steel and must include a drain line to the outside of the building. Place the drip pan on the installation platform in such a manner that it collects condensate from the unit.

To prevent transmission of unit vibration, place an isolation pad or several strips of ½" celltight rubber under the entire width of the unit.

INSTALLING BASE UNIT PROJECTING THROUGH THE WALL

The location of the opening is usually determined in the survey. Provide for 3/4" clearance around the unit. This clearance is the maximum recommended to permit easy weathersealing of the hole. Wall opening construction is the same as for inside unit location.

The weight of the unit requires substantial support when installed. Be sure the sill of the opening safely supports the weight of the unit.

The unit must be installed on a rigid and well-constructed platform to prevent any possible dislocation during operation. When planning the dimensions of any field constructed platform, allow for the removal of side panels for servicing.

Condensate is removed through ½" FPT fittings in the base of the unit. A drip pan is not required in through-the-wall installations.

The unit must be installed so as to prevent transmission of vibration. Place an isolation pad or several strips of ½" celltight rubber under the entire width of the base unit to deaden sound and vibrations.

All wiring must comply with local and National Electric Code requirements. The unit must be grounded.

The units are usually completely wired at the factory for either 230-volts, 1-phase, 60-cycle or 220-volts, 3-phase, 60-cycle electrical characteristics. Check the nameplate characteristics of the unit against the available power supply. Power at the unit must be within 10% of rated voltage, and on polyphase units the phases must be balanced within 3%. Contact the Power Company for correction of line voltage that is not within 10% of standard or is unbalanced.

JOB 60

SERVICE GLOBE, GATE AND CHECK VALVES

RIP: 55-61
HDP: 250-252

1. What are the four types of Globe Valves?
2. Why are Globe Valves called control valves?
3. Valves are made from what materials?
4. What methods are used in joining pipe to valves?
5. Why should valves be installed in upright position?
6. What should be done to the line before valves are installed?
7. Why should gate valves not be used for throttling?
8. What are the types of gate valves?
9. The Gate Valve is known as what type valve?
10. What is the purpose of check valves?
11. What are the two basic types of check valves?

JOB 61

CHECK WATER METERS, CURB BOXES AND STRAINERS RIP: 62-66

1. What are water meters?
2. Water meters are installed in what position?
3. Why are meters one size larger than the pipe sometimes used?
4. Where is the valve placed on waterline in relation to the meter?
5. How may you know the direction of flow of a meter?
6. What units of measure do meters register?
7. Where is the curb box installed?
8. Where is the proper location for a strainer?
9. What is the effective area of a good strainer?
10. What size should the strainer be?

JOB 62

CHECK PRESSURE VALVES AND BYPASS RIP: 67-70

1. What is the purpose of pressure-reducing valves in a water supply system?

2. What is considered excessive pressure in a water supply system?

3. If the entire water supply system is to be protected where is the pressure-reducing valve located?

4. When protecting special fixtures or equipment where is the pressure-reducing valve located?

5. Where is the safety valve installed on supply line with pressure-reducing valve on supply line to a heater?

6. How may the pressure at which valve closes be increased?

7. What is the purpose of a Bypass?

8. What kind of valve is installed in a Bypass?

9. What is placed on each side of a Reducing Valve?

JOB 63

CHECK HOUSE SERVICE PIPE-BASEMENT WATER MAINS RIP: 71-73

1. What determines the size of the service pipe?

2. What is the danger in using lead pipe for the water system?

3. What kind of service pipe is used in buildings requiring one larger than 2 inches?

4. What type of pipe and fittings are used for basement water mains?

5. Why should pipe be run as direct and with as few bends as possible?

6. What water pressure must be maintained at highest fixture?

7. Why should a larger size galvanized iron pipe be used than a copper pipe?

8. Where should the main shut off valve be located?

9. Where should other shut off valves be located?

10. How close together should supports for basement mains be located?

JOB 64

DETERMINE MAXIMUM FIXTURE UNIT LOAD RIP: 94-96

1. What group developed the fixture unit method?

2. What is the basis for the fixture unit system?

3. What is the number of fixture units for a bathroom group?

4. What is the number of fixture units for a bedpan washer?

5. What is the fixture unit rate for a public lavatory?

6. What is the fixture unit rate for a sink service?

7. What is the fixture unit rate for a water closet? Private? Public?

8. What is the maximum fixture unit load?

9. What is the maximum number of fixture units that may be connected to a 4" pipe that has 1/8" fall per foot? 1/2" fall per foot?

10. What is the maximum number of fixture units that may be connected to 6" pipe that has 1/8" fall per foot? 1/4" fall per foot?

JOB 65

CHECK WASTE AND VENT STACKS RIP: 101-105

1. What is a waste stack?

2. What determines the number of fixture units permitted on waste stacks?

3. What is a branch waste pipe?

4. What is the effect of oversized waste pipes?

5. What size should the branch waste pipe be for a single fixture?

6. What pitch should branches have?

7. What angle should a branch enter the stack?

8. Where should the clean out be placed?

9. What are the purposes of the vent pipe?

10. What is the purpose in providing fresh air to the drainage system?

11. How much higher must vent stacks be than the highest fixture?

JOB 66

CHECK LOSS OF TRAP SEALS RIP: 106-113

1. What is a siphon?

2. What is the effect of water descending in a waste stack?

3. What is a plenum?

4. What is air pressure lower than atmospheric pressure at the top of the stack called?

5. What is the effect of a properly installed vent pipe?

6. What is the average depth of a seal in an "S" trap?

7. What is the best trap and waste pipe connection?

8. Where should the vent pipe never be attached?

9. Where does back pressure usually occur?

10. What is capillary attraction?

11. What is evaporation?

JOB 67

CHECK CONTINUOUS VENT AND WET VENT RIP: 114-117

1. By what other name is the continuous vent known?
2. What determines the size of the vent pipe?
3. What caution must be taken when back venting?
4. What is the reason for keeping the horizontal pipe short?
5. Why does the pipe rust along the top when it is not ventilated?
6. What is a wet vent?
7. Where are wet vents used?
8. What type of turn is best to use in all stacks?
9. What type of pipe is used for the wet vent?
10. What determines the size of the vent pipe?

JOB 68

REPLACE FIXTURE AND GREASE TRAPS RIP: 124-126

1. What are sewer gases?
2. Where are traps installed?
3. What is a trap?
4. What are the four forms of "S" traps?
5. Why is the "drum" trap used?
6. Why is the "S" trap preferred?
7. What is the seal of a trap?
8. What is the depth of water in a safe seal?
9. What is a grease trap?
10. What are the two types of grease traps?
11. What should be the size of a grease trap?

JOB 69

CHECK SUMPS AND CELLAR DRAINERS RIP: 135-137

1. In new construction, how is surface water or water close to surface that is likely to wet basement controlled?

2. What should be used to cover field tile?

3. To remedy the condition of a wet basement after a building has been erected what must be done?

4. What are the two types of cellar drainers?

5. Why should unions be placed on all pipes to the pump?

6. How is the operation of electric cellar draining pumps controlled?

7. Why should a check valve be installed in the discharge line of the cellar drainer?

JOB 70

CONDUCTION - CONVECTION - RADIATION RIP: 144-147

1. What is conduction?

2. What is the effect of heat to the molecules of which a substance is composed?

3. What is an indication that a substance is a good conductor?

4. What are the better conductors? The poorer conductors?

5. What is convection?

6. What difference in weight is there in a cubic foot of water at 39.2^{o} and at 160^{0}?

7. What creates the draft in a chimney?

8. What is radiation?

9. What is the effect of different surfaces on radiation?

10. What effect does the color of cloth have on its ability to absorb heat?

JOB 71

THE BRITISH THERMAL UNIT AND THE EXPANSION OF WATER RIP: 140-14:

1. How may heat be measured?

2. What is a British Thermal Unit (BTU)?

3. What unit of measure of water is approximately one pound?

4. What is the weight of a gallon of water? Cubic Foot?

5. How does the expansion of water differ from that of metals?

6. What is the temperature point of maximum density of water?

7. What is the effect of heat or cooling of water which is at maximum density?

8. Water expanded to steam increases how much in volume?

9. How much pressure is exerted by ice formation?

10. Realizing the tremendous pressures exerted by expanding water, what must be placed on all water heating apparatus?

JOB 72

REPLACE THERMOSTATS RIP: 154-155

1. What controlls the gas valve on an automatic gas water heater?

2. Of what does a thermostat consist?

3. How does the thermostatic element cause the heater to operate?

4. What is the relationship in length of the carbon rod and the copper tubing?

5. With what are most thermostats equipped?

6. What safety precautions should be observed in lighting a gas water heater?

JOB 73

REPLACE RELIEF VALVES RIP: 157-161

1. What is a Relief Valve?

2. From what materials are relief valves usually made?

3. What are the four different types of relief valves?

4. What is the proper setting for a relief valve?

5. What type relief valve is known as a "Pop Valve"?

6. What is the principle upon which the diaphragm safety valve operates?

7. Why should the proper relief valve and proper location be selected on each job?

8. What determines the effectiveness of a diaphragm relief valve?

9. Why may a spring type relief valve become dangerous after long periods of non-use?

JOB 74

INSTALL ELECTRIC WATER HEATERS RIP: 163-165

1. Electric water heaters are usually what type?

2. How do electric water heaters differ from other types of water heaters?

3. Where does cold water enter electric water heaters?

4. Where is hot water taken from the heater?

5. Where should the relief valve be placed?

6. What are the types of heating elements for electric water heaters?

7. What is meant by double heating element?

8. What is used to retard corrosion?

9. Why should water heaters be insulated?

JOB 75

USE MEASURING TOOLS FOC: 44-64

1. The ease and accuracy with which a craftsman lays out his work depends to a great extent upon what?

2. What is the first measuring tool the carpenter finds that he needs?

3. What are the two types of zig-zag rulers?

4. What can be done to assure smoothness of operation and at the same time prolong the life of a new ruler?

5. What type measurements are usually made with the zig-zag extension rule?

6. In what lengths are steel tapes available?

7. List four important uses of the steel tape?

8. In what lengths are the metal pull-push or pocket ruler available?

9. What lengths do carpenters prefer in both the pull-push metal ruler and the steel tape?

10. Why should oil be applied sparingly to both the pull-push metal ruler and the steel tape?

11. What size angles can be checked with the handle of the try and miter square?

12. What is the difference between the try and miter square and the combination square?

13. List the parts of the standard framing square.

14. In terms of materials, what is the best buy in framing squares?

15. List the most common operations the carpenter performs with the use of the framing square.

16. What tables are found on a good framing square?

17. If the angle of a square is less than 90 degrees how can it be corrected?

18. List the uses (5) of the framing square in working with circles.

JOB 75 CONTINUED

19. List the seven parts of the marking gage.

20. For what does the carpenter use the marking gage?

21. For what type work is the sliding tee-bevel used?

22. How is the tee-bevel of use when two pieces of wood are to be fitted together at an angle?

23. What is a plumb bob?

24. For what is the plumb bob commonly used?

JOB 76

USE EDGE CUTTING TOOLS

FOC: 43,48,72-79, 103-105,118-122

1. What is the primary use of chisels?

2. Much of a carpenter's work can be accomplished satisfactorily with three sizes of chisels. What are these sizes?

3. For what is the socket wood chisel or firming chisel used?

4. In finer work such as fitting locks, putting on hinges and for cabinet work, what type chisel is used?

5. What should be used for striking or pounding a wood chisel?

6. Of what use is the plane to the carpenter?

7. Why is the block plane desirable for fitting?

8. What type work is the jack plane used for?

9. What is the recommended size for a smoothing plane?

10. The successful carpenter today must not only know his hand tools but he must know and be very familiar with what other tools

11. In the field of carpentry there are five principal manually operated saws noted for their use. Name them.

12. Of what advantage is the straight back edge saw over the curved back edge saw to the carpenter?

13. The number of points per inch on the blade of a saw determines the size or number of the saw. For rough construction what numbe point saw is used? For fine or finish work?

14. For maximum proficiency a carpenter should have no less than three handsaws: What are they and describe each?

15. What is the primary use of the electric hand saw?

16. Of what use is the miter box?

17. List the uses of the utility knife.

18. What are the uses of the wood rasp and wood file?

JOB 77

USE HOLDING TOOLS

FOC: 40-43, 294
310-312, 342

1. Why is the "C" clamp used in carpentry work?

2. What type clamps are used in relation to the pouring of concrete?

3. What type vise can be carried in the carpenter's tool kit?

4. In what positions may work be secured and held with the portab vise?

5. List the two types pliers used in carpentry.

6. State the specific and common uses of combination pliers.

7. What is the use of the side cutting pliers?

8. For what are pinchers used?

9. Of what use is a door jack to a carpenter?

10. The principles involved in laying out a brace are the same as for laying out what else?

11. Where is the table for brace measure found on the framing squa

JOB 78

USE FASTENING TOOLS FOC: 36-40

1. List the screwdrivers that are normally operated by hand.

2. What size screwdrivers should a carpenter posess?

3. What is the difference between the phillips screwdriver and a conventional one?

4. What is the difference between the ratchet screwdriver and the spiral groove ratchet screwdriver.

5. What type screwdriver should be used around electrical work?

6. The spiral ratchet screwdriver is most useful for what?

7. Why should the tip of the screwdriver not be any wider than the diameter of the screw head?

8. How may screws be removed with the spiral ratchet screwdriver?

9. Why must care be exercised in the use of the spiral ratchet screwdriver?

10. Other than driving and removing screws, in what other operations can the power screwdriver be employed?

11. What safety measures should be taken before removing or installing bits in a power screwdriver?

JOB 79

USE BORING TOOLS FOC: 93-101

1. List the parts of the ratchet brace.

2. What is the "Sweep" of the ratchet bit brace?

3. List the parts of the auger bit.

4. What does the number on the tang of the auger bit indicate?

5. What determines the speed of the auger bit?

6. Of what use is the expansive bit in relation to the auger bit?

7. Why is the bit extension used in form work?

8. What is the specific purpose of a gage bit?

9. What is the difference between the hand drill and the breast drill?

10. Where are markings found on a twist drill that indicates whether it is to be used for drilling wood or metal?

11. The power auger bit is designed to drill into what type material

12. Portable electric drills are available in what sizes?

13. What type power drill is adaptable for routing, mortising, jointing, shaping and sanding?

JOB 80

USE POUNDING TOOLS FOC: 24-29

1. Why is a mallet used?

2. What type mallet is commonly used by carpenters?

3. Name four types of hammers normally used in carpentry.

4. Why is the handle of a hammer usually made of wood?

5. Why is the sledge hammer used?

6. Of all carpentry tools, which is the most used?

7. What is the recommended weight of the straight claw hammer? Wh

8. Name the three types of hatchets.

9. What type blade (bevel) does the claw hatchet have?

10. What is the difference between the claw hatchet and the half hatchet in respect to nail pulling slots?

11. For safety, how should an unsheathed hatchet or ax be carried?

12. Of the three type hatchets, which one weighs less? Why?

JOB 81

USE POWER TOOLS FOC: 79-80, 126-129

1. What are the three types of portable power sanders?

2. For what type maintenance work is the belt sander used?

3. Why is the trigger on the belt sander equipped with a locking device?

4. What is the chief asset the disc sander has that the belt and orbital sanders do not have?

5. Which of the three type sanders can be used with different accessories?

6. List the different jobs that can be performed with the disc sander by attaching (a) a wire torque brush; (b) felt pad; (c) rubber pad.

7. The electric hand saw is used mainly for what work?

8. What controls the maximum depth of a cut that may be made with the electric hand saw?

9. What is the maximum bevel cut in degrees that may be made with the electric hand saw?

10. What is the purpose of the retractable guard?

11. Define the following: (a) ripping fence or guide (b) saw protractor.

JOB 82

USE MACHINE SHOP MEASURING TOOLS MSO: 9-44

1. What is the standard of measurement adopted by American Industry?

2. How are steel rules calibrated?

3. What are the dimensions on a blueprint called and how are they given?

4. When are decimals used with dimensions on a blueprint?

5. How is a standard steel rule graduated and used?

6. Why is the short length rule used?

7. Why is the hook rule used?

8. Upon what does accuracy of tools like inside and outside caliphers depend?

9. Why should a calipher be held with the fingertips?

10. What are the two types of inside caliphers?

11. What four graduations are used in the decimal system?

12. How many divisions are on the thimble of a micrometer?

13. Draw a dial indicator mounted on a stand. Draw a micrometer.

14. What is the scale called on the frame of a vernier calipher?

15. Why is the vernier bevel protractor used?

JOB 83

USE BENCH TOOLS MSO: 45-87

1. What are hand tools?

2. Draw a ball-peen hammer.

3. What two types of hammers are used in machine shop work?

4. Of what is the head of a soft-face hammer made?

5. Describe the size range of ball-peen hammers and the difference in use of the small hammers and the heavier hammers.

6. What is the advantage of a square shank on a larger size screw driver?

7. Describe and illustrate (by drawing) the positions of the blades of the offset screwdriver.

8. How should the flat sides of a screwdriver be grounded when repairing it?

9. All vises are made of what parts?

10. How does a machinist prevent marring a finished surface or soft metal when clamping in a vise?

11. Describe an open end wrench.

12. Describe a combination wrench.

13. Describe an Allen wrench.

14. Describe an adjustable wrench.

15. In which direction should force be applied to an adjustable wrench?

JOB 84

USE HACK SAWS MSO: 67-72

1. What is the most common operation performed in the shop?

2. How is the blade secured in a hack saw?

3. What is meant by the pitch of a hack saw blade?

4. Why are the saw blades set to make a cut slightly wider than the blade?

5. What is the difference between regular-alternate blades and double-alternate blades?

6. Describe a blade with wave set teeth.

7. For what are wave set blades used?

8. Why should the blade never be too tight?

9. Why should the blade never be too loose?

10. Which way should the teeth of a hack saw point? Why?

11. What determines the proper hack saw blade?

12. What is the capacity range of power hack saws?

13. What is the difference between angular-cut capacity and straight-cut capacity of power hack saws?

14. What material is used to manufacture power hack saw blades?

15. Why should the blade be lowered slowly to the work?

JOB 85

USE LAYOUT TOOLS MSO: 73-87

1. What does the term "layout" mean?

2. Why is layout blue or layout dope used?

3. What is the advantage of granite layout plates?

4. Name the nine (9) most common layout tools.

5. Describe the prick punch.

6. Why are dividers used?

7. Give several uses for trammel points.

8. For what is the center head used?

9. Describe the hermaphrodite caliper.

10. Describe the method for setting the hermaphrodite calipher.

11. For what is the surface gage used?

12. Where is the surface gage used?

13. How can the center of a hole be located?

14. Name two methods of locating the center of a piece of square or rectangular stock.

15. Name the safety precautions that should be used when using tools.

JOB 86

USE CHISELS AND FILES MSO: 48-56

1. What are the classes of files according to tooth form?

2. Classify files according to coarseness.

3. Why are handles used on files?

4. When should a second cut file be used?

5. Which file is used for the soft metals, such as brass and bronze?

6. Why should the surface being filed, never be touched?

7. What are the two steps in rounding a corner with a file?

8. What is draw filing?

9. Why is it important to clean a file regularly?

10. For what is the cape chisel used?

11. How is the depth of the cut being made with a chisel controlled?

12. Why shouldn't the chisel be held in one place on the wheel while being ground?

13. How is the chisel kept cool while being ground?

14. Why should the side of the grinding wheel not be used?

JOB 87

USE HAND TAPS MSO: 59-64

1. For what is a tap used?

2. Why is the shank of the tap square on one end?

3. What are the two standard series of unified screw threads used most widely today?

4. What three units make up a standard tap set?

5. Why is the taper tap used?

6. Describe a plug tap and tell why it is used?

7. How is the bottoming tap used?

8. When is the T-handled wrench used?

9. How is the adjustable tap wrench adjusted?

10. Why is it important to chose the correct tap drill size?

11. In what position should the work be clamped in the vise?

JOB 88

CUT THREADS WITH A DIE MSO: 65-66

1. For what purpose is the soild threading die used?

2. What is the advantage of solid dies?

3. Why are solid dies of more than ½" diameter very rare?

4. What is an adjustable die?

5. How are left handed dies identified?

6. How is the size and number of threads of individual dies designated?

7. What numbering system is used in designating the thread?

8. What lubricant is used when threading steel?

JOB 89

USE DRILL PRESS AND ACCESSORIES MSO: 88-134

1. What is the principal purpose of the drill press?

2. What two things must a drill press operator be able to do?

3. Name four types of drill presses.

4. What is the purpose of the spindle on a drill press?

5. Name the three parts of a twist drill.

6. Describe the lips of a twist drill.

7. What are the flutes?

8. What two methods may be used to obtain the drill speed in R.P.M.?

9. Using the Table Xi of the Appendix of MSO, name the recommended cutting fluids for drilling, tapping and reaming.

10. For what is a countersink used?

11. Give six drill sharpening requirements.

12. How are hand reamers identified?

13. How are reamers classified?

14. Give two kinds of holding devices.

JOB 90

REPLACE CALKING MATERIALS PBM: 240-243

1. Why is the use of Calking materials necessary?

2. In what colors does most calking compound come?

3. What is the advantage of purchasing calking compound in cartridges?

4. What is the difference between grade one and grade two calking compound?

5. Where is grade two calking compound often used?

6. Why is a sealer used on certain materials before calking compound is applied?

7. Why are quick drying shellac and thinned varnish not recommended for sealing purposes?

8. What must be done to an area before calking material is applied?

9. What may be done for deep cracks to save calking material?

10. What is a beading tool?

JOB 91

REPLACE BROKEN GLASS PBM: 235-240

1. What is involved in glazing maintenance?

2. What type putty should usually be used when replacing window panes?

3. What is the most economical way to purchase glass for windows and doors?

4. What strength glass should be used for normal locations?

5. For what locations is shatterproof glass recommended?

6. What kind of glass is generally used for entrance ways and large openings?

7. Describe Obscure glass?

8. What can be done to soften old firm putty that is difficult to remove?

9. Why should a window pane be cut slightly smaller than the opening for which it will be used?

10. Why should linseed oil be applied to the window sash before replacing the pane?

11. Why should the putty around window panes be painted within two months?

12. What is used to seal window panes in aluminum sashes?

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Air Conditioning and Refrigeration.

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DESCRIPTORS - *TRADE AND INDUSTRIAL EDUCATION; *STUDY GUIDES; ANSWER KEYS; BIBLIOGRAPHIES; INQUIRY TRAINING; *AIR CONDITIONING; *REFRIGERATION MECHANICS; BUILDING TRADES; SERVICE OCCUPATIONS; *REFRIGERATION

ABSTRACT - Prepared by trade and industrial education coordinators for students of air conditioning and refrigeration, the study guide includes a bibliography, a progress record chart, and 147 job assignment and information lessons and questions. Section I contains 17 units on refrigeration, including: (1) Basic Refrigeration, (2) Basic Electricity, (3) Compressors (Domestic and Commercial), (4) Condensers (Domestic and Commercial), (5) Receivers, (6) Driers, Filters and Moisture Indicators, (7) Liquid Line Solenoid Valve, (8) Metering Devices, (9) Evaporators and Cooling Coils (Domestic and Commercial), (10) Installation Procedures (Commercial), (11) Suction Line Regulators (Commercial), (12) Heat Exchanger (Domestic and Commercial), (13) Bypass Valve (Domestic and Commercial), (14) Electrical Controls (Domestic and Commercial), (15) Pneumatic Controls (Commercial), (16) Electronic Controls, and (17) Special Systems. Section II contains six units on Air Conditioning, including: (1) Instruments for Checking System, (2) Window Air Conditioning Units, (3) Central Air Conditioning (Heating and Cooling), (4) Heat Pumps, (5) Absorption Systems, and (6) Automobile Air Conditioning. An answer book "Answer Book for Air Conditioning and Refrigeration" may be obtained from the source of availability indicated for this document. (GR)

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AIR CONDITIONING AND REFRIGERATION

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The material was edited and prepared for reproduction by J. R. Thomas, Assistant State Supervisor, Trade and Industrial Education and approved by H. F. Worthy, State Supervisor, Trade and Industrial Education.

BIBLIOGRAPHY

AIR CONDITIONING AND REFRIGERATION

Required Texts

MRC - Modern Refrigeration and Air Conditioning
by Althouse-Turnquist-Bracciano
Goodheart-Willcox Company $10.88
18250 Harwood Avenue
Homewood, Illinois 60430

EAE - Electricity and Electronics
by Gerrish $ 4.31
Goodheart-Willcox Company
18250 Harwood Avenue
Homewood, Illinois 60430

POR - Principles of Refrigeration
by Marsh and Olivo $ 5.34
Delmar Publishers
Mountainview Avenue
Albany, New York 12205

PAC - Principles of Air Conditioning
by Lang $ 5.70
Delmar Publishers
Mountainview Avenue
Albany, New York 12205

Supplementary

Introduction to Electrical Trouble Shooting
Refrigeration Products $ .10 each
Whirlpool Corporation
229 Factory Street
LaPorte, Indiana 46350

Refrigeration and Air Conditioning Products
Mueller Brass Company Free
1925 Lapeer Avenue
Port Huron, Michigan 48060

Air Conditioning-Refrigeration Controls
Robertshaw Controls Company, Milford Div.
155 Hill Street $ 1.30
Milford, Connecticut 06461

Electricity and Solid State For Control
Ranco Controls Division
601 West Fifth Avenue Free
Columbus, Ohio 43201

The ABC's of the Thermostatic Expansion
Valve Free
Alco Controls Corporation, Advertising Dept.
Box 12700
St. Louis, Missouri 63141

Solenoid Valve Service Hints
Alco Controls Corporation, Advertising Dept.
Box 12700,
St. Louis, Missouri 63141 Free

Bibliography of Training Aids
Air-Conditioning and Refrigeration Institute
1815 North Fort Myer Drive Free
Arlington, Virginia 22209

HOW TO USE THIS STUDY GUIDE AND RECORD OF PROGRESS

The student's record of progress is kept on the Trade Analysis and Progress Record page. Progress "on-the-job" is kept in the column headed "Job Progress", and related study progress is kept in the adjoining column headed "Related Study".

The four step method of training is used in developing the skills of a trade or occuaption. A record of all these steps for each job is kept in the squares in the column below "Learning Status" (Steps), opposite a specific job.

A dot in the center of the square indicates a student is in the first step; that of observing the job being done. No other mark is made in this square as long as the student remains in this step.

A diagonal line across the same square indicates the student is in the second step; that of helping perform the job under instruction.

Two diagonal lines across the same square indicates that the student is in the third step; that of doing the job under supervision.

The square filled in solid indicates that the student has reached the fourth step; that of a satisfactory level of accomplishment. The date when this accomplishment has been reached is placed in the column "Date Objective Reached", opposite the specific job.

On the day the student has read all the references and has written the answers to all of the questions, for a specific job, the student places this date in the column headed "Date Completed", opposite this job. The grade made on the test on this job is entered in the adjoining square headed "Test Grade".

The word "Information" will be found in the "Job Progress" column for all information lessons. When all references have been read and all answers to the questions have been written, for a specific information lesson, the student places the date of completion in the "Date Completed" column, opposite this lesson number. The grade made on the test on this lesson is entered in the square headed "Test Grade".

The student should read all references before writing the answers to questions. The essay type of answers which are required for most questions have a very definite value as they will help the student form the habit of giving clear-cut, definite answers or explanations. Only a few references and a few questions have been listed on each job sheet to teach the student how to study the literature pertaining to his occupation.

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TRADE ANALYSIS AND PROGRESS RECORD

AIR CONDITIONING AND REFRIGERATION

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION I - REFRIGERATION	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
	UNIT I - BASIC REFRIGERATION				
1.	Fundamentals of Refrigeration	INFORMATION			
2.	Identify and Learn Proper Use of Tools				
3.	Cut and Thread Pipe				
4.	Flare Swage and Bend Copper Tubing				
5.	Soft Solder and Braze Joints				
6.	Use Service Valves				
7.	Use Manifold Gauge				
8.	Evacuate a Refrigerant System				
9.	Refrigerants	INFORMATION			
10.	Purge a Refrigerant System				
11.	Charge a Refrigerant System				
12.	Transfer Refrigerants				
13.	Measure Pressure and Temperature				
14.	Locate and Repair Refrigerant Leaks				
15.	Add and/or Remove Lubrication Oil				
	UNIT II - BASIC ELECTRICITY				
16.	Magnetism	INFORMATION			
17.	The Science of Electricity	INFORMATION			
18.	Sources of Electricity	INFORMATION			
19.	Circuits and Power	INFORMATION			
20.	Instruments and Measurements	INFORMATION			
21.	Check Electric Motors				
22.	Check and/or Replace Capacitors				

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NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION I UNIT II CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
23.	Test a Step-up and Step-down				
	Transformer				
24.	Identify Electrical Symbols				
25.	Check and/or Replace Relays				
26.	Check and/or Replace Magnetic				
	Starters				
27.	Check Circuit Breakers and Fuses				
28.	Service Split-Phase Electric Motor				
29.	Service Capacitor-Induction Motor				
30.	Service Repulsion-Start Induction				
	Motor				
31.	Service Capacitor-Start, Capacitor				
	Run Motor				
32.	Service Poly-Phase and/or Direct				
	Current Motors				
33.	Service Open Type Motor				
	UNIT III - COMPRESSORS (DOMESTIC & COMMERCIAL)				
34.	Compressor Construction	INFORMATION			
35.	Check Open Type Compressor				
36.	Remove Disassemble, Reassemble				
	and Install Open Type Compressor				
37.	Check and/or Test Hermetic Compressor				
38.	Remove and Install Hermetic Com-				
	pressor				

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TRADE ANALYSIS AND PROGRESS RECORD

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION I UNIT III CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
39.	Evacuate and Charge Hermetic Compressor				
40.	Check Crankcase Heater				
41.	Check and Adjust Unloaders				
	UNIT IV - CONDENSERS (DOMESTIC AND COMMERCIAL)				
42.	Check and Service Air Cooled				
	Condensers				
43.	Service and Install Air Cooled				
	Condensers				
44.	Check Performance and Condition of				
	Water Cooled Condenser				
45.	Check Water Flow of Water Cooled				
	Condensers				
46.	Clean and Check Water Cooled Con-				
	densers for Leaks				
47.	Evacuate, Service and/or Install				
	Water Cooled Condenser				
48.	Check Performance of Evaporative				
	Condenser				
49.	Check Water Flow of Evaporative				
	Condenser				
50.	Clean and Check Evaporative Condenser				
51.	Service and Install Evaporative Condenser				
52.	Check and/or Service Water Tower				
53.	Service Water Regulator Valve				

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NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION I UNIT V - RECEIVERS	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
54.	Service and Install Liquid Receivers				
55.	Determine Charge by Checking Receivers				
56.	Check Safety Devices on Receivers				
	UNIT VI - DRIERS, FILTERS AND MOISTURE INDICATORS				
57.	Service and Install Driers and Filters				
58.	Check and/or Install Moisture				
	Indicators				
	UNIT VII - LIQUID LINE SOLENOID VALVE				
59.	Check Solenoid Valve Operation				
60.	Remove and Replace Magnetic Coil				
61.	Check Voltage, Wattage and Amperes				
62.	Remove and Replace Solenoid Valve Body				
	UNIT VIII - METERING DEVICES				
63.	Check Operation of Thermostatic				
	Expansion Valve				
64.	Check Thermal Bulb and External				
	Equalizer Line Location				
65.	Check and Adjust Superheat Setting				
	of Expansion Valve				
66.	Check Operation of Thermal Electric				
	Expansion Valve				
67.	Remove and Replace Diaphragm and				
	Valve Body				
68.	Check Operation of Capillary Tube				

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NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION I UNIT VIII CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
69.	Remove and Replace Capillary Tube				
70.	Correct Malfunction and Restrictions				
	in Capillary Tubes				
71.	Check Operation of Automatic				
	Expansion Valves				
72.	Remove and Replace Automatic				
	Expansion Valves				
73.	Check Operation of Low and High				
	Side Float				
74.	Remove and Replace Low and High				
	Side Float				
	UNIT IX - EVAPORATORS AND COOLING COILS (DOMESTIC & COMMERCIAL)				
75.	Check Operation of Direct Expansion				
	Evaporators				
76.	Check Direct Expansion Evaporator				
	for Leaks, Air Flow, Obstructions				
	and Condensate Drain				
77.	Check Flow and Temperature Rise of				
	Cooling Agent				
78.	Check and/or Replace Chiller or				
	Heating Coil				
79.	Repair Evaporator				
	UNIT X - INSTALLATION PROCEDURES (COMMERCIAL)				
80.	Make Multiple Installation				

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TRADE ANALYSIS AND PROGRESS RECORD

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION I UNIT X CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
81.	Make Two Temperature Installation				
82.	Determine Line Size				
83.	Install Packaged or Self Contained				
	Equipment				
84.	Calculate Commercial Heat Loads				
85.	Select and Balance Evaporators				
	and Condensers				
	UNIT XI - SUCTION LINE REGULATORS (COMMERCIAL)				
86.	Check Operation of Suction Line				
	Regulator				
87.	Adjust and/or Repair Suction Line				
	Regulator				
88.	Remove and Replace Suction Line				
	Regulator				
	UNIT XII - HEAT EXCHANGER (DOMESTIC & COMMERCIAL)				
89.	Check Heat Exchanger				
90.	Remove and Replace Heat Exchanger				
	UNIT XIII - BYPASS VALVE (DOMESTIC & COMMERCIAL)				
91.	Check Hot Gas Bypass Valve				
92.	Remove and Replace Hot Gas Bypass				
	Valve				
	XIV - ELECTRICAL CONTROLS (DOMESTIC & COMMERCIAL)				
93.	Check Low and High Pressure Controls				
94.	Adjust and Calibrate Low and High Pressure Controls				

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TRADE ANALYSIS AND PROGRESS RECORD

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION I UNIT XIV CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
95.	Remove and Replace Low and High				
	Pressure Controls				
96.	Check Oil Pressure Safety Control				
97.	Adjust and Calibrate Oil Pressure				
	Safety Control				
98.	Remove and Replace Oil Pressure				
	Safety Control				
99.	Check Thermostatic Motor Controls				
100.	Adjust and Calibrate Thermostatic				
	Motor Controls				
101.	Check Temperature Control				
102.	Adjust and Calibrate Temperature				
	Control				
103.	Check Defrost Heater				
104.	Remove and Replace Defrost Heater				
105.	Check and/or Set Defrost Timer				
106.	Remove and Replace Defrost Timer				
107.	Check Overload Protectors				
	UNIT XV - PNEUMATIC CONTROLS (COMMERCIAL)				
108.	Service and/or Install Pneumatic				
	Controls				
	UNIT XVI - ELECTRONIC CONTROLS				
109.	Service and/or Install Electronic				
	Controls				

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NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION I UNIT XVI CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
110.	Service and/or Install Solid				
	State Controls				
	UNIT XVII - SPECIAL SYSTEMS				
111.	Service and/or Repair Automatic				
	Ice Makers				
112.	Service and/or Repair Thermo-				
	electric Units				
113.	Service and/or Repair Trans-				
	portation Refrigeration				
114.	Service and/or Repair Soft Service				
	Ice Cream Machines				
115.	Service and/or Repair Water Coolers				
	SECTION II - AIR CONDITIONING				
	UNIT I - INSTRUMENTS FOR CHECKING SYSTEM				
116.	Use Manometer				
117.	Use Air Measurement Instruments				
	UNIT II - WINDOW AIR CONDITIONING UNITS				
118.	Install Window Air Conditioning Unit				
119.	Check for Proper Voltage, Wire				
	and Circuit Breaker				
120.	Check Operation of Window Unit				
	for Proper Charge, Air Flow, and				
	Temperature Difference				
121.	Check Window Unit for Vibration and Noise				

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TRADE ANALYSIS AND PROGRESS RECORD

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION II UNIT II CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
122.	Service Window Air Conditioning				
	Unit				
123.	Check Operating Efficiency of				
	Serviced Unit				
	UNIT III - CENTRAL AIR CONDITIONING (HEATING & COOLING)				
124.	Determine Factors of Load Estimating				
125.	Determine The Size Unit Needed				
126.	Determine The Type Duct System				
	for Air Distribution				
127.	Determine Location and Size of				
	Duct System and Determine Location				
	and Size of Registers				
128.	Install Heating and Cooling Units				
129.	Install Line Wiring				
130.	Install Control Circuits				
131.	Troubleshoot Electrical Circuits				
132.	Troubleshoot Refrigerant System				
	UNIT IV - HEAT PUMPS				
133.	Service and Repair Heat Pumps				
134.	Install Heat Pumps				
	UNIT V - ABSORPTION SYSTEMS				
135.	Check and/or Adjust Heating Devices				
136.	Check and/or Adjust Chiller Units				
137.	Add Refrigerant				

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NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION II UNIT V CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
138.	Repair Leaks				
139.	Add Anti-Freeze				
140.	Repair Electrical Components				
	UNIT VI - AUTOMOBILE AIR CONDITIONING				
141.	Check Belts and Pulleys				
142.	Evacuate and Charge System				
143.	Check and Service Clutch Assembly				
144.	Repair Hot Gas Bypass Valve				
145.	Check and Repair Suction Regulator Valve				
146.	Check Air Distribution System				
147.	Install Automobile Air Conditioner				

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TRADE ANALYSIS AND PROGRESS RECORD

AIR CONDITIONING AND REFRIGERATION

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION I - REFRIGERATION	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
	UNIT I - BASIC REFRIGERATION				
1.	Fundamentals of Refrigeration	INFORMATION			
2.	Identify and Learn Proper Use of Tools				
3.	Cut and Thread Pipe				
4.	Flare Swage and Bend Copper Tubing				
5.	Soft Solder and Braze Joints				
6.	Use Service Valves				
7.	Use Manifold Gauge				
8.	Evacuate a Refrigerant System				
9.	Refrigerants	INFORMATION			
10.	Purge a Refrigerant System				
11.	Charge a Refrigerant System				
12.	Transfer Refrigerants				
13.	Measure Pressure and Temperature				
14.	Locate and Repair Refrigerant Leaks				
15.	Add and/or Remove Lubrication Oil				
	UNIT II - BASIC ELECTRICITY				
16.	Magnetism	INFORMATION			
17.	The Science of Electricity	INFORMATION			
18.	Sources of Electricity	INFORMATION			
19.	Circuits and Power	INFORMATION			
20.	Instruments and Measurements	INFORMATION			
21.	Check Electric Motors				
22.	Check and/or Replace Capacitors				

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NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION I UNIT II CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
23.	Test a Step-up and Step-down				
	Transformer				
24.	Identify Electrical Symbols				
25.	Check and/or Replace Relays				
26.	Check and/or Replace Magnetic				
	Starters				
27.	Check Circuit Breakers and Fuses				
28.	Service Split-Phase Electric Motor				
29.	Service Capacitor-Induction Motor				
30.	Service Repulsion-Start Induction				
	Motor				
31.	Service Capacitor-Start, Capacitor				
	Run Motor				
32.	Service Poly-Phase and/or Direct				
	Current Motors				
33.	Service Open Type Motor				
	UNIT III - COMPRESSORS (DOMESTIC & COMMERCIAL)				
34.	Compressor Construction	INFORMATION			
35.	Check Open Type Compressor				
36.	Remove Disassemble, Reassemble				
	and Install Open Type Compressor				
37.	Check and/or Test Hermetic Compressor				
38.	Remove and Install Hermetic Com-				
	pressor				

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NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION I UNIT III CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
39.	Evacuate and Charge Hermetic Compressor				
40.	Check Crankcase Heater				
41.	Check and Adjust Unloaders				
	UNIT IV - CONDENSERS (DOMESTIC AND COMMERCIAL)				
42.	Check and Service Air Cooled				
	Condensers				
43.	Service and Install Air Cooled				
	Condensers				
44.	Check Performance and Condition of				
	Water Cooled Condenser				
45.	Check Water Flow of Water Cooled				
	Condensers				
46.	Clean and Check Water Cooled Con-				
	densers for Leaks				
47.	Evacuate, Service and/or Install				
	Water Cooled Condenser				
48.	Check Performance of Evaporative				
	Condenser				
49.	Check Water Flow of Evaporative				
	Condenser				
50.	Clean and Check Evaporative Condenser				
51.	Service and Install Evaporative Condenser				
52.	Check and/or Service Water Tower				
53.	Service Water Regulator Valve				

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TRADE ANALYSIS AND PROGRESS RECORD

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION I UNIT V - RECEIVERS	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
54.	Service and Install Liquid Receivers				
55.	Determine Charge by Checking Receivers				
56.	Check Safety Devices on Receivers				
	UNIT VI - DRIERS, FILTERS AND MOISTURE INDICATORS				
57.	Service and Install Driers and Filters				
58.	Check and/or Install Moisture				
	Indicators				
	UNIT VII - LIQUID LINE SOLENOID VALVE				
59.	Check Solenoid Valve Operation				
60.	Remove and Replace Magnetic Coil				
61.	Check Voltage, Wattage and Amperes				
62.	Remove and Replace Solenoid Valve Body				
	UNIT VIII - METERING DEVICES				
63.	Check Operation of Thermostatic				
	Expansion Valve				
64.	Check Thermal Bulb and External				
	Equalizer Line Location				
65.	Check and Adjust Superheat Setting				
	of Expansion Valve				
66.	Check Operation of Thermal Electric				
	Expansion Valve				
67.	Remove and Replace Diaphragm and				
	Valve Body				
68.	Check Operation of Capillary Tube				

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NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION I UNIT VIII CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
69.	Remove and Replace Capillary Tube				
70.	Correct Malfunction and Restrictions				
	in Capillary Tubes				
71.	Check Operation of Automatic				
	Expansion Valves				
72.	Remove and Replace Automatic				
	Expansion Valves				
73.	Check Operation of Low and High				
	Side Float				
74.	Remove and Replace Low and High				
	Side Float				
	UNIT IX - EVAPORATORS AND COOLING COILS (DOMESTIC & COMMERCIAL)				
75.	Check Operation of Direct Expansion				
	Evaporators				
76.	Check Direct Expansion Evaporator				
	for Leaks, Air Flow, Obstructions				
	and Condensate Drain				
77.	Check Flow and Temperature Rise of				
	Cooling Agent				
78.	Check and/or Replace Chiller or				
	Heating Coil				
79.	Repair Evaporator				
	UNIT X - INSTALLATION PROCEDURES (COMMERCIAL)				
80.	Make Multiple Installation				

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NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION I UNIT X CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
81.	Make Two Temperature Installation				
82.	Determine Line Size				
83.	Install Packaged or Self Contained				
	Equipment				
84.	Calculate Commercial Heat Loads				
85.	Select and Balance Evaporators				
	and Condensers				
	UNIT XI - SUCTION LINE REGULATORS (COMMERCIAL)				
86.	Check Operation of Suction Line				
	Regulator				
87.	Adjust and/or Repair Suction Line				
	Regulator				
88.	Remove and Replace Suction Line				
	Regulator				
	UNIT XII - HEAT EXCHANGER (DOMESTIC & COMMERCIAL)				
89.	Check Heat Exchanger				
90.	Remove and Replace Heat Exchanger				
	UNIT XIII - BYPASS VALVE (DOMESTIC & COMMERCIAL)				
91.	Check Hot Gas Bypass Valve				
92.	Remove and Replace Hot Gas Bypass				
	Valve				
	XIV - ELECTRICAL CONTROLS (DOMESTIC & COMMERCIAL)				
93.	Check Low and High Pressure Controls				
94.	Adjust and Calibrate Low and High				
	Pressure Controls				

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NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION I UNIT XIV CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
95.	Remove and Replace Low and High				
	Pressure Controls				
96.	Check Oil Pressure Safety Control				
97.	Adjust and Calibrate Oil Pressure				
	Safety Control				
98.	Remove and Replace Oil Pressure				
	Safety Control				
99.	Check Thermostatic Motor Controls				
100.	Adjust and Calibrate Thermostatic				
	Motor Controls				
101.	Check Temperature Control				
102.	Adjust and Calibrate Temperature				
	Control				
103.	Check Defrost Heater				
104.	Remove and Replace Defrost Heater				
105.	Check and/or Set Defrost Timer				
106.	Remove and Replace Defrost Timer				
107.	Check Overload Protectors				
	UNIT XV - PNEUMATIC CONTROLS (COMMERCIAL)				
108.	Service and/or Install Pneumatic				
	Controls				
	UNIT XVI - ELECTRONIC CONTROLS				
109.	Service and/or Install Electronic				
	Controls				

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NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION I UNIT XVI CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
110.	Service and/or Install Solid				
	State Controls				
	UNIT XVII - SPECIAL SYSTEMS				
111.	Service and/or Repair Automatic				
	Ice Makers				
112.	Service and/or Repair Thermo-				
	electric Units				
113.	Service and/or Repair Trans-				
	portation Refrigeration				
114.	Service and/or Repair Soft Service				
	Ice Cream Machines				
115.	Service and/or Repair Water Coolers				
	SECTION II - AIR CONDITIONING				
	UNIT I - INSTRUMENTS FOR CHECKING SYSTEM				
116.	Use Manometer				
117.	Use Air Measurement Instruments				
	UNIT II - WINDOW AIR CONDITIONING UNITS				
118.	Install Window Air Conditioning Unit				
119.	Check for Proper Voltage, Wire				
	and Circuit Breaker				
120.	Check Operation of Window Unit				
	for Proper Charge, Air Flow, and				
	Temperature Difference				
121.	Check Window Unit for Vibration and Noise				

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NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
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122.	Service Window Air Conditioning				
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123.	Check Operating Efficiency of				
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125.	Determine The Size Unit Needed				
126.	Determine The Type Duct System				
	for Air Distribution				
127.	Determine Location and Size of				
	Duct System and Determine Location				
	and Size of Registers				
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129.	Install Line Wiring				
130.	Install Control Circuits				
131.	Troubleshoot Electrical Circuits				
132.	Troubleshoot Refrigerant System				
	UNIT IV - HEAT PUMPS				
133.	Service and Repair Heat Pumps				
134.	Install Heat Pumps				
	UNIT V - ABSORPTION SYSTEMS				
135.	Check and/or Adjust Heating Devices				
136.	Check and/or Adjust Chiller Units				
137.	Add Refrigerant				

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TRADE ANALYSIS AND PROGRESS RECORD

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SECTION II UNIT V CONTINUED	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
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139.	Add Anti-Freeze				
140.	Repair Electrical Components				
	UNIT VI - AUTOMOBILE AIR CONDITIONING				
141.	Check Belts and Pulleys				
142.	Evacuate and Charge System				
143.	Check and Service Clutch Assembly				
144.	Repair Hot Gas Bypass Valve				
145.	Check and Repair Suction Regulator				
	Valve				
146.	Check Air Distribution System				
147.	Install Automobile Air Conditioner				

NAME_____ OCCUPATION_____ AGENCY_____

STUDENT'S DAILY RECORD

Date	List the Job Numbers Performed the Previous afternoon	List the References Read in the Related Class by Symbols and Pages	List the Number of the Job Studied Today

JOB NO. 1

FUNDAMENTALS OF REFRIGERATION MRC: 9 - 42

1. Compare the operation of a refrigerator with removing water from a leaking canoe.

2. What is heat?

3. What is cold?

4. What is temperature?

5. Explain the operation of the common thermometer.

6. Why were the melting temperature of ice and the boiling temperature of water taken as the standards?

7. Convert 167 degrees Fahrenheit into Centigrade degrees.

8. Convert 0 degrees Centigrade to Fahrenheit.

9. Why does cold preserve food?

10. What is a gas?

11. How is pressure usually expressed?

12. What determines the pressure exerted by a gas on its container?

13. Define Specific Gravity.

14. What is a BTU?

15. What is the difference between Specific Heat and Latent Heat?

16. In what way does pressure effect evaporating temperatures?

17. What is the basic function of a refrigeration system?

18. What is the difference between conduction and convection?

19. What is Sensible Heat?

JOB NO. 2

IDENTIFY AND LEARN PROPER USE OF TOOLS

POR: 248
MRC: 59-72

1. What is the best tool to use if the nut or bolt head has no obstructions over it?

2. When the nuts or bolt heads are in close quarters and the socket wrench cannot be used, which tool is considered satisfactory?

3. What tool is used for a nut on a fitting connected to tubing?

4. When is the use of open-end wrenches necessary?

5. Why is it recommended that end wrenches used in servicing work have a thick jaw?

6. Why is it necessary to use wrenches with an adjustable opening between the jaws?

7. When using adjustable wrenches why should they always be pulled instead of pushed?

8. In tightening bolts, nuts and other attachments on compressor parts and assemblies, why is it important that the degree of tightness be measured?

9. What tool is used to measure the degree of tightness of bolts, nuts and other attachments on compressor parts and assemblies?

10. Explain how the torque wrench is used.

11. How is torque or "twist" calculated?

12. Name the tool that should be used for tightening a setscrew with a recessed opening in its head.

13. Name the tool most used by the refrigeration serviceman to inspect, check sizes, dimensions, and make accurate measurements to a few thousandths of an inch.

14. If the micrometer being used is one inch, the divisions 0, 1, 2, are what part of an inch?

15. The four divisions between the tenths markers on the one inch micrometer are what part of an inch?

JOB NO. 2 CONTINUED

16. What is the right hand end of the micrometer called?

17. One turn of the thimble on the one inch micrometer moves the spindle what part of an inch?

18. Turning the thimble one graduation on the one inch micrometer moves the spindle what part of an inch?

19. How are files classified?

20. What are the purposes of single cut and the double cut files?

21. Name the three types of rectangular cross section files.

22. Discuss the differences in the three types of rectangular cross section files.

23. For what are fourteen teeth per inch hacksaw blades used?

24. What is the use of thirty-two teeth per inch hacksaw blades?

25. Explain the proper way to stroke a hacksaw.

26. What are two main uses of the mallet in refrigeration and air conditioning work?

27. Give two uses of the center punch.

28. Give the purpose of drift punches and pin punches.

29. What are the uses of the following types of pliers:
(a) Gas pliers (b) Cutting pliers (c) Slim nose and duckbill pliers and (d) Round nose pliers?

30. How is the length of a screwdriver determined?

31. Name some of the types of screwdrivers.

32. In what three set sizes do drills for drilling metal come?

33. What does the term straight shank type drill mean?

34. What do numbers indicate about the size of drills?

ERIC 143

JOB NO. 3

CUT AND THREAD PIPE MRC: 57, 73-74

1. Upon what are pipe thread sizes based?

2. With what are the external threads cut on a pipe?

3. With what are the pipe thread taps (for cutting the female or internal threads) turned?

4. Name the three types of taps.

5. In drilling the hole for the tap generally the hole size should be what percent of the full size of the tap?

6. Explain the procedure for starting the threading operation using the tap and the die.

7. If the stock to be threaded by the die is undersized what may result?

8. What will result if the drilled hole to be tapped is too small?

9. What classification of pipe fittings and pipe threads are used extensively for air conditioning?

10. Describe the ASA pipe threads.

11. If the ASA threads were not tapered what would be necessary to provide a leakproof joint?

JOB NO. 4

FLARE, SWAGE & BEND COPPER TUBING

MRC: 43-50
POR: 236-244

1. Most copper tubing used in air conditioning and refrigeration work is known as what?

2. Why is ACR tubing charged with gaseous nitrogen?

3. What material is used for making most of the tubing used in refrigeration and air conditioning?

4. With what type fittings is soft copper tubing most often used?

5. Name and describe the process by which copper tubing is hardened

6. Name and describe the process by which copper tubing is softened

7. Name a type of copper tubing used extensively in commercial refrigeration and air conditioning applications.

8. What type fittings are used with hard drawn copper tubing?

9. What type tubing should be used in connection with R-717 (ammonia refrigerant)?

10. Give the uses of nominal size copper tubing.

11. What is the minimum safe bending radius for copper tubing?

12. Why is it wise to bend the tubing into as large a radius as possible?

13. Why should the complete bend not be made in one operation?

14. What is the purpose of a tube bending spring?

15. The internal bending spring is used for what portion of the tubing?

16. Name four important steps to be taken and checks to be made when forming copper tubing.

17. When tubing is bent with the bending spring and it binds on the tubing, how may it be easily removed?

18. What is the importance of a good flare on tubing?

19. For what are double thickness or "double flares" used?

JOB NO. 4 CONTINUED

20. What does the term "single thickness flare" mean?

21. What does double thickness flare indicate?

22. Give the steps necessary to prepare a tube for flaring.

23. What may result if the flare is made using one continuous motion of the flaring cone; that is, without a back-and-forth motion?

24. Why should the flare nut on the tube be placed in the proper position before the flare is made?

25. Define the term swaging.

26. What is the rule for determining the length of engagement of two pieces of copper tubing to be joined by swaging?

27. Name the two types of swaging tools available.

28. Why is the process of swaging copper tubing often used?

JOB NO. 5

SOFT SOLDER AND BRAZE JOINTS

MRC: 52-57
POR: 241-243

1. Define and explain soldering.

2. What is "50-50" solder and for what temperatures is its use recommended?

3. If greater strength is required, such as for evaporators, where the temperature goes below 30° F., what type solder is suggested?

4. Beyond the 350° F. range how may metals be jointed?

5. What are the three fundamental rules of soldering?

6. What is the purpose of flux in soft soldering?

7. A satisfactory flux used for fittings, tubing and other parts of the refrigeration system contains what properties?

8. Why should acid flux not be used for soft soldering?

9. Why must the metal being joined be hot enough to melt the solder

10. When joining tubing and tubing fittings how is the exterior cleaned?

11. Why should oxygen never be used when testing for leaks?

12. Why should great care be taken not be overheat the parts to be soldered?

13. What is meant by the term "tinning" the soldering copper?

14. Why is wire solder usually the most convenient type to use with the soldering copper?

15. The silver alloys used for silver brazing usually melt and flow at what temperatures?

16. What should be done if the silver brazing alloy contains cadmium?

17. What is the effect of overfluxing in silver brazing? How may this be prevented?

JOB NO. 5 CONTINUED

18. In preparing the part to be silver brazed, what material or devices are considered good for cleaning the external and internal surfaces?

19. Why should carbon dioxide or nitrogen be circulated through the refrigerator system during any soldering operation on a complete mechanism?

20. Why should the joint being brazed be covered with the flame all during the operation?

21. What is an indication of the proper temperature for silver brazing?

22. Why are large torch tip sizes recommended for silver brazing?

23. Why is it necessary to thoroughly wash with water and scrub the outside of the completed silver brazed joint?

JOB NO. 6

USE SERVICE VALVES

POR: 204, 258, 267
MRC: 437-442, 1094

1. The discharge service valve is fastened to what part of a compressor?

2. The suction service valve is fastened to what part of a compresso

3. Why is the service valve known as a "backseating" type?

4. Why is the valve stem usually backseated on the service valve?

5. What is a service valve?

6. Give the procedure to be followed when using valve adaptors.

7. Name the two general types of service valves which are mounted on suction tubing or discharge tubing.

8. Describe the Schrader valve.

9. After service valves have been mounted on a hermetic system, what are some of their uses?

JOB NO. 7

USE MANIFOLD GAUGE

MRC: 444, 580-583, 1088
POR: 259-260

1. What is a manifold service gauge?

2. What are the advantages of a service gauge and testing manifold?

3. How are typical service gauge manifolds designed?

4. What does the gauge manifold design make possible?

5. The manifold gauge usually has what size square drive valve stems?

6. Explain the procedure that is followed when installing or connecting a gauge manifold.

7. After completing the service operations, how is the manifold removed from the system?

8. Draw a gauge manifold installation as shown in Figure 15-23, page 583, MRC.

JOB NO. 8

EVACUATE A REFRIGERANT SYSTEM

POR: 261
MRC: 582-584

1. What are the only two materials that should be found in a compression refrigeration system?

2. Where are the two strainers which remove dirt and other foreign matter that may have entered the system located?

3. Why is air objectionable in refrigerating systems?

4. What is the usual procedure in removing air from the refrigeration system?

5. What procedure is followed when using the compressor to evacuate a system?

6. After a system has been purged of air, what should be done?

JOB NO. 9

REFRIGERANTS

MRC: 319, 346
POR: 50, 62

1. Everything in the universe is made up of what?

2. What are alloys?

3. What are atoms?

4. Give the chemical symbol for: oxygen, hydrogen, iron, water, table salt.

5. What is the purpose of the refrigerant in a refrigerating system?

6. Why must the freezing point of the refrigerant be lower than any temperature found in the system?

7. Why must the volume of refrigerant vapor be small and the density be high?

8. What five chemical properties should a refrigerant possess?

9. What is the oldest known refrigerant?

10. Give the name and chemical formula for the following refrigerants: R-11, R-12, R-22, R-504, and R-717.

11. For what is sulfur dioxide used as a refrigerant?

12. What are two common trade names for refrigerants?

13. Why must systems using refrigerants be kept free of moisture?

14. What are driers? Desiccants?

15. Why is it important to keep the head pressure at the correct level?

16. What is the purpose of oil in the refrigerating mechanism?

17. In what form should a refrigerant be put into a system? Why?

JOB NO. 10

PURGE A REFRIGERANT SYSTEM

MRC: 582
POR: 262

1. What is the order or sequence of purging an assembled refrigeration system? What is the reason for this order?

2. What is purging?

3. Why is purging not the most desirable method of removing air and moisture from a system?

4. How is the air and moisture pushed out of the system in purging?

5. Why is it advisable to disconnect the liquid line from the evaporator coil, cap the opening to the evaporator coil, and "crack" the liquid receiver service valve in purging?

6. What procedure is followed in purging the evaporator coil?

7. What procedure is followed in purging the suction line?

JOB NO. 11

CHARGE A REFRIGERANT SYSTEM

POR: 264-265
MRC: 588-589

1. How is a refrigerant system usually charged through the low side?

2. What are the advantages of the low side method of charging a system?

3. Describe another method of charging a system through the low side by a slightly different arrangement of the manifold connection; which will speed up the operation.

4. At what two points may a properly evacuated system be charged through the high side?

5. For liquid charging, how is the refrigerant service cylinder held?

6. If the charge is not accurate, what will be the result?

7. What is the principle of operation in charging a commercial system?

8. Why is it very important that liquid refrigerant never be allowed to reach the compressor?

9. What are the advantages and disadvantages of putting liquid refrigerant into the high pressure side of the system?

10. The difference in pressure in the liquid receiver, with the water flowing in a water cooled system, and the pressure in the charging system, will have what effect on the refrigerant in the cylinder?

11. If the unit is air cooled, the pressure in the refrigerant drum must be increased. How may this be done?

JOB NO. 12

TRANSFER REFRIGERANTS MRC: 80-81, 641-64

1. In what size cylinder is it most economical to purchase refrigerants?

2. In transferring refrigerants, about what percent should be allowed for gas loss?

3. Why should a refrigerant cylinder never be completely filled with a liquid refrigerant?

4. How can the serviceman be sure he has left space for expansion when filling a refrigerant cylinder?

5. To what percent of capacity should a refrigerant cylinder be filled?

6. Why should service tanks be weighed before and after filling?

7. Describe the two types of valves found on large service cylinder.

8. If the cylinder has a regular valve how is liquid refrigerant removed?

9. What is the difference in transferring refrigerant if the cylinder has the double valve?

10. Describe a charging board and give its purpose in transferring refrigerants?

JOB NO. 13

MEASURE PRESSURE AND TEMPERATURE

MRC: 14-15, 18-21, 64-66, 340-341

1. Define pressure.

2. What is the average normal pressure of the atmosphere at sea level?

3. How is the pressure per square foot determined?

4. How much pressure would a solid weight of one pound exert, on a flat surface, if its bottom surface area was made one inch square?

5. What determines the amount of pressure exerted by gases in a container?

6. In what terms do most popular pressure indicating instruments (gauges) register?

7. Name some different ways pressure may be indicated.

8. What is the formula for determining absolute pressure?

9. What is the function of a compound gauge?

10. For what are water columns often used?

11. What are water column measuring devices called, and how are they calibrated?

12. What kind of scale is found on a high pressure gauge?

13. What is the purpose of a retarder on a pressure gauge?

14. List five things that should be kept in mind when using the pressure temperature chart?

15. How is the pressure found, on the pressure temperature table, when the temperature is given?

16. What are the uses of the thermometer in refrigeration service work?

17. What is done to determine whether or not the thermometer is accurate?

18. Name some popular thermometers used by the refrigeration service and installation man.

JOB NO. 13 CONTINUED

19. Where are dial thermometers very useful?

20. What is the boiling point of water on the Fahrenheit scale? On the Centigrade scale?

21. Give the formula and an example of converting Centigrade degrees into Fahrenheit degrees.

22. Give the formula and an example in converting Fahrenheit degrees into Centigrade degrees.

JOB NO. 14

LOCATE AND REPAIR REFRIGERANT LEAKS

POR: 265-267
MRC: 465

1. What is used in testing for sulfur dioxide leaks?

2. Describe the double pressure test.

3. Explain the procedure for finding leaks in refrigeration systems using methyl chloride.

4. Name two common methods used to test for leaks in the ammonia system.

5. What device is used to detect "R" type vapor leaks?

6. Why is the pump-up type detector not satisfactory?

7. When testing for the type metal, on which a leak has occurred, how is aluminum identified?

8. How may a leak be repaired on aluminum?

9. Explain the operating principle of the electronic leak detector.

JOB NO. 15

ADD AND/OR REMOVE LUBRICATION OIL MRC: 341-342, 445-446, 64

1. Describe the most rapid method of adding oil to a compressor.

2. Why is it important that some of the oil in the glass containe be left in the container so the filling tube is always immerse in the oil?

3. Why is a glass container used when adding oil to a system?

4. Describe the method of adding oil to the system where the crankcase is evacuated.

5. How may oil be forced into the system?

6. What are some requirements of refrigerant oils?

7. Name and explain the properties of a good refrigerant oil.

8. What may be done to keep oil clean in a refrigerant system?

9. What will be the effect of an over charge of oil to a system?

10. What will be the result of a lack of oil in a system?

11. What device may be used to provide a more accurate method of charging oil into a system than charging directly from the storage cylinder?

JOB NO. 16

MAGNETISM EAE: 53-70

1. Why are natural magnets sometimes called "lodestones"?
2. What are magnetic poles?
3. What are magnetic circuits?
4. In what way is the earth like a magnet?
5. What is the Law of Magnetism?
6. What causes a substance to become magnetized?
7. Why will rough handling sometimes ruin a magnet?
8. How are magnets made?
9. What is the relationship between electric current and magnetism?
10. What is a solenoid?
11. What determines the strength of the magnetic field of a solenoid?
12. What is meant by a material having permeability?
13. What is a relay?
14. List some common uses for relays.
15. For what purpose is a circuit breaker used?
16. What is a magnetic shield?

JOB NO. 17

THE SCIENCE OF ELECTRICITY EAE: 11-18

1. What is matter?

2. What are elements?

3. What is the difference between molecules and atoms?

4. Of what are atoms composed?

5. Compare the structure of an atom with the solar system.

6. What is meant by ionization?

7. What is static electricity?

8. Give the Law of Charges.

9. What is a coulomb?

10. Define voltage.

11. What is the standard unit for the measurement of electric current?

12. In what direction does electric current flow?

13. What is an electric conductor?

14. Name three kinds of material which make good conductors.

15. What common materials are used for insulators?

JOB NO. 18

SOURCES OF ELECTRICITY EAE: 19-31

1. Name five sources of electricity.

2. What safety precautions should be observed when mixing acid and water?

3. What is the major advantage of the nickel-cadmium cell?

4. Draw a schematic diagram of four 1.5 volt cells connected in series.

5. Why is it not advisable to leave cells in a flash-light for long periods of time? Explain your answer.

6. What is meant by the "specific gravity" of a liquid?

7. What is the main difference between a primary cell and a secondary cell?

8. What is the purpose of a battery hydrometer?

9. Explain the meaning of the term "capacity" in respect to a storage battery.

10. What unit is used to measure the capacity of a battery?

11. What happens when a battery is recharged?

12. Why should batteries be connected to the charger before the power is applied.

JOB NO. 19

CIRCUITS AND POWER

EAE: 33-39
IEW: 11-19

1. What is a schematic diagram?

2. Why is it that a large wire can carry more electrons than a small wire?

3. Which is larger--a No. 14 wire or a No. 20 wire?

4. Why should one consider length when selecting a conductor of electricity?

5. State Ohm's Law.

6. Define the letter symbols used in the equation: I=E/R.

7. A certain device which has a resistance of 100 ohms is connected to a 100 volt source of electricity. How much current will flow in the circuit?

8. If the voltage is increased to 200 volts and resistance 100 ohms, how much current will flow?

9. If one returns the voltage to 100 volts but increases the resistance to 200 ohms, what will be the current of this circuit?

10. Explain Ohm's Law in non-mathematical language.

11. A current of .5 amperes is flowing in a circuit which has 100 ohms resistance. What is the applied voltage?

12. What is the only component in an electrical circuit that uses power?

13. Reproduce the memory device used to help solve power problems.

14. Define a series circuit.

15. Define a parallel circuit.

16. Why may resistance units be purposely introduced into a circuit?

17. Why are thermistors used in some circuits?

18. Give the power rule.

JOB NO. 20

INSTRUMENTS AND MEASUREMENTS EAE: 152-164

1. Describe the operation of the D'Arsonval moving coil meter.

2. What instrument is used to measure current flow in a circuit?

3. Why is a shunt used when measuring large currents with the basic movement?

4. In what way is an ammeter connected in an electrical circuit?

5. What instrument is used to measure voltage in a circuit?

6. What type of meter is used to measure the value of an unknown resistance?

7. What is a multimeter?

8. What is the major difference between an iron vane ammeter and an iron vane voltmeter?

9. What type instrument is used to measure the power used in a home?

10. List three steps which should be observed when using a meter.

11. How can a "flash check" of a meter be made?

12. Why are rectifiers sometimes used in meters?

JOB NO. 21

CHECK ELECTRIC MOTOR MRC: 201-220

1. Why is the electric motor the most popular source of power for small and medium size refrigerating units?

2. What is the difference between open motors and hermetic motors?

3. What are the four major uses for motors in refrigeration?

4. What is meant by electromotive force?

5. What is an electrical circuit?

6. What is the difference between an open and a short circuit?

7. Why does an electric current cause an electric motor to turn?

8. Define capacitance.

9. What are Semiconductors?

10. What are Rectifiers?

11. What are Transistors?

12. In what three ways must the electric motor match the electric power furnished by the electric utility?

JOB NO. 22

CHECK AND/OR REPLACE CAPACITORS

POR: 296-297
MRC: 215

1. Define capacitor.

2. How are capacitors constructed?

3. What is a dielectric?

4. Of what materials are conductor plates made?

5. For what are A.C. and D.C. symbols?

6. How is direct current affected by a capacitor?

7. How does a capacitor affect alternating current?

8. Define capacitance.

9. How are capacitors in a series usually designated?

10. What is a forad?

JOB NO. 23

TEST A STEP-UP AND STEP-DOWN TRANSFORMER

MRC: 221-226
POR: 279-281

1. What is the maximum potential difference at which an electric generator delivers energy?

2. What is stepped-up voltage?

3. How high can a standard generated pressure of 13,200 volts be stepped-up?

4. What is used to step-up voltage?

5. What are the three main parts of a transformer?

6. Describe magnetic induction.

7. Why are transformers used at places called sub-stations?

8. What causes line loss of electricity?

9. Why is it necessary to transform from low to high voltage in transmission?

10. What will happen if there is more current in a circuit than needed?

JOB NO. 24

IDENTIFY ELECTRICAL SYMBOLS MRC: 206

1. Draw the symbol for capacitors.

2. Make a drawing of the symbol for a coil.

3. Make a drawing of the symbols for open and closed contacts.

4. Draw the symbol for a fuse.

5. Draw the symbol for a resistor.

6. Draw the symbol for a transformer.

7. Draw the symbol for a terminal.

8. Draw the symbols for male and female connectors.

9. Draw the symbols for a single throw switch and for a double throw switch.

10. Draw the symbol for a general selector switch.

11. Draw the symbol for a thermal relay.

JOB NO. 25

CHECK AND/OR REPLACE RELAYS

MRC: 301-308
POR: 294-295

1. Should relays be replaced or repaired?

2. What is the most effective way to determine if the relay is causing trouble?

3. Why is it necessary to keep the relay cover in place?

4. What should be done when replacing the relay?

5. If an exact potential relay replacement is not available, what should be done?

6. What is the purpose of a relay?

7. What is the relay designed to do?

8. For what purpose are inductors used?

9. In what manner is magnetic force used?

10. For what purpose are solenoids used?

JOB NO. 26

CHECK AND/OR REPLACE MAGNETIC STARTERS

MRC: 505, 509
POR: 319-321

1. When are manual motor starters used?

2. How does a manual motor starter operate?

3. For what purposes are manually started motors used?

4. What type contacts are used with magnetic motors?

5. For what installations are magnetic starters used?

6. Why are magnetic starters often connected with other controls?

7. How does the "starter button" operate?

8. How is overload control provided?

9. If there is an overload while the motor is running, what will happen?

10. What is the importance of the "reset" button in the cover?

JOB NO. 27

CHECK CIRCUIT BREAKERS AND FUSES

POR: 281-284
MRC: 245-249

1. What are the basic devices used for the protection of electrical circuits?

2. What are plug fuses?

3. How are cartridge-type fuses designed?

4. Describe the use of an ordinary fuse.

5. What is the importance of the dual-element time-delay fuse?

6. Why are circuit breakers used?

7. Describe the magnetic circuit breaker.

8. List three things that a serviceman must clearly understand about circuits for refrigeration.

9. What is a line drop?

10. Compare aluminum, iron and copper as electrical conductors.

11. What size fuse should be used with automatically started and stopped motors?

12. What are time fuses?

13. Refrigerating systems have safety devices that protect from what three troubles?

JOB NO. 28

SERVICE SPLIT-PHASE ELECTRIC MOTORS

POR: 314
MRC: 263-264, 228-229
237-238

1. For what are split-phase motors used?

2. Why are light loads stressed for split-phase motors?

3. What systems use split-phase motors?

4. What are the most common causes for motor troubles?

5. What will occur if there is a loose or dirty connection?

6. How may the loose connections in a motor be located?

7. Describe the symptoms of dry bearings.

8. What will occur when the bearings become badly worn?

9. What causes a rattle in the fan motor?

10. If the fan is abused, what should be done?

11. What three windings does a split-phase motor have?

12. Describe a squirrel-cage winding.

JOB No. 29

SERVICE CAPACITOR-INDUCTION MOTOR MRC: 230-231

1. Where does the capacitor type motor get its' name?

2. What is the purpose of the capacitor in the motor?

3. Is there any similarity in the mechanical construction of capacitor motor and the repulsion start-induction motor?

4. Why is the operation of the mechanism quite simple?

5. There are two types of capacitors, list and distinguish between them.

6. What change takes place in the capacitor motor after it starts?

43

JOB NO. 30

SERVICE REPULSION-START INDUCTION MOTOR MRC: 227-230

1. For what purposes has the repulsion-start induction run motor long been popular?

2. What is used to give the motor high starting torque?

3. Induction motors have no windings on the armature or rotor, what is used instead?

4. What causes the turning or torque in induction motors?

5. What two field windings are used in most induction motors?

6. Why must refrigeration motors have high torque at starting speeds?

7. How is the starting torque increased on repulsion-start induction motors?

8. Why are repulsion-start induction motors not suitable for hermetic compressors?

JOB NO. 31

SERVICE CAPACITOR-START, CAPACITOR-RUN MOTOR MRC: 239-241

1. Where are the capacitors in this type motor?

2. What effect do the capacitors have on the power when starting?

3. What happens to the starting capacitor after the motor reaches three fourths of its rated speed?

4. What is the effect of the running capacitor remaining in the circuit?

5. Where is the capacitor-start, capacitor-run motor used?

6. Why is this type motor not used on domestic refrigerators?

7. What is the effect of connecting capacitors in series?

JOB NO. 32

SERVICE POLY-PHASE AND/OR DIRECT CURRENT MOTORS MRC: 241-244

1. The larger hermetic compressors usually use what type motors?

2. What must be done before starting service on motors with high voltage?

3. Why are capacitors and relays not needed on poly-phase motors?

4. Why is it important to have the manufacturers wiring diagram of three phase motors before servicing them?

5. The direct current motor is similar to what types?

6. What two types of field windings are used on compound wound motors?

7. What is the effect of D.C. current on the polarity of the field poles?

8. Why do direct current motors wear more rapidly than other types?

9. What are some possible troubles with direct current motors?

10. How may the direction of rotation of direct current motors be reversed?

JOB NO. 33

SERVICE OPEN TYPE MOTORS MRC: 257-261

1. What are the classes of troubles found in open type motors?

2. List electrical troubles found in electric motors.

3. What may result from frequent starting of the motor?

4. What are the mechanical troubles found in open type motors?

5. What are the two systems used in open motor lubrication?

6. How are open motor bearings made?

7. When should the motor bearings be checked to see if they are worn?

8. List at least six causes that may result in hot bearings.

9. What are the most popular shaft sizes for fractional horsepower motors?

10. What is most important in cleaning open motors?

JOB NO. 34

COMPRESSOR CONSTRUCTION MRC: 139-161

1. What is the purpose of the compressor on a refrigeration system?

2. For what different purposes are the three types of compressors used?

3. How does a reciprocating compressor compress the gas?

4. How many cylinders do compressors have?

5. Why is nickel added to the material from which cylinders are made?

6. What is the purpose of the connecting rod in a compressor?

7. What is used to change rotary motion to reciprocating motion in a compressor?

8. The valve assembly consists of what parts?

9. The material from which gaskets for compressors are made must have what characteristics?

10. Describe the splash system of compressor lubrication.

11. What is the main difference between a hermetic compressor and an open type compressor?

12. What are the three basic hermetic compressor designs?

13. What methods are used to keep the compressor cool?

14. Why are aluminum and carbon blades used on rotary compressors?

JOB NO. 35

CHECK OPEN TYPE COMPRESSOR

MRC: 602-604, 611-612
POR: 190

1. In comparing a refrigerant system to your body, what part is the compressor?

2. What are the two most common causes of compressor troubles?

3. What is one sign of faulty valves in a compressor?

4. What is the difference in the sound of a bad piston and a faulty valve?

5. Name three compressor testing methods.

6. How many inches of vacuum will a good compressor produce?

7. Why should oil removed from a compressor not come in contact with your skin?

8. What is packing a system with dry ice called?

9. After a compressor has been repaired, what should be done?

10. In testing, what will a decrease in pressure indicate?

JOB NO. 36

REMOVE, DISASSEMBLE, REASSEMBLE, AND INSTALL OPEN TYPE COMPRESSOR

MRC: 604-606
610-613

1. What is an indication that a compressor is pumping oil?

2. What procedure should be followed in disassembling and reassembling a compressor?

3. What should be looked for in a good refrigeration parts cleaner?

4. Why should new gaskets be used when reassembling a compressor?

5. What is the thickness of new lead gaskets?

6. How are parts of the compressor dehydrated?

7. In what type of solution are brass and copper fittings soaked?

8. At what tension should new belts be installed?

9. In installing new service valves, what should always be replaced?

10. Why should all hold down bolts be tightened evenly?

JOB NO. 37 & 38

CHECK AND/OR TEST HERMETIC COMPRESSOR — MRC: 353-354, 427-471
REMOVE AND INSTALL HERMETIC COMPRESSOR — 1086

1. Define the terms: (a) hermetic motor (b) hermetic system.

2. What are the two types of hermetic compressors?

3. How is the heat produced by the hermetic motor removed from the system?

4. What are the three major divisions of hermetic refrigerator servicing?

5. What are the sources of external noise in hermetic refrigerators?

6. In what five places may electrical troubles occur in hermetic refrigerators?

7. Why should a test light not be used to test two pole motors?

8. List three basic principles that should be kept in mind during all operations inside the hermetic unit.

9. What trouble may be indicated by a compressor housing that is warmer than usual?

10. For what purpose is the process tube adaptor kit used?

11. What can be done with a gauge manifold?

12. Why is the correct amount of oil in a system very important?

13. What is an indication that a hermetic unit needs refrigerant?

14. Why are high vacuum pumps used?

15. Why are driers and filters used on refrigeration systems?

16. What is the most common trouble with hermetic systems?

JOB NO. 39

EVACUATE AND CHARGE HERMETIC COMPRESSOR MRC: 446-449

1. What are some indications that a system needs charging?

2. What are the methods used to add refrigerant to a hermetic sys

3. Use example 12-37 on page 448 of MRC draw detailed illustratio of charging with a portable refrigerant cylinder.

4. When charging a system that does not have a service valve what should be used?

5. When the correct amount of refrigerant has entered the system how can it be checked?

6. What must be done before charging a system?

7. In charging a unit if frost on the suction line is not adequat what must be done?

8. When evacuating a hermetic system what happens to the moisture, oxygen, and nitrogen?

9. When evacuating a system what must the vacuum be pulled up to and maintained to indicate any leak in the system?

10. Approximately how long must a vacuum pump run before charging?

JOB NO. 40 & 41

CHECK CRANKCASE HEATER MRC: 480-483
CHECK AND ADJUST UNLOADERS

1. What are the two types of unloaders found on large units?

2. What does the unloading device control?

3. What must increase with an increase of the load?

4. In an electrical unloader, where is the unloader piston relief drain located?

5. What is the purpose of a crankcase heater?

6. What is the crankcase heater used to prevent?

7. What is the purpose of the bypass used in some systems?

8. What is the usual capacity of the heater?

JOB NO. 42 & 43

CHECK AND SERVICE AIR COOLED CONDENSERS MRC: 613-614
SERVICE AND INSTALL AIR COOLED CONDENSERS POR: 155-156

1. What are the two important factors governing the performance of an air-cooled condenser?

2. From what materials are air-cooled condensers usually made and how are the fins bonded to the tubes?

3. Why should air-cooled condensers be checked and cleaned periodically, and how is this done?

4. What determines the service procedures of a condenser?

5. What are some troubles encountered in commercial condensers?

6. How may the correct pressure of an air-cooled condenser be determined?

7. What might be the trouble if the pressure is above normal? Below normal?

8. How may air be removed from the condensing system?

9. Explain how air is purged from a condenser.

10. How should belts be checked in the condenser?

11. How should fans and motors be checked?

JOBS NO. 44, 45, 46 & 47

CHECK PERFORMANCE AND CONDITION OF WATER COOLED CONDENSERS
CHECK WATER FLOW OF WATER COOLED CONDENSERS MRC: 484,
CLEAN AND CHECK WATER COOLED CONDENSERS FOR LEAKS 617-624
EVACUATE, SERVICE AND/OR INSTALL WATER COOLED CONDENSER

1. What type refrigerating units use water cooled condensers?

2. Why are water cooled condensers smaller than air cooled?

3. What is an indication of an excess amount of oil in a system?

4. What may be caused by a corroded condenser?

5. What can be used to clean a corroded condenser?

6. How are leaks in condensers repaired?

7. Of what are the liquid receivers used in most commercial systems made?

8. What is the purpose of water valves in water cooled condensers?

9. What two things determine the correct operation of a water valve?

10. Give six troubles of water valves if the water flow is too little.

11. What is the effect of too much water flow?

12. What can be done to prevent water hammer?

JOB NO. 48

CHECK PERFORMANCE OF EVAPORATIVE CONDENSERS

MRC: 486
POR: 162-163, 170

1. Describe the principles involved in the functioning of the evaporative condenser.

2. Why was the evaporative condenser developed?

3. This evaporative condenser was designed to overcome what objections?

4. Sketch the evaporative condenser on page 163 POR. Label or indicate the most important parts.

5. Explain what happens to the air from the time it enters until it leaves the evaporative condenser.

6. Describe the path of the refrigerant as it enters and leaves the condensing unit.

7. What type of condensing coils are usually found on evaporative condensers?

8. How many BTU's of heat does each pound of water that evaporates in the unit remove?

9. How much water do evaporative condensing units use in proportion to a water-cooled condenser?

10. What is the main advantage of the evaporative condenser over the water-cooled condenser?

JOBS NO. 49, 50 & 51

CHECK WATER FLOW OF EVAPORATIVE CONDENSER — MRC: 620
CLEAN AND CHECK EVAPORATIVE CONDENSER — POR: 169
SERVICE AND INSTALL EVAPORATIVE CONDENSER

1. Why must the deposits that are left by the cooling water be removed periodically?

2. How can these deposits on the coil be prevented?

3. Where can water softeners be obtained?

4. How may such deposits as algae, mold and slime be removed?

5. If an evaporative condenser is shut down and subject to below freezing temperatures, what should be done?

6. How may the evaporative coils be emptied of water?

7. How may residual water be removed from the system?

8. Why is a systematic water treatment program necessary for an evaporative condenser?

9. In the absence of such a program, how should the water be treated?

10. What is the method suggested by manufacturers to keep the water fresh and clean?

JOB NO. 52

CHECK AND/OR SERVICE WATER TOWER

MRC: 485-486
POR: 166-170
PAC: 279-282, 286-287

1. Under what conditions might a water cooling tower be used?

2. What purposes do water towers serve?

3. Name and briefly describe the three basic styles of cooling towers.

4. From what materials are cooling towers usually made?

5. How is overflow water handled in a tower?

6. Describe the procedures for installing the forced-draft and the natural-draft water cooling towers.

7. Although forced-draft towers are more expensive to operate than natural-draft towers the increased operating cost is offset by three advantages. What are they?

8. What is used to keep the water used in these systems relatively free from foreign materials and from rusting?

9. What are the three ways corrosion may occur in cooling tower systems?

10. How should the problem of scale, corrosion and algae be handled?

JOB NO. 53

SERVICE WATER REGULATOR VALVE

PAC: 261
POR: 346, 356

1. What is the purpose of the water regulating valve?

2. Where is the water regulating valve installed?

3. Name the five most important parts of this valve.

4. What should be considered when selecting a water regulator valve?

5. In what way should the capillary end of the valve be installed?

6. When is a water regulating valve not recommended?

7. What determines the point at which water regulating valves begin to open?

8. What causes the valve to open and close?

9. What must be done to the valve to which the water regulating valve capillary tube is to be connected?

10. After the connection has been made, what is the next step?

JOBS NO. 54, 55 & 56

SERVICE AND INSTALL LIQUID RECEIVERS
DETERMINE CHARGE BY CHECKING RECEIVERS
CHECK SAFETY DEVICES ON RECEIVERS

POR: 159-162
MRC: 126-127, 486, 619, 710

1. What dual purposes do shell and coil water cooled condensers serve?

2. What are the four purposes of a receiver?

3. What type controls are used on receiver systems?

4. Of what materials are receivers constructed?

5. In what position may receivers be installed?

6. Where is the horizontal receiver located?

7. If a receiver becomes inoperative, should it be replaced or repaired?

8. What are the proper steps in repairing a water cooled receiver?

9. How large should the liquid receiver for a commercial system be?

10. There are two service valves on a receiver. Where are they located, and what are their purposes?

11. What minimum safety device should be installed on liquid receivers?

JOBS NO. 57 & 58

SERVICE AND INSTALL DRIERS AND FILTERS
CHECK AND/OR INSTALL MOISTURE INDICATORS

POR: 57-61
MRC: 532, 533, 638, 1022, 452-453

1. (a) What is the purpose of a drier? (b) Describe its construction.

2. (a) What is the drying agent called? (b) What are the three most common agents?

3. In what forms may the desiccant be used in a drier?

4. Give some of the properties of a desiccant.

5. Where should all driers, except the one used in sulfur dioxide units be placed?

6. What is the purpose of a sight glass?

7. How can the refrigerant charge be checked?

8. How can a serviceman tell if the drier is absorbing moisture?

9. Why should a liquid drying agent not be used with a solid drying agent?

10. What color should a moisture indicator turn if water is in the system?

11. Describe the construction of a strainer.

12. In what two places should a suction line be installed and in what position?

13. What are the four basic steps in cleaning a system?

14. What percent of service calls are directly caused or are traceable to moisture?

JOBS NO. 59, 60, 61 & 62

CHECK SOLENOID VALVE OPERATION	POR:	317, 294-295
REMOVE AND REPLACE MAGNETIC COIL		332-334, 300,
CHECK VOLTAGE, WATTAGE AND AMPERES		341, 352
REMOVE AND REPLACE SOLENOID VALVE BODY	MRC:	74, 196-198

1. Where is the solenoid valve usually placed?

2. What is the liquid line solenoid valve electrical component called?

3. Describe the operation of a solenoid valve.

4. What are the four most important parts of a liquid line solenoid valve?

5. Where and in what manner is the liquid line solenoid pilot valve located in the system?

6. What two purposes does the liquid line solenoid pilot valve serve?

7. Explain the operation of the solenoid valves used in a multiple cooling coil installation. Draw a simple sketch of this installation.

8. What are four important factors to consider in designing and maintaining multiple systems using liquid line solenoid valves?

9. Name and describe the operation of three types of liquid line solenoid valves.

10. What three things could effect the operation of liquid line solenoid valves?

JOBS NO. 63, 64, 65, 66 & 67

CHECK OPERATION OF THERMOSTATIC EXPANSION VALVE MRC: 89, 10
CHECK THERMAL BULB AND EXTERNAL EQUALIZER LINE LOCATION 168-18
CHECK AND ADJUST SUPERHEAT SETTING OF EXPANSION VALVE
CHECK OPERATION OF THERMAL ELECTRIC EXPANSION VALVE
REMOVE AND REPLACE DIAPHRAGM AND VALVE BODY

1. What controls the operation of the thermostatic expansion valve?

2. Where is the thermostatic expansion valve located in a refrigeration system?

3. What causes the thermostatic valve to operate?

4. What is the theory of the thermostatic expansion valve?

5. What is the advantage of the thermostatic expansion valve over the low side multiple float system?

6. List the parts of a diaphragm type thermostatic expansion valve.

7. What are the four types of charges given the power element of the thermostatic expansion valve?

8. Why must the normal power element be charged with the same refrigerant that is in the system?

9. What can be done to eliminate overloading a condensing unit during a pull down from warm condition?

10. What can be done for installations where the body of the valve is exposed to colder temperature than the bulb?

11. For what purpose are pressure limiters used?

12. What will be the effect of an undersize or an oversize valve orifice?

13. How may the power element of a thermostatic expansion valve be tested?

14. What may cause the evaporator coil to be starved?

JOBS NO. 68, 69 & 70

CHECK OPERATION OF CAPILLARY TUBE — MRC: 87, 192-196
REMOVE AND REPLACE CAPILLARY TUBE — 1076
CORRECT MALFUNCTION AND RESTRICTIONS IN CAPILLARY TUBES

1. Where is the capillary tube located in a refrigerating system?

2. What is a capillary tube?

3. With what kinds of refrigeration is the capillary tube system commonly used?

4. Why must the amount of refrigerant used with the capillary tube system be carefully calibrated?

5. What is "vapor lock"?

6. What are the advantages of the capillary tube refrigerant control?

7. Why is a drier usually installed on the inlet of a capillary tube?

8. How is the capillary tube usually attached to the condenser and the evaporator?

9. What is the major problem found with capillary tubes?

10. What may be done to clear capillary tubes that become clogged?

11. What may be done to prevent moisture in the refrigerant freezing and clogging the capillary tube?

12. What may be used to replace a capillary tube?

JOBS NO. 71 & 72

CHECK OPERATION OF AUTOMATIC EXPANSION VALVES MRC: 88, 163-168
REMOVE AND REPLACE AUTOMATIC EXPANSION VALVES

1. What will cause liquid refrigerant to flow through an automatic expansion valve?

2. What happens to the liquid refrigerant when it reaches the evaporator coils?

3. What is the purpose of the automatic expansion valve?

4. Why is a system using an automatic expansion valve sometimes called a "dry" system?

5. Why will the expansion valve never flood the low side when the compressor is running?

6. What must be done if a refrigeration system using an automatic expansion valve is moved to a higher altitude?

7. What is the effect of an over capacity automatic expansion valv

8. Where is the automatic expansion valve chiefly used?

9. Why is a bypass automatic expansion valve used?

10. What type motor control must be used when an automatic expansion valve is used?

11. What four troubles may be found in automatic expansion valves?

12. What will happen if the screen in the expansion valve becomes completely clogged?

JOBS NO. 73 & 74

CHECK OPERATION OF LOW AND HIGH SIDE FLOAT MRC: 90-91
REMOVE AND REPLACE LOW AND HIGH SIDE FLOAT 188-192

1. Why is the high side float system known as a flooded system?

2. Why does the low side float system require a rather large refrigerant charge?

3. Why is the low side float system efficient?

4. What is the low side float?

5. What is the purpose of the float?

6. In what type refrigeration systems is the low side float system used today?

7. What may result if the low side float mechanism is adjusted too low?

8. What will result if the float is adjusted too high?

9. Why are tacks and special wood sometimes placed in the flooded cooling units?

10. What will indicate a leaky needle in the low side float system?

11. Why is a liquid receiver not used on the high side float system?

12. Why do high side float systems have less difficulty with oil binding than low side float systems?

13. What type motor controls are used with the high side float system?

14. What may be done to free a stuck-closed valve?

15. What usually indicates the refrigerant level in the evaporator?

JOBS NO. 75, 76, 77, 78 & 79

CHECK OPERATION OF DIRECT EXPANSION EVAPORATORS	MRC:	29, 127-129,
CHECK DIRECT EXPANSION EVAPORATOR FOR LEAKS, AIR FLOW, OBSTRUCTIONS AND CONDENSATE DRAIN		356, 487, 625-626, 837
CHECK FLOW AND TEMPERATURE RISE OF COOLING AGENT	PAC:	66-67, 72
CHECK AND/OR REPLACE CHILLER OR HEATING COIL		
REPAIR EVAPORATOR		

1. What is evaporative cooling?

2. What is required for evaporative cooling?

3. Where are evaporative cooling systems generally used?

4. How are cooling coils rated?

5. Explain the process of atmospheric cooling.

6. What is the basic purpose or function of a refrigeration system?

7. Upon what three factors does the design and shape of evaporator coils depend?

8. Of what three materials are evaporator coils made?

9. Why are special evaporator units sometimes required?

10. Into what two main divisions may evaporator coils be divided?

11. Coils for cooling air are of what principal types?

12. What determines the classification of an evaporator coil?

13. What type evaporator coil was the first produced by refrigerating companies for cabinets of all kinds?

14. In what ways may evaporator coils be mounted?

15. How does the refrigerant passing through the evaporator cause cooling or refrigeration?

16. What are the five principal types of refrigerant controls?

17. What is used on some refrigerators to prevent the formation of frost?

18. In what condition must direct expansion evaporator coils be kept for efficient operation?

JOBS NO. 75, 76, 77, 78 & 79 CONTINUED

19. How may the temperature of direct expansion coils be checked?

20. What is indicated by frost formation on the coil near the thermostatic expansion valve?

21. With what instrument may air flow through the coil be checked?

22. What is the result of frost accumulation on the evaporator coils?

23. What six repairs may be made on direct expansion evaporator coils?

JOBS NO. 80, 81, 82 & 83

MAKE MULTIPLE INSTALLATION MRC: 571-595
MAKE TWO TEMPERATURE INSTALLATION
DETERMINE LINE SIZE
INSTALL PACKAGED OR SELF CONTAINED EQUIPMENT

1. Give the commonly used classification of installations.

2. What determines whether or not a refrigeration unit is assembled where it is to be installed?

3. What are two main objectives when installing multiple units?

4. In what order should the various parts of a multiple system be installed?

5. Why should the condensing unit be put in a different room from the cabinets?

6. What factors should be considered in determining the location of condensing units?

7. Why should condensing units be installed on a sturdy stand?

8. How are evaporator coils usually installed?

9. What is required by the code to prevent violent rupturing or an explosion of the condensing unit?

10. Why must suction lines be installed so that they will drain toward the compressor?

11. Why should refrigeration tubing never be run near sources of heat such as furnaces?

12. What size copper tubing is usually used for commercial installations?

13. How should valves and driers installed on tubing be supported?

14. What may be used as vibration dampers on refrigeration tubing?

15. What size electrical wire should be used for commercial refrigeration?

16. What should be done to tubing after it is installed to prepare for operation?

JOBS NO. 80, 81, 82 & 83 CONTINUED

17. Why should the unit be checked for correct refrigerant charge before starting?

18. Why should liquid refrigerant never be allowed to reach the compressor?

19. What are the two common methods of making multiple installations of tubing?

20. Why should the number of bends and fittings on a refrigerant line be limited as much as possible?

JOBS NO. 84 & 85

CALCULATE COMMERCIAL HEAT LOADS MRC: 663-681, 1074
SELECT AND BALANCE EVAPORATORS AND CONDENSERS

1. What four steps are required if a commercial refrigeration system is to give good service?

2. The total heat is the sum of what four factors?

3. What five factors affect heat leakage of commercial units?

4. Give the meaning of the following symbols used in figuring heat loads: K_t, K_1, R, and R_t.

5. Define ambient temperature.

6. How does the film of air which clings to the outer and inner surfaces of the cabinet affect the heat conductivity?

7. Give an example of specific heat.

8. What are the sources of miscellaneous heat loads in a refrigerating unit?

9. Using the table in Figure 16-12 page 674 MRC, give the outside square footage of a cabinet that is eight feet, long 14 feet wide, and 10 feet high.

10. What is the capacity of a refrigerator cabinet that is seven feet long, 12 feet wide, eight feet high, with insulating cork four inches thick?

11. What three conditions determine the capacity of evaporators?

12. Upon what does the condensing unit capacity depend?

13. To what should the capacity of the evaporator be balanced?

14. Where may the capacities of evaporators and condensers be obtained?

JOBS NO. 86, 87 & 88

CHECK OPERATION OF SUCTION LINE REGULATOR — POR: 338-341
ADJUST AND/OR REPAIR SUCTION LINE REGULATOR — MRC: 198, 521-523
REMOVE AND REPLACE SUCTION LINE REGULATOR

1. What is the purpose of suction line regulators?

2. How do suction line regulators achieve their purpose?

3. Name the two groups of suction line regulators.

4. Explain the difference in the purpose of the two groups of suction line regulators.

5. Explain the operation of suction pressure hold-back valves.

6. Give an example of the use of the suction pressure hold-back valve.

7. List four basic safety rules to be observed when repairing or removing suction line regulators.

8. Suction line valves are usually made of what material?

JOBS NO. 89 & 90

CHECK HEAT EXCHANGER — MRC: 505, 702-703
REMOVE AND REPLACE HEAT EXCHANGER — POR: 103-105

1. Where is the heat exchanger located?

2. What principle of heat transfer is involved in the use of heat exchangers?

3. Where does the heat exchanger provide for a heat transfer?

4. According to their construction, list two types of heat exchangers?

5. Define "flash gas" or flash vapor.

6. What is another purpose of the heat exchanger in addition to those already mentioned above?

7. Make a schematic drawing showing installation of a heat exchanger.

8. What is the effect of the instantaneous change of a liquid refrigerant to a vaporized refrigerant?

9. Why are heat exchangers needed?

JOBS NO. 91 & 92

CHECK HOT GAS BYPASS VALVE — MRC: 167-168, 475
REMOVE AND REPLACE HOT GAS BYPASS VALVE — 501, 699

1. Describe the bypass automatic expansion valve and its purpose.

2. When using the bypass automatic expansion valve, why is it necessary to have an accumulator?

3. What adjustment of the automatic expansion valve is made to control temperature?

4. What are two types of automatic bypass systems?

5. For what purposes are the "hot gas" bypass valves used?

6. Make a schematic drawing of a commercial refrigerating cycle showing the position of the "hot gas" bypass valve.

7. How does a hot gas bypass valve operate to defrost a refrigerator?

JOBS NO. 93, 94 & 95

CHECK LOW AND HIGH PRESSURE CONTROLS
ADJUST AND CALIBRATE LOW AND HIGH PRESSURE CONTROLS
REMOVE AND REPLACE LOW AND HIGH PRESSURE CONTROLS

POR: 335-336
MRC: 65-67

1. What is the purpose of the low pressure control?

2. As a safety control, what does the low pressure control protect against?

3. What conditions may cause excessively high head pressures?

4. What is the function of the high-pressure cut-off control?

5. How does the electric switch operate in the high-pressure control as compared to the low-pressure control?

6. What happens if the pressure rises beyond a specific setting for the maximum safe operating pressure?

7. Where are the high pressure gauge and the compound gauge used?

8. Describe the high pressure gauge scale.

9. What does the compound gauge measure?

10. How are the high pressure and compound gauge usually graduated?

11. What is meant by calibration?

12. How often should gauges be calibrated?

JOBS NO. 96, 97 & 98

CHECK OIL PRESSURE SAFETY CONTROL — MRC: 508-509
ADJUST AND CALIBRATE OIL PRESSURE SAFETY CONTROL — POR: 336
REMOVE AND REPLACE OIL PRESSURE SAFETY CONTROL

1. Give an important difference between commercial and domestic controls.

2. Of what does the high pressure safety device consist?

3. Why is the high pressure safety device frequently connected to the cylinder head?

4. Explain the action of the bellows if the head pressure should become too high due to air in the system, or other causes.

5. What are the usual settings for the safety motor controls?

6. How does the oil pressure safety cut-out function?

7. What kind of control is the oil pressure safety cut-out and how many bellows are used in it?

8. To what do the bellows respond in the oil pressure safety cut-out control?

9. How does the oil pressure control react when the pressure difference between the two bellows drops below the required pressure needed?

10. What systems use the oil pressure safety cut-out control?

11. What is the usual cut-in and cut-out adjustment for the oil pressure safety control?

JOBS NO. 99 & 100

CHECK THERMOSTATIC MOTOR CONTROLS — MRC: 274-300,
ADJUST AND CALIBRATE THERMOSTATIC MOTOR CONTROLS — 507-509

1. List three types of thermostatic motor controls.

2. What is the purpose of the range adjustment?

3. What two functions do thermostatic controls perform?

4. What does the differential adjustment control?

5. List four troubles that may be encountered in thermostats.

6. On what type commercial system is the thermostatic motor control commonly used?

7. Where is the power element located in brine cooling installations?

8. Name the parts of a thermostatic motor control.

9. Where is the thermostatic motor control mounted in single cabinet installations?

JOBS NO. 101 & 102

CHECK TEMPERATURE CONTROL
ADJUST AND CALIBRATE TEMPERATURE CONTROL

MRC: 275-282, 887-889
PAC: 291-292, 300-301

1. What are the two basic temperature controls?

2. Name five types of devices used in thermostats which react to temperature change.

3. On what differential does the typical room heat thermostat operate?

4. What is the sensitive element of the typical room heat thermostat?

5. What causes the diaphragm movement in a hydraulic heat thermostat?

6. How are thermostats rated?

7. What is a heat anticipator?

8. What is the primary difference between a heating thermostat and a cooling thermostat?

9. What is a combination thermostat?

10. Give an example of an installation that uses the combination thermostat.

11. What is the purpose of the differential adjustment?

JOBS NO. 103, 104, 105 & 106

CHECK DEFROST HEATER	POR: 143-150
REMOVE AND REPLACE DEFROST HEATER	MRC: 289-290,
CHECK AND/OR SET DEFROST TIMER	368-374,
REMOVE AND REPLACE DEFROST TIMER	504, 513

1. What was the earliest and simplest method of defrosting?

2. Describe the temperature defrost method.

3. What is the source of heat in supplementary heat defrost methods?

4. What is the "thermobank" defrost method?

5. How is defrosting accomplished by the reverse-cycle defrost method?

6. What is the source of heat for electric defrost methods?

7. What is the watt rating of electric defrost heating coils?

8. How is the defrost water disposed of in domestic refrigerators?

9. List five principal ways in which the automatic defrost interval is determined.

10. Discuss some ways in which commercial units are defrosted electrically.

11. What time of the day or night is the daily clock timing system usually set?

12. How is the accumulated running time of the condensing unit timed?

13. How is the clock mechanism set?

14. On what principle is the accumulated door open time based?

15. What mechanism is used in the counted number of door openings systems to bring about defrosting?

16. How many door openings are required to bring the racket mechanism into operation?

JOBS NO. 103, 104, 105 & 106 CONTINUED

17. What device is used in the non-frost refrigerator to cause defrosting?

18. Describe a defrost system which uses a timer to operate the defrost cycle every twelve hours.

19. In installations which use a defrost timer, what mechanism is used to operate the switches?

JOB NO. 107

CHECK OVERLOAD PROTECTORS

MRC: 248-249
POR: 318-319

1. What two conditions may cause the refrigerator or air conditioner motor to overheat?

2. What will happen if there is an increased starting load?

3. At what temperature do the units normally operate?

4. What may happen if the serviceman should tap on the controls in an attempt to operate the points?

5. List two types of internal motor overload protectors.

6. Where is the internal overload located in the "Y" type three-phase motors?

7. Why should the thermal type protector never be connected in the main electric line?

8. Where should the thermal type protector be connected?

9. Why are overload protectors needed on electric motors?

10. Where are the terminal type inherent protectors primarily used?

JOB NO. 108

SERVICE AND/OR INSTALL PNEUMATIC CONTROLS PAC: 306-313

1. What causes pneumatic controls to operate?

2. What are the five parts of a pneumatic control system?

3. What is the difference between main line and branch line copper tubing used in pneumatic control systems?

4. What is an actuator?

5. What causes a normally open valve to move toward the open position?

6. Which valves are used for heating and which for cooling?

7. Describe the operation of direct acting thermostats and positive acting thermostats.

8. What three functions can a diverting relay perform?

9. What is the advantage of a differential diverting relay?

10. Explain the operation of the master-submaster control system.

JOBS NO. 109 & 110

SERVICE AND/OR INSTALL ELECTRONIC CONTROLS — MRC: 215-222, 893
SERVICE AND/OR INSTALL SOLID STATE CONTROLS — PAC: 290, 298-306

1. Define electronics.

2. What discoveries brought about the development of electronics?

3. What is meant by capacitance?

4. What unit is used in the refrigeration industry to rate most capacitors (condensers)?

5. What are solid state semiconductors?

6. What are diodes?

7. Define rectifier.

8. What are the three basic parts of a transistor?

9. For what are thermistors used and how does it achieve its purpose?

10. What is the control signal controlled by in electronic circuits?

11. What is an amplifier?

12. What are transducers?

13. What is used by electronic controls to control motors?

14. For what purposes may electronic control circuits be used?

JOB NO. 111

SERVICE AND/OR REPAIR AUTOMATIC ICE MAKERS MRC: 553-565, 621-623 756-772

1. List some of the trouble caused by the water valve in an ice maker.

2. What are some common troubles encountered when water flow is too little?

3. List three things which may cause too great water flow into the ice maker.

4. What is frequently the cause of a leaky water valve and how is the condition corrected?

5. How can the serviceman determine whether the water valve is causing trouble, or if it is caused by parts of the water circulating system?

6. What is water hammer and how can it be eliminated?

JOB NO. 112

SERVICE AND/OR REPAIR THERMOELECTRIC UNITS MRC: 756-757

1. When is it considered good practice to remove the thermoelectric unit and take it to the shop for servicing?

2. What are two major divisions of thermoelectric refrigerator repair service?

3. Make a list of the most common external service operations which do not involve direct servicing of the thermoelectric unit.

4. What two systems are involved in servicing the thermostatic systems?

5. What equipment does the serviceman need to successfully check a thermostatic refrigeration system?

6. What should the serviceman do prior to checking the system?

7. Where is the wiring diagram usually found on the unit?

8. What should the serviceman do before checking the internal power supply unit and wiring?

JOB NO. 113

SERVICE AND/OR REPAIR TRANSPORTATION REFRIGERATION MRC: 565-567, 761-765

1. Name two liquids that are being used increasingly for cooling transportation vehicles.

2. What is the temperature setting for the cold plate cooling system?

3. Explain the operation of the temperature control in the cold plate cooling system.

4. What safety precaution should the serviceman take before entering any refrigerated vehicle?

5. List three methods by which transportation vehicles may mechanically drive the compressors.

6. What two general types of refrigeration systems are used on trains?

7. What restrictions are placed on refrigerants used in marine refrigeration?

JOBS NO. 114 & 115

SERVICE AND/OR REPAIR SOFT SERVICE ICE CREAM MACHINES
SERVICE AND/OR REPAIR WATER COOLERS

MRC: 553-555

1. How much time is required for a ½ hp. refrigeration unit to fast freeze one gallon of ice cream or custard?

2. What device is commonly used as the refrigerant control on soft ice cream makers?

3. At what temperature is the soft ice cream maker adjusted to deliver sherberts?

4. Of what do water cooler cabinets usually consist?

5. What part of the water cooler is insulated?

6. What is the purpose of the heat exchanger on a water cooler?

7. Name two types of self contained water coolers.

JOBS NO. 116 & 117

USE MANOMETER — MRC: 903-914
USE AIR MEASUREMENT INSTRUMENTS — PAC: 316-321

1. How is combustion efficiency usually determined?

2. Describe a manometer.

3. What type manometer is used to measure duct pressures?

4. For what purpose is a barometer used?

5. Why is it necessary to measure air velocities accurately in air conditioning?

6. How are correct velocity readings in a duct obtained?

7. What is the advantage of using a velocimeter?

8. For what purpose are anemometers used?

9. Why is the use of a thermometer necessary in air conditioning service?

10. Why are hygrometers used?

11. Why must the serviceman read and interpret all instrument readings correctly?

JOBS NO. 118, 119, 120 & 121

INSTALL WINDOW AIR CONDITIONING UNIT MRC: 839-842
CHECK FOR PROPER VOLTAGE, WIRE AND CIRCUIT BREAKER PAC: 235
CHECK OPERATION OF WINDOW UNIT FOR PROPER CHARGE, AIR FLOW, AND TEMPERATURE DIFFERENCE
CHECK WINDOW UNIT FOR VIBRATION AND NOISE

1. Why are window mounted or wall mounted units so popular?

2. Explain the operation of the window unit.

3. Why must window units be installed level?

4. What materials are used to seal the unit into the window?

5. What precautions should be taken when installing units in casement windows?

6. What kind of electrical hook up should be used with window units?

7. What is the final step in installing window units?

8. What thermostats are used with window units?

9. What are the advantages of installing window units?

10. What are the disadvantages of window units?

JOBS NO. 122 & 123

SERVICE WINDOW AIR CONDITIONING UNIT MRC: 427, 843-847
CHECK OPERATING EFFICIENCY OF SERVICED UNIT

1. How often should the filter on window units be cleaned or replaced?

2. What part of the window unit should be cleaned once a year?

3. Why should fan blades never be bent?

4. What three capacitors do window units usually have?

5. What should be checked before doing internal service work on a window unit?

6. Name five internal troubles with window units.

7. What is used to check the condition of the motor on window units?

8. What is used to check for lack of refrigerant or clogged refrigerant lines?

9. Servicing window units is similar to the servicing of what?

10. Why must a serviceman have a good knowledge of fundamental refrigeration and a knowledge of the handling of tools before he is qualified to work on a refrigerating mechanism?

JOB NO. 124

DETERMINE FACTORS OF LOAD ESTIMATING PAC: 91-119

1. Why is outdoor heat so important in figuring the cooling load of an enclosed structure?

2. In what two ways does solar heat enter a structure?

3. Why is the solar heat that enters by conduction not immediately absorbed?

4. Why is a "V" factor used? For what does it stand?

5. What two differences determine the rate of heat conduction through materials? What determines the quantity of heat conducted?

6. What is the formula for determining the total sensible heat conducted through a frame wall?

7. Why is building orientation to the sun important in relation to solar heat?

8. How long would it take the heat from the sun to penetrate a 12 inch thick brick wall?

9. Explain the two sources of heat infiltration.

10. Why must air conditioned rooms be ventilated?

11. Write the two formulas for determining the heat gained by ventilation.

12. What are the major indoor heat sources?

13. Why is storage of cool air at night helpful in offsetting the heat load of the daylight hours?

14. Why is zoning used in air-conditioning a building?

15. Why is heat loss during the heating season similar to heat gain during the cooling season?

16. What items or materials can be used to reduce heat gain or heat loss?

17. What is the "U" factor for ordinary window glass? How does the "U" factor of glass compare with other materials in value?

JOB NO. 124 CONTINUED

18. How does the storm window and double window compare with the ordinary window in the redirection of heat flow?

19. List five ways of reducing the solar heat gain through glass.

20. How may heat conducted through walls and ceilings be reduced?

21. Why are the types of materials used in roof construction important?

22. What is the average infiltration load for a 3' by 5' window? a 3' by 7' door?

23. Why is the sensible and latent heat given off by people greater in a bowling alley than in a theatre?

24. What factor is used for calculating the BTU's given off by lights?

25. Why does the same "U" factor, that is applied to cooling, apply to heating?

26. Why is insulation around the edge of a slab floor more effective in winter than in summer?

27. What is the formula for calculating the latent heat load added by ventilation air?

28. Study the problems on page 116-117 PAC.

JOB NO. 125

DETERMINE THE SIZE UNIT NEEDED PAC: 195-217

NOTE: Use the blueprint from the folder in back of PAC.

1. What final results are desired from a survey and estimating form, and why are the resulting values important?

2. Why is a survey checklist important to local estimating?

3. Where is the survey information obtained for an existing home, and for a new home?

4. What is the first item on the checklist?

5. When surveying the construction of the building, what five items should be checked? Explain briefly each area.

6. List the types of shading that should be observed during the survey?

7. Where are the attic louvers on the blueprint, (in back of PAC) located in relation to the roof?

8. What are items 5, 6, 7, 8, and 9 on the survey checklist?

9. Why is outside air, or infiltration air necessary for the furnace?

10. What type information is found under service and utilities on the checklist?

11. It is not always necessary to check the size of ducts and grills during the survey? Why?

12. What does the term "quantity" mean in load estimating?

13. Under what conditions is the Sample Load Estimate in the book presented?

14. (a) What information is recorded in Table 1, page 202, PAC?
    (b) What information is entered in Table 2, page 203? Study step 3.
    (c) What information is entered in Table 3, page 203?
    (d) What is required in step 5?

JOB NO. 125 CONTINUED

15. Using the floor plan, sample load estimate, blueprint, and the information provided in the tables (from packet in back of PAC), carefully study the information in steps 6 through 20, page 204-207. Draw a cooling load estimate form as shown on pages 204 and 207. (Check with the coordinator as to what steps to follow in completing each step.)

16. Using the information from the survey, figure the heating load to determine the size heating unit needed. Follow the example in the book, beginning with step 1 on page 208, and continue through step 9. Draw a worksheet and fill in the information provided in the tables.
(Check with the coordinator as to what steps to follow in completing each step.)

17. What is the final cooling load estimate? The heating load estimate?

18. Why are these load estimates important to the installer?

19. When selecting cooling equipment, what are several important things to remember in regard to capacity?

20. List three ways of reducing heating and cooling loads.

21. Why is the central point of the structure a good location for equipment?

22. Where is the condensing unit usually located, and what are the main considerations in locating it?

23. What are the major steps in residential duct sizing after the load estimate has been determined?

24. Carefully study the duct sizing data table on page 214, PAC, and follow the steps 1 - 10.
    (a) What diameter is recommended for the branch supply ducts?
    (b) Why isn't one size plenum used to supply the air to the rooms?
    (c) How many return grilles are used?

JOB NO. 126

DETERMINE THE TYPE DUCT SYSTEM FOR AIR DISTRIBUTION

PAC: 148-163

1. Why are duct systems used?

2. What component parts are usually included in air distribution systems?

3. When is the propeller fan and centrifugal fan used?

4. What is the main difference between the forward-curved blade and the backward-curved blade found on centrifugal fans?

5. Why is the speed of the fan wheel referred to as "tip speed"?

6. What is meant by the term fan velocity?

7. What factors determine the noise level of the fan unit?

8. Why are round ducts more efficient than square or rectangular ducts?

9. What materials are used in the construction of ducts?

10. Why should the number and types of duct fittings be kept simple and to the minimum in regard to the size, shape, and direction of the duct system?

11. Study the various fittings shown on pages 154-156, PAC. How many fittings are shown?

12. What are the two categories of duct systems?

13. Give five basic duct designs. Describe the type structure for which each is best suited.

JOB NO. 127

DETERMINE LOCATION AND SIZE OF DUCT SYSTEM AND DETERMINE LOCATION AND SIZE OF REGISTERS — PAC: 178-194, 165-177

1. Why is air pressure in duct work referred to as static pressure?

2. Why can't the usual pressure measuring instruments be used to test duct systems?

3. What instrument is used to measure air pressure in duct work?

4. Why is the Pitot tube instrument used?

5. When does friction loss occur?

6. What conditions cause an increase in pressure losses?

7. Give the steps to be followed in building a duct system.

8. Why should the building plans be reviewed before selecting the duct system?

9. What determines whether or not zoning should be used?

10. What three methods may be used in determining air quantities (cfm) for rooms?

11. What information must be known before the tables for determining the size of registers, outlets and grills can be determined?

12. Where is the location of supply and return outlets and cfm requirements placed after sizes have been determined? Carefully study the tables in relation to the information given on the plans on page 185, PAC.

13. Why is velocity reduction used in the static regain method of duct sizing? (See Table 5, page 186, PAC.)

14. Why is the equal friction method of sizing ducts used by many contractors?

15. Upon what is the friction drop based?

16. Explain the four sets of valves that appear on a friction loss chart. (Study Example 1, page 188, PAC; and the friction loss chart on page 189, PAC.)

17. Why are fittings such as elbows, boots, and transformation considered when determining total friction loss?

JOB NO. 127 CONTINUED

18. Why are outlets an important part of the air distribution system?

19. What are the primary functions of outlets?

20. Explain briefly the types of outlets used in air distribution.

21. Why is it important to locate supply and return air openings properly?

22. When heating and cooling systems are being used, what determines the outlet location?

23. Why is it a good idea to locate supply air outlets on the outside under the window, or on the floor under the window?

24. What is the chief cause of discomfort in cooling?

25. Why is the low wall outlet ideal for both heating and cooling?

26. Why is it best to have a return outlet located under the outside wall when using the high wall outlet for heating?

27. Why is sufficient air velocity necessary when using floor outlets?

28. What is required to make the use of a baseboard outlet satisfactory for heating and cooling?

29. Where are ceiling outlets principally used? Where are they the least recommended?

30. Study very carefully the table on page 172, PAC.
    (a) Which register is only fair as far as being used for heating?
    (b) Which three outlets are considered excellent for cooling and heating?
    (c) Which outlet is considered to have the highest installation cost?

31. Define the following terms:
    (a) Primary air
    (b) Secondary air
    (c) Outlet velocity
    (d) Temperature difference
    (e) Temperature variation
    (f) Throw or blow
    (g) Drop (cool air)
    (h) Rise (warm air)
    (i) Spread

32. Why should the return outlets be located at opposite heights from the supply outlets?

33. What steps should be followed when selecting the supply and return outlet registers and grilles?

JOB NO. 128

INSTALL HEATING AND COOLING UNITS PAC: 266-274

1. Why are air cooled package units popular as residential and commercial units?

2. Why is it important that the hold down bolts be removed from the compressors after the unit has been uncrated?

3. Why is it important to use a drip pan when the bare unit is installed inside the building?

4. Why is an isolation pad necessary for indoor installation?

5. What are some important facts to remember when installing the base unit projecting through the wall?

6. How is the base unit located when it is placed outside the building?

7. Describe the two electrical wiring combinations found in most cooling units.

8. Why should air-cooled condensers be located in areas free from loose dirt and foreign matter?

9. How far from a wall should an air-cooled unit be located for air discharge?

10. Why is it important to discharge the air to the outside when a condensing unit is installed indoors?

11. Why is it important to install a trap in a vertical discharge line?

12. At what height is the trap in a vertical line located?

13. What basic rules should be followed when installing refrigerant piping?

14. Give four methods of piping air cooled condensers.

15. It is suggested that the student contact the different dealers in the vicinity and acquire literature on installing the different types of equipment. State, county, city, FHA and UA codes must also be taken into consideration when installing equipment.

JOBS NO. 129 & 130

INSTALL LINE WIRING — MRC: 885-916
INSTALL CONTROL CIRCUITS — PAC: 288-301

1. What three types of controls can be used on air conditioning equipment?

2. Define the following terms: (a) set point (b) deviation (c) corrective action (d) differential gap (e) lag (f) primary element (g) bimetal elements.

3. Give the six basic functions of control systems.

4. For what purposes are two-position controls used?

5. What is done to cause a control to produce an average change?

6. What is the difference between low voltage and line voltage?

7. Why are limit controls used on air conditioning equipment?

8. Why are heat and cold anticipators used in thermostats?

9. What are the four types of electrical circuits used in heating and cooling systems?

10. What are the two most popular refrigerant controls?

11. Why are larger refrigerating units usually equipped with pressure controls?

12. What is the purpose of humidity controls?

13. Why are electronic control circuits used on many commercial and residential heating and cooling applications?

14. What should be done in the checkout of a system after it has been installed?

JOB NO. 131

TROUBLESHOOT ELECTRICAL CIRCUITS PAC: 302-306

1. Why are center control panels helpful in troubleshooting circuits?

2. Where is the test for power made?

3. When the test light fails to burn, what should be checked to determine power failure?

4. Why is line voltage checked on the primary side of the transformer?

5. Which side of the transformer is checked to determine if it is defective?

6. What are two ways of testing the relay coil circuit?

7. When checking the cooling circuit, what should be done with any cutout devices?

8. In what order is the cooling circuit checked in trying to locate a problem?

9. Why is a jump across thermostat terminals O to R made?

10. Which terminals are jumped across to begin testing the fan circuit?

11. Which terminals are jumped to test the heating circuit?

JOB NO. 132

TROUBLESHOOT REFRIGERANT SYSTEM PAC: 329-335

1. What should be done if the starter overload cuts out?

2. When the compressor will not start, what should be checked?

3. Why is it important to clean or replace dirty or plugged air filters?

4. Why should a refrigerant system never be overcharged with a refrigerant?

5. How are air or non-condensable gases removed from a system?

6. What factors can cause a system to operate with a high head pressure?

7. When the sight glass indicates bubbles, or the system indicates a low refrigerant charge, what should be done?

8. Why is it important to remove or loosen shipping bolts before compressor operation?

9. When the compressor and condenser fan motor will not start, what are some of the causes?

10. What instruments are used to test the electrical problems of the compressor and condenser parts?

11. What are the main symptoms of a defective compressor motor?

12. What is an indication of a defective fan relay?

13. When the condenser fan motor runs, but the compressor hums and will not run, what may be the cause?

14. What is used to check the fan motor?

15. Study all the causes, symptoms and remedies for the various problems found in refrigerant systems very carefully. The information provided on pages 329-335 PAC can be a helpful guide to the learning student as well as the "old pro".

JOBS NO. 133 & 134

SERVICE AND REPAIR HEAT PUMPS MRC: 999-1017
INSTALL HEAT PUMPS

1. Why are all refrigeration units actually heat pumps?

2. What is the purpose of the heat pump?

3. What is the principle upon which the theory of the heat pump is based?

4. Why is the term reverse-cycle mechanism which is sometimes used for the heat pump not technically correct?

5. What are the principal parts of the heat pump system?

6. At what outdoor temperature does heating for the inside of a house usually become necessary?

7. How is the coefficient of performance of the heat pump increased by nature?

8. What determines the design of outside coils used in heat pump systems?

9. List some types of coils classified as to the heat medium.

10. Why are variable capacity compressors being used in heat pump systems?

11. What two types of refrigerant and motor controls may be used with heat pumps?

12. How many refrigerant connections does a four-way reversing valve provide?

13. In what two ways is a solenoid used to operate a reversing valve?

14. How many thermostatic expansion valves are used in heat pump installations?

15. How many check valves are used in a heat pump system equipped with thermostatic expansion valves?

16. What are five operational differences between the Hi/Re/Li system developed by Westinghouse Corp. and other systems?

JOBS NO. 133 & 134 CONTINUED

17. When is the operation of the motor compressor most critical in a heat pump system?

18. What safety precautions should be observed when servicing heat pumps?

JOBS NO. 135, 136, 137, 138, 139 & 140

CHECK AND/OR ADJUST HEATING DEVICES
CHECK AND/OR ADJUST CHILLER UNITS
ADD REFRIGERANT
REPAIR LEAKS
ADD ANTI-FREEZE
REPAIR ELECTRICAL COMPONENTS

POR: 8-12, 17, 175-182
MRC: 719-745

1. In what way does the absorption system differ from the compression system?

2. What are the only moving parts in small absorption units?

3. What refrigerant is most commonly used in absorption refrigerators?

4. What is the purpose of the water used in absorption systems?

5. What parts, similar to a mechanical system, must the absorption refrigerator have?

6. Why does the ammonia refrigerant boil in the evaporator?

7. What are the two main types of absorption refrigerators?

8. Describe the experiment performed by Michael Faraday which brought about the absorption refrigeration system?

9. What is the principal advantage of absorption type refrigerators?

10. What occurs in the generator of an absorption system?

11. Trace the absorption cycle of the domestic refrigeration unit shown on page 178, POR, naming each part the refrigerant flows through.

12. What is the source of energy for the Superfex and Trukold systems?

13. Why must absorption refrigerator have proper air flow space beneath, in the back and over the top of the cabinets?

14. Why are flues needed on some absorption refrigerators?

15. What fuel is most commonly used for absorption system refrigerators?

16. Why are regulating valves needed on the gas supply line?

17. How does the thermostat on the absorption refrigerator control the amount of cooling?

JOBS NO. 135, 136, 137, 138, 139 & 140 CONTINUED

18. Why is a safety valve needed on the burner?

19. Why are electrical circuits needed on absorption systems?

20. What should be done if a service call in received which reports the refrigerator is too cold?

JOB NO. 141

CHECK BELTS AND PULLEYS

MRC: 948-949
986-988

1. How many belts are used to drive the air conditioning compressor?

2. How is correct belt tension maintained?

3. How is proper belt tension determined?

4. Describe a method to roughly check belt tension.

5. What purpose does the belt serve in addition to pulling the air compressor?

6. Draw diagram showing belt and pulley installation for air conditioning.

7. What must be moved to adjust belt tension?

8. Why will loose belts cause the pulleys to fail?

9. What is indicated by a shrill squeal when engine speed is increased?

10. If the system has two belts, why should both be replaced if one fails?

11. Give four causes of broken belts.

JOB NO. 142

EVACUATE AND CHARGE SYSTEM MRC: 988-989

1. What can be seen in the sight glass if the system is short of refrigerant?

2. What is used to check the head pressure of the air conditioning system?

3. What is used to charge the system?

4. Describe methods used for adding a small amount of refrigerant and for a complete charge?

5. What is used for evacuating a system?

6. Why is it possible to vary the charge of refrigerant in automobile air conditioning systems?

JOB NO. 143

CHECK AND SERVICE CLUTCH ASSEMBLY MRC: 943-945, 995-996

1. Why is a clutch needed on auto air conditioning compressor?

2. How does the auto air conditioner clutch operate or function?

3. What two basic designs of clutches are used?

4. Explain the principle of the electromagnetic clutch.

5. What type clutches may be replaced?

6. What is a common cause for a slipping clutch?

7. What is used to trace the wiring circuit of an electromagnetic clutch?

8. What is indicated by a noisy clutch?

JOBS NO. 144 & 145

REPAIR HOT GAS BYPASS VALVE MRC: 943, 955-958
CHECK AND REPAIR SUCTION REGULATOR VALVE

1. What is the purpose of the hot gas bypass valve?

2. Where is the bypass valve located?

3. Explain the function or operation of the pressure operated hot gas valve.

4. How does the solenoid operated hot gas bypass system differ from the pressure type?

5. Why does the solenoid valve not give the throttling effect of a pressure operated valve?

6. What opens and closes most suction regulator valves?

7. What is meant by the following symbols: STV, EPR, POA?

8. What is the main purpose of suction pressure valves?

9. What is the purpose of the thermostatic expansion valve on automobile air conditioners?

10. Why must the thermostatic expansion valve be the correct size?

JOB NO. 146

CHECK AIR DISTRIBUTION SYSTEM MRC: 961-966

1. Why does air distribution within an automobile present unusual problems?

2. What is the objection to the distribution system which has two air duct openings back of the back seat?

3. If a separate heating and cooling system is used, which system has a fresh air intake?

4. Where are the heating coil and evaporator located in the combination system?

5. What is included in the duct system?

6. What is used to control the air dampers?

7. What type fans are used to circulate the air?

8. Why are fan motors flexibly mounted?

9. What may be done to remedy too much motor end play?

10. How may the electrical load of the motor be checked?

11. Why are filters not used on some systems?

JOB NO. 147

INSTALL AUTOMOBILE AIR CONDITIONER MRC: 982-986

1. What two things should be checked before installing a unit?

2. Why must drilling be done very carefully?

3. What can be used for making a large hole in the floorboard?

4. Why should two wrenches be used when mounting the lines and tightening the fittings?

5. Why must the electrical wire be very carefully installed?

6. Why must air be kept out of the system?

7. Why must water be kept out of the system?

8. What is used to seal the body openings?

9. Where may information concerning proper amount of refrigerant be found?

10. What is an indication that the compressor shaft seal is blown?

VT 010 601
Volkswagen Mechanics, Study Guide and Job Tests.

Alabama Univ., University. Dept. of Trade and Industrial Education
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IDENTIFIERS - *VOLKSWAGEN MECHANICS

ABSTRACT - Prepared by trade school instructors for students in cooperative education studying Volkswagen mechanics, the study guide includes a bibliography, progress record chart, and 48 job and information lessons on servicing and repair procedures. A separate booklet contains job tests related to each of the 48 job and information lessons. Related documents "Volkswagen Mechanics, Answer Book," and "Volkswagen Mechanics, Job Test Answers" may be obtained from the source of availability indicated for this document. (GR)

VT 010 601

File No. 1584

ED0 45856

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VOLKSWAGEN MECHANICS

A study guide and progression record
for cooperative students training for
Volkswagen Mechanics

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The material was edited by J. R. Thomas, Assistant State Supervisor, Trade and Industrial Education and approved by H. F. Worthy, State Supervisor, Trade and Industrial Education, Alabama State Department of Education.

ERIC

VOLKSWAGEN MECHANICS

BIBLIOGRAPHY

CODE

FYV — Fix Your Volkswagen
Jud Purvis — 1967 Edition
Goodheart-Willcox Co. — $2.63
18250 Harwood Avenue
Homewood, Illinois 60430

VRT — Volkswagen Repair and Tune-Up Guide
Harold T. Glenn — 1966 Edition
Chilton Company, Book Division — $3.95
5605 Chestnut Street
Philadelphia, Pennsylvania 19139

HOW TO USE THIS STUDY GUIDE AND RECORD OF PROGRESS

The student's record of progress is kept on the Trade Analysis and Progress Record page. Progress "on-the-job" is kept in the column headed "Job Progress", and related study progress is kept in the adjoining column headed "Related Study".

The four step method of training is used in developing the skills of a trade or occuaption. A record of all these steps for each job is kept in the squares in the column below "Learning Status" (Steps), opposite a specific job.

A dot in the center of the square indicates a student is in the first step; that of observing the job being done. No other mark is made in this square as long as the student remains in this step.

A diagonal line across the same square indicates the student is in the second step; that of helping perform the job under instruction.

Two diagonal lines across the same square indicates that the student is in the third step; that of doing the job under supervision.

The square filled in solid indicates that the student has reached the fourth step; that of a satisfactory level of accomplishment. The date when this accomplishment has been reached is placed in the column "Date Objective Reached", opposite the specific job.

On the day the student has read all the references and has written the answers to all of the questions, for a specific job, the student places this date in the column headed "Date Completed", opposite this job. The grade made on the test on this job is entered in the adjoining square headed "Test Grade".

The word "Information" will be found in the "Job Progress" column for all information lessons. When all references have been read and all answers to the questions have been written, for a specific information lesson, the student places the date of completion in the "Date Completed" column, opposite this lesson number. The grade made on the test on this lesson is entered in the square headed "Test Grade".

The student should read all references before writing the answers to questions. The essay type of answers which are required for most questions have a very definite value as they will help the student form the habit of giving clear-cut, definite answers or explanations. Only a few references and a few questions have been listed on each job sheet to teach the student how to study the literature pertaining to his occupation.

File No. 849-R
Revised May, 1966

TRADE ANALYSIS AND PROGRESS RECORD

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
1.	Remove Engine from Chassis				
2.	Disassemble Engine				
3.	Inspect Valves, Rocker Arms and Valve Springs				
4.	Cut New Valve Seats				
5.	Adjust Valve Tappets				
6.	Clean and Install Cylinder Head				
7.	Disassemble Crankcase				
8.	Remove and Inspect Bearings				
9.	Check Crankshaft, Camshaft and Connecting Rods				
10.	Check Pistons, Piston Rings and Cylinders				
11.	Trouble Shoot Engine				
12.	Service Generator				
13.	Test Battery				
14.	Service Starter				
15.	Repair Oil Pressure Switch				
16.	Repair Windshield Wiper				
17.	Service Speedometer Cable				
18.	Service Lights				
19.	Trouble Shoot Generating System				
20.	Trouble Shoot Lighting System				
21.	Check Fuel System				

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NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
22.	Inspect and Adjust Carburetor				
23.	Service Fuel Pump				
24.	Adjust Fan				
25.	Inspect and Trouble Shoot Cooling				
	System				
26.	Service Heating System				
27.	Adjust Brakes				
28.	Service Hydraulic Brake System				
29.	Service Brake Drums				
30.	Trouble Shoot Brakes				
31.	Align Wheels				
32.	Service Steering Gear				
33.	Balance Wheels				
34.	Replace Shock Absorbers				
35.	Trouble Shoot Steering				
36.	Remove, Overhaul and Reassemble Clutch				
37.	Adjust Clutch Pedal				
38.	Trouble Shoot Clutch				
39.	Service Gear Control				
40.	Remove and Disassemble Transmission				
41.	Reassemble Transmission				
42.	Assemble Drive Shaft				
43.	Trouble Shoot Transmission				
44.	Remove and Inspect Rear Axle				

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45.	Reassemble Rear Axle				
46.	Trouble Shoot Rear Axle				
47.	Service Crankcase Breather				
48.	Service Oil System				

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NAME_____ OCCUPATION_____ AGENCY_____

STUDENT'S DAILY RECORD

Date	List the Job Numbers Performed the Previous afternoon	List the References Read in the Related Class by Symbols and Pages	List the Number of the Job Studied Today

No. 1

Remove Engine from Chassis

FYV - 87-88
VRT - 54-56

1. What is the most commonly used method of removing an engine from the chassis?

2. By what means is the engine attached to the transmission assembly?

3. How much clearance will be needed while removing the engine?

4. What type jack is recommended for use while removing engine?

5. Why is the rear end of the auto raised?

6. Why must the mechanic be very careful when removing a Volkswagen engine?

7. What are the first two steps in removing the Volkswagen engine?

8. What should be done with throttle and choke cables after they are disconnected?

9. What is the next step after the auto is jacked up and the flexible fuel line is disconnected?

10. What is the last step before removing the engine?

No. 2

Disassemble Engine

FYV - 89
VRT - 56-57

1. When disassembling the Volkswagen engine explain fully how to remove it from frame.

2. How are the piston pin lock rings removed when disassembling a Volkswagen engine?

3. What determines the crankshaft end play?

4. How is the generator secured to its mounting pedestal?

5. How are cylinder ducts held to the cylinder?

6. What is done as soon as the crankshaft is in a holder?

7. (A) After the engine is out of the car how is the valve cover on each cylinder head removed?
   (B) What is removed with valve cover?

8. What kind of tools are used when removing and replacing reconditioned cylinder heads?

9. How is the blower housing fastened?

10. Why is it not wise to use a sharp object when separating the halves of the crankcase?

No. 3

Inspect Valves, Rocker Arms and Valve Springs FYV - 90-95

1. How are valves cleaned?

2. What should be done when the stems on valves are bent or worn more than wear limit specified?

3. What is used for measuring valve stems?

4. If the valve stems are in good condition, what is the next step in valve conditioning?

5. What is done after the valves have been refaced?

6. Why are valves with margin or edge less than .043 in width discarded?

7. What is the required length of the valve spring?

8. What happens if the valve springs are not square?

9. What happens if the valve rocker arms and shafts are not free of sludge and gum?

10. Describe the procedure for cleaning the rocker arm and shaft assembly.

No. 4

Cut New Valve Seats FYV - 92-93

1. When is it time to cut new valve seats in the cylinder head?

2. How is the cutting of new valve seats in the cylinder head made accurate and quick?

3. Why is special equipment necessary for seating valves properly?

4. What is checked before cutting new valve seats?

5. How are valve guides put into position?

6. Why should no attempt be made to push or drill worn valve guides?

7. What happens if the valve seats are cut too narrow?

8. What happens if the valve seats are too wide?

9. How is the correct width of the valve seat secured?

10. What is the width of intake valve seats?

No. 5

Adjust Valve Tappets FYV - 10-12

1. What will happen if insufficient tappet clearance is provided when adjusting valve tappets?

2. If excessive valve tappet clearance is provided, what will happen?

3. In what cylinder order should the valves be adjusted?

4. How are the cylinders numbered when viewed from the rear of a Volkswagen?

5. When and only when are valves adjusted?

6. How should the engine be turned when adjusting the valve in the first cylinder?

7. In what position should the timing mark be when adjusting the valve in the first cylinder?

8. Give step by step procedure for adjusting valves.

No. 6

Clean and Install Cylinder Head FYV - 91-96

1. What is one advantage of having the complete assembly overhauled in an automotive machine shop when cleaning cylinder head?

2. What does the cleaning solution clean from the engine?

3. What can be used for final cleaning of the combustion chamber?

4. Where should particular attention be paid when cleaning cylinder head?

5. With what should the entire cylinder head be washed when cleaning?

6. What will happen if all dirt and carbon is not removed from cylinder and cylinder head?

7. What is done before installing new cylinder heads?

8. What should be properly seated at the ends of the push rod tube?

9. With what should the threads on cylinder head retaining studs and nuts be coated?

10. What kind of tool is used to tighten threads in cylinder head retaining studs and nuts?

No. 7

Disassemble Crankcase FYV - 143-146

1. What should be done before removing all the bolts that hold the two halves of the crankcase together?

2. How should the crankcase halves be separated?

3. What is a precaution to remember about separating the crankcase halves?

4. After the two halves of the crankcase are separated what should be done?

5. What parts may be removed while still connected to the crankshaft?

6. What is the first step when disassembling the crankcase?

7. Each cylinder head serves how many of the cylinder barrels?

8. How is the flywheel held to the crankshaft?

9. Why is the flywheel removed?

10. What items must be removed in order to gain access to the gland nut?

No. 8

Remove and Inspect Bearings FYV - 147-148
156-157

1. What should be done before removing the rod caps?

2. With what are the connecting rods held together?

3. Why must the bearing inserts and rods be reinstalled precisely as they are removed in relation to one another?

4. Which main bearing will not slip out rapidly?

5. What must be removed before removing the bearing behind the timing gear?

6. What holds the distributor drive gear in place?

7. How must the timing gear be placed?

8. To what temperature should the gears be heated before removal?

9. Why should the gears be heated?

10. What is the clearance for the main bearing next to the flywheel?

11. What affects the good quality or usefulness of the bearing insert?

No. 9

Check Crankshaft, Camshaft and Connecting Rods FYV - 149-152

1. What should be done before attempting any measurements of the crankshaft?

2. (A) In checking the crankshaft what is used to check out-of-round?
   (B) Where is it checked?

3. What instrument is used in measuring the taper?

4. If the dowel holes in the end of the crankshaft are damaged, what should be done?

5. In checking the camshaft what is used to check for straightness or run-out.

6. How many different sizes of camshaft gears are available?

7. In examining a rod what is used to check the weight?

8. What is used to check the bearing bore in the big end of the connecting rod?

9. If the bore is distorted or out-of-round, what should be done?

10. How is the correct clearance of the piston pin determined?

No. 10

Check Pistons, Piston Rings, and Cylinders FYV - 152-156

1. What must be remembered when working and checking pistons?

2. When removing and replacing piston rings, what is used?

3. If the piston does not appear to be damaged after a good cleaning, for what should it be measured?

4. After a thorough cleaning, what is stamped on the piston top?

5. In measuring the piston, which end of the skirt is measured?

6. What is the clearance between piston and cylinder?

7. When replacing piston and cylinder, what kind should be used?

8. How near the same weight must all pistons in the same engine be?

9. How is the bushing in the connecting rod adjusted?

10. What is used to measure cylinders?

ERIC

No. 11

Trouble Shoot Engine VRT - 8-9

1. When is troubleshooting performed? Why?
2. What two gauges are needed to locate engine defects?
3. What does the vacuum gauge indicate?
4. For what is the compression gauge used?
5. To what is the vacuum gauge connected?
6. To what is the vacuum gauge calibrated?
7. What will a normal engine show on the vacuum gauge?
8. What do variations in cylinder compression cause?
9. Explain how to connect a compression gauge.
10. What will a defective cylinder head gasket show?
11. What should be done if advancing the ignition timing does not increase the gauge reading to normal?

No. 12

Service Generator

FYV - 49-58
VRT - 45

1. What type generator is used on Volkswagens?

2. When cleaning and inspecting the generator, with what should the field coils and armature be cleaned?

3. What should be used to dry the parts of a generator after washing?

4. For what should the field coils of a generator be tested?

5. Where is a generator located on a Volkswagen?

6. In checking a generator, what is the first test to be made?

7. Describe a way to check a generator without the use of testing equipment?

8. What should be done before making any changes in the voltage regulator?

9. What should be remembered when the generator and voltage regulator are operating correctly?

10. How can the contact points of a voltage regulator be cleaned?

No. 13

Test Battery

FYV - 58-61
VRT - 18

1. What two battery tests are usually performed?

2. What chemical reaction takes place when a battery becomes discharged?

3. What is used to test the electrolyte of a battery?

4. What is the reading for a low charge in a battery?

5. What is a quick way to test a starting battery?

6. What may be used for checking the storage battery?

7. In addition to keeping the battery connections clean, what else should be kept clean?

8. What two types of water are used in the cells of a battery, which is preferred?

No. 14

Service Starter FYV - 61-67

1. What is usually the cause of a defect in the starting system?

2. What is used to engage the gear drive?

3. What is used when the solenoid switch is turned on and the starting motor does not rotate?

4. If the starting motor fails to rotate after a heavy wire is connected, what should be done?

5. To what is the solenoid shaft attached?

6. Why is the pinion gear fitted with an overrunning clutch?

7. What size starting motors were fitted on beetle model Volkswagens in 1966 and 1967?

8. What should be removed when inspecting the brushes and commutator?

9. If the commutator is oily and gummed, how should it be cleaned?

10. Who should overhaul the starting motor if the commutator surface is rough and pitted, or shows burned spots?

No. 15

Repair Oil Pressure Switch FYV - 67-69

1. Where is the oil pressure switch located?

2. What is the spring loaded contact connected with in an oil pressure switch?

3. Explain what happens if the green lamp lights up continuously during a ride?

4. Which parts should be checked if the oil pressure control lamp does not go out until high speeds are reached?

5. Describe how the lamp light operates at low and high outside temperatures.

No. 16

Repair Windshield Wiper FYV - 69-71

1. When is the windshield wiper motor accessible?

2. How often should the moving joints of the wiper gearing and linkage be oiled?

3. In 1966, what speed wiper motor was used on Volkswagens?

4. What speed wiper motor was used on 1967 Volkswagens?

5. What kind of electrical system was introduced to the Volkswagen in 1967?

6. Give five reasons why a windshield wiper motor may operate too slowly or cut out, or come to a standstill.

7. Give two reasons why the windshield wiper motor would continue to run after manual switch is turned off.

8. Give two reasons why the windshield wiper motor does not return the blades to parking position but stops at whatever point the manual switch is turned off.

9. Give a reason for why the gabbling noise when switching on the motor.

10. What causes squeaking noises of the windshield wiper motor?

No. 17

Service Speedometer Cable FYV - 76-78

1. How is a speedometer and mileage recorder driven?

2. Of what does a speedometer cable consist?

3. Explain what to do if a speedometer cable becomes defective.

4. List five steps in removing the speedometer cable.

5. List six steps to install a speedometer cable.

6. Explain how the speedometer cable must run with the front wheels in straight ahead position?

7. When there is pressure on the flexible metal housing, what is the result?

8. What happens if there is a sharp bend in the speedometer cable?

9. What is the function of the rubber sleeve?

10. What should be used as lubricant for a speedometer cable?

No. 18

Service Lights FYV - 72-76

1. What color lamp in the instrument board lights up when the high beam is in use?

2. Why can't the sealed beam headlight be installed incorrectly?

3. What adjustment is required on sealed beam headlights?

4. When is the taillight and stoplight accessible?

5. What kind of screw holds the housing together?

6. Where is the stoplight switch located?

7. Of what does the assembly of dual back-up lights consist?

8. What is the purpose of the flasher unit?

9. Where is the direction indicator switch connected?

10. What kind of device was added to the 1966 and later models of Volkswagens?

No. 19

Trouble Shoot Generating System

VRT - 45
FYV - 54-58

1. Describe the generator used on Volkswagens.

2. Describe the process of disassembling a generator.

3. When cleaning the generator, which parts should not be washed in solvent?

4. When are brushes on a generator considered worn?

5. Why must the entire assembly of a generator be replaced when worn?

6. When removing the generator for replacement, what must be removed with it?

7. What is the first part to examine if the generator lamp does not go out as speed increases?

8. When the steel band surrounding the generator is speckled with drops of solder, what does it indicate?

9. When disassembling, what is the next move after unscrewing generator through bolts?

10. What is another name for drive key?

11. What should be removed after detaching heater hoses when disassembling?

12. When disassembling, what should be pulled off after unsnapping distributor cap?

No. 20

Trouble Shoot Lighting System FYV - 217-218

1. What tests should be made if headlights are dim when the engine is idling or shut off?

2. When testing for trouble of dim headlights when the engine is running above idling with battery full charged, list two tests.

3. What should be done when lights fail altogether?

ERIC

No. 21

Check Fuel System

VRT - 6-8, 15-17
FYV - 209

1. What is the purpose of the fuel system?

2. Of what does the fuel system consist?

3. What can cause trouble in the fuel system?

4. What complaints may result if the fuel system fails to function properly?

5. Give six causes of the fuel mixture being too lean.

6. Give four causes of the fuel mixture being too rich.

7. Give eight causes for there being no fuel in the carburetor.

8. What two accurate fuel tests should be made?

9. What is the purpose of the two accurate fuel test runs?

10. If the result of the accurate fuel tests indicate excessive fuel consumption, what units should be checked?

No. 22

Inspect and Adjust Carburetor FYV - 27-29

1. What must be correct before the carburetor can be adjusted?

2. What is the first step in adjusting the carburetor in a Volkswagen?

3. What will happen in the first step in fixing the carburetor if it is not handled gently?

4. What is the second step in adjusting the carburetor in a Volkswagen?

5. What is the third step in adjusting the carburetor?

6. What is the final step in adjusting a carburetor in a Volkswagen?

7. Explain fully how to check a carburetor of a Volkswagen after it has been adjusted.

8. What may be the cause of poor idling?

9. During the operation of checking a carburetor after it has been adjusted, what can be caused by too rich fuel mixture?

10. Why is the Volkswagen carburetor easy to adjust?

No. 23

Service Fuel Pump FYV - 44-46

1. How is fuel fed to the carburetor?

2. Explain fully how the Solex-diaphragm pump is operated.

3. Where is the Solex-diaphragm pump located on older model Volkswagens?

4. In what way does the operation of push rods differ on the old and new model Volkswagens?

5. Where is the Solex-diaphragm pump located on newer model Volkswagens?

6. Where is the diaphragm and spring found on the fuel pump?

7. Of what does the diaphragm consist?

8. What must be cleaned on late engines through 1965 model Volkswagens every 3,000 miles?

9. When checking the fuel pump, how is the pump pressure determined?

10. Upon what does the pump pressure depend?

No. 24

Adjust Fan FYV - 80-85

1. What does the cooling fan draw air through on older model Volkswagens?

2. How is the quantity of air flow controlled?

3. What happens if the fan ring opens too soon or stays open?

4. What may happen if the fan ring opens too far?

5. Give factory instructions for adjustment of the fan ring.

6. When is the tension correct on the fan belt?

7. Explain fully how the tension of a fan belt is adjusted.

8. On Volkswagens with chassis numbers above 1-0575415, how is a finer adjustment of the fan ring and belt possible?

9. Explain how the generator-blower unit is balanced on Volkswagens after chassis number 1-0929746.

10. What should be kept in mind when searching for overheating in an engine?

No. 25

Inspect and Trouble Shoot Cooling System FYV - 84-85

1. When should thorough inspection of the cooling system be made?

2. What will cause an enclosed cooling system to fail to operate correctly?

3. What repair should be made on the outer housing?

4. What is used to seal the terminal caps on the spark plugs?

5. Where may leakage in the cooling system often be found?

6. What should be kept in mind if the engine is slow to warm-up?

7. What happens if the throttle ring opens too far?

8. When might the thermostat be defective?

9. Give eleven causes for engine overheating and necessary repairs for correction.

10. What should be done to correct overcooling of the engine?

No. 26

Service Heating System FYV - 85-86

1. What opens and closes the flaps in the heating boxes on each side of the engine?

2. When does the heat enter the automobile body in great quantities?

3. Where are the heating boxes located?

4. Why should the exhaust pipe and gaskets around the exhaust pipe be checked carefully?

5. How does unwanted heat pass out through flap valves?

6. What is used to avoid sticking at pins and joints?

7. How are the heating boxes removed?

8. What is done after the heating pipe and control cables are detached?

9. Explain fully what is done before replacing the whole heating unit.

No. 27

Adjust Brakes

VRT - 91-92
FYV - 97-101

1. In adjusting the brakes, when should the handbrake adjustment be checked?

2. What should be done if there is too much slack in the handbrake?

3. How should a test for equal tightness of the cables be made on the handbrake?

4. Name two kinds of brakes used on all export models of Volkswagens.

5. What holds the supply of hydraulic fluid?

6. How many brake drums are attached to each wheel?

7. Explain what happens when the brake pedal is depressed.

8. Explain what the fluid pressure does.

9. Explain what happens when the brake pedal is released.

10. What will normal wear of the brakes cause?

11. How will the need for periodic adjustment of the brake shoes be indicated?

No. 28

Service Hydraulic Brake System FYV - 101-103

1. When does the hydraulic brake system need attention?

2. How may considerable trouble be avoided when servicing hydraulic brake systems?

3. Explain what should be done when the brake drums have been removed for any purpose.

4. Why will the brake fluid gradually deteriorate?

5. When should the hydraulic fluid be drained?

6. With what should the hydraulic brake system be thoroughly flushed?

7. From the top of the reservoir at what level should the hydraulic fluid in the master cylinder be?

8. What is done before adding any fluid to the master cylinder?

9. What kind of hydraulic fluid is used when additional fluid is needed?

10. What may happen if inferior fluid is used?

No. 29

Service Brake Drums FYV - 112-113

1. When the brake drums are to be removed for inspection, for what should they be inspected?

2. When can good brakes be really secured?

3. How are brake drums resurfaced when they are slightly scored?

4. How can a rough check to determine if a brake drum is out-of-round be made?

5. How can you determine between a perfectly true and a slightly scored drum?

6. What is the lowest thickness to which a brake drum should be reduced in resurfacing?

7. What is the permissible lateral and radial run-out on brake drums?

8. What should be used when the drums are resurfaced?

9. Why must a mechanic never touch the braking surface of the drum with his hands?

10. What must be removed if new brake drums are installed?

No. 30

Trouble Shoot Brakes

VRT - 26-27
FYV - 114-115

1. What is the most common complaint made by automobile owners about brakes?

2. What must be done as the lining wears on the brakes?

3. What causes a soft pedal or one that goes slowly to the floorboard?

4. What must be removed to repair a leak in the brake system?

5. Why is it considered good practice to overhaul the entire hydraulic system in the event of a leak in any one part?

6. Give five causes for the brake pedal going to the floorboard.

7. Give five causes for only one brake dragging.

8. Give five causes for a car pulling to one side.

9. Give five causes of a soft pedal.

10. Give five causes for erratic braking action.

No. 31

Align Wheels FYV - 117-124

1. Upon what does good handling of the car and satisfactory tire wear depend?

2. Why is it important for caster, camber, toe-in and king pin inclination to be correct?

3. Explain what toe-in means.

4. Explain what caster means.

5. Explain what camber means.

6. Explain what king pin inclination means.

7. Of what does the front axle consist?

8. Of what are torsion bars made?

9. What is attached to the outer end of each torsion bar?

10. What is the correct camber on VW-1200 models?

No. 32

Service Steering Gear

FYV - 126-129
VRT - 91

1. What type steering gear is similar to the roller type used in the later model Volkswagens?

2. Name two types of steering gear boxes used in Volkswagens.

3. Explain fully how the worm end play adjustment is made.

4. Explain fully how the mesh adjustment is made.

5. Why must the adjustments of the steering wheel not be too tight?

6. Give the procedure for adjustment of the steering wheel.

7. What should you look for when checking the steering gear with the front wheels off the floor?

8. Where is the worm mounted?

9. What covers the steering roller shaft?

10. What lubrication is required for the steering gear?

No. 33

Balance Wheels

FYV - 130
VRT - 89-91

1. What is done if the front torsion bars are damaged?

2. Why do torsion bars have a different number of splines at each end?

3. Explain fully how to adjust the angle of the radius arms.

4. What affect does depressing the rear of the radius arms have?

5. What is the proper camber adjustment for rear wheels?

6. List ten important parts of the whole front end mechanism.

7. List twelve important parts of the rear end mechanism.

8. Tell briefly how wheels are suspended.

9. How can a reasonably accurate job be done of balancing the wheels?

10. Where should wheel balance weights be attached?

No. 34

Replace Shock Absorbers FYV - 130-132

1. What type of shock absorbers are used on Volkswagens?

2. What is done if the shock absorbers are not working properly?

3. What should be kept in mind if the shock absorbers are defective?

4. What will underinflated tires cause?

5. What is the effect of out of balance wheels or tires on tire wear?

ERIC

No. 35

Trouble Shoot Steering FYV - 131-132

1. Give three reasons why hard steering is equally stiff from lock to lock and front wheels do not automatically resume straight-ahead position after a turn.

2. Give two causes for hard steering and squeaking noises.

3. What causes hard steering, unequal resistance and chafing noise? Explain how to remedy this cause.

4. What causes excessive play in tie rod joints?

5. What causes excessive play in the front wheel suspension?

6. What causes excessive play in the steering gear?

7. What is the remedy for excessive play in the front wheel suspension?

8. What should be done if the steering set is worn?

9. What should be done if the front wheels are improperly adjusted?

No. 36

Remove, Overhaul and Reassemble Clutch FYV - 167-173

1. After removing the engine what is done first before removing the clutch?

2. What should you look for when checking damage on the surface of the clutch pressure plate?

3. Explain how to remove the clutch from the flywheel.

4. Where are wooden wedges sometimes inserted?

5. What is used to clean the release bearing?

6. How can the pilot bearing be removed from the flywheel?

7. What should be done before installing the clutch assembly?

8. How can distortion of the clutch cover be avoided?

9. Why must the transmission be supported during reassembly?

10. Give the length and strength of clutch springs.

No. 37

Adjust Clutch Pedal FYV - 173

1. Describe proper clutch adjustment.

2. Where is the adjustment of the clutch pedal made?

3. Why must the adjustment at the lock nut on the threaded cable end be maintained?

4. What should be done to the clutch operating cable when its being installed?

5. What should be avoided in any cable?

6. Which end of the adjusting nut should be greased?

7. Why should the adjusting nut be greased?

No. 38

Trouble Shoot Clutch FYV - 174-175

1. Give three reasons for a noisy clutch.

2. Give three causes for clutch chattering or grabbing.

3. What is the remedy if insufficient preload on the clutch cable guide tube causes the clutch to grab?

4. What is the remedy for grease and oil on the clutch linings?

5. Give three causes for the clutch dragging or incomplete release.

6. Give two causes for the clutch slipping?

7. How can excessive pedal free play be stopped?

8. What can be done if the release plate is not running true?

9. What should be done if the pilot bush in flywheel gland nut is worn?

10. What is done if uneven contact of pressure plate occurs?

No. 39

Service Gear Control FYV - 177-180

1. What does the shifting rod in the frame tunnel link?

2. Of what does the synchro-system consist?

3. What is provided to assure positive gear engagement and prevent the selection of more than one pair of gears at a time?

4. With what are the synchronizer stop rings provided?

5. How may a person insure a correct operation of the synchro-system?

6. What will cause the synchronizer stop rings to wear rapidly?

7. What will cause the clutch plate to become completely locked?

8. When is it not possible to shift gears?

9. What kind of clutch linings should be used?

10. Which gear carries the synchronizer stop ring around until the ring is stopped by the shifting plates?

No. 40

Remove and Disassemble Transmission FYV - 180-186

1. Why would it be advisable to take the transmission assembly to a Volkswagen shop for rebuilding?

2. What is used in the adjustment of the bearings?

3. What is used to separate case halves?

4. When must the rubber blocks be detached?

5. What must be removed for service work on the transmission?

6. What is the first step in removing the transmission?

7. What is the fourth step in removal of transmission?

8. What is the sixth step in removal of transmission?

9. What is the seventh step in removal of transmission?

10. What is the last step in removing the transmission?

No. 41

Reassemble Transmission FYV - 186-187

1. Why must care be taken when turning the open transmission case?

2. What must be installed before the two halves of the case are reassembled?

3. How much pressure should be used in tightening transmission case screws?

4. What is applied to the mating surfaces of the transmission housing before final assembly?

5. What is applied on the outside of the seal in the transmission drive shaft?

6. What must be done to the oil seal inner lip and the shaft before installing?

7. Why must you be careful when installing the spring around the lip?

8. What must be tightened first when installing the transmission carrier?

9. What must you make sure of when connecting the shifting shaft coupling?

No. 42

Assemble Drive Shaft FYV - 194-195

1. When should the selector fork for the third and fourth gears be positioned?

2. How can the detent springs for first, second and reverse gears be easily installed?

3. Where should the detent springs be inserted?

4. How is a check for proper interlock of the selector shaft and interlock plungers made?

5. Which selector shaft must be locked?

6. What tool is used to position the pinion correctly in the bearing seat?

7. How tight should the ball bearing screws be drawn?

8. What is done before installing the rear half of the main drive shaft?

9. How tight are gear carrier stud nuts drawn?

10. How tight is the drive pinion nut drawn?

No. 43

Trouble Shoot Transmission VRT- 24

1. What causes a Volkswagen to be noisy in neutral?

2. Give five reasons why a Volkswagen will slip out of high gear.

3. Give five reasons why a Volkswagen will slip out of second gear.

4. Give five reasons why a Volkswagen will slip out of first and reverse gears.

5. What causes Volkswagen gear shifting difficulty?

6. What causes clashing when shifting?

7. What are the causes for backlash?

8. What causes a Volkswagen to be noisy in motion in any gear? (Give five reasons).

ERIC

No. 44

Remove and Inspect Rear Axle FYV - 197-201

1. What is removed before disassembly can be accomplished?

2. What is the maximum dimension of the rear axle tube inner end joint?

3. What holds the ring gear to the differential housing?

4. Explain what is done if the differential gears are worn.

5. What clearance should the flattened inner end of the axle shaft have?

6. What is the clearance between flat of axle and fulcrum plates?

7. What is used for checking wear and scoring of the ring gear?

8. What two parts of a Volkswagen rear axle are mated in pairs?

9. What determines the contact of the gear faces?

10. Why is the contact pattern of gears made different?

No. 45

Reassemble Rear Axle FYV - 201-203

1. When reassembling the differential, how should the wire through the capscrew holes be threaded?

2. What is done before installing axle tubes?

3. When should all clips be tightened?

4. Why is the bearing housing checked?

5. What check should be made on the oil seal?

6. Why is the outer surface of the spacer checked?

7. In which direction does the oil drip nose point?

8. Why must the oil drip tube be snug against the brake drum?

9. What is the last step in reassembling the rear axle?

ERIC

No. 46

Trouble Shoot Rear Axle

FYV - 204
VRT - 25

1. What is the most common rear axle complaint?

2. What must be done before road testing a Volkswagen?

3. How can engine noise or exhaust noise be detected?

4. What is used to determine where the noise is located in a Volkswagen?

5. What causes noise on acceleration?

6. Give five reasons why a Volkswagen will vibrate.

7. Explain how backlash is checked.

8. What causes axle to be noisy when driving?

9. What causes axle noise when coasting?

10. How are loose wheel bolts corrected?

ERIC

No. 47

Service Crankcase Breather FYV - 133-137

1. What is the purpose of the breather at the oil filler tube?

2. When was a crankcase ventilation device first installed in Volkswagens?

3. Where does the special outlet fit?

4. How far does the metal sleeve project on earlier model Volkswagens?

5. Where do crankcase fumes go on early model Volkswagens?

6. Where is the condensed water drain pipe fitted?

7. How is the rubber drain pipe valve held in place?

8. When should the valve and the crankcase ventilation device be inspected?

9. What is done if the valve slot does not close properly?

No. 48

Service Oil System FYV - 138-142

1. Where is the strainer from which oil is drawn located?

2. Why is it important that the oil suction pipe fit snugly within the opening in the screen?

3. What happens if the retainer nuts are too tight?

4. How can the plunger be pulled out if it sticks tightly in the bore?

5. How is the oil cooling unit held in place?

6. If a leak appears, how can the oil cooler be tested?

7. When repairing the oil pump, what is removed before the puller is used?

8. What is the proper clearance between pump gears and cover?

9. What must be removed in order to remove the pulley?

10. When reassembling the fan pulley, what must be checked?

VT 010 611
Business and Office Education: Before and After in Indiana.

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DESCRIPTORS - BUSINESS EDUCATION; *OFFICE OCCUPATIONS EDUCATION; *HIGH SCHOOL CURRICULUM; TIME BLOCKS; *COOPERATIVE EDUCATION; BUSINESS SUBJECTS; STATE PROGRAMS; PROGRAM IMPROVEMENT; PROGRAM DESCRIPTIONS
IDENTIFIERS - INDIANA; INTENSIVE OFFICE LABORATORY

ABSTRACT - Improvements in business and office education were realized in Indiana through the introduction of cooperative education programs and block time teaching in office laboratories designed to be comparable to modern business offices. The improvements are listed in detail for the pupil, the parent, the school, and the employer. The business and office education curriculum for Indiana is shown as follows: Grade 9, General Business; Grade 10, Typing I; Grade 11, Typing II, Shorthand I, and Machine Calculation; Grade 12, Shorthand II, and Intensive Office Laboratory or Cooperative Office Education. The course sequence can be modified to facilitate a curricular specialty or special student needs. As a comparison with Indiana's program, the business and office education curriculum of seven other states are listed showing grade location and curriculum sequence. Brochures describing the Intensive Office Laboratory and Cooperative Office Education programs are attached. (CH)

VT 010 611

BUSINESS and OFFICE EDUCATION

EDO 45856

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Before and After

in

INDIANA

VT010611

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THE "BEFORE"

IN BUSINESS AND OFFICE EDUCATION

WORK PROGRAM

Before: The Pupil

1. Is hired as a producing worker.
2. Learns only the "how-to-do-it" aspects of his job.
3. Is not always able to understand the relationship of his work experience to his classroom activities.
4. Does not always rotate from job to job within the organization but performs same duty each day.
5. Is tempted to drop out of school to accept a full-time position.
6. May work under conditions which may deteriorate.

Before: The School

1. Has little or no opportunity to integrate classroom activities with the work experiences of the pupil.
2. Has no opportunity to assist the pupil in matters of social adjustment.
3. Ordinarily does not give credit for unsupervised work experience.

Before: The Parent

1. Is not sure where the responsibility of the school begins or ends.
2. Is not sure of the relationship of the job experiences and the classroom activities.
3. Is not sure that the pupil knows what he got himself into.
4. Is not sure when the pupil's working hours begin or end.
5. Does not know what prestige the job has, in terms of acceptance of the pupil by his peers.

Before: The Employer

1. Obtain a raw recruit who wants to earn money.
2. Must train the worker.
3. Does not feel obligated to train the pupil.
4. Can hire or fire the pupil at will.
5. Does not always have a continuing relationship with the school after the job is filled.

THE "NOW"

IN BUSINESS AND OFFICE EDUCATION

COOPERATIVE OFFICE EDUCATION

Now: The Pupil

1. Is hired as a learning worker.
2. Learns also the "why-it-is-done" aspects of his work.
3. Engages in classroom activities which are integrated with his on-the-job experiences.
4. Follows a planned rotation schedule during the length of the year-long program.
5. Receives the benefits of a job analysis.
6. Is matched to the job by an occupationally experienced coordinator.
7. Will work in an establishment which is continuously approved by the coordinator.

Now: The Parent

1. Knows that the school has not relinquished responsibility for the pupil.
2. Knows that the pupil received the benefit of good guidance before being placed on the job.
3. Knows that the pupil is not being exploited.
4. Knows that the pupil receives the maximum of prestige from an approved credit-carrying course of study.
5. Knows that the on-the-job experiences and the classroom activities compliment and strengthen each other.

Now: The School

1. By means of the job analysis, is able to integrate the classroom activities of each pupil with his on-the-job experiences.
2. Is prepared, when the need arises, to assist the pupil to make necessary social adjustments.
3. Can give credit for vocational experience, part of which is acceptable for college entrance.
4. Has the advantage of the services of an advisory committee.

Now: The Employer

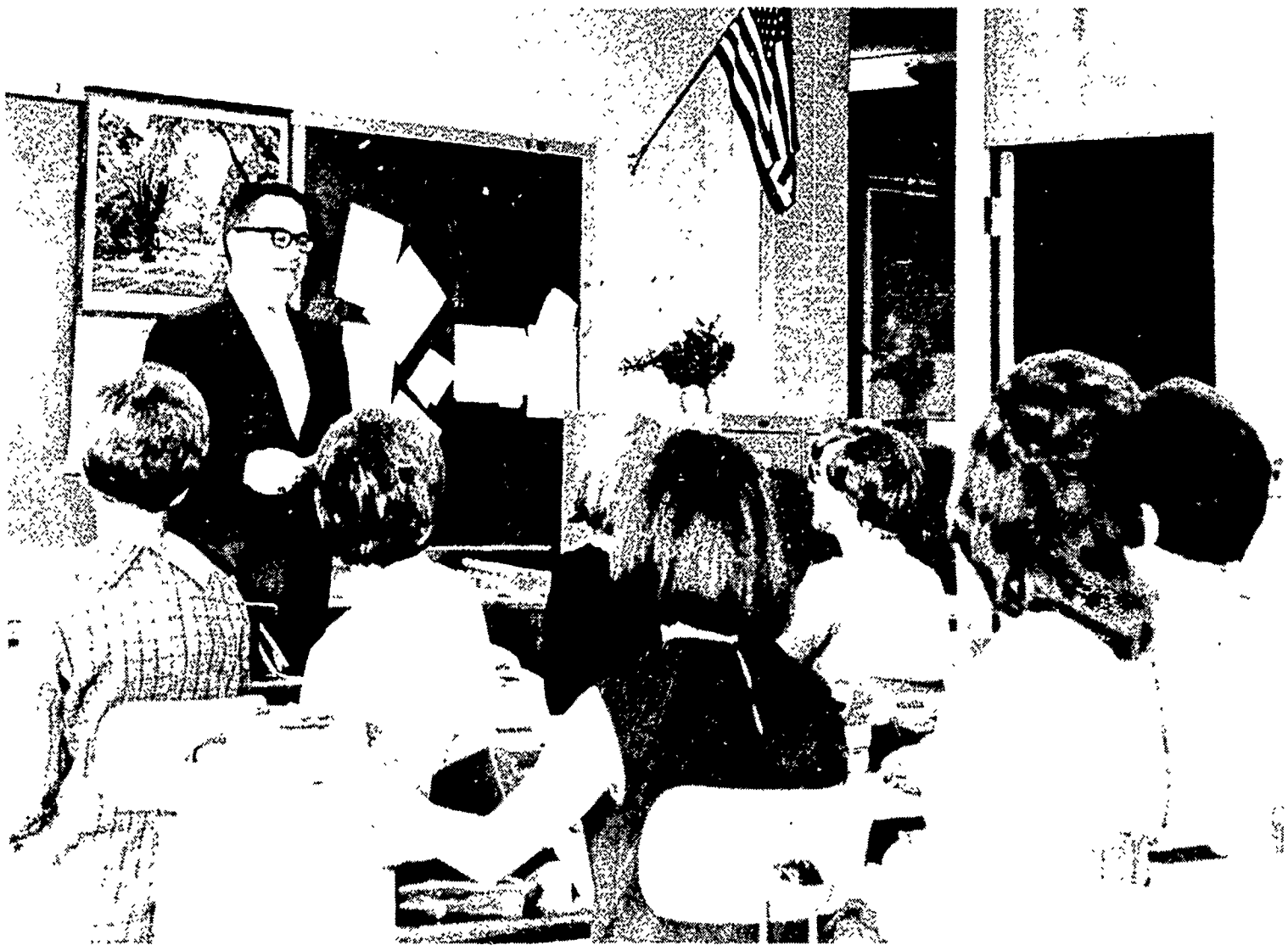
1. Obtain an oriented pupil who wants to learn to work.
2. Receives the assistance of the school and the coordinator in training the pupil.
3. Participates in the planning which results in better training of the pupil.
4. Receives the benefit of guidance and testing techniques which bring to light the abilities of the pupil.
5. Has a continuous relationship through an organized program with the school.

"THE NOW"

IN BUSINESS AND OFFICE EDUCATION COOPERATIVE OFFICE EDUCATION

THE "BEFORE" IN BUSINESS AND OFFICE EDUCATION

CLASSROOM



1. All students are doing the same thing at the same time.
2. Materials and projects come from published textbooks and practice sets.
3. Mostly developing basic skills rather than applying skills to an office situation.
4. Length of instruction, no matter career objective of the student, is usually the same for all.
5. Lacks office pressures, and so the student usually enters private schools for additional training.
6. The classroom doesn't bridge the gap between the school and the world of work.
7. Equipment mainly of the same make rather than of the variety found in the business offices.
8. Usually a course and not a program of instruction for immediate and gainful employment: presents much "how" and lacks "why" something is done.
9. Usually represents general preparation for a job rather than preparation for a career.
10. Course work is not maintained with advice from occupational groups or according to employment opportunities.
11. The classroom doesn't provide technical training for the above or below average student but the middle-of-road approach for all.

THE "NOW"

IN BUSINESS AND OFFICE EDUCATION

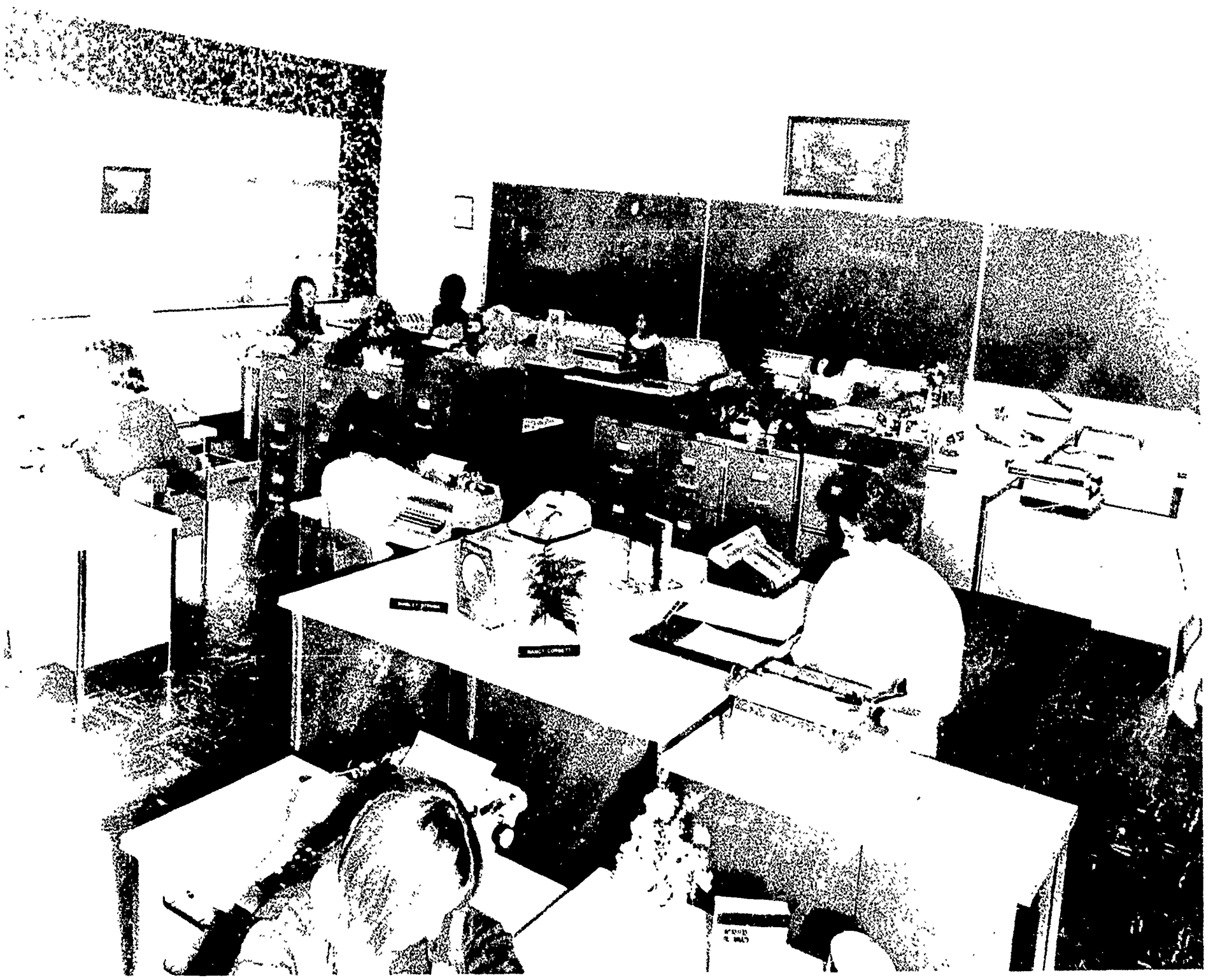
INTENSIVE OFFICE LABORATORY

1. In atmosphere, layout, and equipment, the office laboratory is fully comparable to a modern, well-designed, functional business office.
2. Experiences are provided through the lab in which exercises and problems involving the application of knowledges and skills will be an integral part of the learning experiences, and also in which the instruction will center in the performance of production tasks on actual occupational and educational projects which are brought into the laboratory from outside agencies or from within the school rather than a textbook or practice set.
3. The program is directly related to employment opportunities and has course work set up and maintained with advice from the occupational groups concerned.
4. There is a statement of career objective for each student that is a matter of record.

5. Instruction is offered only to persons who need, desire, and can profit from it occupationally.
6. Each student in the office laboratory is required to perform a variety of major tasks which comprise the office occupation for which the student is preparing.
7. The length of instruction is determined by the requirements of the occupation and the needs of the students.
8. Each student performs actual office activities as an individual, while under office pressures, and not as a group.
9. Grade requirements are equal to actual entry job standards.
10. Instruction is provided on the individual basis and thus can provide the above average a higher degree of proficiency and technical education as well as offering the below average an employable skill.

"THE NOW"

IN BUSINESS AND OFFICE EDUCATION INTENSIVE OFFICE LABORATORY



BOE CURRICULUM COMPARISON OF INDIANA TO OTHER STATES

(The comparison of grade location and curriculum sequence, used for prerequisite courses, is only being made in reference to general business, typewriting, clerical practice, shorthand, the Intensive Office Laboratory, machine Training, and the Cooperative Office Education Program and does not mean this is the only pattern used. All information was forthcoming from 37 state plans on file in the state office.)

OUT-OF-STATE

Grade 9	General Business
Grade 10	Typewriting I (full year)
Grade 11	Typewriting II Shorthand I
Grade 12	* Clerical Office Practice (double period) (Advanced Shorthand included in instruction) * Cooperative Office Education

*Reimbursed Programs.

ANOTHER STATE

Grade 9	General Business
Grade 10	Typing I
Grade 11	Typing II Shorthand I
Grade 12	Shorthand II * Office Practice (double period) (Machine Instruction included here for one period) * Cooperative Office Education

*Reimbursed Programs.

ANOTHER STATE

Grade 9	General Business
Grade 10	Typing I
Grade 11	Typing II Shorthand I
Grade 12	Shorthand II * Cooperative Office Education

*Reimbursed Program.

ANOTHER STATE

Grade 10	General Business
Grade 11	Typing I Shorthand I
Grade 12	* Typing II * Shorthand II * Machine Calculation * Cooperative Office Education

*Reimbursed Programs.

ANOTHER STATE

Grade 9	General Business
Grade 10	Typing I
Grade II	Shorthand I
Grade 12	Shorthand II * Secretarial Office Practice (double period) (Advanced Typing instruction and machines given here)

*Reimbursed Program.

ANOTHER STATE

Grade 9	General Business
Grade 10	Typing I
Grade 11	Typing II Shorthand I Clerical Office Practice I
Grade 12	* Shorthand II * Clerical Office Practice II

*Reimbursed Programs - each meets for one period.

ANOTHER STATE

Grade 9	General Business
Grade 10	Typing I
Grade 11	Shorthand I Clerical Practice I (double period - 1st is Typing II; 2nd is Bookkeeping)
Grade 12	Shorthand II * Clerical Practice I (double period - one period used for machine instruction)

*Reimbursed Program.

STATE OF INDIANA

Grade 9	General Business
Grade 10	Typing I (year)
Grade 11	Typing II Shorthand I ** Machine Calculation I (II)
Grade 12	Shorthand II * Intensive Office Laboratory (block of time - two or more periods) * Cooperative Office Education

*Reimbursed programs. The laboratory program requires the incorporating of all projects to be developed from outside resources through the use of an advisory committee.

**Machine Calculation, depending upon student enrollment, may meet for a full year or for one semester; but in either case, it is a prerequisite for the senior program. It includes all business machines, as well as electric typewriters.

Schools who have greatly incorporated materials from outside resources have placed many projects within this area, and it has now been classified as clerical practice rather than just machine training. This sequence does much in serving two types of students:

(1) If the student should drop out of school at the end of the junior year, he has had experience on all business machines as well as as a saleable skill in typing.

(2) If the individual should go on, there will be an opportunity to really apply previously developed skills to an actual office system. This allows many to be qualified for more than an entry position in true gainful employment.

Course sequence is not the same for bookkeeping or data processing as shown above. The laboratory in Indiana can be separated into many occupational goals or be classed as one type: example - data processing. It may be separated into low achievers, average, or technical occupational preparation. If the school enrollment is small, a laboratory may consist of many levels of students as well as career objectives. In any laboratory, the following must be true:

(1) The program is directly related to employment opportunities and has course work set up and maintained with advice from the occupational groups concerned.

(2) There is a statement of career objective for each student that is a matter of record.

(3) The instruction duplicates, as nearly as possible, desirable working conditions and at the same time provides effective learning situations.

(4) In atmosphere, layout, and equipment, the facilities should be fully comparable to a modern, well-designed, functional general business office.

(5) Experiences should be provided through the program in which exercises and problems involving the application of knowledges and skills will be an integral part of the learning experiences, and also in which the instruction will center in the performance of production tasks on actual work projects which are brought into the laboratory from outside agencies or from within the school.

(6) Each student in the office laboratory should be required to perform a variety of major tasks which comprise the office occupation for which the student is preparing.

Cooperative Office Education

* What it is....
* Whom it serves
* How it operates

Division of Vocational Education
Department of Public Instruction

Cooperative

What it is....

COOPERATIVE OFFICE EDUCATION, COE is a vocational program providing--
A cooperative venture between school and community and designed to combine a maximum of efficiency with broad opportunity in preparing boys and girls, 16 years of age or older, for occupational life.

Training on a part-time basis for high school credit.

Occupational experience and training on-the-job coordinated with related study for well-balanced occupational preparation.

Earning as well as learning. The emphasis is on learning rather than earning.

Adjustment, growth, and achievement in a chosen occupation under guidance of a qualified coordinator.

Training based on a survey of needs and "Tailor Made" to meet community needs and training opportunities.

Occupational-training designed within the framework of local, state, and federal labor laws.

For regular high school credits, based upon satisfactory completion of both on-the-job training and in-school related study.

For utilization of offices of local establishments as laboratories for the training.

Office

Whom it serves

THE STUDENT

Actual occupational experience and employment—record-building,development of self-confidence and "Know How" in real situations.

Provides for a better understanding through study of related technical knowledge.

High school credit as well as job entry and experience. Bridging gap between school and employment.

THE EMPLOYER AND LABOR

Assists in selection of better qualified habits, job ethics and loyalty, and encourage initiative and honesty.

Opportunity for developing related technical knowledge beyond the job experience.

A chance to provide a worthwhile community service through training of youth.

THE SCHOOL AND COMMUNITY

Can provide youth broad training opportunities at minimum costs.

Helps more students stay in school for graduation, while training them for full citizenship.

Holds school and community in close working relationship.

Education

How it operates

A certified coordinator is responsible for program operation.

An active advisory committee provides guidance and advice.

Students, faculty, and community are kept well informed.

Guidance, placement and follow-up services and evaluations are made and used for directions.

Employer must agree to an organized program of on-the-job training.

The schedule of work, related training and pay is determined by written agreement of employer, coordinator, student and parent.

Students meet in a regularly scheduled study class for individualized technical instruction as well as group instruction for personal and job adjustment.

On-the-job training is supervised by the coordinator and employer jointly.

Records and reports for state and local use are promptly executed.

Training programs are developed to meet local needs and provide opportunities for employment.

Regular high school credit allows graduation on schedule.

A supplement to Business Education. . .
Not a substitute. . .

STUDENTS REQUIREMENTS FOR ENTRANCE

1. The student must have some job in the field of office education as a career objective.

2. The student must have the general education necessary to be an effective worker.

3. The student must have the necessary office education courses to satisfactorily prepare them for effective job performance.

4. Show character and ability required to profit from the Cooperative Plan of Education.

Additional information for installing such a program and/or the in-school Intensive Office Laboratory can be acquired by contacting:

John D. Lee, State Supervisor
Business and Office Education
Room 401, State House
Indianapolis, Indiana 46204
317-633-4845

INTENSIVE OFFICE LABORATORY

IN

I N D I A N A

Division of Vocational Education
Department of Public Instruction

WHAT IT IS

Business and Office Education Intensive Office Laboratory is an in-school vocational education for a career in office work; it prepares people to produce services for business. It gives them a skill in one or more of the many techniques and procedures used in the modern office, such as automation, operational systems, data processing, and the coordinating and communication of information. In this program, skills, knowledge, and procedures developed within the Intensive Office Laboratory are fused with learning in a simulated office situation.

WHO IS IT FOR?

It is for high school seniors who want it, need it, and are able to profit by it.

HOW YOU CAN TELL IF IT IS A QUALITY PROGRAM

The title of a course alone is not a reliable guide for distinguishing occupational education and preparation from non-vocational instruction. The course must have certain essential characteristics:

1. The program is directly related to employment opportunities and has course work set up and maintained with advice from local occupational groups concerned.
2. There is a recorded statement of career objectives.
3. The facilities and employment used in instruction are comparable to those found in the particular occupation.
4. The instruction duplicates, as nearly as possible, desirable working con-

ditions and at the same time provides effective learning situations brought in and developed through actual business firms.

5. The length of instruction is determined by the requirements of the occupation and the needs of each student.

6. It is not a classroom situation but a simulated office situation.

7. It is not single-task preparation but career preparation.

WHO BENEFITS FROM THE INTENSIVE OFFICE LABORATORY?

The Student:

--Gains credit toward graduation
--Develops good work attitudes
--Becomes vocationally competent and an employable office worker
--Develops confidence through simulated office situations while still in school
--Is prepared for immediate and gainful employment upon graduation

The School:

--Develops better school-business relations
--Utilizes current business knowledge in designing its programs
--Gains prestige and recognition in the community
--Gains the support of state and federal agencies

The Business Employer:

--Realizes a good supply of full and part-time office personnel
--Can draw from young office workers trained for work in their community
--Gains insights and understanding of school programs
--Realizes a reduction of training costs and labor turnover

DOES BUSINESS AND OFFICE EDUCATION HAVE A FUTURE?

*In the next decade office employment will increase approximately 45 percent. We will need more vocationally-competent office employees than ever before.

*Office work is the second largest employment classification in the U. S., more than 16 percent of all employed persons are involved in office work.

*Offices are the largest employer of women. One of three employed women work in an office.

*Approximately 40 percent of all high school graduates not attending college enter office work--58 percent of the girls and 11 percent of the boys.

WHAT YOU MUST DO TO INITIATE SUCH A PROGRAM

--Show a need for the program you wish to offer

--Have a vocationally competent and certified Business and Office Education teacher

--Develop and submit a proposal to the State Office. Procedures to follow are set forth in the Business and Office Education, Administrators, Teachers, and Coordinators Handbook.

Additional information for initiating such a program and/or the out-of-school cooperative program can be acquired by contacting:

John D. Lee, State Supervisor
Business and Office Education
Room 401, State House
Indianapolis, Indiana 46204
317-633-4845

BUSINESS

&

OFFICE

EDUCATION

VT 010 615
Vocational Office Education in Florida High Schools.

Florida State Dept. of Education, Tallahassee. Div. of Vocational, Technical, and Adult Education.
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Bulletin 73H-5-Revised
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IDENTIFIERS - FLORIDA

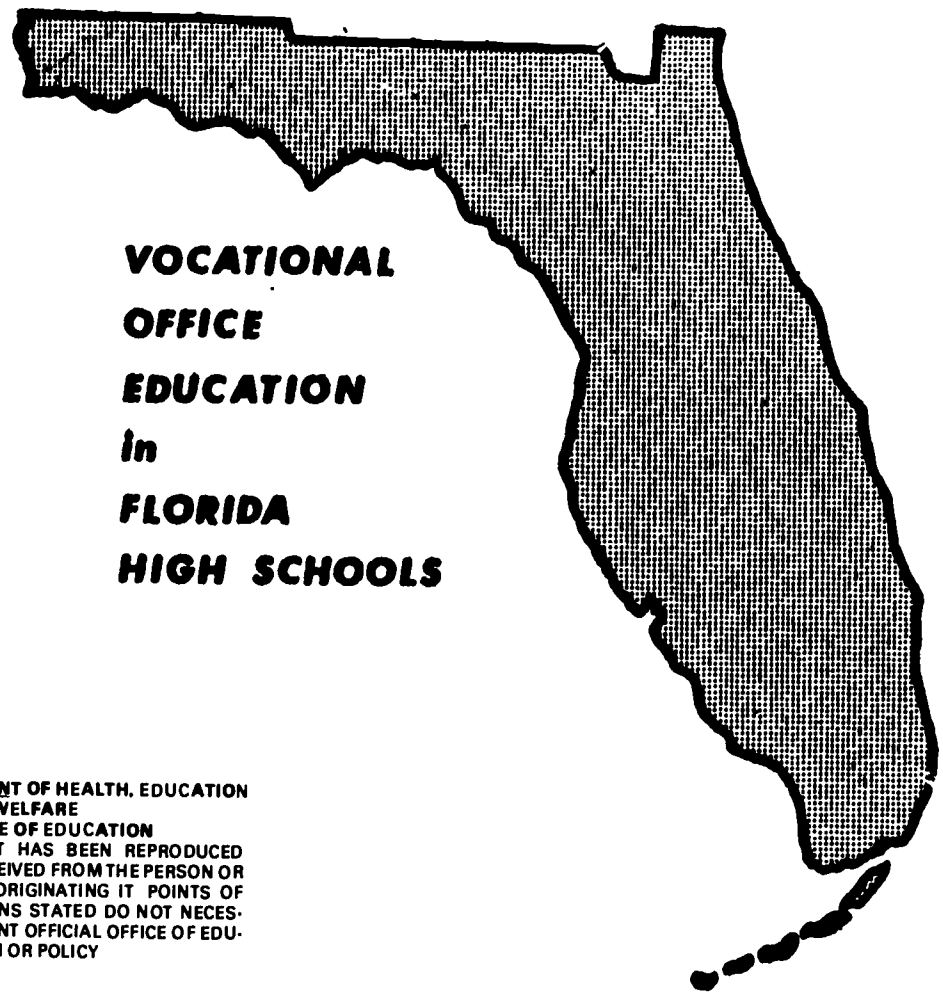
ABSTRACT - Florida's vocational office education program is organized into two approaches. In the "directing time" approach, students follow a planned sequence leading to career objectives in clerical, secretarial, bookkeeping, or automation and data processing. The "block time" approach outlines a 3-hour secretarial block or a 2-hour clerical block in which course content is listed for each subject. Several sample units are offered demonstrating the integration of different skills, such as English, typewriting, dictation, filing, and mailing. Minimum requirements for teacher certification are outlined as well as detailed criteria for the selection of prospective students. Copies of forms used at the state and local levels are appended. Also appended is a 79-item annotated bibliography of instructional materials with an additional 70 citations of reference materials, periodicals, and films. (CH)

VT 010 615

ED0 45856

BULLETIN 73H-5...Revised

JULY, 1968



VOCATIONAL OFFICE EDUCATION in FLORIDA HIGH SCHOOLS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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VT 010615

DIVISION OF VOCATIONAL, TECHNICAL, AND ADULT EDUCATION

CARL W. PROEHL, Assistant Superintendent

BUSINESS and DISTRIBUTIVE EDUCATION SECTION

JOSEPH R. BARKLEY, Director

F O R E W O R D

Vocational Office Education was initiated in Florida in 1961 as a specially designed program predicated on three definitive purposes:

1. To identify and select students who have employment in the office occupations as a career objective

2. To guide these students through a planned and meaningful sequence of experiences leading to their career objective

3. To provide concentrated training in a block-of-time concept which will result in an occupational competency

The purposes are implemented through two separate but interrelated approaches:

a. Vocational Office Education (Directing Time)

b. Vocational Office Education (Block-Time)

It is essential that the selection of one or both approaches for any given community be based upon a carefully devised employment survey in order to establish definite need.

The guide explains the organization, administration, and operation of the program in addition to providing suggested student experiences and teaching techniques. Flexibility in scheduling activities and instructional ingenuity is both permitted and encouraged.

A C K N O W L E D G M E N T S

This first revision of an administrative-teaching guide for Vocational Office Education in Florida High Schools was developed in a two-week workshop at King High School, in Tampa, Florida, June 13 - 24, 1966.

Grateful acknowledgment is made to the following workshop participants for invaluable assistance and cooperation:

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Mrs. Frederica Clark	Blake High School, Tampa
Miss Sharon Coker	King High School, Tampa
Mrs. Jacqueline Colson	Supervisor, Business Education Hillsborough County, Tampa
Mrs. Charlotte Cottingham	Brandon High School, Brandon
Mrs. Glenn Hiers	Robinson High School, Tampa
Mrs. Grace Pelaez	Jefferson High School, Tampa
Miss Lucy Robinson	Curriculum Specialist Business Education State Department of Education Tallahassee
Mrs. Marguerite Starford	King High School, Tampa

Appreciation is extended also to the vocational office education teachers, county supervisors of business education, and others who contributed helpful suggestions and materials.

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VOCATIONAL OFFICE EDUCATION

Introduction

The Vocational Office Education programs should be composed of meaningful sequences of experiences which will result in an occupational competency. The term "occupational competency" refers not only to business skills at a level in keeping with the demands of the businessman but also to a broad basic education and understanding of our economic society.

Vocational Office Education should serve youth and the employment needs in any given community. The youths who are entering the labor market for the first time should possess the basic skills for entry-level positions and sufficient background and knowledges to lead toward promotion in an occupational family. Vocational Office Education programs must provide for students who have chosen the office occupations as their career objective.

The skilled, trained and vocationally certified professional business educator shall work cooperatively with guidance counselors and school administrators to make available and interpret a broad variety of vocational and occupational information to students. Opportunities must be provided to identify, select, and guide students through a planned and meaningful sequence of courses and experiences.

Criteria for Secondary School Vocational Office Education

A comprehensive office education program on the high school level should reflect:

1. Provision for efficient instruction with occupational competencies as an expected outcome. Emphasis should be upon programs designed to meet job requirements, not upon individual courses.

2. Evidences of flexibility in the programs offered, both in terms of ability groupings and in the time element allotted to the learning of the occupational skills, understandings, and knowledges.

3. Indication that the faculty is constantly studying and evaluating the offerings and outcomes in terms of occupational needs as well as educational objectives.

4. That the staff is personally acquainted with the operation of the local business offices. This allows for examples in the classroom of local application as well as hypothetical ones presented in textbooks.

5. A yearly follow-up of the graduates who are employed and the compiled results being used for planning future programs in addition to becoming a part of individual student folders for reference purposes.

6. Evidence of a great number of application and problem-solving situations in which students implement skills and knowledges learned. This implies the use of an office laboratory which allows for problem-solving sessions and adequate equipment for testing the suggested solutions by completing integrated office projects.

7. Evidence that previously learned skills are integrated into a realistic office situation through a simulated office organization within the classroom and/or actual work experience similar to the Work-a-Day or Work-a-Week plan employed in some schools.

8. Business machines being used as tools in the laboratory with which practical problems are solved in preference to merely developing a working proficiency as to operation.

9. Instruction relative to the automated office. This should be an orientation to the subject of electronic data processing and its effect on the office occupations.

Criteria for the selection of Stenographic Students[1]

Why Criteria?

There is an acute shortage of competent stenographic and secretarial employees. . .These criteria provide guidelines of minimal qualifications for potential secretarial success.

What do they provide?

Objective criteria to aid in selecting qualified students to enter a high school stenographic-secretarial program.

Who developed them?

Professional secretaries, management personnel, and business education teachers in cooperation with The National Secretaries Association. Each group consisted of approximately 200. Responses from 37 states, 3 Canadian provinces, and the territory of Puerto Rico.

How?

Participants were requested to rank in the order of importance criteria they felt to be essential for the selection of prospective students.

THESE ARE DEPENDABLE CRITERIA

CRITERIA NO. 1

The students must have the ABILITY to develop stenographic-secretarial skills.

Ranked as most important by all groups is the realization that a student about to enter the stenographic-secretarial curriculum must possess a certain ability or aptness. This competency can be measured in part by clerical and business aptitude tests such as the Minnesota Clerical Test. It can also be demonstrated by the individual student's rating on many of the following guidelines.

CRITERION NO. 2

The student must have an INTEREST in the secretarial profession.

Ranked directly after ability is interest. All groups are aware that ability and interest are of prime importance. Note, however, that interest and desire are modified by ability. They are not enough within themselves and should

[1]Prepared for the World Council of Secretaries by the National Secretaries Association (International)

not be considered before the ability to develop skills. A recommended interest profile is the Strong Vocational Interest Blank. Interest may also be measured by past curriculum choices.

CRITERION NO. 3

The student must demonstrate AMBITION and INITIATIVE.

The desire to do well, the eagerness to perform efficiently, and the faculty of self-reliance are important to the success of the student entering the stenographic curriculum--just as they are to the person already in the field. The student must be able to "do things without continuously being told." Skills must be developed-and the student must be enterprising enough to do her part in their development.

CRITERION NO. 4

The student must be a RESPONSIBLE person.

Could you depend on the student to do a job for you? Reliability in competing tasks entrusted by an employer ranks high among the factors needed in a stenographic position. A degree of self-confidence (comparable to the student's age) regarding her work now might prove a measure of her self-assurance and dependability in the future.

CRITERION NO. 5

The student must have average skills in READING, WRITING, ARITHMETIC, and TYPEWRITING as measured by standardized TESTS.

Specialized skills are best built on a solid foundation of basic skills! A "below average" student is already on shaky ground. Standardized tests, such as the Iowa Tests of Basic Skills, administered correctly, can supply valuable information about the student's present scholastic accomplishment and help predict future achievement.

CRITERION NO. 6

The student must demonstrate GOOD HUMAN RELATIONS.

Personal skills are ranked next in order after academic and technical skills. Does the student "get along" with others? Some employees lose their jobs because they find this aspect of a secretarial career difficult. An office staff works as a team.

CRITERION NO. 7

The student must have the ability to SPEAK CORRECTLY.

Thoughts and ideas expressed correctly and articulately are important in today's business world--and will be even more

important in the future. Consider the number of contacts and transactions done completely by telephone.

CRITERION NO. 8

The student must have GOOD GROOMING HABITS.

A person's very first impression of another is based on personal appearance. An employee often makes that first impression for his company.

CRITERION NO. 9

The student must have a GOOD ATTENDANCE RECORD.

What degree of success can be expected in school--especially during the development of skill subjects--or on the job, if excessive absence or tardiness is present? Good attendance and punctuality are a necessity.

CRITERION NO. 10

The student must have a GRADE POINT AVERAGE OF AT LEAST "C" for all previous course work.

Results of course work in grades 7, 8, and 9 can be used to predict senior high school success. Grades in related junior high school courses such as typewriting and general business should be given special attention.

Continued advancement is based on continued education. The secretary must be a good student.

Employment Outlook

Employment in clerical occupations is expected to rise very rapidly during the 1965-75 decade. As employment rises to meet the needs of an expanding economy, it is anticipated that more than 300,000 new positions in clerical and related occupations will be added each year. Employment opportunities will be particularly numerous for workers who handle paperwork in the offices of private and public organizations--for secretaries and stenographers, typists, and bookkeeping and accounting clerks, for example. These workers will be needed particularly in banks and insurance companies, both of which are expected to continue to expand rapidly; in manufacturing establishments and in wholesale and retail trade; and in government offices, educational instituions, and professional service organizations.

The number of clerical and related jobs is expected to increase mainly because the volume of paperwork will undoubtedly expand as business organizations grow in size and complexity. On the other hand, more and more mechanical equipment will undoubtedly be used to speed the process of keeping business records, particularly in large cities, and in some of these offices, the number of clerical employees may be reduced.

For the economy as a whole, however, the new positions created by growth are expected to far outnumber the clerical jobs eliminated by mechanization. Furthermore, many types of clerical workers are in jobs unlikely to be materially affected by mechanization, e.g. secretaries, receptionists, people responsible for collecting bills and handling complaints, and others whose duties bring them into contact with the public and require them to exercise initiative and judgment.

Some of the occupational classifications for which vocational office education students may be trained are:

20 STENOGRAPHY, TYPING, FILING, RELATED OCCUPATIONS

This division includes occupations concerned with making, classifying, and filing records, including written communications

201. Secretaries
This group includes occupations concerned with carrying out minor administrative and general office duties in addition to taking and transcribing dictation. . . .

201.368 Secretary (clerical)
girl Friday--secretarial stenographer

202. Stenographers
This group includes occupations concerned with taking shorthand or speedwriting notes by hand or machine and transcribing them

203. Typists
This group includes occupations concerned with recording data by means of a typewriter.

204. Correspondence Clerks
This group includes occupations concerned with composing correspondence and related items for the purpose of obtaining or giving information.

206. File Clerks
This group includes occupations concerned with classifying, sorting, and filing correspondence, records, and other data.

207. Duplicating-Machine Operators
This group includes occupations concerned with making copies of data by means of machines. Machines frequently used are:

207.782 Duplicating-Machine Operator (clerical) III
Ditto-Machine Operator (clerical)
Mimeograph Operator (clerical)
Offset-Duplicating-Machine Operator (clerical)
Typewriter Operator, Automatic (clerical)

207.885 Duplicating-Machine Operator (clerical) IV
Thermofax Operator (clerical)

208. Miscellaneous Office Machine Operators
This group includes occupations, not elsewhere classified, concerned with recording data by machine.

208.138 Transcribing Operator, Head (clerical)

208.588 Transcribing-Machine Operator (clerical)
dictating-machine transcriber
dictating-machine typist

21 COMPUTING AND ACCOUNT-RECORDING OCCUPATIONS

This division includes occupations concerned with systematizing information about transactions and activities into accounts and quantitative records, and paying and receiving money.

210. Bookkeepers
This group includes occupations concerned with computing, classifying, and recording numerical data to keep sets of financial records complete. Occupations concerned primarily with bookkeeping machines, computing machines, and account-recording machines are included in Groups 215, 216, and 217 respectively.

213. Automatic Data-Processing-Equipment Operators
This group includes occupations concerned with electronic and electro-mechanical machines that record, store, process, and transcribe data from punchcards, paper tape, magnetic tape, or other sources; solve mathematical, engineering, or technical problems; keep records; or supply information. Includes machines that transcribe data to or from punchcards or tape for use in automatic data-processing equipment.

213.582 Key-Punch Operator (clerical)

213.588 Data Typist (clerical)

214. Billing Machine Operators
This group includes occupations concerned with operating billing machines with or without computing devices to keep accounts and prepare statements, bills and invoices.

215. Bookkeeping-Machine Operators
This group includes occupations concerned with operating bookkeeping machines to copy and post data, make computations, and/or compile records of transactions.

215.488 Pay Roll Clerk (clerical)

216. Computing-Machine Operators
This group includes occupations concerned with operating adding or calculating machines to perform arithmetic operations. Occupations concerned with computing by automatic-data processing equipment are included in Group 213.

216.488 Adding-Machine Operator (clerical)

216.488 Calculating-Machine Operator (clerical)

DEFINITIONS OF TITLES

SECRETARY (clerical) 201.638. girl Friday; secretarial stenographer.

Schedules appointments, gives information to callers, takes dictation, and otherwise relieves officials of clerical work and minor administrative and business detail: Reads and routes incoming mail. Locates and attaches appropriate file to correspondence to be answered by employer. Takes dictation in shorthand. . . .and transcribes notes on typewriter, or transcribes from voice recordings. . . .Composes and types routine correspondence. Files correspondence and other records. Answers telephone and gives information to callers or routes call to appropriate official and places outgoing calls. Schedules appointments for employer. Greets visitors, ascertains nature of business, and conducts visitors to employer or appropriate person. May not take dictation. May arrange travel schedule and reservations. May compile and type statistical reports. May supervise clerical workers. May keep personnel records. May record minutes of staff meetings.

STENOGRAPHER (clerical) 202.388. clerk-stenographer.

Takes dictation in shorthand of correspondence, reports, and other matter, and transcribes dictated material, using typewriter. Performs variety of clerical duties except when working in stenographic pool.
(Clerk, General Office). May transcribe material from sound recording
(Transcribing-Machine Operator).

TRANSCRIBING-MACHINE OPERATOR (Clerical) 208.588. dictating-machine transcriber; dictating-machine typist.

Transcribes letters, reports, or other recorded data, using transcribing (voice reproducing) machine and typewriter; Positions record or tape on machine spindle and sets needle on record, or threads tape through machine. Depresses pedal to rotate record or tape. Turns dials to control volume, tone, and speed of voice reproduction. Types message heard through earphones. Reads chart prepared by dictator to determine length of message and corrections to be made. May type unrecorded information such as name, address, and date. May keep file of records. . . .May receive and route callers (Receptionist).

CLERK-TYPIST (clerical) 209.388

Performs general clerical work requiring use of typewriter in majority of duties; Compiles and types reports, bills, application forms, shipping tickets, and other matter from clerical records. Files records and reports, posts information to records, sorts and distributes mail, answers telephone, and performs similar duties. Computes amounts using adding machine.

CLERK, GENERAL (clerical) 209.388 office clerk, routine

Performs any combination of following and similar clerical tasks not requiring knowledge of systems or procedures: Writes or types bills, statements, receipts, checks, or other documents, copying information from one record to another. Proofreads records of forms. Counts, weighs, or measures material. Sorts and files records, Receives money from customers and deposits money in bank. Addresses envelopes or packages by hand or with typewriter or addressograph machine. Answers telephone, conveys messages, and runs errands. Stamps, sorts, and distributes mail. Stamps or numbers forms by hand or machine. Operates office duplicating equipment.

OFFICE BOY (Girl) (clerical) 230.878

Performs any combin tion of the following duties in business office of workers with clerical supplies. Opens, sorts, and distributes incoming mail, and collects, seals, and stamps outgoing mail. Delivers oral or written messages. Collects and distributes paperwork, such as records or time cards, from one department to another. Marks, tabulates, and files articles and records. May use office equipment, such as envelope-sealing machine, letter opener, record shaver, stamping machine, and transcribing machine. May be known according to specific task performed as Mail Boy. Feminine title: Office Girl.

FILE CLERK (clerical) I. 206.388

Files correspondence, cards, invoices, receipts, and other records in alphabetical or numerical order, or according to subject matter, phonetic spelling, or other system: Reads incoming material and sorts according to file system. Places material in file cabinet, drawers, boxes, or in special filing cases. Locates and removes material from files when requested. Keeps records of material removed, stamps material received, traces missing file folders, and types indexing information on folders. May enter date on records. May be designated. . . .

FILE CLERK (clerical) II. 206.388

Performs essentially the same duties as File Clerk I except that in addition to putting material in and removing it from file, performs clerical work in searching and investigating information contained in files, inserting additional data in file records, making up reports, and keeping files current, which may require making calculations and supplying written information from file data. Classified material when classification is not readily discernible (Classification Clerk). Disposes of obsolete files in accordance with established retirement schedule or legal requirements. May operate keypunch or enter data on tabulating cards. May photograph records on microfilming devices. May type records. May use calculating machine. May be designated. . .

CLASSIFICATION CLERK (clerical) coding file clerk, Classifies materials according to subject matter and assigns numbers or symbols from predetermined coding system to facilitate accurate filing and reference: Reads or observes correspondence, reports, drawings, and other materials to be filed to determine subject matter. Ascertains specified number of symbol, using code book or chart, and marks or stamps code on material. Assigns cross-indexing numbers of subject matter should be classified and filed under more than one heading.

DUPLICATING-MACHINE OPERATOR (clerical) III. 207.782

Sets up and operates duplicating machine to print typewritten or handwritten matter directly from master copy: Places master copy on drum of machine and blank paper in feed tray. Adjusts machine for speed, size paper, and flow of process liquid to moistening pad and transfers image from master copy onto copy sheet. May type or draw diagram to prepare original copy. May be designated according to trade name of machine operated as Ditto-Machine Operator.

DUPLICATING-MACHINE OPERATOR (clerical) IV. 207.885

Reproduces handwritten or typewritten matter using duplicating machine: Places original copy on glass plate in machine. Places blank paper on loading tray. Sets control switch for number of copies. Image of original is transferred to blank paper by photographic and static electricity process. May clean and repair machine. May be designated according to trade name of machine operated as Thermofax Operator; Xerox-Machine Operator.

MIMEOGRAPH OPERATOR (clerical) 207.782

Operates machine to reproduce handwritten or typewritten matter from stencil; Pours ink into cylinder reservoir and turns cylinder lever to distribute ink on ink pad. Attaches stencil to cylinder of machine. Selects paper according to color, size, weight, and quality specified, and loads paper onto feed tray. Sets gauges and dial controls to adjust paper feed and cylinder speed, and starts machine. Assembles and staples printed copies. Removes stencil from machine, and cleans and files stencil for reuse. Cleans and oils machine, replaces ink pads. May cut stencils, using typewriter, or trace stencil by hand. May reproduce copies on facsimile machine. May record number and kind of copies made. May operate machine by turning cylinder manually.

CALCULATING-MACHINE OPERATOR (clerical) 216.488 calculator operator

Computes and records statistical accounting and other numerical data, using machine that automatically performs mathematical processes, such as addition, subtraction, multiplication, division, and extraction of roots: Presses keys and moves levers to feed

data into machine. Posts results to records, such as inventories, payrolls, invoices, and summary sheets. May verify computations made by other workers. May be designated according to trade name of machine used, as Computer Operator. May be designated according to type of computations made as Weight Calculator (ship and boat bld. & rep.). May be designated according to subject matter as Extension Clerk; Formula Figurer (paint & varn); Pay-Roll-Machine Operator; Premium-Note Interest-Calculator Clerk (insurance); Toll-Adding Clerk (tel. & tel.).

ADDING-MACHINE OPERATOR (clerical) 216.488.

Performs addition and subtraction, using electrically driven or lever-operated machine that automatically performs computations and records results, usually on paper tape. Copies figures onto records or reports. May verify and record totals of items on batch sheets and be designated Batch Clerk (banking). May sort, list, total, and recapitulate batches of clearings for distribution to other banks and be designated Out-Clearing Clerk (banking).

BOOKKEEPER (clerical) I. 210.388. full-charge bookkeeper; general bookkeeper.

Keeps records of financial transactions of establishment: Verifies and enters details of transactions as they occur or in chronological order in account and cash journals from items such as sales slips, invoices, check stubs, inventory records, and requisitions. Summarizes details on separate ledgers, using adding machine, and transfers data to general ledger. Balances books and compiles reports to show statistics, such as cash receipts and expenditures, accounts payable and receivable, profit and loss, and other items pertinent to operation of business. Calculates employee wages from plant records or timecards and makes up checks or withdraws cash from bank for payment of wages. May prepare withholding, Social Security, and other tax reports. May compute, type, and mail monthly statements to customers. May complete books to or through trial balance. May operate calculating and bookkeeping machines.

GENERAL-LEDGER BOOKKEEPER (clerical).
Compiles and posts in general ledgers information or summaries concerning various business transactions that have been recorded in separate ledgers by other clerks.

BOOKKEEPER (clerical) II. 210.388.

Keeps one section of set of financial records, performing duties as described under Bookkeeper I. May be designated according to section of bookkeeping records kept, such as Accounts-Payable Bookkeeper; Accounts-Receivable Bookkeeper.

BOOKKEEPING-MACHINE OPERATOR (clerical) I. 215.388. account clerk; bookkeeper, machine; posting-machine operator; recording clerk.

Records complete set of records of financial transactions of establishment in same manner as Bookkeeper I, using bookkeeping

machine: Sorts documents to be posted, such as checks and debit and credit items. Selects and places bookkeeping form on writing surface of machine, and sets carriage. Depresses keys of machine keyboard to record identifying headings and data, and to calculate and post totals, net amounts, and other computations. Verifies entries and summarizes and balances totals to insure accuracy. Prepares periodic trial balances and other statistical information as required. May operate other office machines, such as adding and calculating machines.[2]

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[2] Dictionary of Occupational Titles, U. S. Department of Labor, Volumes 1 and 2, 3rd Edition. 1965.

Organization

Counties interested in receiving a vocational instructional unit for Vocational Office Education should follow a procedural policy adopted by the State Board for Vocational Education.

Step 1	Secure necessary forms from the Business and Distributive Education Section, State Department of Education, and return to the Director for consideration.
Step 2	Upon notification of tentative approval, submit on the appropriate form the number of vocational instructional units desired for Vocational Office Education
Step 3	Establish the priority ranking of vocational units needed
Step 4	Include in the County Planning Guide project proposals for the acquisition of needed equipment and instructional supplies and materials

Thereafter, these proposals are studied intensively and those which appear to have the most potential for contributing to county and state program development may be developed into projects and submitted for funding support upon invitation from the Assistant Superintendent for Vocational, Technical, and Adult Education.

Invitation to submit a project is not tantamount to approval, however. Once a project has been studied, it is again reviewed and recommended by the Assistant Superintendent for Vocational, Technical, and Adult Education to the State Superintendent of Public Instruction for disposition.

Vocational instructional units will be granted by the state when it has been certified that the following provisions essential to the program have been met:

1. Minimum classroom facilities, including materials and equipment are provided.

2. The program has met enrollment requirements of a minimum of fifteen and a maximum of twenty students in each of two sections.

3. A well-qualified vocationally certified business education teacher is employed to teach the courses.

4. An operating budget will be provided which includes funds for the teacher to attend at least one out-of-county professional meeting each year called by the State Department of Education. The budget will also include funds to provide instructional materials, reference materials, and needed consumable supplies.

5. Provision should be made to ensure acquisition of additional equipment indicative of community need as well as to provide adequate maintenance and systematic equipment replacement.

Teacher Certification

The Florida State Department of Education sets up minimum requirements for Ranks I, II, and III teaching certificates. Detailed requirements may be found in the publication, Florida Requirements for Teacher Certification, State Department of Education, Tallahassee, Florida. Minimum requirements for a Rank III certificate are:

Business Education (Broad Field)

1. A Bachelor's degree with a major in business education (bookkeeping and stenography)

or

2. A Bachelor's degree with thirty (30) semester hours in business education including the areas specified below:

   a. Six (6) semester hours in accounting or bookkeeping
   b. Six (6) semester hours in economics
   c. Six (6) semester hours in shorthand
   d. Four (4) semester hours in typewriting
   e. Two (2) semester hours in business English
   f. Two (2) semester hours in business law

Vocational Office Education

In order to qualify for the Graduate Certificate, Rank III, covering Vocational Office Education, the applicant shall meet the following requirements:

a. Satisfy all requirements for the Graduate Certificate covering the broad field of secondary business education

b. Furnish signed statements from employers or other documentary evidence verifying specific work experience of at least one year of full-time employment in the same area to be taught

c. Present three (3) semester hours in principles or philosophy of vocational education.

Vocational Office Education may be shown on a Provisional Graduate Certificate covering secondary business education when the applicant has satisfied the requirement for work experience and furnished documented verification. (Section b.)[4]

[4]Florida Requirements for Teacher Certification (Tallahassee: State Department of Education, 1964), p. 119

Operation

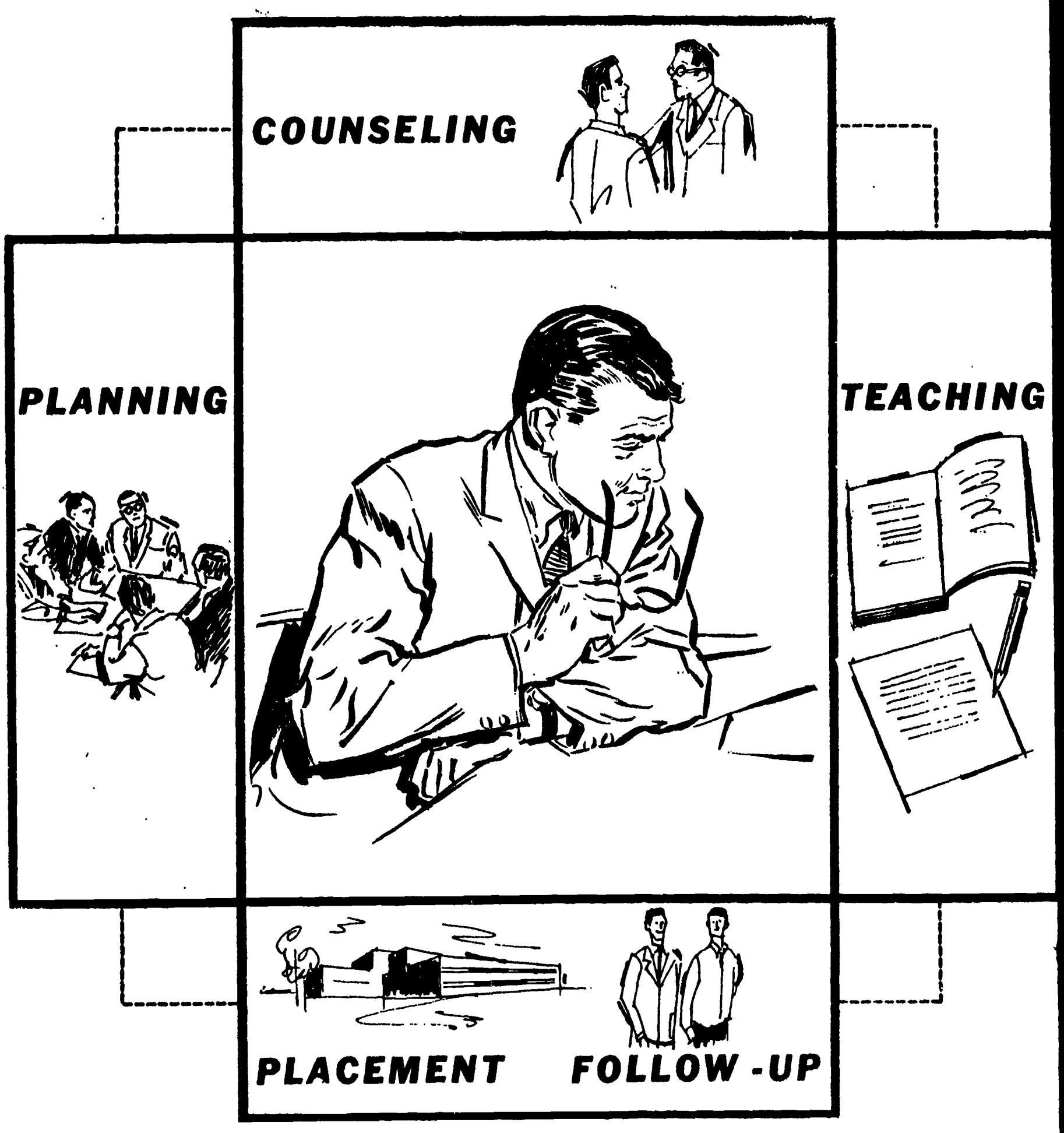
The Florida State Plan for Vocational Education includes provisions for three business and office education programs to operate in secondary schools and for high school youths in area vocational-technical centers. Two Vocational Office Education plans are identified in addition to the Cooperative Business Education program.

This guide relates only to the two separate but interrelated approaches through which vocational office education is implemented.

a. Vocational Office Education - (Directing Time)
   (Course Code # 0904)

b. Vocational Office Education - (Block Time)
   (Course Code # 749)
   Secretarial Block - (3 hours)
   Clerical Block - (2 hours)

VOCATIONAL OFFICE EDUCATION
DIRECTING TIME



Vocational Office Education (Directing Time)

The high school business education curriculum must be adapted to meet the constantly changing needs of society. Within a local community, consideration must be given to the mobility of the working population, the expanded employment community, the rapid developments in technological progress, and the dynamic nature of economic opportunities. In the development or modification of a business education curriculum for a school, careful attention must be given to the following factors:

1. Surveys of community needs and student interests.

2. Socio-economic and vocational characteristics of the community, including the expanded employment community.

3. Suggestions from local advisory committees.

4. Placement records and follow-up studies of graduates.

5. School size, teaching staff, facilities, and equipment.

It is unwise for any school to follow a business education curriculum developed in another school merely because of its apparent success in that school.

The Vocational Office Education (Directing Time) Plan enables a school to designate a directing teacher who, through released time planning and conference periods, may assume responsibility for the development of an efficient, realistic, and practical program geared to the career objective of vocational office education students.

Responsibilities of the Directing Teacher

1. The directing teacher should work cooperatively with the guidance department and school administration by providing them with occupational information and educational requirements for clerical and stenographic workers, by helping each student to recognize his special interests and aptitudes through an interpretation of his school records, background, and his inventory and test profile.

2. The directing teacher should work closely with the guidance department and school administration in the identification, selection, and tracking of students for the vocational office education program.

3. The directing teacher should know the factors which determine student identification, selection, and placement and be able to define and explain the enrollment procedure to all concerned.

4. The directing teacher should identify early the number of students with a stated career objective in the office occupations and the grade level of each.

5. The directing teacher should confer with parents about the factors relating to vocational choice and career planning.

6. The directing teacher should identify the sequence of experiences to be followed by vocational office education students which lead to their stated career objective.

7. The directing teacher should review periodically with the students their (a) career objectives, (b) achievement in relationship to aptitude and ability, (c) personal and social development, and (d) job performance record.

8. The directing teacher should confer with other business education teachers about the purposes of the program, identification and selection of students, any proposed changes in planned sequences and/or course outlines, standards of achievement, evaluation procedures and the like, and progress of vocational office education students.

9. The directing teacher should be responsible for equipment and instructional materials purchased with Federal funds for use in the vocational office education program.

10. The directing teacher is responsible for maintaining accurate and current student personnel records containing the information listed for reporting, placement, and follow-up purposes:

    a. personal data
    b. scholastic information
    c. test results
    d. career objectives
    e. work experience
    f. extra-curricular activities

11. The directing teacher should maintain a current file of job opportunities available to graduates.

12. The directing teacher should maintain a follow-up file of the graduates from the vocational office education programs.

Suggested Sequences

To be classified as a Vocational Office Education student, it is essential for that student to enroll in a minimum of two business education classes daily in the planned sequence leading to his career objective.

The Secretarial Sequence

Grade	Suggested Courses	Length
12	Business English	1 Year
12	Secretarial Office Practice	1 Year
12	Shorthand II	1 Year
11	Bookkeeping I	1 Year
11	Shorthand I	1 Year
10 or 11	Typewriting I	1 Year
9 or 10	General Business	1 Year

The Clerical Sequence

Grade	Suggested Courses	Length
12	Clerical Office Practice	1 Year
12	Office Machines (if not included in Clerical Office Practice)	1 Year
12	Introduction to Data Processing	1 Semester
12	Data Recording Devices	1 Semester
12	Business English	1 Year
10, 11, or 12	Bookkeeping I or Recordkeeping	1 Year
10 or 11	Typewriting I	1 Year
10 or 11	Business Mathematics	1 Semester or 1 Year
9 or 10	General Business	1 Year

The Bookkeeping Sequence

Grade	Suggested Courses	Length
12	Bookkeeping	1 Year
12	Office Practice, Clerical	1 Year
12	Introduction to Data Processing	1 Semester or 1 Year
11 or 12	Business Law	1 Semester or 1 Year
11 or 12	Economics	1 Semester or 1 Year
11 or 12	Bookkeeping I	1 Year
10 or 11	Typewriting I	1 Year
9 or 10	Business Mathematics	1 Year
9 or 10	General Business	1 Year

Automation and Data Processing Sequence

Grade	Suggested Courses	Length
12	Data Recording Devices	1 Semester
12	Introduction to Data Processing	1 Semester
11-12	Bookkeeping I	1 Year
11-12	Office Practice, Clerical (office machines should be included in the course)	1 Year.
10-11	Typewriting I	1 Year
10	Business Mathematics*	1 Year
9-10	General Business	1 Year

*The talented or above average students should elect an advanced mathematics course if arithmetic skills are superior.

The Directing Teacher's Schedule (Example)

The following illustrates a high school directing teacher's schedule in the business education department:

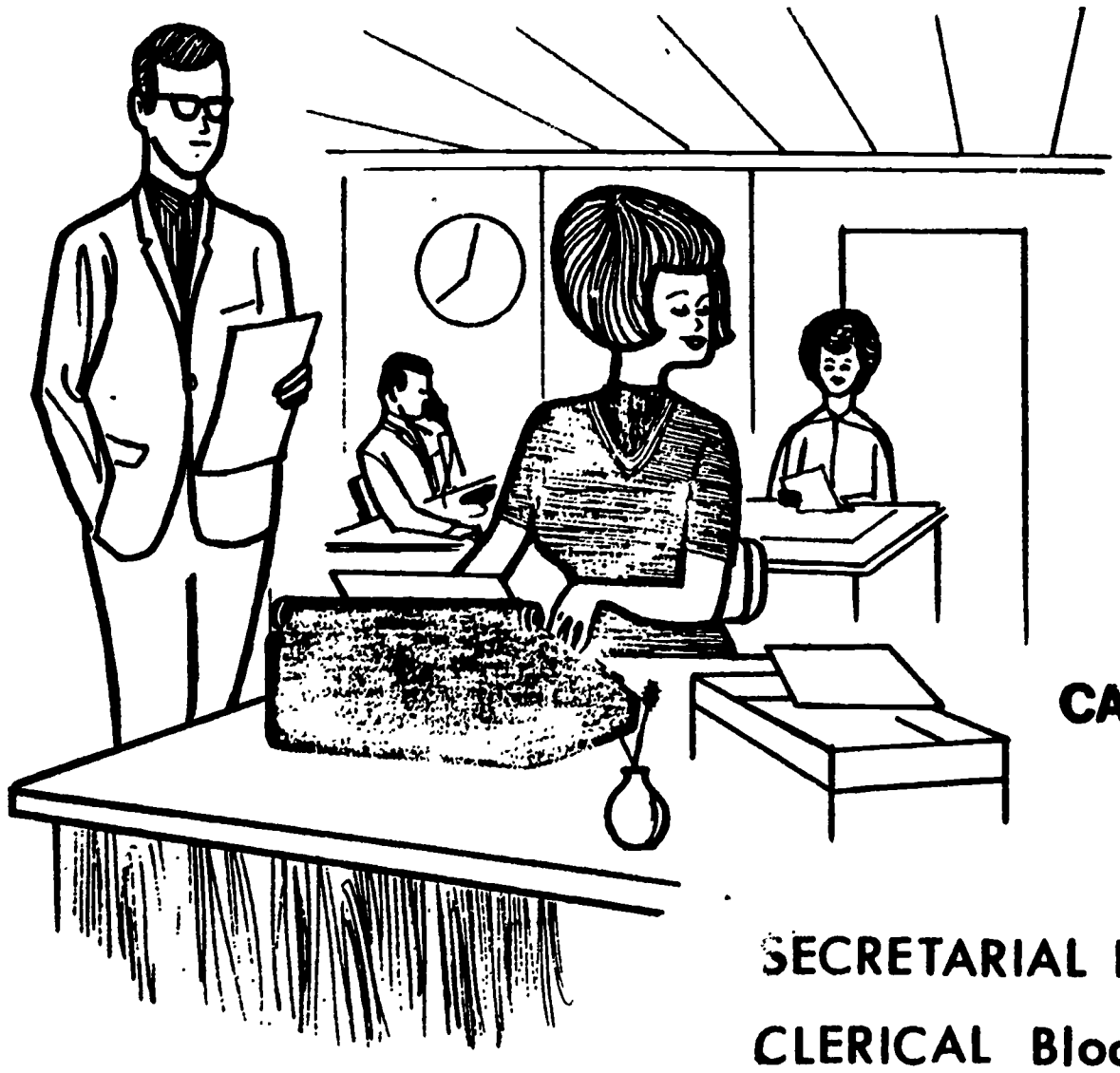
Period	Subject
1	Clerical Office Practice
2	Shorthand II
3	Planning Period
4	Clerical Office Practice
5	VOE Directing Time
6	Shorthand II

It is conceivable that a directing teacher might work in a team teaching situation with the Vocational Office Education (Block Time) instructor, plus utilizing the released time periods, in lieu of the above schedule. The following schedule illustrates such utilization of periods:

Period	Subject
1	VOE Clerical
2	" "
3	Planning Period
4	Bookkeeping
5	VOE Directing Time
6	Shorthand

For more complete and detailed information pertaining to planned sequences for the high school business education curriculum refer to Bulletin 72: A Guide to Business Education in Florida Schools, (Tallahassee: State Department of Education, 1967), Chapter 2, pp. 27 - 45.

VOCATIONAL OFFICE EDUCATION
BLOCK TIME



CAPACITY

SECRETARIAL Block (3hrs.)

CLERICAL Block (2hrs)

CAPITAL

Vocational Office Education (Block Time)

Historical Development of Block Programming

Although the comprehensive study on the use of block-time classes by Grace Wright[4] indicates that this trend is more widely followed in junior high schools, there is a definite increase in the use of the block time programs at the senior high school level. These programs are alike in that they are designed to have classes meet for two or more consecutive periods. But this is their only similar characteristic. For example, Nelson Bossing at the 1958 convention of the National Association of Secondary Principals listed five different ways of defining block scheduling. These are:[5]

1. Classes meeting for two or more class periods and combining or replacing two or more subjects required of all students.

2. Each subject retains its identity with consciously planned or with no correlation.

3. Subjects included are unified or fused around a central theme or units of work or problems stemming from one or more subject field.

4. Predetermined problem areas based upon the personal-social needs of adolescents determine the scope of the core. Subject matter is brought in as needed in working on problems.

5. Scope of the program is not predetermined. Pupils and teachers are free to select the problems upon which they wish to work.

Therefore, it is not surprising to find experimental programs in business education that meet for a daily block of time, but there the similarity ends.

In January, 1960, Fred S. Cook[6] predicted that an intensified modern curriculum in business education, including a clerical and stenographic block program of one year, would soon be in existence. It is interesting to note, by looking at several different experimental programs in business education in existence at the present time, that this prediction has proven valid.

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[4]Grace S. Wright, "Block-Time Classes and the Core Program in the Junior High School," Bulletin No. 6, 1958, p. 2, U. S. Dept. of Education.

[5]Nelson L. Bossing, "What are the Trends in Providing for Block-Time Classes in Today's Curriculum," A prepared address presented before the 43rd Annual Convention, p. 37, National Association of Secondary Principals.

[6]Fred S. Cook, "Wanted! A Modern Business Education Curriculum," Business Education Forum, Vol 14, No. 4, January, 1960, pp. 21-22.

Definition

The Vocational Office Education (Block Time) Plan is a specialized instructional method designed for high school seniors, consisting of a three-hour block for secretarial students and a two-hour block for clerical students, which provides training consisting of organized classroom learning experiences in specific office activities. This approach trains students to refine proficiency in skills needed to secure employment in office occupations immediately following graduation. The Vocational Office Education teacher coordinates and integrates advanced business education subjects in a planned sequence of activities to provide the student with an understanding of the relationships of the course content to office occupations.

Objectives

The primary objective of this approach is to prepare students vocationally to take their place in business as secretarial and/or clerical workers. Specific objectives are:

1. To present, develop, and refine the required skills necessary for job competency

2. To instill a sense of pride in office occupations and develop wholesome attitudes toward work and learning

3. To relate learnings and understandings in the classroom to actual job situations

4. To teach participants the importance of cooperation through actual work situations

5. To provide opportunities for students to develop an ability to solve problems which might arise in everyday business activities

6. To help students develop personality traits desirable in the office positions: accuracy, neatness, promptness, dependability, honesty, loyalty, and ability to follow directions.

7. To encourage each student through individual attention to develop his abilities to the highest degree

Operation

The program should be an integral part of the business education department and the Vocational Office Education instructor and department chairman should work closely in the following operational phases:

1. A committee, which may include the Vocational Office Education instructor, the business education department chairman, and the guidance counselor or principal, will select the students assigned to this program.

2. Two tenths (.2) of a unit is allocated for each hour of the block program offered; i.e., six tenths (.6) for the three-hour secretarial block and four tenths (.4) for the two-hour clerical block.

3. Each section will contain integrated units of work to emphasize the secretarial or general clerical areas of office occupations.

4. Credits will be earned for satisfactory completion of the subject for each classroom period. The secretarial student will receive credit for business English, office practice, and second-year shorthand. The clerical student will receive credit for business English and office practice. Students achieving a satisfactory rating on the National Business Entrance Test in all subjects in their particular block will be eligible to receive a Certificate of Proficiency awarded by the National Business Education Association.

5. Each section will be limited to a maximum of 20 students and a minimum of 15.

6. Classes will meet daily during the regular school year. (A yearly enrollment report must be filed at the beginning of the school year, a yearly attendance report at the end of the year, and a program follow-up form.)

7. Students permitted to enroll simultaneously in both Vocational Office Education and Cooperative Business Education in schools offering these programs should be reported for only one of them.

Student Prerequisites and Requirements

Secretarial Block

1. Vocational Office Education classes are restricted to seniors.

2. Students should be planning to enter the field of office occupations or to pursue a career in business education or business administration.

3. It is preferable to have students apply a year in advance to take VOE.

4. Scholarship, attendance, prognostic test scores, dependability, honesty, and willingness to work should be taken into consideration when students make application to enroll.

5. Secretarial students must enroll in the entire three-hour block. They are not permitted to enroll in any single subject unit of the program.

6. Secretarial students must have earned at least one unit in typewriting and one unit in shorthand prior to entering the program. (It is recommended that Typewriting II be taken one year previously or be taken concurrently.)

7. Students should have at least a C average in Shorthand I, Typewriting I, and all previous English courses.

Clerical Block

1. Vocational Office Education classes are restricted to seniors.

2. Students should be planning to enter the field of office occupations or pursue a career in business education or business administration.

3. Scholarship, attendance, prognostic test scores, dependability, honesty, and willingness to work should be taken into consideration.

4. Clerical students must enroll for the two-hour block. They are not permitted to enroll in any single subject unit of the program.

5. Clerical students must have earned at least one unit in typewriting prior to entering the program. One unit in bookkeeping or recordkeeping must have been taken previously or be taken concurrently. (If Bookkeeping II and Typewriting II are offered in the school, it is recommended that the above-average clerical student enroll in either or both of these courses.)

FACILITIES

Classroom

Classroom facilities must provide adequate work space and furniture to simulate actual office conditions. Minimum standards as indicated in the current Accreditation Standards in Florida Schools must be met. In addition to bulletin boards, chalkboards, filing cabinets, and necessary tables and chairs, the following should be provided:

An ample number of electrical outlets through the use of plugmolding, or individual outlets for each work station where an electrically powered machine will be operated

A lavatory which is easily accessible (preferably in the classroom)

At least one secretarial desk and posture chair per student

An adequate amount of storage space

Facilities, physical layout, and equipment are fully covered in Bulletin 72: A Guide to Business Education in Florida Schools. (Tallahassee: State Department of Education, 1967), Chapter IV, pp. 137-153.

Office Machines and Equipment

The following is a minimum list of equipment which should be made available in the classroom. Selection should be indicative of community usage.

20 L-shaped desks

20 adjustable posture chairs

20 typewriters of various makes, preferably elite type. (at least half of these are to be electric typewriters)

1 filing cabinet

1 electric full-keyboard adding machine

2 electric ten-key adding machines

2 electric or electronic rotary calculators

2 printing calculators

4 transcribing machines with adaptors (multi listening units) preferred

1 stencil duplicator

1 fluid process duplicator

1 mimeoscope (illuminated drawing board)

1 set of styli and lettering guides

1 paper cutter with guard--at least 19" x 18"

1 stapler and staple remover

1 interval timer

1 stop watch

Additional desirable equipment, such as the following, shall be provided when possible:

1 posting machine (Clerical Block)

1 long-carriage typewriter (elite type preferred)

1 key-driven calculator (may be reconditioned)

1 photocopy machine

1 EDL Projector (rapid reader for shorthand and typewriting)

1 collating rack

1 postal scale

1 telephone (teletrainer may be used)

Additional models of electric typewriters, adding machines, calculators, transcribing machines, and other equipment.

Instructional Materials, Audio-Visual Aids, Reference, and Supplies

It is recommended that the following should be made available for classroom use:

tape recorder

record player

projectors
(overhead, film, and filmstrip)

postal zip code guides

reference books

unabridged dictionary

regular dictionaries

telephone directories-
classified (city) and others

Atlas

World Almanac

secretaries' handbooks

shipping and railroad guides

plane, rail, bus, ship
timetables

Hotel Redbook

dictation tapes or records

filing sets

workbooks

practice sets

necessary consumable
supplies (see p. 13, #4)

SUGGESTED PROGRAM OUTLINE

This is a brief outline of the integrated skill subjects offered in the Vocational Office Education program. Immediately following, a suggested course content for each subject is listed.

Part I - INTRODUCTION AND DESCRIPTION

A. Program Orientation

1. The three hour secretarial block

2. The two hour clerical block

B. Relationship of Vocational Education to General Education

C. Overall Objectives

D. Classroom Procedure and Management

1. Preliminary instruction for using and caring for equipment

a. Machines

b. Furnishings

2. Materials

a. Textbooks and manuals

b. Supplies

Part II - EVALUATING THE STUDENT

A. Pre-testing

1. Business English

2. Personality and aptitude (Civil Service)

3. Shorthand and transcription (Byers Shorthand Aptitude Test)
(ERC Stenographic Aptitude Test for Shorthand)
(Turse Prognostic Tests)

4. Typewriting - see p. 192, Bulletin 72

B. Evaluate pre-testing

1. Student discovers what he already knows

2. Teacher discovers what student needs to learn

Part III - REVIEW OF SKILLS AND TECHNIQUES

A. Business English

1. Vocabulary and sentence structure

2. Oral and written communication

3. Grammar

4. Punctuation and capitalization

5. Abbreviations and Figures

B. Shorthand and Transcription (Secretarial Block only)

1. Theory

2. Brief Forms and phrases

3. Transcribing from material dictated

C. Typewriting

1. Electric

2. Manual

Part IV - NEW MATERIAL

A. Business English

1. Composing Business Letters

2. Types of Business Letters

a. Everyday Business Letters

b. Letters for Problem Situations

c. Letters that Sell

d. Other Business Communications

3. Speaking for Business

B. Office Practice

1. Acquaint student with machines and equipment that are available.

a. Adding

b. Calculating

c. Duplicating

d. Transcribing

e. Electric and Manual Typewriters

2. Teach related areas

a. Filing

b. Data Processing

c. Postal Information

d. Grooming

e. Job Application

f. Telephone Usage

g. Personality

h. Office Etiquette

i. Human Relations

j. Managerial Services

k. Travel and Transportation

l. Receptionist and Secretarial Duties

m. Reference Books

C. Shorthand and Transcription (Secretarial Block Only)

1. Vocational Dictation with Related Vocabulary

2. Produce Mailable Copy

D. Typewriting

1. Minutes, Resolutions, and Legal Papers

2. Business Reports and Financial Statements

3. Business Forms

4. Production Typewriting

5. Daily Statistical Typing

6. Itineraries

BUSINESS ENGLISH

Objectives

A comprehensive practical course in business communications is planned for all students entering the business world regardless of the jobs they are to fill. To meet this need, the course has as its general objective the mastery of effective oral and written communications together with an understanding of:

Problems encountered by business in oral and written communication

Importance of good human relations - with the public, fellow employees, and management

Desirable work habits, attitudes, and personality traits necessary for a successful business career.

The specific objectives are:

1. To review the fundamentals of grammar, stressing the importance of spelling, punctuation, sentence structure, mechanics, diction, and euphony.

2. To stress the importance of intelligent reading as a necessary element in developing reading comprehension.

3. To encourage the student to develop an extensive vocabulary with emphasis on business and related terminology, and to form habits of frequent and intelligent reference to the dictionary and other reference books on business correspondence.

4. To acquaint the student with different types of social and business letters, business reports, and business forms used by individuals and business concerns.

5. To develop the student's ability to express himself correctly and forcefully in the writing of acceptable personal and business letters.

6. To improve the student's oral expression in personal and business situations.

7. To provide an understanding of how and why people react as they do to oral suggestions or directions or to business letters.

8. To develop good listening habits so that students will follow directions properly and convey information accurately to others.

9. To understand and conform to the accepted rules of business and social etiquette.

10. To encourage legible handwriting.

Suggested Course Content

I - Grammar Review

A. The Sentence

B. Verbs

C. Nouns

1. Plurals

2. Possessive case

D. Pronouns (Case)

E. Predicate Agreement

1. Simple subject

2. Compound subject

F. Adjectives

G. Adverbs

H. Prepositions

I. Conjunctions

Materials and Supplies

Filmstrip
Posters on parts of speech (see English Easy Way)
Today's Secretary, newspapers, television

Teaching Suggestions

1. Use filmstrip series to illustrate the principles of grammar.

2. Prepare a bulletin board from posters or pictures on the various parts of speech.

3. Use Today's Secretary on "Watch Your English" to obtain supplementary materials for instructing, reviewing, and testing.

4. Prepare transparencies.

II - Punctuation, Abbreviations, and Figures Review

A. Period

B. Question Mark

C. Exclamation mark

D. Comma

E. Semicolon

F. Colon

G. Dash

H. Quotation marks

I. Hyphen

J. Parentheses

K. Apostrophe

L. Capitalization

M. Abbreviations

N. Figures

Materials and Supplies

Filmstrip
Posters on punctuation (See English Easy Way)
Today's Secretary

Teaching Suggestions

1. Use filmstrip to illustrate the principles of punctuation, abbreviations, and figures.

2. Prepare a bulletin board from posters or pictures to illustrate the principles of punctuation, abbreviations, and figures.

III - Business Writing

A. Qualities of effective letters

B. Parts of the business letter

C. Style of the business letter

D. Everyday business letters

1. Ask and transmit

2. Answer

a. Acknowledgments
b. Responses

E. Letters for problem situations

1. Psychology applied to problem situations

2. Claim and adjustment letters

3. Credit and collection letters

F. Letters that sell

1. Sales letters

2. Public relation letters

3. Employment letters

G. Other business communications

1. Social-business communications

2. Memorandums

3. Business reports

4. Telegrams

5. Minutes

6. News releases

Materials and Supplies

Newspapers, magazines, periodicals
Business forms
Stationery
Samples of actual letters and application forms
Flannel board and business letter cut-outs
Book on parliamentary procedures

Teaching Suggestions

1. Have the class make a collection of letterheads, business letter styles, business correspondence, and social-business correspondence, memorandums; business reports, telegrams, minutes, news releases, announcements, and application blanks for bulletin board display, instructional purposes, etc.

2. Secure actual application forms for display or instructional purposes.

3. Assign business reports involving research on career opportunities to utilize learnings in fundamentals of grammar, punctuation, spelling, sentence structure, etc. The students may write letters to various business firms to secure information regarding their reports.

4. Prepare a bulletin board display under the heading of "Yours for the Asking." Have students clip free advertisement offers from newspapers and magazines and write requesting material to share with the class.

5. Prepare a flannel board presentation on the parts of a business letter.

6. Have a representative of Dun and Bradstreet, a representative of the Retail Credit Bureau, or the credit manager of a local firm speak to the class on one of the following topics:

   a. The Importance of a Good Credit Standing
   b. How We Determine Credit Risk
   c. The Function of My Agency

   Students may take notes to be used later as minutes, as a report, or as a news release.

7. Have a student committee prepare an interesting display of various types of sales letters arranged under two headings--"Letters That Sell Merchandise" and "Letters That Sell Ideas."

8. Have students cut advertisements from newspapers and magazines that use descriptive words to sell their products.

9. Have a personnel representative speak to the class on the importance of the data sheet and the letter of application in getting a position.

10. Encourage each student to prepare a "Job Seeker's Portfolio." This might include the following:

    a. Sources of positions in community
    b. Sample application forms, properly filled out
    c. Personal data sheet
    d. Sample letter of application
    e. Sample letter requesting permission for reference, reference, etc.
    f. Sample letter requesting an interview
    g. Student's work, student awards, etc.

11. Have students bring announcements from business page of newspaper to study writing techniques used for preparing news releases.

12. Prepare minutes of a mock meeting. At the same time this will provide opportunity for students to see parliamentary procedure in action.

IV - Business and Social Speaking

A. The art of conversation

B. Meeting the public

1. In person

2. By telephone (also included in Office Practice)

C. Working with groups

D. Giving a talk

E. Employment Interview (also included in Office Practice)

Materials and Supplies

Telephone or Teletrainer
Telephone message forms
Tape recorder

Teaching Suggestions

1. Have students take turns making introductions. (Use tape recorder as micro-teaching technique)

2. Introduce topics of conversation and have students participate.

3. Conduct the following activities for working with groups:

a. Conference Method--Groups of 10 to 15 students can work mutually with a leader to develop a problem situation within their range of experiences.

b. Buzz Method--Class divided into small groups with a chairman and a reporter to discuss a problem within a limited time. Reporters act as spokesmen when groups meet to pool ideas, recommendations, etc.

c. Case Method--Individuals or groups identify the facets of a case problem. Experience is gained in amplifying and pinpointing the problem.

d. Role-playing--Students dramatize a realistic situation in which they are forced to think and speak in terms of characters being portrayed. Characterization should help to recognize the feelings, prejudices, and frustrations of others.

4. Have each student select a topic, seek library and other resource information, outline, and then write a three-minute talk for oral presentation.

5. Have resource person discuss job interviews, employment application forms, grooming for business, etc., regarding employment requirements. (Also included in Office Practice outline)

6. Have students visit business firms for job interviews arranged by telephone or letter. Follow up with the proper employment letters. (Also included in Office Practice outline)

Evaluation

An evaluation of various areas in Business English may be determined through the use of the following:

1. Short answer test items for achievement testing in fundamentals of grammar, punctuation, word usage, spelling, vocabulary development, and letter format and style.

2. Long-answer test items are most appropriate where students are expected to rephrase sentences in order to correct them, to add clarity or conciseness, or improve the tone of business correspondence.

3. Multiple choice type to be used in connection with all parts of speech, for correct spelling, grammar, precise meaning or improvement of tone quality.

4. Self-evaluation and class-evaluation may be used for testing oral communication. A check list may be presented for the students and teacher to rate the qualities.

5. True-false test items may be used where applicable.

6. Letter or short essay composition in response to case problem situations.

7. Satisfactory completion of the National Business Entrance Test, available from National Business Education Association, 1201 Sixteenth Street, N. W., Washington, D. C.

OFFICE PRACTICE

Purposes

1. To develop an understanding of machine operation and functions with some degree of job proficiency

2. To train students to consistently proofread their work

3. To develop personal traits of desirable behavior in business situations

4. To acquaint students with automation in the office and business

Materials and Supplies

Fixed Equipment

Machine Manuals and Keys
Signature Writing Plate and Styli
Reference Books
Secretarial Training Records

Consumable Supplies

Voice recorder tapes, discs, belts
Cards: 3 x 5 Index; Ledgercards, IBM 5081 cards
Manila folders and guides
Letterheads, plain bond, onionskin, second sheets, carbon paper
Envelopes--No. 10, No. 7-1/2, No. 6-3/4
Correct-a-Type
Adding machine tape; typewriter ribbons
Stencils and Spirit Masters
Mineograph and Duplicator paper
Correction fluid; single-edge razor blades
Duplicating fluid and ink
Hand cleaner
Working papers: checks, invoices, purchasing forms, credit memos, telegrams, etc.
Filing Practice Sets; Data Processing Practice Sets
Miscellaneous Supplies: paper clips, staples, rubber bands scotch tape

Suggested Course Content

I Text Units

A. Receptionist

1. Grooming, manners, speech
2. Receiving callers and making appointments

B. Handling Mail

1. Incoming mail
2. Outgoing mail
3. Equipment used

C. Reference books and office supplies

D. Others

II Transcribing Machines

A. Operation

B. Indication slip

C. Producing mailable transcripts

III Calculators

A. Operation of key-driven, printing, and rotary calculators

B. Fundamentals of addition, subtraction, multiplication and division

IV Adding Machines

A. Operation of ten-key and full-key

B. Touch system and most efficient techniques of using materials

V Duplicating

A. Stencil

B. Spirit

C. Dry Copy

D. Others

VI Typing (electric typewriter)

A. Basic operation of machine

B. Production techniques

VII Bookkeeping Machine (optional for secretarial block)

A. Posting of debits and credits

B. Handling of materials

VIII Office Secretary) (Different titles may be used and a
Office Receptionist) combination of duties may be required)

A. Office secretary does work for teacher and helps students

B. Office receptionist greets callers and works on projects at secretary's desk

IX Telephone Usage

A. Business Telephone Calls

1. Terminology
2. Preparation for placing calls
3. How to make a call
4. How to receive a call

B. Switchboard (PBX)

1. Types
2. Operation

X Grooming

A. Appearance (dress, make-up, posture, etc.)

B. Manners; annoying habits

C. Speech

XI Filing

A. What is filing

B. How to file

C. Rules for coding and indexing (alphabetic)

D. Charge, follow-up, and transfer methods

E. Other methods of filing

XII Data Processing

A. Need for Data Processing

B. Manual Data Processing

C. Mechanical Methods of Data Processing

D. Input Media

E. Output Media

XIII Job Application and Interviews

A. Letter of Application

B. Personal Data Sheet

C. Application forms

D. Employment tests

E. The interview

F. Follow-up

G. Accepting and Rejecting Positions

XIV Postal Seminar

XV Key Punch or Simulated Equipment

XVI Housekeeping Duties in the Office

Evaluation

Instruction in office practice may be evaluated by determining the degree to which the pupil:

1. Meets the standards of proficiency required of beginning office workers

2. Possesses the knowledge necessary to function as a beginning office worker

3. Develops a desirable personality and businesslike attitudes

These may be determined by giving:

1. Production tests with time limits to measure the student's ability to efficiently use machines on which he has received training

2. Objective tests to determine the student's familiarity with and understanding of the preparation of materials

3. Observation of personal traits and attitudes

<u>Teaching Suggestions</u>

1. Invite stationer or salesman to discuss office supplies.

2. Visit an automated office and have students file Field Trip Form (Appendix J) on return. Students may assist in making the arrangements. Write thank you letters.

3. In data processing, use completion of forms as a means of reviewing the fundamentals of business arithmetic. The EDL Business Math Filmstrips are suitable for such review.

4. Make information tapes or discs on voice transcription machines related to various areas such as spirit or stencil duplicating; include, for example, what it is, when used, advantages of its use, instructions for typing and correcting masters and stencils. Have students make a carbon copy to keep for reference when they are on this unit.

5. Dramatize various types of telephone calls that occur in business situations. Have students make practice calls with dialogue already composed or ask students to write dialogue; as these are enacted record the conversations on tape and play the recordings to the class, having them fill in message forms while listening. Check and discuss.

6. Use Teletrainer Kit available through the local telephone company.

7. Invite a businessman, preferably a personnel manager, to conduct interviews in front of class. As an alternative, have students go to a business office. Students should already have prepared preliminary materials such as application letter and data sheet.

8. Have mock interviews of the correct and incorrect way to approach an interview.

9. In adding up checks, etc., teach to lift form with left hand as keys are depressed and flip over as + bar is depressed, thus keeping checks in original order. When adding a list, use a card to move down column to keep from losing place.

10. Actual work may be done for other teachers or offices in the school so long as this does not interfere with assigned work. Work Request Sheets (Appendix G) should be completed by person desiring work at least two days in advance and all supplies should be furnished. Person desiring work should rate work and return form. If time allows in the Rotation Plan, students may be assigned work for individual teachers for which they shall receive a grade. (Sample of Rotation Plans follow)

11. Invite a fashion expert from local department store to give a demonstration. Other suggestions are to have the students prepare a project illustrating a week's wardrobe for a working girl or boy, using dolls, etc. The students might put on a fashion show. To publicize the VOE program simultaneously, other students and/or parents may be invited.

12. Have students compile a Handbook of useful information which can be used later as a reference source on the job.

13. Have students write letters of introduction and thank you letters to Work-a-Week (paid work experience in an office situation) employers.

14. Have students evaluate their own work on a Work-Appraisal Sheet. (Appendix I). Also have students keep a daily record of the work they do. (Appendix H)

15. Make out Rotation Plan for machines for at least six weeks at a time or by the semester.

16. Arrange for machine demonstrations by a sales representative.

Rotation Plan

On the following 3 pages are suggested rotation plans which may be applicable to the secretarial block.

SUGGESTED ROTATION PLAN

First Semester--_____

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1			CS	FB	VR	VR	10K		10K	FIL						BM	DUP	
2			10K	10K	DUP	CS	VR		VR	FIL						ET	FB	
3			10K	10K	PR CAL	ET	ET	G	ET	FIL						VR	VR	
4			DUP	CS	VR	VR	10K	N	10K	FIL						ROT CAL	ET	
5			VR	VR	FB	BM	DUP	I	CS	KP	PR CAL	DP	DP	DP	ET	ET	ET	
6	S	S	VR	VR	10K	10K	PR CAL	S	DP	DP	DP	KP	DUP	CS	ET	ET	ROT CAL	E
7	T	T	PR CAL	DUP	10K	10K	ET	S	DP	DP	DP	ET	KP	VR	VR	ET	ET	N
8	H	H	ROT CAL	DUP	CS	ET	ET	E	DP	DP	DP	10K	10K	KP	ET	VR	VR	O
9	N	N	FIL	FIL	FIL	FIL	FIL	C	FIL	DUP	CS	VR	VR	10K	10K	PR CAL	ET	H
10	U	U	FIL	FIL	FIL	FIL	FIL	O	FIL	10K	10K	ET	ET	DUP	CS	VR	VR	P
11			FIL	FIL	FIL	FIL	FIL	R	FIL	ET	ET	10K	10K	VR	VR	FB	BM	E
12	Y	Y	FIL	FIL	FIL	FIL	FIL	D	FIL	ROT CAL	DUP	CS	FB	BM	PR CAL	DUP	CS	L
13	O	O	FB	BM	ROT CAL	ET	ET		ET	VR	VR	DP	DP	DP	KP	10K	10K	E
14	O	O	ET	ET	ET	FB	BM	T	DUP	CS	KP	DP	DP	DP	ROT CAL	10K	10K	T
15	B	B	ET	ET	ET	ROT CAL	FB	I	BM	VR	VR	DP	DP	DP	DUP	CS	KP	
16			ET	ET	ET	DUP	CS	C	FB	BM	ROT CAL	VR	VR	PR CAL	DP	DP	DP	
17			ET	ET	ET	PR CAL	VR	O	VR	FB	BM	DUP	CS	ET	DP	DP	DP	
18			ET	ET	ET	ET	ROT CAL		KP	PR CAL	FB	BM	ET	ET	DP	DP	DP	
19			FIL	FIL	FIL	FIL	FIL		FIL	10K	10K	FB	BM	ET	DP	DP	DP	
20			FB	ROT CAL	BM	ET	ET		DP	DP	DP	ET	ET	10K	10K	KP	PR CAL	

BM - Bookkeeping Machine
CS - Class Secretary
DP - Data Processing
DUP- Duplicating

ET - Electric Typewriter
FIL- Filing
KP - Keypunch
PR
CAL- Printing Calculator

ROT
CAL-Rotary Calculator
10K-10-Key Add
VR - Voice Recorder
FB - Fullbank Add

Hillsborough High School
Tampa, Florida

SUGGESTED ROTATION SCHEDULE

Steno	Stenocord Transcriber	Sel	IBM Selectric
Dic	Dictaphone Time-Master Transc.	Mim	Mimeograph
Gray	Gray Audiograph Transc.	Scope	Mimeoscope
DX94	Remington Calculator	Dit	Ditto
#99	Remington Calculator	LC	Long-Carriage Type
10-K-UO	Underwood-Olivetti Add Machine	3-M	Thermofax
10-K-VE	Victor-10-Key Elec. Add Mach.	Veri	Verifax
10-KRM	Remington-10-Key Man. Add Mach.	PS(F)	Practice Sets (Filing)
10-KSM	Sunstrand Man. Add Mach.	Auto	Automation Office Practice
FKV	Victor Full-Keyboard Add Mach.	Mach	Machines Practice Set

Group A	1	2	3	4	5	6
Thrasher	FKV	FKV	MACHINE	PRACTICE	SET	
Jackson	10-K-UO	10-K-UO	"	"	"	
Green	#99	#99	"	"	"	
Knowles	10-K-UO	10-K-UO	"	"	"	
Sanders	DX94	DX94	"	"	"	
Wilkerson	10-KSM	10-KSM	"	"	"	
Group B						
Brookins	Dic	Dic	Dic	PRACTICE	SET	(F)
Hicks	Steno	Steno	Steno	"	"	"
Summerall	Dic	Dic	Dic	"	"	"
Shaw	Steno	Steno	Steno	"	"	"
La Fontaine	Gray	Gray	Gray	"	"	"
Mixon	Gray	Gray	Gray	"	"	"
Group C						
Sullivan	Sec	Sec	Sel / TR	3M / Veri	Ditto	Sc / Mim
Bovette	File	File	Mim / Sc	Sel / TR	3M / Veri	Ditto
Blewett	Lib	Lib	Ditto	Mim / Sc	Sel / TR	3M / Veri
Mellgren	Bul	Bul	3M / Veri	Ditto	Mim / Sc	Sel / TR
Davis	10-KRM	10-KRM	TR / Sel	3M / Veri	Ditto	Mim / Sc

Kathleen High School
Lakeland, Florida

ROTATION PLAN
20 weeks
20 students

UNIT	WEEKS																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Filing	AB	AB	CD	CD	EF	EF	GH	GH	IJ	IJ	KL	KL	MN	MN	OP	OP	QR	QR	ST	ST
Transcribing	CD	CD	AB	AB	GH	GH	EF	EF	KL	KL	IJ	IJ	OP	OP	MN	MN	ST	ST	QR	QR
Rotary Calculator	EF	EF	GH	GH	IJ	IJ	KL	KL	MN	MN	OP	OP	QR	QR	ST	ST	AB	AB	CD	CD
Production Typewriting	GH	GH	EF	EF	KL	KL	IJ	IJ	OP	OP	MN	MN	ST	ST	QR	QR	CD	CD	AB	AB
Data Processing and Ten-Key Adding Machine*	IJ KL	IJ KL	IJ KL	IJ KL	MN OP	MN OP	MN OP	MN OP	QR ST	QR ST	QR ST	QR ST	AB CD	AB CD	AB CD	AB CD	EF GH	EF GH	EF GH	EF GH
Receptionist	M	N	O	P	Q	R	S	T	A	B	C	D	E	F	G	H	I	J	K	L
Fluid Duplicating	N	M	P	O	R	Q	T	S	B	A	D	C	F	E	H	G	J	I	L	K
Stencil Duplicating	OP	OP	MN	MN	ST	ST	QR	QR	CD	CD	AB	AB	GH	GH	EF	EF	KL	KL	IJ	IJ
Full-Key Adding Machine	QR	QR	ST	ST	AB	AB	CD	CD	EF	EF	GH	GH	IJ	IJ	KL	KL	MN	MN	OP	OP
Printing Calculator	ST	ST	QR	QR	CD	CD	AB	AB	GH	GH	EF	EF	KL	KL	IJ	IJ	OP	OP	MN	MN

*One student will always be working on the Ten-Keyboard Adding Machine. One week is allotted to the Ten-Keyboard Adding Machine.

State of Kentucky
Office Practice Manual
Frankfort, 1966

SHORTHAND DICTATION AND TRANSCRIPTION

Purposes

1. To constantly review shorthand theory
2. To develop further a vocabulary to include common business terms
3. To increase shorthand writing speed
4. To improve techniques of taking dictation and transcribing usable and mailable copy
5. To continue the development of desirable work habits
6. To integrate typewriting and business English skills to meet production standards

Materials and Supplies

1. Dictionary for each student
2. Reference books and manuals
   a. Ruth E. Gavin and Lillian Hutchinson, Reference Manual for Stenographers and Typists, (New York: McGraw-Hill, 1965).
   b. Larsen and Koebele, Reference Manual for Office Employees, Fourth Edition, (Cincinnati: South-Western, 1965)
3. Film: Secretary Takes Dictation
4. Filmstrip: Dictation Shortcuts
   Taking Dictation and Transcribing
5. Dictation Material
   a. Foundation for Business Education
      Irvington, New York

      Office style dictation and proofreading projects

   b. Louis Leslie and Charles Zoubek, Transcription Dictation, (Hightstown: Gregg Publishing Division)
   c. Louis Leslie and Charles Zoubek, Dictation for Mailable Transcripts, (Hightstown: Gregg Publishing Division).

d. Charles Zoubek, Progressive Dictation, (Hightstown Gregg Publishing Division)

e. Charles Zoubek, Speed Dictation, (Hightstown Gregg Publishing Division).

f. Leonard J. Porter, Shorthand Dictation Pamphlet Series, (Englewood Cliffs: Prentice Hall Publishing Co.)

Suggested Course Content

A. While the shorthand course is integrated with office practice and business English, the traits and attitudes to be stressed in this unit are some of those that apply particularly to dictation and transcription.

1. Accuracy - The student is made aware of the necessity for checking all aspects of the finished transcript--English usage, typing, letter form, dates, names, and figures.

2. Resourcefulness - The student learns to use available sources of information, such as reference books and files, to supply any information not given by the dictator.

3. Willingness to Accept Responsibility - In the class activities the student develops the ability to carry through on his own the assignments given and to complete them in the time allotted.

4. Common Sense and Judgment - The student develops the ability to proofread for sense, to select the correct typing form and appropriate stationery, and to decide the number of copies to be made.

5. Loyalty to the Company - The student is taught the importance of recognizing the employer's interests as being paramount, keeping dictation confidential, conserving office supplies, and making proper use of office time.

6. Ability to Follow Directions - The student is taught the value of writing down all instructions given, asking necessary questions, and checking to see that all instructions have been carried out.

7. Ability to Work Under Pressure - The student is trained to concentrate on producing quality work in a limited time and in the face of distractions.

8. Pride in Work - The student is taught to develop personal standards of accomplishment.

B. Some of the desirable work habits to develop in this unit include:

1. Assembling materials

2. Arranging the secretarial desk

3. Handling enclosures

4. Handling finished transcripts

C. Instruction and practice are given in the handling of materials required during the dictation period, techniques to be used in taking and transcribing dictation, and personal conduct during the dictation period.

D. Experience in taking dictation from different people and under different conditions is an integral part of the class activities.

Evaluation

It is desirable to set standards for the following aspects of the second year of shorthand:

A. Dictation speed

B. Transcription rates

C. Mailable letters, memorandums, and short articles

Business standards and employment opportunities in the community should be considered when determining the goals for the course.

The National Business Entrance Stenographic Test or a similar test shall be used as a check on final vocational competence.

Teaching Suggestions

These points are to be presented to students and demonstrated where possible. The material may be duplicated and presented to the students.

Techniques in taking dictation:

1. Have notebook, pens, and pencils ready to take dictation immediately.

2. Separate used portion from unused portion of notebook with a rubber band.

3. Put the day's date in longhand at the bottom of the page.

4. Write special instructions, such as mailing directions, with a colored pencil.

5. Take dictation in the left column of the notebook; reserve right column for additions or corrections.

Techniques in transcribing:

1. Have all necessary materials at hand before starting to transcribe

2. Transcribe "Rush" items first. Unless the dictator instructs otherwise, follow this priority: telegrams, air mail and special delivery letters.

3. Use eye level placement in arranging transcript.

4. Draw line through notes that have been transcribed.

5. Proofread transcript for accuracy and complete thought before removing it from typewriter.

TYPEWRITING

All Vocational Office Education students will have completed one year of typewriting, but it is conceivable that there may be students in any of the following categories.

1. Students who have already completed a course in Typewriting II

2. Students who are presently enrolled in a course in Typewriting II

3. Students who have not and will not be able to take a separate course in Typewriting II

The Typewriting pretest should reveal the previously acquired skills and techniques of each student. From this, the teacher can formulate a plan whereby each individual student will be familiar with all new material before the end of the school year.

In the block concept it is understood that typewriting is a major force for integrating skills in business English, office practice, and shorthand transcription.

Purposes

1. To improve basic typewriting skills

2. To provide remedial instruction in business application of typewriting skills

3. To introduce advanced business applications of typewriting skills

4. To develop a high level of performance of business applications with a minimum of direction and supervision

5. To develop proper attitudes and work habits in office practice and transcription procedure

Materials and Supplies

1. Students are expected to furnish typing paper, carbon paper, onionskin paper, and large and small envelopes

2. A variety of business forms (preferably original) should be available. Other forms may be obtained from workbooks and practice sets. Forms not available may be duplicated.

Suggested Course Content

I Review of Basic Skills

A. Machine Parts

1. Paper guide
2. Ribbon Control

B. Kinds of type face

C. Operating Techniques

1. Margin stops
2. Vertical and horizontal centering
3. Ribbon changing
4. Differences between manual and electric machines

D. Building Skill and Accuracy

1. Foundations

a. Keyboard control
b. Figures and specialized characters

2. Building Skill in Sustained Typewriting

a. Increase muscular power
b. Ways of combating fatigue
c. Shortcuts to increase efficiency
d. Correcting Errors

E. Care of the Typewriter

1. Type cleaning
2. Cylinder or platen
3. Daily care

II Tabulation

A. Placement

B. Internal tabulation

C. Tabulated reports

1. Ruled reports
2. Unruled reports
3. Proofreading emphasis

III Business Forms

A. Rough Drafts and Manuscripts

1. Rough drafts

a. Preliminary copies
b. Proofreader's marks
c. Typing from rough draft

2. Manuscripts

   a. Title page
   b. Table of contents
   c. Outlines
   d. Body of manuscript (placement and footnotes)
   e. Bibliography

B. Minutes, Resolutions, and Legal Papers

C. Business Reports and Financial Statements

   1. Forms
   2. Bookkeeping statements
   3. Graphs

D. Other Business Forms

   1. Buying procedures and forms
   2. Selling procedures and forms

Evaluation

The evaluation of the various areas in typewriting may be determined by the following:

1. Timed production work to measure student's ability to use machines effectively and knowledge of the various business forms

2. Timed writings to determine student's speed as well as accuracy

3. Objective tests to determine proficiency in parts of machine and familiarity with materials

Teaching Suggestions

1. Use of a practice set gives the student experience in actually setting up and submitting final mailable copies of business forms

2. In typewriting letters use judgment placement

3. Keep carbon pack even by dropping it into slip of envelope or folded piece of paper, twirl the setup into the machine, and remove folded piece of paper or envelope. Cut off corners of carbon paper so that all carbons may be removed simultaneously.

4. In typewriting from rough drafts and corrected copies make the necessary corrections in rough draft, read material thoroughly and understand all corrections and markings before beginning to type. Plan the format before beginning to type.

5. Use proper type of eraser and erase with light, repeated strokes in order to preserve finish of the paper.

6. When correcting carbon copies, preserve carbon paper by placing protective shield in front of carbon paper.

7. The student learns to place all materials in the proper position for ease of handling and speed of production. Correct techniques are emphasized as an element in reducing fatigue.

8. The student is taught that his daily responsibilities include keeping the cleaning supplies readily accessible, and using them, moving carriage to one side when making corrections, keeping the machine covered when not in use, and keeping working area clean and neat.

GENERAL TIPS TO TE[illegible]

1. Place a note on teachers' bulletin board about student help available for faculty. Include details concerning the services which can be performed.

2. Compile a list of resource people. Include charm schools, data processing centers, prospective employers, former students, etc.

3. Have a former VOE student talk to class.

4. Keep a monthly attendance report to help facilitate making yearly report. The State does not require monthly reports as do some counties, but does require a yearly report.

5. Send out job opportunity survey forms or have students send them to local businesses to determine possible jobs for placement after graduation. (Appendix N)

6. Form an Advisory Committee of business people who can help develop a better program. The committee serving the Business Education Department or CBE program may be used.

7. Students enrolling in VOE may be asked to serve as office assistants in the school whenever this is practical.

8. The student assigned as office receptionist should be asked to dress appropriately for the office that week.

9. Have representatives of Civil Service Commission and Florida State Employment give employment tests to classes.

10. Have company representatives give machine demonstrations before class.

11. Hold an "Open House" for parents; Christmas party for parents and/or faculty

12. Have students plan bulletin boards centered around text topics.

13. Have Work-a-Week or Work-a-Day where students work in local business offices observing regular office hours. Generally, they are not paid for this work but will receive a grade. The cooperation of the students, school administration, faculty, parents, and local businesses is required. The following steps may be followed:

    a. Obtain written permission from faculty and parents. (Appendix K)
    b. Contact businessmen by letter and/or telephone to determine available placement of students. (If done by letter, it is suggested that these go out with the principal's signature also.)
    c. Schedule students for work in various offices. Have students write letters of introduction to businessmen to whom they have been assigned.

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d. Provide forms for use by businessmen to evaluate students. (Appendix L)
e. Provide forms for students to evaluate activity. (Appendix M) Students may be asked to prepare an oral and/or written report on this experience. (These can be graded.)
f. Provisions should be made for the teacher to visit students at least once while they are on the job.
g. Have students write letters of appreciation to businessmen for providing the opportunity for office experiences. (These may also be signed by the teacher.)

SAMPLE

INTEGRATED

UNITS

ERIC

INTEGRATED LESSON

General Objective:

To provide an opportunity for the student to follow directions--both direct and implied--in a realistic manner and to follow through on an assignment.

Specific Objectives:

1. To provide an opportunity to type index cards and to make a mailing list.

2. To take a letter from dictation and to assume responsibility for correctly placing it on the page and correcting all errors--English and otherwise.

3. To give students an opportunity to complete tasks that integrate English, typewriting, duplication, dictation, filing and mailing.

4. To place responsibility on the student to complete a task in its entirety as would be done in an office.

Things Involved:

1. Preparing the index cards from the mailing list given them
2. Arranging names in alphabetical order
3. Dictating the letter to be sent to the names on the cards
4. Transcribing the letter
5. Typing letter on master sheet and having it signed
6. Running off 20 copies on duplicator
7. Addressing a letter to each of the names on the index cards
8. Addressing an envelope for each letter
9. Folding letter and inserting it and the card to be enclosed in the envelope
10. Stamping letters and sealing
11. Clean up desk, file cards and extra letters for future use

Evaluation of techniques used in presenting the lesson and the final results obtained. Ask yourself these questions: Did all the students understand your directions? Did they follow through from one task to the other as they should have done? Were they orderly in what they did? Did they seem to have a feeling of accomplishment? If not, then how can I improve on my instruction?

Supplies:

Index cards--3 X 5
Plain cards for enclosures
Duplication carbon
Duplication paper
Envelopes
Stamps
Mailing list
Shorthand notebook

Equipment:

Typewriters
Duplicator

Procedures:

Give students mailing list that has already been duplicated
Give each student the correct number of index cards to be typed and the cards to enclose in the finished letters
Make envelopes available for the letters
Dictate letter
Transcribe letter on plain paper
Type letter on master set
Run off 20 copies
Address letters
Fold letters and insert in envelope with enclosure
Seal letters and stamp
Clean up desk

The letter to be dictated and duplicated is enclosed.

List of Names for Mailing List

The South Georgia Grocery Company
1134 South Street
Adel, Georgia

The Central Grocery Company
11346 Central Avenue
Orlando, Florida

John Higgins Packing Company
11360 Kings Street
Jacksonville, Florida

A. H. Hernes Grocery Company
1123 University Avenue
Athens, Georgia

W. L. Long and Company
1130 Dogwood Avenue
Asheville, N. C.

Williams Brothers, Incorporated
11450 Magnolia Street
Birmingham, Alabama

W. R. Robers Company
1189 Greenbrier Avenue
Charleston, South Carolina

Lone Star Motor Express Company
1407 Centennial Avenue
Fort Worth, Texas

Nelson Grocery Company
8340 East Southport Road
Atlanta, Georgia

Dillingham Packing Company
30595 East Carrollton Avenue
New Orleans, La.

Current Date

It required six months for us to gather and to condense into a 28-page booklet all the information the shipper needs for the selection, packaging, sealing and shipping of corrugated fiber shipping boxes.

This booklet shows how to select the proper style of box construction, how to pack various commodities to conform to transportation regulations, how to seal every sort of corrugated box, and how to specify just what you require when you are ordering boxes or packing supplies.

We shall be glad to mail you a copy of this useful little booklet with our compliments and to supply, without cost or obligation, any further information that you may wish to have. Just check and mail the enclosed card at once, while you have it in hand.

Yours very truly,

William A. Johnson
Sales Manager

lhh

Enclosure

Louise Hines
Santa Fe High School

A ONE-DAY PROBLEM-SOLVING PROJECT

FOR THE

SECRETARIAL PRACTICE COURSE

Your work as secretary to Jack W. Barnett, Manager of United Products Corporation, covers a variety of job responsibilities in a normal work day. Naturally, you move from one activity to another with efficiency and ease, remembering such details as not to attach any initials or signature to memos because Mr. Barnett prefers to do so with pen personally; that he likes his coffee at 10:00 right on the dot--"blonde but not sweet"; that he signs all letters with black ink over his official title "because it looks better with block styling and no punctuation"; to quote Boss B.

Today you must remember to get stamps for his Christmas cards, drop off his tuxedo to be pressed, and take a receipt to Binders, Incorporated for $27.50 when you go to lunch which paid their account in full.

With these little tid-bits carefully digested, you now set about the chores at hand!

JOB 1 - Dictated Letter

Mr. Barnett dictated the following letter requesting that you send carbons to Frank B. Wilson, Manager of our Detroit factory at 601 Wynnton Rd., where the cuff links are made and to Nathan Siebert our salesman for the Chicago area whose address is Michigan Shores Apartment Hotel, Oak Park, Illinois. He also directs you to send a copy to the principal of Miss Watkins' school, Darrell J. Hutchins, for reference purposes without her knowing it, lest she feel we are apprehensive about getting stuck with the order. "Don't forget, says Boss B., to send her one of our wallet calendars." Idiot! What does he take you for--a plumb ninny?

(Note: There are envelope forms attached for you to use)

Miss Mary Jo Watkins, Grove Hills High School, Chicago, Illinois. Dear Miss Watkins: Thank you for your letter of December 2 requesting cancellation of your order "400-P for 70 pairs of #14203 cuff links. We are canceling the order in our factory today.

We are also asking the factory to make the substitution of 70 keys #19038-B in black enamel and sterling. However, you must have taken the $1.75 price from an old catalogue, because the current price of this key in sterling is $2.75 plus a 20% tax. If this price is not satisfactory, will you please let us know right away just what disposition you wish made of the order.

Best wishes for the New Year. Cordially,

JOB 2 - Checks - Invoices - Credit Memo

It is your job to write checks in payment of invoices which, of course, means keep the stub record also. Write the necessary checks, the last used check being No. 297, putting the Invoice No. in the lower left hand corner

of each. Mr. Barnett signs all checks. One thing: on Invoice No. 49292, we did not receive the chair pads and have requested a credit memo. The invoice has been approved for payment without these being included.

JOB 3 - Invoice

On our No. 14H293, we sold and shipped to Plastico Industries, Incorporated, 4178 Abbott Road, Cleveland, Ohio, the following from their Purchase Order No. 29671:

1 gross	Elixir, R-4	@	$21.65
3 doz.	Caledon	@	7.90
4 sheets	12' x 14' Ibsen	@	6.50

All of our shipments go by motor freight.

JOB 4 - Note

The company has been approved for a 90-day loan from J. P. Stevens Co., in the amount of $650, payable at the Merchants & Farmers Bank with interest at 6%.

JOB 5 - Draft

The Trust Company of Georgia is depositing $1085.65 to the account of Beck & Gregg Hardward Co. of Atlanta. Thirty days from today, United Products Corporation guarantees to repay the bank with our Draft No. 149.

JOB 6 - Interoffice Memo

Send Paul J. Lovett, Treasurer of UPC, a memo from Mr. Barnett informing him about the foregoing draft being drawn and its due date so that his books will balance accordingly.

JOB 7 - Telegram

Boss B. is making a hurried (and harried!) trip to Philadelphia tomorrow and you need to get him a reservation--BUT QUICK! Choosey fellow, a studio-type room is the only accommodation that he will consider, and the $15 range.

Wire the Reservation Clerk of the Sheraton-Ranier Hotel for overnight accommodations and be sure to ask for a confirmation.

JOB 8 - Tabulated Report

NOW he tells you that he needs a composite report of UPC sales for the First Quarter of the year to take with him on the trip.

Lucky you, you collected such data some time ago but failed to write in totals. Run these hurriedly (but accurately) now and type up the attached report. (And they say women are unpredictable!)

A ONE-DAY PROBLEM-SOLVING PROJECT

FOR THE

SECRETARIAL PRACTICE COURSE

Job Description	Integrated Activities
General Instructions	1. Office Practice a. Handling memos b. Personal habits c. handling receipts 2. Correspondence a. letter style b. punctuation style c. buying postage (petty cash)
Job 1 - Dictated Letter	1. Handling Correspondence a. correct no. of carbons b. special notations--cc, bcc, enclosures c. check ZIP code 2. Dictation a. verification of names, and figures 3. Typewriting - Transcription a. correct letter style and punctuation b. space allowance for notations c. correct alignment and placement of notations d. proper distribution of carbon copies for mailing
Job 2 - Checks, Invoices, Credit Memo	1. Recordkeeping a. re-figure discount 2. Typewriting a. erasing vs voiding negotiable instruments

Job Description	Integrated Activities
	b. When to & when not to write checks in payment of invoices
	3. Business Machines
Job 3 - Invoice	1. Typewriting
	2. Business Machines
	a. running extensions & totals
Job 4 - Bank Note	1. Office Procedure
	a. notation on Tickler File for due date
	2. Typewriting
	a. correctly typing negotiable instruments b. proper identification of all parties on note
Job 5 - Bank Draft	1. Role-playing
	a. who owes whom b. repayment process
	2. Typewriting
	a. correct typing of negotiable instruments b. erasing vs voiding negotiable instruments
Job 6 - Interoffice Memo	1. Typewriting
	a. correct form for memos b. composition at the Keyboard
	2. Following Instructions

Job Description	Integrated Activities
Job 7	1. Communications a. telephone b. verification of names, dates, prices c. telegraph - type service, word count, wording 2. Typewriting a. correct typing of telegram b. verification of address in Hotel Red Book
Job 8 - Tabulated Report	1. Business Machines a. running extensions & totals 2. Typewriting a. tabulation b. statistical typing c. proofreading

Note: This is merely a suggested approach to planning integrated projects. Necessary forms for the particular project are not attached.

- Lucy C. Robinson
Tallahassee

A ONE-WEEK TYPING UNIT BASED ON OFFICE AUTOMATION
for the
CLERICAL PRACTICE COURSE

Lesson Plan 1

	Minutes
Conditioning Practice	3
Two one-half minute timings on each of the three sentences in conditioning pr.	4
Quick review of manuscript typing.	4
Using numbered carbon, practice typing footnotes to end one inch from bottom of page. 1 min.--Footnote 4; 1-1/2 min.--Footnotes 1, 2; 1-1/2 min.--Footnotes 1,2,5,	7
Begin Problem 1. Problems 1-3 will be completed tomorrow	30
Call attention to bulletin board and the fact that this unit contains information on automation and data processing. Mention some of the things computers can do: Used in some states to keep record of all drivers' licenses and tells when each one needs to be renewed. Also keeps record of fines paid by each person. This information can be obtained from a computer in a matter of seconds.	6
Give suggested reading lists and explain that one article from this list or some other appropriate article is to be read and outlined. On Friday each student will compose a short report at the typewriter, using his outline as a source of information.	1

Lesson 1

Conditioning Practice

a;sldkfjghfjdksla;sldkfjghfjdksla;sldkfjghfjdksla;sldkfjghfjdksla;sldkfjghfjdksla;
Accuracy in automation is essential as one error may create thousands.
To typing ability one must add the capacity to think through problems.
The Binary system combines the figures 0010 0110 0011 which equal 263.

Directions:

Problems 1, 2, and 3 which follow are based on information about automation. Use the directions for manuscript typing on Page 149 of your text. Type one carbon copy of each problem and make neat corrections. These problems will be completed tomorrow.

Problem 1--Manuscript

THIS IS AUTOMATION

The word "automation" is a relatively recent addition to the English language. It was coined in 1951 by John Diebold when he was a student at Harvard Business School. At that time he used the word to mean a new system of making factory assembly lines almost automatic through electronic control systems.[1] The word was first listed in dictionaries in 1956, and a 1961 Webster's New Collegiate Dictionary[2] gives the meaning as "the technique of making a process or system automatic; automatically controlled operation of an apparatus, process, or system, especially by electronic devices."

The Reader's Guide listed articles under Automation for the first time in the March 1955-February 1957 index. Many magazines had articles expressing a sudden interest in this word. This interest was not confined to a particular type of publication, and the magazines ranged from Monthly Labor Review and Time and Reader's Digest to Scholastic, Christian Century, and National Education Association Journal.

Automation has been heralded by some as a system that will cause mass unemployment and degradation of the human spirit while others believe it will bring the nation to the threshold of Utopia.[3]

One area of automation which has aroused a great deal of public curiosity is that of the computers. This is probably because they perform such complex operations and are capable of maintaining such an infinite array of information that man finds their accomplishments almost unbelievable. Some computers, for instance, can store more than eight million characters of information and complete calculations in a millionth of a second.

The Federal government made use of computers in 1951 in connection with the 1950 Census, and the first installation of a computer in a business firm was completed in 1954.[4] Today several thousand computers are in use and many more are in the process of being installed. These giant computers are found most often in those businesses which employ a large number of office workers such as government agencies, insurance companies, banks, and public utilities.

Computers are speeding up the work in modern business offices. Management has more current information and more types of information as a result of the electronic processing of data. This up-to-the-minute business information, rather than the savings in clerical costs, provides the basic justification for the expense of automation in business offices.

Automation in the factory and the office will not come without some "growing pains." Some jobs will be eliminated by the machines, but new jobs will also be created. Like the industrial revolution, there will be problems; but automation will also bring increased benefits to mankind.

Of one thing we may be sure, automation will require a greater need for trained technicians and "increased education is needed in the ability to think and understand mathematical and logical methods."[5] Because of these needs, automation will bring some changes into the system of education.

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[1] Diebold, John, "Facing up to Automation," Saturday Evening Post, CXXXV (September 22, 1962), 26.

[2] Webster's New Collegiate Dictionary, (Springfield, 1961), p. 60.

[3] "What is Automation?" Collier's, CXXXVII (March 16, 1956), 38.

[4] Lomax, Paul S., "What Should Business Teachers Do About Office Automation?" Business Education World, XXXIX (May, 1959), 14.

[5] Collier's, op. cit., p. 44.

Problem 2--Title Page
THIS IS AUTOMATION Compiled by (your name) Refugio High School April 22, 1965

Problem 3-- Bibliography

BIBLIOGRAPHY

Diebold, John, "Facing up to Automation," Saturday Evening Post, CXXXV (September 22, 1962), 26.

Lomax, Paul S., "What Should Business Teachers Do About Office Automation?," Business Education World, XXXIX (May, 1959), 14.

Webster's New Collegiate Dictionary, Springfield, Massachusetts, G. & C. Merriam Co., 1961.

"What is Automation?," Collier's, CXXXVII (March 16, 1956), 38-44.

READINGS ON AUTOMATION

Business Week

"How a Big Computer Takes Over," July 24, 1954, p. 58-62.

Collier's

"What is Automation?," March 16, 1956, p. 38-44.

Look

"Man vs. Machine," December 13, 1955.

Monthly Labor Review

"Experience with the Introduction of Office Automation," April, 1960, p. 376-380.

Popular Mechanics

"My Most Exciting Moment," January, 1961, p. 133.

Reader's Digest

"Automation: Friend or Foe?," October, 1962, p. 101-106.
"Look What Those Knucklehead Machines Are Doing!," April, 1963, p. 278-280.
"What is Behind This Word Automation?," May, 1955.

Saturday Evening Post

"Don't Swap Your Brains for a Computer," July 2, 1955.
"Facing Up to Automation," September 22, 1962, p. 26.

Time

"Automating the Archives: Computer to Take Over the Lawyer's Plodding Search Through Archives," December 13, 1963, p. 82.
"IBM vs. the Others," March 8, 1963, p. 86-87.
"Let 315 Do It; Plan to Share a Computer Center," February 15, 1963, p. 89.

Lesson Plan 2

	Minutes
Conditioning Practice	3
Two one-half minute timings on each of three sentences in conditioning practice.	4

Timed Writings on Paragraph Material — Minutes

Practice preview words for paragraph 1
Two one-minute timed writings
Practice preview words for paragraph 2
Two one-minute timed writings — 13
Practice preview words for paragraph 3
Two one-minute timed writings
Practice preview words for paragraph 4
Two one-minute timed writings

Mention reading assignment to see if students are finding articles. Ask for interesting fact from reading (one student).

Type of facts to incorporate into conversation: — 7

Most computers cost a million or more dollars.
IBM rents machines from $2,600 to $63,000 a month.
Because many companies cannot afford these amounts on their own and do not have enough work to keep the machines busy, some are going together to buy or rent machines.
IBM has 80 per cent of the 1.5 billion a year computer market. Only one company actually makes money on computers in competition with IBM.
IBM spends a great deal on research, and this is a constantly changing field.

Complete manuscript, title page, and bibliography. — 28

Lesson 2

Conditioning Practice

a;sldkfjghfjdksla;sldkfjghfjdksla;sldkfjghfjdksla;sldkfjghfjdksla;sldk
Automation can lead to increased leisure time and more rewarding jobs.
The demand for office workers has increased during the last ten years.
Page 89 of Business Automation is described as "highly controversial."

Preview Words for Timed Writing

Paragraph 1--automation second human initiative think information
Paragraph 2--subjects minimum shorthand increase emphasis electric classrooms
Paragraph 3-- key-punch offered colleges manufacturers
Paragraph 4--increasing acquiring purposeful teachers equipment

TIMED WRITING

DIRECTIONS: Use a seven-inch line of writing. Indent the paragraphs five spaces.

	Words	
Some students may wonder just what effect office	10	10
automation will have upon education. A major item to	20	20
remember is that the machines known as computers are being	32	32
used to solve problems in less than a second which would	43	43
require many man hours, but these machines are not really	54	54
"brains." They can use only that information which has been	66	66
given them, and human initiative is still required. In fact,	79	79
there will be an even greater need for students to learn to	91	91
think through problems in terms of how and why.	100	100
Many high school subjects will contine with a minimum	11	111
of change. Shorthand will still be taught, for even though	23	123

	Words	
dictating machines have been used for a number of years, the	35	135
demand for workers who are able to write shorthand has con-	46	146
tinued to increase. There will be added emphasis on accuracy	59	159
and on the typing of numbers, and electric typing skill will	71	171
be taught more and more in the classrooms of our schools.	82	182
A few large high schools have been able to add a course	11	193
which includes training in the use of the key-punch machine.	23	205
Other high schools now offer a short course about automation	35	217
in the office, but they do not teach the operation of the	46	228
vast machines. Most of the machine training is now offered	58	240
in private business schools, in colleges, in special courses	70	252
given by the machine manufacturers, and on the job.	80	262
The need for skilled workers is increasing, and few	10	272
jobs remain for those who drop out of school before acquiring	22	284
these skills. High school boys and girls may become more	34	296
informed about automation in the office through reading and	46	308
by purposeful talks with school counselors, teachers and	57	319
workers who use this type of office equipment in their jobs.	69	331

Lesson Plan 3

	Minutes
Conditioning Practice	3
Control typing--Everyone begins with one-half minute writing. When student types the individually determined speed without error, he progresses to one minute, then 1-1/2 minute, etc. Each half minute during all timings is called. (Use timed writing material.)	10
Two five-minute writings--same timed writing material used yesterday (auto mation and education).	17
Data Processing terms--Review directions.	25

1/2 minute timing
1 minute timing
1-1/2 minute timing
2 minute timing
2-1/2 minute timing

Lesson 3

Conditioning Practice

a;sldkfjghfjdksla;sldkfjghfjdksla;sldkfjghfjdksla;sldkfjghfjdksla;sldk
The electric typewriter is considered a basic modern business machine.
Memory devices for computers include magnetic tapes, drums, and cores.
The typewriter was purchased for $365; the adding machine was $147.50.

Directions:

The list of terms which are used in automation in the office should be typed in a form which you believe would be most attractive and which would make for ease in locating words and in reading the definitions. Type one carbon copy.

Problem 1

AUTOMATION TERMS[1]

1. Access time--The length of time required to find information in a device's memory.

2. Binary--The type of arithmetic system used in electronic computers. Instead of the 10-place decimal system commonly used, binary arithmetic is based on two digits, 0 and 1. When the decimal number 296 is converted to a binary number, it becomes 100101000.

3. Bit--The smallest unit of information in the binary numbering system. An abbreviation of "binary digit." Normally, a bit refers to one ("on"), while a no bit means zero ("off"); may also mean "yes" or "no".

4. Code--A system of symbols and rules for representing information in a language that can be understood and handled by the computer.

5. Input--The transfer of external information into the computer.

6. Magnetic drum--A storage device consisting of a rotating cylinder surfaced with a material that can be easily magnetized. Information is stored by the presence or absence of magnetized spots on the surface of the drum.

7. Magnetic tape--A ribbon of metal or plastic that is coated on one side with a material which can be magnetized. Information is stored by the presence or absence of magnetized spots on the surface of the drum.

8. Memory--A general term for the equipment that holds information in machine language in electrical or magnetic form. This equipment also receives information for storage and gives out the stored information for later use. The word "memory" usually means storage inside the computer, while "storage" refers to magnetic drums, discs, cores, tapes, punched cards, etc., outside the computer.

9. Output--The information that is sent out from the computer.

10. Program--Noun: A sequence of steps to be executed by the computer to solve a given problem. Verb: To plan and prepare the procedures required to solve a specific problem.

11. Programmer--A person who prepares the planned sequence of events the computer must follow to solve a problem but who need not necessarily convert them into detailed instructions (coding).

12. Test routine--A procedure that shows whether or not a computer is functioning properly.

Lesson Plan 4

	Minutes
Conditioning Practice	5

Timings on Problem 3

Correct errors as you type. Check wpm after each timing.

1 minute beginning at first of letter

2 minutes beginning at first of letter

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[1]Munsinger, John P., "Data Processing Terms in Gregg Shorthand," Today's Secretary, LIII (March, 1961), 43-44.

	Minutes
2 one-minute beginning with tenth line 1 minute beginning with third paragraph 2 minutes beginning with third paragraph	10
Review directions for Problems 1, 2, 3.	3
Production typing on Problems 1, 2, 3.	25
Remainder of period checking wpm, handing in papers, comments on data processing.	12

Illustration:

The people who have been hurt most by loss of jobs when computers are installed are those who are not skilled. Many jobs are available for those with the necessary skills, but the untrained and uneducated are the first to lose jobs and the last to find new jobs. Companies know several years ahead of time that they will be installing automated equipment, and they try to shift workers to appropriate positions and do not hire as many new workers during this period so that they will not have to let many workers go when the new equipment is put in.

What automated equipment can do in a library, in insurance office, in the armed forces.

Mention again the article which is to be summarized tomorrow.

Lesson 4

Conditioning Practice

a;sldkfjghfjdksla;sldkfjghfjdksla;sldkfjghfjdksla;sldkfjghfjdksla;sldk
Electronic computers work some problems in a millionth of one second.
A Christmas seal and stamp are the same to automated postal equipment.
Electronic computer equipment may be rented for up to $63,000 a month.

Problem 1

DIRECTIONS: This letter is to be typed two times in modified block style with mixed punctuation. Type an envelope and one carbon copy for each letter. Type your address with the current date, and use your name in the signature position. The letters are to be written to the two addresses given below.

			Words
Kerr Business College	216 Main Street	Dallas, Texas	11
Kingston University	Houston, Texas		18

Gentlemen: At the end of this semester I will be graduating	30
from high school. I feel that my interest is in the field	42
of data processing although at the present I do not have in	54
mind a specific type of training. (P) Since I am not	65
familiar with the various types of training available in the	78
field, I would like a description of your offerings, the	89
cost of the courses, and the length of time required for	100
the training. Yours truly, (Your name)	109

Problem 2

DIRECTIONS: This rough-draft letter should be typed in modified block style with mixed punctuation. Set up the course names in tabulated form with the longest name centered. Type an envelope and one carbon copy of the letter.

	Words
Mr. Clark Gillum 610 Huisache Street Refugio, Texas	10
Dear Mr. Gillum: The University bulletin has been mailed	22
to you. It gives details on tuition, room and board, plus	33
general information about the school. (P) Pages 199-200	44
give detailed information on the School of Business Adminis-	56
tration. As you will see, five courses are offered in the	67
general area of automation and data processing. None of	78
these courses are required in the degree plans that are	89
offered; however, they may be taken as electives. Complete	101
descriptions of the courses which are listed below will be	113
found in the Bulletin: Punched Card Machines	122
Principles of Data Processing Data Processing Systems	132
Analysis Automation and Accounting Problems in	141
Electronic Data Processing	146
(P) Please write or call if you have questions about our	158
program. Yours very truly J. Matthew Lynn, Dean	168

Problem 3

DIRECTIONS: Type this letter in modified block style with open punctuation. Type one carbon copy and an envelope.

Mr. Clark Gillum 610 Huisache Refugio, Texas	9
Dear Mr. Gillum This school offers many types of courses,	21
and several of them include training in the area of data	32
processing. In fact, about 75 per cent of our students	43
include some form of data processing as a part of their	54
course of study. (P) Our Computer Programming Course is	65
a most popular program for men. The average time to	75
complete this program is from five to seven months, although	87
some students take longer and a few require a shorter period.	98
The cost of this course, with tuition and textbooks, is	109
$675. In addition to computer programming, this course	120
includes typewriting, ten-key adding listing machine,	130
accounting, payroll accounting, and IBM key-punch machine.	142
(P) Enclosed are programs of instruction offered at our	152

Ruth I. Anderson
North Texas State University
Denton, Texas

FORMS

*	1.	Appendix A	Initial Survey Form for New Programs (Directing)
*	2.	Appendix A	Initial Survey Form for New Programs (Block)
*	3.	Appendix B	Initial Report for VOE Block
*	4.	Appendix C	Initial Report for VOE Directing
	5.	Appendix D	Business Education Equipment & Repair Record
*	6.	Appendix E	Instructional Resources Inventory
	7.	Appendix F	Initial Interview Form
	8.	Appendix G	Registration Form in Approved Sequence
	9.	Appendix H	Work Request Form
	10.	Appendix I	Daily Work Record
	11.	Appendix J	Student Work Appraisal Sheet
	12.	Appendix K	Field Trip Report
	13.	Appendix L	Work-a-Week Permit
	14.	Appendix M	Work-a-Week Employer Appraisal Form
	15.	Appendix N	Work-a-Week Student Appraisal Form
	16.	Appendix O	Job Placement Survey
	17.	Appendix P	VOE Permanent Record Card
*	18.	Appendix Q	Final Report Form (Directing)
*	19.	Appendix R	Final Report Form (Block)
*	20.	Appendix S	Follow-up Survey of VOE Graduates
*	21.	Appendix T	Follow-up Reporting Form

* State Forms

Rev. 1967

BUSINESS AND DISTRIBUTIVE EDUCATION
DIVISION OF VOCATIONAL, TECHNICAL, AND ADULT EDUCATION
STATE DEPARTMENT OF EDUCATION
TALLAHASSEE, FLORIDA 32304

INITIAL SURVEY FORM FOR NEW PROGRAMS

Vocational Office Education, (Directing Time), Number of Periods _____ Date _____

County _____ School _____

Mailing Address _____ Principal _____

---

1. Is a teacher available to coordinate this program who is certified in vocational office education? 1. Yes _____ No _____

   If so, give Name _____ Certificate Number _____
   Rank _____ Years Teaching Exp. ____ Years Work Exp. _____

2. Suitable facilities will be available for the VOE teacher to use for individual interviews with students. 2. Yes _____ No _____

3. All students will be enrolled in at least two business education classes daily to be classified as a VOE student. 3. Yes _____ No _____

4. Number of students identified as VOE. (Directing Time) students. 4. _____

5. Will this person be permitted to attend an out-of-county professional meeting called by the State Department of Education? 5. Yes _____ No _____

6. Will the VOE (Directing Time) teacher have responsibilities other than directing this program? 6. Yes _____ No _____

   If so what will they be _____

DO NOT WRITE IN THIS SPACE	Signed:
Date recommended for approval: _____	_____ (School Principal)
Date Rejected: _____	_____ (Local County Director)
_____ (Program Supervisor)	_____ (County Superintendent)

(Submit in Duplicate)

APPENDIX A

Rev. 1967

BUSINESS AND DISTRIBUTIVE EDUCATION SECTION
DIVISION OF VOCATIONAL, TECHNICAL AND ADULT EDUCATION
STATE DEPARTMENT OF EDUCATION
TALLAHASSEE, FLORIDA 32304

INITIAL SURVEY FORM FOR NEW PROGRAMS

Vocational Office Education (Block Time)
Two hour block, Number of sections _____
Three hour block, Number of sections _____

_____ (Date)

County: _____ School: _____

Mailing Address: _____, Principal: _____

---

1. Give number of students (those who will be juniors and seniors next school year) who have indicated an interest in the program. — 1. Juniors _____ Seniors _____

2. Is a teacher available to teach and coordinate this program who is certified in Vocational Office Education? — 2. Yes _____ No _____

   If so give: Name: _____, Certificate No. _____
   Rank: _____, Years Teaching Exp. _____, Work Exp. _____

3. Will instructional materials and equipment, as specified in the teacher's guide, be provided for the VOE classroom when school opens in September? — 3. Yes _____ No _____

4. After conferences with interested students, will your program meet the enrollment requirements of a minimum of 15 and a maximum of 20 students in each block? — 4. Yes _____ No _____

5. Will each student enrolled in VOE have earned the required two business education units prior to enrollment? — 5. Yes _____ No _____

6. According to community reports and surveys, will there be positions available to students upon graduation from high school? (Attach any supporting information to this form.) — 6. Yes _____ No _____

7. Will arrangements be made to allow the VOE teacher to attend at least one out-of-county professional meeting called by the State Department of Education? — 7. Yes _____ No _____

8. Will the instructor have responsibilities in addition to teaching in the VOE program? — 8. Yes _____ No _____
   If so, list them on the reverse side.

DO NOT WRITE IN THIS SPACE

Date Recommended for Approval: _____

Date Rejected: _____

_____
(Program Supervisor)

Signed:

_____
(School Principal)

_____
(Local County Director)

_____
(County Superintendent)

(Submit in Duplicate)

DC. -6

STATE DEPARTMENT OF EDUCATION

Distributive, Cooperative, and Business Education Section
Tallahassee, Florida

Initial Report of VOE Classes

School _____ City _____ County _____

Instructor _____ Date Report Submitted _____ Teaching Certificate No. _____

Section I 2 hr. / / 3 hr. / /						Section II 2 hr. / / 3 hr. / /					
No	Name of Student	Sex	grd	Bus. Subj. prior to grd 12 *	Grd. 12 Bus. subjects (not VOE)	No	Name of Student	Sex	grd	Bus. Subj. prior to grd. 12	Grd. 12 Bus. subjects (not VOE)
1						1					
2						2					
3						3					
4						4					
5						5					
6						6					
7						7					
8						8					
9						9					
10						10					
11						11					
12						12					
13						13					
14						14					
15						15					
16						16					
17						17					
18						18					
19						19					
20						20					

Enrollment
Male _____
Female _____
Total _____
*Refer to reverse side

Signature of VOE Instructor

Signature of Principal

Signature of Director
or Superintendent

Appendix B

ABBREVIATIONS FOR BUSINESS SUBJECTS ARE AS FOLLOWS:

Bookkeeping I	B 1
Bookkeeping II	B 2
Briefhand	Bh
Business Arithmetic	BA
Business English	BE
Business Law	BL
Business Principles and Management	BPM
Clerical Office Practice	COP
Consumer Education	CE
Cooperative Business Education	CBE
Distributive Education	DE
Diversified Cooperative Training	DCT
Economics	E
Filing	F
General Business	GB
Notehand	Nh
Office Machines	OM
Office Practice	OP
Personal Typing	PT
Recordkeeping	R.
Salesmanship	S
Secretarial Office Practice	SOP
Shorthand I	Sh 1
Shorthand II	Sh 2
Speedwriting	Sp
Stenoscript	St
Transcription	Tr
Typewriting I	T 1
Typewriting II	T 2
Vocational Office Education	VOE

Appendix C

Form No. DCBE-7

STATE DEPARTMENT OF EDUCATION
Business and Distributive Education Section

Vocational Office Education
Directing Teacher

INITIAL REPORT

School_____City_____

County_____Date Submitted_____

Directing Teacher_____

Teaching Certificate Number_____

1. Are you certified for Vocational Office Education_____yes_____no

2. Directing Teacher's Schedule

List classes by title and number of students in each

Period	Course	Pupils
1		
2		
3		
4		
5		
6		
7		

3. How many students have you identified with a stated career objective in office occupations? (List on attached sheet)

Grade Level	Number Male	Number Female
10		
11		
12		
	Total	

4. Check appropriate space if your school offers following special business and office education programs.

Program	Enrollment
CBE _____	_____
VOE Block_____	_____
Other _____	_____
(Specify)	

5. Identify the sequences of courses being taken by the Vocational Office Education students and report how many are enrolled in each sequence. Sequences may be listed as secretarial, clerical, bookkeeping, data processing, or others that you offer. (Refer to Page 18, Bulletin 73H-5, Vocational Office Education in Florida Schools).

A. Sequence _____
Number of students by grade level
10 _____ 11 _____ 12 _____

List business education courses included in sequence

_____ _____

_____ _____

_____ _____

B. Sequence _____
Number of students by grade level
10 _____ 11 _____ 12 _____

List business education courses included in sequence

_____ _____

_____ _____

_____ _____

C. Sequence _____
Number of students by grade level
10 _____ 11 _____ 12 _____

List business education courses included in sequence

_____ _____

_____ _____

_____ _____

6. Please describe briefly what procedures were used to schedule Vocational Office Education students in a sequence. (Use additional space if needed.)

_____

_____

7. List the ways in which you have cooperated with the guidance department.

_____

_____

Appendix C

All Vocational Office Education (Directing Time) students must be enrolled in at least two business education courses. Complete the following information on your students. Group the students by grade level.

Name (Last first)	Sex	Grade	Business Course Enrollment	
			Course I	Course 2

Directing Teacher

Principal

Director or Superintendent

Appendix D

Room No._____ Desk No._____ Type of Machine_____ Serial No._____

School_____ Make_____ Model_____

Date Received_____ New_____ Used_____

BUSINESS EDUCATION EQUIPMENT AND REPAIR RECORD

PINELLAS COUNTY PUBLIC SCHOOLS

Date Reported Out of Order	Description of Repair	Date Repair Requested	Date Repair Completed	OK ✓	Remarks About Repairs Unsatisfactory

INSTRUCTIONAL RESOURCES INVENTORY

SECTION I. CLASSROOM EQUIPMENT

	Number of Machines Electric -- Elite Pica	Number of Machines Manual : Elite Pica	PURCHASED WITH: Local or State Funds	PURCHASED WITH: Federal Funds	Rental
A. TYPEWRITERS					
Adler	____	____	____	____	____
Facit	____	____	____	____	____
Hermes	____	____	____	____	____
IBM Executive	____	____	____	____	____
IBM Selectric	____	____	____	____	____
IBM Standard	____	____	____	____	____
Olivetti-Underwood	____	____	____	____	____
Olympia	____	____	____	____	____
R. C. Allen	____	____	____	____	____
Remington	____	____	____	____	____
Royal	____	____	____	____	____
Smith-Corona	____	____	____	____	____
Other:					
_____	____	____	____	____	____
_____	____	____	____	____	____

Age of Typewriters: 1 to 5 years ____ over 5 years ____ over 10 years ____
Number:

SPECIAL TYPEWRITERS					
Flexowriter	____	____	____	____	____
Varityper	____	____	____	____	____
IBM MTST	____	____	____	____	____
Other:	____	____	____	____	____
_____	____	____	____	____	____
B. DUPLICATING EQUIPMENT					
SPIRIT PROCESS					
A. B. Dick	____	____	____	____	____
Ditto	____	____	____	____	____
Heyer	____	____	____	____	____
Standard	____	____	____	____	____
Other: _____	____	____	____	____	____
MIMEOGRAPHING PROCESS					
A. B. Dick	____	____	____	____	____
Gestetner	____	____	____	____	____
Other: _____	____	____	____	____	____
OFFSET PROCESS					
A. B. Dick	____	____	____	____	____
Ditto	____	____	____	____	____
Multilith	____	____	____	____	____
Other: _____	____	____	____	____	____

PHOTOCOPY MACHINES

A. B. Dick	_____	_____	_____	_____	_____
Thermofax	_____	_____	_____	_____	_____
Xerox	_____	_____	_____	_____	_____
Other: _____	_____	_____	_____	_____	_____

Age of Duplicating Equipment:	1 to 5 years	over 5 years	over 10 years
Number:	_____	_____	_____

	Number of Machines		Purchased With		
	Electric	Manual	Local or State Funds	Federal Funds	Rental
ADDING AND CALCULATING MACHINES					
TEN-KEY ADDING MACHINES					
Burroughs	_____	_____	_____	_____	_____
Facit	_____	_____	_____	_____	_____
Friden	_____	_____	_____	_____	_____
Hermes	_____	_____	_____	_____	_____
Marchant	_____	_____	_____	_____	_____
Monroe	_____	_____	_____	_____	_____
NCR	_____	_____	_____	_____	_____
Olivetti-Underwood	_____	_____	_____	_____	_____
Remington	_____	_____	_____	_____	_____
Victor	_____	_____	_____	_____	_____
Other: _____	_____	_____	_____	_____	_____
FULL-KEYBOARD ADDING MACHINES					
Burroughs	_____	_____	_____	_____	_____
Monroe	_____	_____	_____	_____	_____
NCR	_____	_____	_____	_____	_____
Remington	_____	_____	_____	_____	_____
Victor	_____	_____	_____	_____	_____
Other: _____	_____	_____	_____	_____	_____

Age of Adding Machines:	1 to 5 years	over 5 years	over 10 years
Number:	_____	_____	_____

KEY-DRIVEN CALCULATORS					
Burroughs	_____	_____	_____	_____	_____
Victor Comptometer	_____	_____	_____	_____	_____
Other: _____	_____	_____	_____	_____	_____
PRINTING CALCULATORS					
Burroughs	_____	_____	_____	_____	_____
Friden	_____	_____	_____	_____	_____
Marchant	_____	_____	_____	_____	_____
Monroe	_____	_____	_____	_____	_____
Olivetti-Underwood	_____	_____	_____	_____	_____
Remington Rand	_____	_____	_____	_____	_____
Victor	_____	_____	_____	_____	_____
Other: _____	_____	_____	_____	_____	_____

ROTARY CALCULATORS

Facit-Odhner	_____	_____	_____	_____	_____
Friden	_____	_____	_____	_____	_____
Marchant	_____	_____	_____	_____	_____
Monroe	_____	_____	_____	_____	_____
Olympia	_____	_____	_____	_____	_____
Other: _____	_____	_____	_____	_____	_____

Age of Calculators:	1 to 5 years	over 5 years	over 10 years
Number:	_____	_____	_____

BOOKKEEPING MACHINES

Burroughs	_____	_____	_____	_____	_____
Monroe	_____	_____	_____	_____	_____
NCR	_____	_____	_____	_____	_____
Other: _____	_____	_____	_____	_____	_____

Age of Bookkeeping Machines:	1 to 5 years	over 5 years	over 10 years
Number:	_____	_____	_____

D. MACHINE SHORTHAND

Stenograph	_____	_____	_____	_____	_____
Stenotype	_____	_____	_____	_____	_____
Other: _____	_____	_____	_____	_____	_____

E. DICTATION/TRANSCRIPTION EQUIPMENT

	Number of Machines in Classroom	Purchased With Local or State Funds	Purchased With Federal Funds	Rental
MAGNETIC BELT				
IBM Executary	_____	_____	_____	_____
Stenocord	_____	_____	_____	_____
Other: _____	_____	_____	_____	_____
MAGNETIC DISC				
Telefunken	_____	_____	_____	_____
Other: _____	_____	_____	_____	_____
MAGNETIC TAPE				
DeJur-Grundig Stenorette	_____	_____	_____	_____
Other: _____	_____	_____	_____	_____
PLASTIC BELT				
Dictaphone	_____	_____	_____	_____
Other: _____	_____	_____	_____	_____
PLASTIC DISC				
Edison Voicewriter	_____	_____	_____	_____
SoundScriber	_____	_____	_____	_____
Other: _____	_____	_____	_____	_____
TAPE				
Norelco	_____	_____	_____	_____
Rekotape	_____	_____	_____	_____
Other: _____	_____	_____	_____	_____

Age of Dictation/Transcription Equipment: 1 to 5 years over 5 years over 10 years
Number: _____ _____ _____

F. SHORTHAND TAPE LABORATORIES

	Number of Machines in Classroom	Purchased With Local or State Funds	Purchased With Federal Funds	Rental
Console with individual listening stations				
Tape Recorders with listening stations				
Phonographs with listening stations				
Other: _____				
_____				

G. DATA PROCESSING EQUIPMENT

Keypunch				
Sorter				
Collator				
Interpreter				
Reproducer				
Verifier				
Calculator				
Accounting Machine				
Computer and Printer				
Other: _____				
_____				
_____				

KEYPUNCH SUMULATORS

IBM Selectric				
Royal Training Tandem				
Smith-Corona 250KPT				
Portable Card Punch				

SECTION II. CLASSROOM FACILITIES AND FURNITURE

A. CLASSROOM FACILITIES

Answers

1. Number Feet of Counter Space _____
2. Number Feet of Uncer-Counter Cabinets _____
3. Number Feet of Cabinet Space Over Counter _____
4. Number Feet of Open Shelving _____
5. Sink in Classroom Yes _____ No _____
6. Air Conditioning in Classroom Yes _____ No _____
7. Type of Lighting in Classroom:

   a. Fluorescent:

      Ceiling Strips _____ Ceiling Fixtures _____

      Dropped Ceiling (Indirect) _____

   b. Other Type:

      _____

   c. Is lighting: Completely satisfactory _____ Adequate _____ Inadequate _____

8. Windows in Classroom:

   Venetian Blinds _____ Shades _____ Drapes _____ Black-out Shades _____

9. Type of Floor in Classroom:

   Tile _____ Wood _____ Cement _____ Carpeted Floor _____

10. Electrical Outlets:

    a. Number of electric machines in classroom _____

    b. Number of electric outlets in classroom _____

    c. Are outlets placed for satisfactory room arrangement: yes _____ no _____

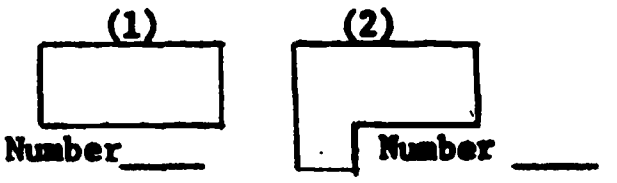
    d. Are electric outlets satisfactory: yes _____ no _____

    e. Is master electrical switch easily accessible: yes _____ no _____

CLASSROOM FURNITURE

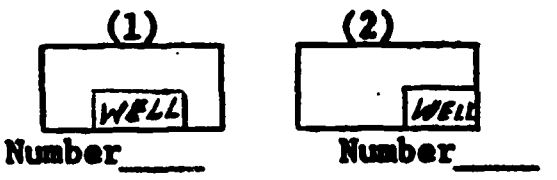
1. Student Desks: (Circle those in classroom and indicate number)

a. Bookkeeping Desk



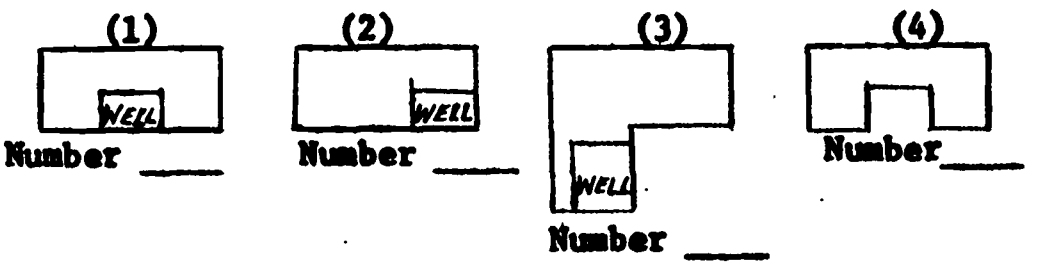
Number____ Number ____

b. Machines Desk



Number____ Number____

c. Typewriting Desk



Number ____ Number ____ Number ____ Number____

d. Other Type:

2. Student Chairs:

a. Posture Chairs (Number) _____

b. Other Type: _____

3. Student Work Tables:

_____

(Specify Number, Type and Size of Tables)

4. Closet Storage Space:

One Closet _____ Two Closets _____ Three Closets _____

Storage Cabinets _____ Other _____

5. Teacher's Equipment:

Desk _____ Personal Filing Cabinet _____ Telephone _____

Teacher's Work Table _____ Bookcase (Number) _____

Other _____

6. Filing Cabinets in Classroom:

	Number of Cabinets	
	Metal	Wood
a. Four-Drawer File Cabinet		
b. Three-Drawer File Cabinet		
c. Two-Drawer File Cabinet		
d. File for Mimeograph Stencils		
e. Drum Files		
f. Other: _____		
_____		

7. Miscellaneous Supplies and Small Equipment:

Misc. Supplies	Number	Misc. Supplies	Number
Clip Boards		Paper Punch-Electric	
Collating Rack		Paper Trays	
Copy Holders		Postal Scale	
Demonstration Stand		Stapler-Manual	
Interval Timer		Stapler-Electric	
Mimeograph Styli		Staple Removers	
Mimeo Lettering Guides		Stop Watch	
Mimeoscope		Wall Charts	
Numbering Machines		Wire Baskets	
Paper Cutter		Other:	
Paper Punch-Manual			

SECTION IV. CLASSROOM LAYOUT

Approximate number of square feet in room _____.

. Do you have an office or planning area: yes _____ no _____.

C. If a drawing of your classroom layout is available, please enclose.

SECTION IV. INSTRUCTIONAL MATERIALS / MEDIA

	Available in Classroom	Available in School	Can be obtained from Co. Office	Purchased with Federal funds
A. Media				
1. Projectors:				
Slide Projector	_____	_____	_____	_____
Film Projector	_____	_____	_____	_____
Single-Concept Film Projector	_____	_____	_____	_____
Overhead Projector	_____	_____	_____	_____
Opaque Projector	_____	_____	_____	_____
2. Tape Recorder	_____	_____	_____	_____
3. Tele-Trainer	_____	_____	_____	_____
4. Phonograph	_____	_____	_____	_____
5. Controlled Reader (EDL)	_____	_____	_____	_____
6. Television Facilities	_____	_____	_____	_____
7. Other: _____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

B. Reference Materials	Number of Copies Available: 1 p/student	1-5	6-10	10+
1. Dictionaries				
2. Secretarial Handbooks				
3. Telephone Directories				
4. City Directories				
5. Zip-Code Directories				
6. Transportation Schedule Books				
7. Basic Textbooks:				
Title Pub.				
_____				
_____				
_____				
_____				

Appendix F

Date _____

Name _____ Grade _____
Last First Middle

Address _____ Phone _____

Name of Parents _____

CLASS SCHEDULE (Present)

Period	Subject	Teacher	Room No.
0			
1			
2			
3			
4			
5			
6			

Are you interested in a career in business? Yes ____ No _____
(Please check one)

If "Yes", what is your career objective? _____

_____

_____

Are you interested in teaching business education? Yes ____ No _____

Are your plans now to attend college? Yes ____ No _____

Lakeland Sr. High School
Lakeland, Florida

Appendix G

REGISTRATION FORM

FOR

BUSINESS EDUCATION STUDENTS

NAME _____ DATE _____

SEQUENCE _____

COURSES APPROVED FOR 1967-68:

_____

_____

_____

_____

_____

_____

_____

PARENTS' APPROVAL _____

DATE _____

CONFERENCE DATE:

_____

_____

_____

_____

DIRECTING TEACHERS:

_____

_____

_____

_____

Lakeland Senior High School
Lakeland, Florida

WORK REQUEST FORM

(This sheet should accompany work until completion and then be retained for Stenographic file)

WORK FOR _____

COMPLETE PREFERABLY _____

BUT NOT LATER THAN _____

NO. OF COPIES _____

CARBONS _____
DITTO _____
MIMEOGRAPH _____

TYPE
PICA _____
ELITE _____

KIND AND PAPER SIZE _____ MARGIN _____

_____ SHEETS NUMBERED YES _____ NO _____

SPACE SINGLE _____ DOUBLE _____

TYPIST PROOFREADER APPROVED DELIVERED BY

PUT IN SETS YES _____ NO _____

STAPLE YES _____ NO _____

SPECIFIC INSTRUCTIONS

Appendix I

D A I L Y W O R K R E C O R D

Week of: _____

Monday	Tuesday	Wednesday	Thursday	Friday

STUDENT WORK-APPRAISAL SHEET

Name_____ Date_____

Chapter _____ Page _____ Exercise _____

Time Spent on Job _____ Estimated Time _____

I have proofread my work carefully. Yes_____ No_____

My appraisal of each of the following items is:

	Good	Fair	Poor
Original Copy			
Carbon Copies			
Placement			

	Good	Fair	Poor
Erasures			
Clean Type			
Planning			

I have studied and followed the directions to the best of my ability.

Yes_____ No_____

My criticism of my work is:_____

_____

_____

_____

Improvements I suggest making in my work:_____

_____

_____

_____

Would I be proud to put this work on my employer's desk as a sample of my production ability? Yes_____ No_____

Would I be justified in asking for a raise if my work were consistently of this caliber? Yes_____ No_____

Grade I think I deserve on this assignment _____

Instructor's comment_____

_____

_____

_____

Instructor's grade _____

APPENDIX K

FIELD TRIP REPORT

NAME _____

Name of Company _____

Size of Company _____

Name of Guide _____

Departments That Were Visited	Office Machines That Were Observed

Employment Qualifications:

Employment Test Information:

Salary Scale:

Advancement Policy:

Vacation and Sick Leave Policy:

Company Benefits:

Employment Advantages:

Employment Disadvantages:

Additional Comments on Trip:

V O E WORK-A-WEEK PERMIT

Student Name _____

Student Number _____ B. R. SECTION NUMBER _____

The above student wishes to work one week in the office of a cooperating business or professional person in this area. The school administration is agreeable with this plan in lieu of the student's coming to school providing he is doing satisfactory work in his/her classes and it is agreeable with each teacher.

Please sign below if you approve of his/her absence from your classes for the week of _____ to _____

Period	Subject	Teacher
2		
3		
4		
5		
6		
7		

Dean's Approval _____
Signature

Business Name _____

Address _____

_____

PARENTS' PERMISSION FORM

I approve my daughter's/son's participation in the VOE Work-A Week program. I understand that she/he will report for work every day for the above-mentioned week and she/he will receive a grade for this work in lieu of her/his school attendance.

Signed,

_____ _____
Date Parent or guardian

Brandon High School
Brandon, Florida

APPENDIX M

Name of Student Employee_____

VOE WORK-A-WEEK

	Always	Usually	Seldom
Personal Appearance			
1. Dresses neatly and in good taste.			
2. Good posture.			
3. Neither too shy nor too aggressive.			
Personality			
4. Assumes responsibility and cooperates.			
5. Works well with others.			
6. Well-mannered and never disrespectful.			
7. Shows initiative.			
8. Pleasant and diplomatic.			
Work Habits			
9. Punctual and prompt.			
10. Persistent in completing every assignment.			
11. Follows instructions well.			
12. Works without constant supervision.			
13. Production ability average or above.			
14. Makes very few errors.			
15. Not easily discouraged.			

The above qualities include most of those desired in an employee, but if you wish to make any other comments I would be glad to have them in the space below. I have attempted to keep the list brief and to make it simple so as not to burden you with an extensive report. Just check in the appropriate column. This form is strictly CONFIDENTIAL.

COMMENTS:

GRADE YOU THINK THIS STUDENT EARNED_____

If you were a prospective employer would you hire this student with the knowledge you now have of his or her ability?_____

Brandon High School
Brandon, Florida

Appendix N

STUDENT EVALUATION
OF WORK WEEK

PLEASE ANSWER THE FOLLOWING QUESTIONS HONESTLY AND IN FULL DETAIL

1. Name of your employer: _____

2. What were your working hours? _____

3. Were you made to adhere to these hour? Yes No

4. Was the physical set-up of the office satisfactory? Yes No

   Comment: _____

5. What duties did you perform? (check)

   Typing _____
   Shorthand _____
   Filing _____
   Answer Telephone _____
   Meeting Public _____
   Handwriting _____
   Bookkeeping _____
   Other (name _____

6. What machines did you use? (check)

   Adding machine _____
   Calculator _____
   Duplicator _____
   Mimeograph _____
   Other (name) _____

7. Indicate the percentage of total time spent on each job:

8. What forms did you type?

   1. Letters _____
   2. Memos _____
   3. Form letters _____
   4. Bills _____
   5. Telegrams _____
   6. Envelopes _____
   7. Statements _____
   8. Index cards _____
   9. Other (name) _____

Brandon High School
Brandon

9. Did you have the opportunity to use your own initiative in composing an answer to a letter, etc._____ If so, what?

_____

_____

_____

10. Did the employer treat you as a "high-school girl" or were you treated as an employee? _____
Comment: _____

_____

_____

11. Was any of your work turned back to you to be redone or corrected?
_____ How much? _____
Why? _____

_____

12. Was any of your work redone by another person? _____
Why? _____

_____

13. Did you waste any materials? _____
Why? _____

_____

14. Were you satisfied with your work? _____
Comment: _____

_____

15. In what areas did you feel your school work was adequate preparation?

_____

_____

Comment: _____
Inadequate: _____

16. What do you feel you really gained from the week of work? _____

_____

_____

_____

_____

_____

_____

Brandon High School
Brandon

JOB-PLACEMENT SURVEY

(Current date)

Gentlemen:

King High School is interested in helping its Business Education graduates to secure employment within the Greater Tampa area.

This June, we will graduate about 460 young men and women, approximately half of whom will be seeking employment. We are vitally interested in presenting a school program that will prepare these fine teen-agers for employment within the Greater Tampa area.

We need your help. We will be most appreciative if you will supply us with the information we need by completing the enclosed questionnaire and returning it in the self-addressed stamped envelope as soon as possible.

Thank you for your interest and cooperation.

Sincerely yours,

Braulio Alonso,
Principal

mel

Enclosure

KING HIGH SCHOOL

QUESTIONNAIRE FOR JOB-PLACEMENT SURVEY

1. What jobs do you have available to high school graduates? (Please check)

___ Stenographers	___ Dentist's Assistant	___ Voice-Machine Operator
___ Office Receptionist	___ Doctor's Assistant	___ Payroll Clerk
___ General Clerk	___ Switchboard Operator	___ File Clerk
___ Typist Clerk	___ Bookkeeper-Stenographer	___ Stock Boy
___ Stock Clerk	___ Assistant Bookkeeper	___ Repairman (Machines)

Do you prefer male or female personnel for the jobs? _____

2. What duties would they perform? (Please check)

Typing:	___ Transcription	___ Diction	___ Combinations:
	___ Invoices	___ Dictation	___ Payroll-Clerical
	___ Bills	___ Telephone	___ Shipping-Clerical
	___ Other office forms	___ Receptionist	___ Filing-Clerical
	_____	_____	_____
	_____	_____	_____

3. What are your skill requirements:
Typing: Words per Minute _____ Production _____
Dictation: Words Per Minute _____

4. What office machines will they be expected to use?

Typewriter: Manual _____ Electric _____ Name _____
Ten-Key Adding Machine: Manual _____ Electric _____ Name _____
Full-Bank Adding Machine: Manual _____ Electric _____ Name _____
Mimeograph: Manual _____ Electric _____ Name _____
Duplicator: Manual _____ Electric _____ Name _____
Calculator: Name _____
Photocopy: Name _____
Posting Machine: Name _____
Dictaphone: Kind: _____
Others: _____ _____ _____

Do you prefer to train your own personnel in machine operation?

_____

Do you require a basic skill in machine operation?

_____

5. Do you have openings at present? _____

Do you see possibilities of openings in the near future? _____

How do you wish applicants contact your office for appointments? _____

When may applicants contact you? _____

6. What kinds of tests do you give applicants?
Skill: _____ Personality: _____
Publisher: _____ Publisher: _____

7. What are some of the personal traits that you think are most important? (Please check)

___	Tact	___	Social Attitude	Others: _____
___	Voice and Diction	___	Initiative	_____
___	Expression	___	Manners	_____
___	Sense of Humor	___	Good Grooming	_____

8. What is your approximate beginning salary? _____

9. What weaknesses have you found in the high school graduate on his or her first job? _____

10. Comments: _____

NAME OF BUSINESS: _____ EMPLOYER: _____

ADDRESS: _____ OFFICE HOURS: _____

KIND OF BUSINESS: _____ TELEPHONE NUMBER: _____

NOTE: Suggest this section be filled in before mailing so as to have name of business contacted.

NAME OF BUSINESS:
ADDRESS:
KIND:

EMPLOYER:
OFFICE HOURS:
TELEPHONE:

1. Jobs Available:
2. Duties Performed:
3. Skills Required:

4. Machines Used:

5. Openings: Yes No
6. Tests given:
7. Personal Traits Needed:
8. Salary:
9. Weaknesses of Former Employees:

10. Comments:

Contact: (letter, tel. person)

King High School
Tampa

APPENDIX

A PERMANENT RECORD OF VOE GRADUATES

The following is a facsimile of an 8" x 5" index card on which is kept pertinent information on one VOE student.

DOE, JANE 116 North Atlantic Avenue, Daytona Beach

Class of _____
Date of Birth _____

Business Subjects

Type 1 B
Shhd. 1 B
Bkkg. 1 A

VOE
Bus. Eng. B
Shhd. 2 B
Off P Sec A

Citizenship grade A
Total days absent 4

English C-B-B
Foreign Lang. B-C

Maximum shhd. Speed 100
Maximum typing speed 55

Comments: Fine attitude; dependable; works to capacity.

Employment: XYZ Corp. 6/15 - Steno-Clerk - $50 per week.

VOE Follow-up Survey:

Seabreeze High School
Daytona Beach

These are some of the advantages in keeping a permanent record of the VOE graduate on cards.

1. Provides a permanent record of VOE graduates.
2. The information is compact and easy to read.
3. A minimum of effort is required to compile the information.
4. If you are asked to give a job reference at some future time, recall is facilitated, particularly if a school picture is attached.
5. All the information called for on the fall State report is readily available.
6. Addresses for the State Follow-up survey are readily available.
7. One card will hold all the information on one student.

8. It is easy to keep information current

9. Records for an entire class take little space in the file box.

10. Cards are easy to handle.

11. Card records are easy to file and easy to find.

Cards for each class are alphabetized, then filed numerically under year of graduation, such as "1965, Class of," "1966, Class of," etc.

Appendix Q

VOE-DF

BUSINESS AND DISTRIBUTIVE EDUCATION SECTION
DIVISION OF VOCATIONAL, TECHNICAL, AND ADULT EDUCATION
STATE DEPARTMENT OF EDUCATION
TALLAHASSEE, FLORIDA 32304

DIRECTING TEACHER'S FINAL REPORT

School _____ City _____

County _____ Date Submitted _____

Directing Teacher _____

Teaching Certificate Number _____ Periods per day as directing teacher _____

Directing teacher educational services have been received by the following number of students:

Male _____ With secretarial career objective Male _____ With clerical career objective

Female _____ With secretarial career objective Female _____ With clerical career objective

1. Have you had individual conferences with Vocational Office Education students? Yes___ No ___ If yes, how many per student? ____ Please indicate how conferences were scheduled--regular basis, individual need or request, etc. Also, identify what you consider to be the major accomplishments and benefits from such conferences.

_____

_____

_____

_____

_____

2. List the ways in which you have cooperated with the guidance department.

_____

_____

_____

3. Submit with this report a sample copy of each form, record, etc. that you used as a directing teacher.

4. Please report what you consider to be your major accomplishments while serving as a directing teacher for Vocational Office Education.

_____

_____

_____

Appendix Q

Please identify program strengths and weaknesses as you visualize them in this approach.

List any recommendations you feel should be considered for further development of this approach.

(Directing Teacher)

(Principal)

(Date)

(Date)

STATE DEPARTMENT OF EDUCATION

Final Report of
Vocational Office Education
Classes

School _____ City _____ County _____

Instructor _____ Date Report Submitted _____ Teaching Certificate No. _____

List All Students Enrolled In Program During Year	Check Appropriate Columns								
	Curriculum							Course Work	
Name of Student	Secre-tarial	Clerical	Completed Course	Did not Complete Course	Dropped Out of School	Trans-ferred	Other*	Satis-factory	Unsatis-factory

Appendix S

FOLLOW-UP SURVEY OF VOCATIONAL OFFICE EDUCATION GRADUATES

School Year _____

1. Name of high school from which you graduated. _____

2. Age _____ 3. Are you married? Yes ___ No ___

4. Current employment status: (If you are now employed, check items in Column I.) (If you are unemployed, check items in Column II.)

COLUMN I

A. Are you gainfully employed?
Full-time __ Part-time __

B. What is your present position?
Stenographer __ Clerk-Typist __
Bookkeeper __ Other (write below)
Secretary __ _____

C. Approximately, what was your beginning weekly take-home pay? $35-40__ $41-45__ $46-50__ $51-55__ $56-60__

Have you received any salary increases? Yes __ No __

D. What is the specific business of your employer?
Insurance __ Sales __
Banking __ Telephone Co. __
Government __ Other (indicate)
_____

E. If you use a typewriter, check name of manufacturer:
Royal __ IBM __
Underwood __ Remington __
Smith-Corona __ Other _____ __
Electric __ Manual __

F. If you perform duties for which you were not trained, please list at least three you consider important.
1. _____
_____
2. _____
_____
3. _____
_____

COLUMN II

A. Are you seeking employment?
Yes ___ No ___

B. Have you applied for an office position in the last three months?
Yes ___ No ___

C. Why are you unemployed?
Inadequate training ___
Lack of jobs for which trained ___
Health Condition ___
Marriage ___
Continuing my education ___
No interest in office work ___
Other (Please list below)
_____
_____

D. If inadequate training is a reason for being unemployed, please explain why you feel this is so.
_____
_____
_____

E. Check the type of position for which you are prepared.
General Clerk __
Stenographer __
Typist __
Secretary __
Other _____

COLUMN I (cont'd)

G. What are your chances for promotion:

With additional training.

Good__ Fair__ Poor__

Without additional training.

Good__ Fair__ Poor__

H. If you are enrolled in school, answer item F in Column II.

COLUMN II (cont'd)

F. If you are continuing your education check the type of school you are attending.

Junior College
University __
Private Business School __
Public Vocational School __
Other _____

What is your major field of study?

_____

5. List all gainful employment since graduation from high school.

Position	Kind of Job	Length of Employment	Reason for Change
1			
2			
3			

6. Check one or more of the following methods used in securing your first full-time position.

Friends __
Family __
Personal Application __
Advertisement __
VOE Instructor
Other School Personnel __
Employment Agency __
Other _____

7. Your personal estimate of the value of VOE training.

In Column I check all VOE subjects or units you consider very valuable.
In Column II check all VOE subjects or units you consider of little value.
(Please feel free to add additional items and check in appropriate column)

	I	II	COMMENTS
Business English			
Shorthand			
Typewriting			
Adding Machines			
Calculators			
Transcribing Machines			
Calculators			
Transcribing Machines			
Mimeograph Duplicating			
Ditto Duplicating			
Telephone Usage			
Filing			
Office Procedures			
Personality Development			
Job Application			
Other _____			
_____			
_____			

8. Enter here any additional comments on the strengths and weaknesses of this program.

Strengths	Weaknesses

FOLLOW-UP OF GRADUATES OF VOCATIONAL BUSINESS AND DISTRIBUTIVE EDUCATION PROGRAMS

DCT_____
CBE_____
VOE_____
VE_____
ALD
MGMT._____

School Name _____ School Code No. _____ City _____ County _____ County Code No. _____

Teacher or Coordinator _____ Certificate No. _____ Date Report Submitted _____

		REPORT DATA AS OF OCTOBER 1 OF THE CURRENT YEAR										
		Number Not Presently Available for Placement			Employed or Available for Employment (Add columns 3, 4, & 5 and Subtract from Column 2)	Number Obtaining Full-Time Jobs						
Sex	Total Number Graduated as of June 30	Entered Armed Forces	Continued Full-time School	All Other Reasons		In Occupation for which Trained	In Field Related to Training	In Field not Related to Training	TOTAL Number Obtaining Full-Time Jobs (Add Col. 7,8, & 9)	Number Employed Part-Time	Number Unemployed	Number/Status Unknown
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)

Note: Students should not be reported in columns 7 through 13 that have been reported in columns 3, 4, and 5. Columns 10, 11, 12, and 13 should equal total of column 6.

Signature of Teacher or Coordinator _____ Signature of Principal _____ Signature of Director or Superintendent _____

PARTIAL BIBLIOGRAPHY

BIBLIOGRAPHY OF 79 INDIVIDUAL INSTRUCTIONAL MATERIALS

1. Alphabetic Indexing by Fisher. South-Western Publishing Company. Combination textbook--workbook which provides training in alphabetic indexing. Two weeks work.

2. Alphabetic Indexing by Guthrie. South-Western Publishing Company. Combination workbook--textbook that may be used for a short intensive basic course. Consists of 28 simple alphabetic and 2 achievement tests.

3. Applied Arithmetic Essentials by Mitchell and Reigner. H. M. Rowe Company. Combination textbook and workbook on basic arithmetic and its everyday applications.

4. Applied English Essentials by Reigner. H. M. Rowe Company. Combination textbook and workbook which develops and strengthens the use of good English.

5. Applied Penmanship by L. H. Lyon. South-Western Publishing Company. Combination textbook--workbook which contains penmanship drills, corrective drills, and diagnostic drills.

6. Applied Punctuation by Reigner. H. M. Rowe Company. Combination textbook and workbook on punctuation usage.

7. Automation Office Practice by Wanous and Wanous. South-Western Publishing Company. Textbook and practice set available. Designed to get a basic understanding of automated data processing. Five to six weeks of work.

8. Basic Typewriting Operations--Principles and Problems by Frank E. Liguori. A new kind of supplementary typewriting book with five sections.
   Section 1 - Basic Skill and Mastery Drills
   Section 2 - Centering
   Section 3 - Manuscript
   Section 4 - Business Letters
   Section 5 - Tabulation

9. Bookkeeping Charts by George F. Cram Company, 730 East Washington Street, Indianapolis, Indiana. Based on 20th Century Bookkeeping and Accounting Textbook. Available in three sets:
   Set #20 - Based on 20th Edition
   Set #21 - Based on 21st Edition
   Set #22 - Based on 22nd Edition

10. Business Filing and Records Control by Bassett - Agnew - Goodman. South-Western Publishing Company. Textbook and practice set available. Coverage of four basic correspondence filing systems--alphabetic, numeric, subject, and geographic.

11. Business Letter Typing by Bowman. South-Western Publishing Company. A paper-bound book which includes 24 letter models for further training in the mechanical preparation of business letters.

12. Business Machine Laboratory Manual by C. A. Swenson. William C. Brown Book Company, 135 South Locust Street, Dubuque, Iowa. A 244-page comprehensive business machines manual which contains complete instructions for operating 12 fully-illustrated types of machines, 1,000 approximate practice problems and 27 tests, and instructors' procedure guide when school adopts the manual.

13. Business Practice. South-Western Publishing Company Practice set that may be used for record keeping.

14. Can I Be An Office Worker. General Motors Corporation. A paper-bound booklet describing the job of office employees. A good promotional booklet.

15. Careers in Business Chart. South-Western Publishing Company. A good chart which can be used for promotional activities and student counselling.

16. Charm--The Career Girl's Guide to Business and Personal Success by Whitcomb and Lang. Gregg Division of McGraw-Hill Book Company. A new book on beauty, poise, personality, glamour, and style designed especially for young women planning careers. It contains many practical hints to help the career girl to become more attractive and an interesting appearing person. 72 pages.

17. Clerical Occupations for Women, Today and Tomorrow--1964. U. S. Government Printing Office, Washington, D.C. Bulletin #289. A report produced by the Department of Labor, Women's Bureau.

18. Clerical Practice and Record Keeping by Pendery. South-Western Publishing Company. Combination textbook--workbook that covers clerical procedures in payroll work.

19. Clerical Practice and Record Keeping by Kirk-Scott-Lurie. H. M. Rowe Company. A combination textbook--workbook giving drills in arithmetic, handwriting, and spelling. It also gives training in indexing and filing, payroll, and record-keeping of a small business office.

20. DDC Spelling Aid (Record)
Dictation Disc Company, 170 Broadway, New York, N.Y. 10038

21. Dictation Disc Sets (Record)
Dictation Disc Company. Each set contains:
1. Four 45 rpm records
2. 45 minutes dictation
3. Three different speeds
4. Instruction for speed development
5. Shorthand Achievement Progress Chart

BUSINESS LETTERS
Set 40-40, 50, 60
Set 400-50, 60, 70
Set 410-70, 80, 90
Set 42-80, 90, 100
Set 42-B-80, 90, 100
Set 420-90, 100, 110
Set 43-100, 110, 120
Set 44-110, 120, 130
Set 430-120, 130, 140
Set 440-130, 140, 150
Set 441-140, 150, 160

CHALLENGE SERIES
Set 52-50 to 160
Set 53-50 to 120
Set 54-80 to 150

BRIEF FORM AND PHRASE LETTERS
Set 38-60, 70, 80, 90
Set 380-100, 110, 120, 130

500 COMMONEST WORDS
Set 39-60, 70, 80, 90
Set 390-100, 110, 120, 130

5-MINUTE DICTATIONS
Set 450-60, 70, 80, 90, 100
Set 460-100, 110, 120, 130, 140
Set 462-100, 110, 120, 130

FOR BEGINNING SHORTHAND WRITERS
Gregg--from the new book
Set 480: Brief forms and phrases in letters
Graded and Cumulative 40 to 80
Set 481: Word beginnings and endings in letters
Graded and Cumulative 40 to 80
Set 482: Complete theory review 60 to 90

PITMAN-MASTERY REVIEW LESSONS
Set 64 - 40 to 60
Set 65 - 50 to 80
Set 66: Short forms and phrases in letters
Graded and Cumulative 50 to 90
Set 20: 20th Century Typewriting Records
Set 99: Typing to music 20 to 50

MISCELLANEOUS
Set 49 Reporting 130 to 180
Set 50 Legal 80 to 120
Set 51 Medical 80 to 120

22. Directed Homework in Gregg Shorthand by Young. Gregg Division of McGraw-Hill Book Company. New theory-drill workbooks used for supplementary aid for shorthand correlated for lesson-by-lesson use with Gregg Shorthand (Basic Manual) Diamond Jubilee Series. 144 pages.

23. Eleven inch by fourteen inch posters. Reprint Department, Today's Secretary, 330 West 42nd Street, New York, N.Y. 10036
Illustrates pictorially the qualities that make up the perfect boss and the perfect secretary. Ideal for bulletin boards in secretarial classrooms.

24. English The Easy Way by Norman Schacter. South-Western Publishing Company. Textbook--workbook on the use of correct English.

25. Essential Business Practice and Essential Business Forms by Charles G. Reigner. H. M. Rowe Company. A practical set for extra training in the preparation of business forms. Each unit in the 56-page book of instructions, describes one of the most often-used business forms, explains its purpose, and gives detailed directions for completion.

26. Ezerase Test Packet. Millers Falls Paper Company, Millers Falls, Massachusetts 01349. A free test packet is available for use in typing or secretarial practice when studying types of paper.

27. Filing Office Practice by Bassett-Agnew-Goodman. South-Western Publishing Company. Contains a set of 64 cards for filing, 256 names, and a set of 96 pieces of business correspondence.

28. Full-Keyboard Adding-Listing Machine Course by Agnew and Pasewark. South-Western Publishing Company. 20 jobs for instruction on standard manual and standard electric machines.

29. Gregg Shorthand Course for Speed Development. Dictaphone Corporation A set of 60 dictabelt records.

30. Gregg Typing Picture Posters. Gregg Supplies and Recordings Department, McGraw-Hill Book Company. Two sets are available. One, Gregg typing picture posters--personal typing series, and two, Gregg typing picture posters--letter style series.

31. Gregg Typing Wall Chart. Gregg Recordings and Supplies Department-McGraw-Hill Book Company. A king-size wall chart that doubles as a projection screen.

32. How to Find and Apply For A Job by Keily and Walters. South-Western Publishing Company. An 84-page paper-bound book containing such topics as (1) First step in selling yourself: Personal Inventory, (2) Discovering your opportunities, (3) Selling yourself in a personal interview, (4) Promoting and selling by your application blank, and (5) Selling your services by a letter of application.

33. How to Find the Right Secretarial Job. Today's Secretary. a 64-page step-by-step guide to job satisfaction and personal contentment.

34. How to Punctuate a Business Letter by Edward Kramer. Pitman Publishing Corporation. A pocket-sized paper-bound booklet giving rules on punctuation.

35. How to Use Adding and Calculating Machines by Walker-Roach-Hanna. Gregg Division of McGraw-Hill Book Company. 250 Pages

36. How to Write Effective Reports by Addison-Wesley Publishing Company, Inc., Reading, Massachusetts. A self-teaching programmed text which probably would be used on a limited basis.

37. Human Relations (Booklets). Enterprise Publications, 20 North Walker Drive, Chicago, Illinois 60606. Twenty 16-page booklets. Titles of interest: Everyday human relations
A tale of four companies
How you communicate accidentally
The high cost of a blabber mouth
What gives a business organization vitality?

38. Instant Spelling Dictionary. Career Institute, 30 East Adams, Chicago, Illinois 60603. 320 pages, 4 x 6 inches, 25,000 words, spelled, divided, and accented.

39. Intensive Clerical and Civil Service Training by Fisher. South-Western Publishing Company. Combination textbook-workbook and tests to prepare students to take jobs in business and to pass civil service examinations.

40. Job Study Guides. University of Minnesota and the University of Ohio. Available from Nicholson Hall Bookstore, University of Minnesota, Minneapolis, Minnesota.

(1) OF-1 File Clerk
(2) OI-1 Insurance Secretary
(3) OL-1 Legal Secretary
(4) OM-1 Mailing Clerk
(5) OP-1 Payroll Clerk
(6) OT-1 Tabulating Clerk
(7) OA-1 Advertising Office Stenographers
(8) OB-1 Bank Office Worker (General)
(9) OD-1 Dental Assistant (Office)

41. Key-Driven Calculator Course by Agnew and Pasewark. South-Western Publishing Company. 60 jobs for instruction for Burroughs Calculators, the Comptometer and the Plus Calculator.

42. Machine Office Practice by Agnew. South-Western Publishing Company. Contains 40 different jobs using business forms such as checks, sales slips, deposit tickets, invoices, and time cards. For use with any adding or calculating machine after the student obtains reasonable operating skill.

43. Mathematics Skill Builder by Briggs. South-Western Publishing Company. Workbook that provides a thorough review of the fundamentals of mathematics.

44. Medical Secretary Course for Speed Development. Dictaphone Corporation. A set of 10 dictabelt records.

45. Office Career Notebook by Bernard M. Ohm and Dr. Ralph E. Mason. Interstate Printers and Publishers Inc., Danville, Illinois 61834. A notebook which may be used by each student enrolled in vocational on-the-job business education program, that will acquaint them with their business.

46. Office Machines Course by Agnew and Cornelia. South-Western Publishing Company. 10 jobs for full-keyboard adding-testing machines, 10 jobs for ten-key adding-listing machines, 15 jobs for rotary calculators, and 15 jobs for key-driven calculators.

47. Office Practice For Typists. H. M. Rowe Company. A short course--31 assignments--giving students an opportunity to improve their typing skills on true-to-life office problems.

48. Office Typing. H. M. Rowe Company. A set consisting of a textbook and envelope of working materials for typing true-to-life office jobs.

49. Opportunities in Office Occupations by Estelle L. Popham, Vocational Guidance Manuals. Educational Books Division of Universal Publishing and Distributing Corporation, 800 Second Avenue, New York, N.Y.

50. Programmed Business Mathematics by Harry Huffman. Gregg Publishing Division of McGraw-Hill Book Company.

51. Programmed Instruction Units. Argyle Publishing Corporation, 605 Third Avenue, New York, N.Y. 10016. Units included are:
    (1) Improving Your Written Communication
    (2) Methods Improvement in Work Controls
    (3) The Secretary--Jill of All Trades
    (4) Understanding Public Relations
    (5) Introduction to PERT
    (6) Cutting Office Costs
    (7) Application on Reliability Techniques
    (8) Selling to Business and Industry
    (9) Conducting Employee Interviews

52. Projects in Clerical Practice by Goodfellow and Rosenberg. South-Western Publishing Company. Textbook-workbook containing 6 projects involving writing checks, keeping purchases invoice register, taking stock, calculating, tax deductions, preparing cash register tallies, reports of past-due accounts, alphabetic and numerical indexes, daily and periodic summary sheets for salesmen and handling complaints and making adjustments.

53. Record Keeping For Small Businesses. South-Western Publishing Company. A complete, self-contained bookkeeping outfit emphasizing record keeping for small businesses--36 hours of work.

54. Reference Manual For Office Employees by Larson and Koebele. South-Western Publishing Company. 150-page paper-bound book that is reasonable for all students. Covers topics such as mail, style letters, capitalization, care of typewriter, abbreviations, and punctuation.

55. Resources for Office Education Programs. U. S. Government Printing Office, Washington, D. C. A ready source of information listing films, filmstrips, major publications, periodicals, and supplementary materials.

56. William A. Roberts, M. D. Practice Set by Palmer and Archer. Gregg Division of McGraw-Hill Book Company. Realistic, up-to-date Medical practice set for first term accounting students. Materials designed to take about 25-30 hours.

57. Rotary Calculator Course by Agnew and Pasewark. South-Western Publishing Company. 30 jobs for manual, electric semi-automatic, and fully automatic calculators.

58. Rowe Filing Practice Set. H. M. Rowe Company. A set consisting of an instruction book, a file box, and an envelope of miniature letters and cross reference sheets that teaches both alphabetic and geographic filing.

59. Shorthand Transcription Studies by Balsley and Wanous. South-Western Publishing Company. Textbook that leads the student from simple to complex matter.

60. Specialized Dictation Tapes for Medical Secretaries, Gregg Division of McGraw-Hill Book Company. The set consists of ten dual-track one-hour reels of skill-building tapes for training medical secretarial students.

61. Spelling Drills and Exercises by Brendel and Near. Gregg Division of McGraw-Hill Book Company. A new programmed-style book containing fifty 15-minute lessons for a thorough review of spelling principles.

62. Statistical Typing by Wanous. South-Western Publishing Company. Recommended for special emphasis in tabulating. Well-planned with special review drills followed by exercises which emphasize special problems in centering and tabulating.

63. Successful Devices for Teaching Shorthand by Wayne A. Alston. J. Weston Walch Co., Box 1075, Portland, Maine.

64. Sustained Timed Writings by Grubbs and White. Gregg Division of McGraw-Hill Book Company. A book of 46 timed writing selections.

65. Ten-Key Adding-Listing Machine and Printing Calculator Course by Agnew and Pasewark. South-Western Publishing Company. 30 jobs for instruction on the standard manual, the standard electric, the automatic multiplier, and the printing calculator.

66. 300 Commas by Leonard J. West. Gregg Publishing Company. A new programmed book that presents in step-by-step sequence the major use of the comma. 112 pages.

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ABSTRACT - Content and teaching methods, including job skills, mechanical procedures, and technical and related information, are provided for these 22 variety store merchandising areas: (1) household utensils, (2) chinaware, (3) glassware, (4) tableware, (5) linens, (6) bedding, (7) notions and yard goods, (8) draperies, curtains, and upholstery, (9) floor coverings, (10) paint, wallpaper, and hardware, (11) paper and related products, (12) natural and synthetic rubber, (13) plastic products, (14) leather goods, (15) cosmetics, (16) jewelry, (17) clothing accessories, (18) lingerie, (19) ladies' outerwear, (20) men's and boy's wear, (21) sporting goods, and (22) toys and games. Assignments, keyed to each unit and designed to develop the student's personal-social traits for the job skills and procedures, contains introductory information, the assignment, reference sources, and study questions. (SB)

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VARIETY STORE MERCHANDISING

A Course of Study

Designed for
Cooperative Part-Time Students
Employed in Variety Stores

VT 010619

ED0 45856

FOREWORD

This course of study is a temporary printing supplied to Missouri coordinators for immediate use in the 1967-68 school year. It will be edited and printed by the Industrial Education Department of the University of Missouri and made available for purchase. This source will replace the State Department of Education.

This course of study was prepared by Duaine Hodges, Coordinator of Riverview Gardens. It is a revision of the one printed by the University of Missouri in 1960. The reference books have been changed, but the assignments are basically the same. One exception is the omission of the last four assignments which were actually taken from a food service course of study.

We acknowledge the cooperation of Dr. H. H. London, Dr. James Karnes and the Riverview Gardens School officials for their cooperation in the writing and printing of this course of study.

Lester B. Kesterson, Director
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INTRODUCTION

In preparing this course of study it has been assumed that the attainment of occupational competency in any type of work involves three different, yet closely related, types of learning. They are:

1. Mastery of the practical job skills and mechanical procedures performed by the worker in a distributive occupation.

2. Comprehension of the technical and related information basic to an understanding of human nature, sales techniques, and merchandise information.

3. Development of those personal-social traits which are essential for the successful worker.

The first group of the "learning units"--the job skills and mechanical procedures--has been arranged in the analysis under the heading of "Job Training". Since the duties performed in the selling of merchandise are fundamentally the same, the items in "What The Worker Should Be Able to Do" are repeated for each section of the analysis. These can best be learned through supervised work on the job. The school class of distributive students engaged in retailing can develop a fundamental understanding and practice these skills as a group, but the actual application of theory can best be developed in the job selling situations.

The second group of "learning units"--technical and related information--has been limited to merchandise information, and is included in the analysis under the heading of "Related Information". The techniques and principles of selling and an understanding of customer buying problems are to be taught from another course of study by group methods. Merchandise information can best be learned on an individual basis. Therefore, the school can make a major contribution to occupational competency by assuming the responsibility of teaching the contents of this course of study under the supervision of the coordinator in the classroom.

The third group of "learning units"--personal-social traits--can be acquired only through practicing them during the process of acquiring skills and information in one's daily conduct. Therefore, both the employer and the school, as well as the home, must assume responsibility for developing in the student-worker those habits, attitudes and character traits which are essential for success in his occupation and in life. Both the employer and the school should be constantly on the alert to see that the student-worker places desirable interpretations on his experiences, and that he does not practice habits or exhibit character traits detrimental to his success.

Since the coordinator's class will be made up of fifteen or more students, each employed in a different type of retail establishment, it will be impossible for him to teach, through group methods, the merchandist information which each student specifically needs. In order to be most effective, this type of instruction must be individualized. The twenty or more categories of merchandise included in this study guide

may actually be sold by student-learners in a variety of retail stores such as variety, general merchandise, drug, department, or even supermarkets. Therefore, the specific merchandise determines the information needed, and not a specific store. This means that this study guide may be used by student-learners working part-time in any of the various types of retail outlets.

Students in distributive occupations obviously have much to learn about general retailing, business organization, etc., as well as such topics as workmen's compensation, wage-hour laws, unemployment insurance, employer-employee relations, and income tax withholdings. All of these can be taught effectively by group methods. However, a major contribution to the in-service vocational education of student-learners can be made by the coordinator who devotes a sizable portion of his classroom instruction to individualized study of merchandise information specifically related to the work of the student-learner.

The assignments in this study guide have been prepared with this point of view. Each assignment has introductory paragraphs which attempt to arouse an interest in the subject, emphasize the importance of the study, and briefly outline exactly what is included in the assignment. Provision has been made for more extensive study of each division of merchandise through the specific suggestions in the assignments which provide readings, objective-type study questions, and projects that will expand the student-learner's knowledge of the merchandise.

Obviously, it is desirable to teach the related information in the school at the time it will be used most advantageously on the job. This requires a selection of assignments by the coordinator and the student to parallel the student's job experience. The assignment sheets are easily used this way because they are not cumulative in nature. It is obvious that a coordinator cannot know the facts about all merchandise. Therefore, his job will be to serve as a supervising study teacher who motivates, assists, and checks the progress of the student by the use of the key to the questions which is provided to accompany the study guide.

In selecting books for this course of study an effort has been made to restrict the number to an adequate coverage of the material. The three references are used to cover the 22 assignments. And numbers in parenthesis indicate the number of assignments that use each reference. Facts About Merchandise is used for assignments 2, 3, 4, - 6, 7, 9, 10, - 15, 16, - 21, 22. Know Your Merchandise is used for assignments 1, 2, 3, 4, 5, - 8, 9, - 11, 12, 13, 14, 15, 16, 17, 18, 19, 20. Textile Fabrics and Their Selection is used for assignments 5, 8, 9, 17, 18, 19, 20.

The key to the study guide has been prepared to enable the coordinator to score quickly the objective questions which are a part of each assignment sheet. The key sheets provide the correct answers, the reference and the page in the reference that answers the questions. The key should be kept by the coordinator and the questions of the assignments used as study questions rather than as tests.

TO THE STUDENT WORKER

Successful selling of any merchandise requires the salesperson to master four general aread of information. One of these is merchandise information. Just as an insurance agent or an automobile salesman must be able to explain his product, so must the salesperson be responsible for presenting any item requested by a customer. Today's customers are often well informed, and expect to talk with a well-informed salesperson. On the other hand, many customers must rely heavily upon the salesperson to help them make a wise choice. Therefore, an extensive technical knowledge of merchandise is required.

Two other areas of information are the sales process and customer nature. Some authorities add a fourth--self-understanding. Certainly all four are fundamental to success in a distributive occupation.

Opportunities in Retailing

About eight million people are employed in selling positions. Less than half of these are actually in retailing jobs, but most of those in the better-paying positions used a retail selling job as a steppingstone. The rapid increase in population and the productive power of industry are combining to provide an ever-increasing variety of merchandise and a growing market of consumers. This means a growing demand for good trainees to enter the field of distribution. Industry must have highly efficient salesmen to compete in the distribution of its manufactured products, and retail establishments can survive only with skilled employees.

Beginning wages are usually less attractive than assembly line jobs, but the chances for promotion and the security of job opportunities for trained salesmen can result in salaries running into five figures. Unionization, prestige, and fringe benefits are increasing, and an attractive goal of executive or department head is possible for many ambitious young salespeople.

Requirements for Retailing

A broad general education on the high school level is a minimum requirement in most desirable positions. The growing complexity of retailing is demanding some training in business subjects. This training may be obtained through part-time distributive programs, adult evening classes, or business courses in college. The more vocational education acquired through these sources, the better the chances for advancement on the job. Courses in marketing, retailing, merchandising, advertising, business management, and psychology are considered beneficial to occupational competency in selling.

Personal Qualifications of Retail Salespeople

The interrelationship of our present society demands much from individuals in any line of work as to personal-social qualities, but

this is even more significant in selling positions. Customers immediately judge a salesperson by his personality that shows in a short period of time. Therefore, satisfaction and success in a retailing position will depend upon the cooperative attitude and feeling of respect of both fellow workers and prospective customers.

Many personality traits can be improved, but the first essential is to know what traits are desirable. Some of those ranking as very important for selling are the following

Mental traits. Accuracy, alertness, enthusiasm, initiative, judgment, memory, and ambition.

Social traits. Sincerity, courtesy, cheerfulness, friendliness, cooperation, tact, tolerance, sympathy, and refinement.

Physical traits. Health, posture, speech, grooming, and industry.

Character traits. Honesty, loyalty, dependability, integrity, and morality.

Salespeople deal with money, people, and valuable merchandise, and they determine an employer's profits by their display of personal-social traits. Therefore, these traits should be developed to the finest degree by every retail selling employee.

REFERENCES FOR VARIETY STORE MERCHANDISING

1967 Edition

References for Assignments 1-22

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*Frequency of use in assignments

ANALYSIS OF VARIETY STORE MERCHANDISING

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	Household Utensils	
1. Prepare displays	1	1. Material used in making utensils and their advantages
2. Demonstrate household utensils		
	1	3. Types of pots and pans
4. Emphasize special features and qualities of household utensils		
	1	5. Care of utensils
6. Present household utensils	1	6. Types of cutlery and gadgets
	1	7. Varieties of electrical appliances and their care
	1	8. Techniques of selling household utensils
9. Suggest related items		
	Chinaware	
10. Display chinaware	2	10. Types of dishes
	2	11. Materials used in dishes
12. Emphasize special features and qualities of chinaware		
13. Present chinaware		
	2	14. Processes in making dishes
	2	15. Care of ceramic wares
16. Suggest related items	2	16. Techniques in selling chinaware

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	Glassware	
17. Display glassware		
	3	18. Composition of glass
	3	19. Types of glassware
20. Emphasize special features and qualities of glassware	3	20. Qualities of glassware
	3	21. Steps in glass making
22. Present glassware	3	22. Principles of selecting glassware
	3	23. Uses of glassware
	3	24. Care of glassware
	3	25. Techniques of selling glassware
26. Suggest related items		
	Tableware	
27. Display tableware		
	4	28. Nature of materials
	4	29. Methods of silver plating
30. Emphasize special features of tableware	4	30. Types of tableware
	4	31. Processes in making tableware
32. Present tablewares		
	4	33. Importance of design and finish on tableware
	4	34. Care of silverware and stainless steel
	4	35. Techniques of selling tableware
36. Suggest related items		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	Linens	
37. Display linens		
38. Demonstrate linens		
	5	39. Classification of towels
	5	40. Qualities and construction of towels
41. Emphasize special qualities of linens	5	41. Materials, sizes and types of table and novelty linens
	5	42. Materials and processes in making shower curtains
43. Present linens		
44. Suggest related items		
	Bedding	
	6	45. Wearing quality of sheets; sizes, styles and brands of sheets
46. Prepare displays		
47. Demonstrate bedding		
	6	48. Linen sheets and sheeting
	6	49. Care of sheets and pillowcases
50. Emphasize special features of bedding		
	6	51. Materials used for mattresses
	6	52. Care of mattresses
53. Present bedding		
	6	54. Qualities and types of blankets

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know.
	6	55. Care of blankets
	6	56. Fillings, coverings and design of comforters
57. Suggest related items		
	6	58. Types of pillow materials and their advantages
	6	59. Principles of selecting bedspread
Notions and Yard Goods		
60. Prepare displays		
	7	61. Types of laces and their use
	7	62. Styles of laces
63. Demonstrate notions and yard goods		
64. Emphasize special features of notions and yard goods	7	64. Characteristics of yard goods materials
	7	65. Types of closet accessories
	7	66. Types of hair goods
	7	67. Types of sewing aids
68. Present notions and yard goods		
69. Suggest related items		
	7	70. Techniques of selling notions
	7	71. Techniques of selling yard goods

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Draperies, Curtains and Upholstery		
72. Prepare displays		
	8	73. Meaning and importance of design in home decorations
	8	74. Essentials of harmonious ensemble
	8	75. Classifications of draperies and curtains
76. Demonstrate uses of draperies, curtains, and upholstery		
	8	77. Materials used in making draperies and curtains
	8	78. Care of draperies and curtains
79. Emphasize special features and qualities of draperies, curtains and upholstery		
	8	80. Types and qualities of upholstery
	8	81. Care of upholstery
	8	82. Nature of tapestry
Floor Coverings		
83. Prepare displays		
84. Demonstrate types of floor coverings		
	9	85. Consideration when selecting floor coverings
	9	86. Types of rug construction
	9	87. Color and design of rugs
88. Emphasize special features of floor coverings	9	88. Judging quality of rugs
	9	89. Care of rugs

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	9	90. Linoleum, felt-base and asphalt tile coverings
91. Present floor coverings		
	9	92. Techniques of selling rugs
93. Suggest related items		
	9	94. Techniques of selling linoleum and asphalt tile
Paint, Wallpaper and Hardware		
95. Prepare displays		
96. Demonstrate paint, wallpaper and hardware		
	10	97. Types and composition of paints
	10	98. Uses of paint
	10	99. Techniques of selling paint and painting accessories
	10	100. Design and composition of wallpaper
	10	101. Techniques of selling wallpaper
102. Emphasize special features of paint, wallpaper and hardware		
103. Present paint, wallpaper and hardware		
104. Suggest related items		
	10	105. Sizes, types and uses of nails
	10	106. Types of bolts, nuts and screws
	10	107. Types of household hardware items
	10	108. Techniques of selling hardware

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
Paper and Related Products		
109. Prepare displays		
110. Demonstrate paper and related products	11	110. Uses of paper materials
	11	111. Variations in paper
112. Emphasize special features and qualities of paper	11	112. Composition of paper
	11	113. Preparation of paper
	11	114. Characteristics of pencils and fountain pens
115. Present paper and related products		
	11	116. Nature of ink
	11	117. Kinds of school supplies
118. Suggest related items		
	11	119. Techniques of selling paper and paper products
Natural and Synthetic Rubber		
120. Prepare displays		
	12	121. Source and processing of natural rubber
	12	122. Types of synthetic rubber
	12	123. Manufacture of rubber
124. Demonstrate rubber products	12	124. Articles made from rubber
125. Emphasize special features and qualities of rubber products		

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
126. Present rubber products		
	12	127. Care of rubber
	12	128. Techniques in selling rubber products
129. Suggest related items		
Plastic Products		
130. Prepare displays		
131. Demonstrate plastic products		
	13	132. History of plastics
	13	133. Types of plastics
	13	134. Ingredients in plastics
	13	135. Procedures for shaping plastics
136. Emphasize special features of plastic products	13	136. Qualities of plastics
137. Present plastic products		
138. Suggest related items		
	13	139. Uses of plastic materials
	13	140. Care of plastics
	13	141. Techniques in selling plastic items
Leather Goods		
142. Prepare displays		
	14	143. History of leather
	14	144. Methods of tanning

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	14	145. Finishing methods used on leather
	14	146. Classification of animal hides used for leather
147. Emphasize special features and qualities of leather goods	14	147. Characteristics of various types and classes of leather
148. Present leather goods		
149. Suggest related items		
	14	150. Care of leather goods
	Cosmetics	
	15	151. Federal regulations of cosmetics
	15	152. Nature of allergies
153. Prepare displays		
154. Demonstrate cosmetics		
	15	155. Effects of cosmetics on the skin
	15	156. Chemistry of cosmetics
	15	157. Types of soaps
158. Emphasize special features and qualities of cosmetics		
159. Present cosmetics		
160. Suggest related items		
	15	161. Characteristics of shampoos
	15	162. Functions of bath salts and water softeners
	15	163. Values of dentrifices

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	15	164. Uses of deodorants, antiseptics and depilatories
	15	165. Types of facial creams
	15	166. Types of lotions
	15	167. Types of powders, rouge and lipsticks
	15	168. Varieties of hair cosmetics
	15	169. Varieties of eye makeup and nail preparations
	15	170. Composition of perfumes
	15	171. Techniques of selling cosmetics
	Jewelry	
172. Prepare displays		
173. Demonstrate jewelry		
	16	174. Types of metals in jewelry
	16	175. Procedures in making jewelry
	16	176. Types of stones in jewelry
	16	177. Procedures for cutting stones
178. Emphasize special features and qualities of jewelry		
179. Present jewelry		
180. Suggest related items		
	16	181. Types of jewelry
	16	182. Care of jewelry
	16	183. Techniques of selling jewelry

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION What the Worker Should Know
Clothing Accessories		
184. Prepare displays		
	17	185. Types of millinery materials
	17	186. Types of gloves
	17	187. Care of gloves
188. Demonstrate clothing accessories		
189. Emphasize special features and quality of clothing accessories		
	17	190. Types of handbags
	17	191. Styles of shoes
192. Present clothing accessories		
	17	193. Materials used for shoes
	17	194. Care of shoes
195. Suggest related items		
	17	196. Neckwear, trimmings and handkerchiefs
	17	197. Techniques for selling clothing accessories
Lingerie		
198. Prepare displays		
199. Emphasize special features and qualities of lingerie	18	199. Types and styles of undergarments
	18	200. Types of hosiery and their characteristics
	18	201 Guides for selection of hosiery

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
202. Present lingerie		
	18	203. Care of hosiery and lingerie
	18	204. Characteristics of materials used in lingerie
205. Suggest related items		
	18	206. Techniques in selling lingerie
Ladies' Outerwear		
	19	207. Types and characteristics of women's coats and suits
208. Prepare displays		
209. Demonstrate ladies' outerwear		
	19	210. Sizes and styles of dresses
	19	211. Types of sportswear for women
	19	212. Fashion factors in garments
213. Emphasize special features of ladies' outerwear		
214. Present ladies' outerwear	19	215. Types of fabric in women's and girls' outerwear
	19	216. Points to consider when selecting fabrics
217. Suggest related items		
	19	218. Requirements of good garment construction

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
	Men's and Boys' Wear	
	20	219. Types of shirts and their sizes
	20	220. Appearance and durability of shirts
221. Prepare displays		
222. Demonstrate men's and boys' wear		
223. Emphasize special features of men's and boys' wear		
	20	224. Sizes and types of underwear
225. Present men's and boys' wear		
	20	226. Types of ties
227. Suggest related items	20	227. Nature of accessories for men's clothing
	20	228. Types of suiting materials
	20	229. Selection of topcoats, overcoats, ulsters
	20	230. Proper dress for various occasions
	20	231. Techniques of selling men's and boys' wear
	Sporting Goods	
232. Prepare displays		
233. Demonstrate sporting goods		
	21	234. Varieties of game equipment
	21	235. Varieties of picture equipment
	21	236. Varieties of sports equipment

JOB TRAINING: What the Worker Should Be Able to Do	Assign. No.	RELATED INFORMATION: What the Worker Should Know
237. Emphasize special features and qualities of sporting goods		
238. Present sporting goods		
239. Suggest related items		
	21	240. Techniques in selling sporting goods
Toys and Games		
	22	241. Types of toys suitable for various ages of children
242. Prepare displays	22	242. Principles of displaying toys and games
243. Demonstrate toys and games		
244. Emphasize special features of toys and games		
	22	245. Purposes of book classification
	22	246. Methods of advertising toys
247. Present toys and games	22	247. Techniques of selling toys and games
248. Suggest related items		

Assignment
Sheet No. 1

Covering
Units 1-9

HOUSEHOLD UTENSILS

The "good old days" that grandmother may talk about had no kitchen blessed with electrical gadgets, fancy cutlery, and attractive cooking utensils of this modern day. Grandmother did it the "hard way" compared to the young bride of today just recently showered with gifts too varied to mention.

The salesperson in utensil selling has to know much more than how to wrap an odd-shaped object. They must inform and advise both old experienced and young innocent purchasers, as to the qualities and uses of a host of kitchen utensils.

In this assignment you will study the materials used in utensils, the types of pots, pans, and cutlery, the care of and selling points about these kitchen tools.

Assignment:

1. Read the references listed below.
2. Confer with your coordinator as to the availability of the National Retail Hardware Association's pamphlets entitled Housewares and Electrical Housewares and Gifts. If available, make plans to study these with the aid of the assignments prepared for them or the assistance of your coordinator.
3. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study, to extend your knowledge of this merchandise.
4. Answer the questions below. Turn these answers in to your instructor by _____.

References:

A. Wingate, Gillespie and Addison, Know Your Merchandise, pp. 540-557.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. The most useful metal in the production of cooking utensils is aluminum.

T F 2. Iron cooking utensils heat slowly and evenly.

T F 3. The iron cooking utensil that is used constantly and cared for properly will still rust easily.

T F 4. The process of seasoning an iron pan involves the removal of a coating of lacquer.

T F 5. Foods scorch more easily in cast iron than in sheet iron pans.

T F 6. Food poisoning is commonly caused from the chromium plating being worn off of cast iron pots.

T F 7. Steel is unlike iron in that it will not rust.

T F 8. Stainless steel is affected by the food acids found in citrus fruits.

T F 9. Copper conducts heat better than stainless steel.

T F 10. Heavier enamelware wears better than light enamelware.

T F 11. The enamel on the surface of pans will crack and chip very much like glass does.

T F 12. Thick, heavy-constructed aluminum pans are cheap constructions that are not desirable as cooking utensils.

T F 13. Aluminum utensils should be thoroughly cleaned with strong soap at frequent intervals.

T F 14. Tin used in a body of a tin can has a very high melting point to provide for cooking of the contents in the can.

T F 15. A gold coated lining of a tin can is a coating of enamel that prevents sulphur from discoloring the tin.

T F 16. Block tinware is a more expensive product than ordinary coated lids and pans.

T F 17. Tin pans are quite desirable as frying pans because tin will not melt at 500 degrees.

T F 18. Silicone and Teflon are chemical coverings for pots and pans to prevent food from sticking.

T F 19. Glassware needs to be preheated before placing upon a high flame.

T F 20. Pots and pans are essentially the same type of cooking utensil but there is a distinct difference between them.

T F 21. The saucepots are available in larger sizes than saucepans.

T F 22. A spider is an oval-shaped pan with a bail.

T F 23. A black bottom iron skillet wastes more heat than a shiny bottom stainless steel skillet.

T F 24. Metal scrapers are very effective in the cleaning of plated articles.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A Dutch oven is made of a smelted iron ore known as _____ iron.
2. Two metals used to provide a silvery plated finish on cast iron pans are _____ and _____.
3. A garbage pail covered with zinc is called a _____ iron pail.
4. Steel is better than iron because it has had _____ added.
5. Copper is undesirable as a cooking utensil because it gives the food a _____ flavor.
6. The metal which serves as a basis for enamelware is _____.
7. Enamel is a substance quite similar to glass and _____.
8. The two processes involved in coating enamelware are dipping and _____.
9. Enamelware of the best quality has been dipped _____ times.
10. A dark gray enamelware pan has only _____ coating of enamel.
11. The use of aluminum for common cooking purposes began about _____ years ago.
12. The two most desirable qualities of aluminum are _____ and _____.
13. The two serious changes of shape in aluminum pans are dents and _____.
14. Discoloration on aluminum can be removed by a solution of _____.
15. Pitting of aluminum may be due to the presence of food and hard _____.
16. The main purpose of tin on the surface of a steel can is to prevent _____.
17. The stains on a tin cooking utensil may be removed by boiling in a solution of washing _____.
18. Acids of apples will not attack the tin of a tin pan unless it is _____.

19. Two trade names of glassware are _____ and _____.

20. Pots and pans are abbreviations for _____ and _____.

21. Pots and pans that may be used as double boilers, casseroles, baking dishes, etc., are called _____ pots and pans.

22. Kettles have a handle which is called a _____.

23. The lid of a chicken fryer is provided to permit _____ of food.

24. Griddles have a very small ridge around the _____.

25. The best cutting knives have blades made of high content _____ steel.

26. A _____ knife is a short, thin-bladed knife used for peeling and sectioning vegetables and fruits.

27. A knife with serrated edge is used in cutting bread to prevent _____ of the bread.

28. A hot meat knife is either a _____ knife or a French cook's knife.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. A spider is a (A) kettle; (B) teakettle; (C) griddle; (D) skillet.

_____ 2. A pan that is usually quite shallow is a (A) roasting; (B) utility; (C) cake; (D) chicken fryer.

_____ 3. A coffee pot that makes use of a perforated cup called a "coffee well" is the (A) dripolator; (B) Silex; (C) percolator; (D) casserole.

_____ 4. Knife blades that cut the best have been (A) stamped; (B) forged; (C) milled; (D) filed.

_____ 5. The part of the knife that fits into the handle is the (A) tine; (B) Serrate; (C) bolster; (D) tang.

_____ 6. A knife with a serrated blade is the (A) spatula; (B) butcher; (C) bread; (D) utility.

_____ 7. A metal used for construction of sinks is (A) wrought iron; (B) monel metal; (C) ductile metal; (D) rolled steel.

_____ 8. The process of shaping metal by heating and hammering is (A) smelting; (B) burnishing; (C) forging; (D) casting.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The substances used on iron cookingware to prevent rusting are:

   (A)_____ (B)_____ (C)_____

2. The metals found in the alloy of the stainless steel are:

   (A)_____ (B)_____ (C)_____

3. Four desirable features of enamelware are:

   (A)_____ (C)_____

   (B)_____ (D)_____

4. Five desirable features of cooking in glass are:

   (A)_____ (D)_____

   (B)_____ (E)_____

   (C)_____

5. The foods that are commonly cooked in double boilers are:

   (A)_____ (C)_____ (E)_____

   (B)_____ (D)_____

6. The advantages of heavier pans are:

   (A)_____ (C)_____

   (B)_____ (D)_____

7. The advantages of the flat-bottom, straight-sided pans are:

   (A)_____ (B)_____ (C)_____

8. The features of pans that save work in cleaning are:

   (A)_____ (C)_____

   (B)_____

9. The mistakes in design of the handles in the construction of pots and pans are:

   (A)_____ (D)_____

   (B)_____ (E)_____

   (C)_____

10. Cuttery items other than knives are:

(A)_____ (E)_____

(B)_____ (F)_____

(C)_____ (G)_____

(D)_____ (H)_____

ERIC

Assignment
Sheet No. 2

Covering
Units 10-16

CHINAWARE

The old saying, "like a bull in a china shop", has a meaning for the salespeople of chinaware. Unless they know the facts about china and can present them to the customer, salespeople can be as destructive to sales as the bull was to the china. Chinaware effectively described to the customer results in pleasing profits to the company and lifelong joy of ownership to the customer.

This assignment provides fundamental information about terminology, construction, decorations, uses and care of chinaware.

Assignment:

1. Read the references listed below.
2. Prepare an alphabetical list of terms used in this study of chinaware and be sure you can define the terms if requested by your coordinator.
3. Ask your coordinator about the possibility of obtaining a free rental film for those of you who are interested in this merchandise. The Distributive Education Bibliography Supplement suggests some of these for china, on page 129.
4. Check with your coordinator as to the availability of The Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study to extend your knowledge of this merchandise.

5. Answer the questions below. Complete items two and three and turn in this assignment by _____.

References:

A. Wingate, Gillespie and Addison, Know Your Merchandise, pp. 558-578.
B. Prentice-Hall, Inc., Facts About Merchandise, pp. 149-157.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Few customers are actually familiar with the qualities of earthware, chinaware or plasticware.

T F 2. Pottery and ceramics are general words referring to any dishes or other products made from clay and baked.

T F 3. The more expensive and durable dishes, although the most fragile looking, are called earthenware.

T F 4. Non-porous china or pottery may be unsanitary due to chips.

T F 5. Bone china is made all over the world while earthenware is made almost exclusively in England.

T F 6. Melarmine or plastic dishes were accepted by the public shortly after the turn of the century.

T F 7. Coloring materials used to color clay or to apply designs on ceramic products are metallic oxides.

T F 8. Slip is the term applied to the impurities removed from the clay.

T F 9. The kiln is an oven in which molded clay is baked.

T F 10. The higher the temperature in the oven the more durable, less porous, and finer the finished ware will be.

T F 11. Crack or "craze" is caused by exposing chinaware to extremely hot water.

T F 12. Decorations on ceramic dishes may be applied while dishes are being shaped, after the first firing or after the second firing.

T F 13. Lustware is the result of using silver or copper or some other metallic substance in the glaze.

T F 14. Underglaze decoration is usually limited to a few colors in the design.

T F 15. Second grade includes ware with noticeable defects that are not marketable.

T F 16. Run-of-the-kiln is a common grade or classification that expresses the quality as being just ordinary.

T F 17. A coupe dish has a convient edge which may be held while serving.

T F 18. Vitrified means that the china is not porous.

T F 19. Plates, cups, saucers and so on are shaped by machines called jollies or jiggers.

T F 20. Decalcomania is commonly known as a decal.

T F 21. "Open stock" means to buy by the piece.

T F 22. Matte glaze is a bright clear glaze.

T F 23. Haviland is a dinnerware originally made in England but now made in Germany.

T F 24. Kaolin is one of the purest and whitest of all clays and one of the principal materials from which china is made.

T F 25. Throwing is an age old process of forming ware by hand and without a mold, usually on a revolving wheel turned by foot or hand.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Other items found in the china department are _____ and _____.
2. Another name for real china is _____.
3. Bone china is made by mixing bone _____ with purified _____.
4. The basic material for all ceramic ware is _____.
5. Handles, spouts and knobs are fastened onto pottery by _____.
6. The thick cream mixture of clay and water in making china is called _____.
7. Two firings used to bake clay are the biscuit and _____.
8. The temperature required to bake porcelain is _____ degrees C.
9. The temperature required to bake earthenware is _____ degrees C.
10. In order to cover the porous texture of earthenware it is sealed by a surface _____.
11. The best plastic dishes are made from a basic plastic compound of _____.
12. The price of earthenware is determined by its source, design and _____.
13. The two basic shapes for plates and other flatware dishes are _____ and _____.
14. The two methods of measuring flatware are _____ and _____.
15. The two ways of indicating the size of a set of dishes are the number of _____ settings and _____ pieces.
16. Earthenware may be divided into pottery and _____ earthenware.
17. The process of molding the slip into the desired shape is called _____.

18. One can often buy a _____ consisting of 16 pieces--four dinner plates, four bread and butter plates, four cups and four saucers.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. Hand shaping of pottery is done on (A) jigger; (B) jollie; (C) pug mill; (D) potter's wheel.

_____ 2. Clay used for making china is originally (A) blue; (B) red; (C) white; (D) yellow.

_____ 3. An example of biscuit ware is found in a (A) medallion; (B) Sculptured figure; (C) flower pots; (D) all of these.

_____ 4. Gold is more likely to be found in china glazed by (A) underglaze; (B) overglaze; (C) in the glaze; (D) in the clay.

_____ 5. The most inexpensive process of adding colored designs to china is (A) engraving; (B) hand painting; (C) stamping; (D) Transfer painting.

_____ 6. A large serving bowl with a cover is called a (A) demitasse; (B) bouillon; (C) Tureen; (D) Nappy.

_____ 7. A cup for after dinner coffee is a (A) bouillon; (B) demitasse; (C) casserole; (D) tureen.

_____ 8. A covered vegetable dish is a (A) casserole; (B) tureen; (C) demitasse; (D) nappy.

_____ 9. A cup with two side handles is a (A) coupe soup; (B) fruit dish; (C) bouillon; (D) eggcup.

_____ 10. Porcellana is (A) Porcelain; (B) shell; (C) china; (D) Kaolin clay.

_____ 11. Wedgewood is a distinctive type of (A) glassware; (B) silverware; (C) earthenware; (D) all of above.

_____ 12. The rustic or country atmosphere of a table setting is best acquired with (A) earthenware; (B) bone china; (C) Peasant Pottery; (D) porcelain.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The three ingredients used in holding clay together are:

(A)_____ (C)_____

(B)_____

2. Six characteristics of china are:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____ (F)_____

3. List six characteristics of Earthenware:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____ (F)_____

4. The four times that designs may be applied to china are:

(A)_____ (C)_____

(B)_____ (D)_____

5. The three methods used by manufacturers for grading ceramic wares are:

(A)_____ (C)_____

(B)_____

6. A 20-piece service for four includes:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

7. A place setting consists of the following five pieces:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

8. Dinnerware may be classified as:

(A)_____ (C)_____

(B)_____ (D)_____

9. A typical classification of dinnerware is:

(A)_____ (C)_____

(B)_____ (D)_____

ERIC

Assignment
Sheet No. 3

Covering
Units 17-26

GLASSWARE

There are crystal balls for the superstitious to try to discover facts, but the seller of crystal and other precious glass will never acquire the facts that help sell glassware by gazing into a crystal ball. Customers expect salespeople to know as much, if not more, than they do about glassware.

This assignment covers the ingredients, manufacturing processes, types and classifications, and uses and care of glassware.

Assignment:

1. Read the references listed below.
2. Prepare a list of six selling phrases for each of six glassware items in your store, emphasizing what you have learned in this assignment.
3. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study to extend your knowledge of this merchandise.
4. Answer the questions below. Complete items 2 and 3 and turn in this assignment by _____.

References:

A. Wingate, Gillespie and Addison, Know Your Merchandise, pp. 579-598.
B. Prentice-Hall, Inc., Facts About Merchandise, pp. 158-161.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. All glass articles are nonporous or vitrified and are therefore sanitary.

T F 2. Today glass wool is used mainly for curtains and draperys.

T F 3. Pyroceram is the trade name for a type of heat resistant glass.

T F 4. The great majority of glass today is lime glass.

T F 5. Lime glass has a bright lustre.

T F 6. Lime glass has a softer surface than lead glass.

T F 7. Heat resistant glass is often known by the brand name Pyrex, Fire King or Glassbake.

T F 8. Glass blowing has changed a great deal over the last two thousand years.

T F 9. A furnace used to soften glass for additional shaping is a glory hole.

T F 10. Blown glass is inexpensive and used quite frequently.

T F 11. The thickness of glass used in mirrors can be tested by holding a pencil point at an angle against the mirrors.

T F 12. The annealing process is used in shaping glass objects.

T F 13. A popular method of applying designs to glass is by means of hydrofluoric acid.

T F 14. Cased glass refers to the process of cutting through several layers of colored glass to develop glass with many colors.

T F 15. Rhodium is a metal used to coat silver so as to make it nontarnishable.

T F 16. Glassware is purchased for its style, its simplicity or ornateness, the cut of the glass or the shape of the article.

T F 17. Blown glass is made by machine or by hand.

T F 18. Embossed glass is made by a technique of wax, acid, steel plates, and transfer paper to produce lacy designs, initials, and so on.

T F 19. Frosted effects are produced by exposure to acids or sand-blasting.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Silica, the main ingredient in _____, is the most common mineral on our planet.

2. _____, which are shells of heavy glass with a vacuum inside to act as an insulator, have become popular for use in homes, offices and manufacturing plants.

3. A glass that was developed in the latter part of the seventeenth century in England, has a surface softer than lime glass, and can be cut readily is _____.

4. Some heat-resistant glass, known as _____ can actually be used for cooking over the flame or electric plate.

5. Glassware which is thicker and heavier and used for baking is referred to as _____.

6. There are two main steps in glass making: the preparing and firing of the ingredients and the _____.

7. Broken glass scrap known as cullet is added to the _____ to aid in melting it.

8. The glass maker can shape glass in any desired way by rolling the _____ as he is blowing.

9. The process of blowing the glass within the framework of an iron cast is known as _____.

10. An American inventor, _____ developed the first crude bottle-making machine.

11. The glass panes made by cutting open a bubble of glass and flattening it out is referred to as _____.

12. Two layers of glass with a clear, colorless layer of vinyl plastic in between is known as _____.

13. An oven that slowly diminishes heat so that outer and inner layers of glass are cooled simultaneously is an _____.

14. A special testing device known as a _____ shows whether any stresses or strains are present that might later cause the glass to break.

15. Consumers can depend on glassware to give good service if it has undergone the _____ test which plunges the glass alternately into hot and cold water.

16. The process of pressing designs with molds onto the surface while the glass is still taffylike is _____.

17. One of the most beautiful and costly methods of decorating glassware, _____, became possible after the invention of lead glass.

18. A method of etching that is inexpensive and done by machine is known as _____.

19. When the design is deeply cut by sandblasting, the glass is known as _____.

20. Silver is applied to glassware by a process called _____.

21. By mixing various kinds of material salts with basic materials, _____ may be developed.

22. Glass cut by machine or hand on a moving wheel or stone is called _____.

Multiple-Choice

Directions: In the space at the left of each statement, write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. All glass is (A) opaque; (B) vitrified; (C) heat resistant; (D) lime glass.

_____ 2. Rhinestones are made from (A) feldspar; (B) artificial diamonds; (C) bisque; (D) lead glass.

_____ 3. The least expensive way of shaping glass is (A) molding; (B) blowing; (C) pressing; (D) etching.

_____ 4. The most costly method of decorating glassware is (A)annealing; (B) etching; (C) cutting; (D) engraving.

_____ 5. A polariscope measures (A) density; (B) transparency; (C) stresses; (D) composition.

_____ 6. One of the following is a piece of stemware: (A) sherbert-glass; (B) tumbler; (C) fruit dish; (D) ice-tea glass.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Four trade names for heat resistant glass are:

(A)_____ (C)_____

(B)_____ (D)_____

2. The best sand for glassware in the United States is found in:

(A)_____ (C)_____

(B)_____ (D)_____

3. Three methods of shaping glass are:

(A)_____ (C)_____

(B)_____

4. Glass departments usually divide glass into the following sections:

(A)_____ (C)_____

(B)_____ (D)_____

5. People buy fine glassware for three main reasons:

(A)_____ (C)_____

(B)_____

6. The three most common types of glass are:

(A)_____ (C)_____

(B)_____

7. Some cleaning hints for glassware:

(A)_____

(B)_____

(C)_____

(D)_____

(E)_____

(F)_____

(G)_____

(H)_____

Assignment
Sheet No. 4

Covering
Units 27-36

TABLEWARE

Probably in no other phase of daily living have customs and habits changed as radically as in the serving of food. Eating habits have been a true measure of our advance of civilization. The earliest man known used a pointed stick to spear a piece of meat from the communal pot boiling over a camp fire. Early American settlers ate their meals from pewter plates, wooden trenchers or from thick slabs of bread instead of plates. How different it is today!

We have the finest china and silverware for those special occasions. Our day-to-day eating habits are blessed with stainless steel ware and plastic or china dishes. How fortunate we are!

In this assignment the composition, types, qualities, terminology, designs, and care of tableware are topics for your careful study and application to the sales situations.

Assignment:

1. Read the references listed below.
2. Prepare a complete concise outline of types of silverware.
3. Make a list of six quotations that are likely to be made by silverware customers that express their unwillingness to pay the price for the better silverware.
4. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study to extend your knowledge of this merchandise.
5. Answer the questions below and turn in this assignment by _____.

References:

A. Wingate, Gillespie and Addison, Know Your Merchandise, pp. 599-620.
B. Prentice-Hall, Inc., Facts About Merchandise, pp. 163-172.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Silver is a very hard, unworkable substance.

T F 2. All metals have the same tasteless contribution to food.

1. Designs can be stamped, hammered, or engraved into _____ because it is very soft.

2. The price of silverware is determined by the amount of silver in the article and how _____ the workmanship is.

3. The combining of two or more metals is known as _____.

4. The metal added to silver to make it firm and durable without affecting its beauty and workability is _____.

5. In the United States there is a law stating articles stamped sterling silver must be 925 parts pure silver and _____ copper.

6. Careful workmanship in flatware items may be determined by the varied thickness of the metal, called _____.

7. Knife blades used on quality products are carefully shaped by _____.

8. Expensive flatware is commonly sold in open stock, _____, and sets.

9. A regular sized knife with knife blade that may be sharpened is a _____ knife.

10. A small knife with a sharp blade suitable for cutting fruit and peeling fruit is a _____ knife.

11. A short fork with short tines used for salads, cakes and pies is called a _____ or _____ fork.

12. A regulation oval shaped spoon is a _____.

13. A large serving spoon with rounded bowl, that is used for serving vegetables, fruit, and salads is a _____.

14. Candlesticks with two or more branches are called _____.

15. Large bowls with deep centers and wide curved rims used with racks for flowers or without racks as a fruit bowl are called _____.

16. Short-stemmed and long-stemmed candy and nut bowls are _____.

17. Short candlesticks that are sold in pairs and used with a center piece are _____.

18. The most expensive method of decorating silver by hand and used only on sterling silver is _____.

19. A method of machine controlled engraving that puts geometric patterns on metal products is known as _____.

20. A mirrorlike finish known as _____ is achieved by polishing the metal with brushes and buffing wheels.

21. Silver that was manufactured many years ago, but which is not old enough to be classed as antique is _____silver.

Multiple-Choice

Directions: In the space at the left of each statement write the letter of the item which will provide the correct answer to complete the statement.

_____ 1. The most desirable base for electroplating is (A) copper; (B) brass; (C) steel; (D) an alloy.

_____ 2. Flatware refers to all but one of the following: (A) knives; (B) plates; (C) forks; (D) spoons.

_____ 3. The original piece of metal for a spoon or fork is called (A) tines; (B) blanks; (C) plates; (D) stock.

_____ 4. A cross between a fork and a spoon is the (A) viande; (B) oyster; (C) pastry; (D) ice cream fork.

_____ 5. A three tine fork is a: (A) fish; (B) salad; (C) oyster; (D) viande.

_____ 6. Quality in flatware is determined by all but one of the following methods. Which is not a method? (A) weight; (B) thickness; (C) grading; (D) fineness of finish along the edges.

_____ 7. A round bowl spoon is the (A) salt; (B) ice tea; (C) bouillon; (D) oval dessert spoon.

_____ 8. A sharp pointed spoon is the (A) soup spoon; (B) fruit spoon; (C) coffee spoon; (D) bouillon spoon.

_____ 9. A teaspoon with a long handle used for stirring cold drinks in glasses is a: (A) salt spoon (B) iced tea spoon; (C) tablespoon; (D) none of these.

_____ 10. Most holloware is made by: (A) stamping; (B) spinning; (C) casting; (D) all of these.

_____ 11. A candy bowl and nut bowl is called: (A) waiter; (B) waste bowl; (C) compote; (D) gurnsey.

_____ 12. A short, elongated, lipped server that may have a separate matching tray or may be attached to a tray is a (A) gurnsey; (B) gravy bowl; (C) center piece; (D) creamers.

_____ 13. When the metal is gouged out to produce designs on silverware, the method is (A) piercing; (B) engraving; (C) chasing; (D) etching.

_____ 14. The official stamp placed on a piece of silver to indicate its purity is known as a (A) mark; (B) Hallmark; (C) plate (D) stamp.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Most of the world's silver comes from:

   (A)_____ (D)_____

   (B)_____ (E)_____

   (C)_____

2. In the United States silver is used in the following three forms:

   (A)_____ (C)_____

   (B)_____

3. List the six rules for placing flatware on the table:

   (A)_____

   (B)_____

   (C)_____

   (D)_____

   (E)_____

   (F)_____

4. List seven methods of applying designs to silverware:

   (A)_____

   (B)_____

   (C)_____

   (D)_____

   (E)_____

   (F)_____

   (G)_____

5. The five periods in history that have the most influence on present flatware patterns are:

(A) _____

(B) _____

(C) _____

(D) _____

(E) _____

6. The pieces in a place setting are:

(A) _____ (D) _____

(B) _____ (E) _____

(C) _____ (F) _____

ERIC

Assignment
Sheet No. 5

Covering
Units 37-44

LINENS

The pride a woman takes in her linens is equal to the pride a flower grower takes in her self-grown bouquet. The wise salesperson will strive to understand the qualities a housewife prefers and make every effort to speak the language of linens with a vocabulary equal to the best-informed linen customer. The host of materials, mixtures, and finishes, as well as the qualities of each, calls for a very technical and careful study of the facts.

In this assignment there is a coverage of linen classifications, and special details about types of towels, qualities of shower curtains, and table and novelty linens.

Assignment:

1. Read the reference given below.
2. Confer with your coordinator as to the possibility of further study about linens in some study guide on home furnishings.
3. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study to extend your knowledge of this merchandise.
4. Answer the questions below and turn in this assignment by _____.

References:

A. Wingate, Gillespie and Addison, Know Your Merchandise, pp. 242-251.
B. Wingate, Textile Fabrics and Their Selection, pp. 495-512.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Strong pastel colors will generally keep their color better than light pastels.

T F 2. The color scheme of the bathroom is of little importance in selling towels.

T F 3. Cocktail napkins are standard in size with 12 inches on each side.

T F 4. Damask is a fabric in Jacquard weave whose pattern is reversible.

T F 5. A loose weave in damask indicates a superior quality material.

T F 6. Count of cloth should be carefully considered in buying the damask.

T F 7. Sizing provides a leathery stiffness to new linens.

T F 8. Well bleached damasks will wear longer than unbleached damasks.

T F 9. The double type of damask has a seven-float construction.

T F 10. Pile construction of terry cloth increases its absorbency.

T F 11. A three-pick terry cloth is one of the most superior quality towels.

T F 12. Knitted washcloths are more desirable than terry cloths.

T F 13. Cotton crash is superior to linen crash as a material for dishtowels.

T F 14. Nearly all the laces classified as "real laces" can be duplicated by machine with slight variations and simplification.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A turkish towel with its looped-pile surface is made of a material called _____ cloth.

2. Table covering, like sheets and pillowcases, are frequently spoken of as _____, even though they may also be made of cotton, rayon or mixtures of these.

3. The most popular size of luncheon cloth is _____inches square.

4. For formal occasions the _____ dinner cloths are preferred.

5. The largest damask tablecloths are called _____ cloths.

6. A term applied to plain-weave fabrics in linen, cotton, rayon, or mixtures is _____.

7. A high count of _____ yarns to the inch is an excellent grade.

8. Art linen is often called _____ linen.

9. Linens belong in a classification of merchandise called _____ or household _____.

10. If a store divides its household textiles into three groups or departments they are _____, _____, and _____.

11. Towels may shrink in the first five washings as much as _____ per cent.

12. Instead of ironing terry cloth towels, before they are hung up they should be _____.

13. Glass towels are intended for drying glasses and thus should be free of _____.

14. Fabrics for shower curtains may be either water resistant or _____.

15. When the fabric is treated with a solution of rubber and oil that so impregnates the fibers that the water proofing substance becomes a part of the fabric itself it is called _____.

16. A damask cloth 72 x 108 is large enough to seat _____ people.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the towels for personal use:

   (A)_____ (B)_____ (C)_____

2. List the towels for household use:

   (A)_____ (B)_____ (C)_____

3. What are the four things that customers want to know about towels?

   (A)_____ (C)_____

   (B)_____ (D)_____

4. List the materials from which face towels are made:

   (A)_____ (C)_____

   (B)_____ (D)_____

5. List the factors that determine the quality of terry cloth:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

6. List the materials from which dish towels may be made:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____ (F)_____

7. Linen is used extensively for dining tablecloths because:

(A)_____ (C)_____

(B)_____ (D)_____

8. The chief selling points for dining tablecloths is:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____ (F)_____

9. Customers look for the following points when buying linen crash cloth:

(A)_____

(B)_____

(C)_____

(D)_____

(E)_____

(F)_____

10. To judge the wearing qualities of a damask, the following factors should be considered:

(A)_____ (C)_____

(B)_____ (D)_____

11. The five kinds of real lace are:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

ERIC

Assignment
Sheet No. 6

Covering
Units 45-59

BEDDING

One of the prized possessions of many homemakers is a quilt or antique comforter made by grandmother. The "quilting bee" is one of the fond memories of homemakers familiar with the household arts at the turn of the century. Today the modern homemaker must find a different source from which to secure the bedding so essential to the comfort of her family.

The first requisite for successful selling of bed linens is familiarity with the fabrics and other materials used in their manufacture.

In this assignment you have the opportunity to gain valuable information about the materials and fabrics, their qualities, durability, and unique characteristics which will enable you to be of real service to the homemaker as she shops for bedding.

Assignment:

1. Read the reference listed below.
2. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study to extend your knowledge of this merchandise.
3. Answer the questions below and turn in this assignment by _____.

Reference:

A. Wingate, Textile Fabrics and Their Selection, pp. 512-586.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Mousseline is the French word that means muslin.

T F 2. Mousseline de soie is a very thick, crisp silk organdy.

T F 3. Real linen sheets and pillow slips are used in most homes.

T F 4. In recent years nylon sheets have been offered for sale.

T F 5. The better grade of cotton sheet is the percale which has the higher count.

T F 6. The salesperson really means longcloth when she refers to muslin.

T F 7. Large department stores have the policy of showing the medium-priced sheets first.

T F 8. The housewife that is a good buyer of sheets knows and considers the factors determining wearing qualities of sheets.

T F 9. The best sheets contain cotton fibers at least one-half inch long.

T F 10. In cotton sheets the tight twist of the fiber prevents them from pulling out with wear.

T F 11. Loosely spun yarns have a greater tensile strength than tightly spun yarn.

T F 12. Sheets are marked seconds if there are some defects in weave or imperfections in the yarn.

T F 13. The store selling the sheet determines whether it is a second.

T F 14. The number of warp and filling yarns to the inch determines the balance of the cloth.

T F 15. An important factor in determining the durability of a sheet is its tensile or breaking strength.

T F 16. Warp is usually stronger than filling.

T F 17. A poor-quality sheet has a finishing that is sizing made from starch or china clay.

T F 18. Glossing given by sizing and calendering is permanent.

T F 19. Sizing in a high grade sheet is often 20 to 25 per cent.

T F 20. Largely through ignorance, many customers buy their sheets too short.

T F 21. The sheet required for a standard mattress is 108 inches long.

T F 22. Customers that do not know the factors determining the wearing quality of sheets should buy them by brand name.

T F 23. Unbleached sheets usually wear better than bleached sheets.

T F 24. A good reason for buying linen sheets is that they cost less than cotton sheets.

T F 25. The housewife that expects a mattress to last several years should protect it with a mattress cover.

T F 26. According to health experts the mattress should adjust itself to the various degrees of pressure from different parts of the body.

T F 27. South American horsehair instead of loose cotton is used as filling in the less expensive mattresses.

T F 28. Mattresses filled with Kapok are not suited to damp climates.

T F 29. Felt fillings are more resilient than Kapok fillings.

T F 30. All 4-pound wool blankets will be warmer than cotton blankets of the same weight.

T F 31. The weight of a blanket is a true indication of its warmth.

T F 32. A closely napped cloth blanket is warmer than an unnapped cloth blanket.

T F 33. The most attractive blankets usually have a soft texture.

T F 34. When buying blankets the wise homemaker realizes that allowance for ample tuck-in should be made.

T F 35. A vital factor from the standpoint of comfort and wear, to be considered when purchasing a comforter is the covering.

T F 36. Heaviness rather than resiliency determines the warmth of a comforter.

T F 37. A quick way to test the resiliency of a comforter is to place one hand on top and one hand on the bottom of the comforter, press the hands together and note how fast the comforter springs back into shape.

T F 38. The chief factor in determining the price of a comforter is the filling.

T F 39. Down from the breast of the eider duck is the softest, lightest, most expensive filling for a comforter.

T F 40. A satisfactory comforter covering is soft and pliable, with good draping qualities.

T F 41. Antique patchwork quilts are of standard size.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. There are two kinds of cotton sheets, _____ and _____.
2. The poorer grades of sheets are _____ and the better grades are _____.

3. A sheet free from imperfections in the weave is considered to be of _____quality, or _____ quality.

4. Sheets with defects due to imperceptible uneven threads or to little oil spots are classed as _____.

5. A high count sheet of good balance would be _____; a low count sheet of poorer balance would be _____.

6. The number of pounds to break a strip of cloth an inch wide is called the _____ strength.

7. Because most sheets shrink in laundering, an allowance of _____ to _____ per cent should be made for shrinkage when size is being considered.

8. Sheets that make bed making easier for the homemaker are called _____ or _____ sheets.

9. A standard size pillow requires a pillowcase that is _____ x _____ or _____ x _____ inches in size.

10. When purchasing mattresses, housewives want one that is _____ and _____.

11. The _____ is largely responsible for comfort and durability.

12. The types of mattresses that retain their resiliency the longest have _____ or are made of _____.

13. The mattress covering or bag that holds the filling is called _____.

14. The brush-like button of clipped cotton yarn that appears at regular intervals on mattresses is called _____.

15. Persons suffering with asthma or hay fever may buy pillows with fillings such as _____ and _____.

16. Four points considered by most customers when they buy blankets are _____, _____, _____, and _____.

17. The attractiveness of blankets is determined by their _____, _____ and _____.

18. Fillings for comforters are made of _____, _____, _____, _____, and _____.

19. The first consideration in purchasing a bedspread is _____.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Four things the average housewife considers in buying sheets and pillowslips are:

   (A)_____ (C)_____

   (B)_____ (D)_____

2. The reasons why many persons buy heavier sheets are:

   (A)_____

   (B)_____

   (C)_____

   (D)_____

3. Labels on sheets specify the following:

   (A)_____ (D)_____

   (B)_____ (E)_____

   (C)_____

4. The Pepperell Manufacturing Company lists the following selling points of their fitted sheets:

   (A)_____

   (B)_____

   (C)_____

   (D)_____

   (E)_____

   (F)_____

   (G)_____

(continued)

(H) _____

(I) _____

(J) _____

(K) _____

5. The hints salespeople should give customers that will result in the longer wear of sheets are:

(A) _____

(B) _____

(C) _____

(D) _____

(E) _____

(F) _____

(G) _____

(H) _____

(I) _____

6. Mattresses without intersprings are filled with:

(A) _____ (D) _____

(B) _____ (E) _____

(C) _____

7. The advantages of a foam rubber mattress are:

(A) _____

(B) _____

(C) _____

(D) _____

(E) _____

8. The materials used in the manufacturing of blankets are:

(A) _____ (D) _____

(B) _____ (E) _____

(C) _____

9. Important factors in judging the wearing qualities of blankets are:

(A) _____

(B) _____

(C) _____

(D) _____

(E) _____

(F) _____

ERIC

Assignment
Sheet No. 7

Covering
Units 60-71

NOTIONS AND YARD GOODS

A few notions, a few ideas and a few yards of fabric in the hands of a do-it-yourself seamstress produces a creation that far outshines a store-bought garment. These are the creative people you deal with in the notions and yard goods department.

They may be experts. If so, you must not be ignorant and get caught. They may be only beginners. So if you fail to be a real help you may contribute to their failure and both of you will lose because they fail to return to your store's notions department.

This assignment provides a few essential facts about clothes protectors, hair equipment, sewing aids, fabrics, ornamental embroidery and laces.

Assignment:

1. Read the references listed below.
2. Prepare a display on a card including a small piece of each ornamental trimming in your store, with a label below them by name.
3. Ask your coordinator about the possibility of obtaining a free rental film for those of you who are interested in this merchandise. The Distributive Education Bibliography Supplement suggests some of these for Fabrics on page 129.
4. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study to extend your knowledge of this merchandise. Notions references will be found in the bibliography on page 102.
5. Answer the questions below and turn in this assignment by _____.

References:

A. Prentice-Hall, Inc., Facts About Merchandise, pp. 1-33.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. A rather definite list of merchandise is included in the notions department.

T F 2. Suggestions are usually out of place by a salesperson in a notions department.

T F 3. A shoe tree is designed to prevent shoe toes from turning up.

T F 4. The points of a barber style comb should be sharp.

T F 5. Widely spaced tufts are preferred in a brush.

T F 6. It is possible to buy sharps in size 20.

T F 7. Straight and safety pins are usually made of steel.

T F 8. A number three pin is larger than a number 1 pin.

T F 9. Detachable pads for shoulders of coats are attached by the use of snaps.

T F 10. Embroidery scissors have blunt-end blades that are safe around children.

T F 11. Pinked seams ravel readily and must be bound to prevent raveling.

T F 12. Woolen garments and blankets should be brushed and aired often.

T F 13. New or virgin wool has never previously been made into cloth.

T F 14. Consumers use more than three times as much cotton as all other fibers combined.

T F 15. Linen fiber is obtained from the linen plant.

T F 16. Man made fibers are made in a test tube.

T F 17. Fibers are blended to produce new and unusual fabrics by mixing them together in staple form and then spinning them into yarn.

T F 18. A wide variation in the proportion of blends is possible and practical.

T F 19. A garment of wool or Dacron should have 75 per cent or more of Dacron to have good wrinkle resistance.

T F 20. Silk and the man-made filaments are prepared by a process known as throwing.

T F 21. In weaving, the yarn that runs lengthwise of the cloth is known as warp.

T F 22. The yarn that runs crosswise to the warp in weaving is known as filling or woof.

T F 23. Color fastness means that the color will not fade under normal conditions.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The notched plastic hangers are designed to hold _____.
2. A brush designed for men that has no handle is classed as a _____ brush.
3. A plastic form to place in a sock when darning it is called a _____.
4. Hooks and eyes are made of nickel plated _____.
5. The type of marker for hems on a skirt which squirts powder is called the _____ type.
6. Sewing needles are made of finely tempered _____.
7. A crewel needle is another name for an _____.
8. Saw-toothed blades are found on scissors called _____ shears.
9. There are two major classifications of fibers, _____ and _____.
10. The major vegetable fibers are _____ and _____.
11. Wool yarn made from fine, long, smooth fibers and tightly twisted is called _____.
12. Wool yarn made from short, fuzzy fibers, loosely twisted is _____.
13. The United States produced about _____ per cent of all cotton grown.
14. The first man-made fiber was _____.
15. Linen fiber is prepared by the _____ process.
16. Dyes that are fast for the purpose for which the fabric is intended are known as _____.
17. Dyes are classified according to origin as _____ and _____.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The features to emphasize about a garment bag are:

   (A)_____ (C)_____

   (B)_____ (D)_____

2. The type of dress shields are:

   (A)_____ (C)_____

   (B)_____

3. Two types of laundry marking tape are:

   (A)_____ (B)_____

4. List the three classifications for wool fibers as stated by the Wool Products Labeling Act:

   (A)_____ (C)_____

   (B)_____

5. List the characteristics of linen:

   (A)_____ (C)_____

   (B)_____ (D)_____

6. List the characteristics of man made fibers:

   (A)_____ (D)_____

   (B)_____ (E)_____

   (C)_____ (F)_____

7. List the three basic types of weave:

   (A)_____ (C)_____

   (B)_____

8. The three basic stitches used in weft knitting are:

(A)_____ (C)_____

(B)_____

9. The three methods of giving fabrics shrinkage control are:

(A)_____

(B)_____

(C)_____

10. Color is applied to textiles in any of the following stages of production:

(A)_____ (C)_____

(B)_____

11. The most common method of printing fabrics are:

(A)_____ (C)_____

(B)_____ (D)_____

NOTIONS

The notions department is one of never-ending variety. Notions range from closet accessories to hair goods, from sewing aids to washing aids, and from travel accessories to rubber goods. The dictionary defines notions as an ingenious device; knicknack; any of various small useful articles that make life more convenient.

Notions should be displayed so that customers can see the items in the bins with labels and the price. Bins should be kept filled at all times and should be arranged so that related items are near to each other. Suggestion-selling in this department will pay greater dividends than in any other department of the store. Many of the notions are related and when the customer buys one you are doing her a favor by suggesting related items she may need.

CLOSET ACCESSORIES

Garment Bags are used to store clothes and keep them neat and clean. They are made from transparent plastic or coated cotton material with tape-bound seams and a 36-inch zipper opening. Sizes run from full length which is 54 inches long to suit and blouse length which is 40 inches long. Many of the garment bags have moth preventive units built in.

Hangers come in various types from covered hangers, plastic hangers, shirt or trouser hangers, wire hangers and wooden suit hangers. Covered hangers prevent marks on shoulders of the garment and plastic hangers are usually notched for holding shirt and suit coat on the same hanger. Shirt or trouser hangers have pinch-clips which holds shirt waist band or trouser cuff or a padded-bar type which is of metal or wood. Wooden suit hangers have well-built shoulders for coats and a cross-bar to hold trousers or shirts. The regular heavy wire hanger is most popular and used most frequently.

Other closet accessories include boxes of various types used in keeping and storing of wearing apparel such as the hat box, lingerie, glove, handkerchief and hosiery box. Shoe bags and racks are used for storage of men's and women's shoes. Shoe trees for men and women are used to keep shoes in shape and toes from turning up. Shoulder covers are used in closets to protect clothes from dust while they are stored.

HAIR GOODS

Bows, braids, barrettes and bands are used frequently with plain hair styles. They give ornamentation to the simple hair style. Bobby-pins and hair-pins are used to hold hair in place during daytime or evening.

Combs come in the following types:

Barber style: Seven to seven and one-half inches long and tapered at one end.
Dresser style: Large comb for hair from 7 to 9 inches long.
Handle style dressing comb: Four inch handle for convenient grip.
Pocket comb: Pocket or purse size 5 to 7 inches long.
Rat-tail comb: Pencil-thin handle to help wind curls.
Side comb: Holds stray ends of upsweep.

When buying a comb the customer should look for one that suits her purpose. The teeth should not be too sharp and they should be slightly flexible.

Hair brushes come in plastic or lucite backs with nylon or natural bristles. The customer should buy the size and type best suited to his or her use. Brushes with widely spread or spaced tufts do a better brushing job and they are easier to keep clean.

Hair brushes come in the following types:

Club: Short handle brush for men.
Military: No handle brush for men.
Hairbrush: Four inch handle brush for ladies.

Curlers come in lightweight aluminum or plastic. Customers should look for curlers that will do the job, have strong springs, durable material and rounded edges that are comfortable in use. The following types of curlers are available: pro-curlers, spring or springless clamp, wave clip and wire curlers.

Hair rolls are padding used for the "chignon" on pompadour hairdo. They are usually made from crimped wool or mohair covered with rayon mesh.

Hair nets come in various colors and shapes. Some of the more popular are the invisible, turbans and the wave nets.

Hair pieces and wigs are becoming more and more popular and important as a part of the notions department as women become interested in developing a wardrobe of these items.

RUBBER GOODS

Dress shields protect dresses from perspiration. They come in the following types: pin-in, sew-in and bodice type. Materials used for dress shields are rubber, synthetic rubber, or plastic linings covered with nainsook or rayon.

Shower caps made from waterproof plastic or coated fabric edged with rubber, elastic or tape.

SEWING AIDS

Darners are smooth wooden or plastic forms to place under the hole while darning.

Hooks and eyes are made from nickel plated steel and run in sizes from small to large.
Markers: bulb and pin-it type. Bulb squirts powder on garment at desired point and pin-it uses straight pins to mark point.
Name Tapes used to identify articles sent to laundry or school. They come in the sew-on type and the press-on type.

Needles are made from non-rusting, finely tempered steel. They come in the following types:
Sharp for regular use which ranges in size from 1 (large) to 10 (small).
Rug needles which have blunt points and large eyes.
Chenille needles which have sharp points and large eyes in sizes from 18 to 26.
Embroidery (crewel) needles which have large eyes for several threads ranging in sizes from 1 to 10.
Darning needles which have a large eye and are extra long in sizes 3 to 10 for cotton and silk hose and 16-18 for sweaters and socks.

Pins are made of rustless brass or nickel-coated steel. Straight pins by the box run in the following sizes: 1¼ inches long = size #20; 1 1/16 inches long = #17; 1 inch long = #16; and 7/8 inches long = #14.

Straight pins by the paper run in the following sizes: 1¼ inches = MC; 1 1/16 inches - SC; 1 inch - F3½; and 7/8 inch = SW.

Safety pins come on cards and sizes range from 00 (small) 0, 1, 2, 3, and 6 (large). Graduated sizes come on a ring.

BINDING, SHOULDER PADS AND FASTENERS

Rickrack is a zigzag braid for trimming. Usually made from cotton in all colors and sizes from ¼ to ½ inch widths.

Seam binding keeps raw edges from raveling. Seam binding is divided into Bias binding which allows slight stretch which fits circular edges and straight binding which is a straight cut and gives strength to the seams.

Shoulder pads give shape to shoulders of suits, coats, dresses. They come in sew-in pads that are permanent, removable padding which comes out of sewed-in-case, detachable pads which snap in place. They are made from muslin, rayon or silk.

SEWING TOOLS

Tailor's chalk, tape measures and thimbles are all necessary to the seamstress. Thread for general dress-making comes in cotton, silk and nylon. Heavy cotton thread comes in #8, 10, 12, 16, 20, and 24 for canvas ticking, awnings, denim and khaki. Medium cotton comes in #30, 36, and 40 for slip covers and quilting. General sewing thread comes in #50, 60, and 70 for cotton and spun rayon. For light cotton #70, or #100 for sheer cotton, and silk or nylon thread, size A or B, for dressmaking. Silk twist comes in size D for buttonholes. Thread can be most economically bought in the 200-yard spool.

Scissors come in the following types for dressmaking, household and art uses:

Sewing -- medium length, pointed blades.
Blunt ends -- children may use with safety.
Embroidery -- very sharp points for fine work.
Shears -- long, large blades for cutting out dresses.
Pinking shears -- saw-toothed blade for non-ravel edges which do not have to be bound.

Assignment
Sheet No. 8

Covering
Units 72-82

DRAPERIES, CURTAINS AND UPHOLSTERY

A dressed chicken is stripped of its ornamental plumage and appreciated in this condition, but a room stripped of its ornamental curtains and draperies is an unsightly and naked condition undesired by modern house dwellers. People are far from the cave man existence, and too highly in tune with design, decoration, and showy splendor to live in a barren room.

The problem of a wise choice of curtains and draperies to withstand the often critical eye of visitors and other associates is a housewife's dilemma. The salesperson who can truthfully counsel with or converse intelligently in principles of design and qualities of various fabrics, is one worth his weight in silver for these expensive decisions.

This assignment includes some basic information about structural design, and other essentials of harmony. It also covers classifications, care, and materials in draperies, curtains and upholstery.

Assignment:

1. Read the reference given below.
2. Locate a manufacturer's informational publication that provides facts about their merchandise and prepare a brief summary in writing.
3. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references, some of the free or inexpensive ones. Write for them and bring to class to study and extend your knowledge of this merchandise.
4. Answer the questions below and turn in this assignment by _____.

References:

A. Wingate, Textile Fabrics and Their Selection, pp. 588-608.
B. Wingate, Gillespie and Addison, Know Your Merchandise, pp. 265-278.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. One of the functional factors in decorating is design.

T F 2. A printed design on a woven fabric is a structural design.

T F 3. Direct designing is a trial-and-error hand-loom process.

T F 4. Fabrics designs are commonly patented to prevent others from copying them.

T F 5. A foyer should be decorated with a restful effect.

T F 6. A monochromatic scheme combines a variety of shades of one color.

T F 7. Lightweight draperies should be hung with more fullness than heavy materials.

T F 8. A low, wide window needs a deep valance to make it look taller.

T F 9. Cotton draperies may be used if an informal spirit or atmosphere is desired.

T F 10. A valance is more to be desired on windows in rooms with low ceilings.

T F 11. A hunting lodge or a den can be given a masculine atmosphere by the use of woolen draperies.

T F 12. A draw curtain should be made of an opaque material.

T F 13. A sash curtain may cover only the upper half of a double-hung window.

T F 14. Cafe curtains are hung in tiers with fabric loops and other special means of attaching them to a rod.

T F 15. Glass curtains are longer than draperies on a window.

T F 16. Casement ready-made curtains are hemmed at the top but left unhemmed at the bottom to allow for various lengths of windows.

T F 17. Silk and nylon are both desirable in their ability to resist injury from sunlight.

T F 18. Linen draperies are usually washable provided the dyes are fast.

T F 19. It is advisable to iron linen while it is still damp to remove wrinkles.

T F 20. Wool fabrics and blends should be dry-cleaned.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Design not only includes form but also _____.

2. After a designer produces a design which is approved by the chief designer, the design is sent to the _____ laboratory.

3. The major difference between draperies and curtains is that the heavier of the two is _____.

4. Terms used to describe style of drapery are dignified, theatrical, cottage-like, _____ or _____.

5. A striped pattern in draperies, hung vertically, may make the ceiling look _____.

6. High, narrow windows should have draperies hung on the _____.

7. A decorative construction across the top of a window is called a _____.

8. A draw curtain may serve the purpose of insuring _____ or shutting out _____.

9. The hems of home-made curtains require 6 inches at the _____ and 3 at the _____.

10. Draperies should reach to either the bottom of the _____ or to the _____.

11. Three loops caught together form pleats called Flemish or _____ pleats.

12. When valances hang in loops supported at only a few points they are said to be _____.

13. A seven-piece set of sash curtains, tiebacks, a valance, etc., is called a _____ set.

14. The smoothness or roughness of the surface of draperies is referred to as _____.

15. A fundamental principle of design is that too much pattern in a room is _____.

16. The most resistant to sunlight of these three materials--rayon, cotton and acetate--is _____.

17. Of the two materials used in upholstery, plastic-coated and acetate, the more durable of the two is _____.

18. The best materials for covering upholstery fabrics during the summer are _____ and _____.

19. Moths can be kept from reaching the inside of furniture upholstery by a lining of _____.

20. Moths can be killed in furniture by the use of _____ crystals.

21. Spots may be removed in furniture upholstery by use of water and soap, dry cleaning fluids or powdered _____.

22. In middle ages tapestries were used as protection against _____.

23. A drapery fabric in a fancy twill weave to produce a pebbled surface is _____.

24. A glass curtaining made in plain weave with its warp yarns spaced in pairs is _____.

25. A crisp plain weave silk, or synthetic fabric, appropriate for formal rooms in Louis XV, XVI, Empire styles is _____.

26. A sheer, plain-weave fabric for glass curtains is _____.

27. For upholstery, _____ will give the longest wear of all natural fibers.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Four essential points to creating harmonious decorative schemes are:

   (A)_____ (B)_____ (C)_____ (D)_____

2. Four groups of inner curtains are:

   (A)_____ (C)_____

   (B)_____ (D)_____

3. Three important factors in the selection of drapery fabrics are:

   (A)_____ (B)_____ (C)_____

4. The class of upholstery fabrics are:

   (A)_____ (B)_____ (C)_____ (D)_____

5. Four most satisfactory materials for upholstery are:

   (A)_____ (B)_____ (C)_____ (D)_____

6. The materials commonly used as slip covers are:

   (A)_____ (F)_____

   (B)_____ (G)_____

   (C)_____ (H)_____

   (D)_____ (I)_____

   (E)_____

7. The materials commonly used in making draperies are:

   (A)_____ (E)_____

   (B)_____ (F)_____

   (C)_____ (G)_____

   (D)_____

Assignment
Sheet No. 9

Covering
Units 83-94

FLOOR COVERINGS

Not too many years ago rugs often meant slippery footing or luxury living. Only recently have they been made with the latex backing that makes them safe to tread upon.

Variety stores are not usually very well stocked in floor-covering. They carry small throw rugs, small linoleums and runners made of rubber and plastic which are sold by the foot. A knowledge of these little rugs means sales of merchandise with some rather high price tags.

In this assignment you can find out something about the difference in materials, the types and features of various floor coverings.

Assignment:

1. Read the references listed below.
2. Obtain a list of the various kinds of floor coverings your employer sells. Using sales literature or catalogs which your employer has or can get, write a brief description of each. Mail order catalogs may be helpful also.
3. Confer with your coordinator as to the availability of the study guide, Floor Coverings, published by the University of Texas. If it is available, make plans to follow this guide for a more detailed study of floor coverings.
4. Answer the questions below, and turn in this assignment by _____.

References:

A. Wingate, Isabel B., Textile Fabrics and Their Selection, pp. 547-587.
B. Wingate, Gillespie and Addison, Know Your Merchandise, pp. 279-295.
C. Prentice-Hall, Inc., Facts About Merchandise, pp. 131-136.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Textile floor coverings are broadly classified as rugs and carpets.

T F 2. Carpets are soft floor coverings laid on the floor but not fastened to it.

T F 3. A rug is a soft covering fastened to the entire floor.

T F 4. Broadlooms are popular because there are no seams to break the attractive pile surface.

T F 5. When choosing color it is best to listen to the advice of the salesman.

T F 6. Starting a sales talk with a question is considered bad practice.

T F 7. Solid color broadloom or one that has a two-tone effect will blend nicely with any period furnishings.

T F 8. The wool produced in this country is too fine and soft for use in textile floor covering.

T F 9. Fiber rugs are made of tightly twisted strips of paper.

T F 10. A double-faced reversible rug is made out of old carpets, rags, and clothing.

T F 11. The woolen fibers for rugs average two inches in length.

T F 12. Cotton yarns for rugs are made from one-inch.

T F 13. Carpet yarns in major production are two-ply and three-ply yarns.

T F 14. The process of tufting has speeded up carpet construction and brought prices down.

T F 15. In present day advertising, more emphasis is placed on content and brand name than on weave or construction.

T F 16. Patterns in hooked rugs may be geometric or floral.

T F 17. The United States is a major source of inexpensive hand-hooked rugs.

T F 18. Hooked rugs are best suited to bedrooms and Early American interiors.

T F 19. If a new rug sheds some of its short fibers, it can be regarded as a poor-quality material.

T F 20. Any long ends, tufts, or knots projecting above the surface of the pile should be pulled out.

T F 21. Hand-hooked rugs should not be shaken or cleaned with a vacuum cleaner.

T F 22. Mohair makes a more lustrous carpet than sheep's wool.

T F 23. Fleece from the wire-haired sheep is used for the druggets and rugs made in India.

T F 24. The quality of linoleum is determined by the thickness and the pattern.

T F 25. The thickness of linoleum varies from 1/16 to 1/32 inch.

T F 26. Asphalt tile takes rougher wear than linoleum.

T F 27. Vinyl floor covering is the most widely used.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. A seamless carpet of any weave or style, six to eighteen feet wide is a _____.

2. Floor coverings are solid colored, two-toned, or varicolored, and are frequently called _____ or carved.

3. Rugs may be broadly classified as _____ or imported.

4. Rugs may be divided into _____ and machine-made.

5. Most modern hooked rugs can be cleaned by _____.

6. Hand-tied Orienrals are of three kinds: _____, _____, and _____.

7. Persian rugs are perhaps the most sought-after of the orientals because of their artistic, intricate designs and fineness of _____.

8. The dark and light marks sometimes found in solid-color rugs are called _____.

9. When rugs are used to identify different functions of a room, these rugs are called _____.

10. American Orientals are sometimes referred to as _____.

11. Federal legislation called the _____, requires that a tag or label giving fiber content of carpets and rugs be attached to them.

12. The term "fiber" usually denotes _____ when it is applied to a rug.

13. Hand-tied rugs are made on a vertical _____.

14. A mixture of ground cork and oxidized linseed oil pressed into a burlap base is known as _____.

15. Rug cushions, sometimes called _____, are made of sponge rubber or hair felt.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Wearing quality of domestic floor covering is based on:

   (A)_____ (D)_____

   (B)_____ (E)_____

   (C)_____

2. Some of the most common types of Turkish rugs are:

   (A)_____ (D)_____

   (B)_____ (E)_____

   (C)_____

3. Three factors to be considered in the selection of Oriental rugs are:

   (A)_____

   (B)_____

   (C)_____

4. List the advantages of wool rugs and carpets:

   (A)_____

   (B)_____

   (C)_____

   (D)_____

   (E)_____

   (F)_____

5. Five selling points for Nylon are:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

6. List five selling points of Oriental Rugs:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

ERIC

Assignment
Sheet No. 10

Covering
Units 95-108

PAINT, WALLPAPER AND HARDWARE

"Powder and paint makes a woman what she ain't", but they are generally preferred that way. Likewise, paper and paint can work wonders with walls, woodwork, and even a porch floor. Customers are usually sold on buying before they show their interest. So paint, wallpaper, and even hardware, are not hard to sell if you know the facts necessary to help you make the final decisions for the exact choice of the correct product.

The salesperson cannot show the contents of the paint can, the four walls of paper, or the hardware in it's proposed setting, but a supply of information and the ability to build work pictures can create the imaginary picture the customer desires.

Therefore, this assignment provides a limited amount of basic points related to selecting and explaining the variations in paint, wallpaper and hardware.

Assignment:

1. Read the reference given below.
2. Confer with your coordinator as to the availability of the National Retail Hardware Association's pamphlets entitled, Paint and Paint Sundries and Hardware, or the Hardware and Housewares Manual, published by the Texas Distributive Education Section of the State Department of Education. If available confer with your coordinator as to the additional assignments to study these more extensive materials on the subjects of paint, wallpaper and hardware.
3. Ask your coordinator about the possibility of obtaining a free rental film for those of you who are interested in this merchandise. The Distributive Education Bibliography Supplement suggests some of these for Wallpaper on page 134.
4. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study to extend your knowledge of this merchandise.
5. Answer the questions below. Turn in the answers to your instructor by _____.

Reference:

A. Prentice-Hall, Inc., Facts About Merchandise, pp. 182-207.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. A universal want of all customers when buying equipment is that it be safe.

T F 2. Equipment must be simple to operate and easy to care for.

T F 3. A number appearing at the butt of every saw blade designates the length of the saw.

T F 4. The cross cut saw has more teeth per inch then the rip saw.

T F 5. Auger bits come in sizes 7 to 1/8 of an inch.

T F 6. The two types of auger bits are the solid center and the double-twist.

T F 7. Ball bearings are not a necessary item in a good grade brace.

T F 8. The most popular drills are those in the ½" size.

T F 9. Paint lengthens the life of the things it covers.

T F 10. Paint simplifies cleaning.

T F 11. Pigment is added to the paint in the form of a powder.

T F 12. The vehicle is in the form of a powder.

T F 13. Tung oil is especially desirable as a vehicle because of its fast-drying properties.

T F 14. All wall paints are of the oil type base.

T F 15. Casein paints are low cost paints.

T F 16. Casein paints are washable.

T F 17. High-grade enamels are formulated with a alkyd-resin vehicle.

T F 18. Shellac will not water spot.

T F 19. The process of lacquering dates back 2000 years.

T F 20. Wallpaper is used because walls have cracks, blemishes and structural imperfections.

T F 21. Wallpaper can make a room appear larger or smaller.

T F 22. Wallpaper became fashionable in the courts of kings in Europe during the 17th century.

T F 23. All wallpaper has a series of repeated patterns that match on all sides.

T F 24. Some of the most significant designs are colonial, provincial and modern.

T F 25. Murals cover an entire wall with one scene.

T F 26. By using a mirror at one end of the room you can make the room look smaller.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Power equipment should be sold on the basis of _____.
2. The term, _____, refers to merchandise made of metal, such as tools, nails, and fittings.
3. Two types of customers buy hand tools: the _____ and the _____.
4. Saws with teeth straight across like chisels and a count of 5, 6, or 7 points per inch are called _____.
5. Pliers are generally divided into _____ and _____.
6. Each of the above categories are divided into _____ or _____.
7. The basic types of adjustable wrenches are _____ and _____.
8. A tool used to cut and remove wood when making a hole for some object is a _____.
9. A tool designed to cut cast iron, rivets and other types of metal is a _____.
10. A tool that guides a saw for accurate cutting is a _____.
11. The three types of chucks in general operation are _____chuck, _____ chuck, and _____chuck.
12. A tool whose function it is to plane smooth, square edges and surfaces, and to plane surfaces that are to be joined together is a _____.
13. Bolts and screws are classed according to _____, _____, _____ and _____.
14. Cap screws come in some of the following styles: _____, _____, button head, and fillister head.

15. Outstanding advantages of alkyd-resins are less amber-colored, providing clearer varnishes and whiter-white paints, and _____.

16. Paints consisting of emulsified resins, varnishes, laquers, and oils and that can be thinned by water are called _____ paints.

17. Shellac is made from the secretion of the _____ bug of _____.

18. Two types of stain that are available are the _____ and _____ stain.

19. Varnish that has stain included in it is called _____.

20. Stripes are good for creating an illusion of a _____ ceiling.

21. In offices, hallways and rooms where period furniture is used, _____ are popular

22. The process of changing the surface texture by pressing raised patterns into paper is _____.

23. Wallpaper hanging stocks come in many weights, ranging from _____ ounce to _____ ounce.

24. Most wallpaper is printed on a type of paper stock that the trade calls _____ stock.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The three general classifications of planes are:

   (A)_____ (C)_____

   (B)_____

2. Three types of carpenter's squares are:

   (A)_____ (C)_____

   (B)_____

3. Electric sanders are divided into:

   (A)_____ (C)_____

   (B)_____

4. The major classes of cabinet hardware:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

5. The five basic types of locking mechanisms are:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

6. The requirements of a good paint are:

(A)_____

(B)_____

(C)_____

(D)_____

(E)_____

7. The principal types of paint coatings are:

(A)_____ (E)_____

(B)_____ (F)_____

(C)_____ (G)_____

(D)_____ (H)_____

8. The three essential parts of paint are:

(A)_____ (C)_____

(B)_____

9. The three main types of varnish are:

(A)_____ (C)_____

(B)_____

10. The five things that must be known in order to estimate the amount of paint needed for a job are:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

11. Give ten tips on successful painting:

(A)_____

(B)_____

(C)_____

(D)_____

(E)_____

(F)_____

(G)_____

(H)_____

(I)_____

(J)_____

ERIC

12. List the different types of patterns found in wallpaper:

(A)_____ (F)_____

(B)_____ (G)_____

(C)_____ (H)_____

(D)_____ (I)_____

(E)_____

13. List five basic methods of printing wallpaper:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

14. List four types of foundations on which wallcoverings are printed or impregnated:

(A)_____ (C)_____

(B)_____ (D)_____

15. List four types of fabric wallpaper:

(A)_____ (C)_____

(B)_____ (D)_____

16. The basic information the salesman must know about the room in order to help the customer is:

(A)_____

(B)_____

(C)_____

(D)_____

Assignment
Sheet No. 11

Covering
Units 109-119

PAPER AND RELATED PRODUCTS

A love letter, a legal form or a formal note communicates the written word through the use of paper. From newsprint to parchment there is a range of quality that calls for well-informed salespeople to interpret needs, satisfy desires and fulfill the intentions of customers. A knowledge of paper products from rags to richly embossed announcements is a reserve of selling power required by an efficient salesperson.

This assignment offers you a study plan about stationery, greeting cards, pens and pencils, and other miscellaneous school supplies.

Assignment:

1. Read the references listed below.
2. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study to extend your knowledge of this merchandise.

References:

A. Wingate, Gillespie and Addison, Know Your Merchandise, pp. 344-358.
B. Information sheet located on the page following these questions.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. It has been estimated that our consumption per capita of paper is 600 pounds each year.

T F 2. Parchment was first made from goatskins and sheepskins.

T F 3. For important papers and documents that must be good indefinitely, 100 per cent rag content pulp is used.

T F 4. In order to achieve a leather-like texture known as vellum finish, the paper is pressed against smooth sheets of leather.

T F 5. It is not very important that envelopes match the color and quality of the letter paper.

T F 6. The United States Post Office Department has banned the use of envelopes less than 4¼ inches long and three inches wide.

T F 7. The most expensive and finest method of imprinting paper is by means of printing.

T F 8. There are 17 degrees of hardness in pencils and 72 shades.

T F 9. The first automatic-feeding fountain pen was invented by Lewis Waterman.

T F 10. More expensive fountain pens have a steel alloy pen point.

T F 11. Ink for ballpoint pens is made from oily substances which fade in time.

T F 12. Carbon is the basic ingredient of India ink.

T F 13. Ferrous sulfate is a coal tar substance used with other chemicals to produce all colors in ink.

T F 14. Better carbons do not smear but cannot be used repeatedly without wearing down their transferring quality.

T F 15. Mimeograph paper is usually sold by the ream but can be broken down as a courtesy to your customers.

T F 16. Stationery for men should be in light pastel colors.

T F 17. Men generally prefer note-size, unfolded sheets of stationery.

T F 18. Airmail envelopes are usually bordered with red and yellow stripes.

T F 19. Manufacture of paper is the nation's fifth largest industry.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Writing material was first developed about 4,000 years ago from a plant known as _____.

2. Vellum is made by a process that is similar to the making of _____.

3. The making of paper was greatly stimulated by the invention of the _____.

4. Most of the moisture is removed from paper by large rollers called _____.

5. Most paper is made from _____.

6. Wood is reduced to pulp by the _____ and _____ process.

7. Rag pulp is known as _____.

8. The first step in the papermaking process is known as _____.

9. Paper that has a high, glossy shine is known as _____ paper.

10. A translucent paper that is grease resistant is known as _____.

11. A characteristic of handmade sheets of paper is a _____ edge which is rough or uneven.

12. On greeting or announcement cards we often find sloping or _____ edges.

13. Small note-sized single or folded sheets which are used for "thank you" notes and similar purposes are called _____.

14. Imitation engraving is sometimes known as _____ or _____.

15. A soft and popularly used number-2 pencil has about two-thirds _____ and one-third _____.

16. A small rod with cut channels for the ink, made of hard rubber or plastic, located under the point of the pen is called the _____.

17. Paper quality is designated by the number of pounds to the _____.

18. Superior-quality paper for business letters is a _____ pound paper.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Four kinds of business stationery are:

   (A)_____ (C)_____

   (B)_____ (D)_____

2. The finishes of stationery generally used by women are:

   (A)_____ (B)_____ (C)_____

3. The two types of greeting cards which a well-rounded stock includes are:

   (A)_____ (B)_____

Information

STATIONERY

Personal stationery comes in several sizes ranging from typewriter size (8½ x 11 inches), club size (7¼ x 10½ inches) and note sizes with varying sizes. Men generally use white typewriter or club size paper of good quality. Women may use any size paper either full sheet or folded sheet. White is most popular but pastel colors, plaids, borders and designs on the paper are also acceptable. In purchasing stationery three major features should be considered. These features are weight and strength of the paper, smoothness of the paper and the finish.

In addition to regular stationery we have air mail stationery which is very thin and light in weight. This stationery was developed because of the importance of weight when mailing by air. Envelopes for this type of stationery are lined to protect the contents from being read. Many times the air mail envelopes will have red and blue stripes on them to call special attention to them in the post office.

Men's stationery generally comes in ripple or vellum finish, while women's may use these two types or a linen finish. Vellum gives a leather-like texture or finish while ripple has an uneven but smooth finish and the linen finish gives an actual imprint of linen fabric on the paper.

Greeting cards have become a half billion dollar business in recent years. Over five billion cards are sold each year in the United States. Each stationery department needs to get its share of this business to be successful. The best way to accomplish this is to have an attractive display of the greeting cards carried in the department, arranged so that the customers may spend time looking over the selection of cards. A well-rounded stock of greeting cards includes daily sellers and holiday cards. Daily sellers include birthday cards, illness, sympathy, anniversary, wedding, graduation and thank you cards. The holiday cards include Christmas, Valentine's Day, Easter, Mother's and Father's Day and Thanksgiving cards.

Business stationery is generally a good quality bond paper with the most common size being 8½ by 11 inches standard typewriter size. Executives sometimes use a 5½ by 8½ memo sheet (called Baronial) or a 7½ by 10½ called Monarch, for semi-social letters. In addition, legal size paper is used on legal matters and its size is 8½ by 14 inches.

Quality in stationery is indicated by the number of pounds per ream. Twenty-four pound substance is considered superior quality and 20 pound quality is considered good for most business uses, while 16 pound substance is average quality and 13 pound substance is light weight and good for business only if it contains 25% rag content.

Second sheets are extra-light in weight. They may be manifold or onion skins. Onion skin is tougher than manifold and has one side

highly glossed. For file size most companies use an inexpensive manila paper often colored. Manifold and onion skin range in weight from eight pounds to sixteen pounds with the lighter used most frequently.

A thinly coated, light weight carbon paper with a hard finish will make the sharpest impression. The heavier standard weights of carbon are easier to handle and wear better. Medium weight carbon paper is most serviceable and therefore preferred for making three or four carbon copies. Heavy carbon paper produces somewhat thickened characters when used in making many copies, but it is very satisfactory when only one carbon is desired.

Duplicating paper may be divided into two types. These are: mimeograph paper and paper for the spirit duplicators. The mimeograph paper comes in a 20 pound weight with an all sulphite soft surface so that the mimeograph ink penetrates easily and dries fast. The paper for spirit duplicator usually has a glossy finish. Both mimeograph and duplicator paper is sold primarily by the ream but may be sold in lesser amounts.

Assignment
Sheet No. 12

Covering
Units 120-129

NATURAL AND SYNTHETIC RUBBER

Rubber is one of the most versatile materials we have today. Chemists can make rubber hard enough for bowling balls, soft enough for pillows, durable enough for truck tires, and thin enough to be transparent.

During World War II, when we could not import sufficient quantities of natural rubber, the government sponsored extensive research to develop rubber substitutes. As a result we now have "synthetic" rubber that has some qualities superior to natural rubber. Many new uses for rubber have been found and many new products are hitting the market each year. The retail salesperson needs to know something about the qualities of these new products so he can help his customers buy intelligently.

In this unit we shall learn about sources and manufacturing processes of rubber, as well as products and their care.

Assignment:

1. Read the reference listed below.
2. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study to extend your knowledge of this merchandise.
3. Answer the questions below and hand in by _____.

Reference:

A. Wingate, Gillespie and Addison, Know Your Merchandise, pp. 319-333.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. The latex is found only in the bark of the tree.

T F 2. The name "rubber" was first used by an English chemist when he found it would "rub" pencil marks off paper.

T F 3. Some natural rubber is obtained from Brazil.

T F 4. A hole is drilled into the tree to tap the latex.

T F 5. Most countries developed rubber substitutes because they were cheaper.

T F 6. Smoked rubber will mold or rot unless it has chemicals added to it.

T F 7. Smoked sheets are stronger than pale crepe.

T F 8. Crude rubber is shipped to the manufacturer in either liquid or solid form.

T F 9. Vulcanized rubber is a good conductor of electricity.

T F 10. Reclaimed rubber must be combined with crude rubber for best results.

T F 11. Excessive amounts of reclaimed rubber will impair the wearing qualities of articles made from it.

T F 12. Many household articles are formed directly from the liquid latex.

T F 13. Liquid latex is less costly to use than solid rubber.

T F 14. Rubber cement has excellent adhesive qualities.

T F 15. Airplane de-icers attached to the wings of planes are made of rubber.

T F 16. Rubber products should be kept dry and free from oil when not in use.

T F 17. Sunlight and heat will deteriorate rubber products.

T F 18. The most important use for rubber has been for tires.

T F 19. The rubber used for making tires today is 100% synthetic rubber.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The annual use of rubber in the United States has grown from less than a pound per person in 1900 to around _____ pounds today.

2. The gummy, milky-looking substance from which rubber is made is called _____ when it is taken from the tree.

3. Rubber was known to the natives of _____ as long ago as the eleventh century.

4. Early uses for rubber were limited because it became _____ in the summer and _____ in the winter months.

5. The process of curing rubber and preparing it for use is called _____.

6. The Far East produces about _____ per cent of the natural rubber used.

7. A rubber tree is not ready for tapping until it has reached _____ years of age.

8. In the United States almost _____ of the rubber used is synthetic rubber.

9. Butadiene is a gas which can be derived from alcohol or _____.

10. A tire is formed by cords made of cotton, _____, or _____.

11. Each layer of the fabric used in a tire is called a _____.

12. The addition of a top layer of rubber cemented to the old worn tire is called _____.

13. It requires more than _____ years supply of natural rubber to make one tire.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Five of the countries of the world that produce a large part of the world's supply of natural rubber are:

   (A)_____ (B)_____ (C)_____

   (D)_____ (E)_____

2. Five common types of synthetic rubber are:

   (A)_____ (B)_____ (C)_____

   (D)_____ (E)_____

3. Name two commercial uses for unvulcanized rubber:

   (A)_____ (B)_____

4. List the basic ingredients for vulcanizing rubber.

(A)_____ (B)_____ (C)_____

5. What qualities of the rubber are improved by vulcanization?

(A)_____ (C)_____

(B)_____ (D)_____

6. Tires are classed according to quality as:

(A)_____ (C)_____

(B)_____ (D)_____

7. Some causes of unnecessary wear and tear on tires are:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____ (F)_____

Assignment
Sheet No. 13

Covering
Units 130-141

PLASTIC PRODUCTS

Many metals have been replaced by plastic discoveries. To most people all plastic is about the same, but this is far from the truth.

Today's plastics are as varied in composition and qualities as the metals they have replaced. Unless the salesperson knows the facts about plastic products there can be no effective sales presentation. In this assignment a study of the chemical composition of the various types of plastics, their uses, qualities and care, is available for strengthening your sales ability.

Assignment:

1. Read the reference given below.
2. Do some research on the possibility of product information available about the plastic products you sell. Bring what you find to your coordinator for his advice in the use of it.
3. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study to extend your knowledge of this merchandise.
4. Answer the questions below and hand them in by _____.

Reference:

A. Wingate, Gillespie and Addison, Know Your Merchandise, pp. 297-318.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Cellophane is a trade name for a type of plastic material.

T F 2. All plastic products are subject to the heat-softening weakness.

T F 3. Plastics are basically produced to serve as a substitute for other materials.

T F 4. After being formed, plastics cannot be changed back to the original chemicals from which they were made.

T F 5. Plastics are natural substances.

T F 6. Most of the household-used plastics are the kind that are made from thermoplastic.

T F 7. Thermosetting means that the material once shaped by the use of heat can not be softened or melted at any temperature.

T F 8. Buttons and dishes can be made by the process of compression molding plastics.

T F 9. Plastic can be extruded into sheets, rods, tubes, or filaments.

T F 10. Casting plastic in lead covered molds is very expensive.

T F 11. Safety glass is made by laminating two plates of glass.

T F 12. Plastic products may be stenciled, printed, painted, or metal plated to impart attractive appearance.

T F 13. Cellulose Acetate is colored and sold as a nail polish.

T F 14. Cellulosics are highly desirable for high temperature uses.

T F 15. Camera and projection film are made from casein plastics.

T F 16. Cellulose acetate plastics are affected by moisture.

T F 17. Cellophane is not a true thermoplastic nor is it moisture proof unless a special lacquer coating is applied on its surface.

T F 18. Casein plastic can be made to imitate semi-precious stones.

T F 19. Carved plastic designs may be made in acrylic resin.

T F 20. Lucite and Plexiglas are made from two quite different combinations of ingredients.

T F 21. Vinyl resin plastic is always an elastic material.

T F 22. Vinyl plastics are recommended for objects which can be constructed with sewing of seams.

T F 23. Nylon is limited to uses in textile forms.

T F 24. Nylon will resist boiling temperatures.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The name of the first plastic material was _____.

2. The object that was the first use of plastic was _____ ball.

3. Casein plastic was developed by using sour milk and _____.

4. The substance in Bakelite are formaldehyde and _____ acid.

5. The word "plastic" is descriptive of a material that can be _____.

6. Two types of plastic are thermoplastic and _____.

7. Two substances that may go into the making of cellulose plastics are _____ or _____.

8. When plastics do not need to be very strong or to support heavy weight, they may be formed by pouring them into _____ steel molds.

9. Fountain pens and imitation jewelry are examples of _____ plastics.

10. Regenerated cellulose is best known in its fiber form as _____, and it is also known as _____, a packaging material in the form of transparent sheets.

11. Cellophane wrapping paper can be made water-proof with a coating of _____.

12. The type of plastic known as Plexiglas is _____.

13. The "elastic plastic" is the popular name for _____.

14. Foamed vinyls known as _____ have been used as insulation in household products and in clothing as protection against cold weather.

15. Styrene plastic may be identified by a _____ sound when tapped, or _____ smoke when burned.

16. Polyethylene has a rather recent discovery date of _____.

17. Once having been set by heat into any given form, the _____ plastics can never be melted.

18. Molded Phenolics are used for handles and bases because they remain cool and do not conduct _____ or _____.

19. Familiar trade names of cast Phenolics are Gemstone, _____, and _____.

20. Urea is derived from _____ and _____.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Some of the very early uses of plastic were:

(A)_____ (E)_____ (I)_____

(B)_____ (F)_____ (J)_____

(C)_____ (G)_____ (K)_____

(D)_____ (H)_____ (L)_____

2. Three common ingredients used in making plastics are:

(A)_____ (C)_____

(B)_____

3. List six methods of shaping plastics:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____ (F)_____

4. The forms in which a plastic manufacturer ships the product to fabricators are:

(A)_____ (C)_____

(B)_____ (D)_____

5. Some objects that are made from laminating plastics to fabrics are:

(A)_____ (C)_____

(B)_____ (D)_____

6. The major points to know about the care of plastics are:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____ (F)_____

7. The most common varieties of cellulosics are:

(A)_____ (C)_____

(B)_____ (D)_____

8. Some uses of the nitrocellulose plastic are:

(A)_____ (E)_____

(B)_____ (F)_____

(C)_____ (G)_____

(D)_____ (H)_____

9. The disadvantages of nitrocellulose are:

(A)_____ (C)_____

(B)_____

10. The ingredients of acrylic resin are:

(A)_____ (C)_____

(B)_____

11. The desirable qualities of acrylic resin plastics are:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____ (F)_____

12. The plastics that will carry light around curves are:

(A)_____ (B)_____

13. The desirable qualities of vinyl resin are:

(A)_____ (E)_____

(B)_____ (F)_____

(C)_____ (G)_____

(D)_____

Assignment
Sheet No. 14

Covering
Units 142-150

LEATHER GOODS

The tanned skin of a bathing beauty and the tanned skin of Daniel Boone's old leather shirt are far from the same thing. The many skins that are tanned, the many processes of tanning, and the many products made from tanned skins call for a wide knowledge by the seller of leather goods.

Leather has been used by man as clothing for a long time. Long ago man procured and processed his own leather objects, but today the user seldom knows anything about the materials. This information must be passed on by an informed salesperson.

The sources, preparation processes, kinds, qualities and care of leather goods are covered in this assignment.

Assignment:

1. Read the reference listed below.
2. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study to extend your knowledge of this merchandise.
3. Answer the questions below and turn in this assignment by _____.

Reference:

A. Wingate, Gillespie, Addison, Know Your Merchandise, pp. 359-379.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. The use of skins of animals for articles of clothing dates back to the time of primtive man.

T F 2. Bristles removed from calf skin leave noticeable holes which are characteristic of that leather.

T F 3. The flesh side, in addition to its attractive appearance, is more durable, firmer, and smoother than the non-flesh side.

T F 4. Suede is produced by raising all fibers to a uniform height.

T F 5. The center back section of most animals produce the best leather.

T F 6. Leather is obtained after the animal has been used for its milk and meat, and thus is comparatively low in cost.

T F 7. Skins of animals come from all over the world to American tanneries.

T F 8. Chamois skins used for gloves and cleaning purposes are tanned by the oil-tanning method.

T F 9. Vegetable tanned leather is a recent development.

T F 10. Vegetable tanning is quite expensive due to the long tanning period.

T F 11. Leather tanned by the alum process can be used immediately for the making of gloves or shoes.

T F 12. Chrome tanned leather is not very durable.

T F 13. Vegetable-tanned soles for shoes do not soak up water or become slippery as easily as do leathers tanned by chrome tanning methods.

T F 14. Chrome tanned leathers are generally washable.

T F 15. Formaldehyde-tanned leathers are generally not washable.

T F 16. Skins that are too thick are sometimes split into two or more layers, all of which are used to make leather articles.

T F 17. Top-grain leathers usually have a rougher, coarser appearance than the splits.

T F 18. When a nap is raised on leather, it is usually done on the grain side.

T F 19. The process using heat and pressure to stamp artificial grain on leather is called embossing.

T F 20. Patent leather lacks the elasticity and porosity of other leathers.

T F 21. Patent leather should have a small amount of grease applied to it occasionally to prevent drying out.

T F 22. Calfskin produces a smooth-surfaced, fine-grained, firm leather.

T F 23. "Saddle leather" is vegetable-tanned calfskin or cowhide.

T F 24. The more noticeable the grain marks in kidskin the better the leather.

T F 25. Kidskin is excellent for gloves and shoes.

T F 26. Gold kid is produced by pounding thin gold leaves into the grain side of the skin until it becomes part of the leather.

T F 27. Morocco leather means kidskin that has been boarded to give a fine, pebbly surface to the leather.

T F 28. Leather made from kangaroo skin is stronger than leather made from kidskin.

T F 29. Sheepskin is more durable than most other leathers and does not stretch as much.

T F 30. Chamois skins are made from the undersplit or "fleshier" part of the sheepskin which has been oil tanned.

T F 31. Capeskin is not as durable as sheepskin.

T F 32. Animals known as the peccary are the main sources of pigskin.

T F 33. The best baseball covers and baseball mitts are made from pigskin.

T F 34. Domestic pigskin is used only for heavy work gloves.

T F 35. Walrus leather is very thin.

T F 36. Sharkskin is noted for its scuff resistance.

T F 37. The best alligator skin comes from the animal's back.

T F 38. Ostrich skins are quite expensive.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The term applied to preserving of the skins of animals is _____.

2. The side next to the flesh of the animal is known as the _____ side.

3. In the leather trade, animals whose skins weigh 15 pounds or less when they are shipped to the tannery are referred to as _____.

4. Skins that weigh between 15 and 25 pounds are called _____.

5. Skins that weigh over 25 pounds are called _____.

6. The center back section of cowhide is known as the _____.

7. Imitations of leather are frequently made from plastic materials such as nitro-cellulose lacquer or vinyl resin which is coated over _____ or _____.

8. The epidermis, the natural oils and the liquids of the skin are removed, leaving only the dermis, or _____ to be tanned.

9. In vegetable tannage, the substance causing the chemical change which converts the skin into leather is _____.

10. If you look at the cut edge of a piece of leather and see a tan colored streak, this indicates the leather was _____ tanned.

11. Alum-tanned leather, when it emerges from the tanning process, is _____ in color.

12. Chrome tanning requires _____ to _____ hours to change the skin to a leather.

13. A pale, bluish gray streak in the center of a piece of cut leather indicates it was _____ tanned.

14. Formaldehyde-tanned leather is _____ in color when it emerges from the tanning process.

15. Processes that make the skin pliable and beautiful are known as _____ processes.

16. All leathers except those that have been oil-tanned have _____ oil or _____ oil added to them to keep them soft.

17. The process of running leather through a press which imparts a high shine to it is called _____.

18. The process of folding and creasing leather is called _____.

19. Doeskin-finished lambskin and mocha leathers are napped on the _____ side.

20. Patent leather is made by putting a _____ coating on the leather.

21. Suede articles should be brushed with a _____ or _____ in a circular movement.

22. Leather articles not marked washable should be cleaned by the _____ process.

23. Cowhide which is pre-tanned and oiled but not actually tanned is known as _____.

24. Sheepskin that is tanned with some of the wool left on it is known as _____ or _____.

25. A tough outer layer of sharkskin with a beadlike grain sometimes used in novelty leather items is called _____.

26. The proper term for any whole-grain or top-grain leather is _____ leather.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. Nine "selling points" of leather are:

(A)_____ (D)_____ (G)_____

(B)_____ (E)_____ (H)_____

(C)_____ (F)_____ (I)_____

2. Five methods used in tanning leather are:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

3. Six objects made from kidskin are:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____ (F)_____

4. Three uses for snakeskin and lizard skins are:

(A)_____ (C)_____

(B)_____

Assignment
Sheet No. 15

Covering
Units 151-171

COSMETICS

The use of cosmetics by American women increases steadily each year. The modern retailer cannot overlook this natural ever-present market for cosmetics. The many facts about this merchandise are vital to a salesperson who will be facing expert customers across the cosmetic counter.

This assignment will provide a basic knowledge of the types, composition, uses, and qualities of lotions, powders, creams, rouges, lipsticks and nail polishes.

Assignment:

1. Read the references listed below.
2. Confer with your coordinator as to the availability of the more extensive study guide, Toiletries Manual, published by the University of Texas, or Selling Cosmetics, published by the University of Alabama. If available, make arrangements to follow these guides in a much more detailed study of cosmetics after completing the questions in this assignment.
3. Ask your coordinator about the possibility of obtaining a free rental film for those of you who are interested in this merchandise. The Distributive Education Bibliography Supplement suggests some of these for Cosmetics on page 128.
4. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study to extend your knowledge of this merchandise.
5. Answer the questions below and turn the answers in by _____.

References:

A. Wingate, Gillespie and Addison, Know Your Merchandise, pp. 495-521.
B. Prentice-Hall, Inc., Facts About Merchandise, pp. 123-129.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Consumers spend about a billion and a half dollars yearly on cosmetics in the United States.

T F 2. Customers purchasing cosmetics are interested in their effect.

T F 3. Cosmetics to the average man is a term including only rouge, lipstick and powder.

T F 4. Only women use cosmetics.

T F 5. The Federal Food, Drug and Cosmetic Act which stopped exaggerated advertising caused big reduction in the sale of cosmetics.

T F 6. Cosmetic ingredients may cause allergies that are of lasting damage and difficult to cure.

T F 7. The scales that peel off of the skin surface are layers of the dermis.

T F 8. The human pores do not all contain a hair but the oil of a gland is still present.

T F 9. Cosmetics are capable of stopping the secretion of oil in the pores of the skin.

T F 10. Cosmetics may be used to rebuild the fatty tissue in the dermis and prevent the wrinkles that develop with age.

T F 11. The duty of the dermis is to protect the epidermis.

T F 12. Cosmetics have been developed to penetrate the skin's surface and nourish the dermis.

T F 13. Chemistry is the basis of all cosmetic products.

T F 14. The different types of soaps are determined by the oil and alkali used.

T F 15. All colored and perfumed soaps are made of finer ingredients than white, unperfumed soaps.

T F 16. The term "castile" means that olive oil has been used in the soap.

T F 17. Soap cleans because it makes water "wetter" and releases dirt easily.

T F 18. Floating soaps are usually white in color and have no perfume added.

T F 19. Silk and woolen fabrics are harmed by the presence of alkali in some laundry soaps.

T F 20. Shampoos are considered cosmetics.

T F 21. Coconut oil in shampoo leaves a lovely shine on the hair.

T F 22. Calgon helps soften water.

T F 23. Water softeners must be used with detergents.

T F 24. Ammoniated dentrifices assures better teeth cleaning.

T F 25. Fluorine chemicals are not recommended by the American Dental Association in preventing tooth decay.

T F 26. Dentrifices are effective in countering the various causes of bad breath.

T F 27. Tooth whiteners may contain acids harmful to tooth enamel.

T F 28. Perfumes are antiseptics.

T F 29. Perfume will not stain clothing.

T F 30. Deodorants are more harmful to clothing than anti-perspirants.

T F 31. Night creams and Emollient creams are the same thing.

T F 32. Hand lotions protect the hands by leaving a greasy film.

T F 33. Tanning agents are all drugs.

T F 34. Talc dust may be harmful if breathed into the lungs.

T F 35. Liquid-base makeup is an oil suspension of coloring matter.

T F 36. Lipsticks are a heavy cream with an addition of coloring matter.

T F 37. Liquid mascara is soluble in water.

T F 38. All oil should be removed from the nails before applying polish.

T F 39. All substances used in hair dyes are approved by the Department of Agriculture.

T F 40. Vegetable dyes are harmless.

T F 41. Color restorers are merely hair dyes.

T F 42. No known cosmetic can restore hair.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. The customer for cosmetics is not purchasing chemicals, but a jar of _____.

2. The dermis or true skin is protected by the _____.

3. Cosmetics applied to the skin and hair serve only to keep them smooth, clean and _____.

4. Many of the leading cosmetic houses hire and train their own salespeople who are known as _____.

5. The basic formula for soap is _____ plus _____ equal soap and glycerine.

6. Colored and perfumed soaps are made by a process known as _____.

7. Products that clean without usual fats and oils are known as "soapless soaps" or _____.

8. Scented bath salts perform two functions: impart a delightful aroma to the bath and _____.

9. Toothpastes are made into paste form by the addition of _____ to the tooth powder.

10. Perfumes are sold in "bulk" by the _____ or already packaged.

11. Perspiration has an unpleasant odor because of _____ on the skin.

12. Chemicals that deflect perspiration to some other area of the body, as well as serving as a deodorant, are known as _____.

13. A _____ pencil acts to close the cuts after shaving.

14. Creams may be broken down into two broad classifications: _____ and _____ creams.

15. A white, thick, opaque-looking cream that is pleasant and smooth to apply is a _____ cream.

16. Vanishing cream has a _____ base.

17. The base for most powder in use today is _____.

18. Talcum powder is usually pure talc with a little _____ added.

19. Too much starch in a powder may cause it to _____ on the face.

20. Most hair bleaches contain _____ and _____.

21. To remove hair permanently one must use the _____ process.

22. In 1938 the _____ was passed to protect consumers, relative to truthfulness of claims made by advertisers.

23. Perfume that has been diluted with water is called _____.

24. The outer layer of the hair is called _____.

25. The inner layer of the hair is the _____.

26. The two types of home waves available are the _____ and _____ permanent.

27. Nail-polish remover consists of a _____, a _____, and acetone.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The seven main types of perfume odors are:

   (A)_____ (E)_____

   (B)_____ (F)_____

   (C)_____ (G)_____

   (D)_____

2. List three disadvantages of tanning liquids:

   (A)_____ (C)_____

   (B)_____

3. The common methods of removing hair are:

   (A)_____ (C)_____

   (B)_____

4. List the various types of soaps:

   (A)_____ (E)_____

   (B)_____ (F)_____

   (C)_____ (G)_____

   (D)_____

5. List the products necessary to a well-manicured hand:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____ (F)_____

ERIC

Assignment
Sheet No. 16

Covering
Units 172-183

JEWELRY

African natives, army generals, and American women all want to be decorated. These additions to a woman's attire are selected with caution and exactness. Then they become precious, priceless, fabulous, and flattering jewelry.

The jewelry counter represents a tremendous investment in slow-moving merchandise. This challenges the salesperson to really sell, not just dust and polish. The need for technical information includes facts about precious metals and valuable stones. This assignment presents selling information on the types, composition, production, grades and care of jewelry merchandise.

Assignment:

1. Read the references given below.
2. Select a specific line of jewelry and write the company for merchandise information designed to help you sell their product.
3. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study to extend your knowledge of this merchandise.
4. Answer the questions below and hand in by _____.

References:

A. Wingate, Gillespie and Addison, Know Your Merchandise, pp. 462-491.
B. Prentice-Hall, Inc., Facts About Merchandise, pp. 112-121.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Inexpensive men's jewelry is a type of costume jewelry.

T F 2. Anodizing imparts a permanent shine and lustre.

T F 3. Platinum tarnishes badly.

T F 4. Platinum darkens the skin.

T F 5. Platinum may be replaced by palladium which is similar in appearance.

T F 6. Platinum is more expensive than palladium.

T F 7. Rhodium is the most costly of all the platinum family metals.

T F 8. Rhodium is used for plating only fine jewelry.

T F 9. Copper in gold jewelry causes the skin to turn green.

T F 10. Gold can be hammered into sheets so thin that they cannot be picked up by hand.

T F 11. Twenty-four Karat gold would be over 100 per cent gold or solid gold.

T F 12. Twenty-two Karat is the finest quality gold used in jewelry.

T F 13. The term "Karat" may not be used if the proportion of gold is less than 10/24 or 10 Karat.

T F 14. In order to be called gold filled, the layer of karat gold must weight at least 1/20 of the weight of the entire metal used.

T F 15. Gold filled articles give good service.

T F 16. Gold filled jewelry gives twice to four times the wear of rolled-gold items.

T F 17. Platinum is heavier than silver.

T F 18. A great disadvantage of silver is that it tarnishes.

T F 19. Solid silver does not mean pure silver.

T F 20. Sterling silver means pure silver.

T F 21. Jewelry made by hand is most expensive.

T F 22. It is a simple matter to tell a real stone from a synthetic stone.

T F 23. Imitation stones are found in costume jewelry.

T F 24. If a stone will scratch glass this means it is a diamond.

T F 25. A diamond is almost pure carbon.

T F 26. Heat or chemicals may be used to artificially color some stones.

T F 27. The more facets on a stone the less expensive it becomes.

T F 28. The brilliant cut is expensive.

T F 29. The shape of the stone is determined by the shape of the original "rough" stone.

T F 30. The step or emerald cut is useful for diamonds.

T F 31. Most stones are measured by the carat weight.

T F 32. Rings are often lost when left on washbasins.

T F 33. Synthetic jewels are used in most jeweled movements in watches.

T F 34. The way you hold jewelry when showing it to the customer makes little difference.

T F 35. In displaying expensive diamonds, no more than three should be brought out at one time.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Jewelry is divided into inexpensive, which is known as _____ jewelry, and expensive, which is known as _____ jewelry.

2. Metals used in jewelry are divided into _____ metals and _____ metals.

3. When two or more metals are heated and mixed together it is known as an _____.

4. The most popular color used for jewelry is _____.

5. Of all metals, _____ is considered the most desirable for settings for diamonds.

6. Coin silver is nine parts silver to _____ part(s) of a hardening alloy.

7. Settings with a plain band of metal around the edges of the stone are known as _____ settings.

8. Inexpensive stones may be glued into the setting and are known as _____ settings.

9. When a pale stone is glued over a deeper colored stone or a colored piece of glass, it is to enrich the color of the stone, and it is called a _____.

10. When a piece of glass is inserted between two layers of stone it is known as a _____.

11. Another name for the cutter is _____.

12. Transparent stones are usually _____.

13. The final cut shape is selected to make the largest possible stone from this unfinished _____.

14. The _____ is made from uniform or graduated beads or from metal links and fits snugly around the neck.

15. Rings with stones which may or may not be colored and have fancy shapes and are appropriate for evening and dress-up wear are _____.

16. Better quality watches are known as _____ movement watches.

17. A trade term for a substitute for white metal is "_____".

18. The parts of the ring are the _____, the _____ and the shoulders.

19. The two major parts to a watch or clock are the exterior and the _____.

20. The jewelry center of the United States is located at _____.

21. Jewelry should be shown to the customers on a _____.

Matching

Directions: In the left hand column is a list of the months of the year. The right hand column contains the names of the stones that are traditionally associated with a month of a year. Match the stone to the month of the year by placing the letter of the stone in the blank at the left of the appropriate month.

_____	1.	January	A.	Ruby
_____	2.	March	B.	Sardonyx or peridot
_____	3.	May	C.	Sapphire
_____	4.	July	D.	Garnet
_____	5.	September	E.	Amethyst
_____	6.	November	F.	Bloodstone or aquamarine
_____	7.	February	G.	Turquoise or lapis lazuli
_____	8.	April	H.	Topaz or yellow quartz
_____	9.	June	I.	Opal or tourmaline
_____	10.	August	J.	Diamond
_____	11.	October	K.	Emerald
_____	12.	December	L.	Pearl or moonstone

5. List five means of identifying stones:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

6. List the various types of necklaces:

(A)_____ (E)_____

(B)_____ (F)_____

(C)_____ (G)_____

(D)_____ (H)_____

7. Jewelry is purchased on the basis of the following five reasons:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

8. Give the three ways in which gold is prepared for use:

(A)_____ (C)_____

(B)_____

9. List eight types of setting for jewelry:

(A)_____ (D)_____ (G)_____

(B)_____ (E)_____ (H)_____

(C)_____ (F)_____

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the members of the platinum family:

   (A)_____ (C)_____

   (B)_____

2. List the base metals that are used in fine jewelry:

   (A)_____ (E)_____

   (B)_____ (F)_____

   (C)_____ (G)_____

   (D)_____ (H)_____

3. List the qualities that determine a good setting:

   (A)_____

   (B)_____

   (C)_____

   (D)_____

   (E)_____

   (F)_____

4. The qualities of a beautiful stone are:

   (A)_____

   (B)_____

   (C)_____

5. List five means of identifying stones:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

6. List the various types of necklaces:

(A)_____ (E)_____

(B)_____ (F)_____

(C)_____ (G)_____

(D)_____ (H)_____

7. Jewelry is purchased on the basis of the following five reasons:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

8. Give the three ways in which gold is prepared for use:

(A)_____ (C)_____

(B)_____

9. List eight types of setting for jewelry:

(A)_____ (D)_____ (G)_____

(B)_____ (E)_____ (H)_____

(C)_____ (F)_____

Assignment
Sheet No. 17

Covering
Units 184-197

CLOTHING ACCESSORIES

If you want to know how important this department is, ask the window trimmer; or count the number of places in the store which have this merchandise on display. Almost every ready-to-wear showcase and window has in it many small items of clothing or personal adornment, such as neckwear and scarfs, artificial flowers, handbags, or gloves. These items are classified as accessories.

People who sell accessories must be artistic and up-to-the-minute on fashions. They need to know how to put their knowledge of style, color, and design into action when they assist customers. Accessories are to dresses, suits, and coats what salt is to vegetables and meat. They give flavor and distinction to the whole outfit.

In this unit you will have a chance to obtain a better knowledge of this group of merchandise and you will be better able to help women select the articles which suit their needs, tastes, and the season's dictates. You will also be better able to help men select gifts for women.

Assignment:

1. Read the references listed below.
2. After studying this assignment and from what you have learned on your job, make a list of twelve selling phrases that are appropriate for use in selling various accessories which your store carries.
3. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study to extend your knowledge of this merchandise.
4. Ask your coordinator about the possibility of obtaining a free rental film for those of you who are interested in this merchandise. The Distributive Education Bibliography Supplement suggest some of these for Women's Accessories.
5. Answer the questions below. Complete items 2 and 3 and turn in by _____.

References:

A. Wingate, Isabel B., Textile Fabrics and Their Selection, pp. 449-452, 474-477.
B. Wingate, Gillespie and Addison, Know Your Merchandise, pp. 209-216, 226-230.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Flowers on coats and dresses are often made of the same material as the coat or dress.

T F 2. Handkerchiefs cut by machine are considered better than hand-torn because their dimensions are more even.

T F 3. The careful buyer selects a handkerchief for a particular occasion.

T F 4. Few handbags are made of textile fabrics.

T F 5. Fabric bags are often popular for summer use.

T F 6. A "pure Irish linen" handkerchief is the best money can buy.

T F 7. Men prefer leather gloves over fabric gloves.

T F 8. Most outfits for street wear look more attractive when women wear an appropriate hat.

T F 9. Rabbit fur is used for the majority of fur hats.

T F 10. Wool felts are soft to the touch and are used in expensive millinery.

T F 11. Both natural and synthetic straws are used for millinery.

T F 12. Stores may change their entire stock of millinery every few weeks.

T F 13. A calot is a small skull cap made from fabric or felt.

T F 14. Many styles of hats fit all head sizes.

T F 15. A hat that fits too snugly may cause a headache.

T F 16. Older men in higher income brackets form the best market for hat sales.

T F 17. A large number of men prefer to go hatless.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Common materials used in millinery are _____, _____, _____, and _____.

2. Handkerchiefs for men may be classified as _____, _____, and _____.

3. Most belts are made of leather or a nontextile plastic, but some are made of a heavy cotton called _____.

4. Straw hats are worn from _____ to _____.

5. Women's hats may be trimmed with _____, _____, and _____.

6. A firm large-brimmed hat which resembles a wheel is a _____.

7. A hat commonly made from felt with a stiff rounded crown and a small rolled brim is a _____.

8. A tall brimless hat made from felt, straw, fur, or soft materials over a frame is a _____.

9. A brimless hat made from fabric draped gracefully around the head is a _____.

10. Men's hats come in three shapes, _____, _____ and _____.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. When buying a handkerchief, the following points should be considered:

(A)_____ (C)_____

(B)_____ (D)_____

2. Important factors in selecting hats that are becoming are:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

3. List three types of hats men wear for formal occasions:

(A)_____ (B)_____ (C)_____

Assignment
Sheet No. 18

Covering
Units 198-206

LINGERIE

The salesgirl who finds herself in the lingerie department is surrounded by many items necessary to every woman's wardrobe, and is also in the midst of luxurious gift items.

Several factors guide the woman in her selection of lingerie. Fashion is not nearly so important as in the case of outer garments. Women want dainty, attractive items of lingerie that are easy to care for. They want the garment to be comfortable, the correct size, one that will stay in place, and not be irritating. Serviceability and price are also factors that often enter into the choice of the garment.

In this assignment you will obtain selling information which must be right at the tip of your tongue. Each customer will be looking for special features. Knowing these features will be your best sales ammunition. It will help you to sell your brands and meet competition. After studying this assignment you will be able to offer some practical advice,too. You can tell the customer how to take care of her lingerie and thus get the most service from it.

Assignment:

1. Read the references listed below.
2. Make a list of ten or twelve phrases that will help push the sale of hosiery or lingerie.
3. Make a list of ten or twelve phrases that will help the customer care for hosiery or lingerie and thus lengthen its life.
4. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study to extend your knowledge of this merchandise.
5. Answer the questions below. Complete items 2, 3, and 4 and turn in by _____.

References:

A. Wingate, Isabel A., Textile Fabrics and Their Selection, pp. 438-448.
B. Wingate, Gillespie and Addison, Know Your Merchandise, pp. 166-183.

Questions

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Undergarments should not stick or cling to the outer garment.

T F 2. Machine-rolled hems are considered to be better than hand-rolled hems.

T F 3. Cotton makes a better-molded hipline than does rayon or nylon.

T F 4. Nylon, acetate and rayon can be laundered in an automatic washer.

T F 5. Nylon lingerie should be washed often and then wrung or spun-dry.

T F 6. The amounts, type, and quality of the trim accounts for some of the differences in prices of slips.

T F 7. Woven slips predominate.

T F 8. When possible, a slip should be tried on in the store to be sure it fits.

T F 9. The fit of the dress is not effected by the foundation of the garment.

T F 10. The term "lisle" means that the hosiery or part of it is cotton.

T F 11. Nylon has virtually replaced silk.

T F 12. In full-fashioned hosiery the fabric is narrowed to fit the ankle by knitting two stiches as one to decrease the number.

T F 13. Circular knit hose have fashion marks on each side of the hose, of the heel, and on the sole under the arch of the foot.

T F 14. Circular knit hosiery usually fits better than full-fashioned hosiery.

T F 15. For men the circular knit hosiery is preferable.

T F 16. A hose that has an irregularity in dimension, size, color, or weave is a "second".

T F 17. If nylon stockings are made properly they will measure the same length on any size leg.

T F 18. Since the high-gauge hose has more stitches to the inch, there is less durability and snag resistance.

T F 19. The higher gauge number, the finer the stocking.

T F 20. Denier refers to the weight of the yarn used in stockings.

T F 21. Since nylon is a weak fabric, all sheer nylon hosiery is reinforced in the toe, heel and sole.

T F 22. Hosiery dyed in the yarn has more even brilliance than that dyed in the piece.

T F 23. Cotton undergarments cling to the body better than nylon or rayon.

T F 24. Styles in underwear are not subject to the dictates of fashion.

T F 25. Some women cannot wear nylon hosiery because they are allergic to the nylon.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Another term for a jersey or knitted material is _____.

2. If the nylon's appearance is improved by ironing, the temperature control should be set to _____.

3. The stiffness of a bouffant nylon petticoat is fast to washing because of the _____ _____ finish.

4. Slips are either _____ length or _____ lengths.

5. Sizes in slips run according to _____ measure.

6. Sizes of gowns and pajamas are determined by the _____ measure.

7. For a woman wearing a size 14 dress, a size _____ slip should be selected; for a size 16 dress, a size _____ slip; and so forth.

8. The items of apparel that control and support the figure are specially classed as _____ garments.

9. A professional _____ should be consulted in the fitting of a corset.

10. Cotton fabrics for foundation garments are preshrunk so that no more than _____ shrinkage can be expected in length or width.

11. The two types of panties are _____ and _____.

12. Elasticized panties, sometimes called panty _____, are made of power net, spandex synthetic, or rubber elastic yarns.

13. The standard length of women's hosiery is _____ inches from the heel to the top of the garter belt.

14. With nylon and rayon hose, sheerness is measured by _____.

15. The stretch crosswise at the top of the garter belt in women's hosiery should be _____ to _____ inches when measured flat.

16. Styles in stretch hose include (1)_____, (2)_____, (3)_____ weights.

17. Stockings advertised for relieving those who suffer from foot and leg fatigue are referred to as _____ hosiery.

18. Petticoats are sometimes called _____.

19. The sizes of petticoats are according to _____ measurements.

20. The size 6 panty is a _____ inch hip measurement.

21. Another name for tights is _____.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. The chief points to notice in judging workmanship of an undergarment are:

   (A)_____ (C)_____

   (B)_____

2. Fabrics commonly used for underwear generally fall into two main classifications. List these two classifications:

   (A)_____

   (B)_____

3. List four selling points for women's and girls' underwear:

   (A)_____ (C)_____

   (B)_____ (D)_____

4. List the kinds of foundation garments:

   (A)_____ (D)_____

   (B)_____ (E)_____

   (C)_____ (F)_____

Assignment
Sheet No. 19

Covering
Units 207-218

LADIES' OUTERWEAR

The well-dressed woman of today is always juggling these elements--silhouette, color, fabric texture and accessories. She studies her figure and her coloring, the current styles and colors, and then chooses only those lines and colors that are becoming to her. The designs are almost limitless, the choice of fabric is up to the woman, but the result of careful selection can be very personal fashion success.

Women who dress smartly do not always choose clothes that are expensive, startling fashions, but more often select medium-priced, well-made, handsome classics that will wear and be in style for several seasons; for example, the little black basic dress, the grey flannel suit, and the shirtwaist dress. Certainly these are symbols of good fashion taste found in the American woman of today.

In this assignment you will have an opportunity to learn about fashion elements--silhouette, color, and fabrics, and how to select or help other women select the clothes which are appropriate.

Assignment:

1. Read the references listed below.
2. Answer the questions below and turn in this assignment by _____.

References:

A. Wingate, Textile Fabrics and Their Selection, pp. 417-438.
B. Wingate, Gillespie and Addison, Know Your Merchandise, pp. 184-207.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Fabric is a main factor to consider in judging the fashion rightness of a garment.

T F 2. The silhouette or outline of a garment remains constant from season to season.

T F 3. Sweaters should be fitted one size larger than the dress size.

T F 4. Sportswear is usually the least popular of the American women's wardrobe.

T F 5. Velvet texture is one of the most luxurious of all textures.

T F 6. The vertical lines of the dress design should run parallel with the warp.

T F 7. The filling yarns in the sleeves and blouse should run similarly (crosswise).

T F 8. Arm holes in blouses fit better if they are cut low.

T F 9. A tall, mature woman with full hips, arms, and bust would wear a stout size.

T F 10. When selling blouses the customer should try them on.

T F 11. Skirts are sold by hip measurement.

T F 12. Skirt fabrics are usually heavier than blouse fabrics.

T F 13. Certain classic styles of suits are good for many seasons.

T F 14. Suits have a fully lined jacket.

T F 15. A cardigan sweater slips over the head.

T F 16. A fashioned sweater refers to the seam construction.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. In the purchase of their apparel, most women seek primarily for _____ and _____.

2. Any plain weave cotton cloth, ranging from the sheerest batiste to the coarsest sheeting is called _____.

3. Women's shirts are cut on the straight, _____, or circularly.

4. Bulky cable stitch and cowl neck sweaters are usually of the _____ style.

5. An _____ usually consists of a suit with a three-quarter-length coat over it.

6. Active sportswear can be classified as garments for _____ and _____ sports.

7. Side seams on a dress should be _____ inch wide, waist seams should be _____ inch wide, and hem seams should be _____ inches wide.

8. Dresses for the normal, mature woman's figure are classed as the _____ sizes.

9. The two classic styles of sweaters that every store must carry are the _____ and _____.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the requirements for good garment construction:

(A)_____

(B)_____

(C)_____

2. The size ranges in women's outer apparel are:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

3. List the Crisp Fabrics used in dresses:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

4. List the sheer fabrics used in dresses:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

5. List the velvets used in dresses:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

6. List the selling points of a good blouse:

(A)_____

(B)_____

(C)_____

(D)_____

(E)_____

7. List the selling points of sweaters:

(A)_____

(B)_____

(C)_____

(D)_____

(E)_____

(F)_____

Assignment
Sheet No. 20

Covering
Units 219-231

MEN'S AND BOYS' WEAR

"Clothes make the man" is an often-quoted saying. For the salesman, this may be enlarged upon to say "the salesman who knows which clothes meets his customer's needs makes the sales". The male customer of clothing probably depends upon the advice and knowledge of the salesman more in the selection of clothes than any other article. This customer may not know exactly what he needs and wants, but he is quite positive in his degree of satisfaction with his purchase. It is especially true in this area that a satisfied customer is a repeat customer.

A familiarity with merchandise, styles, and the customer's individual needs is a "must" to be a successful salesman which the customer calls upon time and again to assist in making the right decision.

This assignment presents information about men's and boys' clothing, men's buying habits, and fitting techniques that a store clerk must possess before he can be called a salesman.

Assignment:

1. Read the references listed below.
2. With the help of your instructor, select a project that will help you in gaining information as to latest trends and styles in this rapidly changing merchandising area.
3. Confer with your coordinator as to the availability of the Men's Furnishings and Men's Wear, published by the University of Texas. If available, make plans to study these with the aid of the assignments prepared for them or the assistance of your coordinator.
4. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study to extend your knowledge of this merchandise.
5. Answer the questions below and turn in the assignment by _____.

References:

A. Wingate, Isabel B., Textile Fabrics and Their Selection, pp. 460-491.
B. Wingate, Gillespie and Addison, Know Your Merchandise, pp. 218-241.

Questions;

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Men in general have become more fashion conscious in this country.

T F 2. Businessmen need two distinct types of wardrobes.

T F 3. It was found in measuring boys for clothes, that hips are a better indicator than chest.

T F 4. Shrinkage of one per cent or less in a shirt is enough to make the collar uncomfortable.

T F 5. Collars generally come in a button-down, tab or spread style.

T F 6. An active school boy prefers shirts with tails.

T F 7. Sweat shirts may not be classified as a kind of sport shirt.

T F 8. Workmanship affects the durability of a shirt.

T F 9. A button cuff on a shirt will outwear the double or French cuff.

T F 10. Double cuff shirts are easier to iron than those with single cuffs.

T F 11. Most men place price as the first consideration in buying shirts.

T F 12. A tie made of a fabric cut on the bias will hold its shape better than one cut on the straight of the material.

T F 13. Knitted ties stay tied better than woven materials.

T F 14. Rayon, acetate, cotton and weighted silk ties wrinkle badly and do not hand out.

T F 15. A large size pair of men's shorts would be approximately 36 to 40 inches.

T F 16. Comfort is not too important in purchasing underwear.

T F 17. One disadvantage of a blend of synthetic and natural fiber is that it takes much longer to dry after laundering than natural fiber alone.

T F 18. A bathrobe and lounging robe serve about the same purpose; however, the lounging robe is better-appearing, as it is made out of more luxurious material.

T F 19. Women who influence the purchase of men's and boys' suits are credited with knowing much about fabrics used in their manufacture.

T F 20. Flannel is a soft, fine and generally expensive fabric used in men's suits.

T F 21. In general, worsteds are more durable and expensive than woolens.

T F 22. Fabrics such as tweeds, worsted cheviot and gabardine are especially good for active hard use.

T F 23. Different fabrics flatter different builds of men.

T F 24. Vertical lines give the appearance of breadth, while horizontal lines give the appearance of height.

T F 25. Boys' suits are sized according to age.

T F 26. Full or three-quarter length coats come under the description of an overcoat.

T F 27. The trend is to wear rain coats for all-weather occasions.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Men's wear may be classified as men's _____ and men's _____.
2. Men's dress shirts run from size 14 to _____.
3. The two main styles in men's ties are the formal and the _____.
4. The two types of sweaters are _____ and _____.
5. The three classic stitches for sweaters are the _____, _____, and _____ knit.
6. The two styles of men's shorts are the _____ and _____.
7. Sizes for men's shorts are based on _____ measurements.
8. The most comfortable underwear is made of a _____ fabric.
9. Men's socks come in hosiery for _____ wear and hosiery for _____ wear.

10. The two main types of wool fabric are _____ and _____.

11. For hard work men prefer _____ or _____.

12. Two popular forms of ties are the long tie, known as the _____ and the _____.

13. In 1958 the _____ style became popular in the United States

14. The criteria used for determining suit sizes are measurements of the _____, _____, and _____.

15. Wash and wear fabrics include _____, _____, _____, and _____, _____.

16. Measurements for overalls are the same as for slacks: size of _____ and _____.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List five items that are classified as men's and boys' furnishings:

   (A)_____ (D)_____

   (B)_____ (E)_____

   (C)_____

2. Five items classified as men's and boys' clothing are:

   (A)_____ (D)_____

   (B)_____ (E)_____

   (C)_____

3. The classifications of shirts are:

   (A)_____ (C)_____

   (B)_____ (D)_____

4. The things a purchaser of a shirt is interested in, other than size, are:

(A)_____ (E)_____

(B)_____ (F)_____

(C)_____ (G)_____

(D)_____

5. List seven of the fabrics used for sport slacks:

(A)_____ (E)_____

(B)_____ (F)_____

(C)_____ (G)_____

(D)_____

ERIC

Assignment
Sheet No. 21

Covering
Units 232-240

SPORTING GOODS

Play is a great American pastime for many more than the idle rich. Games and sporting equipment are demanded by amateurs and professionals. Either group may be well informed. The amateurs may be totally ignorant about the desired items.

The salesperson is called upon to talk intelligently with the well-informed and advise effectively the uninformed. You may not play the game or even like it, but your customers have their own choices and your job is to make that choice a pleasant reality.

This assignment will introduce you to terms, qualities, technical details, and other fundamental facts involved in the sale of sporting goods.

Assignments:

1. Read the references given below.
2. Confer with your coordinator as to the availability of the two National Retail Hardware Association's pamphlets entitled, Sporting Goods, and Recreational Equipment. If available, make arrangements to study these with the aid of the assignments prepared for them or the assistance from your coordinator.
3. Confer with your coordinator as to the availability of the study guide, Sporting Goods, published by the University of Texas. If it is available, make plans to follow this guide for a more detailed study of sporting goods.
4. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study to extend your knowledge of this merchandise.
5. Answer the questions below. Turn these question answers in to your instructor by _____.

Reference:

A. Prentice-Hall, Inc., Facts About Merchandise, pp. 233-241.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Sports are next in importance to the weather in everyday conversation.

T F 2. Archery is not considered a family sport.

T F 3. A beginner in archery usually uses a laminated bow.

T F 4. The pull is the amount of pounds needed to draw the bowstring 26" from the bow.

T F 5. Wood bows are much better than steel and glass bows.

T F 6. The shaft determines the price of the arrow.

T F 7. The point of the arrow is referred to as the fletching.

T F 8. Arrows vary in weight and should be selected by weight based on the weight of the bow.

T F 9. Bowstrings are made of Dacron or hemp and have many strands.

T F 10. Archery equipment deteriorates more rapidly than any other type of sports equipment.

T F 11. Archery equipment should be stored near some type of heat.

T F 12. Bowstrings need not be waxed.

T F 13. Bows should be flexed several times before using them to limber them up.

T F 14. Spin cast fishing is recommended for beginners.

T F 15. Salt-water rods are primarily fresh-water equipment adapted for rough usage.

T F 16. Metal fishing rods are very popular.

T F 17. Bamboo rods generally come in one piece.

T F 18. Fly lines are made of silk, nylon and Dacron.

T F 19. American Standard Fly-line Calibrations are designated by letter.

T F 20. In golf, the iron clubs are numbered 1 through 10.

T F 21. The number 10 iron is known as a putter.

T F 22. Quality of golf balls is based on the construction and type of covering.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. Sports are divided into two groups--_____ and _____ sports.
2. Unclassified sports are camping, _____, conditioning exercises.
3. The three kinds of bows are the _____, _____, and _____.
4. Men target shooters generally use bows rated _____ to _____ pounds, and ladies about _____ to _____ pounds.
5. There are three basic requirements of a good bow. These are: _____, _____, and _____.
6. A decoration on better arrows is known as a _____.
7. The _____ is the notch that holds the string at each end of the bow or the notch for the insertion of the string on the arrow.
8. The two types of arm guards are the _____ and the hunter.
9. Two types of bait casting reels are the _____ and the _____ reel.
10. A _____ fly is one that is fished on top of the surface and the _____ fly is one that is fished below the surface.
11. Fly reels may be divided into the _____ and _____.
12. Action in a fishing rod is determined by the length, diameter, and the degree of _____.
13. Fishing rods are made of three kinds of materials. They are: _____, _____, and _____.
14. Lures are classified as _____, _____, and _____.
15. The two types of golf clubs are the _____ and _____.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List the additional equipment needed by an archer:

   (A)_____ (D)_____

(B)_____ (E)_____

(C)_____

2. List the four types of bows:

(A)_____ (C)_____

(B)_____ (D)_____

3. Some types of wood used in bows are:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____ (F)_____

4. The various types of points used on bows are:

(A)_____ (C)_____

(B)_____ (D)_____

5. The five types of rods and reels for fishermen are:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____

6. There are four types of wood clubs:

(A)_____ (C)_____

(B)_____ (D)_____

Assignment
Sheet No. 22

Covering
Units 241-248

TOYS AND GAMES

A happy child with a colorful toy is a pleasant sight to a loving mother. In fact, every toy should bring happiness to the child, his family, the salesperson, and your boss. An understanding of children is as important as an understanding of toys. Together they are that old "one-two" punch.

Both are emphasized in this assignment so you will know the types of toys, features to play up, and the time to sell what toy for which child.

Assignment:

1. Read the reference given below.
2. Confer with your coordinator as to the availability of the study guide, Selling Toys, published by the University of Alabama. If it is available, make plans to follow this guide for a more detailed study of toys.
3. Check with your coordinator as to the availability of the Distributive Education Bibliography Supplement and select from the sources of additional references some of the free or inexpensive ones. Write for them and also bring to class any company literature to study to extend your knowledge of this merchandise.
4. Answer the questions below. Turn these question answers in to your instructor by _____.

Reference:

A. Prentice-Hall, Inc., Facts About Merchandise, pp. 243-257.

Questions:

True-False

Directions: The following statements are either true or false. If the statement is true, draw a circle around the letter "T". If it is false, draw a circle around the letter "F".

T F 1. Selling toys means selling fun.

T F 2. Toys help children develop both physically and mentally.

T F 3. Toys can be an aid to the child in developing his personality.

T F 4. The child's chronological age is the best guide for determining the right toy.

T F 5. Nursery school age children generally want toys they can push, pull, pedal, pound and slam.

T F 6. Kindergarten age is considered from 4 to 6 years old.

T F 7. Children at kindergarten age are not apt to be interested in dress-up games.

T F 8. Children from the ages four to eight have primarily the same interests.

T F 9. From 8 to 10 years years of age, boys and girls broaden their interests through school, travel, and participation in youth groups.

T F 10. Hobbies are not appealing to the age group 8-10 years of age.

T F 11. At age 10 each child has usually developed an area of interests such as sports or hobbies.

T F 12. Toys may be used to help children develop good habits such as saving money, knowing the value of money, and how to make change.

T F 13. Boats are of little value in helping a child enjoy his bath.

T F 14. Marbles develop muscular coordination and good sportsmanship.

T F 15. Tools and work benches can promote a closer relationship between father and son.

Completion

Directions: Fill in the blank(s) in each statement with the word(s) required to complete the sentence correctly.

1. From birth to two years of age is referred to as the _____ age for children.

2. From age two to four is the _____ of children.

3. The "doing things age" is from _____ to _____.

4. The growing up age is from _____ to _____.

5. Games are classified as _____ and _____ games.

6. Construction toys help the child to plan, _____ and _____ among sizes and weight.

7. Guns give children an opportunity for _____ outlet.

8. Furniture encourages a child to develop orderliness and to understand the _____ of others.

9. Electric trains come in three sizes that are referred to by _____.

Listing

Directions: List the items called for in each of the following. Select your answers carefully.

1. List six games that are classified as action games:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____ (F)_____

2. Six quiet games are:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____ (F)_____

3. The graded levels for children's books are:

(A)_____ (D)_____

(B)_____ (E)_____

(C)_____ (F)_____

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ABSTRACT - Developed for students, this study guide contains content, examples, and problems for these topics: (1) fractions, (2) decimals, (3) interest and percentage, (4) square root, (5) point system, (6) spacing, (7) measuring type, (8) weighing type, (9) finding leads to the pound, (10) finding value of stock, (11) cutting and finding weight of paper, (12) proportion, (13) margins, (14) ratio and proportion, (15) copy fitting, (16) imposition, (17) estimating the ink, and (18) estimating a printed job. An answer book "An Answer Book for Everyday Arithmetic for Printers" may be obtained from the source of availability indicated for this document. (SB)

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EVERYDAY ARITHMETIC FOR PRINTERS

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FRACTION

A FRACTION is one or more than one of the equal parts of a unit. It requires two numbers to express a fraction, one of which is called the numerator, and the other, the denominator.

The numerator is placed above the denominator, with a line placed between them, as 1/2. The 2 is the denominator and shows into how many equal parts the number is divided. The numerator 1 denotes how many of the equal parts are indicated.

If a pica is divided into 12 equal parts, one of these equal parts would be called a point, or 1/12 of a pica. One-half (1/2) of a pica is called a nonpareil, equal to 6 points.

Fractions must first be reduced to a common denominator before they can be added.

Example: 1/2 + 1/4 = 2/4 + 1/4 = 3/4 Ans.

Fractions must likewise be reduced to a common denominator before they can be subtracted.

Example: 1/3 - 1/4 = 4/12 - 3/12 = 2/12 Ans.

To find the least common denominator it is necessary to find the smallest number that will contain all the denominators of each fraction without having a remainder.

Example: 1/3, 1/2, 1/8, 1/6.

Explanation: Write each denominator in a row, separating each number by a comma and divide by the number that will go into the largest number of the denominators, as shown below:

2) 3, 2, 8, 6

3) 3, 1, 4, 3

1, 1, 4, 1

2 X 3 X 1 X 1 X 4 X 1 = 24, the least common denominator.

If fractions are to be multiplied it is not necessary to reduce the fractions to fractions that have a common denominator. By multiplying the numerator or by dividing the denominator by a number multiplies the fractions.

Example: Multiply 3/4 X 5 = $\frac{3 \times 5}{4}$ = $\frac{15}{4}$ = 3 3/4 Ans.

If the fractions are to be divided the denominator is inverted and the same procedure as is done in multiplication is followed.

Example: $2/3 \div 1/2 = 2/3 \times 2/1 = 4/3 = 1\ 1/3$ Ans.

If the numerator is divided or the denominator is multiplied in a fraction, this also divides the fraction.

Example: Divide 6/8 by 2

$$6/8 \div 2 = \frac{6 \div 2}{8} = 3/8 \text{ or } 6/8 \times 1/2 = 6/16 = 3/8 \text{ Ans.}$$

PROBLEMS

1. Reduce 5/7 to 49ths.
2. Reduce 2/3 to 24ths.
3. Find the least common denominator of 4/9, 5/12, 7/18.
4. Find the least common denominator of 3/4, 2/3, 7/8.
5. Add 1/2, 5/8, and 2/3.
6. Add 2/7, 5/6 and 3/8.
7. Subtract 6 1/4 from 25.
8. Subtract 8 1/3 from 11.
9. Multiply 3/4 X 4
10. Multiply 5 7/8 X 3.
11. Multiply 66 1/2 X 3 5/8.
12. Multiply 14 5/6 X 9 3/4
13. Divide 3/4 by 3.
14. Divide 4/5 by 11/2.
15. Divide 10 1/2 by 2/5.
16. Divide 30 by 6/8.
17. Divide 15 by 6 3/7.

18. Divide 12 by 3/4.

19. Divide 25 by 5/8.

20. Divide 2/3 by 6.

21. 30 picas X 5/6 equals what?

22. Add 2/3 of an inch and 5/6 of an inch.

23. Add 12 1/4 points to 18 2/3 points.

24. Find the sum of 2/3 of a pica, 3/4 of a pica and 1/4 of a pica.

25. From a rule 48 picas long two pieces were cut, one 3 1/2 picas and the other 12 3/4 picas; find the length of the part remaining.

26. A certain job is scheduled at 16 1/2 days. A works 3 2/3 days, B 5 1/2 days and C 2 3/4 days; what part of the work is still to be done?

27. Multiply 654 by 7/12.

28. How much is 6 times 5/7? 8 times 7/9? 9 times 7/11?

29. If a compositor can do 6/7 of a job in 3 days, how much can he do in 1 day?

30. How many pieces 3 3/4" X 5 1/2" can be cut from a sheet of cardboard 20 1/2" X 24 3/4"?

31. What is the sum of 2/9, 1/6 and 1/2?

32. If you had 2500 sheets and were told to use 7/8 of them, how many would you use?

33. What is the quotient of 25 ÷ 7/8?

34. If 1/5 of a ream of note paper costs 75 cents, what will the ream cost?

35. A man bought a press for $75, and sold it for 7/8 of what it cost; how much did he lose?

36. How many pieces 4 1/4" X 5 1/2" can be cut from a sheet 17" X 22"?

37. What is the sum of 5/16, 7/8, 2/13, 9/16, and 2/32?

38. Find the sum of 12 1/3, 2 1/14, 3 3/8, 4 2/3, 5 1/8, and 7 2/18.

39. If a pressman can run 3/5 of a job in 60 minutes how long will it take him to run the job?

40. A job consists of 80,000 ems, (a) sets 3/8 of the job, (b) 2/10, (c) 1/8, how many ems will (d) have to set?

41. Multiply 3/4 X 2/3 X 15/16 X 1/2 X 11/12.

42. Find the answer to the following example:
3/12 X 2/3 + 3/5 - 1/2 ÷ 1/10.

43. If it takes 2 hours to set up 2/3 of a job how long will it take to set up 3/4 of the job?

44. A man feeds 5,000, which is 5/8 of a run. He feeds 2,000 the next day, what fraction of the job is still to be fed?

45. What is the answer of: 10/12 ÷ 7/4 X 12/15 + 3/4?

DECIMALS

A DECIMAL, or a decimal fraction, is a fraction whose denominator is 10, 100, 1,000, etc.

The denominator is always 10 or a power of 10, and is expressed by writing it under the numerator.

The denominator is always understood to be followed by as many zeros as there are figures at the right of the point, the numerator consisting of the figures on the right of the unit figure of the number.

In order to distinguish the unit figure, a period (.), called the decimal point, is placed between the unit figure and the next figure on the right.

The value of a decimal depends upon the number of decimal places in it; i.e., upon the number of figures to the right of the decimal point.

The relation of decimals and whole numbers to each other is shown by the following table:

INTEGRAL ORDERS	DECIMAL ORDERS
0 Hundred-millions	0 Hundred-millionths
0 Ten-millions	0 Ten-millionths
0 Millions	0 Millionths
0 Hundred-thousands	0 Hundred-thousandths
0 Ten-thousands	0 Ten-thousandths
0 Thousands	0 Thousandths
0 Hundreds	0 Hundredths
0 Tens	0 Tenths
0 Units	. Decimal Point

DECIMALS REDUCED TO COMMON FRACTIONS

To reduce .875 to a common fraction in its lowest terms, proceed as follows:

$$.875 = \frac{875}{1000} = \frac{35}{40} = 7/8, \text{ Ans.}$$

COMMON FRACTIONS REDUCED TO DECIMALS

To reduce a common fraction to a decimal we annex decimal zeros to the numerator and divide by the denominator and point off as many decimal places in the quotient as there are annexed zeros--thus,

Change 3/125 to a decimal.

```
125 ) 3.000 ( .024, Ans.
      2 50
        500
        500
```

ADDITION AND SUBTRACTION OF DECIMALS

To add and subtract decimal numbers proceed in much the same way as in ordinary addition and subtraction, the only difference being that the decimal points must be kept in a vertical column and figures of the same order placed in the same column. Thus,

```
 82.459          5641.93
561.050            2.61
-------         -------
643.509         5639.32
```

MULTIPLICATION OF DECIMALS

Proceed as in ordinary multiplication, taking care to point off as many decimal places in the product as there are decimal places in both multiplicand and multiplier. Thus,

```
   .562
    .21
   ----
    562
   1124
  ------
  .11802
```

To multiply any number by 10 move the decimal point one place to the right; by 100, two places, etc. Thus,

5.65 X 10 = 56.5
5.65 X 100 = 565.

DIVISION OF DECIMALS

Divide as in whole numbers and point off in the quotient as many places to the right of the decimal point as those in the dividend exceed those in the divisor. Thus,

Divide .325 by .25

```
.25) .325 ( 3.3, Ans.
      75
      75
      75
```

Divide 600 by .08

```
.08) 600.00
     -------
     7500.  Answer
```

PRINCIPLES OF DECIMALS

1. The value of a decimal is not changed by annexing or rejecting a zero at the right.
   Thus, .5 = .50. for .5 = 5/10 = 1/2, and .50 = 50/100 = 1/2.

2. A decimal is divided by 10 by moving the decimal point one place to the left.
   Thus, .5 = 5/10; 5/10 ÷ 10 = 5/100 = .05.

3. A decimal is multiplied by 10 by moving the decimal point one place to the right.
   Thus, .05 = 5/100; 5/100 X 10 = 5/10 = .5.

PROBLEMS

1. Change .325 to a common fraction.

2. From the sum of 87.6 and .43 take their difference.

3. From the sum of 89.4 and .026 take their product.

4. Multiply 5.62 + .083 by 5.62 - .075.

5. Divide .0684 by .034 X .004.

6. Divide 16 ten-millionths by 23 thousandths.

7. Find the number of reams in 458,625 sheets. (one ream equals 500 sheets.)

8. The product of three decimals is .0189, and one of them is .54 and another 2.5. What is the third?

9. What is (.07 1/4 X 1.2 1/3) ÷ (.005 1/4 X .015)?

10. Divide .031812 by 4.82.

<u>Find the sum of</u>:

11. 375.8, 12.375, 1012 and .1867.

12. .2743, 401.51, 21.147 and 142.100.

13. 72.001, 41.105, 12.65, 507 and 2.7.

14. 3742.1, 65.41, .2473, 40.701 and 21.7.

15. 14.23, .501, 3.4021 and 14.17.

<u>Subtract the following</u>:

16. From 241.37 subtract 172.621.

17. From 71.218 subtract 7.1042

18. From 704.583 subtract 325.004.

19. From 4.3202 subtract 1.1714.

20. From 407.385 subtract 235.004.

21. From 236.006 subtract 139.896.

22. From 682.0 subtract 479.410.

23. From 599. subtract 219.763.

24. From 2.3402 subtract 1.1417.

25. From 41.999 subtract 5.891.

Find the product of

26. 4003.2 X 1.2.

27. .3865 X .042.

28. .714 X .0002.

29. 78.65 X 1.03

30. 178.352 X .01.

31. 5197 X .079.

32. 41.65 X 2.98.

33. .926 X .918

34. 1.73 X .92.

35. 271.98 X 2.5.

Divide the following:

36. .07 by .007.

37. .3 by .0012.

38. .002 by 200.

39. .14 by .024.

40. 718.124 by 231.107

41. .625 by .25.

42. .125 by .005

43. .326 by .25.

44. .232 by .001

45. .825 by .13

Reduce the following common fractions to decimals:

46. 3/4

47. 4/10

48. 2/30

49. 7/8

50. 1/5

51. 4/25

52. 5/8

53. 25/100

54. 10/200

55. 15/32

56. 3/9

57. 1/16

58. 3/75

59. 3/15

60. 2/7

INTEREST AND PERCENTAGE

THE general problems of percentage not including the time element, that are considered here are Profit, Loss and Discount.

PROFIT AND LOSS

The cost of an article is the amount paid for it by the purchaser.

The selling price of an article is the amount received by the seller.

The gain is the amount above the cost price that an article is sold for.

The loss is the amount below the cost price that an article is sold for.

Gain or loss per cent is usually reckoned on the cost. The cost is always 100% of itself.

The names of the different terms used in percentage are: base, rate per cent; the percentage, the amount, and the difference.

The base is the number or quantity which is supposed to be divided into 100 equal parts.

The rate per cent, is that number of the 100 equal parts into which the base is supposed to be divided, -- that is, taken or considered.

The percentage is the result obtained by multiplying the base by the rate per cent.

The amount is the sum of the base and the percentage.

The difference is the remainder obtained when the percentage is subtracted from the base.

INTEREST

Interest is money paid for the use of money.

Principal is the sum of money upon which interest is paid.

The rate of interest is a certain percentage of the principal which is paid for its use, usually computed on a yearly basis of

360 days or 12 months of 30 days each.

Example: Find the interest on $150.50 for 3 years, 9 months, 18 days, at 5%.

```
   $150.50
       .05
12)  7.5250 X 3 = $22.5750
                    Int. for 3 years.
   $.6270 int. for 1 mo.
     9.6 = 9 mos. 18 days
     37620
   56430
  $6.01920
   $22.575 = 3 yrs.
     6.019 = 9 mos. 18 days
   $28.594 = Total Interest
```

Example: Find the interest on $200 for 3 years 6 months at 5%.

Solution: 3 years 6 months = 3 1/2 years; $200 X .05 X 3 1/2 = $20. Ans.

Example: What is the interest on $148.50 for 2 years 5 months 15 days at 6%.

Solution: $148.50 X .06 X $\frac{59}{24}$ = $21.903

Explanation - change the time to years. To do this, begin with the days, 15 days = 1/2 mo.; 5 1/2 mo. = $\frac{11}{2}$ or

$$\frac{11}{2 \times 12} \text{ yr.} = \frac{11}{24} \text{ yr.}; \; 2\frac{11}{24} \text{ yr.} = \frac{59}{24} \text{ yr.}$$

TRADE DISCOUNT

The list price is the price asked for any article and is usually fixed at a certain per cent above the cost price.

The discount is a certain per cent deducted from the list price.

The net price is the price the purchaser pays. It is the list price less all discounts.

RULES FOR FINDING BASE, RATE AND PERCENTAGE

To find the percentage, multiply the base by the rate.
To find the rate, divide the percentage by the base.
To find the base when the percentage and rate are given, divide the percentage by the rate

Example of explanation:
$500 = base
.06 = rate per cent
$30.00 = percentage

Find 6% of $500.00
If rate is desired when base and percentage are known
$500 = base) 30.00 (.06 = rate per cent or 6%

If base is to be found when percentage and rate are known.

500 = base
.06) 30.00 percentage.

PROBLEMS

1. Find the interest on $1.00 for one year and six months at 6%.

2. Find the interest on $1.00 at 6% for two years, two months; for three years, ten months.

3. Find the interest on $100.00 for two years, 3 months, fifteen days at 5%.

4. Find the interest on $1000.00 for four years, 6 months, eighteen days at 4%.

5. Find the interest on $250.60 for three years, eighteen months, twelve days, at 6 1/2%.

6. Find the interest on $3000.00 for five years, three months, twenty-five days at 8%.

7. Find the interest on $4500.00 for six years, nine months, twenty days, at 4 1/2%.

8. Find the interest on $3700.50 for two years, six months, twenty-five days at 6%.

9. Find the interest on $5112.50 for ten years, two months and fifteen days at 6%.

(Interest and Percentage Problems
continued)

10. Find the interest on $33,100.00 for two months twenty-eight days at 6%.

11. A paper manufacturer had 7,000 reams of bond paper on hand he sold 10% of them. How many reams did he sell?

12. The same manufacturer had 5,000 reams of a certain cover stock and sold 1,500. What per cent of the whole amount did he sell?

13. If the same manufacturer sold 500,000 envelopes, which consisted of 25% of his entire stock of envelopes, how many envelopes comprised his entire stock?

14. How much is 42% of 1,960; 18% of 350; 6% of 2220; 99% of 100?

15. What percent of 360 is 5; what percent of 150 is 30; what percent of 762 is 2; what percent of 94 is 47?

16. 42 is 6% of what number? 104 is 2% of what number? 5000 is 25% of what number? 126 is 31 1/2% of what number?

17. What is 16% of 684?

18. 625 is 8% of what number?

19. The gain on a certain job was $192.50, which was 3 1/2% of the cost. What was the selling price?

20. On a run of 5000, 4% was allowed for spoilage. How many sheets were allowed for spoilage?

21. A job press is listed at $350, and discounts of 30 and 5% are allowed. What is the selling price?

22. A printer buys paper amounting to $864.50, on the following terms: 10% off if paid before 30 days. How much would the bill cost if paid 28 days after date?

23. A printer sells 500 panelled calling cards, which cost him $2.50, at a discount of 10% and 2%. What is the price of the cards if he wants to make a 33 1/3% profit?

24. A wholesale dealer sells type at $2.75 per font, subject to a discount of 30%, 10% and 5%. How many fonts can be bought for $247.50?

25. A paper cutter costs $8.50. What is the marked price if a profit of 20% and a discount of 25% is given?

SQUARE ROOT

NEEDED INFORMATIONS

To extract the square root follow this formula: Take a number, let it be in this case 724201 beginning at the unit figure or the decimal point, point off the number into periods two numbers each. Should there be an odd number of figures in the given number, the last period to be left will have only one figure. Find the greatest whole number the square of which does not exceed the value of the figures in the left hand period (72) and write this number as the first number in the root. In this example this number is 8 the square of which is 64 substract this from the left-hand period, and move down the next period of two figures and annex it to the remainder, Multiply the figure of the root obtained by the constant 20 (8 X 20 = 160) find how many times this product is contained in the number 842, this gives a trial figure for the second figure in the root 160 is contained 5 whole times in 842 and 5 is therefore placed as the next figure of the root. Subtract from 842 the product of 160 plus the figure of the root just obtained (5) multiplied by the same figure (5); (160 plus 5) X 5 equal 825 if this product were larger than 842 it would indicate that the trial figure was too large and that a figure smaller should be used. Then move down the next two periods of figures and annex it to the remainder. Multiply the figures in the root thus far obtained by 20 (85 X 20 =1700) find how many times this product is contained in 1701. This gives a trial figure for the next number in the root. Then proceed as before. If there is a remainder when the last period of figures has been drawn down place a decimal point after the figures already obtained and draw down two (00) to the remainder, and proceed as before until a sufficient decimal has been reached. Hence the square root of 851.

```
                          8  5   1
                         72'42'01
                 8 X 8 = 64
8 X 20 = 160 plus 5 = 8 42
                        8 25
                           17 01
(85 X 20 = 1700 plus 1 = 17 01
```

SQUARE ROOT PROBLEMS

Extract the square root of the following:

1. 324, 256, 121, 81, 400, 4944.9024

2. Find the square root of 12 correct to three decimal places.

3. Find the square root of the following: 264,196, 55,225, 10,609, 3281, 5478, 3844, 1849, 14.3641, 6811.2009, 44,605.44, 224,486.44, .256036.

4. Find the approximate square root of the following correct to three decimal places: 7, 17.3, 18,956.241, 375.625, 145.63, 47, 643.27, 3410.73, 2.85, 6714.10, 23.

5. Find the square root of the following fractions: 4/9, 25/49, 196/144, 49/100, 1/256.

THE POINT SYSTEM

THE POINT SYSTEM is the recognized standard of measurement for type, borders, rules and other standard equipment used by printers. The English system, or linear measure, is used for measuring and cutting paper.

The "Point" which is the unit upon which the point system is based, is equal to .01384 of an inch, or approximately 1/72 of an inch. For practical purposes of measuring, 1/72" is used, but for more exacting purposes, where the micrometer is used, the point is equal to .014 of an inch.

All type sizes are indicated by the point system. The size in points is equal to the measurement through the body of the character from the nick side to the back. A type that measures 12/72 of an inch is referred to as 12-point type. Twenty-four point type is equal to 24/72 of an inch or 1/3 inch in size. Wood type, which comes in larger sizes, is measured by "lines," a line being equal to one pica, or 1/6 of an inch. Materials such as leads, reglets and furniture are also based upon the point system for both width and length.

LINEAR MEASUREMENTS

Those who buy their printing generally express their measurement in inches, but the printer usually measures in picas or ems. Inches may readily be reduced to picas by multiplying the given dimensions by 6, the number of picas per inch. Thus if a customer wishes a sheet printed from a form 3 inches wide, this form will be set 18 picas wide (3 inches X 6 picas = 18 picas).
3 inches X 6. (the number of picas to 1 inch) = 18 picas.

The pica or em (em-pica) is used as a basis of measurement for length of leads, slugs, and lengths of composition. A lead 4 inches in length is referred to as 24 picas long, and a line of type is referred to as 18 picas or 24 picas wide as the case may be.

The term "nonpareil" is used to designate types and materials of 6-point size and is one of the few surviving terms used to name the size of type. Six point slugs are known as "nonpareil" slugs.

An em is the square of a type body. For example, an em of 12-point is 12 points wide, of 8-point, 8 points wide; and 6-point, 6 points wide.

This is a pica or 12-point em .

The em is the unit of measurement of the quantity of type. A line 3 inches long is 216 points long, and if set in 12-point type contains 18 ems of 12-point (216 ÷ 12 = 18). If it is set in 10 point type it contains 21.6 ems of 10-point (216 ÷ 10 = 21.6).

To find the number of lines of type contained in a column 3 inches deep divide the number of points per inch by the size of the type used. This quotient multiplied by the length of the column in inches will give the number of lines in the column.

To illustrate: If we wish to find the number of 8-point lines in a column 5 inches long, set solid, proceed as follows:

72 ÷ 8 = 9, the number of lines per inch.
9 X 5 = 45, the number of lines in the column.

If the type column were leaded with two-point leads, it would be equal to 10-points and would be figured on the basis of 10-point.

72 ÷ 10 = 7 1/5, the number of lines per inch.
7 1/5 X 5 = 36, the number of lines in the column.

On a sheet of paper, 3 1/2 X 5 1/2 make a table showing the number of lines of type, both solid and leaded with a 2-point lead, will occupy in a space of 1 inch. Use 6-point, 8-point, 10-point, 12-point, 14-point, and 18-point for this table.

ADDING PICAS AND POINTS

If picas and points are to be added the problem is solved as follows:

12 picas and 6 points.
7 picas and 8 points

19 picas and 14 points, which equals 20 picas and 2 points (14 points being equal to 1 pica and 2 points).

Problems in subtraction are solved as follows:

20 picas and 4 points
8 picas and 10 points.

Since 10 points cannot be subtracted from 4 points, one of the 20 picas is changed to points, which makes the minuend 19 picas and 16 points. 8 picas and 10 points are then subtracted from this, leaving a remainder of 11 picas and 6 points.

Problem in division and multiplication can be solved if the above factors are kept in mind.

THE POINT SYSTEM PROBLEMS

Ems = Pica ems or 12 points

1. How many points are there in 5 inches?

2. How many points are there in 10 picas?

3. How many picas equal 8 inches?

4. Change 5 picas to points.

5. What fraction of a pica is 4 points?

6. If a form is set 3 1/2 inches wide, how many picas wide is it?

7. If a type face measures 1/9 of an inch, what is the size in points?

8. If a line of type measures 18 ems, what is the length in inches?

9. What would be the equivalent in points, of 6 line wood type?

10. How many 8-point em quads would it take to form an area of one square inch?

11. What decimal part of one inch is 1 point?

12. If the width of a printed page is 240 points, how many inches wide is the page?

13. If a printed page is 420 points long, how many inches long is the page?

14. A printed page is 264 points wide and 408 points long. How wide and how long is the page in inches?

15. How many points wide is the printing on a page which measures 3.45 inches wide?

16. A column in the daily paper measures 21 1/2 inches. How many picas in the column?

17. The galley proof of a job measures 32 inches long. If the job is divided with 6 pages of equal length, how many picas long will each page be?

18. Add 10 picas and 4 points and 7 picas and 10 points.

19. Subtract 7 picas and 10 points from 18 picas and 6 points.

20. Divide 18 picas and 4 points by 5, giving picas and points.

21. How many 2-point leads would be required to make up a space of 1 inch?

22. How many 6-point slugs would be required to fill the same space filled with 36 2-point leads?

23. How many 8 point em- quads would it take to make the equivalent of a 48-point em-quad?

24. How many lines of 12-point type, set solid, can be set in a space 6 inches long?

25. How many lines of 8-point type, leaded with 2-point leads, can be set in a space 8 1/2 inches long?

26. How many square ems of 10-point are there in 1 square inch?

27. If a column contains 31 lines of 8-point leaded type, how many lines of 12-point type, set solid, will one of the same length contain?

28. If a point is .0138 of an inch, how much will 24 picas lack of being four inches?

29. If a column is 6 inches long and is set in 12 point solid, how many lines must be removed to make room for double leading?

30. A space 4 inches long is to contain 21 lines in 10-point type. How many points are placed between the lines?

31. An area of two square inches contains how many 10 point ems?

32. Eight and one-half picas is equal to how many points?

33. A line of type measures 5 inches. What is its length in picas?

34. What is the length in points of a line 4 inches long?

35. A lead is 6 inches long. What is its length in picas?

36. A column in a Sunday newspaper measures 126 picas, what is the length of the column in inches?

37. How many ems of 10 point are there in an area five inches square?

38. How many points wide is a form set 5 1/2 inches?

39. If a form is set 5 inches wide and six inches long what is the area in picas?

40. Add 6 inches, 10 picas, and 8 points, and 11 picas and 6 points. Give answer in picas and points.

SPACING

GOOD printing requires that the space between the words should appear even. In order to obtain this result a line does not always have an equal amount of space after each word. Good spacing and justification are necessary in composition in order to secure good results. A line may be justified correctly and yet not be spaced properly. Also, spacing may be uniform but justification may be too loose or too tight. Justification deals with mechanical features, spacing deals with appearance. Lines should be spaced enough to make the words quickly distinguishable. Equal spacing in a line means a slight variation in width of actual spaces used. Good spacing requires care and judgement. A close examination of a printed page shows a great variety of spaces. The ordinary reader does not, however, notice these variations.

The names of these spaces are 5-em, 4-em, 3-em, and 2-em or en spac The 5-em space is so called because it takes five of these spaces to make an em, or square of the type of which they are used; four 4-em spaces to make an em (square). It may help one to remember that 5-em, 4-em, etc., are really abbreviations of 5-to-the-em, 4-to-the-em, etc. The relation of these spaces are based on the em-quad (square). A 12-point em-quad is 12 points square; a 12 point em-quad is 12 points high and 6 points set (thick) while a 12-point 3-to-em square is 12 points high and 4 points set. Each space is based on the em-quad and is a part of that em (square). Thus a 3-em space is 1/3 of an em-quad or 1/3 of 12 points, 4 points in thickness is called the set of the type body.

The least common multiple of the preceding spaces 5, 4, 3, and 2, is 60. If we divide 60 into 60 parts each part is called a unit. Since five 5-em spaces are equal in width to an em-quad, then, considering an em quad as having 60 units in its width, a 5-em space has 1/5 of 60 units, or is 12 units wide. A 4-em space is 15 units wide; a 3-em space is 20 units wide, and a 2-em space is 30 units wide.

If it becomes necessary to justify a line by respacing it, replacing the 3-em spaces with wider spaces, the next wider space is the 24-unit space, made by using two 5-em spaces. The next wider space is the 27-unit space, made by using a 4-em and a 5-em space. Next after the 27-unit space comes the 30-unit space, made by replacing the 3-em space with an en-space. Other combinations up to 35-units, made by using a 3-em space and a 4-em space can be used. Wider spacing is not recommended in general composition.

Correct spacing then becomes a series of problems in arithmetic. While at first some difficulty may be experienced in getting the correct combinations, the principle when once learned usually insures a firm foundation for future composition.

PROPER MEASURES FOR BODY TYPE

Small type should never be used in wide measures, nor large type in narrow measures. It is extremely trying to the eye to follow line after line of small type across a wide page, or a jumble of large type set in a narrow measure where every other word must be divided on account of the type being too large for the words to go in the measure. The following list gives what have been adjudged the proper widths in which the various sizes of body type should be used:

For 6-point	8 to 10 picas
For 8-point	10 to 15 picas
For 10-point	15 to 20 picas
For 12-point	20 to 25 picas
For 14-point	25 to 30 picas
For 18-point	30 to 36 picas

NUMBER OF UNITS IN DIFFERENT SPACES AND SPACE-COMBINATIONS

No.	5-space	4-space	3-space	5=5	5=4	en	3=5	3=4
1	12	15	20	24	27	30	32	35
2	24	30	40	48	54	60	64	70
3	36	45	60	72	81	90	96	105
4	48	60	80	96	108	120	128	140
5	60	75	100	120	135	150	160	175
6	72	90	120	144	162	180	192	210
7	84	105	140	168	189	210	224	245
8	96	120	160	192	216	240	256	280
9	108	135	180	216	243	270	288	315
10	120	150	200	240	270	300	320	350
11	132	165	220	264	297	330	352	385
12	144	180	240	288	324	360	384	420

AN EVEN-SPACED LINE

Good Spacing Requires Care and Judgment

If the above line lacks a 3-em space and a 4-em space of filling the line and it is necessary to space this line to the full measure, what space or spaces would be used after each word?

Method: First find the total number of units in the entire line. There are five places (spaces) in the line and each space has a 3-em space. The total number of units in the five places (spaces) equal 100 units (5 X 20) (20 unit to each 3-em space) to which is added the 3-em space and the 4-em space which it lacks

of filling the line. The 3-em space equals 20 units, the 4-em equals 15 units, total 35 units, plus the 100 units, between the words, makes a total of 135 units.

Since there are five places in the line, divide 135 units by 5 and the answer is 27 units. Referring to the chart of space combinations we find that 27 units is equal to a 5-em and a 4-em space. A 5 and a 4-em space should be used after each word to have the line equally spaced.

AN UNEVEN-SPACED LINE

Good Spacing Requires Care and Judgment

If the above line lacks a 3-em space and a 5-em space of filling the line and it is necessary to space this line to the full measure, what space or spaces would be used after each word?

Method: The total number of units in the line is 100 (5 X 20) to which is added the 3-em and the 5-em space on the end. 3-em equals 20 units, 5-em equals 12 units, total 32 units, plus the 100 units, makes a total of 132 units.

Since there are five places in the line, divide 132 units by 5 and the answer is 26 2/5. This number being uneven we proceed thus. We will use a 4-em and a 5-em in four places. This will give us 4 X 27 units = 108. We then have 24 units left (132 - 108). The fifth space would have 24 units or two 5-spaces. This space being smaller, care should be taken to place it between letters having no ascenders or descenders.

SPACING PROBLEMS

Find Number of Units

1. A line of type is 8 words long and between the words are 3-em spaces. How many units of space are there in the line?

2. The words in a line contain 6 words spaced with 3-em spaces. How many units are there in the line?

3. A line of 8 words has three 3-em, two 5-em and 4-em, and two 5-em spaces. Find the number of units in the line.

4. A line of 10 words has four 3-em, three 5-em and 4-em, and two 5-em spaces in the other places. How many units in the line?

5. In a 5 word line two places are each filled with the 5-em and a 4-em space, and the other two places are filled with 3-em spaces. Find the number of units of space in the line.

6. In a line of 12 words, two 5-em spaces are used, five 3-em spaces are used, and the other words have a 5-em and a 4-em space between them. How many units in the line?

7. A 9 word line has two 3-em spaces, two 5-em spaces in each of two places, and a 5-em and a 4-em in the other places. How many units are there in the line?

8. A 12 word line has five 3-em spaces, two spaces of two 5-em, two spaces of 5-em and 4-em and two spaces filled with ens. How many units are there in the line?

9. In a line of 10 words, two 5-em spaces are used in 3 places and 3-em spaces are used between the other words. How many units are there in the line?

10. A 14 word line has two places filled with 3-em, three filled with a 5-em and 4-em, two places with two 5-em in each, two places with en spaces and a 5-em and a 3-em space in each other place. How many units in the line?

It is assumed that the following lines are to be set flush and to fill the line. The lines lack the number of spaces given in small type. If these spaces are to be inserted between the words what would you change them to in order to get your lines spaced properly to fill the measure?

1.

The people came to the Town Hall.
Lacks an en-quad and a 5-em space.

2.

Name two uses for the hyphen.
Lacks a 3-em space to fill the line.

3.

Name ten words containing ligatures.
Lacks two 3-em spaces to fill the line.

4.

Printing was done in Boston in 1676.
Lacks one 5-em space to fill the line.

5.

Energy brings success; keep working!

How many units contained in the line?

6.

The skillful compositor is exceedingly particular about his justification.

Lacks a 5-em space to fill the line.

7.

The first printing press in North America was erected in Cambridge.

Lacks five en-spaces.

8.

The New York Times uses many tons of paper in each issue.

Lacks two 3-em spaces and two 5-em spaces.

9.

Bond paper is made by a process of

Lacks two 5-em spaces to fill the line.

10.

Success was never achieved by sleeping.

Lacks one 3-em and one 5-em spaces to fill line.

HOW TO MEASURE TYPE

IN order to find the number of ems in a type form, multiply the number of ems in the width of the line by the number of lines in the form. Leads are usually measured as type.

How many ems are contained in a line 20 picas long, set in 10 points? To find the number of ems, change the length of the line in picas to points and divide this number by the size of the type used.

If the printer's pica gauge is used this will give the number of pica ems (12 point) in the type form. Type, however, is not always set on the 12-point basis and it becomes necessary to change the basis to conform to the size of type used. This is illustrated in the following example:

$$\frac{\overset{2}{20} \times 12}{10} = 24, \text{ the number of 10-point ems.}$$

The following formula may be used in working out problems of this nature.

$$\frac{\text{Number of lines} \times 12 \times \text{width of lines in picas}}{\text{Size of type used}} = \text{No. of ems.}$$

A page set in 8-point type is 15 picas wide and 24 picas long. Find the number of ems.

15 X 12 points = 180 (points in a line).
180 points ÷ 8 points = 22.5 (the number of ems in a line).
24 X 12 points = 288 (points in the length of a page).
288 points ÷ 8 points = 36 (the number of lines to a page).
22.5 the number of ems to a line, multiplied by 36, the number lines, gives 810, the number of ems to a page.

A type page is 24 picas wide and 36 picas long, set in 10-point type solid. How many ems in the page?

Since the type is set in 10-point and measurements given in picas change the picas to points (multiplying by 12) and divide by 10, the size of type used. Multiplying the length by width equals the number of ems to the page.

$\frac{36 \times 12}{10} = 43.2$, the length of page.

$\frac{24 \times 12}{10} = 28.8$. $43.2 \times 28.8 = 1{,}244.16$ ems, answer.

Another method can be used as follows:

$\frac{36 \times 12}{10} = 43.2$, the number of lines.

$\frac{43.2 \times 12 \times 24}{10} = \frac{12441.6}{10} = 1244.16$ ems. Answer.

Example: A galley proof measures 3 1/2 inches by 18 inches, set in 12-point type. How many ems are there in the job?

Solution: Change the inches to picas (12 point) and multiply the width by the length. 3 1/2 X 6 (no. of pica ems to the inch)= 21; 18 X 6 = 108; 108 X 21 = 2,268 ems of 12-point.

If the above type matter was set in 10-point instead of 12-point it would be necessary to change the inches to points in order to find the measurement in 10-point.

Illustration: Change inches to points and divide by 10 (the size of type used). 3 1/2 X 72 = 252 points ÷ 10 = 25.2; 18 X 72 = 1296 points ÷ 10 = 129.6.
25.2 X 129.6 = 3,265.92 ems.

For those who do considerable estimating of type forms special (line) gauges are available which designate practically all the popular type sizes. These gauges enable the estimator to measure a type form very readily without reducing to the pica basis. It is not assumed that the student will have these gauges available in his early training and no attempt to measure type forms in this way is here considered.

In measuring composition do not confuse the terms "picas" and "ems." Pica refers to 12-point (pica size) type or material. Em does not refer to any certain size of type. Em may refer to any of the sizes used. It is the basis (square ⬚) used for measuring type composition and varies in points with each size used.

Display type is sometimes measured on the em basis. A full display letterhead is usually set 45 picas wide and about 12 picas deep. Measured as 12-point, this would be 45 X 12, or 540 ems. Figured on a time basis it would be equal to about three-quarters of an hour on the hand basis of composition. In 10-point, this

would be 54 X 14, or 756 ems. If the lines were composed of small type it might be measured in 8-point, 67.5 X 18, or 1,215 ems.

It would require about one hour and 15 minutes to set one thousand ems of 10-point type by hand. About 800 ems, hand set, is considered average production.

COMPOSITION BY THE SQUARE INCH

Measure the type form overall in picas, multiply the width by the depth and divide by 36, which will give the number of square inches of the form.

The following table will be found helpful in finding the number of ems on the square inch basis:

6-point type contains 144 ems.
8-point type contains 81 ems.
10-point type contains 51.84 ems.
12-point type contains 36 ems.
14-point type contains 26.44 + ems.
18-point type contains 16 ems.

An average hand compositor sets between 700 and 800 ems an hour while 4,000 ems is a safe average for machine composition. Rates for composition vary according to the description of the matter being set. Machine composition in small quantities is usually charged on the time basis. Figure work, tabular, etc., usually are figured at a higher rate than plain matter.

Some idea of the area covered by one thousand ems of different sizes can be gained by the diagram shown in this chapter on the page following.

On a basis of 16 picas wide, there would be 32 lines of 6-point type, set solid. This makes a square of 2 5/8 inches.

COMPOSITION BY THE SQUARE INCH

In 8-point, based on the square 3 1/2 inches, we have an area 21.5 picas wide and 32 lines.

In 10-point a square, (4 3/8 inches) we have an area 27 picas wide and 31.8 lines.

In 12-point a square (approximately 5 1/4 inches) we have an area 32 picas wide and 31 lines.

Diagram showing amount of space 1,000 ems of various type sizes occupy. These spaces are the equivalent of 1,000 ems of type of six and eight point type sizes.

1,000 ems 6-pt.

1,000 ems 8-pt.

PROBLEMS

1. How many ems of 8-point are there in a line 20 picas wide set in 8-point type?

2. How many ems of 10-point are there in a line 24 picas wide?

3. A form is 20 picas wide and 35 picas long, set in 12-point. How many ems does the form contain?

4. How many ems are contained in a form of 8-point set to a measure of 18 picas and containing 21 lines?

5. A form contains 15 lines of 12-point type and 9 lines of 8-point, set 18 picas wide. How many pica ems does the form contain?

6. Find the number of ems in a page 18 picas wide and 33 picas long, set in 10-point.

7. Find the number of ems in a form 3 1/2 inches wide and 6 inches long set in 8-point solid.

8. Given a page 6 X 9 inches with type set in 10-point solid with 1 inch margin on all sides, how many ems would the form contain?

9. If the rate is 80 cents per thousand ems, what is the cost of setting a form 3 1/2 inches wide and 5 inches long set in 8-point solid?

10. If a man can set 1000 ems per hour, how long would it take him to set the page in example number 8?

11. Find the number of ems in a column 15 picas wide and 8 inches long if 14 picas of the length is used for the headings. The body type is set in 8-point solid.

12. How many ems of 14-point are there in a form 28 picas wide and 12 inches long?

13. A 4-page folder 5 inches by 7 inches is set in 10-point leaded. It has 3/4 inch margins at the top and the sides and 1 inch at the bottom. What is the cost of composition at $1.20 per thousand ems. Leading being paid for as type composed.

14. A form 40 picas long is set in 10-point leaded and contains 864 ems. How wide is the form?

15. A form is set 21 picas wide and contains 756 ems of 10-point type. How many lines does it contain if set solid?

16. Find the cost of composition at 90 cents per 1000 ems, of a pamphlet containing eight pages, set in 10-point, size is 3" X 5 1/4".

17. How many ems of 12-point Goudy O.S. in a page 24 picas by 42 picas? If the page is reset, same measure, in 10-point how many ems would there be?

18. At the rate of 800 ems per hour, how long would it take to set a four page folder, the form for each page being 3 1/2 inches by 5 inches? Type is set 10-point solid.

19. If you set a form 18 picas by 30 picas long in 10-point solid what is the cost of composition at 65 cents per thousand?

20. If you are paid .80 per thousand ems, what is the cost of setting a form 3 1/2 inches wide and 5 inches long in 10-point solid?

21. If 1000 ems of 6-point cost $1.20 what would be the cost of 1 square inch?

22. A page of type 6 X 9 contains 54 square inches. If set in 8-point and figured at $1.00 per 1000 ems, what would be the cost of setting this page?

23. What would be the cost of a page that contains 24 square inches of 12-point if composition costs $1.25 per 1000 ems?

24. If a page measures 21 picas by 27 picas, what would be the cost at $1.10 per thousand ems?

25. The price of 1000 ems of 8-point was figured at .0972 per square inch. What is the cost of the thousand ems?

WEIGHT OF TYPE

THE printer is often required to estimate the number of pounds a certain job will contain. Since much of our type is ordered in pound fonts, reasonable accuracy can be obtained if it is remembered that 4 (four) square inches of type equal one pound. Although a slight difference will result in the weights of linotype, monotype and foundry metal, due to the varied percentage of alloys used, it is so small that it is generally disregarded.

The approximate amount of body type required for a given page can be determined by finding the number of square inches in the page, divide by four (4 sq. in. to the pound), and the quotient will be the approximate weight of type.

To find the weight of type required for a page 18 picas by 33 picas:

18 picas ÷ 6 = 3 (the number of inches in the width).
33 picas ÷ 6 = 5½ (the number of inches in length of the page).
3 X 5½ ÷ 4 = 4 1/8 (the number of pounds).

A square of type two by two inches (four square inches) will weigh ., approximately, one pound. On this basis the number of ems in a pound of type, of any given size, can safely be estimated as follows:

One pound of	5	point will contain	829 ems
One pound of	5½	point will contain	685 ems
One pound of	6	point will contain	576 ems
One pound of	7	point will contain	423 ems
One pound of	8	point will contain	324 ems
One pound of	10	point will contain	207 ems
One pound of	11	point will contain	171 ems
One pound of	12	point will contain	144 ems

PROBLEMS

1. Find the weight of 2,835 ems of 8-point.

2. How many ems in 5 1/4 pounds of 6-point type?

3. Find the weight of a form 21 picas by 5 1/4 inches.

4. How many pounds of type in a form 50 by 60 picas?

5. Find the weight of 24-point type in a 6-inch square.

6. Find the weight of type required for a page 20 by 36 picas.

7. Find the weight of 10-point type required to set a page 20 by 35 picas.

8. A form measures 45 by 57 picas. How many pounds does it weigh?

9. If a form contains 1,512 12-point ems, how much does the form weigh?

10. If 6-point slugs weigh the same as type matter, how many running inches in 10-pounds?

11. What is the weight of type in a circular having 16 pages, the type mass being 6 by 9 1/2 inches?

12. Find the number of pounds of 10-point type required to set a page 16 picas wide and 30 lines to a page.

13. A page is set solid at 30-pica measure in 10-point. It contains 54 lines. How much does the form weigh?

14. A type form is 36 by 48 picas. It contains a halftone that measures 15 by 21 picas. What does the type weigh?

15. A 4-page folder is set in 12-point type. The type is set 26 picas wide and 44 picas long. How much does the type weigh?

Ems Long	2 point	3 point	Ems long	2 point	3 point
3	288	192	27	31	21
4	216	144	28	30	20
5	168	112	29	30	20
6	144	96	30	29	19
7	123	82	31	28	19
8	108	72	32	27	18
9	96	64	33	26	17
10	84	56	34	25	17
11	78	52	35	24	16
12	72	48	36	24	16
13	66	44	37	23	15
14	61	41	38	22	15
15	57	38	39	22	15
16	54	36	40	21	14
17	51	34	41	21	14
18	48	32	42	20	14
19	45	30	43	20	13
20	42	28	44	19	13
21	40	27	45	19	13
22	39	26	46	18	12
23	37	25	47	18	12
24	36	24	48	18	12
25	34	23	49	17	11
26	33	22	50	17	11

PROBLEMS

1. A page set in 12-point is leaded 6 points. It measures 24 picas and 37 lines to a page. What is the weight of leads required for the page?

2. Find the cost, at 18 cents a pound, of leads required for a four-page folder set 2-point leaded, 10-point type. There are 34 picas to the page, 18 picas wide.

3. A circular is set 42 picas wide in 14-point type, 4-point leaded, and 60 picas long. How much would the leads cost at 18 cents a pound?

4. Find the cost at 18 cents a pound of leads for 8 pages, set in 18-point type, 24 picas wide and 39 lines to a page, 3-point leaded.

5. A booklet of 24 pages measures 18 picas wide and 55 picas long; is 2-point leaded and set in 12-point. Find the number of pounds of leads required.

6. Find the cost at 18 cents a pound of leads required for an eight-page folder set 4-point leaded, 12-point type. There are 30 picas to the page, 20 picas wide.

7. A circular is set 50 picas wide in 18-point type 6-point leaded, and 70 picas long. What do the leads weigh?

8. Find the cost at 18 cents a pound of leads for a book of 150 pages, set in 10-point type, 24 picas wide and 40 lines to a page, 3-point leaded.

9. A page is set in eight point type, 2-point leaded, 18 picas wide and 30 picas long. What is the weight of the leads required?

10. A booklet of 32 pages 30 X 50 picas, 12-point type is 2-point leaded. What is the cost at 18 cents per pound of the leads for this job?

TYPE METAL

TYPE METAL is a mixture of lead, tin, and antimony. Lead forms the base for type metal and takes approximately five parts to one part of tin and two parts of antimony. These proportions are varied according to the sizes of type made. The smaller types are usually made harder by increasing the amount of tin and antimony while the larger types, having a greater body have a great amount of lead and less of the tin and antimony. Linotype has a greater amount of lead than foundry type. Lead melts easily and fuses readily with other metals. It is too soft for practical use so tin is added to give it toughness and antimony to give it hardness. Ordinary type forms will print about 50,000 impressions. To insure longer wear, type forms are made into electrotypes, sometimes nickel faced, sometimes copper faced. The electrotypes will print about 250,000 impressions.

The proportion of the metals used for the different classes of type is approximately as follows:

Kind of Metal	Antimony	Tin	Lead
Linotype	12%	5%	83%
Monotype	18%	8%	74%
Foundry	25%	10%	65%

Melting Points of Chemical Elements

	Melting Points	Specific Gravity
Tin	450°F.	7.29
Lead	621°F.	11.37
Zinc	787°F.	7.15
Antimony	1166°F.	6.71

PROBLEMS

1. If 1200 pounds of linotype metal contain 996 pounds of lead, how many pounds of antimony and tin should the balance contain?

2. A lot of foundry type weighing 1500 pounds contains 25% antimony, 10% tin, and 65% lead. How many pounds are there of each metal?

3. A printer wants to mix 1400 pounds of monotype metal. How many pounds of antimony, of tin, and of lead must he use?

(Type Metal Problems Continued)

4. How many pounds of tin in 2600 pounds of linotype metal?

5. How many pounds of antimony in 1000 pounds of foundry type?

6. Find the number of pounds of lead in a lot of 1600 pounds of foundry type?

7. In a lot of 1800 pounds of monotype metal there are 1332 pounds of lead. Find the number of pounds of tin? of antimony?

8. A lot of 1200 pounds of linotype metal contains 996 pounds of lead. How many pounds of lead would the same lot contain in foundry metal?

9. In mixing 1200 pounds of monotype metal. How many pounds of antimony are required?

10. How many pounds of lead in 2000 pounds of monotype metal?

FIND VALUE OF STOCK

Most paper stock, excepting cut cards, envelopes, etc., is sold by the ream and on the pound basis. Most of the problems of a printer deal with reams of stock and the number of sheets used for printing. No attempt to explain the process of paper-making, its many kinds or sizes is given here. This is left for the instructor to embody in his own way in the course of his instruction.

The ream is the accepted basis for count and weight. A ream contains 500 sheets and comes wrapped in packages weighing 13, 16, 20, 24 and 28 pounds for bond papers and 40, 45, 50, 60, 70, 80, 90 and 100 pounds in the book papers. The prices for these papers vary and it is best to consult a paper dealer's price list when specified papers are called for.

The size most frequently used for bond paper is 17 by 22 inches and weighs 20 pounds. If a medium grade bond is priced at 15 cents per pound, the cost of the ream would be 20 lbs. X 15 cents = $3.00.

To find the cost of 245 sheets of bond paper 17 X 22-20 lbs. at 15 cents per lb., multiply 245 X 20 X .15 and divide by 500 (the number of sheets to the ream). The answer is $1.47.

Solution: 245 X 20 X .15 = 735.00 ÷ 500 = $1.47 Ans.

Example: find the cost of 40 sheets, 24 lbs. per ream, price 12 cents per pound.

Solution: 40 X 24 X .12 = 115.20 ÷ 500 = $.23 + Answer.

When more than a thousand sheets are required the problem can be solved by using 1000 as a basis instead of the ream count of 500. When this method is used the weight is doubled. The fractional part of a thousand sheets should be expressed in decimals and multiply as in previous example.

Example: To find the cost of 2450 sheets of 25 X 38-60 lbs. book paper at 13 cents per pound.

Solution: The number of sheets 2.450 (expressed decimally) X 120 (double the ream weight) X .13 (cost per lb.) = $38.22 Ans.

Example: (Method No. 1) Find the cost of 180 sheets, weight 50 lbs. per ream at 12 1/2 cents per lb.

Solution: 180 X 50 X .125 ÷ 500 = $2.25 Ans.

Example: (Method No. 2) Find the cost of 180 sheets, weight 50 lbs. per ream at 12 1/2 cents per lb.

Solution: .180 X 100 X .125 = $2.25 Ans.

In method number two doubling the weight of the ream raises the number of sheets to a one thousand basis. Dividing by 1000 is done by pointing off three places in the number of sheets. As shown in the example above, 180 sheets, pointing off the three places gives .180.

When the prices of the paper contains a fraction, the fraction changed to a decimal, simplifies the problem.

Example: Find the cost of 350 sheets, 80 pounds per ream, price 6 3/4 cent per pound.

Solution: (method I) 350 X 80 X .0675 ÷ 500 = $3.78
Solution: (method II) .350 X 160 X .0675 = $3.78

In the example shown no allowance has been made for spoilage. The percentage of spoilage in printing varies according to the paper used and difficulties encountered in different types of job to be done. Use the following table in working out the problems. If binding or extra color is called for, add the percentages together and multiply the number of copies by the total percentage. Include binding for eight or more pages.

SPOILAGE TABLE

Quantity	First Color	Each Extra Impression	Binding
100- 250	10 %	5 %	5 %
251- 500	6	4	4
501- 1,000	5	2½	2½
1,001- 5,000	4½	2½	2
5,001-10,000	3½	2½	2
10,001-25,000	2½	2½	2
Over 25,000	2	2	2

PROBLEMS

No Allowance for Spoilage

1. Find the cost of 225 sheets, 80 pounds per ream, at 6 3/4 cents per pound.

2. Find the cost of 350 sheets, 80 pounds per ream, at 9 3/4 cents per pound.

3. Find the cost of 125 sheets, 70 pounds per ream, at 14 cents per pound.

4. Find the cost of 190 sheets, 70 pounds per ream, at 17 3/4 cents per pound.

5. Find the cost of 48 sheets of 50-pound paper if the cost is 11 1/4 cents a pound.

6. What is the cost of paper for 3,500 copies of a 6 X 9 circular, cut from 19 X 24-24 pound bond paper at 17 cents a pound? Include spoilage.

7. An order for 1,750 copies requires 875 sheets of 45-pound paper, at 17 1/4 cents per pound. What is the cost of the paper?

8. What is the cost of 2,500 Bristol cards, size 5 X 3 inches cut from 22 1/2 X 28 1/2 stock? The cost of stock is $3.84 per 100 sheets.

9. A program 5 X 7 inches is cut from stock 28 X 42-37 pounds at 13 1/4 cents per pound. If 2,500 copies are required, what is the cost of the paper? Include spoilage.

10. What is the cost of paper for 2,000 copies of a 4-page program, printed 2 pages to a form, page size 5 X 8 inches, cut from 17 X 22-20 pounds at 13 cents per pound? Include spoilage.

11. An order for 2,000 programs, size 5 X 7 inches, calls for two colors. Paper is cut from 25 X 38-70 pounds book stock. What is the cost of the paper at 14 1/2 cents per pound? Include spoilage.

12. An 8-page folder, page size 4 X 9 inches, printed in two colors, calls for 5,000 copies. Paper used is 38 X 50-140 pounds, at 12 cents per pound. Find the cost of the paper. Include spoilage.

13. An order for 10,000 5 X 3 cards is cut from 20 1/2 X 24 3/4 Index Bristol. The cost of the Index Bristol is $3.85 per 100 sheets. What is the cost of stock for the cards? Include spoilage.

14. An order for an 8-page folder calls for 1,500 copies. Stock 25 X 38-60 pounds at 12 1/2 cents is used. What is the cost of the stock for this order? Page size 7 1/2 X 10 1/2. Include spoilage.

15. A 4-page folder, size of page 7 X 9 inches, is to be cut from stock 25 X 38-70 pounds. The paper costs 11 1/2 cents per pound. What would be the cost of the paper for 5,000 copies? Include spoilage.

CUTTING AND FINDING WEIGHT OF PAPER

In cutting stock the largest number of pieces of the given size is usually strived for with the least amount of waste. Waste may, however, be of a size that can be used later for small jobs in printing. Sometimes it is necessary to cut stock a trifle larger than the required size, to be trimmed later in order to get all the edges perfectly even. When this is necessary be sure to allow for the trim to be taken off.

Paper comes in many sizes and weights and the size of sheet which cuts to best advantage, that is the least amount of waste, should be selected. Paper is wrapped in flat sheets and in rolls. Rolls used for Rotary and newspaper presses weigh from 1000 to 2000 pounds. The flat sheets, with which we are familiar, come in packages of 500 sheets, called a ream. A ream weighs a specified number of pounds. A ream 25 X 38-70 lbs. means that 500 sheets 35 X 38 inches weigh 70 pounds. A case weighs approximately 500 pounds.

A case of 20 lb. bond paper would contain 25 reams (20 lbs. to 1 ream) 25 reams X 20 (lbs. to 1 ream) = 500 lbs.

For bond and ledger papers the following sizes are considered standard sizes: 17 by 22 inches, 17 by 28, 19 by 24, and the doubles of these sizes.

For book papers: 25 by 38 inches, 28 by 42, 28 by 44, 32 by 44 and the doubles of these sizes.

For cover papers: 20 by 26 inches, 23 by 35, and the doubles of these sizes.

To find the number of pieces to be cut from a sheet divide the required size into the given sheet size.

Example: How many pieces 8 1/2 by 11 inches can be cut from a sheet 17 by 22 inches?

$$\frac{17 \times 22}{8\frac{1}{2} \times 11} = 4, \text{ the number of pieces}$$

Occasionally a large strip of waste results in figuring the number of pieces to be cut. Sometimes the strip may be used to get additional pieces.

Example: How many pieces 7 by 10 inches can be cut from a sheet 17 by 22 inches?

$$\frac{17 \times 22}{7 \times 10} = 4, \text{ the number of pieces to a sheet.}$$

In dividing there apparently remains but a small amount of waste yet if the division is reversed an additional piece can be cut from the sheet. This works out as follows:

$\frac{17 \times 22}{7 \times 10} = 3$ out. Part remaining $\frac{7 \times 22}{10 \times 7} = 2$ out.

This gives a total of 5 pieces cut from the sheet.

To find the weight of a ream of paper when two sizes of the same basic weight are given the problem may be worked out by proportion.

Example: What is the weight of a ream of paper 19 by 24 inches, if a ream 17 by 22 inches weighs 20 pounds?

Solution: 17 X 22 : 19 X 24: : 20 lbs. : unknown weight.

$$\frac{19 \times 24 \times 20}{17 \times 22} = 24.3 \text{ lbs.}$$

In the above the product of the means equals the product of the extremes, that is 19 by 24 inches X 20 lbs. ÷ 17 by 22 inches X the unknown weight. To find the unknown weight, divide 19 X 24 X 20 by 17 X 22.

The problem may be worked out on the square inch basis. The sheet 17 by 22 inches contains 374 square inches. If the 500 sheets 17 by 22 inches weigh 20 pounds, one square inch will weigh 20 pounds divided by 374 = $\frac{10}{187}$ pounds to the square inch.

A sheet 19 by 24 inches contains 456 square inches.

A ream would weigh 456 X $\frac{10}{187}$ lbs. = 24.3 on the 20 pound basis.

Example: If a ream of paper 17 by 22 inches weighs 20 pounds, what would the ream weigh if size 22 by 34 inches is used?

Solution: 17 X 22 : 22 X 34 : : 20 lbs. : unknown weight.

$$\frac{22 \times 34 \times 20}{17 \times 22} = 40 \text{ pounds}$$

To find the weight of part of a ream multiply the number of sheets by the weight of the ream and divide by 500, the number of sheets to a ream.

Example: Find the weight of 63 sheets of paper, weight of ream 50 pounds.

Solution: $\frac{63 \times 50}{500} = 6.3$ lbs.

When over 1000 sheets are computed the result may be more easily worked out if the ream count is changed to 1000 basis. Take for example, book paper, size and weight expressed as follows:

2125 sheets, 25" X 38" -40lbs. (per ream) find the weight.

The number of sheets, divided by 1000, is 2.125, multiplied by 80 lbs. (twice the weight of a ream) gives the weight, 170 lbs.

2125 sheets	2.125
Multiply by weight of 1000 sheets	80
The product is the weight . . .	170.000

PROBLEMS

1. If a ream of paper 17 X 22 inches weighs 20 pounds, find the weight of a ream 19 X 24 inches.

2. A ream of book paper 25 X 38 weighs 70 pounds. What would a ream of the same paper, size 28 X 44, weigh?

3. A ream of cover stock 20 X 26 weighs 65 pounds. What would a ream, size 23 X 35, weigh?

4. How many sheets 25 X 38 inches are required for 600 pieces 4 X 8 inches?

5. How many sheets 25 X 38 inches are required for 3,500 pieces 7 X 14 inches?

6. How many sheets 19 X 24 inches are required for 500 pieces 5 X 7 inches?

7. What is the cost of a ream of paper 19 X 24 inches at 21 cents per pound, basis 17 X 22-16 pounds?

8. How many pieces 3 X 5 inches can be cut from 1,500 sheets 8 X 16 inches?

9. How many sheets of 17 X 22 would be required for 1,000 pieces 6 X 8 1/2 inches?

(Cutting and Finding Weight of Paper
Problems Continued)

10. How many sheets of 32 X 44 would be required for 2,500 pieces 5 1/4 X 5 inches?

11. How many cards 4 1/2 X 3 1/2 inches can be cut from 250 sheets of cardboard 22 1/2 X 28 1/2 inches?

12. If the paper costs 12 cents per pound for a ream 19 X 24, basis 29 pounds, how much would 2,600 sheets 17 X 22 inches, same basis, cost?

13. An order calls for 20 M letterheads (8½ X 11). How many sheets 17 X 22 inches would be required? Include spoilage.

14. What is the cost of 10 reams of paper 22 X 34 inches, basis 17 X 22-20 pounds, if the paper costs 27 cents a pound?

15. Find the cost of 2,000 blotters, size 6 X 3 1/4 inches, cut from 19 X 24-160 pounds, price $16.80 per ream. Include spoilage.

16. Find the cost of 10,000 pieces, 5 X 3 inches, cut from 19 X 24-24 pounds, at 11 1/2 cents per pound. Include spoilage.

17. An order calls for 45,000 letterheads cut from 17 X 22-20 pounds bond paper. Would it be cheaper to buy the paper at the ream price of 14 cents or at case price of 12 cents per pound? What would be the difference in price? Include spoilage.

18. A 4-page program 6 X 9 inches is to be printed 2 pages at a time. How many sheets of 25 X 38 inches are required for 500 copies? Include spoilage.

19. An order for 1,500 8 1/2 X 11-inch letterheads is cut from 17 X 22-20 pounds at 17 3/4 cents per pound. What is the cost of the paper, including spoilage.

20. Find the cost of paper required to print 10,000 4-page folders, 6 X 9 inches, printed work and turn. Stock is 25 X 38-70 pounds at 14 cents per pound. Include spoilage.

21. Find the cost of paper for 2,500 4-page folders. Size of page is 7 X 10 inches, printed in two colors, sheetwise. Stock is 28 X 42-90 pounds at 14 cents per pound. Include spoilage.

(Cutting and Finding Weight of Paper
Problems Continued)

22. A 6-page folder, 7,000 copies, printed work and turn, is cut from stock 25 X 38-60 pounds. Page size is 3 1/2 X 6 inches. What is the cost of the paper, including spoilage, at 12 3/4 cents per pound?

23. Find the cost of paper for 3,500 copies of an 8-page folder, printed work and turn. Size of page is 5 X 7 inches, with 1/4 inch trim cut from 32 X 44-119 pounds at 14 cents per pound. Include spoilage.

24. Find the cost of paper for 1,000 8-page booklets and cover. Size of page is 5 X 7 1/2 inches. Cover stock is 23 X 35-100 1/2 pounds at 19 cents per pound. Inside is 32 X 44-119 pounds at 14 cents per pound. Include spoilage.

25. Find the cost of paper for 1,500 copies of a 12-page folder. Size of page is 6 X 9 inches. Job is printed in two forms; 8 pages work and turn, and 4 pages work and turn. Stock 25 X 38-70 pounds at 11 cents per pound. Include spoilage.

PROPORTION

PROPORTION may be defined as the comparative relation of one thing to another with respect to size. As such, it is a broad term and many sizes may be mathematically in proportion. The quality of any proportion in design is always assumed to be a pleasing relationship of sizes. It therefore becomes necessary to determine what relationship of sizes will be most pleasing.

Below are given four dimensions to help the student choose between what are considered agreeable proportions.

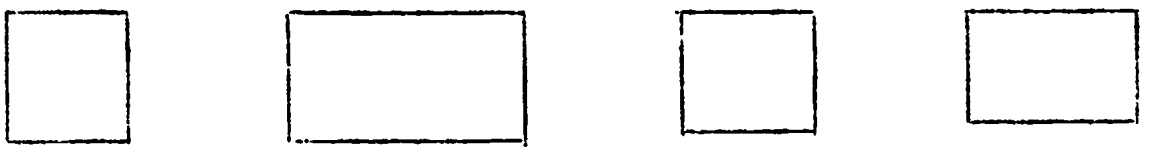


Fig 1 Fig 2 Fig 3 Fig 4

Some dimensions are agreeable, while others are not. A perfectly square sheet as represented in figure 1 is not pleasing. A rectangle that is twice as long as it is wide as in figure 2 is a little more pleasing. In figure 3 the length of the rectangle bears no mathematical relation to its width and is not pleasing. In figure 4 the width is based on the proportion of 2 to 3. The width is 2/3 of the length and constitutes a regular oblong, and is well proportioned.

The printer has to deal with four oblongs, each of which is considered to be in good proportion. These are called the Printer's Oblong, the Golden Oblong, the Regular Oblong and the Hypotenuse Oblong. If the width of a page is given, the length may be found by multiplying the width by the following factors. If the length is given reverse the operation and divide to find the width.

If 20 picas are used for the width the difference in length of pages works out as follows:

Oblong	Width (picas)	Factor	Length
Regular	20	1.5	30.
Hypotenuse	20	1.41	28.2
Golden	20	1.62	32.4
Printer's	20	1.73	34.6

When the length is given, to find the width, divide instead of multiplying, using the same factor.

Note - The factor figures may be substituted for the methods described. In find the Printer's Oblong, it is much easier to use the decimal figure than to construct a right angle drawing.

For the Regular Oblong the length of a page is the width plus one half of it. A page 20 picas wide would be 30 picas long. 20 + 10 (½ of width) = 30 picas, length of page.

The Printer's Oblong is found by squaring the width of the page, square the diagonal, then extract the square root of the difference of the squares. The answer will be the length of the page.

Example: What is the length of a page that is 20 picas wide?

Solution: The width is 20 picas. The diagonal is 40 picas (twice the width)

Square the diagonal 40^2	1,600
Square the width 20^2	400
The difference	1,200

The square root of 1,200 = 34.6, the length of the page.

The Golden Oblong is based on approximately the 3:5 ratio. If the width of a page is given and the length is to be found, divide the width by 3 and multiply by 5. If the length is given multiply by 3/5 to find the width.

Example: To obtain a Golden Oblong if the width of the page is 15 picas.

Solution: 15 ÷ 3 = 5 X 5 = 25. Size of oblong is 15 wide by 25 long. Ratio is 3:5.

The Hypotenuse Oblong is found by squaring the width of the page, double the square of the width, then extract the square root of the number.

Example: What is the length of a page that is 20 picas wide?

Solution: The width is twenty picas.
Square the width 20^2 = 400
Double the square (400) =800
The square root of 800 = 28.2 picas.

To find the width when the length is given, square the length of the page, take one-half the square of the length, then extract the square root of the number. Solution: (By using factor) 15 X 1.41 = 21.15. Size of oblong is 15 wide by 21.15 long.

TO FIND THE TYPE AREA

Since most pages are based on sizes pertaining to one of the oblongs given in this chapter, type pages should conform as near as possible to the proportions of the page size used. To find the proper type mass to use when the page size is given the procedure would be as follows:

To find the proper type mass for a page that is 6 by 9 inches (ratio is 2:3).

Since type matter is measured in picas change 6 by 9 inches to picas = 36 by 54 picas. The area of the sheet equals 36 X 54 = 1,944 square picas. To allow for margins the area of the type mass is equal to one-half the area of the sheet. 1,944 picas divided by 2 = 972 square picas, which represents the area of the type mass.

Since the sheet, 6 by 9, is in the ration of 2 to 3, the type matter should conform to the ratio of 2 to 3. To find the length and width of the type mass, 972 square picas, first find the length. The type mass, 972 sq. picas X 3 = 2,916 divided by 2 = 1,458. Extracting the square root of 1,458 gives the length, 38 picas. To find the width of the type, take 2/3 of the length, 38, and the answer is 25 picas. If the ratios of 3 to 5 or 5 to 8 is to be used, use the factors of 3 and 5 to multiply the type mass and the factors 5 and 8 to divide the product obtained.

Not all page sizes used by printers conform to the oblongs given here since page size is often governed by economy in cutting. When a page does not conform to any of the standard ratios, use the ratio that conforms with the page given.

Pages may be well proportioned when based on ratios of 1 to 1½, 2 to 3, 3 to 5, and 5 to 8.

To find the length of a page based on a ratio of 5 to 8 when the width is given the problem is solved as follows:

Example: A sheet 10 inches wide, find the length, ratio 5:8.

Solution: 10 ÷ 5 = 2 X 8 = 16", the length. In proportion: The ratio 5:8 :: 10 (width) : X (the unknown length) 5X = 80, X = 16 (the length).

The length should be 8/5 of the width, and the width should be 5/8 of the length. Worked out on this basis it would be as follows:

Example: A page is 24 picas wide. What is the length?

Solution: Width equals 24 picas (5/8 of length) $24 \times \frac{8}{5} = \frac{192}{5} = 38.4$ picas, the length.

The same problem worked out according to the Printer's Oblong, by squaring the width of the page, square the diagonal, then extract the square root of the difference of the squares, the result gives the length of the page.

Example: A page is 24 picas wide. What is the length?

Solution: 24 picas = width of the page.

$24 \times 2 = 48$ picas, diagonal of the page.

$24^2 = 576$

$48^2 = 2,304$

$2,304 - 576 = 1,728$

$\sqrt{1,728} = 41.5$ picas, length of page.

There is no definite basis as to what shall be the proper size for a page. The four oblongs described in this chapter represent well-proportioned pages. De Luxe book pages and commercial requirements may find other sizes more convenient.

PROBLEMS

Carry problems to two decimal places

1. If a page is 20 picas wide, what is the length of a Regular oblong?

2. If a page is 16 picas wide, what is the length of the Hypotenuse oblong?

3. A type page is 29.16 picas long. What is the width, based on a Golden oblong?

4. A Printer's oblong is 25.95 picas long. How many ems of 12-point in a page?

5. How many 8-point ems in a type page 20 picas wide, based on the Golden oblong?

(Proportion Problems Continued)

6. A Hypotenuse oblong is 18 picas wide. How many ems of 10-point leaded in the page?

7. A page is 31.14 picas long. Based on a Printer's oblong, how many 8-point ems, leaded, in the page?

8. How many 14-point ems in a type page whose length is 36 picas, based on the Hypotenuse oblong?

9. If a page is 5 1/4 X 8 3/4 inches, find the width and length of the type page based on ratio of 2:3?

10. If a rectangle 4 X 6 inches is divided into a ratio of 2:3, what does each space measure?

11. If a rectangle 2 1/4 X 5 1/4 inches is divided into a ratio of 3:5, what does each space measure?

12. A page set in 12-point is 24 picas wide. If the length is based on a 2:3 ratio, how many ems in the page?

13. Which page has the larger number of ems and how many, a Golden oblong page 15 picas wide, set in 6-point, or a page whose length is 36 picas, based on a Printer's oblong?

14. Find the width and length of the type for a page 4 X 6 inches.

15. A page measures 8 X 12 inches. Find the width and length of the type page.

16. A page measures 5 X 7 1/2 inches. Find the width and length of the type page.

17. A page measures 7 X 10 1/2 inches. Find the width and length of the type page.

18. A page measures 21 X 35 picas. Find the width and length of the type page.

19. A page measures 36 X 54 picas. Find the width and length of the type page.

20. A page measures 24 X 36 picas. Find the number of 10-point ems in the type page.

21. A type page is 24 picas wide. How many ems of 10-point leaded in the page, if the page is based on the Golden oblong?

22. A type page is 36 picas long. How many ems of 8-point in the page if the page is based on the Hypotenuse oblong?

MARGINS

MARGINS vary with certain classes of work and cannot be confined to one method. The rule applied to the governing of the margins on a page is that the amount of white space in the margins shall equal the amount of space in the type matter.

For the smaller size pages where paper is a consideration there may be the same width of margins on each of the four sides. Since inequality is more pleasing than equality, the width for margins should differ for each side of the type pages. If correctly proportioned pleasing results are obtained.

Leading authorities agree that the most pleasing effect in margins is obtained where the area of a page is divided in two, one-half is given the type area and one-half divided among the margins. The relation of these margins to each other should be as 2 is to 3 or as 3 is to 5.

If 12 picas are to be divided between the inner and outer margins, place 4.8 picas (2/5 of 12) at the back and 7.2 picas (3/5 of 12) at the front. This would give a ratio of 2 to 3.

If the ratio of 3 to 5 is used, place 4.5 picas (3/8 of 12) at the back margin and 7.5 picas (5/8 of 12) at the front margin.

In order to find the length and width of a type mass and the proper margins, if based on the 2-3 ratio, when the paper page is given, proceed as follows:

Example: Given a page 5 X 7 inches, equal to 30 X 42 picas. Solve for the proper margins and find the length and width of the type page, if based on the 2-3 ratio.

Explanation: Multiply 30 X 42 picas, this equals 1260 pica ems or square picas. This is the area of the paper page in pica ems.

In a well balanced page the type should occupy about half of the paper page and the other half would be white space left for margins.

Divide 1,260 by 2 equals 630 pica ems, which will be the area of the type mass and also the area of the white space left for margins.

Based on the 2-3 ratio, the 630 pica ems is divided by 2/3.

$$630 \div 2/3 = 630 \times 3/2 = \frac{1,890}{2} = 945$$

Taking the square root of 945 gives the length of the type page.

$$\sqrt{945} = 30.74$$

To find the width of the type page take 2/3 of 30 and this will give 20 picas for the width. Dimensions of the type page are 20 X 30 picas.

Having found the size of type page, and having given the paper page, subtract the type page from the paper page, which will give the total margins for the sides and also for the top and bottom.

Paper page	30 X 42 picas
Type page	20 X 30 picas
	10 X 12 picas

For the side margins a total of 10 picas remain, and a total of 12 picas for the top and bottom margins.

The proper side margins, according to the 2-3 ratio are obtained by dividing 10 picas by 2/5 which equals 4 picas for the back margin. Then 3/5 of 10 which is 6 for the front margin. For the top and bottom margins divide the total 12 by 2/5 equals 4.8 top. Divide the 12 by 3/5 equals 7.2 for the bottom margin.

The above problem worked out:

Page size 5" X 7" = 30 X 42 picas
Ratio 2-3
30 X 42 = 1260 square picas

1260 ÷ 2 = 630 square picas (area of type page)
630 square picas (area of margins)
630 ÷ 2/3 = 630 X 3/2 = 1090 ÷ 2 = 945
(2-3 ratio)

$\sqrt{945} = 30.74$
30 picas, length of type
30 X 2/3 = 20 picas width of type page

Paper page	30 X 42 picas
Type page	20 X 30 picas
Total width of margins	10 X 12 picas

Total of side margins is 10 picas
2/5 of 10 = 4 picas for back margin
3/5 of 10 = 6 picas for front margin

Total of top and bottom margins is 12 picas.
2/5 of 12 = 4.8 picas for top margin
3/5 of 12 = 7.2 picas for bottom margin

The fractional part in both the length and width of the type form may be dropped in order to avoid half measures. Retain the fractional part in the margins, since the space can be more easily adjusted in actual shop work.

Since the margin of 4.8 does not work out in pica or point material, this can be made 4.5 (equal to 4 1/2 picas). Again, 7.2 may be raised to 7.5 picas.

The problems that follow should be worked out with this kept in mind.

It will be found by working out these problems that the factor 0.7071 is obtained when type occupies 50% of the sheet. The factor can be used to multiply the length and width of a page to determine the length and width of the type mass.

Example: Find the length and width of type mass on a page 30 X 45 picas.

30 picas X 0.7071 = 21+ picas width of type mass
45 picas X 0.7071 = 32- picas length of type mass

PROBLEMS

1. A page measures 5 by 7 1/2 inches. Find the type area and the margins for each side based on the 2:3 ratio.

2. A page measures 6 by 9 inches. Find the type area and the margins for each side.

3. A golden oblong has for its width 24 picas. Find the type area and the margins for each side.

4. A page measures 3 1/4 by 5 1/4 inches. The type matter is 13 by 23 picas. Find the margins for each side.

(Margin Problems Continued)

5. A page based on a Hypotenuse oblong is 5 inches wide. Find the type area and the margins for each side.

6. A type page measures 20 by 30 picas. Find the paper size and the margins for each side.

7. A type page measures 24 by 40 picas. Find the paper size and the margins for each side.

8. The type area of a page contains 486 pica ems. Based on a 2:3 ratio, what is the size of the paper page?

9. A page based on a 3:5 ratio measures 27 picas wide. Find the length and width of the type page and the margins for each side.

10. The type area for a page contains 1,944 pica ems. If a 3:5 ratio is used, find the page size and the margins for each side.

11. A page based on a 3:5 ratio measures 35 picas long. Find the length and width of the type page and the margins.

12. A Printer's oblong has for its length 41 1/2 picas. What are the width and the margins for each side?

RATIO AND PROPORTION

RATIO is the term used to compare two numbers. How does 6 compare with 3? Six is twice three. Then the ratio of 6 to 3 is 2.

If we wish to know how many times larger 10 is than 2, we divide 10 by 2 and obtain 5 for the quotient; thus 10 ÷ 2 = 5, 10 is five times as large as 2; it contains five times as many units as 2. If we wish to know what part of 10 is 2 we divide 2 by 10 and obtain 1/5; thus, 2 ÷ 10 = 1/5, or .2. This operation of comparing two numbers is called finding the ratio of the two numbers.

If we wish to compare 10 and 2 and express this comparison as a ratio it may be done as follows: 10 ÷ 2, 10:2, or 10/2. All three are 2/10 read the ratio of 10 to 2.

The first term of a ratio is called the antecedent, from the Latin , meaning to go before. The second term of a ratio is called the consequent, from the Latin, meaning, which follows.

The ratio of two numbers is the quotient which is obtained by dividing the antecedent by the consequent, i.e., the ratio of 10 to 2 is 5.

The quotient in ratio, is obtained by dividing one number by another. Thus, to find the ratio of 72 points to 6 point divide 72 by 6 and get 12 as the quotient.

The sign of a ratio is the colon (:), which is the sign of division (÷) with the line omitted; as 12:6, which is read, "the ratio of 12 to 6," and means "the quotient of 12 divided by 6."

Instead of expressing the value of a ratio by a single number it is customary to express it by means of another ratio in which the consequent is 1. Thus, suppose that it is desired to find the ratio of the weights of a type page having for its dimensions 45 picas in length and 30 in width. The ratio of the length to the width is then 45:30, an inconvenient expression. Using the fractional form, we have 45/30. Dividing both terms by 30, the consequent, we obtain 1½/1, or 1½:1. This is the same result as obtained above, for 1½ ÷ 1 = 1½, and 45 ÷ 30 = 1½.

Proportion is the comparative relation of one thing or part to another with respect to its size.

Example: If the circumference of a circle is 22 inches and the diameter is 7 inches, what is the ratio of the circumference to the diameter?

$22 : 7 = \frac{22}{7} = 3\ 1/7$ 3 1/7 is the ratio. Answer.

When two ratios are expressed as equal they make a proportion. The following are proportions because the ratios are equal:

6:12 :: 8:16
5:20 :: 16:48

Sometimes the sign of equality (=) is used instead of the double colon (::).

The first and last terms of a proportion are called the extremes, while the second and third terms are called the means. In the proportion, 10:5 :: 24:12 the extremes are 10 and 12, the means 5 and 24. It is read 10 is to 5 as 24 is to 12.

The product of the extremes is equal to the product of the means. Any expression where this is not true is not a valid proportion.

Text the validity of the following proportions:

8:60 :: 10:75
3:9 :: 12:36
4:6 :: 6: 9

PROBLEMS

1. What is the ratio of a page 15 X 37 1/2 inches?

2. Find the ratio of 12:72; 15:45; 35:105.

3. Which is the greater of the two ratios, 2:3 or 3:5, and how much?

4. Find the profit on three presses, if the profit on eight presses is $157.

5. Divide 300 into three parts that shall be in the proportion 3:5:7.

6. If it takes five presses to complete a job in 8 days, how many presses would be required to do the job in 5 days?

7. If a page 6 inches wide by 9 inches long equals a ratio of 2:3, what would be the length of the page if a 3:5 ratio is used?

8. In 100 pounds of type metal there are 46 parts of lead. How many pounds of lead in 425 pounds of type metal?

9. If three presses printed 30,325 copies in 2 days, how many copies could be printed if five presses were used?

10. Three men were paid $305 for labor. They were paid in the proportion 3:5:7. What did each receive?

11. If 3 gallons of benzine are used in 14 days, how many gallons will be used in 90 days?

12. A printer earns $225 in 5 weeks. How many weeks would it take to earn $875.50?

13. A plant worth $280,000 was left to three sons and divided into the ratio of 1:3:4. How much did each receive?

14. A halftone measures 9 inches wide by 6 inches long. It is to be reduced to 6 inches wide. What will be the length?

15. How much tax should Smith pay on his printing plant, valued at $14,500, if Brown paid $145 on his plant, valued at $10,200?

COPY FITTING

Word Method - Em Method

FOR general estimating, where slight variations in the amount of space or number of words will not affect the finished result, the word method is the simplest method of finding the number of words that will fit into a given space.

It is not so accurate in determining the amount of space that type will occupy as counting the letters; yet it does serve as a fairly accurate guide in fitting type into a given area.

The copy is usually determined for the printer. The copy-fitter's or the printer's problem is to have it fit into a space, either specified for him or determined by himself.

The word method of copy fitting deals mainly with straight-matter composition. For display purposes the letters of each word are counted and figured in terms of units or characters and picas deep.

First count the number of words in the copy. Typewritten copy may be counted word for word or the approximate number taken as a basis. It may be well to count the words in three or four lines of the copy to find the average number of words per line. Then count the number of lines and multiply by the number of words per line to find the total number of words per page.

A page of typewritten matter 8 1/2 X 11 inches, when doubled-spaced, contains about 300 words. When single-spaced, a page contains about 500 words.

Next find the number of square inches of printing space that the type is to occupy. If the number of words per square inch of type selected (see word table on 66) when divided into the total number of words in the copy does not exceed the printing space that the type is to occupy, then the size selected should fit the space.

Example: The printing space of a government post card, allowing ¼-inch margin on all sides, is equal to 13.75 square inches. A page of typewritten matter, 8½ X 11 inches double-spaced, contains about 300 words. To fit these words on a post card it is found that the type size that comes nearest to filling the printing area is 8-point leaded.

Eight-point leaded equals 23 words (see chart) to 1 square inch. The 300 words divided by 23 equals 13.04 square inches. This is slightly under the 13.75 square inches and will fit in the space.

Point size of Type	Approximate Number of Words per Square Inch		Lines of Type per inch		Leads to the inch		APPROXIMATE NUMBER OF WORDS AND LETTERS IN LINES OF VARIOUS NUMBER OF PICAS IN LENGTH Figures Below Black Rule - Number of Words Per Line " Above " " - " " Letters " "															
	Solid	2-pt. Leaded	Solid	2-pt. Leaded	1 pt.	2 pt.	6	8	10	12	14	16	13	20	22	24	26	28	30	32	34	36
6	47	34	12	9	10.2	9	4 22	5 29	6 37	8 45	9 54	10 62	11⅓ 70									
8	32	23	9	7+	8	7.2	3⅓ 17	5 23	6 30	7 36	8 42	9 48	10 54	11⅓ 60	12⅓ 66	14 72	15 78					
10	21	16	7+	6	6.5	6	3 15	4 20	5 25	6 30	7 35	8 40	9 45	10 50	11 55	12 60	12½ 65	13½ 70	14½ 75	15½ 80	16⅓ 85	17½ 90
12	14	11	6	5+	5.5	5.1	2 13	3 18	4 23	4⅓ 27	5 32	6 36	7 41	7½ 45	8 50	9 54	10 59	10½ 64	11 68	12 73	13 77	13⅓ 82
14	11	7	5+	4+	4.8	4.5	2 10	3 13	3⅓ 17	4 20	5 23	6 27	6⅔ 30	7 34	8 37	9 41	9⅓ 44	10 47	11 50	11⅓ 53	12⅓ 57	13 60
18	7	5	4	3÷	3.7	3.6	1⅓ 8	2 11	3 14	3⅓ 17	4 20	5 23	5⅓ 26	6 29	6⅔ 32	7 35	7⅓ 38	8 41	9 44	9⅓ 47	10 50	10⅔ 53

If the order is reversed to find the number of words that can be printed on the post card, then multiply the number of square inches (13.75) by the number of words per square inch of the type selected.

Example: If there are 4 typewritten sheets, double-spaced, to be set for a 4-page folder with printing space 4 X 6½ inches on each page, what size type can be used?

Answer: The 4 typewritten sheets contain approximately 1,200 words (300 per sheet). The printing area for 4 pages is 26 X 4 = 104 square inches. Dividing 1,200 words by 104 square inches equals 11, the number of words in 1 square inch. The word chart shows that either 14-point solid or 12-point leaded can be used.

All type faces are not the same thickness. Some are thicker than others. The word method is based on average width letters only, and some allowance must be made for thick or thin type faces. Goudy, Century, Cloister, and Garamond are average width letters. Cheltenham O.S. is a thin-faced letter. Chaltenham Wide and Century Expanded are wide-faced letters, and some allowance for variation in different faces must be made.

EM METHOD OF COPY FITTING

Closely associated with the character count method is the em method. It is based on the number of ems per word. The average number of ems for each word is three. Count the number of words in the copy and multiply by 3 to find the number of ems in the copy. The number of ems can then be estimated for the type area and the number of pages.

Counting the words in the copy as before, the total words are multiplied by 3, the average ems per word. Three hundred words of copy, multiplied by 3, = 900 ems.

Taking the post-card size 5½ X 3¼ used in the word method and allowing for margins leaves a printing space 5 X 2 3/4 inches (13.75 square inches). Changed to pica ems, this equals 30 X 16.5 picas, equal to 495 square picas. The copy has 900 ems, which will mean that the type must be smaller than pica (12-point)size.

By using 8-point the problem becomes:

$$\frac{30 \times 12}{\text{(8-Point)}} = 45 \text{ width} \qquad \frac{16.5 \times 12}{10 \text{ (8-point leaded)}} = 19.8$$

Raise 19.8 to next figure 20 (lines.)

Answer: 45 X 20 = 900 ems.

Example: How many words, 10-point leaded, will be required for a page 5 X 7 inches?

Answer: Figured in terms of ems, 5 inches changed to 10-point ems = 36 ems wide. (5 X 72 ÷ 10 = 36). The depth would be 7 X 72 ÷ 12 = 42 lines of 10-point. Total number of ems 36 X 42 = 1,512 ems. Divided by 3 (ems to 1 word) = 504 words.

The same example figured on the word method gives 560.5 X 7 = 35 square inches X 16 (words to 1 inch) = 560 words.

The same example, if figured in terms of picas long, as given in the chart, equals 609 words. There are 14½ words in one line (see chart) of 30 picas X 43 lines = 609 words.

All three methods differ. The type face and style of composition, plus experience, will enable the student to select the method best suited for the requirements in copy fitting.

The following table contains the approximate number of words in 1,000 ems:

6-point solid	334	6-point leaded	242
8-point solid	419	8-point leaded	301
10-point solid	352	10-point leaded	268
12-point solid	392	12-point leaded	308

The amount of space occupied by 1,000 ems of 10-point is slightly under 19.29 square inches.

6-point = 6.94 inches	12-point = 28 inches
8-point = 12.34 inches	14-point = 37.8 inches

Example: Given a manuscript containing 36,000 words to fit on a type page 5 X 7 inches, 10-point solid. Estimate the number of type pages the copy will make.

Answer: 36,000 words X 3 = 108,000 ems. The type page, 5 X 7 inches, = 35 sq. in. Changed to 10-point ems, type page = 1814.4 ems per page. (5 in. X 72 ÷ 10 = 36 wide. 7 in. X 72 points ÷ 10 = 50.4 length. 50.4 X 26 = 1814.4). Raise to the next figure. 108,000 ÷ 1815 = 59.5 (60 pages total).

When type matter is leaded the number of pages increases. Each line increases 2 points when leaded with 2-point leads. Find the number of ems per page and divide into the total number of ems in the copy to find the number of pages.

The width of the page is 5 inches X 72 points = 360 points ÷ 10 = 36 ems. The length of the page is 7 inches X 72 points = 504 points ÷ 12 (10-pt. leaded) = 42. 36 X 42 = 1,512 ems per page. 108,000 ems ÷ 1,512 = 71.4 (72 pages).

NUMBER OF EMS TO THE SQUARE INCH

Size of type	Ems for solid matter	Ems for leaded matter
5-point	207	148
5½ point.	171	124
6-point	144	110
7-point	106	82
8-point	81	65
9-point	64	52
10-point	52	43
11-point	43	35
12-point	36	31
14-point	27	23
18-point	16	14
24-point	9	8

APPROXIMATE NUMBER OF WORDS TO THE INCH

For Calculating the Amount of Space a Manuscript Will Occupy If Set in Body Type of Standard Measurement

13 point, solid	7 words to square inch
14 point, solid	11 words to square inch
12 point, solid	14 words to square inch
12 point, leaded	11 words to square inch
11 point, solid	17 words to square inch
11 point, leaded	14 words to square inch
10 point, solid	21 words to square inch
10 point, leaded	16 words to square inch
9 point, solid	28 words to square inch
9 point, leaded	21 words to square inch
8 point, solid	32 words to square inch
8 point, leaded	23 words to square inch
7 point, solid	38 words to square inch
7 point, leaded	27 words to square inch
6 point, solid	47 words to square inch
6 point, leaded	34 words to square inch
5 point, solid	69 words to square inch
5 point, leaded	50 words to square inch

"Leaded," as here used, means type spaced with a 2-point lead between the lines.

PROBLEMS

Copy Fitting (Word Method - Em Method)

1. A type page 6 by 9 is set in 10-point leaded. How many words on the page?

2. A space 2½ by 5 inches would require how many words if set in 10-point solid?

3. There are 478 words to be set in 12-point, 20 picas wide. How many lines will be required?

4. A post card has a printing space of 28 by 16 picas. How many words can be used if set in 12-point leaded?

5. An 8-page folder, type page 15 by 30 picas, is to be set in 8-point leaded. How many typewritten pages, single-spaced, can be used?

6. How many type pages will be required for 10 pages of typewritten copy, single-spaced, for a page size 6 by 9 inches? The depth of the page is 28 picas, the width 24 picas, set in 14-point.

7. A 16-page booklet, type-page size 15 by 30 picas, is to be set in 8-point leaded. How many typewritten pages, single-spaced, can be used?

8. Given a copy that contains 9,950 words to be printed in booklet form, find the number of pages required if set in 12-point type, leaded, 24 by 36 picas.

9. A customer wants to know how many words of copy can be used for a 4-page folder set in 14-point, 2-point leaded, 28 picas wide and 8 inches deep? The front page is to carry only the title

10. There are 3 pages of typewritten matter, single-spaced. It is to be set on a sheet 9 by 12 inches. There is a margin of 3/4 inch on all sides plus an additional inch on top for a heading. What is the largest type size that can be used?

11. A 16-page folder has a printing space that measures 4 by 6 inches per page. It has one half tone that measures 2 by 3½ inches, one half tone that measures 4 by 3½ inches. How many words can be accommodated if 10-point type, leaded, is used?

COPY-FITTING

The Letter Method

MOST methods of copy-fitting rely on an average number of words to the square inch, but variations in the character of copy and in the width of different faces combine to make such methods inaccurate and deceptive.

The letter method of computing space is more accurate and more definite than the "word" method, and applies particularly well to advertisements.

In order to explain this method it would be well to take some concrete example and illustrate by working it out. Let us take, for instance, an advertisement, size 5½ by 8 inches. This advertisement has a border and an illustration. The copy contains several display lines and 14 lines of body-matter. First decide what sizes of type can be used for the display-lines and then the size for the reading-matter.

The copy of the advertisement is as follows:

Illustration: Width, 4½ inches; depth, 2½ inches.

"Save Your Eyes. Use Kryptok lenses cut by our experts."

Fourteen (14) lines of reading matter (typewritten), average - 65 characters to each line.

"Eyes Examined Free of charge. Schoffield & Schoffield, 132 Waltham Ave."

Instructions: Rule-border; illustration at the head. Size of advertisement 5½ by 8 inches."

The first thing to do, for good result, is to make a layout of the advertisement. When the layout has been made, the size of type for the display-lines are to be indicated; then, the reading-matter is to be computed.

Allow ½ inch (36 points) of white space for the margin between the border and type. This will allow 4½ by 7 inches for illustration and type-matter. The illustration occupies 2 1/2 by 4 1/2 inches - which will leave 4 1/2 by 4 1/2 inches for the type-matter alone.

In estimating the display lines, we have lines of the following sizes to consider: 36-, 12-, 6-, 18-, 10-point. This makes a total of 82 points. Adding up the spacing between the lines, as follows: 18-, 2-, 14-, 14-, 10-, 6-point, makes 64 points. The display lines and the spacing, added up, total 146 points. This will be approximately 2 inches. Deducting the 2 inches for the body-matter.

Within this space - 4½ by 2½ inches 14 lines of typewritten matter can be placed, 65 characters per line (including spaces). 4½ by 2½ inches equals 27 by 15 picas - it is better to use the pica system, because it is easier to calculate.

Next measure the 65 characters, to see how much they will make in type. If we try 10-point type we find that the 65 characters in that type measure 25 picas (a little over 4 inches). There are 14 of these typewritten lines - which will make 350 picas of consecutive reading matter:

14 lines X 25 picas = 350 picas.

These 350 picas of body-matter will have to be spread, so that each line will occupy 27 picas. Let us see how many lines these 350 picas will make:

350 picas divided by 27 picas = 13 (or lines).

Two leads are to be used between the lines of reading-matter. This will make each line 14 points in depth (10 points, plus 4 points for leads). There are 13 lines, each 14 points in depth-which, multiplied, will make 182 points:

13 lines X 14 points = 182 points (depth).

182 points will amount to about 15 picas (2½ inches) - just fitting the space that is left:
182 points divided by 12 points = 15 picas, 2 points.

The type for the reading-matter will be 10-point, doubled-leaded.

(Character-count method)

The most accurate system is one based on the character count. Just how to determine that number of characters in a certain measure can be done by counting the number of characters of the type face to be used and setting up a line of type in the measure desired.

Number of Characters in Manuscript - Typewriters are so designed that each character receives the same space horizontally. On typewriters, 12 point size, there are 10 characters to the inch. Multiply the average number of characters per line by the number of lines. Example: A manuscript has an average of 64 characters to the line, 25 lines to the page, 10 pages: 64 X 25 = 1600 X 10 = 16,000 characters.

The short lines at the end of paragraphs can be counted as full lines because there will be similar short lines when it is set in type. Exception: If there is a large difference between the width of manuscript and the width of type, say the manuscript averages 70 characters to the line and the type 30, this will not average out and some allowance should be made.

To Find Number of Lines of Type - Select your type-face, size, and length of line. Set type by hand or consult tables in copy-fitting books for the average number of characters to the line. Space between words and punctuation points are counted as characters. Divide this into the number of characters in your manuscript. Example: We will set the manuscript of the previous example in 10 point Goudy O.S. 18 picas wide. We find that this will average 38 characters to the line. 16,000 ÷ 38 = 421 + lines.

To Find Depth in Picas - Multiply the number of lines by the fractional relation which the body size bears to 12: i.e., 6 pt. = 1/2; 8 pt. = 2/3; 10 pt. = 5/6; 12 pt. = 1; 14 pt. = 1 1/6; 18 pt. = 1 1/2. Example: We are setting 421 lines of 10 point, 421 X 5/6 = 350 5/6, or 350 picas, 10 points, which will be the depth of the column.

If Matter is Leaded - Leading does not affect the number of lines but does affect the depth in picas. Be careful to use body size instead of face size. 8 point, leaded 2 points, is on a 10 point body. Example: If the manuscript is to be set in 10 point 2 point leaded it is on a 12 point body and therefore will be 421 picas deep.

Spacing - Calculation should be based on close spacing which is always to be recommended not only for economy of space but for appearance.

Length of Line - The ideal length of line is about 40 characters in any size. Lines of less than 30 or more than 50 characters should be avoided. Some authorities claim that one and one-half alphabets is the ideal length of lines.

Other widths to determine the proper widths to set type is based on, "One and one-half the width of the lower-case letters of the alphabet." This rule has been found very satisfactory among printers.

6 point makes ten and three-quarter picas

8 point makes thirteen picas

10 point makes fourteen and one-half picas

12 point makes sixteen and one-half picas

14 point makes eighteen and one-half picas

Another easy method is to remember that thirty minimum and fifty maximum characters to the line gives an agreeable width, with a preference for an average of forty characters to the line.

Typing to Fit - If type-face, size and measure are determined in advance, the copy can be set to the printer typed with the proper number of characters to the line so that the proof will run practically line for line with it. Example: Type is to be set in 12 point Caslon Old Face 20 picas wide. Instruct typist to set typewriter for average line of 48 characters.

There are approximately 53 characters to 25 ems of straight matter according to the monotype system of layout. Approximately 1 en will average for all characters. If 12-point type were used the measure to set would be 20 picas. (40 characters equal 20 picas.) If 10-point type were used the measure to set would be 16.8 or 17 picas. (20 X 10 = 200 ÷ 12 = 16.8).

Setting Run-Around - Type to be set around cuts or in irregular shapes can be accurately charted by this method.

12-point Typewriter type is equal to 14 point type, and is about 95% efficient. For convenience in computing typewritten copy the following table will be found helpful.

6-point equals	45%
8-point equals	55%
10-point equals	66%
12-point equals	79%
14-point equals	95%
18-point equals	125%

PROBLEMS

Copy-Fitting (The Letter Method)

1. A typewritten sheet, single-spaced, is to be set for a 5½ X 8½ inch page. What size type can be used, single-leaded, figured on word method?

2. A sheet 8½ X 11 inches has a printing surface 42 X 58 picas. Type to be set in 18-point, 6-point leaded. How many words can be used according to the em method?

3. There are 12 typewritten pages, single-spaced, to be set 10-point solid. Size of type area is 5 X 7 inches. How many pages required according to the word method?

4. A job set 10-point leaded, 24 picas wide, has 756 words in the job. What is the length of the type form?

5. An advertisement measures 26 X 30 picas. Set in 14-point, there are 1.7 characters in 1 pica. How many words in the advertisement if each word averages 5½ characters?

6. There are 78 running inches of typewritten copy to be set in 8-point, 18 picas wide. How many lines of type if each line average 54 characters?

7. A 4-page folder, 24 X 42 picas per page, will require how many words if set 12-point solid, based on the em method?

8. A copy contains 12,000 words. How many pages 4 X 6 inches, 10-point solid are required according to the word method?

9. A typewritten sheet contains 324 words. How many lines of 10-point type are there if set 24 picas wide, based on the pica-measure method?

10. A notice for a meeting contains 178 words. Figured on the em method, what size type can be used to fit on a post card, leaded?

THE UNIT METHOD OF COPY-FITTING

THE square inch method of estimating the space required in type to fit a certain amount of copy seems to be the method in popular use, if one is to judge by the number of articles on the subject in the various books on advertising and the type specimen books from various machine composition houses.

There is another method of figuring that may be used which gives surprisingly accurate results, and this is the unit method. All advertisers, printers and layout men must have some plan to determine the proper size of type to use for certain copy in order to produce a good looking job. Some simply guess at it, and get good results; but for those who are not so experienced the unit method of figuring is helpful.

It would be simple indeed to estimate the space required for any amount of copy if the different type faces were cast to a standard width or on some unit system plan. In 8-point type, for instance, the alphabet set in the different type styles varies in width from 11.9 ems to 16.75 ems. But it is not advisable to adopt any standard width plan because type would then lose its individuality and in print would not present the legibility it now possesses.

The average word contains 5 or 6 letters. Take, for example, the sentence,

"The truth is always the strongest argument."

There are 42 characters, or units, in this sentence.

Divide by 7, the number of words, the result is 6, or the average number of units per word. Try any sentence of 7 to 12 words, count the spaces and the letters, divide by number of words, and the average number of letters per word will most always be 5 or 6. It would be mighty heavy reading that averaged more than 6 letters per word. We therefore take 5½ as our average for the number of letters (units) per word.

The following table gives the average number of letters or units in the different type sizes that are contained in one pica em:

Type Size	Units
5 and 5½ point	4
6 and 7 point	3.5
8 and 9 point	3
10 and 11 point	2.5
12 point	2
14 point	1.7
18 point	1.4

To find, then, the space required by copy of a certain number of words in any desired type size, the procedure is as follows:

Problem - How many lines will be required to set 154 words in 18-point, 21 picas wide?

Multiply 154 words by 5½, which will give the number of units contained. Referring to the table it is seen that in 18-point type 1.4 units go into one pica.

154 X 5½ = 847 units.
Divide this number by 1.4 (the unit figure for 18-point.)

847.0 ÷ 1.4 = 605 picas.
Now, to allow for wide spacing, paragraph breakovers, etc., it is necessary to add 1/18 of the 605 picas.

1/18 of 605 = 33 (approximately).
605 plus 33 = 638 picas.
So 154 words of 18-point, set 21 picas, would go into 638 picas, or 30 lines 21 picas wide (638 divided by 21 = 30).

No matter what size type is being figured, the fraction that is added to allow for wide spacing and paragraph breakovers, is always the same as the type size figures; that is, in figuring 6-point one sixth more should be added, in 8-point one-eighth more should be added, etc.

In order that the method be better understood, we will work another problem.

Problem - How many lines are required for 680 words of 8-point 20 picas wide?

Solution -

680 X 5½ = 3740
3740 ÷ 3 = 1246
1/8 of 1246 = 155
1246 plus 155 = 1401 picas.

Therefore, 680 words of 8-point will go in 1401 picas, or 70 lines 20 picas wide.

To find the approximate number of words which would be required to fill a certain space, the method is the same, but simply reversed.

IMPOSITION

THE operation of arranging a number of pages or parts of a form in such a manner that when the sheet is printed and folded the pages or parts will follow each other in proper sequence, is called imposition.

In order to illustrate the different ways in which forms of various numbers of pages may be imposed, the following diagrams, showing plans for both hand and machine-folding, have been arranged. A folder is usually composed of from four to twelve pages, while a booklet embraces a larger number of pages and such of the smaller forms as may not conveniently be used as folders. Folders are seldom stitched. Booklets rarely contain more than sixty-four pages, and the sixteen and thirty-two page forms are most commonly used.

The diagrams shown in this pamphlet are arranged according to the number of pages represented and in a number of cases several ways of placing the pages are shown. Forms are commonly printed work and turn, although the size of the form, the stock, or some other reason may make it more expedient to print the matter in two forms, sheetwise.

A work-and-turn form is so arranged that after an impression is taken the sheet may be turned over and the same form printed on the back, each page "backing up" the other properly in consecutive order. A sheetwise form is printed in two forms, one backing up the other. A tumbled form is so arranged that the back edge of the sheet becomes the gripper edge when the reverse side is printed. The fold-over form is printed in such a manner that one row of pages may be folded over the adjoining row to establish consecutive order in the completed booklet.

When the lines of type run the long way of the page, the form is said to be imposed the broad way; when the lines run the short way, as is most common, the form is imposed the deep way.

The simplest form of imposition is the four-page folder shown on page 78 . This form is imposed to be run work and turn, and from the illustration one can readily see that printing the same form on the sheet would bring pages 2 and 3 in their proper place on the back of pages 1 and 4. The other half of the form is at the same time printed vice-versa, so that when the sheet is cut in half two complete folders will result. All the plans of imposition follows much the same principle, only becoming more complicated as the number of pages is increased.

When imposing a form it should be remembered that allowance must be made for trimming the folder or booklet after it is printed and folded. For this purpose it is customary to leave about one-eighth to one-quarter of an inch, in addition to the regular margin, or the sides to the pages which are to be cut.

For those who wish to practice laying forms it might be well to cut a number of oblong pieces of cardboard to represent pages. These may be numbered, marking them page 1 on the upper left hand corner of the card, page 2 on the upper right hand corner of the next card and so on. This makes the page numbers the same as they appear on the type pages. All odd pages would appear on the upper left hand and all even pages on the upper right hand corners.

To lay a square four, start from your left with page 1 with the head away from you, page 2 with the head to page 1, page 3 to the right of page 2, head the same as page 2, page 4 beside page 1 with the head same as page 1.

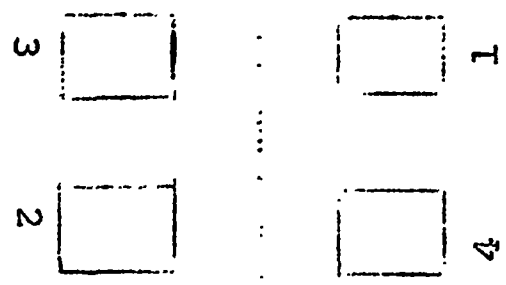
To lay an 8 page form:

Page 1 at left hand side, head away from you.
Page 2 at right hand side, head away from you.
Page 3 head to head with page 2.
Page 4 head to head with page 1.
Page 5 beside page 4, head same as page 5.
Page 6 beside page 3, head same as page 6.
Page 7 beside page 2, head same as page 7.
Page 8 beside page 1, head same as page 1.

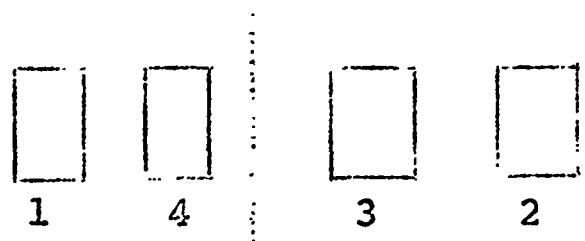
Other forms may be practised in the same manner. This method affords excellent practice when the facilities for carrying on the actual work is not available. It will be interesting to note that in all regular forms the total of every two pages laying side by side equal one more than the total number of pages in the form being imposed.

FOUR-PAGE FORMS

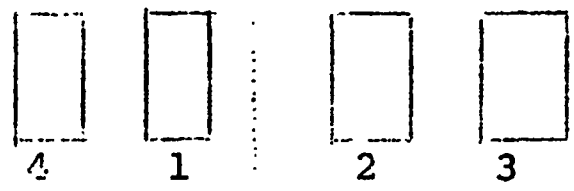
Folios on Bottom of Page, Stone Layout



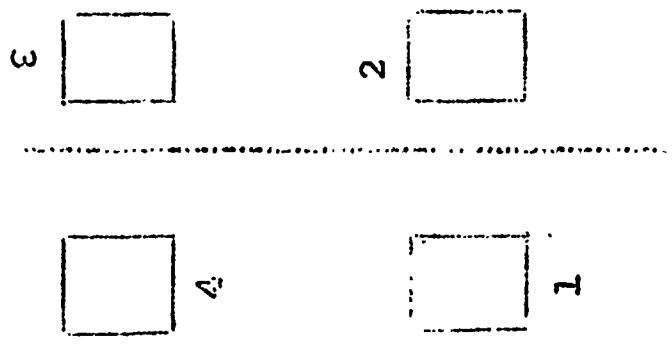
Four-page, Work-and-turn



Long Four-page, Work-and-turn

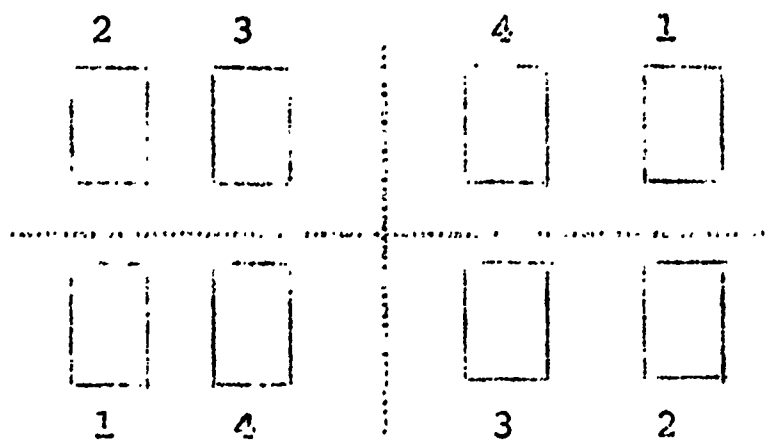


Long Four-page, Work-and-turn
Imposed from Center



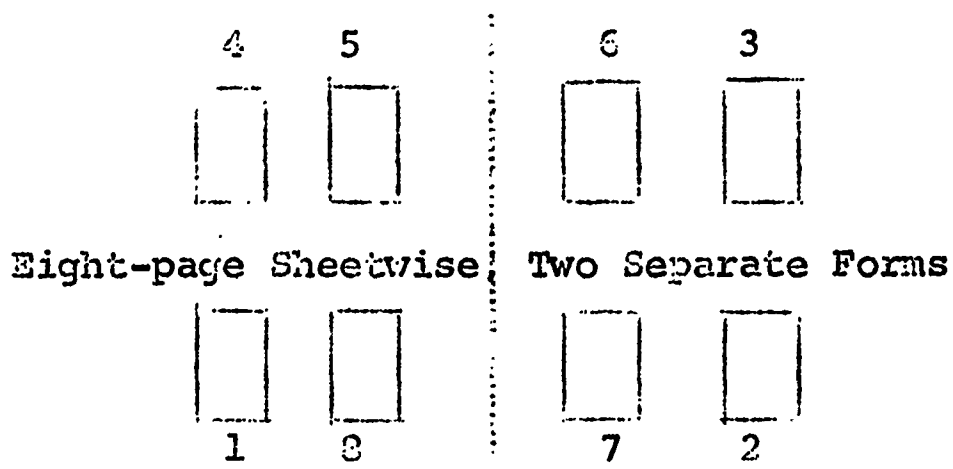
Legal Four-page, Work-and-tumble

FOUR-PAGE FORMS

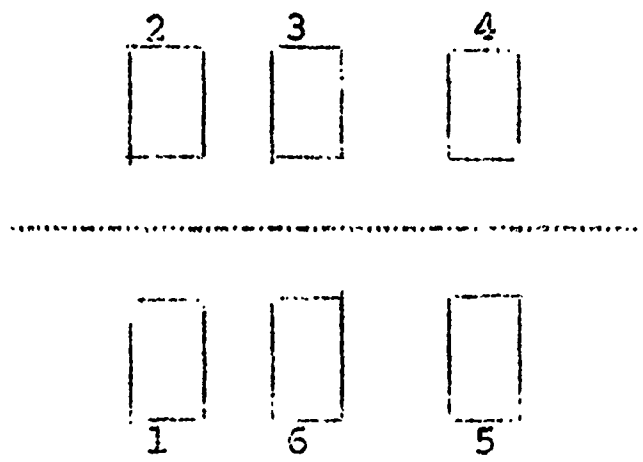


Four-page, Printed two-on

EIGHT-PAGE FORM

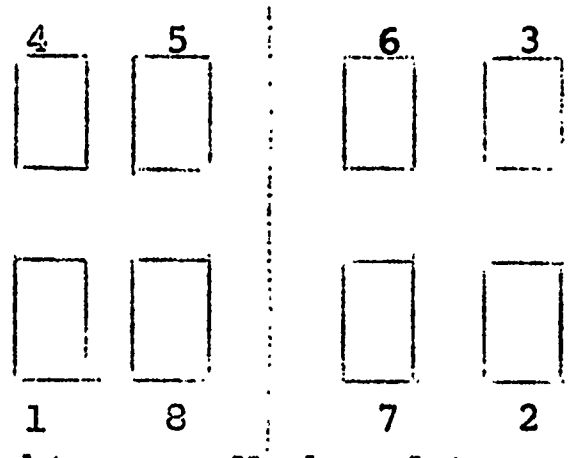


SIX-PAGE FORM

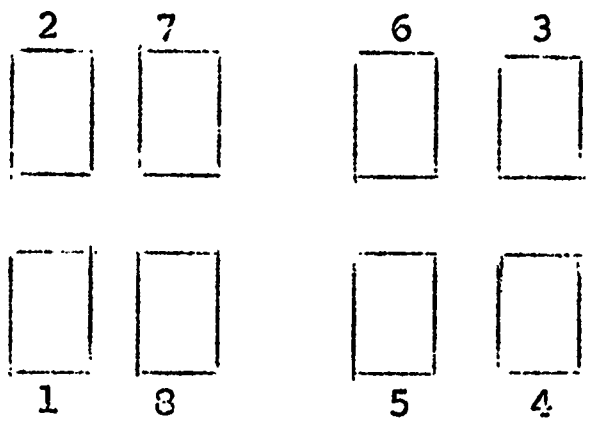


Six-page, Work-and-tumble

EIGHT-PAGE FORMS



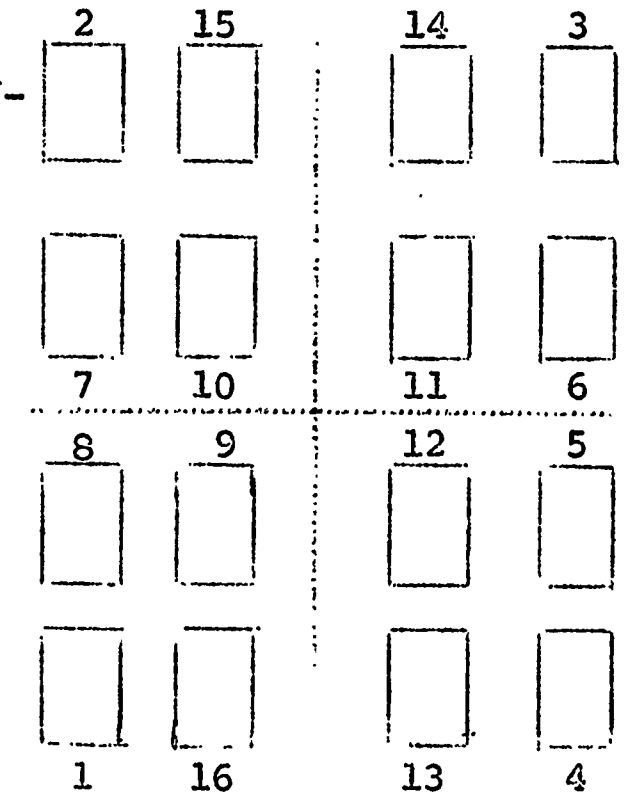
Eight-page, Work-and-turn



Eight-page, Work-and-tumble

IMPOSITION OF SIXTEEN-PAGE FORM

Folios on Bottom of Page, Stone Layout



IMPOSITION PROBLEMS

1. A customer places an order for 1,000 4-page folders, page size 6 X 9 inches. If printed as a work-and-turn form, how many sheets of 25 X 38 M.F. will be required?

2. An order calls for 10,000 copies of an 8-page folder, page size 5½ X 8¼ inches. Printed work-and-turn on 25 X 38 sheet, how many sheets will be required?

3. How many sheets are required for 2,500 folders? There are 6 pages, page size 3½ X 6 inches, printed sheetwise on 28 X 44 stock.

4. An 8-page booklet is to be printed as a sheetwise form. Size of page is 6 X 9 when trimmed. If 1,500 copies are required and stock 28 X 42 is used, how many sheets will be required?

5. An order calls for 3,500 4-page programs. Printed sheetwise on 25 X 38 M.F. The folder measures 6 X 9 inches per page. How many sheets will be required?

6. A catalogue with page size 6 X 9 inches contains 16 pages. Printed work-and-turn on 25 X 38 stock, how many sheets will be required for 1,000 copies?

7. A 12-page folder is to be printed as a work-and-turn form. If the page size is 4½ X 6½, how many sheets of 25 X 38 stock will be required to print 4,000 copies?

8. Find the number of sheets for 2,500 12-page folders, page size 5 X 7 inches, printed work-and-turn. Size of the sheet is 28 X 44 inches.

9. Find the amount of stock required to print 10,000 copies of a 32-page booklet, The size of the page is 7 1/2 X 10 1/4 inches, printed sheetwise on 44 X 64 stock.

10. How many sheets required to print 2,000 24-page booklets? Size of a page 5 X 8 inches. Size of stock is 25 X 38 inches. Printed 8 pages to one form.

ESTIMATING THE INK

ASCERTAINING AMOUNT OF BLACK INK NEEDED

Factors to be determined:

1. Number of square inches type-page area per page.
2. Determine the number of pages each class- light to solid.
3. Classification of paper - rough to coated.
4. Number of impressions, or books.

Colored ink - Actual tests indicate quantity increase for colored ink, therefore, on colored ink forms, additions should be made as follows:

	Per cent		Per cent
Aluminum.....	5	Green.....	25
Gold.....	15	Yellow.....	45
Blue.....	15	White.....	65
Red.....	25	Duotone, Blue-Black.....	10
Brown.....	25	Duotone, All others.....	15

Double Rolling - Add 20% to final number of pounds required.

Two Impressions - Double printing of same color add 60% to final number of pounds required.

Overlapping Colors - Take about two-thirds the amount of ink used on the first color.

Class of Work	Kind of Stock	Pounds of Black Ink per 100 sq. inches for M impressions
Very open light forms	Rough	.102
	M. F.	.074
	S. & S. C.	.052
	Coated	.047
Book work, open display ...	Rough	.153
	M. F.	.111
	S. & S. C.	.078
	Coated	.070
Catalog with illustration..	Rough	.254
	M. F.	.186
	S. & S. C.	.130
	Coated	.117

Heavy plates and type	Rough	.381
	M. F.	.278
	S. & S. C.	.196
	Coated	.175
Reverse plates.....	Rough	.763
	M. F.	.557
	S. & S. C.	.392
	Coated	.350
Solid plates.....	Rough	1.272
	M. F.	.928
	S. & S. C.	.653
	Coated	.584

PROBLEMS

In working out the problems drop figures after three decimal places.

1. According to the table, what would be the estimate for ink for 10,000 blotters containing 15 square inches of very light matter? Use class 1, rough finish.

2. An 8-page folder has 54 square inches of type and illustrations per page. Assuming that class 3 were used, what would you estimate the ink for 5,000 copies of the folder, printed on M.F. Book?

3. A single sheet, 8½ X 12, contains a halftone comparable to class 4. The size of the plate is 7 X 9½. How much ink would be required to print 2,500 copies?

4. An order calls for 10,000 circular letters, with double-spaced type matter. If the ink costs $1.50 per pound, what is the cost of the ink for this order? Use class 1, printed on bond paper. The type area is 93.5 square inches.

5. A 48-page booklet, size 5 X 7½, type page 22 X 36 picas, classed under book work, open display, printed on rough stock, was printed on brown ink. How much ink was required for 1,000 copies of the booklet?

6. How much ink is required to print 5,000 copies, 4-page folder containing two halftones, 22 X 36 picas, printed in brown ink, class 4, and 2 pages of type matter (same size) printed in black, class 2, coated paper?

(Estimating the Ink Problems
Continued)

7. A four-color process sheet 9 X 12 inches is printed in yellow, red, blue, and black. How much ink would be required of each for 3,000 copies class 5?

8. How much ink is required to print 7,500 copies 9 X 12 inches? The form contains a heavy plate and type such as class 4, coated paper?

9. How many pounds of green ink was required to print 25,000 sheets from a solid tint block on S. & S. C.? Double rolling was necessary. Plate size 7.5 X 10 inches.

10. A halftone 6 3/4 X 8 3/4, is printed in dark brown over a light-brown tint block. If the cut is a class 4 halftone and both inks are priced at $1.50 per pound, what is the total cost of the ink for 5,000 copies? Printed on coated stock.

ESTIMATING

TO estimate the cost or selling price of a printed job it is necessary to know the time that is required to print the job and to know what to charge for each operation in the production of the job. If a job requires a drawing, or an engraving to produce the job, and these must be purchased from other agencies, they must be included in the estimate. Machine composition, ruling and binding are usually purchased items.

Profit and handling charges are usually added to the cost price. The labor or part done by the printer is divided into several operations. In the composing room would be listed: Composition, making up into pages, lock-up for press, foundry lock-up, etc.

In the pressroom would be make-ready of forms and feeding the sheets. Many other details such as making mechanical overlays, slip-sheeting and taking out slip-sheets, form a part of the pressroom charges.

The labor or time spent to produce the job of printing is charged for according to the number of hours consumed. The hour costs for the various items should be used in working out the problems on estimating that follow. The figures that are given are the selling prices and are for estimating practice only.

The time schedule for make-ready and lock-up is based on overage time, probably too high for small jobs and possibly too low for larger ones. If a type form is slightly under or over the size given in the schedule use the one nearest to the size given. When no press size is given in the problems use the most economical size for the job.

Allow for spoilage when estimating problems, except boxed orders, cards, envelopes, tickets, etc. (usually provided with overs). When figuring spoilage take percentage on the number of copies. Include spoilage for binding or folding jobs for 8 or more pages.

Considerable time would be required to figure the cost of ink if the square-inch basis were used on all jobs. Small jobs would not require such exactness nor warrant the time consumed. Since it is generally recommended that ink be charged for, use 5 cents per 1,000 impressions as a charge for ink on small presses. For Miehle, Kelly and cylinder presses charge 10 cents per 1,000 impressions. When two colors or more are used, charge 10 minutes for wash-up time for each additional color for platen presses and 20 minutes for cylinder and automatic presses, according to the press used.

Add 10% charge to the cost of paper if cutting is required and 10% for handling.

A profit of 25% should be added to the total cost to arrive at the selling price. The figures used here for estimating were prevailing at the time of publication. They are subject to change in conditions and must not be regarded as accurate for selling purpose. They are given to the student as a basis for estimating practice only.

EXAMPLES OF LINOTYPE COMPOSITION

Linotype composition is done on either an hour basis or a piece rate basis at the option of the trade plant.

Piece rates are minimum and apply to straight matter in galley form. Piece rates includes one proofreading and office correction. Minimum is 20 ems of the type in which job is set. All type above 10-point is measured as 10-point. Leaded is measured as solid.

STRAIGHT MATTER-PIECE RATE

This is straight-matter composition in the form of reading matter where no boldface, italics or small capitals are used.

PRICE AND ONE HALF

Lines Containing Roman and Italic or Boldface

Mechanics: Applied mechanics and physical testing of materials.

Tabular Matter with Single Justification

Machine Composition Company..... $125.75
Tileston & Hollingston Company..... 73.45

Leader Work

Goudy Oldstyle.....
Garamond Oldstyle.....

DOUBLE PRICE

Foreign Languages-Italian, German, Spanish, French and Special Characters

Tabular Matter Leaded Out to Columns

690 Boston Printing Ink Co..... $94.80 $33.45
374 Carter & Rice Co..... 67.00 43.50

Straight Matter over 30 Picas in Length

Never be satisfied with "good enough" in justification. Make every line perfect. This cannot be too strongly emphasized, as

Tabulated Matter over 30 Picas in Length

690 Boston Printing Ink Co..... $76.90 $43.56
374 Carter & Rice Co..... 85.00 55.35

Lines Containing All Caps

BOSTON HERALD TRAVELER AND BOSTON GLOBE
PRINTERS AND PUBLISHERS, INC., BOSTON, MASS.

Centered Lines

Price and One-half up to 20 Ems, From 21 to 30, Double

Miehle Vertical

Mr. Robert Jones

Matter with Periods or Hyphens Interspaced

II Trovatore . . . . . Verdi
Harken Unto Me - - - - - - - - - - - - - - - - Solo and Chorus

Lines Set in Small Caps or Caps and Small Caps

BOSTON PUBLIC AUDITORIUM will have for its speaker, Mr. James T. Humphrey, graduate of HARVARD UNIVERSITY

Requiring the Numbering of Each Line

4 chapter headings in the index, programs, problems, etc.
28 usually required numbered lines shown in this specimen.

Running Headings with Folios on One Line

THE SATURDAY EVENING POST 43
78 THE SATURDAY EVENING POST

TIME WORK

Repetition of Matter with Ditto Marks

Repetition of matter with ditto marks
" " " " " "

Matter Containing Technical Characters

Matter in (parenthesis) and [brackets], § last year, *new matter

$HNO_3 \div \frac{165.03 \times 597}{H_2O + 11.5}$ = % of solution.

Boldface, Roman, and Italic Set in One Line

This specimen line is set with BOLD, Italic, and Roman characters.

Box Headings

Day	Month	Year	$	Total

Initials or 2- or 3-line Advertising Figures

ATTENTION, men. Sale on fine suits and overcoats, Sport or plain back. Woven tweeds from Ireland. New Styles. Which can be bought for as low as $35.95

Matter Set 8 Ems or Less, Larger than 6-point Requiring Hand Spacing

A customer wants to know how much it would cost to set up

Matter Set Over 30 Picas With 50 Per Cent or More Roman and Boldface or Italic, or When Lines are Numbered

32 HOPE is the great stabilizer in life; it is the strong magnet,
33 is more apt than anything else to draw our thoughts, our plans
34 toward the great goal, which alone makes life worth while.

HOUR COST

Hand Composition 750 ems, leaded, per hour.....$3.40
Machine Composition 4,000 ems per hour..... 4.00
Monotype, average, 4,000 ems per hour..... 4.50

LOCKUP SCHEDULE
$3.40 PER HOUR

Time Given in Hours and Tenths of Hours

Size of Form	Size of Press	Type of Form	Number of pages 1	2	4	8	16	32
3 X 5 to 6 X 9	8 X 12	Slug or plate	.1	.15	.2			
		Type	.1	.2	.25			
6 X 9 to 8 X 12	10 X 15	Slug or plate	.1	.15	.2			
		Type	.1	.2	.3			
8 X 12 to 10 X 15	12 X 18	Slug or plate	.1	.15	.2			
		Type	.15	.2	.25			
10 X 15 to 12 X 18	13 3/4 X 19 3/4 Miehle V. 13½ X 20	Slug or plate	.15	.2	.3	.5		
		Type	.2	.25	.35	.7		
12 X 18 to 16 X 21	17 X 22 Kelly	Slug or plate	.2	.25	.3	.5		
		Type	.25	.3	.4	.7		
16 X 21 to 24 X 37	25 X 38	Slug or plate	.25	.3	.4	.6	.8	1.0
		Type	.3	.4	.5	.7	1.0	1.5
24 X 37 to 34 X 48	38 X 50	Slug or plate	.3	.4	.6	.8	1.0	1.5
		Type	.4	.6	.8	1.0	1.5	2.0

PAPER SIZES AND COST

Name	Size	Weight	Av. Cost per lb.	Cost per Ream
Bond	17 X 22	20	$ .13	$ 2.60
	19 X 24	24	.13	3.12
	22 X 34	40	.13	5.20
Book	25 X 38	70	.14	9.80
	28 X 44	90	.14	12.60
	32 X 44	119	.14	16.66
Cover	20 X 26	65	.19	12.35
	23 X 35	100 1/2	.19	18.05
	26 X 40	130	.19	24.70
			Per 100 sheets	
Bristol	20 1/2 X 24 3/4	91	3.75	18.75
	22 1/2 X 28 1/2	115	4.70	23.50
	25 1/2 X 30 1/2	140	5.80	29.00

PRESS WORK SCHEDULE

Press	Size	Impressions Per Hour	Cost Per Hour	Price Per M	Make-ready
Hand-fed	8X12	1,200	$2.00	$1.66	0.2 hour
Hand-fed	10X15	1,100	2.00	1.82	0.5 hour
Hand-fed	12X18	1,000	2.25	2.25	0.5 hour
Hand-fed	14X22	850	2.50	2.94	0.6 hour
Small Auto	10X15	2,000	2.50	1.25	0.8 hour
Miehle Vert.	13X19	3,000	4.00	1.33	1.0 hour
Kelly	17X22	3,000	4.00	1.33	1.0 hour
Cylinder	25X38	1,200	4.00	3.33	1.5 hour
Cylinder	38X50	1,000	4.00	4.00	2.5 hour

FOLDING AND BINDING

Figures Include Cutting and Trimming

Number of Pages	No Cover Per M	Additional	With Cover per M.	Additional M.
4	$ 1.00	$1.00	$ 5.10	$ 5.10
8	3.65	2.90	6.50	5.75
12	5.15	3.65	8.00	6.50
16	5.75	3.75	8.75	6.75
24	8.10	6.35	10.45	8.70
32	9.00	7.00	10.85	9.40
36	9.30	7.35	11.65	9.85
48	10.65	8.40	12.90	10.65

Binding: Hand (1 Fold) $1.00 per M.
Padding: .25 per M.

SIZES OF BOOKLETS

Following are common sizes of booklets and catalogues and the number of pages that will cut from standard sizes of book and cover paper. Trim allowance in most cases 1/8 inch.

Size of page	Sheet Size	Number of Pages	Cover Stock
3 1/4 X 6 1/4 cuts from	28 X 44	8,16,48	23 X 35 - 15 out
3 3/4 X 5 1/8 cuts from	32 X 44	16,32,64	23 X 35 - 16 out
4 1/2 X 6 cuts from	25 X 38	8,16,32	20 X 26 - 8 out
4 X 9 1/8 cuts from	25 X 38	4,12,24	20 X 26 - 6 out
4 X 9 1/8 cuts from	38 X 50	8,16,48	20 X 26 - 6 out
5 1/4 X 7 1/2 cuts from	32 X 44	8,16,32	23 X 35 - 8 out
5 1/2 X 8 1/2 cuts from	35 X 45	8,16,32	23 X 35 - 8 out
6 X 9 cuts from	25 X 38	4, 8,16	20 X 26 - 4 out
6 X 9 cuts from	38 X 50	8,16,32	20 X 26 - 4 out
7 3/4 X 10 5/8 cuts from	32 X 44	4, 8,16	23 X 35 - 4 out
9 1/4 X 12 1/8 cuts from	38 X 50	4, 8,16	20 X 26 - 2 out
8 1/2 X 11 cuts from	35 X 45	4, 8,16	23 X 35 - 4 out

PROBLEMS

Directions: Use blank estimate form. Attach work to completed form.

1. Estimate the cost of 1,000 tickets. Hand composition requires 20 minutes. Printed on an 8 X 12 press. Cost of stock is $1.10 per M.

2. Find the cost of 1,500 No. 6½ envelopes. Machine composition and lockup total 15 minutes. The price of the envelope is $1.20 per M. Printed on an 8 X 12 press.

3. Find the cost of 5,000 No. 4 shipping tags. Use 8 X 12 press, composition .4 hour. Cost of stock $1.34 per M.

4. Find the cost of 3,000 cards. Printed on an 8 X 12 press, machine composition .5 hour. Cost of stock $1.50.

5. Find the cost of 4,000 6 X 9 programs. Coated book, 25 X 38 - 70 pounds. Printed on 10 X 15 press, machine composition 1 hour.

6. Find the cost of 10,000 letterheads. Machine composition requires ½ hour, ink 5¢ per M., 12 X 18 press, hand-fed, bond paper 17 X 22 - 20 pounds at 13¢ per pound.

7. Find the cost of 2,500 blotters, 4 X 9 inches, printed on enameled blotting 19 X 24 - 120 pounds at 21¢ per pound. Machine composition takes 1¼ hours. Use 10 X 15 press.

8. Find the cost of 10,000 letterheads, Machine composition takes 1 hour printed on Kelly automatic, 2 on, bond paper at 13¢ per pound. Charge for ink is 10¢ per 1,000 impressions.

9. Find the cost of 425 posters, size 11 X 14 inches, printed in two colors, on 115 Bristol. Machine composition requires 1 hour and 20 minutes, printed on 12 X 18 press. Make-ready time is .3 hour for each form. Cost of ink is 10¢.

10. Find the cost of 5,000 announcement cards, No. 5 Baronial cards at $2.39 per M. (with 5% discount). Machine composition takes 45 minutes, printed 1 color, on 8 X 12 press. Ink is 5¢ per M. impressions.

11. Find the cost of 1,000 two color programs, size 6 X 9 inches, printed on 70 pound book paper. Hand composition 1.5 hours, 12 X 18 press. Ink 5¢ for each color.

12. Find the cost of 10,000 handbills, size 8 X 10 inches, M.F. Paper, 25 X 38 - 60 pounds, at 8¾¢ per pound, printed on Miehle vertical. Machine composition 1.3 hours. Figure ink on full sheet, class 3, at 90¢ per pound. Allow 1-inch margin on all sides.

13. If the order for 10,000 handbills in problem 12 is printed on a 12 X 18 hand-fed press, what is the cost?

14. Find the cost for 10,000 deposit slips, printed in blue ink, 4-up from electros furnished. The size is 3 X 6 inches, in pads of 100 each, stock 19 X 24, 20 pounds, at 9½ cents. Ink 10 cents per M run, 10 X 15 automatic press.

15. Find the cost of 1,500 programs, 4 pages, size of page 5 X 7 inches, printed on 10 X 15 hand-fed press. Composition takes 2 hours, stock antique book 32 X 44 - 119 pounds at 14 cents. Printed sheetwise.

16. Find the cost of the problem in example 15 if the job is printed on the Miehle vertical press. Instead of running two forms, print 4 pages, work-and-turn. Compare the cost.

17. Estimate the cost of 5 M envelope enclosures, consisting of 4 pages, size 4 X 9 inches. Printed in two colors, brown and orange, on a 25 X 38 - 80 pound coated paper. Paper 15 3/4 cents per pound. Composition takes 4½ hours. Printed on Miehle vertical press, work-and-turn form. Using the ink schedule, orange measures 10 square inches, and the brown measures 60 square inches. Class two-coated. Ink is $1.50 per pound.

18. Estimate the cost of 8,000 four-color process sheets 8½ X 11 inches, coated paper. The size of halftone is 7 by 8½ inches. Sheet size is 25 X 38 - 100 pounds, at $.16 3/4 cents per pound. Ink is $1.50 per pound. Printed on a Kelly press. Include lockup, make-ready, running time, spoilage on paper in the estimate. Class 4, yellow, red, blue and black ink.

19. Give your estimate for a 16-page folder, 5 X 7, self cover, 5,000 copies. Printed on 32 X 44 - 119 pounds. M.F. book paper, 14 cents per pound. Printed as a sheetwise form on a Kelly press. Composition in linotype set, based on $1.20 per M ems. Type page measures 21 X 33 picas, set in 10-point. Make-up requires 10 minutes per page. Ink is $1.00 a pound (12 pages), class 2. Include cost of binding.

20. Find the cost of 5,000 school catalogues, 48 pages, trimmed size 5½ X 8 inches. Cover is cut from 23 X 35 - 100½ pounds. Inside 38 X 50 - 140 pounds. Paper is 11 cents per pound. Composition contains approximately 800 ems of linotype per page, 42 pages and 6 hours of make-up and hand composition. Printed 16 pages on a 38 X 50 cylinder press, lockup time 1¼ hours for first form, 45 minutes for each additional form. Use binding figures for folding and binding. The cover to be printed on a Miehle vertical press. Ink 25 cents per M copies, including cover.

21. Find the cost for 1,500, 16 pages and cover, advertising programs size 6 X 9 inches, type page 4 X 7 inches, printed on a 38 X 50 cylinder press. Antique stock 25 X 38 - 70 pounds, at 11 cents per pound. Cover is cut from 20 X 26 -65 pounds, 14 cents per pound. Composition estimated at $1.50 per page, plus 35 cents per page for make-up and printed as a 16-page work-and-turn. Cover is cut from 20 X 26 - 65 pounds at 14 cents per pound. Composition charges same rate as page rate, plus make-up. Printed on Miehle vertical. Figure ink as class 2, price. 90 cents per pound, for both cover and inside.

22. Find the cost for 2,500 32-page booklets and cover. Page size 6 X 9 inches, cut from 25 X 38 - 130 pounds M.F. at 14 cents per pound. Type page is 4 X 7 inches, printed on a 38 X 50 cylinder press. Printed as a sheetwise form. Monotype set in 10-point type. Make-up 40 cents per page. Cover stock is 26 X 40-130 pounds at 19 cents per pound. Composition estimated at .6 hour, 1 page, printed on a 10 X 15 automatic press.

BLANK ESTIMATE FORM

Name of customer or problem _____		
Quantity and description of problem _____		
COMPOSITION:		
Hand set		
Machine		
Make-up		
Lock-up		
PRESSWORK: State press, no. of hours required, etc.		
Make-ready		
Running cost		
Ink		
Washup for color		
ENGRAVINGS:		
Drawings		
Half-tones		
Line-cuts		
BINDING:		
Folding		
Stitching		
Punching		
Padding		
Cutting		
STOCK:		
Inside		
Cover		
Envelopes		
Cutting or/and handling charges		
SPECIAL		
PROFIT		
TOTAL COST		

VT 010 621
Offset Printing, A Study Guide.

Alabama Univ., University. Dept. of Trade and Industrial Education
MF AVAILABLE IN VT-ERIC SET.
Trade and Industrial Education, State Department of Education, P.O. Box 2847, University, Alabama 35486 ($1.75, answer book $1.00).
PUB DATE - May64 92p.

DESCRIPTORS - *TRADE AND INDUSTRIAL EDUCATION; *COOPERATIVE EDUCATION; *PRINTING; GRAPHIC ARTS; PHOTO COMPOSITION; *STUDY GUIDES; BIBLIOGRAPHIES; INQUIRY TRAINING

ABSTRACT - This study guide and progression record for offset printing students in a cooperative training program was prepared by a committee of State trade and industrial education coordinators. Eighty job and information lessons are given including related study references. After the student completes the job sheets and references, he records his progress on the progress chart, included at the beginning of the guide with the bibliography of references. An answer book may be obtained from the source of availability indicated for this document. (GR)

VT 010 621

ED0 45856

OFFSET PRINTING

A study guide and progression record for Offset Printing students in a cooperative training program.

Prepared by:

A committee of
Alabama Trade and Industrial
Education Coordinators Working
With Competent Consultants

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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Issued by:

Department of Trade and Industrial Education
University of Alabama
University, Alabama

May, 1964

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These books can be bought at a great discount by schools.

Code

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O.P.S. Offset Platemaking, Lithographic Technical Foundation Inc. 131 East 39th Street, New York 16, New York. Price $5.00

L.O.P. Lithographic Offset Press Operating, Lithographic Technical Foundation, Inc., 131 East 39th Street, New York 16, N.Y. Price $6.00

S.O.L. Survey of Lithography, Lithographic Technical Foundation Inc., 131 East 39th Street, New York 16, New York. Price $4.00

O.P.T. Offset Press Troubles, Lithographic Technical Foundation, Inc., 131 East 39th Street, New York 16, New York. Price $5.00

P.T.B. Paper Technical Bulletin No. 8, Lithographic Technical Foundation, Inc., 131 East 39th Street, New York 16, N.Y. Price $5.00

P.O.F. Photo-Offset Fundamentals, McKnight and McKnight Publishing Company, Blommington, Illinois.

P.A.T. Printing and the Allied Trades, by Randalph Karch, The Pitman Publishing Corporation, 20 East 46th Street, New York, New York.

P.C.O. Printing Careers and Opportunities for you, Philip Pollack The Chilton Company, Philadelphia, Pennsylvania.

HOW TO USE THIS STUDY GUIDE AND RECORD OF PROGRESS

The student's record of progress is kept on the Trade Analysis and Progress Record page. Progress "on-the-job" is kept in the column headed "Job Progress", and related study progress is kept in the adjoining column headed "Related Study".

The four step method of training is used in developing the skills of a trade or occupation. A record of all these steps for each job is kept in the squares in the column below "Learning Status" (Steps), opposite a specific job.

A dot in the center of the square indicates a student is in the first step; that of observing the job being done. No other mark is made in this square as long as the student remains in this step.

A diagonal line across the same square indicates the student is in the second step; that of helping perform the job under instruction.

Two diagonal lines across the same square indicates that the student is in the third step; that of doing the job under supervision.

The square filled in solid indicates that the student has reached the fourth step; that of a satisfactory level of accomplishment. The date when this accomplishment has been reached is placed in the column "Date Objective Reached", opposite the specific job.

On the day the student has read all the references and has written the answers to all of the questions, for a specific job, the student places this date in the column headed "Date Completed", opposite this job. The grade made on the test on this job is entered in the adjoining square headed "Test Grade".

The word "Information" will be found in the "Job Progress" column for all information lessons. When all references have been read and all answers to the questions have been written, for a specific information lesson, the student places the date of completion in the "Date Completed" column, opposite this lesson number. The grade made on the test on this lesson is entered in the square headed "Test Grade".

TRADE ANALYSIS AND PROGRESSION RECORD

Job No.	Type Job	Job Performance	Reference Reading
1.	The History of Printing	Inf.	
2.	Shop Safety		
3.	Introduction to Lithography	Inf.	
4.	The Development of Lithography	Inf.	
5.	Composition Methods Used in Lithography	Inf.	
6.	The Offset Press	Inf.	
7.	Operate Different Types of Offset Presses		
8.	Maintain the Offset Press		
9.	Wash the Press		
10.	Packing the Offset Press		
11.	Run the Offset Press		
12.	Makeready on Offset Press		
13.	Operate the Printing Unit		
14.	Determine Printing Unit Troubles		
15.	Operate Press Feeders		
16.	Use Blankets		
17.	Detect Offset Blanket Trouble		
18.	Control the Dampening Process		
19.	Wash Dampeners		
20.	Use Lithographic Inks		
21.	Maintain the Inking System		
22.	Trouble Shoot Ink Feed and Distribution System		
23.	Use Different Types of Press Plates		

TRADE ANALYSIS AND PROGRESSION RECORD

Job No.	Type Job	Job Performance	Reference Reading
24.	Practice Safety and Hygiene in Platemaking		
25.	Correct Plate Dampening Troubles		
26.	Correct Press Plate Troubles		
27.	Make a Photomechanical Plate		
28.	Handle Glass Plates and Glass Ware		
29.	The Construction of the Camera	Inf.	
30.	Operate the Camera		
31.	Produce Linear Reversal		
32.	Use Panchromatic Materials		
33.	Reduce or Enlarge Type Matter		
34.	Care for the Process Lens		
35.	Focus the Image the Same Size		
36.	Place the Lens, Arc-lights and Ground Glass		
37.	Read Proofs		
38.	Observe Legal Restrictions on Copying		
39.	Scale Copy		
40.	Arrange Copy for the Camera		
41.	Make Contact Positives		
42.	Arrange the Dark Room		
43.	Use Standard Exposure		
44.	Prepare for the Developing Operation		
45.	Develope the Film		
46.	Compound Developers		
47.	Use Developing Chemicals		
48.	The Effects of Time and Temperature		
	on Developing Solutions		

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Job No.	Type Job	Job Performance	Reference Reading
49.	Use Illumination		
50.	Place the Sensitive Material		
51.	Use Photographic Materials and Film		
52.	Different Types of Negatives	Inf.	
53.	Fix Negatives		
54.	Make a Negative		
55.	Clearing the Negative		
56.	Stripping Negatives		
57.	Intensifying the Negative		
58.	Making Strip-Film Negative		
59.	Producing Negatives from Fine Line Copy		
60.	The Properties of Paper	Inf.	
61.	The Manufacture of Paper	Inf.	
62.	Test Paper		
63.	Cut Paper		
64.	The Effect of Paper Properties on Print		
	Quality		
65.	Requirements for Printability of Offset		
	Paper		
66.	Offset Paper	Inf.	
67.	Spot and Correct Paper Troubles		
68.	Conditioning Paper		
69.	Correct Sheet Feed and Delivery Troubles		
70.	Handle Paper in the Pressroom		
71.	How Books are Bound		
72.	Folding Paper		

TRADE ANALYSIS AND PROGRESSION RECORD

Job No.	Type Job	Job Performance	Reference Reading
73.	Jogging Paper		
74.	Padding, Drilling and Punching Holes		
75.	Rounding Corners		
76.	Stapling, Stitching and Gold Stamping		
77.	Collating and Gathering		
78.	Die Cutting and Paper Ruling		
79.	Cutting Paper		
80.	Treating Book Edges and Embossing		

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78.	Die Cutting and Paper Ruling		
79.	Cutting Paper		
80.	Treating Book Edges and Embossing		

NAME_____ OCCUPATION_____ AGENCY_____

STUDENT'S DAILY RECORD

Date	List the Job Numbers Performed the Previous afternoon	List the References Read in the Related Class by Symbols and Pages	List the Number of the Job Studied Today

Job 1

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
The History of Printing	Inf.	P.C.O. pp 3-12	

1. What is printing on a mass scale?

2. Who invented movable type?

3. In what country was movable type utilized long before it was ever used in Europe?

4. Who were the world's first printers?

5. In what century was the oldest known printed book made?

6. The Chinese language is made up of how many symbols?

7. Why was the Bible printed by Gutenberg called the 42-line Bible?

8. Where was the first press in the United States located?

9. Who set up the first press in the United States?

10. What is printing directly responsible for all over the world?

Job 2

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Shop Safety		P.O.F. pp 176-178	

1. What kind of safety operation should be set up in every shop?
2. Why should there always be more than one person at a time in the dark room?
3. What are several good fire precautions?
4. Why should a press or machine be operated by one person at a time?
5. Why should chemicals be stored on the lowest shelves?
6. What does the word dermatites mean?
7. At what distance from the eyes should chemicals be mixed?
8. What type gloves should be worn while mixing a solution?
9. Why should there never be any doubt when mixing chemicals?
10. Why is personal cleanliness important in printing?

Job 3

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Introduction to Lithography	Inf.	S.O.L. pp 1-6 P.O.F. pp 1-7	

1. Why is it necessary to make a comparison with the other graphic arts processes in a survey of lithography?

2. How many adequate dictionaries of graphic art terms are available today?

3. What term is commonly used to describe a web-fed press?

4. Describe the printing elements in all three graphic arts processes?

5. When are the presses called rotary presses?

6. What are the elements called when doing letterpress printing on rotary presses?

7. How are the plates mounted on to the plate cylinder?

8. What are the presses called when the printing is being done from flat printing elements?

9. What are the two principal means of feeding a "sheet-fed" press?

10. Name the eight different materials on which printing is done?

11. Name five major printing processes?

12. What are other names by which the offset process is known?

13. What is the purpose for using greasy or fatty inks in offset printing?

14. Define the term "mirrored image"?

Job 4

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
The Development of Lithography	Inf.	S.O.L. pp 7-13 P.O.F. pp 8-19	

1. What is the modern commercial lithographic process called?

2. In what year did Alois Senefelder invent his third method of stone printing?

3. What did Alois Senefelder call lithography?

4. Who were the only craftsmen available in the early years of lithography?

5. In what year did Goya, execute his famed "Bullfighter" lithographs with blunt litho crayons?

6. What is the name of the first mechanical screen invented and widely used in lithography for commercial work?

7. In what year was the rotary principle applied to the lithographic press?

8. In what year was the development of the offset press accomplished?

9. What equipment and materials are involved in platemaking?

10. Why was the Lithographic Technical Foundation established?

11. Where did the word lithography originate?

12. Name two metals used for lithographic plates today.

13. Who was George Eastman? What was his contribution to photography?

Job 5

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Composition Methods Used in Lithography	Inf.	S.O.L. pp 74-77 P.O.F. pp 33-55	

1. What is required when photographing copy?

2. What kind of copy can be reproduced without setting in type?

3. What can be ordered from typographers to avoid camera work for books if deep-etch plates are to be used?

4. For what purpose are transfer proofs used?

5. What is the quality of photographic composition on film, either negatives or positives?

6. How are hand-lettered headings produced?

7. What is a varigraph?

8. What is the function of the varigraph?

9. What type of typer gives a wide choice of interchangeable type faces?

10. What is used for doing the second typing from a perforated paper tape and may be used for text matter in volume?

11. What are the different kinds of metal type?

12. Name six methods of type composition in addition to metal.

13. What is another name used for metal type .918?

Job 6

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
The Offset Press		S.O.L. pp 53-53 P.O.F. pp 146-156	

1. To what extent is the offset process used today?

2. What type presses are still used for some specialties, such as poster and decals?

3. What is between the plate cylinder and the impression cylinder on the offset press?

4. What is the purpose of the offset cylinder?

5. How is the regular offset plate attached to the plate cylinder?

6. What standard type press is used for most types of productions?

7. What is responsible for eliminating much of the press make-ready?

8. When must register be accomplished?

9. How many steps are necessary for inking the plate on the lithographic press?

10. What is the smallest size four color press?

11. What type presses are generally used in the smaller offset shops?

12. How many basic parts does an offset plate have?

13. What is the total recommended squeeze between the blanket and plate?

14. What should be done to the blanket, if the press is to be idle even for only a half day?

Job 7

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Operate Different Types of Offset Presses		L.O.P. pp 3-14	

1. What is a press?
2. For what was the scraper-type press invented?
3. How did the press get the name steam-press?
4. What was developed to obtain greater speed than the steam-press?
5. What do all presses carry, both flat-bed and rotary?
6. What brought the offset press to its present popularity?
7. What is the single color offset press commonly called?
8. Of what is the multicolor press made?
9. How is paper fed to a web offset press for printing?
10. How did the offset duplicator start?

Job 8

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Maintain the Offset Press		L.O.P. pp 217-220 P.O.F. pp 169	

1. How is maintenance performed in a well-operated plant?

2. Why are records kept on the maintenance of the machines?

3. How can it be determined whether a man is right or wrong if he should suddenly get an idea that the plant can be run without a maintenance man?

4. What routine schedule should a maintenance man follow?

5. What is a good maintenance?

6. What are pressman's responsibilities for maintenance?

7. What should the pressman do if he notices any irregularities in the way the electrical system operates?

8. When is a good time to do general work on the press?

9. When is there any excuse for a dirty press?

10. What is an important part of cleaning the press?

11. What two inflamables may be used to clean the press?

12. After using kerosene, what must be used to remove it? Why?

13. Why should kerosene be used for cleaning?

14. What type of container should be used for cleaning?

Job 9

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Wash the Press		L.O.P. pp 185-187	

1. What is likely to be overlooked when oiling the press?

2. When is a good time to clean up hard-to-get-at places on a press?

3. What type of wash-up on the press is not considered a clean wash-up?

4. What type wash-up system usually gives good results?

5. What must a wash-up solvent be able to do to be considered good?

6. What percent of efficiency is kerosene in removing and holding pigment in suspension on moving rollers?

7. What must be done to obtain a good job when using kerosene?

8. What causes much of the glaze that forms on rollers?

9. What should be occasionally removed and scrubbed with pumice?

Job 10

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Packing the Offset Press		L.O.P. pp 100-108	

1. What does the term "packing" mean when pertaining to offset presses?

2. How is the true diameter of a cylinder found?

3. What is the difference between the surface of the body and the surface of the bearer called?

4. What is the undercut designed to accommodate?

5. What is done in order to reduce pressure when running a grainless plate and a hard blanket?

6. What must be done when paper stretches between colors on a single color press?

7. What must be done to the cylinder in order to match a stretched print?

8. In what direction is the grain of the paper as it is run across the press?

9. What must be done in order to obtain flat-size?

10. Why cannot the ordinary machinist's micrometer be used for finding the true thickness of a blanket?

Job 11

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Run the Offset Press		L.O.P. pp 190-198	

1. What is the pressman's responsibility in getting the job off?

2. What is the result if the makeready has been slighted and the fountain is not properly balanced before starting?

3. To whose attention should a pile of poorly conditioned stock be brought?

4. Who is responsible for seeing that the paper behaves in a manner that will insure good fit and register?

5. Who examines the paper before the makeready?

6. What will the paper for a multicolor job on a single color press do if it is too dry?

7. How is the paper tested for a bowed gripper edge?

8. What is the responsibility of the pressman?

9. What must be done to the sheet in order to insure uniformity of color?

10. What are the characteristics of a good pressman?

Job 12

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Makeready on Offset Press		L.O.P. pp 175 - 185	

1. In what way will a job improperly started suffer?

2. What does a lithographer mean when he refers to makeready?

3. Into how many general classes can offset makereadies be divided?

4. What type makeready is usually used in printing book work or forms?

5. What type makeready consists of a color change?

6. When can the final setting of dampeners be made?

7. What is the correct time to check a blanket?

8. What was the weakness of natural rubber blankets?

9. What must be changed even if the blanket is not changed?

10. What must be done to the blanket when a shift is made on the plate? Why?

Job 13

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Operate the Printing Unit		L.O.P. pp 14 - 26	

1. What is the printing unit of any press?

2. How is the printing accomplished on a modern offset press?

3. Why is one of the cylinders called the plate cylinder?

4. How is the cylinder driven?

5. What are the functions of the plate clamps?

6. What does the blanket cylinder closely resemble?

7. Why must the distance between the blanket cylinder and the impression cylinder be adjustable.

8. What cylinder carries the paper on single color presses and most multicolor presses?

9. How must the bearers be set?

10. What cylinder is not really a cylinder?

Job 14

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Determine Printing Unit Troubles		O.P.T. pp 23 - 32 P.O.F. pp 171 - 175	

1. What will cause gear streaks?

2. How is too much backlash remedied?

3. How are non-gear streaks caused?

4. What is used to check the thickness of the blanket?

5. What is done to remedy the running of too much ink on coated stacks?

6. What is the initial point where troubles should be stopped?

7. What are the signs of scumming troubles?

8. What is a good remedy for oxidation on the plate?

9. What is an indication of tinting troubles?

10. What is an indication of filling up troubles?

11. What causes set off troubles?

12. What is a good remedy for set off troubles?

13. What is meant by "roller stripping"?

14. What is a remedy for a glazed roller?

Job 15

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Operate Press Feeders		L.O.P. pp 57 - 66 P.O.F. pp 158 - 169	

1. Of what does successful feeding consist?

2. What may ruin a lot of sheets as well as spoil the uniformity of the job?

3. Where is the paper piled on many small presses?

4. How is the paper piled on most larger presses?

5. How many men does it take to pile medium size paper?

6. What does the loading consist of on large presses where the pile has been put on a skid type platform?

7. What is all important to the performance of the feeder?

8. What happens when a rotating comber contacts the sheet near the corner?

9. What is the first thing the feeder should do when feeding by hand?

10. What can too high a vacuum cause?

Job 16

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Use Blankets		L.O.P. pp 87 - 99	

1. Why do blankets play a very important role in offset lithography?

2. Of what were the first blankets made?

3. What type blanket will not take a full charge of ink from the plate?

4. Why does the glazed blanket print extremely sharp?

5. What does too tacky a blanket make difficult?

6. In what condition must the surface of the blanket be kept at all times?

7. Why is scrubbing blankets necessary?

8. What will a properly scrubbed blanket feel and look like.

9. What happens when a new blanket is placed on the press?

10. What must be done to insure even tension on the blanket when it is stretched on the cylinder?

Job 17

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Detect Offset Blanket Troubles		O.P.T. pp 60 - 65 P.O.F. pp 171	

1. List the various sizes of offset blankets used for special purposes?

2. What presses use two layers of offset blankets?

3. What is done for loss of impression, due to the blanket subsiding or becoming thinner under the roller pressure?

4. What may cause a blanket to become embossed or swollen?

5. What may cause the blanket surface to be cut, smashed or indented?

6. What is "scumming"?

Job 18

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Control the Dampening Process		L.O.P. pp 43 - 55 P.O.F. pp 150-160-161	

1. What is used to separate the printing areas from the non-printing areas in lithography?

2. Why were excellent results obtained in the offset process with stone lithography?

3. When the steam-press was invented, what besides an automatic dampening system was used?

4. What can the stone plate do that the metal plate cannot?

5. What organization was founded in the middle twenties and immediately set to work on the problem of scumming of plates?

6. What is the greatest hazard facing the pressman in the operation of the dampening system?

7. Why must the form rollers be properly adjusted?

8. What can be caused by too much moisture being transferred to the paper from an over-dampened plate?

9. What are the basic requirements of good dampening?

10. What is the purpose of the dampening mechanism?

11. Where is the solution kept that dampens the rollers?

Job 19

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Wash Dampeners		L.O.P. pp 187 - 189	

1. What is changed when the color on the press goes from black to yellow?

2. What type detergent can be used to wash dampeners to make them become water receptive?

3. After washing dampeners what care must be taken before putting the rollers back in the press?

4. What is "carbose"?

5. Why should rollers be run in water for fifteen minutes when breaking in new dampeners?

6. What must be done if it is necessary to put dampeners in the press immediately after washing?

7. What must be done when starting up a press with dry dampeners?

8. What must the pressman do to systematize his work in the actual makeready and get it down to a routine?

Job 20

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Use Lithographic Inks		S.O.L. pp 64 - 66 P.O.F. pp 130 - 132	

1. What materials are used in making lithographic inks?

2. What are reducers and compounds commonly called?

3. What change takes place in the inks as they work through the inking system of the press?

4. How are the inks applied when using the multicolor offset presses?

5. What prevents the lithographic inks from running together while wet and causing a muddy appearance?

6. What is used for making pigments for offset inks?

7. What is lithographic varnish?

8. For what are job black inks used?

9. What is a metallic ink?

10. How should ink be stored after it has been opened?

11. Why are modifiers added to inks?

12. How is ink packaged?

Job 21

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Maintain the Inking System		L.O.P. pp 27 - 42 P.O.F. pp 130	

1. How was ink applied on stone in early lithography?

2. Of what does a modern inking system essentially consist?

3. Describe the ink fountain?

4. How was the inking system originally driven?

5. What causes most roller streaks?

6. What is necessary for most modern presses to lay down a healthy film of ink?

7. What may happen to the rollers to cause serious trouble?

8. What should receive special care when removing rollers from the press?

9. How many systems are used in the mounting of form rollers?

10. What is the first thing to do in adjusting rollers?

11. Describe a good system for replacing rollers without sacrificing roller life.

12. What skill is required in operating an inking system?

Job 22

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Trouble Shoot Ink Feed and Distribution System		O.P.T. pp 33 - 39 P.O.F. pp 172 - 174	

1. What will cause horizontal streaks in the printing?

2. How are worn or mismatched drive belts remedied?

3. How is ink fed?

4. What causes stripping of ink drums or rollers?

5. What is done when the ink backs away from the fountain roller?

6. What will remedy ink builds, cakes or piles on the roller surface and on the image area of the plate and blanket?

7. Why should the blade and roller be kept clean at all times?

8. What can be done to remedy ink which is too tacky?

9. What causes mottling?

10. What causes chalking troubles?

11. What is meant by "set-off"?

12. What is a good remedy for acid getting into ink from an improperly washed out plate?

Job 23

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Use Different Types of Press Plates		S.O.L. pp 45 - 49 P.O.F. pp 108 - 110	

1. For what are surface plates most widely used?

2. What elements are used for making a surface plate?

3. Why is the plate immersed in water after the developing ink has been applied?

4. Why is the plate rubbed with a piece of cotton under flowing water in the developing tank?

5. How many basic types of lithographic press plates are there?

6. Why are deep-etch plates used?

7. Describe the development of deep-etch plates.

8. What must be taken under consideration when dealing with light-sensitive coatings?

9. What is the effect of moisture being absorbed from the air?

10. What is the thickness of a dry-offset plate?

11. How many main types of offset plates are in use today?

12. What must be done to the surface of an offset plate to make it water receptive?

13. What are the main ingredients in an albumin coating solution?

Job 24

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Practice Safety and Hygiene in Platemaking		O.P.S. pp 143 - 158	

1. How can platemakers be as safe from personal injury as workers in any industrial occupation?

2. What is meant by good personal hygiene in platemaking?

3. What type gloves should be worn when there is danger of getting chemicals on your skin?

4. What type gloves should be worn when handling petroleum solvents or turpentine. Why?

5. Who should be consulted if you should develop dermatitis?

6. Name six things that contribute most to safe operation in platemaking?

7. Why must spilled chemicals be cleaned up thoroughly?

8. Why must extreme fire prevention be taken in platemaking?

9. Name five hazards connected with handling chemicals.

10. What effect do corrosive materials have on the skin?

Job 25

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Correct Plate Dampening Troubles		O.P.T. pp 40 - 45 P.O.F. pp 171 - 174	

1. What is included in the conventional dampening system?

2. Why is the water distributing roller no longer made of brass?

3. What is the conventional ductor roller?

4. What is the remedy for wash marks?

5. What is the remedy for snowflaky solids?

6. What causes the color to vary with no change of ink feed?

7. What are the two (2) causes of scum streaks?

8. What will cause the plate to scum generally after 10-20000 impressions?

9. What is the cause if halftones sharpen and highlight dots are lost during run?

10. What will cause fiber-shaped white spots to appear in printed solids?

Job 26

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Correct Press Plate Troubles		O.P.T. pp 47 - 60 P.O.F. pp 171 - 174	

1. How are surface press plates made?

2. Why cannot plate images under developing ink be washed out with naptha or lithotine?

3. What will cause plates to refuse to roll up properly?

4. When asphaltum is put on so thick that water cannot penetrate it and dissolve the gum, what is done?

5. What is done with dirty or worn dampener covers?

6. What will happen to inks designed for large or high speed presser when used on small presses or at low speed?

7. What causes bimetal plates to go blind?

8. Why should sulphur never be used to dust the offset blanket?

9. What will cause deep-etch plates to fail to completely develop?

10. What may be caused by using a letterpress paste drier that contains lead acetate?

Job 27

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Photomechanical Plate		S.O.L. pp 14 - 18	

1. How are most printing plates made for the three major processes today?

2. With what does the making of photomechanical plates for all the three processes start?

3. What are the three major printing processes?

4. How are line copies photographed?

5. How are tone copies photographed?

6. What are the elements of a unit of copy?

7. In what form are copies supplied for the lithographic process?

8. What should be understood about platemaking in lithography?

9. What are the two kinds of copy?

Job 28

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Handle Glass Plates and Glassware		O.P.S. p 153	

1. How should glass plates be carried?

2. Why should glass plates never be carried in front of a person?

3. How should glass plates be lifted?

4. What should be done before picking up a glass plate?

5. What should be worn while cleaning plates with corrosive chemicals?

6. Where should glass plates be kept?

7. Why should a person never stand under a plate while moving it?

8. What laboratory glassware is usually handled by the platemaker?

9. What type glass will not break if filled with hot water when cold?

Job 29

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
The Construction of the Camera	Inf	L.P.L. pp 8 - 13 S.O.L. pp 20 - 21 P.O.F. pp 71 - 73	

1. What size dark room type camera is normally found in lithographic schools?

2. What are the parts of the camera outside the dark room?

3. What must be obtained in any camera, regardless of make, at any adjusted size of reproduction?

4. Where are the elements of a lens mounted?

5. Describe a method of checking for sharpness of the image on the ground glass?

6. What will be prevented by adding a piece of glass to the copy holder?

7. What is the rear section of the camera designed to hold?

8. What is stirred up by fans and vacuum pumps in the dark room?

9. What are the basic parts of all cameras?

10. Why should the worker keep his fingers off the lens surface?

11. What part of the camera is the most delicate, expensive, and critical?

12. What is the purpose of the waterhouse stop slot?

13. What parts or compounds are located in the camera back or (rear case)?

14. What is the function of the bellows?

Job 30

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Operate the Camera		S.O.L. pp 20 - 21 P.O.F. pp 68 - 77	

1. What type of camera is used for photographing flat copy?

2. What type camera has the camera back permanently fixed into the dark room wall?

3. List the three parts of the process camera?

4. The halftone screen, the plate or film holder and a ground glass make up what part of the process camera?

5. To what does camera size refer?

6. What shape is the glass on a halftone screen for black and white work?

7. How is the movable lens board connected to the camera back?

8. Name the basic parts of the camera?

9. What is a copyboard?

10. Describe the gallery camera.

11. Which is probably the most delicate, expensive and critical part of the camera?

12. What is a waterhouse stop slot?

13. How may Focal Length be defined?

Job 31

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Produce Linear Reversal		L.P.L. pp 111 - 116	

1. What should be obtained if a thin film stock is used, and the back of the film is clean and free from scratches?

2. What should be remembered when processing the reversed negative, and especially when intensifying?

3. What may be used in place of the reflecting prism?

4. What are the three mirrors required to maintain?

5. What type of bulb does the LTF contact printing lamp use?

6. How is the positive image separated from the plate when printing the deep-etch plate through an unreversed positive?

Job 32

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Use Panchromatic Material		L.P.L. pp 119 - 123 P.O.F. p 96	

1. A panchromatic emulsion is sensitive to what part of the visible spectrum?

2. What two devices will assist selection of the filter to secure greatest contrast?

3. How may exposure be determined after having selected the filter and panchromatic emulsion?

4. How many color separations are frequently used between optical flats?

5. When is it preferable to focus with the film in place?

6. Give one reason for using a filter chart?

7. For what are gelatine filters, slipped into the waterhouse stop slot of the lens barrel used?

8. For what is panchromatic film used?

9. Under what conditions must panchromatic film be developed?

Job 33

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Reduce or Enlarge Type Matter		L.P.L. pp 80 - 84 P.O.F. pp 74 - 75	

1. What is meant by reproduction ratio?

2. What is a reproduction ratio greater than one (1) called?

3. How do many modern process cameras focus?

4. When is the quality of reproduction by lithography best?

5. Cameras are equipped with what automatic devices?

6. Give the formulas used for determining Copyboard extension and Bellows extension.

7. Why must lights sometimes be moved to the side?

Job 34

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Care for the Process Lens		L.P.L. pp 13 - 18 P.O.F. pp 71 - 74 S.O.L. pp 21 - 22	

1. For what has the modern process lens been especially designed?

2. For what four purposes is the modern process lens used in lithography?

3. What is a photographic lens?

4. Which lens does not form an image, but is necessary in the lens assembly?

5. Upon what is the speed of the lens and it's resolving power dependent?

6. What is the distance of the focal length?

7. To what is the exposure time directly related?

8. From what are the elements of a photographic lens made?

9. What will cause flare and a fogged negative?

10. Why is silk an undesirable lens duster?

11. What is the safest method for cleaning the lens?

12. What should be done with a lens when it is not in use?

Job 35

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Focus the Image the Same Size		L.P.L. pp 56 - 59	

1. What is meant by focusing the image?
2. What is the first step in focusing the image the same size?
3. Where should the ground glass be placed?
4. What determines the method of focusing?
5. What can't the unaided eye judge without the precision of the ten power microscope?
6. Where is the microscope first focussed?
7. What may be used as a final focusing refinement?
8. When final focus has been obtained, what is the last step?
9. What "scale" are some cameras equipped with?
10. How is the camera focussed when the focal plane is adjustable?
11. How is the camera with fixed copy board focussed?

Job 36

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Place the Lens, Arc-lights and Ground Glass		L.P.L. pp 34 - 35 P.O.F. p 114	

1. Why must the lens be handled carefully?

2. Why should the retainer rings that hold the individual elements together never be unscrewed?

3. Where in standard practice are the arc-lights placed?

4. Why must the ground glass be kept clean?

5. What method should be used for inserting the lens in the camera?

6. What must be followed when securing the ground glass in place?

Job 37

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Read Proofs		P.O.F. pp 56 - 60	

1. What are the functions of a proof reader?

2. What are the duties of the proof marker?

3. What usual mistakes are made when one person reads and marks?

4. What is the purpose of a revised proof?

5. What extra precautions may be taken in correcting errors?

6. Where should the errors and corrections be placed, which are found on the left hand side of the line?

7. Where should the errors and corrections on the right hand side of the line be placed?

8. Why has a proof reader not completed his job even if the proof exactly matches the copy?

9. List three kinds of proofs?

10. What are proofreaders marks?

Job 38

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Observe Legal Restrictions on Copying		P.O.F. pp 180 - 183	

1. What three elements should be in the copyright notice?

2. How long does the first statutory copyright run?

3. On what date does the first statutory copyright begin?

4. How may a copyright be renewed?

5. Who protects unpublished maps, books, photographs and other works from being copied?

6. What is a copyright?

7. What should be done before copying any written material?

8. When can photographs which show clearly recognizable faces of persons be used for advertising purposes?

9. Under what conditions is it legal to make reproductions of U. S. Savings Bonds or Saving Stamps?

10. What year was the restriction on photographing and printing illustrations of United States coins removed?

Job 39

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Scale Copy		L.P.L. pp 29 - 34 P.O.F. pp 74 - 75	

1. Why is scaling copy necessary?

2. Scaling copy is what kind of operation?

3. To what does reproduction ratio refer?

4. What is the first essential in handling copy?

5. In what condition should the surface of the cover glass be kept at all times?

6. What is the purpose of the cover board on a copy board?

7. What is the best method for cleaning a cover glass?

8. What should be the last step in placing copy on the copy board

9. How should the copy be positioned on the copy board?

10. Why is it necessary to have cameras with different settings?

11. What does F.L. symbolize?

12. What do the letters C.E. symbolize?

13. Give the meaning of each letter symbol in the following problem.

    PROBLEM: CE=(FL+M)

Job 40

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Arrange Copy for the Camera		S.O.L. pp 35 - 36 P.O.F. pp 61 - 62	

1. What must be done to copy of several elements before it is photographed?

2. What is the purpose of the instructions on the copy?

3. What figure does the cameraman want for adjusting his camera?

4. How does the cameraman figure the reproduction ratio when figuring some size as 100?

5. What size copy board, using a 30 inch camera, can handle the equivalent of four standard newspaper pages?

6. In what position does the copy board stay while placing various pieces of copy?

7. How are the various pieces of copy held on the copy board?

8. Who usually does the imposition?

9. What type work does a line copy include?

10. What type work does a halftone include?

11. How should the resulting height be figured when the illustration is to be enlarged to a certain width?

Job 41

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make Contact Positives		L.P. pp 117 - 119	

1. From what are individual positives generally made?

2. Why should care be exercised in cleaning the vacuum frame glass?

3. With what should both sides of the emulsion be dusted?

4. What might happen if foreign matter is anywhere between blanket and plate glass?

5. How does processing of the positives differ from the negatives?

6. What determines exposure time in making contact positives?

7. Is it possible to use orthochromatic film for the positive?

Job 42

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Arrange the Dark Room		L.P.L. pp 59 - 61 P.O.F. pp 91 - 92	

1. What material is preferred for the dark room entrance?

2. How should the dark room be arranged?

3. What color paint is used on the dark room walls?

4. For what should suitable safe-light be provided?

5. How should processing equipment be arranged?

6. What operation should never be done in the darkroom?

7. At what temperature should the developing and fixing bath be maintained?

8. Why is ventilation an important part of darkroom installation?

Job 43

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Use Standard Exposure		L.P.L. pp 84 - 98 Dictionary	

1. What is meant by the resolving power of a lens?

2. When are different exposures required?

3. What simple device can be placed on the lens barrel for setting the iris diaphragm?

4. A constant exposure cannot be maintained under what conditions?

5. Give the meaning of the word "aperture".

6. Why is it possible to establish a constant exposure time with the modern process lens?

7. Define resolving power.

8. Define the following words: a) variable b) diaphragm c) constant

Job 44

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Prepare for the Developing Operations		L.P.L. pp 61 - 62 P.O.F. p 93	

1. Why should the developing solutions, fixing bath and solutions be ready for the processing operations before an exposure is made in the camera?

2. How do the developers usually reach the dark room?

3. What is used for the storage of stock developers and water?

4. What should be used if there is not a reliable thermostatic control of developer and other processing solutions?

5. Why should the safe-light be checked?

6. Why is the exposure developed in darkness?

7. What does a satisfactory short stop bath contain?

8. In what form is the fixer usually purchased?

9. What temperature should the water be for washing?

10. How should vessels be held for accurate measuring of liquids?

Job 45

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Develop the Film		L.P.L. pp 65 - 66 P.O.F. pp 93 - 94	

1. Where should orthochromatic film be handled?
2. How is the developing action stopped?
3. How long is the negative immersed in the short stop bath?
4. How long is the negative immersed in the fixing solution?
5. What is done to remove the fixing solution?
6. Where is the negative dried?
7. Where is the negative placed to be examined?
8. How is the film handled?
9. Why should the developer tray be raised and lowered?
10. What is the appearance of a well developed negative?
11. Describe the washing process.

Job 46

TYPE JOB		LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Compound	Developers		L.P.L. pp 70 - 75	

1. How are most recommended developers put on the market?

2. What is the ideal solvent for photographic chemicals?

3. What is one of the major operations in developing and preserving the visible image?

4. What is the compounding solution operation?

5. Where should the solutions never be compounded?

6. Why should the developer recommended by the manufacturer for a particular emulsion be used?

Job 47

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Use Developing Chemicals		L.P.L. pp 66 - 70 Dictionary	

1. What is the term most often used to indicate the quality of chemicals used for plate lithographic reproduction?

2. For what does the abbreviation N.F. stand?

3. What is the effect of light on the silver halides?

4. What should the practical photographer know about the formation of the latent images?

5. Why is it important to have a preservative in the developer?

6. What dual purpose do acid sulphites serve in stock solution developers?

7. What is the purpose of an accelerator in the developing solution?

8. Upon what does the reactive ability of the developing solution depend?

9. Why should the formula be followed precisely when compounding developers?

10. What will be the result if the alkali is too strong?

11. Define the following words: a) alkali b) preservative c) formula d) latent

Job 48

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
The Effect of Time and Temperature on Developing Solutions	Inf.	L.P.L. pp 75 - 76	

1. When does the rate of chemical reaction proceed most rapidly?

2. What temperatures are recommended for completely dissolving most chemicals?

3. What temperature controlling devices are being increasingly used to maintain normal temperature of solutions?

4. Where should all day chemicals be stored?

5. What is the most desirable temperature for most dark room solutions?

Job 49

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Use Illumination		L.P.L. pp 18 - 24	

1. What are the principle types of illuminants now used in photo - lithographic reproductions?

2. At what angles are the lamps set?

3. How is candlelight measured?

4. To what does the term brightness refer?

5. How is the brightness of a surface expressed?

6. What is the principle involved in light emission?

7. When the lamp angle and the lamp distance are inproper what happens?

8. Define the term brightness.

Job 50

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Place the Sensitive Material		L.P.L. pp 62 - 63	

1. What kind of light should exist in the camera darkroom?

2. When is there little danger of static?

3. What is the effect of the thickness of the film?

4. What kind of containers should be used for sensitive materials?

5. What part of the hand is an excellent cleaning tool?

6. How may dust be removed from sensitive material?

Job 51

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Use Photographic Materials and Film		S.O.L. pp 22 - 24	

1. What are photographic emulsions for photomechanical reproduction?

2. How are the light sensitive silver salts supported?

3. Why are dry plates used only to a limited extent?

4. For what is emulsion on paper used?

5. What are the two general types of emulsion encountered in lithography?

6. Into how many color types are contrast emulsions classified?

7. What type film is sensitive to all colors?

8. Why must action of developing solution on the emulsion be stopped for inspection at the discretion of the camera and then fixed?

Job 52

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Use Different Types of Negatives	Inf	S.O.L. pp 24 - 27 P.O.F. pp 92 - 96	

1. Why does lithography employ the use of dots of varying sizes?

2. What color tone is frequently used for a reversed area, background, headline or rule?

3. With what type emulsion are continuous tones made?

4. In what shade is tone picked up?

5. What is a negative from a snap shot camera called?

6. What type image is formed on the film, by reflected light, during exposure of the film in the camera?

7. What is the effect of the developing bath?

8. What type bath removes all unexposed particles of silver from the film?

9. How is a short stop bath mixed?

10. In what form is the developer usually sold?

11. How is a film positive made?

Job 53

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Fix Negatives		L.P.L. pp 76 - 80	

1. What is fixation?

2. What is the most universally used substance for fixing films and dry plates?

3. Name three types of hypo fixing baths?

4. Of what do acid hypo baths consist?

5. For what are acid hardener baths used?

6. What must be done to ensure permanency?

7. What is used to make a short stop bath?

8. How long should the developed negatives be immersed in the short stop bath?

Job 54

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Make a Negative		L.P.L. pp 7 - 8 P.O.F. pp 92 - 97	

1. With what type copy is live photography usually concerned?

2. What does the lens project?

3. Upon what does the size of the image in relationship to the copy depend?

4. Upon what does the time of the exposure depend?

5. What are the essential elements of a camera assembly for line photography?

6. What does development change?

7. What does the developing bath do to the latent image?

8. What purpose does the short stop bath serve in making a negative?

9. What does the fixing bath remove from the film?

10. What is a running water bath?

11. What are the characteristics of a well developed negative?

12. How long should a negative be washed in running water?

Job 55

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Clearing the Negative		L.P.L. pp 107 - 108	

1. What is necessary if the negative does not show practically clear lines?

2. What will cause paper negatives to sometimes have a brown stain in the lines?

3. What is universally used for clearing negatives and positives?

4. Why should the chemicals in Farmers Reducer be kept in separate bottles?

5. What is the convenient equipment for reduction?

6. Must all the negative always be reduced?

Job 56

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Stripping Negatives		S.O.L. pp 35 - 38 P.O.F. p 101	

1. When does the photographer strip inserts, either negatives or positives?

2. What is the usual method of stripping inserts?

3. What other elements may be used for stripping inserts?

4. When does the camera department handle the stripping instead of the stripper?

5. When may halftones be handled on a separate halftone flat?

6. How does the stripper work, when stripping negatives?

7. Which is the unreadable or back side if a negative is made correctly?

8. Why is the negative placed on the flat with the emulsion side up, when stripping?

9. What would happen if the negative was placed with the emulsion side down on the flat?

10. What is the creeping and spreading of the light rays called?

11. How should the negative be handled?

12. Why should the negative be trimmed no closer than 1/4 inch from image.

13. How should the negative be placed on the lighted stripping table?

Job 57

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Intensifying the Negative		L.P.L. pp 108 - 110	

1. What are the two steps in the process of intensifying the negative?

2. Of what does bleaching consist?

3. Of what does blackening the image consist?

4. How does a developer blacken?

5. How is it possible to control the amount of intensification?

6. Why must care be used in handling potassium dichromate?

7. Why are paper negatives unsuitable for intensification?

Job 58

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Making Strip-Film Negatives		L.P.L. pp 103 - 104 P.O.F. p 101	

1. What is strip-film?

2. Why should fixing and washing be performed quickly?

3. What instructions for processing and stripping should be followed?

4. What should be used to prevent change of size?

5. How is the paper handled up to the time of processing?

Job 59

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Producing Negatives from Fine Line Copy		L.P.L. pp 100 - 103	

1. Why must care be exercised throughout the lithographic process?

2. What copy requires special care?

3. Where should the diaphragm be set for making the negatives?

4. Why was a masking method developed during the war?

5. What is the standard procedure in normal development?

6. What are undoubtedly the most critical steps in lithographic process?

7. Where should careful exposure tests be made?

8. What is the most important part of the procedure of fine line development?

Job 60

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
The Properties of Paper	Inf	P.T.B. pp 12 - 19 P.O.F. pp 134 - 145	

1. How is structure of paper determined?

2. What are the most obvious characteristics of paper?

3. What is a characteristic of all machine made paper?

4. What is meant by the density of paper?

5. What happens when a sheet of paper is freely exposed to the atmosphere?

6. What is the maximum difference in final moisture content as compared to previous moisture content?

7. What is meant by the "two-sideness"of paper?

8. What are the effects of grain on paper properties?

Job 61

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
The Manufacture of Paper		P.T.B. pp 1-6 P.O.F. pp 134-144	

1. What is the principal raw material used for making paper?

2. What are the principal commercial fibers for making paper?

3. What in addition to fibers does paper contain?

4. What is the effect of mineral fillers on paper?

5. On what machine are most printing papers made?

6. What is done to prevent excessive alignment of fibers in the paper web?

7. What may the pulp contain?

8. How is super - calendered paper made?

9. How is surface - sized or tub - sized paper made?

10. Where is the sizing equipment located in the drier section of the machine?

Job 62

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Test Paper		P.T.B. pp 100-156 P.O.F. pp 134-145	

1. To what has a great amount of research in the manufacture of paper been devoted?

2. What does paper making involve?

3. What in the past did lithographers have a tendency to take for granted?

4. What does the degree of sizing of paper and paperboard determine?

5. From what is the density or specific volume of paper calculated?

6. For what is TAPPI routine control test RC-70 suitable?

7. Where was the IGT pick tester developed?

8. Who developed the Waldron pick tester?

9. Who developed the surface tension test?

10. What is meant by the tensile strength of paper?

Job 63

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Cutting Paper		P.O.F. pp 141-144	

1. How should paper be bought or cut for economy?

2. How should you plan your job if the paper is already on hand?

3. For what is the long swab used?

4. With what should the long handle swab be dampened?

5. What percent moisture does paper usually have when it is shipped from the mill?

Job 64

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
The Effect of Paper Properties on Print Quality	Inf.	P.T.B. pp 35-40	

1. Why should colored paper never be used in a process which requires reproduction of color?

2. What is brightness?

3. What does opacity determine?

4. What is gloss?

5. What did the work of Yule, Neilson, and Clapper of Eastman Kodak Company show?

6. How does the printer measure the refractiveness of paper?

7. What is the effect of the smoothness of a paper's surface?

Job 65

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Requirements for Printability of Offset Paper	Inf.	P.T.B. pp 19 - 35 P.O.F. pp 134 - 145	

1. What characteristic must paper have to pass through the uniform squeeze impression of the offset press without distortion?

2. What will result if sheet paper has a wavy edge?

3. In what are the papers wrapped when they are packaged at the mill?

4. What is important in roll paper for web offset printing?

5. What will happen if the edges of roll paper lose moisture and shrink?

6. What is the meaning of dimensional stability?

7. How many actions are there for stretching paper in offset printing?

8. What is an important requirement for sheet paper?

9. What causes linting?

10. What causes piling of coated papers?

Job 66

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Offset Paper		S.O.L. pp 59 - 61 P.O.F. pp 134 - 144	

1. What is the principal characteristic of offset paper?

2. Where is uncoated offset paper surface-sized?

3. Why is uncoated offset paper surface-sized?

4. When is coated offset paper waterproofed?

5. What is the classification of offset paper?

6. How is uncoated offset paper usually rated in comparison with coated paper?

7. What is the heaviest type stock run on the offset press?

8. From what is all paper made?

9. What are the different kinds of pulp?

10. By what process is old paper changed to paper pulp?

11. How is alpha-cellulose pulp obtained?

12. What is meant by "sizing"?

13. What is the stuff chest?

Job 67

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Spot and Correct Paper Troubles		O.P.T. pp 65 - 85 P.O.F. pp 171 - 174	

1. What do all papers and paperboards have in common even though they come in wide variety of types and finishes?

2. What does the word "Close" mean in printing?

3. What type sheet papers should be used for multicolor work?

4. What causes the paper to wrinkle or crease?

5. What will cause the second printing to be longer across the back edge than the first?

6. How may misregister on cockled or embossed papers be minimized?

7. What will cause a slur in halftones and at the back edge of solids?

8. What is doubling of halftones on multicolor presses?

9. When will sheets curl on delivery and fail to jog properly?

10. When tint appears on the non-image areas of the plates how can it be washed off?

Job 68

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Conditioning Paper		S.O.L. pp 61 - 63	

1. Why must the moisture content of the paper and any unequal distribution of moisture in the sheet be given attention?

2. Why is paper conditioning equipment used by many of the large lithographers?

3. For what is the L.T.F. paper hygroscope used?

4. What does the L.T.F. register rule determine?

5. What is important about the paper when running long runs?

Job 69

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Correct Sheet Feed and Delivery Troubles		O.P.T. pp 11 - 22	

1. What causes the feeder to fail to feed single sheets?

2. What will remedy too much or too little air blast under the separated top sheet?

3. What will cause oil from air compressor to stain sheets on the feeder?

4. What is done on a single-sheet feeder if the two forwarding wheels do not drop at exactly the same time?

5. What is done to remedy front edge or corners of sheets from curling up and failing to enter the side guide, causing them to cock and jam?

6. What should be done if the side guiding varies from sheet to sheet?

7. What should be done when the gripper edge of the sheets are nicked or torn?

8. What should be done when tension on the grippers is too weak to hold the paper against the pull of the ink?

9. What may cause printed sheets to be marked or smeared?

10. What should be done when sheets fall short of the front stops or gate or tend to strike them too hard and buckle under?

Job 70

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Handle Paper in the Pressroom		P.T.B. pp 44 - 56	

1. What is the responsibility of the lithographer when the paper is received in a flat condition?

2. Where is the paper stored in many lithographic shops?

3. Why can't waviness caused by unwrapping cold paper in a warm pressroom, be removed by ordinary paper conditioning methods?

4. How may the approximate temperature of the paper be found?

5. What is moisture conditioning usually called in the shop?

6. How do some lithographers condition wavy edged paper?

7. Where were the paper conditioning methods and their effects on color register studied?

8. Where is protection of paper between printings not necessary?

9. Why check the side guide edge of the sheet?

10. A short run requires the paper to be placed where, generally?

Job 71

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
How Books Are Bound		P.A.T. pp 280-284	

1. Why are school books and novels printed by machine?
2. What is pamphlet binding?
3. Name several methods of binding.
4. What materials are most commonly used to bind school books?
5. What is the inside margin called?
6. What binding process is used most in binding catalogs?
7. In what type binding should the binding edge be wide?
8. In what process of binding is the hand stapler used?
9. Describe the loose leaf binding process?
10. What is the waste material of the loose leaf binding process?
11. What type of material binding should be folded back to back?
12. What is another name for adhesive binding?
13. In what process is the Reader's Digest bound?
14. What does the adhesive binding eliminate?
15. On what did the Egyptians write?

Job 72

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Folding Paper		P.A.T. pp 284 - 286	

1. What happens to sheets when they hit a stop in the plate?

2. How many pages can be folded into sections at one time?

3. Describe the operation of a folding machine.

4. What is the speed of a Dexter Paper Folding machine?

5. Where is a rotary folder attached to the press?

6. What is the amount of paper put out an hour by a rotary folder?

7. What width roll will a rotary folder fold?

Job 73

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Jogging Paper		P.A.T. pp 286-287	

1. What is jogging?

2. To what is jogging similar?

3. What is necessary for straighening paper?

4. How many types of joggers are shown on page 287 P.A.T.?

5. When is winding used?

6. Why is winding done?

7. List the six steps in jogging?

Job 74

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Padding, Drilling and Punching Holes		P.A.T. pp 289 - 290	

1. What is padding?

2. What is the purpose of a padding press?

3. What is sometimes applied to wet glue in the padding process?

4. Why is a sheet of heavy board placed between each 100 sheets of paper?

5. How are most holes placed in paper?

6. Why do paper drilling machines usually have automatic gauges?

7. For what is the punching machine used?

8. Why is a paper drill hollow?

9. What is sometimes used instead of a padding press?

10. What is used to apply glue to a pad?

Job 75

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Rounding Corners		P.A.T. pp 291 - 294	

1. What is the purpose of rounding the corners of cards?

2. What products often have rounded corners?

3. What is dry perforating?

4. How can dry perforation be accomplished without the perforating rule?

5. Explain the perforating wheel?

6. What is the round-cornering cutting machine?

7. What makes the small holes in a postage stamp?

Job 76

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Stapling, Stitching and Gold Stamping		P.A.T. pp 294 - 295	

1. What type die is required for gold or silver stamping?

2. Why does gold stamping require the use of metal dies?

3. What is stapling?

4. What is stitching?

5. Describe the machine shown on page 295 P.A.T.?

6. How is the leaf usually fed into a gold stamper?

Job 77

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Collating and Gathering		P.A.T. pp 296 - 297	

1. To what did the term "collating" formerly refer?

2. What probably changed the meaning of collating?

3. What is the other meaning of collating?

4. What is a gathering machine?

5. What is the function of the automatic collator?

Job 78

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Die Cutting and Paper Ruling		P.A.T. pp 297 - 298	

1. What does P.M.C. represent?

2. In a large operation how is the waste stripped from a die cut job?

3. What type of die is used on platen and converted cylinder presses?

4. Why is sponge rubber glued near the cutting rule?

5. What are pen or disc lines?

6. What are the rules for forms on a typewriter?

7. How do printers obtain billheads and statements?

8. How are pens on a ruling machine supplied with ink?

9. How many colors can pass through the ruling machine at once?

10. What is the purpose of a striker?

11. At what speed are disc devices ruled?

Job 79

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Cutting Paper		P.A.T. pp 287 - 289	

1. Why must most paper be cut?

2. How is cutting done?

3. Why does the hand paper cutter have a long handle?

4. What is a three knife cutter?

5. What type cutter is the power cutter?

Job 80

TYPE JOB	LABORATORY PERFORMANCE	RELATED STUDY REFERENCES	DATE READ
Treating Book Edges and Embossing		P.A.T. p 299	

1. What is embossing?

2. What is sprinkling?

3. Why are edges of sheets of a book marbled?

4. How is imitation marbling applied?

5. What is a British made Griddmore press?

6. How are designs and advertisements placed on book edges?

7. Who usually makes counter "Discs"?

8. From what is a counter die made?

9. How is staining accomplished?

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ABSTRACT.- Prepared by Trade and Industrial Education coordinators for high school cooperative students preparing for the plumbing trades, the study guide includes a bibliography, a progress record chart, and 70 job assignments and information lessons. An answer book may be obtained from the source of availability indicated for this document. (GR)

VT 010 627

PLUMBING

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The material was edited by Mr. J. R. Thomas, Assistant State Supervisor and approved by Mr. H. F. Worthy, State Supervisor, Trade and Industrial Education.

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HDI	How To Design and Install Plumbing Matthias and Smith Fourth Edition, 1968 printing American Technical Society 848 E. 58th. Street Chicago, Illinois 60637	$3.96
BRS	Blueprint Reading and Sketching Plumbing Trades Delmar Publishers, Inc. Mountainview Ave. Albany, New York 12205	$3.00
RIP	Related Information Plumbing - 2 Delmar Publishers, Inc. Mountainview Ave. Albany, New York 12205	$2.46
PPM	Mathematics - Plumbers and Pipefitters Delmar publishers Mountainview Ave. Albany, New York 12205	$2.34
APS	Audels Plumbers and Steam Fitters Guide Volumes No. 1 and No. 2 Theodore Audel and Co. Division of Howard W. Sams and Co., Inc. 4300 West 62nd. Street Indianapolis, Indiana 46268	$8.50

HOW TO USE THIS STUDY GUIDE AND RECORD OF PROGRESS

The student's record of progress is kept on the Trade Analysis and Progress Record page. Progress "on-the-job" is kept in the column headed "Job Progress", and related study progress is kept in the adjoining column headed "Related Study".

The four step method of training is used in developing the skills of a trade or occuaption. A record of all these steps for each job is kept in the squares in the column below "Learning Status" (Steps), opposite a specific job.

A dot in the center of the square indicates a student is in the first step; that of observing the job being done. No other mark is made in this square as long as the student remains in this step.

A diagonal line across the same square indicates the student is in the second step; that of helping perform the job under instruction.

Two diagonal lines across the same square indicates that the student is in the third step; that of doing the job under supervision.

The square filled in solid indicates that the student has reached the fourth step; that of a satisfactory level of accomplishment. The date when this accomplishment has been reached is placed in the column "Date Objective Reached", opposite the specific job.

On the day the student has read all the references and has written the answers to all of the questions, for a specific job, the student places this date in the column headed "Date Completed", opposite this job. The grade made on the test on this job is entered in the adjoining square headed "Test Grade".

The word "Information" will be found in the "Job Progress" column for all information lessons. When all references have been read and all answers to the questions have been written, for a specific information lesson, the student places the date of completion in the "Date Completed" column, opposite this lesson number. The grade made on the test on this lesson is entered in the square headed "Test Grade".

The student should read all references before writing the answers to questions. The essay type of answers which are required for most questions have a very definite value as they will help the student form the habit of giving clear-cut, definite answers or explanations. Only a few references and a few questions have been listed on each job sheet to teach the student how to study the literature pertaining to his occupation.

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TRADE ANALYSIS AND PROGRESS RECORD

PLUMBING

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
1.	USE BRASS PIPE AND FITTINGS				
2.	USE COPPER TUBING AND FITTINGS				
3.	USE LEAD PIPE AND CONNECTIONS				
4.	USE PLASTIC OR BITUMINIZED FIBER				
	PIPE				
5.	USE TRANSITE OR GLASS PIPE				
6.	READ BLUEPRINTS - PLOT PLANS				
7.	READ BLUEPRINTS-BASEMENT PLANS				
8.	READ BLUEPRINTS-FLOOR PLANS				
9.	READ BLUEPRINTS-ELEVATION AND				
	ROOF PLANS				
10.	SCALE MEASUREMENTS				
11.	SOLVE PROBLEMS OF MEASUREMENT				
12.	SOLVE PROBLEMS OF MEASUREMENT OF				
	AREAS				
13.	SOLVE PROBLEMS OF CUBIC MEASURE				
	AND VOLUME				
14.	SOLVE PROBLEMS OF COSTS AND PER-				
	CENTAGES				
15.	STUDY JOB PLUMBING SPECIFICATIONS				
16.	CALCULATE CUTTING MEASUREMENTS FOR				
	STANDARD WEIGHT PIPE				
17.	CALCULATE CUTTING MEASUREMENTS WITH				
	ALLOWANCE FOR FITTINGS				

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18.	CALCULATE CAST IRON ASSEMBLIES WITH 1/4 BEND				
19.	ANGLES IN PLUMBING	INFORMATION			
20.	SOLVING FOR CONSTANTS AND PIPE LENGTH				
21.	CALCULATE CAST IRON ASSEMBLIES WITH 1/6 AND VARIOUS BENDS				
22.	SOLVE PROBLEMS OF GRADE, DROP, AND RUN				
23.	MAKE ISOMETRIC DRAWINGS				
24.	DRAW ISOMETRIC PIPE DIAGRAMS				
25.	DIMENSIONING OF ISOMETRIC DRAWINGS				
26.	MAKE A DRAWING OF WASTE AND VENT FOR KITCHEN SINK				
27.	MAKE A DRAWING OF WASTE AND VENT FOR TWO LAVATORIES				
28.	MAKE A DRAWING OF THREE LAVATORIES TO A SINGLE STACK				
29.	MAKE A DRAWING OF SOIL STACK, WASTE AND VENT PIPING FOR WATER CLOSET AND LAVATORY				
30.	MAKE A DRAWING OF A THREE FIXTURE BATH ON ONE WALL				
31.	MAKE A DRAWING OF BATHROOM FIXTURES ON OPPOSITE WALLS				

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32.	MAKE A DRAWING OF A FOUR FIXTURE BATH				
33.	MAKE A DRAWING OF TWO BATHROOMS BACK TO BACK				
34.	MAKE A DRAWING OF BATHROOM AND KITCHEN FIXTURES INTO ONE STACK				
35.	INSTALL A SEPTIC SERVICE				
36.	INSTALL A DISTRIBUTION FIELD FOR A SEPTIC TANK				
37.	EXCAVATE FOR SEWERS				
38.	CONNECT A HOUSE SEWER TO A STREET SEWER				
39.	PLAN A RESIDENCE HOUSE DRAIN				
40.	INSTALL PIPE FOR A HOUSE DRAIN				
41.	INSTALL SOIL PIPE				
42.	INSTALL A BACK-FLOW VALVE				
43.	INSTALL FLOOR DRAINS				
44.	INSTALL A GARAGE CATCH BASIN				
45.	INSTALL A SEWAGE EJECTOR				
46.	INSTALL A GREASE TRAP				
47.	PLAN INSTALLATION OF A STORM DRAIN				
48.	PIPE A BUILDING FOR DOMESTIC HOT WATER				
49.	INSTALL A WATER HEATER				

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PLUMBING

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
50.	PIPE A RESIDENCE FOR COLD WATER				
51.	INSTALL A WATER SERVICE				
52.	INSPECT AND TEST ROUGHED-IN WORK				
53.	INSTALL VENTS FOR FIXTURES				
54.	MAKE INSTALLATION OF A MAIN VENT				
55.	PLAN VENTING FOR AN INSTALLATION				
56.	INSTALL FIXTURE TRAPS				
57.	ROUGH-IN WASTE BRANCHES FOR FIXTURES				
58.	ROUGH-IN A MAIN STACK FOR A RESIDENCE				
59.	PLAN A SOIL PIPE OR STACK INSTALLATION FOR A RESIDENCE				
60.	INSTALL A PRESSURE PUMP				
61.	INSTALL OR REPAIR A COLD WATER SYSTEM FOR A TALL BUILDING				
62.	SELECT AND INSTALL A WATER CLOSET				
63.	SELECT AND INSTALL A LAVATORY				
64.	SELECT AND INSTALL A BATHTUB				
65.	SELECT AND INSTALL A KITCHEN SINK				
66.	INSTALL UTILITY OR COMMERCIAL SINKS				
67.	UNSTOP CLOGGED DRAINS				
68.	GRIND AND SHARPEN CUTTING TOOLS				
69.	ROUGH-IN A BAR OR SODA FOUNTAIN INSTALLATION				

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PLUMBING

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
70.	CHECK INSTALLATIONS FOR BY-PASS				
	CONNECTIONS				

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PLUMBING

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	PIPE				
5.	USE TRANSITE OR GLASS PIPE				
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70.	CHECK INSTALLATIONS FOR BY-PASS				
	CONNECTIONS				

NAME_____ OCCUPATION_____ AGENCY_____

STUDENT'S DAILY RECORD

Date	List the Job Numbers Performed the Previous afternoon	List the References Read in the Related Class by Symbols and Pages	List the Number of the Job Studied Today

JOB NO. 1

USE BRASS PIPE AND FITTINGS

RIP: 1-3
HDI: 41

1. What is brass?

2. Why is lead often added when making brass?

3. Why is brass pipe used extensively for waste installations?

4. What distance apart must supports be placed when using brass pipe?

5. What pressures will brass pipe withstand?

6. How may brass pipe be bent?

7. Why are bronze silbraze fittings often used with brass pipe?

8. Why should friction vises and wrenches be used to hold and turn brass pipe?

9. Why is the standard weight brass fitting not satisfactory for high quality jobs?

10. What are the five advantages to using silver solder joints?

JOB NO. 2

USE COPPER TUBING AND FITTINGS

HDI: 225
RIP: 5-9

1. Why have many cities quit using copper pipe with its service water supply?

2. For how many years has copper tubing been in use?

3. What are the advantages of copper tubing over wrought iron or steel?

4. Why must more space be allowed for copper tubing than for iron or steel?

5. For what purpose is soft copper tubing used?

6. What are the three types of copper tubing?

7. Why are all soft copper joints outside buildings flared?

8. What kinds of fittings may be used on copper tubing?

9. What kind of fitting is used to connect copper tubing to threaded pipes or equipment?

10. How are flared fittings jointed to form a water tight joint?

11. On what pipes may soft solder be used?

JOB NO. 3

USE LEAD PIPE AND CONNECTIONS

RIP: 13-14
HDI: 225-226

1. Why do few cities use lead pipe for water service?

2. Describe lead used in plumbing.

3. Why is lead pipe used for short connections between plumbing fixtures and waste pipes?

4. Why is lead pipe never used for conveying soft water which is to be used for drinking?

5. Why is lead pipe used for the waste pipes of chemical plants?

6. How are dents removed from lead pipe?

7. What are the advantages of lead pipe?

8. What is used to join lead pipe to cast iron soil pipe?

9. What is used to connect lead pipe to wrought iron?

10. How are connections made from lead pipe to a screwed pipe?

JOB NO. 4

USE PLASTIC OR BITUMINIZED FIBER PIPE RIP: 16-22

1. From what is plastic pipe made?

2. For what may plastic pipe be used?

3. How is plastic pipe joined?

4. What are the advantages and disadvantages of plastic pipe?

5. How are plastic pipes threaded?

6. How is bituminized fiber pipe made?

7. How is fiber pipe installed?

8. What is used to attach fiber pipe to clay, soil or screw pipe?

9. For what is fiber pipe recommended?

10. How are screw fittings on hard plastic pipe tightened?

JOB NO. 5

USE TRANSITE OR GLASS PIPE RIP: 23-24

1. From what materials is transite pipe made?

2. For what is glass pipe being used today?

3. How is transite pipe cut?

4. How may transite pipe be joined to cast iron or vitrified clay pipe?

5. What are the advantages of pyrex glass pipe?

6. What temperature will pyrex glass pipe resist?

7. What can be done to prevent having to cut glass pipe and shaping the ends?

8. How are pyrex pipe and fittings joined?

9. Why should glass pipe be handled carefully to prevent it from being nicked or scratched?

10. What can be done to protect pyrex glass pipe from damage by pressure surges?

11. What should be used to connect glass pipe to equipment where vibration occurs?

12. How are joints in glass pipe tested to be sure they are tight?

13. What precautions should be taken when working on pipe that carries acid?

JOB NO. 6

READ BLUEPRINTS-PLOT PLANS

HDI: 374, Plate 1 of Blueprints
BRS: 1-2, Blueprint 1/7

1. When an architect makes out his plans, which he conveys to the workmen, what do these plans include?

2. Why is it necessary for a plumber to study the architect's plans?

3. A plumber sometimes draws a mechanical plan to show piping. How is this done and what information is given on it?

4. On Plot Plan 1/7, in back packet BRS, what are the dimensions of the lot?

ANSWER THE FOLLOWING QUESTIONS ON THE PLOT PLAN, PLATE 1 OF THE BLUEPRINTS FURNISHED WITH REFERENCE HDI.

5. In which direction does the lot face?

6. What are the dimensions of the lot?

7. What scale was used for the drawing?

8. Give the location of the sanitary sewer.

9. Give the measurements locating the foundation on the lot.

10. What driveway construction and width is shown?

11. Give the horizontal distance from the near side of the dwelling to the sanitary sewer.

12. Are any indications given as to the elevation and slope of the lot?

13. What is the horizontal distance from the property line to the sanitary sewer?

14. On what street is the lot located?

JOB NO. 7

READ BLUEPRINTS-BASEMENT PLANS

HDI: Plate # 2, 374
BRS: 9-11

1. Why would a laundry tray not be included in a basement plan as it usually shows?

2. Where is the description and details of a laundry tray found in the architects plans?

3. In figure 10, page 11, BRS, what is the width of the footing for the concrete wall?

4. What are the inside diminsions of the rectangular laundry room in figure 10, page 11, BRS?

ANSWER THE FOLLOWING QUESTIONS ON THE BASEMENT PLAN, PLATE # 2 OF THE BLUEPRINTS FURNISHED WITH REFERENCE HDI.

5. What rooms are in the basement?

6. Name the plumbing fixtures to be installed in the basement?

7. How many outside hose bibs are shown?

8. Of what materials are the main foundation walls made? How wide are the walls?

9. What material is used for the porch and area foundations? How reinforced?

10. What is the size and spacing of the floor joists?

11. What material is used for the house drain?

12. What size is the main run of the house drain?

13. The kitchen sink and laundry tubs have what size drains?

14. What size branch is the laundry floor drain?

15. What is the construction of the sump discharge?

16. Where does the storm drain terminate? What type of pipe is used?

JOB NO. 7 CONTINUED

17. Give the locations of light fixtures in the basement?

18. Does the door to the laundry room swing in or out? The vegetable room? The fruit room?

19. What type basement floor is shown?

20. Give the inside dimensions of the garage?

21. What size basement windows are shown on the west side?

22. How does the laundry room differ from the other basement doors?

23. Two motors are shown. For what are they used?

JOB NO. 8

READ BLUEPRINTS - FLOOR PLANS

BRS: 12-17
HDI: Blueprints Plates 3-4, 374

1. How are sinks, ranges and refrigerators identified on floor plans?

2. Show in a sketch a double compartment sink and symbol.

3. According to the floor plan blueprint 3/7, found in packet back page, BRS, what is used for the floor covering in the kitchen?

ANSWER THE FOLLOWING QUESTIONS ON THE FLOOR PLANS, PLATES 3 AND 4 OF THE BLUEPRINTS FURNISHED WITH REFERENCE HDI.

4. What fixtures does the first floor bath have?

5. What type floor does it have?

6. What fixtures are located in the second floor bathroom?

7. What type floor does it have?

8. Why are 6" studs used in the bathrooms?

9. What size floor joists are used? How spaced?

10. What size ceiling joists are used on the second floor? How spaced?

11. Does the kitchen sink have a right or left hand drainboard?

12. What type walls does the kitchen have?

13. Give a brief description of the heat circulating arrangement as shown on the floor plans.

14. How many risers does the main stair have? The basement stair?

15. Is there a room over the garage? For what use?

JOB NO. 8 CONTINUED

16. Is the garage floor level?

17. How many steps are there from the garage door to the floor?

18. What kind of door does the small garage entrance have?

19. What size gas vent does the stove have?

20. What is the size of the bathtub?

JOB NO. 9

READ BLUEPRINTS - ELEVATION AND ROOF PLANS

HDI: Blueprints Plates 5,6,7,8
BRS: Blueprints 5/7; 6/7

1. On blueprints 6/7, what is the distance from the center of the cupolia to the north west wall or left side of the house of the blueprint.

2. In blueprint 5/7 staff section, what distance does the garage cornice hang over the wall?

3. In blueprint 5/7 staff section, what size lumber is designated for the rafters?

ANSWER THE FOLLOWING QUESTIONS ON THE ELEVATION AND ROOF PLANS, PLATES 5,6,7,8 OF THE BLUEPRINTS FURNISHED WITH REFERENCE HDI.

4. Give the dimensions of the concrete footing.

5. What is the height of the cement block part of the foundation?

6. What outside finish is given the cement blocks?

7. What materials are used for the outside walls?

8. Give the pitch of the roof.

9. What material is used for the roof?

10. How are the inside walls finished?

11. What is the difference in elevation of the second floor and the storage room?

12. The roof drain conductors are of what size?

13. Toward which end of the lot does the finished grade slope? Toward which side?

14. How many windows are shown on the south side of the garage?

JOB NO. 9 CONTINUED

15. What is the size of the coal chute opening?

16. What is the purpose of the two areaways?

17. How are the areaways drained?

18. What will be the approximate depth of the house drain below the finished grade at the point of connection to the house sewer?

JOB NO. 10

SCALE MEASUREMENTS

BRS: 6
HDI: Blueprints, Plates 1 & 2, 374.

1. What is the purpose of a scale drawing?

2. What are two things a plumber should be able to do with an architects scale?

3. How is the architects scale usually measured when on the job?

ANSWER THE FOLLOWING QUESTIONS ON THE BLUEPRINT PLATES 1 & 2, FURNISHED WITH THE REFERENCE HDI.

4. Scale and record the length of the 4" cast iron house drain from the 4" soil pipe to the point of connection to the 4" crock house sewer.

5. Give the scale lengths of the two 3" branches serving the floor drains.

6. What is the length of the 4" drain branch to the water softener?

7. Scale and record the 4" and the 2" pipes on the branch to the laundry tubs and kitchen sink. (Note: The sink drain is 4" to the wall.)

8. What is the total scaled length of 4" pipe and fittings? 3" pipe and fittings? 2" pipe and fittings?

9. What is the scaled distance from the service sink to the water softener?

10. Give the total scaled length, as accurately as possible, of the 4" crock outside drain to the fitting at the northwest corner.

JOB NO. 11

SOLVE PROBLEMS OF MEASUREMENT APS NO. ONE: 2633-2661

1. Add the following dimensions:

(a)	(b)	(c)	(d)
6"	67 2/5"	4.2 meters	3' 6"
3 1/2"	5/8"	12.15 meters	8"
11 5/8"	21 1/4"	.02 meters	12' 1"
		10. meters	

2. Subtract the following:

(a) 1116 - 24 (b) 11.16 - 2.4 (c) 1/2 - 1/4, 7/8 - 3/4, 3/4 - 1/2

(d) 2 1/4 - 3/4, 6 7/8 - 3 1/2, 6 15/16 - 5

(e) 12' - 6" from 48' - 1"

(f) 2' - 8" from 4' - 3"

3. Multiply the following:

(a) 116 x 26, 120 x 1.8

(b) 48.1 x 6.7, 32.6 x 4

(c) 1/6 x 3/4, 1/2 x 1/2, 7/8 x 2/3

(d) 2 1/2 x 2 1/2, 6 3/4 x 24, 1/2 x 3 2/3

(e) 6' - 5" by 8, 9" by 2

(f) 12 sq ft. by 6

4. Divide the following:

(a) 108 by 9, 4 by 8

(b) 4.8 by 2.4, 12.1 by 1.1, 143.62 by 7.6

(c) 1/2 by 2/3, 3/4 by 7/8, 15/16 by 5

(d) 2 3/4 by 1 1/2, 12 2/3 by 3 3/4, 9 7/8 by 3/4

(e) 16' - 8" by 4, 24' - 6" by 6

5. A rectangular building has a foundation 50' - 6" by 25' - 6". What is the distance around the foundation?

JOB NO. 11 CONTINUED

6. Four pieces of water pipe, each 4' - 2" long are to be cut from a 20' - 0" length. Disregarding cutting loss, what length pipe is left?

7. A city sewer having a grade, or fall or pitch of 1/64" per foot will have a total fall of how many feet in a mile?

8. The weight of extra heavy cast iron pipe is approximately 65 pounds per 5 foot length. How many lengths will weigh approximately one ton?

9. A local code specifies that 1 1/2" extra light lead pipe shall weigh not less than 3 pounds 8 ounces per lineal foot. What is the weight of 100 feet of such pipe?

10. For calking lead joints, the local code requires 12 ounces of lead per inch of pipe diameter. How many pounds will be required to calk 56 four-inch and 21 two-inch joints?

JOB NO. 12

SOLVE PROBLEMS OF MEASUREMENT OF AREAS APS NO. 1: Chapter 102

1. Give the rule for finding the area of a square or a rectangle.

2. What is the floor area of a 10 x 12 foot room?

3. A hot air vent measures 18" x 24". How many square feet does a cross-section contain?

4. A space contains 576 sq. in. How many sq. feet does it contain?

5. An area of 54 sq. ft. contains how many sq. yards?

6. A circle has a diameter of 6 feet. What is the radius? The circumference? The area?

7. The cross-sectional area of a 4" pipe is how many times the same area of a 2" pipe?

8. A storage tank measures 10' - 0" in length and 3' - 0" in diameter, outside measurements. What is the radiating surface or outside area in sq. feet?

9. Copper sheet weighing 18 oz. per sq. foot is used to line inside an open top wood tank. The inside measurements of the tank are 6' - 0" diameter and 4' - 0" height. What weight of copper sheet is required?

10. For lead safing the bottom of a tile shower stall, a 3 foot square pan with 6" sides is made. If a 4 foot square sheet is used, how much of the sheet is waste?

11. The area of a triangular surface is to be found. The base of the triangle measures 10' - 6" and the height, 6' - 9". What is the area in square feet?

12. In finding the area of an irregular surface, it was necessary to divide the surface into a 12 foot square and two triangles having 4 and 6 foot bases and 6 and 8 ft. altitudes respectively. What is the total area?

13. What is the area of a ring having an outside diameter of 8 inches and an inside diameter of 3 1/2 inches?

JOB NO. 12 CONTINUED

14. A circle contains how many degrees?

15. The sum of all the angles of a triangle equals how many degrees?

16. Two angles of a triangle are 90 and 45 degrees respectively. What is the size of the other angle?

17. Find the square of the following numbers: 6, 12, 14.7, 1.5.

18. From your table on squares and square roots give the square roots of the following: 18, 3, 98.

19. The legs of a right triangle measure 3" and 4" respectively. What is the length of the hypothenuse?

20. The hypothenuse of a right triangle is 10 feet and one leg is 8 feet. What is the length of the other leg?

JOB NO. 13

SOLVE PROBLEMS OF CUBIC MEASURE
AND VOLUME

APS NO.ONE: Chapter 102

1. A rectangular water tank measures 4' - 0" by 6' -0" inside base measurements and is 5' - 0" high. What is its capacity in gallons?

2. The inside measurements of a basement sump are 13" by 19" and the pump starts when the water reaches a level of 15". How many gallons are in the sump when the pump starts?

3. How many cubic yards of dirt are removed in digging a 50 foot ditch, 2 feet wide with an average depth of 18 inches?

4. A water bill reading in hundreds of cubic feet of water used had a reading of 130 at the beginning of a 3-month period, and at the end of the period read 400. How many gallons of water were used furing the period?

5. A house tank weighing 300 pounds has an inside diameter of 6 feet. What is the total weight to be supported when the depth of water in the tank is 3 feet?

6. What is the capacity in gallons of a hot water storage tank having an inside diameter of 4 feet and a length of 6 feet?

7. A 4 inch pipe 16' - 4" long will hold how many gallons of water?

8. What is the weight of a cast iron ball or sphere 4 inches in diameter? The weight of cast iron is approximately .26 pounds per cubic inch.

JOB NO. 14

SOLVE PROBLEMS OF COSTS AND PERCENTAGES

APS NO. 1: Chapter 102

1. A shipment of fixtures was billed in the amount of $1142.80. If a discount of 42 percent was allowed, what was the net amount of the bill?

2. On a repair job, one man worked 10 1/2 hours at $1.75 per hour and another 16 hours at $1.125 per hour. If the cost of material for the job was $21.10, what percent of the total was spent for labor? For materials?

3. A wiping solder is composed of 57 percent lead and 43 percent tin. How many pounds of each are in 13 1/2 pounds of solder?

4. A storage shed was built on the back of a shop for storage of pipe, fittings, and tools. The bill of material included the following lumber and other materials:

   40' - 4 x 4 @ $70 per M
   250' - 2 x 4 @ $78 per M
   250 board feet # 3 1 x 6 decking @ $ 60 per M
   2 squares roll roofing @ $4.80 per square
   15 lbs nails @ 7 1/2 cents per lb.

   What was the total material cost for this job?

5. A contractor's audit showed a net profit of 8.2 percent on a $62,487.15 volume of business. What was his income?

6. A 6.4 percent net profit giving an income of $8264.96 would represent how much gross business?

7. The cost installed of a kitchen sink was $160.00. What percent of the cost went for labor if $122.50 was paid for the sink?

8. A contractor receives a discount of 40% and 10%, if payment is made within 15 days. What would the net be on a $100 purchase if both discounts applied?

JOB NO. 15

STUDY JOB PLUMBING SPECIFICATIONS HDI: 375-380

1. Give the purpose of written specification for a plumbing job.

2. In what form are specifications shown on blueprints?

3. By whom are specifications written?

4. What protection is afforded the owner against violation of laws through improper installation or construction in the sample specifications?

5. What are the requirements for cast iron joints and clay pipe joints in the sample specifications?

6. Are the appliances and fixtures to be installed specified exactly and in detail, or just in general terms?

7. What main points are covered in the specifications regarding underground pipe?

8. What main points are covered on the installation of piping inside the house?

9. Does acceptance of the sample job obligate the contractor to cooperate with other trades and to use the best in materials?

10. Where can the quality, kind and manufacturer of an item to be installed be found?

11. Where can a plumber obtain a copy of the general conditions of the contract?

JOB NO. 16

CALCULATE CUTTING MEASUREMENTS FOR STANDARD WEIGHT PIPE

PPM: 20, 171
Dictionary

1. What are the three weights of pipes?

2. What determines the weight of pipe to be used?

3. Why are the outside diameters of the three weights of 1 inch pipe the same?

4. Upon what is the nominal or name size of pipe based?

5. Why do American National Pipe threads have a slight taper? How much taper per inch?

6. Why will a properly threaded pipe turn by hand 3 to 4 threads into a fitting?

USING DATA # 1, page 171, PPM, ANSWER THE FOLLOWING QUESTIONS.

7. Compute the maximum clearance between a 3/4" pipe and the wood auger hole.

8. Compute the same for 1", 2-1/2", and 6" pipe.

9. What is a tap drill? Why is it smaller than the O.D. of the pipe?

10. How far will a 2-1/2" pipe advance into a fitting with one full turn?

11. How far will a 1" pipe advance into a fitting with one full turn?

JOB NO. 17

CALUCLATE CUTTING MEASUREMENTS WITH ALLOWANCE FOR FITTINGS

PPM: 22-23, 172-175

1. The length to cut threaded pipe cannot be measured directly, why?

2. Define the following:

   (a) End to end.
   (b) End to center.
   (c) Center to center.
   (d) Center to back.
   (e) Center to throat.
   (f) Face to face.
   (g) Back to back.

3. Where is pipe length measured?

4. Why is on the job measurement of fittings necessary?

5. Solve problems 1 through 5 on page 23, PPM.

JOB NO. 18

CALCULATE CAST IRON ASSEMBLIES WITH 1/4 BEND PPM: 67-71
Appendix

1. How are cast iron pipe connections made?

2. Complete Unit 24 assignments 1 - 5 on page 68, PPM.

3. How many ounces of lead and oakum are used to join cast iron pipes?

4. Why does estimating practice generally specify one pound of lead for each inch of diameter of pipe?

5. Complete Unit 25, assigment 1 page 69, PPM.

6. What is the angle of a 1/4 bend cast iron pipe?

7. What is the angle of a 1/32 bend cast iron pipe?

8. What is the difference between the long center and the short center of a bend?

9. Complete Unit 26 assignment, page 71, PPM. Include amount of oakum required.

JOB NO. 19

ANGLES IN PLUMBING

PPM: 1-19, 26-29
Appendix
Square Root Table

1. How is the fitting angle measured?

2. How is the complimentary angle found? Give the formula.

3. Give and explain the formula for finding a bend.

4. Complete Unit 10 assignments 1 - 4, page 27, PPM.

5. To what does the term offset refer?

6. How is the offset distance determined for two parallel pipes?

7. Why is the diagonal construction preferred to the 90 degree fittings?

8. What is meant by a diagonal?

9. What is meant by rise and run?

10. Complete Unit 11 assignments, page 29, PPM.

11. What is meant by taking the square root of a number?

12. What is the hypotenuse and what is it called in Plumbing?

13. Complete the assignments, A & B, page 13, PPM.

JOB NO. 20

SOLVING FOR CONSTANTS AND PIPE LENGTH PPM: 30-51, 172, 176-178

1. Why are diagonals and offsets said to be proportional?

2. What is a constant?

3. With how many fitting angles may a certain constant be used?

4. What are the constants for a 45 degree angle?

5. Complete assignment 2, page 31, PPM.

6. What are the constants for a 60 degree angle?

7. How are pipe lengths found using the diagonal?

8. Complete Unit 13, assignments 1-10, page 33, PPM.

JOB NO. 21

CALCULATE CAST IRON ASSEMBLIES WITH 1/6 AND VARIOUS BENDS

PPM: 72-78
Appendix

1. Complete Unit 27 assignment, page 73, PPM.

2. Complete Unit 27 assignment, page 74, PPM.

3. Complete Unit 27 assignment, page 75, PPM.

JOB NO. 22

SOLVE PROBLEMS OF GRADE, DROP, AND RUN PPM: 88-94

1. What is grade?

2. What is drop?

3. What is run?

4. Give the formula for finding drop.

5. Give the formula for finding grade.

6. Complete Unit 32 assignments 1 - 8, page 89, PPM.

7. Complete Unit 33 assignment, page 91, PPM.

8. What is the "bench mark"?

9. Complete Unit 34 assignments A - D, page 94, PPM.

JOB NO. 23

MAKE ISOMETRIC DRAWINGS BRS: 32-34

1. What is an isometric drawing?

2. Why are isometric drawings necessary?

3. Why has the plumbing trade adopted the isometric system?

4. What rules are followed in isometric drawings?

5. What happens to the length of the lines when changed from the orthographic drawing to the isometric drawing?

6. Make an isometric drawing of a brick 8" x 3 3/4" X 2 1/4". Make each line full size, but do not dimension the drawing.

7. A bathroom is 5' wide, 8' long, and 7'-6" high. Make an isometric drawing of this shape to a scale of 1/2" equal 1'. Line should be drawn accurately but need not be dimensioned.

8. Practice similar projects until you have mastered the isometric representation of the rectangular solid.

USE THE FOLLOWING DRAWING PAPER.

JOB NO. 24

DRAW ISOMETRIC PIPE DIAGRAMS BRS: 35-38

1. In what three ways can an isometric drawing be made so the plumber may look into the room?

2. How does a plumber think of a 45 degree angle?

3. How is a 45 degree angle drawn in isometrics?

4. Draw an isometric pipe diagram similar to figure 41, page 38, BRS, except that all fittings are to be 45 degree instead of 90 degree as shown.

5. Draw a room 8'-0" X 10'-0" X 7'-6" high in an isometric representation with ceiling and two walls removed. Use a scale of 1/4" equals 1'. Show walls as 6" thick.

USE FOLLOWING DRAWING PAPER.

JOB NO. 25

DIMENSIONING OF ISOMETRIC DRAWINGS BRS: 39-40

1. Why is it more difficult to dimension the isometric drawing than the orthographic drawing?

2. What should be referred to in making the isometric pipe diagram?

3. Re-draw the pipe diagram of page 40, BRS, figure 43, as an isometric pipe layout. Check to see that the lengths are to scale and dimension the pipe size. Make a list of fittings and pipe required.

JOB NO. 26

MAKE A DRAWING OF WASTE AND VENT FOR KITCHEN SINK BRS: 41-42

1. Where is the waste stack when a sink is installed under a window?

2. To what is the sink trap connected?

3. What size pipe is usually required by the Plumbing Code for the waste line pipe?

4. What size pipe may be used for the vent?

5. What size is the vent at the roof and above? Why?

6. How far above the roof does the vent extend?

7. How is provision made for a cleanout?

8. What size should the house drain pipe under the cellar be?

9. Complete assignments 1 - 4, page 42, BRS.

USE THE FOLLOWING DRAWING PAPER

JOB NO. 27

MAKE A DRAWING OF WASTE AND VENT FOR TWO LAVATORIES

BRS: 43-44

1. What determines the pipe size of Waste Stack for two lavatories?

2. What size pipe and how long can each horizontal run or branch be?

3. Complete assignments 1 - 3, page 44, BRS.

USE THE FOLLOWING DRAWING PAPER

JOB NO. 28

MAKE A DRAWING OF THREE LAVATORIES TO A SINGLE STACK

BRS: 45-48

1. When is a back vent used and how are the pipes run?

2. Complete assignments 1 - 4, pages 46, 47, and 48, BRS.

JOB NO. 29

MAKE A DRAWING OF SOIL STACK, WASTE AND VENT PIPING FOR WATER CLOSET AND LAVATORY

BRS: 49-53

1. To what is the closet bend connected?

2. What is the minimum size soil stack?

3. Why is the tapped tee used?

4. Distinguish between the soil stack and the waste stack.

5. How may other fixtures such as lavatories be connected to a soil stack?

6. What is used to make the last connection in the loop formed by the lavatory waste and vent piping?

7. What size should the house drain be?

8. What is wet venting?

9. Complete assignments 1 - 3, page 52, BRS.

USE THE FOLLOWING DRAWING PAPER

JOB NO. 30

MAKE A DRAWING OF A THREE FIXTURE BATH ON ONE WALL BRS: 54-

1. Why have all fixtures on one wall?

2. When three fixtures are located on one wall where is the stack located?

3. When the water closet is the end fixture in the bathroom, what size waste pipe is required for the tub and lavatory

4. May the water closet be wet vented in the three fixture bath? If so, how?

5. Complete assignments 1 - 3, page 56, BRS.

USE THE FOLLOWING DRAWING PAPER

JOB NO. 31

MAKE A DRAWING OF BATHROOM FIXTURES ON OPPOSITE WALLS BRS: 58-59

1. Why is this kind of bathroom set-up easier for the first floor than the second floor?

2. What is a drum trap and where is it used?

3. Why must vent piping be installed in the wall rather than in the floor?

4. Why is it better to have piping in inside partitions rather than outside walls?

5. Complete assignment 1, page 59, BRS.

USE THE FOLLOWING DRAWING PAPER

JOB NO. 32

MAKE A DRAWING OF A FOUR FIXTURE BATH BRS: 60-61

1. What may be used as the fourth fixture in a bathroom?

2. Complete assignment 1, page 60, BRS.

USE THE FOLLOWING DRAWING PAPER

JOB NO. 33

MAKE A DRAWING OF TWO BATHROOMS BACK TO BACK BRS: 62-64

1. If the waste line for two tubs is combined, what size pipe is used?

2. Complete assignments 1 - 2, page 63, BRS.

USE THE FOLLOWING DRAWING PAPER

JOB NO. 34

MAKE A DRAWING OF BATHROOM AND KITCHEN FIXTURES INTO ONE STACK

BRS: 65-67

1. How many stacks are needed when the bathroom and kitchen fixtures are combined? What size?

2. What determines whether the waste pipe will be 1 1/2" or 2"?

3. Complete assignments 1 and 2, page 65, BRS.

USE THE FOLLOWING DRAWING PAPER

JOB NO. 35

INSTALL A SEPTIC SERVICE HDI: 20-27

1. Why must the contour and character of the soil first be considered?

2. Why should the septic system be installed close to the surface of the soil?

3. What is the septic tank's purpose?

4. Of what does raw sewage consist?

5. Of what is a septic tank constructed?

6. What is the minimum size of a septic tank for a family of six people?

7. Where should the septic tank be located?

8. What three objectives does the purification unit of a septic system accomplish?

9. Why should a person be careful when entering a septic tank to make repairs or clean?

10. List the types of gases produced in a septic tank.

JOB NO. 36

INSTALL A DISTRIBUTION FIELD FOR A SEPTIC TANK

BRS: 70
HDI: 30-32

1. Using the Residental Blueprint Number 1/7; what is the length of outflow line from the septic tank to the distribution box?

2. In what types of subsoil may the distribution field be used?

3. How many feet of tile should be used for each person?

4. What should be placed at the end of each distribution field?

5. Why should a siphon compartment be used on some large septic tanks?

6. What is the function of the distribution box?

7. Of what should the distribution box be constructed?

8. Give three different designs of a distribution field?

9. How many outlets should lead from the distribution box to the disposal field?

10. Where is the distribution box located?

JOB NO. 37

EXCAVATE FOR SEWERS

RIP: 20-22
HDI: 53-61
APS-2: 1556, 3121

1. Of what is a bituminized fiber sewer pipe made?

2. Why should the plumber take pride in his work and fit the joints carefully?

3. What is the minimum size house sewer constructed of clay pipe?

4. What is the recommended slope for the house drain and house sewer?

5. What is a house sewer?

6. What type of pipe should be used in soil of an unstable nature?

7. How can additional grade be made?

8. What precautions should be taken when laying a house sewer in clay soil?

9. What are the causes of sewer obstructions?

10. How may sewer obstructions be prevented?

JOB NO. 38

CONNECT A HOUSE SEWER TO A STREET SEWER

HDI: 53-61
APS: 3055

1. Describe how a connection into a concrete main sewer should be made.

2. What precaution must be taken when connecting to a concrete main?

3. Name the three types of sewers.

4. Why should the sleeve in a concrete main be flush with the sides?

5. At what angle should the house sewer run into the main sewer?

6. How should the house sewer be connected to a brick sewer?

7. How should a house sewer be connected to a vitrified clay sewer?

8. How may a new Y be inserted in a public sewer?

9. How can a slant connection be used to make a new connection into a vitrified clay sewer?

10. Why is a back water valve sometimes used on a house sewer?

JOB NO. 39

PLAN A RESIDENCE HOUSE DRAIN

APS: 3056
HDI: 63-74

1. What is the house drain?

2. What materials are used in a house drain?

3. What are the four calssifications of house drains?

4. What is the oldest form of house drain?

5. What type drain is most commonly used today?

6. What is equipped with cleanouts?

7. Why should care be taken when backfilling around a vitrified clay house drain?

8. How much pitch or fall should a house drain have?

9. What is the fresh air inlet pipe?

10. What depth should a vitrified clay sewer pipe be below the ground level?

JOB NO. 40

INSTALL PIPE FOR A HOUSE DRAIN HDI: 63-74

1. What is the house drain?

2. What material can be used in the construction of a house drain?

3. List the types of drains and give the use of each:

4. Why are cleanouts necessary in the house drain?

5. Where should the cleanouts be installed?

6. Why should the house drain have a correct amount of pitch on it?

7. Why are fixture units important to the plumber?

8. Why should change of directions of the house drain be made with fittings of long radius fittings?

9. How should pipe for the house drain be laid?

10. Why should care be taken in backfilling the trenches of the clay house drain?

JOB NO. 41

INSTALL SOIL PIPE HDI: 107-124

1. What is soil pipe?

2. Why is careful workmanship necessary for installing soil pipes?

3. What size soil pipe is most commonly used?

4. What materials are used for soil pipes?

5. Why must joints on soil pipe be made substantial?

6. What is used to support soil pipe?

7. What is used to change the direction of soil pipe from the vertical to the horizontal?

8. What must be done for soil pipes that extend through the roof?

9. What can be done to protect the roof terminal from freezing?

10. What methods are used for connecting the soil pipe to the house drain?

JOB NO. 42

INSTALL A BACK-FLOW VALVE HDI: 76-78

1. What is the purpose of a back-flow valve?

2. Why is the back-flow valve used on the house drain?

3. Why is the balanced back-flow valve most commonly used?

4. Describe the construction of the balanced-valve.

5. Why should the unbalanced valve not be used?

6. Where may a back-flow valve be installed?

JOB NO. 43

INSTALL FLOOR DRAINS

HDI: 79-81
BRS: 9-10

1. Define a floor drain.

2. Why should every laundry room have a floor drain?

3. Where should the floor drain be located?

4. Why may a floor drain become a means of by-passing sewer air?

5. Describe the construction of a floor drain?

6. Why should every floor drain be supplied with running water?

7. Why should a strainer be fitted in the top of the drain?

8. Of what should the drain plate be constructed?

9. Draw the floor plan symbol for floor drain.

10. Give the locations and number of floor drains in BRS, page 11, Fig. 10.

JOB NO. 44

INSTALL A GARAGE CATCH BASIN HDI: 82-84

1. Why is the garage catch basin used?

2. What do the wastes from a garage contain?

3. Of what are the vitrified clay or concrete basins constructed?

4. Of what is the manufactured garage catch basin constructed?

5. Upon what does the efficiency of a garage catch basin depend?

6. Why should gasoline be prevented from entering the public sewer?

7. Why should the invert on the vitrified basin be placed close to the top?

8. How is sediment collected in the cast iron basin?

JOB NO. 45

INSTALL A SEWAGE EJECTOR HDI: 87-90

1. What is the depth of public sewers?

2. What is the most commonly used sewer ejector?

3. Of what is the impeller of the modern sewage ejector made?

4. To what is the house drain outlet connected?

5. Why are sewage ejectors needed?

6. What causes the electric motor which operates the ejector to automatically start and stop?

7. Why is a back flow valve used on the house drain?

JOB NO. 46

INSTALL A GREASE TRAP HDI: 91-94

1. Describe the construction of the earth-cooled grease basin.

2. In what two ways may the waste branch be connected to the concrete receptor?

3. In a larger grease tray , why are baffles and man holes used?

4. What is the main reason for using grease traps?

5. Describe the waste pipe.

6. What prevents waste water from entering directly into the grease compartment?

7. What will happen if the grease trap is neglected?

8. For what are water sealed inlets used?

9. What determines the size and design of interceptors?

JOB NO. 47

PLAN INSTALLATION OF A STORM DRAIN HDI: 95-106

1. How is the storm water disposed of?

2. Where does the water go after it leaves the plumbing fixtures?

3. What materials are used for the storm drain?

4. Where are inside storm drains located?

5. Where is the outside storm drain located?

6. Where is the over storm drain used?

7. Why is the grade of storm drains important?

8. How is the size of the drain determined?

9. Why does a roof with 45° pitch require a larger drain than a flat one?

10. How does the height of the building affect the size of drain needed?

JOB NO. 48

PIPE A BUILDING FOR DOMESTIC HOT WATER HDI: 291-298

1. Why must the upfeed and gravity return system be properly installed?

2. Upon what principle does the gravity return system operate?

3. Where must the heating unit and storage tank be placed on an upfeed and gravity return system?

4. What is the purpose of the circulating return main on the overhead feed system?

5. In what way should the hot water riser be connected to the distributing main in the upfeed and gravity system?

6. In what way is the horizontal riser branch connected into the main on an overhead system?

7. How is the hot water circulated in the pump circuit system?

8. What is the advantage of using a pump on the overhead and upfeed systems?

9. Where is the pump located in the pump circuit system?

10. How is a by-pass connected to the pump?

JOB NO. 49

INSTALL A WATER HEATER

HDI: 273-290
RIP: 140-143

1. When heat is applied to water, what is the results?

2. What is the boiling point of water?

3. Name the two types of hot water tanks.

4. Of what materials are range boilers made?

5. What determines the correct size of hot water tank?

6. What determines the working load of a hot water system?

7. Of what material is the water back constructed?

8. For what buildings is the coal heater mostly used?

9. What precaution must be observed on the underwater heater?

10. Why should the plumber and the home owner hot tamper with the setting of relief valves?

11. Why should a small water heating tank be set in a vertical position?

12. Where are the flow and return tappings usually located on a water heater?

13. Why must high temperature and pressure of a water heater be controlled?

14. When the cold water supply is connected to the top of the water heater, what must be done? Why?

15. Define B.T.U.

16. How could a person find the number of B.T.U. to raise water to a certain number of degrees?

17. Find the number of B.T.U. to heat 100 pounds of water 40 degrees.

18. Any hot water system is made up essentially of three elements. What are they?

JOB NO. 50

PIPE A RESIDENCE FOR COLD WATER

HDI: 249-254, 412-414
RIP: 71-75

1. To assure ample flow of water at plumbing fixtures, how should piping be laid out?

2. What must be done by the plumber before he can install the actual piping?

3. How is a water system tested after installation?

4. How many shutoff valves does a properly installed water system have?

5. In a small building, what size galvanized iron pipe is used for the basement main? Why?

6. What causes water pipes to sweat and how can this be corrected?

7. How and with what should a basement main be supported?

8. At what angles should connections be made to the main and its branches?

9. At what grade should water pipes be run?

10. When the water pressure to a water supply system is too great, what device and what type of this device is used to reduce the pressure?

11. What is water hammer, what causes it and how is it corrected?

12. Name and explain the two basic types of check valves.

13. Why is the insulation of the cold water distribution system so important?

JOB NO. 51

INSTALL A WATER SERVICE

HDI: 233-247
RIP: 62, 72
APS: 3001

1. What part of the plumbing system is the water service or house service?

2. Why must the water service to a house be installed correctly?

3. Why is the water main pressure and the size of the house service pipe essential factors in installing a house service?

4. Why should turns, offsets, and traps be avoided in a water service?

5. Why and how deep should a water service be placed in the ground?

6. What type of materials can be used for a water service?

7. How is the installation of the materials used for a water service governed?

8. What factors affect the size of the water service pipe?

9. With what brass materials do most municipal water departments supply the plumber? Why?

10. How can a water service be protected where it passes through a concrete wall or floor?

11. Why are meters a larger size than the pipe on which they are installed?

12. In a cast iron water service, what kind of oakum must be used? Why?

13. What effect does too much or too little street water pressure have on a plumbing system?

JOB NO. 52

INSPECT AND TEST ROUGHED-IN WORK HDI: 209-213

1. Why is the testing of a plumbing system necessary?

2. In the cast iron drain water test, what must be done before beginning the test?

3. What causes a test plug to seal an opening completely?

4. What must be done to a joint which is found to have a leak?

5. How are openings in clay pipe sealed for testing?

6. In an air test on a house drain, what amount of air pressure should be applied to a house drain?

7. Why should plumbing be tested by sections in a large building if a water test is used?

8. Why is the air test not as thorough as the water test?

9. Describe the smoke test of a plumbing system.

10. Explain the smoke machine and how it works.

JOB NO. 53

INSTALL VENTS FOR FIXTURES HDI: 182-195

1. What is a unit vent?

2. Why is the unit vent form of ventilation commonly applied to fixture traps serving apartment and hotel toilet rooms?

3. How is the size of the unit vent determined?

4. What is the main objection to using a short pattern tee?

5. What type of fitting should be used on water closets and fixtures of similar design? Why?

6. Define circuit ventilation.

7. What is the advantage of circuit venting?

8. What determines the correct size circuit vent?

9. What is a relief vent.

10. What size relief vent should be used?

11. What is a looped vent?

12. What is a local vent?

JOB NO. 54

MAKE INSTALLATION OF A MAIN VENT HDI: 169-177

1. What is the main vent?

2. Where is the main vent usually located?

3. What is the purpose of the main vent?

4. How is the size of the main vent determined?

5. What is an individual vent?

6. What is the most practical method of ventilating a fixture trap?

7. Why is it so important to use the proper size vent?

8. What materials are used in the construction of vent pipes?

9. Why is the grade so important?

10. Where are the vent pipes usually located?

JOB NO. 55

PLAN VENTING FOR AN INSTALLATION

APS: 3058, 3263
RIP: 103
BRS: 40-43

1. What is the object of the ventilation stack?

2. Why should ventilation stacks be increased in size before passing through the roof?

3. What are the two purposes of vent pipes?

4. How is the vent stack connected to the soil or waste stack?

5. What causes back pressure in a vent?

6. What determines the size of the vents?

7. Why must the vent pipe be increased in size before going through the roof?

8. How are pipe sizes measured?

9. What is the plumbing code?

10. What is the present tendency in plumbing?

JOB NO. 56

INSTALL FIXTURE TRAPS

HDI: 147-155
RIP: 124-126

1. What is a trap?

2. What is the basic function of a trap on a drainage system?

3. What are the terms used for some of the common styles of traps?

4. What are the two forms of water-sealed traps?

5. What is the water seal of a trap?

6. What advantage does the drum trap have over the P-trap?

7. What is the purpose of the bell trap?

8. What is the required size seal for drum traps?

9. Where shall the fixture trap be placed relative to its fixture?

10. What materials are used to construct traps?

11. There are two types of fixture traps used today; What are they?

12. Why is the "S" trap preferred over the "Drum" trap?

JOB NO. 57

ROUGH-IN WASTE BRANCHES FOR FIXTURES

APS: 3197-3294
RIP: 101-103
HDI: 132

1. Define roughing in.

2. What determines the location of the fixtures?

3. What are the most common materials used for the drainage system?

4. What are some of the things to consider in designing any drainage system?

5. What are the two methods of doing the roughing in work?

6. All the piping of any plumbing installation must be both water tight and air tight. There are several kinds of tests that should be made. What are the tests?

7. What is a waste stack?

8. What is a branch waste pipe?

9. Why must forty-five degree elbows be used to make an offset in a waste stack?

10. What is a branch from a toilet called?

11. Branch soil or waste pipes may be made of what material?

12. Waste pipe is classified in two ways. Name and describe each way.

JOB NO. 58

ROUGH-IN A MAIN STACK FOR A RESIDENCE

RIP: 97-99
BRS: 49
APS: 3197,3223

1. What is a stack?

2. How far does a stack extend through a roof?

3. What is the requirement for a stack running within 12 feet of a window door or airshaft?

4. Of what may stacks be constructed?

5. What two fittings are used to connect a water closet to a stack?

6. When a stack is installed first in the system, what should be done?

7. With what angle must offsets on stacks be made? Why?

8. At what angle must a stack enter the main drain?

9. In respect to fixtures such as a sink and tub, where should the stack be located? Why?

10. Define roughing-in.

11. How are stacks supported?

12. If a stack is in a wall 12 inches thick or larger, what must be done to it?

13. What must be done to stacks of less than 4 inches in cold climates? Why?

14. What kind of fitting should be used at the base of a stack? Why?

JOB NO. 59

PLAN A SOIL PIPE OR STACK INSTALLATION
FOR A RESIDENCE HDI: 108-125

1. What is the minimum diameter for a soil pipe?

2. What two materials are commonly used in a soil stack?

3. Why should the joints on the soil pipe be made in a substantial manner?

4. A "stack" is a vertical drain pipe. What is a "soil stack"?

5. How far above the roof should soil stacks extend?

6. Why are sanitary tees placed in stacks for branch connections?

7. Why are roof flanges placed around stacks where they pass through the roof?

8. What is a soil branch?

9. Why are cleanouts essential on the soil branch?

10. How should change of direction of the soil branch be made?

11. In whay way may the soil pipe installation be protected against freezing?

JOB NO. 60

INSTALL A PRESSURE PUMP

HDI: 256-260
APS: 4017

1. Name and describe the two kinds of pumps in common use today.

2. What is the scientific principle involved in the elevation of water?

3. Why is the lift of a common pump never greater than 27 feet?

4. Name the three types of piston pumps.

5. Why is it necessary to have an air chamber installed on piston pumps?

6. What is an air chamber?

7. What type of pump is most commonly used for the elevation of water in modern buildings?

8. What is the advantage of a centrifugal pump?

9. Describe the construction of a centrifugal pump.

10. Explain how the duplex piston pumps work.

11. How does the double action piston pump work?

12. Define a power pump.

13. How may pumps employed for water be classified?

JOB NO. 61

INSTALL OR REPAIR A COLD WATER SYSTEM
FOR A TALL BUILDING HDI: 263-270

1. What are the two types of water distribution systems which may be used for tall buildings?

2. What is the delivery agent which is used in the pressure system?

3. What are the advantages of the air (pneumatic) pressure system?

4. What is the scientific principle on which a pneumatic pressure system operates?

5. What are the four mechanical devices used on air pressure systems?

6. What is an overhead feed system of water supply?

7. What are the disadvantages in an overhead system of water supply?

8. What are the advantages contained in the cross connection installation?

9. What are the advantages of the air water system?

10. What controls the pressure on the well cylinder?

JOB NO. 62

SELECT AND INSTALL A WATER CLOSET

HDI: 331-334
BRS: 25
APS: 3461

1. What are two types of water closets used in standard plumbing installations?

2. Why is the jet closet not usually used in a domestic residence?

3. Why must the bathroom floor be swept clean before installing a water closet?

4. Why is it advisable to set the bowl on the closet flange temporarily before actually installing it?

5. How is the connection of the bowl and flange made water tight?

6. Why is wax recommended over putty for setting a bowl?

7. How is the tank containing the flush valve supported after it is connected to the bowl?

8. What device is used to flush a water closet?

9. What are the most common types of flush valves used on plumbing fixtures today?

10. With what must every flush valve be equipped?

11. Why are flush tanks less expensive to install than flush valves?

12. How does a closet tank receive its water supply?

13. Why is it essential that closet bowls be protected with an after fill tube?

14. Of what does the toilet combination consist?

15. What is the most important fixture of all sanitary appliances?

JOB NO. 63

SELECT AND INSTALL A LAVATORY

HDI: 343-347
APS: 3426

1. What are four types of lavatories or wash basins?

2. What is an adequate height for a wash basin and why is this height used?

3. What faucet is most commonly installed on a water supply to a lavatory?

4. Why are self-closing faucets used in commercial or public buildings rather than compression faucets?

5. Why is it necessary to get self-closing faucets properly installed?

6. What are three types of waste connections associated with lavatories?

7. What kind of trap should be installed on a lavatory and what size must it be?

8. When may the plumber set the lavatory?

9. How is a lavatory fastened to the wall?

10. How are the connections of the trap tailpieces made water tight to the fixture?

11. Name the two general classes of plug top.

JOB NO. 64

SELECT AND INSTALL A BATHTUB

APS: 3433-3437, 3449
HDI: 347-353
BRS: 15

1. What is the average size in feet of most bathtubs?

2. Bathtubs are made for several methods of delivering water. What are those methods?

3. Name the two general classes of bathtub waste connections.

4. Why should the bathtub have a smooth hard surface and a flat bottom?

5. Name the different types of bathtubs used in homes and hospitals today.

6. Why should the water supply device be installed above the rim of the bathtub?

7. Of what material should the combination waste and overflow be made?

8. What type lift waste is used with built-in bathtubs?

9. Why is venting so important in the installation of a bathtub?

10. What is the function of the trap when installing a bathtub?

11. What is the minimum size of a bathroom?

12. With respect to the disposition of the waste, shower baths are of two general classes. What are they?

JOB NO. 65

SELECT AND INSTALL A KITCHEN SINK HDI: 358-365

1. What are the two most common patterns of kitchen sinks?

2. Where should the kitchen sink be located?

3. What distinct features does the electric sink have over other sinks?

4. Why should dish-washing appliances not be directly connected to the drain?

5. What is the purpose of an air gap between washer and trap?

6. Why are steel cabinet kitchen sinks popular?

7. List three types of sink strainers.

8. How are strainers fastened to the sink?

9. How are cabinets with flat-rim sinks secured?

10. At what height should the sink be installed?

JOB NO. 66

INSTALL UTILITY OR COMMERCIAL SINKS HDI: 133,363-365

1. List two types of commercial sinks.

2. What is the primary purpose of a slop sink?

3. What 2 ways may slop sinks be trapped?

4. What size pipe does the slop sink use when the trap goes into the wall?

5. What size pipe does the slop sink use when the trap goes into the floor?

6. What is the purpose of scullery sinks?

7. What size waste pipe should be used on pantry sinks?

8. Of what are scullery sinks made?

9. What size waste pipe does a factory wash-up sink require?

10. What are the two types of faucets for sinks?

JOB NO. 67

UNSTOP CLOGGED DRAINS APS VOL. 2: 16-20

1. In what two ways may sewer lines be cleaned?

2. What tool is used for kitchen sinks and toilets?

3. What is the purpose of the hook-on cable?

4. How many feet will a motor driven cable clean in a sewer or pipe?

5. What is the purpose of the motor driven power rodder?

6. What size pipe will the power unit clean?

7. What size cable is used in the power driven snake rodding line?

ERIC

JOB NO. 68

GRIND AND SHARPEN CUTTING TOOLS

APS: 1301,1305-1306

1. At what angle should a firmer chisel be sharpened?

2. Which chisels are more easily sharpened?

3. Why should a chisel never be sharpened on the back or flat side?

4. In sharpening a chisel, how may best results be obtained?

5. What is the proper method for holding the chisel when honing?

6. How should the spur on an auger be sharpened?

7. How should the cutter be sharpened?

8. What kind of file is used for sharpening the worm?

9. What type of file is used for filing the lip?

JOB NO. 69

ROUGH-IN A BAR OR SODA FOUNTAIN INSTALLATION HDI: 137, 318

1. Where should the water supply line to a soda fountain be connected?

2. Why should the supply line never be returned to the underside of the washing equipment?

3. Why should cross-connections be avoided?

4. As a general rule, where is the waste pipe located?

5. What size pipe should be used for soda fountain waste?

6. Why does the soda fountain provide a dangerous type of cross-connection?

7. Where should the supply valve be located?

JOB NO. 70

CHECK INSTALLATIONS FOR BY-PASS CONNECTIONS RIP: 67-68

1. What is the purpose of a by-pass?

2. Name three pieces of equipment on which by-passes are used?

3. What care must be taken when the by-pass is used?

4. What kind of a valve should be placed on the by-pass?

5. Why are unions put in the by-pass and the mainline?

6. Draw a diagram showing how a by-pass is used.

7. When using a by-pass, how can you keep water or steam pressure from becoming excessive?

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ABSTRACT - This textbook was written by a state teacher trainer to provide a text for students with an occupational interest in weaving and design technology. Chapters are: (1) The Slashing Operation, (2) Drawing-in Operation, (3) The Weaver and Weaving Operation, (4) Essential Motions in the Loom and the Weaving Process, (5) Type of Looms, (6) Cloth Room, (7) Finishing Processes, (8) Designing Basic Weaves, (9) Designing Derivative Weaves, and (10) Cloth Analysis. Photographs and line drawings illustrate the text. (SB)

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WEAVING AND DESIGN TECHNOLOGY

L. R. BOOKER

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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This book was written by the late L. R. Booker, former State Teacher Trainer for Trade and Industrial Education, Clemson College, Clemson, South Carolina, and is reproduced by permission of the South Carolina State Department of Education.

ERIC

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Chapter I

THE SLASHING OPERATION

Slashing or sizing warp yarn is one of the most important operations in a textile plant where weaving is done. In the weaving process warp threads are kept under continuous tension and are subjected to considerable flaying or whipping action by different moving parts of the loom. One only needs to stand in front of a modern high speed loom while it is running to see that warp yarn takes an unusual amount of punishment.

To minimize the affect of the loom action on the threads, the warp is slashed or sized. This means that the warp threads are coated with a size preparation consisting mainly of starch. The starch provides a tough surface around the yarn and prevents excessive warp yarn breakage. This insures the plant of maximum production of woven goods.

All cotton warps are sized except those used in making heavy fabrics such as plied yarn duck and other industrial type fabrics.

Purpose of Sizing. As has been mentioned the chief purpose for sizing warp yarn is to reduce warp yarn breakage to a minimum and thereby increase loom production. It, however, accomplishes several other rather important objectives, among which are adding weight to fabric, giving the fabric proper feel, and increasing the tensile strength of the yarn.

Weight of the goods or fabric is considered essential unless it is to be bleached or dyed later. If the goods are sold directly in the grey (greige), the sizing imparts body or "feel" that causes it to be more salable.

To resist the action of the loom, sizing must bind fibers in the yarn together. This causes the individual fibers to adhere together, covers up certain minor defects in the yarn and gives the warp a smooth even appearance. To accomplish this purpose the size must penetrate into the yarn but not so much that it will make the yarn stiff and brittle.

Increasing the tensile strength means that it requires more pull to break warp threads. The coating of starch on the yarn gives considerable more strength to the yarn but will reduce its elongation or ability to stretch to a rather high degree. Research seems to find that sizing should not reduce elongation more than 25 per cent.

Sizing Ingredients

Size contains stiffeners, softeners, emulsifiers, lubricants, deliquescents or humectants, preservatives, fillers, water, and sometimes special ingredients to perform a specific purpose. All of these ingredients, used in varying proportions in a size mix, serve a necessary function in making good warps.

Starch. The chief ingredient of a size mix is starch. This is usually corn starch but potato starch may be and is used in some mixes. Starch imparts stiffness, provides most of the film coat around the yarn and protects the yarn from the abrasive action of the loom.

Attempts have been made to find a substitute for starch in size mix. Certain chemicals such as polyvinyl alcohol, resins or certain cellulose deriratives have been tried. Although these chemicals are more easily removed from the yarn in desizing operations in bleaching, they are more expensive. Up to now chemicals are used only in special applications.

Other film forming substances have also been used. These include gelatin, glue and vegetable gums such as gum tragacanth. Starch, however, still remains the main ingredient for coating yarn and giving it the desirable stiffness for weaving. Other ingredients must be used, however, in the size mix because starch and water alone would make an undesirable warp. The threads of such warp would be harsh, brittle, have limited flexibility, would have excessive shedding on the loom, and would feel harsh.

Softeners. Softeners give the yarn a soft feeling and, in addition, they cause the starch film to be more elastic and pliable. Softeners reduce brittleness and consequently less shedding is done on the loom.

There are any number of softeners on the market. The more common one is Japan wax. To put softeners in the yarn some kind of emulsifier must be used, such as soap or other water insoluble substance. At the same time lubricants are also put into the size mixture. The lubricants give a smooth surface to the yarn thereby reducing friction.

Frequently softeners, emulsifiers and lubricants are contained in a single substance to be added to the size mix. For example, sulphonated oil, emulsified tallow and emulsified tallow mineral oil combination serve all three purposes. Generally, however, textile

plants prefer using separate substances because a single compound has not proven too satisfactory. Paraffin wax and mineral oil are used widely when substances are not combined into a single compound.

Soap in the size mix acts as an emulsifier but it must be used in very small quantities; too much soap will weaken the starch film and cause excessive shedding of the warp on the loom. Soap has some softening properties but its main use is to incorporate other softeners and lubricants.

Mineral oil makes an excellent lubricant but has no softening properties whatever. On the other hand, glycerel is an excellent softener but does not lubricate.

Most textile plants through experience have found the most satisfactory substances and the correct proportion of each to obtain the size mix that best fits their operating condition.

Deliquescents or Humectants. Some kind of substance should be used with the starch to cause it to absorb and retain water. Humectants prevent the starch film from becoming too dry as the yarn passes over the drying cylinders, provided the work is running normally. The yarn should come from the cylinder with about 8 per cent moisture in it. This amount of moisture enables the yarn to retain satisfactory elasticity and flexibility properties. More than 8 per cent moisture may cause the yarn to mildew.

Several humectants are available for use, with ethylene glycol, glycerol and glucose being commonly used. However, calcium chloride, zinc chloride and magnesium chloride are also extensively used. Calcium chloride, a salt, is plentiful and cheap. Zinc chloride has the additional advantage of acting as a permanent preservative in preventing growth of fungi or the decomposition of the starch by bacterial action.

Preservatives. The size mixture usually contains some substance that will prevent mildew or bacteria on the yarn after it has been sized. If sizing conditions were always ideal, the warps stored in a dry place or put on looms immediately, a preservative would not be necessary. However, it is good practice to use preservatives because they protect the warp and are cheap.

Preservatives include sodium silicofluoride, zinc chloride, phenol, cresol and salts of salicylic or benzoic acid. Very little is used in the sizing mix, usually ranging from 0.1 to 2 per cent. It should be emphasized that preservatives prevent mildew under ordinary conditions but will not prevent it if warps are stored in places conducive to fungi growth.

Weighting Material. It is not often that weighting materials are used in sizing since they are used in the finishing process. Weighting materials add weight to the fabric. They are inorganic powders and their use may increase the weight of cotton goods from 25 to 200 per cent. They are held on the warp thread by the adhesive nature of the size.

The most commonly used weighting materials are China clay, falx and barium or calcium sulfate.

Water. It is important that the water supply be of the best for size mixtures. Quite often difficulties with sizing are caused by the kind of water used but it is usually the last factor checked. If the water is too soft, it will likely cause excessive foaming; this, in turn will result in uneven sizing and a warp that will give trouble on the loom. Agents are available to prevent or greatly reduce foaming but it is generally better to modify the mix or correct the water condition than to use antifoam agents.

Other Substances. Many other substances are sometimes added to the size mix. To obtain better penetration of the mix a wetting out agent is used. This is not necessary, however, if the viscosity of the mix is modified. A compound known as a starch stabilizer is often used in the size mix. This compound keeps the size mix in a liquid or paste condition.

Some plants make it a practice to make up batches of size mix and store it for future use. To do this starch is mixed with cold water to make a paste, and then heated until it becomes a gelatine. Further heating brings the mix to a rather constant viscosity. At this point heating is discontinued and the size stored for future use. While stored the mix should be kept at a temperature of about 200° F. and agitated slowly to prevent it from congealing. If it should congeal the mix must be thrown away because it would make a lumpy size mix and therefore be unsuitable for use. Starch stabilizers are used in the mix to prevent it congealing. It is advisable, however, to use such size mix within 24 hours or it may congeal even with the stabilizer if kept longer than that period of time.

Preparing the Size Mix

A great deal of care should be used in preparing size mix. A correct mix, insuring proper sizing of the warp yarn, is undoubtedly one of the most important processes in any textile plant doing weaving.

To mix the size cold water is run into the mixing kettle, the starch weighed and added to the water. The agitator must be running while this is done at about 60 r.p.m. The mixing of starch and water

should be thorough so that it will be free of lumps. It takes about 10 or 15 minutes to do this. Next the steam is turned on and the mix gradually heated.

If chemicals or enzymes are added to thin the mix, they should be added to the starch and water before other ingredients. It is essential that care be used to control the temperature when enzymes are used because excessively high temperature will destroy the action of the enzymes.

Other ingredients of the mix are added after the thinning chemicals or enzymes. In case thinning chemicals are not used, the other ingredients may be added as soon as the starch and water are heated. It is important that all ingredients be accurately measured or else the mix will not be of the quality desired for the best work.

Boiling. Ordinarily the mix should come to a boil in about 30 minutes. Boiling should be continued until the mix reaches the right thickness or viscosity. The amount of boiling time will vary according to the kind of starch used. Starches, other than Sago, however, boil about an hour to 1½ hours to reach the proper viscosity; Sago requires three or more hours.

Never run cold water into a size mix because it will cause congealing. If water must be added, do it in the mixing kettle with the agitator running and mixing continued for about ten minutes. When the size mix has cooked sufficiently it is run into the storage kettle. If there is still some mix in the storage kettle it is all right to run the new mix in with it.

Preparing the Mix. Large jacketed, copper-lined, nickel-plated or stainless steel kettles are used in preparing the size mix. The storage kettle is made of the same material. Mixing kettles and storage kettles should be thoroughly insulated in order to conserve heat and prevent the size from cooling and congealing. The mix should be kept at approximately 200° F. to insure good size.

The size of kettles vary a great deal but most plants running steadily use kettles of 160 gallon capacity. A large kettle makes size equally as well as smaller ones and batches do not have to be made as frequently. Actually the capacity of the mixing kettle is determined largely by the number of slashers to be served. Pipes leading to and from the kettle should be insulated. Pipe size should be 4 to 6 inches and the drain pipe should be flush with bottom of kettle. Mixing kettles have an open steam coil for heating the mix.

When the size mix has been cooked sufficiently it is pumped into a storage kettle, which should be large enough to hold two batches

from the mixing kettle. The mix is kept at a constant temperature of about 200° F. in the storage kettles. The heat is provided by closed steam coils to prevent dilution of the mix.

It is recommended that size mix not be kept over three hours. If kept longer than that the mix loses adhesive qualities and will not adhere to the yarn as well.

Cautions. The importance of observing exactly the direction for making a good size mix cannot be over-emphasized. Unless there is some stated reason for changing, each mix prepared should have the same weight of ingredients, the same amount of water, and have the same heating time.

Most textile plants have a favorite size mix with formulas for the exact amount of each ingredient. The kind of mix used is determined by the counts of the yarn, the color of the yarn, the twist of the yarn, how the fabric will be finished and to some extent the kind of weave.

As a general rule more softeners and lubricants are used in low count coarse yarn so it will remain partly elastic. Fine yarns require a rather hard smooth film. Very little softener is used in slashing fine yarn. Likewise, yarns of high twist require a thin size mix in order to obtain better penetration. Some yarns require that the twist be set to prevent excessive breakage. In this case thin mix is necessary and a minimum of softener is used. Transparent mix is used on colored yarn to prevent dulling the shade. Sizing put on fabrics that are to be bleached and dyed must be removed easily. Cloth of heavy construction, like good broadcloth, requires much better sizing than fabrics of light construction.

Formulas

It has been mentioned that textile plants have their favorite size mix. Such plants have determined by experience the particular formula that gives best results for the fabrics they weave. It would be impossible to discuss all the different formulas used. Most mills, however, make print cloth or broadcloth and it is generally accepted that a thin boiling starch must be used on such fabrics. A standard or basic formula for such fabrics would be as follows:

100 pounds of starch
6 pounds of softener
100 gallons of water
Disinfectant and penetrant added as needed

Slashing

Although slashing has been recognized all these years as one of the more important processes through which warp yarn must undergo, it has been only in comparatively recent years that study and research have been applied to the process. Few processes in a modern textile plant have been improved as much as slashing the last fifteen years.

The slasher consists of a creel, a size box with temperature controls, dryer cylinders, housing and exhaust system, moisture control indicator, separator rods, measuring clock, expansion comb, beam end and press roll.

Creel. The creel in which section beams containing warp yarn to be processed are placed upright, horizontal or of the magazine type. The upright creel is used when floor space is at a premium. In this type of creel the beams are placed in a vertical rack. The horizontal creel requires more floor space because the section beams are placed one behind the other in the creel at normal level. This type of creel has been in common use and has the advantage of permitting the slasher tender to load and get to the beams easily.

The magazine creel is essentially like the horizontal creel. It consists of two creels mounted on frames, which in turn are mounted on metal tracks. While one magazine is being used the other magazine can be prepared for use. The track enables the creel to be easily positioned behind the slasher. The magazine creel speeds up the slashing operation considerably. In addition, newer creels have anti-friction bearings on which the section beam spindles are seated causing them to revolve easily with little stretch of the yarn. Brakes are used to prevent the section beams from over-running.

Stretch Control. It is important that yarn stretch be minimized as it is pulled from the section beams. The amount of stretch in no case should exceed about 2 per cent. To control stretch of the yarn an assembly of rolls placed back of the size box is used. The roll assembly consists of a measuring roll 4 inches in diameter, a stretch control roll 9 inches in diameter, which is cloth covered, and a press roll 9 inches in diameter. The roll assembly has change gears so that the amount of stretch can be set to maintain a constant even specific stretch.

Size Boxes. Old slashes had only one size box but two size boxes are found in practically all plants today. The size boxes are made of jacketed copper or monel metal and are heavy and strong. One box sizes the top sheet of yarn and the other the lower sheet.

The size boxes contain an immersion roll, two heavy copper size rolls, 9 inches in diameter, running in sealed anti-friction bearings and a cast iron squeeze roll. The squeeze roll is covered with sheeting, felt or rubber.

The object of the squeeze roll is to force the penetration of the size into the yarn and to remove surplus size from the yarn. Improvement in this respect has been the feature of a piston, air cylinder and valve assembly used with the squeeze roll. The assembly increases the pressure on the yarn causing much better penetration, which results in more uniform slashing, more even drying and much less shedding on the looms. By means of the assembly the squeeze rolls can be raised or lowered easily.

Steam is used to heat the size mixture in the size box. The temperature of the mix should not vary more than 2 degrees plus or minus the required temperature. The temperature is controlled by means of an air operated temperature recorder and a diaphragm type steam valve, which regulates the admission of steam into the box or jacket.

The level of the mix in the size box must be controlled. This is done electrically by stopping the flow of size into the box at the proper level. Electrical control is possible because the size mix conducts electricity. When the size level is such that it touches an electrode, it establishes a circuit, the relay unit closes a solenoid valve in the airline of the diaphragm valve causing the flow of size to the box to stop. When the level falls, the circuit is broken and the diaphragm valve opens allowing size to flow into the box. Size level is important to assure proper immersion of the yarn and it should vary very little, if at all, even when the size foams a great deal. Signal lights inform the slasher tender of the operation at all times.

Cylinders. Large cylinders, steam heated to 180° to 225° F., are used to dry the yarn after it comes from the size mix. The number of drying cylinders used vary with different plants, manufacturer, and types of yarn being slashed. Most plants today use 4 or more cylinders. The Saco-Lowell slasher has 4 cylinders, each 5 feet in diameter. A slasher made by the Cocker Machine Company has up to 9 small cylinders ranging from 25 to 30 inches in diameter.

Drying is one of the critical operations on the slasher. The yarn must be thoroughly dried before it is beamed at the front and utmost care must be exercised to prevent overdrying or scorching. Thermometers and temperature controls are used to regulate the heating and temperature of the cylinders. The cylinders are also equipped with automatic pressure and vacuum relief safety valves.

Steam pressure at five to nine pounds is maintained. Instruments are frequently used to record the amount and constancy of pressure.

Exhaust or live steam may be used to heat the cylinders. In using the latter a reduction valve is required to reduce the pressure. The condensed steam in the cylinders must be removed. This is done by means of buckets inside the cylinder, which collect the water and discharge it through a Johnson joint.

The cylinders necessarily must be strong and of relatively heavy construction. They are mounted on anti-friction bearings, which lessens the friction, reduces the amount of lubrication and minimizes vibration. The cylinders are made of copper or stainless steel, the latter being more suitable in many respects.

The first two cylinders of the Saco-Lowell slasher are driven by the yarn being pulled over them. The third and fourth, however, are positively driven by a gear train equipped with a releasing gear. If the speed of the yarn sheet becomes greater than the surface speed of the cylinder, the releasing device disengages the positive gear train, thus preventing loss of yarn elasticity and strength.

Dryer Housing or Hood. Most plants use some kind of hood over slasher cylinders and size boxes. Hoods or housing carry off the steam. An exhaust fan mounted in the hood sucks the steam and wet air upward and discharges it outside. Hoods should be kept clean and care must be taken to prevent condensed steam dripping back on the yarn.

Moisture Control Assembly. One of the improvements made in the slashing operations in recent years has been that of controlling the moisture content in the yarn. The moisture control unit, connected with a variable speed drive, speeds up the slasher if the yarn is becoming too dry and slows the speed down if the yarn is too moist.

The moisture control unit works on the principle that cotton yarn of various degrees of wetness or regain will carry various degrees of electric current. Thus, the moisture controller measures moisture content in the yarn sheet by the amount of resistance the yarn shows in carrying a current of low intensity. The wetter the yarn, the more current will flow; the dryer the yarn, the more resistance and less flow of current. The device utilizes a detector roll and the warp measuring roll to measure the regain. The moisture in the yarn is recorded by instruments and observations are made at frequent intervals by the slasher tender.

Cut Marker. A cut usually is 60 to 80 yards of warp. The cut marker on the slasher marks the warp yarn with aniline dye, which is removed easily in washing or finishing. The cut marker is connected with the measuring clock and marks the yarn when the given number of yards have been slashed. Cut marks are used on warps to enable the weaver to compute or know his production.

Measuring Clocks. There is a measuring clock at back and front of the slasher. The stretch of the yarn is determined by the difference in the reading of the back and front clocks. It has been pointed out that stretch should not exceed about 2 per cent. More stretch than that will cause the yarn to lose some of its elasticity, weaken it and cause a bad running warp on looms. The modern slasher is equipped with anti-friction bearings where possible to reduce pull and the amount of stretch.

Separator Rods and Lease Rods. As the sized yarn comes from the cylinders it is a sheet of several thousand warp threads adhering to each other by the starch sizing. To separate the yarn into two sheets a separator rod is used. The rod is steel, chrome plated steel or stainless steel and is rather large in diameter. If there is an unusually large number of warp threads, two or three separator rods may be used to make the separation of yarn less violent and to prevent yarn breakage.

After the yarn is separated into two sheets by the separator rod, it is leased. That is, lease rods further separate the yarn into as many sheets as there are section beams in the creel. Lease rods are elliptical shaped wooden rods that extend all the way across the yarn sheets. Separation of the sheet by lease rods is accomplished with little tearing because the separator rod has done the major task.

Expansion Comb. The expansion comb is used to control the width of the yarn sheet to the width of the loom beam on which it is wound. The comb is a ziz-zag type and is quickly adjusted by means of a ratchet and worm assembly.

Tension Roll. The purpose of the tension roll is to cause the yarn to be wound on the loom beam at a firm and constant tension. As the warp yarn comes from the expansion comb it passes over an iron roll and then around the tension roll, which is covered with cloth in order to provide some friction on the yarn.

Loom Beams. The warp yarn is wound on the loom beam to complete the slashing operation. The beam is large enough to accommodate several thousand yards of warp yarn. The beam is mounted in the beam stand and is driven by a friction arrangement regulated

by a hand wheel. New slashers have an automatic friction device, which tends to eliminate human judgment error in increasing friction as the loom beams fill up.

Operating the Slasher

Slashers are equipped with slow and fast speed. This is done by means of a variable speed drive or by special motors with two speeds. Slow speeds are necessary in creeling and starting up the slasher. In creeling the yarn sheet must be separated and leased. The slasher tender must also have time to check and make a few necessary adjustments. When all adjustments have been made, the slasher is put on fast speed. The usual speed is from 75 to 90 yards per minute. It is possible to run the slasher somewhat faster but care must be exercised not to sacrifice quality warps merely to obtain slasher production.

Selvages. In many cases selvage yarn is a coarser count than the regular warp yarn and for that reason does not require the same amount of sizing. If the same amount of size were put on relatively coarser selvage yarns, they would fail to dry sufficiently on the cylinders and could possibly mildew. This being the case, selvage yarns are passed only between the squeeze rolls. An alternative is to run them around the cylinders twice.

If the selvage yarns are the same count as the regular warp, they are processed alike. If the selvage yarns are two or more ply, they are generally not sized at all but are run directly from spools to the loom beams.

Storing Loom Beams. After the beams are removed from the slasher, unless they are used immediately, they should be stored in a room where the relative humidity is 80 per cent. This humidity will keep the sized warps in excellent condition. A higher humidity may cause mildew to grow and weaken or ruin the warp. A lower humidity may cause the warp to dry out, become brittle and cause excessive shedding on looms.

Care of Equipment

All equipment used in sizing should be kept clean. Great care must be shown in keeping mixing kettles, storage kettles and the size boxes clean. They should be washed carefully after each run. Keep size at a sufficient temperature to prevent the mix cooling or congealing. It is good insurance to strain the size as it is

run into the size box to prevent lumps getting into the mix. All rolls should be clean and smooth, free of strings, and level. Special attention must be given to the blanketed upper rolls. The blanket is about five yards of wool blanket cloth put on the rolls. The rolls should be of uniform diameter throughout their length. After each run the blankets must be cleaned of all size. At the first sign of wear, blankets should be replaced immediately.

Instruments should be kept clean. Dust or lint should not be permitted to collect on any part of the slasher. Valves should be checked regularly. Any leak or seapage from the drying cylinders should be attended to without delay.

Chapter II

DRAWING-IN OPERATION

When the loom beam is removed from the slasher, if not stored, it is taken to the drawing-in room or the tying-in room and made ready to put on a loom for weaving. Drawing-in consists of pulling each warp thread through a drop wire, the heddle of a designated harness, and through dents in the reed. Drawing-in is done by hand or by machine. In most cases, however, the new warp is not drawn-in but is tied to threads of the old warp by means of a tying-in machine.

Tying-in Machine. In plain goods plants the warp tying-in machine is especially useful in saving both time and money. To tie the warp to the threads of the old, both warps are placed in the frame of the machine. The depleted warp has sufficient length of threads left to extend through the heddles, harnesses and reed, which are taken off the loom with the depleted warp. The threads of the new warp are combed out into a sheet with each end straight and parallel to each other. The threads of the depleted warp are likewise combed out into a sheet with each end straight and parallel to each other.

The head of the tying-in machine, which essentially consists of a warp thread selector and a knot tying device, moves down a track, selects warp thread of new warp and depleted warp and ties them together. The machine is completely automatic.

It takes only a few minutes for a warp tying-in machine to tie a warp of many thousand ends. It would take a drawing-in person several hours to do it by hand. The machine, thus, saves a great deal of drawing-in by hand, which is a slow and costly job.

Many plants use a portable tying-in machine. By using this machine the reed, harnesses and drop wires are left on the loom and the new warp is tied to threads of the depleted warp at theloom rather than having the operation done in a special room.

The portable tying-in machine saves considerable time, eliminates the possibility of damage to reed,harnesses anddrop wires in handling, minimizes greatly the adjustments to be made in putting new warp on loom, and saves a great deal of time. The portable tying-in machine is widely used.

Drawing-in by Hand. This is a slow process but must be resorted to in many instances. In plain goods plants weaving the same cloth day in and day out, the warps are re-drawn about every fourth time they are removed from the loom or more often if a par-

ticular warp has given trouble. In plants making fancy goods, all new patterns must be hand or machined drawn.

Women are usually employed to do the drawing-in. The warp is placed on a frame with the reed, harnesses and drop wires in line and each warp thread is drawn successively through each beginning at the drop wires and working to the front or to the reed. A reed hook is used to draw-in the yarn.

Drawing-in drafts are prepared to guide the drawing-in person on how the warp is to be drawn. The harness with the largest number of ends is usually placed in front, the harness with second largest number of ends is next and so on for each harness.

Drawing-in drafts indicate drawing the warp from right to left for convenience. The left hand is used to find the proper drop wire and heddle with the right hand holding the reed hook. The drawing-in draft shows the harness each warp thread is to be drawn through and the number of warp threads to be drawn in each dent of the reed.

The simplest type of drawing-in draft is the straight draw. Figure 1 illustrates this draft. It is drawn back to front and right to left.

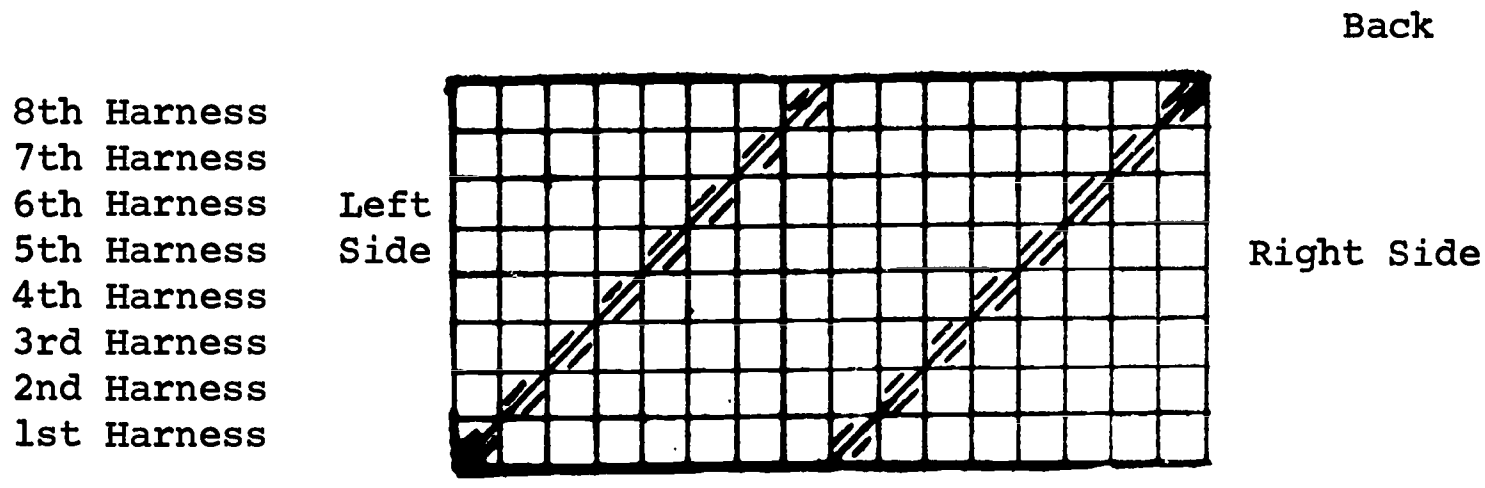


Figure 1

Sometimes drafts are shown with numbers instead of checks or squares. See Figure 2 . This is especially helpful on irregular draws.

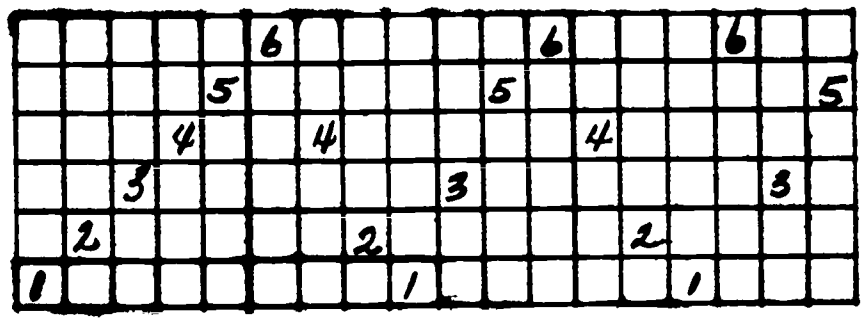


Figure 2

A more complete discussion of harness drafts will be made when the students begin designing. At this point it is only required that the drawing-in person and the weaver know how to read plans and draw the warp threads accordingly. Figure 1 illustrating the straight draw, is a weave requiring 8 harnesses. The student must visualize the horizontal spaces as different harnesses. The illustration indicates that the drawing-in begins on the back or 8th harness and the draw is made a harness at a time until an end is drawn on the first harness. This makes one repeat of the pattern. After drawing-in an end in the first harness, start drawing again on the 8th harness and work to the first harness again. This operation is repeated until the entire warp is drawn.

Point Draft. This draft is used in some plants. It is relatively easy for the drawing-in person and the weaver to follow. Figure 3 illustrates this draft. It will be noticed that an end is drawn successively through each harness through the 8th, and then instead of starting at the first harness, the next warp thread is drawn on 7th harness, the next on 6th harness and so on down to 1st harness. This gives a pointed effect as can be observed.

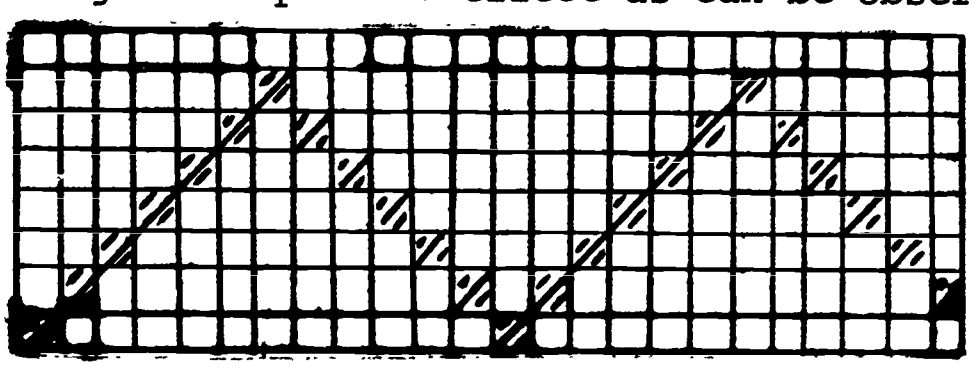
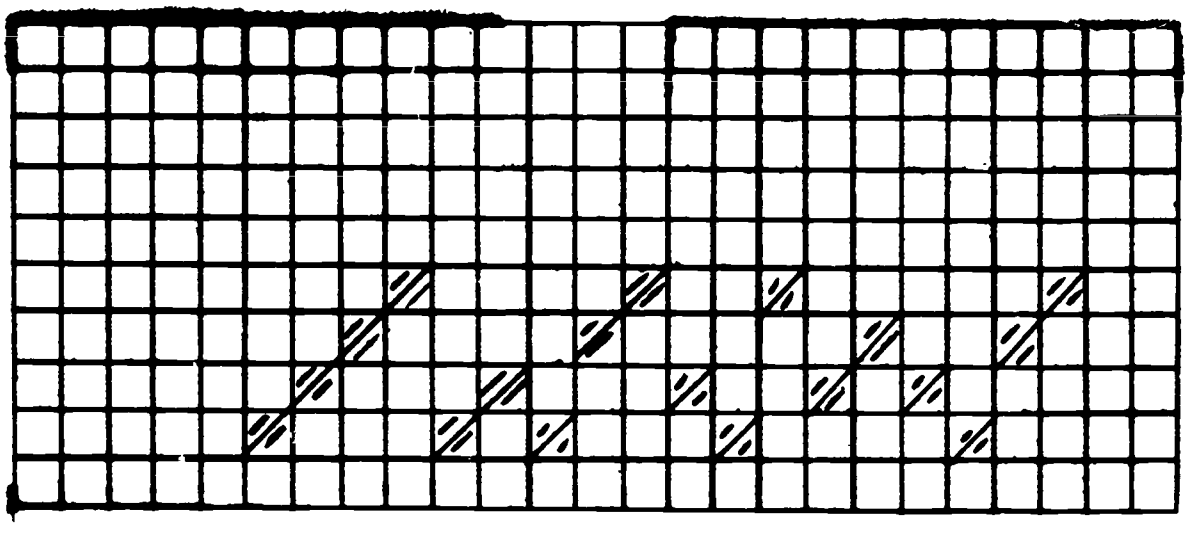


Figure 3. Point Draft

Skip Draft. From its name one gathers that the warp threads are drawn-in in a "skip" manner. That is true. Figure 4 shows that the draft looks like a straight draft but does skip from time

Figure 4.
Skip Draft



to time. As long as ends which work alike are drawn on the same harness, it makes no difference how much skipping around is done. It is more confusing to the drawing-in person and the weaver, however.

Irregular Draft. This is a difficult draft to follow and is probably used only in special weaves. Figure 5 is an illustration of an irregular draft. Notice how irregular the draw in.

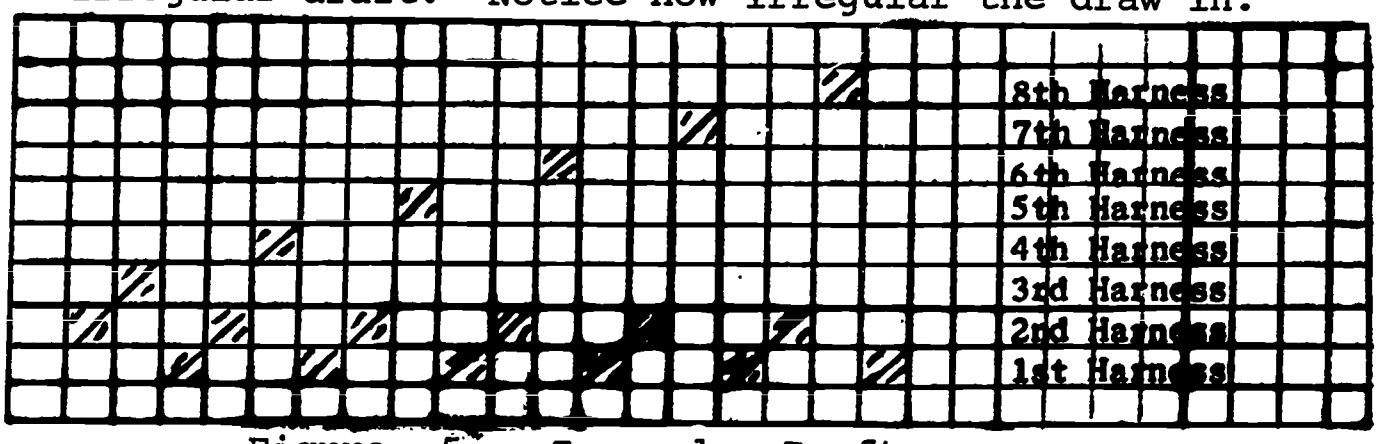
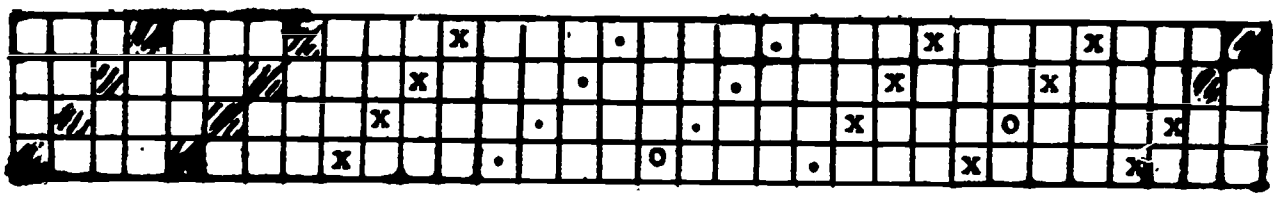


Figure 5. Irregular Draft

Symbols. Symbols are used to designate color and special threads in drawing-in drafts. Colored ink is generally used if color is put on the draft. Often, however, crosses, squares, dots, circles, or numbers are used. Sometimes color and several different symbols will be used on a single drawing-in draft. A draft having several colors should have a legend for the drawing-in person to use.



Legend: Figure 6.

- white
- . green
- x red
- o two ply white

The ends per dent (number of ends drawn in each dent) is usually indicated at the bottom of the drawing-in draft in one of the ways shown in Figure 7.

A drawing-in draft may frequently look like the one illustrated in Figure 7 . All information is given drawing-in person without having to show all the ends of the weave. The draft shows the number of repeats to be drawn, harness for right and left-hand selvage and is drawn two threads to the dent in the reed.

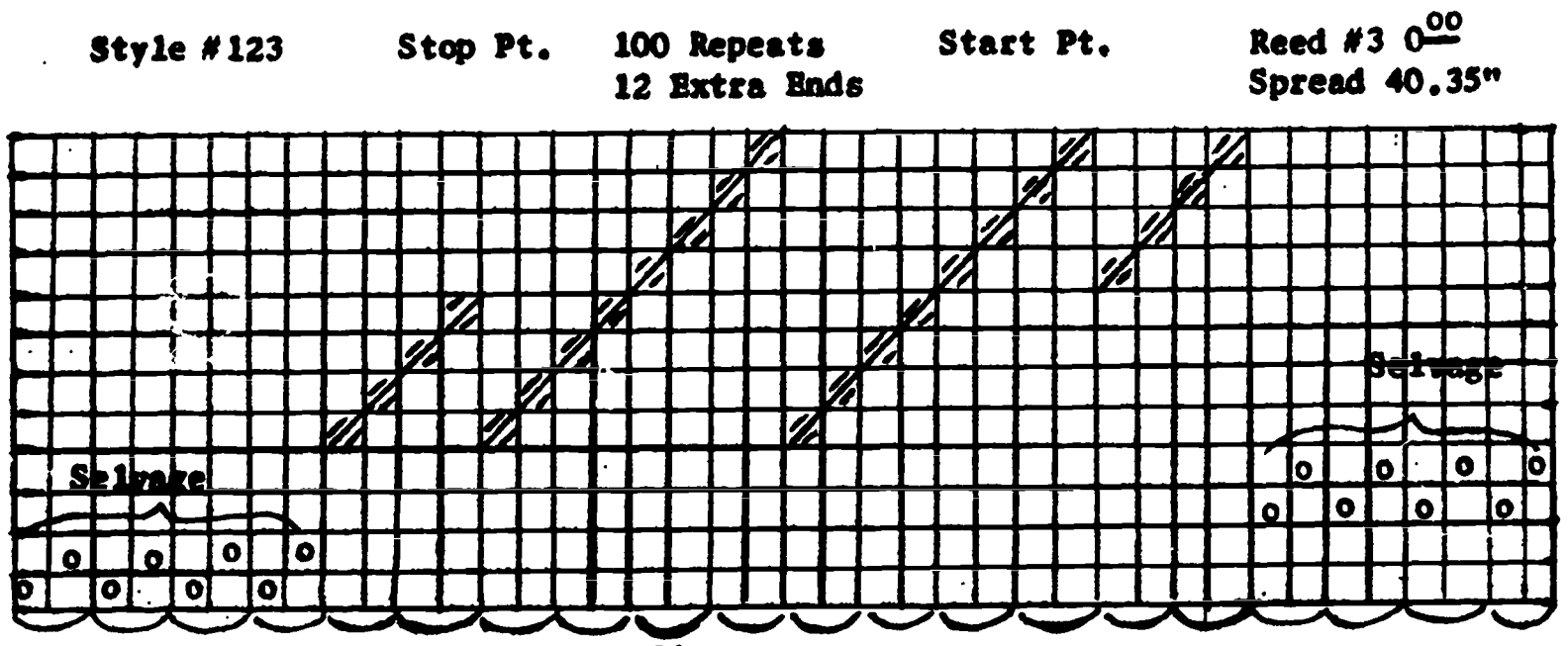


Figure 7.

Ends Per Dent in Reed. The number of warp threads drawn to each dent in the reed is important. A reed plan is given with the harness drawing-in plan, usually placed at bottom of the drawing-in plan, if the weave is a simple one and with the usual number of warp threads. See Figure 8 .

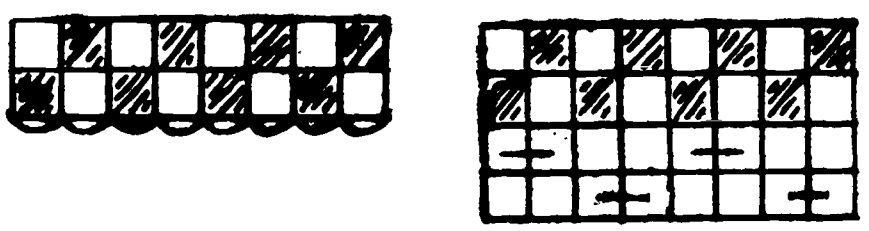


Figure 8.

When the reeding or denting is out of the ordinary, a reed plan must be shown to show how the warp is to be dented. The drawing-in operator must follow the plan exactly or else the pattern will not turn out as planned. Each dent must have the required number of ends in it and dents must not be skipped. The work should be checked occasionally to see that the drawing-in is correct. Errors must be corrected as soon as discovered. The work

takes concentration and undivided attention, especially on an irregular draw. After drawing 20-30 or more threads through the reed they should be twisted lightly and tied into a loose knot to prevent them being inadvertently pulled out.

Mechanical Drawing-In. Like many other operations in textile plants which require a person to do a single job that is slow and expensive, a machine has been developed and is used in some plants to draw in warp threads. Quite a number of years ago, a warp drawing-in machine was put on the market but was not successful. Recently a new type of warp drawing-in machine was introduced to the trade and it seems to meet most conditions satisfactorily. Up to now the machine does not have widespread use but it is likely to be accepted in the years ahead.

Chapter III

THE WEAVER AND WEAVING OPERATION

The operator of looms is known as a weaver. It is one of the skilled jobs in the textile industry. Up to now, everything done in the way of processing cotton into yarn and the slashing of the warp threads, has been done for one single purpose - to make cloth of the yarn. The weave room is the single place in the plant that makes goods to be sold. Everything else has been in preparation for weaving a product that will be of good quality and will find a purchaser. The weave room and the weaving process, then, is the one place in the textile plant that will make the plant successful or cause it to suffer loss. The importance of looms in good running shape and skilled weavers cannot be overemphasized.

Essentially the job of a weaver is to keep looms running. He does this by drawing in broken warp threads, broken filling threads and being alert to factors that may cause yarn breakage. He must also be alert to anything that is causing or may cause the loom to make defective cloth. The weaver should know when a loom needs a loomfixer to make some adjustment or repair and not wait until damage is done to the cloth before flagging it for the loomfixer's attention.

As has often been said, "A good weaver spends more time in the warp alleys watching the back of his looms than he does in the weaver alleys starting up looms." It is very important that the weaver get in the habit of watching the back of the looms for such things as gouts, mat-ups, bad warps, and other things that would cause warp threads to break and looms to stop. This is one of the best ways to make the job easier and at the same time increase production. It will also cut down on seconds. Production and seconds are two things that a weaver hears quite a bit about, and a weaver can do much to help raise production and cut down seconds by learning the correct ways of performing the jobs of weaving.

Sets. Looms are arranged in the weave room so that the fronts face each other on a narrow alley known as the "weaver's alley." The warps are back to back on a "warp alley." The warp alley is wider than the weaver's alley because warps must be trucked to looms.

A set of looms is the number of looms the weaver operates as a job. There are several factors affecting the number of looms a person can tend. The kind of fabric being made, type of loom, width of loom, arrangement of looms and skill of the weaver are some factors that must be considered. In some efficient plants a good weaver will run 100 or more looms making narrow print goods.

Formerly, the weaver filled his own batteries and removed the cloth from the cloth rolls of the looms of his set. Today, however, the skill of the weaver is capitalized on and lesser skilled workers fill batteries and remove cloth from the looms. This recognition of skill in a weaver removed the fatiguing and time consuming work done by weavers and enabled him to concentrate on weaving alone. Thus, he is able to run four or five times as many looms by giving his attention only to weaving.

Tools of A Weaver. The only tools a weaver needs are a reed hook and a pair of small scissors or pocketknife. The hook is used to pull in ends after a warp thread has been broken. The scissors or knife is used to cut excess ends from the weaver's knot, if such be necessary. They are also used to cut away lint or tangled ends in the warp as the occasion arises. As a matter of fact, most good weavers spend considerable time in the warp alley checking warps to keep tangles from occurring, which if not caught in time, would cause warp threads to break.

Weaver's Knot. The weaver must know how to tie the weaver's knot. This is a square knot and is used by weavers because it does not slip; it is small, it passes readily through drop-wire eyes, heddle eyes, and dents in reed. Skilled weavers tie the knot very rapidly and surely everytime.

Starting Loom. In starting a loom the position of the lay and the shuttle must be observed. The lay should always be at back center and the shuttle completely in its box before the loom is started. To start the loom pull the shipper handle with a smooth, quick motion. Generally, it is a good idea to run the loom pick at a time for the first two or three picks and watch for any adjustment that may be needed. If the loom has stopped because of a broken warp thread and obviously nothing else caused it to stop, it is not necessary to start it pick at a time.

Broken Ends or Picks. When the loom stops, it will usually be caused by one of two things - a broken filling pick or a broken warp end. If the filling is broken, remove the shuttle and rethread the shuttle eye, then find the loose pick and put the shuttle in the proper box and start the loom. When the shuttle has been removed from the loom, the lay cannot be moved to front center because of the protector motion unless the dagger finger is pushed back. To find a broken warp end, if the filling is not broken, have the harness level and check by the warp stop motion. Tie a thread to the broken end and draw through the necessary parts (drop wire, harness, reed). All warp threads should be drawn through the drop wire, heddles, and reed straight. Any crossing whatsoever will either cause the thread not to weave or to break. Hold the end and start up the loom.

There are several things the weaver should observe in drawing-in a broken warp end. Be sure only one end is drawn to a drop wire. The drop wires are part of the warp stop motion. If a thread breaks, the wires drop and through action of levers, the loom knocks off. Obviously, if two warp threads were drawn to a drop wire the loom would not knock off if only one of the ends break, and considerable bad cloth may be woven.

Only one warp end is drawn to a harness heddle. Threads are drawn through harnesses according to the weave. Threads must be individually controlled to divide the warp into the desired sheets to make the pattern being woven. If a heddle should break, there is a special heddle that can be put in the harness. Weavers must become proficient at this because heddles do break and must be replaced temporarily with a spare type of heddle.

Warp threads are drawn one or more to a reed dent according to the reed drawing-in plan. The weaver must be thoroughly familiar with the reed plan and draw warp threads according to it when drawing in a broken thread. Be careful in use of reed hook or else the reed might be damaged. After the broken warp thread is pulled through the reed, it should be held at the fell of the cloth and then the loom started. The thread should interlace with the filling without any noticeable discoloring or gap caused by repairing the broken end. It is important that weavers keep their hands clean because dirty hands will mark the cloth when drawing-in a broken end.

Pick-outs And Mispicks. Occasionally the thread cutters fail to cut the filling yarn on a bobbin change causing several inches of yarn from the ejected bobbin to be pulled into the shed with the new filling and be woven into the cloth. The short end should be removed by the weaver. Before starting loom, the pick should be checked to see that the next pick will be correctly made; that is, that a double pick will not occur.

Flagging Loom. Looms sometimes have to be repaired in order for them to run correctly and produce cloth. When a loom stops, the weaver goes to it and quickly determines if an end is broken or something else is wrong. If a minor reason caused the stop the weaver may be able to get loom running without flagging the loom. If the loom needs adjusting or if some part is broken or excessively worn, it will need the services of a loomfixer. To call attention of the loomfixer to the loom the weaver places two or three bobbins together and stands them on a pin on the upper frame of the loom. This is known as "flagging." The loomfixer sees the flag, goes to the loom, repairs the trouble and starts the loom up again.

Loom Drive. Most looms today are equipped with individual electric motors but occasionally one finds belt drives being used. Individual loom motors enable much more light to be disseminated in the weave room; the room looks better, cleaner and presents a better and safer environment in which to work.

The crankshaft of the loom is driven either by individual motor or belt. All other motions of the loom, working through gear trains, are driven by the crankshaft. The crankshaft makes one revolution for each pick. The camshaft is driven from the crankshaft by a gear having one-half as many teeth in it as the gear on the camshaft. This makes the camshaft turn at one-half the speed of the crankshaft, or the crankshaft makes two revolutions while the camshaft is making one revolution.

On a plain weave, one up and one down, the crankshaft will make two revolutions to each warp repeat (two picks) but the camshaft will make only one revolution in the same time. To operate more than two harnesses or weave cloth other than plain weave, an auxiliary camshaft is needed.

Shrinkage And Contraction. In weaving the interlacing of warp and filling threads cause shrinkage and contraction. This is easy to understand. Both the warp and filling curve a little on interlacing. This means that each pick must be a little longer than the width of the cloth because it curves over and under the warp yarn. The warp also curves a little on interlacing with the filling. Shrinkage is the amount of filling yarn required in ratio to width of cloth. Contraction is the amount of warp yarn required to weave a given length in ratio of the length of cloth actually woven. Both shrinkage and contraction are figured on per cent basis.

Weaver's Pay. Weavers are paid by their production. This may be figured on basis of picks, pounds, cuts, or yards. Probably the fairest way to pay weavers is by the picks. The looms are equipped with pick clocks, which have a dial for each shift, and at changing time, the new shift weavers will turn the clock to their particular shift. At the end of the week the picks are recorded for each shift and the weaver gets credit for the picks he runs. The pick clock records the picks by the thousand and by the hundred. Where weavers are paid by the pound, cuts, or yards, the production is divided between the weavers who run the looms. Most of the cloth on looms is taken off at the cut marks, which consist of about 60 yards for a single cut and 120 yards for a double cut. The cut mark is put on by the slashers.

Causes of Cloth Defects

A large number of things may cause cloth defects. The loom is a machine of precise timing and accurate setting. Although it is a relatively heavy machine, it runs with jerks, pounding and abrupt and somewhat violent motions. The vibration of a loom in operation is a great deal. All these things contribute to nuts and bolts coming loose, and this, added to wear and tear on parts, causes looms to get out of good mechanical running order. Other factors that contribute to loom failure are those pertaining to cleanliness of loom, the humidity, temperature and quality of parts used.

A few common defects in cloth are listed to give students an idea that a weaver must be constantly alert to prevent bad work. All the causes listed require the attention of a loomfixer. By no means should a weaver attempt to fix a loom. The duty of a loomfixer primarily is to give general oversight of the looms in his charge, to keep all looms in good running condition mechanically, to check the looms frequently in order to reduce or greatly minimize seconds, and to cooperate with weavers as well as others in making good cloth.

1. Heavy Places In Cloth. This is caused by improper take-up of cloth. At least twenty different things might cause take-up to not work properly. The motion should be checked frequently.

2. Thin Places In Cloth. Take-up moving too fast.

3. Curved Cloth. Take-up roll uneven or not level is likely cause but a number of other factors may cause it.

4. Overshots. Caused by insufficient power.

5. Undershots. Caused by insufficient power.

6. Pull-ins. Thread cutter misses yarn. Often caused by loom slowing down on the pick.

7. Break-out. Caused by weak pick.

8. Skips. Filling floats over two or more ends. Same as overshots.

9. Mispicks. May be caused by improper harness sequence.

10. Reediness. Caused by ends in dents running together. Shed is either too late or bottom shed is too high.

11. Tight Selvage. Tape selvage motion working improperly.

12. Loose Selvage. Tape selvage timed too early.

13. Filling Kinks. Insufficient tension on filling. Timing shed a little early will help condition; shuttle bouncing in box.

14. Shuttle Slap. This may lead to serious cloth defect. Several things can cause it.

15. Flying Shuttle. Dangerous to weaver and to cloth. Usually caused by improperly working harness motion.

16. Open Places. Filling stop motion not working properly.

Loom Calculations

The speed of the loom is given as picks per minute (p.p.m.), which will be the same as the r.p.m. of the crankshaft, as one pick is inserted for one revolution of the crankshaft.

To find 100% production in yards:

$$\frac{\text{p.p.m. x minutes run}}{\text{p.p.m. x 36}} = \text{yarn}$$

Shrinkage and Contraction

When warp and filling are interlaced, both sets of threads are bent out of a straight line. More than a yard of warp is needed to make one yard of cloth. If the cloth is 27 inches wide, the length of filling which has extended from selvage to selvage is more than 27 inches. Suppose we ravel out both warp and filling from cloth 36" x 27". If the average length of several warp ends is 38 inches, then there was apparently two inches of warp take-up or contraction. The amount of contraction is usually expressed as a percentage, with full length used as the base.

$$\frac{\text{Length out of cloth - length in cloth}}{\text{Length out of cloth}} \times 100 = \text{\% contraction}$$

Substituting for above:

$$\frac{38.12 - 26.00}{38.12} \times 100 = 5.2\% \text{ contraction}$$

The per cent of shrinkage of filling is calculated the same way as contraction.

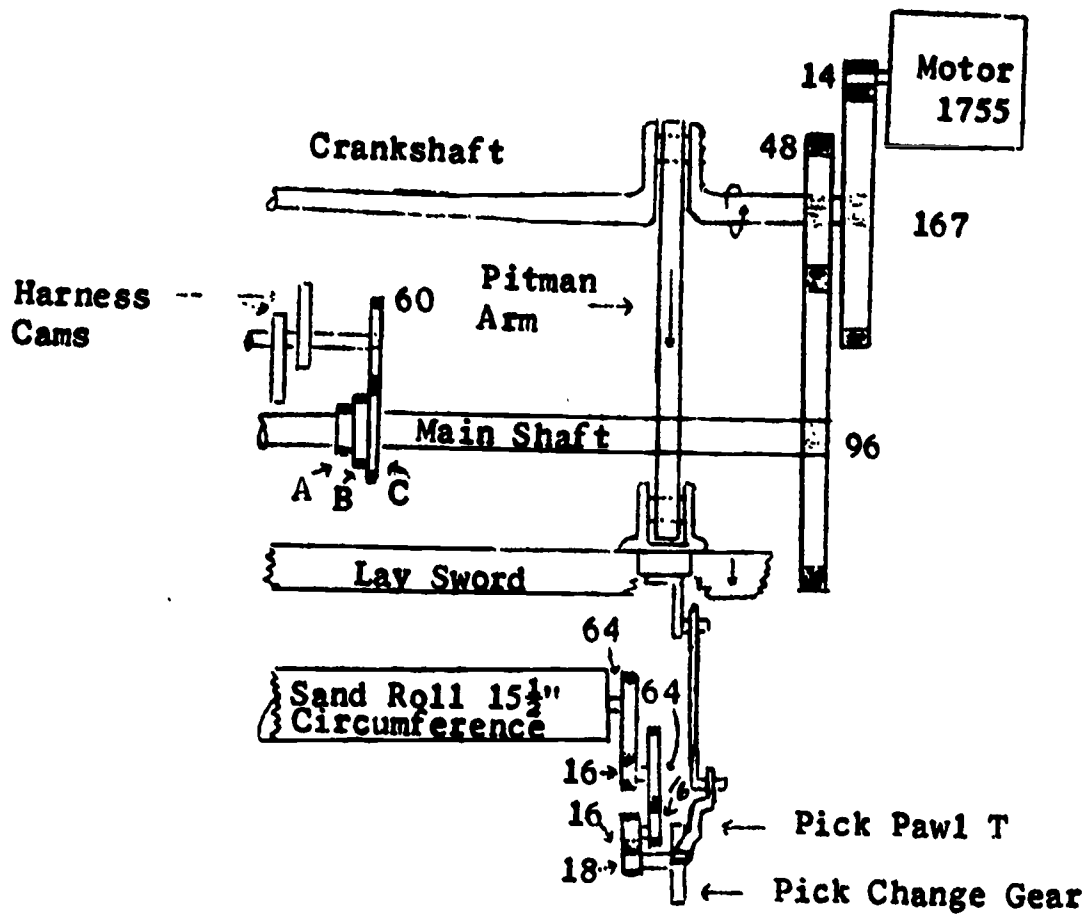


Figure 9.
Take-up Gearing of a Loom
With a Pick Pawl Take-up

A study of Figure 9 reveals that the drive for all parts of the loom is received from the crankshaft. The take-up which controls the number of picks per inch, is driven by the crankshaft through a series of gears. All cloth, of course, does not have the same picks per inch. To change the picks per inch the speed of the take-up must be changed. This is done very easily by changing the pick change gear.

The pick pawl is so arranged that as the lay comes forward it will move the pick change gear 1 tooth. In calculating take-up consider the pick pawl as a one tooth driver gear. Tracing the gearing, the following equation is set up to find the number of teeth in the pick gear, which causes the sandroll to take up the desired amount to put 60 picks per inch into the cloth.

$$\frac{1 \times 18 \times 16 \times 16 \times 60 \times 15}{16 \times 60 \times 60} = 72 \text{ change gear}$$

Pick Constant. It is much more convenient to use a pick constant in determining the size pick gear to use for a given number of picks to be placed per inch in the cloth. To find the pick constant, trace gears as under pick change gear but leave out picks per inch in the equation.

$$\frac{1 \times 18 \times 16 \times 16 \times 15}{16 \times 60 \times 60} = 1.2 \text{ pick constant}$$

Knowing the pick constant and desiring to put 64 picks per inch in the cloth, multiply the pick constant by the number of picks desired.

$$1.2 \times 64 = 76.8 \text{ or } 97 \text{ teeth pick gear}$$

In making calculations where a worm is used instead of a pawl on the take-up, consider the worm as a 1 tooth gear.

Harness Change Gear. To operate more than two harnesses or weave cloth other than a plain weave, an auxiliary camshaft is necessary. Figure 9 of a Draper loom with a pick pawl take-up shows an auxiliary camshaft arrangement, which is fastened to the loom back of the camshaft. Harness change gears, A, B, and C are placed on the cam or main shaft. The harness gear drives the auxiliary shaft gear through an idle gear. The auxiliary shaft gear usually has 60 teeth and the number of teeth in the harness change gear depends upon the weave desired. The harness cams have different shapes for different weaves.

If the loom is to be put on a $\frac{2}{1}$ weave, which means that for three picks or revolutions of the crankshaft, the auxiliary camshaft will make only one revolution.

To set up the equation to find the required gear, start with the number of picks necessary to repeat the weave and go to the auxiliary camshaft, letting C be the change gear. Example: To find the change gear necessary to make a $\frac{2}{1}$ weave:

$$3 \times \frac{48}{96} \times \frac{C}{60} = 40 \text{ (number of teeth in the harness change gear)}$$

Chapter IV

ESSENTIAL MOTIONS OF THE LOOM AND THE WEAVING PROCESS

Weaving is the process of making cloth out of yarn. It is done by taking two sets of yarn and interlacing them so that they will be bound together to form cloth. The process is very old and was known by primitive people. For many hundreds of years weaving was done by hand but today it is done on a weaving machine known as a loom.

The modern loom is a complicated machine with many parts which must be set and timed correctly to give proper performance. Looms are made to make many kinds of fabrics but all work on the principle that yarn interlacing at right angles to other threads makes cloth. Reference to Figure 10 will assist one in understanding the interlacing of the yarn.

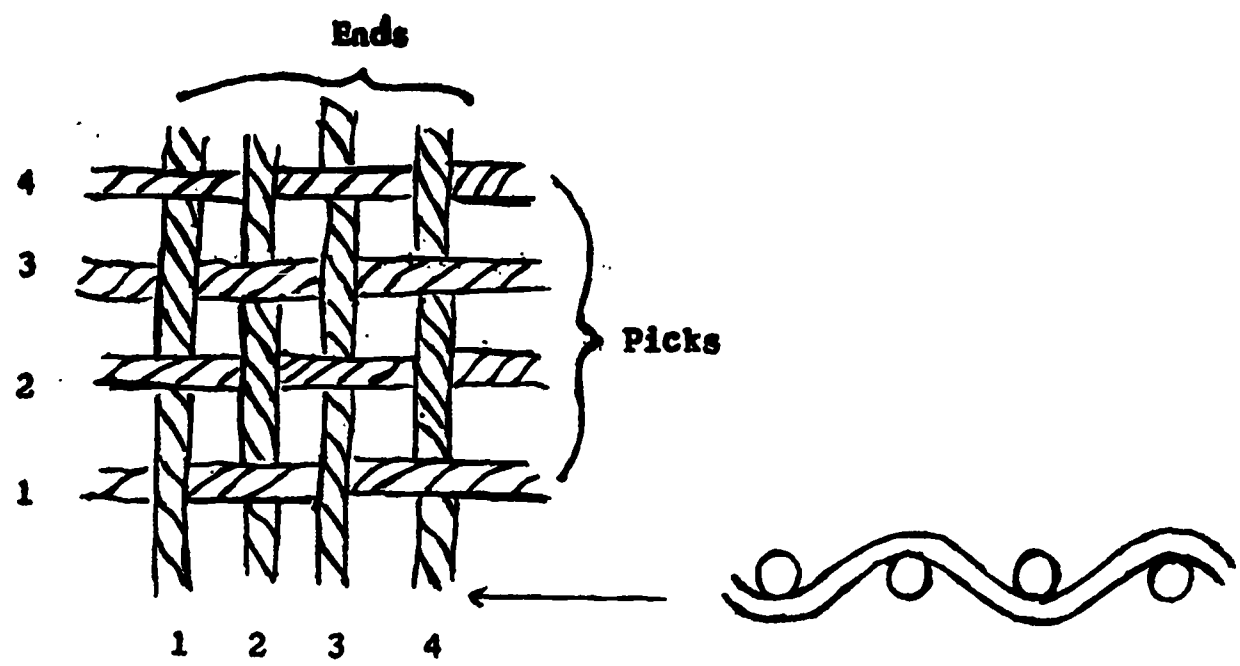


Figure 10.

Yarns used in weaving are known as warp and filling or as ends and picks. The warp ends are those from the loom beams at the the back of the loom. Filling ends are those carried across the warp ends at regular interval by a shuttle. After a filling end has been carried across by the shuttle, warp ends change position causing the filling end to be interlaced and bound in place. Warp ends are vertical and filling ends are horizontal. Figure 10 shows 4 warp ends and 4 filling ends.

Of course all interlacings are not the same on all woven fabrics. To change the appearance, the effect, or to make a pattern in the cloth, the manner of interlacing ends and picks is made. However, all this is done on a loom of some kind. It is therefore important that students understand the essential parts of looms and how they function to perform efficient weaving.

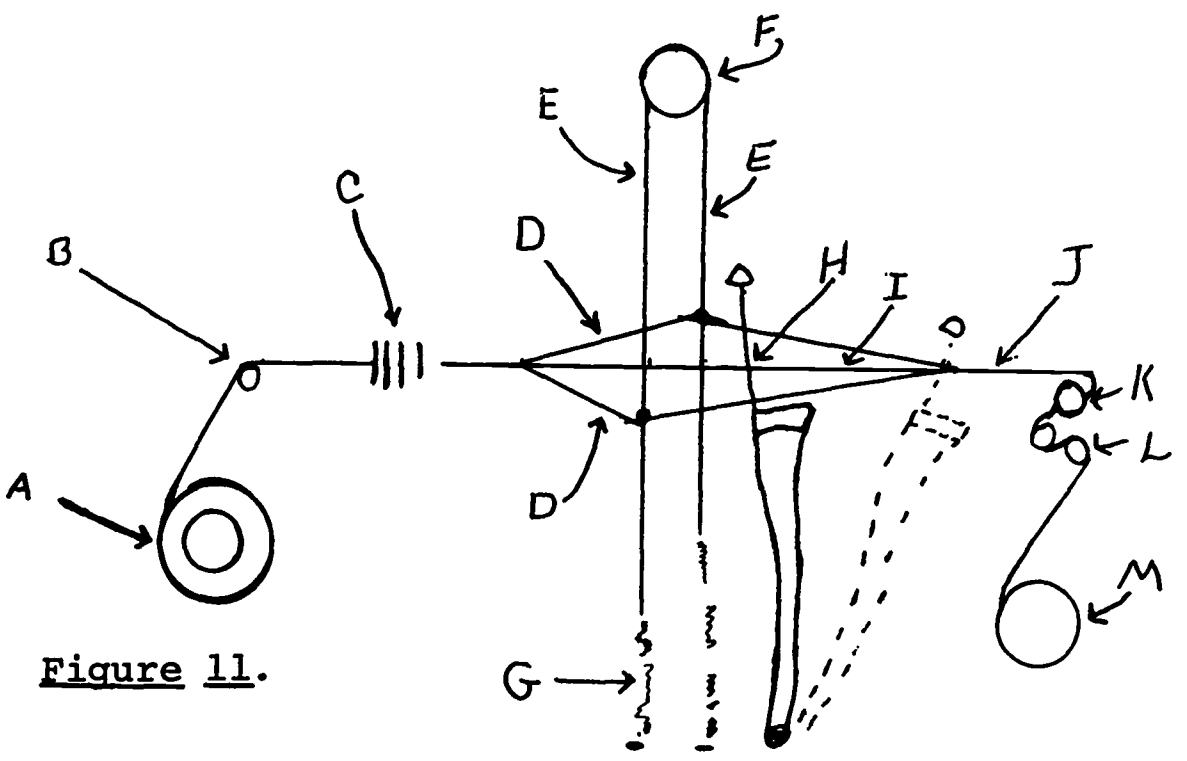
The Loom and Weaving

The loom is a machine that causes ends and picks (warp and filling) to be interlaced rapidly according to the pattern desired. To accomplish this the loom has three principal motions: the shedding motion, the picking motion and the beating-up motion.

The Shedding Motion

The shedding motion uses harnesses to perform its function. By means of harnesses the warp threads are separated into a top and bottom layer of threads known as the shed. In making a plain weave this is done by drawing threads alternately through the harness eyes of two harnesses so that one-half the threads are on one harness and one-half on the other. The shed is formed by raising one harness with half the threads and lowering the other harness with half the threads. After one pick, as in a plain weave, the harnesses change position, cause interlacing which binds the pick into place. The shed is open just wide enough to permit the shuttle to carry the pick thread across. The harnesses are actuated by cams designed to give sufficient dwell so harnesses do not change position until the shuttle travels the width of the loom.

The harness cams are located on the camshaft under the loom. They control the movement of harnesses through a treadle arrangement, jack straps fastened to the harness and a roll shaft and strap arrangement at top of loom frame. As many as eight cams may be used. Since each cam controls the movement of a single harness, only up to eight harnesses can be used on cam looms.



A. Warp Beam
B. Whiproll
C. Drop Wires
D. Warp Threads
E. Harness
F. Harness Roll
G. Harness Strap
H. Reed
I. Shed
J. Fell
K. Sandroll
L. Guide Rolls
M. Cloth

Figure 11.

Harness. Weaving could not take place without interlacing of threads. This is done on the loom by means of two or more harnesses. Each harness used divides the warp into a sheet of yarn controlled by that harness. All patterns are put into fabrics by the raising or lowering of harness which determines the way in which interlacing with filling yarn is made.

The harnesses take a great deal of punishment in the weaving operation so they must be of strong construction. The frame is usually built of knot-free wood. Often the top and bottom cross pieces are held in position by a metal brace. Steel slide rods extend parallel to the two cross pieces and fit into the metal brace. The heddles are placed on the slide rods. Hooks are used to support the slide rods at regular intervals over the width of the harness.

Heddles used on harnesses are made of cotton cord, twisted wire or flat steel. Probably most plants use flat steel heddles, especially those making leno weaves or broadcloth. Cotton cord is still used on Jacquard looms in which each heddle is a harness. Some plants continue to use twisted wire but the flat steel heddle is by far the more popular.

Only one warp thread is drawn to a heddle. It must be so built that it will allow the warp thread to be pulled forward without breaking the yarn, regardless of condition of the yarn. The heddles hold the yarn relatively straight and cause the warp yarn to be raised and lowered into two sheets as the harness frame is raised and lowered. Since the heddles are in contact with yarn they should be free of rust and eyes should be free of excessive sharpness or any roughness. The weaver should inspect heddles as a cause of some bad running work. Bent, crooked or damaged heddles should be removed and new ones put in the harness. Spare heddles may be put on by the weaver, if one should break during operation. Spare heddles should be replaced before the harness is used on a new warp.

It is important that the heddles do not bind on the slide rods. Some side motion is necessary to prevent heddles from binding and causing excessive warp breakage on the loom. It is by far better to use more harnesses than to crowd too many heddles on one.

Picking Motion

The picking motion throws the shuttle containing the filling yarn across the lay when the shed is open. The yarn is pulled from the shuttle and lays in the open shed until it is beat into the fell of the cloth and the harnesses change position to interlace it with

the warp threads. The picking motion requires a picker, picker stick, a shuttle and an action to cause the shuttle to be thrown back and forth across the loom.

The shuttle is thrown back and forth across the loom rapidly by means of a pick ball and cam fastened to the main shaft of the loom, which actuates the picker stick through a series of levers and straps. The filling in the shuttle is on a bobbin or quill held tightly in the shuttle. It is the same bobbin on which filling yarn in the spinning room was wound.

Figure 12 gives details of the picking motions. The pick cam shown in (B) has a sharp angle known as the pick point. The pick ball rides the cam and the pick point gives it abrupt and violent action. Working through an arm, shaft and a lug strap, the action causes the picker stick to be pulled forward sharply. The shuttle resting against the picker at the top of the picker stick is thus thrown across the lay to the opposite shuttle box. The same action on the other side of looms throws the shuttle back across.

The shuttle must be thrown straight across the lay; the picker, then, must travel level although the picker stick has a raking motion. To have the picker level in its movement a <u>parallel</u> or <u>parallel motion</u> is used. The lower end of the picker stick is fastened to a parallel shoe, which rides on a parallel stand as the picker stick is jerked forward. This arrangement keeps the picker parallel. The picker stick is returned to its position by a spring and strap arrangement.

<u>Picker Stick and Picker.</u> The picker stick is a wooden stick, usually of hickory or similar tough wood. At the top of the picker stick is a laminated leather piece called a picker that fits on the stick and is held in position by a screw. The picker has a notch cut or bored into its face just large enough for the nose of the shuttle to fit. The loom speed is fast, 140 to 240 picks per minute, but the shuttle does come momentarily to rest against the picker before it is thrown across the lay.

The picking motion is an efficient method of throwing the shuttle across the loom but it is a major contributor to noise in the weave room; it also is a cause of wear and tear on the parts involved and a source of considerable cost over a period of time.

<u>Shuttle.</u> The shuttle is used to carry the filling yarn across the loom. Inside the shuttle is the filling yarn on a bobbin held firmly in place by the shuttle spring. The rings on the bobbin fit into grooves in the spring and hold it in correct alignment until it is ejected by the transferrer when a new bobbin is inserted.

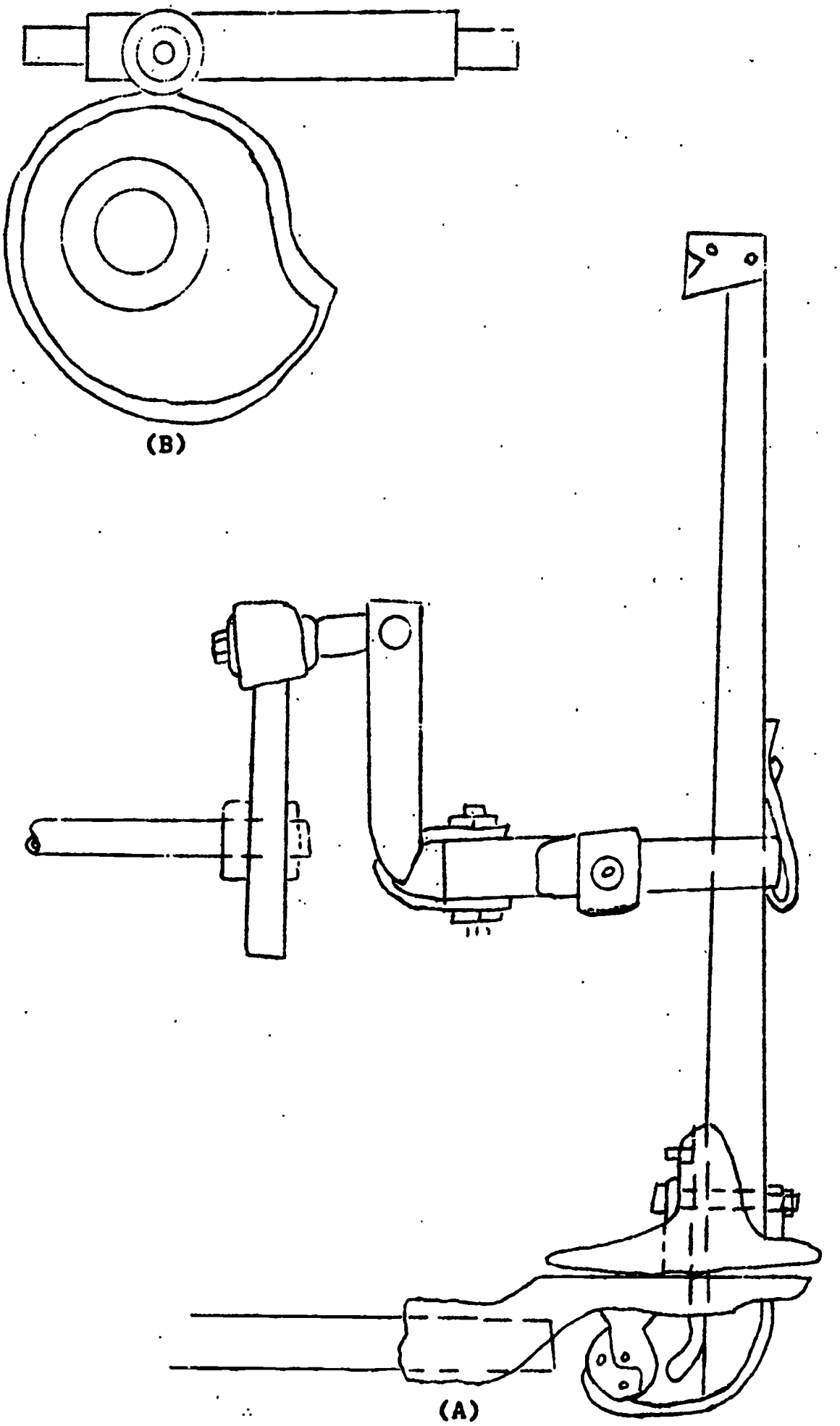


Figure 12. Picking Motion

The shuttle has an eye through which the filling yarn is pulled as the shuttle is thrown across the loom by the picking motion. Tension is often applied to the yarn to prevent it pulling off the bobbin too fast and to prevent more from coming off than is required by the width of the loom. Tension is given by having the yarn pulled over felt, feathers, fur or some light material that will cause a small amount of friction.

The eye must be so constructed that the filling yarn will remain in it until the bobbin is exhausted or is ejected. It must also be constructed so that it will be self-threading when the bobbin is changed. This is accomplished by the design of the shuttle eye and the angle yarn is placed in the battery.

Shuttles are made of dogwood or persimmon wood. Those two woods are reasonably heavy, free of splintering and finish smoothly. In recent years a plastic shuttle has been introduced and is meeting with some success. Various materials, such as aluminum, have been experimented with but up to now have not been satisfactory.

If feelers are used on the loom, the shuttle must have a slot for the feeler tip to enter the shuttle and indicate a change in bobbin when yarn for only two or three picks remains on the bobbin.

A slot must also be provided for the Stafford thread cutter. This slot is located near the eye of the shuttle and permits the thread cutter to enter the shuttle and cut the thread of the ejected bobbin when the bobbin is changed.

Beating-up Motion

The beating-up of the filling yarn is accomplished by the reed, which is seated on the lay of the loom. The lay consists of a plate for the shuttle to travel on in crossing the warp and has a shuttle box on each end. The lay is supported by two pivoted upright supports called lay swords. The lay has a reciprocating or backward and forward motion imparted by a crankshaft through pitman arms. The purpose of the lay is twofold: first, it beats up the filling close to the preceding pick; second, it provides a bed or track called a race plate on which the shuttle travels on its journey across the loom from one box to the other.

The beating-up of the filling is accomplished by the reed through which warp threads are drawn. The motion to the lay is given by the crankshaft connected by a pitman arm to the lay.

The beating-up is very rapid. The lay must go forward after each pick. As it moves forward the shuttle is completing its trip across. The forward movement pushes the filling into the fell of the cloth. On the backward movement of the lay, the loom is timed so that the harness changes position causing interlacing of warp and filling thread. The harness changing position opens a shed and the shuttle is thrown across the lay at the proper time while shed is open.

Loom Boxes. On each side of the lay is a loom box. The shuttle comes to a momentary rest in the box before it is thrown across the lay by the picker stick. A groove in the bottom of the boxes permits the picker stick to protrude into the box and the shuttle is seated in a notched leather picker located at the top of picker stick. One side of the box swings on a pin. This side is called a binder. It slows the shuttle down somewhat as it enters the box and also, when shuttle is in box, raises the protector fingers and prevents loom from slamming off. Check straps just under the box slow the shuttle down, by giving resistance to backward movement of picker stick which the shuttle strikes as it enters the box.

Reed. Another necessary part of the loom is the reed. The reed provides a backrest for the shuttle on its journey across the lay; distributes the warp yarn evenly over the prescribed width determined by width of cloth being woven; and it beats the filling yarn into the fell of the cloth.

Reeds are made of pitchblend or metal. The metal reed is practically always used with fine cotton and has many advantages over the pitchblend.

The reed consists of thin flat strips of steel set in wood or metal frame, called ribs. The space between the steel strips is called a dent. The number of dents or spaces to an inch indicates the number of the reed. For example, if the reed has 20 dents to an inch, it is a No. 20 reed. If a fabric needs a No. 20 reed, it means that a reed with 20 dents to an inch must be used in weaving the fabric. Reed manufacturers sometimes stamp the total dents and reed width on the reed. A stamp 800-50 means 800 dents in 50 inches, or 16 dents to an inch.

Reeds are strong and rugged. The steel strips, however, may be damaged by a weaver careless in use of a reed hook. Any damage to one of the strips may cause reed marks in the cloth, that is, a wider space in the fabric in that particular place than in the rest of the fabric.

Auxiliary Motions

Although the three motions described are essential for weaving, the modern loom has a number of other motions. These motions make the weaving process more efficient, speed up production, protect warp threads from damage and greatly assist in making quality cloth. The auxiliary motions include take-up motion, let-off motion, protector motion, warp stop motion, filling stop motion, filling change motion, and in connection with the latter, a feeler motion. All of these go to make the loom completely automatic so that one weaver can take care of a hundred or more looms, depending on the fabric woven.

The Take-up Motion causes the cloth to take up or wind up uniformly. This, in turn, causes the pick to be spaced evenly in the cloth. This is a very important motion because a frequent cause of thick and thin places in cloth results when the motion does not perform smoothly. Such cloth must be classified as seconds and be sold at much less than quality cloth. The take-up roll is turned by means of a spur gear or a worm.

Gear trains, usually consisting of four gears, are used by both types of take-ups. A pawl and ratchet actuated by the lay sword, gives motion to the spur gear type. The worm type is driven from the spring shaft by means of a worm and worm wheel.

The take-up motion controls the speed of the take-up or sand roll. This roll is covered with perforated strips of tin or sandpaper. It pulls the cloth forward, keeps it tight, and delivers it to the cloth roll. The rate or rotation may be changed according to the number of picks per inch desired in the cloth.

The Let-off Motion controls the rate of rotation of the warp beam. It permits the beam to let off the warp yarn sufficiently to keep good tension on the warp threads. At one time the friction let-off was thought to be rather satisfactory but practically all looms today are equipped with automatic let-offs. The friction type let-off consisted of a chain wrapped around a drum on the loom beam head. One end of the chain is fastened to the frame of the loom and the other end fastened to a weighted arm. The position of the weights on the arm could be changed to increase or decrease friction as required.

The automatic let-off on Draper looms is actuated by the lay sword through an internal gear, pinion gear and worm or pawl.

The automatic let-off, such as the Roper and Bartlett, controls the tension of the warp by means of a whiproll over which the warp threads pass. The tighter the tension the more the take-up. The tension presses the whiproll down and through a lever to a vibrator spring. This action, working through a pallet and pallet lever, causes the let-off wheel to move letting the warp off a little at a time. In addition to the let-off after each pick or two, both the Roper and the Bartlett let-offs have a control lever with a follower resting on the warp beam. When the warp beam is full the lever is always up and the let-off is very small. As the warp decreases in size the lever goes down and actuates the pawl to give more let-off.

The Whiproll has another important function in addition to being one of the control factors in the amount of let-off. On the end of the crankshaft outside of loom frame a cam is placed. An arm from the whiproll rests on the cam. When the point of the cam is at top, momentarily much more tension is put on the warp threads. The cam is set at its highest point, top center, when the reed is about three-fourths inch from the fell of the cloth. The extra tension of the warp threads at this point causes them to be tight and straight. This causes the filling to do most of the curving and the warp threads very little as the filling is beat up into the fell of the cloth. The filling yarn is softer than the warp threads, is well beat up and fills up minute openings in the cloth. This results in the fabric having good cover, making it look and feel better.

The Protector Motion protects the warp threads from being broken or smashed if for some reason the shuttle does not get across the lay before it moves forward. The protector motion consists of a protector rod; two dagger fingers, one on each side of the loom; and a live and dead frog, one of each side of the loom. When the shuttle is in the box, the binder of the box is pushed out, which causes the two dagger fingers to be raised and clear the frogs. If the shuttle does not get into the box, the dagger fingers engage the frogs causing the loom to knock off. The protector motion undoubtedly has saved many warps from a "smash-out."

The Warp Stop Motion is another highly important part of the loom. This motion may be either mechanical or electric. In recent years the electrical stop motion has gained considerable favor but probably most looms still use the mechanical stop motion. This motion is of the sliding bar type and consists of drop wires on a drop wire bank made up of two notched bars riveted together and which is held firmly in position. Another notched bar slides in a groove back and forth from side to side. If a warp thread breaks or is too slack, the drop wire through which the warp thread passes, falls into a notch. This prevents the sliding bar from moving from side to side. This action exerts pressure upon a wire plunger, which actuates the knock-off and causes the loom to stop.

The mechanical warp stop motion is designed to stop the loom:

With the harnesses level
With crank on bottom center
With shuttle in box opposite battery
With indicator showing where wire is
With warp open at broken end down

All of these are of great advantage to the weaver. He can determine immediately where an end is down because the drop wire turns sidewise when it is caught and this causes an open place in the warp and between it and other drop wires.

The electrical stop motion works on the same principle. If an end breaks, the drop wire falls and completes an electric circuit, which will act to stop the loom. Some electric stop motions have an attachment which flashes on a light when a warp thread breaks and the loom is stopped. The light acts as a signal to the weaver and also assists him in finding the broken end because it flickers when the weaver brushes his hand over the contact wires.

The Filling Stop Motion stops the loom if the filling thread breaks. This, too, is a most important motion. Filling stop motions may be of the following types: single fork, double fork or center fork. All perform equally well.

The motion consists of a grate, a fork, a filling motion hook, slide trip and finger. If the filling thread is unbroken, it lies across the grate mounted on the lay. As the lay moves forward the thread across the grate does not permit the filling fork to go through, tips it, causing back of the fork to be raised. This action allows the hook to move backward in the slide without engaging the fork. If the filling thread is broken, the fork goes through the grate, it is not tipped and the hook engages the rear of the fork. This action causes the loom to knock-off.

In most cases the single or double side fork is used for both wide and narrow cotton goods. The double fork gives twice the protection of the single fork. If the loom is equipped with a feeler, the side fork will transfer the bobbin and stop the loom so that the partial pick can be removed. If the loom does not have a feeler, a bobbin will be supplied on one or two mispicks while the loom keeps running. If for some reason a third mispick is made, the loom will stop.

Center Fork Stop Motion. The center fork filling stop motion is used on looms making fine fabrics or when cloth perfection is essential. The center fork motion stops the loom when the filling

yarn breaks before the lay comes to the fell of the cloth. It thus prevents marking the cloth and enables the weaver to correct the fault immediately. If the thread should break toward the end of the pick, the center fork may fail to stop the loom until the next pick.

The center fork stop motion is used extensively because many plants are producing fine cotton goods or synthetic fabrics. It will be described in some detail for the student to understand how it operates.

Refer to Figure 13. Feeler wires (1) are located in front of an open well (2) in center of the lay (3). The fork end of feeler wires extends toward the reed. As the lay moves toward its back-center position, feeler wires (1) tilt upward through the warp, high enough to allow the shuttle to pass beneath them. The back and forward motion of the lay imparts motion to the top of pump rod (4), which, in turn, transmits motion to lever (5) and connector (6). This motion is further transmitted by crank (7), through shaft (8), to the feeler wires.

Feeler wires (1) also control knock-off dagger (9) which is attached to the front of lever (5). Pin (10) limits the movement of the feeler wires, since it is located within the cut-out section of crank (7). As long as there is filling beneath the feeler wires, dagger (9) will be depressed out of the path of dog (11), which is part of the knock-off assembly attached to the breast beam.

If the shuttle does not lay filling under the feeler wires, or, if the filling the shuttle lays under the feeler wires is broken, the wires will drop into the well in the lay and so actuate the crank linkage that dagger (9) will be raised into position to strike dog (11) as the lay comes forward. When dagger (9) strikes dog (11), cam (12) will rotate and depress coupling (13), which is attached to the shipping and brake mechanism shaft. The shaft (14) will release the clutch and set the brake to stop the loom before the lay reaches the fell of the cloth.

The other numbers used in the figure are concerned with adjustment of the motion and not its operation so will not be discussed at this time.

The center fork is used on Draper XK, XD and XP model looms. Practically all Crompton and Knowles looms use the center fork except those making terry cloth. In all cases a feeler is used with the motion.

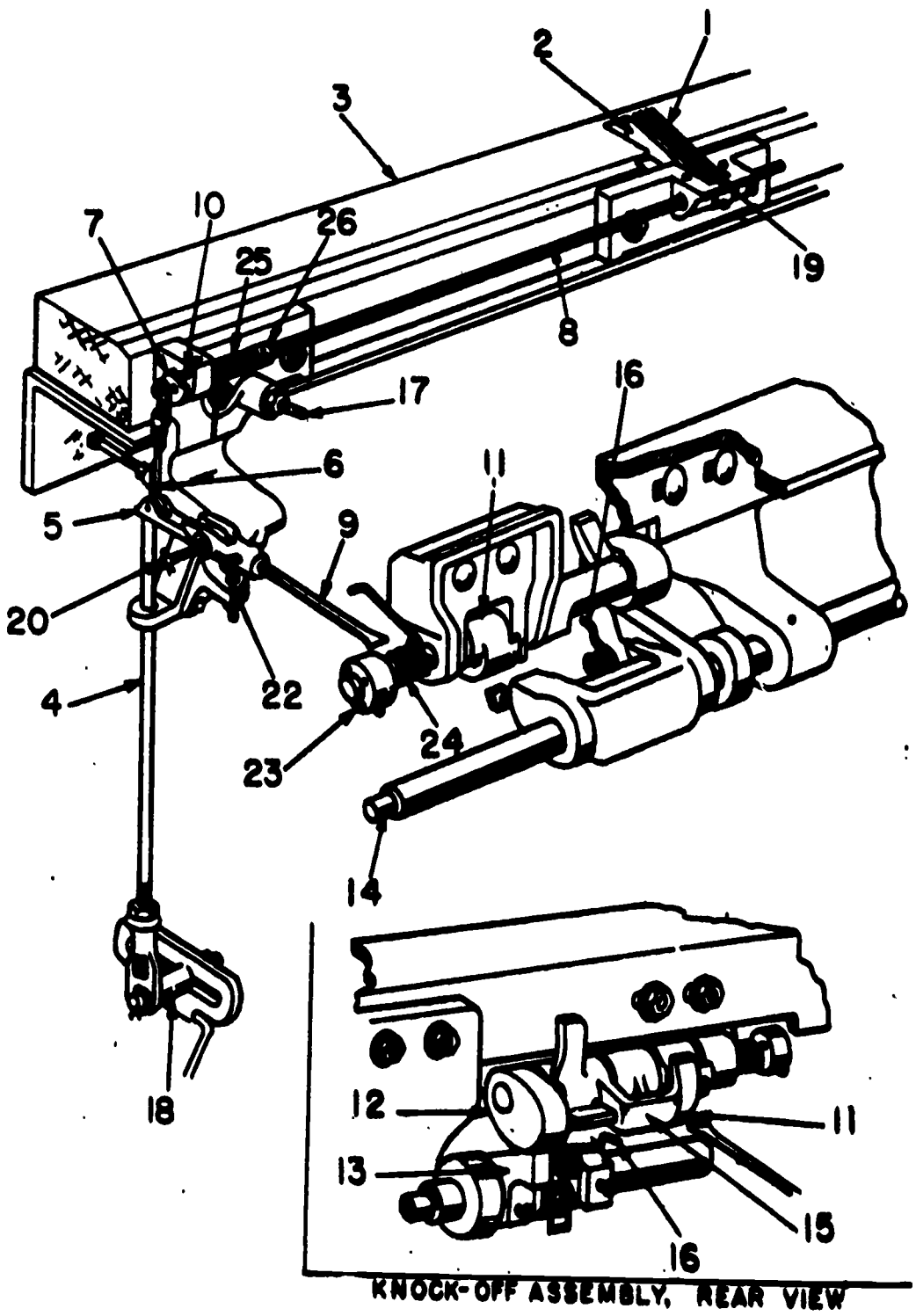


Figure 13. Center Fork Stop Motion
(Courtesy Crompton & Knowles Corp.)

The Filling Change Motion is the one single motion that makes the modern loom automatic, although all the other motions and the thread cutter contribute to a loom being automatic. The Draper Northrop loom was the first to be equipped with an automatic filling change motion.

The filling change motion consists of a battery or magazine which holds a supply of full bobbins and a transferrer mechanism. When the yarn on the bobbin in the shuttle is down to a predetermined amount, a feeler indicates the fact to the transferrer. This mechanism is put into operation and causes a full bobbin to be forced into position in the shuttle, ejecting the depleted bobbin at the same time. The same action occurs if the filling yarn breaks. The change is very rapid, taking only about one-twentieth of a second. The bobbin knocked from the shuttle falls into a metal container.

Threading the new bobbin in the shuttle is accomplished by having the threads from each bobbin in the battery held by a holder. After a pick has been made the thread is held by the selvage and the holder. As the lay comes forward the thread is cut at the selvage by a thread cutting temple leaving a smooth side.

If a feeler is used on the loom, the bobbin forced from the shuttle on the filling change, will have a thread extending from shuttle eye to selvage of cloth. The thread cutter cuts this thread and the ejected bobbin pulls the cut thread from shuttle and selvage as it falls.

Midget Feeler. This is a simple but effective device for indicating a change in the bobbin. In making filling yarn a bunch builder is used to bunch sufficient yarn for several picks. It is necessary that the bunch be on the bobbin or the feeler will not work. Each time the lay comes forward the feeler tip goes through the slot in the shuttle and contacts the bobbin. As long as there is yarn on the bobbin, the feeler is pushed back without any other action taking place. When there is only enough yarn for four or five, however, the feeler slips on its contact with the bobbin, slides to the right and indicates a bobbin transfer.

Electric Feeler. Crompton and Knowles has an electric feeler on some models of their looms. The electric feeler is located under the magazine assembly and operates only on the active shuttle. As the lay comes forward, the feeler tip passes through a slot in the box front of the shuttle and contacts the bobbin. This pushes the feeler tip back into its housing. Since the two tips of the feeler are part of the electric feeler circuit, there will be no electrical indication for transfer of bobbin as long as the bobbin has yarn on it.

When the yarn is expended, however, the metal ring or band on the bobbin contacts the feeler tips as the lay comes forward, completing the electric circuit, which energizes the transfer mechanism.

On box looms, where several colors are being run, a reserve of 4½ picks are left on the bobbin. If a bobbin of a particular color is within 4½ picks of being depleted, the indication for a change of bobbins will be stored until the same shuttle returns to the magazine end of the loom.

The Crompton and Knowles looms come with magazine, battery or shuttle changing filling transfer motion, depending on the type of loom. All of these operate equally well but the shuttle changing type is necessarily much slower. For this reason it is used on loom weaving special fabrics and where speed of production is not as important a factor as it is with ordinary narrow goods weaving.

Within the last two or three years Draper has introduced an automatic filling magazine. Advantages claimed for the magazine are: reduces filling handling, gives more continuous loom operation, the yarn is kept cleaner and fewer seconds are made. These advantages add up to better loom performance, better quality cloth, and some reduction in labor cost.

The Draper magazine looks similar to the Crompton and Knowles. It, however, does not have stationary magazines. One or more magazines filled with yarn are placed on a conveyor attached to the loom. Rollers guide the full magazine to a position where bobbins can be transferred into the shuttle the same as from a battery. The mechanism for ejecting the empty bobbin from the shuttle and driving in a new one is essentially the same as for the battery type filling change.

Temples. Although it is not a part of the beating-up motion, the temple is acted upon by the lay as it beats the pick into the fell of the cloth. The function of the temple is to hold the cloth to the desired width, which is a little less than the warp in the reed.

Temples are used on both sides of the loom and are placed at the selvage near the fell of the cloth. It consists of a housing and a wooden roll covered with many small pins. The pins in the right temple bend to the right and in the left temple to the left. As the lay comes forward it strikes a bunting under the temple causing the temple assembly to slide back and causing the rolls to revolve. As the rolls turn the rotation keeps the cloth pulled out to the desired width and the pins hold it that width.

On fine cotton fabrics and fabrics using synthetic yarn, the temple rolls are made of rubber with a spival which acts the same way as the wooden roll with pins. Rubber rolls are used for these type fabrics, because pins would pluck and fray the yarn.

The temple also has a temple knife which cuts the yarn at the selvage when a new bobbin is put in the shuttle. A new scissor type thread cutter was introduced by Draper about three years ago. It will fit any Draper loom. The new temple has fewer parts and permits cutting shorter ends after bobbin transfer.

Stafford Thread Cutter. This cutter is important with the automatic filling change. When the filling is changed the thread cutter enters a slot near the eye of the shuttle and cuts the thread of the ejected bobbin and withdraws the severed thread from the eye. The thread must be withdrawn or else it would enter the shed and cause a broken pick thread to be laid with the full thread of the new bobbin. After cutting the thread the Stafford cutter holds the thread for several picks or until the temple cuts the thread at the selvage.

Selvage Motion. The outer edge of cloth must be rather strong. This added strength is usually done by using ply yarn in the selvage or a yarn courser count than that used in the body of the cloth. Sometimes the selvage is made by putting two or three ends of the regular warp yarn in a single heddle. On plain goods selvage threads are drawn on same harness as the regular warp threads.

A tape selvage is used when the filling does not interlace with warp ends each pick. The tape selvage is a two up, two down weave. Different cams are used on each side of the loom to raise and lower the selvage. They are timed to change or interlace each time the shuttle is on their side. The tape selvage is necessary on other than plain goods to prevent tight selvage, which would result if the selvage ends interlaced with every pick.

Chapter V

Type of Looms

The loom as a weaving machine has undergone refinement continuously since it was introduced. The modern loom is a rather heavy machine of many parts. All parts and devices have an important function and all perform with a high degree of efficiency to make quality cloth of all kinds. The loom looks complicated, and is, to the uninitiated. After one has worked on or around them they seem much less complicated. It does, however, require a competent thoroughly skilled mechanic to repair them. This person is known as a loomfixer.

The loom consists essentially of shafts, levers, cams and gears, all of which must be set and timed properly for the loom to operate efficiently. The loom is of heavy rugged construction. It has to be built sturdily because of the nature of the weaving process. The motions of the loom are fast, violent, abrupt and rather noisy. A greater portion of the noise is made by the picking motion but other parts contribute to the noise. In the last few years shutterless looms have been introduced to eliminate to some extent the noise and to increase the efficiency of the loom. Several types of shutterless looms will be discussed later in this chapter.

Probably the most famous and the most universally used loom in the textile industry is the Draper E model. The forerunner of this loom was the Draper Northrop A model, the first fully automatic loom to be put on the market. The Northrop loom revolutionized weavings. Today, with the Draper E model, Draper X models or Crompton and Knowles looms a weaver may run 100 or more looms, depending upon the fabric made and a few other factors.

Draper Looms

The Draper E model loom is a cam loom used in weaving all ordinary fabrics requiring from 2 to 8 harnesses. This includes a large number of weaves but primarily narrow sheeting, wide sheeting, print goods, broadcloth, dimity, twills, satines, and a host of other fabrics are woven on this loom.

New and improved looms, changing styles and the use of synthetic yarns are causing the gradual replacement of the Model E, but it is still the conventional loom for many plain goods plants and will be so for many years to come.

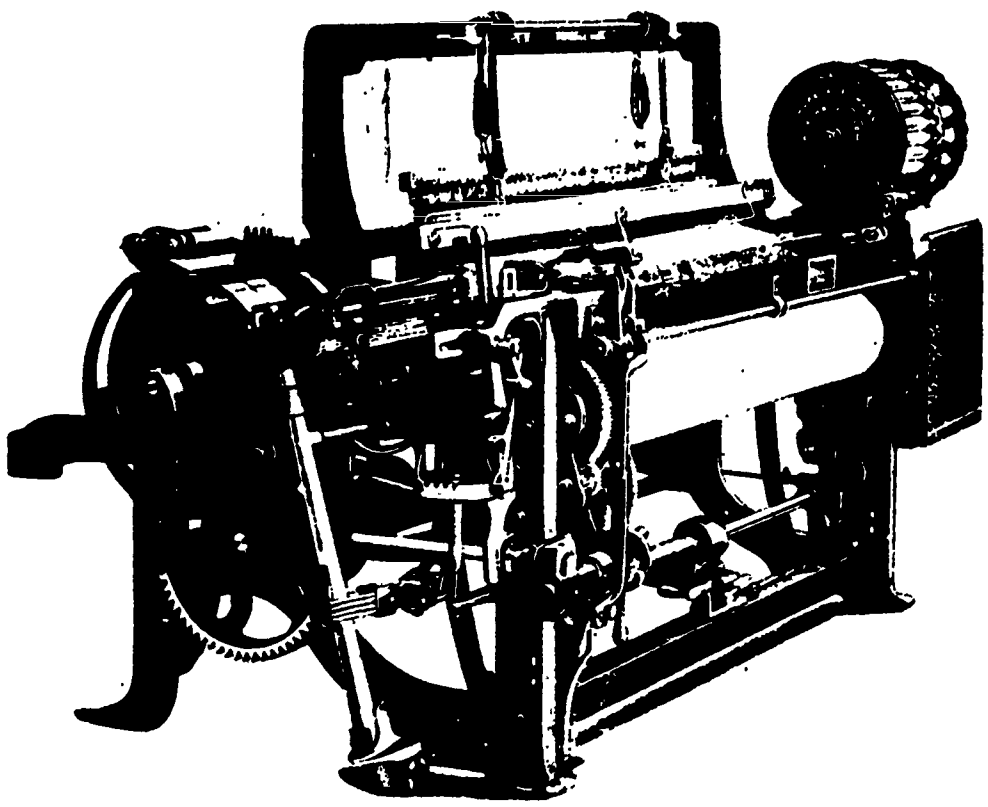


Figure 14. Draper E Model Loom
(Courtesy Draper Corp.)

Draper has made any number of looms for special use such as the models D, H, K, and L. However, the X family of looms are in general use and next to the E model, more of them are being used, perhaps, than any other loom. Several of the X family looms are illustrated with a brief statement of the types of cloth woven on them.

Looms following the Draper E model are better machines and have refinements that were introduced to meet changing trends in industry.

The X-2 loom is built to make cloth from 22" to 60" and is a high speed precision machine. It will take a beam head up to 32" in diameter. It comes equipped with rotary or magazine type battery (Draper Automatic Filling Magazine). It is a cam loom but dobby head may be used up to 16 harnesses. It is also adaptable for use of Jacquard head. This loom is widely used in the textile industry and stands up well under production conditions. A wide variety of cotton and synthetic weaves may be woven on it.

The Draper X-D is another type high speed loom. It was developed for weaving practically all types of continuous filament or spun synthetic yarns, blends, and fine cotton goods. It will

weave cloth up to 72" wide and a 2 x 1 box motion can be used on it. It is suitable for dobby work up to 25 harnesses. This loom, too, enjoys wide use in the textile industry, and is a worthy successor to the Model E. While the Model E could have and has been used for weaving synthetics, finer points, such as the center fork filling motion, makes the X-D loom much more adaptable for weaving fine goods.

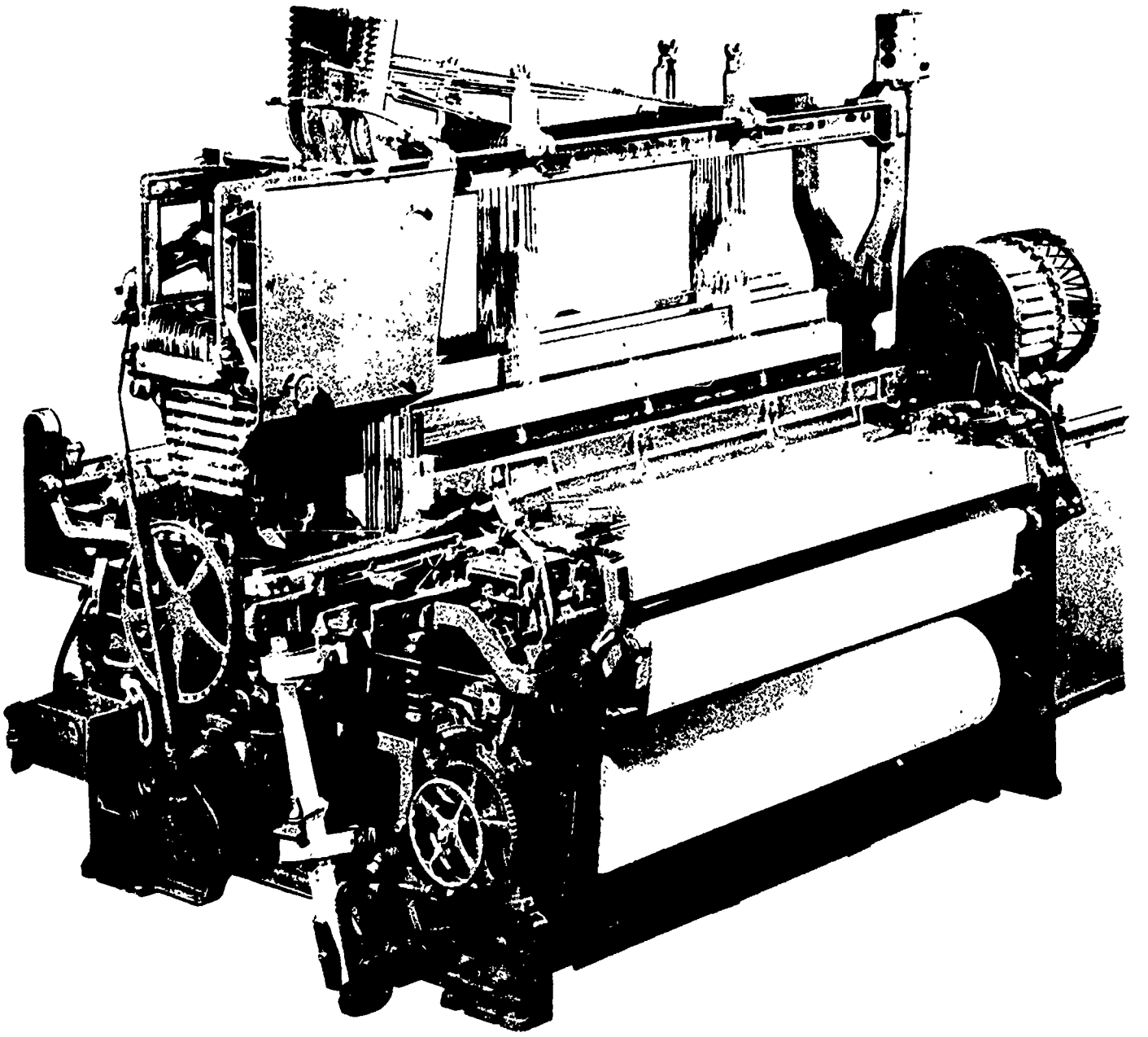


Figure 15. Draper X-3 Loom
(Courtesy Draper Corp.)

This loom was designed to weave all fabrics usually woven on the X-2 and many synthetics now woven on the X-D. In time it may supplant those two looms. It weighs about 500 pounds more than the X-2, which gives it good stability. It operates at 200 p.p.m. but the added weight, distributed well over the loom, is a factor making for smooth running even at this high speed.

The versatility of this loom and its ability to operate at high speed makes it a real competitor for any loom made.

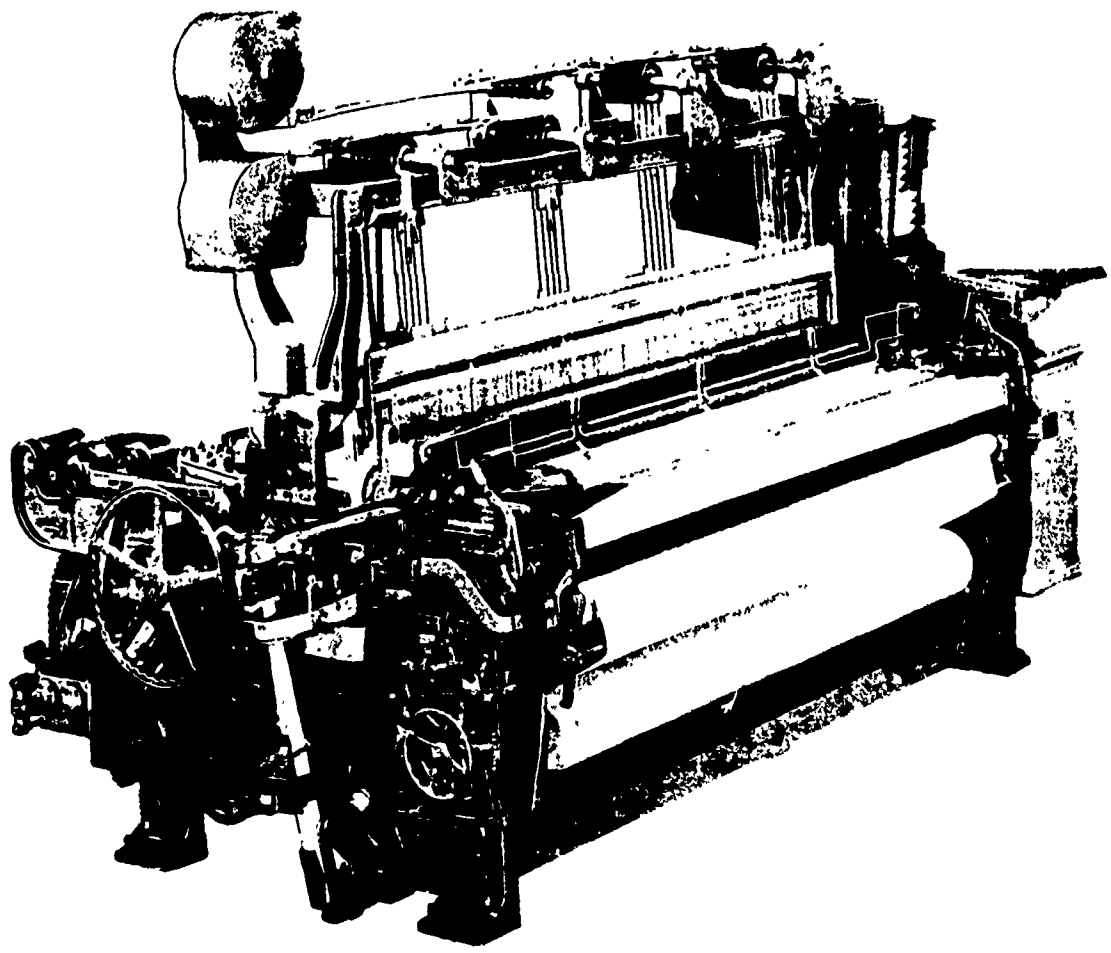


Figure 16. Draper X-B Loom
(Courtesy Draper Corp.)

This new Draper is designed to weave heavy suiting. It will make 175 p.p.m.

Crompton and Knowles Looms

Another famous manufacturer of looms is the Crompton and Knowles Corporation. This company makes all kinds of special looms, including box looms, as well as looms that may be used for making ordinary fabrics. The company also makes dobby heads, Jacquard heads, and multipliers, all of which will be discussed later.

The illustrations of Crompton and Knowles looms show dobby heads and boxes because most looms they make are used by plants making fancy goods or ginghams. The Crompton and Knowles loom is a well built production machine. The company has been one of the leaders in developing looms for weaving special fabrics and has introduced many innovations and improvements for looms, which have increased their efficiency in making good cloth.

Most Crompton and Knowles looms use a magazine type bobbin change although the magazine or rotary battery type is optional on many of their models.

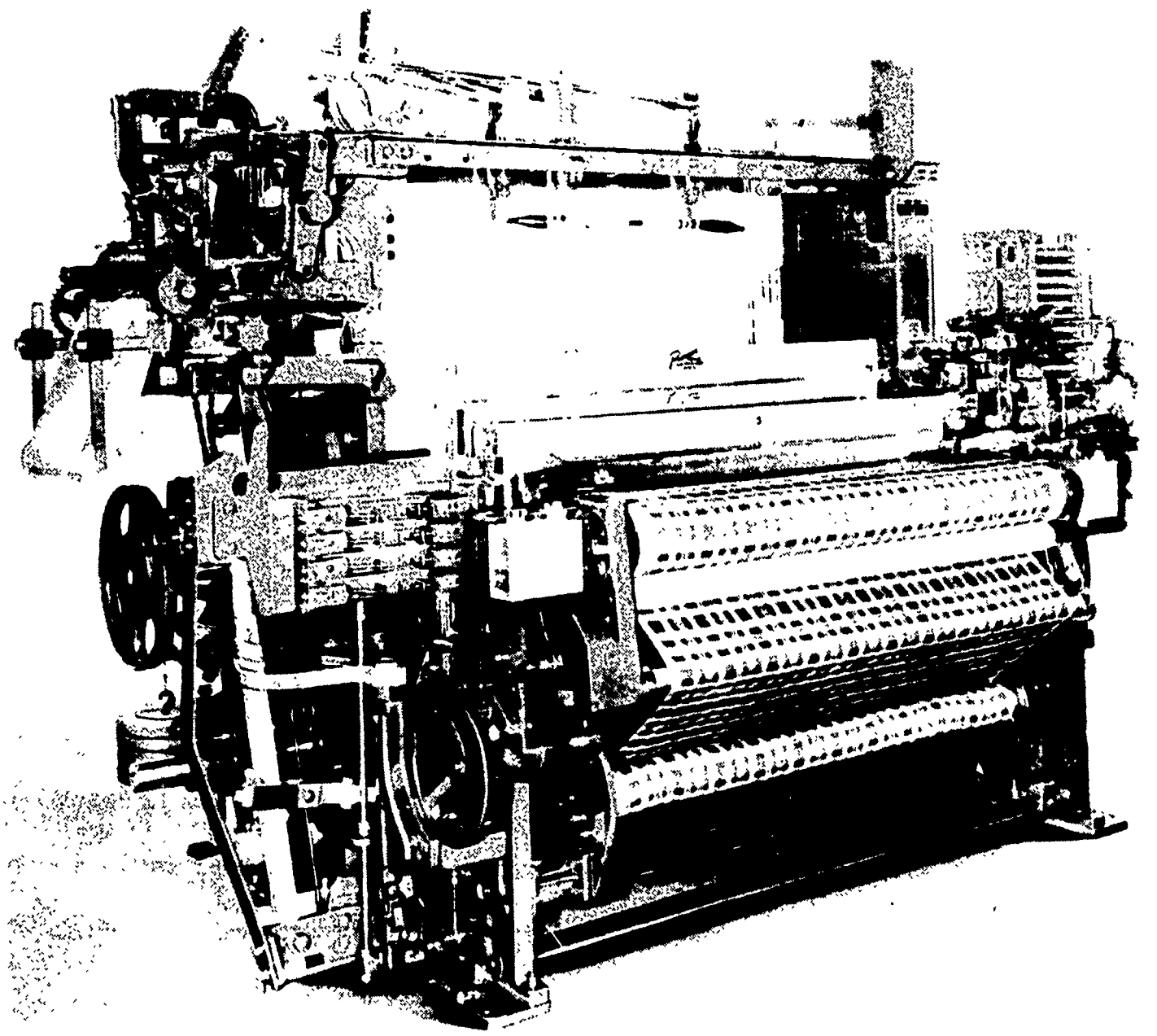


Figure 17. Crompton and Knowles C-7 Loom
(Courtesy Crompton & Knowles Corp.)

Figure 17 shows a front view of Crompton and Knowles' newest loom, the C-7 for dress goods. Notice boxes on left and dobby head on left above the boxes. Also notice the magazine type bobbin change on right of loom.

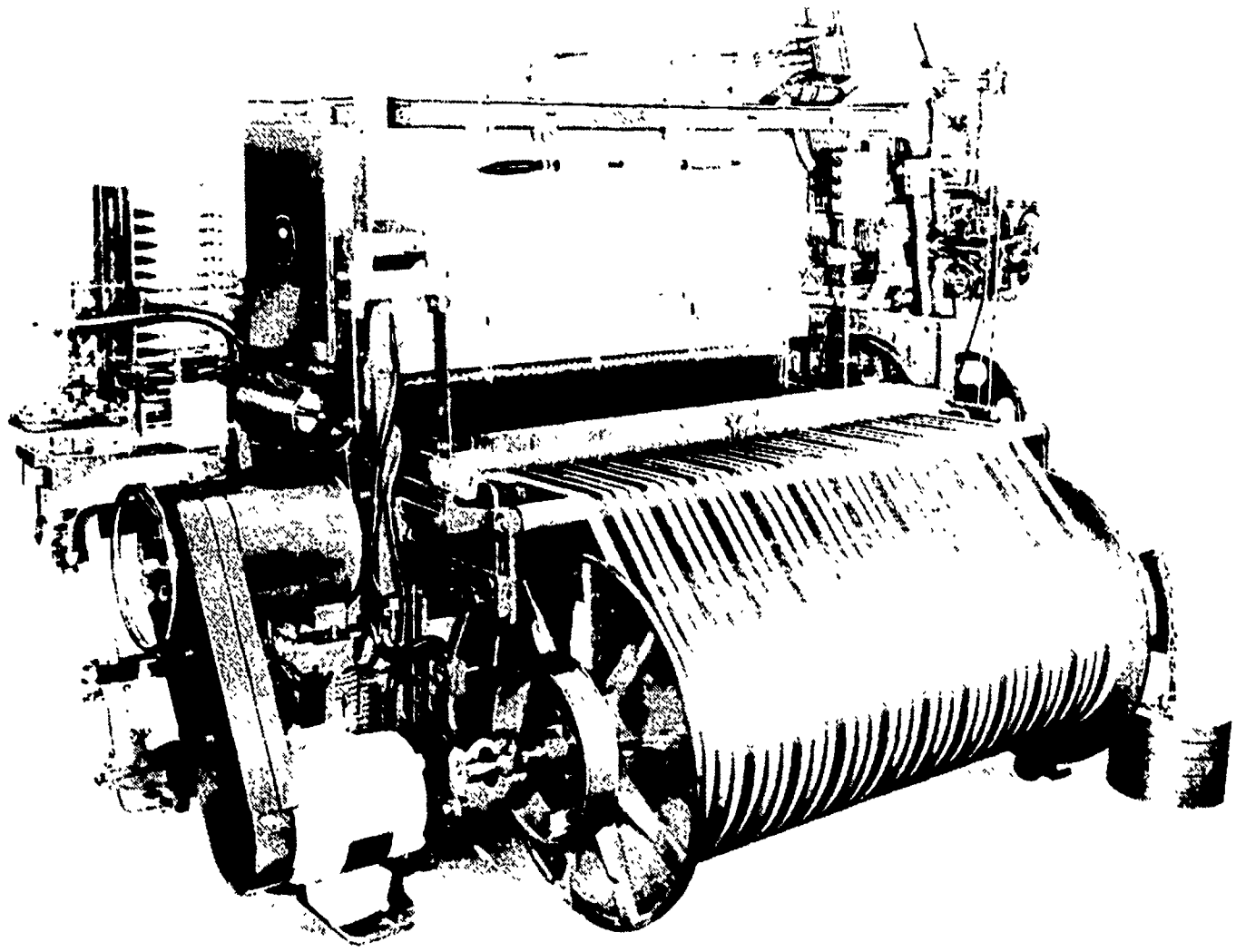


Figure 18. The Crompton a Knowles Loom

(Courtesy Crompton & Knowles Corp.)

The rear view of the C-7 shows its sturdiness. Notice how the threads from the bobbins in the magazine are held. Just underneath the electric control box on the left upper frame of the loom is the pump that controls the vacuum for disposing of the filling ends from both the ejected bobbin and the newly transferred bobbin so that ends will not be accidentally woven into the fabric.

Notice also the motor hook-up and the weights working on an arm to control let-off.

c - 7 Terry Towel

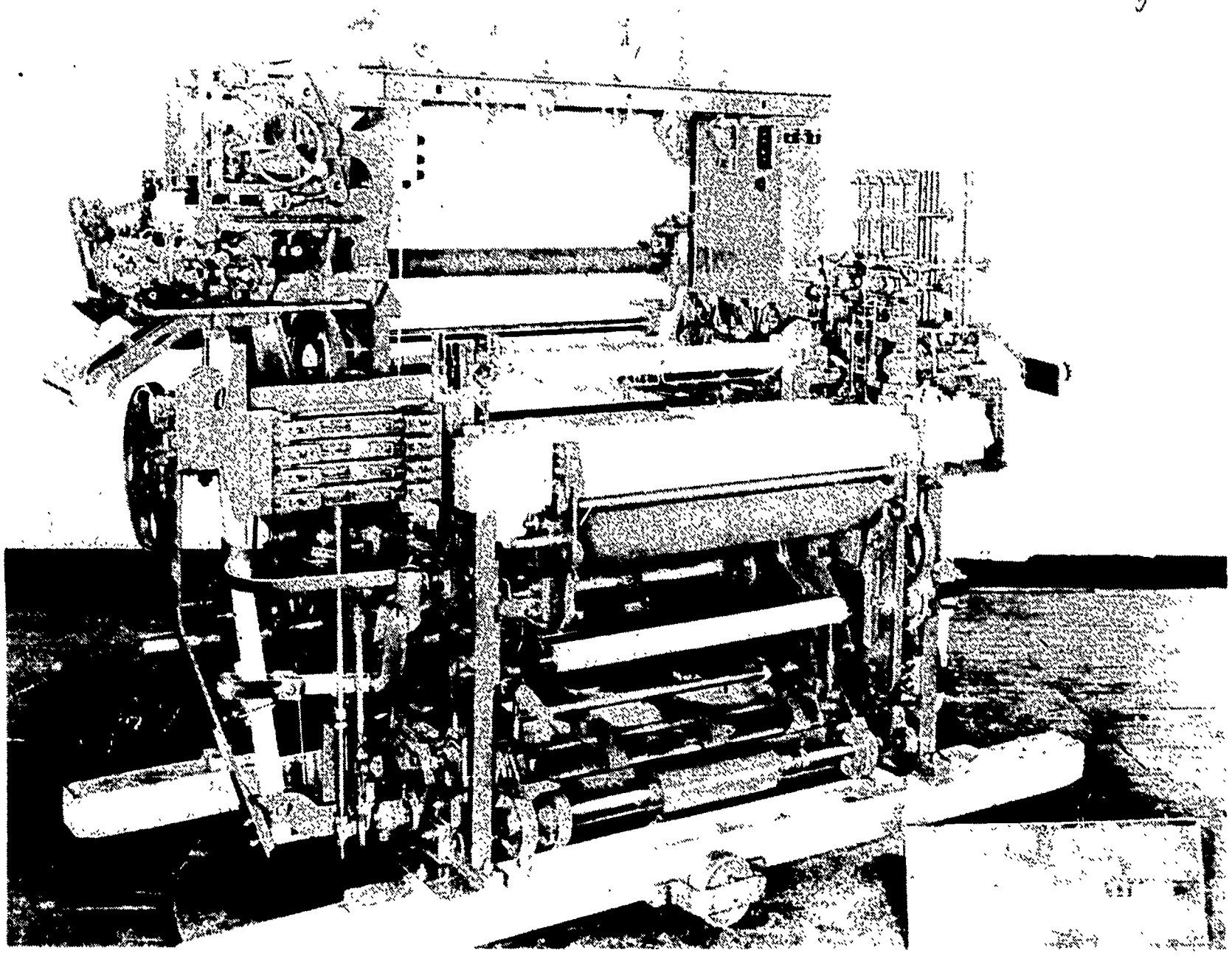


Figure 19. Crompton & Knowles Terry Towel Loom
(Courtesy Crompton & Knowles Corp.)

This is a heavy rugged type loom used for weaving terry towels. The loom is equipped to handle two warps, one in normal position and the other mounted over it. This is a 4 x 1 box loom, with center fork stop and filling change. This is a new model loom and made to meet the demands of plants making terry toweling.

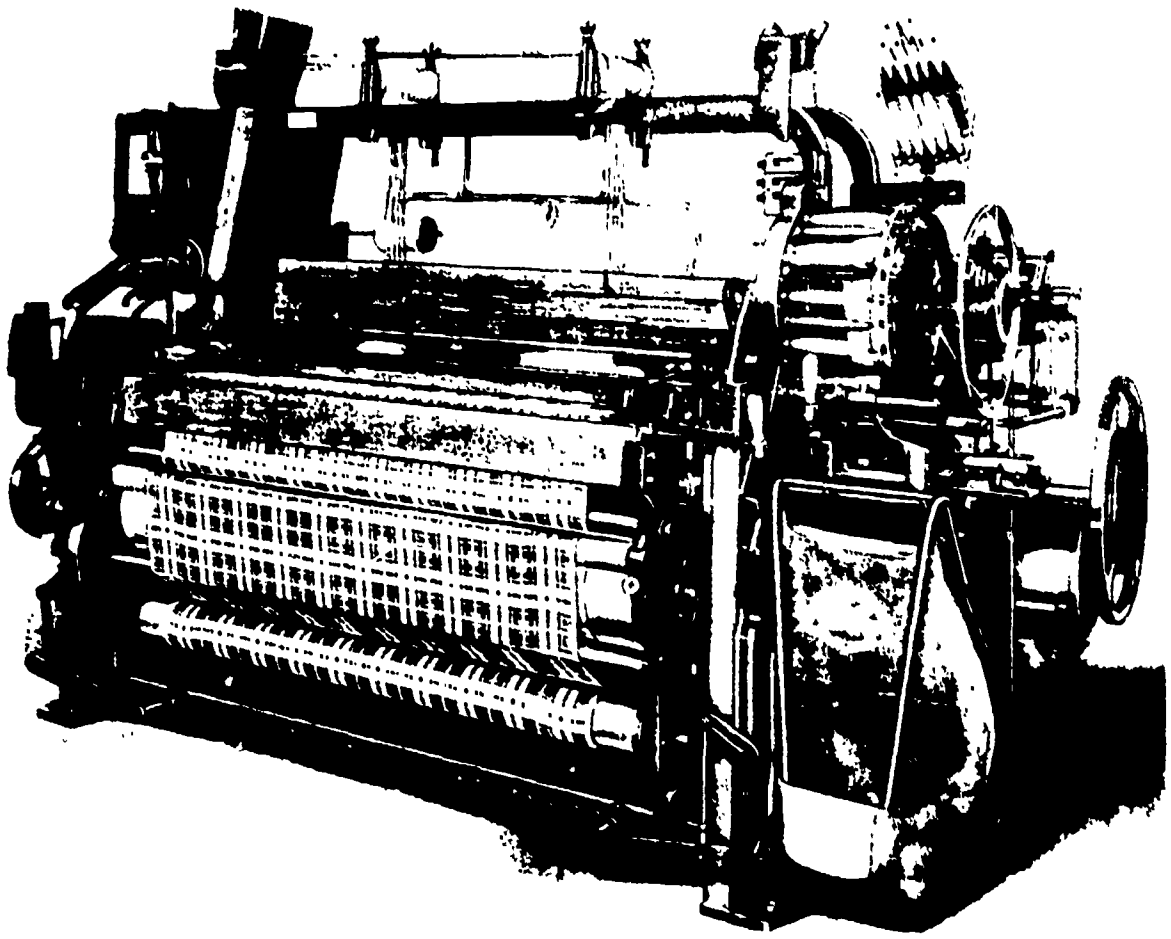


Figure 20. Crompton & Knowles MP Loom
(Courtesy Crompton & Knowles Corp)

The MP loom is one of the newer Crompton and Knowles looms. Notice the rotary type magazine, the thread holder, and the vacuum accumulator for disposing of yarn from ejected bobbin. Also notice the bag for receiving ejected bobbins. This loom is made in sizes from 48" between swords to 92", comes with 2 x 1 or 4 x 1 boxes, but may be converted to 1 x 1.

Box Looms

When it is desired to weave a cloth in which it is necessary to put more than one kind of filling, some method of inserting the filling must be used that differs from that found on a loom which carries only one shuttle and has but one box at each end of the lay. A loom made for this class of work is known as a box loom.

The principle of these looms is to have shuttle boxes at one or both ends which are generally operated by levers and other suitable mechanisms that will move the bottom of the desired box in line with the race plate of the loom and thus allow the picker to throw the shuttle contained in that box. By this means, several shuttles containing different kinds of color or filling can be operated, and the one to be used selected automatically by the box motion. The box motion that we are interested in is known as the drop-box motion.

In speaking of box looms, the number of boxes is designated by the number of boxes at each end of the lay with a multiplication sign between such as 4 x 1, or 4 x 4, etc. This means that the loom has four boxes on one end and one on the other, or four boxes on each end.

The boxes are arranged directly over one another and are so connected to the end of the lay that they can be easily moved up or down without much resistance to the motive power of the loom. Because the boxes receive an up and down motion, some means must be provided by which the picker may be brought out of contact with the boxes while the boxes are being lifted and lowered. This is done by having a recess at the end of the lay in which the picker rests during the time that it is set in motion. The picker used at this end of loom is much different from those used on looms without drop-boxes.

Boxes for different color filling are found on cam looms, looms using dobby heads or on Jacquard looms. Without a suitable motion to control the boxes or to put a given shuttle in position to make a determined number of picks of different color filling the use of color filling-wise would be limited to one. An understanding of the box motion is important for those studying textiles.

The Crompton and Knowles loom comes to mind when box looms are mentioned, although Draper makes a box loom. However, Crompton and Knowles have specialized in box looms and dobby heads and the box motion of the Crompton and Knowles will be described along with the multiplier used on box looms.

A box motion for selecting the filling yarn desired in color or size is the important feature of the Crompton and Knowles looms. The student should understand the principle of operation and should know something about the settings and adjustments of the box motion.

The 4 x 1 box motion is perhaps the most commonly used and will be described. It is commonly used on the Crompton and Knowles Type C loom with a dobby head.

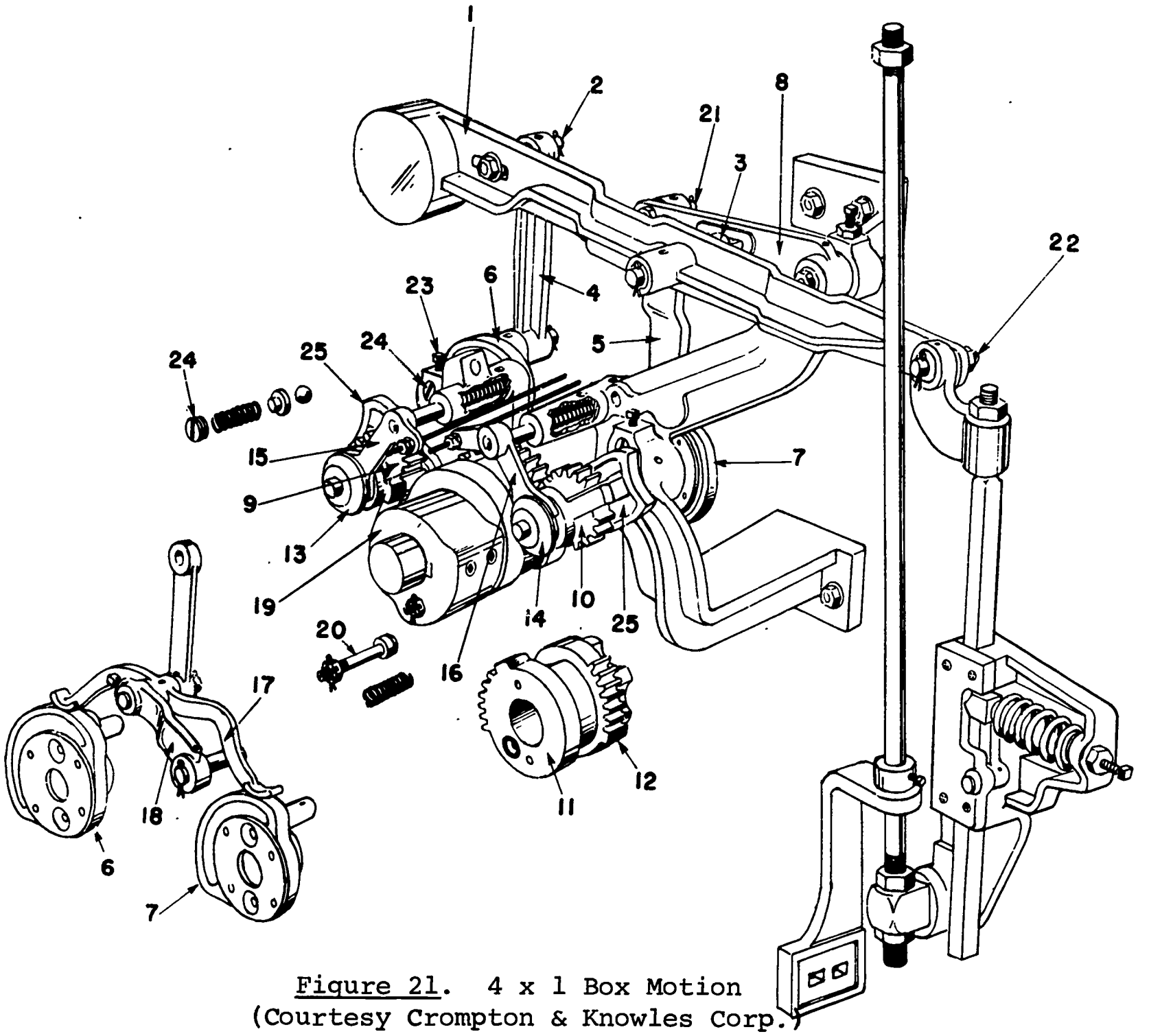
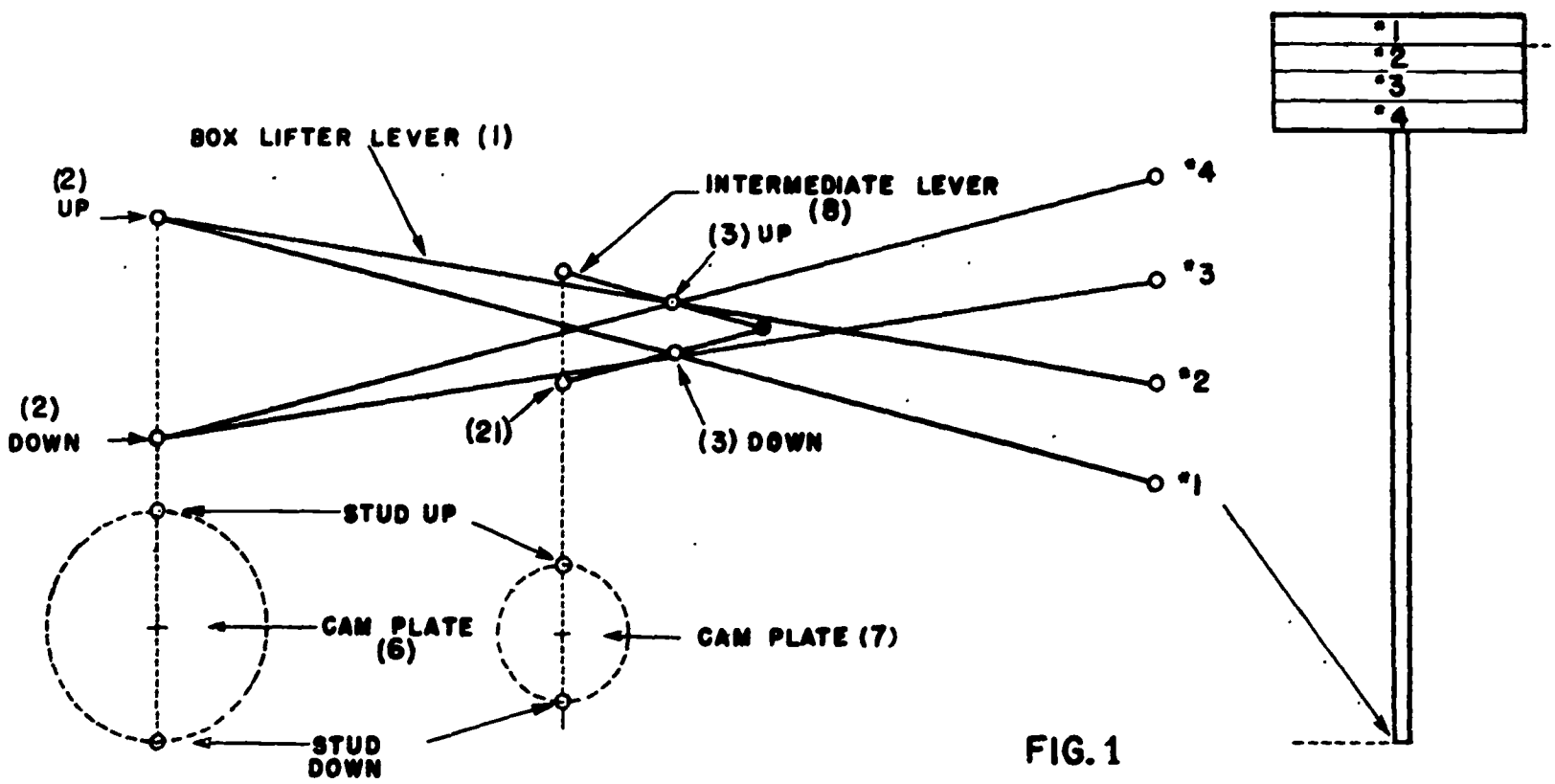


Figure 21. 4 x 1 Box Motion
(Courtesy Crompton & Knowles Corp.)

To understand the principle of the box motion and its setting one must have a knowledge of the lever system by which the movements of the boxes are controlled. Follow explanation of box motion by referring to Figure 22. Only two levers are used to control the boxes: the box lifting lever 1 and the intermediate lever 8. Motion of lever 1 around stud 2 will lift the box one cell. Motion of box lifter lever 1 around stud 3 will lift box two cells. A box can be brought to any desired cell level by a combination of motions by box lifting lever 1 around studs 2 and 3. Intermediate lever 8 controls position of stud 3.



THE 4 x 1 BOX MOTION

Figure 22. The 4 x 1 Box motion
(Courtesy Crompton & Knowles Corp.)

The connectors 4 and 5 control motion of box lifting lever around studs 2 and 3. The connectors are controlled by motion of studs in cam plates 6 and 7. The position of the shuttle box, then, is controlled by position of studs in cam plates 6 and 7.

Motion of stud in cam plate 7 is transmitted to center 3 by intermediate lever 8. Any motion of stud in cam plate 6 is transmitted directly to center 2.

To move the cam plate studs from top to bottom, which control the position of the shuttle box, cam plates 6 and 7 must be rotated 180°. This is done by meshing pinions 9 and 10 with the mutilated driving gears 11 and 12. Sliding teeth 13 and 14 cause the mutilated gears 11 and 12 to mesh with pinions 9 and 10. When the sliding tooth is held against the pinions, the tooth on one side will mesh with the driving gear, causing the stud to be turned to one position. When the sliding tooth is released to its outer position, the tooth on the other side will meet with driving gear and the stud will be rotated 180°.

The movement of the sliding teeth to inner and outer positions is controlled by indicator fingers 15 and 16. The fingers are controlled by connections to the box motion indicator.

The diagrammatic sketch, Figure 22 will assist in understanding of the lever actions. Study Figure 22 and determine that the cam plate studs should be as follows to call the various cells:

Call desired at race plate level		Position of stud in cam plate 6	Position of stud in cam plate 7
Top or	No. 1	up	down
	No. 2	up	up
	No. 3	down	down
Bottom or	No. 4	down	up

The position of the sliding teeth for calling the different cells are:

Call desired at race plate level		Position of sliding tooth 13	Position of sliding tooth 14
Top or	No. 1	out	out
	No. 2	out	in
	No. 3	in	out
Bottom or	No. 4	in	in

The box motion is connected to the magazine through a color control mechanism. This assures that indication will occur on the proper call as determined by the box and shuttle then at race plate level. Color indication is given by means of cam plates 6 and 7, which actuate lever 17, which in combination with lever 18, keeps the color indication rod on the magazine in phase with the box motion.

Safety devices are provided in the box motion to prevent breakage of parts, if, for some reason, the boxes hang up.

Timing Box Motion. The motion of the box should take place only during the proper interval in the loom cycle. This is important and should be checked by turning the loom by hand after any adjustment of the motion. The most important consideration is that the box must complete its movement before the pick has started.

The box motion is timed by means of box motion driving gears 11 and 12 and collar 19. For timing loosen collar and turn loom to top center position just preceding a pick from the drop box end. Then turn the driving gears so that as the sliding teeth go in and out they barely clear the last tooth on the driving gear. With plunger mating firmly with recess of driving gear, tighten the collar.

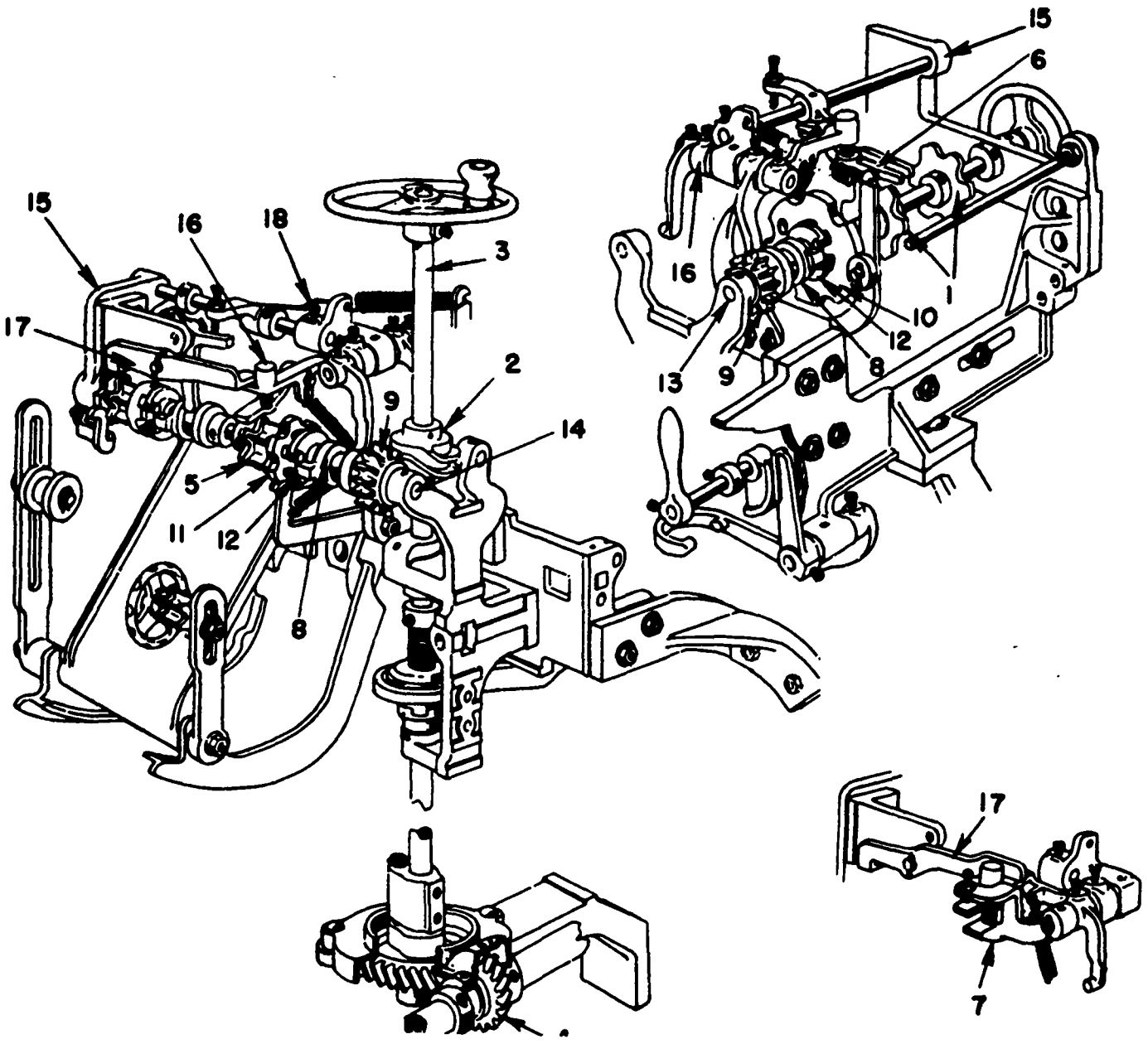


Figure 23. Box Motion Indicator and Multiplier

(Courtesy Crompton & Knowles Corp.)

Box Motion Indicator. There must be some means of calling for different colors of filling in using the box motion so a box motion indicator is provided to do that. It is a mechanism which controls the selective operation of the multiple cell box motion. It is also used to indicate or control other loom mechanisms which can be operated from the box chain. The indicator works with the multiplier, a device used to reduce the length of the box chain required to weave designs calling for wide filling stripes. See Figure 23 which shows both the box motion indicator and the multiplier.

The indicator works as follows: the box motion indicator chain cylinder (1) is driven by worm (2), which is pinned to vertical shaft (3), and which, in turn, is driven by gear (4) on the crankshaft at the head end of the loom. Gear (4) controls the timing of the box motion indicator with respect to the rest of the loom mechanism.

The box chain consists of rolls and tubes. As the chain revolves with the box cylinder, the rolls and tubes contact the indicator fingers causing them to be either raised or lowered. It is this motion that controls the motion of the shuttle boxes.

Incorporated in the box motion indicator is a device known as the multiplier, the function of which is to stop the chain on any bar for a certain number of picks and then start the chain in motion again.

Multiplier Chain (5) is located on the opposite side of shaft (3) from box chain cylinder (1) but is also driven by worm (2). Box chain cylinder (1) must move without interference from the multiplier chain. The box chain cylinder should start to move as the lay comes to protection position after the shuttle has been picked from the head end of the loom. Since the crankshaft makes two revolutions while shaft (4) makes one revolution each roll on the box chain and each link on the multiplier chain holds the box in a given position for two picks.

In the box motion indicator mechanism when a riser roll placed in the second space from the right link of the box chain comes into position on the top of box chain cylinder (1), it will lift finger (6), which controls the multiplier chain cylinder clutch. This action engages the clutch and as the lay reaches protection position following the next pick, multiplier chain cylinder (5) will turn. This will roll a high link of the multiplier chain out from under follower finger (7) which is pulled downward by a spring. The finger controls clutch (8) on box chain cylinder (1). The movement will disengage the clutch and cause box chain cylinder (1) to stop and remain stationary until another high link of the multiplier chain comes into position under finger (7). At this time finger (7) is raised and will cause clutch (8) on the box chain cylinder to engage. This action rotates the riser from under finger (9), thus disengaging clutch (8) on the multiplier chain cylinder.

Multiplier. On the 4 x 1 box loom it will be seen that each shuttle multiplier will insert at least two picks of filling because it will be necessary for the shuttle to always return to the side with four boxes before another shuttle can insert filling. One bar of the box chain serves for only two picks of the loom; therefore, if the pattern being woven contains a large number of picks of each

color, it will be necessary to build a very long chain. To overcome this difficulty, a mechanism known as the multiplier motion is applied to the box loom. If it were desired to make a pattern with 24 picks of blue, a roll would be put on the box chain to indicate the multiplier motion and instead of having 12 bars with two picks each, two bars with the multiplier motion working would give the 24 picks. An explanation of how the multiplier operates was given in explaining operation of box motion indicator. Refer to Figure 23 to study the mechanism.

Box chains are built from pattern drafts which show the number of picks of each color in one repeat and the order in which they are placed in the cloth.

Dobby Heads

Cam looms can use only 7 or 8 harnesses so necessarily the weaves made on cam looms are limited. To increase the number of harnesses and to provide for their motion a dobby head is used. A dobby head is made to handle from 8 to 32 harnesses. They are made to go on any type of loom, automatic or nonautomatic. Their use increases greatly the range of pattern design without interferring with efficient loom operation.

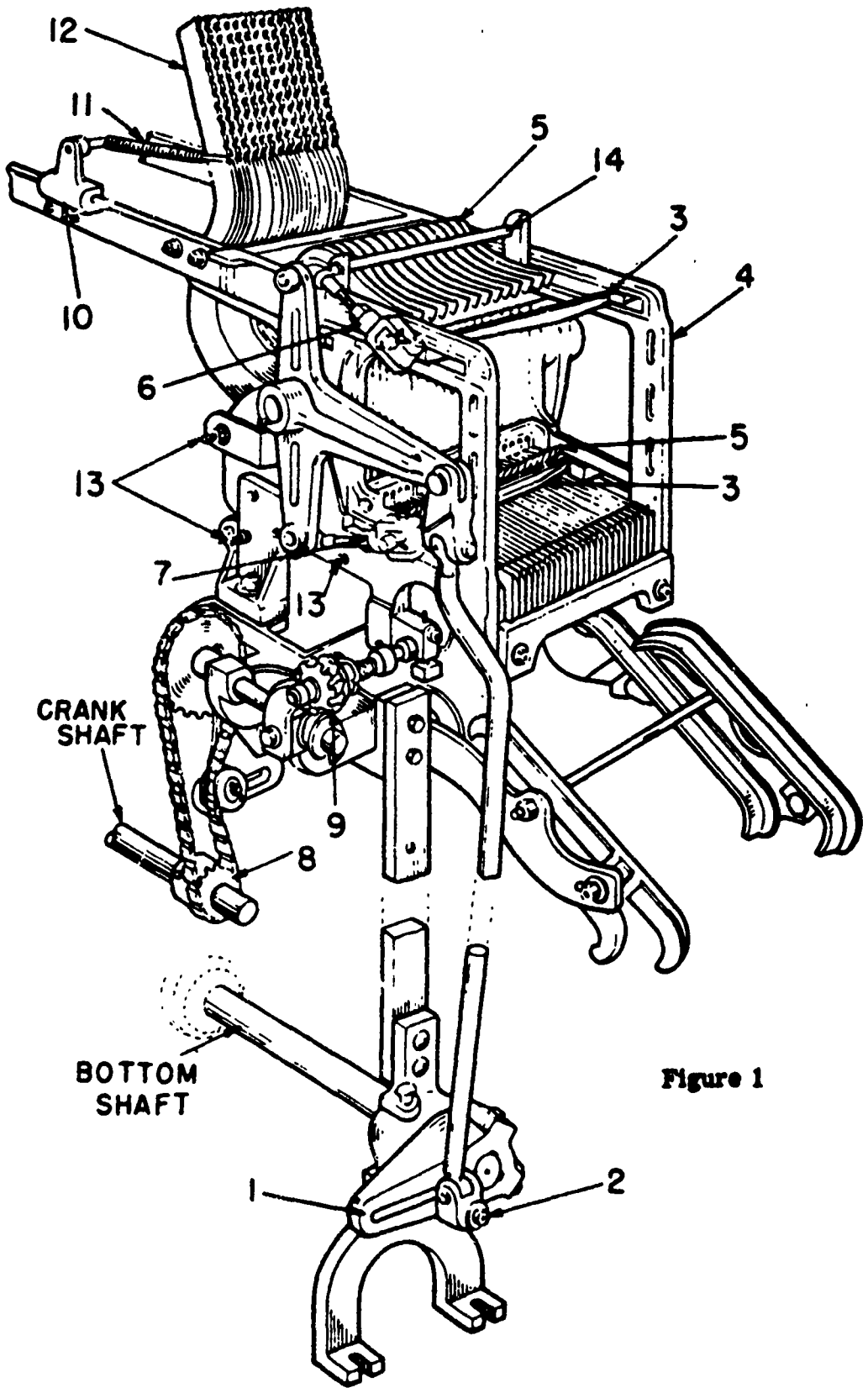
Dobbies are either single index or double index; some have a double cylinder and some have a two-weave motion.

The dobby is a frame placed on one side of the loom at top. It consists of a number of levers equal to the number of harnesses used. Each lever is connected at one end to its corresponding harness and the other end is arranged to be pulled on at the required time by an oscillating bar worked from the bottom shaft of the looms.

The method of drawing the warp ends through the harness is the same for a dobby loom as for a cam loom. The arrangement is determined by the weave desired and drawn according to the drawing-in draft. Dobby weaving is more complicated than plain weaving; therefore, a weaver cannot run as many dobby looms as plain looms.

Operation of Dobby. The dobby usually receives its motion from the camshaft through a rod known as the driving rod to the rocker arm on the back of the dobby. This rocker arm is connected to the front rocker arm by a rod or rocker shaft. The top and bottom knives are connected to the rocker arms by connecting rods.

S-6 DOUBLE INDEX DOBBY

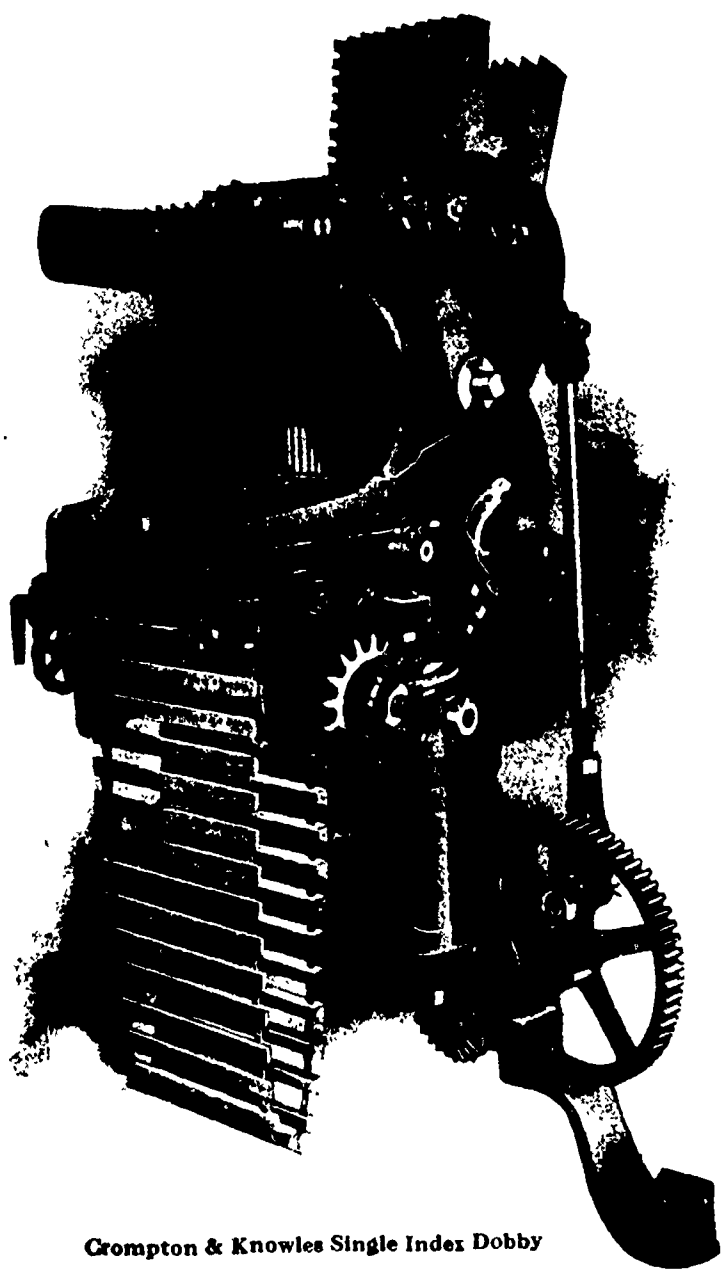


1. Dobby Drive Crank
2. Stud
3. Dobby Knives
4. Dobby Frame
5. Hooks
6. Connectors
7. Connectors
8. Sprocket
9. Worm Gear
10. Stand
11. Spring
12. Jack
13. Set Screws

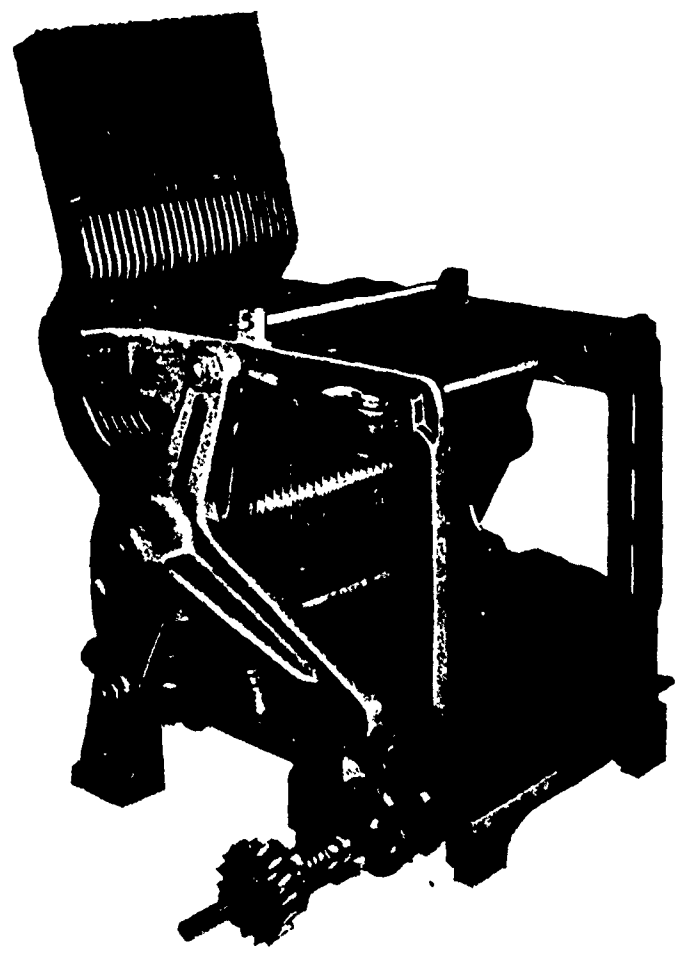
Figure 24. Double Index Dobby
(Courtesy Crompton & Knowles Corp.)

To the center of the harness levers are connected the jacks and the jacks are connected to the top and bottom hooks. The hooks are worked from the pattern chain with pegs through the index fingers and needles. The harnesses are connected to the harness lever by harness lever hooks, leader wires, and straps. To raise the desired harness, pegs are placed in the pattern chain which raise the index fingers at the large end and lower them at the small end. This, in turn, lowers the top or bottom hooks which are caught on the top or bottom knife, and when the knife is moved toward the end of the loom, the harness is raised. Empty spaces in the pattern chain indicate the harness is to remain down.

Reference to Figure 24 gives the nomenclature of the dobby and shows the drive. Students may easily follow through the operation by studying the figure.



Crompton & Knowles Single Index Dobby



Crompton & Knowles Double Index Dobby
Type 6

Patented June 23, 1931

[14]

Figure 25. Single Index and Double Index Dobby
(Courtesy Crompton & Knowles Corp.)

Single Index Dobby. This dobby has only one set of indicator fingers and only one row of peg-holes in each bar of the harness pattern chain. The chain revolves, advancing one bar with each pick of the loom. (Figure 25)

Double Index Dobby. This dobby may be said to be a double single index. It has two rows of peg holes on each bar of the harness pattern chain and two sets of indicator fingers. (Figure 25)

One row of pegs indicates for the top set of hooks and the other for the bottom. The pattern chain in this case advances one bar each two picks of the loom. The double index dobby will require only half as many bars in the chain as the single index weaving the same pattern. This dobby is particularly suited for weaving long patterns for that reason.

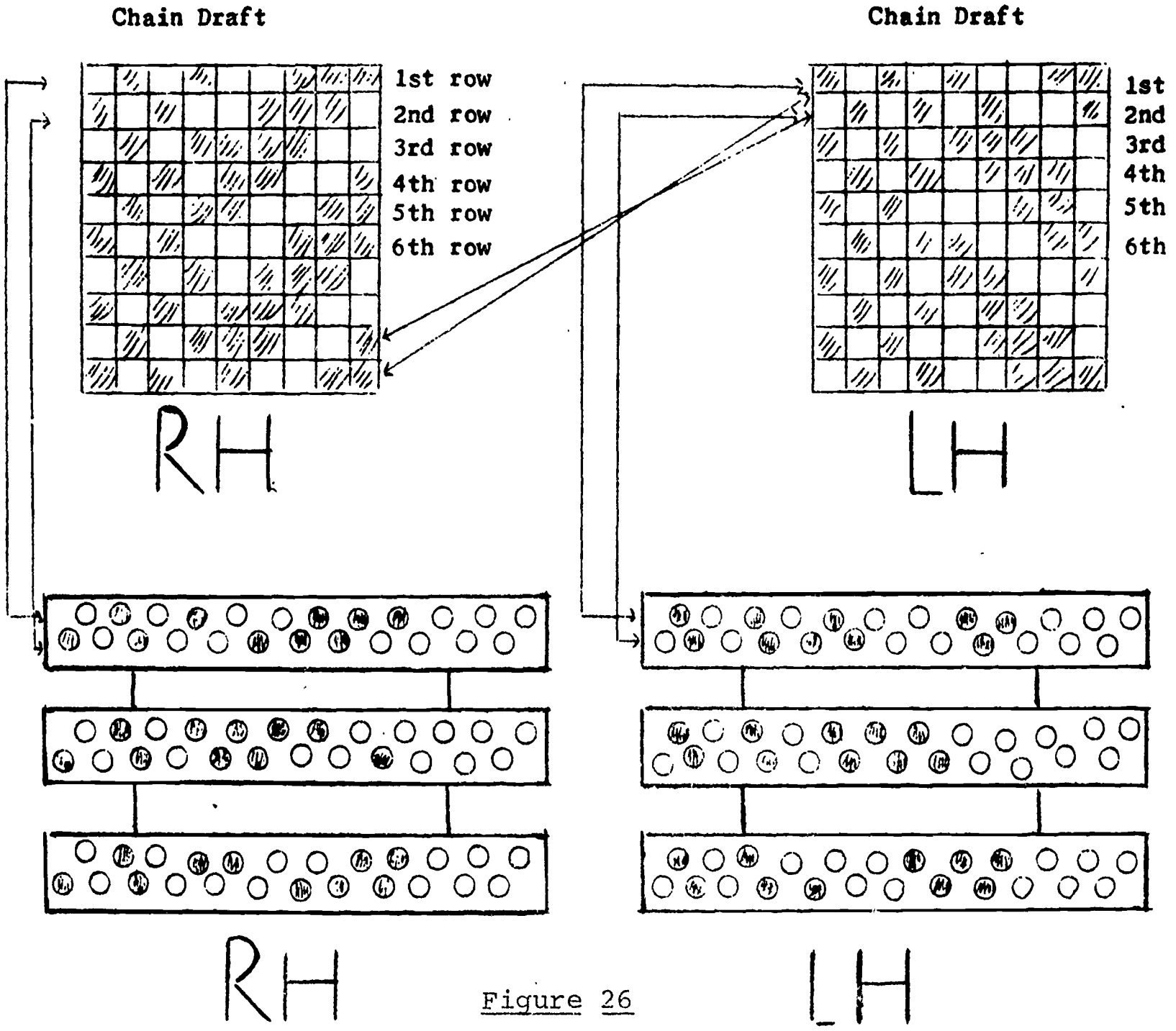


Figure 26

Pegging Pattern Chain. The pattern chain controls the pattern because the pegs in the chain raise the harness. Empty spaced in pattern chain indicate the harness to remain down. The method of raising and lowering the harness, is shown on the chain draft and from this draft the pattern chain is pegged. In pegging a pattern chain, two things must be considered: first, whether it is for a left-hand or right-hand dobby; second, the direction the chain barrel revolves. A right-hand dobby is one that is placed on the left-hand side of the loom, as one faces the front of the loom, the barrel turning to the right. A left-hand dobby is one that is placed on the right-hand side of the loom as one faces the loom, the barrel turning to the left.

When pegging a pattern chain, always read the chain draft from left to right and down, and peg from left to right and down. The designer should always make a right-hand or a left-hand chain draft, depending upon the dobby.

To remove a pattern chain from the dobby cylinder, turn chain to the first bar of the pattern and spread the chain link with an awl or screw driver by forcing it into the chain link. Turn the cylinder and the chain will come out.

When the filling breaks on a dobby loom, it is necessary to match the filling (find loose pick). This can be done by taking the shuttle out and turning the pattern chain back three bars, then turn the crankshaft over one pick at a time until the loose pick is in the shed. After each pick, stop the lay with the shed open. If necessary, let the cloth back until it touches the reed, then pull the warp back until tight. Put the shuttle in the proper box and start the loom.

Dobby Multiplier. It has been mentioned that the double index dobby uses only half as many bars on the pattern chain as the single index and on long pattern this is a consideration always given. Even with the double index there are patterns that take an excessively long chain. By use of a dobby multiplier further reduction in the length of the pattern chain may be made. There are two conditions that must be observed: the dobby must be equipped with double index fingers, and the cylinder must be driven by a worm.

The multiplier is useful only on fabrics that have a warp stripe, such as handkerchiefs. The upper cylinder carries only the chain bars that control the warp stripe. Not more than twelve bars can be used with the multiplier. This multiplier has an upper cylinder which carries chain bars that only control the warp stripes. The fingers above the upper cylinder are connected to the regular fingers directly under them by cords so that the actual indication to operate the dobby levers is accomplished in the regular manner.

Each double index chain bar on the upper cylinder has both rows pegged alike. The bar is turned one bar each pick, which is equal to one bar every two picks if pegged double index. When putting in a cross border such as in handkerchiefs, the multiplier turns the cylinder once only one bar every two picks. The result is two picks to a shed where the cross and lengthwise border meet.

Paper Indicator. The paper indicator results in considerable savings to a plant. It eliminates the box motion indicator and multiplier, and eliminates wood dobby pattern chains and pegs. The fact that paper is inexpensive and patterns are easily stored is another important reason for the acceptance of the paper indicator. It also reduces by about 75 per cent the length of pattern, depending somewhat on the pattern.

Crompton and Knowles claim further that the paper indicator eliminates fabric defects often caused by improperly pegged pattern chains, reduces load on dobby when weaving long patterns, and positive synchronization between box and harness motion is assured since indications for both motions are included on the same paper pattern. The paper indicator enables patterns to be changed quickly and easily; it is easily adjusted and maintained.

The pattern must be punched in the paper. A punching service is operated by Crompton and Knowles for plants that do not care to do their own punching.

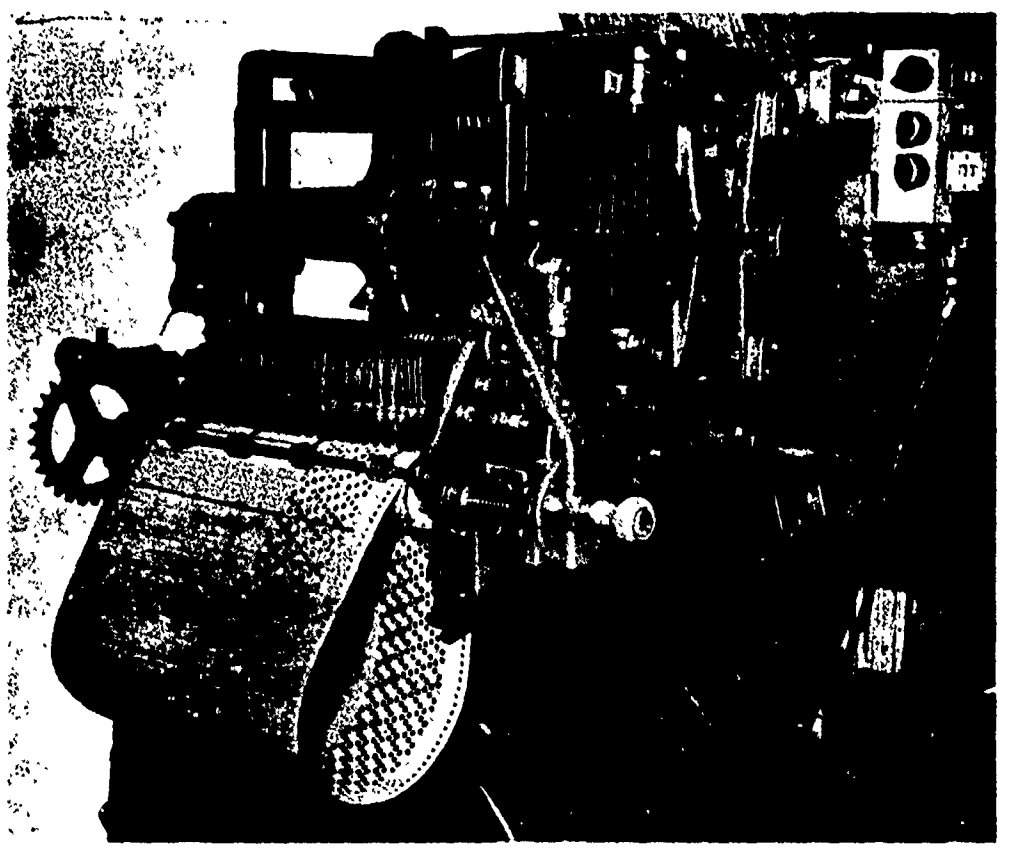


Figure 27. Paper Indicator on Loom
(Courtesy Crompton & Knowles Corp.)

PAPER-INDICATED DOBBY ATTACHMENT

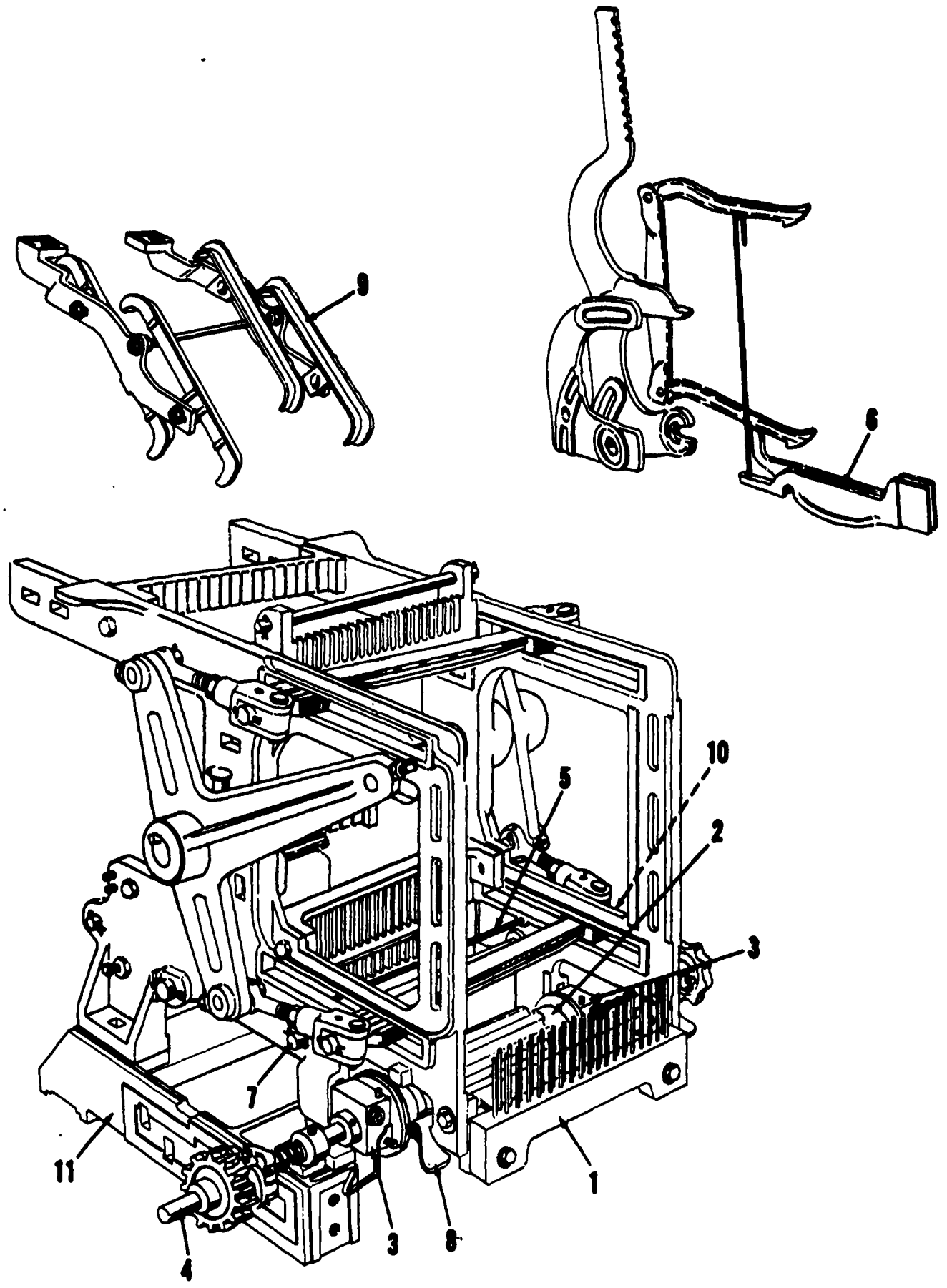


Figure 28.

Nomenclature of Paper I[illegible]cor. Figure 27 shows paper indicator used with double index dobby head. (1) wood rack, (2) wood cylinder, (3) bearing, (4) cylinder shaft, (5) wire stop, (6) indicators, (7) indicator finger shaft, (8) evener comb, (9) chain guide, (10) drip fan, (11) bracket.

Two Weave Dobby And Multiplier. This is about the same as two single index dobbies controlled by one harness chain. By this device two different weaves may be combined in the same harness and either weave may be called by indication from the box pattern chain.

Jacquard Loom

The Jacquard loom is one in which the number of harnesses is limited only by the number of ends in the warp. Each warp thread is controlled by a card, a punched card and cylinder. The pattern desired is punched on cards and mounted on a frame. As the cylinder revolves, the cards turn on it. Needles go through the perforations in the card and raise warp threads in combination to produce the desired pattern.

The Jacquard loom was named for Joseph Marie Jacquard of Lyon, France, who perfected it in 1804. The loom is used for weaving intricate figures, which are beyond the capacities of dobby heads. There are many types of Jacquards but the direct lift, single cylinder is by far the most common.

Special Looms

There is a loom for about every purpose, such as for making tape, bands, ribbon or carpets. These are special looms weaving special fabrics and do not require discussion here. All these type looms have the same principle of operation as all other looms. Several illustrations of different types of looms are given for information to students and so that they might compare them with conventional type looms.

There are several types of narrow looms or machines, such as used for making ribbon, braids and the like. A typical special loom is the needle loom illustrated in Figure 29.

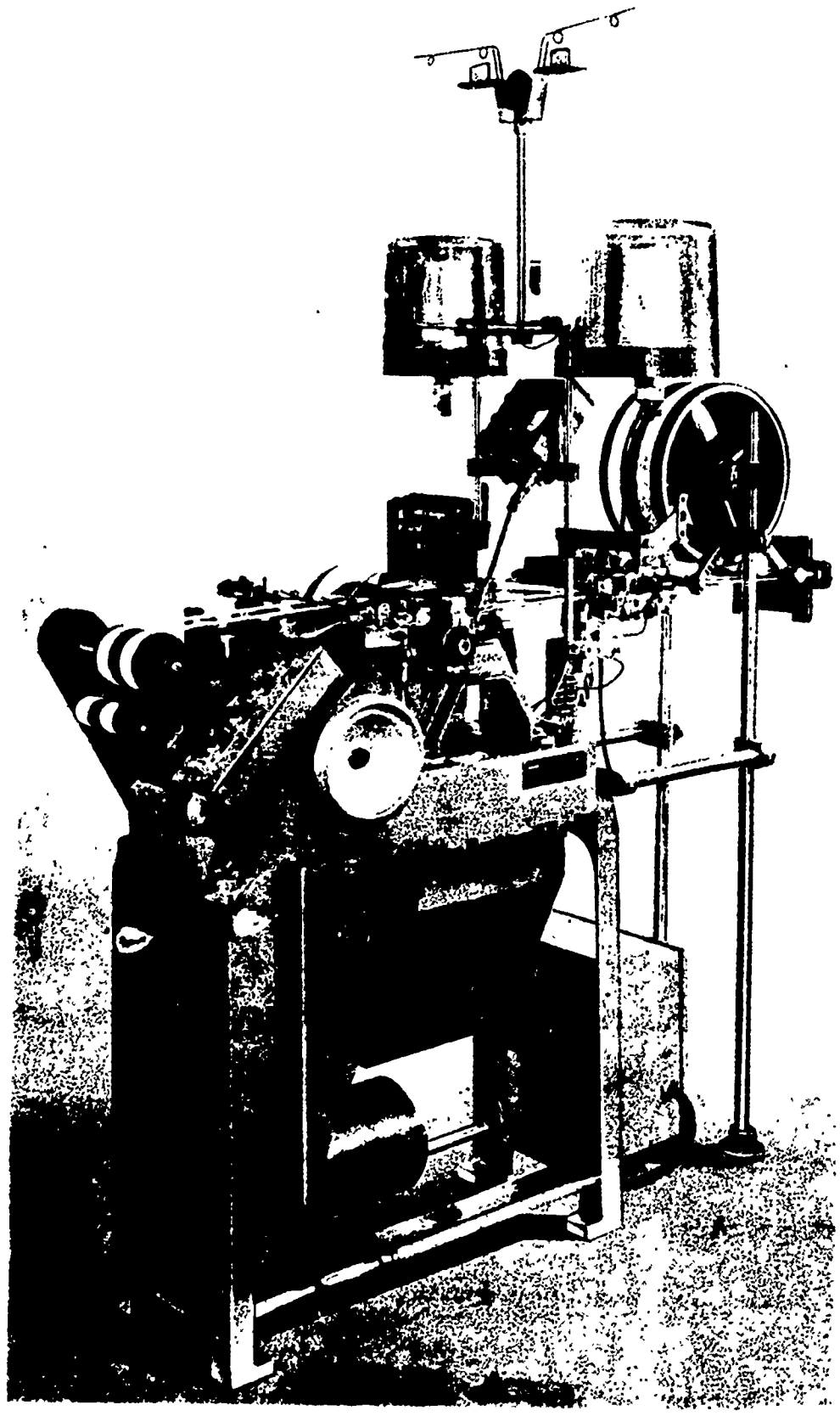


Figure 29. Crompton & Knowles Needle Loom
(Courtesy Crompton & Knowles Corp.)

Several other types of ribbon or narrow fabric looms are built for weaving tape, webbing, labels, belting, and trimming. The machine illustrated will make up to 1400 sheds per minute. A weaver can attend about 40 of this type loom.

Shutterless Looms

For many years loom manufacturers, and undoubtedly many persons employed in textile plants, have sought the answer of a shutterless loom. Such a loom would eliminate a good portion of the noise in the weave room, would make for savings in many ways including elimination of shuttles, picker sticks, check straps, parallel motion, lug strap pickers and other parts that are subject to a great deal of wear.

Several companies have introduced the shutterless loom the last several years. So far as is known only two manufacturers have installed shutterless looms in plants and have them in operation. The Warner-Swazey weaving machine was the first of this type loom to be made available and be placed in plants.

Draper introduced its shutterless loom within the last year or so and is installing them on a limited basis in a larger number of plants.

Several foreign textile machinery manufacturers have experimented with the shutterless loom. The Southeastern Loom Company of Greenwood, South Carolina, a subsidiary of Abney Mills, has the United States rights to make and sell a shutterless loom which was developed in Sweden. This loom is known as the Maxbo and has been exhibited in one of two textile shows.

Warner and Swazey - Sulzer Weaving Machine

The Warner and Swazey-Sulzer Weaving Machine was introduced several years ago and quite a number are now in use. This was the first shutterless loom to be put on the market and stimulated other loom manufacturers to speed up their research and experiments. The price of the Warner-Swazey Machine may have held back its use somewhat. Then, too, plants with good running looms probably saw little advantage of purchasing the new machine until there was a general movement in the industry to use it. The trend, however, is toward shutterless looms and in a few more years one may find every plant with a large number of such looms.

The Warner and Swazey-Sulzer Machine is a remarkably efficient weaving machine. The description that follows must necessarily be brief because a detailed description would become involved and unless the student is in a locality where such machines are in operation and can be observed, a detailed description would mean little.

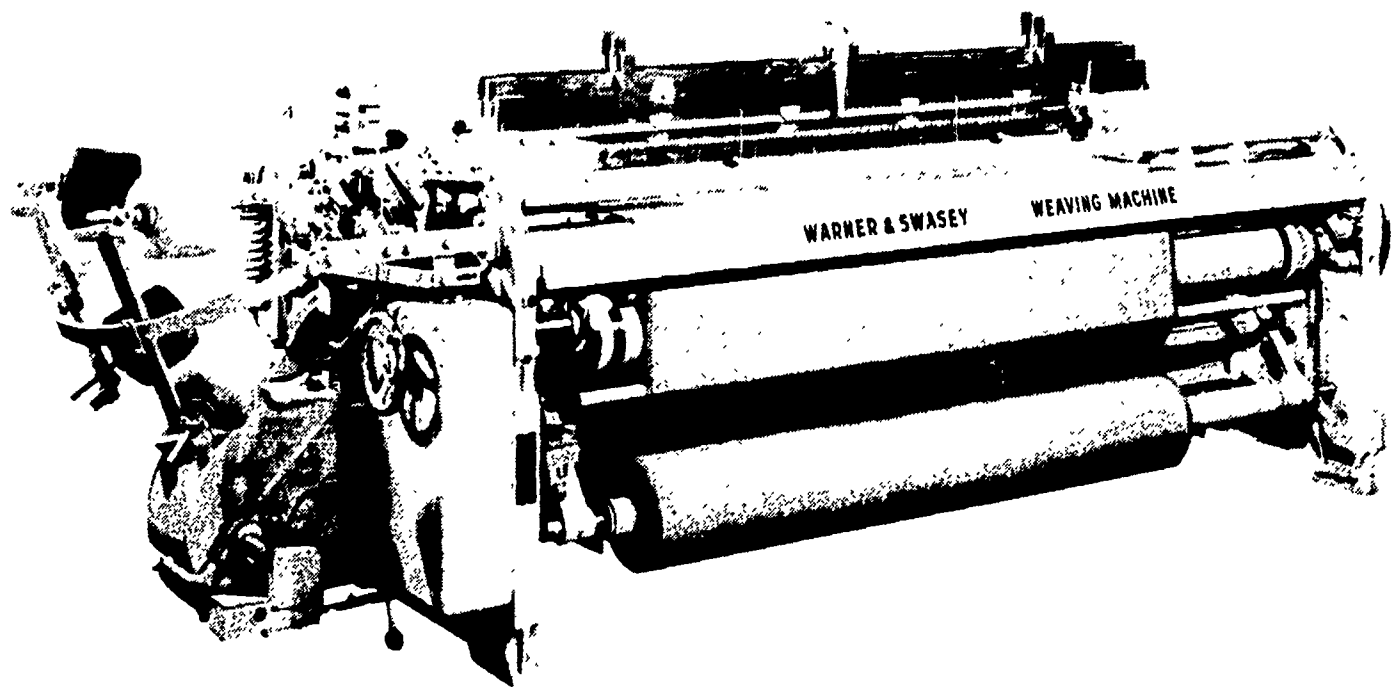


Figure 30. Warner and Swazey-Sulzer Weaving Machine
(Courtesy Warner and Swazey Co.)

First of all, the machine is low because there is no need for a frame over the loom to support the harness. This gives the loom a low center of gravity, permits better view of the weave room, results in a more even temperature and better distribution of humidification in the weave room, and gives more light to the room.

The machine actually has a shuttle, or rather a series of shuttles made of light weight steel, 3 1/8 inches in length and weighing only one ounce. The shuttles cross the loom at high speed. They are propelled by a short picking lever. The picking lever receives its energy by twist put on a torsion rod through cam action in the picking box. The lever is locked in loaded position after the proper twist. The action is amazingly fast as four times a second a shuttle is placed in firing position and the lever released. The shuttle carries the filling with it. A hydraulic dash pot cushions the picking lever as it nears the end of each stroke. The correct driving force may be adjusted to various width of cloth.

The filling is drawn from a large stationary cone or cylinder mounted on a curved bar at one end of machine. Several such cones can be tied together to make almost a limitless supply of filling. From the cone the yarn passes through a guide in a plastic shield. It is held at correct tension by mechanical fingers in order for it to be grasped by the shuttle. The shuttle has a thread gripper which holds the yarn securely. Since the shuttle is small it travels in a tunnel of guides and does not touch the warp in its

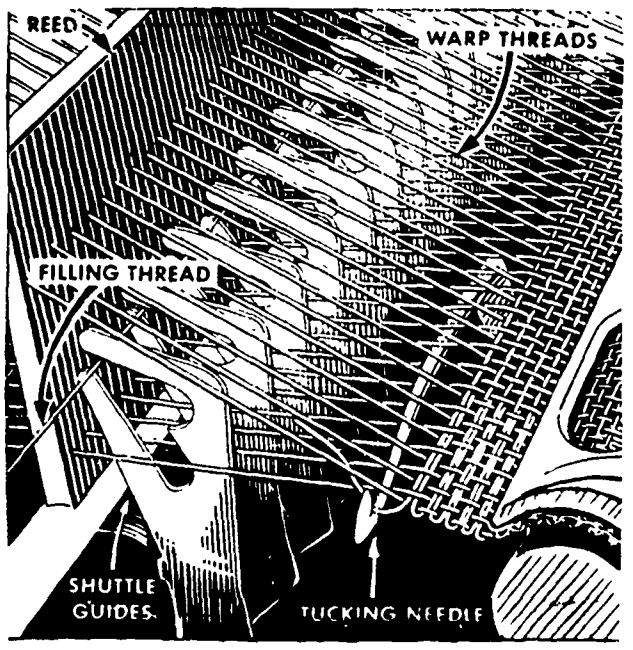


Figure 31.
(Courtesy Warner and Swazey Co.)

Notice how the tucking needle takes the pick and ties it in. Also notice the shuttle guides that provide the tunnel for the shuttle as it goes across the loom.

journey across the loom. After the shuttle completes its trip it falls onto a conveyor or shuttle return chain. The number of shuttles used in weaving depends upon the width of the machine and width of cloth being woven.

To change the number of picks per inch four change gears are relocated. A total of eight ground gears supplied with each machine, running on bronze sleeve bearings can, in different combinations of four, give a range of picks per inch from 13 to 120.

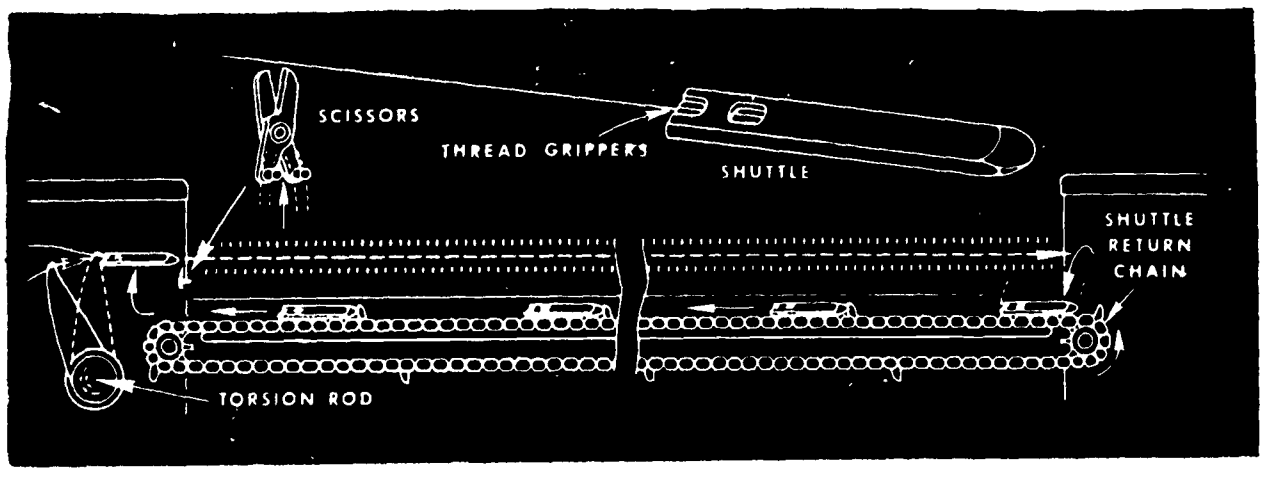


Figure 32. Shuttle Return on Warner and Swazey Loom
(Courtesy Warner and Swazey Co.)

Harnesses are driven upward and downward positively controlled by fully enclosed cams and lever actions. All possibility of wrong harness lift and skips are eliminated. Harnesses are slipped in and out to change and there are no springs, straps, cards or adjustments to make when warps are changed. Harness cams are located outside the machine. They may be easily changed when style of fabric on loom is changed.

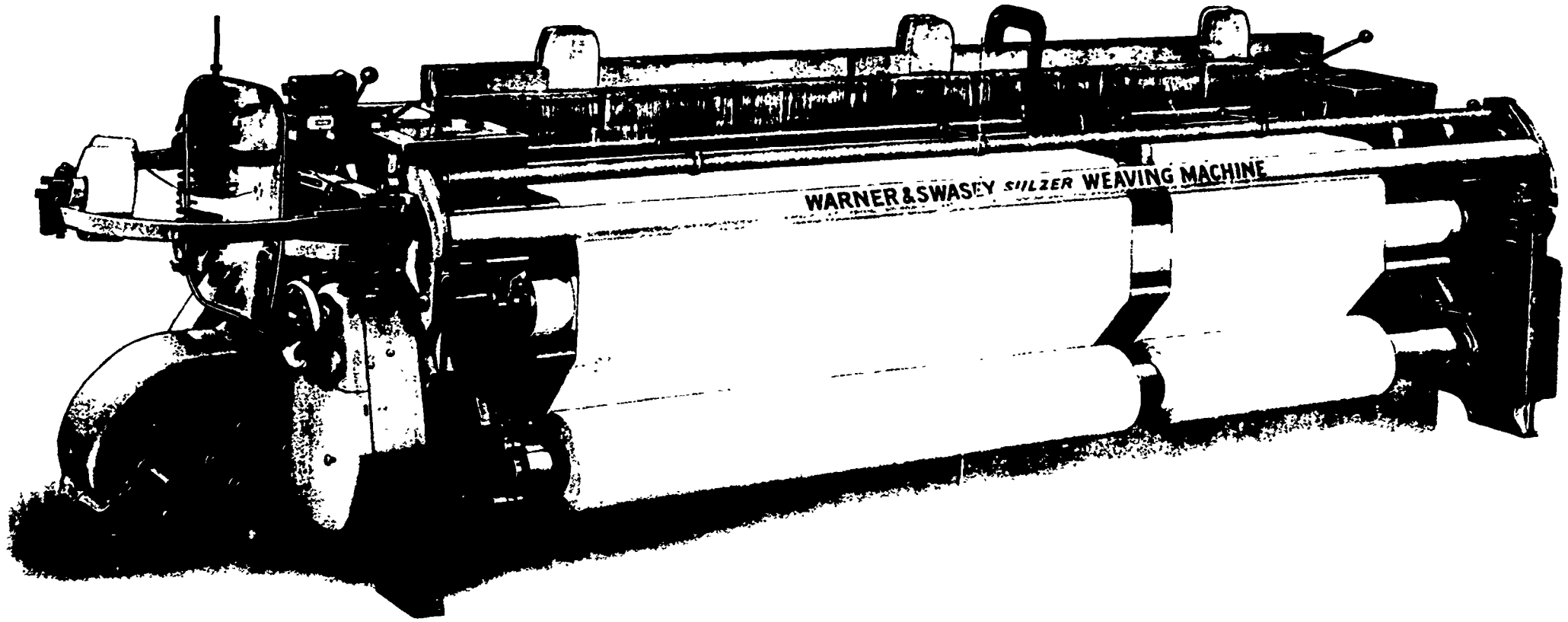
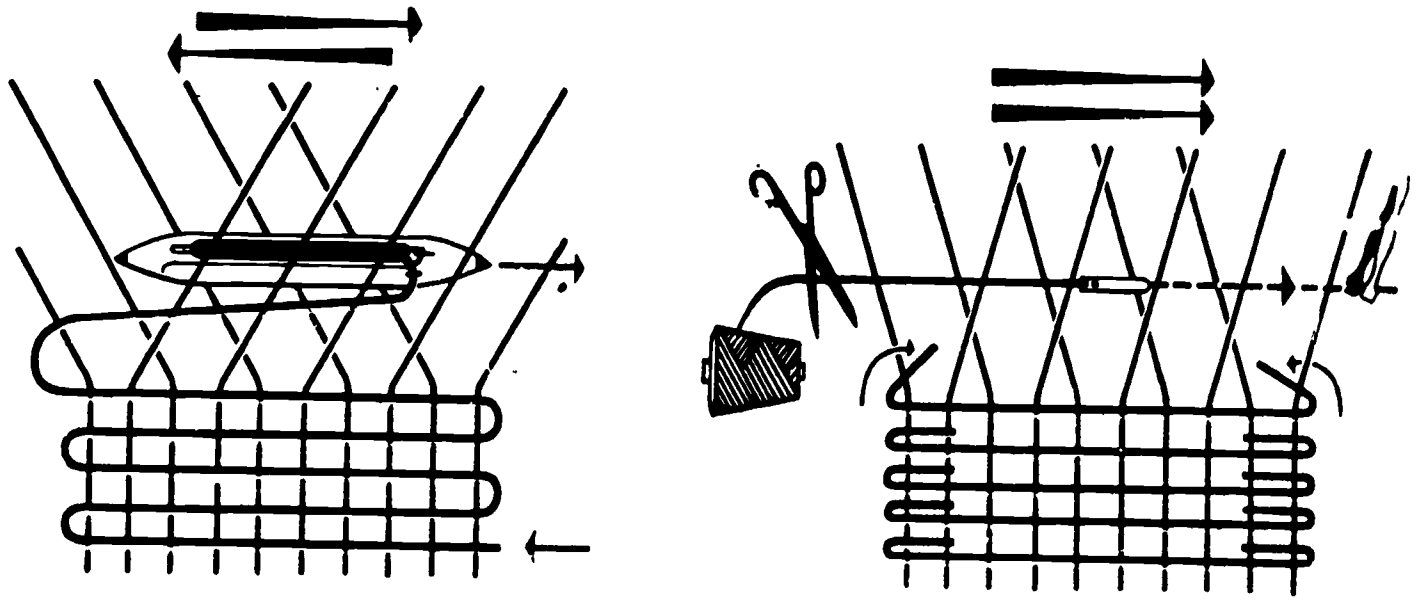


Figure 33. Two Weaves on One Loom

The Warner and Swazey Machine is made in three widths: 80", 95", and 110". A unique feature of the machine is that it can weave two or more widths of cloth at the same time. This is done by placing intermediate selvage units at any point on the machine. The selvage is put in by a tucking needle, which tucks the cut filling yarn into the last several warp ends on both edges of cloth.

The machine makes 220 picks per minute on the 110" size and 240 picks per minute on the 80" size. A maximum of 8 harnesses can be used. Overall length of machine ranges from 160½" to 190½"; height to top of breast beam 35" and overall height is 49". The machine weighs from 7,250 pounds to 8,050 pounds depending upon width.

Warner and Swazey claim their machine introduces a new principle of weaving. Figure 34 (A) shows the conventional principle and (B) the principle used by Warner and Swazey Machine. Figure 35 shows the weaving process in some detail.



A

Ancient, but still universal weaving principle in which each filling is inserted by a heavy bobbin-carrying shuttle that moves back and forth across the machine.

B

Using the new principle, the filling is pulled directly from a large stationary package. Filling is then cut, and its ends either tucked into the edge or bound by twisting, to form the selvage.

Figure 34.

(Courtesy Warner and Swazey Co.)

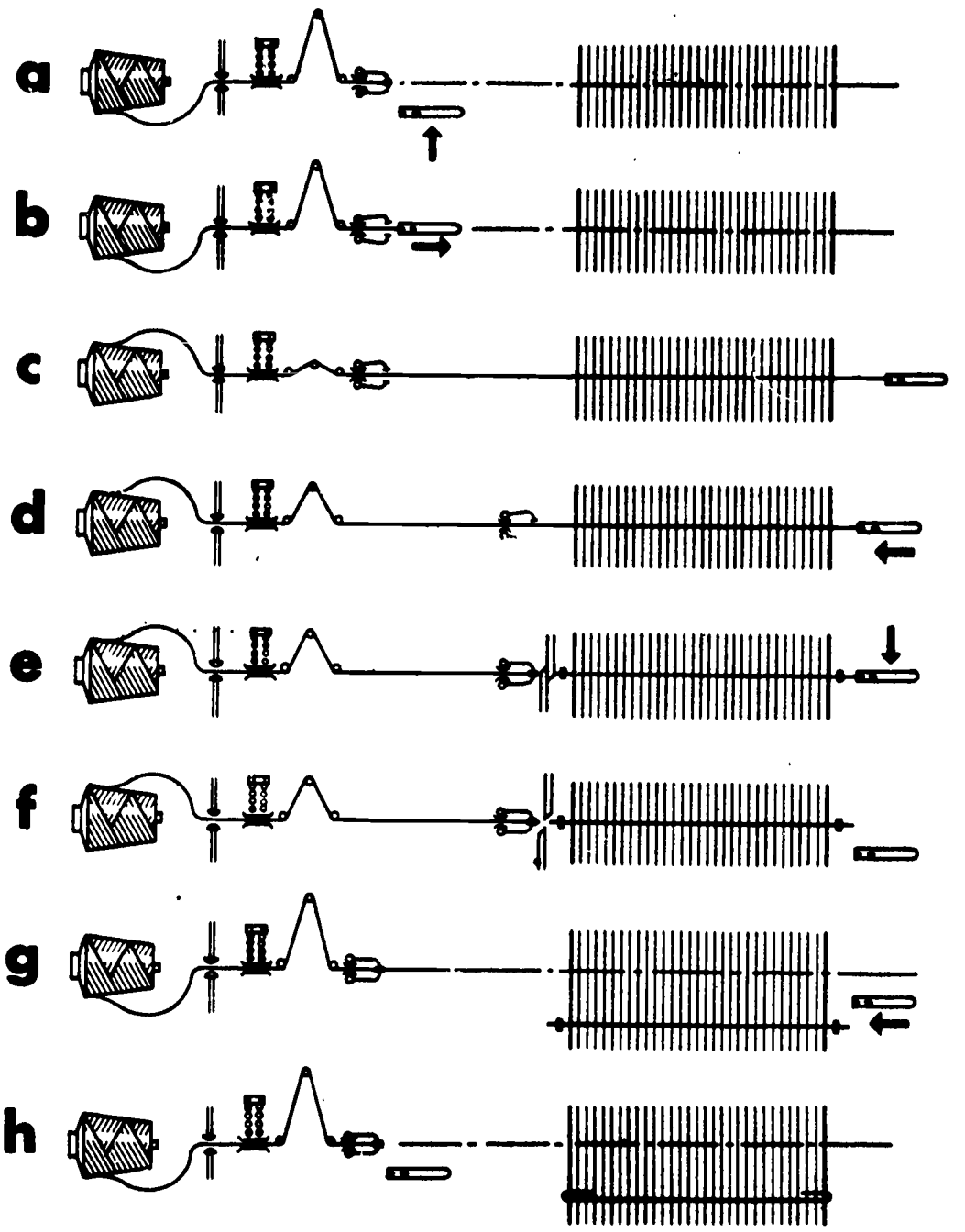


Figure 35. Weaving Principle
(Courtesy Warner and Swazey Co.)

a. Filling is drawn from the package through a filling brake and a tension arm to a shuttle feeder. A shuttle rises from the conveyor with its gripping fingers open, into firing position.

b. The gripping fingers of the shuttle close, holding the end of the filling, and the fingers of the shuttle feeder open.

c. The shuttle is flipped through the shed, taking the filling with it, as the tension arm releases the tension on the yarn.

d. The shuttle is positioned to give the selvage end the proper length, the tension arm putting the required tension on the filling. The shuttle feeder advances to the position shown.

e. The shuttle feeder fingers close and a gripper on each side holds the filling under tension while it is cut.

f. The shuttle releases the end of the filling and is ejected onto the conveyor.

g. The filling is beaten up against the fell of the cloth while the grippers maintain the filling under the desired tension. The shuttle feeder returns to its original position.

h. The ends of the filling are tucked in to form the selvage and another shuttle is ready to be brought into firing position.

The Draper Shutterless Loom

The Draper shutterless loom dispenses with the shuttle altogether. Claim is made that the loom gives increased production speed, economics in loomfixing, reduces handling of filling, makes for economy in filling preparation, power consumption and reduces the noise level.

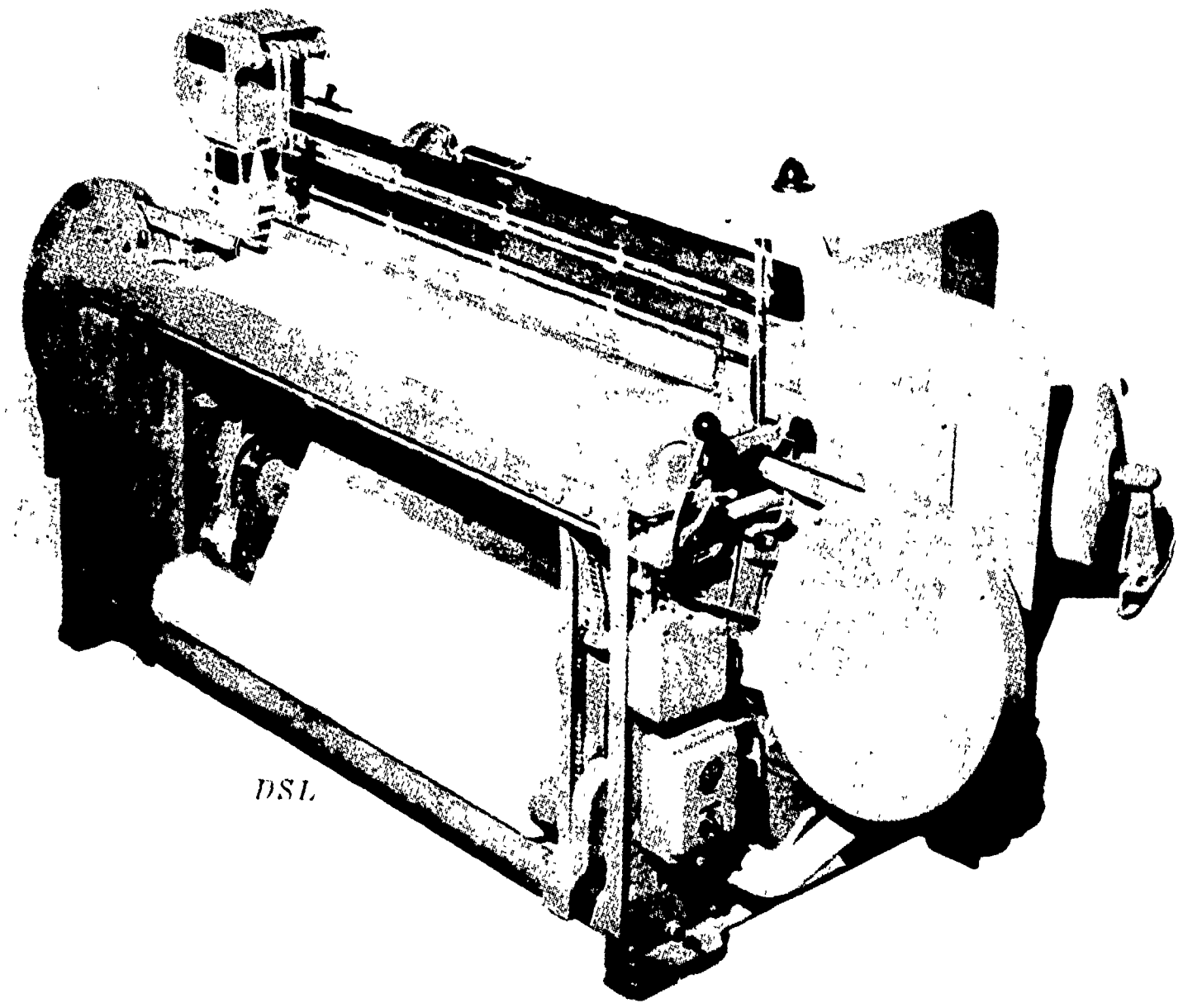


Figure 36. Draper Shutterless Loom
(Courtesy Draper Corp.)

The difference in this loom and the conventional shuttle loom is method used in placing the filling. To place the filling a right-hand and left-hand filling carrier are used. The filling supply consisting of two cones creeled together, the RH and LH filling carrier, which place the pick, are mounted on the ends of flexible steel tapes. The tapes meet near the center of the loom and the RH carrier

passes the filling to the LH carrier. The filling control mechanism is on the right side of the loom. It positions, measures and cuts the filling so that the correct length of yarn is drawn into the shed under tension by the filling carriers.

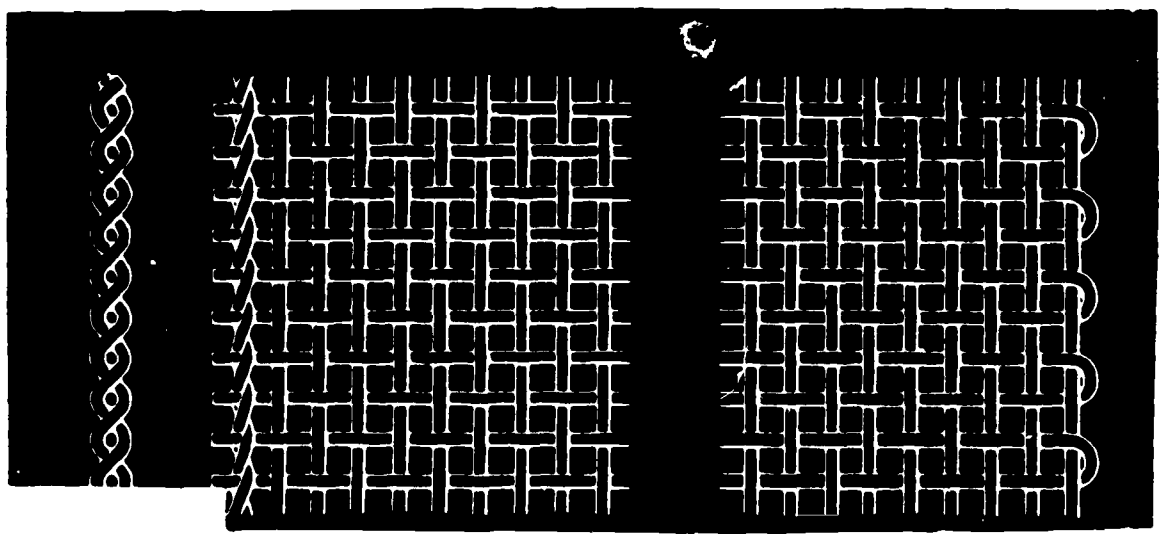


Figure 37. How Filling is Laid in Draper Shutterless Loom

The filling is laid in cycles of two picks, one pick to a shed. These two picks resemble a hairpin. The bend is on the right-hand side and gives a conventional selvage on the right side edge of the cloth. The open end is on the left and this gives a trimmed selvage on left side edge of cloth. The two outside warp ends, known as binder cords, on the left-hand selvage are on separate spools. As these revolve a full leno locks each pick in place.

The Draper Shutterless Loom is low and does not have arches. It is presently being made in 40", 44", and 46" and 50" widths. It makes from 220 to 250 picks per minute. The floor space required for the loom is somewhat less than that required of the Draper X-2 model. The loom uses a center fork type filling change motion, has a capacity of 6 cam operated harnesses. The loom eliminates shuttles, bobbins, picker sticks, pickers, and all leather straps except that used on harnesses. There is no crankshaft as the lay is driven by cams.

The Draper Shutterless Loom is being produced in rather large quantities, and a large number of textile plants have installed 100 or more of the looms. Additional installations undoubtedly will be made, if the loom stands up under textile plant weaving requirements and when the loom is available in quantity.

The Maxbo Loom

One of the most remarkable shutterless looms is the Maxbo Loom, a Swedish loom being made by the Southeastern Loom Works, Greenwood, South Carolina.

The claim is made that the Maxbo loom gives increased production, fewer stops, quiet running with little vibration, thinner reed dents, constant warp tension, less risk of accident, no lubrication or attendance.

The loom has a low silhouette since an arch to support harnesses is not required. It is 47½" high and 37" wide and weighs 3,100 pounds. It will make up to 400 picks per minute.

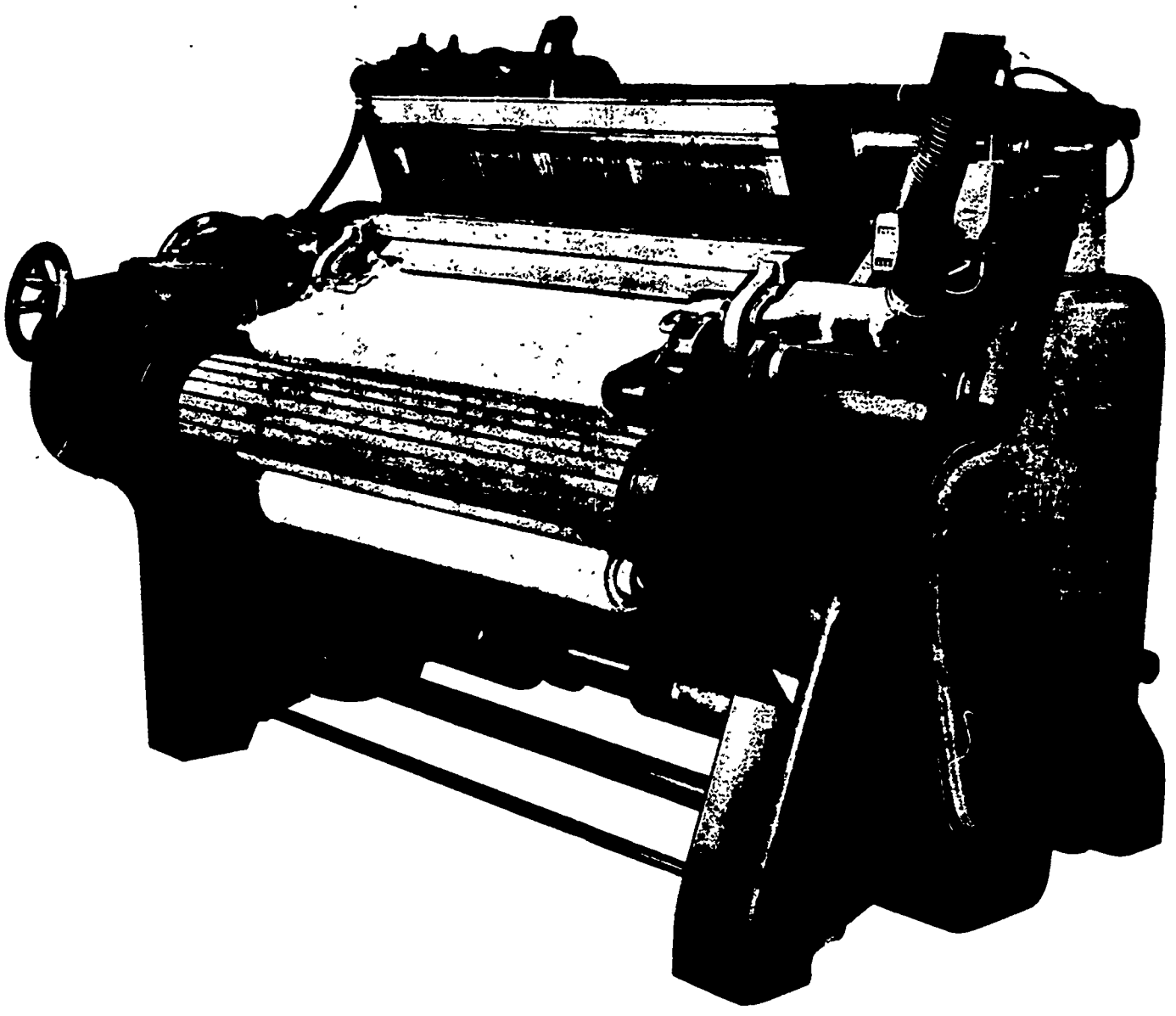


Figure 38. Maxbo Loom
(Courtesy Southeastern Loom Co.)

Instead of using a shuttle, the loom uses an air jet to blow the filling yarn through the shed. The air is provided by an air nozzle from which a concentrated jet of air is ejected. This system of picking greatly reduces stress on the warp yarn. The filling thread is supplied from two large capacity cheese or cones, which insures almost continuous operation. After each pick, sufficient filling yarn is wound on a wheel and made ready for the next pick. The wheel is changed for the different width cloth being woven.

The Maxbo Loom is practically vibrationless. It seems to perform the function of weaving more in a kind of rotary motion. The air jet makes very little noise and the whole operation is quiet.

Since there is no shuttle, there is no need for a race plate. Reed dents may be made thinner because there is no rubbing action caused by shuttles. The loom is equipped with a warp beam regulator, which operates automatically, requires no setting and which keeps the warp at constant tension at all times from full to empty beams.

An oil pump lubricates certain parts as needed. All movements of the thread feeding devices, heald, reed, sandroll and warp regulator are housed in the box frame. All shafts are mounted in ball or roller bearings and require lubrication only once a year.

A permanent magnet operates in contact with a filling detector which excludes any wear. The loom uses either an electrical or mechanically operated warp stop motion.

This amazing loom will soon be perfected and undoubtedly will soon take its place in the textile industry along with other revolutionary type machinery rapidly being introduced in the industry.

Chapter VI

CLOTH ROOM

The cloth comes from the weave room to the cloth room in roll form where it is prepared for shipping. The cloth goes through several machines which shear all loose and floating ends from the cloth. All the cloth is then inspected for defects and is graded accordingly. All cloth classed as seconds is cut out and the remaining first quality cloth is stitched together and then run on the calender rolling machine which makes it into rolls, or else it is sent to the folding room and pressed into bales for shipment.

The cloth inspector cuts out all bad filling, washes out oil spots, and marks all seconds. The shearers, calender rolling machine, and stitchers are machines on which accidents are most likely to occur.

Some mills sell their cloth after sending it through the cloth room. Cloth sold in this form is known as grey goods. Other mills send their cloth to bleacheries and have it finished before selling.

Graders and Shipping. After the cloth has been inspected, it is then passed over a grading table where a grader cuts out all seconds and remnants. Next, all the first class cloth is stitched together and run through a calender rolling machine which puts the cloth into roll form again. The rolls are then ready for shipment after being weighed, tagged, and bagged. Some mills do not ship their cloth in roll form, so the cloth would be sent to the book fold room instead and made into bales or bolts and prepared for shipment. If made into bales, the bales are compressed by the bale press to conserve space in shipping.

Chapter VII

FINISHING PROCESSES

Finish depends upon the purpose for which the cloth is to be used. Briefly, the complete finishing process consists of the preparation of the cloth, application of color, and the finishing. The preparation processes usually consist of singeing, shearing, bleaching, and mercerizing. The finishing processes are starching, tentering, napping, calendering, and other special processes.

The cloth may go through part or nearly all of the above processes, depending on the finish desired and purpose to which the cloth is to be put. Some special fabrics require special finishing processes, as oil cloth, rubberized tire fabrics, water proofing, and imparting absorbent qualities.

Preparation for Finishing

Singeing. The cloth is passed over hot plates or rolls or through gas flames to burn off the loose threads. The speed of the cloth is sufficient to prevent scorching or burning. The cloth is run immediately into water, usually containing some malt solution so that the starch size in the cloth may be dissolved. The cloth is left to steep for several hours to let fermentation develop.

Kier Boiling. The cloth is taken from the steeping pits to kier boilers, (cylindrical tanks) usually holding from 6 to 10 tons of cloth. The purpose of kier boiling is to dissolve motes and size and remove oil and grease. Certain chemicals are added to help in this process. The cloth is usually boiled from 6 to 10 hours, after which the liquid is drained off and water run through the cloth until well rinsed. In recent years the continuous process of bleaching has come in and kier boiling is not used as extensively as it once was.

Brown Souring. After rinsing in the kier boiler, the cloth is removed to pits where acid is added to dissolve the grease and oil loosened in the kiers. It is now ready for bleaching.

Bleaching. The word bleach means to whiten. So we are ready to whiten or bleach the cloth. This is a chemical process. Chlorinated lime or bleaching powder is used. The cloth is put in vats, treated with the bleaching compound mixed with water and left to stand for two to six hours. It is then washed in a weak acid to neutralize the lime. The cloth is now ready for finishing if it is to be sold as white or bleached material. If it is to be dyed or printed, more preliminary processes will be necessary before color is applied.

Mercerizing. The treating of cloth with caustic soda gives it a luster or bright effect. This is applied either before or after bleaching.

Finishing Processes

Tentering. The process of stretching the cloth evenly back into shape by gradually pulling it back into place over a distance of from 30 to 90 feet is called tentering. Special attention should be paid to the squaring of the pick.

Shearing. Before dyeing or printing, it is necessary to run the cloth over a series of rotating blades or brushes to remove uneven places, knots, etc. This may be done before or after bleaching; but as the cloth is softer after bleaching, this is probably the best time to do it.

Drying. During various stages of the finishing processes it is necessary to dry the cloth for the next process. Various types of dryers are in use, but most of them consist of a series of heated cans or rollers between which the cloth is passed. At the same time fans and blowers operate.

Dyeing. There are various methods and ways of dyeing, depending to a large extent upon the type dye used. The most simple process of dyeing is by boiling until the dye is absorbed.

Printing. This is imparting color, design, or pattern to the cloth in portions only and in combinations of color. This is usually done commercially by cutting the design on a copper roll and pressing the color on as the cloth passes over the roll. One roll is required for each color used in the pattern.

Napping. This process is used to impart a soft, fluffy effect to the cloth. The cloth is usually made of soft twist filling yarn. The cloth is passed slowly over a roller. Cylindrical wire brushes revolve in contact with the cloth with sufficient force to break the top fibers of the thread and raise them above the body of the cloth. Flannels and blankets are two examples of cloth finished by napping.

Calendering. This is the final process of finishing. In the home we sprinkle clothes and iron with a hot iron to remove creases and give a smooth finish to cloth. In the finishing process the cloth is ironed by passing through hot rolls under pressure to give the final finish.

Special Processes. Grease proofing, water proofing, sanforizing, beetling, wrinkle proofing, air conditioning, chintz glazing, oil cloth backing, photographic printing, bellmanizing, etc., are special processes which will not be discussed here.

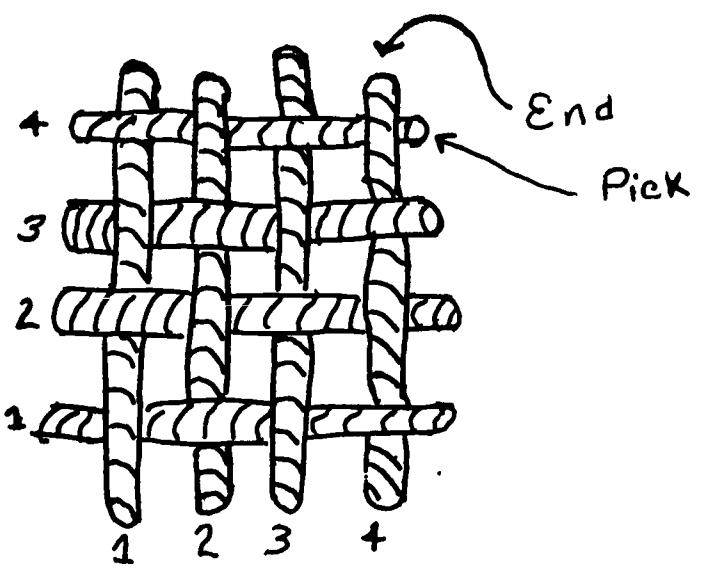
Chapter VIII

DESIGNING - BASIC WEAVES

The designer in the mill plays a very important part in the manufacture of cloth. A mill may have the best yarn available, the best workers and best equipment obtainable and still turn out inferior goods due to the lack of proper and timely design of the fabric. Textile designing is different from the commonly conceived idea of designing in that the designer deals with construction or interlacing of warp and filling to obtain a desired effect or figure in the finished cloth.

All woven fabrics are constructed by the interlacing of two yarns; namely, the warp and the filling. The warp yarn comes off the beam at the back of the loom and each thread is known as a warp end or simply as an end. The filling is put in at right angles to the warp, and each individual filling thread is known as a pick. The interlacing of a large group of ends and picks is known as weaving.

The simplest method of interlacing the warp and filling is by the use of the plain weave system. Figure 39 shows the method of interlacing the ends and picks.



Note: Vertical threads represent warp ends, and those running from side to side represent the picks.

Figure 39

In Figure 39, the student will notice that the odd picks go under the odd ends and over the even ends and that the even picks weave over the odd ends and under the even ones. This system of interlacing warp and filling is the simplest method of weaving known; therefore, it is called plain weave.

The student must not get the idea that warp and filling interlacings are the same in all woven goods. The only way of changing the effect of the weave in the cloth is by changing the manner of interlacing.

There are many methods of indicating the interlacings of warp and filling. The most commonly used system is on paper which is known as design paper. Designing paper is made in various forms and sizes from notebook size to large sheets. The paper is divided by heavy lines into blocks of eight rows of squares running each way. See Figure 40. Each vertical row of squares represents one warp end, and each horizontal row represents a pick of filling. It is necessary for the student to remember that the lines on the designing paper do not represent the ends and picks, but the squares enclosed by the lines represent the ends and picks. Thus, 8 ends and 8 picks can be represented on a piece of designing paper having 8 lines of squares running in each direction. See Figure 40.

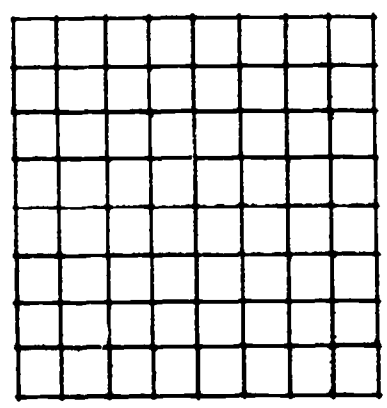


Figure 40.

8 x 8 Design Paper

The method used to indicate the interlacings of warp and filling on design paper is by painting in different squares. The warp ends are painted in when the warp is over the filling. When the filling is over the warp, the square is left blank. See Figure 41.

The warp ends are drawn through harness and when an end is painted in on a design, it shows that the harness through which that end was drawn has raised the end up so that it is over the filling. When a square is left blank, it shows that the harness through which that end was drawn is lowered, thereby putting the pick on top.

Look at Figure 41. (A) shows the interlacings of the warp and filling as it is in the cloth. (B) shows how the interlacings are represented on design paper. In (A) the student will notice that the first end is over the first pick, and in (B) this is shown by painting in the first square. The second end in (A) is under the first pick and this is shown in (B) by leaving a blank. (C) is

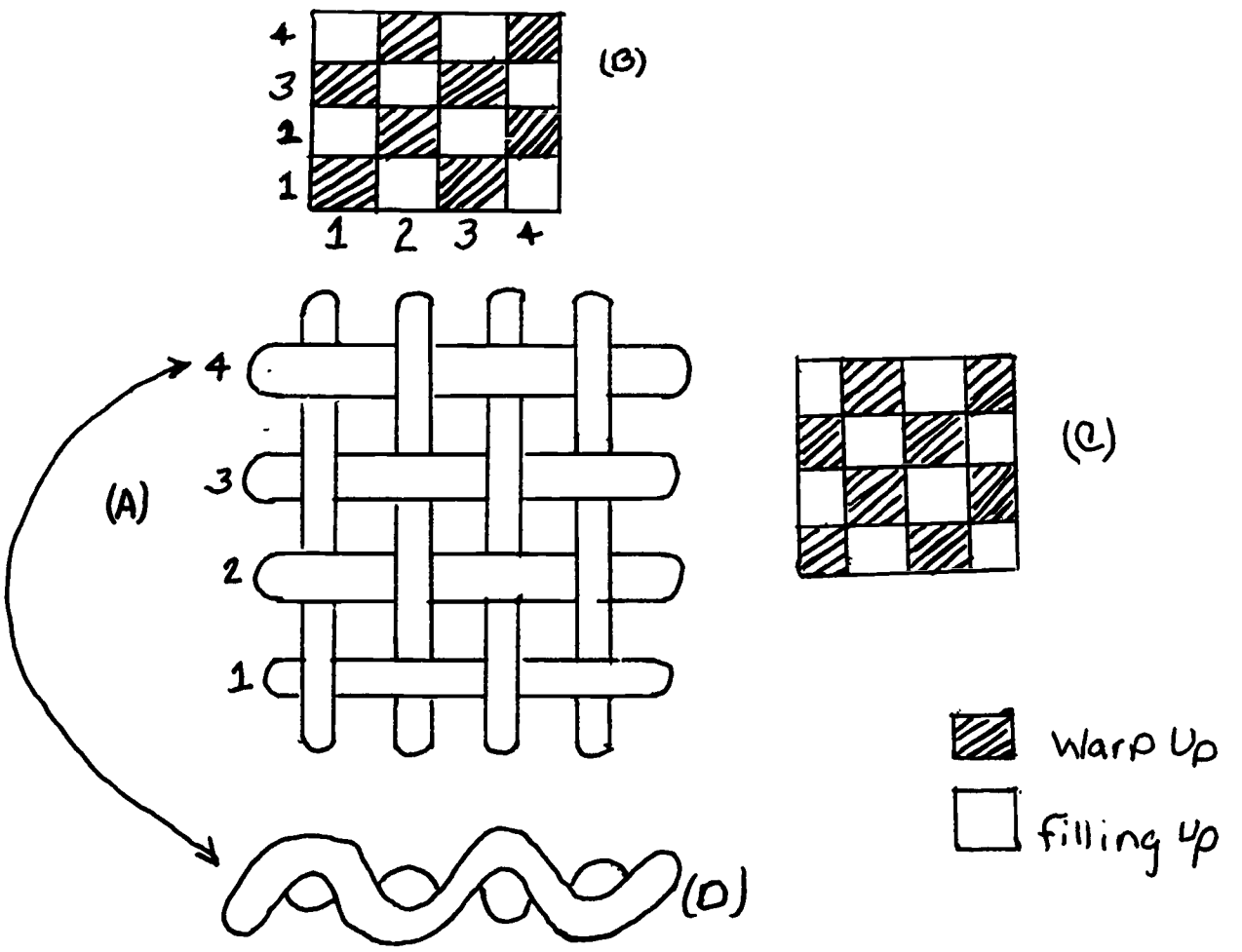


Figure 41.

exactly like (B) except that instead of using the ends to make the design, the picks were used, starting with the first pick in (A) and going across instead of up as was done in making (B). Figure 41 (D) is a cross sectional view showing the interlacings of one pick of filling with four warp ends.

Designs are put on design paper. The simplest weave is the plain weave and is represented as shown in Figure 42. The weave is called a one up, one down or is written $\frac{1}{1}$. It requires two harnesses, which is the minimum for weaving to be done. It repeats on two ends and two picks. The figure shows four repeats of the weave; beginning with 3rd, 5th, and 7th ends; the weave repeats itself.

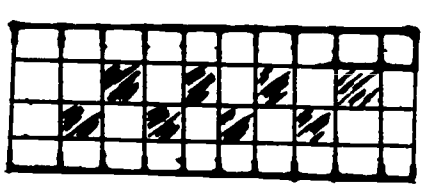


Figure 42.

When speaking of the first end of a weave, the end of the extreme left is always the first and the first pick is always the one on the bottom. The first end and pick are always represented by square in the lower left hand corner of design.

Fortunately, the whole width of the cloth does not have to be shown on design paper. It is not necessary to show more than one repeat, although several repeats may be shown in order to get a better visualization of how the weave will look.

If the entire sheet of design paper were used to represent a $\frac{1}{1}$ weave, it would be of no particular assistance to anyone concerned. Figure 43 shows a plain weave carried out to 8 ends and 8 picks. Notice that odd numbered ends starting at lower left, have been marked out and all even ends left blank. This indicates that all odd numbered ends work alike and all even numbered ends work alike. The figure shows 4 repeats but for practical purposes, it is only necessary to show one repeat.

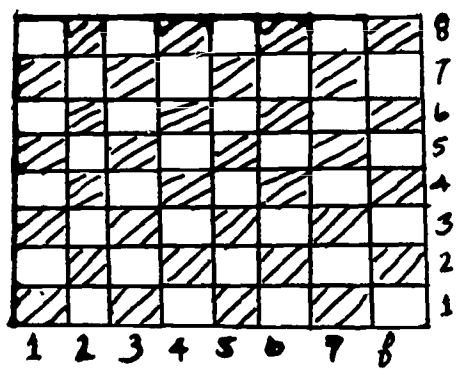
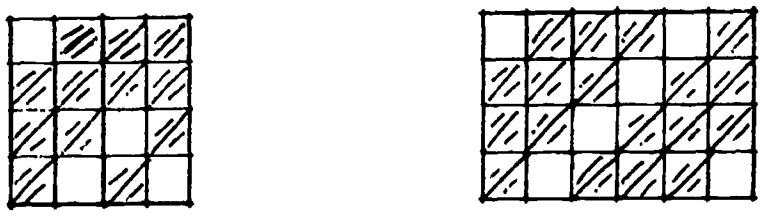


Figure 43.

Suppose a little more complicated weave is discussed to emphasize the matter of repeats shown in making a design. A common twill weave is the three up, one down (written $\frac{3}{1}$). Figure 44 (A) shows one repeat of this weave. This weave repeats on 4 ends and 4 picks. It requires 4 harnesses to weave it. Notice that the 1st, 2nd, 3rd, and 4th ends work differently, so it necessarily takes 4 harnesses.



(A) (B)

Figure 44.

Remember, only ends that work exactly alike can be put on the same harness. Thus, the 1st, 2nd, 3rd, and 4th harness work differently. (B) of Figure 44 shows a 5th and 6th end, but since the 5th end works like the 1st end, it is drawn on the 1st harness; the 6th end works like the 2nd end, so it is placed on 2nd harness, and so on for entire width of cloth.

Weaving is done by interlacing of yarn and interlacing must be accomplished in each repeat of the pattern. On a plain weave, interlacing occurs every other pick widthwise and lengthwise. On more complicated patterns there is less interlacing of yarn but each repeat must show one or more ends interlacing with picks.

The Harness Draft

Each warp end that interlaces with the filling differently from any of the other ends must be drawn on a separate harness, but all ends that interlace with the filling in the same manner may be drawn through the same harness. In the case of a plain weave where every other end is alike, then the even-numbered ends will be drawn through heddles of another harness. These two harnesses rise and fall alternately, and with each change of harness a pick is put in, giving an interlacing as shown in Figures 39 and 41 (A).

The method of drawing each end through the harness is indicated on design paper by means of a draft, usually called harness draft or drawing-in draft (D.I.D.). This is shown on design paper by coloring in the squares or by numbers.

In Figure 45 (A) shows 8 ends and 8 picks of plain weave and (B) shows drawing-in draft, or the harness through which each end is drawn.

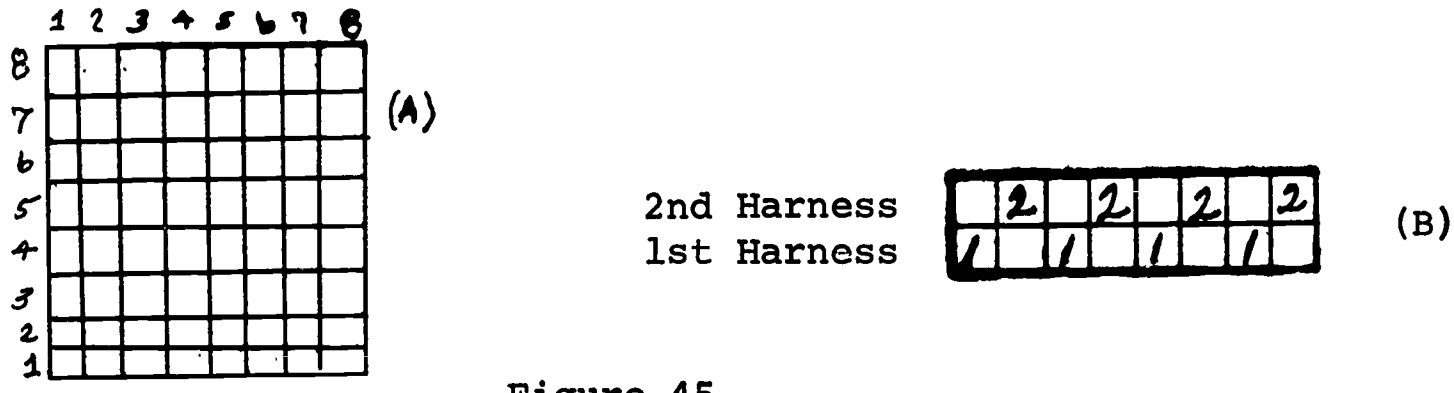


Figure 45.

The numbers in (A) indicate the number of warp ends and (B) shows that the first end is drawn through the first harness while the second end is drawn through the second harness because it interlaces with the filling differently from the first end. By observing (A) in Figure 45, it is seen that ends 3, 5, and 7 weave like the first end and are therefore drawn through the first harness. Ends 4, 6, and 8 weave like end 2 and differently from ends 1, 3, 5, and 7 so they must be drawn on the second harness.

Because two harnesses were used in the drawing-in draft of the plain weave, the student must not get the idea that the drawing-in draft of all weaves can be made on two harnesses. The number of warp ends that interlace differently from any other ends in the design determines the number of harness to be used in making the drawing-in draft.

Figure 46 will further illustrate the drawing-in draft. (A) shows one repeat of a weave on designing paper and (B) shows the drawing-in draft. Looking at the design, it will be seen that the first 4 ends weave differently and that they are drawn through different harness in the drawing-in draft. Then the 5th end weaves like the 3rd, so it is placed on the same harness as the 3rd end. The 6th end weaves like the 4th and it is placed on the same harness as the 4th end. Ends 7 and 8 weave differently from the first 6 ends, so they are placed on different harness. Beginning with the 9th end, find an end already drawn to match it, then place the 9th end on the same harness in the drawing-in draft.

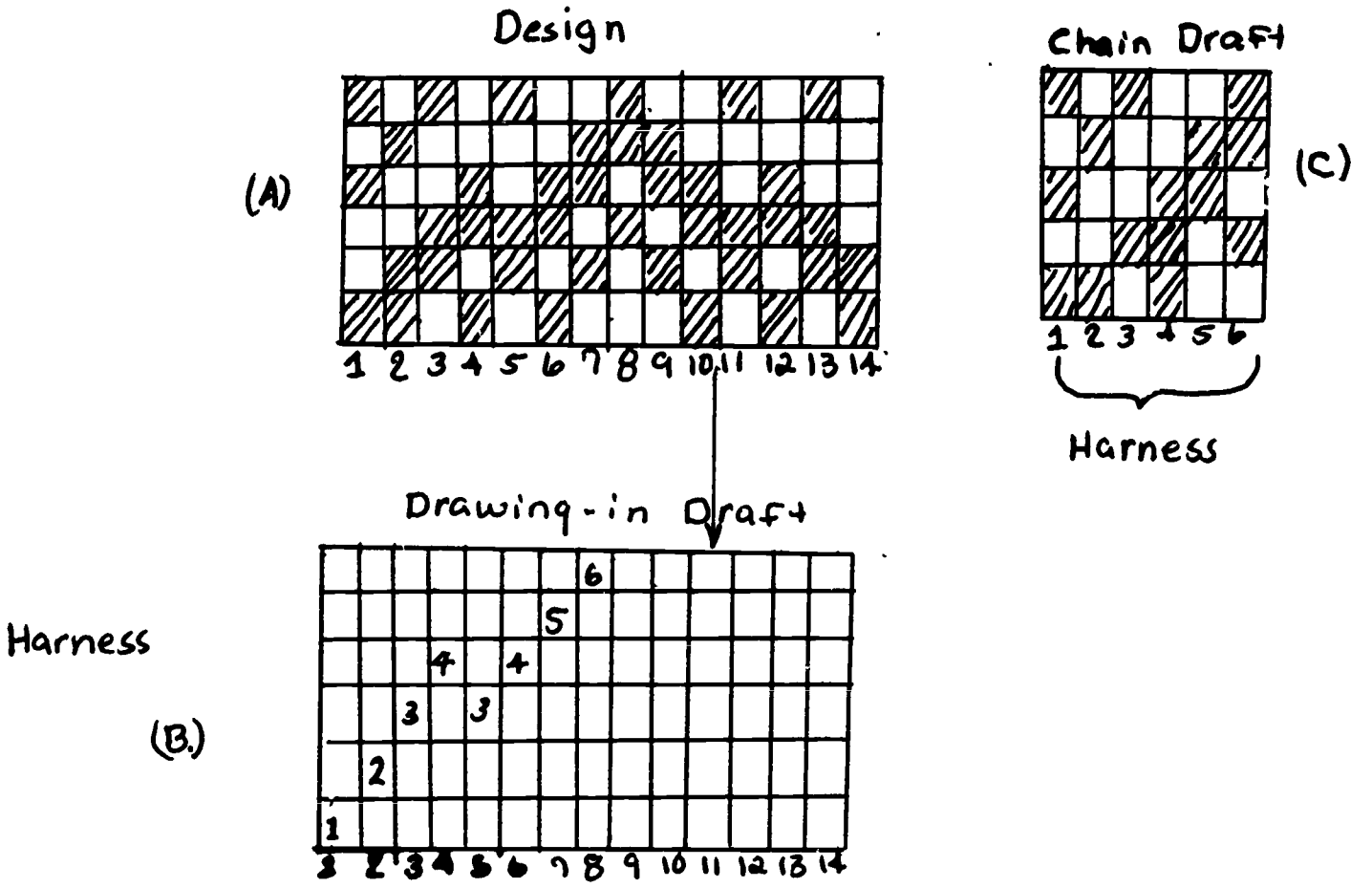


Figure 46.

Chain Drafts. Some system must be used to raise harnesses at the required time in accordance with the harness draft. On cam looms this is done by means of cams. On dobby looms, however, a

chain draft must be made to show how the pattern chain must be pegged to show when a harness will be raised. The chain draft provides a plan for pegging the pattern chain bars. In making chain drafts for a right hand dobby, the front harness is the first harness, and the back harness is the last.

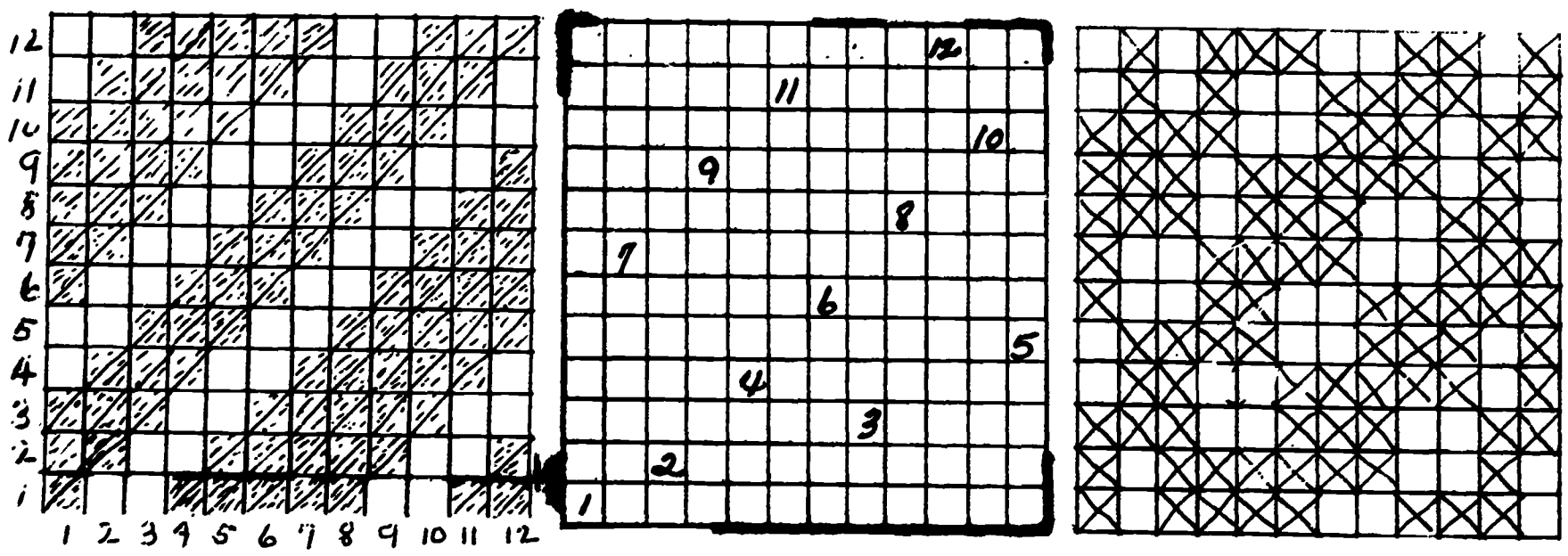
After the drawing-in draft has been completed showing how the end is drawn in the harness, a plan must be made showing in what order the harness must be lifted or lowered on each pick to give the desired effect in the cloth. This plan is known as the chain draft and is obtained from the design and drawing-in draft.

Referring to Figure 46 (C), the student will see a completed chain draft. All the ends in the design that weave alike are placed on the same harness in the drawing-in draft. The chain draft requires the same number of harness as the drawing-in draft, but the number of ends in the chain draft depend on the number of ends that weave differently in the design. It will be noticed in the design in Figure 46 that ends 1, 2, 3, 4, 7, and 8 weave differently from each other; therefore, they are placed in a chain draft. If two or more ends weave alike, only one has to be shown in the chain draft, because all like ends are drawn on the same harness.

Chain drafts are not always as simple as the foregoing. In the first place a 6 harness weave would probably be run on a cam loom and would not require a chain draft. However, many 4 to 6 harness weaves use a dobby where the construction is rather high and for technical reasons. A more complicated chain draft of a $\frac{3}{2}\frac{5}{2}$ twill, along with the design and harness plan is shown in Figure 47.

(A) shows the design, (B) the harness plan and (C) the chain draft. On a straight harness draw, the chain draft would be exactly like the design. Since an irregular draw was used for the harness, the chain draft had to be made to conform. On any draw but the straight draw, the chain draft must be made up from the harness draft.

Students will have ample opportunity to make harness plans and chain drafts when dobby work is discussed.



(A) (B) (C)

Figure 47.

Number of Harness. The designer should plan on using as few harness as possible. The closer a harness is to the lay or front of the loom, the less height it has to be raised for from a shed for the shuttle to pass through. The back harness of a weave requiring 7 harnesses has to be raised considerably more than the first harness and it takes a correspondingly large harness cam to do it. On patterns where certain harnesses have many more ends than others, the harnesses with the most ends should be as near the front of the loom as possible. Likewise, certain ends interlace more frequently than others so harnesses on which they are drawn should be placed as near the front of the loom as possible. These considerations result in economy of power, less wear and tear on harness, less fraying of ends, and less likelihood of ends breaking.

Twill Weaves

Certain weaves are grouped in classes, because of their similarity of construction and of the particular effect they produce on the face of the woven fabric. The fundamental or standard weaves are the plain weave, the twills, and sateens. The twill weaves and

derivatives form one of the largest classes of the standard weaves. These weaves are called twills because of the effect produced on the face of the cloth.

In a twill weave, the warp ends are so raised that the warp and filling floats form diagonal lines across the cloth, known as twill lines. In weaving a twill, each warp end must float over or under the filling for at least two picks in succession and at least two successive warp ends must be raised or lowered on each pick in order to obtain the diagonal lines in the cloth.

At least three harness are necessary to weave a twill; that is, three is the smallest number of harness that a twill can be woven on. A twill woven on three harness is called a three harness twill, and is the simplest twill that can be made. Twill weaves can be woven on any number of harness between 3 and 25. For all practical purposes, only 6 harness are used on a cam loom, while a dobby can efficiently operate up to 32 harness.

Twill weaves may be warp effect, which means that more warp floats are on the face of the cloth than filling. Filling effect is having more filling floats on the face of the cloth than warp. An equal effect is obtained by having the same amount of warp and filling floating on the face of the cloth. Cloth woven with a warp effect on the face shows a filling effect on the back; and if woven with a filling effect on the face, a warp effect appears on the back of the cloth. When the effect is mentioned, the student should remember that it refers to the face of the cloth.

One of the important things for the student to learn is to be able to tell when a weave repeats. This is especially important in twills. Practice in extending the weaves for several repeats on designing paper will help the student to determine the number of ends and picks in a repeat. Repeats may be extended in a warp-wise direction, filling-wise direction, or in both directions. Study Figure 48.

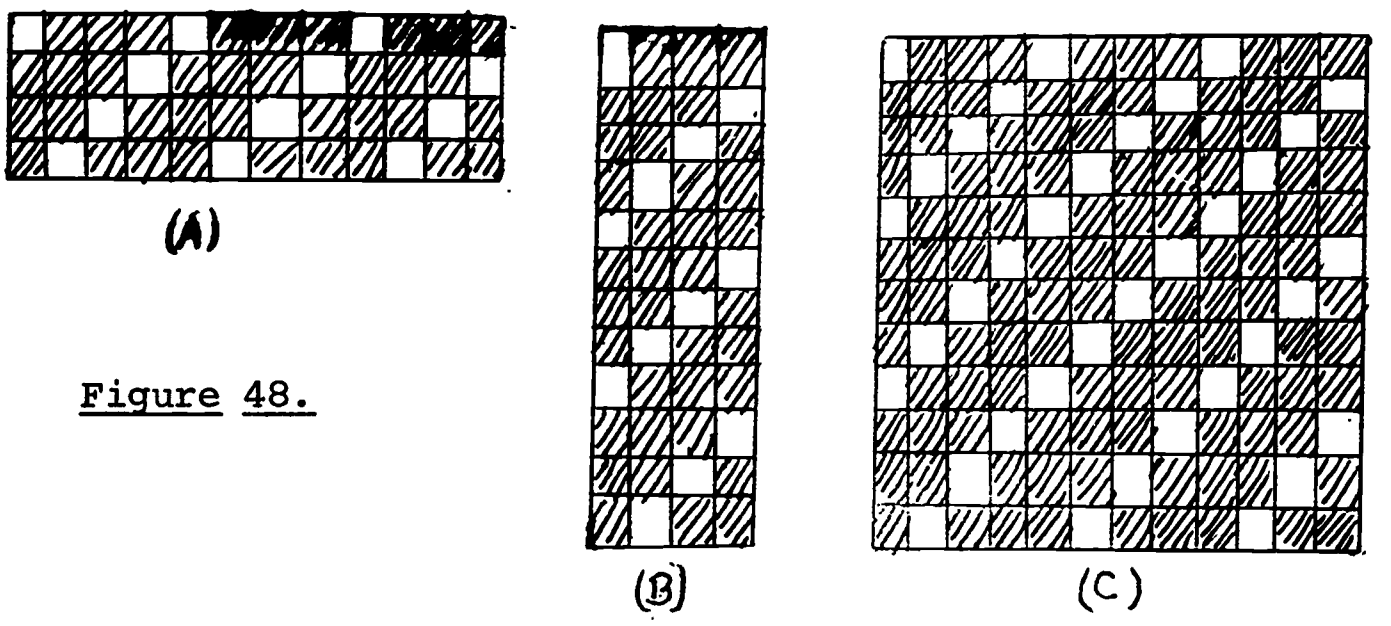


Figure 48.

(A) in Figure 48 shows three repeats warp-wise of a $\frac{3}{1}$ (read as 3 up and 1 down) twill. (B) shows three repeats filling-wise, and (C) shows three repeats warp and filling-wise.

Regular twills are those that run in regular order, and these twills are designated by writing numbers above and below a horizontal line, for example, $\frac{3}{1}$ twill means that the first end is up for three picks and down for one. $\frac{2\ \ 4}{3\ \ 5}$ is another example of a twill. The first end in a design made from this counter will be up the first two picks, down three, up four, and down 5. To find the number of harness that a twill will repeat on, add the numbers in counter. In $\frac{3}{1}$ the weave will repeat on 4 harness, and in the $\frac{2\ \ 4}{3\ \ 5}$ counter the weave repeats on 14 harness. (2 + 3 + 4 + 5 = harness). The student should study Figure 49 carefully; then make up several counters of his own and make the design for them.

Twill weaves can be made either right hand or left hand; that is, having the twill lines pointing right or left. All twills are made with the twill lines running to the right unless otherwise stated.

When making designs for twills from counters, a 45° twill is always made unless another angle is stated. Figures 48 and 49 are examples of 45° twills. To make a 45° twill each successive end is moved up one pick each time for right or left hand twills. In making a left hand twill, it is best to start in the bottom right hand corner and go up.

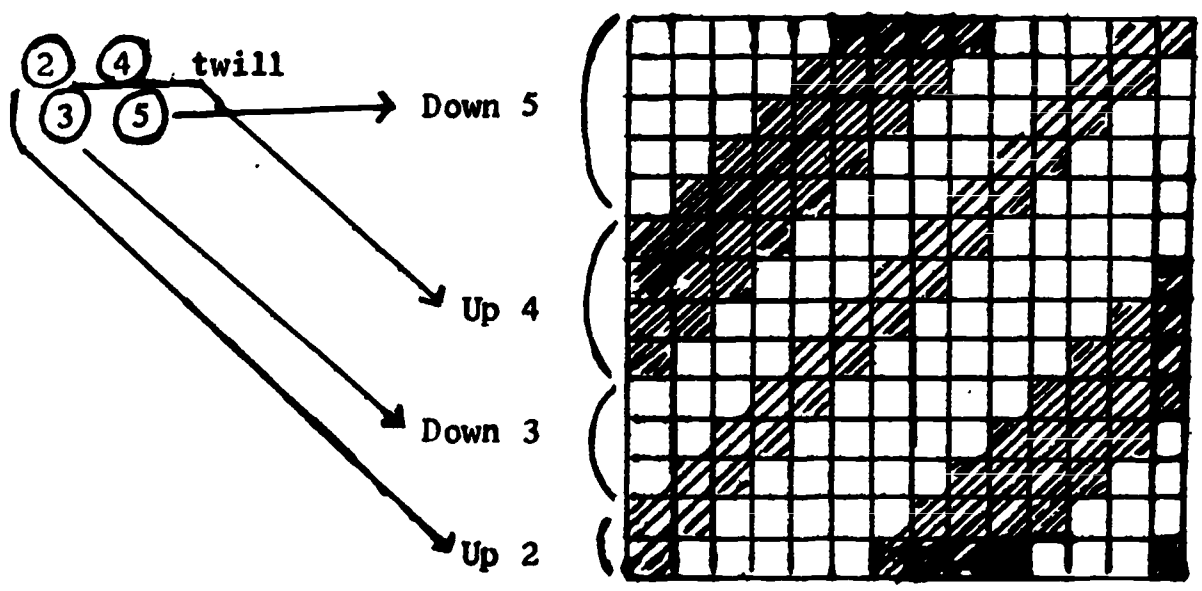


Figure 49.

The same rules apply in making all drawing-in drafts and chain drafts used in plain weaves. All unlike ends in design are placed on different harness in drawing-in draft. All regular twills have straight draws.

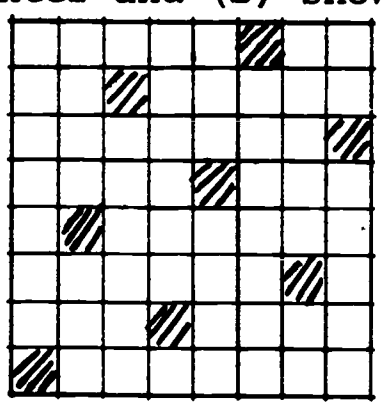
Sateen Weave

Sateen weaves are one of the most important of the fundamental weaves. They are used in all kinds of weaving and all the important fibers can be used in the making of cloth with sateen weaves.

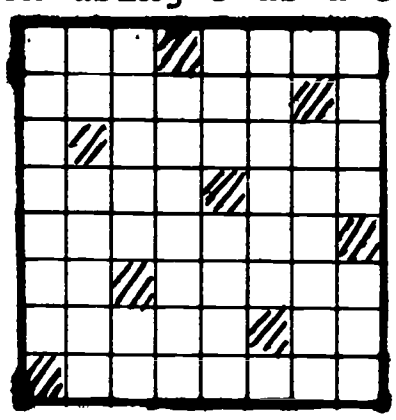
Sateen weaves are just opposite to twills. The object of twills is to show a twill line, while in a sateen an attempt is made to avoid the diagonal lines; however, the twist in the yarn causes a slight twill effect.

In a regular sateen, each end interlaces one or more picks from the interlacing of any of the ends next to it. Each end interlaces with the filling only once in each repeat. This produces a smooth, soft effect on the face of the cloth.

When determining the base on which to construct a sateen weave, any number can be used except the number 1 or the number that is 1 less than the total number of ends in one repeat of the weave. Also any number that is a factor of the total number of ends in a repeat or any multiple of this factor. Take an eight harness sateen, for example. The number 1 cannot be used nor the number 7 since it is one less than 8; 2, 4, and 6 cannot be used since they are factors or multiples of 8. Then 3 and 5 are the only counters to be used. Figure 50 (A), sateen weaves, shows an 8 harness sateen using 3 as a counter and (B) shows an 8 harness sateen using 5 as a counter.



(A)



(B)

Figure 50.

When making a sateen design, the first end and pick is usually filled in. Using (A) in Figure 50 the first square was filled in. Then starting with the square directly above the filled in square,

count horizontally the number of squares equal to the counter used. The counter being 3 in this case, then 3 squares were counted off and the 4th square was filled in.

The drawing drafts and chain drafts for sateen weaves are made the same method as explained in discussing plain and twill weaves. Reference to Figure 51 shows the straight draw and a draw like the pattern. The latter is considered to be more desirable draw for sateens because it gives better separation of ends.

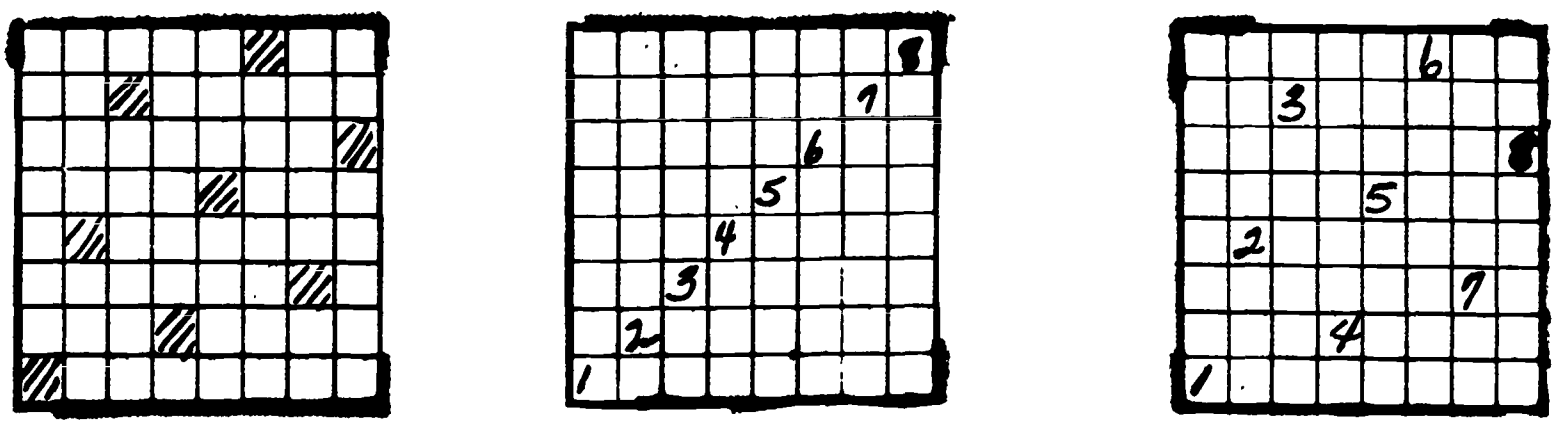
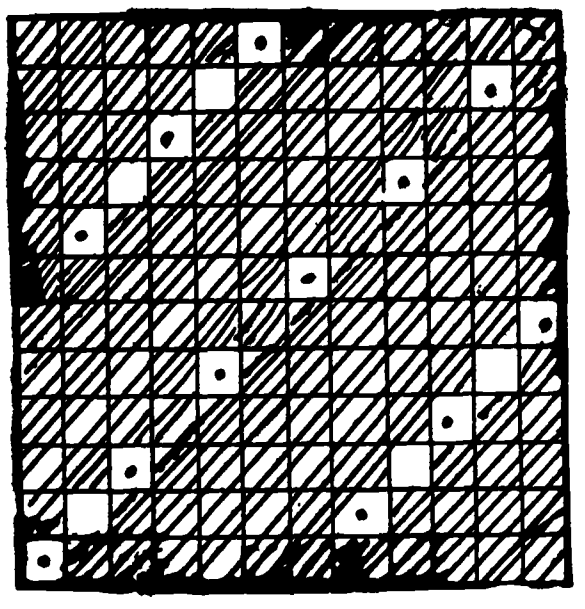


Figure 51. An 8 Harness Satin Weave

(A) The design using 3 as counter
(B) Straight draw
(C) Draw based on weave

Sateen weaves may be warp effect or filling effect. Warp effect contains more warp on the face of the cloth and the filling effect contains more filling on the face of the cloth. The filled-in squares represent warp on the face of the cloth, and the blank squares represent filling. Figure 51 (A) and (B) are filling effect. Figure 52 shows a twelve harness warp effect sateen using 7 as a counter.

Figure 52.



In Figure 52 seven was used as a counter. The first square was marked and starting directly above, seven squares were counted and the eighth square was marked by a dot. Using this dot, count off seven more squares as before and place a dot in the square. This is done until a repeat is completed. Since Figure 52 is a warp effect, all squares with the exception of the ones with the dots must be colored in, thus giving a warp effect.

The smallest number of ends on which a regular sateen can be constructed is five. A regular sateen cannot be made on six ends; however, an irregular sateen is sometimes made on six ends.

The Three Basic Weaves

The weaves discussed, plain, twill and sateens, are the three basic weaves and are used in combination with all other weaves. The student must not get the impression that a two harness weave is limited to a $\frac{1}{1}$ construction. Fifteen or twenty different constructions may be made of two ends and two harness. With cam looms, which may use 7 or 8 harnesses or make a complete weave on 2 to 8 ends, 200 or more patterns can be constructed.

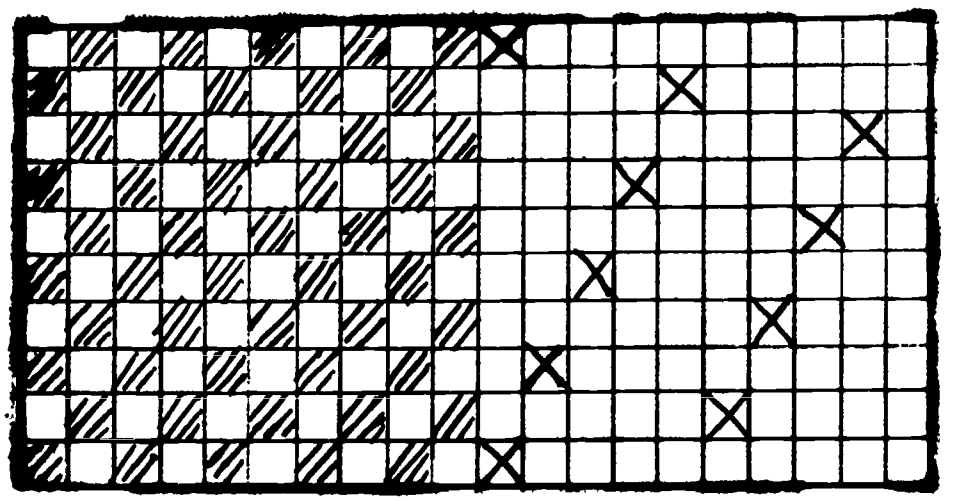
Reed Plans

The reed plan, which is a part of every design, shows how many ends are drawn to each dent of the reed. This is an important factor in many weaves because frequently the number of ends to a dent affects the appearance of the fabric. With a coarse reed more ends can be drawn to a dent than on a fine reed but a coarse reed may leave reed marks. In any case the ends per dent should not be excessive in order to minimize fraying of ends.

Generally, the number of ends per dent are the same for width of fabric but to obtain certain effects and for several other reasons there is often variation. For example, rib weaves or weaves in which it is desired to make a stripe more prominent would be reeded differently from the ground weave.

Of course, the number of ends in the warp or fabric to be made and the width of reed are the important factors to consider in making the reed plan. If the fabric is to be 40 inches wide and contains 3600 ends, all the ends must go in the dents of the reed used. The designer customarily indicates on the loom ticket the size reed and the number of ends to be reeded per dent. In this case suppose the reed is a No. 30 - that is 30 dents per inch. The 3600 ends must be reeded in 1500 dents or be reeded 3 per dent.

Study the illustrations following of reed plans for certain types of fabrics to get an understanding of how to make reed plans.



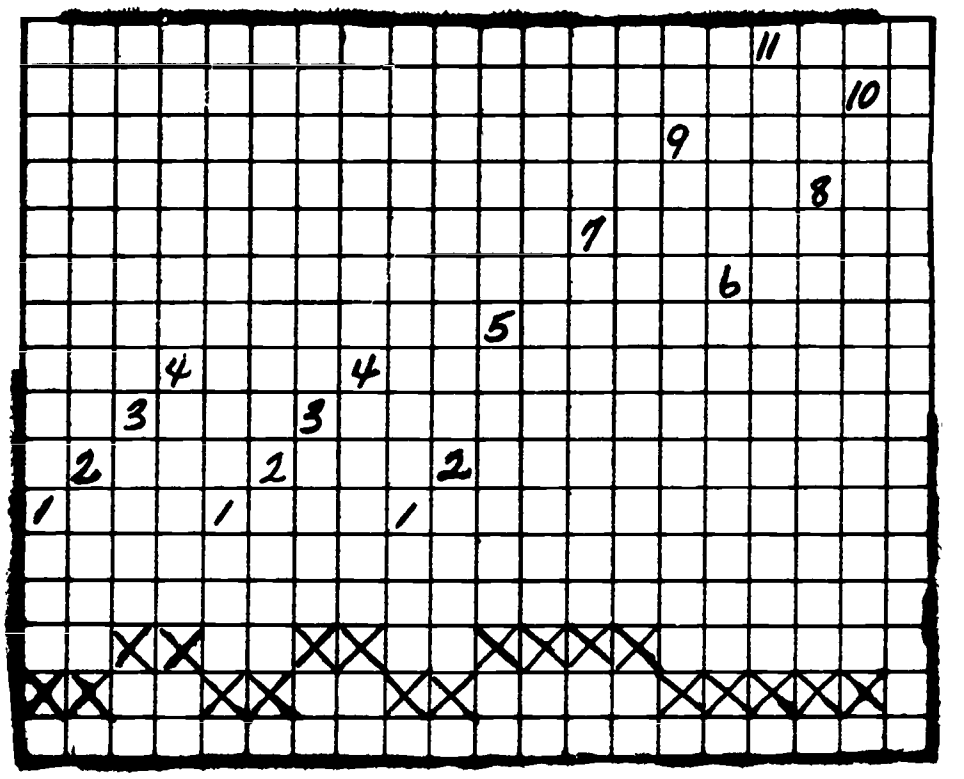


Figure 53. Irregular Reed Plan

Chapter IX

DESIGNING - DERIVATIVE WEAVES

The weaves taken up in this chapter will consist of derivative weaves, or weaves derived from plain weaves, twills, and satins; also, some single cloth weaves for fabrics of a special construction.

The plain weaves are classified into two divisions--first, warp effect, and second, filling effect. The most common derivative of plain weaves are rib weaves. These will be taken up first.

The object in the construction of these weaves is to put more than one pick in the same shed. This design repeats on two ends and four picks. There are three repeats warp-wise and 1 1/2 repeats filling-wise. The ends are interlacing alternately on every two warp ends. The principles of interlacing of these rib weaves are the same as plain weave, except that two or more ends in filling effect or picks in warp effect, are placed in the same shed.

Warp and filling ribs can be made on any number of harness so long as the floats are not too long. Floats are usually not allowed to float over six to eight ends or picks.

Figure 54 shows an eight harness filling effect rib repeating on eight warp threads and two picks, two repeats shown warp-wise and four filling-wise.

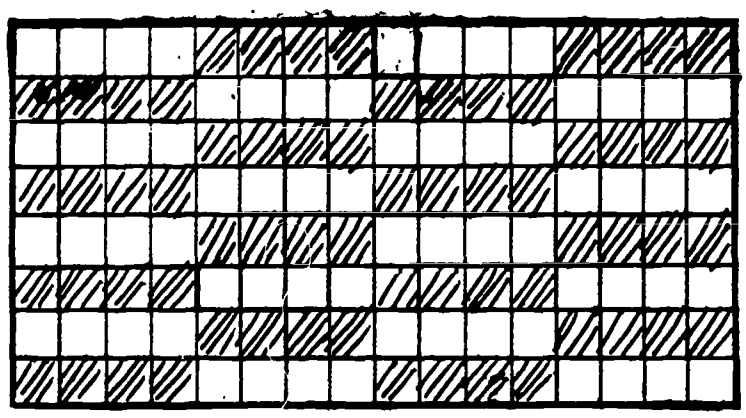


Figure 54.

Basket Weaves. Basket weaves are a combination of warp and filling ribs produced by the successive interlacing of two or more warp threads with two or more filling threads, alternating up and down. Figure 54 shows two repeats each way of a four harness basket.

All common basket weaves are made with the same number of ends and picks interlacing alternately.

All common basket weaves are made with the same number of ends and picks interlacing alternately.

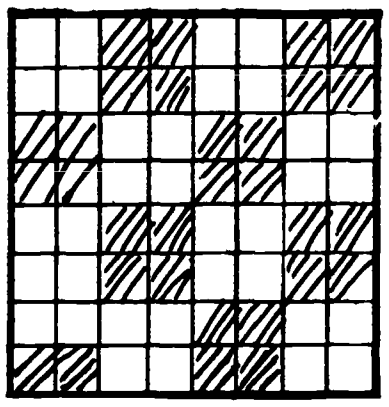
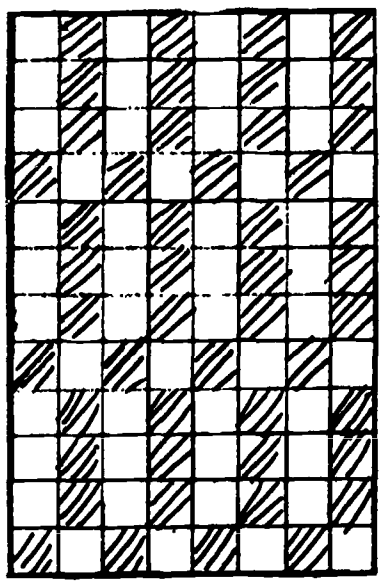
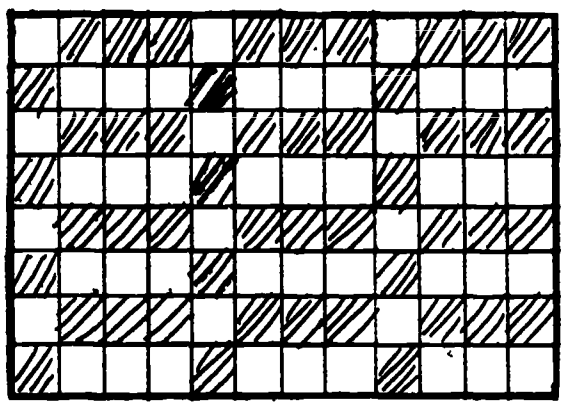


Figure 55.

Fancy Rib. Fancy rib weaves are a combination of the regular plain weave with the common rib weave. The plain weave alternates with the rib weave; that is, a pick of plain weave is put in one shed and several picks in the next shed. Figure 56 (A) shows warp effect fancy rib repeating on two ends and four picks. Figure 56 (B) shows filling effect, repeating on four ends and two picks. The number of picks put in each shed will cause different effects in the cloth.



(A)



(B)

Figure 56.

Fancy Basket Weaves. These fancy basket weaves are obtained by combining common baskets of different sizes in one design, also, the combining of corresponding warp and filling effects of the fancy rib weaves. Figure 57 shows a fancy basket alternately changing on two and four ends and picks both ways and repeating on six ends and six picks.

When changes are made and warp and filling ends or picks are of uneven numbers, the repeat for those ends and picks will have to be double; for example, if the changes are 5, 3, 1. Five is an uneven number; thus, 5 + 3 + 1 = 9 x 2 = 18 ends and picks necessary for a complete repeat.

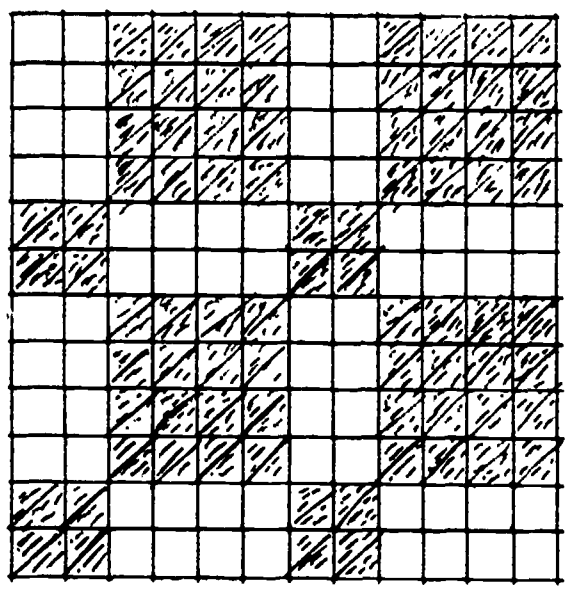


Figure 57.

Figured Rib Weaves. These are obtained by combining a common and a fancy rib weave. Figure 58 illustrates a $\frac{3}{3}$ warp effect with a $^{3}_____{3}$ filling effect. Each effect is arranged for a repeat on six ends and six picks. A complete repeat is made on twelve ends and twelve picks. Different effects can be obtained by moving the rib up or down one end or pick after a certain number of ends and picks have been put in in succession. Figure 59 will illustrate this. Given $\frac{3}{1}$ fancy rib, repeat on eight ends and four picks.

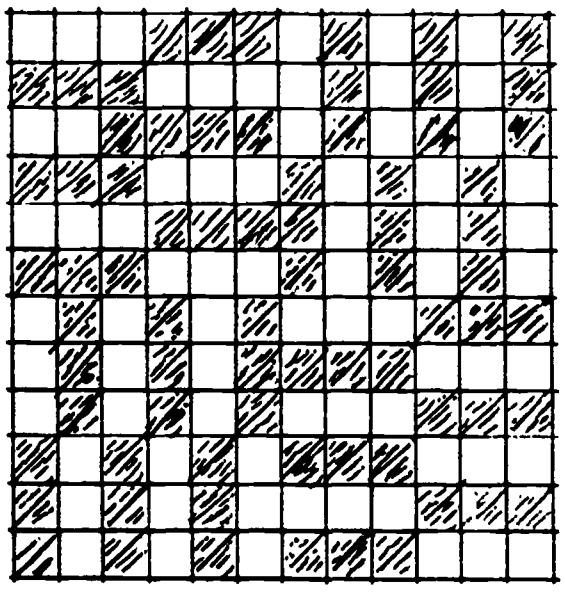


Figure 58.

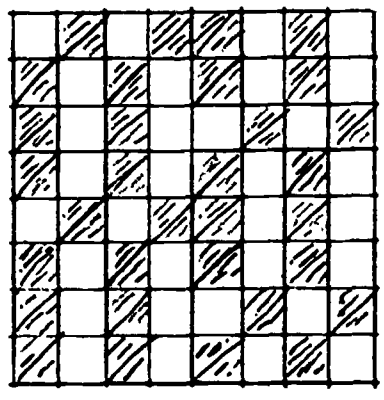


Figure 59.

Oblique Rib Weaves. These weaves must be equal warp and filling-wise, which usually requires an even number of harness. To make an oblique rib on eight harness, divide the number of squares used on design paper into four equal parts. Figure 60 shows an example of an eight harness oblique rib repeating on eight ends and eight picks.

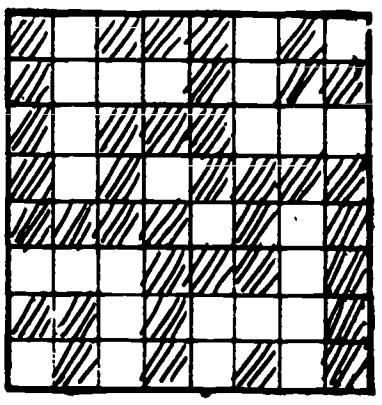


Figure 60.

Broken Twills. These weaves are derived from regular twills by running the twill line in its normal direction for half of the repeat and then in the other direction for the other half of repeat; that is, one-half of the repeat has a right hand twill line and the other half has a left hand twill line.

Four harness is the least number that a broken twill can be woven on. The numbers used as counters for a broken twill must be added together and the total divided by two. Figure 61 shows $1_____3$ broken twill. 1 + 3 = 4 and 4 ÷ 2 = 2; therefore, the twill line will run for two picks to the right and two picks to the left. The first warp thread interlaces with the first pick and the second warp thread with the second pick. Then change the direction of the twill line by interlacing the third end with the fourth pick and the fourth end with the third pick.

Broken twills are made to break in warp or filling direction in sections; that is, the twill line runs right for a certain number of ends or picks then left for the same number. Figure 62 shows a $4_____4$ twill in sections of six ends broken warp-wise, 2 repeats. The twill line is run to the right for six ends, then a clean break is made on the seventh end and the direction of the twill line is changed to run from right to left for six ends.

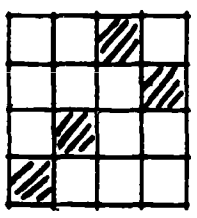


Figure 61.

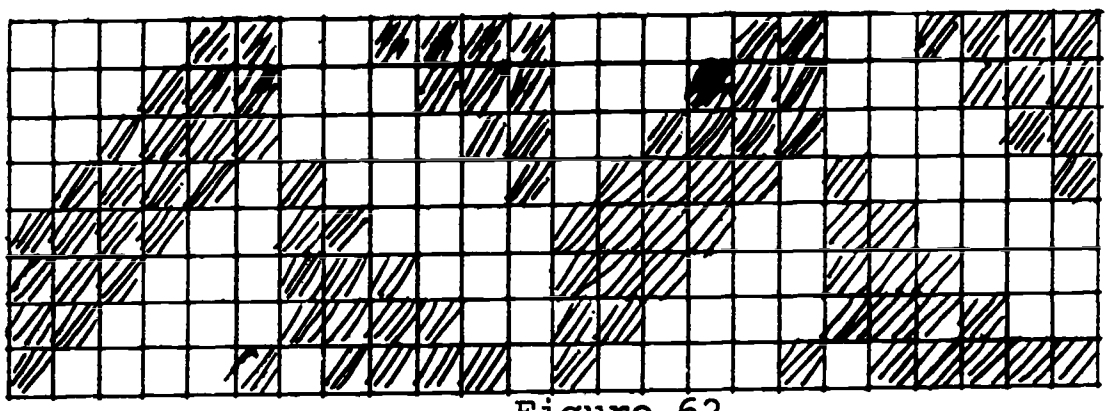


Figure 62.

Broken twills tend to form figures when the regular twills are broken off in the direction of warp and filling.

Steep and Reclining Twills. Figure 63 is a diagram showing the construction of steep and reclining twills of 15, 20, 27, 38, 45, 63, and 70°. Steep twills are above 45° and reclining are below 45°. Figure 64 shows a 20° reclining twill on eight harness.

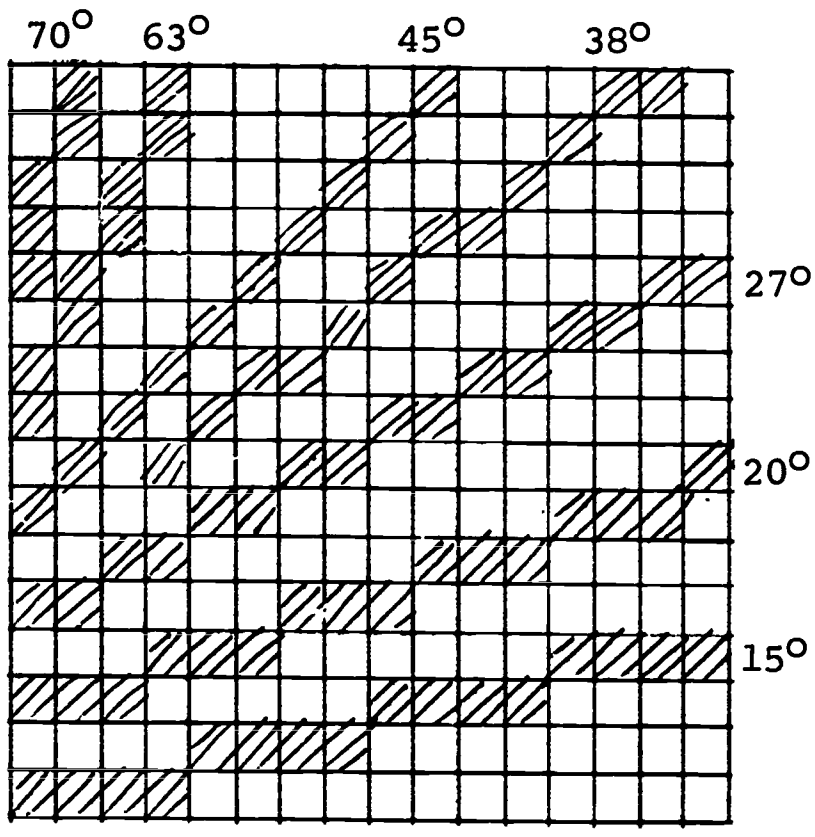


Figure 63.

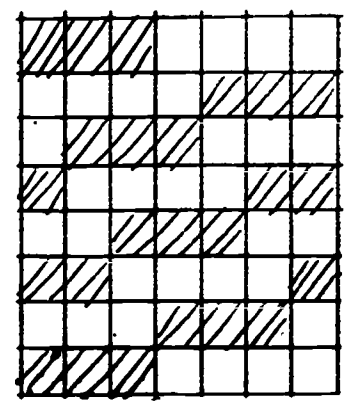
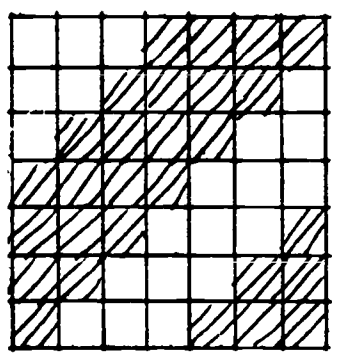


Figure 64.

Cork Screw Twills. Cork screws are derived from the regular 45° twills by means of a double draw. These twills have a larger sley than regular twills.

(A)



(B)

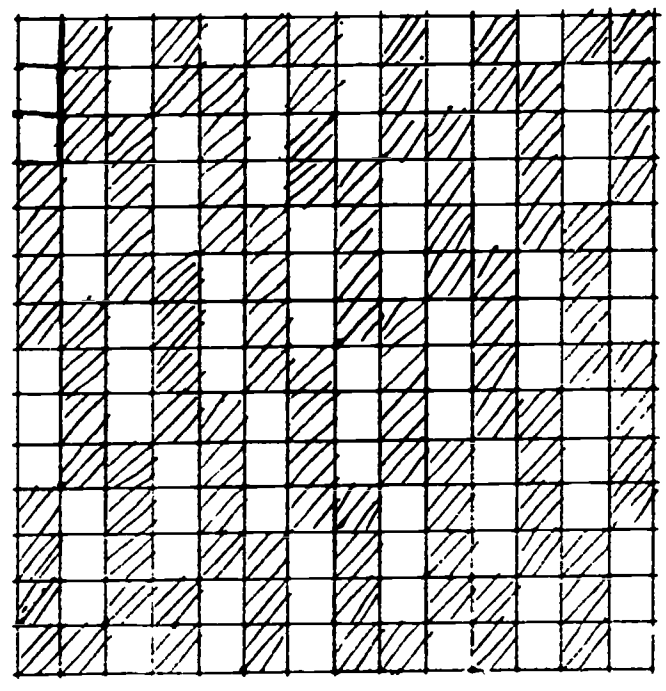


Figure 65.

Cork screws are made on any number of harness above five that is desired. Figure 65 (A) shows $4\frac{1}{3}$ regular twill and (B) shows the corkscrew which is derived from (A).

If the floats are too long, the cloth will be loose and spongy. If possible, long floats should be avoided.

Entwining Twills. Entwining twills might be considered another kind of broken twill and they are derived from the regular twill weaves by running one or more twill lines parallel in one direction and a second set of the same size and construction at right angles to the first set.

To find the number of harness for a given entwining twill, multiply the number of harness required for a repeat of the foundation twill by the number of twill lines wanted in the entwining twill. For example, if a $2\frac{1}{2}$ foundation twill was used to make an entwining twill with four twill lines, then a repeat would be 4 x 4 = 16 harness required. Figure 66 shows an entwining twill made from a regular $2\frac{1}{2}$ twill with three twill lines. The first twill line is started in the bottom left hand corner and taken up half way, then the next twill line running in the opposite direction is started on the next end and two picks above the finish of the first twill line, then the shorter twill lines are filled in.

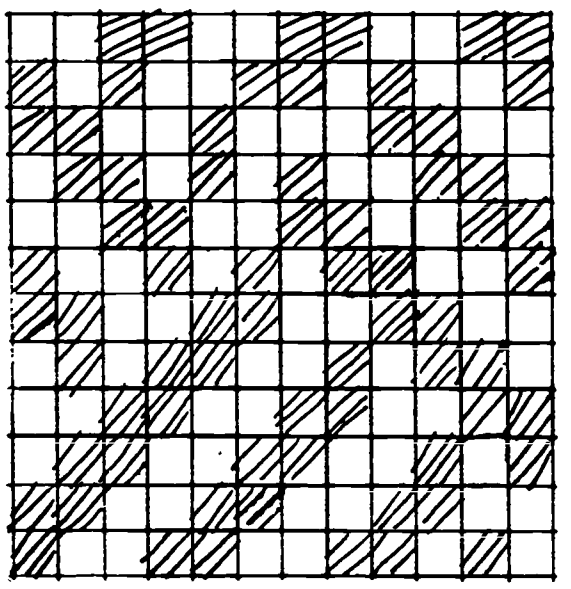


Figure 66.

Satin Derivatives. Double satin weaves are used in goods where we desire to increase the strength and still retain the satin finish on the face of the cloth. These weaves are obtained by adding one or more intersections of warp and filling in each repeat to a regular satin. These interlacings are added to the right or left, above or below, in regular distances from the original point.

Figure 67 (A) shows an eight harness satin weave using five as a counter. (B) shows (A) made into a double satin with extra interlacings at the right of the original point and (C) above the original point.

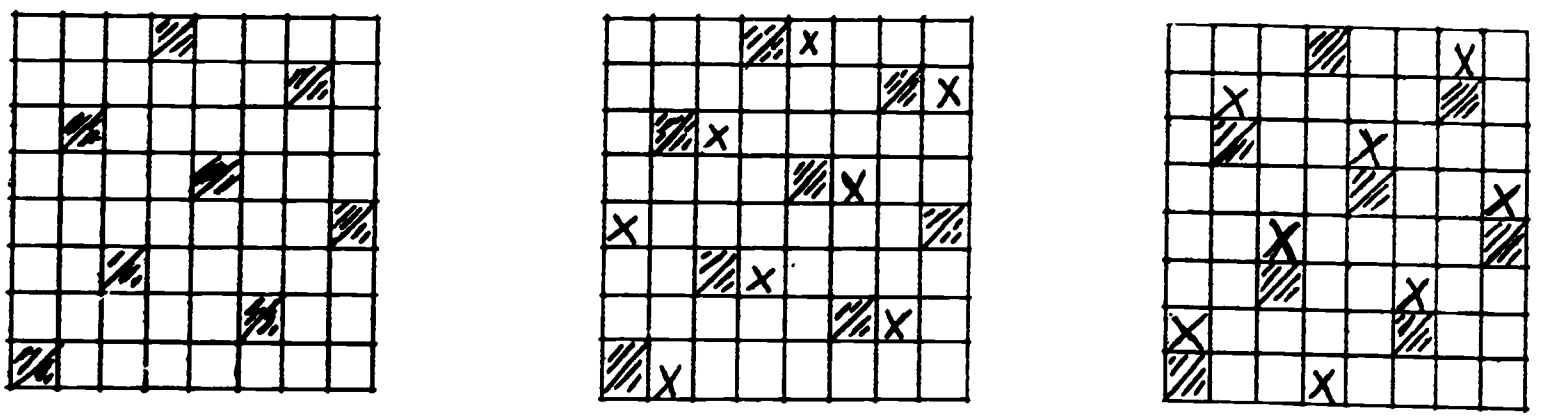


Figure 67.

Granite Weaves. Granite weaves are composed of small broken up effects located with respect to original points in regular satins. Figure 68 shows an original ten harness satin using three as a counter, with three lacings located with respect to the original point.

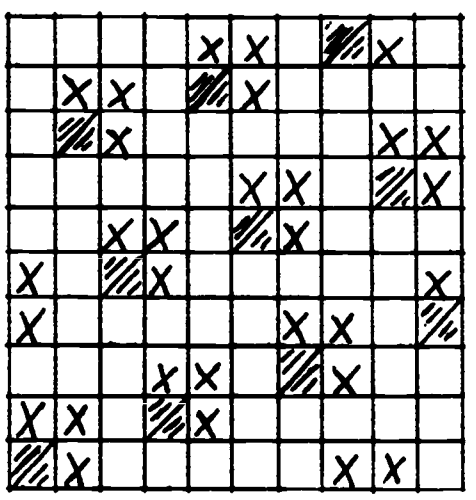
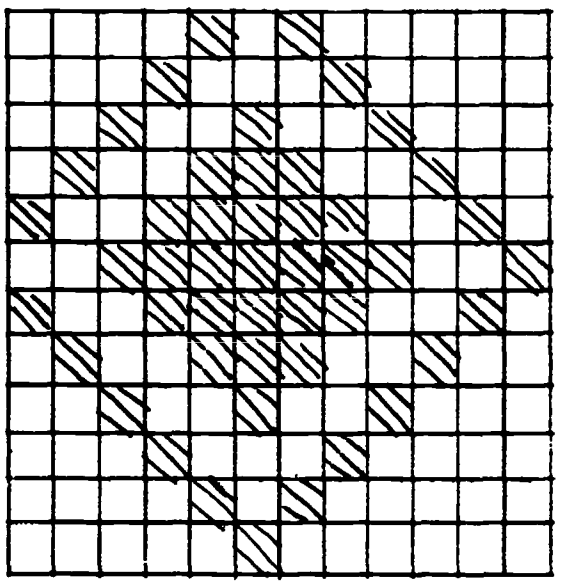
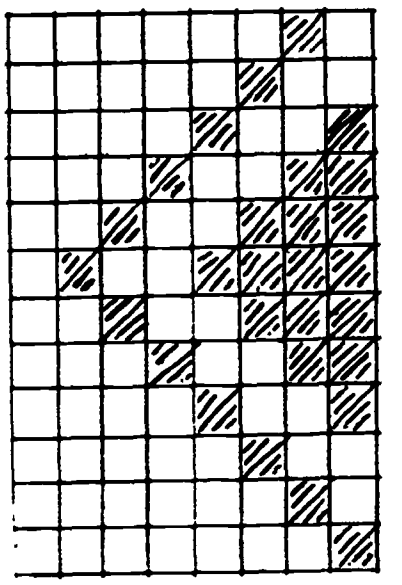


Figure 68.

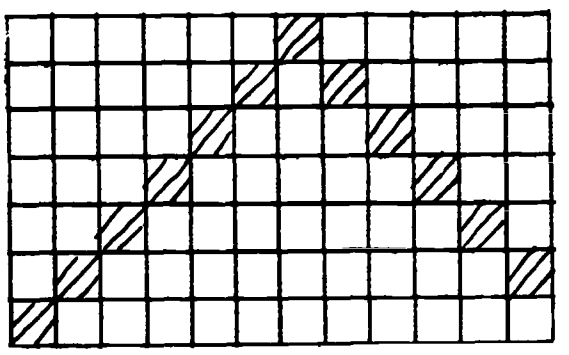
Single Cloth Weaves of A Special Construction. Honeycomb weaves are formed by floating part warp and filling so as to form squares in the cloth. These floats form grooves in the cloth; thus giving the effect or appearance of honeycomb. These weaves are drawn on pointed draws; that is, the drawing-in draft is a pointed draw. Figure 69 shows one repeat of a twelve harness honeycomb with drawing-in draft and chain draft.



Pattern or Weave



Chain Draft



Drawing-in

Figure 70.

Designing Weaves By 4 Change Method. This method designing is obtained by placing one or two weaves four times to each other. An original weave is made and the space for the new weave is layed out. It is four times as large as the original weave. The original weave is placed on the odd ends and picks only. Each time the original weave is placed in the new weave it is rotated clockwise 90° until all four sides have been completed. Figure 71 shows $1_____3$ twill combined to give the new weave. 1 + 3 = 4 and 4 x 2 = 8 harness necessary for 1 repeat.

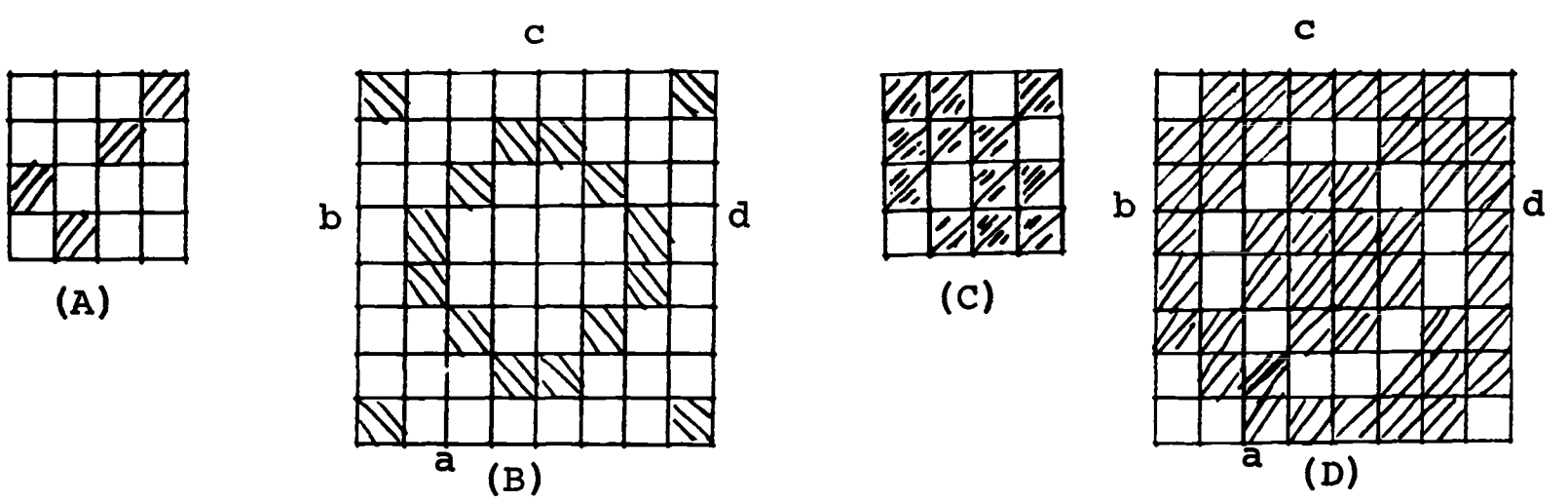


Figure 71.

When (A) was used by the 4 change method, it gave a figure like (B); and when (C), the opposite of (A), was used, the figure (D) was obtained which is just the opposite of (B).

Shaded Fabrics. Shaded fabrics are obtained by a gradual change from warp to filling effect, or vice versa. This is produced by having long warp or filling floats and gradually decreasing the length of floats until the opposite effect is obtained.

Shaded Satin Weaves. To produce a shaded satin, first an original satin is made. To this, add an extra interlacing to each repeat, thus shortening the long float. Keep adding an extra interlacing until the opposite effect is obtained. Figure 72 shows an 8 harness satin with three changes of shades, using a counter of 5.

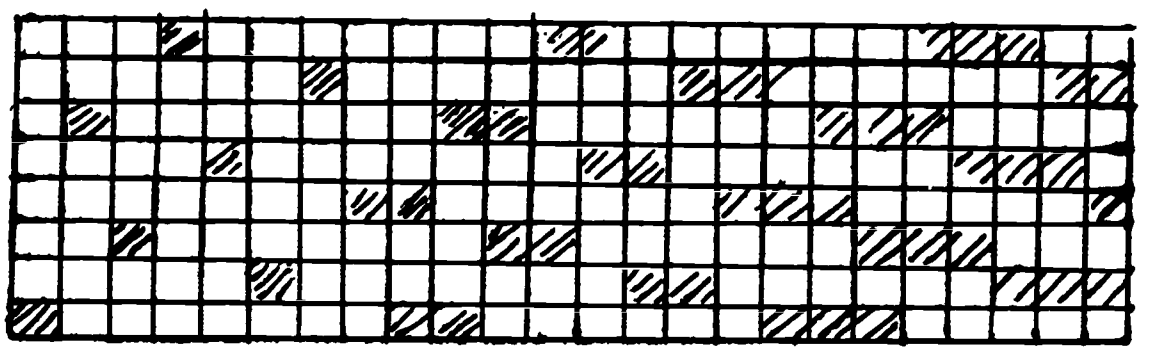


Figure 72.

Shaded Twills. Shaded twills are woven by using a rather large variation of counters, with the long filling floats separated by short warp floats and gradually reversing the above procedure until the filling floats are short and the warp floats are long. This produces a ray appearance in the cloth.

The designer makes a sketch or diagram on paper when he wishes to make a new design. If diagrams are not available, use samples used in analysis so that the student can see the comparison of actual and theoretical construction.

Each different colored stripe in the diagram is measured with a fine graduated rule and the width of each stripe is recorded opposite its color. Some construction is assumed in this case; for example, 64 ends per inch in ground reeded 2 per dent and 4 per dent in stripe. The filling has 62 picks per inch in the body and 124 picks per inch in stripe. The width of the stripe times the dents per inch gives dents calculated. A fraction of a dent can't be used, so the closest whole number is recorded under dents per stripe used. The end per dent for plain weave is usually two per dent up to 90 ends per inch. When two or more ends are combined in a fabric, one will probably take up more than others; therefore, to prevent using more than one beam, the different weaves are reeded differently. In this example, a plain weave and a $1____3$ twill were used to find the ends per dent, the ratio of interlacings was determined. Lay out one repeat of the

loosely interlaced material and beside it enough of the other material to use the same number of picks. The ratio of interlacings of a plain weave to a 1 ____ 3 twill is 4 to 2; thus, if 2 ends of plain weave are placed in a dent, both weaves should take up the same. Then, dents per stripe used times ends per dent gives ends per stripe.

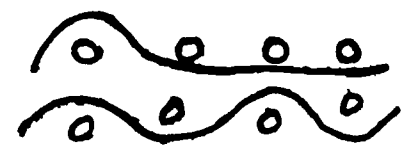


Figure 73.

In the filling layout, the stripes were measured and placed opposite the color. The width of stripe times pick per inch gives picks calculated. The closest even number to the calculated picks is recorded under picks per stripe used. An even number of picks and pick loom is used.

Rules to Use in Designing

(1) To find the width of cloth outside of selvage, use a steel tape. The selvage can be measured or calculated and subtracted from the total width inside the selvage. To calculate the width of the selvage, it is necessary to know the ends per inch which can be counted, ends per dent, the number of selvage threads, and how the selvage is reeded. For example, if a sample of cloth has 60 ends reeded 2 per dent:

60 ends ÷ 2 ends per dent = 30 dents per inch in the body
48 ends ÷ 4 ends per dent = 12 dents per inch in selvage
$\frac{12}{30}$ = .4 inch width of selvage

Assuming 36 inches is the width of the cloth, then:

36 - .4 = 35.6 as width inside selvage

(2) Dents per inch in the cloth equals ends per inch divided by ends per dent. When a designer makes a new design, he usually sketches a diagram of the weave on paper, then he has to make a warp and filling layout to determine the warp and filling threads used in each stripe given in the example below.

Warp Layout

Color	Width of Stripe	Dents Per Inch	Dents Calculated	Dent Per Stripe Used	End Per Dent	End Per Stripe
Blue	.07	32	2.24	2	4	8
White	.06	32	8.32	8	2	16
	.13		10.56	10		24

(Ends Per Pattern)

Filling Layout

Color	Width of Stripe	Picks Per Inch	Picks Calculated	Picks Per Stripe Used
Blue	.08	124	9.92	10
White	.26	62	16.12	16
	.34		26.04	26

(3) Total dents = width cloth x dent per inch

(4) Dents inside selvage = total dents - selvage dents

(5) Number of patterns = dents inside selvage ÷ used dents in pattern from warp layout

(6) Reed number = $\frac{\text{(Ends per inch - 1) x .95}}{\text{2 ends per dent}}$

(7) Width in reed = total dents - reed number

(8) Filling shrinkage = $\frac{\text{ends per inch x 4 (constant)}}{\text{warp count}}$

(9) Take-up = $\frac{\text{P.P.F. x 4}}{\text{Filling count}}$

Note: Multiply by 4 instead of 3.5 when counts are lower than 50^s.

(10) Total ends of each color = number of ends of each color x no. of patterns

(11) Yds. warp per yd. cloth = $\frac{\text{total ends each color per yd. of cloth}}{\text{1 - \% take-up}}$

(12) Oz. of warp per yd. of cloth = $\frac{\text{yds. warp for each color per yd. cloth x 16}}{\text{840 x count of warp}}$

(13) Picks per inch of each color = P. P. I. x $\frac{\text{picks per stripe}}{\text{picks per pattern}}$

(14) Yds. filling per yd. cloth = P. P. I. x width in reed

(15) Oz. filling = $\frac{\text{yds. of each color filling per yd. x 16}}{\text{840 x count of filling}}$

(16) Yds. per lb. = $\frac{16}{\text{Weight of warp and filling}}$

(17) Heddles per harness = no. heddles on first harness D. I. D. x no. of patterns + extra heddles between starting and ending points

(18) Counts = $\frac{\text{yds. each color x 8.33}}{\text{Weight in grains}}$

Note: When sized cloth is being analyzed - warp count by (1-% size).

To determine the center point, start at the ending point. If there is much white in the pattern, it is best to start and end in the white. The number of extra ends will have to be divided on each side of the center point and the extra ends will come against the selvage. An example follows: given a pattern with 24 white ends, 8 green, 12 red, 24 patterns and 24 extra ends, 48 ends in selvage. Pick the center point in middle of white. This will give 12 extra ends on each side next to the selvage.

24 end selvage	
24 white	
8 green	24 patterns
12 red	
24 white extra	
24 selvage	

Chapter X

CLOTH ANALYSIS

The purpose of cloth analysis is to find out from a small sample of cloth all the requirements necessary to reproduce goods similar to or to duplicate a given sample. Cloth similar in appearance to certain samples is often produced with changes in counts and construction. The purpose of this is to reduce cost.

Cloth is made up of ends and picks, or some say that cloth is so many sley, which means so many ends per inch or such a pick cloth, which means so many picks per inch. Thus, a 72 x 80 would mean 72 sley or 72 ends per inch and 80 picks per inch. Cloth specifications are usually written as follows: 40" 72 x 80 - 4.50 - 30^{s}W - 46^{s}F. This means that the cloth is 40 inches wide, 72 ends per inch and 80 picks per inch, 4.50 yards weigh one pound, 30^{s}single warp and 46^{s}single filling count. The student should remember the order in which these specifications come.

To begin an analysis of a sample of cloth, the student must be able to determine the following:

1. Which threads are warp and which are filling
2. Face and back of cloth
3. Width inside and outside selvage
4. Ends per inch
5. Picks per inch
6. Number of selvage ends
7. Total ends in one pattern or repeat
8. Body ends
9. Total ends
10. Warp take-up and contraction
11. Filling shrinkage
12. Number of patterns in warp

Tools and Materials. To pick out a sample of cloth one needs a pick-out needle or a sharp pencil, a pair of scissors, a pick glass and design paper. The pick glass is a necessity on fine goods. The base of the glass is 1 inch square and some have a pointer for counting ends and picks.

Picking Out Sample. A great deal of care must be taken in analyzing a piece of cloth. It is very easy to make a wrong count of picks and ends to an inch in some fabrics. Likewise, it is easy to count an end up when it isn't. Once and awhile warp threads are pulled out of position and will cause a mistake in the pick-out.

The beginner will have some trouble with pick-out mistakes but with experience he will soon know when the weave should repeat or when an end obviously is marked wrong on the pick-outs. Students should pick out samples of fairly coarse yarn and of well defined and simple pattern until he gains some experience. Readily identified twills, basket and honeycomb weaves make good ends to start with. These may be followed by more complicated weaves as practice is gained.

The sample for the pick-out is usually about 2 inches square but this may be determined by the pattern. Two or three repeats should be in the pattern.

Start the pick-out at the bottom of the sample. Pull out 5 or 6 picks to leave the ends protruding about 1/4 inch. Then push out the next pick carefully and observe the ends that are up on that pick from left to right across the sample. Mark the ends up on design paper horizontally or pick-wise. Make an X rather than blacking out the squares in order to save time. The square blank in the pick is on top.

After the first pick has been put on design paper go up until a repeat is reached filling-wise, then take the next end and fill in squares where the warp is over the filling and leave the squares blank where the filling is over the warp. Continue this until a repeat is made warp-wise.

It must be remembered that although the pick is picked out in the sample, the way the ends interlace is put on design paper by "X-ing" out the squares.

Quite often the pattern looks anything but right after it has been picked out. This is because pick-out was started at no particular place in the sample. The pick-out design can be rearranged to look better by looking over the pattern and deciding where to start. Be sure the pick-out is carried to the number of ends and picks to make a full repeat.

Pick-out is only one aspect of fabric analysis. Quite a bit of further information must be obtained to duplicate the sample. There are certain formulas used in finding the required information. These formulas are given in this chapter.

Rules and Formulas

1. Determining Warp and Filling. Sometimes this may be difficult to do, especially if the sample to work from is small. Several ways to distinguish between warp and filling are: the selvage always runs parallel to warp. The warp also runs parallel to reed marks, provided there are some reed marks in the sample; prominent stripes usually run warp-wise; there is usually less stretch warp-wise than filling-wise; warp yarn, generally, are coarser than filling yarn and have more twist. If the selvage is on the sample, it is easy to determine warp; if it is missing, it will take careful study.

2. Face of Cloth. The face of the cloth can be determined by the finish which is usually better on the face than back. When examining twills, the twill lines usually run from left to right on face, and right to left on back. In printed goods, the face is always printed. When two qualities of material are used, the better quality is shown on the face. Determining face comes quickly after student has had some experience in fabric analysis. While the weave can be determined by using the back, it is preferable to use the face.

3. Width Outside and Inside Selvage. The width outside the selvage is usually found by measuring with a steel tape. Then measure the selvage on each side and subtract from the total width to get the width inside the selvage. The measurement must be accurately made or it may affect the complete duplication of the pattern.

4. Ends and Picks Per Inch. The best and easiest method of finding ends and picks per inch is to count them through a pick glass. If this can't be done, then cut two pieces of cardboard one inch square and place the sample between them and cut the cloth around the edges. Pull out and count ends and picks in this inch of cloth.

5. Selvage Ends. The number of selvage threads is obtained by pulling them out of the sample. The student should untwist several selvage threads to see if two or more threads have been twisted together to form ply yarn.

6. Ends and Picks in Repeat. To find the ends and picks in one repeat of the pattern the sample must be picked out. With some patterns it may be done by looking through the pick glass. Students should remember, however, that patterns do not repeat on some number of picks as it does ends. It is safest to pick out the sample.

7. Body Ends. Body ends may be counted through the pick glass by counting the number of patterns the width of cloth and multiplying this by the ends in a pattern, or by counting the ends in one inch and multiplying by width of cloth, exclusive of selvages.

8. Total Ends. Total ends are obtained by counting selvage ends and adding to body ends.

9. Warp Take-up or Contraction. Warp take-up is obtained by carefully measuring the sample warp-wise, then pull out one end and measure it after straightening. The length out of cloth minus length in cloth equals the difference. The difference divided by length out of cloth times 100 equals per cent take-up. Example: A 6 inch sample was measured, then one end pulled out and when measured again, it was found to be 6.5 inches.

$$6.5 - 6 = \text{difference}$$
$$\frac{.5}{6.5} \times 100 = 7.6\% \text{ take-up}$$

10. Shrinkage. Filling shrinkage is found the same way as warp take-up except that the filling yarn is measured instead of the warp yarn.

11. Patterns in a Fabric or Warp. The number of patterns in a warp is determined by finding the beginning and end of one pattern, then counting the number of pattern in the warp.

12. Yarn Counts. To find the yarn count, cut out a sample of cloth to some given dimension, 4 inches for example; then pull out 36 warp and filling threads, keeping them separate.

13. $\frac{\text{Number of Threads Pulled Out} \times \text{Length of Threads} \times 7000}{\text{Inches in 1 yd.} \times \text{wt. in grains} \times 840} = \text{yarn counts}$

Both warp and filling counts may be found by the above formula.

14. Body Dents. Dents per pattern x number of patterns x extra dents = body dents.

15. Dents Over-all. Body dents plus selvage dents = dents over-all.

16. Number of patterns in warp. Body ends ÷ ends per pattern = pattern in warp.

17. Extra Ends. Ends between starting and ending point = extra ends.

18. Ends of Each Color. Ends of each color in one repeat x number of patterns + extra ends = ends of each color.

19. Weight Each Color Warp.

$$\frac{\text{Total ends of each color} \times 16}{1 - \%\text{ take-up} \times \text{counts} \times 840} = \text{Oz. each color warp}$$

20. Width in Each Reed. $\frac{\text{Width of cloth}}{1 - \%\text{ shrinkage}}$ = Width in each reed

21. Reed Number. Total dents ÷ width of reed = reed number

22. Yards of Filling in 1 Yard of Cloth.
Width in reed x picks per inch = yds. of filling in 1 yd. of cloth

23. Lbs. in Each Color Filling.
$\frac{\text{Yds. of each color filling per yd. of cloth}}{\text{Counts x 840}}$ = Lbs. in each color of filling

24. Weight of Warp and Filling in 1 Yard of Cloth.
Wt. of warp in 1 yd. + wt. of filling 1 yd. of cloth = wt. of warp and filling in 1 yd. of cloth

25. Yards Per Pound.

$\frac{16}{\text{Wt. in oz. of warp and filling per yds. of cloth}}$ = yds. per pound

26. Yards Per Pound From Small Sample. Cut out a small sample of cloth, 4 inches by 4 inches, and weigh it; then use following formula.

$\frac{\text{Width x length of sample x 7000}}{\text{30 x wt. in grains of sample x width of cloth}}$ = yds. per pound from small sample

27. Heddles Per Inch Per Harness. Number of Heddles
$\frac{\text{Number of heddles}}{\text{Width in reed}}$ = Maximum heddles per inch per harness

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SERVICING CARBURETOR AIR CLEANERS

LESSON I OF SKILLS SERIES

Developed under

MANPOWER DEVELOPMENT and TRAINING ACT of 1962
(P.L. 89-15 as amended)

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VOCATIONAL EXPERIMENTAL - DEMONSTRATION PROJECT
UNDER
MANPOWER DEVELOPMENT AND TRAINING ACT

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WHY ARE AIR CLEANERS USED?

An AIR CLEANER is a filter used to remove dust particles and other small pieces of dirt from the air that is used inside an engine. Most air cleaners are attached to the CARBURETOR, a device which mixes air and gasoline. If dust and dirt particles pass through the carburetor into the engine, the engine is damaged.

WHY DO AIR CLEANERS NEED CLEANING?

When an air cleaner gets dirty, air cannot flow easily through the carburetor and into the engine. This will cause the carburetor to mix more gasoline than the engine needs. Also, a dirty air cleaner does not filter the air as well as a clean one.

WHAT TYPES OF AIR CLEANERS ARE USED?

There are FOUR types of air cleaners. This lesson will teach you how to service each type. You cannot tell which type of air cleaner is being used on an engine until the COVER of the air cleaner has been removed.

BELOW ARE THE NAMES OF THE FOUR TYPES OF AIR CLEANERS
(be sure that you KNOW them)

1. WIRE GAUZE
2. PAPER CARTRIDGE
3. POLYURETHANE (notice the spelling)
4. OIL BATH

When you look at an air cleaner with the cover on, will you be able to tell which type it is?

YES NO
(Circle the answer)

CHECK YOUR ANSWER BY THE ANSWER BOOK

From the outside, the four air cleaners look almost alike. But, on the inside, they are very different.

The most important difference in the four types of air cleaners is in the ELEMENT used to clean the air. Each type air cleaner uses a different ELEMENT.

An air cleaner is known by the name of the element which it uses. The chart below shows this:

NAME OF ELEMENT	NAME OF AIR CLEANER
WIRE GAUZE	WIRE GAUZE
PAPER CARTRIDGE	PAPER CARTRIDGE
POLYURETHANE	POLYURETHANE
OIL BATH	OIL BATH

It is the *filter element* which does the actual work of removing the dust particles and dirt from the air that passes into the engine through the carburetor. Each of these elements is made of a material that "filters," or "strains out" the dirt; in other words, the element *traps* the dirt while letting the air pass through.

There are FIVE STEPS in servicing an air cleaner.

BE SURE THAT YOU KNOW THESE FIVE STEPS:

STEP 1. DISASSEMBLE: remove the cleaner from the car, and the cover and element from the cleaner.

STEP 2. CLEAN PAN AND COVER: wipe out cover and pan with clean cloth, or wash with solvent if extremely dirty.

STEP 3. CLEAN OR REPLACE THE ELEMENT.

STEP 4. OIL THE ELEMENT IF NECESSARY.

STEP 5. REASSEMBLE: replace the element and cover in the cleaner, and replace the cleaner on the car.

NOW USE THE ABOVE INFORMATION

Write in the number of the step to which each statement refers. Hint: They are not in order.
Write in the name of the step to which each statement refers.

STEP____. _____ replace the element and cover.

STEP____. _____ remove the cover and element from the cleaner.

STEP____. _____ soak element in oil.

STEP____. _____ wipe out cover and pan with clean cloth.

STEP____. _____ wash element in kerosene.

Circle the correct meaning: To "disassemble" means to (take apart/put together again), while to "reassemble" is to (take apart/put together again.)

CHECK YOUR ANSWERS BY THE ANSWER BOOK.
CORRECT ANY ERRORS; THEN GO ON.

Remember that an AIR CLEANER is known by the name of the ELEMENT used in it.

Don't forget to *write in* the answers on the blank lines below.

The PAPER CARTRIDGE air cleaner has a _____ ELEMENT.

The POLYURETHANE air cleaner has a _____ ELEMENT.

Write in the names of the FOUR elements on the blank lines below.

1. _____

2. _____

3. _____

4. _____

The name of the element determines the name of the air cleaner.

Since the element is INSIDE the air cleaner, it cannot be seen until the COVER has been removed. Therefore, you should remove the *cover* of the air cleaner.

CHECK AND CORRECT YOUR ANSWERS IN THE ANSWER BOOK.

Below is a picture of an air cleaner with its cover removed. You can see the ELEMENT insi

1. Write the letter C on the cover.

2. Circle the WING NUT.

3. The ELEMENT sits inside the

_____.

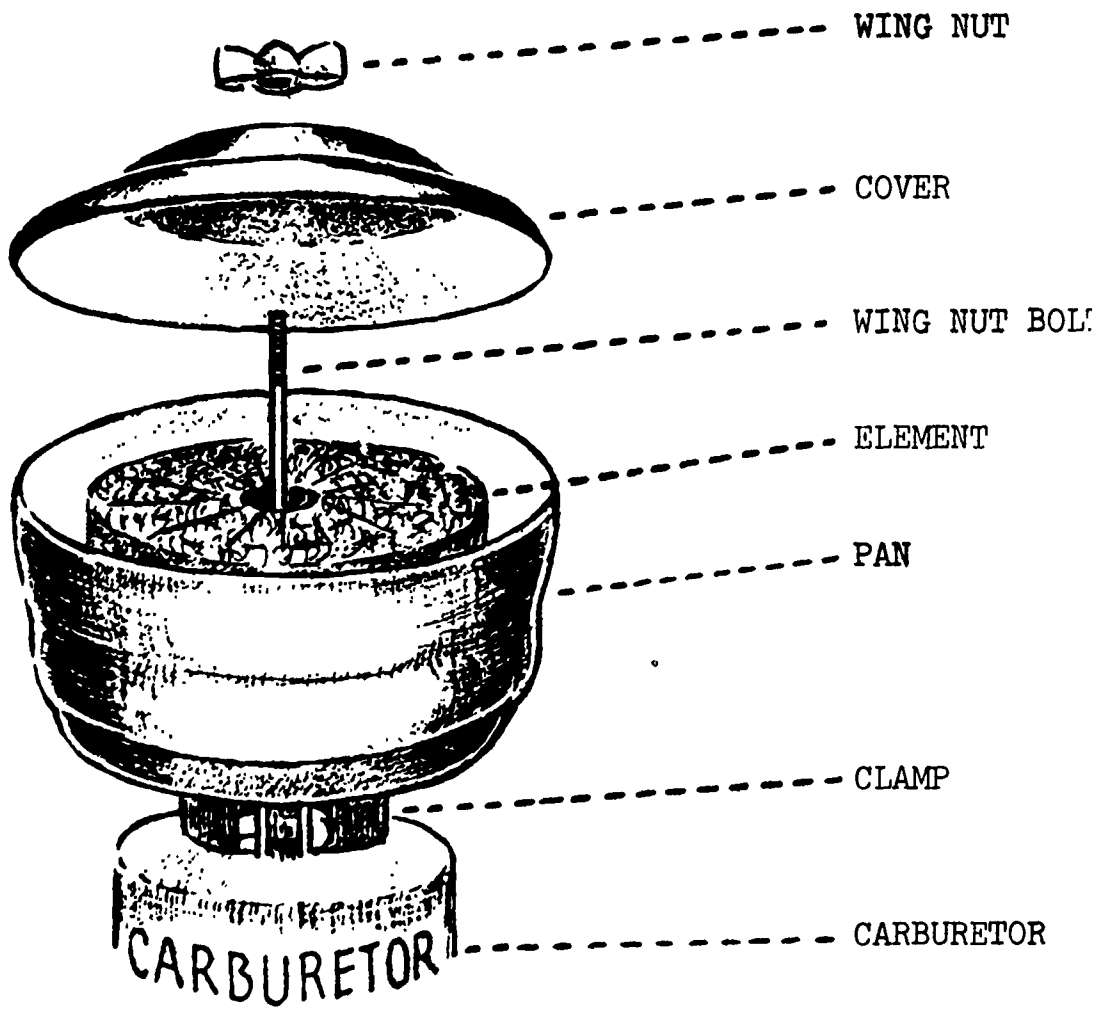
(Write in answer)

4. Draw an arrow from here to the CLAMP.

5. The clamp holds the air cleaner onto the

_____.

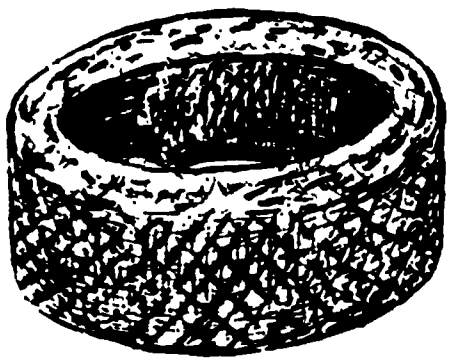
(Write in answer)



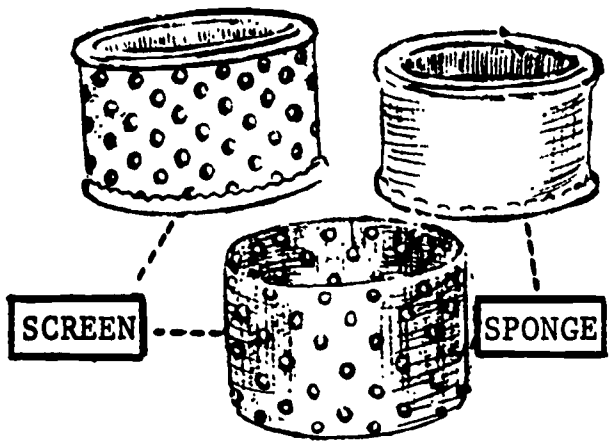
HOW TO DISTINGUISH THE FOUR TYPES OF ELEMENTS

1. WIRE GAUZE

otice that the wire auze element is made f tiny hairlike WIRES, hich are the wire gauze hat gives the element ts name.



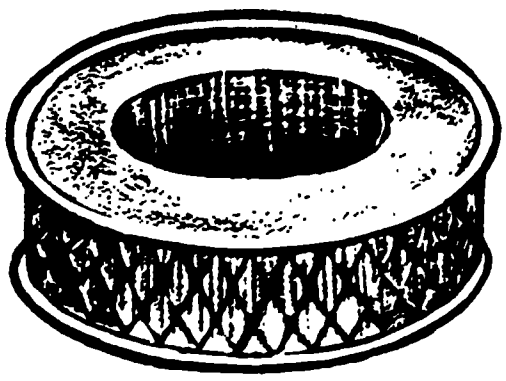
2. POLYURETHANE



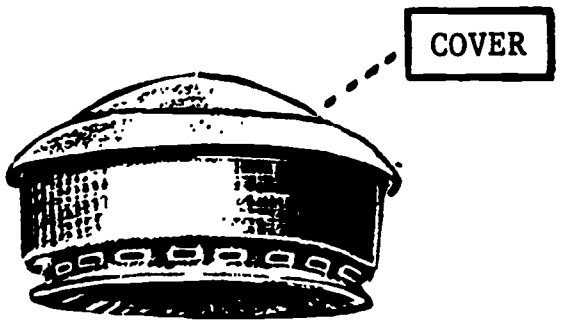
This element has SPONGE that fits outside the supporting screen. You can remember this more easily if you know that the word "polyurethane" is the name for that foamy plastic sponge material.

3. PAPER CARTRIDGE

'his element is made rom folded paper.



4. OIL BATH



The element of this air cleaner is joined to the cover. It cannot be removed.

ANSWER THE QUESTIONS BELOW.

1. Which element is made of folded paper? _____

2. Which element is made of tiny wires? _____

3. On which air cleaner are the element and cover joined together?

_____

4. The POLYURETHANE element is a SPONGE. Where would you find this sponge?

_____

5. The OIL BATH air cleaner can be removed from the cover. TRUE FALSE
(*Circle the answer*)

6. Which TWO types of ELEMENTS look somewhat alike?

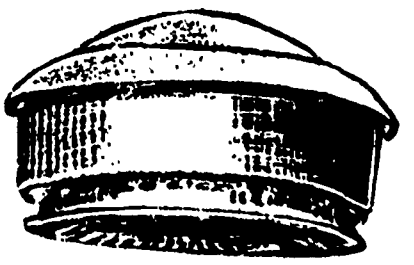
(a) _____

(b) _____

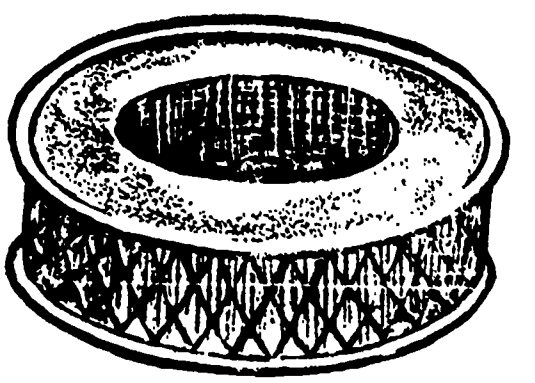
7. What is the name of the element that contains a sponge? _____

WRITE THE NAME OF THE ELEMENT ON THE BLANK LINE OVER EACH PICTURE.
(refer to page 6 if you need to)

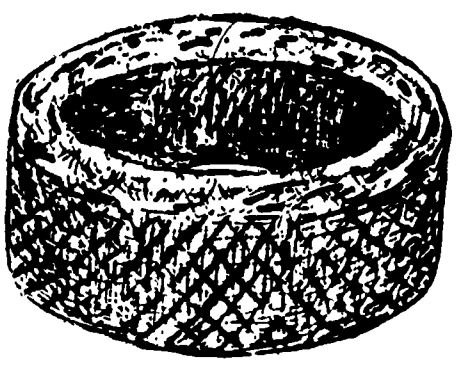
(a) _____



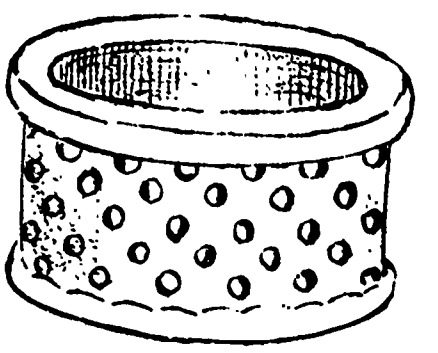
(b) _____



(c) _____



(d) _____



ANSWER THE QUESTIONS BELOW

1. Which air cleaner has the ELEMENT joined to the bottom of the cover? _____

2. Which air cleaner has both a sponge and a screen? _____

3. Which air cleaner uses PAPER as a filter? _____

4. Which air cleaner has tiny hairlike WIRES on the inside? _____

5. What does the element filter out? _____

CHECK YOUR ANSWERS BEFORE GOING ON.

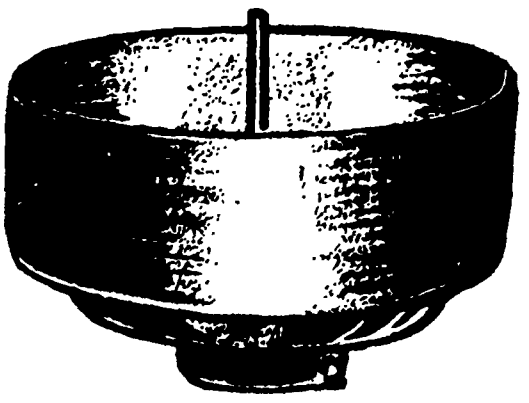
Step 1 is easy, so you'll learn that later. Begin with

STEP 2: CLEAN COVER AND PAN

1. When you begin this step, have the disassembled air cleaner before you on a bench or other flat surface. The element should be out of the pan (the oil bath type has no separate element, remember).

2. Soak a clean cloth in a solvent (which may be kerosene, mineral spirits, or another fluid, depending on the custom of the particular service station at which you are working.)

3. Use the solvent - soaked cloth to wipe the dirt out of the pan and off the cover.



4. There is no need for you to wipe off the *element*, for that will be cleaned in the next step.

CIRCLE THE ANSWER

1. Should you spend any time wiping off the element in this step? YES NO

2. Should you wet the cloth with the solvent <u>before</u> you have the air cleaner ready before you?
   YES NO

3. Should you soak the cloth in water before wiping out the pan and cover?
   YES NO

4. Should you pour the solvent into the pan? YES NO

5. Would kerosene be a good solvent to use? YES NO

6. Would mineral spirits be a good solvent to use? YES NO

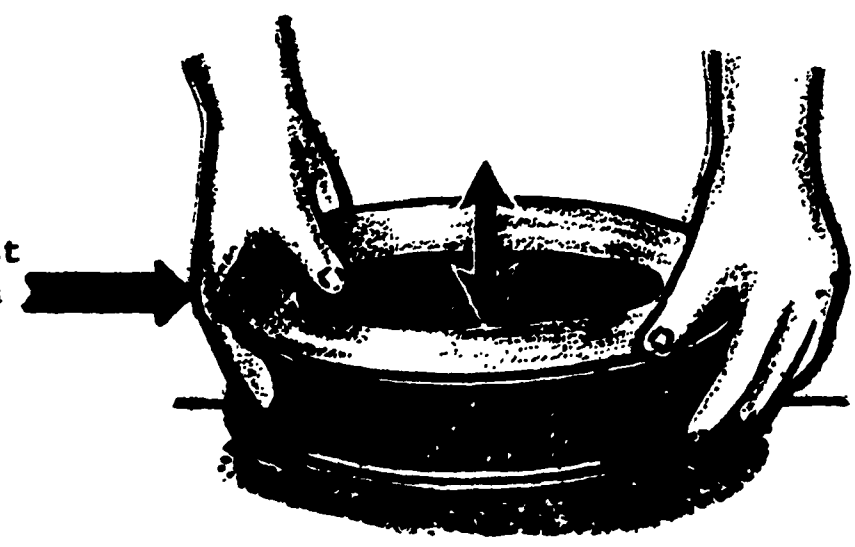
7. The parts which you clean in this step are: PAN ELEMENT WING NUT COVER

STEP 3: CLEAN THE ELEMENT

The easiest element to clean is the PAPER CARTRIDGE.

)TE: Always read the instructions on the cartridge. Some paper cartridges should be REPLACED rather than cleane

Tap the bottom of the element firmly but *not too hard* against a hard flat surface, such as a table or floor. Keep tapping until no more dirt will come.



1. How do you know whether to clean or to replace a paper cartridge element?

   _____.

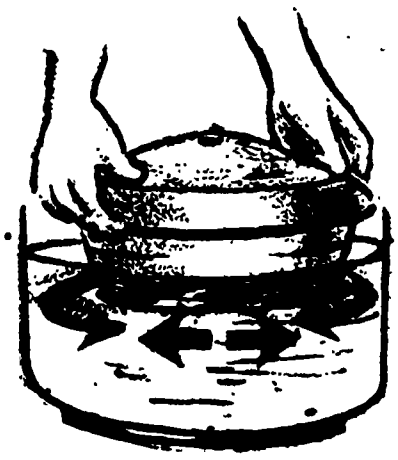
2. How do you know when you have tapped enough? _____.

THESE THREE OTHER TYPES OF ELEMENTS ARE CLEANED BY WASHING THEM IN KEROSENE OR SOME OTHER SOLVENT.

I

OIL BATH

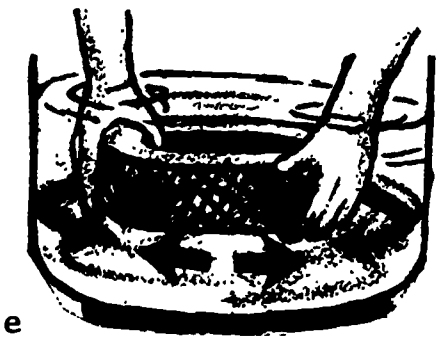
Hold the cover over the bucket so that only the element is in the kerosene. Swish the element around in the kerosene using a circular motion. Do this for about one minute, on the average, or until all the dirt is gone.



II

WIRE GAUZE AND SOME POLYURETHANE

Again swish the element around in kerosene or some other solvent. You should completely submerge both of these elements in the solvent. Here, too, it should take about one minute or so to get it clean, although this depends on how dirty the element is at the start.

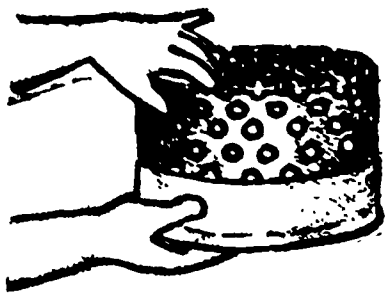


III

POLYURETHANE

If you cannot remove the sponge from the element, follow the directions in column II.
If you can remove the sponge, do it this way:

1. Remove the sponge by pulling it from the screen.



2. Gently squeeze this sponge in the solvent until the sponge is clean.

1. (a) POLYURETHANE: if you can remove the sponge, how should you clean the filter?

_____

(b) If you *cannot* remove it, how do you clean it? _____

2. When you are washing in kerosene or solvent, of which type must you be careful so that *only the element* is in the solvent?

_____

3. (a) As a *general rule*, you should rinse the element in solvent for about *how many* minutes?

_____

(b) But, despite the general rule, the most important thing is to get the element

_____

4. (a) Should you try to remove the wire gauze from the element? _____

(b) Should you try to remove the polyurethane from the element? _____

(c) Should you try to remove the filtering material from the oil bath element?

_____

5. Which type of element is *not* cleaned by solvent? _____

6. How should you clean the paper cartridge element? _____

7. What steps should you have finished before you begin to clean the element?

_____

8. What materials and equipment do you need for cleaning the pan and cover?

_____

The two ELEMENTS below must be allowed to DRAIN after they have been washed.

1. WIRE GAUZE

2. OIL BATH

WIRE GAUZE

Hang the element on a stick until the solvent stops dripping.

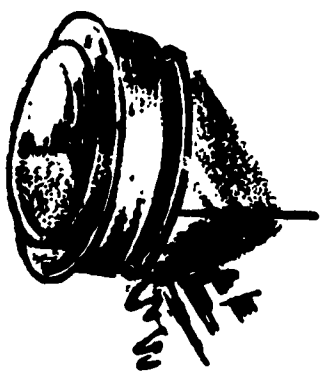
1. Which two elements must be drained after washing?

(a) _____

(b) _____

OIL BATH

Set the OIL BATH cover on its side until the solvent stops dripping.



2. Which two elements need not be drained?

(a) _____

(b) _____

STEP 4: How To Oil The Elements (This is done after they have been cleaned.)

I

WIRE GAUZE

t all the kerosene or solvent rain out of the element. hen *dip* the element in a ucket of oil and again ang it on stick to rain.

II

POLYURETHANE

Squeeze the sponge in oil until it is fully soaked.

Then, squeeze most of the oil out of it. The sponge should stay a little *oily*; there should be a slight *film* of oil on the sponge.

If the sponge will not come out of the screen, then dip the whole element into the oil, just as you do the wire gauze element, and let it drain.

III

OIL BATH

This type is *special*. Read these directions carefully.

After you have wiped it out (Step 2), replace the pan on top of the carburetor.
Then fill the pan with clean oil to the "Oil Level" mark, which will be on the inside of the pan.

NOTE THAT THE PAPER ELEMENT IS NOT OILED.

1. How much oil should be left on the polyurethane element? _____

2. Which type of element is *not* oiled? _____

3. (a) In which type of air cleaner do you *fill the pan* with oil? _____

   (b) How *far* should the pan be filled? _____

4. Should you ever dip the whole element from a polyurethane type element into the oil?

   If so, when? _____

5. Is the step of oiling the element done <u>before</u> or <u>after</u> you clean the *pan* and

   cover? _____ Is it done <u>before</u> or <u>after</u> you clean the

   element? _____

6. Altogether, how many times must you drain the wire gauze filter? _____

ERIC

Match the *method* of cleaning on the right with the *name* on the left by writing the letter in the spaces:

AIR CLEANERS	METHODS OF CLEANING
1. Wire Gauze ( )	(a) Squeeze sponge in solvent.
2. Oil Bath ( )	(b) Tap element on flat surface.
3. Paper Cartridge ( )	(c) Swish element around in solvent.
4. Polyurethane, when sponge can be removed. ( )	(d) Swish element around in solvent while holding onto cover.
5. Polyurethane, when sponge cannot be removed. ( )	

STEPS 1 AND 5: DISASSEMBLY AND REASSEMBLY

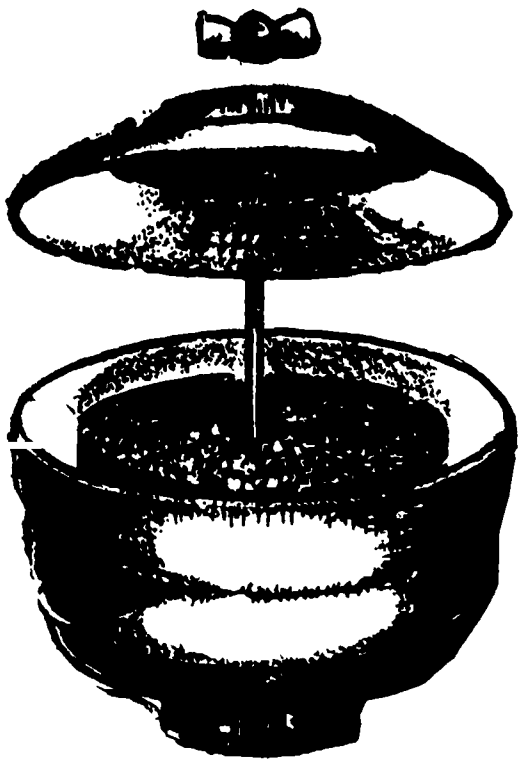
You will learn these two steps at the same time, because the work done in both is so much alike.

o disassemble,

First thing, remove the air cleaner from the car. Do this by loosening the clamp at the bottom and lifting off the entire cleaner. (On the oil bath type, you should now *pour away* the dirty oil.)

1. Unscrew the wing nut.
2. Lift off the cover.
3. Lift out the element. (On the oil bath type, the element is connected to the cover and comes off with it.)

TO REASSEMBLE, SIMPLY DO THE STEPS IN REVERSE ORDER.
(Fill in the blanks as you read.)



1. Set the _____ back into the pan.

2. Replace the _____.

3. Tighten the _____.

Finally, replace the air cleaner on the car. Do this by setting the entire cleaner in position over the carburetor, then tightening the _____ so the cleaner is held securely in place.

Then tighten the wing nut once again to be sure the cleaner is on tightly.

7. What equipment and materials do you need to clean the cover and pan of any element?

_____.

8. List the five basic steps in servicing an air filter.

_____

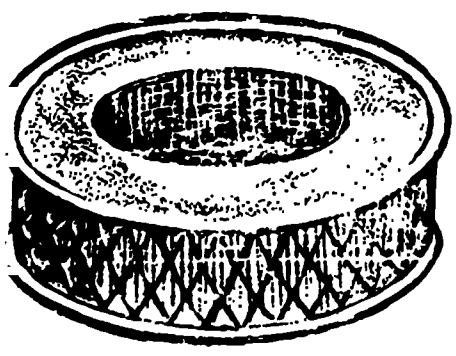
_____

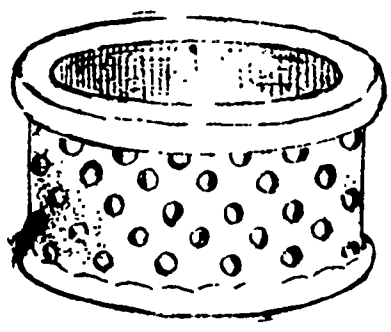
_____

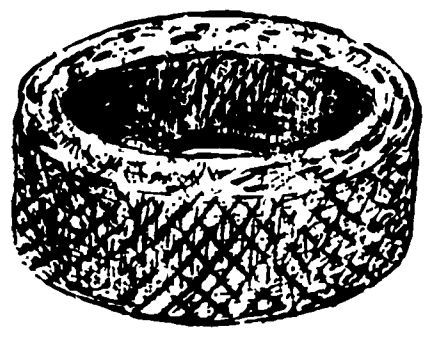
_____

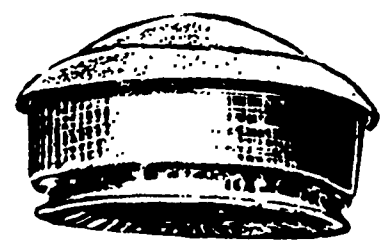
_____

9. Label by name:









_____ _____ _____ _____

ANSWER BOOK

TO

SERVICING CARBURETOR AIR CLEANERS

ERIC

Page 1

No

Page 3

5 REASSEMBLE
1 DISASSEMBLE
4 OIL ELEMENT IF NECESSARY
2 CLEAN PAN AND COVER
3 CLEAN OR REPLACE ELEMENT
take apart put together again

Page 4

paper
polyurethane
1 paper
2 polyurethane
3. wire gauze
4. oil bath

Page 7

1. paper cartridge
2. wire gauze
3. oil bath
4. outside the screen
5. FALSE
6. (a) wire gauze
   (b) paper cartridge
7. polyurethane

Page 8

(a) oil bath
(b) paper cartridge
(c) wire gauze
(d) polyurethane

Page 9

1. oil bath
2. polyurethane
3. paper cartridge
4. wire gauze
5. dust & dirt

Page 11

1. NO
2. NO
3. NO
4. NO
5. YES
6. YES
7. PAN & COVER

Page 13

1. Read instructions
2. No dirt will come out

Page 15

1. (a) squeeze in solvent
   (b) swish in kerosene or other solvent
2. oil type
3. (a) one
   (b) clean
4. (a) No
   (b) Yes
   (c) No
5. paper cartridge
6. tapping it
7. Disassemble, clean pan & cover
8. Cloth & solvent

Page 17

1. (a) wire gauze
   (b) oil bath
2. (a) paper cartridge
   (b) polyurethane

Page 19

1. slight film
2. paper element
3. (a) oil bath
   (b) to "level" mark
4. Yes, when it does not come off the screen
5. after
   after
6. twice

Page 21

1. (c)
2. (d)
3. (b)
4. (a)
5. (c)

Page 23

1. element
2. cover
3. wing nut
   clamp

Page 24 & 25

1. wire gauze, oil bath, polyurethane
2. paper cartridge, tapping it
3. paper cartridge
4. oil bath
5. dip wire gauze in oil, soak the polyurethane and squeeze
6. (b)
   (c)
   (a)
   (d)
   (b)
7. cloth & solvent
8. Disassemble
   Clean pan & cover
   Clean or replace element
   Oil the element if necessary
   Reassemble
9. (in order)
   paper cartridge
   polyurethane
   wire gauze
   oil bath

BEFORE LESSON TEST

FOR

SERVICING CARBURETOR AIR CLEANERS

Name: _____

School: _____

Date: _____

ERIC

1. List the five basic steps in servicing an air filter:

a. _____

b. _____

c. _____

d. _____

e. _____

2. What equipment and materials do you need to clean the cover and pan?

_____

3. What is the purpose of the carburetor air filter? _____

_____

4. Match the method of cleaning with the name of the air cleaner on the right by writing the correct letter in the spaces.

METHODS OF CLEANING	AIR CLEANERS
(a) Swish element around in solvent while holding onto cover.	( ) Polyurethane, when sponge cannot be removed.
(b) Swish element around in solvent.	( ) Paper cartridge
(c) Tap element on flat surface.	( ) Oil bath
(d) Squeeze sponge in solvent.	( ) Polyurethane, when sponge can be removed.
	( ) Wire gauze

5. Which elements are cleaned in solvent? _____

_____

6. Which type of element is not cleaned in solvent? _____

7. Name the four types of carburetor air cleaners.

a. _____

b. _____

c. _____

d. _____

8. a. In which type of air cleaner do you fill the pan with oil?

_____

b. How far should the pan be filled? _____

ERIC

AFTER LESSON TEST

FOR

SERVICING CARBURETOR AIR CLEANERS

Name: _____

School: _____

Date: _____

ERIC

1. List the five basic steps in servicing an air filter:

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

2. What equipment and materials do you need to clean the cover and pan?

   _____

3. What is the purpose of the carburetor air filter? _____

   _____

4. Match the method of cleaning with the name of the air cleaner on the right by writing the correct letter in the spaces.

METHODS OF CLEANING	AIR CLEANERS
(a) Swish element around in solvent while holding onto cover.	( ) Polyurethane, when sponge cannot be removed.
(b) Swish element around in solvent.	( ) Paper cartridge
(c) Tap element on flat surface.	( ) Oil bath
(d) Squeeze sponge in solvent.	( ) Polyurethane, when sponge can be removed.
	( ) Wire gauze

5. Which elements are cleaned in solvent? _____

_____

6. Which type of element is not cleaned in solvent? _____

7. Name the four types of carburetor air cleaners.

a. _____

b. _____

c. _____

d. _____

8. a. In which type of air cleaner do you fill the pan with oil?

_____

b. How far should the pan be filled? _____

ERIC

VT 010 682
Textile Technician, A Study Guide.

Alabama Univ., University. Dept. of Trade and Industrial Education
MF AVAILABLE IN VT-ERIC SET.
Trade and Industrial Education, State Department of Education, P.O. Box 2847, University, Alabama 35486 ($1.75, answer book $1.50).
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DESCRIPTORS - *TRADE AND INDUSTRIAL EDUCATION; OCCUPATIONAL HOME ECONOMICS; *STUDY GUIDES; SUBPROFESSIONALS; *TEXTILES INSTRUCTION; DESIGN; MECHANICAL DESIGN TECHNICIANS; ON THE JOB TRAINING; COOPERATIVE EDUCATION; ANSWER KEYS; *JOB SKILLS

ABSTRACT - This revised study guide and progress record for high school cooperative students in the field of textile manufacturing was prepared by a committee of trade and industrial education coordinators. The first part of the guide contains a listing of 60 job skills with spaces for the student to check his job progress in on-the-job training, and to check his related study progress in completing reading assignments and answering study questions. The remaining part of the guide contains study questions and suggested references for the 60 job skills. The job skills are grouped according to these topics: (1) General, (2) Opening and Cleaning, (3) Carding, (4) Drawing, (5) Roving, (6) Spinning, (7) Winding and Warping, (8) Slashing, (9) Weaving, and (10) Cloth Room. A bibliography of student references is included, and an answer book, "Textile Technician," may be obtained from the source of availability indicated for this document. (SB)

VT 010 682

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107 p

TEXTILE TECHNICIAN

A study guide and progress record
for high school cooperative students
in the field of textile manufacturing.

U.S. DEPARTMENT OF HEALTH, EDUCATION
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The information sheets were prepared by the engineering department of the Opp and Micolas Cotton Mills, Opp, Alabama.

The material was edited and prepared for publication by J. R. Thomas, Assistant State Supervisor, Trade and Industrial Education, and approved by H. F. Worthy, State Supervisor, Trade and Industrial Education.

TEXTILE TECHNICIAN

Bibliography

COP Cotton Opening and Picking $2.50
CCG Cotton Carding 2.50
CDR Cotton Drawing and Roving 3.00
CRS Cotton Ring Spinning 3.75

Order above books from:
Gilbert R. Merrill
364 Varnum Avenue
Lowell, Massachusetts 01854

TFG Textile Fundamentals 6.35
W. K. Lynch, School of Textiles
Box 5006
Raleigh, North Carolina 27607

ACH American Cotton Handbook, Vol. I 15.00
by D. S. Hamby
John Wiley & Sons,Inc., Publishers
605 Third Avenue
New York, New York 10016

WDT Weaving and Design Technology 1.75
Department of Trade and Industrial
Education
P. O. Box 2847
University, Alabama 35486

Supplementary

Textile Fibers and Their Properties
Burlington Industries, Inc.
Greensboro, North Carolina

American Cotton Handbook, Vol. II 20.00
John Wiley & Sons
605 Third Avenue
New York, New York 10016

HOW TO USE THIS STUDY GUIDE AND RECORD OF PROGRESS

The student's record of progress is kept on the Trade Analysis and Progress Record page. Progress "on-the-job" is kept in the column headed "Job Progress", and related study progress is kept in the adjoining column headed "Related Study".

The four step method of training is used in developing the skills of a trade or occuaption. A record of all these steps for each job is kept in the squares in the column below "Learning Status" (Steps), opposite a specific job.

A dot in the center of the square indicates a student is in the first step; that of observing the job being done. No other mark is made in this square as long as the student remains in this step.

A diagonal line across the same square indicates the student is in the second step; that of helping perform the job under instruction.

Two diagonal lines across the same square indicates that the student is in the third step; that of doing the job under supervision.

The square filled in solid indicates that the student has reached the fourth step; that of a satisfactory level of accomplishment. The date when this accomplishment has been reached is placed in the column "Date Objective Reached", opposite the specific job.

On the day the student has read all the references and has written the answers to all of the questions, for a specific job, the student places this date in the column headed "Date Completed", opposite this job. The grade made on the test on this job is entered in the adjoining square headed "Test Grade".

The word "Information" will be found in the "Job Progress" column for all information lessons. When all references have been read and all answers to the questions have been written, for a specific information lesson, the student places the date of completion in the "Date Completed" column, opposite this lesson number. The grade made on the test on this lesson is entered in the square headed "Test Grade".

The student should read all references before writing the answers to questions. The essay type of answers which are required for most questions have a very definite value as they will help the student form the habit of giving clear-cut, definite answers or explanations. Only a few references and a few questions have been listed on each job sheet to teach the student how to study the literature pertaining to his occupation.

TRADE ANALYSIS AND PROGRESS RECORD

TEXTILE TECHNICIAN

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	GENERAL	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
1.	The Economic and Statistical				
	Background of Cotton	INFORMATION			
2.	Cotton Production	INFORMATION			
3.	Harvesting and Ginning Cotton				
4.	Cotton Fibers	INFORMATION			
5.	Wool and Silk Fibers	INFORMATION			
6.	Classifying Cotton				
7.	Textile Number Systems	INFORMATION			
8.	Power For Textile Mills	INFORMATION			
9.	Mechanical Parts and Mechanisms				
	of a Cotton Mill	INFORMATION			
	OPENING AND CLEANING				
10.	Opening Cotton Bales				
11.	Mixing Cotton in The Opening Room				
12.	Preparing Cotton For Blending				
13.	Using Blending Feeders				
14.	Blending Cotton				
15.	Operating Cotton Opening Machinery				
15a	Information Sheet				
16.	Arranging Cotton Opening Machinery				
17.	Cleaning Cotton				
18.	Operating Picker				
18a	Information Sheet				
19.	Making Picker Calculations				

TRADE ANALYSIS AND PROGRESS RECORD

TEXTILE TECHNICIAN

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
20.	Making Picker Draft Calculations				
	CARDING				
21.	Operating The Card				
21a	Information Sheet				
22.	Clothing The Card				
23.	Card Construction	INFORMATION			
24.	Learning The Theory of Card Actions				
24a	Information Sheet				
25.	Following The Path of Cotton				
	Through The Card				
26.	Stripping The Card				
27.	Setting The Card				
28.	Grinding The Card				
29.	Checking The Quality of Carding				
30.	Working Card Drafts				
	DRAWING				
31.	Cotton Drawing	INFORMATION			
32.	Checking The Drawing Frame				
33.	Finding The Production of Drawing				
	Frames				
34.	Operating Drawing Frames				
34a	Information Sheet				
	ROVING				
35.	Cleaning Roving Frames				
35a	Information Sheet				

TRADE ANALYSIS AND PROGRESS RECORD

TEXTILE TECHNICIAN

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
36.	Operating The Roving Frame				
36a	Information Sheet				
37.	Learning Roving Terms				
37a	Information Sheet				
	SPINNING				
38.	Cleaning The Spinning Frame				
38a	Information Sheet				
39.	Doffing The Spinning Frame				
39a	Information Sheet				
40.	Operating The Ring Spinning Frame				
40a	Information Sheet				
41.	Making Spinning Draft Calculations				
42.	Learning The Functions of Important				
	Parts of Spinning Frame				
43.	Changing Spinning Travelers				
43a	Information Sheet				
44.	Learning Spinning Winds				
	WINDING AND WARPING				
45.	Winding For Warp				
45a	Information Sheet				
45b	Information Sheet				
46.	Operating Warper				
46a	Information Sheet				
46b	Information Sheet				

TRADE ANALYSIS AND PROGRESS RECORD

TEXTILE TECHNICIAN

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
	SLASHING	Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
47.	Preparing Size Mix				
48.	Operating The Slasher				
	WEAVING				
49.	Operating Draw-in Machine				
49a	Information Sheet				
49b	Information Sheet				
50.	Weaving				
50a	Information Sheet				
51.	Making Loom Calculations				
51a	Information Sheet				
52.	Checking The Essential Parts				
	of The Loom				
52a	Information Sheet				
53.	Learning Auxiliary Motions of The				
	Loom				
53a	Information Sheet				
54.	Operating Different Types of Looms				
54a	Information Sheet				
55.	Operating Special Looms				
55a	Information Sheet				
	CLOTH ROOM				
56.	Working in The Cloth Room				
56a	Information Sheet				
56b	Information Sheet				

TRADE ANALYSIS AND PROGRESS RECORD

TEXTILE TECHNICIAN

NO.	JOBS AND INFORMATION LESSONS	JOB PROGRESS		RELATED STUDY	
		Learning Status (Steps)	Date Objective Reached	Date Com-pleted	Test Grade
56c	Information Sheet				
56d	Information Sheet				
56e	Information Sheet				
57.	The Finishing Process	INFORMATION			
58.	Designing Basic Weaves				
59.	Designing Derivative Weaves				
60.	Making Cloth Analysis				

TRADE ANALYSIS AND PROGRESS RECORD

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43a	Information Sheet				
44.	Learning Spinning Winds				
	WINDING AND WARPING				
45.	Winding For Warp				
45a	Information Sheet				
45b	Information Sheet				
46.	Operating Warper				
46a	Information Sheet				
46b	Information Sheet				

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	WEAVING				
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52.	Checking The Essential Parts				
	of The Loom				
52a	Information Sheet				
53.	Learning Auxiliary Motions of The				
	Loom				
53a	Information Sheet				
54.	Operating Different Types of Looms				
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55.	Operating Special Looms				
55a	Information Sheet				
	CLOTH ROOM				
56.	Working in The Cloth Room				
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56d	Information Sheet				
56e	Information Sheet				
57.	The Finishing Process	INFORMATION			
58.	Designing Basic Weaves				
59.	Designing Derivative Weaves				
60.	Making Cloth Analysis				

NAME_____ OCCUPATION_____ AGENCY_____

STUDENT'S DAILY RECORD

Date	List the Job Numbers Performed the Previous afternoon	List the References Read in the Related Class by Symbols and Pages	List the Number of the Job Studied Today

JOB NO. 1

THE ECONOMIC AND STATISTICAL BACKGROUND OF COTTON

ACH: 1-25

1. What two things embrace the economic and statistical background of cotton growing and manufacturing?

2. What percent of the average consumers expenditure in the United States is for clothing?

3. What is considered the general basis of economic analysis of cotton?

4. Name the four agencies that furnish statistics on cotton and related products for the United States.

5. What is considered the crop year for cotton?

6. Define the terms: (a) carry-over, (b) carry-in.

7. Why is carry-over and carry-in necessary in the cotton industry?

8. What cotton is not available for consumption without special legislative authorization?

9. Identify the term free cotton.

10. Name the eight states in the United States with the largest cotton acreage in 1963.

11. What caused the increase in cotton yields per acre in recent years?

12. Give in order the five leading cotton producing nations of the world in 1964.

13. How are cotton imports into the United States restricted?

JOB NO. 2

COTTON PRODUCTION

TFG: 1-2
ACH: 26-43

1. Into what two classes can textile fibers be divided?

2. Is there such thing as a "natural textile fiber?"

3. Name the three principal groups of cotton that are of commercial importance.

4. What percent of cotton grown in the United States is mechanically harvested?

5. Why has controversy arisen about the use of additional cleaning equipment at many of the cotton gins in this country?

6. Explain what is meant by cotton classing in (a) grade and, (b) staple length.

7. Why do different growths of cotton with the same grade and staple length produce acceptable yarns in one case and unacceptable yarns in another?

8. Name several cotton fiber properties, how is this determined?

9. How is the spinning quality of a particular cotton judged?

10. What is the normal length of cotton staple?

11. Why is staple length important?

12. What were cotton plants originally like?

13. What part of the United States developed cotton as an industrial crop on a large scale?

14. Answer the following on the cotton plant:
    (a) How large does the plant grow to be?
    (b) Name the two kinds of branches.
    (c) Give the meaning of indeterminate and determinate.
    (d) What is a cotton square, ovary, ovules, embryo?

15. What is the cause for motes in cotton lint?

16. When is cotton planted and usually harvested?

17. Name the insects that hinder cotton production.

18. What organic insecticides have made it possible to control pest?

JOB NO. 3

HARVESTING AND GINNING COTTON ACH: 82-109

1. When is hand picking usually done? How many pounds can an average picker pick? What is he usually paid for his work?

2. When was the first patent for mechanical picker taken out? How many manufacturers are building the machines today?

3. How many bales can be picked per day with the cotton picker?

4. What makes cotton picking by machine difficult?

5. What can be done to help solve some of the problems with mechanical pickers?

6. Why have ginners installed more extensive drying, conditioning, and cleaning equipment?

7. Define the following terms: (a) Lint, (b) Linters, (c) Ginning turnout, (d) Yield per acre, (e) Gin Cut.

8. What is the purpose of the following machinery: (a) Extracting machinery, (b) Cleaners, (c) Driers, (d) Feeders.

9. Name the two classes of gins.

10. Give the two general types of cotton bales.

11. What is meant by automatic sampling?

12. What was invented by Fones McCarthy of Demopolis, Alabama that caused the extensive use of rollers in ginning cotton?

JOB NO. 4

COTTON FIBERS ACH: 44-81

1. What are the cotton fibers of commerce?

2. Describe the fibers produced by each type of cotton.

3. Tell how the Sea Island and Egyptian cotton differ from American upland cotton.

4. Where is Sea Island cotton grown?

5. What is pima cotton?

6. What percent of the raw cotton for factory use do upland cottons produce?

7. Describe the cotton fiber.

8. Give the physical characteristics of cotton.

9. What are "linters?"

10. Name the six cross sectional parts of cotton fiber.

11. What are the lengths of the three cotton staples?

12. What is meant by fiber maturity?

13. What gives cotton fiber its strength?

14. What is meant by "elongation?"

JOB NO. 5

WOOL AND SILK FIBERS TFG: 2-5

1. What is the source of wool?

2. Why are there many varieties of wool?

3. Define the term "Grease wool."

4. Give the characteristics considered in grading wool.

5. How does the blood system of grading wool of the United States differ from the English system?

6. Give three length classifications of wool.

7. What is meant by shrinkage?

8. What factors determine the quality of wool?

9. Name the major wool producing countries.

10. When was silk first used?

11. Where are most of the silkworms produced?

12. Why has the United States failed to produce silk?

13. Name the four stages in the life cycle of the silk caterpillar.

14. What determines the quality of silk?

15. Define "spun silk."

16. Why does silk still have an appeal today just as it has for countless generations in the past?

JOB NO. 6

CLASSIFYING COTTON ACH: 110-131

1. How many bales of cotton are produced in the United States annually?

2. What causes the quality variations in the cotton grown in the United States?

3. What are the grade factors of cotton?

4. What is meant by classing?

5. How is grade and staple determined?

6. Explain what is meant by sampling, how is this done?

7. Describe a good sample.

8. What are the best lighting conditions for the sampling room?

9. The American classing system recognizes three general headings, name them.

10. Identify these terms: (a) chroma, (b) neps, (c) naps, (d) pull, (e) break, (f) wasty, (g) perished staples.

11. Name the seven grades of cotton most commonly used.

12. Explain what is meant by "U.S.D.A. Calibration Cottons."

JOB NO. 7

TEXTILE NUMBERING SYSTEMS TFG: 87-123

1. Why must all textile materials be identified?

2. How was the textile numbering systems started?

3. What change in numbering system is under consideration at this time?

4. Give the two basic methods used to describe the size of a textile fiber.

5. What is used in the direct systems of numbering?

6. What do the large and small numbers usually represent?

7. What do the numbers in the indirect system of numbering represent?

8. How may temperature and humidity affect the numbering systems?

9. How is the linear density or fineness of cotton fibers described?

10. What causes the fineness of cotton to vary?

11. Give the two methods used to determine the ounce lap size being produced on a picker.

12. Give two methods available for sizing sliver.

JOB NO. 8

POWER FOR TEXTILE MILLS TFG: 141-152

1. Why is it possible to have less spindles even though our population increased from 106 million in 1920 to 180 million in 1962?

2. Why are power requirements for the modern textile plant so tremendous?

3. What must be considered when selecting the source of power?

4. What power was first used to grind or mill grain?

5. What determines the amount of power that can be generated with water?

6. Why is the turbo-generator so important?

7. What was considered secondary sources of power for the early textile mills?

8. How do the mills purchase power today?

9. Explain what is meant by transmission of power.

10. What is meant by converting electrical energy into mechanical energy?

JOB NO. 9

MECHANICAL PARTS AND MECHANISMS OF A COTTON MILL

TFG: 153-185

1. What constitutes a machine?

2. When a machine designer builds a machine what is considered important?

3. What is a shaft?

4. What two factors should be considered when selecting the proper diameter of the shaft?

5. Define: (a) countershaft, (b) stud, (c) arbors and spindles, (d) top rolls.

6. Name and describe four kinds of rolls.

7. Identify: (a) collar, (b) beveled shaft, (c) coupling, (d) journal, (e) step bearing, (f) thrust bearing.

8. Define: (a) alloys, (b) babbitt metals, (c) porous metals.

9. Name four classes of ball bearings.

10. For what purpose are pulleys used?

11. Why are stepped pulleys used?

12. Define: (a) cam, (b) clutch, (c) flexidyne.

JOB NO. 10

OPENING COTTON BALES COP: 2-8

1. Define cotton opening.

2. Give the first step in the process of manufacturing cotton cloth.

3. What are the advantages of allowing opened cotton bales to stand?

4. Where does the opening of bales take place? Why?

5. With what three different classes of machinery is the mechanical opening of cotton done?

6. Give the purposes of opening machinery.

7. Name and give the uses of lattice apron slats.

8. Define bale breaker and give it's purpose.

9. Sketch a bale breaker and name it's parts.

10. How much cotton can the hopper bale breaker handle per hour?

11. What horsepower is required for this bale breaker?

JOB NO. 11

MIXING COTTON IN OPENING ROOM ACH: 138-141

1. What is necessary to understand the problem of opening cotton?

2. How is a bale of cotton made up?

3. What must be done to bales of cotton for further processing?

4. In what way is the condition of cotton picked by machines different from that of hand picked cotton?

5. Give the advantages and disadvantages of bin mixing.

6. What has replaced the bin mixers? Why?

7. Why is it almost impossible for the mill to get exactly the cotton it desires?

8. What are the two main phases to the problem of mixing cotton?

9. Describe a recent development in opening room practice.

JOB NO. 12

PREPARING COTTON FOR BLENDING TFG: 35-42

1. What has brought about changes in the manufacture of cotton cloth?

2. What areas remain open for improvement?

3. Give the steps taken when bales of cotton are delivered to the mill.

4. Give several ways the mill may design a mix.

5. What number of bales is considered a good mix?

6. What is a perpetual type mix?

7. Describe the method of feeding the hoppers of the blending feeder.

8. Draw figure 2.3 on page 39 TFG. Tell what takes place at each labeled part.

9. What is the purpose of the Fiber Meter?

10. How is tramp iron removed from the cotton?

11. What is the main difference betweeen the bale breaker and the blending feeder?

12. Why have blending feeders been remodeled?

JOB NO. 13

USING BLENDING FEEDERS ACH: 148-152

1. Describe the operation of the blending feeder.

2. Give the advantages of the blending feeders.

3. Name the parts of the blending feeder.

4. Why is it best for blending feeders to handle only 200 pounds per hour?

5. What is a hopper feeder?

6. How is the vertical opener designed?

7. What are the objects of the process performed by the vertical opener?

8. Why is the vertical opener given this name?

9. What are the principal parts of the vertical opener?

10. Draw the automatic feeder on page 11, COP, Figure 5.

11. Define and give the purposes of the condenser.

12. For what purpose is the automatic sprinkler used?

13. Describe the operation and give the purpose of the air filter.

JOB NO. 14

BLENDING COTTON ACH: 132-168

1. Define the word blend.

2. Give the full definition of blend and mix in the textile language.

3. How may perfect blending be defined?

4. What is meant by micronaire reading?

5. Give the objectives of blending by cotton manufactures.

6. Why is it possible to fail to get a 50-50 blend even if an equal number of bales of the two properties that are to be blended are laid down?

7. What big mistake can the opening room operator make if he is not careful in doing his job?

8. What is the primary duty of the opening room operator?

9. Define: (a) sandwich blend, (b) weight blending, (c) bale blending, (d) preblending.

10. How may the number of bales needed for a blend be determined?

11. What is meant by XYZ warehousing plan?

12. What is the proper basis for selection of bales for a blend?

JOB NO. 15

OPERATING COTTON OPENING MACHINERY

ACH: 215-220
COP: 18-42
IS: 15 A

1. Describe a Buckley opener and give the purpose for its use.

2. How is the opening and cleaning action performed by the Buckley Opener?

3. Tell how the upstroke Buckley Opener operates.

4. Where are the feed rolls located on the down stroke Buckley Opener and what is their purpose?

5. Why are rolls made of wood used on some opening machines?

6. Why is the Spirawhirl Horizontal Cleaner designed as it is?

7. What is the purpose of the baffle plates in the Spirawhirl Horizontal Opener?

8. What is a cleaning trunk and how does it operate?

9. How often should the dirt be removed from a cleaning trunk?

10. Name one of the most serious problems in opening and picking.

11. What is the purpose of the permanent magnet separators?

12. When and how are the magnets cleaned?

13. What is the principle of the Superior Cleaner?

14. Give the principle of Number 15 opener.

15. How is the Hunter Cyclo-Tuft Opener designed?

16. How is the cleaning operation performed in the Aldrich Super-Jet Cleaner?

17. When did the development of new textile machinery begin?

18. What are the advantages of the Whitin Axi-Feed Unit?

19. Give the advantages and disadvantages of the Saco-Lowell Number 15 Opener.

20. What idea was introduced by the Aldrich Super-Jet Cleaner?

OPERATING COTTON OPENING MACHINERY

21. Name two advantages of the Tweesdales and Smalley Shirley Opener.

22. Give three important parts of the SRRL Opener Cen-Tennial Model and tell what purpose each serves.

23. Give the work of the two-bladed doffer and the "Vacuum Dropper" in the Cen-Tennial textile separator.

24. Name the three sections of the Saco-Lowell Number 16 Opener.

25. What is the most recently offered opening machine? Give the purpose of this machine.

26. Make a list of the duties of an opener tender.

Information Sheet 15 A

OPENER TENDER
OPERATOR DUTIES

1. Feed individual hoppers with correct stock and at proper intervals.

2. Feed waste machine.

3. Change cotton mixes when required.

4. Keep floors clean at all times.

5. Pull motes from beneath opening machines.

6. Sack motes for removal to waste house.

7. Carry motes to waste house.

8. Weigh and record waste.

9. Return empty sacks to opening room.

10. Clean machine according to assigned schedules.

11. Miscellaneous duties:
    (a) Remove chokes from waste machine, blending feeders, conveyors, opening machines or trunk lines.
    (b) Put on belts.
    (c) Inspect job and report to supervisor any improperly operating machines or irregularities in condition of stock.
    (d) Inform picker tender of any operation or condition which may interrupt or interfere with normal picker operation.
    (e) Perform any other duties as assigned by supervision.

JOB NO. 16

ARRANGING COTTON OPENING MACHINERY

COP: 44-48
ACH: 221-222, 206

1. What is the customary way to plan a line of machinery to open and clean cotton?

2. Who determines what units are selected for a cotton opening line?

3. What is the best way to get a good mix?

4. Where are vertical openers usually placed?

5. Why have the condensers become quite important in the opening and picker room?

6. What four newer units are all designed to follow the blending feeders?

7. Give the recommendations made by manufacturers of Number 16.

8. Give the proper way for the use of the Axi-Flo unit.

9. What is the danger of "over machining" or "over processing?"

10. Why are mills hesitant in making radical changes in the arrangement of machinery?

11. Draw Figure 29, page 47 COP and name the parts.

12. What are the necessary steps for getting cotton from a tightly packed bale into a uniform lap?

13. Give the two features of the earlier opening lines.

14. What takes place in Figure 7.12 on page 225 ACH?

JOB NO. 17

CLEANING COTTON TFG: 42-45

1. What should be remembered when cleaning cotton?

2. Give the two purposes of the blending feeders.

3. What happens as the cotton progresses through the other machines in its continuous automated flow?

4. By what method do the machines open and clean cotton?

5. What determines the number, type and sequence of opening machines?

6. How does the Axi-Flow opener work?

7. Give the steps in the operation of the superior cleaner.

8. What is the purpose of condensers?

9. How is the production of the opening line controlled?

10. Where is even-running lap formed?

JOB NO. 18

OPERATING PICKER

COP: 58-82
IS: 18 A

1. In what condition is the cotton when delivered by the opening machinery to the pickers?

2. Define picking.

3. What are the objects of picking?

4. How are the objects of picking accomplished?

5. How are the machines used for picking?

6. Why are pickers arranged in different sections?

7. Give the work done by: (a) feeding device, (b) beater section, (c) screen section, (d) lap heads.

8. What is done by the automatic feed control?

9. Define: (a) feed rolls, (b) beaters.

10. What determines the beater settings?

11. Give the range of beater settings.

12. What is the purpose of: (a) grid bars, (b) stripping rail, (c) leaf bars, (d) screens or cages, (e) dust room, (f) calendar rolls?

13. Make a list of the duties of a picker tender.

Information Sheet 18 A

PICKER TENDER
OPERATOR DUTIES

1. Doff picker:
   (a) Properly identify lap and extract mandrel.
   (b) Doff lap and place on scales.
   (c) Replace mandrel and start picker.

2. Weigh each lap doffed and reject those that exceed limits of variation.

3. Oil and grease pickers as required by schedule.

4. Blow off pickers on schedule.

5. Remove motes and fly from all pickers as scheduled.

6. On pickers scheduled, open all doors and clean picker thoroughly with compressed air.

7. Clean chokes from screens, beaters, and rolls on all pickers.

8. Observe operation and report abnormal stock or mechanical conditions to fixers or supervisor.

9. Miscellaneous duties:
   (a) Keep supply of lap pins in rack on each picker.
   (b) Place lap pins in mandrel between doffing cycle.
   (c) Keep lap trucks arranged conveniently and out of traffic lane.
   (d) Put on belts.
   (e) Fill grease gun and oil can.
   (f) Oil mandrel trays regularly.
   (g) Make minor adjustments on machinery.
   (h) Put up ends.
   (i) Run bad laps on back of pickers.
   (j) Remove any chokes and dispose of choke waste.
   (k) Keep floor clean at all times.
   (l) Fill blending reserve when necessary.
   (m) Wipe vertical calendar rolls when needed.
   (n) Weigh laps for supervisor twice per shift.
   (o) Bleed and check air lines each shift.
   (p) Write shift report on bad laps, downtime, etc.
   (q) Take all waste to wastehouse, weigh and record.
   (r) Perform any other duties as assigned by supervision.

JOB NO. 19

MAKING PICKER CALCULATIONS

COP: 82-84
ACH: 237-238

1. What determines the number of yards wound into one package called the lap?

2. Give the two standard widths of pickers.

3. How is the weight per yard of the lap given? Which weights are most commonly used?

4. What is meant by a 40 inch, 42 pound, 14 ounce breaker lap?

5. What is involved in picker calculations?

6. Give the number of picker drafts for breaker and finisher pickers.

7. How does production and blows per inch vary?

8. Define and tell how draft may be considered?

9. What is actual draft and how is it determined?

10. Study examples 1, 2, 3, and 4 on page 84 COP before answering these questions: (a) identify the numbers 28 and 14 in example 1, (b) identify the number 4 in example 2, (c) identify X in examples 3 and 4.

11. Find acutal draft if a picker is fed 4 laps weighing 28 oz. per yard and is to make a lap weighing 24 oz. per yard.

12. What is the weight per yard delivered if a picker is fed 4 26 oz. laps and the actual draft is 7.8?

13. If a 24 oz. lap is desired with an acutal draft of 4.2, what must be the weight per yard of each of the 8 laps fed?

14. How is picker production given?

15. What causes the pounds produced to vary?

16. Give the simple approach to production calculation.

17. Give the formula for production per eight hours.

18. Why is it important to know the number of blows struck per inch on the lap being fed?

JOB NO. 20

MAKING PICKER DRAFT CALCULATIONS COP: 84-102

1. How may mechanical draft be considered?

2. How is mechanical draft determined?

3. Why is mechanical draft always less than actual draft?

4. Work examples 5, 6, 7, and 8, pages 85 and 86 COP finding mechanical draft, not actual draft.

5. Work example 9, using Figure 54 for information, COP: 85-86.

6. Give the formula for example 10, page 86 COP.

7. Work out the formula to find 3.75 draft.

8. Find the draft constant in example 11, page 88 COP. How is this different from example 10?

9. Work example 14, page 88 COP to find production.

10. Find the blows per inch in example 19 COP.

11. Find the length of a full lap using figure 57, page 95 COP for your formula.

12. Find the number of yards in a full lap using figure 58, page 57.

13. What is an "evener?"

14. How are picker laps judged? Define a perfect lap.

JOB NO. 21

OPERATING THE CARD

CCG: 1-4
TFG: 49-53
ACH: 245-248
IS: 21 A

1. From what Latin word is our word "card" derived?

2. How does Webster define a card?

3. Give the statements of the following people regarding carding: (a) Evan Leigh, (b) Richard Marsden, (c) Nasmith, (d) W. S. Taggart, (e) Harmuth.

4. What is the definition of carding as it applies to modern processing of cotton fibers?

5. How was carding carried on before the start of the factory system?

6. What was done to increase production of the early cards?

7. Describe the operation of large hand cards.

8. What other early attempts were made to improve carding?

9. Describe the improvements made in carding by Sir Richard Arkwright.

10. Give the improvements made in the 1880's.

11. What kind of cotton card is considered standard today?

12. What three things remain to be done after carding?

13. What are the three objects of carding?

14. There are two important points in cleaning, name them.

15. (a) Define sliver, (b) How is grain sliver found?

16. Give the key to successful carding.

17. How is carding action accomplished?

18. Tell how stripping action is accomplished.

19. What will cause severe entanglement of the fibers?

20. Make a list of the duties of a card tender.

Information Sheet 21 A

CARD TENDER
OPERATOR DUTIES

1. Procure laps from picker room and rack on card.

2. Lay laps when required.

3. Return lap trucks and empty lap pins to picker room.

4. Procure empty cans from area of drawing process and push to card to be doffed.

5. Doff cards according to schedule.

6. Push full cans of sliver to area of drawing after doffing card.

7. Properly identify cans that are placed in cards of different stocks or blends.

8. Repair ends that break on the cards assigned.

9. Inspect for and repair laps that are unrolling improperly.

10. Clean feed roll clearers and wipe licker-in bonnet.

11. Clean calendar roll clearers.

12. Wipe card fronts.

13. Clean hackle comb.

14. Clean trashmasher and doffer roll clearer.

15. Remove flat strips and place in waste bag.

16. Mop front and back of card.

17. Patrol job as necessary and inspect for improper operation of machines or stock.

18. Correct improper operation if within the scope of duties; if otherwise, report condition to fixer or supervisor.

19. Miscellaneous duties:
    (a) Procure colored rubber bands for can identification.
    (b) Remove chokes from coiler head and doffer.
    (c) Place needed band on cans or exchange bands on cans.

CARD TENDER
OPERATOR DUTIES

19. Miscellaneous duties, continued.
    (d) Dispose waste, weigh and record.
    (e) Help strip cards.
    (f) Pre-position bag for waste.
    (g) Perform any other duties as assigned by supervision.

JOB NO. 22

CLOTHING THE CARD CCG: 6-12

1. What is meant by card clothing?

2. Define foundation, what are the requirements for satisfactory foundations?

3. Define the following terms: staple, point, knee, crown.

4. How is the actual construction of clothing done?

5. Name the general types of clothing.

6. What is meant by the "setting" or "set" of card clothing? Name the two types.

7. Give the difference between twill set and rib set.

8. What kind of wire is used in clothing?

9. Describe the three types of grinding for card clothing.

10. How is metallic clothing different from that used in common clothing?

11. Why have some mills been reluctant to change to metallic clothing?

JOB NO. 23

CARD CONSTRUCTION

CCG: 14-16
ACH: 248-253

1. How old is mechanical carding?

2. Upon what is the card built?

3. What is the purpose of the bearing?

4. What holds the flats in working position?

5. Where are the removable covers located?

6. Give the location of the following: (a) doffer bearing, (b) licker-in bearing, (c) feed plate, (d) cylinder.

7. Why should the card frame be properly leveled?

8. How is the card erected in a level position?

9. What determines the size of cotton cards?

10. Identify: (a) front, (b) hand, (c) creeling, (d) doffing.

11. Why must there be a firm rigid frame in card construction?

12. How is the principal carding action produced?

13. Give the purpose of the feed works.

14. Make a drawing labeling the parts of a card feed works. Figure 8.11, page 250 ACH.

15. What is the heart of the card?

JOB NO. 24

LEARNING THE THEORY OF CARD ACTIONS

CCG: 14-15
IS: 24 A

1. Why are all the actions accomplished by the use of card clothing considered as brushing actions?

2. What controls the effect on the cotton being processed?

3. Define carding action.

4. How is carding action obtained?

5. What is carding action often called?

6. How are the tufts of cotton pulled apart?

7. Describe stripping action.

8. In what other way is stripping done?

9. What is the difference between "point vs. point" and "point vs. back?"

10. What are the duties of the card room fly puller?

Information Sheet 24 A

CARD ROOM FLY PULLER
OPERATOR DUTIES

1. Procure empty sacks for all card room.

2. Pull front and back fly on all cards as scheduled.

3. Carry fly waste to waste house.

4. Weigh and record waste.

JOB NO. 25

FOLLOWING THE PATH OF COTTON
THROUGH THE CARD

CCG: 16-54

1. What takes place in the following during the path of cotton through the card?

   (a) feed plate, (b) licker-in, (c) cylinder, (d) flats, (e) wires, (f) doffer, (g) doffer comb, (h) "trumpet," (i) calendar rolls, (j) coiler, (k) "tube gear," (l) can table, (m) mote knives, (n) backplate, (o) cylinder and flats, (p) flexible bends, (q) front plate.

JOB NO. 26

STRIPPING THE CARD CCG: 68-76

1. What is meant by stripping the card?

2. What is the object of stripping?

3. How are the flats stripped?

4. How often does stripping take place?

5. Give the classification of strips.

6. What device is used in stripping the cotton card cylinders and doffers?

7. Why is it best to stop the card before stripping the cylinder?

8. List the steps taken in stripping a card with the plain stripping roll.

9. How does the dustless stripper operate?

10. Give two ways the air stripper differs from other strippers.

11. What are the advantages of the vacuum stripper?

12. What effect does stripping have on sliver?

13. Name the advantages of the continuous stripper.

JOB NO. 27

SETTING THE CARD CCG: 92-96

1. What is meant by setting the card?

2. Why is proper card setting important?

3. What are the commonly used gauges for card settings?

4. In what terms are the settings usually given?

5. Describe the leaf gauge.

6. Why should considerable care be given when handling card gauges?

7. How is the pin gauge used?

8. What determines what setting should be used?

9. Give the average card settings.

10. When making settings, what must be done to free the part for movement?

11. In using the adjusting devices, what must be done?

12. When the setting is completed, what precautions must be taken?

13. What is the purpose of the sliver tester?

JOB NO. 28

GRINDING THE CARD CCG: 82-92

1. What is the purpose of card grinding?
2. How often are the cards ground?
3. Give the two attitudes on card grinding.
4. What is considered best to use when grinding the card?
5. How is the medium used for grinding cards described?
6. What instruments are used in grinding card clothing?
7. How is a gauge used in making the settings for grinding?
8. Name the four main divisions of the work done in grinding.
9. Give the eight steps for cleaning the card.
10. What are the twelve steps in preparing for grinding?
11. Give briefly the four steps for setting the grinding rolls.
12. Give the twelve steps for starting up after grinding.

JOB NO. 29

CHECKING THE QUALITY OF CARDING CCG: 100-107

1. What is considered the ultimate test of the quality of carding?

2. Where is the best opportunity to judge how thoroughly and uniformly cotton is opened?

3. What two things will show up in the doffer web?

4. How do experienced carders judge the quality of work being done by a card?

5. How is the success of a card in cleaning judged?

6. What is found in the short waste test?

7. For what purpose is the Shirley Analyzer used?

8. What does the Department of Agriculture recommend for classification?

9. Define uniformity.

10. For what purpose is the sliver tester used?

11. What is the second object of carding?

12. Give the four general classes of waste.

13. Define: (a) motes, (b) fly, (c) strips, (d) sweeps, (e) neps.

JOB NO. 30

WORKING CARD DRAFTS

CCG: 54-68
ACH: 259-262

1. How are cotton cards driven?

2. What is the standardized cylinder speed?

3. What is meant by card draft?

4. What is known as an average draft?

5. Under what two headings can draft be considered?

6. Define actual draft, how is it determined?

7. How is grain sliver found?

8. Give the formula for finding actual draft.

9. How is mechanical draft found?

10. Draft constant is equal to _____ X _____.

11. What causes the reduction to take place from the lap to the sliver?

12. Tell how draft gear is found.

13. How is card production stated?

14. When calculating production, what is it necessary to know?

JOB NO. 31

COTTON DRAWING CDR: 1-2

1. Define drawing.

2. How is this drawing action obtained?

3. Who claimed credit for the invention of the drawing frame?

4. What two purposes does Roller Drawing serve?

5. What is important in making good cotton yarns?

6. How is the straightening action of roller drawing accomplished?

7. How is the straightening action controlled?

8. Why is there considerable confusion regarding the straightening action theories?

9. Give the condition of cotton when: (a) it reaches the drawing frame, (b) it comes from the card, (c) it comes from the comb.

10. What are the two objects of the drawing process?

11. How is the uniformity of sliver measured?

JOB NO. 32

CHECKING THE DRAWING FRAME CDR: 2-21

1. Define the following: (a) delivery, (b) head, (c) frame, (d) railway head, (e) evener drawing frame.

2. Describe the construction of a drawing frame.

3. What are the functions of the rolls?

4. Identify: (a) boss, (b) solid roll, (c) roller bearing, (d) shell roll.

5. Explain how draft is found.

6. Define tension.

7. How are old rolls cleaned?

8. How are the rolls covered?

9. How are metallic rolls different from other rolls?

10. What materials have been used through the years for covering the rolls?

JOB NO. 33

FINDING THE PRODUCTION OF
DRAWING FRAMES

CDR: 22-36

1. What four factors are needed to find production of drawing frames?

2. Show how the production of 50 grain sliver per 10 hours, allowing 20% stops, when the front roll turns 300 r.p.m. is found.

3. Where is the weight located in metallic rolls?

4. What determines the amount of weight to use under different conditions?

5. Give the difference between "spring weighting" and "dead weighting."

6. What are the purposes of (a) clearers, (b) clearer cloth?

7. How are calender rolls equipped and what purpose do they serve?

8. How is the web converted into a sliver?

9. Explain how the web is kept tight.

10. Make a sketch of the two types of trumpets shown in Figure 16, page 29 CDR.

11. What is the purpose of the coiler?

12. Why are stop motions necessary? Name two types.

13. Give the difference between railway head and evener drawing frames.

14. Check Figure 20, page 37 CDR and give formula for finding draft on 36 draft gear.

JOB NO. 34

OPERATING DRAWING FRAMES

CDR: 38-49
IS: 34 A

1. Define the terms (a) piecing up, (b) picking clearers.

2. Give step by step procedure in doffing a drawing frame.

3. Why is the adjustment of mechanical stop motions important?

4. How is the desired roll setting obtained?

5. Give the five factors to consider when finding the distances used for roll settings.

6. What kind of cotton gives more resistance to straightening and control?

7. What care should be given leather rolls?

8. Name the most common leather roll defects and what causes them.

9. Draw a roll tester. Figure 22, page 43 CDR.

10. Give the advantage of the Bi-Coil Drawing.

11. In what ways does the construction of a drawing frame having five rolls differ from others?

12. Check Figure 11, page 21 and Figure 25, page 49 CDR and tell the actual difference in gears.

13. List the duties of a drawing frame operator.

Information Sheet 34 A

DRAWING TENDER
OPERATOR DUTIES

1. Piece end on front.

2. Remove lap-up and piece end.

3. Clear choked trumpet and piece end.

4. Clear pneumafil choke and piece end.

5. Piece end on back.

6. Walk and select sliver for creeling.

7. Push selected sliver to frame for creeling.

8. Creel sliver.

9. Turn cans of piece drawing.

10. Dispose empty cans.

11. Procure cans for doffing.

12. Doff and dispose full cans to storage area.

13. Procure colored rubber bands for can identification.

14. Place bands on cans and, or exchange bands on cans.

15. Wipe front of frames.

16. Clean out back of frames.

17. Brush rolls.

18. Sweep under frames.

19. Pull pneumafil waste.

20. Clean pneumafil waste sack.

21. Pick creel clearers.

22. Miscellaneous duties:
    (a) Arrange cans in storage area.
    (b) Dispose waste.
    (c) Restore overturned drawing and/or can.

JOB NO. 35

CLEANING ROVING FRAMES

CDR: 51-52
IS: 35 A

1. To what does the name roving apply?

2. Define roving.

3. What is the object of roving?

4. Compare drawing and roving.

5. How is uniformity improved?

6. Show by chart on page 51, CDR roving operations for different yarns.

7. When is cotton wound on bobbins?

8. Explain how bobbins are made.

9. Why have some mills tried using paper tubes fitted over roving bobbins?

10. Explain the meaning of the word "hank."

11. How much do the usual sizes of rovings vary?

12. List the duties of a roving frame cleaner.

Information Sheet 35 A

ROVING FRAME CLEANER
OPERATOR DUTIES

1. Pick top rollers on slubbers.

2. Clean lower section of spindles on slubbers.

3. Clean out back of slubbers.
   (a) Put reworkable waste in waste can.
   (b) Put sweep waste in sweep sack.

4. Get roving bobbin for lab.

5. Get picker laps for lab.

6. Push all cans of drawing to slubbers.

7. Return empty cans from slubbers to drawing.

8. Pull slubber pneumafil and dispose waste.

9. Clean out slubber sweepers.

JOB NO. 36

OPERATING ROVING FRAME

CDR: 56-64
IS: 36 A

1. What is the work of the roving frame?

2. What is the object of drawing in the roving process?

3. Of what does the foundation of the roving frame consist?

4. Make a cross sectional drawing of a roving frame.

5. How are roll sections put together?

6. Name several types of rolls.

7. Draw Figure 9, page 61 CDR and name the parts.

8. Give the chart on roving roll settings.

9. How is actual draft found?

10. How are draft and draft gear found?

11. List the duties of a roving frame operator.

Information Sheet 36 A

ROVING FRAME TENDER
OPERATOR DUTIES

1. Doff frame.
   (a) Run frame to doff position and kink end.
   (b) Wind rack and reposition knock-off lever.
   (c) Remove flyers.
   (d) Mark roving.
   (e) Procure empty box for doffing.
   (f) Remove roving and stack in box.
   (g) Reverse box while doffing.
   (h) Push full box from alley.
   (i) Procure box of bobbins.
   (j) Put on empty bobbins.
   (k) Push bobbin box from alley.
   (l) Replace back flyers.
   (m) Wrap ends on backline.
   (n) Replace front flyer.
   (o) Wrap ends on front line.
   (p) Start frame and stop.
   (q) Tighten loose ends.
   (r) Prepare brokebacks.
   (s) Repiece brokebacks.
   (t) Restart frame.

2. Creel sliver.
   (a) Break out cans.
   (b) Creel in full can.
   (c) Turn cans.
   (d) Recreel turn cans.
   (e) Dispose empty cans.
   (f) Start runouts.
   (g) Repiece runouts.

3. Piece ends.
   (a) Piece front break.
   (b) Remove lap-up.
   (c) Piece breaks in creel.
   (d) Break back end.
   (e) Walk to end down.

4. Cleaning duties.
   (a) Pick front bottom clearers.
   (b) Clean carriage with brush.
   (c) Clean roll beam, stands, pneumafil pipes and hooks.
   (d) Brush baffle board.

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ROVING FRAME TENDER
OPERATOR DUTIES

4. Cleaning duties continued.
   (e) Wipe head ends.
   (f) Pick back clearers.
   (g) Oil bobbin gears and spindle bolsters.
   (h) Wipe spindle tops with oily cloth.

5. Walk and inspect job.

JOB NO. 37

LEARNING ROVING TERMS

CDR: 96-116
IS: 37 A

1. Define the following:
   a. winding
   b. tension
   c. tight tension
   d. slack tension
   e. flyer lead
   f. bobbin lead
   g. winding revolutions
   h. actual revolutions
   i. compound
   j. building
   k. hank clocks
   l. creeling
   m. piecing up

2. List the duties of a roving hauler.

Information Sheet 37 A

ROVING HAULER
OPERATOR DUTIES

1. Lay up roving and take down empty bobbins.

2. Push roving to spinning parking areas on frames assigned.

3. Return empty bobbins to slubber.

4. Procure roving from storage for frames assigned.

5. Store surplus roving if needed.

6. Take up roving waste in spinning.

7. Take roving waste to opening room, weigh and record.

8. Gather, straighten and dispose bad roving on frames assigned.

9. Help keep all roving trucks arranged conveniently in storage area.

JOB NO. 38

CLEANING THE SPINNING FRAME

CRS: 1-8
IS: 38 A

1. What is the purpose of spinning?

2. What is yarn?

3. What are "carded yarns?"

4. What can be done to improve the quality of yarn without increasing the cost too much?

5. What are combed yarns?

6. What is the difference between single and ply yarns?

7. What are the three general headings under which most cotton yarns come?

8. How are the different types of cotton yarns used?

9. What term is used to give the size of yarn?

10. What is meant by: (a) "S," (b) "30's," (c) "30s/1," (d) "23/3."

11. Define: (a) hank, (b) "class A" yarns.

12. For what purpose is the cotton yarn reel used?

13. Name the parts of the cotton yarn reel.

14. Define: (a) warp, (b) "lea."

15. Explain how the grain scales are operated.

16. Give the formula for finding corrected count.

17. Define: (a) skein strength, (b) strength constant, (c) single strand strength, (d) yarn variation.

18. List the duties of a spinning cleaner.

Information Sheet 38 A

SPINNING CLEANERS
OPERATOR DUTIES

1. Pick top rolls, saddles, cradles, back steel rolls and stands.

2. Brush back guides, weight levers, stirrups, roll stands, and drafting gear assembly covers.

3. Clean roller bars and roving traverse.

4. Clean top revolving clearers

5. Clean roll weights.

6. Repair ends broken while cleaning frame.

7. Repair roving breaks broken while cleaning frame.

8. Report irregular conditions of stock, machine, or other factors to section men or supervisor.

9. Extra work items:
   (a) Procure roll picker hose and connect.
   (b) Dress air hose to work area.
   (c) Position roll picker hose.
   (d) Pull roll picker hose.
   (e) Disconnect and store roll picker and hose.
   (f) Remove clearer and place on other side.
   (g) Procure and dispose brush.
   (h) Procure and dispose waste cotton.

JOB NO. 39

DOFFING THE SPINNING FRAME

CRS: vi-x
Introduction
IS: 39 A

1. Describe the prehistoric spinner.

2. How may production vary in spindles?

3. What is meant by: (a) spindles in place, (b) active spindles?

4. Give statistics to show how the number of spindles has changed since 1925.

5. What was the total square yards produced per year?

6. What change was made in Arkwright's spinning frame?

7. How were the speeds of spindles changed from 1888?

8. Why is the spinning frame considered to be automatic?

9. What is considered the work of the spinner?

10. What is the doffer's work?

11. Make a list of the doffers duties.

Information Sheet 39 A

SPINNING DOFFER
OPERATOR DUTIES

1. Prepare frame for doffing.

2. Remove filled bobbins from spinning spindle and replace with empty bobbins. Bobbins should be properly seated on spindle.

3. Properly identify yarns by placing the proper chalk mark on each bobbin or by other devices which may be used from time to time.

4. Piece up all ends broken while doffing or starting frame.

5. Place yarn doffed in the proper storage area.

6. Procure empty doff boxes from storage area.

7. Replenish supply of bobbins in doff box.

8. Procure empty quills from quill machine when needed.

9. Retrieve all bobbins, empty or full, that are dropped.

10. Remove improperly fitting bobbins or bobbins otherwise unfit for use and dispose to proper receptacle.

11. Properly restart frame after doffing.

12. Maintain doffing schedules in the manner prescribed by supervision or in that manner offering the best possible frame efficiency.

13. See that all frames doffed are filled to the prescribed capacity before doffing.

14. Report to the section man all frames that operate improperly as to bunch, bobbin build, stopping, starting, traverse motion, and others too numerous to list.

15. Extra work items:
    (a) Replace separators.
    (b) Position thread guides.
    (c) Rethread end.
    (d) Stuck bobbin.
    (e) Press down empty.
    (f) Clean spindle.
    (g) Dispose bad bobbin.

JOB NO. 40

OPERATING THE RING SPINNING FRAME

CRS: 8-28
IS: 40 A

1. How old is ring spinning?

2. How are frames designed?

3. Describe a spinning frame.

4. Name the parts of a spinning frame skeleton.

5. Draw Figure 6, page 11 CRS.

6. Define: (a) creels, (b) creeling, (c) regular creels, (d) open creels.

7. Describe a bobbin holder.

8. Give the four basic operations of the spinning frame.

9. What s the theory of drafting?

10. Name the two general divisions of spinning drafting equipment.

11. Give the function of the traverse motion.

12. What is the purpose of the "Cap Bars?"

13. What is the purpose of the clearers?

14. List the duties of the spinning operator.

Information Sheet 40 A

SPINNING SPINNER
OPERATOR DUTIES

1. Piece ends on sides assigned.

2. Repiece ends on sides assigned.

3. Creel roving on sides assigned.

4. Run out guides on sides assigned.

5. Repair roving breaks on sides assigned.

6. Remove laps from rolls on sides assigned.

7. Patrol and inspect sides for ends down, roving to be creeled, improper stock conditions and improperly operating machines or spindles.

8. Flag spindle for section man.

9. Stop frame when full.

10. Extra work items:
    (a) Replace traveler .
    (b) Remove bobbin from spindle.
    (c) Strip yarn from bobbin.
    (d) Remove lint from traveler.
    (e) Locate lost end.
    (f) Pull off bad roving.
    (g) Pick lint from rolls, thread guides, etc.

JOB NO. 41

MAKING SPINNING DRAFT CALCULATIONS CRS: 48-56

1. What determines the practical limit of draft?

2. What factors determine the amount of draft which may be used for spinning?

3. Define draft.

4. How is draft accomplished?

5. Why is waste ignored in draft calculations?

6. Define mechanical draft.

7. Define actual draft. Give an example in finding actual draft.

8. How is draft constant found?

9. Give the formula for finding draft gear.

10. How is "Break Draft" and main draft different?

JOB NO. 42

LEARNING THE FUNCTIONS OF IMPORTANT PARTS
OF THE SPINNING FRAME CRS: 56-94

1. For what are bobbins used?

2. When did paper tubes replace wooden bobbins?

3. Define: (a) end breakage, (b) ends down, (c) spindle hour.

4. What is the purpose of the thread guides?

5. Give the work of the following: (a) slub catcher, (b) traversing thread boards, (c) spinning spindles, (d) oil deflector, (e) spindle clutch (f) bolsters, (g) bolsters case, (h) separators, (i) twist counter.

6. Give the advantages of frames of sufficient width to eliminate the need of separators.

JOB NO. 43

CHANGING SPINNING TRAVELERS

CRS: 100-138
IS: 43a

1. How is the production of a spinning frame given?

2. Upon what four basic items does production depend?

3. Define: (a) RPM, (b) TPI.

4. What will cause loss in production to vary?

5. How can end breakage be reduced?

6. What is the usual approach to spinning production?

7. What are hank clocks? Spinning rings? Travelers?

8. Draw a traveler, Figure 68, page 121 CRS.

9. From what kind of wire are most travelers made?

10. How is traveler speed found?

11. Show by diagram the development of traveler operating position.

12. Name the special forms of travelers.

13. What factors are considered in determining the traveler to use?

14. Define: (a) lay, (b) lay calculations.

15. List the duties of the spinning traveler changer.

Information Sheet 43 A

SPINNING TRAVELER CHANGER
OPERATOR DUTIES

1. Break off travelers on frame to be changed.

2. Place new travelers on frame.

3. Thread up travelers after changing.

4. Start frame and piece up broken ends.

5. Wire up travelers on traveler wire.

6. Record traveler changes by frame number, yarn counts, size and type traveler and date changed.

JOB NO. 44

LEARNING SPINNING WINDS CRS: 139-155

1. Define building.

2. Describe off the side, and over the end unwinding.

3. Name the kinds of winds and tell when each is used.

4. What is the spinning frame builder? Give the three types.

5. What is a "bunch?"

6. Define "bunch builder."

7. Define change-over.

8. Why did larger spindles replace original spindles?

9. Since World War II, why did the frames have creel "change-overs?"

10. What changes have been made in the width of spinning frames in recent years?

JOB NO. 45

WINDING FOR WARP

TFG: 71-80
IS: 45 A,
45 B

1. Why is winding of the yarn performed?

2. Define: (a) slub catching, (b) spooler.

3. Give the size of the spools.

4. What is the function of the cone winder?

5. How is the twisting operation different from spinning operation?

6. Draw Figure 2.21, page 73 TFG and label the parts.

7. List the duties of a spooler tender.

8. List the duties of a spooler yarn man.

Information Sheet 45 A

SPOOLER TENDER
OPERATOR DUTIES

1. Fill all available pockets on assigned job with either new bobbins or those that have broken back.

2. Doff all full cheese and place on storage trucks.

3. Remove all breakbacks from tray and distribute as necessary for retie or repair.

4. Dispose empty bobbins to bobbin box.

5. Exchange cheese when changing from one yarn count or stock to another.

6. Maintain cheese in proper condition for spooler to tie-up next bobbin.
   (a) Kink cheese.
   (b) Clear tangles.
   (c) Remove chokes from core.

7. Record name and job number on trident punch cards and place at proper location for recording.

8. Notify section man of mechanical or stock defects.

Information Sheet 45 B

SPOOLER YARN MAN
OPERATOR DUTIES

1. Doff and rack beams from warper #1 and #2.

2. Blow off warper #1 and #2.

3. Perform all yarn handling duties on 234 spindle spooler.

4. Tend bobbin tray on 234 spindle spooler.

5. Help keep full yarn trucks arranged conveniently in storage area.

6. Help keep empty yarn trucks arranged conveniently in storage area.

7. Procure and take out all spooler yarn waste.

JOB NO. 46

OPERATING WARPER

TFG: 76-79
IS: 46 A,
46 B

1. What are warp threads?

2. What is filling?

3. By what other names is filling known?

4. What is the purpose of warping?

5. Describe a typical section beam.

6. At what speed do warpers operate?

7. What is the usual weight of yarn on beams?

8. Make a list of the duties of a warper tender.

9. Make a list of the duties of a warper creeler.

Information Sheet 46 A

WARPER TENDER
OPERATOR DUTIES

1. Run all scheduled warps on specified beams, mark beam and warper, record properly.

2. Check for correct number of ends per beam and correct yardage.

3. Thread up new creels, count into comb and restart warper.

4. Rearrange drop wires of creel when changing the number of ends per beam.

5. Help to exchange combs when required by production changes.

6. Place end and end lease in all warps run.

7. Remove defective cheese or cheese of wrong stock from creel and replace with proper cheese.

8. Repair all breaks in yarn and hold loose ends to a minimum.

9. Nofify section man of any mechanical defects or abnormal stock conditions.

10. Inspect stock as it runs over the measuring roll and onto the beam, being especially watchful for broken ends that fail to stop the warper.

11. Prepare all beams for doffing.

Information Sheet 46 B

WARPER CREELER
OPERATOR DUTIES

1. Fill creels with the specified counts, stocks and number of ends while the preceding creel is running out.

2. Remove cheese from spooler area and place them to be convenient for creeling when scheduled.

3. Remove starters from warper creels and place on empty racks for spooler tender use or, if not in current production, in storage for later use.

4. Procure from storage area such yarns as required for creeling schedules.

5. Punch trident record cards at spooler for each trident removed from that particular area.

6. Report abnormal conditions of yarns or area to section man.

7. When only a part of a creel is put in either at the beginning or end of a shift, the number creeled must be recorded on the warper report.

JOB NO. 47

PREPARING THE SIZE MIX WDT: 1-6

1. Why is sizing necessary for the weaving process?
2. What is meant by sizing?
3. How does the starch protect the yarn?
4. What cotton warps are not sized?
5. Give the purpose of sizing.
6. Name the sizing ingredients.
7. Why are softners made and used?
8. What is meant by preservatives?
9. Why is water so important to size mixture?
10. How is size mix prepared?
11. Why is boiling necessary?
12. What is the danger of running cold water into a size mix?
13. What is used to heat the mix?
14. Give the precautions used in preparing a good size mix.
15. What is considered a good formula for fabrics?

JOB NO. 48

OPERATING THE SLASHER WDT: 7-12

1. Name the parts of the slasher.

2. Give the purpose of the creel. Name two types of creels.

3. How is the amount of stretch in the yarn controlled?

4. Why are two size boxes used?

5. What is the object of the squeeze roll?

6. How is the size mixture heated, controlled and kept at the right level?

7. Give the purpose of the dryer cylinder.

8. Upon what principle does the moisture control unit work?

9. What information is given by the front and back clocks?

10. What is the purpose of the separator rods?

11. For what purpose is the expansion comb used?

12. Why does the slasher have two speeds?

13. Why does some selvage yarn not require as much size?

14. Where are the loom beams stored?

15. Give four ways of caring for equipment used in sizing.

JOB NO. 49

OPERATING DRAW-IN MACHINE

WDT: 13-18
IS: 49 A
49 B

1. What is done in the drawing-in operation?

2. How may drawing-in be done?

3. Explain fully the work of the tying-in machine.

4. Compare time and effort of the tying-in machine and that of drawing-in by hand.

5. Give the advantages of the portable tying-in machine.

6. How is drawing-in done by hand?

7. Why are drawing-in drafts used?

8. Explain Figure 1, page 14 WDT.

9. How does the point draft work?

10. What symbols are used in drawing-in drafts?

11. Why are mills trying the mechanical drawing-in machine?

12. List the duties of the draw-in machine operator.

13. List the duties of the draw-in helper.

Information Sheet 49 A

DRAW-IN MACHINE OPERATOR
OPERATOR DUTIES

1. Operates draw-in machine, drawing warps to patterns as required when extra patterns are not available or style is to be changed.

2. Procure warp from slasher room storage area.

3. Procure harness, reed, and drop wires from storage area for each warp drawn.

4. Prepare and set up pattern prior to drawing on draw-in machine.

5. Repair all missed or broken ends after drawing is completed.

6. Ties warp ends into four or five sections at reed.

7. Remove drawn warp from machine and secure pattern to beam.

8. Remove warp from rack and push to storage area.

9. Remove production stub from warp, tag and mark properly for pay purposes.

10. Mark warp drawing report board as to warps completed and operator's name.

11. Report to supervisor any malfunction of draw-in equipment or bad warp from slasher room.

Information Sheet 49 B

DRAW-IN HELPER
OPERATOR DUTIES

1. Keep floor clean around draw-in area.

2. Looks after old patterns.

3. Cleans and keeps old harness, drop wires and reeds in running condition.

4. Strings drop wires on stop motion bars.

5. Places a sufficient number of correct heddles on harness for new patterns to be drawn.

6. Prepares harness with a heddle separator spring that fits over a worm rod before being placed on draw-in machine.

7. Stores all extra harness by size for later use.

8. Disposes of all damaged harness, heddles, drop wires and reeds.

9. Helps draw-in operator repair all broken and misdrawn ends after complete warp has been drawn.

10. Helps draw-in operator remove pattern from draw-in machine and drop to beam to be secured to beam.

JOB NO. 50

WEAVING

WDT: 19-22
IS: 50 A

1. Who is known as the weaver?

2. What is the object of weaving?

3. What really determines if the mill plant is successful or if it will suffer a loss?

4. Give the two important jobs of the weaver.

5. For what does the weaver look at the back of the loom?

6. Give the two words that the weaver hears most from the overseer.

7. How are the looms arranged in the loom room?

8. What determines the number of looms a person can tend?

9. Name the tools of the weaver and how they help him on the job.

10. Why is the weaver's knot important to the weaver?

11. How is the loom started?

12. What two things will cause the loom to stop?

13. Explain the word "flagging."

14. Give the difference in the revolution of the crankshaft and camshaft. Why?

15. Define shrinkage and contraction.

16. How are weavers paid and in what way is this figured?

17. Explain how the pick clock operates to determine the weavers pay.

18. Make a list of the duties of a weaver.

Information Sheet 50 A

WEAVER
OPERATOR DUTIES

1. Repair warp breaks and restart looms.

2. Repair filling breaks and restart looms.

3. Post to smash board those looms requiring service of smash hands due to pick-outs, break-outs, badly crossed warps, ends running out, selvages requiring redrawing and the several other infrequently occurring items delegated as smash hand duties.

4. Post to warp out board those looms requiring new warps.

5. Flag for fixer those looms which fail to operate properly or defected as weaving second quality cloth.

6. Flag for supervisor those looms requiring his attention.

7. Report to supervisor instances of difficulty encountered in getting looms fixed, batteries properly filled, inadequate service from other personnel, bad warps, improper or bad filling or any other conditions which may prevent the best in quality and/or production.

8. Inspect cloth for defects due to weaving or yarn conditions.

9. Patrol warp alleys and keep warps straight and free of foreign matter.

10. Flag to cloth doffer's attention those looms requiring his service.

11. Restart mechanical stops.

JOB NO. 51

MAKING LOOM CALCULATIONS

WDT: 24-26
IS: 51 A

1. How is the speed of the loom given?

2. Why is this the same as the rpm of the crankshaft?

3. How is 100% production in yards found?

4. Give the formula for finding contraction and shrinkage.

5. Draw Figure 9, page 25 WDT and name the parts.

6. How is the change gear found?

7. Give the equation for finding pick constant.

8. Make a list of the duties of a loom cleaner.

Information Sheet 51 A

LOOM CLEANER
OPERATOR DUTIES

1. Put up and take down air hose.

2. Reposition hose to most convenient outlet.

3. Blow off front of looms.

4. Blow from beneath loom and weaver alley.

5. Blow off back of loom.

6. Remove lint and other foreign matter that may be dropped into warp, between the lay and fell of the cloth or on the face of the woven cloth.

7. Clean reed cap, shuttle guards, filling forks and around feeler and lizards of looms.

8. Cut strings from take-up shaft.

9. Cut strings off end of crankshaft.

10. Blow off overhead and walls.

11. Blow out from around drink machines, cookie machines, and small vents located along the side of wall.

JOB NO. 52

CHECKING THE ESSENTIAL PARTS OF THE LOOM

WDT: 27-33
IS: 52 A

1. Define weaving.

2. What is the work of the loom?

3. What are the yarns used in weaving called?

4. What is the difference between warp and filling?

5. Why is the interlacing on woven fabrics changed?

6. Name the three principal motions of the loom.

7. How does the shedding motion use harness to perform it's function?

8. In Figure 11, page 28 WDT, name the working parts of the loom from the warp beam to cloth.

9. What is the purpose of the picking motion? What is needed for this operation?

10. Give the disadvantage of the picking motion.

11. What is the work of the shuttle?

12. Name the purposes of the lay in the beating-up motion.

13. What is the purpose of the loom box?

14. Why is the reed so important in weaving?

15. Make a list of the duties of a battery filler.

Information Sheet 52 A

BATTERY FILLER
OPERATOR DUTIES

1. Fill batteries on all looms assigned.

2. Insure that proper filling is being used according to color tag on loom and color chalk mark on filling.

3. Remove empty tray to upper stand for pick up by filling hauler.

4. Replace empty tray with full tray from surplus storage position on filling stand.

5. Keep loose ends wound up on battery thread holder as batteries are filled.

6. Report irregularities in yarn conditions, bobbin size or any other condition to supervisor or loom fixer.

JOB NO. 53

LEARNING AUXILIARY MOTIONS IN WEAVING

WDT: 34-41
IS: 53 A

1. Name the auxiliary motions of a loom.

2. What is the purpose of the auxiliary motions?

3. Give the two main purposes of the take up motion.

4. Why is the let off motion important?

5. What protection is given the warp threads by the protector motion?

6. How is the mechanical warp stop motion designed?

7. When does the filling motion stop the loom?

8. When is the center fork stop motion used?

9. Why is the filling change motion considered important in making the loom automatic?

10. What is the purpose of: (a) midget feeler, (b) electric feeler, (c) temples, (d) stafford thread cutter, (e) selvage motion?

11. Make a list of a cloth doffers duties.

Information Sheet 53 A

CLOTH DOFFER
OPERATOR DUTIES

1. Doff cloth rolls from all looms assigned on regular doff area when above minimum size.

2. Doff all looms flagged for cut off if roll contains more than 40 yards.

3. Haul all doffed rolls to cloth room and unload storing by style.

4. Mark both ends of cloth, after cutting, as to loom number, style, and doffer.

5. Patrol regular doff area, taking off all rolls that will not run till following day.

6. Patrol flag area once an hour or as load is transported to cloth room.

7. Advise supervisor of any conditions unusual to proper coverage of job.

8. Use a piece of paper or cloth under each roll or cloth that is put on floor.

9. Use paper tubes for styles that require tubes. Procure tubes in cloth room.

JOB NO. 54

OPERATING DIFFERENT TYPES OF LOOMS

WDT: 42-63
IS: 54 A

1. The loom consists essentially of what parts?

2. Give the causes of noises in the loom.

3. Name the most famous and most universally used loom in the the textile industry.

4. What fabrics are woven on the Draper Model E Loom?

5. What seems to be the main cause for replacement of the Model E Loom?

6. Give the advantage of the Draper X-2 Looms.

7. Why was there a need for the Draper X-D Loom?

8. What are the advantages of the Draper X-3 Loom?

9. For what purpose was the new Draper X-3 Loom designed?

10. Name another famous manufacturer of looms, what plants use these looms?

11. Give three features important to weaving found in the Crompton-Knowles Looms.

12. What is the purpose of the dobby heads?

13. Explain how the dobby is operated.

14. For what purpose is the Jacquard Loom used?

15. Make a list of the duties of a weaving smash hand.

Information Sheet 54 A

WEAVING SMASH HAND
OPERATOR DUTIES

1. Repair warp breakouts.

2. Pick out defects and start loom.

3. Straighten up new warps both drawn or tied.

4. Straighten badly crossed selvage.

5. Clean battery thread holder and refill at warp out.

6. Cut lapped ends from warp.

7. Put shift mark on cloth.

8. Inspect cloth and correct misdraws.

9. Check off those jobs completed.

10. Walk to board.

11. Walk to loom.

JOB NO. 55

OPERATING SPECIAL LOOMS

WDT: 63-73
IS: 55 A

1. Why are special looms necessary?

2. Name some goods that are made with special looms.

3. What are the advantages of: (a) shutterless looms, (b) Warner and Swazey-Sulzer Weaving Machines, (c) Drapper Shutterless Loom, (d) Maxbo Loom?

4. From what country did the Maxbo Loom come?

5. What replaces the shuttle on the Maxbo Loom?

6. Describe the method of placing the filling in a Draper Shutterless Loom.

7. What parts are eliminated by the Draper Shutterless Loom?

8. Show by a drawing of Figure 34, page 69 WDT, the new principle of filling used by the Warner and Swazey Weaving Machine.

9. In what way does the Warner and Swazey Machine differ from all other looms?

10. Make a list of the duties of a filling hauler.

Information Sheet 55 A

FILLING HAULING
OPERATOR DUTIES

1. Maintain an adequate supply of the proper filling on each loom assigned.

2. Haul all filling from the storage area in the spinning room and place on looms or in weave room storage area.

3. Remove all empty trays from the looms or weaving storage area and return same to spinning storage area.

4. Place filling in weaving storage area in such a manner as to be readily identified when needed for loom operation.

5. Place winder package on looms with unifil.

6. Report shortage on any count of filling to the supervisor.

7. Collect bad filling as assigned.

JOB NO. 56

WORKING IN THE CLOTH ROOM

WDT: 75
IS: 56 A, B, C, D

1. In what form does the cloth go from weave room to the cloth room?

2. What kind of work is done in the cloth room?

3. How are seconds removed?

4. Give the duties of the cloth inspector.

5. On what machine do most accidents occur in the cloth room?

6. In what two ways do mills sell cloth?

7. What takes place after the cloth has been inspected?

8. How is all first class cloth handled?

9. Explain how rolls are prepared for shipment.

10. In what forms do mills ship their cloth?

11. Why are bales of cloth compressed?

12. Make a list of the duties of a cloth folder.

13. Make a list of the duties of a bale press and sack roll operator.

14. Make a list of the duties of a roll machine operator.

15. Make a list of the duties of a cloth-stitcher-shearer operator.

16. Make a list of the duties of a cloth grader.

Information Sheet 56 A

CLOTH FOLDER OPERATION
OPERATOR DUTIES

1. Fold all cloth scheduled for his machine.

2. Inspect cloth for defects and place flag in fold at proper place.

3. Separate cloth at seam after fold has been placed on table.

4. Mark proper style and yardage on each fold of cloth.

5. Reset yardage counter, prepare and restart machine.

6. Watch delivery side of shearing machine and in case of a breakout, or other malfunction, stop machine or signal to stitcher-shearer operator.

7. Help stitcher-shearer operator repair breakout on his line.

8. Report to his supervisor any irregularity of material, job conditions or machines.

9. Help to clean up department at the end of the shift.

Information Sheet 56 B

BALE PRESS AND SACK ROLL OPERATION
OPERATOR DUTIES

Bale Press Operation

1. Properly prepare press to receive bale.

2. Fill press with correct yardage and style.

3. Operate press to assure proper compression of bale.

4. Secure bale with ties before releasing pressure of press.

5. Release press, sew burlap seams on bale, and remove from press.

6. Weigh bale, record all data, properly identify and remove to temporary storage.

7. Miscellaneous duties.

Sack Roll Operation

1. Weigh roll of cloth and record data.

2. Encase roll of cloth in burlap tubing and secure tubing at each end.

3. Properly identify roll and place in temporary storage area.

4. Miscellaneous duties.

Information Sheet 56 C

ROLL MACHINE
OPERATOR DUTIES

1. Procure pallet of cloth and position near stitching machine.

2. Procure ends of cloth from pallet, sew two ends together until all folds are sewed together; then sew first end of the cloth to the last end on the pallet previously run.

3. Position and start stitcher head which sews the ends together.

4. Make any minor repairs or adjustments on stitcher when need arises.

5. Change stitches when different type seam is required.

6. Position truck with pallet behind roll-up machine.

7. Start and stop roll-up machine.

8. Adjust machine when varying widths of cloth requires different settings.

9. Procure tag and record yards.

10. Separate seam, tag and doff roll.

11. Tape ends on all styles that require taping.

12. Prepare and restart roll-up machine after doffing.

13. While roll up machine is running, sew next pallet of cloth together.

14. Procure a supply of paper tubes and tags.

15. Oil all parts of roll-up machine and stitching machine that requires oiling.

16. Report irregular conditions of material received and other jobs or machine conditions which may effect normal operations.

17. Help to clean up department at the end of shift.

Information Sheet 56 D

CLOTH STITCHER-SHEARER OPERATION
OPERATOR DUTIES

1. Procure rolls of cloth from storage and sew the first end of cloth to the last end of the roll previously run.

2. Start machine which unrolls the cloth into a scray for delivery to the brushing and shearing sections of the process line.

3. Inspect machine for proper operation and make routine adjustments.

4. While machine is in operation, preposition rolls in storage for greater convenience.

5. Record yardage and/or numbers of rolls processed.

6. Tear off thrums and bad ends from rolls before sewing and re-identify roll if necessary.

7. Remove empty cloth tubes from machine and place in proper storage area.

8. Repair breakouts, straighten cloth lapped on rolls and rethread machine if necessary.

9. Report to supervisor irregular conditions of material, job conditions or mechanical defects.

10. Help to clean up department at end of the shift.

Information Sheet 56 E

CLOTH GRADER OPERATION
OPERATOR DUTIES

1. Grade all cloth passed to his table.

2. Repair, if practical, the defects flagged by the folder operator.

3. Cut cloth when necessary to eliminate defects or to meet length requirements.

4. Classify as seconds when cloth quality or yardage requires such.

5. Pass to the seconds grader all cloth classified as seconds or otherwise requiring his attention.

6. Record production as it passes over his table. Production is recorded as to style, yardage, and quality classification. Prepare baling list for styles to be rolled.

7. Report irregular conditions of material or other job factors which may effect normal performance on his job or quality of production.

8. Put up rolls on inspecting frames and remove same after inspection.

9. Assist in maintaining or improving production on his line of processing.

10. Help clean up department at the end of the shift.

JOB NO. 57

THE FINISHING PROCESSES WDT: 76-78

1. Upon what does the finishing of cloth depend?

2. Give the difference between the preparation processes and the finishing processes.

3. What fabrics require special finishing processes?

4. Describe the following processes in the preparation for finishing: (a) singeing, (b) kier boiling, (c) brown souring, (d) bleaching, (e) mercerizing.

5. What takes place in the following finishing processes: (a) tentering, (b) shearing, (c) drying, (d) printing, (e) napping, (f) calendering.

6. List the special processes through which the cloth may be put.

JOB NO. 58

DESIGNING BASIC WEAVES WDT: 79-92

1. Why does the designer in a mill play a very important part in the manufacturer of cloth?

2. How are all woven fabrics constructed?

3. Define: (a) warp end, (b) pick, (c) weaving.

4. Show by diagram, Figure 39 page 79 WDT, and explain briefly the method of interlacing of the plain weave system.

5. What is actually the difference in A, B, and C in Figure 41, page 81 WDT.

6. Explain what is meant by 8 x 8 design paper.

7. In Figure 43, explain the use of 8 ends and 8 picks shown on odd and even numbers.

8. Using Figure 45 (A) explain the plain weave.

9. Draw Figures 46 (A), (B), and (C) and tell what each represents.

10. What do (A), (B), and (C) show in Figure 48?

11. Name the three basic weaves and tell how they differ.

JOB NO. 59

DESIGNING DERIVATIVE WEAVES WDT: 93-103

1. What are the derivative weaves?

2. Give the object in the construction of the rib weave.

3. Define: (a) basket weaves, (b) fancy rib, (c) fancy basket weaves, (d) broken twills, (e) satin derivatives, (f) shaded fabrics.

4. Give the formulas for finding the following: (a) width inside selvage, (b) total dents, (c) reed number, (d) take-up, (e) total ends of each color, (f) picks per inch of each color, (g) yards per pound, (h) counts.

JOB NO. 60

MAKING CLOTH ANALYSIS WDT: 105-109

1. Give the purpose of making a cloth analysis.

2. What is cloth made up of?

3. To find the analysis of a sample of cloth, what must a person be able to determine?

4. Name the tools necessary to pick out a sample of cloth.

5. Why is it easy to be wrong in making a count of picks and ends?

6. Give the easy or proper way to find the pick out sample.

7. How may warp and filling be determined?

8. What is meant by the face of the cloth?

9. How may ends and picks per inch be found.

10. Give the means of finding total ends.

11. What is the formula for finding the number of patterns in a warp?

12. How are yards per pound figured?

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Automobile Body and Fender Repair and Refinishing, Job Tests.

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ABSTRACT - This document, prepared by trade and industrial education personnel, contains 71 job tests on automobile body and fender repair and refinishing. It is designed to accompany a related study guide available as ED 013 929 or VT 002 376 (AIM Winter 1967). An answer book "Automobile Body and Fender Repair and Refinishing, Job Test Answers" may be obtained from the source of availability indicated for this document. (GR)

VT 010 690

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ED0 45856

AUTOMOBILE BODY AND FENDER REPAIR AND REFINISHING

JOB TESTS

U.S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
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VT010630

JOB 1 - TEST

HISTORY OF BODY AND FRAME CONSTRUCTION

TRUE AND FALSE

(T) (F) 1. The automobile bodies and fenders of today are made from light gauge metal.

(T) (F) 2. A sheet of metal that is crowned is not as strong as the same sheet would be if it were flat.

(T) (F) 3. The instrument panel is usually considered as part of the cowl panel.

(T) (F) 4. The roof panel is one of the largest of all major body panels.

(T) (F) 5. Unit or unitized body construction is a new engineering concept.

(T) (F) 6. Most windshields and rear windows are held in place by a rubber weather strip.

(T) (F) 7. Both the glass and outside trim molding are recessed in the weather strip.

(T) (F) 8. Most one-piece windshields can be removed from the inside of the vehicle.

(T) (F) 9. The grille is usually the largest single unit of trim.

(T) (F) 10. When the fender is bolted to the body properly, it is considered as an independent type fender.

MULTIPLE CHOICE

1. As research continued_____ways to give strength to body panels were found. (Two) (Three) (Four) (Several)

2. The openings through which passengers gain access to the body interiors are referred to as_____. (Lids) (Decks) (Doors) (Gates)

3. When a surface has a lot of crown, or is in effect a corner rounded in all directions, it is called_____. (Low Crown) (Crown) (High Crown) (Crowned Surface)

JOB 1 - TEST
Continued

HISTORY OF BODY AND FRAME CONSTRUCTION

4. In the hard top sedan, the center pillar attaches to the_____ only. (Top Panel) (Side Panel) (Bottom Panel) (Floor Panel)

5. On_____ _____sedan type bodies, the center pillar is incorporated into the rear quarter side panel. (Hard Top) (Two Door) (Four Door) (Station Wagon)

6. At the time of assembly, all panel joints are sealed. In some cases a _____to_____inch diameter stream of mastic is laid in the joints where two panels come together. (5/8 - 3/4) (1/2 - 3/4) (1" - 3") (2" - 4")

7. Many cars now have a _____system which forces air into the body. (Air-conditioning) (Ventilating) (Cooling) (Fan)

8. All deck lid handles are secured from the inside with _____ which are accessible when the deck lid is open. (Sheet Metal Screws) (Machine Screws) (Stove Bolts) (Wood Screws)

9. The quarter window is the window in the _____ _____side panel. (Rear quarter upper) (Front quarter upper) (Rear quarter lower) (Front quarter lower)

10. Automobiles' bodies are generally regarded as having_____ sides which are exactly the same. (Two) (Three) (Four) (Five)

JOB 2 - TEST

SELECTING AND CARING FOR HAND TOOLS

TRUE AND FALSE

(T) (F) 1. A mallet having a face diameter of about two inches permits a good distribution of force.

(T) (F) 2. A pick hammer is not considered part of the minimum kit of tools.

(T) (F) 3. The pick hammer is required when jobs are necessary to form the metal up to a corner.

(T) (F) 4. The body spoon must be quite heavy and rugged as compared with the dinging spoon.

(T) (F) 5. The low-crown spoon is used more often than the high-crown spoon.

MULTIPLE CHOICE

1. Body spoons are used for _____ basic purposes. (Two) (Three) (Four) (Five)

2. Pry tools may be used on any panel. Their most frequent use is on_____. (Hoods) (Fenders) (Doors) (Tops)

3. Two factors which must be considered in selecting a Dolly Block are_____and_____. (Length-Width) (Shape-Form) (Weight-Balance) (Size-Gauge)

4. The _____ crown spoon is used more often than the High Crowned spoon. (Low) (Body) (General Purpose)

5. When a flange or a fender bead is torn, it will be necessary to _____ the two sides of the split metal together again. (Braze) (Weld) (Solder) (Wire)

JOB 3 - TEST

USING THE BASIC HAND TOOLS

TRUE AND FALSE

(T) (F) 1. To straighten metal, force is applied to a piece of damaged sheet metal.

(T) (F) 2. The purpose of all dolly blocks are the same.

(T) (F) 3. The heel dolly and toe dolly are both special purpose tools.

(T) (F) 4. Body spoons are used as prying and driving tools about as much as they are used for dolly block substitutes.

(T) (F) 5. Very few special purpose tools are used for straightening sheet metal.

MULTIPLE CHOICE

1. The width of the head on bumping hammers may vary according to styles, but most popular ones will be approximately_____ inches. (1/2) (1) (1-1/2) (2)

2. Although pry tools may be used on any panel, their most frequent use is on _____. (Hoods) (Doors) (Tops) (Panels)

3. There are so many_____tools used for straightening sheet metal it would be impossible to list them all.
(Sheet Metal) (Special Purpose) (Special Flange) (Pry Rod)

4. Drain holes in the lower facing of the door offer convenient opening through which _____may be inserted. (Panels) (Heat) (Caulking) (Tools)

5. Body spoons are used for_____basic purposes.
(two) (three) (four) (five)

JOB 4 - TEST

SELECTING AND USING POWER TOOLS

TRUE AND FALSE

(T) (F) 1. The body jack consists of five basic units.

(T) (F) 2. Regardless of how the power is developed inside the jack, the principle involved for their correct application is the same.

(T) (F) 3. Air equipment is equally as fast and easy to operate as the hydraulic equipment.

(T) (F) 4. The pneumatic fender iron can be used for repairs other than on fenders.

(T) (F) 5. The leverage dolly is also a power operated tool.

MULTIPLE CHOICE

1. The jacks most widely used are_____operated.
(Air) (Pneudraulic) (Hydraulically) (Manually)

2. With any of the power tools it is always necessary to _____ the jacks firmly against something before power is applied.
(Anchored) (Placed) (Stand) (Set-up)

3. The Hex arrangement allows you to position the tool to _____ different ways without distrubing the jack set-up. (4) (5) (6) (7)

4. Tubing is usually made from _____steel. (Mild)
(Seamless) (Stainless) (Medium)

JOB 5 - TEST

LEARNING WELDING TERMS

TRUE AND FALSE

(T) (F) 1. Most welding torches consist of 5 basic units.

(T) (F) 2. The exact pressure to which the oxygen and acetylene regulators should be adjusted are determined by tip sizes.

(T) (F) 3. There are three basic torch flames which are made by adjusting the torch valves to vary the ratio of oxygen and acetylene which is being used.

(T) (F) 4. The neutral flame is used for most all welding operations on mild steel.

(T) (F) 5. The oxidizing flame is not used in welding steel.

MULTIPLE CHOICE

1. The temperature of the neutral flame is approximately _____ degrees at the tip of the cone. (8,550) (5,850) (2,000) (2,300)

2. The midsection of the sheath flame will be about _____ degrees. (3,800) (5,850) (2,300) (2,000)

3. Temperatures up to _____degrees can be developed by adjusting the flame to an excess of oxygen. (6,000) (6,300) (3,600) (3,000)

4. Adjust the flame so that the feathery streamers extend at least _____ inches beyond the inner cone. (1/2) (1) (1½) (2)

5. There are _____basic torch flames which are made by adjusting the torch valve to vary the ratio of the oxygen and acetylene being used. (Two) (Three) (Four) (Five)

JOB 6 - TEST

EQUIPPING FOR WELDING

TRUE AND FALSE

(T) (F) 1. An oxygen acetylene flame can be used for fusing practically any kind of metal.

(T) (F) 2. The actual welding is done with the torch tip.

(T) (F) 3. To light the torch open the acetylene valve two quarter turns.

(T) (F) 4. An oxidizing flame will injure the metal.

(T) (F) 5. Always turn the oxygen torch valve on first.

MULTIPLE CHOICE

1. The standard oxygen tank is a seamless steel bottle about _____feet high. (4) (8) (5) (3)

2. The tank when full contains approximately _____cubic feet of oxygen. (120) (220) (300) (200)

3. Free carbon in the welding flame will result in what is called a _____. (Neutral flame) (Reducing flame) (Oxidizing flame)

4. The use of too much _____will cause the metal to burn rapidly. (Oxygen) (Acetylene) (Filler rod)

5. When an excess of _____is used the flame will be ragged. (Oxygen) (Acetylene) (Flux)

JOB 7 - TEST

SETTING UP AN OXYACETYLENE WELDING OUTFIT

TRUE AND FALSE

(T) (F) 1. Both hoses are the same size.

(T) (F) 2. The regulators for both gases operate on the same principle and are made so that they are interchangeable.

(T) (F) 3. The gas cylinders are considered as part of a package kit.

(T) (F) 4. An oxygen acetylene flame can be used for fusing practically any kind of metal.

(T) (F) 5. Oxygen alone is noninflammable but will actively support combustion.

MULTIPLE CHOICE

1. The standard oxygen tank, when full, contains approximately _____cubic feet of oxygen. (200) (220) (240) (245)

2. The acetylene in the cylinder is compressed until it exerts a pressure of _____to_____PSI on the cylinder. (200-250) (250-275) (275-300) (200-300)

3. The oxygen hose may be either _____or _____and is fitted with right-hand thread connections. (Green or black) (Red or Green) (Black or Red) (Red or Blue)

4. _____feet is the minimum length of hose which is practical for work on an automobile. (Five) (Ten) (Fifteen) (Twenty)

JOB 3 - TEST

LIGHTING THE TORCH

TRUE AND FALSE

(T) (F) 1. An oxyacetylene torch may be used to melt and apply solder to body panels.

(T) (F) 2. A small blowtorch can be used for applying solder to body panels.

(T) (F) 3. A material known as oxide enables a welder to achieve either fusion or adhesion.

(T) (F) 4. It is necessary to supply all of the oxygen through the torch.

(T) (F) 5. When lighting the torch, the acetylene is turned on first.

MULTIPLE CHOICE

1. What color is the oxygen hose? (Black) (Blue) (Red) (Yellow)

2. What color is the acetylene hose? (Black) (Blue) (Red) (Yellow)

3. What is the proper flame for most welding? (Neutral flame) (Reducing flame) (Oxidizing flame)

4. When an excess of acetylene is used, the flame will be _____. (Ragged) (Purplish) (Yellow)

5. The use of too much oxygen will cause the _____to burn rapidly. (Oxygen) (Metal) (Acetylene)

JOB 9 - TEST

OBSERVING SAFETY RULES IN WELDING

TRUE AND FALSE

(T) (F) 1. The risk of fire is always present when any welding is done.

(T) (F) 2. The operator does not need protection from the ultra-violet light given off by the electric arc.

(T) (F) 3. The light given off by the arc will burn similar to sunburns.

(T) (F) 4. A small drop of oil grease in an oxygen valve can be the cause of a fire and explosion.

(T) (F) 5. Worn insulation can cause a short circuit.

MULTIPLE CHOICE

1. The arc should never be used if the operator is not wearing _____. (Boots) (Apron) (Gloves) (Eye-shield)

2. The problems of safety in arc welding fall into _____ classifications. (2) (3) (4) (5)

3. The operator needs protection from the _____light given off by the electric arc. (Bright) (Ultraviolet) (Red) (Blue)

4. Even under perfect operating conditions, the electrodes will throw off _____hot particles of metal. (Red) (White) (Blue) (Yellow)

5. Protection against electrical hazards are also equally important, particularly with portable machines which operate on a _____ volt in-put. (110) (210) (120) (220)

JOB 10 - TEST

MAKING ADJUSTMENTS FOR DIFFERENT FLAMES

TRUE AND FALSE

(T) (F) 1. The reading on the gauge will always be at least equal to the number of the tip.

(T) (F) 2. If the gas flows too slowly, there will be backfiring, making it easier to weld.

(T) (F) 3. Molten particles of metal which fly from the puddle will cause backfiring.

(T) (F) 4. The valve should be shut off immediately if the flame enters the mixing head.

(T) (F) 5. Acetylene burning alone will give off a large quantity of sooty black smoke.

MULTIPLE CHOICE

1. The _____flame does not throw off either carbon, or oxygen to contaminate the molten metal. (Neutral) (Carburizing) (oxidizing)

2. The sheath flame serves to prevent _____of the molten metal. (Smoking) (Burning) (Cooling) (Warping)

3. What is the approximate temperature of the neutral flame? (5,000) (3,000 deg. F.) (5,850 Deg. F.)

4. The carburizing flame will cause the molten metal to _____ and lose the clear appearance. (Boil) (Burn) (Shrink) (Warp)

5. An excess of _____will cause the molten metal to burn. (Oxygen) (Acetylene) (Air) (Distance)

JOB 11 - TEST

OPERATING THE OXYACETYLENE WELDING OUT-FIT

TRUE AND FALSE

(T) (F) 1. When welding butt joints in heavier metal, it is not necessary to space the edges.

(T) (F) 2. In making a simple butt weld, the angle of the flame should be between 30 and 45 degrees.

(T) (F) 3. In welding sheet metal it is desirable to raise the temperature to the melting point slowly.

(T) (F) 4. Controlling heat distortion can be done best with a torch.

(T) (F) 5. The size of a tack weld should be kept as small as possible.

MULTIPLE CHOICE

1. The _____corner weld is the easiest of all welding operations with the acetylene torch. (Inside) (Outside) (Edge) (Overhead)

2. _____requires more care because of the overlapped position of the piece to be welded. (Torch) (Flame) (Rod) (Heat) (Tacking)

3. The distance of the _____end from the work can vary to some degree for different welds. (Flame) (Rod) (Heat)

4. A _____weld is made by melting a hole in the upper piece. (Butt) (Button-hole) (Lap) (Overhead)

5. _____welding is necessary for any seam more than an inch long. (Tack) (Seam) (Zig-zag) (Flat)

JOB 12 - TEST

OPERATING ELECTRIC WELDER

TRUE AND FALSE

(T) (F) 1. In arc welding, the arc is established by a motor generator.

(T) (F) 2. When you are working with arc welders, it is not necessary to use protective equipment.

(T) (F) 3. The current used in arc welding has a direct bearing on the soundness of the weld.

(T) (F) 4. In arc welding with any type of equipment, the metal to be welded is made a part of the electric circuit.

(T) (F) 5. It is not always desirable to use the arc instead of the torch when welding metal which is heavier than sheet.

MULTIPLE CHOICE

1. Worn _____can cause short circuits. (Machine) (Plug ins) (Insulation) (Rods)

2. When the arc is used on a lapped sheet-metal joint, the surface must fit _____together. (Tightly) (Adjoining) (Loosely)

3. When cutting with the electric arc welder, the amperage is set _____. (Lower) (Higher) (The same) (Automatic)

4. There is a crater at the end of each weld. It is necessary to fill this crater to _____the weld. (Strengthen) (Uniform) (Smooth) (Seam)

5. Starting the _____is a matter of touching the electrode to the work and pulling it away a short distance. (Weld) (Carbon) (Arc) (Circuit)

JOB 13 - TEST

MAKING SPOT WELDS

TRUE AND FALSE

(T) (F) 1. Under perfect operating conditions, the electrode will throw off white hot particles of metal.

(T) (F) 2. Amperages may vary from 5,000 to as much as 35,000.

(T) (F) 3. Soft copper tips will stand more wear than alloy tips.

(T) (F) 4. Pressure must be held on the weld until the temperature has dropped sufficiently to restore strength.

(T) (F) 5. The pieces to be joined must be spaced.

MULTIPLE CHOICE

1. The voltage is rarely more than _____volts and some machines are designed to work with as low as one volt. (5) (15) (6) (10)

2. The _____must be relatively heavy to supply the high amperage current required for welding. (Electrode) (Transformer) (Welder)

3. The primary of the transformer, operating on _____volts is extremely dangerous if handled improperly. (220) (120) (400)

4. A spot welder can be equipped with a _____which will control the time to a fraction of a cycle of the alternating current. (Tip) (Switch) (Timer)

5. The operator usually must use the machine not more than_____ feet from his eyes. (1) (4) (2) (½)

JOB 14 - TEST

BRAZING METAL

TRUE AND FALSE

(T) (F) 1. Braze welding and brazing are similar in that both require a nonferrous filler rod.

(T) (F) 2. Silver base alloys are also used as brazing material on both ferrous and nonferrous metal.

(T) (F) 3. Silver base alloys are always used in body repairing.

(T) (F) 4. It is common practice in the body shop to call both braze welding and brazing by the same name.

(T) (F) 5. A nonferrous filler rod melts above 600 degrees F.

MULTIPLE CHOICE

1. Braze welding and brazing are similar in that both require a _____. (Welding rod) (Ferrous rod) (Nonferrous filler rod)

2. One advantage in brazing is that it can eliminate the need for sealing if the joint is brazed_____. (Half length) (Full length) (Uniformly) (Lapped)

3. Brazing _____serves as a chemical cleaner for the surface to be brazed. (Rod) (Post) (Flux) (Base)

4. Nonferrous filler rods melt above _____degrees F. (400) (600) (700) (800)

5. It is useless to expect _____if the joint is filled with sealer, rust, and other materials. (Brazing) (Bond) (Appearances) (Penetration)

JOB 15 - TEST

INSPECTING AND TESTING WELDS

TRUE AND FALSE

(T) (F) 1. Piping systems and similar structures are frequently subjected to a pressure test.

(T) (F) 2. At times extra material is left at the end of a weld and this is later removed and tested to destruction.

(T) (F) 3. The shear test is of wide use in welding work.

(T) (F) 4. The hardness testing methods are used in determining the softness of welds.

(T) (F) 5. Methods for examining welds can be described as destructive or non-destructive tests.

MULTIPLE CHOICE

1. The completeness of any _____program and the carefulness of the inspection will depend, naturally, upon the requirements. (Testing) (Safety) (Welding) (Soldering)

2. All weld inspection and testing methods have but one purpose in determining whether the work done constitutes a _____. (Bad Weld) (Good Weld) (Fair weld) (Weak Weld)

3. The defects that can occur in welding can be classified into _____groups depending upon whether or not they are externally apparent. (1) (4) (5) (2)

4. Oversize or undersize welds can be readily observed by_____ examination. (X-ray) (Visual) (Tension Test) (Hardness Test)

5. The _____test can be used only on magnetic substances. (X-ray) (Radiographic) (Magnaflux) (Pressure Test)

JOB 16 - TEST

CUTTING LIGHT METAL WITH THE OXYACETYLENE TORCH

TRUE AND FALSE

(T) (F) 1. Most iron and steel will oxidize when exposed to the air, regardless of temperature, to form a layer of iron oxide on the surface.

(T) (F) 2. Manual flame cutting is used with entirely satisfactory results for a wide range of cutting operations.

(T) (F) 3. Unless the proper gas pressures, speed, and blowpipe motion are maintained, the desired type of cut will not be produced.

(T) (F) 4. As a stream of pure oxygen impinges against the white hot metal a spot will oxidize.

(T) (F) 5. When iron is heated very hot and exposed to high purity oxygen, an intense reaction will not take place.

MULTIPLE CHOICE

1. Theoretically it requires _____cubic feet of oxygen to oxide one pound of iron completely. (9½) (15-2/3) (1 1/3) (4.58)

2. Actually, in the cutting of ordinary iron, the consumption varies from 2 to _____cubic feet of oxygen per pound of iron removed from the cut. (15) (14) (13) (6)

3. Cutting _____are made with a ring of openings, usually four or more, surrounding the cutting oxygen orifice. (Torches) (Blades) (Blowpipes) (Nozzles)

4. Most iron and steel will _____when exposed to the air. (Burn) (Oxidize) (Melt) (Heat)

5. Although, in principle, the cutting blowpipe needs but_____ preheat flame. (One) (Three) (Two) (Four)

JOB 17 - TEST

CUTTING HEAVY METALS WITH THE OXYACETYLENE TORCH

TRUE AND FALSE

(T) (F) 1. An oxygen lance and cutting blowpipe are never used together.

(T) (F) 2. Steel and iron of practically unlimited thickness can be cut by means of a device known as an oxygen lance used either alone or in conjunction with a cutting blowpipe.

(T) (F) 3. An oxygen lance consists essentially of a length of black iron pipe connected by an oxygen hose to a regulated supply of oxygen.

(T) (F) 4. In general practice, the hand-cutting blowpipe is used for severing sections even 12 inches thick.

(T) (F) 5. Heating a starting point on the metal may be done only one way.

MULTIPLE CHOICE

1. For connecting the regulator to the lance, the hose is preferably at least _____nominal size. (1½) (3/8) (1 in.) (2 5/8)

2. In using the oxygen lance it is desirable to have _____ workmen. (1) (2) (3) (4)

3. Heavy cuts can also be made by using _____lances together. (5) (4) (3) (2)

4. The_____cutting process depends simply upon the chemical reaction between oxygen and red hot iron and steel. (Modified lance) (Oxygen) (oxyacetylene) (Oxygen lance)

5. The cutting blowpipe operator starts the cut at one side, using a blowpipe fitted with the _____size nozzle. (Small) (Medium) (Middle) (Largest)

JOB 18 - TEST

CUTTING STEEL WITH THE OXY-ACETYLENE TORCH

TRUE AND FALSE

(T) (F) 1. Cast iron cutting is a much hotter job than cutting steel.

(T) (F) 2. The hardest pipe cutting operation is to make a square cut, as in preparation for a line joint.

(T) (F) 3. The beveling of pipe ends affords excellent practice in freehand control of the cutting blowpipe.

(T) (F) 4. The amount by which the top of the cut lags behind the bottom is known as the "drag" or "lag".

(T) (F) 5. A fast and economical method for removing rivets under certain conditions employs a special, low velocity, rivet cutting nozzle.

MULTIPLE CHOICE

1. Since cutting action is dependent upon the chemical reaction between the metal and_____, it is desirable that the surface be clean before attempting to cut. (Pre-heating) (Oxygen) (Blowpipe) (Nozzle)

2. The only special equipment required for gouging operations is a series of_____. (Blowpipes) (Nozzles) (Blades)

3. The technique for cutting_____differs from that for steel in that much higher preheat is required, and the cutting nozzle is moved back and forth constantly across the line of the cut. (Steel) (Sheet metal) (Gray Iron) (Cast Iron)

4. Because of the air-hardening properties, precautions must be taken with the straight_____to_____percent chromium steels to avoid the rapid cooling of local areas heated during the removal of risers either by friction sawing or by acetylene cutting. (4 to 6) (8 to 10) (15 to 20) (20 to 30)

5. To prevent cracks and checks in straight 4 to 6 per cent chromium steel, the entire casting should be preheated to about _____degrees F. before starting the cutting operation. (100) (500) (900) (1000)

JOB 19 - TEST

APPLYING SOLDER

TRUE AND FALSE

(T) (F) 1. Acid core solder wire is about ½ inches in diameter.

(T) (F) 2. The most commonly used method of soldering is with a torch.

(T) (F) 3. Rust cannot be removed in the same manner as paint.

(T) (F) 4. A soldering iron is seldom used in a body shop.

(T) (F) 5. The sinking of welds is a hand operation.

MULTIPLE CHOICE

1. The area covered by _____should always be slightly greater than actually needed. (Oil) (Rust) (Solder)

2. Solder is the _____ _used for filling the depressions. (Method) (Material) (Flux)

3. Be sure to keep plenty of _____on the paddle during the paddling operation. (Solder) (Acid core) (Oil)

4. As soon as enough solder has been applied, it is necessary to smooth it. This is called_____. (Paddling) (Building up) (Tinning)

5. If regular bar solder is used the_____is played over the tinned surface to keep it hot. (Paddle) (Torch) (File)

JOB 2[illegible] - TEST

USING BASIC STRAIGHTENING PROCEDURES AND EQUIPMENT

TRUE AND FALSE

(T) (F) 1. Roughing is the most important phase of the total straightening operation.

(T) (F) 2. Roughing cannot restore the overall contour to the damaged area of the panel.

(T) (F) 3. The exact conditions of a misalignment can vary widely.

(T) (F) 4. Roughing is an application of force.

(T) (F) 5. There are five basic methods of applying force to rough out a damaged panel.

MULTIPLE CHOICE

1. The hydraulic type body jack is available in _____basic sized.
(2) (3) (4) (5)

2. The important feature of any body jack is that it is fitted with _____ends. (Round) (Screw-threaded) (Clamp-on) (Bevel)

3. Most heavy duty jacks are rated from _____to_____tons.
(3-5) (5-7) (7-10) (10-15)

4. Most light duty jacks are rated from _____to_____tons.
(1-2) (2-3) (3-4) (4-5)

5. _____is the most important phase in total straightening.
(roughing) (aligning) (bumping) (Tension)

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JOB 21 - TEST

BUMPING AND DINGING METAL

TRUE AND FALSE

(T) (F) 1. Restoring of automotive body panels that have been damaged is referred to as metal "bumping" or "dinging"

(T) (F) 2. The difference between dinging and metal bumping is the dingman will damage the paint.

(T) (F) 3. In collision work the power saw is the most important factor.

(T) (F) 4. 50 separate tools are considered the minimum number of tools to start a small shop.

(T) (F) 5. Body bumping and dinging are highly paid trades which anyone with a mechanical aptitude can learn by practice.

MULTIPLE CHOICE

1. In collision work the use of the_____is one of the most important. (Wood mallet) (Hammer) (Power saw) (Surfacing Spoon)

2. What excercise will permit you to judge whether or not you should attempt to master metal bumping. (Driving nails) (Using a power saw) (Driving a car) (Spot welding)

3. _____separate tools are considered the minimum number of tools for minor repairs on fenders. (25) (16) (10) (34)

4. Continue until you can drive_____nails without bending any of them. (10) (20) (30) (100)

5. The chief difference in dinging and metal bumping is the dingman must do his work without damaging the_____. (Fender) (Hood) (Paint) (Doors)

JOB 22 - TEST

SHRINKING METAL

TRUE AND FALSE

(T) (F) 1. Stretched metal is in almost any area of an automobile damaged in a collision.

(T) (F) 2. When shrinking is done as a part of any straightening operation, it is because of a stretched condition.

(T) (F) 3. False stretch is the term used to identify a condition which often is confused with a true stretched condition.

(T) (F) 4. Quenching is a means of controlling the rate of heating.

(T) (F) 5. Overshrinking is a result of shrinking some of the temporarily expanded metal in addition to that which was stretched.

MULTIPLE CHOICE

1. Most _____are the result of a high speed impact by a relatively small, rigid object. (Shrinking) (Stretched materials) (Gouges) (False stretch)

2. _____is the result of shrinking some of the temporarily expanded metal in addition to that which was stretched. (Overshrinking) (Gouge) (Stretched metal) (False stretch)

3. _____metal is simply a matter of making an upset where it is needed. (Gouge) (Shrinking) (False stretch)

4. _____is the term used to identify a condition which often is confused with a true stretched condition. (Stretched metal) (False Stretch)

5. One of the most important steps in any shrinking operation is the application of _____. (Hammer blows) (Heat) (Dolly Block) (Quenching)

JOB 23 - TEST

REPAIRING FENDERS

TRUE AND FALSE

(T) (F) 1. A dolly block and a bumping hammer are generally used to reform flanges and beads.

(T) (F) 2. The fastest way to work the sharp fold area is to go all over it.

(T) (F) 3. The correct way to reform a flange is to use a disk and sander.

(T) (F) 4. The metal all around the bottom edge of the outside of the fender is a flange.

(T) (F) 5. After the fender has been pushed out it should be removed to straighten the inner skirts.

MULTIPLE CHOICE

1. The metal all around the bottom edge of the outside of the fender is_____. (Beaded) (Flanged) (U Shaped) (Reform)

2. In cases where the fender has been damaged so badly that the flange or bead has been torn, it will be necessary to repair the tear by _____. (Soldering) (Stretching) (Welding) (Sanding)

3. On one end or side of each dolly block, there is an_____ which can be used to form a flange. (Hammer) (Support bar) (Anvil) (Hammer and dolly block)

4. After the worst of the damaged part has been pushed out, the fender should be _____ to permit straightening the inner skirts. (Finished) (Removed) (Attached) (Inspected)

5. After fender is replaced, the rest of the straightening should be finished with_____. (Lock support bar) (Hammer and dolly block) (Disk and Sander) (Anvil)

JOB 24 - TEST

REPLACING DOOR PANELS

TRUE AND FALSE

(T) (F) 1. The technique is more complicated to fix a door panel than it is to fix a hood or fender.

(T) (F) 2. The strain should be relieved before the application of tension so that there will be the least possible resistance to the lifting action.

(T) (F) 3. Outer door panels are not usually damaged in collision which involves the side of an automobile.

(T) (F) 4. A butt joint can be used wherever it is possible to conceal the joint.

(T) (F) 5. A flange joint is usually used when only the upper portion of a door panel is replaced.

MULTIPLE CHOICE

1. All doors are provided with _____holes at the bottom so that water which runs on the outside of the glass between the door panels can run out. (Round) (Square) (Drain) (Long)

2. A series of _____blows along this sharp bend will straighten it partially and reduce the strain it exerts on the adjoining metal. (Hammer) (Heavy) (Light) (Medium)

3. In working a _____it is important to start at its beginning. (Hill) (Ridge) (Gouge) (Dented)

4. When a panel or a portion of a panel is replaced, the_____ should be removed. (Bumper) (Fender) (Door) (Hood)

5. _____door panels are usually damaged in any collision which involves the side on an automobile. (Inner) (Center) (Outer) (Middle)

JOB 25 - TEST

STRAIGHTENING DOOR

TRUE AND FALSE

(T) (F) 1. When one is using a rocker action spoon for door straightening, be sure to position it so as it will not match the contour of the surface being worked.

(T) (F) 2. Cracks or tears can be welded before the bumping is done.

(T) (F) 3. All bumping and any welding necessary should be done before stretched areas are removed.

(T) (F) 4. In checking your progress with the pick tools, use the body file.

MULTIPLE CHOICE

1. After all the low spots have been eliminated, disk sand the panel with a No._____closed coat disk. (25) (34) (60) (50)

2. The proper tool is the _____tool. (wrong) (expensive) (safe)

3. If a door panel is found to be_____after the bumping operations, it will be necessary to shrink the portion before the metal finishing can be done. (Long) (wide) (stretched) (round)

4. After the door is bumped out and ready for the metal finishing operations, any necessary _____should be done. (Soldering) (welding) (Patching) (Grinding)

5. The best method of straightening a damaged door is by using a _____. (Hammer) (Power grinder) (Power saw) (Holding unit)

JOB 26 - TEST

ALIGNING AND ADJUSTING DOORS

TRUE AND FALSE

(T) (F) 1. Door alignment is not a necessary part of collision work.

(T) (F) 2. Sometimes you will encounter jobs where the trouble appears to be misalignment of the door, when actually the door itself is not the cause of the fault.

(T) (F) 3. In all cases, replace the striker plate.

(T) (F) 4. A dovetail adjustment is necessary only when you wish to move the lock side of the door up or down slightly.

(T) (F) 5. In cases where a door is severely damaged and a good deal of straightening is necessary, it is a good policy to check the door before any attempt is made to reinstall and align the door with body.

MULTIPLE CHOICE

1. Door_____is a separate trade in many of the automobile factories. (Repair) (Painting) (Alignment) (Finishing)

2. How many types of door-bar units are available? (1) (8) (6) (2)

3. Any collision involving the windshield pillar will, in all likelihood, damage the_____. (top) (side) (fender) (Door)

4. When a condition of door sag is encountered on cars without adjustable_____, it is usually necessary to spread the leaves of the lower hinge. (Screws) (Bolts) (Rods) (Hinges)

5. In all cases when a _____plate needs adjustment, check to see if it is worn to the extent it needs replacing. (Striker) (Door) (Hinge) (Side)

JOB 27 - TEST

APPLYING FIBER GLASS AND PLASTIC FILLER

TRUE AND FALSE

(T) (F) 1. One very acceptable, low cost method of repair is to use a plastic body filler.

(T) (F) 2. Lead cannot be used as a body filler.

(T) (F) 3. A wooden paddle should be used to smooth out the lead.

(T) (F) 4. Several advantages can be claimed for a plastic material with very few disadvantages.

(T) (F) 5. The material must be mixed on a clean surface.

MULTIPLE CHOICE

1. The _____ is used to spread the material over the surface. (knife) (spoon) (Wooden Paddle) (Piece of glass)

2. The surface preparation for the use of plastic fillers is similar to that for _____. (Solder) (Lead) (Welding) (Putty)

3. One of the desirable tools for large areas is the_____. (Grater type plan) (Sandpaper file) (Rubber sanding block) (Wooden paddle)

4. If the material is allowed to set up hard, it will be necessary to use a _____and_____. (File and disk sander) (Grater type plane) (Sandpaper and file)

JOB 28 - TEST

FILLING WITH BODY SOLDER

TRUE AND FALSE

(T) (F) 1. The clean, bright metal surface left by the disc sander is ideal for solder application.

(T) (F) 2. It is always best to clean the metal by chemical means for soldering.

(T) (F) 3. The beginner should learn to judge the temperature of the solder by its appearance.

(T) (F) 4. The grain structure of solder will become thin if it is kept heated for any length of time.

(T) (F) 5. The best results will be obtained if filling is started by blending the edges of the soldered area into the surrounding metal surface.

MULTIPLE CHOICE

1. _____may be used on any place where it alone will restore the proper surface level. (Solder) (Filling) (Metal) (Plastic)

2. There are_____basic steps in applying body solder. (10) (12) (7) (4)

3. _____is the operation of coating with melted solder, the surface to be soldered. (Filling) (Sanding) (Tinning) (Cleaning)

4. _____of some sort is essential for soldering on almost all metals. (Filling) (Shaping) (Flux) (Sanding)

5. If the disk sander must be used on solder, the operator should have a _____. (Glove) (Respirator) (Helmet)

JOB 29 - TEST

REPAIRING AND SERVICING THE HOOD

TRUE AND FALSE

(T) (F) 1. The hood of an automobile or truck is substantially anchored when it is closed.

(T) (F) 2. Generally, when damage occurs to the hood, you will find that the hood flange will not crack.

(T) (F) 3. When the gap between the hood and the fender is too wide at one side but is normal at the other, the hood opening is too large.

(T) (F) 4. Hood alignment is easily and quickly checked in most instances by visual examination.

(T) (F) 5. To move the hood forward, loosen the bolts, fastening each hinge to the fender.

MULTIPLE CHOICE

1. What type of mallet is used while hammering on a hood_____.
(Steel) (Bronz) (Iron) (Wooden)

2. The hood itself rests on small blocks of hard rubber or on a lubricant impregnated fabric sometimes known as_____.
(Nosqueak) (Antisqueak) (Rubber bumpers) (Hinges)

3. Automobile hoods, when latched in position, are generally held in place at the rear with spring-loaded_____. (Bolts) (Nuts) (Rods) (Hinges)

4. The _____hinges on most cars are constructed so that they can be adjusted to move the hood forward, rearward, or to move either rear corners in or out or up or down. (Bumper) (Fender) (Door) (Hood)

5. The contour of the hood must match the contour of the_____ exactly, that is, the two surfaces should be exactly flush with each other at all points. (Sides) (Cowl) (Front) (Back)

JOB 30 - TEST

ALIGNING HOODS

TRUE AND FALSE

(T) (F) 1. On the sides of the hood a uniform gap should exist for the full length of the hood on each side.

(T) (F) 2. When a condition of misalignment exists that affects the hood opening, it will not be necessary to shift either the fenders or the front end sheet metal.

(T) (F) 3. Proper deck lid alignment should be maintained at all times.

(T) (F) 4. Whenever a deck lid is repaired because of damage, close attention should not be given to proper alignment.

(T) (F) 5. If the deck lid does not follow the contour of the roof panel but works freely, the roof panel is out of alignment.

MULTIPLE CHOICE

1. The hood itself rests on small blocks of hard rubber or on a lubricant impregnated fabric sometimes known as_____. (Silhouette) (antisqueak) (no squeak) (contour)

2. If the misalignment is along the extension panel above or forward of the tail light openings, it can usually be corrected by the use of a _____only. (Hammer) (Rubber mallet) (Door bar unit)

3. If the deck lid does not fit properly along the lower back panel, place a piece of_____between the deck lid and lower back panel. (metal) (wood) (paper) (rubber)

4. Automobile hoods, when latched in position, are generally held in place at the rear with _____loaded hinges. (metal) (Rubber) (spring) (wood)

5. When the hood sets too high all across the rear, a _____ adjustment is necessary. (Front) (rear) (middle) (hinge)

JOB 31 - TEST

FILING AND SANDING

TRUE AND FALSE

(T) (F) 1. To use the body file properly requires a thorough understanding of the purpose of filing.

(T) (F) 2. The direction of the file stroke is not important because of the difference in lengthwise and crosswise crowns which are found in almost all panels.

(T) (F) 3. You should never use glasses while running the disc sander.

(T) (F) 4. It is difficult to use a round sanding disc in a sharp reverse crown because the edge cuts a sharp grove in the surface.

(T) (F) 5. The file should be stroked in the general direction of the flattest crown of the panel.

MULTIPLE CHOICE

1. Resin bonded discs are made only in _____coat. (one) (ten) (fifty) (one hundred)

2. Most disc sanders require a _____ inch center hole. (1½) (2) (7/8) (1/3)

3. Most of the time a body file is_____long. (1½ ft.) (1 ft.) (6 inches) (14 inches)

4. The outer edge of a 9 inch disc driven by a high speed sander will travel at speeds faster than_____miles per minute. (10) (5) (1½) (3)

5. The operator should never use a _____disc without full protection for his face and eyes. (star-shaped) (round) (square) (oblong)

JOB 32 - TEST

UNDERSTANDING FUNDAMENTALS OF FRAME AND BODY LAYOUT

TRUE AND FALSE

(T) (F) 1. The use and purpose of the datum line often is considered to be more difficult to understand than the use of the centerline.

(T) (F) 2. The repairman always makes a direct measurement to the centerline.

(T) (F) 3. Diagonal measurements are made frequently when minor damage is suspected.

(T) (F) 4. The use of the center line probably comes from the method of making mechanical drawings.

(T) (F) 5. The original layout of any automobile is made from four bases.

MULTIPLE CHOICE

1. The original layout of any automobile is made from _____ bases. (1) (4) (6) (2)

2. The points on the frame from which the dimensions are taken are called _____points. (Rear) (Center) (Reference) (Front)

3. The repairman does not need a _____plate to measure datum line. (Tin) (Metal) (Surface) (Steel)

4. A _____will be found running lengthwise through the bottom view. (Reference) (Line) (Centerline) (Straight)

5. The repairman rarely makes a _____measurement to the centerline. (Cross) (Long) (Direct) (Square)

JOB 33 - TEST

STRAIGHTENING FRAME DAMAGE

TRUE AND FALSE

(T) (F) 1. Straightening of a frame is best accomplished on a frame straightener.

(T) (F) 2. If the frame is not deemed strong enough after the straightening is completed, it should not be reinforced.

(T) (F) 3. It will be necessary to push the damaged portion beyond its normal position to overcome any spring-back which might occur.

(T) (F) 4. A diamond-shaped frame comes as the result of a side impact.

(T) (F) 5. Reinforcements can be made from any stock thickness which may seem desirable-depending on the use for which the vehicle is intended.

MULTIPLE CHOICE

1. Frame side rails and cross members are usually formed from low-carbon_____(Iron) (Solder) (Steel) (Pig Iron)

2. The _____should be applied directly on the damaged portion which you want to bend or reshape. (Metal) (Wrench) (Ram) (Heat)

3. Start to heat the buckled portion or damaged area near the _____. (Middle) (End) (Top) (Edge)

4. An_____beam, chains, and blocks can be used not only to hold the frame down, but can be used to hold the frame when straightening it in a horizontal plane as well. (A) (B) (C) (I)

5. A_____shaped frame comes as the result of a lower impact, sufficient to push the cross members out of right angles to the side rails. (Upward) (Downward) (Twisted) (Diamond)

JOB 34 - TEST

CHECKING FRAME ALIGNMENT

TRUE AND FALSE

(T) (F) 1. Frame alignment can be checked with a steel tape and a frame gauge.

(T) (F) 2. "Self-Centering" gauges are not used to check frame alignment.

(T) (F) 3. The floor is used as a reference point and is known as the "datum line".

(T) (F) 4. The principles remain the same in checking bodies and frame alignment, regardless of the kind of equipment used.

(T) (F) 5. There is a Combination Body-Frame Correction Service.

MULTIPLE CHOICE

1. In most cars, the _____section of the frame is designed so that it will be level when the car is under the anticipated normal load. (side) (back) (front) (center)

2. After the alignment of the center section has been checked, the alignment of the _____section can be checked. (front) (back) (center) (side)

3. Always measure from like points at both sides of the_____. (fender) (top) (doors) (frame)

4. The_____section of the frame is considered as that portion of the frame from the center section to the rear. (front) (middle) (rear) (side)

5. Measurements can also be made from any point along the frame to the_____. (hood) (top) (wheels) (floor)

JOB 35 - TEST

INSTALLING AND SERVICING DOOR GLASS

TRUE AND FALSE

(T) (F) 1. Installation of the glass begins with inserting the glass in the weather strip.

(T) (F) 2. Most windshields and rear windows are held in place by a metal weather strip.

(T) (F) 3. The windshield and rear window glass are quite similar in construction.

(T) (F) 4. Mark bonding surfaces with crayon.

(T) (F) 5. The quarter window is the window in the rear quarter side upper panel.

MULTIPLE CHOICE

1. _____often cracks for no apparent reason. (Metal) (Glass) (Solder) (Bronze)

2. Most windshields and rear windows are held in place by a_____ strip. (Rubber) (Steel) (Metal) (Rod)

3. If it is necessary to replace half of a_____piece windshield only the broken half will have to be removed. (1) (2) (4) (6)

4. _____glass is fastened along the bottom only in a channel which is connected to the window regulator assembly. (Front) (Back) (Side) (Door)

5. In some cars, the _____window is an integral part of the window reveal or garnish molding. (Front) (Back) (Side) (Vent)

JOB 36 - TEST

REMOVING AND INSTALLING WINDSHIELDS

TRUE AND FALSE

(T) (F) 1. Water test windshield immediately after installation using cold water spray.

(T) (F) 2. Apply a ¾ inch strip of masking tape across front of instrument panel with the front edge of tape lined up with break line of instrument panel.

(T) (F) 3. Modern windshields are partly held in position by garnish moldings.

(T) (F) 4. Convertibles side reveal moldings are secured by screws.

(T) (F) 5. Do not position by tapping or hammering glass at any time.

MULTIPLE CHOICE

1. Install _____windshield checking blocks. (2) (3) (4) (5)

2. Before installing new glass be sure to check all_____ retaining clips for damage. (Reveal molding) (Garnish molding) (Weather strip) (Channel molding)

3. Apply _____inch wide masking tape to inside of windshield glass. (¾) (3/4) (1) (2)

4. If upper end of clip is bent away from body metal more than _____inches, replace or reform clip. (1/32) (5/8) (¼) (½)

5. Be sure to check windshield_____for leaks. (Molding) (Weatherstrip) (Reveal molding) (Garnish moldings)

JOB 37 - TEST

REPLACING AND ALIGNING ROOFS

TRUE AND FALSE

(T) (F) 1. Usually, the roof is of all steel, two-piece construction.

(T) (F) 2. On some cars, the roof ends above the rear window at the rear.

(T) (F) 3. Most roof panels have stiffeners which are small metal strips.

(T) (F) 4. To remove the roof means breaking the spot welds.

(T) (F) 5. It would be desirable to weld the new roof in place with solder.

MULTIPLE CHOICE

1. The _____panel and roof are joined to one another by welding. (Front) (Rear) (Cowl) (Middle)

2. When the cowl extends above the windshield, as is the case on many truck cabs, a continuous _____is made all along the edge where the two panels join. (Panel) (Weld) (Solder) (Strip)

3. Most roof panels have _____. (Welds) (Joints) (Stiffeners) Seams)

4. The secret of using _____properly to straighten a body is to apply exactly the right amount where it is needed. (Heat) (Welding) (Force) (Jack)

5. All of the parts which make up the _____framework will have to be straightened individually after the general alignment has been restored. (Roof) (Fender) (Hood) (Top)

JOB 38 - TEST

REMOVING AND REPLACING TRIM

TRUE AND FALSE

(T) (F) 1. The grille is usually the largest single unit of trim.

(T) (F) 2. All of the doors on a vehicle have handles with which the latch is operated.

(T) (F) 3. Door trim pads are usually metal and assembled on the door as one unit.

(T) (F) 4. Bumpers may or may not be considered trim.

(T) (F) 5. The deck lid door lock is not an integral part of the handle.

MULTIPLE CHOICE

1. Some_____are strictly decorative, while others are functional. (Wheels) (Moldings) (Hoods) (Fenders)

2. The _____is usually the largest single unit of trim. (bumper) (moldings) (Grille) (Handles)

3. Rear_____are stationary. That is, no provision is made for moving them. (Seats) (Bumpers) (Doors) (Grilles)

4. The _____used around the windshield and rear windows on most are held in place in an entirely different manner. (Metal) (Grille) (Rubber) (Moldings)

JOB 39 - TEST

PREVENTING DUST AND WATER LEAKS

TRUE AND FALSE

(T) (F) 1. Dust or water can enter at any point where two metal panels are joined.

(T) (F) 2. In a car which has a ventilating system, the air is pulled in through all of the minute openings.

(T) (F) 3. When a window ventilator is opened, air is pulled into the body creating a vacuum.

(T) (F) 4. Most automobile manufacturers have been unsuccessful in designing sealing methods which make a car tight against dust or water leaks.

(T) (F) 5. The mastic used on automobile bodies for sealing will remain elastic enough so that it can absorb the flexing between the panels without breaking away from the panels.

MULTIPLE CHOICE

1. When a car is _____the air is forced out through all openings. (Unsealed) (Sealed) (Presurized) (Ventilated)

2. The doors and deck lid are provided with _____to keep out dust and water. (Sealers) (Mastic tape) (Felt) (Weather stripping)

3. Dust leaks most usually occur around the _____. (Underbody) (Hinges) (Cowl panel) (Doors)

4. Fumes from the engine compartment can enter the passenger compartment if not protected through the _____. (Underbody) (Dash board openings) (Vents) (Cowl panel)

5. _____is used between all reveal molding and the body proper. (Sealer) (Weather Stripping) (Felt) (Mastic)

JOB 40 -TEST

SERVICING POWER SEATS, WINDOWS AND TOPS

TRUE AND FALSE

(T) (F) 1. Power operated seats, windows and tops are electrically operated.

(T) (F) 2. On recent model General Motor cars equipped with power tops, the hydraulic-electric unit consists of a 6 volt reversible type motor.

(T) (F) 3. On General Motor cars, after the top is fully lowered, continue to operate the motor and pump assembly for 20 seconds or until noise level of pump is noticeably reduced.

(T) (F) 4. If a Ford power operated top will not operate satisfactorily first check the toggle switch.

(T) (F) 5. Chrysler power operated top units are installed similar to that on the Fords.

MULTIPLE CHOICE

1. The Fords power windows, seats and convertible tops electrical system are all connected through the same_____AMP circuit breaker. (15) (20) (30) (60)

2. Fractional surfaces of the transmission used should be lubricated with _____or some similar lubricant. (Lubrioil) (Pure-o-lube) (Lubriplate) (Motor Oil)

3. To fill the hydraulic-electric reservoir, it will be necessary to drill a _____inch diameter hole through the center of a spare reservoir. (5/8) (1/4) (1/2) (3/4) (3/16)

4. If the power top on the Ford cannot be lowered or raised satisfactorily you should first check the _____(fluid) (Switch) (Battery) (Current)

5. Principles of operation of the power top unit as installed on the Chrysler built vehicles are similar to that used on _____ cars. (General Motors) (Ford) (American Motors) (All Power)

JOB 41 - TEST

REPAIRING SHIELDS AND HOODS

TRUE AND FALSE

(T) (F) 1. The most commonly used hood on later automobile is the two piece type.

(T) (F) 2. A mudguard protects the underside of the fender from being struck by road dirt.

(T) (F) 3. In most late model automobiles, the headlights and sometimes the parking lights are recessed in the front hood.

(T) (F) 4. The purpose of the fender apron is to keep road dirt and mud from entering the engine compartment.

(T) (F) 5. One-piece type hoods are quite small.

MULTIPLE CHOICE

1. Each car is equipped with _____fenders. (1) (2) (4) (6)

2. The purpose of the _____apron is to keep road dirt and mud from entering the engine compartment. (Hood) (fender) (Shields) (Grille)

3. The hood is the panel which covers the _____compartment. (Trunk) (Front) (Rear) (Engine)

4. Most one-piece type hoods, however, are of the _____type. (Steel) (Aligator) (Hinge) (Bolt)

5. Early model cars used a _____hinged type of hood. (Double) (jointed) (fabric) (tin)

JOB 42 - TEST

STRAIGHTENING THE DECK LID

TRUE AND FALSE

(T) (F) 1. The principles involved in straightening the deck lid are much the same as those involved in straightening any door.

(T) (F) 2. Not many kinds of damage occurs to the deck lid, since it is subject to rear collision.

(T) (F) 3. All welding or shrinking that is necessary should be done before the bumping operations are performed.

(T) (F) 4. When all the low spots are removed, the surface can be filed and sanded smooth.

(T) (F) 5. Care should be exercised not to remove too much metal while filing or sanding.

MULTIPLE CHOICE

1. To make the surface ready for the painter, use a grinder with a No._____grit close-coat disk. (25) (50) (75) (100)

2. When the surface has been made as smooth as possible by _____ use the pick tool to raise the low spots. (Welding) (Painting) (Bumping) (Filing)

3. The first operation in straightening the damage can be done with an _____rocket action spoon used in conjunction with a hydraulic jack. (10 inch) (21 inch) (18 inch) (30 inch)

4. When a deck lid is to be straightened, a much more satisfactory job can be done if the deck lid is removed from the car and placed in a _____ device. (Welding) (Holding) (Spring)

5. Remove any low spots revealed by _____. (Welding) (Sanding) (Filing) (Painting)

JOB 43 - TEST

ALIGNING DECK LID

TRUE AND FALSE

(T) (F) 1. When deck lids are repaired or replaced because of damage, close attention should be given to proper alignment.

(T) (F) 2. Proper deck lid alignment exists when the deck lid matches at the bottom.

(T) (F) 3. Bending or twisting operations with the hands or hand tools can't be used in aligning deck lids.

(T) (F) 4. If bending or twisting has to be done, it can always be done with the Door Bar Unit or by the use of power tools.

(T) (F) 5. Never apply excessive pressure against the mallet.

MULTIPLE CHOICE

1. An improperly aligned deck lid will allow _____and _____ to enter the luggage compartment. (Snow and rain) (Water and dust) (Wind and Snow)

2. A simple, but effective, way to make a proper deck lid alignment check is to _____the edge of the body flange which contacts the deck lid weather strip. (Paint) (Chalk) (Weld) (Bend)

3. If the misalignment is along the extension panel, above or forward of the tail light openings, it can usually be corrected by the use of a _____only. (Hammer) (Power jack) (Rubber Mallet) (Door Bar Unit)

4. The same principles apply for using a _____ _____ _____ on a deck lid as for using on a regular door. (Door Bar Unit) (Door Hinge) (Power Jack) (Rubber Mallet)

JOB 24 - TEST

DETERMINING WHEN TO REPAIR AND WHEN TO REPLACE PARTS

TRUE AND FALSE

(T) (F) 1. In most cases, the cost of the part as compared to the cost of the repair will be the determining factor as to which course you will follow.

(T) (F) 2. If you are working for a new or used car dealer, you will find that you will have no problem of restoring used cars to a salable condition.

(T) (F) 3. In considering the question of repair versus replacement, don't be misled into believing that the replacement of a part is more quickly effected than the repair of the part. This in many cases is not true.

(T) (F) 4. Time is not a factor in repairing collision jobs.

(T) (F) 5. Often you will be working on fenders which have had innumberable previous repairs.

MULTIPLE CHOICE

1. Where an _____company pays the damage or where an uninsured owner of a new car or nearly new car requires correction of collision damage, the quality of your work must be such that when you have finished there is no indication of the damage having occured. (Used car) (New car) (Insurance) (Finance)

2. _____, of course, is always a factor in repairing collision jobs. (cost) (time) (quality) (judgement)

3. The _____condition refers not only to appearance, but to function as well. (Collision) (Like new) (Old) (New)

4. The following parts and materials are almost always replaced rather than repaired_____parts. (Fender) (Hood) (Top) (Bright metal)

5. In arriving at a conclusion as to whether a particular part should be replaced or repaired, don't lose sight of _____ time. (Welding) (Installation) (Paint) (Parts)

JOB 45 - TEST

USING REINFORCEMENTS IN BODY WORK

TRUE AND FALSE

(T) (F) 1. Maximum strength can be obtained by adding the fourth side to the three-sided channel, making what is commonly termed a box construction.

(T) (F) 2. The reinforcing effect is greatest when the flange is turned facing the load.

(T) (F) 3. Box construction is limited to the square shape.

(T) (F) 4. Most of the strain on a frame is vertical.

(T) (F) 5. Reinforcements can be made from any stock thickness which may seem desirable, depending on the use for which the vehicle is intended.

MULTIPLE CHOICE

1. Reinforcements can be made from _____iron. (Steel) (Sheet metal) (Angle) (Tin)

2. The type of _____used depends on whether or not it can be installed without interfering with other members of the frame or working parts of the chassis. (Weld) (Solder) (Reinforcement) (iron)

3. Maximum strength can be obtained by adding the fourth side to the three-sided channel, making what is commonly termed a_____ construction. (Box) (Frame) (Channel) (Flange)

4. Reinforcements are of_____basic types. (1) (2) (5) (10)

5. The reinforcing effect is greatest when the _____is turned away from the load. (Box) (Flange) (Weld) (Square)

JOB 46 - TEST

MAKING LOW COST SHORT DURATION REPAIRS

TRUE AND FALSE

(T) (F) 1. Low cost, fiber glass panels are available for most cars.

(T) (F) 2. Another very acceptable and low cost method of repair is to use a plastic body filler.

(T) (F) 3. Do not tin the areas that are to be leaded.

(T) (F) 4. The installation of the replacement panel is a difficult job.

(T) (F) 5. Replacement panels can be secured at local auto parts, outlets, or hot rod shops.

MULTIPLE CHOICE

1. Low cost fiber glass_____are available for most cars. (Fenders) (Hoods) (Tops) (Panels)

2. A very acceptable and low cost method of repair is to use a _____body filler. (Plastic) (Lead) (Solder) (Tin)

3. When a _____area is reinforced, it should be done in the same way with the fabric extending at least two inches onto firm metal. (Bent) (Broken) (Rusty) (Sprung)

4. When a hole or tear in the metal is mended, it should be backed up with a _____screen or cloth. (Fiber glass) (Plastic) (Metal) (Tin)

5. When applying the _____, use a wide flame to melt the bar. (Solder) (Fiber glass) (Lead) (Plastic)

JOB 47 - TEST

MASKING

TRUE AND FALSE

(T) (F) 1. Good masking paper should have a slight amount of stretch.

(T) (F) 2. Some tape adhesives should remain on the surface after the tape is removed.

(T) (F) 3. Masking paper dispensers will despense both paper and tape.

(T) (F) 4. Masking tape should be stored in a cool place.

(T) (F) 5. The upper part of the rear glass should be masked first.

MULTIPLE CHOICE

1. When masking chrome trim, select a tape of sufficient_____ to cover the parts. (Weight) (Depth) (Width)

2. The _____method can be used to good advantage on wheels. (Pleating) (Apron) (Sleeve) (Spiral)

3. When masking a panel for a two-tone paint job, select paper which is slightly _____than the panel. (Higher) (narrower) (Wider) (Smaller)

4. The number of sheets of masking paper used on the windshield depends on the height of the windshield and the _____ of the paper. (Width) (Gauge) (Length) (Weight)

5. When a small ornamental light is being masked, the _____of the light is first covered with tape. (Inside) (Outside) (Case) (Top)

JOB 48 - TEST

GRINDING AND SANDING

TRUE AND FALSE

(T) (F) 1. Always wear goggles while grinding or sanding to protect your eyes from flying particles of metal and from the small abrasive particles.

(T) (F) 2. The only function of a No. 50 close-coat disk is for performing rough operations on metal surfaces.

(T) (F) 3. To permit grinding concave surfaces, many metal finishers use two 9 inch grinding disks with 7 inch backing plates.

(T) (F) 4. There are 10 different minerals commonly used for manufacturing abrasives.

(T) (F) 5. When operating the grinder, hold it as flat as possible without permitting the center connecting bolt to come in contact with the surface being ground.

MULTIPLE CHOICE

1. The No. _____grit close-coat disk is used for several purposes in the body shop. (50) (24) (1613) (80)

2. The only function of a No. _____close-coat disk is for performing finish operations on metal surfaces. (50) (24) (1613) (80)

3. Generally, only _____different disks will be used in body work. (3) (5) (10) (7)

4. _____basic types of grinders are in common use. (2) (4) (3) (5)

5. _____, a semiprecious jewel, is by far the most important of natural minerals. (Garnet) (Flint) (Emery) (Silicon Carbide)

JOB 49 - TEST

REMOVING OLD PAINT

TRUE AND FALSE

(T) (F) 1. Burning off paint with the blow torch is one of the oldest methods of removing old paint.

(T) (F) 2. There is no risk in burning old paint with the use of the blow torch.

(T) (F) 3. Solvent removers come either in paste or a liquid form.

(T) (F) 4. Alkali or caustic strippers are the most dangerous to use.

(T) (F) 5. For a complete refinishing job, the old finish can be painted over.

MULTIPLE CHOICE

1. For a complete_____job, the old finish must be entirely removed. (Refinish) (Stripping) (Finishing)

2. Solvent removers come in _____or _____form. (Powder or paste) (Liquid or paste) (Lump or wax)

3. A favorite _____material of the old-time finisher was a hot solution of lye or caustic soda. (Lacquer) (Solvent) (Stripping) (Soldering)

4. When using phenolic or emulsion type strippers, _____and _____must be worn. (Goggles and rubber gloves) (Hat and gloves) (Mask and Gloves) (Gloves and Boots)

5. The present day use of _____materials, both baked and air-dry, make the refinishing job a more or less complicated affair. (Synthetic) (Stripping) (Caustic) (Alkali)

JOB 71 - TEST

OPERATING THE AIR COMPRESSOR

TRUE AND FALSE

(T) (F) 1. The very best of air compressors will pick up moisture from the atmosphere.

(T) (F) 2. The air transformer and oil extractor should be as far from the spray gun as possible.

(T) (F) 3. The air transformer should be no closer to the compressor than 25 feet.

(T) (F) 4. The air chamber also serves as an oil and water extractor.

(T) (F) 5. Some compressors and storage tank units have automatic drains.

MULTIPLE CHOICE

1. The fluid hole sizes generally used are the _____inch and _____ inch. (1/8 and 3/8) (3/8 and 1/2) (1/2 and 3/4) (3/4 and 1)

2. With small guns and light bodied material, a _____hose may be satisfactory. (5/32) (5/16) (5/8) (3/16)

3. For heavy bodied materials, a _____inch or even a _____inch inside diameter might be required. (5/8 or 3/4) (3/4 or 1) 1 or 1 1/2) (1 1/2 or 1 3/4)

4. When air pressure in a tank drops below a certain predetermined point, the _____mechanism again operates to admit air into the compressor. (Unloader) (Cut outs) (Automatic) (Transformer)

5. _____will at times find its way into the air lines, but the presence is not as prevalent as water. (Gas) (Oil) (Dust) (Dirt)

JOB 52 - TEST

MAKING SPOT REPAIRS

TRUE AND FALSE

(T) (F) 1. In making spot repairs, always use the original color.

(T) (F) 2. Whether the original finish was lacquer or synthetic enamel, the spot repair is always made with synthetic.

(T) (F) 3. The entire fender or panel involved is first compounded to restore the original color.

(T) (F) 4. It is practical to try to tint or blend colors so that they match the aged paint on the balance of the fender or panel.

(T) (F) 5. Spot repairs can be made on either lacquer or synthetic.

MULTIPLE CHOICE

1. In case the original color was synthetic enamel, use the same color in _____.(Synthetic) (Enamel) (Lacquer) (Gloss)

2. _____tends to lighten colors and reduce gloss. (Rain) (Snow) (Weathering) (Sanding)

3. The _____paint must be removed from the entire fender or panel. (Synthetic) (Lacquer) (Oxidized) (Enamel)

4. If the paint has worn through to bare metal, primer-surfacer must be applied and _____smooth. (Sprayed) (Washed) (Sanded) (Welded)

5. After the spot repair has dried, _____the entire fender. (Wet) (Polish) (Compound) (Sand)

JOB 53 - TEST

OPERATING THE SPRAYING EQUIPMENT

TRUE AND FALSE

(T) (F) 1. In any shop which does a large amount of paint work, remote-cup gun installation should be considered because of the advantages of controlled-pressure spraying.

(T) (F) 2. All bare metal need not be covered with either a coat of primer or several coats of surfacer.

(T) (F) 3. If your strokes slow down, too much paint will pile in one place and the paint will sag.

(T) (F) 4. If you use synthetic enamel primer-surfacer, allow it to dry two hours.

(T) (F) 5. To avoid excessive line loss, the hose carrying air to your spray gun should have a 5/16 inch diameter passage.

MULTIPLE CHOICE

1. Paint spray guns are provided with a _____adjustment and a pattern adjustment. (Front) (Rear) (Middle) (Material)

2. The pattern adjustment controls the air to the _____holes. (Back) (Front) (horn) (Short)

3. If the color coat is to be put on the same day, use_____ primer surfacer. (Lacquer) (Color) (Enamel) (Synthetic)

4. A change of _____while you are applying paint can cause considerable trouble. (Pressure) (Wind) (Color) (Material)

5. Excessive air pressure wastes thinners when spraying (Lacquer) (Synthetic) (Enamels)_____.

JOB 54 - TEST

USING PROPER TECHNIQUE IN SPRAY PAINTING

TRUE AND FALSE

(T) (F) 1. Always move the entire arm and body with the gun in order to keep the gun straightened on the surface.

(T) (F) 2. The first thing required in spray gun operation is always to spray at right angles to the surface and at the same distance from it.

(T) (F) 3. Proper trigger control is not very essential to insure consistent results.

(T) (F) 4. The air pressure at the nozzle need not be regulated to conform with the amount of material being delivered.

(T) (F) 5. After considerable spraying of some materials, the nozzle is apt to become gummed up.

MULTIPLE CHOICE

1. Usually the most skillful _____painter is the man who has been, or is a first class painter with a brush. (Color) (Brush) (hand) (Spray)

2. _____Spraying, that is not holding the gun at right angles to the surface being sprayed, will cause trouble. (Pivoting) (Oblique) (Hand)

3. To adjust the _____on the paint in the tank, hold the gun at working height, pull the trigger all the way back, and then by means of the material pressure relating valve gradually raise material pressure until the paint flows in a steady stream from the nozzle. (Tank) (Nozzle) (Pressure) (Hose)

4. One of the most important points in spray gun manipulation is to keep the gun perfectly _____.(Oiled) (Clean) (Fixed)

JOB 55 - TEST

PREVENTING SPRAYING DEFECTS

TRUE AND FALSE

(T) (F) 1. Orange peel defect is so called because it resembles the texture of the outside surface of an orange.

(T) (F) 2. When an enamel finish shows pinholes, the cause is usually to be found in the topcoats.

(T) (F) 3. Lacquer and oil are bitter enemies.

(T) (F) 4. Crawling is a fault which often occurs when varnish or enamel is sprayed on clean surfaces.

(T) (F) 5. Piling a heavy coat of lacquer onto poorly repaired cracks often causes blisters.

MULTIPLE CHOICE

1. Make sure that all spraying surfaces are properly filled and that room and material temperatures are kept at about _____ degrees F. (50) (70) (90) (100)

2. _____is usually caused by worn and dried out packing around the needle valve, or dirt on the fluid nozzle. (Wet spots) (Spitting) (Streaks) (Wrinkling)

3. _____at times appears on a surface, especially after a lacquer coating has been applied. (Bridging) (Discoloration) (Distortion) (Crawling)

4. In every finishing room there should be installed a humidiguide and a thermometer, and readings from them should be taken regularly. Normal humidity should be around_____per cent. (100) (80) (25) (50)

5. All _____should be strained before using to make sure that it is absolutely free from foreign matter. (Peeling) (Material) (Streaks) (Wet spots)

JOB 56 - TEST

USING SYNTHETIC FINISHING MATERIALS

TRUE AND FALSE

(T) (F) 1. In recent years, new types of coatings, the synthetic resin finishes, which are made on the base of the alkyd type resins, have been produced.

(T) (F) 2. As a rule oven dried finishes are more water proof than air dried finishes.

(T) (F) 3. One of the difficulties encountered in the application of synthetic finishing materials is orange peel effect.

(T) (F) 4. The right thinner for use with synthetic finishing materials is very important. Mineral spirits should be used.

MULTIPLE CHOICE

1. _____is a by product of the coke oven. (Synthetics) (Phenol) (Thinners) (Resins)

2. _____is commonly obtained by partial oxidation of methyl alcohol. (Glycerine)(Formaldehyde) (Naphthalene) (Alkyds)

3. There are _____different type resins. (1) (9) (10) (4)

4. _____are very versatile and can be adapted to the particular needs of the user much more easily than laquers. (oil paints) (Varnishes) (Enamels) (Synthetics)

5. _____are reducers for synthetics. (Oil paints) (Thinners) (Enamels) (Varnishes)

JOB 57 - TEST

REFINISHING WITH LACQUER

TRUE AND FALSE

(T) (F) 1. In a general way, all those finishing products which use nitro-cellulose as a base are classified as lacquers.

(T) (F) 2. The plasticizers, or softeners, have no function in lacquers.

(T) (F) 3. The base of most lacquers is nitrocellulose.

(T) (F) 4. Thinners are low in cost as compared with the solvents used in formulating the lacquer.

(T) (F) 5. Lacquer sealers are not ideal undercoats for all types of finishes on wood.

MULTIPLE CHOICE

1. Physically, solvents are divided into how many boilers? (1) (8) (10) (3)

2. _____is considered by many to be the most satisfactory of all lacquer dilvents and is used in large quantities in most commercial thinners. (Benzine) (Xylene) (Tolvene) (Plasticizers)

3. To give covering qualities and color to a lacquer _____in white, black and various colors are added. (Benzine) (Xylene) (Pigments) (Tolvene)

4. The_____point of solvents plays a very important part in the technology of lacquers. (High) (Low) (Boiling) (Botyl)

5. Ethyl acetate may be classed as a low boiling solvent because it distills at _____degrees. (98) (76) (77) (55)

JOB 60 - TEST

REFINISHING METAL

TRUE AND FALSE

(T) (F) 1. The major refinishing materials fall into two broad groupings.

(T) (F) 2. Masking tape is not waterproof.

(T) (F) 3. The purpose of sanding is to obtain a smooth surface that will provide teeth for the new paint.

(T) (F) 4. The first coat material is called the primer. It functions as an adherent to bare metal.

(T) (F) 5. If you encounter deep pits that do not go down to bare metal, it is necessary to sand them out.

MULTIPLE CHOICE

1. To repaint all of the fender, all of the old paint should be wet-sanded with No._____grit waterproof paper. (100) (320) (200) (250)

2. When all of the surface to be repainted, including any putty-glazed spots, has been sanded, the entire surface must be_____. (Painted) (Washed) (Sanded) (Cleaned)

3. A spray gun uses approximately _____cubic feet of air per minute. (25) (40) (9) (10)

4. When the lacquer color coat is thoroughly dry, all traces of orange peel or any slight imperfections can be removed with No. _____grit wet or dry sandpaper and water. (100) (200) (400) (600)

5. The wider the masking tape, the harder it is to apply on a curve. You can usually save considerable time by masking around curves with _____inch tape first. (1/4) (2 1/2) (3 1/2) (4)

JOB 62 - TEST

ESTIMATING THE COST OF BODY WORK

TRUE AND FALSE

(T) (F) 1. Most collision shops consider insurance companies as valuable customers to whom they are willing to give a discount or parts.

(T) (F) 2. The cost of labor that you indicate on your estimate is based on the retail labor rate that has been established for your shop.

(T) (F) 3. The actual cost of labor is the amount of money paid to the insurance company.

(T) (F) 4. The amount of hardware and trim which you must remove are not important considerations.

(T) (F) 5. Regardless of whether you are figuring your estimates on a flat rate or on a time and material basis, the automobile body and frame must be considered by sections in order to locate and determine the extent of the damage.

MULTIPLE CHOICE

1. Most collision jobs are paid for by a/an_____ .
Individual) (Insurance Company) (Motor Company)

2. Insurance Companies generally require at least _____ estimates. (1) (2) (6) (10)

3. In some sections a working agreement between labor and management calls for the collision man to receive _____ per cent of the retail charge. (25) (50) (75) (85)

4. The actual cost of labor is the amount paid to the_____man.
(Insurance) (Collision) (Mechanic) (Dealer)

5. It is an easy matter to establish a _____labor rate for any community. (medium) (Retail) (High) (Low)

JOB 63 - TEST

REPAIRING FIBER GLASS BODIES

TRUE AND FALSE

(T) (F) 1. A fiber glass body has high resistance to impact.

(T) (F) 2. Fiber glass panels are not available for replacement.

(T) (F) 3. Polyester resin does not stick to metal satisfactorily.

(T) (F) 4. Do not leave mixed resin and catalyzed material for extended lengths of time in the shop.

(T) (F) 5. When grinding or polishing the resin repair areas, it is advisable to use an orbital sander.

MULTIPLE CHOICE

1. If the putty-like filler hardens too quickly, use less_____.
(Fiber glass) (Catalyst) (Wax) (Resin)

2. Scuff the area around the hole with coarse No. _____grit paper to make a good bonding surface. (80) (100) (120) (160)

3. The resin is activated by the addition of a _____in proper proportion. (Catalyst) (Fiber glass) (Polyester) (Putty-filler)

4. Never return mixed filler or_____to the stock can.
(Catalyst) (Resin) (Putty) (Wax)

JOB 64 - TEST

CUSTOMIZING AUTO BODIES

TRUE AND FALSE

(T) (F) 1. The purpose of the wire mesh is to provide a form for the resin.

(T) (F) 2. The method of building a complete auto body is to first build a form of wire mesh.

(T) (F) 3. When sealing plaster of paris, you spray it with lacquer.

(T) (F) 4. The fiber glass cloth method of making repairs can be used extensively when repairing auto bodies.

(T) (F) 5. Doors can be fabricated by making wooden frames and covering them with wire mesh.

MULTIPLE CHOICE

1. When sanding the plaster of paris, be sure to wear a _____
(Resuscitator) (Respirator) (Mask) (Projector)

2. The location of the _____behind the engine is very important.
(Dashboard) (Fire wall) (Steering wheel) (Floor pan)

3. Instead of wire mesh, some body men use _____to form body.
(Steel) (Resin) (Plaster of paris) (Cardboard)

4. The _____mold is used as the master mold. (Female)
(male) (best) (left)

5. Customizing or altering the lines of automobile bodies can be easily accomplished by using _____and fiber glass.
(Wire mesh) (Plaster paris) (epoxy resin)

JOB 65 - TEST

SERVICING DOOR HARDWARE

TRUE AND FALSE

(T) (F) 1. To remove the front door ventilator regulator on Fisher bodies, first lower the window.

(T) (F) 2. When removing the vent window regulator of a Ford, it is necessary to remove the arm rest.

(T) (F) 3. A plier type tool is usually employed when removing the door inside handles on Ford cars.

(T) (F) 4. The door lock cylinder on Chrysler built bodies is removed by first removing the inside handles, trim panel and water shield.

(T) (F) 5. Locks on recent model Fisher bodies are of the rotary bolt type.

MULTIPLE CHOICE

1. When replacing vent window regulator on a Ford the regulator shaft is at a _____degree angle to the handle shaft. (60) (80) (90) (75)

2. Installing the inside door handle on a Ford, the procedure is to press the trim panel inward to engage the _____. (Allen wrench) (Retainer Clip) (Spring) (Clamp)

3. The Fisher rear door lock assembly is of the _____type with safety interlock feature. (Rotary bolt) (Channel) (Lock cylinder) (T shaft)

4. The lock cylinder on Chrysler built bodies are held in place by a _____retainer. (Paddle handle) (Spring) (Pen) (U-shaped)

5. The door _____plate is considered door hardware along with window regulators, control handles, and door locks. (Striker) (Fender) (Bottom) (Top)

JOB 66 - TEST

RECOVERING CONVERTIBLE TOPS

TRUE AND FALSE

(T) (F) 1. In most cases it will be advantageous to replace the back curtain when replacing the top fabric.

(T) (F) 2. Raise top to gain access to the underside of the front bow.

(T) (F) 3. To install a new top fabric, first remove the roof bows.

MULTIPLE CHOICE

1. _____the molding retainer off of the bow. (Rip) (cut) (pry) (burn)

2. In the case of _____cars, the tops consist of a deck and two side quarters bonded into one piece of material. (General Motors) (Ford) (Chrysler) (American Motors)

3. You must remove the _____that attach the top curtain tacking strips to the body. (Bolts) (Screws) (Trim cement) (zipper)

JOB 68 - TEST

REMOVING AND INSTALLING HEADLINING

TRUE AND FALSE

(T) (F) 1. Listing wires are interchangeable when replacing headlining.

(T) (F) 2. The headlining on recent Fisher bodies are formed to the contour of a roof panel by concealed listing wires.

(T) (F) 3. When removing headlining on Fisher bodies, first place protective coverings over seats and backs.

(T) (F) 4. You should trim the headlining around the back window approximately 1/2 inch below the weatherstrip edge.

(T) (F) 5. On Fisher bodies, the listing wire may be adjusted up or down by placing in appropriate holes in side roof inner rails.

MULTIPLE CHOICE

1. To eliminate gathering of the material, cut the headlining at the _____retainers. (Front) (Top) (Bow) (Bottom)

2. Pull the headlining down at the _____to remove wrinkles. (Sides) (Windshield) (Rear) (back)

3. _____cuts are in the material to indicate the center. (Square) (Round) (Cross) (V-shaped)

4. Use a dull putty knife to tuck the first and second seam between the _____and retainers. (Roof side rail) (seam) (bow tension spring) (Windshield)

5. On Chrysler headlining replacements, each bow is held in place by an attaching _____pressed into each roof rail. (Ring) (Loop) (Nut) (spring)

JOB 69 - TEST

ALIGNING WHEELS

TRUE AND FALSE

(T) (F) 1. Correct alignment calls for the use of reliable, accurate equipment.

(T) (F) 2. Positive caster is the amount the steering axis is tilted toward the front of the car.

(T) (F) 3. Camber is the key to good steering control.

(T) (F) 4. Negative caster is the angular amount the steering axis is tilted at the top toward the rear of the car.

(T) (F) 5. Toe-in is the amount in inches that the front wheels are pigeon-toed.

MULTIPLE CHOICE

1. The small amount of _____serves to keep the front wheels running parallel by offsetting the forces that tend to spread apart. (Positive caster) (Negative caster) (Toe-in) (Camber)

2. _____is the outward tilt of the wheel at the top. (Caster) (Camber) (Toe-in) (Pigeon-toed)

3. _____is the steering angle that utilizes the weight and momentum of the vehicle.

4. _____caster is the amount the steering axis is tilted toward the front of the car. (Toe-in) (Camber) (Positive) (Negative)

5. On some cars, the adjustments are made by means of _____ on the connecting rods. (Spindle) (Sleeves) (Brackets) (Tie-rod-ends)

JOB 70 - TEST

MAINTAINING THE AUTO BODY

TRUE AND FALSE

(T) (F) 1. There are three principal methods used to locate water and dust leaks.

(T) (F) 2. Most rattles are caused by loose bolts or screws.

(T) (F) 3. One of the least causes of rusted auto panels is parking outdoors.

(T) (F) 4. When using volatile cleaners, it is generally advisable to do the work indoors.

(T) (F) 5. The bright metal parts of a car made of stainless steel require no special care.

MULTIPLE CHOICE

1. There are _____general types of material used to upholster the seats in automobile bodies. (Three) (Four) (Five) (Six)

2. Do not use hot water or soap on _____stains. This will set the stain and make it difficult to remove. (Candy) (Fruit) (Blood) (Nausea)

3. Most all _____stains can be removed with hot water. (Blood) (Oil) (Fruit) (Tar)

4. There are _____basic types of cleaners commonly used for removing spots and stains from auto-upholstery materials. (2) (3) (4) (5)

5. Use a _____cleaner to remove dust and dirt from the upholstery or floor covering. (Strong) (Mild) (Ammonia) (Vacuum)

JOB 71 - TEST

SAFETY IN THE AUTO BODY SHOP

TRUE AND FALSE

(T) (F) 1. No smoking signs should be prominently displayed around the shop.

(T) (F) 2. It is always advisable to stand in the plane of rotating parts.

(T) (F) 3. Paints and thinners should always be kept in closed containers.

(T) (F) 4. There can be no practical jokes or horseplay around the body shop.

(T) (F) 5. Painting should always be done in a spray booth.

MULTIPLE CHOICE

1. All body shops should be provided with an ample number of _____. (Fire extinguishers) (Air compressors) (oxy-acetylene) (Smoking signs)

2. Compressed air is an important_____in every shop. (Tool) (Machine) (Danger)

3. _____should not be used without protective handles. (Files) (Hammers) (Pliers) (Drills)

4. Safety is _____responsibility. (Employee's) (Employer's) (Everyone's) (Shop foreman's)

5. Never allow oil or grease to contact _____under pressure. (Acetylene) (Oxygen) (Compressor)

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Courson, R.L.
Nitrates in Water Supplies, Field Crops, and Ruminant Nutrition.

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IDENTIFIERS - *NITRATES

ABSTRACT - This individually-authored student text and reference is for use in high school or adult vocational agriculture classes studying production agriculture. Contents cover seven problem areas, including: (1) amount of nitrate being lost in water, (2) nitrate accumulation in plants, (3) reduction of the danger of nitrates, (4) nitrates in water supplies, (5) safety of well water, (6) protection of water supplies, and (7) nitrate consumption by ruminants. The material should be covered in 1 to 3 class hours. (AW)

VT 010 726

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NITRATES IN WATER SUPPLIES, FIELD CROPS, AND RUMINANT NUTRITION

1. How Much Nitrate Is Being Lost in Water?
2. How Do Plants Take in Nitrates?
3. How Can I Reduce the Danger of Nitrates?
4. How Do Nitrates Get Into Water Supplies?
5. How Safe Is Well Water?
6. How Can I Protect My Water Supply?
7. What Happens to Nitrates Consumed by Ruminants?

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The quality of our environment is of concern to both the urban and rural populations. In certain situations, the environment has become unfit for plant and animal life because of man's influence. In many others, the environment has been greatly improved by man. In some instances, man's activities have improved one aspect of the environment while impairing another. For example, fertilizer is used to improve the soil as a growth medium for crop plants, but any that is not used by plants may be leached from the soil and adversely affect water quality.

There are many sources of pollutants in our environment but they can be broadly classified as industrial and agricultural. Industrial pollutants include those from such places as factories, sewage-disposal plants, and homes. Agricultural pollutants include some things such as soil sediments, pesticides and insecticides, herbicides, and fertilizer nutrients. The amount of pollutants coming from a factory would be relatively easy to measure. The amount coming from agriculture is generally difficult to measure since the source includes the entire agricultural landscape instead of just one point of entry or source.

VT010729

With increased use of fertilizer there is some concern in the amount of fertilizer nutrients that may get into streams, lakes, wells, and underground reservoirs. There are mainly two reasons for concern: first, the effect of the nutrients on water quality; second, the efficient use of fertilizer by crop plants. If fertilizer nutrients leach and find their way into rivers and other bodies of water, then, it is obvious that those nutrients are "lost" from the standpoint of being available for uptake by crop plants. The efficiency of such "lost" nutrients would be zero.

Fertilizer nutrients differ in their susceptibility to leaching. For example, phosphorus generally does not leach much in fine-textured soils, because it reacts with the clay and because it forms compounds that are not very soluble in water. However, nitrogen in the nitrate form may leach readily, because nitrate is not attracted to clay and because nitrate compounds are very soluble in water.

Nitrates can affect human health and this hazard is usually associated with nitrates in the water supply. The U. S. Public Health Service has recognized the hazards of nitrates by assigning a maximum limit of 45 milligrams per liter (as NO_3) as the standard for drinking water supplies. Nitrates are especially a hazard to babies. Infants not yet eating solid foods are particularly subject to nitrate cyanosis or methemoglobinemia (the condition that causes blue babies) resulting from nitrates in the water supply. This disease reduces the ability of the blood to absorb oxygen and may be fatal unless properly treated.

Veterinarians and public health officials have been aware of nitrate poisoning for about 100 years. Recently articles in scientific and popular journals have created an unjustified concern for this problem. Actually, there have been few proven cases of nitrate poisoning causing the death of animals or humans.

There will almost always be some nitrate in plants and water supplies, but it is only

under certain conditions that the nitrate level reaches the danger point. Much of the unwarranted concern about the nitrate problem may have arisen from misinterpretation of the results of chemical analyses that show the amount of nitrates in feeds and water supplies. Laboratory tests may interpret nitrate content in terms of potassium nitrate (KNO_3), sodium nitrate ($NaNO_3$), or nitrate (NO_3). The content may be expressed as a percentage or in parts per million (p.p.m.).

Because nitrates are a potential problem for humans and farm animals, this unit discusses how problems can arise in field crops, water supplies, and ruminant nutrition. It provides information that will enable farmers and rural residents to have their animal feeds and water supplies checked for nitrate content. It also discusses measures that can be taken to guard against the unsafe buildup of nitrates in feeds and water supplies.

1. HOW MUCH NITRATE IS BEING LOST IN WATER?

Research was started in 1968 to determine the amount of nitrate nitrogen in tile water. Tile-drainage water from farmers' fields at six locations was sampled from May 28 to July 12. Samples were also taken at one location on the Kaskaskia River. Samples were collected on 14 dates. The average nitrate-N content of water from all tiles and dates was 12.2 parts per million. The average content of nitrate-N for all sampling dates was 9.9 p.p.m. for the river water. However, the nitrate-N content of water from two tiles was less than that of the river water on all sampling dates (Table 1).

Dates in the table show the variation between the two tiles. The nitrate-N content of water from tile No. 6 was at least twice as great as that from tile No. 2. The rate of water flow ranged from 9 to 200 gallons per minute for the two tiles on various dates. The time required for 1 pound of nitrogen to flow from the tile ranged from 51 to 2,466 minutes.

Studies will be conducted on management practices that affect the amount of nitrate-N in drainage water. Practices of interest would include those involving the rate and time of nitrogen application.

Table 1. Nitrogen Content and Water-Flow Rate for Two Drain Tiles Near Urbana, Illinois, 1968 a/

	N in water p.p.m.		Flow rate, gal./min.		Minutes for 1 lb. of N to flow	
Date	No. 2b/	No. 6b/	No. 2	No. 6	No. 2	No. 6
May 31 ...	7.7	17.4	60	110	259	63
June 4 ...	7.0	14.9	50	75	342	107
10 ...	5.6	11.1	25	39	856	277
17 ...	6.5	11.7	138	200	134	51
24 ...	5.9	12.6	33	55	616	173
July 1 ...	6.3	14.7	32	47	594	173
8 ...	5.4	14.2	9	30	2,466	281

a/ Data from: L. F. Welch and A. A. Bomke, Dept. of Agronomy
b/ Drain tile location number

2. HOW DO PLANTS TAKE IN NITRATES?

Nitrates in field crops

Nitrogen is taken into crop roots mainly in the nitrate form. When conditions are favorable for growth, nitrates move up the plant stem and into the leaves where they are built into proteins. Under normal growing

conditions, the nitrate content gradually declines to near zero as the plant reaches maturity.

When conditions are unfavorable for plant growth, but nitrates are still in good supply in the active feeding zone of the roots, they may accumulate within grass plants.

Nitrates accumulate in plants to the extent that they are available to the roots. Normally they accumulate in the vegetative parts of the corn plant rather than in the grain, because the enzyme (nitrate reductase) that transforms them to nitrite does not perform well when the leaves lack water (Fig. 1).

Nitrates normally accumulate in the corn plant as follows:

A. Upper leaves. Very little nitrate accumulates because these leaves are not shaded by other leaves. Nitrates are continually converted to proteins.

B. Upper stalk. More nitrates accumulate here than in the upper leaves, but still contains only a small amount under normal conditions.

C. Grain. Mature grain contains almost no nitrate. The nitrogen is in protein.

D. Middle stalk. This section contains an amount of nitrate that is intermediate between that in the upper and lower sections of the stalk.

E. Lower leaves. The actual amount of nitrate that accumulates is influenced by the factors that cause nitrates to buildup in plants but the relative amount is higher than in the upper leaves because the lower leaves are partly shaded. The enzyme that converts nitrate (NO_3) to nitrite (NO_2), the first step toward protein building, does not function as well in leaves that are shaded. The higher the plant population, the more the nitrates in the bottom leaves.

F. Lower stalk. Nitrates are higher in this section than in any other part of the plant. Under normal growing conditions, nitrates are only high enough to assure plenty of nitrogen for top yields and the level drops sharply as the plant approaches maturity. Under abnormal growing conditions this is the place where nitrates may be dangerously high.

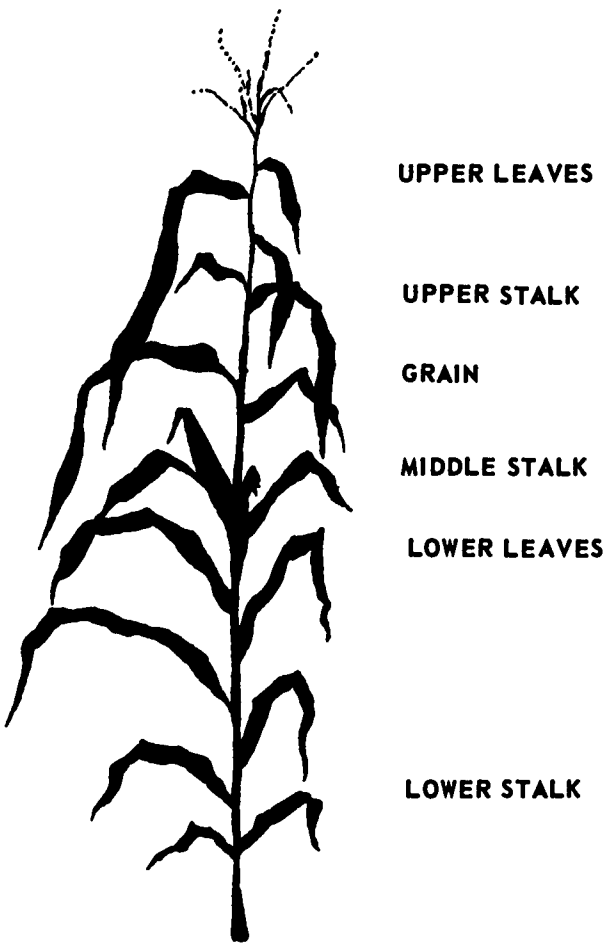

Fig. 1. The concentration of nitrates is higher in the lower stalk and lower leaves than in any other part of the plant. Under abnormal growing conditions this is the place where nitrates may be dangerously high.

Causes for nitrate buildup in plants. The most important causes for nitrate buildup in crop plants are as follows:

1. A high total nitrogen supply, not just from fertilizer, but from any source. A large growth of legumes (alfalfa, clover, lespedeza), a heavy application of manure, and high organic-matter content all contribute to the nitrogen supply. Any one or a combination of these factors can cause nitrate buildup when other conditions favor it.

2. Drouth often increases nitrates in corn because the enzyme (nitrate reductase) loses some effectiveness in converting nitrates to nitrites enroute to protein formation. Drouth increases the number of barren stalks and this leads to a buildup of nitrates.

Corn plants with levels of nitrates high enough to be toxic to livestock are rare, except in the dry western Corn Belt and Great Plains. A drouth by Illinois standards is not as severe as one by Kansas, Colorado, or Nebraska standards.

At the onset of drouth in most corn-growing regions, soil nitrates move upward

and concentrate near or on the surface. As a result, nitrates become less available. The corn plant often lacks nitrates and shows nitrogen deficiency symptoms. (See VAS-4011a, Hunger Signs in Crops for typical nitrogen-starved leaf deficiency symptoms.) In other words, the movement of available nitrates and water tends to slow down simultaneously when dry weather comes. The one exception is that when corn is grown on an old feedlot the deep subsoil is very high in nitrates that accumulated over the years from the manure. During a drouth nitrates continue to be available in this situation and may raise the nitrate content in the corn stalks to a high level.

Very high plant populations increase nitrate content because the extra shading reduced nitrate reductase, the enzyme that converts nitrate (NO_3) to nitrite (NO_2). Thick planting can cause barren stalks, thus, there would be no high-energy, low-nitrate grain to dilute the nitrate content of the stalk. In an Illinois study, solid-stand corn (100,000 to 200,000 plants per acre) raised the nitrate content more than a very heavy application of nitrogen. Some hybrids maintain their nitrate reductase activity in high populations and, therefore, are less likely to have a buildup of nitrates.

3. Cloudy weather increases nitrates because with less sunlight the nitrate reductase enzyme becomes less active in converting nitrate to nitrite.

4. An acute shortage of any nutrient other than nitrogen increases nitrates in the plant. The roots continue to take in nitrates, but since nutrient deficiency limits growth, the nitrates pile up in the stalk and lower leaves.

5. A good rain following a long dry period will temporarily increase nitrates because the nitrates that were concentrated near the soil surface are swept into the roots along with the water. High nitrate content in this case will clear up within a few days when active plant growth begins again.

6. Chemical sprays on some weeds and woody plants (not corn) increase nitrates and also improve the palatability of poisonous plants that livestock do not normally eat. This, of course, is a problem different from nitrates in corn.

3. HOW CAN I REDUCE THE DANGER OF NITRATES?

In green-chopped corn

If there is a significant number of ears, one way to increase the yield and reduce the nitrate hazard in green-chopped corn is to postpone harvesting. As the ears develop, the nitrate content of the whole plant will decrease because grain does not contain nitrates. If, on the other hand, there are few ears, nothing can be gained by delaying the harvest.

One way to reduce the amount of nitrates when corn is green-chopped for feeding or for silage is to cut extra high (15 to 18 inches) and leave in the field the part of the plant that is highest in nitrates.

In silos

Farmers have been killed and others have become ill from poison gases generated by nitrates in silos (Fig. 2). Unless farmers are aware of the danger, the instances of sickness and death to humans and livestock

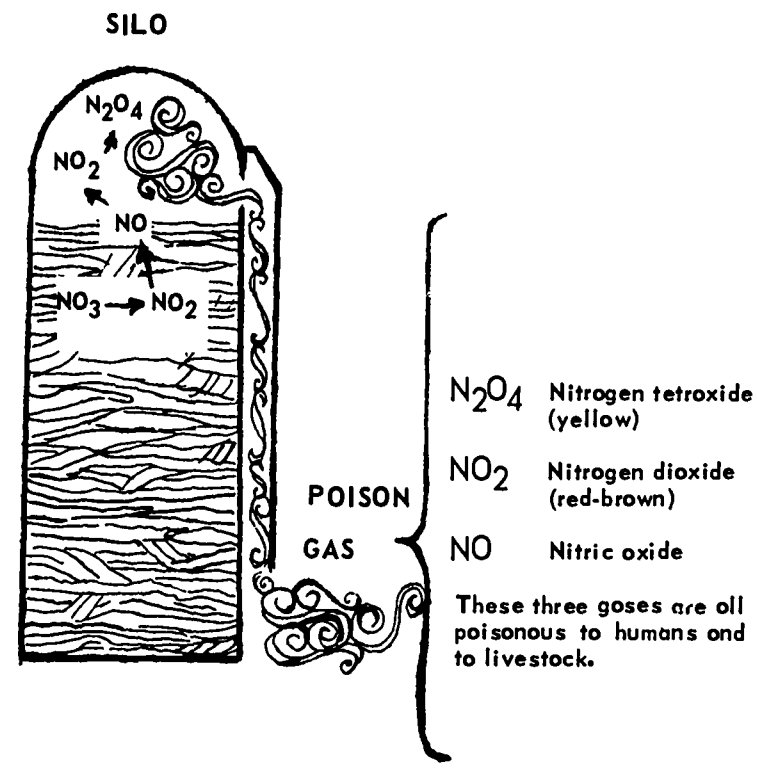

Fig. 2. An unusually high concentration of nitrates (NO_3) in corn silage may be converted to poisonous gases which are deadly to humans and livestock. Before entering a freshly filled silo, run the blower for 10 to 15 minutes.

will increase as plant populations are raised and more nitrogen fertilizer is applied. This problem may eventually be offset by breeding hybrids that will retain their nitrate reductase activity at high plant-population levels.

Poisonous yellow and brown gases may form in a newly filled silo and below the chute if the nitrate level is high, but farmers don't always notice this warning. Therefore, as a safety measure, the blower should always be run for 10 to 15 minutes before anyone enters a silo for the first three weeks after it is filled. Running the blower a few minutes each day will avoid any possible effect on livestock from gases that form and flow down the chute.

A simple test can be made for dangerous nitrogen dioxide gas by exposing a starch-potassium iodide-impregnated paper strip in the silo. The paper strip is moistened in water that is free from chlorine (city water supplies often contain chlorine). If there is only a small amount of dangerous gas, the paper will slowly turn blue around the edges. In a high concentration of the gas, the paper will turn dark in a few seconds.

In pastures

When 100 to 200 pounds per acre of nitrogen are applied to pastures, there may be a temporary sharp rise in nitrates. This increase disappears when the pasture responds with new growth and the nitrate is converted to protein. It is doubtful that there is any nitrate problem in fertilized pastures in Illinois.

4. HOW DO NITRATES GET INTO WATER SUPPLIES?

Source of nitrates

Nitrates are water soluble and are very mobile in solution. This factor favors the accumulation of nitrates in water supplies. Sources of nitrates include animal excreta, crop residues, human wastes, some industrial wastes, or any decomposing animal or plant tissue. Nitrogen fertilizer, naturally occurring deposits of nitrate-containing materials, nitrogen fixed by soil bacteria, and silage juices are additional sources of nitrates.

Since nitrates are water soluble, a portion of the nitrate added to or produced within the soil may be leached or washed away by either surface runoff or ground-water percolation. Nitrates leached by percolating water tend to accumulate in the upper portion of the groundwater table if rapid groundwater movement is absent. Nitrate concentration may be diluted by groundwater containing little or no nitrate and by groundwater movement.

Groundwater pumped from a well may contain excess nitrates even though the decomposing organic waste or other nitrogen source may be located a considerable distance from the well. If the groundwater moves rapidly through a porous sand or creviced rock formation with little opportunity for dilution, a well several miles from the nitrogen source may contain water high in nitrate.

5. HOW SAFE IS WELL WATER?

Reports by the Illinois State Water Survey show that in Illinois about 25 percent of all water samples from wells 50 feet deep or less contain an excessive concentration of nitrate. In another study conducted in the northwestern part of the state, 22 to 24 samples were taken from each of 11 wells between February 10, and January 10. The objective was to gather information about the fluctuation of the nitrate content of well water supplies. During the first four months of this period, samples were collected from each of the wells once a week. When it was observed that no significant change occurred in the samples collected at weekly intervals, the interval between sample collection was lengthened to one month. The monthly sampling schedule was continued for the remainder of the study.

The results of the mineral analyses are reported in Table 2. To avoid lengthy tabulations, the values shown represent the mean value of the mineral constituents of the samples analyzed. Table 3 provides statistics about the nitrate content for each of the wells.

Table 2. Mean Values of the Mineral Constituents on Samples Collected From Wells in Northwestern Illinois a/

Well No.	Depth (ft.)	Turbidity	Color	Odor	Iron (Fe)	Nitrate (NO_3)	Chloride (Cl.)	Alkalinity (as $CaCO_3$)	Hardness (as $CaCO_3$)	Total dissolved minerals
					(mg./1.)					
1	70	4	0	0	.9	161	76	528	808	884
2	280	1	0	0	Tr.	11	7	254	297	322
3	180	1	0	0	Tr.	29	11	277	343	391
4	90	1	0	0	Tr.	109	22	265	435	526
5	50-60	1	0	0	.2	177	51	352	663	819
6	200	9	0	0	1.5	1	1	294	256	300
7	20-30	1	0	0	Tr.	135	28	268	450	568
8	20-30	1	0	0	Tr.	146	31	272	403	579
9	32	1	0	0	1	90	20	252	344	501
10	20-30	1	0	0	Tr.	125	28	232	388	384
11	28	1	0	0	Tr.	130	57	452	613	832

a/ Data from: L. M. Henley, State Water Survey, Urbana, Illinois.

Table 3. Statistics for the Nitrate Content on Samples Collected From Wells in Northwestern Illinois a/

Well No.	Well depth (ft.)	Mean (mg./1.)	Median (mg./1.)	Rangee (mg./1.)	Standard deviation b/ (mg./1.)	Percent coefficient of variation c/
1	70	161	160	144-183	11.0	6.8
2	280	11	12	8-14	1.6	14.5
3	180	29	24	16-56	11.9	41.0
4	90	109	106	93-145	14.3	13.1
5	50-60	177	175	143-225	18.2	10.3
6	200	1	1	0-3	.9	90.0
7	20-30	135	131	119-177	15.2	11.3
8	20-30	146	144	128-162	8.4	5.8
9	32	90	88	62-164	18.7	20.8
10	20-30	125	125	114-131	4.0	3.2
11	28	130	127	92-165	20.4	15.7

a/ Data from: L. M. Henley, State Water Survey, Urbana, Illinois

b/ Standard deviation is a measure of the variation about the mean. When the standard deviation is small compared to the mean, it suggests that the values tend to cluster rather closely around the mean.

c/ Percent coefficient of variation = $\frac{\text{standard deviation}}{\text{mean}} \times 100$.

Many of these wells are old and little information about their construction is available. It was reported, however, that all the wells are located close to unpaved livestock holding areas that would allow seepage and runoff to enter poorly constructed wells. At some of the wells, no attempt had been made to provide a sanitary seal that would prevent surface water from entering the well around the casing.

Some variation of the nitrate content is indicated by these analyses. However, wells generally high in nitrate (over 45 milligrams per liter) remained high throughout the sampling period. The exception to this is well No. 3 which ranged from 16 to 56 milligrams per liter as NO_3.

It has been found that water samples from shallow, dug, bored, and driven wells more frequently contain excess nitrates than do samples from deeper, drilled wells. Shallow wells generally are not adequately constructed to prevent the direct entrance of polluted surface and subsurface water. Seldom do these wells extend deeper than the shallowest water-bearing stratum. Shallow wells are often located beside a waterway or other surface depression which increases the hazard of nitrate pollution.

A drilled well, however, does not assure nitrate-free water. Many drilled wells are improperly located and are not constructed to prevent the entrance of polluted surface and groundwater. Even a relatively deep water-bearing stratum may contain nitrates. Pollutants enter deep strata through old wells which have been abandoned but not filled with concrete; through pumped wells with rusted and perforated casings; through old wells which are misused for sewage and waste disposal; and through drainage wells, natural sinkholes, and river valleys.

Well water should be tested. However, very little is known of the variation in nitrate concentration in a well. Test reports indicate that the nitrate level may fluctuate as indicated in Tables 2 and 3. Nitrate levels are generally highest following wet periods and are lowest during dry periods. Therefore, a single sampling and test is sometimes of doubtful value. Testing during dry periods may cause a false sense of security. Preferably, a well should be tested immediately after a wet period.

A well supply should also be tested for bacterial purity and nitrate content whenever a change in color, odor, or taste causes the continued purity of the water to be questioned. An annual test for water purity following a wet period in the spring is recommended as a routine practice.

Some well waters containing excess nitrates also contain bacterial pollutants. However, some nitrate-containing waters may show no evidence of bacterial pollution by animal or human wastes. Either the nitrates originate from other sources or the nitrate-containing groundwater has moved through enough soil to filter out the bacteria. Since the nitrates are dissolved in the water, they are nonfilterable.

Ponded waters may also contain nitrates and cause problems. Ponds, road ditches, and other surface depressions that collect runoff from feedlots and heavily fertilized fields, silo drainage, and septic tank discharge sometimes contain high-nitrate water. Ponds and depressions with few or no green plants growing in them may contain a significant amount of nitrate. Excess nitrates will not usually be found in ponded water which contains abundant algae and other plant growth. Apparently the plant growth uses the excess nitrate almost as rapidly as it enters the pond with runoff water. Nitrates may also be lost by denitrification in the anaérobic decomposition or organic matter in the ponded water.

If an excess of nitrate is present in the water supply, this may be an indication of the presence of harmful bacteria that will further contaminate the supply. Bacteriological analyses to determine the sanitary quality of water supplies in Illinois are made by the State Department of Public Health. For information regarding bacteriological analyses, write to the State Department of Public Health, Springfield, Illinois 62700. If there is a question concerning the mineral constituents of the water, the State Water Survey will perform a mineral analysis of the water from wells located within the State. For information about mineral analyses, write to the State Water Survey, Box 232, Urbana, Illinois 61801.

6. HOW CAN I PROTECT MY WATER SUPPLY?

Any well that provides drinking water should be built and located so that it will always yield safe water under all conditions. Contamination usually enters a well from one of two sources: (1) seepage from privy vaults, sewers, and septic tanks, and (2) surface contamination from filth that may be carried by humans, animals, surface water, and shallow groundwater that may enter the well directly through the top or upper portion of the well lining.

The well site should have good surface drainage and be higher than the surrounding ground. The well platform should be placed on an earth fill at least one foot higher than the natural ground surface. Sources of pollution, such as privies, cesspools, septic tanks, and sewers, should be located downhill from the well. Surface drainage should prevent the accumulation of surface water within 15 feet of the well.

The well should be located uphill and at least the minimum distances as shown below from the respective sources of pollution:

Privy vaults	50 feet
Tile sewers or drain lines	50 feet
Septic tanks	50 feet
Cesspools	75 feet
Seepage pits	75 feet
Subsurface seepage tiles	75 feet

If it is necessary for a sewer or drain line to pass closer than 50 feet from a well, the sewer must be constructed of cast iron pipe having watertight joints. Under no condition should any buried drain pass within 10 feet of the well.

The source of water often influences the occurrence of nitrates in water. Water from shallow wells usually contains a higher level of nitrate than does water from deep wells. A thorough understanding of the underlying strata and direction of groundwater movement may clarify many questions.

The watershed is a major consideration when studying the occurrence of nitrates in water. During decay nitrogen-containing animal and plant residues form a major source of soil nitrate. In many cases in which shallow wells have shown high levels of nitrate in the water, the wells have been located near feedlots or heavily manured areas.

A close examination of some deep wells that contained water with high levels of nitrate, showed that poor well construction has allowed runoff to enter the wells directly or through faulty casings.

7. WHAT HAPPENS TO NITRATES CONSUMED BY RUMINANTS?

At present there appears to be much confusion surrounding nitrate utilization and especially nitrate toxicity. It is natural for the feed and water that animals consume to contain some nitrate. Nitrates by themselves are not a major problem to the animal. When cattle and sheep consume nitrate, some of it is converted to nitrite by rumen microorganisms. If nitrite is produced in sufficient quantity, some of it is absorbed into the blood stream where it changes the red blood pigment, called hemoglobin, to a brown pigment called methemoglobin. Hemoglobin carries oxygen from the lungs to other body tissues, but methemoglobin is severely restricted in its oxygen-carrying capacity.

Nitrate toxicity in ruminants can be diagnosed and treated

Symptoms of nitrate toxicity in animals are weakness, staggering gait, increased rate of breathing, and sometimes diarrhea.

Nitrates cause chemical reactions in the blood which decrease the ability of the blood to carry oxygen and also lower the blood pressure. This results in internal asphyxiation. The diarrhea is caused by irritation of the intestines by nitrates.

An animal that has died from nitrate toxicity may have hemorrhages in the heart, lungs, and kidneys. The liver and spleen will be chocolate brown. The intestine may contain blood that has a chocolate-brown color.

Treatment attempts to restore the ability of the blood to carry oxygen. This is accomplished by injecting intravenously a solution of methylene blue. Stimulants used to raise blood pressure are not very effective.

Small quantities of nitrates can be eaten by ruminants without adverse effects because some nitrate in the rumen is converted through nitrite to ammonia. Small amounts of nitrate are also excreted in the urine. Animals also possess an enzyme, methemoglobin reductase, for converting methemoglobin back to hemoglobin, and they can tolerate some methemoglobin in their blood.

Nitrate becomes toxic only when the production of methemoglobin exceeds the rate at which it can be converted back to hemoglobin.

You may wonder at what nitrate content in feeds and water is dangerous for ruminants. Extensive research conducted at many college experiment stations indicates that the problem in cattle and sheep has been greatly exaggerated. One research worker concludes that care should be taken in diagnosing deaths and illness of cattle from nitrate poisoning. Laboratory analyses of feeds produced under drouth conditions in Illinois have rarely shown a level of nitrates that would be considered toxic to ruminants. Therefore, many cattle illnesses and deaths in Illinois have been improperly diagnosed as resulting from nitrate toxicity.

The level of nitrates required to produce toxicity in cattle varies with the age of the animal, type of ration fed, and the nitrate intake. Young animals on a poor diet or under stress from other diseases appear more susceptible to nitrate toxicity. In some studies nitrate levels as low as .6-.9 percent of the total ration on a dry-matter basis have shown signs of being toxic to cattle, whereas nitrate levels as high as 6 to 7 percent have produced no signs of toxic effects in cattle on an adequate energy diet of corn silage, hay, and grain. In general, feed containing 2 percent or more of nitrate should be fed only with extreme caution.

If laboratory analysis of feeds reveals high levels of nitrates, follow these steps:

1. If it is necessary to feed the high nitrate feeds, introduce them into the ration gradually and to a limited number of animals over a period of 7 to 10 days.

2. Feed relatively high levels of grain for the species involved.

3. Provide supplemental Vitamin A to cattle at the rate of 30,000 I.U. per head daily.

4. Observe animals for these symptoms: reduced appetite, unthriftiness, drop in milk production, labored breathing, or staggering gait.

5. Obtain veterinary assistance where nitrate toxicity is suspected.

APPENDIX

CONVERSION OF REPORTED NITRATE EXPRESSIONS

Expressions of nitrate concentration

Different laboratories express results of a nitrate analysis in different ways. The nitrate content of water, soils, forages, and foods may be expressed as nitrate ion (NO_3) or some equivalent expression of nitrate concentration. Some commonly used equivalent expressions are nitrate-nitrogen (NO_3-N), potassium nitrate (KNO_3), and sodium nitrate ($NaNO_3$).

The conversion factors presented in Table 4 will greatly aid in comparing nitrate concentrations when results of analyses are reported by different methods.

Units of nitrate concentration

The various units used for reporting results of chemical analyses may sometimes cause confusion in interpreting the results of analyses. Units which are commonly used are percentage (%), parts per million (p.p.m.), milligrams per liter (mg./1.), and millimoles per liter (m. mole/1.).

The familiar percentage expression is the weight of the constituent (amount of nitrate) determined by chemical analysis, divided by the weight of the total sample, multiplied by 100. Percentage may be thought of as the number of parts of the constituent in a hundred parts of sample.

Correspondently, parts per million (p.p.m.) is the number of parts of the constituent in a million parts of sample. Since 100 parts multiplied by 10,000 equals a million parts, percentage expressions may be readily converted to parts per million by multiplying them by 10,000.

The results of chemical analyses of solutions are often reported in milligrams per liter (mg./1.). For dilute solutions milligrams per liter are equivalent to parts per million. Since the solvent is usually water and a milliliter (1/1,000 of a liter) of water at normal temperatures weighs about one gram, the results of analyzing a solution can be reported as grams of substance (nitrates) per 1,000 grams of solution. Therefore, if both top and bottom of the ratio (grams per 1,000) are multiplied by 1,000, the resulting expression is parts per million.

Table 4. Conversion Factors for Comparing Various Nitrate Designations

Method of expression	Desired chemical designation	Designations of reported concentration[a/]			
		NO_3	NO_3-N	KNO_3	$NaNO_3$
		(Factors for multiplying reported concentrations to obtain desired chemical designation)			
Nitrate ion	NO_3	1.0	4.43	.614	.729
Nitrate nitrogen	NO_3-N	.226	1.0	.139	.165
Potassium nitrate	KNO_3	1.63	7.21	1.0	1.19
Sodium nitrate	$NaNO_3$	1.37	6.07	.842	1.0

a/ As an example, if the nitrate concentration were expressed as NO_3, one would multiply the expression by 0.226 to convert it to NO_3-N, or by 1.63 to convert it to KNO_3, or by 1.37 to convert it to $NaNO_3$.

Results of chemical analyses of solutions are sometimes expressed as a fractional part of a mole per liter--most commonly as millimoles per liter (1/1,000 of a mole per liter). A mole is one atomic molecular weight of solute. One mole of a substance, dissolved in a total solution volume of one liter, is a molar solution. When millimoles per liter are multiplied by the atomic molecular weight of the constituent (nitrate content) as determined by analysis, the resulting expression is milligrams per liter (mg./1.) or parts per million (p.p.m.).

Table 5 is presented to aid in converting various expressions of nitrate concentrations to other forms of expression.

Table 5. Conversion Factors for Comparing Various Expressions of Nitrate Concentration

Desired concentration expression	Designation of reported concentration			
	p.p.m.	%	mg./1.	m. mole/1.
	(Factors for multiplying reported concentrations to obtain desired chemical designation)			
Parts per million (p.p.m.)	1	10,000	1	mol. wt.[a]
Percent (%)	.0001	1	.0001	mol. wt. x .0001
Milligrams per liter (mg./1.)	1	10,000	1	mol. wt.
Millimoles per litter (m. mole/1.)	1	10,000	1	1

a/ Atomic molecular or ion weights: NO_3 = 62, NO_3-N = 14, KNO_3 = 101, and $NaNO_3$ = 85.

NOTES and REFERENCES

This subject-matter unit was prepared by R. L. Courson. It was taken primarily from material prepared by a committee consisting of J. G. Cash, Dairy Science Extension; S. R. Aldrich, Soil Fertility Extension; C. J. W. Drablos, Agricultural Engineering; L. M. Henley, State Water Survey; T. D. Hinesly, Soil Management Extension; R. P. Link, Veterinary Physiology and Pharmacology; J. R. Pickard, Veterinary Pathology and Hygiene; and G. E. Ricketts, Animal Science Extension.

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ABSTRACT - Selected to provide information to blind homemakers and to aid teachers in home economics instruction, this bibliography of resource materials contains materials published 1929-1968. Areas include: (1) General References, (2) Agencies and Institutions, (3) Child Development and Family Relations, (4) Home Management, (5) Textiles and Clothing, (6) Etiquette, (7) Money Management, (8) Nutrition and Health, (9) Diabetes, (10) Cookbooks, (11) Magazines and Popular Publications, and (12) Miscellaneous References. Within each subject area the materials are listed by availability: braille, records, tape recordings, and print. A few of the citations are annotated. (SB)

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RESOURCES IN HOME ECONOMICS for the BLIND HOMEMAKER

By

VERDA M. DALE and SUSAN J. UHLINGER

Massachusetts Home Economics Association

1969

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This publication has two purposes:

(1) to provide the home economist with a source of information concerning blindness and teaching home economics to blind individuals

(2) to provide a list of resources in various areas of home economics for blind homemakers

Many individuals and agencies have provided information and encouragement for this project. We gratefully acknowledge their support and the financial assistance of the Massachusetts Home Economics Association in preparing this publication.

Verda M. Dale

Susan J. Uhlinger

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A checksheet for home teachers to use in evaluating blind persons' ability to do housework, eat, groom themselves, and communicate.

"Home Teaching Courses for Home and Hospital Living." Mimeographed. 10 pages. Office of the Blind, Department of Public Welfare, 7th and Forster Streets, Harrisburg, Pennsylvania.

Orientation course outlines for teaching blind persons about moving about the home and immediate vicinity safely, eating, grooming, identification of money, telephone dialing and keying, and hand sewing.

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Report on an institute held to explore ways in which Extension Home Economists, Vocational counselors, and home teachers might cooperate to provide service to newly blinded homemakers.

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ABSTRACT - Written by a graduate assistant in agricultural education, and field tested in 17 schools prior to publication, this manual is for teacher use in planning and teaching a unit on Agricultural Stabilization and Conservation Service (ASCS) programs. The unit is intended for use in high school or area vocational-technical school classes comprised of students having occupational interests in farming or off-farm agricultural business. Contents are divided into the following four sections, each containing one or more lessons: Federal Farm Programs, ASCS Organization, History and Background, and Economic Principles. General ASCS information, unit references, and teaching suggestions are given for the unit lessons and printed on green paper for ease in locating. Appendixes provide overhead transparency masters and order forms for ASCS resource materials and audio-visual materials. The related student manual is available as VT 010 746, also in this issue. (AW)

VT 010 745

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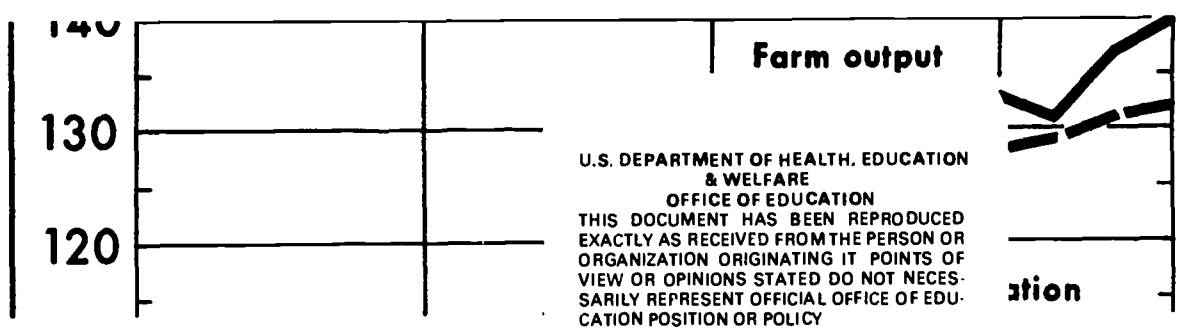

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ASCS AND YOU

A TEACHER'S MANUAL
FOR
A student resource unit developed for use in teaching about the ASCS and farm programs. It should be useful for high school students and young and adult farmer classes

by
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and
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FOREWORD

This publication is the product of a contract between the Agricultural Stabilization and Conservation Service (ASCS), an agency of the United States Department of Agriculture, and the Department of Agricultural Education, The Pennsylvania State University. An advisory committee of ASCS and The Pennsylvania State University personnel was named to provide direction for the project and to make suggestions as the project progressed.

Valuable assistance was given the project by ASCS in Washington, D. C., and the state ASCS office in Pennsylvania. The idea to write a student resource handbook on ASCS programs originated with a former vocational agriculture (vo-ag) teacher, Joseph H. Moore, who is now a farmer fieldman for ASCS in Pennsylvania. It was principally through his efforts that the project became a reality. As the project was formulated, another former vo-ag teacher, Tom Lett, became an interested participant in the project. From this early stage to completion, Mr. Lett of the Employment Development and Training Staff of ASCS worked closely with the project. He actively participated in reviewing the course materials. Program specialists for ASCS in Washington and Harrisburg reviewed the material for accuracy.

The unit was written by Rodney Tulloch, a graduate assistant; the project director was Dr. Samuel M. Curtis, assistant professor.

For the agriculture teacher to effectively teach this unit, the cooperation of many people will be needed. It is especially important that the county ASCS office managers and agriculture teachers work together in planning the instructional activities.

INTRODUCTION FOR TEACHER'S GUIDE

Before beginning to teach any part of this unit on the ASCS, it is suggested that the teacher read through the entire handbook. Section III on History and Background and Section IV on Economic Principles will provide useful information for discussions of Section I on Federal Farm Programs.

Teaching suggestions are included on the green pages in the teacher's manual. It is not expected that any one teacher will use all of the suggestions, or that the list cannot be added to or changed. Each teacher will have to adapt the teaching suggestions to his situation. Blank information sheets are included for some programs and will require that teachers get the necessary current data to complete them from the county ASCS office. This is necessary because the data for each county as well as for each year varies for many of the programs. Therefore, the information must be updated each time the unit is taught.

The unit has been divided into four sections any of which could be taught at any time. Although the unit has purposely been written with this flexibility, Section I seems to be most important and relevant to the students' present needs and should probably receive the most emphasis.

Since few visual aids and reference materials have been found to be available locally, ASCS has arranged to supply reference materials, slides, scripts, tapes, and other materials. Forms to order these materials and also to have your name placed on the ASCS mailing list are included in the appendices. Masters from which you can produce overhead transparencies have also been included in the appendices.

County ASCS Information

The _____ County ASCS office is located at _____

_____.

The County ASCS office manager's name is _____

_____ and phone number is _____.

In the chart below list the county and community committeemen who will assist in teaching this unit. (Ask the County ASCS office manager to suggest names for this list).

Name	Address	Telephone	Comments

Resource People (Get suggestions from County ASCS Office Manager)

Position or Service	Name	Address	Phone	Comments*
County ASCS Office Manager				
ASCS District Fieldman				
Soil Conservation Service				
Soil Conservation District				
Agricultural Extension Service				
State Forest Service				
U. S. Forest Service				
State Water Resources Board				
Farmers Home Administration				
Farmers who have participated in ASCS programs				

*List special areas of interest

GENERAL REFERENCES FOR UNIT

1. Baker, Gladys L., Wayne D. Rasmussen, Vivian Wiser, and Jane M. Porter, Century of Service: The First 100 Years of the United States Department of Agriculture, Washington, D. C., U. S. Government Printing Office, 1963.

2. Compilation of Statutes, Agriculture Handbook No. 361, Washington, D. C., U. S. Government Printing Office, 1969. (This compilation is brought up to date on alternate years).

3. Doanes Agricultural Report, Doanes Agricultural Services, Inc., St. Louis, Missouri.

4. Farm Commodity and Related Programs Agricultural Handbook No. 345, Washington, D. C., U. S. Government Printing Office, 1967.

5. United States Government Organization Manual, 1968-69, Washington, D. C., U. S. Government Printing Office, 1968.

INTRODUCTION

Production and income of agriculture affect directly or indirectly every individual in our nation. No matter what occupation a person may choose as his life's work in one way or another he will come in contact with, or be directly dependent upon, agriculture. Likewise, the USDA, the ASCS, and farm programs affect every person in the United States. Some of the programs have world-wide significance.

This handbook contains general information on farm programs, ASCS organization, history and background of farm programs, and selected economic principles. The information has been intentionally limited to the more important facts, thus leaving out many of the rapidly changing details. Persons interested in the details of the programs should visit the county ASCS office where complete information is available.

The handbook is divided into four sections, (1) farm programs, (2) ASCS organization, (3) history and background, and (4) economic principles. Each section contains one or more lessons.

Government programs in agriculture have a long history. Yet, confusion still exists concerning their purposes. Programs administered through ASCS are presented in this handbook. The relationship of ASCS with other USDA agencies is also discussed.

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SECTION 1. FEDERAL FARM PROGRAMS

INTRODUCTION

Virtually every citizen is affected by ASCS programs whether or not he participates directly. ASCS programs affect prices and availability of major farm commodities as well as the products into which they are converted.

Reasons for Federal Farm Programs

The problem is simple. With their supply of cropland and management know-how farmers produce far more than we can eat, sell, or afford to give away.

Farmers have been aware for a long time of the cost-price squeeze - aware of the fact that the more successful they are in creating abundance, the lower the price they receive in the marketplace.

City residents are becoming aware of the problem as communications media do a better job of informing the public. For example, city folks know that fewer farmers are using more machinery, more fertilizer, and improved varieties on fewer acres to produce more corn, wheat, beef -- more of just about everything. Because of increased supplies of farm products, an hour's factory work now buys more food than ever before.

Farm Program Aims

Although the problem is simple, solutions to it are not so simple. Agricultural abundance, price stability, conservation, and national security have been major farm program aims since the first legislation dealing with price support and production adjustment was passed by Congress in 1933.

Farm Program Administration

Congress enacts farm legislation and appropriates funds to carry out the legislation. Authority for the administration of these programs is vested in the President, the Secretary of Agriculture, and the Commodity Credit Corporation (CCC). The CCC is under the general supervision and direction of the Secretary. At the county level these programs are administered by the county ASCS office.

Compliance

Compliance is designed to protect the producer and the government.

The most important facets of compliance are to: (1) protect the government's interest by guaranteeing taxpayers and Congress that agricultural payments are made in accordance with the law, (2) protect producer's interest by determining accurately the extent of participation in the program, and (3) provide payments and benefits when rightfully earned.

ERIC

TEACHER'S GUIDE FOR CONSERVATION PROGRAMS

Objectives:

1. To develop an understanding of the conservation programs administered by the ASCS.
2. To develop the ability to identify good conservation practices.
3. To be able to discuss the purposes of conservation programs.
4. To be able to calculate cost share on ASCS programs.

Suggested Learning Activities:

1. Arrange field trips to one or more conservation program sites. (See Page 2f).

   Field trips to see conservation programs in operation can effectively show how the programs are working locally. When making a field trip, it is desirable to have someone present to answer questions about the programs visited. Visit this person ahead of time to be sure he has available information on the total cost of the program or practice and the amount of ASCS reimbursement. County and community committeemen will usually help you arrange and set up field trips.
2. Arrange a field trip to the county ASCS office.

   Every farmer should be acquainted with the county ASCS office. This is the place where farmers find answers to questions and obtain help with problems involving farm programs. Help the office manager prepare an organized agenda for explaining ASCS and its activities to the class.
3. Have students report on ASCS cost-share conservation practices used on their farms or on other farms with which they are acquainted.
4. Schedule guest speakers or panel members to discuss conservation needs and conservation programs in the county. (See resource persons list, page iic).

5. Discuss how ASCS conservation programs can help local farmers. Also, discuss ASCS conservation programs used by class members on their farms including initial contact, requirements, and cost-sharing.
6. Compare county costs of conservation programs (see page 2e) with county welfare costs and other county cost figures of interest to the class.
7. Have students debate the pros and cons of ASCS conservation programs.
8. Discuss alternatives available to farmers under various conservation programs.
9. Discuss conservation programs as they are or could be applied to the school land laboratory.

Conservation programs available in _____ County for 19 _____.

(Teacher should secure this information from the county ASCS office before attempting to teach this unit).

PROGRAM	MAJOR PROVISIONS

ERIC

ACP Practices available in _____ County for 19 _____.

Fill in the chart below with information for your county's Agriculture Conservation Program (ACP). You may obtain this information at the county ASCS office. List ACP practices for your county by priority, starting with the highest priority. This information for the local county should be made available to students or collected by students during the field trip to the ASCS office.

ACP PRACTICES	PERCENT OF COST-SHARE	COMMENTS

Results and Costs* of Conservation Programs in _____ County for 19_____. Total cost for all conservation programs in county _____.

NOTE: Put county costs in the blanks following the name of each program.

In the blank space below, briefly summarize the results or accomplishments of each program.

1. Agricultural Conservation Program (ACP) _____
   See chart page 2d.

2. Regional Conservation Program (RCP) _____

3. Cropland Adjustment Program (CAP) _____

4. Conservation Reserve Program of the Soil Bank _____

5. Other _____

*Are these the total costs paid by ASCS in the county? If not, explain in the space below what the figures do cover.

Field trips:

List below suggestions of ASCS personnel and committeemen for field trips where conservation programs are in effect and can be observed and where sufficient cost data is available for profitable discussion.

PROGRAM OR PRACTICE	LOCATION	COMMENTS OR SPECIAL FEATURES

Audio-Visual Aids:

The best audio-visual aids are those that show local or county conservation programs and practices. Many audio-visual aids that emphasize the local area are usually available from some of the individuals in the list of resource people on page iic. Other audio-visual aids are available from ASCS in Washington, D. C. Order forms are included in the appendices.

Slide Series:

Land Use and Conservation Programs - ASCS, Washington, D. C.

References:

1. ACP; Agricultural Conservation Program at Work, PA-838, Washington, D. C., U.S. Government Printing Office, 1968.

2. ACP and You; Information About the Agricultural Conservation Program, PA-611, Washington, D. C., U.S. Government Printing Office, 1964.

3. Agricultural Conservation Program, BI No. 18, Washington, D. C., USDA, ASCS, April, 1968.

4. Cropland Adjustment Program for 1966, The, PA-697, Washington, D. C., U.S. Government Printing Office, 1965.

5. Cropland Adjustment Program, The 1966, PA-687, Washington, D. C., U.S. Department of Agriculture, 1965.

6. Conservation of Our Renewable Natural Resources; Suggestions for Science Fair Projects in Junior and Senior High Schools, Washington, D. C., Agricultural Stabilization and Conservation Service, 1964.

7. Farm Family -- Manager of Natural Resources, The, An Address by Horace D. Godfrey, Administrator of ASCS, Washington, D. C., Agricultural Stabilization and Conservation Service, 1965.

8. Greenspan Way -- To More Space; for Park, Recreation, and Wildlife, The, PA-762, Washington, D. C., U.S. Government Printing Office, 1966.

9. Progress Under the Agricultural Conservation Program, Washington, D. C., U.S. Government Printing Office, 1967.

10. We Call It Greenspan, A Message from the Secretary of Agriculture, Washington, D. C., U.S. Department of Agriculture, 1966.

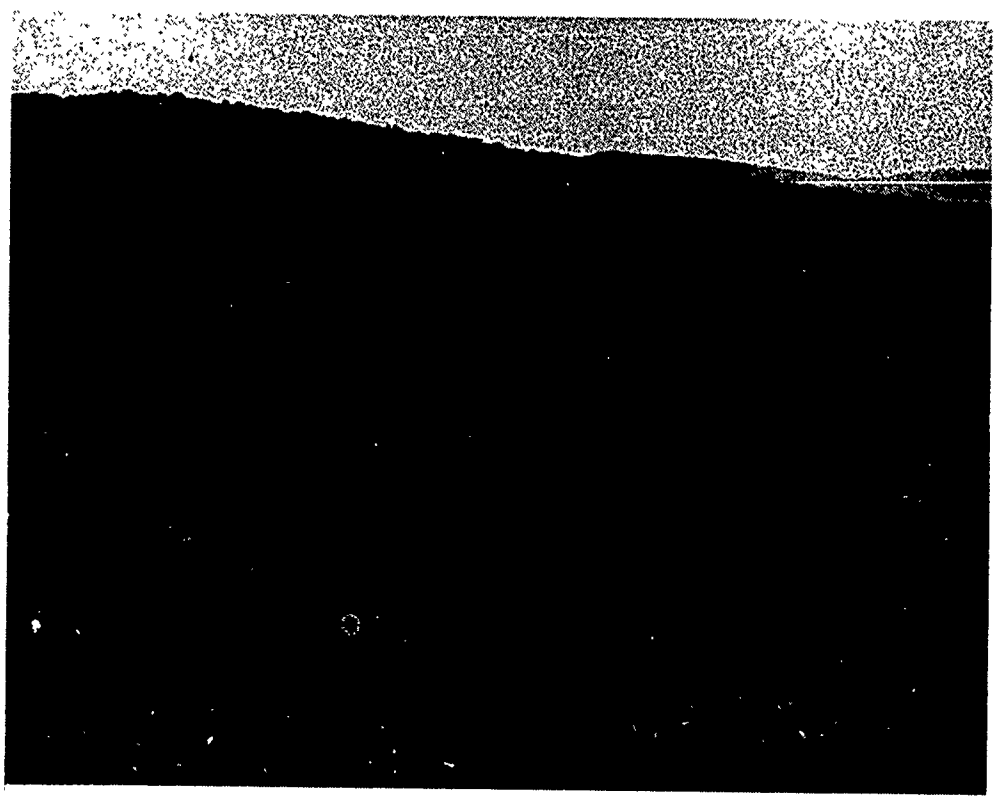
CONSERVATION PROGRAMS

Agricultural Conservation Program (ACP)

Introduction

The Agricultural Conservation Program (ACP) is an effort by the United States Department of Agriculture in cooperation with agricultural producers to preserve and improve the nation's farm land, water, and timber resources. Under ACP the federal government assists agricultural producers by sharing the cost of performing conservation work approved for that county.

At the present time the landowner bears the primary responsibility for conservation of the land. Clean air, water, and a beautiful productive country are of concern to everyone whether they are from a rural or urban area. The public must become aware of and participate with greater vigor in the conservation of our natural resources to preserve them for future generations.



Contour Strips

Goals of the Agricultural Conservation Program are:

(1) Soil erosion control

(2) Healthy stands of trees

(3) Luxuriant growth on pasture and rangeland

(4) Disposal of excess water or conservation of scarce water

(5) Plentiful habitat for wildlife

(6) A beautiful countryside

A farmer applies for cost-sharing

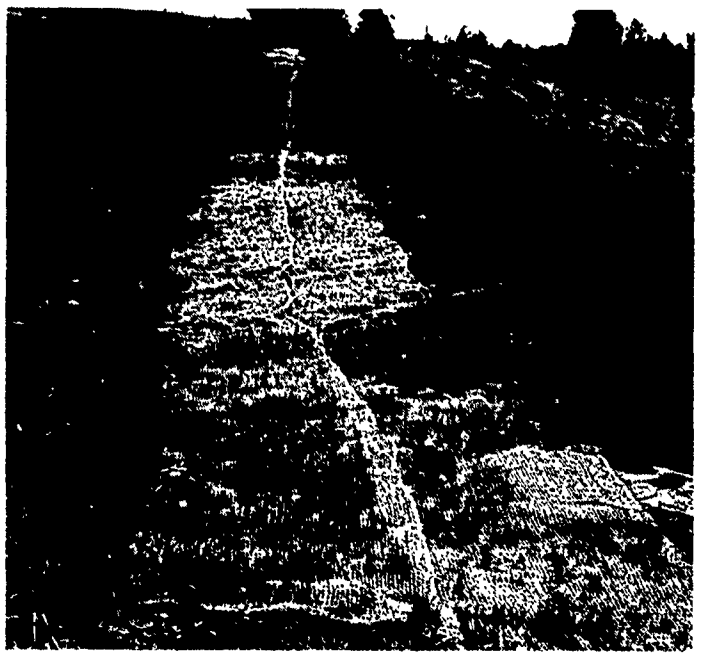
How ACP Works

A farmer files a request with the ASC county committee for ACP cost-sharing before carrying out the conservation practice. Upon favorable action by the committee and after an approved practice has been completed according to the specifications designated by the committee, the farmer certifies compliance to the county office. One of the technical agencies checks to determine that specifications have been met in cases where technical responsibility has been assigned. Annually, a small number are spot checked for compliance with the ASCS program. The Soil Conservation Service (SCS) and the Forest Service are responsible for providing technical program guidance to ASCS committees as well as technical aid to farmers in carrying out conservation practices. The Agricultural Extension Service and other governmental agencies also provide technical assistance. For exact details of how ACP works in your county visit the county ASCS office.

ACP Practices

ACP offers a wide range of conservation, soil, woodland, water, and wildlife practices to meet the varied conservation problems throughout the nation. But, since each county determines which practices are available, requests for detailed information should be directed to the county ASCS office. Major categories of these practices are listed on the following pages.

Permanent seeding



Sod waterway

Cross-slope strips improve pasture and pond

Wildlife habitat

Vegetative Cover Practices

Seedbed preparation, seeding, liming, fertilizing, and other measures needed in the establishment or improvement of grass and legume cover for soil protection.

Forestry Practices

The planting of trees and shrubs for forestry purposes and for erosion control, and the improvement of established stands of trees by such measures as thinning, pruning, and the control of competing and undesirable vegetation.

Establishment of Conservation Systems of Farming

The construction of terraces and the performance of farming operations on the contour or in strips for the prevention of wind or water erosion.

Water Impoundment Practices

The construction of dams, pits, or ponds for erosion control, livestock water, irrigation, or other agricultural purposes.

Disposal of Excess Water

The construction of sod waterways and the installation of farmland drainage systems.

Conservation and Effective Use of Water

The lining of irrigation ditches, leveling of land, and the installation of structures to conserve water, prevent erosion, and to permit more efficient use of irrigation water.

Wildlife Conservation Practices

The establishment of vegetative cover which will provide food, cover, and habitat for wildlife as well as soil protection, and the impoundment of water for fish and other wildlife.

Beautification and Conservation Practices

The performance of measures which will enhance the appearance of areas visible to the public and at the same time provide substantial soil and water conservation benefits.

Annual Summary of Major ACP Practices in the United States

- 50,000 water storage reservoirs constructed to distribute grazing, control erosion, and conserve irrigation water or provide wildlife habitat.

- 734,000 acres terraced to control erosion or conserve water

- 345,000 acres established in strip cropping systems to control wind or water erosion and conserve water

- 43,000 acres of sod waterways established to control erosion and permit safe disposal of excess run-off

- 12,708,000 acres established in enduring vegetative cover to control erosion and conserve water

- 200,000 acres planted to trees for forestry purposes

- 210,000 acres of low quality forested areas improved to develop desirable forest resources

Emergency ACP

Emergency conservation measures are authorized under the ACP in designated disaster areas where emergency conservation measures are needed to control severe wind erosion on farmlands, or to rehabilitate farmlands damaged by wind erosion, floods, hurricanes, fires, earthquakes, or other natural disasters.

Regional Conservation Program (RCP)

Thus far this long term program has been limited to the Appalachian Land Stabilization and Conservation Program (ALSCP).

The program assists in development of the Appalachian region by providing cost-sharing and technical assistance to landowners, operators, or occupiers of land in that region. ALSCP contracts provide for land stabilization, erosion, and sediment control, reclamation through changes in land use, and the establishment of measures for the conservation and development of soil, water, woodland, wildlife, and recreation resources. This program accelerates conservation work in selected project areas and supplements other Appalachian Region programs. Emphasis is placed on solving conservation problems inhibiting economic growth. Cost-sharing agreements are for periods of three to ten years. The federal share may not exceed 80 percent of the treatment cost. Not more than 50 acres of land for any one person may be included in the program. Cost-sharing is limited to 50 dollars per acre and 2500 dollars per contract.

Cropland Adjustment Program (CAP)

Objectives

The voluntary Cropland Adjustment Program (CAP) is designed to help agricultural producers reduce farming operations, change cropping plans, or put land to conservation and other needed uses rather than growing crops. Goals of the Cropland Adjustment Program are to:

(1) divert cropland from production of unneeded crops to conservation and other uses for five to ten years;

(2) give conservation assistance on cropland taken out of production;

(3) make adjustment payments based on crop values, production history, and need for diverting some crops more than others; and

(4) provide financial incentive to farmers for permitting free public access to hiking, hunting, fishing, and trapping areas.

Regular CAP Program

The program's flexibility benefits the individual who wants to shift from production of surplus crops to other activities, or who is gradually retiring from farming while continuing to live on the farm. It is helpful for those whose objectives are to reduce farming operations in order to reduce labor requirements, to continue working off the farm, or to take advantage of other employment opportunities.

The CAP program helps to adjust land use to current and future needs. In the United States only about two-thirds of the cropland available is used for crop production. The upward trend in farm production is continuing, even though the number of farms has decreased.

On the other hand, the growing population, especially in already crowded metropolitan areas, needs more open spaces and woodland for hunting, fishing, and other outdoor recreational needs. The Cropland Adjustment Program helps take care of these needs.

The conservation cost-share feature available to farmers under this program helps to assure that land taken out of crop production is shifted to a resource conserving use.

The legislative authority for all phases of the CAP program ends in 1970. The authority for new business each year depends upon annual appropriation of funds by the Congress. CAP funds were deleted from the appropriation bill for both fiscal years 1968 and 1969.

CAP Public Access

In addition to adjustment payments and conservation cost-share payments, a farmer may be able to get an extra incentive for allowing the general public free access to land designated under a CAP agreement. This free access would be for the purpose of hiking, hunting, fishing, and trapping.

Greenspan Program

The "Greenspan" phase of the cropland adjustment program is authorized by Congress as one answer to the need for more open space and less land in surplus crops. The Greenspan idea is to take cropland out of agricultural production and convert it to open space, public recreation, wildlife habitat, natural beauty, or to other uses that control air and water pollution.

The purposes of the program may be accomplished in two ways: (1) a community may acquire land; and (2) a farmer may shift acres out of certain crops while retaining title to the land. Communities buying cropland may receive financial help under the program similar to that going to farmers who sign CAP agreements.

Conservation Reserve Program of the Soil Bank

The Conservation Reserve Program was started in 1956. Farmers were encouraged to enter into contracts to take land out of production and to help conserve soil, water, and wildlife. Contracts were accepted each year through 1960. No new contracts have been accepted since 1960 but payments are continuing for contracts still in effect.

TEACHER'S GUIDE FOR PRODUCTION ADJUSTMENT PROGRAMS

Objectives:

1. To develop a means of differentiating various production adjustment programs.
2. To understand reasons for production adjustment.
3. To learn how to list major production adjustment programs and identify important provisions of each.
4. To recognize the relationship of federal production adjustment to production adjustment on the individual farm.
5. To apply production adjustment programs to their individual situations.

Suggested Learning Activities:

1. Discuss acreage allotments as they affect local farmers, students' farms, and/or land laboratory.
2. Explain marketing quotas and how they affect the local area.
3. Explain marketing certificates.
4. Use a student's farm or a hypothetical farm. Use worksheets on pages 16, 17, and 18 as a model; then ask students to suggest various ways of managing a farm to meet certain needs, using the various Production Adjustment Programs and the options available in each. (See page 22c).
5. Schedule guest speakers to discuss production adjustment programs (See resource persons list, page iic).
6. Have students individually or in small groups study production adjustment program of a commodity of interest to them.
7. Discuss production control alternatives.
   a. Examine efforts of farmers to control production
   b. Evaluate the effectiveness of voluntary production adjustment
   c. Study and discuss positions and proposals of various farm organizations.

8. Discuss the alternatives available to farmers under the various production adjustment programs, (See page 22c).
9. Have students debate or prepare speeches on the pros and cons of production adjustment programs.
10. Allow students to prepare a "model" farm production adjustment program. Write to U.S. Senator or Congressman explaining the "model" program and invite his reaction.

References:

1. ASCS Production Adjustment Programs, BI No. 5, Washington, D.C., ASCS, USDA, April, 1967.
2. Results of Marketing Quota Referendums, BI No. 10, Washington, D.C., ASCS, USDA, April, 1968.
3. The 1969 Voluntary Feed, Grain, and Wheat Programs, PA-906, Washington, D. C., U.S. Government Printing Office, 1969.

Other references and audio-visual aids may be ordered on forms located in the appendices.

PRODUCTION ADJUSTMENT PROGRAMS

History of Adjustment Programs

(See also History and Background, page 65)

Congress has authorized a number of programs to help adjust the production and marketing of farm crops. Base acreages were first used with programs carried out under the Agricultural Adjustment Act of 1933. (See the Agricultural Adjustment Act of 1933, The Soil Conservation and Domestic Allotment Act of 1936, and the Agricultural Adjustment Act of 1938).

Through these acts and their amendments, an effort has been made to have farmers adjust production to requirements for food and fiber.

Acreage Allotments and Marketing Quotas

The Agricultural Adjustment Act of 1938 was amended to cover six basic commodities: wheat, corn, cotton, rice, tobacco, and peanuts. Subsequent amendments added non-basic commodities such as barley, oats, and rye.

Both acreage allotments and marketing quotas are used to adjust production. Acreage allotments when used alone are primarily guides with accompanying inducements for compliance. The farmer not complying usually loses the privilege of taking part in the price-support available for the crop.

Acreage allotments are usually set for the nation and then divided among the states. The states either divide them directly among farms or by counties. If allotments are divided by counties, the county ASCS office then divides them among farms. The method used depends upon the commodity.

Marketing quotas and acreage allotment programs may be used together under conditions of heavy supply when a two-thirds majority of the voting producers approve. When quotas are in effect, all producers who are not covered by exemptions are subject to monetary penalties on production or marketings from their excess acreage. Excess acreage is that acreage which exceeds the farm allotment.

Under present controlling legislation, marketing quotas can be applied only to the six basic crops. The Secretary of Agriculture is directed by law to proclaim marketing quotas when supplies of a basic crop are excessive. The level at which quotas must be proclaimed for most crops is specified by law.

Provision is made for increasing, suspending, or terminating quotas under certain supply and demand conditions, in the interest of consumers, or in national emergencies.

Quotas seek to limit the marketing of the commodity during the marketing year by placing penalties of so much per pound or per bushel on marketings in excess of the quota. The crop grown on the farm allotment acreage may be considered as the farm quota.

Voluntary Diversion Programs

Wheat Program

The wheat program is designed to maintain farm income from wheat, to stabilize wheat supplies, and to meet increased demands for the crop.

Several methods are used to obtain these goals under the Food and Agriculture Act of 1965. A national wheat allotment is set each year.

Planimetering operations to determine acreages

Sending report of measured acres to farm operations

When the national wheat allotment is less than 55 million acres each farm must divert a share from the production of wheat to conservation uses.

Wheat used for domestic food consumption is supported at the parity price. This is accomplished through a combination of wheat marketing certificates and price-support loans and purchases.

Wheat marketing certificates may be issued on a percentage of the projected production from the farm allotment. The normal yield times the number of acres of wheat seeded for harvest, not to exceed the allotment, is considered the projected production. The value of the certificates is the difference between full wheat parity and the national average loan value. Marketing certificates are equivalent to direct payments. Processors of wheat are required to buy domestic certificates for each bushel of wheat they use to manufacture food products for domestic consumption.

Marketing certificates must be shared between landlord and tenant in the same proportions as the crop is shared, unless other arrangements are approved by the state ASC committee.

When authorized for the crop year, diversion payments can be earned by diverting acreage below the farm allotment. The per acre payment is based on a percent of the county wheat loan value multiplied by the projected yield.

Where a producer is signed up for both the wheat and feed grain programs, wheat may be substituted for feed grains or feed grains for wheat within the total permitted acreage. Price-support loans and purchases will be available on the entire production of wheat and feed grains.

Feed Grain Program

The objectives of the feed grain program include preventing the buildup of excess stocks, reducing program costs, and raising farm income by assuring fair prices for feed grain producers, and providing a basis for stability for livestock prices.

Loans and price-support payments may also be available on some feed grain crops. Payments are made only if the acreage of one or more of the feed grains covered by the program are reduced. This reduction must be at least the minimum percentage below the farm's total base acreage and the acreage diverted is in an approved conserving use. Payments for the minimum required diversion generally are limited to growers on small farms. Additional diversion is permitted subject to current program regulations.

Where a producer is signed up for both the wheat and feed grain programs, wheat may be substituted for feed grains or feed grains for wheat within the total permitted acreage. Price-support loans and purchases are available on the entire production of wheat and feed grains. For specifics of the latest feed grain program provisions, see your county ASCS office manager.

Directions for Using Production Adjustment Worksheets

The two worksheets on the following pages are to be used to calculate program benefits for the voluntary wheat and feed grains programs. The brief outline below indicates the sources for the information needed to complete the worksheets.

Voluntary Wheat Program Worksheet - Page 16

A. Sign up dates - obtain dates from ASCS office

B. Farm data - secure from farmer or at ASCS office

C. Price Support and Loan Provisions - secure from ASCS office

D. Diversion Payments - calculate from information secured above

E. Substitution - check on program for current year at ASCS office

Voluntary Feed Grains Worksheet - Pages 17 - 18

A. Sign up dates - obtain data from ASCS office

B. Farm data - secure from farmer or at ASCS office

C. Feed Grain Crops - obtain data from ASCS office

D. Price Support and Loan Provisions - obtain data from ASCS office

E. Price Support Payment Formula - use formula to calculate price support payments for farm

F. Diversion Payment Provision - calculate diversion payments for farm

Worksheet for Voluntary Wheat Program _____ County

A. Sign Up Dates _____ to _____

B. Farm Data for farm of _____

Farm wheat allotment _____

Farm conserving base _____

Feed grain base _____

Acres of cropland on farm _____

Normal wheat yield per acre for farm _____

Wheat price support rate for current year _____

Wheat parity _____

Wheat loan rate per bushel _____

Value of domestic marketing certificates _____

C. Price Support and Certificate Eligibility Provisions

Must comply with wheat allotment to be eligible

Must divert acreage equal to _____% of wheat allotment to soil conserving uses

Marketing certificates

Formula:

Allotment x normal yield x _____%[1] x value of wheat marketing certificate
equals total certificate value per acre

Certificate value = (wheat parity - average national loan value)

D. Diversion Payments

Maximum diversion eligible:

Allotment less than 21.7 acres can be totally diverted

Allotment of 21.7 to 38.3 acres, diversion can be 25 acres plus 15% of 38.4

Allotment larger than 38.3 acres, 50% of allotment can be diverted

_____% of county wheat loan x normal farm yield equals diversion payment per acre

E. Substitution

By signing up for and complying with the feed grain and wheat programs, wheat can be substituted for feed grains.

[1] Percentage of wheat yield expected from the allotment for the farm. Set at 43 percent in 1969.

Worksheet for Voluntary Feed Grains Program _____ County

A. Sign Up Dates _____ to _____

B. Farm Data — Acres

Farm feed grain base	_____
Farm wheat allotment	_____
Farm conserving base	_____
Acres of cropland on farm	_____

C. Feed Grain Crops included in program this year (check crops that apply)

Crop	Established yield	Loan rate	Support rate
_____ Corn	_____	_____	_____
_____ Oats	_____	_____	_____
_____ Barley	_____	_____	_____
_____ Rye	_____	_____	_____
_____ Grain sorghum	_____	_____	_____
_____ Other[1]	_____	_____	_____

D. Price Support Eligibility Provisions

Diversion Requirements

Minimum percentage _____ of feed grain base

E. Price Support Payment Formula

Support Payments = Support rate x established yield x (smaller of permitted acreage, actual planting, or _____ per cent of feed grain base)

F. Diversion Payments Provision[2]

Total acres diverted _____

Farm conserving base _____

Price support minimum diversion _____

Diversion eligible for payments = acres diverted up to _____ percent of feed grain base less price support minimum acreage diversion

Acres eligible for diversion payments _____

Diversion Payment Formula[3]

Amount per acre = (Loan rate + support rate x established yield per acre) x _____ percent.

[1] When wheat is substituted for feed grain, it should be included here

[2] Go to next page for small farm provisions

[3] Applies to feed grain bases above 25 acres

F. Diversion Payment Provision[4]

Total acres diverted _____

Farm conserving base _____

Price support minimum

diversion _____

Diversion eligible for payments

1. Minimum diversion _____ acres
2. Additional diversion (total acres diverted minus minimum diversion) _____ acres

Diversion Payment Formula

1. Amount per acre for minimum diversion = (loan rate + support rate x established yield per acre) x _____ percent.
2. Amount per acre for additional diversion = (loan rate + support rate x established yield per acre) x _____ percent.

[4] Applies to feed grain bases 25 acres or less

Level of and Eligibility for Price Support

Price support payments for the basic crops - wheat, cotton, corn, rice, peanuts, and tobacco - are provided for by law. The only exception is that support for tobacco is not available if quotas have been disapproved at the last referendum by growers.

Eligibility for price support payments for individual farmers on all of the basic crops, except corn, depends on not exceeding the acreage allotment for that crop. Allotments and quotas do not apply to corn. Price support payments may be made available to non-cooperators at the discretion of the Secretary of Agriculture. Support levels for non-cooperators cannot exceed the levels of price support to cooperators. Each farm has an established farm base for feed grains.

A grower may qualify for feed grain price support on approved crops by participating in the feed grain program. This means reducing the total acreage of approved crops to at least the minimum required diversion below the total farm base and shifting this diverted acreage to a conserving use, plus meeting other provisions of the program.

Price support for wheat covered by domestic certificates (estimated to be the wheat needed for domestic use) shall be at 100 percent of parity, or as near thereto as the Secretary determines practicable. Support for wheat not covered by marketing certificates is determined by the Secretary at a level not in excess of the parity price. He takes into consideration competitive world prices of wheat, the feeding value of wheat in relation to feed grains, and the level at which price support is made available for feed grains. (See explanation of wheat program, Page 12). In the event of an emergency, the Secretary of Agriculture may increase the support above the specified parity level for any needed crop.

On tobacco crops for which quotas have not been disapproved, legislation directs that the support level be determined by adjusting the 1959 support level upward or downward in proportion to changes in the parity index (prices paid by farmers, including interest, taxes, and wage rates), using

the previous three-year moving average. Thus, the "change in the parity index" will be determined according to the ratio of the average prices paid by farmers during the previous three years to the average prices paid in 1959. The 1959 support level multiplied by this ratio will be the support level for the current crop. Average of $\frac{\text{last 3 years}}{\text{1959 price}}$ x 1959 support level = current support.

For corn, legislation provides that in the case of any crop for which an acreage diversion program is in effect for feed grains, the level of price support for corn shall be at a level not less than 65 percent or more than 90 percent of the parity price. The Secretary determines the percentage in order to achieve the acreage reduction goal established by him for the crop. A portion of the support price for any feed grain included in the acreage diversion program may be made available to producers through payments. This strengthens the assurance that those producers who cooperate in reducing their acreages of feed grains may receive the direct benefits of the price support and diversion programs. (See explanation of feed grain program, Page 13).

Price supports for the other feed grains are established by law according to the parity price level which the Secretary determines is fair and reasonable. He considers the level at which price support is made available for corn, and takes into consideration the feeding value of such commodity in relation to corn and certain other factors. These factors include supply in relation to demand, the ability of the Commodity Credit Corporation to dispose of stocks acquired under price support, and the ability and willingness of producers to keep supplies in line with demand and support levels for other commodities.

The Conservation Reserve of the Soil Bank
(See Page 10)

Farmers took part in the Conservation Reserve of the Soil Bank by voluntarily contracting with the Commodity Stabilization Service (the predecessor of ASCS) to "reserve," or withdraw, a stated acreage of their

cropland from production for a period of three, five, or ten years, and to devote it to an approved conservation practice. For this, the farmer received conservation cost-sharing and technical assistance in addition to annual payments to compensate for the loss of income the acreage would otherwise have produced.

The Conservation Reserve was begun in 1956, and authority to put new land in the program ended with the 1960 program. Annual payments will continue to be made for the term of the contracts in effect. All contracts except a few special forestry cases have expired.

Cropland Conversion Program

Under a land-use adjustment program authorized on a test or pilot basis by the Food and Agriculture Act of 1962, farmers receive assistance in converting cropland to other income-producing uses which also conserve soil and water resources. The program encouraged profitable alternative uses of cropland which had been producing row crops and small grains that were not needed at present. The Secretary of Agriculture entered into agreements with farmers to convert cropland for a period of three to ten years to grass, forests, water storage, wildlife habitat, or recreational facilities.

Farmers who participated in the program received adjustment payments, cost-sharing payments, and technical assistance. The program is administered by ASC committees with technical assistance provided by the Soil Conservation Service and the federal or state forestry agencies.

As a test or pilot program it has had little significance in the total farm program. However, information learned from the program has significance for future program planning.

Cropland Adjustment Program (See Page 8)

The Cropland Adjustment Program (CAP) authorized by the Food and Agriculture Act of 1965, seeks to shift cropland producing crops in actual or potential surplus into long-term (5 to 10 years) conservation, recreational, and open space uses. The program also offers assistance to farmers who because of age, off-farm employment, or other personal adjustment reasons desire to reduce their farming operations.

Accepted agreements are paid at a rate determined by the crop diverted and the productivity of the farm for that crop. Additional payments may be made, where offered, under agreements which permit free public access to designated acreage for hunting, trapping, fishing, and hiking. CAP participants agree to divert all of at least one of their bases or allotments and can then divert other crop bases and allotments.

The program's Greenspan provision makes grants to local and state governments to help them acquire cropland for non-farm uses such as preservation of open space and natural beauty, wildlife habitat, recreation, and prevention of air and water pollution. (See Page 10).

TEACHER'S GUIDE FOR PRICE SUPPORT THROUGH LOANS AND PURCHASES AND FARM STORAGE FACILITY AND DRYING EQUIPMENT LOANS

Objectives:

1. To develop an understanding of programs which support prices of farm commodities through loans and purchases.
2. To develop an understanding of commodity marketing, storage, and drying.
3. To develop the ability to write about agriculture and its relationship to the national economy.
4. To develop an understanding of the relationship of supply to demand and the effects of orderly marketing to price.
5. To develop an understanding of farm storage facility and drying equipment loans.

Suggested Learning Activities:

1. Discuss the stabilizing effect of price support through loans and purchases.
2. Discuss how loans help spread commodity marketing throughout the year and taper off the peaks at harvest time.
3. Discuss storage and drying facility loans and how these may affect a farmer's marketing program.
4. Compare prices at harvest time for common commodities in the area with prices at other times of the year. Make a wall chart or graph to illustrate this point.
5. Plan a visit to a farm and/or commercial grain drying and storage facility. Instruct class to prepare a list of questions for owner or manager to answer. Give the questions to the owner or manager ahead of time.
6. List reasons why farm price stability with a fair level of income is important to the entire national economy.

7. Discuss the theory that protecting farm income also protects farmlands from abuse in times of low net income.

8. Study the supply and price situation of an important local commodity.

References:

1. ASCS Price Supports, BI No. 4, ASCS, USDA, Washington, D. C., ASCS, USDA, October, 1968.

2. Enough Grain Storage on Your Farm, PA-462, Washington, D. C., U. S. Government Printing Office.

3. Hathaway, Dale E., and John F. Stollsteimer, The Impact of Price Support Programs Upon the Available Supplies of Farm Products, 1948-56, TB-277, East Lansing, Michigan, Michigan State University, Agricultural Experiment Station, 1960.

Production Adjustment Programs available in _____ County for 19 _____.

PROGRAM	MAJOR PROVISIONS

ERIC

PRICE SUPPORT THROUGH LOANS AND PURCHASES

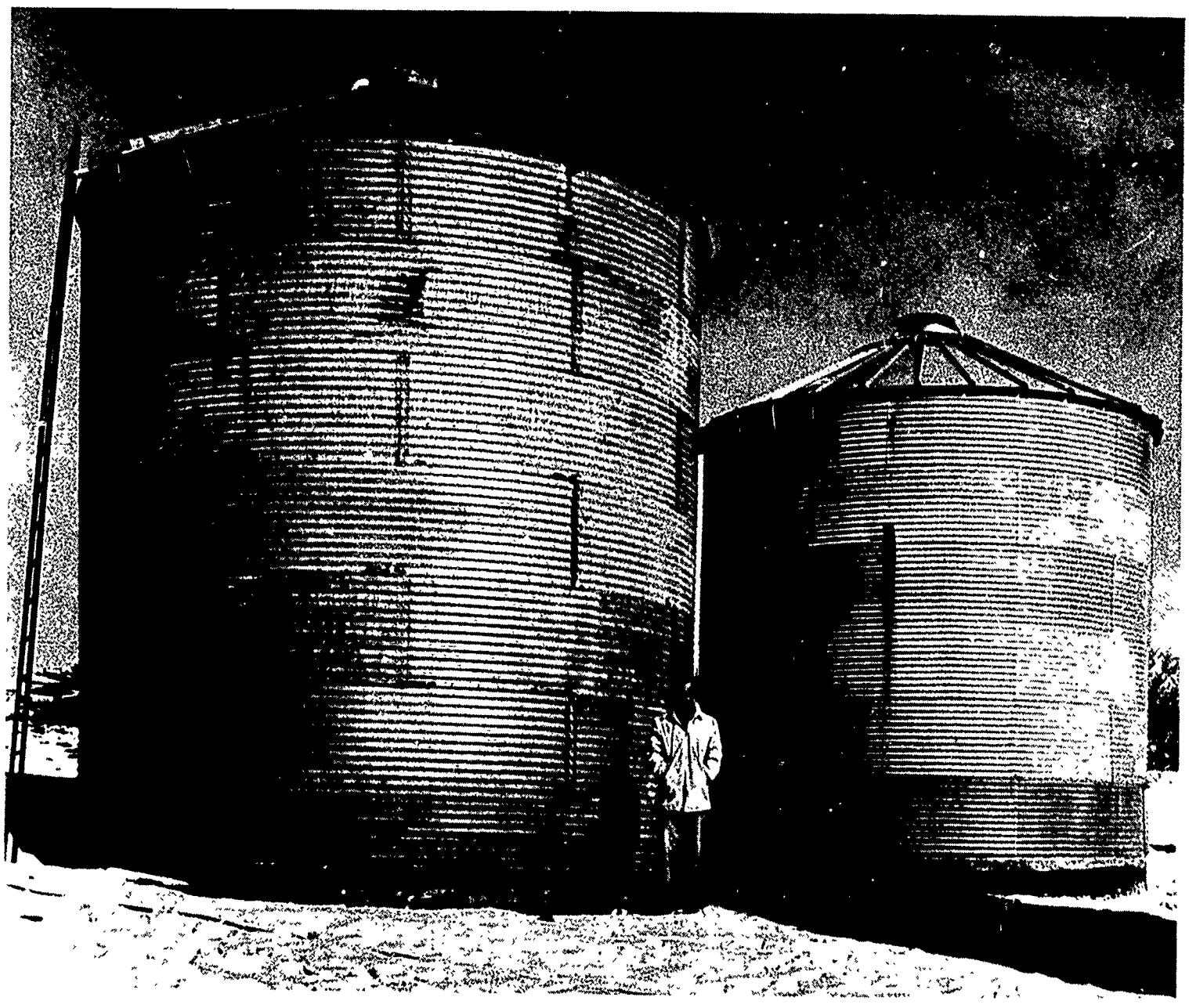
Objectives

The major objectives of the price support program are:

(1) to help assure stability of farm income and prices in the interest of all people;

(2) to assist in bringing about a better balance between agricultural production and consumption; and

(3) to promote orderly marketing of crops.



Farm stored corn under government price support loan. Bin was constructed with help of a farm storage facility loan.

Eligibility to Participate in Commodity Marketing

Producer compliance with acreage allotments, production goals, and marketing practices, including marketing quotas when authorized by law, may be required as a condition for eligibility for price support.

Types of Programs

Direct Purchases

The initiative to purchase and to acquire commodities and their products under the price support program rests with the Secretary of Agriculture and the Commodity Credit Corporation (CCC). In the case of dairy products this action is directed by law.

Direct purchases may be made in quantities necessary to carry out the support program. Direct purchases are used primarily for perishable commodities which must be purchased and disposed of, or processed promptly to avoid waste. When to make direct purchases is determined largely by production in relation to market demand and market price.

Direct purchases of many commodities may be made in areas where farm or commercial storage is not available for immediate delivery at the support price.

Price Support Payments

Direct payments to producers are made for some commodities. Marketing certificates may be issued in the case of wheat. These methods in effect raise the return to the producer per unit of commodities produced.

Commodity Loans

Government price support loans to farmers are made directly through ASCS county offices or through approved agricultural cooperative marketing associations, or both, on the security of the stored commodities. Depending on the commodity, storage may be on the farm, in country elevators, in terminal elevators, or in other commercial warehouses.

Price support loans are non-recourse. CCC looks only to the pledged or mortgaged collateral (the commodity) for settlement of the loan. Except for tobacco, which is handled by approved cooperatives, and peanuts, the farmer may repay the loan, with interest, at any time prior to its maturity. A service fee is charged on each loan that involves farm-stored commodities and on most loans that involve warehouse storage. Monthly interest is charged on the loan except for the month of the repayment. If the farmer chooses not to repay, CCC takes title to the commodity, and the loan, including interest, is satisfied. Before assuming title to the stored commodity, however, CCC determines through ASCS county offices that the commodity is the same grade and quantity as it was when stored. In addition, a small delivery fee is charged per bushel or per hundred pounds on delivered commodities.

Tobacco loans are made available through cooperatives and the collateral, or commodity, of all producers' crop is pooled. In the case of tobacco redemptions, the cooperative markets the collateral and remits the sales proceeds to apply to the loan. If the sales by the cooperative return a profit over advances, charges, and interest, it is returned to the growers as a patronage dividend.

While the loan programs do not guarantee the participating farmer a profit, they do offer definite safeguards and advantages to his operations if his commodity is eligible to be placed under loan. The loan program gives farmers an opportunity to obtain cash and to hold their crops for later sale without market risk. In practice, if the producer cannot profitably pay off his loan and sell the collateral, the loan may be satisfied in full by his paying a delivery fee and letting CCC take over the collateral.

The loan program tends to even out marketings. In order to meet operating costs, farmers would otherwise be inclined to market their crops at harvest time. This sometimes makes for market gluts, undue burdening of the transportation system, and lower prices. Price swings and transportation bottlenecks are minimized to a great extent by spreading commodity marketing over the season.

The loan programs also give producers a chance to exercise greater independence in their marketing operations and the opportunity to benefit from price increases which otherwise may not have occurred until after their products were sold.

Reseal Program

How Reseal Works

"Reseal" is a term commonly applied to the renewal or extension of a price-support loan beyond the original maturity date. The commodity held on the farm as collateral is put under "seal," and when the loan is extended the collateral is "resealed." The term "reseal" is also used in referring to extended loans on warehouse-stored commodities, although such commodities are not sealed as they are on the farm.

Extension of the loan, "resealing," enables the farmer to keep the commodity under loan for a longer period, while retaining ownership. The farmer continues to have the option of paying off the loan and selling the crop himself, if this would be to his advantage. Or, the farmer can deliver the commodity to Commodity Credit Corporation to satisfy the loan.

CCC retains the option to terminate reseal loans and ask for immediate payment.

Storage Payment

Reseal storage payments are made to the farmer on resealed crops if he provides farm storage, or if he prepays warehouse storage charges for the extended period.

If warehouse charges are not prepaid, CCC will make payments for the extended period to the storing warehouse. The farmer, however, is still liable for any warehouse charges which occur during the initial loan period.

Where Available

Reseal loans in commercial storage will be available in all areas throughout the country.

Reseal loans on farm-stored crops will be available in areas where the ASC State Committee determines that the commodity can be safely stored on the farm.

For further details on the reseal program see your ASCS County Office manager.

Incentive Payment Program

Incentive payments are made to encourage greater production of necessary commodities for national requirements. For example, production of wool in this country is well below national requirements. In fact it is on the decline due to factors such as increased cost of production and diminishing range lands. (See Page 31).

Procedures for Obtaining Price Support

Your ASC county committee can give you the provisions for a specific crop year including:

final date for requesting price support

loan maturity date

eligibility and compliance requirements

whether or not crop may be stored on farm as designated by state ASC committee

Options Available to the Farmer

Many options are available to the farmer. He may participate in one or more of the previously mentioned types of programs. In most cases, when a farmer has a price support loan, he can repay it with interest and then sell the commodity. He also may turn the commodity over to the CCC in payment of the loan and interest, or he may reseal the commodity.

Repayment Procedure

The loan method of support gives the farmer an option of either marketing his crop or keeping it under loan. If the market price rises above the loan level plus charges, he has the privilege of paying off the loan and selling his commodity in the open market. If the price fails to rise above the loan level, however, the non-recourse character of the loan agreement permits him to deliver the commodity to the Commodity Credit Corporation instead of repaying the loan and charges.

Every loan has a cut-off period before which time the farmer must choose an option and act upon it, or the CCC will take over the crop to satisfy the loan.

CCC Inventory Operations

Commodities acquired by CCC under the price support program are stored in commercial warehouses, if available, or in CCC-owned bins.

CCC may sell non-storable commodities without any restriction. Generally, sales of storable commodities for domestic use may be completed only if the price is 115 percent of the current support rate plus carrying charges. In addition, commodities owned by CCC may be made available under various donation programs - foreign and domestic - and for export sale.

FARM STORAGE FACILITY AND DRYING EQUIPMENT LOANS

Under these loan programs, ASCS encourages and aids farmers in the expansion of facilities needed for farm storage of price supported commodities. Government loans are available to farmers to enable them to construct grain storage bins and obtain the necessary drying equipment to effectively utilize the storage facilities.

Loans are authorized up to 85 percent of the out-of-pocket cost of storage facilities and drying equipment. Loans are made at approximately four percent interest and are repayable in four equal annual installments over a period of five years.

Farm storage facilities established in Venango County through farm storage facility loan

TEACHER'S GUIDE FOR WOOL AND SUGAR PAYMENT PROGRAMS

Objectives:

1. To differentiate between production incentive programs and production adjustment programs.
2. To write a brief explanation of the importance of wool and sugar to the nation.
3. To develop an understanding of incentive payment programs.
4. To identify the sources of revenue for incentive payment programs.

Suggested Learning Activities:

1. Discuss these programs as they involve incentive payments to increase production. Both of these commodities are produced at levels far below U. S. needs.
2. Discuss the fact that funds for the wool program come from import duties on wool and wool products.
3. Ask a student with a sheep project or a local sheep producer to explain how the wool program affects individual producer.
4. Discuss factors that could increase the importance of sugar production in Pennsylvania.

References:

1. The United States Sugar Program, BI No. 19, Washington, D. C., ASCS USDA, December, 1966.

2. The Wool Payment Program, PA-621, Washington, D. C., U. S. Government Printing Office, 1964.

WOOL PAYMENT PROGRAM

Objectives

The wool program makes incentive payments on sales of shorn wool and unshorn lambs to encourage production.

The United States does not produce nearly as much wool as it uses. As a result Congress set a policy of encouraging production in the National Wool Act of 1954. The Congress based this policy on the importance of wool to the U.S. economy and the national security.

Source of Revenue

The total amount of payments under the Act is limited to 70 percent of the duties collected on imports of wool and wool manufacturers. All revenue for this program comes from import duties on wool and wool products.

How Program Works

An incentive price for shorn wool is announced by the U.S. Department of Agriculture in advance of the marketing year. The producer sells his wool in the usual market channels.

At the end of the marketing year, the national average of the prices received by all growers is used to determine the percentage rate required to bring the national average of the prices received in the free market up to the incentive level previously announced.

The percentage is applied to each grower's net proceeds from his sales of shorn wool and unshorn lambs for the particular year to arrive at the amount of his incentive payment.

SUGAR PROGRAMS

Objectives

The United States Sugar Program has a three-fold purpose: (1) to protect the welfare of the U. S. sugar industry; (2) to provide U. S. consumers with ample sugar supplies at reasonable prices; and (3) to promote and strengthen the export trade of the United States.

Main Program Features

To meet these objectives, the sugar program sets annual U. S. sugar requirements; domestic and foreign sugar quotas; and processor marketing allotments. It also sets farm proportionate acreage shares; makes producer payments; and assures equitable division of sugar returns among growers, farm workers, and processors.

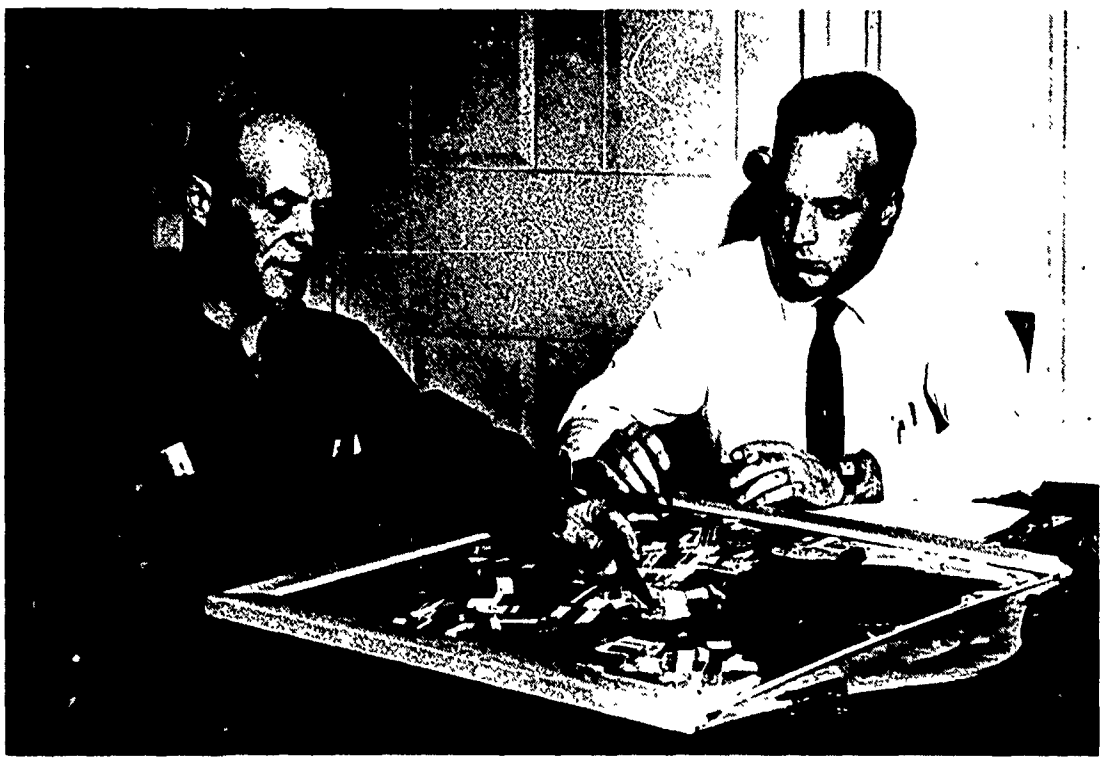
Payment Eligibility

Payments to producers and producer-processors are based on observance of acreage controls when needed, non-employment of child labor, payment of fair wages to workers, and payment of fair prices for sugar crops purchased from other producers.

COMPLIANCE

Compliance provisions began with the Agricultural Adjustment Act of 1938. Compliance operations have come far since their inception. At first, each and every field on each farm was measured. Now, certification is required. This is accomplished by the producer reporting his acreage to the ASCS county office.

For conservation practices the farmer's report of completion is usually accepted, except that practices requiring technical specifications must be certified by the agency having technical responsibility, such as the SCS or Forest Service. Farmers determine and report to the ASCS county office all program acreages for the farm and certify that all program



County Office Manager discussing a compliance visit with the Compliance Reporter

requirements have been met. These certifications replace most of the farm visits that used to be made to determine compliance; however, a percentage of the farms are visited to check the accuracy of acreages certified. The county office will give farmers assistance in determining their acreages, including a copy of the aerial photograph showing field acreages, measurement services at cost, and assistance in computing acreages from measurements made by the farmer.

Farmers may obtain special measurement services upon request and payment of the cost. These services help the farmer to comply with program limitations. In many cases they save the expense of growing excess crops that must later be destroyed to meet compliance. The principal service available in most counties is called pre-measurement.

Through this service an ASCS reporter will measure and stake the exact acreage to be planted. A farmer may also have his acreage measured after planting. He can then adjust the acreage, if necessary, before he certifies acreage to the county office.

If you have any questions on any program contact your County ASCS office for assistance.

TEACHER'S GUIDE FOR FOOD AID PROGRAMS

Objectives:

1. To develop an understanding of food aid programs sponsored by the USDA designed to prevent starvation.
2. To show that food aid programs help distribute surplus food and are designed to develop new markets.

Suggested Learning Activities:

1. Arrange a class discussion of the value of food aid programs in wiping out starvation pockets around the world.
2. Discuss the effect of hunger on the political climate of countries.

Audio-Visual Aids:

Filmstrip, "The World Food Crisis," New Holland Division of Sperry Rand Corporation, New Holland, Pennsylvania 17557.

References:

1. The New Food Aid Program, Washington, D. C., USDA, November, 1966.

FOOD AID PROGRAMS

A former president said: "Men first joined together for the necessities of life--food for their families, clothing to protect them, housing to give them shelter. These are the essentials of peace and progress. But in the world today, these needs are still largely unfulfilled. When men and their families are hungry, poorly clad, and ill-housed, the world is restless--and civilization exists at best in troubled peace. Hunger poisons the mind. It saps the body. It destroys hope. It is the natural enemy of every man on earth."

Since 1954, when Congress passed the Agricultural Trade Development and Assistance Act, Public Law 480, the United States has attempted to use domestic agricultural surpluses to combat hunger.

New programs will likely cover at least the following four areas that have been used in past programs.

Important features of P.L. 480 have included:

Title I -- authorize sales of U.S. farm products for local currencies and for dollar credits.

Title II -- authorize famine relief and donations of food, both on government-to-government basis and through voluntary organizations.

Title III -- authorize barter of U.S. farm products for materials and service from abroad.

Title IV -- stipulate that the programs will be used to help those friendly countries that seriously try to cope with their own problems of food and population. Also provides criteria for determining selection of commodities to be used in the program.

Summary of Past Achievements

The food aid programs, since 1954, have come from Public Law 480. This program has performed a service unique in world history--massive sharing of U.S. agricultural products with less-developed, food deficient countries as a means of preventing hunger and stimulating economic development.

Public Law 480 has been supplying food aid to 116 countries, containing about one-half of the world's population. It has prevented mass starvation in India. It has improved the diets of more than 40 million of the world's school children. It has helped countries to become more prosperous. It has built bigger cash markets for American farm products.

From the beginning of Public Law 480 in 1954 through June 30, 1966, the program has moved to foreign consumers about 165 million metric tons of U.S. farm products, having a market value of $15.5 billion.

This type of food aid obviously helps the many foreign people who, without it, would be going hungry--but it brings back benefits to the U.S. as well. Large amounts of foreign currencies received from sales of U.S. farm products abroad are being used to pay U.S. expenses overseas. Large amounts are used to pay costs of the programs designed to build larger foreign markets for U.S. farm products, carried out by the U.S. Department of Agriculture in cooperation with U.S. food, agriculture, and trade groups. Since Public Law 480 began, more than half of the $116.8 million spent for export market development in the joint government-industry program has come from such funds.

The economic development that is built into these food aid programs improves U.S. export sales opportunities. A USDA study shows that when per capita income of less-developed countries increases 10 percent, dollar sales of U.S. farm products go up 21 percent. In other words, as incomes of foreign consumers go up, their purchases of U.S. farm products increase twice as fast. In this way a number of countries have moved from "aid" to "trade"--Japan, Italy, and Spain are examples. Once aid recipients, now they are big cash buyers of U.S. farm commodities.

Evidence that this transition from "aid" to "trade" can and does take place is found in the export statistics. Exports of U.S. farm products under government programs as a percentage of total agricultural exports have dropped steadily from 39 percent in fiscal year 1956 to 24 percent in fiscal year 1966.

U.S. food aid has been accompanied by a dramatic increase in dollar-earning commercial exports.

TEACHER'S GUIDE FOR DISASTER ASSISTANCE

Objectives:

1. To develop an understanding of disaster assistance programs and where to find aid.
2. To develop the ability to identify the major responsibilities of ASCS for disaster assistance.
3. To list the types of disasters that could qualify under assistance programs.

Suggested Learning Activities:

1. Discuss past cases of disaster assistance or some that could occur in the area and/or how disaster assistance could become vitally important to the area.
2. Discuss the role of disaster assistance in protecting such important farm commodities as foundation herds.
3. Have students develop a history of past disaster assistance programs used in the area.

Audio-Visual Aids:

Slide Series - Disaster Programs, ASCS, Washington, D. C.

References:

1. Disaster Assistance Available Through ASCS, BI No. 20, Washington, D. C., ASCS, USDA, March, 1966.

DISASTER ASSISTANCE PROGRAMS

Disaster assistance to meet the emergency needs of agriculture is available through the ASCS. Disasters may be floods, hurricanes, earthquakes, drought, windstorms, or unfavorable economic conditions as the result of natural catastrophes. Farmers Home Administration offers emergency credit to farmers in a disaster area.

The measures used can be applied to any designated disaster area in the United States to offset or prevent losses or damage when natural disasters strike farmers or ranchers, livestock, farm or range lands, water supplies, or wildlife.

The assistance is provided through: (1) donation or sale of Commodity Credit Corporation-owned feed grains, (2) grazing and haying privileges on diverted or retired croplands, (3) emergency conservation measures under the Agricultural Conservation Program, and (4) emergency wildlife feeding assistance.

Feed donation, sale of feed, and grazing and haying programs on diverted acres directly affect the maintenance of livestock in designated disaster areas. The need for any or all of these programs is recommended first by County Disaster Committees. State Disaster Committees then review the recommendations and determine whether assistance should be made available. In addition, certification by the governor of the state involved is required before affected areas are designated as "disaster areas." Certification by the governor of a state is not required when only emergency conservation or wildlife feeding is involved.

Three member disaster committees have been established in each state. Members are the directors of the Farmers Home Administration, the Cooperative Extension Service, and the ASC State Chairman, who also serves as disaster committee chairman. State Disaster committees report all emergency situations, and, when necessary, recommend that U.S. Secretary of Agriculture designate as disaster areas any regions that require emergency assistance.

Inspecting drought stricken corn in anticipation of requesting emergency livestock feed program

TEACHER'S GUIDE FOR DEFENSE READINESS PROGRAMS

Objectives:

1. To learn how a nuclear attack could affect rural people, livestock, land, and crops.
2. To understand how ASCS and other USDA agencies are involved in and organized for defense readiness.

Suggested Learning Activities:

1. Discuss how a nuclear attack could:
   a. Affect rural people and their need for adequate shelter
   b. Affect livestock and the need to protect and provide clean feed and water for them
   c. Affect land and crops
2. Discuss how farmers would get seed, fertilizer, and farm equipment and repair parts following a nuclear attack.
3. Discuss how USDA is organized to carry out its defense emergency responsibilities.

Audio-Visual Aids:

Audio-Visual materials on fallout and related subjects should be available from the county agent.

Fallout and Agriculture, (16mm. sound, color, 23 minutes), Agricultural Extension Film Library, Armsby Building, University Park, Pennsylvania.

The Safest Place, (16mm. sound, color, 12-1/2 minutes), Agricultural Extension Library, Armsby Building, University Park, Pennsylvania.

References:

1. Defense Against Radioactive Fallout on the Farm, Farmers' Bulletin No. 2107, U.S. Department of Agriculture.

2. Defense Responsibilities in USDA. Reprint of Chapter 4, Title 1, of the USDA Administrative Regulations, Washington: United States Department of Agriculture, June, 1968.

3. Farm Equipment and Repair Parts; What Manufacturers, Distributors, and Dealers Should Do with Them in a National Emergency, PA-498, Washington: U.S. Government Printing Office, 1962.

4. Fertilizers: What Manufacturers, Distributors, and Dealers Should Do with Them in a National Emergency, PA-540, Washington, D. C. U.S. Government Printing Office, 1962.

5. Seed: What Producers, Processors, Distributors, and Suppliers Should Do with Seed in a National Emergency, PA-753, Washington, D.C., U.S. Government Printing Office, 1966.

DEFENSE READINESS PROGRAM

The objective of the defense readiness program in the Department of Agriculture is to maintain a state of readiness in order to carry out food and agricultural programs in an emergency. In an emergency situation USDA is to provide leadership and guidance to state and local governments, farmers, and the food industry to assure conservation and continuity of the nation's food supply and the preservation of agricultural resources.

Defense responsibilities in USDA stem from regular program authorities, defense emergency legislation, and special executive orders. These

A County Defense Board in Session

responsibilities have been assigned to agencies whose peacetime activities bear a close relationship to programs that are essential in an emergency.

ASCS has been assigned defense preparedness functions relating primarily to farm production and the management of grains and price support. ASCS personnel are experienced in the administration of farm and price support programs, and programs to alleviate the effects of natural disasters. This experience would be valuable in defense emergency programs including:

(1) emergency production of crops and livestock, including poultry;

(2) processing, storage, and distribution of seed and livestock feed;

(3) mixing of fertilizers and distribution of fertilizers and farm equipment;

(4) storage and movement of all grain in raw form; and

(5) estimating requirements for manpower, equipment, fertilizer, fuels, and other supplies and services needed for agricultural production, and other emergency programs for which ASCS is responsible.

ASCS also is responsible for the Commodity Credit Corporation programs which guarantee emergency loans made by financing institutions to business firms that handle food for which USDA has emergency responsibility. In some instances ASCS has authority to make direct loans.

Commodity Credit Corporation stocks which are administered by ASCS automatically provide a stockpile of food and livestock feed for emergency use.

TEACHER'S GUIDE FOR SECTION 32 PROGRAMS

Objectives:

1. To understand the Section 32 programs.
2. To learn to compare and contrast Section 32 programs and Food Aid programs.

Suggested Learning Activities:

1. List Section 32 programs in which students have participated.
2. Discuss how these programs have helped lower the supply of surplus commodities.
3. Prepare a committee of students to interview the school cafeteria manager regarding use of surplus foods in the lunch program. Determine the effect on the cost of lunch per pupil.

ERIC

SECTION 32 - DIRECT PURCHASES FOR SURPLUS REMOVAL

Purposes

Section 32 programs are administered by the Consumer and Marketing Service, USDA. The purchase of the Commodities used is handled by ASCS.

The main objectives of Section 32 programs are:

a. to encourage exports of agricultural commodities and products;

b. to encourage domestic consumption of commodities or products by diverting them from the normal channels of trade and commerce; and

c. to re-establish farmers purchasing power by making payments in connection with the normal production of any agricultural commodity for domestic consumption;

One way of increasing commodity utilization has been emphasis on use by persons in low income groups.

Export Programs

Most export programs under Section 32 have involved cash payments to commercial exporters following the export of privately owned commodities.

Purchase and Donation Programs

Under purchase and donation programs the Department of Agriculture purchases surplus agricultural commodities from farmers, farmers' agents, cooperatives, and processors. Purchases also are made from Commodity Credit Corporation stocks.

Commodities purchased are donated through the facilities of state distributing agencies to groups eligible to receive them. These groups include:

a. public or non-profit private schools of high school grade or under which operate non-profit school lunch programs;

b. non-profit, non-penal, or non-educational public or private institutions devoted to a charitable or public welfare purpose, where needy persons are served. This group includes hospitals,

homes for the aged, orphanages, missions, summer camps, child care centers, and state and local correctional institutions;

c. public or private welfare agencies that assist needy persons; and

d. non-profit organizations providing emergency or disaster relief.

State distributing agencies, acting under agreements with the Department of Agriculture, determine the specific organizations meeting the requirements specified by the department to obtain donated food.

The federal government pays the cost of shipping the commodities in carload lots to central receiving points within the state. The states are responsible for arranging for delivery of the commodities to recipients.

Section 32 purchases are limited to the quantities that can be moved to eligible outlets. These outlets must be determined before a program is initiated.

Other Diversion Programs

New use programs have been used much less widely than export, purchase, and donation operations. Their objective is to encourage the use of surplus commodities in different ways that would occur without the program.

Diversion programs have taken many forms, including experiments or demonstrations to develop new uses, such as cotton for insulation; operations involving increased use of surpluses in by-product or secondary uses, such as potatoes for livestock feed and starch, and tobacco for insecticides. Other products have been made available to consumers outside the products' regular marketing areas.

Payments are made after the diversion has taken place. The terms and conditions under which payments are made are generally contained in a contract. Payments sometimes are made to a processor who uses a commodity for other than a normal purpose. These payments allow him to pay the full market price for the commodity. In other cases, payments are made to the farmer or to another person, who sells the commodity at a

reduced price to a diversion outlet that does not involve processing as part of the diversion. This payment helps to equalize the return the farmer receives from the lower-priced use as compared with the regular outlet. All products produced under a diversion program are sold by the manufacturers through regular trade channels.

Programs to Re-establish Farmers Purchasing Power

No programs have been initiated in recent years. The last program was undertaken in fiscal year 1960 to re-establish the purchasing power of cranberrry growers.

Source of Section 32 Funds

Section 32 programs are financed by a continuing appropriation equal to 30 percent of the import duties collected on all commodities entering the United States under the custom laws, non-agricultural commodities as well as agricultural, plus unused balances up to $300 million. These funds become available at the beginning of each fiscal year without any further legislation.

Under the Agricultural Act of 1956, an additional sum of $500 million may be appropriated annually to carry out the purposes of Section 32.

Occasionally, Section 32 funds have been made available by legislative action for other purposes such as foreign market development, agricultural utilization and production research, the pilot food stamp program, school lunch programs, and special milk activities.

The National School Lunch Program

The National School Lunch Program, as well as the special milk, food stamp, and other food assistance programs described on the following pages, is not administered by ASCS. However, ASCS purchases the commodities for these programs. These programs are operated through the Consumer and Marketing Service of the USDA.

Program Objectives

The school lunch program is designed to accomplish the following:

a. to improve children's health and well-being by providing them a well-balanced, nutritious lunch at school. In addition, the program is designed to develop proper and nutritionally beneficial food habits.

b. to broaden the market for agricultural food commodities by:

(1) providing an expanding market for agricultural commodities through local purchases of food by school lunch programs in commercial channels of trade;

(2) serving as an outlet for agricultural commodities purchased by the Department of Agriculture to lessen local and seasonal surpluses;

(3) expanding the outlet for highly nutritious foods, particularly in areas of nutritional deficiencies; and

(4) introducing a wider variety of foods to create a demand for commodities that many families otherwise could or would not buy.

Special Milk Program

The program is designed to encourage consumption of fluid milk by children in (a) non-profit schools of high school grade and under, and (b) non-profit nursery schools, child-care centers, settlement houses, summer camps, and similar non-profit institutions devoted to the care and training of children.

Food Stamp Program

The Congress established the Food Stamp program in the expectation that increased utilization of foods to maintain adequate national levels of nutrition would (a) tend to distribute agricultural abundance in a beneficial manner; (b) strengthen the agricultural economy; and (c) result in more orderly marketing and distribution of food.

Other Food Assistance Programs

The Child Nutrition Act of 1966, which extended the special milk program for three years, also authorized the department to:

a. provide funds to help buy food service equipment for schools in low income areas;

b. initiate a pilot program offering nutritious breakfasts to children who live in low income areas, or have to travel long distances to school; and

c. extend the benefits of school food service to pre-school programs operated as part of a regular school system.

SUMMARY

Following is a brief summary of the relationship of farm programs to farm problems and the major areas in which ASCS is attempting to solve farm problems.

Conservation and Land-Use Adjustment Assistance

Conservation and land-use adjustment assistance is carried out by sharing with individual farmers the cost of installing needed soil, water, woodland, and wildlife conserving practices through the following programs:

a. The Agricultural Conservation Program
b. The Regional Conservation Program
c. The Cropland Adjustment Program
d. Greenspan Program
e. The Conservation Reserve of the Soil Bank
f. The Cropland Conversion Program

Production Adjustment

Production adjustment is carried out through acreage allotments, marketing quotas, land diversion payments, and price support. Increased production is encouraged by incentive payments for two commodities, sugar and wool, in which the nation is not self-sufficient.

Price Support

Price support is carried out through commodity loans and payments to farmers or through direct purchases of agricultural commodities from farmers or processors.

Management of Inventories

Management of commodity inventories are carried out through sales, export, and domestic payments, donations, storage, and related processing and shipping arrangements. The individual farmer is assisted in management of his inventories through loans on commodities and storage and drying facilities.

Disaster Assistance

Disaster assistance through direct assistance to farmers and ranchers whose supplies have been destroyed or whose farmlands have been seriously damaged by widespread flood, drought, or other disaster.

Defense Readiness

Assistance is available in preparedness and planning for civil defense purposes. In food production and protection the ASCS is prepared to assist farmers and consumers in case of enemy attack.

Section 32 Funds

Section 32 funds are used for direct purchases to remove surpluses from the normal market channels. The commodities purchased are used to improve diets of persons in the United States and other countries.

Food Aid Program

Through Public Law 480 food has been supplied to 116 countries. These 116 countries contain about one-half of the world's population. It has prevented mass starvation, improved diets, and helped countries to become more prosperous. The program has helped the U.S. by increasing cash markets for agricultural products and lowering surpluses of U.S. farm products.

TEACHER'S GUIDE FOR ASCS ORGANIZATION

Objectives:

1. To develop an understanding of the USDA and ASCS organization so that the student is better equipped to participate at the local level.
2. To develop an understanding of the farmer committee system.
3. To understand how farm programs are established by law and administered through ASCS.

Suggested Learning Activities:

1. Encourage students to attend an ASCS committee meeting.
2. List areas where the USDA affects student activities.
3. Invite the county ASCS office manager and/or county or community committeeman to speak to the class regarding ASCS organization.
4. List and discuss USDA agencies, emphasizing some with which students are familiar.
5. Arrange for more students to interview county or community committeemen. Coach students on how to get useful information.
6. Require students to be familiar with the United States Government Organizational Manual listed under references.
7. Acquaint students with the directory of ASCS personnel and committeemen located in the appendices of the teacher's manual.

Visual-Aids:

Slide Set No. 13, "Understanding the ASCS Organization," (Order forms are included in the appendices).

Make overhead transparencies of the charts on USDA and ASCS, pages 49 and 50.

References:

1. Election by Mail of ASC Community Committeemen; Vote for Farmers of Your Choice, PA-774, Washington, D. C., U.S. Government Printing Office, 1968.

2. The Agricultural Stabilization and Conservation Service, BI No. 1, ASCS, USDA, Washington, D. C., March, 1967.

3. Farmer Committee Administration of Agricultural Programs, BI No. 6, Washington, D. C., U.S. Government Printing Office, March, 1965.

4. The Farmer Committee System, PA-576, Washington, D. C., U.S. Government Printing Office, 1963.

5. Training Materials for Vo-Ag Teachers, SA-5, Washington, D. C., U.S. Government Printing Office, 1964.

6. United States Government Organizational Manual, Washington, D. C., U.S. Government Printing Office, 1968. (This publication is produced annually and should be available in school libraries).

7. You and the USDA, PA-542, Washington, D. C., U.S. Government Printing Office, 1963.

8. Your United States Department of Agriculture, PA-824, Washington, D.C., U.S. Government Printing Office, 1967.

SECTION II. ASCS ORGANIZATION

History and Structure of USDA and Parent ASCS

(A functional organization)

The Agricultural Stabilization and Conservation Service (ASCS) is part of the United States Department of Agriculture. The USDA administers many programs essential to public welfare in addition to the farm programs. These functions relate to research, education, credit, public health, the preservation of natural resources, assistance to needy persons, and foreign aid.

Just a few of the functions of the USDA are the sale of farm commodities to foreign countries or their donation to needy people in friendly countries. Other functions are the development and maintenance of our national forests, meat inspection, farm credit, rural area development, and a multitude of other programs and services for the benefit of the nation as a whole.

On May 15, 1862, President Lincoln signed the bill that established the Department of Agriculture. The bill was one of three designed to serve the interests of the family farmer. The other two were the Homestead Act and the Land-Grant College Act. In 1889 Congress created the cabinet rank position of Secretary of Agriculture.

In a broad way, the USDA's objectives are: (1) economic production and distribution of essential food and fiber and wise conservation of material resources; (2) sound stabilization of farm prices and income; (3) investigation by science of newer and better methods of production; (4) supervision of markets and trade in farm products and facilities; and (5) informing farmers and the public on achievements and progress made toward accomplishing these objectives.

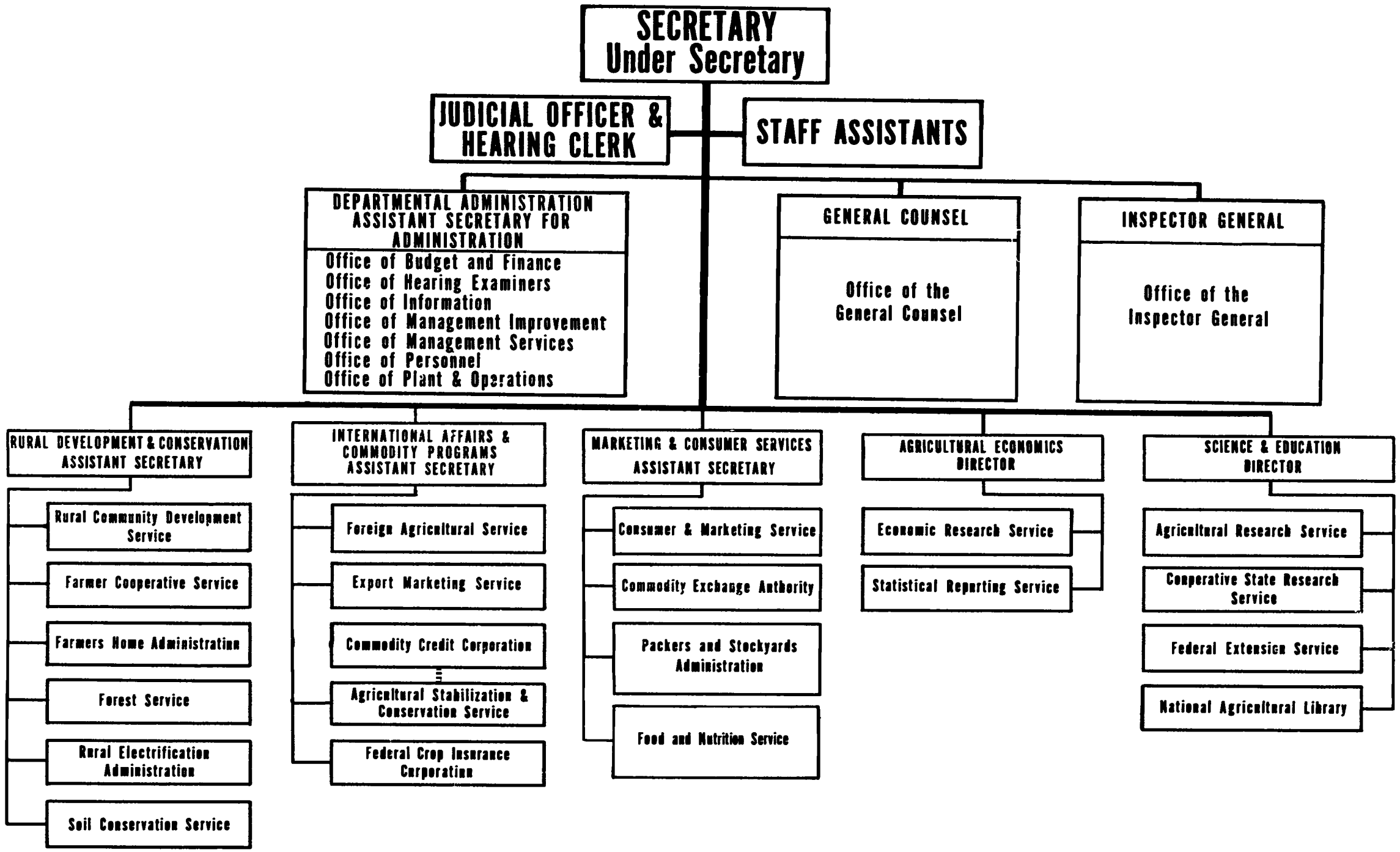
The ASCS has the responsibility for programs and services in the following general groups: Agricultural Conservation Program (ACP), Conservation Reserve (Soil Bank), Cropland Adjustment Program (CAP), the Wheat and Feed Grain Programs, Wool Incentive Program, and the Sugar Program. ASCS also administers the Farm Storage Facility Loan Program and the Price Support Program.

The charts on the following pages point out how the ASCS is organized beginning with its position in the USDA to its county offices.

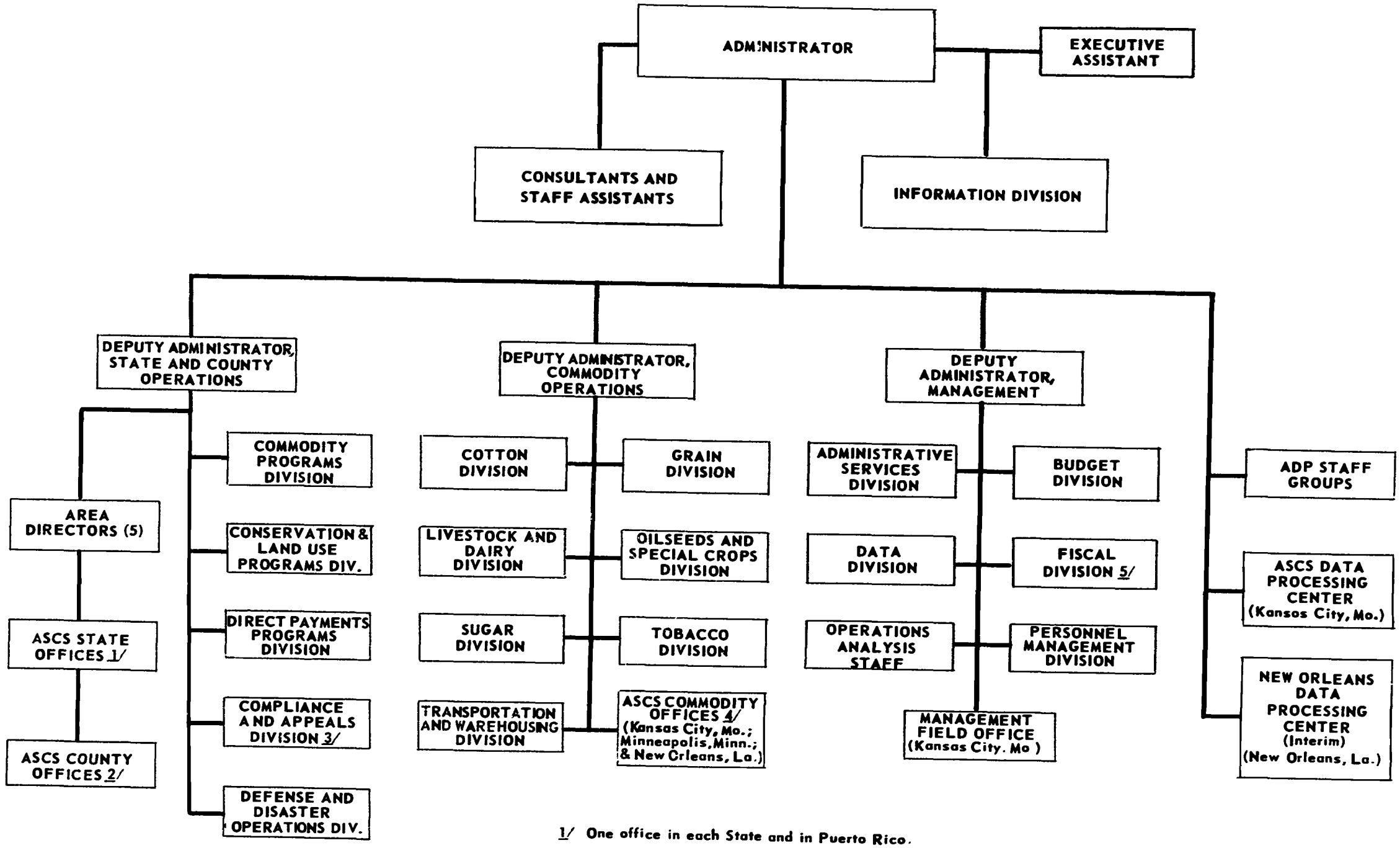
Many of the agricultural programs developed over the past thirty years involve the individual farmer. So it is obvious that the various program policies stem largely on the advice and recommendations of local farmer committees.

August 8, 1969

UNITED STATES DEPARTMENT OF AGRICULTURE



U. S. Department of Agriculture
AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE



1/ One office in each State and in Puerto Rico.

2/ One office in each agricultural county (over 2,500 in number.)

3/ Maintains and directs two field Aerial Photography Laboratories.

4/ KCCO maintains and directs branch offices.

5/ Maintains and directs field office.

DATED. June 26, 1969

Commodity Credit Corporation (CCC)

The Commodity Credit Corporation (CCC) was organized October 17, 1933, under the laws of the state of Delaware. A charter act was passed by Congress making the CCC an agency of the United States Department of Agriculture effective July 1, 1948.

The CCC is managed by a board of directors. It is, however, subject to the general supervision and direction of the Secretary of Agriculture, who is an ex-officio director and chairman of the board. The board consists of six members in addition to the Secretary of Agriculture. They are appointed by the President of the United States with the advice and consent of the Senate.

In addition to the board of directors, the CCC has a five-member advisory board, the members of which are appointed by the President of the United States. Not more than three of the members may belong to the same political party.

The CCC is capitalized at $100,000,000. CCC also has authority to borrow not to exceed $14,500,000,000 for use in carrying out its programs.

In carrying out its principal operations, the CCC utilizes the personnel and facilities of the Agricultural Stabilization and Conservation Service.

Major activities financed by CCC include price support and production stabilization programs. Price support programs are administered for wheat, corn, cotton, peanuts, rice, tobacco, butterfat, milk, wool, mohair, honey, tung nuts, barley, oats, grain sorghums, rye, flaxseed, soybeans, dry edible beans, cottonseed, and crude pine gum. To encourage production adjustments and to maintain farm income, payments are made under the cotton and feed grains programs for diverting cropland from the production of these commodities to conserving uses.

Commodities acquired under the price support program are disposed of through domestic and export sales, transfers to other government agencies, and donations for domestic and foreign welfare use. The CCC is also authorized to exchange surplus agricultural commodities acquired by the CCC for strategic and other materials and services produced abroad.

Under Public Law 480, the Agricultural Trade Development and Assistance Act of 1954, as amended, CCC carries out assigned activities. Major emphasis is also being directed toward meeting the needs of developing nations under the Food for Peace Act of 1966 which further amends the Agricultural Trade Development and Assistance Act of 1954. Under these authorities, agricultural commodities are procured and exported for foreign currencies, famine relief and donations, barter for materials, and service from abroad.

Administration of United States operations under the International Grains Arrangement, upon its approval for ratification by the Senate, will become a responsibility of the CCC.

Under its storage facilities program, CCC is authorized to undertake such operations as may be necessary to provide storage adequate to carry out efficiently and effectively CCC's programs where commercial storage facilities are inadequate.

History of Committee System

Establishment by Congress

The United States Congress by passage of the Soil Conservation and Domestic Allotment Act of 1936, particularly Section 8(b), created the ASC farmer committee system at the state, county, and community levels. Farmer committees had been used to locally administer adjustment programs since the early 1930's, but the 1936 act made it official and mandatory.

An ASC committee at work

Local Involvement

The use of farmer elected committees provides for involvement of local people in solving local problems. This offers the farmer a role of leadership and responsibility in public affairs. Because of their interest, ability, and economic astuteness in handling local programs, the Congress and the USDA have given them much of this responsibility.

The Washington ASCS office, under the direction of the Secretary of Agriculture, establishes official regulations to help committees carry out federal laws. There is, however, considerable latitude left for committees to apply local guidelines in making decisions. The fact that ASC committees determine policy and administer programs immediately distinguishes them from purely advisory groups.

Developing a Cooperative Attitude

The farmer committeeman has helped to develop a cooperative attitude between farmers and the ASCS. The ASC county committee often works with other agencies of the USDA, such as the Soil Conservation Service, Fish and Wildlife Service, Agricultural Extension Service, and Forest Service in planning the Agricultural Conservation Program (ACP).

State Committee

State Committee Membership

Many of the present agricultural programs under ASCS supervision deal with the individual farm and farmer. Therefore, the Secretary of Agriculture appoints state ASC committees of from three to five farmer members. Terms run for one year and are renewable. In addition, the Director of the Agricultural Extension Service of each state is an ex-officio member of the state ASC committee.

State Committee Responsibilities

The state committee is responsible for the administration of farm programs in each state, and for general supervision of the work of county committees. Each state committee appoints a state Executive Director who supervises and directs the work of the state office under policies established by the committee.

The state committee receives ideas from community and county committees. These may be incorporated into any of the state programs or passed along to the ASCS in Washington.

Each state office has program specialists for the programs used in that state. These people help answer questions and explain programs to county office personnel. District fieldmen who cover several counties also help coordinate programs throughout the several counties of a state.

A directory containing the names of the present state committeemen and employees and county committeemen and employees is available at the county ASCS office.

County Committee

County Committee Election

County convention election of county commiteemen

(1) A public notice of the convention shall be given by the county committee at least ten days before the convention date. The notice shall include the date, time, and place of the convention, and indicate that it shall be open to the public.

(2) The incumbent chairman or acting chairman shall organize and supervise the convention. A quorum consisting of a majority of the delegates or their alternates shall be present before the convention may proceed. A permanent chairman is elected to conduct the business of the convention.

Nomination and election procedure

(a) Nominations are received from the floor by secret written ballot. or orally unless the state committee specifies another method. The election of county committeemen is by secret ballot with the person receiving the most votes on a ballot being elected. The balloting for each term of office and/or alternates on the committee is completed and the results announced before proceeding with nominations for the next vacancy.

(b) Persons shall be nominated and elected to fill all vacancies. Three positions will always have to be filled. They are the three-year term and the first and second alternates. The one-year and two-year terms will only be open when persons previously elected to regular terms cannot or will not serve. Alternate committeemen are selected for one-year terms only. The nominations and election ballots will proceed in the following order:

(1) three-year term
(2) two-year term (if vacant)
(3) one-year term (if vacant)
(4) first alternate
(5) second alternate

(c) After all vacancies on the county committee are filled, election of a chairman from the three regular members follows: then the election of a vice-chairman from the two remaining members takes place. This includes newly elected committeemen and carry-over committeemen still serving their current terms of office. The County Agricultural Extension Agent is the one non-voting ex-officio member of the county committee. He is eligible to serve as secretary.

(d) Wherever an entire county is classified as one community, the balloting takes place by mail. Most other election procedures are the same as for a county convention except that all positions are filled in order of the number of votes on the ballot that is mailed in.

County Committee Responsibilities

The county committees are responsible for operation of county ASCS offices usually located in or near the county seat. Committees hire county office managers who operate the office within established state and county ASC committee guidelines. The manager hires the office and field workers necessary to effectively operate the county office. The county ASCS office is the place to sign up for and receive program information on agricultural programs for the county. The county committee is assisted by the community committees within the county.

In the bulletin, The Farmer Committee System, the following responsibilities are listed for county committees:

In production adjustment, they determine the size of individual farm acreage allotments each year, establish farm normal yields, program yields, consider complaints and appeals of producers, supervise referendums on marketing quotas, and determine penalties, and adjustments.

In conservation, they formulate local programs, review farmer requests for cost-sharing on needed practices and allocate funds, and recommend changes in state and national conservation programs.

In price support, they determine the eligibility of producers, appoint loan clerks and witnesses, and set the amount of collateral needed for loans.

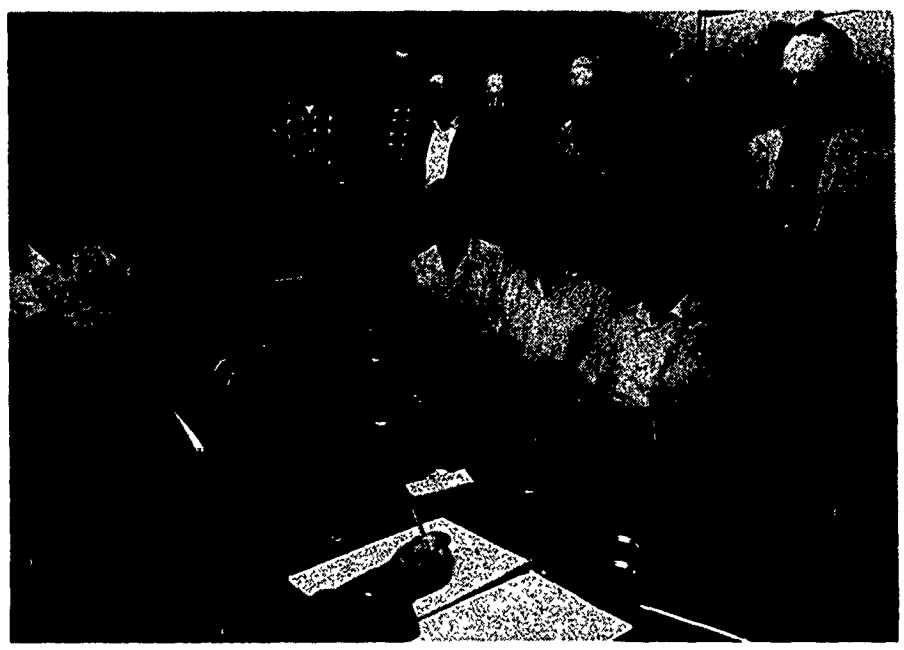
In storage activities, they give general supervision to Commodity Credit Corporation-owned facilities, determine the adequacy of proposed farm storage and loan collateral.

In the sugar program, they hold hearings and make decisions on labor wage claims, and determine sugar payments and production quotas.

In connection with emergency disaster assistance, they pass on the eligibility for and extent of assistance to farmlands damaged by flood, drought, fire, or other natural disasters.

Committees have similar kinds of responsibilities in connection with the wool, cropland conversion, feed grain, and wheat stabilization programs.

A means is provided for a dissatisfied producer to obtain a reconsideration of a decision made by the county committee. His right to appeal a decision extends from the county committee to the state ASC Committee to Washington, D. C. Some of the cases that the county committee must judge are very difficult. They require a delicate balance between the individual's and the public's welfare.



ASC Community Committee assembled in convention to elect county ASC Committeemen

Community Committee

Importance of Community Committees

One of the most important parts of the farmer committees system is the community committee. It is at this grass roots level that local farmers help establish payment rates for farm programs. ASC committee members are paid on a part-time basis.

In addition to helping the county committee and making recommendations on ASCS programs, the community committee acts as a source of communication for local farmers. The committeemen seek out local farm problems that relate to agricultural programs and pass them along to the county committee.

Community Committee Membership

Three community committee members and two alternates are elected annually for each community. A community may be a township, school zone, or other natural boundary.

Election Procedure

In electing farmer committeemen for a community committee only a certain segment of the population is directly involved; therefore, voting qualifications are established.

Most persons who are either farm owners or operators may vote. Both husband and wife may vote if they are joint operators or owners. Youths who run farms may also vote.

Ballots are mailed out ten days before elections to all known eligible voters. Any eligible voter not receiving a ballot should contact the county ASCS office with proof of his right to vote. The election normally takes place the third week of September. Each voter may choose five or less of the alphabetically listed names on the ballot or write in up to five names that are not listed, thus voting for a total not to exceed five.

Nominating Commiteemen

To seek the office of committeemen a person must be an eligible ASC voter and live in the county or community where he is attempting to win a committee post. Other requirements are mainly to prevent partisan political activity involving the commitee.

A farmer can be nominated for committeemen in three ways. Six or more farmers in his community may nominate him by signing a petition. A farmer may sign any number of petitions. The community committee nominates six to ten candidates. The county committee makes nominations if the community committee has nominated less than six candidates and it may also add candidates. Any minority group making up ten percent of the electorate must be represented by at least one candidate or the county committee will select a candidate.

Electing Committeemen

Three committeemen and two alternates are elected annually for community committees. There are five positions to fill and they are filled in order from the largest number of votes to the fifth largest number of votes respectively.

The five positions are chairman, vice-chairman, regular member, first alternate, and second alternate. The alternates succeed or fill in anytime the regular members cannot.

Summary

For more than thirty years now farmers, who know farm problems and local conditions, have served on ASC committees. The farmer committee system has much responsibility for successfully and efficiently administering these programs. It is important that men capable of the responsibility be elected to community committees.

The structure of the committee system provides for local representation by having community, county, and state committees.

TEACHER'S GUIDE FOR FACTORS AFFECTING FARM POLICY

Objectives:

1. To develop an understanding of and appreciation for land policy.
2. To develop the ability to differentiate among the various measures for directing land use.
3. To recognize the importance of transportation to agriculture.
4. To develop an understanding of quarantines and when, where, and how they are used.
5. To develop the ability to discuss changes in agriculture and the effect these changes have had on farm income and government farm programs.
6. To be able to identify and write a brief explanation of economic problems that affect farm policy.

Suggested Learning Activities:

1. Discuss homesteading. Encourage students to give reports on this period of history. (This might be a chance for students to work with their history teacher or an opportunity for a team-teaching effort.)
2. Invite members of the local zoning commission to talk to the class about local ordinances and problems.
3. Assign students to secure copies of local zoning ordinances and discuss them in class.
4. Assign students to obtain a copy of local sub-division regulations and discuss them in class.
5. Discuss regulations that may be set up in special districts (such as irrigation districts) and when and where such districts are likely to be set up.
6. Discuss other land-use controls such as building, fire, and sanitary codes. (These codes may include control of water and air pollution, rent, oil production, and forest-cutting restrictions.)
7. Help students to prepare a discussion or debate on taxation. For example: What are the best type of taxes? This question could be used to start an animated discussion.

8. Tariffs have been imposed on some agricultural products to protect producers in this country. Examples of tariff products include sugar, wool, and cotton. Discuss the effects of these tariffs.
9. Encourage students to give reports on the effects of transportation. Visit a transportation terminal if possible.
10. Discuss quarantines and how they have been or could be used to protect local areas (use local examples such as the gypsy moth).
11. Organize a buzz session to discuss changes that have taken place in agriculture.
12. Visit farmers, governmental agencies, businesses, and/or field days to view the changes in agriculture.
13. Schedule speakers to discuss changes in agriculture.
14. Schedule finance people from FHA banks, Federal Land Bank, or Production Credit Association to discuss economic problems that affect farm policy.
15. Select and use appropriate audio-visual aids.

Audio-Visual Aids (films)

1. Agriculture Story, The. 13-1/2 min., color, Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.
2. Agriculture, USA. 29 min., color, Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.
3. American Imports - A New Look. 11 min., color, The Pennsylvania State University, Audio-Visual Aids Library, University Park, Pennsylvania 16802.
4. American Tax System, The. 30 min., color, The Pennsylvania State University, Audio-Visual Aids Library, University Park, Pennsylvania 16802.
5. Death and Taxes. 30 min., color, The Pennsylvania State University, Audio-Visual Aids Library, University Park, Pennsylvania 16802.
6. Development of Transportation in the U.S. 11 min., color, The Pennsylvania State University, Audio-Visual Aids Library, University Park, Pennsylvania 16802.
7. Distributing America's Goods. 11 min., color, The Pennsylvania State University, Audio-Visual Aids Library, University Park, Pennsylvania 16802.

8. Exports, Imports, Dollars, and Gold. 30 min., color, The Pennsylvania State University, Audio-Visual Aids Library, University Park, Pennsylvania 16802.

9. From One Anvil. 16 min., b & w, John Deere Film Library, 102 W. 25th Street, Baltimore, Maryland 21218.

10. Grain Exchange - Instrument of Freedom. 21 min., color, Farm Film Foundation, Suite 819, Southern Building, 1425 H Street, N. W., Washington, D. C. 20005.

11. New Uses for Farm Products. 20 min., b & w, Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

12. Opportunity Land. 16-1/2 min., color, John Deere Film Library, 102 W. 25th Street, Baltimore, Maryland 21218.

13. Our Land - Its Many Faces. 14 min., color, Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

14. Packaging Food for You. 17 min., color, Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

15. Power to Tax, The. 30 min., color, The Pennsylvania State University, Audio-Visual Aids Library, University Park, Pennsylvania 16802.

16. Principles of Taxation. 30 min., color, The Pennsylvania State University, Audio-Visual Aids Library, University Park, Pennsylvania 16802.

17. Research Points the Way. 27 min., color, Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

18. Road to the Cameroun. 27-1/2 min., color, Farm Film Foundation, Suite 819, Southern Building, 1425 H Street, N. W., Washington, D. C.

19. Trade and Aid. 30 min., color, The Pennsylvania State University, Audio-Visual Aids Library, Universi y Park, Pennsylvania 16802.

References:

1. Agricultural Markets in Change. U.S. Department of Agriculture, Economic Research Service, Agricultural Economic Report No. 95, Washington, D. C.: U.S. Government Printing Office, 1966.

2. Barker, Richard L., ed. Profit Maximizing Principles, Columbus, Ohio: Ohio State University, 1967.

3. Barlowe, Raleigh. Land Resource Economics: The Political Economy of Rural and Urban Land Resource Use, Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1958,

4. Bird, Alan R. Surplus: The Riddle of American Agriculture, New York: Springer Publishing Company, Inc., 1962.

5. Castle, Emery N., and Manning H. Becker. Farm Business Management: The Decision Making Process, New York: The MacMillan Co., 1962.

6. "Consumers All," The Yearbook of Agriculture, Washington, D. C.: U. S. Government Printing Office, 1965.

7. Hall, I. F., and W. P. Mortenson. The Farm Management Handbook, Danville, Illinois: The Interstate Printers and Publishers, Inc., 1960.

8. Hamilton, James E., and W. R. Bryant. Profitable Farm Management, second edition, Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1963.

9. King, Frank P., and L. S. Hardin. Better Farm Management, Atlanta, Georgia: Turner E. Smith and Company, 1956.

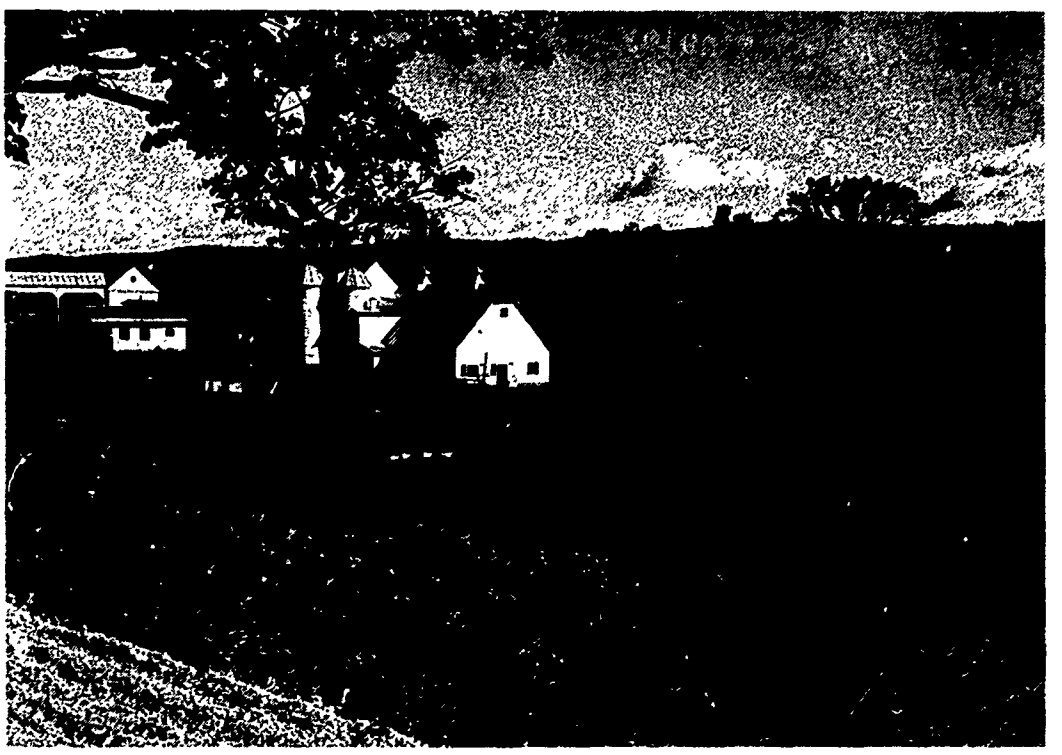
10. "Marketing" The Yearbook of Agriculture, Washington, D. C.: U.S. Government Printing Office, 1954.

11. Moser, David E., and Wesley R. Kriebel. Transportation in Agriculture and Business, Manual 63, Columbia, Missouri: University of Missouri, Extension Division, 1964.

12. "Protecting Our Food," The Yearbook of Agriculture, Washington, D. C.: U. S. Government Printing Office, 1966.

13. "Science for Better Living," The Yearbook of Agriculture, Washington, D. C.: U. S. Government Printing Office, 1968.

SECTION III. HISTORY AND BACKGROUND FACTORS AFFECTING FARM POLICY



Land Policy

Homesteading

In May 1862, Congress passed the Homestead Act. This act provided that citizens (or aliens who intended to become citizens) who were over 21 and head of a family could obtain title to 160 acres of public land. To obtain title, a person had to live on and improve the land for five years. Or, as a substitute for the five-year residence requirement, the person could pay $1.25 per acre.

The Homestead Act was intended to improve worthless land and to help U.S. citizens obtain small farms. Up to this time farmers generally had been against the government's policies of selling land to raise money. Instead, farmers wanted the government to sell the land at low prices or give it to settlers. Toward the mid-eighteenth century the homestead movement became a national political issue. Southerners generally opposed homestead bills. When the southern states seceded at the beginning of the Civil War, the Homestead Act was passed. By 1900 about a half million families had found farms and new homes.

Measures for Directing Land-Use

Land-use is one of the most important policy decisions made in any country and affects nearly all the people. Many land-use direction and control measures are applied in the United States. Since special districts or small units of government may make land-use policy, methods of carrying out land-use policy from area to area may differ. Because of the large number of people involved and the many situations that occur in land-use, policy decisions are difficult and slow in coming. Authority of government to direct land-use stems from the police power of the state which is among the most important powers held by government.

Zoning ordinances illustrate how government directs land-use. Zoning ordinances provide land-use regulations and restrictions. For example, land in a certain area may not be used for a "junkyard." In another situation the type of buildings, materials used, and even the maximum height of a structure or its distance from a road or sidewalk may be specified. Many early ordinances were measures to provide safety and to control nuisances. Zoning ordinances tend to change slowly, thus problems arise as conditions change. Zoning ordinances vary greatly from area to area. Usually they protect the landowner or resident from nearby land being used for undesirable purposes. Since zoning ordinances are important locally, it is necessary to find out what is being done in your community.

Another important control measure is the regulation of sub-division development. This requires that if land is sub-divided into building lots, certain regulations must be adhered to for each lot. For example, a minimum size may be required; or, streets, sewage systems, or water systems may have to be installed. Exceptions to these regulations are common where only one or two lots of a farm are to be sold.

What are the sub-division regulations in your area? What are the steps you would follow were you to decide to sub-divide your farm?

Other special land-use controls may be set up on a district basis. This might be done for irrigation, drainage, grazing, weed control, or soil conservation in rural areas. In metropolitan areas, districts might be set up for water, sanitation, or park development. To set up a special district requires state enabling legislation. Then, a new unit of government is set up to administer, tax, and carry out the purposes of the special district.

Still other land-use measures include building, fire, and sanitary codes. Building codes usually set minimum health and safety standards for all new structures. The codes set such standards as strength of structure, fire hazard prevention, and sanitary installations. Agricultural production controls may also be established to regulate the production of crops (reference to Section I, Page 11).

Another important land-use control measure is the power of eminent domain. This power enables government or public utilities to take land without the owner's consent for the "public good." Land may be taken for schools, highways, streets, utilities, parks, military installations, or other public improvements.

Government also affects land-use by spending patterns and control of the land it already owns. For example, the types of services and costs of services at military installations or state or national forests may influence the surrounding area. If government land can be rented for range or pasture or other uses, this will also have an effect. Types and costs of government services offered to other citizens may also affect land-use. Examples are police and fire protection.

Taxation

"Nothing in life is so certain as death and taxes." Taxation is necessary since it is the major source of money for government. Government then uses this money to pay operating costs and provide services to the people.

Many of these services would not be available privately at a reasonable cost. One of the big questions in a democracy is how much control should government exercise.

> "However, contrary to common belief, the power to tax is not a 'necessary evil,' but rather, if wisely used, the most important source of revenue upon which the strength and support of government depends and without which an owner's rights may lack necessary protection and enforcement."[1]

In general, government services and taxation have been accepted as a necessary part of life. These taxes do affect land-use. For example, as real estate taxes increase, it becomes harder to make a profit on the land by using it for agricultural production. If real estate taxes become too high, as around the fringes of a city, land must be used for other than agricultural purposes. Since the tax structure may vary from area to area, new businesses may choose a location with these taxes in mind. Taxes can affect the kinds of homes built and the salability of property by simply limiting what people can afford. Even the amount of take-home pay of an employee is affected by the types and level of taxation.

Since there are a great number of different taxes only a few of the more important are discussed here.

Property tax is one of the oldest forms of taxation. It has been felt that people should be taxed on their wealth. One of the main sources of wealth was land and therefore it became an important criterion for taxation. As time went on, people developed other sources of wealth such as buildings and equipment. Many states assess personal property taxes which include equipment and other personal property. Property tax is a very important tax for most agricultural producers since most of them own large amounts of land and equipment. Real estate tax is the main source of revenue for most counties, cities, towns, villages, and school districts.

[1] North, Nelson L. and Alfred A. Ring. Real Estate Principles and Practices, (fifth edition, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1960).

Federal income tax is the main source of income for the federal government. It is not an important consideration in land-use development since it is uniform throughout the United States.

State income taxes have been adopted in several states and currently are being considered in others. Although state income taxes may have deterred some industries from locating in states levying them, industries already there are unlikely to leave. This is especially true of large factories and farms. Since this tax may lower property taxes or increase the services rendered, it is argued that it has little effect on land-use or industrial location.

Income taxes seem to be a more equitable tax today than property tax because of large numbers of people who have sizable incomes but own little or no property. Also, many people own stocks, bonds, and bank holdings that are not covered by property tax. This, and the fact that many local governments are short of local funds for schools and other services, has caused some municipalities to levy a local income tax.

Other problems that arise with a state or local income tax have posed the following questions: What income should be included and excluded as well as what exemptions should be allowed? Should a flat or progressive rate be used? How should corporate income, capital gains, and rent be taxed? Should the tax be calculated from the federal income tax? What geographical area should be included and how can double taxation be avoided?

Sales taxes have proved to be fairly stable and important sources of revenue. The sales tax provides some automatic increases in state income in periods of increased general price level. In the past few years, income from sales tax has increased in most states because of rising prices and expansion in the dollar volume of business.

The chief criticism of the general sales tax is that it does not consider a person's ability to pay. In other words, sales tax often takes a larger

percentage of a smaller income than a larger income. This situation is somewhat improved if food and clothing are exempted. Another bad feature is the cost of administering this tax. Its cost to state governments is not much higher than administering some other taxes, but it is a burden to the retail merchandiser.

The gasoline tax, supplemented by taxes on other motor fuels used by highway vehicles, is one of the most widely used and best producers of revenue for both state and federal governments. Currently, the federal tax is four cents per gallon of gasoline, the state tax in Pennsylvania is seven cents per gallon. Taxes paid on fuel consumed for non-road uses, such as that used on farms, are refunded to the user. In many states the gasoline tax is allocated to the highway fund. The highway fund is used for building and maintaining roads. Accessibility of land to potential users influences both its value and use. An argument heard in defense of gasoline taxes is that those who use the roads are the ones who ought to pay for them.

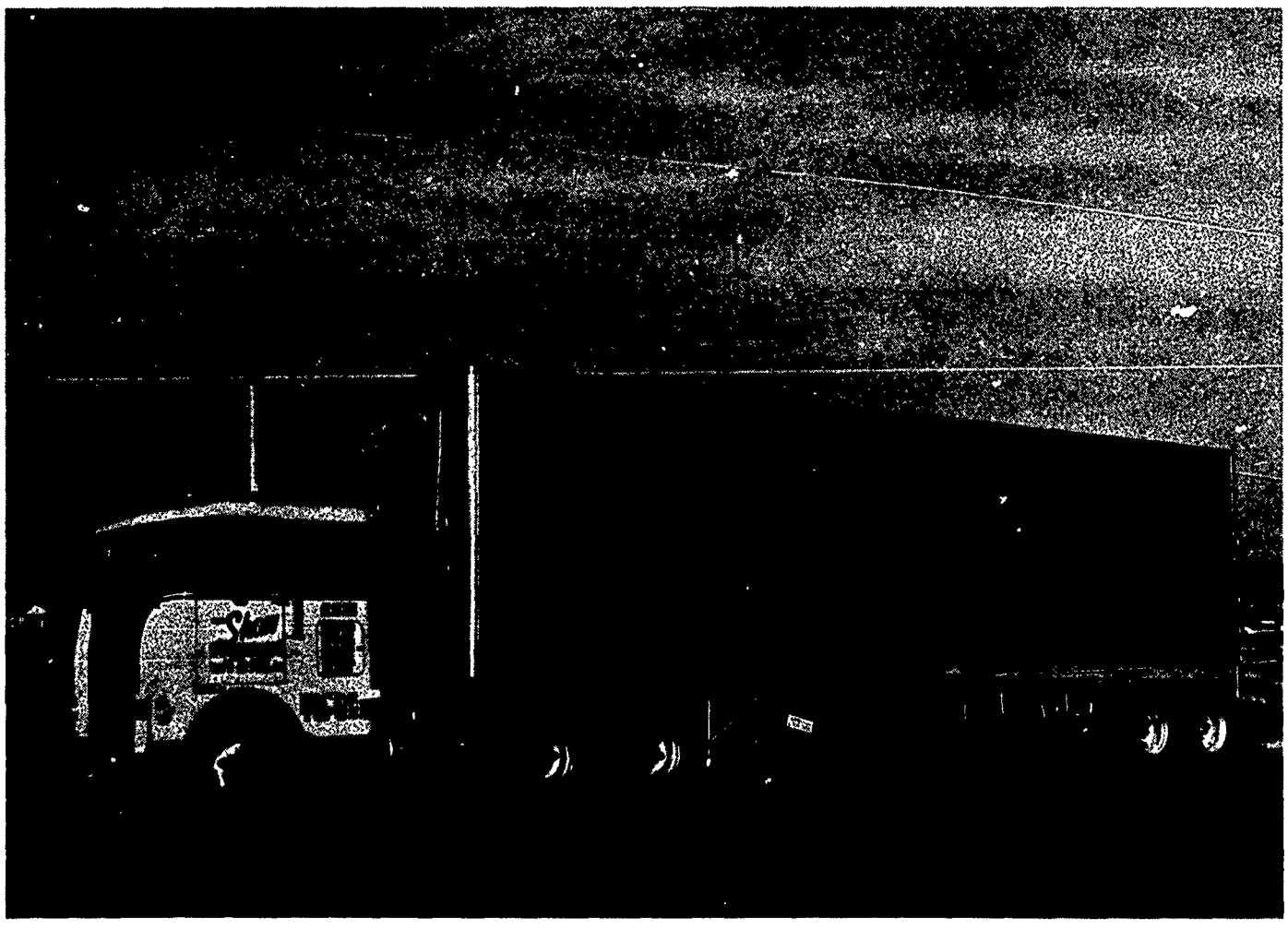
Tariff Policy

One type of tariff is a specific duty tariff. An example of a specific duty tariff is the tariff on raw sugar imports. This tariff is based on a fixed amount per pound. Therefore, it becomes proportionately higher as the price of sugar falls. Conversely, it becomes proportionately lower as the price of sugar rises.

Most tariff duties are based on the value of the product. Ad valorem duties, as they are called, are often placed on manufactured and miscellaneous articles. Duty rates may vary from zero to as high as 100 percent or more of the price of the article.

Tariffs tend to fall into two categories. Revenue tariffs are primarily aimed at raising revenue or income for the government. Protective tariffs, on the other hand, have the primary purpose of protecting home

industry such as agriculture from importation of similar products from foreign countries. If a revenue tariff is imposed on a product produced in other countries, then it is almost sure to also act as a protective tariff. That is, producers in this country will have a price advantage over foreign competitors since they will not have to pay the tariffs imposed on similar products from other countries. Tariffs have been imposed on many foreign agricultural products to protect producers in this country. Examples include sugar, wool, and cotton. In addition to protective tariffs, domestic goods are often protected by import quotas on foreign goods such as oil.



Transportation

Improvements in transportation have greatly affected agriculture. Many of the advantages formerly given an agricultural producer by his location geographically have been reduced by improved transportation. The costs of most items that are needed on farms are relatively uniform across the country. Likewise, the price of agricultural products to users is relatively uniform from area to area. Prices received by farmers vary and reflect costs of moving the commodity from the farm to the market.

The advantages of a close market for fresh fruits and vegetables have become less important. Jet transport can move large quantities of produce from any point to any other point in the continental United States in a few hours. Transportation by truck has been made faster and more economical by improved roads and super highways. Refrigeration has made long distance movement of perishable items possible by truck and rail. This has allowed many of the large livestock packing facilities to move nearer the large production areas.

The opening of the St. Lawrence Seaway has brought new raw materials and products to inland ports far into the midwest. More importantly for United States agriculture, the seaway has provided a means whereby huge quantities of grains from terminals such as Duluth, Minnesota, can be moved to destinations around the world. This transportation development has contributed to greatly increased exports of United States farm products.

New developments in transportation are sure to affect agriculture in the future as remarkably as they did in the past.

Quarantines

Many serious disease and insect outbreaks in this country have been caused by diseases or insects imported from other countries or areas. Therefore, plants and animals to be brought in from other nations are inspected and may be kept from entering or unloading at ports until

precautions are taken. Use of quarantines, that is, not allowing movement of animals or crops from an infected farm or area, has stopped or slowed the spread of many diseases and insects. Some states forbid interstate transportation of plants, parts of plants, or even ripened fruit unless the articles have been carefully inspected. Even with these protective measures, insects and diseases have managed to enter this country and spread from area to area.

Changes in Agriculture

Research and Education

Research is organized scientific investigation using systematic methods to make new discoveries or evaluate present knowledge. Many of the goods and services now enjoyed have been made possible through research and education. Research and education have increased productivity for all classes of workers. This has shortened the work week and increased pay levels. These factors have all contributed in giving us the highest standard of living in American history.

There are two major types of research. The primary aim of basic research is to discover more about the fundamental laws of nature. Basic research explores the unknown. The results are often unpredictable. The time needed to complete experimental work on one phase of a project may extend for years. Therefore, it is usually the professional researchers who do basic research.

Applied research is directed toward a specific objective. When a problem arises,it is often solved by applied research. Many of the new products, processes, and materials developed through applied research have both directly and indirectly affected agriculture. Many of the discoveries made in basic research have also been applied to make farming a more scientific and regulated business.

Studies of plant and animal breeding have led to greater production and better quality of fruits, vegetables, and meats. Chemicals have been developed which increase growth and affect speed of growth, protect crops, defoliate plants, and control and prevent animal diseases.

Some of the important developments in education and research affecting agriculture include the following:

(1) Establishment and expansion of schools and colleges at all levels. This would include land-grant colleges, vocational agriculture in high schools, vocational-technical schools, and junior colleges.

(2) Dissemination of research performed done by colleges, universities, and the federal extension service.

(3) Rapid adoption of new practices developed by agricultural research, stemming from economic conditions and educational programs.

Expanding Markets

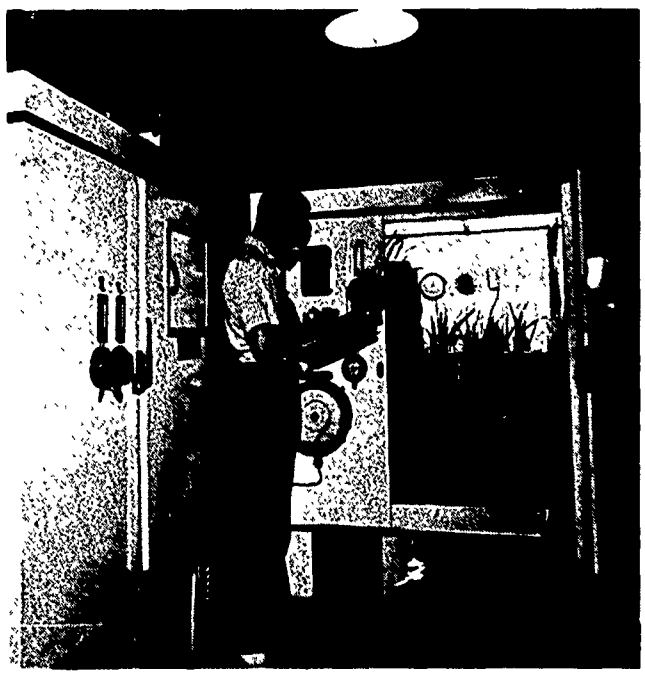
Exports

Exports provide an important source of markets for U. S. agricultural products. The production from one acre out of six is exported. However, over one-half of these exports are supported by some form of government assistance. On the other hand, about $2 billion worth of agricultural products are exported without government assistance each year.

Since many people around the world do not have enough to eat, it would appear that exports could increase at a rapid rate for many years. There are, however, many problems involved in world food distribution. For example, the countries which most need food are least able to pay for it. Even with raw agricultural products in their possession, some under-developed countries still lack the means to process and utilize them in an efficient manner.

Technology

Demands for agricultural products can be increased in at least two ways. Both methods would help alleviate the problems involving the current capacity to overproduce. We can find new ways to use commodities presently produced on farms. This would be true if corn or soybeans could be used to produce a new plastic-like substance. A second way would be to develop uses for new crops and animal products which could replace crops now in surplus.



Processing and Packaging

Many of the food products we buy are protected and merchandised by modern processing and packaging methods.

Sweet corn, for example, used to be available only for a month or two in the late summer. Canned cream-style corn was one of the early major canned items. Now we have sweet corn canned and frozen in a number of ways, and field-chilled fresh sweet corn is available most of the year.

In order to provide an abundance of quality food to the consumer, food processing must control: (1) spoilage and toxic microbes, (2) enzymes, and (3) oxidation.

Processing makes it possible to harvest high quality fruits and vegetables, stabilize them, and preserve their high quality. Likewise, poultry, meat, dairy products, and most other agricultural products are processed for a great variety of purposes.

The product may be protected from physical damage, moisture changes, gains or losses of gases, odors, or flavors. Other package protections include control of grease or fat loss, color changes, prevention of contamination by dust, or entry of micro-organisms and insects. This protection makes it possible to receive products in fresher condition. Products with greater shelf life in the store lowers cost. Protection is only one function of packaging. We also expect it to be economical, but at the same time promote sales. It may provide convenience, save time in processing or shopping, improve handling and transportation, and may reduce the amount of shelf space needed. It may lower pilfering and make units of a more acceptable size.

Packaging has affected what can be sold directly from the farm, what can be sold elsewhere, and when it can be sold. Packaging has spread the marketing of fruits and vegetables more evenly throughout the year. It has increased the sales of many agricultural products.

Fresh produce having live tissues that continue the process of respiration causes many special problems in packaging. The tender tissues of these commodities require careful handling and refrigeration.

Mechanization and Invention

The American economy depends on agriculture for its food, much of its clothing, building materials, and recreation. To a great extent agriculture has been able to supply all of this because of the adaptation of mechanization and new inventions. These innovations have allowed a smaller number of farmers to produce more with less labor.

Population Changes

The world population has been increasing at more than two percent per year. Or, in other words, about 69 million people are added to the world each year. The population of the world has more than doubled in the last one-hundred years. If population continues to increase as it has been at about one to two percent per year in the United States the demand for agricultural products should continue to increase.

Cooperatives

Farmer owned and controlled cooperatives provide farmers with agricultural supplies, market his products, and make available credit and other services. These services include: specialists to give advice, delivery of feed and fertilizer, custom machinery operation, light, power, telephones, insurance, and credit. The cooperative organization was developed by the farmer to give him more power in the marketplace. Five out of six farmers now do business with cooperatives.

Corporate Power

Large corporations now control many of the inputs farmers use and also set the prices of these items. The farmer has little control over the cost of input items. The prices paid for most farm products are also set

by the market with the farmer having only the choice to sell or not sell. Industries of many types also compete with farmers for laborers. The working conditions and/or high wages offered by industry make it very difficult for farmers to find hired help in many areas. In many cases the net result is that the margin between what it costs the farmer to produce food and fiber and what his return is in the marketplace is very small.

Farm Organizations

Farm organizations have provided farmers with a powerful lobby for many years. They also promote agriculture in many other ways. They have involved farmers in the political scene at all levels. They have made the farmers' voice heard across the country even though the organizations have not agreed consistently among themselves. In fact, their position has had to change quite rapidly to keep up with changing times. Farm organizations have tried to prevent the sale of some artificial or substitute items which can replace farm products, such as oleomargarine. Some of the new products that can replace present farm products use other farm products in their production. For example, soybeans are used in making artificial milk. This makes it hard for a farm organization to keep both dairy and crop farmers happy with a stand on this issue. Many farm organizations have also helped advertise farm products to promote sales.

Economic Problems That Affect Farm Policy

Low Farm Income

Basic USDA farm policy goals, as we approach the 21st century, include better income for farmers and a balanced abundance for consumers.

U. S. farmers earned a record gross of $49.5 billion in 1966. Over $16.3 billion of this was net income. This is about $2.1 billion over the 1965 net - recovery from the post-war low of $10.7 billion in 1957 and second only to 1947, when we were feeding a devastated world.

The average farm family received about $5,000 as net income in 1966, about $800 more than in 1965, and two-thirds again as much as in 1960. The increase per farm is partly because there are fewer farms to divide the total among, but the total to be divided is much larger.

Farmers are doing better, compared with past years. But compared with what other Americans are earning, there is still a gap. In 1966 people on farms still lacked $900 each of enjoying as much spendable income as non-farm people.

Labor

Labor is one of the most important inputs on modern farms. It is obvious, therefore, that the management of labor is an important factor in the total farm business. About 25 percent of all farm labor is done by hired farm workers. Only about one out of ten of these workers is a full-time employee. Almost one-third of the employees are under 17 years of age. These factors make farm labor problems somewhat unique.

Farm wage levels, in general, are considerably lower than for non-farm workers. This, of course, has an effect on the farmer's ability to hire farm labor. Fringe benefits such as housing, farm products, and vacations may be important in attracting good employees. The labor problems that affect the farmer are important to the agricultural economy and must be considered when developing farm policy.

Surpluses

The Commodity Credit Corporation (See Page 55) acquires stocks of various farm products as a result of its price-support activities. These stocks have been variously referred to as the "farm surplus," the "price-support" inventory, the "CCC" inventory, and as "Ever-Normal-Granary" stocks. These stocks may be stored under the loan on the farm. Stocks owned by individuals and corporations add to the total inventory at any given time.

Although CCC inventory may be larger than normal carry-over, it may be considered desirable as a reserve to ease tight supply situations. This helps level prices and keeps new producers entering the field at an orderly rate. Thus, greater price and supply fluctuations are avoided. CCC inventory may also provide a stockpile for possible national emergencies. Stocks of some commodities, such as wheat, are down to near adequate reserve levels.

While CCC inventories may be national assets, they offer disadvantages as well. Storage costs can be large. At one time, CCC storage costs ran well over $1,000,000 a day. Consequently, CCC keeps seeking useful outlets through which it can dispose of stocks. The disposition of this inventory by meeting domestic and export needs helps keep inventory at manageable levels.

The problem in a nutshell is to lower surpluses, increase farmers' income, and to cut farm program costs, all at the same time. To complicate the problem, the programs that lower surplus are also expected, by some, to combat rural poverty on marginal farms. That is not the aim of present adjustment programs. There are special approaches for fighting rural poverty. Present program objectives include the adjustment of production to demand, giving farmers some voice in the market, and to give them some surety of income through price supports.

Over Production Capacity

Not only do we have a surplus of some commodities, but we are continuing to produce them beyond our needs. Problems will exist until supply and demand are reasonably balanced with production capacity. Expanding markets (see Page 74) will help this balance become a reality. Many economists agree, however, that production adjustment programs will be necessary for many years.

Conservation

Many of the conservation activities that need to be carried out on individual farms are not economically feasible for an individual farmer. Other conservation activities take community-wide action and finance. The carrying out of both kinds of conservation activities is for the public good. This is the reason that the public has shared the cost of these activities to insure that they are carried out (See Page 3).

The public has provided several resources and tools to help farmers develop and carry out area and farm conservation programs. These include research, educational services, conservation program planning, technical services, commercial services and materials, credit, and cost-sharing. The principal cost-sharing resource is the Agricultural Conservation Program.

A sound program of public cost-sharing is dependent upon:

(1) an adequate research program;

(2) an aggressive and effective educational program to provide information and motivation, and to teach certain skills;

(3) sources of technical services to supply skills not readily acquired by many farmers;

(4) credit adapted to farm needs; and

(5) adapted commercial services and materials available where and when needed.

Private enterprise has developed numerous services to help meet conservation needs. Also, the U. S. Department of Agriculture and other governmental agencies (federal and state) have developed various action programs to encourage or stimulate needed progress in solving conservation problems.

Margin

Many factors have combined to make the margin between gross income and expenses small for most farm commodities. Prices of farm products have risen slowly, if at all. At the same time, the costs of most inputs have increased substantially. Taxes and other fixed costs have also gone up. Thus, the farmer has had to become even more efficient to stay in business. The way many farmers have coped with this is to increase production per unit, thus causing greater surpluses. In other instances, farmers have shifted from the production of one commodity to another.

TEACHER'S GUIDE FOR IMPORTANT AGRICULTURAL LEGISLATION

Objectives:

1. To develop an understanding of how farm programs have evolved in the legislative process.
2. To develop an understanding of how wartime adjustments were required in farm programs.
3. To develop the ability to discuss developments in agricultural legislation, with an emphasis on recent acts.

Suggested Learning Activities:

1. Discuss why farm programs are necessary.
2. Discuss important agricultural legislation.
3. Discuss factors that affect farm policy such as wars.
4. Invite speakers to discuss agricultural legislation.
5. Evaluate current agricultural legislative proposals.

Audio-Visual Aids (Slide Series)

A New Farm Law: The Food and Agriculture Act of 1965 - ASCS, Washington, D. C.

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IMPORTANT AGRICULTURAL LEGISLATION

The Farm Crisis During the Depression Years

In the summer of 1920 farmers began to get caught in a squeeze between the prices they received for farm products and the prices they had to pay for supplies. Although farm organizations and publications had been advising farmers to control production, little was accomplished. Withholding movements developed in some areas but proved unsuccessful over a period of time. Farmers next turned to cooperative marketing associations. Things became even worse as the depression hit in 1929. The entire country was left in a near state of despair. Farmers, likewise, had been pushed to the point of desperation. Realized net income of farm operators in 1932 dropped to less than one-third of what it had been in 1929.

President Franklin D. Roosevelt, in his 1932 campaign, committed himself to direct government action to solve the farm problem. The primary tool used to raise farm prices and income became the control of agricultural production.

The Agricultural Adjustment Act of 1933

Organization

The Agricultural Adjustment Act (AAA) was passed on May 12, 1933. Its goal was to restore prices to farmers at a level which would give agricultural commodities their 1909 to 1914 purchasing power. Two major program divisions were organized. They were the Division of Production and the Division of Processing and Marketing. The program divisions were divided into commodity sections. The Secretary of Agriculture, Henry A. Wallace, had new powers invested in his office. These new powers included the authorization to appoint experts without regard to civil service laws; and with the President's approval, to make regulations which would have the force and effect of law. To restore farm purchasing power, the Secretary of Agriculture had many methods he could use. These included the authorization: (1) to secure voluntary reduction of the acreage in basic crops through agreements with producers, and the use of direct payments for participation in acreage control programs; (2) to regulate marketing through voluntary agreements with processors, associations of producers, and other handlers of agricultural commodities or products; (3) to license processors, associations of producers, and others handling agricultural commodities to eliminate unfair practices or charges; (4) to determine the necessity for and the rate of processing taxes; and (5) to use the proceeds of taxes and appropriate funds for the cost of adjustment operations, the expansion of markets, and the removal of agricultural surpluses. Congress declared its intent, at the same time, to protect the consumer's interest. Base acreages were established for basic crops. Different base years were used for different crops.

Basic Programs in Early Legislation

The following commodities were listed as basic in the original legislation: wheat, cotton, field corn, hogs, rice, tobacco, milk, and milk

products. Amendments to the legislation in 1934 and 1935 added the following to the list of basic commodities: rye, flax, barley, grain sorghums, cattle, peanuts, sugar beets, sugar cane, and potatoes. However, acreage allotment programs were only in operation for cotton, field corn, peanuts, rice, sugar, tobacco, and wheat.

It was impossible to reduce acreage effectively before the 1933 crops were ready for market. As emergency measures, portions of cotton and tobacco crops were plowed under during 1933. Payments were made to farmers for this plowing down of a portion of their crop. Non-recourse loans were initiated to give farmers increased purchase power and allow them to receive the benefits of controlled production more quickly. The increased purchasing power of farmers was in line with the overall recovery program for the country.

History of Marketing Agreements and Order

Marketing orders and agreements originated with the 1933 Act and have continued in various forms through subsequent amendments. A marketing agreement is a voluntary contract entered into by the U. S. Secretary of Agriculture with handlers of a particular commodity, including producers so engaged. It is binding only on those who sign it. A marketing agreement alone is seldom effective.

There are no milk marketing agreements in effect at the present time. Most vegetable and fruit orders are accompanied by marketing agreements. Many fruit and vegetable cooperatives serve as handlers and, therefore, are important signers of the agreements.

A marketing order is issued by the Secretary of Agriculture and is binding on all handlers of the commodity concerned in the specified production or marketing area, regardless of whether they have signed a marketing agreement. An order may be issued for a commodity only if at least two-thirds of the producers, or those who produce two-thirds of the volume, approve the order by referendum. A two-thirds majority

means two-thirds of those voting in the referendum, and not two-thirds of all growers or producers in the industry. Handlers of at least one-half the volume must have signed an agreement to have it made effective with an order. However, an order may be issued by the Secretary when he finds it is the only practicable way to carry out the objectives of the act -- even though the necessary number of handlers have not signed.

The objectives of marketing agreements and orders are to establish and maintain orderly market conditions for commodities, affecting interstate or foreign commerce. This includes giving fair prices to the consumer while also giving an equitable return to the producer and handler. Their purpose is to give the farmer some of the marketing advantages long enjoyed by industry.

These programs are different from other agricultural adjustment measures in that they combine voluntary and regulatory control.

Federal legislation authorizing the use of agreement and licenses for regulating the handling of (1) milk and dairy products; and (2) specialty crops, particularly fruits, vegetables, and nuts, originated in the Agricultural Adjustment Act of 1933. Amendments to the act in 1935 and passage of the Agricultural Marketing Agreement Act of 1937 clarified program use and procedures, defined types of control to be used, substituted orders for licenses, and specifically listed the commodities authorized for marketing orders.

An amendment in 1947 authorized the establishment of minimum standards of quality and maturity for commodities other than milk. The Agricultural Act of 1954 authorized fixing the size, capacity, weight, dimensions, or pack of containers used in packaging crop commodities. The act also authorized program use of marketing research and development projects designed to assist, improve, or promote the marketing, distribution, and consumption of any eligible commodity other than milk. It further provided for the orderly flow of commodities to market.

The Agricultural Act of 1961 extended the programs by making eligible for inclusion in marketing orders any agricultural commodity not specifically excluded in the act, and authorized the Secreatry of Agriculture to consult with farmers, farm organizations, and handlers on possible need for additional program legislation.

Amendments in 1962 and 1965 authorized marketing promotion projects, including paid advertising, for specified commodities other than milk.

Surplus Disposal

As the USDA made non-recourse loans and took other actions to increase farmers' purchasing power it built up its own inventory of surpluses. Surplus disposal programs were initiated as an emergency supplement to crop adjustment programs. The paradox of crop adjustment particularly when it involved crop destruction at a time when people were hungry troubled the Secretary of Agriculture and other top officials. A provision in the 1933 Agricultural Adjustment Act authorized processing tax funds which were used for surplus distribution. These and other funds help distribute both basic and non-basic commodities to unemployed families and through relief distribution channels.

Supreme Court Decision of 1936

The original agricultural adjustment program was dealt a severe setback on January 6, 1936, by the Hoosac-Mills decision rendered by the U. S. Supreme Court. This decision invalidated the production control provisions, including the tax on marketings, provided under the Agricultural Adjustment Act of 1933. Little time was wasted in taking action to replace the act. In the three years from 1932 to 1935, farm income increased more than 50 percent. The effect of the Agricultural Adjustment Act is hard to evaluate because of the many factors involved in the farm income increase.

Soil Conservation and Domestic Allotment Act of 1936

The Supreme Court's ruling negating the production control provisions of the Agricultural Adjustment Act presented the Congress and the USDA with the problem of finding a new approach before arrival of the spring planting season. USDA officials and spokesmen for farmers recommended to Congress that farmers be paid for voluntarily shifting acreage from soil depleting surplus crops into soil-conserving legumes and grasses. The Soil Conservation and Domestic Allotment Act was approved on February 29, 1936. This act combined the objective of promoting soil conservation and profitable use of agricultural resources with that of re-establishing and maintaining farm income at fair levels. The goal of income parity, as distinguished from price parity, was introduced into legislation for the first time. It was defined as the ratio of purchasing power of the net income per person on farms to that of the income per person not on farms which had prevailed from August 1, 1909, to July, 1914.

President Roosevelt stated as a third major objective of the new act, "the protection of consumers by assuring adequate supplies of food and fiber." Under the 1936 program farmers were offered soil-conserving payments for shifting acreage from soil-depleting crops to soil-conserving crops. Also offered were soil-building payments for seeding soil-building crops on cropland and for carrying out approved soil-building practices on cropland or pasture.

Curtailment in crop production due to severe drought in 1936 tended to obscure the fact that planted acreage of the basic crops increased, despite the soil conservation program. Normal weather, crop surpluses, and declining farm prices in 1937 focused attention on the failure of the conservation program to bring about crop reduction as a by-product of better land utilization.

Agricultural Adjustment Act of 1938

Department officials and spokesmen for farm organizations soon began working on plans for new legislation to supplement the Soil Conservation and Domestic Allotment Act. The Agricultural Adjustment Act of 1938 combined the conservation program of the 1936 legislation with new features designed to meet drought emergencies as well as the price and income crisis resulting from surplus production. A marketing control approach was substituted for direct production control. Authority was based on congressional power to regulate interstate and foreign commerce. The new features of the legislation included mandatory non-recourse loans for cooperating producers of corn, wheat, and cotton under certain supply and price conditions (if marketing quotas had not been rejected). Loans were at the option of the U. S. Secretary of Agriculture for producers of other commodities. Marketing quotas were to be proclaimed for corn, cotton, rice, tobacco, and wheat when supplies reached certain levels. Referendums were to be used to determine whether the marketing quotas proclaimed by the Secretary should be put into effect. Other features included crop insurance for wheat and parity payments to producers of corn, cotton, rice, tobacco, and wheat in amounts which would provide a return as nearly equal to parity as available funds would permit. These payments were to supplement and not replace other payments. In addition to payments authorized under the continued Soil Conservation and Domestic Allotment Act for farmers in all areas, special payments were made in ten states to farmers who cooperated in a program to retire land unsuited to cultivation as part of a restoration land program initiated in 1938. The attainment of parity prices and parity income was stated as a goal of the legislation. Another goal was the protection of consumers by the maintenance of adequate reserves of food and fiber. Systematic storage of supplies made possible by non-recourse loans was the basis for the department's "Ever-Normal-Granary" plan.

Wartime Measures

The large stocks of wheat, cotton, and corn resulting from price-supporting loans, which had caused criticism of the Ever-Normal-Granary plan, became a military reserve of crucial importance after the United States entered World War II. Concern over the need to reduce the build-up of government stocks changed during the war and post-war period to concern over attainment of production to meet the then current needs.

On December 26, 1940, the USDA asked farmers to revise plans and to have at least as many sows farrowing in 1941 as in 1940. Following the passage of the Lend-Lease Act on March 11, 1941, Secretary of Agriculture Claude R. Wickard announced a price support program for hogs, dairy products, chickens, and eggs at a rate above market prices. Hogs were to be supported at not less than $9 per hundredweight.

Congress decided that legislation was needed to insure that farmers shared in the profits which defense contracts were bringing to the American economy, and as an incentive to wartime production.

Levels of Price Support-Fixed or Flexible

The end of the Korean War in 1953 necessitated changes in price support, production control, and related programs. For the next eight years, controversy over levels of support-high, fixed levels versus a flexible scale - dominated the scene.

Secretary of Agriculture, Ezra Taft Benson, proclaimed marketing quotas for the 1954 crops of wheat and cotton. The major types of tobacco and peanuts continued under marketing quotas. Dairy prices were supported at 90 percent of parity for one year beginning April 1, 1953. Supports were continued at 90 percent of parity for basic crops during 1953 and 1954, in accordance with the 1952 legislation.

The Agricultural Trade Development and Assistance Act, better known as Public Law 480, was approved July 10, 1954. This Act, which served as the basic authority for sale of surplus agricultural commodities for foreign currency, proved to be of major importance in disposing of farm products abroad.

The Agricultural Act of 1954 established price supports for the basic commodities on a flexible basis, ranging from 82.5 percent of parity to 90 percent for 1955, and from 75 percent to 90 percent thereafter. An exception was tobacco which was to be supported at 90 percent of parity when marketing quotas were in effect.

The Soil Bank

The Soil Bank, established by the Agricultural Act of 1956, was a large-scale effort, similar in some respects to programs of the 1930s, to bring about adjustments between supply and demand for agricultural products by taking farmland out of production. The program was divided into two parts: (1) an acreage reserve; and (2) a conservation reserve. The specific objective of the acreage reserve was to reduce the amount of land planted to allotment crops wheat, cotton, corn, tobacco, peanuts, and rice. Under its terms, farmers cut land planted in these crops below established allotments; or, in the case of corn, their base acreage, and received payments for the diversion of such acreage to conserving uses. In 1957, 21.4 million acres were in the acreage reserve. The last year of the acreage reserve program was 1958.

All farmers were eligible to participate in the conservation reserve by designating certain cropland for the reserve and putting it to conservation use. On July 15, 1960, 28.6 million acres were under contract in this reserve.

The Feed Grain Act

The Feed Grain Act was approved March 22, 1961. It provided that the 1961 crop of corn should be supported at not less than 65 percent of

parity (the actual rate was 74 percent) and established a special program for diverting corn and grain sorghum acreage to soil-conserving crops or practices. Producers were eligible for price supports only after retiring at least 20 percent of the average acreage devoted to the two crops in 1959 and 1960. Subsequent acts in 1962, 1963, and 1964 included wheat and cotton as well as the feed grains.

The Food and Agriculture Act of 1965

Programs established by the Food and Agriculture Act of 1965 were in effect from 1966 through 1969. After approval of the plan in referendum, each dairy producer in a milk marketing area received a fluid milk base, thus, permitting him to cut his surplus production. The Wool Act of 1954 and the voluntary feed grain program begun in 1961 were extended through 1969.

The voluntary wheat certificate program begun in 1964 was extended through 1969 with only limited changes. The rice program was continued; however, an acreage diversion program similar to wheat is to be effective whenever the national acreage allotment for rice is reduced below the 1965 figure.

The Act established a cropland adjustment program. The Secretary is authorized to enter into five-to ten-year contracts with farmers calling for conversion of cropland into practices or uses which will: conserve water, soil, wildlife, or forest resources; or establish, protect or conserve open spaces, national beauty, wildlife, or recreational resources; or prevent air or water pollution. Payments are not to be more than 40 percent of the value of the crop that would have been produced on the land. Contracts may not obligate the government for more than $225 million per calendar year.

The Food and Agriculture Act of 1965 continued many of the features which have characterized farm legislation since 1933. For a third of a century, price support and adjustment programs have had an important impact upon the farm and national economy. Consumers have consistently had a reliable supply of farm products, but the proportion of consumers' income spent for these products has declined. The legislation and resulting programs have been modified to meet varying conditions of depression, war, and prosperity and have sought to give farmers economic equality with other segments of the economy.

TEACHER'S GUIDE FOR OTHER USDA AGENCIES

Objectives:

1. To develop an understanding of and appreciation for USDA agencies and their interrelationships and relationship to ASCS.
2. To know how and when to obtain help from USDA agencies.

Suggested Learning Activities:

1. Discuss functions of USDA agencies listed.
2. Obtain speakers from USDA agencies to discuss the objectives and services of USDA agencies.
3. Visit area USDA agency offices.
4. Select and show appropriate films.
5. Prepare transparencies and use USDA organization charts on Pages 53 and 54.

Audio-Visual Aids (films)

1. Big Gamble, The. 15-1/4 min., b & w, (Crop Insurance) Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.
2. Extra Forest Dollars. 13-1/2 min., color or b & w, (Forest Service) Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.
3. Fact Finders, The. 31 min., color, (Crop Reporting Service) Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.
4. Farmer Cooperatives Today. 21 min., color, (Farmer Cooperative Service), Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.
5. Forest, The. 28 min., color, (Forest Service) Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.
6. Harvest of Cooperation, 19-1/2 min., color, (USDA) Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.
7. Marketing Research Pays Off. 13-1/2 min., color, (ERS), Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

8. Mark of Quality, A. 13-1/2 min., color, (Federal Meat Grading Service) Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

9. Mark of Wholesome Meat, A. 18-1/2 min., color, (Federal Meat Grading Service) Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

10. New Uses for Farm Products. 20 min., b & w, (USDA Research) Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

11. Operation Bootstrap. 4-1/2 min., b & w (RAD) Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

12. Piece of Wood, A. 14-1/2 min., color, (U.S. Forest Service) Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

13. Plans for the Future. 10-3/4 min., color, (RAD) Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

14. Power and the Land. 39 min., b & w, (REA) Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

15. REA Story, The. 27-1/2 min., color, (REA) Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

16. Research Points on the Way. 27-1/4 min., color, (USDA Research) Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

17. Turning Point. 24 min., color, (FHA) Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

18. Unwanted Aliens. 11 min., color (ARS) Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

19. Upstream Where Floods Begin. 11 min., b & w, (filmstrip or motion picture film, SCS), Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

20. We Show the Way. 15 min., color, (Federal Extension Service), Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

21. What is a Farm Worth? 18-1/2 min., color, (Farm Credit Administration), Agricultural Extension Service, The Pennsylvania State University, University Park, Pennsylvania 16802.

References:

1. Baker, Gladys L., Wayne D. Rasmussen, Vivian Wiser, and Jane M. Porter. Century of Service: The First 100 Years of the United States Department of Agriculture, Washington, D. C.: U.S. Government Printing Office, 1963.

2. United States Government Organizational Manual, 1968-69, Washington, D. C.: U.S. Government Printing Office, 1968.

OTHER USDA AGENCIES

Many USDA agencies are working both individually and in groups to provide services for farmers and consumers. Those having the most direct contact with farmers are described briefly. Others not described are listed.

Federal Crop Insurance Corporation

The Federal Crop Insurance Corporation permits farmers to insure against crop production losses such as those caused by weather, insects, and diseases. This insurance helps farmers strengthen their financial position and that of the community.

Rural Community Development Service

The Rural Community Development Service (RCDS) maintains a working liaison with non-USDA agencies to determine what programs and services would be useful to rural people and communities.

Farmer Cooperative Service

The Farmer Cooperative Service conducts research, advises directly with cooperative leaders and others, promotes cooperative organization and development through other federal and state agencies, publishes the results of its research, and issues "News for Farmer Cooperatives" and other educational material.

Farmers Home Administration

The Farmers Home Administration provides financial and management assistance. Loans may be of the following types: operating loans, loans and grants to associations, rural housing loans, emergency loans, watershed protection and flood prevention loans, resource conservation and development loans, rural renewal economic opportunity loans, and Appalachia loans.

Forest Service

The Forest Service is charged with the responsibility of promoting the conservation and best use of the nation's forest land which covers approximately

a third of the total land area of the United States. These responsibilities include: national forests, forest research, cooperation with states and private owners of forest lands, and leadership and direction of the rural fire defense program.

Rural Electrification Administration

The Rural Electrification Administration (REA) administers loan programs for (1) rural electrification, and (2) telephone service in rural areas. REA furnishes its borrowers with technical assistance.

Soil Conservation Service

The Soil Conservation Service (SCS) has responsibility for developing and carrying out a national soil and water conservation program. This is to be done with farmers and ranchers and other land users and developers. The planning is done in cooperation with community planning agencies, regional resource groups, and other agencies of government.

Assistance to individual soil conservation district cooperators include: (1) giving the cooperator a soil and land-capability map of his land; (2) giving him information about practical alternatives for treating and using the land within its capabilities, as indicated on the map; (3) helping him develop an orderly plan for installing the treatment measures and making the land-use changes needed; and (4) helping him apply parts of the plan that require special skills or knowledge.

Federal Extension Service

The Federal Extension Service is one of three partners in the Cooperative Extension Service. State governments, through their land-grant universities, and county governments, are the other partners. All three share in financing, planning, and conducting extension programs.

Extension helps the public interpret and apply to everyday problems the latest technology developed through research by the land-grant universities,

the USDA, and other sources. Extension works directly with the people through offices located in almost every county in the United States.

Other Agencies

-Foreign Agricultural Service

-Export Marketing Service

-Consumer and Marketing Service

-Commodity Exchange Authority

-Packers and Stockyards Administration

-Economic Research Service

-Statistical Reporting Service

-Agricultural Research Service

-Cooperative State Research Service

-Food and Nutrition Service

The USDA also includes:

-International Organizations Staff

-National Agricultural Library

-Research Program Development

-Evaluation Staff

In addition there are nine departmental administration staffs.

TEACHER'S GUIDE FOR ECONOMIC PRINCIPLES

Objectives:

1. To develop an understanding of selected economic principles.
2. To develop the ability to discuss economic principles as they relate to agriculture, agricultural programs, and the individual farmer.

Suggested Learning Activities:

1. Discuss each of the economic principles listed in the student handbook and ask students to relate instances in their own experience where these principles apply.
2. Point out that the application of economic principles to their projects may help students make money.
3. Use the audio-visual materials to help students understand principles of economics.

Audio-Visual Aids (films)

1. Allocating Our Resources. 30 min., color, The Pennsylvania State University, Audio-Visual Aids Library, University Park, Pennsylvania 16802.
2. Basic Elements of Production. 11 min., color, The Pennsylvania State University, Audio-Visual Aids Library, University Park, Pennsylvania 16802.
3. Case for Competition. 30 min., color, The Pennsylvania State University, Audio-Visual Aids Library, University Park, Pennsylvania 16802.
4. Economics of Democracy. 28 min., color, Farm Film Foundation, Suite 819, Southern Building, 1425 H Street, N. W., Washington, D. C. 20005.
5. Fact Finders, The. 30 min., color, Farm Film Foundation, Suite 819, Southern Building, 1425 H Street, N. W., Washington, D. C. 20005.
6. Going Places. 10 min., color, Farm Film Foundation, Suite 819, Southern Building, 1425 H Street, N. W., Washington, D. C. 20005.
7. Partners. 28-1/2 min., color, Farm Film Foundation, Suite 819, Southern Building, 1425 H Street, N. W., Washington, D. C. 20005.
8. Tomorrow's Foodpower. 27 min., color, Farm Film Foundation, Suite 819, Southern Building, 1425 H Street, N. W., Washington, D. C. 20005.

References:

1. Agricultural Markets in Change. U. S. Department of Agriculture, Economic Research Service, Agricultural Economic Report No. 95, Washington, D. C.: U.S. Government Printing Office, 1966.

2. Barker, Richard L., ed. Profit Maximizing Principles, Columbus, Ohio: Ohio State University, 1967.

3. Barlowe, Raleigh. Land Resource Economics: The Political Economy of Rural and Urban Land Resource Use, Englewood Cliffs, N. J.: Prentice -Hall, Inc., 1958.

4. Bird, Alan R. Surplus: The Riddle of American Agriculture, New York: Springer Publishing Company, Inc., 1962.

5. Castle, Emery N., and Manning H. Becker. Farm Business Management: The Decision Making Process, New York: The MacMillan Co., 1962.

6. "Consumers All," The Yearbook of Agriculture, Washington, D. C.: U.S. Government Printing Office, 1965.

7. Hall, I.F., and W. P. Mortenson. The Farm Management Handbook, Danville, Illinois: The Interstate Printers and Publishers, Inc., 1960.

8. Hamilton, James E., and W. R. Bryant. Profitable Farm Management, second edition, Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1963.

9. King, Frank P., and L.S. Hardin. Better Farm Management, Atlanta, Georgia: Turner E. Smith and Company, 1956.

10. "Marketing," The Yearbook of Agriculture, Washington, D. C.: U.S. Government Printing Office, 1954.

11. Moser, David E., and Wesley R. Kriebel. Transportation in Agriculture and Business, Manual 63, Columbia, Missouri: University of Missouri, Extension Division, 1964.

12. "Protecting Our Food," The Yearbook of Agriculture, Washington, D. C.: U.S. Government Printing Office, 1966.

13. "Science for Better Living," The Yearbook of Agriculture, Washington, D. C.: U.S. Government Printing Office, 1968.

SECTION IV. ECONOMIC PRINCIPLES

Supply and Demand

Both prices of farm products and costs of resources used in the production of agricultural products are affected by the interaction of supply and demand. Supply reflects attitudes and actions of producers and sellers. Demand reflects the attitudes and actions of buyers.

In general, it can be said that as supply decreases and/or demand increases, prices will rise. Also, as supply increases or demand decreases, prices go down. This is not a simple relationship, however, since many other factors are involved. For example, the storability, desirability, and amounts needed will vary price and/or demand. A perishable product such as lettuce must be sold in a short period of time or it will spoil. A desirable commodity such as apples may continue to sell even though the price is well above "normal." A product such as bacon which is used in relatively small quantities might be purchased even if the price were to double.

Farm programs have attempted either to bring supply and demand into balance via cropland adjustment or to protect farmers' incomes from oversupply by means of price support. For many farm products, a combination of approaches is used.

Elasticity

A supply or demand is said to be elastic when a change in price results in a more than proportionate change in the quantity of product supplied or purchased. When a price change results in less than a proportionate change in quantity, the supply or demand is inelastic. For example, the demand for necessary food items will tend to be inelastic. On the other hand, luxury food items will tend to have an elastic demand.

Opportunity Costs

Most farmers do not have the amount of capital they would like to have. Consequently, they cannot do everything they want to do. Thus, they have to make decisions. The difference in net income among the various alternatives is the opportunity cost. For example, on ten acres of cropland, a farmer might be able to raise hay, oats, or corn. The figures might look like this:

	Hay	Oats	Corn
Gross income	$ 1100	$ 500	$ 1150
Expenses	500	450	650
Net income	$ 600	$ 50	$ 500

The opportunity cost of hay to oats is $550, of hay to corn, $100; and corn to oats, $450.

Resource Allocation

On the basis of opportunity costs the farmer allocates fixed or limited resources to the most profitable livestock and crop enterprises. He attempts to get the highest return on his most limiting resource. Thus, if capital is limited, he allocates his capital resource among enterprises to realize his highest net return to capital. Farm programs influence the profitablility of various alternative crop or livestock enterprises. The farmer will weigh the affect of these programs as he plans how to allocate resources.

Diminishing Returns

As inputs are added, outputs follow a predictable pattern. The first inputs cause output to increase at an increasing rate. Additional inputs cause outputs to increase but at a decreasing rate. Finally, at some point, additional inputs will cause output to decrease.

Cost-Price Margin

The cost-price margin is the difference between cost of production and price of product. The smaller this margin, the harder it is to make a profit. Thus, greater efficiency is required to break even. Most businesses raise prices as costs increase, thus, maintaining their margin. Farmers, however, have to pay the costs set by others if they want to buy many of the things they need. At the same time when they sell their products, they must usually accept the prices set by the market. Price supports are among the devices used to insure that the farmer has a margin between his costs of production and the selling price of his products.

Purchasing

The purchasing power of the farmer significantly influences both the farm and total business economy. One aim of farm programs has been to protect the farmer's purchasing power. Where farmers can estimate with reasonable assurance the value of their product at harvest, their expenditures for inputs, such as fertilizer and seeds, can be geared to securing the highest net return. As his risk is lowered, the purchasing power of the farmer is stabilized.

Specialization versus Diversification

Specialization refers to the production of a limited number of products. The major advantages are that fixed costs, such as necessary machinery, are spread over more units of production and any comparative advantages are used to the fullest extent. With specialization comes greater risk, since other sources of income are not available in the event of low prices, low yields, or high costs.

Diversification, on the other hand, reduces risk. It may take better advantages of the resources of a farm by spreading labor requirements more evenly throughout the year. Types of soils and buildings may also be better used through diversification.

Demand for Quality

Part of meeting demand is having the quality that is being demanded. Even if pork is in great demand, the demand for lard may be almost non-existent. The demand in this case is for lean hogs. If the quality of one product drops, consumers may substitute something else for it. This might cause surplus of poor quality of the first product and drastically reduce the price of the product. Consumers are increasingly demanding quality products.

Price Supports

Price supports can both increase supply and decrease demand by raising the price. If price supports are lowered, the opposite can occur. (See Page 19).

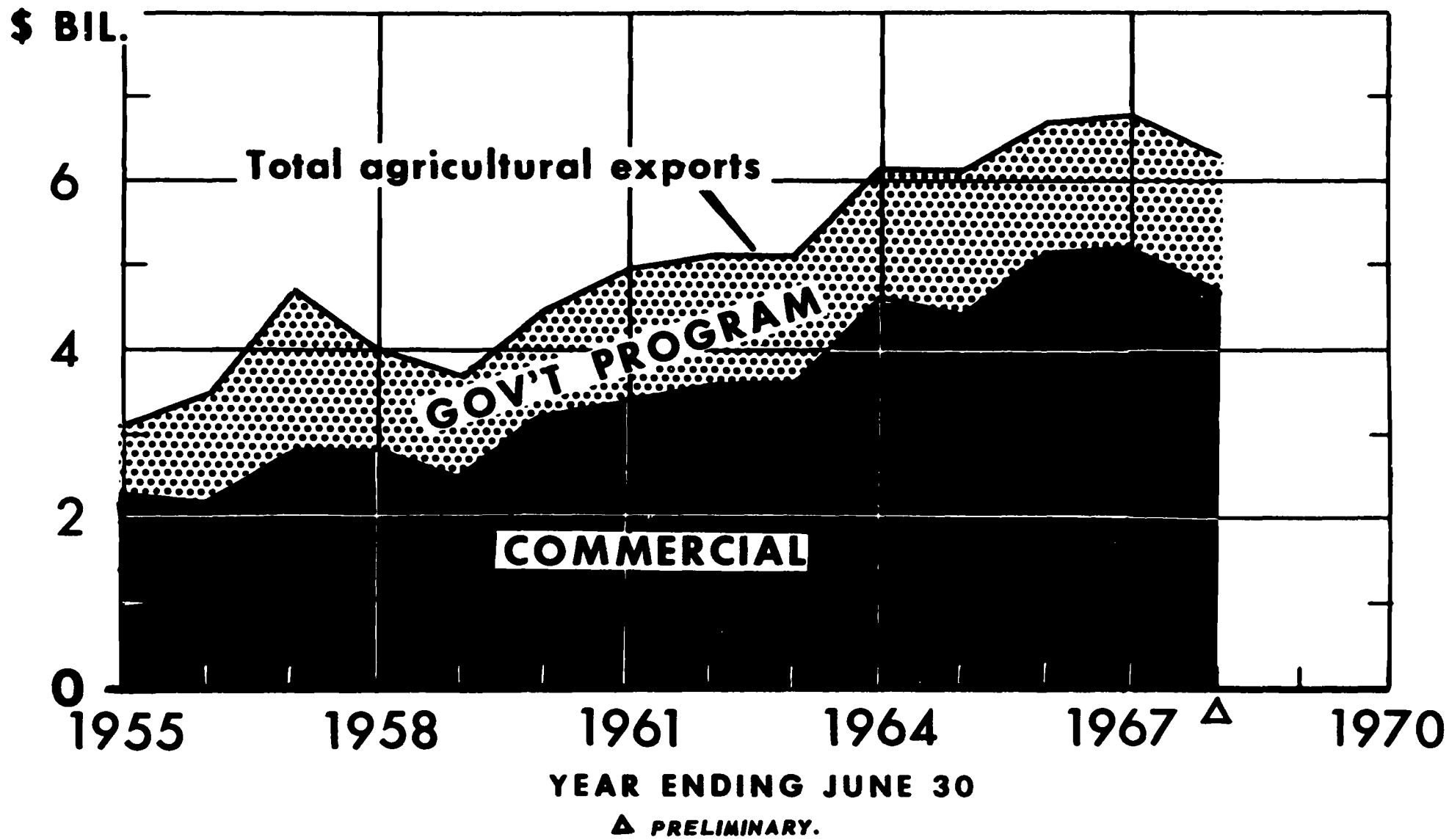
Marketing, Storage, and Seasonal Products

Marketing is part and parcel of the modern productive process. Goods grown and sold by farmers must be stored, transported, processed, and delivered in the form, at the time, and to the places that consumers desire.

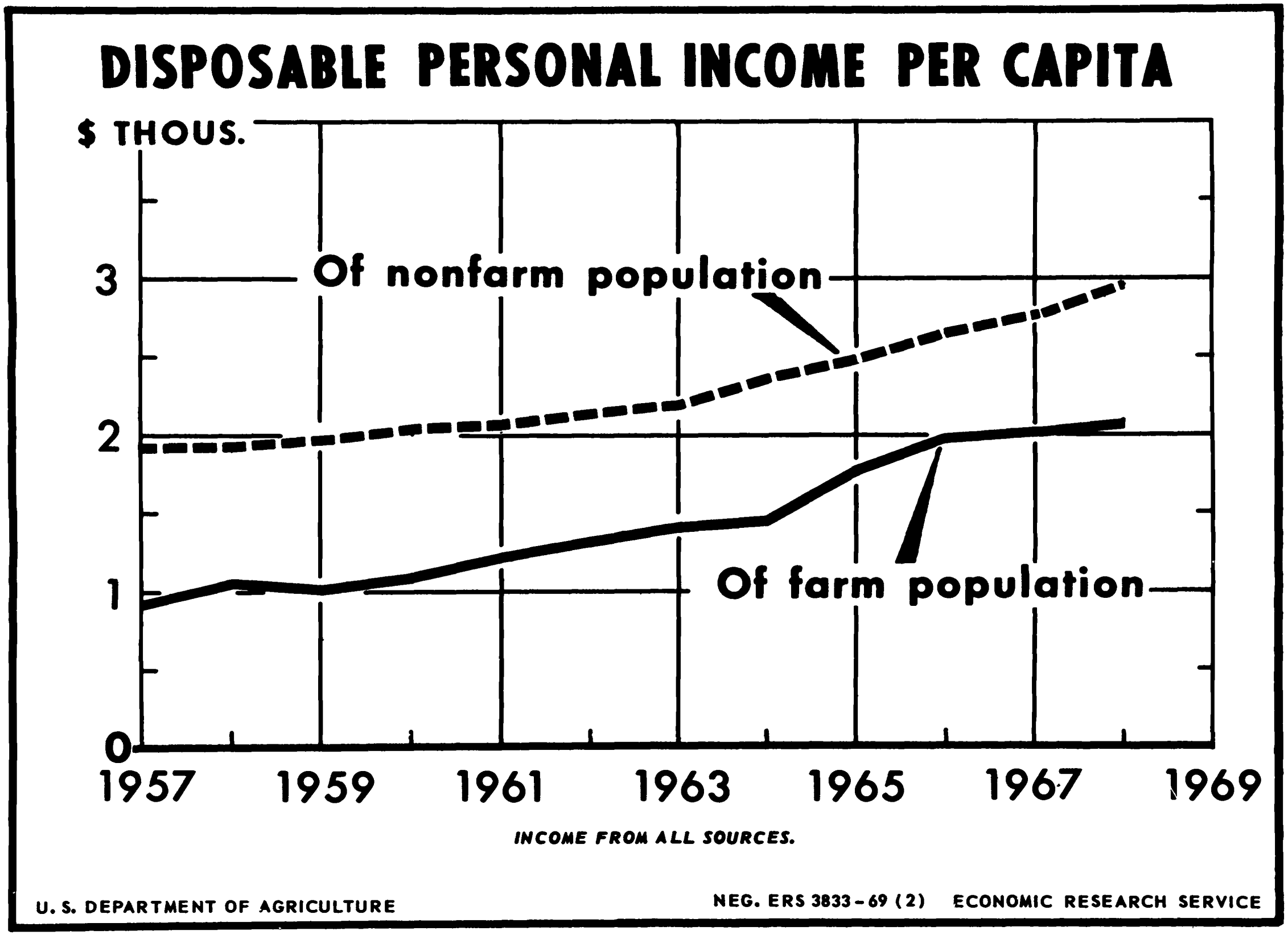
Methods of storage have improved greatly in the past fifty years. Controlled environment and other modern storage facilities make farm products available year round, thus, helping to balance supply and demand.

APPENDICES

U.S. AGRICULTURAL EXPORTS: COMMERCIAL AND UNDER GOVERNMENT PROGRAMS



U.S. DEPARTMENT OF AGRICULTURE NEG. ERS 5366-68 (9) ECONOMIC RESEARCH SERVICE


DISPOSABLE PERSONAL INCOME PER CAPITA
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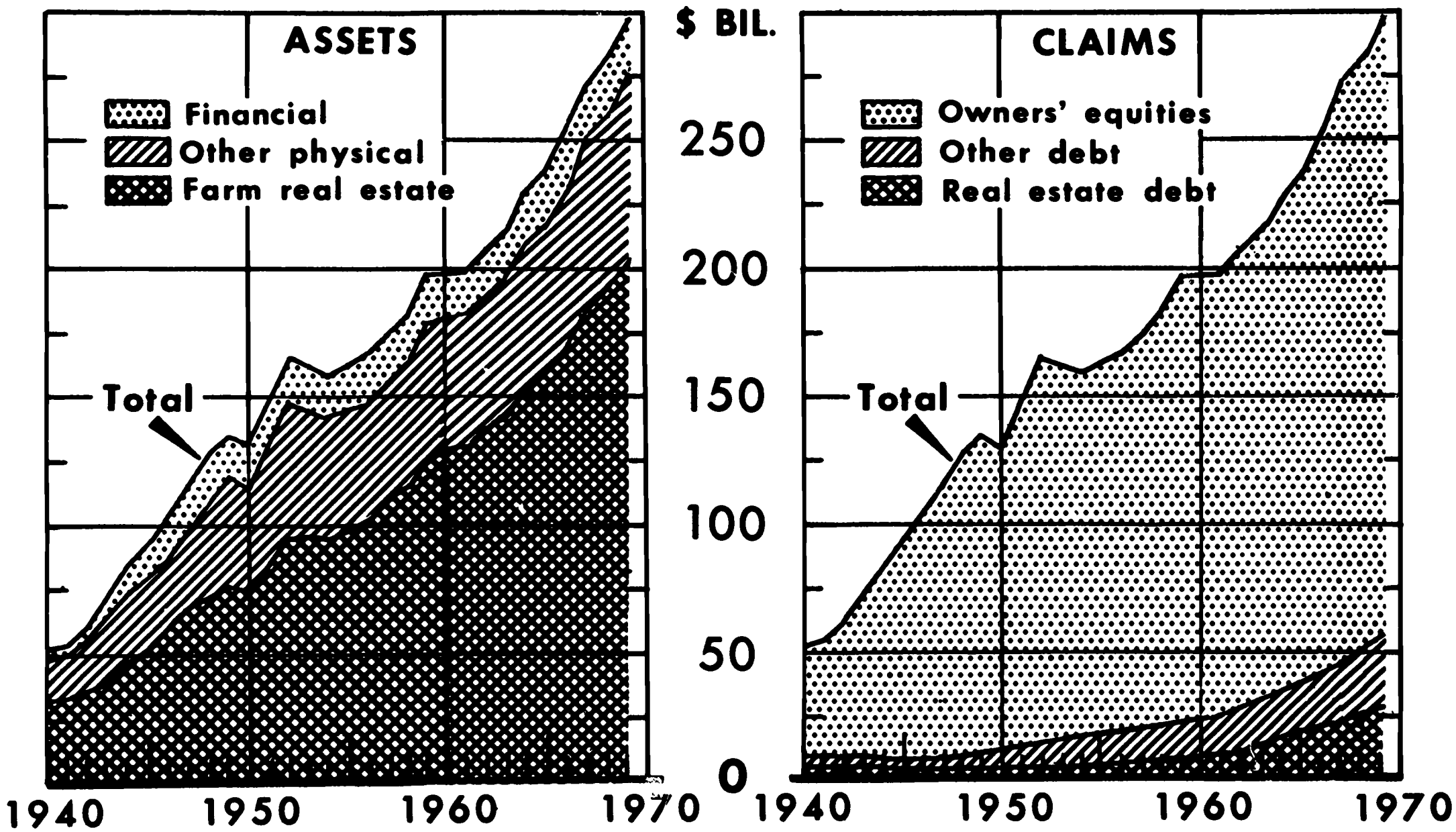
Of nonfarm population
Of farm population
1957
1959
1961
1963
1965
1967
1969
INCOME FROM ALL SOURCES.
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 3833-69 (2)
ECONOMIC RESEARCH SERVICE

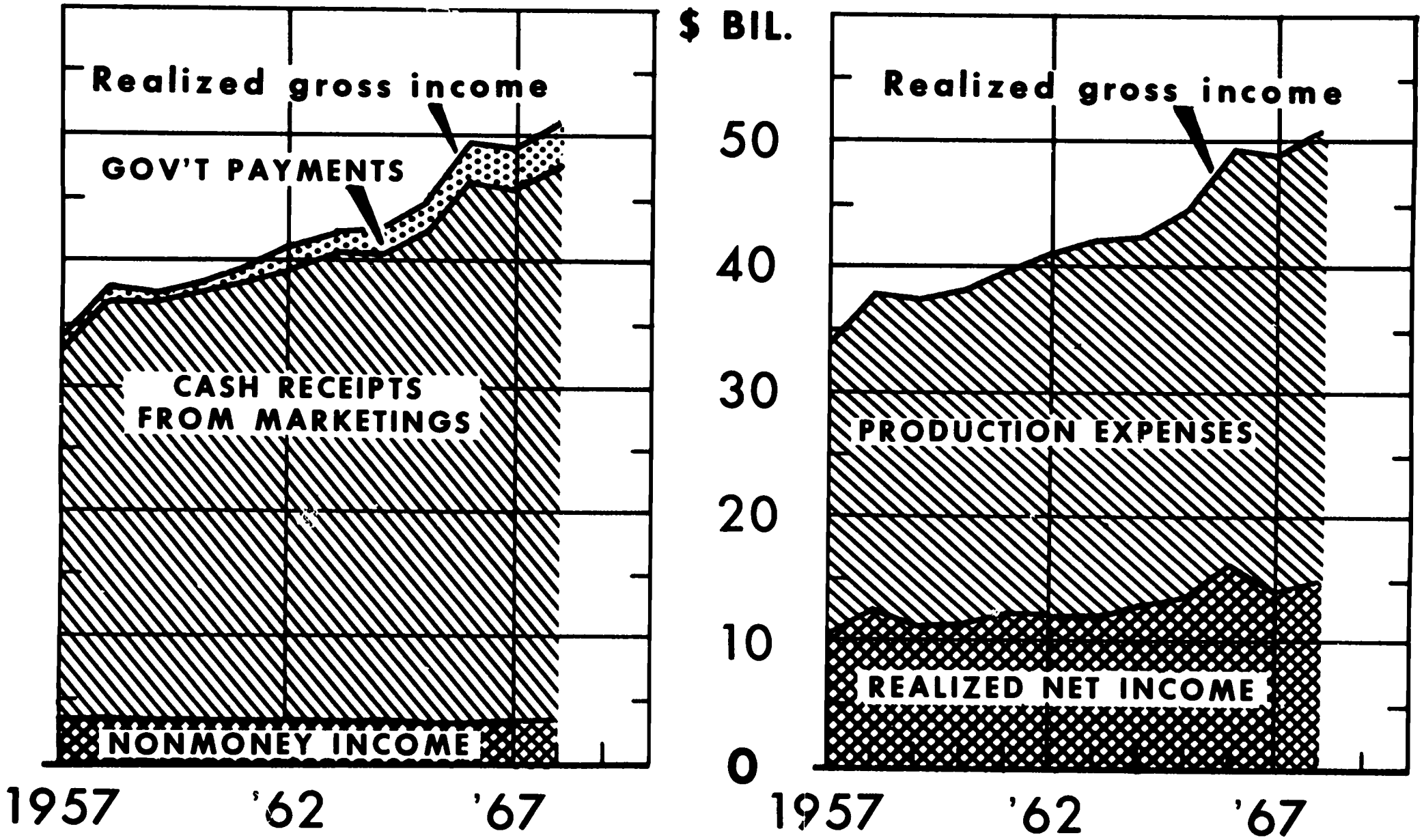
THE BALANCE SHEET OF AGRICULTURE



DATA ARE AS OF JANUARY 1 EACH YEAR. *1969 PRELIMINARY.* *DATA FOR 48 STATES ONLY.*

U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 965-68 (12) ECONOMIC RESEARCH SERVICE

FARM INCOME COMPONENTS

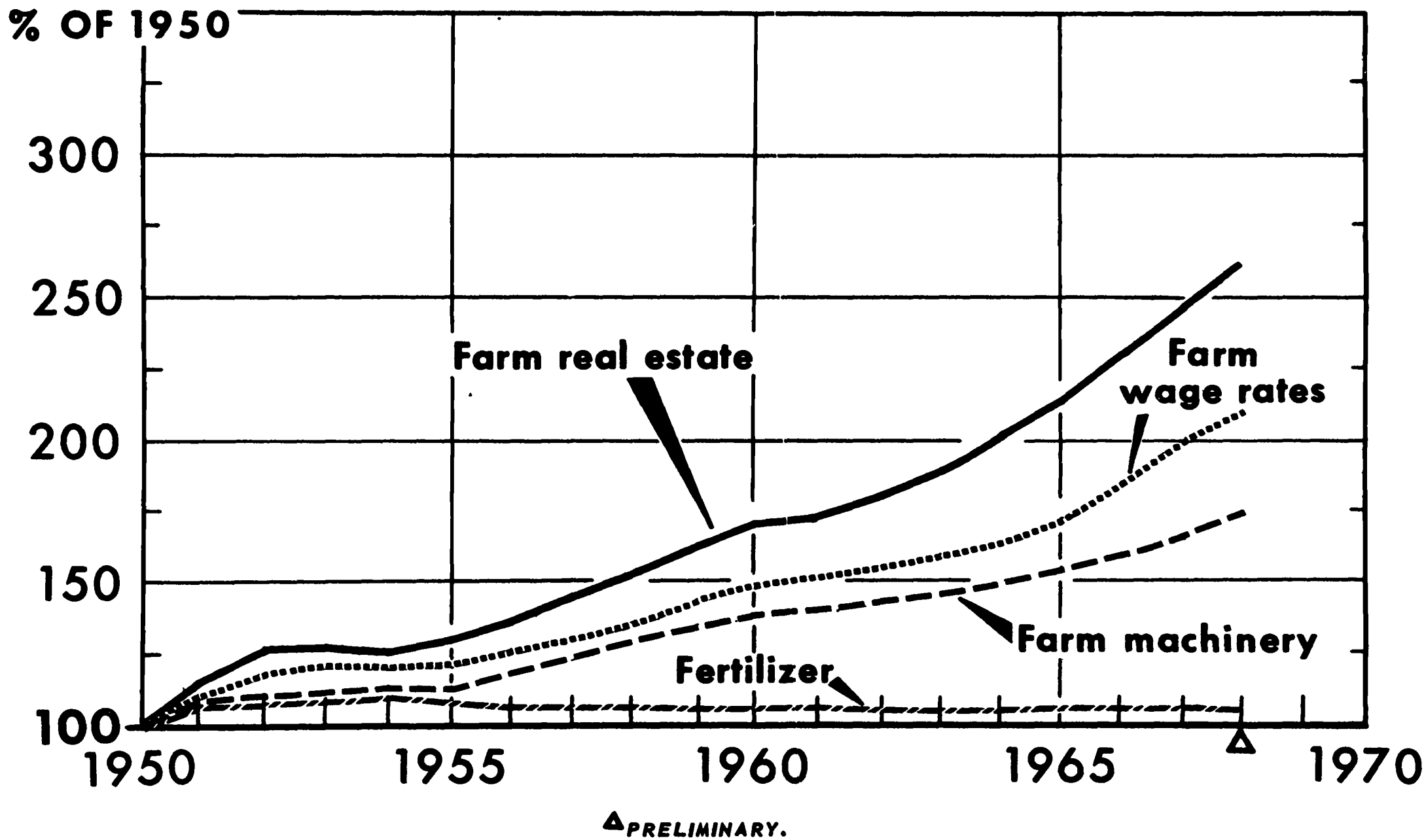


50 STATES STARTING IN 1960.

U. S. DEPARTMENT OF AGRICULTURE

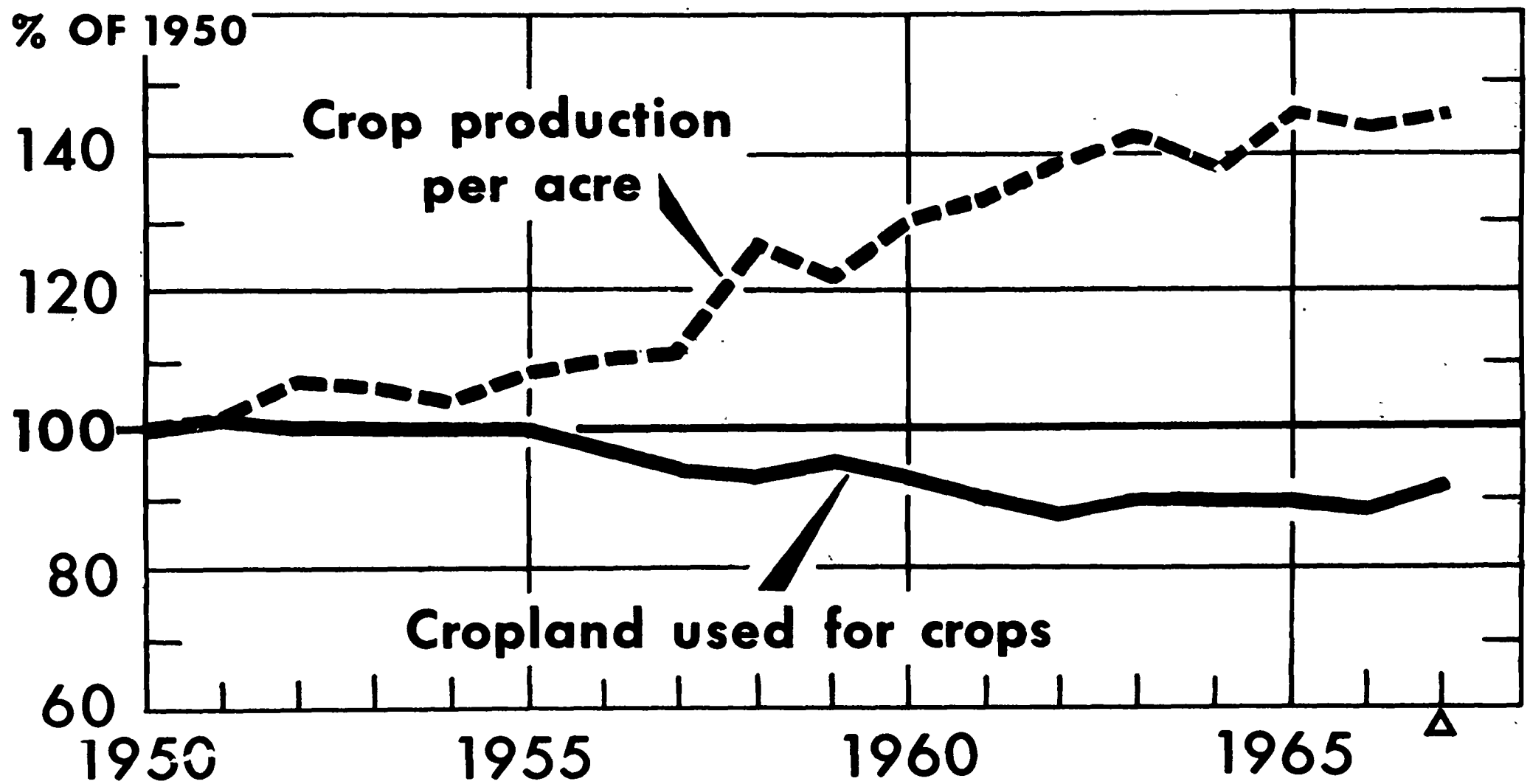
NEG. ERS 3780-68 (12) ECONOMIC RESEARCH SERVICE

PRICES OF SELECTED FARM INPUTS



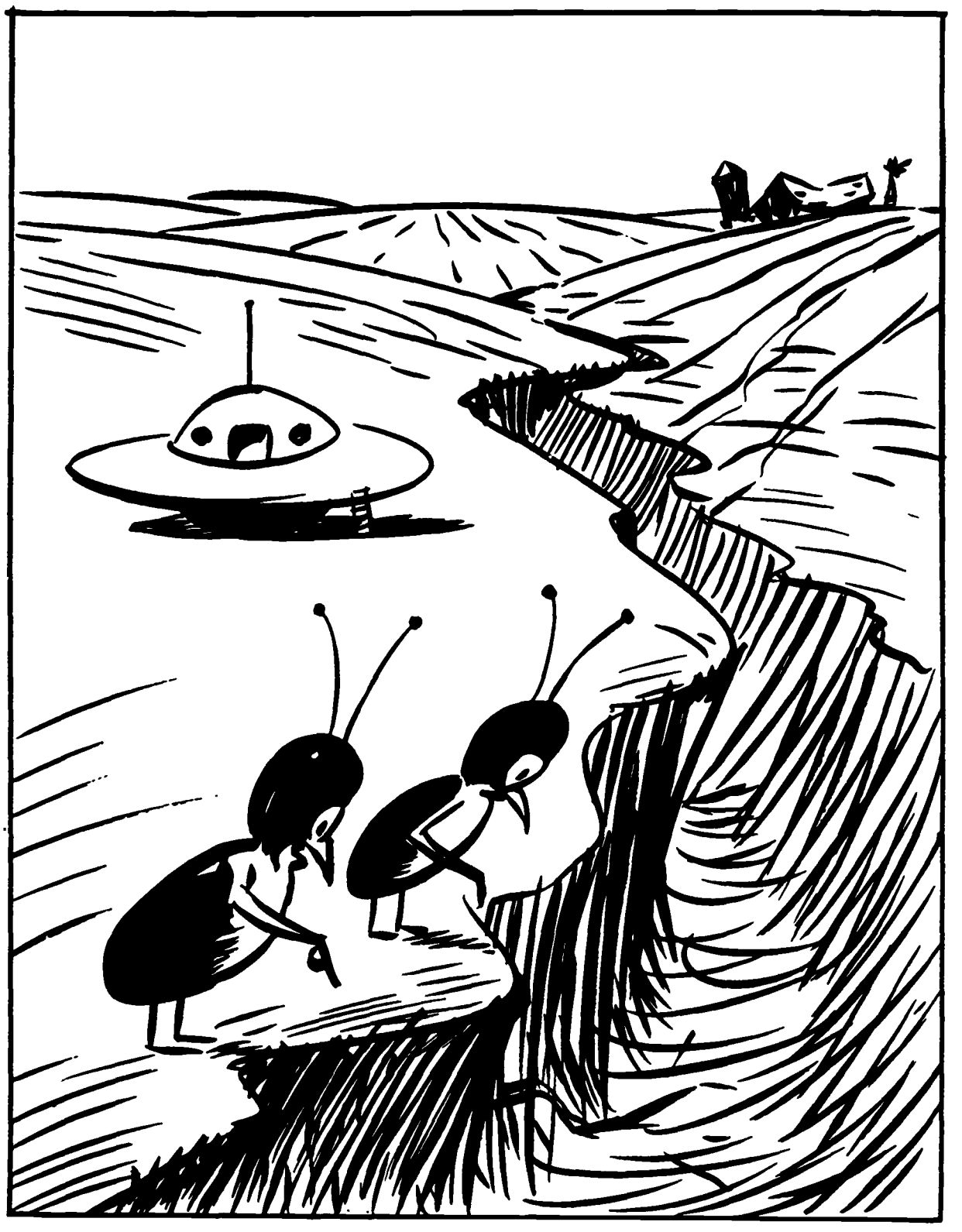
U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 3995-68 (9) ECONOMIC RESEARCH SERVICE

CROP PRODUCTION PER ACRE AND CROPLAND USED FOR CROPS



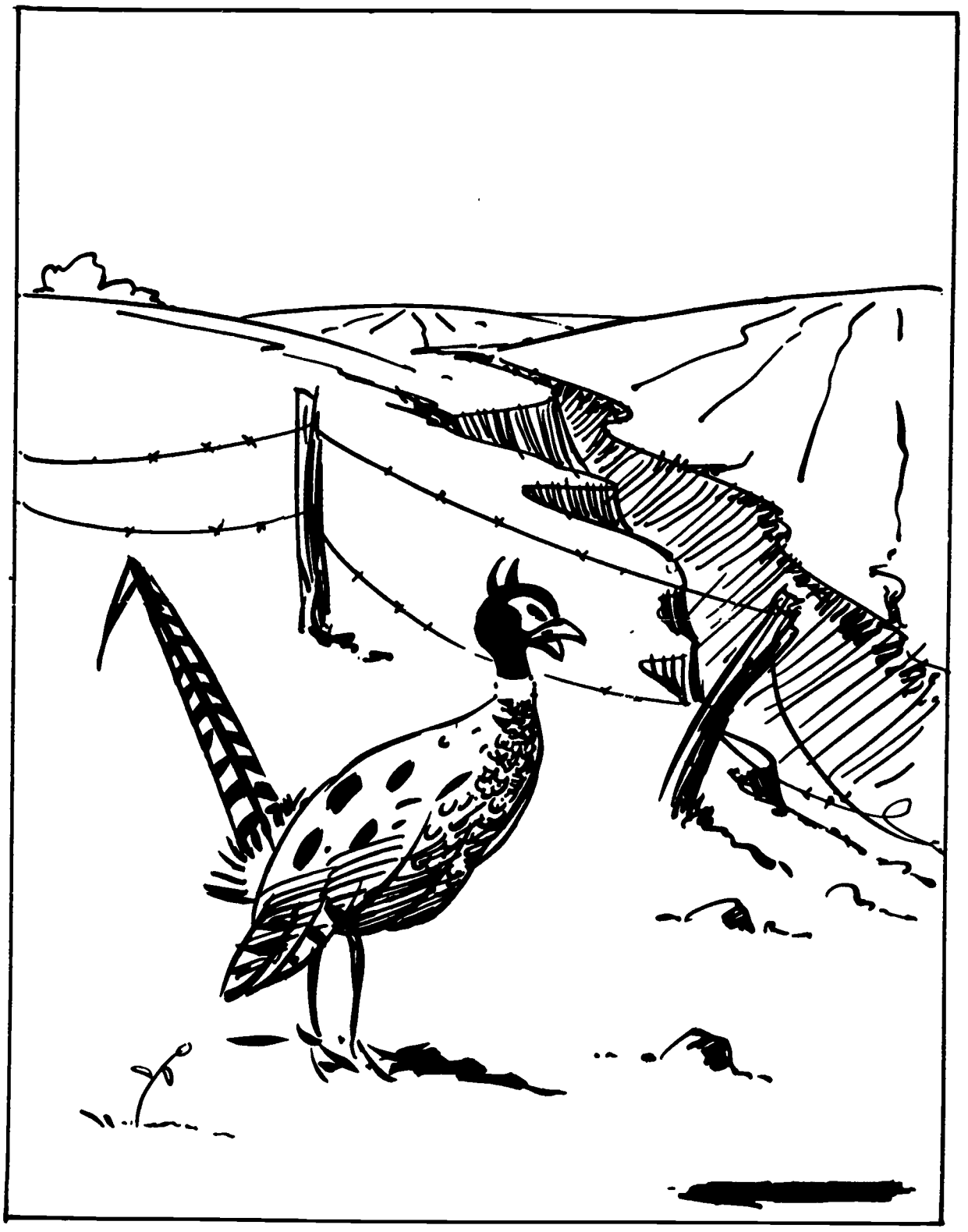
ΔSEPTEMBER INDICATIONS.

U. S. DEPARTMENT OF AGRICULTURE NEG. ERS 1355-67 (9) ECONOMIC RESEARCH SERVICE

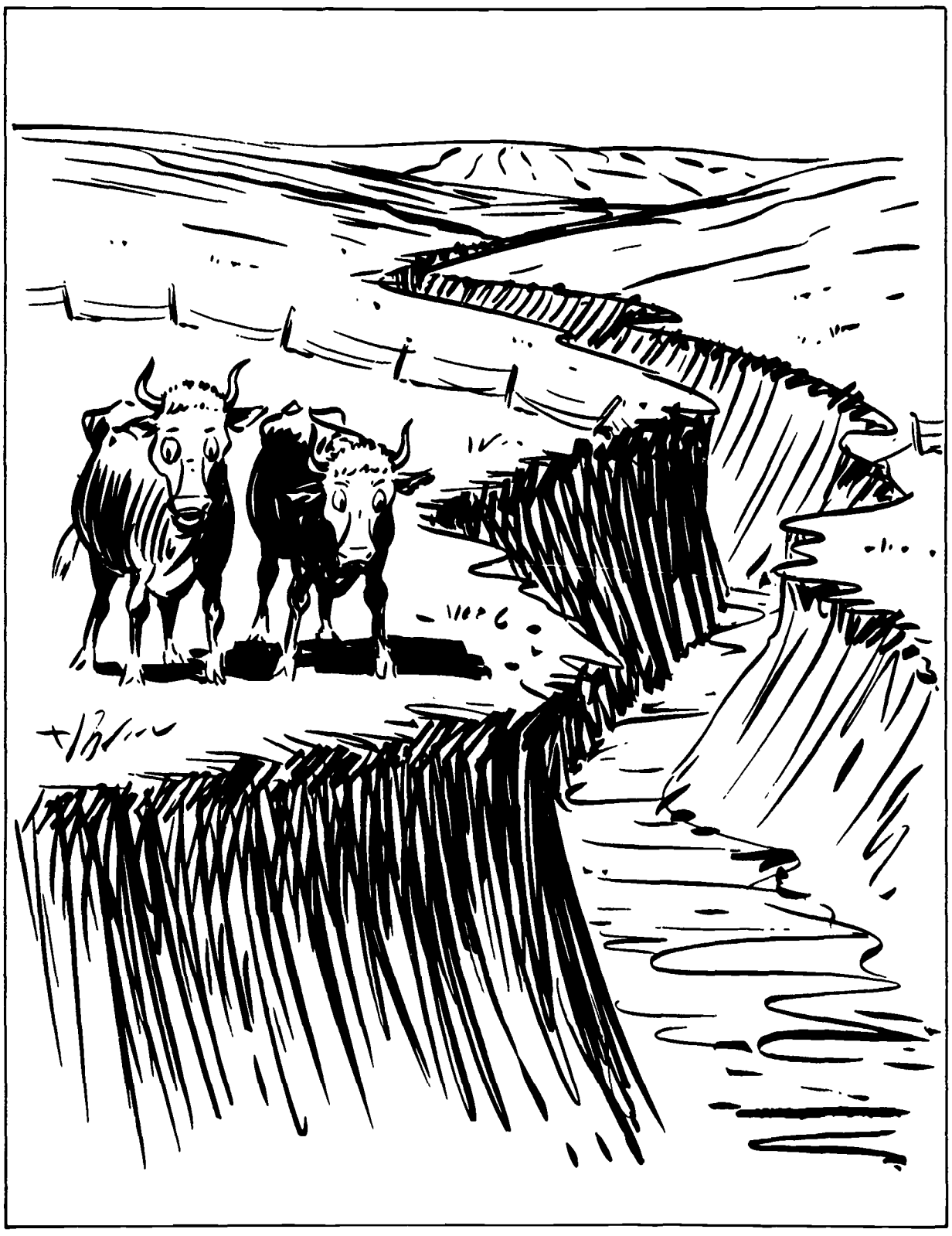


"Erosion or explosion?"

"Someday this will all be yours,son."



"Darned housing shortage!"



"When we were calves we could hop across this ditch!"

"Erosion is nothing to crow about"

ORDER FORM FOR ASCS RESOURCE MATERIAL

Mail to: Information Division
Room 46W
USDA/ASCS
Administration Building
Washington, D. C. 20250

Check below the areas on which you would like the latest information. If you wish to order particular publications, you may list them in the space near the end of this form.

- [ ] Conservation Programs
- [ ] Production Adjustment Programs
- [ ] Price Support through Loans Programs
- [ ] Farm Storage Facility and Drying Equipment Loans
- [ ] Disaster Assistance Programs
- [ ] Defense Readiness Programs
- [ ] Section 32 -- Direct Purchases for Surplus Removal
- [ ] Wool Payment Programs
- [ ] ASCS Commodity Fact Sheets
- [ ] Sugar Programs
- [ ] Food Aid Programs
- [ ] ASCS/USDA Organization
- [ ] Farmer Committee System
- [ ] Economic Principles
- [ ] Occupational Opportunities
- [ ] History and Background
- [ ] Other (list below)

_____
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- [ ] Please place our school's name on mailing list to receive new materials as they become available.

Please send the above materials to:

Name of Teacher _____

Name of School _____

Address - Street _____

City _____ State _____ Zip _____

ORDER FORM FOR AUDIO-VISUAL MATERIALS

Mail to: Employment Development and Training Staff
4746 USDA/ASCS
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Washington, D. C. 20250

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VT 010 746
Tulloch, Rodney W.; Curtis, Samuel M.
ASCS and You, A Student Resource Unit. Teacher Education Series, Volume 10, Number 5s.

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ABSTRACT - This student resource manual was written by a graduate assistant in agricultural education, field tested in 17 schools, and reviewed by state and national Agricultural Stabilization and Conservation Service (ASCS) specialists prior to publication. The unit provides information about ASCS programs for those high school or vocational school students interested in farming or in off-farm agricultural business. Divided into four sections, each containing one or more lessons, the content covers: Federal Farm Programs, ASCS Organization, History and Background, and Economic Principles. The related teacher's manual is available as VT 010 745, also in this issue. (AW)

VT 010 746

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105 pg

ASCS AND YOU

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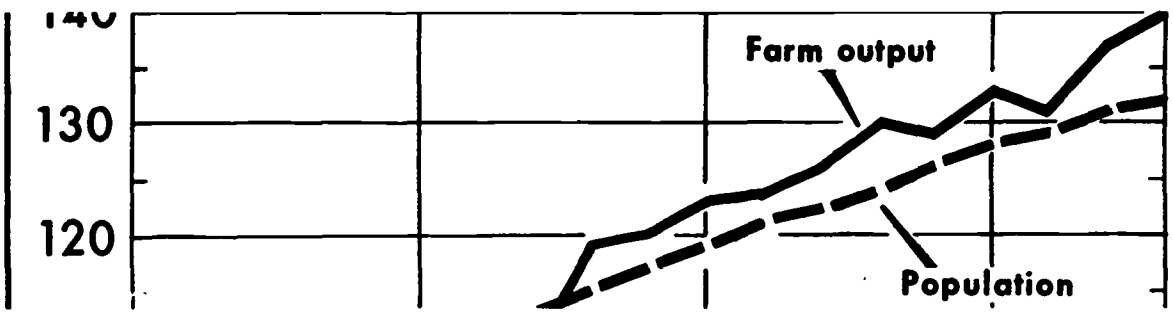

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(Address) 101 Ag. Education Building, The Pennsylvania State University University Park, Pennsylvania 16802

DATE: March 4, 1970

RE: (Author, Title, Publisher, Date) Tulloch, R. W., and S. M. Curtis, ASCS and You (Student Handbook), Teacher Education Series, Vol, 10, No. 5s, 1969.

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ASCS AND YOU

A student resource unit to be used in teaching the ASCS and farm programs. It should be useful for high school students and young and adult farmer classes

by
Rodney W. Tulloch
Graduate Assistant in Agricultural Education

and
Samuel M. Curtis
Assistant Professor of Agricultural Education

The Pennsylvania State University
College of Agriculture
Department of Agricultural Education
University Park, Pennsylvania 16802

in cooperation with

The U. S. Department of Agriculture,
Agricultural Stabilization and Conservation Service
Washington, D. C.

Teacher Education Series
Volume 10, Number 5s

FOREWORD

This publication is the product of a contract between the Agricultural Stabilization and Conservation Service (ASCS), an agency of the United States Department of Agriculture, and the Department of Agricultural Education, The Pennsylvania State University. An advisory committee of ASCS and The Pennsylvania State University personnel was named to provide direction for the project and to make suggestions as the project progressed.

Valuable assistance was given the project by ASCS in Washington, D. C., and the state ASCS office in Pennsylvania. The idea to write a student resource handbook on ASCS programs originated with a former vocational agriculture (vo-ag) teacher, Joseph H. Moore, who is now a farmer fieldman for ASCS in Pennsylvania. It was principally through his efforts that the project became a reality. As the project was formulated, another former vo-ag teacher, Tom Lett, became an interested participant in the project. From this early stage to completion, Mr. Lett of the Employment Development and Training Staff of ASCS worked closely with the project. He actively participated in reviewing the course materials. Program specialists for ASCS in Washington and Harrisburg reviewed the material for accuracy.

The unit was written by Rodney Tulloch, a graduate assistant; the project director was Dr. Samuel M. Curtis, assistant professor.

For the agriculture teacher to effectively teach this unit, the cooperation of many people will be needed. It is especially important that the county ASCS office managers and agriculture teachers work together in planning the instructional activities.

INTRODUCTION

Production and income of agriculture affect directly or indirectly every individual in our nation. No matter what occupation a person may choose as his life's work in one way or another he will come in contact with, or be directly dependent upon, agriculture. Likewise, the USDA, the ASCS, and farm programs affect every person in the United States. Some of the programs have world-wide significance.

This handbook contains general information on farm programs, ASCS organization, history and background of farm programs, and selected economic principles. The information has been intentionally limited to the more important facts, thus leaving out many of the rapidly changing details. Persons interested in the details of the programs should visit the county ASCS office where complete information is available.

The handbook is divided into four sections, (1) farm programs, (2) ASCS organization, (3) history and background, and (4) economic principles. Each section contains one or more lessons.

Government programs in agriculture have a long history. Yet, confusion still exists concerning their purposes. Programs administered through ASCS are presented in this handbook. The relationship of ASCS with other USDA agencies is also discussed.

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SECTION 1. FEDERAL FARM PROGRAMS

INTRODUCTION

Virtually every citizen is affected by ASCS programs whether or not he participates directly. ASCS programs affect prices and availability of major farm commodities as well as the products into which they are converted.

Reasons for Federal Farm Programs

The problem is simple. With their supply of cropland and management know-how farmers produce far more than we can eat, sell, or afford to give away.

Farmers have been aware for a long time of the cost-price squeeze - aware of the fact that the more successful they are in creating abundance, the lower the price they receive in the marketplace.

City residents are becoming aware of the problem as communications media do a better job of informing the public. For example, city folks know that fewer farmers are using more machinery, more fertilizer, and improved varieties on fewer acres to produce more corn, wheat, beef -- more of just about everything. Because of increased supplies of farm products, an hour's factory work now buys more food than ever before.

Farm Program Aims

Although the problem is simple, solutions to it are not so simple. Agricultural abundance, price stability, conservation, and national security have been major farm program aims since the first legislation dealing with price support and production adjustment was passed by Congress in 1933.

Farm Program Administration

Congress enacts farm legislation and appropriates funds to carry out the legislation. Authority for the administration of these programs is vested in the President, the Secretary of Agriculture, and the Commodity Credit Corporation (CCC). The CCC is under the general supervision and direction of the Secretary. At the county level these programs are administered by the county ASCS office.

Compliance

Compliance is designed to protect the producer and the government.

The most important facets of compliance are to: (1) protect the government's interest by guaranteeing taxpayers and Congress that agricultural payments are made in accordance with the law, (2) protect producer's interest by determining accurately the extent of participation in the program, and (3) provide payments and benefits when rightfully earned.

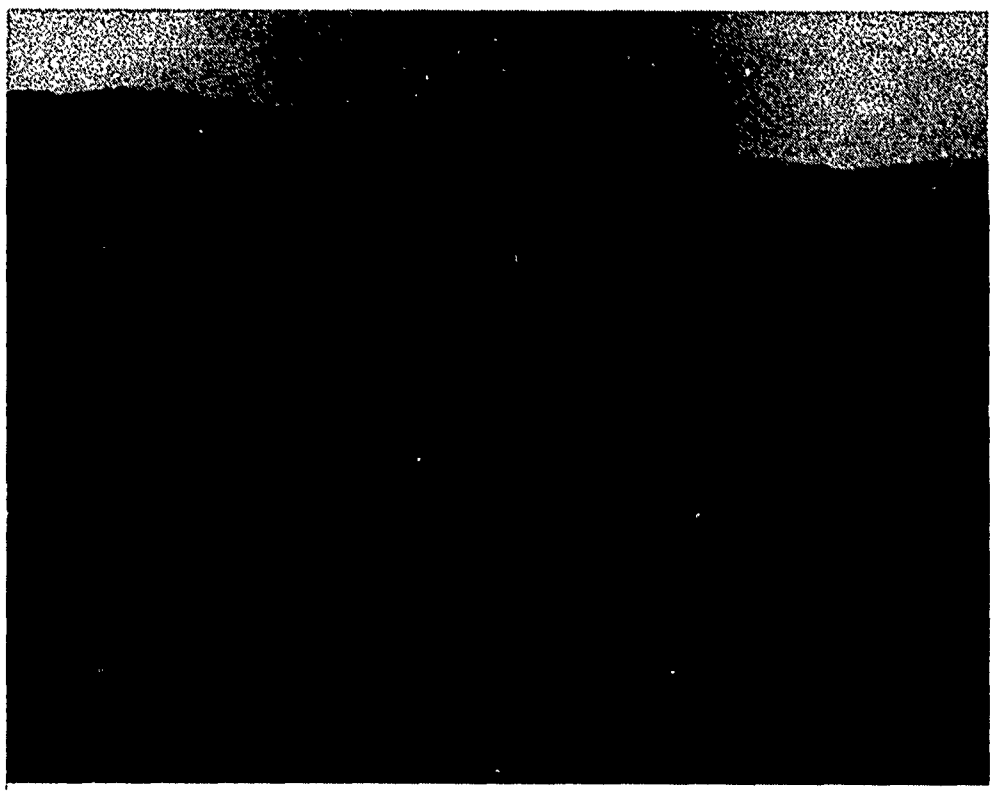
CONSERVATION PROGRAMS

Agricultural Conservation Program (ACP)

Introduction

The Agricultural Conservation Program (ACP) is an effort by the United States Department of Agriculture in cooperation with agricultural producers to preserve and improve the nation's farm land, water, and timber resources. Under ACP the federal government assists agricultural producers by sharing the cost of performing conservation work approved for that county.

At the present time the landowner bears the primary responsibility for conservation of the land. Clean air, water, and a beautiful productive country are of concern to everyone whether they are from a rural or urban area. The public must become aware of and participate with greater vigor in the conservation of our natural resources to preserve them for future generations.



Contour Strips

Goals of the Agricultural Conservation Program are:

(1) Soil erosion control

(2) Healthy stands of trees

(3) Luxuriant growth on pasture and rangeland

(4) Disposal of excess water or conservation of scarce water

(5) Plentiful habitat for wildlife

(6) A beautiful countryside

How ACP Works

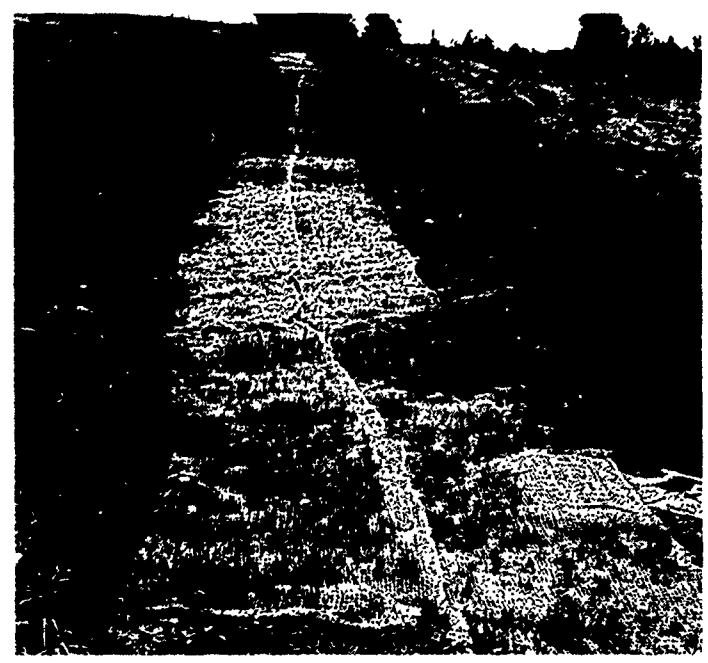
A farmer applies for cost-sharing

A farmer files a request with the ASC county committee for ACP cost-sharing before carrying out the conservation practice. Upon favorable action by the committee and after an approved practice has been completed according to the specifications designated by the committee, the farmer certifies compliance to the county office. One of the technical agencies checks to determine that specifications have been met in cases where technical responsibility has been assigned. Annually, a small number are spot checked for compliance with the ASCS program. The Soil Conservation Service (SCS) and the Forest Service are responsible for providing technical program guidance to ASCS committees as well as technical aid to farmers in carrying out conservation practices. The Agricultural Extension Service and other governmental agencies also provide technical assistance. For exact details of how ACP works in your county visit the county ASCS office.

ACP Practices

ACP offers a wide range of conservation, soil, woodland, water, and wildlife practices to meet the varied conservation problems throughout the nation. But, since each county determines which practices are available, requests for detailed information should be directed to the county ASCS office. Major categories of these practices are listed on the following pages.

Permanent seeding



Sod waterway

Cross-slope strips improve pasture and pond

Wildlife habitat

Vegetative Cover Practices

Seedbed preparation, seeding, liming, fertilizing, and other measures needed in the establishment or improvement of grass and legume cover for soil protection.

Forestry Practices

The planting of trees and shrubs for forestry purposes and for erosion control, and the improvement of established stands of trees by such measures as thinning, pruning, and the control of competing and undesirable vegetation.

Establishment of Conservation Systems of Farming

The construction of terraces and the performance of farming operations on the contour or in strips for the prevention of wind or water erosion.

Water Impoundment Practices

The construction of dams, pits, or ponds for erosion control, livestock water, irrigation, or other agricultural purposes.

Disposal of Excess Water

The construction of sod waterways and the installation of farmland drainage systems.

Conservation and Effective Use of Water

The lining of irrigation ditches, leveling of land, and the installation of structures to conserve water, prevent erosion, and to permit more efficient use of irrigation water.

Wildlife Conservation Practices

The establishment of vegetative cover which will provide food, cover, and habitat for wildlife as well as soil protection, and the impoundment of water for fish and other wildlife.

Beautification and Conservation Practices

The performance of measures which will enhance the appearance of areas visible to the public and at the same time provide substantial soil and water conservation benefits.

Annual Summary of Major ACP Practices in the United States

- 50,000 water storage reservoirs constructed to distribute grazing, control erosion, and conserve irrigation water or provide wildlife habitat.

- 734,000 acres terraced to control erosion or conserve water

- 345,000 acres established in strip cropping systems to control wind or water erosion and conserve water

- 43,000 acres of sod waterways established to control erosion and permit safe disposal of excess run-off

- 12,708,000 acres established in enduring vegetative cover to control erosion and conserve water

- 200,000 acres planted to trees for forestry purposes

- 210,000 acres of low quality forested areas improved to develop desirable forest resources

Emergency ACP

Emergency conservation measures are authorized under the ACP in designated disaster areas where emergency conservation measures are needed to control severe wind erosion on farmlands, or to rehabilitate farmlands damaged by wind erosion, floods, hurricanes, fires, earthquakes, or other natural disasters.

Regional Conservation Program (RCP)

Thus far this long term program has been limited to the Appalachian Land Stabilization and Conservation Program (ALSCP).

The program assists in development of the Appalachian region by providing cost-sharing and technical assistance to landowners, operators, or occupiers of land in that region. ALSCP contracts provide for land stabilization, erosion, and sediment control, reclamation through changes in land use, and the establishment of measures for the conservation and development of soil, water, woodland, wildlife, and recreation resources. This program accelerates conservation work in selected project areas and supplements other Appalachian Region programs. Emphasis is placed on solving conservation problems inhibiting economic growth. Cost-sharing agreements are for periods of three to ten years. The federal share may not exceed 80 percent of the treatment cost. Not more than 50 acres of land for any one person may be included in the program. Cost-sharing is limited to 50 dollars per acre and 2500 dollars per contract.

Cropland Adjustment Program (CAP)

Objectives

The voluntary Cropland Adjustment Program (CAP) is designed to help agricultural producers reduce farming operations, change cropping plans, or put land to conservation and other needed uses rather than growing crops. Goals of the Cropland Adjustment Program are to:

(1) divert cropland from production of unneeded crops to conservation and other uses for five to ten years;

(2) give conservation assistance on cropland taken out of production;

(3) make adjustment payments based on crop values, production history, and need for diverting some crops more than others; and

(4) provide financial incentive to farmers for permitting free public access to hiking, hunting, fishing, and trapping areas.

Regular CAP Program

The program's flexibility benefits the individual who wants to shift from production of surplus crops to other activities, or who is gradually retiring from farming while continuing to live on the farm. It is helpful for those whose objectives are to reduce farming operations in order to reduce labor requirements, to continue working off the farm, or to take advantage of other employment opportunities.

The CAP program helps to adjust land use to current and future needs. In the United States only about two-thirds of the cropland available is used for crop production. The upward trend in farm production is continuing, even though the number of farms has decreased.

On the other hand, the growing population, especially in already crowded metropolitan areas, needs more open spaces and woodland for hunting, fishing, and other outdoor recreational needs. The Cropland Adjustment Program helps take care of these needs.

The conservation cost-share feature available to farmers under this program helps to assure that land taken out of crop production is shifted to a resource conserving use.

The legislative authority for all phases of the CAP program ends in 1970. The authority for new business each year depends upon annual appropriation of funds by the Congress. CAP funds were deleted from the appropriation bill for both fiscal years 1968 and 1969.

CAP Public Access

In addition to adjustment payments and conservation cost-share payments, a farmer may be able to get an extra incentive for allowing the general public free access to land designated under a CAP agreement. This free access would be for the purpose of hiking, hunting, fishing, and trapping.

Greenspan Program

The "Greenspan" phase of the cropland adjustment program is authorized by Congress as one answer to the need for more open space and less land in surplus crops. The Greenspan idea is to take cropland out of agricultural production and convert it to open space, public recreation, wildlife habitat, natural beauty, or to other uses that control air and water pollution.

The purposes of the program may be accomplished in two ways: (1) a community may acquire land; and (2) a farmer may shift acres out of certain crops while retaining title to the land. Communities buying cropland may receive financial help under the program similar to that going to farmers who sign CAP agreements.

Conservation Reserve Program of the Soil Bank

The Conservation Reserve Program was started in 1956. Farmers were encouraged to enter into contracts to take land out of production and to help conserve soil, water, and wildlife. Contracts were accepted each year through 1960. No new contracts have been accepted since 1960 but payments are continuing for contracts still in effect.

PRODUCTION ADJUSTMENT PROGRAMS

History of Adjustment Programs

(See also History and Background, page 65)

Congress has authorized a number of programs to help adjust the production and marketing of farm crops. Base acreages were first used with programs carried out under the Agricultural Adjustment Act of 1933. (See the Agricultural Adjustment Act of 1933, The Soil Conservation and Domestic Allotment Act of 1936, and the Agricultural Adjustment Act of 1938).

Through these acts and their amendments, an effort has been made to have farmers adjust production to requirements for food and fiber.

Acreage Allotments and Marketing Quotas

The Agricultural Adjustment Act of 1938 was amended to cover six basic commodities: wheat, corn, cotton, rice, tobacco, and peanuts. Subsequent amendments added non-basic commodities such as barley, oats, and rye.

Both acreage allotments and marketing quotas are used to adjust production. Acreage allotments when used alone are primarily guides with accompanying inducements for compliance. The farmer not complying usually loses the privilege of taking part in the price-support available for the crop.

Acreage allotments are usually set for the nation and then divided among the states. The states either divide them directly among farms or by counties. If allotments are divided by counties, the county ASCS office then divides them among farms. The method used depends upon the commodity.

Marketing quotas and acreage allotment programs may be used together under conditions of heavy supply when a two-thirds majority of the voting producers approve. When quotas are in effect, all producers who are not covered by exemptions are subject to monetary penalties on production or marketings from their excess acreage. Excess acreage is that acreage which exceeds the farm allotment.

Under present controlling legislation, marketing quotas can be applied only to the six basic crops. The Secretary of Agriculture is directed by law to proclaim marketing quotas when supplies of a basic crop are excessive. The level at which quotas must be proclaimed for most crops is specified by law.

Provision is made for increasing, suspending, or terminating quotas under certain supply and demand conditions, in the interest of consumers, or in national emergencies.

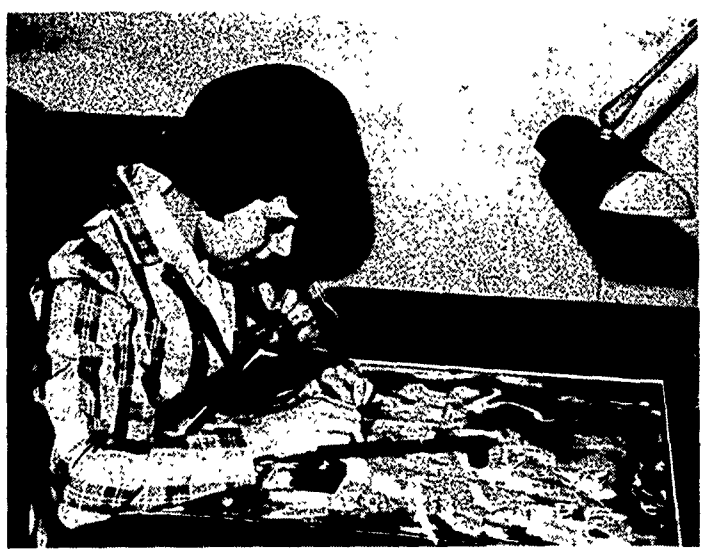
Quotas seek to limit the marketing of the commodity during the marketing year by placing penalties of so much per pound or per bushel on marketings in excess of the quota. The crop grown on the farm allotment acreage may be considered as the farm quota.

Voluntary Diversion Programs

Wheat Program

The wheat program is designed to maintain farm income from wheat, to stabilize wheat supplies, and to meet increased demands for the crop.

Several methods are used to obtain these goals under the Food and Agriculture Act of 1965. A national wheat allotment is set each year.



Planimetering operations to determine acreages

Sending report of measured acres to farm operations

When the national wheat allotment is less than 55 million acres each farm must divert a share from the production of wheat to conservation uses.

Wheat used for domestic food consumption is supported at the parity price. This is accomplished through a combination of wheat marketing certificates and price-support loans and purchases.

Wheat marketing certificates may be issued on a percentage of the projected production from the farm allotment. The normal yield times the number of acres of wheat seeded for harvest, not to exceed the allotment, is considered the projected production. The value of the certificates is the difference between full wheat parity and the national average loan value. Marketing certificates are equivalent to direct payments. Processors of wheat are required to buy domestic certificates for each bushel of wheat they use to manufacture food products for domestic consumption.

Marketing certificates must be shared between landlord and tenant in the same proportions as the crop is shared, unless other arrangements are approved by the state ASC committee.

When authorized for the crop year, diversion payments can be earned by diverting acreage below the farm allotment. The per acre payment is based on a percent of the county wheat loan value multiplied by the projected yield.

Where a producer is signed up for both the wheat and feed grain programs, wheat may be substituted for feed grains or feed grains for wheat within the total permitted acreage. Price-support loans and purchases will be available on the entire production of wheat and feed grains.

Feed Grain Program

The objectives of the feed grain program include preventing the buildup of excess stocks, reducing program costs, and raising farm income by assuring fair prices for feed grain producers, and providing a basis for stability for livestock prices.

Loans and price-support payments may also be available on some feed grain crops. Payments are made only if the acreage of one or more of the feed grains covered by the program are reduced. This reduction must be at least the minimum percentage below the farm's total base acreage and the acreage diverted is in an approved conserving use. Payments for the minimum required diversion generally are limited to growers on small farms. Additional diversion is permitted subject to current program regulations.

Where a producer is signed up for both the wheat and feed grain programs, wheat may be substituted for feed grains or feed grains for wheat within the total permitted acreage. Price-support loans and purchases are available on the entire production of wheat and feed grains. For specifics of the latest feed grain program provisions, see your county ASCS office manager.

Directions for Using Production Adjustment Worksheets

The two worksheets on the following pages are to be used to calculate program benefits for the voluntary wheat and feed grains programs. The brief outline below indicates the sources for the information needed to complete the worksheets.

Voluntary Wheat Program Worksheet - Page 16

A. Sign up dates - obtain dates from ASCS office

B. Farm data - secure from farmer or at ASCS office

C. Price Support and Loan Provisions - secure from ASCS office

D. Diversion Payments - calculate from information secured above

E. Substitution - check on program for current year at ASCS office

Voluntary Feed Grains Worksheet - Pages 17 - 18

A. Sign up dates - obtain data from ASCS office

B. Farm data - secure from farmer or at ASCS office

C. Feed Grain Crops - obtain data from ASCS office

D. Price Support and Loan Provisions - obtain data from ASCS office

E. Price Support Payment Formula - use formula to calculate price support payments for farm

F. Diversion Payment Provision - calculate diversion payments for farm

Worksheet for Voluntary Wheat Program _____ County

A. Sign Up Dates _____ to _____

B. Farm Data for farm of _____

Farm wheat allotment _____

Farm conserving base _____

Feed grain base _____

Acres of cropland on farm _____

Normal wheat yield per acre for farm _____

Wheat price support rate for current year _____

Wheat parity _____

Wheat loan rate per bushel _____

Value of domestic marketing certificates _____

C. Price Support and Certificate Eligibility Provisions

Must comply with wheat allotment to be eligible

Must divert acreage equal to _____% of wheat allotment to soil conserving uses

Marketing certificates

Formula:

Allotment x normal yield x _____%[1] x value of wheat marketing certificate
equals total certificate value per acre

Certificate value = (wheat parity - average national loan value)

D. Diversion Payments

Maximum diversion eligible:

Allotment less than 21.7 acres can be totally diverted

Allotment of 21.7 to 38.3 acres, diversion can be 25 acres plus 15% of 38.4

Allotment larger than 38.3 acres, 50% of allotment can be diverted

_____% of county wheat loan x normal farm yield equals diversion payment per acre

E. Substitution

By signing up for and complying with the feed grain and wheat programs, wheat can be substituted for feed grains.

[1] Percentage of wheat yield expected from the allotment for the farm. Set at 43 percent in 1969.

Worksheet for Voluntary Feed Grains Program _____ County

A. Sign Up Dates _____ to _____

B. Farm Data — Acres

Farm feed grain base	_____
Farm wheat allotment	_____
Farm conserving base	_____
Acres of cropland on farm	_____

C. Feed Grain Crops included in program this year (check crops that apply)

Crop	Established yield	Loan rate	Support rate
_____ Corn	_____	_____	_____
_____ Oats	_____	_____	_____
_____ Barley	_____	_____	_____
_____ Rye	_____	_____	_____
_____ Grain sorghum	_____	_____	_____
_____ Other[1]	_____	_____	_____

D. Price Support Eligibility Provisions

Diversion Requirements

Minimum percentage _____ of feed grain base

E. Price Support Payment Formula

Support Payments = Support rate x established yield x (smaller of permitted acreage, actual planting, or _____ per cent of feed grain base)

F. Diversion Payments Provision[2]

Total acres diverted _____

Farm conserving base _____

Price support minimum diversion _____

Diversion eligible for payments = acres diverted up to _____ percent of feed grain base less price support minimum acreage diversion

Acres eligible for diversion payments _____

Diversion Payment Formula[3]

Amount per acre = (Loan rate + support rate x established yield per acre) x _____ percent.

[1] When wheat is substituted for feed grain, it should be included here

[2] Go to next page for small farm provisions

[3] Applies to feed grain bases above 25 acres

F. Diversion Payment Provision[4]

Total acres diverted _____

Farm conserving base _____

Price support minimum

diversion _____

Diversion eligible for payments

1. Minimum diversion _____ acres
2. Additional diversion (total acres diverted minus minimum diversion) _____ acres

Diversion Payment Formula

1. Amount per acre for minimum diversion = (loan rate + support rate x established yield per acre) x _____ percent.
2. Amount per acre for additional diversion = (loan rate + support rate x established yield per acre) x _____ percent.

[4] Applies to feed grain bases 25 acres or less

Level of and Eligibility for Price Support

Price support payments for the basic crops - wheat, cotton, corn, rice, peanuts, and tobacco - are provided for by law. The only exception is that support for tobacco is not available if quotas have been disapproved at the last referendum by growers.

Eligibility for price support payments for individual farmers on all of the basic crops, except corn, depends on not exceeding the acreage allotment for that crop. Allotments and quotas do not apply to corn. Price support payments may be made available to non-cooperators at the discretion of the Secretary of Agriculture. Support levels for non-cooperators cannot exceed the levels of price support to cooperators. Each farm has an established farm base for feed grains.

A grower may qualify for feed grain price support on approved crops by participating in the feed grain program. This means reducing the total acreage of approved crops to at least the minimum required diversion below the total farm base and shifting this diverted acreage to a conserving use, plus meeting other provisions of the program.

Price support for wheat covered by domestic certificates (estimated to be the wheat needed for domestic use) shall be at 100 percent of parity, or as near thereto as the Secretary determines practicable. Support for wheat not covered by marketing certificates is determined by the Secretary at a level not in excess of the parity price. He takes into consideration competitive world prices of wheat, the feeding value of wheat in relation to feed grains, and the level at which price support is made available for feed grains. (See explanation of wheat program, Page 12). In the event of an emergency, the Secretary of Agriculture may increase the support above the specified parity level for any needed crop.

On tobacco crops for which quotas have not been disapproved, legislation directs that the support level be determined by adjusting the 1959 support level upward or downward in proportion to changes in the parity index (prices paid by farmers, including interest, taxes, and wage rates), using

the previous three-year moving average. Thus, the "change in the parity index" will be determined according to the ratio of the average prices paid by farmers during the previous three years to the average prices paid in 1959. The 1959 support level multiplied by this ratio will be the support level for the current crop. Average of $\frac{\text{last 3 years}}{\text{1959 price}}$ x 1959 support level = current support.

For corn, legislation provides that in the case of any crop for which an acreage diversion program is in effect for feed grains, the level of price support for corn shall be at a level not less than 65 percent or more than 90 percent of the parity price. The Secretary determines the percentage in order to achieve the acreage reduction goal established by him for the crop. A portion of the support price for any feed grain included in the acreage diversion program may be made available to producers through payments. This strengthens the assurance that those producers who cooperate in reducing their acreages of feed grains may receive the direct benefits of the price support and diversion programs. (See explanation of feed grain program, Page 13).

Price supports for the other feed grains are established by law according to the parity price level which the Secretary determines is fair and reasonable. He considers the level at which price support is made available for corn, and takes into consideration the feeding value of such commodity in relation to corn and certain other factors. These factors include supply in relation to demand, the ability of the Commodity Credit Corporation to dispose of stocks acquired under price support, and the ability and willingness of producers to keep supplies in line with demand and support levels for other commodities.

The Conservation Reserve of the Soil Bank
(See Page 10)

Farmers took part in the Conservation Reserve of the Soil Bank by voluntarily contracting with the Commodity Stabilization Service (the predecessor of ASCS) to "reserve," or withdraw, a stated acreage of their

cropland from production for a period of three, five, or ten years, and to devote it to an approved conservation practice. For this, the farmer received conservation cost-sharing and technical assistance in addition to annual payments to compensate for the loss of income the acreage would otherwise have produced.

The Conservation Reserve was begun in 1956, and authority to put new land in the program ended with the 1960 program. Annual payments will continue to be made for the term of the contracts in effect. All contracts except a few special forestry cases have expired.

Cropland Conversion Program

Under a land-use adjustment program authorized on a test or pilot basis by the Food and Agriculture Act of 1962, farmers receive assistance in converting cropland to other income-producing uses which also conserve soil and water resources. The program encouraged profitable alternative uses of cropland which had been producing row crops and small grains that were not needed at present. The Secretary of Agriculture entered into agreements with farmers to convert cropland for a period of three to ten years to grass, forests, water storage, wildlife habitat, or recreational facilities.

Farmers who participated in the program received adjustment payments, cost-sharing payments, and technical assistance. The program is administered by ASC committees with technical assistance provided by the Soil Conservation Service and the federal or state forestry agencies.

As a test or pilot program it has had little significance in the total farm program. However, information learned from the program has significance for future program planning.

Cropland Adjustment Program (See Page 8)

The Cropland Adjustment Program (CAP) authorized by the Food and Agriculture Act of 1965, seeks to shift cropland producing crops in actual or potential surplus into long-term (5 to 10 years) conservation, recreational, and open space uses. The program also offers assistance to farmers who because of age, off-farm employment, or other personal adjustment reasons desire to reduce their farming operations.

Accepted agreements are paid at a rate determined by the crop diverted and the productivity of the farm for that crop. Additional payments may be made, where offered, under agreements which permit free public access to designated acreage for hunting, trapping, fishing, and hiking. CAP participants agree to divert all of at least one of their bases or allotments and can then divert other crop bases and allotments.

The program's Greenspan provision makes grants to local and state governments to help them acquire cropland for non-farm uses such as preservation of open space and natural beauty, wildlife habitat, recreation, and prevention of air and water pollution. (See Page 10).

PRICE SUPPORT THROUGH LOANS AND PURCHASES

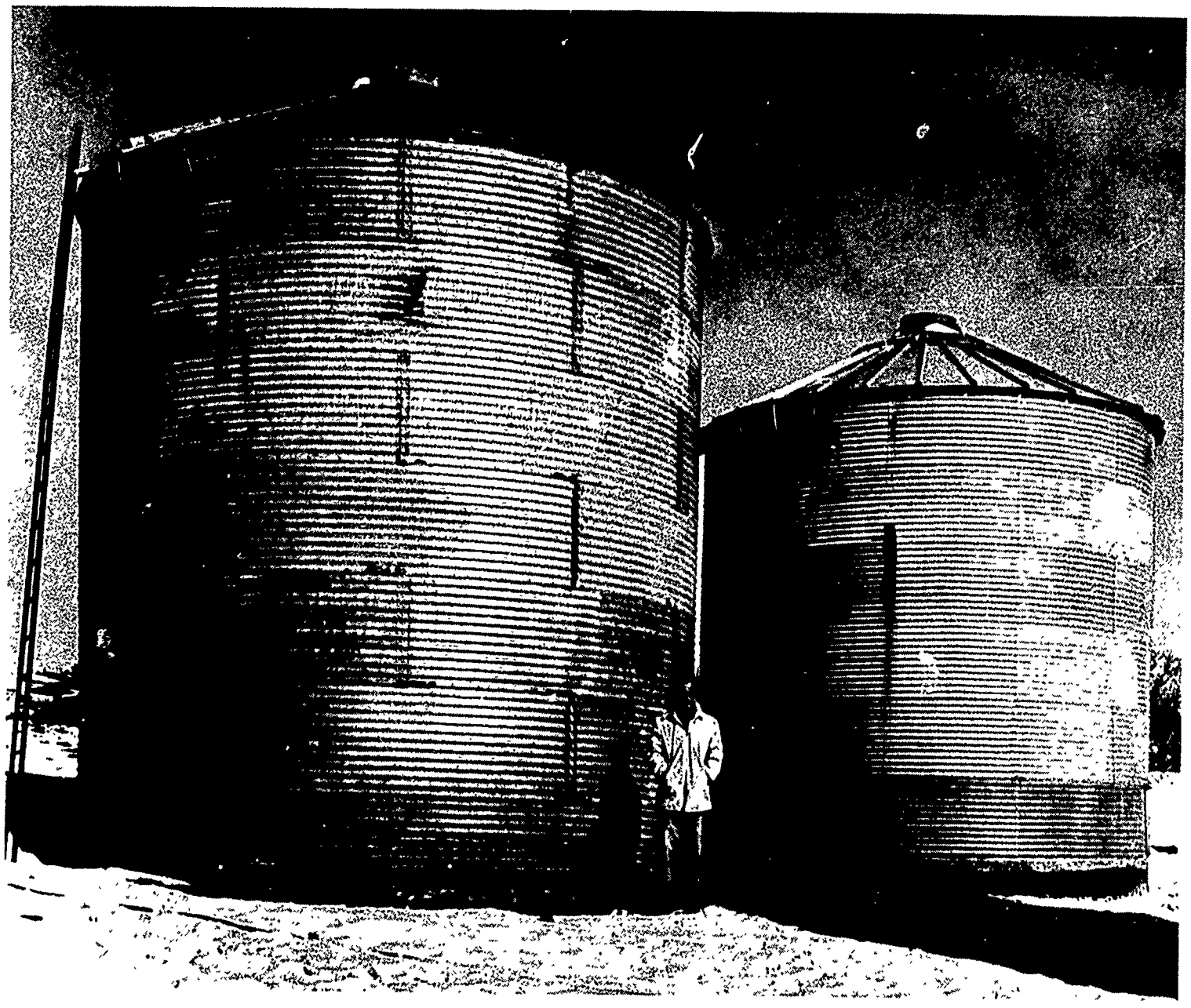
Objectives

The major objectives of the price support program are:

(1) to help assure stability of farm income and prices in the interest of all people;

(2) to assist in bringing about a better balance between agricultural production and consumption; and

(3) to promote orderly marketing of crops.



Farm stored corn under government price support loan. Bin was constructed with help of a farm storage facility loan.

Eligibility to Participate in Commodity Marketing

Producer compliance with acreage allotments, production goals, and marketing practices, including marketing quotas when authorized by law, may be required as a condition for eligibility for price support.

Types of Programs

Direct Purchases

The initiative to purchase and to acquire commodities and their products under the price support program rests with the Secretary of Agriculture and the Commodity Credit Corporation (CCC). In the case of dairy products this action is directed by law.

Direct purchases may be made in quantities necessary to carry out the support program. Direct purchases are used primarily for perishable commodities which must be purchased and disposed of, or processed promptly to avoid waste. When to make direct purchases is determined largely by production in relation to market demand and market price.

Direct purchases of many commodities may be made in areas where farm or commercial storage is not available for immediate delivery at the support price.

Price Support Payments

Direct payments to producers are made for some commodities. Marketing certificates may be issued in the case of wheat. These methods in effect raise the return to the producer per unit of commodities produced.

Commodity Loans

Government price support loans to farmers are made directly through ASCS county offices or through approved agricultural cooperative marketing associations, or both, on the security of the stored commodities. Depending on the commodity, storage may be on the farm, in country elevators, in terminal elevators, or in other commercial warehouses.

Price support loans are non-recourse. CCC looks only to the pledged or mortgaged collateral (the commodity) for settlement of the loan. Except for tobacco, which is handled by approved cooperatives, and peanuts, the farmer may repay the loan, with interest, at any time prior to its maturity. A service fee is charged on each loan that involves farm-stored commodities and on most loans that involve warehouse storage. Monthly interest is charged on the loan except for the month of the repayment. If the farmer chooses not to repay, CCC takes title to the commodity, and the loan, including interest, is satisfied. Before assuming title to the stored commodity, however, CCC determines through ASCS county offices that the commodity is the same grade and quantity as it was when stored. In addition, a small delivery fee is charged per bushel or per hundred pounds on delivered commodities.

Tobacco loans are made available through cooperatives and the collateral, or commodity, of all producers' crop is pooled. In the case of tobacco redemptions, the cooperative markets the collateral and remits the sales proceeds to apply to the loan. If the sales by the cooperative return a profit over advances, charges, and interest, it is returned to the growers as a patronage dividend.

While the loan programs do not guarantee the participating farmer a profit, they do offer definite safeguards and advantages to his operations if his commodity is eligible to be placed under loan. The loan program gives farmers an opportunity to obtain cash and to hold their crops for later sale without market risk. In practice, if the producer cannot profitably pay off his loan and sell the collateral, the loan may be satisfied in full by his paying a delivery fee and letting CCC take over the collateral.

The loan program tends to even out marketings. In order to meet operating costs, farmers would otherwise be inclined to market their crops at harvest time. This sometimes makes for market gluts, undue burdening of the transportation system, and lower prices. Price swings and transportation bottlenecks are minimized to a great extent by spreading commodity marketing over the season.

The loan programs also give producers a chance to exercise greater independence in their marketing operations and the opportunity to benefit from price increases which otherwise may not have occurred until after their products were sold.

Reseal Program

How Reseal Works

"Reseal" is a term commonly applied to the renewal or extension of a price-support loan beyond the original maturity date. The commodity held on the farm as collateral is put under "seal," and when the loan is extended the collateral is "resealed." The term "reseal" is also used in referring to extended loans on warehouse-stored commodities, although such commodities are not sealed as they are on the farm.

Extension of the loan, "resealing," enables the farmer to keep the commodity under loan for a longer period, while retaining ownership. The farmer continues to have the option of paying off the loan and selling the crop himself, if this would be to his advantage. Or, the farmer can deliver the commodity to Commodity Credit Corporation to satisfy the loan.

CCC retains the option to terminate reseal loans and ask for immediate payment.

Storage Payment

Reseal storage payments are made to the farmer on resealed crops if he provides farm storage, or if he prepays warehouse storage charges for the extended period.

If warehouse charges are not prepaid, CCC will make payments for the extended period to the storing warehouse. The farmer, however, is still liable for any warehouse charges which occur during the initial loan period.

Where Available

Reseal loans in commercial storage will be available in all areas throughout the country.

Reseal loans on farm-stored crops will be available in areas where the ASC State Committee determines that the commodity can be safely stored on the farm.

For further details on the reseal program see your ASCS County Office manager.

Incentive Payment Program

Incentive payments are made to encourage greater production of necessary commodities for national requirements. For example, production of wool in this country is well below national requirements. In fact it is on the decline due to factors such as increased cost of production and diminishing range lands. (See Page 31).

Procedures for Obtaining Price Support

Your ASC county committee can give you the provisions for a specific crop year including:

final date for requesting price support

loan maturity date

eligibility and compliance requirements

whether or not crop may be stored on farm as designated by state ASC committee

Options Available to the Farmer

Many options are available to the farmer. He may participate in one or more of the previously mentioned types of programs. In most cases, when a farmer has a price support loan, he can repay it with interest and then sell the commodity. He also may turn the commodity over to the CCC in payment of the loan and interest, or he may reseal the commodity.

Repayment Procedure

The loan method of support gives the farmer an option of either marketing his crop or keeping it under loan. If the market price rises above the loan level plus charges, he has the privilege of paying off the loan and selling his commodity in the open market. If the price fails to rise above the loan level, however, the non-recourse character of the loan agreement permits him to deliver the commodity to the Commodity Credit Corporation instead of repaying the loan and charges.

Every loan has a cut-off period before which time the farmer must choose an option and act upon it, or the CCC will take over the crop to satisfy the loan.

CCC Inventory Operations

Commodities acquired by CCC under the price support program are stored in commercial warehouses, if available, or in CCC-owned bins.

CCC may sell non-storable commodities without any restriction. Generally, sales of storable commodities for domestic use may be completed only if the price is 115 percent of the current support rate plus carrying charges. In addition, commodities owned by CCC may be made available under various donation programs - foreign and domestic - and for export sale.

FARM STORAGE FACILITY AND DRYING EQUIPMENT LOANS

Under these loan programs, ASCS encourages and aids farmers in the expansion of facilities needed for farm storage of price supported commodities. Government loans are available to farmers to enable them to construct grain storage bins and obtain the necessary drying equipment to effectively utilize the storage facilities.

Loans are authorized up to 85 percent of the out-of-pocket cost of storage facilities and drying equipment. Loans are made at approximately four percent interest and are repayable in four equal annual installments over a period of five years.

Farm storage facilities established in Venango County through farm storage facility loan

WOOL PAYMENT PROGRAM

Objectives

The wool program makes incentive payments on sales of shorn wool and unshorn lambs to encourage production.

The United States does not produce nearly as much wool as it uses. As a result Congress set a policy of encouraging production in the National Wool Act of 1954. The Congress based this policy on the importance of wool to the U.S. economy and the national security.

Source of Revenue

The total amount of payments under the Act is limited to 70 percent of the duties collected on imports of wool and wool manufacturers. All revenue for this program comes from import duties on wool and wool products.

How Program Works

An incentive price for shorn wool is announced by the U.S. Department of Agriculture in advance of the marketing year. The producer sells his wool in the usual market channels.

At the end of the marketing year, the national average of the prices received by all growers is used to determine the percentage rate required to bring the national average of the prices received in the free market up to the incentive level previously announced.

The percentage is applied to each grower's net proceeds from his sales of shorn wool and unshorn lambs for the particular year to arrive at the amount of his incentive payment.

SUGAR PROGRAMS

Objectives

The United States Sugar Program has a three-fold purpose: (1) to protect the welfare of the U.S. sugar industry; (2) to provide U.S. consumers with ample sugar supplies at reasonable prices; and (3) to promote and strengthen the export trade of the United States.

Main Program Features

To meet these objectives, the sugar program sets annual U.S. sugar requirements; domestic and foreign sugar quotas; and processor marketing allotments. It also sets farm proportionate acreage shares; makes producer payments; and assures equitable division of sugar returns among growers, farm workers, and processors.

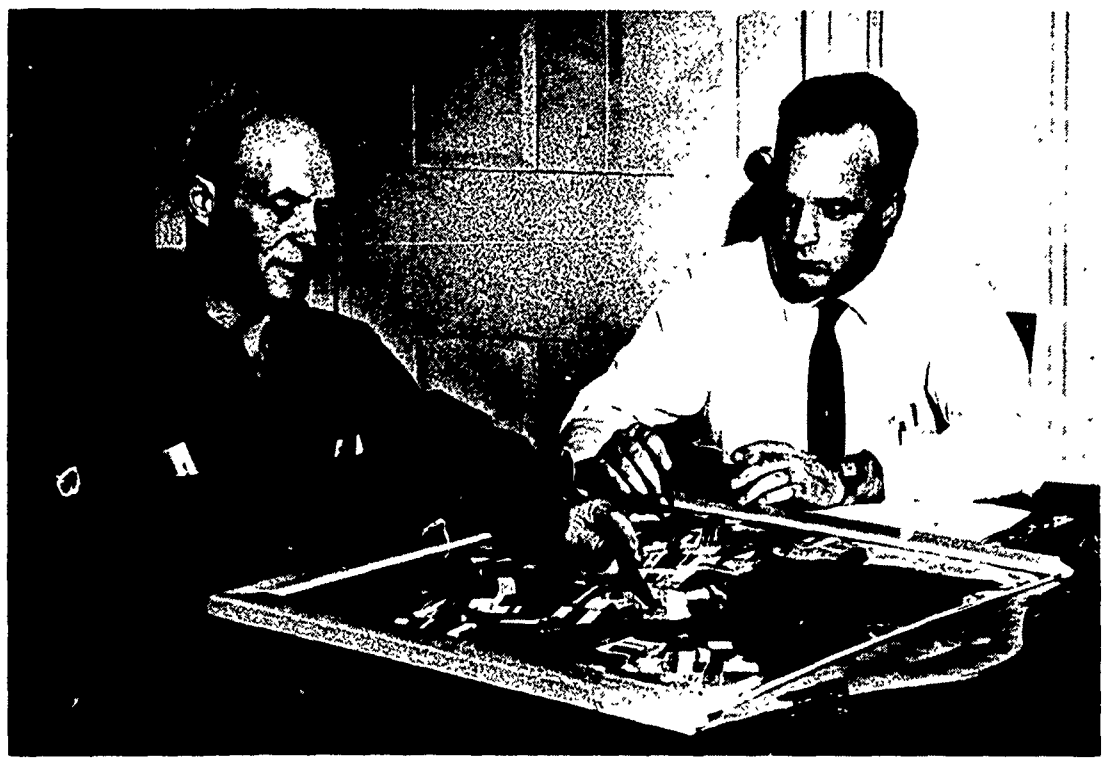
Payment Eligibility

Payments to producers and producer-processors are based on observance of acreage controls when needed, non-employment of child labor, payment of fair wages to workers, and payment of fair prices for sugar crops purchased from other producers.

COMPLIANCE

Compliance provisions began with the Agricultural Adjustment Act of 1938. Compliance operations have come far since their inception. At first, each and every field on each farm was measured. Now, certification is required. This is accomplished by the producer reporting his acreage to the ASCS county office.

For conservation practices the farmer's report of completion is usually accepted, except that practices requiring technical specifications must be certified by the agency having technical responsibility, such as the SCS or Forest Service. Farmers determine and report to the ASCS county office all program acreages for the farm and certify that all program



County Office Manager discussing a compliance visit with the Compliance Reporter

requirements have been met. These certifications replace most of the farm visits that used to be made to determine compliance; however, a percentage of the farms are visited to check the accuracy of acreages certified. The county office will give farmers assistance in determining their acreages, including a copy of the aerial photograph showing field acreages, measurement services at cost, and assistance in computing acreages from measurements made by the farmer.

Farmers may obtain special measurement services upon request and payment of the cost. These services help the farmer to comply with program limitations. In many cases they save the expense of growing excess crops that must later be destroyed to meet compliance. The principal service available in most counties is called pre-measurement.

Through this service an ASCS reporter will measure and stake the exact acreage to be planted. A farmer may also have his acreage measured after planting. He can then adjust the acreage, if necessary, before he certifies acreage to the county office.

If you have any questions on any program contact your County ASCS office for assistance.

FOOD AID PROGRAMS

A former president said: "Men first joined together for the necessities of life--food for their families, clothing to protect them, housing to give them shelter. These are the essentials of peace and progress. But in the world today, these needs are still largely unfulfilled. When men and their families are hungry, poorly clad, and ill-housed, the world is restless--and civilization exists at best in troubled peace. Hunger poisons the mind. It saps the body. It destroys hope. It is the natural enemy of every man on earth."

Since 1954, when Congress passed the Agricultural Trade Development and Assistance Act, Public Law 480, the United States has attempted to use domestic agricultural surpluses to combat hunger.

New programs will likely cover at least the following four areas that have been used in past programs.

Important features of P.L. 480 have included:

Title I -- authorize sales of U.S. farm products for local currencies and for dollar credits.

Title II -- authorize famine relief and donations of food, both on government-to-government basis and through voluntary organizations.

Title III -- authorize barter of U.S. farm products for materials and service from abroad.

Title IV -- stipulate that the programs will be used to help those friendly countries that seriously try to cope with their own problems of food and population. Also provides criteria for determining selection of commodities to be used in the program.

Summary of Past Achievements

The food aid programs, since 1954, have come from Public Law 480. This program has performed a service unique in world history--massive sharing of U.S. agricultural products with less-developed, food deficient countries as a means of preventing hunger and stimulating economic development.

Public Law 480 has been supplying food aid to 116 countries, containing about one-half of the world's population. It has prevented mass starvation in India. It has improved the diets of more than 40 million of the world's school children. It has helped countries to become more prosperous. It has built bigger cash markets for American farm products.

From the beginning of Public Law 480 in 1954 through June 30, 1966, the program has moved to foreign consumers about 165 million metric tons of U.S. farm products, having a market value of $15.5 billion.

This type of food aid obviously helps the many foreign people who, without it, would be going hungry--but it brings back benefits to the U.S. as well. Large amounts of foreign currencies received from sales of U.S. farm products abroad are being used to pay U.S. expenses overseas. Large amounts are used to pay costs of the programs designed to build larger foreign markets for U.S. farm products, carried out by the U.S. Department of Agriculture in cooperation with U.S. food, agriculture, and trade groups. Since Public Law 480 began, more than half of the $116.8 million spent for export market development in the joint government-industry program has come from such funds.

The economic development that is built into these food aid programs improves U.S. export sales opportunities. A USDA study shows that when per capita income of less-developed countries increases 10 percent, dollar sales of U.S. farm products go up 21 percent. In other words, as incomes of foreign consumers go up, their purchases of U.S. farm products increase twice as fast. In this way a number of countries have moved from "aid" to "trade"--Japan, Italy, and Spain are examples. Once aid recipients, now they are big cash buyers of U.S. farm commodities.

Evidence that this transition from "aid" to "trade" can and does take place is found in the export statistics. Exports of U.S. farm products under government programs as a percentage of total agricultural exports have dropped steadily from 39 percent in fiscal year 1956 to 24 percent in fiscal year 1966.

U.S. food aid has been accompanied by a dramatic increase in dollar-earning commercial exports.

DISASTER ASSISTANCE PROGRAMS

Disaster assistance to meet the emergency needs of agriculture is available through the ASCS. Disasters may be floods, hurricanes, earthquakes, drought, windstorms, or unfavorable economic conditions as the result of natural catastrophes. Farmers Home Administration offers emergency credit to farmers in a disaster area.

The measures used can be applied to any designated disaster area in the United States to offset or prevent losses or damage when natural disasters strike farmers or ranchers, livestock, farm or range lands, water supplies, or wildlife.

The assistance is provided through: (1) donation or sale of Commodity Credit Corporation-owned feed grains, (2) grazing and haying privileges on diverted or retired croplands, (3) emergency conservation measures under the Agricultural Conservation Program, and (4) emergency wildlife feeding assistance.

Feed donation, sale of feed, and grazing and haying programs on diverted acres directly affect the maintenance of livestock in designated disaster areas. The need for any or all of these programs is recommended first by County Disaster Committees. State Disaster Committees then review the recommendations and determine whether assistance should be made available. In addition, certification by the governor of the state involved is required before affected areas are designated as "disaster areas." Certification by the governor of a state is not required when only emergency conservation or wildlife feeding is involved.

Three member disaster committees have been established in each state. Members are the directors of the Farmers Home Administration, the Cooperative Extension Service, and the ASC State Chairman, who also serves as disaster committee chairman. State Disaster committees report all emergency situations, and, when necessary, recommend that U.S. Secretary of Agriculture designate as disaster areas any regions that require emergency assistance.

Inspecting drought stricken corn in anticipation of requesting emergency livestock feed program

DEFENSE READINESS PROGRAM

The objective of the defense readiness program in the Department of Agriculture is to maintain a state of readiness in order to carry out food and agricultural programs in an emergency. In an emergency situation USDA is to provide leadership and guidance to state and local governments, farmers, and the food industry to assure conservation and continuity of the nation's food supply and the preservation of agricultural resources.

Defense responsibilities in USDA stem from regular program authorities, defense emergency legislation, and special executive orders. These

A County Defense Board in Session

responsibilities have been assigned to agencies whose peacetime activities bear a close relationship to programs that are essential in an emergency.

ASCS has been assigned defense preparedness functions relating primarily to farm production and the management of grains and price support. ASCS personnel are experienced in the administration of farm and price support programs, and programs to alleviate the effects of natural disasters. This experience would be valuable in defense emergency programs including:

(1) emergency production of crops and livestock, including poultry;

(2) processing, storage, and distribution of seed and livestock feed;

(3) mixing of fertilizers and distribution of fertilizers and farm equipment;

(4) storage and movement of all grain in raw form; and

(5) estimating requirements for manpower, equipment, fertilizer, fuels, and other supplies and services needed for agricultural production, and other emergency programs for which ASCS is responsible.

ASCS also is responsible for the Commodity Credit Corporation programs which guarantee emergency loans made by financing institutions to business firms that handle food for which USDA has emergency responsibility. In some instances ASCS has authority to make direct loans.

Commodity Credit Corporation stocks which are administered by ASCS automatically provide a stockpile of food and livestock feed for emergency use.

SECTION 32 - DIRECT PURCHASES FOR SURPLUS REMOVAL

Purposes

Section 32 programs are administered by the Consumer and Marketing Service, USDA. The purchase of the Commodities used is handled by ASCS.

The main objectives of Section 32 programs are:

a. to encourage exports of agricultural commodities and products;

b. to encourage domestic consumption of commodities or products by diverting them from the normal channels of trade and commerce; and

c. to re-establish farmers purchasing power by making payments in connection with the normal production of any agricultural commodity for domestic consumption;

One way of increasing commodity utilization has been emphasis on use by persons in low income groups.

Export Programs

Most export programs under Section 32 have involved cash payments to commercial exporters following the export of privately owned commodities.

Purchase and Donation Programs

Under purchase and donation programs the Department of Agriculture purchases surplus agricultural commodities from farmers, farmers' agents, cooperatives, and processors. Purchases also are made from Commodity Credit Corporation stocks.

Commodities purchased are donated through the facilities of state distributing agencies to groups eligible to receive them. These groups include:

a. public or non-profit private schools of high school grade or under which operate non-profit school lunch programs;

b. non-profit, non-penal, or non-educational public or private institutions devoted to a charitable or public welfare purpose, where needy persons are served. This group includes hospitals,

homes for the aged, orphanages, missions, summer camps, child care centers, and state and local correctional institutions;

c. public or private welfare agencies that assist needy persons; and

d. non-profit organizations providing emergency or disaster relief.

State distributing agencies, acting under agreements with the Department of Agriculture, determine the specific organizations meeting the requirements specified by the department to obtain donated food.

The federal government pays the cost of shipping the commodities in carload lots to central receiving points within the state. The states are responsible for arranging for delivery of the commodities to recipients.

Section 32 purchases are limited to the quantities that can be moved to eligible outlets. These outlets must be determined before a program is initiated.

Other Diversion Programs

New use programs have been used much less widely than export, purchase, and donation operations. Their objective is to encourage the use of surplus commodities in different ways that would occur without the program.

Diversion programs have taken many forms, including experiments or demonstrations to develop new uses, such as cotton for insulation; operations involving increased use of surpluses in by-product or secondary uses, such as potatoes for livestock feed and starch, and tobacco for insecticides. Other products have been made available to consumers outside the products' regular marketing areas.

Payments are made after the diversion has taken place. The terms and conditions under which payments are made are generally contained in a contract. Payments sometimes are made to a processor who uses a commodity for other than a normal purpose. These payments allow him to pay the full market price for the commodity. In other cases, payments are made to the farmer or to another person, who sells the commodity at a

reduced price to a diversion outlet that does not involve processing as part of the diversion. This payment helps to equalize the return the farmer receives from the lower-priced use as compared with the regular outlet. All products produced under a diversion program are sold by the manufacturers through regular trade channels.

Programs to Re-establish Farmers Purchasing Power

No programs have been initiated in recent years. The last program was undertaken in fiscal year 1960 to re-establish the purchasing power of cranberrry growers.

Source of Section 32 Funds

Section 32 programs are financed by a continuing appropriation equal to 30 percent of the import duties collected on all commodities entering the United States under the custom laws, non-agricultural commodities as well as agricultural, plus unused balances up to $300 million. These funds become available at the beginning of each fiscal year without any further legislation.

Under the Agricultural Act of 1956, an additional sum of $500 million may be appropriated annually to carry out the purposes of Section 32.

Occasionally, Section 32 funds have been made available by legislative action for other purposes such as foreign market development, agricultural utilization and production research, the pilot food stamp program, school lunch programs, and special milk activities.

The National School Lunch Program

The National School Lunch Program, as well as the special milk, food stamp, and other food assistance programs described on the following pages, is not administered by ASCS. However, ASCS purchases the commodities for these programs. These programs are operated through the Consumer and Marketing Service of the USDA.

Program Objectives

The school lunch program is designed to accomplish the following:

a. to improve children's health and well-being by providing them a well-balanced, nutritious lunch at school. In addition, the program is designed to develop proper and nutritionally beneficial food habits.

b. to broaden the market for agricultural food commodities by:

(1) providing an expanding market for agricultural commodities through local purchases of food by school lunch programs in commercial channels of trade;

(2) serving as an outlet for agricultural commodities purchased by the Department of Agriculture to lessen local and seasonal surpluses;

(3) expanding the outlet for highly nutritious foods, particularly in areas of nutritional deficiencies; and

(4) introducing a wider variety of foods to create a demand for commodities that many families otherwise could or would not buy.

Special Milk Program

The program is designed to encourage consumption of fluid milk by children in (a) non-profit schools of high school grade and under, and (b) non-profit nursery schools, child-care centers, settlement houses, summer camps, and similar non-profit institutions devoted to the care and training of children.

Food Stamp Program

The Congress established the Food Stamp program in the expectation that increased utilization of foods to maintain adequate national levels of nutrition would (a) tend to distribute agricultural abundance in a beneficial manner; (b) strengthen the agricultural economy; and (c) result in more orderly marketing and distribution of food.

Other Food Assistance Programs

The Child Nutrition Act of 1966, which extended the special milk program for three years, also authorized the department to:

a. provide funds to help buy food service equipment for schools in low income areas;

b. initiate a pilot program offering nutritious breakfasts to children who live in low income areas, or have to travel long distances to school; and

c. extend the benefits of school food service to pre-school programs operated as part of a regular school system.

SUMMARY

Following is a brief summary of the relationship of farm programs to farm problems and the major areas in which ASCS is attempting to solve farm problems.

Conservation and Land-Use Adjustment Assistance

Conservation and land-use adjustment assistance is carried out by sharing with individual farmers the cost of installing needed soil, water, woodland, and wildlife conserving practices through the following programs:

a. The Agricultural Conservation Program

b. The Regional Conservation Program

c. The Cropland Adjustment Program

d. Greenspan Program

e. The Conservation Reserve of the Soil Bank

f. The Cropland Conversion Program

Production Adjustment

Production adjustment is carried out through acreage allotments, marketing quotas, land diversion payments, and price support. Increased production is encouraged by incentive payments for two commodities, sugar and wool, in which the nation is not self-sufficient.

Price Support

Price support is carried out through commodity loans and payments to farmers or through direct purchases of agricultural commodities from farmers or processors.

Management of Inventories

Management of commodity inventories are carried out through sales, export, and domestic payments, donations, storage, and related processing and shipping arrangements. The individual farmer is assisted in management of his inventories through loans on commodities and storage and drying facilities.

Disaster Assistance

Disaster assistance through direct assistance to farmers and ranchers whose supplies have been destroyed or whose farmlands have been seriously damaged by widespread flood, drought, or other disaster.

Defense Readiness

Assistance is available in preparedness and planning for civil defense purposes. In food production and protection the ASCS is prepared to assist farmers and consumers in case of enemy attack.

Section 32 Funds

Section 32 funds are used for direct purchases to remove surpluses from the normal market channels. The commodities purchased are used to improve diets of persons in the United States and other countries.

Food Aid Program

Through Public Law 480 food has been supplied to 116 countries. These 116 countries contain about one-half of the world's population. It has prevented mass starvation, improved diets, and helped countries to become more prosperous. The program has helped the U.S. by increasing cash markets for agricultural products and lowering surpluses of U.S. farm products.

SECTION II. ASCS ORGANIZATION

History and Structure of USDA and Parent ASCS

(A functional organization)

The Agricultural Stabilization and Conservation Service (ASCS) is part of the United States Department of Agriculture. The USDA administers many programs essential to public welfare in addition to the farm programs. These functions relate to research, education, credit, public health, the preservation of natural resources, assistance to needy persons, and foreign aid.

Just a few of the functions of the USDA are the sale of farm commodities to foreign countries or their donation to needy people in friendly countries. Other functions are the development and maintenance of our national forests, meat inspection, farm credit, rural area development, and a multitude of other programs and services for the benefit of the nation as a whole.

On May 15, 1862, President Lincoln signed the bill that established the Department of Agriculture. The bill was one of three designed to serve the interests of the family farmer. The other two were the Homestead Act and the Land-Grant College Act. In 1889 Congress created the cabinet rank position of Secretary of Agriculture.

In a broad way, the USDA's objectives are: (1) economic production and distribution of essential food and fiber and wise conservation of material resources; (2) sound stabilization of farm prices and income; (3) investigation by science of newer and better methods of production; (4) supervision of markets and trade in farm products and facilities; and (5) informing farmers and the public on achievements and progress made toward accomplishing these objectives.

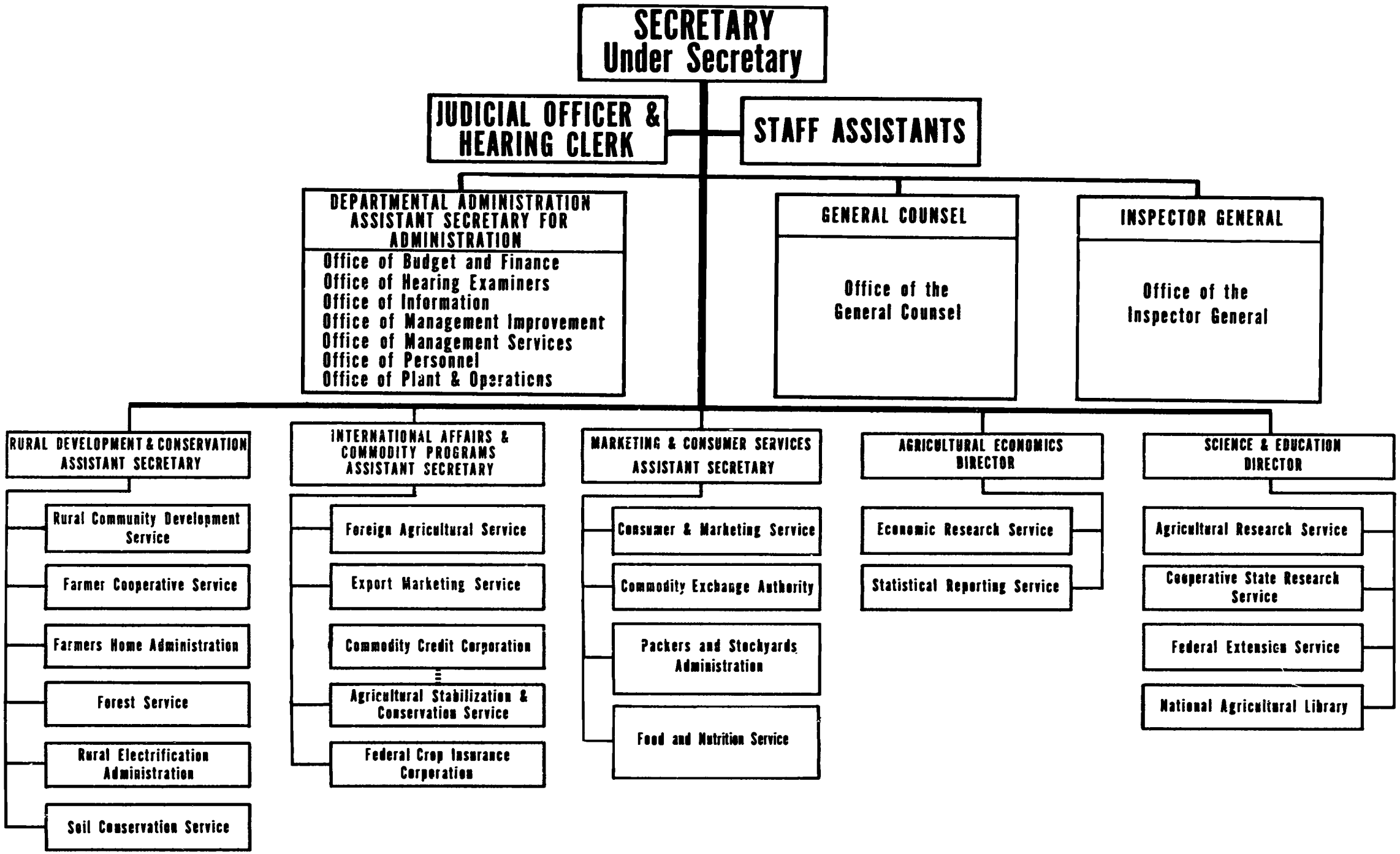
The ASCS has the responsibility for programs and services in the following general groups: Agricultural Conservation Program (ACP), Conservation Reserve (Soil Bank), Cropland Adjustment Program (CAP), the Wheat and Feed Grain Programs, Wool Incentive Program, and the Sugar Program. ASCS also administers the Farm Storage Facility Loan Program and the Price Support Program.

The charts on the following pages point out how the ASCS is organized beginning with its position in the USDA to its county offices.

Many of the agricultural programs developed over the past thirty years involve the individual farmer. So it is obvious that the various program policies stem largely on the advice and recommendations of local farmer committees.

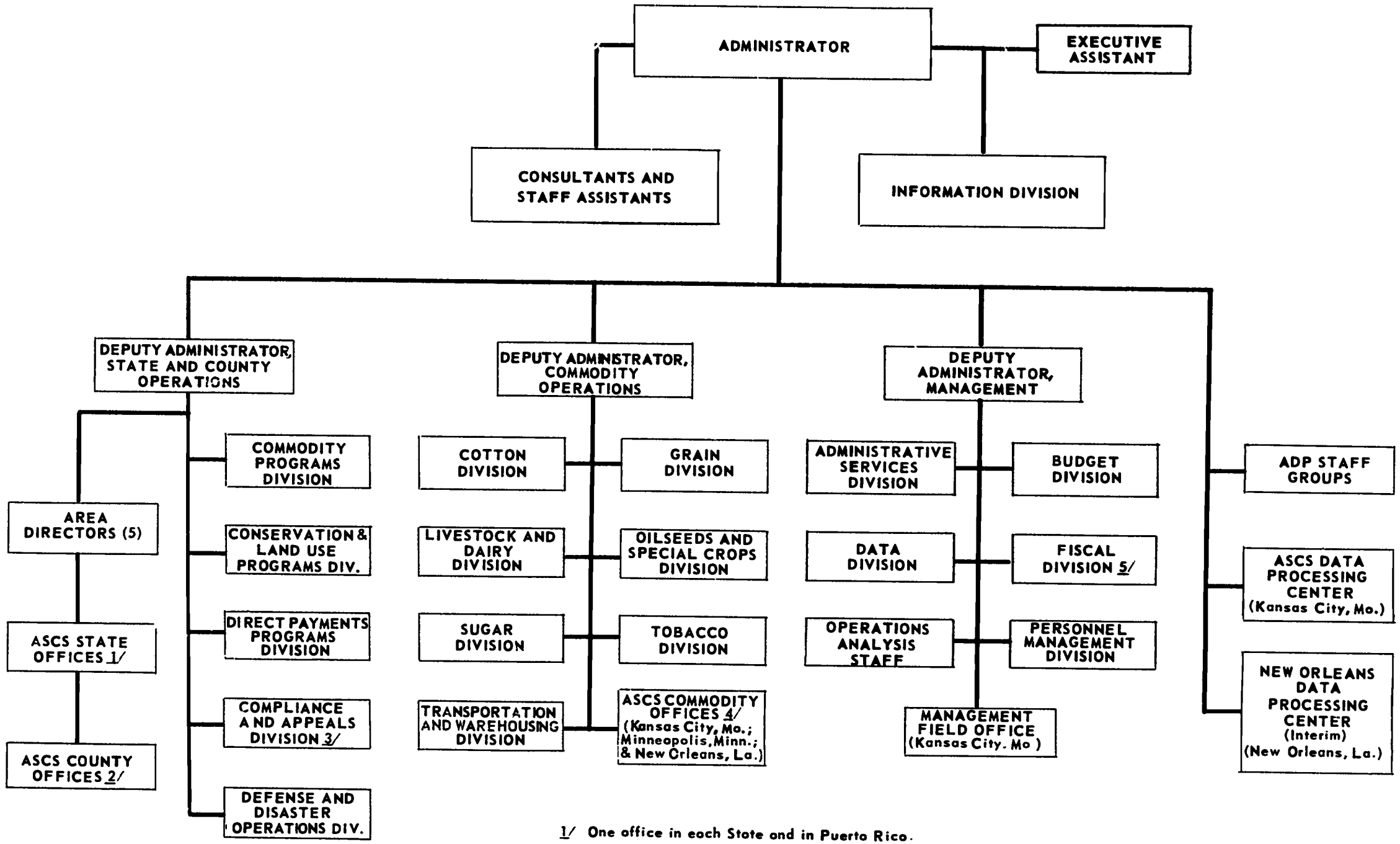
August 8, 1969

UNITED STATES DEPARTMENT OF AGRICULTURE



U. S. Department of Agriculture

AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE



1/ One office in each State and in Puerto Rico.

2/ One office in each agricultural county (over 2,500 in number.)

3/ Maintains and directs two field Aerial Photography Laboratories.

4/ KCCO maintains and directs branch offices.

5/ Maintains and directs field office.

DATED. June 26, 1969

Commodity Credit Corporation (CCC)

The Commodity Credit Corporation (CCC) was organized October 17, 1933, under the laws of the state of Delaware. A charter act was passed by Congress making the CCC an agency of the United States Department of Agriculture effective July 1, 1948.

The CCC is managed by a board of directors. It is, however, subject to the general supervision and direction of the Secretary of Agriculture, who is an ex-officio director and chairman of the board. The board consists of six members in addition to the Secretary of Agriculture. They are appointed by the President of the United States with the advice and consent of the Senate.

In addition to the board of directors, the CCC has a five-member advisory board, the members of which are appointed by the President of the United States. Not more than three of the members may belong to the same political party.

The CCC is capitalized at $100,000,000. CCC also has authority to borrow not to exceed $14,500,000,000 for use in carrying out its programs.

In carrying out its principal operations, the CCC utilizes the personnel and facilities of the Agricultural Stabilization and Conservation Service.

Major activities financed by CCC include price support and production stabilization programs. Price support programs are administered for wheat, corn, cotton, peanuts, rice, tobacco, butterfat, milk, wool, mohair, honey, tung nuts, barley, oats, grain sorghums, rye, flaxseed, soybeans, dry edible beans, cottonseed, and crude pine gum. To encourage production adjustments and to maintain farm income, payments are made under the cotton and feed grains programs for diverting cropland from the production of these commodities to conserving uses.

Commodities acquired under the price support program are disposed of through domestic and export sales, transfers to other government agencies, and donations for domestic and foreign welfare use. The CCC is also authorized to exchange surplus agricultural commodities acquired by the CCC for strategic and other materials and services produced abroad.

Under Public Law 480, the Agricultural Trade Development and Assistance Act of 1954, as amended, CCC carries out assigned activities. Major emphasis is also being directed toward meeting the needs of developing nations under the Food for Peace Act of 1966 which further amends the Agricultural Trade Development and Assistance Act of 1954. Under these authorities, agricultural commodities are procured and exported for foreign currencies, famine relief and donations, barter for materials, and service from abroad.

Administration of United States operations under the International Grains Arrangement, upon its approval for ratification by the Senate, will become a responsibility of the CCC.

Under its storage facilities program, CCC is authorized to undertake such operations as may be necessary to provide storage adequate to carry out efficiently and effectively CCC's programs where commercial storage facilities are inadequate.

History of Committee System

Establishment by Congress

The United States Congress by passage of the Soil Conservation and Domestic Allotment Act of 1936, particularly Section 8(b), created the ASC farmer committee system at the state, county, and community levels. Farmer committees had been used to locally administer adjustment programs since the early 1930's, but the 1936 act made it official and mandatory.

An ASC committee at work

Local Involvement

The use of farmer elected committees provides for involvement of local people in solving local problems. This offers the farmer a role of leadership and responsibility in public affairs. Because of their interest, ability, and economic astuteness in handling local programs, the Congress and the USDA have given them much of this responsibility.

The Washington ASCS office, under the direction of the Secretary of Agriculture, establishes official regulations to help committees carry out federal laws. There is, however, considerable latitude left for committees to apply local guidelines in making decisions. The fact that ASC committees determine policy and administer programs immediately distinguishes them from purely advisory groups.

Developing a Cooperative Attitude

The farmer committeeman has helped to develop a cooperative attitude between farmers and the ASCS. The ASC county committee often works with other agencies of the USDA, such as the Soil Conservation Service, Fish and Wildlife Service, Agricultural Extension Service, and Forest Service in planning the Agricultural Conservation Program (ACP).

State Committee

State Committee Membership

Many of the present agricultural programs under ASCS supervision deal with the individual farm and farmer. Therefore, the Secretary of Agriculture appoints state ASC committees of from three to five farmer members. Terms run for one year and are renewable. In addition, the Director of the Agricultural Extension Service of each state is an ex-officio member of the state ASC committee.

State Committee Responsibilities

The state committee is responsible for the administration of farm programs in each state, and for general supervision of the work of county committees. Each state committee appoints a state Executive Director who supervises and directs the work of the state office under policies established by the committee.

The state committee receives ideas from community and county committees. These may be incorporated into any of the state programs or passed along to the ASCS in Washington.

Each state office has program specialists for the programs used in that state. These people help answer questions and explain programs to county office personnel. District fieldmen who cover several counties also help coordinate programs throughout the several counties of a state.

A directory containing the names of the present state committeemen and employees and county committeemen and employees is available at the county ASCS office.

County Committee

County Committee Election

County convention election of county commiteemen

(1) A public notice of the convention shall be given by the county committee at least ten days before the convention date. The notice shall include the date, time, and place of the convention, and indicate that it shall be open to the public.

(2) The incumbent chairman or acting chairman shall organize and supervise the convention. A quorum consisting of a majority of the delegates or their alternates shall be present before the convention may proceed. A permanent chairman is elected to conduct the business of the convention.

Nomination and election procedure

(a) Nominations are received from the floor by secret written ballot or orally unless the state committee specifies another method. The election of county committeemen is by secret ballot with the person receiving the most votes on a ballot being elected. The balloting for each term of office and/or alternates on the committee is completed and the results announced before proceeding with nominations for the next vacancy.

(b) Persons shall be nominated and elected to fill all vacancies. Three positions will always have to be filled. They are the three-year term and the first and second alternates. The one-year and two-year terms will only be open when persons previously elected to regular terms cannot or will not serve. Alternate committeemen are selected for one-year terms only. The nominations and election ballots will proceed in the following order:

(1) three-year term

(2) two-year term (if vacant)

(3) one-year term (if vacant)

(4) first alternate

(5) second alternate

(c) After all vacancies on the county committee are filled, election of a chairman from the three regular members follows: then the election of a vice-chairman from the two remaining members takes place. This includes newly elected committeemen and carry-over committeemen still serving their current terms of office. The County Agricultural Extension Agent is the one non-voting ex-officio member of the county committee. He is eligible to serve as secretary.

(d) Wherever an entire county is classified as one community, the balloting takes place by mail. Most other election procedures are the same as for a county convention except that all positions are filled in order of the number of votes on the ballot that is mailed in.

County Committee Responsibilities

The county committees are responsible for operation of county ASCS offices usually located in or near the county seat. Committees hire county office managers who operate the office within established state and county ASC committee guidelines. The manager hires the office and field workers necessary to effectively operate the county office. The county ASCS office is the place to sign up for and receive program information on agricultural programs for the county. The county committee is assisted by the community committees within the county.

In the bulletin, The Farmer Committee System, the following responsibilities are listed for county committees:

In production adjustment, they determine the size of individual farm acreage allotments each year, establish farm normal yields, program yields, consider complaints and appeals of producers, supervise referendums on marketing quotas, and determine penalties, and adjustments.

In conservation, they formulate local programs, review farmer requests for cost-sharing on needed practices and allocate funds, and recommend changes in state and national conservation programs.

In price support, they determine the eligibility of producers, appoint loan clerks and witnesses, and set the amount of collateral needed for loans.

In storage activities, they give general supervision to Commodity Credit Corporation-owned facilities, determine the adequacy of proposed farm storage and loan collateral.

In the sugar program, they hold hearings and make decisions on labor wage claims, and determine sugar payments and production quotas.

In connection with emergency disaster assistance, they pass on the eligibility for and extent of assistance to farmlands damaged by flood, drought, fire, or other natural disasters.

Committees have similar kinds of responsibilities in connection with the wool, cropland conversion, feed grain, and wheat stabilization programs.

A means is provided for a dissatisfied producer to obtain a reconsideration of a decision made by the county committee. His right to appeal a decision extends from the county committee to the state ASC Committee to Washington, D. C. Some of the cases that the county committee must judge are very difficult. They require a delicate balance between the individual's and the public's welfare.

ASC Community Committee assembled in convention to el county ASC Committeemen

Community Committee

Importance of Community Committees

One of the most important parts of the farmer committees system is the community committee. It is at this grass roots level that local farmers help establish payment rates for farm programs. ASC committee members are paid on a part-time basis.

In addition to helping the county committee and making recommendations on ASCS programs, the community committee acts as a source of communication for local farmers. The committeemen seek out local farm problems that relate to agricultural programs and pass them along to the county committee.

Community Committee Membership

Three community committee members and two alternates are elected annually for each community. A community may be a township, school zone, or other natural boundary.

Election Procedure

In electing farmer committeemen for a community committee only a certain segment of the population is directly involved; therefore, voting qualifications are established.

Most persons who are either farm owners or operators may vote. Both husband and wife may vote if they are joint operators or owners. Youths who run farms may also vote.

Ballots are mailed out ten days before elections to all known eligible voters. Any eligible voter not receiving a ballot should contact the county ASCS office with proof of his right to vote. The election normally takes place the third week of September. Each voter may choose five or less of the alphabetically listed names on the ballot or write in up to five names that are not listed, thus voting for a total not to exceed five.

Nominating Commiteemen

To seek the office of committeemen a person must be an eligible ASC voter and live in the county or community where he is attempting to win a committee post. Other requirements are mainly to prevent partisan political activity involving the commitee.

A farmer can be nominated for committeemen in three ways. Six or more farmers in his community may nominate him by signing a petition. A farmer may sign any number of petitions. The community committee nominates six to ten candidates. The county committee makes nominations if the community committee has nominated less than six candidates and it may also add candidates. Any minority group making up ten percent of the electorate must be represented by at least one candidate or the county committee will select a candidate.

Electing Committeemen

Three committeemen and two alternates are elected annually for community committees. There are five positions to fill and they are filled in order from the largest number of votes to the fifth largest number of votes respectively.

The five positions are chairman, vice-chairman, regular member, first alternate, and second alternate. The alternates succeed or fill in anytime the regular members cannot.

Summary

For more than thirty years now farmers, who know farm problems and local conditions, have served on ASC committees. The farmer committee system has much responsibility for successfully and efficiently administering these programs. It is important that men capable of the responsibility be elected to community committees.

The structure of the committee system provides for local representation by having community, county, and state committees.

SECTION III. HISTORY AND BACKGROUND FACTORS AFFECTING FARM POLICY

Land Policy

Homesteading

In May 1862, Congress passed the Homestead Act. This act provided that citizens (or aliens who intended to become citizens) who were over 21 and head of a family could obtain title to 160 acres of public land. To obtain title, a person had to live on and improve the land for five years. Or, as a substitute for the five-year residence requirement, the person could pay $1.25 per acre.

The Homestead Act was intended to improve worthless land and to help U.S. citizens obtain small farms. Up to this time farmers generally had been against the government's policies of selling land to raise money. Instead, farmers wanted the government to sell the land at low prices or give it to settlers. Toward the mid-eighteenth century the homestead movement became a national political issue. Southerners generally opposed homestead bills. When the southern states seceded at the beginning of the Civil War, the Homestead Act was passed. By 1900 about a half million families had found farms and new homes.

Measures for Directing Land-Use

Land-use is one of the most important policy decisions made in any country and affects nearly all the people. Many land-use direction and control measures are applied in the United States. Since special districts or small units of government may make land-use policy, methods of carrying out land-use policy from area to area may differ. Because of the large number of people involved and the many situations that occur in land-use, policy decisions are difficult and slow in coming. Authority of government to direct land-use stems from the police power of the state which is among the most important powers held by government.

Zoning ordinances illustrate how government directs land-use. Zoning ordinances provide land-use regulations and restrictions. For example, land in a certain area may not be used for a "junkyard." In another situation the type of buildings, materials used, and even the maximum height of a structure or its distance from a road or sidewalk may be specified. Many early ordinances were measures to provide safety and to control nuisances. Zoning ordinances tend to change slowly, thus problems arise as conditions change. Zoning ordinances vary greatly from area to area. Usually they protect the landowner or resident from nearby land being used for undesirable purposes. Since zoning ordinances are important locally, it is necessary to find out what is being done in your community.

Another important control measure is the regulation of sub-division development. This requires that if land is sub-divided into building lots, certain regulations must be adhered to for each lot. For example, a minimum size may be required; or, streets, sewage systems, or water systems may have to be installed. Exceptions to these regulations are common where only one or two lots of a farm are to be sold.

What are the sub-division regulations in your area? What are the steps you would follow were you to decide to sub-divide your farm?

Other special land-use controls may be set up on a district basis. This might be done for irrigation, drainage, grazing, weed control, or soil conservation in rural areas. In metropolitan areas, districts might be set up for water, sanitation, or park development. To set up a special district requires state enabling legislation. Then, a new unit of government is set up to administer, tax, and carry out the purposes of the special district.

Still other land-use measures include building, fire, and sanitary codes. Building codes usually set minimum health and safety standards for all new structures. The codes set such standards as strength of structure, fire hazard prevention, and sanitary installations. Agricultural production controls may also be established to regulate the production of crops (reference to Section I, Page 11).

Another important land-use control measure is the power of eminent domain. This power enables government or public utilities to take land without the owner's consent for the "public good." Land may be taken for schools, highways, streets, utilities, parks, military installations, or other public improvements.

Government also affects land-use by spending patterns and control of the land it already owns. For example, the types of services and costs of services at military installations or state or national forests may influence the surrounding area. If government land can be rented for range or pasture or other uses, this will also have an effect. Types and costs of government services offered to other citizens may also affect land-use. Examples are police and fire protection.

Taxation

"Nothing in life is so certain as death and taxes." Taxation is necessary since it is the major source of money for government. Government then uses this money to pay operating costs and provide services to the people.

Many of these services would not be available privately at a reasonable cost. One of the big questions in a democracy is how much control should government exercise.

> "However, contrary to common belief, the power to tax is not a 'necessary evil,' but rather, if wisely used, the most important source of revenue upon which the strength and support of government depends and without which an owner's rights may lack necessary protection and enforcement."[1]

In general, government services and taxation have been accepted as a necessary part of life. These taxes do affect land-use. For example, as real estate taxes increase, it becomes harder to make a profit on the land by using it for agricultural production. If real estate taxes become too high, as around the fringes of a city, land must be used for other than agricultural purposes. Since the tax structure may vary from area to area, new businesses may choose a location with these taxes in mind. Taxes can affect the kinds of homes built and the salability of property by simply limiting what people can afford. Even the amount of take-home pay of an employee is affected by the types and level of taxation.

Since there are a great number of different taxes only a few of the more important are discussed here.

Property tax is one of the oldest forms of taxation. It has been felt that people should be taxed on their wealth. One of the main sources of wealth was land and therefore it became an important criterion for taxation. As time went on, people developed other sources of wealth such as buildings and equipment. Many states assess personal property taxes which include equipment and other personal property. Property tax is a very important tax for most agricultural producers since most of them own large amounts of land and equipment. Real estate tax is the main source of revenue for most counties, cities, towns, villages, and school districts.

[1] North, Nelson L. and Alfred A. Ring. Real Estate Principles and Practices, (fifth edition, Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1960).

Federal income tax is the main source of income for the federal government. It is not an important consideration in land-use development since it is uniform throughout the United States.

State income taxes have been adopted in several states and currently are being considered in others. Although state income taxes may have deterred some industries from locating in states levying them, industries already there are unlikely to leave. This is especially true of large factories and farms. Since this tax may lower property taxes or increase the services rendered, it is argued that it has little effect on land-use or industrial location.

Income taxes seem to be a more equitable tax today than property tax because of large numbers of people who have sizable incomes but own little or no property. Also, many people own stocks, bonds, and bank holdings that are not covered by property tax. This, and the fact that many local governments are short of local funds for schools and other services, has caused some municipalities to levy a local income tax.

Other problems that arise with a state or local income tax have posed the following questions: What income should be included and excluded as well as what exemptions should be allowed? Should a flat or progressive rate be used? How should corporate income, capital gains, and rent be taxed? Should the tax be calculated from the federal income tax? What geographical area should be included and how can double taxation be avoided?

Sales taxes have proved to be fairly stable and important sources of revenue. The sales tax provides some automatic increases in state income in periods of increased general price level. In the past few years, income from sales tax has increased in most states because of rising prices and expansion in the dollar volume of business.

The chief criticism of the general sales tax is that it does not consider a person's ability to pay. In other words, sales tax often takes a larger

percentage of a smaller income than a larger income. This situation is somewhat improved if food and clothing are exempted. Another bad feature is the cost of administering this tax. Its cost to state governments is not much higher than administering some other taxes, but it is a burden to the retail merchandiser.

The gasoline tax, supplemented by taxes on other motor fuels used by highway vehicles, is one of the most widely used and best producers of revenue for both state and federal governments. Currently, the federal tax is four cents per gallon of gasoline, the state tax in Pennsylvania is seven cents per gallon. Taxes paid on fuel consumed for non-road uses, such as that used on farms, are refunded to the user. In many states the gasoline tax is allocated to the highway fund. The highway fund is used for building and maintaining roads. Accessibility of land to potential users influences both its value and use. An argument heard in defense of gasoline taxes is that those who use the roads are the ones who ought to pay for them.

Tariff Policy

One type of tariff is a specific duty tariff. An example of a specific duty tariff is the tariff on raw sugar imports. This tariff is based on a fixed amount per pound. Therefore, it becomes proportionately higher as the price of sugar falls. Conversely, it becomes proportionately lower as the price of sugar rises.

Most tariff duties are based on the value of the product. Ad valorem duties, as they are called, are often placed on manufactured and miscellaneous articles. Duty rates may vary from zero to as high as 100 percent or more of the price of the article.

Tariffs tend to fall into two categories. Revenue tariffs are primarily aimed at raising revenue or income for the government. Protective tariffs, on the other hand, have the primary purpose of protecting home

industry such as agriculture from importation of similar products from foreign countries. If a revenue tariff is imposed on a product produced in other countries, then it is almost sure to also act as a protective tariff. That is, producers in this country will have a price advantage over foreign competitors since they will not have to pay the tariffs imposed on similar products from other countries. Tariffs have been imposed on many foreign agricultural products to protect producers in this country. Examples include sugar, wool, and cotton. In addition to protective tariffs, domestic goods are often protected by import quotas on foreign goods such as oil.

Transportation

Improvements in transportation have greatly affected agriculture. Many of the advantages formerly given an agricultural producer by his location geographically have been reduced by improved transportation. The costs of most items that are needed on farms are relatively uniform across the country. Likewise, the price of agricultural products to users is relatively uniform from area to area. Prices received by farmers vary and reflect costs of moving the commodity from the farm to the market.

The advantages of a close market for fresh fruits and vegetables have become less important. Jet transport can move large quantities of produce from any point to any other point in the continental United States in a few hours. Transportation by truck has been made faster and more economical by improved roads and super highways. Refrigeration has made long distance movement of perishable items possible by truck and rail. This has allowed many of the large livestock packing facilities to move nearer the large production areas.

The opening of the St. Lawrence Seaway has brought new raw materials and products to inland ports far into the midwest. More importantly for United States agriculture, the seaway has provided a means whereby huge quantities of grains from terminals such as Duluth, Minnesota, can be moved to destinations around the world. This transportation development has contributed to greatly increased exports of United States farm products.

New developments in transportation are sure to affect agriculture in the future as remarkably as they did in the past.

Quarantines

Many serious disease and insect outbreaks in this country have been caused by diseases or insects imported from other countries or areas. Therefore, plants and animals to be brought in from other nations are inspected and may be kept from entering or unloading at ports until

precautions are taken. Use of quarantines, that is, not allowing movement of animals or crops from an infected farm or area, has stopped or slowed the spread of many diseases and insects. Some states forbid interstate transportation of plants, parts of plants, or even ripened fruit unless the articles have been carefully inspected. Even with these protective measures, insects and diseases have managed to enter this country and spread from area to area.

Changes in Agriculture

Research and Education

Research is organized scientific investigation using systematic methods to make new discoveries or evaluate present knowledge. Many of the goods and services now enjoyed have been made possible through research and education. Research and education have increased productivity for all classes of workers. This has shortened the work week and increased pay levels. These factors have all contributed in giving us the highest standard of living in American history.

There are two major types of research. The primary aim of basic research is to discover more about the fundamental laws of nature. Basic research explores the unknown. The results are often unpredictable. The time needed to complete experimental work on one phase of a project may extend for years. Therefore, it is usually the professional researchers who do basic research.

Applied research is directed toward a specific objective. When a problem arises,it is often solved by applied research. Many of the new products, processes, and materials developed through applied research have both directly and indirectly affected agriculture. Many of the discoveries made in basic research have also been applied to make farming a more scientific and regulated business.

Studies of plant and animal breeding have led to greater production and better quality of fruits, vegetables, and meats. Chemicals have been developed which increase growth and affect speed of growth, protect crops, defoliate plants, and control and prevent animal diseases.

Some of the important developments in education and research affecting agriculture include the following:

(1) Establishment and expansion of schools and colleges at all levels. This would include land-grant colleges, vocational agriculture in high schools, vocational-technical schools, and junior colleges.

(2) Dissemination of research performed done by colleges, universities, and the federal extension service.

(3) Rapid adoption of new practices developed by agricultural research, stemming from economic conditions and educational programs.

Expanding Markets

Exports

Exports provide an important source of markets for U. S. agricultural products. The production from one acre out of six is exported. However, over one-half of these exports are supported by some form of government assistance. On the other hand, about $2 billion worth of agricultural products are exported without government assistance each year.

Since many people around the world do not have enough to eat, it would appear that exports could increase at a rapid rate for many years. There are, however, many problems involved in world food distribution. For example, the countries which most need food are least able to pay for it. Even with raw agricultural products in their possession, some under-developed countries still lack the means to process and utilize them in an efficient manner.

Technology

Demands for agricultural products can be increased in at least two ways. Both methods would help alleviate the problems involving the current capacity to overproduce. We can find new ways to use commodities presently produced on farms. This would be true if corn or soybeans could be used to produce a new plastic-like substance. A second way would be to develop uses for new crops and animal products which could replace crops now in surplus.

Processing and Packaging

Many of the food products we buy are protected and merchandised by modern processing and packaging methods.

Sweet corn, for example, used to be available only for a month or two in the late summer. Canned cream-style corn was one of the early major canned items. Now we have sweet corn canned and frozen in a number of ways, and field-chilled fresh sweet corn is available most of the year.

In order to provide an abundance of quality food to the consumer, food processing must control: (1) spoilage and toxic microbes, (2) enzymes, and (3) oxidation.

Processing makes it possible to harvest high quality fruits and vegetables, stabilize them, and preserve their high quality. Likewise, poultry, meat, dairy products, and most other agricultural products are processed for a great variety of purposes.

The product may be protected from physical damage, moisture changes, gains or losses of gases, odors, or flavors. Other package protections include control of grease or fat loss, color changes, prevention of contamination by dust, or entry of micro-organisms and insects. This protection makes it possible to receive products in fresher condition. Products with greater shelf life in the store lowers cost. Protection is only one function of packaging. We also expect it to be economical, but at the same time promote sales. It may provide convenience, save time in processing or shopping, improve handling and transportation, and may reduce the amount of shelf space needed. It may lower pilfering and make units of a more acceptable size.

Packaging has affected what can be sold directly from the farm, what can be sold elsewhere, and when it can be sold. Packaging has spread the marketing of fruits and vegetables more evenly throughout the year. It has increased the sales of many agricultural products.

Fresh produce having live tissues that continue the process of respiration causes many special problems in packaging. The tender tissues of these commodities require careful handling and refrigeration.

Mechanization and Invention

The American economy depends on agriculture for its food, much of its clothing, building materials, and recreation. To a great extent agriculture has been able to supply all of this because of the adaptation of mechanization and new inventions. These innovations have allowed a smaller number of farmers to produce more with less labor.

Population Changes

The world population has been increasing at more than two percent per year. Or, in other words, about 69 million people are added to the world each year. The population of the world has more than doubled in the last one-hundred years. If population continues to increase as it has been at about one to two percent per year in the United States the demand for agricultural products should continue to increase.

Cooperatives

Farmer owned and controlled cooperatives provide farmers with agricultural supplies, market his products, and make available credit and other services. These services include: specialists to give advice, delivery of feed and fertilizer, custom machinery operation, light, power, telephones, insurance, and credit. The cooperative organization was developed by the farmer to give him more power in the marketplace. Five out of six farmers now do business with cooperatives.

Corporate Power

Large corporations now control many of the inputs farmers use and also set the prices of these items. The farmer has little control over the cost of input items. The prices paid for most farm products are also set

by the market with the farmer having only the choice to sell or not sell. Industries of many types also compete with farmers for laborers. The working conditions and/or high wages offered by industry make it very difficult for farmers to find hired help in many areas. In many cases the net result is that the margin between what it costs the farmer to produce food and fiber and what his return is in the marketplace is very small.

Farm Organizations

Farm organizations have provided farmers with a powerful lobby for many years. They also promote agriculture in many other ways. They have involved farmers in the political scene at all levels. They have made the farmers' voice heard across the country even though the organizations have not agreed consistently among themselves. In fact, their position has had to change quite rapidly to keep up with changing times. Farm organizations have tried to prevent the sale of some artificial or substitute items which can replace farm products, such as oleomargarine. Some of the new products that can replace present farm products use other farm products in their production. For example, soybeans are used in making artificial milk. This makes it hard for a farm organization to keep both dairy and crop farmers happy with a stand on this issue. Many farm organizations have also helped advertise farm products to promote sales.

Economic Problems That Affect Farm Policy

Low Farm Income

Basic USDA farm policy goals, as we approach the 21st century, include better income for farmers and a balanced abundance for consumers.

U. S. farmers earned a record gross of $49.5 billion in 1966. Over $16.3 billion of this was net income. This is about $2.1 billion over the 1965 net - recovery from the post-war low of $10.7 billion in 1957 and second only to 1947, when we were feeding a devastated world.

The average farm family received about $5,000 as net income in 1966, about $800 more than in 1965, and two-thirds again as much as in 1960. The increase per farm is partly because there are fewer farms to divide the total among, but the total to be divided is much larger.

Farmers are doing better, compared with past years. But compared with what other Americans are earning, there is still a gap. In 1966 people on farms still lacked $900 each of enjoying as much spendable income as non-farm people.

Labor

Labor is one of the most important inputs on modern farms. It is obvious, therefore, that the management of labor is an important factor in the total farm business. About 25 percent of all farm labor is done by hired farm workers. Only about one out of ten of these workers is a full-time employee. Almost one-third of the employees are under 17 years of age. These factors make farm labor problems somewhat unique.

Farm wage levels, in general, are considerably lower than for non-farm workers. This, of course, has an effect on the farmer's ability to hire farm labor. Fringe benefits such as housing, farm products, and vacations may be important in attracting good employees. The labor problems that affect the farmer are important to the agricultural economy and must be considered when developing farm policy.

Surpluses

The Commodity Credit Corporation (See Page 55) acquires stocks of various farm products as a result of its price-support activities. These stocks have been variously referred to as the "farm surplus," the "price-support" inventory, the "CCC" inventory, and as "Ever-Normal-Granary" stocks. These stocks may be stored under the loan on the farm. Stocks owned by individuals and corporations add to the total inventory at any given time.

Although CCC inventory may be larger than normal carry-over, it may be considered desirable as a reserve to ease tight supply situations. This helps level prices and keeps new producers entering the field at an orderly rate. Thus, greater price and supply fluctuations are avoided. CCC inventory may also provide a stockpile for possible national emergencies. Stocks of some commodities, such as wheat, are down to near adequate reserve levels.

While CCC inventories may be national assets, they offer disadvantages as well. Storage costs can be large. At one time, CCC storage costs ran well over $1,000,000 a day. Consequently, CCC keeps seeking useful outlets through which it can dispose of stocks. The disposition of this inventory by meeting domestic and export needs helps keep inventory at manageable levels.

The problem in a nutshell is to lower surpluses, increase farmers' income, and to cut farm program costs, all at the same time. To complicate the problem, the programs that lower surplus are also expected, by some, to combat rural poverty on marginal farms. That is not the aim of present adjustment programs. There are special approaches for fighting rural poverty. Present program objectives include the adjustment of production to demand, giving farmers some voice in the market, and to give them some surety of income through price supports.

Over Production Capacity

Not only do we have a surplus of some commodities, but we are continuing to produce them beyond our needs. Problems will exist until supply and demand are reasonably balanced with production capacity. Expanding markets (see Page 74) will help this balance become a reality. Many economists agree, however, that production adjustment programs will be necessary for many years.

Conservation

Many of the conservation activities that need to be carried out on individual farms are not economically feasible for an individual farmer. Other conservation activities take community-wide action and finance. The carrying out of both kinds of conservation activities is for the public good. This is the reason that the public has shared the cost of these activities to insure that they are carried out (See Page 3).

The public has provided several resources and tools to help farmers develop and carry out area and farm conservation programs. These include research, educational services, conservation program planning, technical services, commercial services and materials, credit, and cost-sharing. The principal cost-sharing resource is the Agricultural Conservation Program.

A sound program of public cost-sharing is dependent upon:

(1) an adequate research program;

(2) an aggressive and effective educational program to provide information and motivation, and to teach certain skills;

(3) sources of technical services to supply skills not readily acquired by many farmers;

(4) credit adapted to farm needs; and

(5) adapted commercial services and materials available where and when needed.

Private enterprise has developed numerous services to help meet conservation needs. Also, the U. S. Department of Agriculture and other governmental agencies (federal and state) have developed various action programs to encourage or stimulate needed progress in solving conservation problems.

Margin

Many factors have combined to make the margin between gross income and expenses small for most farm commodities. Prices of farm products have risen slowly, if at all. At the same time, the costs of most inputs have increased substantially. Taxes and other fixed costs have also gone up. Thus, the farmer has had to become even more efficient to stay in business. The way many farmers have coped with this is to increase production per unit, thus causing greater surpluses. In other instances, farmers have shifted from the production of one commodity to another.

IMPORTANT AGRICULTURAL LEGISLATION

The Farm Crisis During the Depression Years

In the summer of 1920 farmers began to get caught in a squeeze between the prices they received for farm products and the prices they had to pay for supplies. Although farm organizations and publications had been advising farmers to control production, little was accomplished. Withholding movements developed in some areas but proved unsuccessful over a period of time. Farmers next turned to cooperative marketing associations. Things became even worse as the depression hit in 1929. The entire country was left in a near state of despair. Farmers, likewise, had been pushed to the point of desperation. Realized net income of farm operators in 1932 dropped to less than one-third of what it had been in 1929.

President Franklin D. Roosevelt, in his 1932 campaign, committed himself to direct government action to solve the farm problem. The primary tool used to raise farm prices and income became the control of agricultural production.

The Agricultural Adjustment Act of 1933

Organization

The Agricultural Adjustment Act (AAA) was passed on May 12, 1933. Its goal was to restore prices to farmers at a level which would give agricultural commodities their 1909 to 1914 purchasing power. Two major program divisions were organized. They were the Division of Production and the Division of Processing and Marketing. The program divisions were divided into commodity sections. The Secretary of Agriculture, Henry A. Wallace, had new powers invested in his office. These new powers included the authorization to appoint experts without regard to civil service laws; and with the President's approval, to make regulations which would have the force and effect of law. To restore farm purchasing power, the Secretary of Agriculture had many methods he could use. These included the authorization: (1) to secure voluntary reduction of the acreage in basic crops through agreements with producers, and the use of direct payments for participation in acreage control programs; (2) to regulate marketing through voluntary agreements with processors, associations of producers, and other handlers of agricultural commodities or products; (3) to license processors, associations of producers, and others handling agricultural commodities to eliminate unfair practices or charges; (4) to determine the necessity for and the rate of processing taxes; and (5) to use the proceeds of taxes and appropriate funds for the cost of adjustment operations, the expansion of markets, and the removal of agricultural surpluses. Congress declared its intent, at the same time, to protect the consumer's interest. Base acreages were established for basic crops. Different base years were used for different crops.

Basic Programs in Early Legislation

The following commodities were listed as basic in the original legislation: wheat, cotton, field corn, hogs, rice, tobacco, milk, and milk

products. Amendments to the legislation in 1934 and 1935 added the following to the list of basic commodities: rye, flax, barley, grain sorghums, cattle, peanuts, sugar beets, sugar cane, and potatoes. However, acreage allotment programs were only in operation for cotton, field corn, peanuts, rice, sugar, tobacco, and wheat.

It was impossible to reduce acreage effectively before the 1933 crops were ready for market. As emergency measures, portions of cotton and tobacco crops were plowed under during 1933. Payments were made to farmers for this plowing down of a portion of their crop. Non-recourse loans were initiated to give farmers increased purchase power and allow them to receive the benefits of controlled production more quickly. The increased purchasing power of farmers was in line with the overall recovery program for the country.

History of Marketing Agreements and Order

Marketing orders and agreements originated with the 1933 Act and have continued in various forms through subsequent amendments. A marketing agreement is a voluntary contract entered into by the U. S. Secretary of Agriculture with handlers of a particular commodity, including producers so engaged. It is binding only on those who sign it. A marketing agreement alone is seldom effective.

There are no milk marketing agreements in effect at the present time. Most vegetable and fruit orders are accompanied by marketing agreements. Many fruit and vegetable cooperatives serve as handlers and, therefore, are important signers of the agreements.

A marketing order is issued by the Secretary of Agriculture and is binding on all handlers of the commodity concerned in the specified production or marketing area, regardless of whether they have signed a marketing agreement. An order may be issued for a commodity only if at least two-thirds of the producers, or those who produce two-thirds of the volume, approve the order by referendum. A two-thirds majority

means two-thirds of those voting in the referendum, and not two-thirds of all growers or producers in the industry. Handlers of at least one-half the volume must have signed an agreement to have it made effective with an order. However, an order may be issued by the Secretary when he finds it is the only practicable way to carry out the objectives of the act -- even though the necessary number of handlers have not signed.

The objectives of marketing agreements and orders are to establish and maintain orderly market conditions for commodities, affecting interstate or foreign commerce. This includes giving fair prices to the consumer while also giving an equitable return to the producer and handler. Their purpose is to give the farmer some of the marketing advantages long enjoyed by industry.

These programs are different from other agricultural adjustment measures in that they combine voluntary and regulatory control.

Federal legislation authorizing the use of agreement and licenses for regulating the handling of (1) milk and dairy products; and (2) specialty crops, particularly fruits, vegetables, and nuts, originated in the Agricultural Adjustment Act of 1933. Amendments to the act in 1935 and passage of the Agricultural Marketing Agreement Act of 1937 clarified program use and procedures, defined types of control to be used, substituted orders for licenses, and specifically listed the commodities authorized for marketing orders.

An amendment in 1947 authorized the establishment of minimum standards of quality and maturity for commodities other than milk. The Agricultural Act of 1954 authorized fixing the size, capacity, weight, dimensions, or pack of containers used in packaging crop commodities. The act also authorized program use of marketing research and development projects designed to assist, improve, or promote the marketing, distribution, and consumption of any eligible commodity other than milk. It further provided for the orderly flow of commodities to market.

The Agricultural Act of 1961 extended the programs by making eligible for inclusion in marketing orders any agricultural commodity not specifically excluded in the act, and authorized the Secreatry of Agriculture to consult with farmers, farm organizations, and handlers on possible need for additional program legislation.

Amendments in 1962 and 1965 authorized marketing promotion projects, including paid advertising, for specified commodities other than milk.

Surplus Disposal

As the USDA made non-recourse loans and took other actions to increase farmers' purchasing power it built up its own inventory of surpluses. Surplus disposal programs were initiated as an emergency supplement to crop adjustment programs. The paradox of crop adjustment particularly when it involved crop destruction at a time when people were hungry troubled the Secretary of Agriculture and other top officials. A provision in the 1933 Agricultural Adjustment Act authorized processing tax funds which were used for surplus distribution. These and other funds help distribute both basic and non-basic commodities to unemployed families and through relief distribution channels.

Supreme Court Decision of 1936

The original agricultural adjustment program was dealt a severe set-back on January 6, 1936, by the Hoosac-Mills decision rendered by the U. S. Supreme Court. This decision invalidated the production control provisions, including the tax on marketings, provided under the Agricultural Adjustment Act of 1933. Little time was wasted in taking action to replace the act. In the three years from 1932 to 1935, farm income increased more than 50 percent. The effect of the Agricultural Adjustment Act is hard to evaluate because of the many factors involved in the farm income increase.

Soil Conservation and Domestic Allotment Act of 1936

The Supreme Court's ruling negating the production control provisions of the Agricultural Adjustment Act presented the Congress and the USDA with the problem of finding a new approach before arrival of the spring planting season. USDA officials and spokesmen for farmers recommended to Congress that farmers be paid for voluntarily shifting acreage from soil depleting surplus crops into soil-conserving legumes and grasses. The Soil Conservation and Domestic Allotment Act was approved on February 29, 1936. This act combined the objective of promoting soil conservation and profitable use of agricultural resources with that of re-establishing and maintaining farm income at fair levels. The goal of income parity, as distinguished from price parity, was introduced into legislation for the first time. It was defined as the ratio of purchasing power of the net income per person on farms to that of the income per person not on farms which had prevailed from August 1, 1909, to July, 1914.

President Roosevelt stated as a third major objective of the new act, "the protection of consumers by assuring adequate supplies of food and fiber." Under the 1936 program farmers were offered soil-conserving payments for shifting acreage from soil-depleting crops to soil-conserving crops. Also offered were soil-building payments for seeding soil-building crops on cropland and for carrying out approved soil-building practices on cropland or pasture.

Curtailment in crop production due to severe drought in 1936 tended to obscure the fact that planted acreage of the basic crops increased, despite the soil conservation program. Normal weather, crop surpluses, and declining farm prices in 1937 focused attention on the failure of the conservation program to bring about crop reduction as a by-product of better land utilization.

Agricultural Adjustment Act of 1938

Department officials and spokesmen for farm organizations soon began working on plans for new legislation to supplement the Soil Conservation and Domestic Allotment Act. The Agricultural Adjustment Act of 1938 combined the conservation program of the 1936 legislation with new features designed to meet drought emergencies as well as the price and income crisis resulting from surplus production. A marketing control approach was substituted for direct production control. Authority was based on congressional power to regulate interstate and foreign commerce. The new features of the legislation included mandatory non-recourse loans for cooperating producers of corn, wheat, and cotton under certain supply and price conditions (if marketing quotas had not been rejected). Loans were at the option of the U. S. Secretary of Agriculture for producers of other commodities. Marketing quotas were to be proclaimed for corn, cotton, rice, tobacco, and wheat when supplies reached certain levels. Referendums were to be used to determine whether the marketing quotas proclaimed by the Secretary should be put into effect. Other features included crop insurance for wheat and parity payments to producers of corn, cotton, rice, tobacco, and wheat in amounts which would provide a return as nearly equal to parity as available funds would permit. These payments were to supplement and not replace other payments. In addition to payments authorized under the continued Soil Conservation and Domestic Allotment Act for farmers in all areas, special payments were made in ten states to farmers who cooperated in a program to retire land unsuited to cultivation as part of a restoration land program initiated in 1938. The attainment of parity prices and parity income was stated as a goal of the legislation. Another goal was the protection of consumers by the maintenance of adequate reserves of food and fiber. Systematic storage of supplies made possible by non-recourse loans was the basis for the department's "Ever-Normal-Granary" plan.

Wartime Measures

The large stocks of wheat, cotton, and corn resulting from price-supporting loans, which had caused criticism of the Ever-Normal-Granary plan, became a military reserve of crucial importance after the United States entered World War II. Concern over the need to reduce the build-up of government stocks changed during the war and post-war period to concern over attainment of production to meet the then current needs.

On December 26, 1940, the USDA asked farmers to revise plans and to have at least as many sows farrowing in 1941 as in 1940. Following the passage of the Lend-Lease Act on March 11, 1941, Secretary of Agriculture Claude R. Wickard announced a price support program for hogs, dairy products, chickens, and eggs at a rate above market prices. Hogs were to be supported at not less than $9 per hundredweight.

Congress decided that legislation was needed to insure that farmers shared in the profits which defense contracts were bringing to the American economy, and as an incentive to wartime production.

Levels of Price Support-Fixed or Flexible

The end of the Korean War in 1953 necessitated changes in price support, production control, and related programs. For the next eight years, controversy over levels of support-high, fixed levels versus a flexible scale - dominated the scene.

Secretary of Agriculture, Ezra Taft Benson, proclaimed marketing quotas for the 1954 crops of wheat and cotton. The major types of tobacco and peanuts continued under marketing quotas. Dairy prices were supported at 90 percent of parity for one year beginning April 1, 1953. Supports were continued at 90 percent of parity for basic crops during 1953 and 1954, in accordance with the 1952 legislation.

The Agricultural Trade Development and Assistance Act, better known as Public Law 480, was approved July 10, 1954. This Act, which served as the basic authority for sale of surplus agricultural commodities for foreign currency, proved to be of major importance in disposing of farm products abroad.

The Agricultural Act of 1954 established price supports for the basic commodities on a flexible basis, ranging from 82.5 percent of parity to 90 percent for 1955, and from 75 percent to 90 percent thereafter. An exception was tobacco which was to be supported at 90 percent of parity when marketing quotas were in effect.

The Soil Bank

The Soil Bank, established by the Agricultural Act of 1956, was a large-scale effort, similar in some respects to programs of the 1930s, to bring about adjustments between supply and demand for agricultural products by taking farmland out of production. The program was divided into two parts: (1) an acreage reserve; and (2) a conservation reserve. The specific objective of the acreage reserve was to reduce the amount of land planted to allotment crops wheat, cotton, corn, tobacco, peanuts, and rice. Under its terms, farmers cut land planted in these crops below established allotments; or, in the case of corn, their base acreage, and received payments for the diversion of such acreage to conserving uses. In 1957, 21.4 million acres were in the acreage reserve. The last year of the acreage reserve program was 1958.

All farmers were eligible to participate in the conservation reserve by designating certain cropland for the reserve and putting it to conservation use. On July 15, 1960, 28.6 million acres were under contract in this reserve.

The Feed Grain Act

The Feed Grain Act was approved March 22, 1961. It provided that the 1961 crop of corn should be supported at not less than 65 percent of

parity (the actual rate was 74 percent) and established a special program for diverting corn and grain sorghum acreage to soil-conserving crops or practices. Producers were eligible for price supports only after retiring at least 20 percent of the average acreage devoted to the two crops in 1959 and 1960. Subsequent acts in 1962, 1963, and 1964 included wheat and cotton as well as the feed grains.

The Food and Agriculture Act of 1965

Programs established by the Food and Agriculture Act of 1965 were in effect from 1966 through 1969. After approval of the plan in referendum, each dairy producer in a milk marketing area received a fluid milk base, thus, permitting him to cut his surplus production. The Wool Act of 1954 and the voluntary feed grain program begun in 1961 were extended through 1969.

The voluntary wheat certificate program begun in 1964 was extended through 1969 with only limited changes. The rice program was continued; however, an acreage diversion program similar to wheat is to be effective whenever the national acreage allotment for rice is reduced below the 1965 figure.

The Act established a cropland adjustment program. The Secretary is authorized to enter into five-to ten-year contracts with farmers calling for conversion of cropland into practices or uses which will: conserve water, soil, wildlife, or forest resources; or establish, protect or conserve open spaces, national beauty, wildlife, or recreational resources; or prevent air or water pollution. Payments are not to be more than 40 percent of the value of the crop that would have been produced on the land. Contracts may not obligate the government for more than $225 million per calendar year.

The Food and Agriculture Act of 1965 continued many of the features which have characterized farm legislation since 1933. For a third of a century, price support and adjustment programs have had an important impact upon the farm and national economy. Consumers have consistently had a reliable supply of farm products, but the proportion of consumers' income spent for these products has declined. The legislation and resulting programs have been modified to meet varying conditions of depression, war, and prosperity and have sought to give farmers economic equality with other segments of the economy.

OTHER USDA AGENCIES

Many USDA agencies are working both individually and in groups to provide services for farmers and consumers. Those having the most direct contact with farmers are described briefly. Others not described are listed.

Federal Crop Insurance Corporation

The Federal Crop Insurance Corporation permits farmers to insure against crop production losses such as those caused by weather, insects, and diseases. This insurance helps farmers strengthen their financial position and that of the community.

Rural Community Development Service

The Rural Community Development Service (RCDS) maintains a working liaison with non-USDA agencies to determine what programs and services would be useful to rural people and communities.

Farmer Cooperative Service

The Farmer Cooperative Service conducts research, advises directly with cooperative leaders and others, promotes cooperative organization and development through other federal and state agencies, publishes the results of its research, and issues "News for Farmer Cooperatives" and other educational material.

Farmers Home Administration

The Farmers Home Administration provides financial and management assistance. Loans may be of the following types: operating loans, loans and grants to associations, rural housing loans, emergency loans, watershed protection and flood prevention loans, resource conservation and development loans, rural renewal economic opportunity loans, and Appalachia loans.

Forest Service

The Forest Service is charged with the responsibility of promoting the conservation and best use of the nation's forest land which covers approximately

a third of the total land area of the United States. These responsibilities include: national forests, forest research, cooperation with states and private owners of forest lands, and leadership and direction of the rural fire defense program.

Rural Electrification Administration

The Rural Electrification Administration (REA) administers loan programs for (1) rural electrification, and (2) telephone service in rural areas. REA furnishes its borrowers with technical assistance.

Soil Conservation Service

The Soil Conservation Service (SCS) has responsibility for developing and carrying out a national soil and water conservation program. This is to be done with farmers and ranchers and other land users and developers. The planning is done in cooperation with community planning agencies, regional resource groups, and other agencies of government.

Assistance to individual soil conservation district cooperators include: (1) giving the cooperator a soil and land-capability map of his land; (2) giving him information about practical alternatives for treating and using the land within its capabilities, as indicated on the map; (3) helping him develop an orderly plan for installing the treatment measures and making the land-use changes needed; and (4) helping him apply parts of the plan that require special skills or knowledge.

Federal Extension Service

The Federal Extension Service is one of three partners in the Cooperative Extension Service. State governments, through their land-grant universities, and county governments, are the other partners. All three share in financing, planning, and conducting extension programs.

Extension helps the public interpret and apply to everyday problems the latest technology developed through research by the land-grant universities,

the USDA, and other sources. Extension works directly with the people through offices located in almost every county in the United States.

Other Agencies

-Foreign Agricultural Service

-Export Marketing Service

-Consumer and Marketing Service

-Commodity Exchange Authority

-Packers and Stockyards Administration

-Economic Research Service

-Statistical Reporting Service

-Agricultural Research Service

-Cooperative State Research Service

-Food and Nutrition Service

The USDA also includes:

-International Organizations Staff

-National Agricultural Library

-Research Program Development

-Evaluation Staff

In addition there are nine departmental administration staffs.

SECTION IV ECONOMIC PRINCIPLES

Supply and Demand

Both prices of farm products and costs of resources used in the production of agricultural products are affected by the interaction of supply and demand. Supply reflects attitudes and actions of producers and sellers. Demand reflects the attitudes and actions of buyers.

In general, it can be said that as supply decreases and/or demand increases, prices will rise. Also, as supply increases or demand decreases, prices go down. This is not a simple relationship, however, since many other factors are involved. For example, the storability, desirability, and amounts needed will vary price and/or demand. A perishable product such as lettuce must be sold in a short period of time or it will spoil. A desirable commodity such as apples may continue to sell even though the price is well above "normal." A product such as bacon which is used in relatively small quantities might be purchased even if the price were to double.

Farm programs have attempted either to bring supply and demand into balance via cropland adjustment or to protect farmers' incomes from oversupply by means of price support. For many farm products, a combination of approaches is used.

Elasticity

A supply or demand is said to be elastic when a change in price results in a more than proportionate change in the quantity of product supplied or purchased. When a price change results in less than a proportionate change in quantity, the supply or demand is inelastic. For example, the demand for necessary food items will tend to be inelastic. On the other hand, luxury food items will tend to have an elastic demand.

Opportunity Costs

Most farmers do not have the amount of capital they would like to have. Consequently, they cannot do everything they want to do. Thus, they have to make decisions. The difference in net income among the various alternatives is the opportunity cost. For example, on ten acres of cropland, a farmer might be able to raise hay, oats, or corn. The figures might look like this:

	Hay	Oats	Corn
Gross income	$ 1100	$ 500	$ 1150
Expenses	500	450	650
Net income	$ 600	$ 50	$ 500

The opportunity cost of hay to oats is $550, of hay to corn, $100, and corn to oats, $450.

Resource Allocation

On the basis of opportunity costs the farmer allocates fixed or limited resources to the most profitable livestock and crop enterprises. He attempts to get the highest return on his most limiting resource. Thus, if capital is limited, he allocates his capital resource among enterprises to realize his highest net return to capital. Farm programs influence the profitablility of various alternative crop or livestock enterprises. The farmer will weigh the affect of these programs as he plans how to allocate resources.

Diminishing Returns

As inputs are added, outputs follow a predictable pattern. The first inputs cause output to increase at an increasing rate. Additional inputs cause outputs to increase but at a decreasing rate. Finally, at some point, additional inputs will cause output to decrease.

Cost-Price Margin

The cost-price margin is the difference between cost of production and price of product. The smaller this margin, the harder it is to make a profit. Thus, greater efficiency is required to break even. Most businesses raise prices as costs increase, thus, maintaining their margin. Farmers, however, have to pay the costs set by others if they want to buy many of the things they need. At the same time when they sell their products, they must usually accept the prices set by the market. Price supports are among the devices used to insure that the farmer has a margin between his costs of production and the selling price of his products.

Purchasing

The purchasing power of the farmer significantly influences both the farm and total business economy. One aim of farm programs has been to protect the farmer's purchasing power. Where farmers can estimate with reasonable assurance the value of their product at harvest, their expenditures for inputs, such as fertilizer and seeds, can be geared to securing the highest net return. As his risk is lowered, the purchasing power of the farmer is stabilized.

Specialization versus Diversification

Specialization refers to the production of a limited number of products. The major advantages are that fixed costs, such as necessary machinery, are spread over more units of production and any comparative advantages are used to the fullest extent. With specialization comes greater risk, since other sources of income are not available in the event of low prices, low yields, or high costs.

Diversification, on the other hand, reduces risk. It may take better advantages of the resources of a farm by spreading labor requirements more evenly throughout the year. Types of soils and buildings may also be better used through diversification.

Demand for Quality

Part of meeting demand is having the quality that is being demanded. Even if pork is in great demand, the demand for lard may be almost non-existent. The demand in this case is for lean hogs. If the quality of one product drops, consumers may substitute something else for it. This might cause surplus of poor quality of the first product and drastically reduce the price of the product. Consumers are increasingly demanding quality products.

Price Supports

Price supports can both increase supply and decrease demand by raising the price. If price supports are lowered, the opposite can occur. (See Page 19).

Marketing, Storage, and Seasonal Products

Marketing is part and parcel of the modern productive process. Goods grown and sold by farmers must be stored, transported, processed, and delivered in the form, at the time, and to the places that consumers desire.

Methods of storage have improved greatly in the past fifty years. Controlled environment and other modern storage facilities make farm products available year round, thus, helping to balance supply and demand.

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Secretarial Techniques, Student Manual.

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IDENTIFIERS - *STUDENT MANUAL

ABSTRACT - For student use in a 5-day workshop to develop understandings of the role and function of secretaries in office practice, this manual addresses the following areas: secretarial performance and responsibility, secretarial communications, secretarial human relations, secretarial leadership, and secretarial success. The document is illustrated with line drawings and charts and includes the forms required for making use of the suggestions offered. A bibliography is appended. (CH)

VT 010 747

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Secretarial Techniques

VT010747

STUDENT MANUAL

P U R P O S E

The role of the Government secretary today is one of essential assistance. She no longer serves only as a scribe and a typist. The secretarial role is expanding into new dimensions of responsibility. Secretarial Techniques is designed to aid the secretary as she strives to master these new dimensions.

The purpose of this five-day workshop is to analyze the duties, responsibilities, and dimensions of today's Government secretary; exchange, present and assemble technical, secretarial information; refresh and reinforce the essential office concepts; and stimulate an interest in striving toward increased efficiency, job satisfaction, and applied secretarial dimensions.

F O R E W A R D

The secretary holds an important position in today's office. Her responsibilities and assignments go far beyond the traditional concept of secretarial work. The dimensions of her job place her in a position where she is an intregal part of the decision making, planning, and coordinating.

To meet these new challenges, each secretary will need to expand--to reach out--to examine--and to build new secretarial talents. Yes, today we are faced with new challenges which require new dimensions of secretarial tasks. These dimensions are merely building blocks toward a better, more interesting future.

With our best wishes to you for a successful course, let us introduce to you our SECRETARIAL TECHNIQUES Workshop--A Workshop in Secretarial Dimensions.

Communications and Office Skills
Training Center
Washington, D. C.

S E C R E T A R I A L T E C H N I Q U E S

AGENDA

Session #1

THE SECRETARIAL DIMENSION OF PERFORMANCE AND RESPONSIBILITY

- o Looking at Today's and Tomorrow's Secretarial Role
- o Previewing What Lies Ahead for Secretaries
- o Evaluating Our Present Knowledge
- o Organizing for Better Performance
- o Receiving Visitors with Diplomacy
- o Improving Your Telephone Image
- o Setting New Goals for Ourselves

Session #2

THE SECRETARIAL DIMENSION OF COMMUNICATIONS

- o Reviewing Your Grammar
- o Testing and Refreshing Your Capitalization, Punctuation, and Compounding Skills
- o Communicating Through Appearance
- o Listening to Hear and Understand
- o Speaking to Communicate

Session #3

THE SECRETARIAL DIMENSION OF COMMUNICATIONS (CONT.)

- o Presenting Myself Through Speech
- o Reading to Increase My Knowledge and Effectiveness in the Office
- o Writing for Your Boss
- o Developing Your Information Sources (Resources)

Session #4

THE SECRETARIAL DIMENSION OF HUMAN RELATIONS

- o Putting the "U" in Human Relations
- o Cooperating With Others
- o Understanding Yourself and Others

Session #4 (Continued)

THE SECRETARIAL DIMENSION OF LEADERSHIP

- o Leading is an Art
- o Supervising With Confidence
- o Creating Better Ideas and Methods

Session #5

THE SECRETARIAL DIMENSION OF SUCCESS

- o Evaluating Your Performance
- o Using Your Knowledge, Talents, Skills, and Resources
- o Responding With Professional Proficiency
- o Adapting to the Boss, the Office, and to Progress
- o Excelling With Excellence

SECRETARIAL TECHNIQUES

A WORKSHOP OF SECRETARIAL DIMENSIONS

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NO LEARNING LOST

"That time is never wasted in scholastic atmosphere
Which is intended to prepare for some worthwile career;
For even if we lack the means of opportunity
To carry out the aim of what we hope to do or be,
The knowledge that we gather will be helpful in some way
However indirectly to our progress of the day,
For nothing that we learn is lost to be of no avail
If we keep trying faithfully determined not to fail;
And always it is possible our tide of life will turn
And perseverance will attain the goal for which we yearn."

--James J. Metcalfe

ERIC

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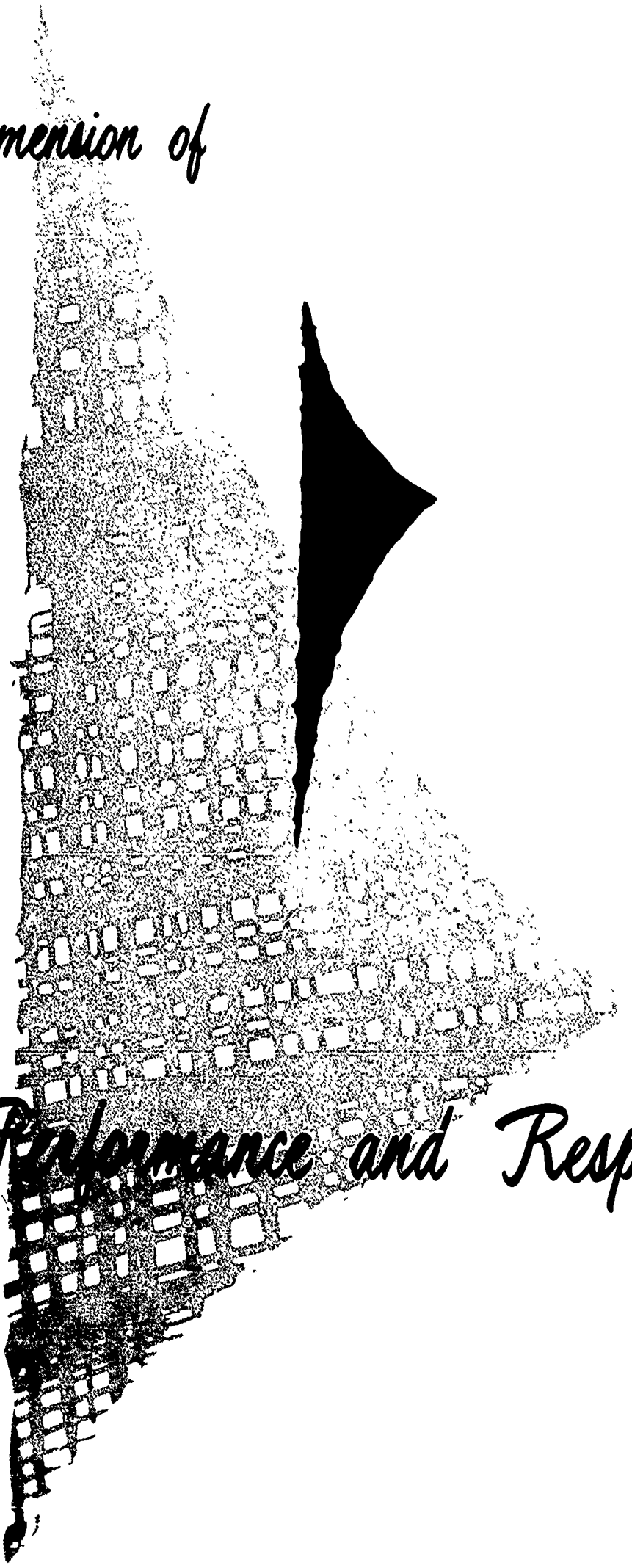

Performance and Responsibility

SUPERIOR PERSONALITY TRAITS

Good grooming and appropriate clothing. While the correctness of first impressions is often debatable, there is no argument at all about the fact that most callers will have formed some sort of impression about you on first sight. Good grooming and neat, appropriate clothing will go a long way to make the impression a favorable one. Also, aside from the impression you make on others, the knowledge that you are as neatly and tastefully attired as possible gives such a boost to your own morale and self-confidence that you naturally do your work better.

Pleasant voice and expression. These two qualities could profitably be given much more attention than they usually receive in any training courses for secretaires. They are ordinarily mentioned as good qualities for a secretary to have, but rarely considered a vital vocational point. Yet your voice and the words you use to express yourself can create a friendly, cooperative attitude in your listener or make him want to disagree with you--perhaps without either of you being aware of the fact that it is your voice and the expression which account for the difference, rather than the ideas which you are trying to convey. In some instances, the cultivation of an optimistic, cheerful outlook on life may automatically bring with it all the improvement necessary in our manner of speaking and our facial expression.

Poise. Poise is the oil which keeps nerves from grating and grinding, eases contact with cantankerous people and problems. and makes you better able to bear the real weight or even the worst day's work. Used as it is here, as one of the desirable qualifications of a secretary, "poise" either includes or arises out of a number of other desirable qualities, all important in themselves. For instance, dignity, graciousness, sincerity, patience, and tact are some of the qualities immediately associated with the secretary who is poised. Your adaptability, imagination add resulting grasp of situations, versatility, knowledge of social and business etiquette, and self-confidence are attributes which contribute to your poise.

Cooperation.is another of the lubricants of the business world, which like poise, involves many other qualities often listed separately:

Ability to listen
Consideration of others
A spirit of fair play
Generosity, giving praise where due
Ability to admit mistakes and profit by them
Ability to take the blame for your own mistakes

One of the greatest aids to cooperation is the cultivation of a positive attitude. Stop short whenever your immediate reaction to a question or a request is an unconsidered "No" or "It can't be done." Consider how much more gracious your final acquiesence can be when your initial approach to the problem is s mething like, "Well, let's see. How should we go about doing that?" rather than a blunt negative from which you later may have to back down.

Possession of a "business viewpoint," as against a personal one is also an asset. Ofter the pressure of time or work may cause your employer or your associates to skip such amenities as "Please" or "Thank you," or to give orders so hurriedly they sound sharp. The secretary with a real business viewpoint will not take personal offense and will avoid complicating a situation by bringing in personalities. She will make decisions without prejudice--letting the facts decide, regardless of her personal feeling toward the individual involved. She will be big enough to help out a fellow worker in a tight spot, instead of merely sitting back and feeling smug because her own work is in good shape. Such cooperation pays off, too. Who knows when you yourself may be the one who needs the extra help? At the very least, you will be learning more about the other person's job and the work of your agency as a whole.

Dependability. When your employer can ask you to do something and can then feel free to forget it, safe in the certainty that you will take care of it satisfactorily, an important part of the foundation for his confidence in you as an efficient secretary has been laid. He is depending upon your work habits as a whole, including:

1. Loyalty
2. Ability to follow instructions and to work without close supervision
3, Good memory, reinforced by adequate notes and reminders
4. Effective review of your own and other's work
5. Ability to cooperate with others
6. Persistence in the face of a dull job or of difficulty in finding some necessary facts or material
7. Alertness to any new facts or conditions
8. Foresight in seeing how much new facts or conditions may change the picture
9. Initiative tempered with good judgement in deciding whether new facts or conditions warrant the employer's attention or whether you yourself should follow through
10. Discretion and ability to treat confidential matters as strictly confidential
11. Honesty and integrity

12. High standards of production (punctuality, speed, industriousness)
13. High standards of quality (accuracy, neatness)
14. Sense of responsibility
15. Maintenance of work progress records which will enable you to give the boss prompt and accurate repoets on the work at any stage.

Each of these points is deserving of considerable elaboration. For instance, let us take the importanc items of loyalty and cooperation.

In her book, The Successful Secretary. Margaret Pratt has summarized loyalty as follows:

> "...there is one quality you must have or all your other assets are valueless. That quality is loyalty and every employer values it even more that he does ability... If you have been unfortuante enough to get a job with someone you cannot respect, leave the job and find another, for you must be able to feel loyalty to your boss, not just just to get ahead, but to enjoy your work."

That summary might well have gone further, for in any position, loyalty should be extended to your whole agency and to the programs which it carries out. Then here again the complex nature of the term "employer" as it applies to us in the Federal service must be considered. Our loyalty should be stretched to include the taxpayer, John Q. Public.

Sometimes this may involve no small amount of moral courage. There will be times, especially as you are given more and more responsibility, when you may not see eye to eye with your boss on some course to be followed or method used. If you are timid or the boss has a rather brusque manner, it may take real moral courage for you to voice your opinion. If you are sure you have true knowledge of the situation, however, you are duty bound to present your side of the question. In fact, the ability to present intelligent differing views is one of the qualities that most top executives value highly in their secretaries or other assistants, for it helps to provide them with a well-rounded view of the entire situation under consideration.

Once having given the employer your facts, though, you should be prepared to follow graciously whatever course he decides is best. The final responsibility is his, after all. You have discharged only part of your obligation by bringing you information to his attention. Your final obligation is to see that his wishes are carried out.

Good health and health habits. The importance of good health and health habits is obvious, for without them, consistent possession or use of the most of the foregoing qualities would not be possible. However, they

are usually so taken for granted that many girls either overlook or ignore the practice of the most elementary health habits.

Do you get enough sleep, so that "tired feeling" does not overtake you at the office? How about exercise? Is your diet aimed at keeping you in tiptop condition? How do you use your leisure time?

The intelligent secretary will realize that what she does outside the office may well have a considerable effect on her success on the job, particularly if she does not observe health habits which will enable her to actually be on the job and not among the absentees.

Ambition. It is not meant to imply here that your aspirations must be toward a higher position, more money, or prestige. Rather, the desire to learn, to grow, and to do your very best, is our definition of "ambition" as a quality of the superior secretary. It plays a big part in increasing your capacity for more responsibility in your job. The other material things, and job satisfactions, have a way of following in the wake of increased capabilities.

ORGANIZATION

"There is no waste of any kind in this world that equals the waste from needless, ill-directed, and ineffective motions and its resulting unnecessary fatigue." Frank B. Gilbreth

Time is a very important ingredient in your working day as a secretary. Much of the success you enjoy is dependent upon your ability to plan and organize your work efficiently. Without a plan, time is lost and you are not able to perform your work efficiently. Today's Government secretary's motto should be "Plan your work and work your plan."

One of the first decisions that must be made is to evaluate each task and determine its priority. In making decisions, an efficient secretary must use good judgment, initiative, be dependable in producing accurate and mailable work, and follow up and follow through each task to its completion.

Since you are faced with a multitude of tasks, one of your biggest problems may be an accumulation of little tasks or unfinished jobs. Be on the lookout for time to do these little tasks that may not be urgent so they do not accumulate. Many times a few minutes of variety from the normal pressures can accomplish the task you have put aside.

Be flexible and stay calm when pressure is applied. Keep everything in perspective and stay in control. Concentrate on one task at a time and accept the challenge of that job. Don't think about the other tasks until you get to them. Regardless of how well organized you may be, there will be emergencies come up during the course of a day. Plan your time to allow for these emergencies.

No one organizes work in the same way. This is not the important thing. The main thing is that some kind of a step by step pattern be established to accomplish the work. Look critically at some of the things you are doing. Analyze the procedure and the way you are accomplishing it. Develop a questioning attitude about all the routine jobs you do. You may be able to come up with a better method of doing the job and to eliminate some of the steps you may be going through. The present way may not be the only way or the best way to do the job but ASK yourself

1. What is to be done?
2. Where is it done?
3. When is it done?
4. Who does it?
5. How is it done?

Regardless of how long you have been a secretary, you will find a very helpful tool in organization is some type of work planner. (See illustration). It may seem like a waste of time to fill one out for the day's activities, but after such a planner becomes part of your routine, you will find you are accomplishing more work than you realize. There is a good feeling of accomplishment to be able to mark off each task on the list upon completion. A good way to plan ahead is to fill out the planner just before leaving the day before. By anticipating your work for tomorrow, you can place the items in order of priority. As you close the office door, you can also close you mind until tomorrow. Spend a few minutes thinking about what has to be done. Do

THE SECRETARY AS A BUILDER OF GOOD PUBLIC RELATIONS

Good public relations is of even greater importance in Governmental service than in any other field, because of the people whom we serve.

In private industry, a company's services are aimed primarily at one goal--the potential customer. In the public service, we are dealing with not only a potential customer but with an even more important, three-sided entity. Our potential customer, John Q. Public, is also our employer, for it is his taxes which pay our salaries; at the same time we are, in an indirect sense, a representative for each one of us, since we as individual citizens are also a part of the employing body.

In private industry, Mr. Potential Customer has the option of refusing to buy--and to pay for--a company's goods, if he feels they are not what he wants. In our case, on the other hand, Mr. and Mrs. Public pay for our services whether or not they feel that they individually have any need for such services or that we are providing them with the best possible service. It is our duty, therefore, to make the instances in which Mr. and Mrs. Public have contact with us as helpful and courteous as possible.

Government secretaries are in a key position to build good public relations through their various contacts, which may include any or all of the following:

Personal callers	Telegrams
Telephone conversations	Reports
Correspondence	Magazines and periodicals
Press	Speeches
Radio or TV	Legislative contacts

However, establishing good public relations is an aspect of <u>every</u> civil service job.

DAILY WORK PLANNER

TO BE DONE	DETAILS	TIME

GUIDELINES ON WORK ORGANIZATION

Each office should have a procedures manual as a guide to work organization. It is necessary for you to think through your job step by step while preparing it. It can be of tremendous help to a substitute or a new person in your office. Remember, the task that may seem routine to you may not be to someone else. The instructions could be prepared under the following headings?

OFFICE

What are the jobs in your office and who does them?
Who are the key people in your office, branch, or section?
Will she have to contact other offices? What are the telephone numbers, and where are the offices located?
What are the names of the secretaries, clerks, etc., with whom she will have contact?
What policy or instruction memoranda should she see?
Where are the instruction booklets for all the equipment used in the office?
What should she know about your reminder systems? (Complete details)

MAIL

What are the pickup and delivery times?
What type of information and material do you route to whom?
What is the purpose of the "buck" slip?
Does the supervisor answer all correspondence?
If you answer some correspondence, where are the samples of such materials?
Where do you keep follow-up materials?
You may want to include a page on franked mail; messenger envelopes; special messenger service.

FILING

What is the method of filing used? (Give complete details.)
Who has access to the files?
Who does the filing?
Which files contain confidential material?
What filed material might your supervisor want during your absence and where is it?

TELEPHONE

In answering the phone, what special phrase is used?
Do you screen all incoming calls?
Is your telephone book up to date?
Do you have a list of frequently called numbers?
What should she know about making calls? (Explain the procedure preferred in your office.)
Is information frequently asked of you?
Special information about long distance calls and unique situations in your office?
What is your IDS number?

VISITORS

What is the routine for receiving callers?
How do you handle visitors who are waiting?
Do you have a list of frequent visitors in your office?
Can you refer visitors to any other office or person?
Who will make the appointments for the supervisor?
Do you remind him of his appointments?

SUPPLIES

Where are the supplies kept?
What procedure do you use for ordering and distributing supplies?
Have you samples of forms used with the information filled in for reference? Have you included necessary instructions about carbon copies?

OTHER OFFICE DUTIES

What dictation procedure do you use?
Do you take dictation at a certain time each day?
Do you have deadlines in getting material transcribed?
What should she know about the intercom system?
What specialized job, not already mentioned, should she know about?
Where are the reference sources used in the office?
What about duplicating facilities?

PERSONAL

What meetings or commitments should your supervisor be made aware of in your absence?
How does he like his coffee? What brand of cigars or cigarettes does he prefer?
When do you usually go to lunch? What facilities are available?
How much time do you have at lunch?

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In private industry, Mr. Potential Customer has the option of refusing to buy--and to pay for--a company's goods, if he feels they are not what he wants. In our case, on the other hand, Mr. and Mrs. Public pay for our services whether or not they feel that they individually have any need for such services or that we are providing them with the best possible service. It is our duty, therefore, to make the instances in which Mr. and Mrs. Public have contact with us as helpful and courteous as possible.

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Radio or TV	Legislative contacts

However, establishing good public relations is an aspect of <u>every</u> civil service job.

OFFICE DIPLOMACY

You are the Ambassador for the U. S. Government, your Agency, your division, your office, and your boss. It is your responsibility to give each caller the "Red Carpet" treatment. Proper treatment of all callers can win a reputation for helpfulness, courtesy and service. Visitors do remember how they are received and executives value a good personality and they appraise employees on how they meet, greet, and get along with others. Patience is the necessary requirement; service is your motto.

GREETING A CALLER:

Greet each person entering your office with a smile and a friendly attitude. A pleasant "Good morning" or "Good afternoon" may also be added. You will set the pace of the visit; the caller will probably judge the office by the manner of approach you use. If the visitor does not offer information about the purpose of his call, ask him, "May I help you?" If you are not near the visitor's point of entry, nod your head to acknowledge his presence and immediately join him. Do not shout or run. Never ignore the visitor.

FIND OUT THE PURPOSE OF THE CALL:

Tactfully ask the visitor why he wants to see your boss, and what service or agency he represents. If he fails to volunteer this information, you may say, "May I tell Mr. Boss what it is you wish to see him about?"

Learn and study names that are important to your office. When a person comes into your office, study his face and then learn the name which corresponds with the face.

Everyone likes to be known. The clerical assistant who wants to climb to the top of the success ladder will start by learning and remembering the names of the office callers.

MAKE THE CALLER FEEL COMFORTABLE:

Help free the visitor from coats, hats, umbrellas, and packages. Hang up his coat and place his hat and/or packages where they will not be disturbed.

If the visitor has to wait for any length of time to see your boss, see that he has a comfortable chair, a newspaper or magazine, perhaps a cup of coffee, an ash tray and matches if he smokes. Sometimes it is necessary to offer a bit of small talk to make the caller feel relaxed. Appropriate "small talk" could be about the weather, local sports events, or a forthcoming holiday. If the visitor has a point of view that does not agree with yours, don't argue or even indicate that you differ with him. Smile, as if in agreement, and casually refer to a related, non-controversial topic. Never discuss agency business or personal problems. A small amount of "small talk" is good; don't over do it. The visitor will realize that you have other duties to perform. After you have settled the visitor, you may excuse yourself and go on with your duties. At this point, you should stay in the room, and busy yourself with your formal tasks.

ESCORTING A VISITOR INTO YOUR BOSS' OFFICE:

If your boss has not met Mr. Visitor, it is your duty to escort him into your boss' office and perform the introductions. If you are not sure, ask him-- "Have you met Mr. Boss before?" If he says yes, then you may escort him into the office without making any formal introduction between the two gentlemen.

(Sometimes it is helpful to the boss if you casually drop the name of the visitor such as--"If I can be of further assistance, Mr. Visitor, please let me know," or "Mr. Visitor, go right in."

When making introductions, use the boss's name first. "Mr. Boss, this is Mr. Visitor." Say the names slowly and distinctly. There are exceptions to this rule. When introducing a congressional person or a minister of a church, use their names first. Your boss also might have his own preferred way. In this case, always follow your boss's wishes. After making the proper introduction, leave quickly.

REFERRING THE CALLER:

If the visitor has the wrong office, politely tell him so, write on a small sheet of paper the number of the office and the name of the party he should see. Help give him directions.

THE CALLER WITH AN APPOINTMENT:

When a caller with an appointment arrives, greet him properly, and notify your boss (in the manner he has requested).

THE CALLER WITHOUT AN APPOINTMENT:

Many visitors do not have appointments. Treat them courteously while you tactfully find out if the boss can see him. Always make each visitor, with or without an appointment, feel welcome.

INTERRUPTING A CONFERENCE:

Try to avoid interrupting a conference; but if you have an understanding with your boss that it is to be interrupted for certain visitors, do so

quietly and unobtrusively. Enter the room without knocking and hand your boss a note and leave unless he signals you to wait.

WHEN THE CALLER LEAVES:

Both your greeting and farewell should be accompanied with a smile. Try to use the name again. You could say, "Goodby Mr. Visitor." Using his name will flatter him and also help you remember his name. Always be pleasant and of service. Remember you are an Ambassador representing your office.

USE OF THE TELEPHONE

S Speak directly into the mouthpiece, with your lips close to the mouthpiece, in an ordinary conversational tone. The telephone is designed so that your voice is carried most clearly if you speak this way.

E Employ a friendly, interested tone of voice. Since your listener cannot see your friendly smile or interested expression, your voice takes on even more importance than in face-to-face contact.

R Refer caller to another person only if you are sure the person to whom you propose to transfer the call is the one who can best take care of it. Volunteering to call back with the requested information or to have someone who knows the entire story call back is the best procedure if you cannot take care of a caller yourself.

V Verify any important calls by writing a prompt letter of confirmation. In addition to making a record for your files, a confirming letter helps to prevent any misunderstanding of the spoken arrangement or agreement.

I Identify your office and/or yourself the first thing when receiving or placing calls. This saves the time and temper involved in the oral sparring which often follows an answer of "Hello".

C Choose your words as carefully as you would in face-to-face conversation or in a letter, avoiding those which sound bossy or have an unpleasant connotation. Be sure to ask any necessary questions tactfully, wording them so they do not sound prying or abrupt.

E End conversation clearly, and hang up carefully in order to guard against causing an unpleasant bang in the caller's ear.

Courteous treatment should be accorded everyone, including the telephone operators. Avoid wrong numbers, but if you should get one, be sure to apologize. Likewise, any apolgies you receive on that score should be accepted graciously.

Answer your telephone promptly, after the first ring, if possible. Make some arrangements to have your phone answered while you are out, and always leave information as to when you will be back or where you may be reached.

Train yourself to recognize voices and to address people by name.

Save both your own and your listener's time by deciding what you want to say before making your call, perhaps jotting down in advance the points you wish to cover.

Avoid keeping people waiting on the line while you check information. If the checking will take more than a few seconds, ask if you may call back. Minutes spent waiting at the end of a telephone line seem very long and irritating. In addition, such waiting keeps your line tied up.

Keep an up-to-date list of frequently used telephone numbers in a handy place--card file, notebook, or any one of the devices seen on the market. If your boss places many of his own calls, a duplicate list for him will be helpful.

Always have a pencil and paper handy for jotting down messages or notes of calls. Then be sure to keep your notes in a prominent place and to follow up on calls whenever necessary. Also be sure to have handy any material to which you must refer often.

Maintain all the necessary directories and an up-to-date schedule of telegraphic, teletype, and telephone services and rates.

Save your employer's time whenever possible by anticipating what data might be needed when he asks you to place a call or whenever possible. Encourage people to dictate messages to you.

Keep personal calls to a minimum.

Be on a constant lookout for ways in which you can improve your telephone techniques. Listen to people about you--notice their best techniques and put them into practice yourself.

Always remember that to the person on the other end of the line YOU are your agency. He may form his impression of the whole department from the way you handle his call.

Problem #1

Your boss wants as much information as possible when receiving a telephone call. How can you get the information without offending the caller?

Problem #2

A caller has called several times for your boss and has been told that your boss is out. You have not given the caller a time that your boss will be in. The caller calls back late in the afternoon and wants to know why your boss has not returned his call. Your boss has returned to his office but has been extremely busy. How would you handle this situation? Remember the caller is angry.

Problem #3

Your boss is very busy. Throughout the day you have taken several telephone messages for him. At the end of the day, he still has not returned the calls. How can you help your boss, and what should you do?

Problem #4

You receive a telephone call from a secretary who is placing the call for her boss. She wants you to put your boss on the line first. What is the proper way to handle this situation?

Problem #5

What would be the best procedure to follow when a person on the telephone becomes rude? Give some specific tips.

Problem #6

How do you handle a caller who has been given the "run-around treatment"? You cannot help him either. Your caller feels that the Government is very inefficient.

Problem #7

What are some accepted telephone phrases that the professional secretary can use? What are some of the phrases that should be avoided?

Problem #8

How do you interrupt a boss who is on the telephone or has left word that he is not to be distrubed? You have just received a very important telephone call that you are sure your boss would like to accept.

Problem #9

How do you correctly place a call for your boss? What should you say?

Problem #10

You have a new employee in your office. What long-distance procedures would you give her? Assume she is new in the Government.

TELEPHONE CRITIQUE

STUDENT NUMBER	EASILY UNDERSTOOD		FRIENDLY		COURTEOUS		TACTFUL		WELL HANDLED	
	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
1.										
2.										
3.										
4.										
5.										
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35.										

TELEPHONE PET PEEVES FROM THE BOSS' VIEWPOINT:

1. Failure to notify person called, who is calling and what about.
2. Interrupting conferences with unwanted calls.
3. Failure to notify person called, that the call is long-distance.
4. Failure to be pleasant when answering. (The indifferent "Hello.")
5. Failure to identify office when answering the telephone.
6. Failure to place calls correctly for the boss.
7. Failure to call right person to the phone. (Presses wrong buzzer.)
8. Leaves phone unattended.
9. Swearing out loud when phone rings.
10. Failure to "cover" for the boss.

SECRETARIAL TECHNIQUES--SUPERVISOR'S QUESTIONNAIRE

As you know, your secretary is attending the Secretarial Techniques Workshop at the U. S. Civil Service Commission. This is being sent to you as a confidential report to be used as a collective opinion of supervisors of the points covered. Your questionnaire will be anonymous and will be used to compile a list of overall opinions. These opinions will be used during a discussion on "The Secretary Strives to Improve." We need to have this form returned to this office by Friday in the self-addressed envelope. Thank you for your assistance. See Page 2 for Evaluation Code.

	1	2	3	4	5
1. *Does your secretary project a pleasant, efficient, and enthusiastic image of your office?*					
2. *Are you satisfied with the way she handles your visitors when you are in or away from the office?*					
3. *Does your secretary have a positive attitude?*					
4. *Does she work well and have good rapport with her co-workers?*					
5. *Are you doing some office tasks that you think she could handle for you?*					
6. *Is your secretary accurate and prompt with her work?*					
7. *Does she have a good command of English in her oral and written communication?*					
8. *Does she show initiative in her work?*					
9. *Do outside interests interfere with her office work?*					
10. *Is she dependable and punctual?*					
11. *Does she provide you with the assistance that allows you to work on priority projects while she coordinates other tasks?*					
12. *Do you allow her to handle any written communications? If yes, what kind?*					
a.					
b.					
c.					
13. *Is she well organized in handling the work flow?*					
14. *Does she follow through with job assignments?*					
15. *Does she handle telephone calls efficiently and diplomatically?*					
16. *Does she scan the mail and provide you with necessary reference materials?*					
17. *Is she well groomed?*					
18. *Are you will pleased with her ability to supervise other employees?*					

	1	2	3	4	5
19. *Is she eager to learn new skills that will help her to be a better assistant to you?*					
20. *Is her typewritten work prepared neatly and accurately?*					
21. *Does she remain poised and even tempered when job pressures are high?*					
22. *My secretary and I have a good working relationship?*					
23. *Does she keep the office files up to date and have an efficient retrival system?*					
24. *Does she research materials to assist you with special projects?*					
25. *Are you satisfied with her job performance?*					

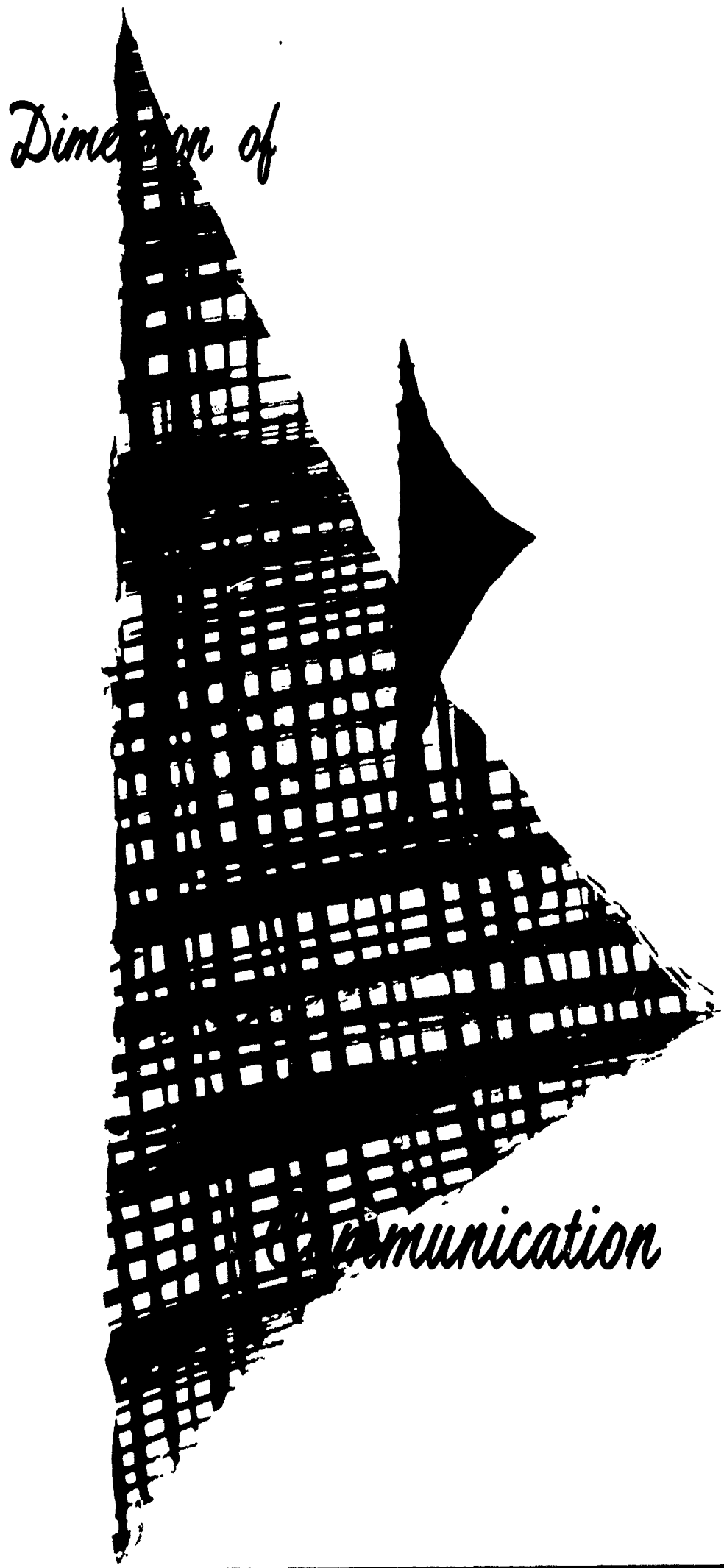
Code for the evaluation:

1 Always
2 Usually
3 Sometimes
4 Never
5 Not Applicable

If you have additional comments, please add them here.

SECRETARIAL TECHNIQUES

GRAMMAR	TEXT
1. Both the director and myself have approved the report.	12-a
2. The tornado damaged John and Mary's home.	14-h
3. The committee has reached an agreement and will announce their decision on June 15.	16a
4. Neither the secretary nor the Division Chief are planning to attend the meeting.	18b
5. Miss Jones is one of the secretaries who is scheduled for a conference this morning.	16e
6. His conclusion seems sound, but his criterion are not valid.	16c
7. Typing letters all morning and answering the telephone all afternoon make a secretary a candidate for Excedrin.	16f
8. The letter with its several attachments were received this morning.	18b
9. Rushing to meet the deadline for the project, many errors were made.	44f
10. A number of our personnel was on leave yesterday after the holiday.	17p.55
PUNCTUATION	
11. He has not yet filed his report, for the investigation has not been completed.	
12. May bought notebooks, pencils, and file folders.	65c
13. Attending were representatives from Chicago, Illinois, Salt Lake City, Utah, Portland, Oregon, and Tucson, Arizona.	66i
14. "Opportunity is not so much in the situation, said Frederick R. Kappel, as in the enthusiasm, the judgment, and courage that men bring to the situation".	66i
COMPOUNDING	
15. The well-written speech was well-received.	41a,b
16. The committee has asked for Federal -State-local cooperation.	41c


Dimension of
Communication

SECRETARIAL TECHNIQUES

GRAMMAR	TEXT
1. The authors of the report are he and I.	12d Note
2. The executive's secretary's report was not completed.	14c
3. Give the letter to whomever answers the door.	12b
4. The books and records described below, as well as the attached signed affidavit, was furnished by the taxpayer.	18b
5. The committee has adjourned and returned to their offices.	16a, 17
6. Two-thirds of the employees in our office is on sick leave.	16b
7. The National Office Evaluation Team has five trips scheduled for the third quarter.	16a
8. Most of the correspondence are routine.	16a (1)
9. Twenty-one pages are our quota for each day.	16b
10. These memorandums have been signed.	16c
11. The date and the time of the meeting has not been decided.	16f
12. A person needs someone to turn to when they are in trouble.	17
13. Clearly visible on the desk was the reports he had asked us to file.	18a
14. After about an hour, they were afraid they went the wrong way.	22d
15. I had hoped to have typed the letter by now.	25b
16. The visitor stormed into the office, sits down beside my desk, and demands an explanation.	23a
17. She did not want a LWOP notation on her leave record.	38a
18. We need someone to audit reports with statistical experience.	47e
19. The secretary who sat at that desk is Miss Jones.	46d
20. To record a telephone message, the revised form should be used.	44f

SECRETARIAL TECHNIQUES
Page 2

21.	I would like a hot glass of chocolate.	47b
22.	The report was lying on the secretary's desk. (Refer to workbook)	
23.	If I was you, I would apply to take the Certified Professional secretaries Examination.	29a
24.	The possibility of you being blamed for the mistake is incredible.	14h
25.	Mr. King will sure like your work.	40c
26.	Give the letter to whomever wrote the draft.	12b
27.	Whoever volunteers must stay until 5 p.m.	12b
28.	Mr. Jones called him and I into his office for a brief chat.	13a
29.	The whereabouts of the boss have not yet been determined.	16c
30.	The analyses has been made and the data compiled.	16c
31.	Everyone must turn in their annual leave schedule today.	16d
32.	One of the men who are scheduled for an appointment this morning called to change his appointment until a later date.	16e
33.	Virginia is one of those secretaries who are applying for the position.	16e
34.	The committee has announced their decision.	17
35.	Our letters, like our speech, is an indication of our knowledge of English.	18b
36.	I give him the letter this morning, even though he says he can't find it.	22c
37.	Your letter dated September 22, 1970, requesting information about the availability of certain training materials and about the plans for distribution of these materials.	24d
38.	Mary is the fastest worker of the two secretaries.	42a
39.	Leaving her desk, the file drawer was opened.	44d
40.	Please send and file the secretary and the letter.	47

SECRETARIAL TECHNIQUES
Page 3

41. The only problem can be defined by this committee. 47d

42. During vacations many secretaries enjoy swimming, dancing sleeping, tennis, knitting, and golf.

43. This letter is about the war on poverty that I typed.

44. The secretary was cleaning the office with her supervisor.

PUNCUTATION

1. I have almost finished these letters; there are only three more on my desk. 56e

2. If you call me before noon I can meet you for lunch. 63a

3. Your letter of January 10, 1969, explains the problem clearly. 66d

4. We submitted the project plans for the Director this morning, they were approved by noon. 66e

5. He asked, "Do you want to attend the meeting"? 66i

6. Of the six applicants, only three--Davidson, Miller, and Moore--are eligible for appointment. 66g

7. Addison remarked, "This phrase 'initiate any appropriate action' seems to leave a lot to the imagination." 66i

8. Give me a current statistical report. 41e

9. It was an involved, difficult case. 41e

10. Our letter of July 6 a copy of which is attached should answer your question. 60

11. He has not yet filed his report, for the investigation has not been completed. 61a

12. Mary bought notebooks, pencils, and file folders for the office. 65c

13. My brother James has been visiting me. 66d

14. The Director publicly commend us for our report, however, he later asked us to rewrite the conclusion. 66e

15. We cannot give you a thorough evaluation of the training course, since not all of the trainees have submitted their evaluation, questionnaires. 66d, 62b

16. We have written to Flowers, Inc. asking for information concerning Mr. Smith. 61c, 66e

COMPOUNDING

1. The information you sent in on the report last week is not up-to-date. 41b

2. There will be 10-minute delay in starting the meeting. 6.36

3. There was a terrific snow storm in the Minneapolis St. Paul area. 6.21

4. Please send us six copies of the above mentioned booklets. 41a

5. Our secretary submitted well-written notes from our last conference. 41a

6. The current report is up-to-date. 41b

7. The new procedure will be outlined in a 3-or 4-page report. 41c

8. It was a Vice-Presidential decision. 41d

9. Sally gave her boss the carefully-written report. 41f

10. There will be a 10 minute delay in starting the meeting. 41a

11. There was a terrific snow storm in the Minneapolis St. Paul area. 41d

CAPITALIZATION

1. The Vice President went to National airport to greet the british ambassador and the prince of wales. 3.37

2. Congress approved the budgets for the Department of Labor, Agriculture, and Interior. 3.17

3. George Romney, the governor of Michigan, is the newly appointed secretary of Housing and Urban Development. 3.36

4. Cloyd Martin, president of George Washington University, addressed the studentbody at the opening convocation. 3.36

5. Would you xerox me a copy of the class agenda? 3.25

NUMBERS

1. When you go to the self-service store, will you buy seven bottles of glue, four boxes of pencils, and 12 boxes of paper clips? 11.4

2. We have 32 participants in the Secretarial Techniques class. 11.4

3.	The Form 37 is due by January 15th.	11.8
4.	The cost of the "Shorthand Excellence" course is $100.00.	11.8
5.	The mailing address of the organization is 405 Seventh Street, Washington, D. C. 20415.	11.11
6.	The cost of the magazine is .50¢.	11.5
7.	The July pay raise may average 8 percent for Federal employees.	11.8
8.	The meeting will be held in Room 3424 at 10:00 o'clock.	11.8

GRAMMAR LETTER

Dear Gentlemen:

Your letter asking for a recommendation for Miss Ima Ladi for a secretarial position in your firm has been referred to me. Our legal council has been impressed with Ima.

Miss Ladi is one of the secretaries who is always punctual, loyal, and dependable. If I was you, I would hire her for the position. I sure feel badly about losing her, but you will be real lucky to have her on your team.

She is not only a fast typer but is accurate handling office callers, the office sincerely relies on Miss Ladi. She is the type of person who you can depend on to meet visitors graciously. None of the other secretaries is so efficient in meeting visitors as her. The boss' secretary's appointment book is always up to date.

Transcribing from machine dictation, accuracy was especially noted. She was able to transcribe rapidly and with ease. A number of the men on the staff is going to miss her ability in correcting their grammar and to proofread materials. Each of the men who she worked for have said they need help in grammar and punctuation. It is me who will miss her mostly.

Thank you for writing Mr. Smart and I for a recommendation on Miss Ima Ladi.

PUNCTUATION, CAPITALIZATION, COMPOUNDING, AND NUMBERS

Mr. Joseph Naughton
436 East 5th Street, NW.
Bugtussle, texas 75401

Dear Mr. Naughton:

Enclosed you will find, some material that we hope will be helpful to you. You will note, that the organizational chart, is dated September 5, 1969 and that it was prepared before Dr. James Pratt accepted his new assignment as Director division of Computer Research and Technology. Therefore, you will notice that it is somewhat out-of-date. The information pertaining to the Computation and Data Processing branch is quite up-to-date; but the information on positions in the office of the director, DCRT, is not accurate since a number of the vacancies have been filled.

We are however looking for new talent to join our staff. May your secretary called and asked us to send some new-application forms to your office. She thought you might want to use them during your interview's. We have therefore enclosed one-hundred Forms SF 171, Application for Federal Employment. It may be that some of the men, women and YOC's will come in for an interview without having a completed SF 171 with them. Only eight percent of all of those people being considered for employment with Uncle Sam remember to bring an updated application.

Application time is upon us, this quarter looks like an exciting one. Please send us some good candidates from your Texas region.

Sincerely,

SPEAK IMPRESSIVELY

I. BUILD A PLEASANT VOICE

A. *Maintain proper breathing control*
B. *Speak in a low-pitched happy tone*
C. *Project your words so that you may be heard*
D. *Deliver your words at a moderate pace*
E. *Enunciate your words distincly*
F. *Pronounce your words correctly*
G. *Add variations to your sentences*

II. PRESENT A PLEASANT PICTURE

A. *Smile*
B. *Check you facial expressions*
C. *Be natural but poised*
D. *Eliminate distracting mannerisms*

III. DELIVER YOUR MESSAGE CORRECTLY

A. *Maintain eye contact with audience or person to whom you are speaking*
B. *Be enthusiastic*
C. *Talk to the audience or person*
D. *Use proper grammar*
E. *Use descriptive words*
F. *Use gestures if they will enhance the meaning*

IV. DEVELOP YOUR PRESENTATION

A. *Have a firm beginning--catch the listener's attention*
B. *Develop a logical sequency--guide the listener along*
C. *Give good examples--relate to the listener*
D. *Make a good conclusion*

TIPS FOR YOUR PRESENTATION

1. Choose your subject carefully
2. Analyze your audience
3. Prepare your presentation on 5" X 8" cards
4. Underline key words in your notes
5. Practice speaking out loud; use a mirror
6. Add natural pauses to your presentation
7. Project a positive attitude
8. Enjoy your opportunity

POLISHING YOUR SPEAKING

TONGUE TRIPPER TEST USED FOR APPLICANTS FOR TV-RADIO JOBS

I bought a batch of baking powder and baked a batch of biscuits. I bought a big basket of biscuits back to the bakery and baked a basket of big biscuits. Then I took a big basket of biscuits and the basket of big biscuits and mixed the big biscuits with the basket of biscuits that was next to the big basket and put a bunch of biscuits from the basket into a box. Then I took the box of mixed biscuits and a biscuit mixer and a biscuit basket and brought the basket of biscuits and the box of mixed biscuits and the biscuit mixer to the bakery and opened a can of sardines.

ALL THE SPEECH SOUNDS OF THE ENGLISH LANGUAGE

An old lighthouse keeper found an old map which he studied carefully and was able to decipher. From the peculiar lines and signs he was able to make it out only after a careful study. The directions were to dig four feet from the lighthouse and five feet underground for a rare chest of treasures. So with a new pick and shovel he was sure he could follow the instructions exactly. However, after several tries he dug through the earth and began lifting out the box of treasure. Suddenly he fell back as the treasure disintegrated into a thousand pieces and became nothing. That night he slept a wiser man.

WRITE FOR YOUR READER

Be sure you know what your correspondent is asking before you answer him. Study his letter carefully. If he is obscure, spare no trouble in trying to get at his meaning. If you conclude that he means something different from what he says (as he well may), address yourself to his meaning not to his words, and do not be clever at his expense.

Get into his skin and adapt the atmosphere of your letter to suit that of his. If he is troubled, be sympathetic. If he is rude, be specially courteous. If he is muddle-headed, be specially lucid. If he is pig-headed, be patient. If he is helpful, be appreciative. If he convicts you of a mistake, acknowledge it freely and even with gratitude. But never let a flavour of the patronising creep in.

-- *Sir Ernest Gowers*

FOR PEOPLE WHO MUMBLE THE FINAL "G" SOUNDS

Gleaming and streaming and steaming and beaming,
And rushing and flushing and brushing and gushing,
And flapping and rapping and clapping and slapping,
And curling and whirling and purling and twirling,
Retreating and meeting and beating and sheeting,
Delaying and straying and playing and spraying.

FOR PEOPLE WITH LAZY LIPS

Betty Botter bought a bit of butter. "But," she said, "This butter's bitter. If I put it in my batter, it will make my batter bitter. But a bit of better butter will make by batter better." So Betty Botter bought a bit of better butter and made her batter better.

FOR PEOPLE WHO CONFUSE THE "D" AND "T" SOUNDS

Rats! They bite babies in their cradles,
They take cheeses out of vats
And lick the soup from cook's old ladles;
They split open the kegs of salted sprats,
Make nests inside man's Sunday hats
And even spoil the woman's chats
By squalling and squealing
In forty different sharps and flats.

FOR PEOPLE WITH TIRED TONGUES

Theophilus Thistle, the thistle sifter, sifted a sieve of unsifted thistles. If Theophilus, the thistle sifter, sifted a sieve of unsifted thistles, where is the sieve of unsifted thistles Theophilus Thistle, the thistle sifter, sifted?

FOR PEOPLE WITH CLOSED MOUTHS

Sarah Shuster said Susie Simpson, Sam Simpson's sister, shouted she saw seven short shivering soldiers sadly standing on the shining, sandy seashore, severely shaking six sick, shy, shorn sheep sold by the sheriff for sixty cents.

SPEAKING CORRECTLY

Here Are a Few Words and Phrases To Practice for Clearer Enunciation.

PRACTICE DRILLS

For Separating Words

Say	Did It Sound Like?
1. Did you ever pay him?	Djever payim?
2. How are you today?	Howr youday?
3. Do you understand?	Dyunnerstan?
4. Won't you give me some?	Wontcha gimmesom?
5. What did you do last night?	Whadjudo last night?
6. I told you I'd go with you.	I toljuh I'd go with yuh.
7. I heard you come in.	I heardjuh come in.
8. Could you come at noon?	Couldya come at noon?
9. I wrote you last week.	I wrotecha last week.
10. Did you ever hear from Fred?	Jever hear from Fred?

For Pronouncing Syllables

	Wrong	Right
1. extraordinary	ex-tra-or'di-nar-y	ex-trawr'di-nar-y
2. mischievous	mis-chee'vee-us	mis'chi-vus
3. camera	cam'ra	cam'er-a
4. directory	dir-rec'try	di-rec'to-ry
5. every	ev'ry	ev'er-y
6. federal	fed'ral	fed-er-al
7. environment	en-vi'ern-ment	en-vi'run-ment
8. hundred	hun'derd	hun'dred
9. prerogative	per-og'ativ	pre-rog'a-tiv
10. applicable	ap-li'ka-bul	ap'li-ka-bul

SECRETARIAL TECHNIQUES

Speaking Evaluation Sheet

Directions: Competition of various kinds is a good stimulus for any of us. We do not see ourselves as others see us. This aspect of our secretarial dimensions will help others to evaluate us so we might look for areas in which we may need to improve. Score each speaker as realistically as you can with the following numerical categories:

1 = A
2 = B
3 = C
4 = D

Student Number	DELIVERY (voice, diction poise, appearance)	MESSAGE (creative, interesting well organized)	PRESENTATION (total impression of speech)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			

SECRETARIAL TECHNIQUES

Secretarial Reading Improvement

Reading Rate means number of words read per minute, commonly referred to as RR or WPM.

Reading Achievement means number of words read and understood, commonly referred to as RA.

$$\text{RR (words per minute)} = \frac{\text{Total number of words read X 60}}{\text{Total reading time in seconds}}$$

Example: (two minutes of reading time)

$$\frac{475 \text{ X } 60}{120} = \frac{2850}{120} = 238 \text{ (Reading Rate)}$$

RA = RR X Comprehension

Example:

(RR)		(75% Comprehension)		(Reading Achievement)
238	X	.75	=	179

Four questions were used in the above example (25% for each).
Ten questions are preferred in testing comprehension (10% for each).

Reading Guide:

Page Number	Half Page	Full Page
90	83	175
91	225	475
92	607	762
93	949	1037
94	1196	1346
95	1487	1636
96	1820	1959
97	2142	2293
98	2475	2610
99	2843	3001
100	3182	3263

WRITE FOR YOUR READER

Be sure you know what your correspondent is asking before you answer him. Study his letter carefully. If he is obscure, spare no trouble in trying to get at his meaning. If you conclude that he means something different from what he says (as he well may), address yourself to his meaning not to his words, and do not be clever at his expense.

Get into his skin and adapt the atmosphere of your letter to suit that of his. If he is troubled, be sympathetic. If he is rude, be specially courteous. If he is muddle-headed, be specially lucid. If he is pig-headed, be patient. If he is helpful, be appreciative. If he convicts you of a mistake, acknowledge it freely and even with gratitude. But never let a flavour of the patronising creep in.

-- *Sir Ernest Gowers*

INCOMING LETTER

Mrs. Lyndon Johnson
First lady
The White house
Washington, D. C.

Dear Mrs. Johnson,

I am in the forth grade at faulk Road school. I am studying soil Conservation and I would like some information on soil conservation. Would you please send me some information on soil conservation. Thank you.

Very Sincerely Yours,

(Signed by "Jonathan," who is working on a school project.)

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

Washington, D. C. 20250

Jonathan Fernald
10 Sorrel Drive
Surrey Park
Wilmington, Delaware 19803

Dear Jonathan:

We were happy to learn from the nice letter you wrote to Mrs. Johnson that you are studying about soil conservation in your fourth grade class at school. Soil conservation is an important subject, for most of our food and the feed for the animals that supply us with meat, milk and eggs is grown on the land. The flowers, shrubs and the trees that we enjoy because they are so pretty also grow in the soil. Birds and other wildlife depend on the soil to grow the plants that furnish them with food, shelter and homes.

If we are to have all these things, we need to use our soil carefully and take care of it properly. That is what soil conservation means. Many practices for soil conservation have been developed. We are sending you several publications that explain those practices.

After you look at these materials, you will want to discuss them with your parents and classmates and show them to your teacher. Maybe you can help use some of the soil conservation measures in your own yard or garden. Or perhaps your class can apply suitable ones on the school grounds.

We are glad Mrs. Johnson showed us your letter and we wish you every success as you study soil conservation.

Sincerely yours,

Administrator

Enclosures

REPLY

Dear Jonathan:

Mrs. Johnson asked me to thank you for your letter.

She appreciates your interest in conservation, and it was thoughtful of you to take the time to write. The enclosed magazine may be helpful to you, and we have also forwarded your letter to the Department of Agriculture with the hopes that they can provide you with additional material.

With best wishes,

Sincerely,

Bess Abell
Social Secretary

Jonathan XXXXXXXXXXX
10 Park Drive
Wilmington, Delaware 19803

cc: Department of Agriculture

PLANNING A REPLY

1. Read the letter carefully.

   a. Underline the main points.

   b. Make marginal notes.

2. Try to understand the problem. Look beyond the words.

3. What needs to be done? What should the reader do? What will we do?

4. How should the letter be organized to accomplish its purpose?

5. Consider the "WRITE" approach.

PLANNING AN ORIGINATING LETTER

1. Who is the reader?

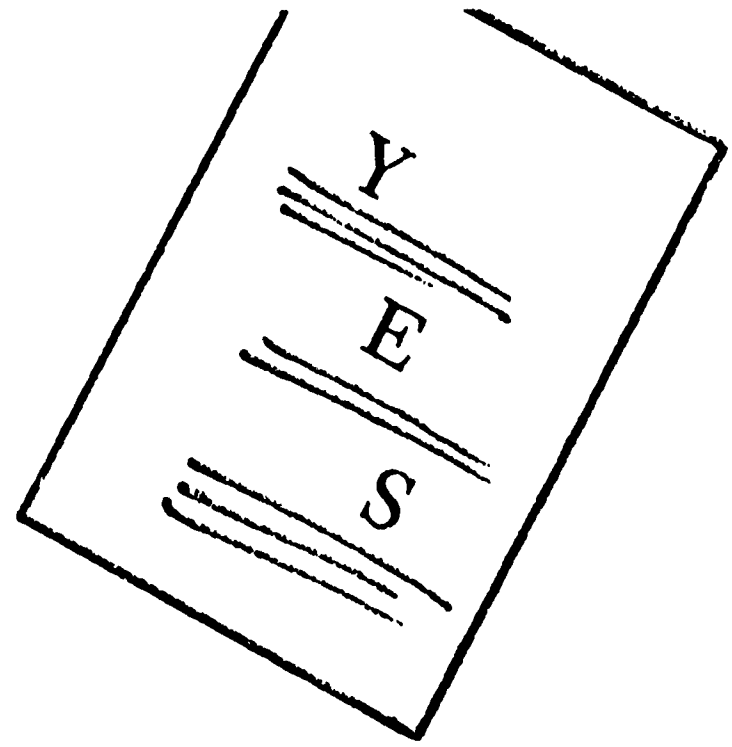
2. How will he use the information?

3. How much does he already know?

4. How will he react?

5. What should he do or know after reading your letter?

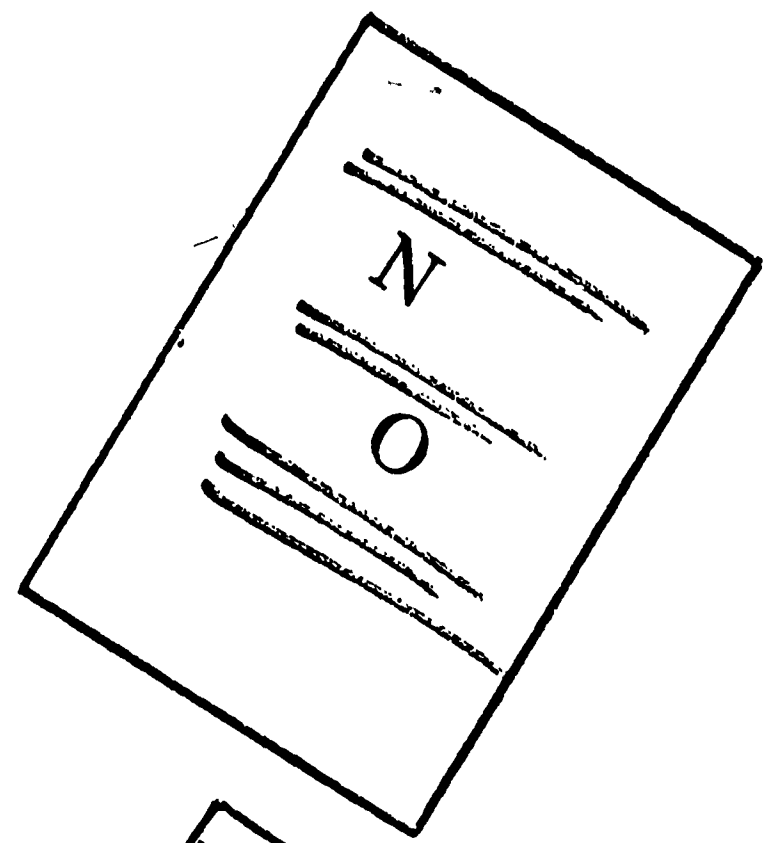
LETTER TYPES FOR BEST RESPONSE



Beginning
Big idea. What reader wants to know.

Body
Necessary details.

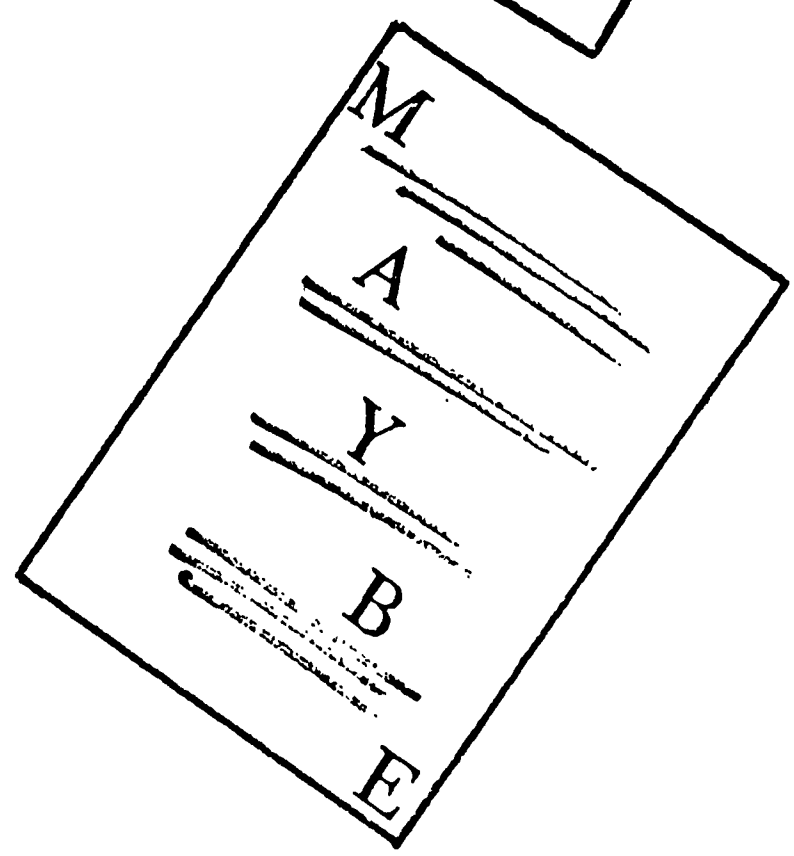
Ending
Short punchline.



Beginning
What you can do. Something on which you and reader can agree.

Body
Careful wording: tactful, fair. Natural transitions

Ending
Maintain goodwill. Pleasant, sincere



Beginning
Benefit to reader

Body
Persuasive details.

Ending
Action desired.

FOR A BETTER BEGINNING

DO

1. Plan your beginning when you plan your letter.
2. Plunge in.
3. Introduce subject or purpose.
4. Make a direct statement about subject.
5. Ask a question or make a request.
6. Focus on your reader.
7. Make beginning clear, concise, natural.
8. Set the tone of your letter.

DON T

1. Belabor the date.
2. Rehash the incoming letter.
3. Use "Reference is made to your letter . . . " or "Receipt of your letter is acknowledged"
4. Stuff the first paragraph with too much detail.

FOR AN EFFECTIVE ENDING

DO:

1. Maintain logical, connected progression to end.
2. Keep goodwill of reader.
3. Conclude letter in reader's mind.
   (a) Tell what writer will do
   (b) Tell what reader should do
4. Be specific
5. Be sincere

DON'T:

1. Use hackneyed endings.
2. Merge ending with complimentary close.
3. Use vague endings such as "as soon as possible".

IMPROVE THE TONE

WRITE A BETTER BEGINNING

1. In accordance with the authority contained in your letter of April 9, 1969, the records of this office have been amended to show your name as James Henry Smith instead of John Henry Smith.

2. It is with the deepest regret that I must decline your kind invitation to speak at the luncheon meeting of the _____ Association to be held on March 14.

3. Reference is made to your letter of April 7, 1969, enclosing the receipt for _____, which was requested by a letter from this office dated April 4, 1969.

4. In reply to your letter of August 10, please be informed that this office does not keep statistical data on the number of people in domestic employment, but it is suggested that you inquire at the Department of Labor.

5. This is in response to your letter of November 15, 1969, in which you request information in regard to the recent amendment to Title _____ of Public Law _____.

6. An examination of the catalog of this agency reveals a pamphlet on connectives entitled "Word Bridges," which appears to be the book to which you make reference in your letter of October 4, 1969.

SECRETARIAL IN-BASKET

YOUR BOSS IS OUT OF TOWN:

Mr. Richard Cannon, your boss, is out of town. He is attending a conference in New York City and will be there for two weeks. Mr Cannon has left the office in "your hands." You are to keep the office running smoothly and to take care of any correspondence that you can handle. Important letters and messages are to be forwarded to Mr. Cannon in New York City. Urgent problems can be called to the attention of Mr. Degn, who is Mr. Cannon's assistant.

Your boss, Mr. Cannon, is well liked by all. He enjoys working with people and is always open to new ideas, ways to handle problems, and new products. You have a very good working relationship with him and usually watch his calendar very carefully. You schedule his appointments and try to keep him free for his own work and yet available for people with new ideas and projects.

As you receive the attached letter, your calendar looks like this:

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	14
15	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~	21
22	23	24	25	26	27	28
29	30					

At the present time you do not have any appointments scheduled for Mr. Cannon the first week of his return (23-27). You thought he might need this time to get caught up from his trip.

PLEASE ANSWER THE ATTACHED LETTER.

Mr. Richard Cannon
XXXXXXXXXXX
XXXXXXXXX
Washington, D. C. 20415

Dear Mr. Cannon:

I will be in Washington, D. C. June 15 through June 24, 1969. Our new project, Operation Success, will be out of the printing office by June 6 and I would like the opportunity to discuss the project with you.

Since you have expressed an interest in putting Operation Success into effect in your agency, I hope that you and I can have a brief meeting while I am in Washington.

Our office is very proud of our project. We are anxious for you to give us your comments.

Sincerely yours,

James B. Smith
Director

SECRETARIAL IN-BASKET

YOUR BOSS IS OUT OF TOWN:

Your boss, Mr. Richard Cannon, is out of town for two weeks. In the morning mail, you receive this request for a booklet. This is routine correspondence. Your office distributes five free booklets. A record is kept of who receives the booklets but your boss never sees the requests unless it involves large quantities or some other special problem.

PLEASE ANSWER THE ATTACHED LETTER.

Dear Mr. Cannon:

Would you please send me a copy of the latest edition of your free booklet entitled "Your Health and Your Future." I read about this booklet in the May issue of Progress and I thought it would be interesting as well as informative.

If there is any charge for mailing, please send me the bill. You may mail the booklet to my home address which is:

Mr. Charles Jordon
12295 Waterfront Avenue
Boston, Massachusetts

I would appreciate your prompt attention.

Sincerely yours,

Charles Jordon

Charles Jordon

SECRETARIAL IN-BASKET

YOUR BOSS IS OUT OF TOWN:

Your boss, Mr. Richard Cannon, is out of town for two weeks. As you went through the morning mail, you saw a newspaper clipping showing that one of Mr. Cannon's friends was recently presented the key to the City of St. Louis.

You feel that your boss would want to send a short note of congratulations to Earl Hedlund.

PLEASE WRITE A LETTER for Mr. Cannon to sign upon his return.

Visitor's Key

DURING HIS official inspection visit to the headquarters of the Defense Contract Administration Services Region, St. Louis, Miss Judy Kuechenmeister, Miss DCASR, presented the key to the city of St. Louis to Lt. Gen. Earl C. Hedlund, director of the Defense Supply Agency.

Dear Fred:

Congratulations on being elected President of the Bibliographic Society of America. It is always gratifying for the Library and its staff when professional groups recognize achievements of staff members and honor them in such a manner. Best wishes for a successful and enjoyable term.

Sincerely yours,

John G. Lorenz
Deputy Librarian of Congress

Mr. Frederick R. Jones
Chief, Rare Book Division
The Library of Congress

Dear Micki:

Congratulations on the forthcoming event. I am sorry, however, that this means that you will be leaving the Library of Congress.

Best wishes to you and your family for the future.

Sincerely yours,

John C. Lorenz
Deputy Librarian of Congress

Mrs. Mary Jones
Information Systems Office
The Library of Congress

Dear Ed:

Congratulations on your new title and enlarged responsibilities as a result of the reorganization in the Processing Department. I feel sure we shall have improvements in communication and over-all operations with three such fine Assistant Directors. Best wishes to you.

Sincerely yours,

John G. Lorenz
Deputy Librarian of Congress

Mr. Edmond S. Smith
Assistant Director for Acquisitions
and Overseas Operations
Processing Department
The Library of Congress

Dear George:

Word has reached me that this is your last day before retirement. Allow me to join your many Library of Congress friends in extending to you best wishes for the future.

Sincerely yours,

John G. Lorenz
Deputy Librarian of Congress

Mr. George E. Jones
Binding Officer
Preservation Office
Administrative Department
The Library of Congress

SOURCES OF INFORMATION

It has been said that the next best thing to knowing everything about a given subject is knowing where to look for the information when you need it.

In the first place, you should have at your fingertips all the information to which you need to make frequent reference. This may be in the form of various publications or may be compilations of your own--in notebooks, loose-leaf binders, or files--depending on the nature of the necessary material.

Most secretaries will need only a few of the following publications at their desks for personal use, but all secreatries should be familiar with them and know where copies are available, whether on someone else's desk, in an office library, or in a public library:

1. Dictionary
2. Thesaurus, book of synonyms and antonyms
3. GPO Style Manual
4. U.S. Government Correspondence Manual
5. Grammar book
6. Agency telephone directory
7. FTS or AVTOVON Directory
8. U.S. Government Organization Manual
9. Congressional Directory
10. Telephone books, local and other, and area codes
11. Secretarial handbook
12. Shorthand directory
13. Statutes governing functions of your agency and any related agencies
14. World Almanac
15. Hotel Guide
16. City Directory
17. Zip Code Directory
18. Official Air Line Guide

The material each of you will compile for yourself will vary with the requirements of your job, the diversity of your interests, and the amount of time you can devote to collecting information. One useful information source will be your own <u>notebook collection</u>, consisting of:

Part I--Vocabulary--words which you looked up more than once for spelling, pronunciation, division, or meaning

Part II--English language rules of grammar and punctuation which meet frequent needs and about which you are usually unsure. Try to include examples to illustrate the correct usage.

Part III--Collection of handy hints--everyday hints for secretarial work, whether devised by the secretary herself or by others.

Part IV--Reflections on secretarial experience--clippings from periodicals, copies of practical or inspirational extracts from books, which appeal as strengthening or as adding to efficiency; humor...cartoons...notes from lectures and courses of study about business procedure, personal appearance, ways of improving.

Your manual may contain all of these things or few of them. The object is to fit it to your own needs and interests.

How-to-do-its and Hints

A desk manual--service book, memory book, or whatever you wish to call it--will be helpful to you from the time you start it, and practically invaluable to anyone who has to take over your job on short notice. It might include samples of forms, letters, minutes, contract reports, or any other special material which you need, and step-by-step directions for particularly detailed jobs. If kept in loose-leaf form, such a book is the logical place for the bulk of the information the secretary needs from day to day, such as:

Mail schedules--office pick-ups, building pick-ups, post office handling, and air mail closing times--as well as a schedule of rates and classes of mail.

Teletype, and telegraphic services and rates.

Any special codes used:
- Proofreaders' marks
- Soundex code if used in any files to which you may need access at odd times
- Verify code for use in clarifying spelling of names and initials over the telephone or in dictating

Office Who's Who, listing the names, titles, addresses, and telephone numbers of agency officials, and main executives of your agency, together with information about their preferences in any matters which you may need to take care of from time to time

Organization chart

Reports, forms, or charts on which you need to make entries periodically

Salary scales

Schedules for trains, buses, and planes

Special decisions on how material is to be handled, whether determinations of policy or small details like uniform capitalization and punctuation

Special address book with telephone numbers of persons outside the agency with whom employer communicates frequently

Sources of Information

Good outside sources of general information which may be available to the public include:

The business and reference sections of any public library
Your local newspapers--especially those which maintain reader's service
The local Chamber of Commerce
Government publications--Information about them can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C., or in the Monthly Catalog of U.S. Government Publications, also put out by the Government Printing Office, may be available at your library.

Then there are reference books of all sorts, and business, trade, and professional directories on everything from "A" to "Z". The enterprising secretary might do well to see what the nearest library has in the general reference area, although we are summarizing here the ones which most conceivably might be of use to secretaries in the Federal service.

Biographies: Who's Who--The Macmillan Co., N.Y.
Who's Who in America--The A.N. Marquis Co., Chicago, Illinois
Specialized "Who's Who's" on everything from Who's Who in American Art to Who's Who in the Major Leagues
Also, most dictionaries include a biographical section

Books: The United States Catalog, supplemented by The Cumulative Book Index--The H. W. Wilson Co., N.Y.
and specialized bibiographies

Cities and Towns: The U.S. Official Postal Guide. This book is particularly helpful in deciphering illegible addresses or completing fragmentary ones, as it lists every post office in the United States in various ways.

Maps and Atlases

City Directories. Although ordinarily used for looking up the names and addresses of individuals or firms, these often give local information concerning the city government, parks, churches, schools, fraternities.

Congress: Congressional Directory--Government Printing Office, Washington, D.C.
This contains biographies of the members of Congress, the cabinet and the Supreme Court; lists the members of congressional committees, executive departments, Federal courts, diplomatic and consular representatives to and from the U.S.

Directories: Directory of Directories--R. L. Polk & Co., N.Y.
Also special directories listing names of members of trade or professional associations.

Express: Official Directory of the Railway Express Company--gives the same information about express as the Postal Guide gives about post office service.

Hotels: The Official Hotel Red Book and Directory--American Hotel Association, New York, N.Y. In addition to listing the hotels, their managers, and room prices, this includes the Standard Code of American Hotel Association for use in making room reservations by telegraph, cable, or radio.
The guidebooks and hotel directories furnished by the various automobile associations, such as the American Automobile Association, are also good sources of up-to-date information.

Libraries: Find it Yourself, by E. Scripture and M. R. Greer--H. W. Wilson Co., N.Y.
Guide to the Use of Libraries, by Margaret Hutchins and others--H. W. Wilson Co., N.Y.
Instruction in the Use of Books and Libraries, by L. E. Fay and A. T. Eaton--F. W. Faxon Co., Boston
The Library Key: An Aid in Using Books and Libraries, by Zaidee Brown--H. W. Wilson Co., N.Y.

Magazine Articles: Readers' Guide to Periodical Literature--The H. W. Wilson Co., N.Y.--Indexes over 100 popular periodicals, with articles listed under name of author, title, or subject.
International Index to Periodicals--The H.W. Wilson Co., N.Y.--indexes over 240 periodicals of a scientific nature.
Magazine-Subject Index--F. W. Faxon, Co., Boston --indexes around 150 periodicals not included in the Readers' Guide, and in a sense is a continuation of Poole's Index to Periodical Literature, which was discontinued in 1906.
Special indexes, such as the Educational Index and the Industrial Arts Index, list articles from trade and technical journals.

Quotations: Bartlett, Familiar Quotations--Little, Brown & Co., Boston, Mass.
Benham, Putnam's Quotations--G. P. Putnam's Sons, N.Y.
Douglas, Forty Thousand Quotations--George Sully & Co., New York, N.Y.

Year Books: American Year Book--American Year Book Corp., New York
Information Please Almanac--Doubleday, Doran & Co., Inc., N.Y.
World Almanac and Book of Facts--World Telegram Corp., New York, N.Y.

A SET OF CATALOG CARDS

973
T349g

U. S. - History.
Thistlethwaite, Frank.
The great experiment; an introduction to the history of the American people. Cambridge Eng. University Press, 1955

335 p. illus. 22 cm.

SUBJECT CARD

NUMBER

973
T349g

The great experiment.
Thistlethwaite, Frank.
The great experiment; an introduction to the American people. Cambridge Eng. University Press, 1955.

335 p. illus. 22 cm.

TITLE CARD

973
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Thistlethwaite, Frank.
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335 p. illus. 22 cm.

1. U. S.--Hist. 1. Title

E178.T35 973 55--4496

Library of Congress 58c5

AUTHOR CARD

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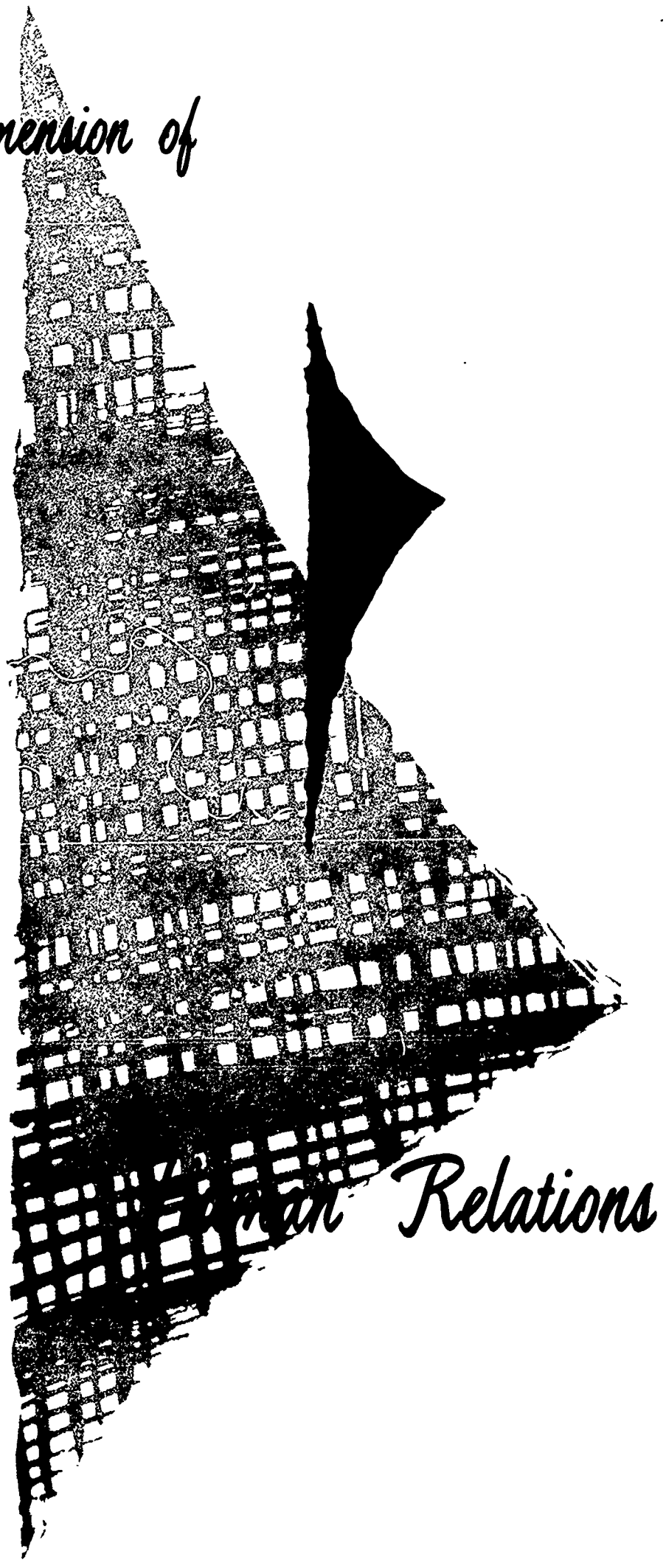


Human Relations

THE ART OF GETTING ALONG

Sooner or later a man, if he is wise, discovers that life is a mixture of good days and bad, victory and defeat, give and take.

He learns that it doesn't pay to be a sensitive soul - that he should let some things go over his head like water off a duck's back.

He learns that he who loses his temper usually loses.

He learns that all men have burnt toast for breakfast now and then, and he shouldn't take the other fellow's grouch too seriously.

He learns that carrying a chip on his shoulder is the easiest way to get into a fight.

He learns that the quickest way to become unpopular is to carry tales and gossip about others.

He learns that most people are human and that it doesn't do any harm to smile and say "good morning" even if it is raining.

He learns that most of the other fellows are as ambitious as he is, that they have brains that are as good or better, and that hard work, and not cleverness, is the secret of success.

He learns that it doesn't matter so much who gets the credit so long as the business shows a profit.

He comes to realize that the business could run along perfectly without him.

He learns to sympathize with the youngsters coming into the business because he remembers how bewildered he was when he first started out.

He learns not to worry when he does not make a hit EVERY time, because experience has shown him if he always gives his best, his average will break pretty well.

He learns that no man ever got to first base alone, and that it is only through cooperative effort that we move on to better things.

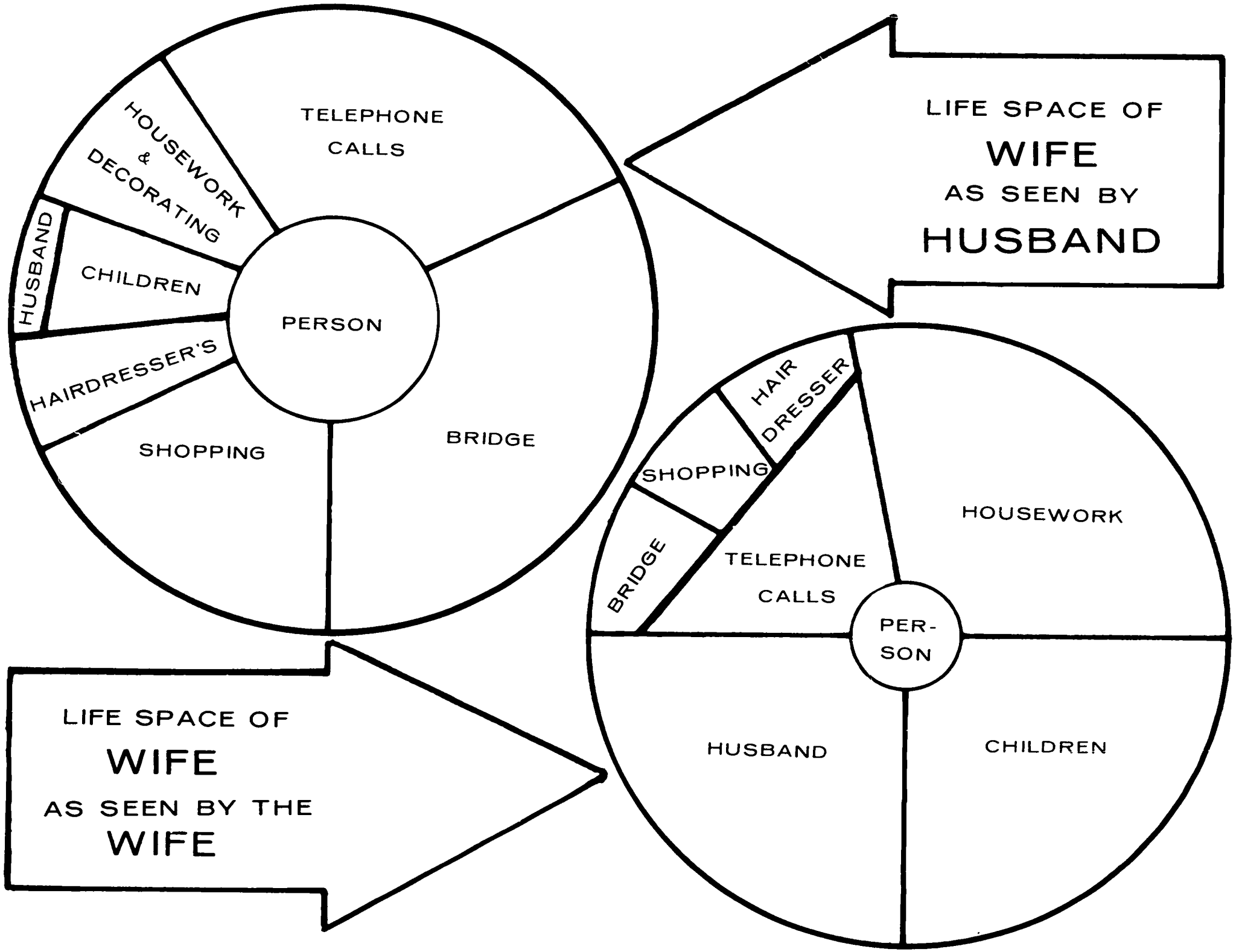
He learns that the fellows are not any harder to get along with in one place than another, and that "getting along" depends about 98 percent on himself.

--ANONYMOUS

James Stevens, a mid-level employee in our Division, continually walks into the Director's office without stopping at my desk first. He doesn't make an appointment or let me check to see if the Director really can see him at just that moment. The Director does not wish to close his door to employees, but does object to heavy traffic which absorbs most of his working day.

Mr. Stevens has been working extremely hard on a project for the Director. Word around the office has it that he works in the office until about 8 p.m. and then works at home on the project until 1 a.m. or 2 a.m. He has even asked some of us to stay and work overtime. We all have things to do at night so we have just been avoiding him lately.

As the office hostess, I just cannot allow Mr. Stevens to keep interrupting the Director with questions that he thinks are urgent at that moment. How can I handle this situation without causing friction or ill-will?


LIFE SPACE OF
WIFE
AS SEEN BY
HUSBAND
TELEPHONE CALLS
HOUSEWORK & DECORATING
HUSBAND
CHILDREN
PERSON
HAIRDRESSER'S
SHOPPING
BRIDGE
LIFE SPACE OF
WIFE
AS SEEN BY THE
WIFE
HAIR DRESSER
SHOPPING
HOUSEWORK
BRIDGE
TELEPHONE CALLS
PER-SON
HUSBAND
CHILDREN

REACTING TO FRUSTRATION

Knowing and understanding frustrations can help you avoid problems and react in a mature manner.

Direct Attack is the best way to react to a problem. The problem is there; we look at it, analyze it, try to find a solution.

Direct attack is always the BEST attack. An individual may not see it in this light. As a result mechanisms are used by all of us. What are some of the Ego Defenses?

1. RATIONALIZATION - Assigning a reason for behaving a certain way but not the real reason. (Tennis player--poor racket)

2. PROJECTION - Unconsciously blaming other people or things outside ourselves for faults or errors. (Typist blames typewriter for misspelled word.)

3. REPRESSION - Keeping impulses repressed in sub-conscious mind. One method of repression is revealed through dreams or outbursts of temper.

4. SUPRESSION - Suppressing unpleasant tasks from our minds by refusing to openly discuss what has happened.

5. FANTASY - Avoiding an issue by day dreaming.

6. SUBLIMATION - Wanting something that is forbidden or impossible; trying to achieve the need in a socially acceptable way--pounding the typewriter instead of hitting a co-worker.

7. COMPENSATION - Trying to make up for a weak area by compensating with a strong area. (A short man who is bossy and domineering)

8. FIXATION - Asking for approval on details because of immaturity.

9. REGRESSION - Feeling threatened with a new situation and not knowing how to behave.

10. IDENTIFICATION - Unconsciously making a person or thing as part of oneself. (Boss calls down a co-worker so you get mad at the boss.)

11. ILLNESS - Getting attention or sympathy by being ill. Causes are emotional and not physical.

PROBLEMS IN THE OFFICE

(1) When a secretary works for nine men and they all want their work out at the same time, what is the best method of handling the situation?

(2) Quite frequently, a secretary is responsible to more than one boss. In this case, the secretary has one boss and the boss has two assistants. The secretary is the secretary to all three. The boss at the top is a very busy person with many important projects; the one assistant is demanding and the other assistant is quiet. Both men have responsible positions. How can the secretary keep all three men happy, maintain a pleasant working relationship, and perform to the best of her ability?

(3) When your main duty is to supervise the other girls in the office, how do you handle an older woman who resents a much younger girl supervising her and telling her what mistakes she makes and how to correct them?

(4) What human relations problems might we have to face with the new Nixon Administration? What should we do as secretaries to make the transition a smooth one?

(5) The newer secretaries do not seem to take as much pride in their work as is needed. It has been brought to their attention, and they retype the materials that are not considered mailable, but they do so grudgingly. It has reached the point that I would rather stay late or come in on the week-ends than listen to the griping. How can this situation be corrected?

SUPERVISION

Whether the secretary directs a large staff or only one person, she should become familiar with the additional responsibilities and duties which supervision entails. She is responsibile as a supervisor for not only the work which she herself does, but also for getting things done through others and for the smoothness with which the staff members under her do their work. Although she may delegate authority for many tasks to others, she herself has the final responsibility for the satisfactory performance of each task.

The responsibilities which first occur to most of us when we think of supervision are (1) planning and organizing the work, (2) delegating authority and the specific tasks, and (3) following through to see that the work is being done according to plan and schedule. However, these are only a part of the general responsibilities of supervision. Some other areas of the supervisor's concern are:

1. Responsibility for getting out production
2. Responsibility for the safety, health, and physical condition of his subordinates
3. Responsibility for development of morale, or proper mental attitude, in his subordinate group
4. Responsibility for cooperation with management, fellow supervisors, and his own subordinates
5. Responsibility for training and developing his subordinates
6. Responsibility for keeping records and making reports

Although there may be no one over whom the secretary has direct supervision, still there are bound to be times when she will have to get someone else to do some work for her chief. Perhaps she will need help with a special job, or perhaps it is the practice in her office for the individual secretaries to send some of their boss' work to a central clerical pool. Here again, although someone else is doing the job, it will be the secretaries' responsibility to see that it is done properly.

Personality traits once more take a top spot in importance. No matter how much you know about how a certain job should be done, your knowledge is of almost no value to your agency if you cannot win the cooperation of the people who should logically do the work. The same personality traits discussed earlier might well be reviewed in connection with this chapter, with special emphasis on:

Fairness and reliability--willingness to take blame and not pass it off on others
Confidence and firmness--know what you need and try to have it done
Frankness, directness--say what you mean, but do so with tact
Generosity--with praise, and in helping employees to advance
Impartiality and open-mindedness
Friendliness

Good work habits are also important in supervision, not only for their part in getting the work done well, but also in setting a good example for the workers under you. The following is an outline for budgeting your time and effort, and it should provide some hints for you in your efforts to be more efficient:

1. Start the day by checking:
   a. Work to do done
   b. Available manpower
   c. Needed materials and supplies
2. Have definite inspection plan
3. Check at close of day to be ready for tomorrow
4. Allow time each day for:
   a. Training employees to handle a variety of jobs
   b. Solving problems involving personnel
   c. Inspecting work as to quality and quantity
5. Delegate routine paper work to others and thus save part of your day for creative planning
6. Keep your budget flexible enough to allow for unforeseen developments

Knowledge of the psychology of leadership will help you learn to lead rather than to drive. A helpful summary of the foundations for good supervisor-employee relations follows:

A Supervisor Gets Results Through People
Let each worker know how he is getting along
    Figure out what you expect of him
    Point out ways to improve
Give credit when due
    Look for extra or unusual performance
    Tell him while "it's hot" - while the experience is still fresh in both your minds
Tell people in advance about changes that will affect them
    Tell them WHY changes are being made
    Get them to accept the change
Make best use of each person's ability
    Look for ability and special interests which are not being used
    Never stand in a man's way

OFFICE TIPS AND SHORTCUTS

YOU ARE THE SUPERVISOR . . .

"How Would You Handle The Situation"

1. A subordinate secretary has been arriving late to work for a two week period. She is only 10 minutes late and she does her work very well. What supervisory action, if any would you take?

2. Your boss has asked you to set up a travel itinerary for his forthcoming trip to Chicago. He has asked for a rough-draft of his itinerary by the end of the day. You also have a conference tomorrow which you need to arrange and set up. The conference arrangements will take you time for the entire day. You have a clerical assistant; however, she is relatively new. What action would you take?

3. An older secretary in your office is not willing to accept new methods of handling office procedures. You are the senior secretary in authority. How would you handle this situation?

4. You have delegated work to a clerk-typist several times and explained how you want it done and how many copies you need. Each time she acts as if she understands but continues to do it the wrong way. What are you going to do?

5. You have just been assigned as supervisor in charge of a clerical pool of eight secretaries. How are you going to do your job and accomplish the work smoothly?

SECRETARIAL TECHNIQUES

I. Supervisory Tips:

A. Let your assistant know the "why's" and "wherefore's."

B. Help your assistant develop a priority list.

C. Permit her some leeway in the methods she uses.

D. Avoid the temptation to do the job yourself.

E. Point out to the boss the jobs your assistant has done particularly well.

F. Spell out the limits of a girl's authority.

G. Be specific.

H. Guard against parceling out leftovers or work you personally dislike.

I. "Time-study" your jobs.

II. What I Like About My Supervisor:

A. She controls her temper.
B. She treats me as a human being and is interested in my welfare.
C. She gives me credit for work done.
D. She permits me to use my initiative as much as possible.
E. She is sincere and objective in appraising my work and never criticizes my intentions but only my methods.
F. She has the courage to admit her errors of decision.
G. She asks my opinion on matters that affect my work and keeps me informed of policies and plans.
H. She gives difinite and clear instructions.

III. What I Dislike About My Supervisor:

A. She uses threats rather than persuasion.
B. She bawls me out before others.
C. She snoops.
D. She never talks to me about my work or interests.
E. She gives arbitrary orders without explaining reasons.

OFFICE TIPS AND SHORTCUTS

WHILE YOU WERE AWAY

L. Kay Warman would like to know if you could take the next evening staff meeting - the date would be May 14.

2. Joe Freitas called and asked if I would arrange a time for you to have lunch with Mr. Wayne Horvitz, Vice President of Matson Aviation, who is a friend of John and Lorraine Frank. Mr. Freitas says he has spoken to you about this. We have tentatively set Thursday, April 18 at 12:30. Is this all right with you?

3. The Under Secretary is calling a meeting on Wednesday, 4:30 p.m. in his office regarding Acquisition of Sec. 221 (d) (3) FHA Projects
f for Low-Rent Use. Messrs. Janice and Brownstein will be present. The background material is on your desk.

4. The meeting with Dr. Stalkfisch of IDA has been set for Thursday, April 18, at 10:15 a.m.

5. The Milwaukee newspaper group and Cong. Steiger will be in your office on Monday, April 22, 9:30 a.m. I have notified Mr. Gross.

6. There will be a reception on Wednesday, April 24, 6 p.m. for the Regional Administrators at NAHRO Headquarters. The invitation is on your desk.

7. There are tentative plans for a reception for the Mexican-American group on May 1 by the Secretary of State.

MAIL HANDLING

"The secretary is guardian of her boss' most important commodity--time." Charles R. Hook, Chairman of the Board, Armco Steel Corp.

The secretary is more responsible for the managing of time than anyone in an organization. In managing time, you must first save your boss' time as well as your own.

You can lighten the reading load of your boss as much as 80 percent. Since the mail comes across your desk, you can SKIM and SCAN the materials to determine what will be of interest to your boss, what can be routed to others, and what you can handle yourself.

Screening the mail separates the important from the unimportant. some information can be thrown away as you can determine whether it would be of interest or value to anyone in the office.

Items of interest should be marked in colored pen for your boss' attention. This can save his valuable time as he does not have to read the material in its entirety.

With the increasing amount of paperwork coming and going into offices, efficient mail handling becomes more and more important to good office management.

Let's review some of the steps you follow in handling the incoming and outgoing mail.

1. Keep up to date on the pick up and delivery schedule for your office.
2. Date stamp the mail if your office uses this procedure.
3. Check envelopes carefully for enclosures and attach to communication.

4. Sort the mail into categories appropriate to your office. i.e. correspondence, inter-office memos, newspapers and periodicals, advertisements.
5. Read the mail and mark file designation to save double reading of the material.
6. Gather and attach reference materials from files before taking the mail into your boss.
7. Log in the mail if your office follows this procedure.
8. Arrange boss' mail in order of priority to save time for him.
9. Make a notation on any correspondence in which you have handled any part of a request.
10. Sort the mail to all "in" boxes of personnel.
11. Route any mail going to other person's attention with a routing slip.
12. Optional--Use file folders for keeping the mailing sorted for each individual. It serves as a confidential folder also.

OUTGOING MAIL

1. Proofread carefully all mail BEFORE getting the person's signature.
2. Gather enclosures to be sent.
3. Check accuracy of names and addresses on envelope against the letter.
4. Use messenger envelopes and RUN STOP number where possible.
5. Use window envelopes as a time saver.
6. Always include ZIP code. ZIP code number IDS ZIP information 177-7633 or 961-7633

7. Use labels for routine mailings. Prepare labels when time allows.
8. Save Government money by using the proper size of franked envelope. A large envelope for a single sheet of paper is expensive.
9. Do not use franked envelopes for personal mailing even if you use a stamp over the frank. You are subject to a $300 fine.
10. Make notations to yourself of any follow up that is necessary.
11. Use a water-filled tube for sealing envelopes. It can save time and help you seal many envelopes at a time.

SHORTHAND TIPS

1. Keep separate notebooks for each dictator.
2. Date the dictation at the bottom of the page. If you file the notebooks, put the dates on the cover.
3. Leave the right column of the notebook blank for corrections or additions to the dictation.
4. Keep a small calendar on the back of the notebook as a ready reference.
5. Flag rush items with a colored pencil, paper clips, or by folding the bottom edge to extend beyond the side edge of the notebook.
6. Keep paper clips along the side of the cover to clip materials together.
7. Use interruptions or pauses in the dictation to fill in punctuation, spell out hard words, etc.
8. Code dictation and the materials given you for easy reference.
9. Phrase as much as possible for faster dictation speed.
10. Keep a shorthand notebook of technical, confusing or hard-to-spell words.
11. When transcribing the dictation, circle the last word of transcription if you have an interruption so you can proceed quickly.
12. When taking dictation, act interested in taking dictation. Your facial expression can affect the dictator.

SHORTHAND SPEED BUILDING TIPS

1. Read from shorthand plates regularly.

2. Take old shorthand notes. Read and write over the plates.

3. Shorthand speed records.

4. Practice your dictation by listening to radio or TV newscasts. The speed will be fast, but in time, you will be able to take more and more of the dictation.

5. Self-dictation is helpful. Dictate out loud at the fastest rate with which you can keep up.

6. Review brief forms and phrases.

7. Practice writing in shorthand from newspaper articles or from magazines.

8. If necessary, review principles from textbook.

FILING

Today's secretary may be regarded as a walking "computer." She needs to store all kinds of information in her brain. She should not be as concerned about having the memory system of a computer as she should be about quick retrival of information when the boss asks for something immediately.

Don't let your filing reach the point of no return. The system should be one that is simple and easy to understand by everyone in the office. A good filing system should be one of FINDING not simply STORING materials. Is your present filing systems giving you the maximum chance of locating materials quickly and easily? Many filing systems have been started without thought or organization. How long has it been since the system was revised? Maybe a better system chould be devised. Contact the FILES DISBURSEMENT OFFICER in your agency if you need assistance or want to make changes in your present system. This person is a filing expert.

The principle filing systems are

1. Alphabetic
2. Encyclopedic
3. Geographic
4. Numeric
5. Continuous

Some DO's and DON'T's in FILING

1. Do file often--preferably daily
2. Do file the current copy in the front of the folder in chronological order.

3. Do make file designations easy to be read. Be uniform.
4. Do keep a file index of file breakdowns in a notebook or an index file of some type. Keep up to date.
5. Do use color tabs or labels to key different types of materials. Colored tabs help to distinguish between similar groups of files.
6. Do pre-file. Designate the file categories when you read incoming mail. It saves time by not having to re-read it.
7. Do make pencil notes on materials where information may be needed in the future. Plan ahead.
8. Do allow four to five inches of work space per drawer to prevent tearing or jamming of materials.
9. Do keep files that are currently in use, close to your desk if possible.
10. Do work from side of the file cabinet to avoid fatigue.
11. Do lift each file folder partially from the file so materials are not misfiled or filed between folders.
12. Do transfer and clean file folders periodically.
13. Do keep a reminder file. A tickler file is a good memory jogger. It is a must as a good follow up. An accordian file set up in 31 days is a good solution.
14. Do develop charge-out system if files are removed from an office. Charge-out cards are necessary.
15. Do be selective in materials you file. Some items should never be filed.
16. Last but by no means least. Do OPEN ONLY ONE FILE DRAWER AT A TIME.

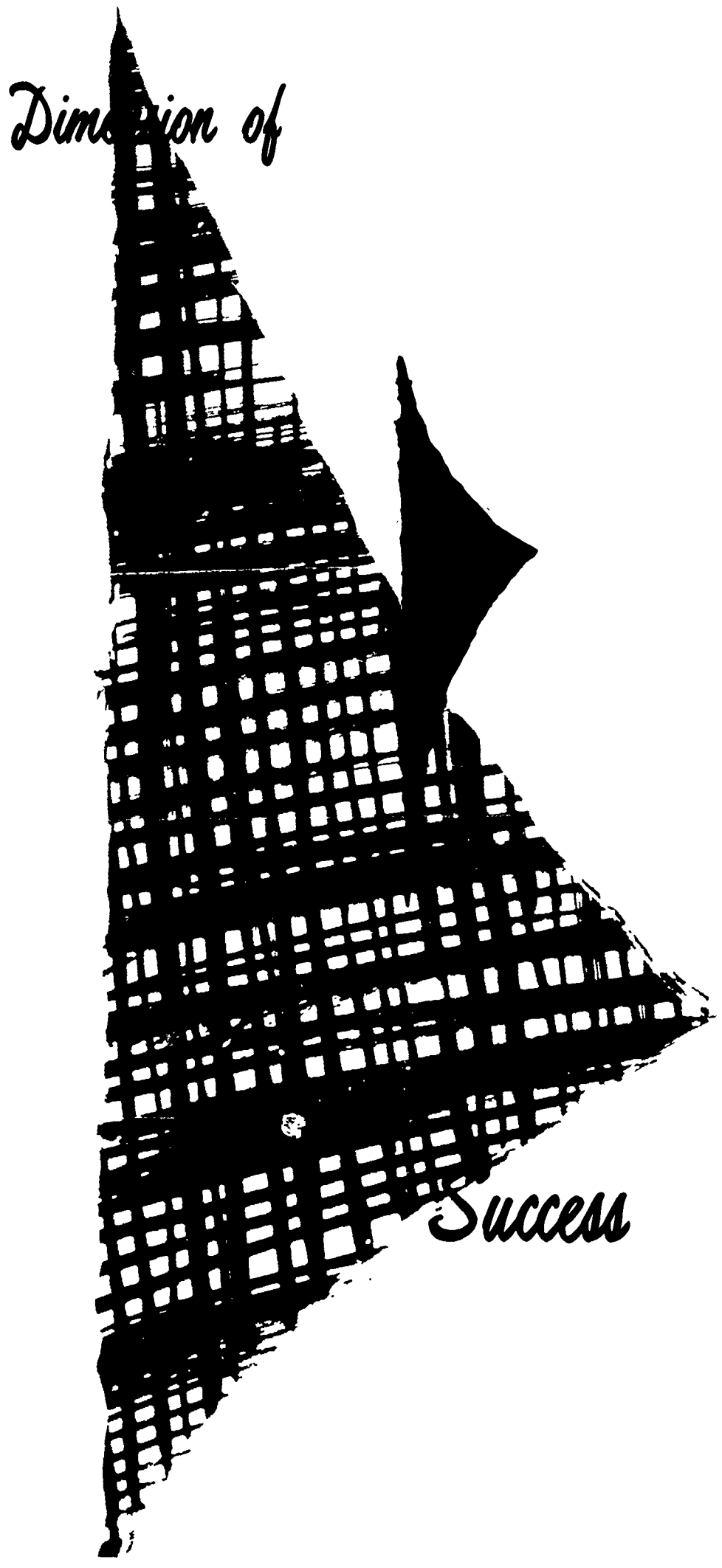
17. Do glue small items to be filed on to a standard size sheet of paper.

18. Don't use paper clips. Staple materials in the upper right hand corner.

19. Don't overload file drawers or file folders. For efficiency, no more than 75-80 letters in folders.

20. Don't let materials extend beyond the edge of folder.

21. Don't limit your system to a traditional one if you can develop a more logical one that will work better.


Dimension of
Success

THE CERTIFIED PROFESSIONAL SECRETARY

Are you a CPS? If not, have you given any thought to taking the CPS examination? The Certified Professional Secretary truly deserves the title of a very professional secretary after she has passed the very intensive two-day examination. The standards are very high, and she can feel a real sense of accomplishment when she has passed it.

If you are not familiar with this examination, let's explore it further. The National Secretaries Association developed this examination in 1951. It was their desire to set professional standards for secretaries, and the examination was prepared through the combined efforts of testing experts, business educators, management representatives, and secretaries. The examination is designed to measure secretarial development and provide a standard of proficiency. It has been NSA's desire and hope that it would give secretaries a definite goal and provide direction for their own educational programs.

The areas included in the examination are personal adjustment and human relations, business law, business administration, secretarial accounting, secretarial skills, and secretarial procedures. The test is multiple choice and objective except for the skills section which is practical.

In order to qualify for the examination, the secretary must have at least 12 months continous secretarial experience with one organization. She does not have to be a member of NSA, nor must she be presently employed.

In order to qualify she must have one of the following work-experience combinations:

1. If not a high school graduate, have 8 years of verified secretarial experience;
2. High school graduate and 7 years of verified secretarial experience;
3. One year of college and 6 years of verified secretarial experience;
4. Two years of college and 5 years of verified secretarial experience;
5. Three years of college and 4 years of verified secretarial experience;
6. Four or more years of college and 3 years of verified secretarial experience.

For the professional secretary who is interested in advancing, consider the advantages of becoming a CPS and the merits of taking the examination. In some Government agencies, the secretary who has successfully passed the examination receives a raise.

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ABSTRACT - Developed by Deere and Company, this training manual is to be used by shop trainees or experienced mechanics in understanding and servicing power trains. The chapters, arranged in a step-by-step manner, are: (1) Power Trains: How They Work, (2) Clutches, (3) Mechanical Transmissions, (4) Hydraulic Assist Transmissions, (5) Hydrostatic Drives, (6) Torque Converters, (7) Differentials, (8) Final Drives, (9) Power Take-Offs, and (10) Special Drives. The text is illustrated with photographs and line drawings. Definitions of terms and symbols and a subject index are included. A comprehensive color slide set of the illustrations in the manual may be obtained from the source of availability indicated for this document. Related documents are available as VT 010 755-VT 010 757 (all in this issue). (SB)

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FOS

Fundamentals of Service Power Trains

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JOHN DEERE

VT010754

TO THE READER

PURPOSE OF THIS MANUAL

The main purpose of this manual is to train the reader so that he can understand and service power trains with speed and skill. Starting with "how it works," we build up to "why it fails" and "what to do about it." This manual is also an excellent reference for the trained mechanic who wants to refresh his memory on power trains. It is written in a simple form using many illustrations so that it can be easily understood.

APPLICATION OF POWER TRAINS IN THIS MANUAL

"Power Trains" is a broad field. But in this manual, the prime interest is in transmissions, etc., as they are commonly used to transmit power on farm and industrial machines.

HOW TO USE THIS MANUAL

This manual can be used by anyone—experienced mechanics and shop trainees, as well as vocational students and interested laymen.

By starting with the basics, build your knowledge step by step. Chapter 1 covers the basics—"how it works;" Chapter 2 covers Clutches, while Chapters 3 through 6 explain the various Transmissions. The remaining Chapters cover Differentials, Final Drives, PTO's, and Special Drives.

Persons not familiar with basic power trains should start at Chapter 1 and study the chapters in sequence. The experienced man can find what he needs on the "Contents" page.

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We, at John Deere, are preparing a series of these manuals called "Fundamentals of Service," or "FOS."

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POWER TRAINS—How They Work / CHAPTER 1

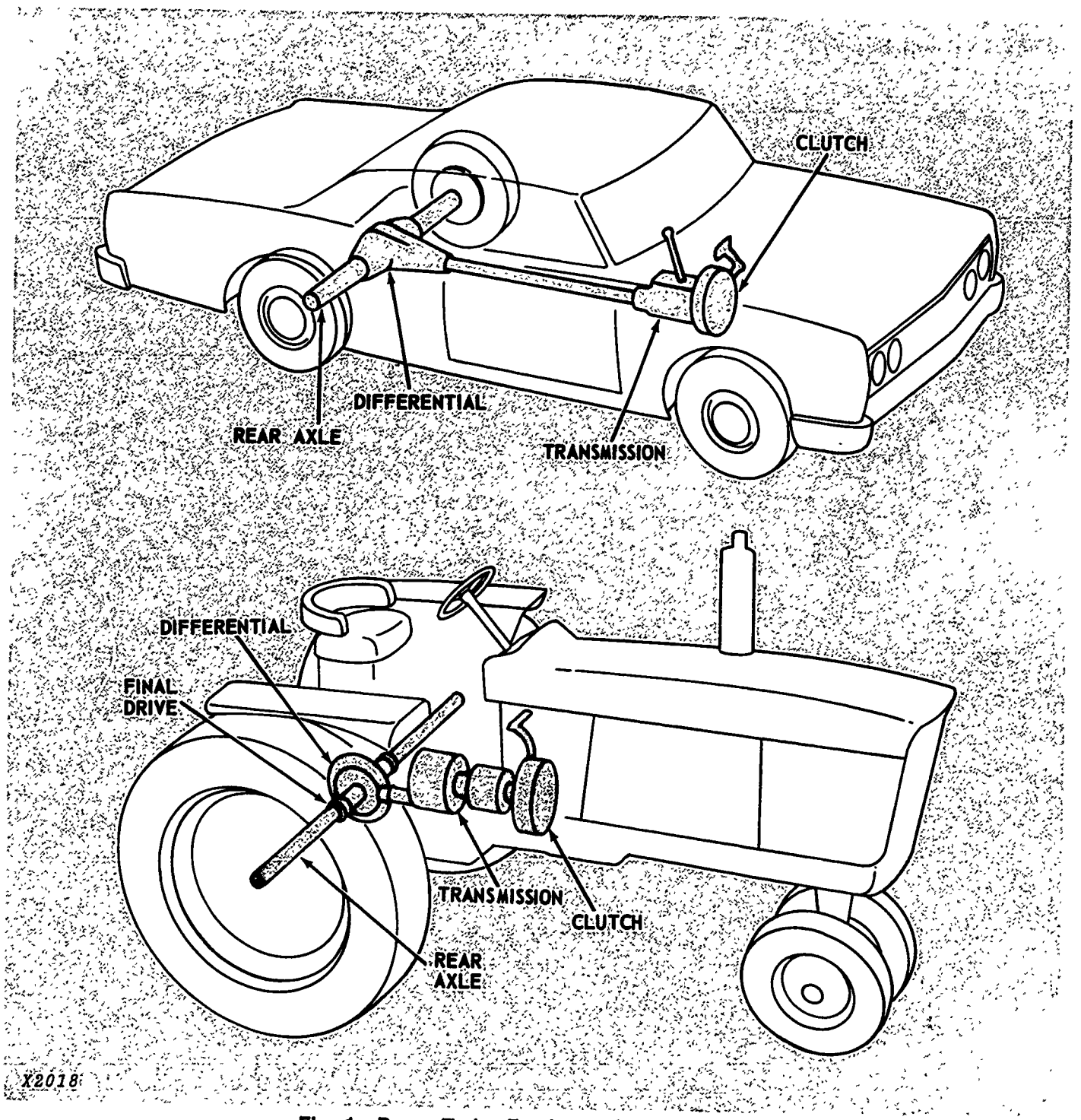

Fig. 1—Power Trains For Automobile and Tractor

INTRODUCTION

Engine power is transmitted to the drive wheels or output shaft of a machine by the **power train.** It does four basic jobs:

1) Connects and disconnects power

2) Selects speed ratios

3) Provides a means of reversing

4) Equalizes power to the drive wheels for turning

To do these jobs, three basic parts are needed:

- **Clutch—to connect and disconnect power**
- **Transmission—to select speeds and direction**
- **Differential—to equalize power for turning**

Other parts are also used to help drive the machine as we'll see later.

Now let's follow the flow of power through a simple power train.

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HOW A POWER TRAIN WORKS

The first part of a power train is the **clutch.**

Its job is to disconnect the engine from the power train, allowing the engine to run while the machine is standing still. The clutch also engages this power to start up the machine.

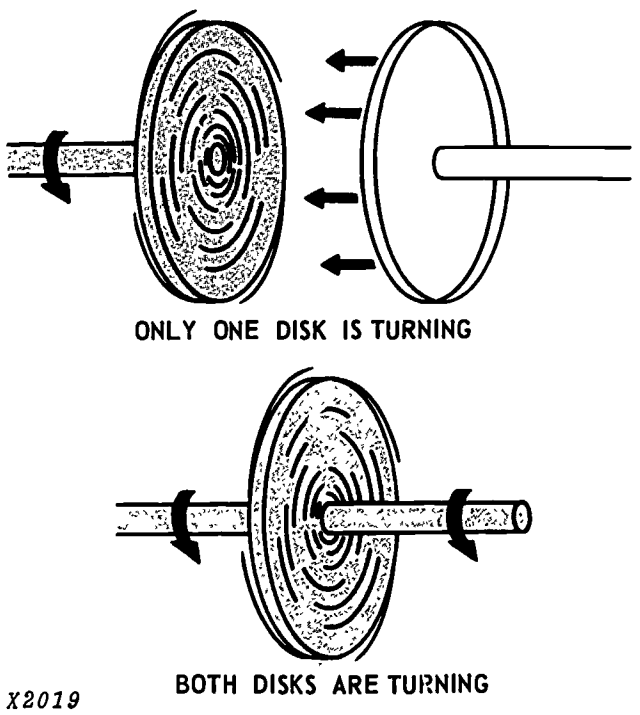

Fig. 2—How The Clutch Works

Think of a clutch as two disks, each on a shaft (Fig. 2).

As long as the disks are not touching, we can spin one as fast as we want to without affecting the other.

But if we move them together when one is spinning, the other will begin to turn and instantly both shafts will be turning as one unit.

This is the principle of the disk clutch as used on many machines.

In an actual disk clutch (Fig. 3), the disks are forced together by strong springs, and are separated by pushing down on the clutch pedal.

Some machines have automatic drives in which the clutch is eliminated. We will discuss these later.

The **transmission** allows us to change the speed of the drive wheels in relation to the engine.

This allows slower speeds when starting up the machine, and faster speeds to match various loads and conditions.

In automobiles, we need more turning force on the rear wheels to start moving than we need for cruising along a good highway. The transmission gives us this increased turning force and also allows the engine to accelerate. The latter is important because the engine does not develop very much power at low rpms. When the car has picked up speed, the transmission is shifted to change the speed ratio between the engine and the wheels, and eventually is shifted into direct drive.

In tractors and other field machines, there is an even greater speed reduction to give more turning force for traction and for pulling loads.

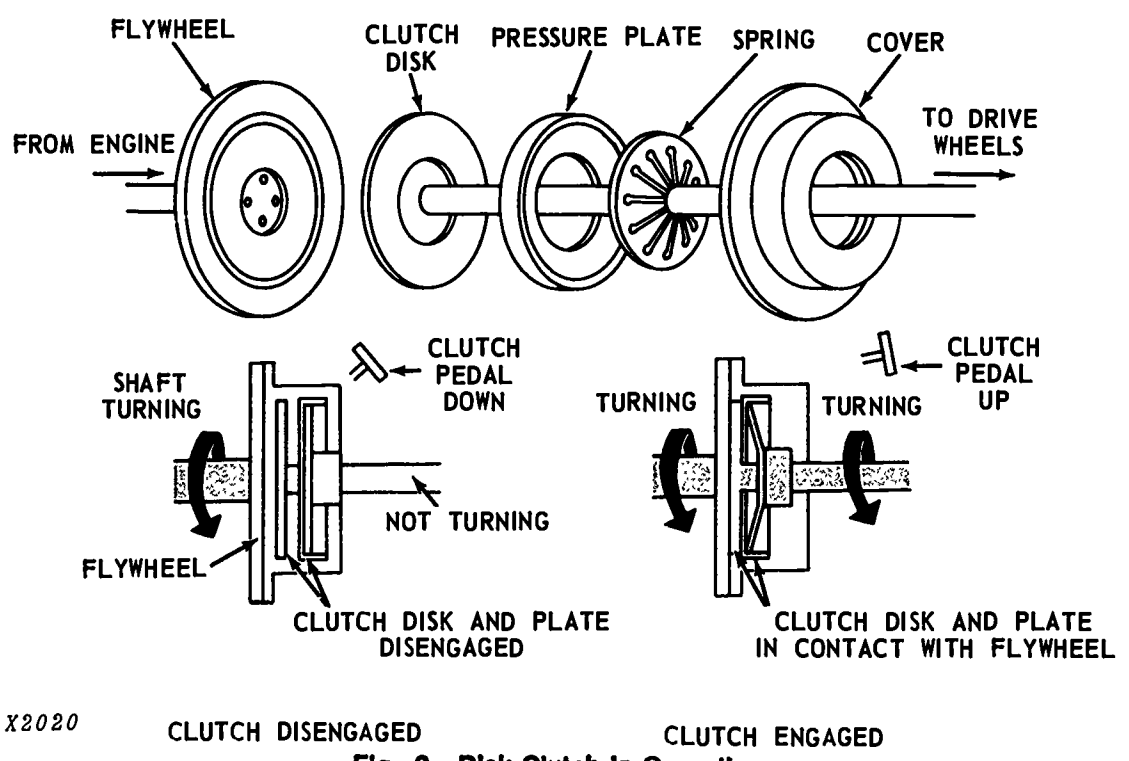

Fig. 3—Disk Clutch In Operation

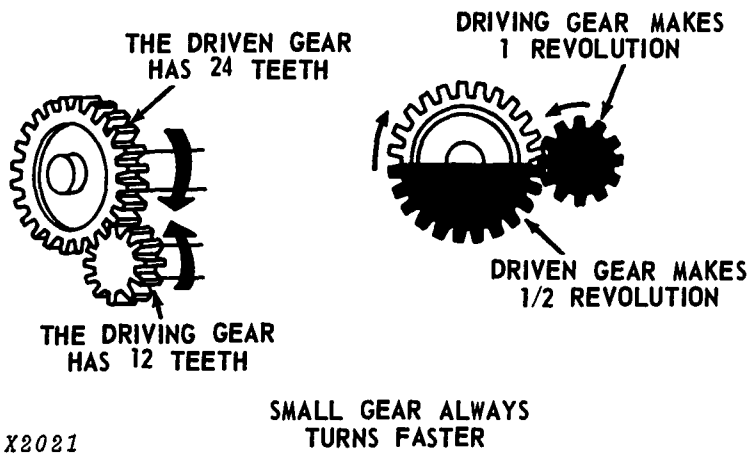

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Fig. 4—How The Transmission Selects A Speed

The transmission is a system of **gears.**

Suppose we have a small gear with 12 teeth driving a larger gear with 24 teeth (Fig. 4).

When the first gear has made one complete revolution, it has gone around the equivalent of 12 teeth. The second one has gone around the same distance—12 teeth—but this means only *one-half* a revolution for the larger gear.

As a result, the second gear and its shaft always turn at one-half the speed of the first gear and its shaft.

The point to remember is that **smaller gears always turn at a faster rate.**

This is the principle of the transmission—several combinations of gears are arranged so that we can select the speed we want to use at any moment.

For **low or first gear,** a small gear on the input shaft drives a large gear on another shaft (Fig. 5).

This reduces the speed and increases the turning force.

Then a small gear on the second shaft drives a large gear on the drive shaft which goes to the driving axle.

This reduces the speed and increases the turning still more, giving a higher gear ratio for starting up or heavy pulling.

For **second gear,** we can use the same first pair of gears as in low.

However, we disconnect the second pair of gears and drive through two other gears (Fig. 6).

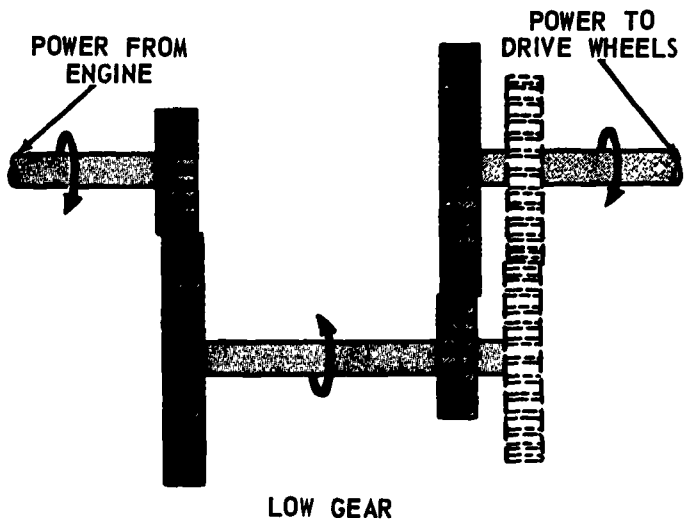

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Fig. 5—Transmission In Low or First Gear

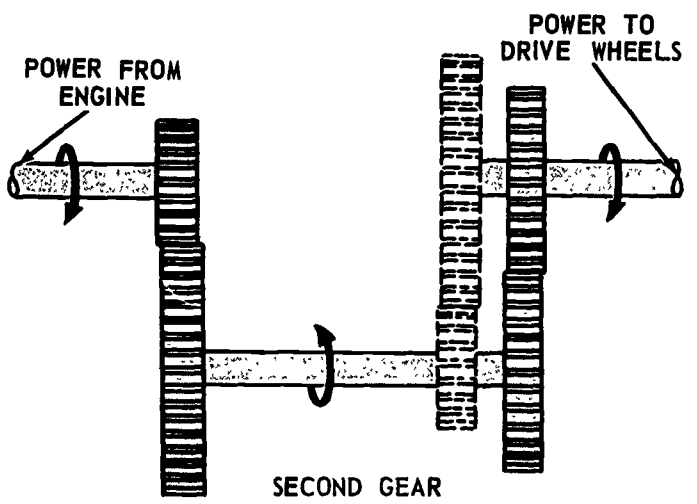

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Fig. 6—Transmission In Second Gear

These gears are arranged so that the larger one drives the smaller, so there is less overall speed reduction than in first gear.

For higher gears, the gear ratio is cut further by using other gear combinations. In fact, high gear for an automobile is normally a direct drive with no reduction (a 1 to 1 ratio).

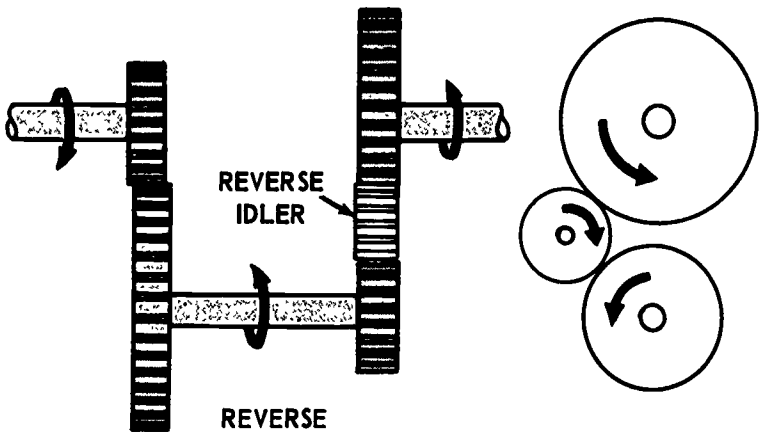

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Fig. 7—Transmission in Reverse Gear

Reverse gear is very much like first, giving about the same ratio and using the same four gears. However, it also uses an extra gear called a reverse idler (Fig. 7) which causes the drive shaft to turn in the opposite direction.

All the gears are mounted in a metal case filled with oil to lubricate the gears and bearings.

The various speeds are selected by moving a shift lever in the driver's compartment.

Other types of transmissions, covered later in this manual, are automatic drives which use hydraulic power to aid in controlling the power train.

Now let's complete the power train from the transmission to the drive wheels.

In the rear axle we have two sets of gears. The first—the **ring gear and pinion**—simply transmits the power around a corner and reduces the speed (Fig. 8).

This allows the propeller shaft to drive the axles which are at right angles to it.

If we never turned a corner, that is all the gearing we would need at the rear axle. But when we turn a corner, the outside wheel has to travel farther than the inside wheel and has to go faster.

The **differential** (Fig. 9) allows each wheel to travel at a different speed and still propel its own load.

When the machine is moving straight ahead, *both wheels are free to rotate* as shown at left.

Engine power comes in on the pinion gear and rotates the ring gear. The four bevel pinions and

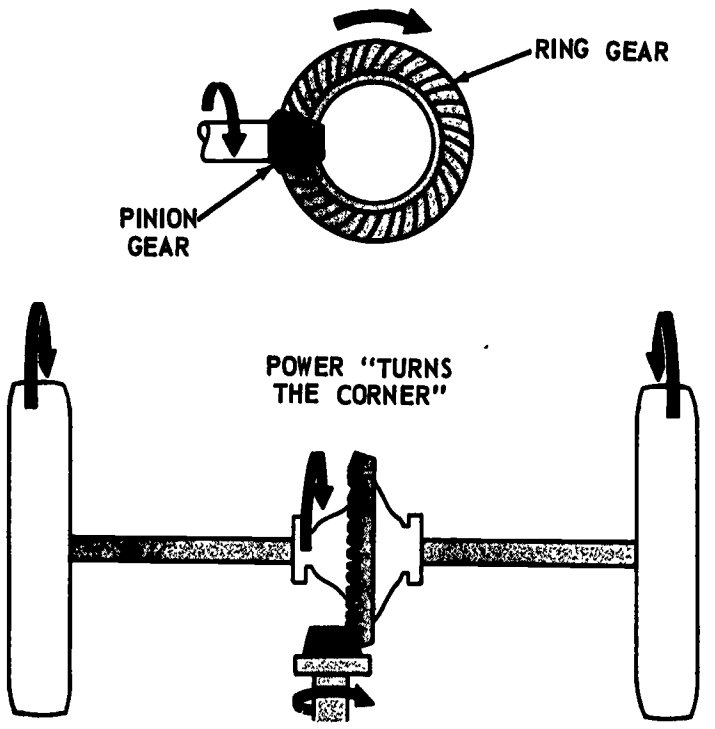

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Fig. 8—Ring Gear and Pinion For Rear Axle

the two bevel gears are carried around by the ring gear and all gears rotate as one unit. Each axle receives the same rotation and so each wheel turns at the same speed.

When the machine turns a sharp corner, only *one wheel is free to rotate* as shown at right in Fig. 9.

Again, engine power comes in on the pinion gear and rotates the ring gear, carrying the bevel pinions around with it. However, the right-hand axle is held stationary and so the bevel pinions are forced to rotate on their own axes and "walk around" the right-hand bevel gear.

Since the bevel pinions are in constant mesh with both bevel gears, the left-hand bevel gear is forced to rotate because it is subjected to the turning force of the ring gear which is transmitted through the bevel pinions.

During one revolution of the ring gear, the left-hand bevel gear makes *two* revolutions—one with the ring gear and another as the bevel pinions "walk around" the other bevel gear.

As a result, when the drive wheels have unequal resistance applied to them, the wheel with the least resistance turns more revolutions. As one wheel turns faster, the other turns slower by the same amount.

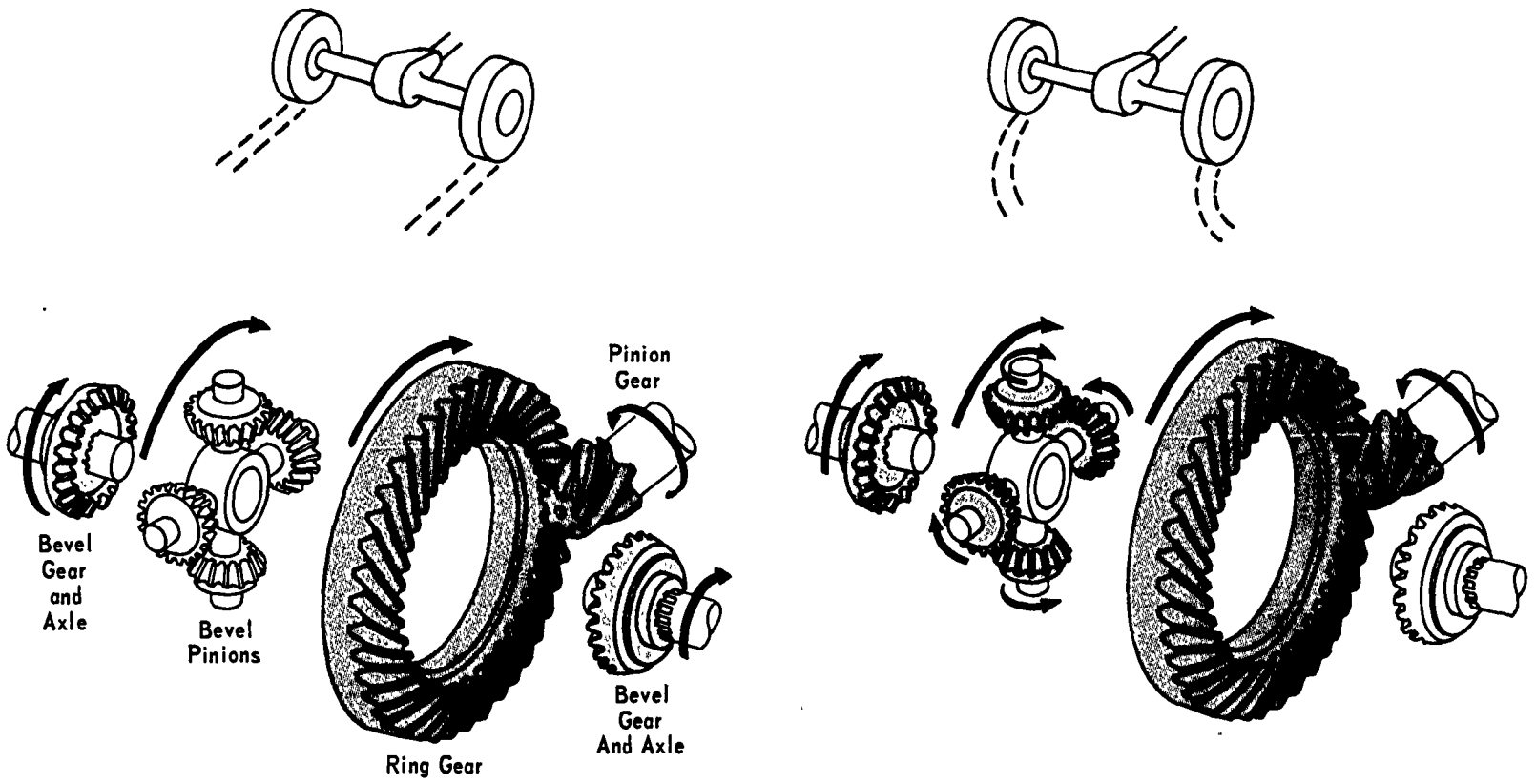


Fig. 9—Differential

Differential action can be a disadvantage when a farm tractor is plowing, for example. One wheel may lose resistance on slick ground and start spinning. To prevent a loss of power, a differential **lock** is often used to lock the two axles together until the slippery spot is passed, when they are released.

Some machines have **final drives** on the axles to further reduce speed and increase torque. They are most common on large machines which handle very big loads. Bull gears and planetary gears are the main types of gearing.

The **axles,** of course, rotate the wheels to make the machine move, which completes our basic power train.

A complete power train in a modern tractor is shown in Fig. 10. The clutch is shown at the right, the transmission in the center, and the differential at the left.

For details on actual power trains, see these chapters:

Chapter 2—Clutches

Chapters 3 and 4—Transmissions

Chapter 7—Differentials

Chapter 8—Final Drives

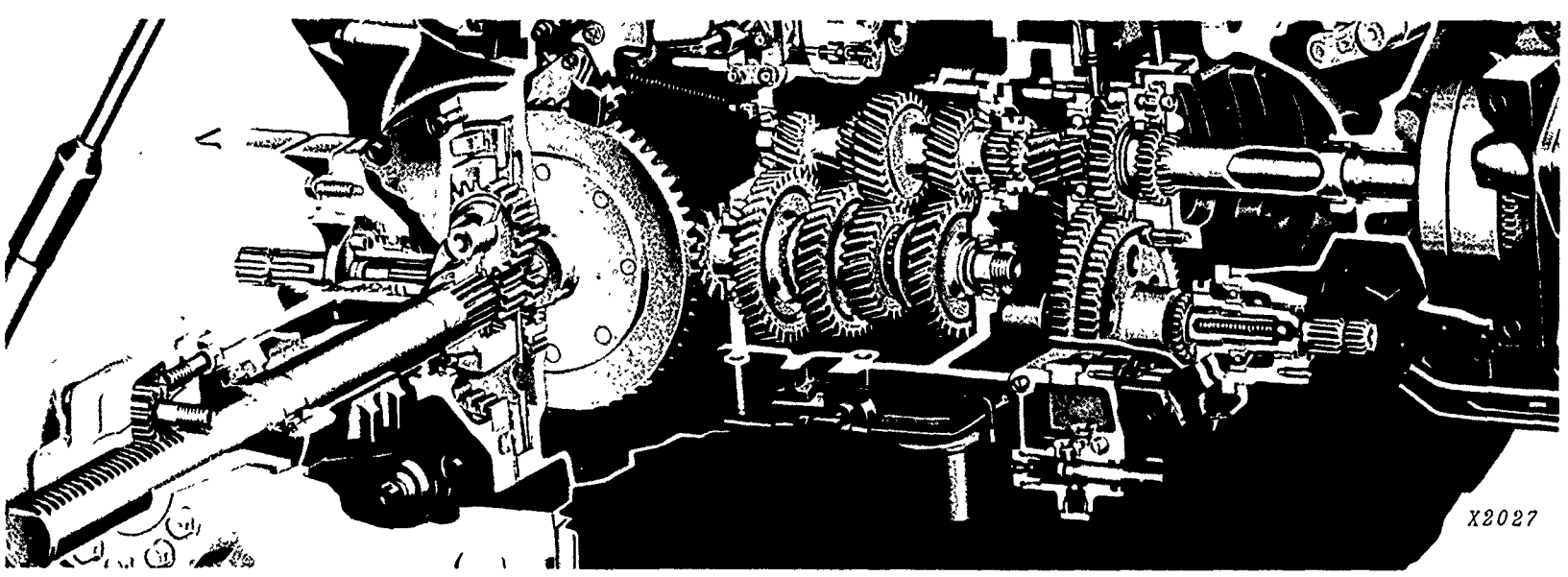


Fig. 10—Complete Power Train In Modern Tractor

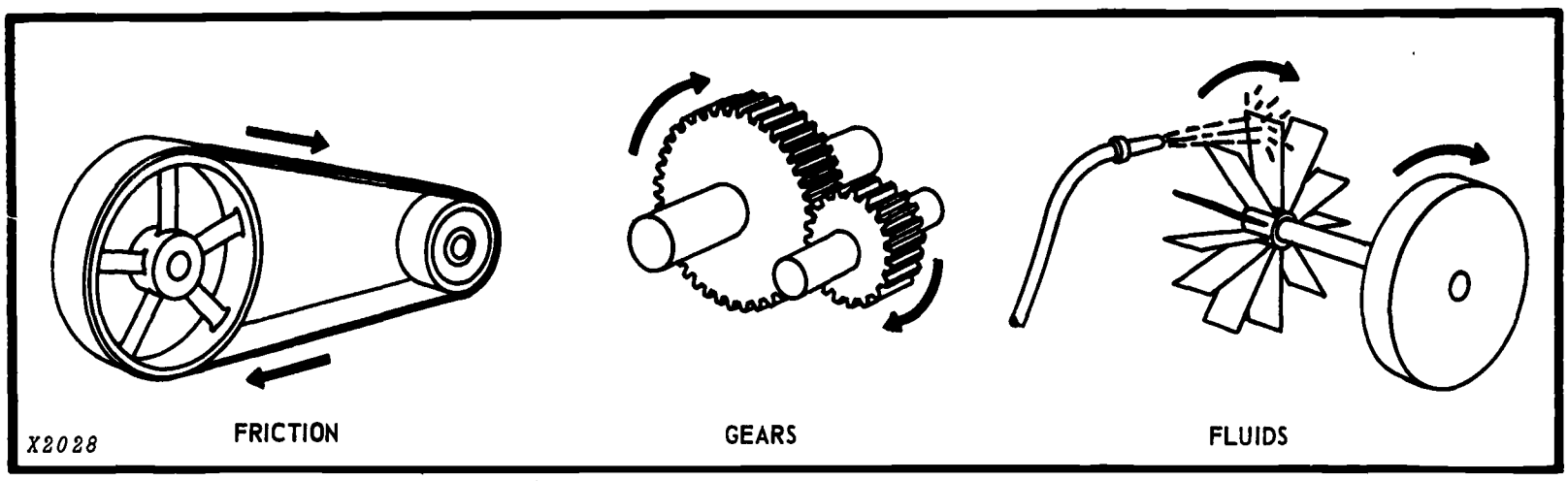


Fig. 11—Three Ways Of Transmitting Power

HOW POWER IS TRANSMITTED

We have seen how power is transmitted in a basic power train.

The clutch uses *friction* to transmit power, while the transmission uses *gears*. A third way to transmit power is by *fluids*, as in automatic drives.

So the three basic ways of transmitting power are:

- **Friction (Wheels and Belts)**
- **Gears (In Mesh)**
- **Fluids (Water Wheel Principle)**

Let's take a look at each type.

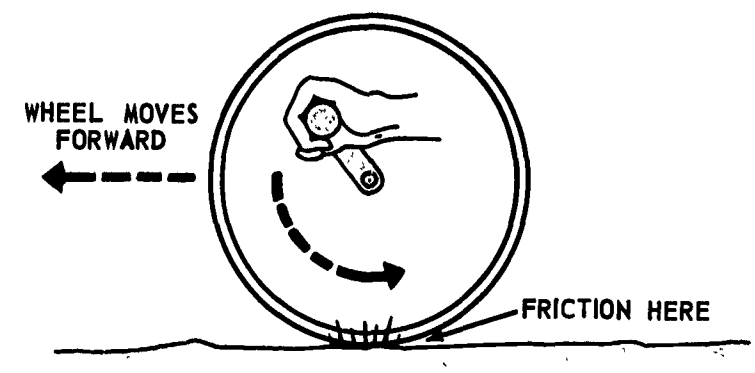
FRICTION DRIVES

Friction is caused by bringing together two surfaces made from materials that will transmit motion from one to the other. Slippage between the surfaces is a matter of engineering design. For our purposes, let's assume no slippage takes place.

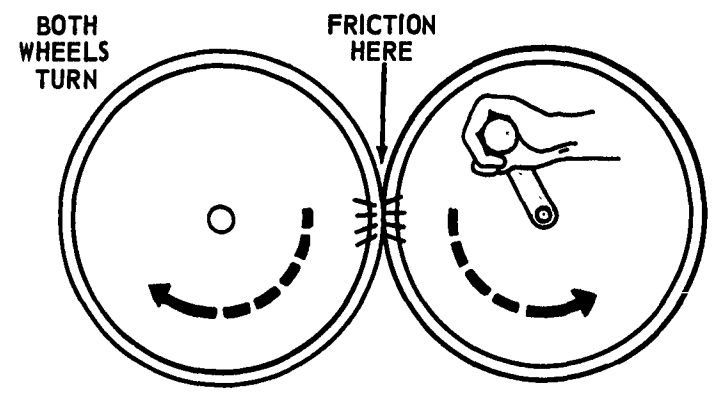
Friction devices include wheels and belts.

Wheel Friction

A simple form of useable friction is obtained by a rubber-tired wheel contacting the ground (Fig. 12, top). If you rotate the wheel by hand, you will feel the rotary force tend to move you forward. The friction between the tire and the ground is transmitting your force to the ground. Since you can't move the ground, the wheel and you must move.



FRICTION BETWEEN WHEEL AND GROUND



X2029 FRICTION BETWEEN TWO WHEELS

Fig. 12—Wheel Friction

Now suppose we suspend the first wheel above ground so it is free to rotate. Let's also suspend a second wheel in contact with the first (Fig. 12, bottom). Now if you apply a rotating force to the first wheel, the second one will rotate. Observe that the two wheels rotate in opposite directions. Thus, we can transmit power from one point to another by means of friction.

The engine clutch is a prime example of transmitting power by friction.

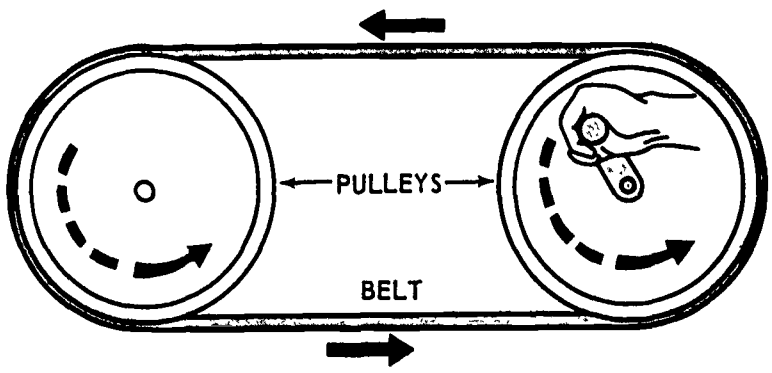


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Fig. 13—Belt Friction

Belt Friction

Another friction drive also has two wheels, called sheaves or *pulleys*. This arrangement permits the axles to be separated by some distance. The friction coupling is provided by the continuous loop of the *belt* as shown in Fig. 13.

This gives a more efficient transmission of power than two wheels because of more surface contact. When one pulley is turned, the belt transmits the power by friction to the other wheel as shown.

Belt drives are covered in detail in Chapter 10.

GEAR DRIVES

Gears are the most common way to transmit power.

When two gears are in mesh, all slippage is gone. For this reason, gears are widely used for high-power applications.

The chain drive is another variation on the gear drive. The gears (sprockets) are not in mesh but are connected by a linked chain which also eliminates slippage (see Chapter 10 for details).

Gears will be covered in detail in the next part of this chapter.

FLUID DRIVES

Fluid drives are both the oldest and most modern ways of transmitting power.

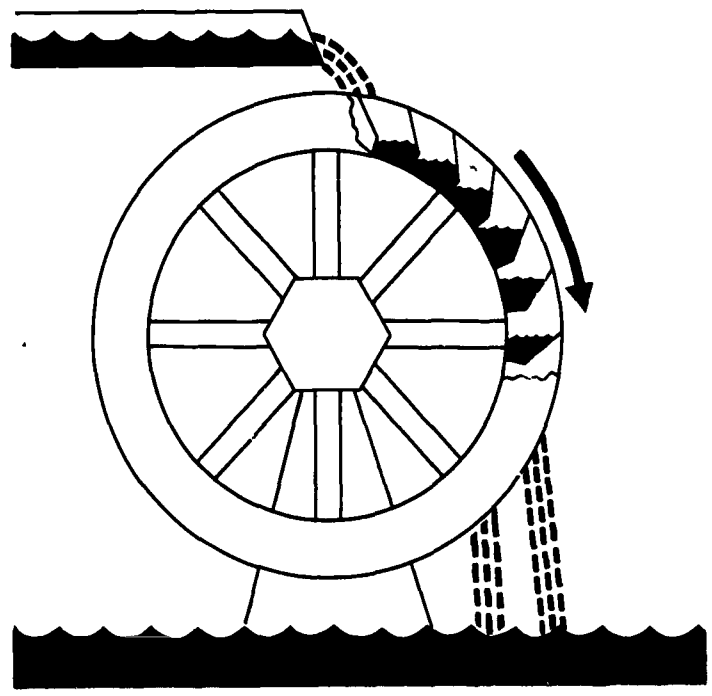

Fig. 14—Fluid Drive In Water Wheel

The old mill water wheel (Fig. 14) is turned by water falling into its buckets.

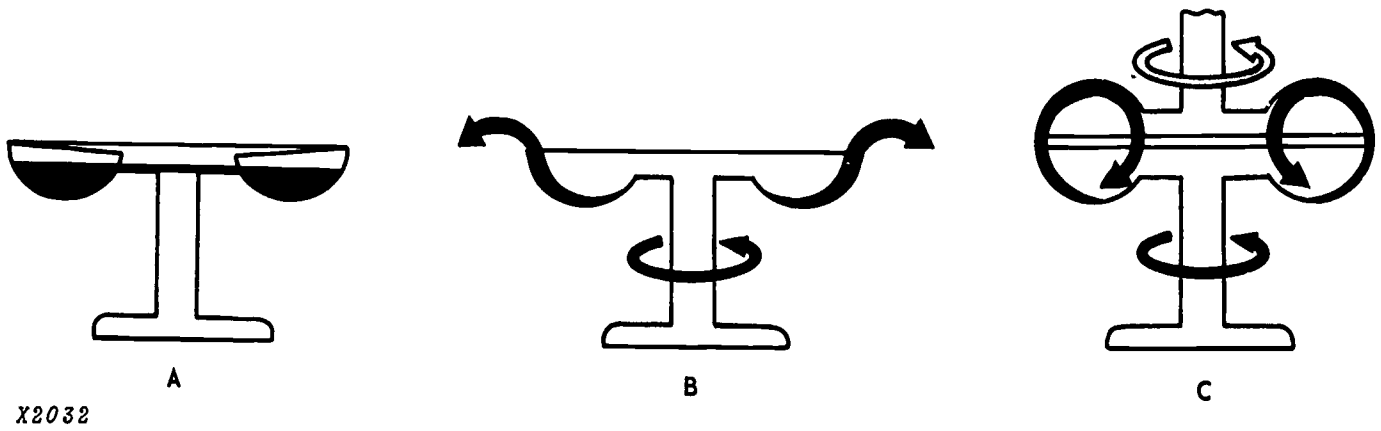

Fig. 15—Fluid Coupling Between Two Shafts

In modern automatic drives, fluid is used as a coupling for power (Fig. 15).

In A, we start with a disk which contains vanes. If we supply a fluid, the vanes fill as shown.

In B, we rotate the disk at high speed and centrifugal force causes the fluid to move out as shown.

In C, we place a second disk above and near the first disk. Fluid now flows into the second disk as shown. The force of the fluid on the second disk will cause it to rotate in the same direction as the first one, forming a fluid coupling which transmits power.

When the disks are sealed and the fluid is under pressure, a solid coupling is formed.

This is the basic principle of fluid drives such as the fluid clutch and torque converter.

In Chapter 6, we will see how these parts are modified to *increase* the torque in a torque converter.

This completes our look at the basic power transmitting devices—**friction, gears,** and **fluids.**

Because gears are so basic to power trains, let's take a detailed look at them now.

GEARS

The basic elements of almost all conventional power trains are **gears.**

Gears are simply a means of applying twisting force—or **torque**—to rotating parts.

The amount of torque you can get from a source of power is proportional to the distance from the center at which it is applied.

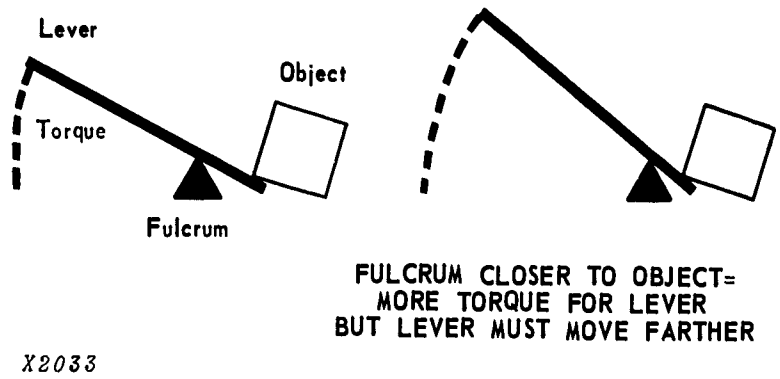

Fig. 16—How Torque Varies With Levers

In Fig. 16, the lever has more torque as the fulcrum gets closer to the object of power application (at right). But the lever must also be rotated farther to get this torque.

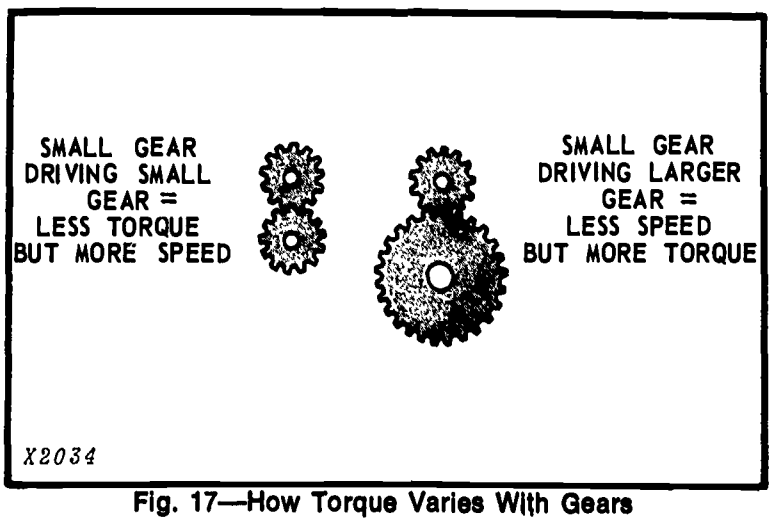

Fig. 17—How Torque Varies With Gears

The same principle is used for gears in mesh (Fig. 17).

A small gear will drive a large gear more slowly but with greater torque.

The gears in a transmission are selected to give the operator a choice of both *speed* and *torque.*

Lower gear range = less speed but more torque.

Higher gear range = less torque but more speed.

The final choice of gears is a compromise to give enough of each to suit the needs of the machine and its operator.

GEAR RATIOS

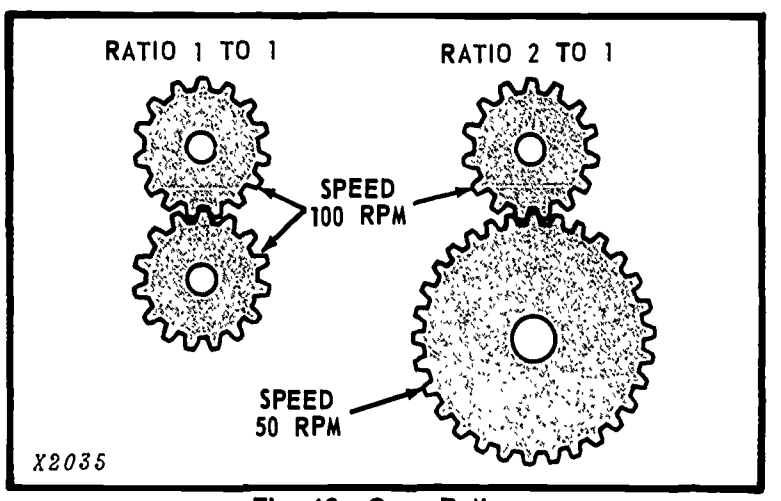

Fig. 18—Gear Ratios

Gear ratio is a measure of the changes in speed and torque in the gear train.

The gear ratio between the gears in Fig. 18 is the ratio of the number of teeth on the lower gear to the number of teeth on the upper gear.

TYPES OF GEARS

A variety of gear types are used to meet the demands of speed and torque.

Gears are normally used to **transmit torque from one shaft to another.** These shafts may operate in line, parallel, or at an angle to each other.

Meshing gears must also have teeth of the same size and design. And at least one pair of teeth must be engaged at all times. Some tooth designs allow for contact between more than one pair of teeth.

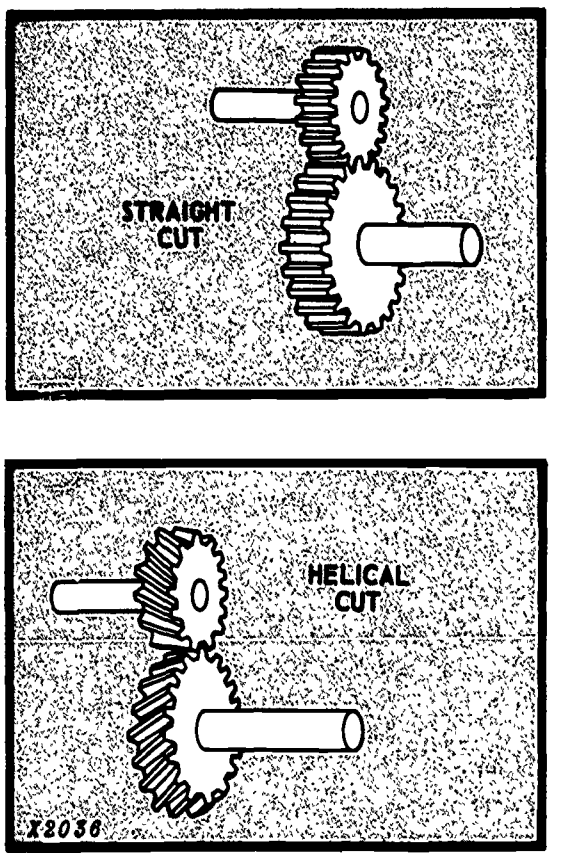

Fig. 19—Gear Teeth—Two Major Types

Gears are normally classified by:

1) Type of teeth.

2) Surface on which teeth are cut.

Fig. 19 shows the two major types of gear teeth—**straight cut** and **helical cut.**

The most common types of gears are shown in Fig. 20.

STRAIGHT SPUR GEARS — These gears have straight teeth cut parallel to the axis of rotation. Normally, mating gears have one to two pairs of teeth engaged at all times. These gears are noisier and so are used mainly for slow speeds to avoid excessive vibration.

Uses: Straight spur gears are used in simple devices such as hand or powered winches. Sliding gear transmissions also use them for speed changes because they can be easily shifted by sliding on the shaft from one gear to another.

HELICAL SPUR GEARS—The teeth of a helical spur gear are cut obliquely across the perimeter of the gear instead of straight. Engagement between two teeth starts at the tooth tip of one gear and rolls down the teeth to the trailing edge. This angular contact tends to cause side thrusts which the bearings must absorb. However, helical spur gears are quieter in operation and have greater strength and durability than straight spur gears—because the contacting teeth are longer.

Uses: Helical spur gears are widely used in machine transmissions today because they are quieter at high speeds, and are durable.

HERRINGBONE GEARS — Herringbone gears are really double helical gears with teeth angles reversed on opposite sides. This causes the thrust produced by one side to be counterbalanced by the thrust produced by the other side. The two sets of teeth are often separated at the center by a narrow gap for better alignment and to prevent oil from being trapped at the apex.

Uses: Herringbone gears are best suited for quiet, high-speed, low-thrust applications where heavy loads are applied. Large turbines and generators frequently use herringbone gears because of their durability.

PLAIN BEVEL GEARS — These gears permit the power flow to "turn a corner". The gear teeth are cut straight on a line with the shaft but at some angle between perpendicular and parallel to the shaft. The two gears are commonly called the "ring gear" (larger driven gear) and "pinion gear" (smaller driving gear).

Uses: Like the straight spur gears, the plain bevel type is used in slow-speed applications which are not subject to high impact forces. Handwheel controls which must operate some remote device at an angle use straight bevel gears.

SPIRAL BEVEL GEARS—These gears were developed for use where higher speed and strength were required while changing the angle of power flow. Their teeth are cut obliquely on the angular faces of the gears. The angle is determined by the angle between the two shafts.

Uses: Farm and industrial machines use these gears in ring gear-and-pinion sets at the drive axles. They not only change the angle of power flow, but they also reduce speed and increase force.

HYPOID GEARS — The hypoid gear resembles the spiral bevel gear but the pinion drive gear (smaller) is located below the center of the ring gear (larger). Teeth and general construction are the same as the spiral bevel gear.

Uses: The most common use for hypoid gears is in modern automobile differentials. Here they allow for lower body styles by lowering the transmission propeller shaft.

PLANETARY GEARS — These are gear sets in which an outer ring gear has internal teeth which mate with teeth on smaller planet gears. These gears in turn mate with a center or sun gear. Many changes in speed and torque are possible, depending on which parts are braked and which are driven. (Operation of planetaries is explained on page 1-12.)

Uses: Planetary gears are widely used in transmissions because each set is capable of more than one speed change. The gear load is spread over several gears, reducing stress and wear on any one gear. Final drives in heavy machinery can also use these gears.

WORM GEARS — The worm gear is actually a screw (inclined plane). It is capable of high speed reductions in a compact space. The mating gear has teeth which are curved at the tips to permit a greater contact area. Power is supplied to the worm gear, which drives the mating gear. Worm gears can also provide right-angle power flows.

Uses: The most common use for the worm gear is where the power source operates at high speed and the output is slow speed with high torque. Many steering mechanisms use a worm gear connected to the streering shaft and wheel and a partial (sector) gear connected to the steering linkage. Small power hand tools frequently use a high-speed motor with a worm gear drive.

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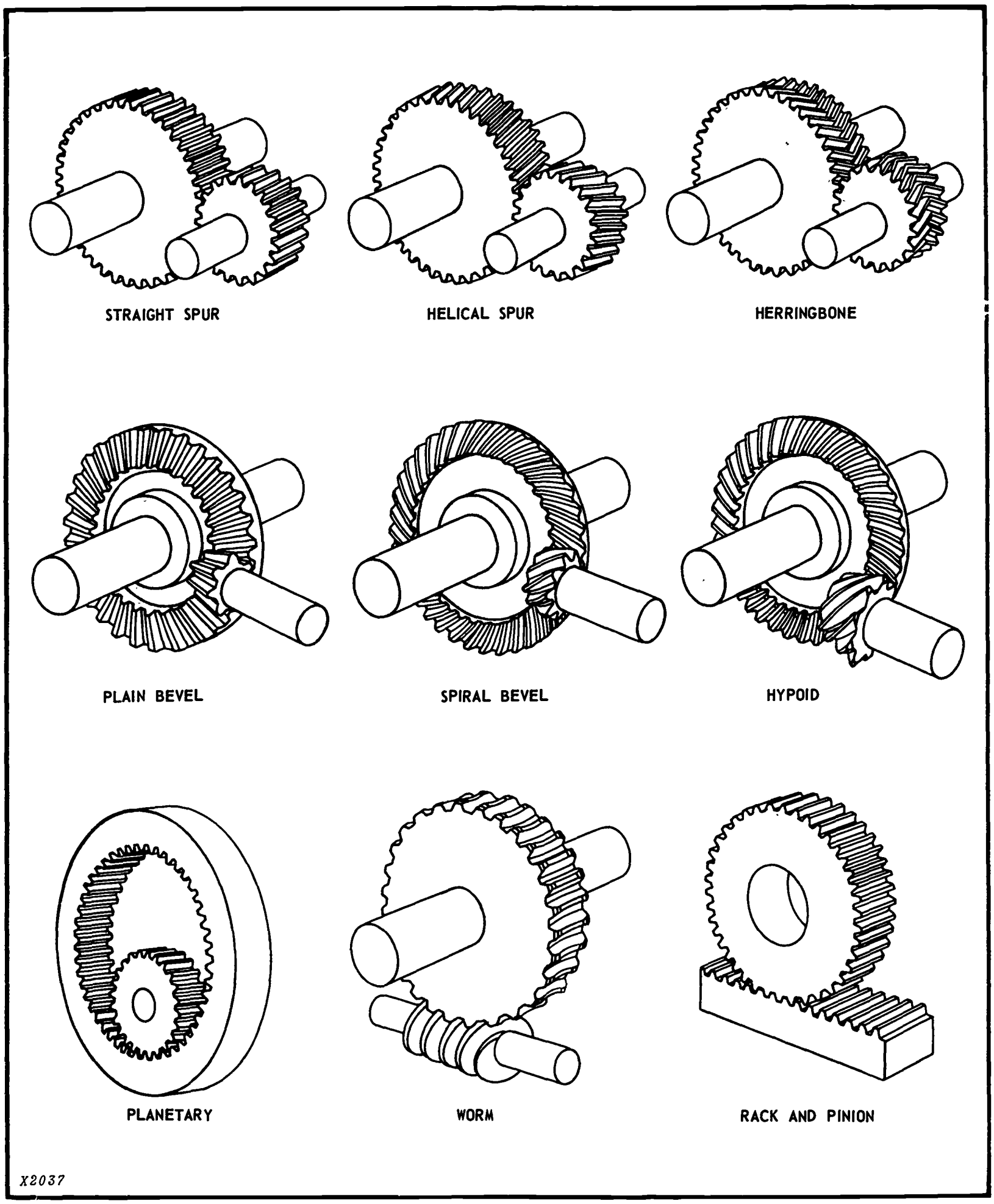

Fig. 20—Types of Gears

RACK AND PINION GEARS—This set of gears converts straight-line motion into rotary motion and vice versa. Rack and pinion gears also change the angle of power flow with some degree of speed change. The teeth on the rack are cut straight while those on the pinion are curved.

Uses: The rack and pinion can provide control of arbor presses and other devices where slow speed is involved.

PLANETARY GEARS—HOW THEY WORK

Planetary gears are simple in design, but their operation is not always well understood.

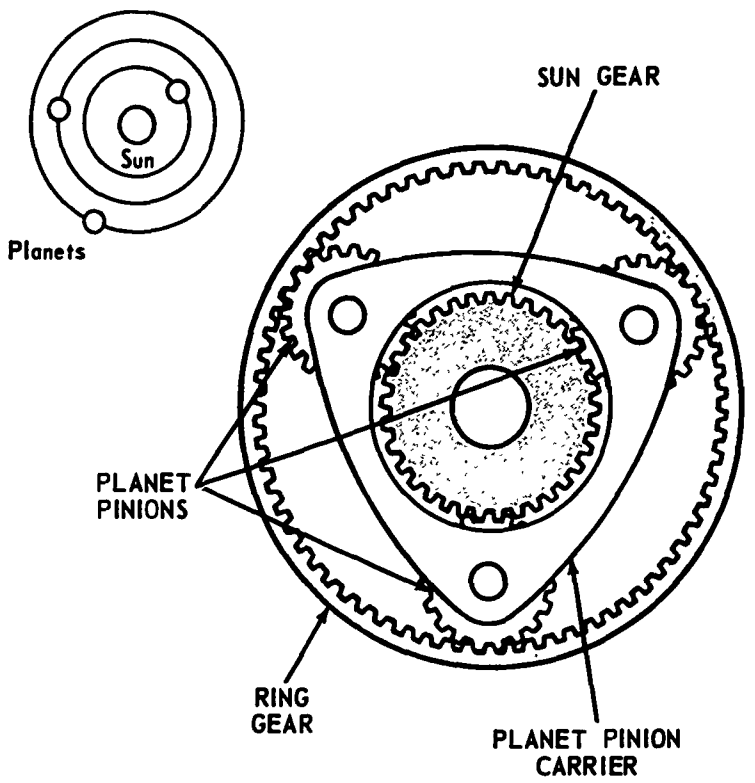

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Fig. 21—Simple Planetary System

Planetary gears are similar to our solar system (Fig. 21). The **planet pinion gears** each turn on their own axes while rotating around the **sun gear.** This is much like the earth and other planets rotating around the sun. The pinion gears in turn mesh with the inside of the **ring gear.**

Notice that the sun gear, the planet pinions, and the ring gear are constantly in mesh.

The planet pinions are mounted on shafts in the carrier, and can rotate on their own axes to "walk around" the sun gear or the ring gear.

When power is applied to drive the sun gear or the planet pinion carrier, the entire system will rotate as a unit unless a restraining force is applied to hold one of the other two members of the system stationary.

When power is applied to one member of the planetary system, and a brake is applied to restrain a second member from turning, the remaining part will become a power output source as illustrated by the following examples.

When The Sun Gear Is Driven

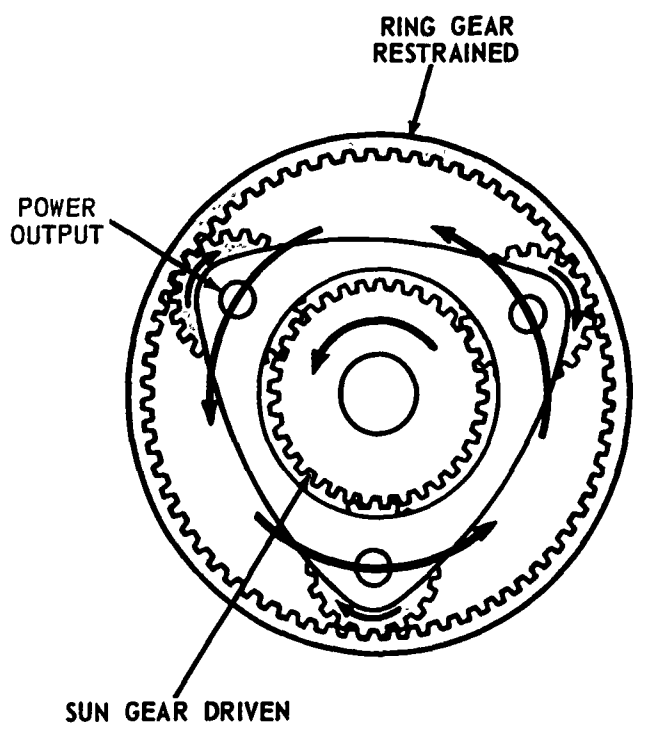

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Fig. 22—Power Flow in Planetary When Sun Gear is Driven

When the sun gear is driven (Fig. 22) and a brake is applied to the ring gear, the planet pinions "walk around" the ring gear, forcing the plant pinion carrier to rotate in the same direction as the sun gear, but at a slower speed.

When Planet Pinion Carrier Is Driven

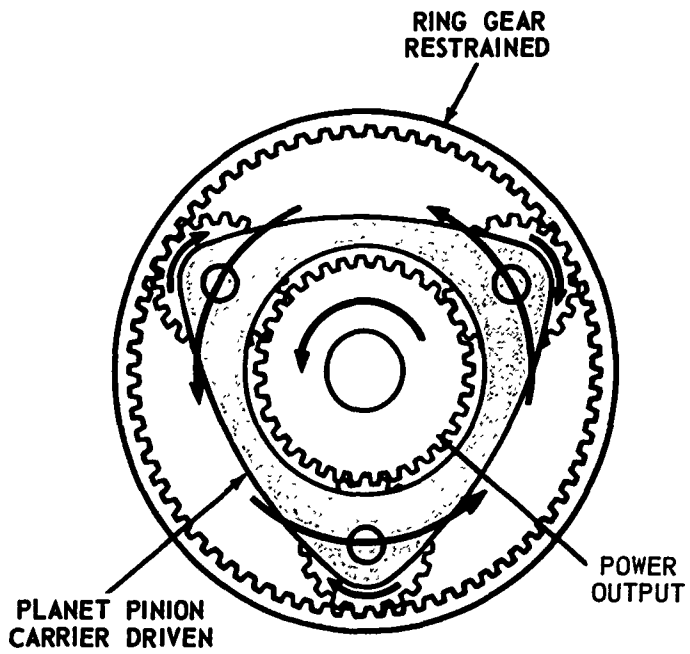

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Fig. 23—Power Flow In Planetary When Planet Pinion Carrier Is Driven

When the planet pinion carrier is driven (Fig. 23) and a brake is applied to the ring gear, the planet pinions "walk around" the ring gear, forcing the sun gear to rotate in the same direction at a higher speed.

In both cases above, one member is driven, one is braked, and the third member becomes the power output.

Depending upon which member is driven and which is braked, the planetary gives different speeds.

Double Planet Pinion Set

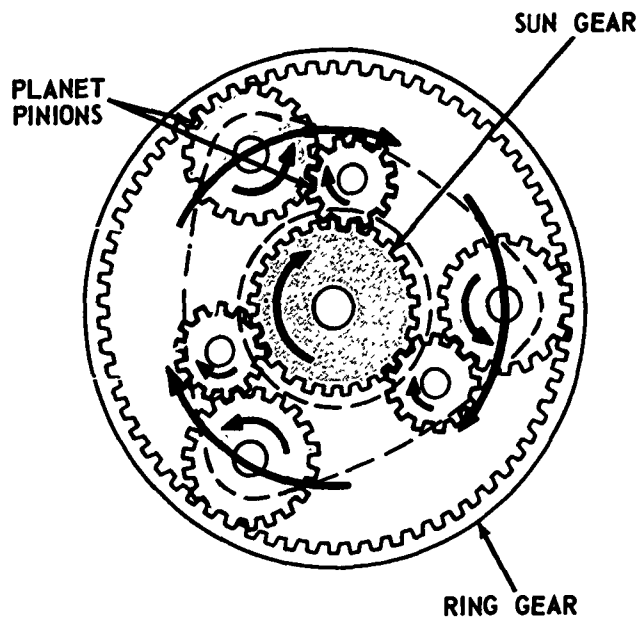

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Fig. 24—Double Planet Pinion Set Giving Reverse Speed

When a second set of planet pinions (Fig. 24) is added to the simple planetary system, so that the two sets of planet pinions are in mesh, reverse speeds can be obtained.

Now when power is applied to the planet pinion carrier and a brake is applied to the ring gear, the planet pinions in mesh with the ring gear are forced to rotate on their axes, driving the inner planet pinions which in turn force the sun gear to rotate in the reverse direction from the planet pinion carrier.

The planetary system we have described will give low, high, and reverse speed ranges.

For an example of how this works in a planetary transmission, see Chapter 4.

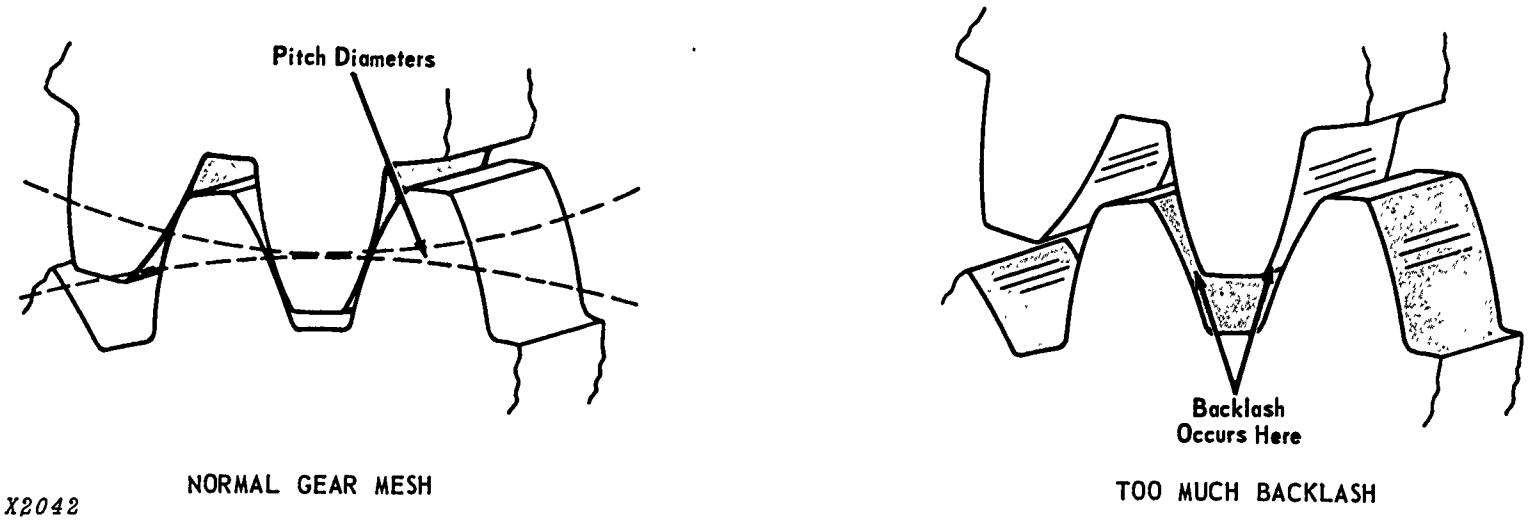

Fig. 25—Backlash in Gears

BACKLASH IN GEARS

Backlash is the clearance or "play" between two gears in mesh.

Too much backlash can be caused by worn gear teeth, an improper meshing of teeth, or bearings which do not support the gears properly.

Too much backlash can result in severe impact on the gear teeth from sudden stops or reverses of the gears.

Fig. 25 shows the normal gear mesh and gear mesh which permits too much backlash.

On the *normal gears* in Fig. 25, the clearance of the teeth at the pitch diameters is very small.

However, on the worn gears with *too much backlash,* forces cause a greater movement and a higher impact which can break the teeth or at least cause the gears to bounce.

Backlash, endplay and preload on gears and shafts is covered later in this chapter under "Adjusting The Gear Train".

GEAR WEAR

New gear teeth have slight imperfections, but they normally disappear during break-in as the teeth are oiled and polished. After that, the teeth should have a long service life.

However, when lack of lubrication or other factors cause a gear to fail, we can examine the failure and determine the cause.

The major types of gear tooth wear and failures are shown in Fig. 26.

NORMAL WEAR—This is the normal polishing of the gear teeth as they operate. The polished surface should extend the full length of the tooth from the pitch diameter to the tip of the tooth. Gears which are manufactured properly, well lubricated, and not overloaded or improperly installed will show this condition after many hours of service.

ABRASIVE WEAR—Surface injury caused by fine particles carried in the lubricant or embedded in the tooth surfaces. The causes are metal particles from gear teeth, abrasives left in the gear case, or sand and scale from castings.

SCRATCHING—This is often found on gears which handle heavy loads at slow speeds. It is caused by particles of metal flaking off the gears which are larger than the abrasive particles. Generally, it indicates the wrong gear design for the load. (Do not confuse this with scoring.)

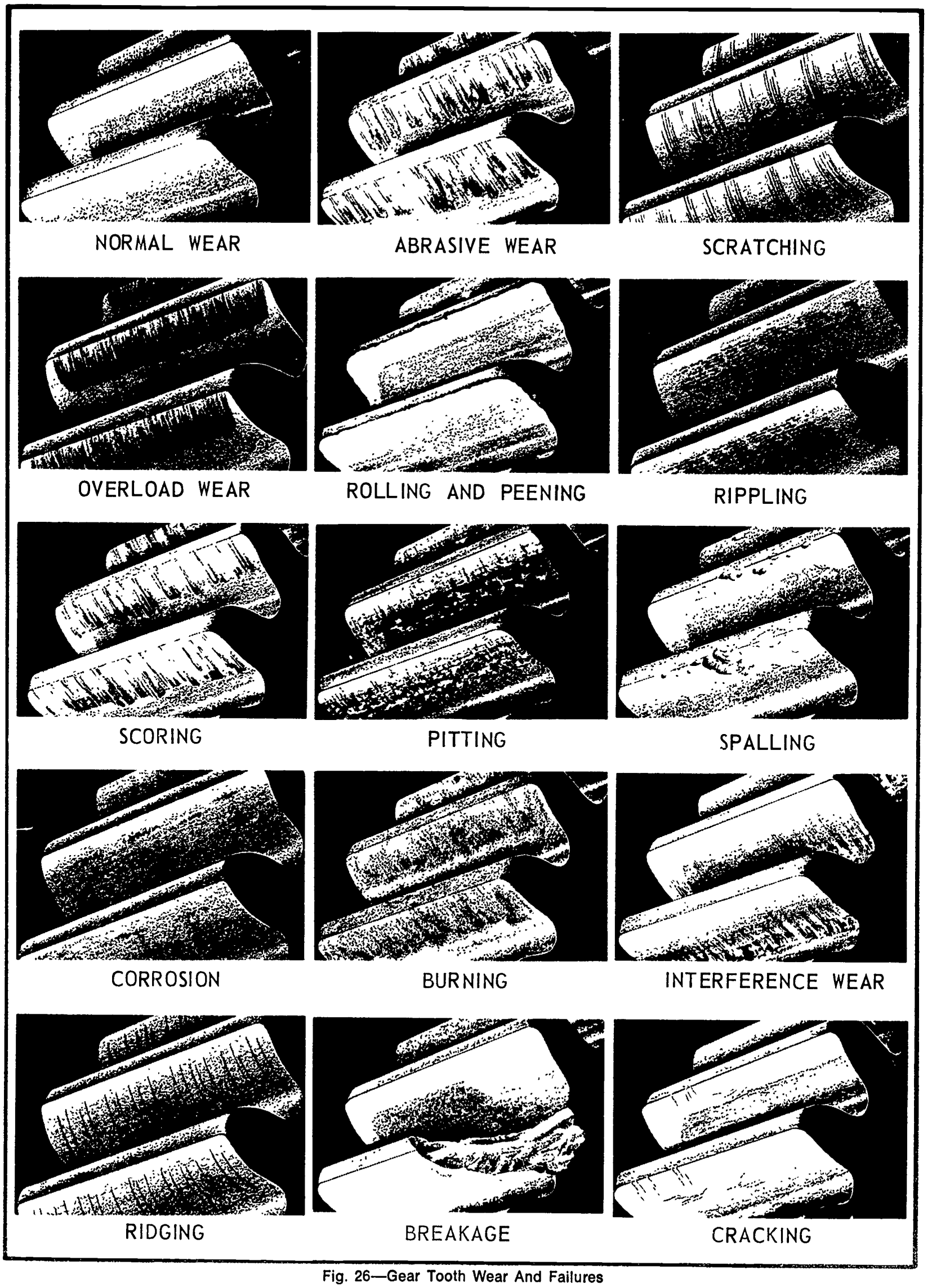

Fig. 26—Gear Tooth Wear And Failures

OVERLOAD WEAR—If the contact surface is worn but smooth, the gears have been overloaded and metal has been removed by the sliding pressure causing a depression in the length of the teeth. Continuous use will result in backlash and severe peening which may be misleading as to the real cause of the wear.

ROLLING AND PEENING—*Rolling* is the result of overload and sliding which leaves a burr on the tooth edge. Too little bearing support or too ductile a metal results in plastic flow of the metal due to sliding pressure. *Peening* is the result of backlash and the force causing a tooth to hammer on another with tremendous impact. In these cases, lubricants are forced out and metal bears directly on metal.

RIPPLING—This is a wavy surface or "fish scales" on the teeth at right angles to the direction of slide. It may be caused by surface yielding due to "slipstick" friction resulting from lack of lubrication, heavy loads, or vibrations.

SCORING—This is caused by temperature rise and thinning or rupture of the lubricant film as from too heavy loads. Pressure and sliding action heats the gear and permits metal transfer from one tooth to the face of another. As the process continues, chunks of metal loosen and gouge the teeth in the direction of the sliding motion. The temperature rise here is slow and not as high as *burning* wear (below).

PITTING—Although a new set of gears may show slight pitting, during normal operation these pits will disappear. However, if the gears are poorly made or under stress, the pitting will continue and result in chipping of the tooth surface. This condition will eventually lead to gear failure by tooth breakage or corrosive wear.

SPALLING—Spalling is a common wear condition which starts with fine surface cracks and eventually results in large flakes or chips leaving the tooth face. Case-hardened teeth are most often subject to this kind of damage due to the brittle nature of the metal. Spalling may occur on one or two teeth but the chips may cause other damage to the remaining teeth.

CORROSION—Corrosive wear results in an erosion of the tooth surfaces by acid. The acid is formed by moisture combining with lubricant impurities and atmospheric contaminants. Generally, the surfaces become pitted, causing an uneven surface and distribution of stresses which lead to chipping and spalling.

BURNING—Burning is usually caused by the complete failure of lubricants or a lack of lubrication. During high stress and sliding motion, friction develops rapid heating and the temperature limits of the metal are exceeded. Burned gear teeth are extremely brittle and easily broken.

INTERFERENCE WEAR—This type of wear can be caused by misalignment of gears which places heavy contact on small areas. Also, mating of two gears with teeth not designed to work together will cause interference wear. More than one wear pattern may show up, as at teeth tips and roots.

RIDGING—These are scratches appearing near one end of a tooth, especially on a hypoid pinion gear. This can be caused by excessive loads or lack of lubrication, or by gear not properly heat treated during manufacture.

BREAKAGE—Broken teeth may be the result of many defects. Make a close study of the other teeth before judging the cause. Breakage can be caused by high impact forces or defective manufacture. To determine if breakage is due to overload or fatigue, examine the broken area closely. If the break shows fresh metal all over the break, an impact overload was the cause. If the break shows an area in the center of fresh metal with the edges dark and old-looking, the breakage was due to fatigue which started with a fine surface crack.

CRACKING—These failures tend to be caused by improper heat treating during manufacture. Improperly machined tooth root dimensions can also result in cracking. Most heat treat cracks are extremely fine and do not show up until a gear has been used for some time.

SUMMARY: GEARS

Gears are very basic to the function of power trains. In general, excessive backlash or endplay, or improper lubrication can lead to gear failures in the system.

Always be aware of the forces which are at work when gears are operating under load.

Alignment and fit are very important to insure that each tooth absorbs its share of the load and that the gears are supported to resist thrust and twisting forces.

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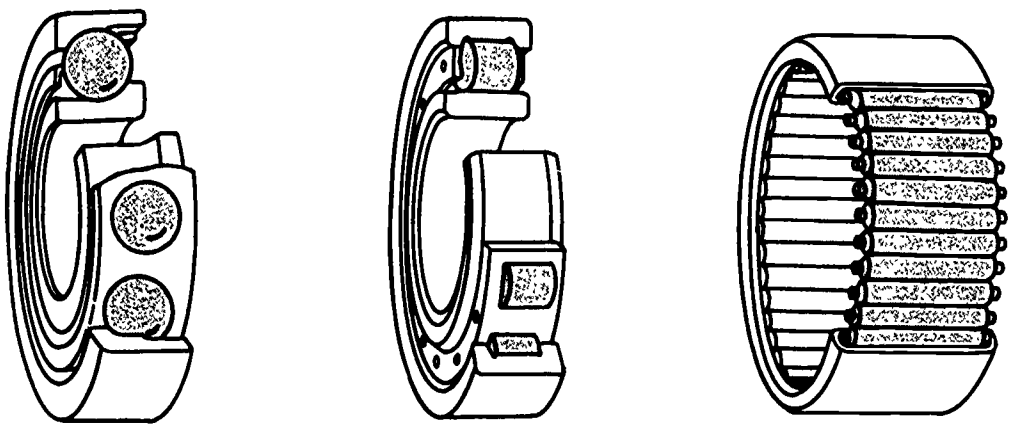

Fig. 27—Bearings—Three Types

BEARINGS

Bearings have two major jobs in a power train:

1) Reduce friction

2) Support a rotating shaft

We are mainly concerned with *anti-friction* bearings (Fig. 27). There are three main types:

- **Ball**
- **Roller**
- **Needle**

All these bearings are made of:

1) Two hardened-steel rings called races (Fig. 28).

2) Balls, rollers or needles which roll between the two races.

3) Optional separators to space the rolling elements around the bearing.

On some bearings, the outer or inner race is omitted. Then the rolling elements are in direct contact with the shaft or other mounting (as in most needle bearings).

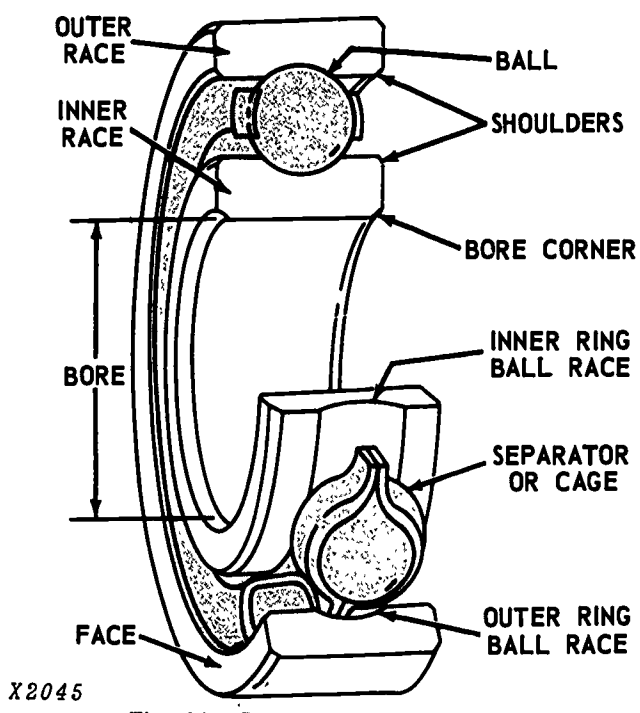

Fig. 28—Basic Parts Of A Bearing

When two races are used, one race is normally pressed or fixed on a shaft or in a bore, while the other race is free to turn with the rolling elements. This is part of the "anti-friction" feature of these bearings.

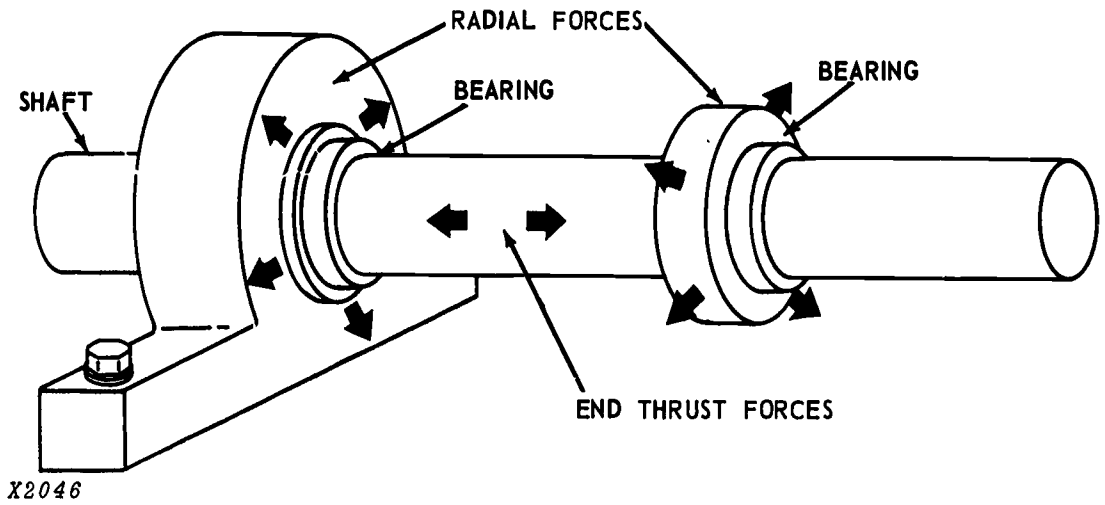

Fig. 29—Load Forces Acting on Bearings

BEARING LOADS

Bearing Loads (Fig. 29) may be of two types:

1) Radial loads—forces perpendicular to the axis of rotation.

2) Thrust loads—forces parallel to the axis of rotation.

Many bearings must be able to carry both radial and thrust loads.

Now let's look at each type of bearing in more detail.

BALL BEARINGS

Ball bearings support a shaft for radial forces as well as thrust forces (Fig. 29). The shaft must be aligned in the bearing bore or the bearing will bind and quickly wear out.

To withstand various radial and thrust forces, the ball bearing types shown in Fig. 30 are widely used. (Thrust forces on each bearing as shown with small blue arrows.) Ball bearings are also available in self-aligning types which compensate for shaft angles in relation to the bearing mount.

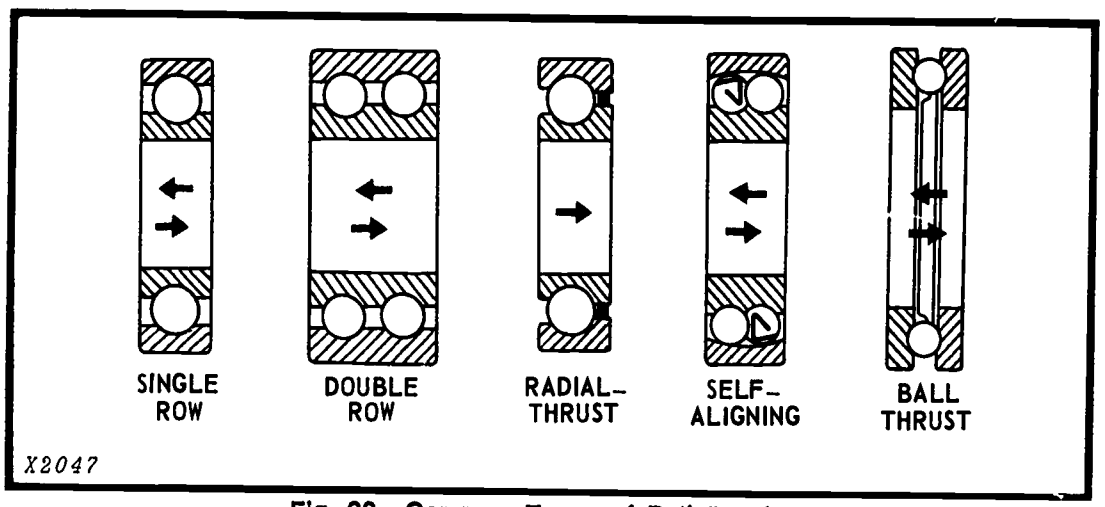

Fig. 30—Common Types of Ball Bearings

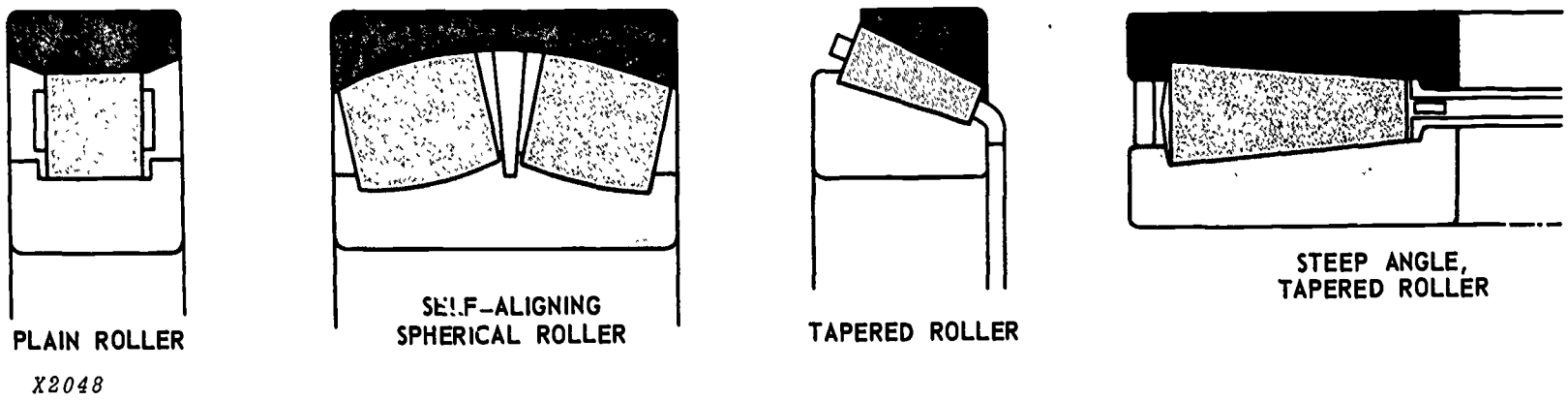

Fig. 31—Common Types of Roller Bearings

ROLLER BEARINGS

Roller bearings are basically the same as ball bearings with the balls replaced by rollers. Often the outer race can be removed without the rollers falling out. Again, the roller bearing can handle radial or thrust forces, or both.

Roller bearings can be designed to handle heavy thrust loads.

For heavy loads—both radial and thrust—*tapered* roller bearings are commonly used. A good example of this is in front wheel bearings. Tapered bearings are also used where high preloads are required on shafts or gears to support thrust.

Fig. 31 shows the common types of roller bearings.

NEEDLE BEARINGS

Needle bearings (Fig. 32) are much like roller bearings except that the rollers are thinner. Also, most needle bearings have no inner race but roll directly on the shaft. The rollers are not separated, but are tightly packed for added support of the shaft.

Needle bearings can support heavy radial loads but must not be placed under thrust loads.

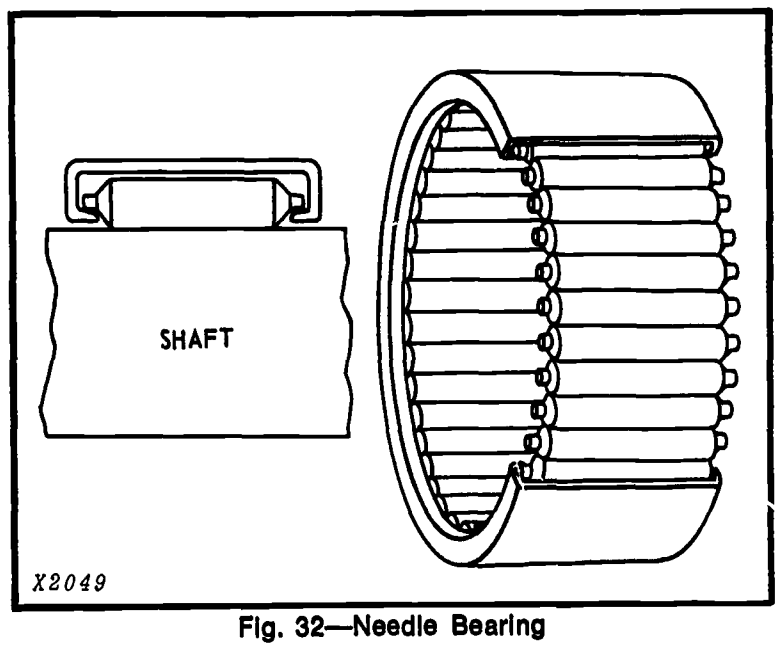

Fig. 32—Needle Bearing

Needle bearings are used in compact locations where relatively high radial loads must be supported. This bearing is frequently located inside a gear which must run free on a shaft or act as an idler. The length of the rollers and their tight packing gives the gear a good support and alignment. Planetary gears are usually supported by needle bearings.

ADJUSTING THE GEAR TRAIN

When a gear train is operated, reaction loads from gears, etc. are transmitted to the bearings and the various parts deflect.

For this reason, the gear train must normally be adjusted for the proper fit between parts.

Three kinds of adjustments are used:

- **Backlash—clearance or "play" between gears in mesh**
- **Endplay—end-to-end movement in a gear shaft due to bearing clearances**
- **Preload—a load within the bearings set up by adjustment**

Let's look at each one and then see how they all work together when adjusting an actual gear train.

BACKLASH IN GEARS

Too much **backlash** in gear trains is the result of: 1) improper mesh between gears or 2) lack of support in bearings.

The result of too much backlash can be broken gear teeth or bouncing of gears under impact forces.

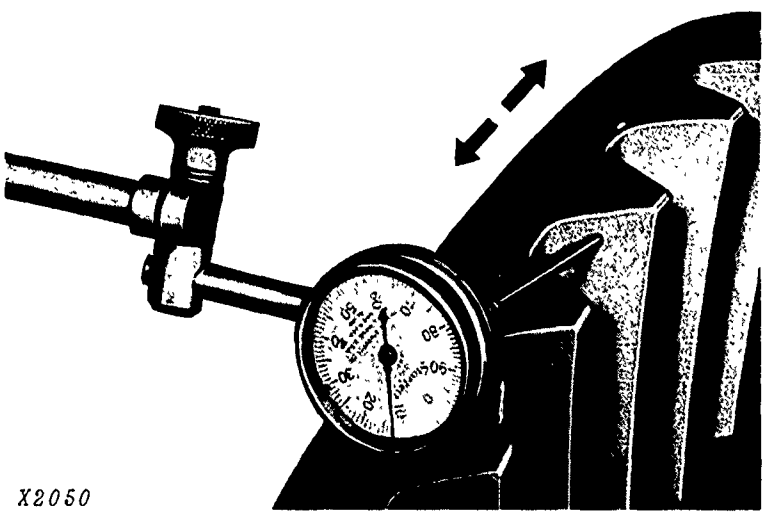

Fig. 33—Checking Backlash On Gear

Backlash is often adjusted to a specified reading on assembled gears (Fig. 33).

The dial indicator is mounted so that it registers the full rotary movement of the ring gear shown.

To adjust the backlash reading, shims are often used (see below).

ENDPLAY IN GEARS AND SHAFTS

Too much **endplay** is caused by lack of bearing support for the thrust produced by the gears rotating.

Preloading is often used to take up the slack and load the bearings (see below).

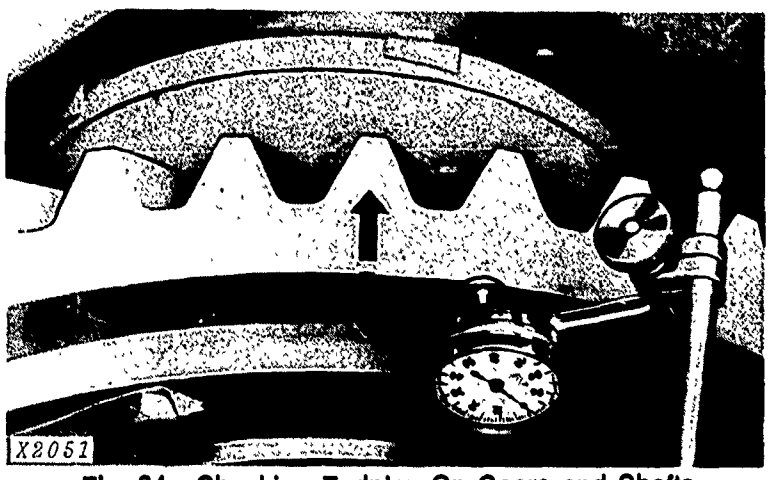

Fig. 34—Checking Endplay On Gears and Shafts

To check endplay (Fig. 34), a dial indicator is mounted against the side of a gear or the end of a shaft. The gear or shaft is then pried in both directions and the readings noted. The difference between the two readings is the endplay.

Shims or adjusting nuts are widely used to adjust endplay.

PRELOADING OF GEAR TRAINS

If the loads are heavy or the thrust too great, gear trains are often **preloaded** to reduce the deflection of parts. This preload must fit the design of the bearings and the strength of the parts.

If bearings are preloaded too tight, they will heat up and fail. If they are set too loose, the supporting parts will deflect too much, causing them to wear rapidly.

Gear trains are preloaded by shims, thrust washers, adjusting nuts, or by using double-race bearings.

Let's use all three of these adjustments—backlash, endplay, and preload—in adjusting an actual gear train.

EXAMPLE: ADJUSTING RING GEAR AND PINION

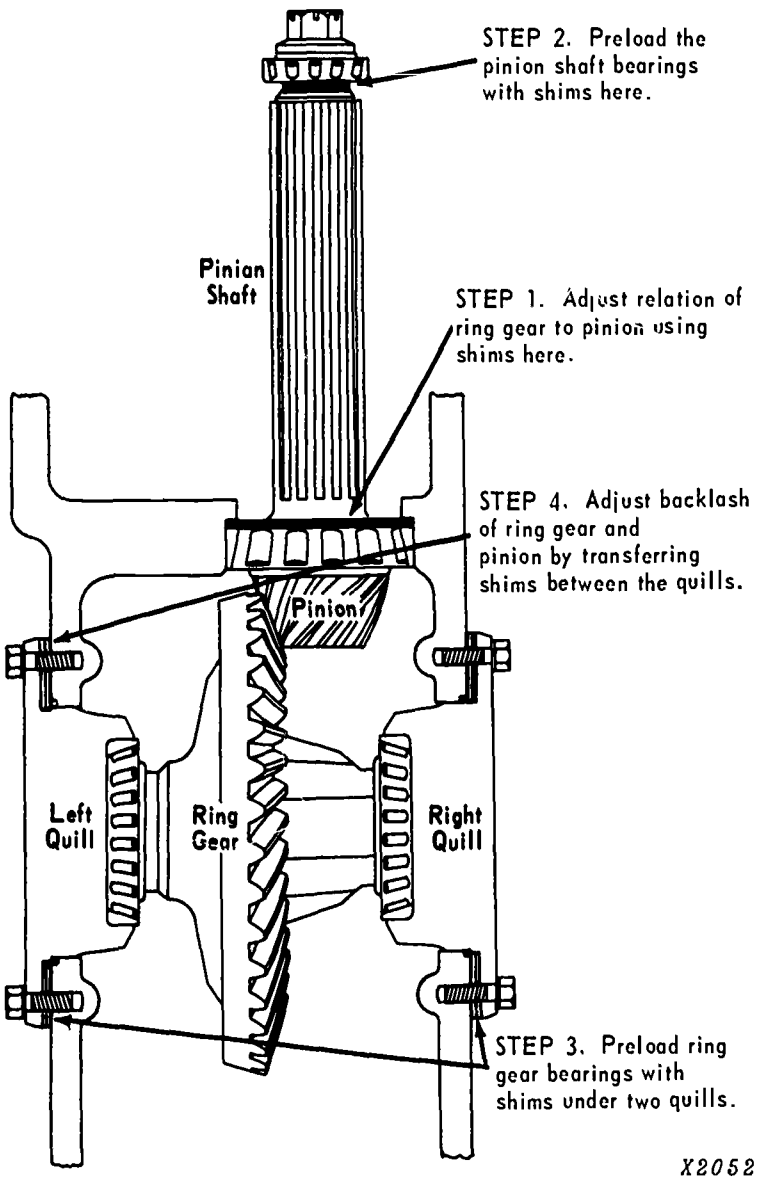

Fig. 35—Adjusting Ring Gear and Pinion (A Typical Example)

A typical ring gear and pinion set is shown in Fig. 35. The pinion shaft at the top meshes with the ring gear at the bottom. The ring gear is supported in two quills which bolt into the sides of the transmission housing. The adjusting shims are shown in blue.

When the gear set is assembled, it is adjusted in four steps:

1. Relation of pinion to ring gear is adjusted with shims under the lower shaft bearing.

2. The pinion shaft bearings are preloaded by using shims under the upper shaft bearing. (The shaft is normally installed without the shims, endplay is checked, and shims are added to equal the endplay **plus** the specified preload.)

3. The ring gear bearings are preloaded by shims under the side quills. (Here again the ring gear is normally installed with a shortage of shims, endplay is checked, and shims are added to equal the endplay **plus** the recommended preload for the bearings.)

4. Backlash between the ring gear and pinion is adjusted by transferring shims under the side quills. Backlash is checked at several points around the ring gear as shown in Fig. 33. To decrease the backlash, shims are transferred from the left to the right quill. To increase backlash, shims are transferred from the right to the left quill. The same shims must be added to the opposite quill as removed from the other one or the preload on the ring gear bearings will be changed.

This is a typical adjustment for a gear train but there are many variations. Consult the machine Technical Manual for the exact steps and readings.

SUMMARY: POWER TRAINS

We have seen how a basic power train works and have looked at the basic elements (Fig. 36).

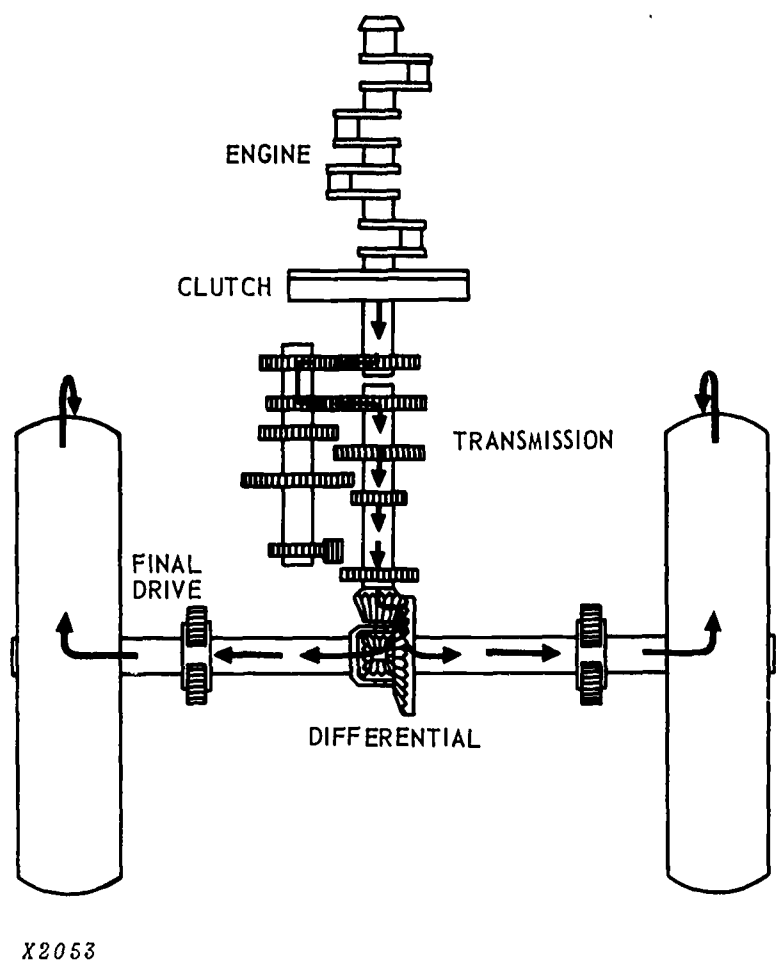

Fig. 36—Parts Of A Machine Power Train

In the rest of this book, we will look at various types of power trains in detail, starting with clutches in Chapter 2.

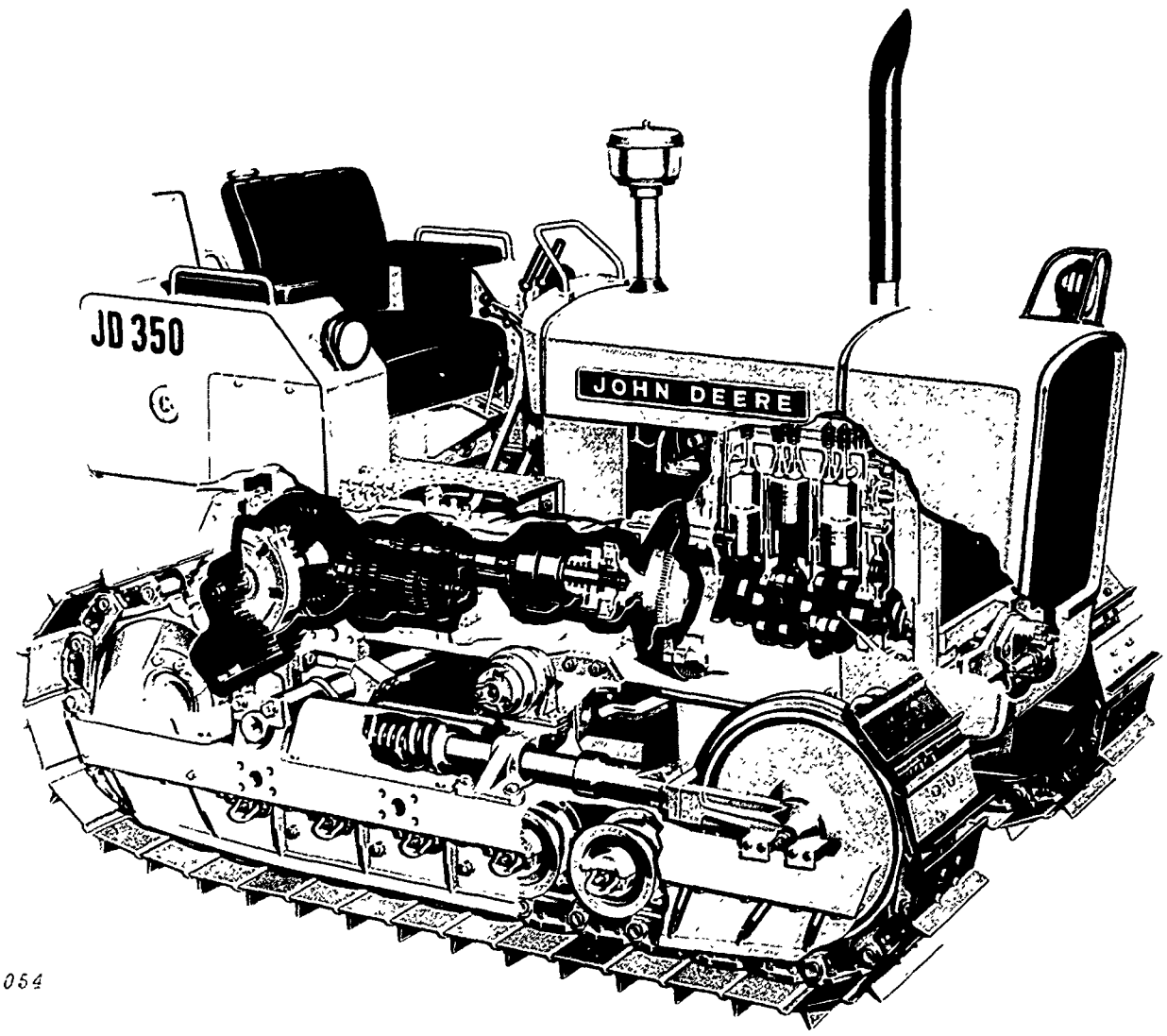

Fig. 37—Complete Power Train In Industrial Crawler Tractor

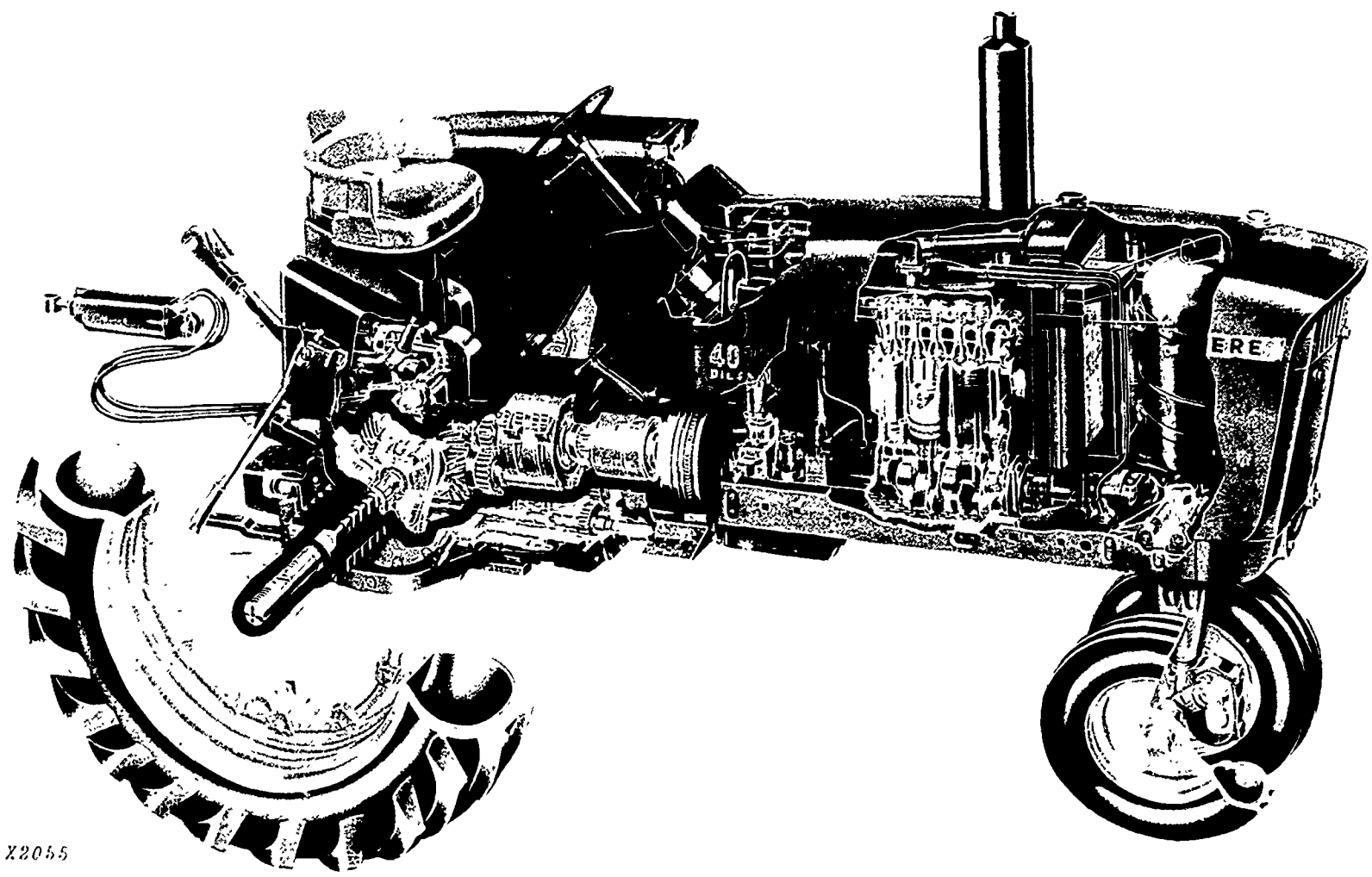

Fig. 38—Complete Power Train In Modern Farm Tractor

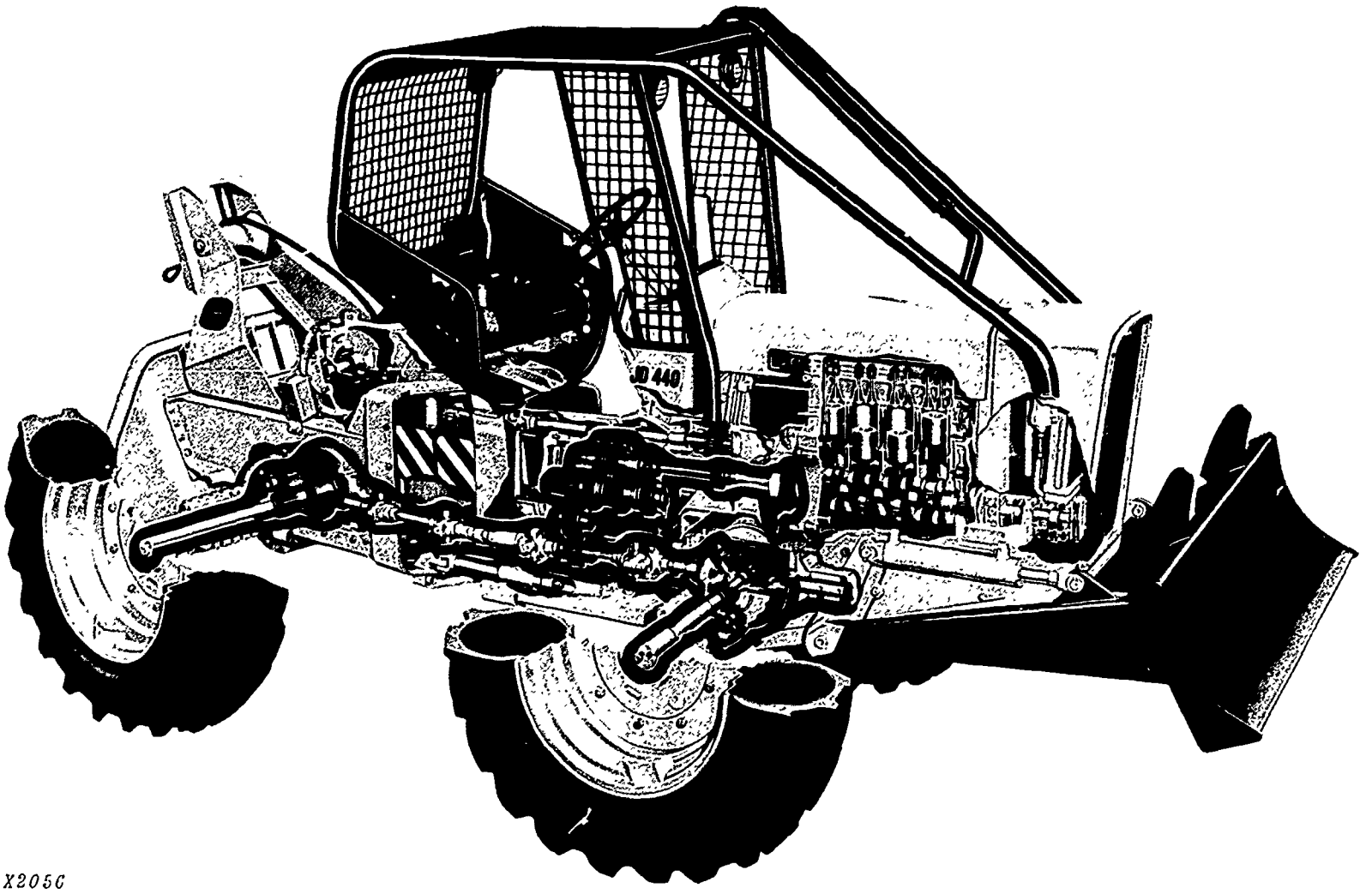

Fig. 39—Complete Power Train In Four-Wheel Drive Machine

TEST YOURSELF

QUESTIONS

1. Match each item below with the correct job it performs listed at the right.

a. Clutch	*1. Equalizes power for turning.*
b. Transmission	*2. Connects and disconnects power.*
c. Differential	*3. Selects speeds and direction.*

2. Two gears are in mesh. Gear A has 12 teeth, while gear B has 24 teeth. When gear A has made one complete revolution, how far has gear B traveled?

— 2 revolutions

— ½ revolution

— 4 revolutions

3. True or false? "For speed reduction in low gears, a large gear drives a smaller gear."

4. Does reducing gear speeds increase or decrease the twisting force of the gear shaft?

5. True or false? "When a machine turns, the outside drive wheel must turn faster."

6. What are the three basic ways of transmitting power?

7. Name an example of each type of transmitting power.

8. Name one advantage of helical gear teeth over straight spur gear teeth.

9. Name the two major jobs of bearings in a power train.

10. (Fill in the blank.) "Bearings are often_____ to offset the thrust of the power train."

11. (Fill in the blank.) "Looseness in a power train from end to end is called_____."

12. (Fill in the blank.) "Clearance between gear teeth in mesh is called_____."

(Answers on next page.)

ANSWERS

1. a—2; b—3; c—1.

2. Gear B has traveled ½ revolution.

3. False. To reduce speeds, a small gear drives a larger one.

4. Reducing gear speeds will **increase** *the twisting force or torque.*

5. True.

6. Friction, gear, fluids.

7. **Friction**—*wheels, belts, clutches, etc.* **Gears**—*transmissions, chains, etc.* **Fluids**—*water wheel, torque converter, fluid drive, etc.*

8. Any one of these: Operate more quietly, wear less rapidly, have greater tooth strength.

9. 1. Reduce friction; 2. Support a shaft.

10. Preloaded.

11. Endplay.

12. Backlash.

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CLUTCHES / CHAPTER 2

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Fig. 1—Clutch In Complete Power Train

INTRODUCTION

The **clutch** is a vital link in the power train. It connects and disconnects power between the source (engine) and the receiver (transmission).

Other clutches connect and disconnect power to auxiliary mechanisms in the gear train itself.

A clutch is used in all machines except some that have hydraulic drives or torque converters.

Chapter 1 explained the basic reasons for a clutch. Now we are going to see how the various clutches operate.

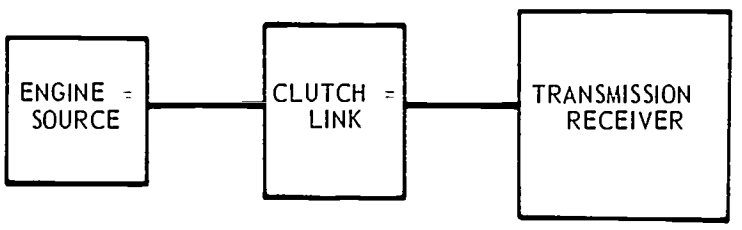

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Fig. 2—Relation Of Engine Clutch To Power Train

TYPES OF CLUTCHES

Seven types of clutches will be covered in this chapter:

- **Disk-Type—two or more plates are brought together to transmit torque.**
- **Plate-Type—a single plate is clamped between two driving parts to transmit torque.**
- **Band-Type—an outside band is tightened over a moving part to transmit torque.**
- **Overrunning-Type—engagement is allowed in one direction, but the unit freewheels in the other.**
- **Magnetic-Type — a magnetic field holds two parts together, allowing them to rotate as a unit.**
- **Cone-Type — two cone-shaped parts are engaged to transmit torque.**
- **Expanding-Shoe-Type — an inner shoe is expanded to contact an outer part to transmit torque.**

Let's look at each type in detail.

DISK-TYPE CLUTCHES

Two major types of *disk* clutches are used:

- **Dry-Type Disk Clutch—operates dry, cooled by air.**
- **Wet-Type Disk Clutch — operates in either oil bath or spray, cooled by oil.**

Let's take a look at each type.

DRY-TYPE DISK CLUTCH

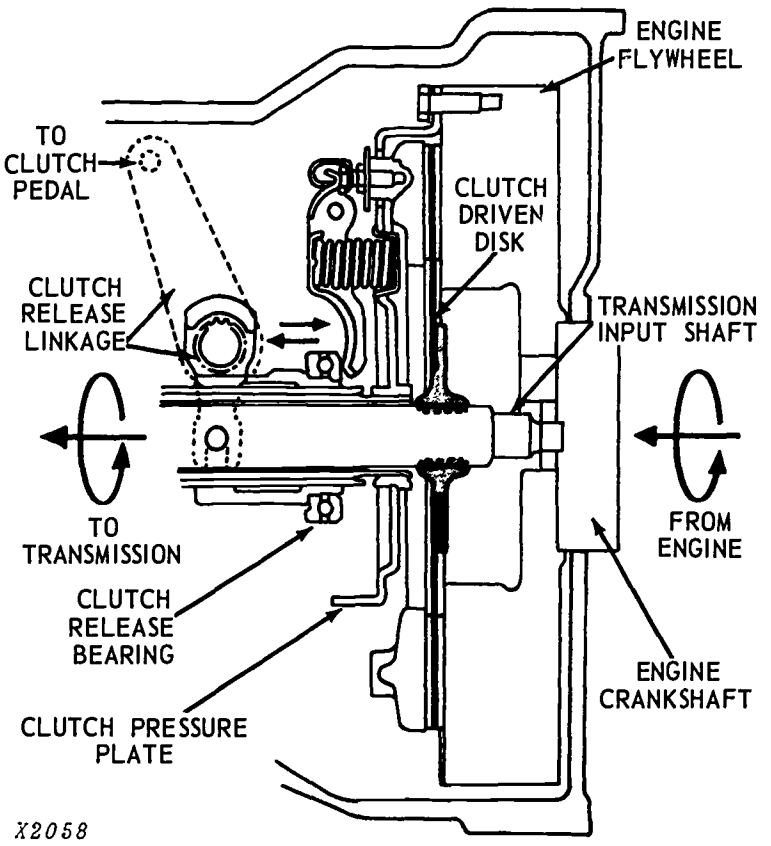

Fig. 3—Dry-Type Disk Clutch

The dry-type clutch shown in Fig. 3 has a driven disk with friction facing (red areas) molded to both sides.

The clutch pressure plate is bolted directly to the engine flywheel, while the driven disk is splined to the transmission input shaft.

Operation When Disengaged

When the clutch pedal is depressed, the clamping action of the pressure plate is released, separating the driven disk from the flywheel and pressure plate. Power flow is now stopped between the engine flywheel (rotating) and the transmission input shaft (where the driven disk is now rotating freely).

The clutch disk is released when the release linkage moves the release bearing to the right and depresses the levers, lifting the pressure plate from the disk.

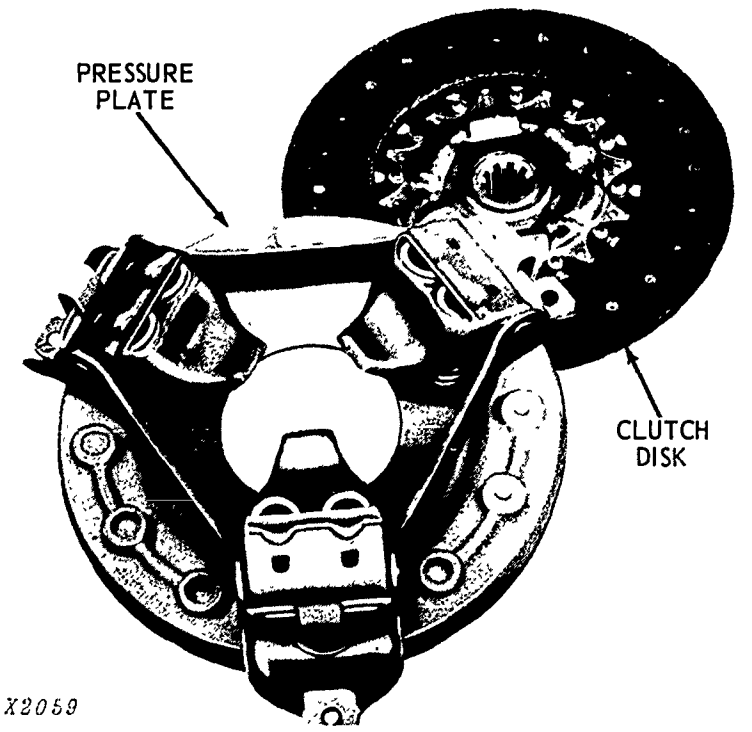

Fig. 4—Dry-Type Clutch Disk And Pressure Plate

Operation When Engaged

When the clutch pedal is released, the release linkage returns to the left, returning the pressure plate levers and allowing the plate to clamp the driven disk against the flywheel again. Now the flow of power is connected between the engine and the transmission input.

The clutch disk is engaged by springs in the pressure plate which clamp it down once the levers are released by the release bearing.

Uses Of Dry-Type Disk Clutches

Dry clutches are widely used on large trucks and heavy industrial units. The main advantage is in the larger contact area. They are not recommended where frequent disengaging or slipping is required because of heat build-up.

Lubrication

Lubrication is limited to the throwout bearing and linkages of this clutch. *Use grease sparingly* to avoid getting any on the friction facings and ruining them.

WET-TYPE DISK CLUTCH

The wet-type disk clutch operates in an oil bath or spray. Operation is similar to the dry-type clutch.

Operation

This clutch is either mechanically or hydraulically actuated.

To engage the clutch, a hydraulic or mechanical force is exerted on the rear plate of the clutch pack. As the force increases, more power is transmitted.

Operation in oil provides these advantages: *Reduced wear, smoother action, and cooler operation.*

Disks for Wet Clutches

One major difference between the dry- and wet-type clutch is in the disk facing material. In a wet clutch, this material must grip when soaked in oil.

Crosshatch marks are normally found on the facing surface of the wet disk. Cork was a common lining material in the past, but new materials are used now. Bi-metal plates without lining are often used for this clutch. An example of bi-metal plates is *steel* driving plates and *bronze* driven plates.

Servicing

Consider these points when servicing a wet-type clutch:

- *Is the oil being circulated properly?*
- *On units equipped with pumps, are the lines clogged?*
- *Is the pump handling its full capacity of oil?*
- *Is the inlet line dirty?*

Before disassembly, check the oil level. Look for traces of oil leakage.

During repair, check all the oil seals—at the clutch release forks, flywheel and clutch shaft end of the housing. Replace badly worn seals. If a seal has small cracks on the lips or retainer, it should be replaced. If the seal material appears compressed and is glazed, it is wise to replace it.

The best practice with seals is, "If in doubt, replace".

Failure to keep oil in the clutch housing will cost a lot more in repairs than the price of an oil seal.

For details, see the machine Technical Manual.

Lubrication

Use the type and grade of oil specified by the manufacturer.

Add oil if necessary to retain the proper level. This will avoid clutch failure from scoring or heat warpage.

PLATE-TYPE CLUTCHES

Both driving and driven members are used in the plate-type clutch.

The **driving** parts are the flywheel, pressure plate, and possibly an intermediate plate.

The **driven** parts are the clutch disks and the clutch shaft of the transmission.

A release bearing is used to disengage the clutch, and spring pressure holds the clutch engaged.

OPERATION

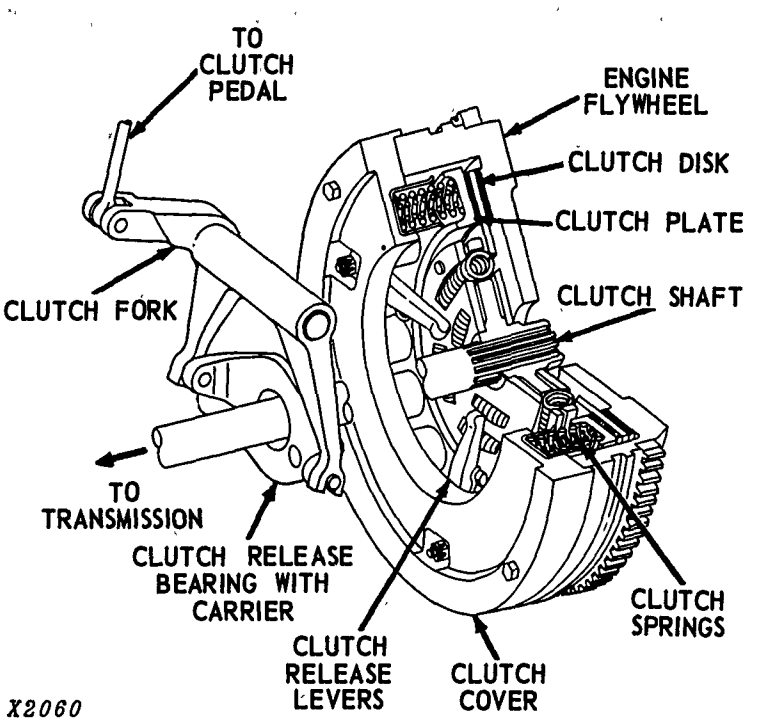

Fig. 5—Plate-Type Clutch (Engaged)

The clutch shown in Fig. 5 is engaged. Notice that the release bearing is away from the release levers. In this position, the clutch springs exert full pressure on the clutch plate, holding the clutch disk against the flywheel.

To disengage the clutch and interrupt the flow of power, the release bearing is pushed forward by the clutch fork. It contacts the release levers, causing them to pivot and pull the clutch plate back away from the clutch disk. The driving parts now rotate without moving the clutch disk and power is interrupted.

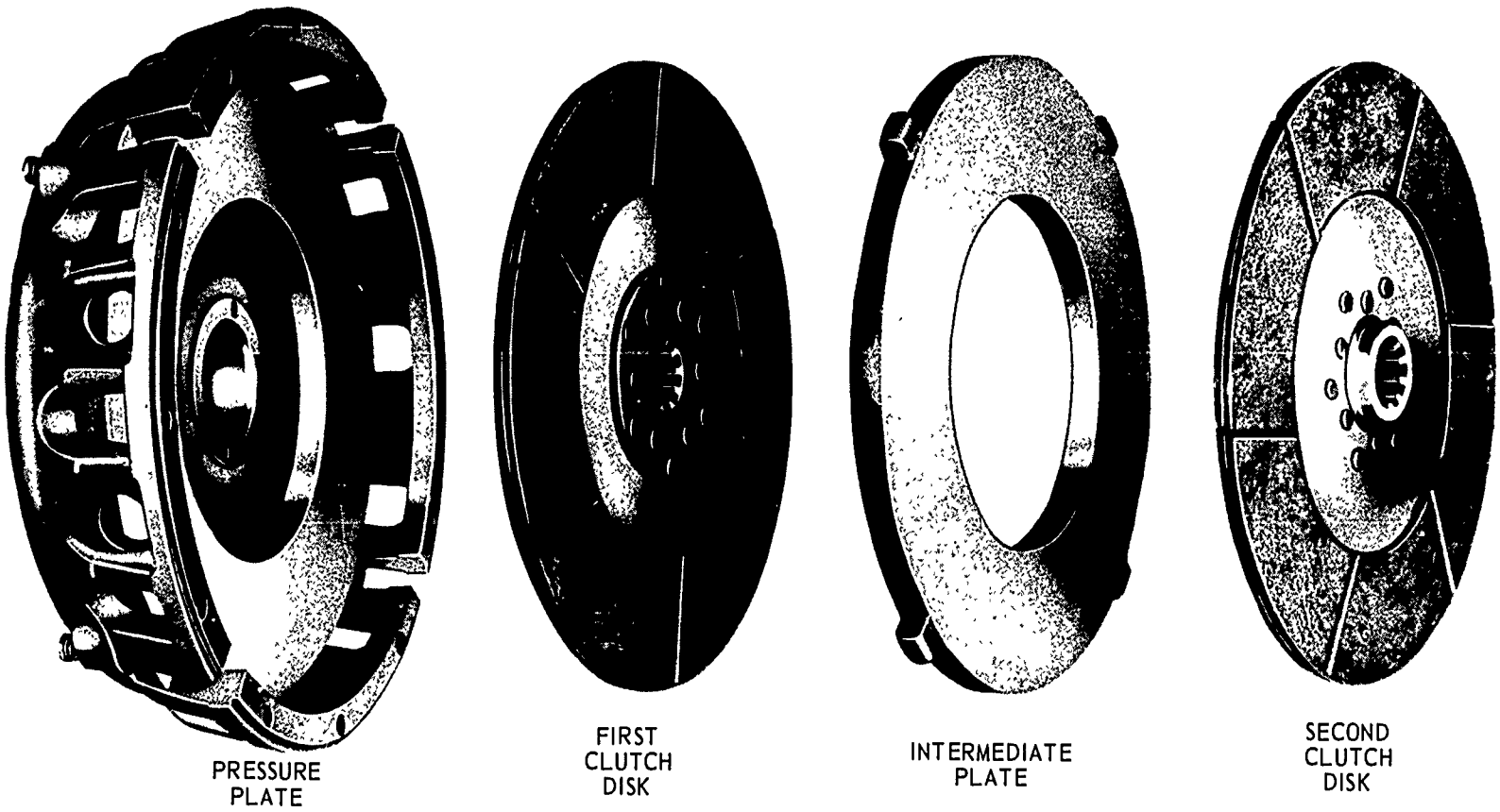

Fig. 6—Parts Of A Plate-Type Clutch

Now let's look at the individual parts of a plate-type clutch (Fig. 6).

FLYWHEEL

The engine flywheel usually provides a machined surface for the clutch to contact.

In some cases a special plate is bolted to the flywheel to provide this surface.

The purpose of the flywheel is:

1) As a balancer for the engine, it levels out power impulses.

2) It provides a surface from which the clutch can pick up torque for transfer to the drive mechanisms.

3) It provides a ring gear for the engine starting motor to contact.

PRESSURE PLATE ASSEMBLY

The pressure plate engages and releases the clutch disk. A typical plate assembly has a clutch plate, bracket, release levers, and springs.

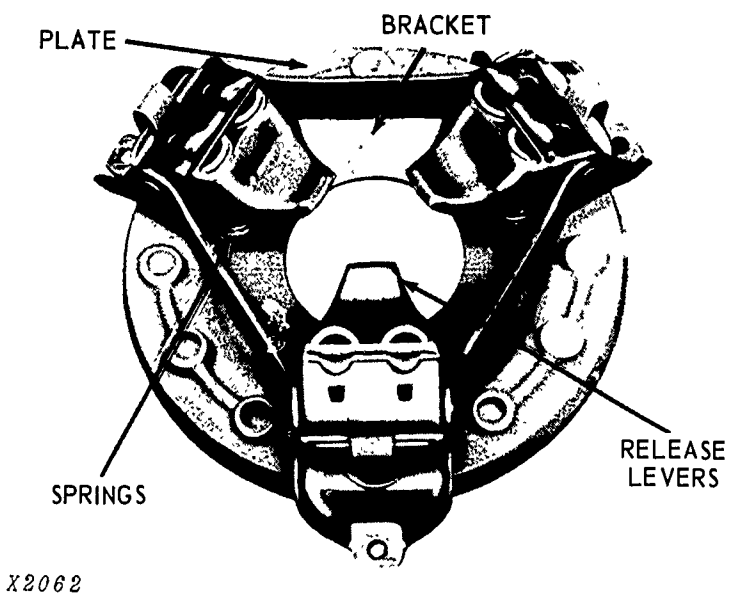

Fig. 7—Pressure Plate Assembly

The heavy *plate* actually engages the clutch by pressing the disk against the flywheel surface.

The *bracket* mounts the *release levers* and *springs*. The levers pivot in bosses on the plate so that when the levers are pressed down by the release bearing, the plate is lifted from the clutch disk.

The *springs* under each release lever push the plate down again when the clutch is engaged and hold it solid.

Some clutches also have centrifugal weights which add extra pressure for holding the clutch plate against the clutch disk.

INTERMEDIATE PLATE

The intermediate plate is used in plate-type clutches having two disks and is placed between the disks.

When the clutch is engaged, the first clutch disk is held between the flywheel and intermediate plate, and the second clutch disk is held between the intermediate plate and the clutch plate.

When disengaged, the intermediate plate, flywheel and pressure plate assembly rotate as a unit. The clutch disks which are not in contact remain idle.

CLUTCH DISKS

There are two kinds of clutch disks—**rigid** and **flexible** (Fig. 8).

A *rigid* or solid clutch disk is a solid circular disk fastened directly to a center splined hub.

The *flexible* clutch disk is easily recognized by the torsional dampener springs located in circles around the center hub. The purpose of the flexible-type disk will be defined more clearly under the "Dampener" section of this chapter.

Asbestos wire-woven material is the most common lining for these clutch disks. A more recent product is ceramic material, a clay and metal substance which is oven-baked.

A lining must be long-wearing, heat-resistant, and still able to overcome slippage.

Linings are attached to the clutch disk by bonding or riveting.

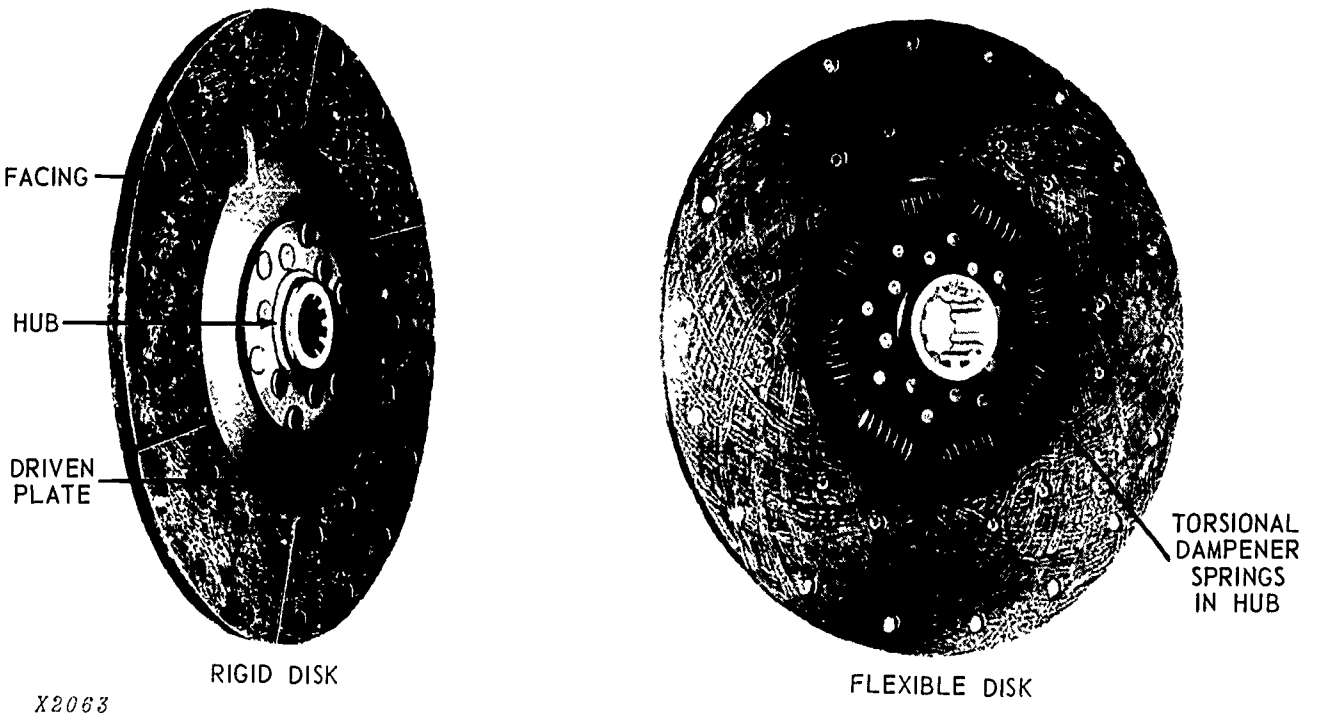

Fig. 8—Clutch Disks—Two Types

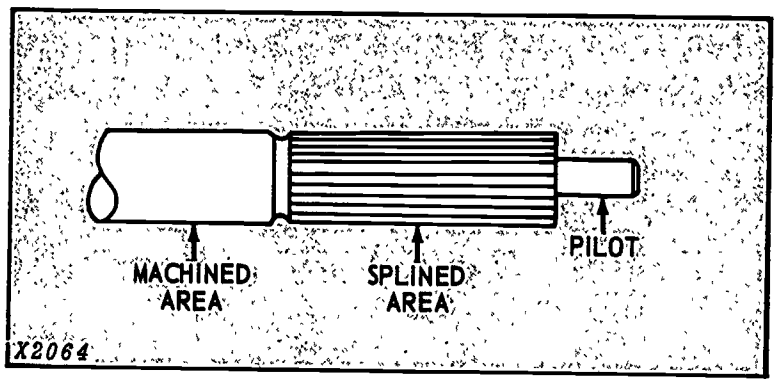

Fig. 9—Clutch Shaft

CLUTCH SHAFT

The clutch shaft projects from the front of the transmission (Fig. 9).

Most clutch shafts have a smaller shaft or pilot which projects from the front end. This pilot rides in the pilot bearing in the engine crankshaft flange.

The splined area is provided for the clutch disk. It must allow the clutch disk to move laterally along the spline but must not allow a rotary rocking motion.

A machined area between the transmission front cover and the spline mounts the release bearing carrier.

A thrust-type ball bearing is the most common release bearing. It rests on this area of the shaft when the clutch is engaged.

SERVICING OF PLATE-TYPE CLUTCHES

1. Always check the clutch release and pressure mechanisms. Pressure should be even all around the clutch. The release levers must be adjusted so that contact with the release bearing will be uniform and the pressure plate will release evenly.

CAUTION: Use proper equipment and methods as prescribed by your Technical Manual when dismantling the direct-pressure clutch. Spring pressure must be kept under control and released evenly to avoid personal injury.

2. After rebuilding the clutch, check the clutch pedal *free travel* (Fig. 10). When the clutch is engaged, a retracting spring pulls the pedal back so that the release bearing fork does not contact the release bearing. Another spring pulls the release bearing carrier back so that the bearing does not contact the clutch plate levers. Thus, in normal driving, with the clutch engaged and

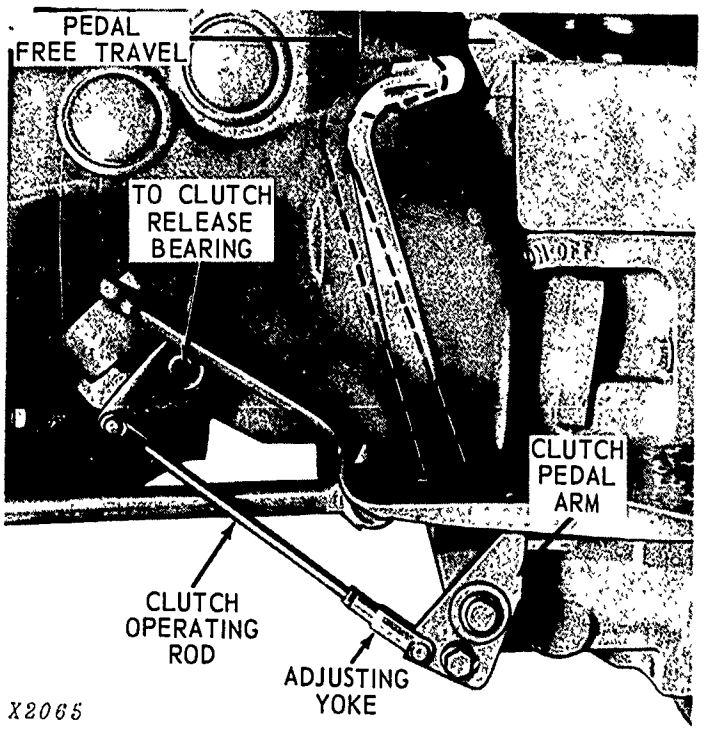

Fig. 10—Clutch Pedal Free Travel Adjustment

the driver's foot removed from the clutch pedal, the clutch release bearing is not turning. This is assured by having the correct free travel on the pedal (Fig. 10).

3. Always check the clutch release setting during clutch service. As the clutch disk facings wear, the clutch disk becomes thinner. The clutch plates then move closer to the flywheel in order to engage the disk. As the pressure plate moves closer to the flywheel, the release fingers move closer to the release bearing. After long operation, these fingers will contact the release bearing and it will run all the time.

Additional wear on the clutch disk cannot be taken up by the pressure plate because the release fingers are contacting the release bearing. The clutch will then start to slip and the release bearing will wear out rapidly.

We will discuss the clutch release adjustment under "Manual Actuating Mechanisms" later in this chapter.

LUBRICATION OF PLATE-TYPE CLUTCHES

Do not use too much lubrication on the clutch pilot bearing, release bearing, or release fork. Excessive lubrication can lead to erratic operation of the clutch.

Some release bearings are sealed units that never need lubrication.

BAND-TYPE CLUTCHES

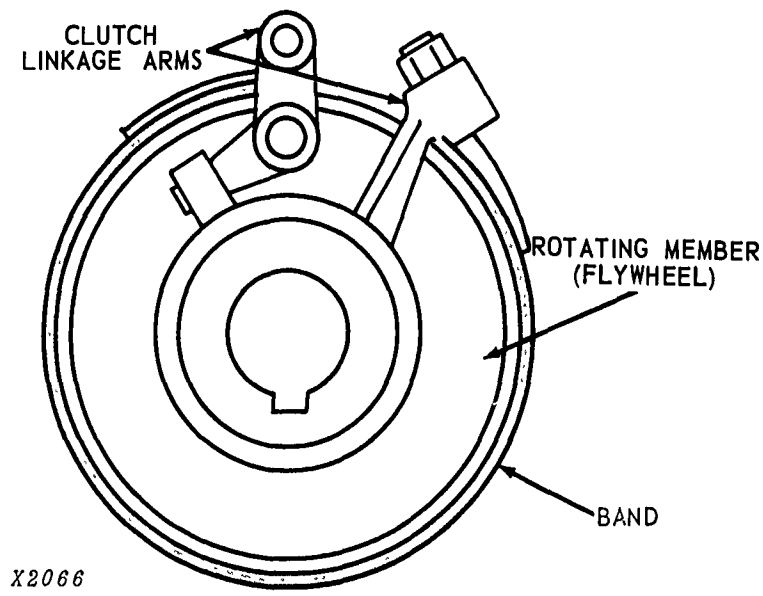

Fig. 11—Band-Type Clutch

The band-type clutch is operated by a band or belt as shown in Fig. 11. This clutch is different from the others in that it receives its torque from the *outside* surface of a rotating member, not on the side or on the same axis.

OPERATION

To engage, the linkage arms (Fig. 11) are drawn closer together, causing the band to tighten. The band and rotating member then revolve as a unit, transmitting torque.

Advantages include the ability to absorb shock loads, more uniform wear of linings, and less heat and wear. A more constant torque is provided because of the large-diameter contact. The lining materials used include leather, wood and asbestos-woven material.

USES

Band-type clutches are adaptable to large stationary equipment rather than mobile equipment because of their bulky size.

SERVICING

Servicing of the actual clutch components is easy. Watch for wear on the flywheel caused by the rivets. To insure long life of the lining, the flywheel must be concentric.

OVERRUNNING CLUTCHES

An overrunning clutch will automatically engage in one direction, but will freewheel in the other.

Fig. 12 shows a simple overrunning clutch. In the top picture, the entire shaft is revolving counterclockwise. As long as the drive line revolves as indicated the clutch will remain **engaged.**

If we stop the source of power or reverse the rotation of either of the members, the clutch will overrun or **freewheel** as shown in the lower picture in Fig. 12. Engagement will not take place until the drive line attains more speed than the driven line.

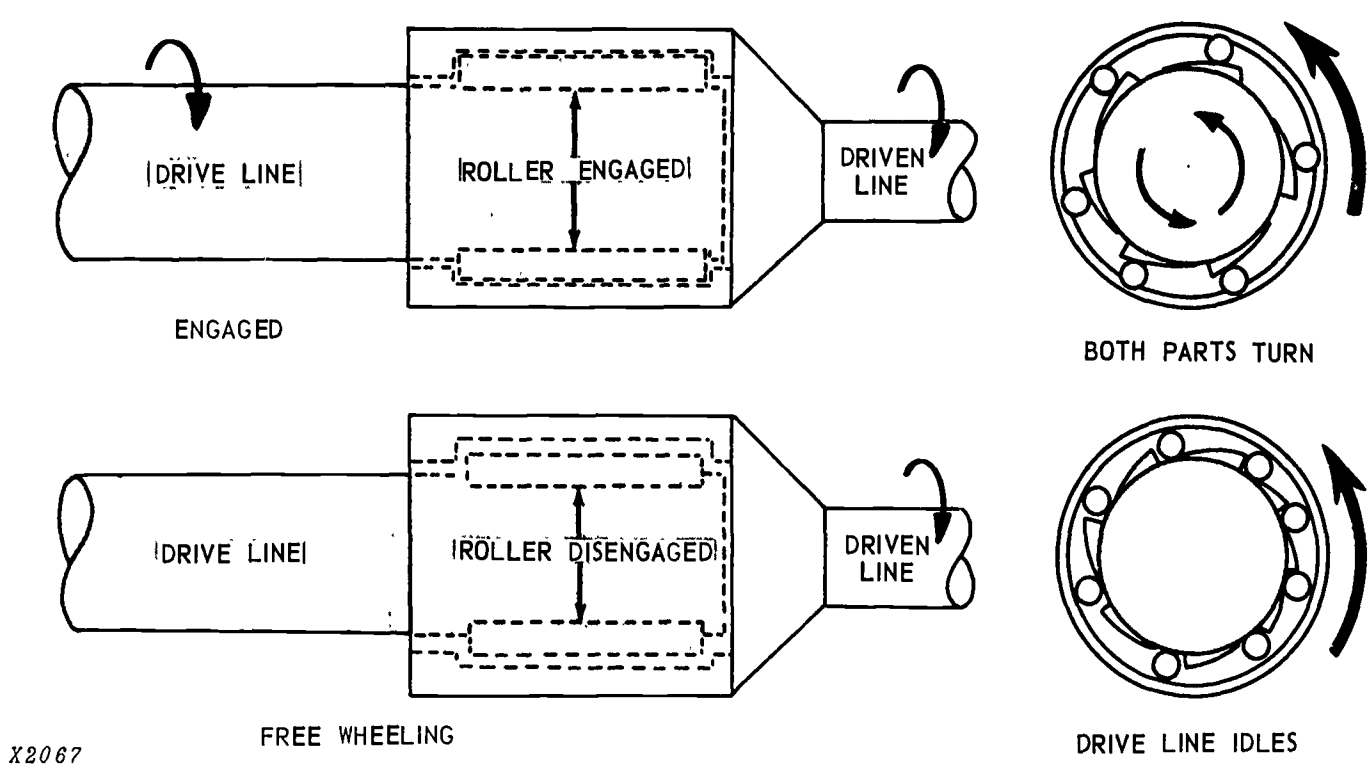

Fig. 12—Overrunning Clutch

TYPES OF OVERRUNNING CLUTCHES

Overrunning clutches have three basic types:

- **Roller**
- **Cam or Sprag**
- **Spring**

Let's look at each one.

Roller-Type Overrunning Clutch

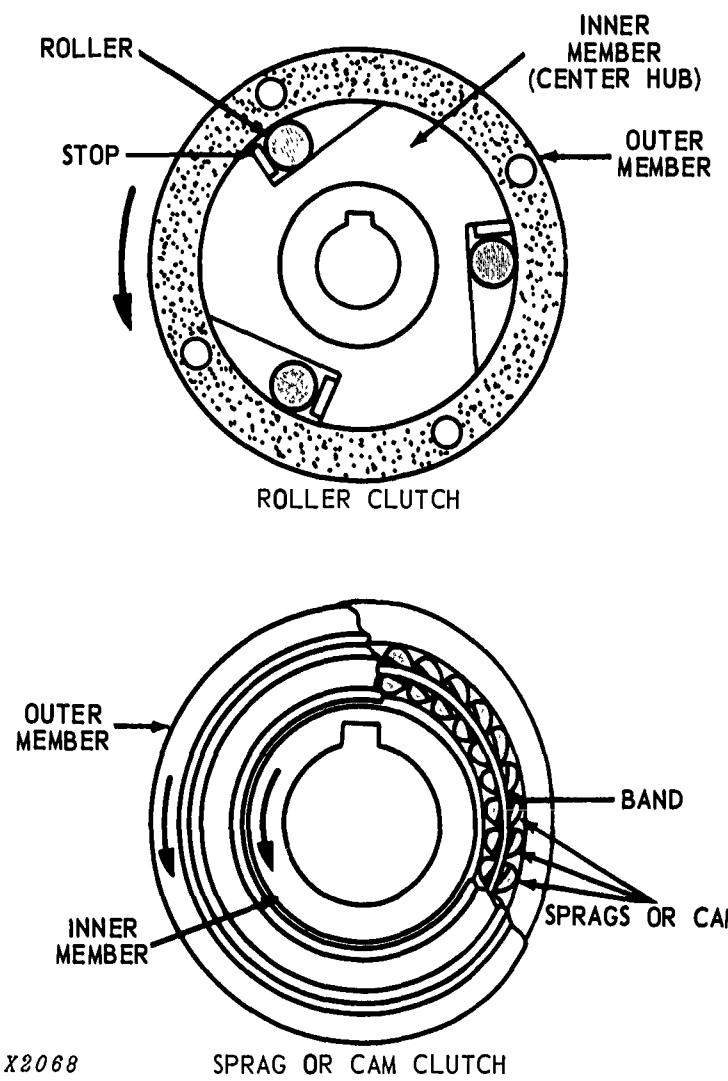

Fig. 13—Roller and Sprag-Type Overrunning Clutches

The upper part of Fig. 13 shows a side view of a roller clutch. Notice that there is an outer member and an inner member. As the center hub turns as shown, the rollers move outward on the inclined ramp until they wedge between the outer and inner members. The members then revolve as a unit to transmit torque.

If we reversed the inner member, the rollers would be free to return down the ramp against the stops. In this position, there would be no contact between the inner and outer member, and they would disengage and freewheel.

Cam- Or Sprag-Type Overrunning Clutch

The sprag-type clutch works in much the same manner as the roller.

The lower part of Fig. 13 shows a sprag- or cam-type clutch. Sprags or cams take the place of the rollers.

The clutch is shown in an engaged position.

To *disengage* the clutch or freewheel, the inner member would have to either stop or turn clockwise. This would allow the cams or sprags to lean forward. The band of material passing through the sprags prevents them from lying flat.

To *engage* the clutch, the inner member rotates counterclockwise as shown. This causes the sprags to stand upright, locking them between the inner and outer members. The members held together by the sprags then rotate as a unit, transmitting the torque.

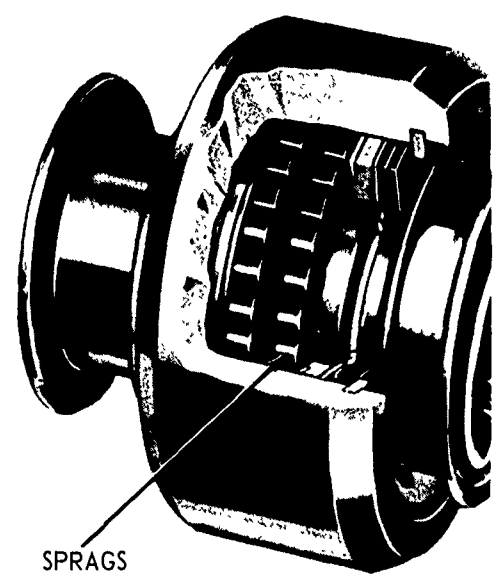

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Fig. 14—Sprag Type Clutch

Spring-Type Overrunning Clutch

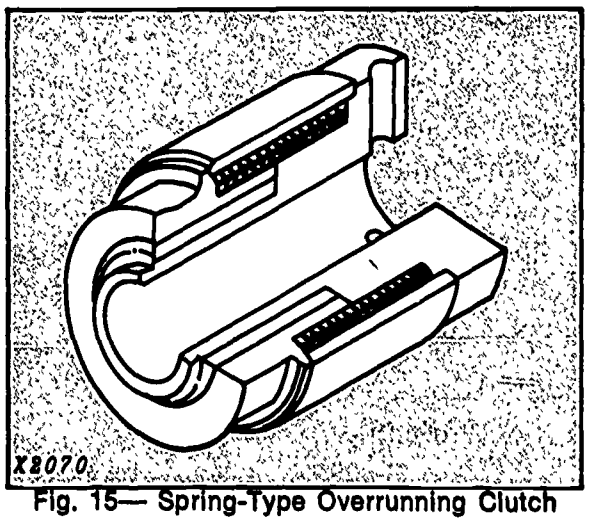

Fig. 15— Spring-Type Overrunning Clutch

The spring-type clutch is restricted to smaller applications. A coil spring is wrapped lightly around a shaft or collar (Fig. 15). When the spring is rotated in one direction, it tightens on the shaft and drives it. When rotated in the other direction, it loosens and does not drive.

SERVICE OF OVERRUNNING CLUTCHES

Refer to your Technical Manual for information on servicing and lubricating these units. Failure to freewheel defeats the purpose of this clutch and can result in costly damage.

MAGNETIC CLUTCHES

There are two types of magnetic clutches:

- **Direct**
- **Indirect**

In the DIRECT TYPE a magnetic field is set up which draws the driving and driven plates together.

In the INDIRECT TYPE a magnetic field is set up between the inner and outer members, which draws fine metallic particles to form a solid connection between the members. The greater the mass of particles, the greater the transfer of torque.

OPERATION

The operation of magnetic clutches will be covered in detail under "Electrical Operating Mechanisms" later in this chapter.

USES

Magnetic clutches are used where frequent engaging and disengaging is required. This electrical clutch gives either positive drive or slippage which cushions any shock loading.

CONE-TYPE CLUTCHES

The cone-type clutch is made up of two cone-shaped members (Fig. 16).

One member provides an internal machined surface for transferring torque and serves as a drive member. The other member provides an external lined surface for picking up the torque and serves as a driven member.

The material used for lining is usually woven asbestos bonded to the cone surface.

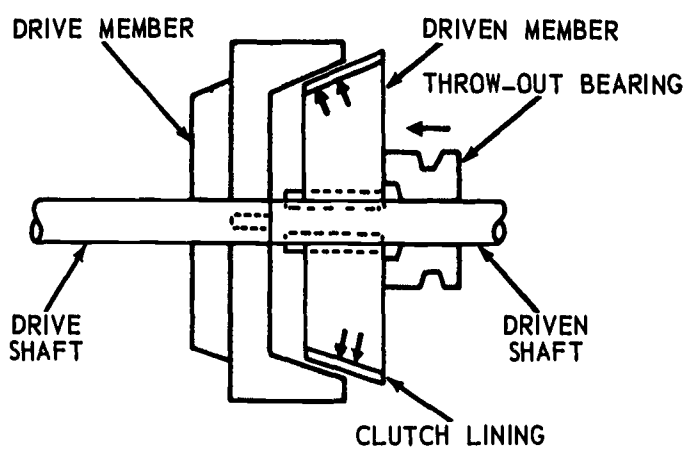

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Fig. 16—Cone-Type Clutch

OPERATION

The cone-type clutch is engaged as follows:

As the throw-out bearing moves on the driven shaft, it slides the driven member forward (Fig. 16). The outer lining of the driven member contacts the inner surface of the revolving drive member to transmit the torque.

USES

The cone clutch was at one time used in trucks and autos, but now is used more for machine auxiliary power trains.

EXPANDING SHOE CLUTCHES

The expanding shoe clutch can be operated either *mechanically* or *centrifugally* (Figs. 17 and 18).

OPERATION

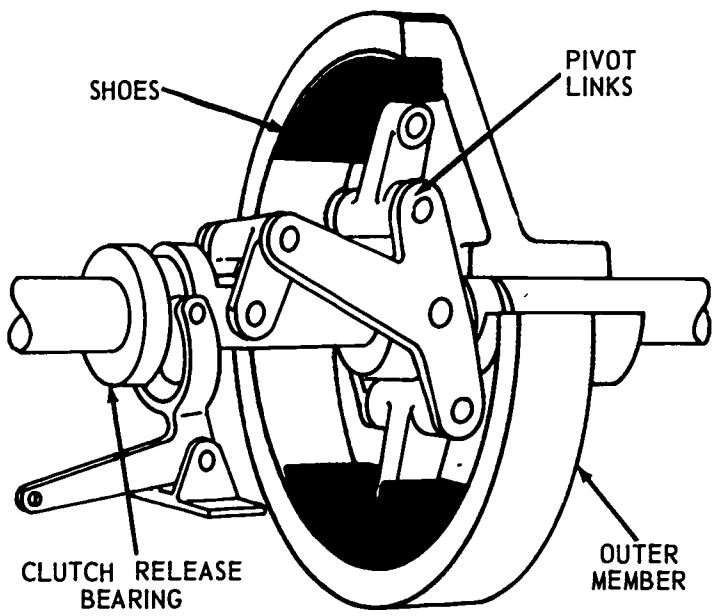

Fig. 17—Expanding Shoe Clutch (Mechanical Type)

To engage the **mechanical** shoe clutch, a release bearing is pushed forward (Fig. 17). This pivots the links and expands the shoes out against the outer member.

Moving the bearing back releases the pressure on the shoes, disengaging the clutch.

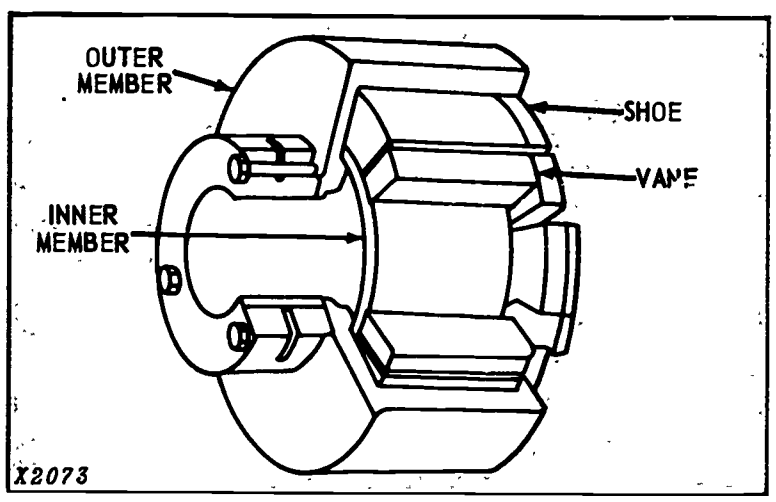

Fig. 18—Expanding Shoe Clutch (Centrifugal Type)

The **centrifugal** clutch (Fig. 18) has an inner member with vanes spaced around the hub. The outer member closes the end of the channels formed by the vanes. Shoes are placed in the channels and are free-floating.

When the inner member rotates at a high speed, the shoes move outward and contact the outer member. The faster the inner member rotates, the greater the centrifugal force holding the shoes against the outer members. The vanes help to hold the shoes and thus form a somewhat solid connection between the two members.

The clutch disengages automatically once the rotating drive member slows down.

OTHER TYPES OF CLUTCHES

We have discussed mechanically- and electrically-operated clutches. New clutches are available using **pneumatics** (air) or **hydraulics** (oil) for control.

PNEUMATIC CLUTCHES

The air-actuated clutch is a clutch pack which contains a small rubber tube. This tube is positioned behind a driven member and a fixed member.

To engage the clutch, a valve is opened and air is forced into the tube, causing it to expand. This expansion forces the driven plate against the drive plate. The higher the air pressure, the greater the force exerted by the tube against the driven plate. Air pressure is decreased to disengage the clutch.

This clutch provides smooth engagement because the rubber tube absorbs the shocks.

HYDRAULIC CLUTCHES

Hydraulic clutches work in much the same way as the pneumatic clutch, but use oil instead of air.

Oil is forced into a chamber between the fixed and moving driven members. A valve is then opened, allowing oil to flow into the chamber. As oil pressure builds up, the walls of the chamber are forced outward, causing contact between the driven and drive members. The amount of pressure exerted on the clutch disk is regulated by the pressure of the oil in the chamber.

These clutches are also fairly shock-proof.

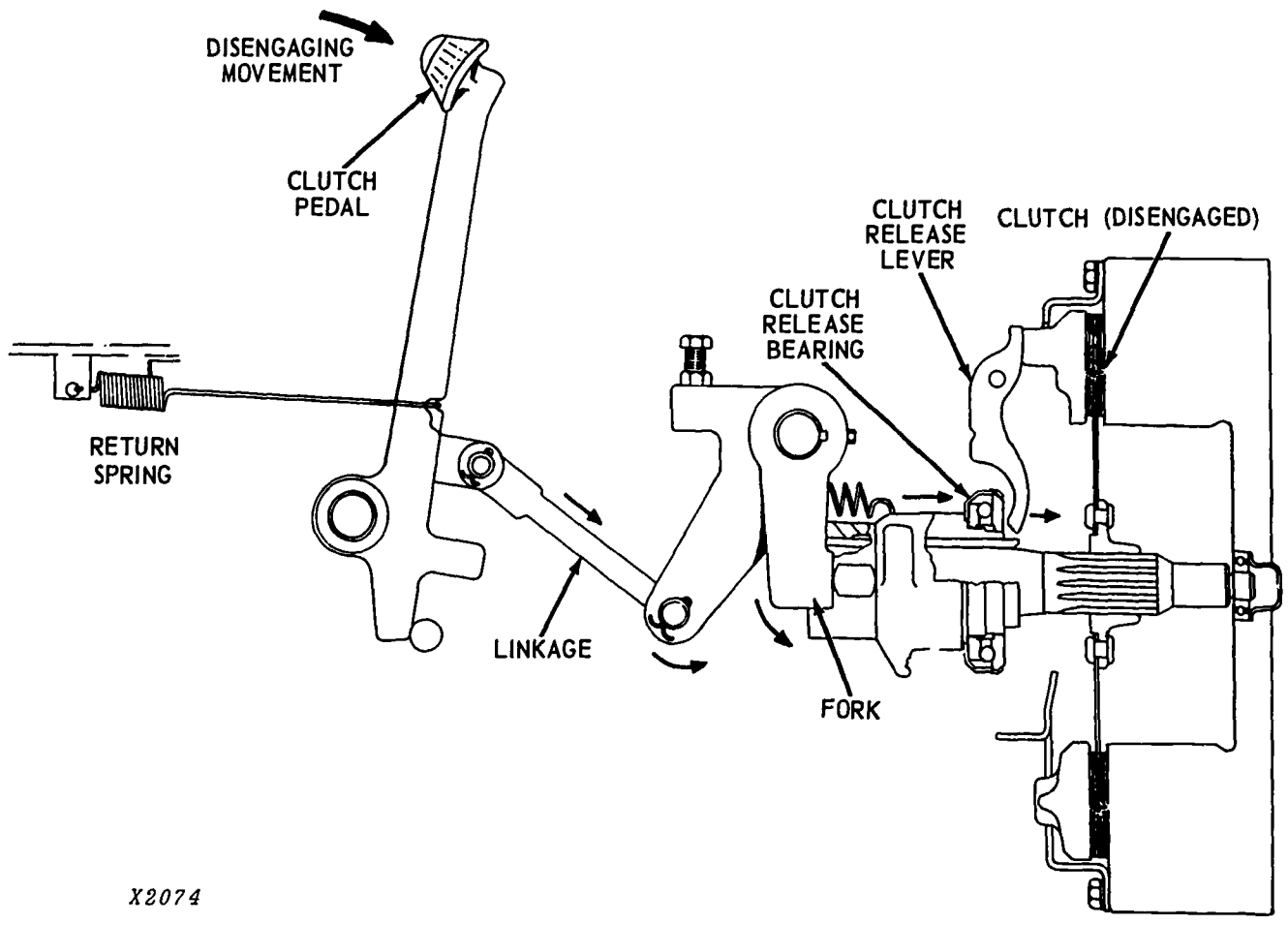

Fig. 19—Standard Linkage For Operating Clutch

SLIP CLUTCHES

Another type of clutch is the **slip clutch.** Its purpose is to allow slippage at moments of excessive demand or shock. It serves as a circuit breaker or safety device in power trains.

This clutch is covered in detail in Chapter 10 of this manual.

CLUTCH OPERATING MECHANISMS

Clutches can be operated in three major ways:

- **Mechanically**
- **Hydraulically**
- **Electrically**

We have also mentioned pneumatics, or air, but let's concentrate on the three controls listed above.

MECHANICAL CLUTCH CONTROLS

Mechanical operation of clutches is the using of linkages and springs to help in manually engaging and disengaging. There are two basic types:

1) Standard

2) Over-Center

STANDARD LINKAGE is the most common; the clutch remains engaged unless a pedal is pushed and held.

OVER-CENTER LINKAGE is where mechanical advantage is used to lock the clutch engaged or disengaged.

Standard Linkage

With standard linkage (Fig. 19), foot motion on the clutch pedal moves through the linkage to the clutch release bearing fork. This pushes the release bearing against the clutch release levers, releasing or disengaging the clutch. Some clutches use springs which serve as aids in disengaging and also as return springs when the clutch is engaged.

Over-Center Linkage

Fig. 20 shows an expanding shoe clutch with an over-center linkage to lock it in place while engaged or disengaged.

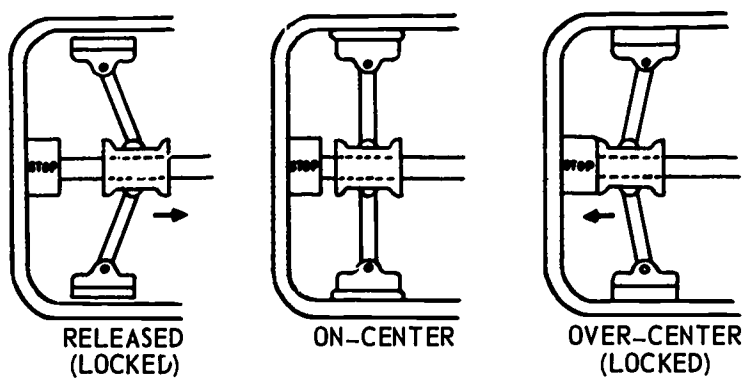

Fig. 20—Over-Center Linkage For Locking The Clutch While Engaged or Disengaged

When the center collar is moved forward, the two arms attached to it move outward. An *on-center* position is obtained when the arms are in line with each other. This is the point of maximum pressure.

If we move the collar ahead still further against the stop, the arms are in an *over-center* position and some of the pressure is relaxed. The collar cannot move ahead because it is against the stop. Rearward movement is impossible unless assistance is provided to overcome the high pressure at the on-center position.

This type of mechanism has the advantage of being able to lock either engaged or disengaged without keeping a grip on the lever or pedal.

Service of Mechanical Clutch Controls

When repairing the clutch, always examine the linkage.

Worn bushings, bent rods, broken springs and damaged cotter pins can result in excessive force being required to operate the clutch.

Clutch pedal free travel is often used as a guide to conditions inside the clutch.

The actual free pedal is more easily determined if checked by hand and should be the clearance between the clutch release yoke fingers and the release bearing housing.

Clutch pedal free play varies; set it according to Technical Manual instructions.

Whenever free pedal travel falls below ½ inch, the clutch should be adjusted internally. If free pedal travel is not then restored to about ½- to 1¾-inches, readjustment of the external linkage may be necessary.

Check the release yoke movement to verify that free pedal travel is actually the release bearing clearance, and not lost motion in linkage due to worn clevis eyes and pins, or worn bushings and shafts at the clutch pedal or linkage arms.

HYDRAULIC CLUTCH CONTROLS

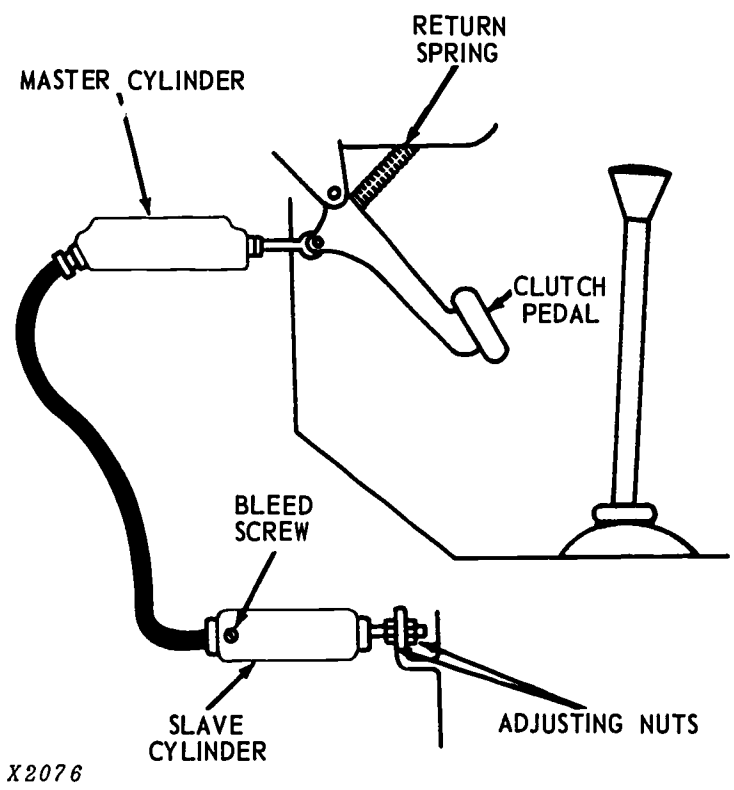

Fig. 21—Hydraulic Clutch Controls

A **master** cylinder similar to the brake master cylinder is attached to the clutch pedal (Fig. 21). A **slave** cylinder is connected to the master cylinder by flexible pressure hose or metal tubing. The slave cylinder is also connected to the clutch release yoke lever.

Movement of the clutch pedal actuates the clutch master cylinder. This movement is transferred by hydraulic pressure to the slave cylinder, which in turn actuates the clutch release yoke lever, disengaging the clutch.

Uses

Hydraulic clutch controls are used on large units which require high pressure to disengage.

By using hydraulics, a small force can be multiplied and used effectively to disengage the clutch.

Service

1. Adjust the clutch pedal free travel per the Technical Manual.

2. Watch for leaking seals, low fluid level, broken or kinked lines, and leaking pistons in the cylinders.

3. Always bleed the air from the system after repair or replacement of parts. In most designs, a special screw is provided to allow bleeding the air from the system.

4. Check the fluid level in the reservoir and add oil if necessary after bleeding the system.

5. Adjust the slave cylinder rod to set the clutch throwout bearing at the proper position.

ELECTRICAL CLUTCH CONTROLS

Electrical clutch controls may be one of two types:

- **Direct-Action**
- **Indirect-Action**

Let's look at each one.

Direct-Action Controls

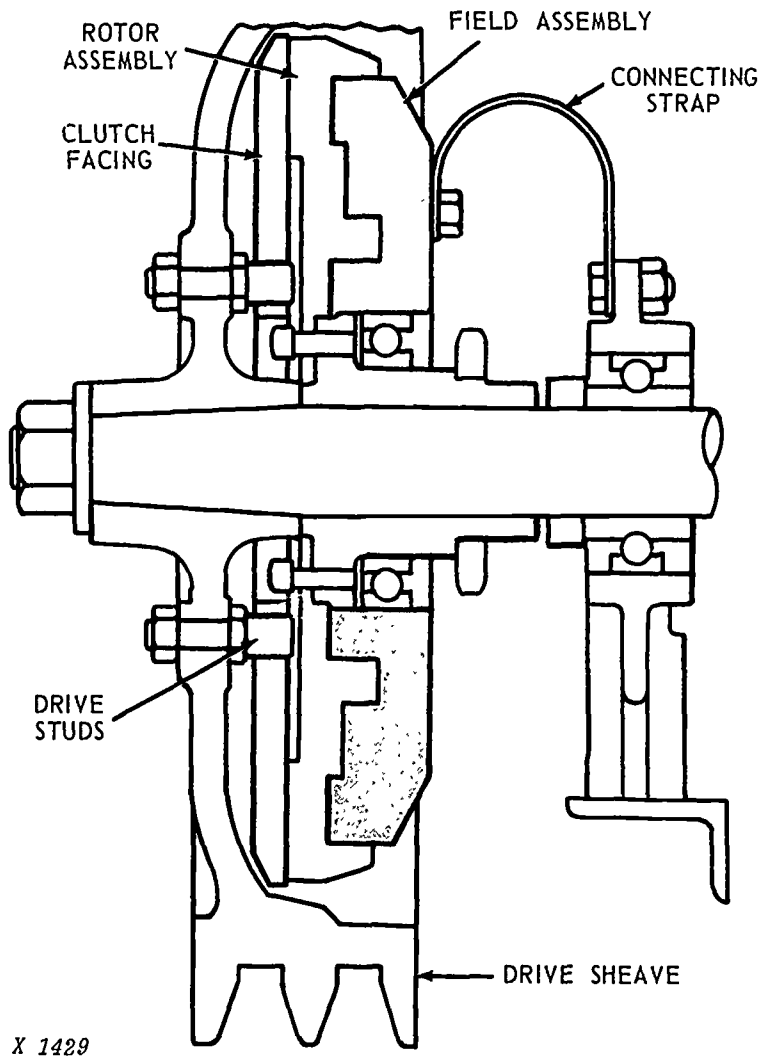

Fig. 22—Direct-Action Electrical Control For Clutch

The direct-action clutch consists of a field coil assembly, rotor unit, face plate, condenser and operating switch (Fig. 22).

When the switch is actuated, current through the field coil inside the rotary assembly sets up a magnetic field which draws the clutch facing against the facing on the rotor assembly. (The face plate is free to slide on the drive studs of the mechanism). Power is then transmitted from the drive pulley through the face plate, rotor, and hub to the drive mechanism.

When the switch is operated again, the magnetic field is collapsed. The face plate is freed from the rotor and the transmitting of power to the mechanism is instantly stopped.

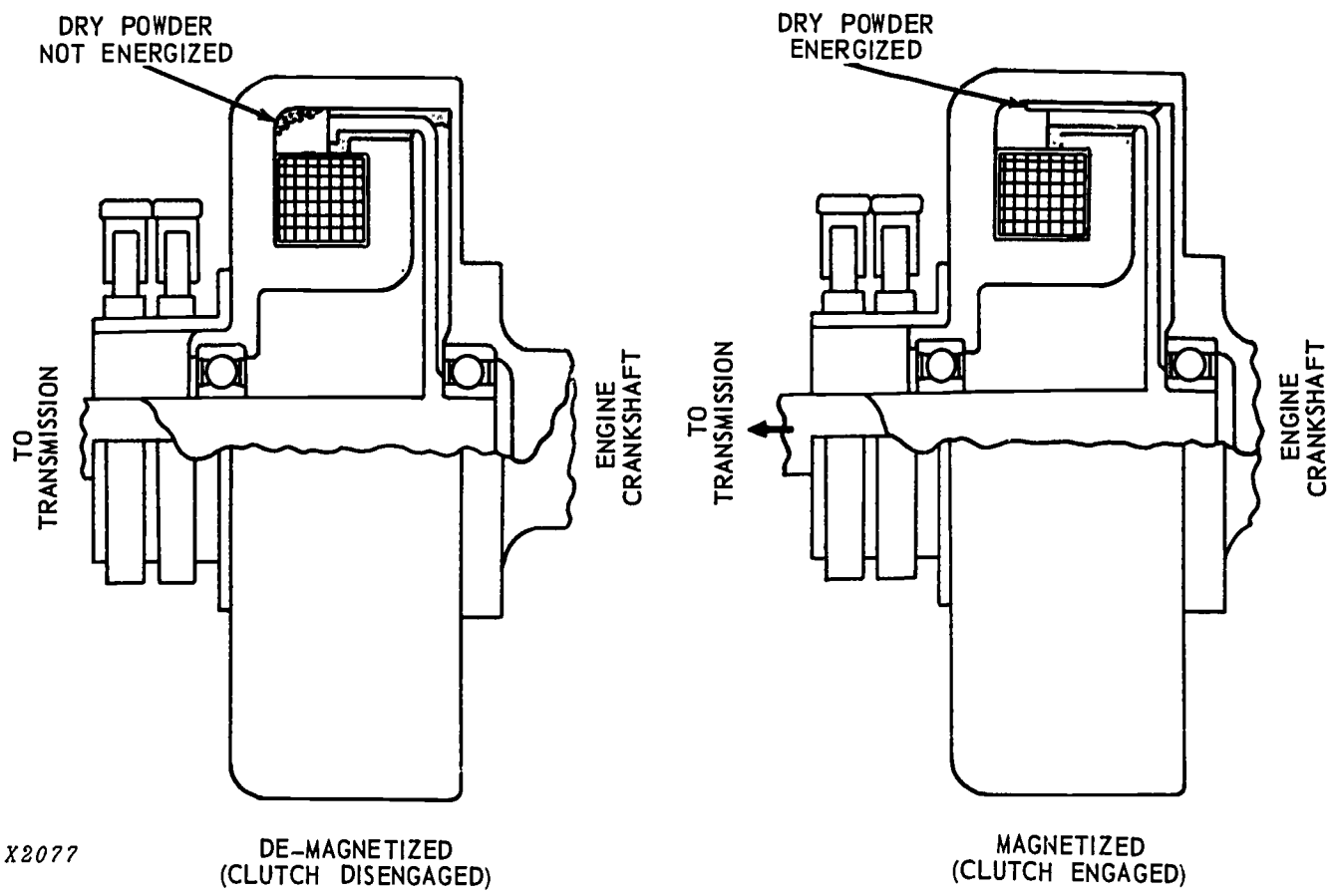

Fig. 23—Indirect-Action Electrical Control For Clutch

Indirect-Action Controls

This clutch consists of a driving member containing a coil, an inner driven member, and a mixture of magnetizable metal and dry lubricant (Fig. 23).

When the coil is energized, the fine metal particles mixed with dry lubricant are driven together in a strong bond which transmits the load. The mixture is literally "frozen" and "unfrozen" in direct proportion to the amount of current applied.

Any desired amount of slippage or solid drive can be obtained by increasing or decreasing the current flow.

Service Of Electrical Clutch Controls

If the clutch suddenly loses power and fails to function, look for a failure in the electrical circuit.

First check the electrical connections, wires, switch and the circuit breaker in the switch.

If these components are okay, check the voltage to the field and amperage of the field.

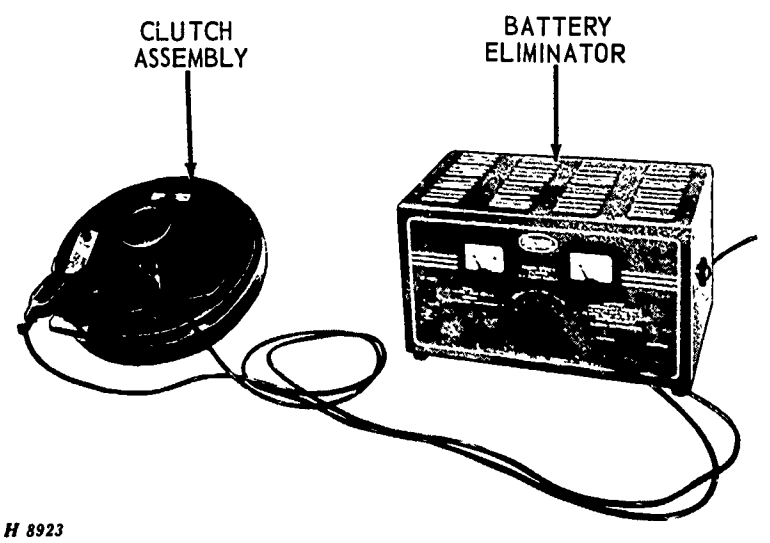

Fig. 24—Testing Field Coil In Electrical Clutch

To check the voltage to the field, the amperage of the field or the resistance of the field, use a battery eliminator (Fig. 24) or a storage battery and voltohmeter. For testing details, see the FOS "Electrical Systems" manual, Chapter 7.

Check the specifications on each clutch for correct input, amperage, and resistance per the machine Technical Manual.

DAMPENERS

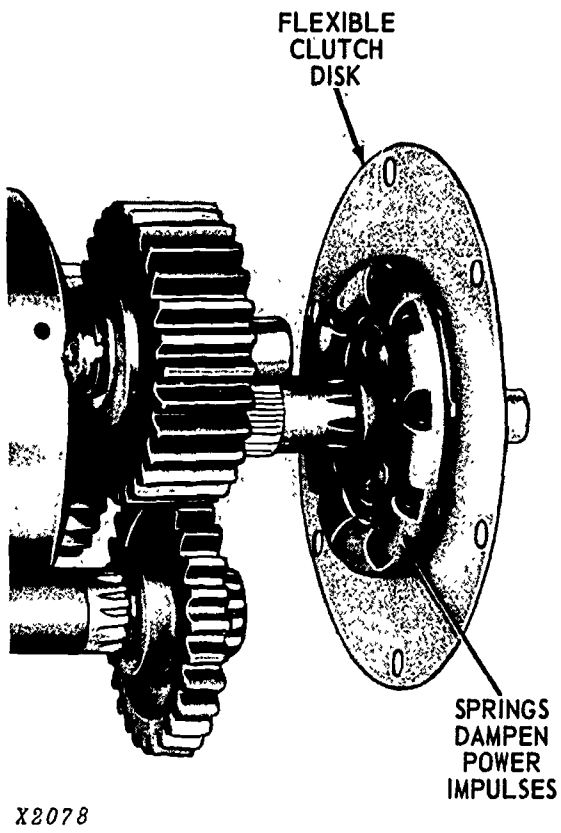

Fig. 25—Dampener Built Into Clutch Disk

The dampener is a shock-absorbing feature built into a flexible clutch disk (Fig. 25). The primary purpose of a flexible disk is to absorb power impulses from the engine which would otherwise be transmitted directly to the gears in the transmission.

A flexible clutch disk has torsion springs and friction disks between the plate and hub.

When the clutch is engaged, the springs cushion the sudden loading by flexing and allowing some twist between the hub and plate.

When the "surge" is past, the springs release and the disk transmits power normally.

MAINTENANCE OF CLUTCHES

Here are some things to watch for when servicing clutches:

1. Use care when disconnecting the clutch linkage. A bent rod or damaged carrier can result in lost motion, hard operation, or faster wear.

2. Don't let the full weight of the transmission rest on the clutch shaft. Use the proper hoists or jacks and keep the parts aligned when separating a machine. Failure to do so will result in damage to the clutch disk and release bearing.

3. Mark the pressure plate assembly and flywheel before removing the pressure plate. When assembled, the unit can be matched with the marks and engine balance maintained. When replacing the entire unit, clutch balance is not so critical because the new unit will be static-balanced. Rear crankshaft oil seal failure is often the result of an unbalanced clutch.

4. After removing the pressure plate assembly, check these four areas: clutch plate, clutch disk, flywheel plate and release bearing.

CAUTION: Use proper equipment and methods prescribed by the Technical Manual when dismantling the pressure plate assembly. Spring pressure must be kept under control and released evenly to avoid personal injury.

CLUTCH PLATE MAINTENANCE

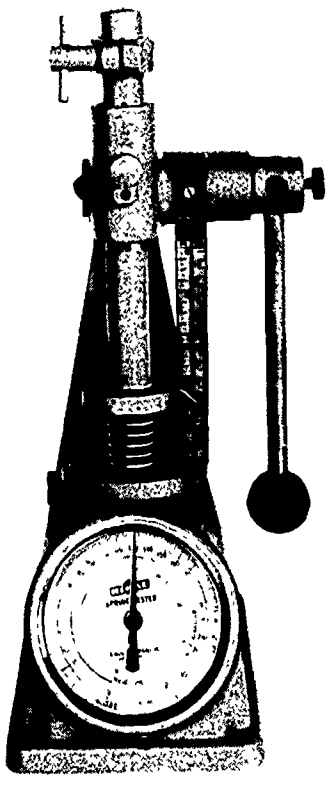

Fig. 26—Checking Tension of Clutch Springs

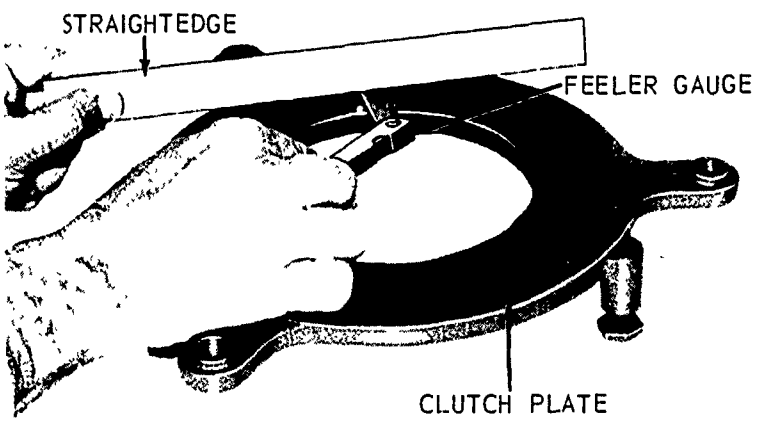

Fig. 27—Checking Clutch Plate For Warping

The clutch plate must be free from ridges, score marks and rough spots. Check the spring tension in the pressure plate assembly (Fig. 26) to make sure the plate is contacting evenly. Watch for excessive wear on release levers. Replace weak or broken springs. If the clutch plate is warped (Fig. 27), replace it.

CLUTCH DISK MAINTENANCE

The clutch disk is actually the heart of the clutch. Check for high and low spots of wear on the friction facings (Fig. 28). On riveted linings, use the level of material above the rivet head as an indicator of wear. Replace the linings if the rivet heads are flush or just below the outer surface.

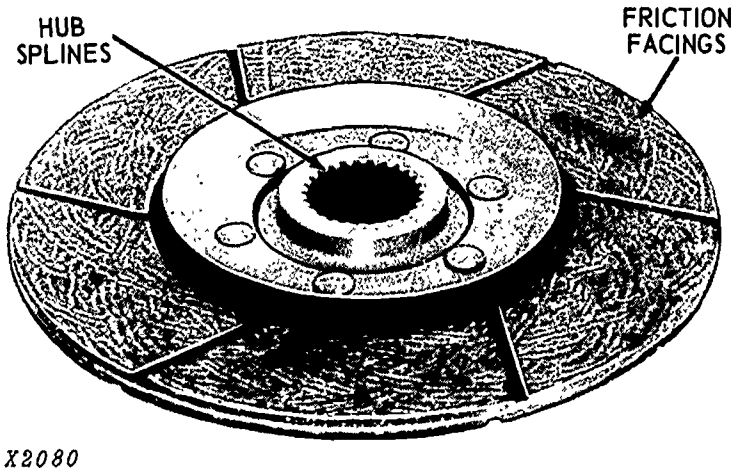

Fig. 28—Clutch Disk

Replace the disk if it appears glazed or cracked. Check any cushion springs and replace if damaged.

Make one last check of the clutch disk: Slide the disk onto the clutch shaft of the transmission. It should slide easily without restriction. If the disk will rock back and forth or from side to side, replace it. This may mean that the splines are badly worn. Try a new disk on the clutch shaft. If you get the same motion, the clutch shaft is worn and it will have to be replaced.

A good indication of clutch alignment is the clutch disk hub. If there is uniform wear along the splines, this means the clutch is aligned. If there is excessive wear on the front of the spline, this means the clutch is misaligned.

FLYWHEEL MAINTENANCE

Fig. 29—Checking The Flywheel Friction Surface For Roughness

The engine flywheel surface should be relatively free from roughness and ridges to engage the clutch correctly. Check it with a straightedge and feeler gauge (Fig. 29).

Look for heat checks on the flywheel surface. If the check markings are excessive, the flywheel must be replaced.

If the pilot bearing for the transmission input shaft appear out-of-round or badly worn, it should be replaced. Score marks on the pilot shaft indicate a bearing failure.

CLUTCH RELEASE BEARING MAINTENANCE

Check the release bearing to see if it rotates freely. If in doubt about the wear or lack of lubrication, replace this bearing.

SUMMARY: CLUTCH MAINTENANCE

When the clutch is disassembled for repair, take a few minutes to inspect all associated parts. This could prevent future problems and expense.

A rule of thumb for clutch repairs might be, "If in doubt, replace". Consider what is involved in the job. Will it be worth saving a few dollars now and having to do the entire job again in a few months?

We have given you the basic things to look for, but they are not the complete story. Remember these points and use your machine Technical Manual as a further guide for each clutch.

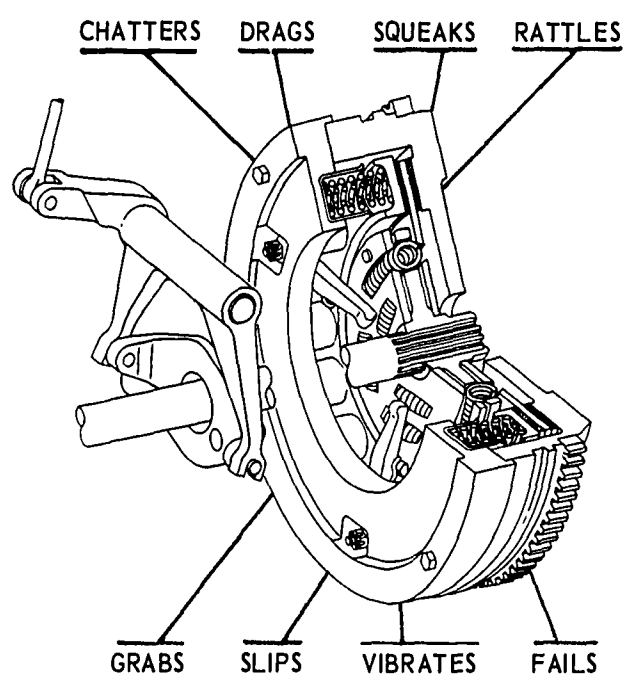

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Fig. 30—Clutch Troubles

TROUBLE SHOOTING OF CLUTCHES

The eight basic clutch troubles are:

- **Chattering:** *especially in low or reverse speeds.*
- **Dragging:** *or failure to release promptly and fully, thus making gears hard to shift.*
- **Squeaks:** *particularly when pedal is depressed.*
- **Rattles:** *especially at low speeds or standing.*
- **Grabbing:** *violent and sudden engagement.*
- **Slipping:** *failure to transmit full power.*
- **Vibrations** *at either high or low speed or periodically.*
- **Failure** *to transmit power at all.*

Note that different clutch problems can have the same cause. For example, oil or grease on the clutch disk facings can cause the clutch to *slip,* but may also make it *chatter, drag,* or *grab.*

CHATTERING

1. Oil or grease on clutch disk facings.
2. Glazed or worn facings.
3. Worn, loose or spongy engine mountings.
4. Worn or loose splines in clutch hub or on clutch shaft.
5. Wear or looseness in universal joint, differential, or drive axles.
6. Splined disk hub sticking on splined shaft.
7. Cracked or scored pressure plate or flywheel face.
8. Warped clutch disk.
9. Warped pressure plate.
10. Pressure plate sticking on driving studs.
11. Sticking or binding release levers.
12. Unequally adjusted release levers.
13. Unequal length or strength of clutch springs.
14. Bent clutch shaft.
15. Misalignment of power train.

DRAGGING

1. Oil or grease in clutch.
2. Warped clutch disk.
3. Splined disk hub sticking on splined shaft.
4. Sticking pilot bearing or bushing.
5. Sticking release sleeve.
6. Warped pressure plate or clutch cover.
7. Broken disk facing.
8. Accumulation of dust in clutch.
9. Incorrect clutch or pedal adjustment.
10. Engine idling too fast.
11. Misalignment of parts.

SQUEAKS

1. Clutch release bearing needs lubrication.
2. Pilot bearing in flywheel needs lubrication.
3. Release sleeve needs lubrication.
4. Misalignment.

RATTLES

1. Loose hub in clutch disk.
2. Worn release bearing.
3. Worn release part.
4. Worn pilot bearing.
5. Worn splines in hub or on shaft.
6. Worn driving pins in pressure plate.
7. Wear in transmission or drive line.
8. Worn transmission bearings.
9. Bent clutch shaft.
10. Unequal adjustment of release levers.
11. Misalignment.

GRABBING

1. Oil or grease on clutch disk facings.
2. Splined hub sticking on splined shaft.
3. Pressure plate sticking on driving studs.
4. Glazed or worn facings.
5. Sticking or binding release levers.
6. Sticking or binding clutch pedal or linkage.
7. Misalignment.

SLIPPING

1. Worn clutch disk facings.
2. Weak or broken springs.
3. Improper clutch or pedal adjustment.
4. Oil or grease on facings.
5. Warped disk.
6. Warped pressure plate.
7. Sticking release levers.
8. Pressure plate sticking or binding on studs.
9. Misalignment.

VIBRATIONS

1. Bent clutch shaft.
2. Defective clutch disk.
3. Dust in clutch.
4. Improper assembly of clutch to flywheel.
5. Use of rigid disk instead of flexible type.
6. Unmatched springs in pressure plate.
7. Misalignment of parts.

FAILURE

1. Clutch disk hub torn out.
2. Friction facings on clutch disk torn off or worn out.
3. Broken springs.
4. Incorrect adjustment of pressure plate.
5. Improper adjustment of clutch or pedal.
6. Splined disk hub stuck on splined shaft.

SUMMARY: TROUBLE SHOOTING OF CLUTCHES

You can locate the basic problems using the charts here. Refer to your Technical Manual for specific problems that you might face in the servicing of a clutch.

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TEST YOURSELF

QUESTIONS

1. Name four types of clutches.

2. What are the two kinds of disk-type clutches?

3. What characteristics must a clutch facing have? Name two.

4. How can you tell a rigid clutch disk from a flexible disk?

5. Fill in the blanks. "An overrunning clutch will _____ in one direction, but will _____ in the other."

6. True or False? "In an overcenter linkage, it is necessary to hold your foot on the pedal to keep the clutch disengaged."

7. True or False? "The clutch release bearing should rotate all the time in a plate-type clutch."

8. Grease or oil on a dry clutch disk surface usually causes:

1. Grabbing

2. Slipping

3. Both of the above

ANSWERS

1. Any four of these: Disk, plate, band, overrunning, cone expanding shoe.

2. Wet and dry.

3. Any two of these: Long wearing, heat resistant, allow little slippage.

4. The flexible disk has springs around its hub.

5. First blank "engage". Second blank "free wheel".

6. False—Overcenter linkage locks both while engaged and disengaged.

7. False.

8. Both grabbing and slipping (No. 3).

MECHANICAL TRANSMISSIONS / CHAPTER 3

X2015

Fig. 1—Mechanical Transmission In A Complete Power Train

INTRODUCTION

A **mechanical transmission** is a train of gears that transfers and adapts the engine power to the drive wheels of the machine.

The transmission does two jobs:

1) Selects speed ratios for various travel speeds.

2) Reverses the travel of the machine.

The transmission can also power a special drive such as a PTO (Chapter 9).

Normally the transmission is located to the rear of the engine and clutch and in front of the differential or ring gear (Fig. 1).

TYPES OF MECHANICAL TRANSMISSIONS

Mechanical transmissions are of three major types:

- **Sliding Gear**
- **Collar Shift**
- **Synchromesh**

The SLIDING GEAR transmission has two or more shafts mounted in parallel or in line, with sliding spur gears arranged to mesh with each other and provide a change in speed or direction.

The COLLAR SHIFT transmission has parallel shafts with gears in constant mesh. Shifting is done by locking free-running gears to their shafts using sliding collars.

The SYNCHROMESH transmission also has gears in constant mesh. However, gears can be selected without clashing, by synchronizing the speeds of mating parts *before* they engage.

In all three cases, the transmission is shifted by hand or foot. So we call them *mechanical* transmissions.

Let's look at each type of transmission in detail.

SLIDING GEAR TRANSMISSIONS

The *sliding gear* transmission is a popular transmission for use in farm and industrial machines. Made up mainly of spur gears and shafts, it is simple but gives a variety of speeds.

There are two basic designs:

- **Input and output shafts parallel**
- **Input and output shafts in line**

Let's see how each one operates.

INPUT AND OUTPUT SHAFTS PARALLEL

The input shaft drives the output shaft, which transmits the power. There is normally a third shaft which reverses or further varies the power flow. All three shafts are in parallel and interact through the shifting of their gears. The transmission in Fig. 2 provides three forward speeds and one reverse speed.

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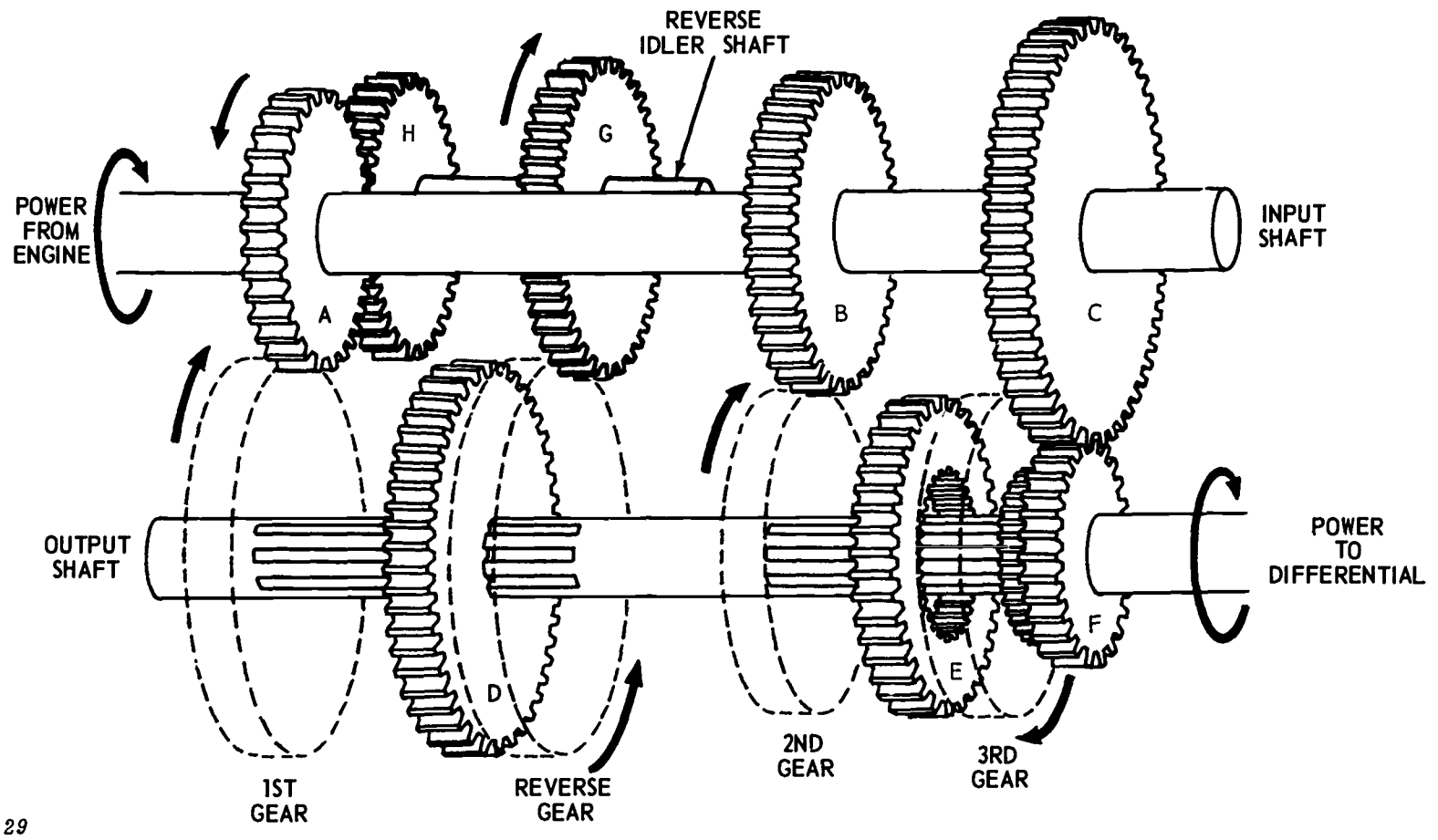


Fig. 2—Sliding Gear Transmission With Parallel Shafts

Gears D and E change the speed and direction (Fig. 2). Both of these gears slide on the output shaft, but are splined to it so as to turn it. All the other gears are fixed on their respective shafts, except gear F, which turns freely on the output shaft.

The dotted lines show how gears are shifted.

When gear D engages gear A, the transmission is in first or low gear.

When gear E engages gear B, the transmission is in second gear.

When gear E is engaged to gear F, the transmission is in third or high gear.

When gear D engages gear G, the rotation of the driven shaft is reversed. This places the idler gear shaft into the power train and feeds power in reverse. Gear G is powered by gear H, which is in constant mesh with gear A.

If neither gears D or E are engaged with another gear, the transmission is in neutral.

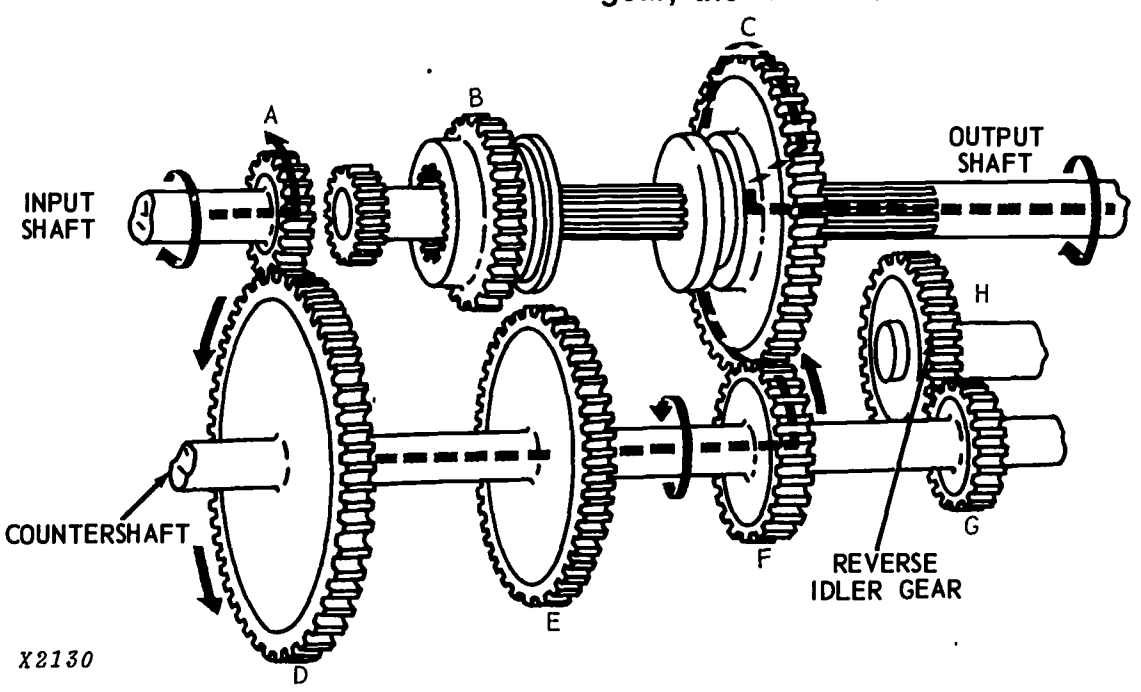


Fig. 3—Sliding Gear Transmission With Shafts in Line (First Gear Shown)

INPUT AND OUTPUT SHAFTS IN LINE

In this transmission (Fig. 3), input and output shafts lie in a straight line but are not connected. A third shaft, called a countershaft, "overlays" the two and transmits power between them.

The power flow in Fig. 3 is shown for low or first gear. Notice that power is flowing from gear A on the input shaft to gear D on the countershaft, which is also turning gear F. Gear F on the countershaft, in mesh with sliding gear C on the output shaft, causes that shaft to rotate and transmit power to the wheels.

A feature of this transmission is a high gear which bypasses the countershaft. It is provided by meshing gears A and B, and so locking the input and output shafts.

These two basic designs of sliding gear transmissions have many variations. They often provide as many as ten forward speeds and two reverse speeds.

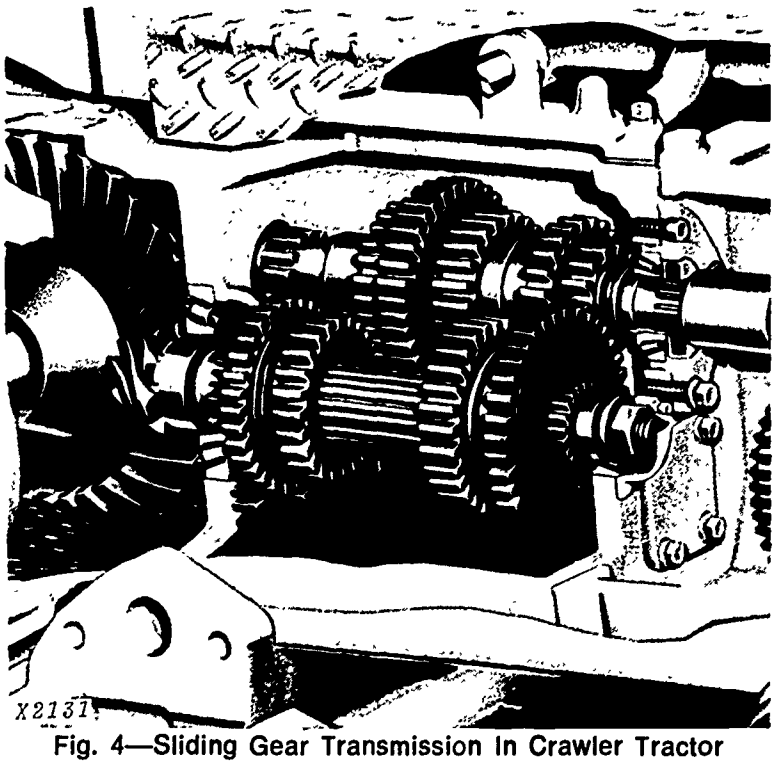


Fig. 4—Sliding Gear Transmission In Crawler Tractor

COLLAR SHIFT TRANSMISSIONS

The *collar shift* transmission (Fig. 5) has parallel shafts with the gears in constant mesh. In neutral, the gears are free-running but when shifted they are locked to their shafts by sliding collars.

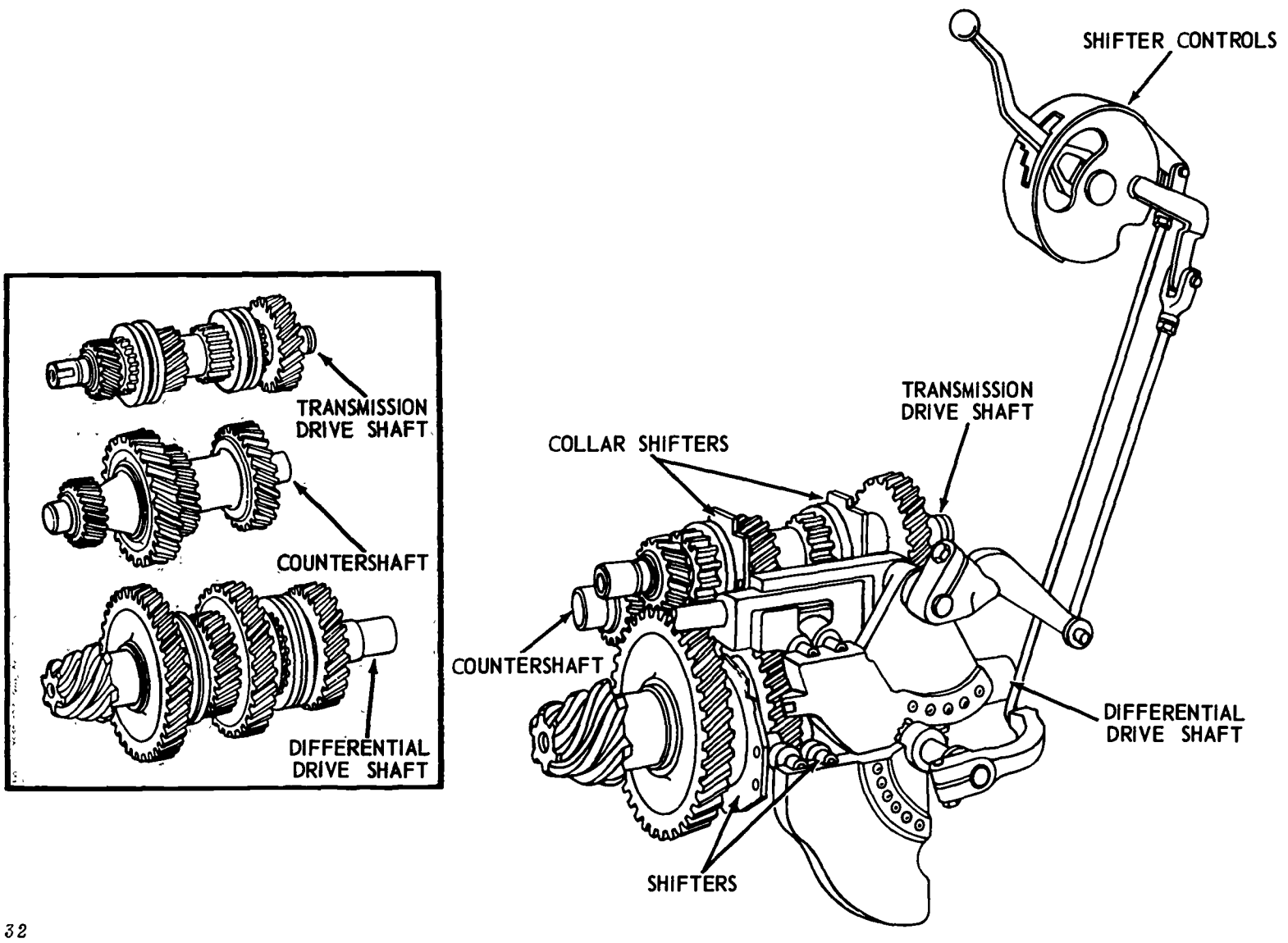


Fig. 5—Collar Shift Transmission For Wheel Tractor

The transmission shown in Fig. 5 has helical gears which remain in constant mesh. Helical gears usually provide quieter operation than the spur gears which the sliding gear transmission must use.

Since the gears are constantly in mesh and cannot slide on their shafts, one gear in each constant mesh gear set runs free on its shaft when in neutral.

When a gear is engaged, it is secured to its shaft by a collar or coupling device. The gear is disengaged when the collar is released and the gear turns freely again.

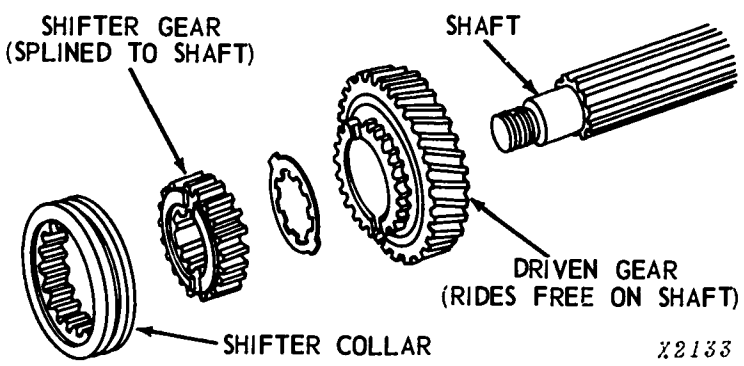


Fig. 6—Typical Shifter Collar And Mating Gear

Let's take a close look at the collar which locks a gear to the shaft. In Fig. 6, we see a typical shifter collar and its mating gear. The side of the gear will usually carry short splines. The shifter collar with internal splines is splined to a shifter gear which is, in turn, splined to the shaft. (Sometimes the shifter collar is splined directly to the shaft without a shifter gear).

Power is transmitted by shifting the collar so its internal splines are engaged with the external splines on the driven gear and the shifter gear.

The splines on the gears and collar have rounded ends for easier shifting.

OPERATION

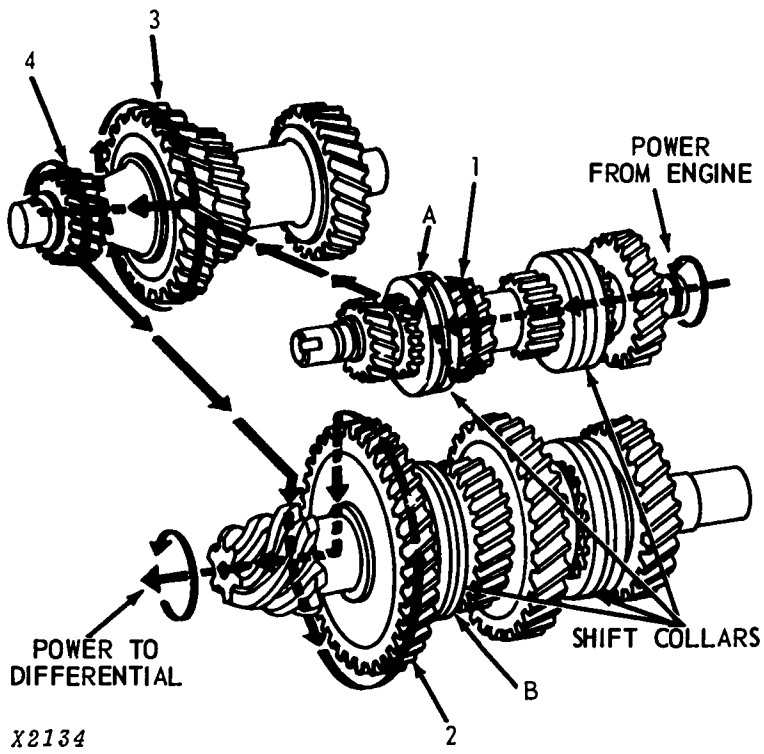


Fig. 7—Collar Shift Transmission
(Power Flow In First Gear Shown)

Now let's look at a collar shift transmission in operation. Fig. 7 shows a transmission which provides eight forward speeds and four reverse speeds. (The complete unit is shown in Fig. 5).

Power flow is indicated for first gear. Notice that collars A and B are locking gears 1 and 2 to their respective shafts, transmitting power to the differential and the drive wheels. Power flows through the mating gears 3 and 4 as shown by the arrows.

All eight speeds are obtained by securing the different gears to the shafts, using the collars.

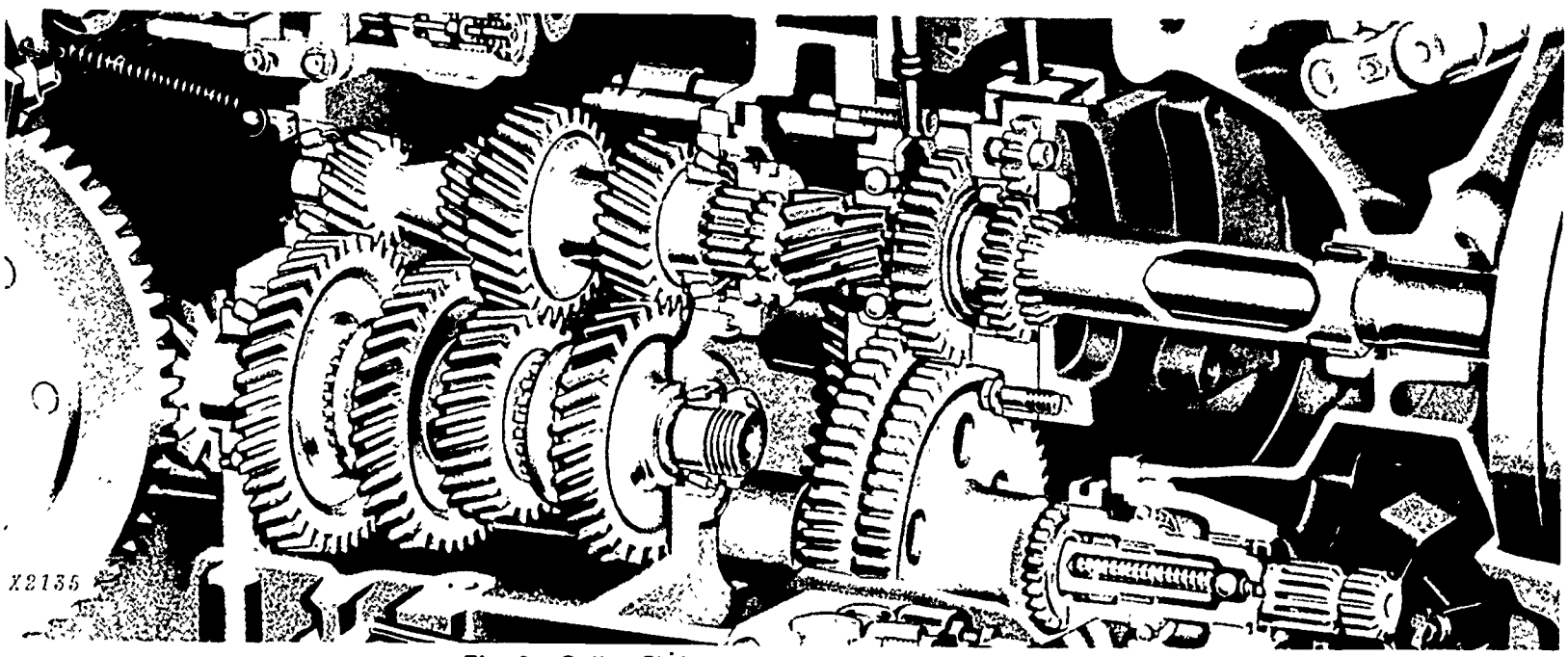


Fig. 8—Collar Shift Transmission In Wheel Tractor

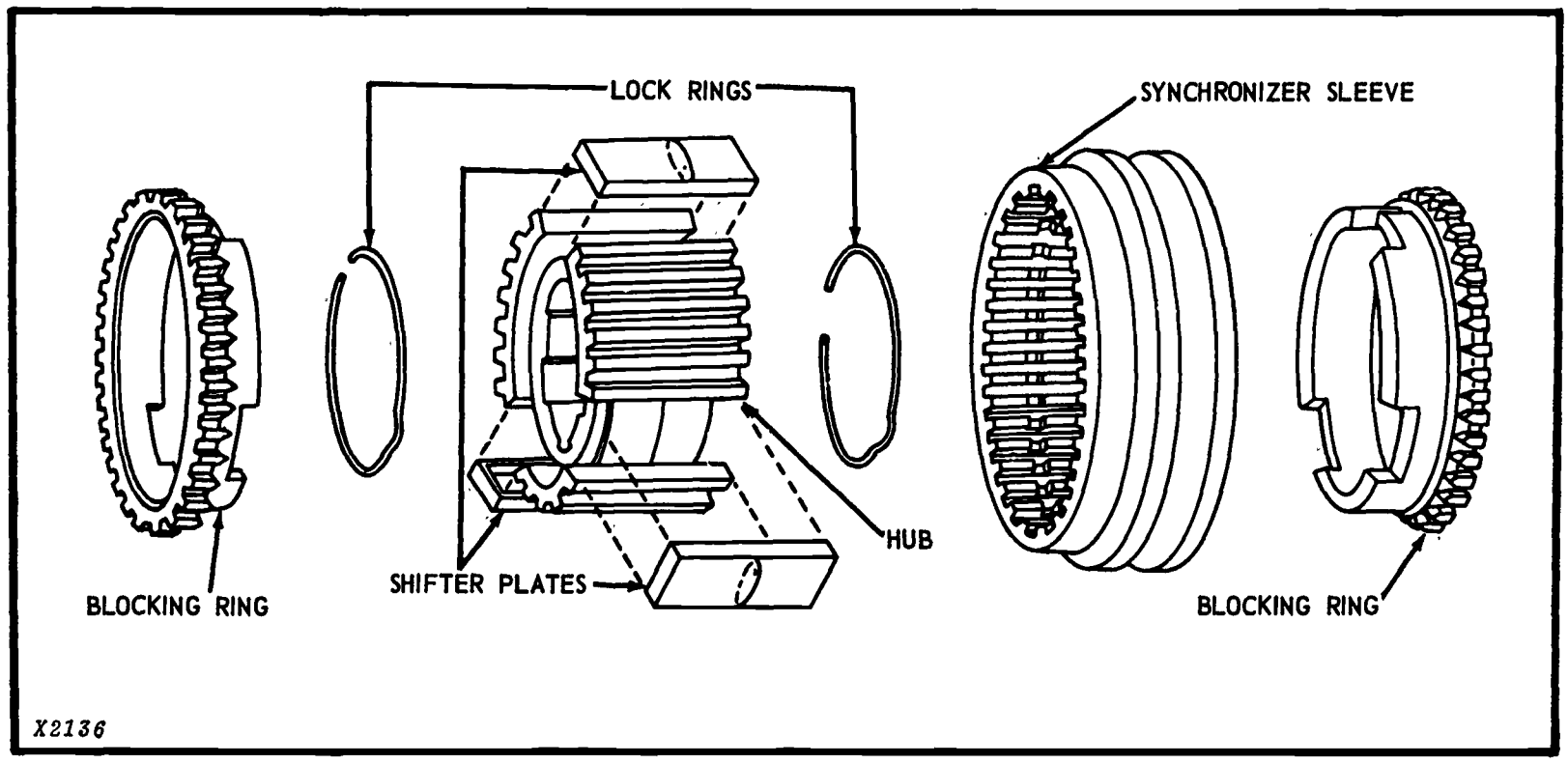


Fig. 9—Exploded View Of Block-Type Syncronizer

SYNCHROMESH TRANSMISSIONS

The *synchromesh* transmission is basically a constant mesh, collar-shift transmission with an extra device (called a synchronizer) to equalize the speed of the mating parts *before* they engage.

The synchronizer is used in all manual automotive transmissions and is common in other machines where "on-the-go" shifting is required.

Four common types of synchronizers are:

- **Block-Type Synchronizer**
- **Disk-And-Plate-Type Synchronizer**
- **Plain-Type Synchronizer**
- **Pin-Type Synchronizer**

Before we look at each of these synchronizers, remember that they have a common function—to help in engaging gears by synchronizing the speeds of the gear and the shaft *before* the connection is made. All types use friction to synchronize the mating parts.

BLOCK-TYPE SYNCHRONIZER

The parts of the block-type synchronizer are: the blocking rings, lock rings, hub, synchronizer sleeve, and shifter plates (Fig. 9).

The hub is splined to the shaft and the synchronizer sleeve is mounted on the hub. The two lock rings hold the shifter plates out against the sleeve. The bronze blocking rings each have three slots into which the ends of the shifter plates fit.

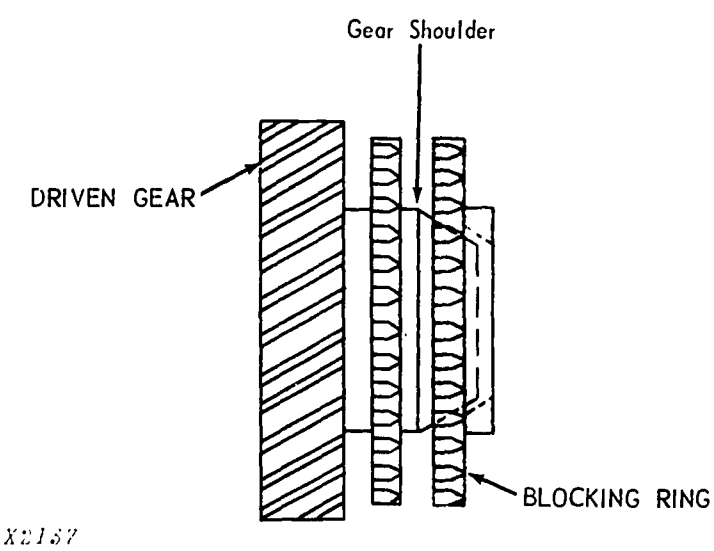
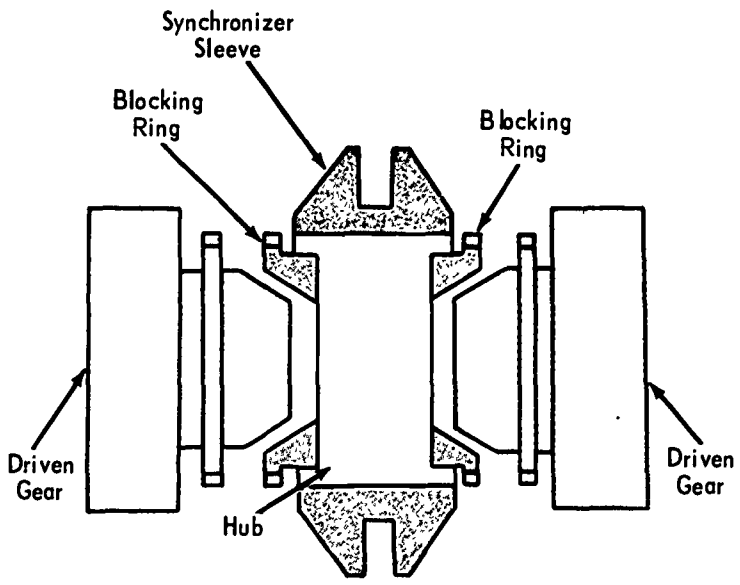
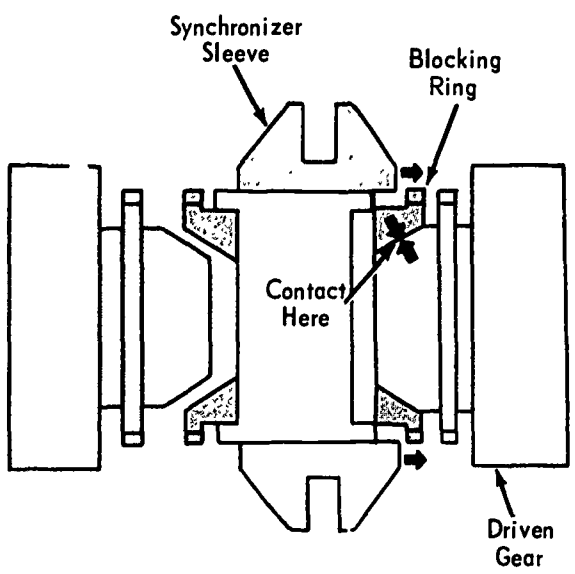


Fig. 10—Matching Cone Areas Of Gear And Blocking Ring

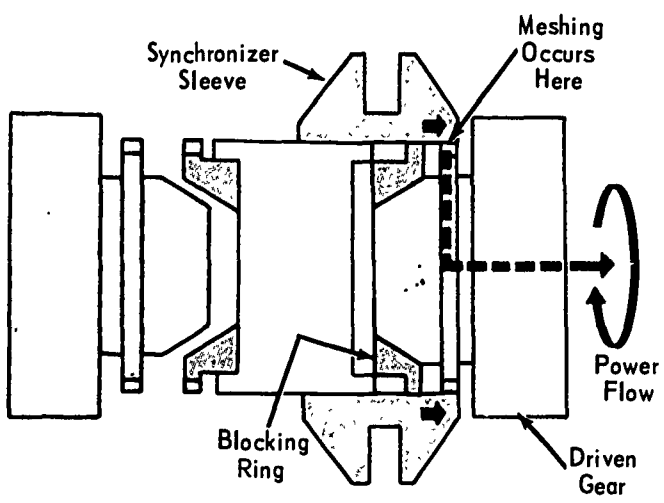
The inner surfaces of the blocking rings are cone-shaped and match the conical shape of the driven gear shoulders which they contact (Fig. 10). These cone-shaped surfaces provide the frictional force to synchronize the speed of the main shaft and the gear.



(A) SYNCHRONIZER IN NEUTRAL POSITION BEFORE SHIFT



(B) DURING SYNCHRONIZATION—BLOCKING RING AND GEAR SHOULDER CONTACTING



(C) SHIFT COMPLETED—COLLAR LOCKS DRIVEN GEAR TO HUB AND SHAFT

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Fig. 11—Block-Type Synchronizer In Operation

Operation Of Block-Type Synchronizer

In neutral, the parts are as shown in Fig. 11A.

During synchronization (Fig. 11B), the sleeve is moved toward the selected gear, pushing the blocking ring to the right. The ring contacts the shoulder of the driven gear and begins to synchronize the speeds of the two parts.

To complete the shift (Fig. 11C), the sleeve teeth pass through the blocking ring teeth (because both are now rotating at the same speed) and mesh with the clutch teeth on the driven gear. Power then flows as shown by the dotted lines and arrows.

DISK-AND-PLATE-TYPE SYNCHRONIZER

Shown in Fig. 12 are the parts which make up the disk-and-plate-type synchronizer.

Note the relationship of the parts to each other.

This synchronizer uses friction disks and plates to bring both gears to the same speed for engaging.

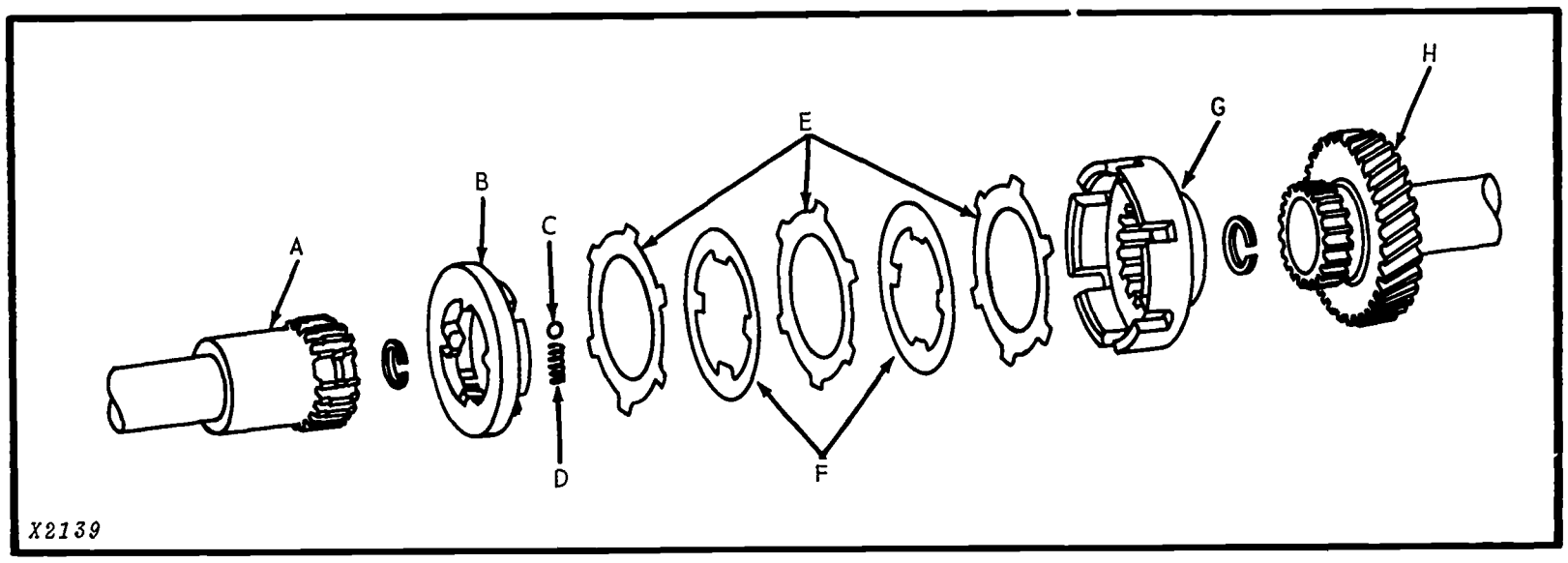
The blocker (B) rides on and is driven by the synchronizer gear (A). The blocker is held in neutral on the gear by four detent balls (C) and springs (D).

The synchronizer drum (G) is driven by the output gear (H). Therefore, the drum is traveling at a different speed than the blocker.

To bring the blocker and the drum to the same speed, three synchronizer disks (E) and two separator plates (F) are housed between the drum and blocker.

The tangs on the synchronizer disks locate themselves inside the synchronizer drum slots and so travel at the same speed as the drum and gear (H).

The separator plates have internal tangs which hold them in position on the blocker, giving them the same rotating speed as the blocker and synchronizer gear.



A—Input Shaft With Synchronizer Gear
B—Blocker
C—Detent Ball
D—Detent Spring
E—Synchronizer Disk
F—Separator Plate
G—Synchronizer Drum
H—Output Gear And Shaft

Fig. 12—Exploded View Of Disk-And-Plate-Type Synchronizer

Operation

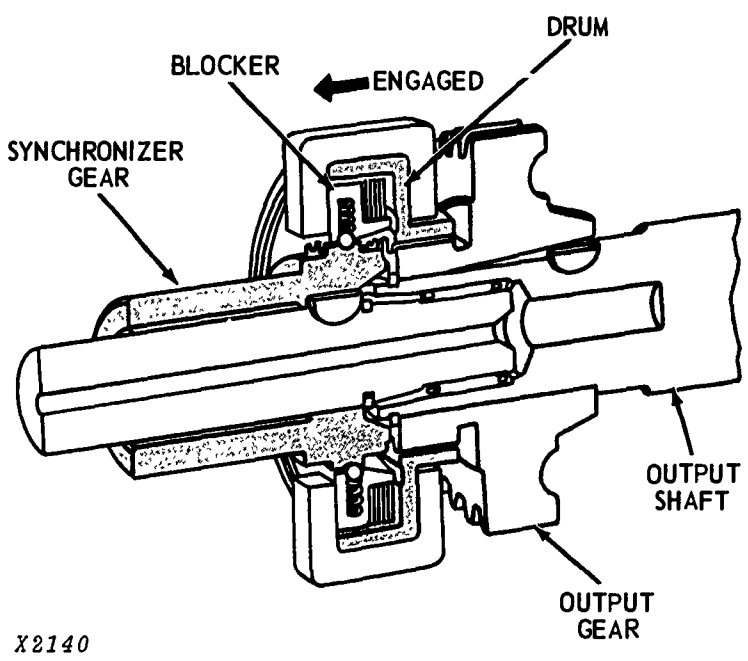


Fig. 13—Action Of Disk-Type Synchronizer

Shifts are made by coupling the output gear to the synchronizer gear (Fig. 13).

When the shifter fork moves the drum forward, the synchronizer disks (which are connected to the drum) and the separator plates (which are connected to the blocker) make contact as shown. As the contact is made, the blocker tends to rotate about its gear instead of moving forward in the direction the shifter fork is moving. This action forces the drive lugs on the blocker to engage into the outer edge of the detent ball depression cut into the synchronizer gear.

Since the blocker is now locked into the synchronizer gear, extra forward motion of the shifter tends to compress the disks and plates into proper clutching action. This action matches the speed of the synchronizer gear and blocker to the speed of the output gear.

As soon as both gears are moving at the same speed, the thrust force locking the blocker into the synchronizer gear is relieved and the blocker backs out of its locked position with the aid of the detent balls and springs.

This synchronizing action is almost instantaneous. When both gears are moving at the same speed, the drum can then be moved forward to engage both gears. A ridge on the highest teeth of the synchronizer gear limits the forward travel of the drum. This prevents the synchronizer drum from traveling too far forward and losing its contact with the output gear.

PLAIN-TYPE SYNCHRONIZER

The plain-type synchronizer is similar to the block-type synchronizer, but has fewer parts.

The hub is splined to the shaft (Fig. 14). The sleeve is mounted on the hub and connected to it by the springs and balls located radially around the hub.

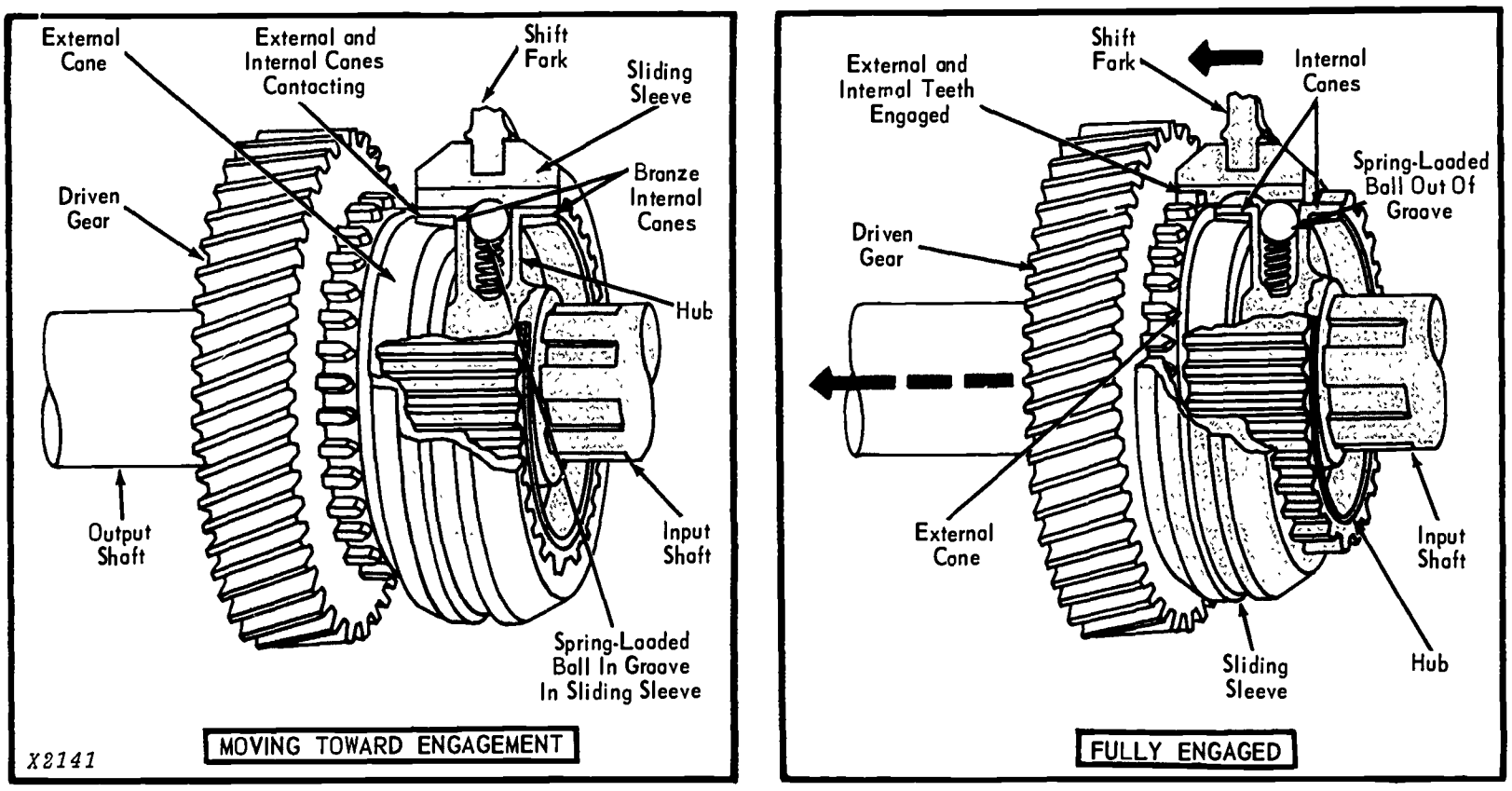


Fig. 14—Plain-Type Synchronizer

Operation

To engage, the assembly is moved toward the gear to be engaged as shown at left in Fig. 14. The cone-shaped friction area of the hub contacts the cone-shaped area of the gear and accelerates or decelerates it to the same speed as the synchronizer. The small coil springs hold the balls in the groove in the center of the sleeve. This prevents the sleeve from moving off the hub and the sleeve teeth from engaging with the gear teeth until enough pressure has been put on the cone-shaped friction area to synchronize the two parts. Then further movement of the sleeve pushes the balls in, compressing the springs, and the sleeve teeth engages the teeth on the gear, completing the shift. This action is shown at right in Fig. 14.

PIN-TYPE SYNCHRONIZER

Fig. 15 illustrates a pin-type synchronizer. The actuating hub is splined to the shaft and rotates with it. The outer stop rings are splined to the ends of the gears. The stop ring and pin assemblies are loosely pinned to the actuating hub.

Operation

When the actuating hub is moved to either the right or left, the stop ring and pin assemblies hold the loose-fitting pin against the side of the holes in the actuating hub. The actuating hub is prevented from engaging the gear by the chamfered shoulder on the stop ring and the pin assembly.

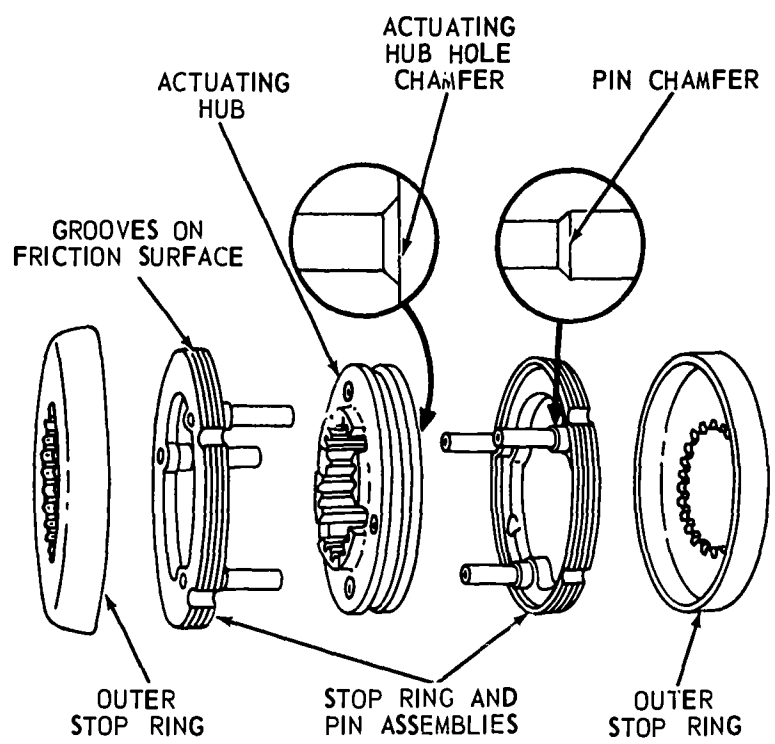


Fig. 15—Pin-Type Synchronizer

When all parts are rotating at the same speed, the force between the pin and actuating hub is reduced. The hub can then move over the large base of the pins, and the internal splines on the hub can engage the splines on the gear. Slight chamfers on the pin and actuating hub, as well as rounded ends of the splines on the hub and gear, permit these parts to align themselves and mesh easily.

SYNCHROMESH TRANSMISSION IN OPERATION

Now that we've explained the different types of synchronizers, let's see how they work in an actual synchromesh transmission.

Fig. 16 shows a three-speed transmission which is synchronized in second and third gear. Notice that this transmission uses both a sliding gear, a synchronizer to change speeds, and in-line shafts.

Gear (A) is splined to the input shaft and is in constant mesh with gear (D). Gear (B) turns freely on the output shaft.

Low and reverse is provided by sliding gear (C) into mesh with gear (F) or gear (G), the reverse idler.

Second gear is provided by sliding the synchronizer towards gear (B), synchronizing it and locking it to the output shaft. Power flow in Fig. 16 is for second gear.

Third or high gear is provided by sliding the synchronizer towards gear (A), synchronizing it, and locking the input shaft to the output shaft. Power then flows directly through the transmission from input to output.

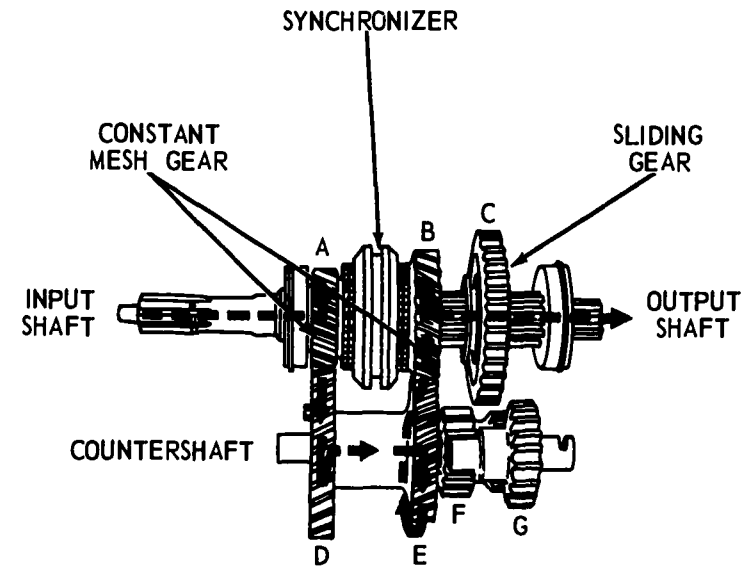


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Fig. 16—Three-Speed Synchromesh Transmission (Power Flow For Second Gear Shown)

A complete synchromesh transmission for a wheel tractor is shown in Fig. 17.

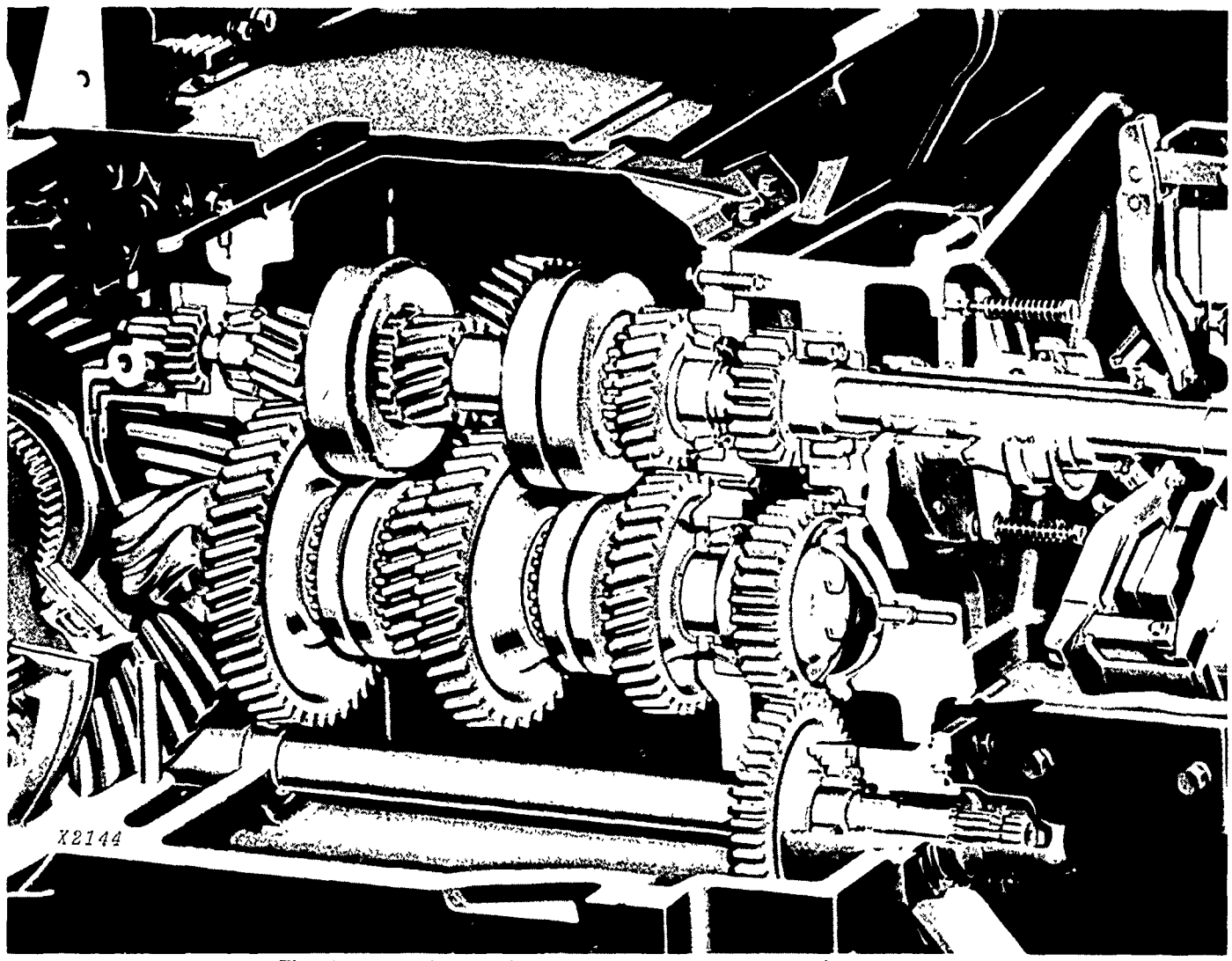

Fig. 17—Synchromesh Transmission In Modern Wheel Tractor

SHIFT CONTROLS

Now let's look at the *shift controls* which actuate the various mechanical transmissions.

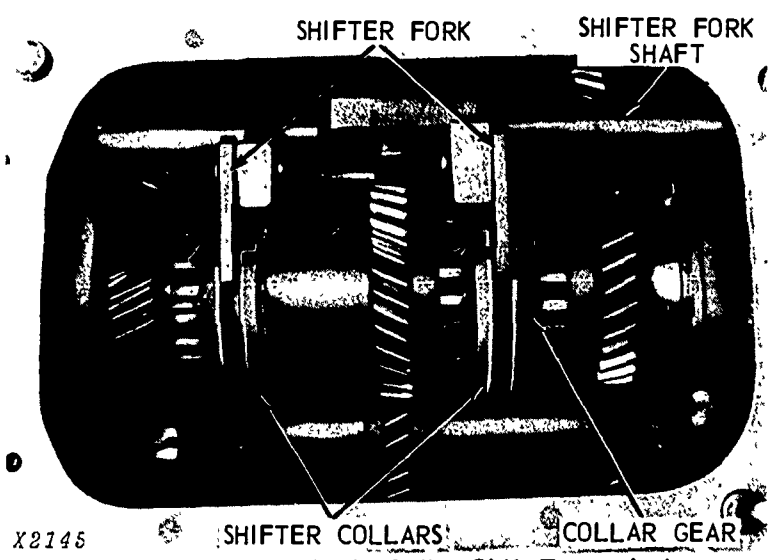

Fig. 18—Shifter Forks In Collar Shift Transmission

In sliding gear, collar shift, and synchromesh transmissions, the gears or collars are moved by means of a shifter fork which fits in a groove in the collar or gear (Fig. 18). This fork is connected to and moved manually by the gearshift lever. How this connection is made varies.

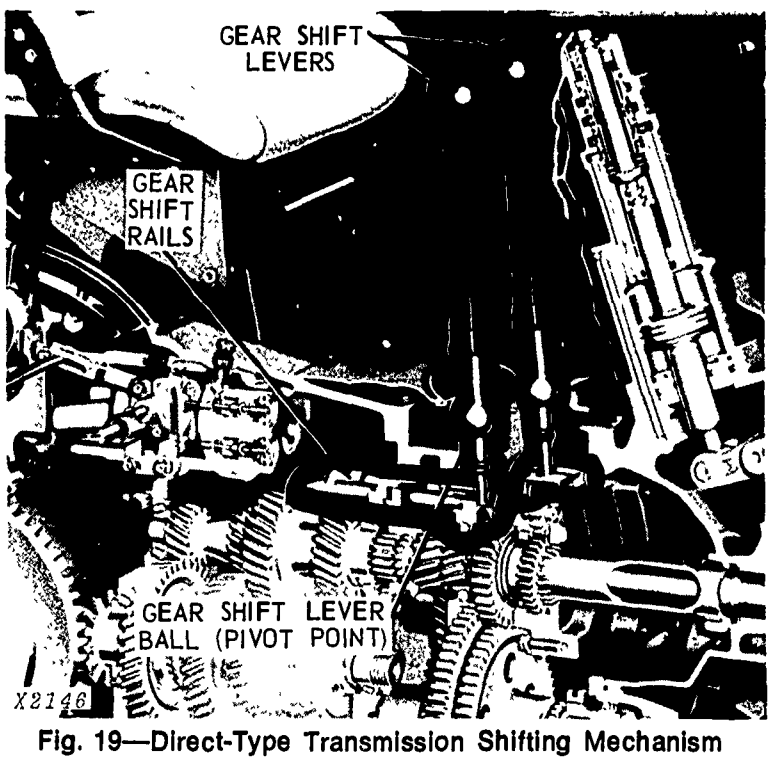

Fig. 19—Direct-Type Transmission Shifting Mechanism

Let's briefly look at two popular shifter mechanisms:

1) Direct-Type Shifters

2) Cam-Type Shifters

DIRECT-TYPE SHIFTERS

In the direct shifter, the gearshift lever reaches directly into the transmission from the operator's platform (Fig. 19).

The shifter forks, which slide the gears or collars, are attached to the gearshift rails or shafts. The gearshift lever in Fig. 19 has a ball that fits into a socket in the top of the transmission cover. This permits swiveling of the gearshift lever into the various shift positions. Movement of the lever causes the finger on the lower end to select and move one of the rails, its forks, and a gear or collar.

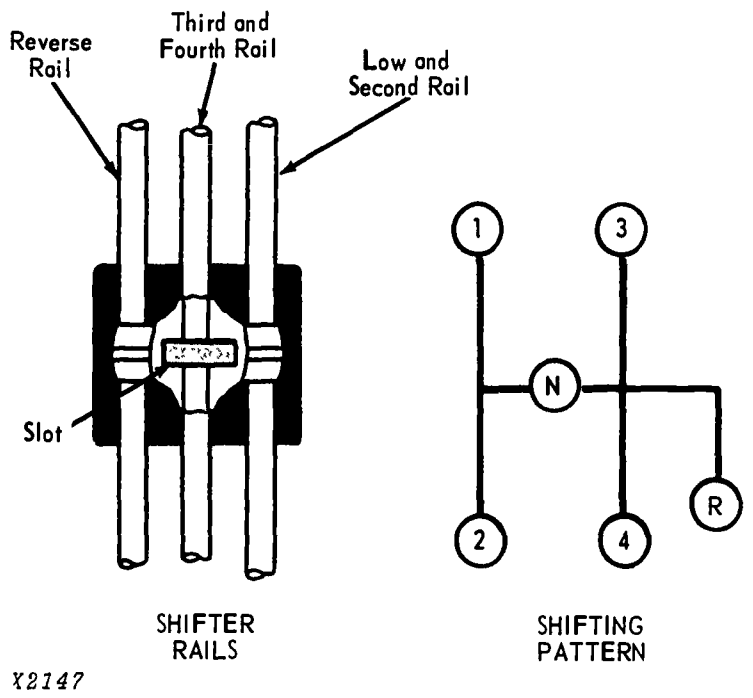

Fig. 20—Shift Pattern On The Four-Speed Transmission Shown in Fig. 19.

For example, in a four-speed transmission (Fig. 20), as the gearshift lever is moved from neutral (N) to the left, the finger on the lower end of the lever moves into the slot in the low-and-second speed rail. This action selects the rail, forks, and gears to be moved. Then, as the lever is pushed forward into low speed, the rail assembly is pushed toward the rear, engaging the low gear.

Locking Of Direct Shifters

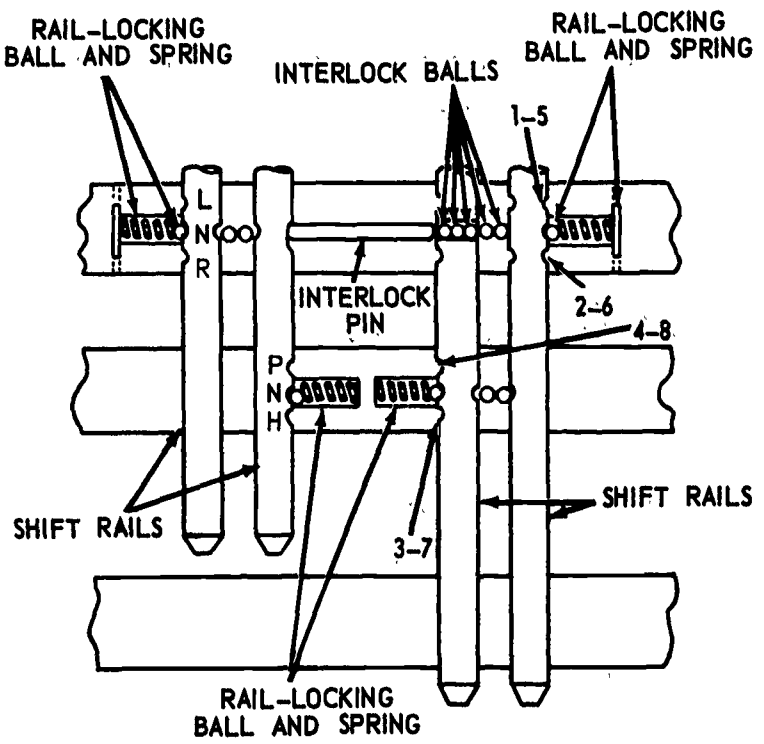

Fig. 21—Locking System For Shifter Rail

To hold the shift rail in position and to prevent other rails from moving, a locking system must be used. Fig. 21 illustrates a popular type.

The shift rails contain spring-loaded *detent balls* that drop down into undercuts on the rails as the rails are moved into the various shift positions. This locks the gears in mesh.

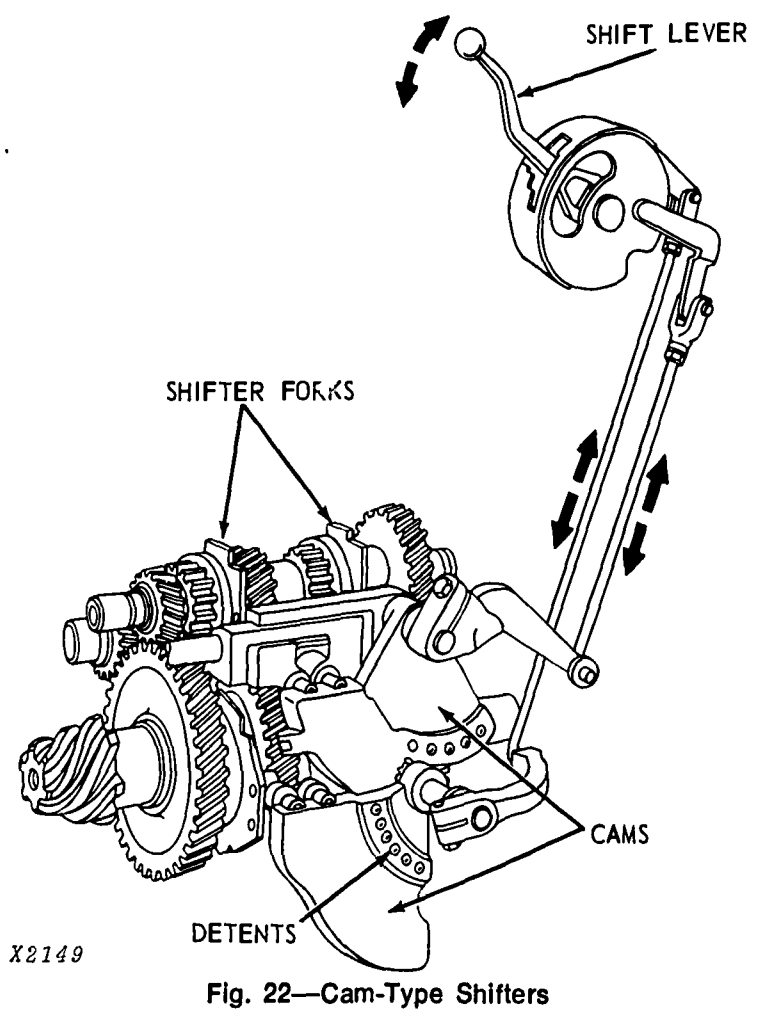

Fig. 22—Cam-Type Shifters

To prevent movement of more than one rail at a time, *interlock balls* are placed *between* the shift rails as shown. When a rail is moved, the balls are forced out of the undercuts in the side of the rail and into the undercuts on the other rails, locking them firmly into position.

CAM-TYPE SHIFTERS

Fig. 22 shows a cam-type shifter with a shifter cam for the range gearing and one for the speed gearing. The cams are operated through a linkage of rods and arms. When the shift lever is moved, the linkage moves the shifter cam about its pivot point. The cam in turn moves the shifter forks.

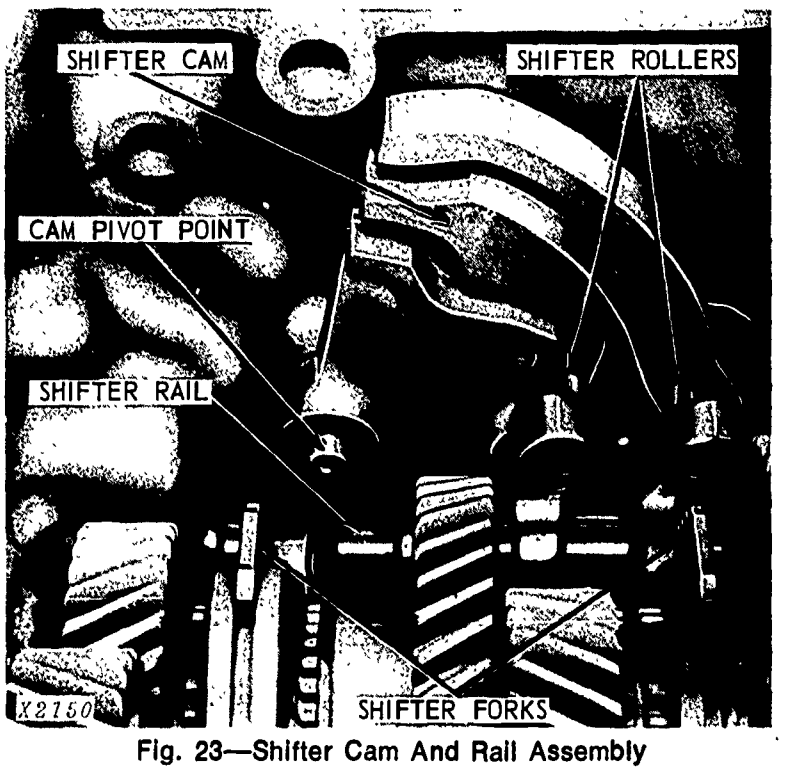

Fig. 23—Shifter Cam And Rail Assembly

The shifter cam (Fig. 23) is a plate with two irregular grooves. Rollers on the rail and fork assembly slide in these grooves. When the cam pivots, the rollers, sliding in the irregular grooves, move the forks to engage the selected gear.

Like the direct-type shifter, this unit has detents which lock the transmission in the desired gear. These detents are located in the cam itself as shown in Fig. 22.

ADJUSTMENTS

When a transmission is disassembled to replace bearings or gears, the shafts may require preload or endplay adjustments as explained in Chapter 1. The specific procedures and measurements are supplied by the manufacturer in his technical manual.

GENERAL MAINTENANCE

Mechanical transmissions need little maintenance other than periodic oil changes. However, when you repair a transmission, examine the whole gear train to locate worn or faulty parts and repair or replace them at that time. Thus you may prevent a breakdown and the need to disassemble the transmission once again.

Some things to look for:

1. Excessive gear tooth wear or broken teeth.

2. Worn-out bearings.

3. Broken or distorted shifter detent springs or scored or flat detent balls.

4. Damaged or plugged transmission oil lines or passages in shafts.

5. In sliding gear transmissions, badly worn splines.

6. In collar shift transmissions, excessively worn teeth in shifter collars and hubs.

7. In synchromesh transmissions, scored contact surfaces on blockers, drums, or disks.

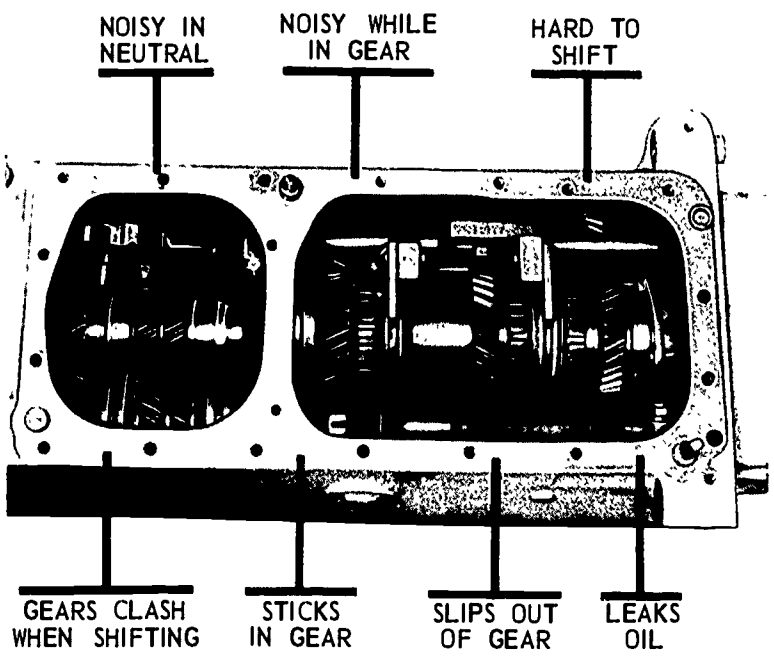

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Fig. 24—Trouble Shooting Problems With Mechanical Transmissions

TROUBLE SHOOTING

These trouble shooting charts are given as a general guide to the common transmission failures. They list what the cause might be, and the remedy.

TRANSMISSION NOISY IN NEUTRAL

Possible Cause	Remedy
1. Transmission not aligned with engine.	1. Align.
2. Bearings dry, badly worn, or broken.	2. Lubricate or replace.
3. Transmission oil level low.	3. Refill.
4. Gears worn, scuffed, or broken.	4. Replace.
5. Countershaft sprung or badly worn.	5. Replace.
6. Excessive endplay of countershaft.	6. Adjust or replace worn parts.

TRANSMISSION NOISY WHILE IN GEAR

1. All causes noted in "Transmission Noisy In Neutral."	1. Same as above.
2. Main shaft rear bearing worn or broken.	2. Replace.
3. Gear teeth worn.	3. Replace gear.
4. Engine vibration dampener defective.	4. Replace or adjust.
5. Speedometer drive gears worn.	5. Replace.
6. Clutch friction disk defective.	6. Replace.
7. Gears loose on main shaft.	7. Replace worn parts.
8. Transmission oil level low.	8. Refill.

TRANSMISSION HARD TO SHIFT

1. Engine clutch not releasing.	1. Adjust.
2. Sliding gear tight on shaft splines.	2. Clean splines or replace shaft or gear.
3. Shift linkage out of adjustment.	3. Adjust.
4. Main shaft splines distorted.	4. Replace or clean splines.
5. Synchronizing unit damaged.	5. Replace defective parts.
6. Sliding gear teeth damaged.	6. Replace.

GEARS CLASH WHEN SHIFTING

1. Clutch not releasing.	1. Adjust.
2. Synchronizer unit defective.	2. Replace defective parts.
3. Gears sticky on main shaft.	3. Free up gears. Replace defective parts.

TRANSMISSION STICKS IN GEAR

1. Clutch not releasing.	1. Adjust.
2. Detent balls stuck.	2. Free.
3. Shift linkage out of adjustment not lubricated.	3. Adjust or lubricate.
4. Sliding gears tight on shaft splines.	4. Clean splines or replace shaft or gears.

TRANSMISSION SLIPS OUT OF GEAR

1. Shift linkage out of adjustment.	1. Adjust.
2. Gear loose on shaft.	2. Replace shaft or gear.
3. Gear teeth worn.	3. Replace gear.
4. Excessive endplay in gears.	4. Replace worn or loose parts.
5. Lack of spring tension on shift lever detent.	5. Install new spring.
6. Badly worn transmission bearings.	6. Replace.

TRANSMISSION LEAKS OIL

1. Oil level too high.	1. Drain to proper level.
2. Gaskets damaged or missing.	2. Install new gaskets.
3. Oil seals damaged or improperly installed.	3. Install new oil seals.
4. Oil throw rings damaged, improperly installed, or missing.	4. Install oil throw rings properly.
5. Drain plug loose.	5. Tighten.
6. Transmission case bolts loose, missing, or threads stripped.	6. Tighten or replace.
7. Transmission case cracked.	7. Replace.
8. Lubricant foaming excessively.	8. Use recommended lubricant.

TEST YOURSELF

QUESTIONS

1. What are the three common types of mechanical transmissions?

2. (True or False?) "In some sliding gear transmissions, the input and output shafts are locked together in high gear."

3. What is one advantage of the collar shift transmission over the sliding gear?

4. Which type of transmission allows "on-the-go" shifting while the machine's wheels are still rolling?

5. What is the purpose of the countershaft?

6. Does a collar shift transmission normally have spur or helical gear teeth?

7. What is a chamfer?

(Answers on next page.)

ANSWERS

1. Sliding gear, collar shift, and synchromesh.

2. True.

3. The collar shift transmission usually runs quieter than a sliding gear type. (This is because it can use helical—instead of spur-tooth gears.)

4. Synchromesh.

5. The countershaft serves to transmit and vary the power flow between the input and output shafts.

6. Helical.

7. A chamfer is a rounded area or bevel or the edge of gear teeth, etc. (It helps to make gears mesh easier when they are shifted.)

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HYDRAULIC ASSIST TRANSMISSIONS / CHAPTER 4

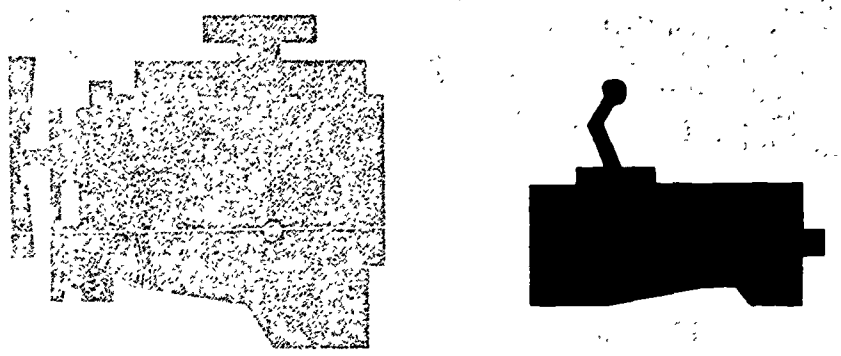

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Fig. 1—Hydraulic Assist Transmission In A Complete Power Train

INTRODUCTION

The **hydraulic assist transmission** is a train of gears which can be shifted without interrupting the flow of power.

The gears are kept in constant mesh while two or more hydraulic clutches control the flow of power "on the go."

The parts work together as follows:

- **Hydraulic clutches—control the power flow**
- **Gear train—transmits the power flow**

When the operator shifts gears, hydraulic oil engages the clutches that route power to the selected gears.

A *hydraulic clutch* is normally an alternating pack of friction disks and plates (Fig. 2).

The clutch is *engaged* when pressure oil is sent to push the piston against the disks and plates, clamping them together. The disks are splined to the drum, while the plates are splined to the hub. As a result, input power through the hub is sent on through the hub to the output by the engaged clutch.

The clutch is *disengaged* when oil pressure is released and the piston moves away from the clutch pack. This frees the disks from the plates and the power flow is stopped. Spring action or oil pressure on the other side of the piston may be used to help release the disks and plates.

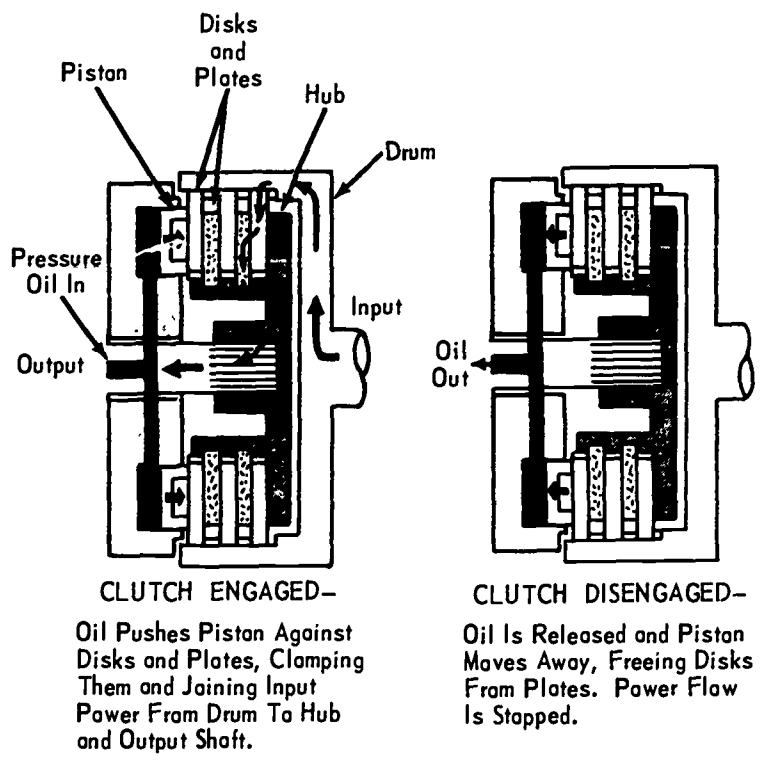

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Fig. 2—Hydraulic Clutches Control The Power Flow In Hydraulic Assist Transmissions

The *gear train* usually takes one of two forms:

- **Countershaft**
- **Planetary**

Let's look at each one in detail.

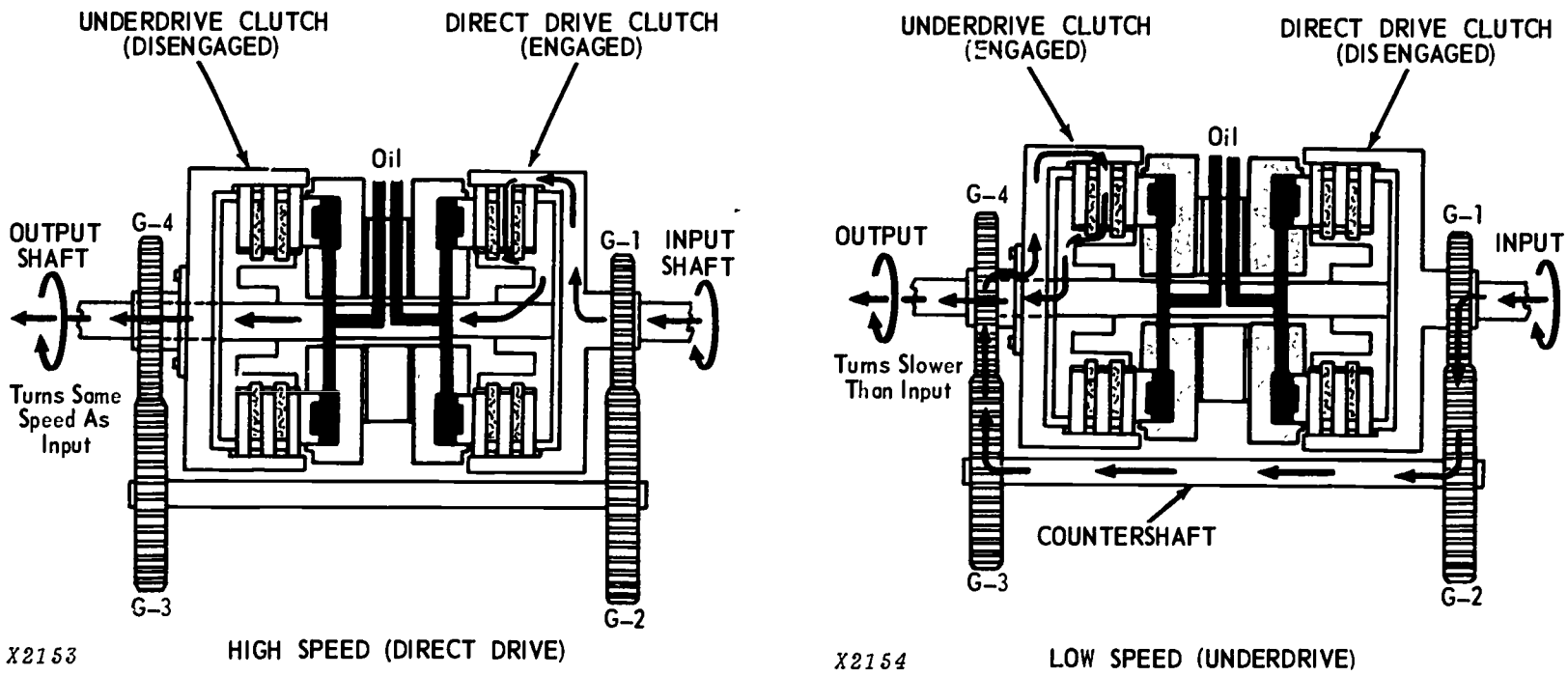

Fig. 3—Countershaft Transmission (High-Low Speed Unit)

COUNTERSHAFT TRANSMISSIONS

Countershaft transmissions allow one set of gears to be shifted without disturbing the other gear ratios in the transmission.

Let's look at three common models—high-low speed units, reverser units, and high-low-reverse units.

HIGH-LOW SPEED UNIT

The simplest countershaft transmission is the high-low speed unit shown in Fig. 3. It has two hydraulic clutches and four gears in mesh. Whenever one clutch is engaged, the other is disengaged.

The input and output shafts are not connected unless the direct drive clutch is engaged.

When engaged, this clutch sends input power from the outer drum through to the inner hub as explained in Fig. 2.

In direct drive, both shafts are locked together and rotate at the same speed. This gives *high speed* as shown in Fig. 3.

For *low speed,* the underdrive clutch is engaged. Gear G-1 is fixed on the input shaft so power is routed through mating gear G-2, along the countershaft, out through gears G-3 and G-4 and to the underdrive clutch drum. Power then flows through the engaged clutch pack to the inner hub which is fixed to the output shaft.

The output shaft turns at a slower speed than the input shaft, giving the low speed. The actual speed depends upon the ratio of the two gear sets.

Underdrive means that the ouput shaft turns *slower* than the input. In some units the output turns *faster* than the input and these are called **overdrives.**

REVERSER UNIT

To get a reverse speed from the countershaft unit, another gear (G-5) is added between gears G-1 and G-2 as shown in Fig. 4.

The countershaft will now rotate in the same direction as the input shaft.

In **forward speed,** the forward clutch is engaged and power flows straight through, bypassing the countershaft.

In **reverse speed,** the reverse clutch is engaged and locks gear G-4 to the output shaft. Power is transmitted through the countershaft as shown by the arrows, causing the output shaft to rotate in the opposite direction from the input shaft.

An actual reverser unit is shown (outlined in blue) in Fig. 5.

The engine power source is shown at right, while the transmission gear train is shown at left center.

The reverser unit gives on-the-go reversing, while the transmission gear train sets up the basic gear ratios. (The gear train is a sliding gear type —see Chapter 3.)

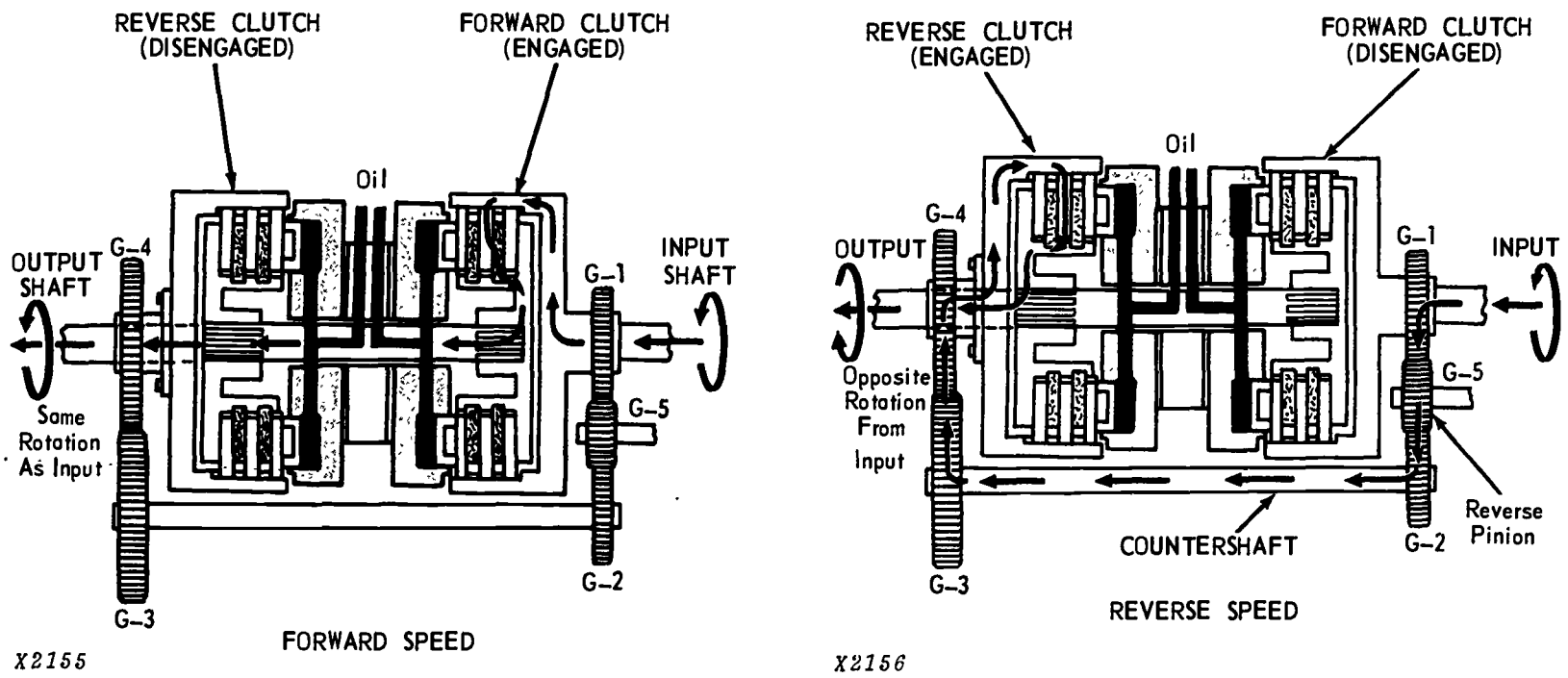

Fig. 4—Countershaft Transmission (Reverser Unit)

HIGH-LOW-REVERSE UNIT

If both a reverse and an underdrive countershaft are used in the same transmission with three clutches, these options are available:

1) High (direct drive)

2) Low (underdrive)

3) Reverse

Extra speeds can be obtained by simply adding more countershafts and more clutches.

PLANETARY TRANSMISSIONS

Planetary gears work like our solar system. The pinions or planet gears each turn on their own axis and, at the same time, rotate around the sun gear (Fig. 6). This is much like the earth and other planets rotating around the sun.

When used with hydraulic clutches and brakes, the planetary can serve as a direct coupler, a reduction gear, or a reversing gear.

A planetary gear set allows gear ratios to be changed without actually engaging or disengaging gears. As a result, there is little or no interruption of the power flow.

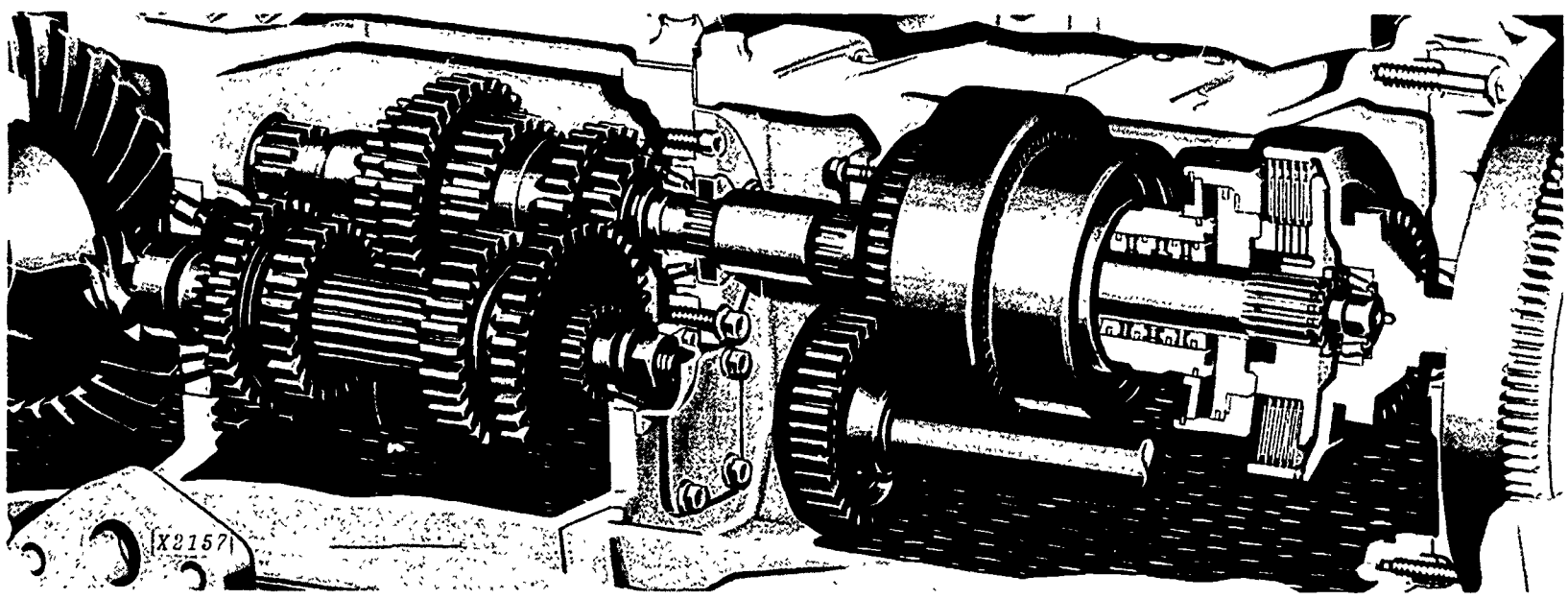

Fig. 5—Reverser Unit In Complete Power Train

Planetaries are compact units which allow the input and output shafts to rotate on the same axis and eliminate the countershaft.

In planetary sets, the gear load is spread over several gears, decreasing the load on each tooth.

The planetary system also spreads the load evenly around the circumference of the system, eliminating the sideways stress on the shafts.

Operation of basic planetaries is explained in Chapter 1.

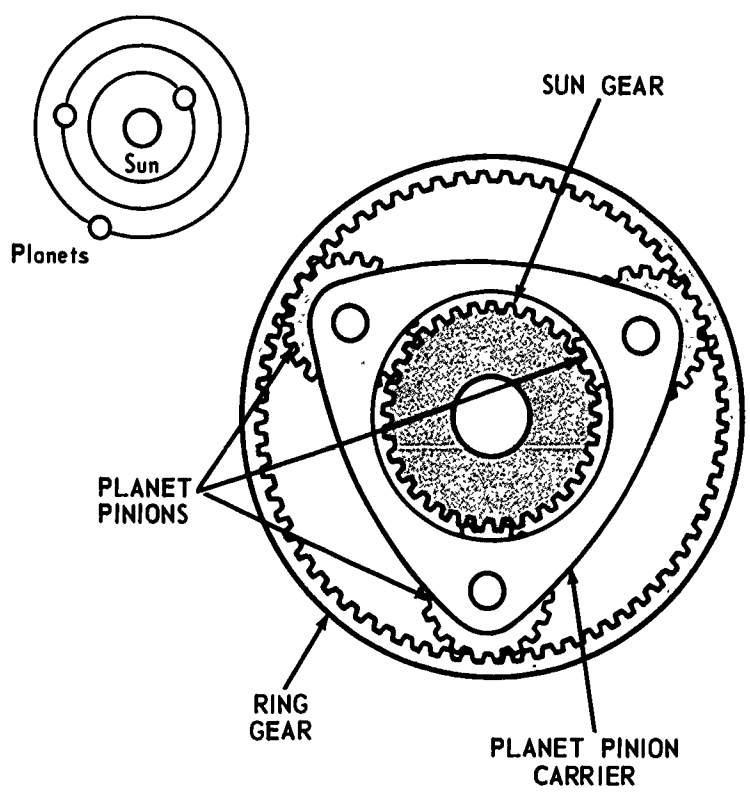

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Fig. 6—Parts Of The Planetary System

The basic parts of the planetary system are shown in Fig. 6. They are:

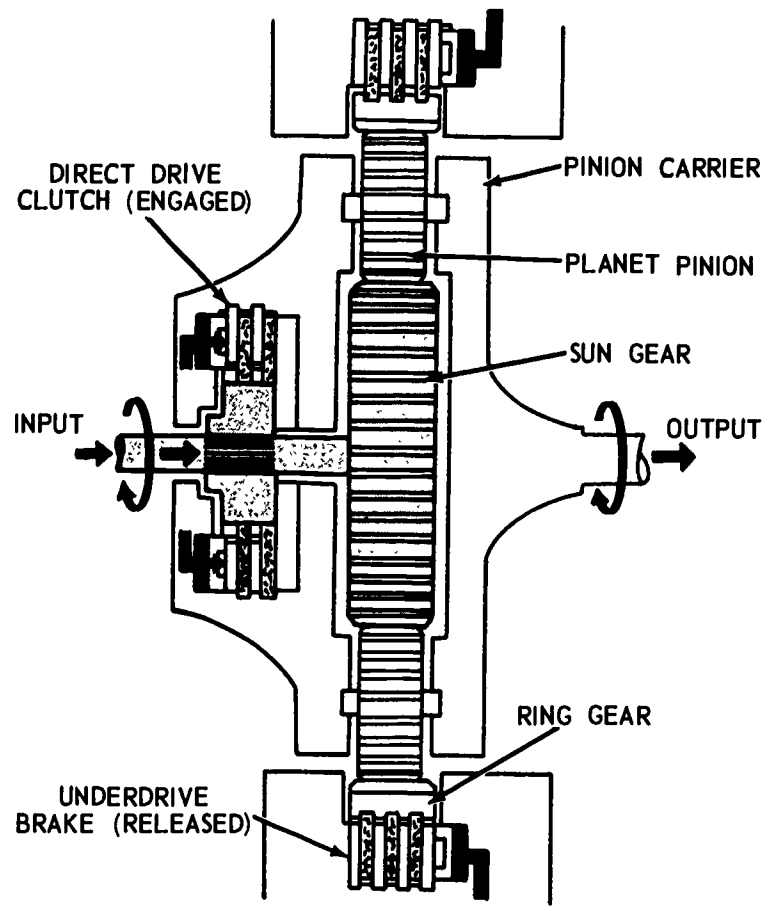
- **Sun gear—center of system**
- **Planet pinions and carrier—rotate around sun gear**
- **Ring gear—surrounds the other parts**

A planetary transmission uses hydraulic clutches and brakes to control the rotation of the planetary parts.

The planetaries may be simple or compound units as we'll see now.

SIMPLE PLANETARY TRANSMISSIONS

The two-speed planetary shown in Fig. 7 has one clutch and one brake. The clutch controls the



X2158 HIGH SPEED (DIRECT DRIVE) SHOWN

Fig. 7—Simple Planetary System (High-Low Speed Unit)

direct drive or high speed, while the brake controls the underdrive or low speed.

Planetaries work on the principle that **when any two parts are locked together, all three parts rotate as a unit.**

In Fig. 7, the sun gear shaft is the power input, while the output shaft is fastened to the planet pinion carrier.

For **high speed** (shown), the direct drive clutch engages and locks the sun gear to the planet pinion carrier, making the input and output shafts rotate in unison for a direct drive.

For **low speed,** the direct drive clutch is released while the underdrive brake is engaged, holding the ring gear stationary. The rotating sun gear then turns the planet pinions against the stationary ring gear and forces the pinion carrier to rotate as the planet pinions "walk" around the ring gear. As a result, the pinion carrier rotates in the same direction as the sun gear, *but at a reduced speed.* So the output shaft turns slower than the input shaft.

For **neutral,** both the clutch and brake are disengaged and the output shaft stops turning.

The unit shown in Fig. 7 is part of a shift-on-the-go transmission having high-low speed options.

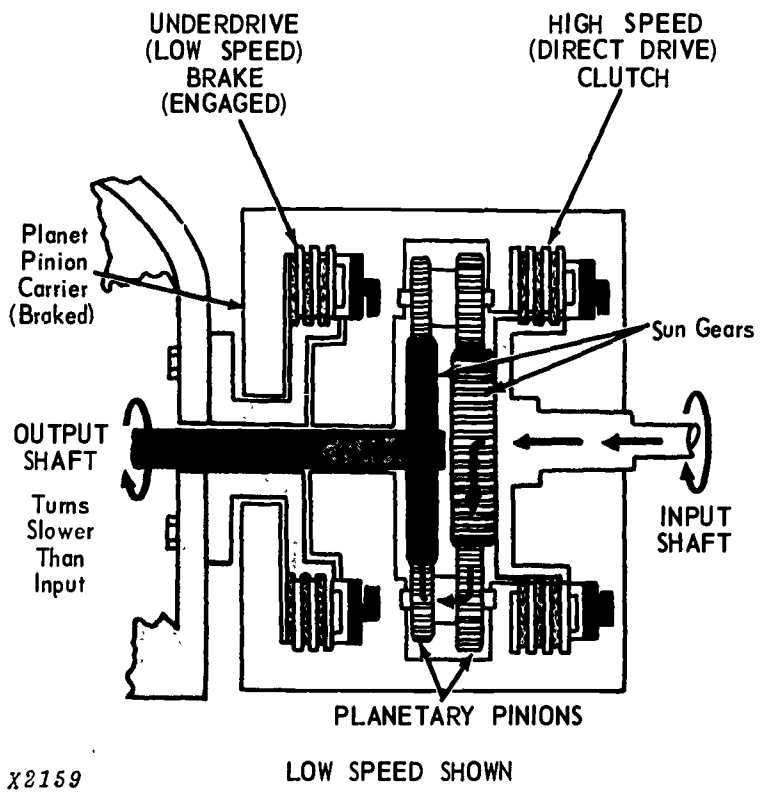


Fig. 8—Simple Planetary System (High-Low Unit)

Fig. 8 shows a two-speed planetary with no ring gear.

For **low speed** (shown), the underdrive brake is engaged, stopping the planet pinion carrier. The whole system then works as a countershaft unit with power coming in on the smaller sun gear and through the "countershaft" (pinions) to the large sun gear. Thus the output shaft turns in the same direction but at a slower speed than the input.

For **high speed,** the direct drive clutch engages and locks the sun gear shaft to the planet pinion carrier. This locks the rotation of the input and output shafts together for a direct drive.

COMPOUND PLANETARY TRANSMISSIONS

Simple planetaries can be combined or connected to obtain extra speed ratios.

To combine two simple planetaries, the output of the first system is connected to the input of the second. Many ratios can then be obtained, as we'll see now.

Compound Planetary Transmission (Twelve Speeds)

Let's build up a compound planetary transmission with eight speeds forward and four speeds in reverse.

NOTE: The brakes will be called B-1, B-2, etc., while the clutches will be named C-1, C-2, etc.

The first two speeds are shown in Fig. 9.

The planetary consists of an input shaft fastened

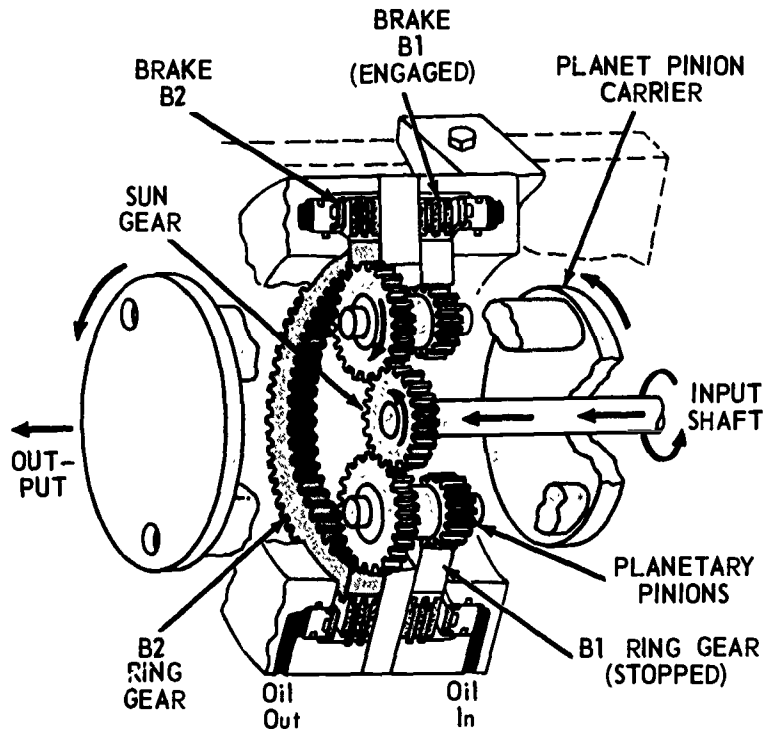


Fig. 9—Compound Planetary Transmission—Speeds 1 and 2

to a sun gear (shown in pink), compound planetary pinions and carrier (shown in light blue), and two ring gears (shown in gray) each equipped with hydraulic brakes to stop their rotation.

When brake B-1 is applied and the sun gear is turning, the planet pinion carrier is forced to rotate by the smaller of the two planet pinions walking around the B-1 ring gear. This turns the carrier very slowly.

When brake B-2 is engaged, the larger of the planet pinions is forced to walk around the B-2

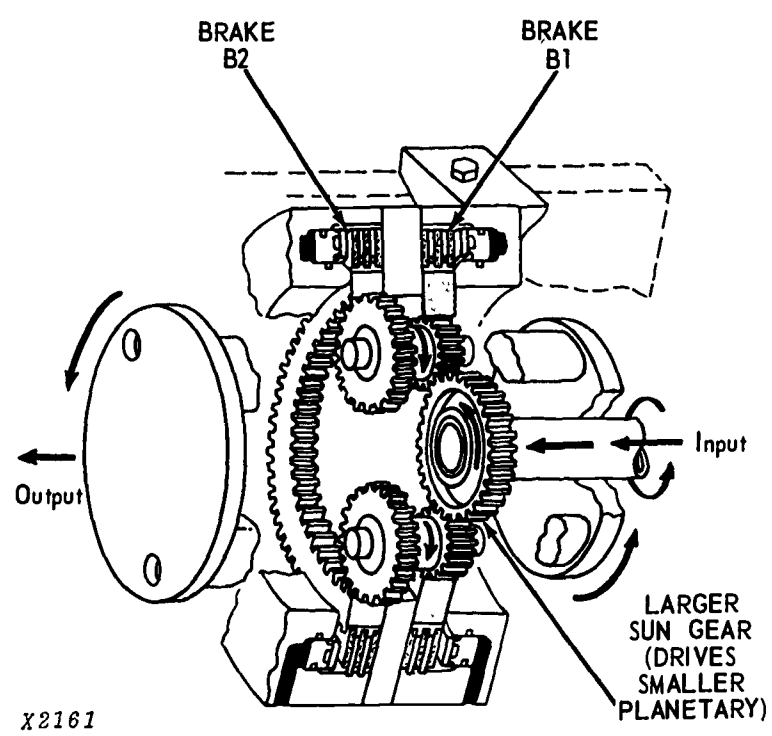


Fig. 10—Compound Planetary Transmission—Speeds 3 and 4

ring gear. This turns the carrier somewhat faster but still much slower than the input shaft. This gives the two speed ratios both of which are underdrives when compared to the input speed.

For neutral, both B-1 and B-2 brakes are released.

In Fig. 10 we have added a second, larger sun gear on a shaft concentric with the first sun gear shaft. By bringing power into the planetary on a sun gear, two extra speed ratios are obtained by engaging first B-1 and then B-2. These two ratios are slightly faster than the ratios achieved with the small sun gear, but are still slower than the input speed. So far we have four underdrive ratios available.

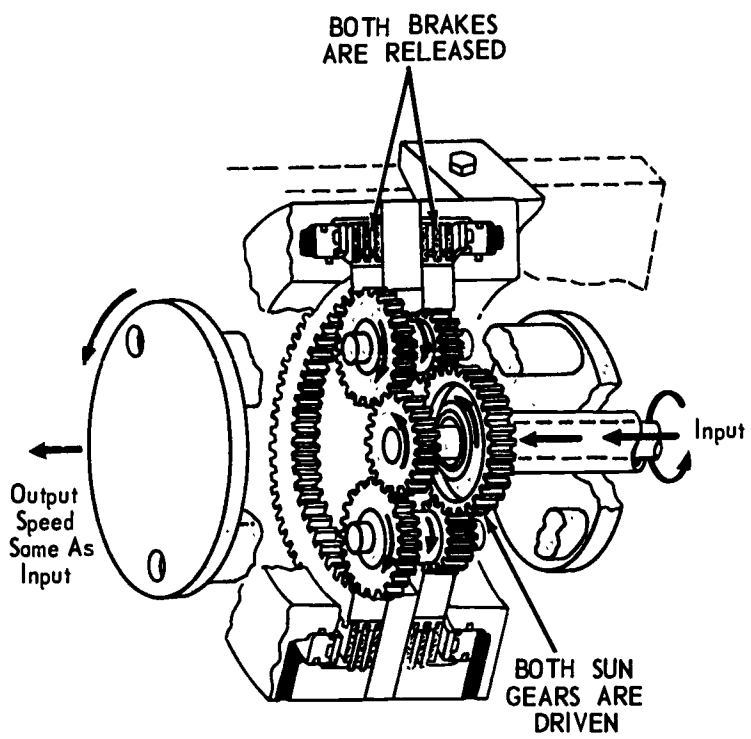


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Fig. 11—Compound Planetary Transmission—Speed 5 (Direct Drive)

The fifth speed ratio is a direct drive (Fig. 11). To do this, we drive *both* sun gears at input shaft speeds. (Both brakes must be released.)

Since the sun gears do not have the same number of gear teeth and are in mesh with the planet pinions, they are locked-up and the carrier speed is the same as the input shaft speed.

To direct the flow of power into the two sun gears, two clutches (C-1 and C-2) are installed at the rear of the engine (Fig. 12).

The clutches turn at engine speed whenever the engine is running, ready to transmit power to either one or both sun gears in the planetary. This power is transmitted to the sun gears through two shafts, one inside the other.

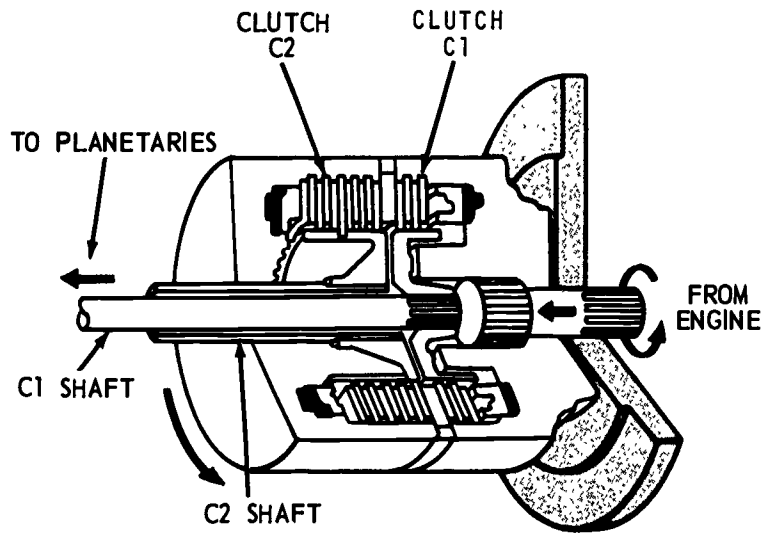

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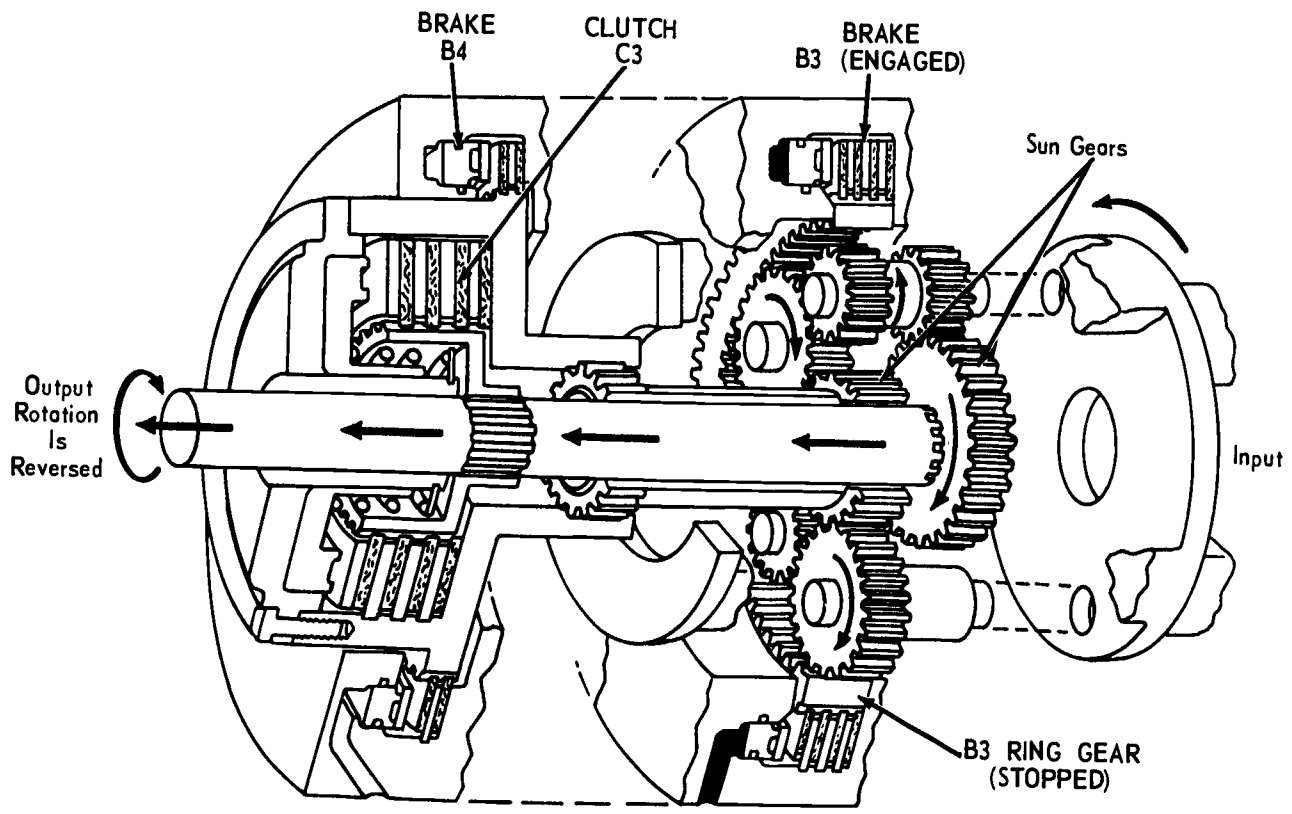
Fig. 12—Hydraulic Clutches Which Control Power To Planetaries

To complete the transmission (Fig. 13), another compound planetary unit (shown in pink) is fastened to the first unit. The planet pinion carriers are fastened together so that the output of the first planetary is the input of the second planetary. This forces the planet pinions to rotate in an orbit around the transmission centerline whenever power is being transmitted through the first planetary. The second planetary is capable of a reverse drive, a direct drive, and an overdrive.

When the B-3 or *reverse* brake is engaged (Fig. 13), the B-3 ring gear stops rotating. As the planet pinions are forced around by the carrier, the large single planet pinion gear is forced to walk around the ring gear and turns in the opposite direction of the carrier. This gear is in mesh with the smaller double planet pinions, and turns them in the same direction as the carrier. This turns the front or largest sun gear to rotate in the opposite direction as the carrier. Since the sun gear is splined to the output shaft, the output shaft turns in the same direction, giving **reverse drive.**

When the C-3 or direct drive clutch is engaged (Fig. 14), the two sun gears in the planetary are forced to rotate together. The hub of C-3 and the first or larger sun gear are both fastened to the output shaft. The C-3 drum is fastened to the second or smaller sun gear. When the two sun gears are locked together by engagement of C-3, the planet pinions cannot turn and the output shaft turns at the same speed as the carrier or input. This is **direct drive.**



REVERSE DRIVE

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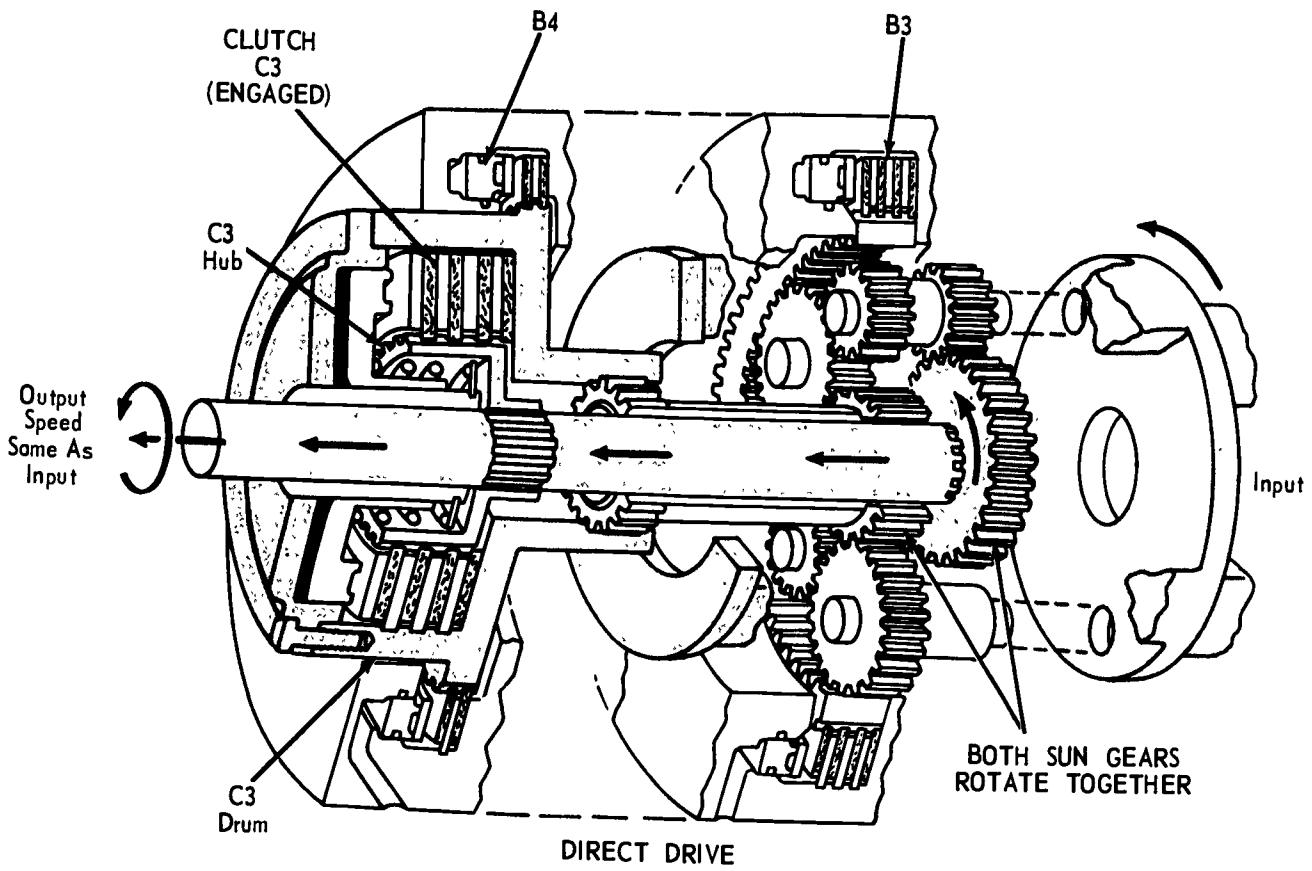
Fig. 13—Compound Planetary Transmission With Second Planetary Added—Reverse Drive Shown



DIRECT DRIVE

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Fig. 14—Second Planetary Transmitting Direct Drive

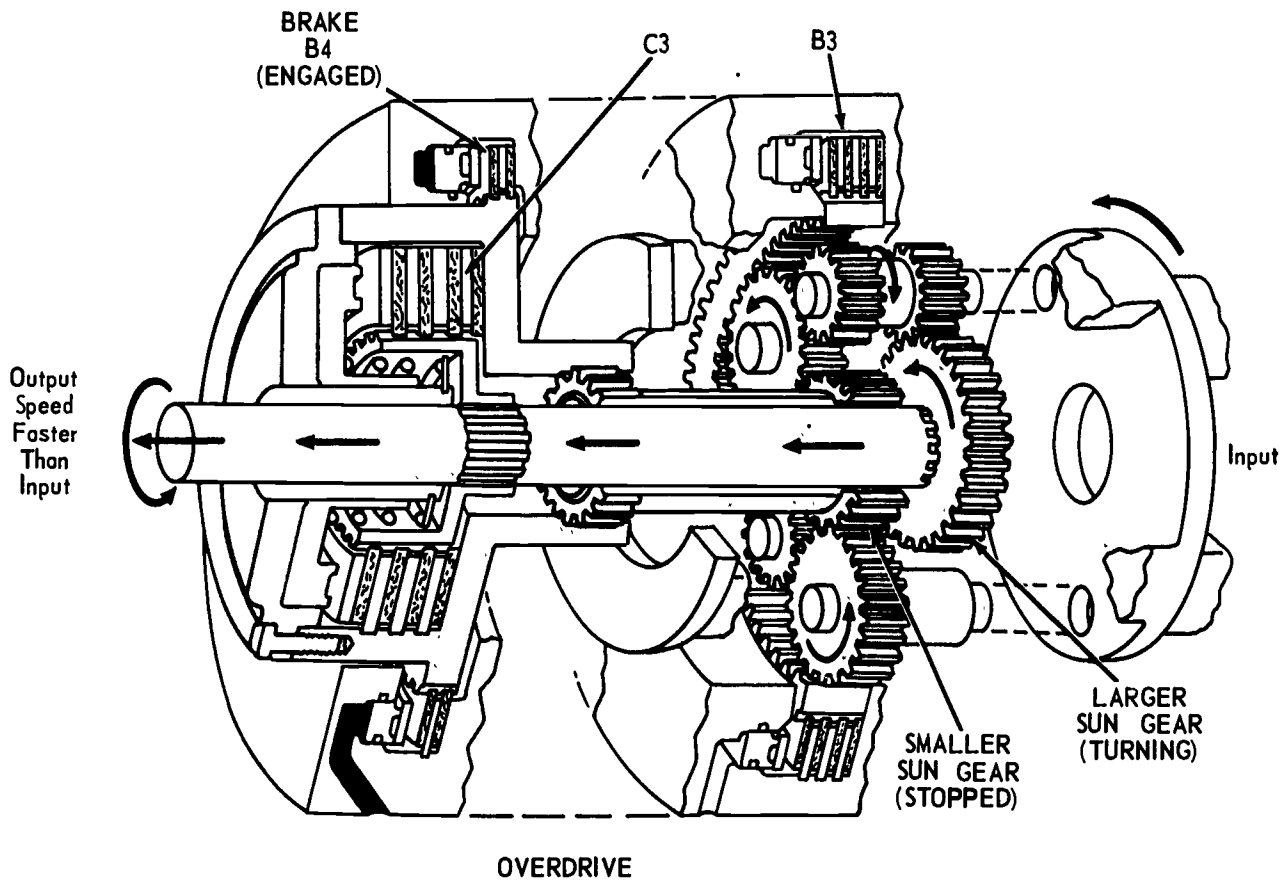

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Fig. 15—Second Planetary Transmitting Overdrive

When the B-4 or overdrive brake is engaged (Fig. 15), the second or smaller sun gear stops rotating, because it is tied to the transmission case through the B4 brake. As the carrier forces the planet pinions around in an orbit, the large single planet pinion is forced to walk around the stationary sun gear. This rotates the large planet pinion the same direction as the carrier, causing the smaller double planet to rotate in the opposite direction. This turns the large sun gear and the output shaft in the same direction as the carrier but at a faster rate of speed. Since the output shaft is turning faster than the input shaft, this ratio is known as **overdrive.**

Since the first planetary is capable of five different ratios and the second planetary is capable of two ratios forward, theoretically the transmission would have 10 speeds forward and five speeds in reverse. However, because of overlap in the ratios, this transmission has 8 forward speeds and 4 reverse speeds, all evenly spaced.

The clutch and brake units that are engaged in each of these ratios is shown in the table (Fig. 16).

An actual compound planetary transmission like the one we have just described is shown in Fig. 17. This unit drives a modern tractor.

1st Fwd.	C1		B1				C3
2nd Fwd.	C1			B2			C3
3rd Fwd.		C2	B1				C3
4th Fwd.		C2		B2			C3
5th Fwd.		C2	B1			B4	
6th Fwd.		C2		B2		B4	
7th Fwd.	C1	C2					C3
8th Fwd.	C1	C2				B4	
1st Rev.	C1		B1		B3		
2nd Rev.	C1			B2	B3		
3rd Rev.		C2	B1		B3		
4th Rev.		C2		B2	B3		

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Fig. 16—Engagement Of Clutches (C) and Brakes (B) In Each Speed Of Compound Planetary Transmission

Summary: Compound Planetary Transmissions

By combining simple planetaries and selecting different parts of each unit as input, output, and

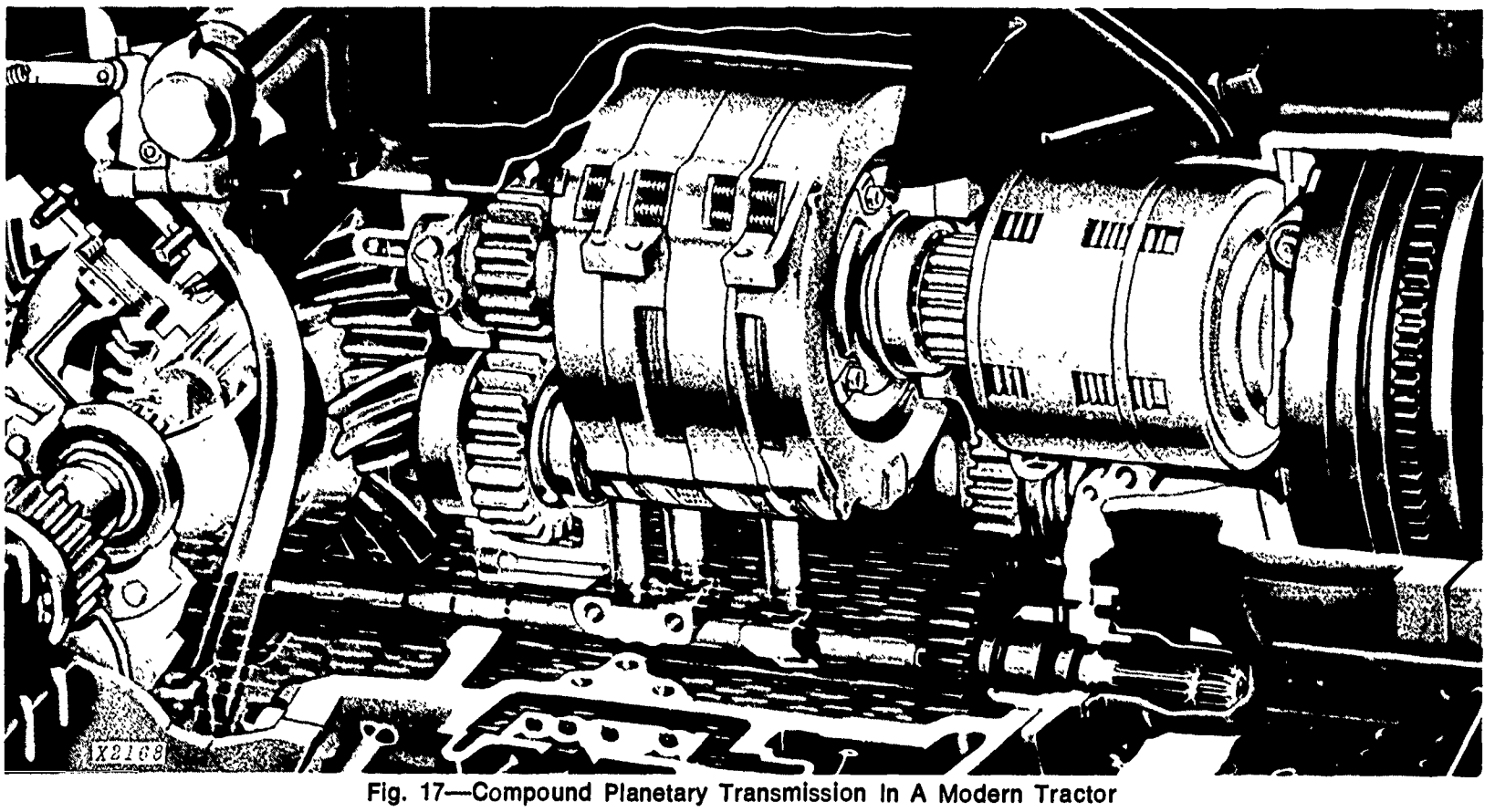

Fig. 17—Compound Planetary Transmission In A Modern Tractor

stationary, a variety of speed ratios can be selected. These range from a large reduction in speed (underdrive) to a large increase in speed (overdrive), plus several reverse drives.

The compound planetary is a very compact transmission for the number of speeds it provides. However, more horsepower is required to run a friction drive than a gear-type transmission.

HYDRAULIC SHIFT CONTROLS

Oil does two jobs in a hydraulic assist transmission:

- **Lubricates and cools the clutches and brakes**
- **Engages the clutches and brakes**

Figure 18 on the next page shows an oil circuit for a hydraulic assist transmission. This circuit is an open-center type (see the FOS "Hydraulics" manual).

The transmission case is often used as a reservoir for the oil. The transmission oil pump draws oil through the reservoir screen and into the pump. From the pump, the oil is filtered to remove all contaminates. The filter is protected from rupture by the relief valve. Since an open-center pump is used, a pressure regulator valve is installed in the pump discharge line to regulate and control the pressure.

From this point the oil flows in two directions—the *lubricating oil route* and the *control oil route.*

LUBRICATING OIL ROUTE

The first route is through the pressure regulating valve to the oil cooler to remove the heat and then into the lubricating circuit of the transmission (see pink oil in Fig. 18). This oil both lubricates and cools the transmission. It flushes the clutches and brakes to cool them of the heat built up when the clutch is slipped. (Slipping occurs momentarily every time the unit is shifted, while the clutch is picking up its load.)

CONTROL OIL ROUTE

The second path taken by oil is the clutch control circuit (shown in red in Fig. 18). From the pressure regulating valve this oil flows through an adjustable orifice and fills the spring-loaded accumulator with oil at system pressure. From the outlet of the accumulator, the oil goes to the valves which direct flow to the different clutches. When a valve is shifted to engage a clutch and brake, the accumulator discharges its oil and takes up the volume behind the clutch and brake pistons necessary to remove the clearance in the plates.

Since the accumulator is discharged, the pressure on the clutch and brake pistons at the start of lockup is relatively low and builds up slowly during lockup as the accumulator refills. When the accumulator piston bottoms, the pressure in the clutch and brake jumps to system pressure immediately and completes the clutch lockup rapidly. If the adjustable orifice is opened wider, the shift is made faster. If the orifice is closed down, the shift is made slower.

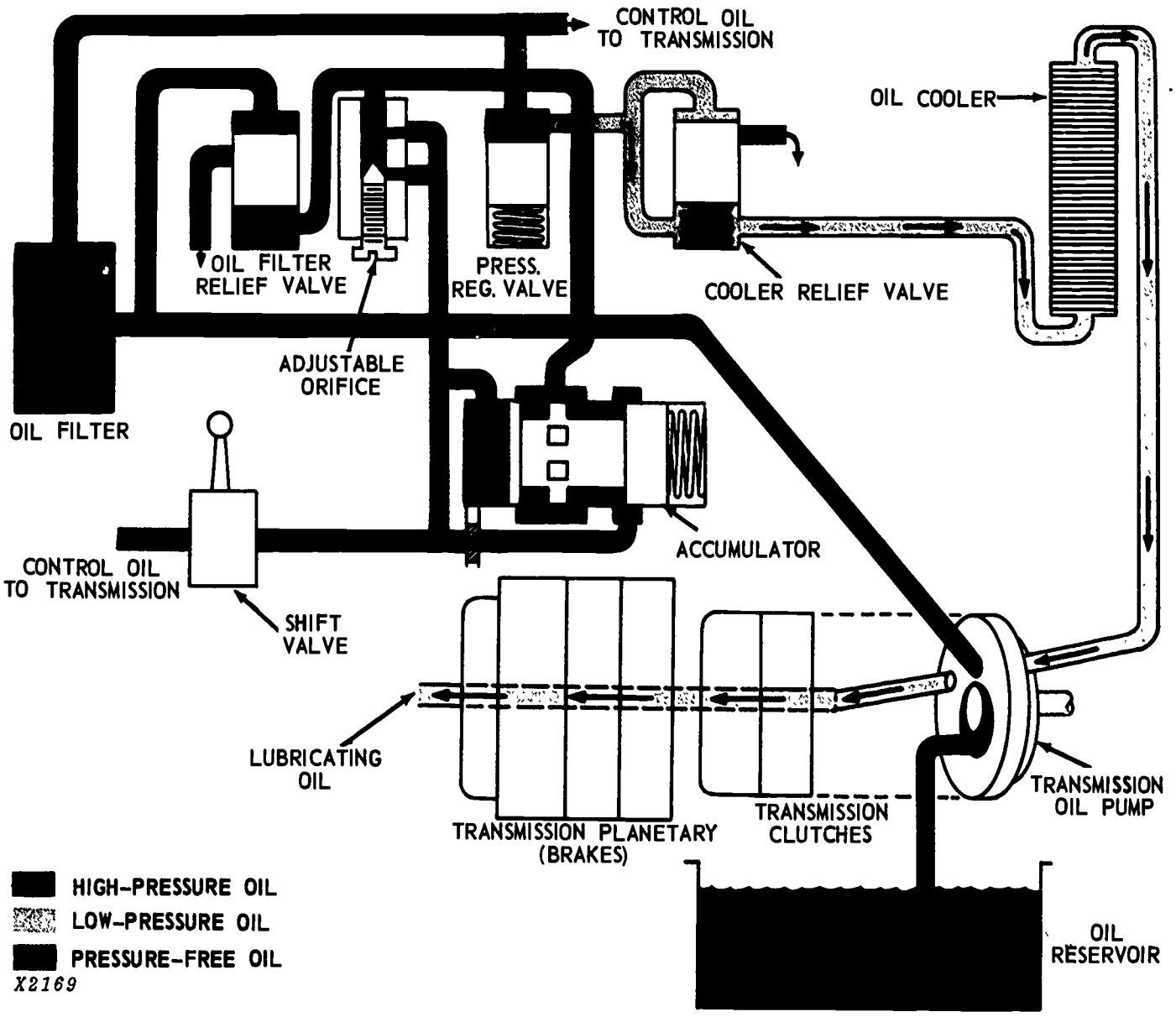

Fig. 18—Hydraulic Oil Circuit For Typical Hydraulic Assist Transmission

This system modulates the shift and prevents the violent lurch that occurs if the clutches are engaged too rapidly.

A *shift valve* is used in the hydraulic assist transmission between the accumulator and the transmission to control the flow of pressure oil to the different clutches and brakes as the operator shifts from one gear to another. The most common shift valves are either the rotary or spool type valve. The shift valve must have as many different positions as there are speed ranges in the transmission. As transmissions become more complex with more speed ranges, the shift valve becomes more complicated. It is often convenient to use two or more valves working together to obtain the necessary ports to control a transmission with many speeds.

NOTE: Operation of basic hydraulic components is covered in the FOS "Hydraulics" manual.

OTHER CONTROL FEATURES

Three extra features are common in hydraulic assist transmissions:

1. An **inching pedal** which disengages enough of the elements in the transmission to obtain a neutral in any gear ratio. This provides a pedal for emergency stops and for maneuvering the machine in close quarters or when attaching equipment.

2. A dry-type **disconnect clutch** between the engine and the transmission for cold weather starting. Cold, stiff oil between the plates causes all the clutches and brakes in the transmission to drag, causing a lockup and drag on the engine starting circuit.

3. A **tow disconnect** or *neutral* between the transmission and the drive members is necessary if the machine is to be towed without the engine running. Since the transmission pump works on when the engine is running, no lubricating oil is available while towing. As a result, some of the shafts and clutches rotating without lubrication would be damaged—unless they can be disconnected. The tow disconnect is normally provided by a splined sliding collar which disconnects the reduction gear from the reduction gear shaft.

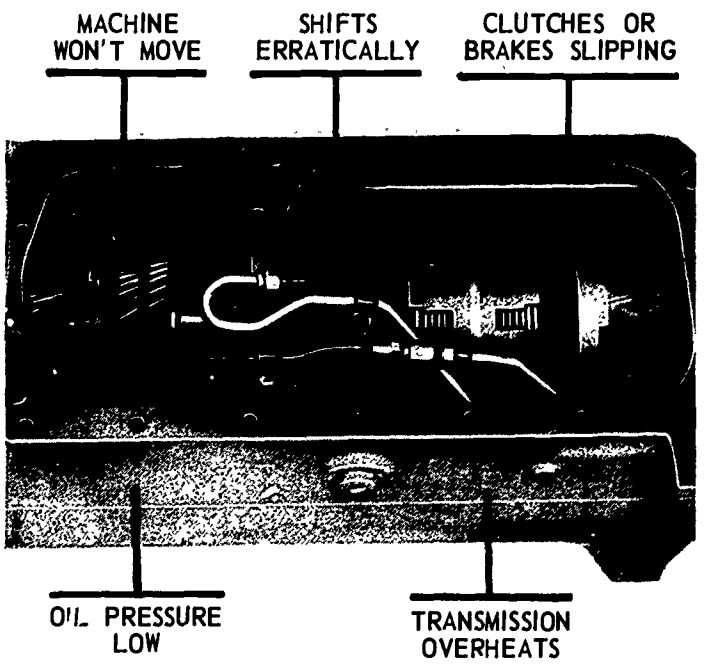

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Fig. 19—Trouble Shooting Problems With Hydraulic Assist Transmissions

TROUBLE SHOOTING

These trouble shooting charts are given as a general guide to the common failures of hydraulic assist transmissions.

Supplement these charts with specific trouble shooting from the machine Technical Manual.

MACHINE WON'T MOVE

1. Tow disconnect disengaged.
2. Cold weather starting clutch disengaged.
3. Failed clutch.
4. Park lock engaged.
5. No oil pressure.
6. Control linkage stuck or disconnected.
7. Blown packing or gaskets.
8. Oil filter plugged.

SHIFTS ERRATICALLY

1. Wrong setting of adjustable orifice.
2. Incorrect system oil pressure.
3. Failed or stuck accumulator.
4. Shift control disconnected or binding.

CLUTCHES OR BRAKES SLIPPING

1. Low oil pressure.
2. Defective gasket or seal.
3. Burned or warped clutch facings.
4. Excessive oil leakage at shift valves.

LOW SYSTEM PRESSURE

1. Plugged oil filter.
2. Low oil level.
3. Blown O-ring or gasket.
4. Plugged reservoir oil screen.
5. Air leak in pump suction line.
6. Wrong adjustment of pressure regulating valve.
7. Inching pedal valve leaking.
8. Stuck filter bypass valve.
9. Stuck cooler relief valve.
10. Failed or worn pump.
11. Pump not turning.

TRANSMISSION OVERHEATING

1. Reservoir oil level too low or too high.
2. Plugged oil filter.
3. Plugged core in oil cooler.
4. Not enough lubricating oil flow.
5. Faulty temperature gauge.
6. Clutch or brake dragging or slipping.
7. Cooler relief valve stuck open.

TEST YOURSELF

QUESTIONS

1. (Fill in the blanks.) "In hydraulic assist transmissions,_____ _____ **control** *the power flow, while the_____ _____* **transmits** *the power flow."*

2. What are the two basic types of gear sets used in hydraulic assist transmissions?

3. What does "underdrive" and "overdrive" mean?

4. Name the three main components of a planetary gear set.

5. True or false? "When any two parts of a planetary are locked together, all three parts rotate as a unit."

6. What is the gear ratio of input to output when a planetary has two parts locked together?

7. What two jobs does oil do in a hydraulic assist transmission?

ANSWERS

1. First blanks — "hydraulic clutches". Second blanks — "gear train."

2. Countershaft and planetary.

3. **Underdrive** *means that the output shaft turns* **slower** *than the input, while* **overdrive** *means that the output turns* **faster** *than the input.*

4. Sun gear, planet pinions (and carrier), and ring gear.

5. True.

6. The ratio is 1 to 1 (a direct drive).

7. 1) Lubricates (and cools), 2) engages the clutches and brakes.

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HYDROSTATIC DRIVES / CHAPTER 5

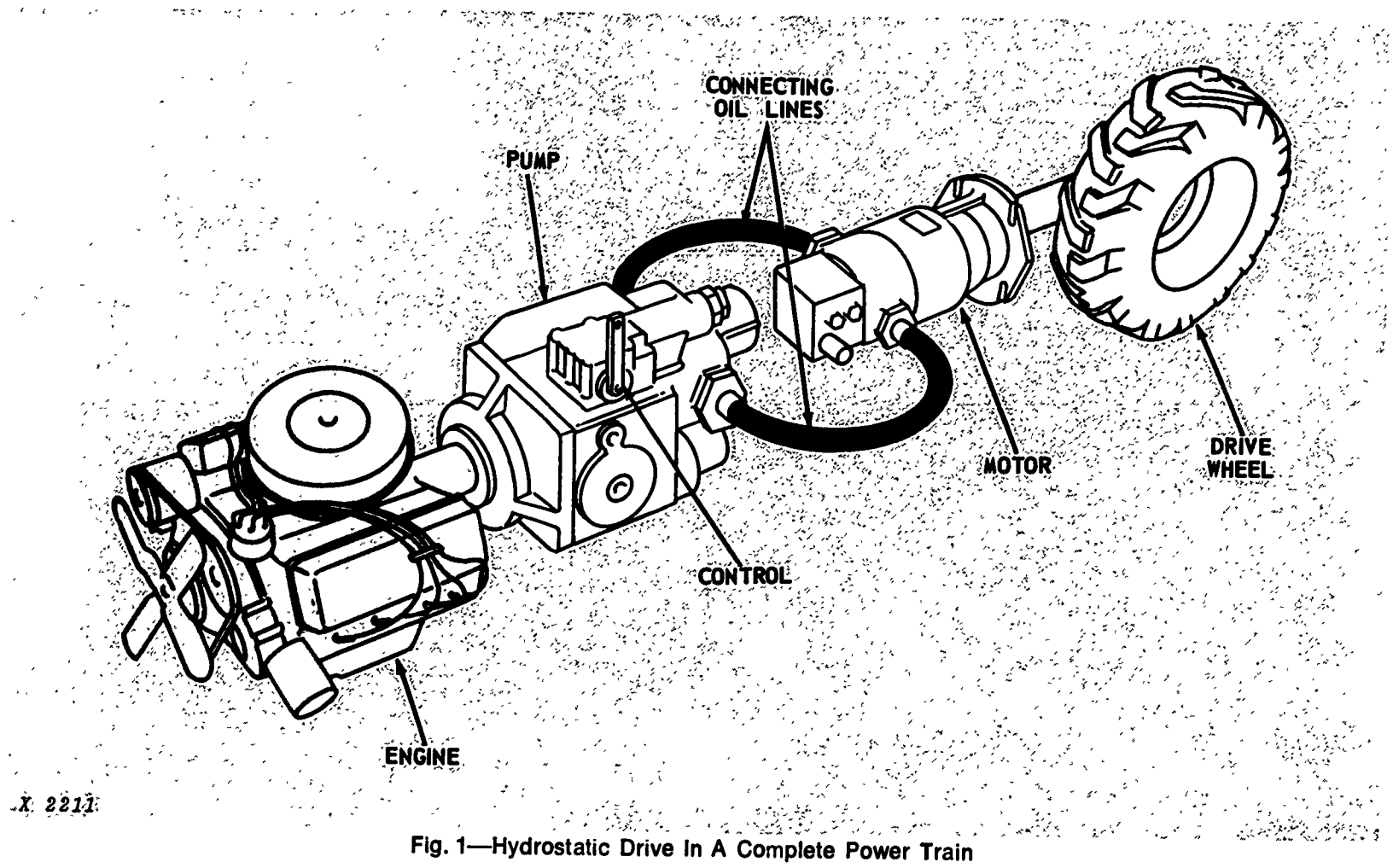

Fig. 1—Hydrostatic Drive In A Complete Power Train

INTRODUCTION

The hydrostatic drive is an automatic fluid drive which uses fluid under pressure to transmit engine power to the drive wheels of the machine.

Mechanical power from the engine is converted to hydraulic power by a pump-motor team. This power is then converted back to mechanical power for the drive wheels.

The hydrostatic drive can function as both a clutch and transmission. The final gear train can then be simplified, with the hydrostatic unit supplying infinite speed and torque ranges as well as reverse speeds.

HOW IT WORKS

There are two basic types of hydraulic transmissions:

- **Hydrodynamic**
- **Hydrostatic**

HYDRODYNAMIC TRANSMISSIONS (Fig. 2) use fluids at *high speeds* but relatively *low pressures.* Basically, a hydraulic pump (hose) forces fluid against a turbine wheel, rotating it as shown.

This type of transmission is used in **torque converters** (Chapter 6).

HYDROSTATIC TRANSMISSIONS (Fig. 2) use fluids at *high pressures* but relatively *low speeds.* Basically, energy is transferred by the fluid itself in a closed circuit between the pump and motor as shown. While the fluid does move through the lines (shown in red), it is still considered as being at rest or under *static* pressure. The rise in pressure of the fluid—which will not compress—is what transfers the energy.

This type of transmission is used in the **hydrostatic drives** we'll cover in this chapter.

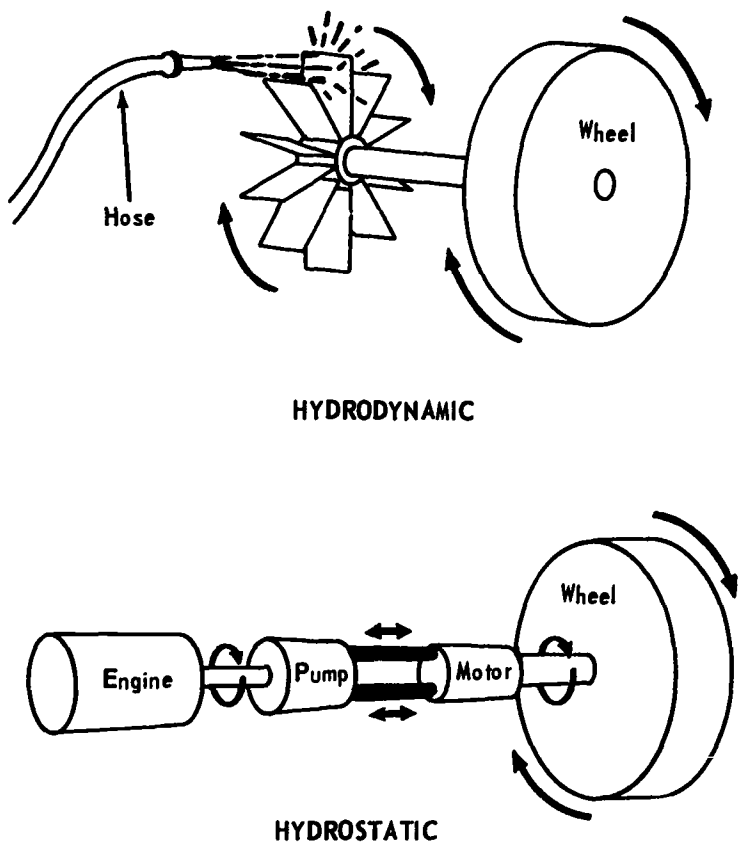

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Fig. 2—Basic Types Of Hydraulic Transmissions

THEORY OF HYDROSTATIC DRIVES

Two principles of hydraulics are required to understand a hydrostatic drive:

- **Liquids have no shape of their own**
- **Liquids will not compress**

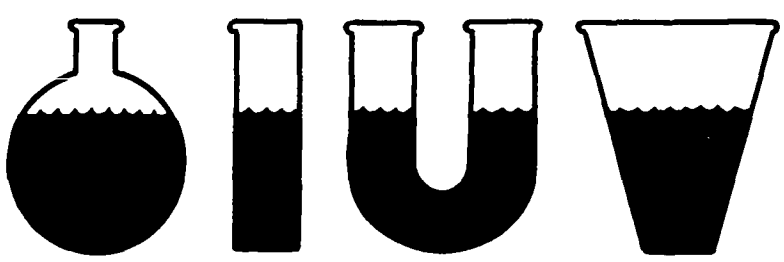

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Fig. 3—Liquids Have No Shape Of Their Own

LIQUIDS HAVE NO SHAPE OF THEIR OWN. They acquire the shape of any container (Fig. 3). Because of this, oil in a hydraulic system will flow in any direction and into a passage of any size or shape.

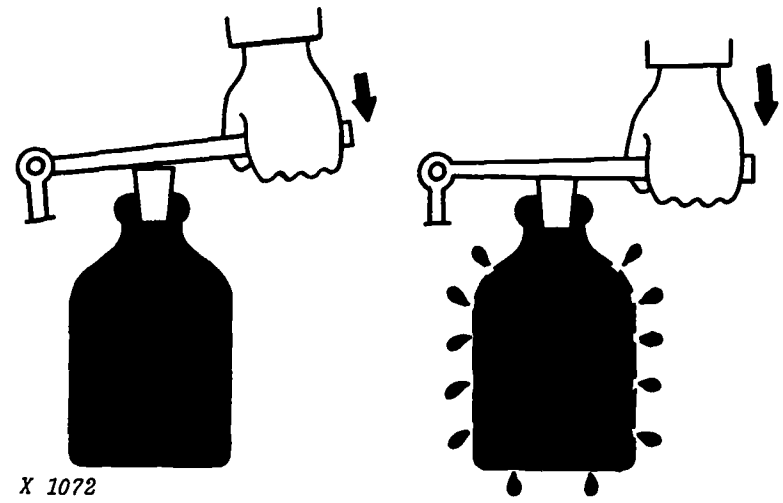

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Fig. 4—Liquids Will Not Compress

LIQUIDS WILL NOT COMPRESS. Fill a glass jar with a liquid (Fig. 4). Then tightly cork it. Now push down on the cork and try to compress the liquid. It won't work—the jar is shattered.

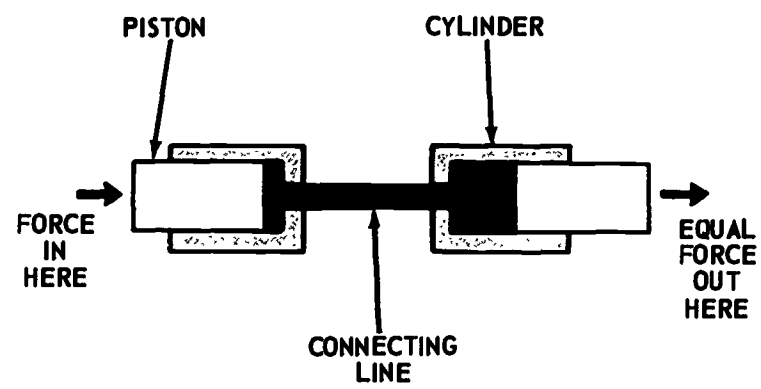

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Fig. 5—Two Cylinders Connected

Fig. 5 shows how these principles work in a hydrostatic drive.

Two cylinders, each containing a piston, are connected by a line. The cylinders and the line are filled with oil.

When a force is applied to the left piston as shown, that piston moves against the oil. The oil will not compress, so it acts as a solid and forces out the right piston.

In a hydrostatic drive, several pistons are used to transmit power—one group in the **pump** sending power to another group in the **motor.**

The pistons are in a cylinder block and revolve around a shaft. The pistons also move in and out of the block parallel to the shaft as we'll see later.

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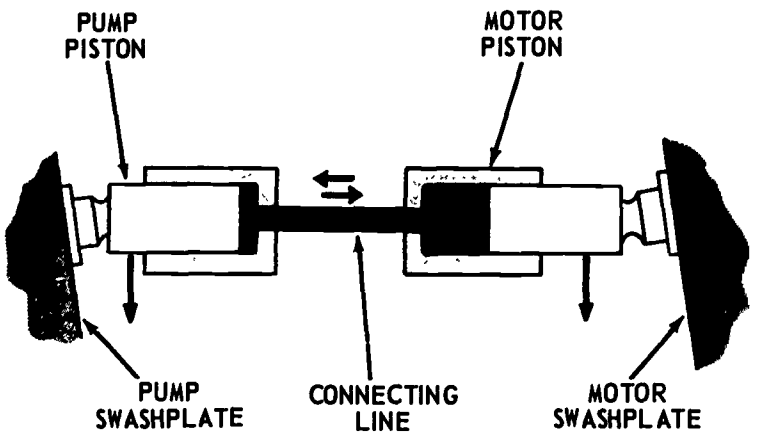

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Fig. 6—Two Connected Cylinders With Swashplates

Fig. 6 shows one piston for the pump and one for the motor. To provide a pumping action for the pistons, a plate called a **swashplate** is located in both the pump and motor. The pistons ride against the swashplates.

The angle of the swashplates (Fig. 6) can be varied so that the volume and pressure of oil pumped by the pistons can be changed or the direction of oil flow reversed.

A pump or motor with a movable swashplate is called a **variable-displacement** unit. A pump or motor with a fixed swashplate is called a **fixed displacement** unit.

Fig. 7 shows a variable displacement pump driving a fixed displacement motor.

As the pump pistons rotate, they move across the sloping face of the swashplate, sliding in and out of their cylinder bores to pump oil in and out. The more the pump swashplate is tilted, the more oil it pumps at higher pressure with each piston stroke and the faster it drives the motor.

The motor swashplate is at a fixed angle so that the stroke of its pistons are always the same. Thus its speed of rotation cannot be changed except as it is driven faster or slower by the pump oil.

The point to remember now is that a given volume of oil forced out of the pump at a given pressure will cause the motor to turn at a given speed. More oil will increase the pressure and speed up the motor; less oil will reduce the pressure and slow it down.

The pump is driven by the machine's engine and so is linked to the speed set by the operator. It pumps a constant stream of high-pressure oil to the motor.

Since the motor is linked to the drive wheels of the machine, it gives the machine its travel speed.

Only three factors control the operation of a hydrostatic drive:

- **Rate of oil flow—gives the speed**
- **Direction of oil flow—gives the direction**
- **Pressure of oil—gives the power**

Control of these three factors is infinite, giving endless selections of speed and torque in a hydrostatic drive.

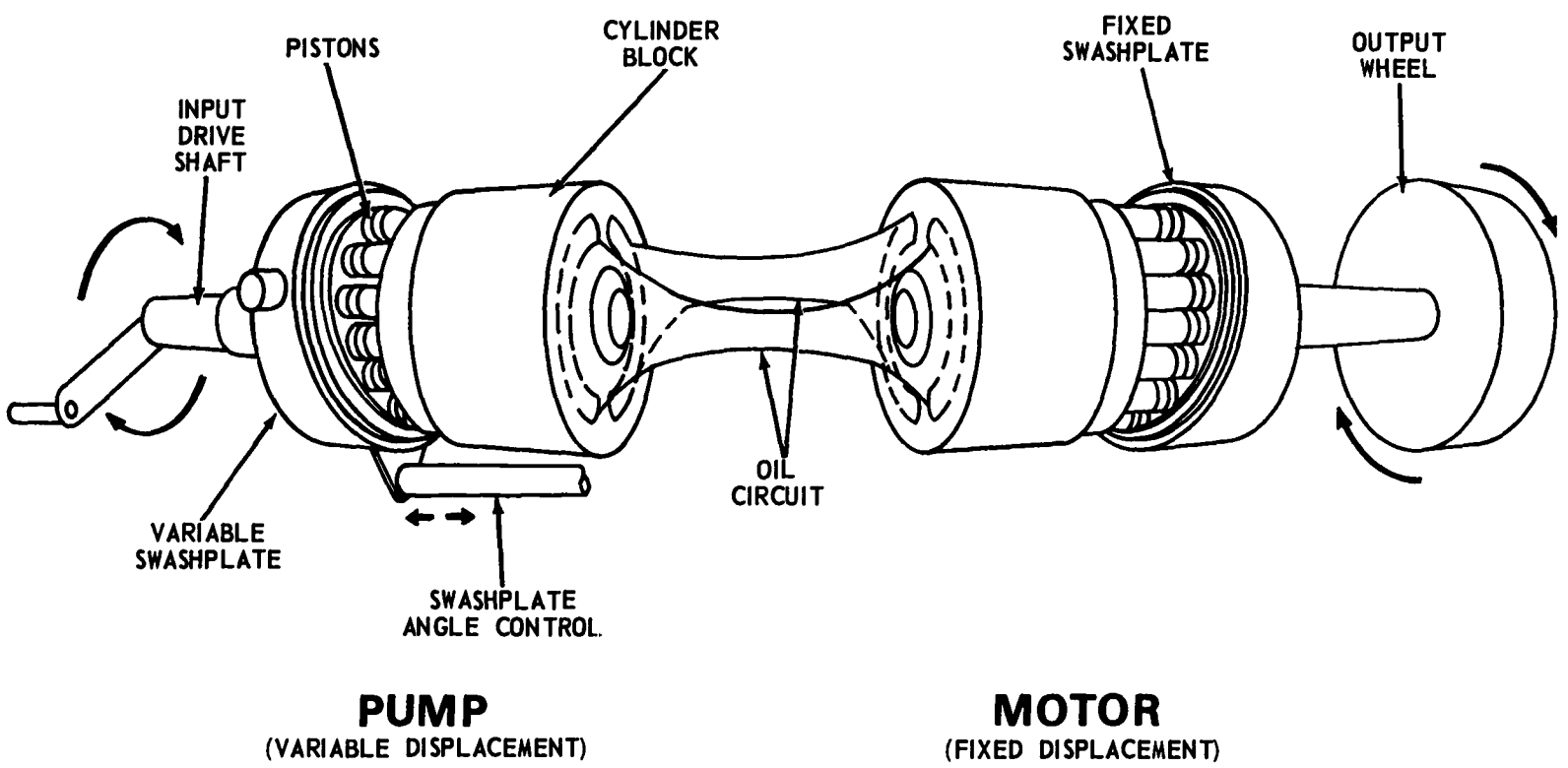

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Fig. 7—Variable Displacement Pump Driving Fixed Displacement Motor

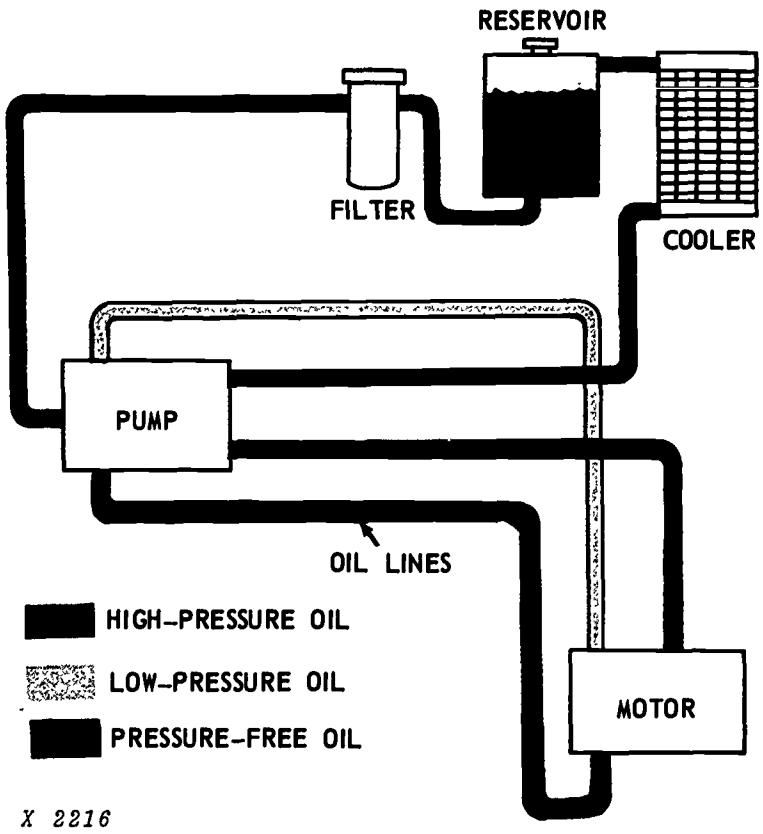

Fig. 8—Complete System For A Hydrostatic Drive

The pump-motor team is the heart of the hydrostatic drive, although the complete hydraulic system (Fig. 8) also includes a **reservoir** to supply the oil, a **filter** to remove dirt, and a **cooler** to remove excess heat from the oil.

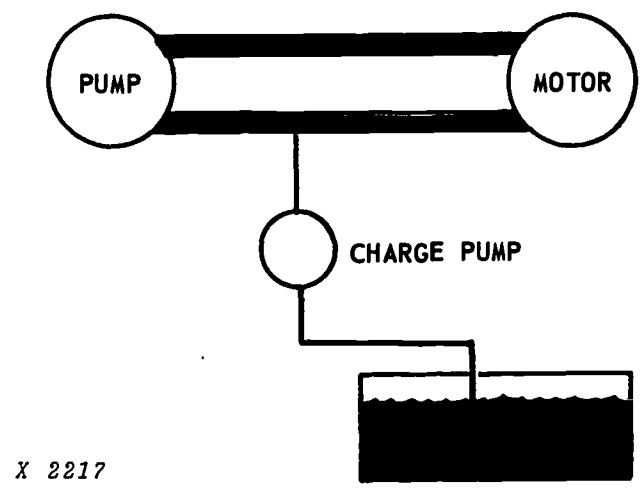

Fig. 9—Pump-Motor Form A Closed Hydraulic Loop

Basically however, the pump and motor are joined in a closed hydraulic loop (Fig. 9); the return line from the motor is joined directly to the intake of the pump, rather than to the reservoir. The charge pump simply maintains the pressure, using supply oil from the reservoir.

NOTE: For basic theory of hydraulic systems, see the FOS "Hydraulics" manual.

TYPES OF HYDROSTATIC DRIVES

Displacement is the quantity of fluid which a pump can move (or a motor can use) during each revolution. It is directly related to the horsepower output of the drive. (Horsepower is a combination of torque X speed.)

As you have already learned, pumps and motors can have a **fixed** displacement or **variable** displacement.

Four pump-motor combinations are possible:

1) **Fixed** *displacement pump driving a* **fixed** *displacement motor.*

2) **Variable** *displacement pump driving a* **fixed** *displacement motor.*

3) **Fixed** *displacement pump driving a* **variable** *displacement motor.*

4) **Variable** *displacement pump driving a* **variable** *displacement motor.*

Let's look at each combination (Fig. 10).

No. 1 circuit with a steady input speed gives constant horsepower and torque at the output. If input speed varies, horsepower and speed will vary but torque will remain constant. Because both pump and motor are fixed-displacement, this system is like a gear drive; it transmits power without altering the speed or horsepower between the engine and the load.

Since the pump flow is variable in *No. 2 circuit,* output speed is variable and torque output is constant for any given pressure. This circuit gives variable speed and constant torque.

Output speed in *No. 3 circuit* is varied by changing the motor displacement. When motor displacement decreases, output speed increases, but output torque drops. When balanced, this circuit gives a constant horsepower output.

No. 4 circuit gives an output of both constant torque and constant horsepower (which is torque X speed). It is the most flexible of all the circuits but also the most difficult to control.

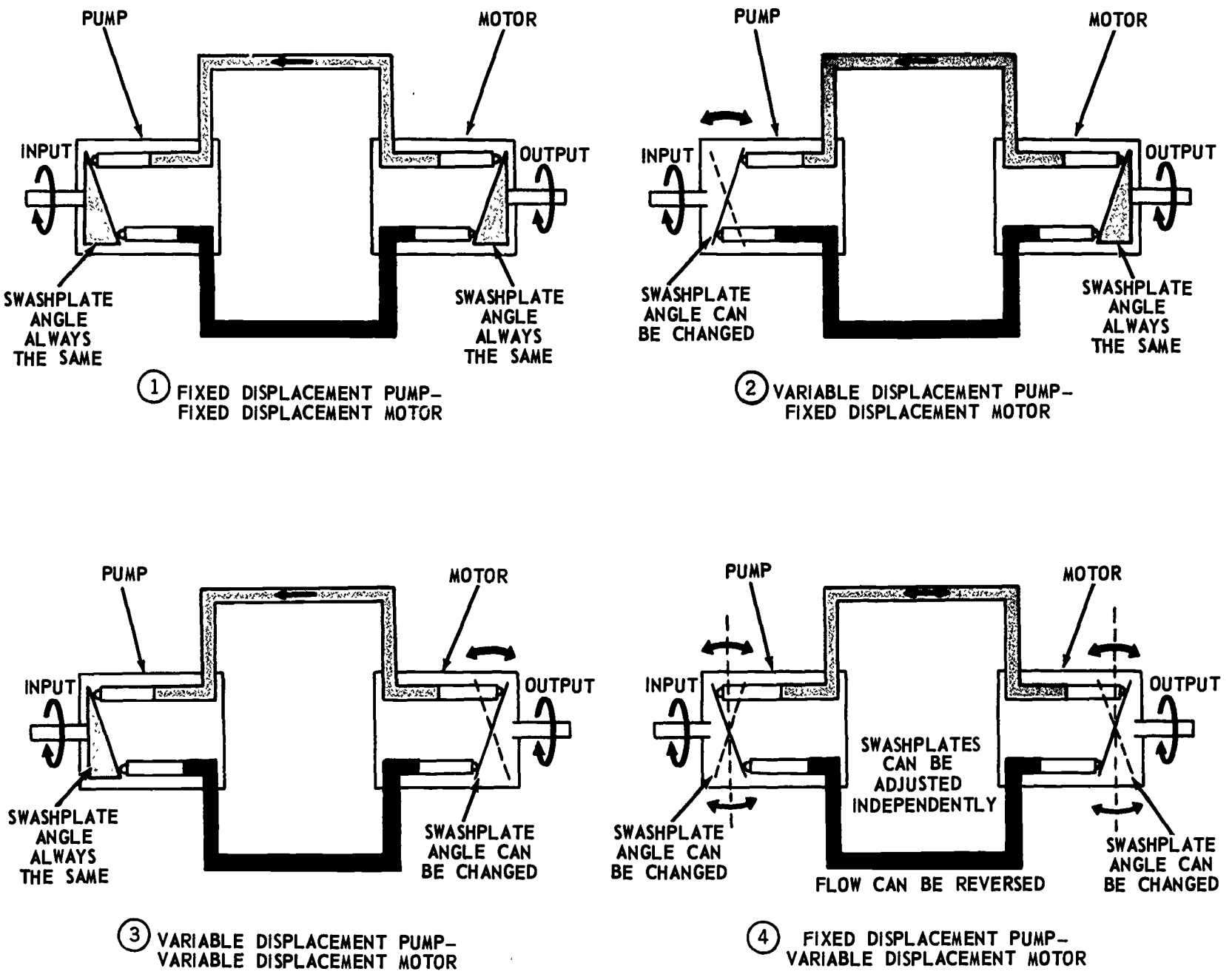

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Fig. 10—Pump-Motor Combinations For Hydrostatic Drives

REVERSING IN VARIABLE PUMP-MOTOR CIRCUITS

The direction of output shaft rotation can be reversed in variable circuits by shifting either the pump or motor swashplates over center (Fig. 11).

In **neutral,** the swashplate is vertical and no oil is pumped.

In **forward,** the swashplate is tilted and oil is pumped as shown at the top.

In **reverse,** the swashplate is tilted the opposite way and the unit pumps oil in the opposite direction.

How this affects the complete drive will be seen under "Operation", which follows.

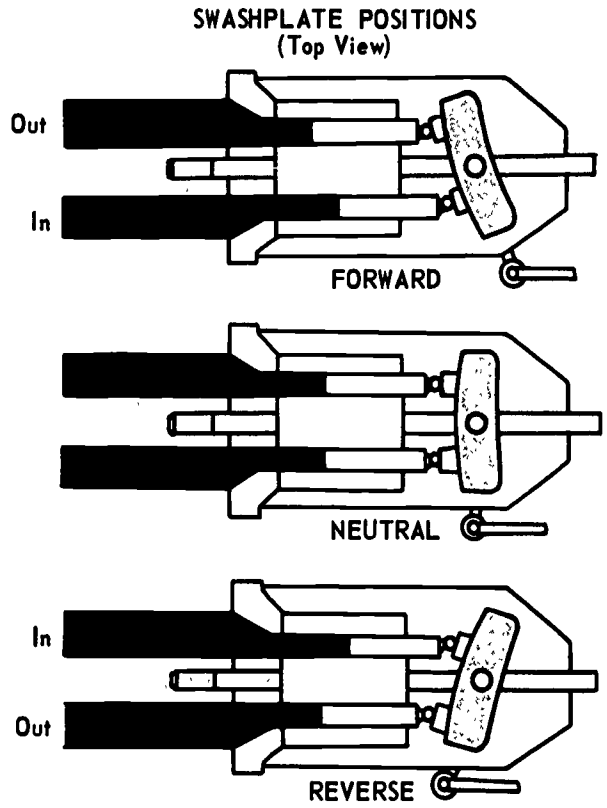

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Fig. 11—How Reversing Is Done With Variable Displacement Pumps Or Motors

OPERATION OF HYDROSTATIC DRIVES

Let's see how a typical hydrostatic drive works.

Our example is a system with an axial piston *pump* (Fig. 12) and *motor* (Fig. 13). This type of unit is most common in hydrostatic drives today.

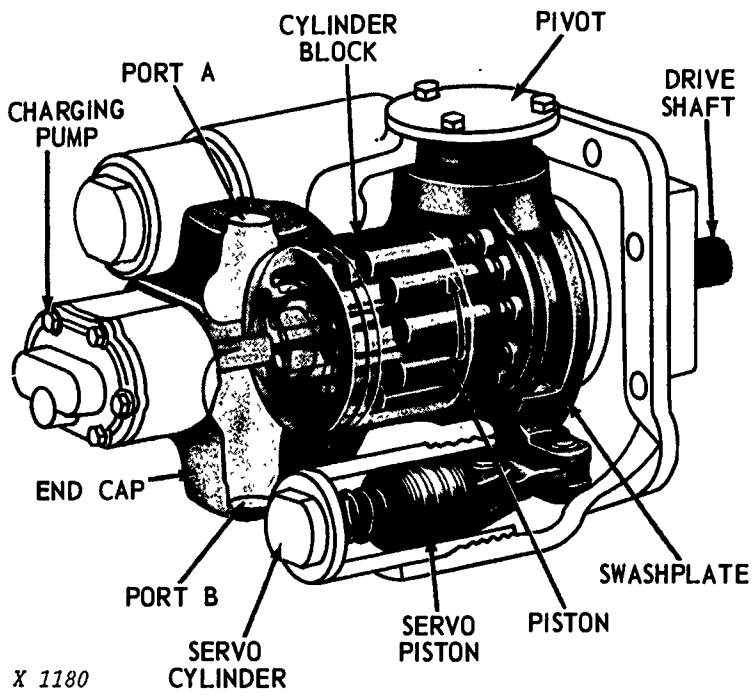

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Fig. 12—Variable Displacement Pump—Axial Piston Type

The *pump* has a **variable** displacement, while the *motor* has a **fixed** displacement. (These units are shown connected in Fig. 7).

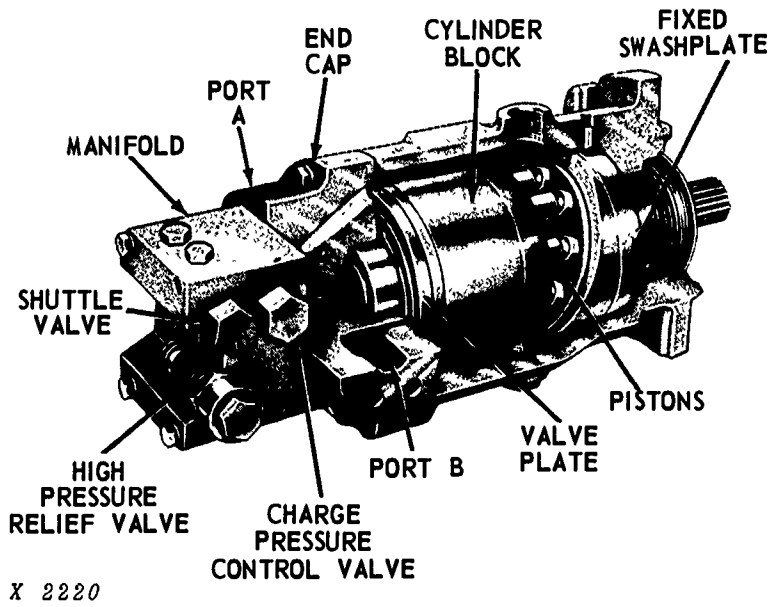

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Fig. 13—Fixed Displacement Motor—Axial Piston Type

Let's look at the complete system in operation in *neutral, forward,* and *reverse* speeds.

NEUTRAL (Fig. 14)

When the speed control lever is in neutral, free oil flows from the reservoir through the oil filter to a charge pump. This pump (which is a gear-type to provide a constant supply of oil to the main pump) pumps the oil past the pressure control valve and into the main pump housing, where it circulates through the housing and then returns through the cooler to the reservoir.

Trapped oil (shown in green) is held in the cylinder block of the pump, in the motor, and in the connecting lines between the pump and motor by two check valves (A) and (B) in the pump end cap.

When the control lever is in neutral, the swashplate in the pump is also in neutral and the pistons in the pump are not stroking. Therefore, no oil is being pumped.

The cylinder block in the pump, driven by the machine engine, rotates in a clockwise direction as viewed from the drive shaft end of the pump.

Because oil is not being pumped to the motor, the cylinder block in the motor is stationary and the output shaft does not move.

NOTE: When the drive system is in neutral, the charge pump pressure is controlled by a high charge pressure control valve, located at the charge pump. When system is activated (forward or reverse), a low charge pressure control valve, located in the motor manifold, controls the charge pressure at a lower psi.

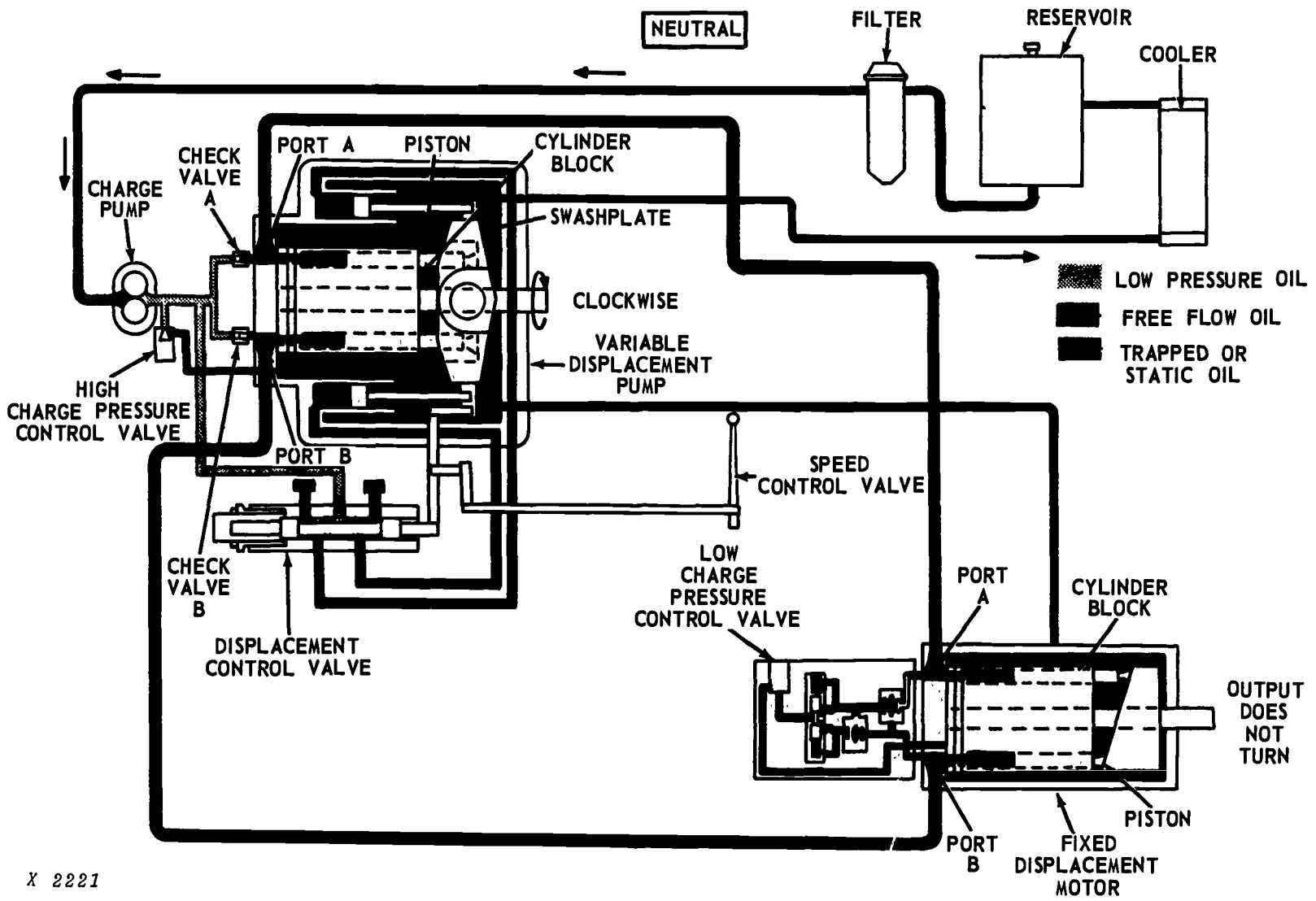

Fig. 14—Hydrostatic Drive In Neutral

FORWARD (Fig. 15)

When the speed control lever is moved forward, the spool in the displacement control valve moves out of neutral. This allows pressure oil to flow into the upper servo cylinder forcing the swashplate (which is connected to the servo cylinder) to tilt. Oil expelled by the opposing servo cylinder returns through the displacement control valve to the pump case.

When the swashplate reaches the tilt set by the control lever, the displacement control spool returns to neutral. This traps the oil to both servo cylinders and holds the swashplate tilted as shown. The swashplate will remain in this position until the speed control lever is moved by the operator.

With the pump drive shaft and cylinder block rotating clockwise and the swashplate tilted to the right, port (A) will be the inlet and port (B) the outlet. As the cylinder rotates past port (A), check valve (A) opens, and oil is forced by the charge pump into the piston bores, which align with port (A) under low charge pressure. Then, as rotation continues, oil is forced out of port (B) at high pressure by each of the pump pistons when they align with port (B). This oil flows to the motor and drives it.

The distance the pistons reciprocate in and out of the cylinder block depends on the angle the pump swashplate is tilted; this determines the volume of oil displaced per revolution of the pump. The greater the angle, the greater the volume and the more oil flows from the pump. Thus, as the swashplate angle is varied, so will the volume of oil displaced from the pump be varied.

As pressure oil enters port (B) in the motor, the pistons which align with port (B) push against the swashplate. Since the fixed swashplate is always tilted, the pistons slide down the inclined surface and the resulting forces rotate the cylinder block, which in turn rotates the output shaft. This drives the machine forward.

As the cylinder block continues to rotate clockwise, oil is forced out port (A) at a low pressure and returns to the pump.

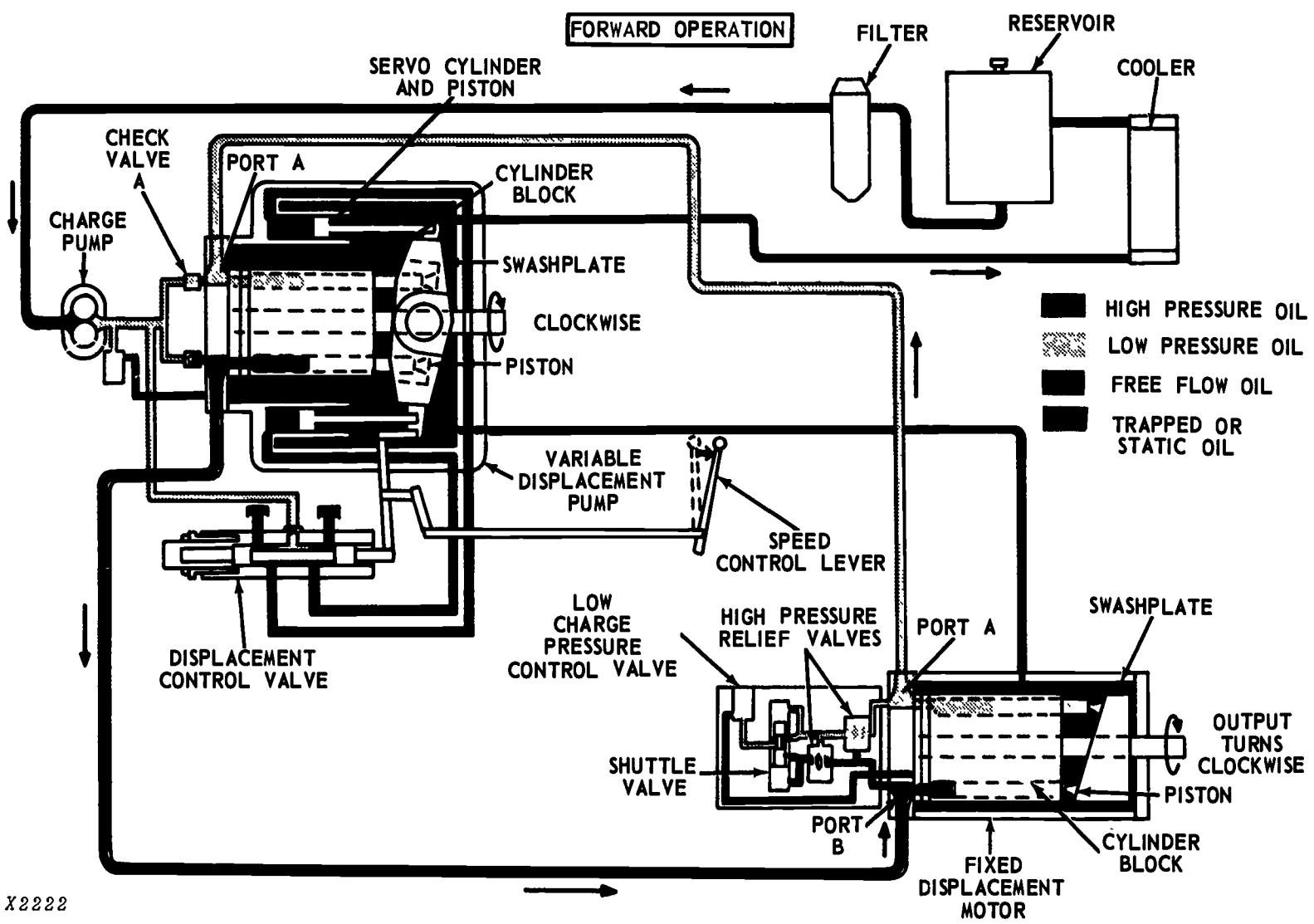

Fig. 15—Hydrostatic Drive In Forward Operation

Oil returned from the motor to the pump is recirculated through the pump cylinder block and back to the motor. This is called a "closed circuit" system because the oil keeps on circulating between the pump and the motor. The only extra oil comes from the charge pump—sometimes called a "make-up" pump. This pump maintains a given flow of oil through the system whenever the machine's engine is running.

A shuttle valve is located in the motor manifold and controlled by the high pressure oil. It prevents the high pressure oil from entering the low pressure side of the system. This keeps the charge circuit open to the low pressure control valve while the system is operating.

A high pressure relief valve, located in the motor manifold, monitors the pressure of the forward flow of oil and protects the system from too-high pressures.

If pressure exceeds the rated psi, the relief valve opens and oil bypasses the cylinder block in the motor, slowing or stopping the machine. The bypassed oil returns to the pump.

This action continues until the load is reduced below the rated psi. Then the relief valve closes and the oil flows to the cylinder block again, moving the machine forward.

REVERSE (Fig. 16)

When the speed control lever is moved to reverse, the spool in the displacement control valve moves out of neutral. This allows pressure oil to flow into the lower servo cylinder, tilting the swashplate as shown.

When the swashplate reaches its desired tilt, as set by the control lever, the displacement control spool returns to neutral. This traps the oil to both servo cylinders and holds the swashplate tilted as shown. The swashplate remains in this position until the speed control lever is moved again by the operator.

With the pump drive shaft and cylinder block rotating clockwise and the swashplate tilted to the left, port (B) becomes the *inlet* and port (A) the *outlet*. As the cylinder rotates past port (B), check valve (B) opens and oil is forced by the charge pump into the piston bores, which align with port

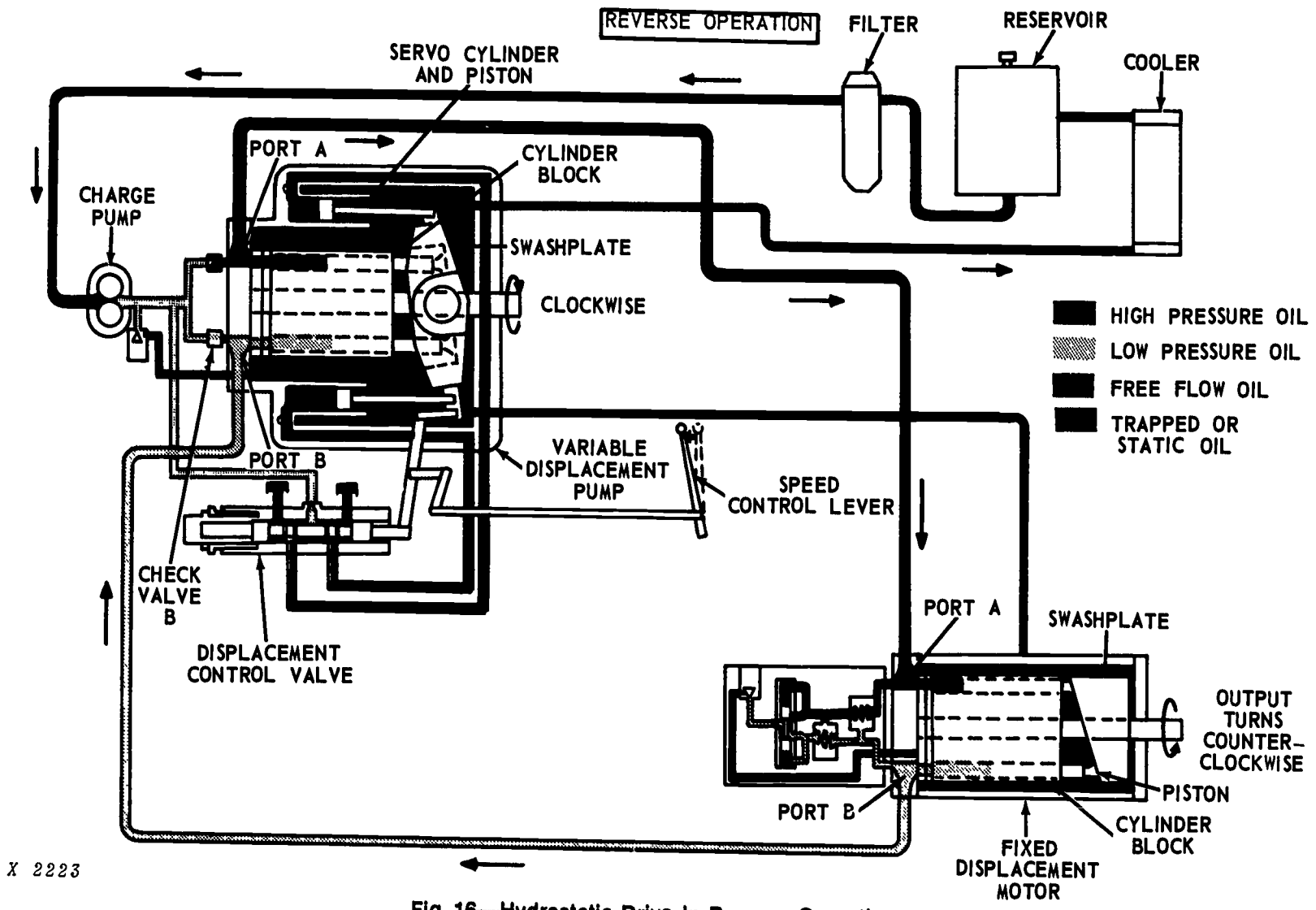

Fig. 16—Hydrostatic Drive in Reverse Operation

(B). Then, as rotation continues, the oil is pressurized and forced out of port (A) by each of the pistons as they align with port (A). This oil flows to the motor.

As high pressure oil from the pump enters port (A) of the motor, it pushes the motor pistons against the swashplate. The pistons slide down the inclined surface of the swashplate, rotating the cylinder block which in turn rotates the drive shaft, driving the machine—but in reverse.

As the motor cylinder block continues to rotate, oil is forced out port (B) at low pressure and returns to the pump.

NOTE: The **pump** *drive shaft and cylinder block always rotate clockwise, but the* **motor** *drive shaft and cylinder block can rotate in either direction, depending on the direction of oil entering from the pump.*

HYDROSTATIC DRIVE AXLES

Integral pump-motor units can be used, one on each drive axle, to propel some machines (Fig. 17).

Each pump-motor is connected at right angles. Both pump and motor have a variable displacement, giving a variable torque and horsepower.

Closed-circuit oil paths between the pump and motor are built into the housing.

A charge pump is built into the unit shown, as well as pressure control and relief valves. The charge pump is a vane type with a fixed displacement.

The swashplates are controlled by linkages which fasten to the yokes above the pump and motor.

The complete system is shown in Fig. 18.

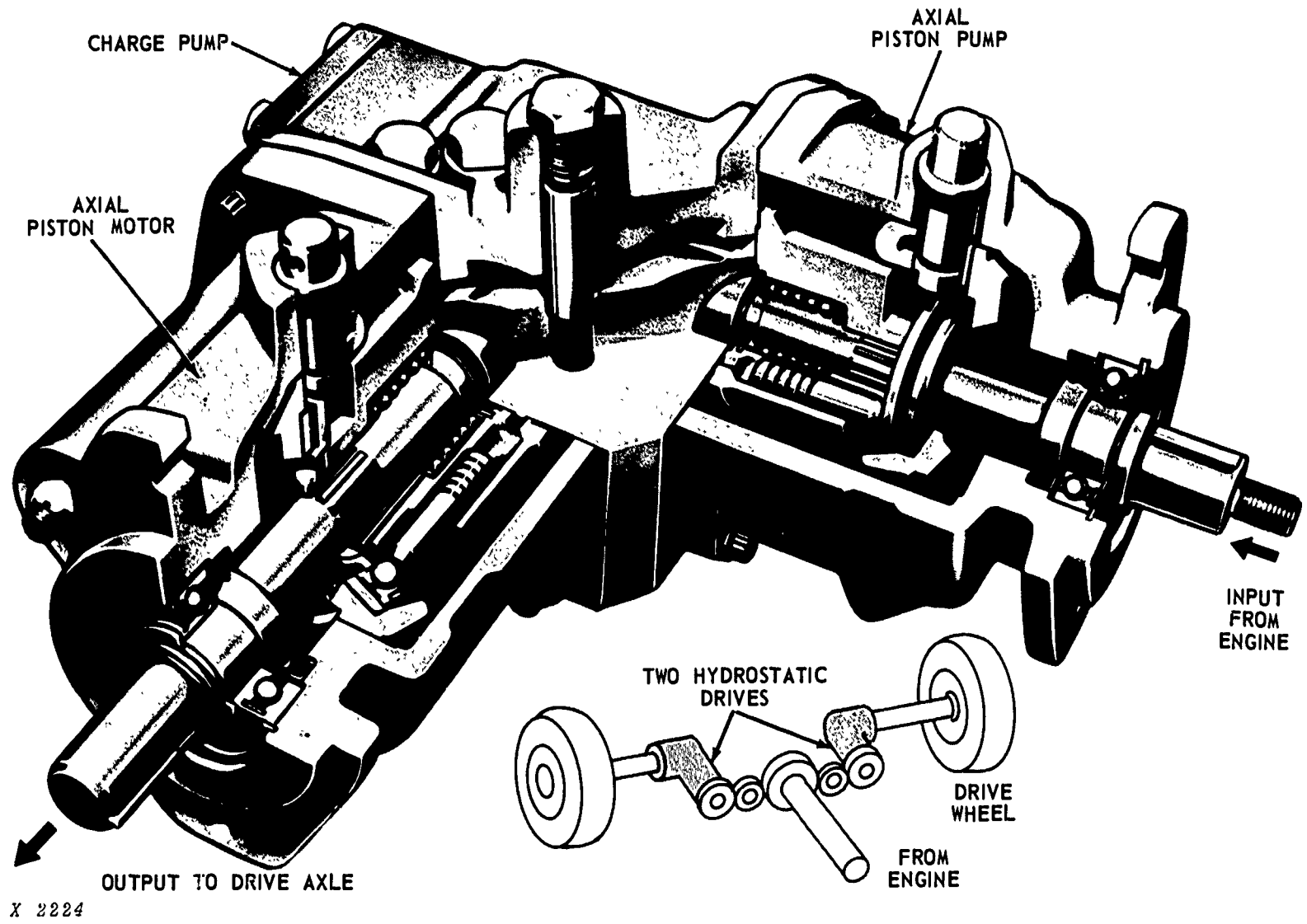

Fig. 17—Integral Pump-Motor For Hydrostatic Drive Axle

OPERATION

Fig. 18 illustrates the oil flow from the **reservoir,** to one **hydrostatic axle,** and the return to reservoir.

Oil flows from the **reservoir** to the **inlet port** of the **charge pump.** The oil passes from the charge pump to the **control valve.** If the control valve is not actuated, oil passes through the control valve into a common line with oil from the other control valve, back to the **filter.** After oil passes through the filter and **cooler,** it enters the **valve block** inlet port of both drives.

The valve block has common oil passages to allow oil to flow from the **piston pump** to the **piston motor** and return to the piston pump. This is a *closed circuit.* When any leakage occurs, the circuit is replenished by cooled oil entering the valve block.

The replenishing oil overcomes the 10 psi spring setting and discharges into the inlet side (low pressure side) of the piston pump at a pressure in excess of 10 psi. Any excess pressure in the common passage empties over the 25 psi relief valve into the motor housing and back to the reservoir. The 25 psi relief valve consists of a sleeve poppet and spring. Pressure acts directly on the poppet against the spring.

To take care of the pressure surges in the outlet passages, relief valve action is provided. The replenishing and relief valve cartridges are pre-set.

The relief valve operates when the outlet pressure on the end of the inner poppet creates a force greater than the pilot spring force (4500 psi) and unseats the inner poppet. This reduces pressure in the spring chamber until the outer poppet moves, discharging excess pressure to the relief cavity. The inner poppet is held open by its pin until the system pressure drops below 4500 psi.

Since either port of the piston pump can be inlet or outlet, two replenishing and relief valves are required to provide relief protection.

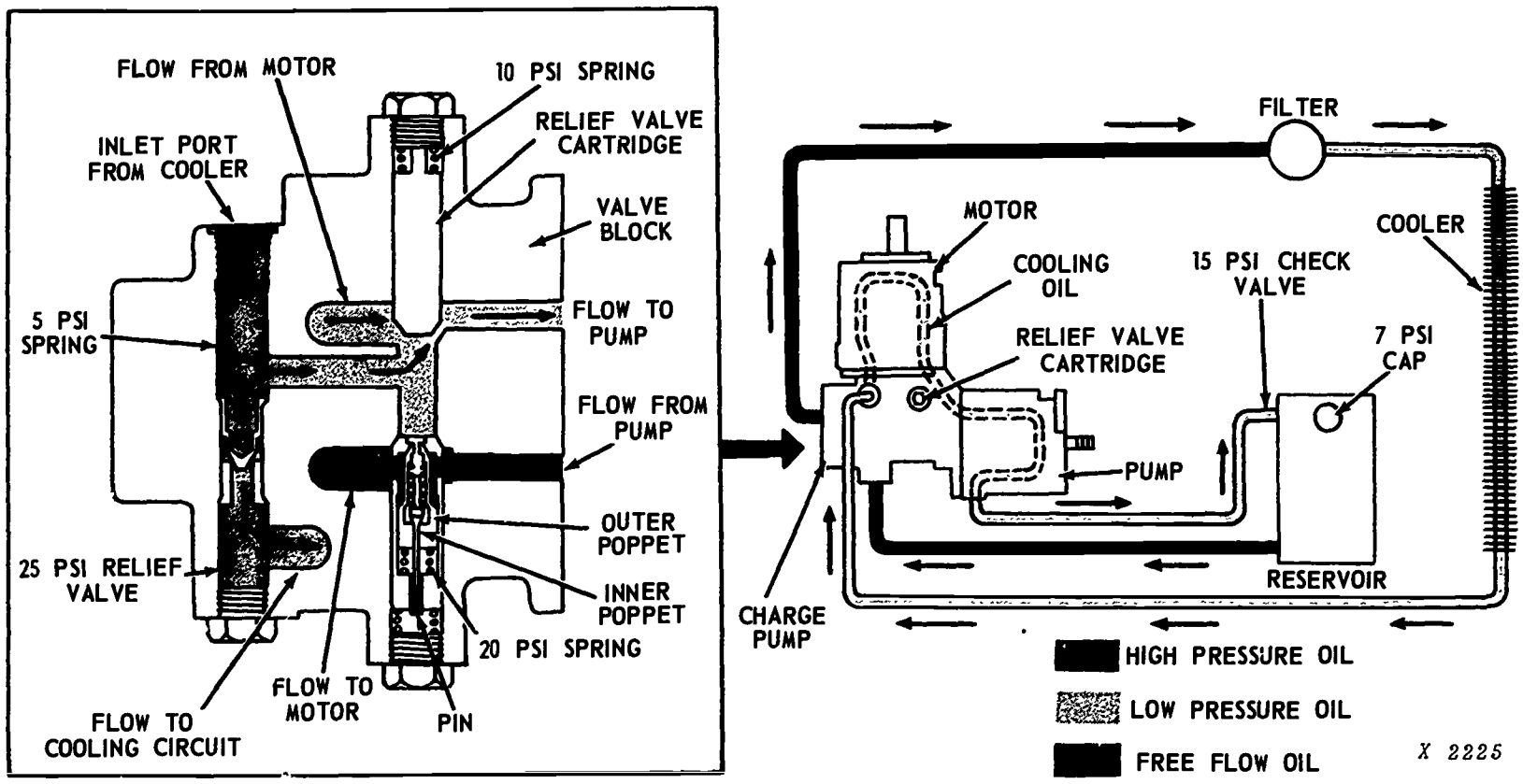

Fig. 18—Oil Flow In Hydrostatic Drive Axle

The pump for each axle is driven by the engine, while the motor for each axle drives that axle.

The machine is steered by actuating the pump swashplate on each axle. For example, a steering wheel can be linked indirectly to the swashplates for gradual turns. For sharp turns or reversing an axle, steering levers—one for each axle—can be used.

For reversing an axle, the pump swashplate is moved overcenter, reversing the flow circuit which drives the motor.

OTHER TYPES OF HYDROSTATIC DRIVES

A variety of hydrostatic units are available for driving machines from the center drive line or from the individual wheels.

To serve these needs, a wide variety of pump-motor locations are used.

We have looked at only a few of the more common designs.

ADVANTAGES OF HYDROSTATIC DRIVES

- *Infinite speeds and torques*
- *Easy one-lever control*
- *Smooth shifting without "steps"*
- *Shifts "on the go"*
- *High torque available for starting up*
- *Flexible location—no drive lines*
- *Compact size for big power*
- *Eliminates clutches and large gear trains*
- *Reduces shock loads*
- *Low maintenance and service*

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MAINTENANCE OF HYDROSTATIC DRIVES

Any hydraulic system is fairly easy to maintain: the fluid provides a lubricant and protects against overload. But like any other mechanism, it must be operated properly.

You can damage a hydraulic system by too much **speed,** too much **heat,** too much **pressure,** or too much **contamination.**

Keep the hydrostatic system clean. Impurities such as dirt, lint, and chaff, cause more damage than any one other thing. Seal any openings when doing service work to prevent dirt from entering the system. Be very careful that all parts are clean before replacing them.

NOTE: Any internal service on either the pump or motor must be done under extremely clean conditions. The tolerances in these units are similar to those in diesel injection pumps and equal care must be taken.

Before removing any part of the hydrostatic system for servicing, be sure that area is clean.

Use steam cleaning equipment, if it is available. However, do not let water enter the system. Make sure all hose and line connections are tight.

If steam cleaning is not possible, fuel oil or a suitable solvent may be used. Do not use paint thinner or acetone. Be certain to remove all loose dirt and foreign material that might get into the system when it is opened.

Use a clean work bench or table when disassembling the pump or motor for servicing. Do not perform internal service work on the shop floor or the ground or where there is danger of dust or dirt being blown into parts. Be sure all tools are clean and free of grease and dirt.

Have these items available before disassembling the pump or motor:

1. Several clean plastic plugs to seal openings when removing hydraulic lines or hoses.

2. Several clean plastic bags to place over open ends of lines or hoses. Secure bags with rubber bands.

3. A clean container of solvent to wash internal parts. Use clean compressed air to dry parts after washing.

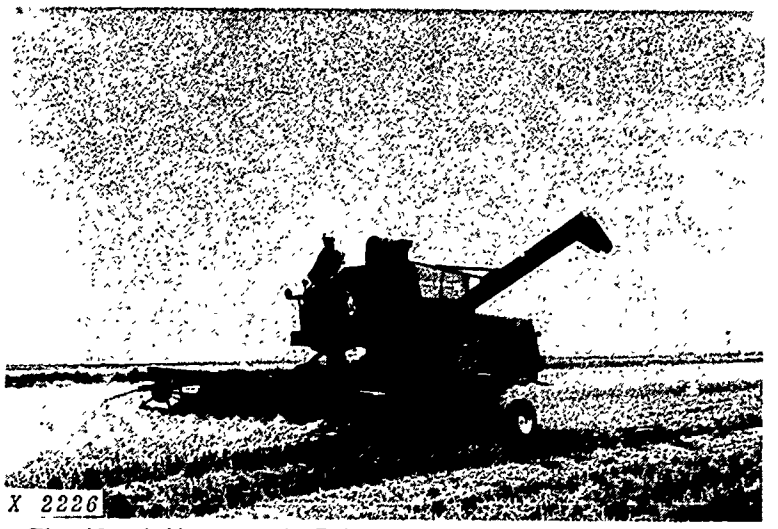

Fig. 19—A Hydrostatic Drive Propels This Grain Combine

4. A clean container of transmission fluid to lubricate internal parts as they are assembled.

5. A clean container of petroleum jelly (petrolatum) to lubricate surfaces where noted during reassembly.

Whenever units are serviced, always install new O-rings, seal, and gaskets during reassembly. This will provide tight seals for mating parts and eliminate leakage.

Do not service the hydrostatic drive system with the machine engine operating unless specifically required.

Never operate the hydraulic system empty. Always check the oil supply after servicing the system.

If the machine is to be stored, be sure the hydraulic system is filled and the reservoir cap is tight. The oil will prevent rust and corrosion.

Always use clean oil in the system. Be careful to use the transmission fluid recommended in the machine operator's manual.

TESTING THE SYSTEM

The only testing required for many hydrostatic drives is for charging and operating oil pressures. Other systems may also require tests for oil flow rate and oil temperature.

Use the proper test equipment and procedures as given in the machine Technical Manual.

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TROUBLE SHOOTING OF HYDROSTATIC DRIVES

Follow the general guide here for major problems and remedies. For specifics, see the machine Technical Manual.

NOTE: These trouble shooting charts include some items that will not apply to simpler drives.

MACHINE WILL NOT MOVE IN EITHER DIRECTION

Cause or Symptom	Remedy
System low on oil.	Check oil level.
	Check for oil leaks.
Faulty control linkage.	Check linkage for binding.
Disconnected coupling	Be sure coupling from engine to pump and from motor to gear train is installed correctly and are not slipping or broken.
Low or zero charge pressure.	Check charge pressure control valve. Also look for binding pump drive shaft or oil line restrictions.
Low on fluctuating charge pressure.	Check for air in system (if noisy). Also look for damaged charge pressure control valve (stuck open) or faulty check valves.

MACHINE MOVES IN ONE DIRECTION ONLY

Faulty control linkage.	Be certain control linkage is connected properly and not binding.
High pressure relief valve stuck open.	Replace valve which is stuck open.
One faulty check valve.	Replace both check valves.
Faulty directional control valve.	Check out speed control.

NEUTRAL HARD TO FIND

Cause or Symptom	Remedy
Faulty speed control linkage.	Adjust control linkage. Be certain linkage is not binding. Also, be sure displacement control valve is adjusted properly. Check out pump servo cylinders for proper adjustment.

SYSTEM OPERATING HOT

Oil level low.	Fill with oil.
Cooler clogged.	Clean cooler air passages.
Engine fan belt slipping or broken.	Tighten or replace fan belt.
Internal leaks. (Usually shown by loss of acceleration and power).	Check for stuck high pressure relief valve. Replace relief valve. Check for internal damage in pump or motor.

SYSTEM NOISY

Air in system.	Check oil supply. Be sure all air is out of system. Check for loose fittings or damaged lines and hoses.

HIGH LOSS OF OIL

Loose connections or leaking lines and hoses.	Tighten connections. Replace damaged lines and hoses. Check O-rings and seats.

ACCELERATION AND DECELERATION SLUGGISH

Air in system.	Remove all air from system. Check for low oil supply.
Control orifice partially blocked.	Check orifice and spool in displacement control unit for foreign material. If orifice and spool are clean, remove charge pump and clean passage between charge and displacement control unit with compressed air.
Internal damage in pump or motor.	Repair pump or motor as necessary.

TRANSMISSION HARD TO SHIFT OR WILL NOT SHIFT

Cause or Symptom	Remedy
Speed control lever not in neutral.	Check and adjust linkage to be sure lever is in neutral.
Gearshift linkage out of adjustment.	Adjust gearshift linkage in all positions.

TEST YOURSELF

QUESTIONS

1. (Fill in each blank with "high" or "low".) Hydrostatic drives use fluids at _____ speeds but relatively _____ pressures.

2. How is a torque converter different from a hydrostatic drive as defined in Question No. 1?

3. What team of components is the heart of the hydrostatic drive?

4. Does a pump with a movable swashplate have a fixed or variable displacement?

5. What does the charge pump do for the hydrostatic drive oil circuit?

ANSWERS

1. First blank—"low". Second blank—"high".

2. Torque converter uses fluids at high speeds but relatively low pressures.

3. Pump and motor.

4. Variable.

5. The charge pump makes up for oil lost from the closed circuit between the pump and motor.

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TORQUE CONVERTERS / CHAPTER 6

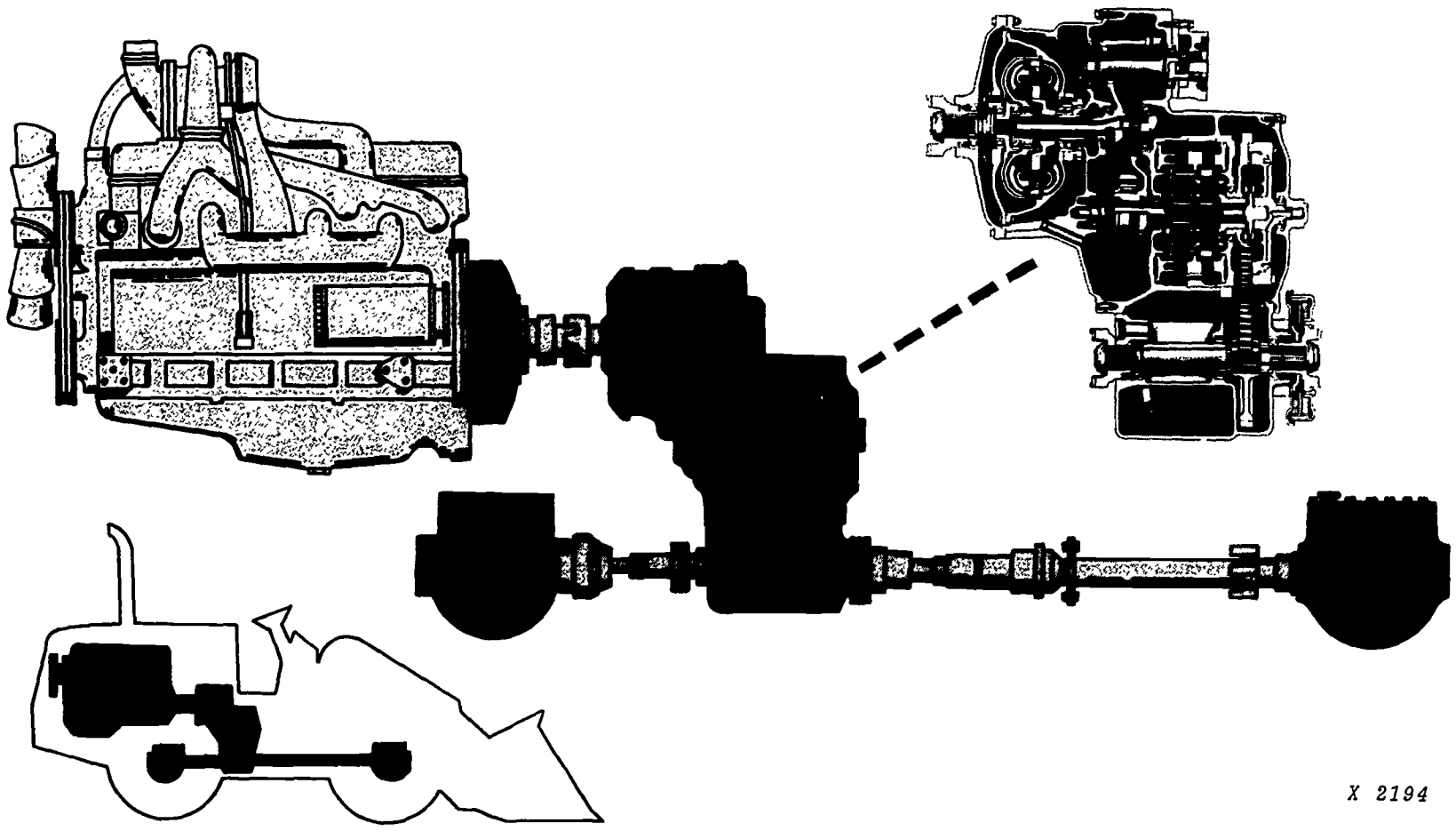

Fig. 1—Torque Converter In Complete Power Train

INTRODUCTION

A **torque converter** is an automatic *fluid* drive. It transmits engine torque by means of hydraulic force, shifting smoothly through an infinite number of speeds.

Actually a gear train is used with the torque converter to give extra speed ranges. But no gear train could give the infinite variations in speed and torque of a torque converter.

Acting as a *clutch,* the torque converter connects and disconnects power between the engine and the gear train. As a *transmission,* the converter gives many more speed ratios than are practical with a strictly mechanical gear box.

To compare a torque converter with a hydrostatic drive (Chapter 5), use this rule of thumb:

Hydrostatic drives are driven by fluids at *high pressure* but at relatively *low velocity,* while **torque converters** are driven by fluids at *low pressure* but at *high velocity.*

Here are the formulas:

- **Hydrostatic Drive** = *HIGH pressure* + *LOW velocity*
- **Torque Converter** = *LOW pressure* + *HIGH velocity*

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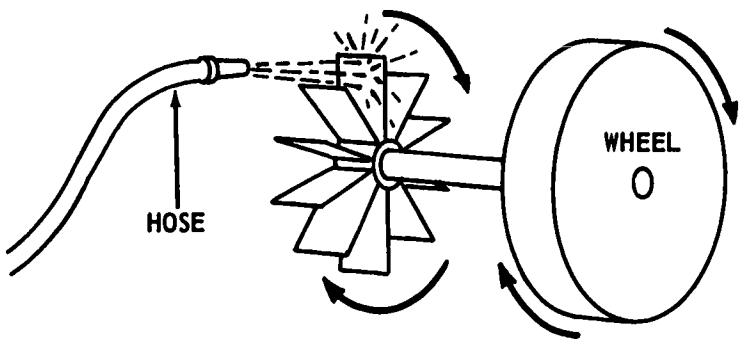
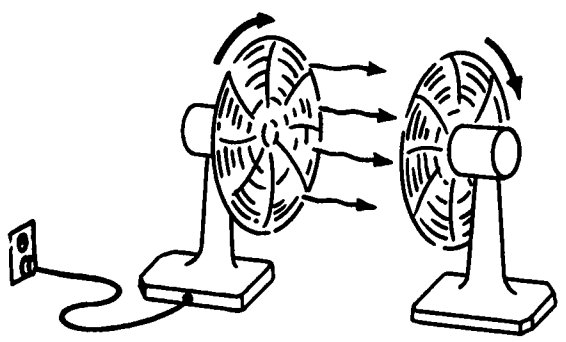
HOW IT WORKS

To understand a torque converter, we must first look at a basic **fluid coupling.**



FLUIDS AT HIGH VELOCITIES CAN TRANSMIT POWER



ONE PART CAN DRIVE ANOTHER BY FORCE OF AIR – OR OIL

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Fig. 2—Basic Principles Of A Fluid Coupling

The basic principles of all fluid couplings are shown in Fig. 2.

At the top, a fluid at high velocity strikes a turbine and forces it to turn, driving the wheel. Thus, **torque is transmitted by a fluid.**

To change this torque, the velocity of the fluid is changed. At low velocity, the fluid will not even move the turbine. At higher velocity, the turbine starts turning and the wheel picks up speed.

This is something like putting two electric fans face to face as shown in the lower part of Fig. 2. By plugging in only one fan, we can cause the other one to rotate.

This principle is used in a fluid coupling as follows:

Inside an oil-filled housing (A, Fig. 3) are two parts: the driving half, or **pump,** and the driven half, or **turbine.**

As the pump is turned by the engine, centrifugal force causes oil to be forced radially outward, crossing over and striking the vanes of the turbine. This rotates the turbine in the same direction and so couples the power.

Drawings B, C, and D explain how the flow of oil drives the turbine.

In B, fluid is placed in a bowl and lies level.

In C, the bowl is spun rapidly and centrifugal force causes the fluid to climb up and spill over the outside edge of the bowl.

In D, another bowl is placed down over the first one. Now when the bowls are spun an axial flow or circuit is created and turning force is transmitted between the driving bowl and the driven bowl.

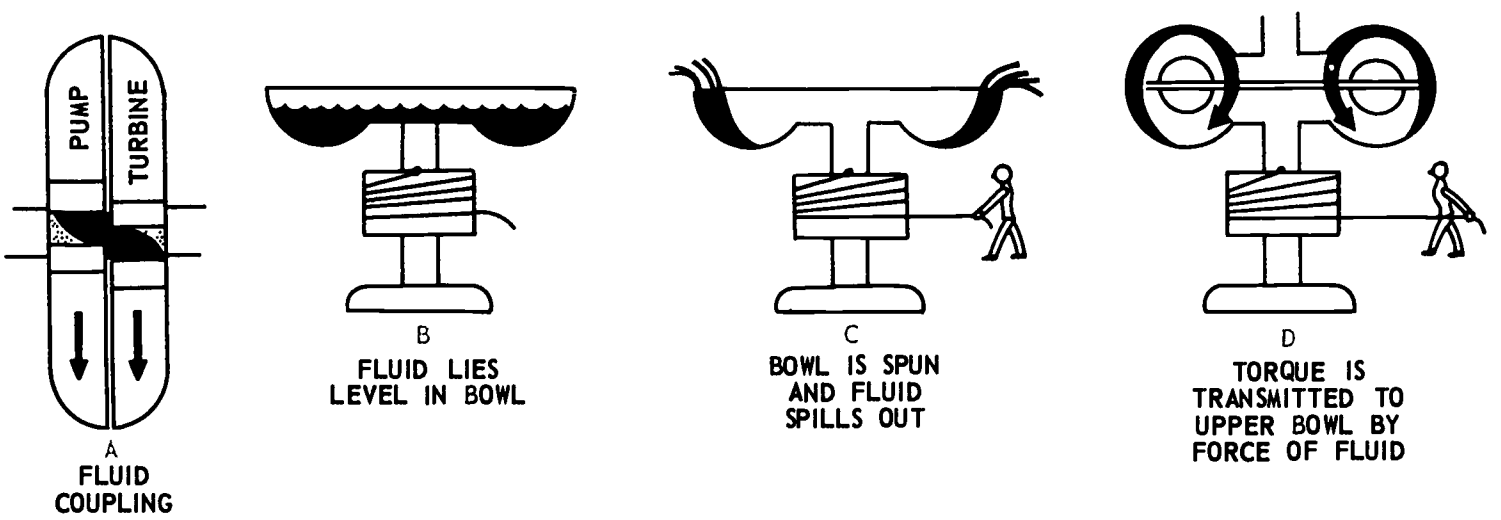

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Fig. 3—Operation Of A Fluid Coupling

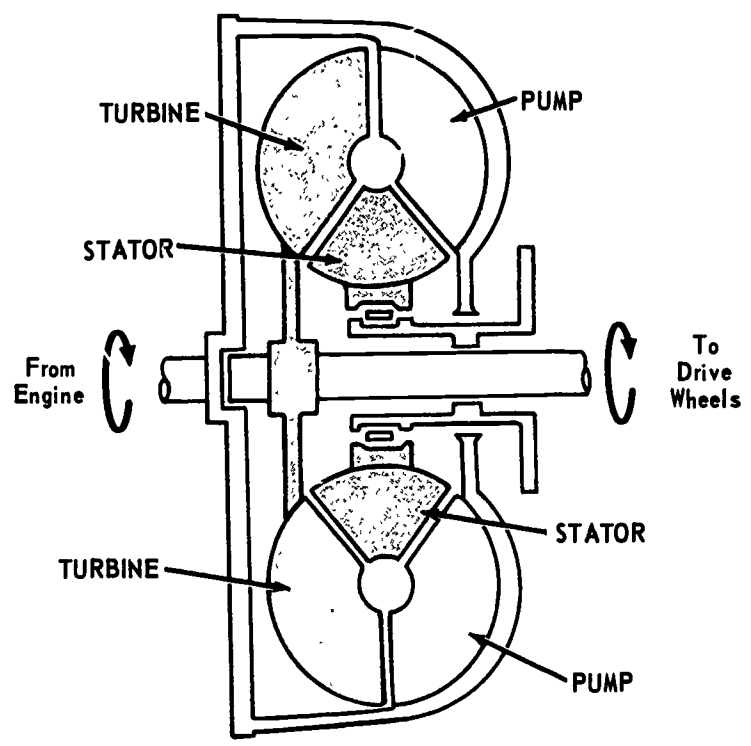

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Fig. 4—Torque Converter

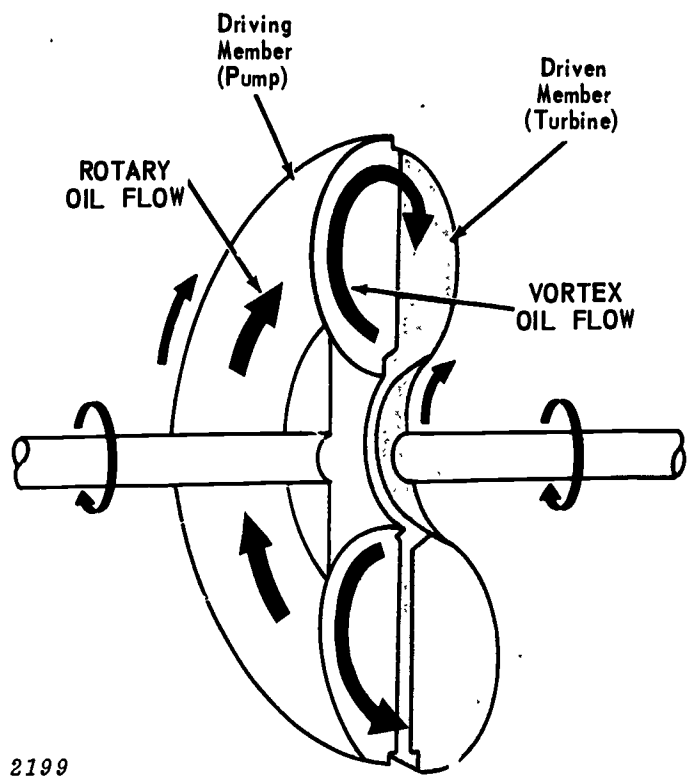

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Fig. 5—Vortex And Rotary Flow In A Fluid Coupling

Torque is thus transmitted, but it is not increased.

This is where the **torque converter** goes beyond the basic fluid coupling, for the converter can **multiply torque.**

A torque converter (Fig. 4) looks much like the fluid coupling we have just described. The main difference is that the torque converter has—in addition to the driving pump and the driven turbine —a set of blades or vanes called a **stator.**

The stator vanes change the direction of oil flow after it has gone through the turbine and sends it back to the pump. This enables the pump to increase the twisting force or *multiply* the torque.

Since the converted is a closed unit, this flow is repeated continuously. Many streams of fluid act against many vanes at once and this is what gives the power to drive a heavy machine.

OIL FLOW IN CONVERTER

Let's look at the flow of oil in the converter during two cycles:

1) Increasing the torque

2) Decreasing the torque

INCREASING THE TORQUE

Remember that the pump is driven by the engine, while the turbine receives fluid energy from the pump and sends it to the drive wheels.

Also remember how centrifugal force sets up a continuous circular flow in the coupling (Fig. 5).

This circular flow of oil *between* the pump and turbine is called **vortex flow.**

Another flow is set up *around* the pump and turbine to form a coupling; this is called a **rotary flow.**

The action of these combined oil flows will transmit torque *but not increase it.*

Increasing the torque is where the stator comes into play.

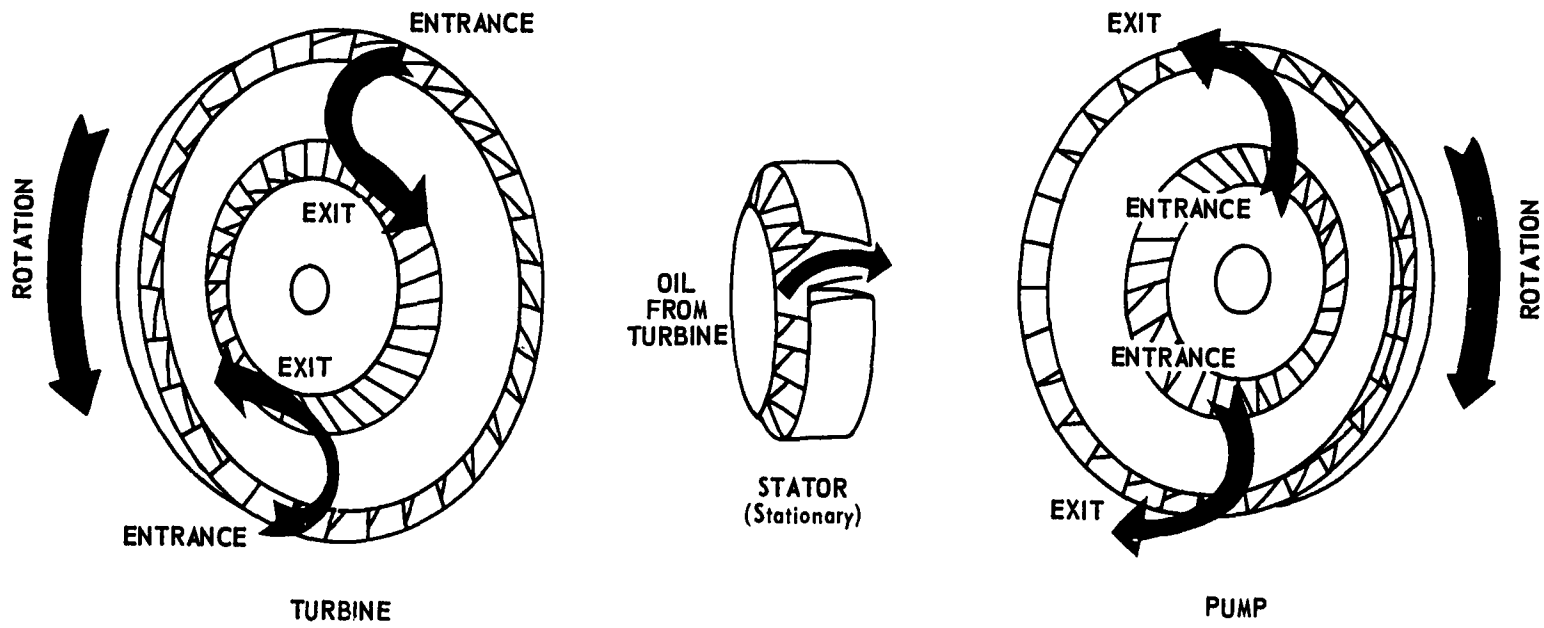

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Fig. 6—Oil Flow Through Pump, Turbine, And Stator

Fig. 6 shows how oil emerges from the turbine in reverse compared to pump rotation. Unless this oil flow is turned around, it will cause a loss of power.

Note in Fig. 6 that the oil passages at the rim of the turbine where the oil enters must become smaller as they approach the smaller diameter of the turbine. As the same volume of oil must squeeze through these funnel-like passages, the oil stream will speed up when it leaves the turbine. This speed is used to increase torque by directing it against the **stator,** which acts as a fluid lever or fulcrum. The stator changes the direction of flow and sends the oil into the pump in the same direction as pump rotation.

Let's see how the stator does its job (Fig. 7). A stream of oil aimed at a flat surface (A) splashes off at various angles. The oil can be made to flow more smoothly by curving the entrance (B) and can be reversed by more curving (C) with a resulting increase in force as indicated by the large arrow.

The stator has curved blades (as in C) which the oil strikes as it leaves the turbine. These blades turn the oil back in the direction of pump rotation.

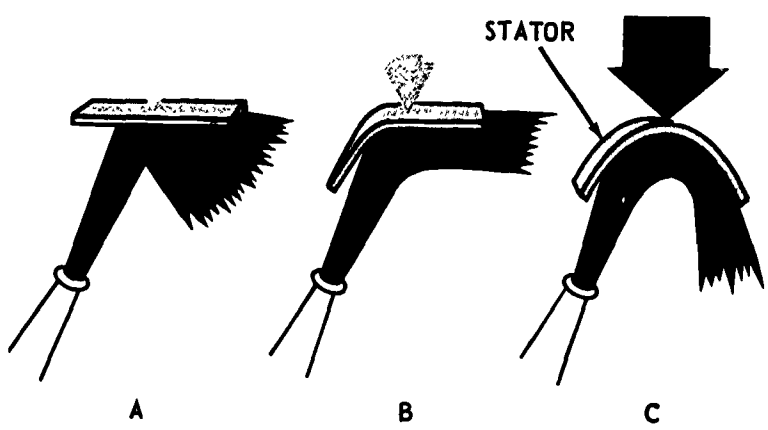

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Fig. 7—Stator As A Fluid Lever

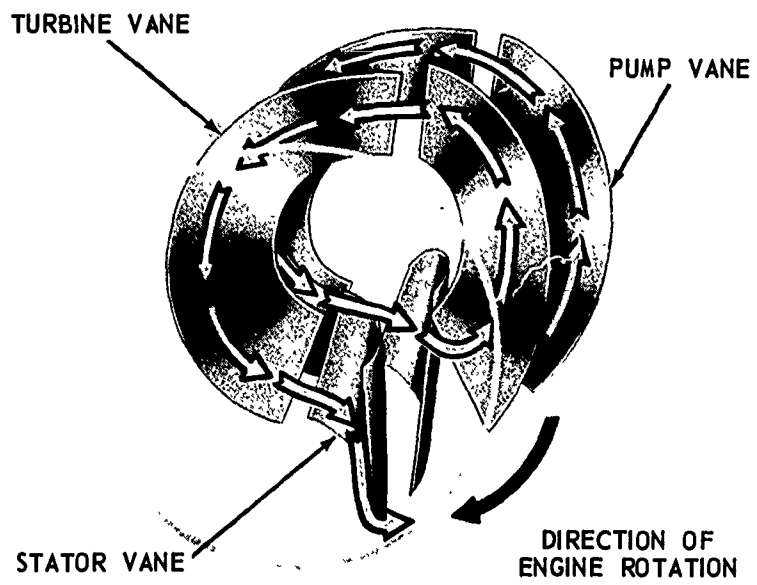

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Fig. 8—Flow Direction Is Reversed By The Stator Vanes

Now that the stream of oil is moving in the same direction but at a greater velocity, it enters the pump smoothly (Fig. 8). Its velocity is added to that developed in the pump so that the total velocity at the pump exits has been increased.

This regenerating action is the key to multiplying torque in a torque converter.

To change the direction of oil flow, the stator must be stationary during the increase in torque. However, once the pump and turbine are turning at the same speed it would create resistance. Therefore, the stator is sometimes mounted on a freewheel clutch so that it can turn in one direction only (once torque stops increasing). (In other torque converters, the stator may be fixed to the converter case.)

DECREASING THE TORQUE

Torque is increased as long as the engine is accelerating to get the machine under way. But as the engine speeds up, the turbine also speeds up, which causes the vortex flow of oil in the converter to decrease. At the same time, the rotary flow increases.

Vortex flow keeps on changing to *rotary* flow (Fig. 9) until the pump and turbine are "locked up" and all torque increase stops.

The torque converter now acts as a simple fluid coupling, sending the same torque it receives on to the drive wheels.

The torque converter is able to automatically reduce or increase torque in infinitely small steps to match the needs of the machine and its driver. This has the same effect as shifting speeds in a gear transmission except that it is done smoothly and automatically while "on the go."

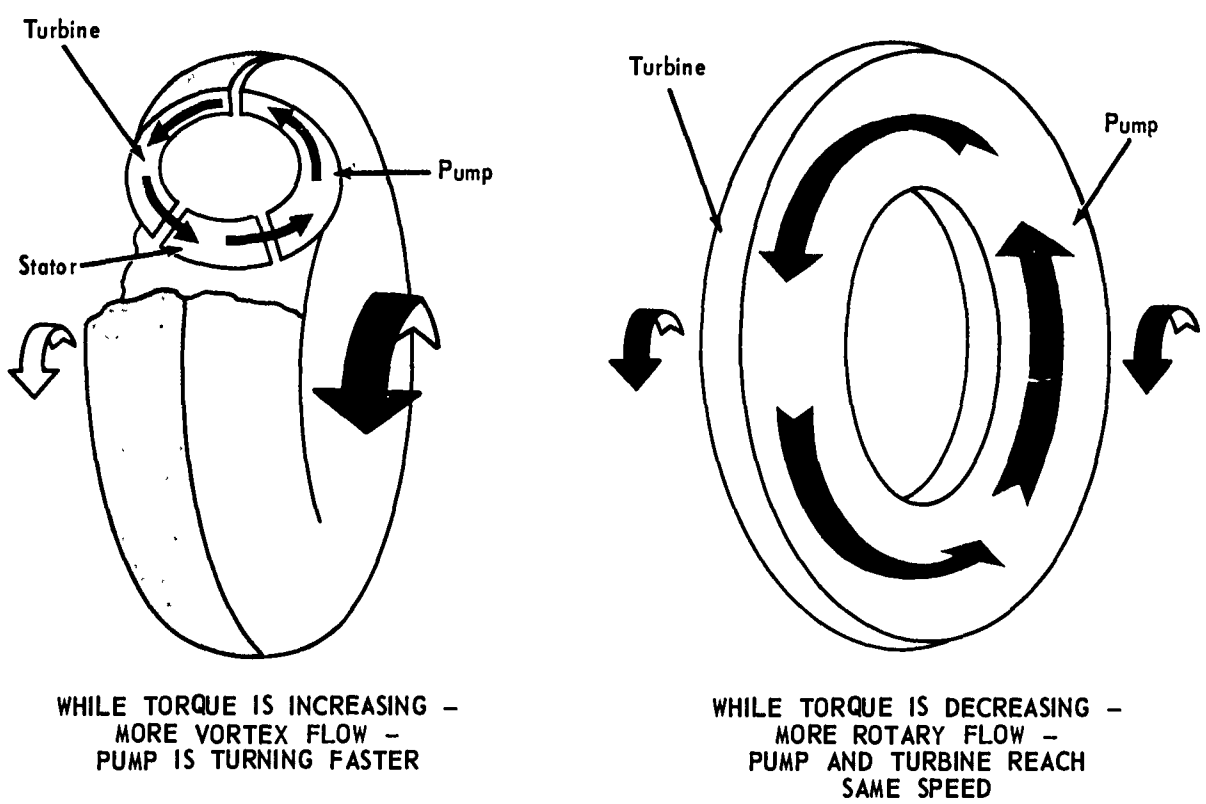

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Fig. 9—How Vortex Flow Changes To Rotary Flow As Torque Is Reduced

VARIATIONS ON TORQUE CONVERTERS

The chart below shows some of the variation in the number of elements used in several torque converters.

Torque Converter Elements	*Design A*	*Design B*	*Design C*	*Design D*
Pump	*2*	*1*	*1*	*1*
Stator	*2*	*1*	*2*	*1*
Turbine	*1*	*2*	*1*	*1*

The design of a torque converter must match the engine torque and road speed for each application. In off-the-road machinery, units are matched to horsepowers ranging from 40 to 600. But the basic principles we've covered apply to all.

TORQUE CONVERTER TRANSMISSIONS

The torque converter is but one part of the complete transmission (Fig. 10).

Here are the major components:

- **Converter Section**
- **Range Gear Section**
- **Final Drive Section**
- **Hydraulic Control System**

Let's look at each part and see what is does for the complete transmission.

CONVERTER SECTION

We have looked at torque converters with three elements—one pump, one turbine, and one stator.

Now we will examine a *twin-turbine* model (Fig. 11) which has one pump and one stator, but *two* turbines (first and second).

The first turbine is shown in blue, while the second is shown in red.

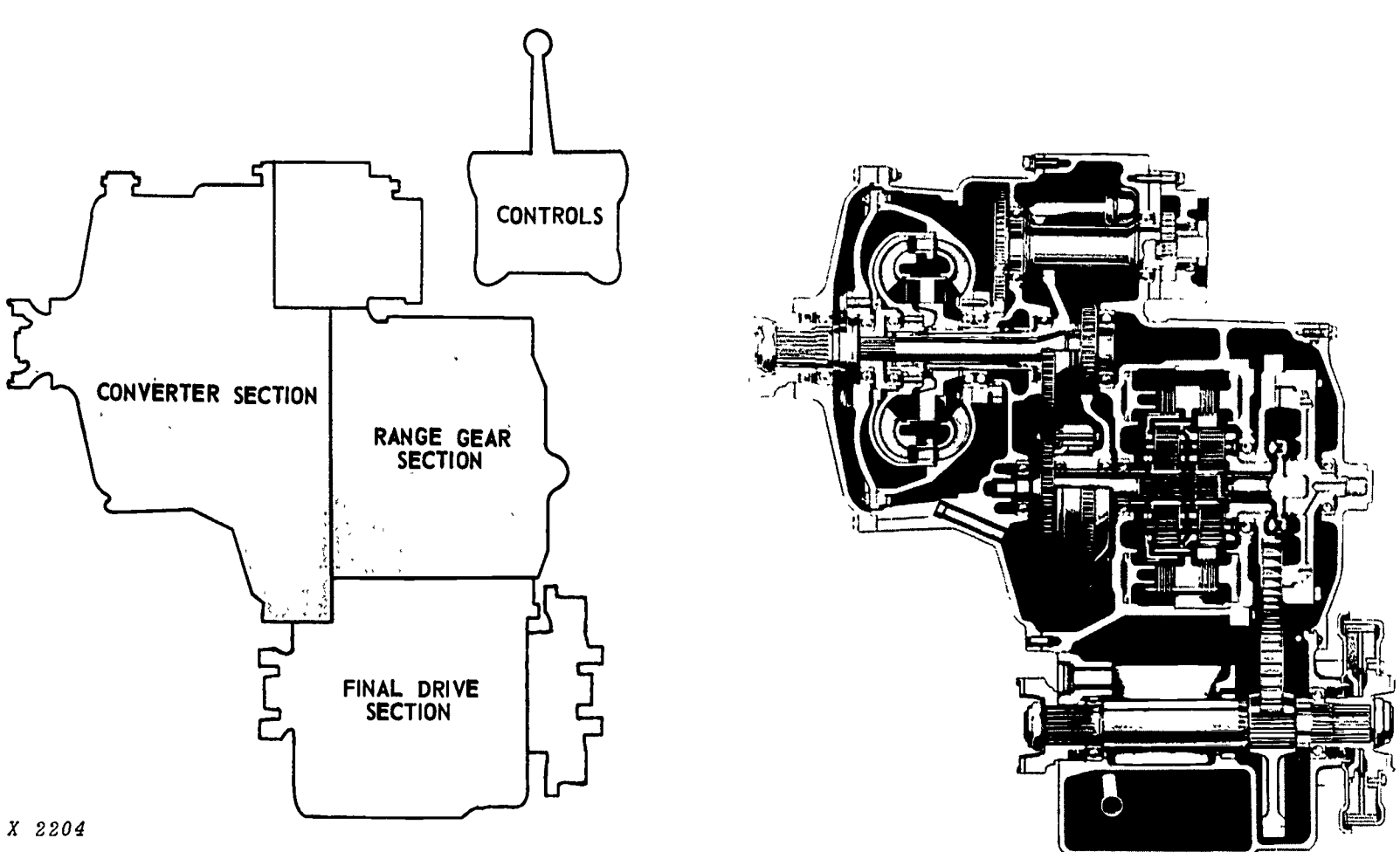

Fig. 10—Complete Torque Converter Transmission

Each turbine is connected to its individual output gear set. In reality, two converters have been combined into one. The first (blue) turbine is connected to its output shaft by a freewheel clutch.

Here is how the two turbines work together:

When torque demand is high, the freewheel clutch is engaged and the first turbine, assisted by the second turbine, drives the gears. When the machine speeds up, torque demand drops. Then the second turbine takes over the entire load and the freewheel clutch disengages the first turbine.

As a result, the first turbine provides *high torque and low speed,* (for starting up and loading) while the second turbine provides *higher speed with lower torque* (for travel).

A combining gear set directs torque from the first and second turbine (or the second turbine only) to the range gear section.

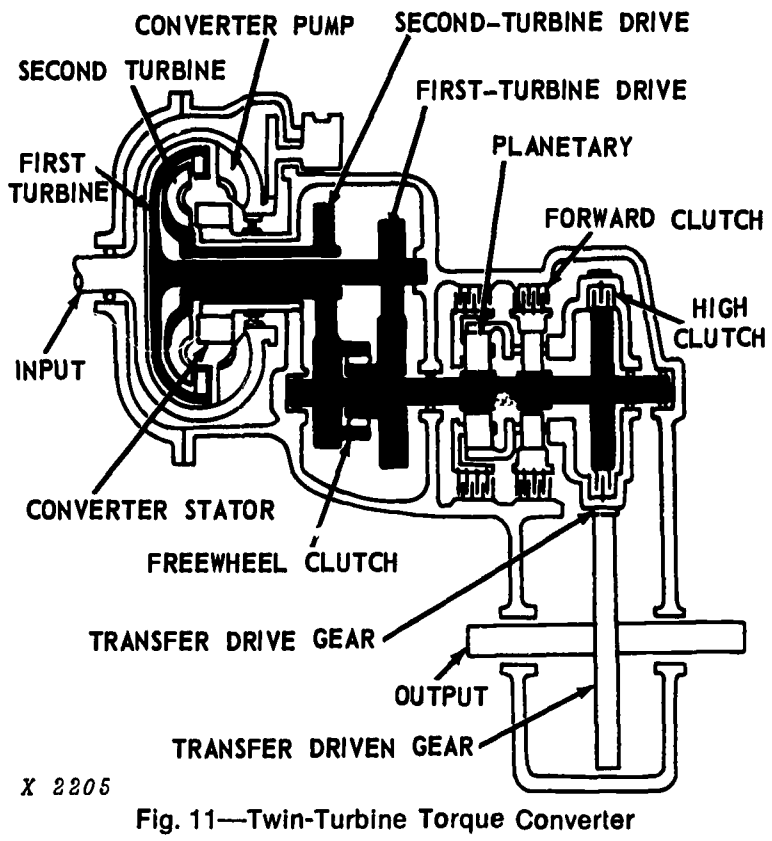

Fig. 11—Twin-Turbine Torque Converter

RANGE GEAR SECTION

Since torque is reduced and increased automatically in the torque converter, only a few gear sets are normally required in the transmission.

However, as the torque converter rotates in only one direction, it is necessary to have a reverse gear. In some applications, it is also desirable to have low and high range gears as shown in Fig. 11.

Simple planetary gear sets meet the needs of extra gear ranges and lends themselves to hydraulic control.

NOTE: Planetary gear sets and their control by hydraulic clutches are explained in Chapter 4.

FINAL DRIVE SECTION

The final drive section includes the transfer drive gear, transfer driven gear and output shaft (Fig. 11). The output shaft provides for one or for two outputs from the same common shaft. Two outputs can be used to propel a four-wheel drive machine as shown in Figs. 11 and 15.

Note also that by adding the transfer gear and one clutch (high range) in Fig. 11, another forward speed range can be obtained.

HYDRAULIC CONTROL SYSTEM

The hydraulic control system uses oil to do these jobs:

- **Oil flow lubricates and cools the parts**
- **Oil pressure engages the clutches**
- **Oil velocity drives the turbines**

Let's use the hydraulic controls for the twin-turbine converter we have just described to see how a typical system works.

There are four basic circuits as shown in Fig. 12:

1) Oil Pump and Filter Circuit (shown by blue lines).

2) Main-Pressure Regulator Valve and Converter-In Circuit (shown by red lines).

3) Converter-Out, Cooler, and Lubrication Circuit (shown by dotted blue lines).

4) Selector Control Valve Circuit (shown by dotted red lines).

Let's build up the system and explain each circuit.

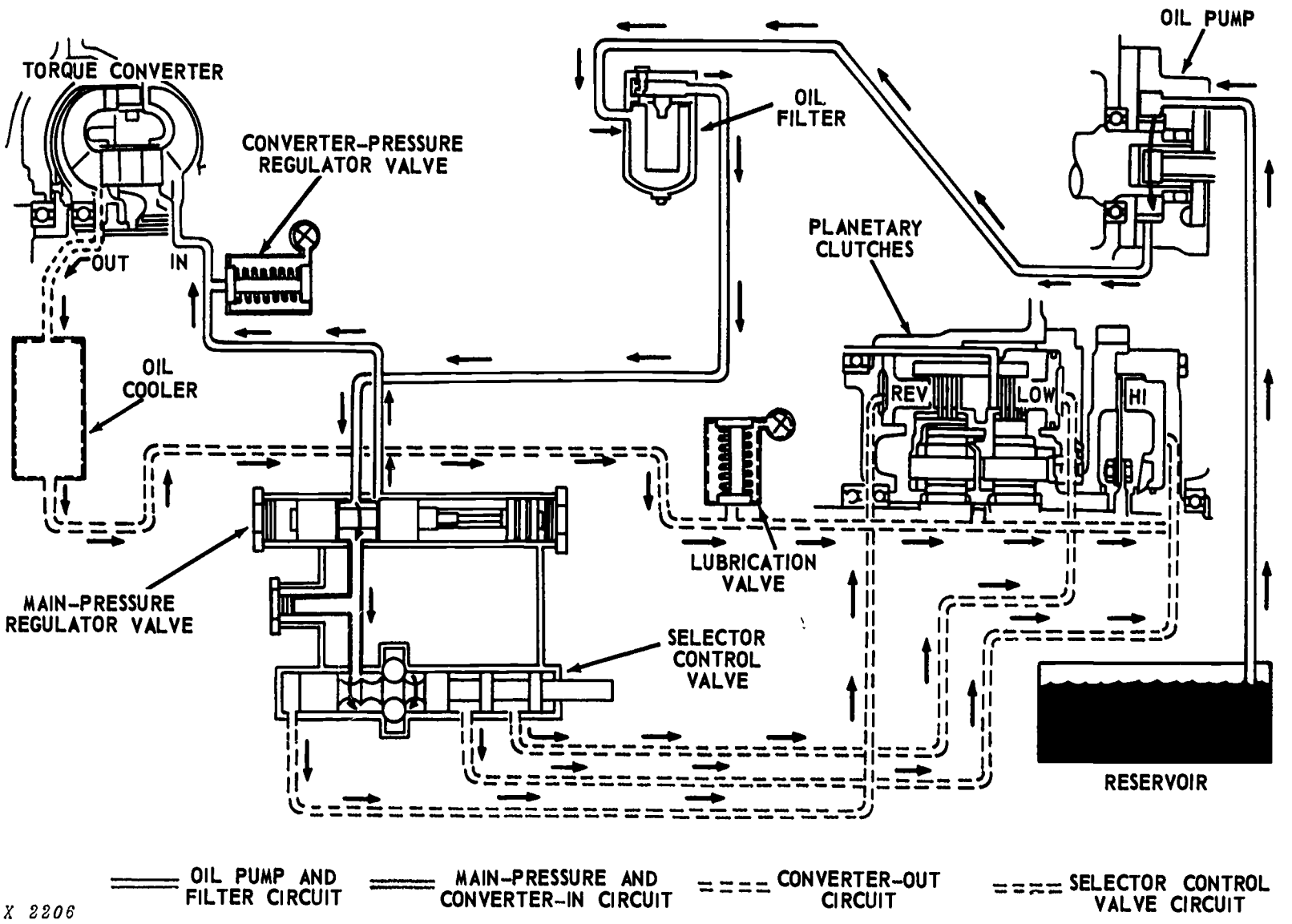

Fig. 12—Hydraulic Control System For Torque Converter Transmission

Oil Pump And Filter Circuit

Oil is drawn from the transmission reservoir by the oil pump as shown in Fig. 12. The pump delivers its entire output to a full-flow oil filter for cleaning. From the oil filter, the oil supply is sent to the main-pressure circuit.

Main Pressure Regulator Valve and Converter-In Circuit

The main pressure regulator valve provides pressure for the planetary clutch packs, directs oil to the selector control valve, and supplies pressure oil into the torque converter. A converter pressure regulator valve in the converter-in line limits the oil pressure there.

Converter-Out, Cooler, and Lubrication Circuit

The torque converter is continuously filled with oil during operation. Rotation of the converter pump imparts energy to the oil which, in turn, drives the turbines. The oil then flows between the stator vanes which redirect it to the pump.

Oil flowing out of the converter is directed into the oil cooler as shown in Fig. 12. The cooler is a heat exchanger in which the oil flows through water- or air-cooled passages.

From the cooler, oil flows to all passages and outlets in the lubrication circuit (dotted blue lines). A lubrication valve between the cooler and lubrication system returns all excess oil to the transmission reservoir.

Selector Valve Circuit

Pressure oil from the main-pressure regulator valve flows into the selector valve bore and surrounds the valve in the area of the detent notches. From this area, main pressure oil is available for operating the low, high, and reverse range planetary clutches (see dotted red lines).

Moving the selector valve allows oil to charge the selected clutch line and to engage that clutch.

This completes the four basic control circuits in our torque converter transmission.

NOTE: For details on hydraulic components, see the FOS "Hydraulics" manual.

SUMMARY: FEATURES OF TORQUE CONVERTERS

1. *Multiply torque*
2. *Provide infinite speed ranges*
3. *Shift smoothly and automatically*
4. *Cushion shock loads on drive lines*
5. *Help to dampen vibrations*

TROUBLE SHOOTING

INTRODUCTION

Oil circulates at high velocity within the torque converter and any foreign material it carries will rapidly wear down the edges and pit the turbine vanes (Fig. 13), changing their effective shape.

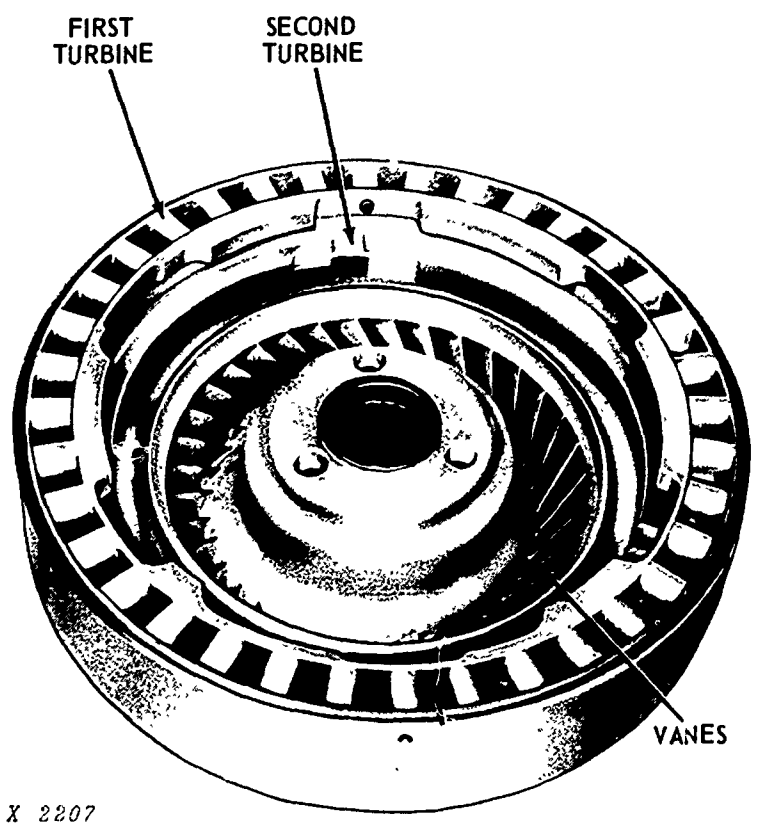

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Fig. 13—Turbines For Twin-Turbine Torque Converter

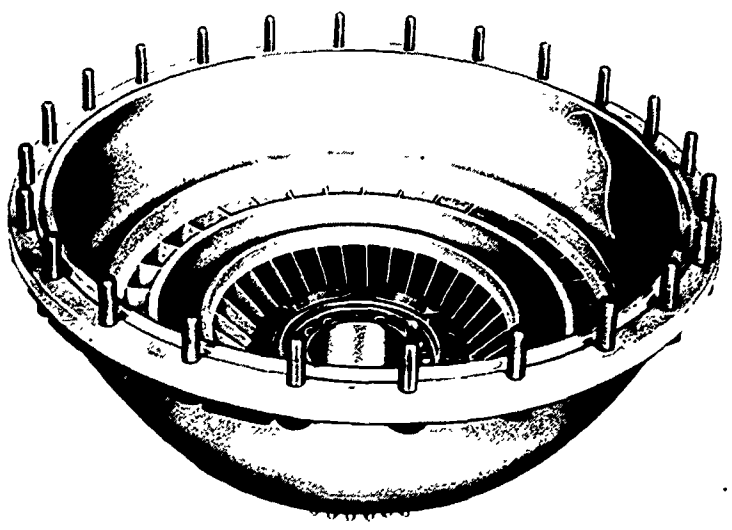

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Fig. 14—Pump For Torque Converter

Vane damage will also cause the turbines to become unbalanced. In addition, dirty oil will damage bearings and seals.

Some torque converters contain parts made of lightweight aluminum alloys (Fig. 14). Converter housings are usually made of cast aluminum.

Be sure to handle all converter parts carefully to prevent nicking, scratching, and denting.

Parts which fit together closely but with operating clearance will stick if damaged only slightly. Parts which depend upon smooth surfaces for sealing may leak if scratched.

All these parts should be carefully handled and protected during removal, cleaning, inspection, and installation.

Use these rules to help prevent failures:

1. *Be sure the oil is kept clean.*
2. *Service the system at proper intervals.*
3. *Repair it only if you are qualified.*
4. *Use all special tools recommended.*
5. *See the machine Technical Manual for details.*

PRELIMINARY INSPECTION

The operator and serviceman can use his eyes, ears, and even his nose to head off trouble before serious damage is done. Here's how:

Look *Check oil levels.* Refer to the operator's manual.

Check gauges. When starting, running or stopping, watch the gauges; they tell the story in terms of pressure and temperature.

Inspect for leaks. Leaks, crimped oil lines, and clogged filters — all affect the converter output.

Examine the oil. Look for water, dirt, and particles from the converter and the clutch plates.

Listen *Unusual noises.* Listen for squealing from a stuck valve, or grinding or grating sounds from inside the converter.

Smell *Overheating.* A strong odor of overheated oil is a major trouble sign. Find the cause at once.

Because one trouble can have the same symptoms as another, only good instruments in the hands of trained servicemen can detect the difference.

Once trouble has been detected in the field, check out the unit with the proper testing tools.

TROUBLE SHOOTING PROBLEMS

The trouble shooting given here will cover four common areas of trouble:

1. *Overheating*
2. *Noise*
3. *Leaks*
4. *Machine Response*

Let's examine each kind of trouble.

1. Overheating

Overheating is a major problem in converter operation. It is affected by the design, the type of work, the operator, the air temperature, and the condition of the unit.

Overheating can cause a loss of power and can damage seals and gaskets and warp metal parts.

A converter may overheat if the *work is heavy*— not always, but heavier work will generally mean more heat.

If the converter is *undersized* for the normal work of the machine, it will operate at low efficiency and will tend to overheat. The operator can usually relieve the load on the converter by operating in a lower gear, or by reducing the load.

Whenever you receive complaints that a converter in a machine is overheating, try to find out by watching or by questions whether the correct gears and work methods are being used.

Air in the converter will also cause overheating. Torque converters can work properly only if they are filled with fluid. Air mixed with the oil will cause poor performance, overheating, and possibly serious damage.

Air may enter the system:

(1) If the fluid in the reserve tank (if used) is low enough to permit the charging pump to suck air.

(2) If a moderately low level of oil permits sucking of air while the machine is working on steep slopes.

(3) If there is a leak in the suction line pump gaskets or O-rings (suction leaks may be too small to show up by outside leaking of oil).

(4) If the oil or filters are changed or when the lines are opened for any reason.

SUMMARY: OVERHEATING

Let's recap the major causes of overheating in the torque converter.

First, overheating is not only a major problem, it is also a major symptom.

Although normal operating temperatures can be exceeded very rapidly, a machine using a torque converter matched to the job should not exceed its normal temperature when properly used.

Second, the cause of overheating may be found in one or more areas outside of the converter.

Before deciding that the converter is the cause of overheating, check these possibilities:

(a) Air in fluid system.

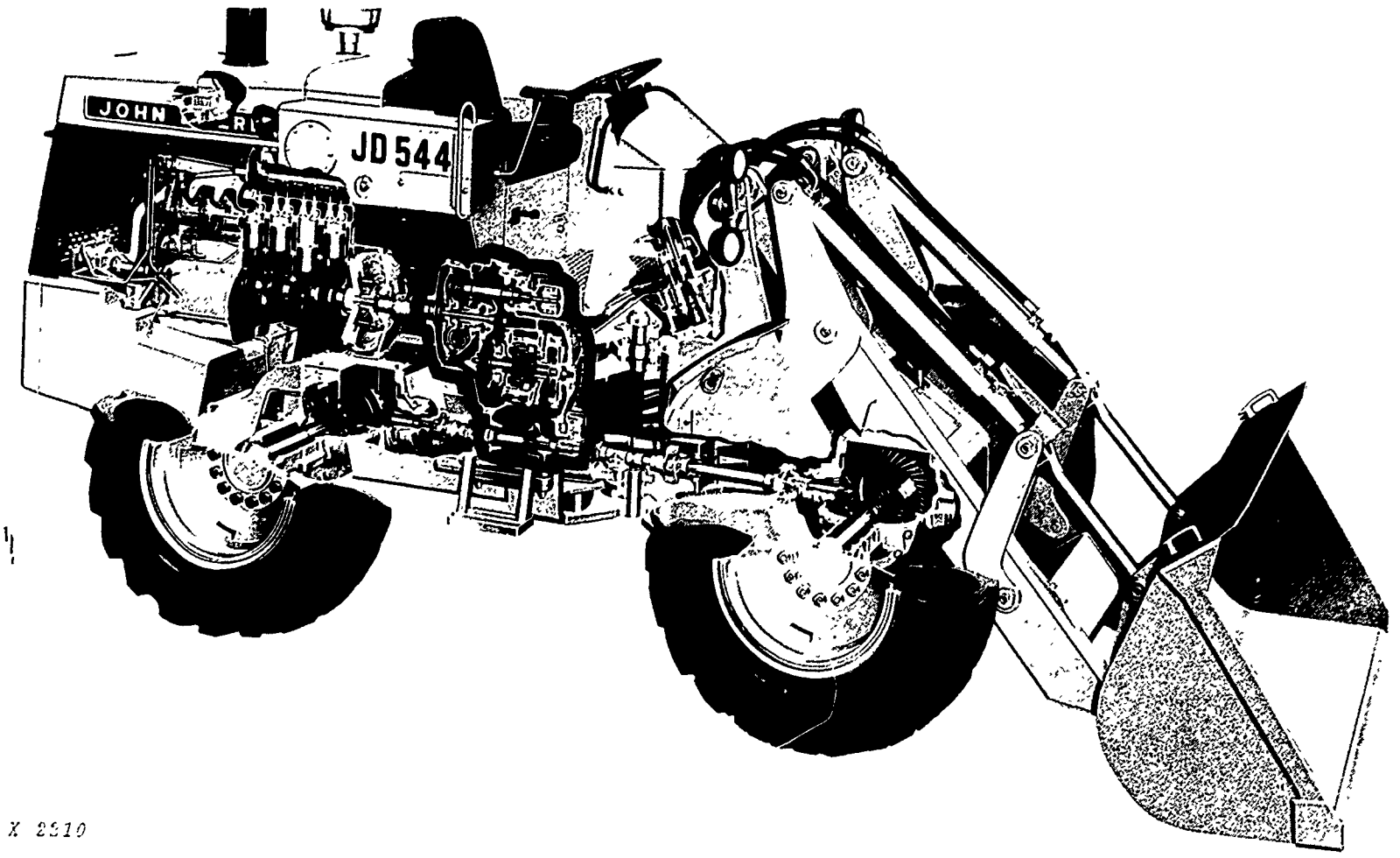

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Fig. 15—Torque Converter Transmission In Four-Wheel Drive Machine

(b) Lack of cooling—plugged cooler core, low coolant level, defective water pump (water-cooled systems only).

(c) Low fluid level—clogged filter, excessive leakage past converter seals, restricted oil line, defective oil pump.

(d) Slipping clutches in planetary gear sets.

Third, failure of the converter may cause the overheating. Worn edges and pits on vanes of pump, stator, or turbines will reduce their efficiency.

2. Noise

Unlike overheating, which can be tested, noise is hard to explain to another person.

A new operator or serviceman may never hear a noise directly related to a converter failure.

Yet, an unusual noise heard by an experienced operator or serviceman may be the first sign of damage in the converter.

Noise from a converter malfunction may be a whining or growling and may be steady or intermittent.

Worn or dry bearings often produce a hissing noise that will develop into a bumping or thudding sound when they completely fail.

Other sources of noise are: Worn gears, worn or bent shafts, excessive shaft endplay, shafts misaligned with the engine, and worn freewheel clutches. All these noises mean a possible converter failure.

A mechanic's stethoscope is a valuable aid for isolating noises in the converter.

3. Leaks

Converter leaks can be one of two types:

- *Internal leaks*
- *External leaks*

INTERNAL LEAKS

By internal leaks we mean those *within* the converter.

As we learned earlier, the converter uses large amounts of oil at high velocity.

If oil is lost from the converter housing by leaks in the pump, turbine, or stator, a loss of power or erratic operation will occur.

Leaks may be caused by the wrong torque on converter bolts.

On some converters, the housing which covers the converter can be removed to determine if a leak has occurred in the converter. Check by starting the engine and operating the transmission until the oil leak shows up.

If leaks form around the converter cover, check the tightness of the cover bolts with a torque wrench. If this fails to correct the leak, disassemble the cover, check the machine surfaces of the cover and flywheel, and install a new gasket.

EXTERNAL LEAKS

By external leaks we mean those occurring outside the converter but still affecting its operation.

These include leaks at cooler lines, filter lines, and pressure or temperature gauge fittings.

Visually check all fittings and oil lines for leakage.

4. Machine Response

Normally a malfunction in the converter will affect the machine's response to load and speed changes.

A machine which lacks power and acceleration at low speed may have a turbine freewheel clutch failure.

Changes in hydraulic pressure, flow, and temperature also affect the performance of the converter, and thus affect the machine's performance.

If you picture the converter as in Fig. 7 (a flow of oil from a nozzle) it is easy to see how heavy cold oil, low pressure, or low flow will affect a response.

TESTING THE TORQUE CONVERTER

As in trouble shooting, *testing* is most effective when the engine, converter, and gear train are regarded as a unit, one part affecting the other.

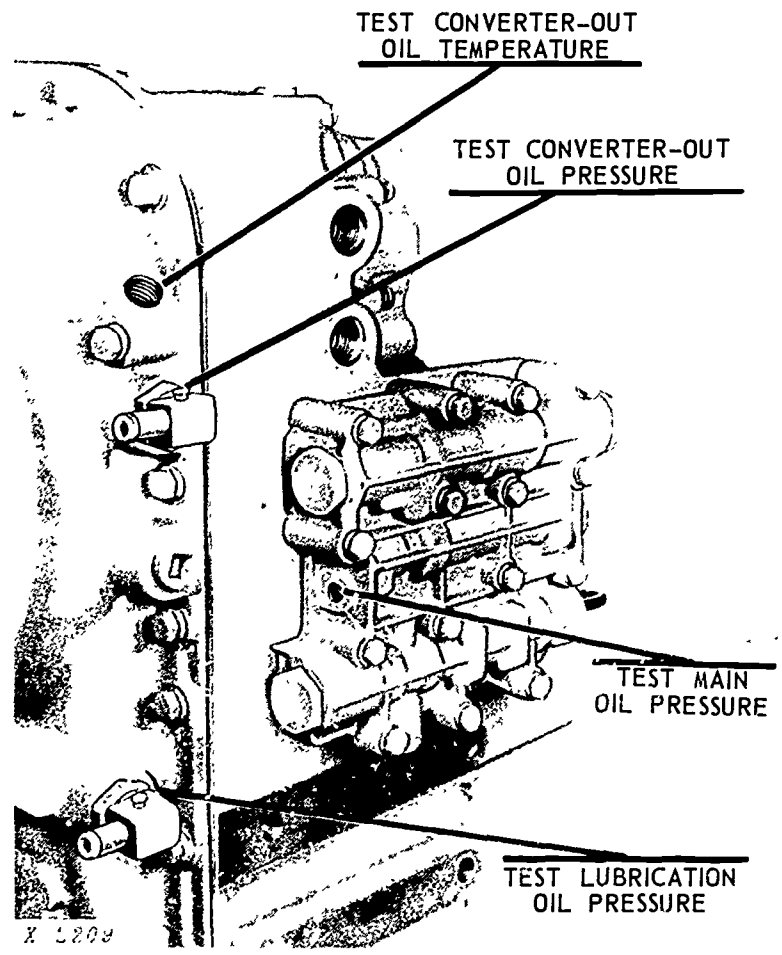

Fig. 16—Pressure And Temperature Check Points On A Typical Torque Converter Transmission

Fig. 16 shows the points where pressures and temperature may be tested on a *typical* torque converter.

Before testing, several checks should be made.

BEFORE TESTING

1. Check the fluid level. Be sure it is not *above* or *below* the required level.

2. Start the engine and warm the engine and transmission to operating temperature.

3. Shift into each gear and operate for a minimum of 15 seconds, checking the selector valve detent positions against the related positions on the shift indicator (if equipped).

4. *Never allow the transmission to heat up beyond the maximum operating temperature.*

TESTING PRESSURE AND TEMPERATURE

Attach the necessary temperature and pressure gauges to the converter. Be sure that all tests are performed as required by the machine Technical Manual.

For example, tests made on the typical unit in Fig. 16 are as follows:

(1) Main Pressure (at full throttle—no load).

(2) Converter-Out Pressure (at full throttle—no load and at full throttle stall in high range).

(3) Lubrication Pressure (at full throttle—no load).

(4) Converter-Out Temperature (during normal operating conditions).

TRANSMISSION STALL TEST

IMPORTANT: Be sure to consult the machine Technical Manual before conducting a stall test. Some manufacturers do not recommend this test.

The stall test tells whether or not the engine, torque converter, and transmission are performing satisfactorily *as a unit.*

The test is made while the output shaft is braked and the engine is running at full throttle.

Refer to the engine-converter matched performance curve to find the acceptable speed at stall (see the Technical Manual).

Procedure

1. With the transmission warmed up, connect an *accurate* tachometer to the engine.

2. Block the machine securely and shift to the desired range.

3. Accelerate the engine to full throttle.

4. After reaching a stabilized engine speed, record the engine speed.

CAUTION: Because of rapid heating of the oil, never hold the machine stalled for more than a few seconds at one time.

Results

If the engine and transmission are failing, it will show up when the actual engine speed in the stall test is compared to the normal speed in the engine-converter chart.

Allow for variations in the test speed due to climate, altitude, engine accessory loads, and power input at converter, all of which affect the stall test results.

TEST YOURSELF

QUESTIONS

1. (Fill in the blanks.) A _____ _____ can only transmit torque, while a _____ _____ can multiply the torque it receives.

2. What part in a torque converter directs the fluid back to the pump?

3. (Fill in the blanks.) Once torque demand is reduced in the converter, the pump and turbine "lock up" and_____ flow is changed to_____ flow.

4. True or false? "The stator will turn in either direction."

5. True or false? "Only one turbine can be used in a single torque converter."

6. Match each item below with the best match at the right.

a. Oil flow	*1. Drives the turbines*
b. Oil velocity	*2. Engages the planetary clutches*
c. Oil pressure	*3. Lubricates and cools*

(Answers on next page.)

ANSWERS

1. First two blanks—"fluid coupling". Second two blanks—"torque converter".

2. The stator.

3. First blank—"vortex". Second blank—"rotary".

4. False.

5. False.

6. a-3; b-1; c-2.

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DIFFERENTIALS / CHAPTER 7

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Fig. 1—Differential in Complete Power Train

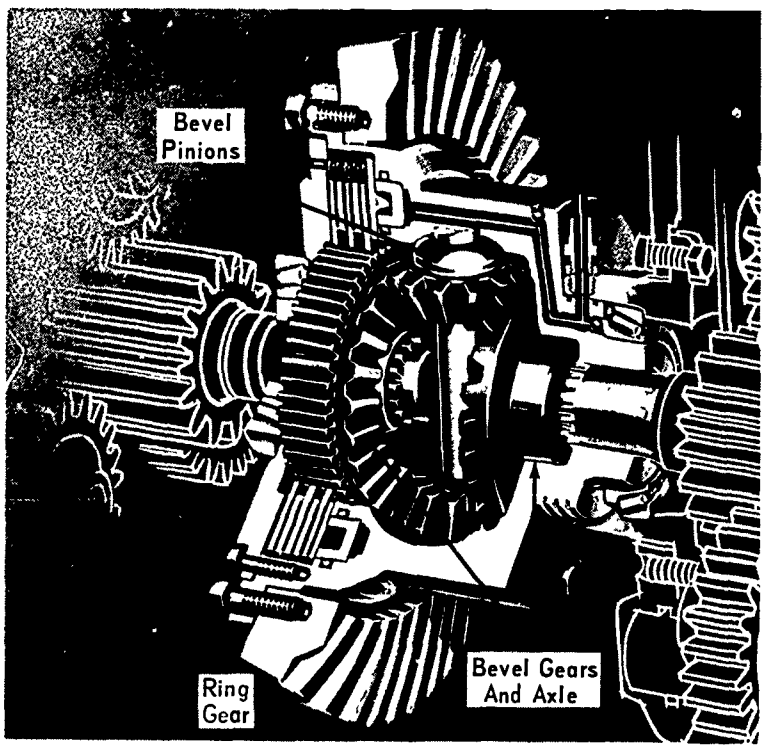
INTRODUCTION

The *differential* does two jobs:

- **Transmits power "around the corner" to the drive axles.**
- **Allows each drive wheel to rotate at a different speed and still propel its own load.**

The ring gear and bevel gears direct the power to the axles, while the bevel pinions give the differential action (Fig. 2).

We saw in Chapter 1 how the differential works. Let's review it briefly here.



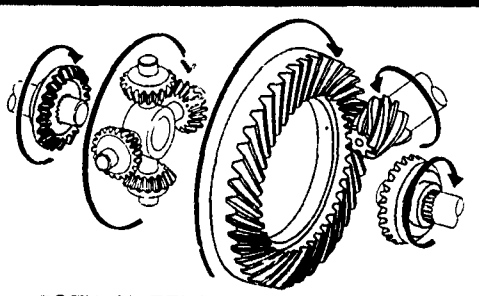
OPERATION

When the machine is moving straight ahead, *both wheels are free to rotate* as shown in Fig. 2.

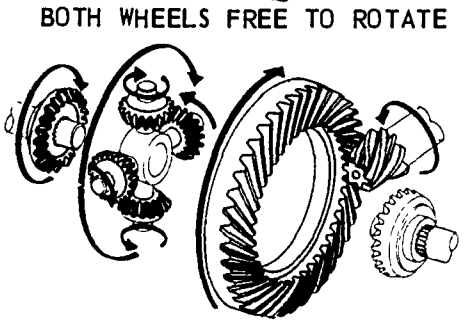
Engine power comes in on the pinion gear and rotates the ring gear. The four bevel pinions and the two bevel gears are carried around by the ring gear and all gears rotate as one unit. Each axle receives the same rotation and so each wheel turns at the same speed.

When the machine turns a sharp corner, only *one wheel is free to rotate* as shown in Fig. 2.

Again engine power comes in on the pinion gear and rotates the ring gear, carrying the bevel pinions around with it. However, the right-hand axle is held stationary and so the bevel pinions are forced to rotate on their own axis and "walk around" the right-hand bevel gear.



BOTH WHEELS FREE TO ROTATE



X 2176 ONE WHEEL FREE TO ROTATE

Fig. 2—Differential In Operation

Since the bevel pinions are in constant mesh with both bevel gears, the left-hand bevel gear is forced to rotate because it is subjected to the turning force of the ring gear which is transmitted through the bevel pinions.

During one revolution of the ring gear, the left-hand gear makes *two* revolutions—one with the ring gear and another as the bevel pinions "walk around" the other bevel gear.

As a result, when the drive wheels have unequal resistance applied to them, the wheel with the least resistance turns more revolutions. As one wheel turns faster, the other turns slower by the same amount. However, both wheels still propel their own loads—but at different speeds.

Differential action can be a disadvantage when the wheels slip. For example, when a farm tractor is plowing, one wheel may lose resistance on slick ground and start spinning while the other wheel holds. Then the driving power is limited by the "wasted" power sent to the wheel that slips.

To prevent this loss of power, *differential locks* are often used, as we'll see now.

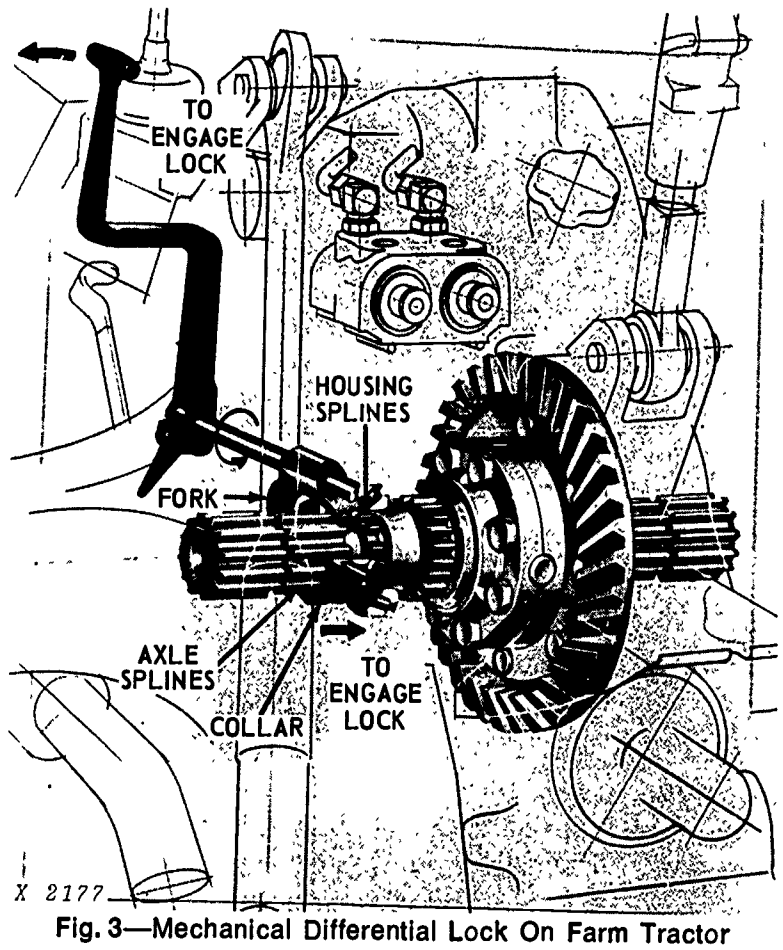


Fig. 3—Mechanical Differential Lock On Farm Tractor

DIFFERENTIAL LOCKS

A *differential lock* directs power equally to both wheels by locking out the differential. This prevents the usual loss of traction when one wheel is slipping.

Three types of differential locks are used:

- **Mechanical**
- **Hydraulic**
- **Automatic (No-Spin)**

Let's see how each lock operates.

MECHANICAL LOCKS

The simplest differential lock is the *mechanical* one shown in Fig. 3.

When the operator moves the upper lever, the fork rotates and slides the collar to the right. This engages the differential housing splines to the collar. Since the collar is already on the axle splines, both the axle and the housing are forced to rotate as a unit. This in turn prevents the bevel gear on the axle from turning and so locks the differential.

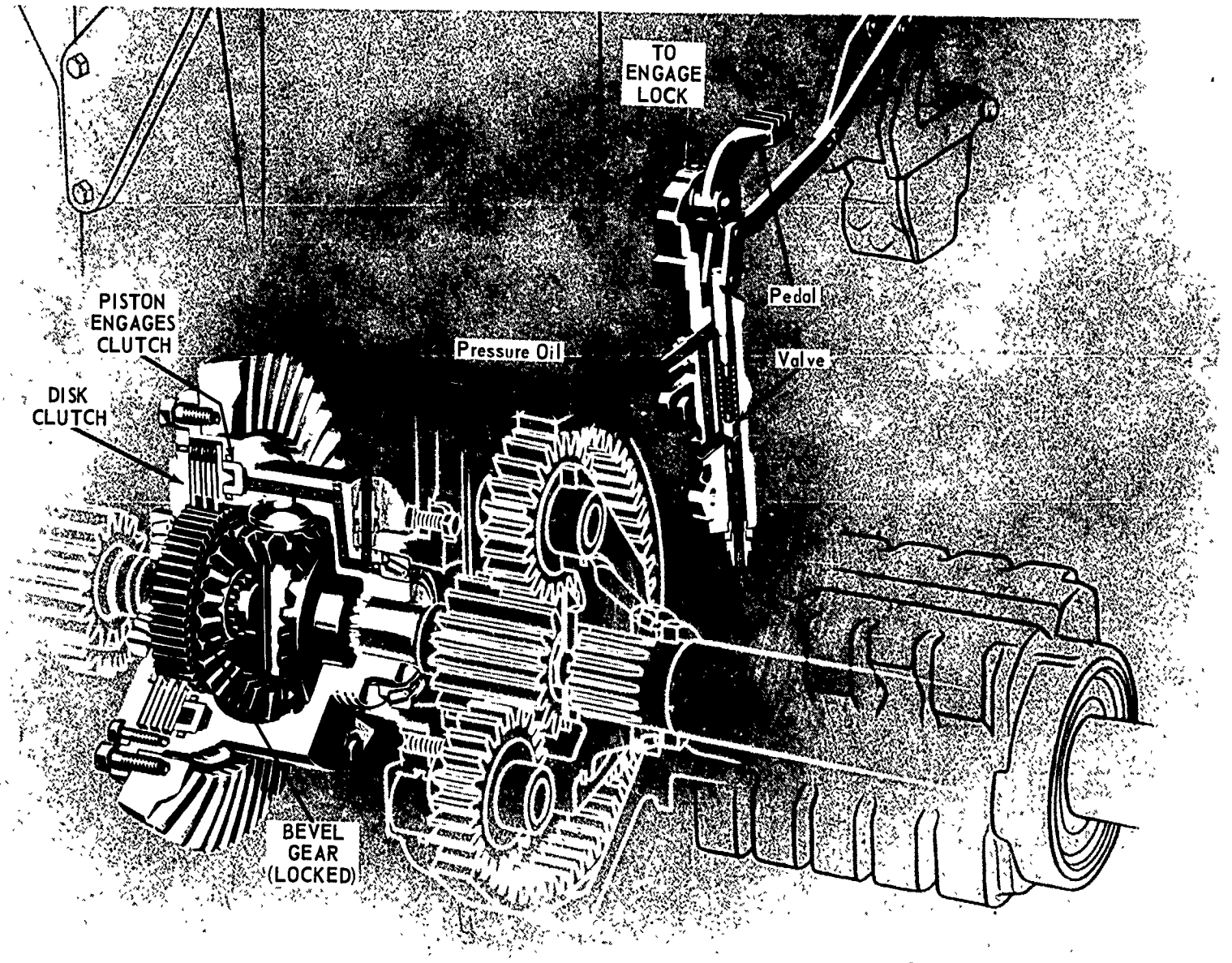


Fig. 4—Hydraulic Differential Lock On Farm Tractor

When the drive wheels again have equal traction, the lock disengages automatically. This happens because the collar is spring-loaded and releases once the torsional forces are gone.

This lock can be engaged "on the go." However, it should always be disengaged before turning the machine.

HYDRAULIC LOCK

The *hydraulic lock* (Fig. 4) uses pressure oil to lock out the differential.

When the operator depresses the pedal, the valve allows pressure oil to flow to the differential. The oil presses the piston against the disk clutch, compressing it against the housing. Since the disks are splined to the bevel and the plates are tanged to the housing, this locks up the bevel pinions and prevents differential action.

This lock can also be engaged "on the go".

When the operator releases the pedal, the valve cuts off oil pressure to the piston, allowing springs to return it, freeing the disk clutch. The differential then operates normally.

The pedal on this unit is linked to the tractor's brake pedals. This is a safety release and unlocks the differential whenever the brake pedals are used, preventing the danger of turning the tractor sharply with the differential lock still engaged.

AUTOMATIC (NO-SPIN) LOCK

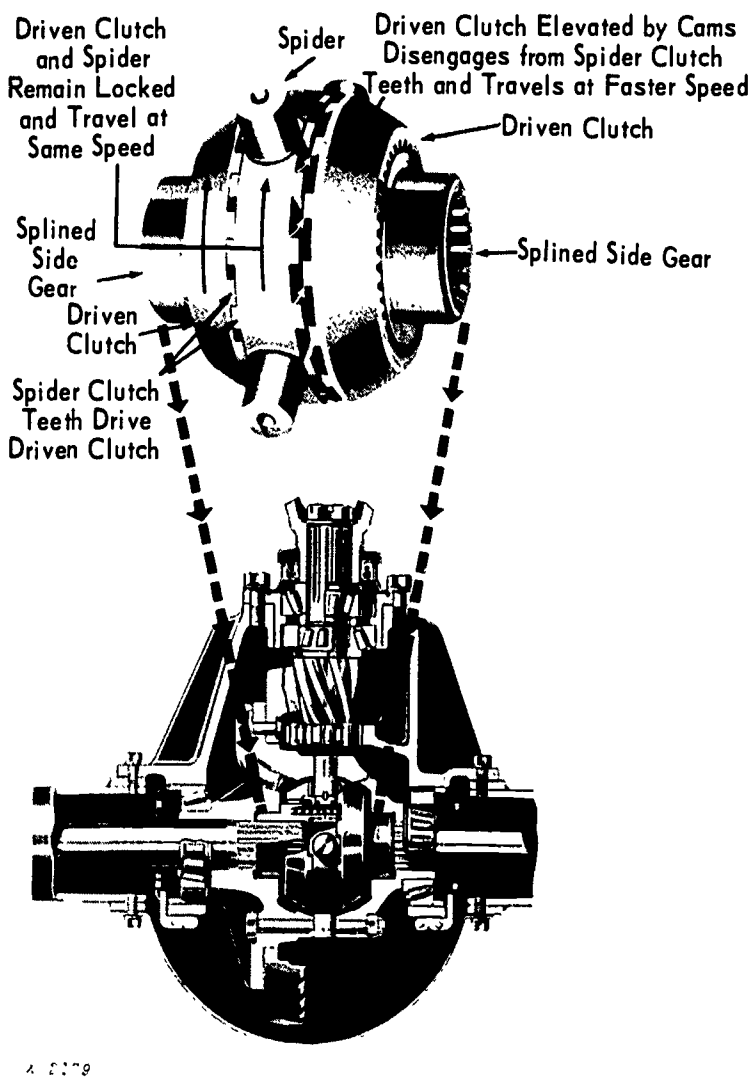


Fig. 5—Automatic (No-Spin) Differential Lock During A Left Turn

The *automatic (no-spin) lock* (Fig. 5) is different in that it is normally *engaged* and still allows for relative motion between the wheels on a corner.

When engaged, it prevents one wheel from spinning when it loses traction and thereby depriving the other wheel of full driving power.

The no-spin unit is located inside the differential housing and replaces the bevel gears, bevel pinions, and their shafts.

In Fig. 5, both axles are splined to the *side gears* of the no-spin unit—one on each side. The side gears in turn are splined to the *driven clutches.*

When driving straight ahead, the clutch teeth of the *spider* and the driven clutches are fully engaged, and the spider drives the driven clutches. The whole system then rotates as a solid unit. The parts are held engaged by springs.

When the machine is turned to the left, the teeth on the center cam (10, Fig. 6) are held to the rear of the right driven clutch teeth (5). The right driven clutch then rotates faster to make the turn, through the overrunning action of the right wheel. This happens as the teeth on the right driven clutch disengage from the spider teeth as shown at the upper right in Fig. 5. Meanwhile, the left driven clutch is held engaged to the center cam by resistance of the slower left wheel.

As the turn is completed and the overrunning motion stops, the speed of the spider and the right driven clutch become the same again. There is a slight reversal of torque which causes the holdout ring to move back into phase with the teeth on the driven clutch, engaging all teeth again.

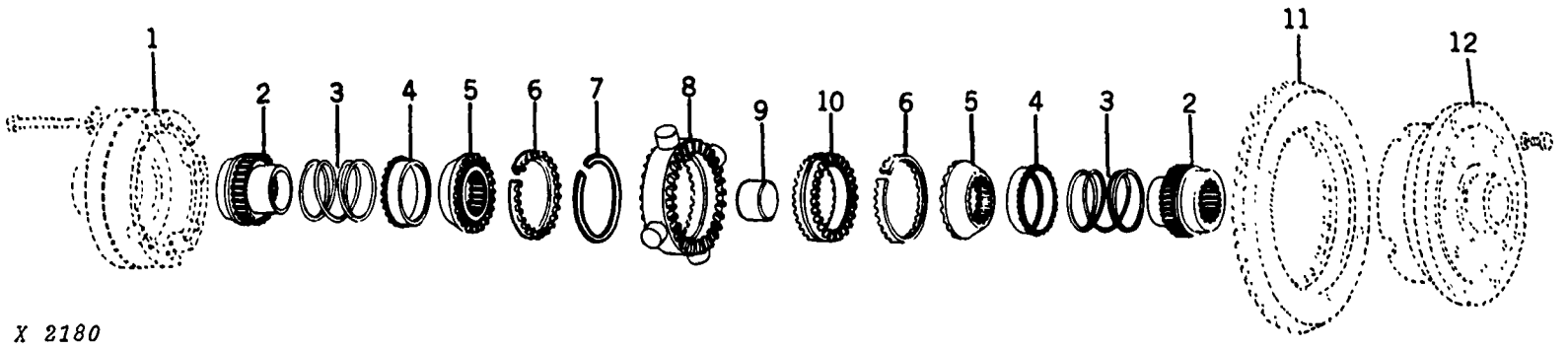
The whole mechanism then returns to the fully locked position until another turn.

The no-spin unit does not allow the inside wheel on a turn to slow down—only the outside wheel to speed up. For this reason, it cannot be used on machines with a great difference in wheel speeds on a turn. In a tight turn, these machines would not decelerate to a safe speed.

ADJUSTMENT OF DIFFERENTIALS

The ring gear and pinion in the differential are normally adjusted for bearing **preload** and gear **backlash.**

Chapter 1 has a story on "Adjusting The Gear Train." It explains the effects of wrong adjustment and gives an example of ring gear and pinion adjustment for a differential unit.



1 — Differential Housing Cover
2 — Side Gear (2 Used)
3 — Spring (2 Used)
4 — Spring Retainer (2 Used)
5 — Driven Clutch (2 Used)
6 — Cam Holdout Ring (2 Used)
7 — Snap Ring
8 — Spider
9 — Stop
10 — Center Cam
11 — Ring Gear
12 — Differential Housing

Fig. 6—Automatic (No-Spin) Differential Lock In Exploded View

TROUBLE SHOOTING

Here is a guide to the common failures of differentials and the possible causes.

1. NOISE IN DIFFERENTIAL AT ALL TIMES

a. Incorrect adjustment of ring gear and pinion.

b. Ring gear or pinion damaged.

c. Damaged bearings on pinion shaft.

d. Damaged bearings in differential housing.

2. DIFFERENTIAL NOT WORKING FREELY ON TURNS

a. Damaged or galled bearing surfaces between bevel gears and differential housing.

b. Damaged or galled bearing surfaces between bevel pinions and differential housing.

c. Damage or galling between bevel pinions and their shafts.

3. MECHANICAL DIFFERENTIAL LOCK DOESN'T HOLD

a. Linkage between engaging lever and shifting collar broken or improperly adjusted.

b. Shifting collar broken or missing.

4. HYDRAULIC DIFFERENTIAL LOCK DOESN'T HOLD

a. Too-low oil pressure.

b. Blown oil seals or gasket.

c. Failed control valve.

TEST YOURSELF

QUESTIONS

1. What *two* jobs does a differential do?

2. What are differential locks for?

3. Name the three types of differential locks.

4. Why is the hydraulic lock sometimes linked to the brake pedals?

5. Which type of differential lock is normally *engaged*?

6. True or false? "The no-spin differential allows one wheel to turn slower and the other faster than ring gear speed."

(Answers on next page.)

ANSWERS

1. Transmits power "around the corner" and allows each wheel to rotate at a different speed.

2. They lock out differential action to prevent a loss of power when one wheel slips.

3. Mechanical, hydraulic, automatic.

4. To prevent the danger of turning the machine with the differential lock engaged.

5. The automatic (no-spin) type.

6. False. The faster wheel turns faster than ring gear speeds, but the slower wheel turns the same as the ring gear.

FINAL DRIVES / CHAPTER 8

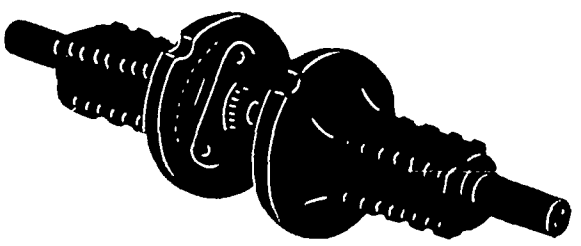


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Fig. 1—Final Drives In Modern Tractor

INTRODUCTION

The final drive is the last phase of the power train. It gives the final reduction in speed and increase in torque to the drive wheels.

Used on most large machines, the final drives are mounted near the drive wheels (Fig. 1) to avoid the stress of long axle shafts.

By reducing speeds, the final drives lower the stress and simplify the transmission, since extra gears and shafts can be eliminated.

Most final drives must support the weight of the machine as well as withstanding torque and shock loads.

TYPES OF FINAL DRIVES

There are four major types of final drive systems:

- **Straight Axle**
- **Pinion**
- **Planetary**
- **Chain**

Each of these four drives have their advantages. All but the first give a speed reduction.

Let's look at each one in detail.

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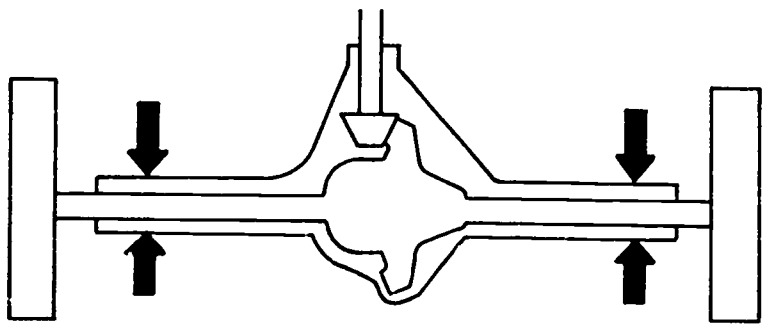
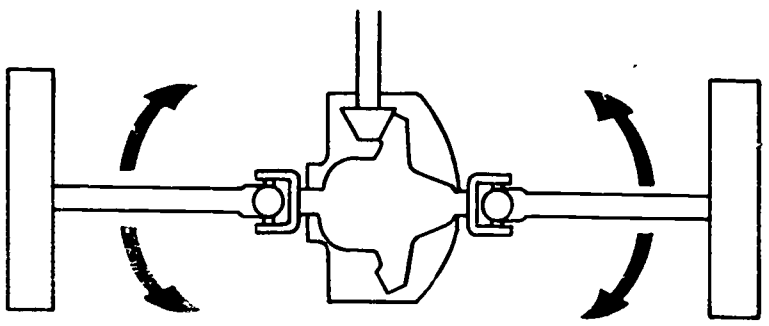
STRAIGHT AXLE DRIVES

The straight axle drive is the least complex of all final drives. It is commonly used in automobiles and light-duty trucks where no extra gear reduction for heavy loads and pulling power is required.



RIGID AXLE SHAFT



FLEXIBLE AXLE SHAFT

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Fig. 2—Straight Axle Drives — Two Types

The drive wheels in a straight axle receive their power directly from the differential. For each revolution of the differential, the axle shaft and wheels make a revolution, giving a direct drive.

The drive axle in any final drive system is known as a "live" axle since it transmits the engine torque as well as supporting part of the machine weight. A "dead" axle on the other hand is one which only supports the machine, such as the front wheel axles of an automobile.

There are two types of straight axle construction:

- **Rigid Axle Shaft**
- **Flexible Axle Shaft**

The RIGID AXLE SHAFT (Fig. 2) is connected to the differential output by a splined coupling and is usually enclosed in an axle housing. The axle housing forms an intergral part of the differential housing, making one long housing from drive wheel to drive wheel.

The FLEXIBLE AXLE SHAFT (Fig. 2) is used when the drive wheels are independently suspended. The axles are connected to the differential by universal joints. This type of axle is sometimes referred to as a "swing axle". The drive wheel in this case is free to move vertically without affecting the position of the differential and transmission. Flexible axles are commonly found in compact automobiles and especially those with engines located in the rear.

FLOATING AXLE SHAFTS IN RIGID DRIVES

Two kinds of floating axles are being used in automobiles and trucks today:

1) Full-Floating Axles

2) Semifloating Axles

They differ in whether or not they have to carry the weight of the vehicle in addition to turning the wheels.

Full-Floating Axle

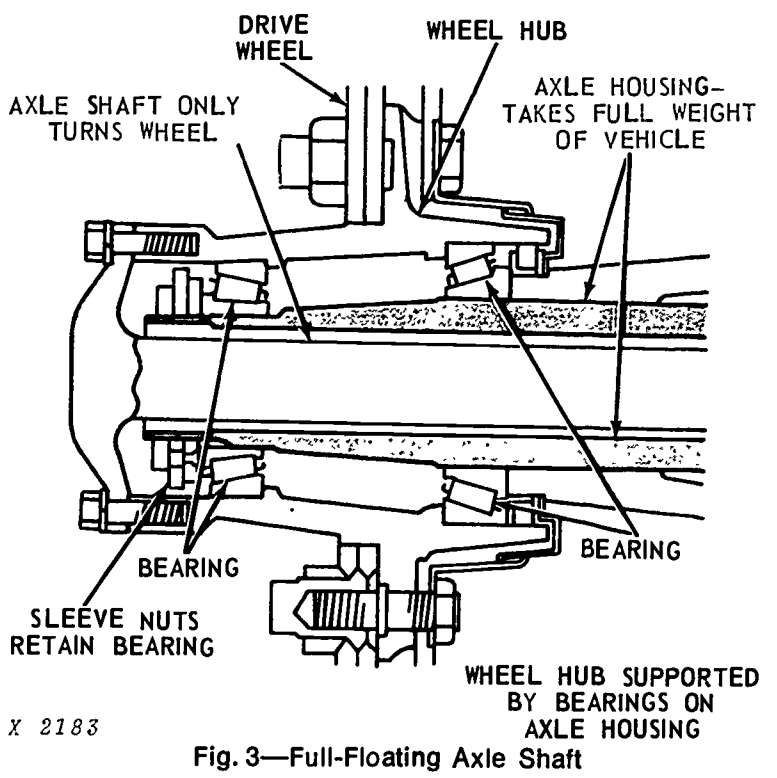

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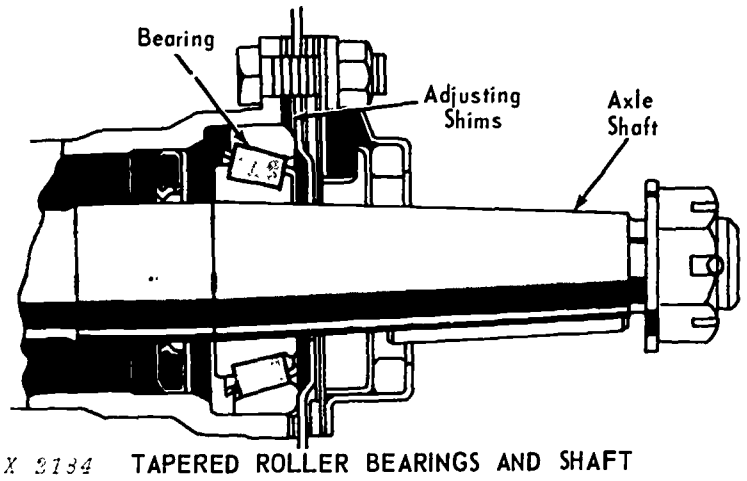
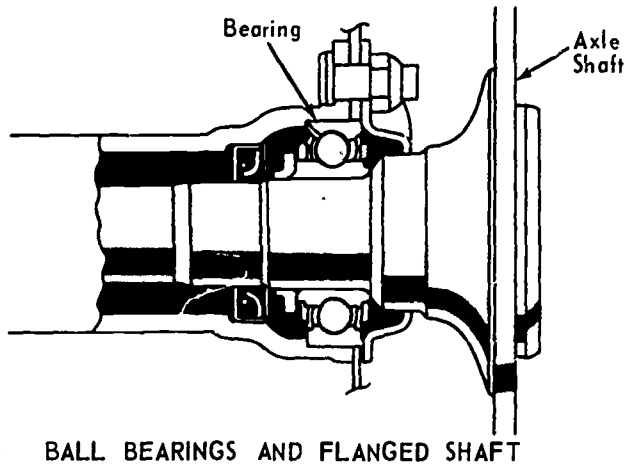
Fig. 3—Full-Floating Axle Shaft

The full-floating axle (Fig. 3) is used in many heavy-duty trucks. Each drive wheel is carried on the outer end of the axle housing on a pair of tapered roller or ball bearings. The bearings are positioned outside the axle housing. In this way the axle housing takes the full weight of the vehicle and absorbs all stresses or end thrust caused by turning, skidding, etc. The axle shaft then only transmits the torque from the engine and so "floats" in the axle housing. The shaft is connected to the drive wheel through a bolted flange and the axle shaft can be removed or serviced without removing the drive wheel.



X 2184 TAPERED ROLLER BEARINGS AND SHAFT



X 2185 BALL BEARINGS AND FLANGED SHAFT

Fig. 4—Semifloating Axle Shafts — Two Types

Semifloating Axles

Semifloating axle shafts (Fig. 4) float in the differential in the same way as full-floating axles. The main difference is at the outer ends of the axle housing. Here a single bearing assembly is positioned between the axle shaft and axle housing (Fig. 4). Therefore, the shaft supports the weight of the vehicle as well as transmitting the engine torque. The axle shafts must now take all stresses caused by turning, skidding, etc.

Two types of wheel bearings are used in semifloating axles—either tapered roller bearings or ball bearings (Fig. 4).

When tapered roller bearings are used, an adjustment for axle shaft endplay is provided. This is done with shims or an adjusting nut at one end of the axle housing. In order to transmit shaft end thrust equally to the bearings at both ends of the axle housing, a thrust bloc, or spacer is located between the inner ends of the two axle shafts within the differential carrier.

Semifloating axles are commonly used in automobiles and light trucks. The outer ends of the shaft may be flanged or tapered as shown in Fig. 4. When the shaft is tapered, the wheel hub is keyed to the shaft and locked in place with a nut.

PINION DRIVES

A spur gear and pinion are used for the final gear reduction on many tractors and self-propelled machines. This enables the differential to transmit power at higher speeds and lower torque.

There are two types of pinion and gear reductions:

- **Pinion drive located within differential case.**
- **Pinion drive located on outer ends of final drives.**

Each has a purpose and some advantages, as we'll see now.

PINION DRIVE WITHIN DIFFERENTIAL CASE

The advantages of having the gear reduction directly driven from the differential are:

1) All gears are enclosed within the differential-transmission case. This is a more compact unit and only one lubrication system is needed.

2) The final drive is in a straight line, permitting a straight axle shaft. On farm tractors this is a big advantage, since a straight axle provides a large range of wheel tread adjustment for operating in various row-crop spacings.

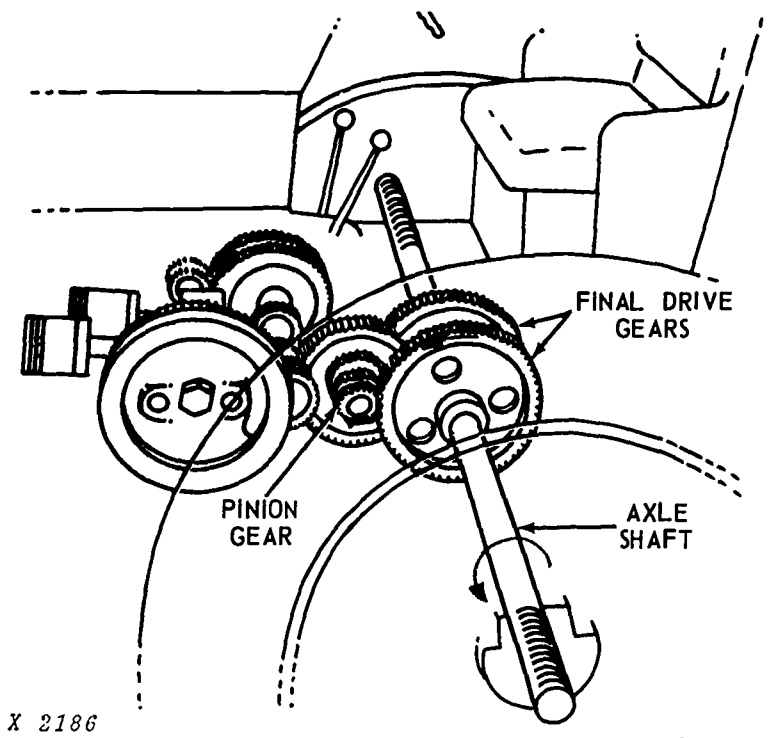


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Fig. 5—Pinion Gear Reduction Within Differential Case

Power is transmitted to the drive wheels through pinion gears which are connected to the differential output. The pinions mesh with the larger final drive gears which in turn rotate the axle shaft (Fig. 5).

The axle shaft is carried on two tapered bearings, while the final drive gear is splined to the inner

end of the shaft. The bearings are positioned internally at both ends of the shaft between the axle housing and shaft. Bearing adjustment is usually made with an adjusting nut. However, some final drives may be equipped with a shim adjustment.

The axle supports the weight of the tractor and absorbs end thrust, as well as transmitting the engine torque.

PINION DRIVE ON OUTER ENDS OF FINAL DRIVE

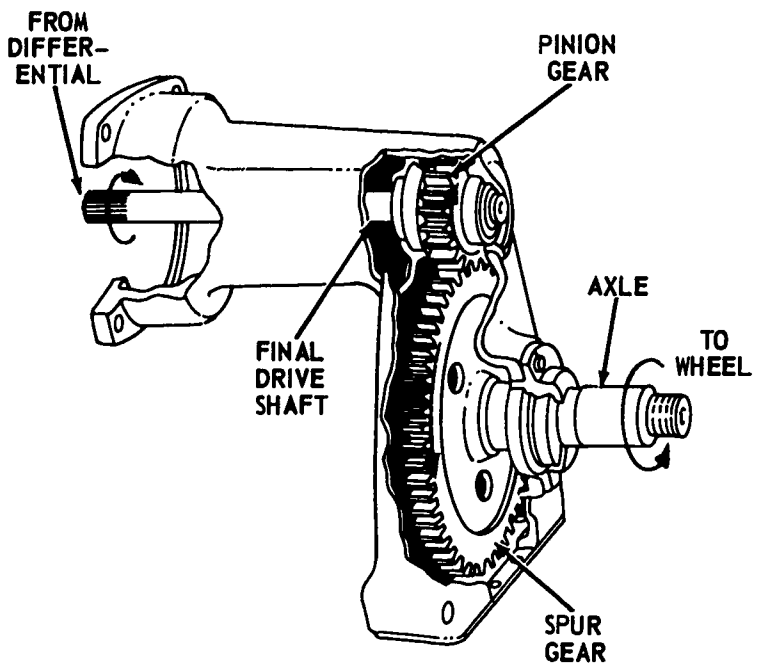

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Fig. 6—Pinion Gear Reduction On Outer Ends Of Final Drives

Placing the pinion and gear reduction drive at the outer end of the final drive gives more clearance under the axle. The gears are contained in a separate case or housing (Fig. 6) and have their own oil reservoir. Power flow is shown by the red arrows.

This system is popular for good crop clearance in farm tractors and other machines.

On most farm tractors, the drive shaft is enclosed in a housing which is attached to the differential case. In turn the gear reduction housing is attached to the end of the drive shaft housing, forming the final drive assembly. This final drive construction is sometimes called a "drop axle housing". In this case, the entire final drive assembly carries the weight of the tractor.

PLANETARY DRIVES

The planetary gear reduction system is smaller and more compact than the pinion type. Planetary systems are also more durable under heavy loads since torque loads are spread more evenly over several gears.

The use of planetary gear systems is becoming more common on farm tractors, industrial machines, and trucks as engine horsepower and pulling loads are increased.

The planetary gear set may be located next to the differential (Fig. 7) or at the outer ends of the final drive (Fig. 8). Both types—inboard and outboard—operate the same, as described below.

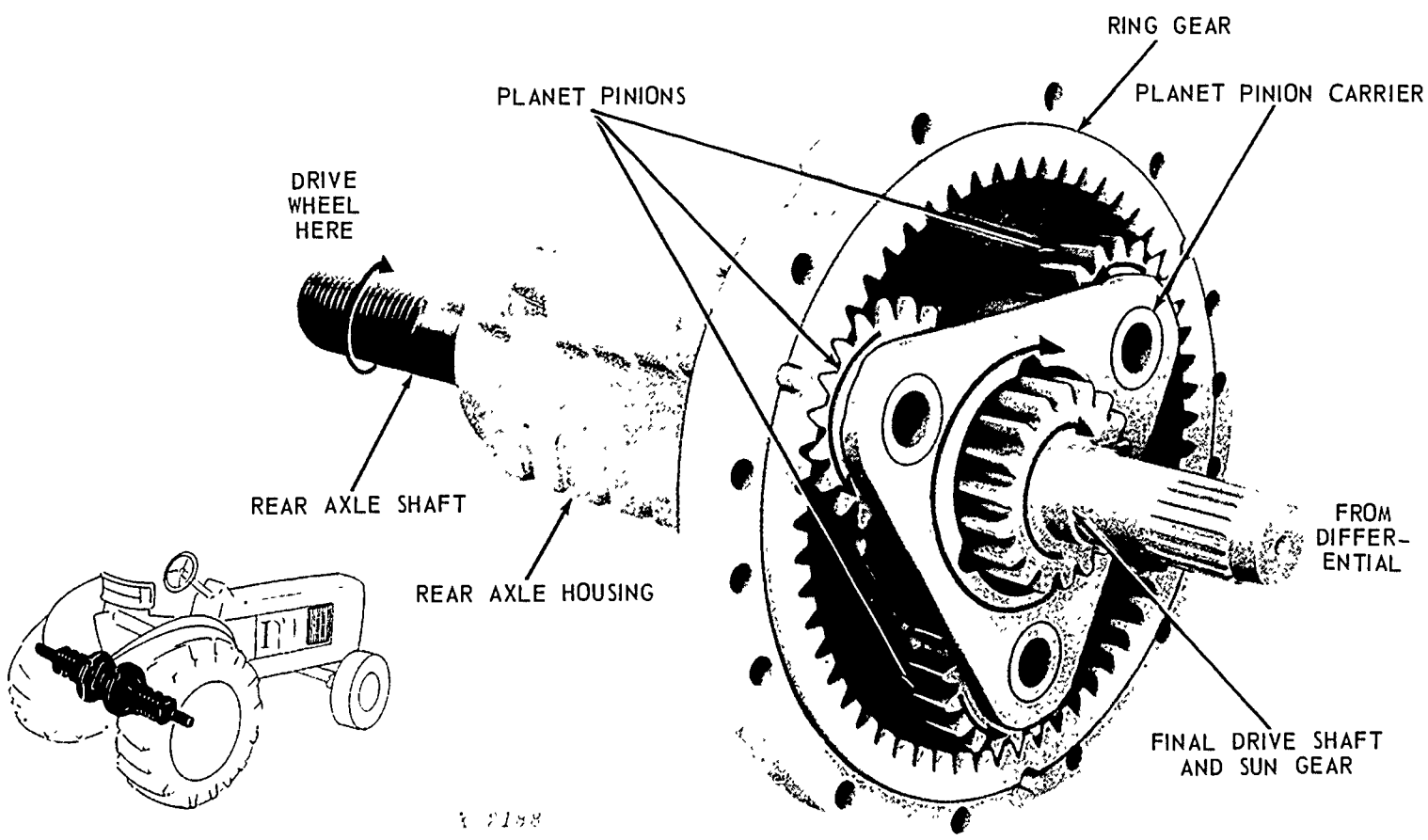

Fig. 7—Final Drive With Planetary Gears Next To Differential (Inboard Type)

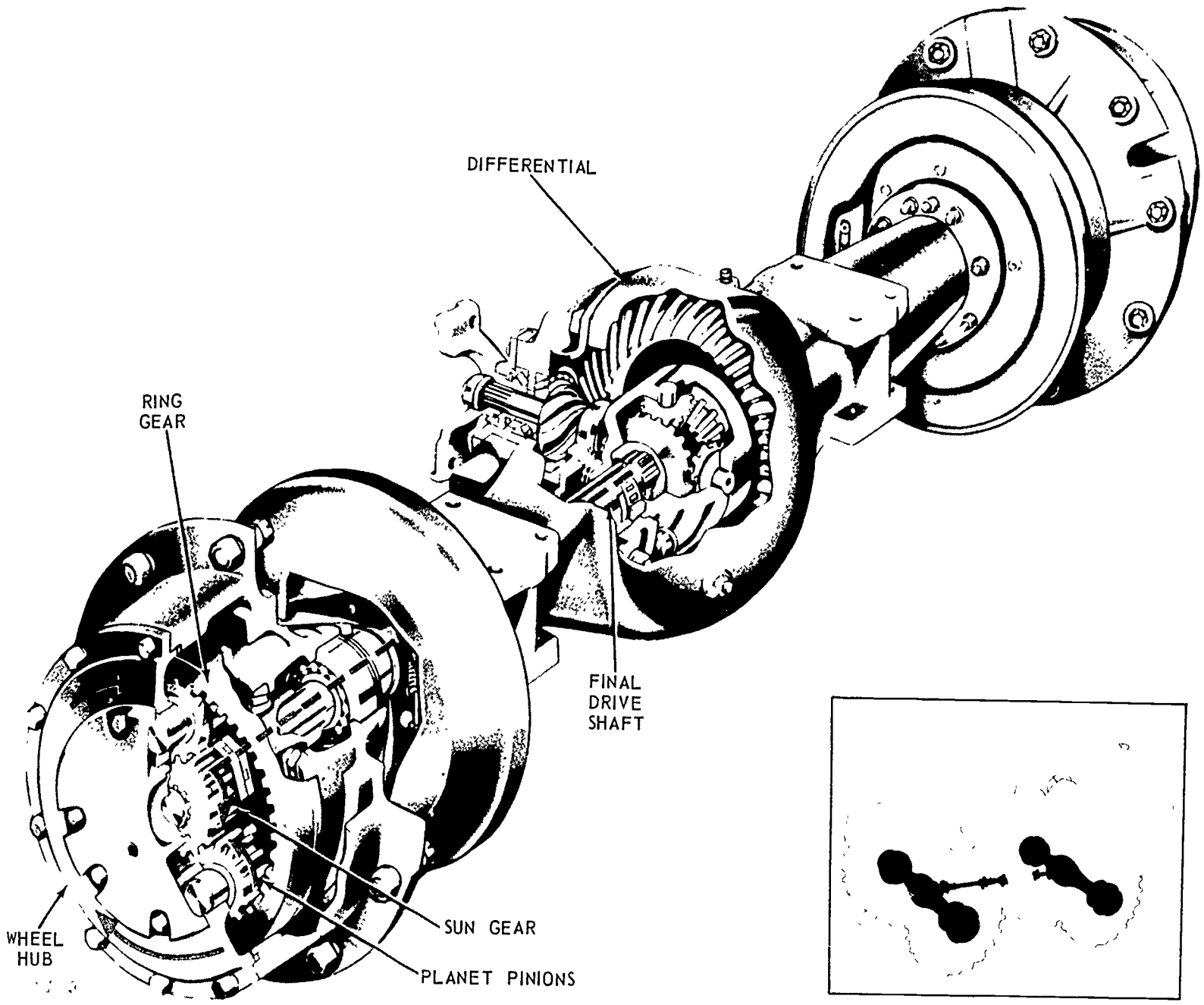

Fig. 8—Final Drive With Planetary Gears At Outer Ends (Outboard Type)

OPERATION

The planetary gear reduction system receives engine power from the differential through the final drive shaft and sun gear. The sun gear is an integral part of the final drive shaft and so turns with the shaft. The sun gear meshes with the planet pinions which are mounted in the planet pinion carrier.

As the sun gear turns, it forces the planet pinions to "walk around" the inside of the ring gear as shown by the arrows. The ring gear is forced to rotate in the same direction as the sun gear, thus delivering engine power to the drive wheels *but at a reduced speed and an increased torque.*

CONSTRUCTION OF PARTS

Let's look at the construction of the planetary systems shown in Figs. 7 and 8.

Planetary Mounted Next To Differential (Fig. 7)

With this planetary, a straight, in-line axle is achieved. This permits a large range of wheel tread adjustments on farm tractors for various widths of crop rows. In addition, all gears are located in one compact housing.

The axle shaft is carried on two tapered bearings with the inner end of the shaft splined to the planet carrier (Fig. 7). The bearings are positioned internally at both ends between the axle housing and shaft.

With this type of axle, the axle shaft supports the weight of the tractor and absorbs end thrust, as well as transmitting engine torque.

Planetary At Outer Ends Of Final Drives (Fig. 8)

When the planetary is located at the outer ends of the final drive, the final drive system is enclosed

in one rigid housing (Fig. 8). That is, the differential housing, both axle housings, and the planetary gear housings (shown) are connected to form a one-piece construction.

The axle shaft in this system is the *full-floating* type which was described earlier. The only difference is that the planetary carrier drives the wheel hub instead of a flanged end of the axle shaft.

CHAIN FINAL DRIVES

The chain final drive system (Fig. 9) provides a greater clearance under the axle than any other system. An example of this is in high-clearance self-propelled sprayers which must operate in high, standing crops.

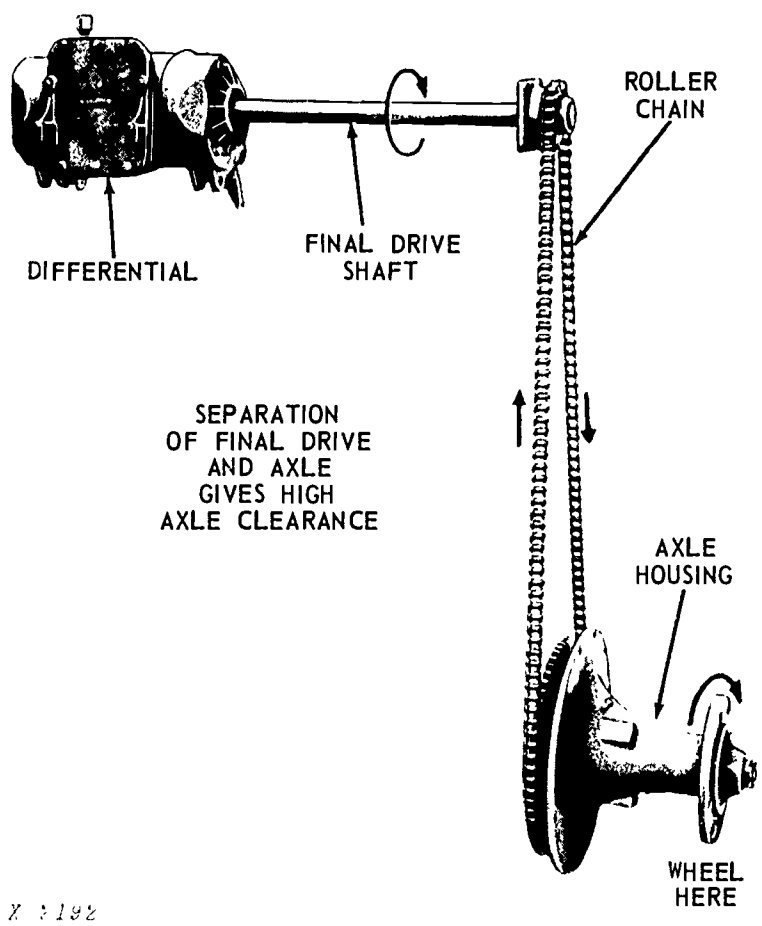

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Fig. 9—Chain Final Drive System

The disadvantage of a chain drive is its tendency to loosen due to wear and stretching. Wear can be held to a minimum by having the chain operate in an oil bath. In most cases, provisions are made to take up the chain slack.

In Fig. 9, an eccentric bearing is provided in the axle housing so that the chain slack can be taken up by rotating the bearing housing. In some tractors, the entire axle housing can be moved for chain adjustment.

Another method of adjusting the chain is the use of a tightener sprocket on the slack side of the chain. However, when the machine is reversed, extra force is exerted to the slack side of the chain and through the tightener sprocket.

For details on roller chains, see Chapter 10.

MAINTENANCE OF FINAL DRIVES

The reliability of any final drive depends upon good maintenance, operating at rated load, and proper repair once a failure has occurred.

Watch these key points when diagnosing final drive failures:

(1) Excessive drive shaft endplay

(2) Overheating

(3) Lack of lubrication

EXCESSIVE DRIVE SHAFT ENDPLAY

Excessive drive shaft endplay is normally caused by loose shaft bearings. However, it can be created by:

(a) Foreign material in the lubricant which will wear bearings rapidly;

(b) Overloading the machine either by weight or engine torque;

(c) Poorly adjusted bearings at the time of assembly.

A continuous noise or knock is a good sign of loose or damaged bearings. On machines with semifloating axles, such as automobiles, the knocking noise can be heard in the differential case, since the ends of the axle shaft are rapping the spacer block. Readjustment of the bearings that are worn or damaged will not provide a satisfactory repair.

Compare the roller ends of a new tapered bearing with a worn bearing. Worn bearing rollers have no shoulder compared to a new bearing.

OVERHEATING

Many final drives are damaged simply by overheating. This is caused by not maintaining the lubricant at the proper level or by using the wrong type of lubricant.

Galling, pitting, or scoring on the surface of a part indicates the lack of lubricating film and that overheating has occurred.

Overloading and abuse of the machine will also cause overheating. Excessive loads cause deflection in the final drive assembly and concentrate stresses and friction in one area.

LACK OF LUBRICATION

Loss of lubricant through worn and broken oil seals and gaskets may cause severe damage to the final drive. While some bearings are automatically lubricated by oil creeping along the drive shaft from the differential, others are sealed off and require separate lubrication.

When installing a new oil seal, make sure it is flexible or pliable in the area where the seal fits around the shaft. Soak the seal in oil before installing it.

ADJUSTING FINAL DRIVES

To prevent premature failures, adjust the final drives properly. This includes adjusting the axle bearings—either preloading or allowing a specified endplay.

ADJUSTING AXLE BEARINGS

Loose gears or bearings that are too tight or too loose will break down prematurely, regardless of their strength and design.

Bearings must be adjusted to the manufacturer's specifications. Some designs require the bearings to be preloaded, while others require a slight amount of shaft endplay.

Preloading Bearings

When the manufacturer's instructions call for preloading the bearings, bearings must be placed under slight tension. In some cases, this is done by SLIGHT overtightening of the bearing adjusting nut, while in other designs it is done with shims. Preload is normally measured in inch-pounds of rolling or rotating torque (NOT starting torque).

Some torque specifications will include frictional drag such as oil seals, gears, etc. in the final drive. If it is not included, measure the rolling torque while the axle shaft still has a slight amount of endplay, and *add* this torque reading to the specified torque. Then make the necessary bearing preload adjustment. Also, when new bearings are installed, a greater amount of torque will be required. Always make the preload adjustment in small increments until the proper preload is obtained.

There are several methods of measuring rolling torque.

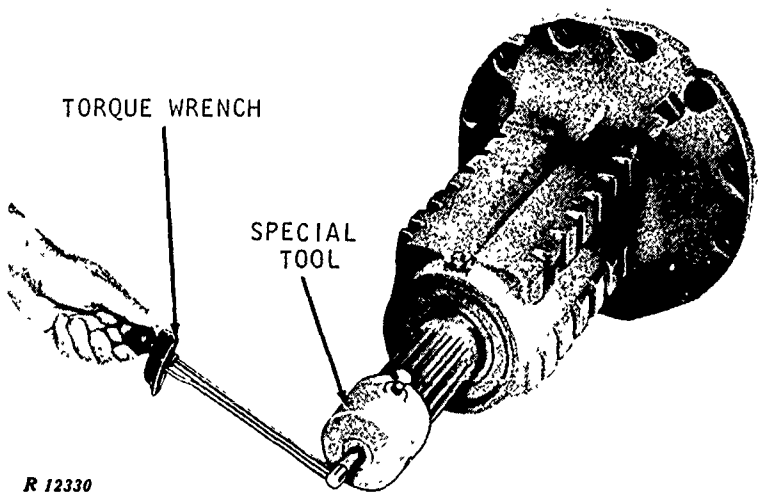

Fig. 10—Checking Bearing Preload With A Torque Wrench

One method is to use a special tool or adapter with a torque wrench (Fig. 10). This gives a direct reading on the wrench.

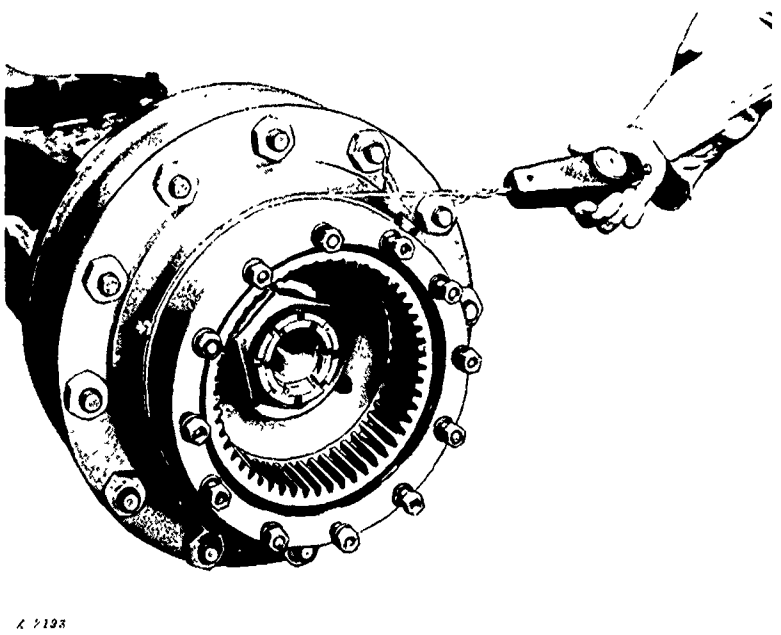

Fig. 11—Checking Bearing Preload With Pull Scale

Another method of checking the preload torque is by means of a cord and pull scale (Fig. 11). The preload is figured by multiplying the radius (distance from the center of the drive shaft to a point on the circumference from which the cord is pulled) by the reading on the pound scale.

For example: Assume the radius is 4 inches and the reading on the scale is 7 pounds. Multiply 4 inches by 7 pounds and you will have 28 inch-pounds of rolling torque.

Adjusting For Endplay

Some types of drive axles call for the axle shaft to have a slight amount of endplay. This means that the shaft when properly adjusted must be free to move endways within the limits specified. The end movement in most cases is between 0.001 and 0.010 inch.

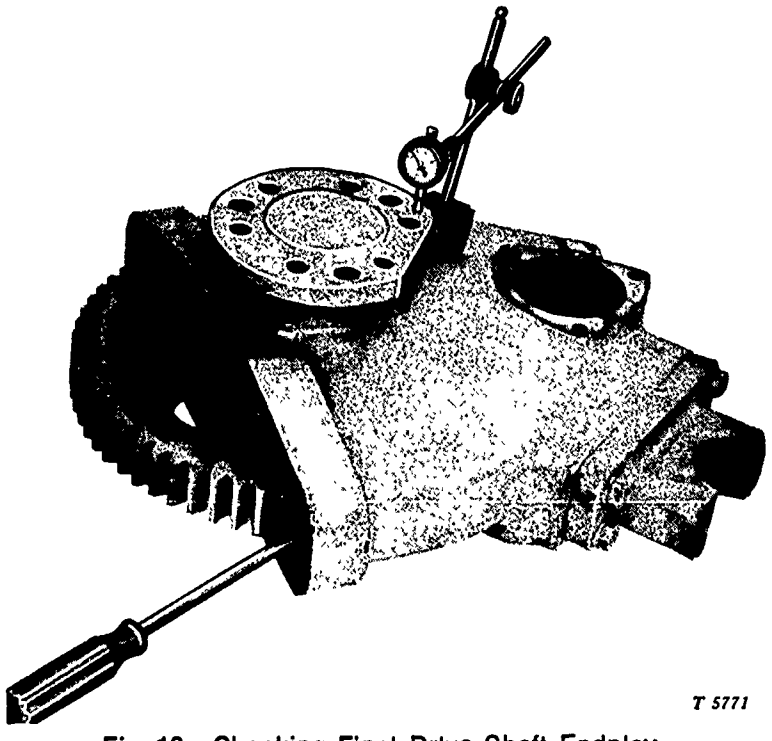

Fig. 12—Checking Final Drive Shaft Endplay With A Dial Indicator

To obtain the proper endplay, shims or an adjusting nut are provided. Measure the endplay with a dial indicator (Fig. 12).

TEST YOURSELF

QUESTIONS

1. What are the four major types of final drive systems?

2. Which one does *not* give a speed reduction?

3. What is the difference between a "live" and "dead" axle?

4. True or false? "In a semifloating axle, the weight of the machine is not carried on the axle shaft."

5. Name one advantage of the planetary final drive over the other three types.

6. What is the main advantage of the chain final drive? The main disadvantage?

ANSWERS

1. Straight axle, pinion, planetary, chain.

2. Straight axle.

3. A *live* axle transmits the torque as well as supporting part of the machine's weight. The *dead* axle only supports the machine.

4. False.

5. Either of these answers: More compact; more durable.

6. The main advantage: Allows for high clearance under the axle. The main disadvantage: Tends to loosen at the chain.

POWER TAKE-OFFS / CHAPTER 9

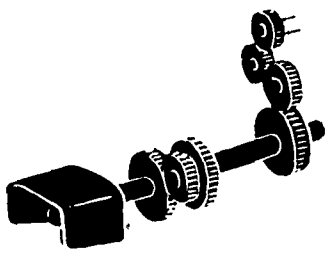

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Fig. 1—Power Take-Off (PTO) For Modern Tractor

The power take-off (PTO) is an attachment in the power train of a machine. It drives auxiliary equipment.

TYPES OF PTO'S

There are three basic types of PTO's:

- **Transmission-Driven**
- **Continuous-Running**
- **Independent**

The three types are compared in Fig. 2.

TRANSMISSION-DRIVEN PTO's operate only when the engine clutch is engaged. They stop whenever the clutch is disengaged.

CONTINUOUS-RUNNING PTO's also operate only when the engine clutch is engaged. However, they have another clutch which can be engaged to operate the PTO even though the power train is disengaged and the machine travel is stopped. One control operates both the engine and the PTO clutch.

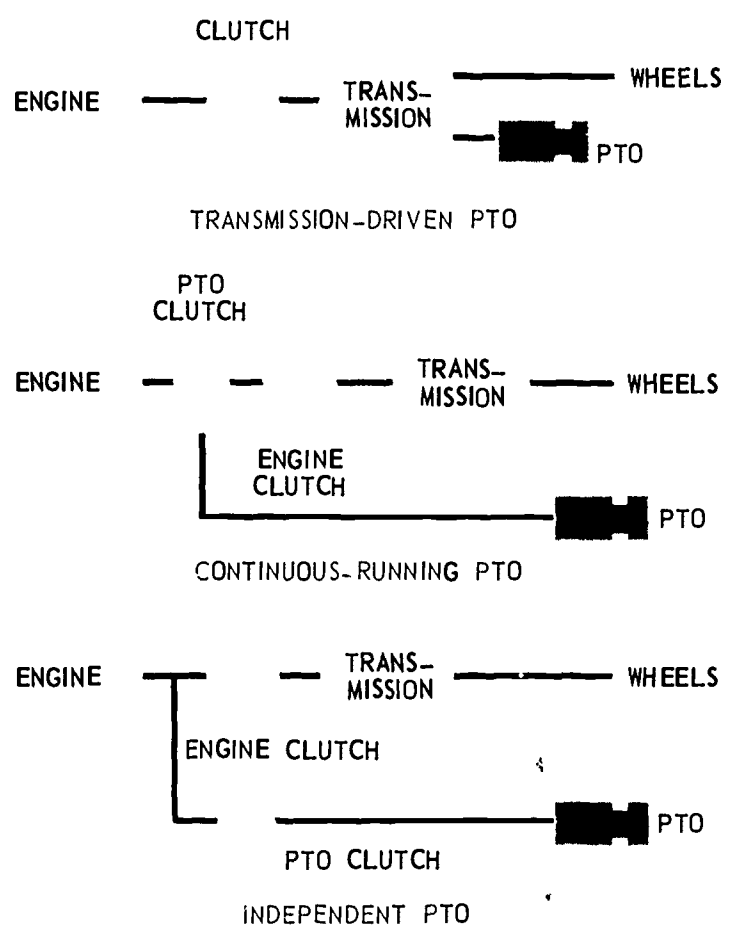

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Fig. 2—Three Types Of Power Take-Offs (PTO'S)

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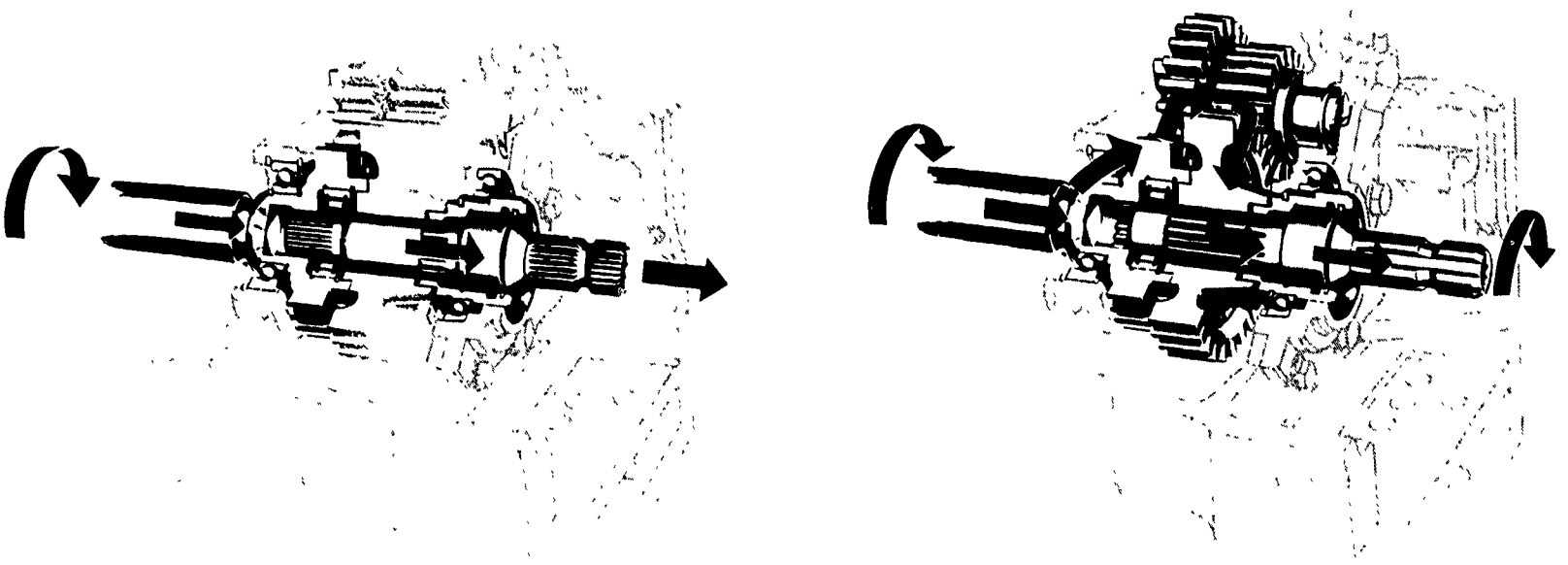

X2120 PTO OPERATING AT 1000 RPM

PTO OPERATING AT 540 RPM

Fig. 3—Operation Of Power Take-Off (Dual Speed Type)

INDEPENDENT PTO's have their own clutch controls and gear train completely separate from the engine clutch and main power train. This means that the PTO can operate while the machine travel is stopped and also that the PTO can be disengaged and engaged while the machine is in motion (not possible with continuous-running PTO's).

OPERATION OF PTO

PTO's are normally gear-driven from the transmission and send power through a shaft to the PTO outlet where the driven equipment is coupled.

Let's look at the operation of a typical PTO.

One PTO (Fig. 3) offers two speeds—540 rpm and 1000 rpm.

To get these speeds, two different stub shafts are used as we'll explain now.

OPERATION AT 1000 RPM

Operation at 1000 rpm is shown at left in Fig. 3. The 1000 rpm stub shaft is installed in the PTO outlet so the splines engage with the splines on the inside of the PTO shaft. Engine power is transmitted directly through to the PTO stub shaft.

The engine is set at a certain speed (such as 2100 rpm) to get the speed of 1000 rpm at the PTO.

OPERATION AT 540 RPM

Operation at 540 rpm is shown at right in Fig. 3.

A different stub shaft is installed in the PTO outlet for 540 rpm operation. This shaft engages a new set of splines inside the PTO drive gear, so power is transmitted through the upper idler gears as shown by arrows. The power is reduced to 540 rpm by the gear ratios.

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PTO DRIVES

Once the power leaves the PTO outlet, it must be transmitted to the driven equipment. This is the job of the PTO **drive** (Fig. 4).

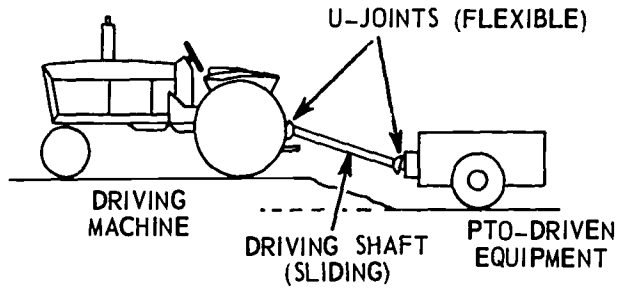

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Fig. 4—PTO Drive

The PTO drive must be flexible for most equipment, especially if it is pulled by the driving machine. For these PTO drives, two major parts are needed:

1) Universal Joints

2) Drive Shaft

Let's look at each part in detail.

UNIVERSAL JOINTS

A universal joint is necessary to join two rotating shafts in different planes (Fig. 4).

The most common type is the Cardon or **Hooke joint** (Fig. 5).

This joint consists of two U-shaped yokes fastened to the ends of the two shafts to be connected. Inside these yokes is a cross-shaped journal which holds the yokes together and allows each yoke to bend, or pivot, with respect to the other. This allows one shaft to drive the other at angles up to 30 degrees out of alignment.

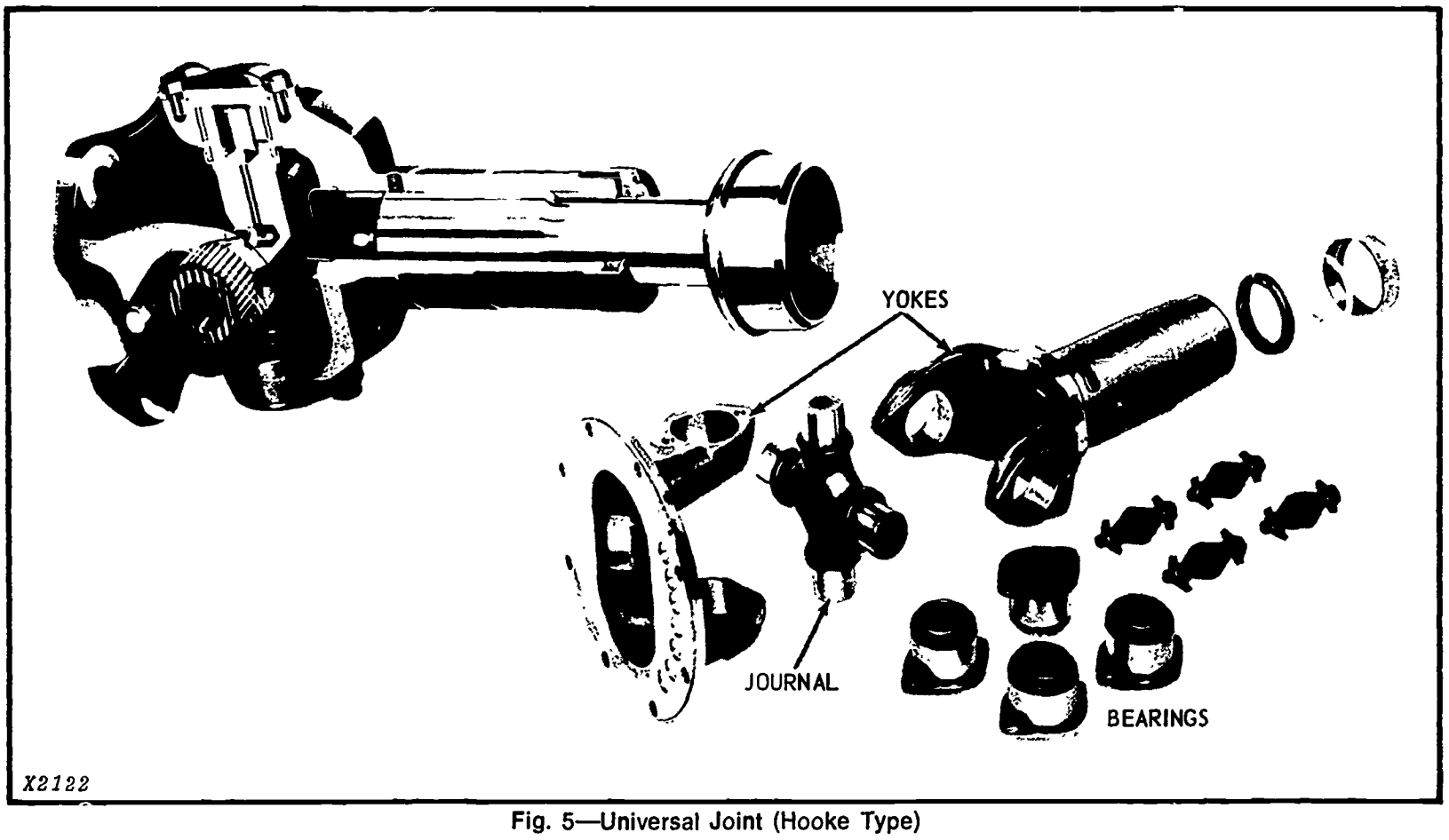

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Fig. 5—Universal Joint (Hooke Type)

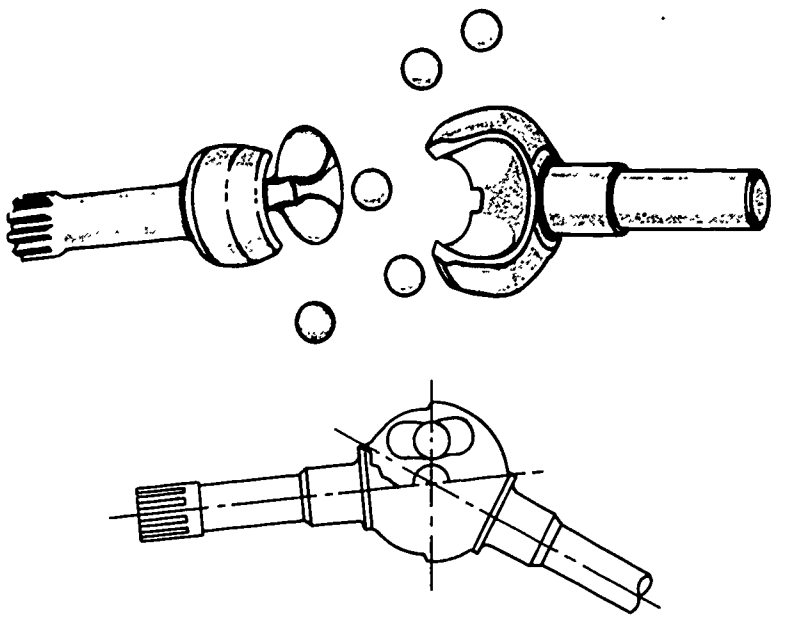

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Fig. 6—Universal Joint (Bendix-Weiss Type)

Another type of universal joint is used to transmit a smoother torque when less power is needed. This type of universal joint is the **Bendix-Weiss** (Fig. 6). This type of joint has four large balls to transmit the rotary force, with a small ball as a spacer.

The Hooke universal joint gives a whipping motion as the shaft rotates. The amount of whipping depends on how much the shafts are out of alignment. The Bendix-Weiss joint transmits rotary motion at a constant rate, but this joint is more expensive and has less strength than the Hooke type.

Most farm and industrial machines use the Hooke type of U-joint.

DRIVE SHAFTS

There are two basic types of drive shafts:

- *Solid shaft*
- *Telescoping shaft*

The difference is that one shaft is flexible while the other is not.

Solid Shafts

The solid shaft has a fixed length and a universal joint at each end. The distance between the two joints is always fixed. This type of drive is used when power is to be transmitted from one fixed plane to another.

Telescoping Shaft

The telescoping shaft has a sliding element and can have either two or three universal joints.

The telescoping shaft with *two* universal joints has one at the machine end and another at the equipment end (Fig. 7). Telescoping occurs between these two points at the slip joint.

The telescoping shaft with *three* universal joints has one solid PTO shaft (on a mount), one telescoping shaft, and three universal joints. This gives the flexibility of the two-joint type, yet allows for the change in hitch angle when equipment is converted to transport position.

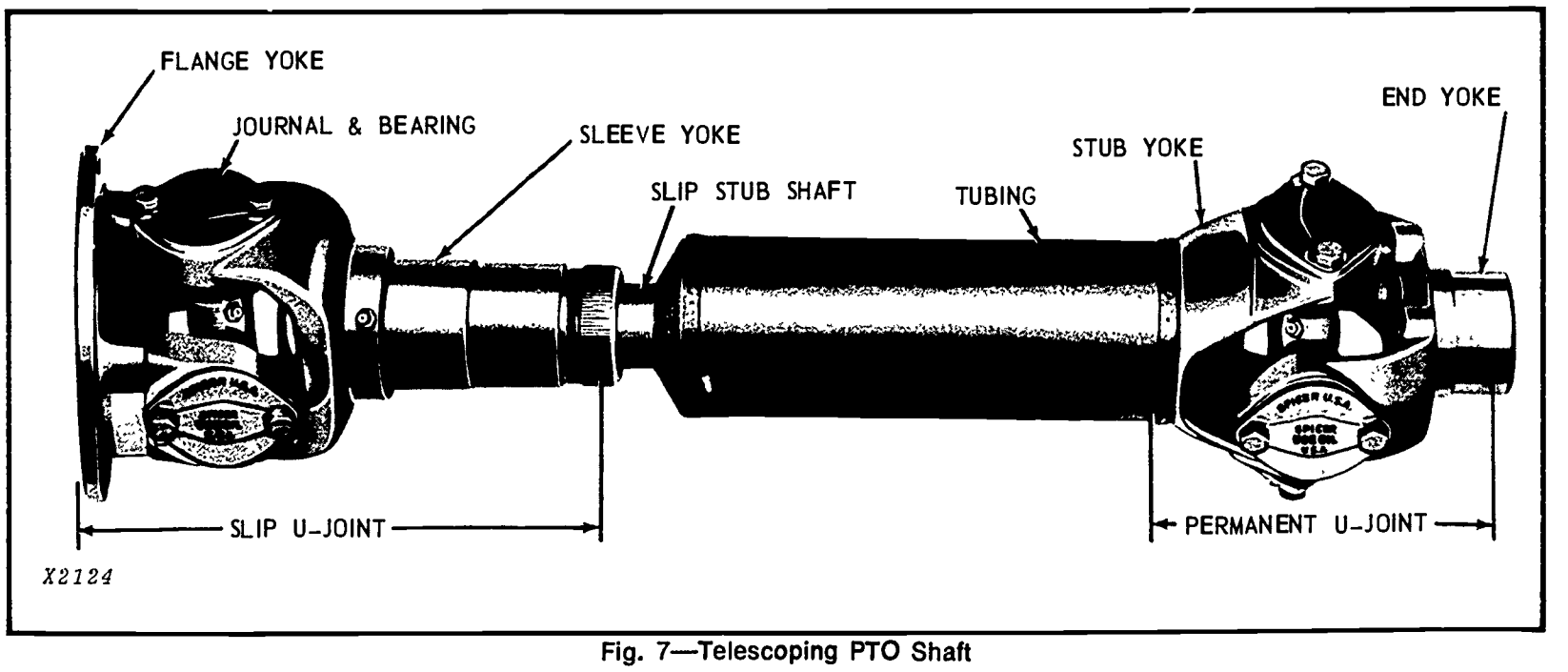

Fig. 7—Telescoping PTO Shaft

STANDARDS FOR PTO DRIVES

ASAE-SAE Tractor Standards

The American Society of Agricultural Engineers (ASAE) along with the Society of Automotive Engineers (SAE) have worked for years to establish standards for tractor and implement manufacturers. These standards help in changing equipment from one tractor to another.

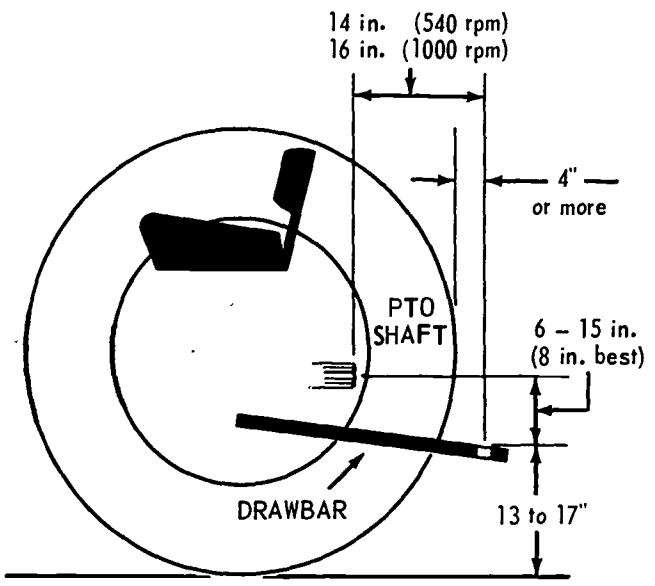

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Fig. 8—Location Of PTO Shaft And Drawbar Hitch On Farm Tractor (ASAE-SAE Standards)

The recommended location of the drawbar hitch point in relation to the PTO shaft for equipment drawn behind a tractor is shown in Fig. 8.

In addition, the lateral location of the PTO shaft should be within 3 inches of the tractor centerline, and the hitch point should be directly under the extended centerline of the PTO shaft.

The PTO shafts of tractors have also been standardized. The shafts have either six splines and rotate at 540 rpm, or twenty-one splines and rotate at 1000 rpm (Fig. 9).

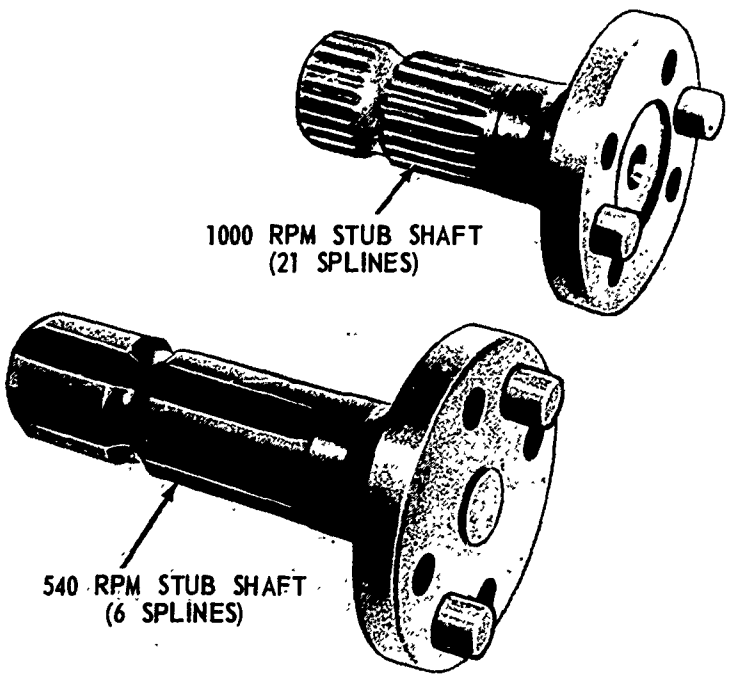

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Fig. 9—PTO Shafts—Two Types

All PTO shafts rotate clockwise when viewed from the rear of the tractor.

PTO Shielding Standards

The tractor PTO shaft and the equipment drive shaft must be covered at all times.

The tractor PTO shaft shield is provided by the tractor manufacturer, while the equipment drive shaft shielding is provided by the equipment manufacturer.

The ASAE and SAE have standards by which manufacturers can build master shields for their PTO shafts.

The equipment drive line has two basic types of shields:

1) The tunnel shield

2) The spinner shield

The tunnel shield is merely an inverted U-shaped piece of steel which covers the moving parts.

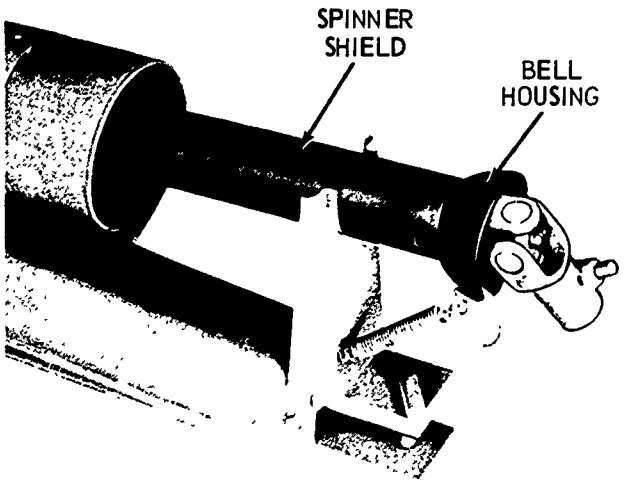

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Fig. 10—Spinner Shield For PTO Drive Shaft

The spinner shield (Fig. 10) is a cylinder-shaped piece which surrounds the shaft with a bell housing on each end to cover the U-joints.

The spinner shield rotates with the shaft except when contact is made with a foreign object. When this happens, the spinner shield stops rotating and allows the shaft to rotate freely inside the shield.

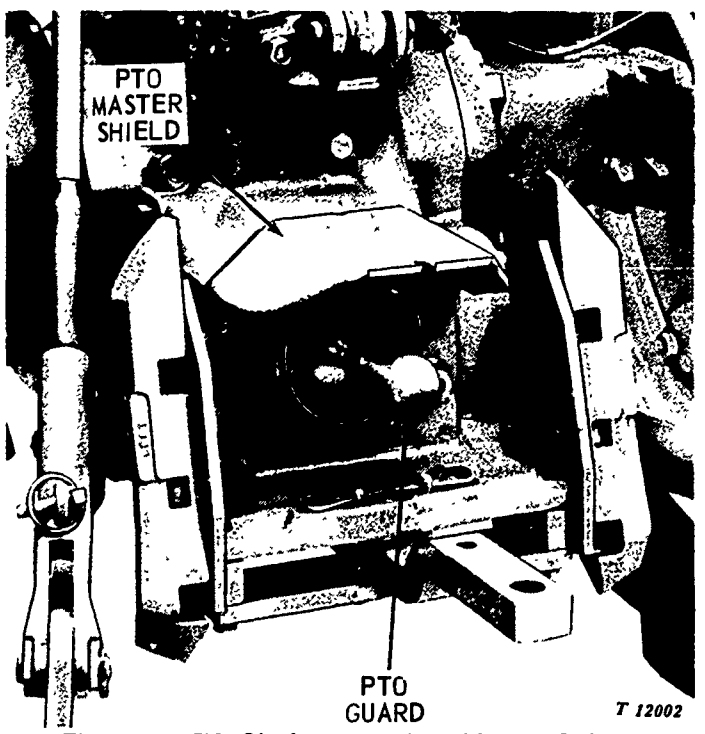


Fig. 11—PTO Shaft Guard And Master Shield

SERVICING THE PTO DRIVE

The service life you get from your PTO drive depends on the service you give it.

Lubricate the drive line in three areas:

- **The telescoping drive shafts**
- **The bearings**
- **The universal joints**

The lubrication intervals will vary with the field or job conditions. Consult the machine operator's manual.

SAFETY RULES FOR PTO'S

Safety is a prime factor in equipment design.

Here are safety rules for working on machines equipped with PTO's.

1. Keep PTO guards and shields in place even when the PTO is not operating.

2. Always disconnect the PTO when not in use.

3. Never engage the PTO while the machine engine is shut off.

4. Keep hands, feet, and clothing away from PTO parts.

5. Be sure your clothing is relatively tight and belted. Loose clothing can become caught in moving PTO parts.

6. Never operate PTO shafts at extreme angles.

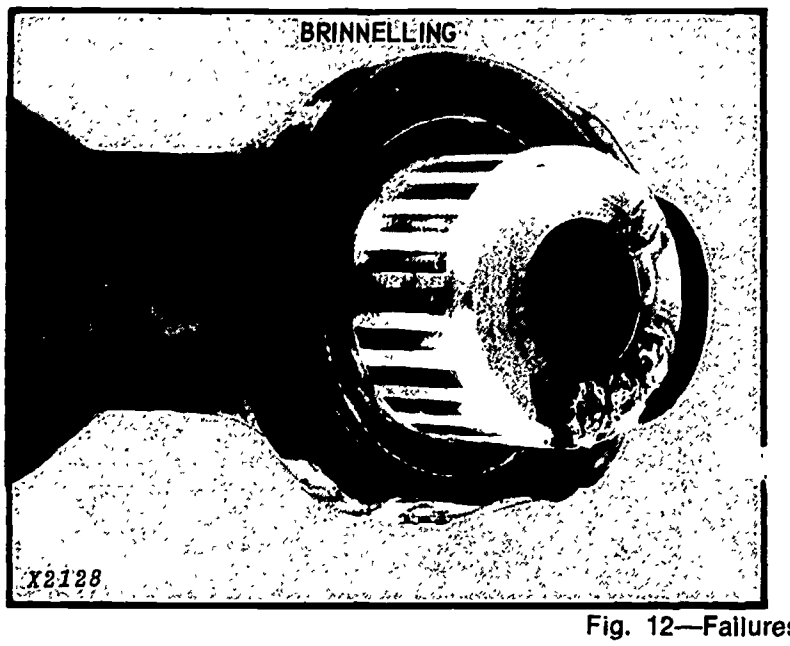
7. Never ride, or permit others to ride, on the drawbar of the tractor.

8. Never hook 540 rpm equipment to a 1000 rpm PTO or vice-versa.

9. Be sure PTO spinner shields rotate freely at all times. Disengage all power and shut off tractor engine before checking spinner shields.

10. Always be sure PTO drive shaft is properly secured to the machine's PTO shaft.

11. Do not service, lubricate, or perform other work on a machine without first disengaging the machine PTO and shutting off the engine.



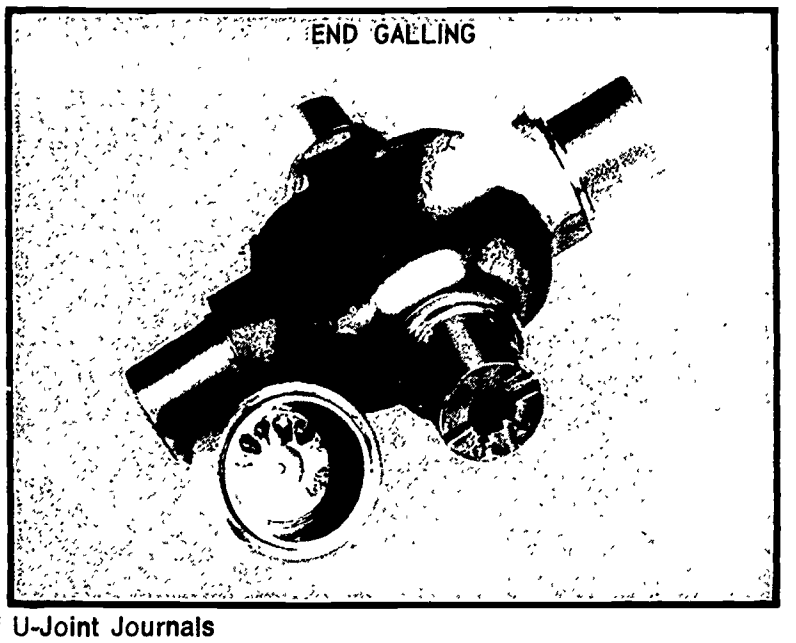


Fig. 12—Failures Of U-Joint Journals

TROUBLE SHOOTING OF PTO'S

Problem	Possible Cause
1. Machine vibrates excessively while operating	PTO shaft is not properly aligned
2. Twisted PTO shaft	Overload on PTO shaft
	Improper hitch setting
3. PTO shafts not telescoping properly	Worn bearings
	Spinner shields or shaft rusted from poor lubrication
4. Brinnelling of U-joint journal (Fig. 12)	Excessive metal fatigue
	Poor heat treatment
5. Galling of U-joint journal cross ends (Fig. 12)	Drive shaft rpm too high
6. Journal cross end and cups chipping	U-joint capacity too low for required hours and angle
7. Abrasive corrosion on PTO shaft	Extreme low angle operation

TEST YOURSELF

QUESTIONS

1. Match the three items at left below with the correct definition at right.

a. Independent PTO	1. Operates only when main engine clutch is engaged, stops when disengaged.
b. Continuous-running PTO	2. Completely separate from main engine clutch.
c. Transmission-driven PTO	3. Can be operated even though main power train is disengaged.

2. How can you tell two PTO stub shafts—540 and 1000 rpm—apart?

3. True or false? "Never engage the PTO while the machine engine is shut off."

ANSWERS

1. a-2; b-3; c-1

2. They have a different number of splines (540 has six splines, while 1000 has twenty-one splines).

3. True.

SPECIAL DRIVES / CHAPTER 10

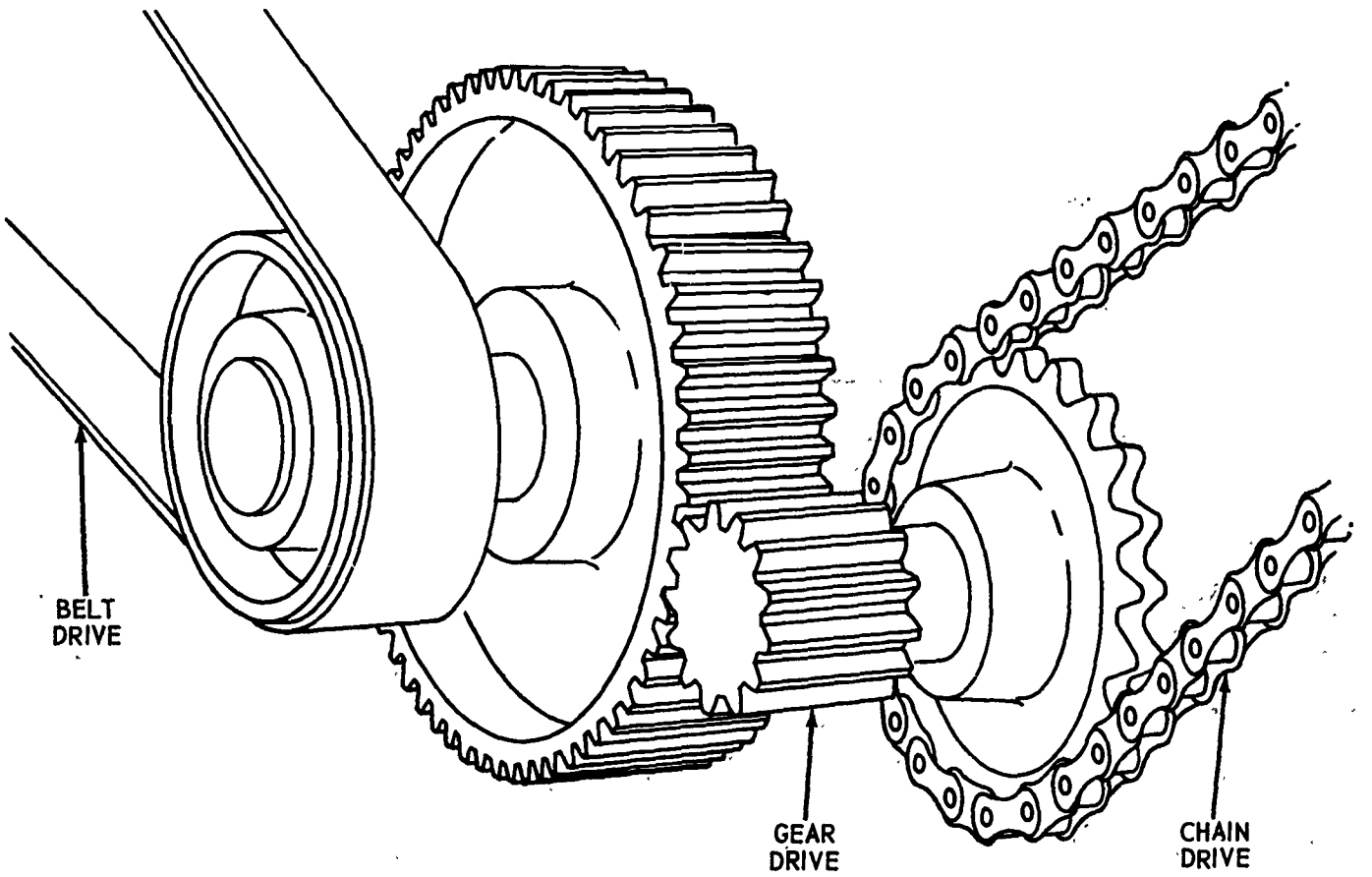


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Fig. 1—Three Kinds Of Drives

In this chapter, we will cover these special drives not included in other chapters of this manual:

- **Belt Drives**
- **Chain Drives**
- **Gear Drives**

Fig. 1 shows these three drives in operation.

We will also look at reciprocating drives and at safety devices like slip clutches, jump clutches, and shear pins.

BELT DRIVES

Belt drives are *frictional* drives. They transmit power by contact between the belt and the driving and driven pulley. Belts should have an adhesive but not a sticky grip on the pulleys. One pulley in any belt drive should be adjustable.

The ability of belts to transmit power depends on:

1. *Tension holding the belt to the pulleys.*
2. *Friction between belt and pulleys.*
3. *Arc of contact (or "wrap") between belt and pulleys.*
4. *Speed of belt (higher speeds cut tension and contact).*

Belts are normally used to transmit power between two parallel shafts but they can also be used in a variety of other ways (Fig. 3).

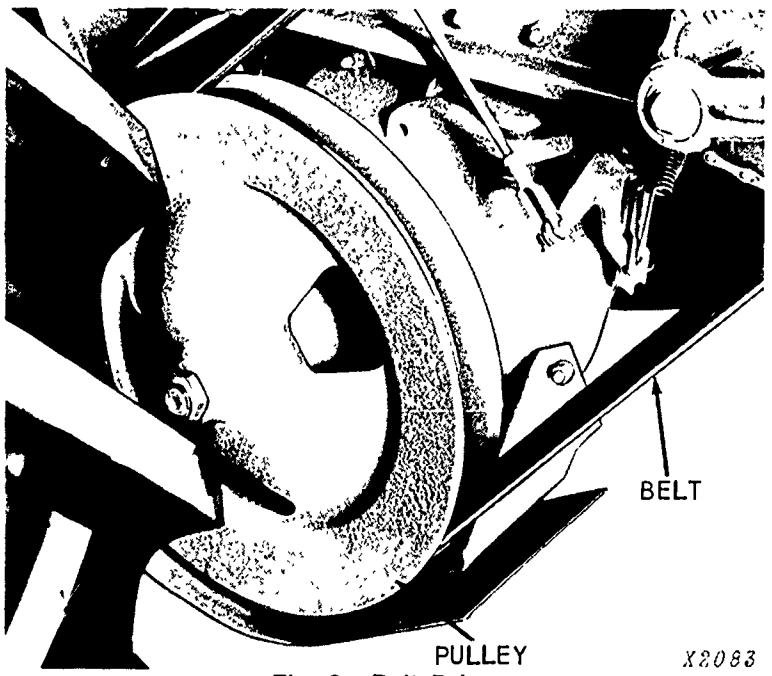

Fig. 2—Belt Drive

ADVANTAGES OF BELT DRIVES

1. *Easy to design*
2. *Inexpensive*
3. *Absorb shock*
4. *Easy to install*
5. *Easy to service*
6. *Permit simple power cutoff*

DISADVANTAGES OF BELT DRIVES

1. *Do not last as long as some drives*
2. *Will not carry as heavy a load*
3. *Cannot be used where exact timing is required (unless a special tooth-type belt is used)*

TYPES OF BELTS

Belts are of three basic types:

- **Flat Belts**
- **V-Belts**
- **Round Belts**

Belts may be constructed of leather, fabric, rubber, rayon, neoprene, hemp rope, thin flat steel, wire, and combinations of these materials.

Flat Belts

Flat belts are used most where the pulleys are far apart. Use of flat belts has decreased because most machines today have built-in drives. Their most common use is in drives where high power is needed for a separate machine. *Examples:* old-time threshers, sawmills.

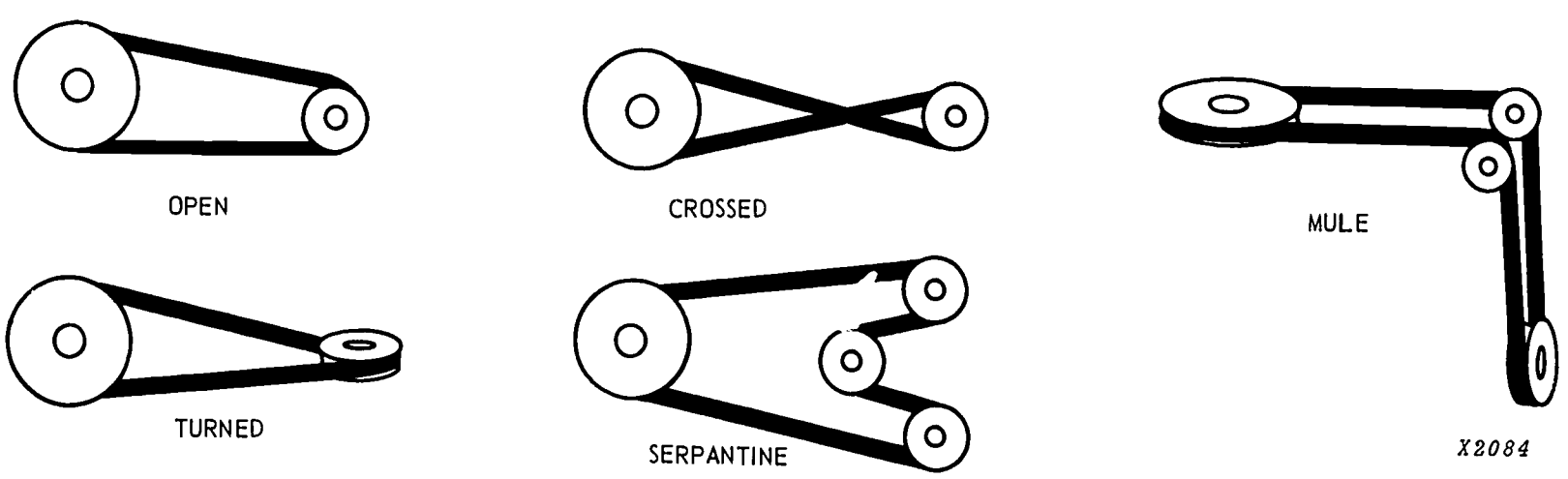

Fig. 3—Forms Of Belt Drives

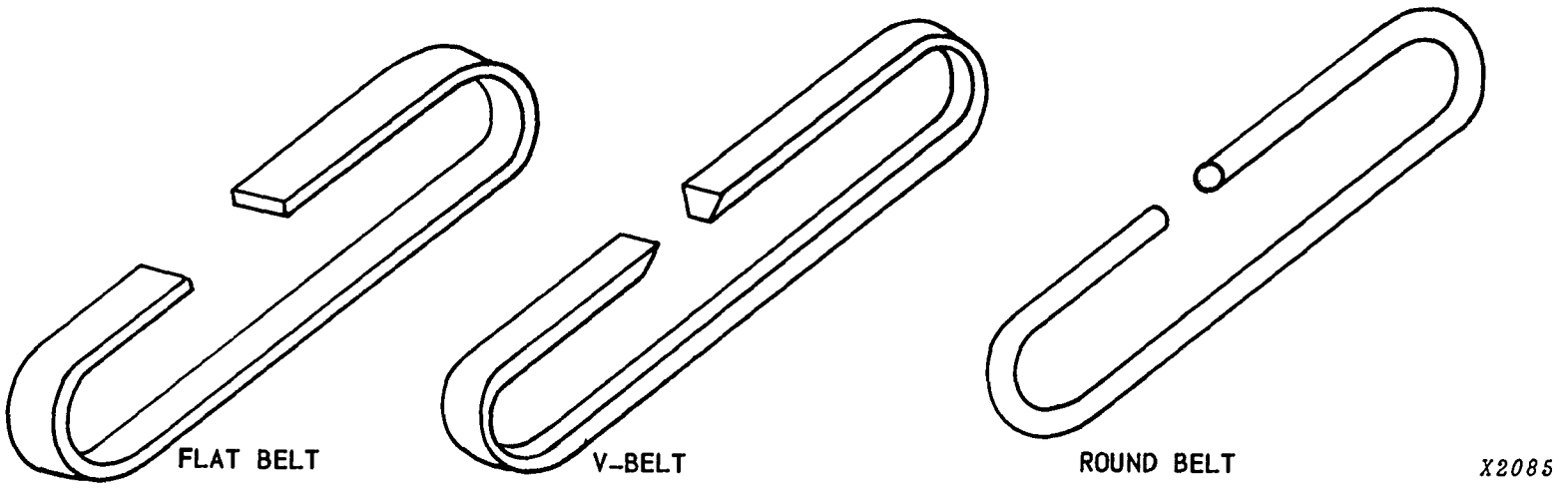

Fig. 4—Types Of Belts

Flat belts are also used where the belt itself performs the work, such as on conveyors and draper belts.

A movable idler may be used to provide clutch action. When clutching, flat belts release more completely than V-belts in grooved sheaves. Some flat belts are designed with a center bulge to help keep the belt on the pulley. This is because centrifugal force tends to throw the belt outward so that it climbs to the widest diameter of the pulley and stays there.

Perfect alignment of pulleys and belt is a must for good operation.

Tension should be no more than needed to transmit the load with the least slippage. However, tension is normally greater than for V-belts.

Flat belts are less expensive than V-belts and usually last longer because their shape reduces friction, which causes fatigue. However, flat belts need much more care and maintenance.

V-Belts

V-belts are the most common means of driving light loads between short-range pulleys. The pulleys (or sheaves) have high, steep flanges so that the belt cannot run off. The driving friction is entirely on the *sides* of the belt and is very effective because of the wedging action of the belt taper. V-belts are small in cross-section to reduce friction and heating. They have a greater load capacity at high speeds than do flat belts.

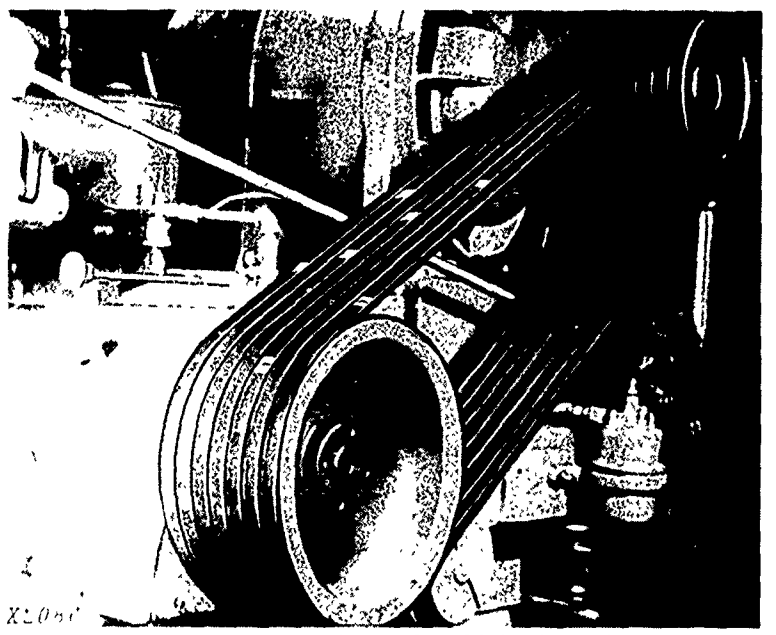

Fig. 5—V-Belt Drive Using Multiple Belts

V-belt tension is not nearly as great compared to flat belts, and V-belts can be operated with slack on top or bottom.

Two or more belts are used when more power must be transmitted than one belt can withstand. These belts work in parallel grooves in the same pulley (Fig. 5). The belts must be the same size or the tighter one will carry too much of the load, resulting in strain, slippage, and rapid wear.

VARIABLE-SPEED BELT DRIVES

This drive allows you to change the speed ratios between the driving and driven pulleys. It is based on the principle that large pulleys turn slower than small pulleys when driven by the same belt.

So the variable speed is obtained by changing the diameter of the pulley or pulleys.

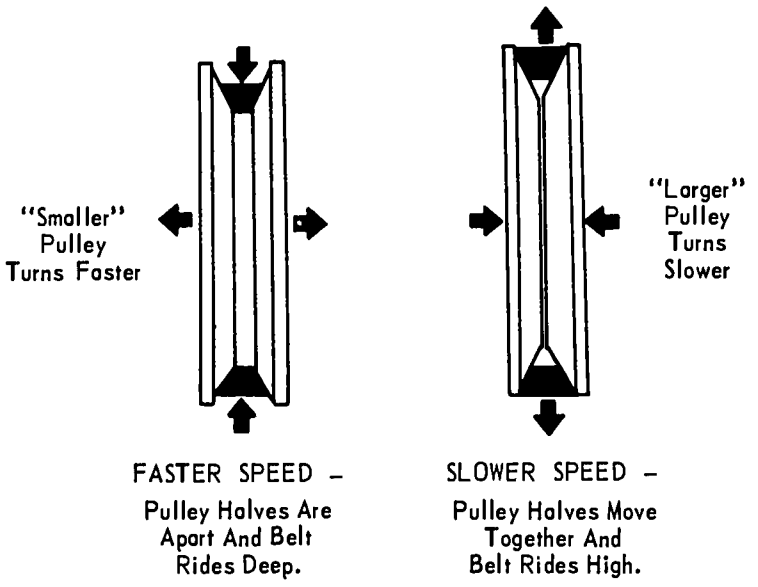

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Fig. 6—Variable-Speed Belt Drive

The pulleys are made up of two halves. By moving the halves together, the driven pulley becomes "larger" since the belt now rides higher in the pulley slot (Fig. 6).

When the pulley halves are pulled apart, the driven pulley becomes "smaller" again and turns at a faster rate.

When the pulley sizes are changed, the belt tension also changes. So there must be a means of "taking up the slack". This may be done in any of these ways:

1) Moving the pulleys closer together or farther apart.

2) Using an idler on the belt which responds to tension or slackening.

3) Using two pulleys of variable-pitch. The pulleys are synchronized so that when one changes its size, the other changes to offset it.

Variable speed drives can be controlled manually or automatically.

MAINTENANCE OF BELT DRIVES

Most maintenance will be for V-belt drives, since this is the most common belt drive today.

Care Of Belts

1. Store belts in a cool, dry place. Coil long belts in natural loops when storing them on pegs.

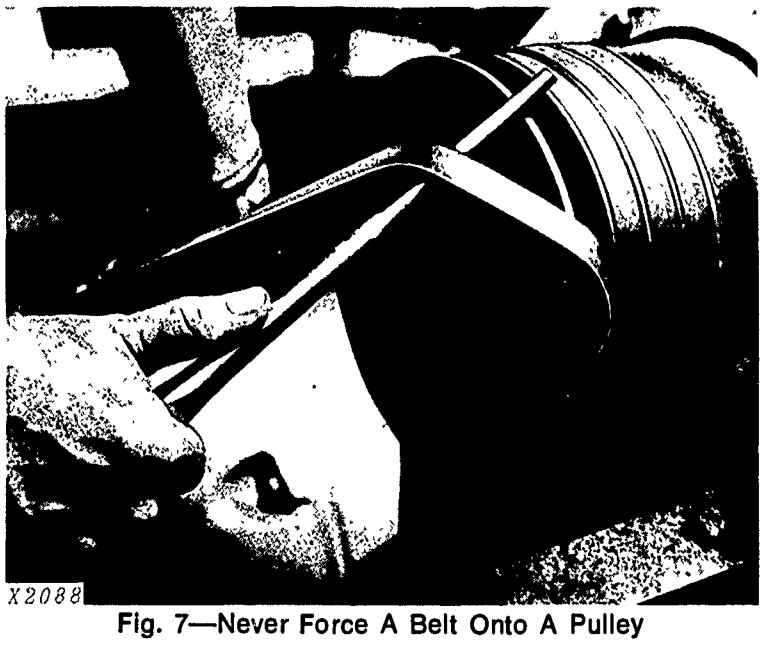

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Fig. 7—Never Force A Belt Onto A Pulley

2. Relieve tension on belt drives when not in operation.

3. Never force a belt onto a pulley (Fig. 7). Forcing will result in injured cords and premature belt failure.

4. Most drives permit easy belt installation through movable pulleys or idlers; if not, remove pulley for proper installation.

SIGNS OF IMPROPER BELT INSTALLATION

- *Belt stretched beyond take-up*
- *Belt fails rapidly for no visible reason*
- *Belt turns over*
- *Belt cut on bottom*
- *Belt creeps or slips*

BELT SLIP AND CREEP

Belt **slip** is the slight loss of speed between the drive and driven pulleys of any belt drive.

Belt **creep** is the slight stretching of the belt itself as it runs over the pulleys (Fig. 8).

Creeping occurs as follows:

When the belt is under load, there is a tight and a slack side to the belt. The tight side stretches, while the slack side contracts.

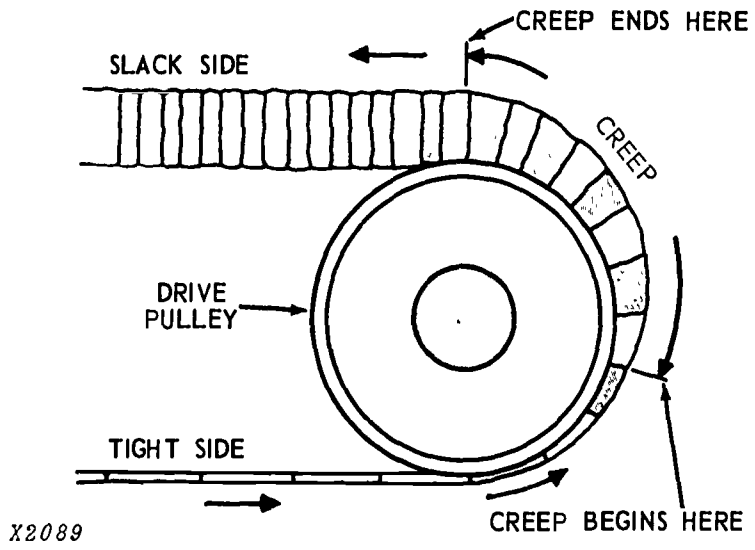

Fig. 8—Belt Creeping (Drive Pulley Shown)

At the *drive* pulley (shown), the section of belt passing onto the pulley is longer than that passing off, while at the *driven* pulley the section of belt passing onto the pulley is shorter.

This change takes place in the belt while it is on the pulley, and is known as *creep*. It should not be confused with *slip*, which is movement of the belt in relation to the pulley.

BELT ALIGNMENT

Pulley misalignment with flat and round belt drives will cause the belt to run off the pulleys.

Improper pulley alignment with V-belt drives is not quite as evident (Fig. 9), but can cause uneven belt wear, belt rollover, cord stretch, or breakage due to the load being carried on one side of belt.

Checking alignment of pulleys is shown in Fig. 10. Place the straightedge or cord to touch pulleys at arrows. The shafts must be parallel. Then rotate each pulley and note whether the contact of either pulley with the straightedge is disturbed. If so, a shaft is bent or a pulley is wobbling.

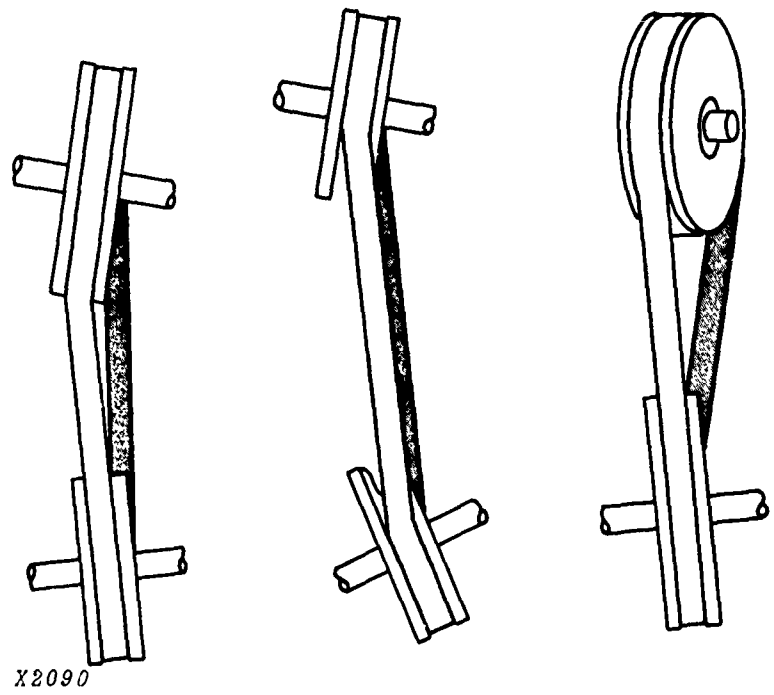

Fig. 9—Pulleys Not Aligned Can Damage The V-Belt

BELT TENSION

Tension of flat belts must be greater than that of V-belts but not tighter than necessary to avoid slippage.

Too little tension will cause slippage or slip-and-grab, causing the belt to break. If the belt does not break, slip will cause excessive cover wear, burned spots, and overheating.

Too much tension will cause belt heating and excessive stretch as well as damage to drive components such as pulleys and shafts. The extra tightness will also place a heavier load on the bearings.

Normally, belts should not be re-tensioned until slippage occurs or the drive works improperly from lack of tension.

Remember that V-belts should ride on the **sides** *of the pulleys, not on the bottom of the groove.*

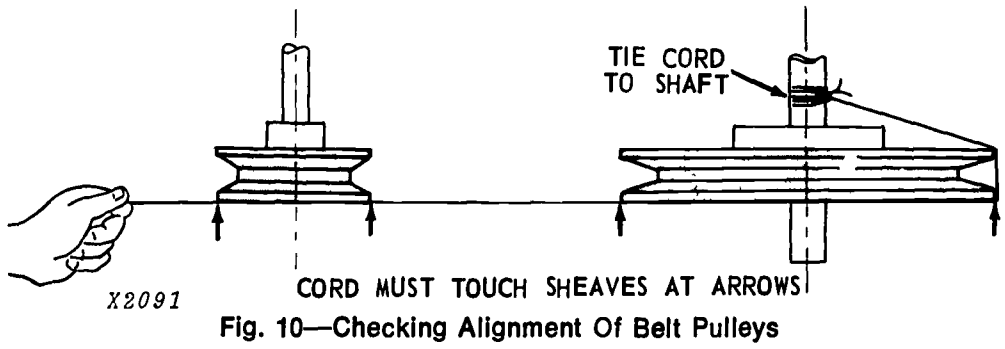

Fig. 10—Checking Alignment Of Belt Pulleys

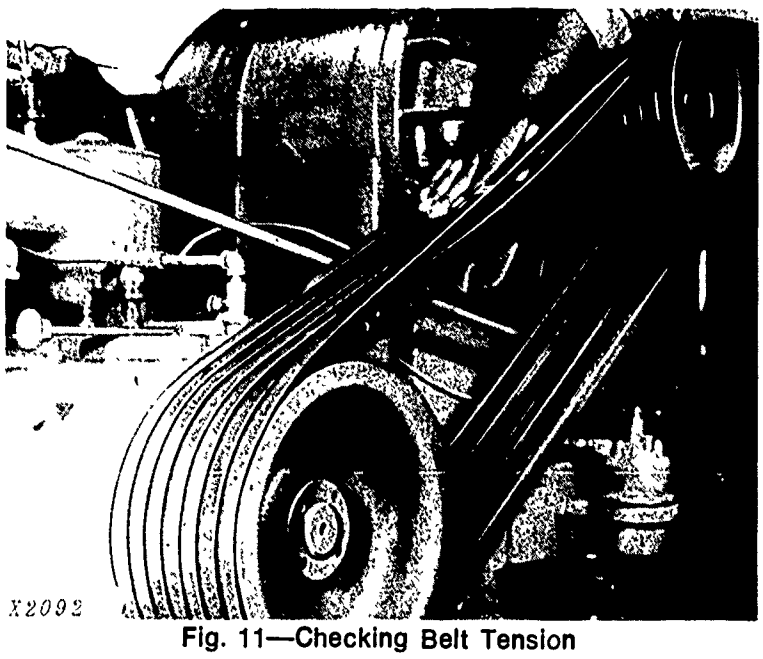

Fig. 11—Checking Belt Tension

Proper belt tension means springiness when hit by the hand but not to the extent of a rubber band vibration (Fig. 11). Normally the belt should not deflect more than one thickness when pushed by hand.

Tension on a new belt should be rechecked after the first hour and watched during the first 24 hours of operation. This is when the initial seating and stretch occurs.

For exact tension on belts, refer to the machine operator's manual.

BELT PROBLEMS WITH OIL AND GREASE

There are certain dressings that may be applied to *flat* belts, usually leather, to increase belt efficiency.

But generally, **all belts should be kept free of oil, grease, and fuel.** Oil and grease cause belts to become soft and to slip. Belts are designed to withstand some exposure to oil or grease, but if detected, the belt should be cleaned with a cloth soaked in solvent.

HEATING PROBLEMS WITH BELTS

Belts operating in temperatures of less than 120°F. are not usually affected by heat. But at hotter temperatures, the belt may harden, causing it to crack and stretch. Be sure to ventilate the belt properly by keeping shields and screens clean. Also be sure that belt isn't slipping, which causes heat.

MATCHING OF BELTS

If one belt in a set breaks, replace all belts in that set. The older belts have worn sides, and initial stretch is gone, causing the entire load to be carried by the new belt.

Never use belts manufactured by different companies in the same set. Length and stretch tolerances are different for each company.

Worn pulleys or misaligned shafts can give the appearance of mismatched belts and should be checked before installing a new set of belts.

FAILURES OF BELTS

For details on failures of belts, see the "Belts and Chains" chapter of the FOS "General" manual.

CARE OF PULLEYS AND SHEAVES

Wear In Sheave Grooves

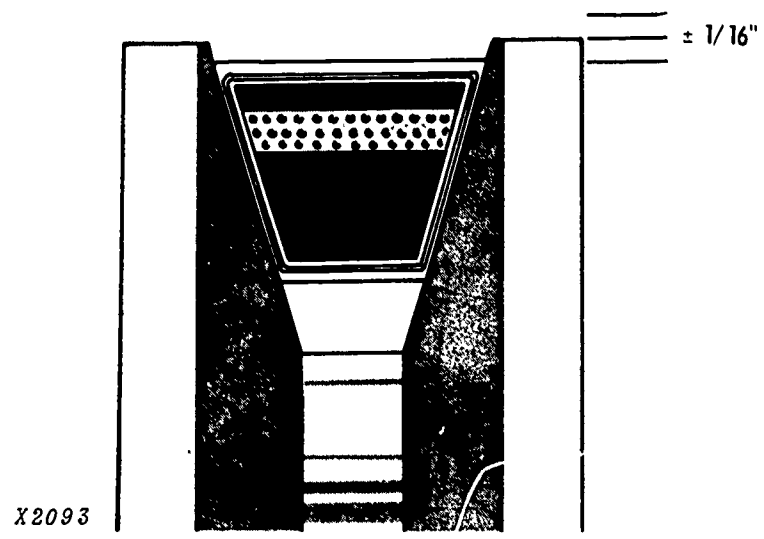

Fig. 12—Proper Position Of V-Belt In Sheave

Generally, when a new belt seats more than 1/16 inch below the top of the sheave groove, the sheave is worn out. Fig. 12 shows the normal position of a V-belt in a good pulley sheave.

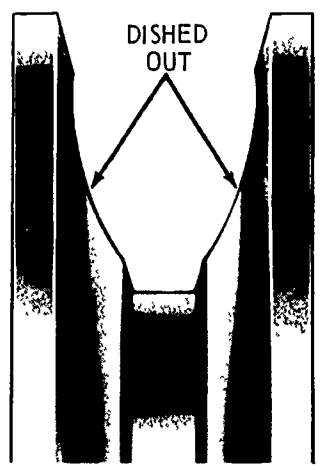

Fig. 13—Sheave Grooves "Dished Out" By Wear

When a sheave groove is worn as much as 1/32 inch, the sheave should be repaired, regrooved, or replaced. Fig. 13 shows a pulley with the sheaves "dished out" by wear.

Sheave grooves wear rapidly when exposed to abrasive dust, and they should be cleaned frequently.

Sheave groove *wear* may result from corrosion, or moisture and chemicals in the air, especially if the drives are idle for long periods.

Shiny Sheave Groove Bottoms

A shiny sheave groove bottom is a sign that the belt or sheave, or both, are badly worn and the belt is bottoming in the groove. Look at the smaller sheave first, since this is where the wear usually appears first.

Possible causes may be a worn sheave or the wrong belt.

Wobbling Sheaves

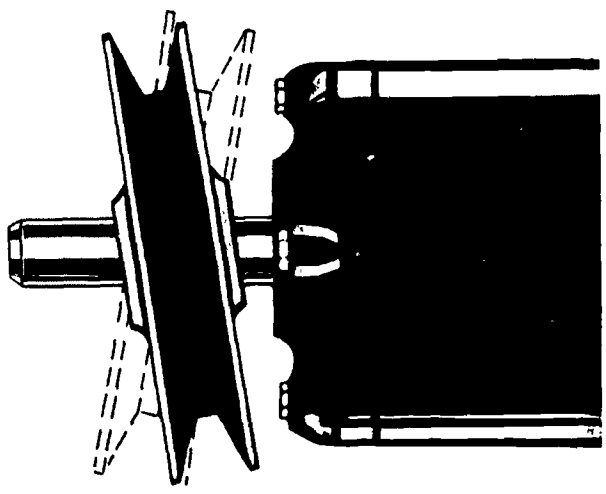

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Fig. 14—Wobbling Sheave

A wobbling sheave means short belt life, but it can be readily spotted (Fig. 14).

Sheave wobble may be caused by:

1. *Bent shaft or sheave.*
2. *Improper sheave installation on shaft.*
3. *Worn or damaged shaft bearings.*

Damaged Sheaves

Cast-iron sheaves may become chipped, or pressed steel sheaves may bend (Fig. 15). Both cause short belt life.

Replace damaged sheaves at once.

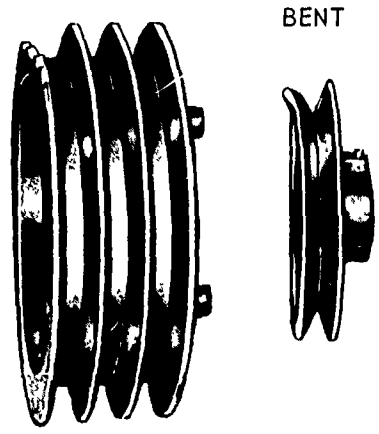

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Fig. 15—Damaged Sheaves

TROUBLE SHOOTING OF BELT DRIVES

Below is a summary of trouble signs and possible causes of belt drive failures.

Trouble	Possible Cause
Belts turn over in sheaves	1. Misalignment of sheaves and shafts.
	2. Worn sheave grooves.
	3. Misalignment of flat idler sheave.
	4. Excessive belt vibration due to improper tension.
	5. Belt cord damage from wrong installation.
Belt squeaks or screeches	1. Too-high starting load, causing belt to slip because of improper tension.
	2. Overload, causing belt to slip because of improper tension.
Belt chirps	1. Movement of belt on flat idler or pulley (not harmful).
Belt stretched beyond take-up	1. Drive operated under too much tension.
	2. Wrong belt or poor storage in damp area.

Belt breaks prematurely	1. Foreign material in sheaves. 2. Shock or extreme overload. 3. Belt damaged during installation.
Belt has short life	1. Worn sheaves. 2. Oil or grease on belt. 3. High temperatures. 4. Belt cover wear, caused by guard or guide interference. 5. Excessive belt slippage. 6. Poor storage of belts.

CHAIN DRIVES

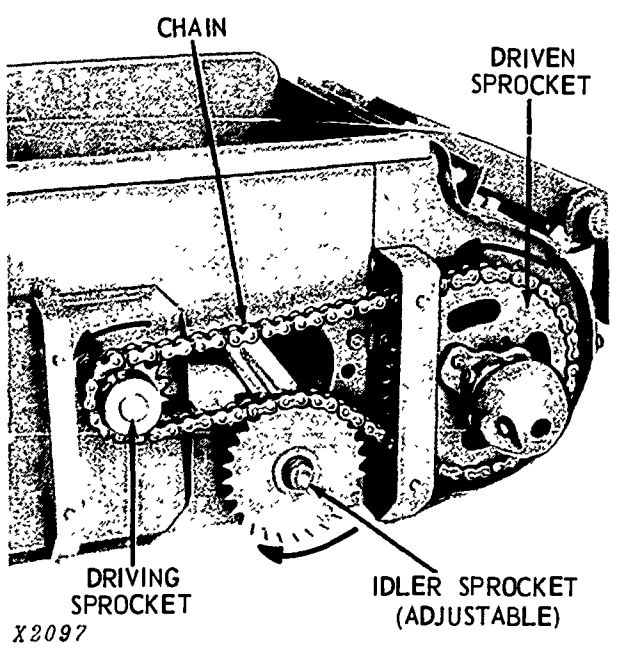


Fig. 16—Chain Drive

Chain drives are similar to belt drives except that they are less flexible but more powerful. They also eliminate the slippage that belt drives may give.

PRINCIPLES OF CHAIN DRIVES

1. Chain drives are used to transmit power from one rotating shaft to another.

2. Chain drives consist of one or more *sprockets* and an endless *chain*.

3. The links of the chain mesh with the teeth of the sprockets and maintain a positive speed ratio between the driving and driven sprockets.

4. Sprockets connected to the same side of a chain revolve in the same direction. If connected on reverse sides, they revolve in opposite directions.

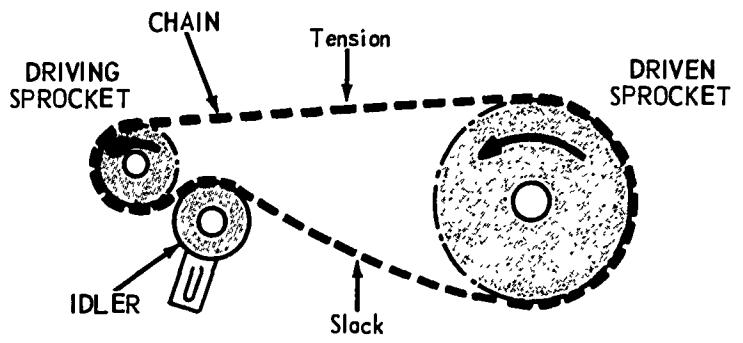


Fig. 17—Parts Of A Chain Drive

5. Sprockets for roller chain drives must not be smaller than ten teeth to avoid excessive wear.

6. If the chain has an even number of pitches (spaces between links), the sprockets have an odd number of teeth, and vice versa. This prevents a single pitch from contacting the same tooth each time, causing uneven wear and vibration.

7. A small sprocket causes sharper bending and more wear.

8. Short links bend less and should be used on smaller sprockets.

9. Chains may be installed in single or multiple strands, depending on the load.

10. Chains must be adjusted from time to time by moving one of the main sprockets or the idler sprocket.

11. Chain drives should have the slack side on the bottom if possible.

12. Idlers should be on the slack side of the chain.

ADVANTAGES OF CHAIN DRIVES

- *Chain drives are efficient and do not slip.*
- *They are fairly flexible and compact.*
- *Chain drives are reasonably inexpensive.*
- *Chains keep a fixed speed ratio without slipping.*
- *They can withstand heat and dirt and are not affected by the weather if properly lubricated.*
- *Chain drives can carry heavier loads than belts.*

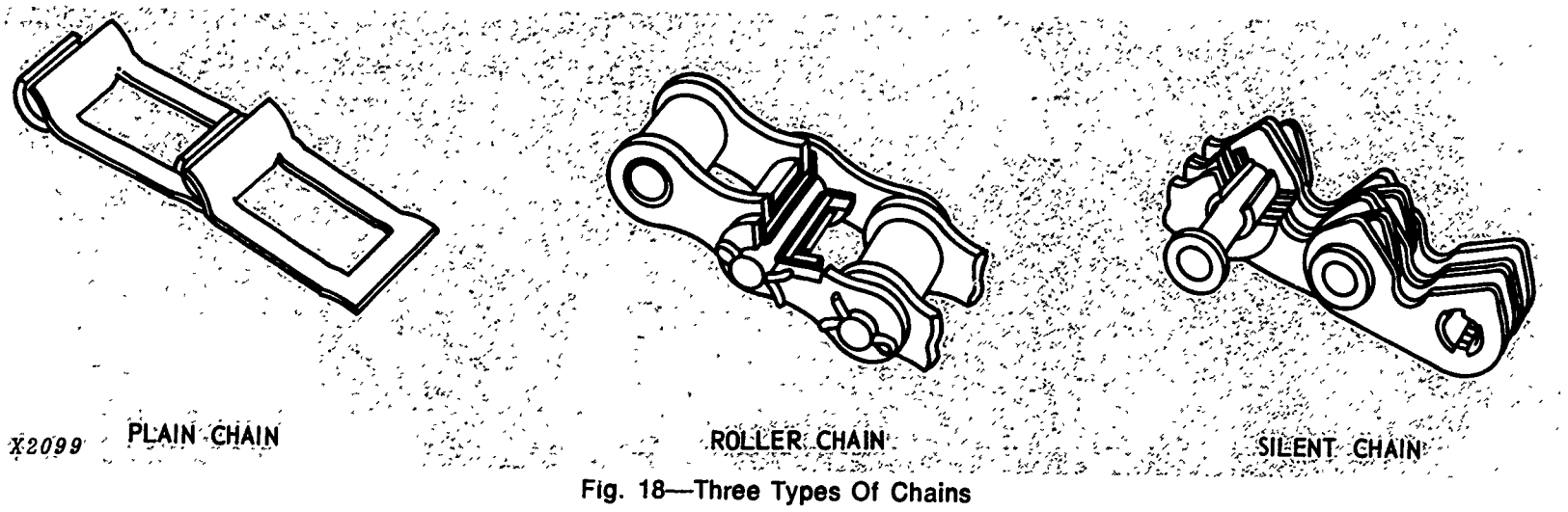


Fig. 18—Three Types Of Chains

TYPES OF CHAINS

Chains are available in three types:

- **Plain Chain**
- **Roller Chain**
- **Silent Chain**

Fig. 18 shows the three types of chains.

Plain Chains

Plain chains are a series of formed links, either open or closed, which can be detached. Larger plain chains are of pintle construction. Plain chains are used in low-speed applications, such as conveyors or drags. Open plain chains are used for light loads, while the closed pintle chains are used for heavier loads.

Roller Chains

Roller chain is made up of alternate roller links and pin links with pins. The bushings are free to turn.

Roller chain is a good way to carry heavy loads at low speeds between shafts that are far apart.

Standard roller chain is made up of alternate roller links and pin links (Fig. 19). Roller links have two roller link plates, two bushings, and two rollers, while pin links have two pin link plates and two pins. Pins are usually in the form of rivets with cotter pins for connecting, although the complete chain may be joined by removable pins.

The side plate of the roller chain determines the pitch (or angle) of the chain. Double pitch or extended pitch roller chain has the same parts as the standard-pitch chain, but the side plates have twice the pitch. Double pitch chains are lighter in weight and less expensive.

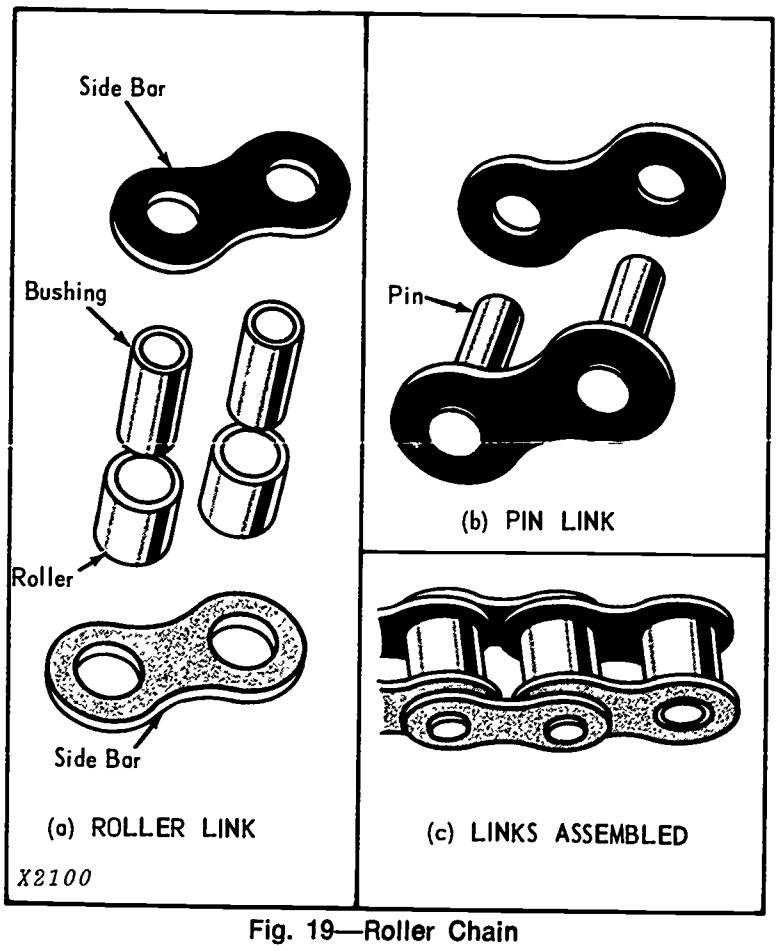


Fig. 19—Roller Chain

Silent Chains

Silent chain is a series of flat metal links, with a tooth shape at each end, connected by pins to form a flexible, continuous chain (Fig. 20).

The sprockets are similar to gears in appearance and design. Silent chain is quieter and has less vibration than roller chain and can be run at a higher speed. Its links are small in proportion to its strength so it can be used on smaller sprockets. Some silent chains are made with links having teeth on both sides so that over-and-under serpentine drives can be used.

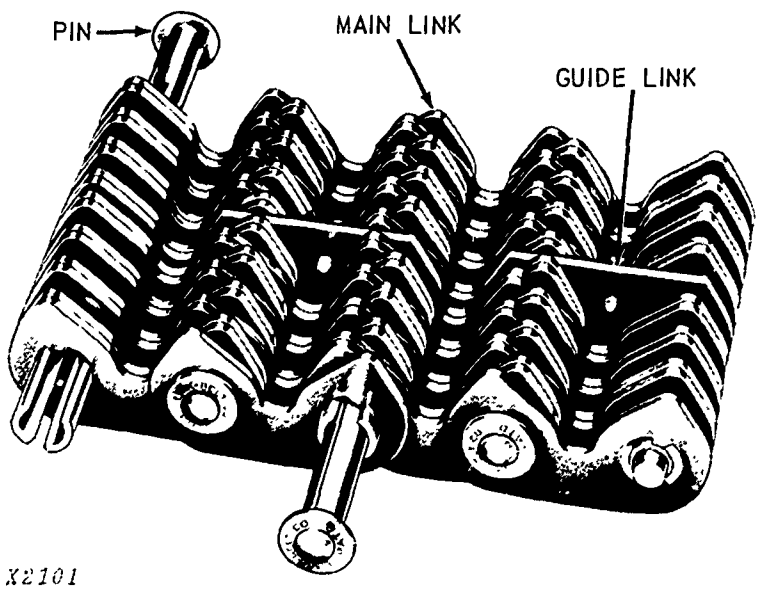


Fig. 20—Silent Chain

INSTALLING CHAINS

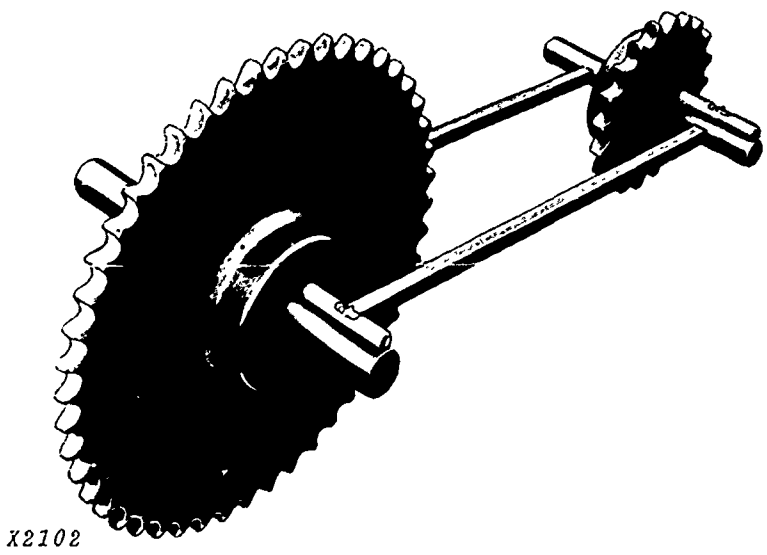


Fig. 21—Aligning Shafts On A Chain Drive Using A Machinist's Level

1. **Align The Shafts**—Level each shaft with machinist's level on shaft, or across teeth if multiple width sprockets are used. Check shafts to see if they are parallel using a feeler bar (Fig. 21). The distance between shafts on both sides should be equal. Then bolt the bearings securely.

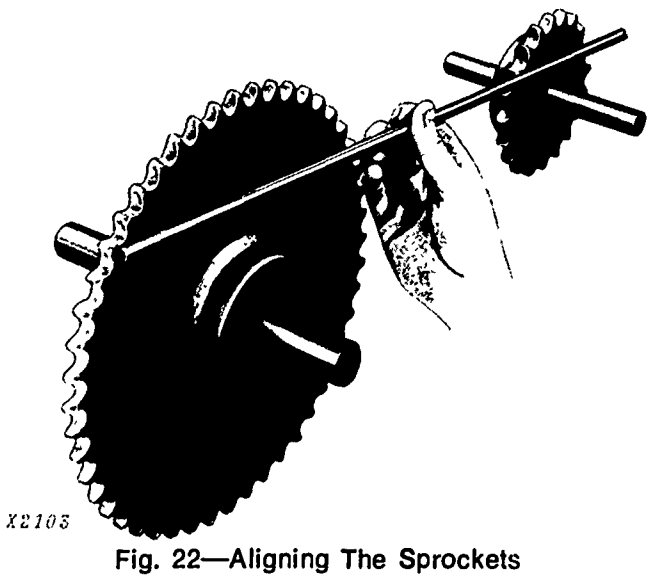


Fig. 22—Aligning The Sprockets

2. **Align The Sprockets**—Check the axial alignment of the sprockets with a straight edge applied to finished surfaces on the sides of the sprocket (Fig. 22). When aligned, tighten the hub set screws.

Fig. 23—Installing The Chain

3. **Install The Chain**—Remove *connector* link and wrap the chain around sprockets, bringing the free ends together on one sprocket. Install connector link (Fig. 22), being sure to tap chain pin links back so that fasteners come up snugly against the outside of the connecting link plate.

This helps in three ways:

a) Designed clearances between link plates across the chain are maintained and oil can get down in between link plates.

b) Joints will be able to flex freely for a smoother chain action.

c) Chain fasteners will last longer.

Offset links should be avoided if possible, but if necessary, use an offset link with press-fit pins.

TENSION ON CHAINS

Adjust the shaft centers for proper chain tension.

For horizontal and inclined drives, the chain sag should be about ¼ inch per foot between shaft centers (with one side of chain taut). Vertical drives and those subject to shock loading or reversal of rotation should be adjusted so that both spans of chain are almost taut. For drives on fixed centers, chain tension can be controlled with an adjustable chain tightener, either an idler sprocket or a shoe.

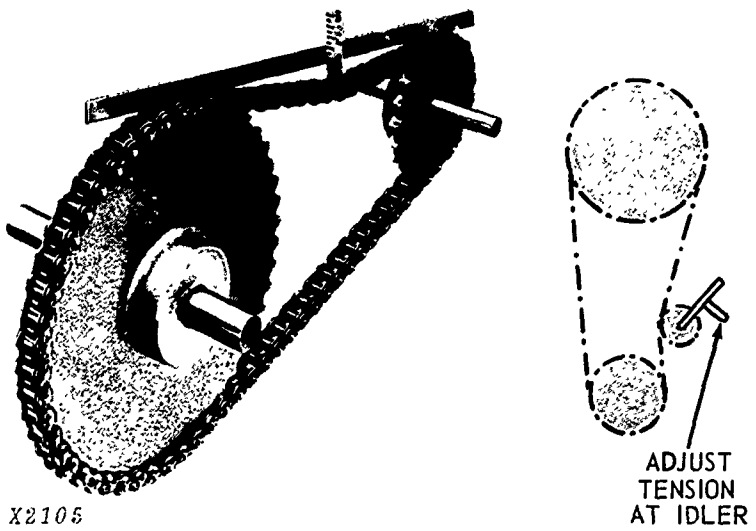


Fig. 24—Checking Tension On Chain

To determine the amount of sag, pull one side of the chain taut, allowing all the excess chain to accumulate in the opposite span.

Place a straight edge over the slack span and pull the chain down at the center (Fig. 24). Measure the amount of sag from the top of the chain to the underside of the straight edge.

If necessary, adjust the shaft centers to provide the recommended amount of sag for proper chain tension.

Stretched Chains

When the shaft or chain tensioner has reached maximum adjustment and the chain begins to ride on the tips of the sprocket teeth (Fig. 25) it may have reached the end of its useful life.

However, if the chain still fits properly when wrapped on the largest sprocket, remove one or two links and reset the shafts or tensioner in their original position. Then adjust to provide proper tension.

LUBRICATION OF CHAIN DRIVES

The importance of lubrication increases with higher chain speeds.

Lubrication will do three basic things for chain life:

1) Reduce wear.

2) Protect against corrosion.

3) Prevent galling or seizing of pins and bushings.

Types Of Lubrication

MANUAL LUBRICATION—Oil is applied with a brush or spout can, preferably once every eight hours of operation. Oil should be applied again before oil discolors between joints.

DRIP LUBRICATION—Oil drops are directed between the link plate edges from a drip lubricator. Oiling should be sufficient to prevent discoloration of oil between joints.

BATH OR DISK LUBRICATION—With bath lubrication, the lower strand of chain runs through a sump of oil in the drive housing. The oil level should reach the pitch line of the chain at its lowest operating level. With disk lubrication, the chain operates above the oil level and a rotating disk picks up oil from the sump and deposits it onto the chain by means of a trough or collector plate.

OIL STREAM LUBRICATION—The lubricant is usually supplied by a pump that sprays oil onto the chain through nozzles. The stream should be directed to the lower, inside strand of chain. Excess will run off and return to pump. Oil should be changed periodically.

Properly lubricated chains will not show brownish color at the joints and the connecting link pins will be brightly polished.

REPAIRING CHAIN DRIVES

1. To separate a roller chain, drive out the two pins of the link with alternate strokes, taking care not to damage adjacent links. If the pins have a head, grind them off before trying to remove. A chain-breaking tool is a quick, efficient method of removing links.

2. Sprocket life may be prolonged by reversing the sprockets, if the design permits. Be careful to check alignment.

3. Never insert a new link in a chain that has been elongated by wear. The new link will have a shorter pitch, causing shock when engaging the sprocket. This will soon destroy the chain.

4. Do not install a new chain on badly worn sprockets (Fig. 25). More damage will occur to the chain in a few hours than under years of normal use.

CLEANING OF CHAINS

Periodic cleaning is good economy under even the best operating conditions. Steps for chain cleaning are:

1. *Remove chain from sprockets.*
2. *Wash chain in kerosene.*
3. *Drain kerosene and soak chain in oil.*
4. *Hang chain to drain off excess lubricant.*

STORING OF CHAINS AND SPROCKETS

Remove chain from sprockets, clean them, and coat with heavy grease. Then wrap chain in heavy grease-resistant paper and store in a dry area.

Sprockets may be left on shaft and coated with heavy protective grease.

Before using the drive again, thoroughly clean grease from the chains and sprockets, and re-lubricate the chain.

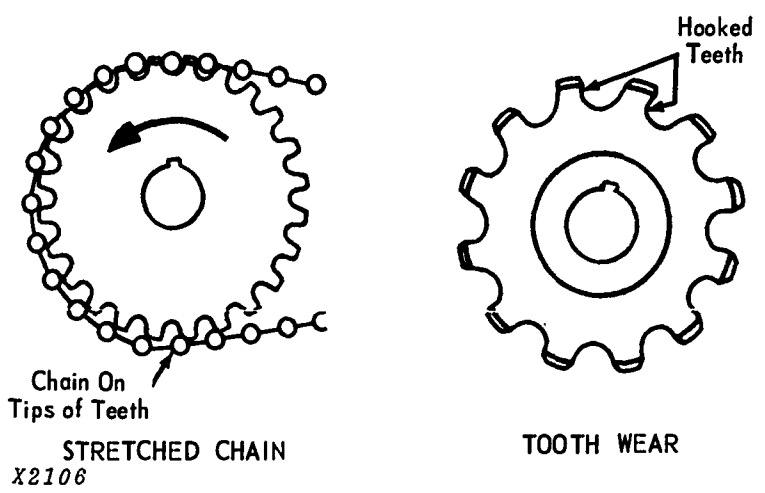


Fig. 25—Problems With Chain Drives

TROUBLE SHOOTING OF CHAIN DRIVES

Trouble	*Possible Cause*
Excessive noise	1. Misalignment of sprockets
	2. Wrong tension
	3. Lack of lubrication
	4. Loose casings or bearings
	5. Chain or sprocket worn out
	6. Chain pitch too large
Wear on side bars, link plates, and sides of sprocket teeth	1. Misalignment
Chain climbing sprockets	1. Wrong chain or poor chain
	2. Chain worn out
	3. Lack of chain wrap on sprocket
	4. Too much chain slack
	5. Material build-up in sprocket tooth pockets
	6. Worn sprockets
Broken pins, bushings, or rollers	1. Chain runs too fast
	2. Heavy slack or sudden loads
	3. Material build-up in sprocket tooth pockets
	4. Lack of lubrication
	5. Chain or sprocket corrosion
	6. Wrong chain or worn sprockets
Chain clings to sprocket	1. Wrong chain or worn sprockets
	2. Heavy or tacky lubricant
	3. Excessive chain slack
	4. Material build-up in sprocket tooth pockets
Chain whips	1. Too much slack in chain
	2. High, pulsating loads
	3. Stiff chain joints
	4. Uneven wear on chain
Chain gets stiff	1. Lack of lubrication, resulting in wear
	2. Corrosion
	3. Excessive overloads
	4. Material build-up in chain joint
	5. Peening of side plate edges
	6. Misalignment

Broken sprocket teeth	1. Obstruction or foreign material 2. Excessive shock loads 3. Chain climbing sprocket teeth
Chain fasteners fail	1. Vibration 2. Obstructions striking fasteners 3. Fasteners improperly installed
Drive runs too hot	1. Chain running too fast 2. Lack of lubrication 3. Chain immersed too deep in oil bath 4. Chain or shafts rubbing against obstruction

GEAR DRIVES

Gears are the most common way to transmit power for heavier loads. With gears in mesh, all slippage is gone. Even the linkage of the chain is eliminated, giving more power potential.

OPERATION

Chapter 1 of this manual covers the basic gear types and their uses. Refer to that chapter for the basics of gear drive operation.

MAINTENANCE

The problems of *gear wear* and *backlash* are also explained in Chapter 1.

LUBRICATION

Gear lubricants range from simple mineral oils to complex formulas containing many ingredients.

For the type of oil to use, consult the manufacturer's operator's manual.

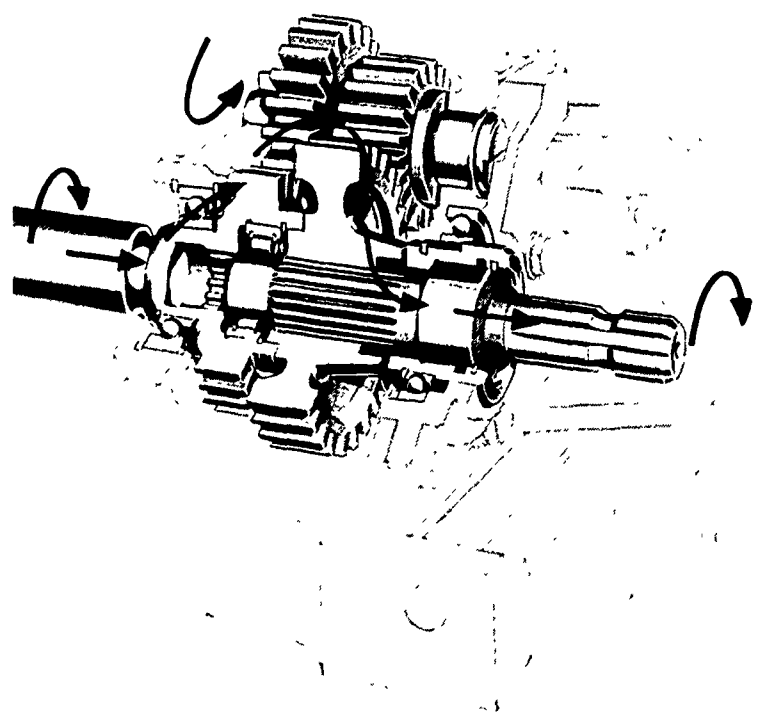


Fig. 26—Gear Drive

Common gear lubricants are:

SPUR GEARS—may use a good grade of petroleum oil—but not always.

BEVEL GEARS—may use an extreme-pressure (E.P.) lubricant.

WORM GEARS—may use an SCL lubricant, which offers even greater lubricant qualities.

Methods Of Lubricating Gears

Enclosed gearing is usually lubricated by the gears moving through a sump of oil and may have additional run-off troughs to lubricate the upper gears. The lubricant should be changed per the manufacturer's recommendations.

Open gears can be lubricated by:

1) Splash pan which the gears run through.

2) Hand lubrication by brushing or squirting (Fig. 27).

3) Automatic lubrication by a drip oiler.

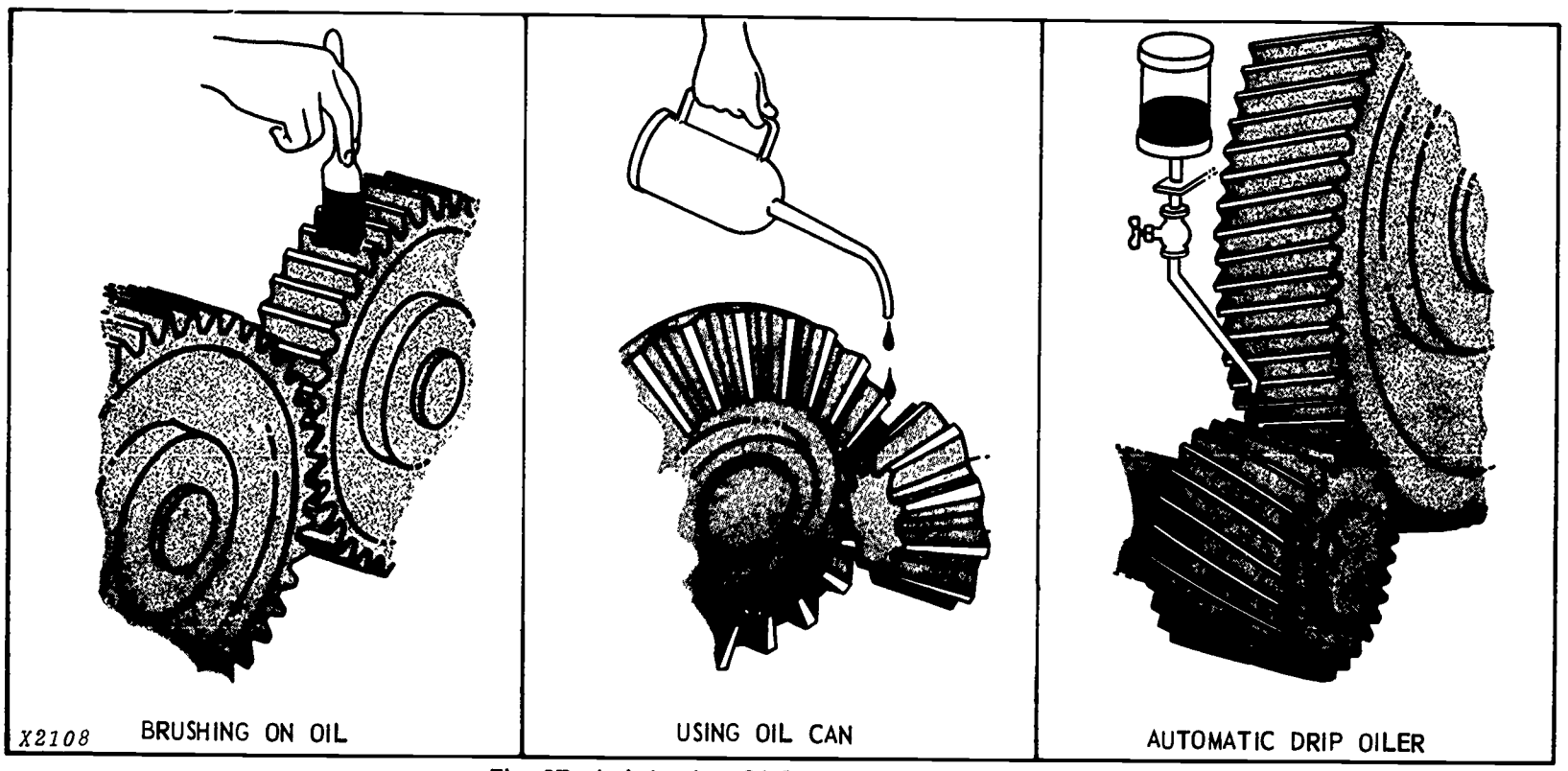


Fig. 27—Lubricating Of Open Gears—Three Ways

TROUBLE SHOOTING OF GEAR DRIVES

Trouble	*Possible Cause*
Fins around edge of teeth	1. Too much backlash
	2. Heavy, continuous loading
	3. Intermittent overloading
	4. Gears not hardened
Gear teeth appear burned from overheating	1. Too little backlash
	2. Overspeeding
	3. Overloading
	4. Lack of lubrication
Gear teeth are scored	1. Lack of proper lubrication
	2. Excessive speeds
	3. Overloading
	4. Too little backlash
Abrasions or fine tooth scratches	1. Dirt, grit, or metal particles in gears
Interference marks on tooth edges	1. Improper manufacturing
	2. Faulty assembly
Pitting of gear teeth	1. Excessive loading
Gouging near bottom of teeth	1. Too little backlash
Teeth broken	1. Too much backlash
	2. Shock impact or overload

RECIPROCATING DRIVES

Reciprocating drives change a *rotary* motion to a *linear* motion. The source of rotary motion could be the drives already discussed (belt, chain, gear) or the hydraulic or electrical devices.

A reciprocating mechanism is not actually a drive but is a supplement or helper for the drive.

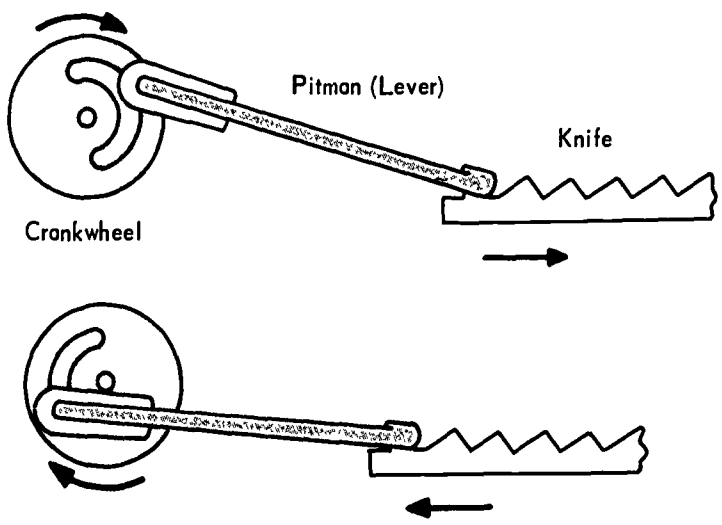
Two uses of reciprocating drives: mowing cutter bars and plungerheads on hay balers.

Reciprocating drives are of four basic types:

- **Crankwheel and lever**
- **Crankarm and lever**
- **Off-center crankarm**
- **Cam**

Let's look at each one.

CRANKWHEEL AND LEVER DRIVE



X2109
Fig. 28—Crankwheel and Pitman Lever Driving Mower Blade

The crankwheel and lever principle works from rotary motion (the crankwheel) with the lever or pitman attached off-center (Fig. 28). As the crankwheel turns, the pitman moves forward and back. One revolution of the crankwheel gives two strokes on the pitman. The mowing cutter bar uses this principle as shown.

Variations On Crankwheel And Lever Principle

A crankwheel and lever, with a *sway bar drive,* helps eliminate the up-and-down motion of the drive and reduces slapping and vibration (Fig. 29). As the pitman moves to the left (A), the knife is driven to the right. As the pitman moves to the right (B), the knife is driven to the left.

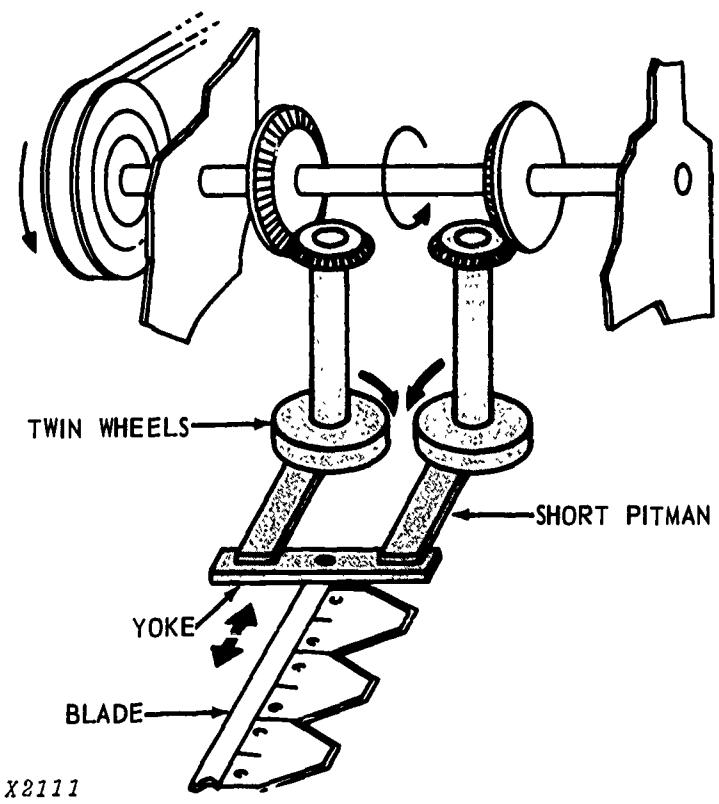


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Fig. 30—Twin Wheel Drive Operating Mowing Cutter Bar

The *twin wheel drive* helps reduce vibration by having two crankwheels and short pitmans which operate in opposition to each other (Fig. 30).

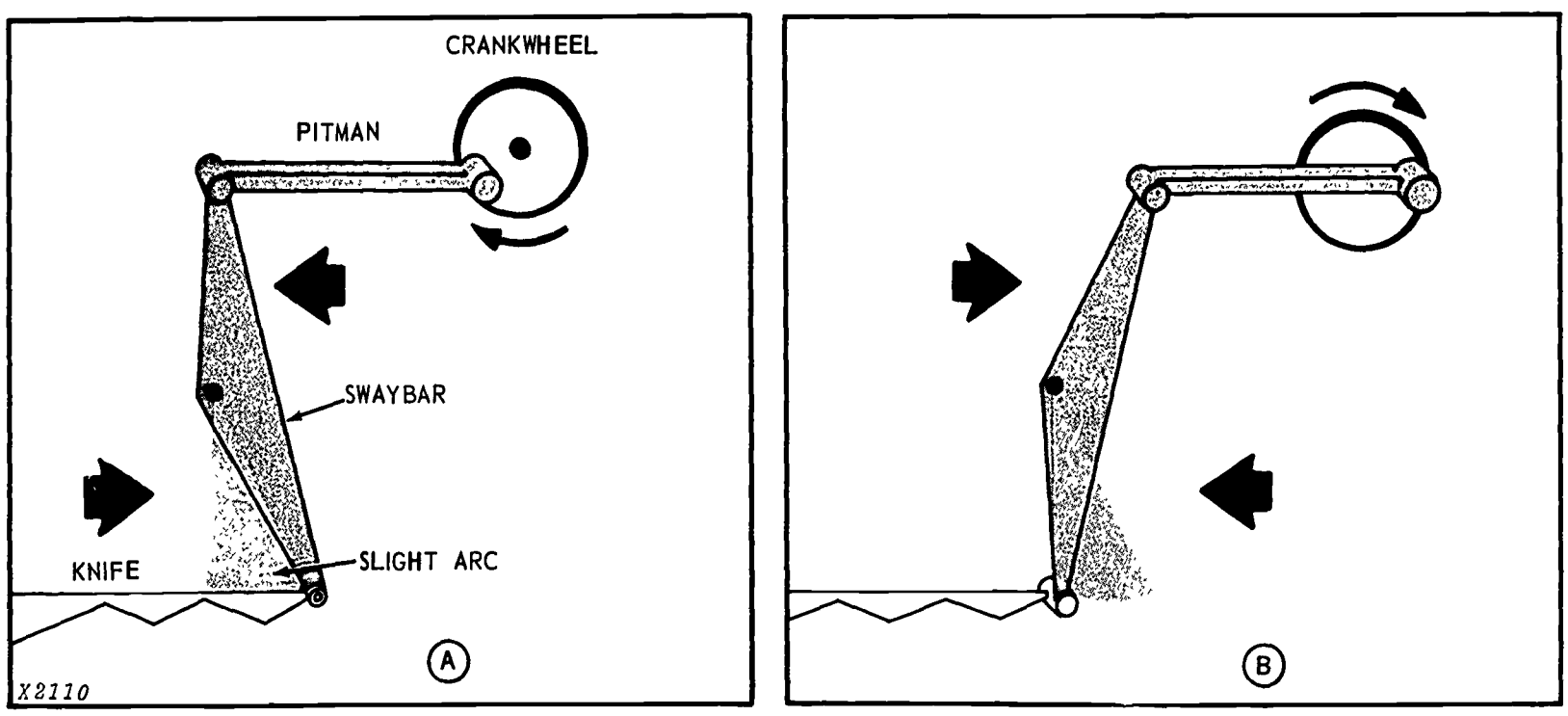

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Fig. 29—Crankwheel And Lever With Swaybar Drive

CRANKARM AND LEVER DRIVE

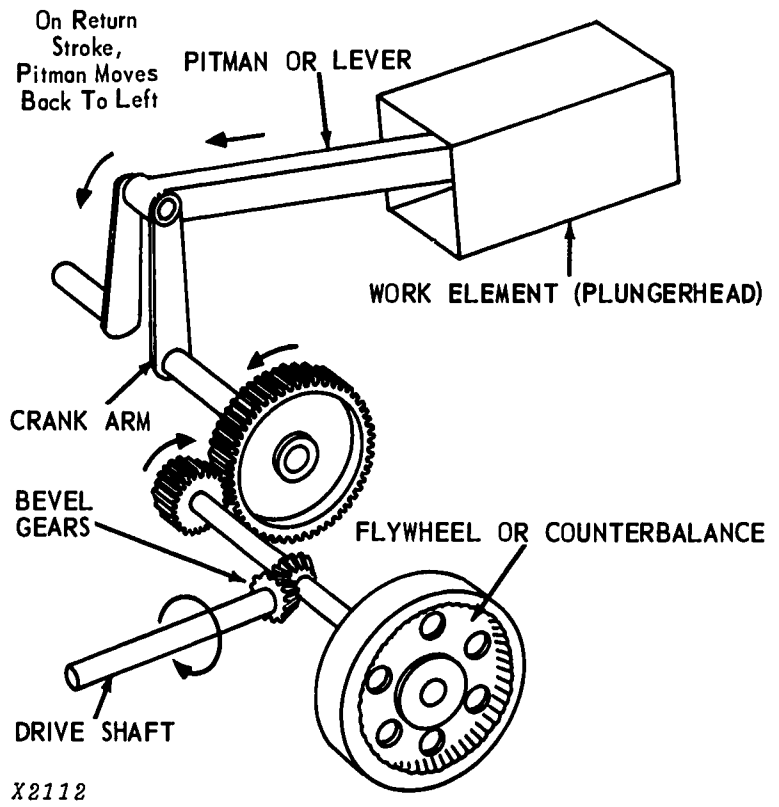

Fig. 31—Crankarm And Lever Drive For Hay Baler Plungerhead

A crankarm and lever drive is similar to a crankwheel and lever drive, except the crankarm takes the place of the crankwheel (Fig. 31).

Most reciprocating drives are counterbalanced to offset the inertia of the sudden changes in direction. This may be a counterweight, a dual drive, or a flywheel. The direction of the counterbalance is always the opposite of the pitman or lever.

OFF-CENTER CRANKARM DRIVE

The off-center crankarm drive is often called the *wobble shaft* or bent shaft drive (Fig. 32). As the shaft turns, the vertical motion is absorbed by a hinged yoke, while the horizontal motion is used for the back-and-forth motion.

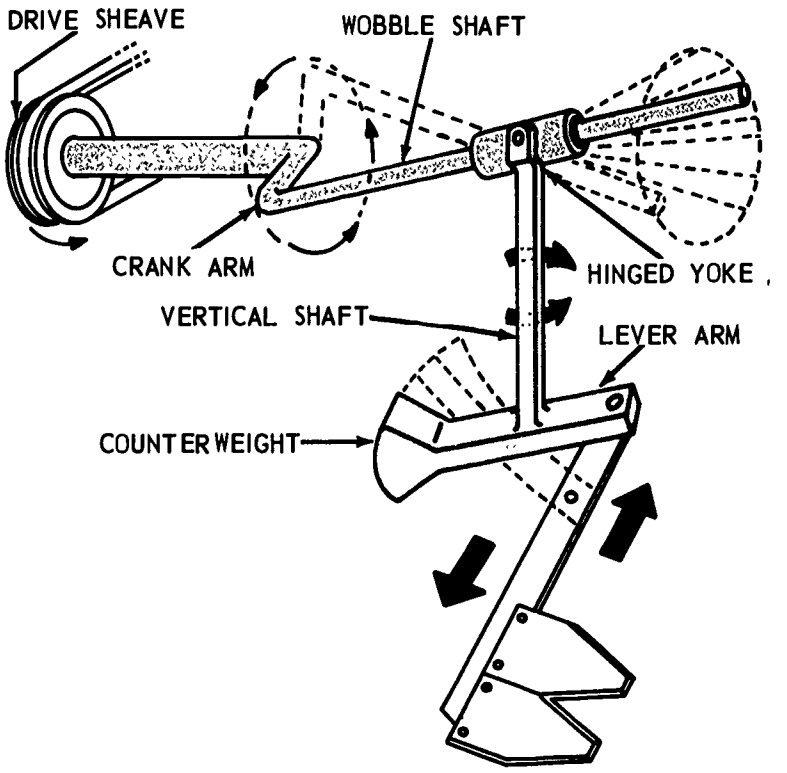

Fig. 32—Off-Center Crankarm Drive (Wobble Shaft)

A counterbalance is often used; however, the device can be used without a counterbalance if the weight of the machine is much greater than the force that must be driven. For example: It can be used as a sickle drive on a hay windrower because the sickle weight is very small in relation to the platform weight. But a counterweight must be used on a basic field mower because its weight is mainly in the cutter bar and drive.

CAM DRIVES

Cam drives are often used in a direct reciprocating motion (Fig. 33). Their action may also involve complicated or delayed motions. However, they always return to a starting point or reciprocate. Cam drives may use a spring load, gravity, or a track to return them to their starting positions as shown in Fig. 33.

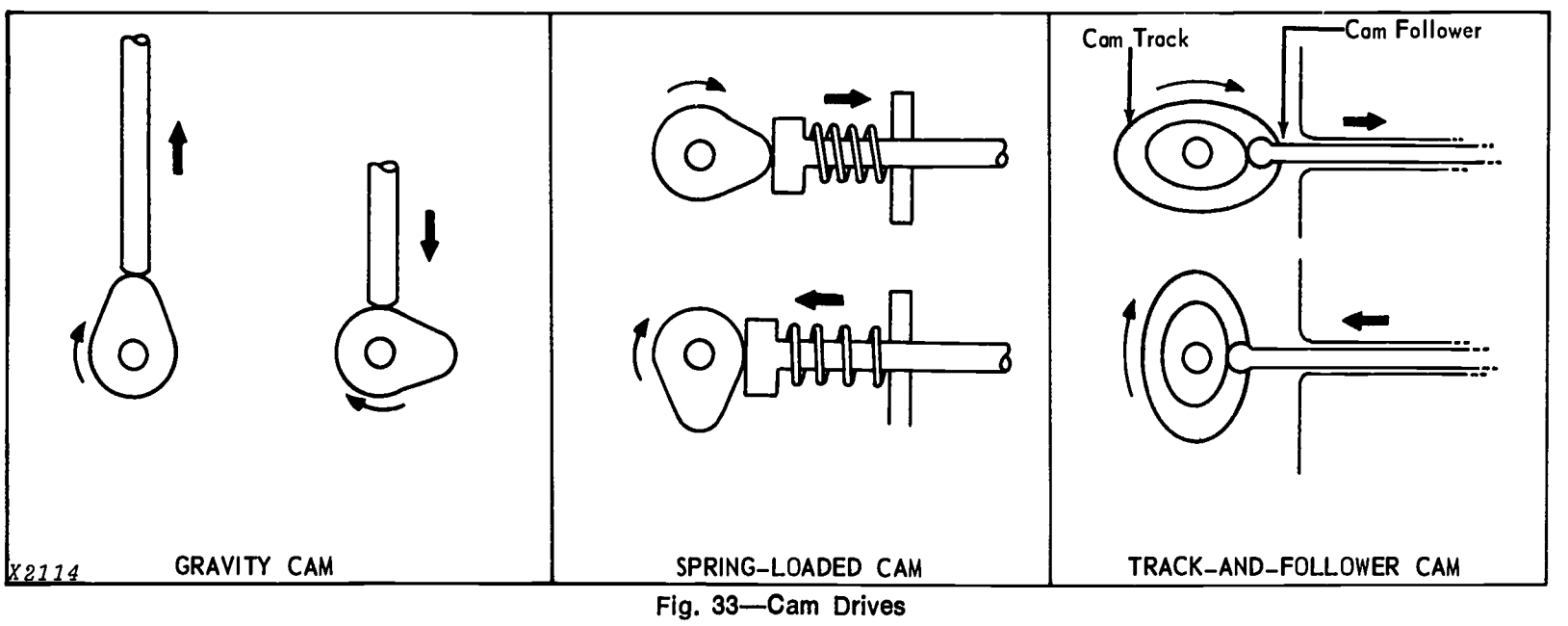

Fig. 33—Cam Drives

MAINTENANCE OF RECIPROCATING DRIVES

Lubrication is the key to good operation of all mechanical drives. Any moving part or parts making contact with another part should be well lubricated.

1) Bearings should be kept lubricated and checked for wear or damage periodically.

2) Cam tracks or cam surfaces require greasing for smooth operation and minimum wear.

3) Hinged areas need lubrication.

4) Enclosed drives should have oil level checked periodically.

5) Above all, refer to the machine operator's manual for proper lubrication.

TROUBLE SHOOTING OF RECIPROCATING DRIVES

Trouble usually starts in some place other than the reciprocating drive itself. Safety devices are usually built into the drive in some way to protect it. For this reason, belts are often used to drive reciprocating devices because the belt will slip and protect the drive in case of an obstruction. For the same reason, a wooden pitman stick which will break is often used on a mower.

Dirt contamination can be the cause of faulty operation of cams and crank drives and can lead to excessive wear. For this reason:

- **Clean drives periodically**
- **Keep shields in place**

Drive *alignment* is a must for proper reciprocation. Coordination is also needed between the power source, reciprocating drive, and work element.

This may mean:

1) Adjusting pitman length or length of stroke.

2) Adjusting cam track or follower.

3) Aligning lever and work element.

SAFETY RELEASE MECHANISMS FOR POWER TRAINS

In many modern machines one power source supplies many work functions. Each function has a different power requirement for its own work load.

Although it might take only 15 percent of total power to perform a certain function on a machine, more power is available, so a torque limiting factor or safety release mechanism is placed in the powerline to prevent damage in case an obstruction enters the machine.

Safety release mechanisms perform two functions:

1) Relieve shock on the power source.

2) Protect the machine part doing the work.

Safety mechanisms are of three major types:

- **Slip Clutches**
- **Jump Clutches**
- **Shear Pins**

Let's look at each one.

SLIP CLUTCHES

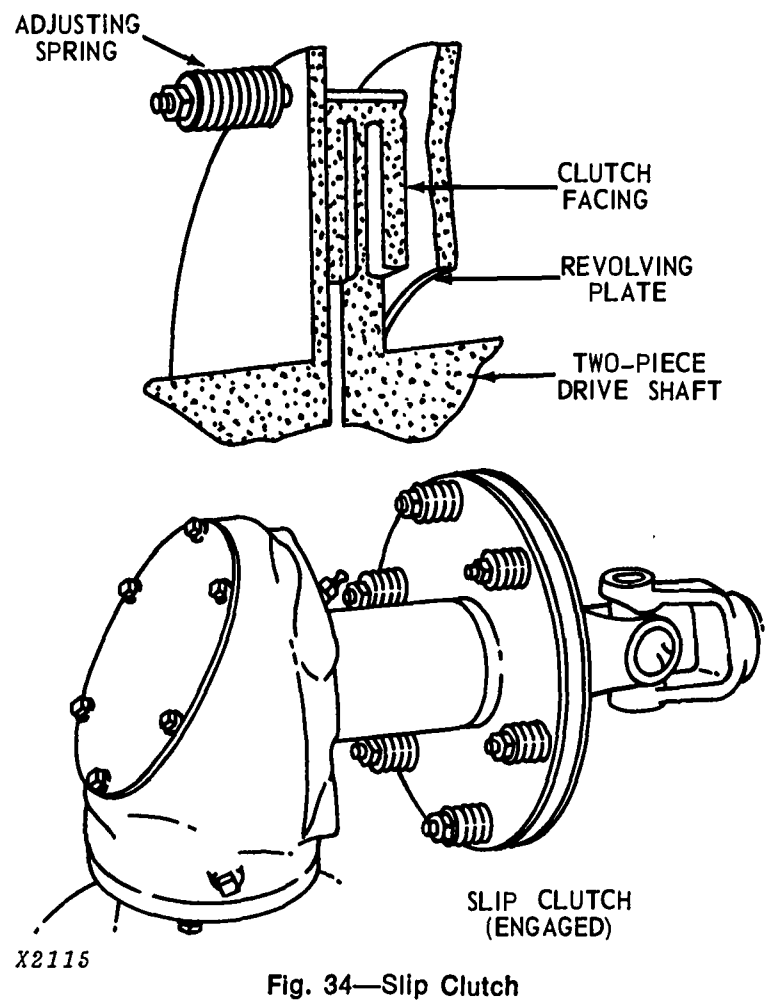

Fig. 34—Slip Clutch

Slip clutches work by friction (Fig. 34). The drive line is separated at the slip clutch, but linked together by means of clutch facings and spring tension.

During an obstruction, the friction force is overcome and the clutch slips, preventing damage to the machine and power line.

Tension can be either adjustable or non-adjustable and is supplied by springs or spring washers.

JUMP CLUTCHES

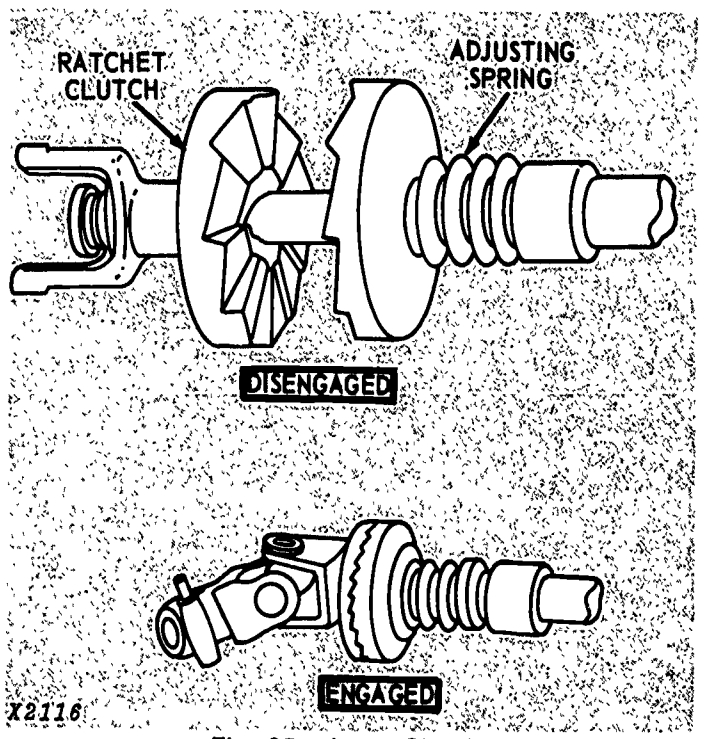

Fig. 35—Jump Clutch

The jump clutch (Fig. 35) does the same job as the slip clutch, although it is not as widely used. The power line connection is joined by a two-piece ratchet. One piece supplies the power, while the other receives and transmits power to the power line. The ratchet is held together by spring tension, which is adjustable.

In case of overload, the spring tension is overcome and the ratchet slips, disengaging the power train to protect it.

SHEAR PINS

Shear pins (Fig. 36) work on the stress principle. A pin or bolt will break if too much force is exerted on it. Size and hardness of pin varies according to the stress needs of the power train.

Again, the power train is actually two pieces, with a shear pin connecting them. In case of overload, the pin shears and disconnects the powerline.

Shear pins are simple and relatively inexpensive, and so are widely used. The major disadvantage

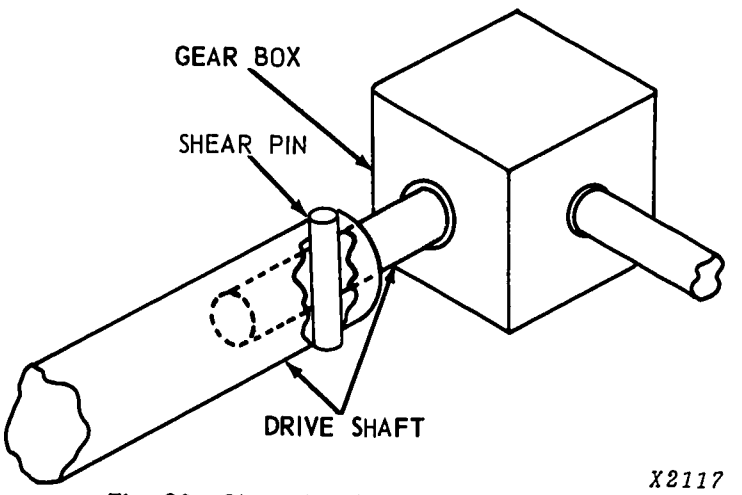

Fig. 36—Shear Pin In Power Driveline

is that each time a pin is sheared the operation is stopped and the pin must be replaced.

MAINTENANCE OF SAFETY MECHANISMS

Lubrication

Lubrication is generally simple in a safety mechanism. Remember these points:

1) A light coating of oil can be used to keep clutch faces from sticking.

2) Too much oil on clutch faces reduces friction and causes slipping.

3) Spring tension for safety mechanisms may require light lubrication.

4) Shafts that are actually separated, but run inside a connecting shaft, should be lubricated to inhibit rust and corrosion that may prevent disengagement of the powerline.

General Maintenance

Specifications for safety *release* mechanism adjustment and setting should be closely followed and can be found in the machine operator's manual.

Many slip clutches and jump clutches are adjusted.

Be sure to replace shear pins with the exact duplicates. Refer to the machine parts catalog. Many times a shear pin is in the form of a bolt, and the bolt strength and size should be closely checked before installation.

TROUBLE SHOOTING OF SAFETY MECHANISMS

Trouble	*Possible Cause*
Slip clutch continually slips	1. Too little spring tension, Belleville washer worn out
	2. Oiled or glazed clutch facings
	3. Improper assembly
	4. Failure of the working element
Slip clutch will not slip	1. Facings have become stuck
	2. Too much spring tension
	3. Improper assembly
Jump clutch continually jumps	1. Too little spring tension
	2. Ratchet worn out
	3. Ratchet surface is slick from lubricant
	4. Dirt build-up not permitting complete contact between ratchet teeth
	5. Working element not functioning
	6. Drive overloaded
Jump clutch will not jump	1. Too much spring tension
	2. Spring bottomed out
	3. Ratchet frozen due to rust or corrosion
	4. Dirt preventing operation of spring release or ratchet
	5. Internal shaft frozen to external shaft
Shear pin continually shears	1. Wrong shear pin or bolt
	2. Working element not functioning
	3. Drive overloaded
Shear pin will not shear	1. Wrong shear pin or bolt
	2. Internal shaft frozen to external shaft

TEST YOURSELF

QUESTIONS

1. What are the three major kinds of special drives?

2. Which one is a friction drive?

3. How do the pulleys change belt speed in a variable speed drive?

4. True or false? "If one belt breaks in a multiple set, you need not replace all the belts."

5. Should the idler be on the tight or slack side of the chain?

6. Reciprocating drives change a _____ motion into a _____ motion.

ANSWERS

1. Belt, chain, gear.

2. Belt.

3. The two halves of the pulley move closer together or farther apart to move the belt in or out.

4. False.

5. On the slack side.

6. First blank—"rotary". Second blank—"linear" or "straight".

DEFINITIONS OF TERMS AND SYMBOLS

A

ABRASION—Wearing or rubbing away of a part.

ALIGNMENT—An adjustment to a line or to bring into a line.

ANTI-CLOCKWISE ROTATION—Rotating the opposite direction of the hands on a clock. The same as counter-clockwise rotation.

ANTI-FRICTION BEARING—A bearing constructed with balls, rollers or the like between the journal and the bearing surface to provide rolling instead of sliding friction.

ASAE—American Society of Agricultural Engineers.

ASME—American Society of Mechanical Engineers.

AXIAL—Parallel to the shaft or bearing bore.

AXLE—The shaft or shafts of a machine upon which the wheels are mounted.

AUTOMATIC TRANSMISSION—A transmission in which gear or ratio changes are self-activated.

B

BACKLASH—The clearance or "play" between two parts, such as meshed gears.

BALL BEARING—An anti-friction bearing consisting of a hardened inner and outer race with hardened steel balls which roll between the two races.

BDC—Bottom dead center.

BEARING—The supporting part which reduces friction between a stationary and rotating part.

BEVEL SPUR GEAR—Gear that has teeth with a straight center-line cut on a cone.

BONDED LINING—A method of cementing brake linings to shoes or bands which eliminates the necessity of rivets.

BRAZE—To join two pieces of metal with the use of a comparatively high melting point material. An example is to join two pieces of steel by using brass or bronze as a solder.

BREAK-IN—The process of wearing-in to a desirable fit between the surfaces of two new or reconditioned parts.

BROACH—To finish the surface of metal by pushing or pulling a multiple-edge cutting tool over or through it.

BURNISH—To smooth or polish by the use of a sliding tool under pressure.

BUSHING—A removable liner for a bearing.

C

CARRIER—An object that bears, cradles, moves, or transports some other object or objects.

CASE-HARDEN—To harden the surface of steel.

CASTELLATE—Formed to resemble a castle battlement, as in a castellated nut.

CENTER OF GRAVITY—The point at which a mass of matter balances. For example, the center of gravity of a wheel is the center of the wheel hub.

CENTRIFUGAL FORCE—A force which tends to move a body away from its center of rotation. Example: whirling a weight attached to a string.

CHAMFER—A bevel or taper at the edge of a hole or a gear tooth.

CHASE—To straighten up or repair damaged threads.

CHILLED IRON—Cast iron on which the surface has been hardened.

CLEARANCE—The space allowed between two parts, such as between a journal and a bearing.

CLUTCH—A device for connecting and disconnecting the engine from the transmission or for a similar purpose in other units.

COEFFICIENT OF FRICTION—A measurement of the amount of friction developed between two surfaces pressed together and moved one on the other.

COMPOUND—A mixture of two or more ingredients.

CONCENTRIC—Two or more circles, having a common center.

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CONSTANT MESH TRANSMISSION—A transmission in which the gears are engaged at all times, but shifts are made by sliding collars which lock together two or more gears.

CONTRACTION—A reduction in mass or dimension; the opposite of expansion.

CORRODE—To eat away gradually as if by gnawing, especially by chemical action, such as rust.

COUNTERBORE—To enlarge a hole to a given depth.

COUNTER-CLOCKWISE ROTATION—Rotating the opposite direction of the hands on a clock.

COUNTERSHAFT—An intermediate shaft which receives motion from a main shaft and transmits it to a working part. Sometimes called a lay shaft.

COUNTERSINK—To cut or form a depression to allow the head of a screw to go below the surface.

COUPLING—A connecting means for transferring movement from one part to another; may be mechanical, hydraulic or electrical.

D

DEAD REAR AXLE—A rear axle that does not turn. An example of this is in a chain drive to the rear wheels.

DEFLECTION—Bending or movement away from normal due to loading.

DENSITY—Compactness; relative mass of matter in a given volume.

DIAGNOSIS—The use of instruments to determine the action or behavior of machine parts in order to locate the cause of failure.

DIAL INDICATOR—A type of micrometer where the readings are indicated on a dial rather than on a thimble as in a micrometer.

DIFFERENTIAL GEAR—The gear system which permits one drive wheel to turn faster than the other.

DIRECT DRIVE—Direct engagement between the engine and driveshaft where the engine crankshaft and the driveshaft turn at the same rpm.

DISTORTION—A warpage or change in form from the original shape.

DOUBLE REDUCTION AXLE—A drive axle construction in which two sets of reduction gears are used for extreme reduction of the gear ratio.

DOWEL PIN—A pin inserted in matching holes in two parts to maintain those parts in fixed relation one to another.

DRIVE LINE—The universal joints, drive shaft and other parts connecting the transmission with the driving axles.

DROP FORGING—A piece of steel shaped between dies while hot.

DUAL REDUCTION AXLE—A drive axle construction with two sets of pinions and gears, either of which can be used.

E

ECCENTRIC—One circle within another circle wherein both circles do not have the same center. An example of this is a cam on a camshaft.

ENDPLAY—The amount of axial or end-to-end movement in a shaft due to clearance in the bearings.

F

FEELER GAUGE—A metal strip or blade finished accurately with regard to thickness used for measuring the clearance between two parts; such gauges ordinarily come in a set of different blades graduated in thickness by increments of 0.001 inch.

FILLET—A rounded filling between two parts joined at an angle.

FIT—The contact between two machined surfaces.

FLANGE—A projecting rim or collar on an object for keeping it in place.

FLUID DRIVE—A pair of vaned rotating elements held in position close to each other without touching. Rotation is imparted to the driven member by the driving member through the resistance of a body of oil. (See Chapter 6 on Torque Converters.)

FOOT POUND (or lbs. ft.)—This is a measure of the amount of energy or work required to lift 1 pound a distance of 1 foot.

FREE-WHEELING CLUTCH—A mechanical device which will engage the driving member to impart motion to a driven member in one direction but not the other. Also known as an "overrunning clutch."

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G

GEAR—A cylinder- or cone-shaped part having teeth on one surface which mate with and engage the teeth of another part which is not concentric with it.

GEAR RATIO—The ratio of the number of teeth on the larger gear to the number of teeth on the smaller gear.

GRIND—To finish or polish a surface by means of an abrasive wheel.

H

HEAT TREATMENT—Heating, followed by fast cooling, to provide a required hardness or metal structure.

HEEL—The outside or larger half of the gear tooth.

HELICAL—Shaped like a coil of wire or a screw thread.

HELICAL GEAR—Gears with the teeth cut at an angle to the axis of the gear.

HERRINGBONE GEAR—A pair of helical gears designed to operate together in which the angle of the pair of gears forms a V.

HUB—The central part of a wheel or gear.

HYDRAULIC PRESSURE—Pressure exerted through the medium of a liquid.

HYPOID GEAR—A gear that is similar in appearance to spiral bevel gear, but the teeth are cut so that the gears match in a position where the shaft centerlines do not meet.

I

ID—Inside Diameter.

IMPELLER—The pump or driving member in a torque converter.

INPUT SHAFT—The shaft carrying the driving gear by which the power is applied, as to the transmission.

INTEGRAL—The whole made up of parts.

J

JOURNAL—A bearing within which a shaft operates.

K

KEY—A small block inserted between the shaft and hub to prevent circumferential movement.

KEYWAY—A groove or slot cut to permit the insertion of a key.

KNURL—To indent or roughen a finished surface.

L

LAPPING—The process of fitting one surface to another by rubbing them together with an abrasive material between the two surfaces.

LINKAGE—Any series of rods, yokes, and levers, etc., used to transmit motion from one unit to another.

LIVE AXLE—The shaft through which the power travels from the drive axle gears to the driving wheels.

LOST MOTION—Motion between a driving part and a driven part which does not cause actuation of the driven part. Also see Backlash.

LOW SPEED—The gearing which causes the greatest number of revolutions of the engine as compared to the driving wheels.

M

MISALIGNMENT—When bearings are not on the same centerline within good functional or working limits.

MULTIPLE DISK—A clutch having a number of driving and driven disks as compared to a single plate clutch.

N

NEEDLE BEARING—An anti-friction bearing using a great number of small-diameter rollers of greater length; also known as a quill-type bearing.

O

OD—Outside diameter.

OSCILLATE—To swing back and forth like a pendulum.

OUTPUT SHAFT—The shaft or gear which delivers the power from a device, such as a transmission.

OVERDRIVE—Any arrangement of gearing which produces more revolutions of the driven shaft than of the driving shaft.

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OVERRUN COUPLING—A free-wheeling device to permit rotation in one direction but not in the other.

P

PEEN—To stretch or clinch over by pounding with the rounded end of a hammer.

PINION—A small gear having the teeth formed in the hub.

PINION CARRIER—The mounting or bracket which retains the bearings supporting a pinion shaft.

PLANETARY GEARS—A system of gearing which is modeled after the solar system. A pinion is surrounded by an internal ring gear and planet gears are in mesh between the ring gear and pinion around which all revolves.

PLANET CARRIER—In a planetary gear system, the carrier or bracket in a planetary system which contains the shafts upon which the pinions or planet gears turn.

PLANET GEARS—The gears in a planetary gear system that rotate around the sun gear.

POWER SHIFT TRANSMISSION—A transmission in which gear changes are selected manually but are power actuated; no master clutch is involved.

PRELOAD—A load within the bearing, either purposely built in, or resulting from adjustment.

PRESS FIT—Mounting with interference, i.e., bore of bearing is smaller than OD of shaft, or OD of bearing is larger than bore of housing, or both.

PUMP—A device which produces motion in a liquid. In a torque converter, the driving member (also see "Impeller").

R

RACE—A channel in the inner or outer ring of an anti-friction bearing in which the balls or rollers roll.

RADIAL—Perpendicular to the shaft or bearing bore.

RADIAL CLEARANCE (Radial displacement)—Clearance within the bearing and between balls and races perpendicular to the shaft.

RADIAL LOAD—A force perpendicular to the axis of rotation.

RATIO—The relation or proportion that one number bears to another.

REACTOR—See "Stator".

REAM—To finish a hole accurately with a rotating fluted tool.

RECIPROCATING—A back-and-forth movement, such as the action of a piston in a cylinder.

RING GEAR—A gear which surrounds or rings the sun and planet gears in a planetary system. Also the name given to the spiral bevel gear in a differential.

RIVET—A headed pin used for uniting two or more pieces by passing the shank through a hole in each piece, and securing it by forming a head on the opposite end.

ROLLER BEARING—An inner and outer race upon which hardened steel rollers operate.

RPM—Revolutions per minute.

S

SAE—Society of Automotive Engineers.

SCORE—A scratch, ridge or groove marring a finished surface.

SEAT—A surface, usually machined, upon which another part rests or seats; for example, the surface upon which a valve face rests.

SEPARATORS—A component in an anti-friction bearing which keeps the rolling components apart.

SHIM—Thin sheets used as spacers between two parts, such as the two halves of a journal bearing.

SHRINK-FIT—Where the shaft or part is slightly larger than the hole in which it is to be inserted. The outer part is heated above its normal operating temperature or the inner part chilled below its normal operating temperature or both and assembled in this condition; upon cooling an exceptionally tight fit is obtained.

SLIDING-FIT—Where sufficient clearance has been allowed between the shaft and journal to allow free-running without overheating.

SLIDING GEAR TRANSMISSION—A transmission in which gears are moved on their shafts to change gear ratios.

SLIP-IN BEARING—A liner made to extremely accurate measurements which can be used for replacement purposes without additional fitting.

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SPIRAL BEVEL GEAR—A ring gear and pinion wherein the mating teeth are curved and placed at an angle with the pinion shaft.

SPIRAL GEAR—A gear with teeth cut according to a mathematical curve on a cone. Spiral bevel gears that are not parallel have center lines that intersect.

SPLINE—Splines are multiple keys in the general form of internal and external gear teeth, used to prevent relative rotation of cylindrically-fitted parts.

SPUR GEAR—Gears cut on a cylinder and the teeth are straight and parallel to the axis.

SQ. FT.—Square feet.

SQ. IN.—Square inch.

STALL CONDITION—A condition in a torque converter when the driving element (pump) is turning and the driven element (turbine) is stopped. Stall produces maximum vortex flow (see Chapter 6 on Torque Converters).

STATOR—In a torque converter, the third member (in addition to turbine and pump) which changes direction fluid under certain operating conditions.

STRESS—The force or strain to which a material is subjected.

SUN GEAR—The central gear in a planetary gear system around which the rest of the gears rotate.

SYNCHROMESH TRANSMISSION—Transmission gearing which aids the meshing of two gears by causing the speed of both gears to coincide at the same time.

SYNCHRONIZE—To cause two events to occur in unison or at the same time. For example, to time a mechanism so that two or more sparks will occur at the same instant.

T

TAP—To cut threads in a hole with a tapered, fluted, threaded tool.

TEMPER—To change the physical characteristics of a metal by applying heat.

TENSION—Effort which elongates or "stretches" a material.

THRUST LOAD—A load which pushes or reacts through the bearing in a directon parallel to the shaft.

TOLERANCE—A permissible variation between the two extremes of a specification or dimension.

TORQUE—A twisting motion, usually measured in ft-lbs.

TORQUE CONVERTER—A turbine device utilizing a rotary pump, one or more reactors (stators) and a driven circular turbine or vane whereby power is transmitted from a driving to a driven member by hydraulic action. It provides varying drive ratios; with a speed reduction, it increases torque.

TORQUE WRENCH—A special wrench with a built-in indicator to measure the applied force.

TORUS SECTION—The confines of a flow circuit in a radial plane in a torque converter or fluid coupler.

TRANSAXLE—Type of construction in which the transmission and differential are combined in one unit.

TRANSMISSION—An assembly of gears, or other elements which gives variations in speed or direction between the input and output shafts.

TROUBLE SHOOTING—A process of diagnosing the source of the trouble or troubles through observation and testing.

TUNE-UP—A process of accurate and careful adjustments to obtain the best performance.

TURBINE—A rotary device for obtaining mechanical power from a pressurized flow of gases or liquids.

TURBULENCE—A disturbed or irregular motion of fluids or gases.

V

VANES—Any plate, blade or the like attached to an axis and moved by air or a liquid.

VORTEX—A whirling movement or mass of liquid or air.

W

WORM GEAR—A gear with teeth that resemble a thread on a bolt. It is meshed with a gear that has teeth similar to a helical tooth except that it is dished to allow more contact.

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ABSTRACT - This guide was developed by Deere and Company for shop trainees or experienced mechanics for use in understanding and servicing hydraulic systems. The chapters, arranged in a step-by-step manner, cover first the basics, followed by nine chapters detailing the working parts of hydraulic circuits, and closing with two chapters on general maintenance and repair. Chapters are: (1) Hydraulics: How It Works, (2) Hydraulic Pumps, (3) Hydraulic Valves, (4) Hydraulic Cylinders, (5) Hydraulic Motors, (6) Hydraulic Accumulators, (7) Hydraulic Filters, (8) Reservoirs, Oil Coolers, Hoses, Pipes, Tubes, and Couplers, (9) Hydraulic Seals, (10) Hydraulic Fluids, (11) General Maintenance, and (12) Diagnosis and Testing of Hydraulic Systems. The line drawings and photographs illustrating the text are available as a comprehensive color slide set from the source of availability indicated for this document. Definitions of terms and symbols are included as well as a subject index. Related documents are available as VT 010 754, VT 010 756, and VT 010 757 (all in this issue). (SB)

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Hydraulics

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TO THE READER

PURPOSE OF THIS MANUAL

The main purpose of this manual is to train the reader so that he can understand and service hydraulic systems with speed and skill. Starting with "how it works," we build up to "why it fails" and "what to do about it." This manual is also an excellent reference for the trained mechanic who wants to refresh his memory on hydraulics. It has been written in a simple form using many illustrations so that it can be easily understood.

WHY IS HYDRAULICS USED SO MUCH TODAY?

When there are so many ways to do work using mechanics, pneumatics, or electricity, why is hydraulics as a prime mover so popular on modern machines?

The main reason is *flexibility*. Few sources of power are as flexible as a confined liquid; yet it can still convey a force like that of solid steel. Another reason is that very small forces can be used to control very large ones, as in power braking. Other reasons for the popularity of hydraulics are simplicity, compactness, economy, and safety.

APPLICATION OF HYDRAULICS IN THIS MANUAL

"Hydraulics" is a broad field. It covers any study of fluids in motion or at rest. But in this manual, the prime interest is in *oil* hydraulics as it is commonly used to produce work on the farm and in industry.

HOW TO USE THIS MANUAL

This manual can be used by anyone—experienced mechanics and shop trainees, as well as vocational students and interested laymen.

By starting with the basics, build your knowledge step by step. Chapter 1 covers the basics—"how it works;" Chapters 2 through 10 go into detail about the working parts of hydraulic circuits. Chapters 11 and 12 return to the complete circuit in terms of general maintenance and "why it fails" and how to remedy these failures.

Persons not familiar with basic hydraulics should start at Chapter 1 and study the chapters in sequence. The experienced man can find what he needs on the "Contents" page.

OTHER MANUALS IN THIS SERIES

We, at John Deere, are preparing a series of these manuals called "Fundamentals of Service," or "FOS."

Other manuals in the FOS series are:

- **Electrical Systems**
- **Engines**
- **Power Transmitting Systems**
- **General Information**

We hope to expand this library in the future to fulfill the needs of our dealer's servicemen, as well as vocational students and interested laymen.

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HOW TO READ THE OIL FLOW DIAGRAMS

HIGH-PRESSURE OIL

MEDIUM-PRESSURE OIL

LOW-PRESSURE OIL

PRESSURE-FREE OIL

TRAPPED OIL

DIRECTION OF OIL FLOW

DIRECTION OF OIL PRESSURE AGAINST A MECHANICAL OBJECT

DIRECTION OF MECHANICAL MOVEMENT

ROTATION

LEVEL OF STANDING OIL

"CUTOFF" ON SHAFTS OR LINES

LOAD OR WEIGHT

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HYDRAULICS–How it works / CHAPTER 1

BASIC PRINCIPLES OF HYDRAULICS

The basic principles of hydraulics are few and simple:

- **Liquids have no shape of their own.**
- **Liquids will not compress.**
- **Liquids transmit applied pressure in all directions.**
- **Liquids provide great increases in work force.**

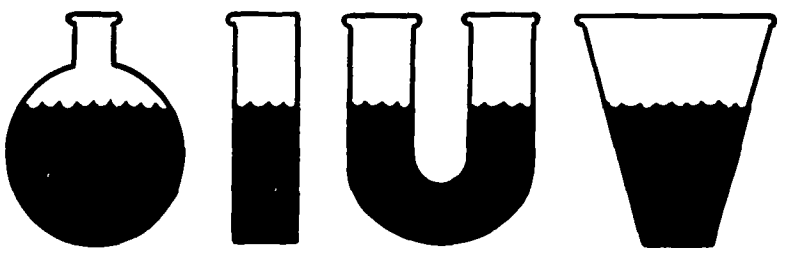

Fig. 1–Liquids Have No Shape of Their Own.

LIQUIDS HAVE NO SHAPE OF THEIR OWN. They acquire the shape of any container (Fig. 1). Because of this, oil in a hydraulic system will flow in any direction and into a passage of any size or shape.

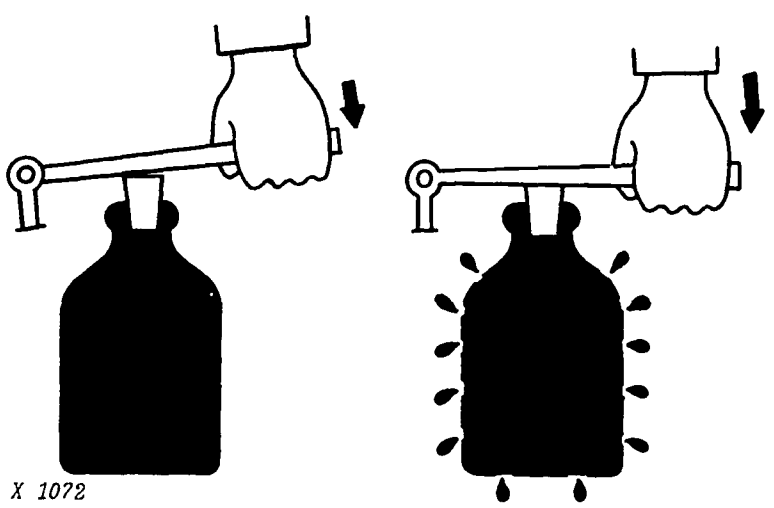

Fig. 2–Liquids Will Not Compress

LIQUIDS WILL NOT COMPRESS. This is shown in Fig. 2. Fill a glass jar with a liquid. Then tightly cork it. Now push down on the cork and try to compress the liquid. It won't work–the jar is shattered.

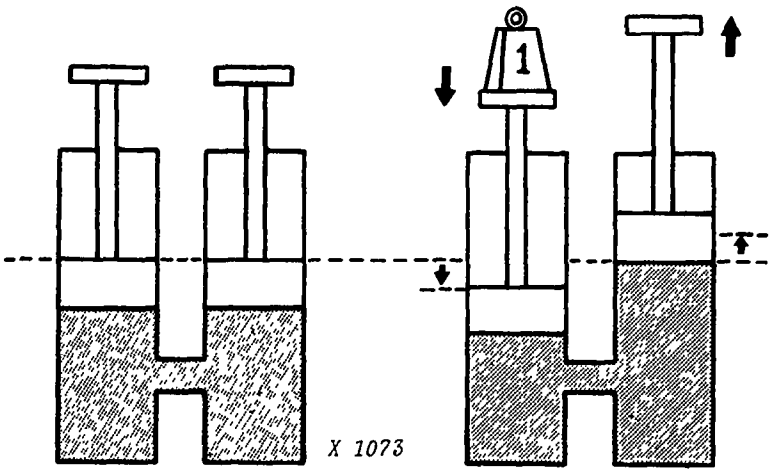

Fig. 3–Liquids Transmit Applied Pressure in All Directions

LIQUIDS TRANSMIT APPLIED PRESSURE IN ALL DIRECTIONS. The experiment in Fig. 2 shattered the glass jar and also showed how liquids transmit pressure–in all directions when they are compressed. This is very important in a hydraulic system. In Fig. 3, take two cylinders of the same size (one square inch) and connect them by a tube. Fill the cylinders with oil to the level shown. Place in each cylinder a piston which rests on the columns of oil. Now press down on one cylinder with a force of one pound. This pressure is created throughout the system, and an equal force of one pound is applied to the other piston, raising it as shown.

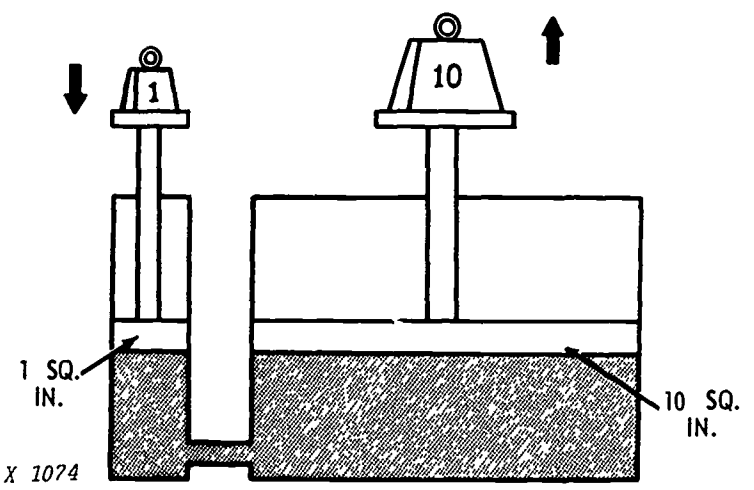

Fig. 4–Liquids Provide Great Increases in Work Force

LIQUIDS PROVIDE GREAT INCREASES IN WORK FORCE. Now let's take two more cylinders of different sizes and connect them as shown in Fig. 4. The first cylinder has an area of one square inch, but the second has an area of ten square inches. Again use a force of one pound on the piston in the smaller cylinder. Once again the pressure is

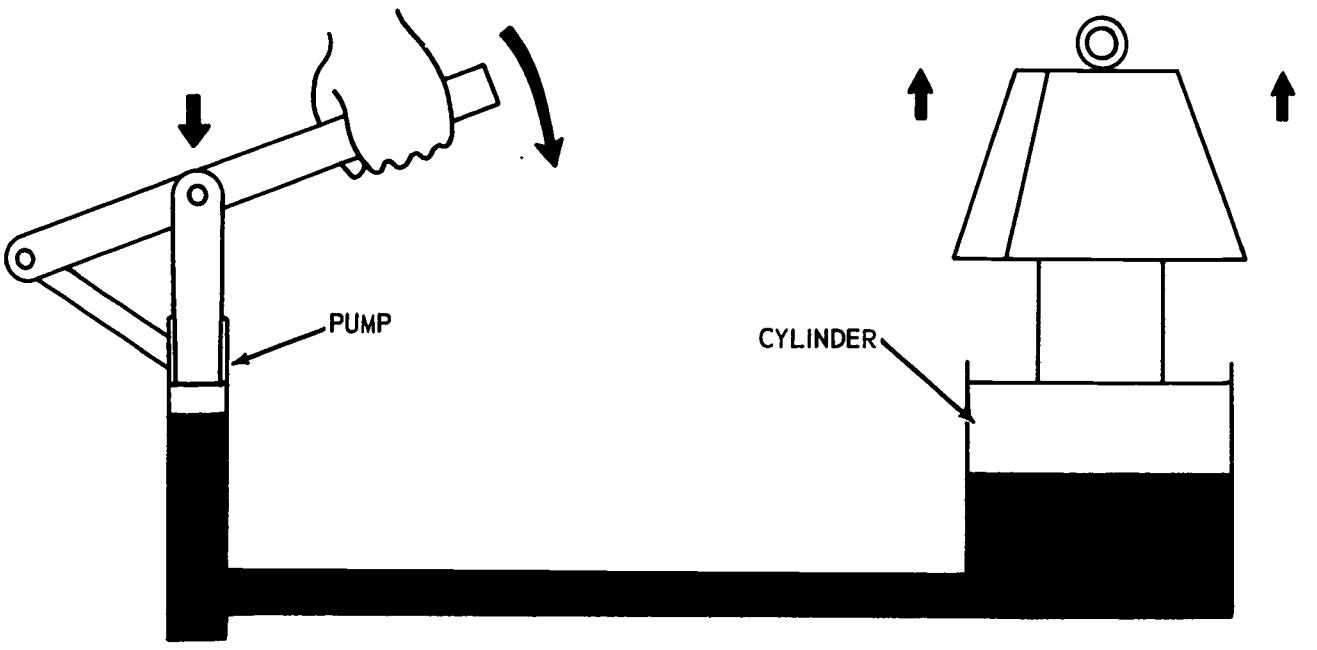

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Fig. 5—A Basic Hydraulic System

created throughout the system. So a pressure of one pound per square inch is exerted on the larger cylinder. Since that cylinder has a piston area of ten square inches, the total pressure exerted on it is *ten* pounds. In other words, we have a great increase in work force.

This principle helps you to stop a large machine by pressing a brake pedal.

HOW A HYDRAULIC SYSTEM WORKS

Let's build up a hydraulic system, piece by piece.

The basic hydraulic system has two parts:

1. The PUMP which moves the oil.

2. The CYLINDER which uses the moving oil to do work.

In Fig. 5, when you apply force to the lever, the hand *pump* forces oil into the *cylinder*. The pressure of this oil pushes up on the piston and lifts the weight.

But for continued operation of the system, we must add some new features (Fig. 6).

3. A RESERVOIR to store the oil. If you keep on stroking the pump to raise the weight, a supply of extra oil is needed. The reservoir has an air vent which allows gravity to push the oil down to the pump inlet.

4. CHECK VALVES to hold the oil in the reservoir and the cylinder between strokes. The ball-type valves open when oil is flowing but close when the flow stops. In this way the valves trap and hold the oil, supporting the raised cylinder.

Notice that the pump is smaller than the cylinder. This means that each stroke of the pump will only move enough oil to lift the piston a small amount. If you want to lift the weight very fast, then you either have to work the pump faster or get a larger pump.

To really work, the hydraulic system must cycle the oil and control its movement. Let's complete the circuit and add some new features as shown in Fig. 7.

5. The RELIEF VALVE limits high pressures. If the pressure of the oil which lifts the load gets too high, this valve pops open and relieves the pressure by dumping oil back to the reservoir. (Notice that we have replaced the hand pump with a gear pump, which works constantly. For this reason, the check valves have been removed. We have also added a return line to the reservoir to complete our circuit.)

6. The CONTROL VALVE directs the oil. Oil from the pump flows to the control valve where it can be directed back to the reservoir or to either end of the cylinder.

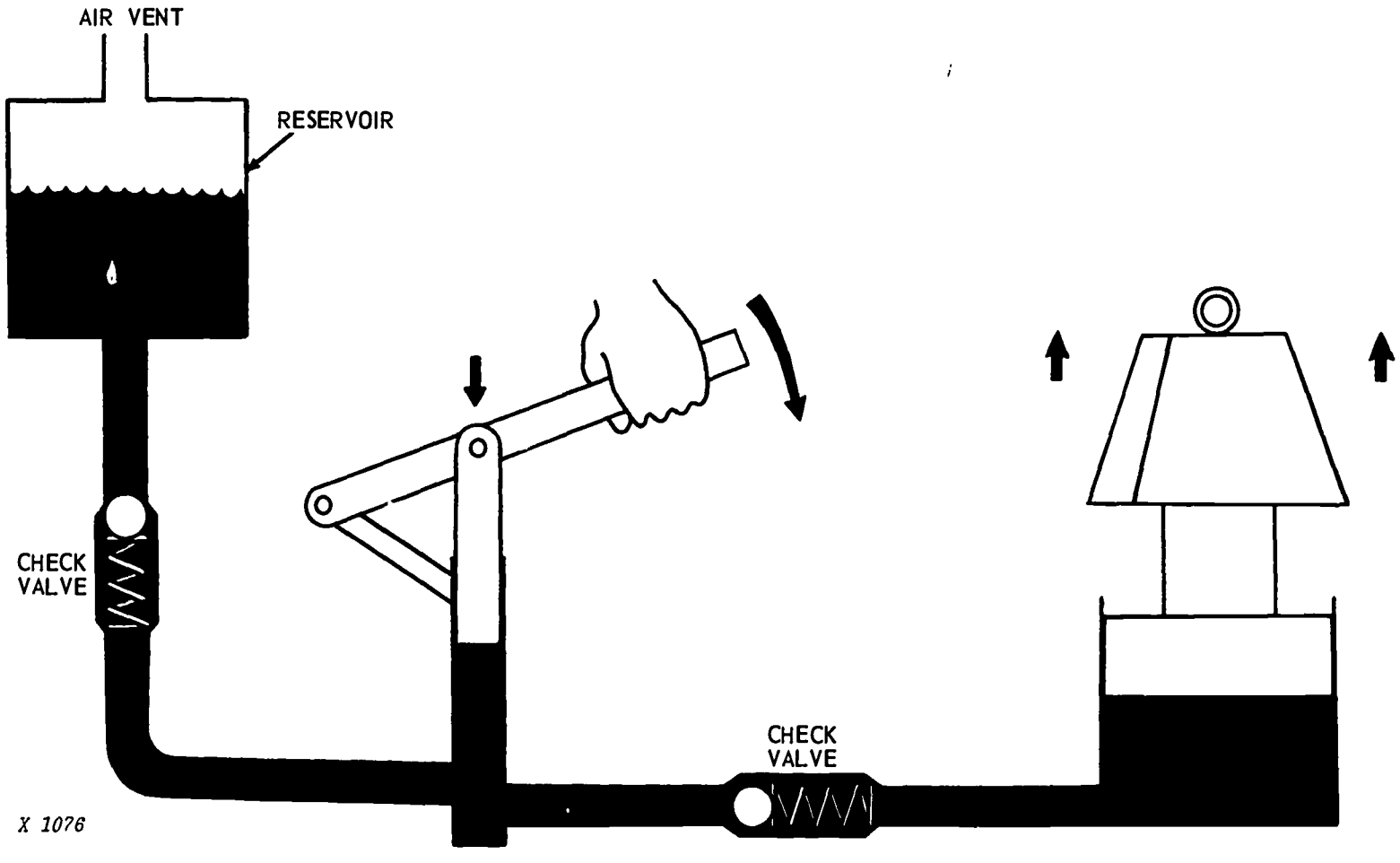

Fig. 6—Hydraulic System with Reservoir and Check Valves Added

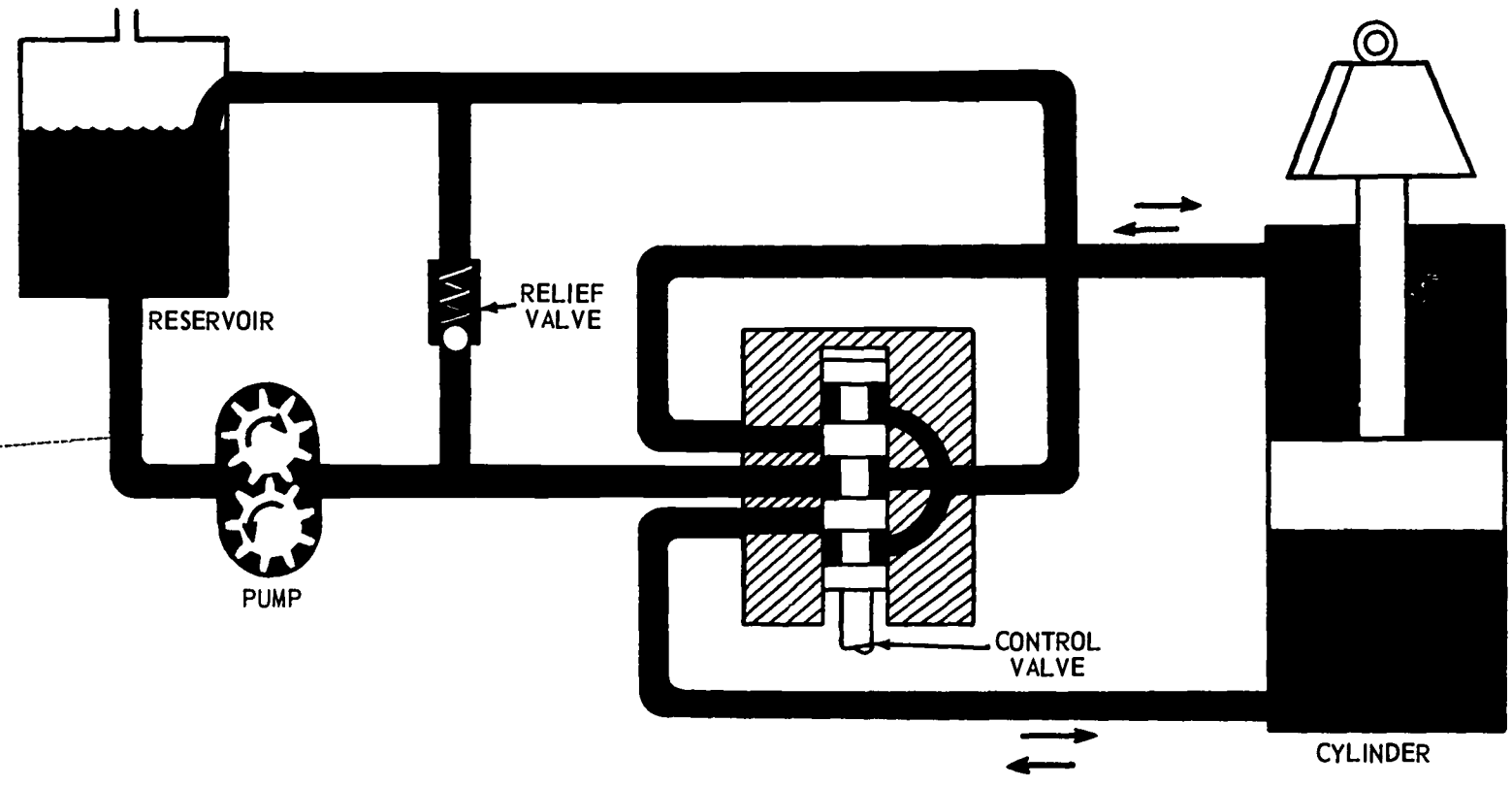

Fig. 7—Hydraulic System with Relief Valve, Four-Way Control Valve, and Double-Acting Cylinder Added

When the control valve is in the position shown, the oil is sent back to the reservoir. This is called the *neutral* position.

When the control valve is moved up, oil is sent to the top of the cylinder, pushing down on the piston and lowering the weight. Oil from the bottom of the cylinder returns through the valve to the reservoir. (Actually the weight will help lower itself by "pushing down" on the piston. Notice that the cylinder is a double-acting one which can both lift and lower the weight.)

When the control valve is moved down, oil is directed to the bottom of the cylinder, raising the piston and the weight. Oil from the top of the cylinder is returned to the reservoir.

This completes our very basic hydraulic system. As we describe more complex circuits, we will add other parts. But all hydraulic systems can be broken down into simplified diagrams as shown in Fig. 7, adding units as necessary. For example, a working hydraulic system might use two pumps, four control valves, and four cylinders, all using one common reservoir.

To summarize:

- **The pump = generating force**
- **The cylinder = working force**
- **The valve = oil control**
- **The reservoir = oil storage**

For more details on how these parts operate, refer to Chapter 2—Pumps, Chapter 3—Valves, Chapter 4—Cylinders, and Chapter 8—Reservoirs.

THE PROS AND CONS OF HYDRAULICS

ADVANTAGES

Why is hydraulics used today for so many big mechanical jobs? Here are a few of the reasons:

1. FLEXIBILITY. No other source of power is as flexible as a confined liquid; yet it can still convey a force like that of solid steel.

2. MULTIPLICATION OF FORCE. In a hydraulic system, very small forces can be used to control very large forces. An example is power steering or power brakes on a modern tractor.

3. SIMPLICITY. A hydraulic system has fewer moving parts, fewer points of wear. And it lubricates itself.

4. COMPACTNESS. Compare the size of a small hydraulic motor with an electric motor of equal horsepower.

5. ECONOMY. This is the natural result of the simplicity and compactness of hydraulic systems. Also, power and friction losses are comparatively small.

6. SAFETY. There are fewer moving parts such as gears, chains, belts, and electrical contacts, than in other systems. Overloads cannot cause extensive damage.

DISADVANTAGES

No mechanical device is perfect, and hydraulic systems have some drawbacks:

1. HIGH PRESSURES. Two or three thousand psi is not uncommon. The special lines and seals are adequate, but they do require good maintenance.

2. NEED FOR CLEANLINESS. Hydraulic systems can be damaged by rust, corrosion, dirt, heat, and breakdown of fluids. Cleanliness and use of the proper fluids are all-important.

COMPARING HYDRAULIC SYSTEMS

Two major types of hydraulic systems are used today:

- **Open-Center Systems**
- **Closed-Center Systems**

THE SYSTEMS IN NEUTRAL

In the OPEN-CENTER SYSTEM, the pump runs constantly, even in neutral (Fig. 8). There is a continuous flow of oil from the reservoir to the pump, to the control valve, and back to the reservoir. In neutral, oil flows *through* the control valve and back to the reservoir—the "open center" feature.

In the CLOSED-CENTER SYSTEM, the pump "takes a break" during neutral (Fig. 9). The control valve *stops* (deadends) the flow of oil from the pump—the "closed center" feature. This causes the pump to stop pumping oil (shut off by a pressure regulating valve). However, if pressure of the oil drops below full system pressure during neutral, the pump starts pumping again long enough to build up the pressure.

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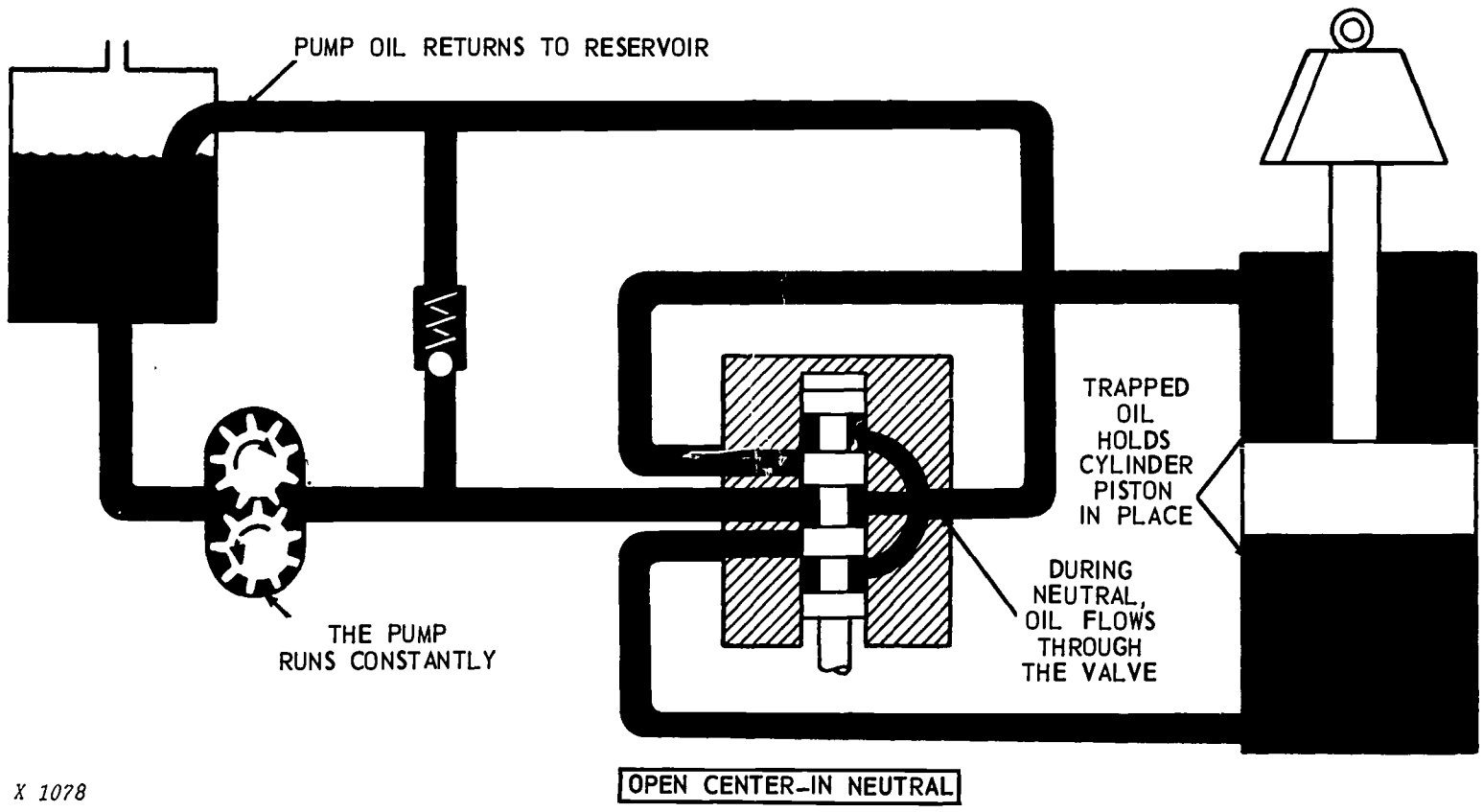

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Fig. 8—Open-Center System in Neutral

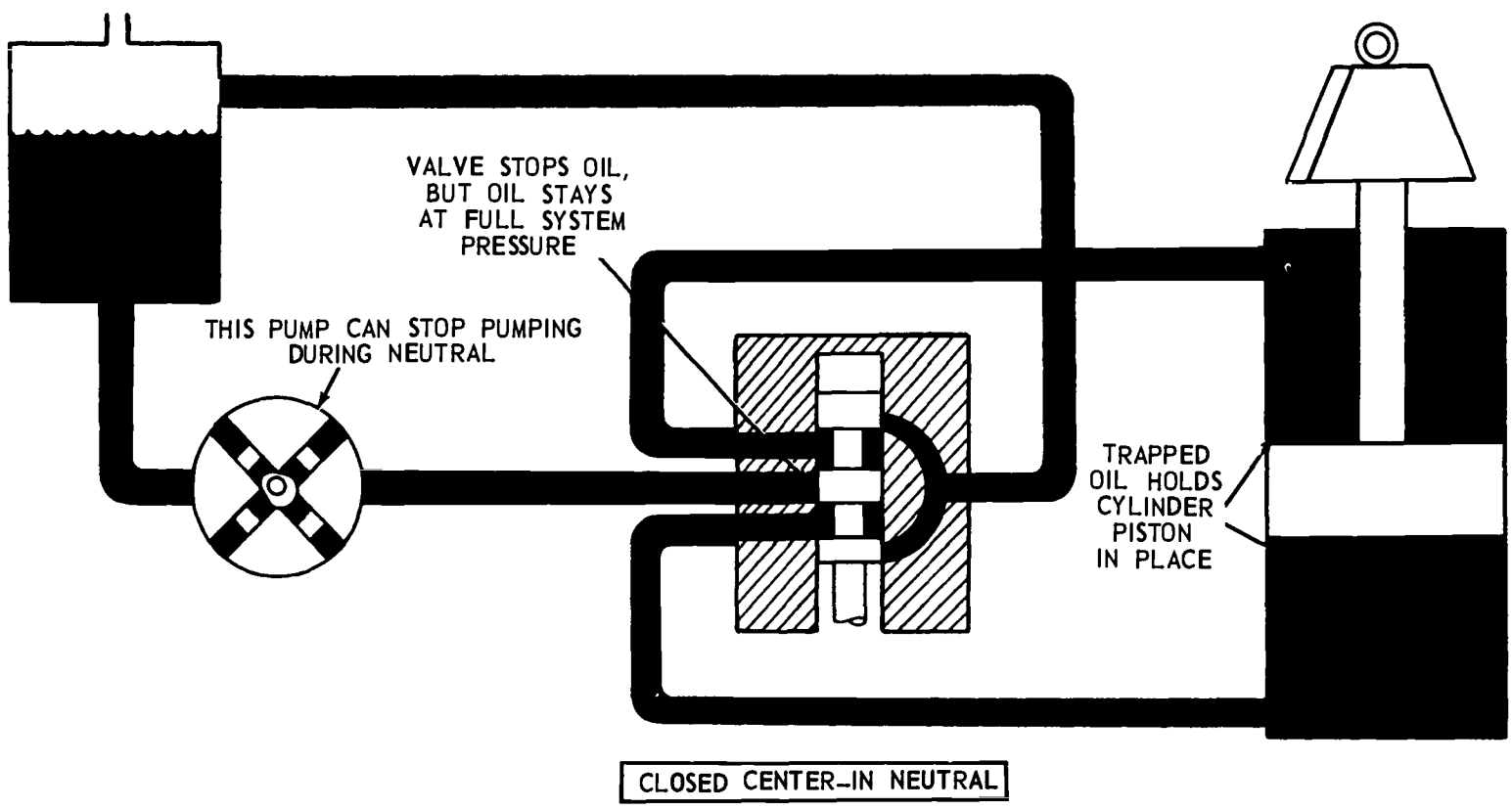

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Fig. 9—Closed-Center System in Neutral

THE SYSTEMS IN OPERATION

Open-Center System (Fig. 10)

When the control valve is operated as shown, oil is diverted to the cylinder to raise the load. However, the pump must build up pressure—a very slight delay.

Closed-Center System (Fig. 11)

When the control valve is operated as shown, oil is diverted to the cylinder to raise the load. This oil rushes in under pressure with little delay. At the same time the pump goes back to work, pumping more oil and keeping up the pressure to complete the cycle, then it shuts off again.

(The pump shown in Figs. 9 and 11 is a radial piston type—see Chapter 2 for details. The four pistons shown go in and out of stroke in response to pressure needs in the system. A pressure regulating valve (not shown) is commonly used to start and stop the pump. A small charging pump (not shown) normally feeds oil to the piston pump. Fig. 11 shows oil returning to reservoir. In some systems, this oil is routed back to the system at the pump end.)

ADVANTAGES OF CLOSED-CENTER SYSTEM

We have just illustrated two advantages of the closed-center system:

1) The pump only works when there is a need for oil.

2) The oil is kept under full pressure for a quick response.

The first advantage means that you save engine horsepower while using hydraulic equipment on a tractor.

For example, let's say you are loading: You "rev up" the engine and head for the pile. The loader digs in and you start to lift the bucket. This function draws on the hydraulic system. So the pump pushes oil, delivering the power you need. This, in turn, uses engine horsepower . . . you can hear the engine "lug down."

But the breakout force needed for a big bucketful may exceed the capacity of the loader hydraulics. What happens then?

With an open-center system, the system relief valves open, and the pump keeps on working. But pumping more oil won't add any more power.

With a closed-center system, the pump goes out of stroke. The oil in the working circuit is trapped under pressure, so you're getting full hydraulic force. But the pump isn't pumping and you save horsepower.

With an open-center system, the engine will continue to "lug down," wasting power. This is because the oil is *not* trapped but is forced through the relief valves. The pump has to work all the time just to keep up full hydraulic force.

The second advantage of the closed-center system is that it saves time. Having oil ready at full pressure means no delay when you use the loader bucket control lever, for example. The instant you operate the lever, pressurized oil is there, ready to do work.

With an open-center system, the oil must first be trapped before you can build pressure to do work. If you are using the hydraulic system for several jobs at once—loading, steering, braking—there may be extra delays as oil pressure builds up in series, down the line.

With closed-center hydraulics, the whole system is tuned to constant pressure.

ADVANTAGES OF OPEN CENTER SYSTEMS

For simpler circuits, however, the open center system has certain advantages. Some of these are:

1) Lower pressures except when working, which reduces shock loading and wear. This also reduces energy loss from leakage, especially in neutral.

2) Simplicity (especially in smaller circuits).

3) Less maintenance. (Lower pressures and greater simplicity mean less upkeep.)

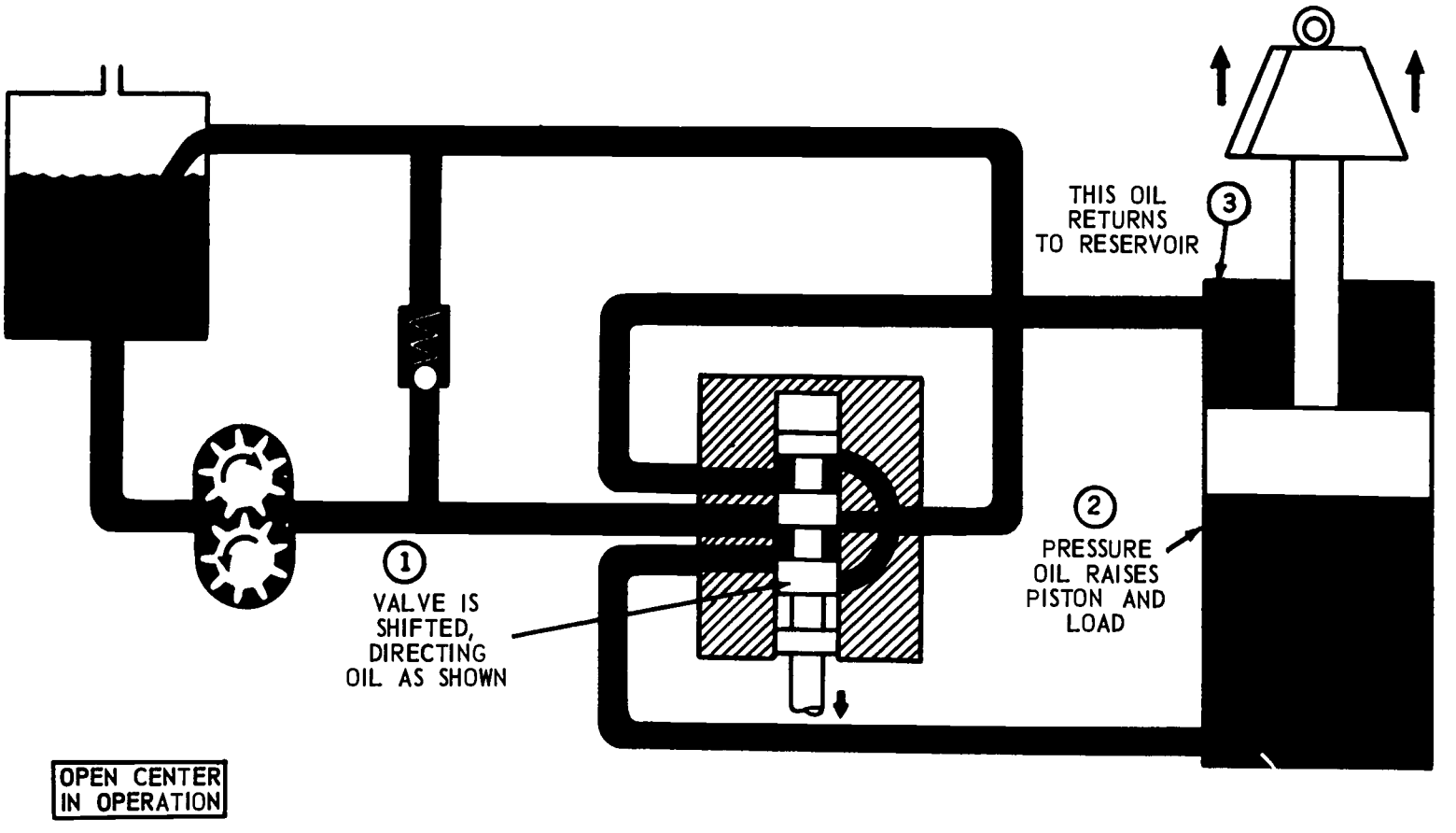

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Fig. 10—Open-Center System in Operation—Raising a Load

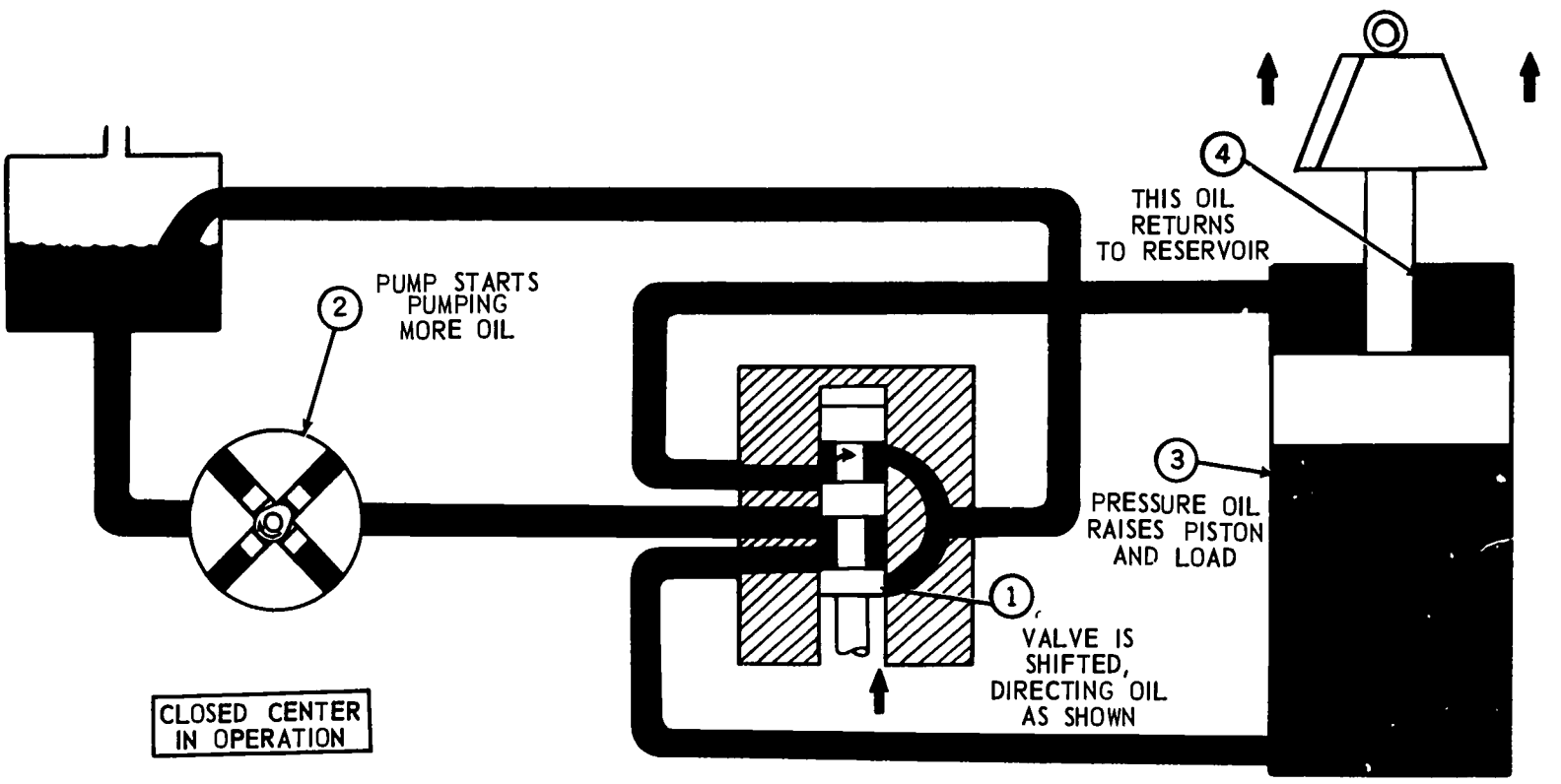

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Fig. 11—Closed-Center System in Operation—Raising a Load

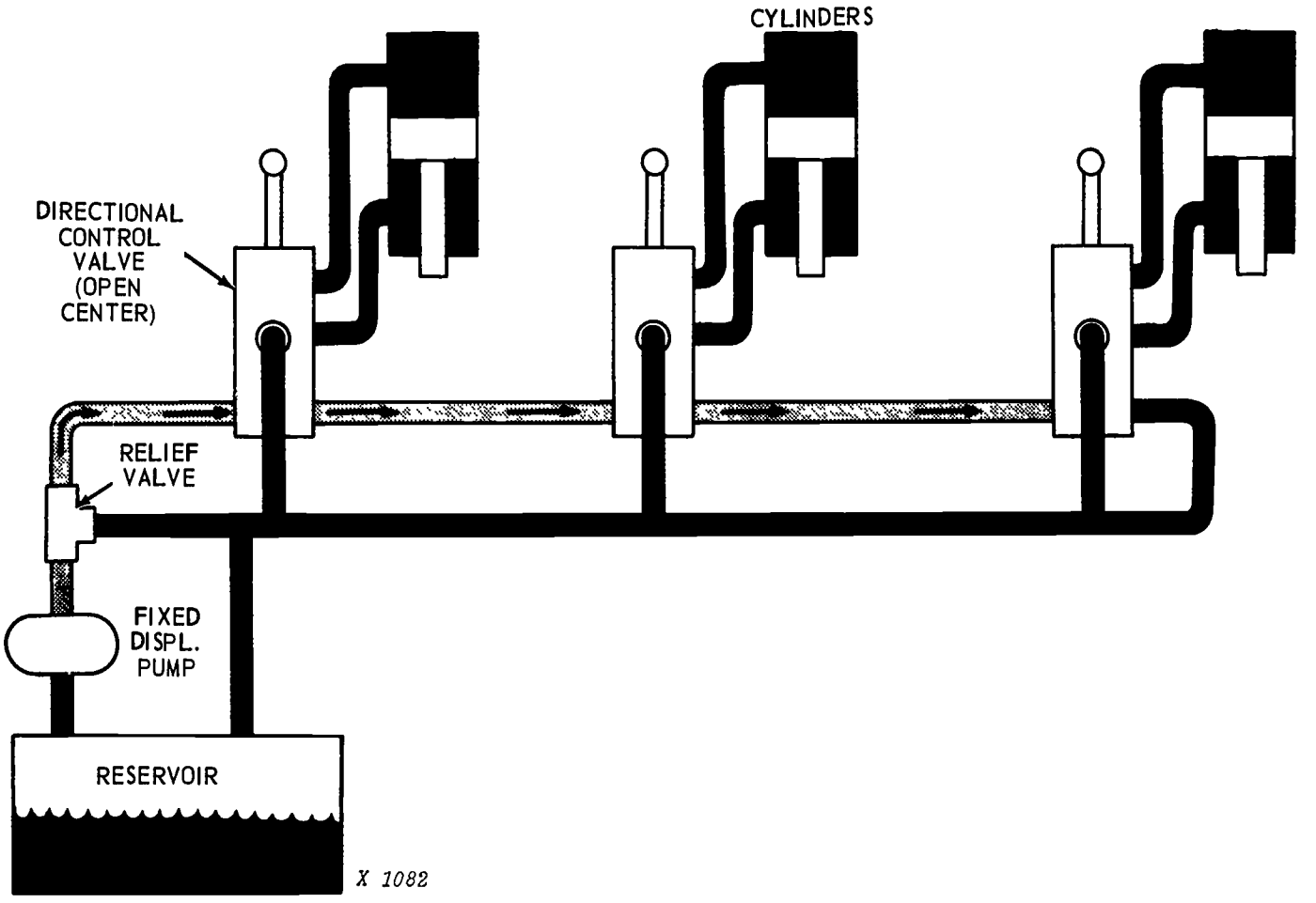

Fig. 12–Open-Center System with Series Connection

VARIATIONS ON OPEN- AND CLOSED-CENTER SYSTEMS

Open- and closed-center systems are often used to operate several functions at once.

This can be done in several ways:

OPEN-CENTER SYSTEMS

- *Open-Center with Series Connection*
- *Open-Center with Series Parallel Connection*
- *Open-Center with Flow Divider*

CLOSED-CENTER SYSTEMS

- *Closed-Center with Fixed Displacement Pump and Accumulator*
- *Closed-Center with Variable Displacement Pump*

Let's discuss these systems one by one.

OPEN-CENTER SYSTEMS

Open-Center System with Series Connection

Fig. 12 shows a series connection of the open-center system. Oil from the pump is routed to the three control valves in series. The return from the first valve is routed to the inlet of the second, etc. In neutral, the oil passes through the valves in series and returns to the reservoir as shown by the arrows. When a control valve is operated, incoming oil is diverted to the cylinder which that valve serves.

Open-Center System with Series Parallel Connection

This system, shown in Fig. 13, is a variation on the series connected type. Oil from the pump is routed through the control valves in series–but also in parallel. The valves are usually "stacked" to allow for the extra passages.

In neutral, the oil passes through the valves in series as shown by the dotted red line. But when any valve is operated, the return is closed and oil is available to *all* valves through the parallel connection. The valve which was operated uses the pressure oil, as shown by the solid red arrows. If another valve is then operated, this valve will not get oil until the first valve is satisfied. In other words, return oil from the first valve becomes pressure oil for the second valve.

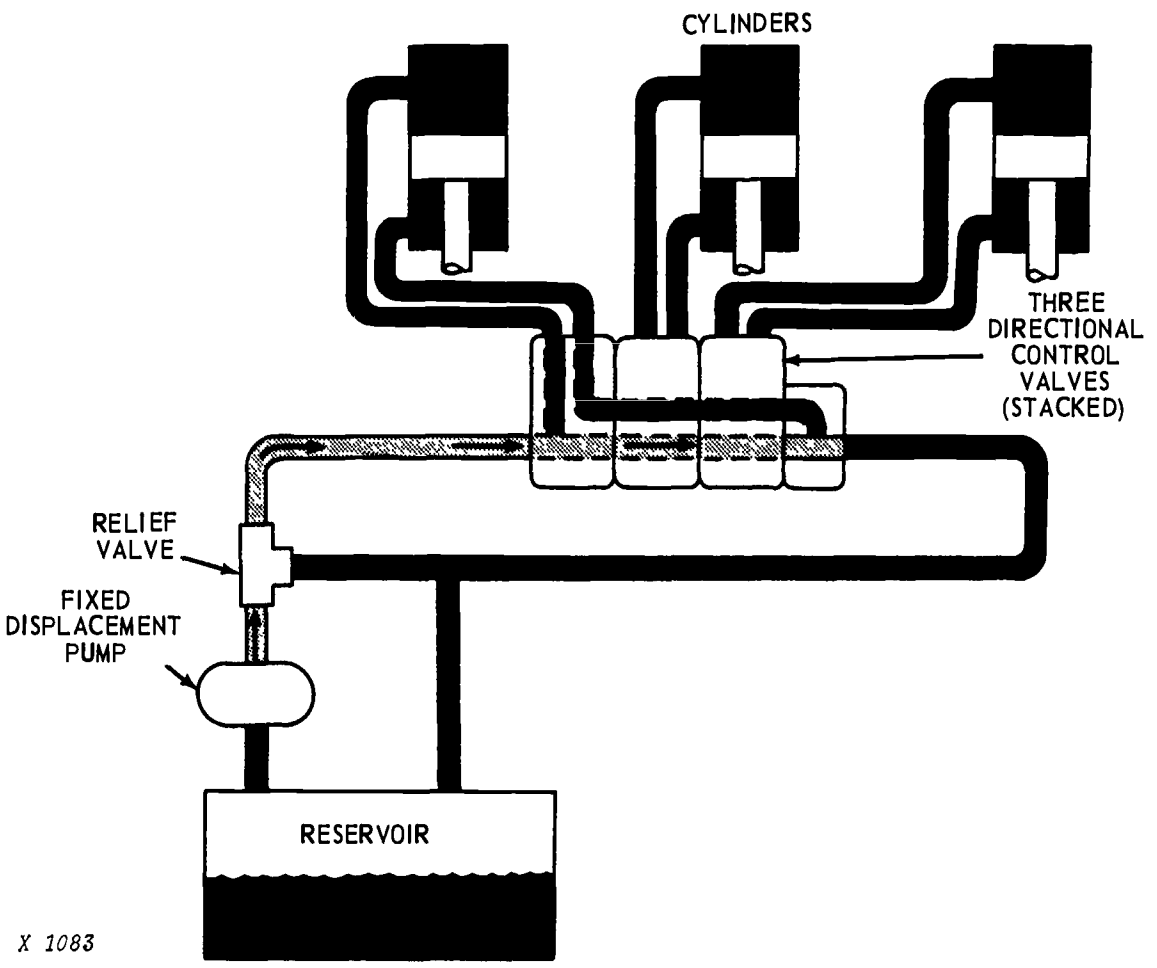

Fig. 13—Open-Center System with Series Parallel Connection

When two or more valves are operated at once, the cylinder which needs least pressure will operate first, then the next least, etc. However, this ability to satisfy two or more functions at once is an advantage over the *series* connection in Fig. 12.

Open-Center System with Flow Divider

Fig. 14 shows a flow divider used with an open-center system. The flow divider takes the volume of oil from the pump and divides it between the two functions. For example, the flow divider might be set to open the left side first in case both control valves were actuated at the same time. Or it might feed oil to both sides—either equally or by percentage. With this system, the pump must be large enough to operate all the functions at once. And the pump must supply all this oil at the maximum pressure of the highest function. This means that running the pump wastes a lot of horsepower.

We can see now that while the open-center system is efficient on single functions, it has a limited value for use with many functions.

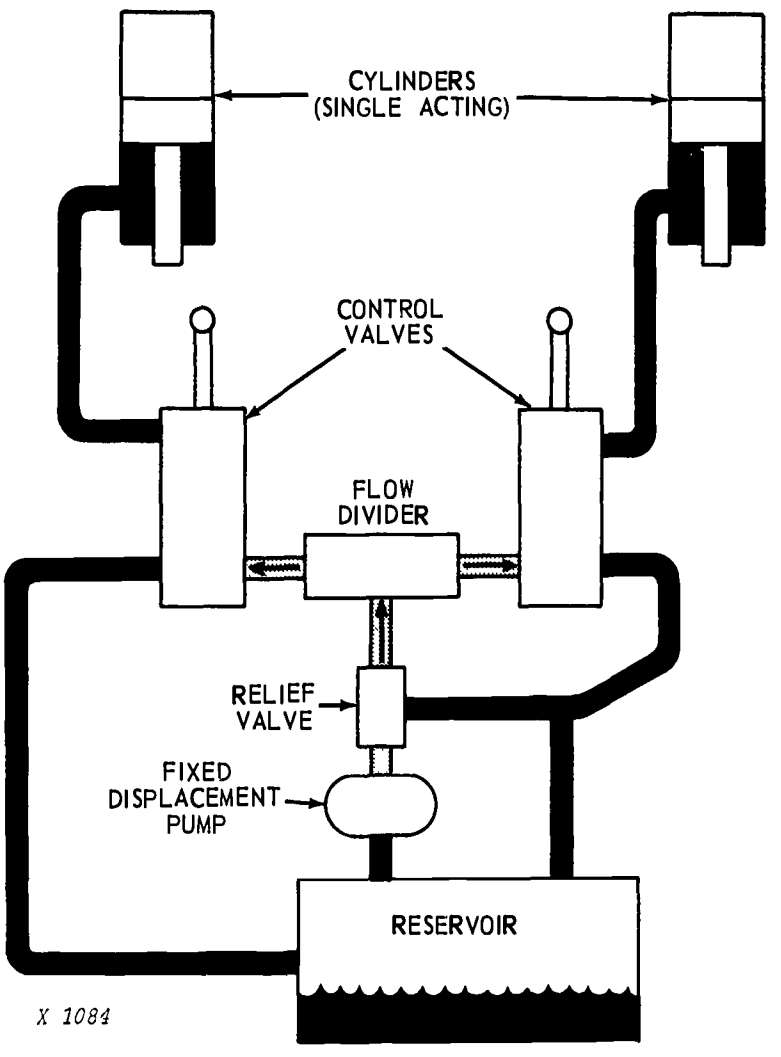

Fig. 14—Open-Center System with Flow Divider

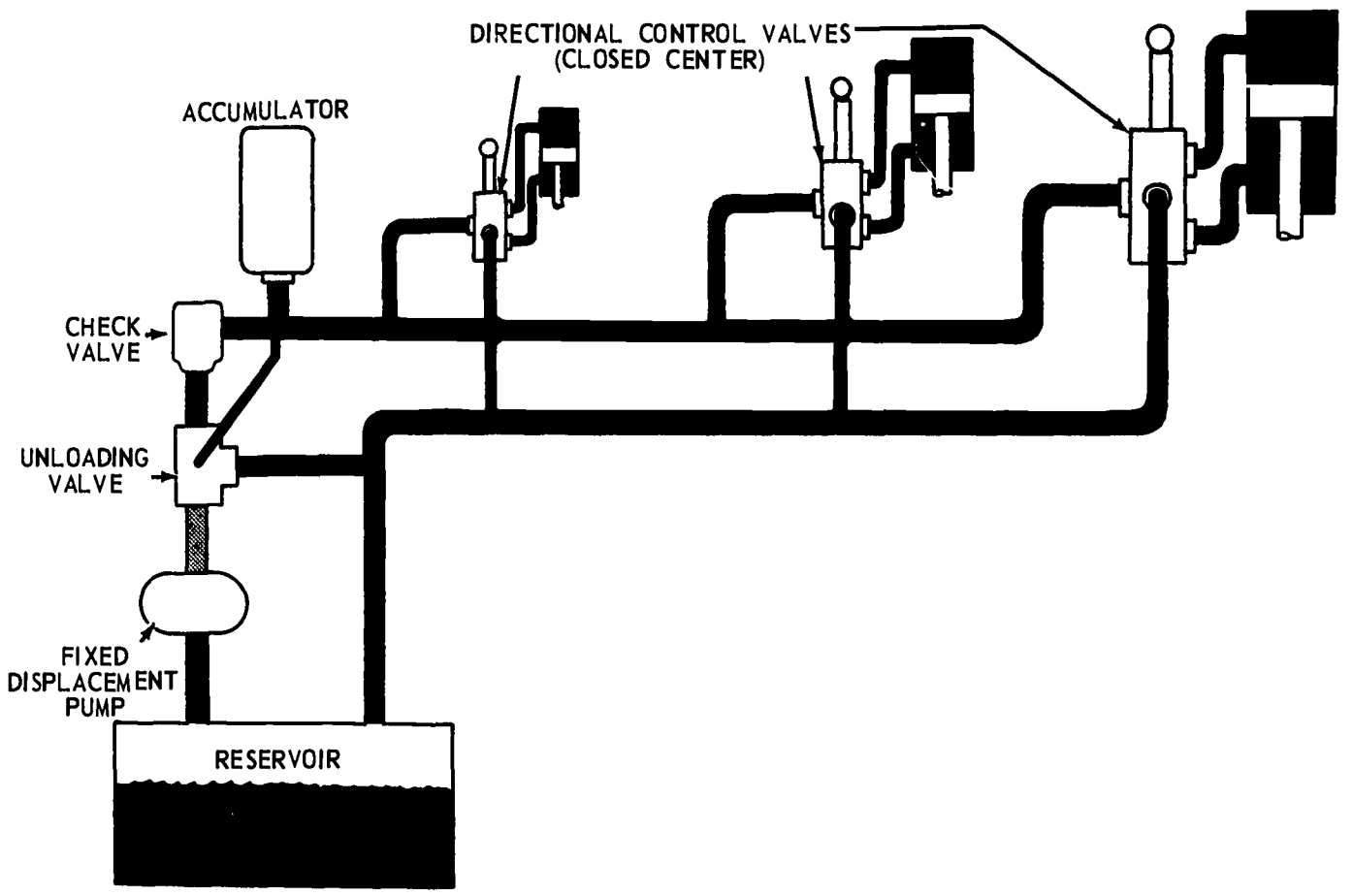

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Fig. 15–Closed-Center System with Fixed Displacement Pump and Accumulator

CLOSED-CENTER SYSTEMS

Closed-Center System with Fixed Displacement Pump and Accumulator

This system is shown in Fig. 15. A pump of small but constant volume charges an accumulator. When the accumulator is charged to full pressure, the unloading valve diverts the pump flow back to the reservoir. The check valve traps pressure oil in the working circuit.

When a control valve is operated, the accumulator discharges its oil and actuates the cylinder. As pressure begins to drop, pump flow is again directed by the unloading valve to the accumulator to recharge it.

This system, using a small capacity pump, is effective when operating oil is needed only for a short time. However, when the functions need a lot of oil for longer periods, the accumulator system cannot handle it unless the accumulator is very large.

Closed-Center System with Variable Displacement Pump

This system is shown in Fig. 16. We have already shown this system in Fig. 9, but now we have added extra cylinders to serve extra functions. The operation remains the same: a large pump supplies oil "on demand" then idles between cycles. Standby pressure is kept in all circuits, ready for quick response when any or all control valves are operated. No flow dividers are needed; there is no waiting for oil left over from another function; and no pause for pressure to build up.

Other advantages of this system: 1) By using a larger pump, reserve force is available for plugging in extra hydraulics, such as a motor; 2) Size of lines, valves, and cylinders can be tailored for each function, since pressures and volumes are limited to that needed for each function; 3) Less heat is generated (a waste of energy) because the pump rests between cycles instead of forcing oil through relief valves; 4) Engine horsepower is saved by having the pump shut off or slow down to match the actual need for oil at each moment.

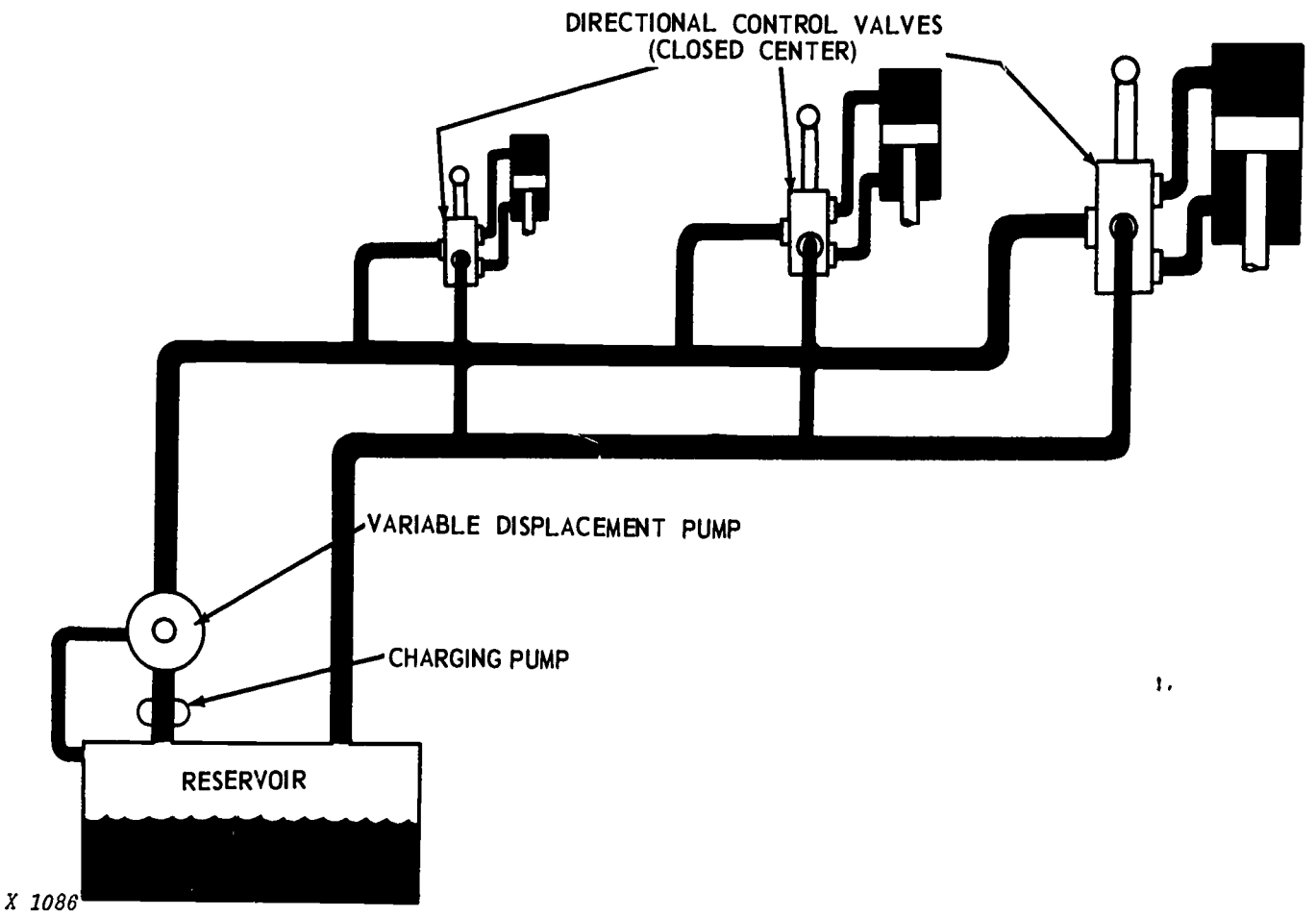

Fig. 16—Closed-Center System with Variable Displacement Pump

SUMMARY: WHY CLOSED-CENTER SYSTEMS ARE GAINING FAVOR

Until recently, open-center systems were used for most hydraulics on the farm and in industry.

But lately, hydraulic systems have become more complex. On a modern tractor, for example, several functions such as power steering, power brakes, remote cylinders, and power lift are often used. To handle all these with one hydraulic circuit, the closed-center system works best. It gives a quick response at any point in the circuit, and the pump shuts off to save engine power when you are not using any hydraulics.

On a modern tractor, up to forty percent of engine power may be needed to operate all the hydraulic functions at once. This points up the importance of saving that power until the times when it is needed for hydraulic work.

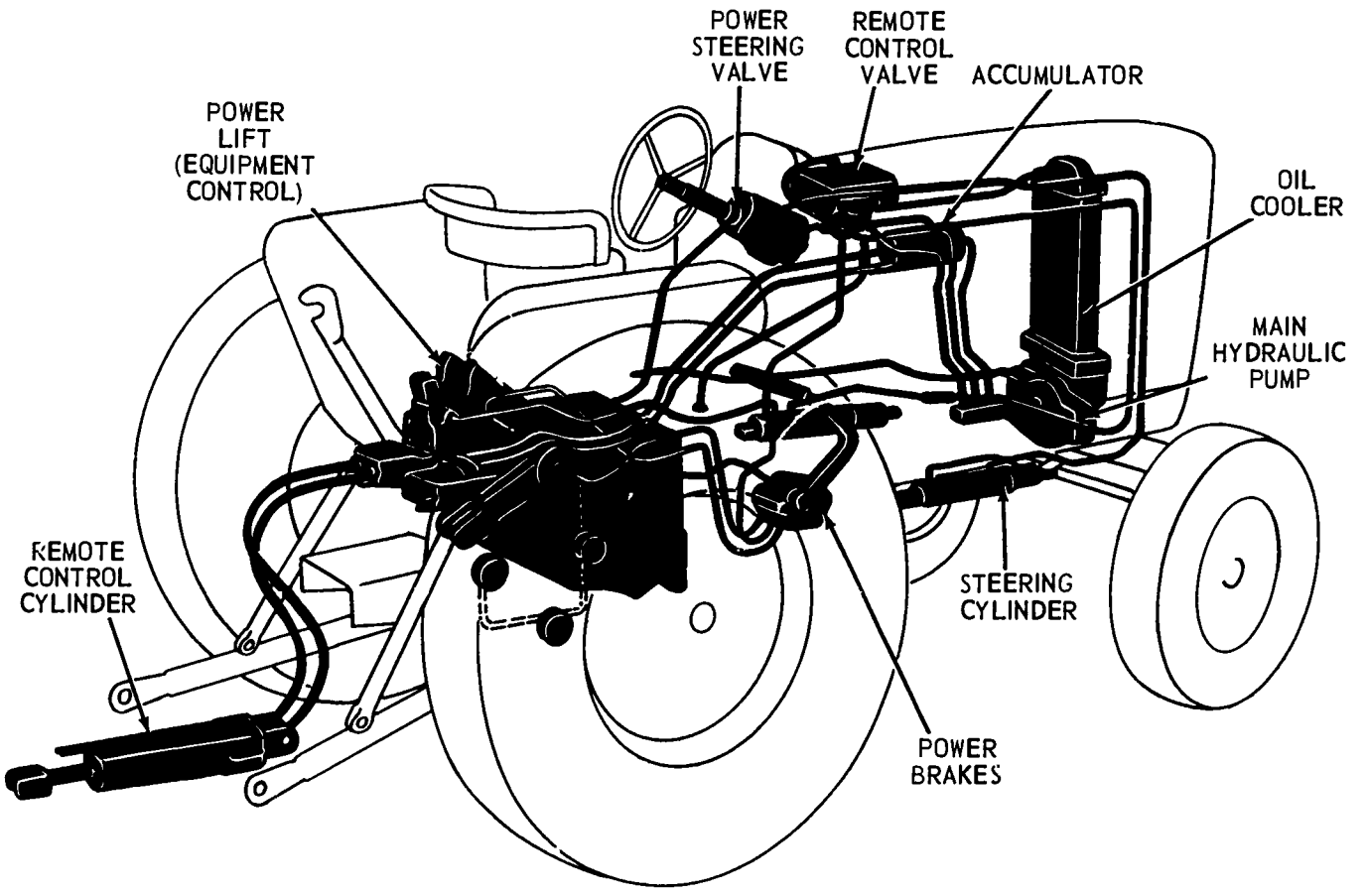

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Fig. 17—A Modern Tractor With Full Hydraulics (Closed-Center System Shown)

THE USES OF HYDRAULICS

Hydraulic power can be adapted to thousands of uses. A few of the major uses on the farm and in industry will be covered here.

Hydraulics can be used at several points on a single machine. The tractor in Fig. 17 uses hydraulics to steer, brake, control mounted equipment, and supply remote operation of tools. A single hydraulic system serves to power all these functions.

Let's briefly discuss the major uses of hydraulics.

HYDRAULIC STEERING SYSTEMS

Three major types of steering are used for today's machines:

1. MANUAL STEERING. The steering wheel is linked directly to the turning wheels and the operator does all the work of steering.

2. HYDRAULIC ASSIST STEERING. The steering wheel is linked to the turning wheels but a hydraulic booster is added to help in steering.

3. FULL HYDRAULIC (POWER) STEERING. The steering wheel has no mechanical link with the turning wheels. Instead, when the operator turns the steering wheel, he actuates hydraulic valving which sends fluid power to an actuator and turns the wheels.

Let's discuss the two major types of hydraulic steering.

Hydraulic Assist Steering

Fig. 18 illustrates hydraulic assist steering on a tractor with an open-center hydraulic system. Operation is shown during a right turn.

For a right turn, the operator turns the steering wheel to the right. This does two things: 1) rotates a worm gear and linkage which mechanically helps turn the front wheels to the right, and 2) shifts a spool valve on the steering wheel shaft which sends oil to a cylinder at the front wheels. This cylinder rotates a rack and pinion device and gives a hydraulic assist in turning the wheels.

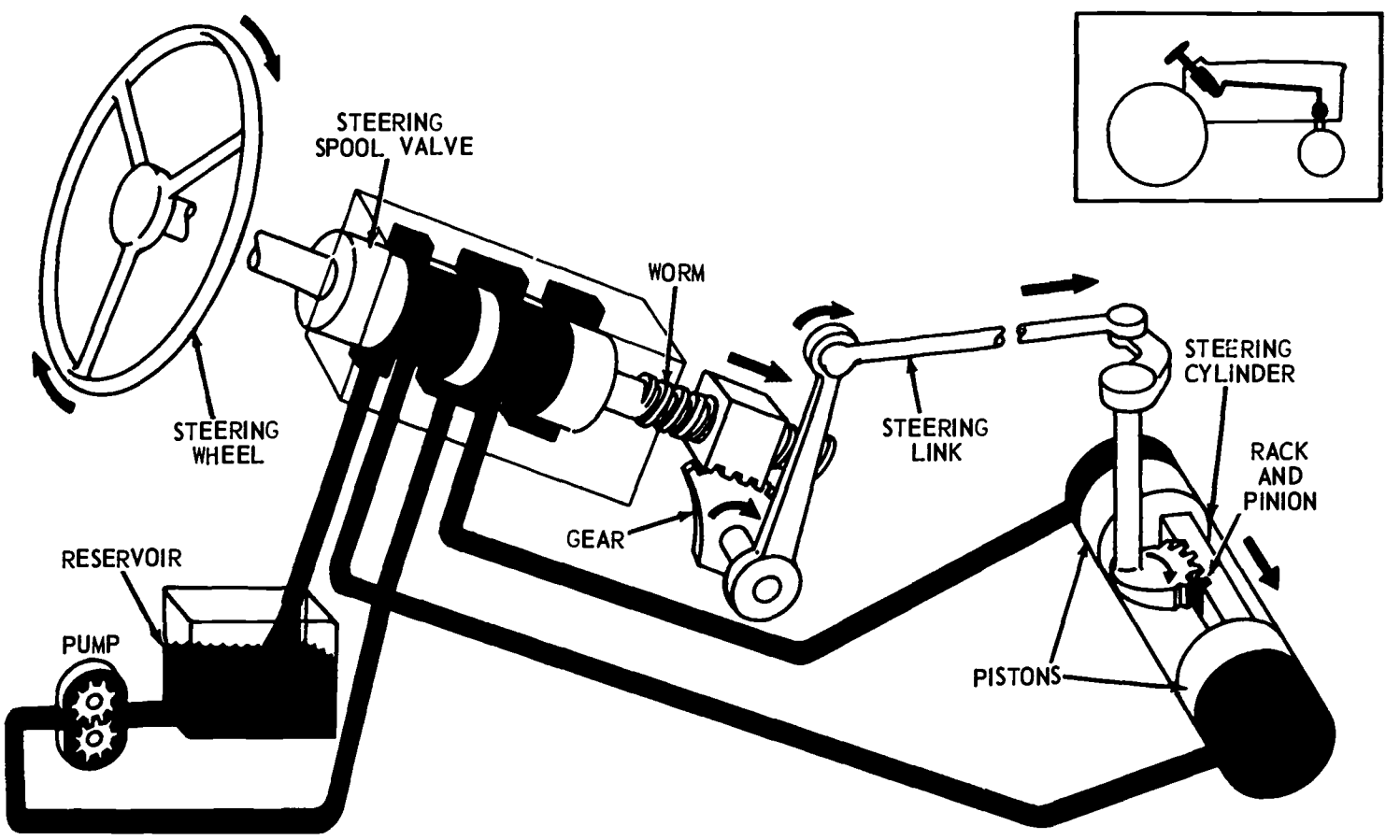

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Fig. 18—Hydraulic Assist Steering During A Right Turn

Oil from the other side of the steering cylinder is returned through the spool valve to the reservoir as shown.

Incoming oil is provided by the hydraulic pump. (In the open-center system shown, the pump sends oil constantly; when not steering, the oil flows through the spool valve and returns to the reservoir.)

The spool valve is shifted by a thrust which develops between the worm gear and linkage mechanism when the steering wheel is turned. (During a left turn, the spool valve moves forward instead of to the rear and thus directs oil to the opposite side of the steering cylinder.)

On some machines, the steering actuator may not be located at the turning wheels; instead it may be located with the steering valve. In this case, the mechanical link to the wheels is actuated both manually and by the hydraulic assist.

HYDRAULIC ASSIST STEERING FOR SELF-PROPELLED MACHINES

Self-propelled machines such as combines and cotton pickers can be steered in much the same way as wheel tractors. A steering wheel and valve is used, as are actuating cylinders on the turning wheels—which are the rear wheels in this case.

HYDRAULIC ASSIST STEERING FOR CRAWLER TRACTORS

Crawler tractors are usually steered by two hand levers in place of a steering wheel.

Hydraulic booster cylinders may be mounted on each lever to aid in steering.

To turn, the operator pulls back on one lever. This causes a valve in the acting cylinder to close, trapping oil behind the cylinder piston. The resulting pressure build-up causes a flow divider to slide over, sending pressure oil to the cylinder, helping to actuate the steering mechanism on that side.

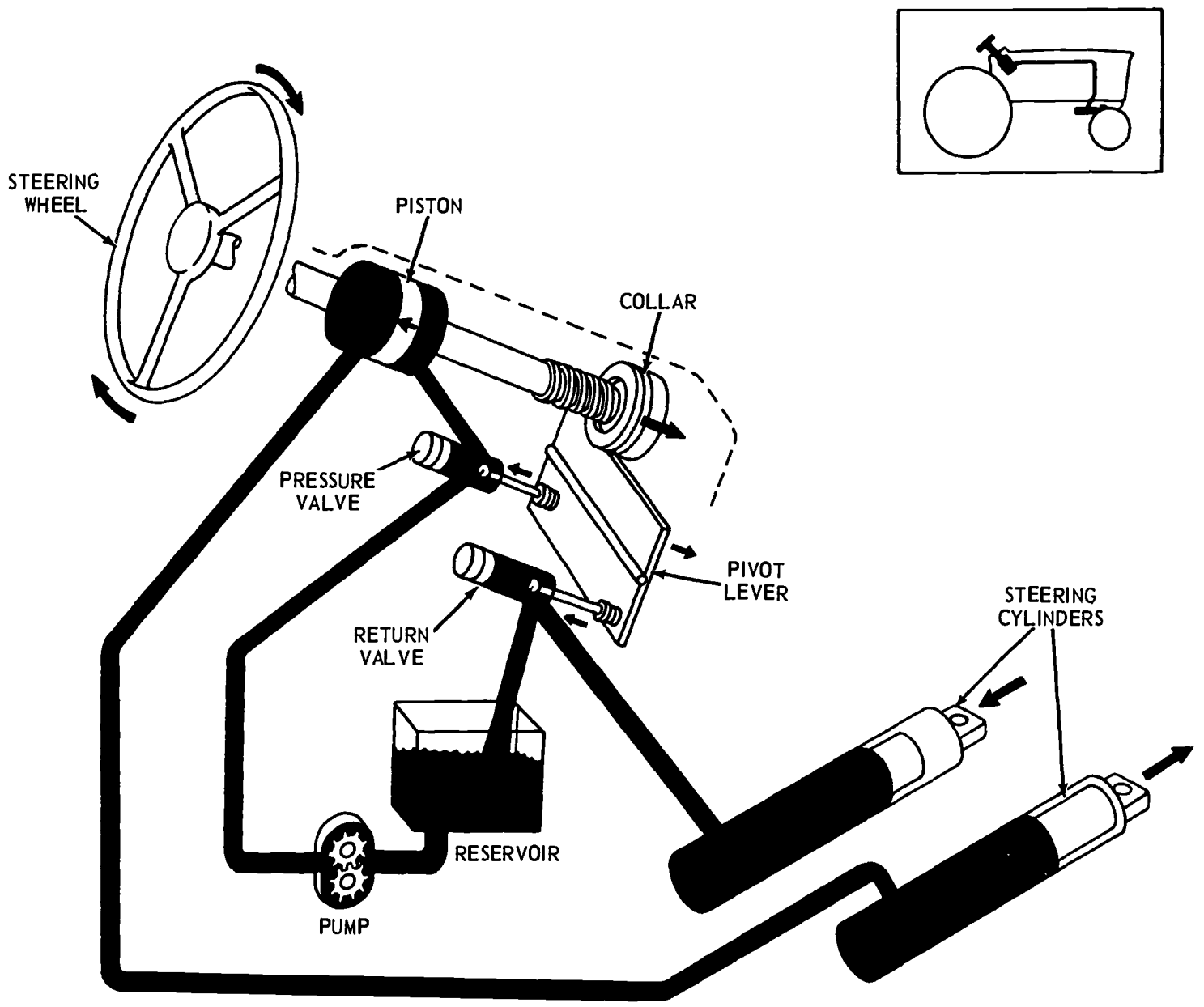

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Fig. 19—Full Hydraulic (Power) Steering During a Right Turn

Full Hydraulic (Power) Steering

"Power" steering means that hydraulic force completely controls the steering of the machine. There is no mechanical linkage between the steering wheel and the turning wheels.

Fig. 19 shows a full power steering system for a modern tractor with a closed-center hydraulic system. Operation is shown during a right turn. When the operator turns the steering wheel to the right, the steering shaft is screwed down, causing the collar to pivot the lever as shown, opening the two valves.

When the valves open, pressure oil enters the steering valve cylinder, forcing the piston upward. This pushes oil out of the valve cylinder and into the right-hand steering cylinder, turning the front wheels to the right.

As the wheels turn, oil is forced out of the left-hand steering cylinder and returns through the open return valve to the reservoir.

When the operator stops turning the steering wheel, the steering shaft is again centered by thrust from the piston. This returns the pivot collar and lever and allows the valves to close. Oil is trapped in the steering cylinders, holding the front wheels solid until another turn is made by the operator.

During a left turn, the operation of the cylinders is reversed. (For simplicity, valves used during a left turn are not shown.)

In some designs, the levers and valves are replaced by a valve disk in the steering valve cylinder itself which flexes to open and close oil passages during each turn.

PROTECTION AGAINST FAILURE OF POWER STEERING

With full power steering, a safeguard is needed in case the pressure oil supply fails. Otherwise the machine could not be steered, since there is no mechanical link between the steering wheel and the front wheels.

A check valve is used to protect most power steering systems. If the oil supply fails and no incoming oil pushes the check valve open, it closes and traps all oil within the steering circuit.

This allows the operator to steer manually by using the trapped oil as a force to actuate the steering. Pressure is created as the operator turns the steering wheel.

HYDRAULIC AND POWER BRAKE SYSTEMS

Three major types of brakes are used to turn or stop farm and industrial machines:

1. MANUAL BRAKES. When the operator applies the brakes, a mechanical link causes dry brake disks, or shoes to slow the rolling wheels by friction.

2. HYDRAULIC BRAKES. When the operator applies the brakes, he pushes a column of trapped oil which clamps the brake disk or shoes to slow the rolling wheels.

3. POWER BRAKES. When the brakes are applied, fluid power takes over and slows the wheels.

On some machines, two types of brakes may be used. For example, the power brakes for stopping may be backed up by a manual brake for parking. Both brakes may actuate the same braking mechanism.

On most tractors, brakes are located on each rear wheel. For turning, the operator presses down the pedal for the left or right wheel. For stopping, he presses down on both pedals at once.

On four-wheel drive machines, a single brake mechanism at the transmission usually controls the whole unit.

Let's discuss the operation of hydraulic and power brakes in more detail.

Hydraulic Brakes

Fig. 20 shows hydraulic brakes on a typical tractor. Operation is shown during a left turn.

For a sharp left turn, the operator presses down the left brake pedal. This rotates the pedal arm against the brake piston as shown and moves it to the rear. The piston closes the inlet check valve from the reservoir, trapping oil in the cylinder. As the piston moves farther, it forces the trapped oil out of the cylinder, unseating the outlet check valve. The oil is pushed through a pipe to the final drive at the left rear axle, where it applies force against the brake pressure plate (see inset). This presses the revolving brake disk against the side of a fixed plate, braking the left axle and wheel.

When the brake pedal is released, the force against the brake disk is relieved. Oil returns from the axle unit and pushes the piston to the front again. This creates a vacuum in the cylinder, allowing the reservoir check valve to open again. More oil then enters the cylinder as needed for the next braking.

When both brake pedals are pressed down at once, oil is sent by both brake valves to both final drives. To assure equal oil pressure on both sides, valves under each brake piston are opened, connecting the two brake cylinders.

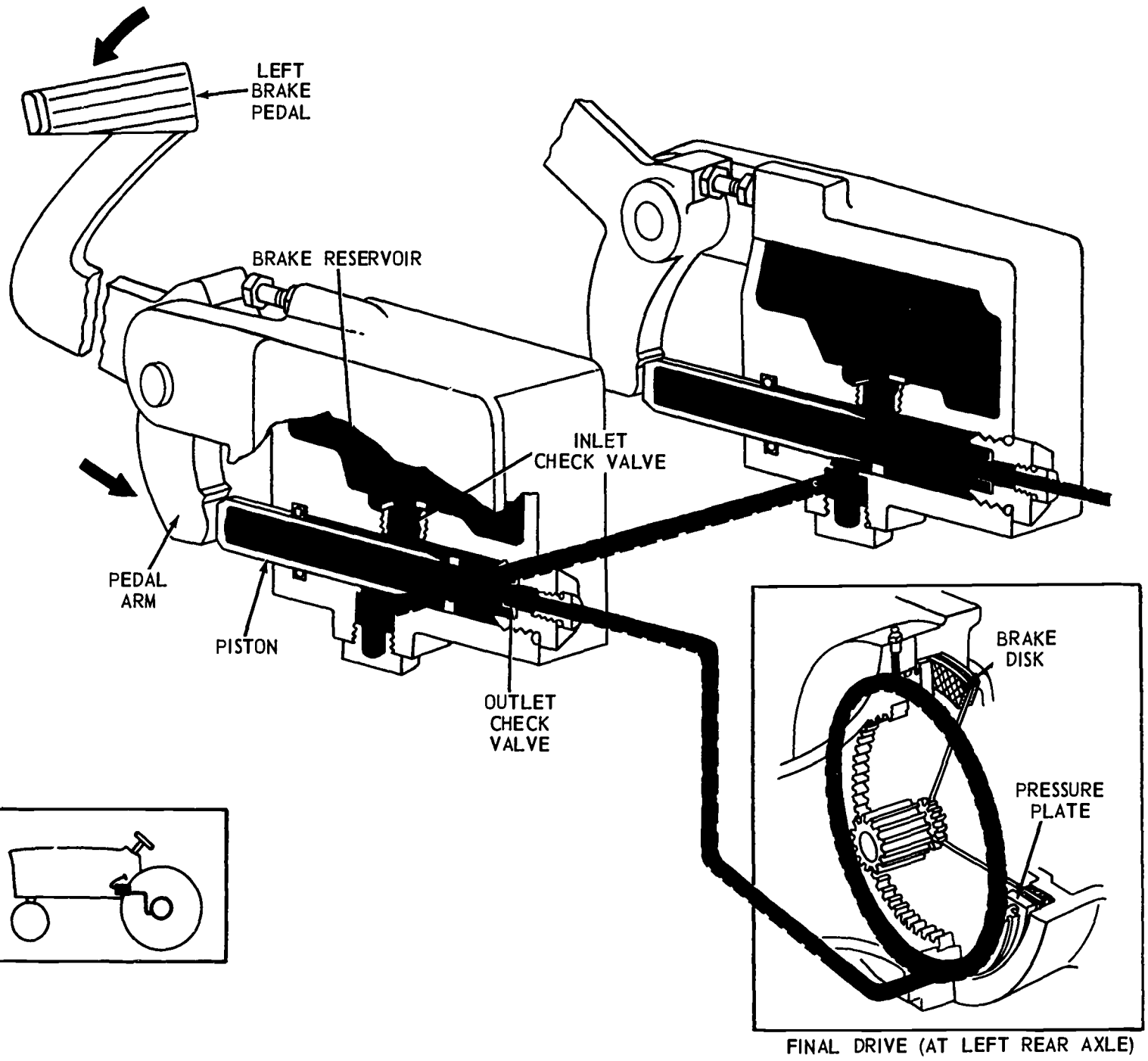

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Fig. 20–Hydraulic Brakes During a Left Turn

If the tractor is stopped or the oil supply fails, braking is still possible using the oil in the brake reservoirs. Normally, oil is supplied to the brake reservoirs from the tractor hydraulic system.

Power Brakes

"Power" brakes mean that hydraulic force completely controls the braking of the machine, once the operator presses down the brake pedal to actuate the valving.

Fig. 21 shows full power brakes on a modern wheel tractor with a closed-center hydraulic system. Operation is shown during a left turn.

For a sharp left turn, the operator presses down on the left brake pedal. This causes a rod linkage to push down on the brake valve and open it. Inlet oil under pressure now rushes in through the open valve, forces the outlet check valve open, and flows on to the final drive at the left rear axle (see inset). Here the oil forces the brake pistons and pressure plates to press the revolving brake disk against a fixed plate and so brakes the left axle and wheel.

When the brake pedal is released, the brake valve is closed again by its spring, and inlet oil is shut off. This relieves pressure on the brake disk at the axle, and braking stops as some oil flows back to the brake valve area. This oil dumps into the brake reservoir after going past the valve and through the valve plunger.

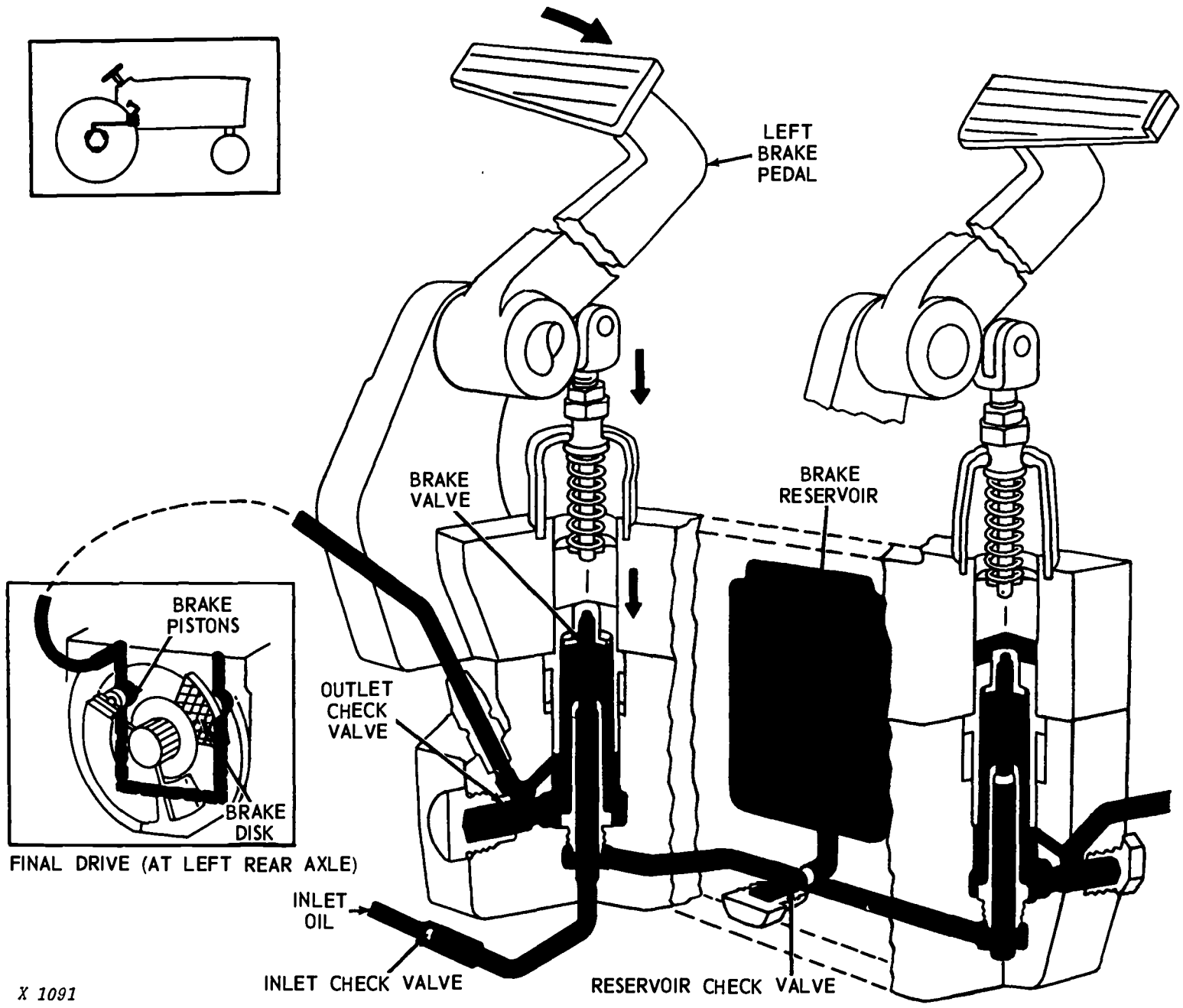


Fig. 21—Power Brakes During A Left Turn

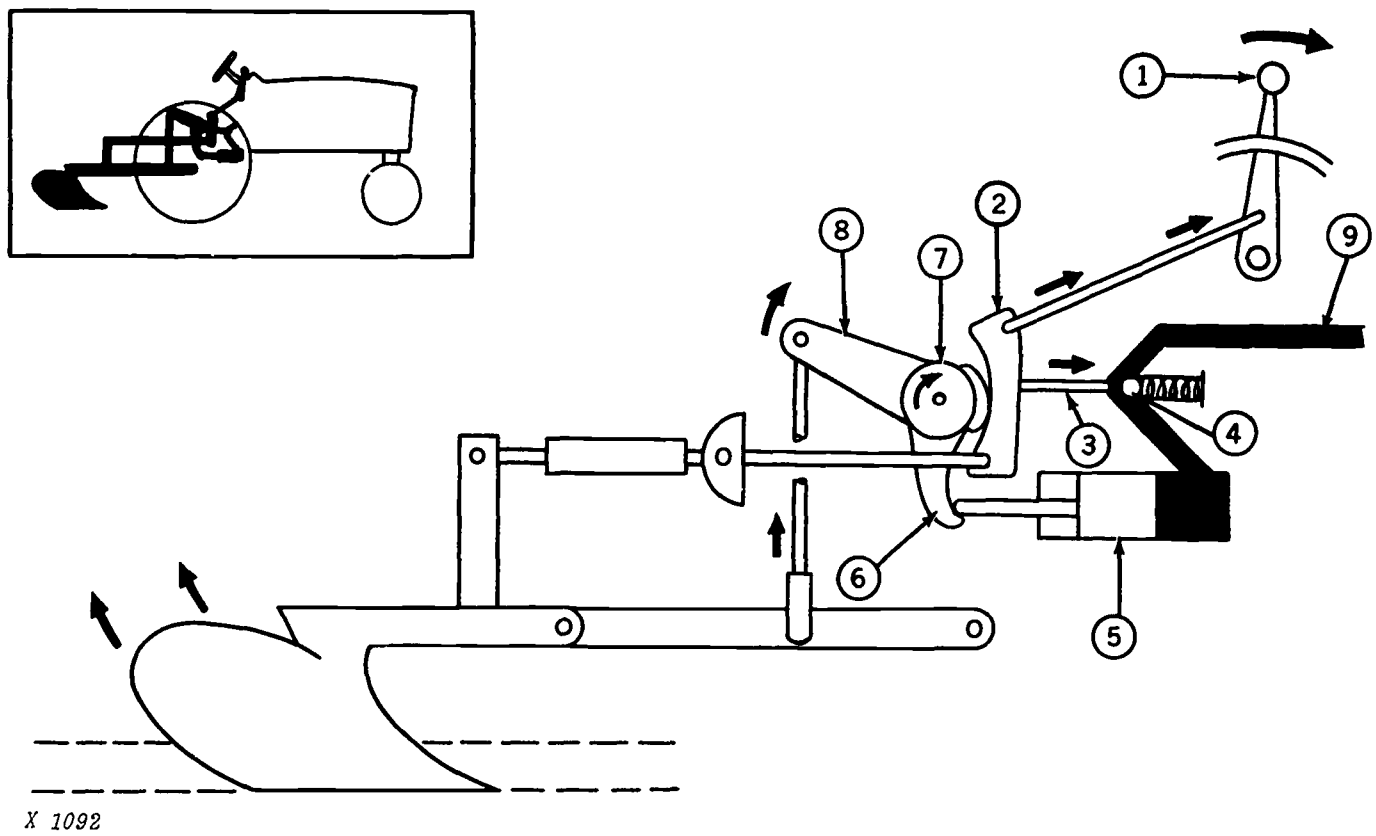
When both brake pedals are pressed down at once, oil is sent by both brake valves to both final drives. To assure equal braking, equalizing valves (not shown) are opened, connecting the two brake valves.

PROTECTION AGAINST FAILURE OF POWER BRAKES

If the tractor is stopped or the pressure oil supply fails, braking is still possible using the oil in the brake reservoir. The "power" brakes then become "hydraulic" brakes, using trapped oil to brake the tractor.

Operation is as follows: As pressure fails, the inlet check valve closes and oil is trapped in the brake valve area. Then if the left brake pedal is pushed down, the brake valve bore becomes a cylinder and piston device, forcing oil out to the rear axle unit. Releasing the pedal allows oil to return to the brake reservoir and more oil to enter the brake valve area past the reservoir check valve for the next braking.

On large machines, an accumulator is used as a "booster" in case the power braking fails. The accumulator holds enough "charges" of pressure oil in reserve for several brakings. When this reservoir power is used up, the brakes can still be applied using oil trapped in the circuit.



1–Control Lever
2–Cam Follower
3–Operating Rod
4–Valve Ball
5–Piston
6–Shaft Arm
7–Rockshaft
8–Lift Arm
9–Oil from Pump

Fig. 22–Raising the Plow Using the Control Lever

HYDRAULIC LOAD SENSING FOR REAR-MOUNTED EQUIPMENT

On modern tractors, equipment such as a plow is often mounted on a power lift (or rockshaft) at the rear of the tractor. The equipment is controlled by hydraulics using two means:

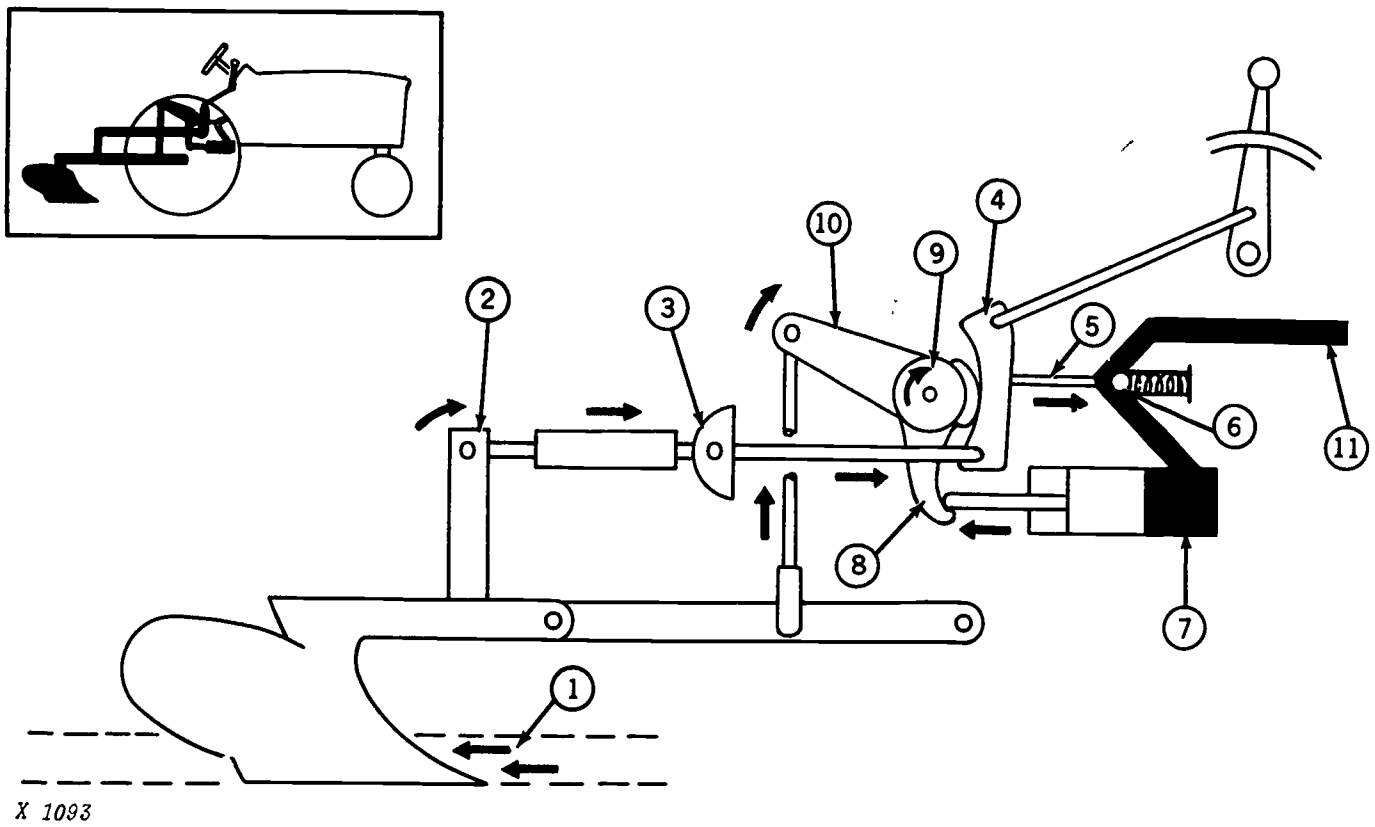
- **A control lever**
- **An automatic load sensing device**

Let's say the plow in Fig. 22 is pulling too hard and needs to be raised. We'll explain what happens when the plow is raised, first by the control lever and then by the automatic load sensing device.

Raising Plow Using Control Lever

In Fig. 22, the plow hits hard ground and the operator wants to raise it slightly. So he moves the control lever (1) to the front. This pivots the cam follower (2) forward and presses it against rod (3) which opens valve (4). Pressure oil is now admitted to the cylinder, forcing piston (5) to the rear. The piston pushes against the shaft arm (6), rotating rockshaft (7) and lift arm (8) upward. The lift arm is attached to the plow and so the plow is raised slightly to help it pass through the hard ground.

The plow stops rising when the valve (4) is closed again, trapping oil in the cylinder. This happens when the cam follower (2) working on the sloping cam of the rockshaft (7), is returned to the rear and releases the rod (3). The valve is then closed by its spring.



1—Plow Furrow
2—Plow Frame
3—Load Sensing Yoke
4—Cam Follower
5—Operating Rod
6—Valve Ball
7—Cylinder
8—Shaft Arm
9—Rockshaft
10—Lift Arm
11—Oil From Pump

Fig. 23—Automatic Load Sensing Raises the Plow

Automatic Load Sensing Raises the Plow

In Fig. 23, the plow hits hard ground (1) and tilts forward (2). The top link presses against the yoke (3) which moves linkage forward and pivots cam follower (4). The cam follower pushes on rod (5) which opens valve (6) and admits pressure oil to cylinder (7). The cylinder piston pushes against the arm (8), rotating rockshaft (9) and lift arm (10) upward. The lift arm is attached to the plow and so raises the plow slightly to help it pass through the hard ground.

With automatic load sensing, the plow will lower itself again when the hard ground is passed. This happens as the plow tilts to the rear again, pulling back on the linkage and actuating other valves (not shown) which release some oil from the cylinder. This lets the lift arms "settle," lowering the plow again.

The regular depth of the plow can be set at the control lever. The plow will stay at this depth unless a signal is given by the load sensing device.

We have just described full load sensing or *load control.*

Two other options are commonly available: If he wishes, the operator can lock out signals from the load sensing linkage by blocking the cam follower (4) at its lower end using a lever (not shown). This is called *depth control,* since the plow now stays at the depth set by the control lever. The other choice allows the operator to partly block the cam follower using the lever. This is called *load and depth control,* since the load signals are now modified by the depth setting.

Some power lifts are designed for dual operations. Two hydraulic cylinders are normally used: one cylinder and valving controls the rear-mounted equipment, and the second operates a front-mounted tool or an attachment. However, the cylinders can be operated in parallel by opening valves which join them to the same pressure oil supply. Two control levers are also used, one for each function. But usually only one function (the rear one) has an automatic load sensing device.

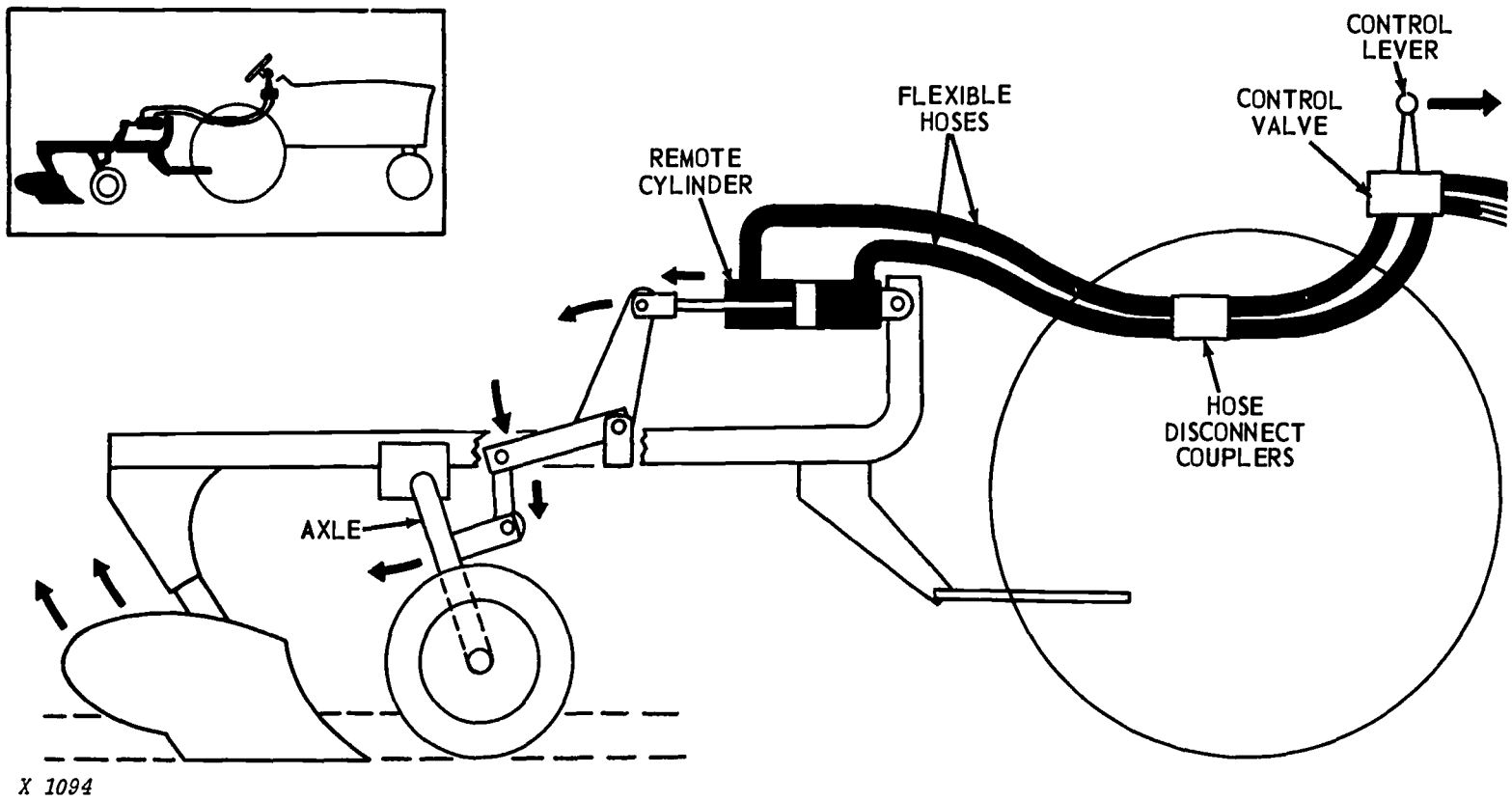


Fig. 24—Raising A Pull-Type Plow Using Remote Control Hydraulics

REMOTE CONTROL OF EQUIPMENT

Tractors may operate equipment that is not mounted, but is pulled or pushed. To control this equipment with hydraulics, a remote actuator such as a cylinder or a motor is needed—separate from the tractor connected by flexible hoses.

Let's take the case of a plow again—this time one that is pulled behind the tractor (Fig. 24). The plow is pulling too hard and the operator wants to raise it. What happens is this:

The operator moves the control lever to the front as shown. This actuates the control valve which sends pressure oil to the front of the remote cylinder. As this oil pushes the piston to the rear, the cylinder rod extends. Oil from the other side of the piston is forced out and returns through the valve to reservoir. As the cylinder rod extends, it pivots a linkage to the plow axle, rotating the bent axle to the rear and so raises the plow.

Remote cylinders have hundreds of uses on modern machines. (See Chapter 4 for details on all types of hydraulic cylinders.)

Another use of remote hydraulics is the hydraulic motor (see Chapter 5). A small motor can be mounted on a portable grain elevator, for example. The motor converts fluid power into rotary motion and so drives the elevating mechanism.

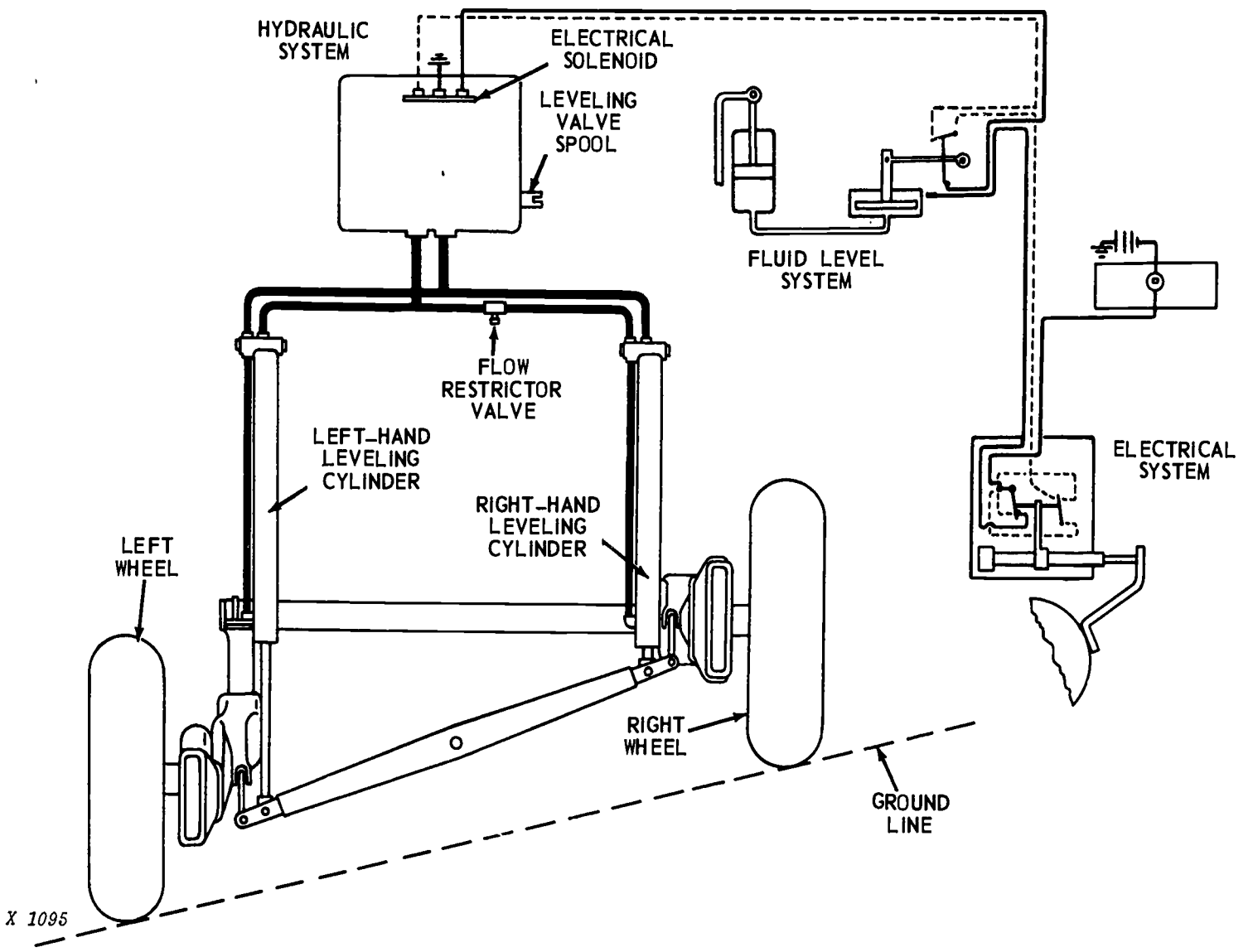


Fig. 25—Automatic Leveling System (Hillside Combine)

AUTOMATIC LEVELING SYSTEMS (Hillside Combines)

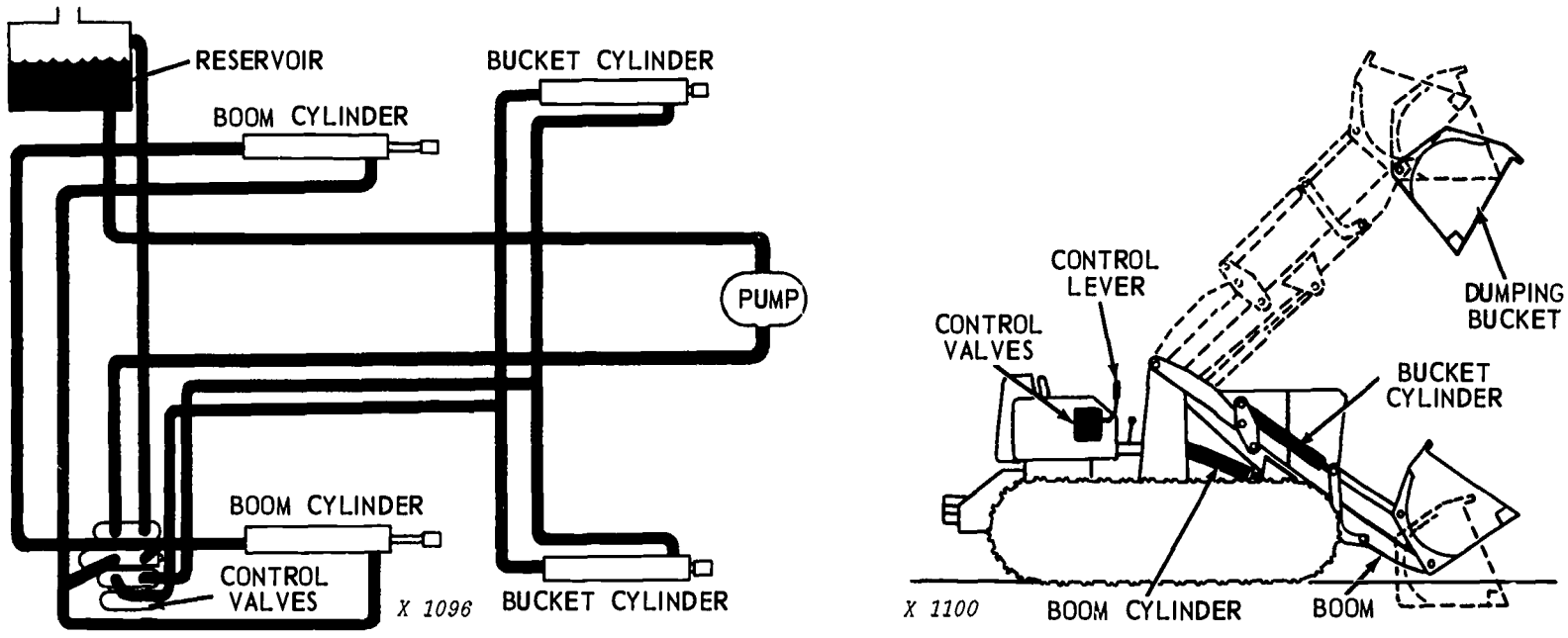
A major use of the automatic leveling system is in the hillside combine.

This special system has three parts: a fluid level system, an electrical system, and a hydraulic system (Fig. 25). The first two systems provide control for activating the hydraulic system.

Operation is as follows: When the combine enters a hillside slope and left wheels lower, a liquid leveling device activates the electrical system. A solenoid moves a leveling valve spool and directs oil to double-acting leveling cylinders on each wheel (Fig. 25). The left cylinder extends and the right cylinder retracts, so that the wheels conform to the slope while the combine is held level.

When leveling in the opposite direction, the sequence is reversed.

After leveling, oil is trapped in the cylinders by check valves and the leveling system is shut off automatically.



Oil Flow with Bucket Dumping

Loader Operating Positions

Fig. 26–Loader Operation

MOUNTED EQUIPMENT CONTROL SYSTEMS

Loaders, bulldozers, backhoes, and forklifts are usually mounted on the machine which propels them. Often they are sold as custom units for a single job. For ease of control, hydraulics is widely used to operate this mounted equipment.

Loader Hydraulic Systems

Most loaders are mounted on the front of wheel or crawler tractors.

Fig. 26 shows a crawler loader which has its own hydraulic system, an open-center type.

Most loaders have two kinds of control: 1) raise and lower boom, 2) dump and retract bucket. Both are usually controlled by hydraulics, using separate oil circuits and controls.

When the operator dumps the loader bucket, he moves a control lever which causes a control valve to send oil to both bucket cylinders. This extends the cylinders, dumping the bucket. Meanwhile, oil is trapped in the boom cylinders, holding up the boom.

The boom and bucket cylinders are double-acting so that they can both raise and lower the heavy boom, or dump and retract the bucket. (Some boom cylinders may be single-acting and are lowered by the weight of the bucket.)

Each circuit–boom and bucket–is served by its own control valve. Each valve is usually operated by its own lever. In some cases, one lever is linked to both valves for four-way operation.

An extra hydraulic circuit is sometimes added for a clam bucket or a logging fork or grapple which mounts on the loader boom.

Bulldozer Hydraulic Systems

The bulldozer usually mounts on the front of a crawler tractor, for greater traction in loose dirt.

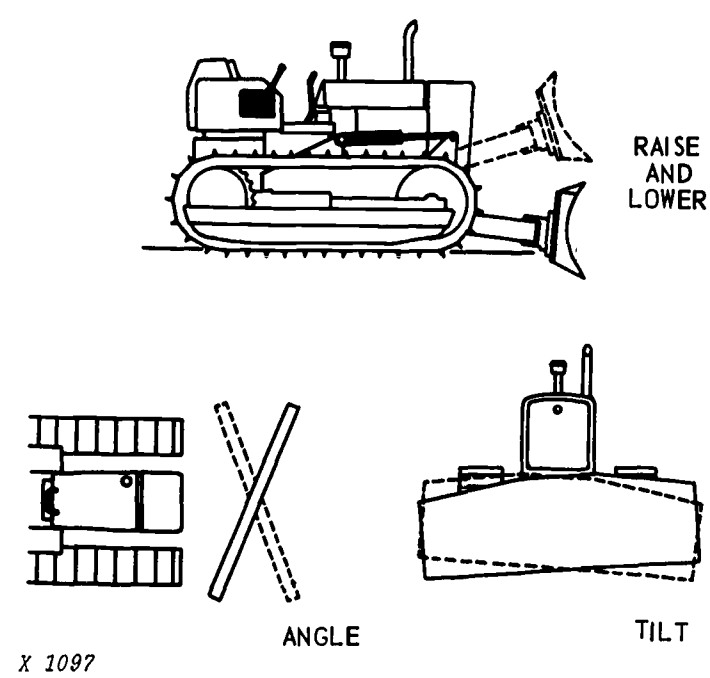
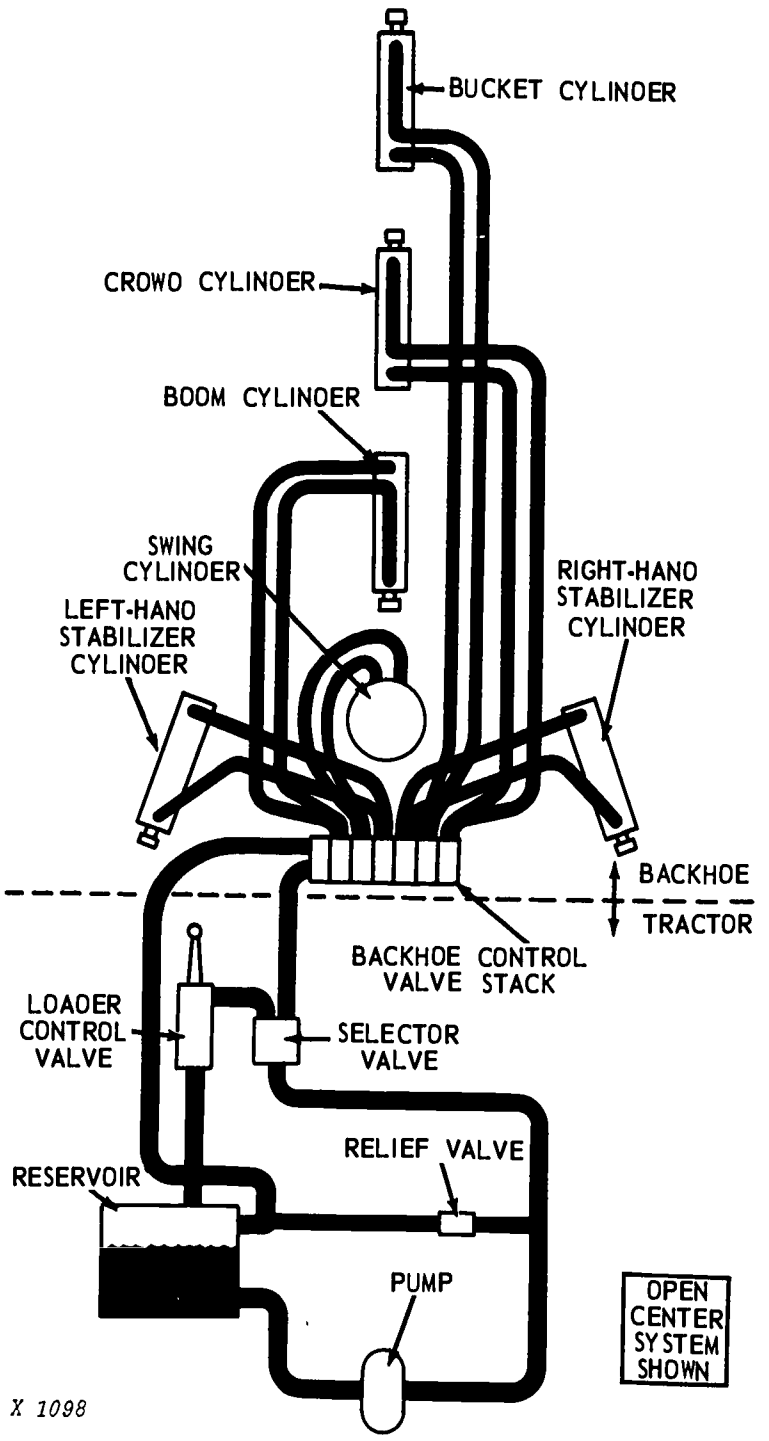
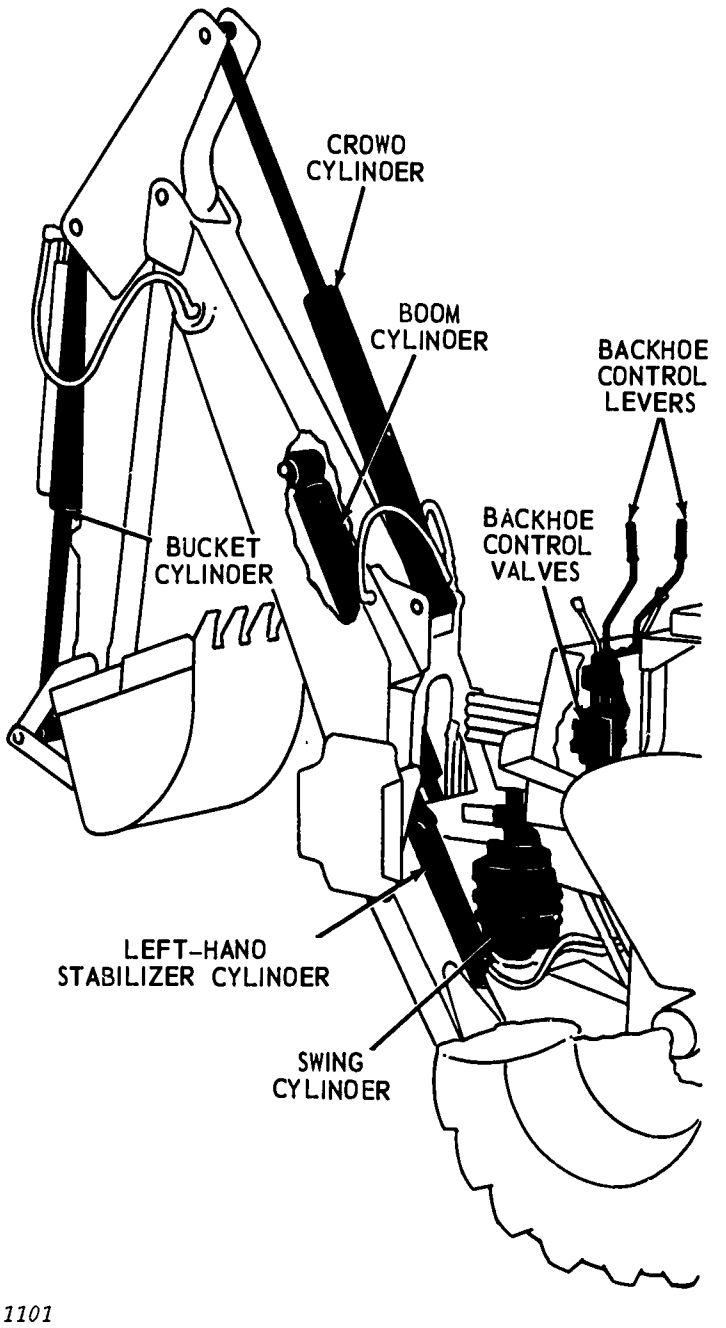


Fig. 27–Bulldozer Operation

Most bulldozers have three types of blade control: 1) raise and lower, 2) angle right and left, and 3) tilt side-to-side (see Fig. 27). On some bulldozers, all three are controlled by hydraulics. On others, only one or two.



Oil Flow with Bucket Dumping and Boom Raising



Backhoe Operating Parts

Fig. 28—Backhoe Operation (When Used With Loader Unit)

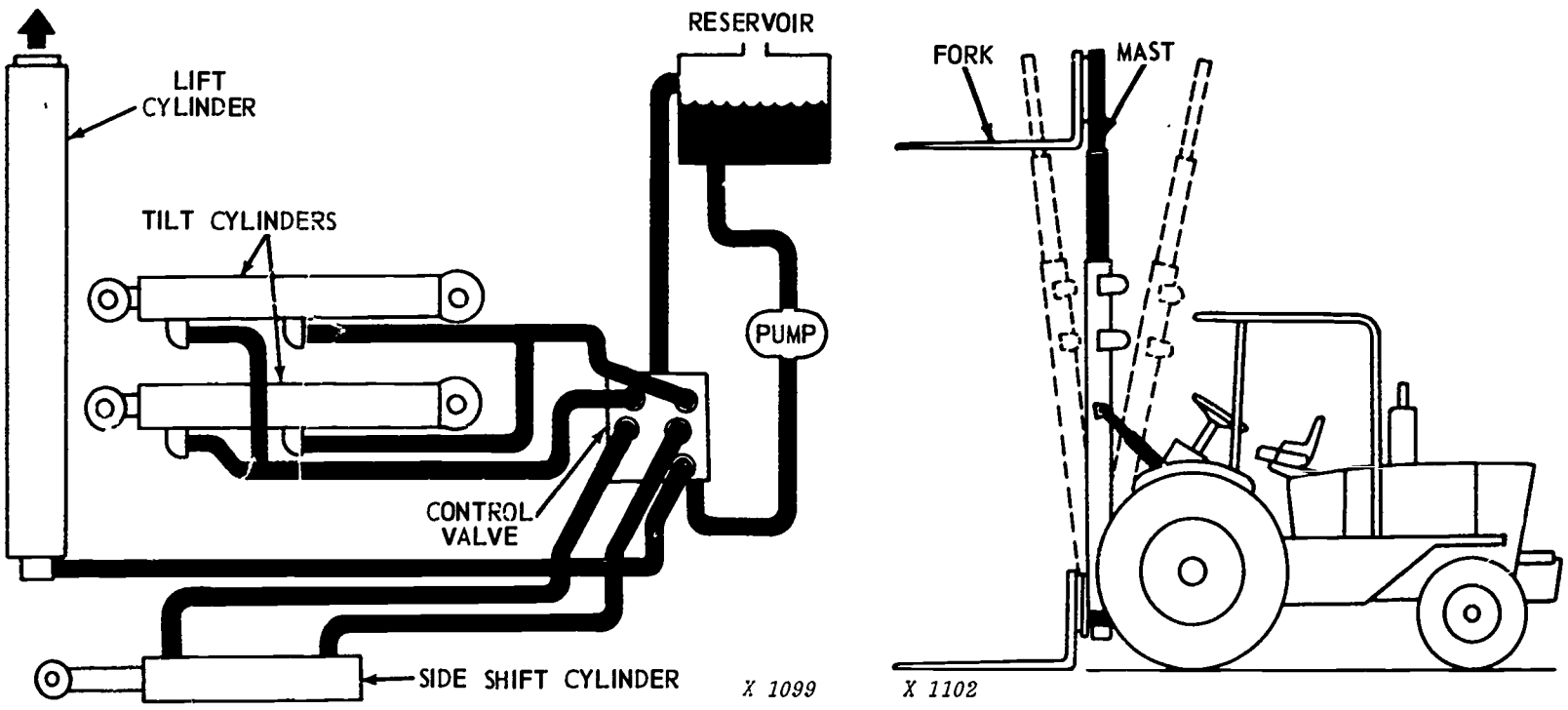
Like loaders, most bulldozers have their own hydraulic systems. Gear-type pumps, spool valves in a "stack," and double-acting cylinders are the common features of these systems.

A float position is built into the control valve which operates the raising and lowering of the blade. This allows the blade to follow the contours of the ground while backdragging and smoothing the earth. In float position, oil in the circuit is free to flow back and forth. (Normally the oil is trapped, holding the blade solid.)

Backhoe Hydraulic Systems

The backhoe is used for digging trenches. It usually mounts on the rear of an industrial tractor such as a loader or bulldozer.

Fig. 28 shows a typical backhoe. Hydraulic oil for the backhoe is supplied from the tractor hydraulic system. With open-center systems, a selector valve is often used to divert oil during backhoe operation. (In Fig. 28, the selector valve diverts oil from the loader when using the backhoe. With closed-center systems, oil is available "on demand.")



Oil Flow While Raising Fork

Forklift Operating Positions

Fig. 29—Forklift Operation

The operator controls the backhoe by means of levers. These levers direct oil through control valves to the proper cylinder to operate the boom, bucket, crowd, or stabilizing functions. The cylinders are double-acting to give full force in both directions. A special swing cylinder is used to rotate the boom for dumping the bucket and returning to the trench.

The use of flexible hoses shown in Fig. 28 allows free movement of the backhoe without damage to the hydraulic circuits.

Forklift Hydraulic System

The forklift is used to handle, lift, and stack products and materials. Many forklifts are mounted on the rear of a wheel tractor. The tractor is then operated in reverse, the operator facing the forklift.

Fig. 29 shows a typical forklift. The vertical frame is called a mast, while the lifting device is called the fork. The forklift may have its own hydraulic system, either a closed- or an open-center type. Spool-type control valves and single- or double-acting cylinders are normally used in the system.

Most forklifts have three types of hydraulic control: 1) to lift and lower the fork, 2) to tilt the mast fore and aft, 3) to shift the mast from side-to-side (optional).

To raise the fork and lift a load, the operator moves a control lever to direct oil as shown in Fig. 29. The control valve sends pressure oil to the lift cylinder, while oil is trapped in the tilt and side shift circuits. (One spool valve is provided for each of the three circuits.)

DIAGNOSIS AND TESTING OF HYDRAULIC SYSTEMS

In the final chapter of this manual, we will once again return to the complete hydraulic system. At that time we will use our knowledge of "how the system works" to find out "why the system fails" and "how to remedy" these failures. Chapter 12 is titled "Diagnosis and Testing of Hydraulic Systems."

But before we try to analyze the complete hydraulic system, we must look at the various working parts in more detail. The following chapters will do that, starting with the hydraulic pump.

HYDRAULIC FACTS

Here are some key facts that will help you understand hydraulics:

1. Hydraulic power is nearly always generated from mechanical power. Example: A hydraulic pump driven by an engine crankshaft.

2. Hydraulic power output is nearly always achieved by converting back to mechanical energy. Example: A cylinder which raises a heavy plow.

3. There are three types of hydraulic energy: a) potential or pressure energy; b) kinetic energy, the energy of moving liquids; and c) heat energy, the energy of resistance to flow, or friction.

4. Hydraulic energy is neither created nor destroyed, only converted to another form.

5. All energy put into a hydraulic system must come out either as work (gain) or as heat (loss).

6. When a moving liquid is restricted, heat is created and there is a loss of potential energy (pressure) for doing work. Example: A tube or hose that is too small or is restricted. Orifices and relief valves are also restrictions but they are purposely designed into systems.

7. Flow through an orifice or restriction normally causes a pressure ***drop.***

8. Oil must be confined to create pressure for work. A tightly sealed system is a must in hydraulics.

9. Oil takes the course of least resistance.

10. Oil is normally ***pushed*** *into a pump, not drawn into it. (Atmospheric pressure supplies this push. For this reason, an air vent is needed in the top of the reservoir.)*

11. A pump does not pump pressure; it creates flow. Pressure is caused by ***resistance*** *to flow.*

12. Compare two hydraulic applications which have the same power output:

Small pump + large cylinder = more force at less speed.

Large pump + small cylinder = less force at more speed.

In other words, two hydraulic systems may produce the same power output—one at high pressure and low flow, the other at low pressure and high flow.

13. A basic hydraulic system must include four components: a reservoir to store the oil; a pump to push the oil through the system; valves to control oil pressure and flow; and a cylinder (or motor) to convert the fluid movement into work.

14. Compare the two major hydraulic systems:

Open-Center System = pressure is varied but flow is constant.

Closed-Center System = flow is varied but pressure is constant.

15. There are two basic types of hydraulics:

a) Hydrodynamics is the use of fluids at high speeds "on impact" to supply power. Example: a torque converter.

b) Hydrostatics is the use of fluids at relatively low speeds but at high pressures to supply power. Example: most hydraulic systems, and all those covered in this manual.

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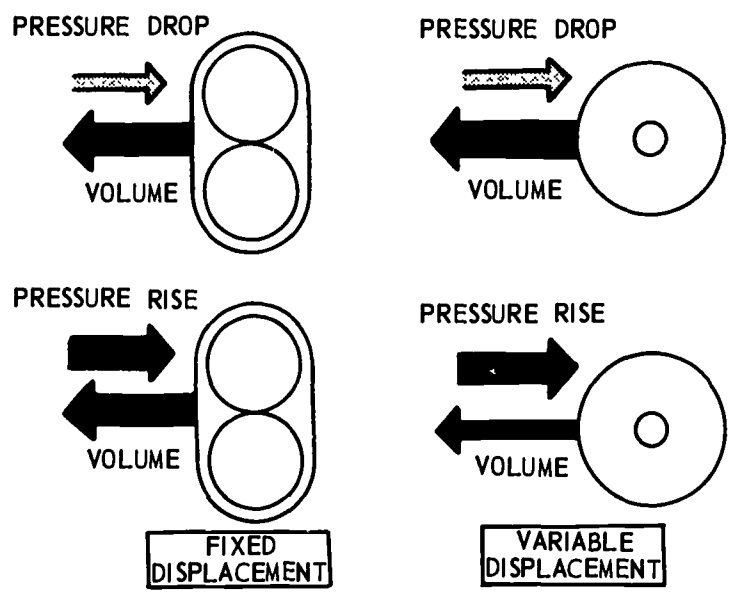

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Fig. 3—Comparing Fixed and Variable Displacement Pumps

• FIXED DISPLACEMENT pumps move the same volume of oil with every cycle. This volume is only changed when the speed of the pump is changed.

Volume can be affected by the pressure in the system, but this is due to an increase in leakage back to the pump inlet. Usually this occurs when pressure rises. This leakage means that fixed displacement pumps are usually found in lower pressure systems or as aids to another pump in a higher pressure system.

• VARIABLE DISPLACEMENT pumps can vary the volume of oil they move with each cycle—even at the same speed. These pumps have an internal mechanism which varies the output of oil, usually to maintain a constant pressure in the system. As shown in Fig. 3, when system pressure drops, volume increases. As pressure rises, volume decreases.

To summarize:

Fixed Displacement = Constant Flow

Variable Displacement = Varied Flow

In Chapter 1, we compared open center and closed center systems. We found that in open center systems, pressure is varied, but flow is constant. In a closed center system, flow is varied but pressure is constant.

Now we can see which type of pump works best for each system:

Open Center System = Fixed Displacement

Closed Center System = Variable Displacement

There are variations to this rule, as we saw in Chapter 1. But basically the two types of pumps are designed to serve the two types of systems.

A word about pressure. Remember: **A hydraulic pump does not create pressure; it creates flow. Pressure is caused by resistance to flow.**

TYPES OF HYDRAULIC PUMPS

Now that we have seen what hydraulic pumps are and what they can do, let's take an "inside" look.

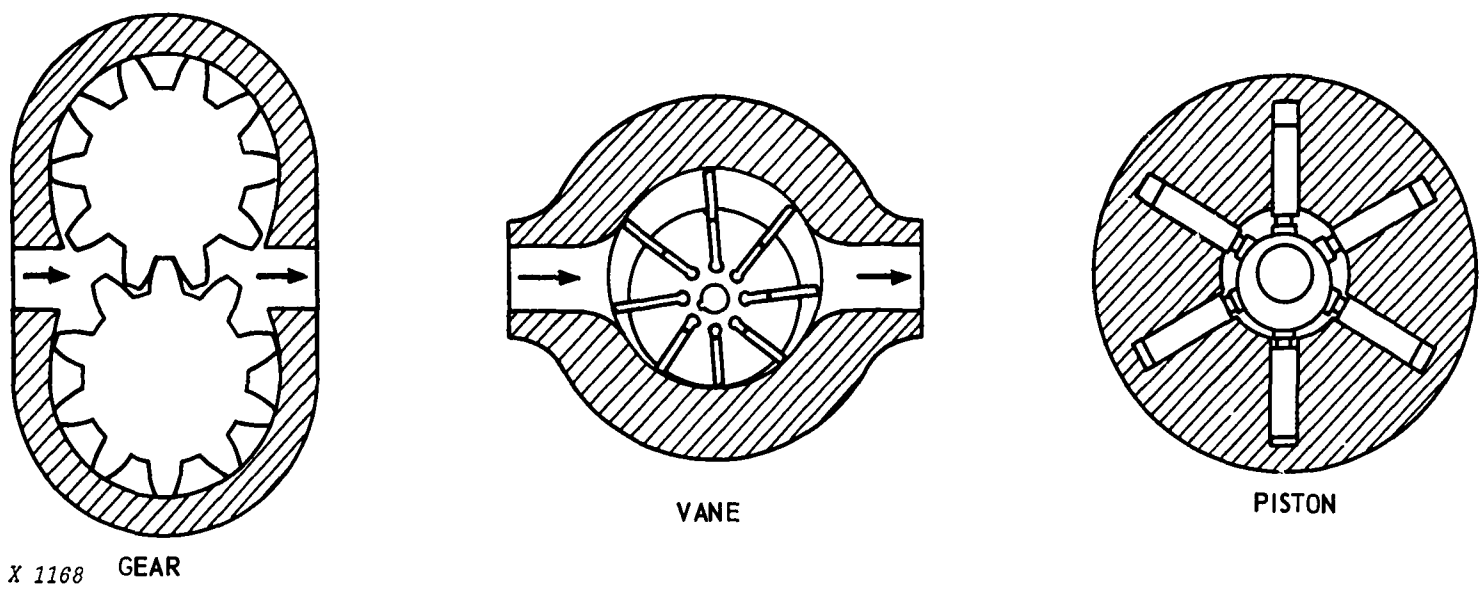

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Fig. 4—Three Types of Hydraulic Pumps

HYDRAULIC PUMPS / CHAPTER 2

INTRODUCTION

The pump is the heart of the hydraulic system. It creates the flow of fluid which supplies the whole circuit.

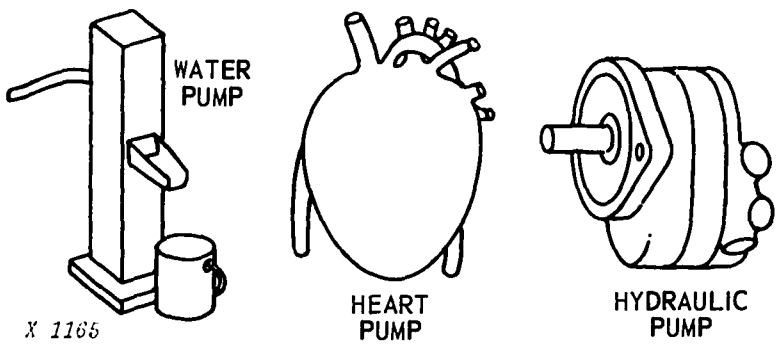


Fig. 1—Three Kinds of Pumps

The human heart is a pump (Fig. 1). So was the old water pump once found on the farm. Somewhere in between, engineers have devised many kinds of hydraulic pumps, which do more than the old water pump, but only strive for the perfection of the human heart pump.

Once the term "hydraulics" meant the study of fluids in motion. Therefore, any pump which moved fluids was considered a hydraulic pump.

But today, "hydraulics" means the study of fluid pressure and flow—fluids in motion **plus** the ability to do work.

Thus a hydraulic pump is now one that moves fluid **and** induces fluid to work . . . in other words, A PUMP THAT CONVERTS MECHANICAL FORCE INTO HYDRAULIC FLUID POWER.

WHEN IS A PUMP "HYDRAULIC"?

All pumps create flow. They operate on a principle called **displacement**. The fluid is taken in and displaced to another point.

Displacement can be done in two ways:

- **Non-Positive Displacement**
- **Positive Displacement**

Fig. 2 compares the two. The old water wheel shows the non-positive aspect. It simply picks up fluid and moves it.

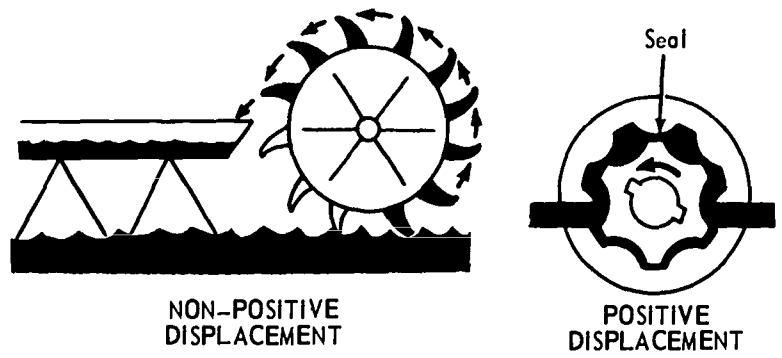


Fig. 2—How to Tell When a Pump is "Hydraulic"

But the positive displacement pump, used in hydraulics today, not only creates flow, it also **backs it up**. Notice the sealed case around the gear. This traps the fluid and holds it while it moves.

As the fluid flows out the other side, it is sealed against back-up. This sealing is the "positive" part of displacement. Without it, the fluid could never overcome the resistance of the other parts in the system.

When high pressure is needed in a circuit, a positive displacement pump is a must. This is true for all modern hydraulic systems which provide fluid power.

In low-pressure systems, such as water cooling or crop spraying types, the old non-positive displacement pump still works.

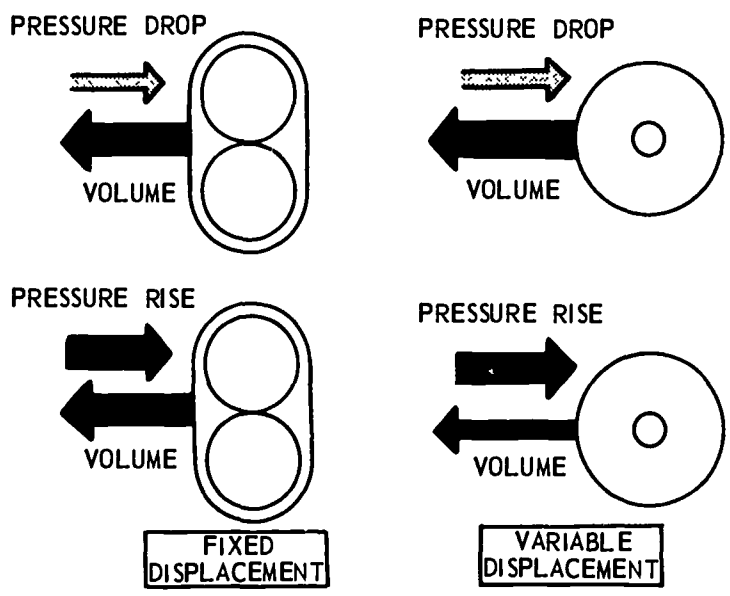
In this chapter, we will discuss only the **positive displacement** pump which is at the heart of modern oil hydraulic systems. This pump is a true HYDRAULIC pump.

DISPLACEMENT OF HYDRAULIC PUMPS

"Displacement" is the volume of oil moved or displaced during each cycle of a pump.

In this sense, hydraulic pumps fall into two broad types:

- **Fixed Displacement Pumps**
- **Variable Displacement Pumps**



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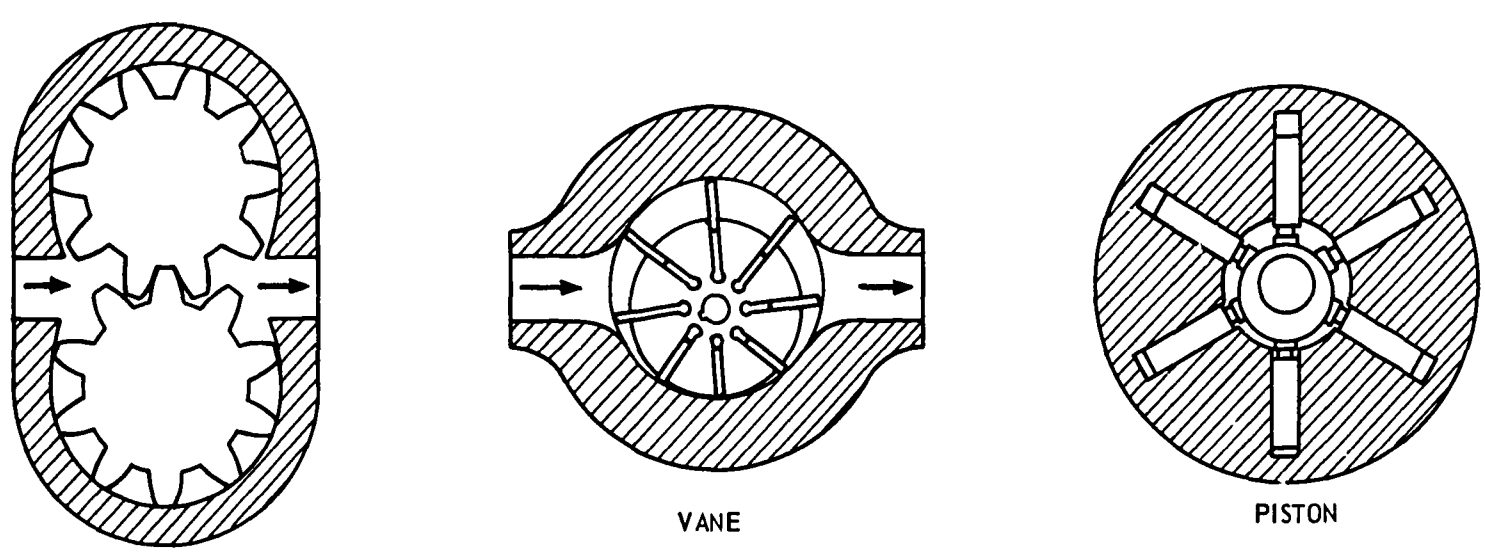

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Fig. 4—Three Types of Hydraulic Pumps

Most pumps used on today's machines are of three basic designs (Fig. 4):

- **Gear Pumps**
- **Vane Pumps**
- **Piston Pumps**

We will show how each type of pump operates and how it is used. A hydraulic system may use one of these pumps, or it may use two or more in combination.

All three designs work on the rotary principle: a rotating unit inside the pump moves the fluid. A rotary pump can be built very compact, yet displace the necessary volume of fluid. This is the number one need in a mobile system where space is limited.

GEAR PUMPS

Gear pumps are the "pack horses" of hydraulic systems. They are widely used because they are simple and economical. While not capable of a variable displacement, they can produce the volume needed by most systems using fixed displacement. Often they are used as charging pumps for larger system pumps of other types.

Two basic types of gear pumps are used:

- **External Gear Pumps**
- **Internal Gear Pumps**

Let's see how they work.

EXTERNAL GEAR PUMPS

External gear pumps usually have two gears in mesh, closely fitted inside a housing (Fig. 5). The drive shaft drives one gear, which in turn drives the other gear. Shaft bushings and machined surfaces or wear plates are used to seal in the working gears.

Operation is quite simple (Fig. 6). As the gears rotate and come **out** of mesh, they trap inlet oil between the gear teeth and the housing. The trapped oil is carried around to the outlet chamber. As the gears mesh again they form a seal which prevents oil from backing up to the inlet. The oil is forced out at the outlet port and sent through the system.

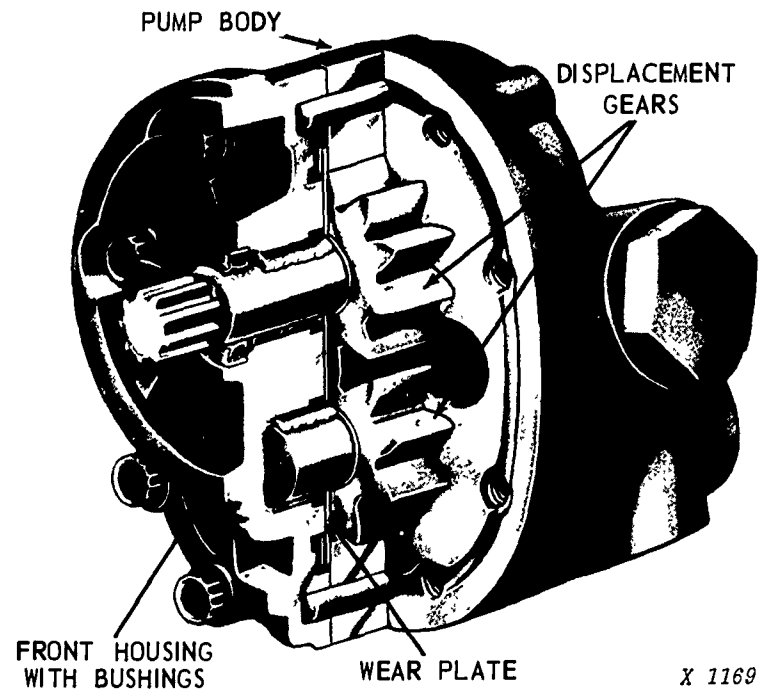

Fig. 5—External Gear Pump

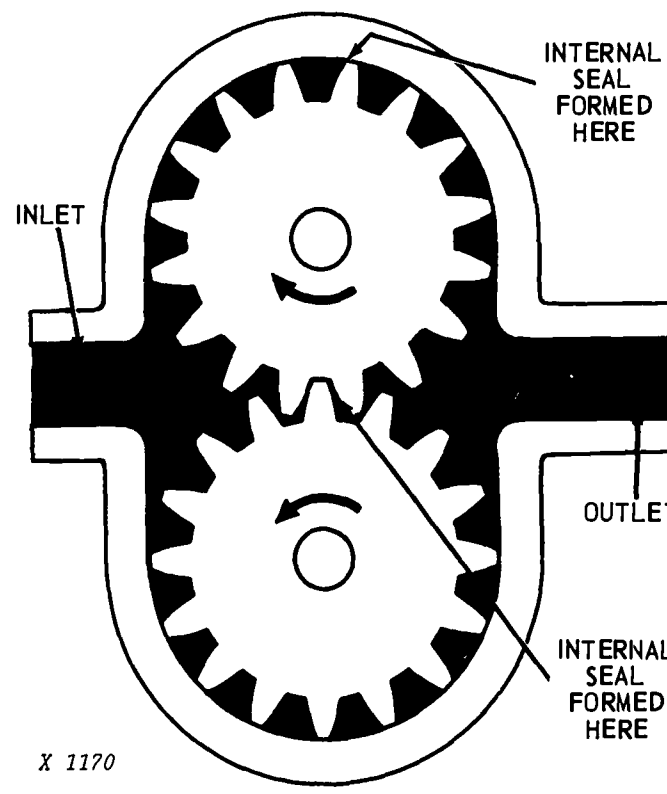

Fig. 6—External Gear Pump in Operation

This oil is pushed out by the continuous flow of trapped oil coming into the outlet chamber with each rotation of the gears.

At the inlet side, gravity feeds in more oil from the reservoir to replace that drawn out by the turning gears.

Some gear pumps use a pressurized plate working against the gears to increase pump efficiency. A small amount of pressure oil is fed under the backing plate, pressing it against the gears and forming a tighter seal against leakage.

INTERNAL GEAR PUMPS

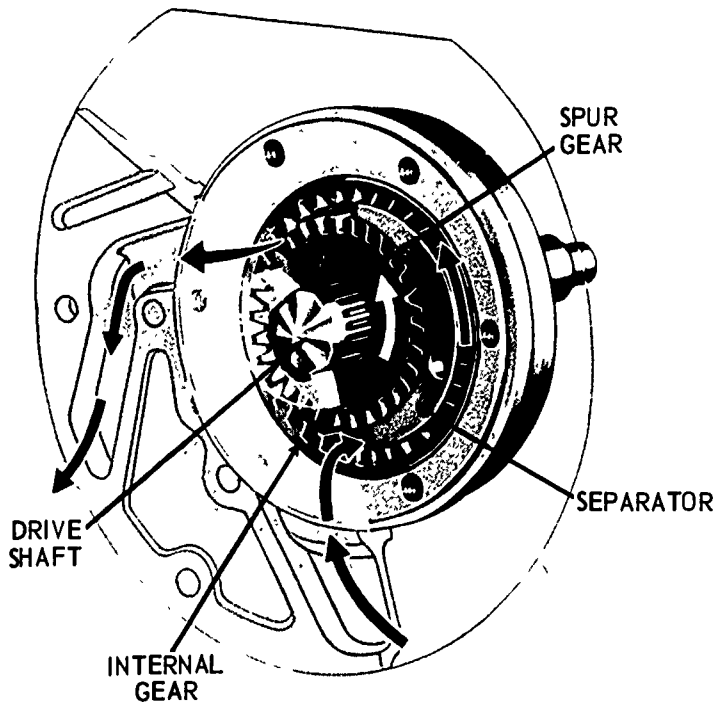

Fig. 7—Internal Gear Pump

The internal gear pump also uses two gears, but now a spur gear is mounted **inside** a larger gear. The spur gear is in mesh with one side of the larger gear, and both gears are divided on the other side by a crescent-shaped separator. The drive shaft turns the spur gear, which drives the larger gear.

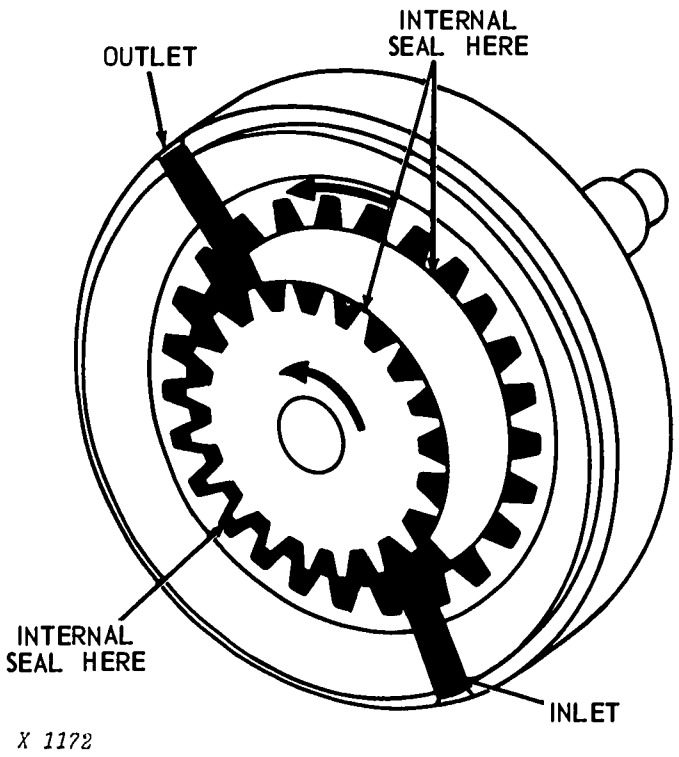

Fig. 8—Internal Gear Pump in Operation

Operation is basically the same as for the ex ·rnal gear pump. The major difference is that both g ars turn in the same direction (Fig. 8).

As the gears come out of mesh, oil is trapped b tween their teeth and the separator and is carrie around to the outlet chamber. As the gears mesh again, a seal is formed, preventing back-up of the oil. A continuous flow of oil to the outlet pushes the fluid out into the circuit.

Gravity keeps feeding oil into the pump inlet to fill the partial vacuum created as oil is drawn in by the gears.

Rotor Version of Internal Gear Pump

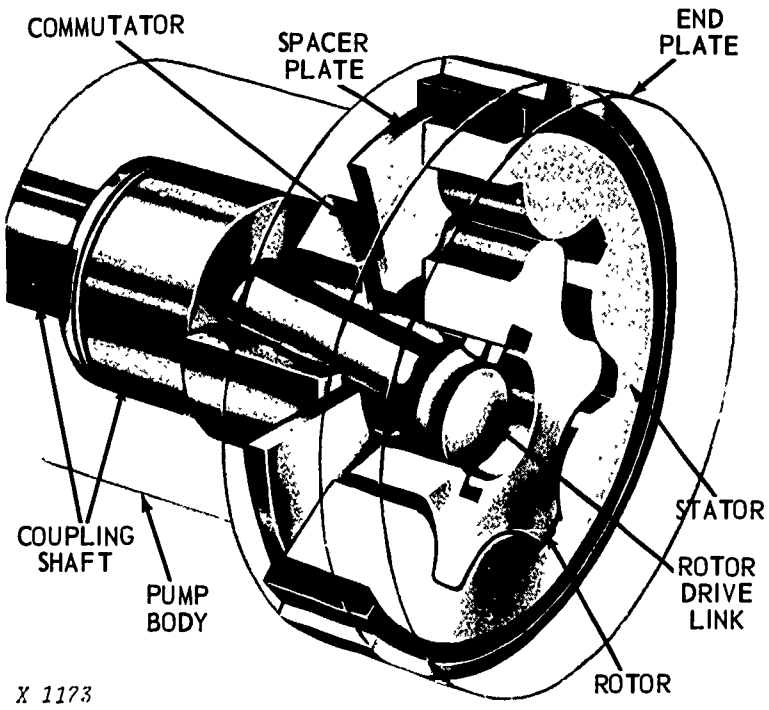

Fig. 9—Rotor Version of Internal Gear Pump

The rotor pump (Fig. 9) is a variation of the internal gear pump. An inner rotor turns inside a fixed rotor ring. The rotor has rounded lobes for teeth. No separator is used.

In operation (Fig. 10), the inner rotor is driven inside the rotor ring. The inner rotor has one less lobe than the ring, so that only one lobe is in full engagement with the outer ring at any one time. This allows the other lobes to slide over the outer lobes, making a seal to prevent back-up of oil.

As the lobes slide up and over the lobes on the outer ring, oil is drawn in. As the lobes fall into the ring's cavities, oil is squeezed out.

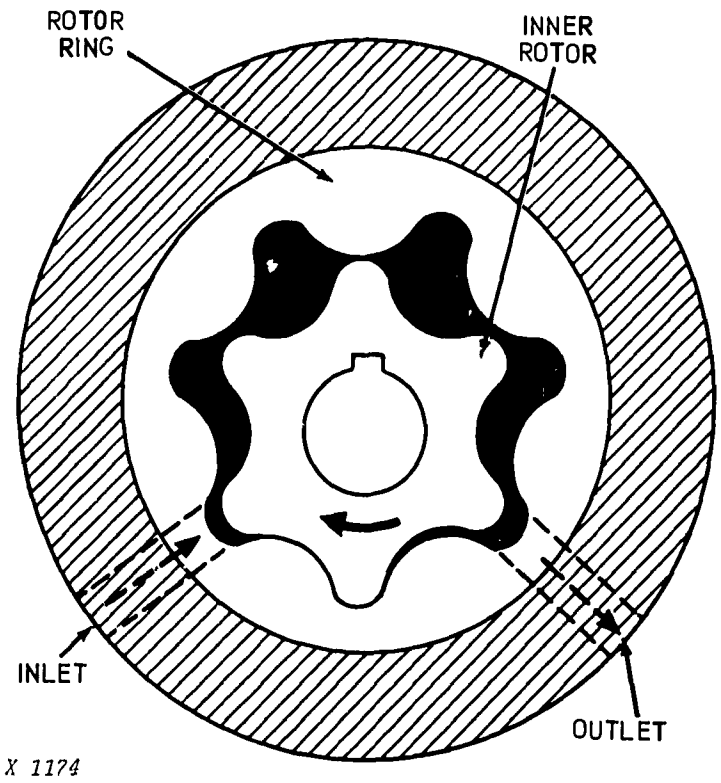

Fig. 10—Rotor-Type Pump in Operation

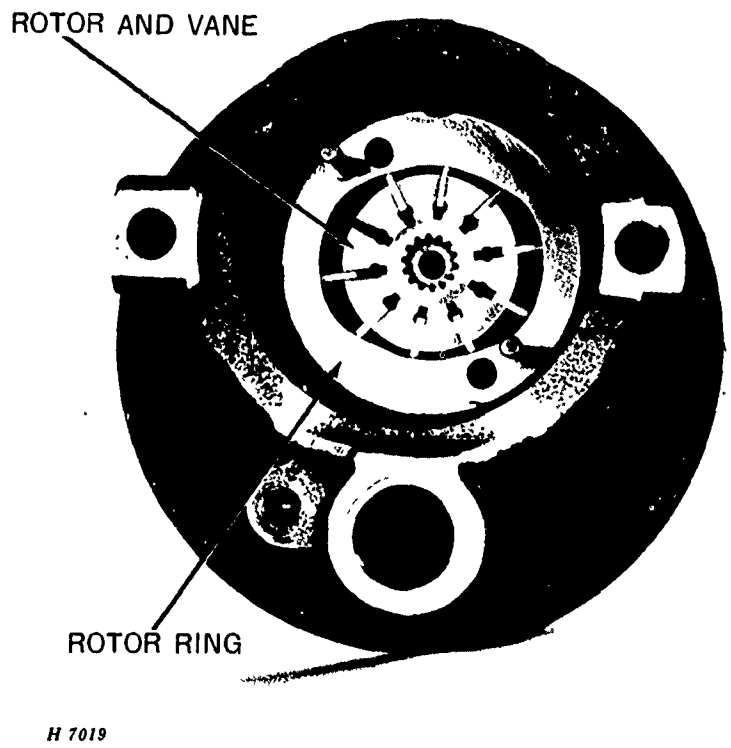

Fig. 11—Balanced Vane Pump

VANE PUMPS

Vane pumps are fairly versatile pumps and can be designed as single, double, or even triple units.

All vane pumps move oil using a rotating slotted rotor with vanes fitted into the slots.

Two types of vane pumps are most often used:

- **Balanced Vane Pumps**
- **Unbalanced Vane Pumps**

The balanced vane pump is strictly a fixed displacement type. The unbalanced vane can have a fixed or a variable displacement.

BALANCED VANE PUMPS

In the balanced vane pump (Fig. 11), the rotor is driven by the drive shaft and turns inside an oval rotor ring.

The vanes are fitted into the rotor slots and are free to move in or out.

The "balanced" part of this pump is shown by the position of the oil ports in Fig. 12. The pump has two inlet ports, located opposite each other. And it has two outlet ports, also on opposite sides of the pump. Both sets are connected to a central inlet and outlet.

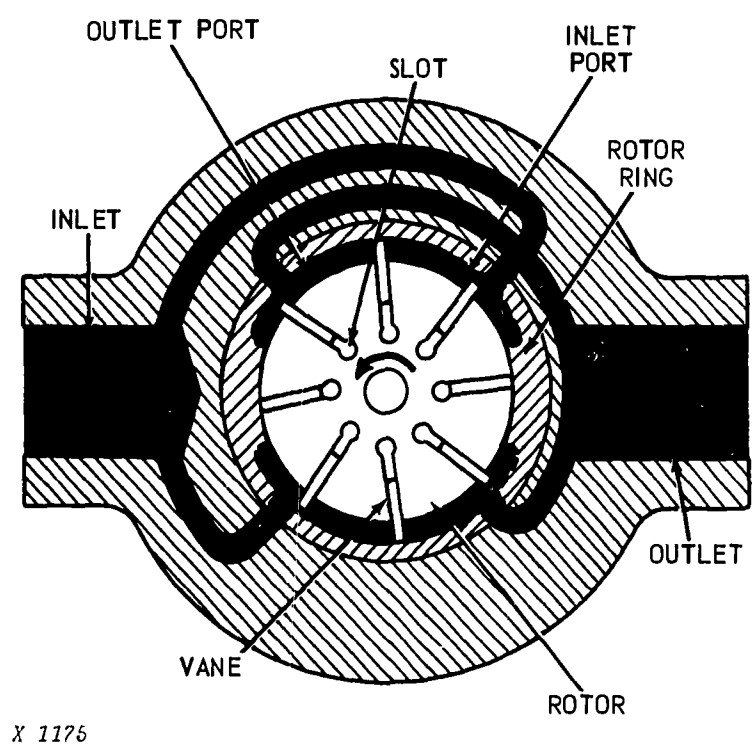

Fig. 12—Balanced Vane Pump in Operation

Operation is shown in Fig. 12. As the rotor turns, the vanes are thrown out against the inside surface of the ring by centrifugal force. As the vanes follow the contour of the oval-shaped ring, they divide the crescent-shaped areas between the rotor and the ring into two separate chambers. These chambers are continually expanding and shrinking in size—twice during each revolution. The inlet ports are located where each chamber begins to expand; the outlet ports are located where each chamber begins to shrink.

As the chamber begins to expand, inlet oil rushes in to fill the partial vacuum. This oil is carried around by the vanes. As the oil chamber begins to reduce, the confined oil is forced out at the outlet port.

In the second half of the revolution, this action is repeated at the second set of inlet and outlet ports.

UNBALANCED VANE PUMPS

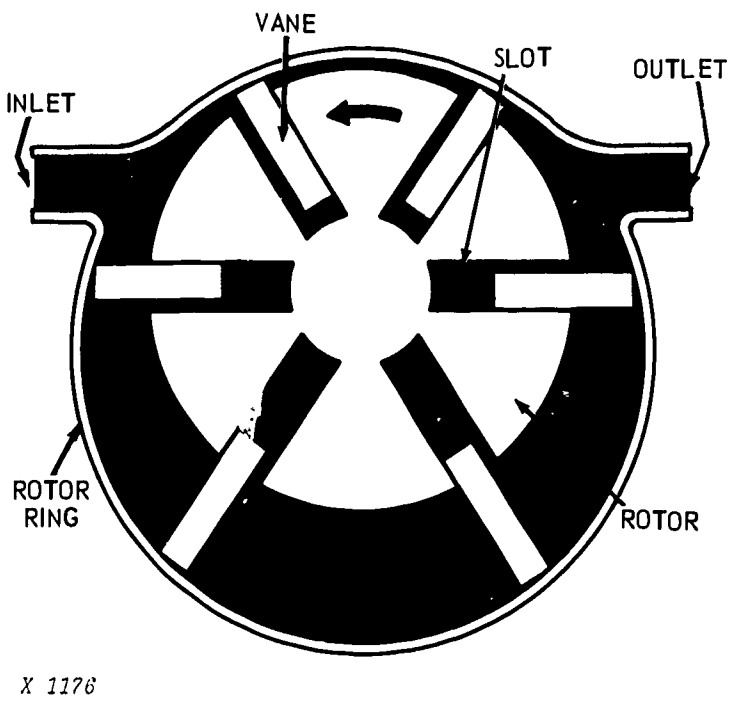

Fig. 13—Unbalanced Vane Pump in Operation

The unbalanced vane pump uses the same basic principle of a turning rotor with vanes working inside a fixed rotor ring.

However, the operating cycle only happens once each revolution (Fig. 13). So this pump has only one inlet and one outlet port. Also, the slotted rotor is now set offside in a circular ring.

In operation, the oil chamber starts to expand at the inlet port, and finishes its contracting at the outlet port.

Oil is drawn in by the partial vacuum, and forced out by the shrinking of the chamber, the same as in the balanced vane pump.

However, the design of the unbalanced vane pump is different from the balanced type, as we'll explain now.

BALANCED VS. UNBALANCED VANE PUMPS

The balanced vane pump is really a refinement of the unbalanced model. Why was this refinement needed?

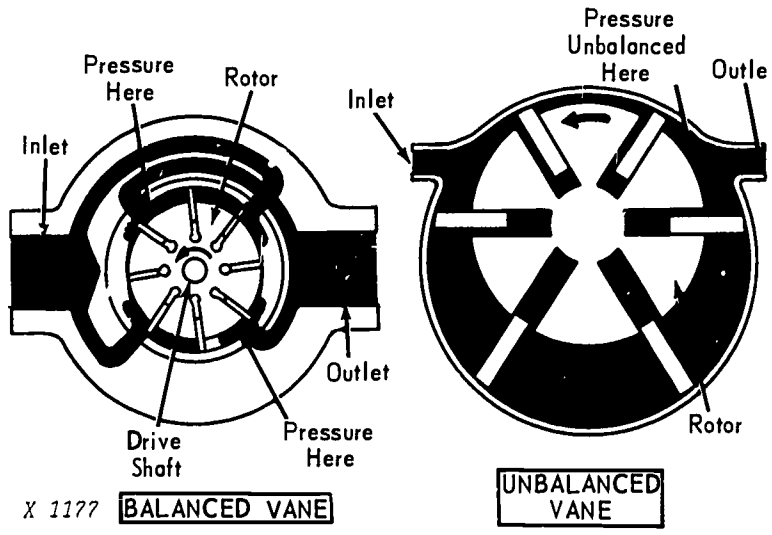

Fig. 14—Balanced Vs. Unbalanced Vane Pumps—Pressure on Rotor and Shaft

The answer is shown in Fig. 14. The unbalanced vane pump seemed to have frequent bearing failures. The cause was found to be force on the shaft and bearings of the back pressure from oil being expelled at the outlet side of the pump. No equal force was exerted on the opposite side, since the inlet oil was under little or no pressure.

The balanced vane pump was a solution to this problem. To balance off the outlet pressures on the shaft, **two** outlet ports were used, directly opposite each other. This equalized the forces, increased bearing life, and made the pump work longer.

While the balanced vane pump solved one problem, it posed another one: it could only be used for fixed displacement. The outlet port positions cannot be changed or the balance would be upset.

The unbalanced model can be used either for fixed or variable displacement. By special design, the position of its rotor ring and oil ports can be changed in relation to the offset of the rotor. This changes the size of the chambers which the vanes create, thus the amount of oil each carries. The result: a variable displacement pump.

So the two vane pumps give you a choice:

1. Longer service life, or
2. More flexible operation.

The final choice for any hydraulic system depends upon the job to be done.

PISTON PUMPS

Piston pumps are often favored on modern hydraulic systems which use high speeds and high pressures.

However, piston pumps are more complex and more expensive than the other two types.

Piston pumps can be designed for either fixed or variable displacement.

Most piston pumps are included in two types:

- **Axial Piston Pumps**
- **Radial Piston Pumps**

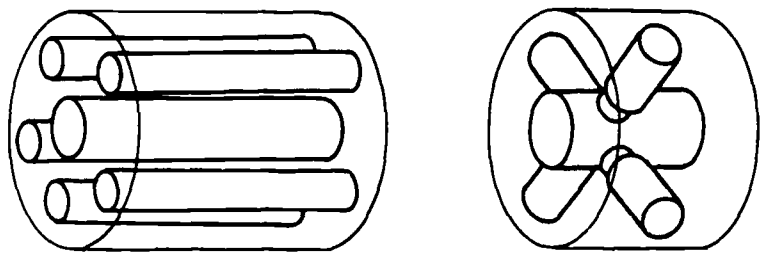

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Fig. 15—Axial and Radial Piston Principles

AXIAL piston means that the pistons are mounted in lines parallel with the pump's "axis" (a line down the center). See Fig. 15.

RADIAL piston means that the pistons are set perpendicular to the pump's center like the sun's rays.

Both styles of piston pumps operate using pistons which pump oil by moving back and forth in cylinder bores. (Another term for this movement is "reciprocate.")

The true reciprocating piston pump is shown in Fig. 16. The most efficient pump in hydraulics, this pump is not used in machine hydraulic systems because it takes up too much space.

Axial and radial piston pumps use reciprocating pistons but drive them by the rotary principle. In this way the efficiency of the reciprocating method is combined with the compactness of the rotary operating pump.

The result is a pump which is efficient, yet can fit into a machine hydraulic system.

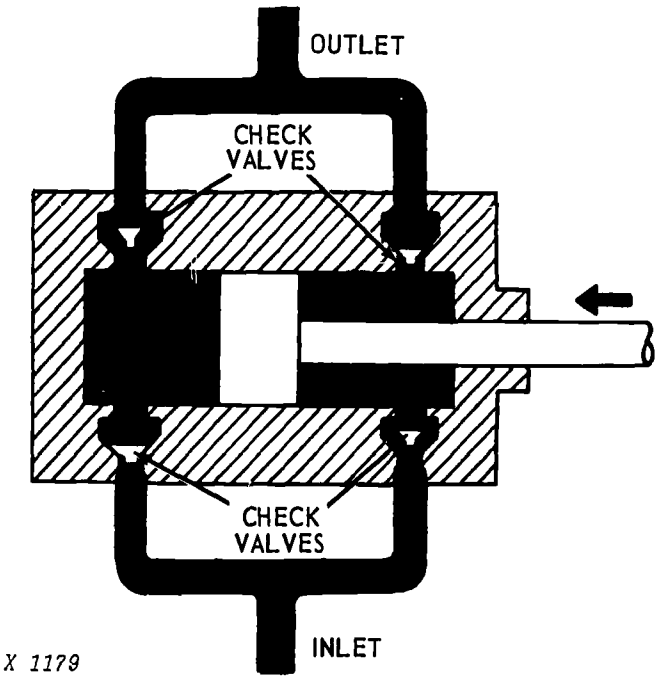

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Fig. 16—Reciprocating Piston Pump

AXIAL PISTON PUMPS

Axial piston pumps usually fall into two broad types: inline and bent-axis.

Inline Axial Piston Pumps

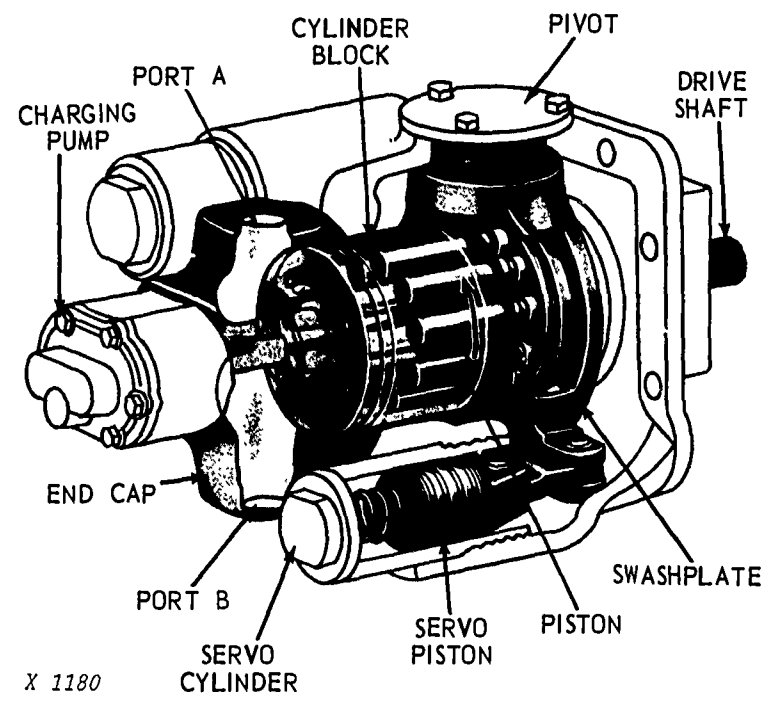

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Fig. 17—Inline Axial Piston Pump—Variable Displacement

In this pump, the cylinder block is mounted on a drive shaft and rotates with the shaft (Fig. 17).

The pistons work in bores in the cylinder block which are parallel to the axis of the block. The heads of the pistons are in contact with a tilted plate called a swashplate.

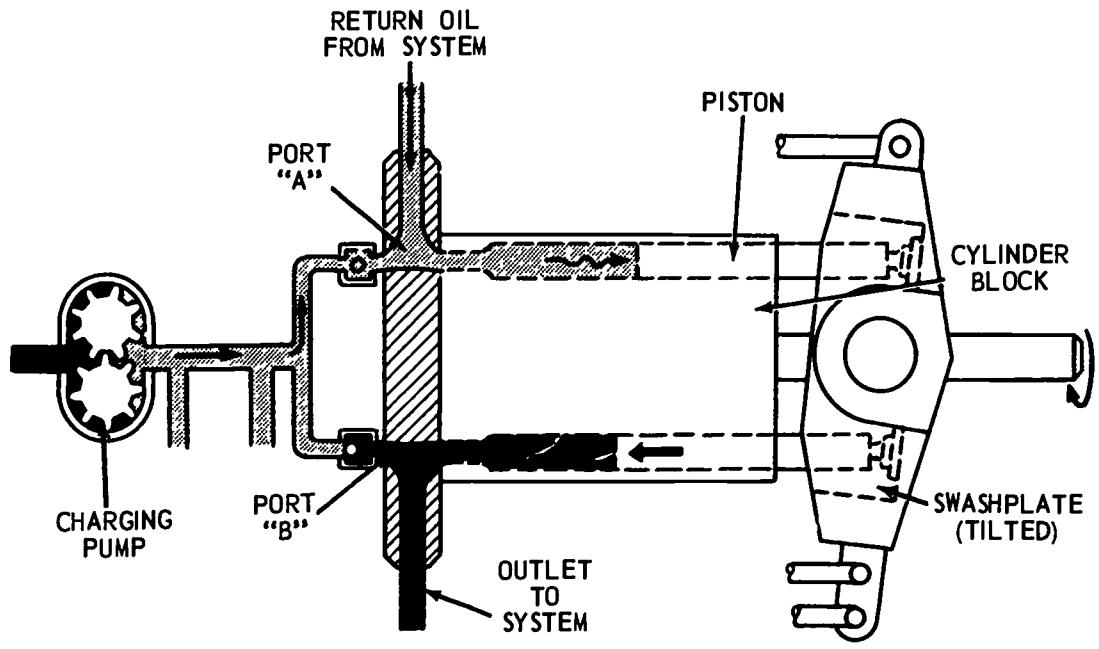

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Fig. 18—Inline Axial Piston Pump in Operation

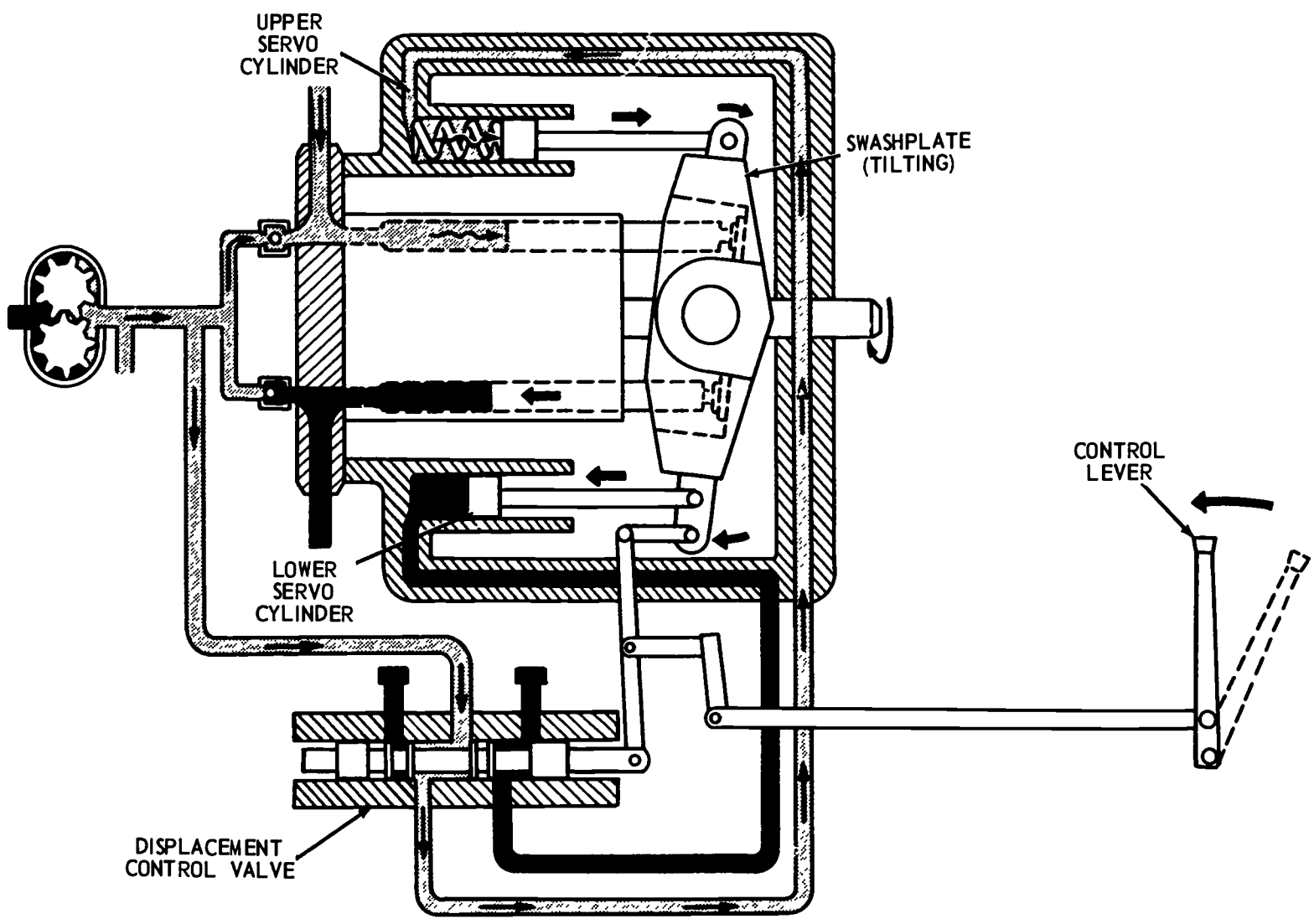

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Fig. 19—Servo Device in Operation, Tilting Swashplate

The swashplate does not turn but it can be tilted back and forth. It mounts on a pivot and is controlled by an automatic "servo" device.

Since the swashplate controls the output of the pistons, this pump has a variable displacement.

First let's see how the basic pump works and then we'll explain the servo device.

In Fig. 18 the swashplate has been tilted to the right at the top.

Remember that the angle of the swashplate controls the distance that the pistons can move back and forth in their bores. The greater the angle, the farther the pistons travel and the more oil that is displaced by the pump.

When the swashplate is tilted as shown, port "A" is the inlet port. As the cylinder block rotates, piston bores align with this port and oil is forced into the bores by the small charging pump. This oil pushes the pistons against the swashplate. Then as they revolve, these pistons follow the tilt of the swashplate and force the oil out of their bores into port "B", the outlet.

If the angle of the swashplate was fixed, the pump would operate as a fixed displacement type, putting out the same amount of oil with each revolution.

But on this pump the swashplate can be moved—hence, variable displacement. This is done by a servo device as we'll explain now.

The servo device has been added in Fig. 19.

To tilt the swashplate, the control lever is actuated, moving the displacement control valve to the left. This directs oil from the charging pump into the upper servo cylinder, moving the piston which tilts the swashplate.

Meanwhile the piston in the lower servo cylinder is pushed in by the lower part of the swashplate, forcing its oil back through the valve to the pump case.

When the swashplate reaches the angle set by the control lever, the control valve returns to neutral and traps the oil in the servo cylinders. This holds the swashplate until the control lever is moved again.

The pump keeps on pumping as explained before, drawing in oil at the top and pushing out oil at the bottom of each revolution.

If the swashplate were tilted the opposite way, the inlet-outlet cycle of the pump would be reversed. Oil would be drawn in at the bottom and pushed out at the top. So the servo device not only controls the pump displacement but also the direction of this oil.

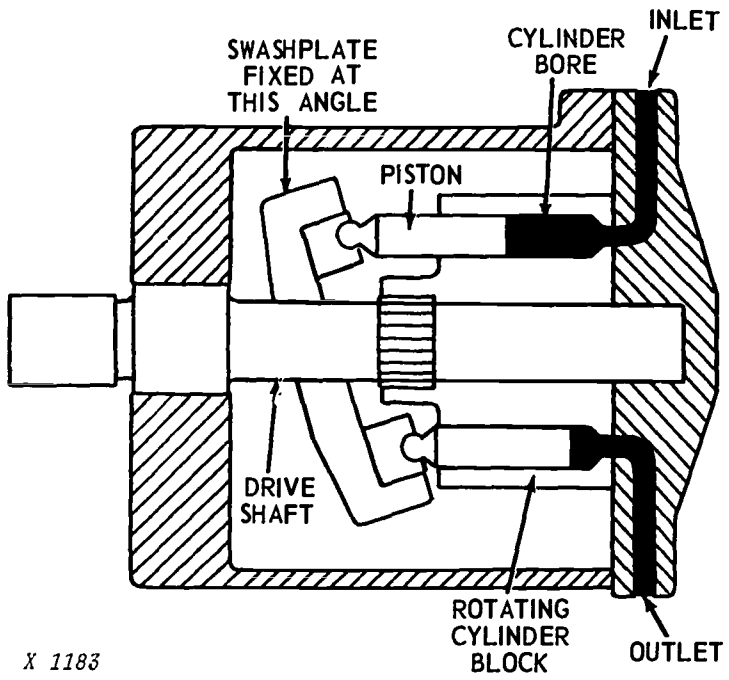

Fig. 20—Inline Axial Piston Pump—Fixed Displacement

There are two other models of the inline piston pump. Both are fixed displacement types.

The first pump, shown in Fig. 20, operates on the same principle we have just described. The only difference is that no servo device is used. The swashplate is fixed at the angle shown.

The second pump, as you can see in Fig. 21 (next page), is quite different. The cylinder block is stationary while the swashplate rotates. The pistons contact the swashplate as it rotates and slide the pistons back and forth in their bores, pumping oil.

Valves are used to separate inlet and outlet oil routes to each piston bore as shown. The check valve balls seat to prevent oil from going out the outlet gallery until forced out by the piston.

Each piston acts like a separate pump, opening and closing its valves to cycle its oil with each revolution.

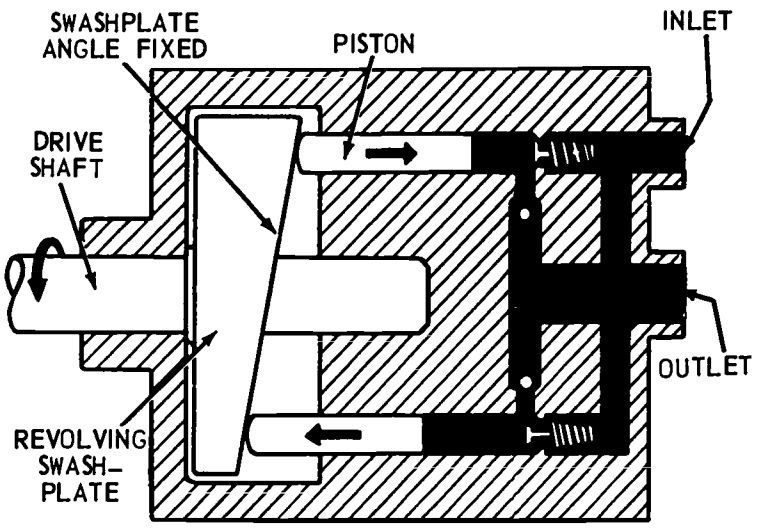

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Fig. 21—Inline Axial Piston Pump—Fixed Displacement

Bent-Axis Axial Piston Pump

Another type of axial piston pump is the bent-axis type. Fig. 22 shows a fixed displacement model of this pump.

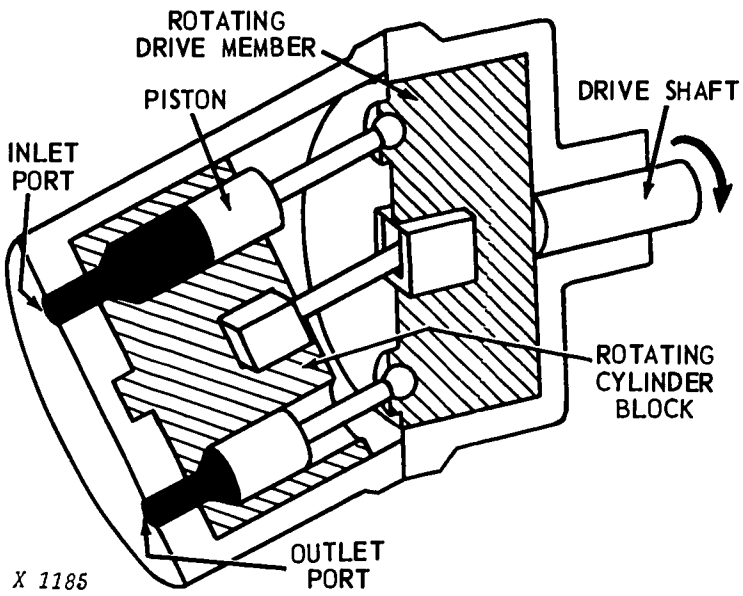

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Fig. 22—Bent-Axis Axial Piston Pump—Fixed Displacement

In this pump, the pump housing is slanted in relation to the driving member. The piston heads are connected to the drive member, which is driven by the drive shaft.

Both the cylinder block and drive member rotate and are enclosed in the pump housing.

As the two units revolve, the pistons are forced in and out of their bores by the tilting of the drive member, pumping oil as shown.

RADIAL PISTON PUMPS

Radial piston pumps are among the most sophisticated of all pumps. They are capable of high pressures, high volumes, high speeds, and variable displacement.

The basic operation is simple, but by using extra valves and other devices, this pump can be adapted to many systems and needs.

This pump is closely fitted, so wear can be a problem unless clean oil is used. And the oil must contain properties which lubricate the closely fitted parts.

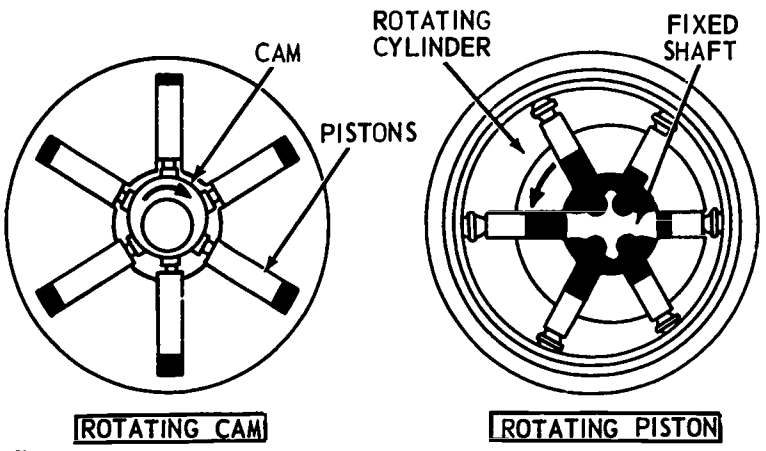

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Fig. 23—Two Operating Principles of Radial Piston Pumps

Radial piston pumps are designed to operate in two ways (Fig. 23).

In the "rotating cam" pump, the pistons are located in a fixed pump body. The center shaft has a cam which drives the pistons as it rotates.

In the "rotating piston" pump, the pistons are located in a rotating cylinder. As the cylinder rotates, the pistons are thrown out against the outer housing. Since the rotating cylinder is set offside in the housing, the pistons are moved back and forth as they follow the housing.

Let's follow the basic operation of each pump.

Radial Piston Pump (Rotating Cam Type)

The typical radial piston pump shown in Fig. 24 uses the "rotating cam" principle and is normally designed as a four- or eight-piston model.

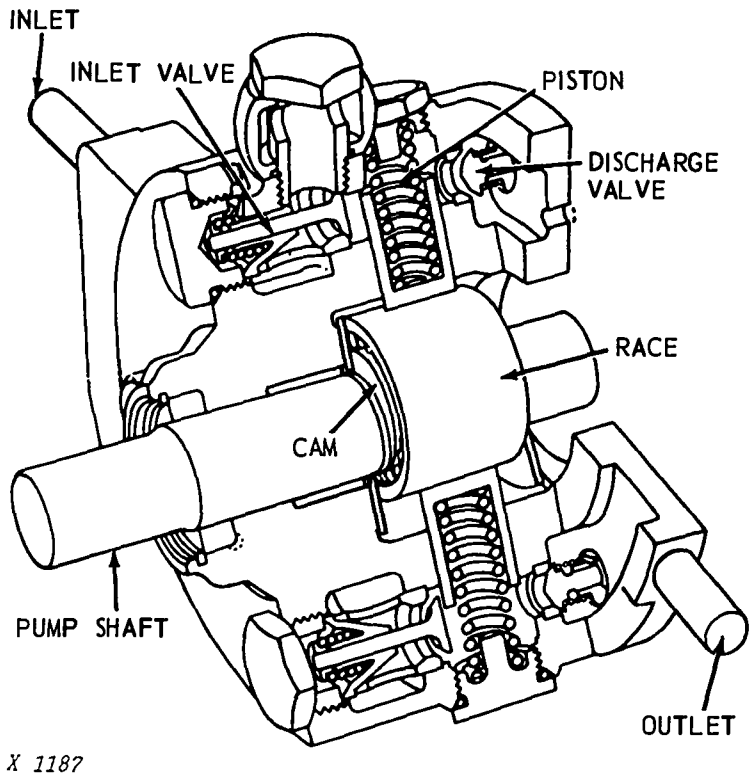

Fig. 24—Radial Piston Pump (Rotating Cam Type)

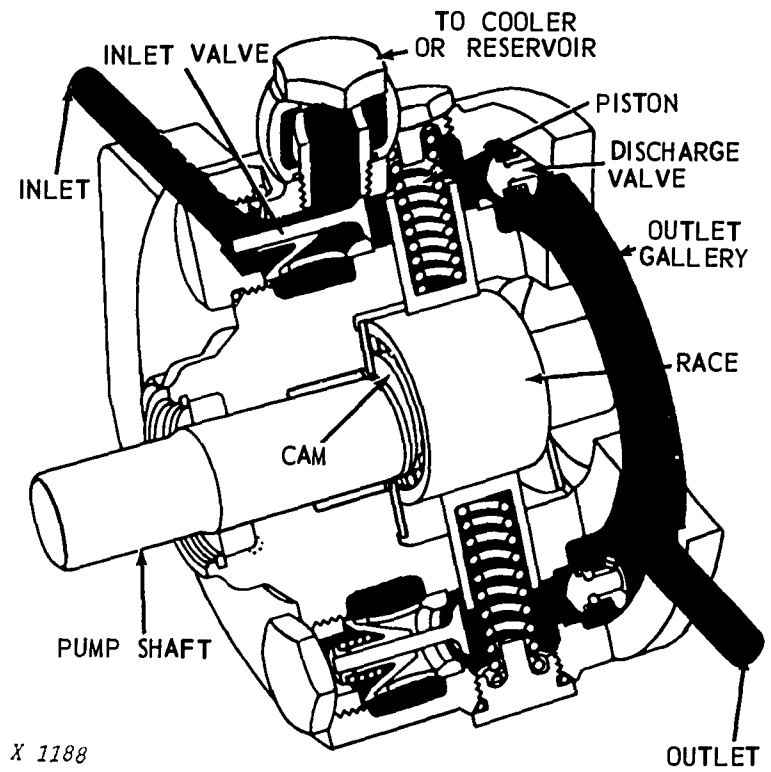

Fig. 25—Radial Piston Pump in Operation (Without Stroke Control Mechanism)

The radial pistons are located in bores in a fixed housing. The drive shaft has an eccentric cam which contacts the pistons as it turns, moving them out to pump the oil.

Oil inlet and outlet is through annular passages, at each end of the pump housing. Ports on each side of the piston bore connect with these passages. Spring-loaded valves in the ports allow oil to flow in and out of the piston bores.

The pistons are driven outward to discharge by the shaft cam; they move inward to take in oil by force of their springs.

As it stands now, this pump could have a fixed displacement. But if that was all we needed, a cheaper gear or vane pump would do the job as well or better.

The radial piston pump is used only where extra features like variable displacement are required.

For variable displacement, a stroke control mechanism is used.

To understand how the stroke control feature works, let's first look at how the pump works without it—as a fixed displacement type.

INLET STROKE OF PISTONS

When the piston springs return the piston to the center of the pump, a partial vacuum is created in the bore. This vacuum plus oil pressure opens the inlet valve and incoming oil fills the piston bore. When the bore is filled, the vacuum is gone and the inlet valve is closed by its spring.

A small charging pump is commonly used to feed in low pressure oil to the radial piston pump.

DISCHARGE STROKE OF PISTONS

To discharge oil, the revolving cam contacts the piston, forcing it outward. This force opens the outlet valve and discharges the oil into the outlet gallery. When the piston reaches the top of its stroke, the flow stops and the outlet valve is closed by its spring.

The piston then starts on its inlet stroke and the cycle begins again.

The cycle of each piston works in rapid sequence as the cam rotates. This produces a constant flow of oil.

The output of oil depends on the speed of the pump alone—**if** it were a fixed displacement pump.

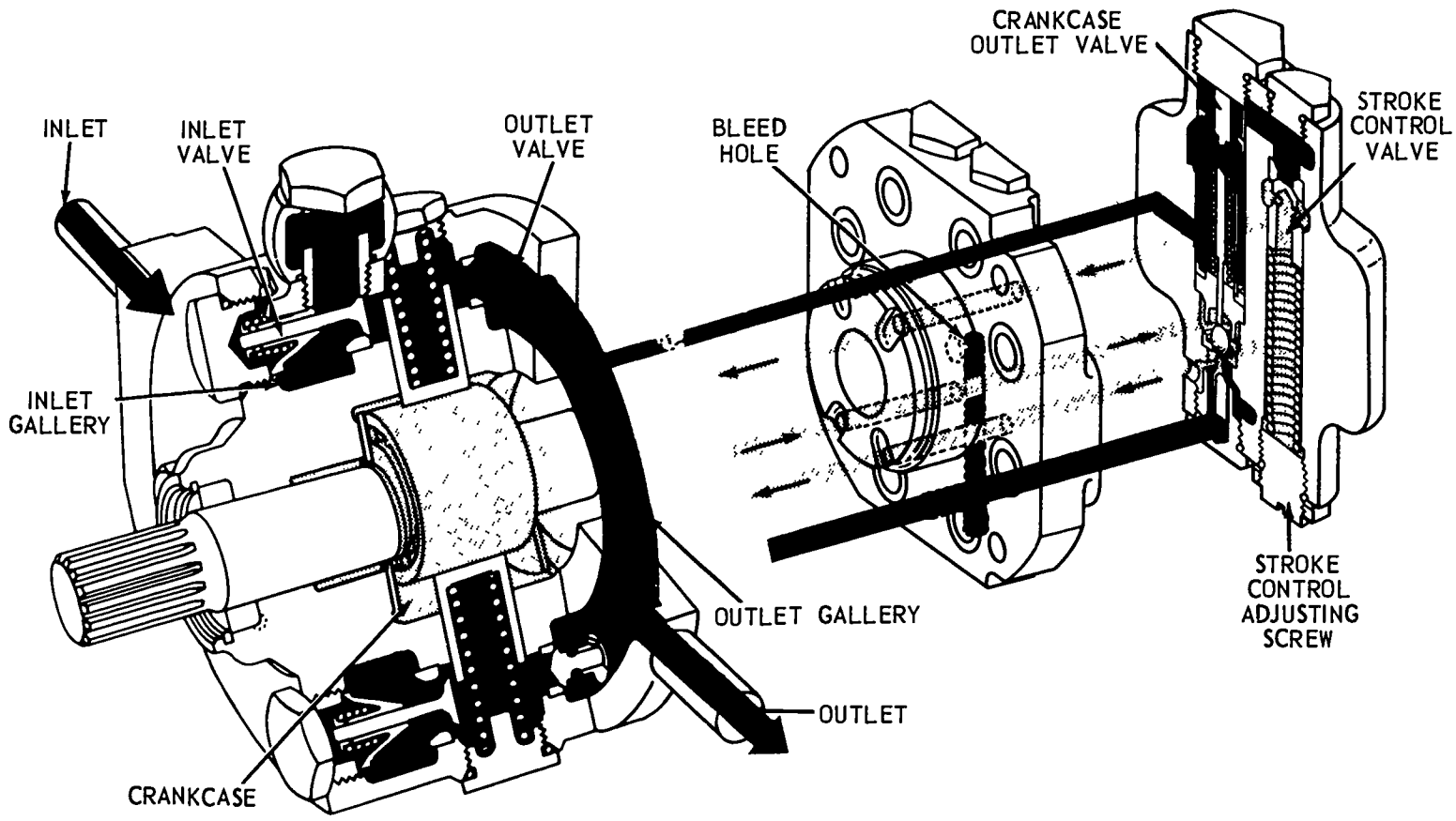

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Fig. 26—Radial Piston Pump Using Stroke Control Mechanism

USE OF STROKE CONTROL MECHANISM

How does a stroke control mechanism vary the displacement of this pump?

One way would be to slow down or stop the pump drive shaft. But this would require a manual or mechanical device that means reaction time lags and human errors.

Another way to control output would be to hold the pistons away from the driving cam. This is what the stroke control mechanism does—automatically, using hydraulics.

The stroke control valve admits oil into the crankcase at the center of the pump (Fig. 26). This oil is under sufficient pressure so that it holds the pistons away from the cam. The crankcase outlet valve is closed, trapping this pressure oil.

This causes the pump to slow down its pumping and go into a "standby" position, even though the drive shaft keeps on turning.

When there is a demand from a hydraulic function, the pressure drops at the crankcase outlet valve, allowing the spring to open it. This releases the oil from the pump crankcase into the inlet gallery.

As pressure drops in the pump crankcase, the pistons contact the cam again and start pumping oil. The pump goes back "in stroke."

As the demand for oil in the system is satisfied, the flow of oil slows down and back pressure closes the crankcase outlet valve and opens the stroke control valve. The pump keeps on pumping until the crankcase pressure holds the pistons away from the cam. The pump goes "out of stroke."

While in standby the pump still moves a slight amount of oil. This oil is directed through a bleed hole back to the inlet gallery to cool and lubricate the pump.

Initial pressure in the system is controlled by an adjusting screw on the stroke control valve. This screw controls the system pressure at which oil is released into the pump crankcase to build pressure. By controlling the distance that the pistons can travel toward the cam, this controls the amount of fluid that flows into the piston bores to be pumped to the system.

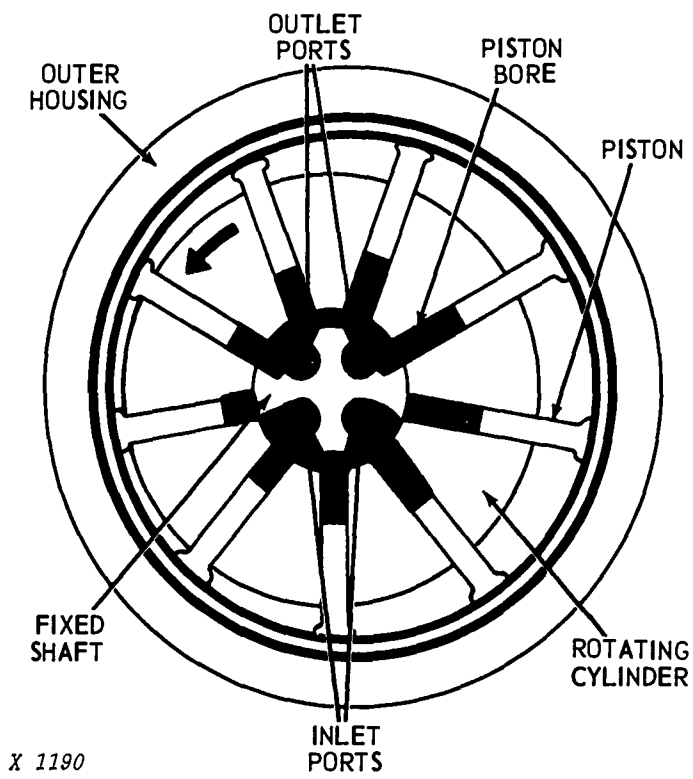


Fig. 27—Radial Piston Pump (Rotating Piston Type)

Radial Piston Pump (Rotating Piston Type)

The other version of the radial piston pump is shown in Fig. 27.

It has rotating pistons and operates much like an unbalanced vane pump. As the eccentric cylinder rotates, the pistons work back and forth on the inner surface of the housing. The inlet and outlet ports are divided by a spindle on the fixed center shaft.

As the cylinder rotates, the pistons are thrown out against the housing by centrifugal force. A partial vacuum is created in the piston bores and oil flows in the inlet ports to fill the bores as shown.

As the cylinder keeps turning, the pistons are pushed back into the bores and force the oil out the ports on the outlet side.

Variable displacement is controlled by adjusting the relation of the outer housing to the cylinder. This governs the travel of the pistons and so the amount of oil pumped during each cycle.

This concludes our descriptions of the three types of pumps used in modern hydraulic systems.

SUMMARY OF PUMP TYPES

Before going into the application and efficiency of hydraulic pumps, let's review some of the points that we have just covered.

In summary:

1. A hydraulic pump converts mechanical force into hydraulic or fluid power—in other words, induces fluid to work.

2. Of the two main types of pumps, positive displacement and non-positive displacement, the positive displacement type is best suited for power hydraulics due to its ability to produce a steady flow of fluid which overcomes resistance in the system.

3. A hydraulic pump can be designed to produce either a specific volume of fluid at a specific speed, or to produce a variable volume of fluid at a constant speed . . . fixed displacement or variable displacement.

4. The three types of pumps most often used in machine hydraulic systems are gear, vane, and piston.

5. These three pumps operate on a rotary principle. This allows them to be constructed as small units, yet still have the ability to produce the required volume of fluid.

6. The preceding text covers only basic hydraulic pumps and there are a great number of variations on all of the pumps selected.

HYDRAULIC PUMP EFFICIENCY

Thus far, we have only described the three most popular types of pumps. This, of course, is not the whole story on hydraulic pumps. Their application and efficiency is just as important as their operation and this may help later in diagnosing hydraulic problems.

PUMP QUALITIES

Because of the wide variety of pumps and hydraulic systems, we could not possibly prescribe a particular model of pump for a particular system.

However, we can describe the desirable and undesirable qualities of the three pumps and let you judge for yourself the reasons why a particular pump is used in a hydraulic system.

PHYSICAL SIZE

One of the first factors to consider when choosing a pump for a machine system is the pump's physical size. Most of these systems have little or no room to spare and may allow just a small area for

the pump. Fortunately, with the wide variety of pumps and pump sizes available, this is not a big problem . . . unless the system requires a function that a pump cannot provide except as a large unit. In this case, space for the pump, regardless of size, will be made available, because the other more important requirements of the system cannot be sacrificed.

PUMP DELIVERY, PRESSURE, AND SPEED

One other requirement is the volume of fluid that the pump produces.

Most pumps are rated by volume, which is usually expressed in gallons per minute (gpm). This rating is called several names—delivery rate, displacement, capacity, or size. Regardless of the rating, it cannot stand alone. It must be accompanied by a figure stating the amount of back pressure that the pump can withstand and still produce the gpm rating; for as pressure increases, internal pump leakage increases and usable volume decreases.

Pump speed must also be included with the volume rating for two reasons.

First, in a fixed displacement pump, flow is directly related to the speed of the pump—the faster the speed, the more fluid pumped.

Second, how fast the pump must go to produce a certain flow indicates at what speed the driving mechanism for the pump must travel (in revolutions per minute or rpm). Add this to the delivery rate of a pump, and here is an example of how a rating could read: "11.5 gpm with 2000 psi at 2100 rpm."

Occasionally, a pump will have an alternate delivery rate, referred to as an intermittent delivery rate. This rating indicates the highest level a pump can operate, in terms of delivery, pump speed and pressure, for a period of time and still maintain satisfactory service life.

PUMP EFFICIENCY

The efficiency of a pump (how well it does its job) is also important in selecting a pump.

We may have a pump that meets the delivery requirements of a system under the existing pressure in the system at the speed that is available to drive the pump—we may have all this and more . . . but what if we find that the pump requires a great amount of mechanical power to attain this delivery rate? Or what if we find that the materials in the pump must be specially and expensively constructed to withstand the pressure or friction in the system? This is why the knowledge of pump efficiency is important before selecting a particular pump. We are not only looking for delivery rate, but delivery rate provided by efficient and economical operating means.

Pump quality is judged by three ratings:

- **Volumetric Efficiency**
- **Mechanical Efficiency**
- **Over-All Efficiency**

VOLUMETRIC EFFICIENCY is the ratio of the actual output of the pump to theoretical output (the amount it should put out under ideal conditions). The difference is usually due to internal leakage in the pump.

MECHANICAL EFFICIENCY is the ratio of the overall efficiency of the pump to volumetric efficiency. This difference is usually due to wear and friction on the pump's working parts.

OVER-ALL EFFICIENCY is the ratio of the hydraulic power **output** to the mechanical power **input** of the pump. This is the product of both mechanical efficiency and volumetric efficiency.

SUMMARY OF PUMP SELECTION

There are sundry other factors in judging pumps and pump applications—such as a pump's adaptability to certain fluids—its adaptability to different types of systems and system layouts—the environment that the pump will be working in—cost of the pump—etc.

All of these factors have a part in selecting a pump for a particular system.

CLASSIFYING GEAR, VANE, AND PISTON PUMP EFFICIENCY

Now that we have discussed some of the factors used in evaluating a hydraulic pump, let's compare the three types of pumps and see how they stack up.

Remember, though, that we are still talking in a general sense. For more detailed specifications, go to the machine technical manual.

PHYSICAL SIZE

In physical size, you will find that all three types of pumps will range from very small to very large. Physical size, then, is not too important.

Of the three, you will generally find that the gear pump is the smallest, the piston pumps the largest, and the vane pumps in between. The reasons for this are not so much because of the lack of space, but because of the delivery requirements of the different systems.

PUMP DELIVERY, PRESSURE, AND SPEED

Delivery rate is another matter. Piston pumps usually deliver more fluid under greater pressure and operate at higher speeds. Vane pumps are second and gear pumps are third in this respect.

Overall, this is how the three pumps measure up in the delivery rate, pressure and speed departments:

	Delivery (Gpm)	Pressure (Psi)	Speed (Rpm)
Gear Pump	0.2 - 150	250 - 2500	800 - 3500
Vane Pump	0.5 - 250	250 - 2500	1200 - 4000
Piston Pump	0.5 - 450	750 - 5000	600 - 6000

As you can see, there is a wide range of available delivery rates. This is not to say that most machines require this wide range.

Delivery rates of pumps used on modern farm and industrial equipment generally range from one to fifty gpm.

Pressure usually runs from 100 to 2500 psi. Top pump speed will generally range from 800 to 3500 rpm.

Efficiency of the gear, vane, and piston pumps range from 75% to 95%.

Piston pumps are usually rated on the high side, gear pumps on the low side, and vane pumps in the middle. These figures are based only on the three efficiency ratings. It does not include the adaptability of the pump to the system, the material used in pump construction, or the initial cost of the pump.

SUMMARY OF PUMP EFFICIENCY

In summary, the major factor in adapting a pump to a particular system is that system's overall needs. It would be foolish to use a pump with high delivery in a system that requires only a low delivery rate. By the same token, using a pump that must produce at its peak continuously just to meet the minimum requirements of the system is equally wrong. Making either of these mistakes produces a poor system due to excessive initial pump costs or continual costly repairs.

Use a pump that is suited to the system, whether a gear pump, which has fewer moving precision parts, or a piston pump, which has many parts fitted to close tolerance and is therefore more expensive.

This kind of choice will give better and more economical service than using a pump that is "overpowered" or "underpowered."

MALFUNCTIONS OF PUMPS

THE HUMAN ERROR FACTOR

The majority of hydraulic pump failures are due to human factors: poor maintenance, bad repair, exceeding operating limits, and the greatest cause—the use of fluid which is dirty or of poor quality.

Hydraulic pumps can wear out through normal use, but few pump failures can be attributed to "old age."

From the list of causes, you will see what is responsible for the majority of failures—the HUMAN ERROR factor.

To prevent this, know your hydraulics, maintain the system, operate it as designed, and use the proper fluids.

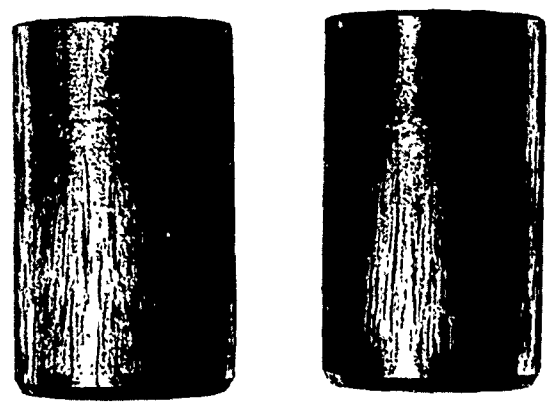
We might point out that this is a prime example of why this manual was written. By presenting you with the basic theory and operation of hydraulic systems, we hope to reduce this large percentage of human error.

In the remainder of this chapter, we will cover the general causes of pump failures, how they can be prevented, and some of the general repairs that can be made on them.

CONTAMINATED FLUID

Since hydraulic fluid and its proper use is covered in Chapter 10, we will only relate here what happens to a pump it the fluid is contaminated or will not adapt to the requirements of the pump.

As we said before, contaminated or improper fluid is the biggest offender in hydraulic pump failures.



X 1191

Fig. 28—Pump Pistons Scored by Contaminated Fluid

Contaminated fluid can damage a pump in many ways. Solid particles of dirt, sand, etc. in the fluid act as an abrasive on the pump's closely fitted parts (Fig. 28). This causes abnormal wear on the parts and increases internal leakage, thus lowering the pump's efficiency.

X 1192

Fig. 29–Vane Pump Rotor Damaged by Contaminants in Fluid

Sludge is formed by the chemical reaction of fluid to excessive temperature change or condensation. It will build up on the pump's internal parts and eventually plug the pump (Fig. 29). If the pump is plugged on the inlet side, it will be starved for fluid and the heat and friction will cause the pump parts to seize.

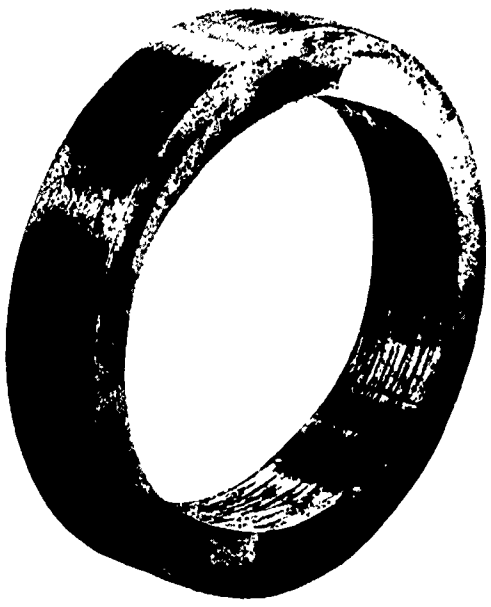


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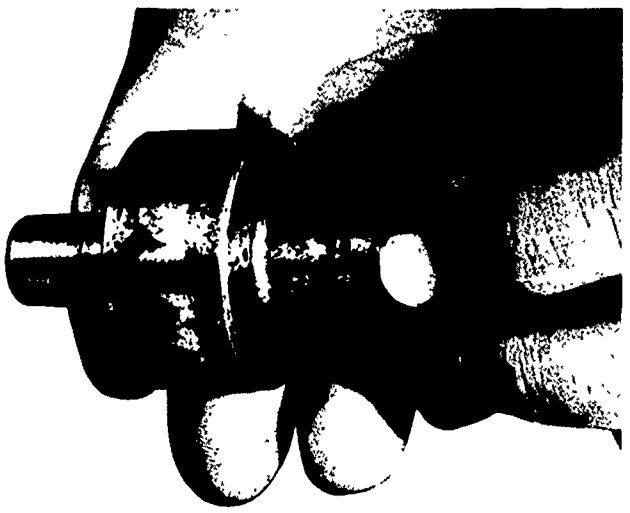
Fig. 30–Abnormal Wear Created by Sludge (Vane Pump Rotor Ring)

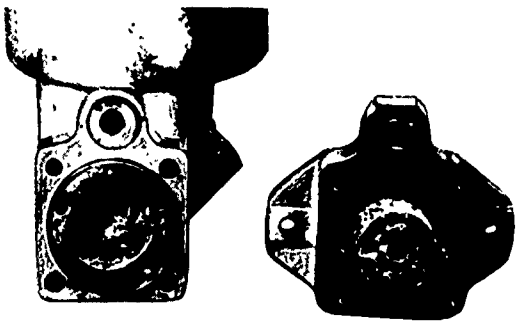
Air, plus water, plus heat will also create sludge by oxidation and the results to the pump will be the same. See Fig. 30.



X 1194

Fig. 31–Pump Drive Cam Pitted by Rust

Water or other foreign liquids in the fluid can rust the pump parts and housings (Figs. 31 and 32). Rust will not only build up on the metal, but will also flake off into the fluid as abrasive solid particles.



X 1195

Fig. 32–Balanced Vane Pump Rusted by Water in the Fluid

IMPROPER FLUID

The selection of the proper fluid viscosity is extremely important. Viscosity is the rating given to the degree that the fluid resists flow. A high viscosity number indicates that the fluid will strongly resist flow. These ratings are usually referred to as "light" and "heavy" fluids.

Below are some of the things that may occur if the fluid viscosity is wrong:

If the fluid is too "light":

1. Both internal and external leakage will increase.

2. Pump slippage will increase, which will cause heat and reduce efficiency.
3. Parts wear will increase for lack of adequate lubrication.
4. System pressure will be reduced.
5. Overall control of the system functions will be "spongy."

If the fluid is too "heavy":

1. Internal friction will increase, which, in turn, will increase flow resistance through the system.
2. Temperature will increase, thus increasing the chance of sludge build-up.
3. Operation of functions will be sluggish and erratic.
4. Pressure drop throughout the system will increase.
5. More power will be required for operation.

X 1196

Fig. 33—Vane Pump Ring Wear from Use of Improper Fluid

SOME FLUIDS—BAD FOR SEALS

The chemicals that make up some fluids can also be troublemakers. They may react unfavorably with the fibers or synthetic materials used in the packings and seals of the pump. This can lead to rapid deterioration of the seals and packings and both internal and external leakage may result.

SOME FLUIDS—BAD IN THEMSELVES

Some fluids are not adaptable to the environment that the pump must work in. For instance, if the pump must work under constant high temperatures at peak performance, the fluid may have to do more work than it is capable of doing.

Thus a fluid can be literally worked to death. This results in many of the failures we have already mentioned.

POOR OPERATING PROCEDURES

Although only a small percentage of failures are due to exceeding the operating limits, this is still a problem that can be eliminated.

X 1197

Fig. 34—Broken Pump Drive Shaft—Overload from Too-Tight Drive Belts

Remember that a hydraulic pump is a precise and delicate instrument. Overspeeding or overloading it will upset the balance between long life and high efficiency, resulting in poor operation and a damaged pump. See Fig. 34.

Overloading the pump

Most pumps are rated far below their utmost capacity to provide continuous service. This allows them to be pushed up to their peak for short periods of time and still have a satisfactory operating life.

What if you continuously operated the pump at its limit? What would happen to the bearings within the pump, for instance?

Let's take an example: Suppose that the pump has been operating at 1000 psi and has a bearing life of 4800 hours. Now let's raise the operating pressure to 2000 psi. How long could we expect the bearings to last? There is a formula that we can use to determine this.

The formula:

$$\text{Bearing Life} = \frac{\text{Old Bearing Life}}{(\text{New Pressure/Old Pressure})^3}$$

Expressed in our example it reads:

$$\frac{4800 \text{ hours}}{(2000 \text{ psi}/1000 \text{ psi})^3} = \frac{4800}{2^3 \text{ (or } 2 \times 2 \times 2)} = \frac{4800}{8}$$

$$= 600 \text{ hours}$$

So we can see that by just doubling the pump operating pressure we have reduced the life of the bearings and subsequently the life of the pump by eight times (from 4800 hours to only 600 hours).

In operation, many things can cause the pump pressure to rise: poor maintenance, overloading the pump, hidden restrictions in the system.

Overspeeding the pump

By increasing the pump speed, we can also reduce bearing life. Here, again, we have a formula to show this. Let's take the same pump we used above and double its speed. Remember that the pump has a normal bearing life of 4800 hours. The formula:

$$\text{New Bearing Life} = \frac{\text{Old Bearing Life} \times \text{Old Pump Speed}}{\text{New Pump Speed}}$$

Our example:

$$\text{New Life} = \frac{4800 \text{ Hours} \times 2000 \text{ rpm}}{4000 \text{ rpm}} = \frac{9{,}600{,}000}{4000}$$

$$= 2400 \text{ hours}$$

By doubling the speed, we have reduced the pump's life by one half. Now we can see why pump failures result from exceeding pump specifications.

CAVITATION

Pump cavitation is another "evil" resulting from either poor maintenance or poor operation.

Cavitation occurs when the fluid does not entirely fill the space provided for it in the pump. This leaves air cavities in the liquid which can be detrimental to the pump.

The combination of the high velocity (speed) of the discharged fluid and a restriction, usually caused by a clogged inlet line, between the reservoir and the pump causes the pressure of the incoming fluid to drop. When it is lowered, it cannot force enough fluid in to meet the demands of the pump. The result is that cavities or spaces are formed in the incoming fluid.

The pressure drops to the vapor tension of the fluid and the cavities fill with vapor. The vapor tension of the fluid is that pressure at which, at a given temperature, the fluid boils and freely evaporates. This evaporation fills the cavities.

The problem is further complicated by the pressure drop because this tends to release any dissolved air in the fluid and it, too, fills the cavities.

The damage to the pump results when these vapor-filled cavities, which have been formed in a low pressure area, meet with a high pressure area in the pump and are forced to collapse. This creates an action similar to an implosion which disintegrates or chips away small particles of the metal parts of the pump, adds excessive noise, and causes pump vibration.

A pump that is allowed to continually cavitate will soon have some seriously eroded parts, not to mention sluggish or erratic operation. Eventually the working parts may seize.

Chapter 1 covers the layout of hydraulic systems. Here we will only relate some of the pump problems that could develop if the system were changed in any way that would affect its operating efficiency.

Remember that the layout of each hydraulic system is precisely designed. The distance that the fluid must travel, the angle of the lines, the diameter of the lines, the placement of valves, filters and reservoirs—all are carefully planned to give the best performance of the overall system.

If a part of the system is changed and/or substandard parts are used, it could affect the operation of the pump and damage it.

For example, substituting a length of tubing that is smaller in diameter than the original, could create a pressure drop that would cavitate the pump.

Or placing the reservoir further from the pump could cause the pump to be starved for fluid.

A reservoir that is too small for the system will also cause starvation of the pump.

Using a line made of material that cannot meet the standards of the system and might burst under a surge of high pressure could also damage the pump.

POOR MAINTENANCE

Poor maintenance can also damage the pump. If hydraulic lines are not frequently checked for leaks, air could be introduced into the system, which could cause the fluid to foam or cavitate. Low fluid level in the reservoir could produce the same results. Failing to clean the system, when there is a chance that the fluid has become contaminated, is a prime way to damage the pump.

For details, see Chapter 11, "General Maintenance."

DIAGNOSING PUMP FAILURES

The following charts describe some of the ways in which the hydraulic pump can be damaged.

We have learned that much of the damage is due to carelessness or human error. To prevent these errors, follow the recommendations in the machine technical manual and follow the preventive maintenance program in the machine operator's manual.

The charts below should help you to remedy some of the problems that you may face in making a general diagnosis of hydraulic pump problems.

I. PUMP DOESN'T DELIVER FLUID

Possible Cause	Possible Remedy
1. Fluid level in reservoir too low.	1. Fill the reservoir with the proper grade and type of fluid. Check for possible external leaks.
2. Pump inlet line plugged.	2. Remove and clean. Check filters and reservoir for other possible obstructions.
3. Air leak in pump inlet line.	3. Repair leak.
4. Pump speed too slow.	4. Increase speed to within manufacturer's specifications. If belt-driven, check the belt.
5. Sludge or dirt in the pump.	5. Dismantle and clean pump. Clean entire system and fill with clean fluid.
6. Fluid viscosity too high.	6. Check manufacturer's recommendation. Refill with same.
7. Variable control mechanism out of adjustment. (Variable displacement pumps)	7. Adjust according to the machine service manual specifications.
8. Broken or worn parts inside the pump.	8. Analyze the conditions that brought on the failure and correct them. Repair or replace the parts according to machine technical manual specifications.

II. NO PRESSURE

1. Pump not delivering fluid.	1. Follow the remedies in Part I above.
2. Vanes in vane pump sticking.	2. Check for burrs or metal particles that might hold vanes in their slots. Repair or replace if necessary. Clean system if contaminants are found.
3. Fluid recirculating back to reservoir and not going to functions.	3. Mechanical failure of some other part of the system, especially a relief valve. If contamination involved, clean and refill with clean proper fluid.
4. Pump piston or valve broken or stuck open to allow fluid to return to inlet side.	4. Disassemble the pump, determine the cause, and correct it. Repair according to machine technical manual.

III. LOW OR ERRATIC PRESSURE

1. Cold fluid.	1. Warm up system. Operate only at recommended operating temperature range.
2. Fluid viscosity wrong.	2. Change to manufacturer's recommended grade.

III. LOW OR ERRATIC PRESSURE—Continued

3. Air leak or restriction at inlet line.	3. Repair or clean according to machine technical manual.
4. Pump speed too slow.	4. Increase speed to within specifications.
5. Internal parts in pump are sticking.	5. Dismantle and repair according to machine technical manual. Look for burrs on parts or metal particles in fluid. If contaminants are the the cause, thoroughly clean system and refill with proper grade of fluid.
6. Distance between internal parts has increased due to wear.	6. Dismantle and repair. If wear is abnormal, determine the cause by checking the operation and maintenance records as well as by examining the pump and system.

IV. PUMP MAKING NOISE

1. Restricted or clogged inlet line.	1. Clean or repair.
2. Air leaks in intake line or air drawn through inlet line.	2. Repair or make sure that inlet line is submerged in fluid in the reservoir. (To check for leaks, pour fluid around joints and listen for a change in sound of operation).
3. Low fluid level.	3. Refill with proper grade and type of fluid to the proper level.
4. Air in the system.	4. Check for leaks. Bleed air from the system.
5. Fluid viscosity too high.	5. Fill with fluid recommended by the manufacturer.
6. Pump speed too fast.	6. Operate pump within recommended speed.
7. Stuck pump part.	7. Check for solid contaminants in fluid or burrs on parts. If burrs are the cause, repair or replace part according to machine technical manual. If contaminated, thoroughly clean system and refill with proper fluid.
8. Worn or broken parts.	8. Check and correct cause of parts failure. Repair or replace bad parts.

V. EXCESSIVE WEAR

1. Abrasive contaminants or sludge in the fluid.	1. Check for cause of contaminants. Install or change fluid filter. Replace or repair worn parts according to machine service manual. Replace fluid with recommended grade and quantity.
2. Viscosity of fluid too low or too high.	2. Replace fluid with proper grade and type.
3. Sustained high pressure above maximum pump rating.	3. Check for possible relief valve malfunction or other parts failures.
4. Air leaks or restriction in system causing cavitation.	4. Eliminate from system. Check parts for degree of wear. Replace if necessary.
5. Drive shaft of pump misaligned.	5. Check and correct according to machine technical manual.

VI. EXCESSIVE FLUID LEAKAGE

1. Damaged seals or packings around drive shaft.	1. Check and replace. Check to be sure that chemicals in fluid are not destroying packing or seals. Follow manufacturer's recommendations on grade and type of fluid.

VII. INTERNAL PARTS BREAKAGE

1. Excessive pressure above maximum limits for pump.	1. Check for parts malfunction and cause. Repair according to machine technical manual.
2. Seizure due to lack of fluid.	2. Check reservoir fluid level, fluid inlet line for restriction, or plugged filter.
3. Abrasive contaminants in fluid getting by the filter.	3. See above.

TEST YOURSELF
QUESTIONS

1. (Fill in the blanks). A hydraulic pump converts _____ force into _____ force.

2. (True or false?) "Hydraulic pumps produce flow, not pressure."

3. (True or false?) "Non-positive displacement pumps make the best hydraulic pumps because they produce a continuous flow of fluid."

4. What three types of hydraulic pumps are generally used in modern farm and industrial hydraulic systems?

5. What is the major difference between an external gear pump and an internal gear pump?

6. A(n) _____ vane pump is capable of being constructed as a fixed or a variable displacement pump. (balanced-unbalanced)

7. What does "axial" and "radial" mean in reference to the piston pumps?

8. A _____ type pump usually has fewer moving parts than the other two types. (gear, vane, piston)

9. What is the most frequent cause of hydraulic pump failures?

10. What effect will doubling the operating pressure have on pump life?

11. Doubling pump speed will (increase-reduce) pump life by (¼ - ½ - ¾).

12. Why does a pump cavitate?

ANSWERS

1. A hydraulic pump converts **mechanical** force into **hydraulic** force.

2. True.

3. False. They have no way of preventing back-feeding of oil.

4. Gear, vane and piston pumps are generally used.

5. An external gear pump has a gear on a gear and these gears rotate in the opposite direction of each other. The internal gear pump has a gear within a gear and these gears both rotate in the same direction.

6. Unbalanced—The eccentricity of the rotor to the rotor ring can be changed to vary the displacement.

7. In "axial" pumps, the pistons are parallel with the axis of their cylinder block. In "radial" pumps, the pistons are perpendicular to the axis of their cylinder block.

8. Gear

9. Human error is the No. 1 cause of pump failures. Specifically, improper condition of the hydraulic fluid is the most frequent single cause of pump failures.

10. It will decrease the life of the pump bearings and thus the pump to ⅛ its normal service life.

11. Reduce—½

12. A pump usually cavitates because of a restricted inlet line. This allows air spaces to develop in the incoming fluid. These spaces collapse when reaching a higher pressure area, thus causing a jarring effect on the pump which may result in damage to the pump parts.

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HYDRAULIC VALVES / CHAPTER 3

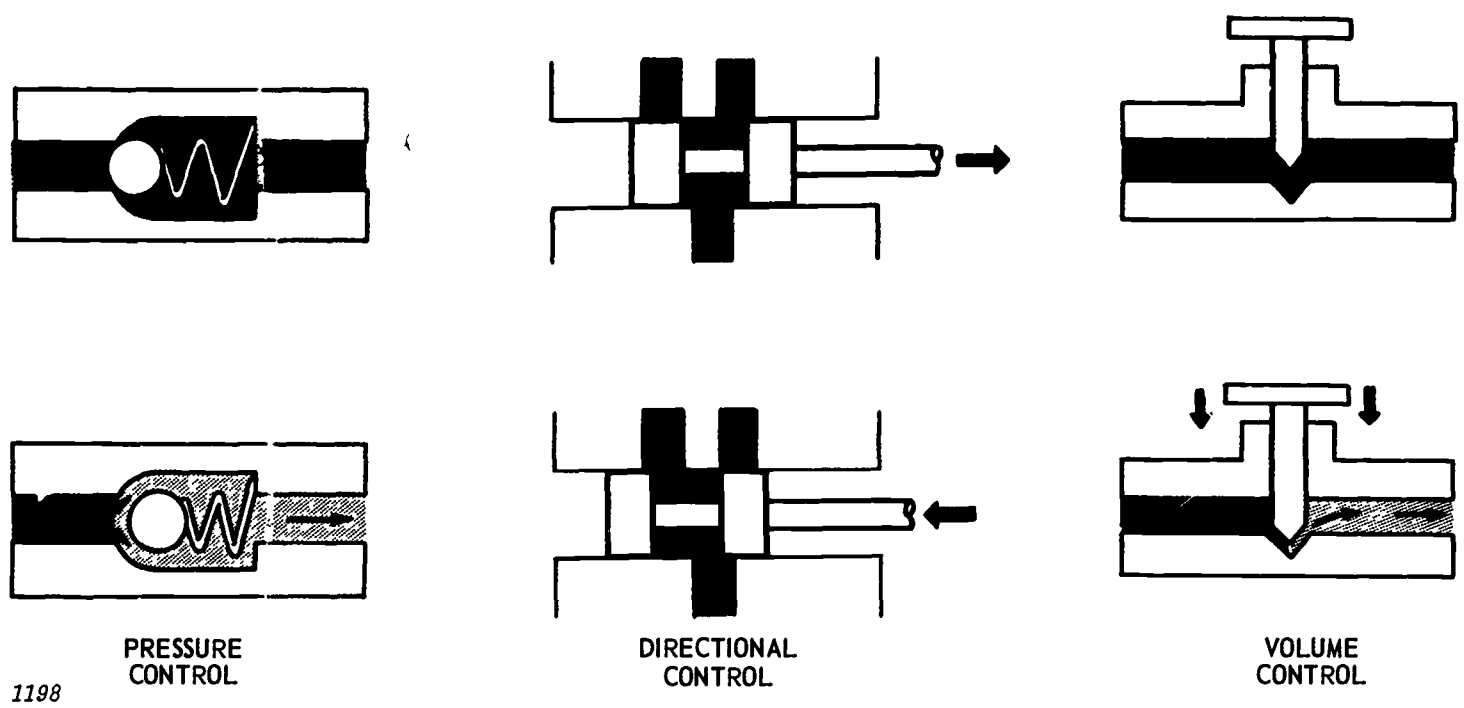

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Fig. 1 – The Three Types of Valves

INTRODUCTION

Valves are the controls of the hydraulic system. They regulate the pressure, direction, and volume of oil flow in the hydraulic circuit.

Valves can be divided into three major types:

- **Pressure Control Valves**
- **Directional Control Valves**
- **Volume Control Valves**

Fig. 1 shows the basic operation of the three types of valves.

PRESSURE CONTROL VALVES are used to limit or reduce system pressure, unload a pump, or set the pressure at which oil enters a circuit. Pressure control valves include relief valves, pressure reducing valves, pressure sequence valves, and unloading valves.

DIRECTIONAL CONTROL VALVES control the direction of oil flow within a hydraulic system. They include check valves, spool valves, and rotary valves.

VOLUME CONTROL VALVES regulate the volume of oil flow, usually by throttling or diverting it. They include compensated and non-compensated flow control valves and flow divider valves.

Some valves are variations on the three main types. For example, many *volume* control valves use a built-in *pressure* control valve.

Valves can be controlled in several ways: manually, hydraulically, electrically, or pneumatically. In some modern systems, the entire sequence of operation for a complex machine can be made automatic.

Let's discuss each type of valve in detail, starting with pressure control valves.

PRESSURE CONTROL VALVES

Pressure control valves are used to:

- **Limit system pressure**
- **Reduce pressures**
- **Set pressure at which oil enters a circuit**
- **Unload a pump**

RELIEF VALVES

Each hydraulic system is designed to operate in a certain pressure range. Higher pressures can damage the components or develop too great a force for the work to be done.

Relief valves remedy this danger. They are safety valves which release the excess oil when pressures get too high.

Two types of relief valves are used:

- DIRECT ACTING relief valves are simple open-closed valves.
- PILOT OPERATED relief valves have a "trigger" which controls the main relief valve.

Direct Acting Relief Valves

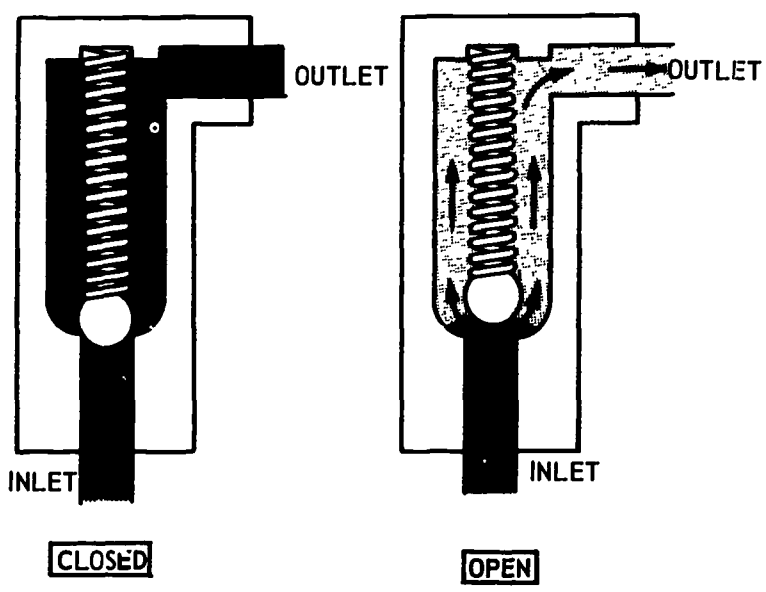

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Fig. 2—Direct Acting Relief Valve in Operation

Fig. 2 shows the operation of this simple valve. When closed, the spring tension is stronger than inlet oil pressure, holding the ball closed on its seat.

The valve opens when pressure rises at the oil inlet and overcomes the spring force. Oil then flows out to the reservoir, preventing any further rise in pressure.

The valve closes again when enough oil is released to drop pressure below the tension of the spring.

Some relief valves are adjustable. Often a screw is installed behind the spring (see Fig. 3). By turning the screw in or out, the relief valve can be adjusted to open at a certain pressure.

"Poppet" is a term for the working part of the valve. Ball poppets are most commonly used (though they may "chatter" during frequent operation). Other poppets used are shaped like buttons (Fig. 3) or like small cones or disks.

CRACKING PRESSURE AND PRESSURE OVERRIDE

"Cracking pressure" is the pressure at which the relief valve first begins to open. "Full-flow pressure" is the pressure at which the valve passes its full quantity of oil.

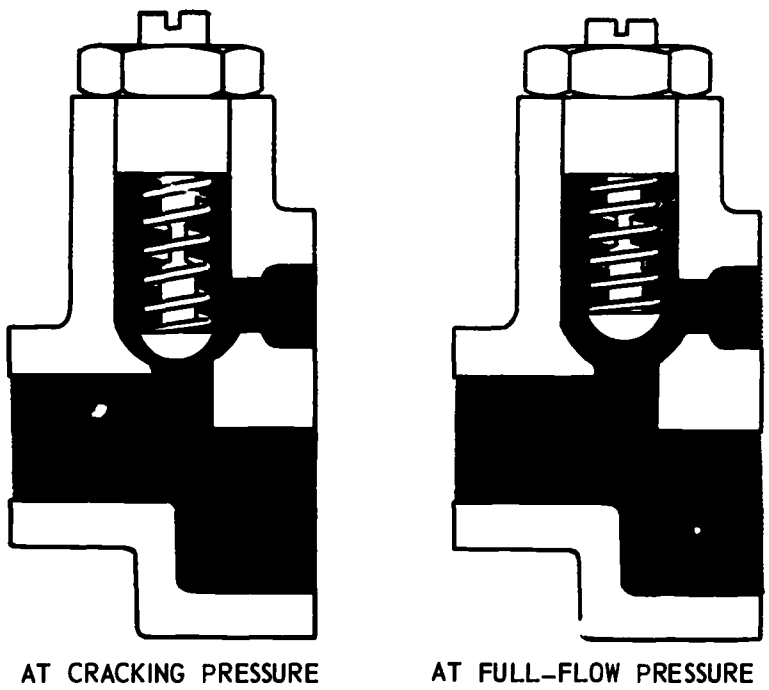

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Fig. 3—Operation of Relief Valve Showing Pressure Override

Fig. 3 shows the oil flow during both of these cycles. Full-flow pressure is quite a bit higher than cracking pressure. This is because the spring tension builds up as the valve opens farther. This condition is called "pressure override" and it is one disadvantage of the simple relief valve.

USES OF DIRECT ACTING RELIEF VALVES

These valves are used mainly where volume is low, and for less frequent operations.

They have a fast response, making them ideal for relieving shock pressures. They are often used as safety valves to prevent damage to components.

Direct acting relief valves also serve as pilot valves for the pilot operated relief valves which are covered next in this chapter.

Direct acting relief valves are very simple. If they fail, no harm is usually done. The resulting pressure loss in the system is apparent to the operator and he can replace the broken spring or worn valve or seat.

Pilot Operated Relief Valves

When a relief valve is needed for large volumes with little pressure differential, a pilot operated relief valve is often used.

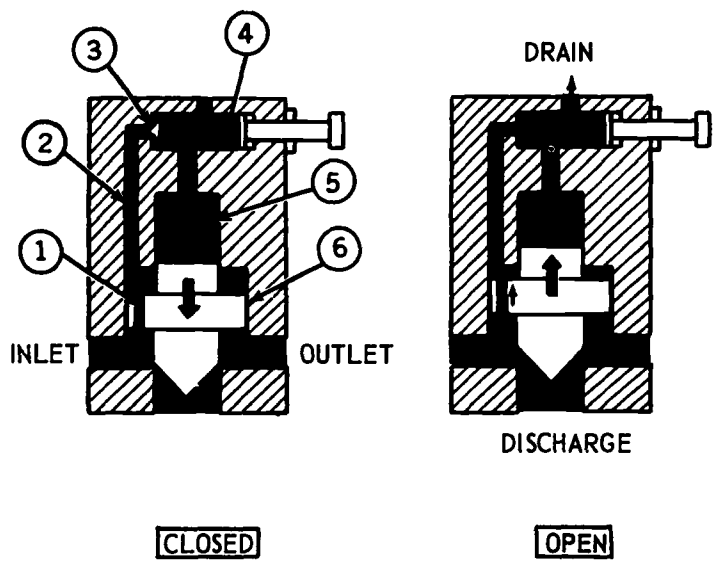

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Fig. 4—Pilot Operated Relief Valve

The pilot valve is a "trigger" which controls the main relief valve. It is usually a small, spring-loaded relief valve built into the main relief valve (Fig. 4).

The main relief valve is closed when inlet oil pressure is below the valve setting. Passage (1) in the main valve (6) keeps it in hydraulic balance, while spring (5) holds it closed.

The pilot valve (3) is also closed at this time. Inlet pressure through sensing passage (2) is less than the pilot valve setting.

As inlet oil pressure rises, pressure in passage (2) also rises. When it reaches the pilot valve setting, the valve (3) is opened. This releases oil behind the main valve through passage (2) and out the drain port. The resulting pressure drop behind the main relief valve (6) causes it to open. Now the main relief operation begins as excess oil is dumped at the discharge port, preventing a further rise in inlet pressure.

The valves close again when inlet oil pressure drops below the valve settings.

CRACKING PRESSURE AND PRESSURE OVERRIDE

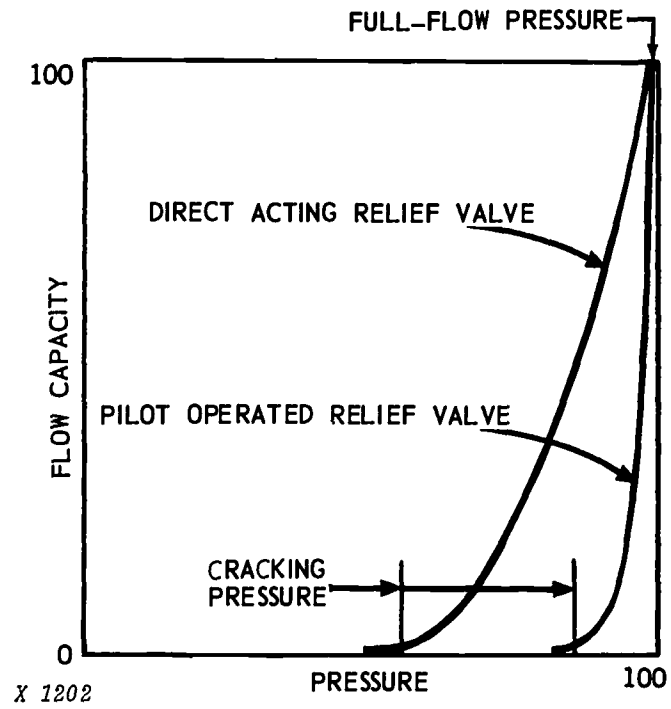

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Fig. 5—Relief Valves Compared at Cracking and Full-Flow Pressures

Pilot operated relief valves have less pressure override than the simple direct acting types. Fig. 5 compares two of these valves. While the direct acting valve in Fig. 5 starts to open at about half its full-flow pressure, the pilot operated valve opens at about 90 percent of its full-flow pressure.

USES OF PILOT OPERATED RELIEF VALVES

Because these valves don't start to open until almost full-flow pressure, the efficiency of the system is protected—less oil is released. These valves are best for high-pressure, high-volume systems.

Although slower to operate than direct acting valves, the pilot operated relief valve keeps system oil at a more constant pressure while releasing oil.

PRESSURE REDUCING VALVES

A pressure reducing valve is used to keep the pressure in one branch of a circuit below that in the main circuit.

When not operating, a pressure reducing valve is *open* (Fig. 6). When it operates, it tends to close as shown.

Operation is as follows: When pressure starts to rise in the secondary circuit, force is exerted on the bottom of the valve spool, partly closing it. Spring tension holds the valve against the oil pressure so that only enough oil gets past the valve to serve

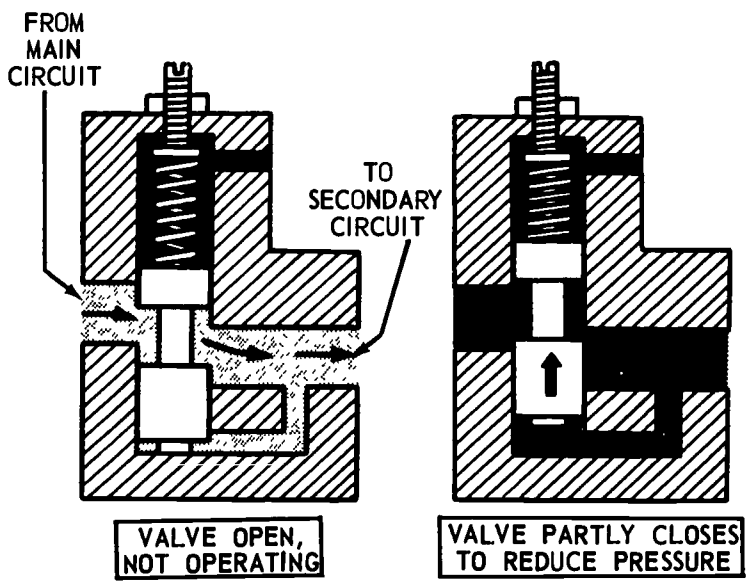

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Fig. 6—Pressure Reducing Valve

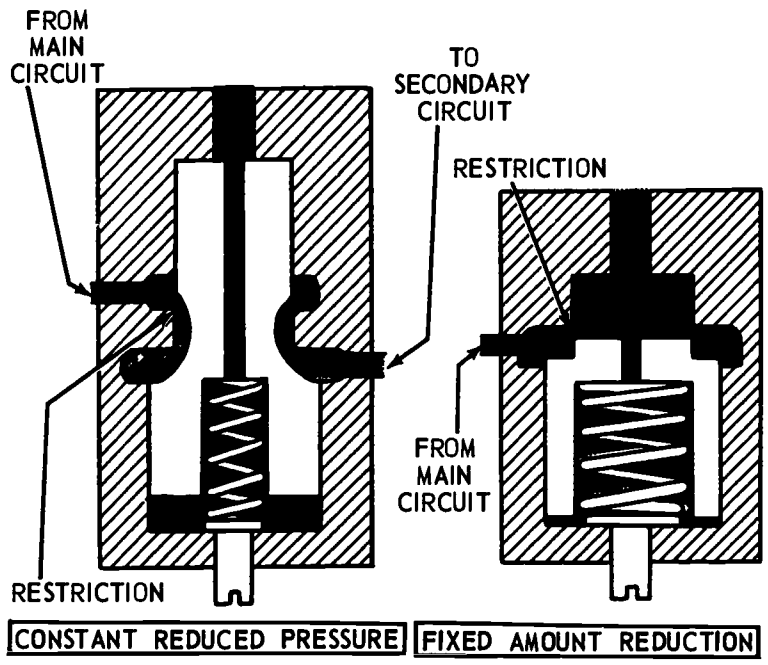

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Fig. 7—Two Types of Pressure Reducing Valves

the secondary circuit at the desired pressure. (The spring tension can be adjusted using the screw shown at the top.)

The pressure sensing for the valve comes from the *outlet* side, or the secondary circuit. This valve operates the reverse of a relief valve, which senses pressure from the inlet and is closed when not operating.

A pressure reducing valve will limit maximum pressures in the secondary circuit, regardless of pressure changes in the main circuit, as long as the system work load does not create back flow into the reducing valve port. Back flow would close the valve completely.

Two Types of Pressure Reducing Valves

Pressure reducing valves can operate in two ways:

- **Constant Reduced Pressure**
- **Fixed Amount Reduction**

CONSTANT REDUCED PRESSURE VALVES supply a fixed pressure regardless of main circuit pressure (so long as it is higher).

FIXED AMOUNT REDUCTION VALVES supply a fixed *amount* of pressure reduction, which means that it varies with the main circuit pressure. For example, the valve might be set to give a reduction of 500 psi. If system pressure was 2000 psi, the valve would reduce pressure to 1500 psi. If system pressure dropped to 1500 psi, the valve would reduce pressure to 1000 psi.

Operation of the two valves is shown in Fig. 7.

The *constant reduced pressure* valve operates by balancing the secondary pressure against an adjustable spring which is trying to open the valve. When secondary pressure drops, the spring opens the valve enough to increase pressure and to keep a constant reduced pressure in the secondary circuit.

The *fixed amount reduction* valve operates by balancing the main circuit pressure coming in against both the secondary pressure at the outlet and the spring pressure. Since the exposed areas of the inlet and outlet sides are equal, the fixed reduction will be that of the spring setting.

Note the restrictions shown in Fig. 7. These are the keys to pressure reduction. By partly closing, pressure reducing valves do their work.

For as we learned in Chapter 1, A RESTRICTION NORMALLY CAUSES A PRESSURE DROP.

Pilot Operated Types

As with relief valves, a small pilot valve can be added to control a pressure reducing valve.

Operation is the same as described above except that the pilot valve acts first to "trigger" the reducing valve.

Using a pilot valve gives a wider range of adjustment and a more consistent relief operation.

PRESSURE SEQUENCE VALVES

Pressure sequence valves are used to control the sequence of flow to various branches of a circuit. Usually the valves allow flow to a second function only after a first has been fully satisfied.

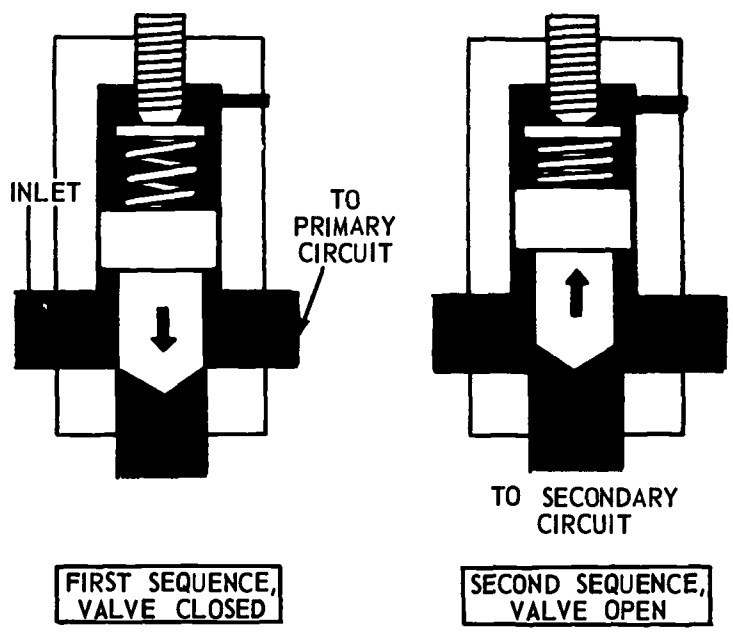

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Fig. 8—Pressure Sequence Valve in Operation

Fig. 8 shows a pressure sequence valve in operation.

When closed, the valve directs oil freely to the primary circuit.

When opened, the valve diverts oil to a secondary circuit.

The valve opens when pressure oil to the primary reaches a preset point (adjustable at the valve spring). The valve is then lifted off its seat as shown and oil can flow through the lower port to the secondary.

One use of the sequence valve is to regulate the operating sequence of two separate cylinders. The second cylinder begins its stroke when the first completes its stroke. Here the sequence valve keeps pressure on the first cylinder during the operation of the second.

Sequence valves sometimes have check valves which allow a reverse free flow from the secondary to the primary, but sequencing action is provided only when the flow is from primary to secondary.

UNLOADING VALVES

The unloading valve directs pump output oil back to reservoir at low pressure after system pressure has been reached. They may be installed in the pump outlet line with a tee connection.

In some hydraulic systems, pump flow may not be needed during part of the cycle. If pump output has to flow through a relief valve at system pressure, much hydraulic energy is wasted as heat. This is where an unloading valve works best.

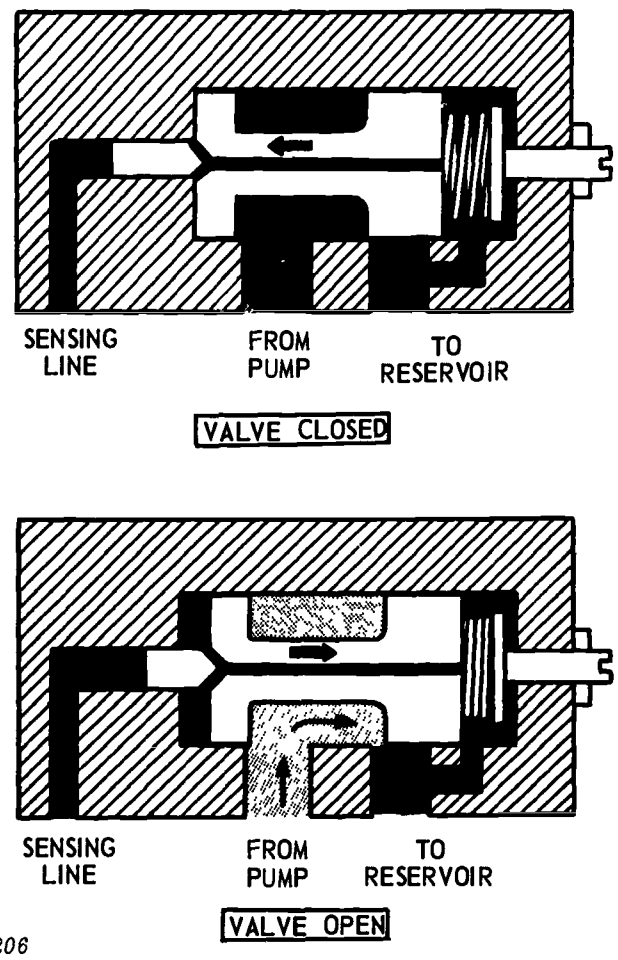

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Fig. 9—Unloading Valve in Operation

When closed (Fig. 9), spring pressure holds the valve on its seat. Sensing pressure at the other end of the valve is less than spring pressure. The reservoir outlet is closed and no unloading occurs.

The valve opens when the sensing pressure rises and overcomes the spring thrust. The valve moves back, opening the outlet to the reservoir. Pump output oil is now diverted to the reservoir at low pressure.

Unloading Valves for Accumulator Circuits

An unloading valve is often used in an accumulator circuit to unload the pump after the accumulator is charged. (See Chapter 6 for details on accumulators.)

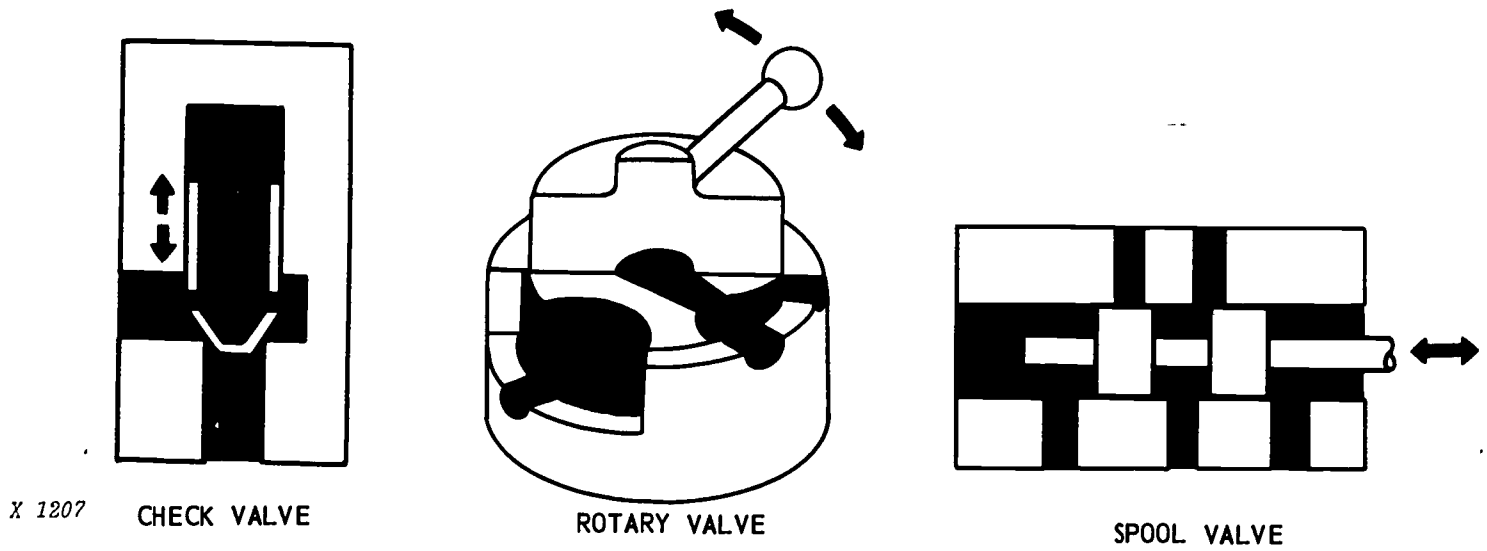


Fig. 10—The Three Types of Directional Control Valves

The valve is closed while the pump recharges the accumulator with oil.

The valve opens to unload the pump after the accumulator is fully charged and can supply the system with pressure oil.

When the accumulator discharges and system pressure drops, the unloading valve closes again, directing pump flow back into the system.

The unloading valve is held open by *both* spring force and oil pressure on the end of the valve spool. But to close the valve, system pressure must overcome only the spring force. This allows the valve to open at a higher pressure than it closes.

A check valve holds the pressure in the main circuit while the pump is being unloaded.

DIRECTIONAL CONTROL VALVES

Directional control valves direct the flow of oil in hydraulic systems. They include these types:

- **Check Valves**
- **Rotary Valves**
- **Spool Valves**

The three directional control valves are compared in Fig. 10. Each uses a different type of valving element to direct oil. The *check valve* uses a poppet which seats and unseats; the *rotary valve* uses a rotary spool which turns to open and close oil passages; and the *spool valve* uses a sliding spool which moves back and forth to open and close oil routes.

Let's discuss each valve in more detail.

CHECK VALVES

Check valves are simple one-way valves. They open to allow flow in one direction, but close to prevent flow in the opposite direction.

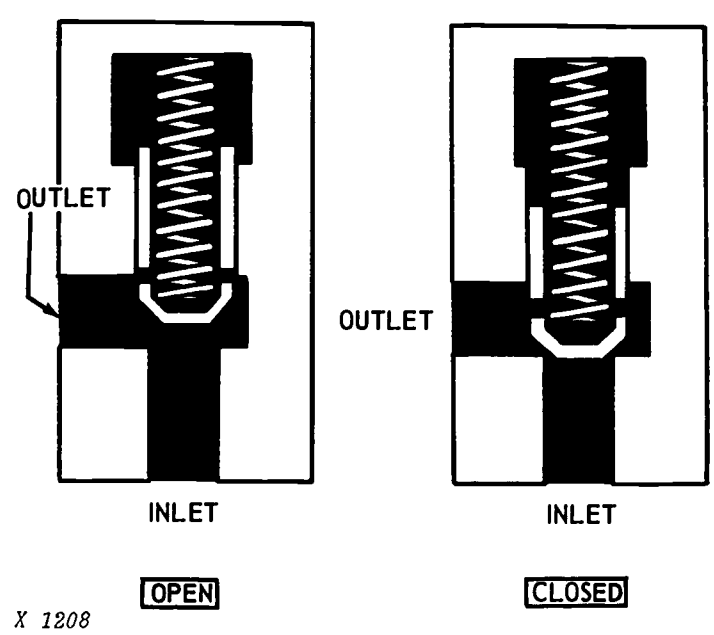


Fig. 11—Check Valve In Operation

Fig. 11 shows a simple check valve in operation.

The valve is opened by system pressure which pushes the valve up against its spring. Oil then flows freely past the valve as shown.

The valve closes when inlet pressure drops. This stops reverse flow and traps pressure oil already in the circuit.

Check valves are usually installed in an oil line. They may also be part of some other valve, such as a sequence or pressure reducing one.

Although a check valve is most often used to stop reverse flow, sometimes reverse flow is needed during one phase of circuit operation. In this case, pilot operated check valves have been devised. For example, a check valve might be used in a cylinder line to prevent leakage, but an extra function is needed to allow reverse flow when the cylinder must be stroked. A pilot piston which can force the check valve open during these cylinder strokes will handle the job.

ROTARY DIRECTIONAL VALVES

Rotary valves are commonly used as pilot valves to direct flow to other valves.

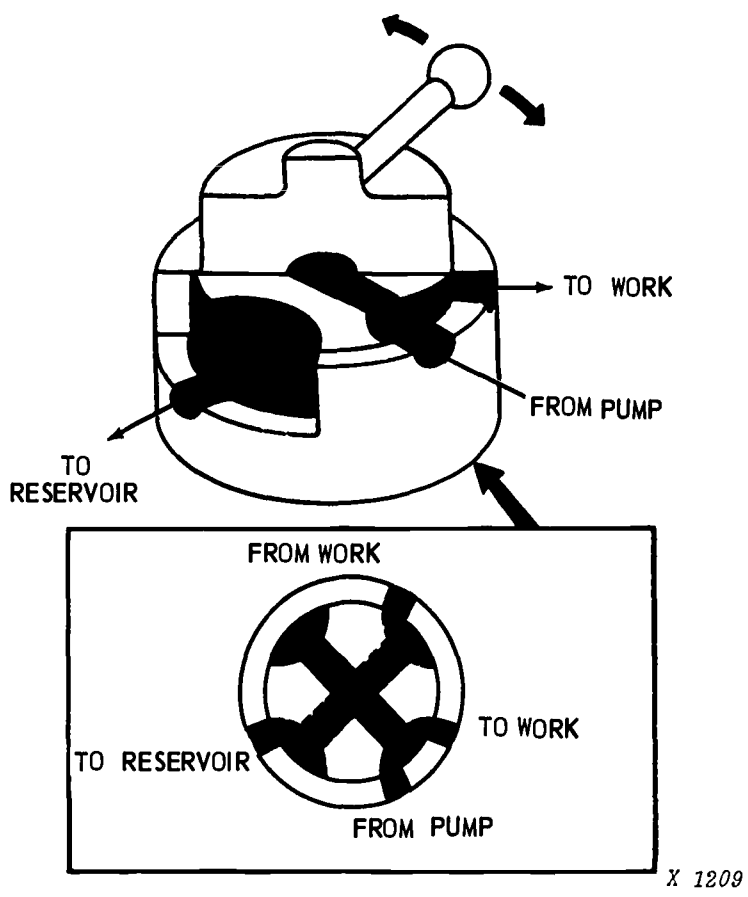


Fig. 12—Rotary Directional Valve

Fig. 12 shows a four-way rotary valve. The valve has holes which match with holes in the main body as the valve turns. The valve is turned by a hand lever; other models may be operated hydraulically or electrically.

Fig. 12 shows the valve positioned to allow pressure oil from pump to enter one port, flow through the valve, and out another port to the work. Meanwhile, oil is returning from another work port through the valve to reservoir. The drilled ports in the valve are actually on two levels to separate them.

Rotary valves can be modified to operate as two-, three-, or four-way valves. This is done by relocating the ports, altering the passages, or adding and removing oil routes. Two-way models are simple on-off shutoff valves; three- and four-way models are usually designed as pilot valves.

Rotary valves are generally used as low-pressure, low-volume controls. They are simple and compact enough for use as pilots for other valves in more complex systems.

SPOOL DIRECTIONAL VALVES

The sliding spool valve is a true directional control. Used as a "control valve," it directs oil to start, operate, and stop the actuating units on most modern hydraulic systems.

There is no limit to the variations in spool valve design. Two-, four-, and six-land spools are most common, often used in valve "stacks" of two or more. In this case, each spool controls a branch of the circuit.

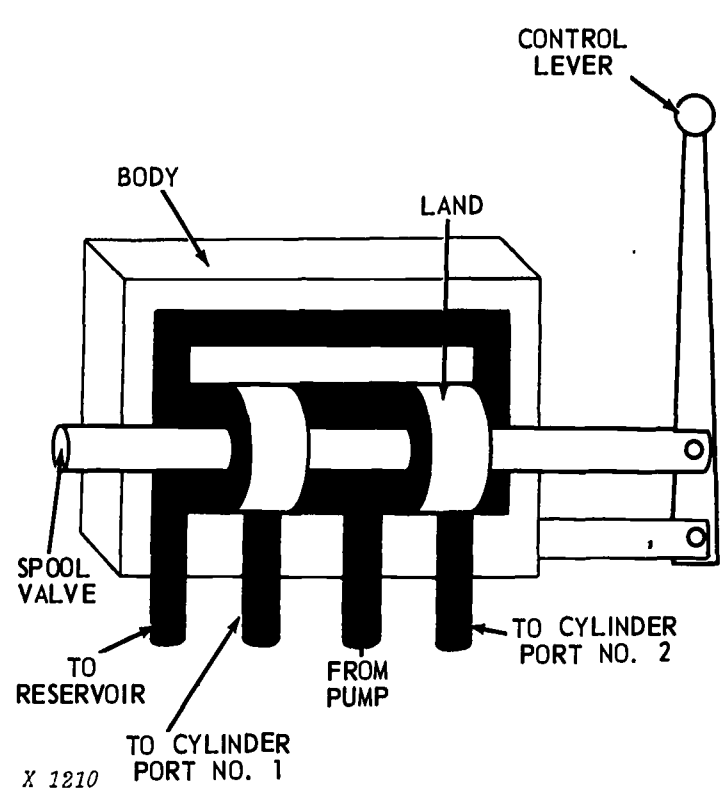


Fig. 13—Spool Directional Valve

Fig. 13 shows a simple two-land spool valve. Moving the spool from neutral (shown) to the right or left opens up some passages and closes others. In this way it directs oil to and from the actuating cylinder. The spool lands seal off the inlet from the outlet oil.

The spool is usually hardened and ground to produce a smooth, accurate, and durable surface. It may also be chrome-plated to resist wear, rust, and corrosion.

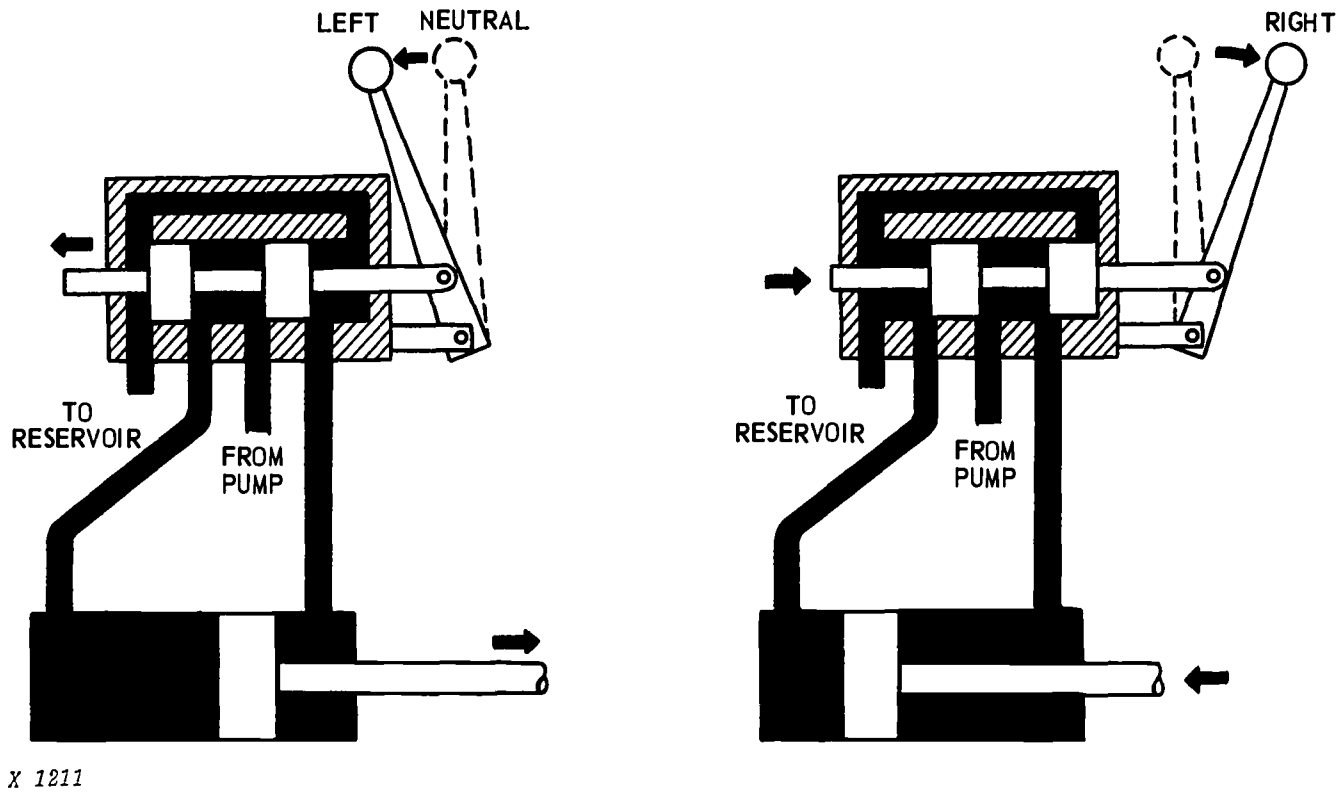


Fig. 14—Spool Valve Directing Oil to Cylinder

The spool valve shown in Fig. 13 is called a "three-position, four-way" valve. The valve has three positions: neutral, left, and right. And it is connected to the circuit in four ways: to pump, to reservoir, to cylinder port 1, and to cylinder port 2.

Fig. 14 shows the same spool valve in operation. As the valve is moved to the left, it directs oil from the pump to the left side of the cylinder, actuating it as shown. At the same time, the valve opens a passage which allows oil from the opposite end of the cylinder to return to the reservoir.

When the valve is moved to the right, the flow is reversed and the cylinder operates in the opposite direction.

In neutral (see Fig. 13), the spool valve lands seal off both cylinder ports, trapping oil to hold the cylinder in place.

Open and Closed Center Spool Valves

In Chapter 1 we covered the two kinds of hydraulic systems, open and closed center. Each uses a different type of spool valve (Fig. 15).

- OPEN CENTER spool valves allow pump oil to flow *through* the valve during neutral and return to reservoir.
- CLOSED CENTER spool valves *stop* (deadend) the flow of oil from the pump during neutral.

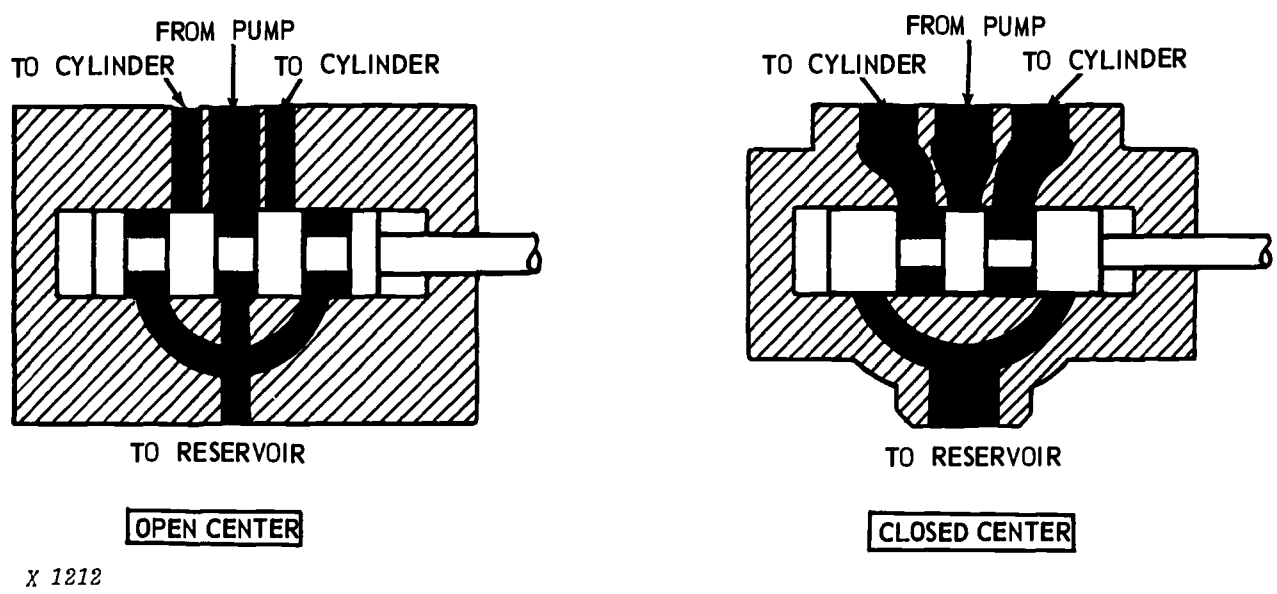


Fig. 15—Open and Closed Center Spool Valves (In Neutral)

Normally the cylinder ports are blocked when a spool valve is in neutral. However, in some designs the ports are open to allow the cylinder to "float."

Control of Spool Valves

Spool valves can be controlled manually or they may use pilot valves, electrical solenoids, or hydraulic oil acting on the ends of the spool.

Detent mechanisms are sometimes used to hold the valve in position during each operation.

Multiple Uses of Spool Valves

Two or more spool valves can be used in one compact control package to operate several functions. This can be done in two ways:

• VALVE STACKS—several sections of valves bolted together.

• "UNIBODY" VALVES—several valves in one solid housing.

Fig. 16 shows the two kinds of spool valve packages.

Valve stacks allow extra valves to be added easily by inserting another section in the package. However, care must be taken in sealing the mating surfaces of each section.

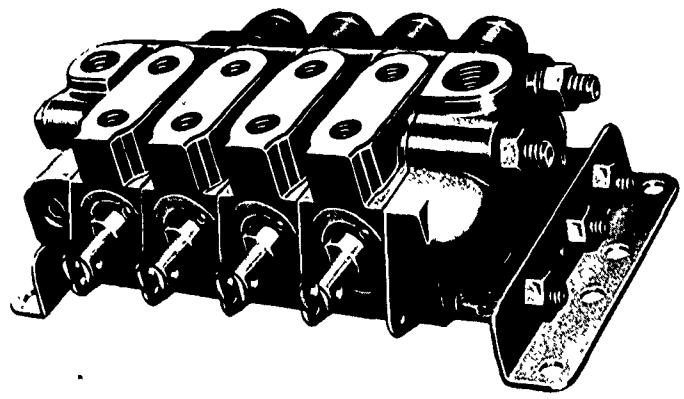
"Unibody" valves are less flexible but more permanent. Oil leakage is less of a problem since one solid housing holds all the valves. However, if one valve bore is damaged it may mean replacing the whole valve housing.

Both valve packages normally use one common oil inlet and outlet to the system. Either package can be designed for open or closed center operation.

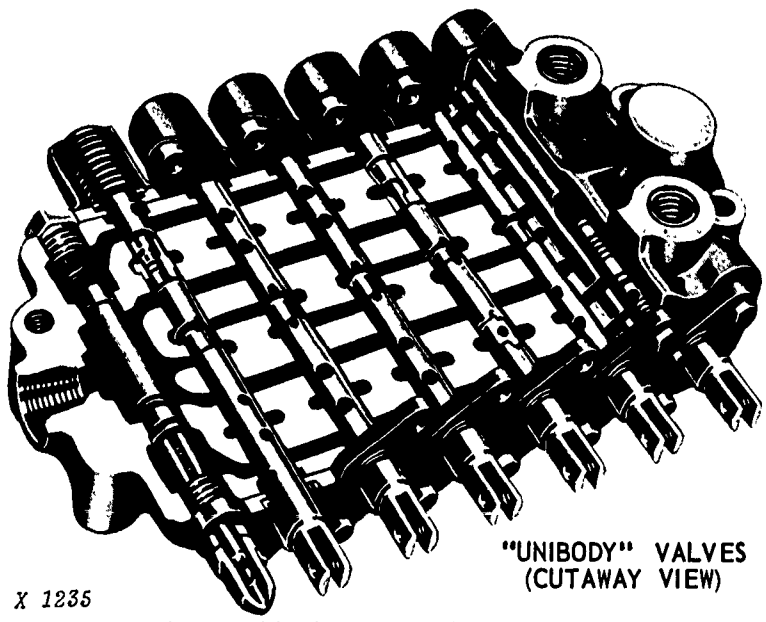
General Uses of Spool Valves

Spool valves are popular on modern hydraulic systems for several reasons:

1) *Quick, positive action.* Spool valves can be precision ground for fine oil metering.



X 1234 VALVE STACKS



X 1235 "UNIBODY" VALVES (CUTAWAY VIEW)

Fig. 16—Multiple Uses of Spool Valves

2) *Adaptibility.* By adding extra lands and oil ports, spool valves can be made to handle flows in many directions.

3) *Compactness.* Stacking of spool valves in one compact control package is easy. This is very important on mobile systems.

However, spool valves also require good maintenance. Dirty oil will damage the mating surfaces of the valve lands, causing them to lose their accuracy. Dirt will also cause these valves to stick or work erratically.

Above all, spool valves must be accurately machined and fitted to their bores.

VOLUME CONTROL VALVES

Volume control valves control the volume or flow of oil, usually by throttling or diverting it (Fig. 17).

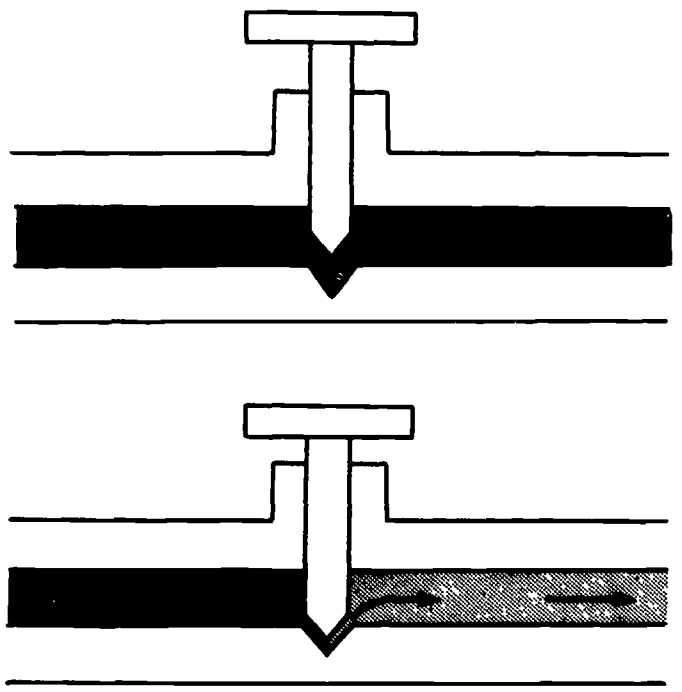


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Fig. 17—Basic Principle of Volume Control Valve

In many hydraulic systems, the speed of a cylinder or motor must be closely regulated. This can often be done by regulating the *volume* of oil flowing to the actuator. When using a fixed displacement pump, the normal way to regulate the speed of a cylinder or motor is with volume control valves.

Volume control valves can be separated in two types:

• FLOW CONTROL VALVES which control volume flow, usually through a metering orifice.

• FLOW DIVIDER VALVES which control volume flow but also divide the flow between two or more circuits.

Let's cover each type in more detail.

FLOW CONTROL VALVES

Flow control valves can regulate flow by:

1) Restricting flow in or out of the component whose speed is being regulated. These valves are *noncompensated.*

2) Diverting flow away from the component whose speed is being regulated. These valves are usually *compensated.*

Noncompensated valves do not compensate for pressure changes. As inlet flow changes, so does the flow through the valve. These valves are not generally used where accurate flow rate control is needed. They include simple needle and globe valves.

Compensated valves maintain a constant flow even though the inlet flow changes. These valves adjust the flow to make up for raises and drops in the inlet flow.

Needle And Globe Valves (Noncompensated)

These "noncompensated" valves are used in many hydraulic circuits. While not sensitive to pressure changes, they are simple and can be adjusted to meter oil flow very carefully and exactly.

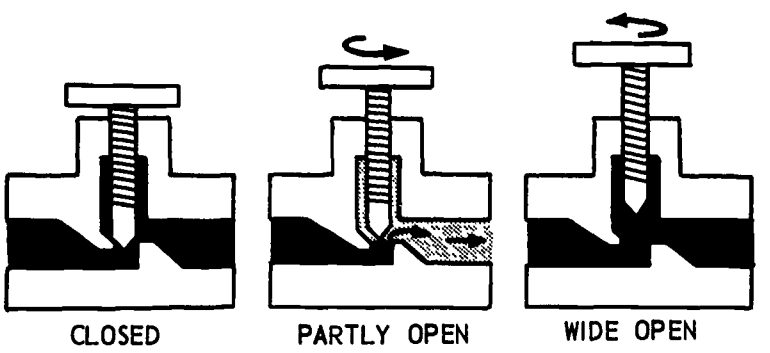

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Fig. 18—Needle Valve

The needle valve (Fig. 18) is a simple restrictor. When the pointed stem is screwed down into the orifice, flow is shut off. When unscrewed a small amount, flow is limited (and pressure drops). When screwed out farther, the stem allows full flow.

A common use for the needle valve is in a tractor rockshaft. Here it regulates the speed of drop of the rockshaft and mounted tool.

The globe valve operates the same except it has a rounded metering tip. (Often globe valves are used in water plumbing systems where finer metering is not needed.)

Compensated Flow Control Valves

As explained above, flow control valves which are pressure compensated maintain a constant flow regardless of how the inlet flow varies in the circuit. For example, if the inlet flow rises, the valve partly closes to reduce the outlet flow. The result is that the *total volume* of oil past the valve always remains the same. Fig. 19 shows such a valve in operation.

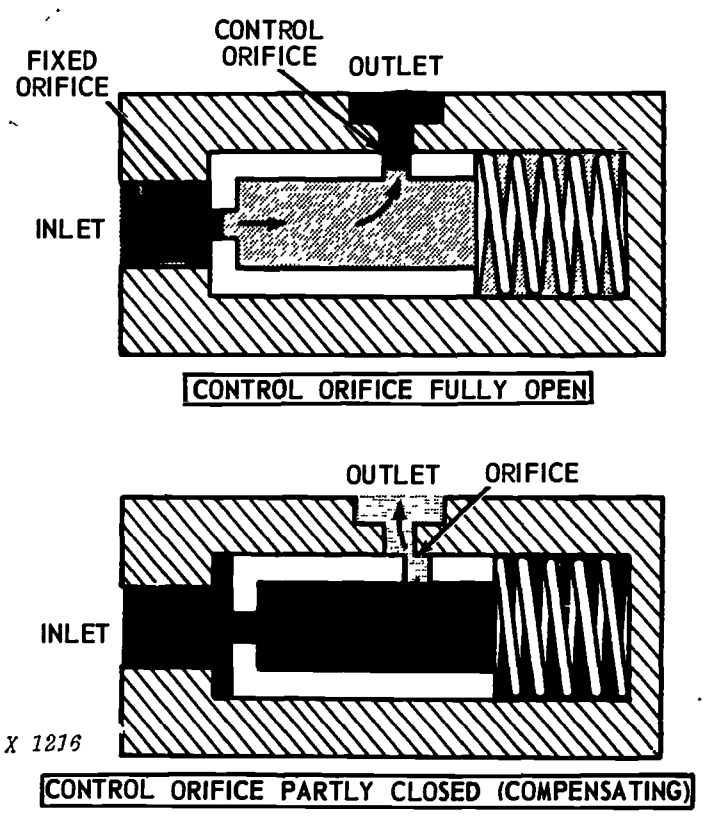

Fig. 19—Flow Control Valve Which is Pressure Compensated

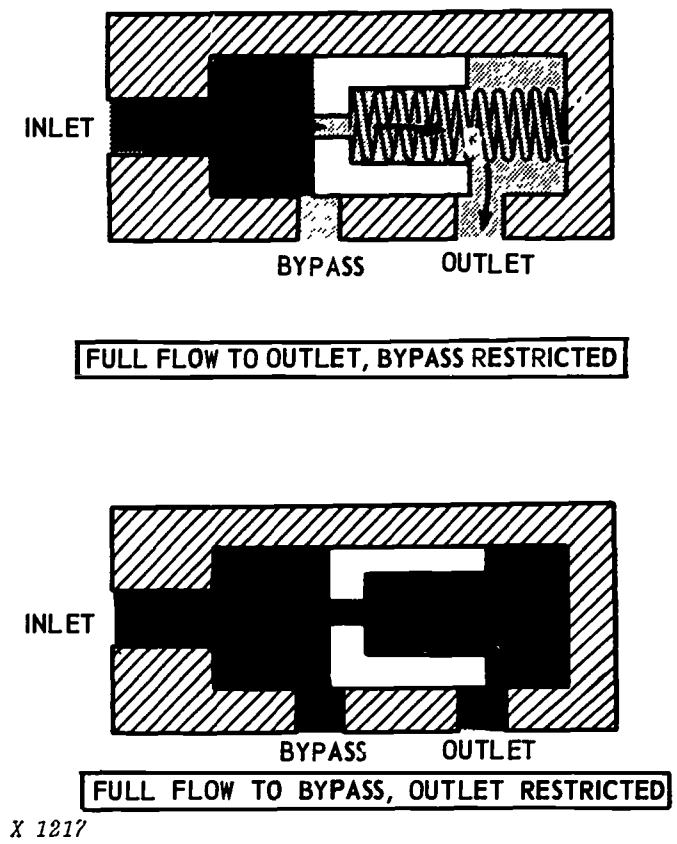

Fig. 20—Bypass Flow Regulator

The compensating action happens as follows: A fixed orifice in the end of the valve admits system inlet oil at a reduced rate and creates a pressure drop. As a result, pressure on the spring side of the valve is less, but the spring helps hold the valve to the left, as long as the system inlet flow is equal to or lower than maximum outlet flow. This keeps the control orifice wide open for full flow to the outlet (see top illustration in Fig. 19).

But if system inlet flow rises, the added pressure drop inside the valve moves it to the right, partly closing the control orifice (see lower illustration in Fig. 19). This limits the outlet flow, but since the inlet flow is now higher, the total output remains the same.

Bypass Flow Regulator

Another form of flow control valve is the bypass flow regulator. It has a built-in valve that bypasses extra pump output and returns it to the reservoir. For accurate metering, the pump output must always be greater than the flow through the valve.

Operation is shown in Fig. 20. In the top illustration, inlet pressure works against the spring and holds the valve so that most oil goes through the valve orifice to the open outlet. Only a small amount of oil is bypassed to the reservoir.

In the lower illustration, inlet pressure rises and moves the valve to the right, bypassing more oil to the reservoir. Th' compensates the outlet volume, which remains the same (higher in pressure but at a lesser flow rate).

A relief valve is installed in the outlet of this valve to protect the system against excess pressures from "surges," which can close the bypass port completely.

FLOW DIVIDER VALVES

Flow divider valves control volume flow but also divide the flow between two or more circuits. They do this in three ways:

• PRIORITY valves deliver all fluid to one circuit until pump delivery exceeds the needs of that circuit; then the extra delivery is made available to other circuits.

• ADJUSTABLE PRIORITY valves do the same as above except that delivery to the No. 1 (priority) circuit can be adjusted.

• PROPORTIONAL valves deliver flow to all circuits at all times. However, the delivery to each circuit can be modified. For example, with two circuits the proportion can be 50-50 or up to a 90-10 ratio.

Priority Flow Dividers

The priority flow divider shown in Fig. 21 is built into a hydraulic pump. It divides the pump flow into two separate outlets. One outlet has priority; the other receives oil after the first is satisfied.

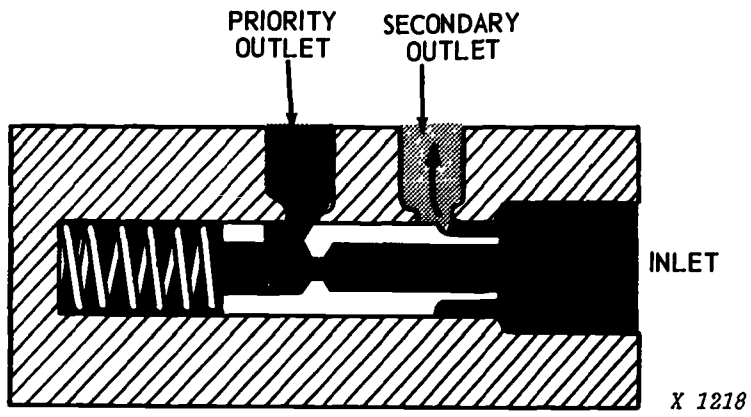

Fig. 21—Priority Flow Divider

The flow divider spool slides in its bore, opening one outlet wider as it restricts the other. Inlet oil presses against one end of the valve spool, while a spring and lower pressure oil push on the other end.

When pump output is lower, the valve moves to the right, opening the priority outlet wider. An orifice in the valve meters oil for this outlet.

As pump output rises, the pressure drop through the valve orifice increases and causes the valve to compress the spring, moving to the left. This opens the secondary port wider and feeds it the excess oil. The priority port still gets its oil, but the secondary gets all the remaining oil.

As an example, the priority port might serve the power steering of a machine, while the secondary feeds a loader circuit. The loader needs more oil, but the steering is more vital to operation of the machine. Let's say the pump has an output of 10 gpm at full speed, while the power steering needs only 2 gpm. At full speed the steering gets 2 gpm while the loader gets 8 gpm. At low speed the pump may produce only 2 gpm. In this case the priority outlet for the steering gets all the pump's flow. At intermediate speeds the flow is divided at different ratios, but the steering always gets its 2 gpm first.

In adjustable priority valves, the delivery to the priority port can be adjusted using external levers, solenoids, or hydraulic balancers, or internally, by changing valve spring tension or by shimming the valve. A relief valve is used with the priority valve to protect it against surge pressures which might close off the secondary outlet.

Note the similarity between the priority flow divider and the bypass flow regulator (Fig. 20). Operation is similar, but the result is different: the flow divider feeds two working circuits while the bypass regulator only feeds one, exhausting the remaining oil back to reservoir.

Proportional Flow Divider

This valve simply takes a single flow of oil and divides it between two circuits (Fig. 22). The dividing of oil may be 50-50 or in ratios up to 90-10.

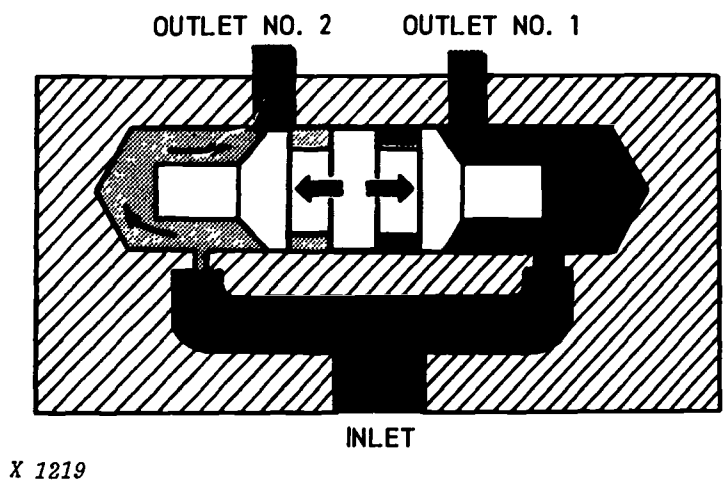

Fig. 22—Proportional Flow Divider

The flow divider shown divides oil about 75-25 between its No. 1 and No. 2 outlets. This is done by making the No. 1 inlet orifice larger than No. 2. To balance the ratio, both orifices can be made the same size. Oil pressure on each end of the valve spool holds it in position for the selected ratio.

One use of the flow divider is to direct oil to the left and right sides of the power steering on a crawler tractor. This flow divider is balanced 50-50 but shuttles back and forth "on demand." If the left steering lever is actuated, for example, pressure build-up in the cylinder backs up to the flow divider, pushing it over to feed oil to the left side. During a right turn, the operation is reversed.

MISCELLANEOUS VALVES

AUTOMATIC AIR VENT VALVES

The automatic air vent valve is used to keep the hydraulic system free from air.

The valve is placed at the highest point in the system where air will collect. Liquid pressure in the system and in the valve keeps it closed.

As air accumulates in the body of the valve, it displaces the liquid, and as the liquid recedes, the valve opens. The liquid, being under pressure, forces out the air and "bleeds" the system. As the air leaves, the liquid in the valve body rises and closes the valve, preventing the escape of oil. When air collects again, the valve repeats the cycle.

GATE VALVES

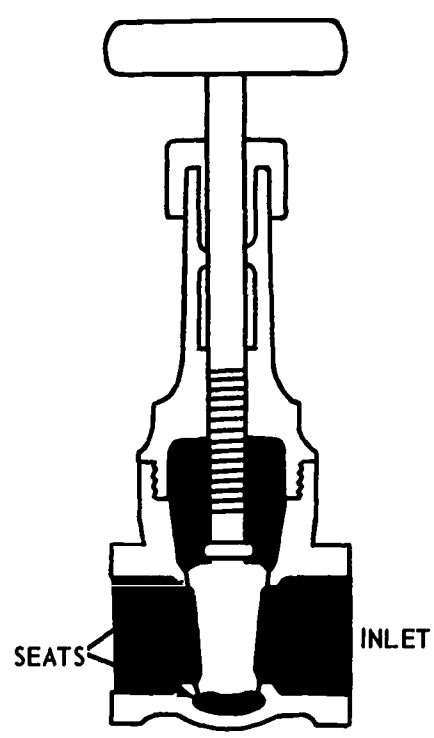

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Fig. 23—Gate Valve in Closed Position

A gate valve is used to open or close a line to flow. The valving element is a wedge-shaped gate which is raised or lowered by screw action (Fig. 23). This valve is designed to completely open or close a line, but not to throttle flow when partly open.

Although a gate valve offers very little resistance to flow when completely open, it is difficult to open and close under high pressure.

COCK VALVES

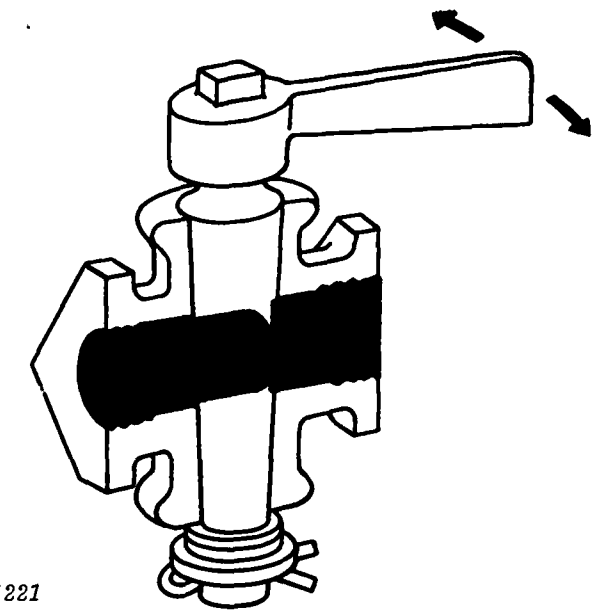

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Fig. 24—Cock Valve in Open Position

Cock valves are very simple and are usually small in size. They are used to bleed air out of a system, turn gauges on and off, or drain the system. Fig. 24 shows a cock valve in the open position. A quarter-turn of the handle will shut it off. The valve shown is designed for moderate pressures. Modifying the valves will make it work for much higher pressures.

FLAPPER VALVES

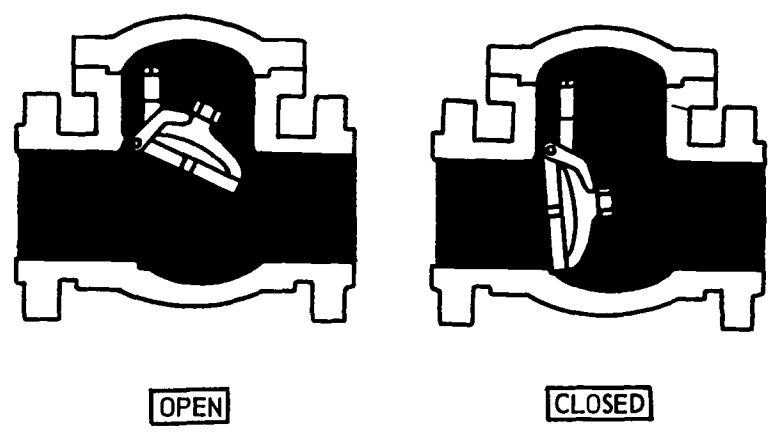

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Fig. 25—Flapper Valve

Flapper valves are essentially check valves. They permit flow in only one direction. They are made in all sizes—very small to very large. They offer little resistance to flow when fully open. Although they are usually installed so that gravity and pressure close them, they sometimes have a spring to start closing the flapper. Back pressure causes the flapper valve to seal tightly.

VALVE FAILURES AND REMEDIES

INTRODUCTION

Hydraulic valves are precision-made and must be very accurate in controlling the pressure, direction, and volume of fluid within a system. Generally, no packings are used on valves since leakage is slight as long as the valves are carefully fitted and kept in good condition.

Contaminants such as dirt in the oil are the major villains in valve failures. Small amounts of dirt, lint, rust or sludge can cause annoying malfunctions and extensively damage valve parts. Such material will cause the valve to stick, plug small openings, or abrade the mating surfaces until the valve leaks. Any of these conditions will result in poor machine operation, or even complete stoppage. This damage may be eliminated if operators use care in keeping out dirt.

Use only the specified oils in the hydraulic system. Follow the recommendations in the machine operator's manual. Because oxidation produces rust particles, an oil that will not oxidize must be used. The oil should be changed and the filters serviced regularly.

For successful valve service, observe the following precautions.

BEFORE SERVICING VALVES

1. Disconnect electrical power source before removing hydraulic valve components to eliminate accidental starting or tools shorting out.

2. Move valve control lever in all directions to release hydraulic pressure in the system before disconnecting any hydraulic valve components.

3. Block up or lower all hydraulic working units to the ground before disconnecting any parts.

4. Clean the valve and surrounding area before removing any part for service. Use steam cleaning equipment if available; however, DO NOT ALLOW WATER TO ENTER THE SYSTEM. Be certain all hose and line connections are tight.

5. If steam cleaning is not possible, use fuel oil or other suitable solvent. Never use paint thinner or acetone as a cleaning agent. Plug port holes immediately after disconnecting lines.

VALVE DISASSEMBLY HINTS

1. Do not perform hydraulic valve internal service work on the shop floor, on the ground, or where there is danger of dust or dirt being blown into parts. USE ONLY A CLEAN BENCH AREA. Be certain all tools are clean and free of grease and dirt.

2. During disassembly, be careful to identify the parts for reassembly. Spools are *selectively fitted* to valve bodies and must be returned to the *same* bodies from which they were removed. Valve sections must be reassembled in the same order.

3. When it is necessary to clamp a valve housing in the vise, use extreme caution. Do not damage the component. If possible, use a vise equipped with lead or brass jaws or protect the component by wrapping it in a protective covering.

4. All valve housing openings should be sealed when components are removed during service work. This will prevent foreign material from entering the housing.

5. On spring-loaded valves, be very careful when removing the back-up plug as personal injury may result. When springs are under high preload, use a press to remove them.

6. Wash all valve components in a clean mineral oil solvent (or other non-corrosive cleaner). Dry parts with compressed air and place on a clean surface for inspection. *Do not wipe valves with waste paper or rags.* Lint deposited on any parts may enter the hydraulic system and cause trouble.

7. DO NOT USE CARBON TETRACHLORIDE as a cleaning solvent as it causes deterioration of rubber seals.

8. After parts are cleaned and dried, coat them immediately with a rust-inhibiting hydraulic oil. Then be sure to keep the parts clean and free of moisture until they are installed.

9. Carefully inspect valve springs during valve disassembly. Replace all springs that show signs of being cocked or crooked, or contain broken, fractured or rusty coils.

Use a spring tester to check strength of springs in pounds, compressed to a specified length (Fig. 26).

VALVE REPAIR

Directional Control Valve Repair

Directional control valve spools are installed in the valve housing by a select hone fit. This is done to provide the closest possible fit between housing and spool for minimum internal leakage and maximum holding qualities.

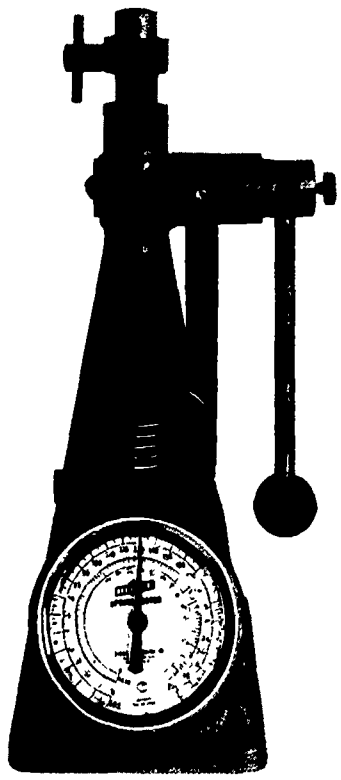

Fig. 26 – Checking Valve Spring Tension

To make this close fit, special factory techniques and equipment are required. Therefore, most valve spools and bodies are furnished for service only in MATCHED SETS and are not available individually for replacement.

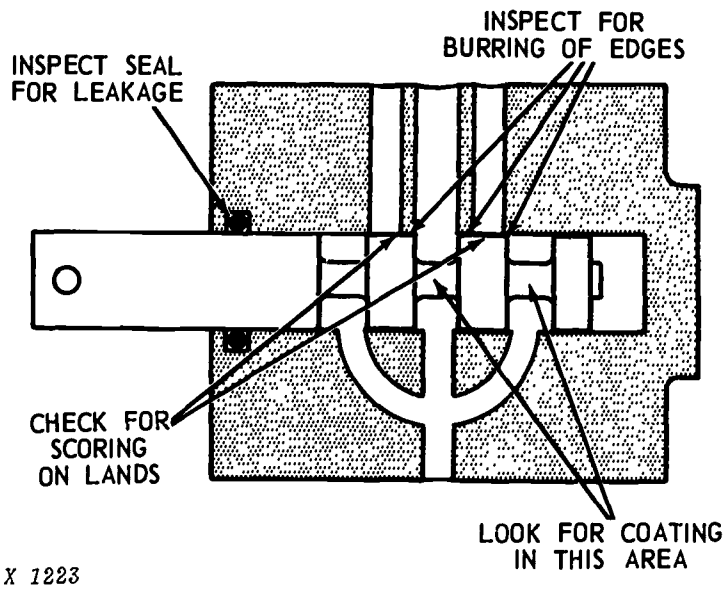

Fig. 27 – Inspecting Directional Control Valve Spools and Bores

When repairing, inspect the valve spools and bores for burrs and scoring in the areas shown in Fig. 27. Spools may become coated with impurities from the hydraulic oil. When scoring or coating is not deep enough to cause objectionable leakage, the surfaces can be polished with crocus cloth. DO NOT remove any of the valve material. Replace the valve body and spool if scoring or coating is excessive. If the action of the valve was erratic or sticky before removal, it may be unbalanced due to wear on the spools or body and should be replaced.

Volume Control Valve Repair

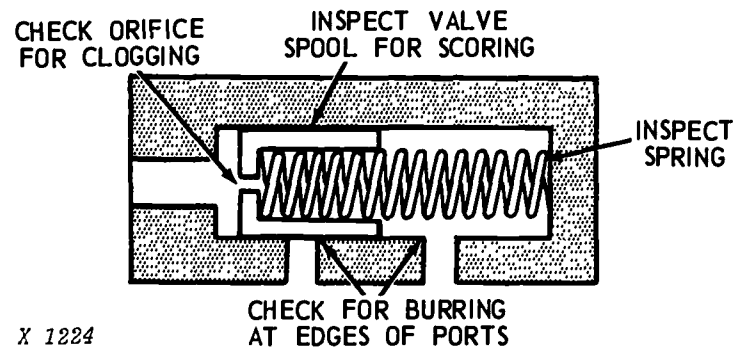

Fig. 28 – Inspecting Volume Control Valve

1. On valve spools with orifices, inspect for clogging by dirt or other foreign matter (Fig. 28). Clean with compressed air or a small wire.

2. Rewash all parts thoroughly to remove all emery or metal particles. Any such abrasive could quickly damage the entire hydraulic system.

3. Check the valve spool for freedom of movement in the bore. When lightly oiled, the valve should slide into the bore from its own weight.

Pressure Control Valve Repair

Check for weak relief valve spring with spring tester if system checks have indicated low pressure. This may be remedied by replacing the spring or by adding shims to increase the compression of the spring in some cases. Never add so many shims that the spring is compressed solid.

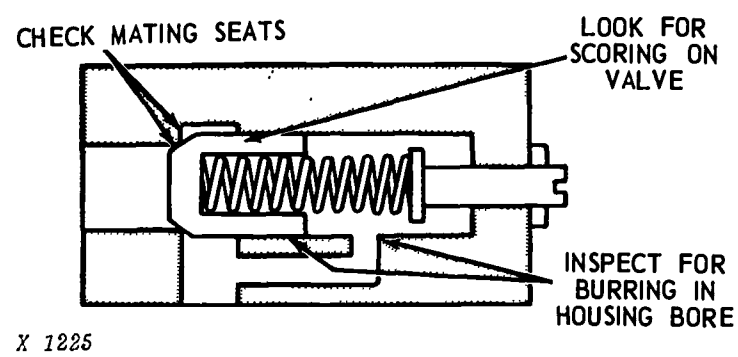

Fig. 29 – Inspecting Pressure Control Valve

VALVE SEATS AND POPPETS

Check valve seats for evidence of leak-by and scoring. Replace valve if flat spots appear on seat or on poppets.

Metal valve seats and poppets may be surface polished with crocus cloth if scoring is not deep. **Do not** remove any valve material.

Some seats and valve poppets are made of nylon. This material is long-wearing and sufficiently elastic to conform perfectly to mating surfaces, giving a tight seal.

The nylon seats on poppet valves will take wear, with no damage to the mating metal point. When repairing these valves, always replace nylon parts with new nylon service parts.

CHECKING NON-ADJUSTABLE CARTRIDGE-TYPE RELIEF VALVES

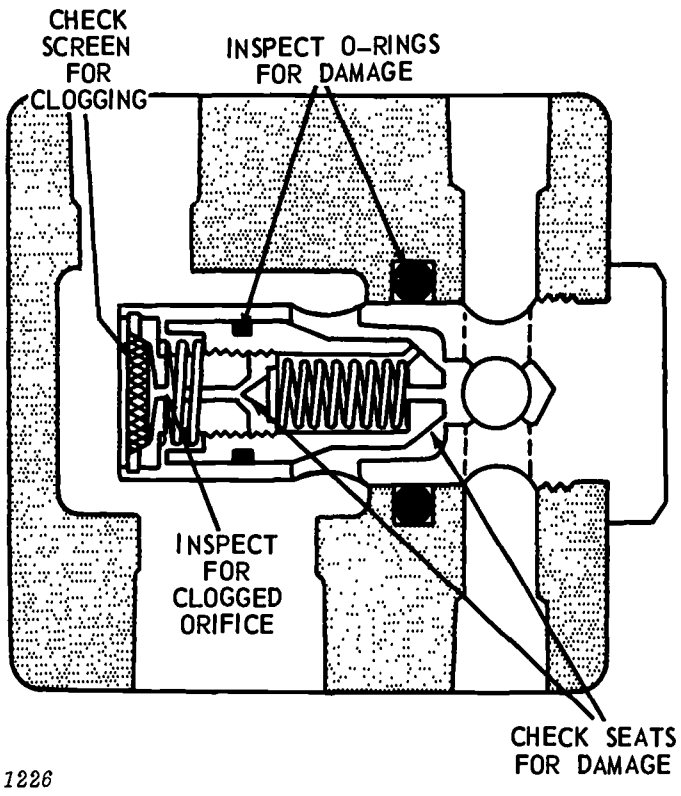

Fig. 30—Inspecting Cartridge-Type Relief Valve

If the relief valve screen or orifice becomes plugged, oil cannot enter the relief valve body to equalize the pressure in the area between the orifice plate and the pilot assembly (Fig. 30).

This plugging then causes the valve to open at lower pressures than it should. The result is sluggish operation of hydraulic units.

Be sure that the relief valve screen and orifice are kept clean at all times.

Also check the O-rings for damage which might cause leakage.

Each relief valve cartridge is stamped with the part number, the pressure limit, and the date of manufacture (Fig. 31). Use this code when testing the cartridges.

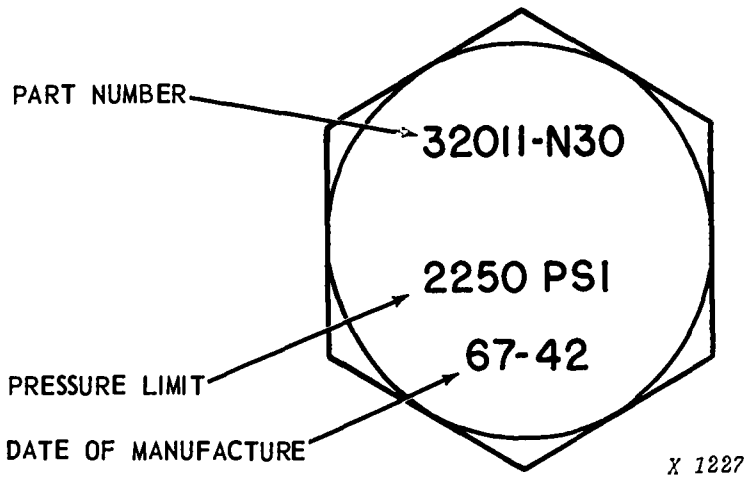

Fig. 31—How to Read a Cartridge-Type Relief Valve Code

Test the valve cartridges for pressure setting by installing in the system and operating until the valve opening pressure is reached. Read the pressure on a gauge installed in the valve circuit.

ASSEMBLY OF VALVES

1. When assembling valves, be sure that they are kept absolutely clean. Wash parts in kerosene, blow dry with air, then dip in hydraulic oil with rust inhibitor to prevent rusting. This will also aid in assembly and provide initial lubrication. Petroleum jelly can also be used to hold sealing rings in place during assembly.

2. Double check at this time to be sure that valve mating surfaces are free of burrs and paint.

3. Replace all seals and gaskets when repairing a valve assembly. Soak new seals and gaskets in clean hydraulic oil prior to assembly. This will prevent damage and help seal the valve parts.

4. Be sure to insert valve spools in their matched bores. Valve sections must also be assembled in their correct order.

5. When mounting valves, be sure there is no distortion. This may be caused by uneven tension on the mounting bolts and oil line flanges, uneven mounting surfaces, improper location of the valve, or insufficient allowance for line expansion when oil temperature rises. Any of these may result in valve spool binding.

6. After tightening bolts, check the action of the valve spools. If there is any sticking or binding, adjust tension of mounting bolts.

TROUBLE SHOOTING OF VALVES

Listed below are trouble shooting steps which may be used to diagnose most hydraulic valve difficulties. When working on a specific machine, refer to the machine technical manual for more detailed diagnostic information.

PRESSURE CONTROL VALVES

Relief Valves

LOW OR ERRATIC PRESSURE

1. Incorrect adjustment.
2. Dirt, chip or burr holding valve partially open.
3. Worn or damaged poppet or seat.
4. Sticking valve piston in main body.
5. Weak spring.
6. Spring ends damaged.
7. Valve cocking in body or on seat.
8. Orifice or balance hold blocked.

NO PRESSURE

1. Orifice or balance hole plugged.
2. Poppet not seating.
3. Loose fitting of valve.
4. Valve binding in body or cover.
5. Spring broken.
6. Dirt, chip or burr holding valve partially open.
7. Worn or damaged poppet or seat.
8. Valve cocked in body or on seat.

EXCESSIVE NOISE OR CHATTER

1. Too-high oil viscosity.
2. Faulty or worn poppet or seat.
3. Excessive return line pressure.
4. Pressure setting too close to that of another valve in circuit.
5. Improper spring used behind valve.

UNABLE TO ADJUST PROPERLY WITHOUT GETTING EXCESSIVE SYSTEM PRESSURE

1. Spring broken.
2. Spring fatigued.
3. Improper spring.
4. Drain line restricted.

OVERHEATING OF SYSTEM

1. Continuous operation at relief setting.
2. Oil viscosity too high.
3. Leaking at valve seat.

Pressure Reducing Valves

ERRATIC PRESSURE

1. Dirt in oil.
2. Worn poppet or seat.
3. Restricted orifice or balance hole.
4. Valve spool binding in body.
5. Drain line not open freely to reservoir.
6. Spring ends not square.
7. Improper spring.
8. Fatigued spring.
9. Valve needs adjustment.
10. Worn spool bore.

Pressure Sequence Valves

VALVE NOT FUNCTIONING PROPERLY

1. Improper installation.
2. Improper adjustment.
3. Broken spring.
4. Foreign matter on plunger seat or in orifices.
5. Leaky or blown gasket.
6. Drain line plugged.
7. Valve covers not tightened properly or installed wrong.
8. Valve plunger worn or scored.
9. Seat of valve stem worn or scored.
10. Orifices too large, causing jerky operation.
11. Binding from coating of moving parts with oil impurities (due to overheating or improper oil).

PREMATURE MOVEMENT TO SECONDARY OPERATION

1. Valve setting too low.
2. Excessive load on primary cylinder.
3. High inertia load on primary cylinder.

NO MOVEMENT OR SLOWNESS OF SECONDARY OPERATION

1. Valve setting too high.
2. Relief valve setting too close to that of sequence valve.
3. Valve spool binding in body.

Unloading Valves

VALVE FAILS TO COMPLETELY UNLOAD PUMP

1. Valve setting too high.
2. Remote pressure source too low.
3. Valve spool binding in body.

DIRECTIONAL CONTROL VALVES

Spool Valves
Rotary Valves
Check Valves

FAULTY OR INCOMPLETE SHIFTING

1. Worn or binding control linkage.
2. Insufficient pilot pressure.
3. Burned-out or faulty solenoid.
4. Defective centering spring.
5. Improper spool adjustment.

ACTUATING CYLINDER CREEPS OR DRIFTS

1. Valve spool not centering properly.
2. Valve spool not shifted completely.
3. Valve spool body worn.
4. Leakage past piston in cylinder.
5. Valve seats leaking.

CYLINDER LOAD DROPS WITH SPOOL IN CENTERED POSITION

1. Lines from valve housing loose.
2. O-rings on lockout springs or plugs leaking.
3. Broken lockout spring.
4. Circuit relief valves leaking.

CYLINDER LOAD DROPS SLIGHTLY WHEN RAISED

1. Defective check valve spring or seat.
2. Spool valve position improperly adjusted.

OIL HEATS (CLOSED-CENTER SYSTEMS)

1. Valve seat leakage (pressure or return circuits).
2. Improper adjustment of valves.

VOLUME CONTROL VALVES

Flow Control and Flow Divider Valves

VARIATIONS IN FLOW

1. Valve spool binding in body.
2. Leakage in cylinder or motor.
3. Oil viscosity too high.
4. Insufficient pressure drop across valve.
5. Dirt in oil.

ERRATIC PRESSURE

1. Worn valve poppet or seat.
2. Dirt in oil.

IMPROPER FLOW

1. Valve not adjusted properly.
2. Restricted valve piston travel.
3. Restricted passages or orifice.
4. Cocked valve piston.
5. Circuit relief valve leaking.
6. Oil too hot.

OIL HEATS

1. Improper pump speed.
2. Holding hydraulic functions in relief.
3. Improper connections.

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TEST YOURSELF

QUESTIONS

I. Introduction

1. Name the three basic valve types.

II. Pressure Control Valves

1. Give a couple of reasons why pressure control valves are used in hydraulic systems.
2. Name the two general types of relief valves.
3. Compare cracking pressure and full flow pressure.
4. At which of these pressures are relief valves rated?
5. Why are direct-acting relief valves considered to be safe should they fail in operation?
6. Compare a pressure *relief* valve with a pressure *reducing* valve.

III. Directional Control Valves

1. Name the three types of valving elements in directional control valves.
2. What is least complicated and most often used of all directional control valves?
3. What are the two basic types of sliding spool valves?
4. What is the difference in oil flow through the two spool valves in neutral?

IV. Volume Control Valves

1. What two methods are used to control volume flow?
2. What are "noncompensated" and "compensated" flow control valves?
3. What is the simplest type of flow control valve?
4. How do you control flow through a pressure-compensated flow control valve?

ANSWERS

I. Introduction

1. Pressure control valves, directional control valves, and volume control valves.

II. Pressure Control Valves

1. A. Limit system pressure, B. Reduce system pressure, C. Unload a pump, D. Set pressure for secondary circuit.
2. A. Direct acting, B. Pilot operated.
3. Cracking pressure is the pressure at which a valve first begins to pass a flow of oil. Full flow pressure is the pressure at which a valve passes its full rated capacity.
4. Both. Depending upon the application, a valve can be rated either way.
5. If a direct-acting relief valve fails, system pressure merely drops, resulting in loss of hydraulic functions. In other words, the pressure does not become dangerously high when a relief valve fails.
6. They are almost exact opposites. Relief valve—normally closed, reducing valve—normally open. Relief valve—sensing line from inlet, reducing valve—sensing line from outlet.

III. Directional Control Valves

1. A. Check valve (poppet type), B. Rotary type, C. Sliding spool type.
2. The simple check valve.
3. Open center and closed center.
4. In neutral, pump flow passes through the open center valve, but is blocked in the closed center spool valve.

IV. Volume Control Valves

1. Restricting fluid flow or diverting it.
2. "Noncompensated" valves control flow simply by restricting it. "Compensated" valves control flow but also regulate it in response to pressure changes.
3. A needle valve.
4. By pressure drop through an orifice.

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HYDRAULIC CYLINDERS / CHAPTER 4

INTRODUCTION

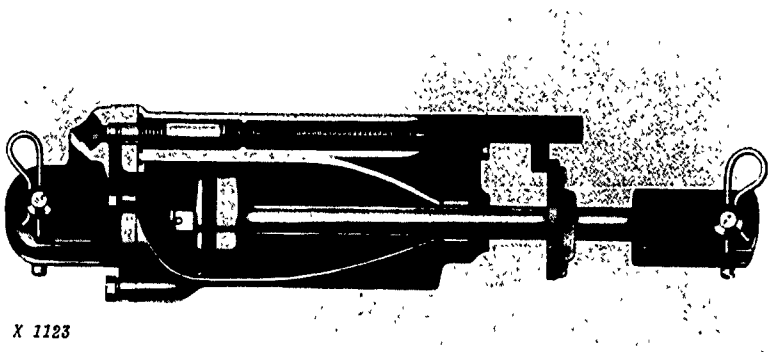


Fig. 1—Piston-Type Cylinder

The cylinder does the work of the hydraulic system. It converts the fluid power from the pump back to mechanical power. Cylinders are the "arms" of the hydraulic circuit.

Chapter 1 explains the uses of hydraulics and shows how cylinders can be used to actuate both mounted equipment and drawn implements (remote uses). In either case, the basic design of the cylinder is the same; only the extra features are different.

TYPES OF CYLINDERS

Two major types of cylinders are covered in this chapter:

- **Piston-Type Cylinders—give straight movement.**
- **Vane-Type Cylinders—give rotary movement.**

(Another type of rotary actuator is the hydraulic motor, covered in Chapter 5.)

PISTON-TYPE CYLINDERS

Two major kinds of piston-type cylinders are used:

• SINGLE-ACTING CYLINDERS—give force only one way (Fig. 2). Pressure oil is admitted to only one end of the cylinder, raising the load. An outside force such as gravity or a spring must return the cylinder to its starting point.

• DOUBLE-ACTING CYLINDERS—give force in both directions (Fig. 2). Pressure oil is admitted first at one end of the cylinder, then at the other, giving two-way power.

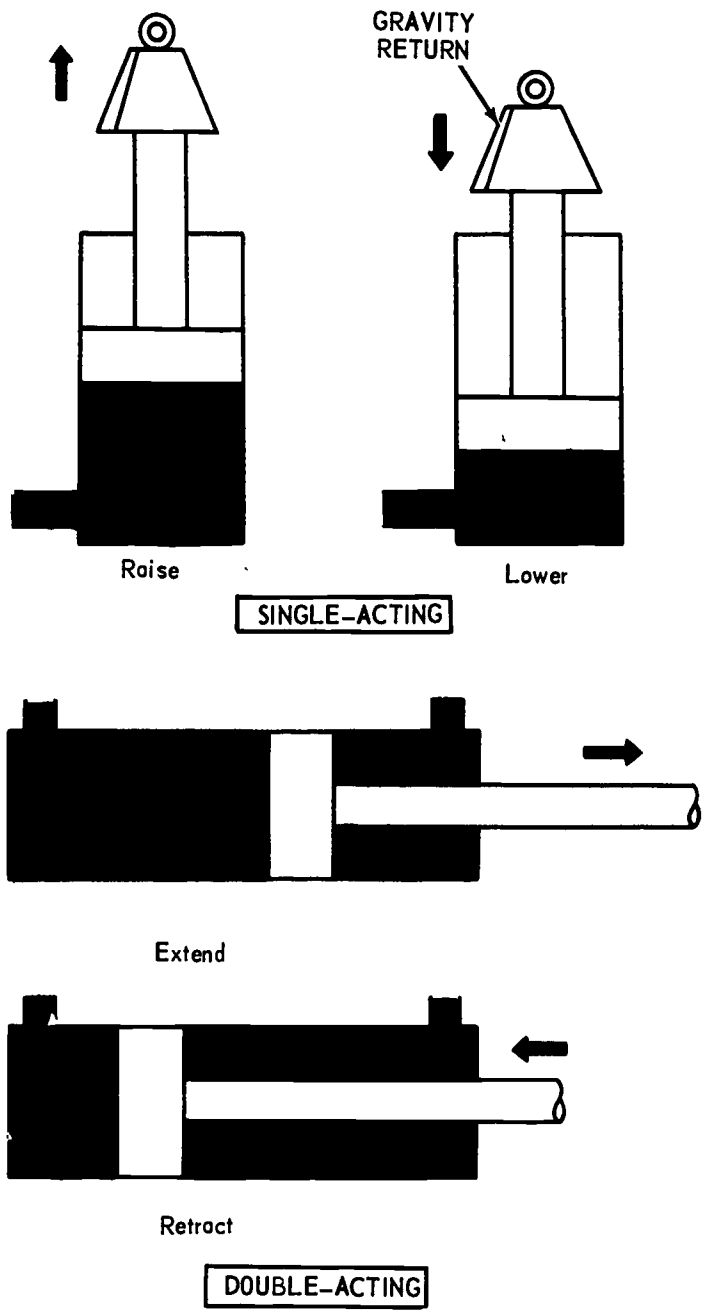


Fig. 2—Single- and Double-Acting Cylinders Compared

In both types of cylinders, a movable piston (or rod) slides in a cylinder housing or barrel in response to pressure oil admitted to the cylinder. The piston may use various packings or seals to prevent leakage.

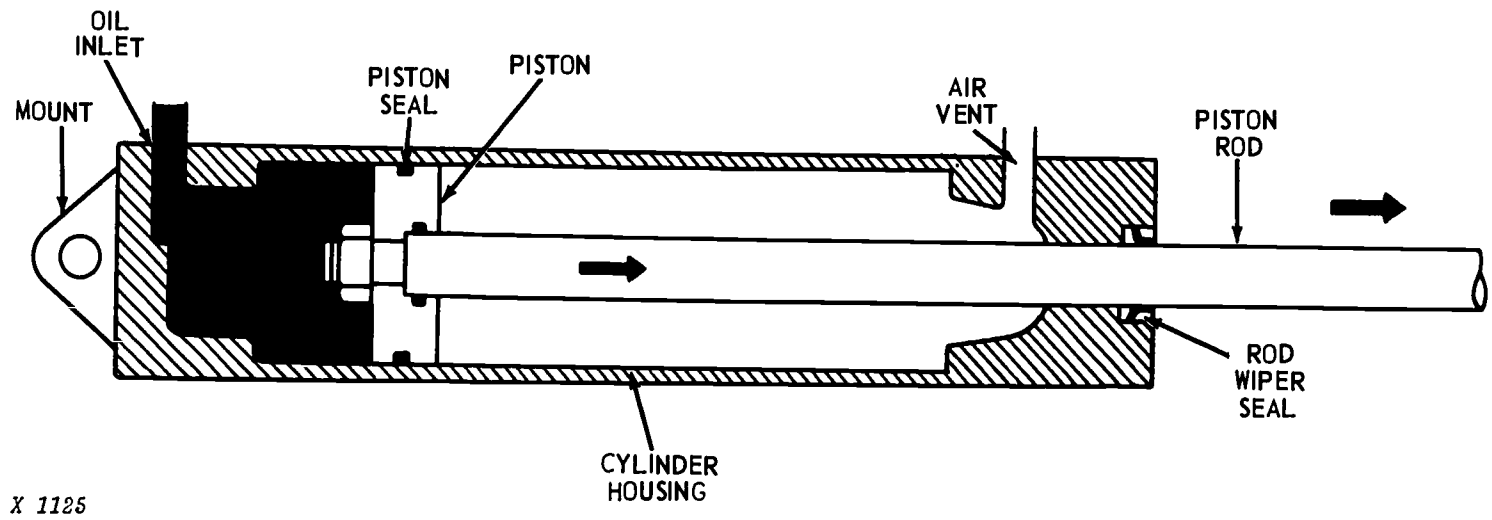


Fig. 3—A Typical Single-Acting Cylinder

SINGLE-ACTING CYLINDERS

In a single-acting cylinder, pressure oil is applied to only one side of the piston (Fig. 3). The piston and rod are forced out of the housing as shown, moving the load. When the oil pressure is released, the weight of the load (or a spring device) forces the rod back into the housing. The cylinder mount holds the cylinder in place while it works.

The other side of the cylinder is dry. A small air vent is required to release air when the piston rod extends, and to let in air when the rod retracts. This allows the cylinder to work smoothly and prevents a vacuum. To keep out dirt, a porous breather is often used in the air vent.

A seal on the piston prevents leakage of oil into the dry side of the cylinder. A wiper seal in the rod end of the cylinder cleans the rod as it moves in and out of the housing.

In some single-acting cylinders, the piston rod has no piston on the inner end. Instead, the end of the rod serves as the piston. This is called a **ram**-type cylinder (Fig. 4). The rod is slightly smaller than the inside of the cylinder. (A small shoulder or ring on the end of the rod keeps the rod from being pushed out of the cylinder.)

The ram-type construction has several advantages over the piston-type: 1) The rod is bigger and resists bending due to side loads. 2) The packing is on the outside and is easier to reach. 3) Scoring inside the cylinder bore will not damage packings. 4) No air vent is needed since oil fills the whole inner chamber of the cylinder housing.

Single-acting cylinders are favored on some mobile equipment where a simple hydraulic lift is needed and the weight of the working unit will lower itself.

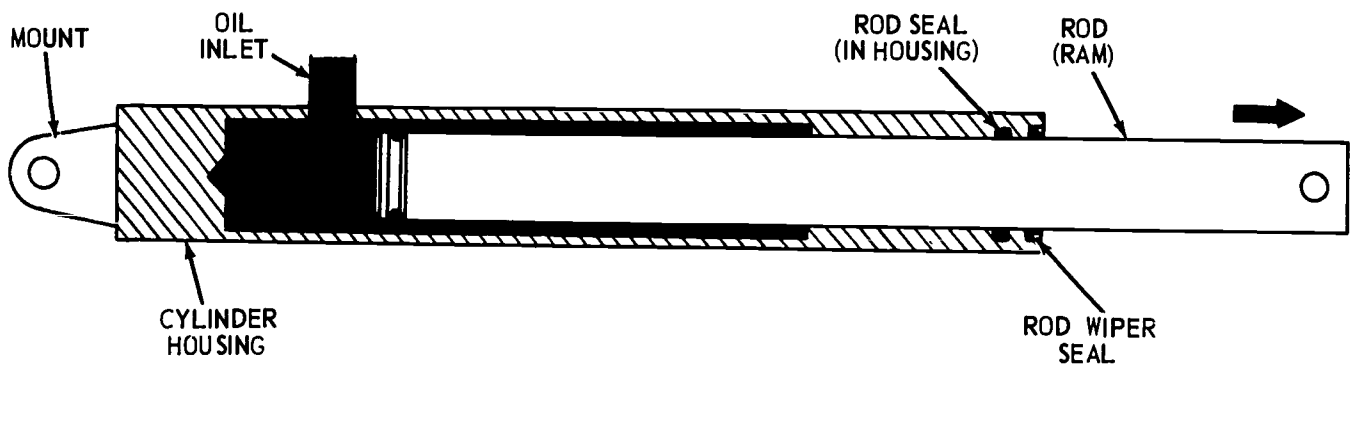
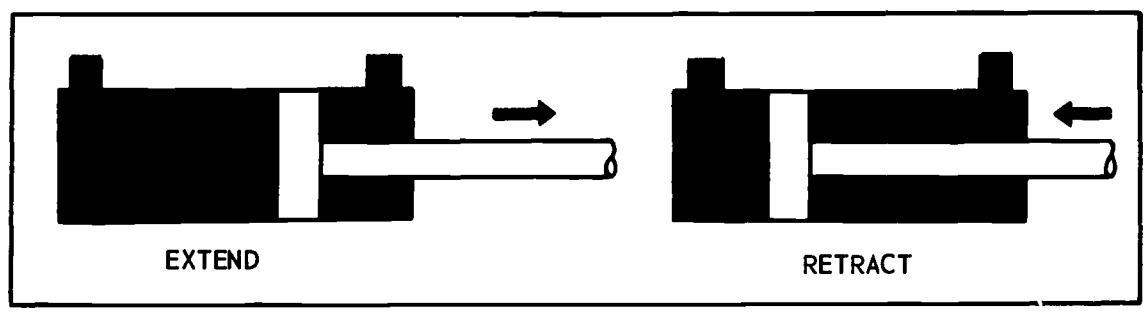


Fig. 4—Ram-Type Cylinder



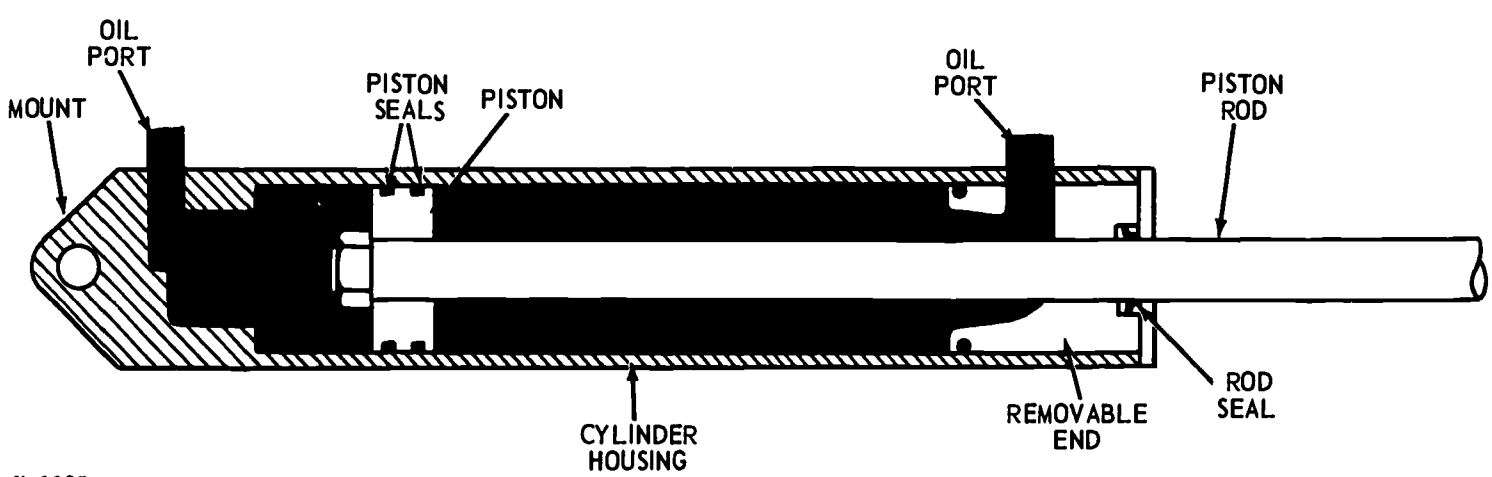


Fig. 5—A Typical Double-Acting Cylinder

DOUBLE-ACTING CYLINDERS

Double-acting cylinders provide force in both directions. Pressure oil enters at one end of the cylinder to extend it, at the other to retract it (Fig. 5). Oil from the opposite end of the cylinder returns to reservoir each time.

With the double-acting cylinder, both the piston head and the piston rod must be sealed to prevent oil leakage.

Two types of double-acting cylinders are shown in Fig. 6.

In the UNBALANCED or differential type, total force on the rod side of the piston is less than that on the blank side. This is because the rod fills in an area not exposed to pressure. This cylinder is usually designed for a slower, more powerful stroke when it extends, and for a faster, less powerful stroke when it retracts.

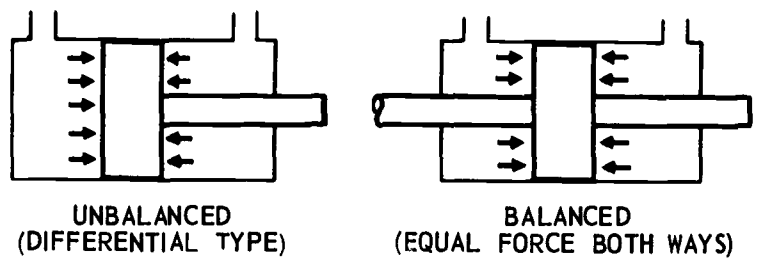


Fig. 6—Two Types of Double-Acting Cylinders

In the BALANCED cylinder, the piston rod extends through the piston head on both sides. This gives equal working area on both sides of the piston and balances the working force of the cylinder whether it is extending or retracting.

(Of course, the balance or unbalance of these cylinders depends also upon the loads. If the cylinder is not attempting to move equal loads in each direction, the balances will vary.)

EXTRA FEATURES OF PISTON-TYPE CYLINDERS

Many piston-type cylinders have extra features which add functions or adapt them to different uses.

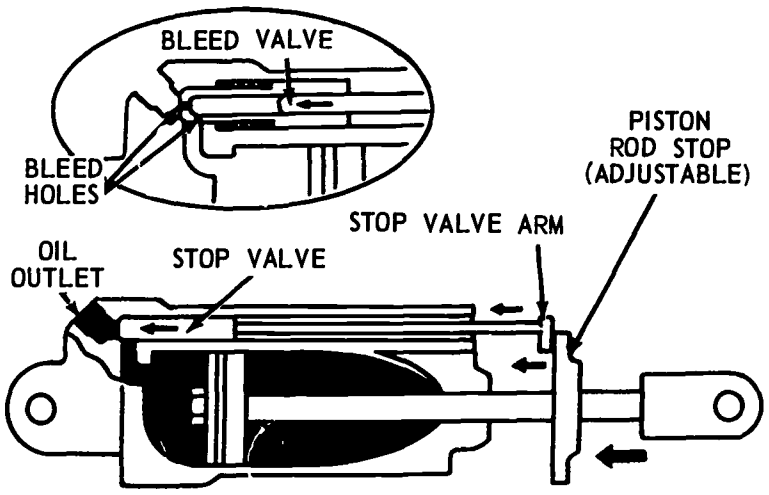


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Fig. 7—Hydraulic Stop in Cylinder

STROKE CONTROL DEVICES

A hydraulic stop is sometimes used to stop the piston at any point of its travel by shutting off the flow of outgoing oil (Fig. 7).

As the piston retracts, the rod stop contacts the arm as shown, moving the stop valve against its seat and closing the oil outlet. The trapped oil resists the piston and causes oil pressure to rise on the opposite end. This pressure rise affects the control valve and returns the system to neutral. The piston rod stop is adjustable for any stroke.

Mechanical stops are also used to stop some cylinders at a preset point on their strokes.

An "override" feature is built into the cylinder shown in Fig. 7. After the stop valve closes, two small bleed holes in the valve (see inset) allow a limited flow of oil out of the cylinder as the piston is retracted further (by holding the control lever in retract position). This action moves a bleed valve inside the stop valve (see inset) until it finally seats in the end of the stop valve, stopping all oil flow from the cylinder.

A spring mechanism allows incoming oil to reopen the valves for the next stroke of the cylinder.

The rate of operation of some cylinders is adjustable. Usually this is done at the control valve for the cylinder by means of a volume control device (see Chapter 3 for details).

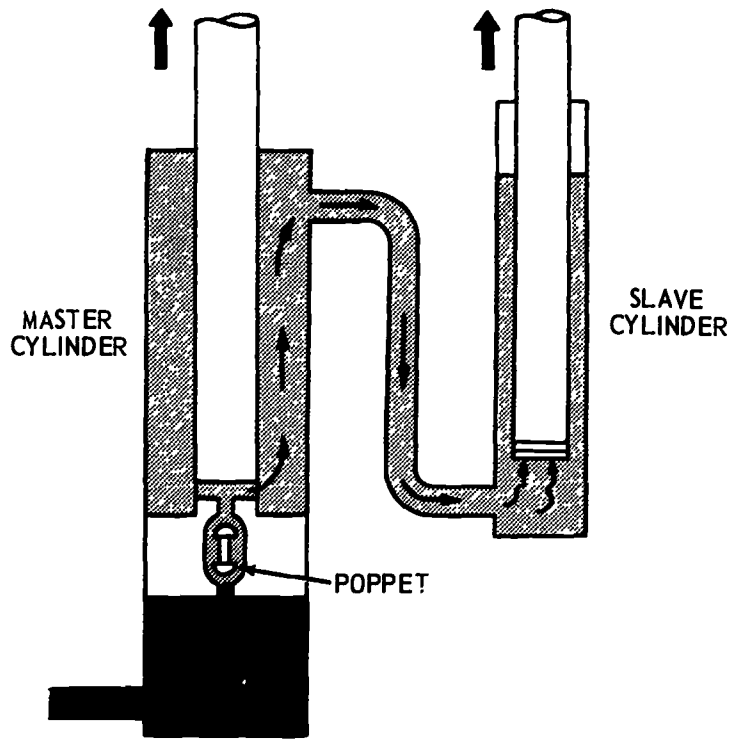

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Fig. 8—Use of Master and Slave Cylinders

SLAVE CYLINDERS

A slave cylinder can be used, supplied by a master cylinder (Fig. 8). Oil flows to the master cylinder, actuating it. Some of this pressure oil flows through a poppet or orifice in the piston and on into the opposite end of the cylinder. This oil then flows to the slave cylinder, actuating it in turn. The poppet or orifice can be designed so that both cylinders operate in unison or by delayed action. When the master cylinder is retracted, a matching poppet in the master cylinder opens, allowing oil to flow back through the master piston and return to reservoir.

In a variation on the slave cylinder setup, three cylinders are connected in series. Oil is fed to the rod end of largest cylinder, actuating it. This cylinder then pumps oil to the second largest cylinder, which in turn serves the smallest cylinder. Cylinder displacements can be matched so that all three cylinders operate at once. A common use is in controlling three sections of drawn implements. However, the largest cylinder must be capable of lifting the entire implement.

CUSHIONS

A cushion is built into some cylinders to slow them down at the end of their strokes. This cushion is used as a "hydraulic brake" to protect against impact damage. In Fig. 9, the cylinder works normally during its main stroke (top), but slows down as the piston seals off the oil outlet (bottom). Now the outlet oil must go through the small orifice, slowing the piston.

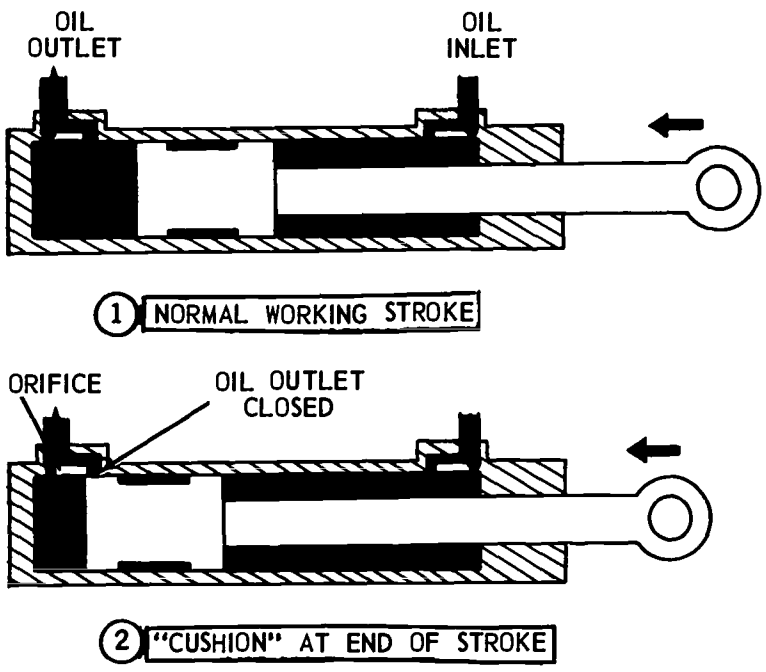


Fig. 9—Use of "Cushion" in Cylinder

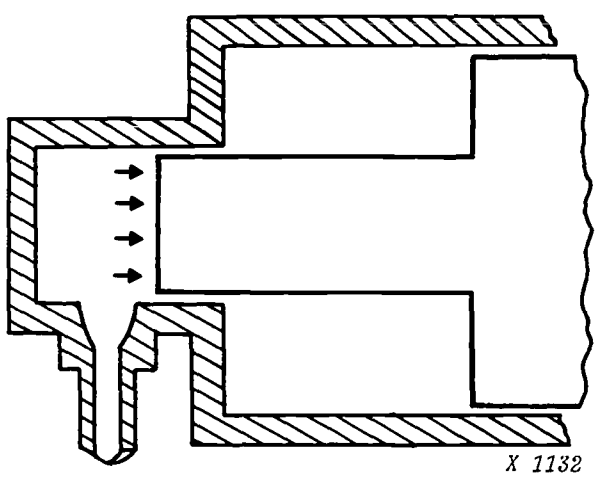


Fig. 10—Use of Stepped Piston in Cylinder

STEPPED PISTONS

A stepped piston allows a cylinder to provide a rapid starting stroke with low force and a slower, more powerful working stroke. This is done by admitting oil first against the smaller part of the piston, which moves rapidly until the work is contacted (Fig. 10). Then the entire piston surface takes over for the power stroke.

REGENERATING CYLINDERS

In a regenerating cylinder, oil discharged from the rod end is routed back to the head end to help speed up the stroke. Discharge oil is usually routed into the pump pressure line as shown in Fig. 11 and adds its volume to the normal flow through the control valve to the cylinder. During this cycle, pressure is equal on both the head and rod end of the cylinder.

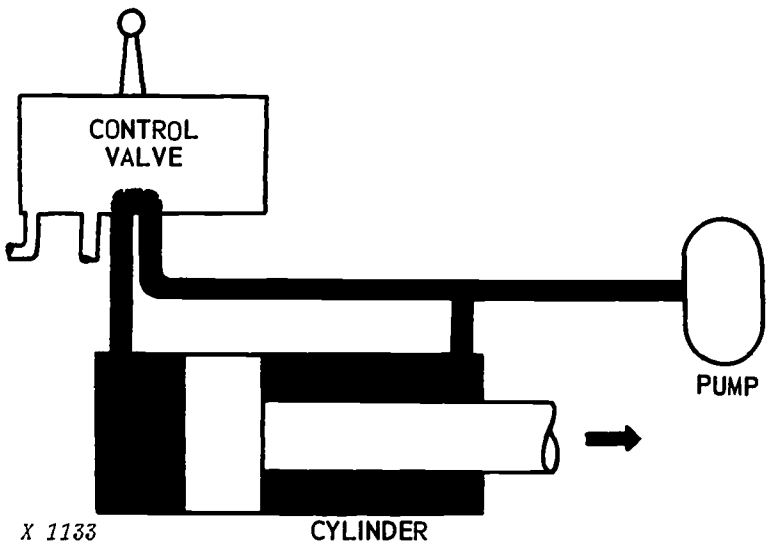


Fig. 11—Regenerating Cylinder (Double-Acting)

PISTON-TYPE CYLINDERS WHICH PRODUCE ROTARY MOTIONS

Two piston-type cylinders mounted opposite each other and operated as a push-pull device can be used to produce limited rotary motion. (Vane-type cylinders also produce rotary motion—see later in this chapter.) In some cases, a rack and pinion assembly is adapted for this, using a single-acting cylinder at each end of the rack. As pressure is applied at one end, the rack slides in its housing, turning the pinion. "Cushions" (see above) are often used to slow down the motion at the end of the piston stroke.

TELESCOPING PISTONS

In this application, the cylinder rod has an inner and outer section. The rod acts as one piece until the outer section reaches its stop. Then the inner section continues to the end of its stroke. They may be designed so that the inner section moves first, followed by the outer section. In this case, a locking device is used between the two sections. The speed of each section depends upon the area of the pushing surface of each. This feature is used only on single-acting cylinders.

PROTECTIVE CHECK VALVES

Some cylinders use a check valve at the oil inlet to protect the cylinder against loss of fluid from a line failure or other leak. If the oil supply fails, the check valve closes and traps the oil in the cylinder. This is very important where a heavy load is riding on the cylinder. An example is the leveling cylinders on a hillside combine. (See Chapter 3 for details on "Check Valves.")

PROTECTIVE THERMAL RELIEF VALVES

Heat can cause oil to expand and raise the pressure in a cylinder. Sometimes the heat of the sun can rupture a cylinder at rest. To prevent this, some cylinders have a thermal relief valve which is set far higher than system pressure and acts as a safety valve for this high pressure oil. (See Chapter 3 for details.)

VANE-TYPE CYLINDERS

A vane-type cylinder provides rotary motion.

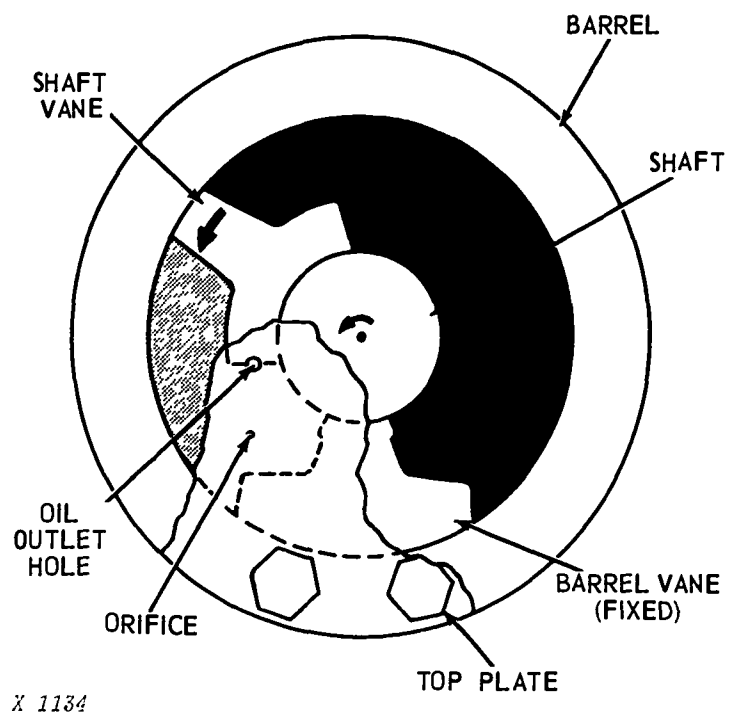


Fig. 12—Vane-Type Cylinder

Fig. 12 shows a vane-type cylinder in operation. In a round barrel, the shaft and vane rotate as pressure oil enters. Oil is discharged through the outlet hole in the other side of the cylinder.

A "cushion" or "hydraulic brake" can be built into the vane-type cylinder as shown. As the shaft vane travels, it shuts off the oil outlet hole in the top plate. This leaves only a small orifice to discharge the oil, slowing the rotating vane as it comes to the end of its stroke.

The vane-type cylinder is used to swing rotary equipment such as a backhoe. It allows the operator to swing the boom and bucket rapidly from trench to pile and back again. The optional "hydraulic brake" prevents jerky stops and impact damage.

Most vane-type cylinders are double-acting, as shown. The fixed barrel vane separates the two chambers of the cylinder. Pressure oil is sent first to one chamber to swing left, then to the other to swing right.

Limited rotary movement can also be devised by using two piston-type cylinders in a push-pull arrangement (see earlier in this chapter).

SEALS

Many different types of seals are used in cylinders. The seal used depends upon the oil pressure and temperature, whether the parts are moving or static, the speed of the moving parts, and the amount of shock loading. See Fig. 13.

Chapter 9 of this manual covers seals in detail. Refer to this chapter for information on types and uses of seals, and correct maintenance.

IDENTIFYING SIZE OF CYLINDERS

Cylinders on mounted equipment are sized for the job by the manufacturer.

However, with remote cylinders, there is a chance that the wrong cylinder may be used on a certain job.

Labels are used on most of these cylinders to identify the size. A typical label can be read as follows:

Label	Cylinder Diameter
25 64	2½"
30 76	3"
35 89	3½"

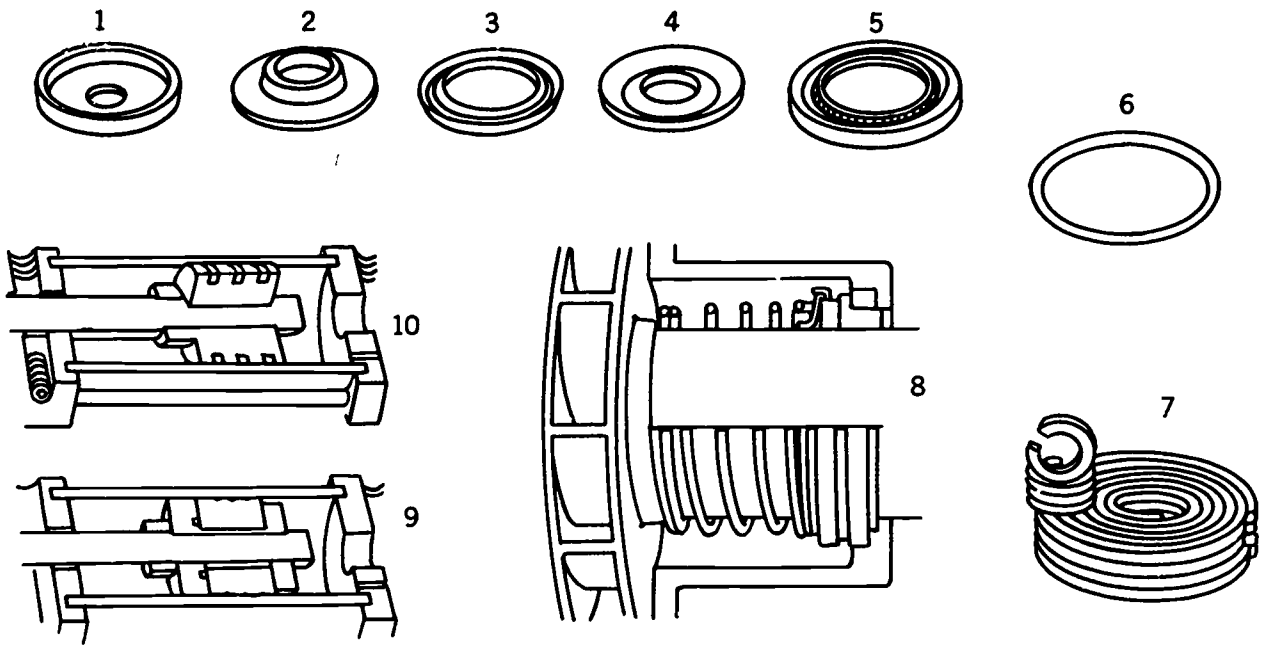
The first two digits on the label give the diameter of the cylinder in tenths of inches. Merely place a decimal point between the two digits and you have the size of the cylinder in inches. For example "25" = 2.5 inches. (The last two digits on the label give the size in millimeters.)

If you are not sure what size cylinder to use for a job, check the operator's manual for the machine. Or check the parts number in the parts catalog.

TESTING AND DIAGNOSING CYLINDER PROBLEMS

Cylinders can be tested on the machine for leaks and other failures. Refer to Chapter 12, "Testing and Diagnosis," for details. This chapter also has charts which list the causes and remedies for each possible failure.

The following section on "Maintenance of Cylinders" covers a few of the common problems.



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1—Cup Packing
2—Flange Packing
3—U-Packing
4—V-Packing
5—Spring-Loaded Lip Seal
6—O-Ring
7—Compression Packing
8—Mechanical Seal
9—Non-Expanding Metallic Seal
10—Expanding Metallic Seal

Fig. 13—Types of Seals for Hydraulic Cylinders

MAINTENANCE OF CYLINDERS

Hydraulic cylinders are compact and relatively simple. The key points to watch are the seals and the pivots. Here are a few service tips:

1. EXTERNAL LEAKAGE—If the cylinder end caps are leaking, tighten the caps. If this fails to stop the leak, replace the gasket. If the cylinder leaks around the piston rod, replace the packing. Be sure the seal lip faces toward the pressure oil. If the seal continues to leak, check items 5 through 9 below.

2. INTERNAL LEAKAGE—Leakage past the piston seals inside the cylinder can cause sluggish movement or settling under load. Piston leakage can be caused by worn piston seals or rings, or scored cylinder walls. The latter may be caused by dirt and grit in the oil.

IMPORTANT: When repairing a cylinder, be sure to replace all seals and packings before reassembly.

3. CREEPING OF CYLINDER—If the cylinder creeps when stopped in midstroke, check for internal leakage (item 2). Another cause could be a worn control valve (see Chapter 3 for details).

4. SLUGGISH OPERATION—Air in the cylinder is the most common cause of sluggish action. (To bleed air, see end of this chapter). Internal leakage in the cylinder is another cause (item 2). If action is sluggish when starting up the system, but speeds up when the system is warm, check for oil of too-high viscosity (see machine operator's manual). If the cylinder is still sluggish after these checks, the whole circuit should be tested for worn components (see Chapter 12, "Testing and Diagnosis," for details).

5. LOOSE MOUNTING—Pivot points and mounts may be loose. The bolts or pins may need to be tightened or they may be worn out. Too much "slop" or "float" in the cylinder mountings damages the piston rod seals. Check all cylinders for loose mountings periodically.

6. MISALIGNMENT—Piston rods must work in line at all times. If they are "side loaded," the piston rods will be galled and the packings will be damaged, causing leaks. Eventually the piston rods may be bent or the welds broken.

7. LACK OF LUBRICATION—Lack of piston rod lubrication may cause the rod packing to seize, resulting in an erratic stroke, especially on single-acting cylinders.

8. ABRASIVES ON PISTON ROD—When piston rods extend, they can pick up dirt and other material. Then when the rod retracts, it carries the grit into the cylinder, damaging the rod seal. This is why rod wipers are often used at the rod end of the cylinder to clean the rod as it retracts. Rubber

boots are also used over the end of the cylinder in some cases. Another problem is rusting of piston rods. When storing cylinders, always retract the piston rods to protect them.

9. BURRS ON PISTON ROD—Exposed piston rods can be damaged by impact with hard objects. If the smooth surface of the rod is marred, the rod seal may be damaged. Burrs on the rod should be cleaned up immediately using crocus cloth.

10. CHECKING AIR VENTS—Single-acting cylinders (except ram-types) must have an air vent in the dry side of the cylinder. To prevent dirt entry, various filter devices are used. Most are self-cleaning, but they should be inspected periodically to insure proper operation.

BLEEDING AIR FROM REMOTE CYLINDERS

Any time a remote cylinder is plugged in the hydraulic circuit, all trapped air must be bled. This will prevent sluggish action of the cylinder.

Fig. 14—Bleeding Air From Remote Cylinder

First attach the cylinder to the circuit. Place the cylinder on the ground (or on a hanger) with the piston rod end down as shown in Fig. 14. (Or on mounted cylinders, place the head end of the cylinder in its working mount, allowing the rod end freedom to move in and out.) Start the machine and move the hydraulic control lever back and forth seven or eight times to extend and retract the cylinder. This will bleed the air. (On double-acting cylinders, you may have to turn the cylinder end-for-end and repeat the cycling of the control lever.)

TEST YOURSELF

QUESTIONS

1. (True or false?) "Cylinders convert mechanical power to fluid power."

2. (Fill in the blanks.) Piston-type cylinders give _____ movement while vane-type cylinders give _____ movement.

3. (Fill in the blanks.) Cylinders which are _____-acting give force in both directions. Cylinders which are _____-acting give force in only one direction.

4. What fills the chambers on each side of the piston in a single-acting cylinder?

5. In a double-acting cylinder, how does a piston rod on one side only affect the working stroke?

6. How does a "hydraulic brake" or "cushion" work in a vane-type cylinder?

ANSWERS

1. False. Cylinders convert fluid power to mechanical power.

2. First blank—"straight." Second blank—"rotary."

3. First blank—"double." Second blank—"single."

4. One side is filled with hydraulic oil; the other side is filled with air.

5. The rod fills an area of the piston which is not exposed to pressure oil. So the stroke produced on this side is less powerful, but usually faster (since less oil is needed to move the piston).

6. It slows down the cylinder movement at the end of its stroke by partly closing off the discharged oil in front of the rotating vane.

HYDRAULIC MOTORS / CHAPTER 5

INTRODUCTION

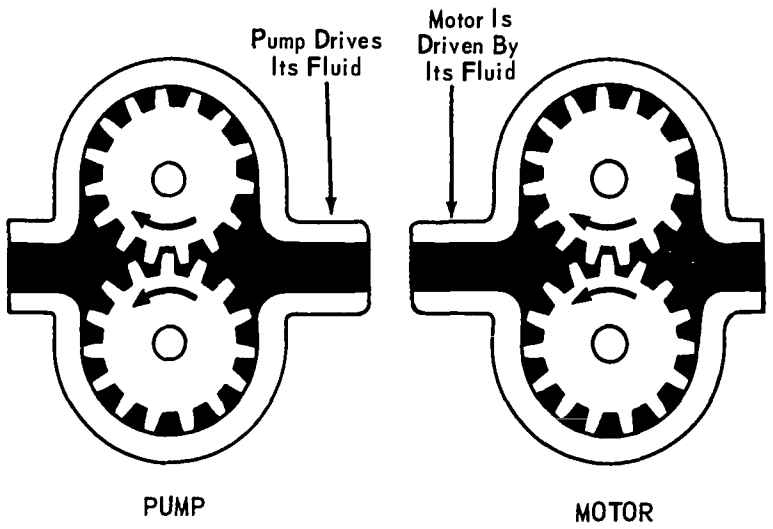

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Fig. 1—Hydraulic Pump and Motor Compared

A hydraulic motor works in reverse when compared to a pump (Fig. 1).

The pump *drives* its fluid, while the motor is *driven by* its fluid. Thus:

- **Pump—draws in fluid and pushes it out, converting mechanical force into fluid force.**
- **Motor—fluid is forced in and exhausted out, converting fluid force into mechanical force.**

In use, the pump and motor are often hydraulically coupled to provide a power drive:

1. *The pump is driven mechanically, drawing in fluid and pumping it to the motor.*

2. *The motor is driven by the fluid from the pump and so drives its load by a mechanical link.*

The motor is really an actuator, like the cylinder (Chapter 4). However, the motor is a rotary actuator that rotates in a full circle. (The vane-type cylinder is a *limited* rotary actuator.)

COMPARING PUMP AND MOTOR DESIGN

The motor is designed much like the pump. Both use the same basic types—gear, vane, and piston. Often their parts can be substituted one for the other.

Both pump and motor use an internal sealing of parts to back up their flow of fluid—*positive* displacement. Without this seal, a motor's elements would not move under force of the incoming fluid.

Sometimes pumps are modified and used as motors. However, a pump should never be used as a motor or converted to a motor without considering all the factors of the application. For example, the wear on shaft bearings often increases in motor usage.

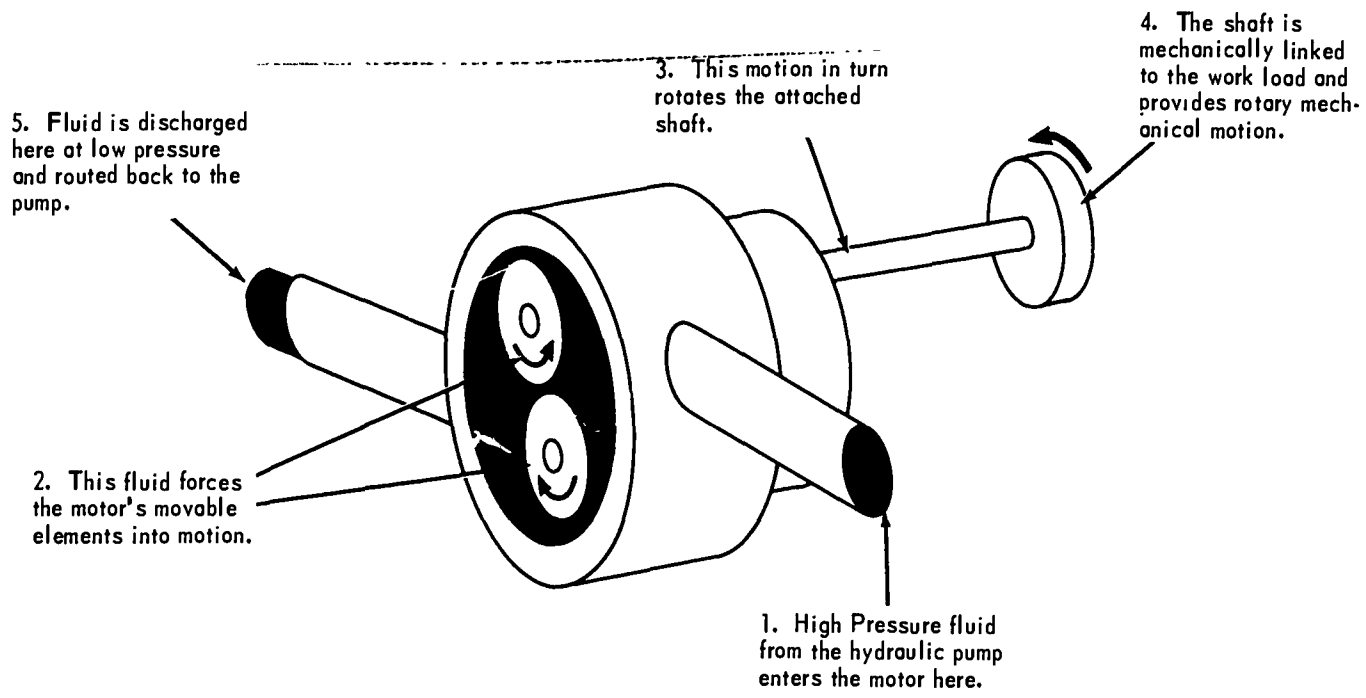

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Fig. 2—Basic Operation of Hydraulic Motor

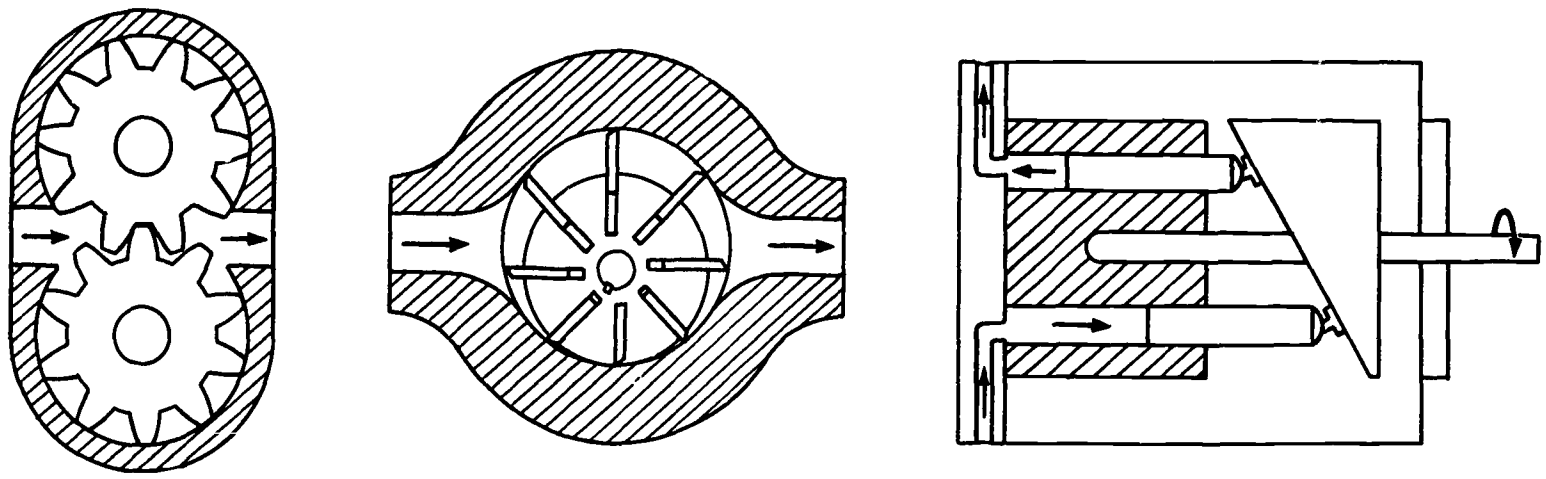

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Fig. 3—Three Types of Hydraulic Motors

DISPLACEMENT AND TORQUE OF MOTORS

The work output of a motor is called *torque*. This is a measure of the rotary force on the motor drive shaft.

Torque is only a measure of force X distance (as in "foot-pounds") not of the *speed* of this force.

The ratio between the speed and torque output of a motor depends upon its *displacement*—the volume of fluid it displaces with each cycle.

Motors, like pumps, are designed for two types of displacement:

• FIXED DISPLACEMENT motors normally have variable speeds which are regulated by varying the amount of input flow. Normally these motors have a fixed torque, or rotary work output.

• VARIABLE DISPLACEMENT motors have both variable speeds and variable torques. The input flow and pressure remain constant, while the speed and torque can be varied by mechanisms which change the displacement.

The applications and efficiencies of these motors will be discussed later in this chapter.

TYPES OF HYDRAULIC MOTORS

Motors are designed in three basic types (Fig. 3):

• **Gear Motors**

• **Vane Motors**

• **Piston Motors**

These basic types are the same as for the pump (Chapter 2).

All three designs work on the rotary principle: a rotating unit inside the motor is moved by the incoming fluid.

Let's discuss the operation of each type of motor.

GEAR MOTORS

Gear motors are widely used because they are simple and economical. Often they are used to drive small equipment in remote applications.

Usually small in size, gear motors are versatile and can be transferred from one use to another by using a universal mounting bracket and flexible hoses.

Gear motors can rotate in either direction but are normally not capable of variable displacement.

Two basic designs are used:

• **External Gear Motors**

• **Internal Gear Motors**

Let's discuss the operation of each.

EXTERNAL GEAR MOTORS

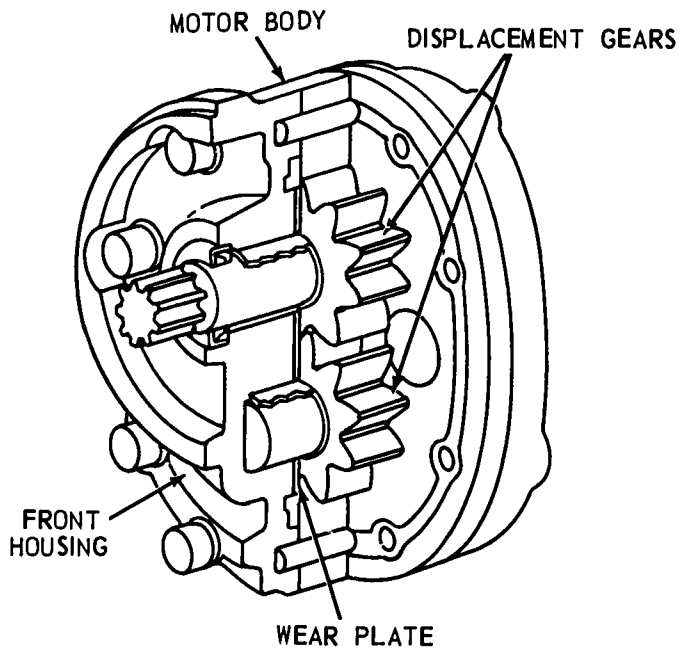

Fig. 4—External Gear Motor

The external gear motor is a duplicate of the external gear pump. It has two equal-sized gears in mesh, sealed in a housing (Fig. 4).

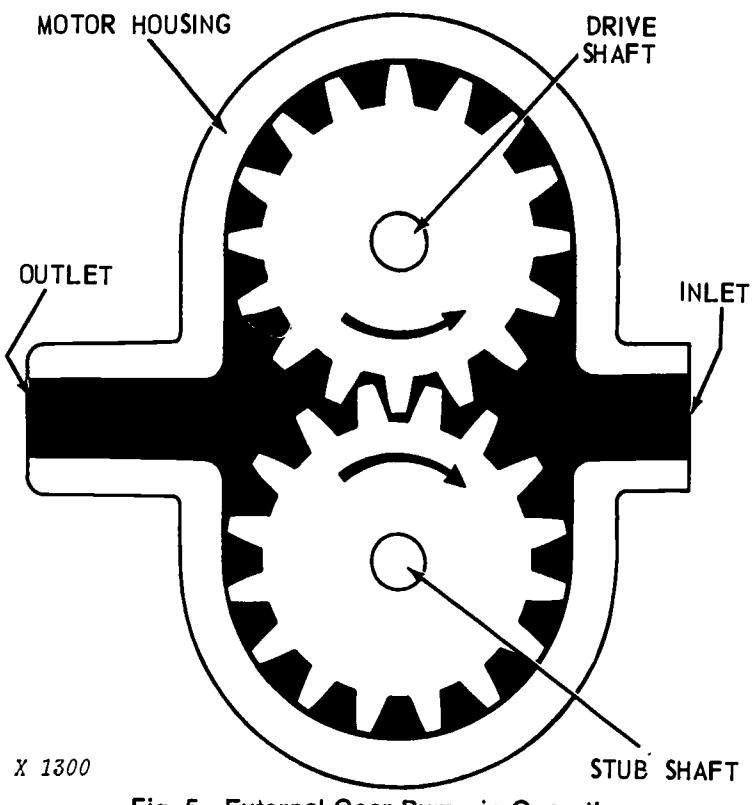

Fig. 5—External Gear Pump in Operation

In operation, pressure oil from the pump forces the motor gears to rotate away from the inlet port. This action rotates the motor shaft connected to the work load.

The force of the pressure oil is expended as it travels between gear teeth and housing to the outlet port. Here it leaves the motor as low pressure fluid and returns to the reservoir or the pump.

Balanced Version of External Gear Motor

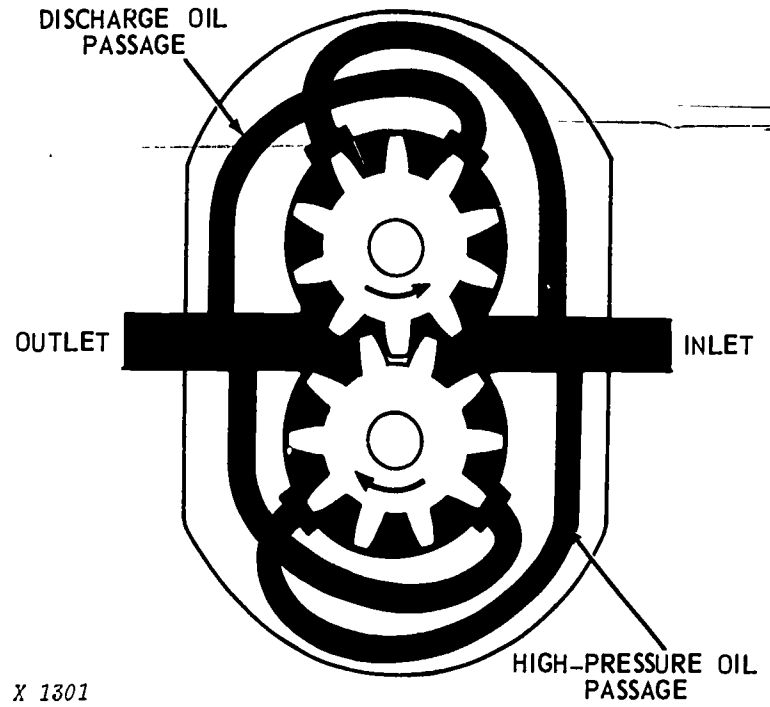

Fig. 6—Balanced Version of External Gear Motor

Some external gear motors are "balanced" for equal pressure on all sides of the rotating parts (Fig. 6). This is done to reduce bearing failures. The basic motor is the same but passages have been added in the housing to connect inlet and outlet oil pressure to the opposite sides of the motor. Now pressure is exerted equally on both sides of the gears and shafts, cancelling out unequal pressures and balancing the motor.

INTERNAL GEAR MOTOR

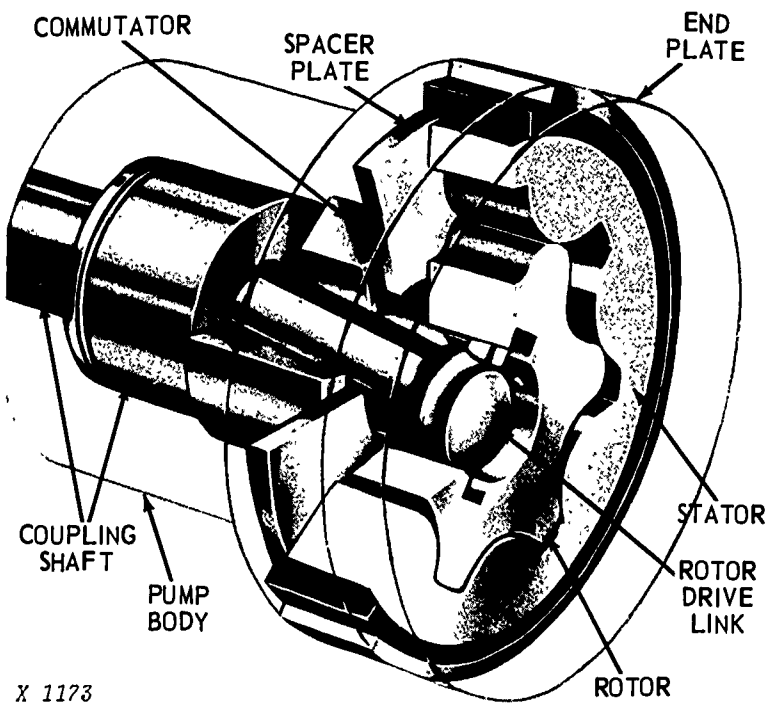

Fig. 7—Internal Gear Motor

One popular internal gear motor is much like the rotor pump (Chapter 2). This motor is shown in Fig. 7.

Not actually gears, the moving parts are called the rotor and the rotor ring. The rotor is driven inside the rotor ring.

The rotor is mounted eccentric to the rotor ring. The ring has one more lobe than the rotor so that only one lobe is in full engagement with the outer ring at any one time. This allows the rotor's lobes to slide over the outer lobes, making a seal.

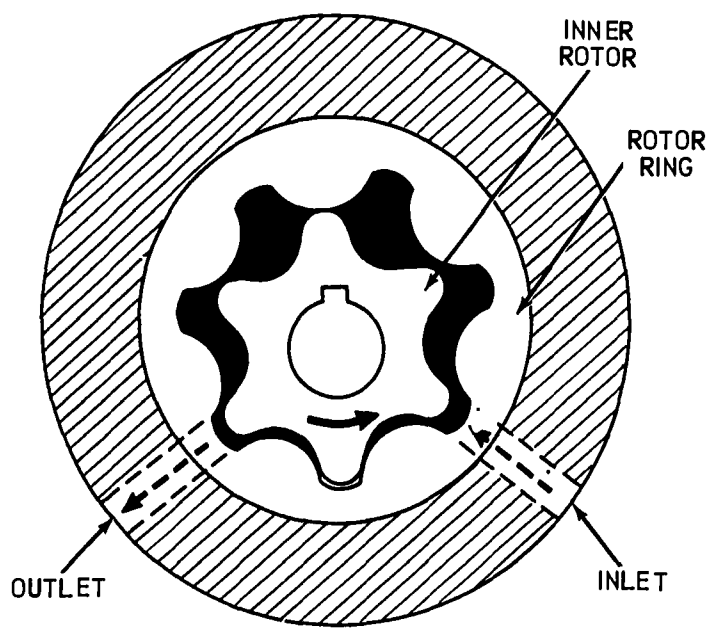

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Fig. 8—Internal Gear Motor in Operation

In operation, pressure fluid enters the motor, striking the rotor and rotor ring lobes, forcing both to rotate (Fig. 8). As they rotate, a seal is formed, then broken, as each inner lobe engages a cavity in the outer ring. The fluid is discharged under low pressure at the outlet port.

Fig. 9 shows another type of internal gear motor. It uses a crescent-shaped separator between the inner and outer gears—just as the internal gear pump in Chapter 2. Operation is basically the same, but with inlet and outlet pressures reversed.

VANE MOTORS

Vane motors, like their "brother" pumps, are available in two types—balanced and unbalanced. Most of the vane motors on today's machines are the balanced type, since most of these applications do not require variable displacement. Balanced motors have a longer service life (less bearing wear) and so are more economical.

The balanced vane motor (Fig. 11) operates much the same as the vane pump (Chapter 2). The slotted rotor turns, driven in this case by the force of incoming oil against the vanes.

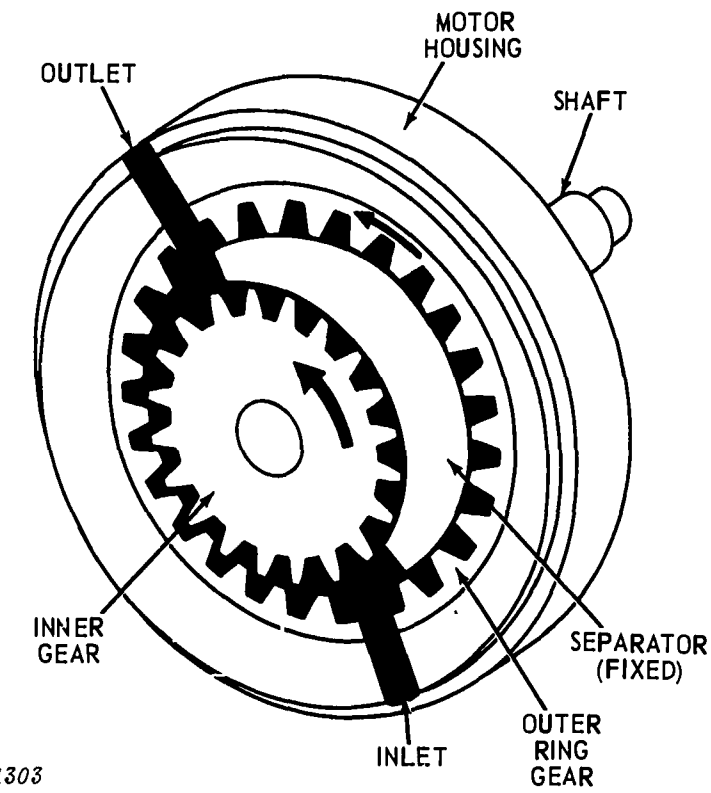

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Fig. 9—Internal Gear Motor With Separator

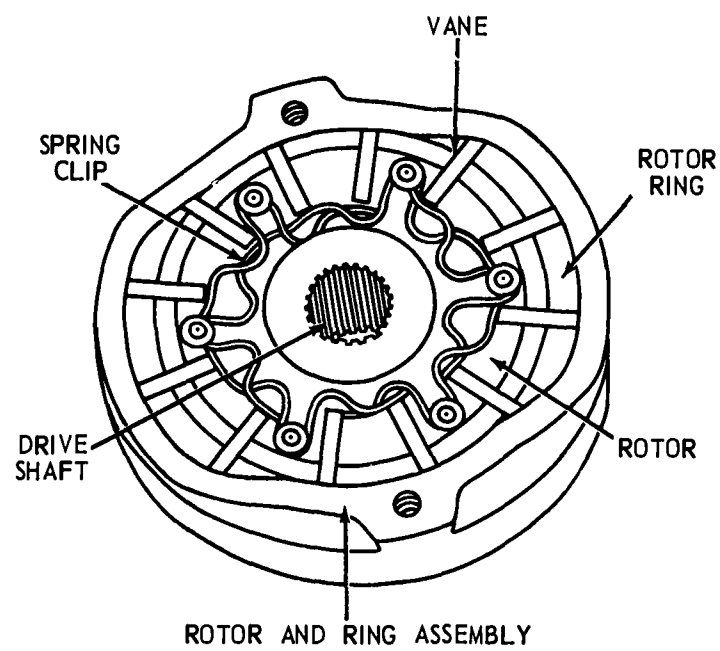

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Fig. 10—Vane Motor (Balanced Type)

The only extra feature of the motor is the devices used to hold the vanes in contact with the outer ring. These devices may be spring clips as shown in Fig. 10 or small springs beneath each vane pushing it out.

These devices are needed for internal sealing in a motor but not in a pump. In the pump, centrifugal force throws the vanes out against the outer ring. But in the motor, incoming oil is under high pressure and would bypass the vanes before rotation began unless the vanes were held out solid against the ring.

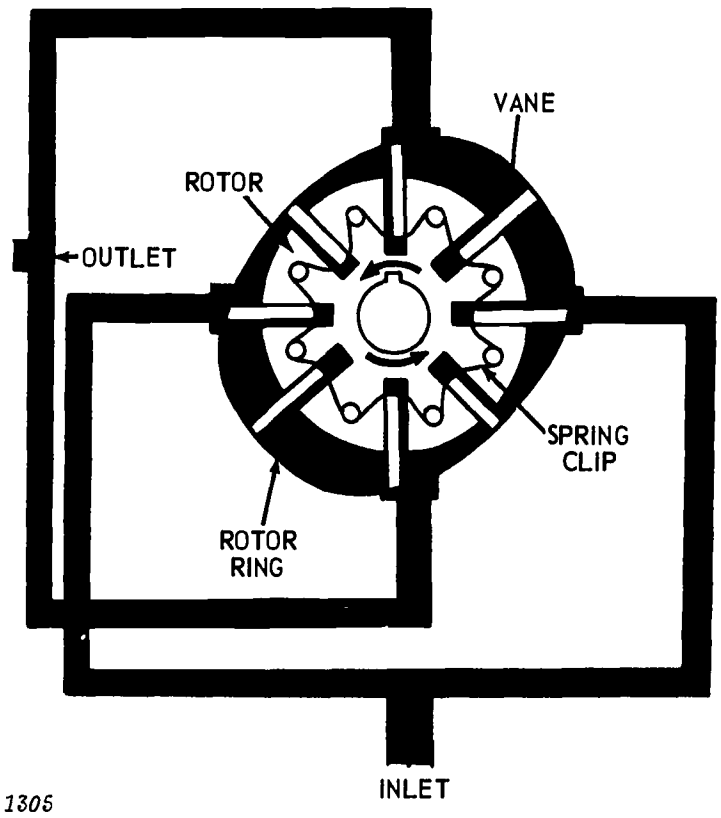

Fig. 11—Balanced Vane Motor in Operation

SUMMARY: BALANCED VANE MOTORS

Balanced vane motors are only capable of fixed displacement. Yet they usually provide more power and efficiency than gear motors. Their direction of rotation can easily be changed by reversing the flow of fluid.

NOTE: Most vane pumps can be converted to motors, but unless a vane pump has clips or springs to hold the vanes in contact with the rotor ring, it will not work as a motor.

PISTON MOTORS

Piston motors are often favored in systems which have high speeds or high pressures. While more sophisticated than the other two types, piston motors are more complex, more expensive, and require more careful maintenance.

Like its pump counterpart, the piston motor is available in two types:

- **Axial Piston**
- **Radial Piston**

On mobile systems, axial piston models are often favored. The radial piston model is usually confined to stationary industrial uses where space is not limited and more power is needed.

AXIAL PISTON MOTORS

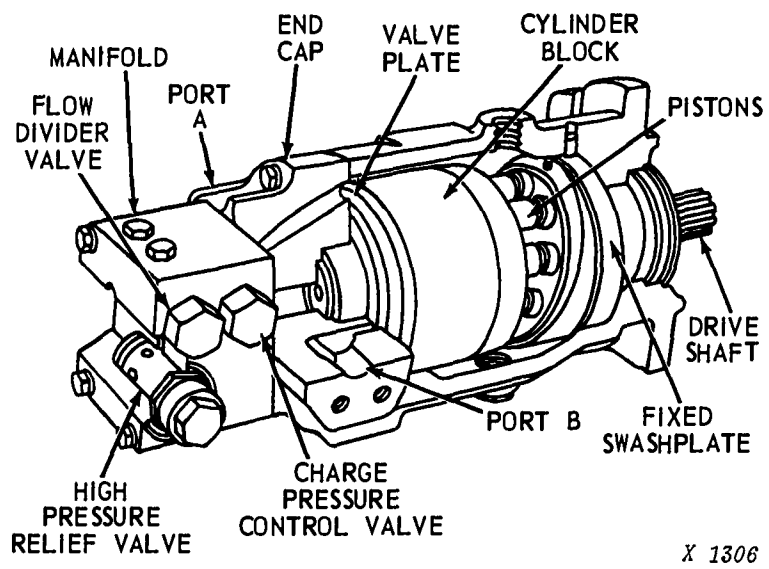

Fig. 12—Axial Piston Motor (Fixed Displacement)

Fig. 12 shows a fixed displacement version of an inline axial piston motor.

The motor shown is used as part of the hydraulic drive on a self-propelled machine.

The end cap contains ports A and B which accept pressure oil from the pump to operate the motor. They also discharge low pressure oil back to the pump.

The pistons work in bores in the revolving cylinder block and contact a fixed-angle swashplate as they revolve.

In operation (Fig. 13), high pressure oil through port A enters cylinder bores, forcing its piston against the angled swashplate. Because the swashplate is fixed, the piston slides down its angled face. This sliding action makes it revolve, turning the cylinder block which in turn drives a shaft which propels the load.

As the cylinder block turns, other bores align with port A and their pistons are actuated, keeping up the rotation.

During the second half of the motor's revolution, low pressure oil is discharged at port B as the pistons are forced back by the thicker part of the swashplate.

To reverse the rotation, simply reverse the flow of oil, feeding pressure oil in at port B and returning it through port A.

The valving shown at left in Fig. 13 helps to control and protect the motor. A flow divider valve, two high-pressure relief valves, and a pressure control valve are used.

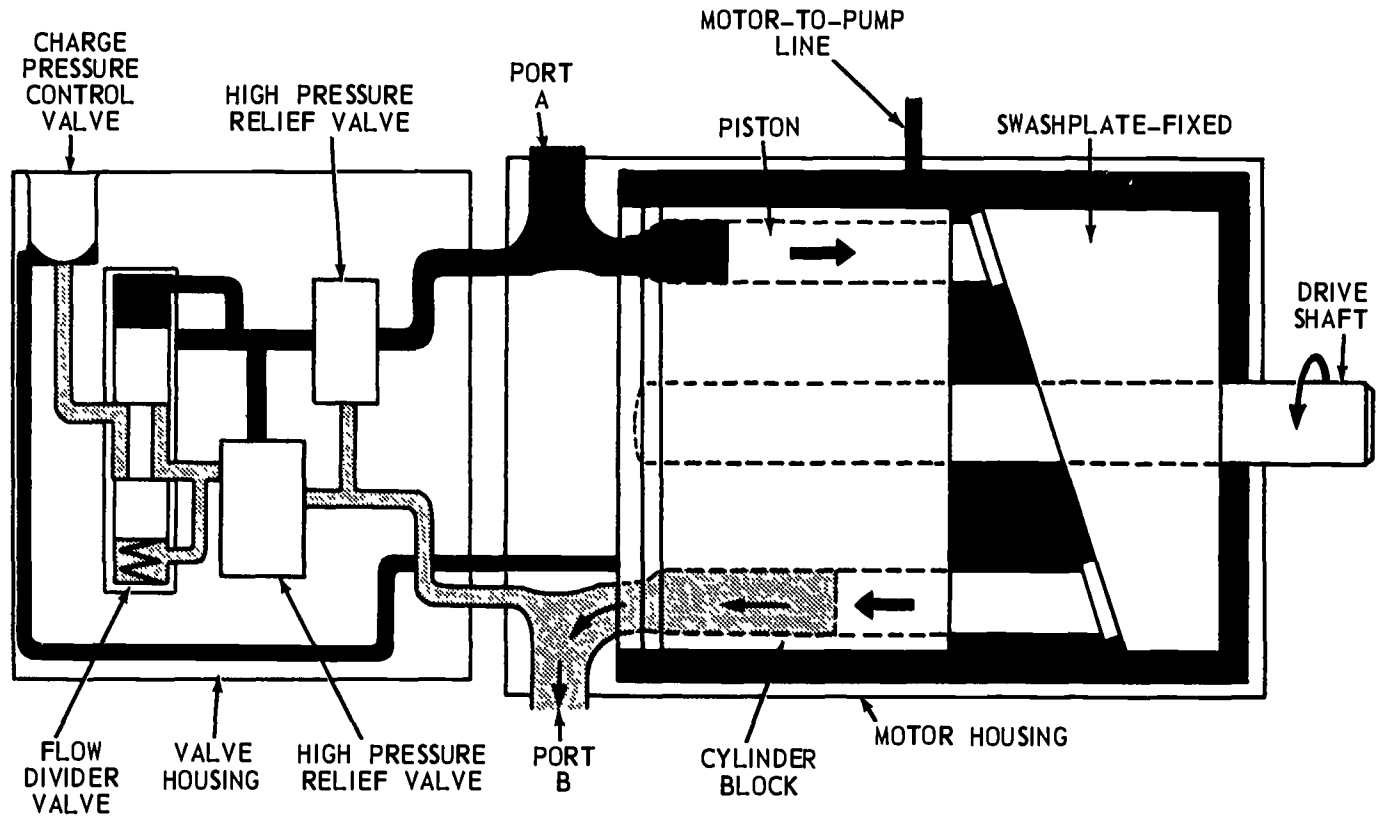

Fig. 13—Axial Piston Motor in Operation (Fixed Displacement)

The basic operation of these valves is given in Chapter 3. For the motor shown, the valves work as follows:

The *flow divider valve* moves back and forth in response to incoming pressure oil and prevents this oil from entering the low pressure side of the circuit. It keeps the incoming oil open to the charge pressure control valve while the motor is "in stroke".

The *high pressure relief valves* monitor the incoming pressure oil at each port—whenever that port is the inlet route for oil. When pressure exceeds the valve setting, it opens and bypasses oil, slowing or stopping the motor. This protects the motor against overloads. When pressures are again lowered to normal, the valve closes and the motor speeds up as inlet oil flows in again.

The *charge pressure control valve* routes excess oil from the system charging pump to the motor housing and back to the main pump. This oil aids in cooling and lubricating the motor and main pump.

Variable Displacement Version of Axial Piston Motor

This motor is shown in Fig. 14. It is used as part of a pump-motor combination to drive a self-propelled machine.

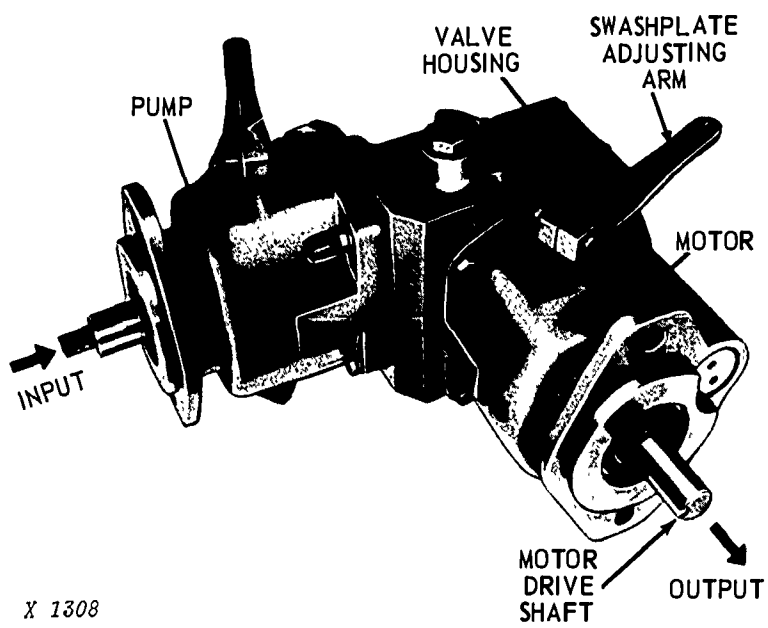

Fig. 14—Axial Piston Motor with Variable Displacement (Pump-Motor Drive Unit Shown)

The pump and motor share common valving and both are connected at a 90° angle as shown. The valving sends fluids from pump to motor. A small charging pump is also built into the valve housing.

The pump and motor are very similar; most parts are identical.

A word of caution: Although many pump and motor parts are identical, do not interchange them after the unit has been in long use. Moving parts tend to set up their own peculiar wear patterns and these may not conform to another component. The result might be internal leakage and loss of efficiency.

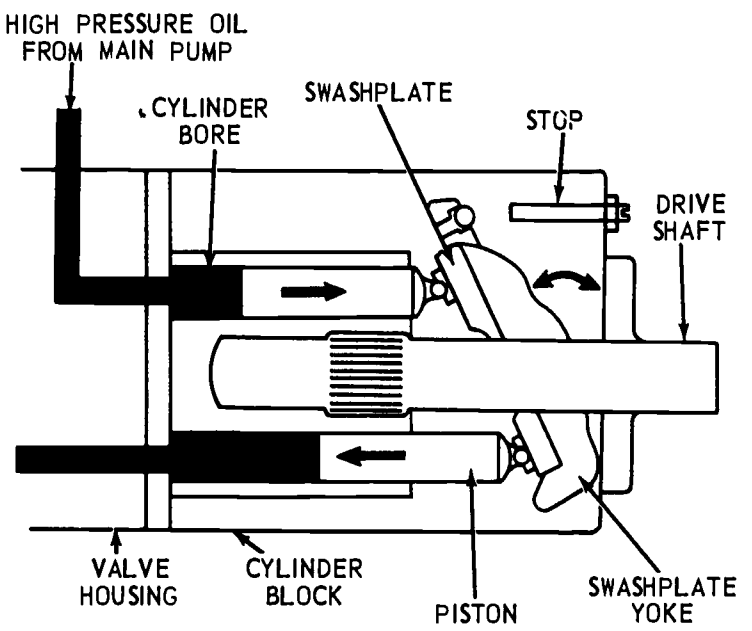

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Fig. 15—Operation of Axial Piston Motor with Variable Displacement

Operation is shown in Fig. 15. This motor resembles the fixed displacement version described above. The main difference is that the former had a fixed-angle swashplate while the latter has an adjustable swashplate.

Operation is much the same as for the fixed displacement model. High pressure oil forces the pistons to contact and slide down the face of the swashplate, revolving the cylinder block and drive shaft. Fluid at low pressure is expelled as the pistons are forced back by the thicker part of the swashplate.

The displacement of oil in each cycle of the motor is determined by how far the piston must travel to contact the swashplate.

In Fig. 15, the angle of the swashplate can be adjusted by tilting it using an arm and lever. By moving the lever, the displacement of the motor is changed.

A mechanical stop is used in this motor to limit the distance the swashplate angle can be changed.

The greater the angle of the swashplate, the more oil that is displaced and the faster the motor will normally drive its load.

SUMMARY OF MOTOR TYPES

This concludes our description of the three basic types of motors.

Before going into the application and efficiency of these motors, let's review some of the points we have just covered.

In summary:

1. A hydraulic motor is the opposite of a pump: A pump drives its fluid, while a motor is driven by its fluid.

2. A pump converts mechanical force into fluid force, while a motor converts fluid force into mechanical force.

3. A pump-motor drive works as follows: The pump is driven mechanically, drawing in fluid and pumping it to the motor. The motor is driven by the fluid from the pump and so drives its load by a mechanical link.

4. A motor is often quite similar to a pump in appearance and construction.

5. However, a hydraulic pump is really an actuator, like a cylinder.

6. The three basic types of motors are: gear, vane, and piston. All three are rotary in operation.

7. We have covered only the basic types of motors. In actual use, there are many variations for special needs.

HYDRAULIC MOTOR APPLICATION AND EFFICIENCY

The first part of this chapter has described the physical construction and operation of the basic types of hydraulic motors as used on modern farm and industrial equipment. Now we must tell another part of the hydraulic motor story—how the hydraulic motor is used, why it is used, and how the three types of motors are rated in regard to power output, efficiency, size, cost, etc.

Again, because of the wide variety of motors and hydraulic systems, we will not attempt to prescribe a particular motor for a particular application. We can only describe in a general way the good and bad points of each type, then let you judge why a particular type of motor is selected for a certain application.

MOTOR SELECTION

To select a hydraulic motor, we must first find out what we expect to achieve by using the motor. This, of course, means analyzing the system's require-

1. The formula for torque:

T(orque) = F(orce) X D(istance)

2. The distance factor is the perpendicular distance from the center of the axis (A) to the line of force (B).

3. Example: If the radius of the pulley is 6 inches (center of the axis to line of force) and the force applied is 100 pounds:

T = F x D

T = 100 x 6

Torque = 600 inch-pounds

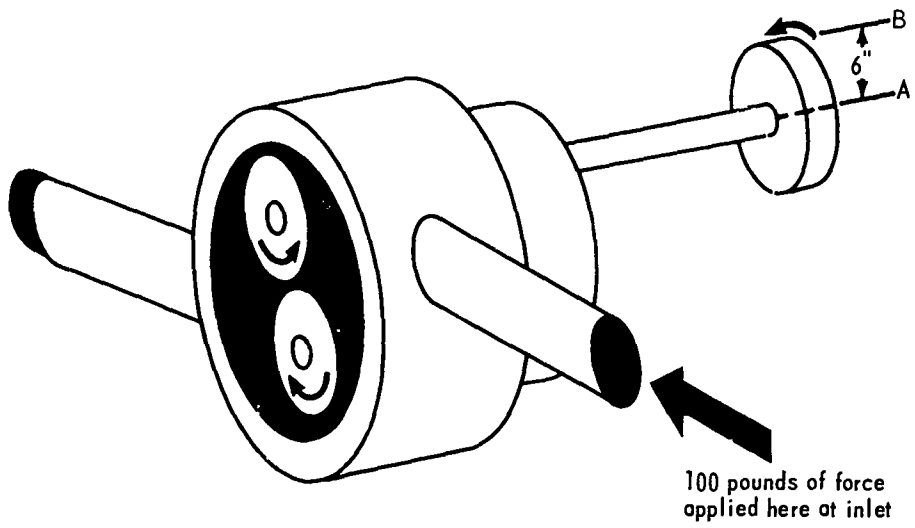

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Fig 16—Simple Torque Calculation

ments, then selecting a motor that best meets these needs. This does not mean that a highly rated motor in terms of power, displacement, efficiency, etc. is best for every application, nor does it mean that using a motor that barely meets the system requirements is good practice, either. It does mean that each application dictates the type of motor to be used, regardless of how it is rated or compared with the other types.

MOTOR TORQUE

The first system requirement that must be met is the amount of power or work needed from the motor. Work defined is the application of force through a distance or in the case of a motor, force applied through a rotary distance or path—normally called **torque.**

So, what we basically want to achieve by using a motor is torque. Torque does not consider time or speed—only force × distance and is usually expressed as inch-pounds or foot-pounds. Fig. 16 provides one simple method of calculating the theoretical torque of a motor.

As we said, torque is not changed by time or speed. The theoretical value in the example would be the same at 100, 200, or 600 rpm.

Torque is affected by system pressure, however. For this reason, most motor torque ratings are given as torque per 100 psi.

Torque should always be calculated at maximum loads. The torque needed to start a motor rotating is always higher than the torque needed to maintain rotation. So the starting torque at maximum loads should be the value used in rating the motor.

Another variable which enters into torque evaluation is the **stall torque rating** of the motor. This rating, much like the maximum rating above, calculates the lowest speed that the motor can operate at full load, as long as pressure is constant, and still provided adequate torque. This value is usually a percentage of maximum torque.

Thus far, we have been discussing theoretical torque. The **actual torque rating** is a percentage of the theoretical rating and takes into consideration slippage, leakage, and inherent motor design which tend to reduce the theoretical torque value.

MOTOR HORSEPOWER

One of the most common methods of rating hydraulic motors is by their horsepower output. Horsepower is the combination of work or torque and unit time, one horsepower being 33,000 ft-lb of work or torque per minute or 396,000 in-lb of work or torque per minute.

OTHER SYSTEM NEEDS

While it is true that horsepower and torque ratings are important in motor selection, they still are, in a sense, theoretical or abstract values based on real or practical requirements of the hydraulic system.

MOTOR SIZE

One of these practical factors is the physical size of the hydraulic motor. As you well know, space for hydraulic components is limited on most mobile

MOTOR COMPARISON CHART

	GEAR MOTORS		VANE MOTORS	PISTON (AXIAL) MOTORS	
	External	**Internal**	**(Balanced)**	**Fixed Displ.**	**Var. Displ.**
Physical Size	Small to Medium	Small to Medium	Small to Medium	Medium to Large	Medium to Large
Average Weight to Power Ratio-lb/hp	0.9	0.9	1.0	1.4	3.2
Pressure Range (psi)	100-2000	100-2000	100-2500	100-5000+	100-5000+
Speed Range (rpm)	100-3000	100-5000	10-3000	10-3000	10-3000
Actual Torque (% of Theoretical)	80-85	80-85	85-95	90-95	90-95
Starting Torque (% of Theoretical)	70-80	75-85	75-90	85-95	85-95
Momentary Overload Torque (% of Actual)	110-120	115-130	120-140	120-140	120-140
Volumetric Efficiency (%)	80-90	85-90	85-90	95-98	95-98
Over-all Efficiency (%)	60-90	60-90	75-90	85-95	85-95
Estimated Bearing Life (hrs.) @½ load	5000-10000	5000-10000	7000-15000	15000-25000	15000-25000
Displacement	Fixed	Fixed	Fixed	Fixed	Variable
Reversibility	Possible	Possible	Possible	Very Good	Very Good
How Operates as a Pump	Good	Good	Good	Very Good	Very Good
Average Initial Cost ($/hp)	2.90	3.35	3.60	5.67	8.40
Average Maintenance Costs ($/year/hp)	0.37	0.32	0.32	0.18	0.22
Estimated Bearing Life (hrs) @ full load	2000-5000	2000-5000	3000-6000	7000-15000	7000-15000

NOTE: Remember that the values in this chart are not absolute. They may vary with each particular model of motor.

equipment. Fortunately, the three basic types of motors used on mobile equipment come in a wide range of sizes. However, some problems may be experienced if the motor must be of a larger size to provide the necessary power. In such cases, power and other system requirements would take precedence over motor size.

MOTOR PRESSURE RANGE

Aside from the fact that pressure affects torque and horsepower, you should know the pressure limits when selecting a motor. Never install a motor that cannot accept the full pressure range of the system; this would require extra valving to control pressure or could damage the motor. By the same token, a motor with a greater pressure range than the system would be a waste of money.

MOTOR SPEED RANGE

Speed is another important factor. To require a motor to operate at speeds lower than recommended is wasteful because of increased slippage and leakage losses. Speed also affects horsepower output so care must be taken to insure that motor speed is capable of producing the necessary horsepower.

TORQUE—RUNNING, STALLED AND OVERLOAD

Since most motors are rated in terms of theoretical torque, the percentages of actual, stalled, and momentary overload torque are important. For instance, a motor with a high theoretical torque may have a low actual running torque or a low starting or stalled torque and may not be able to handle a large load. At some time during operation, the motor may also be called upon to deliver more torque than its normal running torque for a short period of time.

MOTOR EVALUATION

Now that we have given you some ideas as to how a motor is evaluated, let's see how the three basic motors compare with one another.

The chart above compares the three motors in a very general sense. Remember, we are not favoring any particular type of motor or any particular brand of motor. We are simply relating to you what is generally known about the three types of motors. There are cases when a type of motor may be rated above what we have indicated here. For this reason, we suggest that you thoroughly investigate the many brands of motors available before selecting a particular motor.

MISCELLANEOUS FACTORS

Other factors which have a bearing on motor selection and identification are: running volumetric efficiency, over-all efficiency, leakage at stalled torque, bearing life, displacement (fixed or variable), reversability, ability to act as a pump as well as a motor, weight- or size-to-power ratio, ease of maintenance, and initial cost. All of these values play some part in selecting and judging a motor.

HYDRAULIC MOTOR MALFUNCTIONS

In this chapter, we've shown the great similarity between the motor and the pump. Unfortunately, this similarity extends into the realm of motor failures as well.

The majority of motor problems fall into these categories:

- **Improper Fluid**
- **Poor Maintenance**
- **Improper Operation**
- **Poor Motor Selection**
- **Improper System Design**
- **Mechanical Failures**

Let's discuss each one.

IMPROPER FLUID

The motor is no different than any of the other components of the hydraulic system—it must have clean fluid, in adequate supply, and of the proper quality and viscosity.

Failures due to improper fluid are covered quite extensively in Chapters 2 and 10 and much of this information is applicable to hydraulic motors. For this reason, we won't go into the subject here, but instead refer you to those chapters.

POOR MAINTENANCE

A poor maintenance program runs a close second in the list of major problems. We find many causes of failures in this category, all of which can be attributed to human error. Some of these causes are:

1) Failure to check and repair lines and connections for air or fluid leaks. This can allow dirt and air into the system, plus lowering pressure and causing erratic operation.

2) Failure to check and repair other components such as pumps, control valves, or filters. This can lead to excessive wear of internal parts due to excessively high or low pressure, excessive or inadequate fluid.

3) Failure to install the motor correctly. Motor shaft misalignment can cause bearing wear which can lead to loss of efficiency. A misaligned shaft can also reduce torque, increase friction drag and heating, and result in shaft failure.

4) Failure to inspect fluid for proper quality and quantity (see Chapter 10).

5) Failure to find the cause of a motor malfunction. If the motor does fail, always look for the *cause* of the failure first. It is obvious that if the cause is not corrected, the failure will recur.

Maintenance problems are covered in more detail in Chapter 11 of this manual.

IMPROPER OPERATION

Exceeding the operating limits is a prime way to promote motor failure. Every motor has certain design limitations on pressure, speed, torque, displacement, load, and temperature. These limits, of course, vary from motor to motor and are set up by the manufacturer.

The list below describes what can happen if these limits are exceeded:

Excessive Pressure—can cause wear due to lack of lubrication, generate heat due to motor slippage, or cause motor to exceed torque limits.

Excessive Speed—can cause heating due to slippage, or cause wear of bearings and internal parts.

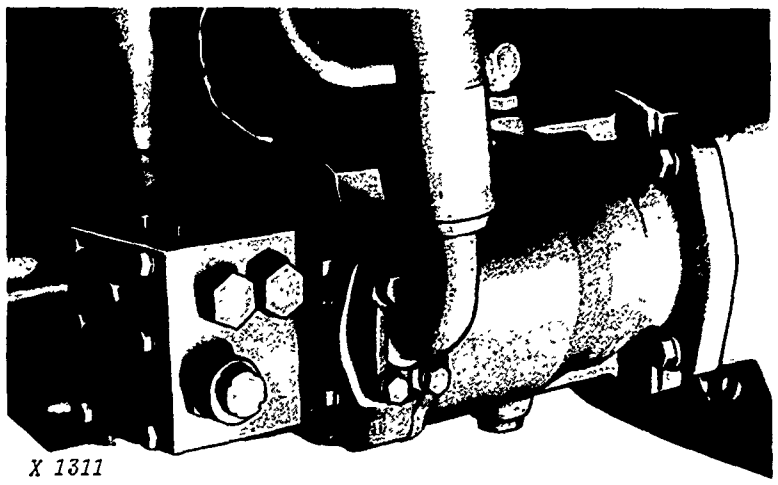
Excessive Torque—can cause fatigue and stress to bearings and shaft, especially on applications that require frequent motor reversing.

Excessive Displacement—can generate heat due to pressure across motor not producing usable work.

Excessive Load—can create bearing and shaft fatigue.

Excessive Temperature—can cause loss of efficiency and speed due to thinned oil, and can produce rapid wear due to lack of lubrication.

Cold weather starting is another common abuse of the motor. Most motor manufacturers give detailed instructions on how to start their motors. Failure to follow these instructions can result in wear and galling, due to lack of lubrication; torque loss below stall torque specifications; and stress and fatigue on bearings and shaft.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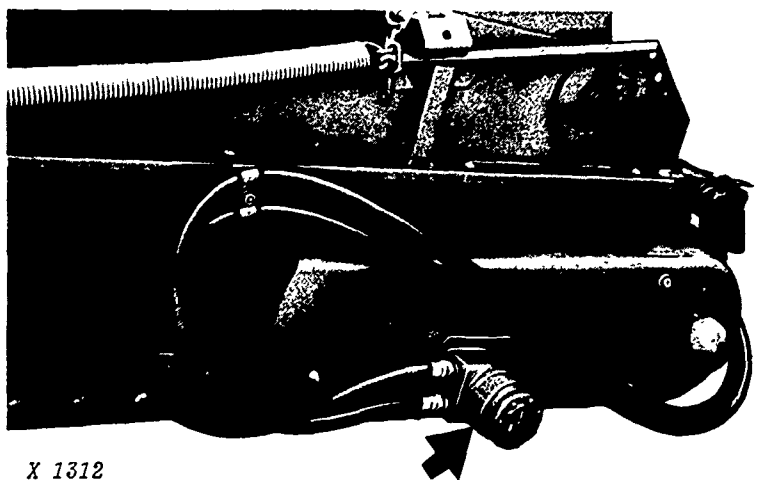
Large Motor Driving Self-Propelled Machine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Small Motor Driving Grain Elevator

Fig. 17—Two Uses of Hydraulic Motors

POOR MOTOR SELECTION, IMPROPER SYSTEM DESIGN, MECHANICAL FAILURES

The last three problems are obvious. They are not big problems, but do deserve attention to prevent them from becoming so.

Poor motor selection has been covered in the motor evaluation section which tells the importance of selecting a motor that meets the requirements of the application.

A properly designed system insures that all lines are of the right size and that they have no sharp bends to create friction and fluid overheating. It also insures that the correct valving is used to control the operation of both the pump and the motor. And lastly, it guarantees that the motor and the system are compatible.

Mechanical failures due to normal wear and operation are not preventable. But they can be anticipated by keeping accurate maintenance and operating records and by using a good preventive maintenance program (see Chapter 11).

SUMMARY: MOTOR APPLICATION AND EFFICIENCY

To sum up this section, here is what must be done to get good operation and long life from the motor.

1. Follow the manufacturers' recommendations and specifications to the letter. This means operating within the motor's limits and repairing the motor with only authorized parts.

2. Select a motor that meets all the requirements of the system and the application. This doesn't mean that the motor should exceed these requirements—often that can cause poor operation and loss of efficiency, too.

3. Have a preventive maintenance program, complete with accurate maintenance and operating records.

CONCLUSION: THE USES OF HYDRAULIC MOTORS

In concluding this chapter, there are several points about hydraulic motors that should be emphasized.

Hydraulic motors are becoming more prominent in systems or applications that had previously used electrical motors or reciprocating engines as the source of power. There are two reasons for this:

1. The use of hydraulic power is becoming more widespread, especially on mobile agricultural and industrial equipment.

2. The hydraulic motor, when fluid power is available, has many advantages over the other sources of power.

The greatest advantage of the motor is the size or weight-to-power ratio. In comparing an electrical motor with a hydraulic motor of the same horsepower, you will find that the hydraulic motor is several times smaller—a desirable quality on mobile equipment.

Another advantage is the ease of control. Very little energy is expended to supply a great deal of force. A good example of this is in power steering.

Still another advantage is accuracy of control. Smooth steady power in small or large quantities is ready at the touch of the hand. No belts or chains to delay the time between actuating controls and the power source.

Simplicity, economy, and safety round out the list. All of these factors are gained by using fewer moving parts in the motor.

In summary, the hydraulic motor can be a prime source of power when it meets the application requirements, is operated according to specifications, and is properly serviced and maintained.

DIAGNOSING MOTOR FAILURES

The following trouble shooting charts are given as a general guide to some of the common motor failures, what the cause might be, and the possible remedy.

I. MOTOR WON'T TURN

Possible Cause	Possible Remedy
1. Shaft seizure due to:	
a. Excessive loads.	a. Check load and load capacity of the motor.
b. Lack of lubrication.	b. Check fluid level and quality Check operating pressure and temperature.
c. Misalignment.	c. Correctly align shaft with work load.
2. Broken shaft.	2. Replace shaft. Find reason for breakage.
3. No incoming pressure.	3. Check and repair clogged, leaking, or broken lines or passages.
4. Contaminated fluid.	4. Check and clean entire hydraulic system (Chapter 11). Find source of contamination. Install clean fluid of proper quantity and quality.

II. SLOW MOTOR OPERATION

1. Wrong fluid viscosity.	1. Install clean fluid of proper quantity and quality.
2. Worn pump or motor.	2. Check pump and motor specifications. Repair or replace if necessary.
3. High fluid temperature.	3. Check for line restrictions, wrong fluid viscosity, or low fluid level.
4. Plugged filter.	4. Check cause of plugging, and clean or replace filter.

III. ERRATIC MOTOR OPERATION

1. Low pressure.	1. Check for air or fluid leaks.
2. Inadequate fluid flow.	2. Check for air or fluid leaks. Check system capacity.
3. System controls failing.	3. Check pump and control valves for proper operation.

IV. MOTOR TURNS IN WRONG DIRECTION

1. Pump-to-motor connections wrong.	1. Reconnect pump and motor.
2. Wrong timing.	2. Check manufacturer's specifications.

V. MOTOR SHAFT NOT TURNING

1. Excessive work loads.	1. Check motor load specifications.
2. Internal motor parts worn.	2. Replace parts or complete motor as necessary.

TEST YOURSELF

QUESTIONS

1. (Fill in the blanks.) A hydraulic motor converts _____ force into _____ force.

2. How is a motor different in operation from a pump?

3. What three types of motors are most popular on modern farm and industrial systems?

4. What is the "torque" of a motor?

5. (True or false?) "A pump can generally be used as a motor."

ANSWERS

1. A hydraulic motor converts *fluid* force into *mechanical* force.

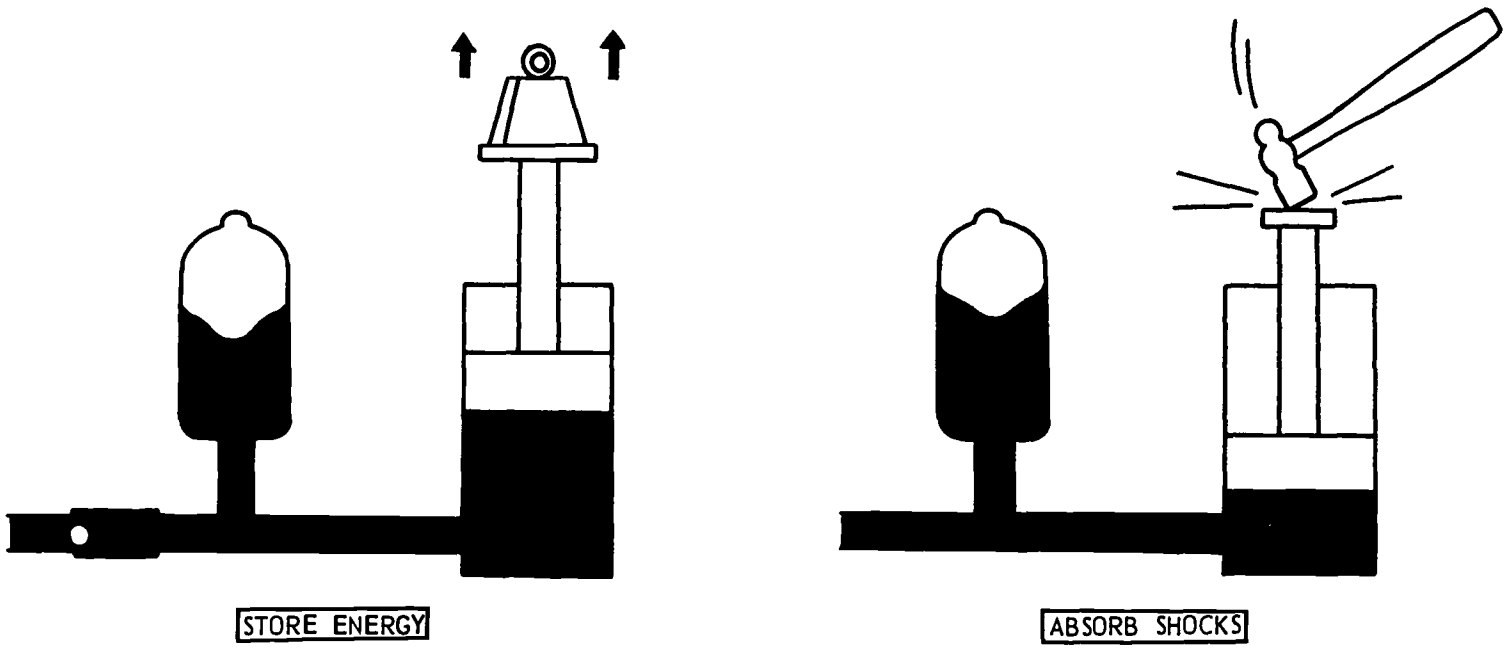
2. The motor works in reverse when compared to a pump. The pump draws in fluid and pushes it out, while the motor has fluid forced in but exhausts it out. In other words, the pump *drives* its fluid, while the motor is *driven by* its fluid.

3. Gear, vane, and piston types.

4. Torque is a measure of the turning force exerted at the outer edge of the motor drive shaft.

5. False. Though very similar, pumps often need special bearings and other parts when used as motors. To avoid trouble, use pumps as pumps and motors as motors.

HYDRAULIC ACCUMULATORS / CHAPTER 6



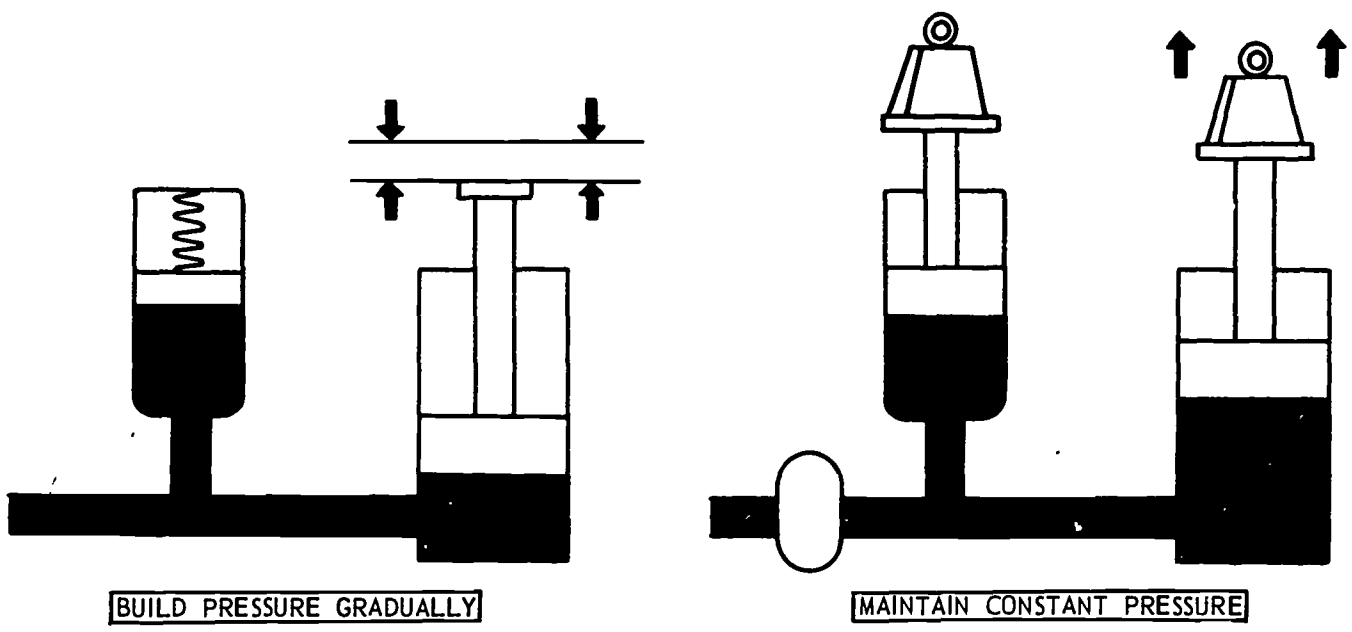


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Fig. 1—The Four Uses of Accumulators

A spring is the simplest accumulator. When compressed, a spring becomes a source of potential energy. It can also be used to absorb shocks or to control the force on a load. Hydraulic accumulators work in much the same way. Basically they are containers which store fluid under pressure.

USES OF ACCUMULATORS

Accumulators have four major uses (Fig. 1):

- **Store Energy**
- **Absorb Shocks**
- **Build Pressure Gradually**
- **Maintain Constant Pressure**

While most accumulators can do any of these things, their use in a system is usually limited to only one.

Accumulators which STORE ENERGY are often used as "boosters" for systems with fixed displacement pumps. The accumulator stores pressure oil during slack periods and feeds it back into the system during peak periods of oil usage. The pump recharges the accumulator after each peak. Sometimes the accumulator is used as a protection against failure of the oil supply. Example: power brakes on larger machines. If the system oil supply fails, the accumulator feeds in several "charges" of oil for use in emergency braking.

Accumulators which ABSORB SHOCKS take in excess oil during peak pressures and let it out again after the "surge" is past. This reduces vibrations and noise in the system. The accumulator may also smooth out operation during pressure delays, as when a variable displacement pump goes into stroke. By discharging at this moment, the accumulator "takes up the slack."

Accumulators which BUILD PRESSURE GRADUALLY are used to "soften" the working stroke of a piston against a fixed load, as in a hydraulic press. By absorbing some of the rising oil pressure the accumulator slows down the stroke.

Accumulators which MAINTAIN CONSTANT PRESSURE are always weight-loaded types which place a fixed force on the oil in a closed circuit. Whether the volume of oil changes from leakage or from heat expansion or contraction, this accumulator keeps the same gravity pressure on the system.

TYPES OF ACCUMULATORS

The major types of accumulators are:

- **Pneumatic (Gas-Loaded)**
- **Weight-Loaded**
- **Spring-Loaded**

PNEUMATIC ACCUMULATORS

We learned in Chapter 1 that fluids will not compress, but gases will. For this reason, many accumulators use inert gas as a way of "charging" a load of oil or of providing a "cushion" against shocks.

"Pneumatic" means operated by compressed gas. In these accumulators, gas and oil occupy the same container. When the oil pressure rises, incoming oil compresses the gas. When oil pressure drops, the gas expands, forcing out oil.

In most cases, the gas is separated from the oil by a piston, a bladder, or a diaphragm. This prevents mixing of the gas and oil and keeps gas out of the hydraulic system.

(Some accumulators for low-pressure or fairly static uses do not have a separator between the gas and oil, but their use is very limited in modern hydraulics. Also, there is no way to precharge these accumulators.)

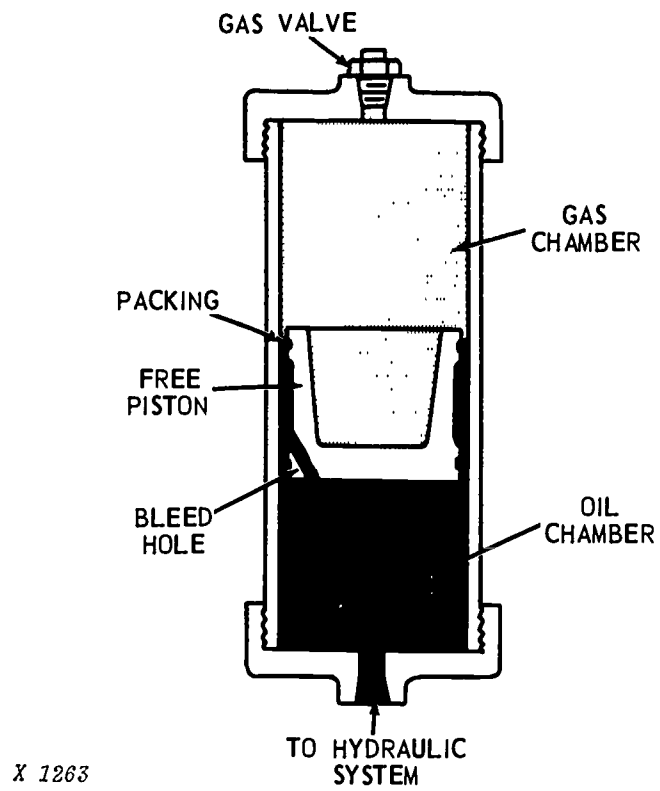


Fig. 2—Piston-Type Accumulator

A typical PISTON-TYPE ACCUMULATOR is shown in Fig. 2. It looks like a hydraulic cylinder minus the piston rod. A "free-floating" piston separates the gas from the oil.

The piston fits into a smooth bore and uses packings to separate the gas from the oil. With double packings, a bleed hole is needed as shown to relieve pressure of any oil seeping into the center area between the two packings.

The accumulator can be "precharged" with gas before use in a system. This is done by filling the gas chamber to a desired pressure with an inert gas such as dry nitrogen.

Piston-type accumulators require careful service to prevent leakage. But they offer a high power output for their size and are very accurate in operation.

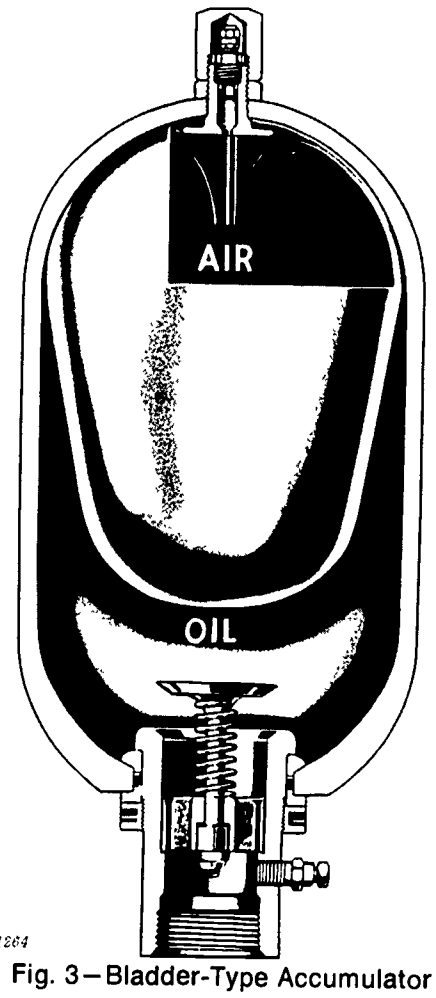


Fig. 3—Bladder-Type Accumulator

BLADDER-TYPE ACCUMULATORS are shown in Figs. 3 and 4. A flexible bag or bladder made of synthetic rubber contains the gas and separates it from the hydraulic oil. The bladder is molded to the gas charging stem located at the top of the accumulator.

To prevent damage to the bladder, a protective button is used at the bottom (Fig. 4). This button prevents the bladder from being drawn into the oil port when the bladder expands. Otherwise, the bladder might be cut or torn.

In the accumulator shown in Fig. 4, the spring-loaded orifice admits a free flow of oil, but meters oil coming out for a slower, gauged action.

Bladder-type accumulators can also be precharged before use.

DIAPHRAGM-TYPE ACCUMULATORS use a metal element to separate the gas from the oil. Molded to the element is a rubber diaphragm which flexes in response to pressure changes (Fig. 5). These accumulators are light in weight and are often used in aircraft systems.

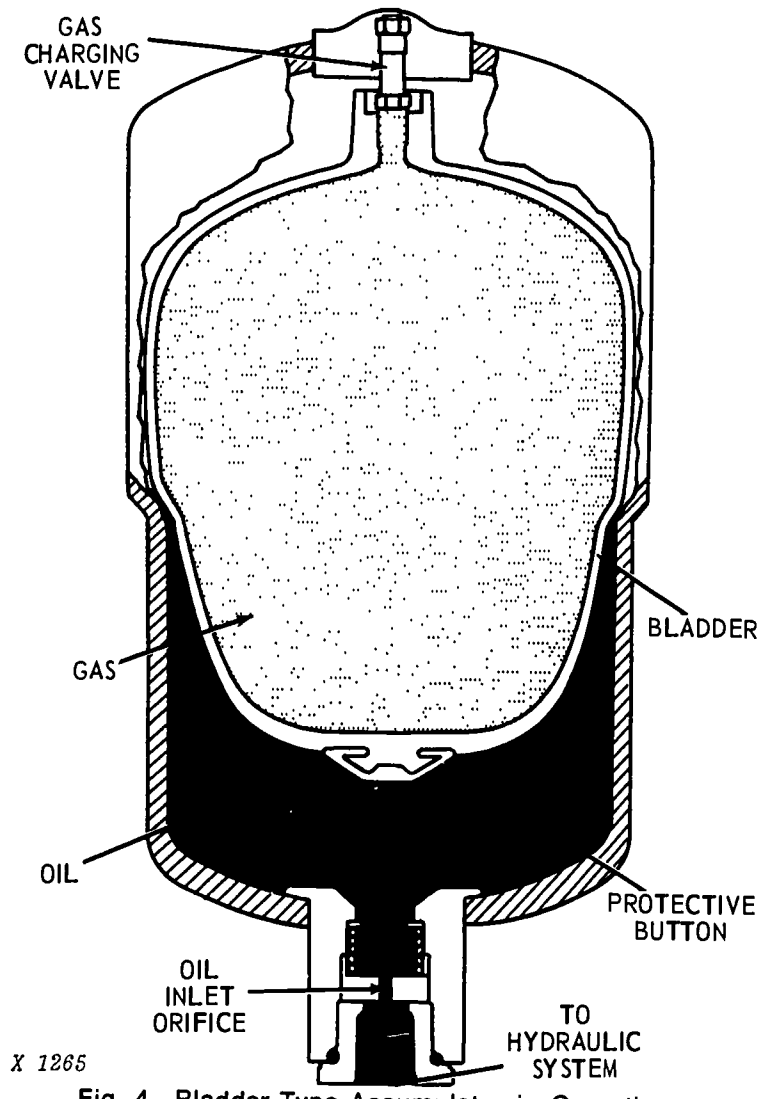


Fig. 4—Bladder-Type Accumulator in Operation

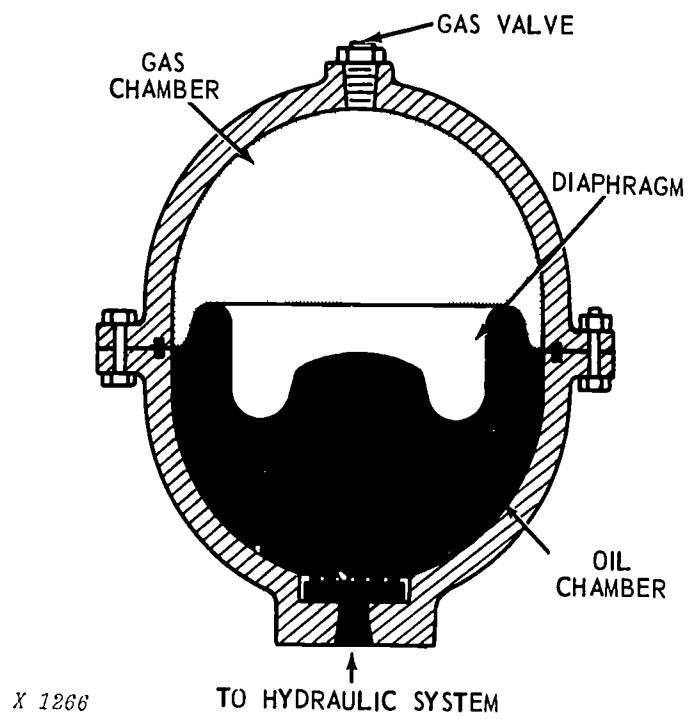


Fig. 5—Diaphragm-Type Accumulator

Effects of Different Precharges on Pneumatic Accumulators

When you precharge an accumulator with gas, how much pressure should you use?

It depends upon how you want the accumulator to work.

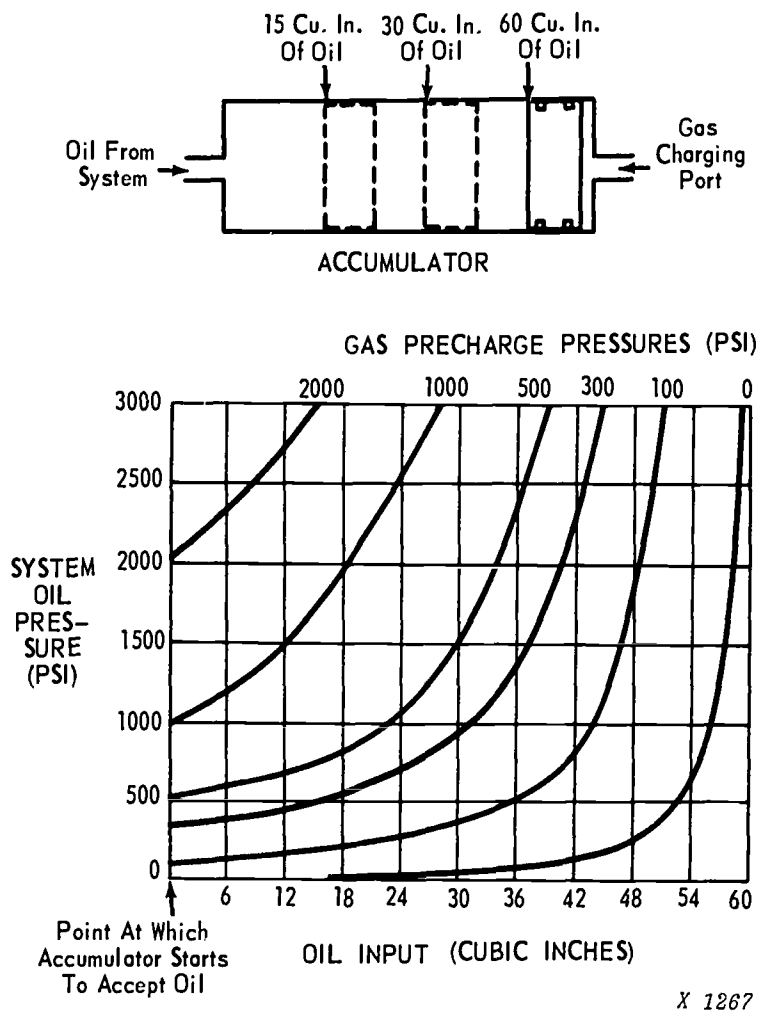


Fig. 6—Effect of Different Precharges on a Pneumatic Accumulator

Fig. 6 shows how six different precharges effect the operation of an accumulator.

The gas precharges shown are 2000, 1000, 500, 300, 100 and 0 psi (see top line).

The accumulator has a 60 cubic inch displacement for input oil (bottom line).

As system oil pressure rises (vertical scale at left), incoming oil displaces gas in the accumulator.

But the accumulator with the highest gas precharge (2000 psi) starts to accept oil much later than the ones which have lower precharges. In other words, system oil pressure must rise above 2000 psi to even start to load the accumulator with the highest precharge.

The precharge also effects *how much* oil the accumulator will accept at a given pressure.

The lower the precharge, the more oil the accumulator will load up at a given pressure.

In summary, the selection and use of a pneumatic accumulator depends upon the pressure and volume needs of the system. In other words, what pressures are required and their limits, and what volume of oil is needed to dissipate oil or supply it to the system.

Precautions for Pneumatic Accumulators

Observe the following precautions when working on pneumatic accumulators. The correct procedures for service are given in detail later under "Servicing and Precharging Pneumatic Accumulators."

1. CAUTION: NEVER FILL AN ACCUMULATOR WITH OXYGEN! An explosion could result if oil and oxygen mix under pressure.

2. Never fill an accumulator with air. When air is compressed, water vapor in the air condenses and can cause rust. This in turn may damage seals and ruin the accumulator. Also, once air leaks into the oil, the oil becomes oxidized and breaks down.

3. Always fill an accumulator with an *inert gas* such as *dry nitrogen*. This gas is free of both water vapor and oxygen; this makes it harmless to parts and safe to use.

4. Never charge an accumulator to a pressure more than that recommended by the manufacturer. Read the label and observe the "working pressure."

5. Before removing an accumulator from a hydraulic system, *release all hydraulic pressure.*

6. Before you disassemble an accumulator, *release both gas and hydraulic pressures.*

7. When you disassemble an accumulator, make sure that dirt and abrasive material does not enter any of the openings.

Servicing and Precharging Pneumatic Accumulators

CHECKING PRECHARGED ACCUMULATOR ON THE MACHINE

1. If you suspect external gas leaks, apply soapy water to the gas valve and seams on the tank at the "gas" end. If bubbles form, there is a leak.

2. If you suspect internal leaks, check for foaming oil in the system reservoir and/or no action of the accumulator. These signs usually mean a faulty bladder or piston seals inside the accumulator.

3. If the accumulator appears to be in good condition but is still slow or inactive, precharge it as necessary (see below).

BEFORE REMOVING ACCUMULATOR FROM MACHINE

First be sure all hydraulic pressure is released. To do this, shut down the pump and cycle some mechanism in the accumulator hydraulic circuit to relieve oil pressure (or open a bleed screw).

REMOVING ACCUMULATOR FROM MACHINE

After all hydraulic pressure has been released, remove the accumulator from the machine for service.

REPAIRING ACCUMULATOR

1. *Before dismantling accumulator, release all gas pressure.* Normally unscrew the gas valve lever very slowly. Install the charging valve first if necessary. Never release the gas by depressing the valve core, as the core might be ruptured.

2. Disassemble the accumulator on a *clean* bench area.

3. Check all parts for leaks or other damage.

4. Plug the openings with plastic plugs or clean towels as soon as parts are removed.

5. Check bladder or piston seals for damage and replace if necessary.

6. If gas valve cores are replaced, be sure to use the recommended types.

7. Carefully assemble the accumulator.

PRECHARGING ACCUMULATOR

Attach the hose from a *Dry Nitrogen* tank to the charging valve of the accumulator and open the accumulator charging valve (Fig. 7).

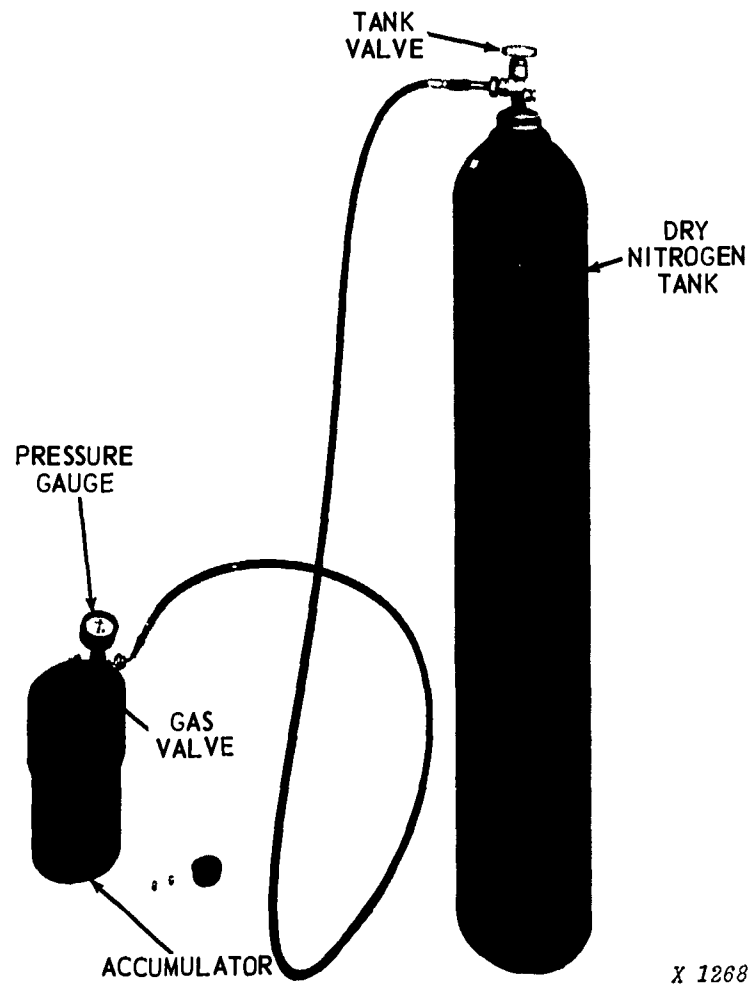


Fig. 7—Precharging Accumulator (Pneumatic Type)

Open the valve on the nitrogen tank very slowly until pressure on gauge is same as that recommended by the manufacturer. Close the charging valve on the accumulator, then close the valve on the tank. Remove hose from charging valve.

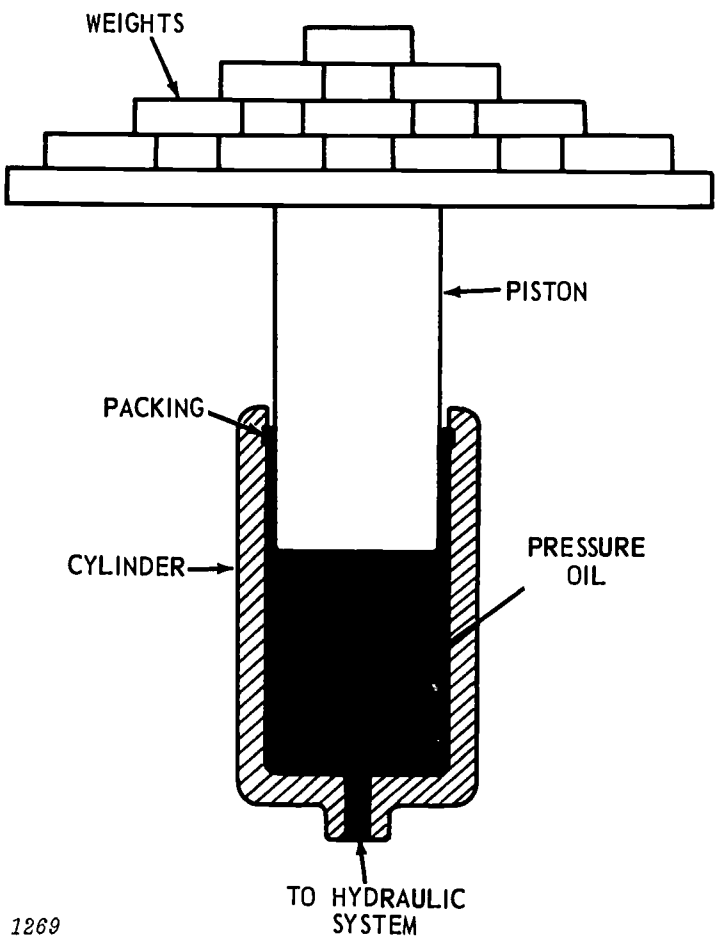
NOTE: When checking precharge on an accumulator installed on a machine, first release hydraulic pressure from the accumulator. Otherwise you will not get a true pressure reading.

INSTALLING ACCUMULATOR ON MACHINE

Attach accumulator to machine and connect all lines. Start machine and cycle a hydraulic function to bleed any air from the system. Then check the accumulator for proper action.

WEIGHT-LOADED ACCUMULATORS

The earliest form of accumulator is the weight-loaded type (Fig. 8).



X 1269

Fig. 8—Weight-Loaded Accumulator

This accumulator uses a piston and cylinder, but heavy weights on the piston do the job of loading or charging the oil. It is loaded by gravity.

Operation is very simple. The pressure oil in the hydraulic circuit is pushed into the lower oil chamber. This raises the piston and weights. The accumulator is now charged, ready for work. When oil is needed, pressure drops in the system and gravity forces the weights and piston down, discharging the oil into the system.

The advantage of the weight-loaded accumulator is that it can provide constant pressure.

The disadvantages are the bulky size and heavy weight. For mobile machines, there is little use for the gravity accumulator.

SPRING-LOADED ACCUMULATORS

This accumulator is very similar to the weight-loaded type except that springs do the loading.

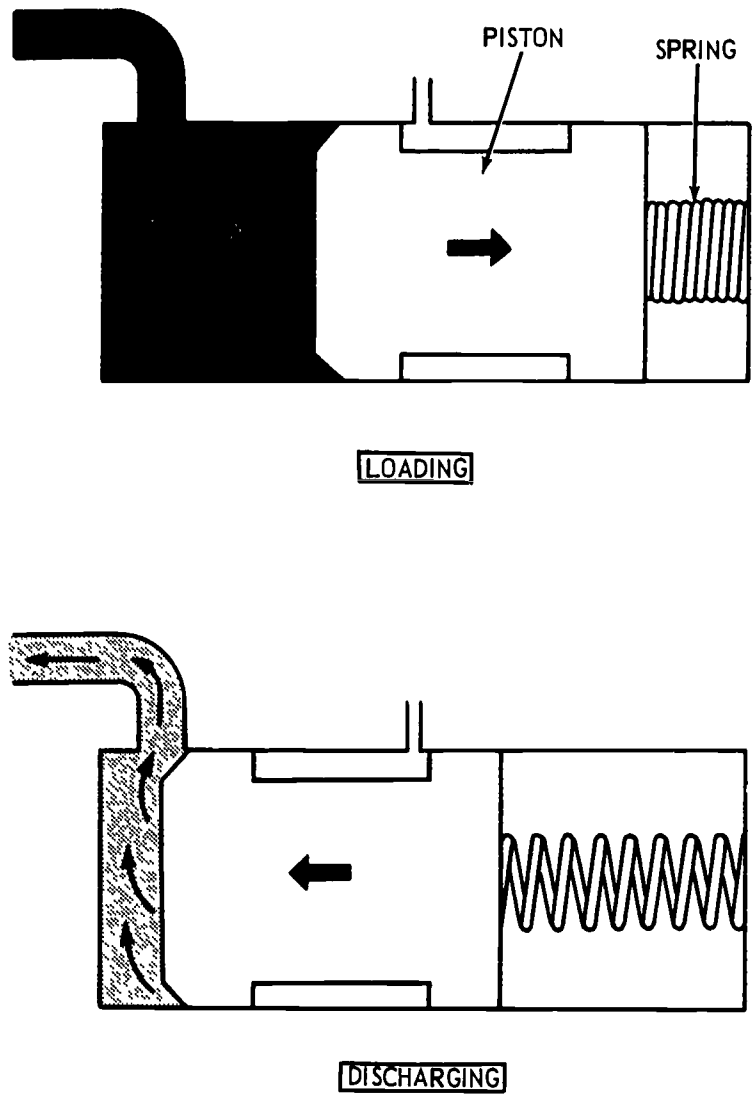


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Fig. 9—Spring-Loaded Accumulator in Operation

In operation, pressure oil loads the piston by compressing the spring (Fig. 9). When pressure drops, the spring forces oil into the system.

The accumulator shown in Fig. 9 is an internal type used as a gradual pressure builder for an automatic transmission. When the transmission is shifted, pressure drops and the accumulator sends a "surge" of oil in to "take up slack." This fills the chamber behind the clutch pistons. Then pressure builds gradually for a smooth engagement of the clutch.

By controlling the flow of oil to the accumulator, the time needed to charge it can also be controlled (Fig. 10). This is commonly done where a "cushioned" engagement of hydraulic components is needed. In the graph, note how pressure drops as the accumulator discharges, then builds slowly as it recharges, rising sharply to full pressure again when it refills with oil. The time lag during the charging cycle can be speeded up or slowed down by feeding in more or less oil to the accumulator.

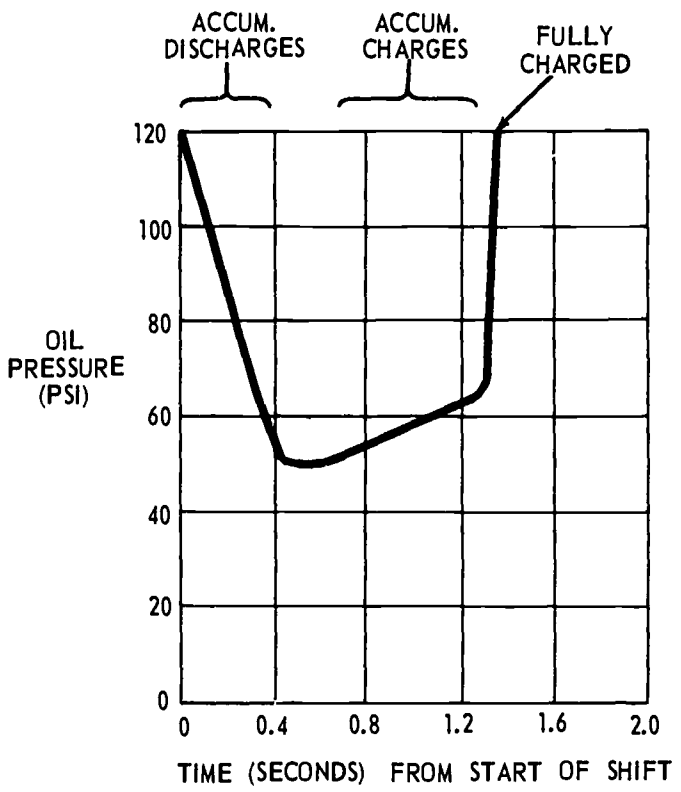

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Fig. 10—Operating Cycle of a Spring-Loaded Accumulator

The operation of spring-loaded accumulators can be varied by changing 1) the strength of the spring, 2) the length of the spring, 3) the preload on the spring, 4) the size of the piston or, 5) the length of the piston stroke.

Fig. 11 shows the effect of using a stronger spring with less preload (B) as opposed to a weaker spring (A).

Now we can see how important the correct spring is in the operation of these accumulators.

Be sure to use genuine parts and to follow the manufacturer's recommendations when repairing accumulators.

In another design shown in Fig. 12, a disk on the end of the piston mounts several rods which hold the springs. As oil pressure raises the piston, the springs are compressed against the solid shoulder of the cylinder. The springs are preset by tightening the adjusting nuts.

The advantage of spring-loaded accumulators is that they never have to be precharged or recharged.

The disadvantage is that these accumulators are too bulky when designed for high volume or high pressure systems. Therefore, they are practical only for low volume or low pressure uses.

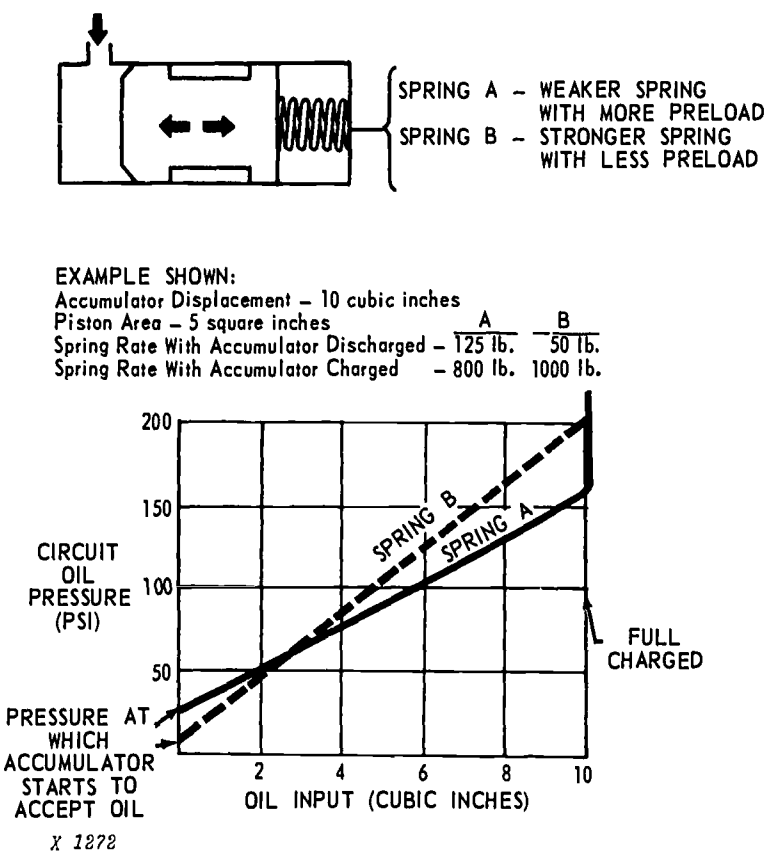

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Fig. 11—How Use of Two Different Springs Affects Accumulator Operation

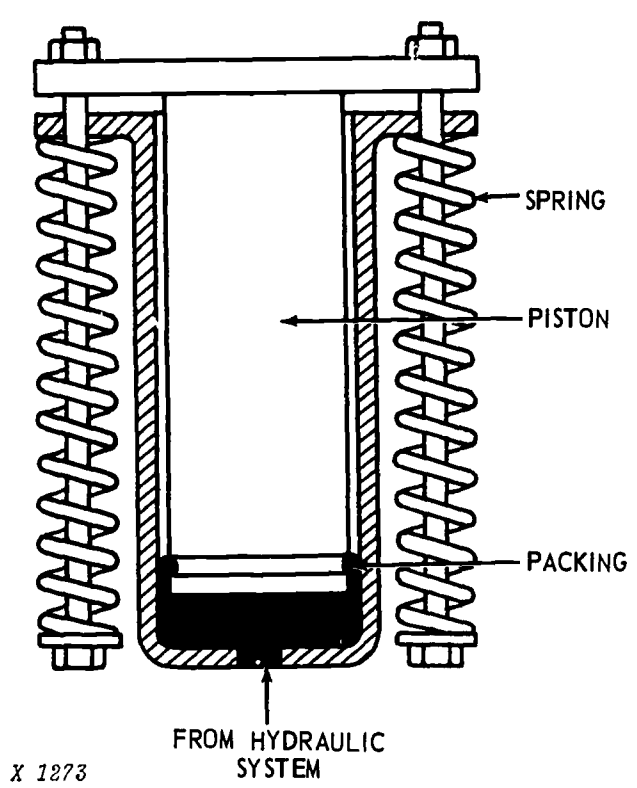

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Fig. 12—Spring-Loaded Accumulator

TEST YOURSELF

QUESTIONS

1. Why is oxygen NOT recommended for use in a pneumatic accumulator?

2. Why is air not recommended for use in a pneumatic accumulator?

3. What should you do first of all before removing an accumulator from a machine?

4. What are the four major uses of accumulators?

ANSWERS

1. If hydraulic oil and oxygen mix under pressure, an explosion could take place. Instead, use an inert gas such as dry nitrogen.

2. When air is compressed, water vapor in the air condenses and can cause rust. This in turn may damage the seals and ruin the accumulator, and once air leaks into the oil, the oil will be oxidized.

3. Relieve all hydraulic pressure in the accumulator.

4. 1) Store energy, 2) Absorb shocks, 3) Build pressure gradually, 4) Maintain constant pressure.

HYDRAULIC FILTERS / CHAPTER 7

WHY ARE FILTERS USED?

Did you ever stop to think that hydraulic fluids are lubricants for precision parts as well as a means of transmitting power?

Contaminated oil can score or completely freeze a precisely fitted valve spool. Dirty oil can ruin the close tolerance of finely finished surfaces, and a grain of sand in a tiny control orifice can put a whole machine out of operation. It's not hard to see that you have to keep the oil clean if you want a hydraulic system to operate without trouble.

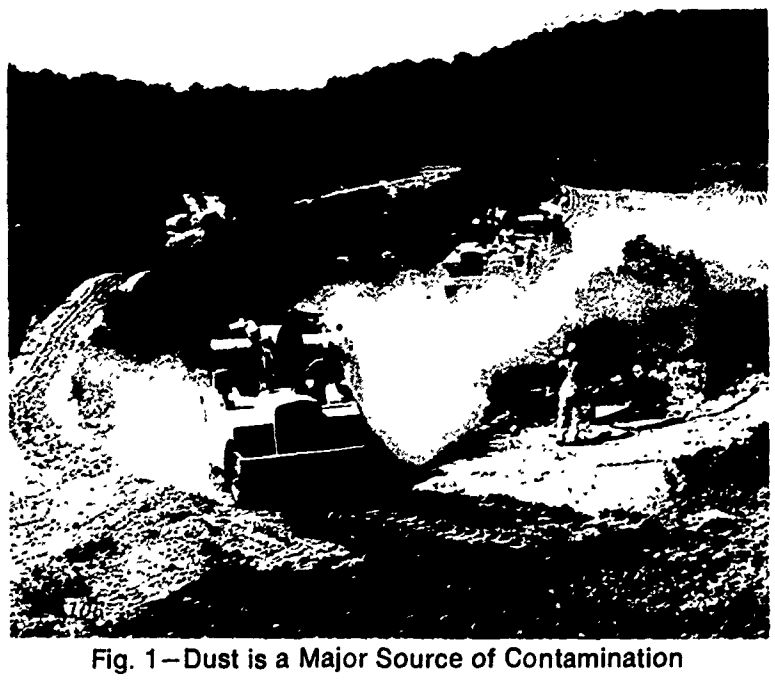

Fig. 1—Dust is a Major Source of Contamination

It's a constant battle because dirt is everywhere. Look at Fig. 1 and you see that the air surrounding a machine is a major source of contamination.

Another source of contaminants is the machine itself. As it works and wears normally, the machine generates burrs and chips of metal.

Measured in dollars and cents, it's a whole lot cheaper to buy a good filter, to maintain it properly, and to keep your oil clean than it is to replace a pump or a valve that is worn out by contamination.

HOW FILTERS ARE USED

A FULL-FLOW system filters the entire supply of oil each time it circulates in the hydraulic system. Filters in a full-flow system are usually located in the pump inlet line and in the return line to the reservoir. Additional filters, of course, may be located in front of or behind other hydraulic components if they are needed.

In contrast, a BYPASS filter system has its filter connected to a tee in the pressure line so that only a small portion of each oil cycle is diverted through the filter. The remainder of the oil goes unfiltered to the system or to the reservoir.

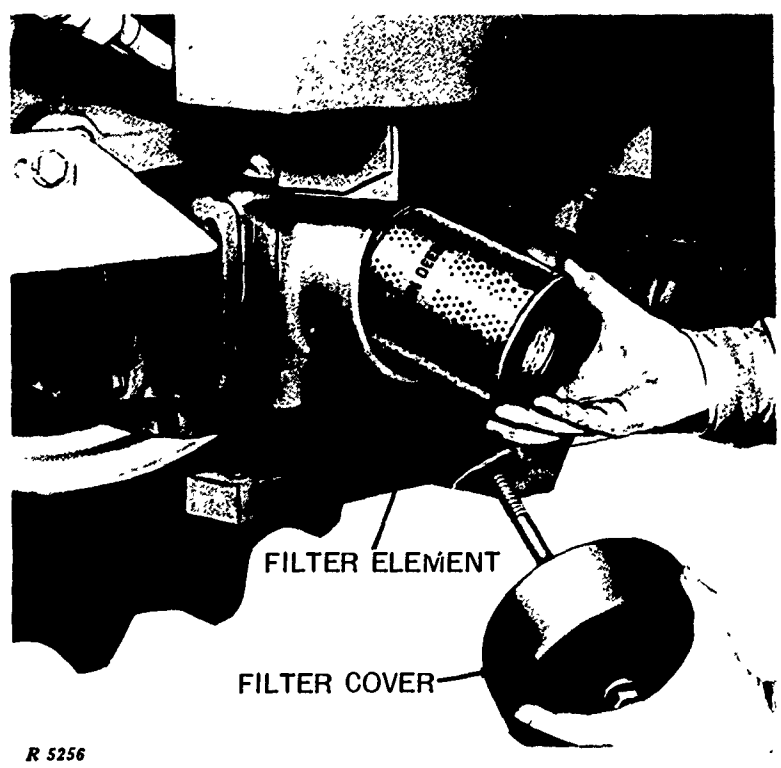

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Fig. 2—Tractor Transmission—Hydraulic System Filter

The location of the filter in a hydraulic system will vary with the design of the machine. Fig. 2 shows a filter that is an integral part of the machine, while Fig. 3 shows a filter hooked into an outside line. Regardless of location, the one purpose of the filter is to keep the oil clean.

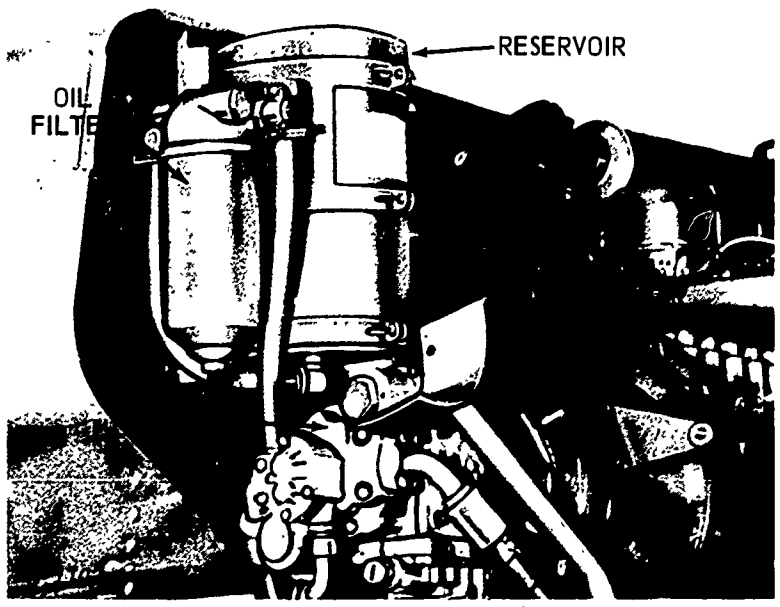


Fig. 3—Combine Hydraulic Drive System Filter

Filtration occurs as oil passes through the filter. Fig. 4 shows a full-flow system with the inlet and return oil filters arranged in one package. Oil from the reservoir enters the inlet screen and, after being filtered, flows to the pump. Then the oil is pumped to the control valve and cylinders and is filtered a second time as it passes through the return filter to the reservoir.

A small pressure difference exists between the inside and outside of even a new filter because the oil is being restricted as it passes through—like pushing a screen door open in a high wind. If you cover the screen and then try to open the door, a great deal of resistance is felt. The same is true with a hydraulic filter. As the filter gets dirty, the pressure difference increases, finally to a point where no oil will flow when the filter is completely plugged.

To prevent pressure from building up so high that it might break the filter or starve one of the hydraulic components, a relief valve is usually used to bypass oil around the filter. (Don't confuse this with a bypass filter system.)

Fig. 5 shows such a relief valve in operation. Please note, however, that the inlet screen has no relief valve protection. Because of the difference in degree of filtration, the return filter element will plug much sooner than the inlet screen.

Of course when the relief valve opens, dirty oil pours into the hydraulic system. Unless the filters are serviced immediately, the dirt in the oil will step up wear in hydraulic components and the inlet screen will continue to plug until pump starvation occurs.

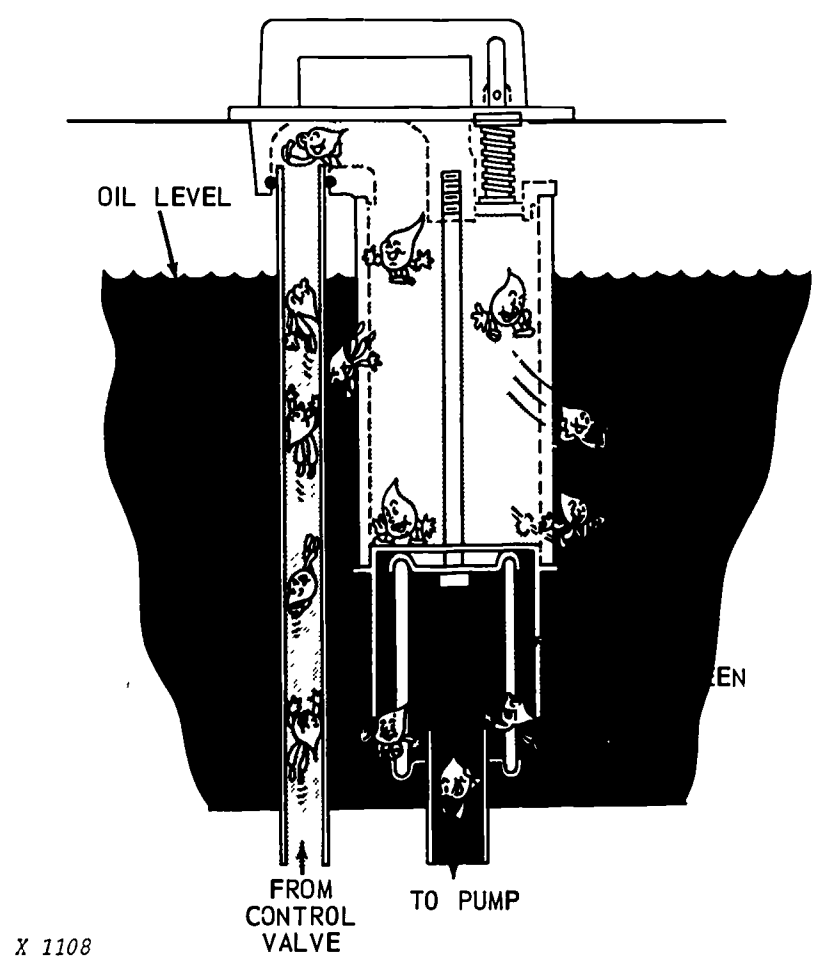


Fig. 4—Full-Flow Hydraulic System Filters

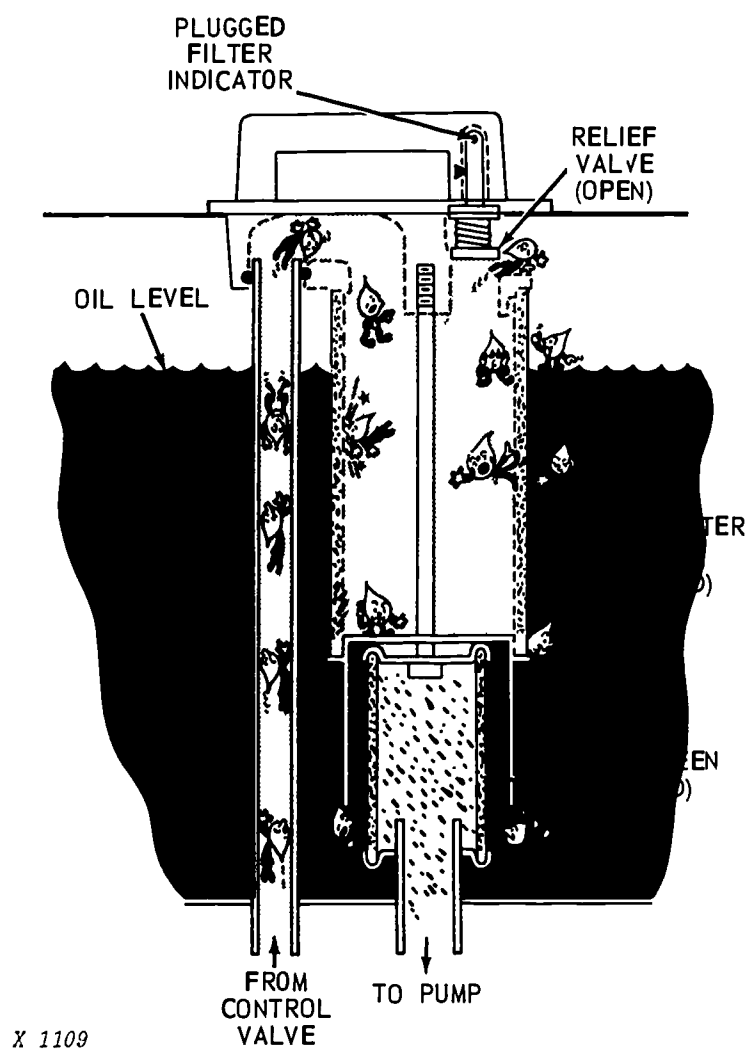


Fig. 5—Hydraulic Filter Relief Valve

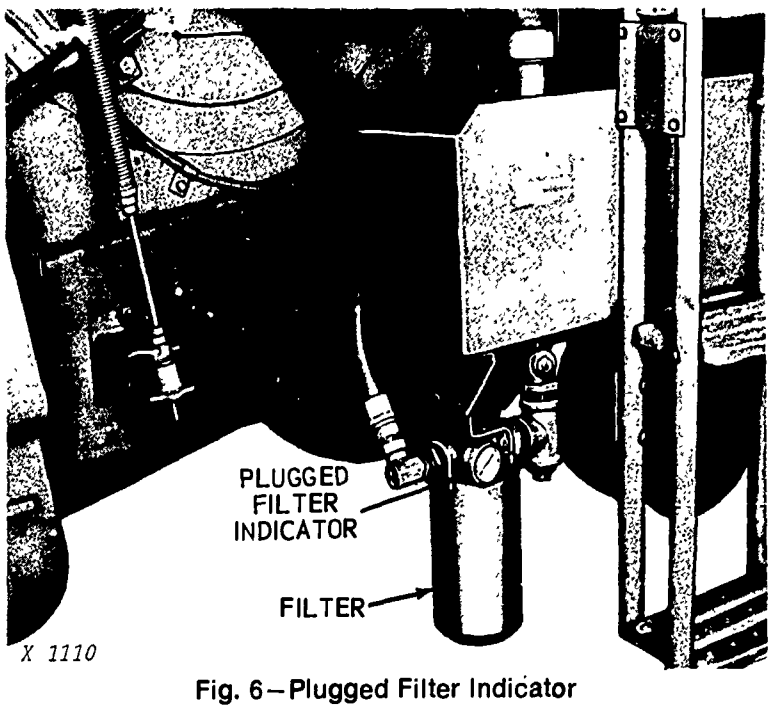


Fig. 6—Plugged Filter Indicator

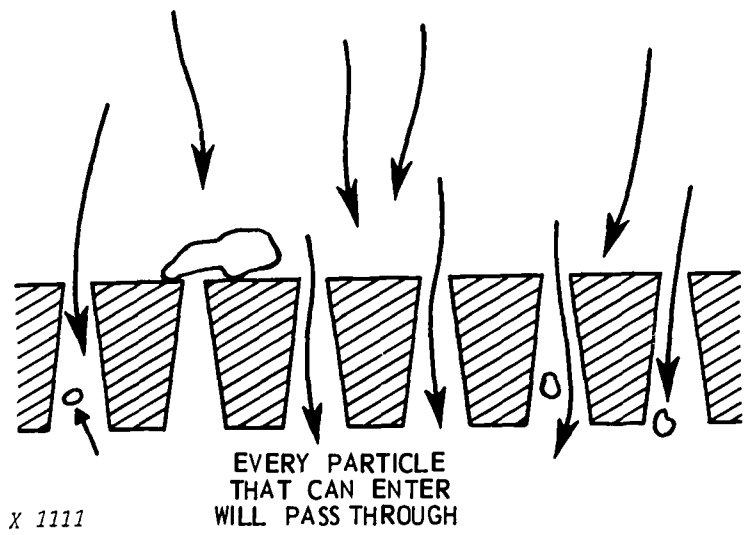


Fig. 7—Tapered Flow Path Helps Prevent Plugging

The indicators for plugged filters shown in Figs. 5 and 6 make it easy to see when the filters require servicing.

With a relief valve in a filter, it's easy to see how important it is to use the right filter and hydraulic oil. If the wrong filter is used, or oil that is too heavy is put in the reservoir, the pressure difference between the inside and outside of a filter can be so great that it exceeds the relief valve setting. When this happens, the valve will open and the oil will never be filtered.

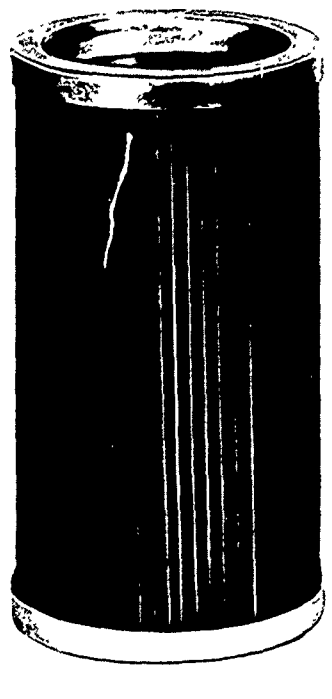


Fig. 8—Wire Mesh Filter

TYPES OF FILTERS

Now let's look at the type of filters used in a hydraulic system and just how much filtering they actually do.

Filters can be classified as either surface-type filters or depth-type filters depending on the way they remove dirt from hydraulic oil.

SURFACE FILTERS have a single surface that catches and removes dirt particles larger than the holes in the filter. Dirt is strained or sheared from the oil and stopped outside the filter as oil passes through the holes in a straight path (Fig. 7). Many of the large particles will fall to the bottom of the reservoir or filter container, but eventually enough particles will wedge in the holes of the filter to prevent further filtration. Then the filter must be cleaned or replaced.

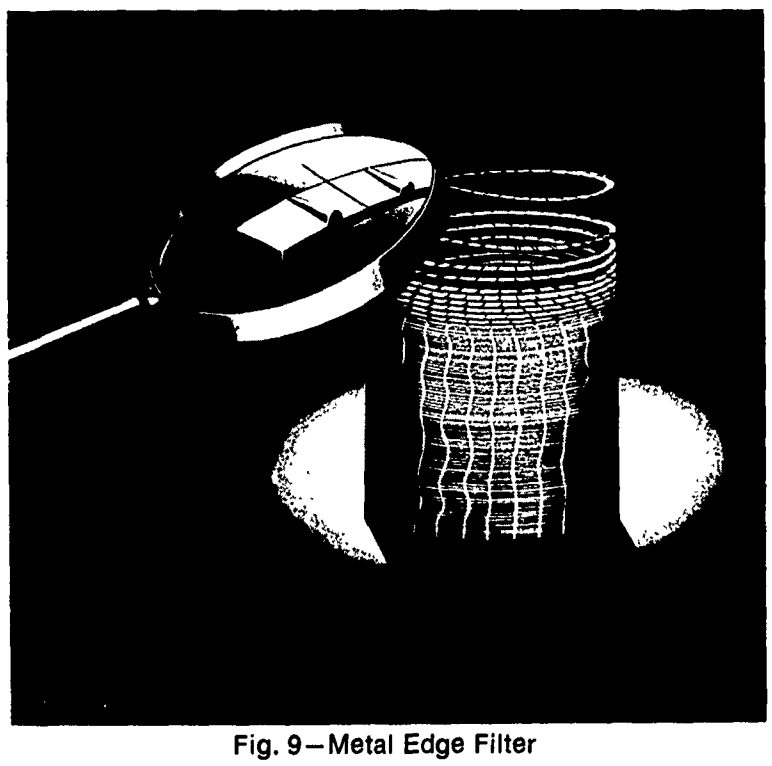


Fig. 9—Metal Edge Filter

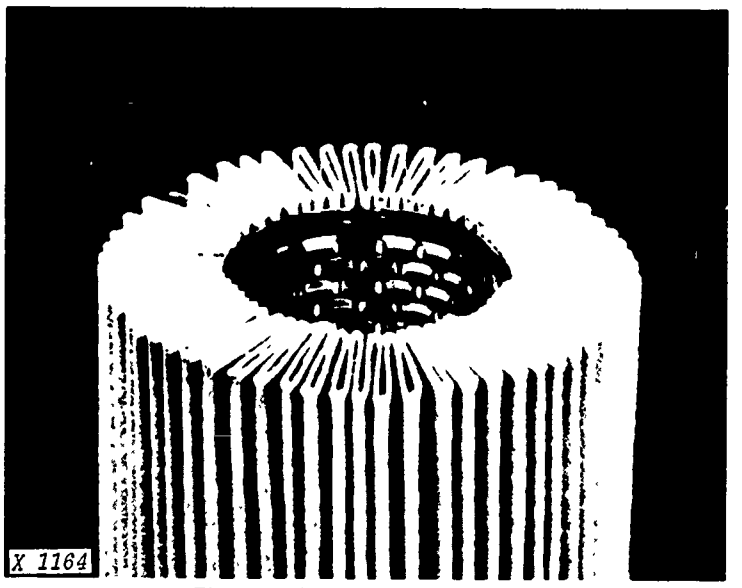


Fig. 10—Pleated Paper Filter

A surface filter may be made of fine wire mesh (Fig. 8), stacked metal or paper disks, metal ribbon wound edgewise to form a cylinder (Fig. 9), cellulose material molded to the shape of the filter, or accordian-pleated paper (Fig. 10).

Fig. 11—Cotton Waste Filter

DEPTH FILTERS, in contrast to the surface type, use a large volume of filter material to make the oil move in many different directions before it finally gets into the hydraulic system (Fig. 11).

Depth filters can be classified as either **absorbent** or **adsorbent,** depending on the way they remove dirt.

Absorbent filters operate mechanically like a sponge soaking up water. Oil passes through a large mass of porous material such as cotton waste, wood pulp, wool yarn, paper or quartz, leaving dirt trapped in the filter. This type of filter will remove particles suspended in the oil and some water and water soluble impurities.

Adsorbent filters operate the same way as absorbent filters but also are chemically treated to attract and remove contaminants. This filter may be made of charcoal, chemically-treated paper or fuller's earth. It will remove contaminating particles, water soluble impurities and, because of its chemical treatment, will also remove contamination caused by oil oxidation and deterioration. Adsorbent filters may also remove desirable additives from the oil and for this reason are not often used in hydraulic systems.

DEGREES OF FILTRATION

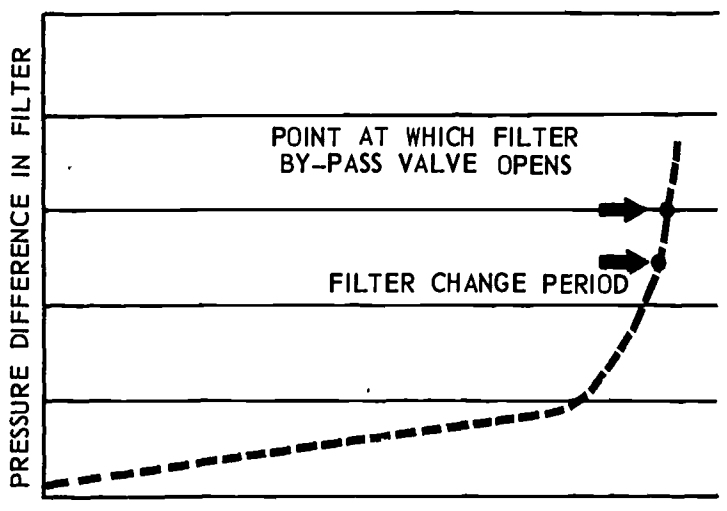
In addition to the type of filter, the degree of filtration is also important to a hydraulic system for it is the degree of filtration that tells just how small a particle the filter will remove. The most common measurement used to determine degree of filtration is a micron (one micron is approximately 0.00004-inch or 40 millionth of an inch). To get an idea of how big a micron really is, 25,000 particles of this size would have to be laid side by side to total just one inch.

The smallest particle that can normally be seen with an unaided eye is about 40 microns, so much of the dirt that is filtered out of a hydraulic system is invisible. For example, grain combines operating in the field today have filters that will remove particles as small as 10 microns in diameter or about one-tenth the size of a grain of table salt.

Some filters, such as those made of wire mesh, may allow particles as big as 150 microns to pass. Although they do not provide as fine a cleaning action as some other types of filters, wire mesh offers less resistance to oil flow and is often used on pump inlet lines to prevent the possibility of starvation.

A filter will pass small solids and stop larger ones but the actual amount of filtering done is difficult to determine. Because the material that is stopped by the filter is not taken away continuously, the size of the openings in the filter will usually decrease with use.

Two or more particles smaller than the holes in the filter may approach at the same time and become wedged in the hole. The result is that the hole will now remove dirt particles far smaller than it would when new. As more dirt wedges in the filter, the holes become smaller and eventually are plugged solid.



X 1115

Fig. 12—Life of a Filter Element

Fig. 12 shows the gradual reduction in the size of the filter pores until, near the end of filter life, the pressure difference between the inside and outside of the filter rises sharply. At this point, the filter stops operating and should be cleaned or replaced.

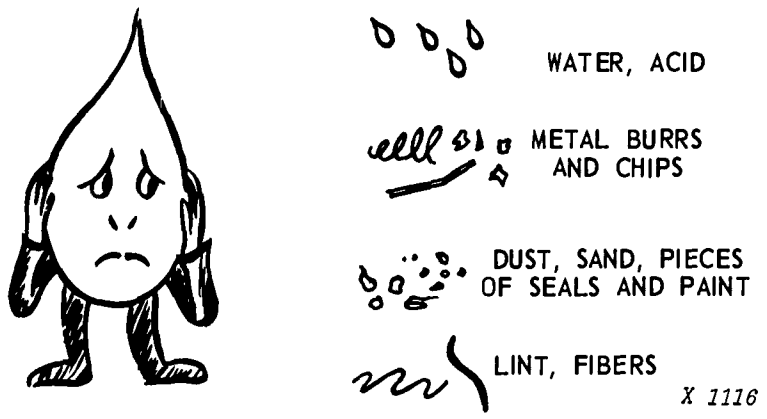
CONTAMINATION

But just what is contamination and how does it get into a hydraulic system?

Liquids, metallic particles, non-metallic particles and fibers are all forms of material that can contaminate the oil (Fig. 13). This material can come from both inside and outside the hydraulic system.

The air is a prime source of contamination. It may contain moisture and particles from the atmosphere, as well as road or field dust. These contaminants can enter through breathers and filler pipes, past seals and gaskets, or when the system is opened for repair or maintenance.

The hydraulic machine itself is a good source of contamination. During break-in, bits of metal and other abrasive particles will contaminate the oil. Later, during normal operation, the machine



X 1116

Fig. 13—Contamination

will generate its own contamination as fragments of paint, pieces of seals and gaskets, and metallic particles caused by wear begin to get into the oil.

Hydraulic oil can be contaminated during maintenance and service if unclean containers and funnels, dirty oil, or dirty and linty wiping cloths are used.

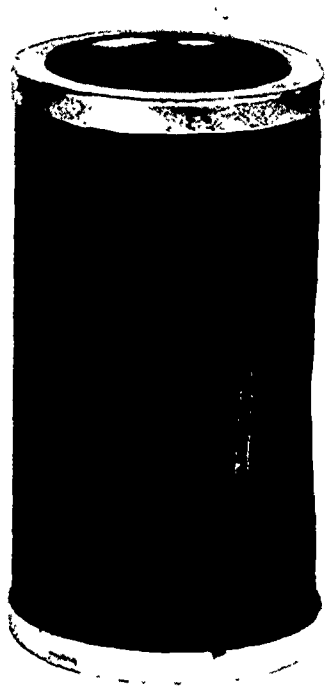


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Fig. 14—Mishandling Will Ruin a Filter

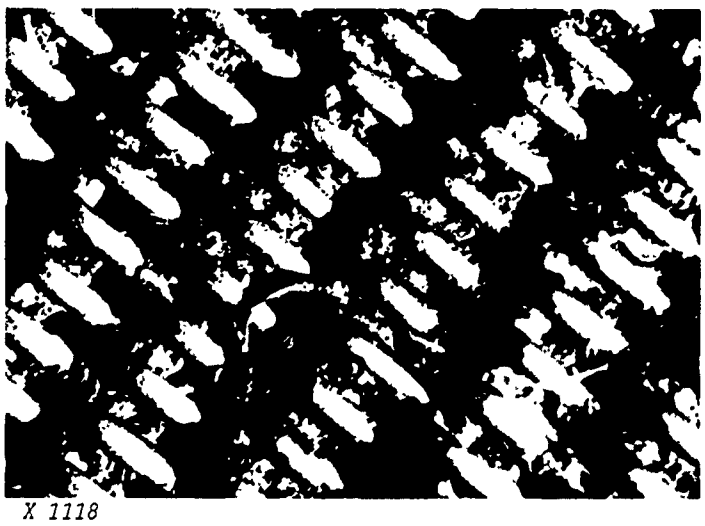
Mishandling of filters can reduce their effectiveness and even cause pieces to break off and get into the oil (Fig. 14).

The oil itself is another source of contamination. As oil works in a system, sludge and acids form because of a chemical reaction to water, air, heat and pressure. Sludge itself is not normally abrasive but is a source of gummy substances that coat moving parts, clog small openings, and trap abrasive particles suspended in the oil.

Acids, by pitting and corroding, cause roughness in moving parts which in turn causes wear and additional contamination in the oil.

EFFECTS OF CONTAMINATION

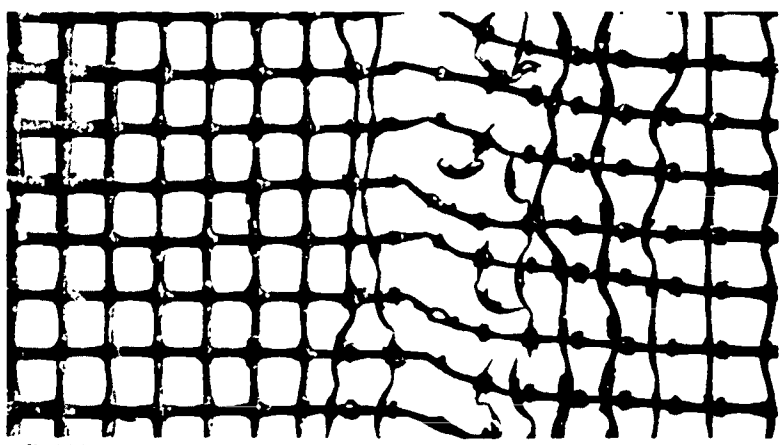
All of these contaminants can have a serious effect on the efficiency of a hydraulic system.



X 1118

Fig. 15—A 100 Micron Filter Completely Plugged

Water, even in small amounts, rusts polished metal surfaces and helps form sludge that coats moving parts and plugs filters (Fig. 15). Plugged filters can cause increased circulation of dirty oil or may even starve the hydraulic components.

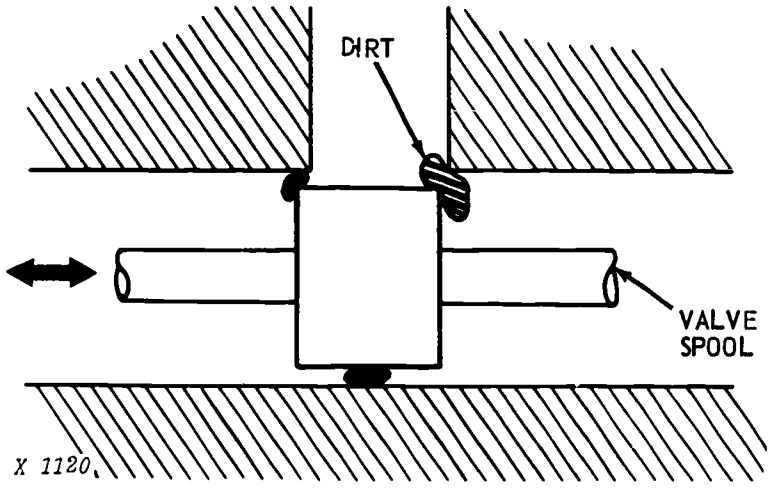


X 1119

Fig. 16—A 150 Micron Filter That Has Been Chemically Corroded

Acids that sometimes form with sludge can corrode parts like the wire mesh filter shown in Fig. 16. This adds still more damaging particles to the oil.

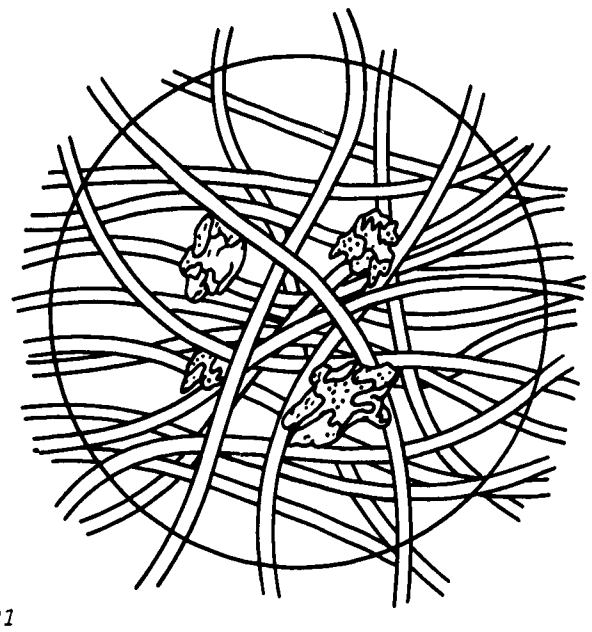
Metallic and non-metallic particles circulating in the oil cause damage that is usually quite apparent. Large particles get caught on the edges of moving



X 1120

Fig. 17—Dirt Will Wear Valve Spools

parts and increase the buildup of sludge or wear off sharp metering edges in valves (Fig. 17). Smaller particles become trapped between closely-fitted parts, causing them to stick or freeze completely. Other particles embed themselves in softer metals to grind away moving parts and seals, causing internal leakage and loss of efficiency.



X 1121

Fig. 18—Fibers Can Plug an Orifice

Tiny fibers or lint from wiping cloths or even from your clothes may mat together in tiny pores and orifices (Fig. 18). The fibers themselves do little harm but the solid particles that they trap can plug and wear hydraulic components.

The important thing to remember about contamination is that the damage it causes is not constant. Each dirt particle is an abrasive "seed" that produces more contamination which finally results in permanent damage to the machine.

MAINTENANCE OF FILTERS

Now that we have identified the reasons for contaminated oil and the problems it causes, what are the remedies or solutions to these problems?

As pointed out before, the purpose of the filter in a hydraulic system is to trap and remove dirt from the oil. It is sometimes difficult then to understand why the use of an oil filter will not extend the period between recommended oil changes. Just remember that oil is constantly being contaminated with new dirt from external and internal sources. Because the capacity of a filter is limited, it can only maintain the oil's original quality for a period of time that has been carefully determined by the manufacturer. It cannot extend the life of the oil.

Like a sponge, the capacity of an oil filter is limited. Only particles above a certain size are removed and only one or two of the elements that cause sludge can be filtered. Smaller particles and the rest of the sludge circulate in the system and can only be removed by draining. As filters remain in use, they begin to plug with the particles they are removing and eventually cease to function at all.

Therefore, the only real solution to contamination problems is a regular program of hydraulic system maintenance.

Faithfully follow the manufacturer's recommendations for draining to remove contaminants that the filter cannot remove. This is especially important during the break-in period because the filter will plug much more rapidly than it will during normal operation.

Be extremely careful about cleanliness when servicing a hydraulic system. No filter can entirely compensate for dirty disassembly or assembly practices. A dirty component or a dirty oil funnel will contaminate the rest of the system and, as we just learned, a small amount of dirt will generate more and more dirt through wear.

Handle filters carefully. A bent or punctured filter will not do the job it is supposed to do. Keep seals in place and store new filters so they are clean when they are installed.

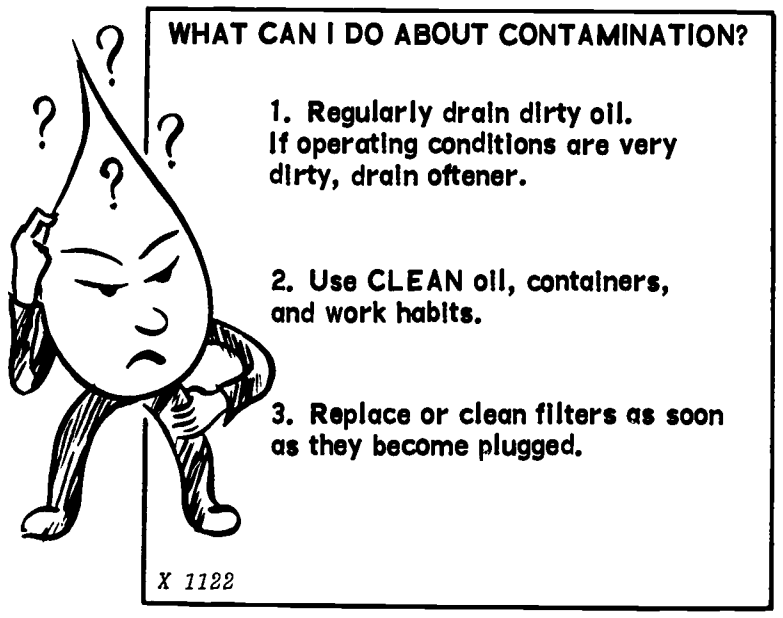


Fig. 19—What Can I Do About Contamination?

Follow the manufacturer's recommendation and clean or replace the filter when it becomes plugged. If the machine does not have a plugged filter indicator, pay strict attention to the filter service intervals shown in the operator's manual. And, finally, use only the filter and oil that is right for that particular hydraulic system.

TEST YOURSELF

QUESTIONS

1. What is the main reason filters are needed in a hydraulic system?

2. Compare full-flow and bypass filtering of hydraulic systems.

3. What does a filter relief valve do?

4. How do surface and depth filters differ?

5. Why are **ad**sorbent filters seldom used in a hydraulic system?

6. What measurement is used to determine the degree of filtration?

7. Explain the term "abrasive seed" as used for dirt in a hydraulic system.

(Answers on following page.)

ANSWERS

1. To keep the oil clean.

2. A full-flow system filters all the oil for each cycle. A bypass system filters only a small part of the oil.

3. It opens to allow oil to flow around the filter when the filter becomes plugged.

4. Surface filters stop dirt outside the filter. Depth filters stop dirt inside like a sponge.

5. Because they chemically remove desirable additives from the oil.

6. A micron (0.00004 inch).

7. A piece of dirt will wear away moving parts in the hydraulic system. Each new wear particle will in turn cause more wear particles and the contamination will continue to multiply.

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RESERVOIRS, OIL COOLERS, HOSES, PIPES, TUBES, AND COUPLERS / CHAPTER 8

INTRODUCTION

This chapter covers the parts which connect the hydraulic system and store and cool the oil. While less complex than the other parts of the system, these components are vital to the working of the system. Many of them require special services which every serviceman must know.

RESERVOIRS

Every hydraulic system must have a reservoir. The reservoir not only stores the oil, it also helps keep the oil clean, free of air, and relatively cool.

CAPACITY OF RESERVOIRS

A reservoir should be compact, yet large enough to:

- Hold all the oil that can drain back into the reservoir by gravity flow.
- Maintain the oil level *above* the suction line opening.
- Dissipate excess heat during normal operation. (See also "Oil Coolers," which follows in this chapter.)
- Allow air and foreign matter to separate from the oil.

FEATURES OF RESERVOIRS

To serve its purpose, the reservoir must have several features (Fig. 1).

1. The FILLER CAP should be air tight when closed, but may contain the AIR VENT which filters air entering the reservoir to provide a gravity push for proper oil flow. The air vent filter must be kept clean to prevent partial vacuums which restrict gravity flow from the reservoir.

NOTE: Ideally, a system may be designed with a sealed reservoir and no air vent. However, since most systems have changing oil levels and temperatures and different piston sizes, air venting is needed.

2. The OIL LEVEL GAUGE shown in Fig. 1 gives the level of oil in the reservoir without opening it. Dipsticks are still widely used, however.

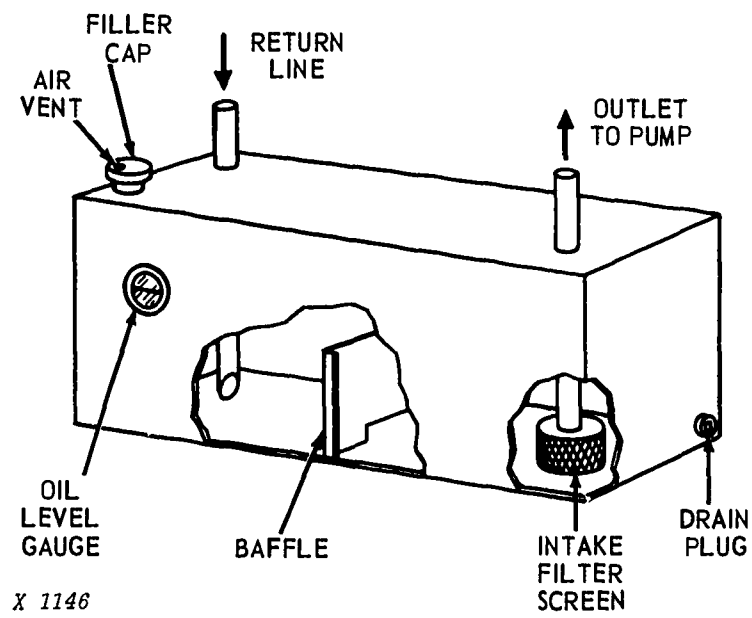

Fig. 1 – Reservoir

3. The BAFFLE helps to separate return oil from that entering the pump. This slows the circulation of oil, gives the return oil time to settle, and prevents constant reuse of the same oil. However, no baffle is needed in many modern systems because the same separation of inlet and return oil is achieved by placement of the lines and filters.

4. The OUTLET and RETURN LINES are designed to enter the reservoir at points where air and turbulence are least. They can enter the reservoir at the top or sides, but their ends should be near the bottom of the tank. If the return is above the oil level, the return oil can foam and draw in air.

NOTE: Be careful when placing extra returns from auxiliary equipment in the reservoir. If not placed correctly, they can cause foaming of return oil.

5. The INTAKE FILTER is usually a screen used in series with the system oil filter, which may also be installed in the reservoir. Refer to Chapter 7, "Oil Filters," for details on these components.

6. The DRAIN PLUG allows all oil to be drained from the reservoir. Some drain plugs are magnetic to help remove metal chips and burrs from the oil.

LOCATION OF RESERVOIRS

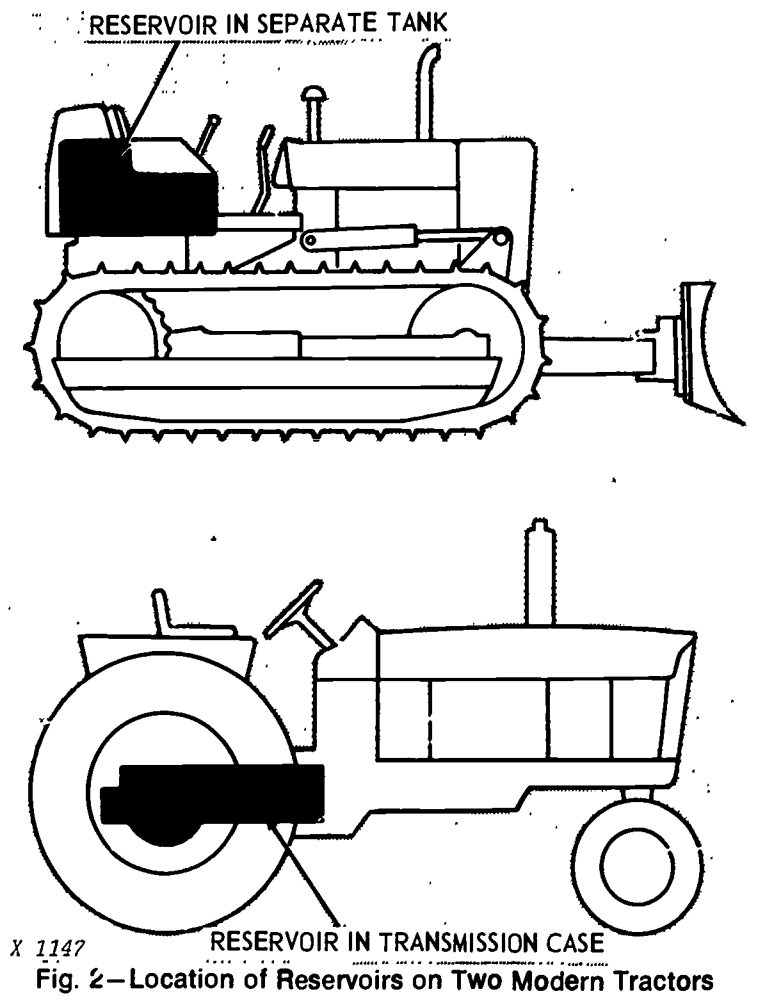

Fig. 2—Location of Reservoirs on Two Modern Tractors

On modern farm and industrial machines, the reservoir must be compact and light. The bulldozer shown in Fig. 2 has a separate mounted tank while the wheel tractor uses its transmission case as a reservoir. The location of the reservoir depends upon the design of the machine—the available space and the size of the reservoir.

OIL COOLERS

On modern high-pressure systems, cooling the oil can be quite a problem. Often the normal circulation of the oil in the system will no longer do the job. This is why oil coolers are becoming more common on modern equipment.

Two types of oil coolers are widely used:

- **Air-to-Oil Coolers**
- **Water-to-Oil Coolers**

Fig. 3 compares the operation of the two coolers.

AIR-TO-OIL COOLERS use moving air to dissipate heat from the oil. On mobile machines, the cooling system (radiator) fan may supply the air blast (see

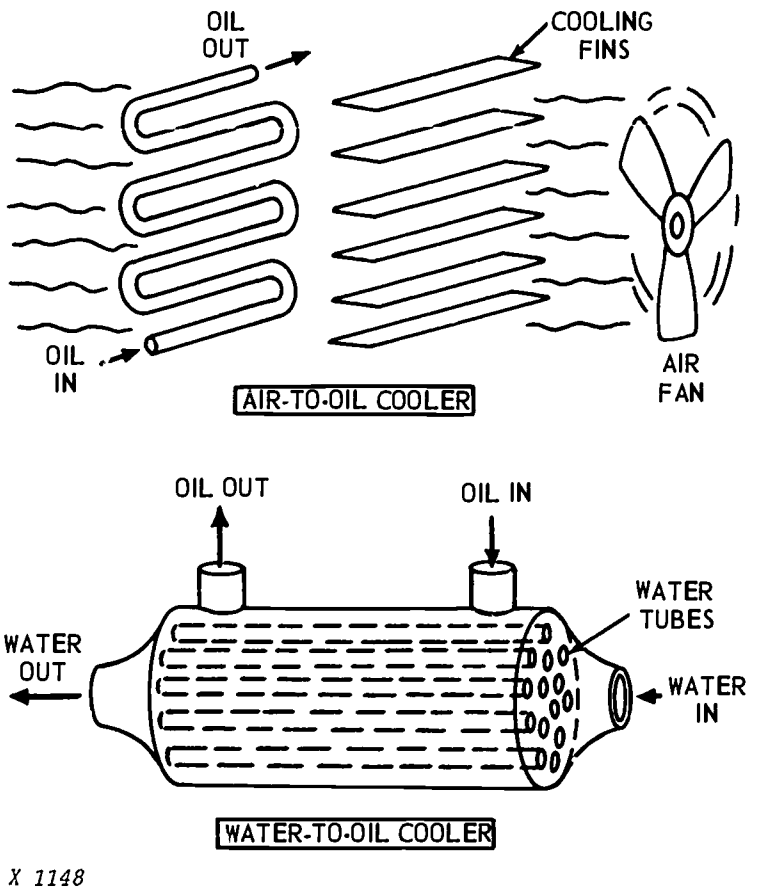

Fig. 3—Oil Coolers

Fig. 4). The cooler has fins which direct the air over long coils of oil tubes which expose more oil to the air. The cooler may also have a tank to store a reserve of cooled oil. A bypass valve is also sometimes used as a safety valve in case the cooler oil tubes become clogged.

WATER-TO-OIL COOLERS use moving water to carry off heat from the oil. The water flows through many tubes and the oil circulates around the cooling tubes as shown. On mobile machines, water from the engine radiator is often used for cooling.

Another less common type of water-to-oil cooler uses the evaporation of water to cool oil. Water is sprayed over coils of oil tubes, while forced air is blown in from the bottom. Part of the water evaporates, cooling the remaining water which in turn draws heat from the oil in the tubes. This cooler is not as compact as the one described above.

LOCATION OF OIL COOLERS

Air-to-oil coolers such as the one shown in Fig. 4 are usually mounted in front of the engine radiator, making use of the fan's air blast. Other coolers can be mounted in a variety of locations, but usually near the reservoir or the engine cooling fan.

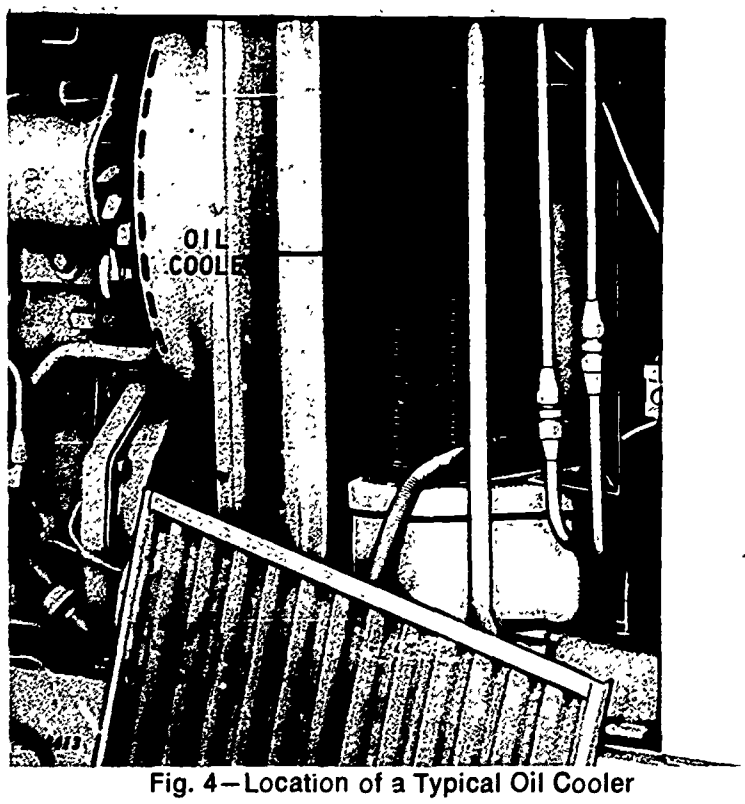

Fig. 4—Location of a Typical Oil Cooler

FLEXIBLE HOSES

Hoses are the best form of hydraulic plumbing for most uses. Not only do hoses allow for motion, they absorb vibrations, withstand pressure "surges," and are easy to route and connect.

Hydraulic hose is composed of three basic parts (Fig. 5):

- **Inner Tube**
- **Reinforcement Layers**
- **Outer Cover**

The INNER TUBE is a synthetic rubber layer which is oil-resistant. It must be smooth, flexible, and able to resist heat and corrosion.

The REINFORCEMENT LAYERS vary with the type of hose. These layers (or plies) are constructed of natural or synthetic fibers, or braided wire, or a combination of these. The strength of this layer depends upon the pressure requirement of the system where the hose is used.

The OUTER COVER protects the reinforcement layers. A special rubber is most commonly used for the outer cover because it resists abrasion and exposure to weather, oil, and dirt.

Hoses also use metal couplers at each end. These will be covered later in this chapter under "Hose Couplers."

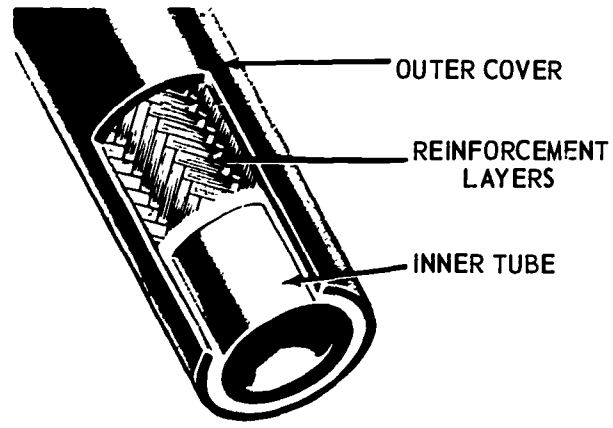

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Fig. 5—Flexible Hose Construction

HOW TO SELECT HOSES

To select the proper hose, you should know:

1. The *flow* of the system to find out what *size* of hose is needed.

2. The *pressures* and *temperatures* in the system to determine the *type* of hose to use.

Remember that the size of the hose should match the flow requirements of the system.

Too-small hoses restrict flow, cause overheating and pressure losses.

Too-large hoses may be too weak for the pressure of the system. This is because larger hoses must be stronger to withstand the same pressure as smaller ones. Also, larger hoses are more expensive.

Selecting the Type of Hose

Hoses are typed by the strength of their wall construction. The four types are:

- **Low Pressure Hose**
- **Medium Pressure Hose**
- **High Pressure Hose**
- **Very High Pressure Hose**

Higher pressure hoses use stronger reinforcing layers or extra layers (Fig. 6).

However, the pressure a hose will handle varies with its size. A larger hose withstands less pressure than a smaller one of the same construction.

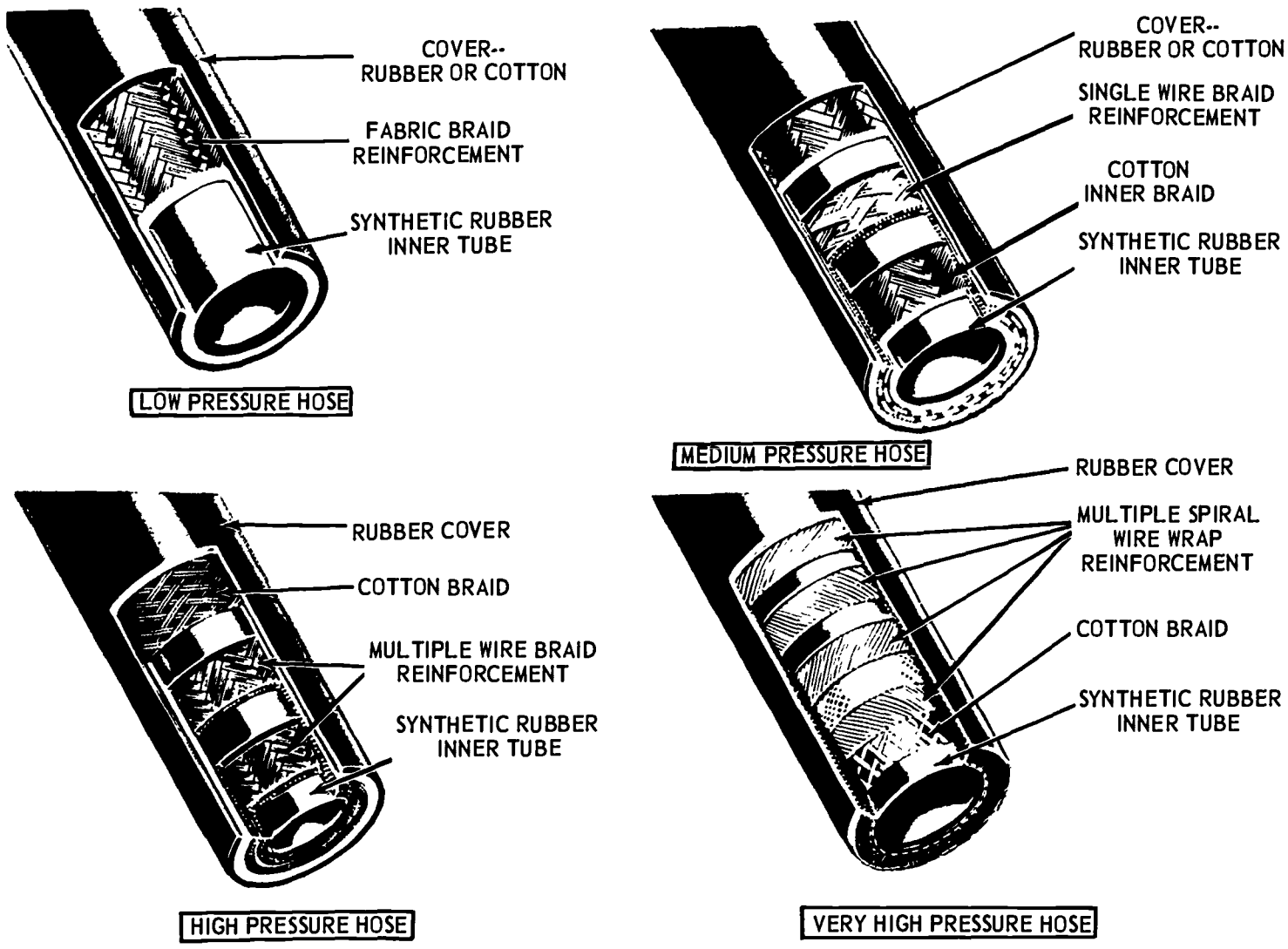

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Fig. 6—The Four Types of Hoses

The hose pressure rating is based on the *working pressure* of the system. This must allow for the maximum "surges" of pressure during the normal operation of the system.

Temperature of the hydraulic oil is also critical in hose selection. All four types will handle the normal heat of hydraulic operation, but special hoses have been designed for extra high temperatures.

The charts which follow give the constructions and applications of the four types of hoses.

LOW PRESSURE HOSE

Construction	*Uses*
Inner Tube: Black synthetic rubber.	Lines for Petroleum-base hydraulic oils, gasoline or fuel oil. In suction lines or in low-pressure return lines.
Reinforcement: Woven fiber reinforced with spiral wire to prevent collapse.	Temperature Range: -40°F. to +250°F.
Cover: Synthetic rubber, oil- and abrasion-resistant.	Vacuum: 30 In. Hg.

LOW PRESSURE HOSE—Continued

Construction	*Uses*
Inner Tube: Black synthetic rubber, oil-resistant.	Hydraulic oil return lines only, or general-purpose fuel oil, gasoline, water, anti-freeze mixtures, air, and other chemicals.
Reinforcement: One-fiber braid.	Temperature Range: -40°F. to +250°F.
Cover: Black synthetic rubber, oil- and abrasion-resistant.	

Inner Tube: Black synthetic rubber, oil-resistant.	Hydraulic oil return lines only, or general purpose fuel oil, gasoline, water, anti-freeze mixtures, air, and other chemicals.
Reinforcement: Two fiber braids.	Temperature Range: -40°F. to +250°F.
Cover: Black synthetic rubber, oil- and abrasion-resistant.	

IMPORTANT: LOW pressure hoses are NOT RECOMMENDED FOR PRESSURE LINE USE IN HYDRAULICS. Therefore, they will not be included in the chart on selecting hoses which follows these charts.

MEDIUM PRESSURE HOSE

Construction	*Uses*
Inner Tube: Black synthetic rubber. Reinforcement: Two fiber braids. Cover: Synthetic rubber, oil- and abrasion-resistant.	Hydraulic oil lines, fuel oil, anti-freeze solutions, or water lines. Temperature Range: −40° F. to +250°F.
Inner Tube: Black synthetic rubber, oil-resistant. Reinforcement: One braid of high tensile steel wire. Cover: Black synthetic rubber oil- and abrasion-resistant.	Hydraulic oil lines, fuel oil, gasoline or water. Temperature Range: −40°F. to +250° F.

HIGH PRESSURE HOSE

Construction	*Uses*
Inner Tube: Black synthetic rubber oil-resistant. Reinforcement: Two braids or more of high tensile steel wire. Cover: Black synthetic rubber, oil- and abrasion-resistant.	Hydraulic oil lines, fuel oil, gasoline or water lines. Temperature Range: −40° F. to +200° F.
Inner Tube: Black, synthetic rubber. Reinforcement: Two braids or more of high tensile steel wire. Cover: Synthetic rubber oil- and abrasion-resistant green color.	Hydraulic lines using phosphate ester base fluids. (Should not be used with petroleum oils.) Temperature Range: −40° F. to +200° F.

NOTE: High pressure hoses of the first type are widely used on farm and industrial equipment hydraulic systems.

VERY HIGH PRESSURE HOSE

Construction	*Uses*
Inner Tube: Black synthetic rubber, oil-resistant. Reinforcement: Multiple spiral of high tensile steel wire and one fiber braid. Cover: Black synthetic rubber, oil- and abrasion-resistant.	Hydraulic oil lines or fuel oil lines. Temperature Range: −40° F. to +200° F.

IMPORTANT: Very high pressure hose is recommended where high surge peaks are encountered. Surges can cause weak spots in the wire braids of the less-strong hoses. The spiral wire reinforcement of very high pressure hose does not weaken under high surges.

Summary: Selecting Hoses

The following chart will help you to select the proper hose for any pressure application. Find the size of the hose you need and read across to the system working pressure nearest your application. If you find it in column 1, use a medium pressure hose. If in column 2, use a high pressure hose, or in column 3 use a very high pressure hose.

SELECTING HOSE FOR VARIOUS PRESSURES

Hose Size in Inches	*1. Use MEDIUM Pressure Single Wire Braid Hose if System Working Pressure Equals . . .*	*2. Use HIGH Pressure Multiple Wire Braid Hose if System Working Pressure Equals . . .*	*3. Use VERY HIGH Pressure Spiral Wire Wrap Hose if System Working Pressure Equals . . .*
¼″	3000 psi	5000 psi	— — —
⅜″	2250 psi	4000 psi	5000 psi
½″	2000 psi	3500 psi	4000 psi
⅝″	1750 psi	2750 psi	— — —
¾″	1500 psi	2250 psi	3000 psi
1″	800 psi	1875 psi	3000 psi
1¼″	600 psi	1625 psi	3000 psi
1½″	500 psi	1250 psi	3000 psi
2″	350 psi	1125 psi	2500 psi

Note again how larger hoses are recommended for lower pressures than smaller ones of the same construction.

HOSE FAILURES

When hoses fail prematurely, look for: cracking or splitting, pin hole leaks, improper hose length, rubbing, heat, twisting, wrong hose selection, wrong fittings, or improper routing.

CRACKING OR SPLITTING is not uncommon and does not always mean the hose is ruined. The *depth* of the break is what is important. This should be watched for regularly on high-pressure circuits.

PIN HOLE LEAKS are often hard to detect. But a slow drip can add up in a few weeks, and can create fire hazards.

IMPROPER HOSE LENGTH can mean that a too-short hose is stretched under pressure or a too-long one is exposed to hazards from moving parts. Either way the hose is likely to be damaged.

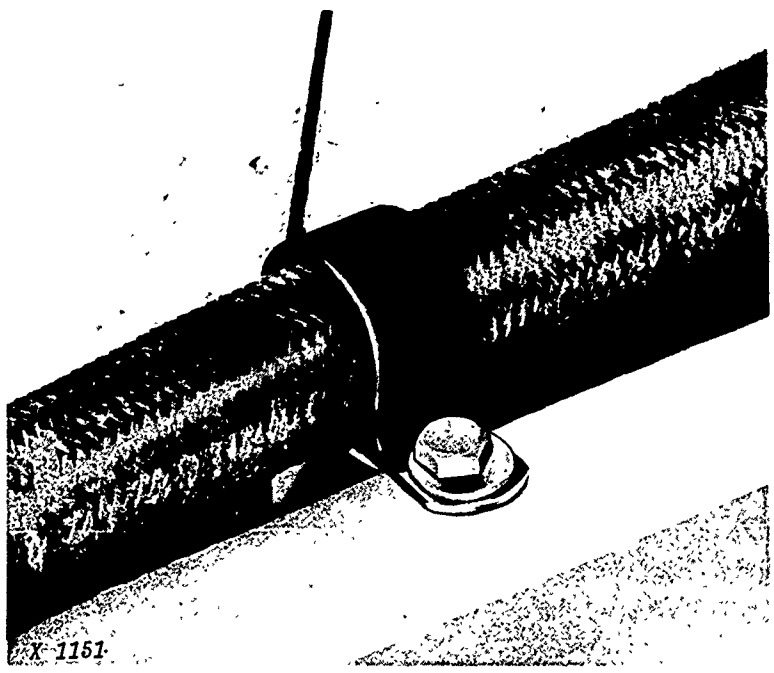

Fig. 7—Hose Clamp

RUBBING wears out hose covers, weakens the reinforcement layers, and so wears out the hose prematurely. Clamp or bracket hoses so they cannot rub, or use hose guards.

HEAT from engine exhaust system and radiator can damage hoses. Be sure all hoses are routed away from hot parts or at least are bracketed or cushioned against contact.

TWISTING can restrict the flow of oil and also damage the hose. Bending or flexing is part of hose design; twisting is not. The most common cause of twisting is when one end of the hose is improperly connected to a moving part. To correct this, clamp the hose at the point where it starts twisting, dividing the motion of the hose into two planes. If some twisting cannot be avoided, allow as much free hose as possible.

WRONG HOSE SELECTION happens when hoses are used that are of the wrong size or pressure rating. See the chart on selecting hoses in this section. Remember, *Don't Economize*! Selecting the wrong hose can cause many of the failures above.

WRONG FITTINGS occur when replacement fittings are not matched to the hoses in size or style. For details, see "Hose Couplers" later in this chapter.

COLLAPSED SUCTION HOSE is another type of breakdown, seemingly simple. But it is possible that the inner layer of rubber of the suction hose will, when it starts to deteriorate, collapse inward, completely sealing off flow, without showing any outer symptoms of collapse. A noisy pump, lack of pressure, "spongy" action, or no action at all are indications of a collapsed suction tube.

IMPROPER ROUTING is the No. 1 cause of hose failure. Included here are twisting and abrasion, but also sharp bends, hoses which are too long or short, use of too many fittings, wrong-way connections. Since there are so many possible causes, care must be taken to find the right remedy to this problem. To prevent improper routing, study the next part of this chapter, "Installing Hoses."

INSTALLING HOSES

Now that we have discussed hose failures, let's talk about the leading remedy—proper hose installation.

Follow the six basic rules when installing a hose:

1. **Avoid Taut Hose.** Even where the hose ends do not move in relation to each other, allow some slack to prevent strain. Taut hoses tend to bulge and weaken under pressure.

2. **Avoid Loops.** Use angled fittings to prevent long loops. Doing this cuts down the length of hose needed and makes a neater installation.

3. **Avoid Twisting.** Hoses are weakened and fittings are loosened by twisting either during installation or machine operation. Use a hose clamp or allow some free hose where necessary. And remember—tighten the fitting on the hose—not the hose on the fitting.

4. **Avoid Rubbing.** Clamp or bracked hoses away from moving parts or sharp edges. If this doesn't work, use a hose guard of wire spring or flat armor spring design.

5. **Avoid Heat.** Keep hoses away from hot surfaces such as engine manifolds. If you can't route the hoses away from these areas, shield them.

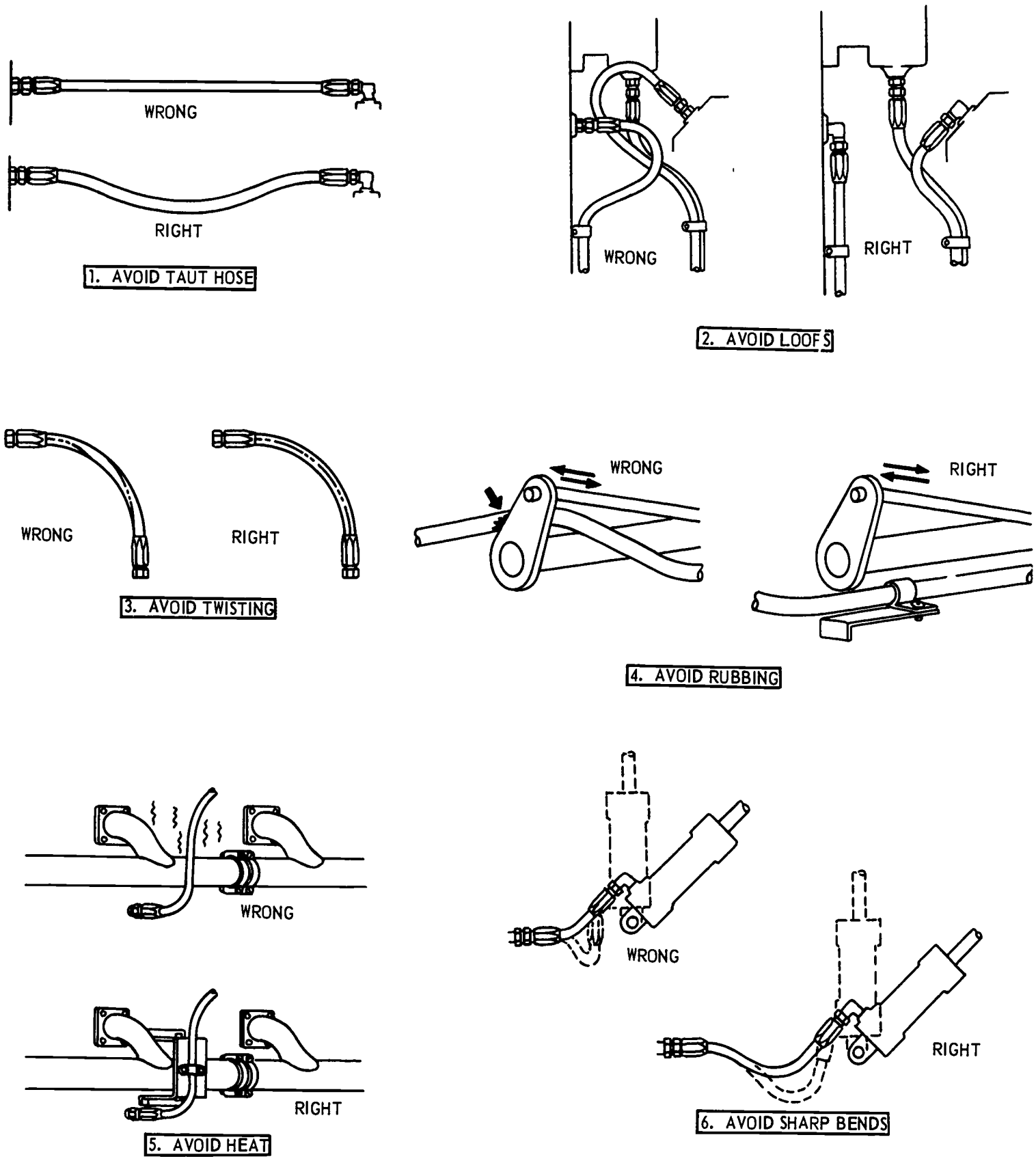

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Fig. 8—Installing Hoses

6. **Avoid Sharp Bends.** The bend radius depends upon the hose construction, size, and pressure. The manufacturer recommends a certain limit for bending on each hose. At lower pressures, a tighter bend is permitted. Where possible, reroute hoses to avoid sharp bends. Or, allow extra slack but watch for kinks or loops. *Remember: Only the hose is flexible, not the fittings.*

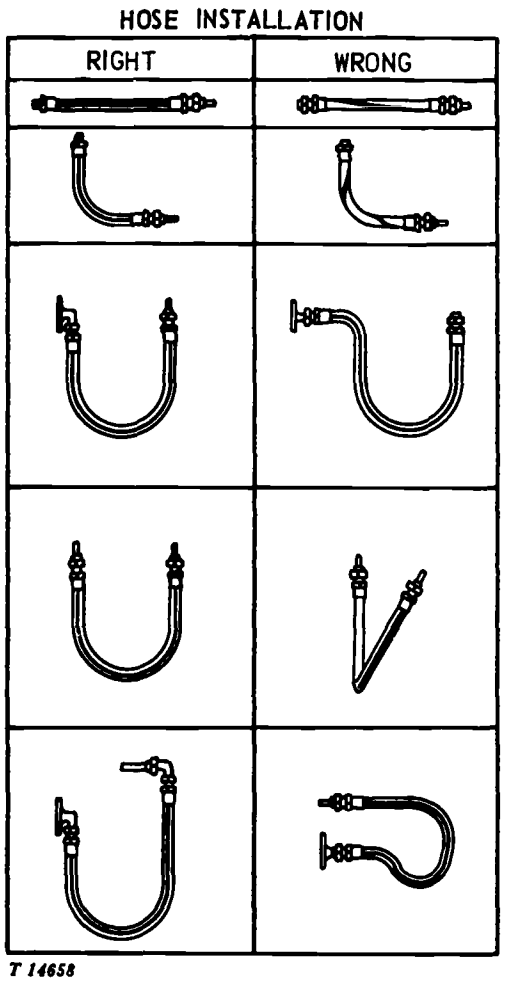

Fig. 9—How to Route Hoses

For a quick check on how to route hoses, refer to Fig. 9.

In summary, route hoses for good appearance. Good appearance and good function go together.

HOSE COUPLERS

Hose couplers include two types:

- Fittings—part of the hose, they have a socket and nipple or sleeve.
- Adapters—a separate part for joining the hose fitting to another line.

Fittings and adapters are called either male or female couplers. The hollow female coupler mates with the male type (Fig. 10).

Hose couplers are made of steel, brass, stainless steel or, in a few applications, plastic. Steel is generally used because it withstands both high pressures and heat.

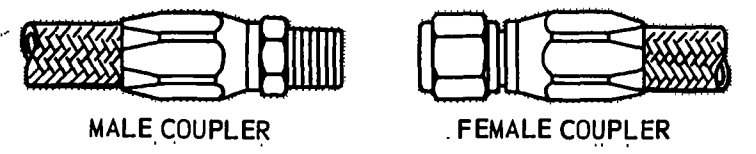

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Fig. 10—Male and Female Couplers

Let's discuss each type of hose coupler.

Hose Fittings

Hose fittings can seal in many ways. The five major methods are shown in Fig. 12.

Besides straight fittings, elbow fittings are also available. Elbows should be used for access to hard-to-reach connections and for special routing problems.

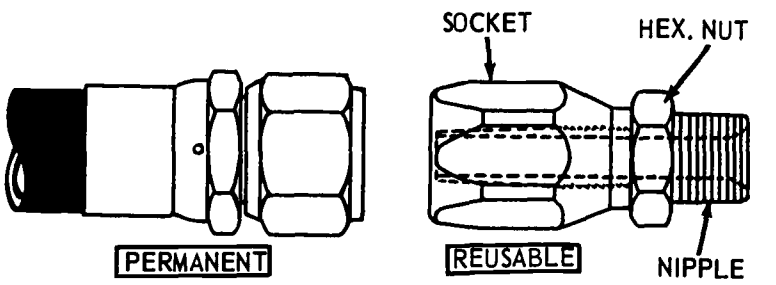

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Fig. 11—Hose Fittings

Hose fittings are also designed to be either permanent or reusable (Fig. 11).

PERMANENT HOSE FITTINGS are discarded with the hose. They are either crimped or swedged into the hose. One drawback to permanent fittings is that the dealer must stock hoses to suit every application since he can't make up his own hoses for replacement.

REUSABLE HOSE FITTINGS are either screwed or clamped onto the hose ends. When the hose wears out, the fittings can be removed and used on a new hose cut from stock. Most reusable fittings can be converted to another thread type by changing the nipple in the socket. As might be expected, reusable fittings are slightly more expensive.

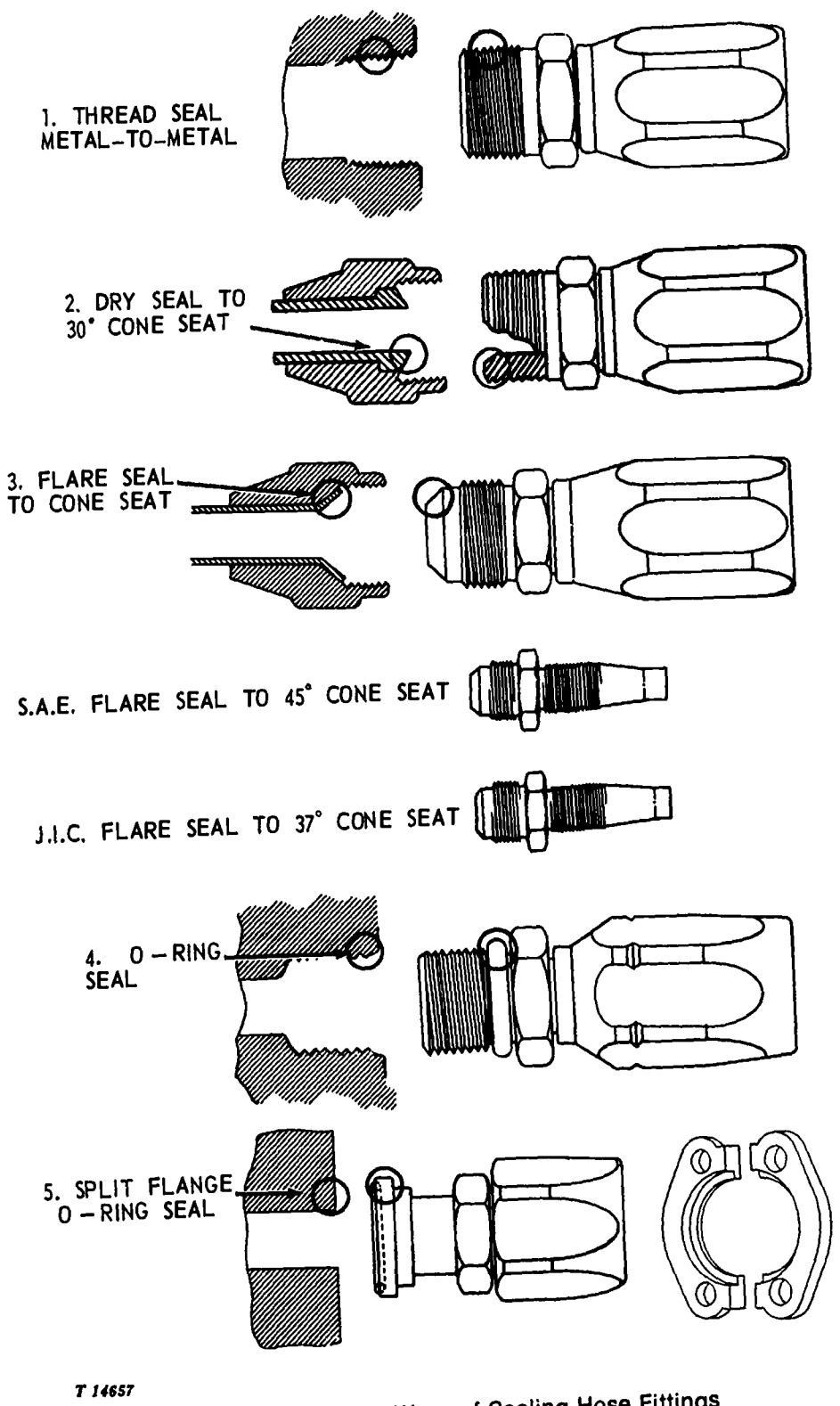

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Fig. 12—Five Major Ways of Sealing Hose Fittings

Medium and high pressure hose fittings may be the same in appearance. Yet, each must be distinguished for proper use.

They are commonly marked by the manufacturer: High pressure fittings have a notch while medium pressure ones do not (Fig. 13).

If hoses and fittings are not matched correctly, the result can be pressure drops, heat build-ups, hose ruptures, and other failures.

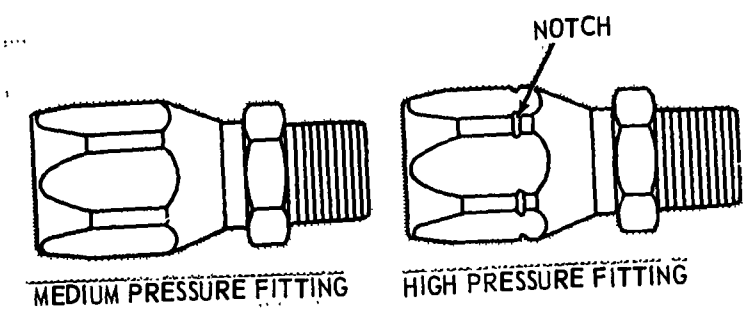

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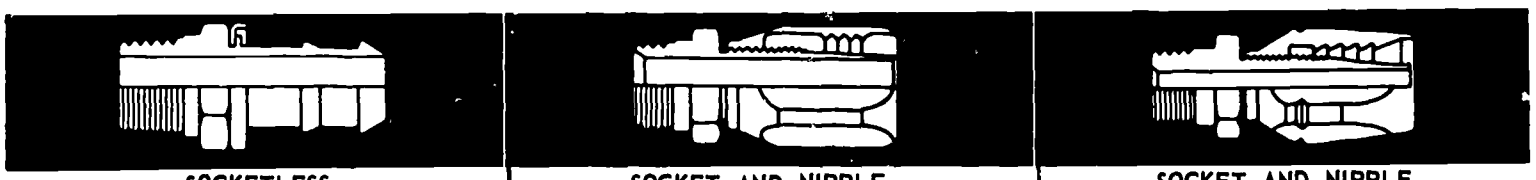
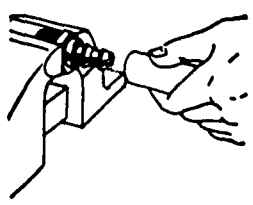
Fig. 13—How to Identify Medium and High Pressure Hose Fittings



SOCKETLESS
(Low Pressure)

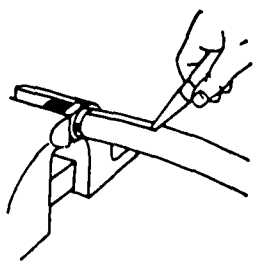
ASSEMBLY

1. Cut hose to length with a sharp knife. Oil inside of hose and nipple liberally.

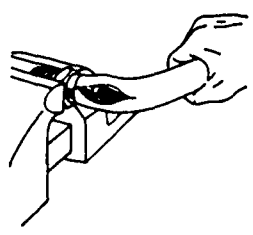


2. Push hose on fitting until it bottoms underneath protective cap.

DISASSEMBLY

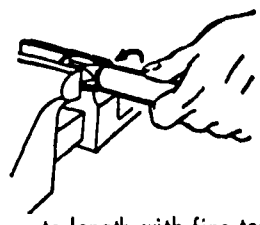


1. Slit hose from protective cap to end of nipple.

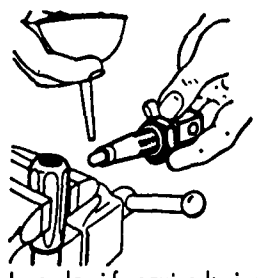


2. Bend hose and snap it off with a quick pull.

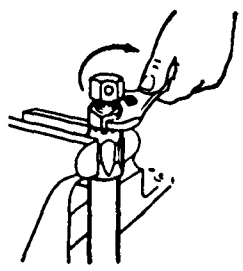
SOCKET AND NIPPLE
(Medium Pressure, Single Wire Braid Hose)



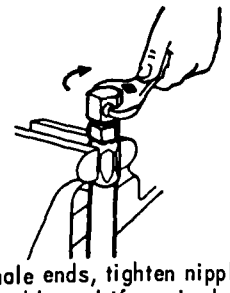
1. Cut hose to length with fine tooth hacksaw or cut-off wheel. Skive if required (see at right). Screw hose counterclockwise into socket until it bottoms. Back off ¼-turn.



2. For male ends, if required: insert assembly tool mandrel (of correct size) into nipple and oil nipple threads, assembly tool, and inside of hose.

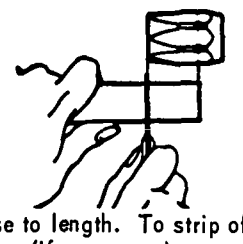


3. For male ends, screw nipple clockwise into socket until snug against socket.

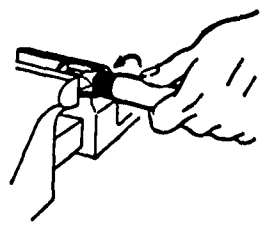


4. For female ends, tighten nipple and nut on assembly tool if required. Screw nipple clockwise into socket. Leave 1/32 in. to 1/16 in. clearance between nut and socket.

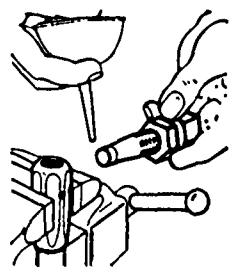
SOCKET AND NIPPLE
(High Pressure – Notch on Socket)
(Multiple Wire Braid Hose)



1. Cut hose to length. To strip off protective cover (if necessary) cut around hose down to metal wire reinforcement, then cut cover lengthwise and pull off cover. Clean wire with wire brush or soft wire wheel. Avoid flaring or fraying wire reinforcement.



2. Screw hose counterclockwise into socket until it bottoms.



3. Oil nipple threads and inside of hose liberally. Use grease for larger sizes.

4. Screw nipple clockwise into socket. Leave 1/32 in. to 1/16 in. clearance.

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Fig. 14—Installing Reusable Hose Fittings

Installing Reusable Hose Fittings

Reusable hose fittings are installed using simple hand tools and a vise (Fig. 14). The socketless type for low pressures is shown in column 1. The socket and nipple types are shown in column 2 (medium pressure) and column 3 (high pressure).

Be sure to securely fasten all hose fittings. *The blowoff of a hose at high pressures can be dangerous!*

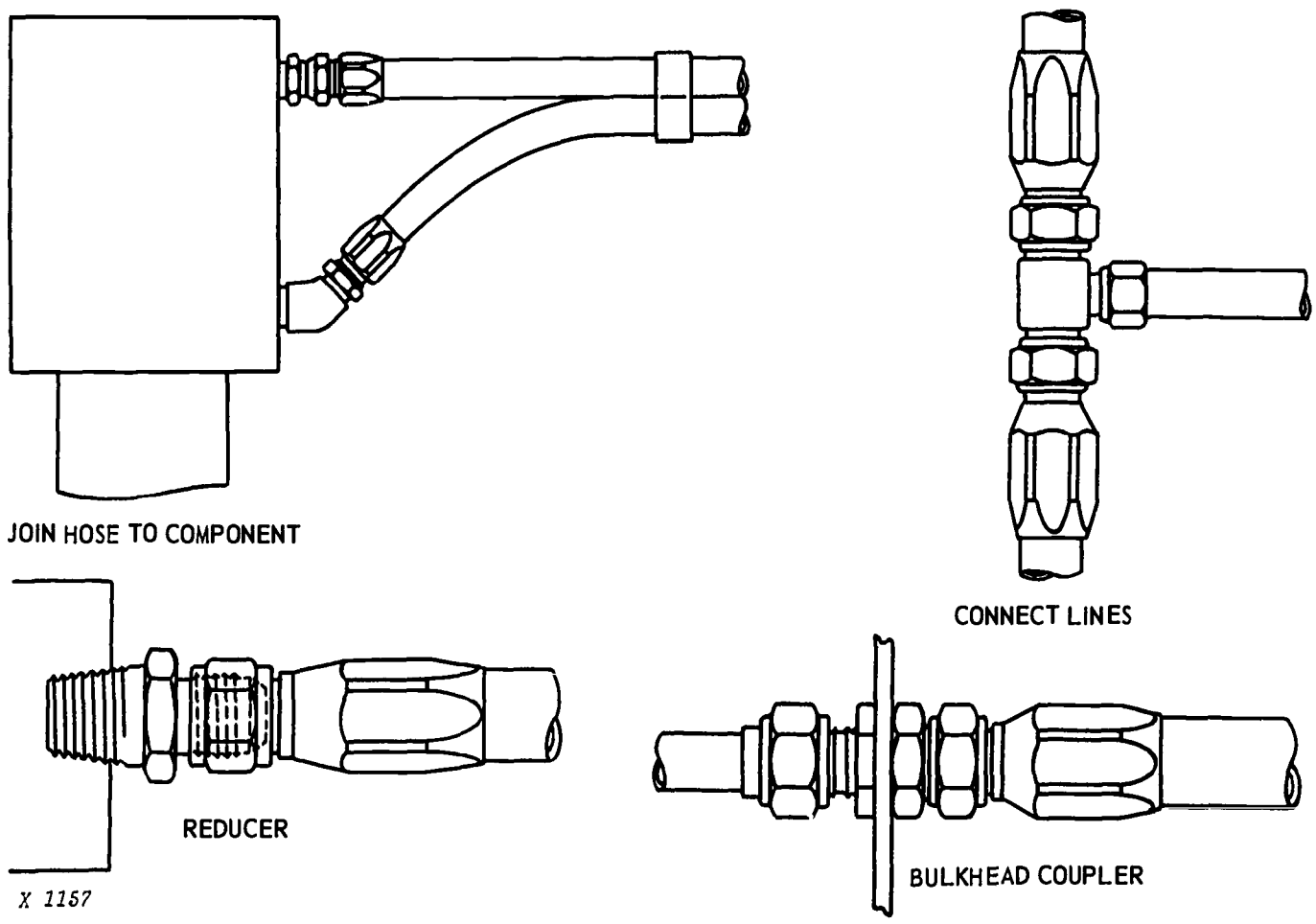


Fig. 15—Four Uses of Hose Adapters.

Hose Adapters

A hose adapter is a separate part for joining a hose fitting to another line or fitting.

Since most hydraulic components have ports with tapered pipe threads, adapters are often needed for proper mating.

Adapters are used in four ways (Fig. 15):

- To join a hose fitting to a component.
- To connect two or more lines or fittings.
- To replace a bushing, as a reducer.
- To both anchor and connect lines (bulkhead coupler).

Installation of Hose Couplers

Besides the rules for installing hoses we covered earlier, there are twelve rules for good hose coupler installations:

1. Be sure working pressure rating of coupler corresponds to working pressure rating of hose.

2. Be sure the seal replacement is matched to the mating coupler.

3. Use flared adapters or elbow hose fittings where possible instead of pipe adapters.

4. Improve line routing by use of 45° and 90° adapters or elbows.

5. Attach male ends of hose assemblies before female ends.

6. Tighten swivel nuts only until snug—do not overtighten.

7. Tighten only nipple hex nut and not the socket.

8. Use pipe sealing compound on male threads only—make sure compound is compatible with the hydraulic oil.

9. Use open-end wrenches for assembly—do not use pipe wrenches.

10. Use two wrenches where necessary to prevent twisting of hoses.

11. Tighten the fitting on the hose—not the hose on the fittings.

12. As a general rule, tighten the fitting until finger tight, then use wrenches to tighten the fitting two extra flats. If leakage occurs after operation, tighten one extra flat.

Failures of Hose Couplers

Leakage is the most common failure of hose couplers. Leakage is usually the result of stripped threads, damaged O-rings, or mis-matched seals.

In some cases, failures have resulted from improper assembly of fittings in the hose ends.

Premature failure also can result from overtightening of swivel nuts while leaving pipe threads loose.

Other possible failures result in using too much sealing compound ("pipe dope") which restricts flow and contaminates the hydraulic oil.

Cracked coupler sockets may result from using a low-pressure socket in a high-pressure system.

PIPES AND TUBES

The choice between pipe or tubing depends on system pressure and flow. The advantages of tubing include easier bending and flaring, fewer fittings, better appearance, better reusability, and less leakage. However, pipe is cheaper and will handle larger volumes under higher pressures. Pipe is also used where straight-line hook-ups are needed, and for more permanent installations.

In either case, the hydraulic lines must be compatible with the entire system. Pressure loss in the lines must be kept as small as possible for an efficient circuit.

CONSTRUCTION OF PIPES AND TUBING

Pipes for hydraulic lines should be made of seamless cold-drawn mild steel. *Galvanized pipe should NOT be used because the zinc coating may flake or scale and damage the valves and pumps.*

Tubing can be made from a variety of materials:

Copper—The use of copper is limited to low pressure hydraulic systems where vibration is limited. Also, copper tends to become brittle when flared and subjected to high heat.

Aluminum—This tubing is also limited to low pressure use, yet has good flaring and bend characteristics.

Plastic—Plastic tubing lines are made from a variety of materials; nylon is the most suitable. For use in low pressure hydraulic application only.

Steel—Tubing constructed of cold-drawn steel has become the accepted standard in hydraulics where high pressures are encountered. There are two types of steel tubing; seamless and electric welded. Seamless is produced by a cold drawing of pierced or hot extruded billets. Welded is made by forming a cold-rolled piece of steel into a tube, then welding and drawing it.

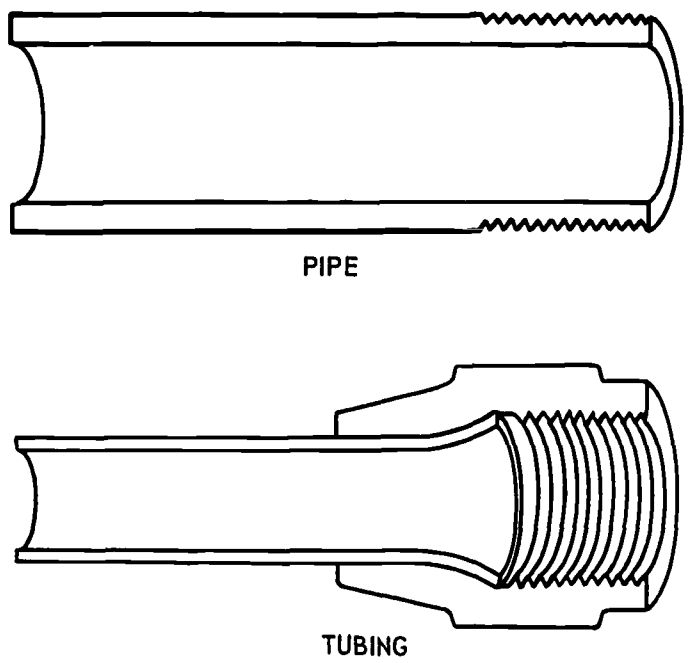


Fig. 16—Pipes and Tubing Compared

SELECTION OF PIPES AND TUBING

The thickness of the wall determines the strength of a pipe or tube. The thicker the wall, the stronger the line.

However, when replacing pipes or tubes, consider both the system pressure and the size of the line.

Remember this when selecting pipes or tubes:

Too-small lines may cause pressure drops, restrict flow, and create heat – a power loss.

Too-large lines are cumbersome and costly.

Be sure that the pipes or tubes match the hoses used in the same pressure circuit. The *inside* diameter of the lines is the critical factor in matching them for size.

FAILURES OF PIPES AND TUBING

If rigid lines are of good quality and are well maintained, failures should rarely occur.

Watch for loose clamps, which cause vibrations.

Check lines that may have been accidently hit, bent, or pinched during operation.

Check for "wet spots" that could mean a pin-hole leak in the line.

INSTALLING PIPES

1. Always replace pipes with ones of identical design and material.

2. Where possible, *avoid straight-line hookups,* especially in short runs. The reason is that straight runs do not allow for enough expansion or contraction during heat and pressure changes.

3. When installing long pipe lines, use brackets and clamps to reduce strain and fatigue. All components or heavy fittings should also be bolted down to eliminate stress on the pipe.

4. For convenience of routing utilize bulkhead fittings where a line passes through a wall or beam. This will not only provide ease of dismantling, but also gives added support.

5. Replacement pipe must be clean and free from rust and scale. To achieve a bright and clean inside surface, two methods are employed by the manufacturer: sand blasting and pickling.

INSTALLING TUBING

1. Always replace tubing with parts of the same material and design. *Do not substitute.*

2. Plan to use as few fittings as possible by using bends in the tubing where practical.

3. Plan the general path of the tubing as follows:

   a. Use the simplest bends, the fewest bends, and the least sharp bends possible.

   b. Avoid points of interference with the operator, the moving parts, and any access doors or controls. Keep the lines from protruding if at all possible.

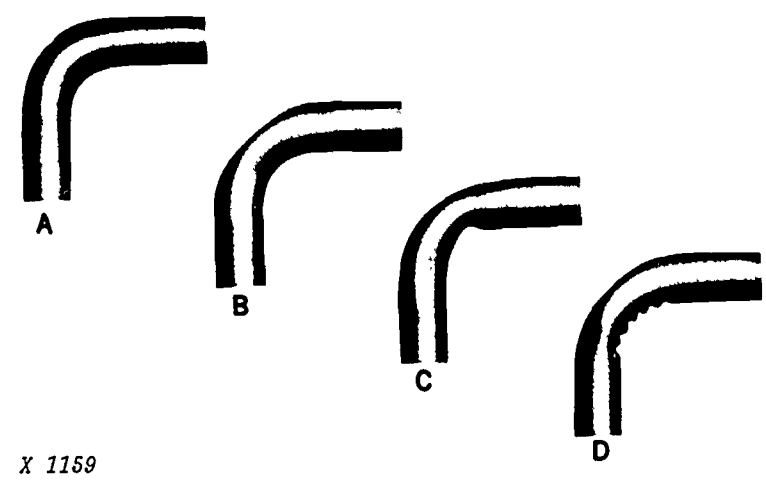
   c. *Avoid straight-line hookups where possible.* These runs make the line difficult to remove and do not allow for enough expansion and contraction.

   d. Support long tubing runs with brackets or clamps. Group lines and clamp several for neater appearance.

   e. Do not route tubes through bulkheads or walls if you can avoid it. If you must, use bulkhead connectors for easier removal and added support.

4. Install the tubing as follows:

   a. Install the couplers on the components to be connected.



A—Good Bend
B—Flattened Bend
C—Kinked Bend
D—Wrinkled Bend

Fig. 17—Good and Bad Bends in Tubing

   b. Line up the tubes and decide exactly where the bends should be made. Use the proper tube bending tools to prevent flattened, kinked, or wrinkled bends (Fig. 17). The bends should be accurate and smooth so they do not restrict flow. As a general rule, the radius of the bend should be three to five times the diameter of the tubing, but follow the manufacturer's recommendations.

   c. Refer to Fig. 18 for a guide in routing tubes properly.

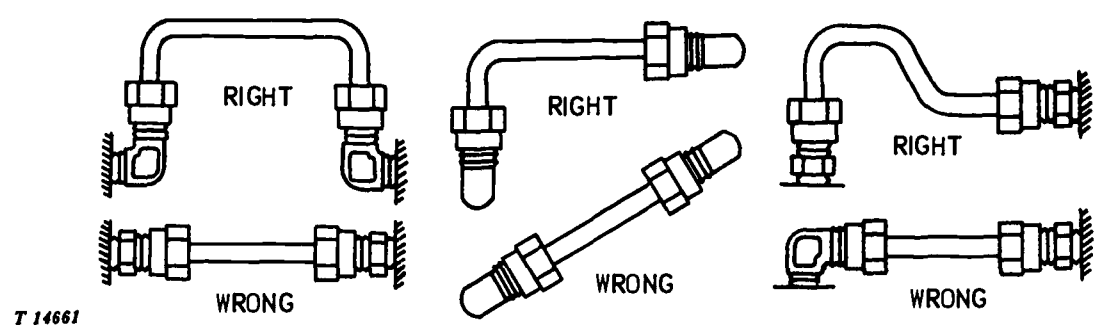


Fig. 18—Routing of Tubes

PIPE COUPLERS

Pipe is normally connected by threading its outside diameter and screwing it into a tapped hole. Two types of threads have become accepted standards for hydraulic applications: The American or National Standard Tapered Thread (NPT) and Dryseal American or National Taper Pipe Thread (NPTF).

In NPT threads, interference contact between thread flank does the sealing. These threads require pipe sealing compound to eliminate leaks.

In NPTF threads, the roots and crests engage before the flanks touch. When tightened, the crests are crushed, creating the seal.

Although NPT and NPTF threads are interchangeable, male and female dryseal threads must be mated to obtain effective sealing.

Besides using pipe sealing compounds, pipe threads and connections can also be sealed by using fittings with pipe lock nuts. These fittings have a free nut with a Teflon seal ring. When positioned and tightened, the nut forms the seal and locks the fitting into position.

Pipe fittings are available in many different styles, both male and female. They are constructed of three types of material:

1. Brass in small sizes for low and medium pressures.

2. Cast iron in large sizes for low and medium pressures.

3. Steel, of varying sizes for hydraulic applications where high pressures are encountered.

Installation of Pipe Couplers

Here are some helpful hints to assist you in proper installation of pipe couplers:

1. When cutting pipe threads, use sharp standard pipe taps or dies, and a good cutting oil. This keeps leakage to a minimum.

2. Remove burrs from both the inside and outside of the pipe end.

3. Clean all foreign matter from pipes and fittings.

4. Use union connectors at various points to aid in later removals.

5. When using pipe sealing compound cover only two-thirds of the threaded male end. *Never apply pipe compound to female threads.* Make certain the pipe compound is compatible with the hydraulic fluid, and *never use shellac as a sealer.*

TUBE FITTINGS

Most tube fittings are joined to the tube by a union which allows the fitting to be tightened while the tube remains fixed. (A few tubes have fittings welded to the tubing.)

Many types of fittings are available, but the main difference is in the way they seal. The two basic types of seals are *flared* and *flareless* (Fig. 19).

Flared Fittings

Flared fittings are used with thin-walled tubing that is easily flared. Sealing is by metal-to-metal contact. The flared end of the tube is squeezed between the mating surfaces as the fitting is tightened firmly to another connection. The flare angle is either 37° or 45°. The 37° flare is the accepted standard for farm and industrial hydraulics, and is available only in steel. The 45° flare is widely used by the auto industry for low pressure circuits and is normally made of brass.

Flared Fittings come in several types (Fig. 19).

1. The standard THREE-PIECE FLARED fitting has a body, a sleeve, and a nut which fits over the tube. The free-floating sleeve allows clearance between the nut and the tube, aligns the fitting, and is a lock washer for the tightened assembly. Advantages are the locking action of the sleeve, plus the fact that the flared tube is not rotated and so worn during assembly.

2. TWO-PIECE FLARED fittings have no sleeve but use a tapered nut to align and seal the flared end of the tube. This fitting has some disadvantages: when tightened, it tends to bind on the flare which may cause unequal sealing. This same friction may twist the tubing somewhat.

3. INVERTED-FLARE fittings have a 45° flare on the inside of the fitting body. This type is used primarily in the auto industries.

4. SELF-FLARING fittings are designed with a wedge-type sleeve. When the nut is tightened, the wedge presses against the tube end and a female part of the fitting to form the flare. This fitting is strong and resists vibration with a minimum of tightening.

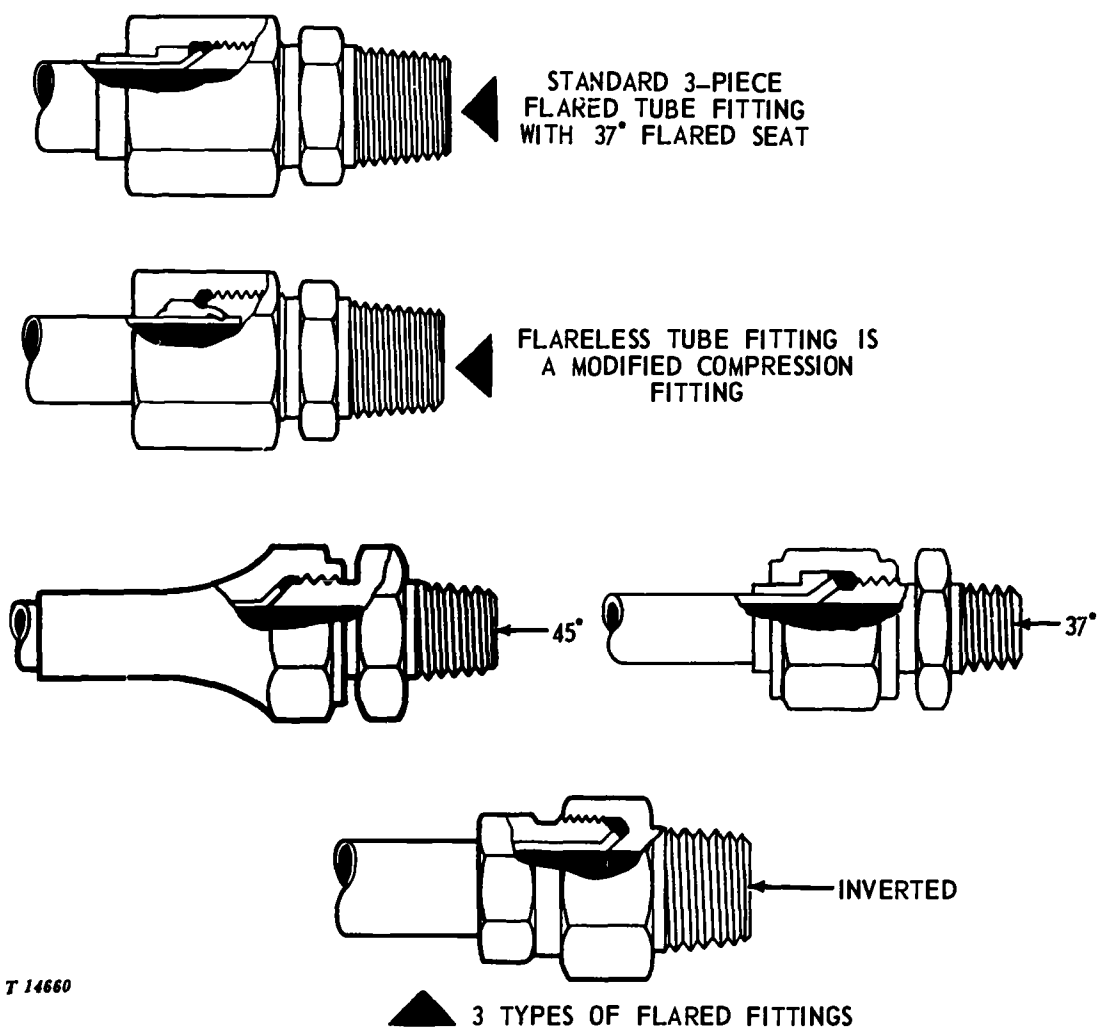


Fig. 19—Tube Fittings

Flareless Fittings

The advantage of flareless fitting is that they require no special tools to flare the tubing. They are not limited by tube size; and they are reusable. There are three basic types of flareless fittings:

1. FERRULE FITTINGS are most commonly used. They are composed of three components—body, nut and ferrule. The wedge-shaped ferrule is drawn down by tightening the nut, creating a perfect seal between the body and the ferrule. At the same time, the cutting edge of the ferrule cuts into the tube wall, creating another positive.

2. INVERTED FLARELESS fittings use the ferrule sealing method, but the seal only takes place in part of the boss. A male thread nut is used to tighten the ferrule into position. The advantage to this fitting is that it reduces by one the number of potential leak points.

3. COMPRESSION fittings are limited to use with thin-walled tubing. They crimp the end of the tube to seal. However, vibrations can work the nut loose in some applications.

Another type of compression fitting seals at both ends of the sleeve, crimping the tube twice between the fitting body and the nut. This type of fitting is restricted. Use with thin-walled tubing where there are no vibrations and pressure is iow.

4. O-RING fittings have the advantage of a replaceable sealing element. Also, the condition of the tube ends is not critical since they do not seal.

Tightening Tube Fittings

The most important rule for tightening tube fittings is: *Tighten only until snug. Do not overtighten.*

Where necessary, use two wrenches on the fittings to avoid twisting the lines.

If a fitting starts to leak and appears loose, *retighten only until the leak stops.*

More damage has been done to tube fittings by overtightening than from any other cause.

The chart on the next page shows how to tighten flare-type tube fittings.

HOW TO TIGHTEN FLARE-TYPE TUBE FITTINGS

Line Size (Outside Diameter)	Flare Nut Size (Across Flats)	Tightness (Ft-lbs)	Recommended Turns of Tightness (After Finger Tightening)	
			Original Assembly	Re-assembly
3/16"	7/16"	10	1/3 Turn	1/6 Turn
1/4"	9/16"	10	1/4 Turn	1/12 Turn
5/16"	5/8"	10-15	1/4 Turn	1/6 Turn
3/8"	11/16"	20	1/4 Turn	1/6 Turn
1/2"	7/8"	30-40	1/6 to 1/4 Turn	1/12 Turn
5/8"	1"	80-110	1/4 Turn	1/6 Turn
3/4"	1 1/4"	100-120	1/4 Turn	1/6 Turn

QUICK DISCONNECT COUPLERS

Quick disconnect couplers are used where oil lines must be connected or disconnected frequently. They are self-sealing devices and do the work of two shutoff valves and a tube coupler.

These couplers are fast and easy to use and keep oil loss at a minimum. More importantly, there is no need to drain or bleed the system every time a hookup is made. However, dust plugs must be inserted in the coupler ports when the oil lines are disconnected.

Quick couplers consist of two halves: the body contains a spring-loaded poppet or seal, while the other half is inserted to open the poppet when the two halves are connected. A locking device holds the two halves and seals them.

There are four basic types of quick couplers:

- **Double Poppet**
- **Sleeve and Poppet**
- **Sliding Seal**
- **Double Rotating Ball**

DOUBLE POPPET couplers (Fig. 20) have a self-sealing poppet in each coupler half. When closed, the poppets seal in oil. When connected, the poppets push each other off their seats to allow oil flow. When disconnected, the poppets close again by spring action before the two halves release their seal. The coupler halves are locked in place by a ring of balls which are held into a ring in the inserted coupler half by a spring-loaded outer sleeve.

SLEEVE AND POPPET couplers have a self-sealing poppet in one half and a tubular valve and sleeve in the other. The sleeve is inserted first and gives an added margin of sealing against oil loss or air entry.

SLIDING SEAL couplers have a sliding gate which covers the port in each coupler half while disconnected. This type of coupler spills more oil during hookup than the others.

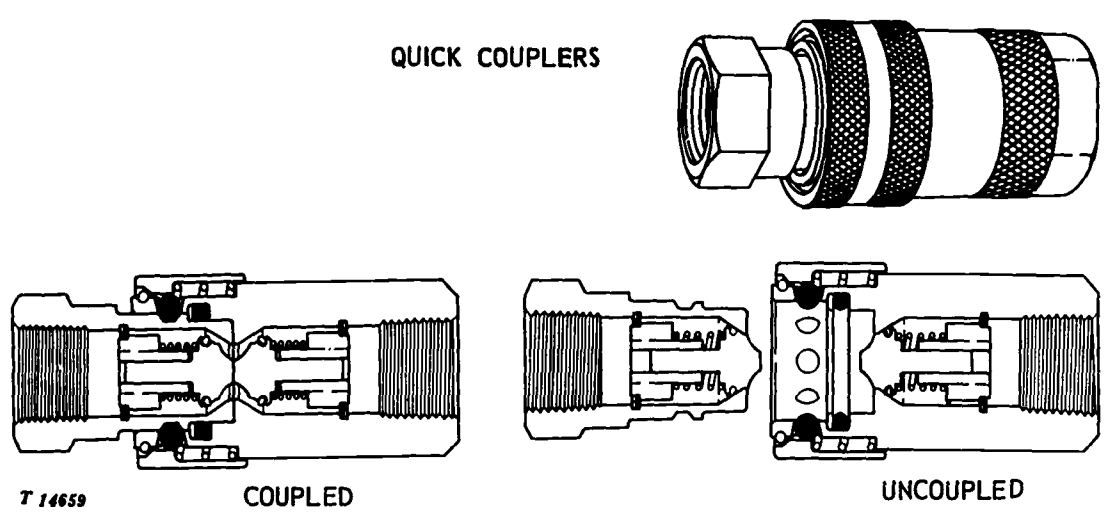


Fig. 20—Quick Disconnect Couplers

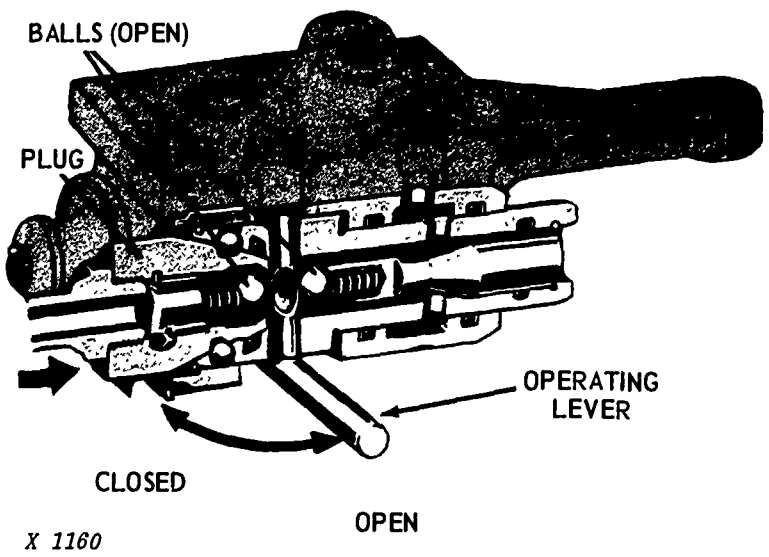


Fig. 21—Quick Disconnect Coupler of Double Rotating Ball Type

DOUBLE ROTATING BALL couplers (Fig. 21) are connected by inserting the line plug into the coupler body while rotating the lever to the position shown. The lever opens the valve balls in both the plug and body, allowing oil to flow. When the coupler is disconnected, pulling the line plug rotates the lever to close the valve balls without loss of oil.

The locking device for this coupler is the same as for the "double poppet" type. The halves are locked by a ring of small balls held into a groove on the inserted plug by an outer sleeve.

However, the coupler in Fig. 21 has an automatic lock release in case the lines are pulled loose. (This is useful when pulling implements such as a plow behind a tractor, for example. If the plow hits a stump or rock, the hitch releases. The disconnect coupler also releases the hose lines at the same moment without damage.)

TEST YOURSELF

QUESTIONS

1. The reservoir takes care of what vital functions besides storing oil?
2. What two mediums are used for cooling in most oil coolers?
3. What are the three basic parts of a flexible hose?
4. Name the six rules of things to "avoid" when installing hydraulic hoses.
5. (True or False) "Galvanized pipe is recommended for high-pressure hydraulic plumbing."
6. (True or False) "The best route for tubing between two points is not a straight line."

ANSWERS

1. It helps to keep oil clean and dissipates heat and air from the oil.
2. Air and water.
3. 1. Inner tube, 2. Reinforcement, 3. Outer cover.
4. 1. Avoid taut hose, 2. Avoid loops, 3. Avoid twisting, 4. Avoid rubbing, 5. Avoid heat, 6. Avoid sharp bends.
5. False. The zinc coating may flake or scale into the oil and damage precision hydraulic parts.
6. True. For ease of removal, tubing should have an angle or two. This also allows for expansion and contraction.

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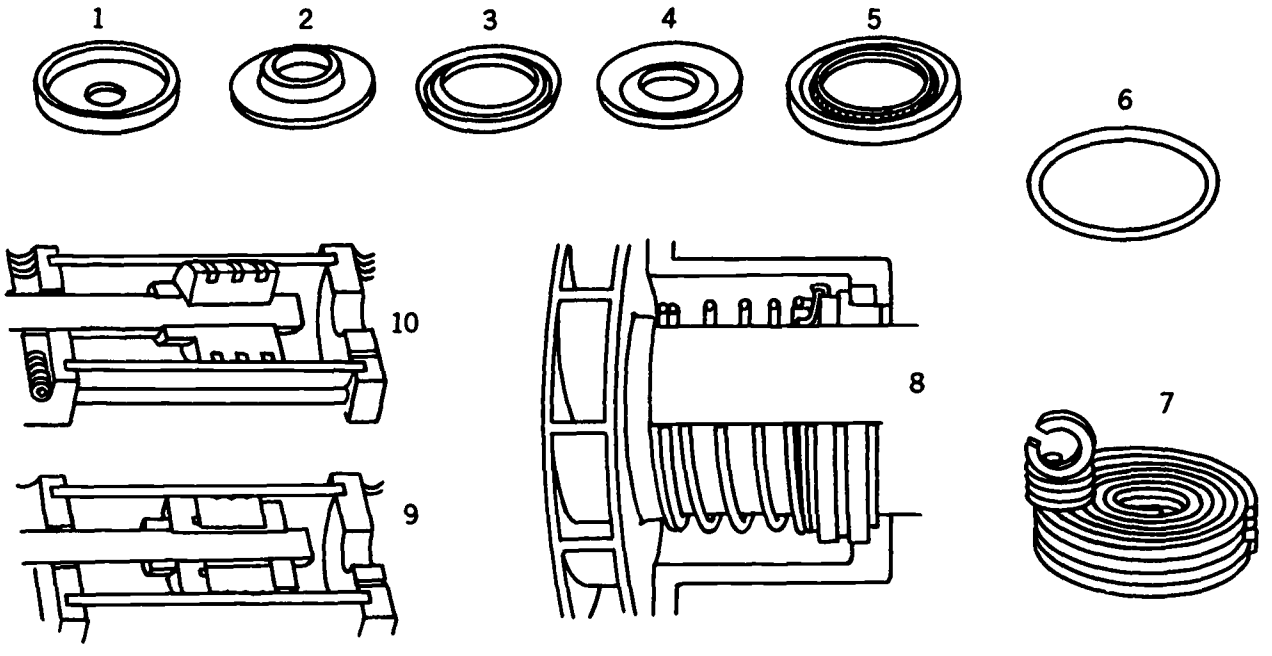
HYDRAULIC SEALS / CHAPTER 9



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1—Cup Packing
2—Flange Packing
3—U-Packing
4—V-Packing
5—Spring-Loaded Lip Seal
6—O-Ring
7—Compression Packing
8—Mechanical Seal
9—Non-Expanding Metallic Seal
10—Expanding Metallic Seal

Fig. 1—Types of Hydraulic Seals

INTRODUCTION

No hydraulic circuit can operate without the proper seals to hold the fluid under pressure in the system. Seals also keep dirt and grime out of the system.

Hydraulic seals appear to be simple objects when held in the hand. But in use they are complex, precision parts and must be treated carefully if they are to do their job properly.

THE USES OF SEALS

Hydraulic seals are used in two main applications:

- **Static Seals—to seal fixed parts**
- **Dynamic Seals—to seal moving parts**

Static seals usually are gaskets, but may also be O-rings or packings (Fig. 2).

Dynamic seals include shaft and rod seals and compression packings. A slight leakage in these seals is permissible for seal lubrication.

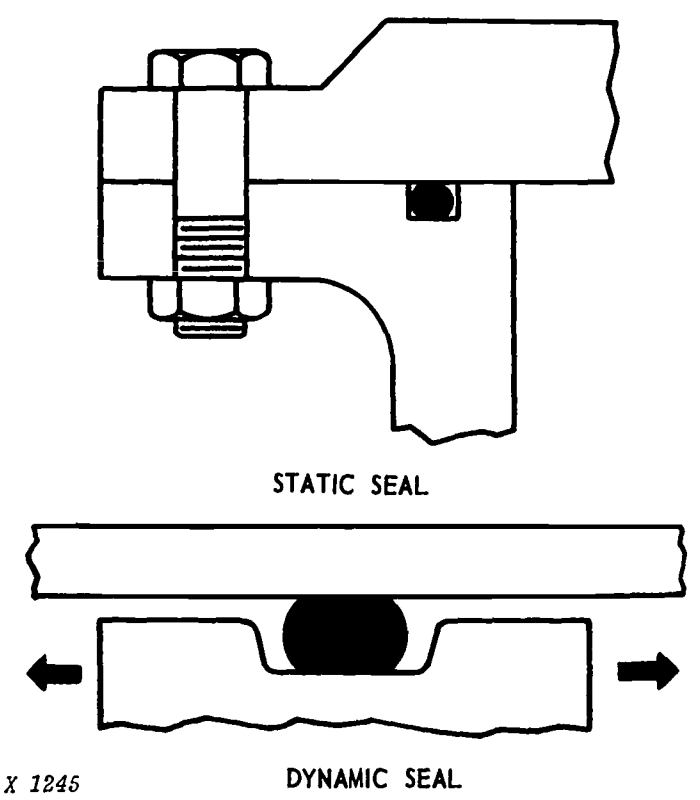

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Fig. 2—Uses of Hydraulic Seals

Later in this chapter we'll talk in more detail about the uses of seals and the problems with each one.

THE TYPES OF SEALS

Seals can be typed by their form or design (Fig. 1). Let's discuss each type of seal.

O-RINGS

The simple O-ring is the most popular seal in farm and industrial hydraulics. Usually made of synthetic rubber, it is used in both static and dynamic applications.

O-rings are designed for use in grooves where they are compressed (about ten percent) between two surfaces. In dynamic use, they must have a smooth surface to work against. O-rings are not used where they must cross openings or pass corners under pressure. Nor are they used on rotating shafts because of wear problems. In static use, under high pressure, they are often strengthened by a back-up ring to prevent them from squeezing out of their grooves. The back-up ring is usually of fiber or leather or synthetic plastic or rubber design.

U- AND V-PACKINGS

U- and V-packings are dynamic seals for pistons and rod ends of cylinders, and for pump shafts. They are made of leather, synthetic and natural rubber, plastics, and other material.

These packings are installed with the open side, or lip, toward the system pressure so that the pressure will push the lip against the mating surface to form a tight seal.

U- and V-packings are made up of several U- or V-shaped elements and are used in packing glands or cases which hold them in one piece. They are popular for sealing rotating shafts, pistons, and rod ends of cylinders.

SPRING-LOADED LIP SEALS

These seals are a refinement of the simple U- or V-packing. The rubber lip is ringed by a spring which gives the sealing lips tension against the mating surface. Usually the seal has a metal case which is pressed into a housing bore and remains fixed. This seal is often used to seal rotary shafts. The lip normally faces in toward the system oil. Double-lip seals are sometimes used to seal in fluids on both sides of an area.

CUP AND FLANGE PACKINGS

Cup and flange packings are dynamic seals and are made of leather, synthetic rubber, plastics, and other material. The surfaces are sealed by expansion of the lip or beveled edge of the packing. They are used to seal cylinder pistons and piston rods.

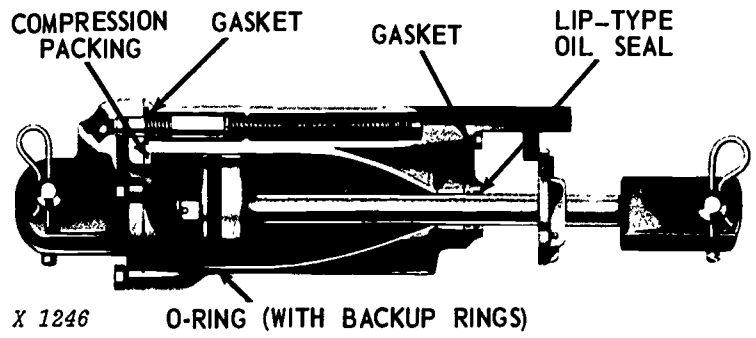

Fig. 3—Uses of Seals in a Hydraulic Cylinder

MECHANICAL SEALS

These seals are designed to eliminate some of the problems in using chevron packings for rotating shafts. They are dynamic seals, usually made of metal and rubber. Sometimes the rotating portion of the seal is made of carbon, backed up with steel.

The seal has a fixed outer part attached to the housing. An inner part is attached to the revolving shaft and a spring holds the two parts of the seal tightly together.

A rubber ring (flange-shaped) or a diaphragm is usually included to permit lateral flexibility, and to keep the rotating part of the seal in motion.

METALLIC SEALS

Metallic seals used on pistons and piston rods are very similar to the piston rings used in engines. They may be either expanding or non-expanding. Used as dynamic seals, they are usually made of steel.

Unless fitted very closely, non-expanding seals will leak excessively. Expanding seals (for use on pistons) and contracting seals (for use on piston rods) are subject to moderate friction and leakage losses.

Precision metallic seals, however, are not as subject to leakage, and are especially well-adapted for use in extremely high temperatures.

Since metallic seals are more subject to leakage than others, fluid wiper seals with external drains are often used.

COMPRESSION PACKINGS

Compression packings (jam packings) are used in dynamic applications. They are made of plastics, asbestos cloth, rubber-laminated cotton, or flexible metals.

Compression packings are often used in the same ways as U- and V-packings. They are designed as single coils or as endless rings from which sized pieces may be cut.

Compression packings are generally suitable only for low pressure uses. Lubrication is very important, as they will score moving parts if allowed to run dry.

COMPRESSION GASKETS

Gaskets are suitable, o course, only for static uses. Gaskets seal by molding into the imperfections of the mating surfaces. This molding depends upon a very tight seal at all points.

Gaskets are made of many materials, both metallic and non-metallic, and come in hundreds of shapes.

HOW SEALS ARE SELECTED FOR EACH USE

The designer of a hydraulic system has many factors to consider when choosing a seal. Some of these are:

1. *Will the seal resist all pressures expected?*
2. *Can the seal withstand the heat of operation?*
3. *Will the seal wear out too rapidly?*
4. *Will the seal be harmed by the hydraulic fluid?*
5. *Does the seal fit without dragging on the moving parts?*
6. *Will the seal score or scratch polished metal parts?*

Each application for a seal presents a different set of problems. This is why so many seals are on the market today. And why the right choice of a seal for replacement is so crucial. Always follow the manufacturer's recommendation listed in his parts catalog.

SEAL FAILURES AND REMEDIES

A top-notch hydraulic system which is very complex still depends upon the simple seal for good operation.

The perfect seal should prevent all leakage. But this is not always practical. In dynamic uses, for example, slight leakage as an oil film aids in lubrication of the moving parts. In practice, a seal is regarded as free of leaks if, after continued operation, any leakage is very hard to detect. In other words, there are no drips or pools of oil.

Of course, internal leakage is always hard to detect and this takes some testing to find out if and where the system is leaking.

To get the best use of seals, proper handling and replacement is vital. Most seals are fragile and can be easily damaged.

To prevent this, keep seals protected in their containers until ready for use. Store them in a cool, dry place free of dirt. Seals should be given the same care as precision bearings.

As a general rule, **replace all seals that are disturbed during repair of the system.** The price of a few seals is very cheap compared to a return repair job to correct leaks.

O-RING MAINTENANCE

O-rings can be easily damaged by cutting or nicks from sharp objects. They can also be damaged by heat, improper fluids, inadequate lubrication, and improper installation (Fig. 4).

Installation of O-Rings

1. Be sure the new O-ring is compatible with the hydraulic fluid. Otherwise, the O-ring may corrode, crack, or swell in operation.

2. Clean the entire area of all dirt and grit before installing O-rings.

3. Inspect O-ring grooves before installing rings. Remove any sharp edges, nicks, or burrs with a fine abrasive stone. Then reclean the area to remove any metal particles.

4. Inspect the shaft or spool (if used). Sharp edges or splines can cut O-rings. Remove any nicks or burrs with a *fine* abrasive stone. Then polish with a *fine* abrasive cloth. Reclean the area to remove any metal particles.

5. Lubricate the O-ring before installing it. Use the same fluid as used in the system. Also moisten the groove and shaft using the hydraulic fluid.

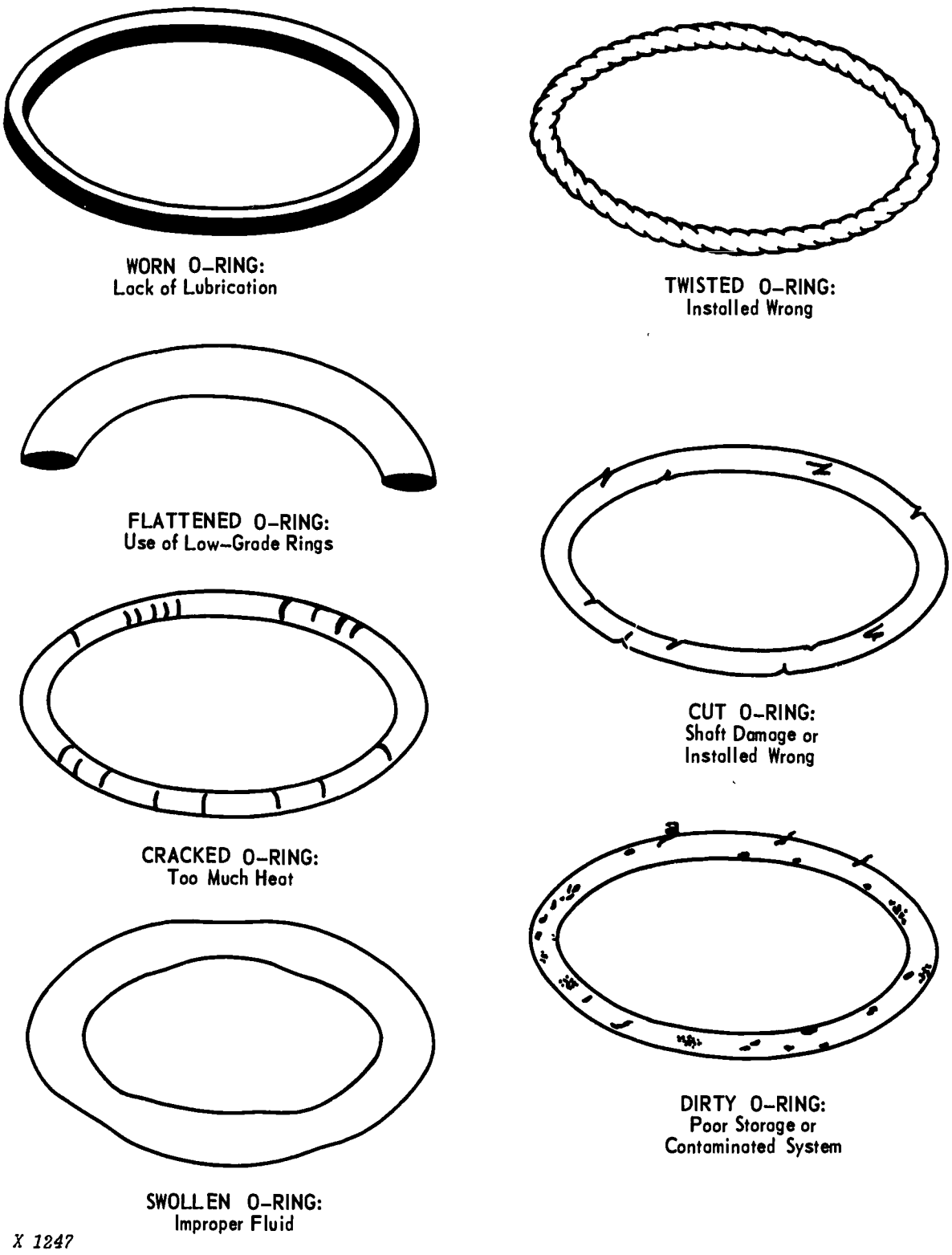

Fig. 4—O-Ring Failures

6. Install the O-ring, protecting it from sharp edges or openings. Be careful not to stretch it more than necessary.

7. Align the parts accurately before mating to avoid twisting or damage to the ring.

8. Check to see that the O-ring is of the correct size to give only a slight "squeeze" in the installed position (Figs. 5 and 6). In dynamic use (Fig. 6), the O-ring should roll in its groove.

IMPORTANT: When installing spool valves, be especially careful of any O-rings. The sharp edges of the spool lands can cut the O-rings unless you are very careful.

Checking O-Rings After Installation

Static O-rings which are used as gaskets should be tightened or torqued again after the unit has been warmed up and cycled several times.

Dynamic O-rings should be cycled (moved back and forth through their normal pattern of travel) several times to allow the ring to rotate and assume a neutral position.

All dynamic rings should pass a very small amount of fluid when rotating, which permits a lubricating film to pass between the ring and the shaft. This film prevents scuffing of the ring, which results in short life.

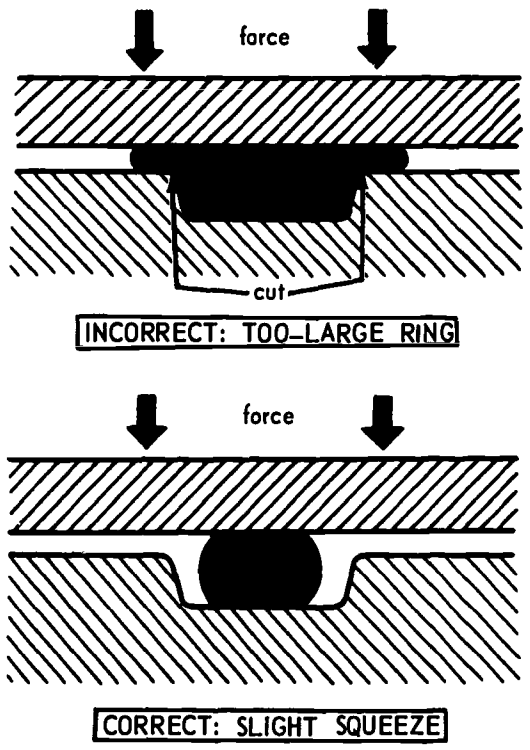

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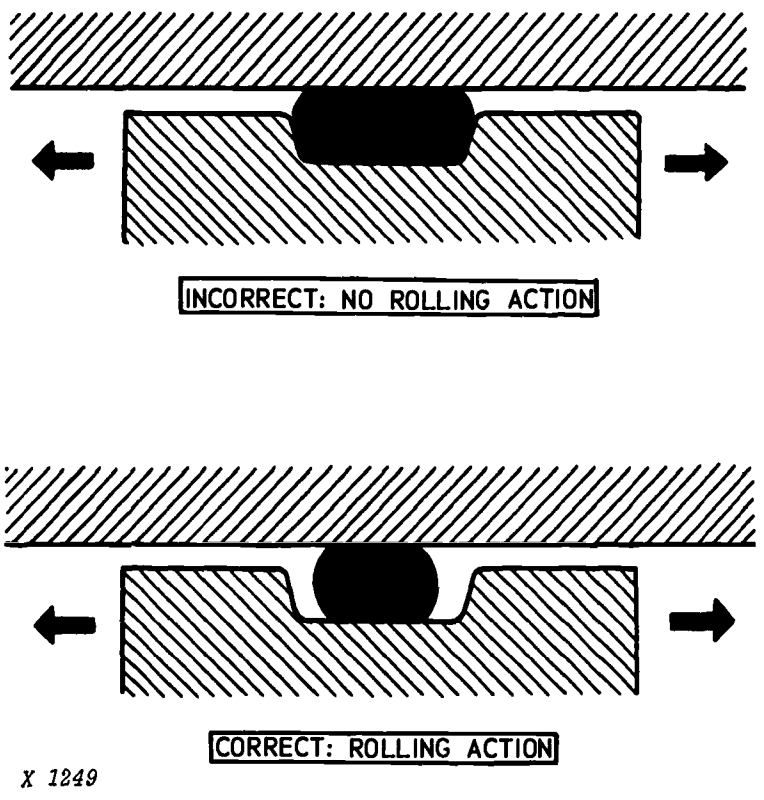
Fig. 5—O-Ring in Static Use



X 1249

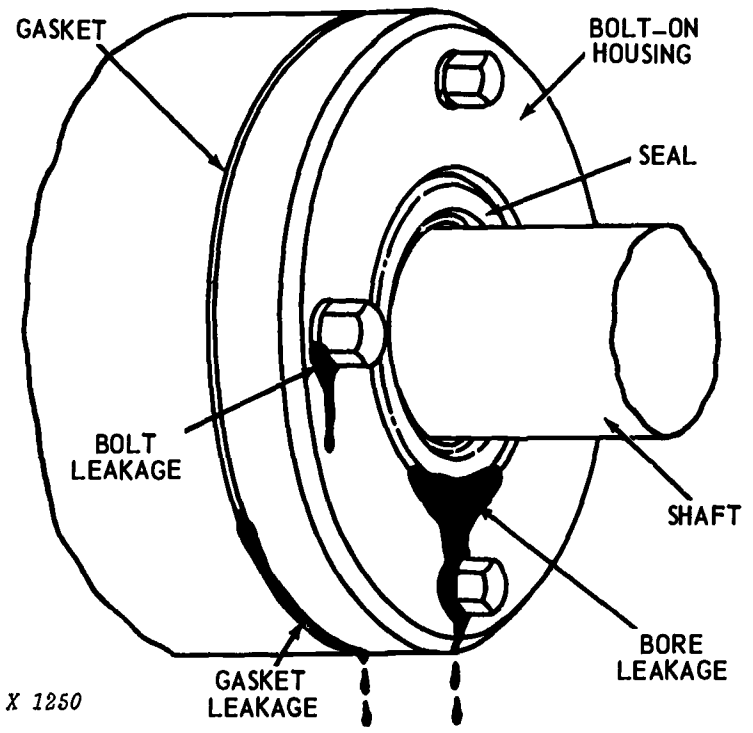
Fig 6—O-Ring in Dynamic Use

MAINTENANCE OF OTHER SEALS

Modern seals use rubber, leather, plastics, and other materials which require special handling. Some of the maintenance rules are given below.

Checking Seals for Leakage

Before disassembling a component, check out the causes of leakage. This may save a return job, caused by problems other than the oil seal.



X 1250

Fig. 7—Common Types of Oil Leaks

Before cleaning the area around the seal, find the path of leakage (Fig. 7). Sometimes the leakage may be from sources other than the seal. Leakage could be from worn gaskets, loose bolts, cracked housings, or loose line connections.

Inspect the outside sealing area of the seal to see if it is wet or dry. If wet, see whether the oil is running out or is merely a lubricating film.

Removing Seals

During removal, continue to check for causes of leakage.

Check both the inner and outer parts of the seal for wet oil which means leakage.

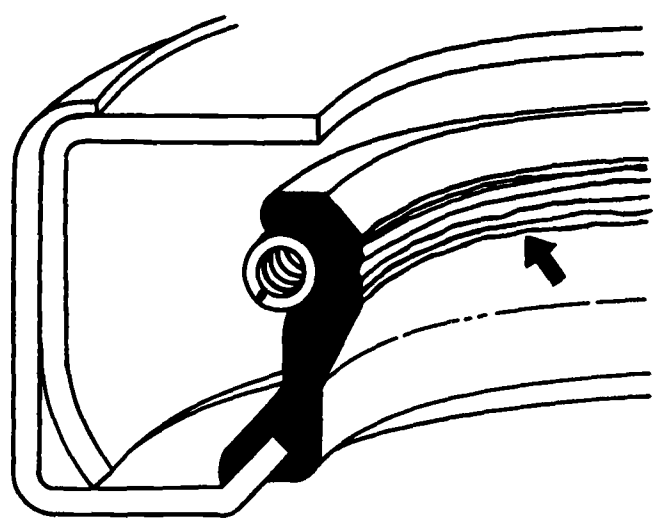


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Fig. 8—Seal Worn by Rough Shaft

When removing the seal, inspect the sealing surface or lips (Fig. 8) before washing. Look for

unusual wear, warping, cuts and gouges, or particles embedded in the seal.

On spring-loaded lip seals, be sure the spring is seated around the lip, and that the lip was not damaged when first installed.

Do not disassemble the unit any more than necessary to replace the faulty seals.

Checking Shafts and Bores

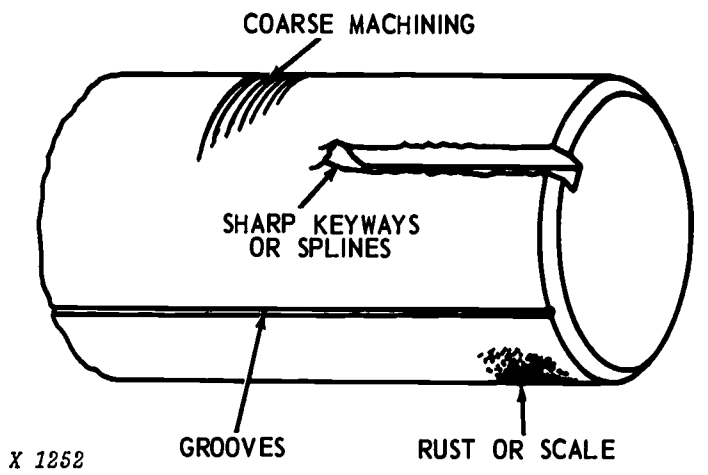


Fig 9—Shaft Conditions Which Can Damage Seals and Cause Leakage

Check shafts for roughness at seal contact areas (Fig. 9). Look for deep scratches or nicks that could have damaged the seal.

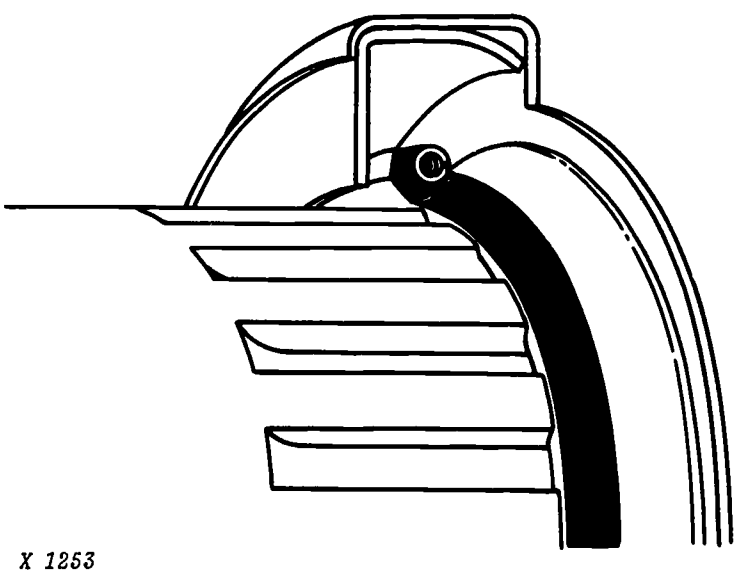


Fig. 10—Shaft Splines or Keyways Can Damage Seals During Installation

Find out if a shaft spline, keyway, or burred end could have caused a nick or cut in the seal lip during installation (Fig. 10).

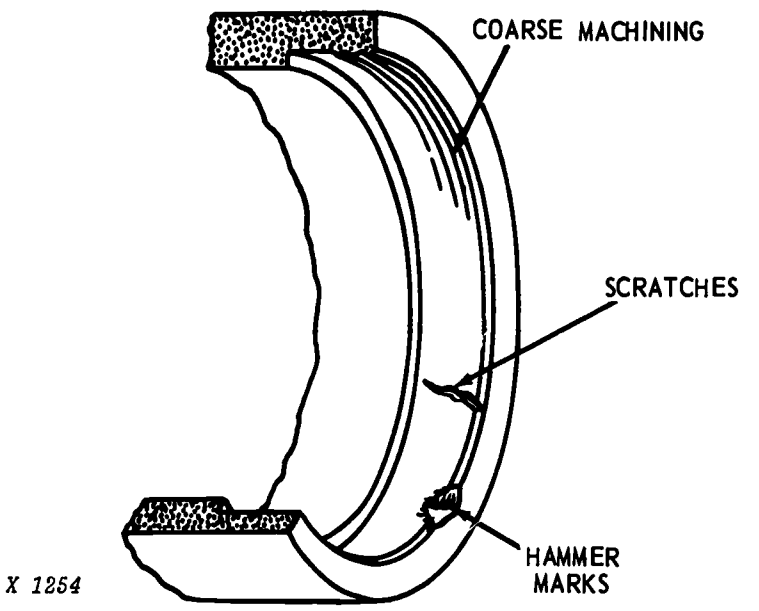


Fig. 11—Bore Conditions Which Can Damage Seals and Cause Leakage

Inspect the bore into which the seal is pressed (Fig. 11). Look for nicks and gouges that could create a path of oil leakage. A coarsely machined bore can allow oil to seep out by a spiral path. Sharp corners at the bore edges can score the metal case of the seal when it is pressed in. These scores can make a path for oil leakage.

Checking Seals for Compatibility with Fluids or Operating Temperatures

Some hydraulic oils are harmful to certain seals, especially rubber lips. An incorrect oil can either harden or soften the synthetic rubber in seals and so damage them.

If the seal lip is "spongy," this probably means that the seal and the hydraulic fluid are not compatible. If the seal is factory-approved, then an improper fluid has been used in the system (see Chapter 10).

Hardening of the seal lip can be caused by either heat or chemical reaction with an improper fluid.

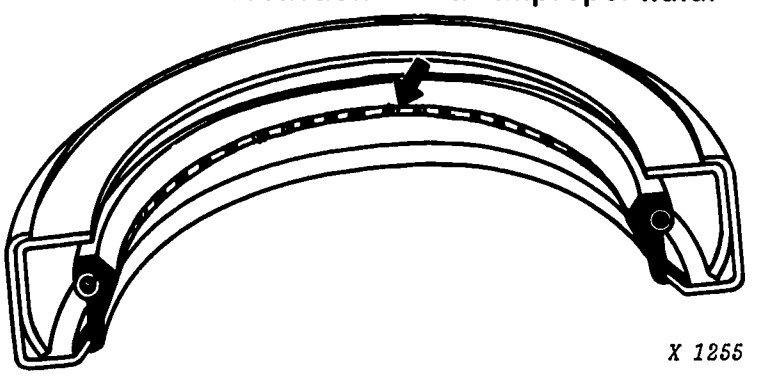


Fig. 12—Seal Lips Damaged by Heat

Hardening of the seal lip on the area of shaft contact (Fig. 12) is generally the result of heat from either the shaft or the fluid.

Installing Seals

1. Install only genuine seals recommended by the manufacturer of the machine.

2. Use only the proper fluids as stated in the machine operator's manual.

3. Keep the seals and fluids clean and free of dirt.

4. Before installing seals, clean the shaft or bore area. Inspect these areas for damage. File or stone away any burrs or bad nicks and polish with a fine emery cloth for a ground finish, then clean the area to remove metal particles. In dynamic applications, the sliding surface for the seal should have a mirror finish for best operation.

5. Lubricate the seal, especially any lips, to ease installation. Use the hydraulic fluid to lubricate the seal. Also soak packings in the hydraulic fluid before installing them.

6. With metal-cased seals, coat the seal's outside diameter with a *thin* film of gasket cement to prevent bore leakage.

NOTE: Pre-coated seals do not require cement on the bore fit.

7. Use a factory-recommended tool to install the seal properly. This is very important with pressed-in seals. If a seal driving tool is not available, 1) use a circular ring such as an old bearing race that contacts the seal case near the outer diameter, or 2) use a square wooden block. *Do not use sharp tools.*

8. Fit packings in snugly without using undue force. Be sure they are not too tight.

9. Use shim stock to protect seals when installing them over sharp edges such as shaft splines. Place rolled plastic shim stock (0.003–0.010 inch) over the sharp edge, then pull it out after the seal is in place.

10. Be sure the seal is driven in evenly to prevent "cocking" of the seal (Fig. 13). A cocked seal allows oil to leak out and dirt to enter as shown. *Be careful not to bend or "dish" the flat metal area of metal-cased seals. This causes the lips to be distorted.*

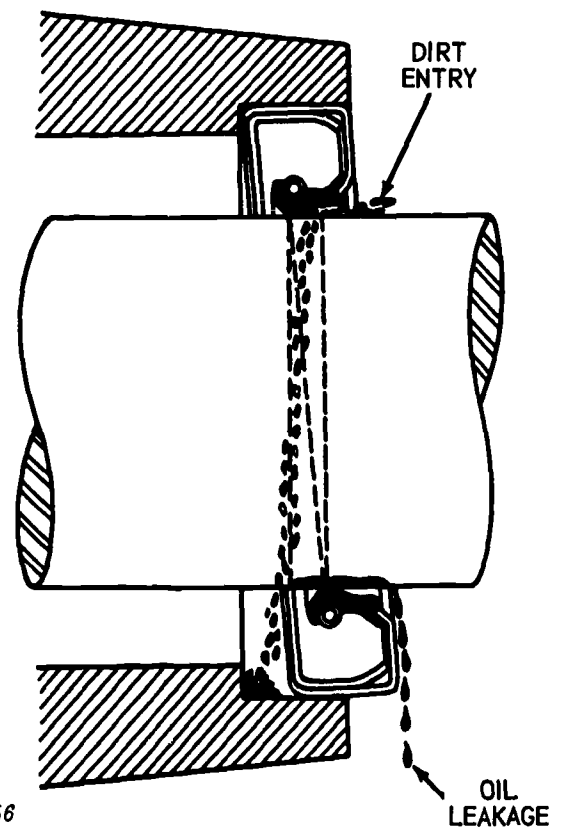


Fig. 13–Cocked Seals Allow Dirt to Enter and Oil to Leak Out

11. After assembly, always check the unit by hand for free operation if possible before starting up the system.

12. Try to prevent dirt and grit from falling on piston rods, etc. and being carried into the seal. This material can quickly damage the seal or score the metal surfaces.

Run-In Checking of New Lip-Type Seals

When a new lip-type seal is installed on a clean shaft, a break-in period of a few hours is required to seat the seal lip with the shaft surface. During this period, the seal polishes a pattern on the shaft and the shaft in turn seats the lip contact, wearing away the knife-sharp lip contact to a narrow band.

During this period, slight seepage may occur. After seating, the seal should perform without any measurable leakage.

TEST YOURSELF

QUESTIONS

1. (Fill in the blanks with "dynamic" or "static".) "_____ seals are used to seal fixed parts, while _____ seals are used to seal moving parts."

2. What is the most common seal used in farm and industrial hydraulic systems?

3. (True or false?) "Slight leakage is permissible in some dynamic seal applications."

4. (True or false?) "When repairing a component, replace only the seals that are damaged."

ANSWERS

1. First blank—"Static." Second blank—"dynamic."

2. O-ring.

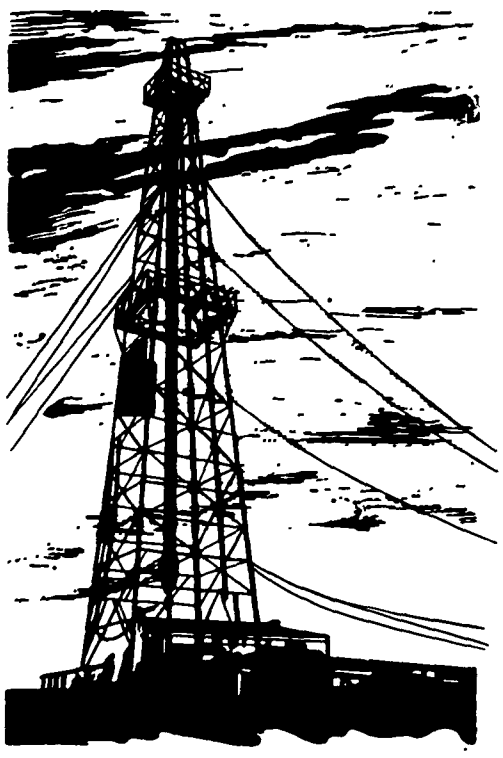
3. True. A small amount of leakage forms a film of oil which lubricates the moving parts. However, oil drips are not permissible.

4. False. All seals that are *disturbed* during a repair job should be replaced, whether they appear damaged or not.

HYDRAULIC FLUIDS / CHAPTER 10

INTRODUCTION

The hydraulic fluid is the medium by which power is transmitted from a pump to the mechanisms which produce work such as cylinders and hydraulic motors. The fluid is just as important as any other part of a hydraulic system. In fact, it has been estimated that 70 percent of hydraulic problems stem from the use of improper types of fluids, or fluids containing dirt and other contaminants.



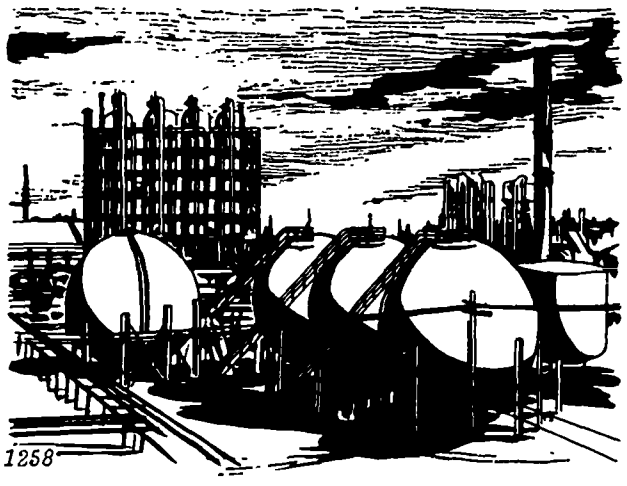


Fig. 1—Hydraulic Fluids are Highly Refined Petroleum Oils

When we speak of a hydraulic fluid, in almost all cases we really mean a highly refined petroleum oil (Fig. 1) usually containing additives, some to suppress unwanted properties and others to give the oil desirable properties.

Here it might be well to interject a word of caution. NEVER use hydraulic brake fluid in a hydraulic system designed to use petroleum-base oils. Brake fluid is **not** a petroleum product and is completely incompatible with petroleum-base hydraulic fluids.

During the development of hydraulic equipment, engineers make careful studies of the available fluids to find one best suited to enable their product to give efficient, trouble-free operation. Sometimes it is even necessary to develop a new fluid which has just the right properties. This is why it is always essential to use the fluid recommended in the instructions that accompany a hydraulic machine or mechanism.

WHAT A HYDRAULIC FLUID MUST DO

First of all, of course, a hydraulic fluid must be capable of transmitting the power applied to it. Of equal importance it must do several other things. It must provide lubrication for moving parts, be stable over a long period of time, protect machine parts from rust and corrosion, resist foaming and oxidation, and be capable of separating itself readily from air, water, and other contaminants. The fluid must also maintain proper viscosity through a wide temperature range, and finally, be readily available and reasonably economical to use.

PROPERTIES OF HYDRAULIC FLUIDS

VISCOSITY

For proper power transmission, this is a most important property. Viscosity is a measurement of a fluid's resistance to flow. Said another way, it is a fluid's "thickness" at a given temperature. Viscosity is expressed by SAE (Society of Automotive Engineers) numbers; 5W, 10W, 20W, 30, 40, etc. All petroleum oils tend to become thin as the temperature goes up, and to thicken as the temperature goes down. If viscosity is too low (fluid too thin), the possibility of leakage past seals and from joints is increased. This is particularly true in modern pumps, valves, and motors which depend on close fitting parts for creating and maintaining proper oil pressure. If viscosity is too high (fluid too thick), sluggish operation results and extra horsepower is required to push the fluid through the system. Viscosity also has a definite influence on a fluid's ability to lubricate moving parts.

Viscosity is determined by measuring the time required for 60 cubic centimeters of an oil at a temperature of 210°F. to flow through a small orifice in an instrument known as a Saybolt Viscometer or another instrument called a Kimematic Viscometer (Fig. 2). The actual SAE number is determined by comparing the time required for the oil to pass through the instruments with a chart provided by the Society of Automotive Engineers.

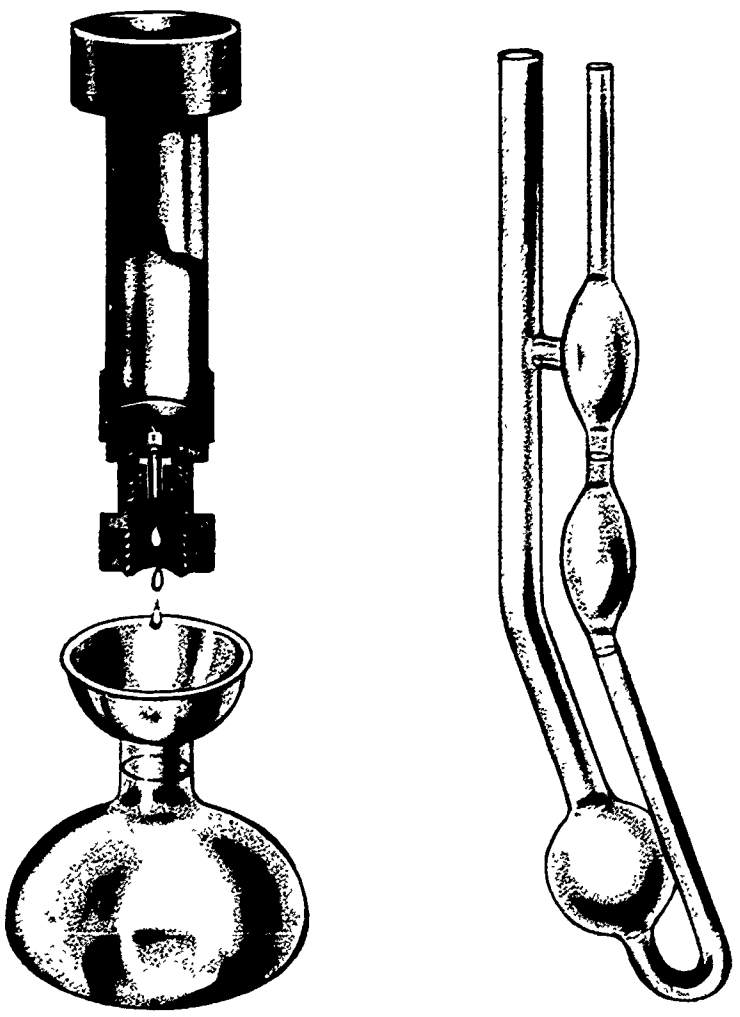
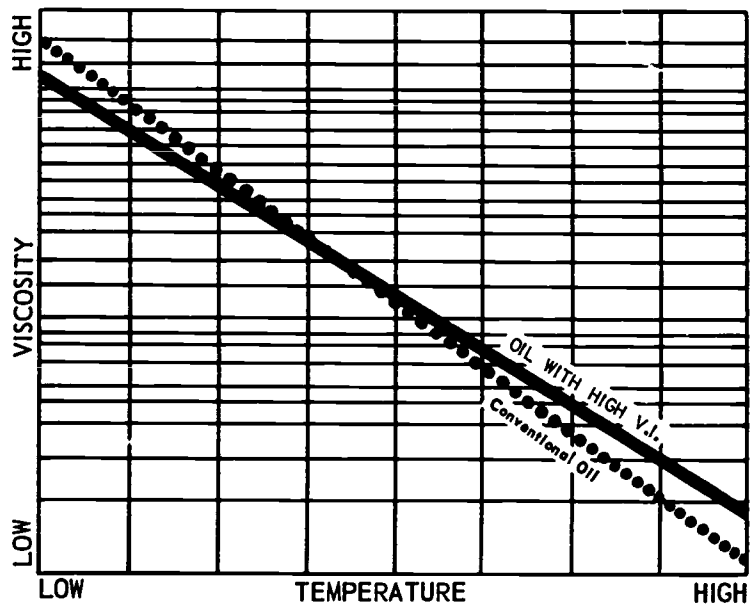


Fig. 2—Saybolt Viscometer (Left) and Kimematic Viscometer (Right)

Viscosity Index (VI)

This is simply a measure of a fluid's change in thickness with respect to changes in temperature. If a fluid becomes thick at low temperatures and very thin at high temperatures, it has a **low** VI. On the other hand if viscosity remains relatively the same at varying temperatures, the fluid has a **high** VI (Fig. 3). As pointed out earlier, in a fluid with good viscosity characteristics, there is a balance between a fluid thick enough to prevent leakage and provide good lubrication while, at the same time, being thin enough to flow readily through the system. Therefore, a fluid with a high VI is almost always desirable and must be an important consideration in hydraulic fluid recommendations.



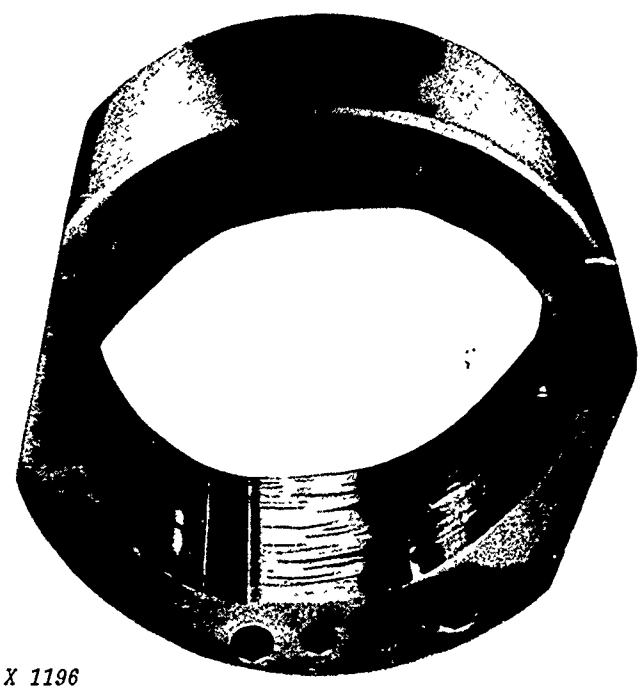
X 1260

Fig. 3—The Viscosity of an Oil with a High VI Contrasted with the Viscosity of a More Conventional Oil

Viscosity Index Improver

Even though carefully refined oils have a good viscosity index, a substance called a viscosity index improver is often added to hydraulic fluids. This substance increases the VI of the fluid so that its viscosity change over a wide range of temperatures is as little as practical.

WEAR PREVENTION



X 1196

Fig. 4—Vane Pump Ring Worn Due to Lack of Lubrication

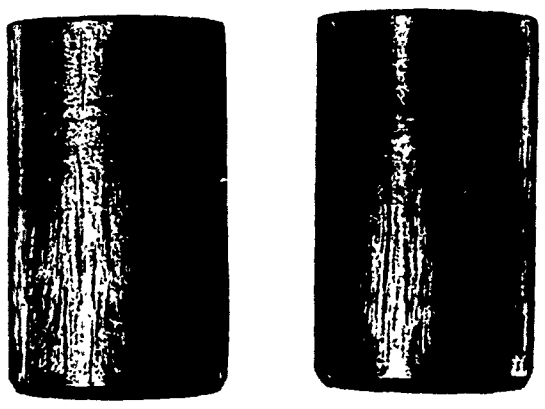
Most hydraulic components are fitted with great precision, yet they must be lubricated to prevent wear (Fig. 4). To provide this lubrication, a satisfactory fluid must have good "oiliness" to get in the tiny spaces available between moving parts and hold friction between the parts to a minimum.

A good fluid must also have the ability to "stick" to these closely fitted parts, even when they are quite warm.

Good lubricating qualities become even more important in many modern machines where the hydraulic fluid has a double purpose—to operate the hydraulic mechanisms, and also to lubricate the transmission, differential, and other parts of the machine.

The best hydraulic fluids contain an "extreme pressure" additive which assures good lubrication of very close fitting metal-to-metal parts operating at high pressures and temperatures. This additive reduces friction and helps to prevent galling, scoring, seizure, and wear.

RESISTANCE TO OXIDATION



X 1191

Fig. 5—Radial Pump Pistons Scored by Contaminated Fluid

Everyone is familiar with the effects of air on a piece of shiny iron, especially in the presence of water; it combines with oxygen in the air to form rust and other foreign materials. Its chemical properties are also changed. Just like the iron, all oils combine to some extent with the oxygen in the air. This changes the oil's chemical composition. Organic acids are formed which may be harmful to metal parts (Figs. 5 and 6) and many types of seals and packings in the system. In addition to the acids, sludges are often formed through the reactions between fluids and air. Both reactions are speeded up by the presence of water and other contaminants such as dust, dirt and metallic particles in the fluid. This is one reason why an efficient filtering system is so important in any hydraulic system. Heat is also a very important factor in

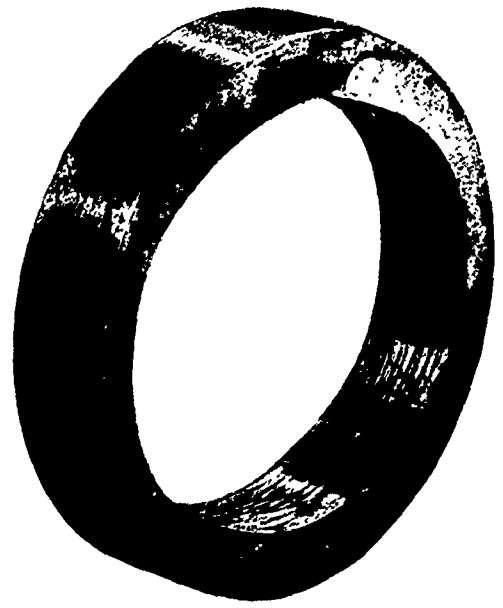


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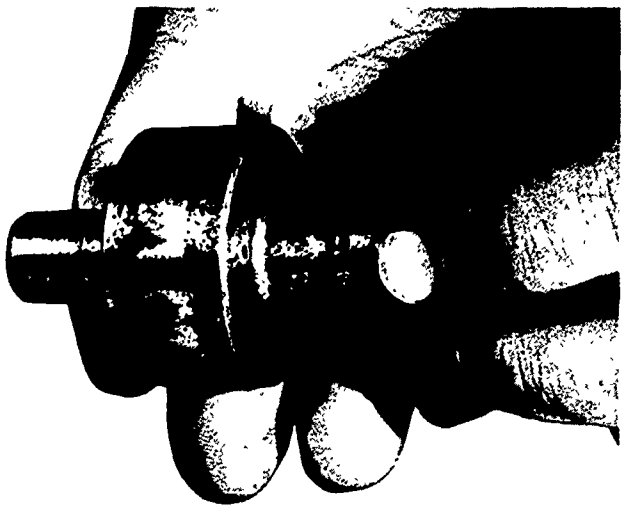
Fig. 6—Vane Pump Rotor Ring Worn and Pitted by Contaminated Fluid

oxidation. It has been determined, for instance, that for every 18°F. rise in temperature, the rate of oxidation doubles. Because of this, some hydraulic systems contain a cooler to hold temperatures to reasonable limits.

Fortunately, carefully refined fluids, plus the addition of a special chemical, successfully resist oxidation. With careful attention to prevent the entrance of dirt and other contaminants, most modern hydraulic fluids will operate for many hours without ill effects due to oxidation. However, oxidation can be a real problem unless high-quality hydraulic fluids, specifically recommended by the equipment manufacturer are used.

RUST AND CORROSION PREVENTION

Rust and corrosion are both related to oxidation, and a hydraulic fluid (providing it is kept clean) with good anti-oxidation qualities is likely to resist rust and corrosion. However, the possibilities of rust or corrosion developing are always present and they cannot be ignored. Rust and corrosion differ in that rusting adds to metal making the part larger while corrosion, caused by acids or local electrochemical cells, is an eating away of the metal. Either condition, of course, is highly detrimental to a hydraulic mechanism. Rust causes rough spots (Fig. 7) which damage seals and close fitting parts. It is most likely to form during storage periods, down-time, or even overnight. Corrosion affects the fit of closely machined parts and permits undesirable leakage. Both rust and corrosion cause erratic operation and untimely wear.



X 1194

Fig. 7—Pump Drive Cam Pitted by Rust

Good hydraulic fluids contain both rust and corrosion additives which neutralize corrosion-forming acids and cling to metal parts to protect them from rusting and corroding.

RESISTANCE TO FOAMING

The proper operation of any hydraulic system is based on the fact that fluids cannot be compressed by pressures normally encountered in the system. In effect the fluid acts like a "liquid" steel rod. Any force applied to it at one end is transmitted to the other end without any "slack" due to compression. However, air which **is** compressible can be absorbed by the fluid. In many systems the fluid reservoir is directly exposed to the atmosphere which promotes entrance of air into the fluid. In addition, air can enter the system through defective packings, leaky lines, or if the fluid level in the reservoir is allowed to get too low. In many systems turbulence promotes the mixing of fluid and air.

Good fluids have the capacity to "dissolve" a small amount of air. The amount of air that can be dissolved increases as pressure and temperature increase. This dissolved air has no harmful effects on operation. But if the amount of air which enters the fluid is greater than the fluid's capacity to dissolve it, bubbles form which, since air is compressible, result in mushy, unsatisfactory operation. Furthermore, some air in solution under pressure comes out of solution when pressure is released. This air creates foam which seriously affects proper action, and especially, lubrication.

While most well refined oils are not subject to excessive foaming, most good hydraulic fluids contain a foam inhibitor additive which speeds up the rate at which bubbles break up. This improves the fluid's ability to do its work properly, and to increase its capacity for adequately lubricating moving parts.

ABILITY TO SEPARATE FROM WATER

Contrary to popular opinion, oil and water **will** mix. This mixture is called an "emulsification." It is almost impossible to keep all water out of a hydraulic system. Water vapor enters the reservoir where it condenses into droplets. It also may enter through tiny leaks in the system. Because of the violent agitation, churning, and continual recirculation in a typical hydraulic system, the water and fluid quickly mix to form an emulsion. Any appreciable amount of water in the fluid is highly detrimental. The emulsion promotes rust (Fig. 8), increases oxidation which forms acids and sludges, and reduces the fluid's ability to lubricate moving parts properly. Also, emulsions often have a slimy, sticky, or pasty consistency which interferes with normal operation of valves and other parts.

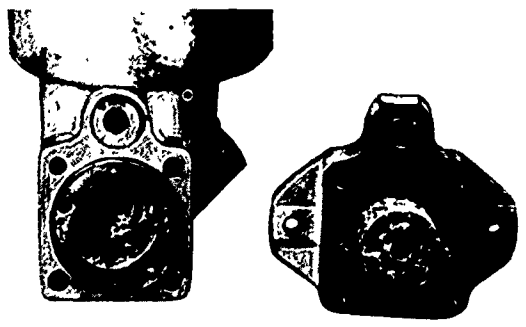


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Fig. 8—Balanced Vane Pump Rusted by Water in Fluid

LACK OF OTHER CONTAMINANTS

It should go without saying that a good hydraulic fluid should be as free as possible of contaminants such as metallic particles, dust, dirt and the like. Such materials are not only likely to damage closely fitted parts, but they also seem to help the undesirable oxidation process to take place.

Use of reliable fluids, careful storage, good filters, proper handling of fluids, and periodic cleaning of hydraulic systems all materially reduce the danger of contamination.

MAINTAINING GOOD FLUID

As has been said many times, dirt and contamination are the worst enemies of any hydraulic system. Continued, long operation at high efficiency is very dependent upon proper fluid maintenance. First of all, **only** a fluid recommended by the

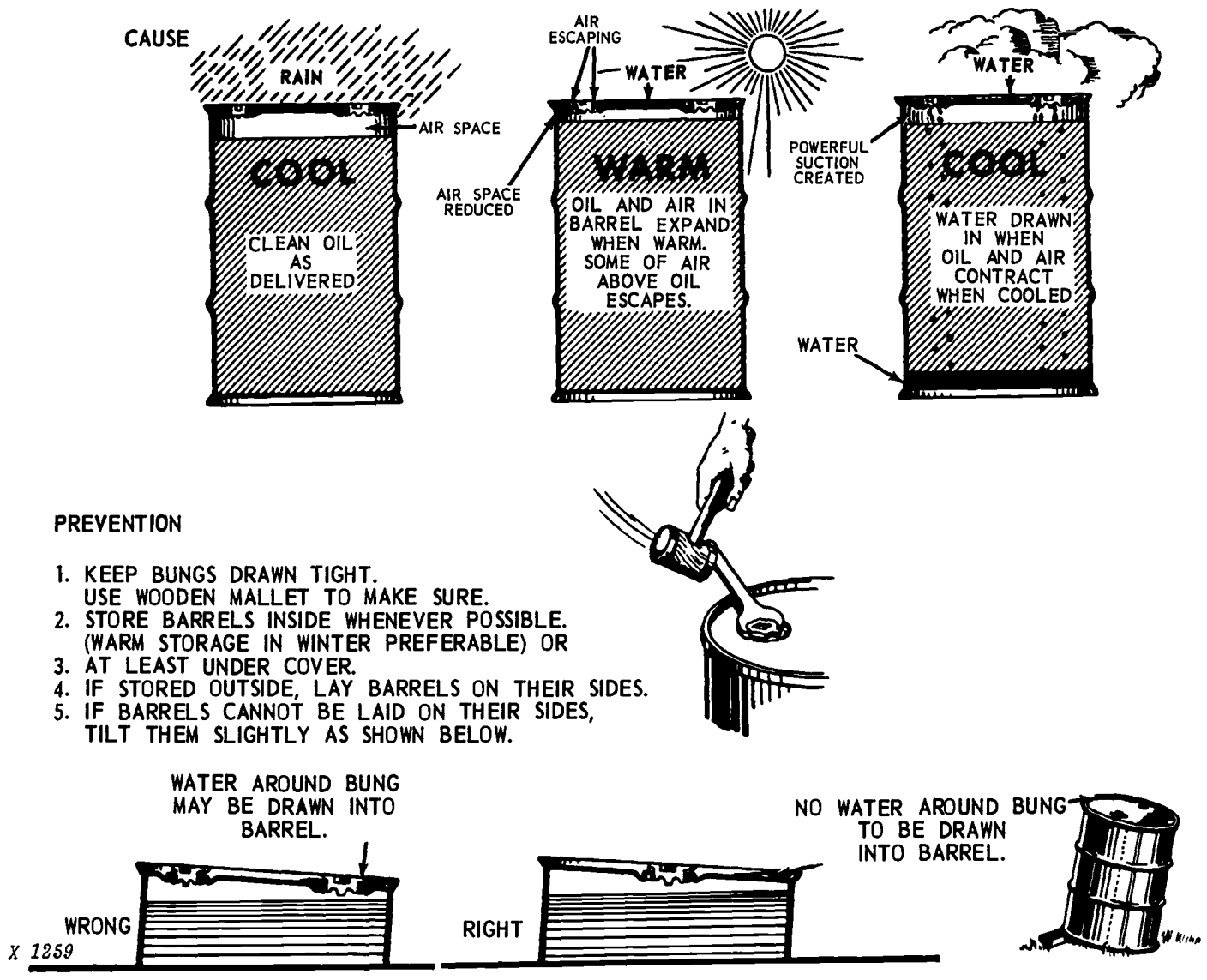

Fig. 9—Oil Contamination Can Be Prevented By Careful Storage Practices

manufacturer of the system should be used; it should be checked at the suggested intervals maintained at the correct level, properly filtered, and changed at the recommended intervals.

DRAIN SCHEDULE

Periodic drainage of the entire system is very important. This is the only way to remove contaminants, products of oxidation such as sludge and acids, and other particles that may be injurious to the system. Actually, in modern hydraulic systems using approved fluids, the drain period is not frequent and it should work no hardship on the part of the owner to follow the manufacturer's directions. Many modern fluids are so highly refined, filtered, and fortified by additives that system flushing is not necessary. However if flushing is recommended by the manufacturer, it is always advisable to follow directions so as not to contaminate the new oil with flushing oil that cannot be drained from the system.

See Chapter 11 for details on draining, cleaning, and flushing systems.

KEEPING HYDRAULIC FLUIDS CLEAN

All good hydraulic fluids, which come in cans or barrels, are delivered perfectly clean and free from contaminants. It is when the containers are opened or stored that troubles develop.

When opening a can or barrel, be absolutely certain that the area around the opening is completely free of dust, dirt, lint, or water. If a container, funnel, or hose is required to fill the system, be sure that it is spotless.

When possible, always store barrels of hydraulic fluid indoors, or at least under cover, and be sure the bung is tight. If barrels are stored in the sun without a tight bung, the fluid will expand, forcing some air from the bung. Then as the fluid cools off, the fluid contracts, drawing any rain, dew, or other moisture into the barrel and fluid. The detrimental effects of water in hydraulic fluids have already been discussed. For this reason, keep the bungs in barrels as tight as possible, and tip the barrels in such a manner that water cannot collect around the bung (Fig. 9).

TEST YOURSELF

QUESTIONS

1. What are good hydraulic fluids composed of?
2. At higher temperature do oils become thicker or thinner?
3. Is a high-viscosity oil thicker or thinner than a low-viscosity oil?
4. What happens when a hydraulic fluid oxidizes?

ANSWERS

1. Highly refined petroleum oil plus additives.
2. Thinner.
3. Thicker.
4. Harmful contaminants develop.

GENERAL MAINTENANCE / CHAPTER 11

INTRODUCTION

A hydraulic system is fairly easy to maintain: the fluid provides a lubricant and protects against overload. But like any other mechanism, it must be operated properly. You can damage a hydraulic system by too much speed, too much heat, too much pressure, or too much contamination.

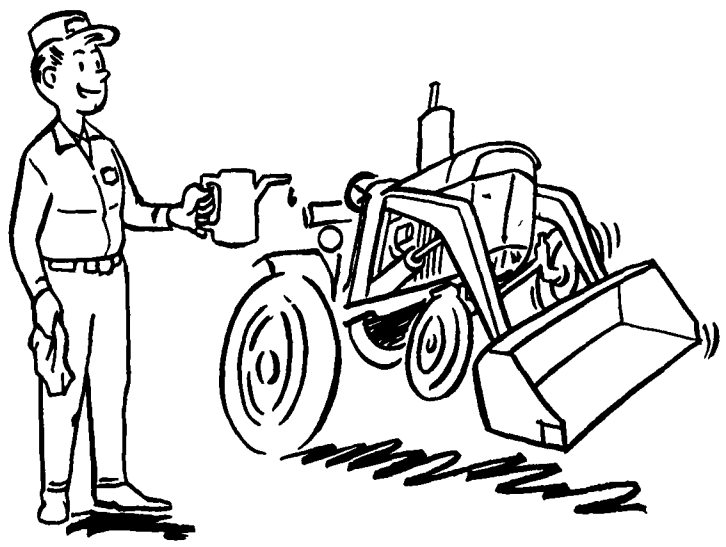

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Fig. 1—The Machine Will Respond to Good Maintenance

Proper maintenance will reduce your hydraulic troubles. By caring for the system using a regular maintenance program, you can eliminate common problems and anticipate special ones. These problems can then be corrected before a breakdown occurs.

Other chapters in this manual tell you how to diagnose failures and remedy them. This chapter will explain how to keep the system going while it is in operation.

Here are the key maintenance problems:

1. *Not enough oil in the reservoir.*
2. *Clogged or dirty oil filters.*
3. *Loose intake lines.*
4. *Incorrect oil in the system.*

All of these problems can be solved or prevented by knowing the system and maintaining it properly.

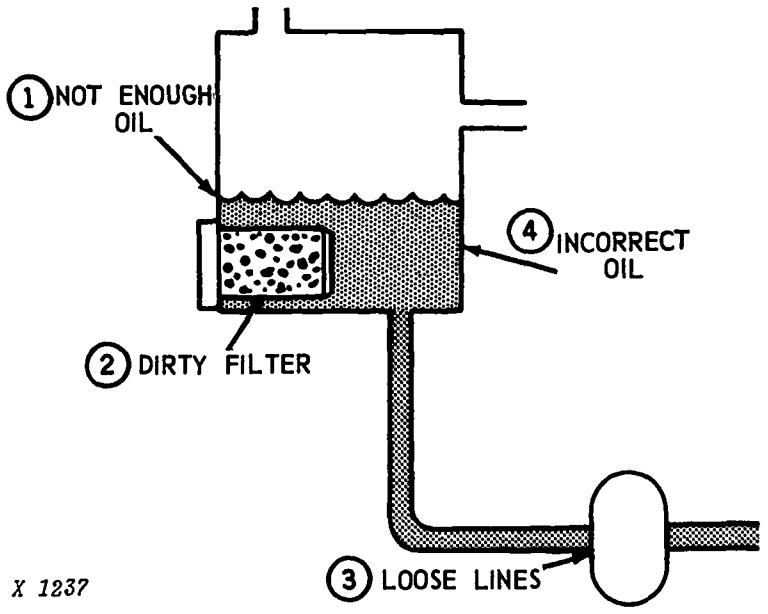

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Fig. 2—The Key Maintenance Problems

Let's discuss some of the practices which will keep the hydraulic system in top-notch condition.

MAINTENANCE OF THE WHOLE SYSTEM

This section covers the general maintenance which keeps the whole system at peak performance.

THE IMPORTANCE OF CLEANLINESS

Cleanliness is No. 1 when it comes to servicing hydraulic systems. KEEP DIRT AND OTHER CONTAMINANTS OUT OF THE SYSTEM! Small particles can score valves, seize pumps, clog orifices and so cause expensive repair jobs.

How do you keep the hydraulic system clean? Let's put it this way:

- **Keep the oil clean**
- **Keep the system clean**
- **Keep your work area clean**
- **Be careful when you change or add oil**

In detail, here's how these steps work.

KEEP THE OIL CLEAN

Fig. 3—Keep the Oil Clean

Strive to keep oil clean from the minute it is delivered to you. Choose a clean location for storing the oil. When the oil is taken out of storage, use only clean containers with lids for carrying oil from storage to point of use. Use a clean funnel fitted with a fine-mesh screen when pouring oil from the container into the reservoir.

Keep an adequate supply of clean strainers, funnels, and oil containers. Store them in a clean, dust-free cabinet. Use a clean, lint-free cloth to wipe the dipstick when checking the oil level.

Caution machine operators to do everything possible to keep dirt from getting into the oil during operation of the machine.

KEEP THE SYSTEM CLEAN

Change the hydraulic oil and oil filters regularly (Fig. 4). Wipe away dirt and grease before removing filler caps or dipsticks. Steam clean or use solvents to clean the machine areas before removing hydraulic components.

NOTE: When steam cleaning or using water to clean a machine, be sure that filler openings, breather caps, etc. are protected from possible entry of water into the system.

Use clean plastic plugs to cover ends of disconnected lines, or to plug openings when working on a hydraulic system.

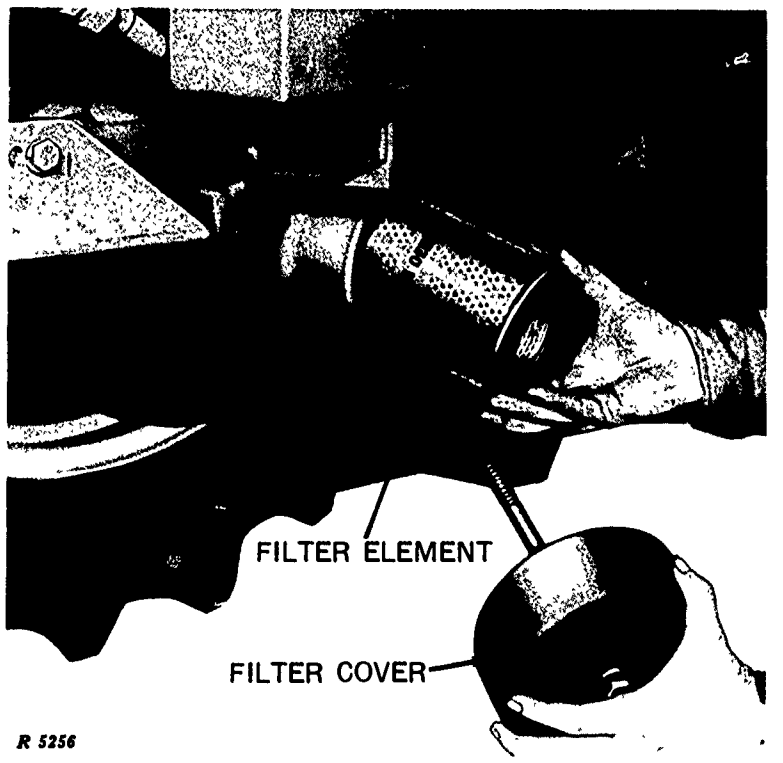


Fig. 4—Changing Hydraulic Oil Filter Element

When removing parts for service, clean them with a suitable solvent, and store them in plastic bags or other clean containers until they are installed again.

When cleaning hydraulic parts, use extreme care to prevent harm to closely fitted, finely finished parts. Use gum solvents or chemical cleaners to clean **metal** parts only. Do not allow these cleaners and solvents to come in contact with seals or gaskets.

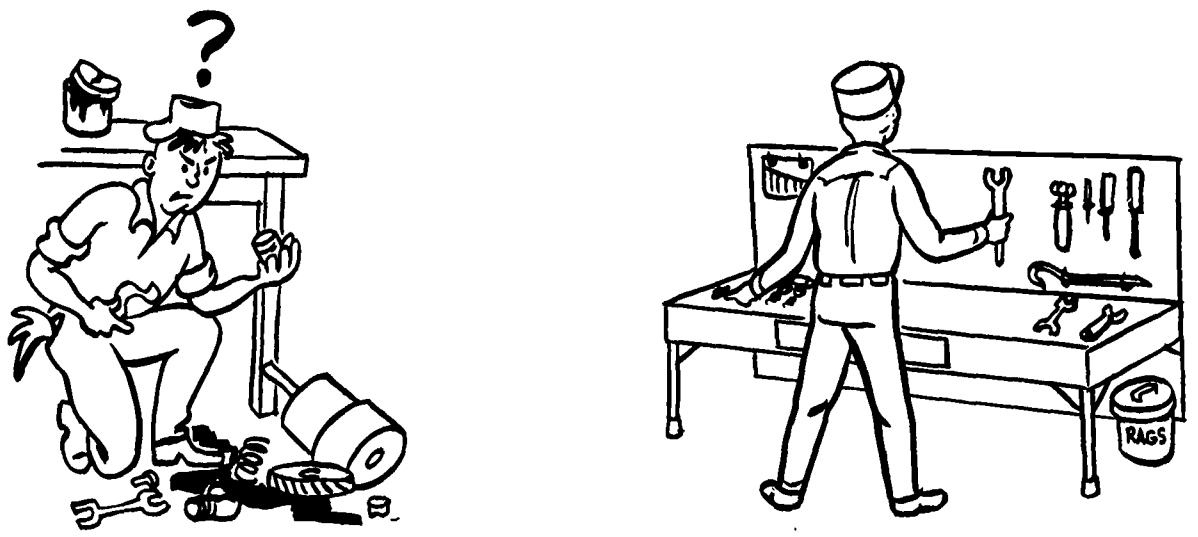
Thoroughly rinse the cleaned parts and dry them using compressed air. Protect the parts immediately with a coating of rust preventive oil.

KEEP YOUR WORK AREA CLEAN

A clean work bench is an absolute must when servicing hydraulic components (Fig. 5).

An industrial-type vacuum cleaner is a valuable aid in removing dust, dirt, and tiny metal particles from the work area.

Check the condition of the tools you use—they should be clean. Always use hammers made of plastic, leather, or brass so there is no danger of metal chips getting into components.



THIS... ...OR THIS?

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Fig. 5—Keep Your Work Area Clean

BE CAREFUL WHEN YOU CHANGE OR ADD OIL

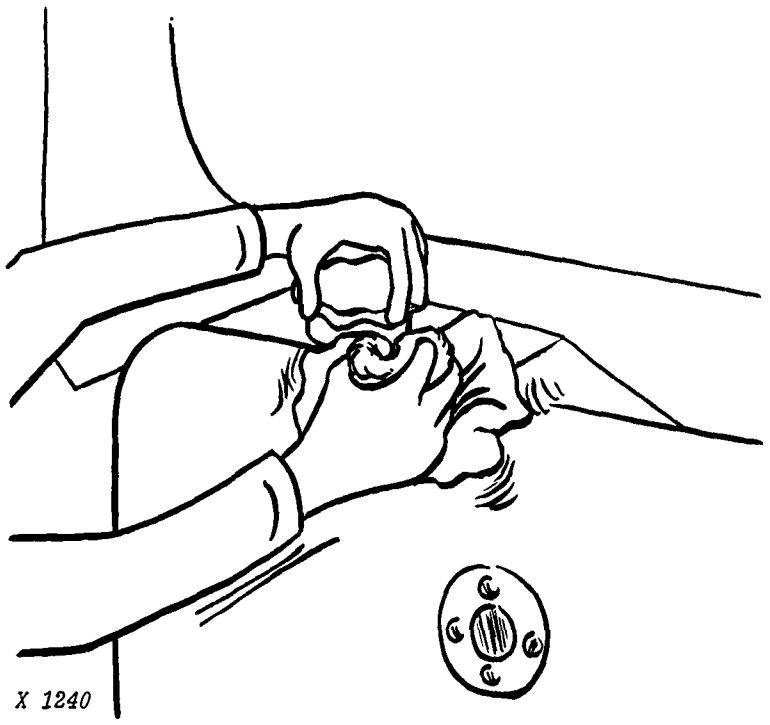

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Fig. 6—Don't Add Dirt to the System—Just Oil

When checking oil level or adding oil to the system, be sure to clean the areas around the dipstick and filler cap before removing them (Fig. 6).

Before adding oil be sure the oil still in the system is clean. If not, drain the oil and refill the system completely with new oil that will give good performance under existing conditions.

However, if the drained oil has sludge, sediment, or gum and lacquer formations, the system should be cleaned and flushed before refilling.

(Details on cleaning and flushing are given later in this chapter.)

IMPORTANCE OF OIL AND FILTER CHANGES

You can't get peak performance out of a hydraulic system that isn't clean.

Despite all the precautions you take when working with the hydraulic system, some contaminants will get into the system anyway. Good hydraulic oils will hold these contaminants in suspension and the filters will collect them as the oil passes through. A good hydraulic oil contains many additives (see Chapter 10) which work to keep contaminants from damaging or plugging the system. However, these additives lose their effectiveness after a period of time.

Therefore, change the oil at the recommended intervals to make sure the additives will do their job.

The system filters can absorb only a limited amount of dirt particles and other contaminants from the oil. After that the filters stop working.

At this point, clean the filters or replace them with new ones so the cleaning process can be maintained.

DRAINING THE SYSTEM

Periodic draining of the entire hydraulic system is very important. This is the only positive way to completely remove contaminants, oxidized fluid, and other injurious substances from the system.

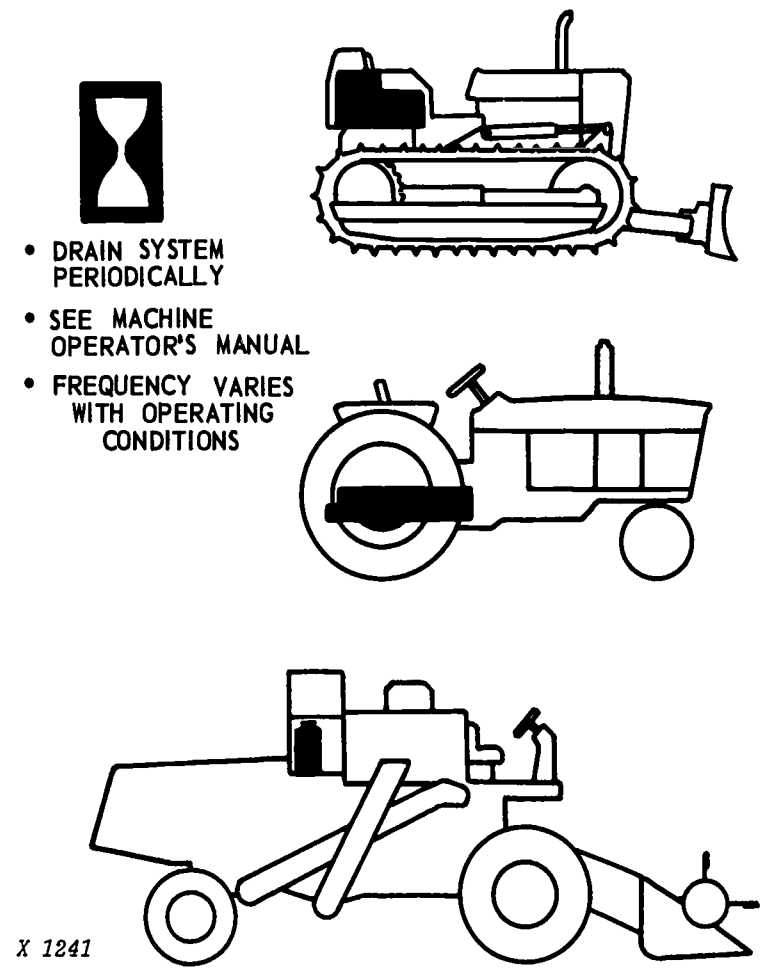

Fig. 7—Drain the System Regularly

The frequency of draining depends on such things as the temperature of operation and the severity of working conditions. The drain schedule recommended by the manufacturer of the equipment should be maintained. The machine operator's manual will tell the method to be used, and the frequency, depending on conditions.

CLEANING AND FLUSHING THE SYSTEM

The nature and amount of deposits in a particular system may vary widely. Inspection may show any condition between a sticky, oily film and a hard, solid deposit (gum or lacquer formation) which completely chokes small oil passages.

If the system is drained frequently enough, the formation of gum and lacquer will be reduced.

When no gum or lacquer formation is suspected, clean the system as follows: After draining the system, clean any sediment from the reservoir, and clean or replace the filter elements.

It may be advisable to flush out the old oil remaining in the system after draining, particularly if the oil is badly contaminated. For this flushing, use the hydraulic fluid recommended for the system involved.

Operate the equipment to cycle the flushing oil through the system. It is important that the valves be manipulated so that the new oil goes through all lines. The time necessary to clean the system will vary, depending on the condition of the system. Run the oil through the system until inspection shows the equipment to be in satisfactory condition, or until it is obvious that the system will have to be disassembled and cleaned manually. Usually from 4 to 48 hours is sufficient for most systems.

Drain out the flushing oil and refill the system with clean hydraulic oil of the recommended type. Be sure to clean or replace the system filters before refilling the system.

NOTE: Most solvents and chemical cleaners on the market today are NOT recommended for use in flushing hydraulic systems: 1) They are poor lubricants, resulting in damage to moving parts, especially the pump. 2) They are difficult to remove completely from the system. Just a trace of some of the commercial chlorinated solvents may be enough to break down the oxidation resistance of even the best hydraulic oils. Also, in the presence of a small amount of water, some of these solvents will corrode steel and copper.

If gums or lacquers have formed on working parts, and the parts are "sticking," remove the affected parts and clean them thoroughly. Do the same if solid particles such as packing material or metal particles have gotten into the system as a result of wear or damage to the components.

CAUTION: Before disconnecting parts of the system, relieve all hydraulic pressure by cycling the control levers. Also discharge the accumulator, if used (see Chapter 6).

When cleaning the disassembled parts, be extremely careful to prevent harm to the closely fitted, finely finished parts. Use of gum solvent or other non-corrosive chemical cleaner is permissible on metal parts ONLY. **Do not allow these materials to come in contact with seals and packings.**

Rinse each cleaned part thoroughly, blow dry with compressed air, and then coat it immediately with a hydraulic oil containing a rust inhibitor. Normally, use the same oil as in the system for this purpose. Freshly cleaned metal surfaces may rust quickly, so be sure they are protected from rust.

After all parts have been cleaned, reassemble the system. Use care to see that no dirt, lint, pipe-thread compound, etc., gets into the system.

As a final step, flush out the system as described above.

FILLING THE SYSTEM

Before filling the system, be sure the area around the filler cap is clean. Fill the reservoir to the specified level with the recommended hydraulic oil. Use only clean oil and funnels or containers. Then be sure to replace the filler cap before operating the equipment.

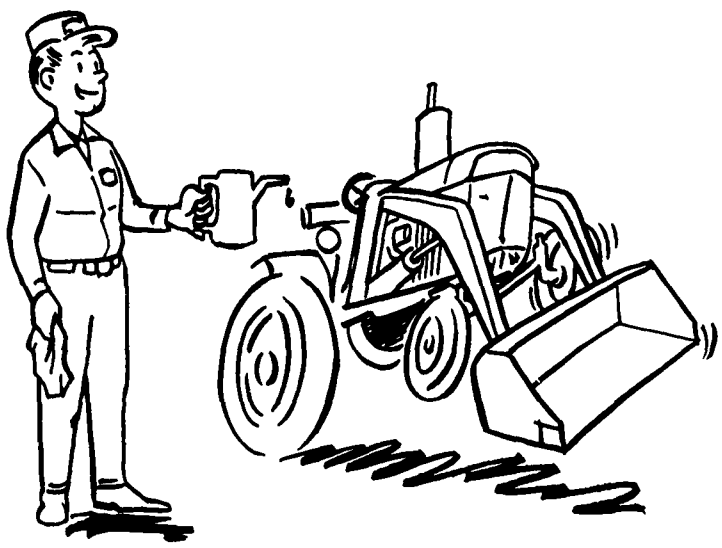

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Fig. 8—The Machine Will Respond to the Proper Lubrication

Start the engine and warm up the hydraulic system. Then run the equipment through its working cycle at least four times to bleed air from the system.

Add oil if necessary, and operate the machine until the equipment will function smoothly at its full, rated capacity.

With the equipment at rest and the engine shut off, recheck the oil level. If necessary, add oil to bring oil to the proper level.

IMPORTANT: Always check the oil level after any repairs have been made on the system.

PREVENTING LEAKS

What causes leaks? There are hundreds of causes, but they fall into two basic types:

- **Internal Leakage**
- **External Leakage**

Internal leakage does not result in actual loss of oil, but it does reduce the efficiency of the system. External leakage does result in direct loss of oil and can have other undesirable effects as well.

INTERNAL LEAKAGE

Internal leakage as a thin oil film is built into the working parts of a hydraulic system. This lubricates the mating surfaces of valve spools, cylinder pistons, and other moving parts. Oil is not lost through this normal internal leakage since it eventually returns to the system reservoir.

However, too much internal leakage will slow the operation of the system and waste power through the generation of heat. In some cases, it may cause cylinders to creep or drift. Or it may cause loss of oil control in the valves.

Internal leakage increases with the normal wear of parts. Leakage is accelerated by using oil which has too low a viscosity because this oil thins faster at higher temperatures. High pressures also force more oil out of leaking points in the system. This is one reason why excessive pressures can actually reduce the efficiency of the hydraulic system.

Internal leaks are hard to detect. All you can do is watch the operation of the system for sluggish action or creeping and drifting. When these signs appear, it's time to test the system and pinpoint the trouble (see Chapter 12).

EXTERNAL LEAKAGE

External oil leaks not only look bad—they can be expensive and hazardous. A drop of oil every second from a leaking connector can cost the operator quite a lot of money.

A small leak can also be the signal for a hydraulic rupture that may injure a person while putting the machine out of operation.

Every joint in a hydraulic circuit is a potential point of leakage. This is why the number of connections in a system is kept at a minimum.

Components can leak, but care in assembly and use of new seals and gaskets during overhaul will help to reduce this problem.

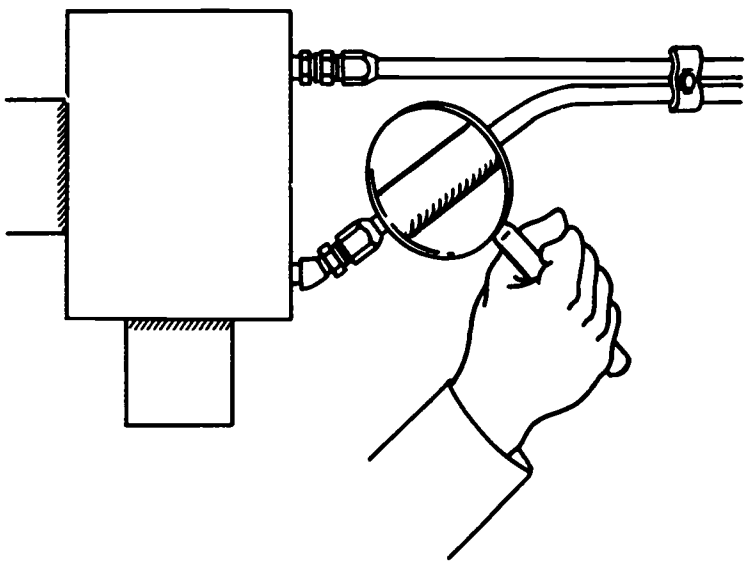

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Fig. 9—Checking Oil Lines for Leaks

The lines that connect the different parts of the system are the No. 1 source of external leaks. Proper use and care of hoses, tubes, and pipes is covered in detail in Chapter 8. Here are a few key points:

1) If the reservoir oil level is lower than normal, check all external oil lines for leaks.

2) Pin-hole leaks are hard to detect, yet they can be dangerous. A "vapor" of oil from a small leak can create a fire hazard, or a fine spray of oil against a hot engine can ignite.

3) The rubber cover on flexible hoses may crack or split without actually leaking. But check very closely for internal damage. The depth of the crack is the deciding factor. Any oil dampness is a sign the hose is leaking.

4) Air leaks in suction lines are hard to locate. One way is to pour oil over the points where you suspect leaks. If the noise or bubbling in the system stops, you've located the leak.

5) Leaks in concealed lines are also hard to find. One routine test for open-center systems is to install a pressure gauge in the discharge line near the pump and then to block off the circuit in progressive stages. When the gauge shows a pressure drop at a given blocking point, the leak is between this point and the one blocked just before it.

NOTE: When making Step 5 test on open-center systems, be careful not to deadend the pump as serious damage to the pump and lines could result.

6. If line connections are leaking, *tighten only until the leak stops.* If the connection will not stay tightened, the threads are probably stripped and the connector must be replaced. If the connector will tighten but still leaks, check for a cracked line flare or a damaged seal. But remember: *More damage has been done to line connectors by overtightening than from any other cause.*

Other chapters in this manual give details on checking and preventing leaks in components such as pumps (Chapter 2), valves (Chapter 3), and cylinders (Chapter 4).

After stopping leaks in a system, be sure to warm up the system and cycle the equipment, then recheck the trouble spots to be sure the leaks are stopped.

Recheck the system oil level and replace any oil lost through leaks or broken connections.

PREVENTING OVERHEATING

Heat causes hydraulic oil to break down faster and lose its effectiveness. This is why cooling of the oil is needed.

In many systems, enough heat is dissipated through the lines, the components, and the reservoir to keep the oil fairly cool. But on high-pressure, high-speed circuits, oil coolers are needed to dissipate the extra heat.

Overheating the system can:

- **Break down the oil**
- **Damage the seals**
- **Coat parts with varnish deposits**
- **Cause extra leakage past working parts**
- **Reduce the output of the system**

To help prevent overheating, keep the oil at the proper level, clean dirt and mud from lines, reservoirs, and coolers, check for dented kinked lines, and keep relief valves adjusted properly. Also be careful not to overspeed or overload the system and never hold control valves in power position too long.

If the system still overheats, refer to the charts at the end of Chapter 12 which list the causes and remedies for overheating.

THERMAL (HEAT) EXPANSION

Thermal expansion is simply the expanding of oil in a system at rest due to heat. This expansion raises the pressure in the system. One degree rise in temperature may cause a pressure rise of 50 to 60 psi in a tightly blocked system.

Normally a hydraulic circuit has built-in escape hatches for this heat expansion. (During operation, the oil circulates and the system adjusts itself to heat changes.) But if there is no outlet, as during storage, a part of the system can "rupture."

In some hydraulic cylinders, for example, there is limited room for expansion, and the heat from the sun could cause breakage.

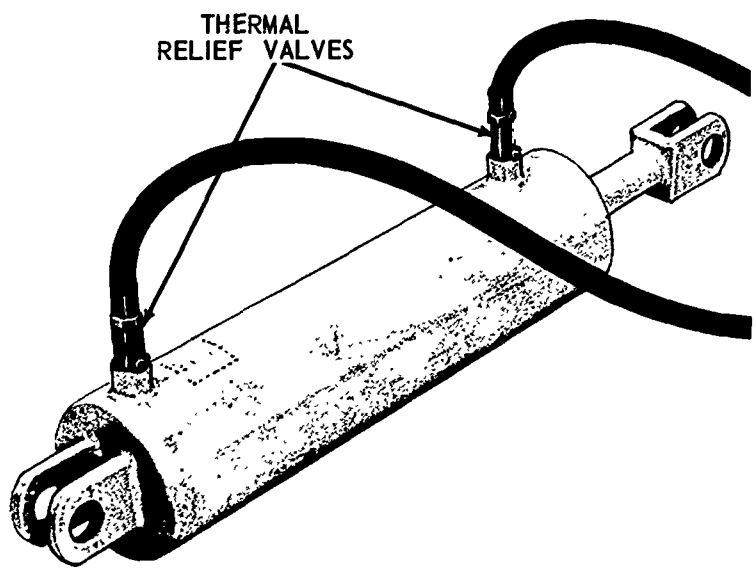

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Fig. 10—Thermal Relief Valves on a Hydraulic Cylinder

Thermal relief valves (Fig. 10) are used to combat this problem. Another solution is for the operator to make sure that the system is not blocked off at any time while it is at rest. Cylinders which have no thermal relief valves should be partly drained before being put into storage.

PREVENTING AIR-IN-OIL PROBLEMS

If air gets into the system, it can result in 1) "spongy" action of equipment, 2) chattering in the system, 3) a noisy pump, and 4) a pump not operating.

If the oil level in the reservoir is too low, air bubbles will form in the reservoir. Air can also get into the system through leaks in the suction line when the oil lines are opened to make repairs, or when the system is drained and refilled.

To keep air out of the system:

1. Be sure the oil in the reservoir is kept at the correct level.

2. Replace any leaking sections of the suction line.

3. Tighten any connections that are leaking. Tighten only until the leak (or noise) stops.

4. After making any repairs and refilling system, cycle the equipment at least four times to bleed all air from the system. (Be sure to recheck reservoir oil level after cycling.) Bleeding may also improve the operation of new machines after a few hours of use.

5. When attaching remote cylinders to the system, bleed air from them as outlined at the end of Chapter 4.

WHAT IS GOOD MAINTENANCE?

- **Use Common Sense**
- **Stop, Look, Touch, Listen Before Picking Up Tools**
- **Keep Parts Clean**
- **Change Oil and Filters Regularly**
- **Maintain Good Records**

GOOD GUYS	*BAD GUYS*
1. Cleanliness	*1. Dirt*
2. High Quality Oil	*2. Water*
3. Proper Filters	*3. Air*
4. Tight Seals	*4. Heat*
5. Normal Operation	*5. Abuse*

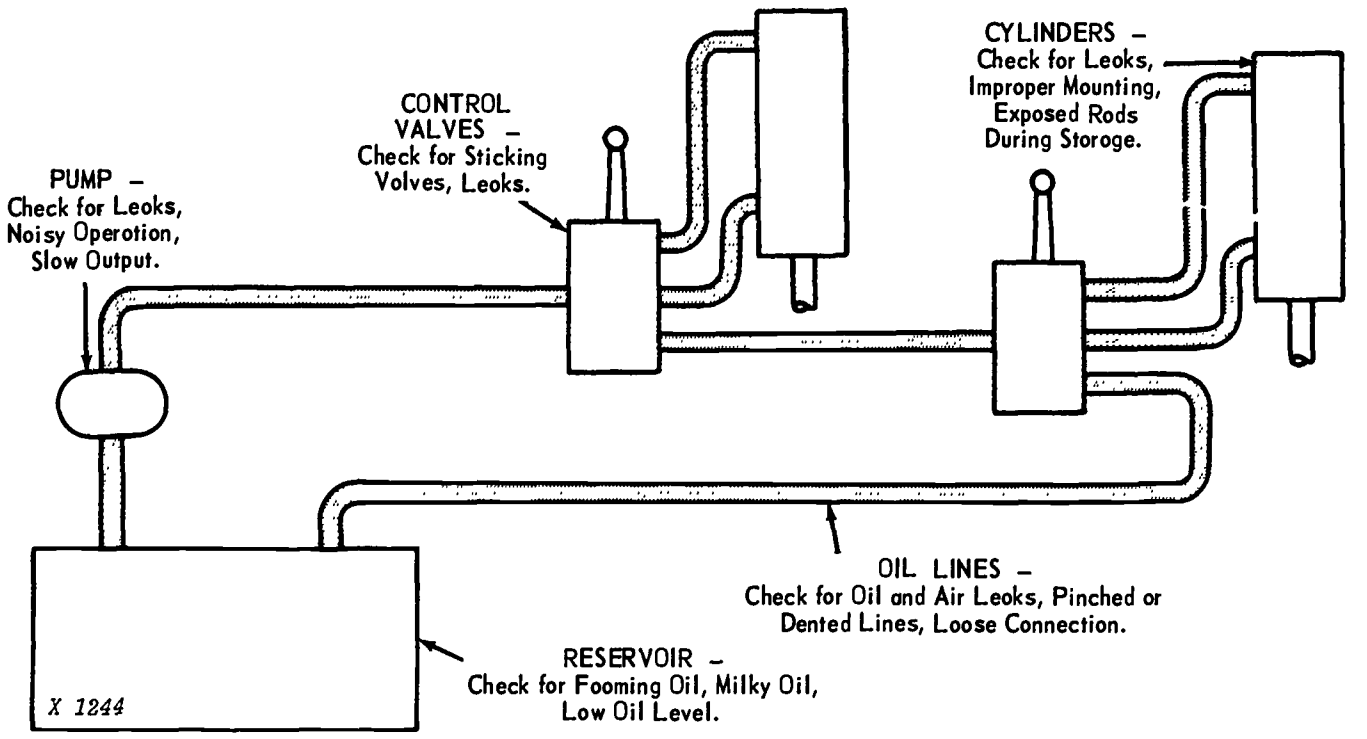


Fig. 11—Check the Whole System Before Operation

CHECKING THE SYSTEM BEFORE OPERATION

After repairs on the system, check the whole circuit for leaks, proper oil level, overheating, etc. *Do this before operating the system on the job.*

For accurate checks, warm up the system and cycle the hydraulic equipment as described under "Filling the System."

Also check the system periodically during operation. Follow the machine operator's manual for the proper intervals.

Following are some areas which should be checked regularly.

CHECKING RESERVOIR AND OIL

1. Check the reservoir oil level and the condition of the oil frequently.

2. At this time, also check for other malfunctions in the system. Look for:

a) *Oil Bubbles* or *Foaming Oil*. This may mean an air leak somewhere in the system.

b) *Change in Oil Level*. If there is a noticeable change in the oil level from day to day, look for leaks or cracks in the external parts of the system.

c) *Milky Oil*. This indicates water in the system or in the oil used. Be sure that oil is stored properly (see Chapter 10).

3. Before removing the filler cap, wipe away all dirt and grime. If a dipstick is used for checking oil, wipe it with a clean, lint-free cloth.

CHECKING COOLER, LINES AND CONNECTORS

1. Clean the oil cooler periodically and check it for leaks. Keep the fins clean on air-to-oil coolers. Check for corrosion in water-to-oil types.

2. Check oil lines and connectors at regular intervals. Look for:

a) *Pressure Oil Leaks*. Oil leaks in the pressure side of the system can be located by examining the outside of lines and fittings.

b) *Air Leaks*. If the suction side of the system is drawing in air, the oil in the reservoir will bubble and foam.

c) *Pinched* or *Dented Lines*. This can cause oil foaming, overheating, and loss of hydraulic power. Replace damaged hoses or tubes at once. Wash lines inside and out with clean solvent before installing them.

3. Tighten any loose lines or connections. Use two wrenches to avoid twisting hose or tubes. Replace any connectors that continue to leak.

IMPORTANT: Tighten loose connectors ONLY until the leak stops.

CHECKING VALVES

Dirt will cause valves to stick or work erratically. Also, after long use, valve spools may become worn, allowing oil to leak past them. Check all valves for leaks periodically. Service the valves as explained in Chapter 3.

CHECKING CYLINDERS

Check cylinders periodically for both external and internal leakage. Make sure cylinders are mounted properly. Be sure the rods of exposed cylinders are not left extended when the machine is stored. Otherwise the rods will collect dirt and moisture which may cause rusting or pitting of the rods. If the rods must be exposed, make sure they are coated with a heavy grease. See Chapter 4 for more details on cylinder maintenance.

CHECKING PUMPS

Check external pumps for possible leaks at mating surfaces of the housing and at cap screws. Check the pump with the machine running to see if it is moving the hydraulic equipment at a satisfactory speed. If not, make the pump and system tests given in Chapter 12 to locate the trouble.

CHECKING MOTORS

Never permit a hydraulic motor to overheat. If it is running hot, make sure the oil supply is adequate and also check the system oil cooler to make sure it is functioning properly. Also inspect for leaks at the motor hose connections, around the shaft, at the seals, and at mating surfaces.

WHEN MAINTENANCE FAILS . . .

In this chapter, we have covered the maintenance which helps to *prevent* failures of the system.

However, with the best of care, hydraulic components will fail at times. When this happens, you must first locate the problem. This is the job of another chapter which follows, Chapter 12 on "Diagnosis and Testing of Hydraulic Systems."

SAFETY RULES FOR HYDRAULICS

Always lower the hydraulic working units to the ground before leaving the machine.

Park the machinery where children cannot easily reach it.

Block up the working units when you must work on the system while raised. Do not rely on the hydraulic lift.

Never service the hydraulic system while the machine's engine is running unless absolutely necessary, as for bleeding the system.

Do not remove cylinders until the working units are resting on the ground or securely on safety stands or blocks. Also shut off the machine's engine.

When transporting the machine, lock the cylinder stops to hold the working units solidly in place.

Before disconnecting oil lines, 1) relieve all hydraulic pressure and 2) discharge the accumulator (if used).

Be sure all line connections are tight and lines are not damaged. Escaping oil under pressure is a fire hazard and can cause personal injury.

Some hydraulic pumps and control valves are heavy. Before removing them, provide a means of support such as a chain hoist, floor jack, or blocks.

*When washing parts, use a **non**volatile cleaning solvent.*

To insure control of the unit, keep the hydraulics in proper adjustment.

TEST YOURSELF

QUESTIONS

1. What four maintenance problems do servicemen discover most often when answering a customer's complaints?

2. True or false? "When flushing the hydraulic system, use a nonpetroleum solvent or a chemical cleaner."

3. (Fill in the blank.) Thermal expansion is the expanding of oil due to _____.

4. Match the items in the left-hand column with the likely cause in the right-hand column:

a. Foaming Oil	1. Water
b. Milky Oil	2. Heat
c. Scorched Oil	3. Air

(Answers are on the next page.)

ANSWERS

1. 1) Not enough oil in the reservoir, 2) Clogged or dirty filters, 3) Loose intake lines, 4) Incorrect oil in the system.

2. False. Most solvents and cleaners are NOT recommended because they are poor lubricants and may damage seals or cause rusting of parts and breakdown of the oil. Instead, use hydraulic oil as a flushing agent.

3. Heat.

4. a — 3. b — 1. c — 2.

DIAGNOSIS AND TESTING OF HYDRAULIC SYSTEMS / CHAPTER 12

INTRODUCTION

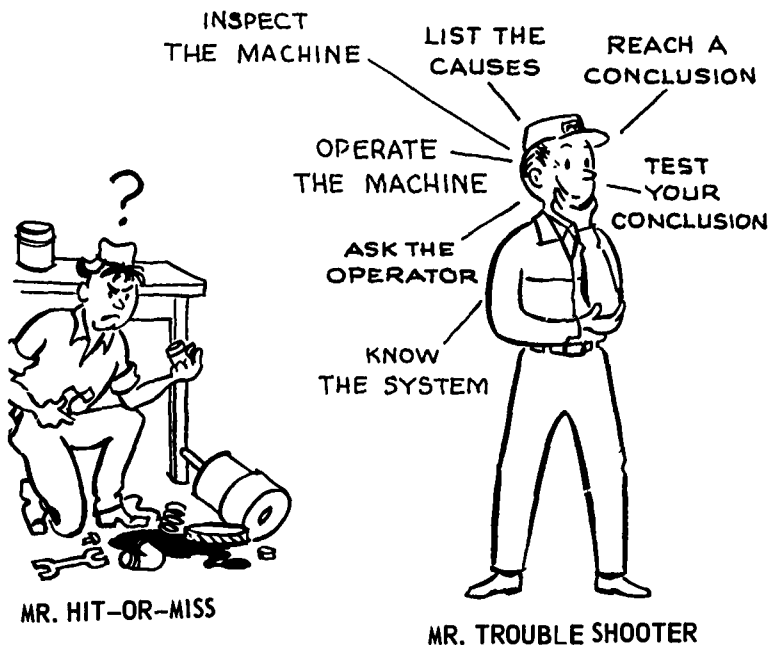


Fig. 1—Which Would You Rather Be?

Mr. Hit-or-Miss or Mr. Trouble Shooter—which would you rather be? Both have the title of serviceman but don't be fooled by that.

Mr. Hit-or-Miss is a parts exchanger who dives into a machine and starts replacing parts helter-skelter until he finds the trouble—maybe—after wasting a lot of the customer's time and money.

Mr. Trouble Shooter starts out by using his brain. He gets all the facts and examines them until he has pin-pointed the trouble. Then he checks out his diagnosis by testing it and *only then* does he start replacing parts.

Mr. Hit-or-Miss is fast becoming a man of the past. What dealer can afford to keep him around at today's prices?

With the complex systems of today, diagnosis and testing by Mr. Trouble Shooter is the only way.

SEVEN BASIC STEPS

A good program of diagnosis and testing has seven basic steps:

1. **Know the System**
2. **Ask the Operator**
3. **Operate the Machine**
4. **Inspect the Machine**
5. **List the Possible Causes**
6. **Reach a Conclusion**
7. **Test Your Conclusion**

Let's see what these steps mean.

1. KNOW THE SYSTEM

Fig. 2—Know the System

In other words, "Do your homework." Study the machine technical manuals. Know how the system works, whether it's open- or closed-center, what the valve settings and pump output should be.

Keep up with the latest service bulletins. Read them and then file in a handy place. The problem on your latest machine may be in this month's bulletin, giving the cause and remedy.

You can be prepared for any problem by knowing the system.

2. ASK THE OPERATOR

X 1137

Fig. 3—Ask the Operator

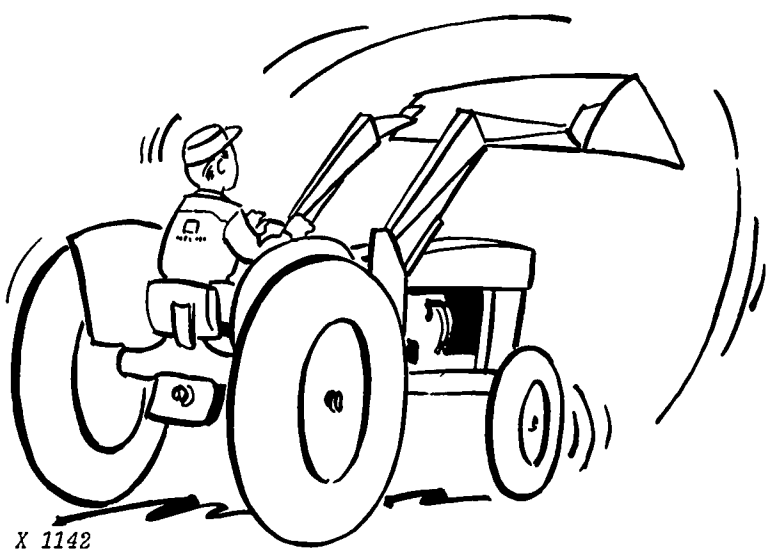
A good reporter gets the full story from a witness—the operator.

He can tell you how the machine acted when it started to fail, what was unusual about it.

Try to find out too if any do-it-yourself service was performed. (You may find out later that the trouble is somewhere else. But you should know if any valves were tampered with, etc.)

Ask about how the machine is used, when it is serviced. Many problems can be traced to poor maintenance or abuse of the machine.

3. OPERATE THE MACHINE



X 1142

Fig. 4—Operate the Machine

Get on the machine and operate it. Warm it up and put it through its paces. Don't completely trust the operator's story—check it yourself.

Are the gauges reading normal? (If not, it may be hydraulic trouble or it may mean the gauges are faulty.)

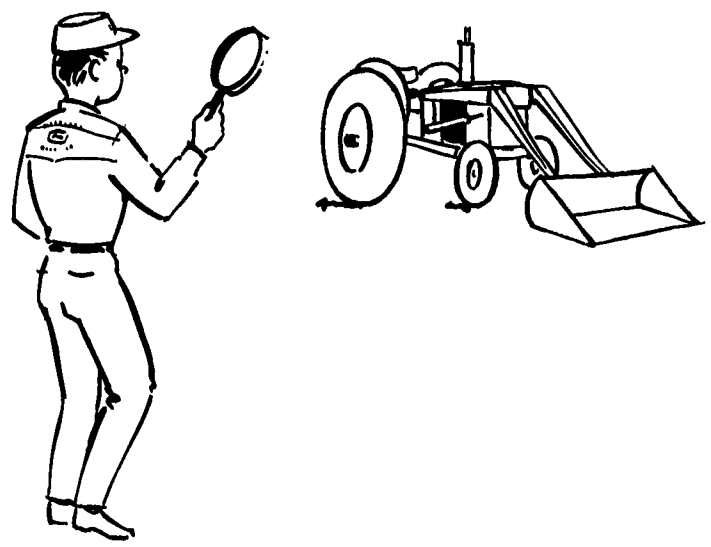
How's the performance? Is the action slow, erratic, or nil?

Do the controls feel solid of "spongy"? Do they seem to be "sticking"?

Smell anything? Any signs of smoke?

Hear any funny sounds? Where? At what speeds or during what cycles?

4. INSPECT THE MACHINE



X 1143

Fig. 5—Inspect the Machine

Now get off the machine and make a visual check. Use your eyes, ears, and nose to spot any signs of trouble.

First inspect the oil in the reservoir. How is the oil level? Is the oil foamy? Milky? Does it smell scorched? Does it appear to be too thin or too thick? How dirty is it?

If the oil is very dirty, also check the filters for clogging.

Feel the reservoir and lines. Are they hotter than normal? Are they caked with dirt and mud? Is the paint peeled off from heat? Check the pump inlet line for restrictions. Check for collapsed hoses.

Follow the circuit and keep on checking. Look for oil leaks at line connectors. Watch for air leaks at loose clamps, etc.

Was only one circuit bad? Then you can eliminate the system components and concentrate on the parts of that one circuit.

Now your list is beginning to narrow so that you can point your tests at one or two components.

The next part of this chapter will tell you how to test the system and pinpoint these final troubles.

But first let's repeat the seven rules for good trouble shooting:

1. **Know the System**
2. **Ask the Operator**
3. **Operate the Machine**
4. **Inspect the Machine**
5. **List the Possible Causes**
6. **Reach a Conclusion**
7. **Test Your Conclusion**

TESTING THE MACHINE

Testing with gauges or a hydraulic analyzer is the most effective way to pinpoint troubles in the system.

However, here are some preliminary checks you can make without using a tester or prior to using one.

CHECKING FOR LEAKS

If you suspect the control valve or cylinder is leaking, do the following:

Raise the hydraulic equipment a few feet off the ground, return the control lever to neutral and shut off the engine.

Notice whether the equipment settles toward the ground. If the equipment settles, temporarily support it and disconnect the return line between the control valve and reservoir, then plug the line (Fig. 9).

Remove the support and examine the open port in the control valve as the equipment settles. If oil leaks from the port, the control valve spool is leaking.

If no oil is leaking from the control valve, check the cylinder as follows:

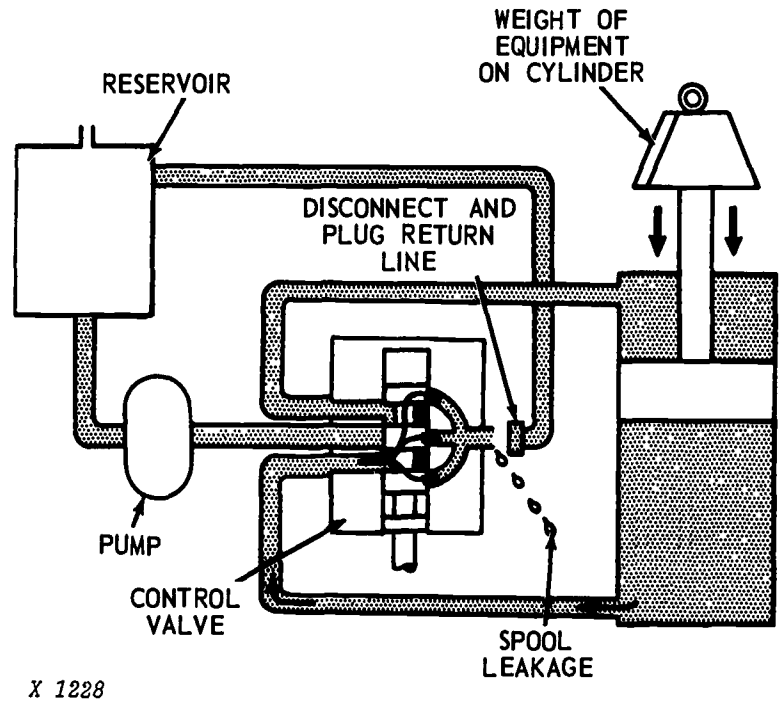


Fig. 9—Checking Control Valve for Leaks

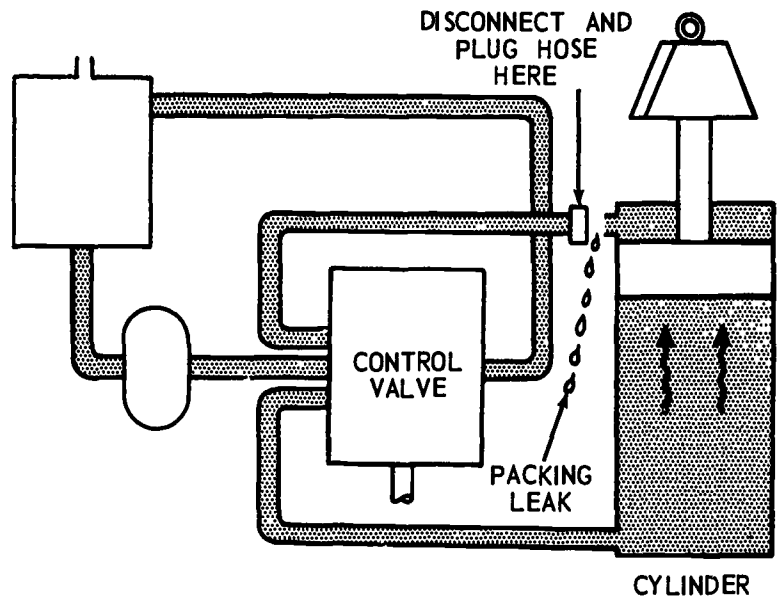


Fig. 10—Checking Double-Acting Cylinder for Leaks

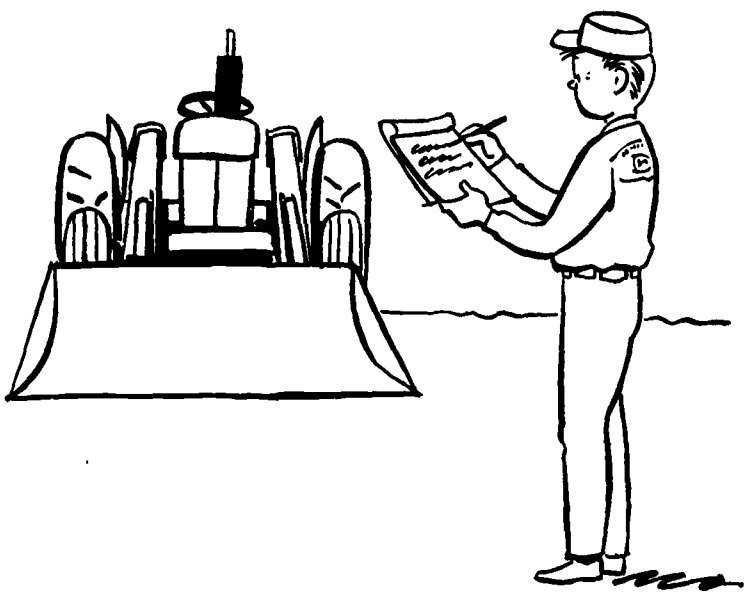
To check a double-acting cylinder, run the cylinder to one end of its stroke. Support the equipment if it is raised, then shut off the engine. Remove the hose from the end of the cylinder that was not pressurized (Fig. 10). Start the engine again, pressurize the cylinder, and see if any oil comes out of the open port. Repeat the test in the opposite direction since it may be possible for the cylinder to leak in only one direction. If oil leaks out the open cylinder port, the packings in the cylinder must be replaced.

Check the oil cooler. Is it free of trash and mud?

Look closely at the components. Inspect for cracked welds, hairline cracks, loose tie bolts, or damaged linkages.

While you inspect, make a note of all the trouble signs.

5. LIST THE POSSIBLE CAUSES



X 1139

Fig. 6—List the Possible Causes

Now you are ready to make a list of the possible causes.

What were the signs you found while inspecting the machine? And what is the most likely cause?

Are there other possibilities? Remember that one failure often leads to another.

6. REACH A CONCLUSION

Look over your list of possible causes and decide which are most likely and which are easiest to verify.

Use the Trouble Shooting Charts at the end of this chapter as a guide.

Reach your decision on the leading causes and plan to check them first.

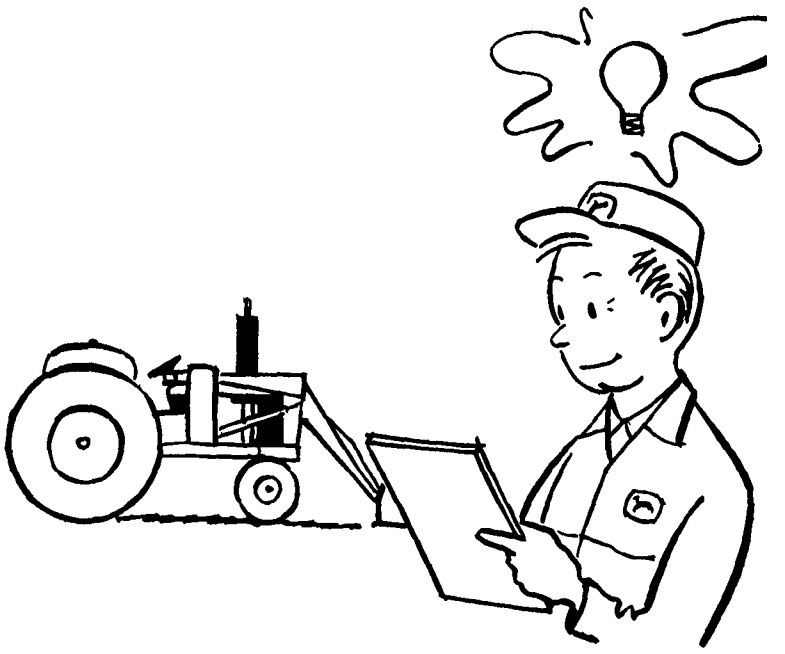


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Fig. 7—Reach a Conclusion

7. TEST YOUR CONCLUSION

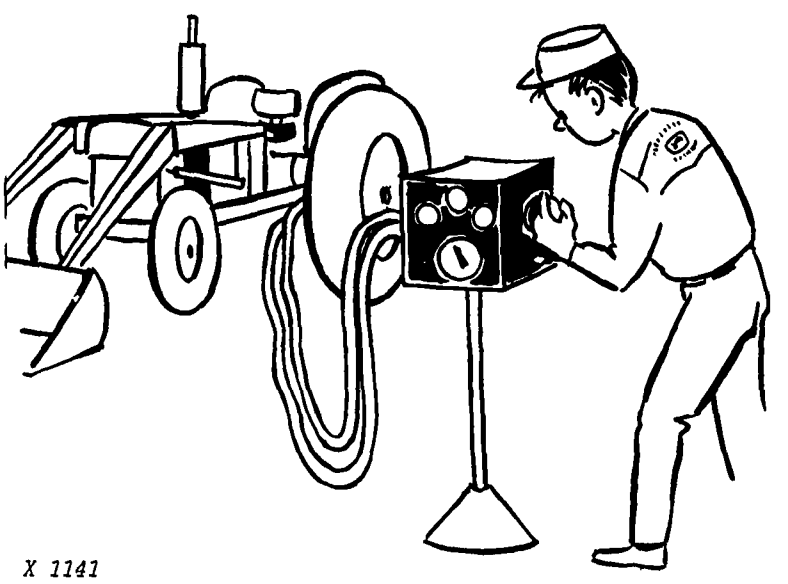

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Fig. 8—Test Your Conclusion

Now for the final step: Before you start repairing the system, test your conclusions to see if they are correct.

Some of the items on your list can be verified without further testing. Analyze the information you already have:

Were all the hydraulic functions bad? Then probably the failure is in a component that is common to all parts of the system. Examples: pump, filters, system relief valves.

WHAT A HYDRAULIC TESTER DOES

If you cannot locate the trouble with the operational checks, check the system using a hydraulic analyzer or test gauges. Using this equipment, you can accurately measure oil flow, pressure, and temperature, and quickly isolate faulty components.

Hydraulic analyzers are available with pressure loading valves, pressure gauges (high and low pressure), flow meters, and temperature gauges to precisely analyze a complex hydraulic system.

In testing any hydraulic circuit, the following four checks are of prime importance:

1. *Temperature*—The oil should be checked for correct operating temperature to assure accuracy of the tests that follow.

2. *Flow*—The flow check determines if the pump is developing its rated output.

3. *Pressure*—Pressure checks test relief valves for proper operation. (In a closed-center system, pressure checks indicate the operation of the main pump.)

4. *Leakage*—The leakage test isolates leakage in a particular component.

These basic checks may be made with most hydraulic testers. Before beginning, however, read the instruction manual furnished with the tester and review the system. You should have a thorough knowledge of the machine's specifications (relief valve pressures, pump output, engine rpm, and operating temperature) to accurately test the system.

To test a machine, you must disconnect some of the oil lines. But remember, DIRT IS THE WORST ENEMY OF A HYDRAULIC SYSTEM. Before disconnecting oil lines, steam clean the machine. And be sure to plug all openings to keep out dirt.

PUMP TESTING

The pump is the generating force for the whole hydraulic system. This is the place to start testing the system.

Installing the Hydraulic Tester

1. Relieve any pressure in the system and disconnect the pressure line between the pump and the control valve. Attach the pressure line to the hydraulic tester INLET port (Fig. 11).

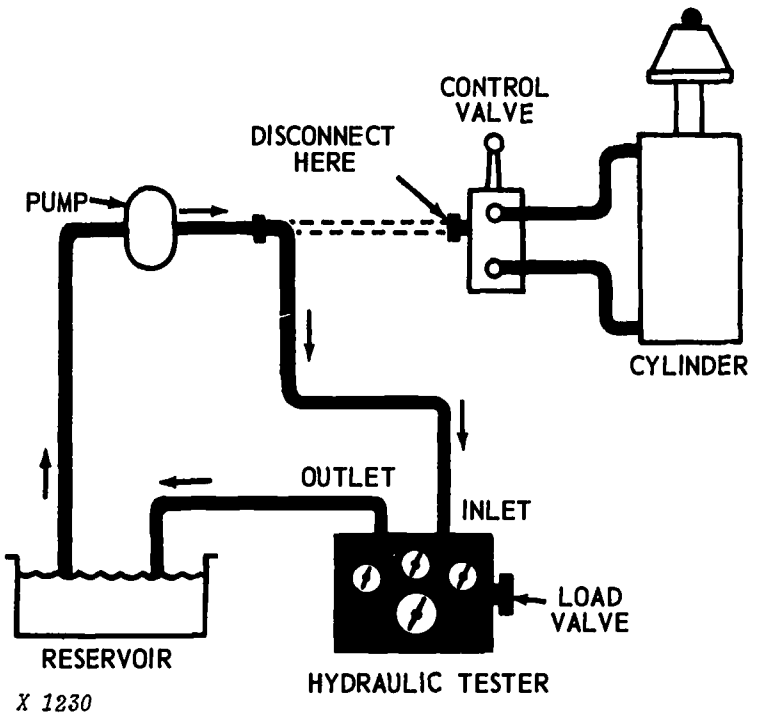

Fig. 11—Testing the Hydraulic Pump

2. Connect hydraulic tester OUTLET port to the reservoir. Whenever possible, connect directly to the reservoir return line because it usually has a return filter. On a closed-center system, always return hydraulic tester oil to a point between the main hydraulic pump and the charging pump to maintain pressure in the system (or to be sure the main pump does not lose its charge).

3. Check the oil level and slowly close the tester load valve to load the system. (Do not exceed the system's maximum rated pressure.) Continue loading until the normal operating temperature of the system is reached (see machine specifications).

Be sure the tester load valve is OPEN before starting any tests. The load valve can develop tremendous pressure on a component if it is closed too far.

Operating the Hydraulic Tester

1. With the tester load valve open, record maximum pump flow at zero pressure.

2. Slowly close the load valve to increase pressure and record the flow at 250 psi increments from zero pressure to maximum system pressure. Write down your test results so you can refer to them later. Use a test form such as the one shown in Fig. 12 on the next page.

3. Open the hydraulic tester load valve until maximum pump flow is again at zero pressure.

4. Shut off the engine.

Owner _____ Serial No. _____

Tractor Model _____ Equipment _____

Comments _____

		Gallons Per Minute @ Psi									
		0	250	500	750	1000	1250	1500	1750	2000	2250
Pump Test		31.0	28.0	25.0	22.0	19.0	16.0	13.0	10.0	7.0	
Circuit Test	Direction Cylinder Travel										

X 1231

Fig. 12—Sample Form for Recording Pump Test Results

Pump Test Diagnosis

Pump flow at maximum pressure should be at least 75 percent of pump flow at zero pressure. (On modern variable displacement pumps of the radial piston type, 90 percent can be expected.) A lower reading like the one shown on the form in Fig. 12 indicates a badly worn pump.

If pump flow is poor during the free flow test as well as the pressure tests, the pump probably is not getting enough oil. This problem could be caused by low oil supply, air leaks, a restricted pump inlet line, or a dirty reservoir, filter or breather.

If the pump tests okay, then start checking the system components for trouble.

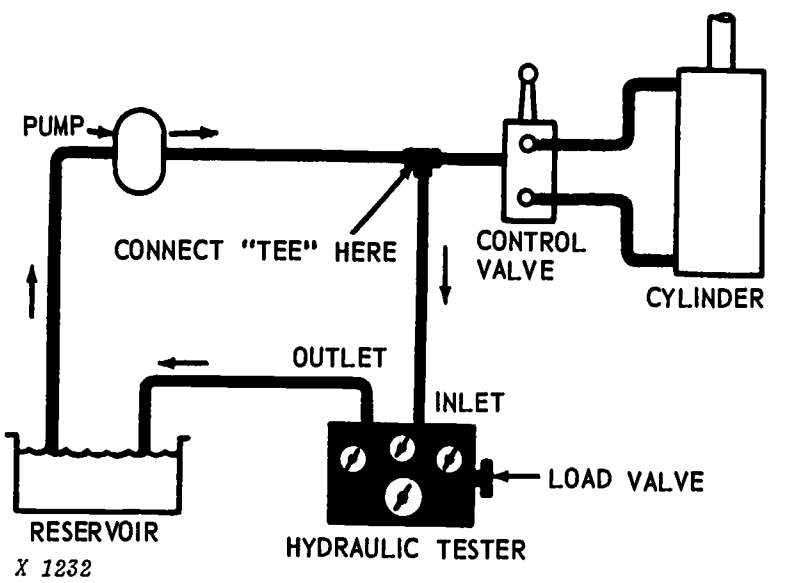

Fig. 13—Testing the System Components

SYSTEM TESTING

Installing the Hydraulic Tester

Install a tee fitting in the line between the pump and the control valve and attach the hydraulic tester INLET port to this tee (Fig. 13).

Leave the return line from the hydraulic tester OUTLET port connected in the same way as it was for the pump test.

Operating the Hydraulic Tester

1. Open the hydraulic tester load valve.

2. Start the engine and adjust it to the manufacturer's recommended operating speed.

3. Slowly close the hydraulic tester load valve to load the system. Continue loading the system until normal operating temperature is reached.

4. Open load valve to record maximum system flow at zero pressure.

5. Operate the control valve and hold it in one of its power positions.

Owner _____ Serial No. _____

Tractor Model _____ Equipment _____

Comments _____

		Gallons Per Minute @ Psi									
		0	250	500	750	1000	1250	1500	1750	2000	2250
Pump Test		32.0	31.7	31.4	31.0	30.6	30.2	29.8	29.3	28.8	
Circuit Test	Direction Cylinder Travel										
Boom Circuit	Lower	32.0	31.7	31.4	31.0	30.6	30.2	29.8	29.3	28.8	
	Raise	32.0	31.7	31.4	31.0	30.6	30.2	29.8	29.3	28.8	
Bucket Circuit	Dump	32.0	31.7	31.4	31.0	5.0	0.0				
	Roll-Bk.	32.0	31.7	31.4	31.0	30.6	30.2	10.0	0.0		

X 1233

Fig. 14—Sample Form for Recording System Test Results

6. Slowly close the hydraulic tester load valve and record flow in 250 psi increments from zero pressure to maximum system pressure (Fig. 14).

7. Open the load valve until maximum flow is again at zero pressure and repeat the test in the rest of the control valve power positions.

Be sure to make all the tests at the same oil temperature to get readings that can be compared. If oil is too hot from the previous test, allow it to circulate through the system for cooling.

System Test Diagnosis

Here's how to judge the system tests:

1. *If flow at each pressure is same as for pump test:* All components are okay.

2. *If pressure begins to drop before full load is reached:* One of the circuits is bad. (Such as the bucket roll-back circuit in Fig. 14).

The pressure drop is caused by leakage. To find out whether the leakage is in the control valve or the cylinder, disconnect the cylinder return line and move the control valve to a power position. If oil leaks from the cylinder return port, the cylinder is at fault and must be repaired. If no oil leaks out, the control valve is probably at fault.

3. *If flow drops the same with the control valve in all positions:* The system relief valve is probably at fault (see following). This condition could also indicate a leak in the control valve.

Relief Valve Diagnosis

If equipment with circuit relief valves is being checked, you can tell when the valves open because flow will suddenly drop about 3 gpm (or drop to zero gpm if a full-flow relief valve is used). Often the relief valves will start to "crack" open before they reach their full-pressure settings. This can be noted by comparing the pressure and flow rate readings made in the circuit test above. Any great decrease in flow rate in these valves indicates a faulty valve.

As a general rule:

Faulty SYSTEM relief valves will affect readings in all tests.

Faulty CIRCUIT relief valves will affect only pressure readings in the individual circuits.

SUMMARY: TESTING THE MACHINE

The tests we have given you are only basic guidelines. Once you start testing actual machines, use your machine technical manual for detailed tests and test results. And remember that the best testing equipment has no value unless the man at the controls knows how to interpret the results.

TROUBLE SHOOTING CHARTS

INTRODUCTION

Use the charts on the following pages to help in listing all the possible causes of trouble when you begin diagnosis and testing of a machine.

Once you have located the cause, check the item in the chart again for the possible remedy.

The technical manual for each machine supplements these charts by giving more detailed and specific causes and remedies.

SYSTEM INOPERATIVE

No oil in system.

Fill to full mark. Check system for leaks.

Oil low in reservoir.

Check level and fill to full mark. Check system for leaks.

Oil of wrong viscosity.

Refer to specifications for proper viscosity.

Filter dirty or plugged.

Drain oil and replace filters. Try to find source of contamination.

Restriction in system.

Oil lines could be dirty or have inner walls that are collapsing to cut off oil supply. Clean or replace lines. Clean orifices.

Air leaks in pump suction line.

Repair or replace lines.

Dirt in pump.

Clean and repair pump. If necessary, drain and flush hydraulic system. Try to find source of contamination.

Badly worn pump.

Repair or replace pump. Check for problems causing pump wear such as misalignment or contaminated oil.

Badly worn components.

Examine and test valves, motors, cylinders, etc. for external and internal leaks. If wear is abnormal, try to locate the cause.

Oil leak in pressure lines.

Tighten fittings or replace defective lines. Examine mating surfaces on couplers for irregularities.

Components not properly adjusted.

Refer to machine technical manual for proper adjustment of components.

Relief valve defective.

Test relief valves to make sure they are opening at their rated pressure. Examine seals for damage that could cause leaks. Clean relief valves and check for broken springs, etc.

Pump rotating in wrong direction.

Reverse to prevent damage.

Operating system under excessive load.

Check specifications of unit for load limits.

Hoses attached improperly.

Attach properly and tighten securely.

Slipping or broken pump drive.

Replace couplers or belts if necessary. Align them and adjust tension.

Pump not operating.

Check for shut-off device on pump or pump drive.

SYSTEM OPERATES ERRATICALLY

Air in system.

Examine suction side of system for leaks. Make sure oil level is correct. (Oil leak on the pressure side of the system could account for loss of oil.)

Cold oil.

Viscosity of oil may be too high at start of warm-up period. Allow oil to warm up to operating temperature before using hydraulic functions.

Components sticking or binding.

Check for dirt or gummy deposits. If dirt is caused by contamination, try to find the source. Check for worn or bent parts.

Pump damaged.

Check for broken or worn parts. Determine cause of pump damage.

Dirt in relief valves.

Clean relief valves.

Restriction in filter or suction line.

Suction line could be dirty or have inner walls that are collapsing to cut off oil supply. Clean or replace suction line. Also, check filter line for restrictions.

SYSTEM OPERATES SLOWLY

Cold oil.

Allow oil to warm up before operating machine.

Oil viscosity too heavy.

Use oil recommended by the manufacturer.

Insufficient engine speed.

Refer to operator's manual for recommended speed. If machine has a governor, it may need adjustment.

Low oil supply.

Check reservoir and add oil if necessary. Check system for leaks that could cause loss of oil.

Adjustable orifice restricted too much.

Back out orifice and adjust it. Check machine specifications for proper setting.

Air in system.

Check suction side of the system for leaks.

Badly worn pump.

Repair or replace pump. Check for problems causing pump wear such as misalignment or contaminated oil.

Restriction in suction line or filter.

Suction line could be dirty or have inner walls that are collapsing to cut off oil supply. Clean or replace suction line. Examine filter for plugging.

Relief valves not properly set or leaking.

Test relief valves to make sure they are opening at their rated pressure. Examine valves for damaged seats that could leak.

Badly worn components.

Examine and test valves, motors, cylinders, etc. for external and internal leaks. If wear is abnormal, try to locate the cause.

Valve or regulators plugged.

Clean dirt from components. Clean orifices. Check source of dirt and correct.

Oil leak in pressure lines.

Tighten fittings or replace defective lines. Examine mating surfaces on couplers for irregularities.

Components not properly adjusted.

Refer to machine technical manual for proper adjustment of components.

SYSTEM OPERATES TOO FAST

Adjustable orifice installed backward or not installed.

Install orifice parts correctly and adjust.

Obstruction or dirt under seat of orifice.

Remove foreign material. Readjust orifice.

OVERHEATING OF OIL IN SYSTEM

Operator holds control valves in power position too long, causing relief valve to open.

Return control lever to neutral position when not in use.

OVERHEATING OF OIL IN SYSTEM—Continued

Using incorrect oil.

Use oil recommended by manufacturer. Be sure oil viscosity is correct.

Low oil level.

Fill reservoir. Look for leaks.

Dirty oil.

Drain and refill with clean oil. Look for source of contamination.

Engine running too fast.

Reset governor or reduce throttle.

Incorrect relief valve pressure.

Check pressure and clean or replace relief valves.

Internal component oil leakage.

Examine and test valves, cylinders, motors, etc. for external and internal leaks. If wear is abnormal, try to locate cause.

Restriction in pump suction line.

Clean or replace.

Dented, obstructed or undersized oil lines.

Replace defective or undersized oil lines. Remove obstructions.

Oil cooler malfunctioning.

Clean or repair.

Control valve stuck in partially or full open position.

Free all spools so that they return to neutral position.

Heat not radiating properly.

Clean dirt and mud from reservoir, oil lines, coolers, and other components.

Automatic unloading control inoperative (if equipped).

Repair valve.

FOAMING OF OIL IN SYSTEM

Low oil level.

Fill reservoir. Look for leaks.

Water in oil.

Drain and replace oil.

Wrong kind of oil being used.

Use oil recommended by manufacturer.

Air leak in line from reservoir to pump.

Tighten or replace suction line.

Kink or dent in oil lines (restricts oil flow).

Replace oil lines.

Worn seal around pump shaft.

Clean sealing area and replace seal. Check oil for contamination or pump for misalignment.

PUMP MAKES NOISE

Low oil level.

Fill reservoir. Check system for leaks.

Oil viscosity too high.

Change to lighter oil.

Pump speed too fast.

Operate pump at recommended speed.

Suction line plugged or pinched.

Clean or replace line between reservoir and pump.

Sludge and dirt in pump.

Disassemble and inspect pump and lines. Clean hydraulic system. Determine cause of dirt.

Reservoir air vent plugged.

Remove breather cap, flush, and clean air vent.

Air in oil.

Tighten or replace suction line. Check system for leaks. Replace pump shaft seal.

PUMP MAKES NOISE—Continued

Worn or scored pump bearings or shafts.

Replace worn parts or complete pump if parts are badly worn or scored. Determine cause of scoring.

Inlet screen plugged.

Clean screen.

Broken or damaged pump parts.

Repair pump. Look for cause of damage like contamination or too much pressure.

Sticking or binding parts.

Repair binding parts. Clean parts and change oil if necessary.

PUMP LEAKS OIL

Damaged seal around drive shaft.

Tighten packing or replace seal. Trouble may be caused by contaminated oil. Check oil for abrasives and clean entire hydraulic system. Try to locate source of contamination. Check the pump drive shaft. Misalignment could cause the seal to wear. If shaft is not aligned, check the pump for other damage.

Loose or broken pump parts.

Make sure all bolts and fittings are tight. Check gaskets. Examine pump castings for cracks. If pump is cracked, look for a cause like too much pressure or hoses that are attached incorrectly.

LOAD DROPS WITH CONTROL VALVE IN NEUTRAL POSITION

Leaking or broken oil lines from control valve to cylinder.

Check for leaks. Tighten or replace lines. Examine mating surfaces on couplers for irregularities.

Oil leaking past cylinder packings or O-rings.

Replace worn parts. If wear is caused by contamination, clean hydraulic system and determine the source.

Oil leaking past control valve or relief valves.

Clean or replace valves. Wear may be caused by contamination. Clean system and determine source of contamination.

Control lever not centering when released.

Check linkage for binding. Make sure valve is properly adjusted and has no broken or binding parts.

CONTROL VALVE STICKS OR WORKS HARD

Misalignment or seizing of control linkage.

Correct misalignment. Lubricate linkage joints.

Tie bolts too tight (on valve stacks).

Use manufacturer's recommendation to adjust tie bolt torque.

Valve broken or scored internally.

Repair broken or scored parts. Locate source of contamination that caused scoring.

CONTROL VALVE LEAKS OIL

Tie bolts too loose (on valve stacks).

Use manufacturer's recommendation to adjust tie bolt torque.

Worn or damaged O-rings.

Replace O-rings (especially between valve stacks). If contamination has caused O-rings to wear, clean system and look for source of contamination.

Broken valve parts.

If valve is cracked, look for a cause like too much pressure or hoses that are attached incorrectly.

CYLINDERS LEAK OIL

Damaged cylinder barrel.

Replace cylinder barrel. Correct cause of barrel damage.

Rod seal leaking.

Replace seal. If contamination has caused seal to wear, look for source. Wear may be caused by external as well as internal contaminants. Check piston rod for scratches or misalignment.

Loose parts.

Tighten parts until leakage has stopped.

Piston rod damaged.

Check rod for nicks or scratches that could cause seal damage or allow oil leakage. Replace defective rods.

CYLINDER LOWERS WHEN CONTROL VALVE IS IN "SLOW RAISE" POSITION

Damaged check valve in lift circuit.

Repair or replace check valve.

Leaking cylinder packing.

Replace packing. Check oil for contamination that could cause wear. Check alignment of cylinder.

Leaking lines or fittings to cylinder.

Check and tighten. Examine mating surfaces on couplers for irregularities.

POWER STEERING DOES NOT WORK, STEERS HARD, OR IS SLOW

Air in system.

Bleed system. Check for air leaks.

Internal leakage in system.

Components may not be adjusted properly. Parts may be worn or broken. Check for cause of wear.

System not properly timed.

Time according to manufacturer's instructions.

Worn or damaged bearings.

Check and replace bearings in steering components.

Insufficient pressure.

Check pump and relief valves. Contamination could cause valves to leak or pump to wear.

POWER BRAKES MALFUNCTION

Heavy oil or improper brake fluid.

Warm up fluid or change to one of lighter viscosity. Use proper oil or brake fluid (see machine operator's manual).

NOTE: Many brake circuits use brake fluid instead of hydraulic oil. DO NOT MIX.

Air in system.

Bleed brake system. Find out where air is coming from.

Contaminated oil.

This may cause components to wear or jam. Clean and repair system and check for cause of contamination.

Brake pedal return restricted.

Clean dirt from moving parts. Check linkage for damage.

Accumulator not working (if equipped).

Check accumulator precharge. If accumulator is defective, repair or replace it.

TEST YOURSELF

QUESTIONS

1. Give the seven basic steps for good trouble shooting.
2. During which of the seven steps should you begin replacing parts?
3. True or false? "Test the system flow first so that you have a guide for readings on the pump flow tests."
4. (Fill in the blanks with "circuit" or "system".) "As a general rule, faulty _____ relief valves will affect pressure readings on all tests, while faulty _____ relief valves will affect only some readings."

ANSWERS

1. 1) Know the system, 2) Ask the operator, 3) Operate the machine, 4) Inspect the machine, 5) List the possible causes, 6) Reach a conclusion, 7) Test your conclusion.
2. During *none* of these steps. Do all these things *before* you start repairing the system.
3. False. Test the *pump* first. It is the generating force for the whole system and affects the operation of all other system components.
4. First blank—"system". Second blank—"circuit".

DEFINITIONS OF TERMS AND SYMBOLS

A

ACCUMULATOR—A container which stores fluids under pressure as a source of hydraulic power. It may also be used as a shock absorber.

ACTUATOR—A device which converts hydraulic power into mechanical force and motion. (Examples: hydraulic cylinders and motors.)

B

BLEED—The process by which air is removed from a hydraulic system.

BYPASS—A secondary passage for fluid flow.

C

CAVITATION—Air pockets in the oil circuit (as at the pump inlet).

CIRCUIT—A series of component parts connected to each other by fluid lines or passages. Usually part of a "system."

CLOSED CENTER SYSTEM—A hydraulic system in which the control valves are closed during neutral, stopping oil flow. Flow in this system is varied, but pressure remains constant.

COOLER (Oil)—A heat exchanger which removes heat from a fluid. (See "Heat Exchanger.")

CUSHION—A device sometimes built into the end of a cylinder which restricts outlet flow and thereby slows down the piston.

CYCLE—A single complete operation of a component which begins and ends in a neutral position.

CYLINDER—A device for converting fluid power into linear or circular motion. An "actuator". Basic design types include piston and vane units.

Double-Acting Cylinder—A cylinder in which fluid force can be applied to the movable element in either direction.

Piston-Type Cylinders—A cylinder which uses a sliding piston in a housing to produce straight movement.

Rotary Cylinders—A cylinder in which fluid force is applied to produce circular motion.

Single-Acting Cylinder—A cylinder in which fluid force can be applied to the movable element in only one direction.

Vane-Type Cylinder—A cylinder which uses a turning vane in a circular housing to produce rotary movement.

D

DISPLACEMENT—The volume of oil displaced by one complete stroke or revolution (of a pump, motor, or cylinder).

DRIFT—Motion of a cylinder or motor due to internal leakage past components in the hydraulic system.

E

ENERGY—Three types of energy are available in modern hydraulics (of the normal hydrostatic type):

1. *Potential Energy*—Pressure energy. The *static* energy of oil which is standing but is pressurized and ready to do work. Example: oil in a loaded accumulator.

2. *Heat Energy*—Friction or resistance to flow. (An energy *loss* in terms of output.) Example: friction between moving oil and the confines of lines or passages produces heat energy.

3. *Kinetic Energy*—The energy of the moving liquid. Varies with the velocity (speed) of the liquid.

F

FILTER (OIL)—A device which removes solids from a fluid.

FLOW METER—A testing device which gauges either flow rate, total flow, or both.

FLOW RATE—The volume of fluid passing a point in a given time.

FLUID POWER—Energy transmitted and controlled through use of a pressurized fluid.

FORCE—A push or pull acting upon a body. In a hydraulic cylinder, it is the product of the pressure on the fluid, multiplied by the effective area of the cylinder piston. It is measured in pounds or tons.

FRICTION—The resistance to fluid flow in a hydraulic system. (An energy loss in terms of power output.)

H

HEAT EXCHANGER—A device which transfers heat through a conducting wall from one fluid to another. (See "Cooler, (Oil)".)

HORSEPOWER—The work or torque produced per unit of time.

HOSE—A flexible line.

HYDRAULICS—The engineering science of liquid pressure and flow. (In this manual, our main interest is in *oil* hydraulics as applied to produce work in linear and rotary planes.)

Hydrodynamics—The engineering science of the *energy* of liquid pressure and flow.

Hydrostatics—The engineering science of the energy of liquids *at rest*. (All the systems covered in this manual operate on the *hydrostatic* principle.)

L

LINE—A tube, pipe, or hose for conducting a fluid.

M

MANIFOLD—A fluid conductor which provides many ports.

MOTOR (Hydraulic)—A device for converting fluid energy into mechanical force and motion—usually rotary motion. Basic design types include gear, vane, and piston units.

O

OPEN CENTER SYSTEM—A hydraulic system in which the control valves are open to continuous oil flow, even in neutral. Pressure in this system is varied, but flow remains constant.

ORIFICE—A restricted passage in a hydraulic circuit. Usually a small drilled hole to limit flow or to create a pressure differential in a circuit.

P

PACKING—Any material or device which seals by compression. Common types are U-packings, V-packings, "Cup" packings, and O-rings.

PIPE—A line whose outside diameter is standardized for threading.

PISTON—A cylindrical part which moves or reciprocates in a cylinder and transmits or receives motion to do work.

PORT—The open end of a fluid passage. May be within or at the surface of a component.

POUR POINT—The lowest temperature at which a fluid will flow under specific conditions.

POWER BEYOND—An adapting sleeve which opens a passage from one circuit to another. Often installed in a valve port which is normally plugged.

PRESSURE—Force of a fluid per unit area, usually expressed in pounds per square inch (psi).

Back Pressure—The pressure encountered on the return side of a system.

Breakout Pressure—The minimum pressure which starts moving an actuator.

Cracking Pressure—The pressure at which a relief valve, etc., begins to open and pass fluid.

Differential Pressure—The difference in pressure between any two points in a system or a component. (Also called a "pressure drop.")

Full-Flow Pressure—The pressure at which a valve is wide open and passes its full flow.

Operating Pressure—The pressure at which a system is normally operated.

Pilot Pressure—Auxiliary pressure used to actuate or control a component.

Rated Pressure—The operating pressure which is recommended for a component or a system by the manufacturer.

Static Pressure—The pressure in a fluid at rest. (A form of "potential energy.")

Suction Pressure—The absolute pressure of the fluid at the inlet side of the pump.

Surge Pressure—The pressure changes caused in a circuit from a rapidly accelerated column of oil. The "surge" includes the span of these changes, from high to low.

System Pressure—The pressure which overcomes the total resistances in a system. It includes all losses as well as useful work.

Working Pressure—The pressure which overcomes the resistance of the working device.

PULSATION—Repeated small fluctuation of pressure within a circuit.

PUMP—A device which converts mechanical force into hydraulic fluid power. Basic design types are gear, vane, and piston units.

Fixed Displacement Pump—A pump in which the output per cycle *cannot* be varied.

Variable Displacement Pump—A pump in which the output per cycle *can* be varied.

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R

REGENERATIVE CIRCUIT—A circuit in which pressure fluid discharged from a component is returned to the system to reduce power input requirements. Often used to speed up the action of a cylinder by directing discharged oil from the rod end to the piston end.

REMOTE—A hydraulic function such as a cylinder which is separate from its supply source. Usually connected to the source by flexible hoses.

RESERVOIR—A container for keeping a supply of working fluid in a hydraulic system.

RESTRICTION—A reduced cross-sectional area in a line or passage which normally causes a pressure drop. (Examples: pinched lines or clogged passages, or an orifice designed into a system.)

S

SOLENOID—An electro-magnetic device which positions a hydraulic valve.

STARVATION—A lack of oil in vital areas of a system. Often caused by plugged filters, etc.

STRAINER—A coarse filter.

STROKE—
1. The length of travel of a piston in a cylinder.

2. Sometimes used to denote the changing of the displacement of a variable delivery pump.

SURGE—A momentary rise of pressure in a hydraulic circuit.

SYSTEM—One or more series of component parts connected to each other. Often made up of two or more "circuits".

T

THERMAL EXPANSION—Expansion of the fluid volume due to heat.

TORQUE—The turning effort of a hydraulic motor or rotary cylinder. Usually given in inch-pounds (in-lbs) or foot-pounds (ft-lbs).

TUBE—A line whose size is its outside diameter.

V

VALVE—A device which controls either 1) pressure of fluid, 2) direction of fluid flow, or 3) rate of flow.

Bypass Flow Regulator Valve—A valve which regulates the flow to a circuit at a constant volume, dumping excess oil.

Check Valve—A valve which permits flow in only one direction.

Closed Center Valve—A valve in which inlet and outlet ports are closed in the neutral position, stopping flow from pump.

Directional Control Valve—A valve which directs oil through selected passages. (Usually a spool or rotary valve design.)

Flow Control Valve—A valve which controls the rate of flow. (Sometimes called a "volume control valve.")

Flow Divider Valve—A valve which divides the flow from one source into two or more branches. (Includes "priority" and "proportional" types.)

Needle Valve—A valve with an adjustable tapered point which regulates the rate of flow.

Open Center Valve—A valve in which the inlet and outlet ports are open in the neutral position, allowing a continuous flow of oil from pump.

Pilot Valve—A valve used to operate another valve or control.

Pilot Operated Valve—A valve which is actuated by a pilot valve.

Poppet Valve—A valve design in which the seating element pops open to obtain free flow in one direction and immediately reseats when flow reverses.

Pressure Control Valve—A valve whose primary function is to control pressure. (Includes relief valves, pressure reducing or sequencing valves, and unloading valves.)

Pressure Reducing Valve—A pressure control valve which limits outlet pressure.

Pressure Sequence Valve—A pressure control valve which directs flow in a preset sequence.

Priority Flow Divider Valve—A valve which directs oil to one circuit at a fixed rate and dumps excess flow into another circuit.

Proportional Flow Divider Valve—A valve which directs oil to all its circuits at all times.

Relief Valve—A valve which limits the pressure in a system, usually by releasing excess oil.

Rotary Directional Valve—A valve designed in a cylindrical shape. When the valve is turned, it opens and closes drilled passages to direct oil.

Selector Valve—A valve which selects one of two or more circuits in which to direct oil, usually operated manually.

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Shuttle Valve—A connecting valve which selects one of two or more circuits because of flow or pressure changes in these circuits.

Shutoff Valve—A valve which operates fully open or fully closed.

Spool Directional Valve—A valve designed as a spool which slides in a bore, opening and closing passages.

Thermal Relief Valve—A valve which limits the pressure in a system caused by heat expansion of oil.

Two-, Three-, Four-, or Six-Way Valve—A valve having 2, 3, 4, or 6 ports for direction of oil flow.

Unloading Valve—A valve which allows a pump to operate at minimum load by dumping the pump's excess oil at a low pressure.

Volume Control Valve—A valve which controls the rate of flow. Includes flow control valves, flow divider valves, and bypass flow regulators.

V

VALVE STACK—A series of control valves in a stack with common end plates and a common oil inlet and outlet.

VELOCITY—The *distance* which a fluid travels per unit time. Usually given as feet per second.

VENT—An air breathing device in a fluid reservoir.

VISCOSITY—The measure of resistance of a fluid to flow.

VOLUME—The amount of fluid flow per unit time. Usually given as gallons per minute (gpm).

ABBREVIATIONS

ASAE—American Society of Agricultural Engineers (sets standards for many hydraulic components for agricultural use)

°F—degrees Fahrenheit (of temperature)

ft-lbs—foot-pounds (of torque or turning effort)

gpm—gallons per minute (of fluid flow)

hp—horsepower

I.D.—inside diameter (as of a hose or tube)

O.D.—outside diameter (as of a hose or tube)

psi—pounds per square inch (of pressure)

rpm—revolutions per minute

SAE—Society of Automotive Engineers (sets standards for many hydraulic components)

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ABSTRACT - Information in this training and reference manual was developed by Deere and Company for shop trainees or for experienced mechanics. Arranged in a step-by-step manner, the first two chapters cover the basics of engines, followed by seven chapters explaining various systems, and concluding with three chapters discussing the complete engine in terms of testing, diagnosis, and tune-up. Chapters are: (2) Engines: How They Work, (2) Basic Engine, (3) Gasoline Fuel Systems, (4) LP-Gas Fuel Systems, (5) Diesel Fuel Systems, (6) Intake and Exhaust Systems, (7) Lubrication Systems, (8) Cooling Systems, (9) Governing Systems, (10) Engine Test Equipment and Service Tools, (11) Diagnosis and Testing, and (12) Engine Tune-up. Also included are definitions of terms and symbols as well as a subject index. A comprehensive color slide set of the line drawings and photographs illustrating the text is available from the source of availability indicated for this document. Related documents are available as VT 010 754, VT 010 755, and VT 010 757 (all in this issue). (SB)

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FOS

Fundamentals of Service Engines

JOHN DEERE

VT016753

TO THE READER

PURPOSE OF THIS MANUAL

The main purpose of this manual is to train the reader so that he can understand and service engines with speed and skill. Starting with "how it works," we build up to "why it fails" and "what to do about it." This manual is also an excellent reference for the trained mechanic who wants to refresh his memory on engines. It is written in a simple form using many illustrations so that it can be easily understood.

APPLICATION OF ENGINES IN THIS MANUAL

"Engines" is a broad field. But in this manual, the prime interest is in engines as they are commonly used to produce work on the farm and in industry.

HOW TO USE THIS MANUAL

This manual can be used by anyone—experienced mechanics and shop trainees, as well as vocational students and interested laymen.

By starting with the basics, build your knowledge step by step. Chapter 1 covers the basics—"how it works;" Chapter 2 covers the basic engine components, while Chapters 3 through 9 explain the various systems—fuel, lubrication, cooling, etc. Chapters 10, 11, and 12 return to the complete engine in terms of testing, diagnosis, and tune-up.

Persons not familiar with engines should start at Chapter 1 and study the chapters in sequence. The experienced man can find what he needs on the "Contents" page.

OTHER MANUALS IN THIS SERIES

We, at John Deere, are preparing a series of these manuals called "Fundamentals of Service," or "FOS."

Other manuals in the FOS series are:

- **Hydraulics**
- **Electrical Systems**
- **Power Trains**
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We hope to expand this library in the future to fulfill the needs of our dealer's servicemen, as well as vocational students and interested laymen.

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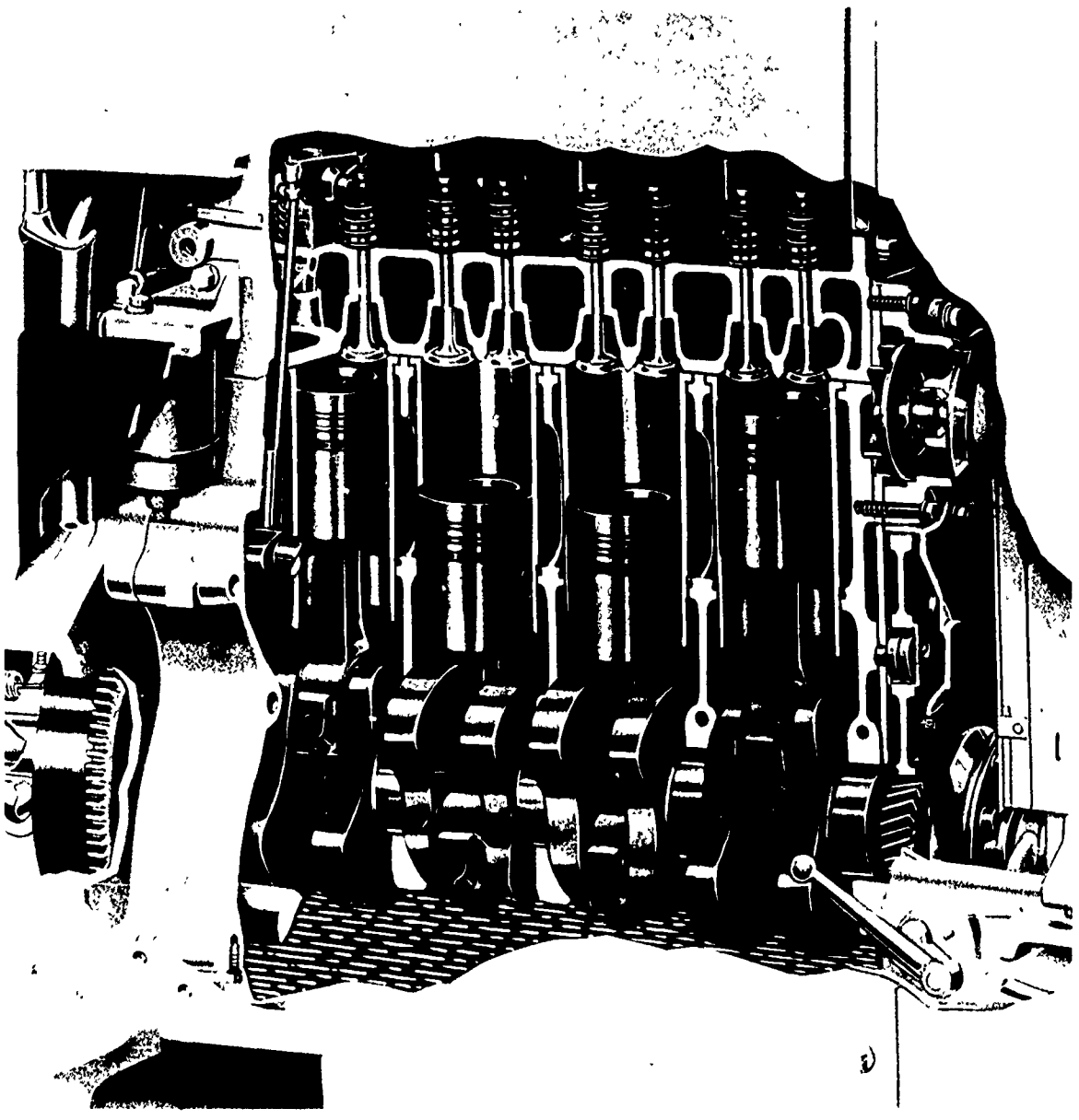

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ENGINES—How They Work / CHAPTER 1

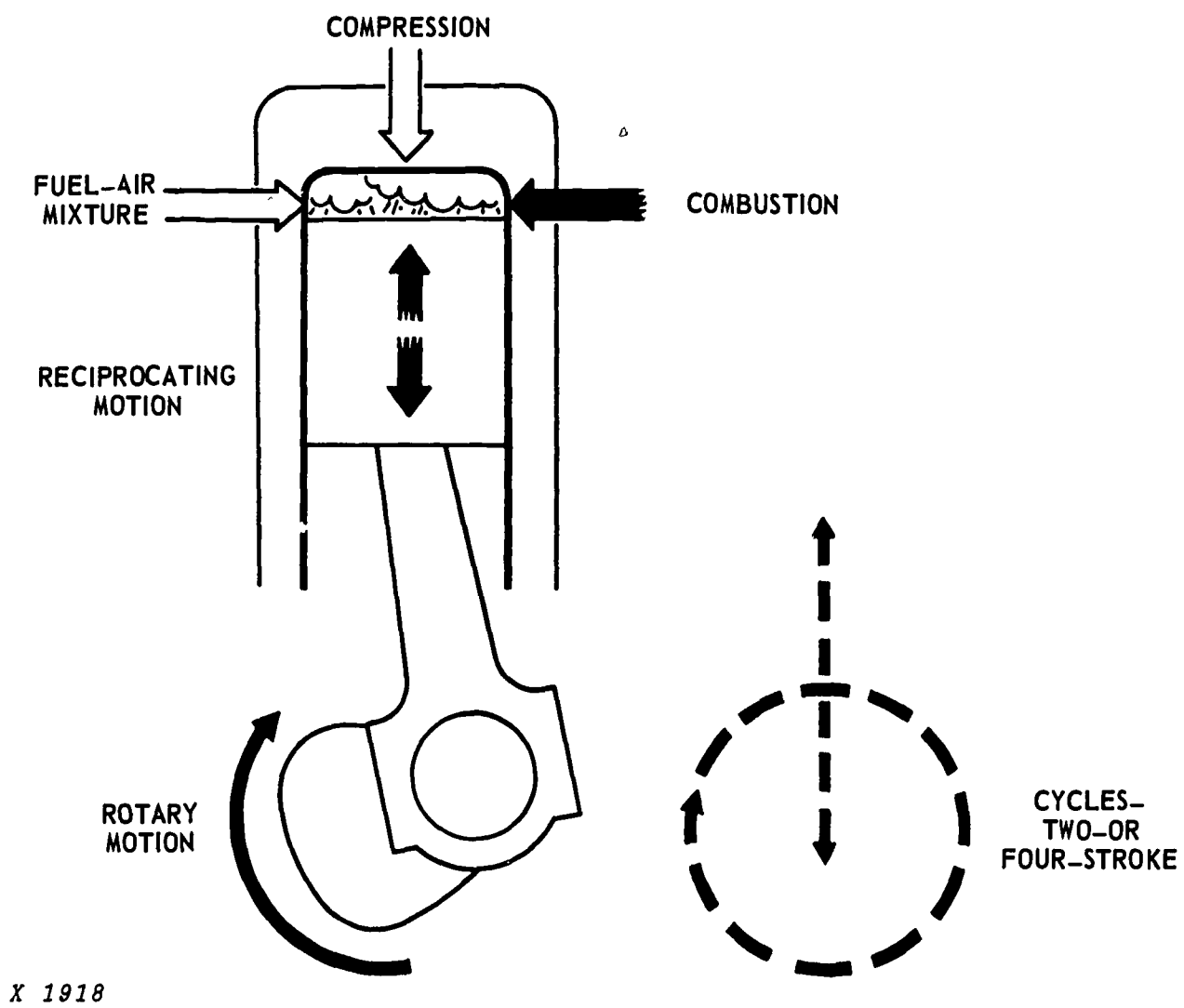

Fig. 1 — Basic Elements Of An Engine

WHAT IS AN "INTERNAL COMBUSTION" ENGINE?

Let's see what the term "internal combustion" means:

- **"Internal" means "inside" or "enclosed"**
- **"Combustion" is the "act of burning"**

Thus an internal combustion engine is one that *burns fuel internally.*

Basically this engine is a container in which we put fuel and air and start them burning.

The mixture expands rapidly while burning and pushes outward. This push can be used to move a part of the engine, and transmitted to drive the machine.

In summary, an engine is a device which converts heat energy into mechanical energy to do work.

WHAT ELEMENTS ARE NEEDED FOR AN ENGINE?

These elements are needed to construct a simple engine:

- **Air, Fuel, and Combustion**
- **Reciprocating and Rotary Motion**
- **Compression of Fuel-Air Mixture**
- **Engine Cycles—Two-or Four-Stroke**

Let's discuss these items one by one.

AIR, FUEL AND COMBUSTION

Three basic elements are needed to produce heat energy in the engine:

- **Air**
- **Fuel**
- **Combustion**

AIR is needed to combine with fuel and give it oxygen for fast burning. Air also has two other properties which affect the engine:

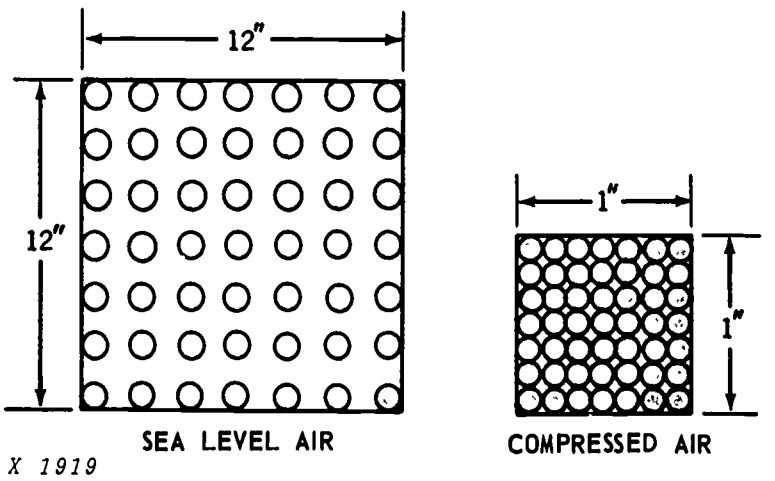

Fig. 2 — Air Can Be Compressed

(1) Air will compress; one cubic foot of air can be packed into one cubic inch or less (Fig. 2).

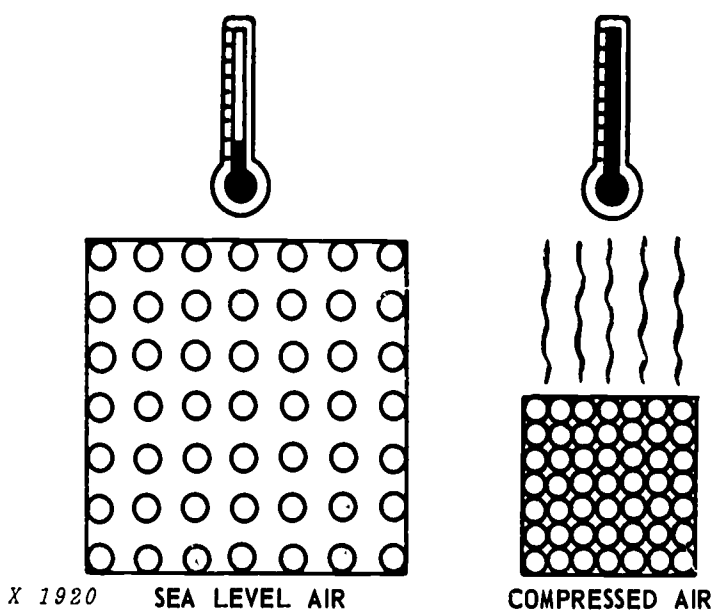

Fig. 3 — Air Heats When Compressed

(2) Air heats when it is compressed. The molecules of air rub against each other and produce heat (Fig. 3).

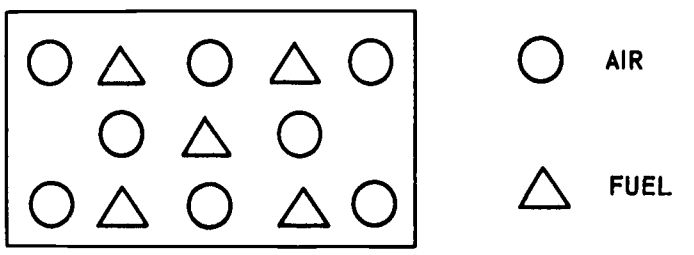

Fig. 4 — Fuel Must Mix Readily With Air And Ignite Easily

FUEL must mix readily with air and ignite easily (Fig. 4). The three we will cover are gasoline, LP-gas, and diesel fuel.

These fuels ignite easily and are readily broken down or vaporized.

Why do we want to vaporize the fuel? To help each particle of fuel contact enough air to burn fully.

COMBUSTION is the actual igniting and burning of the fuel-air mixture. It is the *oxygen* in the air that combines with the fuel for combustion.

What is important here is *how fast* the fuel burns, for this force must be "explosive" to get full power from the engine.

If a container of gasoline is ignited in calm outside air, it burns rather lazily (Fig. 5). This is because the air contacts only the surface of the fuel. To make the fuel burn faster, two things can be done:

1) Heat up the fuel

2) Vaporize the fuel (Fig. 5)

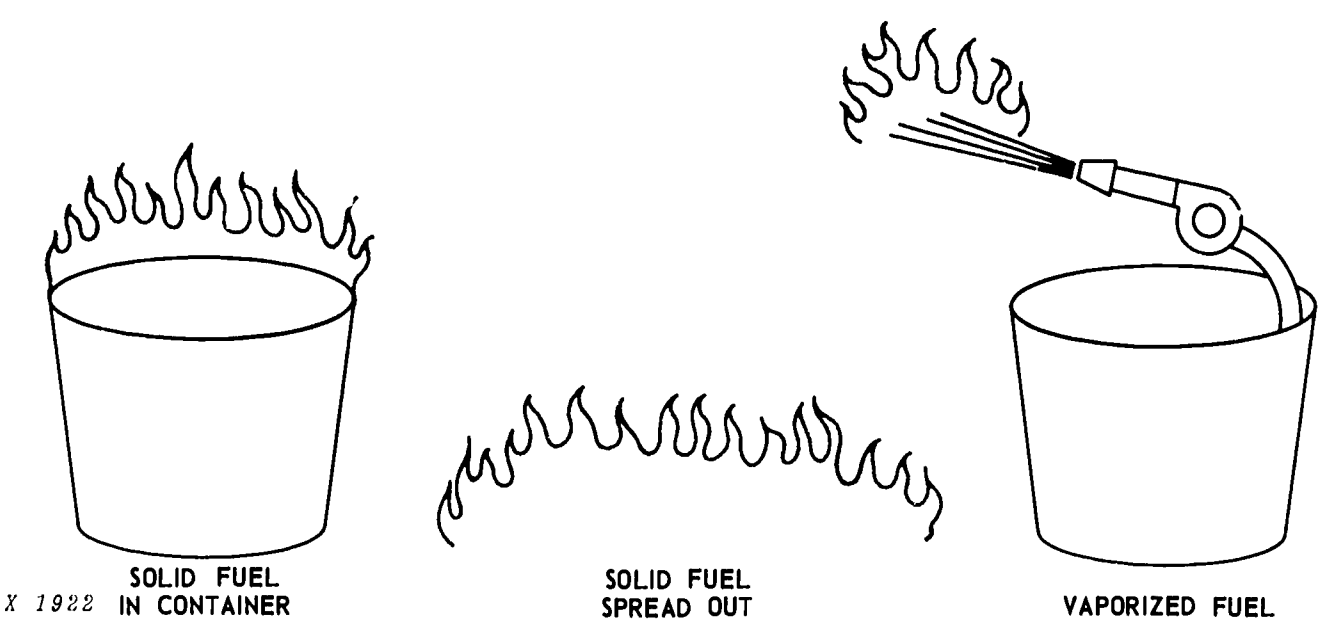

Fig. 5 —Vaporized Fuel Burns Faster

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However, too powerful an explosion would destroy an engine, since combustion takes place in a closed container.

We can control the rate of burning by 1) how far we compress the air (and so heat it up), 2) how much fuel we use and 3) how volatile it is.

RECIPROCATING AND ROTARY MOTION

The engine uses two forms of motion to transmit energy:

- **Reciprocating Motion—up-and-down or back-and-forth motion**
- **Rotary Motion—circular motion around a point**

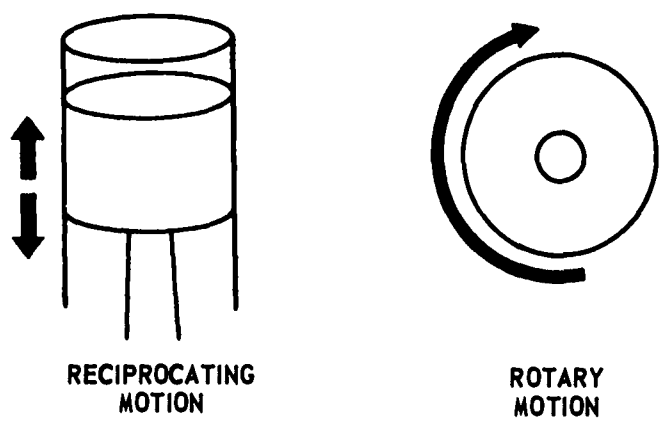

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Fig. 6 — Reciprocating And Rotary Motion

The engine converts reciprocating motion into rotary motion (Fig 6).

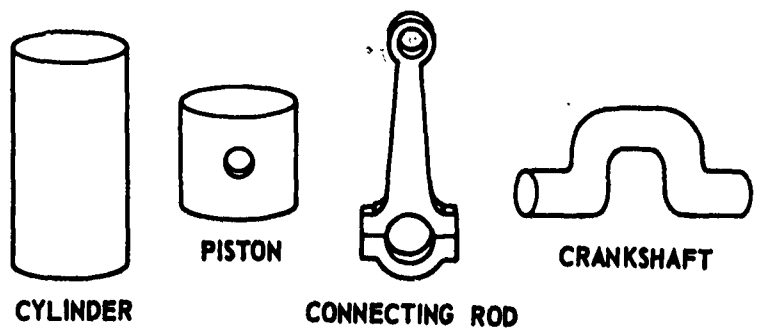

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Fig. 7 — Basic Parts Of The Engine

Four basic parts are needed to make the engine work in this way:

- **Cylinder**
- **Piston**
- **Connecting Rod**
- **Crankshaft**

The *piston* and *cylinder* are mated parts, fitted closely so that the piston glides easily in the cylinder but with little clearance at the sides. The

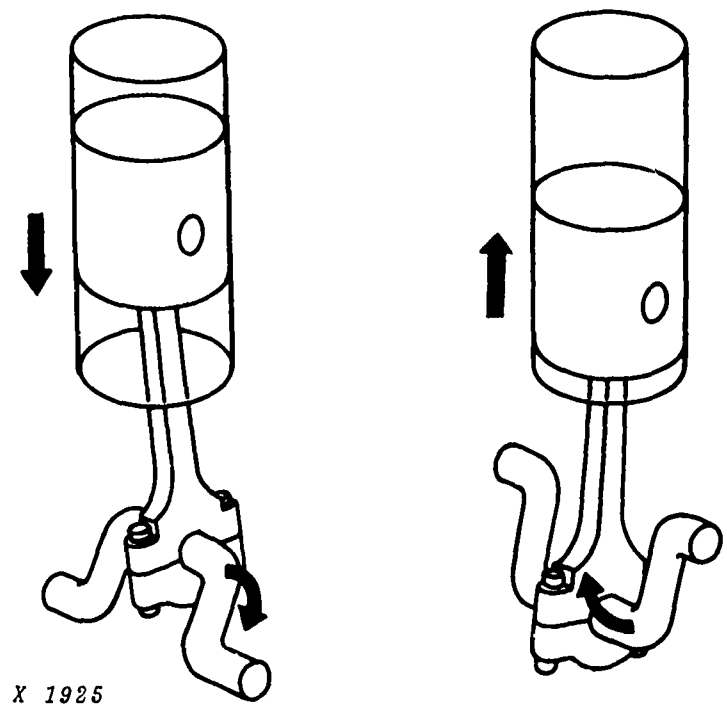

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Fig. 8 — How Reciprocating Motion Is Transmitted To The Crankshaft As Rotary Motion

top of the cylinder is closed, but has extra space for the combustion chamber. A cylinder head of the engine generally closes the end of the cylinder.

The *connecting rod* is the link which transmits the motion of the piston to the crankshaft.

A simple *crankshaft* has a section offset from the center line of the shaft so that it "cranks" when the shaft is turned.

The motion is basically the same as when you pedal a bicycle. Your leg is like the connecting rod while the pedal crank and sprocket are like the crankshaft.

As a result, we have a way of converting the reciprocating motion of the piston into useful rotary motion (Fig. 8).

The stroke of the piston (how far it travels in the cylinder) is set by the "throw" of the crankshaft (how far it is offset).

COMPRESSION OF THE FUEL-AIR MIXTURE

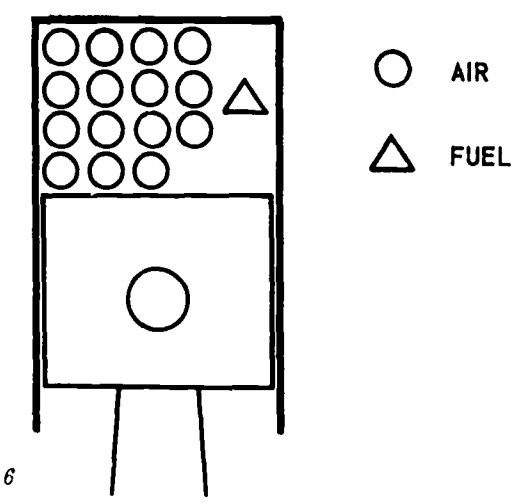

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Fig. 9 — Fuel-Air Ratio For Gasoline Engine

The modern gasoline engine works best when about 15 parts of air are mixed witn 1 part of fuel (Fig. 9).

Fig. 10 — Volume Of Fuel-Air Needed For Gasoline Engine

The fuel and air are mixed by *weight*, not volume. Fig. *10* shows how much greater the *volume* of air needed is than the volume of fuel. The gasoline engine mixes 10 gallons of gasoline with about *90,000* gallons of air.

As a result, we must **compress** the fuel-air mixture to get the desired ratio.

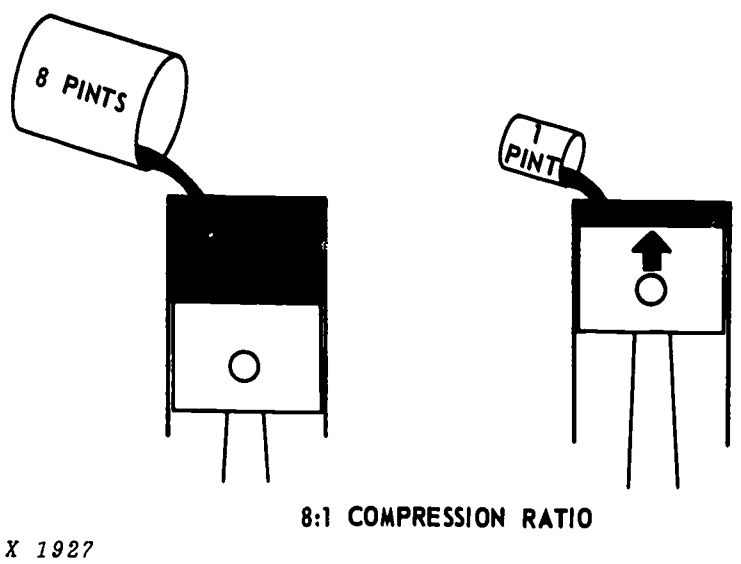


Fig. 11 — Compression Ratios Tell How Much The Fuel-Air Mixture Is Compressed By Volume

Compression ratios tell us how much the fuel-air mixture is compressed by volume. Fig. 11 shows an imaginary case.

When the piston is at the bottom of its stroke, let's measure the amount of liquid the cylinder will hold and say it takes 8 pints.

Now if we remove all the liquid and move the piston to the top of its stroke, we can again pour the cylinder full of liquid. Let's say it only holds one pint.

The ratio is then 8 to 1, which is the *compression ratio.*

In other words, air in this engine is compressed to one-eighth of its former volume by the moving piston. Later we'll see how compression affects the engine.

ENGINE CYCLES

For an engine to operate, a definite series of events must occur in sequence. They are:

1. *Fill the cylinder with a combustible mixture.*
2. *Compress this mixture into a smaller space.*
3. *Ignite the mixture and cause it to expand, producing power.*
4. *Remove the burned gases from the cylinder.*

The sequence above is generally called:

- **Intake**
- **Compression**
- **Power**
- **Exhaust**

To produce sustained power, the engine must repeat this sequence over and over again.

One complete series of these events in an engine is called a *cycle.*

Most engines have one of two types of cycles:

- **Two-Stroke Cycle**
- **Four-Stroke Cycle**

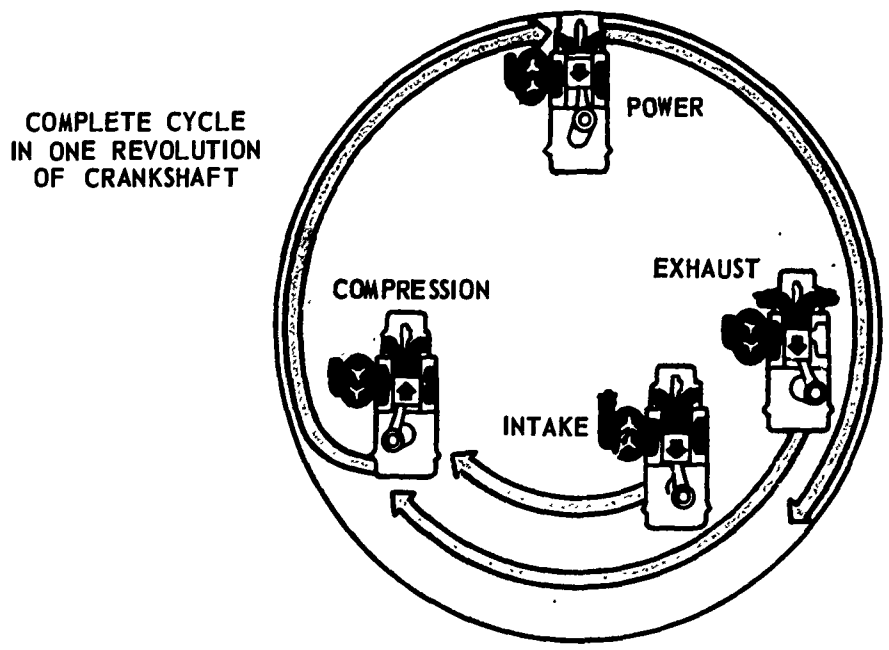
In the TWO-STROKE CYCLE engine, there are two strokes of the piston, one up and one down, during each cycle (Fig. 12). Then it starts over again on another cycle of the same two strokes. This whole cycle occurs during one revolution of the crankshaft.

In the FOUR-STROKE CYCLE engine, there are four strokes of the piston, two up and two down, during each cycle (Fig. 12). Then it starts over again on another cycle of the same four strokes. This cycle occurs during *two* revolutions of the crankshaft. Most engines today operate on the four-stroke cycle.

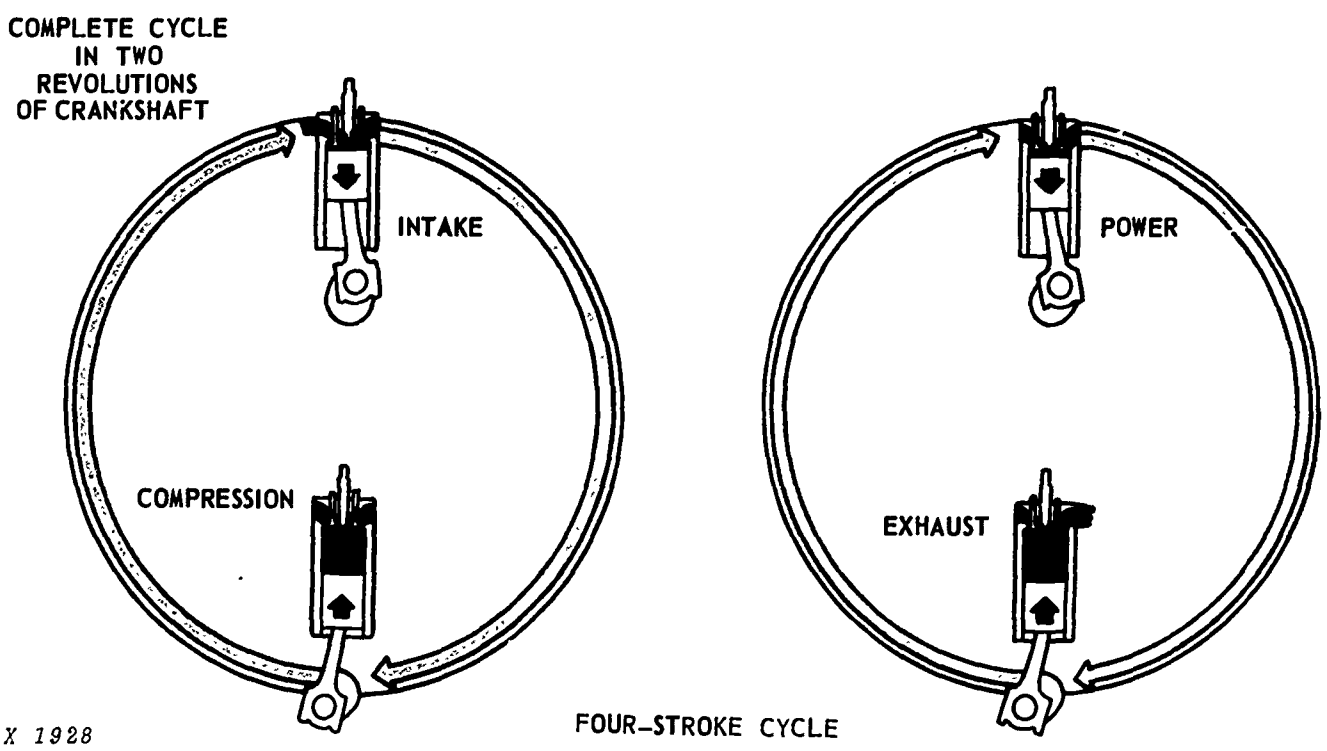
Let's see how each type of cycle works in detail.

TWO-STROKE CYCLE ENGINE

In the **two-stroke cycle** engine, the complete cycle of events—intake, compression, power, and exhaust—takes place during two piston strokes.



TWO-STROKE CYCLE



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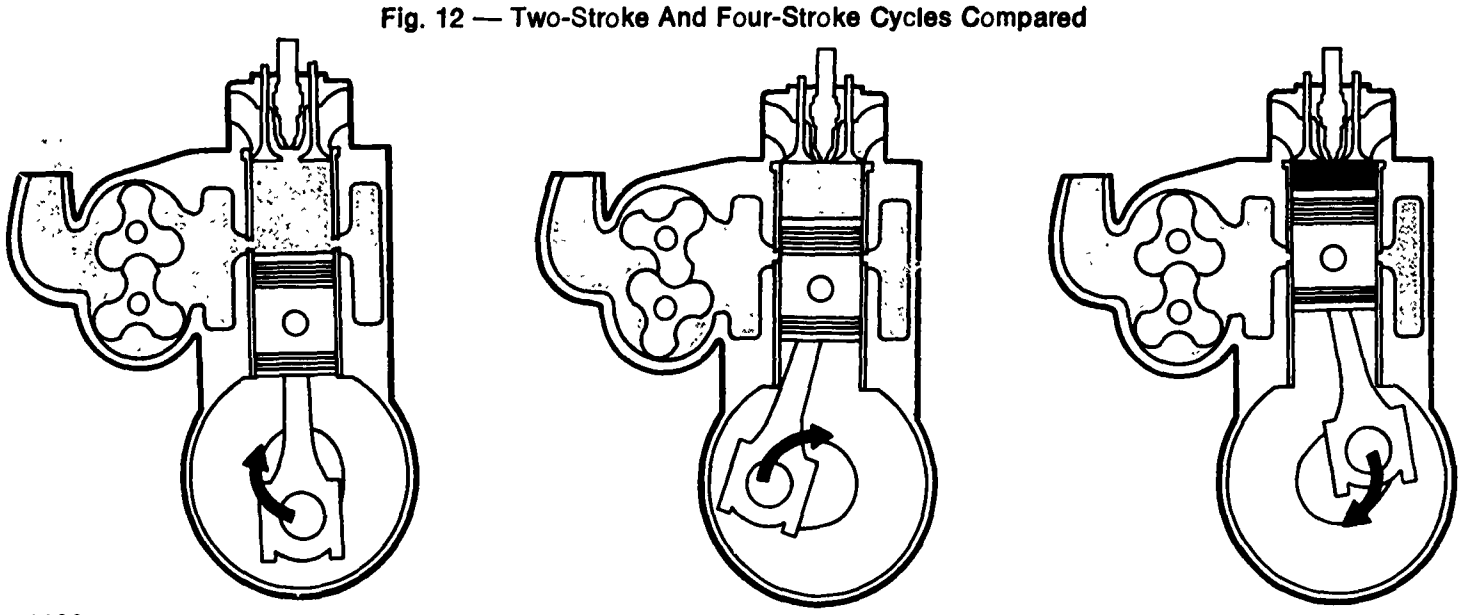
FOUR-STROKE CYCLE

Fig. 12 — Two-Stroke And Four-Stroke Cycles Compared



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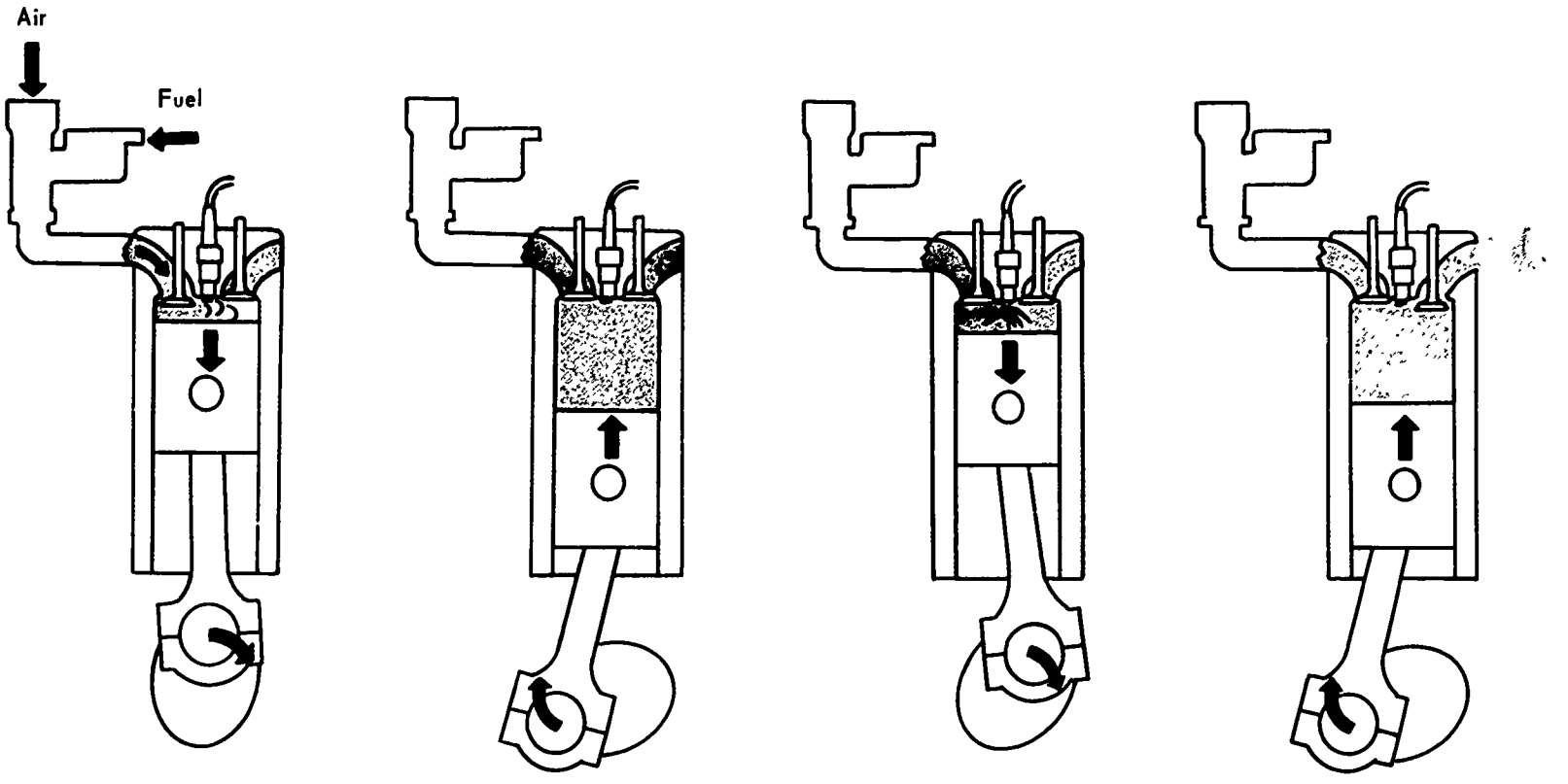
INTAKE AND EXHAUST

COMPRESSION

POWER

Fig. 13 — Two-Stroke Cycle Engine (Diesel Shown)



INTAKE	COMPRESSION	POWER	EXHAUST
Fuel–Air Mixture Is Drawn Into Cylinder From Carburetor Through Open Intake Valve By Down–Stroke Of Piston.	Mixture Is Compressed By Up–Stroke Of Piston. Both Intake and Exhaust Valves are Closed.	Compressed Mixture Is Ignited By Spark Plug and Expanding Gases Force Piston To Bottom Of Cylinder. Valves Remain Closed.	Piston On Up–Stroke Forces Burned Gases From Cylinder Through Open Exhaust Valve.

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Fig. 14 — Four-Stroke Cycle Engine (Gasoline Shown)

Fig. 13 shows a two-cycle diesel engine in operation. Every other stroke is a power stroke; each time the piston moves down it is a power stroke.

In the diesel engine shown, air alone is compressed in the cylinder. A charge of fuel is then sprayed into the cylinder and ignites from the heat of compression.

In the two-cycle engine, intake and exhaust take place during part of the compression and power strokes.

A blower is sometimes used to force air into the cylinder for expelling exhaust gases and to supply fresh air for combustion. The cylinder wall contains a row of ports which are above the piston when it is at the bottom of its stroke. These ports admit air from the blower into the cylinder when they are uncovered (during *intake).*

The flow of air toward the exhaust valves pushes the *exhaust* gases out of the cylinders and leaves them full of clean air wnen the piston again rises to cover the ports (during *compression).*

At the same time, the exhaust valves close and the fresh air is compressed in the closed cylinder.

When the piston almost reaches the top of its *compression* stroke, fuel is sprayed into the combustion area as shown. The heat of compression ignites the fuel and the resulting pressure forces the piston down on its *power* stroke.

As the piston nears the bottom of its stroke, the *exhaust* valves are again opened and the burned gases escape.

The piston then uncovers the *intake* ports and the cycle begins once more.

This entire cycle is completed in *one* revolution of the crankshaft or *two strokes* of the piston—one up and one down.

FOUR-STROKE CYCLE ENGINE

In **four-stroke cycle** engines, the same four operations occur—intake, compression, power, and exhaust. However, four strokes of the piston—two up and two down—are needed to complete the cycle. As a result, the crankshaft will rotate *two* complete turns before one cycle is completed (Fig. 14).

Intake Stroke

The intake stroke starts with the piston near the top and ends with it near the bottom of its stroke. The intake valve is opened, allowing the piston as

it moves down to receive the fuel-air mixture. The valve is then closed, sealing the cylinder.

Compression Stroke

The compression stroke begins with the piston at bottom and rising up to compress the fuel-air mixture. Since the intake and exhaust valves are closed, there is no escape for the fuel-air and it is compressed to a fraction of its original volume.

Power Stroke

The power stroke begins when the piston almost reaches the top of its stroke and the fuel-air mixture is ignited. As the mixture burns and expands, it forces the piston down on its power stroke. The valves remain closed so that all the force is exerted on the piston.

Exhaust Stroke

The exhaust stroke begins when the piston reaches the end of its power stroke. The exhaust valve is opened and the piston rises, pushing out the burned gases. When the piston reaches the top, the exhaust valve is closed and the piston is ready for a new four-stroke cycle of intake, compression, power, and exhaust.

As it completes the cycle, the crankshaft has gone all the way around twice.

TWO-CYCLE VS. FOUR-CYCLE ENGINES

It might seem that the two-cycle engine can produce twice as much power as a four-cycle engine.

However, this is not true. With the two-cycle engine, some power may be used to drive the blower that forces the fuel-air charge into the cylinder under pressure. Also, the burned gases are not completely cleared from the cylinder, this results in less power per power stroke. There is another loss in the effective power stroke because the exhaust valves open earlier in a two-cycle engine.

The actual gain in power with a two-cycle engine is about 75 percent (over a four-cycle engine of the same displacement).

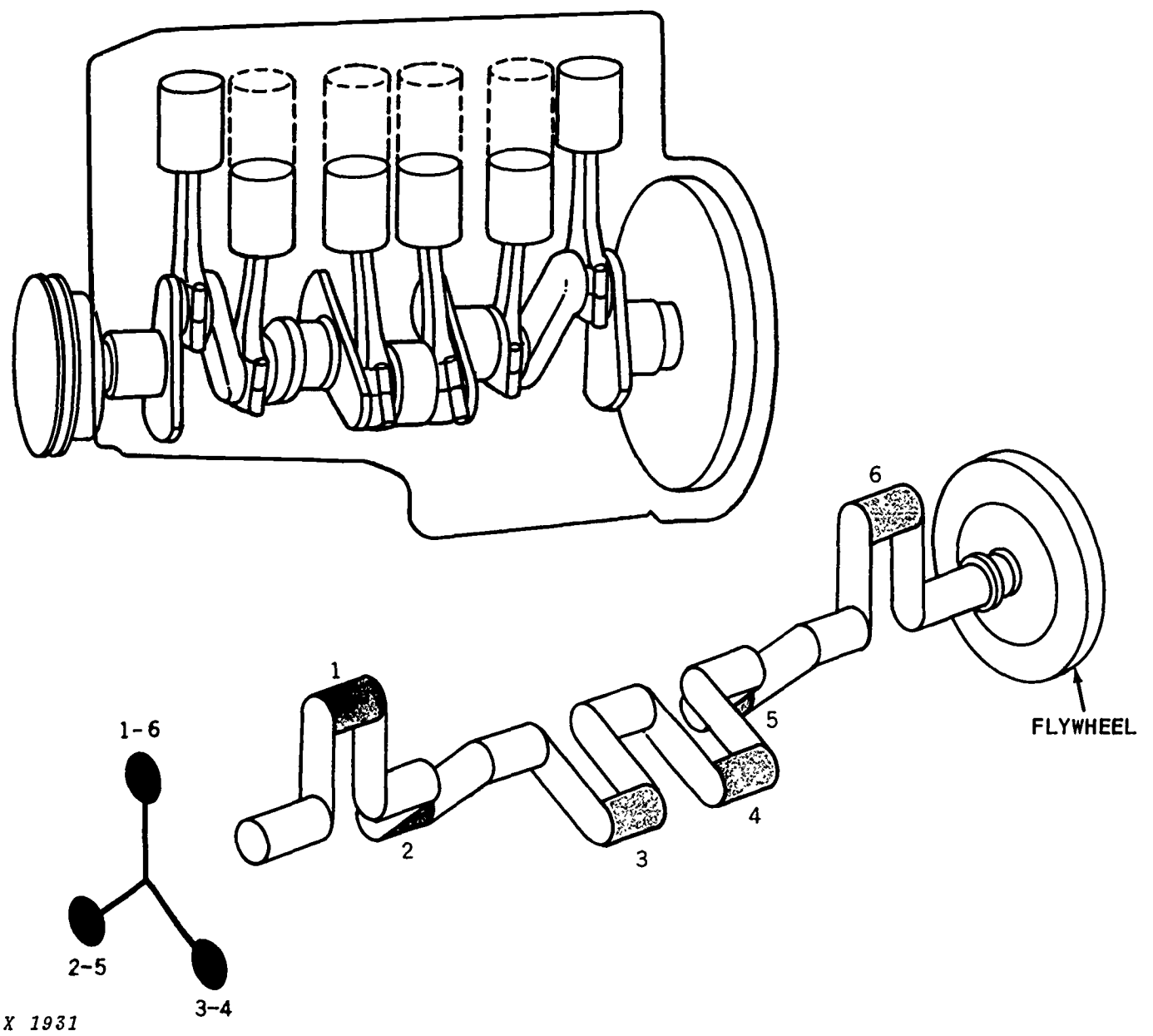

Fig. 15 — Crankshaft For A Six-Cylinder Engine

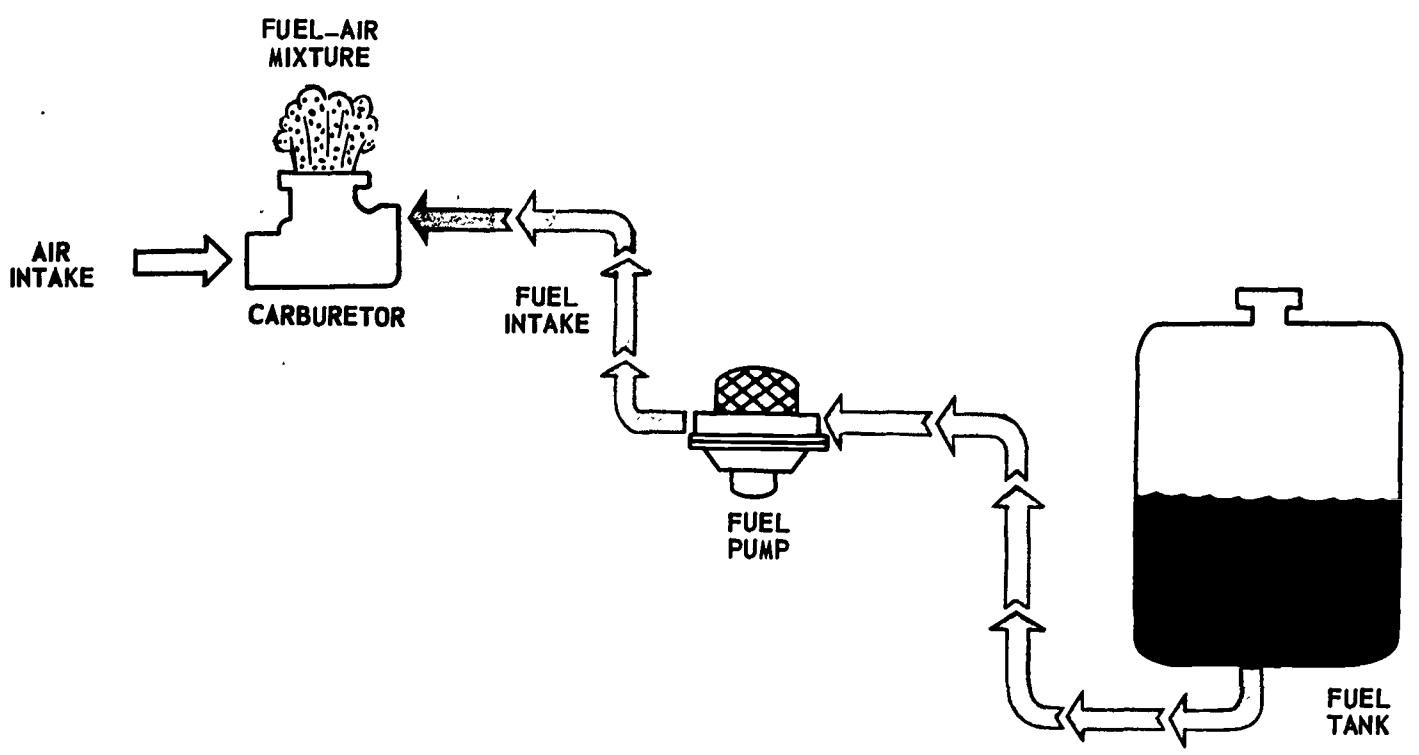

Fig. 16 — Gasoline Fuel System

MULTIPLE-CYLINDER ENGINES

So far we have covered only basic one-cylinder engines.

A single cylinder gives only one power impulse every two revolutions of the crankshaft in a four-cycle engine. Thus it is producing power only one-fourth of the time.

For a more continuous flow of power, modern engines use four, six, eight, or more cylinders. The same series of cycles takes place in each cylinder.

For example, in a typical four-stroke cycle engine having six cylinders, the cranks on the crankshaft are set 120 degrees apart (Fig. 15). The cranks for cylinders 1 and 6, 2 and 5, 3 and 4 are in line with each other as shown.

The cylinders normally fire and deliver their power strokes in the following order: 1-5-3-6-2-4. Thus the power strokes follow each other so closely that there is a fairly continuous and smooth delivery of power to the crankshaft.

The heavy *flywheel* attaches to the rear of the crankshaft and gives it momentum to return the pistons to the tops of the cylinders after each power stroke. Weights on the crankshaft are used to help balance the forces created in the engine by the rapidly moving parts.

For more details on construction of the basic engine, see Chapter 2.

Now let's look at some of the auxiliary systems that help the engine to operate.

ENGINE SYSTEMS

Now that we've put together a basic engine, let's look at some other systems that are required for good operation:

- **Fuel System**
- **Intake and Exhaust System**
- **Lubrication System**
- **Cooling System**
- **Governing System**

Let's discuss these systems one by one.

FUEL SYSTEMS

A fuel system must deliver clean fuel, in the quantity required, to the fuel intake of an engine. It must provide for safe fuel storage and transfer.

The three fuel systems of concern to us are:

- **Gasoline**
- **LP-Gas**
- **Diesel**

GASOLINE FUEL SYSTEMS

The gasoline fuel system supplies a combustible mixture of fuel and air for the engine.

The basic gasoline fuel system (see Fig. 16) has three parts:

- **Fuel Tank—stores fuel**
- **Fuel Pump—moves fuel to carburetor**
- **Carburetor—atomizes fuel and mixes with air**

In operation, the *fuel pump* moves gasoline from the tank to the carburetor bowl.

The *carburetor* is basically an air tube which atomizes fuel and mixes it with air by a difference in air pressure. It meters both the fuel and air for the engine.

On its intake stroke, the engine creates a partial vacuum. This allows outside air pressure to force the fuel-air vapor mixed in the carburetor into the engine cylinder.

Fuel Supply Systems

Fuel can be supplied to the gasoline engine in two ways:

- **Gravity-Feed**
- **Force-Feed**

The GRAVITY-FEED system has the fuel tank placed *above* the level of the carburetor. This system does *not* use a fuel pump. Instead, the fuel flows by *gravity* to the carburetor.

The FORCE-FEED system allows the fuel tank to be located *below* the carburetor if necessary. A fuel pump moves the fuel from the tank to the carburetor as shown.

More details on gasoline fuel systems are given in Chapter 3.

LP-GAS FUEL SYSTEMS

The LP-gas fuel system (Fig. 17) also supplies a combustible mixture of fuel and air to its engine. However, LP-gas vaporizes at low temperatures.

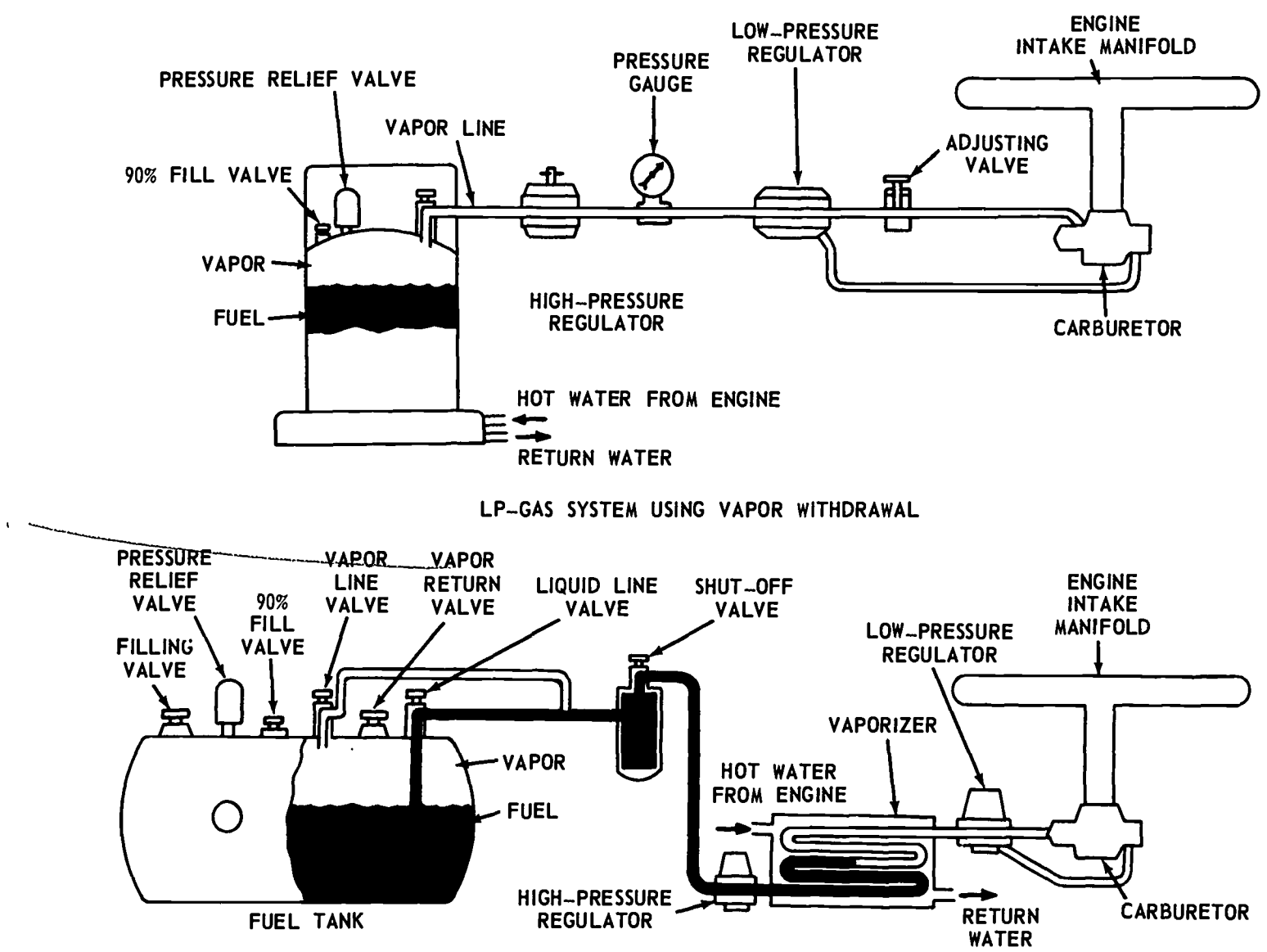

Fig. 17 — LP-Gas Fuel System

Thus the fuel tank must be a closed unit to prevent vapor from escaping.

To withdraw fuel from the tank, two methods are used:

- **Liquid Withdrawal**
- **Vapor Withdrawal**

VAPOR withdrawal of fuel is used in starting; the fuel system is later switched to liquid withdrawal after warm-up. This is because in a cold engine the heat exchanger cannot change the liquid fuel to vapor, and the carburetor operates only on vapor.

The liquid and vapor line valves shown in Fig. 17 provide for safety and for selection of fuel—liquid or vapor. The filters remove moisture and dirt. The pressure regulators keep a constant pressure of fuel at the carburetor for accurate fuel metering.

In the LIQUID withdrawal system, a heat exchanger converts the liquid fuel to vapor. The heat exchanger does this by circulating hot water from the engine cooling system around the fuel line. As the fuel heats up and pressure is reduced, it vaporizes. The *liquid* withdrawal system is most common today.

The LP-gas carburetor is simpler than the gasoline type, since the fuel is already vaporized. It meters the vapor and mixes it with the proper amount of air for the engine.

Chapter 4 of this manual gives more details on LP-gas systems.

DIESEL FUEL SYSTEMS

In the diesel fuel system, fuel is sprayed directly into the engine cylinder where it mixes with hot compressed air and ignites. No electrical spark is used to ignite the mixtures (as in gasoline and LP-gas engines).

Instead of a carburetor, a fuel injection pump and spray nozzle are used.

The major parts of the diesel fuel system are:

- **Fuel Tank—stores fuel**
- **Fuel Pump—moves fuel to injection pump**
- **Fuel Filters—help clean the fuel**
- **Injection Pump—times, measures, and delivers fuel under pressure**
- **Injection Nozzles—atomize and spray fuel into cylinders**

Fig. 18 shows these major parts of the diesel system.

In operation, the *fuel pump* moves fuel from the tank and pushes it through the *filters*. Clean fuel

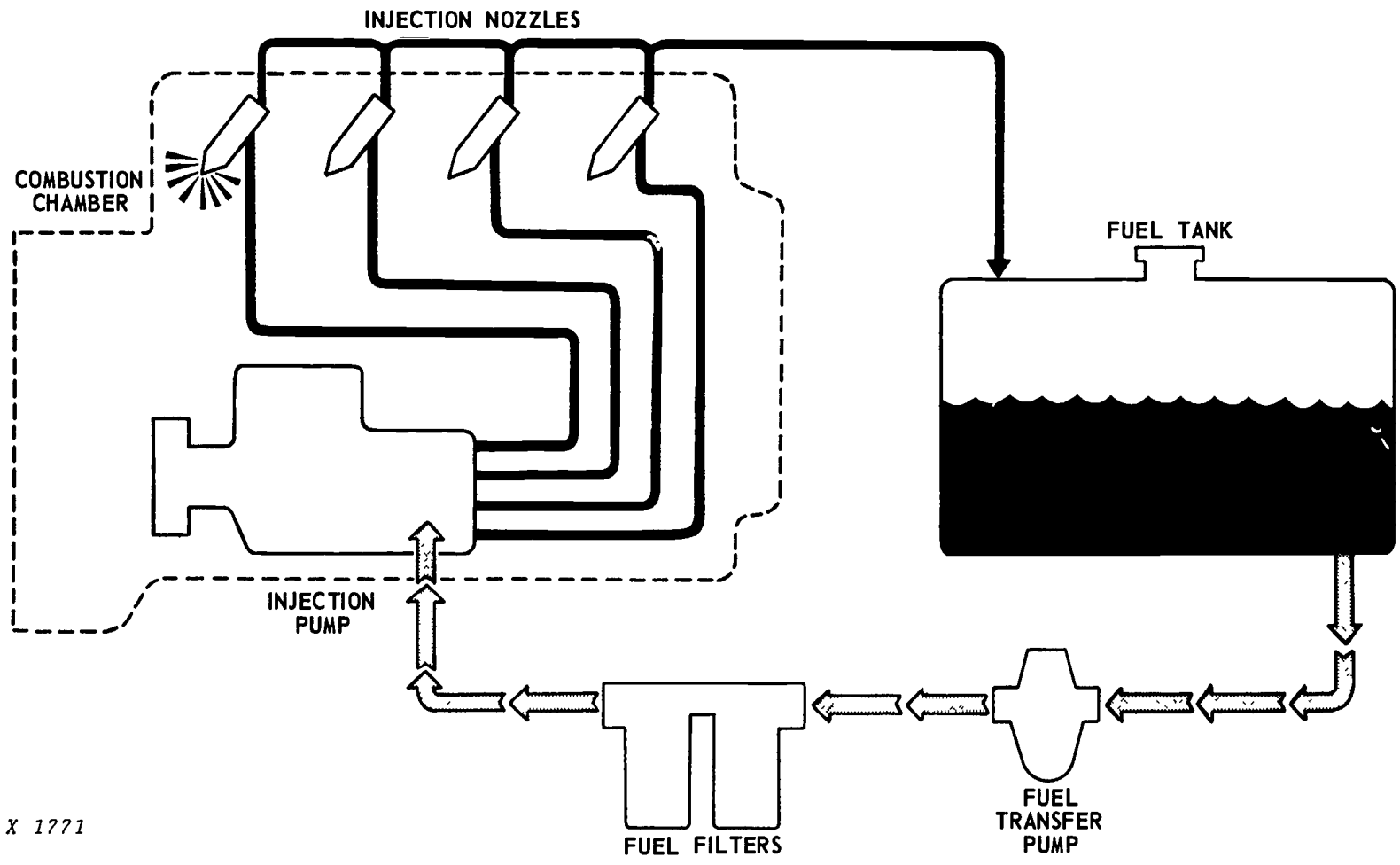

Fig. 18 — Diesel Fuel System

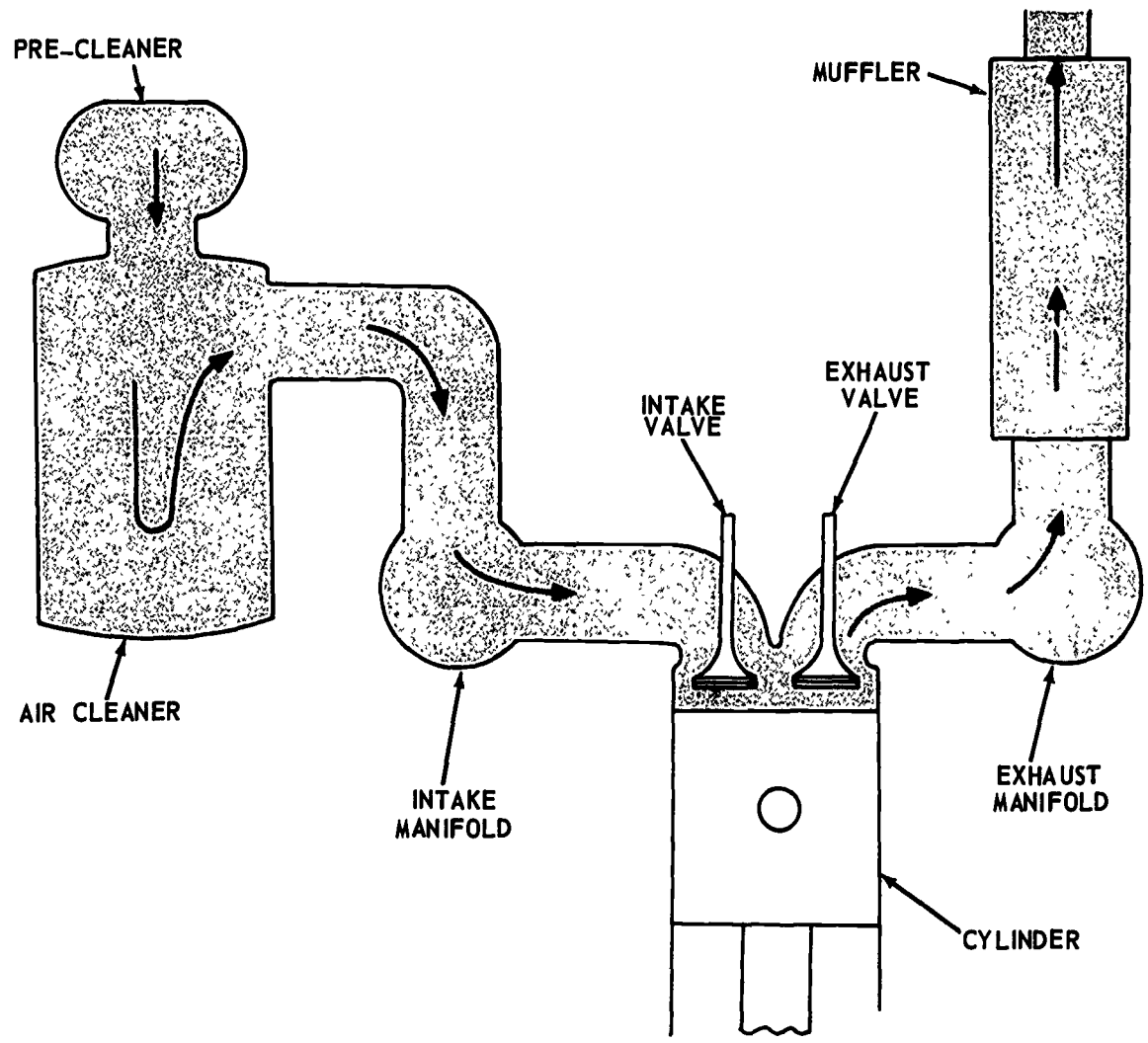

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Fig. 19 — Intake And Exhaust Systems

free of water is very vital to the precision parts of the diesel injection system. Extra filters are often used to assure clean fuel, but buying clean fuel and storing it properly are also prime needs.

The fuel is then pushed on to the *injection pump* where it is metered, put under high pressure, and delivered to each *injection nozzle* in turn.

The nozzles each serve one cylinder; they atomize the fuel and spray it under controlled high pressure into the combustion chamber at the proper moment.

High-pressure fuel is needed at each nozzle to get a fine spray of fuel. This assures good mixing of fuel with the hot compressed air for full combustion.

Chapter 5 of this manual gives more details on the diesel fuel system.

INTAKE AND EXHAUST SYSTEMS

Intake and exhaust systems carry the fuel-air mixture into the engine and remove the exhaust gases after combustion (Fig. 19).

INTAKE SYSTEM

The intake system supplies the engine with clean air of the proper quantity, temperature, and mix for good combustion.

The intake system has five parts:

- **Air cleaners**
- **Blower or turbocharger (optional)**
- **Intake manifold**
- **Carburetor air inlet**
- **Intake valves**

Air cleaners filter dust and dirt from the air passing through them enroute to the carburetor. Precleaners prevent larger particles from reaching the air cleaners and plugging it.

Blowers can be used on two-cycle engines to force air into the cylinder while exhaust gases are driven out. The blower is an air pump which pressurizes air.

Turbochargers increase horsepower by packing more air or fuel-air mixture into the engine cylinders than the engine could take in by itself.

Intake manifolds transport the air-fuel mixture (pure air on diesel engines) to the engine cylinders.

Carburetors mix incoming air with fuel in the proper proportion for combustion, and control engine speed.

Intake valves admit air to diesel engines and the fuel-air mixture to spark-ignition engines. They are normally opened and closed by mechanical linkage from the camshaft.

For more details on intake systems, see Chapter 6.

EXHAUST SYSTEMS

The exhaust system collects the exhaust gases after combustion and carries them away. This is really three jobs:

1) Removing heat

2) Muffling engine sounds

3) Carrying away burned and unburned gases

The exhaust system has these basic parts:

- **Exhaust valves**
- **Exhaust manifold**
- **Muffler**

Exhaust valves open to release the burnt gases on four-cycle engines. The valves are normally driven by the camshaft.

The *exhaust manifold* collects the exhaust gases and conducts them away from the cylinder.

The *muffler* reduces the sounds of the engine during the exhaust period.

See Chapter 6 for details on exhaust systems.

LUBRICATION SYSTEMS

The lubrication system does these jobs for the engine:

1) Reduces friction between moving parts

2) Absorbs and dissipates heat

3) Seals the piston rings and cylinder walls

4) Cleans and flushes moving parts

5) Helps deaden the noise of the engine

With lubricating oil, the system is able to do all these jobs at once (Fig. 20). Without oil, the engine would soon wear out, burn up, or seize. For oil not only reduces friction by forming a film between parts, it also conducts heat away from these parts.

The lubrication system may work by splashing oil on the moving parts or it may feed oil under pressure to the parts via internal oil passages as shown in Fig 22. In some cases, both methods are used at the same time.

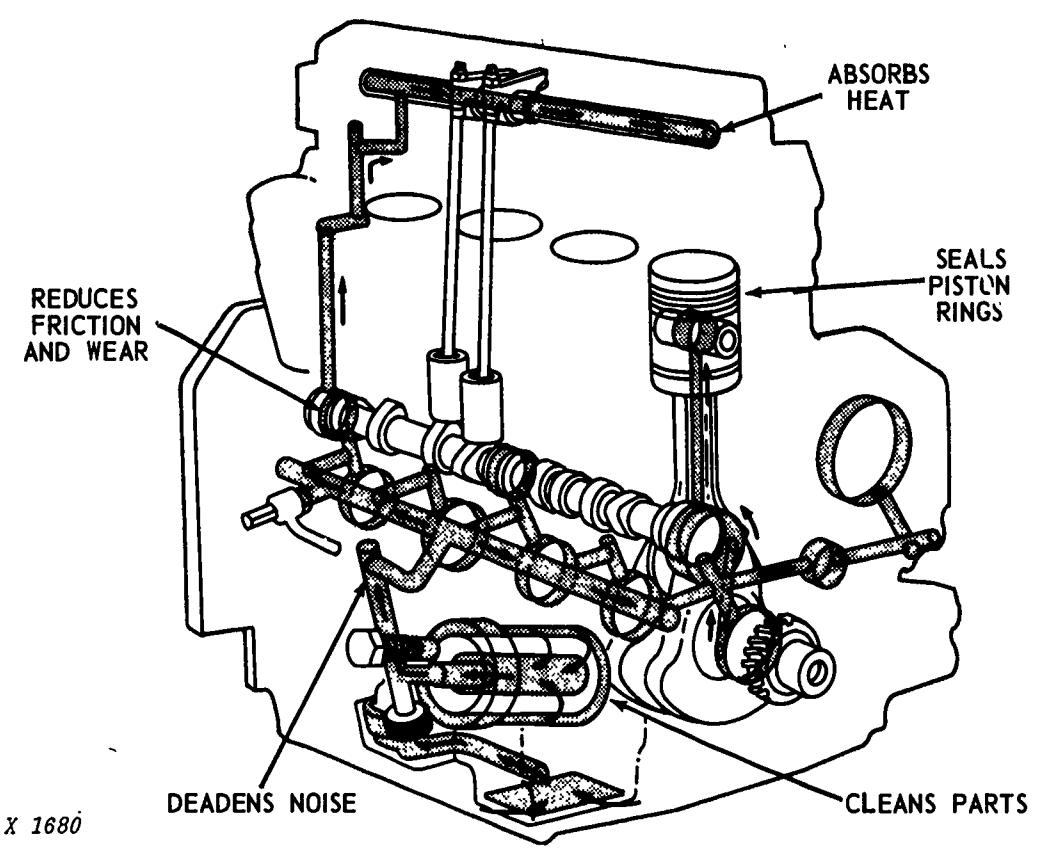

Fig. 20 — Lubrication System

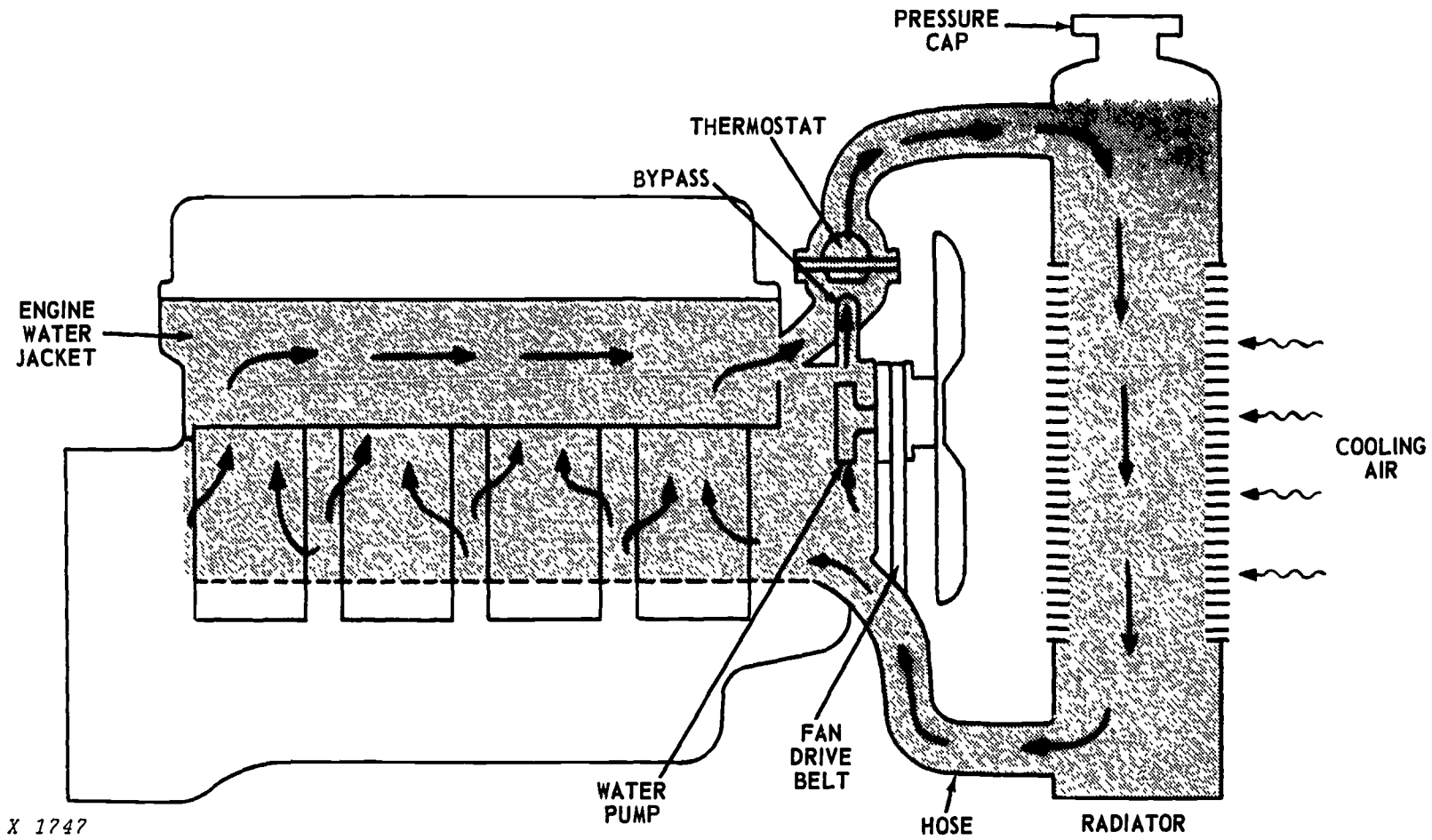

Fig. 21 — Cooling System (Liquid Type Shown)

The engine crankcase forms an oil reservoir where oil is stored and also cooled.

The crankcase must be vented to prevent pressure build-ups from the blow-by of gases past the pistons.

Modern venting sometimes includes a system which routes crankcase vapors back to the intake system to reduce air pollution.

See Chapter 7 for further details on lubrication systems.

COOLING SYSTEMS

The cooling system does two things:

1) Prevents overheating of the engine

2) Regulates temperatures at best levels

OVERHEATING could burn up engine parts in a short time. Some heat is needed for combustion, but the working engine generates too much heat. So the cooling system must carry off the excess heat.

REGULATING TEMPERATURES keeps the engine at the best heat level for good combustion during each operation. During starting, the engine must be warmed up as fast as possible. Later, during peak operations, the engine must normally be cooled.

TYPES OF COOLING SYSTEMS

Two types of cooling systems are used on modern engines:

- *Air Cooling—uses air passing around the engine to dissipate heat*
- *Liquid Cooling—uses water around the engine to dissipate heat*

AIR COOLING is used primarily on small engines or aircraft as it is difficult to route air to all the heat points of larger engines. Metal baffles, ducts, and blowers are used to aid in distributing air.

LIQUID COOLING normally uses water as a coolant. In cold weather, anti-freeze solutions are added to the water to prevent freezing. The water circulates in a jacket around the cylinders and cylinder head. As heat radiates, it is absorbed by the water, which then flows to the radiator. Air flow through the radiator cools the water and dissipates heat into the air. The water then recirculates into the engine to pick up more heat (Fig. 21).

See Chapter 8 for more details on cooling systems.

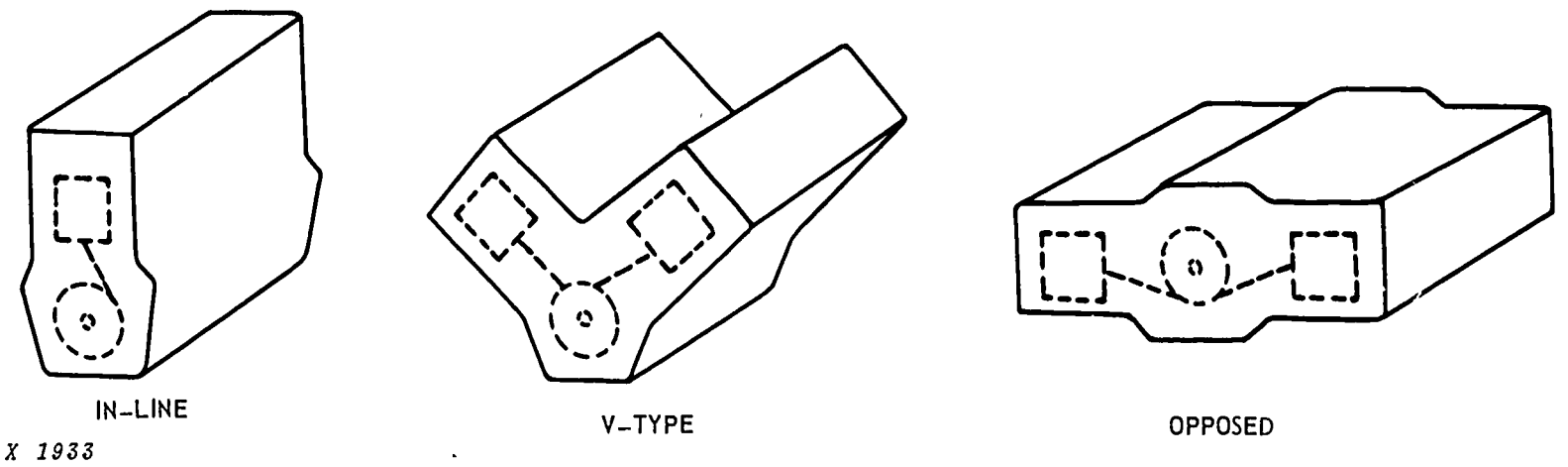

Fig. 22 — Arrangement Of Cylinders—Three Types

GOVERNING SYSTEMS

The governing system keeps the engine speed at a constant level. It does this by varying the amount of fuel on fuel-air mixture supplied to the engine, according to the demands of the load. The level of engine speed is controlled by the position of the speed control lever, connected by linkage to the governor.

The object is to get the engine's power to match the load at all times, to keep the speed at a steady level.

Governors can be either mechanical, hydraulic, or electrical. See Chapter 9 for details.

TYPES OF ENGINES

Engines can be typed in three ways:

- **Cylinder arrangement**
- **Valve arrangement**
- **Type of fuel used**

ARRANGEMENT OF CYLINDERS

Multi-cylinder engines are classified according to the arrangement of cylinders:

- *In-Line—all cylinders in straight line above crankshaft*
- *V-Type—two banks of cylinders in V-shape above crankshaft*
- *Opposed—two rows of cylinders opposite the crankshaft*

The IN-LINE model (Fig. 22) is most popular on farm and industrial machines. The V-TYPE is most popular on automobiles, while the OPPOSED is limited primarily to small cars and aircraft.

The cylinders are normally numbered. With in-line models, the No. 1 cylinder is normally at the end opposite the flywheel. The others are 2, 3, 4 etc. from front to rear. In V-and opposed types, the sequence varies with the manufacturer.

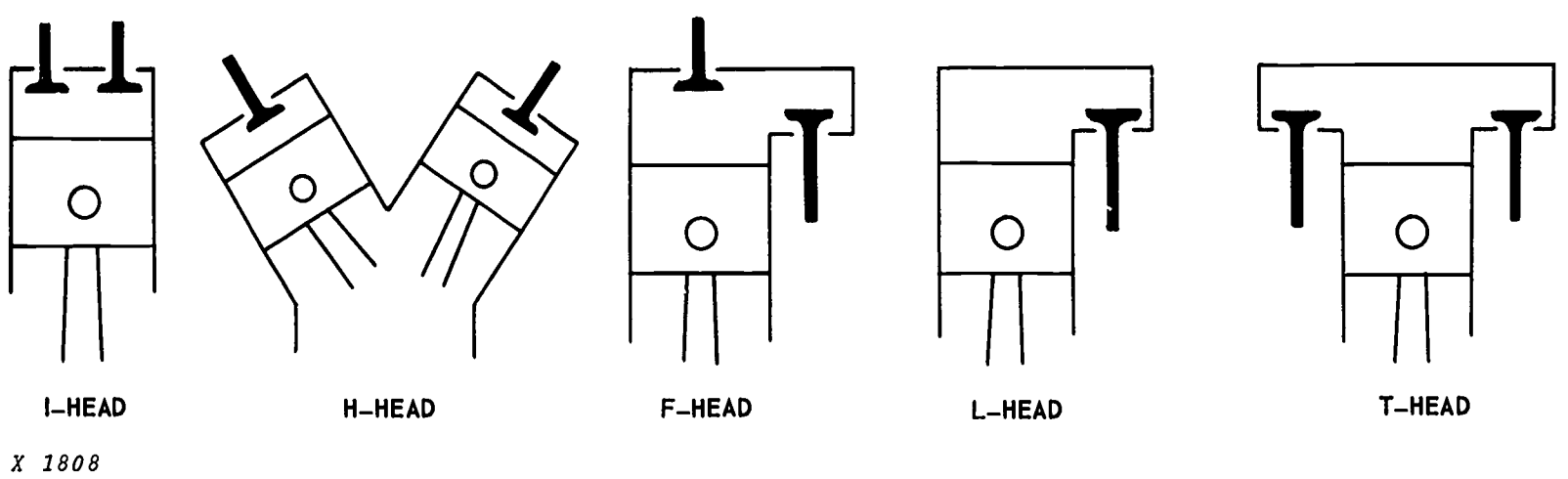

Fig. 23 — Valve Arrangement — Five Types

VALVE ARRANGEMENT

Engines can also be classified by the position and arrangement of the intake and exhaust valves. This normally depends on whether the valves are located in the cylinder block or the cylinder head. The most common types are the *I-head, H-head, F-head, L-head* and *T-head* (Fig. 23). See Chapter 2 for details.

FUEL TYPES OF ENGINES

The most common way to type engines is by the type of fuel used. Three fuel types are most common:

- **Gasoline Engine**
- **LP-Gas Engine**
- **Diesel Engine**

The basic operation of each engine is the same and we have already compared the methods of fueling. But now let's look at the overall performance of each one while comparing gasoline and diesel.

What Are The Main Differences Between Gasoline And Diesel Engines?

1. *The method of supplying and igniting fuel.*
2. *The higher compression ratio in diesels.*
3. *The generally more rugged design of diesels.*
4. *The grade and type of fuel used.*

Let's look at each of these differences.

METHODS OF SUPPLYING AND IGNITING FUEL: GASOLINE VS. DIESEL

In *gasoline engines,* fuel and air are mixed *outside* the cylinders, in the carburetor and manifold. The mixture is forced in due to the partial vacuum of the pistons' intake stroke.

In *diesel engines,* there is no premixing of air outside the cylinder. Air only is taken into the cylinder through the intake manifold and compressed. Fuel is then sprayed into the cylinder and mixed with air as the piston nears the top of its compression stroke. See Fig. 24.

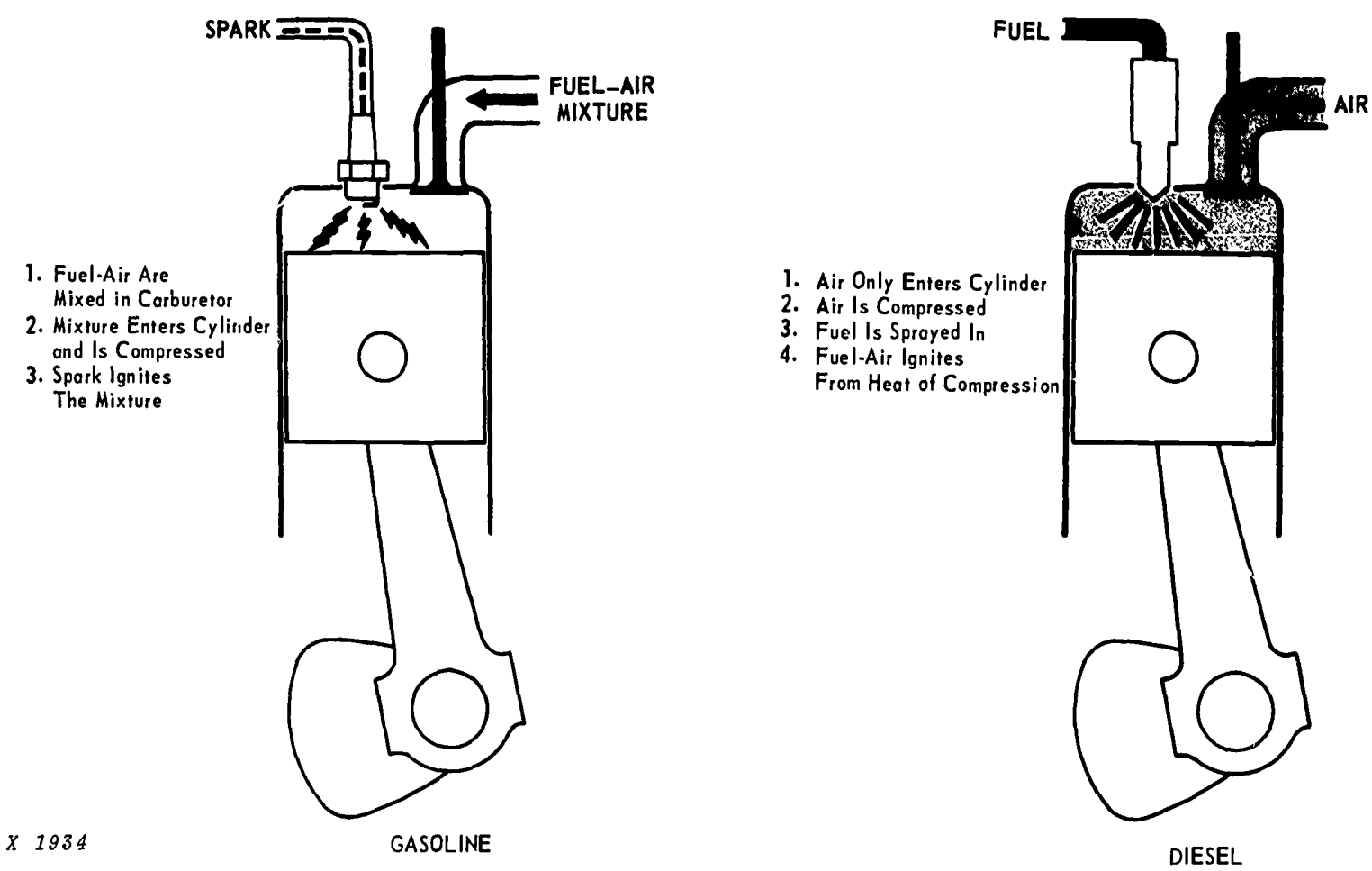

Fig. 24 — Methods Of Supplying And Igniting Fuel

Gasoline engines use an electric spark to ignite the fuel-air mixture, while diesels use the heat of the compressed air for ignition.

COMPRESSION RATIOS: GASOLINE VS. DIESEL

Compression ratio compares the volume of air in the cylinder before compression with the volume after compression.

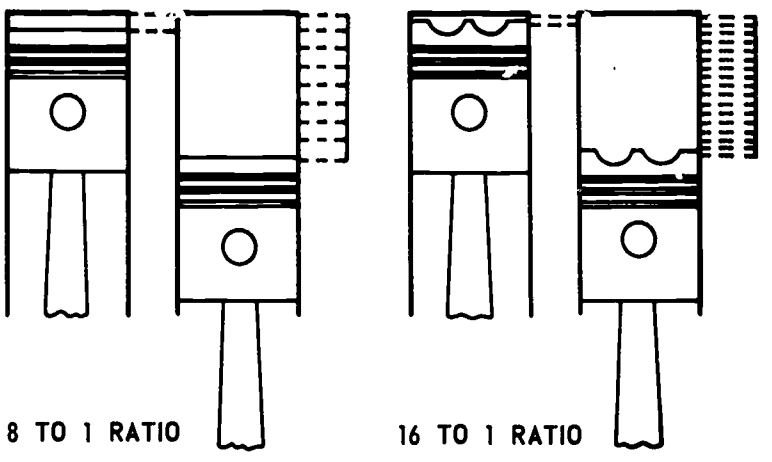

Fig. 25 — Compression Ratios Compared

An 8 to 1 compression ratio is typical for gasoline engines, while a 16 to 1 ratio is common for diesels (Fig. 25).

The higher compression ratio of the diesel raises the temperature of the air high enough to ignite the fuel without a spark.

This also gives the diesel more efficiency because the higher compression results in greater expansion of gases in the cylinder following combustion. Result: a more powerful stroke.

The higher efficiency which results from diesel combustion must be offset by the need for sturdier, more expensive parts to withstand the greater forces of combustion.

DESIGN OF ENGINE PARTS: GASOLINE VS. DIESEL

We have just touched on the next point: diesels must be built sturdier to withstand the greater forces of combustion. This is generally done by "beefing up" the pistons, pins, rods, and cranks, and by adding more main bearings to support the crankshaft.

GRADES AND TYPES OF FUEL: GASOLINE VS. DIESEL

Fuel energy is measured in standard heat units or "British Thermal Units" (BTU) and gives a comparison of the power possible from each fuel.

Diesel fuel has more heat units (BTU) per gallon, and so gives more work per gallon of fuel. In addition, diesel fuel is normally cheaper than gasoline.

However, diesel fuel injection equipment is more expensive than gasoline equipment.

When selecting the fuel type for the engine, the deciding factor is how much fuel is consumed per year in the engine operation.

LP-Gas Engines

The LP-gas engine is similar to the gasoline model, but requires special fuel handling and equipment.

LP-gas engines have higher compression ratios than gasoline engines but not as high as diesels.

In areas where LP-gas fuel is available at low prices, these engines are very popular. However, in many areas, LP-gas fuel is not competitive with the other fuels.

Summary: Comparing Engines

The chart below compares gasoline, LP-gas, and diesel engines.

The comparisons assume that each fuel is available at reasonable prices. Performance is based on general applications which are suited to the engine and fuel type. It is also assumed that the engines are all in good condition.

COMPARING THE ENGINES

	Gasoline	LP-Gas	Diesel
Fuel Economy	Fair	Good	Best
Hours Before Maintenance	Fair	Good	Good
Weight per Horsepower	Low	Low	High
Cold Weather Starting	Good	Fair	Fair
Acceleration	Good	Good	Fair
Continuous Duty	Fair	Fair	Good
Lubricating Oil Contamination	Moderate	Lowest	Low

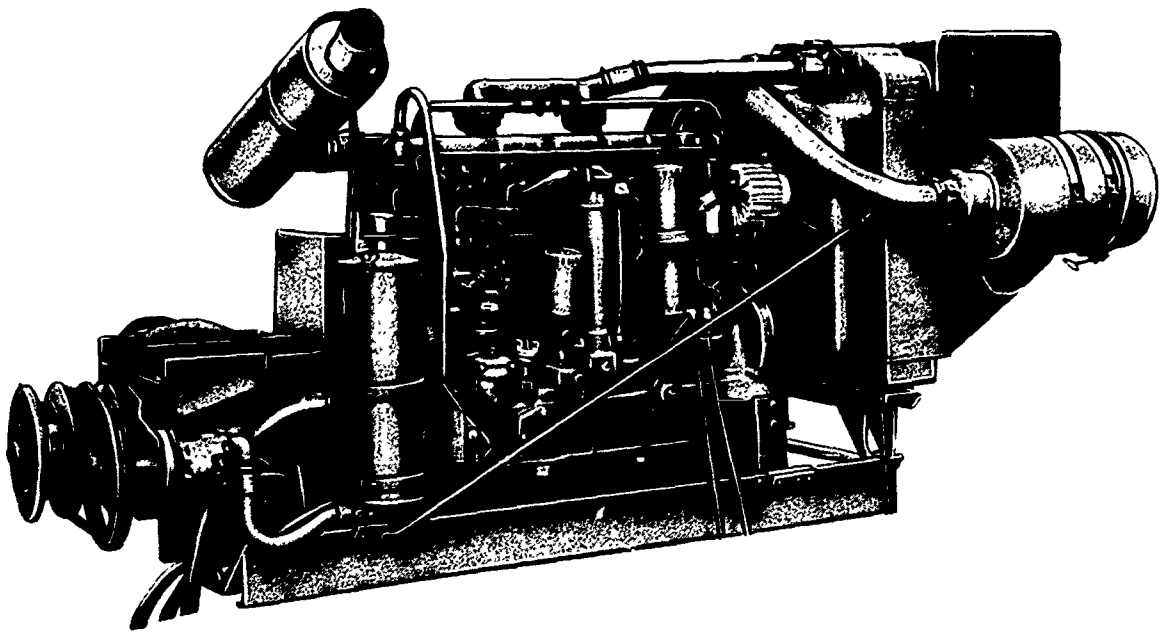

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Fig. 26 — Stationary Engine

USES OF ENGINES

The uses of engines can be divided into two broad groups:

- **Stationary**
- **Mobile**

Let's talk about each one.

STATIONARY ENGINES

A **stationary** engine produces its power from a fixed location (Fig. 26).

These engines are often called "power units" and mount on a stand, driving their power to the load through a coupler or drive line.

Because no mechanism is needed to propel the engine itself, the distribution of power is simplified.

Some uses of stationary engines are:

- *Electric power plants*
- *Motorized pumps*
- *Cranes and power shovels*
- *Diesel starting*

MOBILE ENGINES

Engines which propel themselves from one place to another are called **mobile** (Fig. 27).

In most cases, these engines push or pull a load in addition to driving external loads.

For example, the engine may propel its machine via the power train to the wheels, while another train of gears from the engine drives a power takeoff. The PTO may drive another machine which is pulled behind the first one. A good example of this is a farm tractor pulling a hay baler.

The power train is needed to convert engine speed to the desired machine speed.

Some uses of mobile engines are:

- *Harvesting Machines*
- *Wheel and Crawler Tractors*
- *Trucks and Buses*
- *Automobiles*
- *Aircraft*
- *Ships and Boats*
- *Earthmoving Equipment*
- *Forestry Equipment*

Fig. 27 shows typical uses of mobile engines in farm and industrial operations.

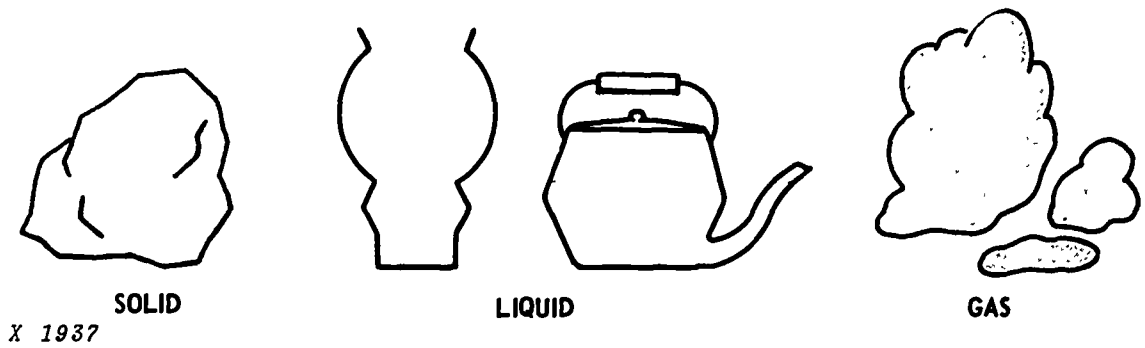

Fig. 28 — Three Physical States Of Matter

THE BASICS OF ENGINES

We have seen how the engine works. Now let's look at some of the basics which go into the design and operation of engines.

First the laws of mechanics:

- **Matter**
- **Mass**
- **Energy**
- **Inertia**
- **Force**
- **Momentum**
- **Torque**
- **Work**
- **Mechanical Power**

Let's discuss these basics one by one.

MATTER

The substances we encounter in engines are: **solids, liquids** and **gases;** they are the three physical states of matter.

If you look at Fig. 28, you will see the following truths:

1. *Solids* have a definite volume and shape.
2. *Liquids* have a definite volume but no definite shape.
3. *Gases* have no definite volume or shape.

All matter can be changed from one state to another by heating or cooling. Water is a liquid which can be changed to ice (solid) or steam (gas) by changing its temperature. However, if the temperature is returned to the original point, the water will become liquid again; the water has been subjected to physical change only, because its characteristics stayed the same.

In summary, matter can be changed, but it cannot be destroyed.

MASS

Mass is often confused with weight. *Mass is the measure of how much matter is in a body.* Weight is the measure of Earth's gravitational pull. A body has the same mass on Earth as it has 2,000 miles out in space, but its weight is much less out in space.

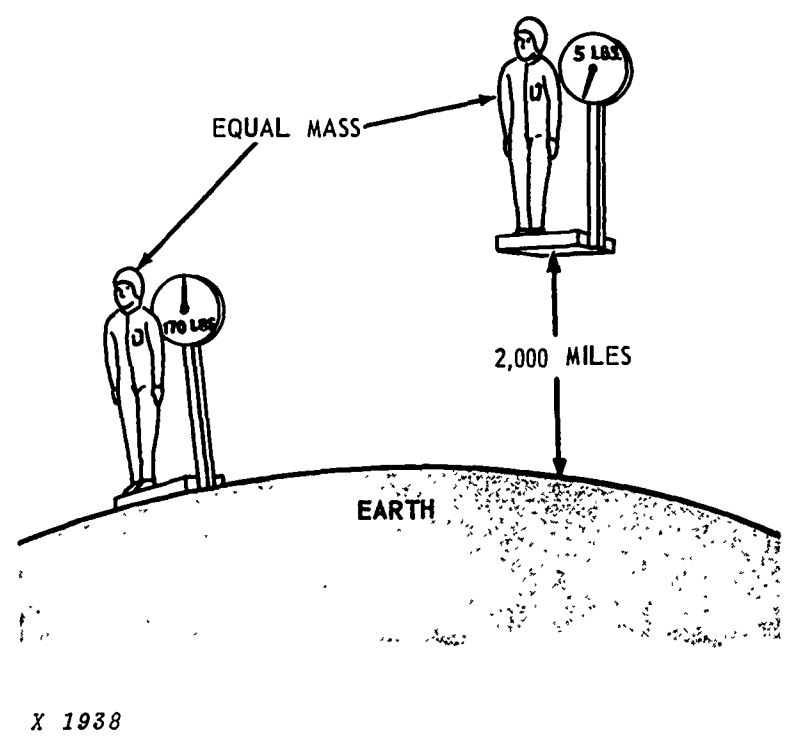

Fig. 29 — Mass Versus Weight

In Fig. 29, the man weighs 170 pounds while standing on the earth. Out in space he may weigh only 5 pounds. However, in either location he has the same amount of *matter* (or mass) in his body.

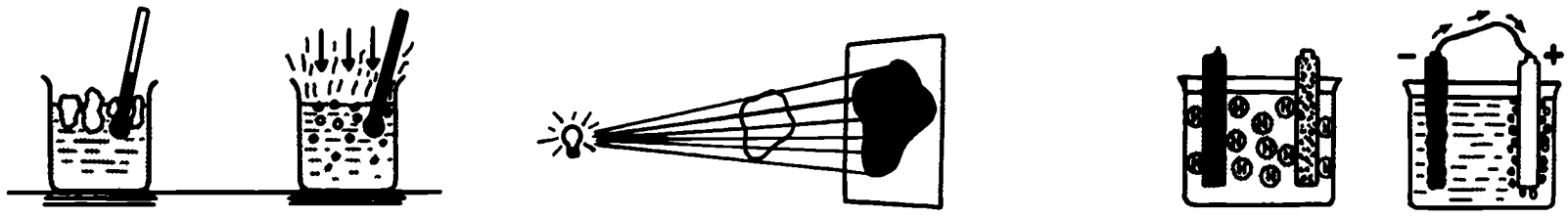

Fig. 30 — Energy At Work

ENERGY

Things like electricity, light, sound and heat are forms of **energy.** They do not occupy space or have weight in the usual sense. *Energy is the thing that produces changes in matter.*

Fig. 30 shows heat energy converting water, light energy forming an image on film, and electrical energy working in a chemical cell. Chemical energy heats your home and runs an engine, and mechanical energy does work.

INERTIA

Inertia is the tendency of a body to keep its state of rest or motion.

If you're sitting in the wagon shown in Fig. 31 and someone gives you a push from behind, your body will fall backward. Nothing actually pushed you backward, your body just tried to stay at rest. If someone stops you while you're in motion, you will pitch forward. This is because your body wants to keep moving at the same speed. The larger the mass of your body, the more you will be affected by inertia.

FORCE

A **force** is a push or pull which starts, stops, or changes the motion of a body.

From this we conclude that if all the forces acting on a body are equal from all directions, the body will be at rest. If any one of the forces is greater, the body will be set into motion in the direction of the force.

If six men push equally hard where shown in Fig. 32, the box will retain its position. When the top man pushes harder, the box will move downward.

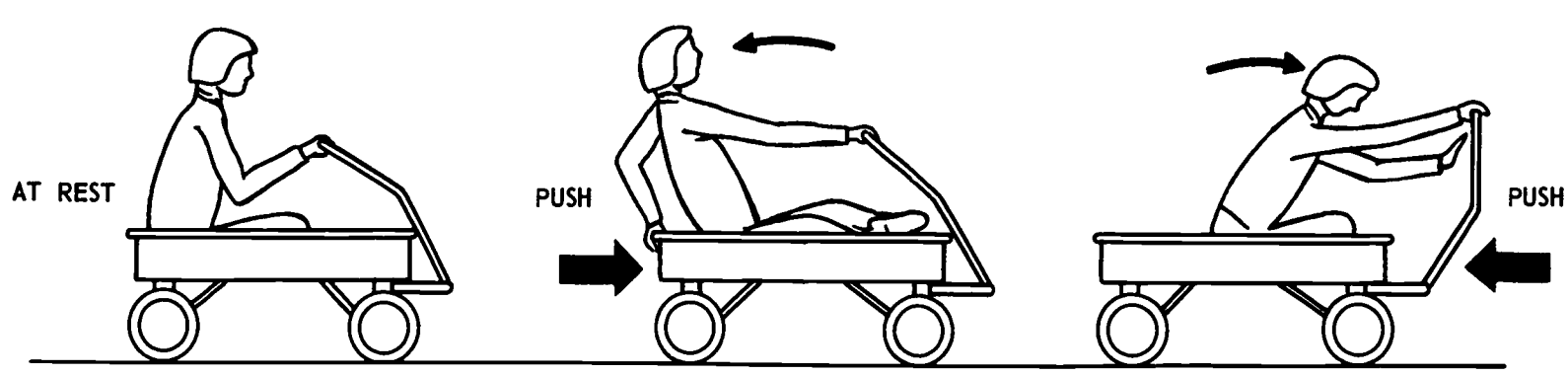

Fig. 31 — Inertia

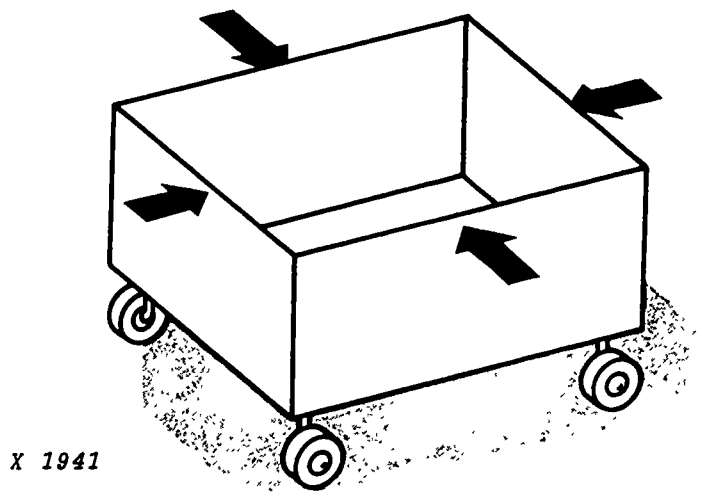

Fig. 32 — Applied Forces

MOMENTUM

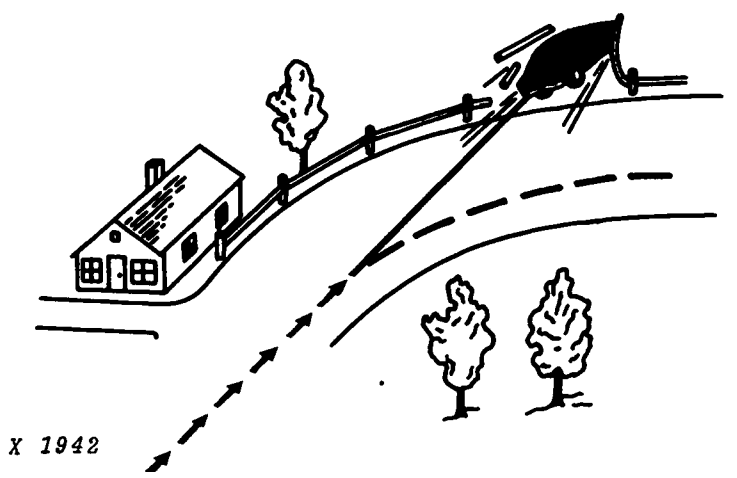

Fig. 33 — Momentum Forces

When a body is in motion, it is said to have **momentum** which is the product of its mass and velocity (speed). A body moving in a straight line will keep going in a straight line at the same speed forever if no other forces act upon it (Fig. 33). The laws of momentum are equally effective when a body is rotating; it would continue to rotate. Momentum and inertia are sources of energy because of their mass.

TORQUE

If the forces applied to a body do not all act at a single point, the body will tend to rotate. The turning effect of any force applied to a body is found by multiplying the amount of the force by the distance from the pivot point to the line of the force.

This *turning* effect of a force is called **torque** and the distance mentioned is the torque arm.

Consider the torque wrench shown in Fig. 34. If we apply more force at the point shown or apply the force farther out, the torque will be increased. This increased torque will cause the wrench to rotate faster or give us more turning force at the pivot point.

An engine crankshaft reacts to the pushing force of the piston and connecting rod in the same manner.

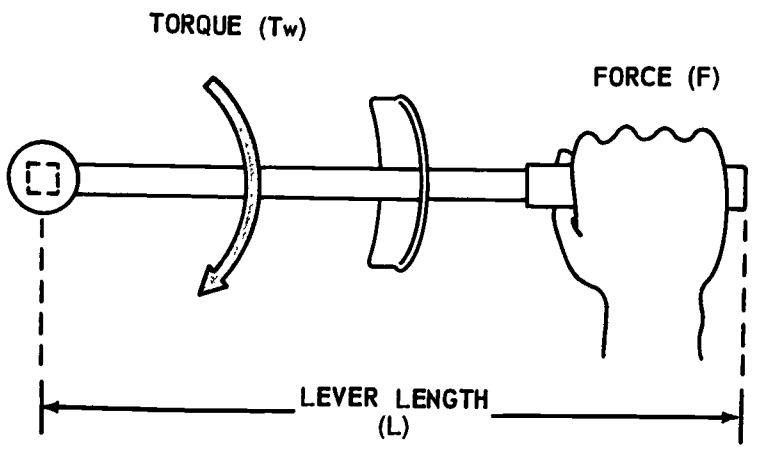

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Fig. 34 — Torque (Or Turning Force)

WORK

When you're pushing on a large rock and it fails to move, you feel like you're working hard. In Physics, **work** is accomplished only when the rock is moved by the pushing you're doing. Work is expressed as a force unit multiplied by a distance unit.

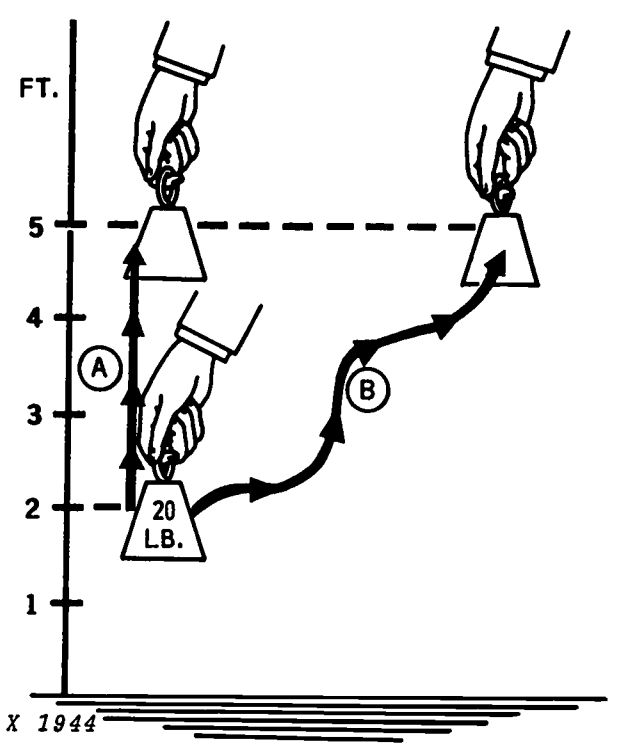

Fig. 35 — Work

If you stand and hold a weight at the 2-foot level as shown in Fig. 35, you aren't really doing any work, as the weight is stationary. However, if you move it to the 5-foot level, you have moved the weight 3 feet, and work was done. The path you take to get to the 5-foot level is not important; the amount of work done is 20 lbs. times 3 feet = 60 lb. ft. as shown, whether you take path A or B.

MECHANICAL POWER

Power is a rate of doing work and the term **mechanical** is the energy method used. Other energy methods include chemical, electrical, heat and sound.

Because we are mainly concerned with engines, our unit of power is the **horsepower.** One horsepower is equal to the lifting of a weight of 550 lbs. one foot in one second (or 33,000 lbs, one foot in one minute).

Energy conversion allows us to compare different types of power. A diesel engine produces *mechanical power* by chemical change (Fig. 36). Fuel (liquid) and air (gas) is burned (chemical change) in the combustion chamber and the engine crankshaft rotates.

An electric motor also produces mechanical power when connected to a battery (Fig. 36). The electrolyte in the battery reacting on the battery plates produces electricity by chemical change and the electric motor runs.

When diesel fuel burns and produces heat at the rate of 2545 BTU per hour, the fuel is expending energy in the engine at the rate of one horsepower per hour.

If the battery delivers 746 watts to the electric motor for one hour it is expending energy at the rate of one horsepower per hour of output.

It is interesting to note that by simple conversion, 746 watts of electrical energy equal 2545 BTU when converted to heat.

This completes our discussion of the basic **laws of mechanics.**

HORSEPOWER

The term horsepower is a unit of measurement in rating engines and motors. There are several categories of horsepower, all very necessary for the design of an efficient engine. To sum them up quickly, we talk about **theoretical horsepower** and **net horsepower (useful)** and of those in between.

The most common horsepower terms are:

- **Indicated (IHP)**
- **Friction (FHP)**
- **Flywheel or Brake (BHP)**
- **Drawbar**
- **Power Take-Off (PTO)**
- **Rated**

Let's see what each type of horsepower means.

INDICATED HORSEPOWER (IHP)

Indicated horsepower (IHP) is measured in the combustion chamber of a cylinder by special instruments. The instrument measures the actual gas pressure developed. Using this measurement, an engineer can calculate the amount of energy that is released in the cylinder.

However, here we're more interested in the measurements we can do something about, for *indicated* horsepower neglects such things as friction and the type of power we actually need to do our work. Indicated horsepower is *theoretical* horsepower (Fig. 37).

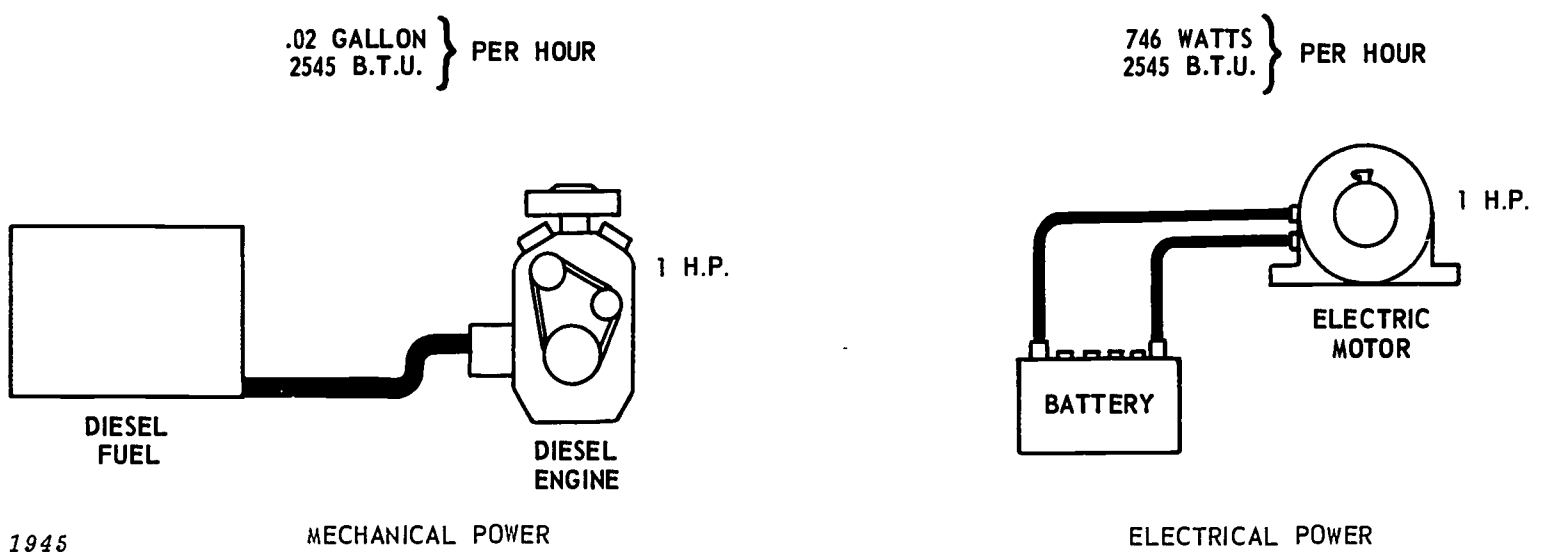

Fig. 36 — Mechanical And Electrical Power Compared

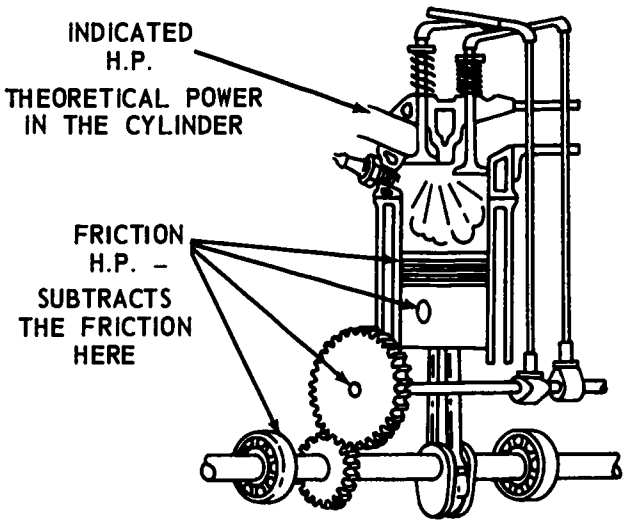

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Fig. 37 — Indicated And Friction Horsepower

FRICTION HORSEPOWER (FHP)

Friction horsepower (FHP) allows for the contact between two engine parts such as pistons and cylinder walls, and the power needed for compression. Friction is a loss factor and a producer of heat.

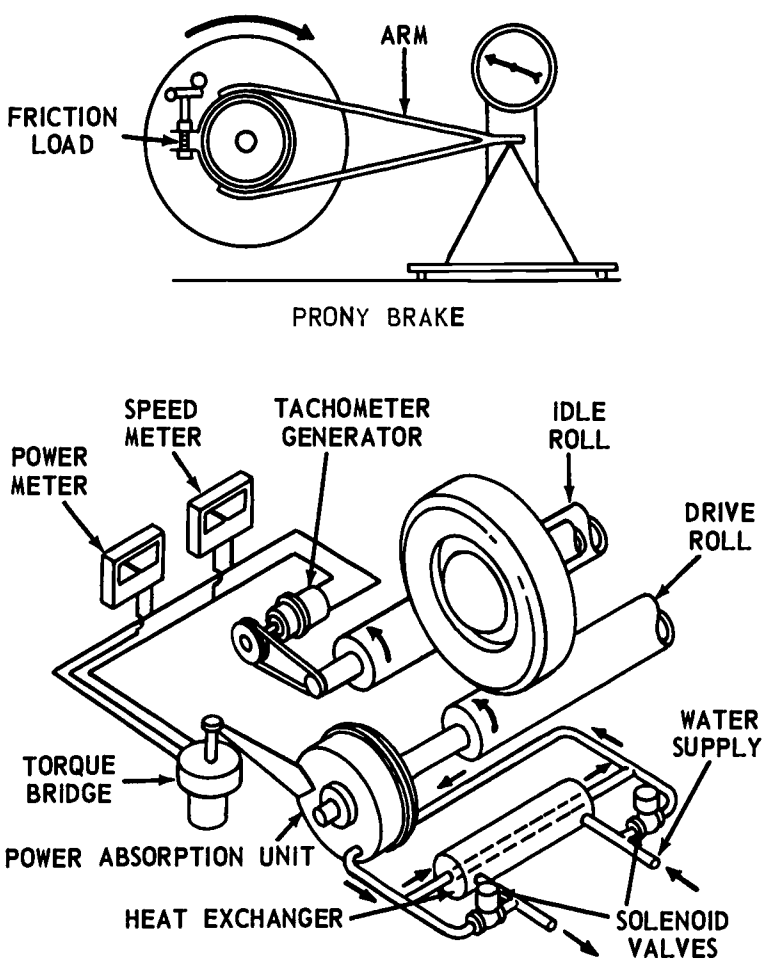

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Fig. 38 — Units Which Measure Horsepower Of An Engine

Remember, energy cannot be destroyed, merely converted or divided. If the bearings are heating up while the mechanical energy is working, some of that mechanical energy is being converted to heat and is lost into the cooling system.

Friction horsepower then is the difference between *indicated* horsepower and *usable* horsepower (Fig. 37). So it is a factor in engine *efficiency*.

Lubricating oils place a thin film between two surfaces to reduce friction. In most engines, bearings are lubricated with oil under pressure to make the shafts float on an oil film and so reduce friction.

FLYWHEEL HORSEPOWER OR BRAKE HORSEPOWER (BHP)

Now we come to the first really practical unit of measurement for an engine. This is the point where we can couple to the engine and actually draw power. **Flywheel horsepower** is the FHP (friction losses) subtracted from the IHP (theoretical horsepower). For simplicity, FHP is all the engine losses; friction, etc. If the losses equal 10 horsepower, and if IHP equal 50 horsepower, the result is 50-10=40 which is the flywheel horsepower.

Flywheel horsepower is also called brake horsepower (BHP).

Flywheel or brake horsepower is measured by a *Prony brake* or a *dynamometer* (Fig. 38). Both test instruments apply a load to the engine which is measured in pounds. If the length of the lever arm is known in feet, we can measure foot-pounds of force as engine load. To complete the measurement, we measure the engine speed for a fixed time period. Speed is measured with a tachometer in revolutions per minute (rpm).

DRAWBAR HORSEPOWER

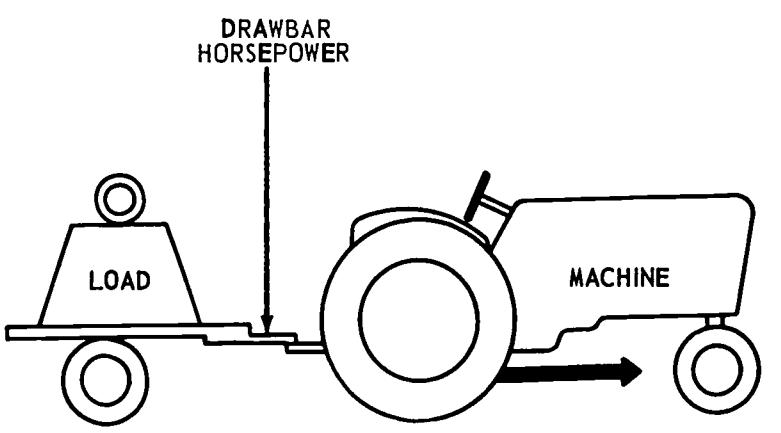

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Fig. 39 — Drawbar Horsepower

Drawbar horsepower is the measure of pulling power an engine can produce when mounted in a moving machine. The load is attached to the machine and the horsepower required to move the machine is calculated by knowing the force required to pull the machine and the speed with which it is moved (Fig. 39).

PTO HORSEPOWER

PTO or power take-off horsepower is a function of torque and speed (rpm) and is measured at the machines' power take-off shaft.

A power take-off usually has some gear reduction between the engine and the PTO shaft. This reduction increases the torque value but reduces the speed. When measuring PTO horsepower, the speed is usually held constant at 1,000 rpm, so the horsepower can be read directly on a gauge measuring torque but having its scale calibrated in horsepower.

RATED HORSEPOWER

Rated horsepower is a value used by engine manufacturers to indicate the horsepower an engine can produce. This rating takes into account the maximum pressure forces in the engine as well as the speed and torsional forces. If these values are exceeded, the engine can be damaged.

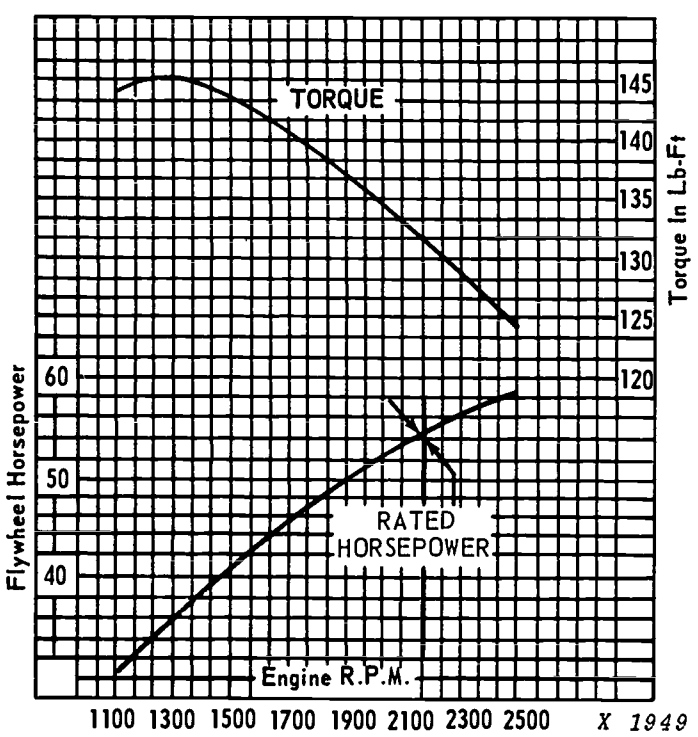

Fig. 40 — Typical Rated Horsepower Chart

Rated horsepower depends in part on the total cubic inches of piston displacement in the engine. From this, the manufacturer determines the maximum pressure stresses and rpm the engine can tolerate without internal damage. He then tests and develops the engine for long life and reliability at a given rated horsepower (Fig. 40).

Rated horsepower may not be the most efficient operating point for the best fuel consumption; this rating is expressed in terms of recommended operating horsepower and rpm.

ENGINE EFFICIENCY

We talk a lot about efficiency, and its importance can't be overstressed. It represents more than fuel economy; it also means the ability to do work at a constant rate with low maintenance.

Here are the prime efficiency factors in engines:

- **Mechanical Efficiency**
- **Volume Efficiency**
- **Thermal Efficiency**
- **Effective Pressure**
- **Torque Efficiency**
- **Fuel Consumption**
- **Compression Efficiency**
- **Load Effects**

Let's take a look at each type of engine efficiency.

MECHANICAL EFFICIENCY

We've mentioned some losses in horsepower between IHP and BHP—friction losses, etc. But in a functional engine other things also absorb horsepower:

1) Fuel Pump

2) Water Pump

3) Cooling Fan

4) Generator or Alternator

5) Ignition System

6) Valves

7) Oil Pump

8) Blowers and Superchargers

9) Hydraulic Pumps

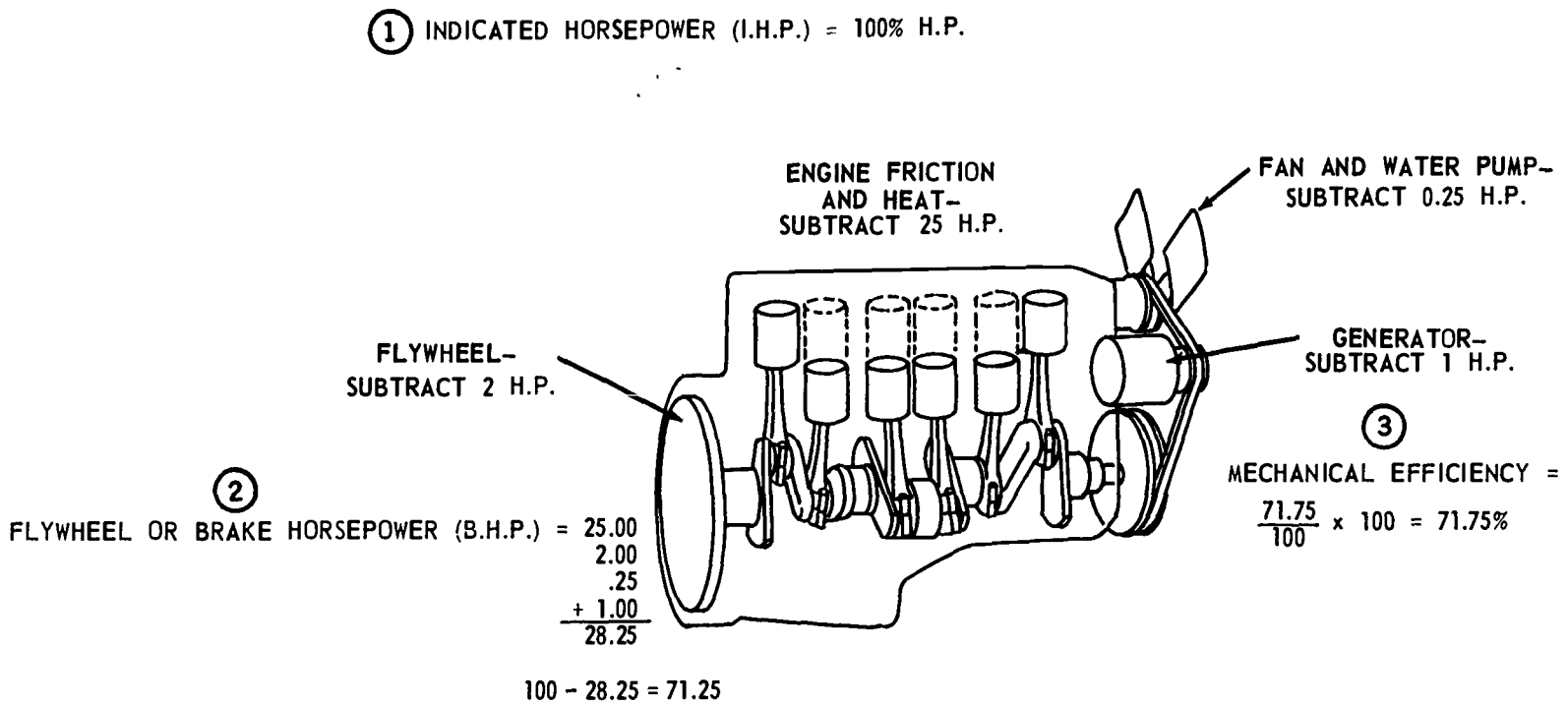

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Fig. 41 — Mechanical Efficiency

Driving all these extra devices draws power from the engine and reduces its efficiency.

Mechanical efficiency then takes into account all these losses as well as frictional losses. To get a true value for mechanical efficiency the engine must be operating at its rated output, with all accessories performing their normal functions when we measure flywheel or brake horsepower (BHP). Then we divide the BHP by the IHP and multiply by 100 to get the mechanical efficiency of the engine (Fig. 41).

VOLUMETRIC EFFICIENCY

Most engines get intake air into the cylinders by creating a partial vacuum as the piston travels down on the intake stroke. However, the intake manifold, carburetor, air cleaner and intake system heat restrict the amount of air that can actually get into the cylinder.

Volumetric efficiency (Fig. 42) is calculated by dividing the actual amount of engine air taken in by the piston displacement and multiplying by 100.

Volumetric efficiency is the main factor governing the maximum torque output of an engine. The rpm at which an engine "breathes" the best will often determine the point of maximum torque.

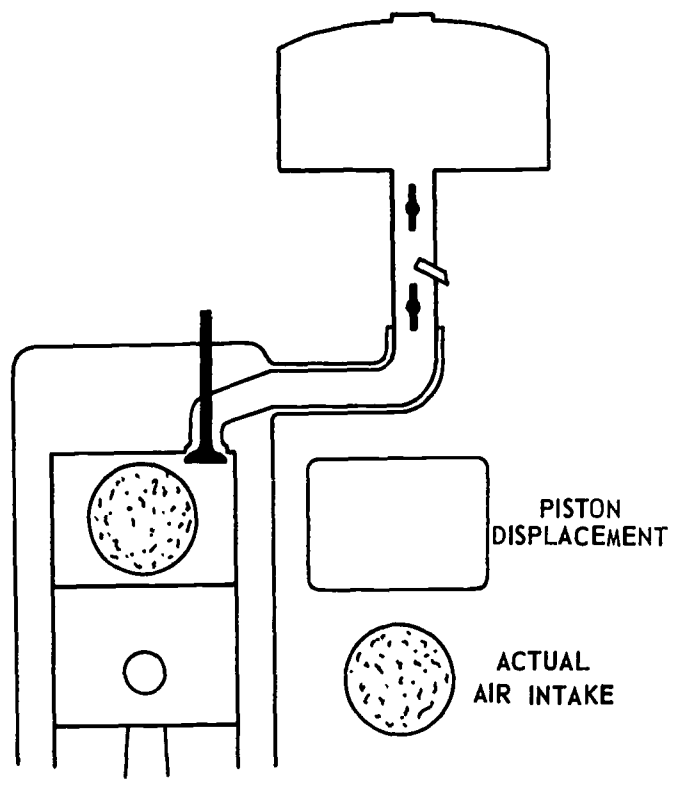

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Fig. 42 — Volumetric Efficiency

THERMAL EFFICIENCY

The ratio of the work done by the gases in a cylinder (indicated work) to the heat energy (thermal energy) of the fuel is called **thermal efficiency.** Thermal efficiency is a laboratory value. We want something more practical—**brake thermal efficiency.**

Brake thermal efficiency is the brake horsepower, converted to BTU, divided by the fuel heat input in BTU, and multiplied by 100.

Thus, the brake thermal efficiency tells us how effectively an engine converts heat energy into usable power.

Brake thermal efficiency takes into account all engine losses and is sometimes called overall efficiency.

1. ENGINE DEVELOPS 100 FLYWHEEL OR BRAKE H.P. PER HOUR
2. 2545 x 100 B.H.P. = 254,500 B.T.U.
3. FUEL BURNED PER HOUR = 800,000 B.T.U.
4. BRAKE THERMAL EFFICIENCY = $\frac{254,500}{800,000} \times 100 = 31.8\%$

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Fig. 43 — Brake Thermal Efficiency For A Typical Engine

Fig. 43 shows the formula applied to a typical engine.

MEAN EFFECTIVE PRESSURE

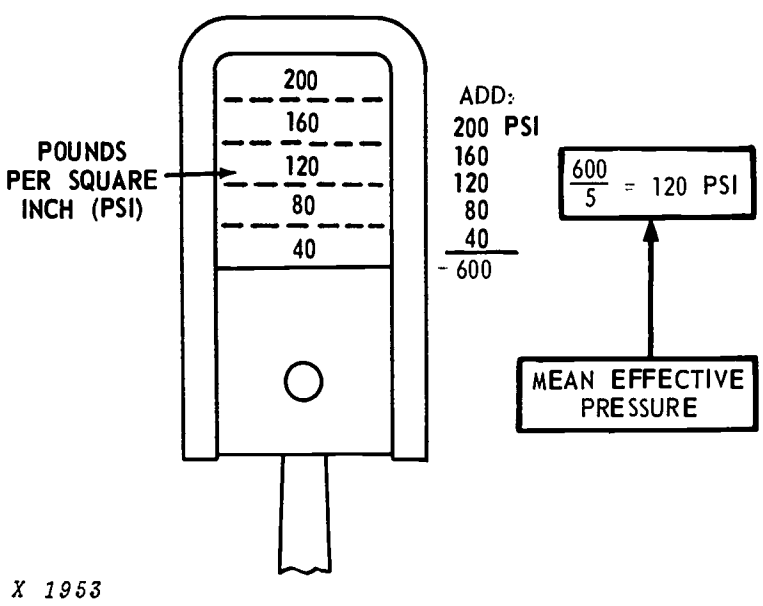

Fig. 44 — Indicated Mean Effective Pressure (IMEP)

Mean effective pressure consists of two phases: *(1) Indicated mean effective pressure (IMEP) and (2) Brake mean effective pressure (BMEP).*

These pressures are the cylinder pressures developed during the combustion power sroke. Pressure is the highest right after starting and decreases as the power stroke progresses.

Indicated mean effective pressure is the average pressure in the cylinder throughout the power stroke.

FUEL CONSUMPTION

Fuel consumption is generally measured by pounds of fuel per horsepower hour.

In a gasoline engine, fuel-air ratio is considered best at one pound of fuel to 15 pounds of air. Pounds of fuel per horsepower hour measures efficiency for engine.

However, for truck and autos, miles-per-gallon is often used.

Each engine manufacturer can furnish a chart which indicates fuel consumption at various speeds and horsepower outputs.

COMPRESSION EFFICIENCY

Increased compression ratio permits the fuel-air mixture to be compressed more, which in turn gives greater heat and expansion during combustion.

However, the higher compression and the resulting extra heat and pressure gives better burning and more energy.

There are limiting factors in the thermal efficiency produced by increasing the compression ratio. These include mechanical stresses, temperatures, and combustion chamber pressures.

Increased compression ratio may reduce fuel consumption, but certain fuels do not permit high compression ratios.

LOAD EFFECTS

Every phase of engine efficiency is affected by the nature of the load the engine drives.

A fluctuating load can set up serious engine vibration and, in extreme cases, "lugging" of the engine.

"Lugging" slows an engine while the throttle is still wide open. The result is excessive heat and firing pressues. This may cause the engine to be damaged.

A lightly-loaded engine may cause a too-lean mixture when the fuel system is designed for normal load ratings.

Lean fuel mixtures result in high cylinder temperatures and possible detonation of certain fuels.

USES OF THERMODYNAMICS

Thermodynamics is the science that deals with heat and mechanical energy and their conversion one to the other.

The basics are as follows:

- **Laws of Thermodynamics**
- **Boyle's Law**
- **Charles' Law**
- **Boyle's and Charles' Law Combined**
- **Heat and Energy**
- **Adiabatic Compression**
- **Compression Ratio Vs. Pressure**

Let's see what each of these means to the engine.

LAWS OF THERMODYNAMICS

Two basic laws of thermodynamics apply to engine fundamentals: *The first states that energy is conserved. The second deals with the irreversibility of the process.*

Mechanical energy can be converted completely to heat but heat energy can never be converted completely to mechanical energy

These fundamental truths are based upon the fact that heat naturally travels to a lower temperature object and seeks equilibrium. There is no such thing as a "cold" object,—some are merely colder than others.

An engine burns fuel and develops heat to produce mechanical energy for doing work. However, a major portion of the heat in the combustion chamber is absorbed by the cylinder walls or blown out the exhaust system; it is lost as far as mechanical energy resulting in BHP output is concerned.

Therefore, the efficiency of an engine is limited by the engine temperature range.

BOYLE'S LAW

Boyle's Law says that a gaseous mass can be compressed and that its pressure and volume will then stay about constant as long as the temperature stays the same.

This law is a governing factor in engine design, relative to piston displacement and compression ratio.

CHARLES' LAW

Charles' Law says that temperature changes on a gaseous mass result in direct changes of volume and pressure.

If the temperature of the gas is raised and the volume is held constant, the pressure will increase; raising the temperature and holding the pressure constant will increase the volume of the gas.

The heat energy in an engine combustion chamber causes the fuel-air mixture to expand. The combustion chamber is somewhat restricted in volume (compression ratio) and the change in volume is quite large over the entire power stroke. However, the change is not as great as the gas would need for full expansion at combustion, so the pressure is raised appreciably.

BOYLE'S AND CHARLES' LAWS COMBINED

The diesel engine takes advantage of the laws just discussed. Air (a gas) is fed into the combustion chamber. Reducing the volume during the compression stroke raises the air temperature and the pressure. Fuel injected into this mixture will then ignite due to the high temperatures of compression. Ignition further raises the temperature and the gases expand to force the piston down on the power stroke. The pressure applied is dependent on the rate of burning and the heat retained in the gases and not lost through the cylinder walls and exhaust system.

This same principal is the cause of detonation or the preignition in gasoline engines. Gasoline will ignite at much lower temperatures than diesel fuel. If the temperature is raised too much by compression, ignition will take place before the compression stroke is complete and the engine will tend to run backwards. Engine design must, therefore, take into account all known conditions resulting from the three laws.

HEAT AND ENERGY

Heat is the greatest source of energy loss, as most engines operate in the varying temperature of the atmosphere.

Remember that heat energy lost to the engine cannot be recovered. This includes the normal losses of heat through the engine cooling and exhaust systems.

COMPRESSION RATIO VS. PRESSURE

The compression ratio of an engine is fixed by the design engineer. He then determines the combustion pressures which result under normal operation of the engine.

Tampering with the fuel rate or combustion rate can change the compression ratio, and may damage the engine.

The higher the compression ratio of gasoline and LP-gas engines, the more critical become fuel and operating temperatures. Detonation is the stray, unwanted explosions that take place in the engine as a result of too-high compression or heat, or low-quality fuels. These explosions cause piston and cylinder damage by excess pressure.

"Lugging" a high-compression engine at low rpm can cause serious detonation as the charge is in the combustion chamber a longer interval.

The laws of thermodynamics cannot be ignored when efficient, trouble-free engine performance is required.

TEST YOURSELF

QUESTIONS

1. (Fill in the blanks.) "An internal combustion engine converts _____ energy into _____ energy."

2. What three basic elements are needed to produce heat energy in the engine cylinder?

3. Air is compressed in the engine cylinder. What else happens to this air?

4. Fuel must be in what form for good combustion in the engine?

5. Match the two items at left with the definitions at the right.

a. Rotary Motion	*1. Up-and-down movement*
b. Reciprocating Motion	*2. Circular movement*

6. (Fill in the blanks.) "The engine converts _____ motion to _____ motion."

7. If an engine compresses eight quarts of air into a one-quart volume, what is its compression ratio?

8. Name the four parts of an engine combustion cycle in the proper sequence.

9. True or false? "In a four-stroke cycle engine, the crankshaft turns one complete revolution during a complete cycle."

10. Match each item on the left with the correct one on the right.

a. Diesel engine	*1. Fuel is mixed with air in the cylinder.*
b. Gasoline engine	*2. Fuel is vaporized before mixing with air.*
c. LP-gas engine	*3. Fuel is mixed with air before it goes into the cylinder.*

11. What are the two major types of engine cooling systems?

12. Which normally has a higher compression ratio—gasoline or diesel engines?

13. Why is the compression ratio higher on diesel engines?

ANSWERS

1. First blank—"heat". Second blank—"Mechanical."

2. Air, fuel, and combustion (or ignition).

3. It heats up. This gives the heat necessary for good ignition of the fuel.

4. Vapor.

5. a — 2, b — 1.

6. First blank—"reciprocating" or "up-and-down". Second blank—"rotary."

7. 8 to 1.

8. Intake, compression, power, exhaust.

9. False. The crankshaft turns two complete revolutions during a four-stroke cycle.

10. a — 1. b — 3. c — 2.

11. Liquid and air.

12. Diesel.

13. Because more heat is needed for fuel combustion without a spark in diesel engines. (The more air is compressed, the more it heats up.)

BASIC ENGINE / CHAPTER 2

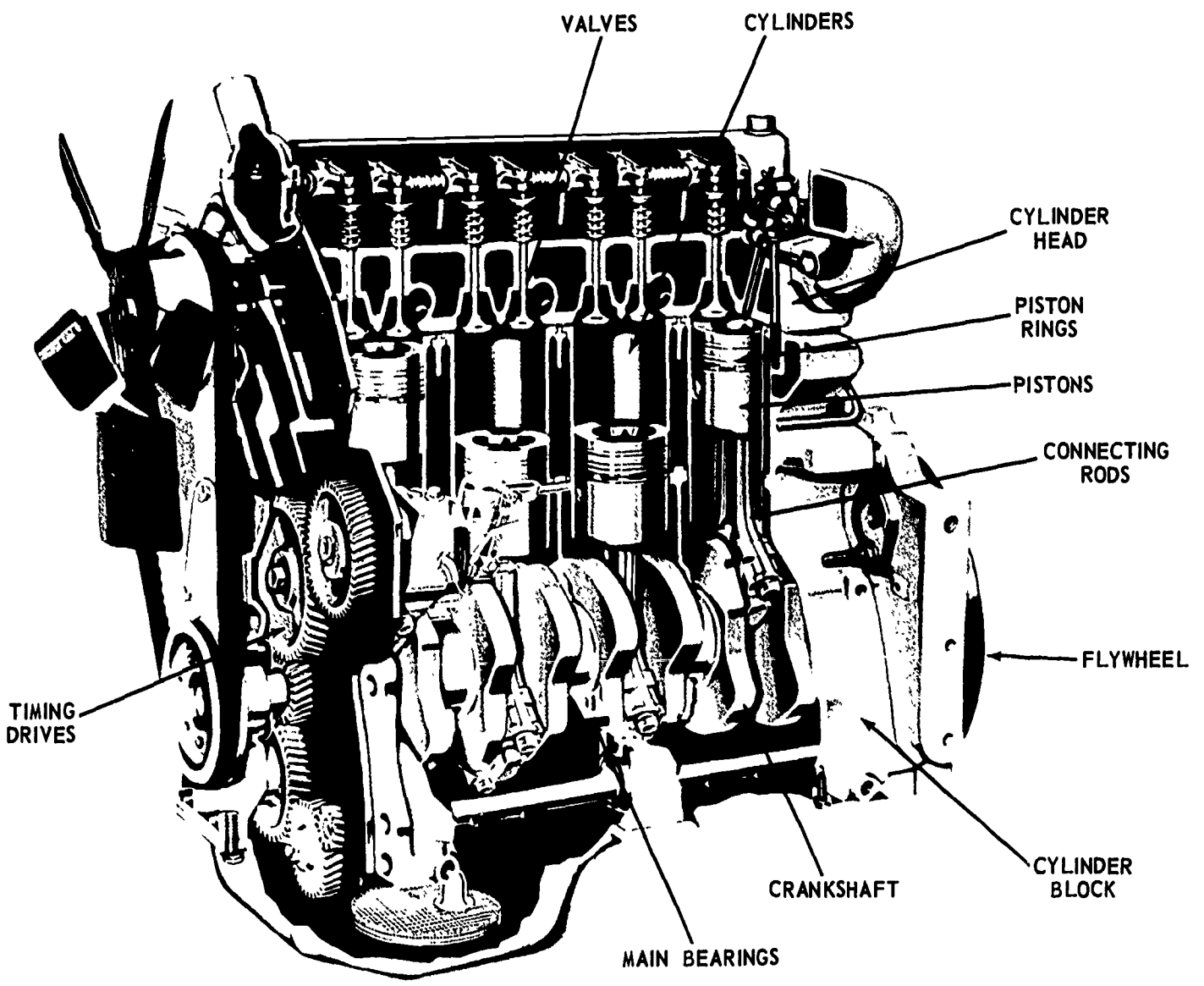

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Fig. 1 — Cutaway of Basic Engine

INTRODUCTION

This chapter covers the *basic* engine—parts common to *all* internal combustion engines.

Chapter 1 told how the engine works, while later chapters cover the fuel systems and other accessories.

General testing and diagnosis of the engine is outlined in Chapter 11.

In this chapter you will learn about these parts of the engine:

- **Cylinder Head** is at the top of the engine and houses the valves and the intake and exhaust passages.
- **Valves** open and close to let fuel in and exhaust gases out of each cylinder.
- **Camshaft** rotating in the engine block opens the valves by cam action.
- **Cylinder Block** is the main housing of the engine and supports the other main parts.
- **Cylinders** are hollow tubes in which the piston works. They may be cast into the cylinder block or made of liners or sleeves.
- **Pistons** move up and down in the cylinders by the force of combustion.
- **Piston Rings** seal the compression in the combustion chamber and also help to transfer heat.

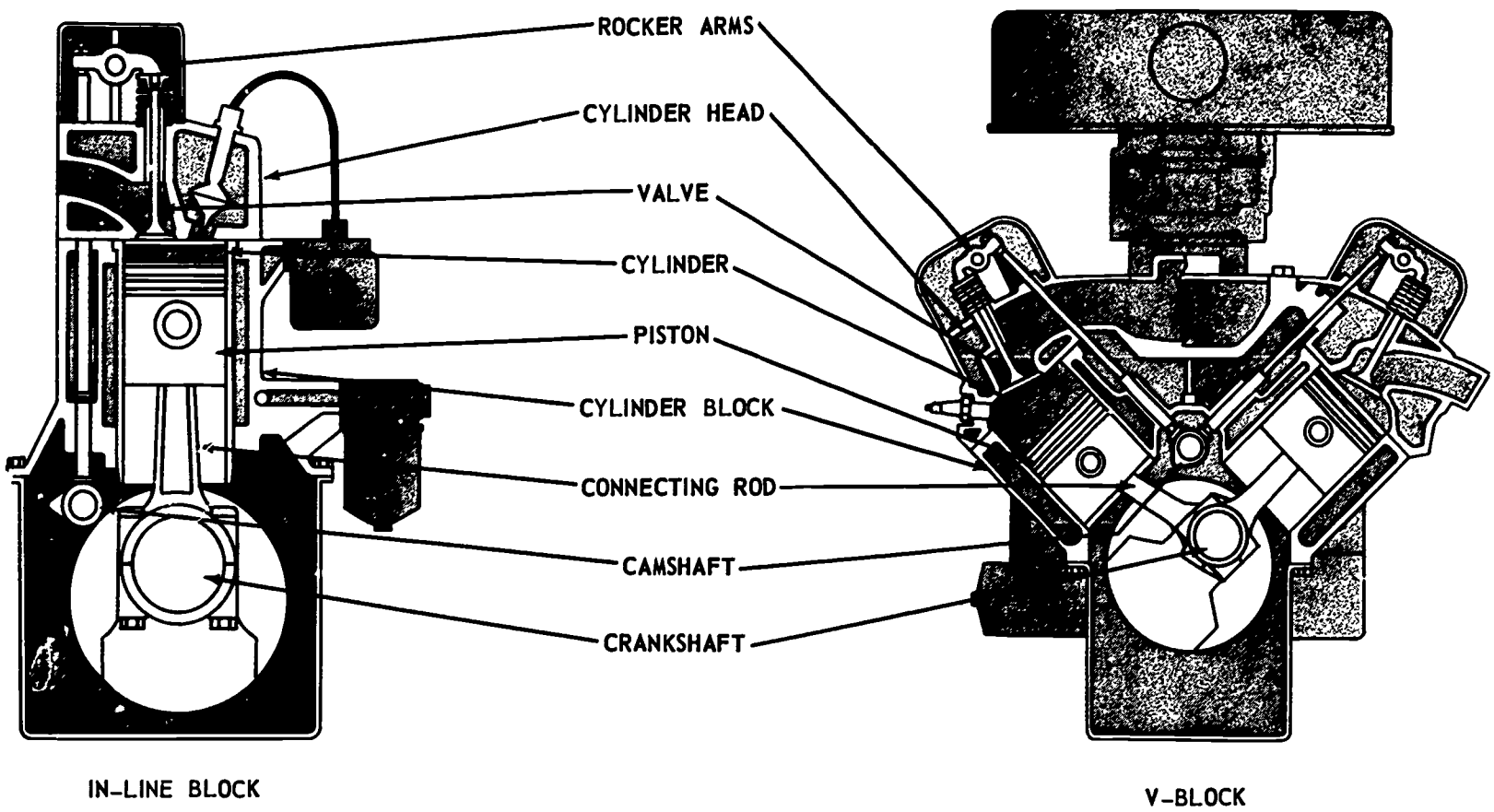

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Fig. 2 — Parts Of A Basic Engine

- **Connecting Rods** transmit the motion of the pistons to the crankshaft.
- **Crankshaft** receives the force from the pistons and transmits it as rotary driving power.
- **Main Bearings** support the crankshaft in the cylinder block.
- **Flywheel** attaches to the crankshaft and gives it momentum to return the pistons to the top of the cylinders after each downward thrust.
- **Balancers** such as shafts or dampers, if used, balance the vibrations in the engine.
- **Timing Drives** link the crankshaft, camshaft, and other key parts together to assure that each is doing its job at the right time.

Engine parts are most commonly arranged in one of two ways (Fig. 2):

1) In-Line Block

2) V-Block

Now let's look at each part of the engine in detail —how it works and how to service it.

CYLINDER HEADS

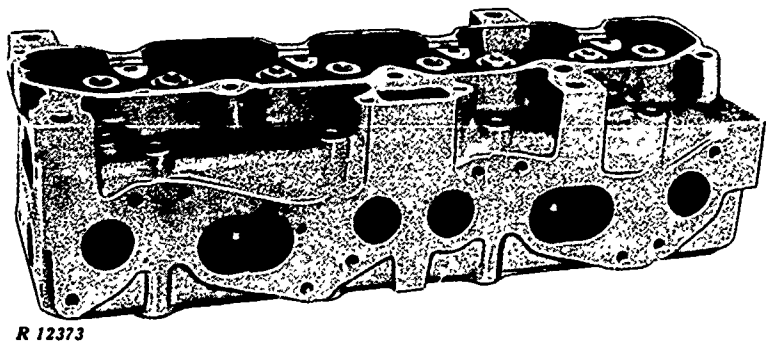

Fig. 3 — Engine Cylinder Head

Most cylinder heads today are separate one-piece castings (Fig. 3) made of an alloy of iron and copper or aluminum for greater strength and durability. The intake and exhaust passages are cast or bored into the head.

The cylinder head is sealed to the engine block with a gasket and careful tightening of the attaching cap screws or studs. This is critical in preventing distortion or gas leaks that lose power from the cylinders.

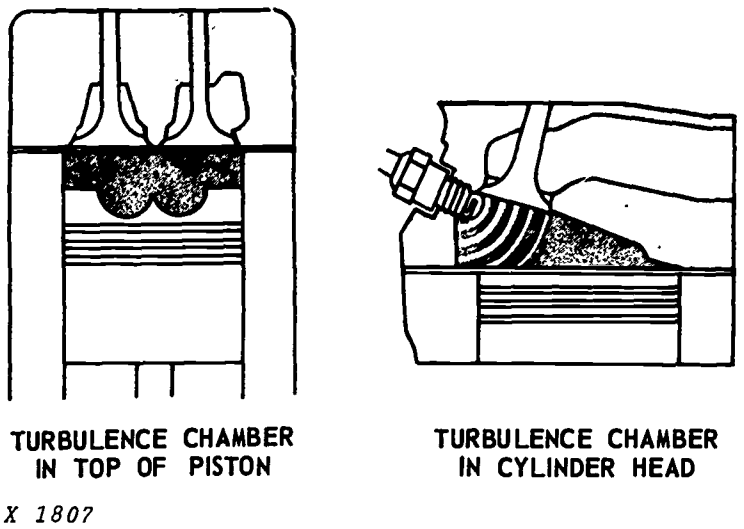

Fig. 4 — Turbulence Chambers

All heads are designed for swirling the fuel to get the fullest combustion.

This is done by having combustion occur when there is the least space between the piston crown and the cylinder head (Fig. 4). Some pistons are recessed as shown to help swirl the fuel-air mixture.

VALVE ARRANGEMENTS

Valves are located in five major ways (Fig. 5):

- **I-Head—both valves above the cylinder (parallel)**
- **H-Head—both valves above angled cylinders (V-block)**
- **F-Head—one valve above and other to side of cylinder.**
- **L-Head—both valves to one side of cylinder (parallel)**
- **T-Head—one valve on each side of cylinder (parallel)**

I-HEAD valves are widely used on modern engines.

H-HEAD valves are found on V-block engines. Only one rocker arm is needed to operate both valves.

F-HEAD valves are sometimes used to allow room for larger valves.

L-HEAD valves are not used much because of the trend toward valve-in-head engines.

T-HEAD was used on early engines but required two camshafts.

CYLINDER HEAD GASKETS

Joints between the cylinders and the head must be gas- and water-tight.

To get this tight seal, head gaskets are made of copper-asbestos, plain copper, asbestos encased in steel, or special composition with a steel core.

These head gaskets firmly seal by "crushing" when the cylinder head is tightened down.

SERVICING CYLINDER HEADS

Removing The Head

Check for oil or gas leaks around the base of the head at the gasket line.

Drain coolant from engine before removing the head.

Steam clean the engine to prevent dirt from getting on the internal parts.

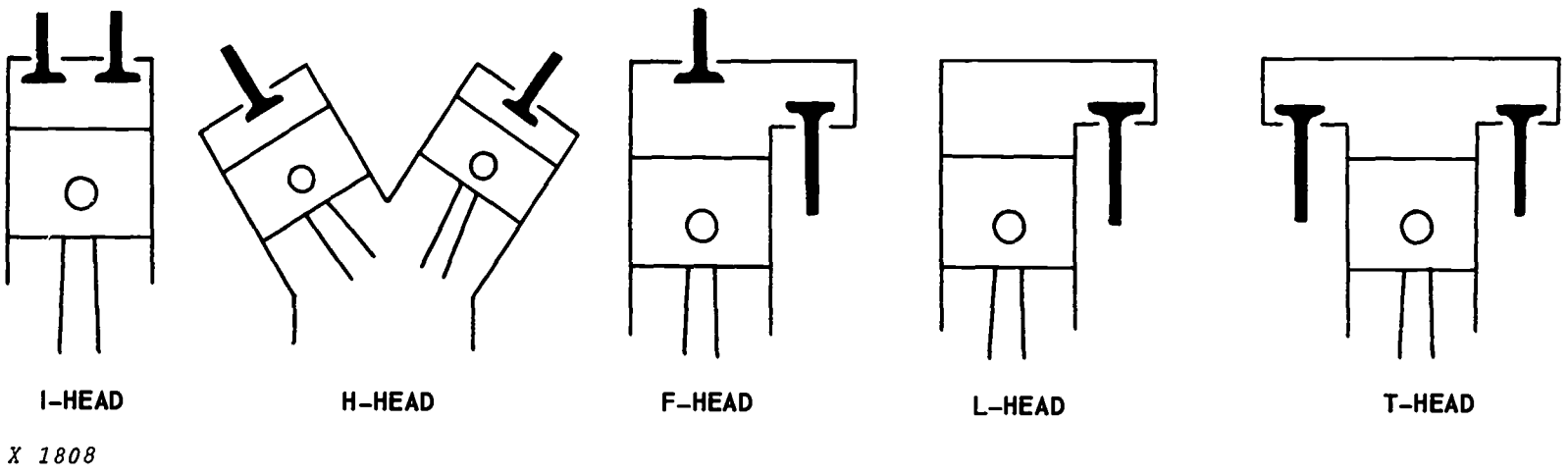

Fig. 5 — Valve Arrangements — Five Types

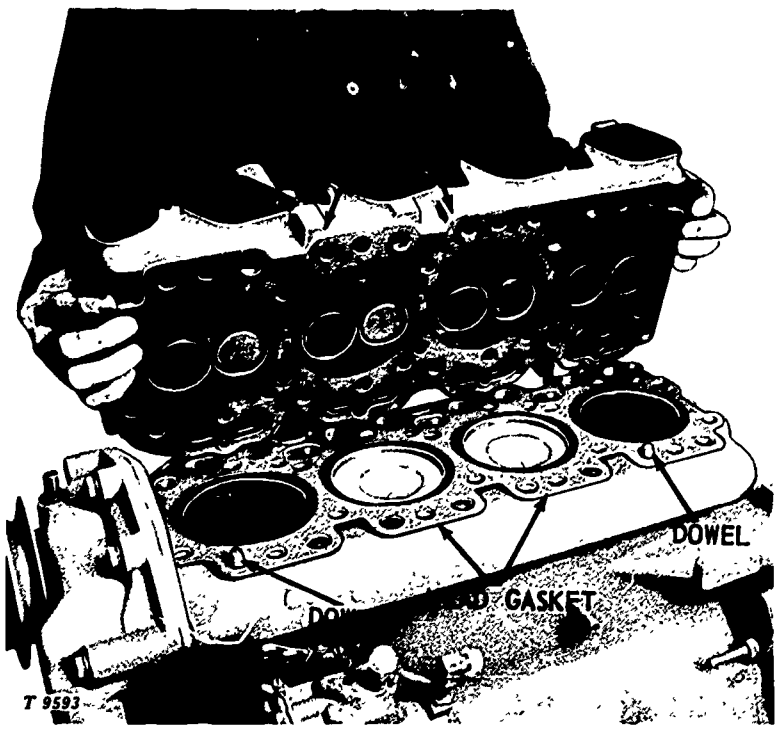

Fig. 6 — Removing The Cylinder Head

When removing a cylinder head (Fig. 6) *do not pry on the contact surfaces.*

If necessary, tap the head lightly with a *soft* hammer to loosen it.

Inspecting The Head

Engines with I-head valves have an oil gallery leading from the bottom to the top of the engine block to carry oil to the rocker arms. When removing the old head gasket, check for leaks around the area.

Replace the gasket to correct the leak.

Check for damage to the sealing surfaces of the head or cylinder block. Clean all carbon deposits from the head by scraping or brushing with a wire brush.

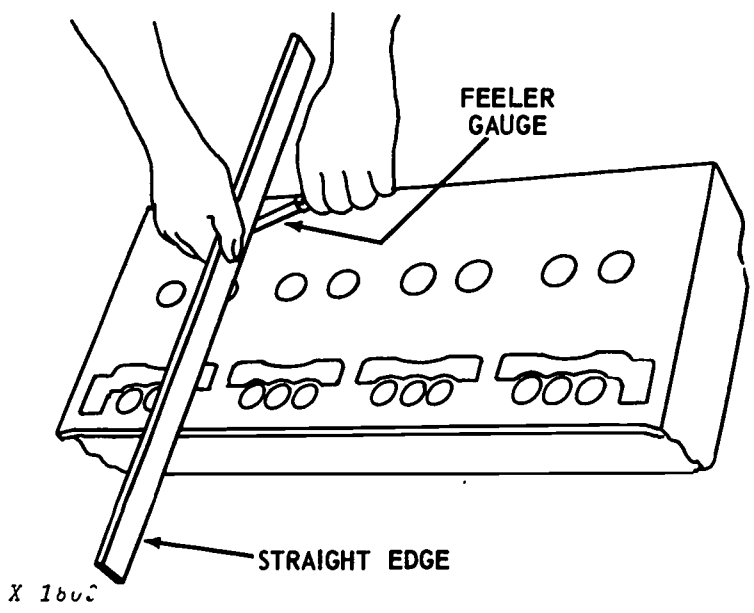

Fig. 7 — Checking The Head For Warpage

Check for lime deposits in the water passages. Use a recommended solution and dip the head to clean out scale and lime. (To prevent lime deposits, condition the cooling system as explained in Chapter 8.)

CHECKING HEAD FOR WARPAGE

After long operation, the head may contour to match the block—this is normal.

However, if the engine has overheated or had compression leaks, the extra heat may have warped the head.

Check the machined surface of the head for warpage as follows:

1. Clean off the machined surface of the head.

2. Use a heavy, accurate straightedge and feeler gauge to check for warpage at each end and between all cylinders (Fig. 7). Also check for end-to-end warpage in at least six places.

3. Decide whether to reinstall the head or to reface it. This will of course be determined by the allowable amount of metal that can be removed. Consult the engine Technical Manual for refacing limits.

CHECKING HEAD FOR LEAKS OR CRACKS

Two methods can be used to check a head for cracks or leaks:

1) Water-and-air pressure method

2) Magnetic crack detector method

Using the *water- and air-pressure method*, the head is sealed and connected to an air hose. The head is than immersed in hot water (180-200°F) for 15 minutes. Leaks are detected by any air bubbles which appear in the water.

The *magnetic crack detector* is placed over the suspected area, setting up a magnetic field (Fig. 8). Fine white metallic powder is then sprinkled over the area and the tool is rotated 90 degrees. After the excess powder is blown off, any cracks are clearly shown in white.

Installing The Cylinder Head

Install the head as follows to prevent leaks and blow-by:

1. Check for defects such as scratches or nicks on the sealing surfaces of the head and block.

2. Clean the cylinder block and head contact surfaces. Install a new cylinder head gasket. Follow the engine manufacturer's recommendations for

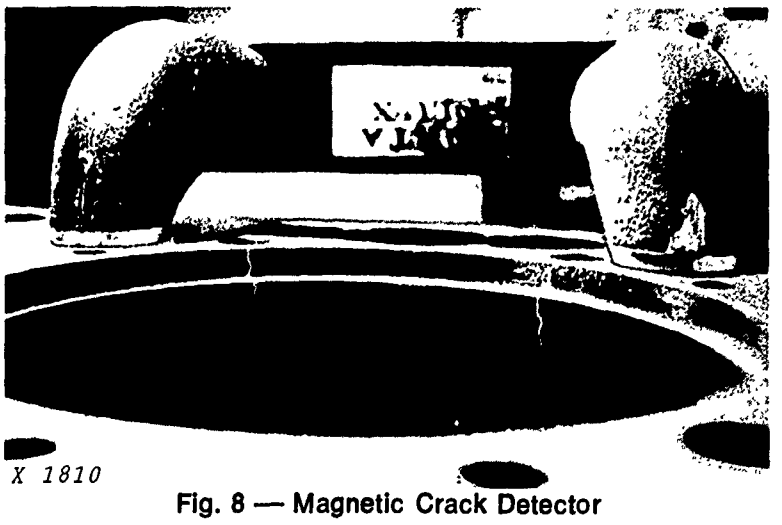

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Fig. 8 — Magnetic Crack Detector

applying a sealing compound to one or both sides of the head gasket.

3. Carefully set the head on the engine block without disturbing the head gasket.

4. Be sure the head cap screws or bolts are clean and lightly oiled.

5. Draw the cylinder head down gradually and uniformly to be sure of a good seal between the cylinder head and block. Tightening the head bolts in one step may distort the head or cylinder liners and result in compression leaks.

6. Turn the head bolts or nuts down finger tight. Tighten each bolt or nut about one-half turn at a time. *Start at the center of the head and work out to both ends of the head until the specified torque is reached.* Fig. 9 shows the general sequence in tightening cylinder heads. This sequence spreads out the head and makes it flat for a better seal.

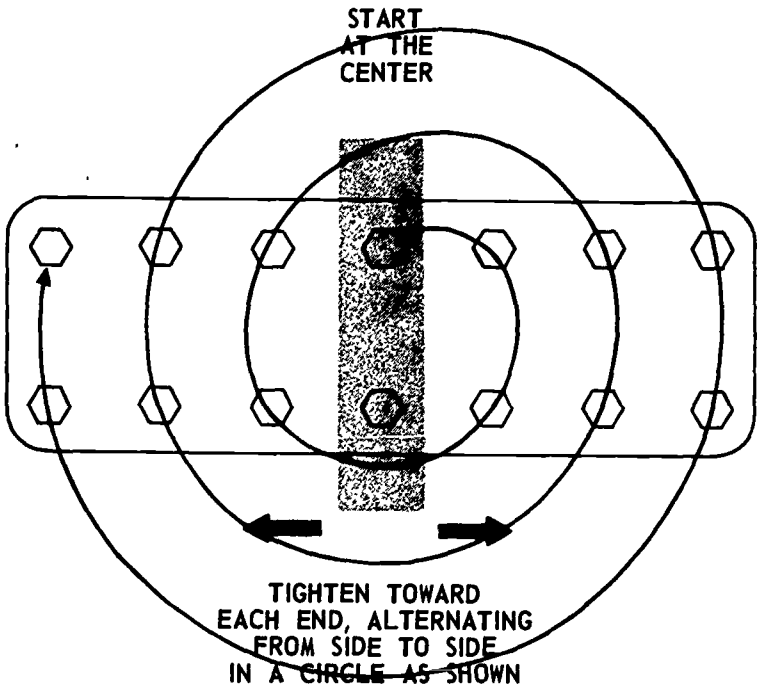

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Fig. 9 — Guide To Proper Sequence For Tightening Cylinder Heads

7. Most engines require a "break-in" or "run-in" after an engine overhaul. The cylinder head should generally be retightened to the specified torque after this run-in.

8. Most engine heads must be retightened after a warm-up. See "Engine Break-In" at the end of this chapter.

VALVES

The engine must take in fuel-air and exhaust spent gases at precise intervals. The **valves** do this job by opening and closing in intake and exhaust ports to the cylinder (Fig. 10).

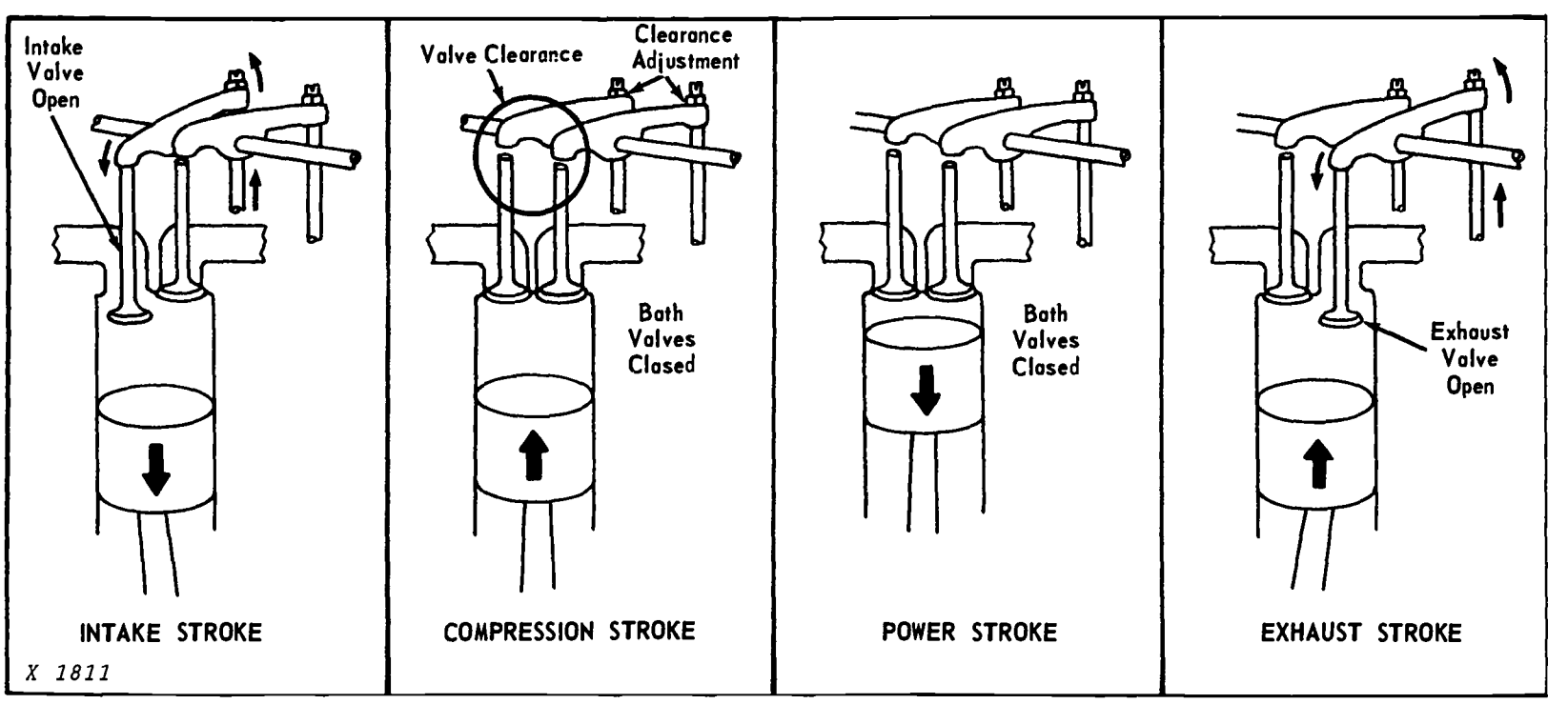

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Fig. 10 — Valve Operation In A Four-Cycle Engine

Fig. 10 shows the sequence of valve operation for a typical four-cycle engine. Each cylinder has two valves—intake and exhaust.

During the intake stroke, the intake valve opens as shown.

During the exhaust stroke, the exhaust valve opens.

Both valves are closed to seal in the combustible mixture during the other two strokes, compression and power.

HOW VALVES ARE COOLED

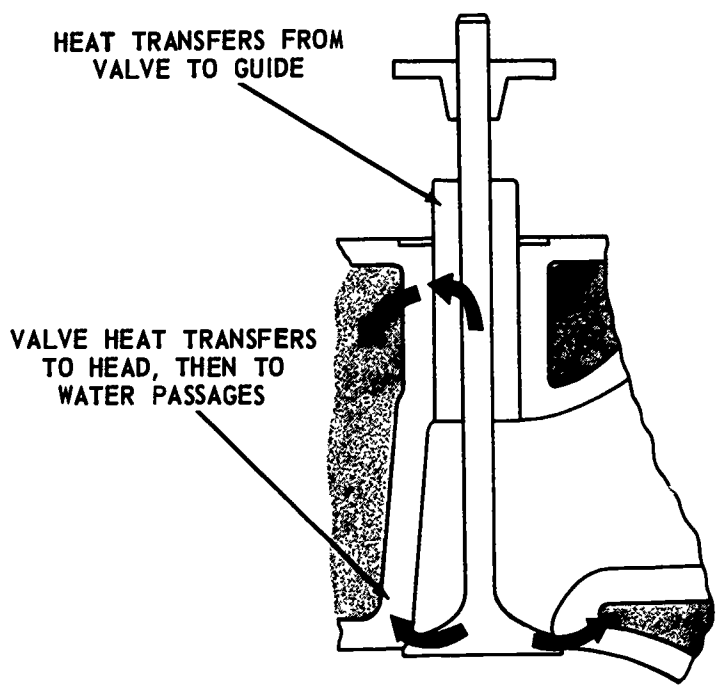


Fig. 11 — How Valves Are Cooled

Fig. 11 shows how valves are cooled during the heat of engine operation.

When the valve is closed, heat in the valve head is transferred to the cylinder head, then to the water passages as shown.

At all times, heat is transferred from the valve stem to the guide.

TYPES OF VALVES

Modern valves are shaped like a poppet or mushroom. The valve is made up of the **head** and the **stem.** The sealing edge is called the **valve face.**

The valve head is conical in shape so that it centers itself when it closes.

Fig. 12 shows three forms of conical engine valves.

The STANDARD VALVE is commonly used in American engines.

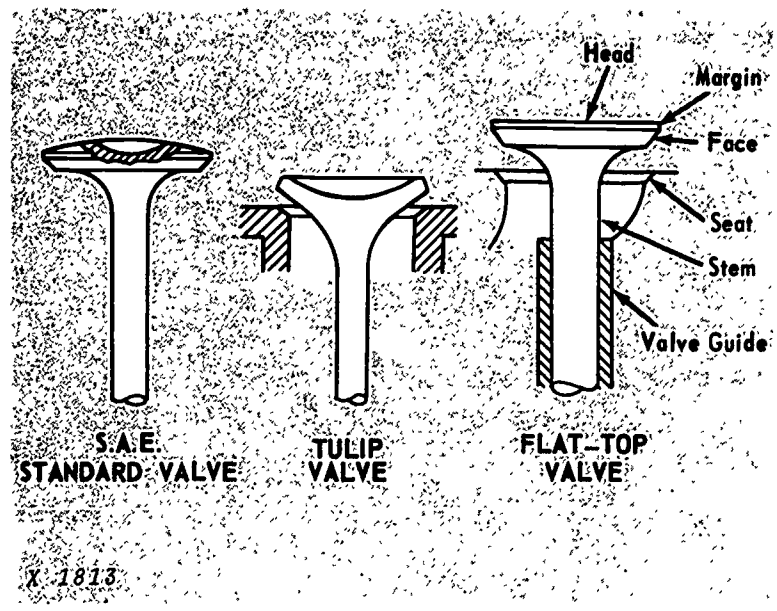


Fig. 12 — Forms Of Engine Valves

The TULIP VALVE is used more in aircraft and racing engines for better flow of gases.

The FLAT-TOP VALVE combines the standard and tulip valve features. The larger taper under the head helps in better flow of gases and also strengthens the valve.

Valves are usually constructed from one or two pieces of special alloy steel—chrome-nickel for intake valves, silichrome for exhaust valves (because of the greater heat).

SERVICING VALVES

Analyzing Valve Troubles

When rebuilding an engine, some servicemen replace almost every part in the valve train while others replace some of the exhaust valves and reface the others. These are extreme cases. The best method is somewhere between the two.

What is best for one valve overhaul may not be best for another.

Fig. 13 — Valve Face Burned From Distortion Of Seat

MAJOR CAUSES OF VALVE FAILURES ARE:

- **Distortion of the Valve Seat**
- **Deposits on Valve**
- **Too little Tappet Clearance—Burned Valves**
- **Preignition—Burned Valves**
- **Erosion**
- **Heat Fatigue**
- **Breaks**
- **Worn Valve Guides**

Let's look at what causes each failure and how to remedy it.

Distortion Of Valve Seat

The valve shown in Fig. 13 is burned because of distortion of the valve seat.

Major causes of seat distortion are:

1. Failure in the cooling system.

2. Out-of-round or loose seat (see "Seat Inserts" later). This may stop the transfer of heat between the insert and the head or block.

3. Warped sealing surfaces on heads or blocks. This often distorts the seats when the head is tightened. Improper tightening, too much torque, and the wrong sequence can also distort valve seats.

4. Failure to grind the valve seat concentric with the valve guide hold.

Fig. 14 — Valve Stem Deposits

Deposits On Valve Stems

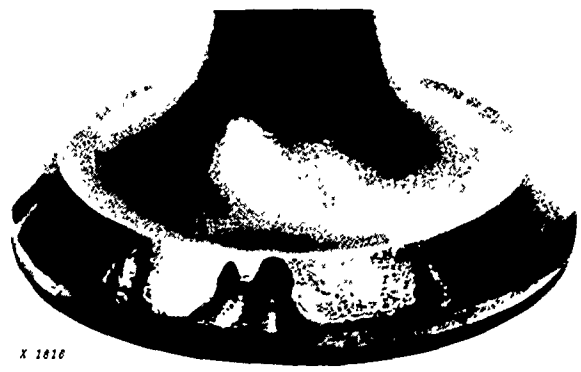


Fig. 15 — Valve Face Deposits

Fig. 15 shows a valve that failed because face deposits built up and then broke off. This damaged the seat and the resulting "blow-by" burned the valve.

Other factors that may cause this type of failure are:

1. Weak valve springs. They cause a poor seal between the seat and the face, allowing deposits to form.

2. Too little tappet clearance. This also causes a poor valve-to-seat seal.

3. Valves sticking in the valve guide. This allows deposits to build up on the valve face and seat.

4. Valve seats that are too wide. They cut down the seating pressure and reduce the crushing of deposits when the valve closes.

5. Lack of valve rotation (which is needed to "scrub" the valve).

Too Little Tappet Clearance—Burned Valves

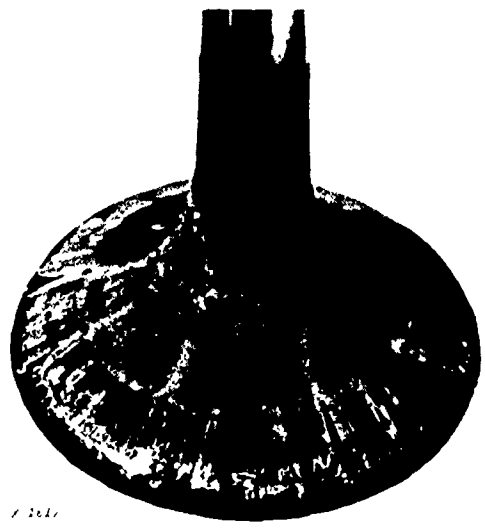


Fig. 16 — Valve Burned From Too Little Tappet Clearance

Failure of the valve in Fig. 16 was caused by too little tappet clearance.

The valve was held off its seat and blow-by caused face burning.

Causes of too little tappet clearance are:

1. Tappet clearance not set to specifications.

2. Failed valve rotators and, as a result, burned valves.

3. Cooling system not operating properly or wrong thermostat installed.

(Heat affects tappet clearance.)

4. Tappet clearance not rechecked after break-in and retorquing of head as recommended by engine manufacturers.

Preignition—Burned Valves

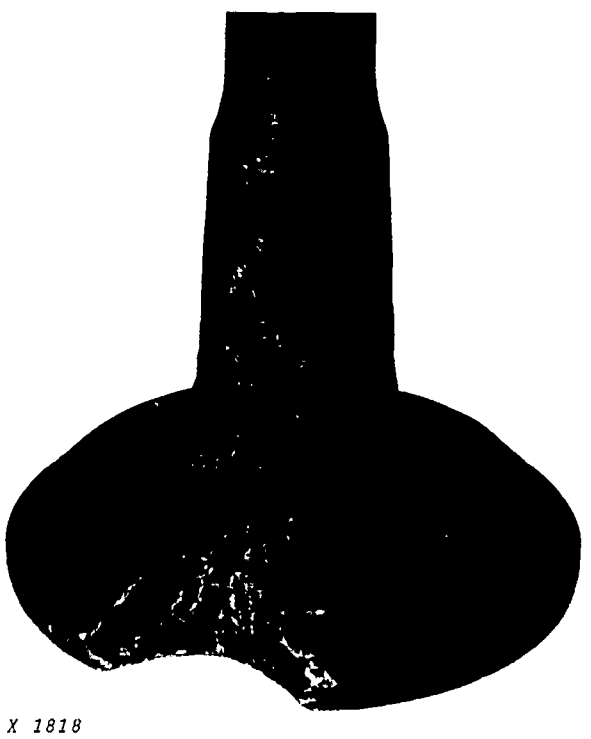


Fig. 17 — Valve Burned By Preignition

Fig. 17 shows a valve that has burned and failed as a result of preignition. Valve temperatures can reach the point where portions of the valve face melt away. Preignition can also cause excessive cylinder wear, and piston ring and land failures.

General causes of preignition are:

1. **Improper timing.** *Timing for maximum power is not always recommended, as preignition cannot always be heard. Follow the recommendations in the engine Technical Manual on timing.*

2. **Combustion chamber deposits.** *Long idling periods, rich fuel-air mixtures and cold engine operation can result in excessive deposits. Oil burning can also cause this.*

3. **High heat range spark plugs or cracked porcelains.** *Replace defective plugs as recommended for the operating conditions.*

4. **Too-high compression ratios.** *When cylinder heads or blocks are resurfaced, the fuel octane requirements also increase.*

Erosion Of Valves

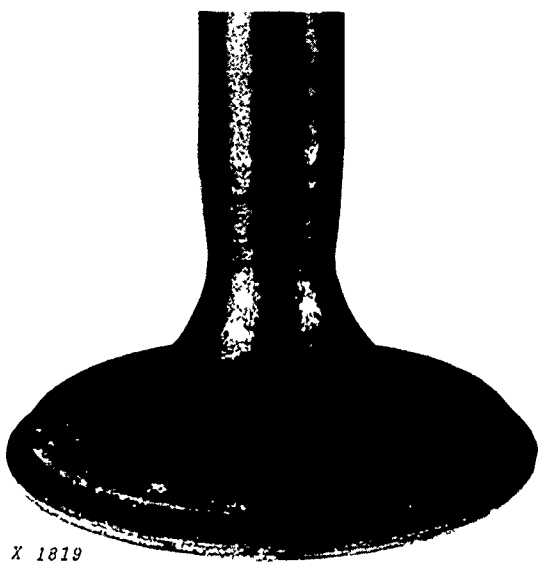


Fig. 18 — Erosion Under Head Of Valve

The valve in Fig. 18 is eroded but has not failed. However, it would have broken after much more service because of the erosion under the head.

Causes of valve erosion are:

1. Wrong type of fuel.

2. Faulty combustion.

3. Too-high valve temperatures.

4. Lean fuel air mixtures which overheat valves and erode them.

Causes of cracked valves from overheating are:

1. Worn guides

2. Distorted seats

3. Preignition

4. Lean fuel-air mixtures

Valves Cracked From Heat

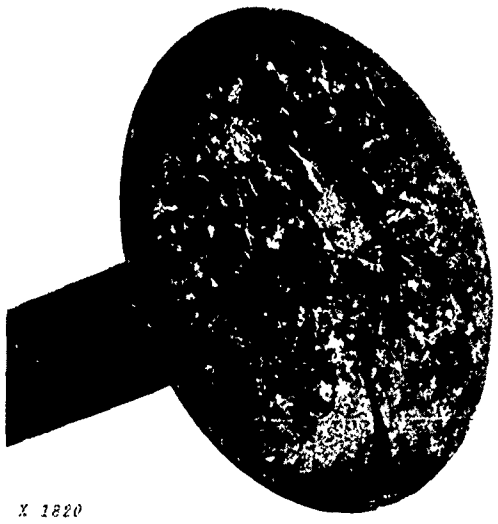


Fig. 19—Valve Cracked By Heat

Overheating of valves can cause cracks in the valve head (Fig. 19). This is sometimes called "Thermal Fatigue". More cracking may cause parts of the valve to break off.

Broken Valves

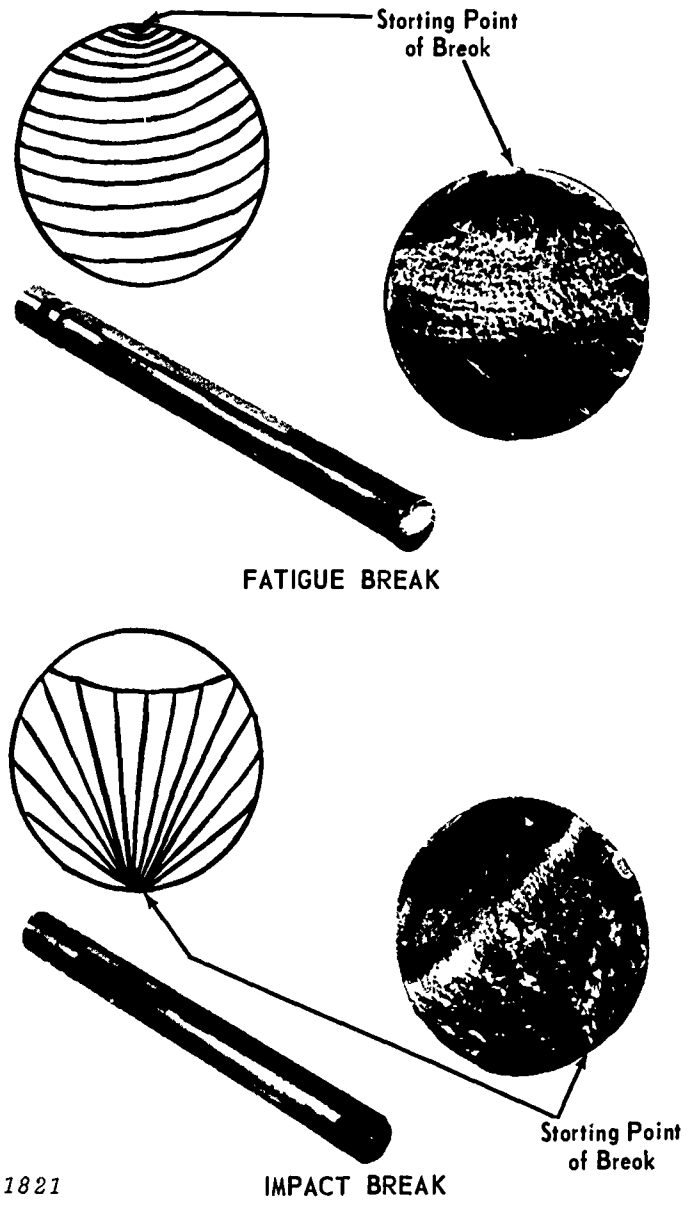


Fig. 20—Broken Valves — Two Causes

The two leading causes of broken valves are:

1. **Fatigue Break.** *A problem not directly related to the mechanical action of the valve. This is the thermal and chemical break-down of the valve. A fatigue break usually shows lines of progression as shown at the top in Fig. 20.*

2. **Impact Break.** *The mechanical breakage of the valve. The cause of this breakage is seating the valve with too much force. An impact break does not show the lines of progression but rather the familiar crow's-feet (see at bottom in Fig. 20).*

Broken valves are not always clearly one type or the other. Combinations of heat and high seating force can produce failures of varying degree and appearance. Fig. 20 shows the differences between fatigue and impact breaks.

Worn Valve Guides

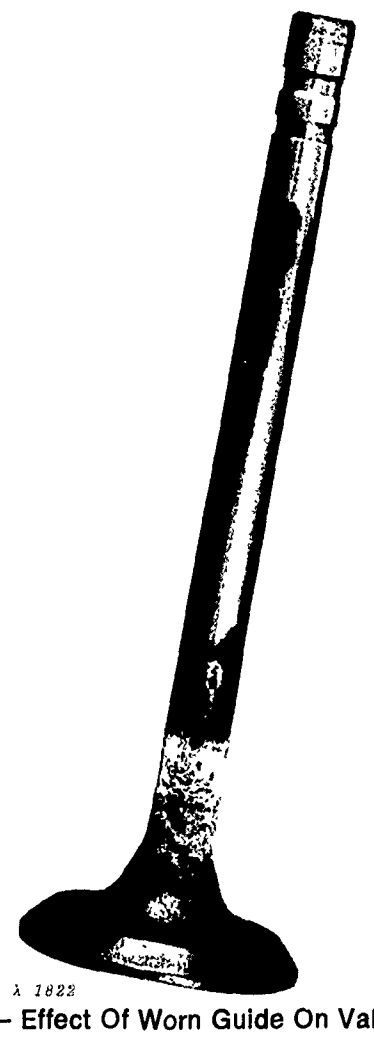


Fig. 21 — Effect Of Worn Guide On Valve Stem

The valve shown in Fig. 21 has failed because of face burning. Wear on the stem and carbon projecting into the guide shows that the valve guide was worn and was the likely cause of the failure.

Worn valve guides lead to valve failure in several ways:

1. *Worn guides prevent concentric grinding of the valve seat. This leads to out-of-square seating which in turn allows gas to leak out and burn.*

2. Worn guides cause the valves to strike at an angle. This damages the sealing surface and leads to blow-by and burning.

3. Excessive stem-to-guide clearance allows too much oil to run down the stem, resulting in excessive carbon deposits that cause valve sticking.

4. When the inside edges of the valve guides wear, they can no longer act as carbon scrapers.

Installing new guides when new valves are installed does not mean they will be trouble-free.

Other factors can also cause valve guides to wear out too fast:

Worn Rocker Arms—cause excessive side thrust on the valve stem.

Poor Lubrication—results in scoring.

Carbon Deposits—deposits on the valve stem wear the valve guide into a bell-mouthed shape.

Cocked Valve Springs—places side thrust on the valve stem and results in excessive wear.

Dimensions Needed When Servicing Valves

A—I.D. of Valve Guide

B—Length of Valve Guide

C—Distance of Guide from Head

D—O.D. of Valve Stem

E—Angle of Valve Face

F—Angle of Valve Seat

G—Width of Valve Head

H—Width of Valve Seat

Fig. 22 shows the dimensions which must be known to recondition valves, seats, and guides.

Refer to the engine Technical Manual for the correct dimension for each engine.

Reworking Or Replacing Valves

When removing valves from the engine, place them in a numbered rack or otherwise mark them. This returns each valve to its own valve guide after servicing.

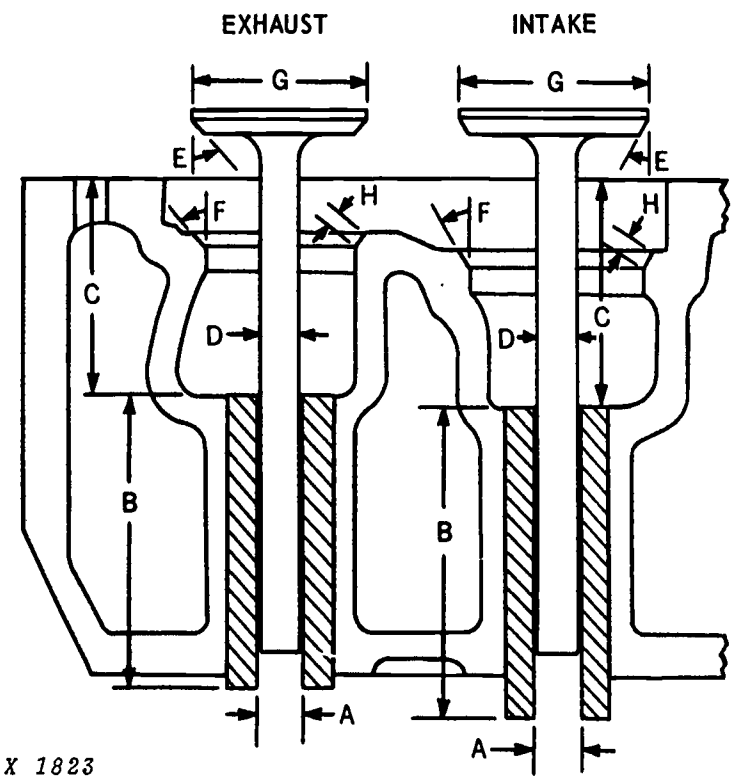


Fig. 22 — Valve Dimensions Needed When Servicing Valves

Special tools are a must when reworking engine valves. *Valves can't be refaced on a shop grinding wheel.*

1. CLEANING

Hold each valve firmly against a wire wheel on a bench grinder.

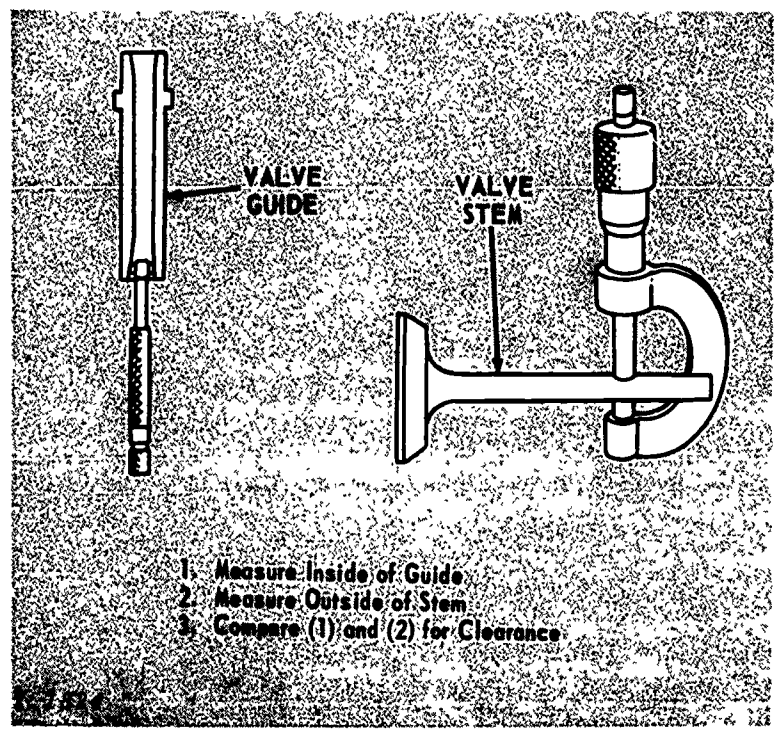


Fig. 23 — Measuring Wear On Valve Stem And Guide

Remove **all** carbon from the valve head, face and stem. Any carbon left on the stem will affect alignment in the valve refacer. Polish the valve stems with steel wool or crocus cloth to remove any scratch marks left by the wire brush.

2. INSPECTION

Use micrometers to measure the clearance of valve stems and guides (Fig. 23) If the measurements exceed the specified clearance, replace either the valve or guide or both.

3. TESTING VALVES FOR BREAKS

Test all used valves as follows:

Hold the valve by its stem, head down, and strike it sharply on end of stem with a hammer. If a fracture exists, the head will break off.

4. REFACING THE VALVES

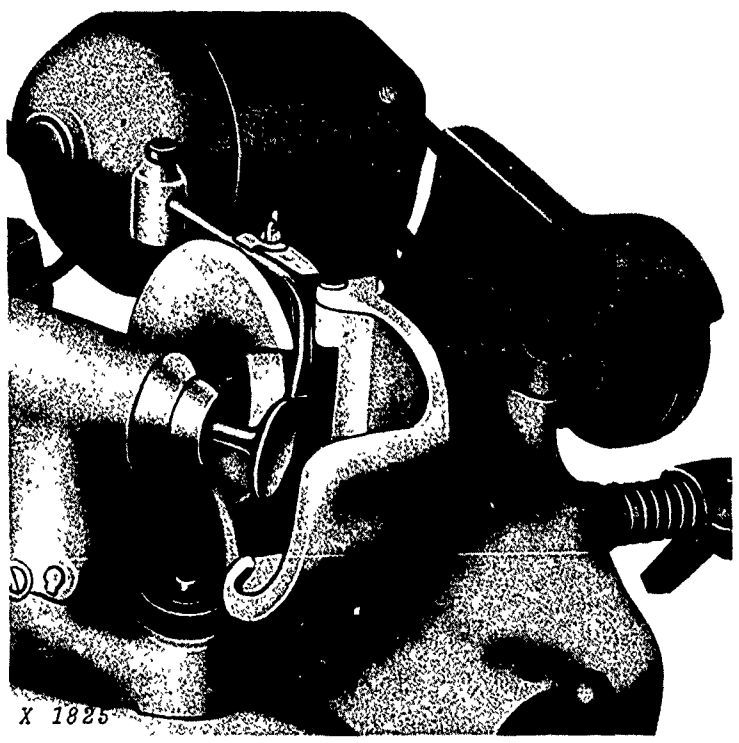


Fig. 24 — Refacing The Valves

Locate the working head of the valve refacer at the specified angle with the valve head (Fig. 24). For quicker seating, an interference angle is normally used.

First be sure the chamfer on the end of the stem is uniform and then be sure the valve is positioned all the way in the chuck and is seated against the conical centering stop.

When grinding, the first cut from face of valve must be light. Observe if there is an unevenness of the metal being removed. If only 1/3 or 1/2 of the valve's face has been touched, check to see if the machine is dirty or the valve is warped, worn, or distorted. When the cut is even around the

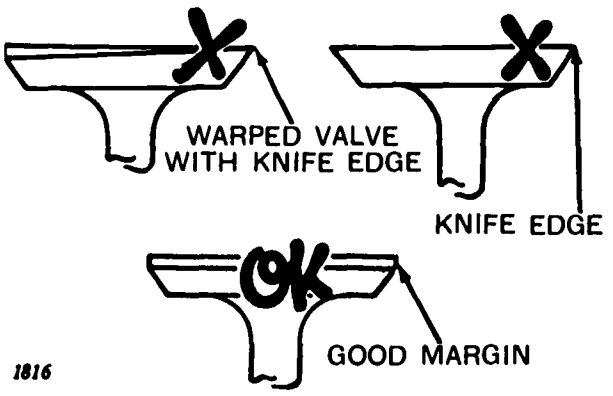


Fig. 25 — Valve Head Margin

whole valve, keep on until the complete face is ground clean. Be sure the correct angle is maintained.

Scrap and replace any valves that cannot be entirely refaced while keeping a good valve margin (Fig. 25). The amount of grinding necessary to true a valve tells whether the head is worn or warped.

Avoid a knife edge around part or all of the valve head (Fig. 25). Heavy valve heads are required for strength and good heat dissipation. Knife edges lead to breakage, burning, and pre-ignition because heat localizes on the edge.

5. GRINDING END OF VALVE STEM

If the end of the valve stem is pitted or worn, true it and clean it up on the refacer attachment—not the grinding wheel. A very light grind is usually enough to square the stem and remove any pits or burrs.

6. ASSEMBLING VALVES

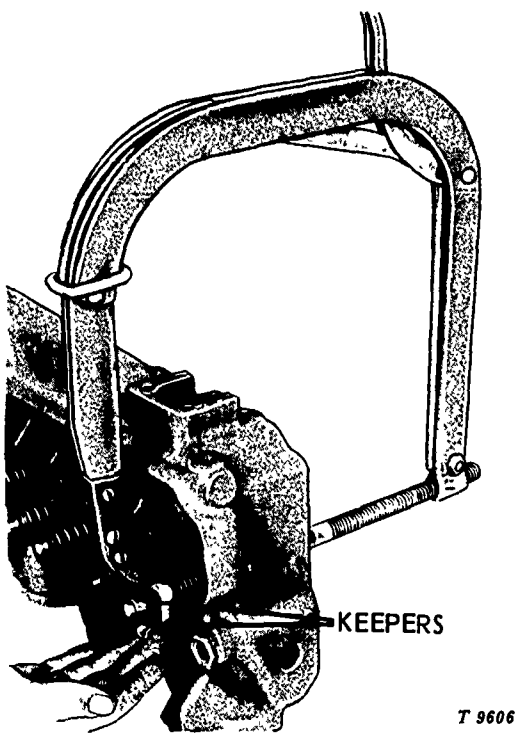


Fig. 26 — Installing Valves (Valve-In-Head Engine Shown)

Apply oil to valve stems and return the valves to same ports from which they were removed. (Commercial valve stem lubricants are available for this purpose). Work the valves back and forth to make sure they slip through easily and seat properly. A properly seated valve will "bounce" when dropped on its seat (without oiling it).

Be sure to seat the valve keepers (locks) and springs seat properly (Fig. 26). Improper seating of these parts may cause valve breakage.

Use **new** valve keepers when reinstalling the valves.

With valve-in-head models, "pop" each spring and valve assembly three or four times by tapping on the end of each valve stem with a soft mallet to insure good seating of the keepers.

If a failed valve is replaced, also inspect the rocker arm and push rod for that valve. The rocker arm or push rod may be bent or otherwise damaged when the valve fails, even though this may not be noticeable.

7. ADJUSTING VALVE CLEARANCES

Refer to page 2—22 of this chapter for adjusting the valve clearances.

VALVE SEATS

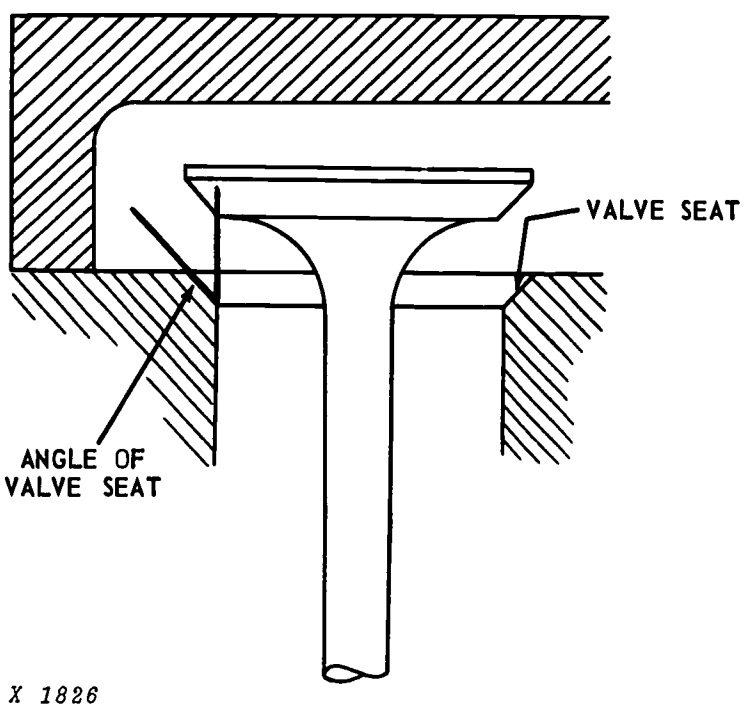


Fig. 27 — Valve Seat

The machined surface of the block or the cylinder head on which the valve rests when closed is the **valve seat.** This seat normally makes an angle of 30 or 45 degrees with the plane of the valve head or bore (Fig. 27).

The valve seat in the block or head is normally of the same material as the block or head and is ground for a tight seal with the face of the valve.

SEAT INSERTS

Valve seat inserts are used on some engines, often only for exhaust valves. The valve insert reduces wear, prevents leakage, and reduces valve grinding frequency. It also allows the seat to be replaced.

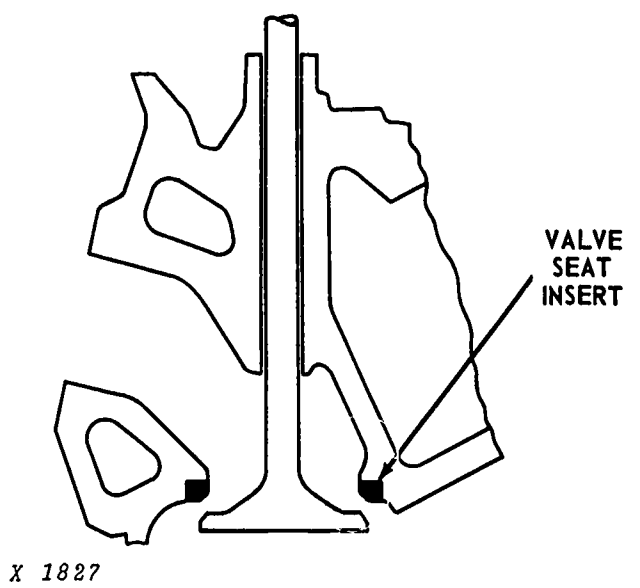


Fig. 28 — Valve Seat Insert

The insert is a ring of special high-grade alloy metal placed in the block or head to serve as a valve seat (Fig. 28).

The seat insert is generally a shrink-fit, although screw-in types are sometimes used. In most applications the inserts are shrunk in place by using dry ice to get the necessary fit without distorting the insert during installation.

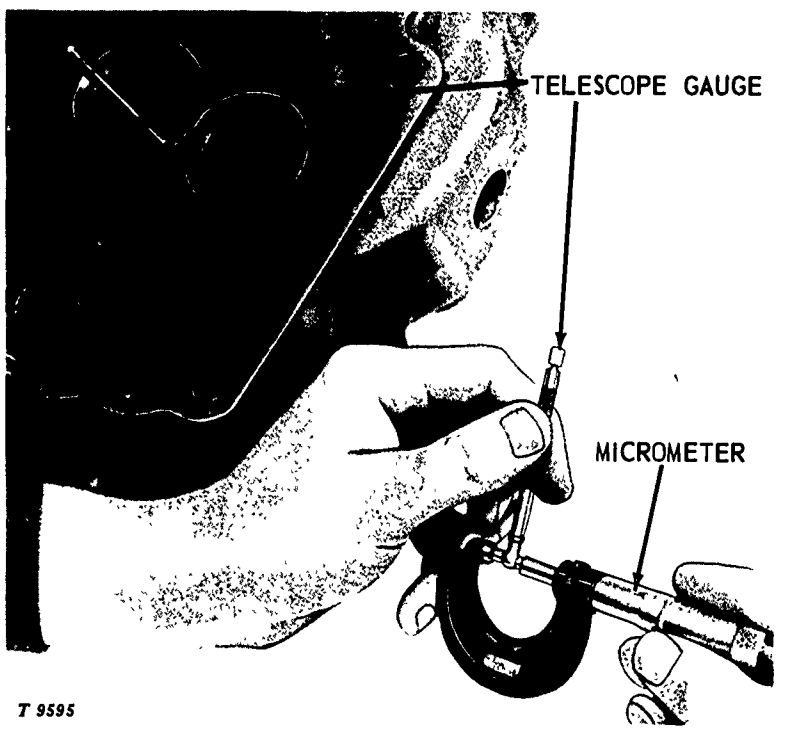


Fig. 29 — Measuring Valve Guides

SERVICING VALVE SEATS

1. **Cleaning Valve Seats**—*Use an electric hand drill with wire cleaning brush and remove all carbon. Use kerosene to help loosen very hard carbon.*

2. **Cleaning Valve Guides**—*Clean valve guides as instructed under "Valve Guides" later in this chapter.*

3. **Measuring Valve Guides**—*Measure the inside diameter of the guide for wear before machining the seat or counterbore (Fig. 29). Replace the guide and ream the guide hole for oversized valves if necessary.*

4. **Servicing Valve Seat Inserts**—*Recut or clean up the counterbore if it is out-of-round or is rough or damaged. Measure the counterbore after recutting and follow recommendations for press fits or other methods. Normally, chill each insert and the driver in dry ice. Use a driver that pilots in the guide hole. Blow out any chips from under the seat before installation. Also check for any nicks or raised edges.*

5. **Servicing Valve Seats**—*The tendency to cut seats too wide can be corrected by using a narrowing stone. This stone is dressed with a sharp face and is used very lightly to reduce the width of the seat face until it is narrower than the valve face.*

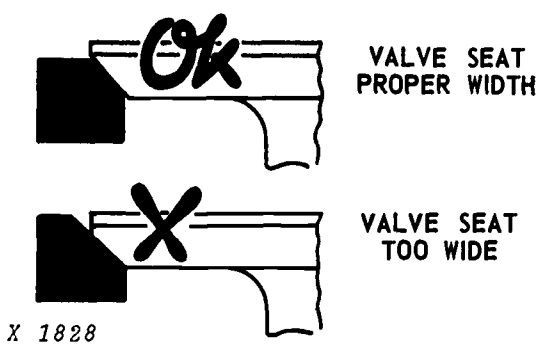


Fig. 30 — Width Of Valve Seat

Fig. 30 shows the right and wrong widths of the valve seat in relation to the valve.

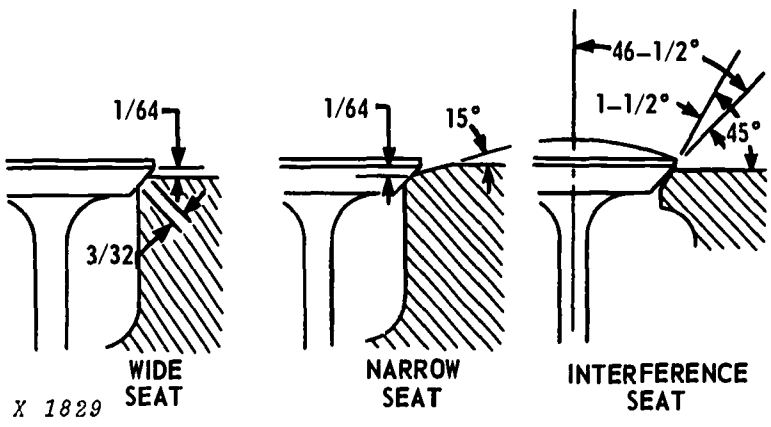


Fig. 31 — Typical Valve Seating Locations

Wide seats improve the heat transfer, while **narrower seats** give better crushing of valve deposits. For even better seating forces, an **interference angle** of the seat to the valve face is used. This is best for high deposits and in some seat distortion conditions, but it will also cause the valve to run hotter.

Grind the valve seat so that little of the valve face is exposed to the combustion chamber. See Fig. 31 for three examples.

Fig. 32 — Grinding Valve Seats

PRECAUTIONS FOR GRINDING VALVE SEATS

1. **Do Not Grind Too Long.** *Only a few seconds are required to recondition the average valve seat. Avoid the natural tendency to grind off too much.*

2. **Do Not Use Too Much Pressure.** *While grinding, support the weight of the driver to avoid excess pressure on the stone.*

3. **Keep The Work Area Clean.** *There can be no precision workmanship in the presence of dirt. Always keep tools and work clean.*

4. **Check The Seat Width and Contact Pattern With Bluing.** *If there are any uneven spots, regrind the seat. Do not lap the seats with grinding compound since this may ruin a good grinding job.*

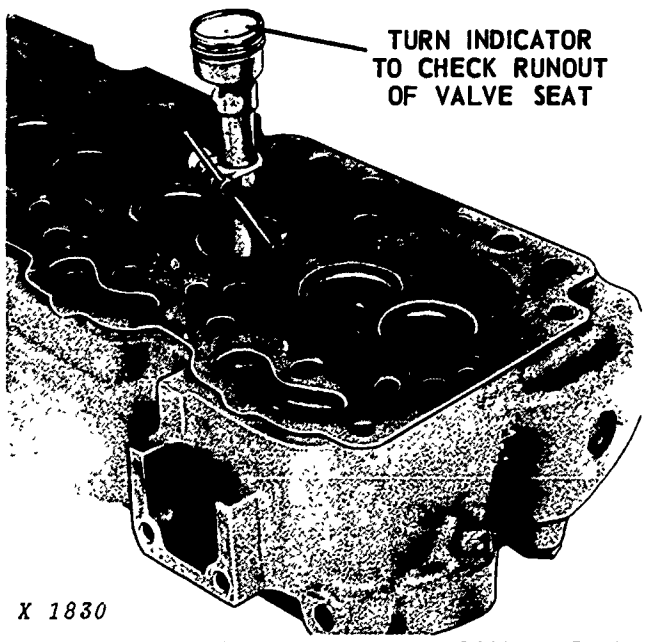


Fig. 33 — Checking Concentricity Of Valve Seat

5. **Check the runout (eccentricity) of the valve seat with a dial indicator (Fig. 33).** *Hold the indicator reading within the specifications shown in the engine Technical Manual.*

This is perhaps the most important valve check. If the indicator reading is low, the grinding equipment and stone are in good condition, and together with the bluing check, assures a good seal of the valve to the seat.

Rotate the pilot 90 degrees in the guide and take a second runout reading. If this reading is also low, the pilot is reasonably straight and the guide is within limits.

VALVE GUIDES

The valve guide holds the valve centered for proper seating. It also transfers heat from the valve stem to help cool the valve.

The guide may be a drilled bore in the head or block or it may be an insert (Fig. 34).

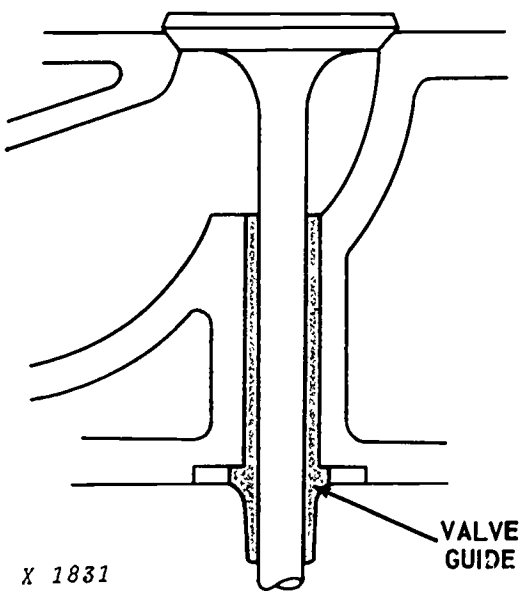


Fig 34 — Valve Guide

The guide is usually as long as space permits to reduce any "cocking" of the valve by the rocker arm.

The valve guide should be lubricated enough to prevent scuffing of the valve stem. Too much lubrication leads to heavy deposits at the hot end of the valve stem. In some engines, an oil seal is provided on the intake valve stem to prevent this.

SERVICING VALVE GUIDES

It is a good policy to replace valve guides or knurl or ream the integral type. However, this is not always practical. But do this when guide-to-stem clearance is more than 50 percent above the specifications.

CAUTION: Never grasp the valve guides when turning over or handling the cylinder head as you may bend or loosen the guides.

Cleaning Valve Guides

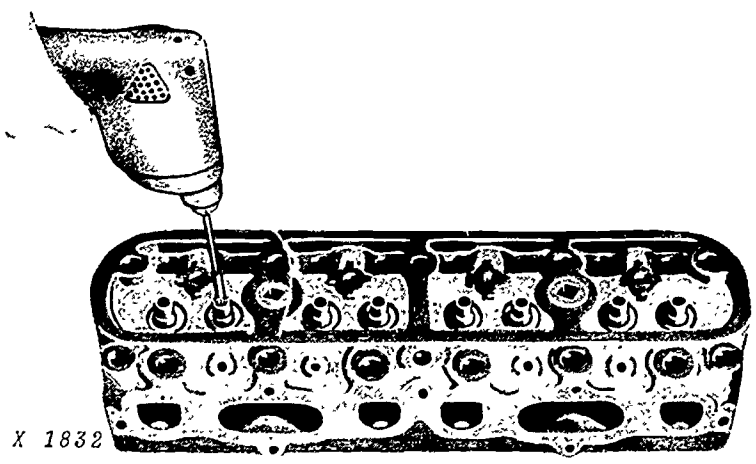


Fig. 35 — Cleaning Valve Guides

Use the correct size wire brush in an electric drill (Fig. 35). Run the brush up and down the full length of the guide. A few drops of light oil or kerosene will help to fully clean the guide.

Measuring Valve Guides

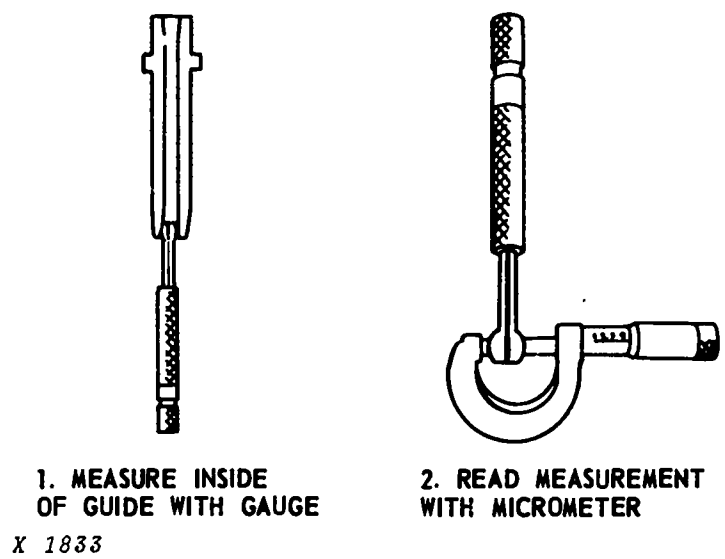


Fig. 36 — Measuring Valve Guides

Guides do not wear round or uniformly. Therefore, don't use plugs, valve stems, or pilots to measure them. Measure the guides at different points within the guide as shown in Fig. 36.

Replacing Valve Guides

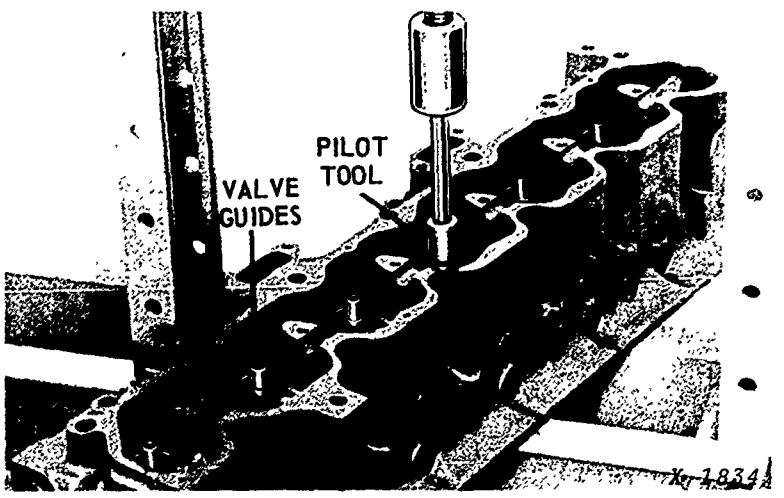


Fig. 37 — Installing Valve Guides

Remove old guides and install new guides as needed (Fig. 37).

Some new valve guides will compress slightly when installed. They must be precision-reamed to specifications after they are installed.

Knurling Valve Guides

"Knurling" a valve guide is upsetting metal on the inside wall to make the bore smaller. Some manufacturers recommend this as a way of reconditioning valve guides using a special tool.

VALVE ROTATORS

Valve rotators are devices that cause the valve to turn during operation. This removes deposits that form on the valve stem and face. The result: an improved gas seal, cooler valves, and less valve erosion.

Two types of valve rotators are:

- **Release Type**
- **Positive Type**

RELEASE-TYPE VALVE ROTATORS

In the release-type rotator (Fig. 38), valve tension is momentarily released, allowing the valve to rotate.

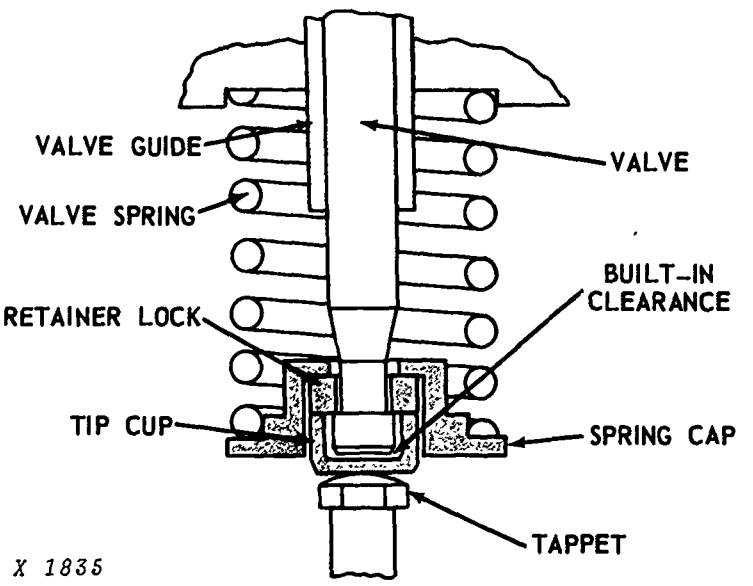


Fig. 38 — Release-Type Valve Rotator

During each valve cycle, the tappet or rocker arm forces the locks away from the shoulder on the valve stem, releasing the spring load from the valve.

The valve then rotates freely for a moment from engine vibrations and moving gases.

POSITIVE-TYPE VALVE ROTATORS

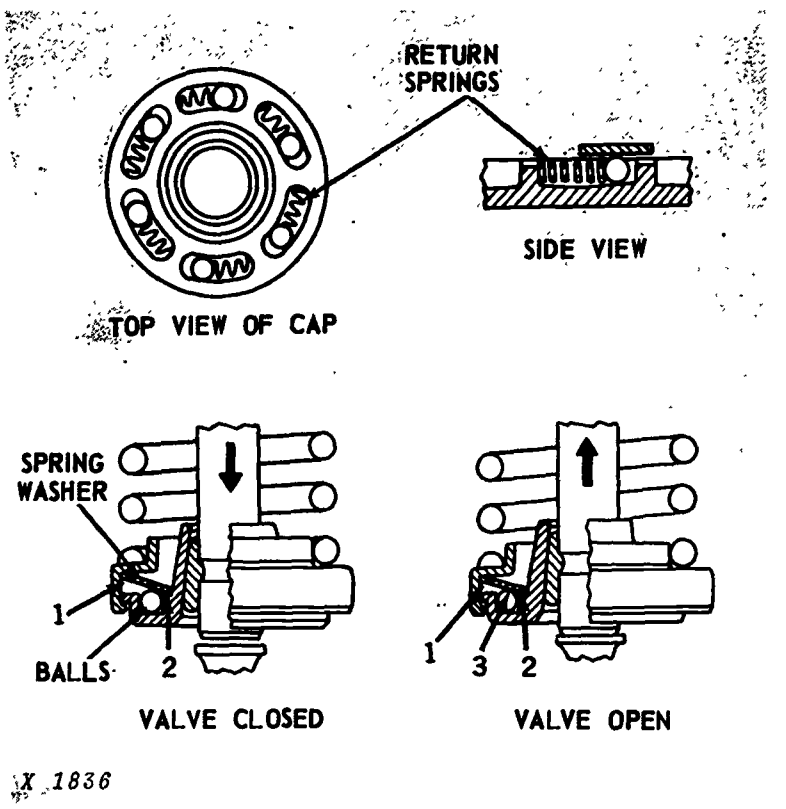


Fig. 39 — Positive-Type Valve Rotator

The positive-type rotator is self-contained and installed in the same way as ordinary valve spring retainers. Rotation occurs when the valve moves and depends on the difference in spring loads between the valve open and closed positions.

Fig. 39 shows this rotator in operation.

When the valve is closed, the spring washer is located at point 1 and at point 2.

As the valve starts to open, the extra spring load causes the washer to flatten, transferring the load from point 2 to point 3. This forces the balls to roll down the inclined races.

This rotates the whole assembly, which transmits the movement to the valve.

As the valve closes again, the spring washer is released from the balls. The balls then return to their closed position by action of the return springs (shown at top).

SERVICING VALVE ROTATORS

Positive-Type Rotators (Rotocap)

There is no maintenance for these valve rotators. However, when valves are replaced or reground, replace the valve rotators.

Check rotation of the rotator by looking for carbon build-up on the valve or by inspecting the seat. (Rotation can also be checked by watching the valve with the engine idling.)

The valve rotator may not rotate when held in the hand, but this does not mean it won't operate in the engine.

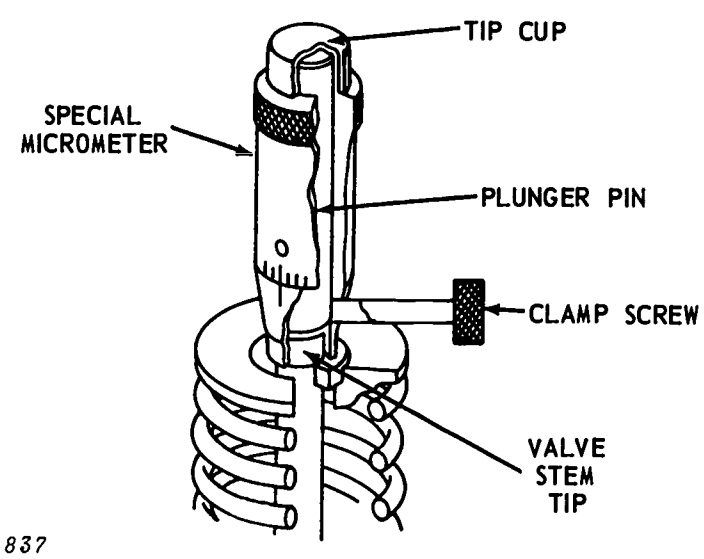


Fig. 40 — Checking Clearance Of Release-Type Rotator Using Micrometer

On valves which use rotators, inspect the valve stem, valve stem cap, and the keepers or locks for wear.

Wear at these points results in false tappet settings and rapid increases in tappet clearance.

Release-Type Rotators

Check the release-type rotator for the clearance built into the valve tip cup. This built-in clearance should be maintained. Wear is uniform up to the wear limit, after which the wear rapidly increases and may cause excessive valve clearance.

To check clearance, use a special micrometer as in Fig. 40 and do the following:

1. Remove tip cup from valve end.

2. Place micrometer on end of valve stem and set at the "0" mark. Hold the plunger pin firmly on top of the valve stem tip and tighten the clamp screw.

3. Place the tip cup against the plunger pin and check the clearance or lack of clearance which is transferred to the micrometer spindle barrel.

4. Readings to the right of "0" indicate too much clearance and readings to the left of "0" indicate too little clearance.

Another means of checking valve tip clearance is the Plastigage method. A plastic strip is inserted between the tip cup and the valve stem tip. With the locks held firmly against the shoulder on the valve, the cup is pressed in place. The width of the plastic strip is then checked.

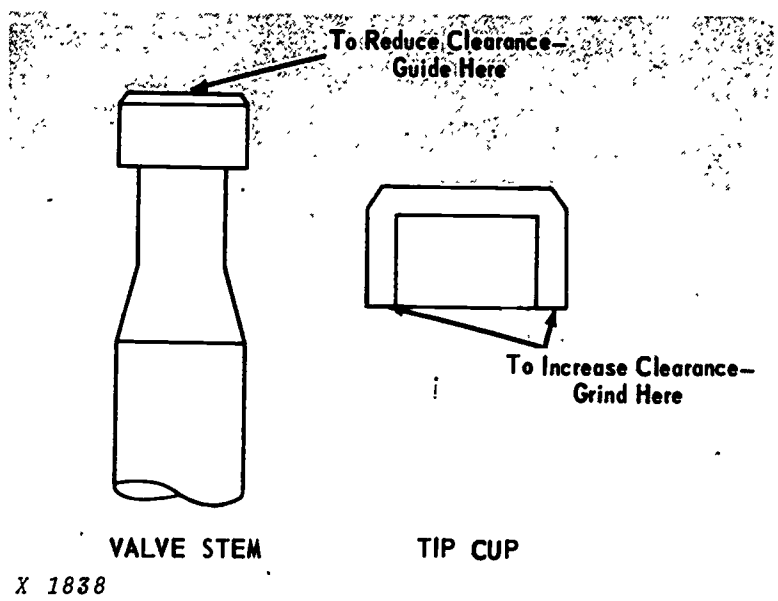
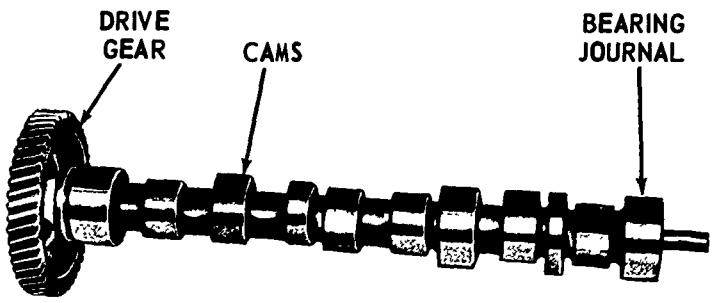


Fig. 41 — Grinding To Maintain Clearance Between Valve Stem And Cup

To reduce clearance, grind the open end of the tip cup (Fig. 41). Grind the valve stem tip to increase clearance.

CAMSHAFTS



X 1839

Fig. 42—A Typical One-Piece Camshaft

Camshafts for small and medium size engines are generally made of a one-piece casting or forging (Fig. 42). One intake and one exhaust cam is provided for each cylinder, along with bearing journals. The journal diameters are large to permit endwise removal of the shaft from its bore.

The camshaft is normally driven by gearing from the crankshaft.

How the cams are arranged on the shaft determines the firing order of the engine. The contour of each cam decides the time and rate of opening of each valve.

Camshafts are made of a low-carbon alloy steel with the cam and journal surfaces carburized before finish grinding. Some high-speed engines use alloy cast-iron camshafts with hardened cams and journals.

On some large engines the camshaft may have integral cams or it may have individual cams assembled on a shaft.

Overhead camshafts for car engines are supported on pedestals mounted on the cylinder head with removable caps, or else in a tunnel formed in the valve housing.

In some dual overhead camshafts for high-speed racing engines, one camshaft operates the two intake valves per cylinder while the other operates the two exhaust valves.

Camshafts may also drive oil pumps, fuel pumps, and distributors using extra lobes or a gear on the shaft.

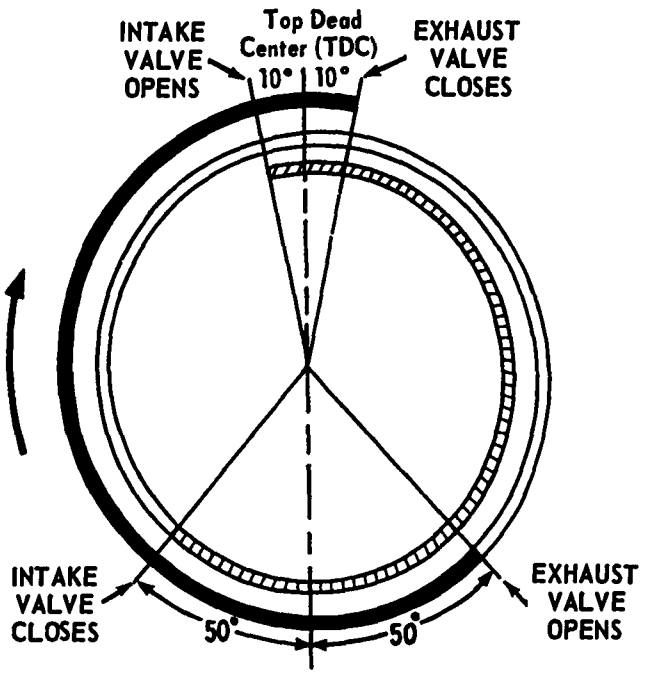
CAMSHAFT TIMING

On 4-cycle engines, the camshaft turns at one-half the speed of the crankshaft, so that each valve is opened and closed once during two revolutions of the crankshaft.

The *exhaust valve* must open before the end of the power stroke and close after completion of the exhaust stroke.

The *intake valve* must open before the end of the exhaust stroke and close after the end of the intake stroke.

This involves an overlapping of the exhaust and intake periods. This "overlap" is required because of the slow valve openings and closings now used for quiet engine operation.



X 1840 Bottom Dead Center (BDC)

Fig. 43 — Typical Valve Timing Diagram

Fig. 43 illustrates the valve timing for a typical highspeed engine.

The **intake valve** opens at 10 degrees *before* top dead center (TDC). It stays open until 50 degrees *after* TDC as shown.

During this time the engine has taken in its full charge of fuel-air and the piston has started its compression stroke.

The fuel is then compressed and ignited, and the power stroke begins.

When the piston reaches a point 50 degrees before bottom dead center (BDC), the **exhaust valve** opens as shown and stays open until the piston has traveled to 10 degrees *beyond* TDC, when it closes.

This sequence will vary depending on the type and model of the engine.

Cam Profiles

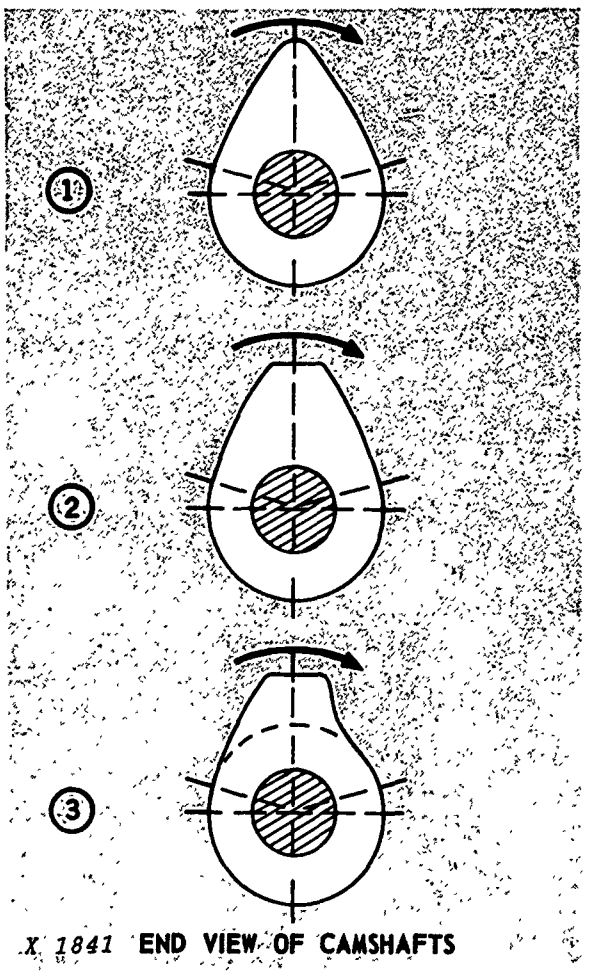


Fig. 44 — Cam Profiles

The **cam profile** is the opening ramp on the cam lobe which "takes up the slack" in the valve train. It also includes the nose which holds the valve open and the backside which allows the valve to close.

The slope of the cam face determines how fast the valve opens.

Cam No. 1 in Fig. 44 has curved faces which cause the valve to open faster at the start and to be held open wide until the end of the closing face is under the valve tappet.

Cam No. 2 provides a rapid opening and closing with a long period at wide open.

Cam No. 3 is used in high-speed engines (racing cars) to give the longest possible opening of the valve.

SERVICING CAMSHAFTS

Always check the camshaft when you recondition the engine.

In modern engines, the cam lobes have a difficult job to do. They must raise the valves, one by one, at the proper time and under pressure, by rapidly moving the tappets, push rods, and rocker arms at high engine speeds.

Inspection Of Bearing Journals And Bore

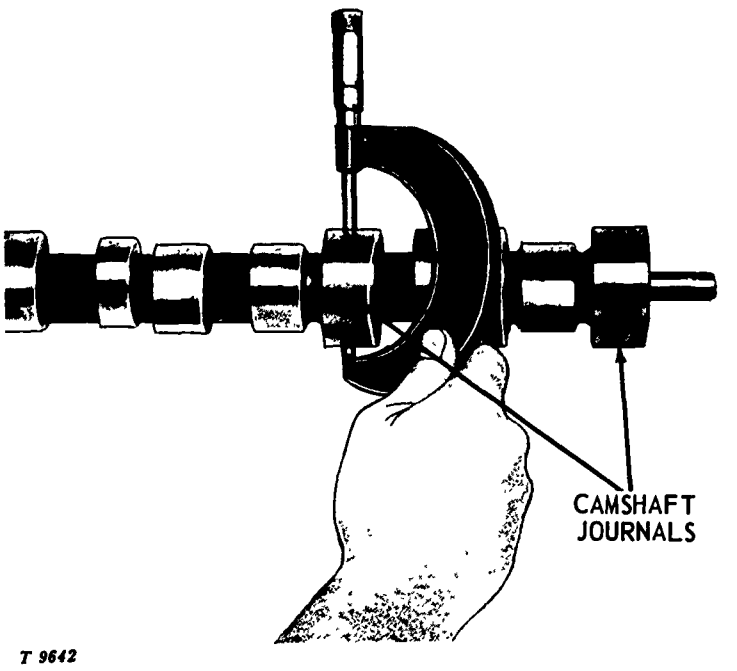


Fig. 45 — Measuring Camshaft Journals

Inspect camshaft journals for signs of wear or out-of-round condition.

Measure the camshaft journals with an outside micrometer as shown in Fig. 45.

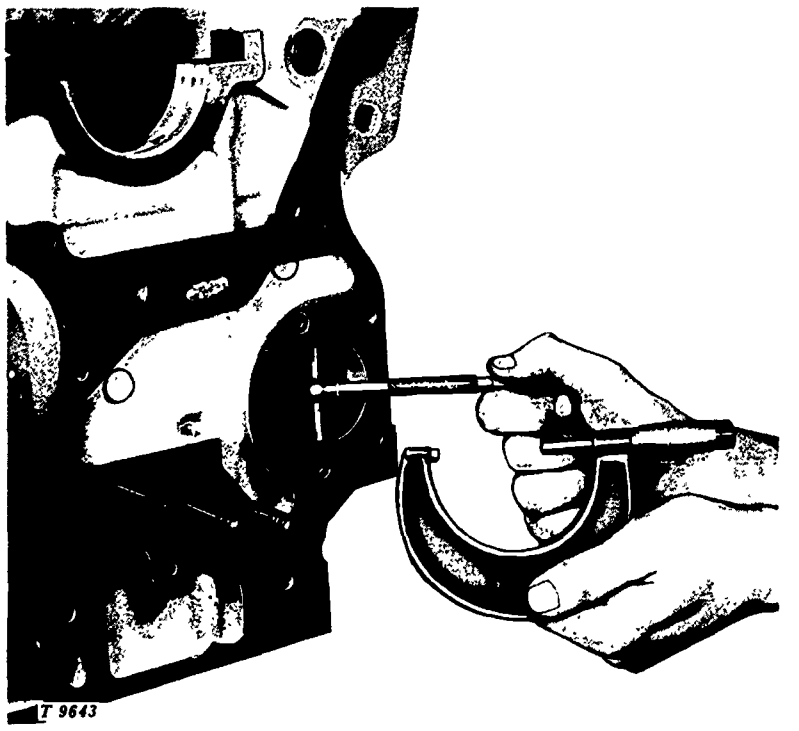


Fig. 46 — Measuring Camshaft Bores

Measure the camshaft bores or bearings with an inside micrometer (or telescoping gauge and outside micrometer) as shown in Fig. 46.

Compare the results with specifications.

Checking Cam Lobes

Using a micrometer, check the height of each cam lobe. Compare intakes to other intakes, and exhaust cams to their counterparts, then check all with specifications. Also inspect the cam faces on which the tappets slide for surface fatigue. The nose of the cam must be polished and flat. If rough or wavy, inspect the cam and its mating follower for possible service.

Regrinding and polishing the cams is not satisfactory on modern high-speed engines. Originally the cam surfaces are treated to provide an oil-absorbing surface for better lubrication. Most engine reconditioners cannot duplicate this process. Therefore, the camshaft must be replaced.

Selecting Bearings

Select the proper bearings to match the camshaft journals. Some manufacturers have undersized bearings for replacement parts as well as special installation tools.

Line up oil holes prior to assembly and after assembly, be sure to check the registry of these holes with those in the cylinder block with a wire.

CAM FOLLOWERS

Cam followers work off the lobes of the camshaft and drive the push rods to operate the valves (Fig. 47).

A cam follower is usually a piston-like part working in a vertical guide against the cam lobe. The follower is commonly hardened and ground to provide a long wearing surface face against the cam lobe.

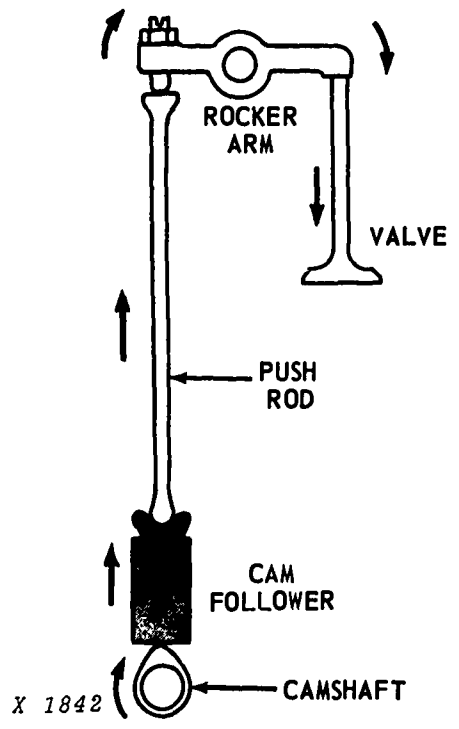


Fig. 47 — Cam Follower

Some cam followers have a roller on the driven end that works against the camshaft lobe. This reduces friction and wear on the follower.

NOTE: Cam followers may also be called "valve tappets."

HYDRAULIC VALVE LIFTERS

With hydraulic valve lifters, the valve clearances are always zero and valve operation is quiet.

The lifter body has an opening through which engine oil under pressure is supplied to the pressure chamber in the lower part of the lifter (Fig. 48).

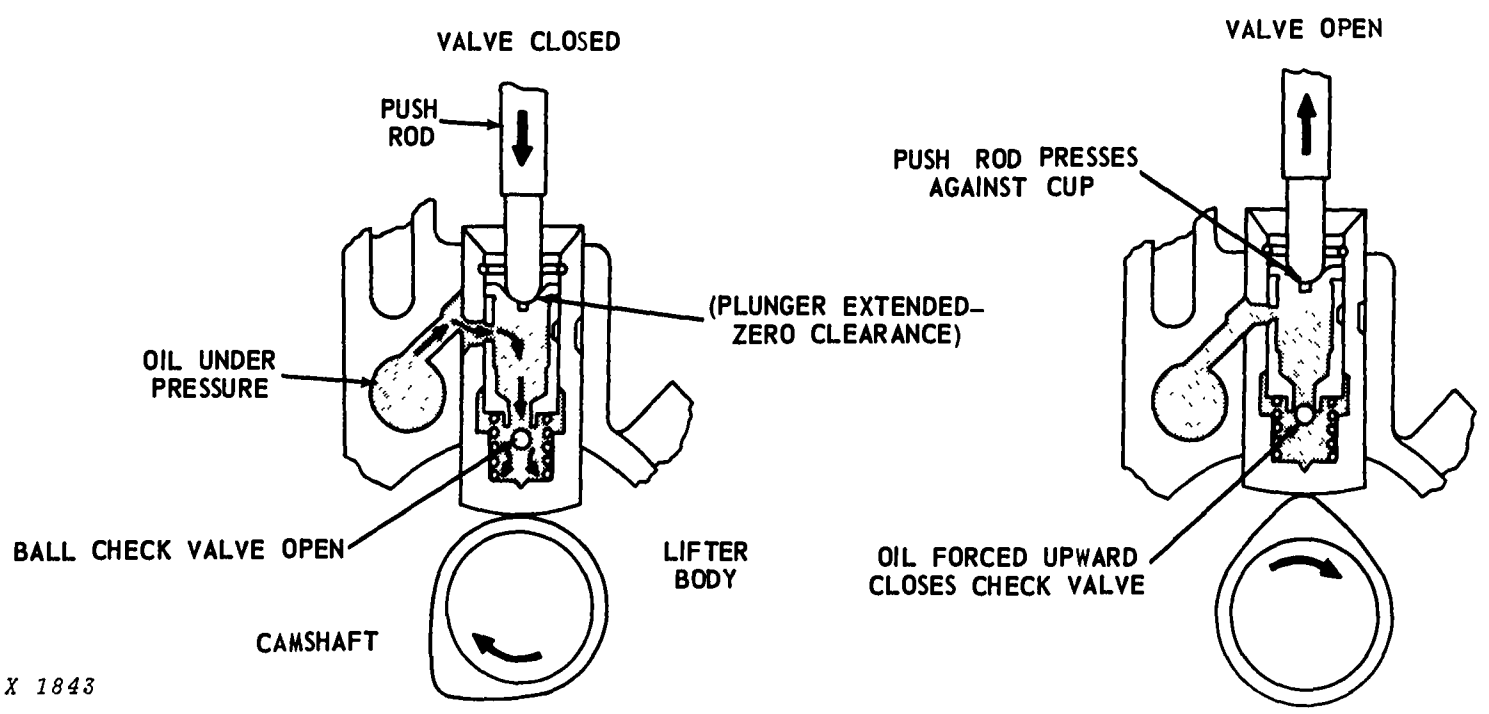


Fig. 48 — Hydraulic Valve Lifter

The oil unseats the check ball and fills the pressure chamber below the plunger. The small spring above the plunger keeps the lifter in contact with the cam when the valve is closed.

As the camshaft moves to open the valve, the pressure of the oil under the plunger increases and closes the check ball. The plunger and valve are lifted by the oil trapped above the check ball.

As the valve is closed, the pressure of the oil under the plunger decreases, and the valve ball opens.

SERVICING OF CAM FOLLOWERS

Proper inspection and service of cam followers is vital to good engine performance.

A change in valve clearance or valve lift can usually be detected by excessive noise at idle speeds.

If you suspect a change in clearance, remove the followers and inspect them for excessive wear.

Mark each one so it can be returned to the same bore.

After the followers are removed, clean all parts thoroughly with fuel oil or solvent and dry them with compressed air.

Look for signs of fatigue on each tappet. If the follower is scuffed or "dished", the camshaft may need replacing.

Examine follower bores to make sure they are clean, smooth, and free of score marks. Clean up any marks.

If the camshaft is replaced, also replace the cam followers.

On roller-type followers, the rollers must turn smoothly and freely on their pins and be free of flat spots or scuff marks.

If the rollers do not turn freely or have been scored or worn flat, examine the cam lobes on which they operate (see "Camshafts".)

Measure the maximum wear on roller-type followers. If clearances do not meet specifications, replace the cam roller and pin, which are usually serviced as a set.

When installing cam followers, lubricate the body and bore with engine oil so that the follower slides in easily. Also apply oil to the camshaft lobes.

VALVE PUSH RODS

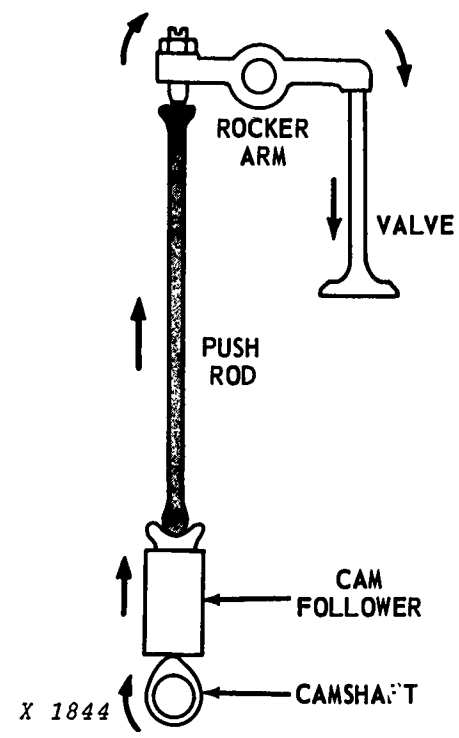


Fig. 49 — Valve Push Rod For Valve-In-Head Engine

The push rod, used in valve-in-head engines, is a steel rod which transmits camshaft motion to the rocker arm (Fig. 49).

Push rods are usually made from hollow steel pipe with solid steel ends.

The lower end of the push rod is usually formed into a half-round head to match a spherical seat in the tappet. The top end usually has a spherical head to match the adjusting screw at the rocker arm.

SERVICING PUSH RODS

1. When removing push rods, identify each rod so it can be assembled with the same mating parts.

2. Inspect push rod ends for wear or damage.

3. Examine push rods for bent condition. Push rods should be replaced if they are bent more than specifications allow. Measure by placing the push rods on a flat plate. Rotate the push rod and measure the deflection with a dial indicator.

4. If a failed valve has been replaced, also inspect its mating rocker arm and push rod. Often the rocker arm or push rod is bent or otherwise damaged when the valve fails, even though this condition may not be noticeable.

VALVE SPRINGS

The main function of the valve spring is to close the valve and keep it closed and seated until opened by the camshaft.

Cylindrical springs are used by most engine manufacturers. In some cases, two springs are used for each valve to cut down spring vibration and valve flutter. Special spring dampers are sometimes used to reduce vibration and humming.

SERVICING VALVE SPRINGS

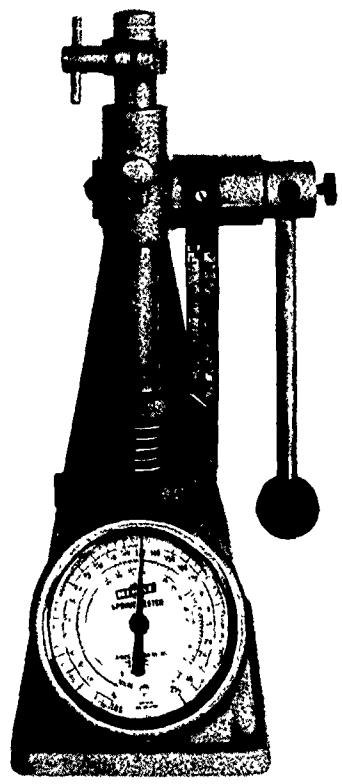


Fig. 50 — Checking Valve Spring In Tester

When **inspecting valve springs,** look for the following:

1. Wear on the casting where the springs rotate.

2. Wear on the spring caps. Spring caps can wear almost to knife edge.

3. Wear on ends of spring.

4. Lack of spring tension. Check against specifications using a spring tester (Fig. 50). A tension loss exceeding 10 percent of the specified load means that the spring needs replacing.

5. Also check for any pressure loss caused by valve grinding. As the valve seat is ground deeper, the spring operating height is longer, decreasing the spring load. Washers can sometimes be added to correct this, but be sure to allow for the washer when testing the spring.

6. Inspect for "cocked" springs. This places a greater than normal side thrust on the valve stem and results in excessive wear. Measure by placing the spring on a flat surface and using a square. Replace springs if they are cocked.

7. Don't be concerned if the valve springs have different free lengths. This can vary and the springs will still have the same length when compressed. Remember, the **force** *of the spring is the critical factor.*

VALVE ROCKER ARMS

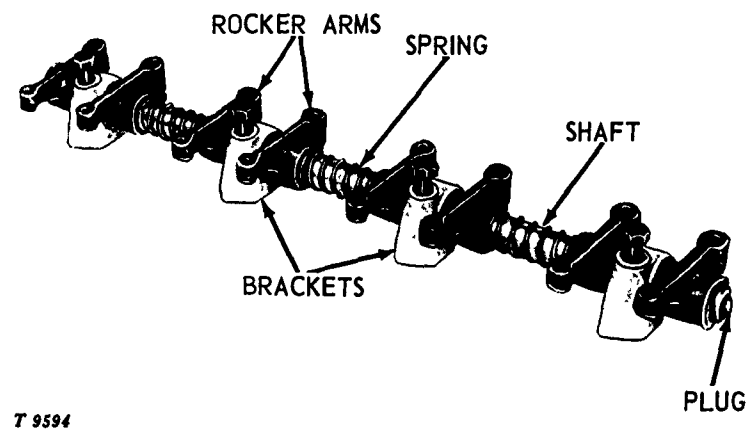


Fig. 51 — Valve Rocker Arm Assembly

In valve-in-head engines, the rocker arms transmit camshaft motion to the valves.

Most rocker arms are mounted on a single hollow shaft located at the top of the engine (Fig. 51).

When the push rods move up, the mating rocker arm is moved down, contacting its valve stem tip and opening the valve.

Lubricating oil is usually supplied through the drilled rocker arm shaft to each rocker arm.

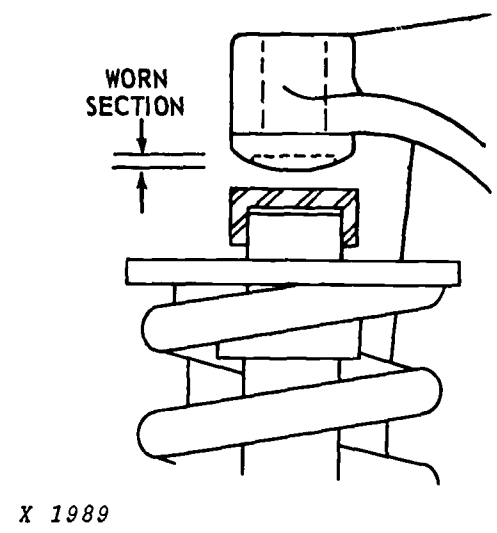


Fig. 52 — Worn Rocker Arm Tip

SERVICING ROCKER ARMS

1. Inspect the rocker arm shaft for scratches, scores, burrs, or excessive wear at points of rocker arm contact. Be sure that all oil holes are open and clean. If a valve has failed, examine the shaft for cracks.

2. Check for cups or concave wear on ends or rocker arms where they contact the valve tips (Fig. 52). Concave wear at this point makes it difficult to get the proper tappet adjustment. A worn rocker arm also creates side thrust on the valve stem and causes wear.

3. Replace or recondition rocker arms when noticeable grooving or wear occurs.

4. Check the rocker arm adjusting screw and nut for damage. Examine the spacer springs on shaft between rocker arm and be sure they are strong enough to exert a positive pressure on the arms.

5. Thoroughly clean holes in rocker arm mounting brackets. This is very important in some engines, because these holes feed oil to the rocker arm shaft.

6. When installing rocker arms, be sure to install the arms and springs in the same sequence as they were removed.

VALVE CLEARANCE

When valves are properly adjusted, there is a small clearance between the valve stem and the end of the rocker arm. (This clearance is sometimes referred to as "valve lash" or "tappet clearance".)

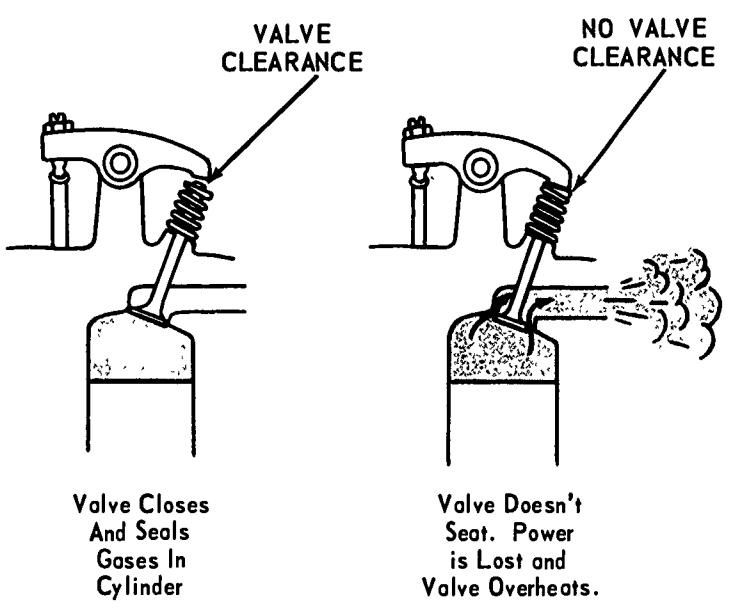


Fig. 53 — Problem Of Too Little Valve Clearance

Valve clearance allows for the heat expansion of parts. Without clearance, the heated parts would cause the valves to stay partly open during operation.

This clearance is small, varying from approximately 0.006 inch to 0.030 inch. Each engine manufacturer recommends a definite clearance for his engine model.

The valve clearance may vary depending on the engine model and whether the engine is hot or cold during adjustment (some engines run hotter than others).

Two little valve clearance throws the valves out of time. This causes valves to open too early and close too late. Also, valve stems may lengthen from heating and prevent valves from seating completely (Fig. 53). Hot combustion gases rushing past the valves cause overheating because the valves seat so briefly or so poorly that normal heat transfer into the cooling system does not have time to take place. This causes burned valves.

Too much valve clearance causes a lag in valve timing which throws the engine out of balance. The fuel-air mixture is late entering the cylinder during the intake stroke. The exhaust valve closes early and prevents waste gases from being completely removed.

The valves themselves also become damaged. When valve clearance is properly adjusted, the camshaft slows the speed of valve movement as it closes. But with too much clearance, the valves close with great impact, cracking or breaking the valve and scuffing the cam and follower.

HOW TO ADJUST VALVE CLEARANCE

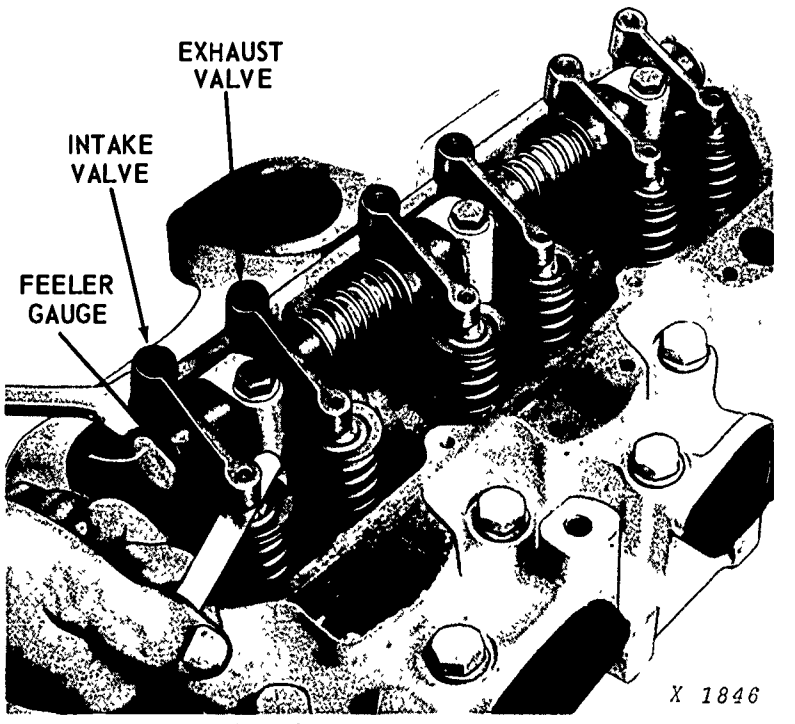


Fig. 54 — Adjusting Valve Clearance

Follow the manufacturer's procedure for correct valve adjustment. Here is a typical valve-in-head procedure:

1. Be sure the engine is at the recommended temperature before you begin valve adjustment.

2. Clean all dirt and oil from around valve cover and remove the cover.

3. Turn engine over until piston in the No. 1 or first cylinder is at top dead center (TDC) of its compression stroke. Most engines have timing marks on the flywheel or fan drive pulley to mark the "TDC" or other timing point.

A positive way to find when a piston is at "TDC" is to remove the spark plug or injection nozzle and hold your finger over the opening. On the compression stroke, air will be forced out against your finger until the piston reaches the "TDC" position.

4. With the No. 1 piston at "TDC", check the valve clearance using a feeler gauge (Fig. 54). Adjust clearance if necessary by turning valve adjusting screw up or down until clearance is to specifications.

5. Be sure to determine which are intake and which are exhaust valves because the clearances are usually different for the two.

6. Rotate the engine crankshaft in its firing order and adjust valve clearances when each piston reaches "TDC" of its compression stroke. Often two or three sets of valves may be set at a time with one rotation of the crankshaft. Refer to the engine Technical Manual for the correct method for each engine.

7. Install the valve cover, using a new gasket.

NOTE: Recheck the valve clearances after a "run-in" of the engine and a retightening of the cylinder head.

CYLINDER BLOCKS

The cylinder block is the main support for the other basic engine parts (Fig. 55). The block is usually a one-piece casting made from gray cast iron.

Blocks are cast with end walls and center webs to support the crankshaft and camshaft and have enlargements in their walls to make room for oil and coolant passages.

The cylinders are often cast into the block and may be bored into the block or machined to receive replaceable liners.

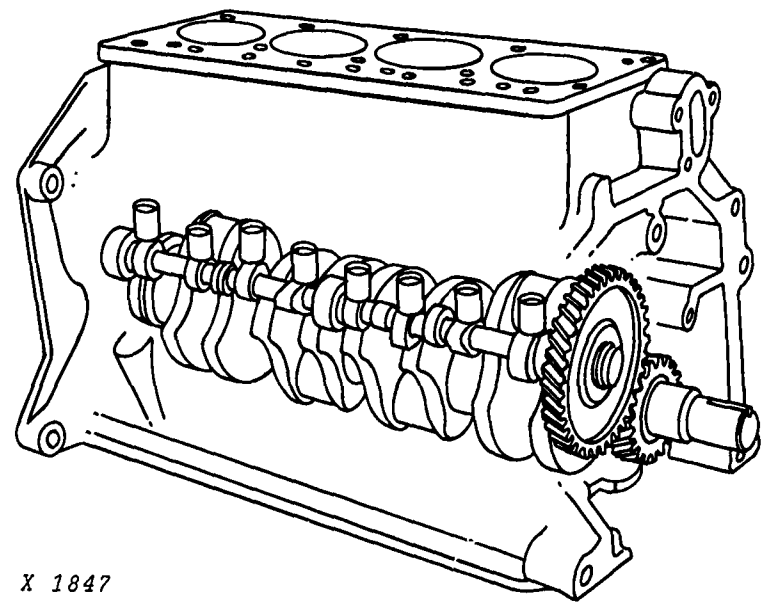


Fig. 55 — A Typical Cylinder Block

SERVICING CYLINDER BLOCKS

Strip the cylinder block as outlined in the engine Technical Manual.

After stripping, inspect the block for damage. If the block is still serviceable, prepare it for cleaning as follows:

Scrape all gasket material from the block. Then remove all oil gallery plugs and core hole plugs to allow the cleaning solution to contact the inside of the oil and water passages.

Cleaning Of Cast-Iron Cylinder Blocks

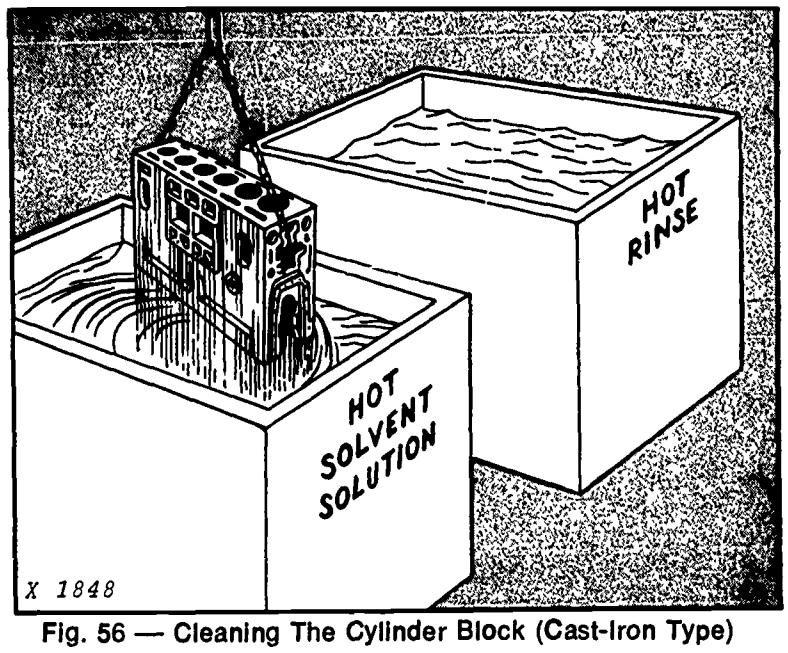


Fig. 56 — Cleaning The Cylinder Block (Cast-Iron Type)

1. Remove grease by agitating the cylinder block in a hot bath of commercial heavy-duty alkaline solution (Fig. 56).

2. Rinse the block in hot water or steam clean it to remove the alkaline solution.

3. If the water passages are heavily scaled, the block can only be cleaned using special equipment as follows:

a. Agitate the block in a bath of inhibited commercial pickling acid.

b. Allow the block to remain in the acid bath until the bubbling action stops (about 30 minutes).

c. Lift the block, drain it, and immerse it in the same acid solution for 10 minutes.

d. Repeat Step (c) until all scale is removed.

e. Rinse the block in clear hot water to remove the acid solution.

f. Neutralize the acid clinging to the casting by immersing in an alkaline bath.

g. Rinse the block in clean water or steam clean it.

4. Be sure that all water passages, oil galleries, and holes have been thoroughly cleaned.

Cleaning Of Aluminum Cylinder Blocks

1. Make a solution of one part emulsion-type soap and five parts of water. Using this solution in a steam cleaner, steam clean the cylinder block.

2. Rinse the block in clear water and dry it with compressed air.

3. If further cleaning is necessary:

a. Brush a commercial chlorinated solvent, suitable for aluminum, on the block. Allow the solvent to remain on the block for several hours.

b. Steam clean the block with the soap solution used in Step (1).

c. Rinse the block with clear water and dry it with compressed air.

4. After the cylinder block is thoroughly cleaned and dried, reinstall any core hole plugs. Coat the threads of the plugs with a sealer.

Testing The Cylinder Block For Cracks Or Leaks

Overheating of the engine may result in cracks between the water jackets and the oil passages. The block can be pressure tested for cracks and leaks by the following method.

1. Seal the water openings in the block by using plates with gaskets. Drill and tap one of the plates to provide a connection for an air line.

2. Immerse the block for 15 minutes in a tank of hot water (180-200°F.)

3. Apply air pressure to the block and observe the water in the tank for bubbles, which mean cracks or leaks. If a large tank is not available, fill the block with water and apply air pressure.

4. Always replace a cracked cylinder block.

Inspecting The Cylinder Block

After cleaning and pressure testing, inspect the cylinder block.

1. Check all dowel pins, pipe plugs, expansion plugs, and studs for looseness, wear or damage and replace as necessary. Coat all parts with joint sealing compound before installing.

2. Inspect all machined surfaces and threaded holes in the block. Carefully remove any nicks or burrs from the machine surfaces with a file. Clean out tapped holes and clean up damaged threads.

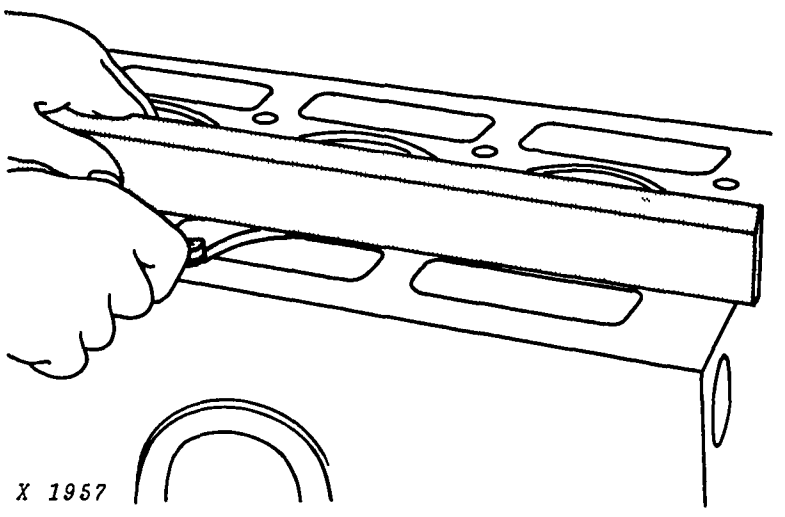


Fig. 57 — Checking Top Face Of Cylinder Block For Flatness

3. Check the top of the block for flatness with an accurate straight edge and a feeler gauge (Fig. 57). This is the critical area for sealing oil, water, and compression. If warped, replace or resurface the block as recommended in the engine Technical Manual.

4. Inspect the cylinder bores (for details, see "Cylinders" and "Cylinder Liners" later in this chapter).

5. After inspection, spray the machined surfaces with engine oil. If the cylinder block is to be stored for a long period, spray or dip the block in a rust-preventive solution. Cast iron will rust when exposed to the atmosphere unless it is greased or oiled.

CYLINDERS

The cylinder is basically a hollow tube in which the piston works.

There are two basic types of cylinders:

- **Cast-in-Block (Enbloc)**
- **Individual Castings (Liners or Sleeves)**

Let's see how they differ.

CAST-IN-BLOCK (ENBLOC)

Automotive engines generally feature the "enbloc" design. The cylinders are cast into the cylinder block so that the cylinders and block form a single unit.

INDIVIDUAL CYLINDER CASTINGS

The chief advantage of individual castings is that replacement is less expensive.

In larger engines, where each separate casting is bolted to a base, it is possible to build up an engine of almost any number of cylinders.

In high-speed engines, these individual castings are called liners or sleeves.

Cylinder liners are of two types:

- **Dry Liners**
- **Wet Liners**

DRY LINERS are sleeves which fit inside an already completed cylinder (Fig. 58). This liner is simply a wearing surface for the piston. They are not exposed to the engine coolant—so they are called "dry".

WET LINERS form not only the cylinder wall but also the inside of the water jacket (Fig. 58). When using wet liners, water seals must be provided for the liners.

Wet cylinder liners usually have a flange at the top of the liner to seat in a mating flange at the top of the cylinder block. Then when the cylinder head is bolted on, the liner is held firmly in place.

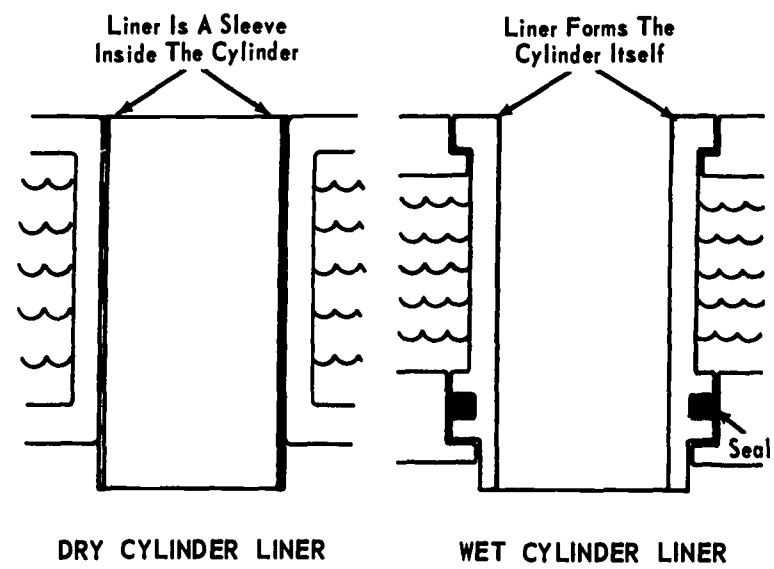


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Fig. 58 — Types Of Cylinder Liners

SERVICING CYLINDERS

Because the servicing for integral cylinders and removable cylinder liners is identical except for removal and installation of the liners, the information in this section will serve for both types of cylinders.

Preliminary Inspection

As soon as the engine head or heads have been removed, inspect the condition of the cylinders in the area of ring travel. When the appearance is good and there are no scuff marks deep enough to require cylinder re-conditioning, check the cylinder for wear or out-of-roundness, described later in this chapter. These measurements help you decide whether to rebore or resleeve the engine.

Removing Ridge From Cylinders

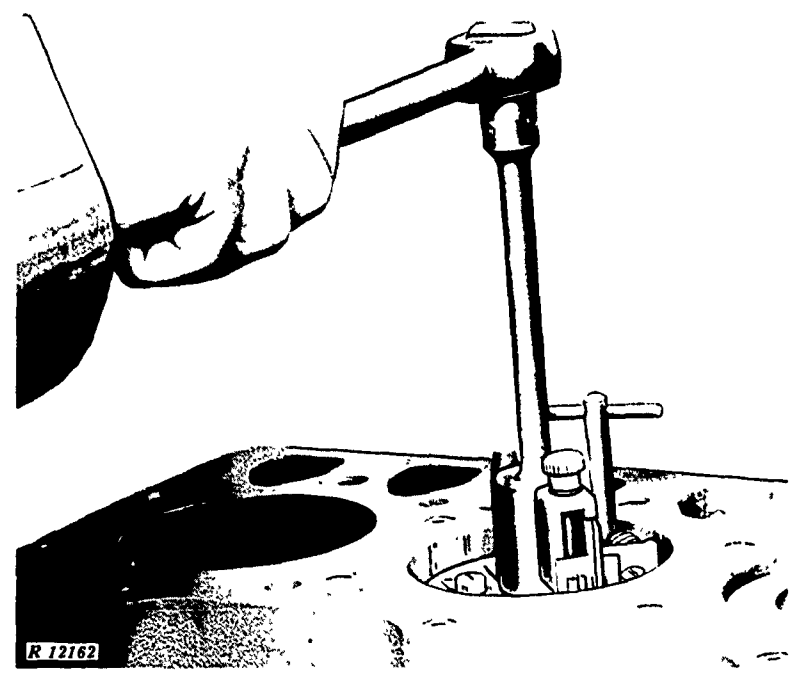

Fig. 59 — Removing Ridge From Cylinder

As the cylinder wears, a ridge is formed at the top of the piston ring travel zone. If this ridge gets too high, pistons can be damaged when they are removed.

Remove any ridges from cylinders using a ridge reamer (Fig. 59).

Do not cut down into the ring travel zone when removing the cylinder ridge.

It is possible to cut so deeply into the cylinder wall or so far down into the ring travel that re-boring or replacement of the engine block or liner is necessary.

Most worn cylinders are out-of-round when cold. Regardless of how uneven the wear, blend the cut made with the ridge reamer so that the area where the worn surface meets the reamed surface is as smooth as possible.

Removing Cylinder Liners

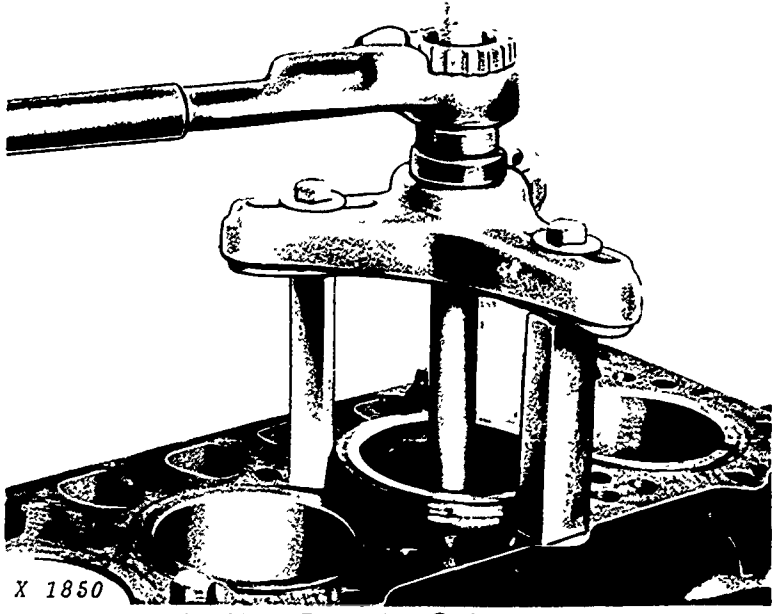

Fig. 60 — Removing Cylinder Liner

After long service, liners collect carbon and rust or "freeze" in place. Details of removal will vary with the size and type of engine, but use these general tips:

1. Use pullers to remove liners (Fig. 60). They may be the conventional screw-threaded type or impact pullers.

2. In stubborn cases, other aids must be used. Removing scales from the water jacket, with inhibited acid compounds, may do the trick. Solvents and penetrating oil may help. Heat may also be used—putting steam or hot water into the water jackets while filling the liner with cold water.

NOTE: Measure cylinder liners for wear before removing them from the block. See "Measuring Cylinders for Taper and Out-of-Roundness".

Cleaning The Cylinder Area

Clean cylinders as instructed under "Cylinder Blocks" earlier in this chapter. Use a wire brush and solvents to clean out hardened carbon and gum deposits.

Thoroughly clean the counterbores in the cylinder block with a scraper. Deposits can unseat the liner, distort it, and possibly break the flange.

On wet liners, thoroughly clean the lower sealing ring surface in the block to prevent coolant leakage past the sealing rings.

Measuring Cylinders For Taper And Out-of-Roundness

Measure cylinder bores as follows:

1. Measure the bore parallel to the crankshaft at the top end of the ring travel zone.

2. Measure the bore in the same position at the bottom end of the ring travel zone.

3. Measure the bore at right angles to the crankshaft at the top end of the ring travel zone.

4. Measure the bore in the same position at the bottom end of the ring travel zone.

Compare the measurements (1) and (3) to find the *out-of-round wear* at the *top* end of the bore.

Compare the measurements (2) and (4) to find the *out-of-round wear* at the *bottom* end of the bore.

Fig. 61 — Measuring Cylinder Bore

Compare the results of measurements (1), (2), (3), and (4) to find out whether or not the bore has worn tapered.

To measure, use a cylinder dial gauge, an inside micrometer, or a telescope gauge and outside micrometer (Fig. 61).

How Much Cylinder Wear?

The amount of cylinder taper and out-of-roundness that can be tolerated without reboring or resleeving the engine depends on the design, the condition, and the type of service for which the engine is used. There is no general rule for all engines.

Generally, whenever cylinder taper or out-of-roundness exceeds 0.005 inch, the engine should be rebored or resleeved.

However, follow the engine manufacturer's rules for the exact wear limits.

When a cylinder bore is worn beyond the wear limit, the piston generally is also worn beyond its limits. Therefore, *normally replace the piston when the cylinder is replaced or reconditioned.* Refer to "Pistons" later in this chapter.

Reboring The Cylinder

Cylinder liners for smaller engines are generally priced for replacement when they have reached their wear limits.

Liners for larger engines and all integral cylinders are commonly rebored.

They are sized to the smallest standard oversize diameter at which they will clean up. Oversize pistons must then be fitted to provide the correct piston-to-liner clearance. The final finish should then be obtained by honing.

A number of boring bars are available which can produce a good finish (ready for honing) in the cylinders. Boring should be done only by competent servicemen who are careful in their work.

When **reboring** cylinders, take these precautions:

1. Grind the cutting tool properly before using it.

2. Be sure the top of the engine block is free of all deposits and irregularities.

3. Clean the base of the boring bar before the bar is set up. Otherwise the boring bar will tilt and the cylinder will be bored crooked.

4. Make an initial rough cut, followed by a finish cut. Then hone the cylinder to the exact size.

When the boring bar is operated wrong, it will produce a rough cylinder surface that may not clean up even when honed. The result: a noisy engine at least during break-in, and faster ring wear.

Honing Cylinders After Reboring

Use the recommended grit size for the honing stone to produce the specified finish. Too smooth a finish can retard piston ring seating, while too rough a finish will wear out the rings.

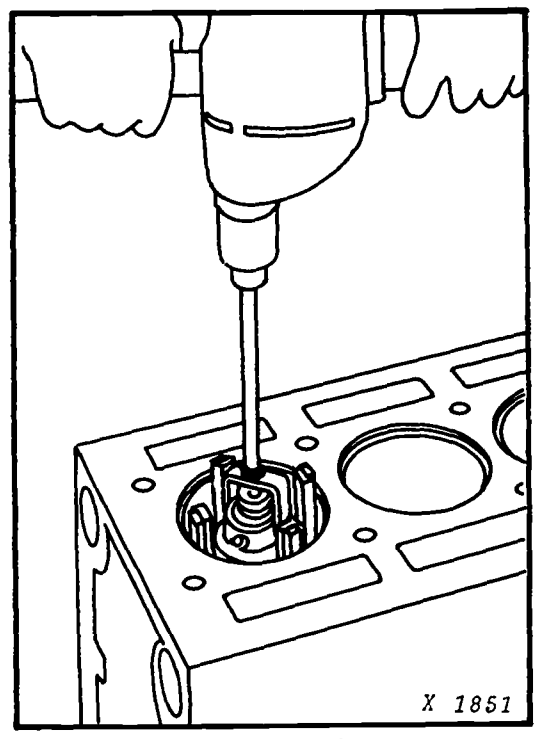

Fig. 62 — Honing The Cylinder Bore

Hone the cylinders as follows:

1. Clean the stones frequently with a wire brush to prevent "stone loading."

2. Follow the hone manufacturer's instructions for the use of oil or kerosene on the stones. **Do not use cutting agents with a dry hone.**

3. Insert the hone in the bore (Fig. 62) and adjust the stones snugly to the narrowest section. When correctly adjusted, the hone will not shake in the bore, but will drag freely up and down when the hone is not running.

4. Start the hone and "feel out" the bore for high spots, which cause an increased drag on the stones. Move the hone up and down the bore with short, overlapping strokes about one inch. Concentrate on the high spots in the first cut. As these are removed, the drag on the hone will become lighter and smoother. Feed the hone lightly to

avoid too much increase in the bore diameter. Some stones cut rapidly even under low pressure.

5. When the bore is fairly clean, remove the hone, inspect the stones, and measure the bore. Determine which spots should be honed most.

6. Moving the hone from the top to the bottom of the bore will not correct an out-of-round condition. Do not remain in one spot too long or the bore will become irregular. Where and how much to hone can be judged by feel. A heavy cut in a distorted bore produces a steady drag on the hone and makes it difficult to feel the high spots. Therefore, use a light cut with frequent stone adjustments.

7. Wash the cylinder block thoroughly after honing.

Deglazing Cylinder Liners

On smaller engines, cylinder liners are usually deglazed, but not rebored.

Deglazing gives a fine finish by removing any scuffs or scratch marks, but does not enlarge the cylinder diameter, so standard-size pistons may still be used.

The purpose for deglazing a crosshatch surface in the cylinder is to provide cavities for holding oil during piston ring break-in.

The reason for angled crosshatch pattern is to prevent the rings from catching in the grooves.

If the cylinder liners are wavy, scuffed, or scratched, **deglaze** them as follows:

1. Remove the pistons and rods. Cover the crankshaft with clean rags or damp paper to prevent the abrasives and dirt caused by deglazing from falling on the crankshaft. The cylinder liner may also be removed and placed in a fixture or scrap cylinder block if desired.

2. Swab the cylinder walls with a clean cloth or cotton string mop which has been dipped in clean, light engine oil.

3. Use a recommended deglazing tool. A brush-type tool with coated bristle tips often gives the best job of deglazing (Fig. 63).

4. Surface hone each cylinder for 10 to 12 complete strokes. The hone should be driven by a slow-speed drill. Move the hone up and down in the cylinder rapidly enough to obtain a crosshatch pattern as shown in Fig. 64. Use the proper grit deglazing cloth or honing stones to produce the recommended fine finish on the cylinder walls.

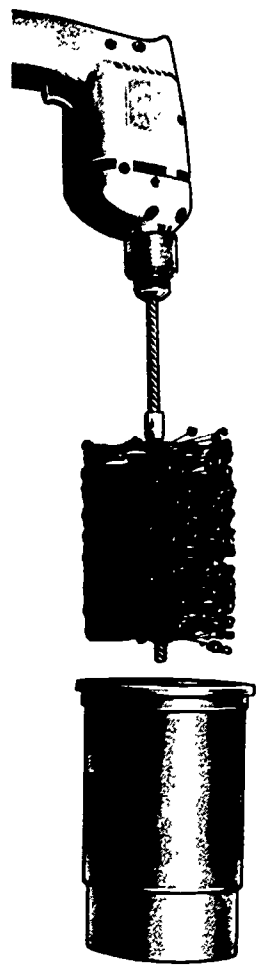

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Fig. 63 — Cylinder Liner Deglazing Tool

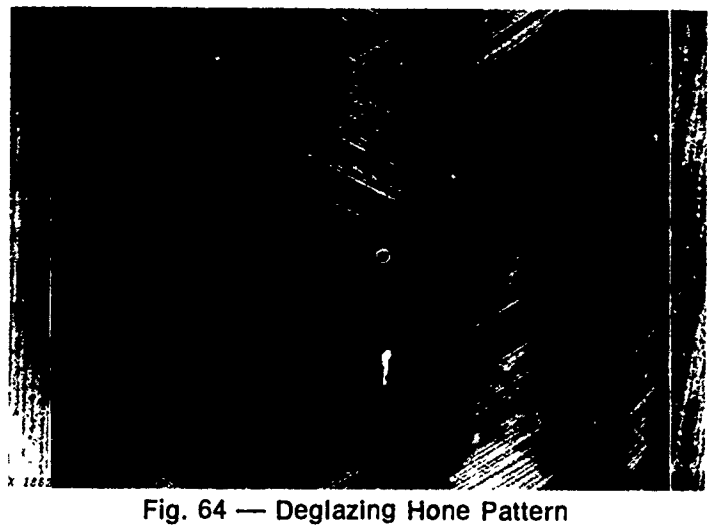

Fig. 64 — Deglazing Hone Pattern

5. **Be sure to thoroughly clean the cylinder bores after honing.** If cylinders are not cleaned, hard abrasives remain in the engine. This rapidly wears rings, cylinder walls, and the bearing surfaces of all lubricated parts.

Wipe as much of the abrasive deposits from the cylinder wall as possible. Then swab out with clean SAE-10W oil and carefully wipe with a clean cloth (Fig. 65).

One swabbing and wiping is not enough. Three operations are usually required—and more may be necessary. Keep on cleaning until a clean white rag shows no discoloring when wiped through the cylinder bore.

Fig. 65 — Thoroughly Clean Cylinders After Honing Or Deglazing

CAUTION: *Never use gasoline, kerosene, or commercial cleaners to clean cylinders after honing. These solvents will not remove abrasives from the walls.*

Installing Dry Cylinder Liners

Before installing dry-type cylinder sleeves, inspect and measure the cylinder bores.

If the bores are distorted, the block must be rebored to take oversized sleeves. Otherwise the cylinder sleeves may conform to the distorted bores, or air pockets will form between sleeves and block, causing hot spots that often result in a break-down of the rubbing surfaces.

Carefully clean all carbon and gum deposits from the cylinder bores as previously described.

The recommended fit of the sleeve in the bore may be either a loose fit or an interference fit. Always follow the recommendations when installing sleeves.

Installing Wet Cylinder Liners

1. *Clean all deposits from under flange of liner and mating bore in block. The liner must rest flat to prevent distortion.*

2. Check the liner bore in the block. If the flange surface is worn unevenly, remachine it.

3. *Clean the lower sealing surfaces in the block and liner to prevent coolant leaks when the liner is installed.*

4. If a new liner is being installed, install it **without seals** and check its height in relation to the top of the block (Fig. 66). Check the height in several places to be sure the liner is seated squarely. Compare the height to engine specifications. *Always pull the liner and install the seals before final assembly.*

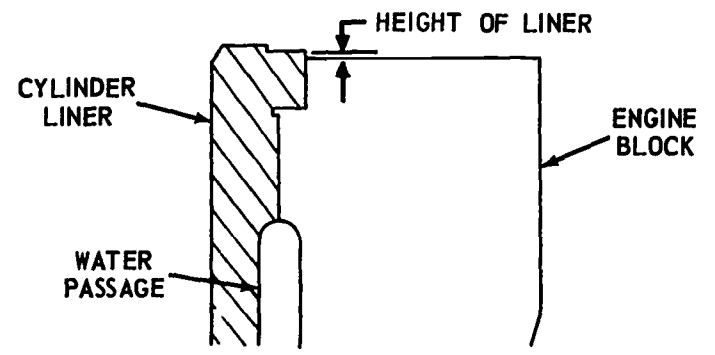

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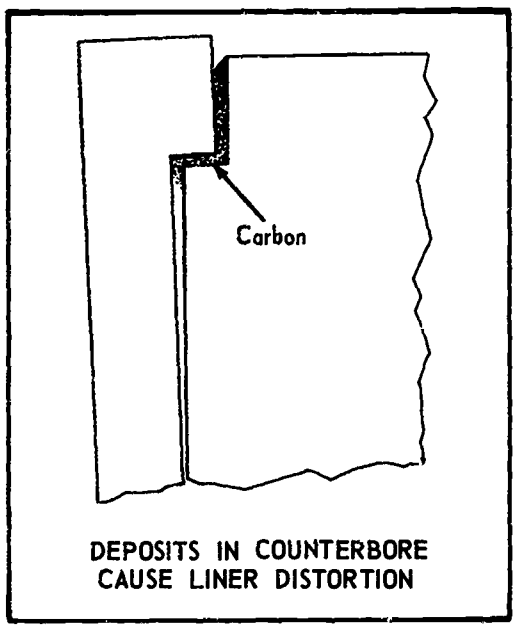
Fig. 66 — Checking Position Of Cylinder Liner In Block

5. If necessary, machine the block to square up the liner, or add shims (if recommended).

6. Place new seals on the liner. Lubricate both the seals and mating surfaces in the block. **Check to be sure the seals are not twisted or crimped.**

7. Work the liner gently into place as far as possible by hand. Finish seating the liner by placing a hard wooden block over it and tapping lightly with a hammer.



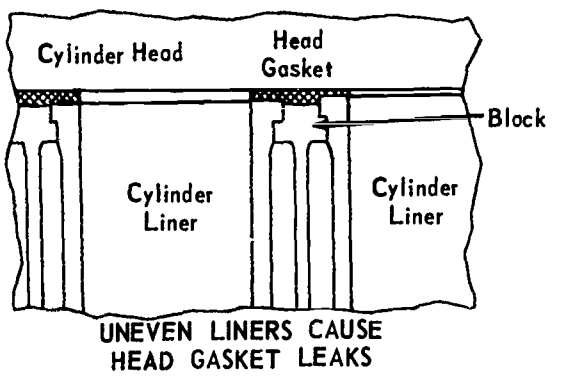


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Fig. 67 — Problems With Cylinder Liners Of Different Heights

8. The liner may protrude above the block because of the uncompressed seals. But if in doubt, check for twisted seals or carbon deposits (Fig. 67). When the cylinder head is installed, the liners must seat evenly or it may become distorted or head gasket leaks may develop if liners are too low in the block..

9. Further check for correct liner installation by measuring for out-of-roundness in the liner bore. If a liner is distorted, check for twisted seals or deposits on the liner bore seats.

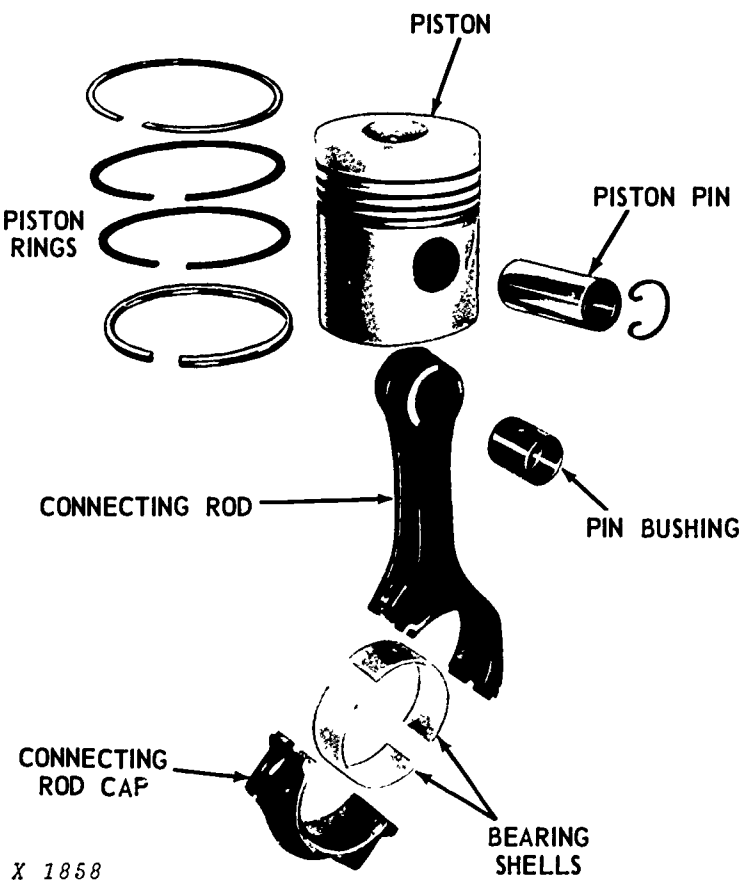

Fig. 68 — Complete Piston And Connecting Rod Assembly

Now let's turn to the parts within the cylinder—the piston with its rings (Fig. 68).

PISTONS

The piston does three jobs:

- **Receives the force of combustion**
- **Transmits this force to the crankshaft**
- **Carries the piston rings which seal and wipe the cylinder**

CONSTRUCTION OF THE PISTON

The piston must be:

1) **Precision-made**—to fit snugly in the cylinder, yet slide freely up and down.

2) **Rugged in Construction** — to withstand the forces of combustion and the rapid stop and start at the end of each stroke.

3) **Carefully Balanced and Weighed** — to overcome inertia and momentum at high speeds.

To be strong yet light, pistons are constructed of cast iron or aluminum alloys. Reinforcing ribs are used to keep the piston as light as possible.

PARTS OF THE PISTON

The main parts of the piston are:

- **Head**
- **Skirt**
- **Ring Grooves**
- **Lands**

These parts are shown on a typical piston in Fig. 69.

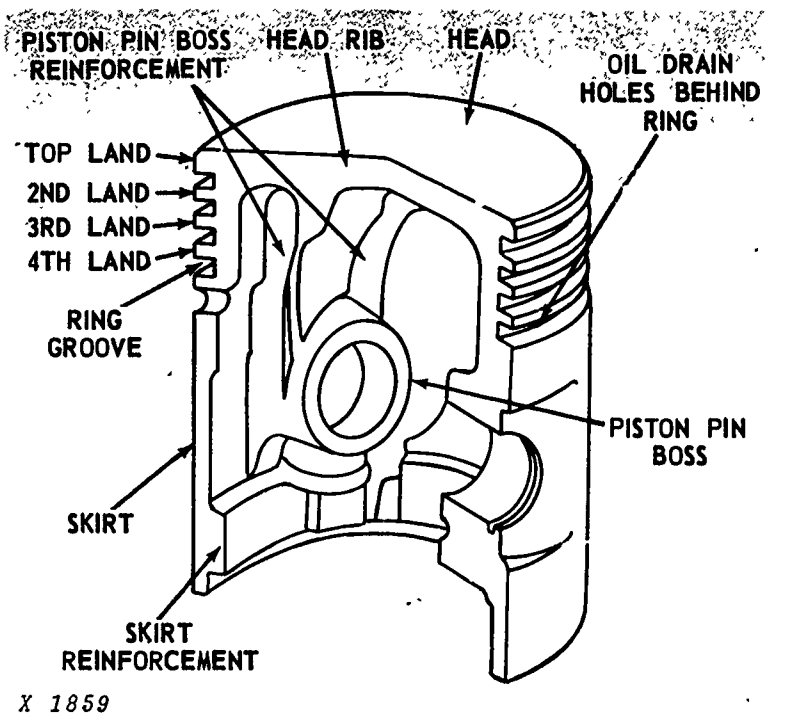

Fig. 69 — Piston

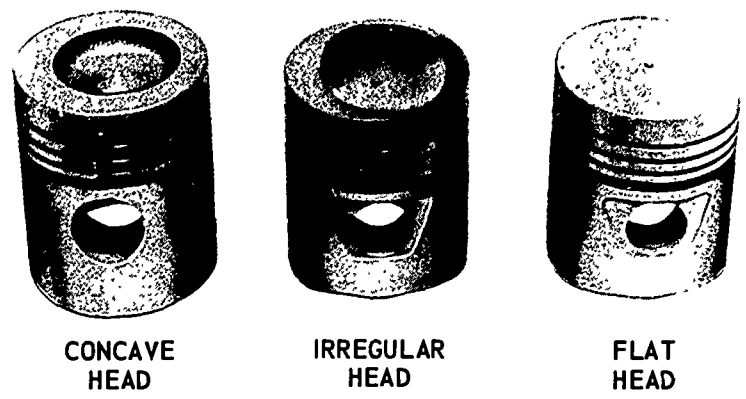

Fig. 70 — Pistons With Three Types Of Heads

The HEAD of the piston is the top surface where the combustion gases exert pressure. The piston head may be flat, concave, convex, or irregular (Fig. 70).

The different shapes of the piston head allow for more or less compression and swirling as needed for the different engines and fuels. Diesel pistons may also have a combustion chamber recessed in the head.

Ribs inside the piston head reinforce it and help to carry heat away from the head to the rings.

The SKIRT of the piston is the outside part below the ring grooves. The piston is kept in alignment by the skirt.

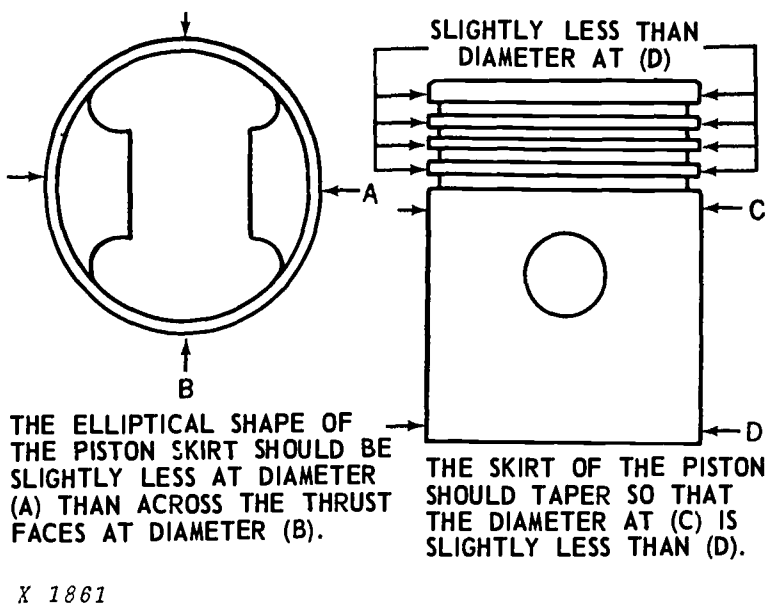

Fig. 71 — Cam-Ground Piston

The piston skirt is usually *cam-ground* and *elliptical* in shape (Fig. 71).

Fitting the piston to the cylinder is very critical because:

1) Metals expand when heated and,

2) Space must be provided for lubricants between the piston and cylinder wall.

The piston clearance depends upon the size and thickness of the piston and whether it is made of cast iron or aluminum (which expands faster when heated). Also, the piston skirt runs much cooler than the top of the piston, so needs less clearance.

By making the piston skirt *elliptical* in shape, it will fit the cylinder during operation when it is hot. The narrower part is at the pin mounts (A), where the metal is thickest, while the wider part is where the metal is thinnest (B).

This fitting prevents noise or slap of the piston during warm-up. Then as the piston gets hot, it expands and becomes round.

Skirts of different shapes are used to allow for the heat and stress on the piston. However, most engines use the *trunk*-type skirt shown in Fig. 71.

The RING GROOVES are cut around the piston to accept the piston rings (see Fig. 69). They are shaped to the proper rings for good control of oil and blow-by. The lower groove has openings for oil collected by the oil control ring to flow back to the crankcase.

The piston LANDS are the areas between the ring grooves which hold and support the piston rings in their grooves (Fig. 69).

PISTON RINGS

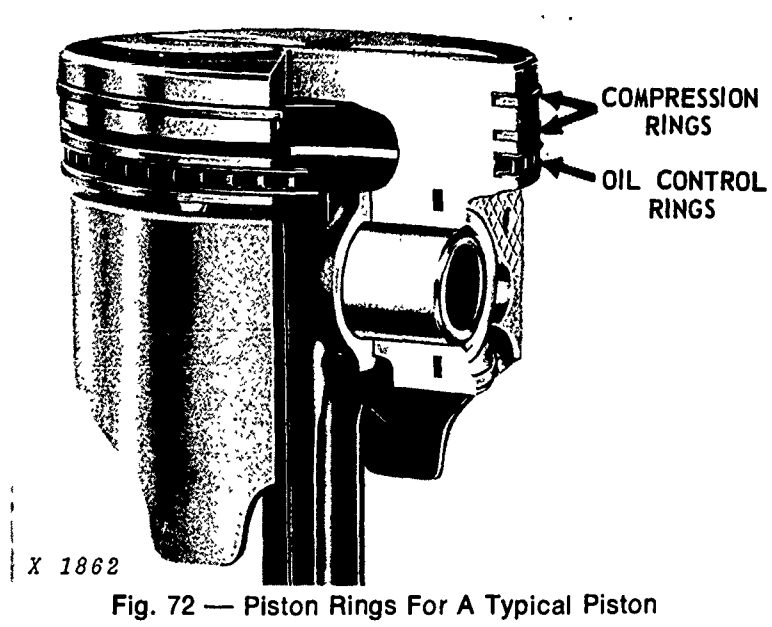

Fig. 72 — Piston Rings For A Typical Piston

Piston rings do three jobs:

1) Form a gas-tight seal between the piston and cylinder.

2) Help cool the piston by transferring heat.

3) Control lubrication between piston and cylinder wall.

Piston rings are of two types:

- **Compression Rings**
- **Oil Control Rings**

COMPRESSION RINGS (Fig. 72) prevent gases from leaking by the piston during the compression and power strokes. They seal by expanding out against the cylinder wall. The rings expand by their own tension and also by combustion pressure behind the rings during the power stroke.

Compression rings are split for easy assembly on the piston. The ends that are split do not form a perfect seal, so more than one ring is used.

If the cylinders are worn, ring expanders are sometimes used inside the rings for tighter sealing.

The OIL CONTROL RING is the bottom ring on the piston. Its job is to wipe the excess oil from the cylinder walls. This oil is fed through slots in the rings to holes in the piston groove, where it returns to the crankcase. For better oil control, spring expanders are often used under the oil control ring.

In some engines, oil rings are used both above and below the piston pin.

Piston rings are usually made of hardened cast iron and are often plated with metals such as chrome on their contact faces. The hard plating reduces the wear on the ring.

Types Of Piston Compression Rings

Various shapes of compression rings are used for pistons (Fig. 73). Many pistons use a combination of these rings.

Rectangular Ring—The common ring bears evenly against the cylinder wall along its whole face.

Taper-Faced Ring—assures that the lower outside edge will have positive contact with the cylinder. This gives quick seating and good wiping of oil on downstroke, but only fair control of blow-by. Seat very quickly.

Barrel-Faced Ring—used as a top ring on some pistons for better control of blow-by.

Inside Bevel Ring—Cutout along the edge of this ring allows it to twist in its ring groove and form a tighter seal during combustion. Used often as an intermediate ring.

Keystone Ring—helps prevent ring sticking by reducing deposits that fill ring grooves and freeze rings. An insert is normally used in the groove as a seat for the ring (Fig. 73). Used mostly in heavy-duty diesel and aircraft engines.

Joints For Compression Rings

Compression ring joints must be wide enough to prevent the ends from touching when the ring heats up and expands in operation.

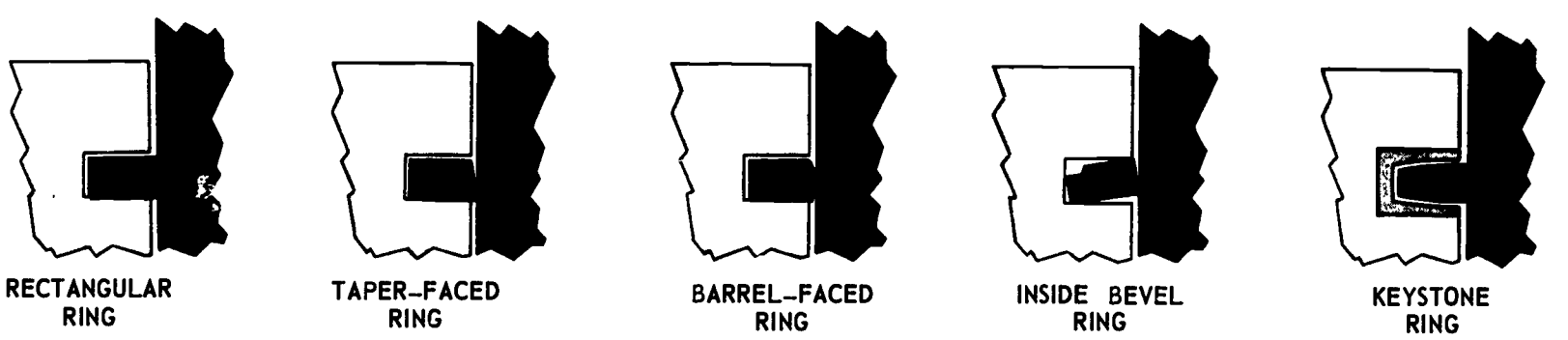

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Fig. 73 — Compression Rings — Five Major Types

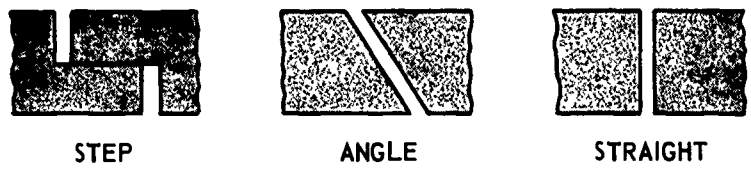

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Fig. 74 — Joints For Compression Rings

The three common ring joints are shown in Fig. 74. The *step joint* gives better sealing, but the *straight joint* or *angled joint* is used most where joint leakage is not a great problem.

Types Of Oil Control Rings

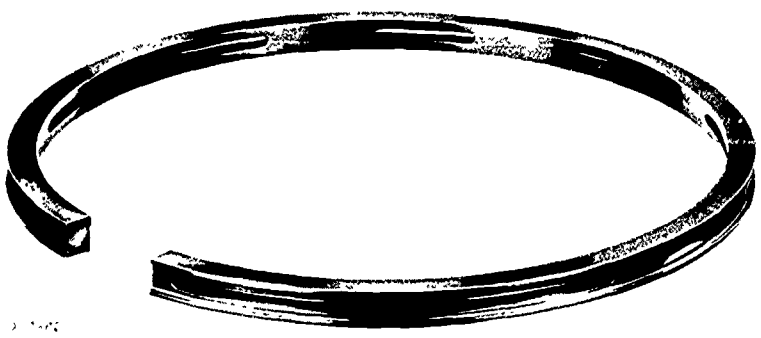

Fig. 75 — Slotted Oil Control Ring

Today's engines throw more oil onto the cylinder walls than is needed for lubrication. (This extra oil absorbs heat.)

To control oil consumption and smoky exhaust, the oil control rings must wipe the excess oil from the cylinder walls and allow it to return to the crankcase.

Oil control rings have a groove in their outer face where oil is collected, fed on through the piston, and returned to the crankshaft (Fig. 75).

The expander springs that are sometimes used under the oil control ring are made of a steel strip or coil.

DIAGNOSING PISTON FAILURES

Why do pistons fail? What do you look for? These are the questions that will be answered on the following pages.

Three Big Engine Problems

Three problems cause trouble in the piston area:

- **Oil Consumption and Blow-by**
- **Combustion Knock (Detonation)**
- **Preignition (Gasoline Engines)**

Let's look at each one of these problems and see what the causes and signs are.

Oil Consumption And Blow-By

The piston and rings are supposed to *seal* the cylinder against two things:

1) Excess oil passing up into the combustion chamber.

2) Gases or blow-by passing down to the crankcase.

Oil Consumption is the problem in Step 1 above. The piston rings must leave a film of oil on the cylinder walls or the parts will wear out too fast. Yet if the rings pass too much oil, the engine will consume too much oil.

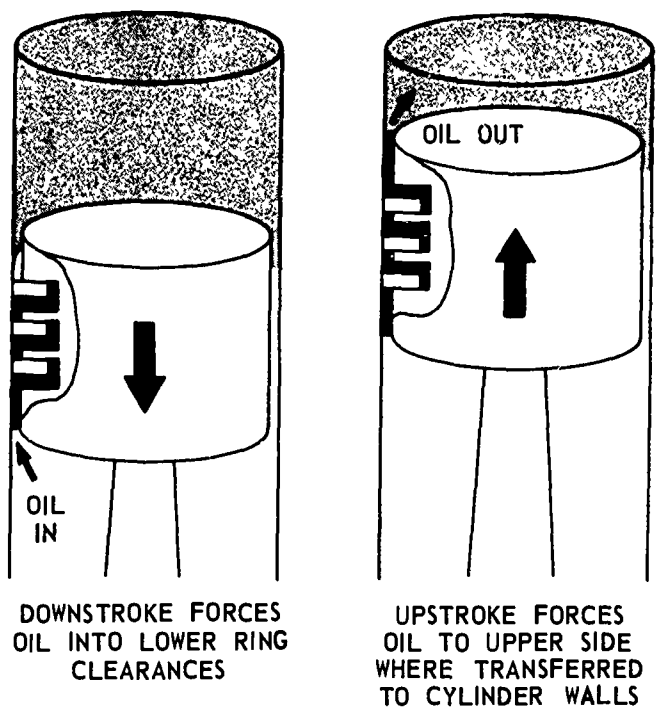

Fig. 76 — Oil Consumption — How The Piston Rings Pump Oil Up Into The Cylinder Where It Is Burned

Slight oil consumption can be expected (Fig. 76). The piston rings must pass a small amount of oil for lubrication as the piston works.

However, the more the piston rings and cylinder wall are worn, the greater the oil consumption. (A lighter oil also causes oil to be used.)

The problem is that engine overhauls are also expensive. The cost of overhaul must be balanced with the cost of oil consumed before deciding when to overhaul the engine.

There are also other ways that oil can reach the combustion chamber from the crankcase: worn valve guides, or leaking manifolds or turbochargers. Check all possible causes when diagnosing engine oil consumption and don't forget that external leaks also consume oil!

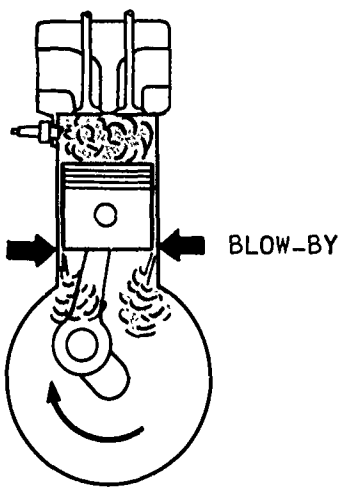

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Fig. 77 — Blow-By Of Gases In Cylinder

Blow-by occurs when combustion gases get past the piston rings and into the crankcase (Fig. 77).

A slight amount of blow-by can be expected—this is why crankcases are usually ventilated.

However, severe blow-by can create real problems:

1. Pistons are overheated and expand, scoring the piston and cylinder wall. 2) Compression is lost, reducing power; 3) Crankcase oil is contaminated, causing wear.

CAUSES OF OIL CONSUMPTION AND BLOW-BY

1. *Piston rings installed wrong*
2. *Stuck rings or plugged oil ring*
3. *Top ring broken or top groove worn*
4. *Overall wear in piston, rings, and cylinder:*
   a. *Abrasive wear*
   b. *Scuffing and scouring*
   c. *Corrosive wear*
5. *Physical damage to pistons*

Let's look at each of these causes in detail.

PISTON RINGS INSTALLED WRONG

For a good seal between the piston and cylinder, the piston rings must conform to the cylinder wall and have plenty of tension.

If rings are installed upside down, are the wrong type or size, or are stretched or even broken by bad installation, more oil and gas vapor get by the piston.

For correct procedures, see "Installing Rings on Piston" later in this chapter.

STUCK RINGS OR PLUGGED OIL RING

Deposits caused by too much heat, unburned fuel, and excess lubricating oils, collect in the piston ring area. Ring failure usually occurs when these deposits **harden** and freeze the rings in their grooves.

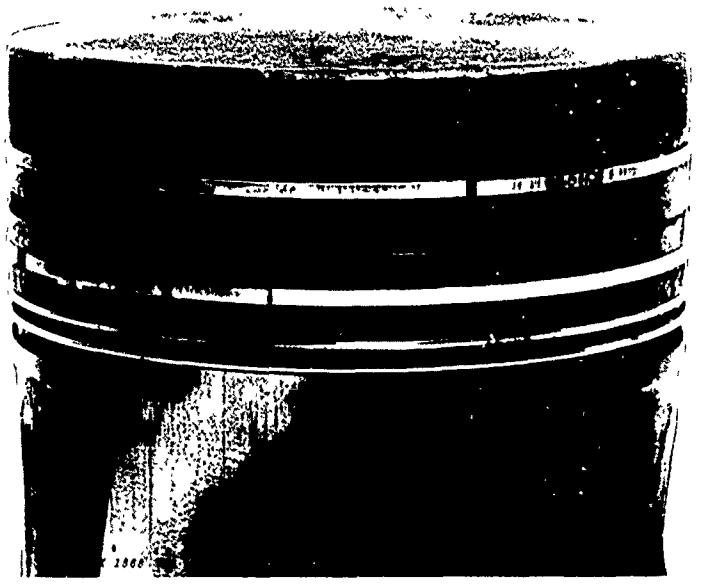


Fig. 78 — Stuck Rings That Have Broken

When the rings are completely stuck, they often break (Fig. 78).

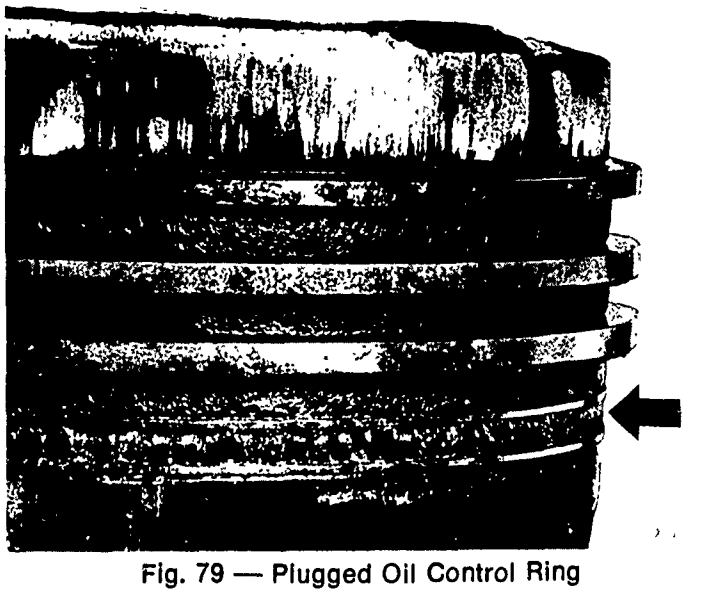


Fig. 79 — Plugged Oil Control Ring

Deposits in the top ring groove can cause sticking, scuffing, and scoring because they keep out oil and trap metal particles that wear off the piston.

Sludge deposits in the oil control ring can cause it to plug (Fig. 79). This means that oil control has been lost.

Other conditions that lead to **stuck or plugged rings** are:

- *Top groove failure*
- *Cylinder Liner distortion*
- *Combustion knock*
- *Preignition*
- *Overloading*
- *Cooling system failure*
- *Improper lube oil*
- *Cold engine operation (stop and go service)*

TOP RING BROKEN OR TOP GROOVE WORN

The top piston ring acts as both a compression and final oil control ring. It must form a seal between its sides and the ring groove, and between its face and the cylinder wall.

A poor seal will allow oil to by-pass the ring seal and be lost.

A poor seal will allow blow-by to contaminate the crankcase oil, forming sludge, which leads to ring sticking, clogging, and possibly scuffing.

The top ring and groove wears most since this area is exposed to the most heat, pressure, and abrasives and gets the least lubrication.

Fig. 80 shows *new* compression rings in *new* groove at the left. The sides of the groove are flat, parallel, and smooth. The ring also has the correct side clearance. Combustion gases in the power stroke force the ring down against the lower side of the groove. At the same time, the gases pass behind the ring and force it out against the cylinder wall. The result is a *good seal.*

At the right in Fig. 80, we see a *new* ring installed in a *worn* groove. The groove permits the ring to sag. This causes the upper corner of the ring face to contact the cylinder wall, resulting in oil being wiped up into the combustion chamber. The flat new ring cannot mate with the worn sides of the ring groove. The result is a bad seal at both the face and sides of the ring.

Top ring *groove* wear results in broken top rings or damaged pistons.

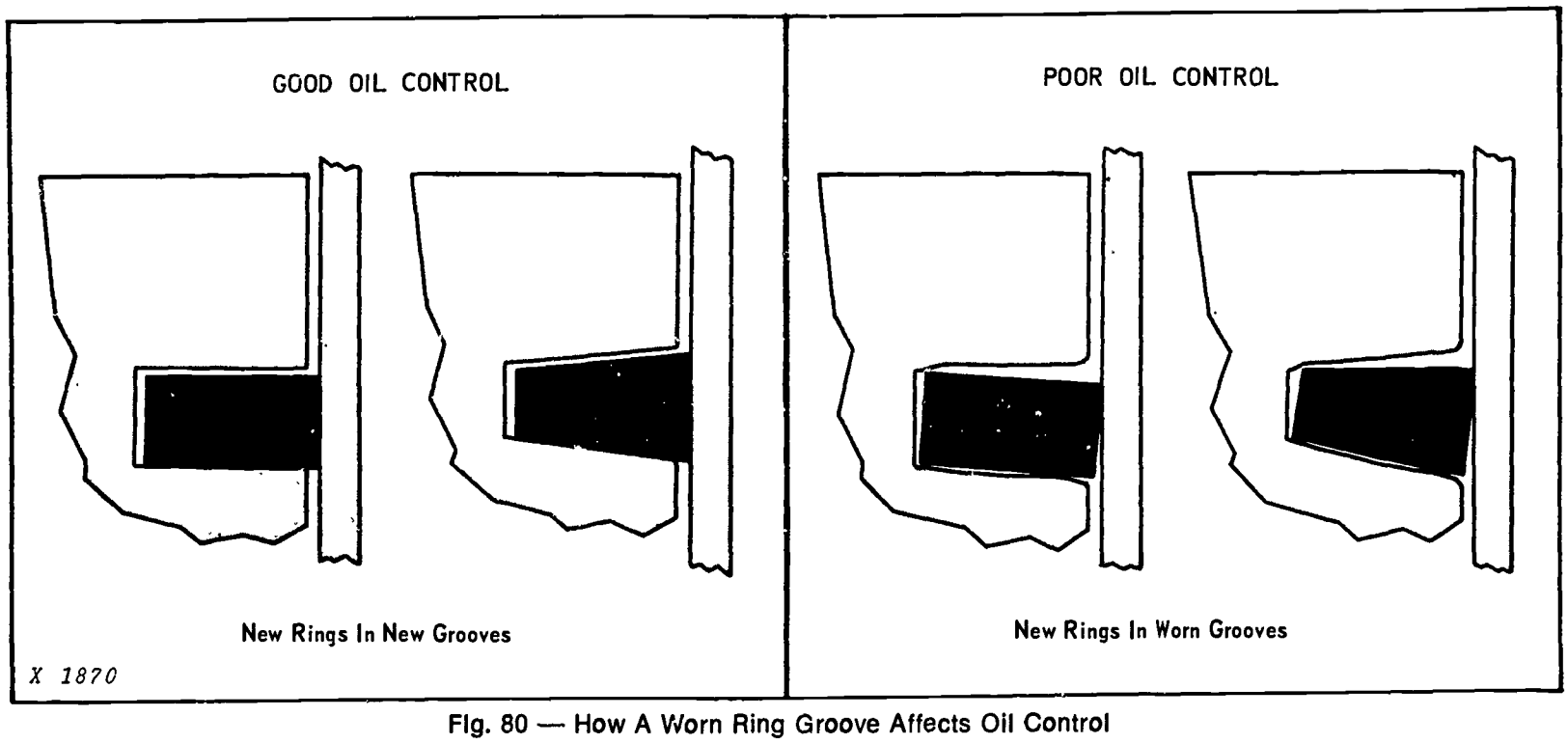


Fig. 80 — How A Worn Ring Groove Affects Oil Control

The following conditions can cause top groove failure:

- *Abrasives entering the engine through the intake system*
- *Combustion knock*
- *Preignition*
- *Installation of new ring in worn groove*
- *Assembly of new ring without ridge reaming the cylinder*
- *Use of wrong-size piston or ring, resulting in too much or too little side or end clearance*

OVERALL WEAR ON RINGS, PISTON, AND CYLINDER

1. Abrasive Wear

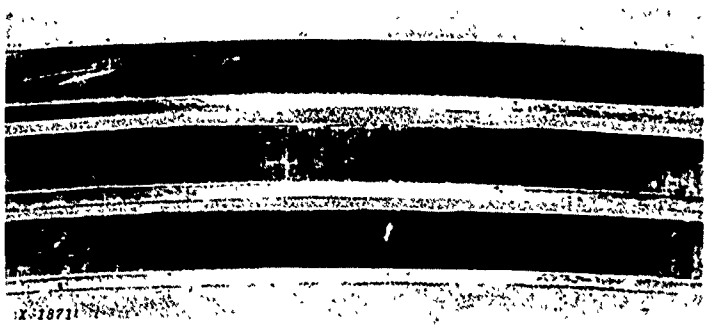


Fig. 81 — Abrasive Wear Causes Dull Gray Vertical Scratches On Ring Faces

When the ring faces are covered with dull gray, vertical scratches and have excessive ring gap (preferably checked in a new cylinder), the rings have been worn by abrasives. See Fig. 81.

Other indications of abrasives present in the engine are dull gray vertical scratches on piston skirts, scratched cylinder bore, high ridge at the top of the cylinder, loose piston fit, or badly scratched rod and main bearings.

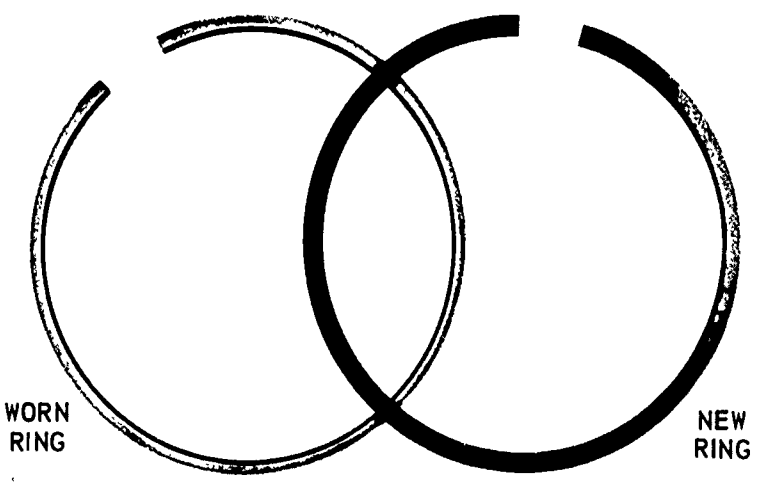


Fig. 82 — Radial Wall Wear On Worn Compression Ring

Badly worn compression rings can be identified by their reduced radial wall. Fig. 82 compares the reduced radial wall of the worn ring on the left with that of a new ring on the right.

We know what causes abrasive wear, but how do the abrasives enter the engine? Possibly from dirt left in the engine during the last engine overhaul. Through the air intake, crankcase breather, or fuel systems. Or from scuffing and scoring of parts as they wear.

2. Scuffing and Scoring

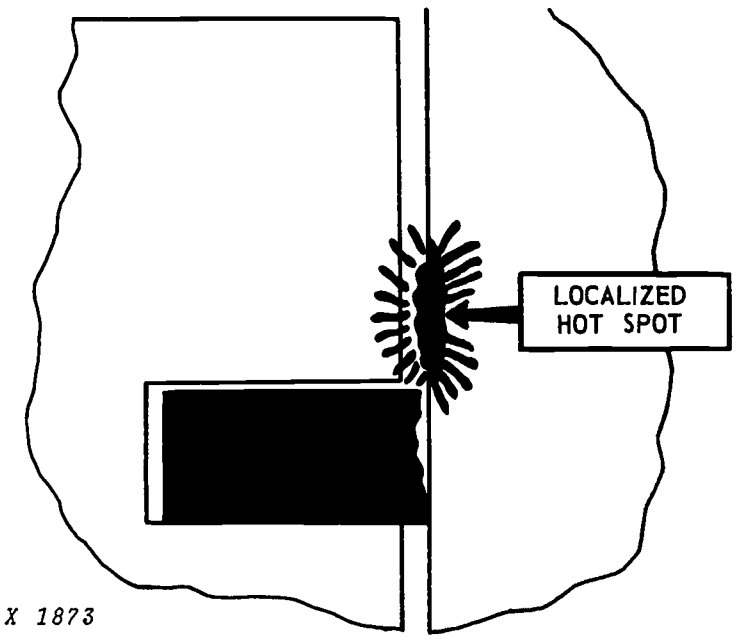


Fig. 83 — How Scuffing And Scoring Occur

Fig. 84 — Severe Piston Scoring

Scuffing is caused by too much heat. When two metal parts rub and the heat builds up to the melting point, a small deposit or "hot spot" of melted metal is pulled out and deposited on the cooler surface (Fig. 83).

Scuffing leaves discolored areas on the surface of rings, pistons, and cylinder walls. Under a magnifying glass, the metal in the center of these areas is burnished and smeared in the direction of motion of the part.

Scuffing starts as a very small surface disturbance, which may be difficult to see and identify. If they are not removed, scuffing spreads to adjacent areas and become noticeable and more severe, at which time it is called **scoring** (Fig. 84).

Fig. 85 — Corroded Piston Has Mottled, Grayish, Pitted Appearance

Any engine condition which heats rubbing parts to the melting point, or which prevents the transfer of heat from these surfaces, has an influence on scuffing.

The following is a list of possible causes of scuffing and scoring:

- *Improper warm-up (fast speeds or big loads too soon)*
- *Lubricating system not functioning*
- *Cooling system plugged*
- *Combustion knock and preignition*
- *Lugging or overloading*

3. Corrosive Wear

The third cause of overall wear on pistons and cylinders is corrosion.

Leaking coolant can corrode pistons. Cold engine operation or the wrong lubricating oils can also deposit chemicals in the crankcase which will corrode parts.

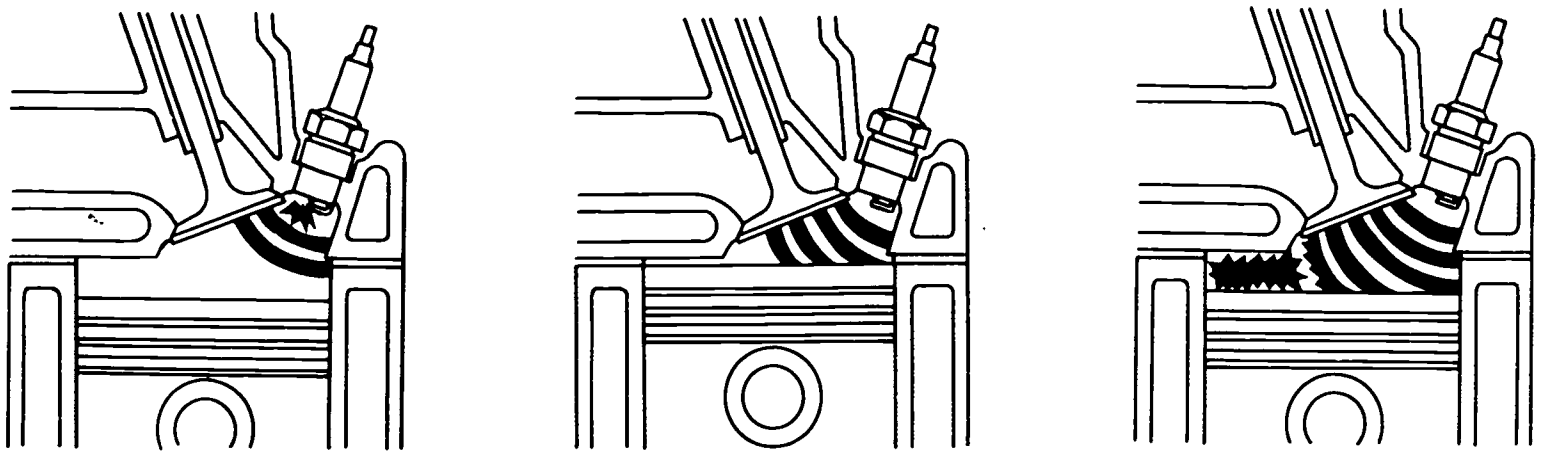
Severe corrosion will show up as a mottled, grayish pitted surface on pistons or cylinder walls (Fig. 85). This corrosion is caused by acids from the products of combustion.

Other corrosion may be harder to find. If excessive wear is found, and scuffing and scoring are eliminated as possible causes, suspect corrosive wear.

PHYSICAL DAMAGE TO PISTONS

Fig. 86 — Piston Damaged By Loss Of Pin Lock

An example of physical damage to the piston is shown in Fig. 86. This piston has lost its pin lock.



1. Spark Begins Fuel-Air Mixture Burning.

2. Flame Advances Smoothly, Compressing and Heating End-Charge.

3. End-Charge Suddenly Ignites With Violence, Producing A Knock.

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Fig. 87 — How Combustion Knock Or Detonation Occurs

Physical damage to pistons can be caused by:

- *Connecting rod out of alignment.*
- *Crankshaft has too much endplay.*
- *Crankshaft journal has too much taper.*
- *Cylinder bore out of alignment.*
- *Piston pin locks installed wrong.*
- *Piston pin locks are faulty.*
- *Ring groove scratched while trying to clean out carbon.*
- *Piston handled carelessly or dropped.*

Combustion Knock (Detonation)

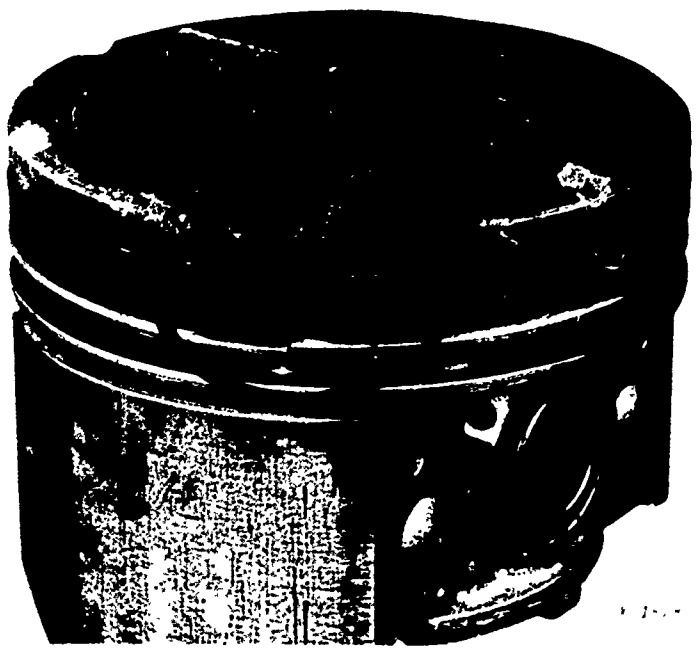

Fig. 88 — Combustion Knock Damaged This Piston And Broke The Top Ring

Knocking occurs when combustion of fuel in the cylinder is delayed, too rapid, or uneven (Fig. 87).

The result is a "knock" which can burn the piston, wear out the top groove, or cause the ring to break or stick (Fig. 88).

CAUSES OF COMBUSTION KNOCK (DETONATION)

1. *Lean fuel mixtures*
2. *Fuel octane too low*
3. *Ignition timing advanced too much*
4. *Lugging the engine or overfueling*
5. *Cooling system not working*

Preignition (Gasoline Engines)

Preignition is when the fuel ignites before the spark occurs.

As a result, part of the fuel burns while the piston is still coming up on its compression stroke.

The burning fuel is compressed and overheated by the piston and by further combustion. The heat can get so high that engine parts are melted.

The piston in Fig. 89 was damaged by the heat of preignition.

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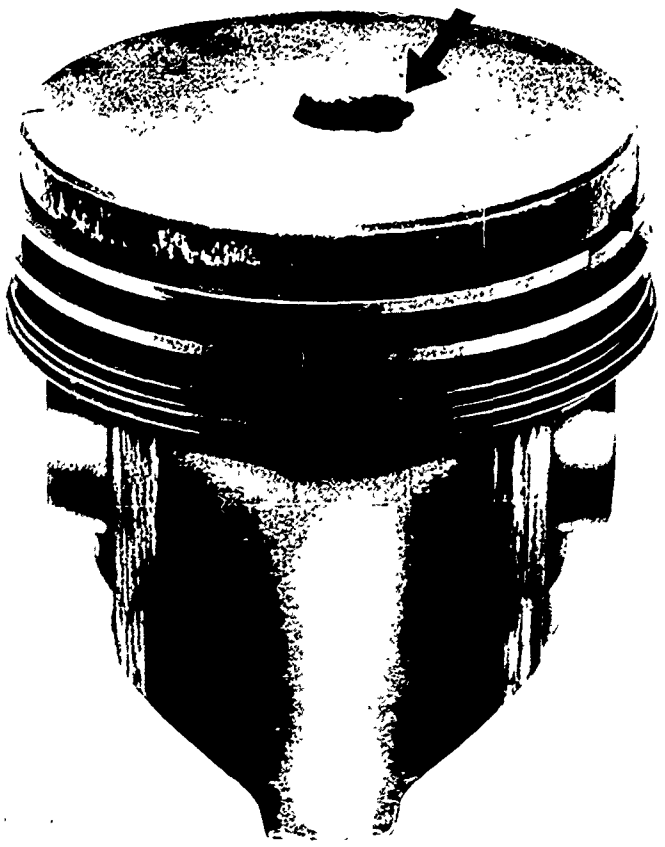

Fig. 89 — Pre-Ignition Burned A Hole Through The Head Of This Piston

CAUSES OF PREIGNITION

1. *Carbon deposits that remain incandescent and ignite fuel early*
2. *Valve operating too hot because of excessive guide clearance or bad seats.*
3. *Hot spots caused by damaged rings.*
4. *Spark plugs of wrong heat range.*
5. *Spark plug loose (means "hotter" plug).*

Summary: Diagnosing Piston Failures

A premature failure of the engine must have a cause.

That cause must be found and corrected if the engine is to run properly again.

SERVICING PISTONS

Removing Piston Rings

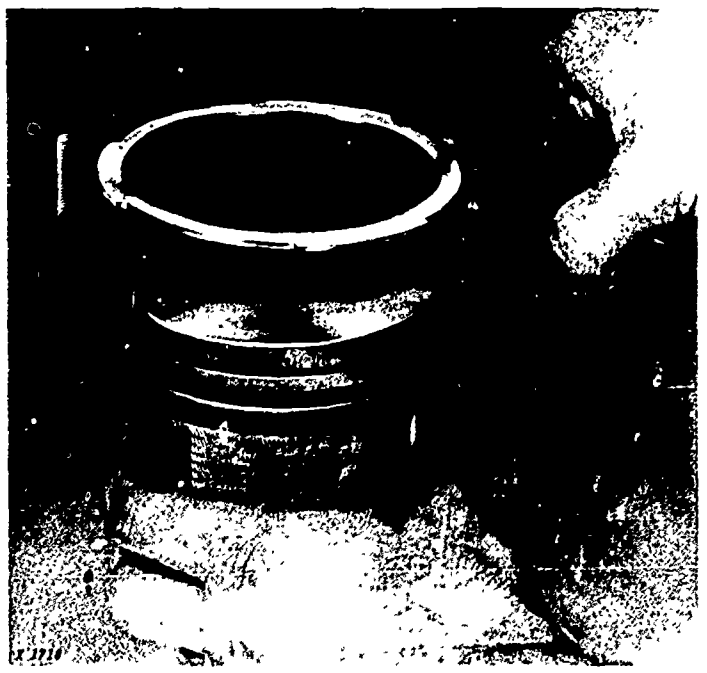

Fig. 90 — Removing Piston Rings

Clamp the connecting rod in a vise to prevent damaging or burring of the piston (Fig. 90). Remove the old rings, using a ring expander.

Never reinstall piston rings once they have been removed. Discard the old rings and replace with new ones.

If the pistons are to be removed from the rods, remove the piston pin locks (if used) and place the pistons in hot water. This will expand them so the pins can be pushed out easily. *Never force pins either in or out of cold pistons.*

Service Hint: Use an electric fry pan and set it at low temperature to heat pistons.

Cleaning Pistons

Careful cleaning of pistons is most important, especially the ring grooves.

Do not scrape with a groove cleaner or a broken piston ring. Hard scraping will scratch the fine surfaces of the piston.

Two methods of cleaning pistons are recommended:

1) Chemical Soaking

2) Glass Bead Cleaning

CHEMICAL SOAKING OF PISTONS

A recommended piston cleaner will soften the carbon on pistons without a lot of effort or any damage. The carbon and residue can then be easily removed with a pressure spray rinse. Follow these steps:

1. Mix the cleaner solution and heat it as recommended.

2. Before soaking, use a solvent to remove oil film from the pistons (otherwise the cleaning solution will be weakened).

3. Soak the pistons in the cleaning solution for the specified period.

4. Soak for a second period if needed. A very light scraping may be required in some cases.

5. After soaking, drain and spray rinse the pistons with water and air.

Caution: *Be careful with the cleaning solution. Store and handle with the recommended safety.*

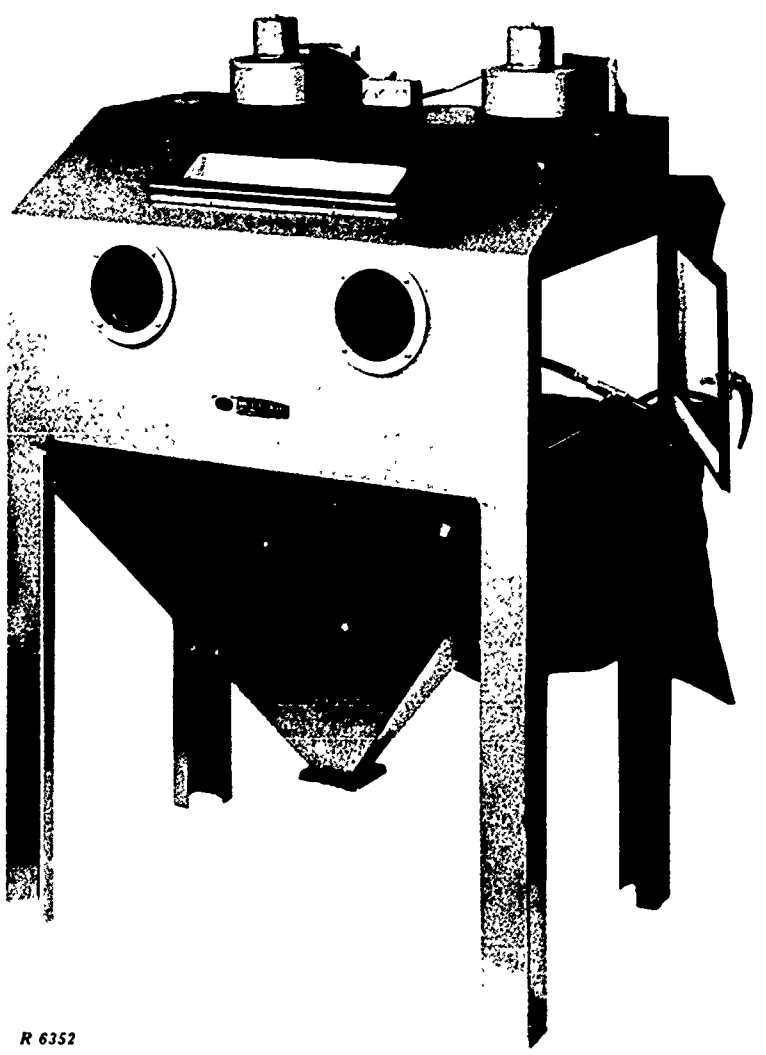

Fig. 91 — Piston Ring Groove Cleaning Machine

GLASS BEAD CLEANING OF PISTONS

This method of cleaning has proven successful if the proper machine is used. The pistons are blasted with glass beads in the machine shown in Fig. 91. Take the following steps:

1. Carefully remove old rings from the pistons.

2. Wash pistons in solvent to remove grease and oil. Use a stiff brush—not a wire brush—to help get them clean.

3. Spray the pistons dry using compressed air.

4. Clean the pistons in the glass bead cleaning machine (Fig. 91). Use the proper size of beads and the correct pressure.

5. Be careful not to hold the bead blast on one area too long or the metal may be eroded. Avoid this by keeping the blast moving.

6. Hold the nozzle away from the surface to be cleaned. The distance will vary depending on the recommended pressure.

PRECAUTIONS WHEN CLEANING PISTONS

1. Be careful to avoid scratching the sides of the piston ring groove.

2. Never use a wire brush to clean pistons.

3. Be sure the piston ring grooves are thoroughly cleaned. Excessive deposits in ring grooves can force the rings out, causing scuffing and scoring.

Inspecting Pistons

After cleaning, examine the piston for score marks, damaged ring grooves, or signs of overheating. Always replace a piston that has been severely scored, overheated, or burned.

Carefully inspect the pistons for cracks in the head or skirt areas and for bent or broken lands. Fatigue failures will often show up as cracks in the area of the pin boss.

The magnetic particle inspection methods outlined under "Crankshaft Inspection" may be used in locating cracks in cast-iron pistons.

Damaged pistons must be replaced.

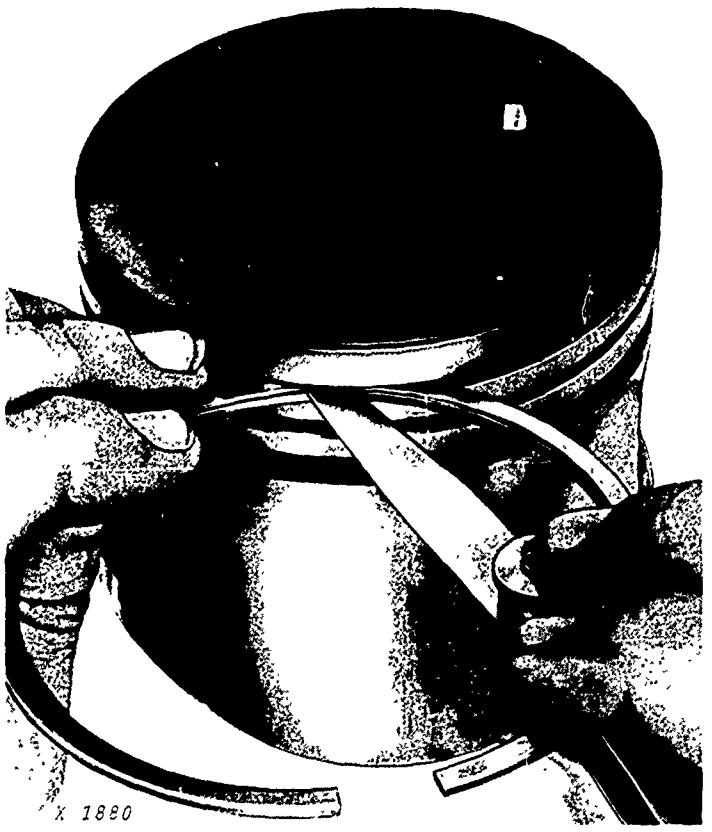

Fig. 92 — Measuring Ring Clearance With A Feeler Gauge

Checking Ring Grooves For Wear

Pistons should be replaced or ring grooves reconditioned whenever the ring grooves are worn excessively. Suspect that wear is excessive when side clearance is over 0.008 inch. (Different wear limits apply to many two-cycle and large-bore diesels. Refer to the engine manufacturer's recommendations for each application.)

Check the piston grooves at several points because the grooves wear unevenly. The top groove receives the most wear, but check all of them.

Check for ring groove wear by installing a *new* ring in the groove. Then insert a feeler gauge between the upper surface of the new ring and the land to check the clearance (Fig. 92).

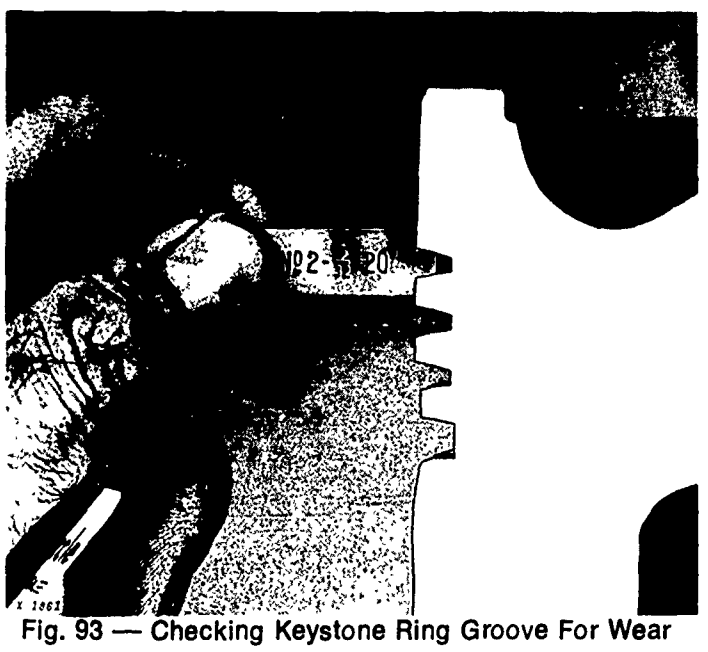

Fig. 93 — Checking Keystone Ring Groove For Wear

Keystone groove wear may also be checked using a special wear gauge (Fig. 93).

Many ring manufacturers provide special gauges for checking ring groove wear. These gauges are available for checking both rectangular and Keystone grooves.

Replace or regroove all pistons which have excessively worn grooves. Regroove with a ring groove cutting tool (only if recommended).

Piston Ring Groove Inserts

Many pistons for heavy-duty service have a steel or alloy insert cast into the top groove. This retards side wear on the groove and ring and lengthens the life of the pistons and rings.

Remachining Of Piston Ring Grooves

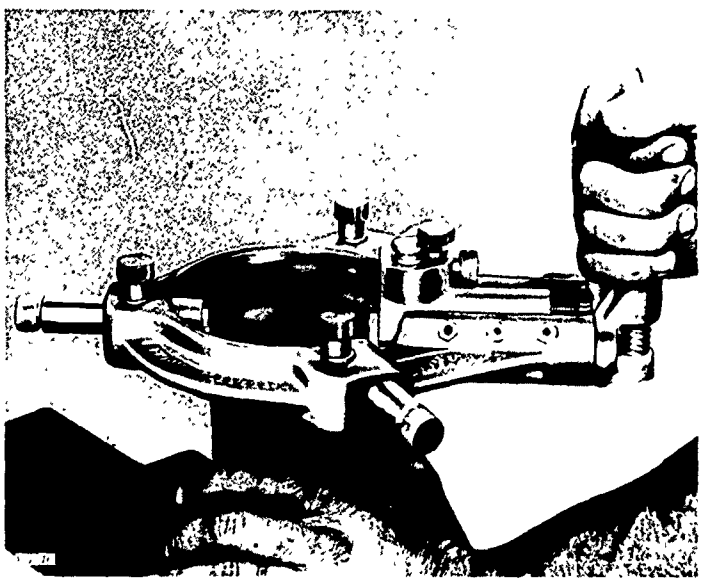

Fig. 94 — Remachining A Piston Ring Groove

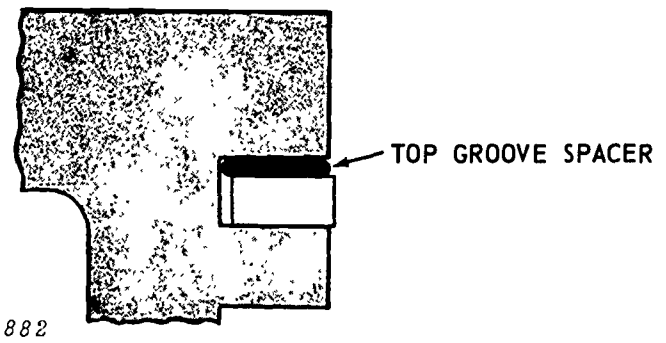

Fig. 95 — Groove Spacer Above Piston Ring

Worn piston ring grooves on some pistons can be remachined with a ring groove cutting tool (Fig. 94).

If recommended, machine these grooves for a new standard ring with a flat steel spacer above the ring.

Heat-treated steel spacers must be installed above the ring to compensate for the metal removed

by regrooving (Fig. 95). The spacers are flat and supply a bearing surface for the full depth of the groove. This assures a good seal and heat transfer between ring and groove. Top groove spacers are easily installed without special tools.

Checking Piston Wear

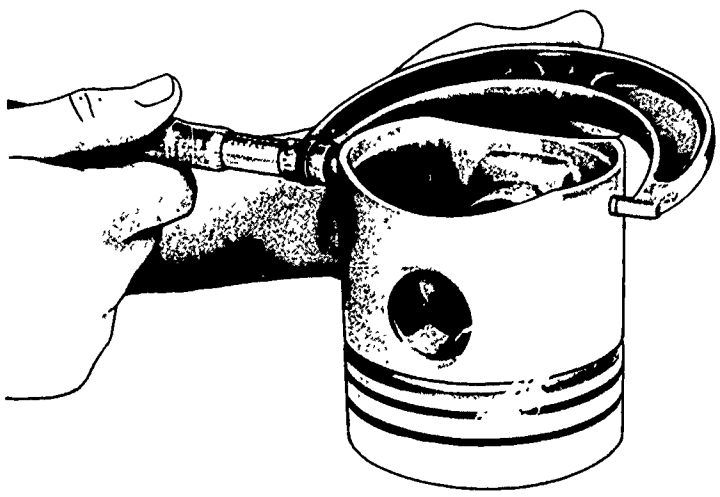

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Fig. 96 — Measuring The Piston For Wear

To check for piston wear, measure the diameter of the piston skirt across the thrust faces (at right angles to the piston pin bore). Take a reading at both the top and bottom of the skirt (Fig. 96).

Compare these measurements with new dimensions given in the engine Technical Manual. The difference between these two measurements determines the piston wear.

Checking Piston-To-Cylinder Clearance

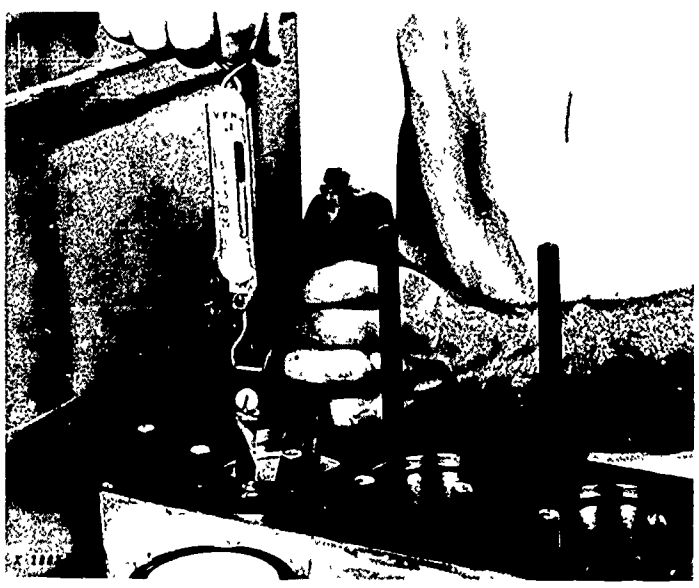

Fig. 97 — Determining Piston Clearance With Feeler Ribbon And Scale

Since most pistons wear with use and may have excessive clearance, be sure to check the piston clearance at every overhaul.

Pistons should be replaced if their clearance exceeds the specifications. (Some automotive pistons can be resized by knurling.)

Measure piston clearance as follows:

1. Measure the cylinder diameter at right angles to the crankshaft in the lower or least-worn area of the cylinder. Use a cylinder dial gauge, an inside micrometer, or a telescope gauge with outside micrometer.

2. Measure the diameter of the piston across the thrust faces with an outside micrometer (see instructions above).

3. The difference between these two measurements is the piston clearance.

Piston clearance may also be determined with a feeler ribbon and spring scale as follows:

1. Place the feeler ribbon in the cylinder along one of the thrust sides. (Several thicknesses of feeler ribbon are available.)

2. Turn the piston over and insert it in the cylinder with a thrust face centered against the ribbon (Fig. 97).

3. Push the piston down into the lower part of the cylinder. The feeler ribbon must be centered between a thrust side of the cylinder and thrust face of the piston or an incorrect measurement will result.

4. Pull out the feeler ribbon from between the cylinder and piston, using a 5- to 10-pound pull on the scales.

5. The thickness of feeler ribbon that can be removed with this pull is the piston clearance.

Knurling Pistons (Automotive Engines)

Knurling increases the diameter of a piston by precisely displacing metal in the two thrust faces. Many automotive pistons are resized in this way (Fig. 98).

The metal of the piston skirt is upset by a special knurling tool as shown. The displaced metal is forced upward between the teeth of the tool, producing a checked surface and increasing the diameter of the piston.

NOTE: Knurling of pistons is not done on engines for farm and industrial machines.

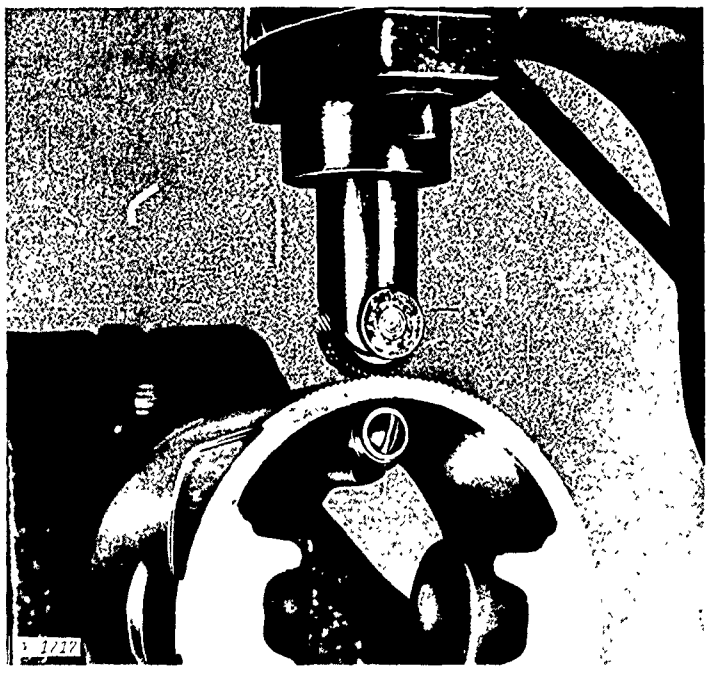

Fig. 98 — Knurling A Piston (For Automotive Engine)

Installing Rings On Piston

First be sure the piston is cleaned thoroughly. *Check the ring grooves for any deposits.*

Rings must be installed with the top side upward to provide good oil control. Refer to engine Technical Manual for directions on installing different ring types properly. Also, each new ring set usually contains an instruction sheet.

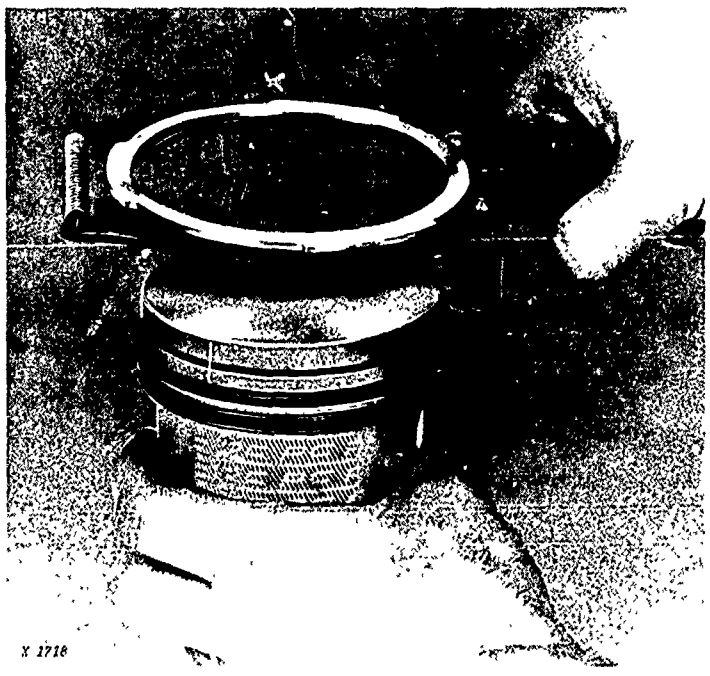

Fig. 99 — Installing Piston Rings Using A Ring Expander

Use a ring expander to prevent twisting or stretching the rings during installation (Fig. 99).

Be extremely careful not to twist or expand the rings too much as this will permanently distort them and reduce their performance. A ring expanding tool helps to avoid this danger.

Normally, ring ends may be located anywhere around the piston, since compression and oil rings are not pinned and usually can rotate around the piston. However the ring ends should be staggered, and locating of the rings may be specified by the manufacturer.

Installing Pistons

NOTE: Before installing pistons, complete all the piston pin, connecting rod, and bearing services which follow in this chapter.

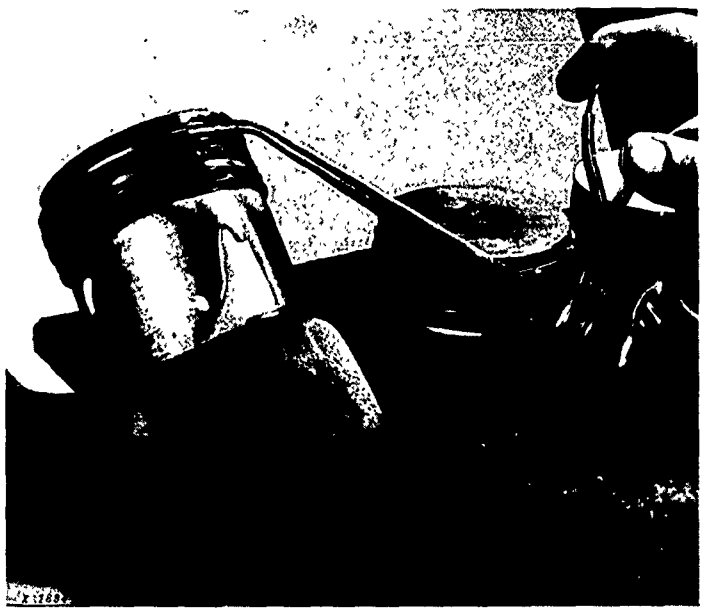

Fig. 100 — Lubricate The Piston And Rings Before Installing

Thoroughly lubricate each piston and its rings with engine oil (Fig. 100) just prior to installation on cylinder. This lubricates the pistons, rings, and cylinders during engine cranking and until the "oil throw-off" from the connecting rod journals is adequate.

Several hundred revolutions may be necessary in a dry engine before the lubrication system supplies oil to all the moving parts.

Use a ring compressor to compress the rings while installing the piston (Fig. 101). Engine manufacturers usually recommend a specific type of compressor for this purpose.

Apply a gentle downward pressure on the piston to compress the rings into the cylinder. If the piston sticks, compress the rings again and check the cylinder for a partially removed ridge.

Do not pound on the piston head, as this may damage the piston or rings.

Refer to the engine manufacturer's instructions on how to position the piston in the cylinder.

Fig. 101 — Installing Pistons

PISTON PINS

The **piston pin** (or wrist pin) connects the piston to the connecting rod.

Piston pins can be fastened in three ways (Fig. 102):

- **Fixed Pin—pin fixed to piston, moves in rod**
- **Semi-Floating Pin—pin fixed to rod, moves in piston**
- **Full-Floating Pin—pin moves in both rod and piston**

Most piston pins are "full-floating" with bearings in both the rod and the piston. These pins must be held within the piston bore to prevent contact with the cylinder. Note the pin locks at the right in Fig. 102.

In high-speed engines most of the floating pins bear directly on the piston material. This is true with both aluminum-alloy and cast iron pistons.

SERVICING OF PISTON PINS

Piston pins should be checked for looseness, etching, scoring, and excessive damage or wear. Replace them if damaged.

Normally, piston pins need not be replaced except when installing new pistons. This avoids the possibility of noisy pins when the job is done.

Always determine the type of pin and rod assembly from the engine Technical Manual before attempting to drive the pin from the piston. This will save time and prevent piston damage.

Precision Pin Fits

The piston pin must take impact loads under all conditions without wearing out or failing. To do this, the pin bearing must have a full bearing surface and still be able to oscillate without any drag.

The requirements for a *precision pin fit* are:

1. A perfectly round pin hole, free from high spots and chatter marks.

2. A straight pin hole, free from taper, waviness and bellmouthing.

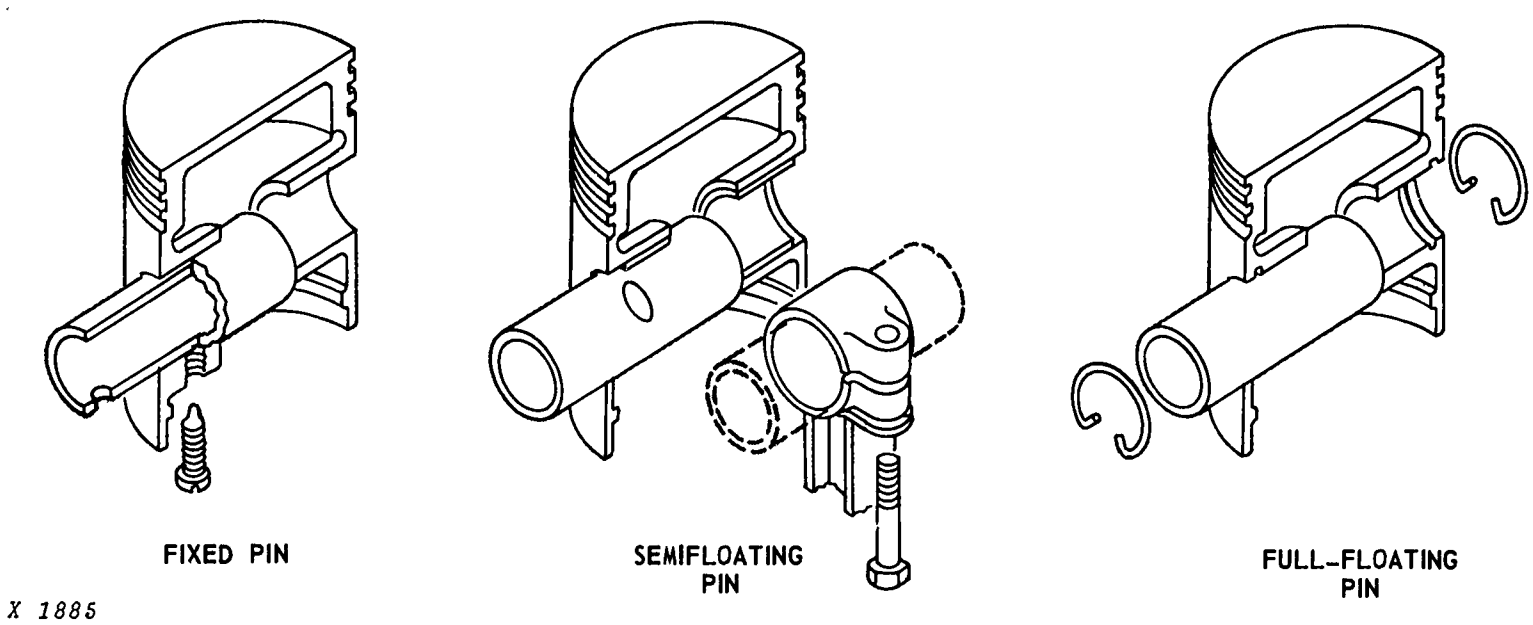

Fig. 102 — Piston Pins — Three Ways Of Fastening

3. A perfectly aligned pin hole between bosses, free from bind and deflection.

4. A correct surface finish to sustain and support an adequate oil film.

5. A good oil clearance, as recommended for each type of piston and rod.

Checking The Pin Fit

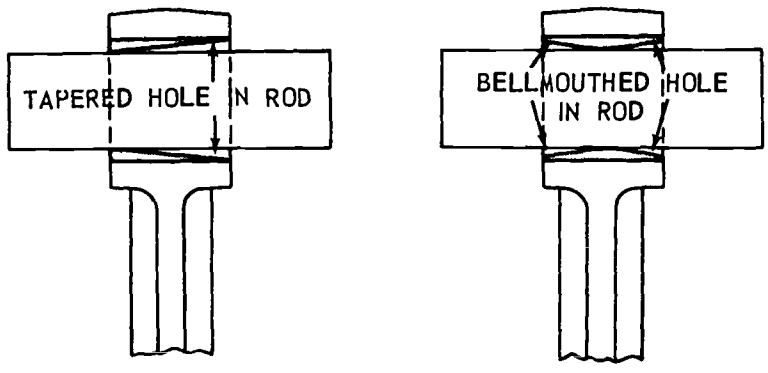

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Fig. 103 — Bad Pin Fits In Connecting Rod

Without a precision pin hole gauge, it is impossible to check a pin fit accurately.

However, these three simple tests will show whether or not you should install new bushings:

1. Check the pin for out-of-roundness or looseness. Clamp the pin in a pin vise and rotate the rod back and forth on the pin several times. Then remove the rod and examine the shiny contact spots. A good pin fit will show pin contact over the entire surface of the bushing.

2. Check the bore for taper or bellmouthing (Fig. 103). Insert the pin from each end of the bushing. If it is free on one end but tight on the opposite end, the pin hole is tapered. If it enters easily from either end but becomes tight in the center, the hole is bellmouthed. A good pin fit must have parallel surfaces.

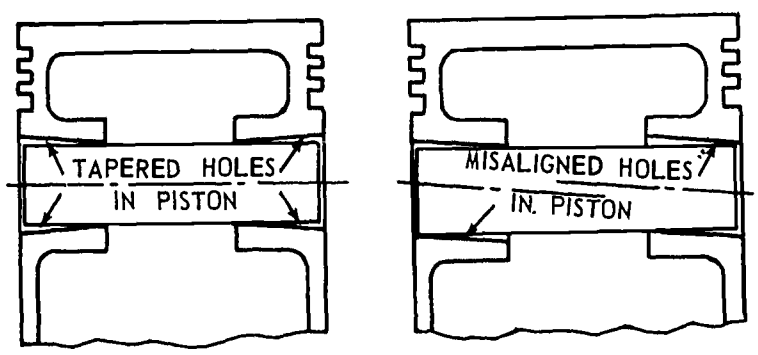

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Fig. 104 — Bad Pin Fits In Piston Bosses

3. Check for taper or misalignment between the piston pin holes (Fig. 104). Check each pin hole in the piston separately with the pin for equal size and for taper. Both holes should be straight and of equal size.

If pin holes are not tapered, push pin through toward second piston boss. Pin should enter second boss without a "click" and without forcing or binding. A good pin bearing should also have an even drag through both pin holes.

Also make these checks after installing new bushings to be sure the new pin fit is accurate.

Know the exact clearance between pin and pin holes for each piston and pin design to get the precision fit required for today's high-compression engines.

CONNECTING RODS

Connecting rods must be light and yet strong enough to transmit the thrust of the piston to the crankshaft.

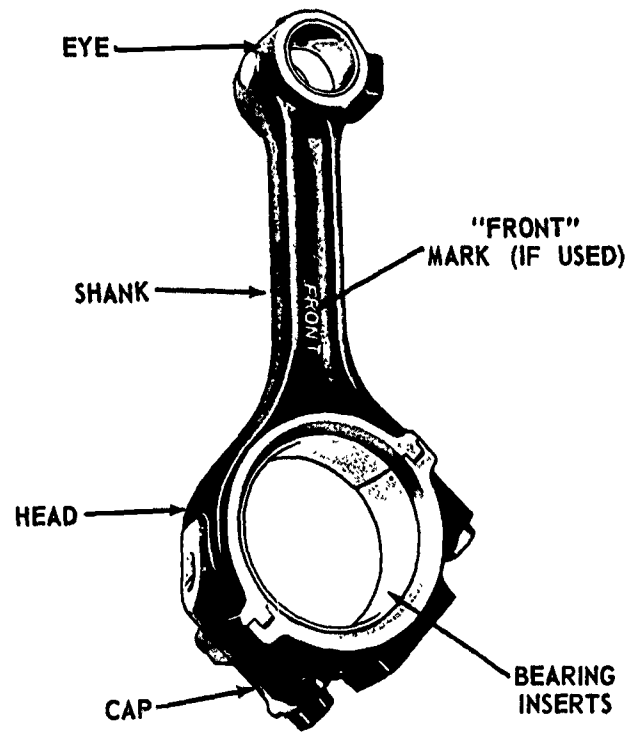

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Fig. 105 — Connecting Rod

The connecting rod (Fig. 105) has a **shank** with a small **eye** at one end and a large **head** at the other. The eye forms a bearing for the piston pin, while the head forms a bearing for the crankshaft. The head end of the rod is split and has a bearing **cap** which is bolted on. Two split bearing halves are inserted into the head and cap.

Most connecting rods are forged in one piece and the cap is then cut off and fitted to the head.

SERVICING OF CONNECTING RODS

Bent Or Twisted Rods

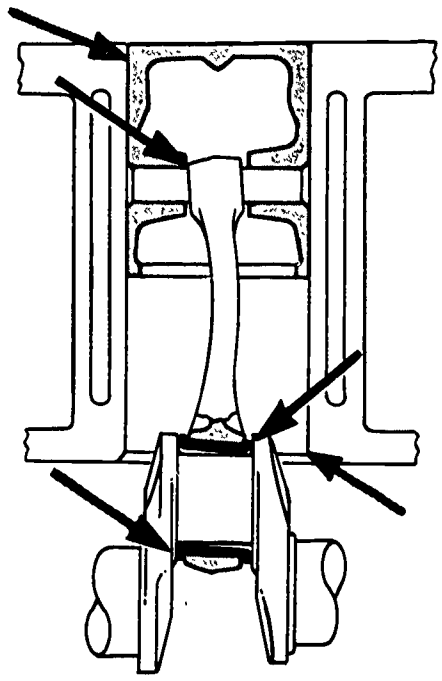

Fig. 106 — Wear Points From A Bent Rod

Generally, connecting rods do not become bent or twisted as the result of normal operation. Both bending and twisting usually result from poor machining or mishandling when reconditioning the engine.

A twisted connecting rod not only places false loads on the connecting rod bearings, but also on the piston, sometimes leading to piston scuffing.

Fig. 106 shows the points of wear from a *bent* connecting rod.

Rod Alignment

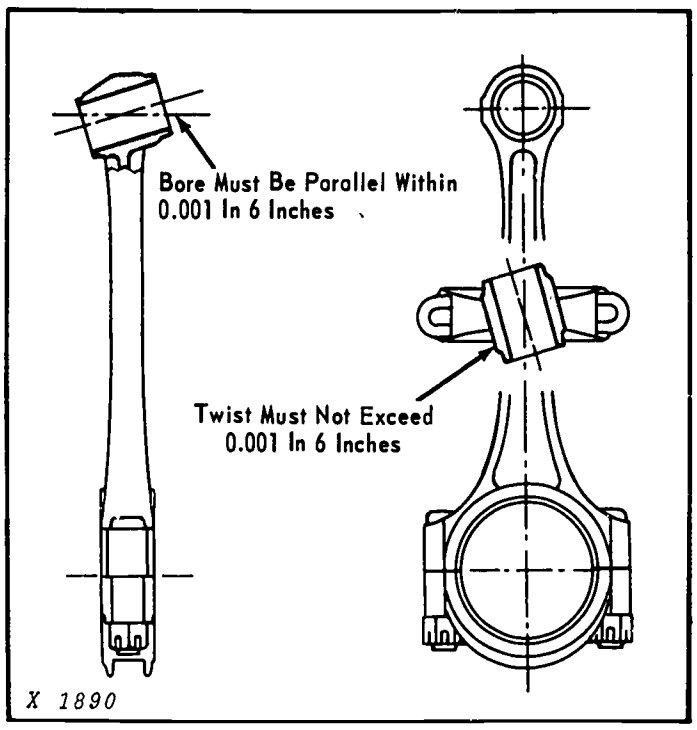

Fig. 107 — Recommended Limits For Rod Alignment

The rod must be aligned within close limits (Fig. 107).

The crankshaft bearing bore and the piston pin bushing bore should be parallel to each other within 0.001 inch in six inches.

New or reconditioned connecting rods usually have enough material in the piston pin bushing end to permit fitting of a standard or oversize piston pin by the removal of stock.

The connecting rods from an engine are normally reused, after checking, by pressing out the old bushing and inserting a new one.

Before a new bushing is installed, be sure to chamfer the pin end to remove the sharp edge that receives the bushing. Otherwise, the pin's sharp edge removes stock from the bushing and the bushing is then loose in the bore.

Piston And Rod Alignment

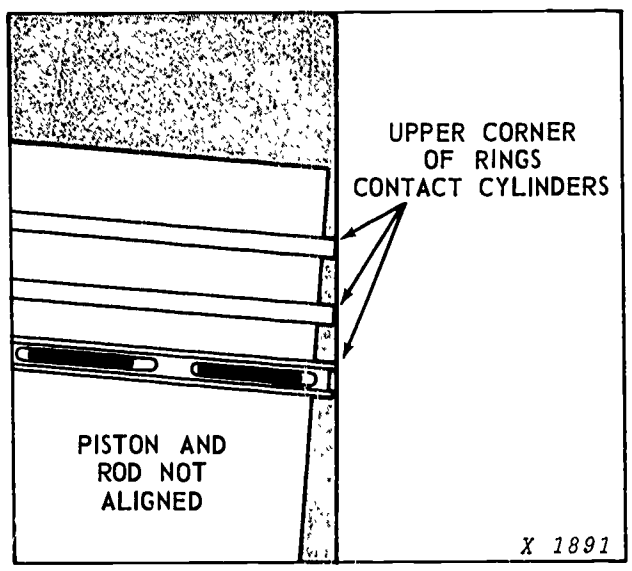

Fig. 108 — If Piston And Rod Are Not Aligned, Engine Uses More Oil

The piston must work squarely in its bore or the rings don't seal (Fig. 108). Misaligned rods not only cause oil consumption and blow-by, they also impose big loads on the rod bearings, the pistons, and the cylinder walls.

To check piston and rod alignment, use a fixture such as the one shown in Fig. 109.

Corrections are usually made by twisting or bending the rod with a notched bar.

Heavy rods seldom remain aligned after this operation because the rod is not permanently set and the rod soon returns to its warped condition. It is better to replace these rods if bent.

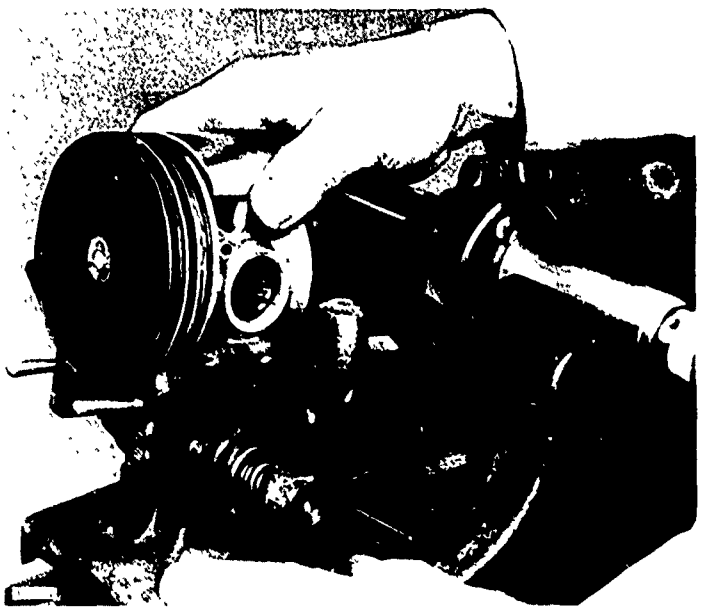

Fig. 109 — Checking Piston And Rod Alignment

Bearing Clearance

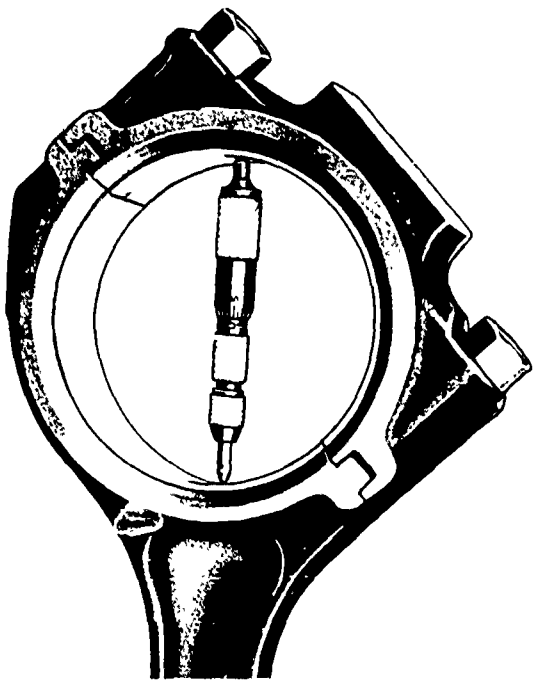

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Fig. 110 — Measuring Connecting Rod Bearing Clearance

Install connecting rod caps with bearing inserts in place and tighten to the specified torque. Measure the inside diameter of the connecting rod bearings at several places (Fig. 110). Also measure the outside diameter of the crankshaft connecting rod journals at several places (Fig. 111). Compare the two measurements to find bearing clearance.

Measuring Bearing Clearance Using Plastigage

Bearing clearance can also be measured with the crankshaft in place by using "Plastigage," a plastic thread which "crushes" to the exact clearance. While this method will give the bearing clearance, it will not tell you whether the wear is on the bearing or on the crankshaft journal.

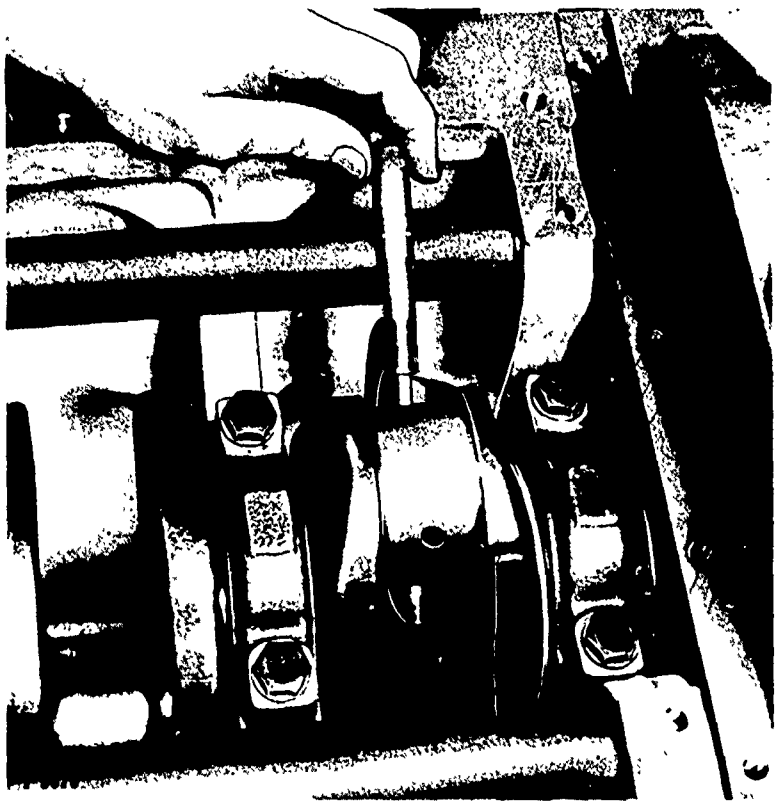


Fig. 111 — Measuring Crankshaft Rod Journals

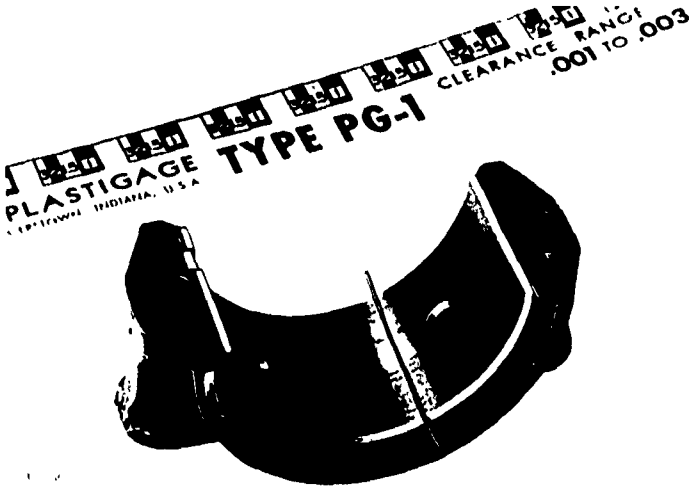


Fig. 112 — Placing Plastigage On Bearing Insert

1. Place a piece of Plastigage the full length of the bearing insert about ¼ inch off center (Fig. 112).

2. Install the bearing cap and tighten the bolts to the specified torque.

3. Remove the bearing cap. The flattened Plastigage will be found adhering either to the bearing insert or the crankshaft.

4. Compare the width of the flattened Plastigage at its widest point with the graduations on the envelope (Fig. 113).

The number within the matching graduation on the envelope indicates the total clearance in thousandths of an inch.

Approximate taper may be seen when one end of the flattened Plastigage is wider than the other.

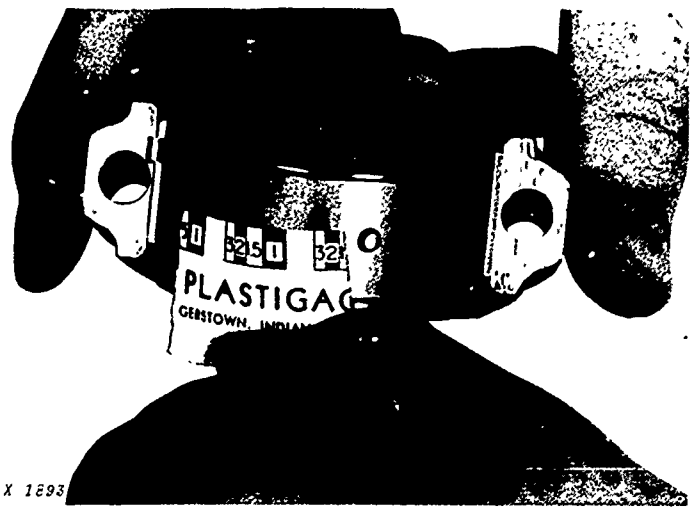


Fig. 113 — Determining Bearing Clearance With Plastigage

Measure each end of the flattened Plastigage. The approximate taper is the difference between the two readings.

ASSEMBLY OF RODS

Install each connecting rod and piston in the cylinder bore from which it was removed.

Some connecting rods are offset with the center of the bearings to one side from the center line of the shank. This makes the engine as compact as possible without skimping on the bearing surface. Be sure that offset rods face the proper way before you install them.

CRANKSHAFT

The crankshaft converts the up-and-down motion of the pistons into rotary motion. It ties together the reactions of all the pistons into one rotary force that drives the machine.

The crankshaft is forged or cast from a heat-treated steel alloy for extra strength. It is usually made in one piece (Fig. 114).

PARTS OF THE CRANKSHAFT

The main parts of the crankshaft are:

- **Journals—bearing surfaces for support and for connecting rods**
- **Throws—counterweights which help rotate the crankshaft**

Fig. 114 shows a typical crankshaft.

ARRANGEMENT OF CRANKSHAFT THROWS

The crankshaft throws are arranged according to:

1) The balance of the engine

2) Vibration from turning of the shaft

3) Loads on the main bearings

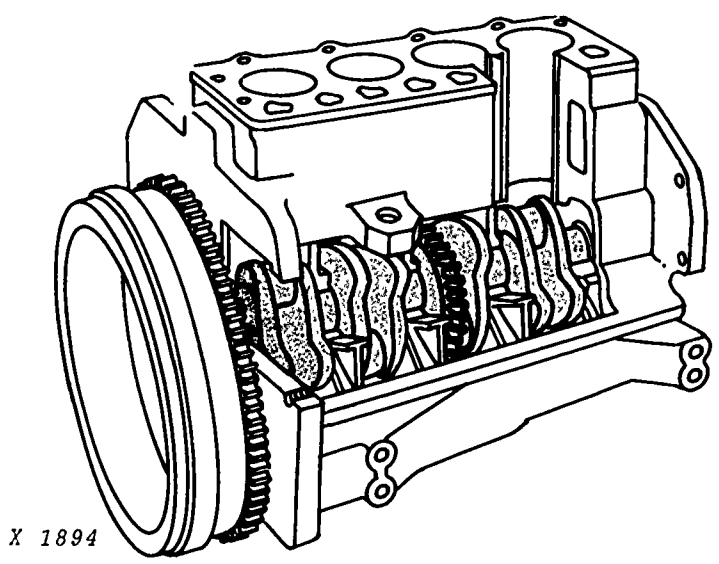
4) The firing order of the engine

The throws are placed so they counterbalance each other when the crankshaft is driven at great force and speed.

Fig. 115 shows the arrangement of throws on several crankshafts.

Four-Cylinder Engine Crankshafts—have either 3 or 5 main support bearings and 4 throws in one plane. As shown, the throws for No. 1 and No. 4 cylinders are 180 degrees from those for No. 2 and No. 3 cylinders.

Six-Cylinder Engine Crankshafts—have each of 3 pairs of throws arranged 120 degrees apart. They may have as many as 7 main bearings—one at each end and one between each pair of throws.



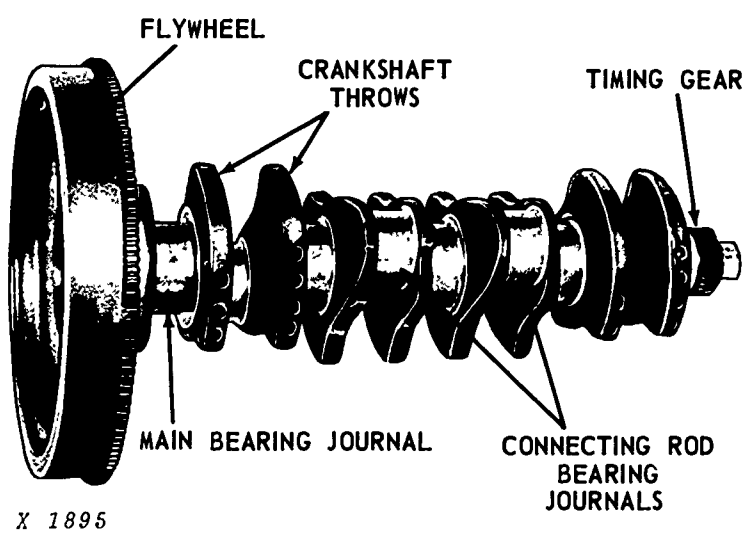


Fig. 114 — Crankshaft Of A Typical 4-Cylinder Engine

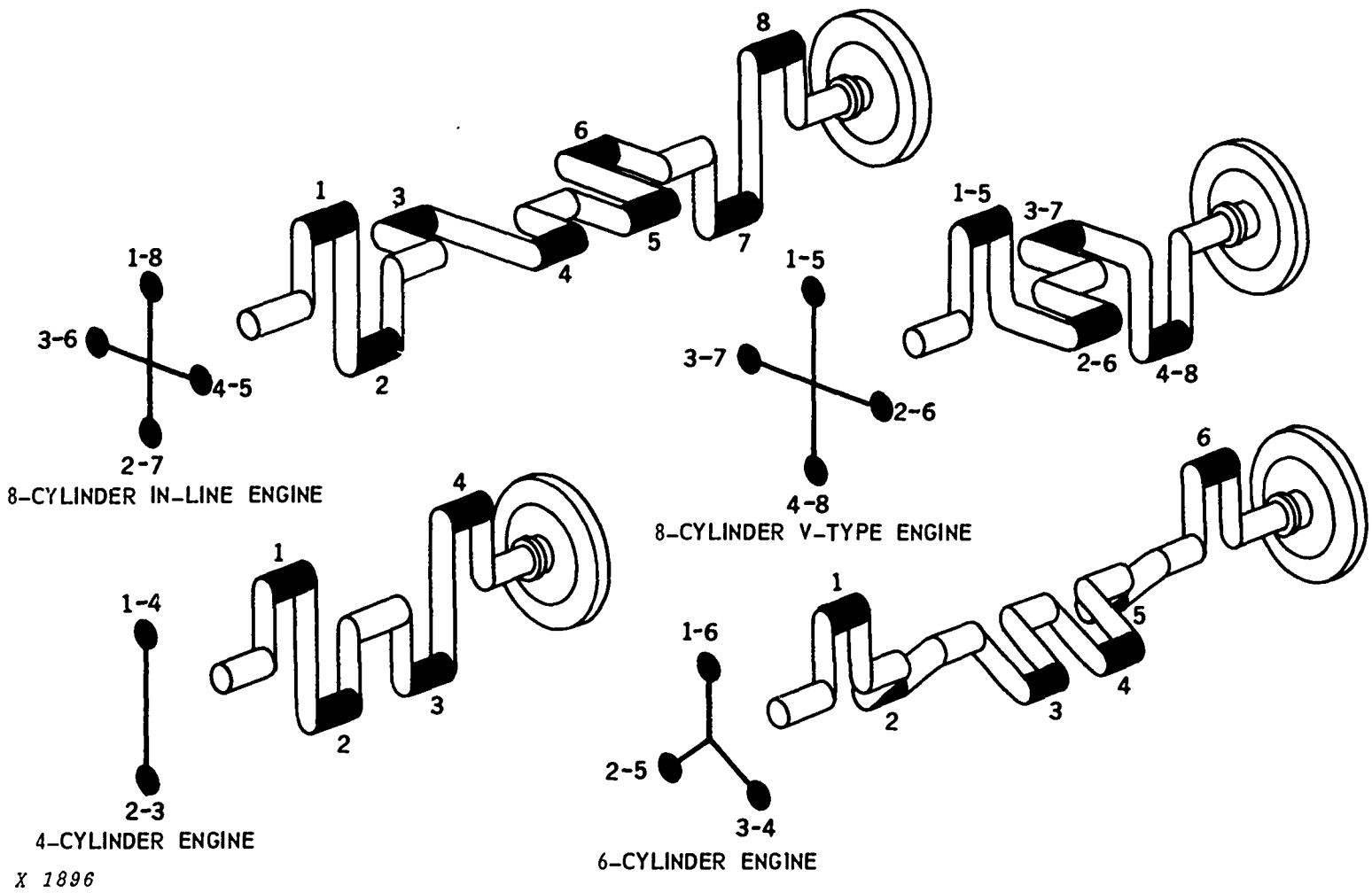


Fig. 115 — Crankshaft And Throw Arrangements

Eight-Cylinder Engine Crankshafts—have different throw arrangements depending upon whether the engine is a V-8 or in-line model (Fig. 115). The crankshafts of V-8 engines are similar to 4-cylinder types or they have the 4 throws fixed 90 degrees from each other, as shown, for better balance and smoother operation. V-8 engines usually have *two* connecting rods side-by-side fastened to one throw.

BALANCING THE CRANKSHAFT

The power impulses of the engine tend to set up torsional vibrations in the crankshaft.

These vibrations must be controlled or the crankshaft might break at high speeds.

To balance the force of the pistons, counterweights or throws are placed opposite the rod journals.

The weight of the flywheel and the use of vibration dampeners also helps to stabilize the turning crankshaft (see later in this chapter).

LUBRICATING THE CRANKSHAFT

Most engines have pressure oil lubricating the crankshaft (Fig. 116).

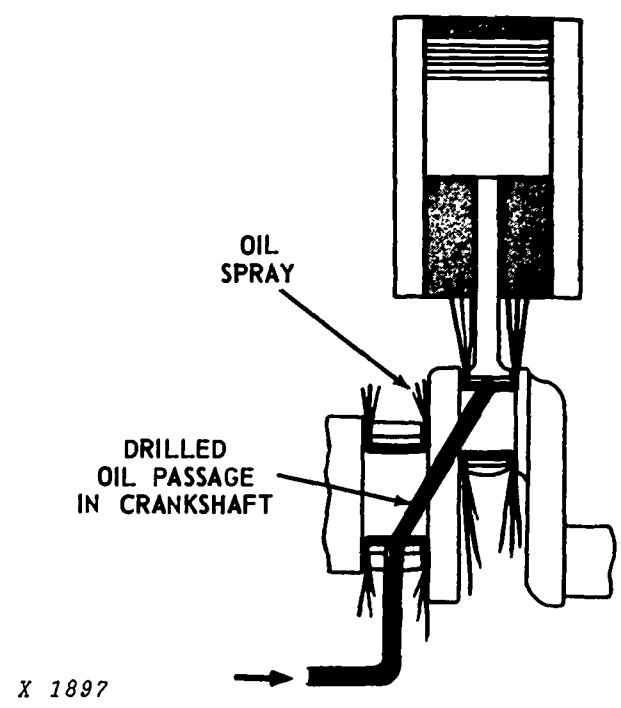


Fig. 116 — How The Crankshaft Is Lubricated

Oil holes are drilled through the crankshaft journals to match the holes leading in from the block. This oils the main and rod bearings as shown, while the excess oil sprays out to help lubricate the pistons and cylinder.

BEARING JOURNALS

Main and connecting rod journals of most crankshafts are induction hardened. They are also ground and polished to the exact bearing size.

Chrome plating of the journals is not very common, although it is one way to reclaim old journals.

SERVICING OF CRANKSHAFTS

Inspecting The Crankshaft

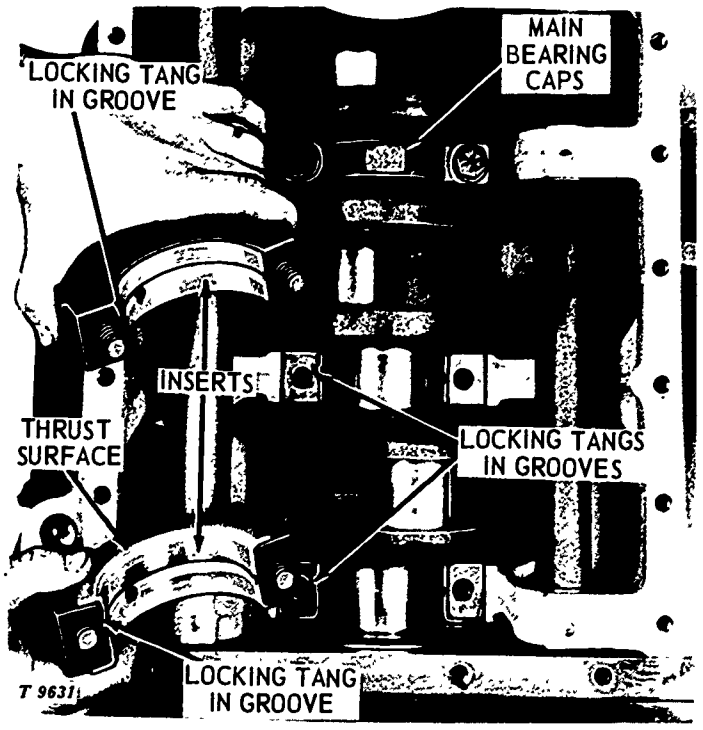


Fig. 117 — Removing Main Bearing Caps From Crankshaft

Bearing trouble is usually related to crankshaft wear. Whenever the main or connecting rod bearings are inspected (see "Bearings" in this chapter), the crankshaft should also be inspected.

PRELIMINARY INSPECTION OF BEARINGS

1. Remove the bearing caps one at a time (Fig. 117). Examine the crankshaft for scoring, ridging, overheating, cracks, or abnormal wear.

2. Identify the main bearing and connecting rod caps so that they can be installed in the same order they were removed.

3. Remove the bearing inserts from the main bearing bore in block and from the main bearing caps. Examine the inserts for evidence of scoring, wear, or "flaking out" of bearing material. Also look for a worn spot on the bearing which means a particle has lodged behind the bearing.

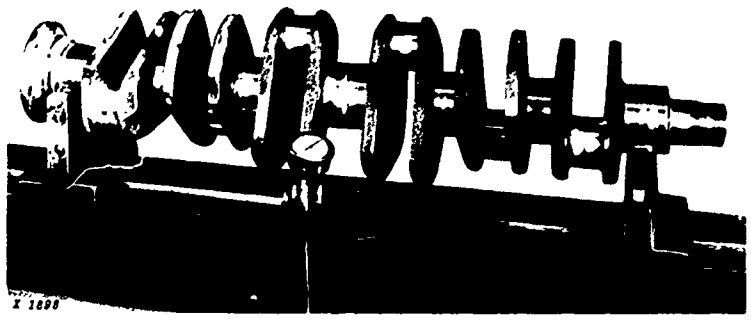


Fig. 118 — Checking Crankshaft Alignment With A Dial Indicator

4. *If one main bearing insert needs replacing, always replace both bearing inserts.*

5. Check clearance and condition of all main bearing inserts at this time. Wear on the damaged insert may be caused by another being out of specifications.

6. If any other inserts are within specifications but show excessive wear, replace them.

7. *Install new main bearing inserts at every major overhaul.*

COMPLETE INSPECTION OF CRANKSHAFT

When a crankshaft has been removed for reconditioning, inspect it as follows:

1. Clean the crankshaft with fuel oil and dry it with compressed air. Clean and blow out all the oil passages thoroughly.

2. Check the alignment of the crankshaft. Support it on its front and rear journals in V-blocks or a lathe and check the alignment at the center

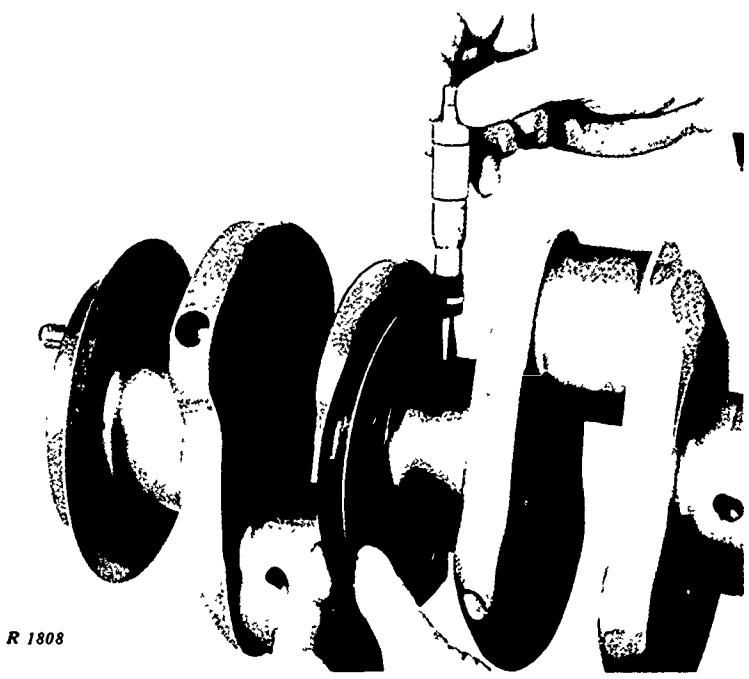


Fig. 119 — Measuring Crankshaft Journals With A Micrometer

or intermediate journals using a dial indicator (Fig. 118). Protect the crankshaft journals from scratches while turning in the V-blocks by laying a strip of paper in the V's.

The center or intermediate journals should not vary more than the average oil clearance allowable in the total indicator reading. Refer to the engine specifiations for the allowable oil clearances.

To test either the front or rear main journals, move one of the V-blocks to the center or to an intermediate journal.

3. Measure all of the main connecting rod bearing journals (Fig. 119). Measure at several places around the journal to find the smallest diameter, in case the journals have worn out-of-round. Refer to the engine Technical Manual for wear limits.

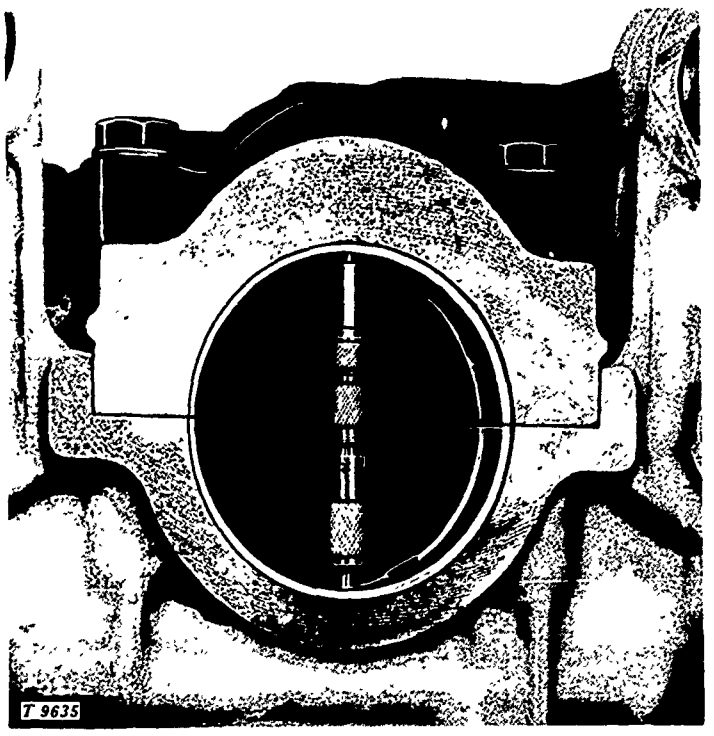


Fig. 120 — Measuring The Main Bearing Clearance

4. Measure the main bearing clearance. With the crankshaft out of the block, install the main bearing caps with bearing inserts in place and tighten to specifications. Using an inside micrometer, measure the inside diameter of the main bearings (Fig. 120). Compare the reading with the outside diameter of crankshaft main journals (see Fig. 119). Calculate this difference between the two readings to determine the bearing clearance.

Main bearing clearance can also be measured with the crankshaft in place by the use of "Plastigage." See earlier in this chapter under "Connecting Rods" for details.

5. Used crankshafts may have some ridging caused by the oil groove in the upper bearing (Fig. 121). If this ridge is not removed before new bearings are installed, pressure on the bearings will be too high during operation.

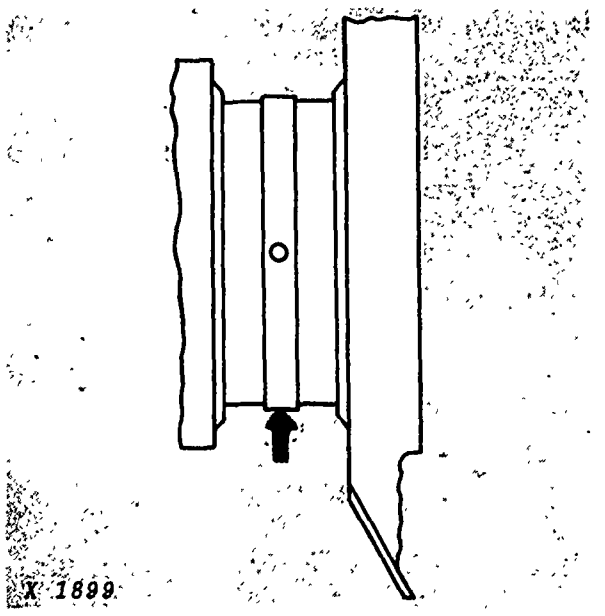


Fig. 121 — Badly Ridged Crankshaft Journal

Low ridges can be removed by working crocus cloth (wet with fuel oil) around the journal. Rotate the crankshaft frequently to eliminate an out-of-round condition. If the ridges are greater than 0.0005 inch, first use 120-grit emery cloth to clean up the ridge, then use 240-grit emery cloth for finishing. Finally, use wet crocus cloth for polishing.

If the ridges are greater than 0.001 inch, the crankshaft may have to be reground.

6. Check the surfaces of the crankshaft for cracks. Several methods of finding minute cracks not visible to the eye are outlined below:

Magnetic Particle Test—The part is magnetized and then covered with a fine magnetic powder or solution. Flaws, such as cracks, form a small local magnet which cause the magnetic particles in the powder or solution to gather, marking the crack. *The crankshaft must be demagnetized after this test.*

Fluorescent Magnetic Particle Test—This method is similar to the magnetic particle method, but is more sensitive since its employs magnetic particles which are fluorescent and glow under ultraviolet light. Very fine cracks that may be missed under the first test, especially on discolored or dark surfaces, will be disclosed under the light.

Fluorescent Penetrant Test—This is a method which may be used on *nonmagnetic* materials such as stainless steel, aluminum, and plastics. A highly

fluorescent liquid penetrant is applied to the part. Then, the excess penetrant is wiped off and the part is dried. A developing powder is then applied which helps to draw the penetrant out of the flaws by capillary action. Inspection is carried out under an ultraviolet light.

A majority of the cracks revealed by the above tests are *normal and harmless* and only a few will damage the part. *Remember that interpreting the results is the most important step.*

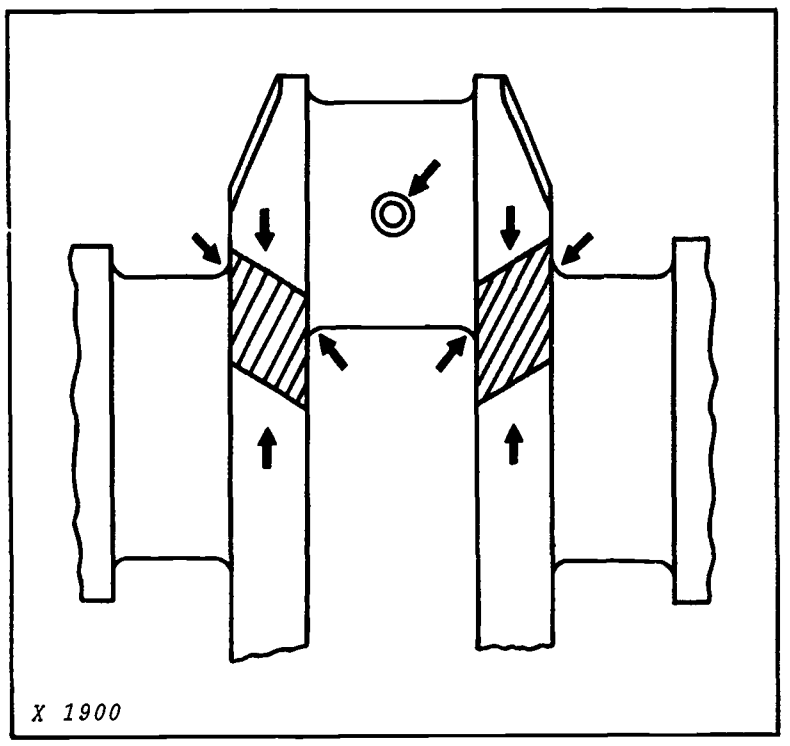


Fig. 122 — Critical Areas Of Load Stress In A Crankshaft

Crankshaft failures are rare; when one cracks or breaks completely, be sure to make a thorough inspection for the causes. Unless these causes are discovered and corrected, there may be a repeat of the failure.

Two types of loads are imposed on a crankshaft:

1) Bending forces

2) Twisting, torsional forces

The design of the shaft is such that these forces produce almost no stress over most of the surface. Certain critical areas, however, sustain most of the load. See Fig. 122.

BENDING FATIGUE FAILURES result from crankshaft bending, which takes place once per revolution.

The crankshaft is supported between each of the cylinders by a main bearing, and the force of combustion on the piston is divided between the adjacent bearings. Abnormal bending stress, particularly in the crank fillet, may result from misalignment of the main bearing bores, improperly fitted bearings, failed bearings, a loose or broken bearing cap, or an unbalanced fan pulley.

Bending failures start at the crank fillet and progress throughout the crank, sometimes extending into the journal fillet.

If the main bearings are replaced due to one or more badly damaged bearings, make a careful inspection to determine if any cracks have started in the crankshaft. These cracks are most likely to occur on either side of the damaged bearing.

TORSIONAL FATIGUE FAILURES result from twisting vibrations occurring at high frequency.

A combination of abnormal speed and load conditions may cause the twisting forces to set up a vibration which imposes high stresses at the locations shown in Fig. 122.

In addition, these stresses occur at the crankshaft journal oil holes near the flywheel end of the shaft. In six-cylinder engines, the No. 5 and No. 6 journal oil holes are critical; in four-cylinder engines the No. 4 journal oil hole is critical. Three-cylinder engines are not troubled by torsional vibrations.

Torsional stresses may produce a fracture in either the crankshaft rod journal or the main journal. Failures of crankshaft journals are usually at the fillet at a 45 degree angle to the axis of the shaft.

Causes of torsional failures are: a loose, damaged, or defective vibration damper, a loose flywheel, or improper or additional fan pulleys or couplings. Other causes may be overspeeding the engine or resetting the governor.

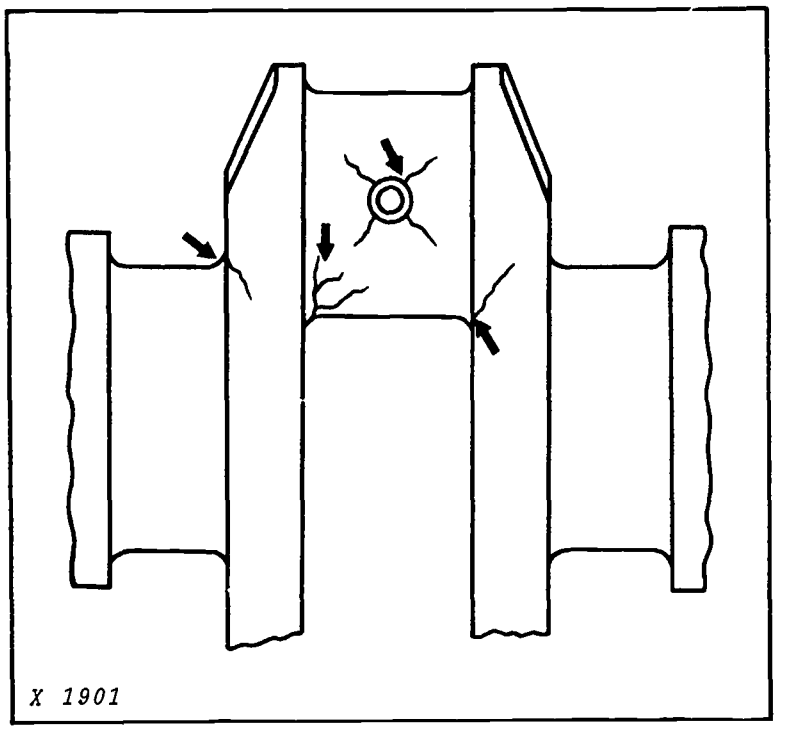


Fig. 123 — Crankshaft Fatigue Cracks That Require Replacement Of The Crankshaft

To repeat: *Most small cracks found in inspection of the crankshaft are harmless.*

Two types to look for are circumferential fillet cracks at the critical areas, and 45 degree cracks (with axis of shaft) starting from either the critical fillet locations or the crankshaft journal holes as shown in Fig. 123. These cracks require replacement of the crankshaft.

7. Check the crankshaft thrust surfaces for evidence of excessive wear or roughness. In many instances, only slight grinding or "dressing up" of the thrust surfaces is necessary. In these cases, new standard thrust washers will probably hold the end thrust clearance within the specified limits (if oversized thrust bearings are used).

8. Inspect the crankshaft keyways for evidence of cracks or wear, and replace the shaft if necessary.

9. Carefully inspect the crankshaft in the area of the rear oil seal contact surface for evidence of rough or grooved conditions. Any marring of this surface will cause oil leaks.

Reconditioning Crankshaft Journals

Two methods are used to recondition the rod and main journals:

1. *Grinding the journals by removing material from the surface.*

2. *Rebuilding the journals by adding material to the surface.*

REGRINDING THE CRANKSHAFT

1. Before grinding the crankshaft, make a careful check for cracks which start at an oil hole and follow the journal surface at an angle of 45 degrees to axis. Any crankshaft with such cracks must be replaced—regrinding only increases the effect of stress.

Also, when a shaft is inspected by the magnetic particle method, minute cracks may be found beneath the surface. These are not harmful *provided* the regrinding does not bring them out onto the surface.

2. Measure the crankshaft journals at A and B (Fig. 124) and compare with the diameters required for various undersize bearings (obtained from engine or bearing manufacturer). This will determine the size to which the crankshaft journals must be reground.

In addition to the standard main and connecting rod bearings, undersize 0.002, 0.010, 0.020 and 0.030-inch bearings are usually available.

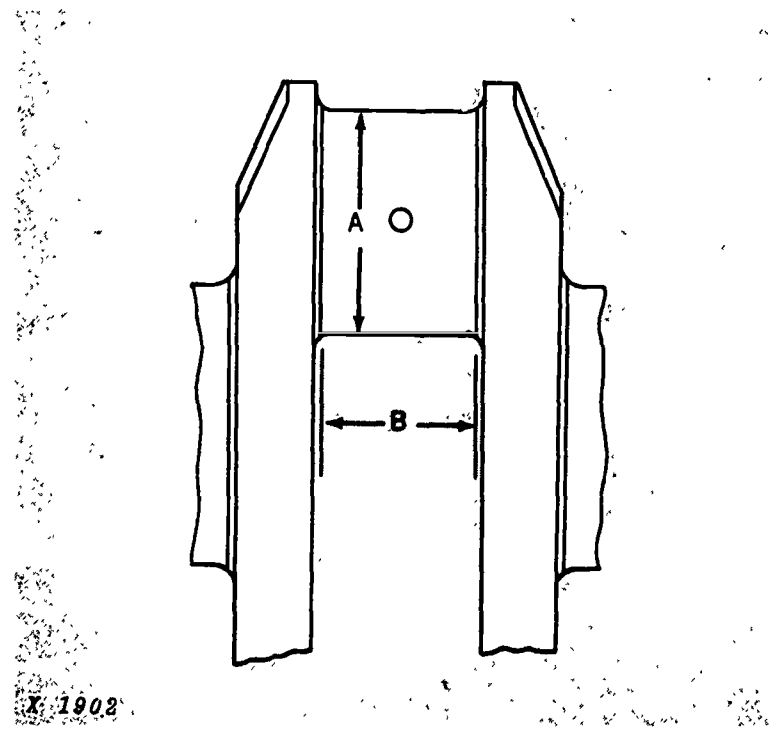


Fig. 124 — Crankshaft Dimensions To Be Measured Before Regrinding

It is not advisable to regrind the average crankshaft below 0.030 inch. This applies to small high-speed engines, but there are some large heavy-duty engines that permit regrinding to sizes below this. As a guide, check to see if undersized bearings are available below 0.030 inch.

REBUILDING CRANKSHAFTS

Rebuilding crankshafts is adding material to the surface of the crankpins and journals.

This is a specialty job and should not be attempted unless the equipment is available and the job is recommended by the engine manufacturer.

Several methods of rebuilding include:

1. *Chromium plating*

2. *Electro-welding*

3. *Metal Spraying*

4. *Gas Welding*

Installing The Crankshaft

1. Install new bearing inserts in the cylinder block and place the bearing caps in the same location from which they were removed. Usually the inserts and bores have locking devices which align to insure proper fit and avoid turning (see Fig. 125). Be sure that these locks align and that the oil holes in the inserts line up with oil passages in the cylinder block.

2. Apply a few drops of clean engine oil to the bearing and spread it over the bearing surface. Carefully position the crankshaft on the bearings. Be sure to hold the crankshaft parallel to the bore and gently lower it into position. This must be done with extreme care because the thrust bearing surface can be easily damaged.

3. Install the remaining bearing halves and caps, making sure the caps are installed on the mains from which they were removed by referring to identification marks made during removal. Loosely install the cap screws in the bearing caps until they are finger tight.

4. Before tightening the caps, align the thrust bearing or washers as follows: Tap the crankshaft to the rear to line up the front flanges. Then tap the crankshaft to the front to line up the rear flanges.

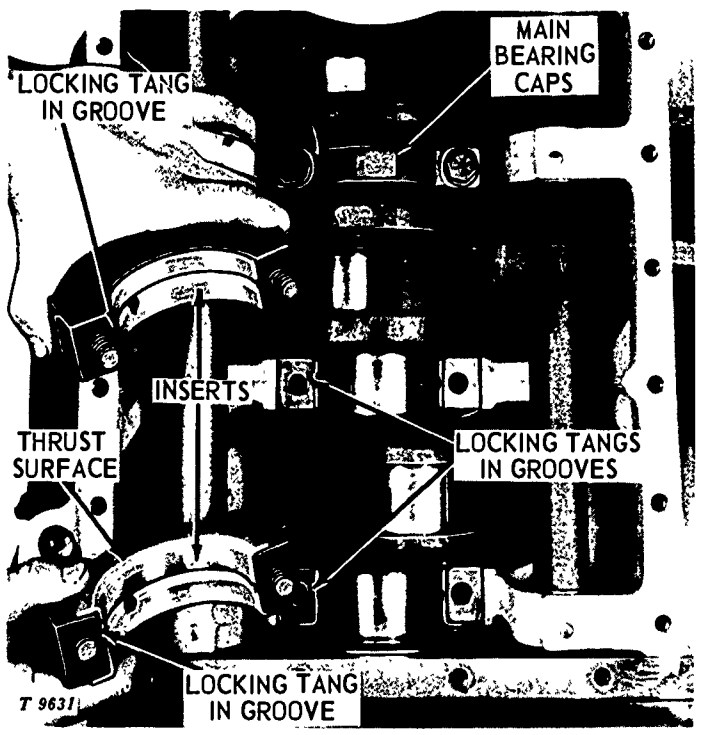


Fig. 125 — Installing A Typical Crankshaft

5. Now tighten the bearing cap screws to the specified torque, starting with the center cap and working alternately towards both ends of the block

6. If the bearings have been installed properly, the crankshaft will turn freely after all the main bearing caps are drawn down to the specified torque.

Checking Crankshaft Endplay

The crankshaft must have a certain amount of endplay to get the proper thrust during operation and to avoid excessive wobble and wear.

The main bearing which absorbs the thrust usually has a double flange (see Fig. 133). Separate thrust washers are sometimes used for the same purpose.

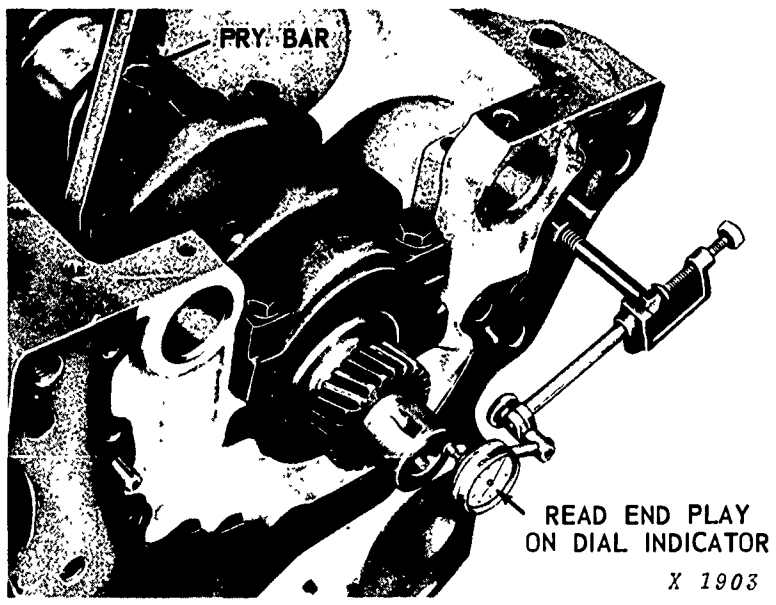


Fig. 126 — Checking Crankshaft Endplay

To check the crankshaft endplay, force the crankshaft toward the dial indicator as shown in Fig. 126. Keep a constant pressure on the tool and set the dial indicator on zero. Then, force the crankshaft in the opposite direction and note the amount of endplay shown on the indicator. Refer to the engine specifications for the correct endplay.

Too little endplay can be the result of a misaligned thrust bearing, or a burr or dirt on the inner face of the bearing flange or thrust washer.

Too much endplay means that the thrust surfaces are worn and need replacement.

ENGINE BALANCERS

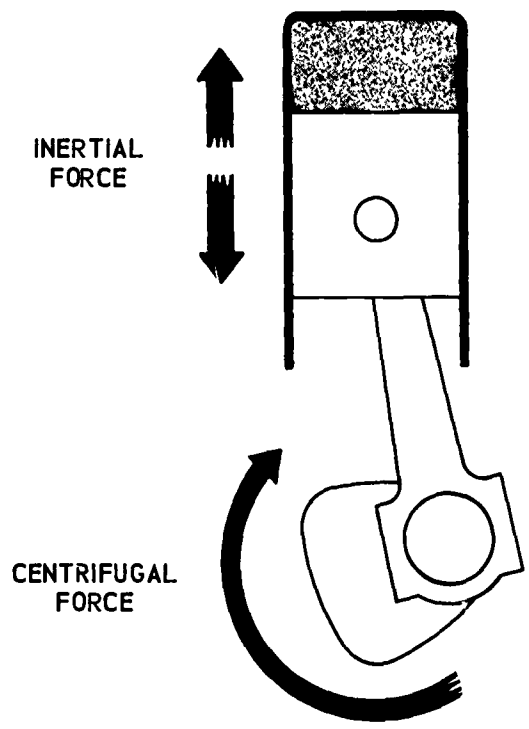
Just as the crankshaft must be balanced, so the whole engine must be balanced. This is a harder job because some parts rotate while others reciprocate—or move up and down.

UNBALANCING FORCES IN THE ENGINE

Two unbalancing forces act on the working engine:

- **Centrifugal Force—rotary outward force at the crankshaft**
- **Inertia Force—up-and-down force at the pistons.**

CENTRIFUGAL FORCE at the CRANKSHAFT is created by the revolving weight of the heavy crankshaft throws (Fig. 127). Many engines can use counterweights on the crankshaft to balance this force and reduce the bending force on the crankshaft and main bearings. Such a crankshaft is said to be *statically and dynamically balanced.*

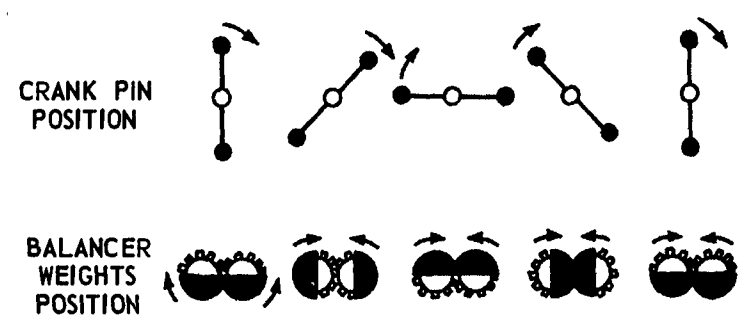


X 1904

Fig. 127 — Unbalanced Forces In The Engine

INERTIAL FORCE at the PISTONS is greatest at the top and bottom of each stroke where the piston must reverse itself at high speeds (Fig. 127). Other inertial forces are created by the motions of the connecting rod and the piston as they "pedal" at high speeds. Counterweight on the crankshaft can also balance these forces in some cases, but not all.

BALANCING THE ENGINE



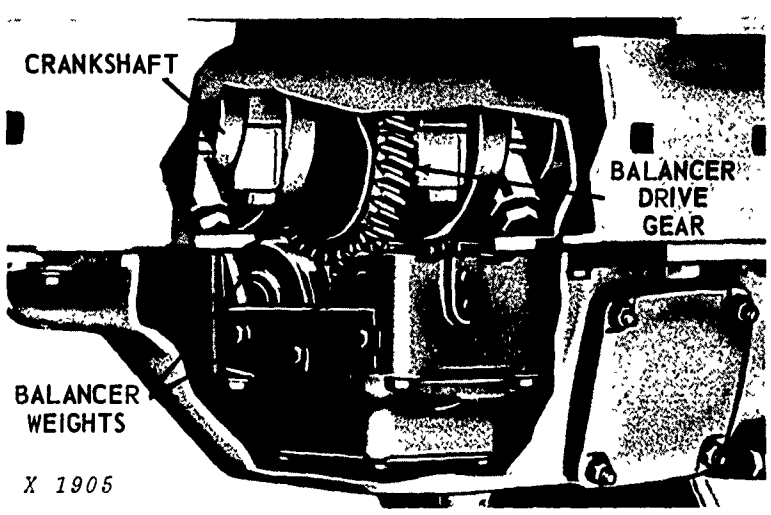


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Fig. 128 — Engine Balancer On A Four-Cylinder, Four-Cycle Engine

In four-cycle engines with more than four cylinders, inertial forces can be balanced by correct arrangement of the crankshaft throws.

With four cylinders or less, however, the crankshaft can be balanced as a whole but the individual cranks are unbalanced. To reduce the stress on high-speed engines, balance weights or balancing shafts are used.

Fig. 128 is a diagram of how balancing weights are able to cancel the inertial forces in a four-cylinder, four-cycle engine.

The balancer shown is driven by the crankshaft and has two rotating gears with counterweights.

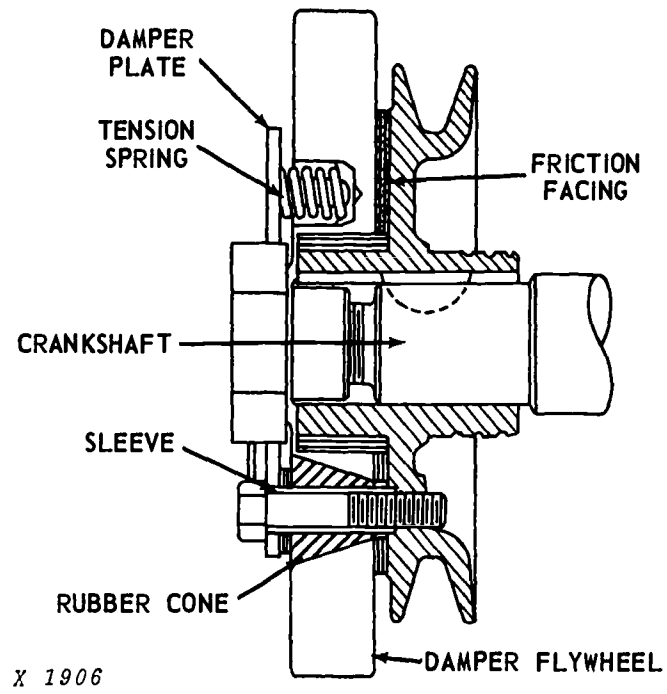
The balancer weights are timed to the crankshaft so that their position (shown in dark color) counteracts the forces on the cranks. These forces are caused by the different speeds of the pistons at the tops and bottoms of their strokes.

For example, when the crank is pulled up, the weights are down. Result: the upward force of the piston is cancelled by the downward centrifugal force of the weights.

Other positions of the crankshaft and weights are also shown in Fig. 130.

ANOTHER FORCE—TORSIONAL VIBRATION

As the cylinders fire, the pressure "twists" the crankshaft, producing *torsional vibrations* in the crankshaft. We saw earlier that the crankshaft throws and the flywheel are weighted and arranged to reduce these forces. However, some



X 1906

Fig. 129 — A Typical Vibration Dampener

engines are operated under extra stress—sudden loads, varying speeds, and the like.

A **vibration dampener** can be mounted on the free end of the crankshaft to control the vibrations.

Most vibration dampeners resemble a miniature flywheel (Fig. 129). A friction facing is mounted between the hub face and a small damper flywheel. The damper flywheel is mounted on the hub face with bolts that go through rubber cones in the flywheel. These cones permit the damper to move slightly on the end of the crankshaft. This reduces the effects of torsional vibration in the crankshaft.

Several other types of vibration dampeners are used which employ springs, rubber bonding, "floating" action of fluids, and loose pins. However, the principle is the same as described above.

MAIN BEARINGS

All the major wear and load points in an engine use *bushings* or *bearings* to reduce friction (Fig. 130).

Let's define the two words:

- **Bushing—small full-round sleeve, pressed in, for lighter loads or slower speeds.**
- **Bearing—full-round or halves, for heavier loads and higher speeds.**

BUSHINGS are used at the piston end of the connecting rod, at the rocker arms, the oil pump, etc.

BEARINGS are used at the crankshaft main journals, at the connecting rod journals, at the camshaft, etc.

Actually, the words "bushing" and "bearing" are synonymous when talking in general about a wear or friction point in an engine.

In the remainder of this section we will use the word "bearing" for all applications.

WHAT BEARINGS ARE MADE OF

The bearing material depends upon the expected wear and stress. Generally the bearing has a steel backing with one of three linings:

1) Tin- or lead-base babbitt

2) Copper or aluminum alloys

3) Multi-layer bearings in copper or aluminum alloys and silver combinations

Normally these materials are applied to the steel backings as a thin layer which is 0.013 to 0.025 inch in thickness in small bearings and somewhat thicker in large bearings. Bearings having one material deposited on the backing are referred to as "bimetal" bearings, while those having extra overlay coatings are called "trimetal" bearings.

WHAT THE BEARING MUST DO

Each type of bearing lining must have these qualities:

1. **Fatigue Resistance**—the ability to creep or flow slightly so that the shaft and bearing will conform to each other.

2. **Embeddability**—the ability to let small dirt particles embed themselves to avoid scratching the shaft.

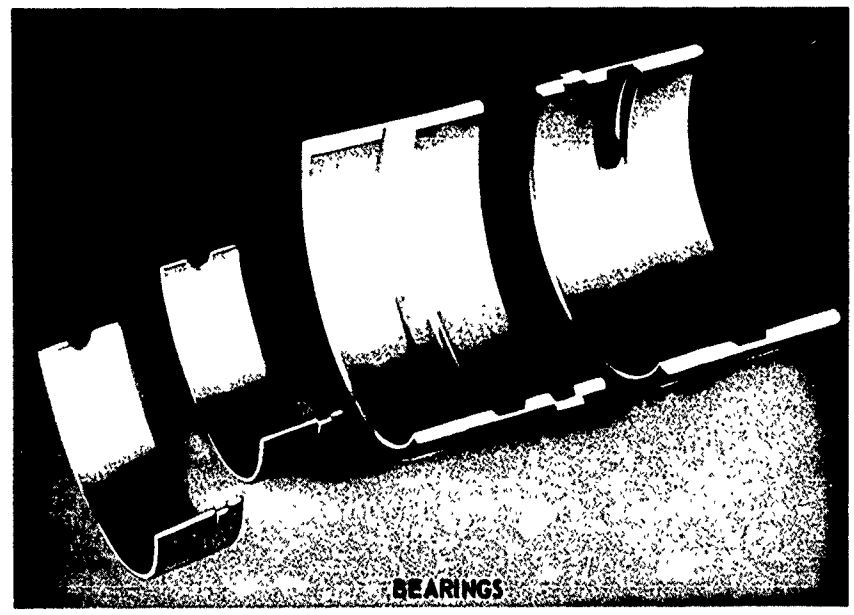


Fig. 130 — Bushings And Bearings For Typical Engine

3. **Seizure Resistance**—smooth surface action, since it is difficult to avoid some metal-to-metal contact during starting or when the oil film becomes thin during operation.

4. **Corrosion Resistance**—the ability of the bearing material to resist chemical corrosion.

5. **Temperature Strength**—the ability of a bearing material to carry its load at high operating temperatures.

Other items such as Wear Rate, Cost, Thermal Conductivity, and the Ability to Form a Good Bond with the backing material must also be considered.

BEARING LOCKS

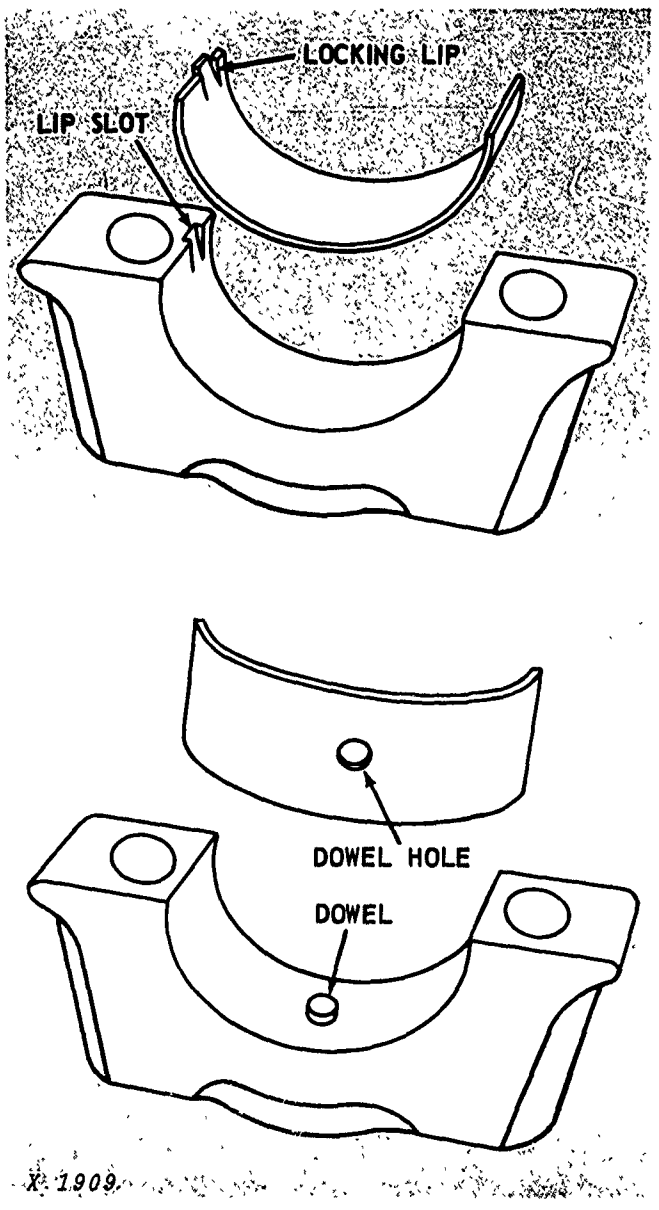


Fig. 131 — Types Of Bearing Locks

Unless it is designed for full-floating operation, the bearing insert must be locked in place to prevent rotation with the shaft (Fig. 131).

This is usually done by means of a locking lug on each half of the insert, which fits in a notch in both the housing and bearing cap. The lug on one insert prevents rotation in one direction while the other lug works in the opposite direction.

In some thick-walled bearings, a dowel may be used in the cap or housing to hold the bearing.

BEARING CRUSH

A *crush fit* provides a close contact between a bearing insert and its housing and cap. When the cap is tightened down fully, the bearing is crushed into place.

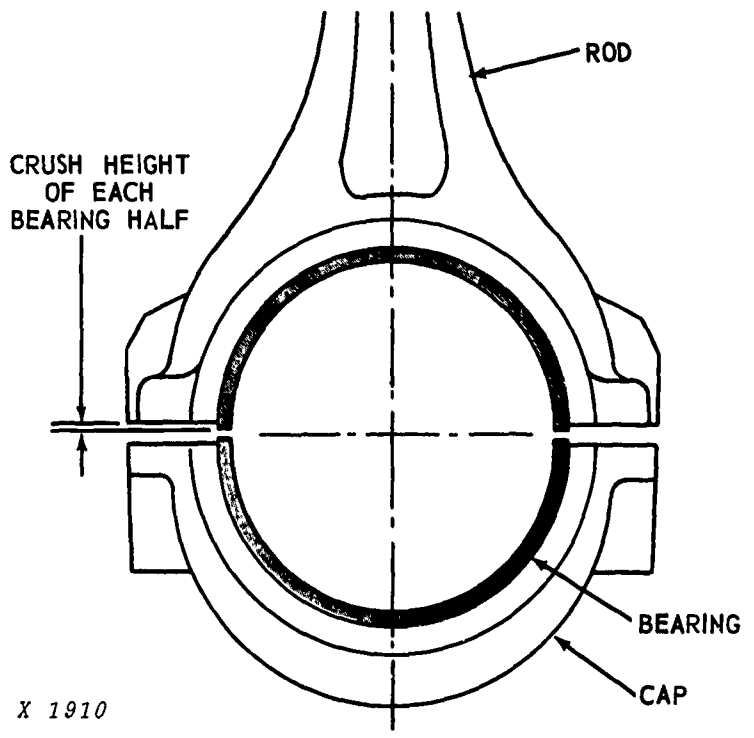


Fig. 132 — Bearing Crush Allowance

Fig. 132 shows the allowable crush height of a bearing insert half.

This tight fit aids the bearing lock in preventing movement of the bearing in the housing and provides full support.

BEARING SPREAD

Most main and connecting rod bearing halves are purposely manufactured with *spread* for a tighter fit. This is an extra distance across the parting faces of the bearing half in excess of the actual diameter of the housing bore.

BEARING OIL GROOVES

In most engines the lubricating oil is supplied to the main bearings through the cap or housing. Part of this oil must pass through a hole in the main bearing journals and then through the cranks to the connecting rod journals.

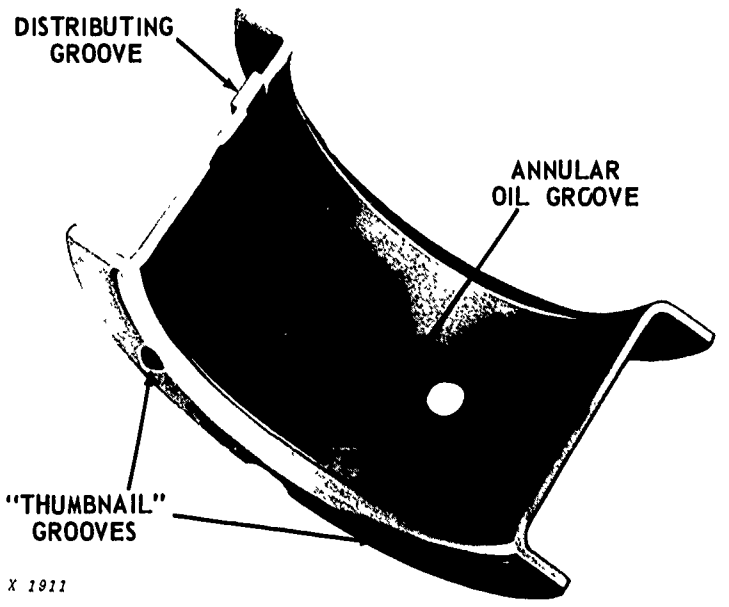


Fig. 133 — Oil Grooves In A Bearing

Some of this oil must get to a passage in the connecting rod and on to the piston pin and piston. Oil grooves must be provided for this oil flow (Fig. 133). In many cases either partial or complete circumferential grooves are provided in the bearing surface. In other cases at least part of the grooving is in the cap or housing outside of the bearing insert.

Distributing grooves are often machined into each bearing half along the parting faces to help distribute the oil the full length of the bearing so that the shaft can pick up the oil and carry it on to the load-supporting area. The term "mud pocket" is sometimes used to describe these grooves because the grooves will temporarily trap wear particles or dirt.

"Thumbnail" grooves are often placed in select locations on flange bearing faces to help distribute the oil evenly over the thrust surfaces (Fig. 133).

CRANKSHAFT THRUST BEARINGS

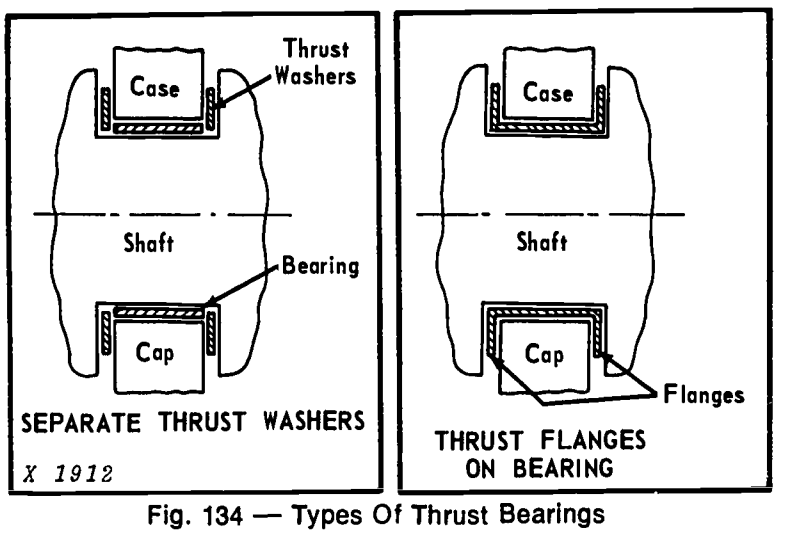


Fig. 134 — Types Of Thrust Bearings

The crankshaft is usually held in position axially at one of the main bearings near the flywheel end. This may be done by flanges which are part of the bearing inserts or separate flat thrust washers on each side of one main bearing (Fig. 134). Thrust flanges must be on both halves of the bearing.

SERVICING OF BEARINGS

Analyzing Bearing Failures

Failure of a bearing in service can be recognized in most cases by the following signs:

1) A drop in the lubricating oil pressure

2) Excessive oil consumption

3) Engine noise—rhythmic knock

Wear will vary widely with different engines and operations. For example, continued overloads or frequent shutdowns. "Normal" wear rate is affected by an "abnormal" operation, even starting the engine.

Major Causes Of Bearing Failure

When bearings fail, find the cause and correct it before installing new inserts. Otherwise, another failure can be expected in a very short time.

One bearing manufacturer found the causes of bearing failures ran like this:

Dirt	*42.90%*
Lack of Lubrication	*15.30%*
Improper Assembly	*13.40%*
Misalignment	*9.80%*
Overloading	*8.70%*
Corrosion	*4.50%*
Undetermined and Other Causes	*5.40%*

Diagnosing Bearing Failures

To locate the cause of an engine bearing failure, take the following steps:

1. Remove the oil pan from the engine after draining.

2. While removing the bearings, mark each one for its correct location. Scribe it with a pointed tool (Fig. 135). A code can be used: "1 U" for No. 1 cylinder—upper half of bearing, "1 L" for the lower half, etc.

3. Clean all of the bearing halves removed in a suitable solvent to remove sludge and oil. Blow or wipe them dry.

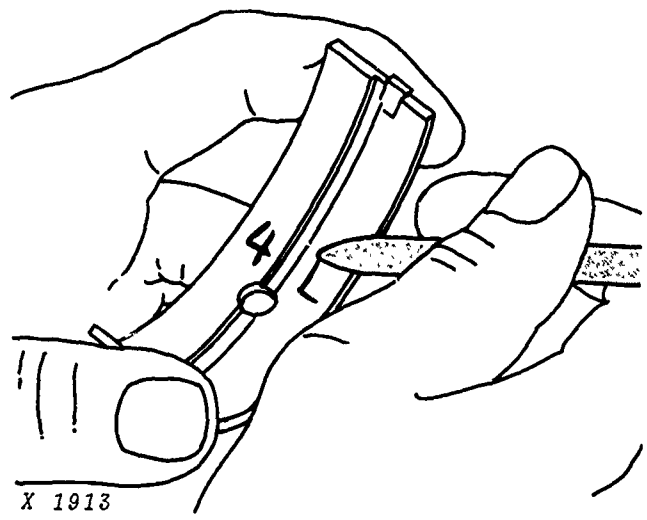


Fig. 135 — Scribe The Bearing To Mark Its Position In The Engine During Removal

4. Observe the sludge or settlings in the engine oil pan. Sometimes sand or metal particles as well as disintegrated bearing linings can be found and identified.

5. Place the cleaned bearings out on a flat surface in the order of position. Make two groups: Connecting rods farther away, main bearing nearer. The bearing surfaces should face up, with 1U on the upper left, 1L below it, and 2U next to 1U, and so on.

6. Keep an open mind; that is, avoid reaching a conclusion at this point.

7. Examine the connecting rod bearing operating surfaces, noting the distress areas, the rubbing areas, and so on.

8. Examine the main bearings in the same way. Closely inspect the mains that match the connecting rod bearings that are most distressed.

9. Turn all the bearings over to show the bearing backs. Examine the fit of the bearings into their housing by noting the transfer pattern on each half. Inspect the backs for interference by dirt particles, and check for a damaged fit of the locking lips into the recesses.

10. Turn the bearings over once more. After noting the condition of all bearings—overheated condition, poorly fitted, poorly installed, dirty, and so on—then make a conclusion.

11. Repair the engine as necessary to eliminate the cause of bearing failure. Then replace the bearings with new, approved sets.

Damage Revealed By Bearings

Here are some examples of bearing damage plus the causes and remedies.

Oil starvation was the cause of damage to the bearing shown in Fig. 136. Lack of oil can occur immediately after overhaul. This is when priming of the engine's lubricating system is vital to assure initial lubrication.

After break-in, other things can happen. Both local and general oil starvation can result from external leaks and mechanical supply failures. Blocked oil suction screen, oil pump failure, oil passages plugged or leaking, failed pressure relief valve springs, or badly worn bearings can stop the circulation of lubricating oil.

A mislocated oil hole will also cut off the oil supply to a bearing, causing rapid failure. Always check to be sure that the oil hole in the bearing is in line with the oil supply hole in the connecting rod or crankcase.

Also, the oil supply may become diluted by seepage of fuel into the crankcase from a defective fuel pump. This will reduce the oil's film strength and score the bearings.

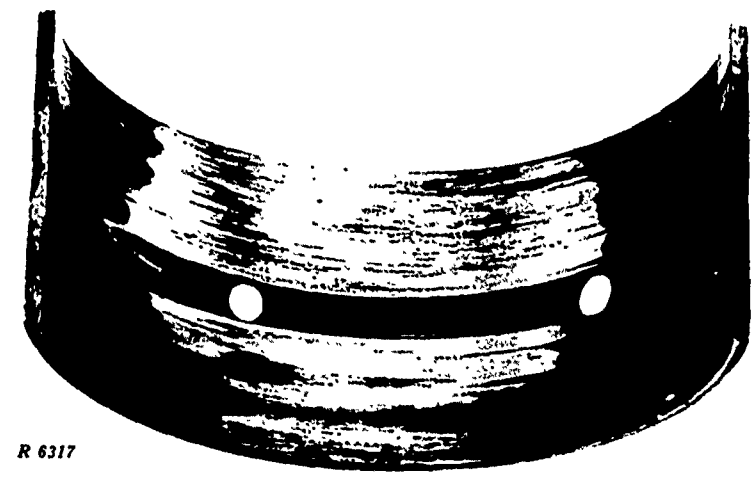
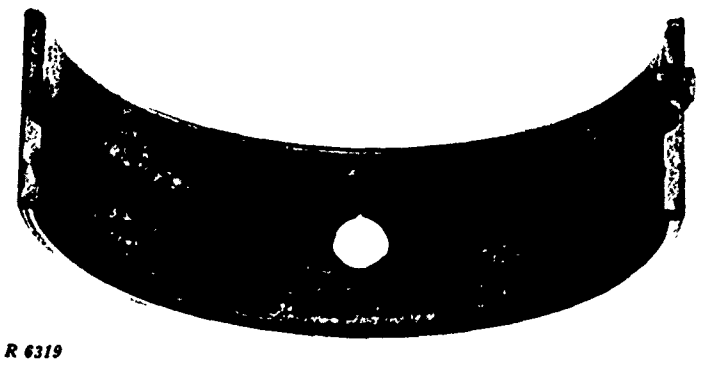


Fig. 136 — Oil Starvation Caused This Damage

Corrosion from acid formation in the oil is seen by a finely pitted surface and large areas of deterioration (Fig. 137).

Corrosion occurs when oil temperature goes above 300°F. and when excessive blow-by occurs. It is also aggravated by stop-and-go operation, which causes condensation in the crankcase.

Fig. 137 — Corrosion From Acid Formation In Oil



R 6319

Fig. 138 — Damage From Dirt Embedded In Bearing

Dirt can embed in the soft bearing material (Fig. 138). This causes wear and decreases the life of both the bearing and its journal.

Prevent this by cleaning the engine thoroughly during bearing installation and by proper maintenance of both air and oil filters.

Prevent corrosion by changing oil at correct intervals and by selecting oil of the proper quality and classification for the machine and type of service. Follow the manufacturer's recommendations.

Bent connecting rods can cause concentrated wear on the bearings (Fig. 139). This angular loading from a bent rod will cause the excessive wear shown on one edge of the upper bearing insert and the opposite edge of the lower bearing insert. When this wear pattern is found, check the connecting rod for poor alignment.

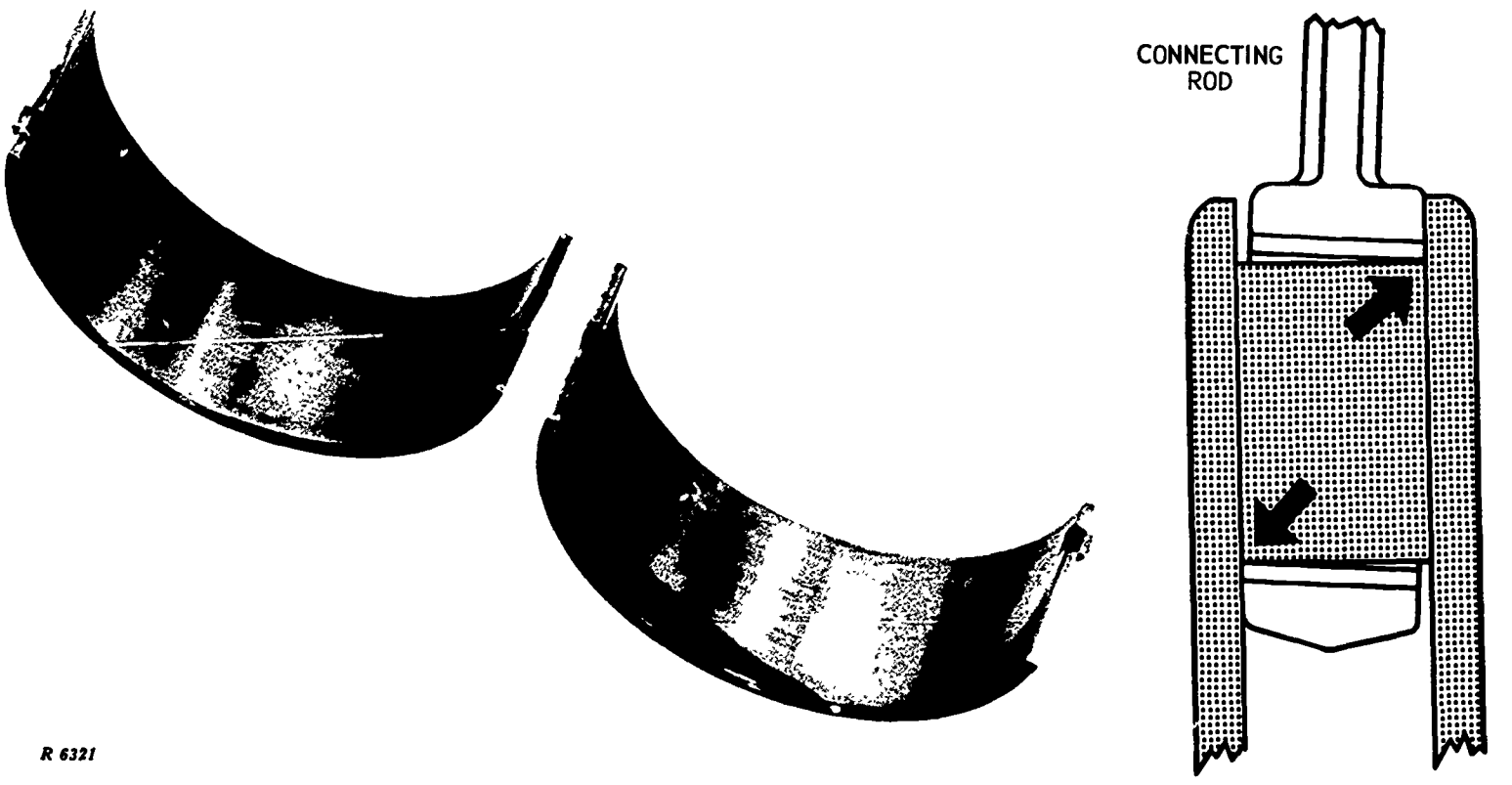


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Fig. 139 — Excessive Wear Caused By A Bent Connecting Rod

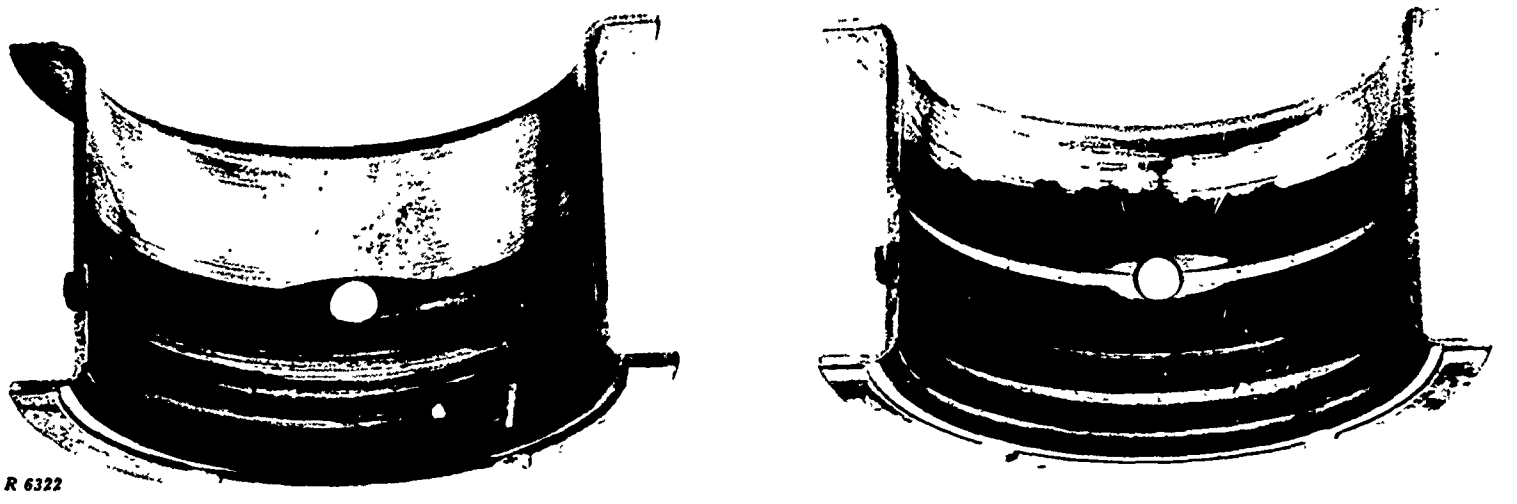

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Fig. 140 — Wear On One Edge Of Bearing Caused By Tapered Journals

Tapered journals allow areas of excessive clearance between the journal and bearing, which distributes more wear on one edge of the bearing (Fig. 140). This wear is further concentrated by the force of the piston on the insert carrying the greater load.

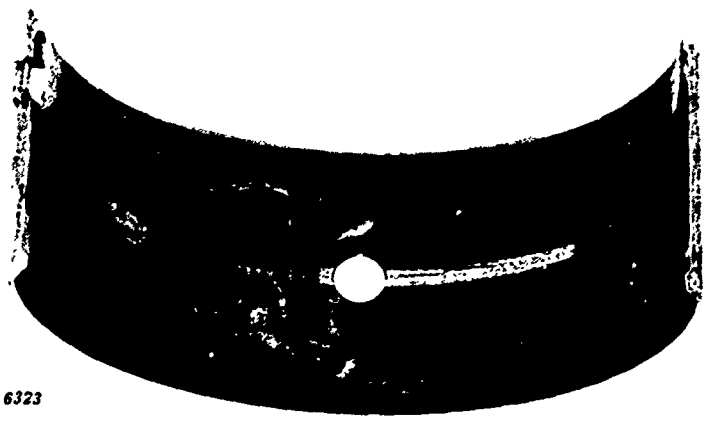

Fig. 141 — Bearing Fatigue Caused By Overloading And Heat

Overheating from overloads on the engine causes a metal fatigue which breaks away and voids the surface of the bearing (Fig. 141).

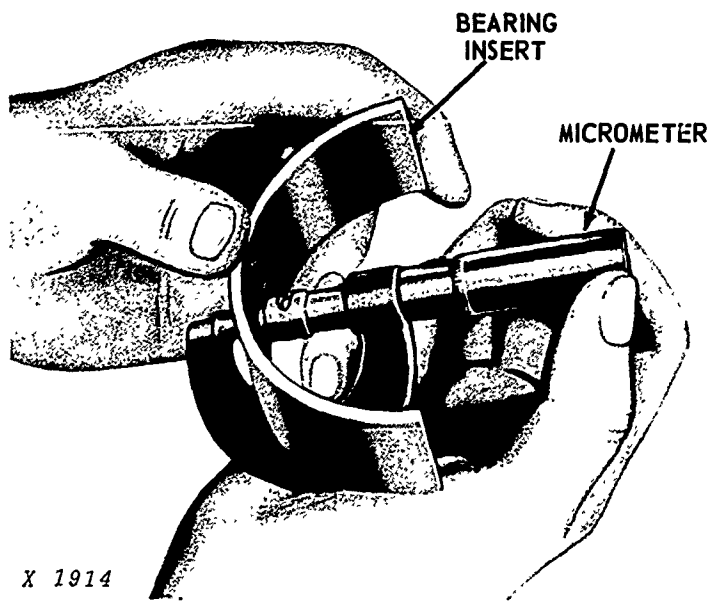

Fig. 142 — Checking Bearing For Wear

To be sure of bearing wear, measure the bearing at several places using an outside micrometer (Fig. 142). Also check for wear on the matching crankshaft journals at this time.

FLYWHEEL

The flywheel does three things for the engine:

- **Stores energy for momentum between power strokes**
- **Smooths out speed of crankshaft**
- **Transmits power to the machine**

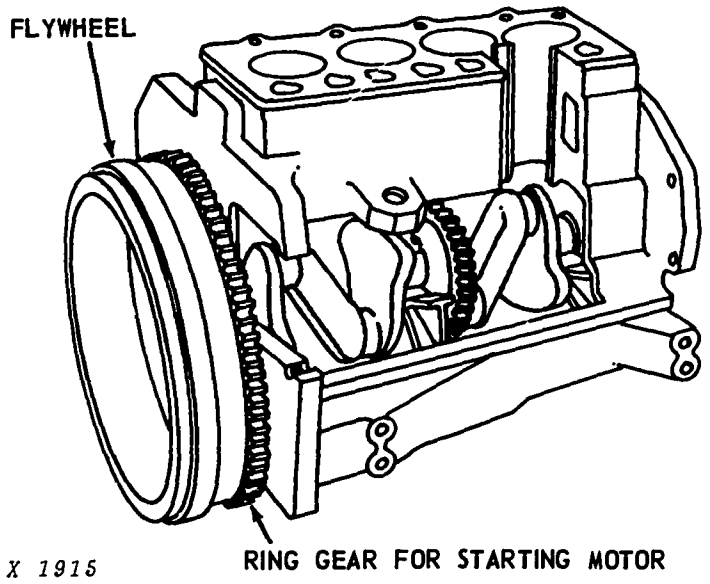

Fig. 143 — Flywheel

Mounted on the rear of the crankshaft (Fig. 143), the heavy flywheel is a stabilizer for the whole engine.

In a 4-cycle engine, the flywheel must be heavy enough to turn the engine during the exhaust, intake, and compression strokes. At the same time, it must transmit power to the driven machine.

The more cylinders in the engine, the less need for a flywheel. This is because the power impulses are more regular and the engine has more momentum of its own.

A lighter flywheel is needed for an engine operated at variable speeds where faster acceleration is required.

Flywheels are generally made of heavy cast iron or steel and are fastened to the crankshaft by dowel pins and bolts.

Flywheels may also have two other jobs:

1) Provide a drive from the starting motor via the ring gear.

2) Serve as a facing for the engine clutch.

SERVICING THE FLYWHEEL

The flywheel is rugged in construction and has no moving parts.

It does place a heavy load on the engine rear main bearing, which should be checked carefully at each overhaul.

The flywheel must also be removed when servicing many parts of the engine.

Inspecting The Flywheel

After removal, check the clutch contact face of the flywheel for scoring, overheating, or cracks. If scored, most flywheels can be refaced. However, do not remove too much material from the flywheel and keep the surface perfectly flat all around.

The ring gear for the starting motor is generally shrunk in place on the flywheel rim. If it becomes damaged, remove and replace it.

Removing Ring Gear From Flywheel

Note whether the ring gear teeth are chamfered. The replacement gear must be installed so that the chamfer on the teeth faces the same direc' on. Then remove the ring gear as follows:

1. Support the flywheel, crankshaft side down, on a solid flat surface or hardwood block which is slightly smaller than the inside diameter of the ring gear.

2. Drive the ring gear off the flywheel, with a suitable drift and hammer. Work around the circumference of the ring gear to avoid binding the gear on the flywheel.

Installing Ring Gear On Flywheel

1. Support the flywheel, ring gear side up, on a solid flat surface.

2. Rest the ring gear on a flat metal surface and heat the ring gear uniformly with an acetylene torch, keeping the torch moving around the gear to avoid hot spots.

IMPORTANT: Never overheat the gear because this may destroy the original heat treatment.

If the engine manufacturer specifies a certain heat range, heat crayons which give the temperature may be obtained from most tool vendors.

3. Use a pair of tongs to place the gear on the flywheel with the chamfer, if any, facing the same direction as on the gear just removed.

4. Tap the gear into place against the shoulder on the flywheel. If the gear cannot be tapped into place readily, remove it and apply additional heat, but DO NOT OVERHEAT.

TIMING DRIVES

The crankshaft is the "hub" around which other parts of the engine can be timed and driven (Fig. 144). This is done by the meshing of gears as shown.

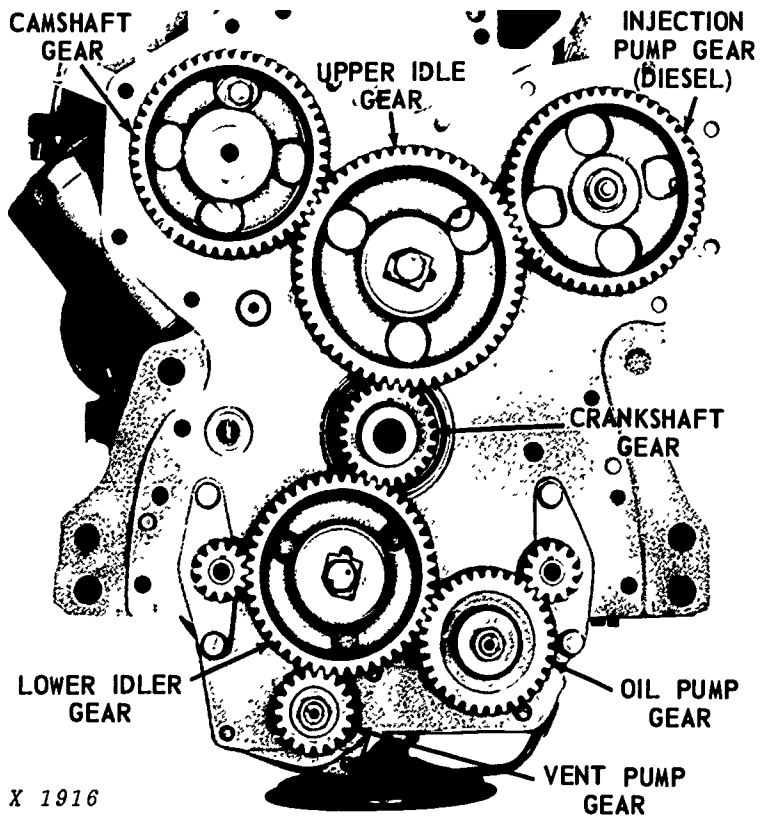

Fig. 144 — Timing Gear Train On Typical Engine

The camshaft runs at one-half engine speed, so a 2-to-1 reduction of gears is used. An idler gear transmits the rotation to the large camshaft gear (which turns half as fast as the smaller crankshaft gear). A chain drive can also be used to turn the camshaft.

Other accessories that can be driven by the crankshaft are fuel pumps, oil pumps, injection pumps (diesel), ventilator pumps, and water pumps.

TIMING THE GEAR TRAIN

Many gears in the engine gear train must be timed to each other.

For example, the camshaft operates the valves and must be synchronized with the pistons and crankshaft.

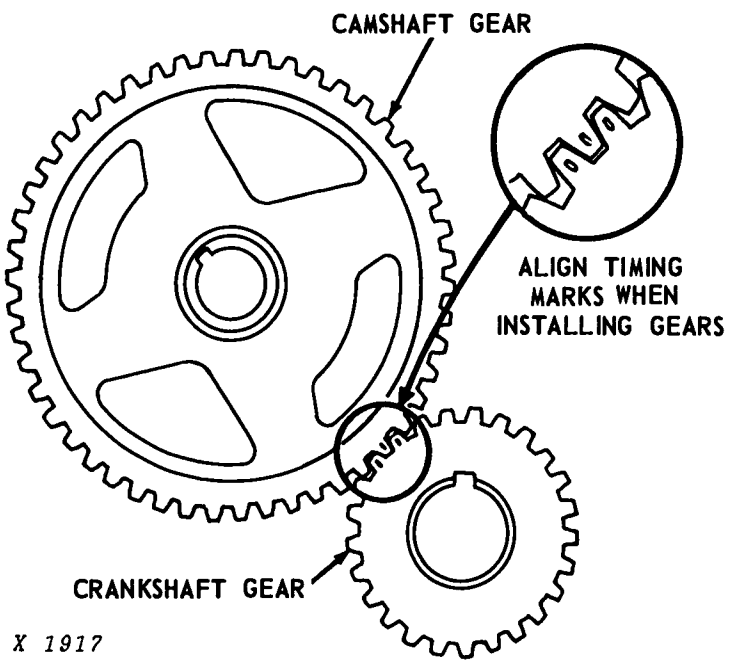

Fig. 145 — Timing Of Engine Gears

Timing of these gears is done by matching timing marks when the gears are installed (Fig. 145). A timing tool may also be required for timing the gears on some engines. Check the engine Technical Manual for timing instructions.

GEAR TRAIN BACKLASH

Backlash is the amount of "play" between two gears in mesh. As gear teeth wear, more backlash occurs.

Check the engine Technical Manual for the allowable backlash between the engine timing gears.

ENGINE BREAK-IN

Modern engines need less break-in than the old ones did. The reason is that design, workmanship, fuels, and lubricants are all better today.

Short but careful break-in periods are the rule on new or overhauled engines.

It is a mistake to "baby" the engine and then suddenly put it under full load. This breaks in the engine for light loads only.

In all cases, follow the recommendations in the engine Technical Manual.

The steps below are widely recommended.

BREAK-IN STEPS

1. Adjust valve tappets, carburetor or injection pump, and engine timing as accurately as you can before starting the engine.

2. Run the engine at half-throttle for a short period until the engine coolant is warmed up to normal.

3. Check for good oil pressure in the engine. Look for oil or coolant leaks.

4. Operate the engine at the specified speed and load for the short time recommended to help seat the head gasket, etc.

5. Shut down the engine and:

a) Retighten the cylinder head

b) Recheck valve tappet clearances

c) Recheck engine timing

6. Operate the engine at normal loads for the first 100 hours (or as recommended). Avoid light loads and excessive idling. Never "lug down" the engine. Check the crankcase oil level more often during this time (special break-in oil may be recommended).

7. At the end of the break-in period, service the engine as specified. This may include changing the oil and replacing the filter.

TEST YOURSELF

QUESTIONS

1. What is the general sequence for tightening cylinder head bolts?

2. What does "knurling" a valve guide do?

3. Why are valve rotators used on some valves?

4. The camshaft turns at (1/4 - 1/2 - 2/3) the speed of the engine crankshaft.

5. Valve clearance is normally adjusted with the piston at _____ of its _____ stroke.

6. Explain the terms "wet" and "dry" cylinder liners.

7. Where is a cylinder normally worn the most by its piston? a. Top inch of ring travel. b. Bottom inch of ring travel. c. Center of ring travel.

8. True or false? "Measure the cylinder liner as soon as it is removed from the engine block."

9. Why are piston skirts not straight up-and-down?

10. Match the three items at left below with the correct item on the right.

a. Blow-By	1. Gasoline igniting before spark occurs
b. Knock(Detonation)	2. Leaking of gases past the pistons
c. Preignition	3. Too-rapid combustion of fuel

11. True or false? "When removing piston rings, replace only the damaged ones."

12. Why mark the position of each connecting rod and piston when removing them from the engine?

13. Why are crankshafts so heavy?

14. What engine part gives momentum between power impulses?

15. True or false? "For an engine operated at variable speeds, a lighter flywheel is needed."

16. When breaking in an engine, what three adjustments should be rechecked after a brief run-in?

ANSWERS

1. Start at the center of the head and work out on both sides.

2. Upsets metal on the inside wall, making the guide bore smaller. This is a way to recondition some valve guides.

3. By turning the valves, the rotators *knock off deposits.* This keeps the valves sealing better, running cooler, and cuts down on corrosion.

4. 1/2

5. First blank — "top dead center." Second blank — "compression".

6. "Wet" liners contact the engine coolant, while "dry" liners do not.

7. a. Top inch of ring travel.

8. False. Measure liners *before* removing them.

9. Because of heat expansion. The thicker top part of the skirt must be slightly narrower since it expands more from the heat of combustion.

10. a-2; b-3; c-1.

11. False. Always replace every piston ring you remove, regardless of its condition.

12. To be sure they are installed in the same cylinder. This gives a better fit, since the parts are already "wear fitted" to their own cylinders.

13. Because of the heavy throws that must be used as counterweights to balance the engine during rotation.

14. The flywheel.

15. True. The lighter flywheel allows faster acceleration and deceleration between various speeds.

16. 1) Cylinder head bolts; 2) valve tappets; 3) engine timing.

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GASOLINE FUEL SYSTEMS / CHAPTER 3

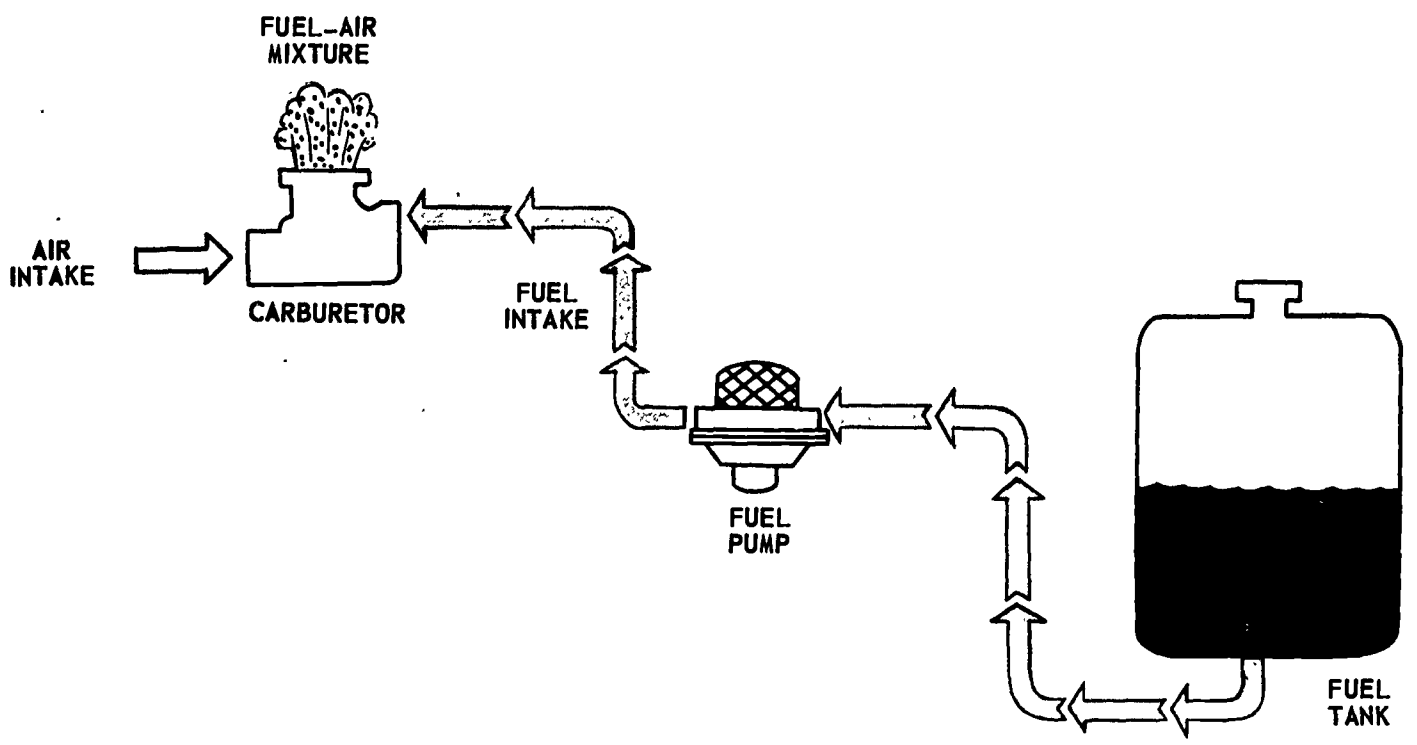

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Fig. 1 — Gasoline Fuel System

INTRODUCTION

The gasoline fuel system supplies a combustible mixture of fuel and air to power the engine.

The gasoline fuel system has three basic parts:

- **Fuel Tank**
- **Fuel Pump**
- **Carburetor**

The FUEL TANK stores the gasoline for the engine.

The FUEL PUMP moves the fuel from the tank to the carburetor. This is an optional feature needed with force-feed supply systems.

The CARBURETOR does two jobs: 1) atomizes fuel with air for the engine, and 2) mixes fuel and air in the proper ratio.

How do these parts work together as a team?

Fig. 1 shows the basic system in operation.

The **fuel pump** draws the gasoline through a fuel line from the tank and forces it to the *float chamber* of the carburetor, where it is stopped.

The **carburetor** is basically an air tube which operates by a change in air pressure.

Filtered air is forced in at one end and vapor is drawn out at the other end (Fig. 2).

The pressure change is created when air flows through the narrow neck, called the *venturi*. Air flow moves faster through a restriction and this lowers the air pressure.

At the same time, the engine creates a partial vacuum on intake stroke and this causes vapor to press into the combustion chamber of the cylinder as shown in Fig. 2.

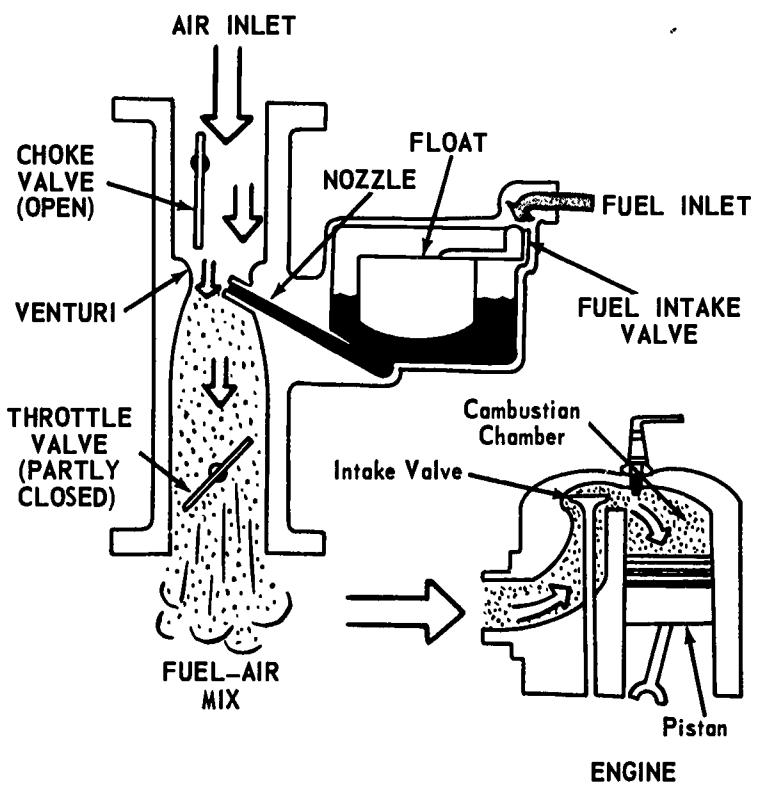

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Fig. 2 — Basic Carburetor at Part Throttle or Low Power

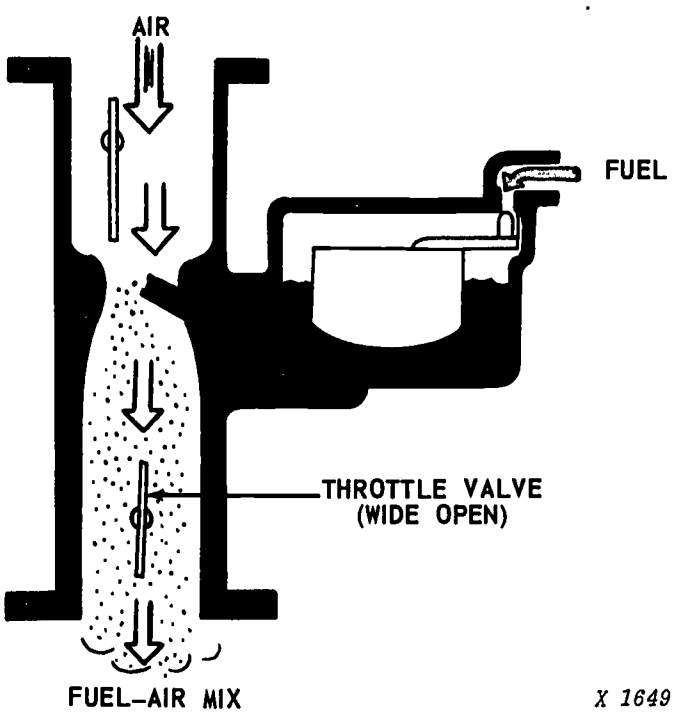

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Fig. 3 — Basic Carburetor at Full Throttle or Full Power

The fuel is drawn into the airstream from the *nozzle* which projects into the tube at the venturi. As low-pressure air rushes by, small drops of fuel are forced out and mixed with the air.

The fuel-air mixture must pass the *throttle valve* which opens or closes to let the right volume of fuel into the engine. This is controlled by the operator at the throttle as he sets the engine speed.

The *choke valve* also controls the supply of fuel to the engine. When starting the engine in cold weather, for example, it can be partly closed, forming a vacuum. This vacuum causes more fuel and less air to be drawn into the combustion chambers. The richer mixture gives extra power in the cylinders for the harder job of starting.

Fig. 2 shows the operation of the carburetor at part throttle or low power, while Fig. 3 shows operation at full throttle or full power.

The actual carburetor is more complex as we'll see later in this chapter.

FUEL SUPPLY SYSTEMS

Fuel is supplied to the gasoline fuel system in two major ways:

- **Gravity-Feed System**
- **Force-Feed System**

Let's see how each of these works.

GRAVITY-FEED SYSTEM

The **gravity-feed system** (Fig. 4) has a fuel tank placed *above* the carburetor; fuel lines; fuel filter; and the gravity-fed carburetor.

A float attached to a valve allows fuel to enter the carburetor at the same rate at which the engine is consuming it. This system maintains a uniform level in the carburetor regardless of the amount of fuel in the tank.

FORCE-FEED SYSTEM

The **force-feed system** allows the fuel tank to be located at a level *below* the carburetor as shown in Fig. 4.

However, a fuel pump is required to raise the fuel from the tank to the carburetor. Fuel pump operation is described later in this chapter.

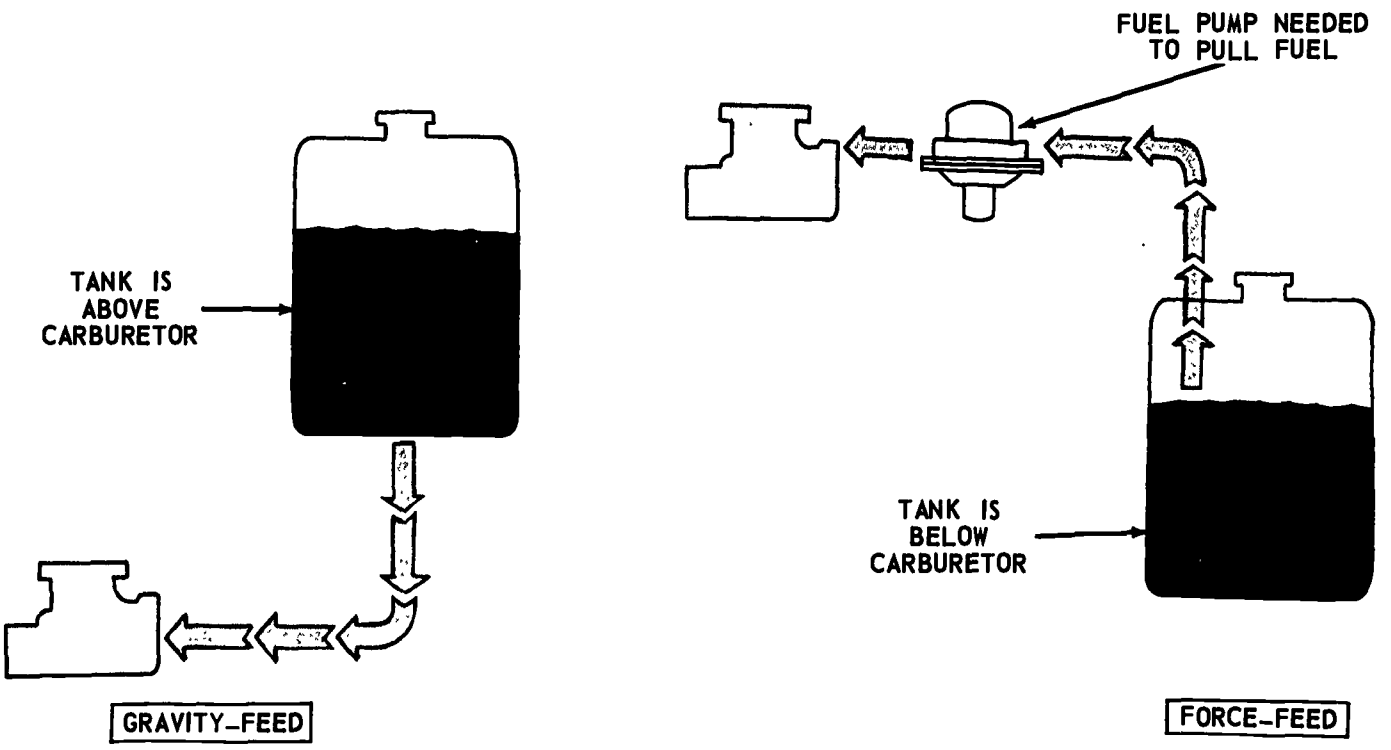

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Fig. 4 — Fuel Supply Systems — Two Types

FUEL TANK

The location of the **fuel tank** varies on each machine. The tank is usually made of sheet metal and attaches to the frame. Fuel tank capacity will vary depending on the size of the engine.

Most systems have the fuel line attached at or near the bottom of the tank and usually have a filter screen at the fuel line connection.

A stand pipe is commonly used on tractor tanks. It provides a fuel inlet which projects above the bottom of the tank to avoid drawing out sediment.

A drain cock at the bottom of the tank allows water and sediment to be drained off periodically.

A shut-off valve may be used to close the fuel outlet before removing the tank.

To ventilate the fuel tank, a vent mechanism may be built into the filler cap or as a separate opening near the top. The vent allows air to replace the fuel as it is drawn out and prevents restriction of the fuel flow or a vacuum in the tank.

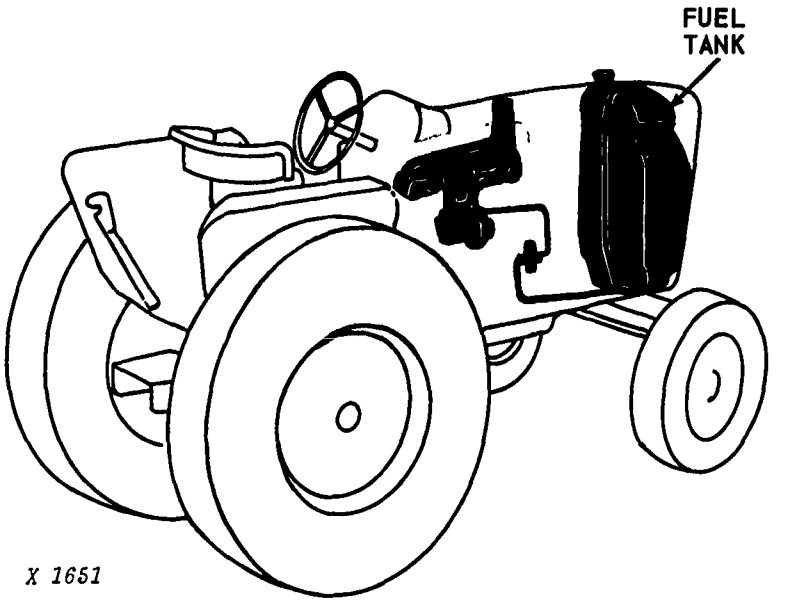

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Fig. 5 — Fuel Tank On Modern Tractor

INSPECTION AND REPAIR OF FUEL TANKS

Cleaning

Flush the tank for 15 minutes with hot water. Run in at the bottom and allow it to overflow at the top.

Steam the tank for 30 minutes. Force in live steam at top of tank and allow it to escape through bottom. If live steam is not available, again flush the tank with boiling water continuously for 30 minutes and dry thoroughly with compressed air.

CAUTION: Cleaning and repairing a fuel tank is very dangerous. Never permit live sparks, smoking, or fire of any nature in the vicinity.

Inspecting for Leaks

Use one of these two methods to test the tank for leaks:

1) Wet method

2) Air Pressure Method

WET METHOD

Plug fuel outlet tightly. Dry entire outer surface of tank thoroughly with compressor air and a clean, dry rag. Place tank so that all surfaces may be easily seen, such as setting it on top of blocks. Then fill tank with water. Insert end of air hose in filler neck and apply approximately 3 pounds air pressure against water. Examine tank surfaces for moist spots where water may have been forced through.

AIR PRESSURE METHOD

Plug filler neck and attach an air hose to fuel outlet. Submerge fuel tank in clean water and apply approximately 3 pounds air pressure. Draw a ring around each spot on fuel tank where bubbles appear. These bubbles indicate leaks in tank that need repairing.

Repair Of Fuel Tanks

SOLDERING

Inspect and repair the tank as soon as possible after it has been cleaned. When soldering, the soldering iron should **not** be red hot. A red-hot iron can ignite any explosive mixture remaining in the tank.

WELDING

Tanks can be welded without danger, **if** precautions are taken.

Weld the tank as follows:

1. To prevent pockets of fuel, plug the tank outlet and *fill the tank full of water.*

2. Leave the filler cap off to allow for expansion of steam. (If the tank must be turned, weld a pipe to an old cap and bend up the pipe while installing the cap.)

3. After welding, retest the tank for leaks.

In summary: *Always fill tank with water and ventilate it before welding.*

Fuel Tank Caps

The fuel tank cap must do three jobs:

1) Seal out dust and dirt.

2) Keep fuel from splashing out of the tank.

3) Allow air to enter the tank to force fuel out (unless the tank has other ventilation).

Be sure the gasket on the cap seals the tank and that the vents are open so the tank can breathe.

If the fuel filler cap is vented, *always replace it with a vented cap.* Otherwise, the tank may collapse when a vacuum is created as fuel flows out.

FUEL LINES

Fuel lines are generally made of steel tubing. However, in recent years, the use of polyethylene lines has become very popular.

The fuel lines simply transfer the fuel from one location to another.

To maintain them, watch for fuel leaks which may be caused by too loose connections or damaged fittings. Also check for bends or dents which might restrict the fuel flow.

FUEL GAUGES

The **electric-type** fuel gauge is widely used today. There are two types:

- **Balancing coil gauge**
- **Thermostatic gauge**

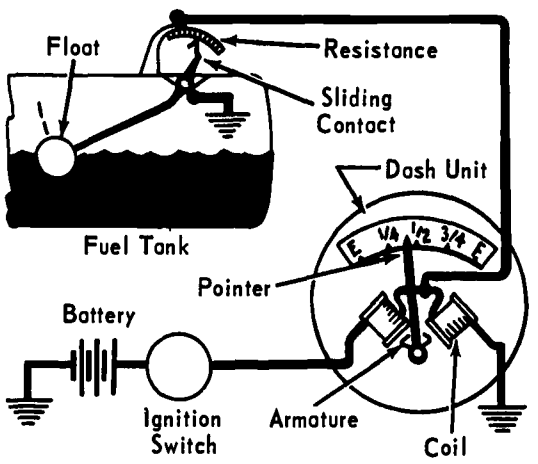
Each type has a tank unit and a dash unit (Fig. 6).

BALANCING COIL FUEL GAUGES

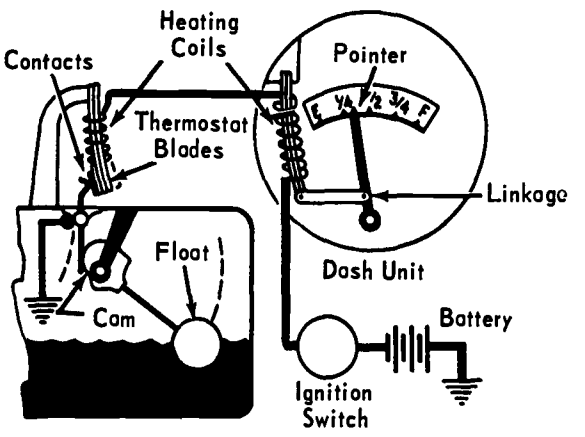
The tank unit in this gauge has a sliding contact that slides back and forth on a resistance as the float moves up and down in the fuel tank. This changes the amount of electrical resistance the tank unit sends to the dash unit. Thus, as the tank empties, the float drops and the sliding contact moves to reduce the resistance. See at left in Fig. 6.

The dash unit has two coils as shown. When the ignition switch is turned on, current from the battery flows through the two coils, producing a magnetic pattern. This acts on the armature to which the indicator is attached.

When the resistance of the tank unit is high (tank filled and float up), then the current flowing through the E (empty) coil also flows through the F (full) coil. This pulls the armature to the right so the pointer indicates F (full) on the dial.



X 1652 BALANCING COIL GAUGE



THERMOSTATIC GAUGE

Fig. 6 — Fuel Gauges — Two Types

As the tank begins to empty, the resistance of the tank unit drops, causing more of the current flowing through the empty coil to pass through the tank unit. This weakens the magnetic field in the "full" coil, causing the "empty" coil to pull the armature toward it. Thus the pointer swings around toward the E (empty) side of the dial.

THERMOSTATIC FUEL GAUGES

This type of gauge has a pair of thermostat blades, each with a heating coil. The coils are connected in series through the ignition switch to the battery. See at right in Fig. 6.

The tank unit also has a float that actuates a cam. As the cam moves, it puts more or less flex on the tank thermostat blade. When the tank is full, the float is up and the cam bends hard on the blade. Then, when the ignition switch is turned on, current flows through the heater coils.

When the tank blade is hot enough, it bends further so that the contacts separate. Then, as the blade cools, the contacts close together. Again the blade is heated and the points reopen. This action continues as long as the ignition switch is on.

Meanwhile, the blade in the dash unit is heated and bends a like amount. Movement of this blade is carried through linkage to the pointer, which then moves to indicate on the "full" side of the dial.

However, if the tank is nearly empty, the float is down and the cam bends the tank thermostat blade only a little.

As a result, only a small amount of heating is enough to bend the blade further and open the contacts. Thus, the dash unit bends only a little and the pointer is toward the "empty" side.

NOTE: Refer to the FOS "Electrical Systems" Manual for diagnosing and repair of these fuel gauges.

FUEL PUMPS

The more basic fuel systems depend on gravity or air pressure to get fuel from the tank to the carburetor.

However, for many years, the fuel pump has been widely used on cars, trucks, buses, tractors, stationary, marine and aircraft engines.

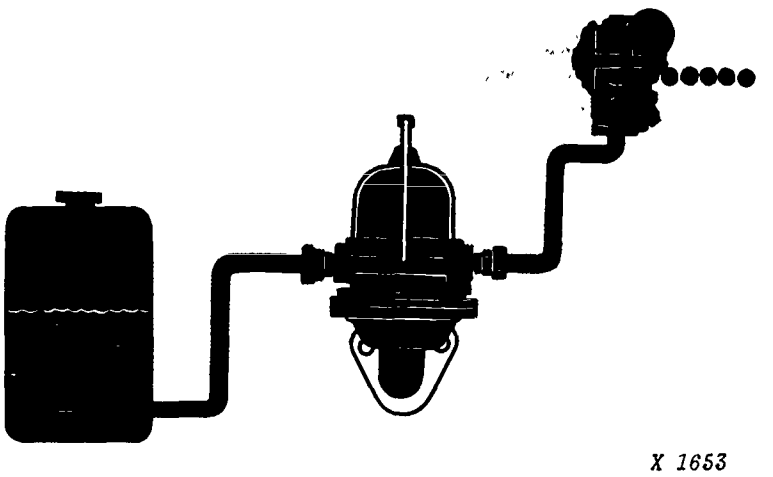


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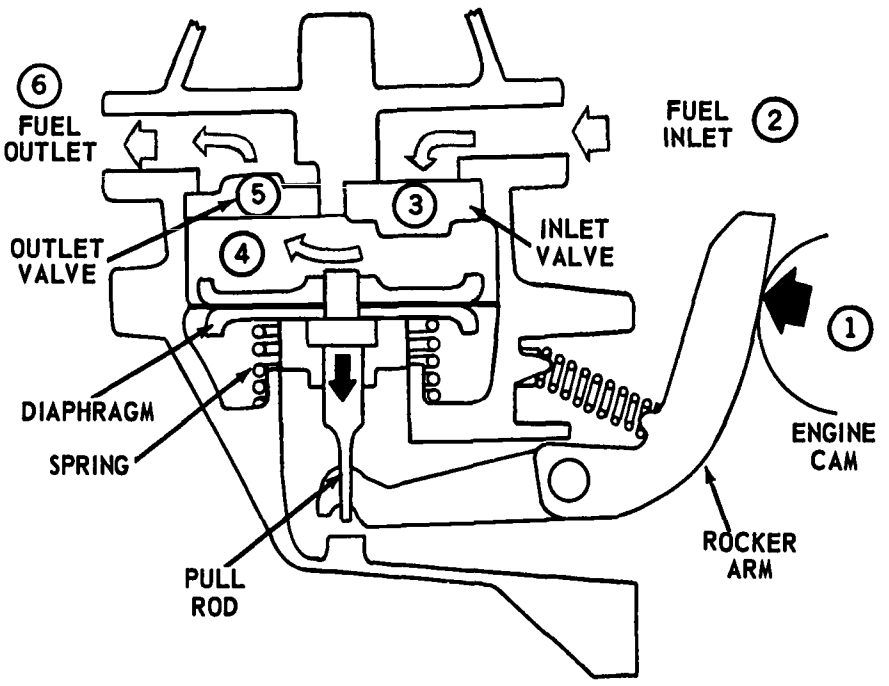
Fig. 7 — The Fuel Pump Draws Fuel From The Tank To The Carburetor

The fuel pump automatically supplies the needed fuel from the tank to the carburetor (Fig. 7).



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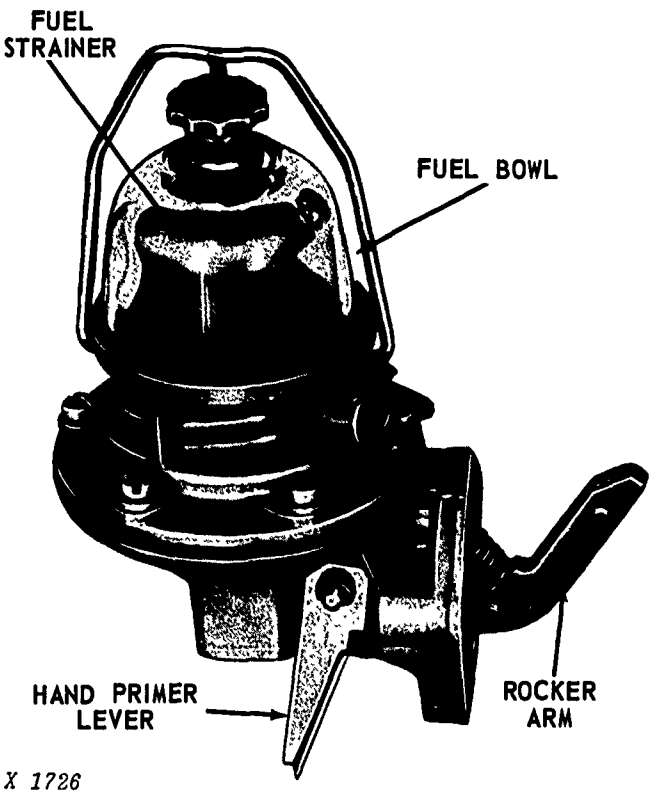

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Fig. 8 — Operation of Fuel Pump

The fuel pump operates as shown at left in Fig. 8. Power is applied to the pump rocker arm at (1) by an eccentric on the engine camshaft. As the camshaft rotates, the eccentric causes the rocker arm to rock back and forth. The inner end of the rocker arm is linked to a flexible diaphragm located between the upper and lower pump housing. As the rocker arm rocks, it pulls the diaphragm down, then releases it. A spring located under the diaphragm forces it back up. Thus the diaphragm moves up and down as the rocker arm rocks.

When the diaphragm is pulled down, a low vacuum or low pressure area is created above the diaphragm. This causes atmospheric pressure in the fuel tank to force fuel into the pump at (2). The inlet valve (3) opens to admit fuel into the center chamber (4).

When the diaphragm is released, the spring forces it back up, causing pressure in the area above the diaphragm. This pressure closes the inlet valve and opens the outlet valve (5), forcing fuel from the pump through the outlet (6) to the carburetor.

If the needle valve in the float bowl of the carburetor closes the inlet so that no fuel can enter the carburetor, the fuel pump can no longer deliver fuel.

In this case, the rocker arm continues to rock but the diaphragm remains at its lower limit of travel so the spring cannot force the diaphragm up. Normal operation of the pump resumes as soon as the needle valve in the float bowl opens the inlet valve, allowing the spring to force the diaphragm up.

COMBINATION PUMP (Fuel and Vacuum)

These pumps contain not only a fuel pump but also a vacuum pump. Both fuel and vacuum sections of the combination pump are actuated by a single rocker arm.

The vacuum pump is similar to the fuel pump in construction and operation. It has a pair of valves and a spring-loaded diaphragm. However, it pumps air instead of fuel, thus creating a vacuum for operating an accessory such as a windshield wiper or a vacuum brake.

ELECTRIC FUEL PUMP

This type of fuel pump is used where a mechanical drive is not practical. It contains flexible metal bellows operated by an electromagnet (Fig. 9). When the electromagnet is connected to the battery (by turning on the ignition switch), it pulls down the armature which extends the bellows. This action creates a vacuum in the bellows and fuel from the fuel tank enters the bellows through the inlet valve.

When the armature reaches the lower limit of travel, it opens a set of contact points. This disconnects the electromagnet from the battery and thus allows the spring to push the armature upward and collapse the bellows. This in turn forces the fuel from the bellows through the outlet valve to the carburetor.

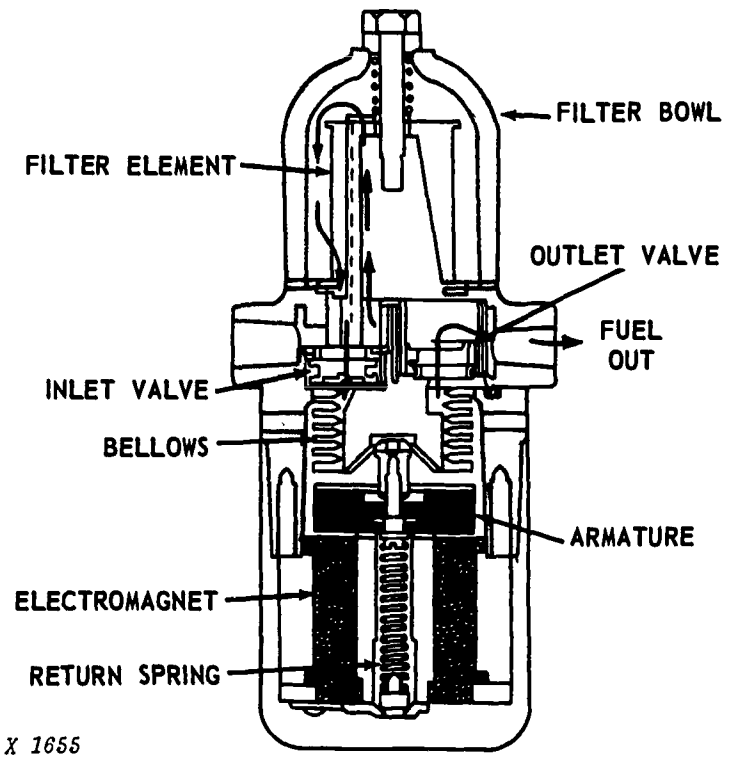


Fig. 9 — Cutaway View of Electric Fuel Pump

When the armature reaches the upper limit of its travel, the contact points are closed. This energizes the electromagnet, causing it to again pull the armature down, starting the cycle again.

SERVICING FUEL PUMPS

Testing The Fuel Pump

A fuel pump analyzer can be used to test the fuel pump for delivery and pressure. Usually, however, the pump is visually checked for defects.

For a visual test, disconnect the pump-to-filter line at the filter.

Set the throttle so that the engine will not start and turn the engine over several times.

If fuel spurts from the line, the pump is operating properly.

If little or no fuel flows, check the following items:

- *Primer lever left in upward position*
- *Leaking sediment bowl gasket*
- *Plugged screen inside sediment bowl*
- *Loose or damaged connections*
- *Clogged fuel lines*
- *Loose cover screws on the pump*

If the problem is not within these areas, repair or replace the pump.

Repairing The Fuel Pump

Whether to repair or replace the fuel pump depends upon the damage and the cost. While most pump manufacturers sell repair kits, it may be more economical to replace the pump. Also, some pumps are sealed units and must be replaced.

Disassemble the pump as outlined in the machine Technical Manual.

Inspect the pump parts as follows:

1) Look for diaphragm punctures or leaks. Check the dot in the diaphragm pull rod for wear.

2) Examine the cover and body assembly for cracked or warped gasket surfaces.

3) Examine the valve and cage assemblies for worn valves or broken springs.

4) Check the diaphragm and rocker arm spring for sufficient tension.

5) Inspect the rocker arm link and pin for worn holes and other wear or damage.

6) Inspect the filter screen for punctures and clogging.

Reassembly of Fuel Pump

Reassemble the pump as instructed in the Technical Manual. Replace all defective parts with new parts from the repair kit, or replace the fuel pump.

FUEL FILTERS

Contamination of fuel is a major cause of excessive engine wear and failures.

Some engines have a separate filter bowl to clean the fuel before it enters the fuel pump. The purpose of the separate filter is to trap water and any foreign objects that may contaminate the fuel system. These filters should be checked and drained periodically. Most of them have a drain plug which can be loosened; the fuel pump primer lever can be actuated until all deposits are drained out.

If the filter has a sediment bowl and screen, remove and clean them periodically.

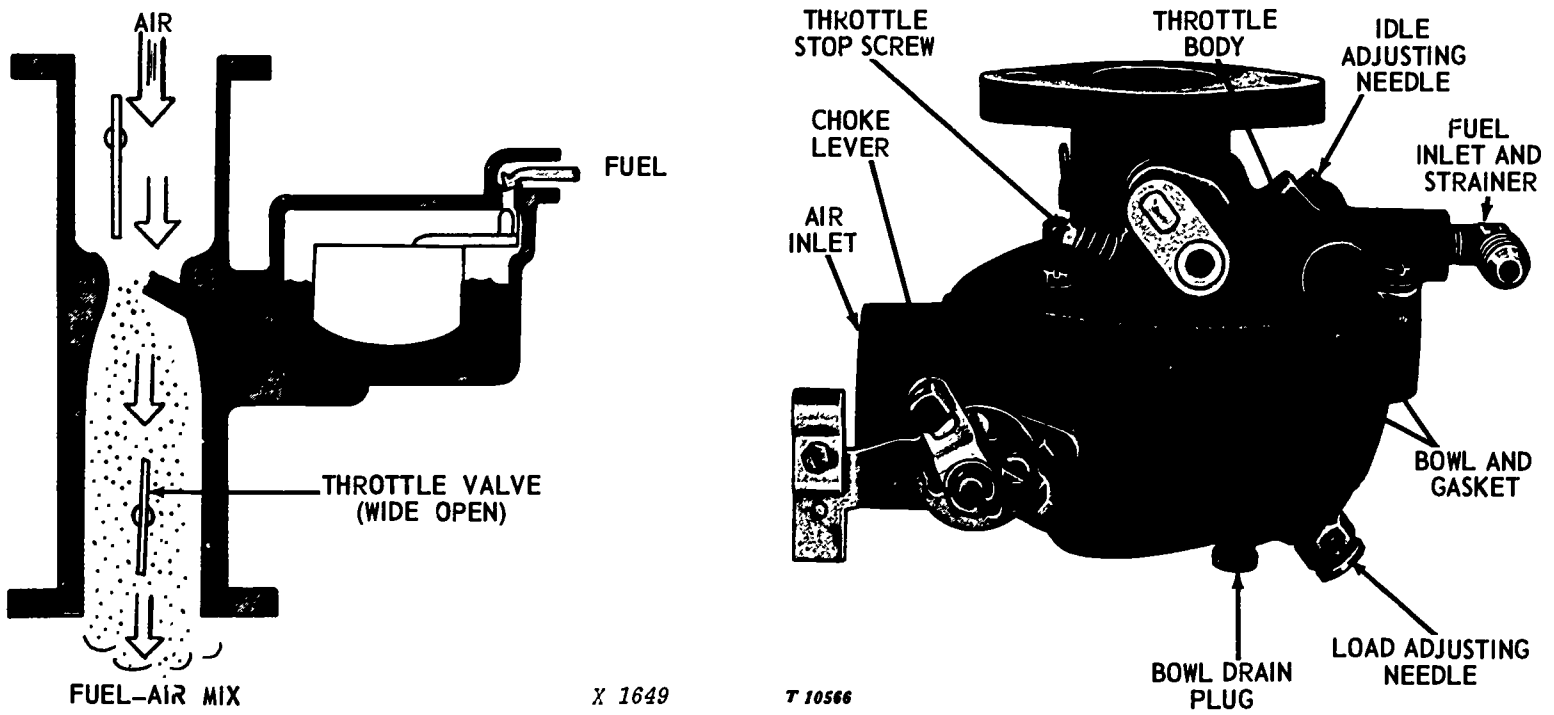


Fig. 10 — Basic Carburetor

CARBURETORS

Engines will not run on "liquid" gasoline. The gasoline must be vaporized and mixed with air for all types of conditions. For example:

- **Cold Or Hot Starting**
- **Idling**
- **Part Throttle**
- **Acceleration**
- **High Speed Operation**

By mixing fuel with air for each of these conditions, the **carburetor** regulates the combustion and so the power of the engine.

To get the right fuel-air mix, the carburetor must "atomize" the fuel and mix the fine particles of fuel with air.

Atomizing is done by adding air to the liquid fuel as it moves through the carburetor passages and then spraying this fuel air mixture through nozzles or jets into a stream of moving air flowing into the engine's intake manifold. See Fig. 10.

This fuel-air mixture must then be atomized before it enters the combustion chamber of the engine.

The various speed and load conditions demand a different volume of air for the mixture. The fuel-air ratio must be kept within flammable limits to permit combustion.

The primary job of the carburetor is to produce this ratio or fuel-air mix for any operating condition.

FUEL-AIR MIXTURE

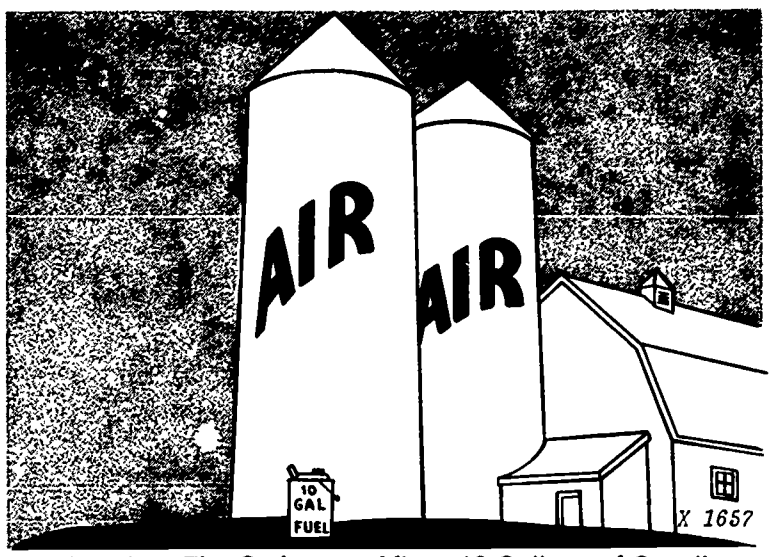


Fig. 11 — The Carburetor Mixes 10 Gallons of Gasoline With About 90,000 Gallons of Air

Fig. 11 illustrates the quantity of air required for the proper fuel-air mixture of 10 gallons of gasoline.

- **Weight Ratio: 15 parts air = 1 part gasoline**
- **Volume Ratio: 9,000 parts air = 1 part gasoline**

This means that the carburetor is a very precise instrument which requires careful maintenance.

THEORY OF PRESSURE DIFFERENCES

Since the carburetor operates by pressure differences, let's look at these terms:

- **Vacuum**
- **Atmospheric Pressure**
- **Venturi Principle**

VACUUM

Absolute vacuum is any closed area completely free of air or atmospheric pressure. We can better understand the carburetor by calling any pressure less than atmopheric a *vacuum* or low pressure area.

ATMOSPHERIC PRESSURE

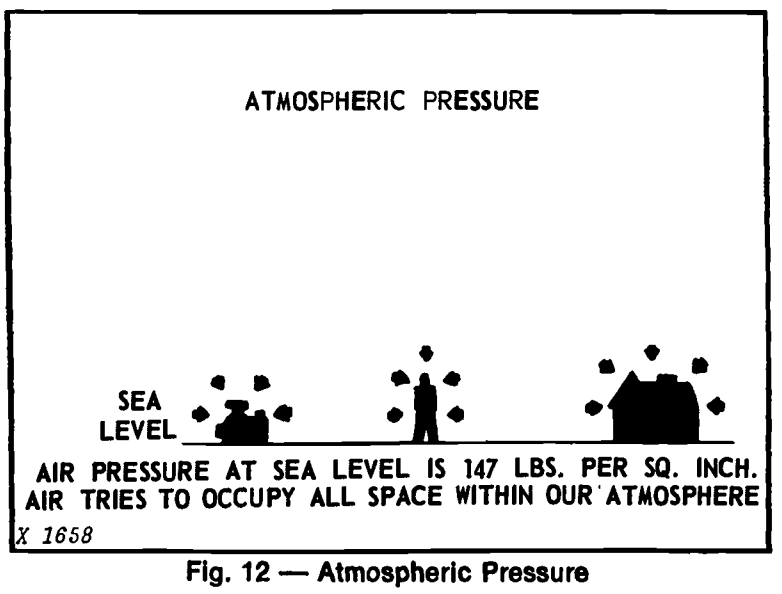


Fig. 12 — Atmospheric Pressure

Atmospheric pressure is the weight or pressure of the air around us (Fig. 12). Air pressure at sea level is 14.7 pounds per square inch. This air tries constantly to occupy all space within our atmosphere.

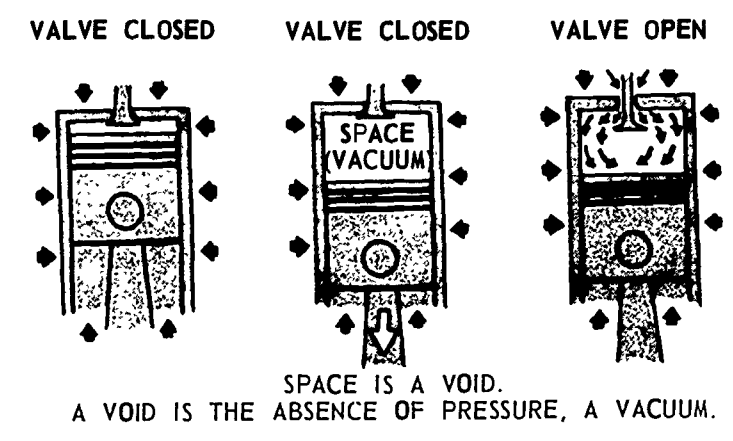


Fig. 13 — The Engine Creates a Vacuum

Piston movement in an engine creates a vacuum or low pressure area. Atmospheric pressure forces air to flow into this vacuum. See Fig. 13.

VENTURI PRINCIPLE

Pressure differences are basic to how a carburetor works. A **venturi** is used in the throat or bore of all carburetors to get this pressure difference.

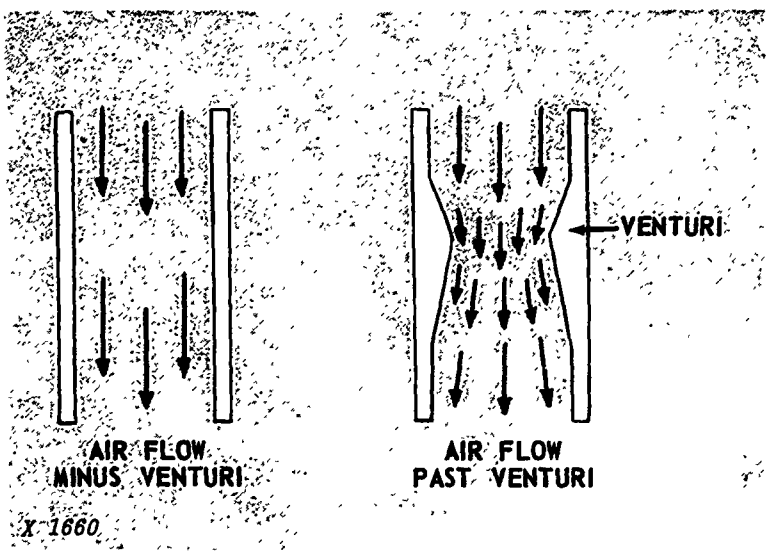


Fig. 14 — The Venturi Is A Restriction Of Air Flow Which Lowers Air Pressure

A venturi is a **restriction** in any passage which causes air to move faster and so lowers the pressure of the air passing through it (Fig. 14).

The faster the air moves, the lower the air pressure at the venturi. This low pressure is the basic force by which a carburetor works.

To see the relation between the speed of air and its pressure, make this simple experiment: Hold the edge of a sheet of paper to your lower lip, allowing the rest of the paper to hang limp. Now blow across the top of the paper and notice how the paper **rises.** Air moving across the top of the paper exerts less pressure to the paper than the stationary air under the paper. The pressure difference forces the paper upward. The faster the air, the lower the pressure above the paper, causing the paper to rise still higher.

In summary:

Faster air = lower air pressure.

Regulating the air velocity through the carburetor by means of a throttle valve allows us to control the amount of fuel delivered to the engine.

OPERATION OF CARBURETORS

The complete carburetor is rather complex but it operates simply on pressure differences.

First let's find out how fuel flows from the carburetor bowl to the throat or bore of the carburetor.

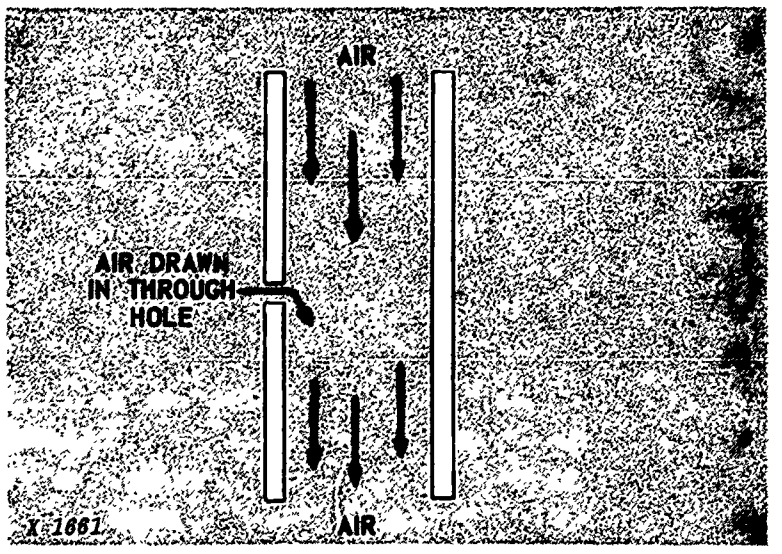


Fig. 15 — Air Is Forced Into Tube

If air moves rapidly through a tube which has a small hole, air will be forced in through the small hole, joining the air already flowing through the tube (Fig. 15).

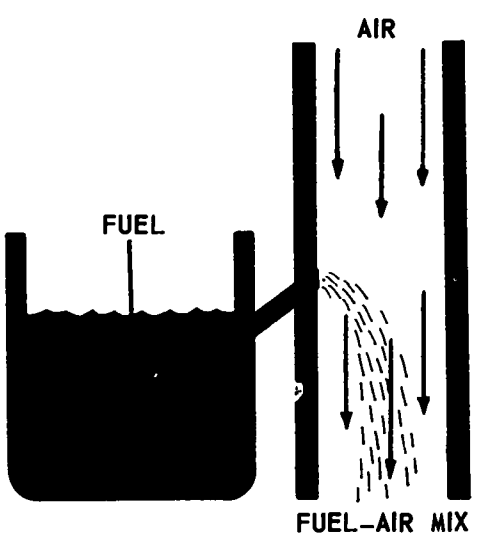


Fig. 16 — Fuel Is Forced Into Airstream

If a pipe is inserted in the small hole and the opposite end is placed in a container of fuel, the fuel will be forced into the airstream (Fig. 16).

The quantity of fuel forced through the tube in this case depends on the speed of air flowing past the small hole in the cylinder.

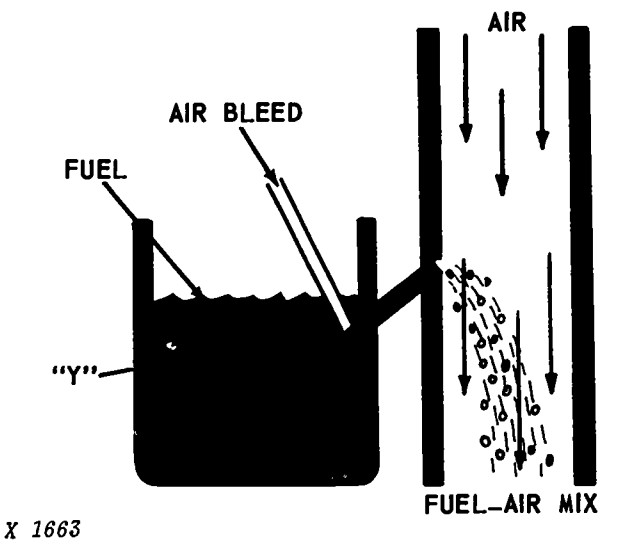


Fig. 17 — Both Fuel And Air Are Forced In

If a Y-shaped air bleed tube is connected to the first tube below the fuel surface with the opposite end exposed to air, both air and fuel will be forced through the tube and into the airstream (Fig. 17). The purpose of the air bleed tube is to aid in breaking up the fuel particles for a better vapor.

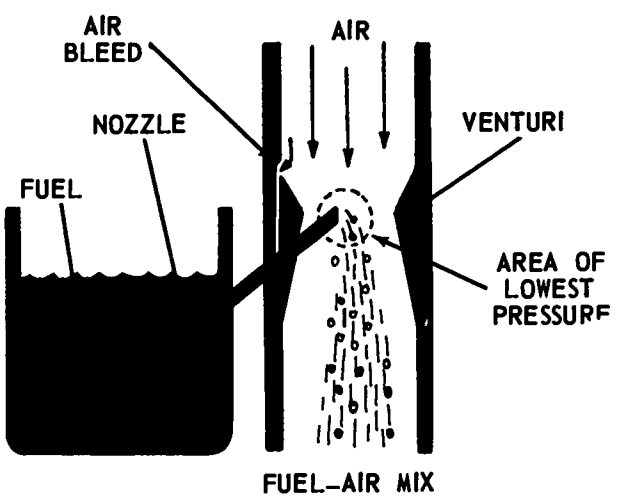


Fig. 18 — Venturi Controls The Amount Of Fuel

Now, since the velocity of the air passing the small hole determines how much fuel-air is forced into the airstream, we can increase the velocity by placing a restriction in the cylinder. This restriction is the *venturi* (Fig. 18).

In the carburetor, the venturi causes the air to momentarily speed up when passing through it. This creates a low pressure or vacuum in the venturi.

In this way, *the venturi controls the amount of fuel.*

At idle speeds, there is not enough air velocity through the venturi to create the pressure drop needed to force the fuel-air mixture into the air-stream. Also, sudden changes in engine operation —such as rapid acceleration— cause the venturi effect to be momentarily lost. Therefore, the carburetor must be designed to compensate for this loss. This is described later in this chapter.

The variations in the fuel-air mixture are very wide. The chart below gives the number of pounds of air that must be mixed with each pound of fuel during four typical operations:

FUEL-AIR MIXTURE

	Air	*Fuel*
For Starting (At 0° F.)	0.4 lb.	1 lb.
For Slow Idle	11.0	1
For Power and Speed	12.0	1
For Best Fuel Economy	15.5	1

BASIC TYPES OF CARBURETORS

There are three basic types of carburetors:

- **Natural draft**
- **Updraft**
- **Downdraft**

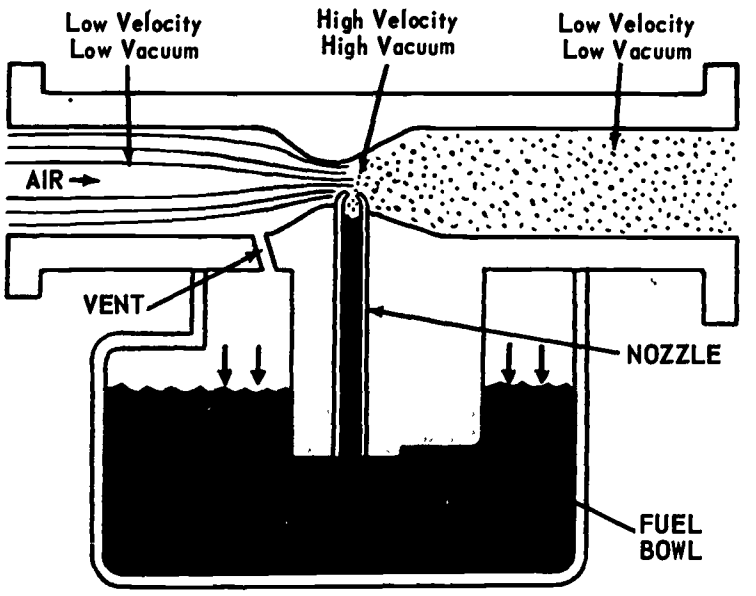
All three do the same job, but in slightly different ways.

Figs. 19, 20, and 21 show each one. They are named for the direction of air flow from their outlets to the engine manifold.

In all three, there is a fuel supply in the *fuel bowl*, a passage or *air tube* through the carburetor for the stream of air going to the engine, and a *nozzle* connecting the bowl to the air tube. The *venturi* is also a feature of all three, creating the pressure drop by which the carburetor works.

Uses of The Basic Carburetors

The *natural draft* carburetor (Fig. 19) uses a cross-draft to supply the air flow and is used on engines where there is little space on top or where the vaporized mixture is heated by the water in the engine water jacket.



X 1665 NATURAL DRAFT

Fig. 19 — Natural Draft Carburetor

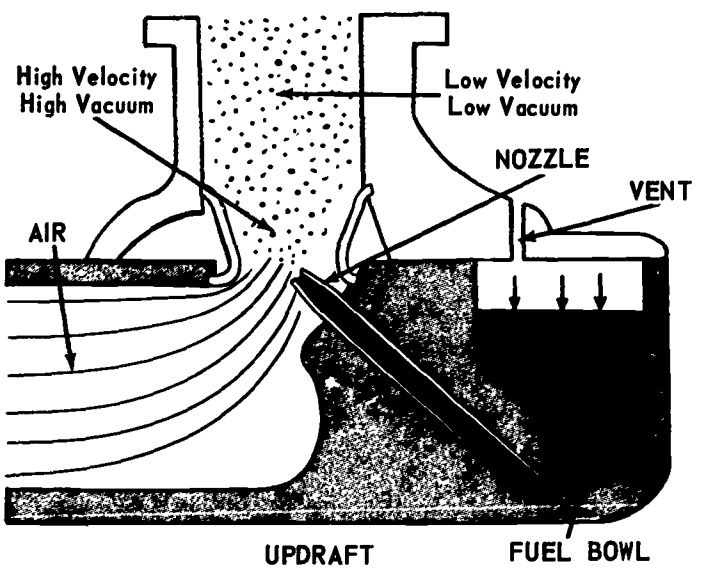


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Fig. 20 — Updraft Carburetor

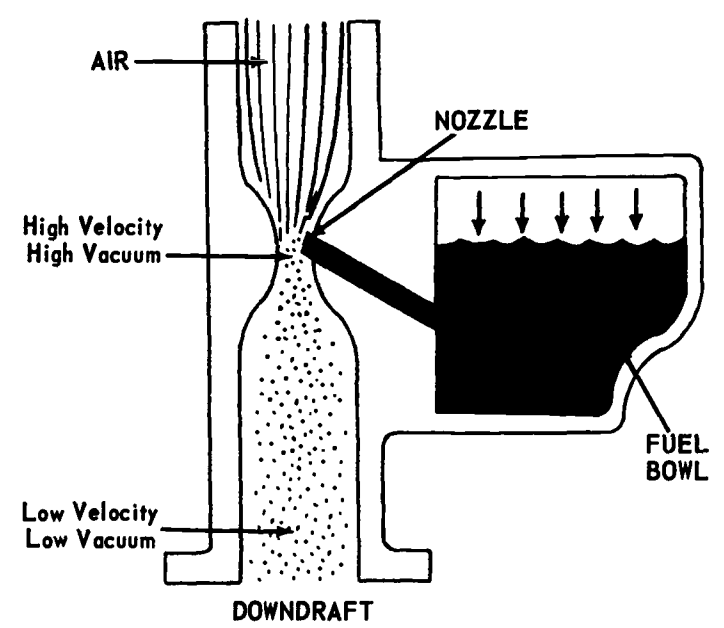

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Fig. 21 — Downdraft Carburetor

The *updraft* carburetor (Fig. 20) can be placed low on the side of the engine and supplied fuel by gravity feed. However, the fuel must then be lifted up into the engine. This means that air velocities must be high, which can only be attained by using small passages in the carburetor and manifold.

These carburetors are best adapted for use on most modern farm and industrial machines.

The *downdraft* carburetor (Fig. 21) allows for larger volumes, since the fuel will reach the engine even though the air velocity is low. These carburetors can be used when high speeds and high power outputs are required.

These models are widely used on automobiles and trucks.

FUEL SUPPLY SYSTEMS

All carburetors require a source of fuel and a means of maintaining the proper level in the fuel bowl.

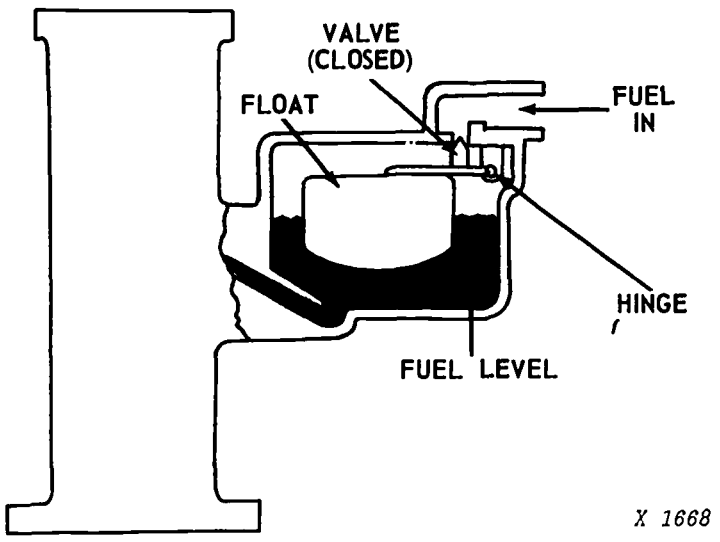

Fig. 22 — Fuel Supply System for Updraft Carburetor

Fig. 22 illustrates a fuel supply system for updraft carburetor.

Fuel enters the bowl under pressure (either gravity or pump) through a valve which is controlled by the float. As fuel rises in the bowl the float rises with it. When the correct fuel level is reached, the float shuts off the fuel supply by forcing the valve against its seat.

As fuel is used by the carburetor the float lowers with the fuel supply, allowing the valve to move from its seat and admit more fuel.

Bowl Vents

Most carburetors are sealed and balanced for equal air pressures.

All air which enters must come through the air cleaner, so the carburetor must be protected against a restriction from a dirty air cleaner.

The bowl vent balances the air pressure on top of the fuel with the air pressure entering the carburetor to assure a free flow of fuel.

When the air cleaner restricts, the lower air pressure feeds in to both throttle opening and the bowl vents so the *balance* of air pressure is still maintained.

However, it is still important to keep the air cleaner free of clogging. A restricted air cleaner limits the capacity of the carburetor and can upset the metering of fuel.

The result is poor operation of the engine, loss of horsepower, or excessive fuel consumption.

CHOKE SYSTEMS

The choke system provides an extremely rich fuel mixture during starting, particularly in cold weather.

This rich mixture is necessary because fuel vapor tends to condense into drops of raw gasoline when contacting the colder walls of the intake manifold. This lessens the amount of fuel which would normally reach the engine cylinders for combustion.

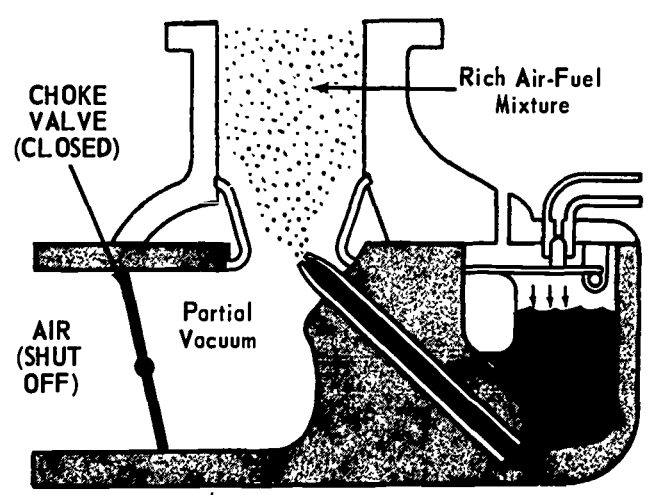

Fig. 23 — Choke System for Updraft Carburetor

To provide this rich mixture, a disk or choke valve is located in the air intake side of the carburetor tube.

Choke valves are operated either manually or automatically.

Fig. 23 illustrates a manual choke system in an updraft carburetor.

When the choke valve is closed, the vacuum created inside the intake manifold extends beyond the nozzle to the choke valve. Because of this vacuum, atmospheric pressure in the fuel bowl can force more fuel into the carburetor, resulting in a richer fuel-air mixture as shown.

Some choke valves have an extra relief device which springs open under medium air pressure. These devices help to get more air past the choke valve when needed and prevent flooding of the engine.

Automatic Chokes

The operation of an automatic choke depends primarily on the unwinding of a thermostatic coil spring as heat is applied. Fig. 24 shows a typical model.

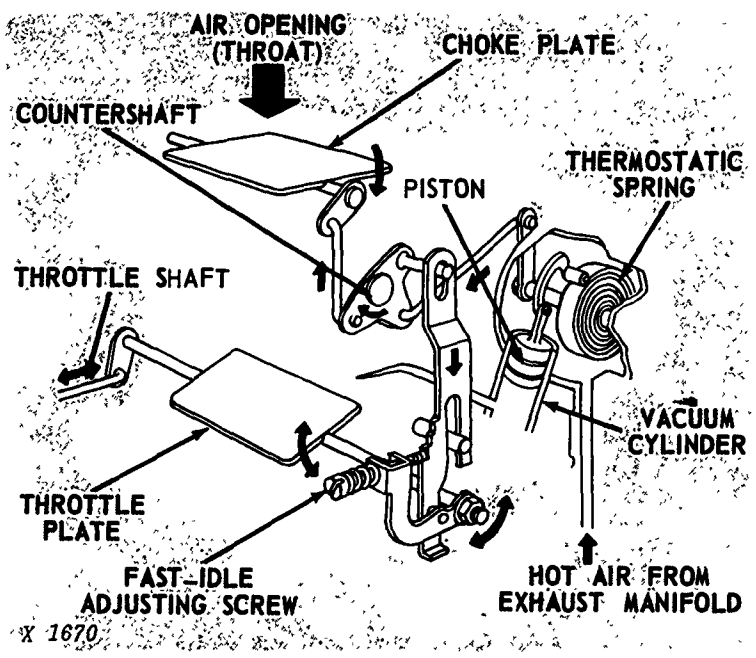

Fig. 24 — Automatic Choke In Operation

When the engine is cold, the thermostatic spring holds the choke valve closed.

When the engine starts, the intake manifold vacuum acts on the vacuum piston and partially opens the choke valve.

Leakage past the vacuum piston causes hot air to be drawn from the exhaust manifold, which heats the thermostatic spring. This heat expands the spring, allowing the choke valve to open wide. Air flow against the offset choke valve also aids in opening the choke. This gives more air to the engine and "leans" the fuel-air mixture for normal operation after the engine is warmed up.

THROTTLE SYSTEMS

There must be a way of regulating the amount of fuel-air mixture entering the engine cylinders.

This is required for two reasons:

1) To vary the engine speed.

2) To keep a uniform engine speed under varying loads.

The **throttle system** does these jobs. The throttle valve is located as shown in Fig. 25.

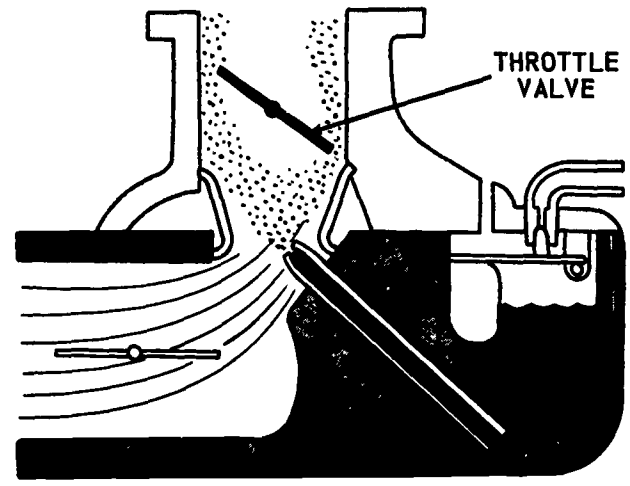

Fig. 25 — Throttle System for Updraft Carburetor

On many engines, the throttle valve is connected by a linkage to a governor, which in turn is connected to a speed control lever. When the speed control lever is set to operate the engine at a given speed, the governor will maintain that speed (unless the engine is overloaded).

If the load is increased, the governor will automatically open the throttle valve wider, permitting more fuel-air mixture to enter the engine, thus maintaining a uniform speed.

Refer to Chapter 9 of this manual for details on "Governing Systems."

LOAD SYSTEMS

The load system delivers the proper fuel-air mixture to the engine in all ranges of speed and load above idling.

Fig. 26 illustrates a load system for an updraft carburetor.

In Fig. 26 the amount of fuel entering the nozzle is regulated by a **load adjusting needle.**

In many carburetors, a **fixed jet or orifice** allows the proper amount of fuel for maximum power and economy to enter the nozzle.

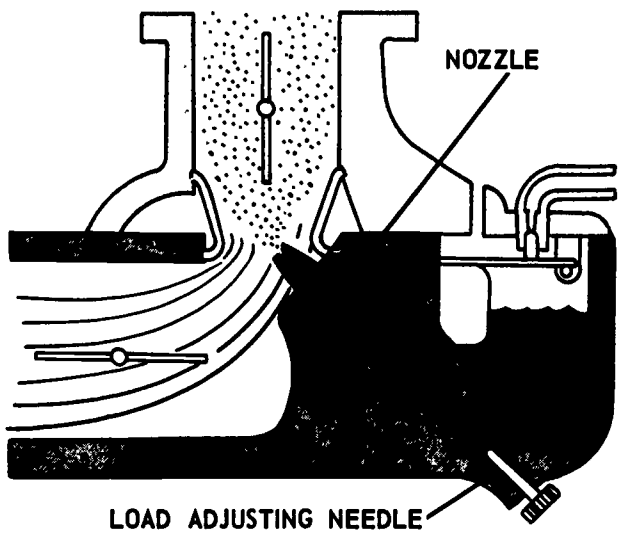

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Fig. 26 — Load System for Updraft Carburetor

ACCELERATING SYSTEMS

Whenever the throttle is opened quickly to give extra power for a sudden load, extra fuel is required for a momentarily richer fuel-air mixture.

This extra fuel can be supplied in two ways:

1) An acceleration pump for rapid acceleration. This can be operated either by the throttle or by a vacuum.

2) An acceleration well or similar device for less rapid acceleration.

Acceleration Pump

The acceleration pump is often a simple piston-type pump (Fig. 27) which delivers fuel into the airstream at the start of acceleration.

The pump is actuated either by the throttle or by vacuum. The throttle actuated pump is shown in Fig. 27.

When the throttle is opened, the plunger descends under the pressure of the plunger spring and fuel is forced out through the accelerating jet. When the throttle is fully depressed and at rest, the spring forces the plunger to the bottom of the well, thus continuing the flow of the accelerating charge. This type of pump will maintain the acceleration charge over a relatively long period of time.

Acceleration Well

Fig. 28 illustrates an acceleration well on an updraft carburetor.

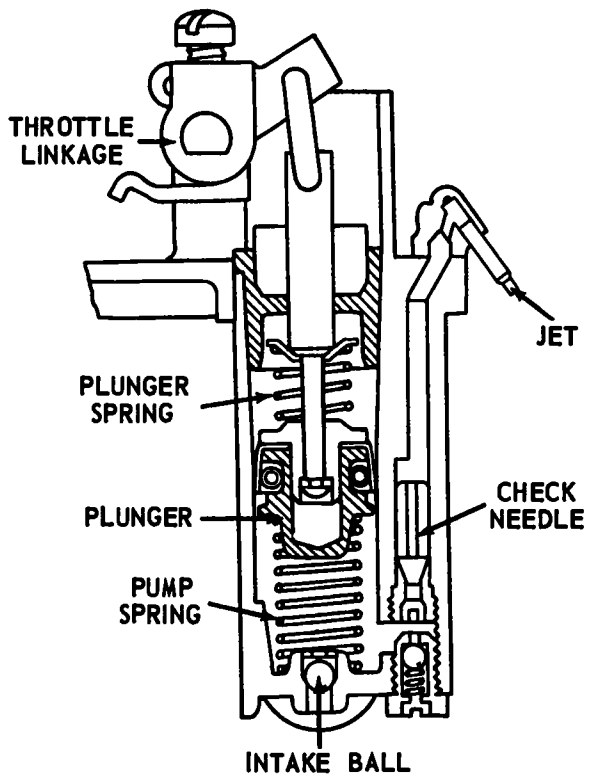

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Fig. 27 — Acceleration Pump (Operated By Throttle)

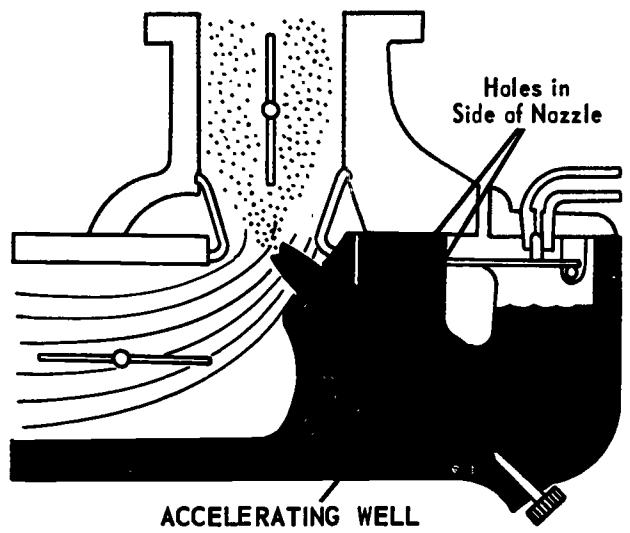

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Fig. 28 — Acceleration Well On Updraft Carburetor

When the engine is idling, fuel rises inside the load nozzle and passes through holes in the side of the nozzle into a chamber or well surrounding the nozzle.

When the throttle is suddenly opened, the fuel stored in the accelerating well gushes through the holes in the side of the nozzle without being metered by the adjusting needle and combines with the normal flow in the nozzle.

The two quantities of fuel enter the airstream, making a much richer fuel-air mixture to satisfy the sudden need for more power.

As the fuel supply drops in the accelerating well, the holes that are uncovered become *air* bleeds.

The accelerating well then remains drained of fuel until the throttle returns to one-fourth load or to fast-idle, at which time it refills.

IDLING SYSTEMS

When the throttle valve is closed, the idling system supplies just enough fuel-air mixture to keep the engine running at slow idle.

The idling system is different for updraft and downdraft carburetors.

Idling System for Updraft Carburetors

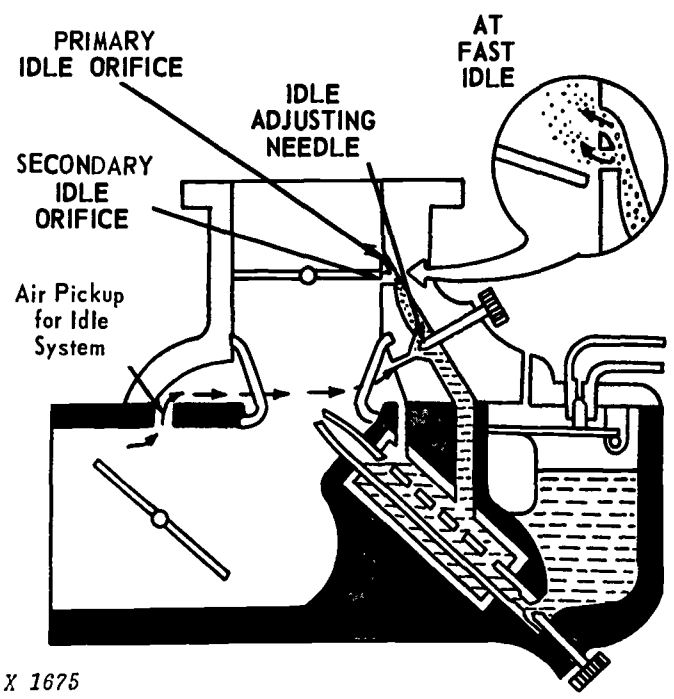

Fig. 29 — Idling System for Updraft Carburetor

In the updraft carburetor shown in Fig. 29, air for the idle system goes around the venturi and enters the fuel system through a drilled passage (see arrows). The idle adjusting needle regulates the amount of air used.

Fuel is brought up through drilled passages from the accelerating well to be mixed with air and delivered to the engine through the primary idle orifice. The operation of the primary and secondary orifices is the same as in the natural draft carburetor.

Idling System for Downdraft Carburetors

In the downdraft carburetor (not shown), air for the idle system enters a small passage above the venturi. Atmospheric pressure pushes air and fuel through the passages. Then they mix and flow past the tapered point of an idle adjusting screw. The fuel-air mixture is very rich but leans out somewhat as it mixes with the small amount of air that gets past the closed throttle valve. The idle adjusting screw regulates the amount of fuel-air mix used.

The operation of the primary and secondary orifices is the same as for the natural draft and updraft carburetors.

ECONOMIZER SYSTEMS

The purpose of the economizer system is to retard the flow of fuel to the engine at part throttle when the full capacity of the nozzle is not required. The basic operation is the same for all three types of carburetors.

The passage providing air for the bowl vent is extended to a point near the throttle valve. When the throttle valve is partially open, the passage is on the engine side of the throttle. Action of the engine draws air through the passage, reducing the air pressure in the bowl.

When the bowl pressure is reduced, the **difference** between the pressure in the venturi and on the fuel in the bowl is also reduced. This retards the flow of fuel out the nozzle.

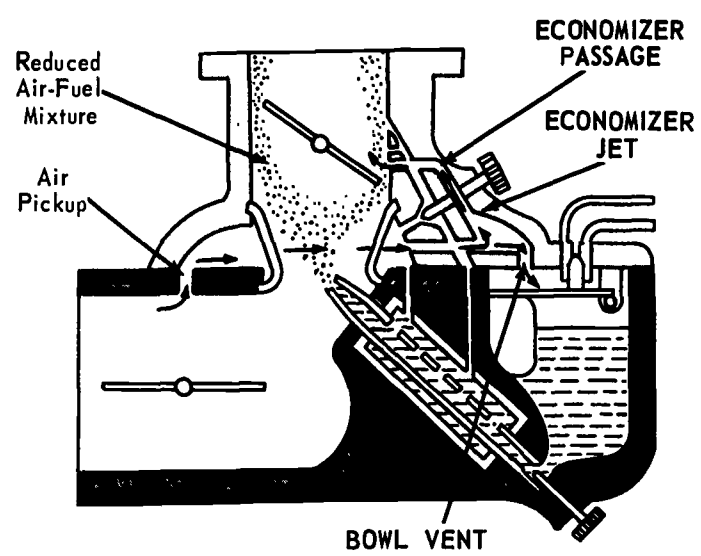

Fig. 30 — Economizer System for Updraft Carburetor

In the updraft carburetor (Fig. 30), an economizer jet in the passage regulates the air pressure at part throttle.

In some updraft carburetors, the economizer passage is brought around the throttle shaft so that when the throttle valve is closed or partially opened, a slot in the shaft permits air to enter the engine.

As the throttle valve is opened, the shaft rotates until its slot closes the passage completely at full throttle and no air can be drawn out of the fuel bowl.

SUMMARY: OPERATION OF CARBURETORS

The chart below gives a summary of the job of each major system in the carburetor.

OPERATION OF CARBURETOR SYSTEMS

System	*Function*
1. **Float**	Controls flow of fuel from tank to carburetor for a constant level of fuel in carburetor.
2. **Choke**	Creates a rich fuel mixture for starting a cold engine.
3. **Throttle**	Allows engine to accelerate smoothly for idle to high speeds.
4. **Load**	Allows engine to operate at its maximum power output.
5. **Idle**	Allows engine to operate economically at idle speeds when power is not needed.

SERVICING OF CARBURETORS

Often, the carburetor is the first component to be blamed for bad engine operation.

An experienced serviceman will first check out other faults:

1) Faulty ignition.

2) Low engine compression.

3) Faulty supply of fuel or air to carburetor.

4) Worn or badly adjusted governor linkage.

5) A faulty carburetor—checked last of all.

Proper carburetion can only be obtained if the pistons, rings, valves, gaskets, manifolds, camshaft, combustion chambers, air cleaner, fuel pump, governor, and ignition system are in good condition and are functioning properly.

Fig. 31 shows some of the things which can affect good carburetion.

Remember that the carburetor adopted for any one engine by the factory has proved to be the best for that engine by long field and laboratory tests. No other carburetor will work as well as the one designed for that particular engine.

Furthermore, the performance of the carburetor cannot be improved by altering its design or

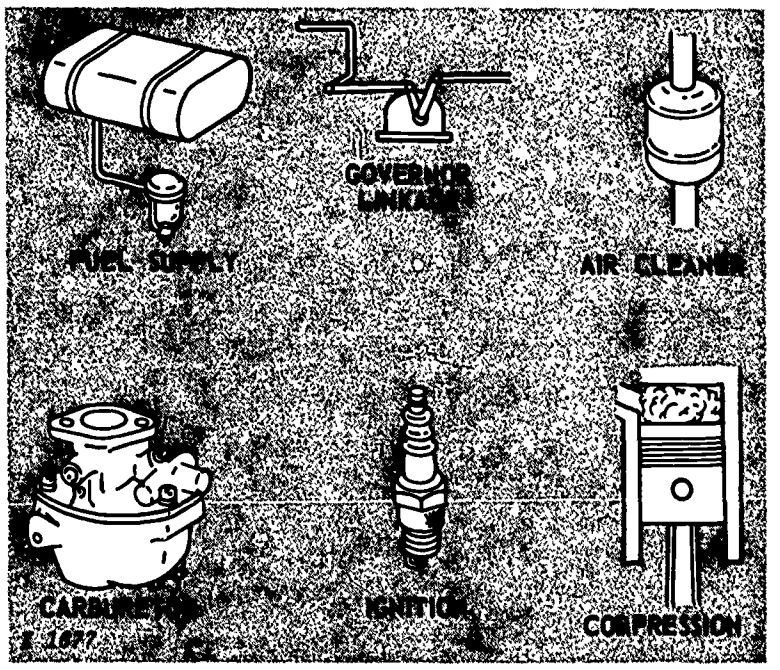

Fig. 31 — Things Which Affect Carburetion

tampering with the parts or passages which are built into it.

The mechanic should use his time in finding out whether the carburetor is clean, replacing worn or damaged parts, making proper adjustments, and seeing that the proper carburetor is installed on the engine.

For complete disassembly and repair, follow the Technical Manual provided for the engine to be serviced.

Most important, make sure that all other parts of the engine which contribute to carburetion are up to factory specifications.

MAINTENANCE TIPS AND PRECAUTIONS FOR CARBURETORS

Below are listed some items which will help you in servicing carburetors:

1. Always **service** the carburetor at these times:

a. *After engine valve grinding or major engine overhaul*

b. *Every year or at the beginning of each season on seasonal machines. At this time, clean the carburetor, repack the shaft, check the bearings, and replace the seals and gaskets.*

2. Always **adjust** the carburetor at the following times:

a. *During engine tune-up*

b. *After major overhaul of the engine*

c. *Whenever the carburetor has been removed for service*

d. Anytime the engine idles badly or requires speed adjustment

3. Repair kits are provided for many carburetors. When repairing, be sure to use ALL of the new parts in the kit.

4. Clean all parts thoroughly when repairing the carburetor. Use a carburetor cleaning solution for removing varnish-like deposits from all metal parts and rinse them in solvent.

5. Never use small wires or drills to clean out jets or orifices. This may enlarge or burn the precision bores and upset the performance of the carburetor.

6. Never use compressed air to clean a completely assembled carburetor. To do so may cause the metal float to collapse.

7. To test a metal float for leaks, immerse it in hot water. If air bubbles escape from the float, replace it. Do not attempt to repair a float unless recommended.

8. Always drain the carburetor before any long storage period. Many carburetors have a drain plug in the fuel bowl.

9. Most carburetors are vented to avoid vapor lock. Be sure the vent is kept clean and open.

10. Never turn adjusting needles too tightly against their seats as you may damage them.

11. Use special tool kits, when available, to recondition the carburetor.

12. Be sure to tighten the screws which hold the throttle disk in place. If loose, suction from the engine may draw them into the combustion chamber.

13. Always check the height of the float when assembling the carburetor (Fig. 32). See the machine Technical Manual for the correct height. If the float is badly bent or warped, replace it. Use a special float bending tool to adjust the float when recommended.

ADJUSTING THE CARBURETOR

Keep the carburetor adjusted for smooth, economical operation of the engine.

However, remember that engine speed adjustments and ignition timing both affect and are affected by carburetor settings. Don't change one without checking the other!

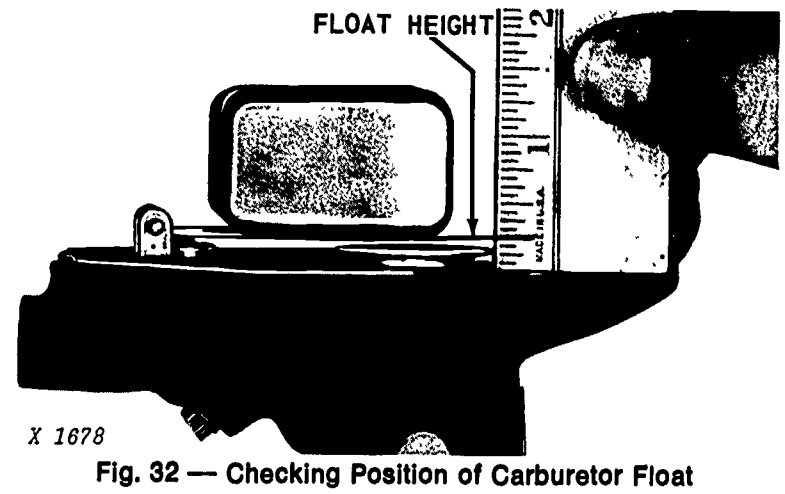

Fig. 32 — Checking Position of Carburetor Float

Most carburetors have three basic adjustments:

- **Idle Speed Adjustment**
- **Idle Fuel Adjustment**
- **Full-Load Fuel Adjustment**

Adjust the carburetor as follows:

1. Warm up the engine fully.

2. Set the *idle speed* with the engine throttle closed. Adjust the screw to get the slowest engine idling without stalling or "roughening" the engine. See the Technical Manual for the recommended idle rpm.

3. Adjust the *idle fuel* mixture for smooth engine idling. Turn the screw in until the engine begins to stall . . . then turn out the screw slightly until the engine idles smoothly.

4. If necessary, readjust the idle speed (step 2) after getting the correct idle fuel adjustment.

5. Adjust the *full-load fuel* mixture last for good fuel economy under load. For safety, adjust while the machine is under load—but is stationary. Adjust at fast idle by turning in the load screw until the engine starts to lose power . . . then back it out a little until the engine picks up speed and runs smoothly.

6. Check the operation of the speed control or governor mechanisms. If they are erratic or overspeed, adjust the linkage. See Chapter 9, "Governing Systems".

Fig. 33 on the next page shows the points which require adjustment and maintenance on typical carburetor.

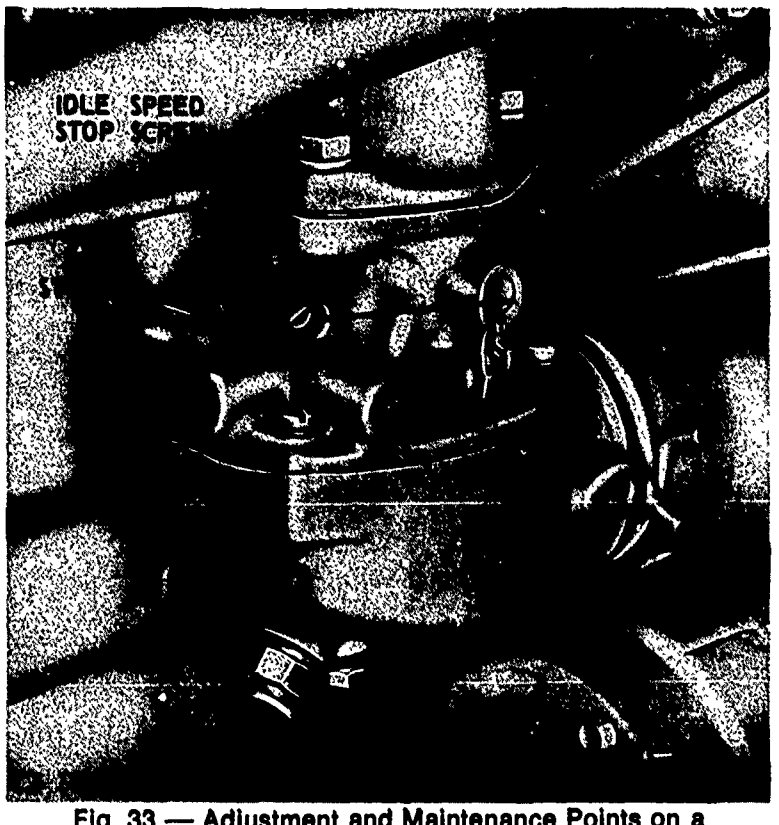

Fig. 33 — Adjustment and Maintenance Points on a Typical Carburetor

CARBURETOR TROUBLE SHOOTING CHARTS

While the basic causes of carburetor trouble will vary, the common difficulties and their respective causes are outlined below.

POOR PERFORMANCE

Possible causes of **poor performance** generally result from too lean a fuel-air mixture. If the carburetor is correctly adjusted, a lean mixture and poor performance may result from the following:

a. Air leaks at carburetor or intake manifold

b. Clogged engine air cleaner

c. Clogged fuel lines

d. Defective fuel pump

e. Low fuel level (defective float)

f. Clogged fuel screen

g. Dirt in carburetor jets and passages

h. Worn or inoperative accelerating pump

i. Load needle valve, economizer or jet not operating

j. Damaged or wrong-size main metering jet

k. Worn idle needle valve and seat

l. Loose jets in carburetor

m. Defective gaskets in carburetor

n. Clogged mufflers, ignition and poor compression

o. Worn throttle shaft or bushings.

POOR IDLING

Poor idling is usually caused by a defective ignition system, leaking engine valves, or uneven engine compression. In the carburetor, check the following:

a. Incorrect adjustment of idle needle valve

b. Incorrect float level

c. Sticking float needle valve

d. Defective gaskets between carburetor and manifold

e. Defective gaskets in carburetor

f. Loose carburetor to manifold nuts

g. Loose manifold to cylinder block nuts

h. Idle discharge holes partly clogged

i. Loose jets in carburetor

j. Vacuum leaks which are partly compensated for by a rich idle adjustment

k. Worn main metering jet

l. Restricted or clogged air cleaner

HARD STARTING

In addition to the fuel system troubles listed below, **hard starting** may be caused by use of engine oil that is too heavy, defective ignition system, low compression, weak starting battery, defective starting motor, or excessive engine friction.

a. Incorrect choke adjustment

b. Defective choke

c. Incorrect float level

d. Incorrect fuel pump pressure

e. Sticking fuel inlet needle

f. Improper starting

POOR ACCELERATION

Poor acceleration may be caused by defective ignition system, excessive engine friction, lack of compression, and incorrect carburetion.

In the case of the carburetor, check the following:

a. Incorrect fuel level

b. Accelerator pump incorrectly adjusted

c. Accelerator pump not operating

d. Corroded or bad seat on accelerator bypass jet

e. Accelerator pump leather hard or worn

f. Clogged accelerator jets or passages

g. Defective ball checks in accelerator system

CARBURETOR FLOODS

The usual causes of **carburetor flooding** are:

a. Dirt on float valve seat

b. Sticking float valve

c. Leaking float

d. Fuel level too high

e. Defective gaskets in carburetor

f. Excessive fuel pump pressure

EXCESSIVE FUEL CONSUMPTION

There are many causes of **excessive fuel consumption** other than defective carburetion. Among the causes are: poor engine compression, excessive engine friction, clogged mufflers, defective ignition. In the carburetor and fuel system, check the following:

a. Poor adjustment of idle mixture

b. Wrong setting of load adjusting needle

c. Fuel leaks in carburetor or lines

d. Clogged air cleaner

e. Defective fuel economizer

f. Defective carburetor gaskets

g. Excessive fuel pressure

h. Sticking fuel inlet needle

TEST YOURSELF

QUESTIONS

1. What are the three basic components of a gasoline fuel system?

2. Name the two most common types of electric fuel gauges.

3. What is the purpose of a fuel pump?

4. What is the primary function of a carburetor?

5. Is the following statement true or false? "The greater the air velocity, the greater the air pressure."

6. Name the three basic types of carburetors.

7. What is the purpose of the choke in a carburetor?

8. What is the purpose of an acceleration pump in a carburetor?

9. Write the correct statement for question No. 5.

(Answers on next page.)

ANSWERS

1. Fuel tank, fuel pump, carburetor

2. Balancing coil and thermostatic

3. To deliver fuel to the carburetor.

4. To mix the proper amounts of fuel and air under all operating conditions.

5. False

6. Natural draft, updraft, downdraft.

7. To provide a richer fuel mixture during starting.

8. To provide extra fuel momentarily during rapid acceleration.

9. The greater the air velocity, the **lower** the air pressure.

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LP-GAS FUEL SYSTEMS / CHAPTER 4

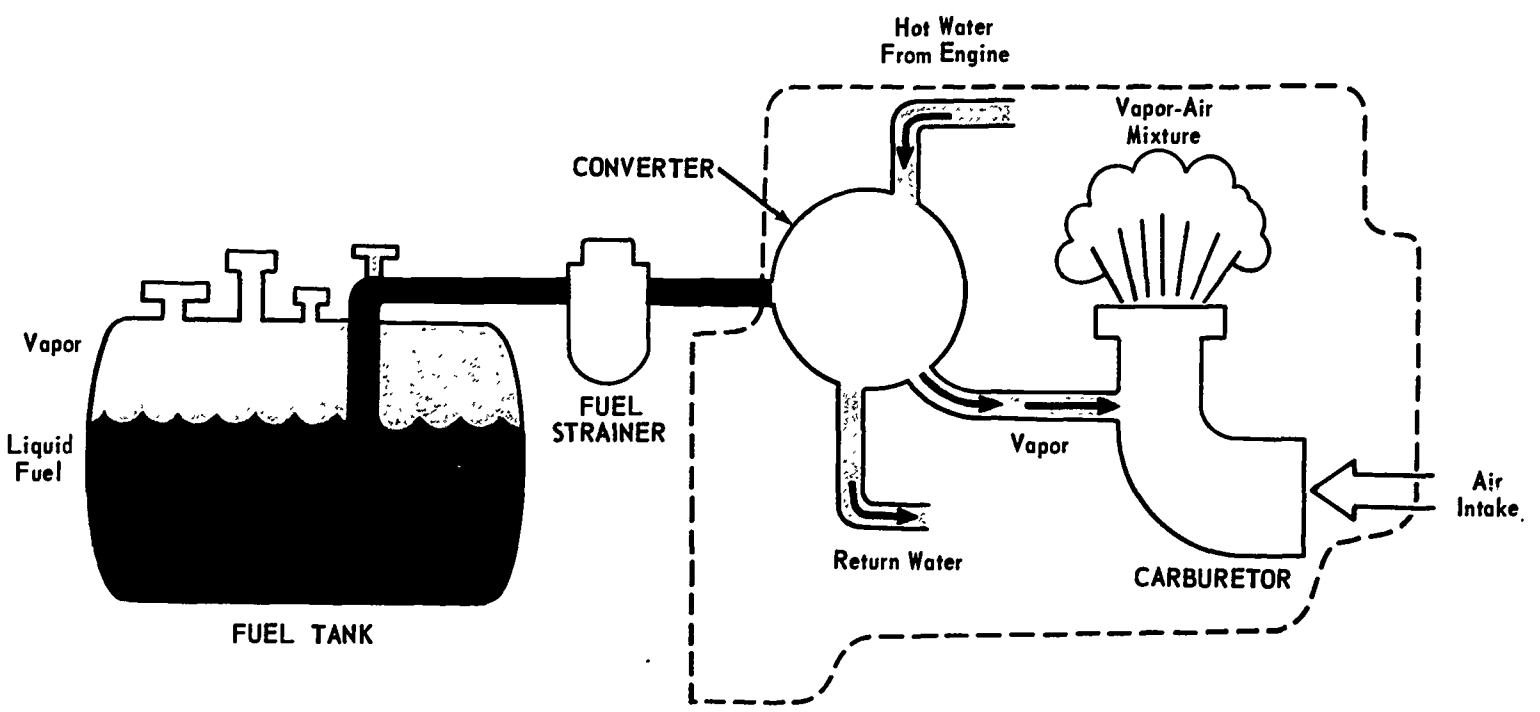

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Fig. 1 — LP-Gas Fuel System

Liquefied petroleum (LP) gas vaporizes very easily. In fact it normally remains a liquid only when under pressure. Therefore it must be kept in strong heavy tanks.

LP-gas is vaporized *before* it reaches the carburetor, while gasoline remains a liquid until this point. This is the basic difference between the two systems.

HOW FUEL IS WITHDRAWN

To withdraw LP-gas fuel from the tank, two methods are used:

1) **Liquid withdrawal**

2) **Vapor withdrawal**

These two systems are compared in Chapter 1.

Most all modern systems use the *liquid withdrawal* method. The fuel is drawn from the tank under pressure as a liquid and then vaporized.

The *vapor withdrawal* method is normally used only for starting the engine. Here the vapor is drawn off the top of the tank and used as starting fuel. This is done because in a cold engine there is not enough heat to convert liquid fuel to vapor. Once the engine is started and warmed up, it can be switched to *liquid withdrawal* again.

PARTS OF LP-GAS FUEL SYSTEM

The LP-gas fuel system (Fig. 1) has four basic parts:

- **Pressurized Fuel Tank**
- **Fuel Strainer**
- **Converter**
- **Carburetor**

The PRESSURIZED FUEL TANK stores the liquid fuel under pressure. A space for vapor is left at the top of the tank.

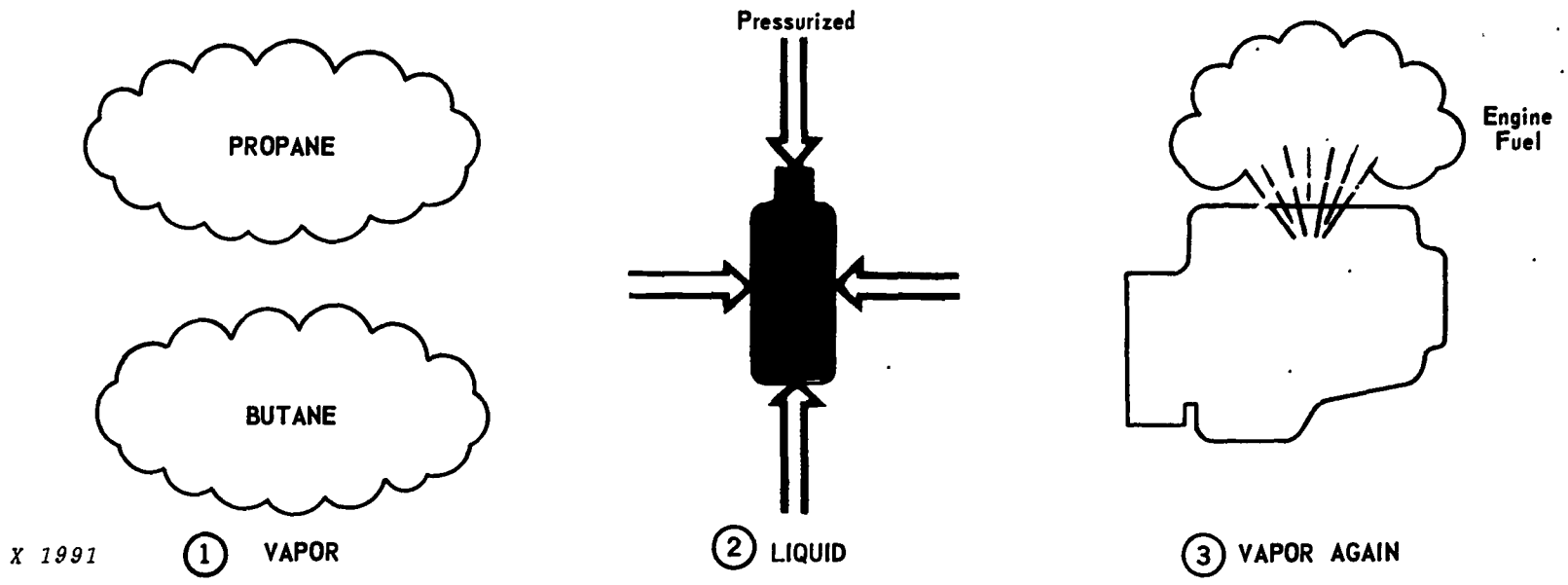

Fig. 2 — How LP-Gas Becomes Fuel For The Engine

The FUEL STRAINER cleans the liquid fuel. It normally has a solenoid which permits flow only when the engine ignition is turned on.

The CONVERTER changes the liquid fuel to vapor by warming it and then drops the pressure of the vapor.

The CARBURETOR mixes the fuel vapor with air in the proper ratio for the engine.

Later we will describe these parts in more detail, but first let's look at LP-gas as a fuel.

FACTS ABOUT LP-GAS FUEL

LP-gas is:

1. *A by-product of gasoline manufacture.*
2. *Also obtained from natural gas.*
3. *Made up mainly of propane and butane.*
4. *A vapor unless compressed or cooled.*
5. *Liquefied by compressing many gallons of vapor into one gallon of liquid.*
6. *Easier to handle and store as a liquid.*
7. *Expansive when heated (due to more vaporization).*
8. *Stored in strong tanks with pressure relief valves.*
9. *Converted to vapor again on way to engine.*

MIXING OF LP-GAS

LP-gas normally has more propane than butane. The mixture is often varied for summer and winter uses.

Propane has a lower boiling point, so it ignites better in cold weather than butane.

More propane in the fuel mixture also helps to assure pressure in the fuel tank to move fuel out during cold weather starting.

In summer, the percentage of propane can be lower to reduce fuel tank pressure (from vaporizing of fuel).

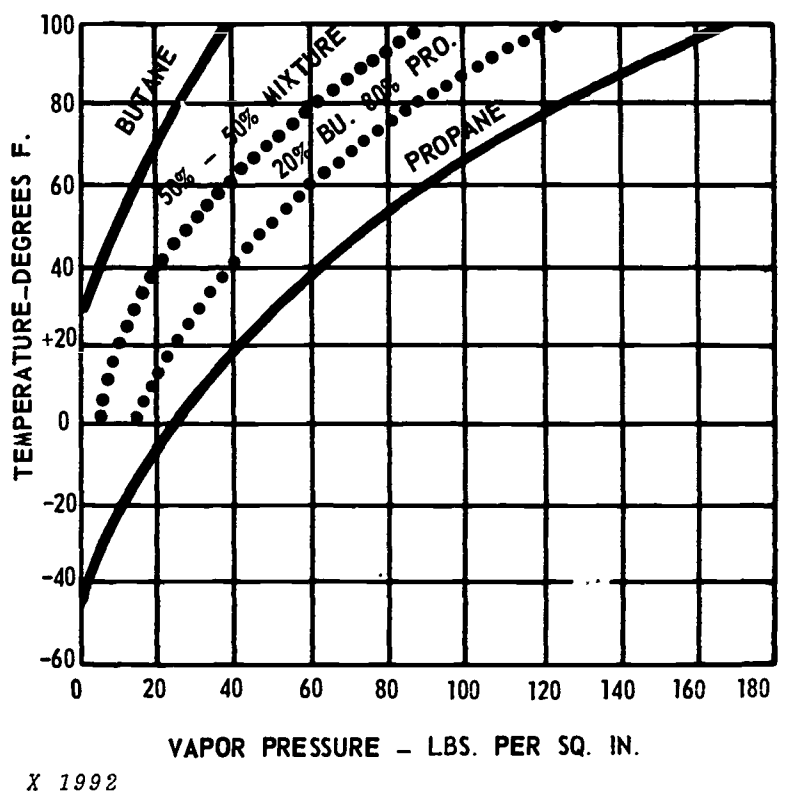

Fig. 3 — How Temperatures Affect The Pressure Of LP-Gas

The chart in Fig. 3 shows how temperatures affect the pressure of various LP-gas mixtures. Note that at 100°F., the pressure of pure propane is almost double that of a 50-50 mixture of propane and butane.

COMPARING PROPANE AND BUTANE

The table below compares propane and butane.

	Propane	Butane
Boiling Point	*—44°F.*	*+32°F.*
Heat Needed to Vaporize One Pound Of Liquid	*185 BTU*	*165 BTU*
Vapor Pressure At 100°F.	*172 Psi*	*38 Psi*
Heat Value Per Gallon	*91,960 BTU*	*103,500 BTU*
Octane Rating	*125*	*91*

FUEL RATINGS OF LP-GAS

Both propane and butane produce slightly less heat per gallon than gasoline.

However, LP-gas has a higher octane rating.

This means that the compression ratio of LP-gas engines can be raised to offset the heat losses.

FUEL COMBUSTION

LP-gas burns slower than gasoline because it ignites at a higher temperature.

For this reason, the spark is often advanced farther on LP-gas engines.

More voltage at the spark plugs may be needed for LP-gas engines than for gasoline.

To solve this, "colder" plugs or smaller spark plug gaps may be recommended in the engine Technical Manual.

LP-gas engines do not require as much heat at the intake manifold as gasoline models. This is because LP-gas will vaporize at lower temperatures. The result: Less heat is wasted and more heat goes into engine power.

ADVANTAGES AND DISADVANTAGES OF LP-GAS

The **advantages** of LP-gas are:

- *Cheaper fuel especially where close to source.*
- *Less oil consumption due to less engine wear.*
- *Reduced maintenance costs—longer engine life between overhauls.*
- *Smoother power from slower, more even burning of LP-gas fuel.*
- *Less noxious exhaust, such as carbon monoxide.*

The **disadvantages** of LP-gas are:

- *Equipment costs are high—bulk storage and carburetion equipment are costly.*
- *Fewer accessible fueling points—not many LP-gas filling stations.*
- *Harder to start engines on LP-gas in cold weather (0°F. or below). This is because oil on the cylinder walls remains undiluted and makes the engine turn harder.*

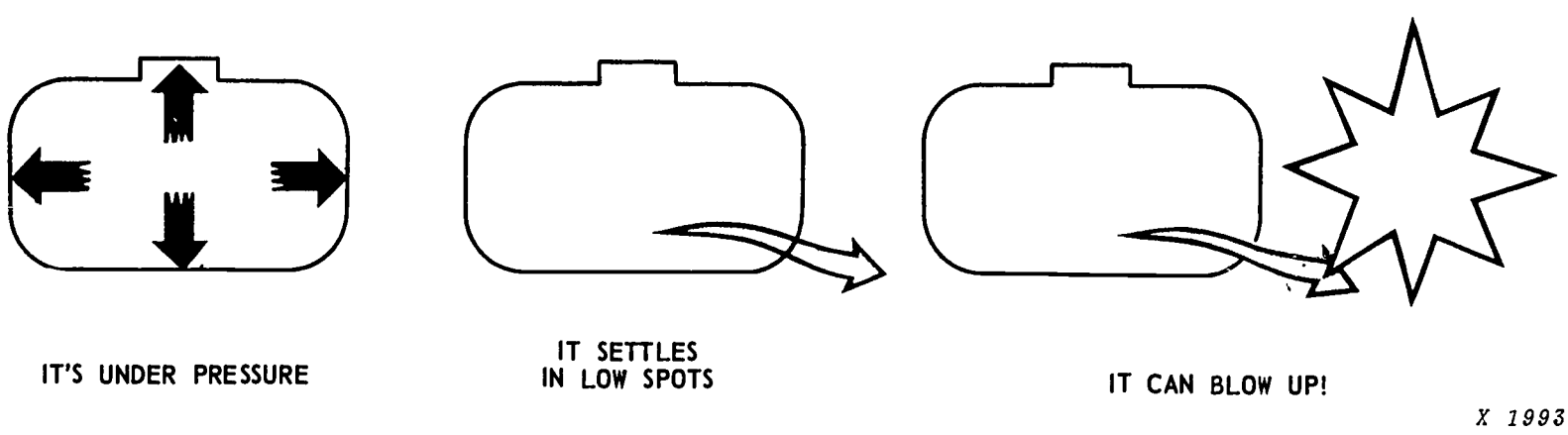

Fig. 4 — Safety With LP-Gas Fuel

Summary: Advantages Vs. Disadvantages Of LP-Gas

The use of LP-gas can be economical where the source of fuel is close by.

In other areas, the savings may be less but they can be computed by figuring the cost of fuel, the cost of conversion, the size of the operation, and any savings on maintenance and oil.

Summarizing the annual savings vs. the extra cost will give a balance sheet on whether using LP-gas will pay.

SAFETY IN HANDLING LP-GAS

LP-gas is not hazardous if handled safely.

However, there are special methods which must be used for LP-gas.

Be sure you understand LP-gas equipment before you handle it.

The safety rules and regulations are given in NBFU Pamphlet No. 58 from The National Board of Fire Underwriters. Get a copy of this pamphlet by writing to:

National Board of Fire Underwriters
85 John Street
New York 38, New York 10038

Many states or local areas have regulations for handling LP-gas. Check this with your local and state governments.

Your local LP-gas distributor can probably give you the facts.

SAFETY RULES FOR LP-GAS

1. Remember first of all that **LP-gas is always under pressure.** It wants to get out of the tank, lines, and other components. They MUST be leak-proof.

2. Never loosen a line or fitting without first reducing the pressure.

3. Natural LP-gas cannot be smelled or seen. It is odorless and colorless—and therefore **dangerous.** However, commercial gases are generally odorized to help in detecting them.

4. LP-gas is heavier than air and will settle in low spots. These pockets are explosive until the leak is stopped and the area is ventilated.

5. Stay outdoors away from buildings when transferring fuel from storage to fuel tank. Some fuel always escapes when hoses are disconnected.

6. Never smoke or use any flame near the fuel system while filling or servicing it.

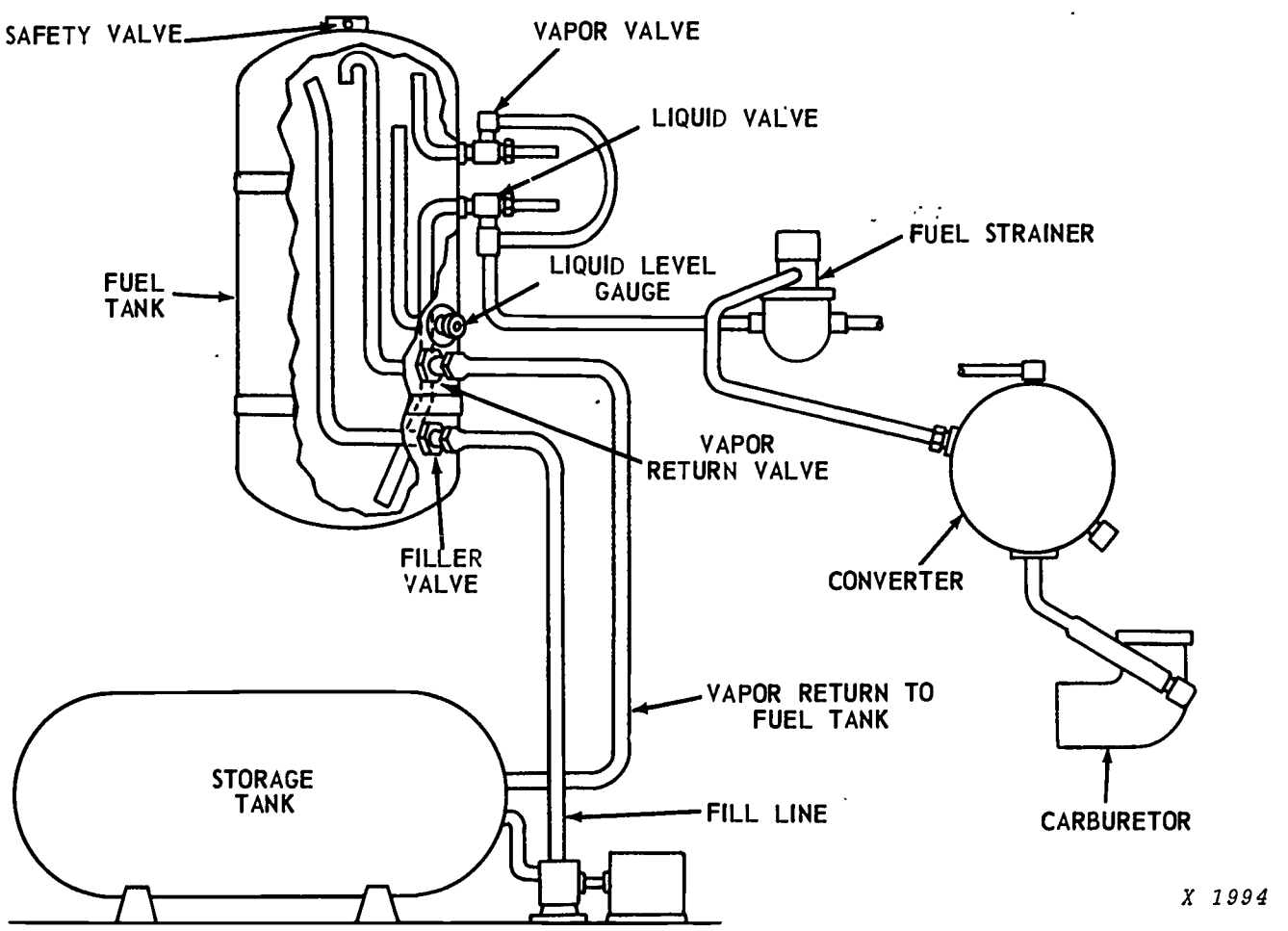

Fig. 5 — Valves And Gauges In LP-Gas Fuel System

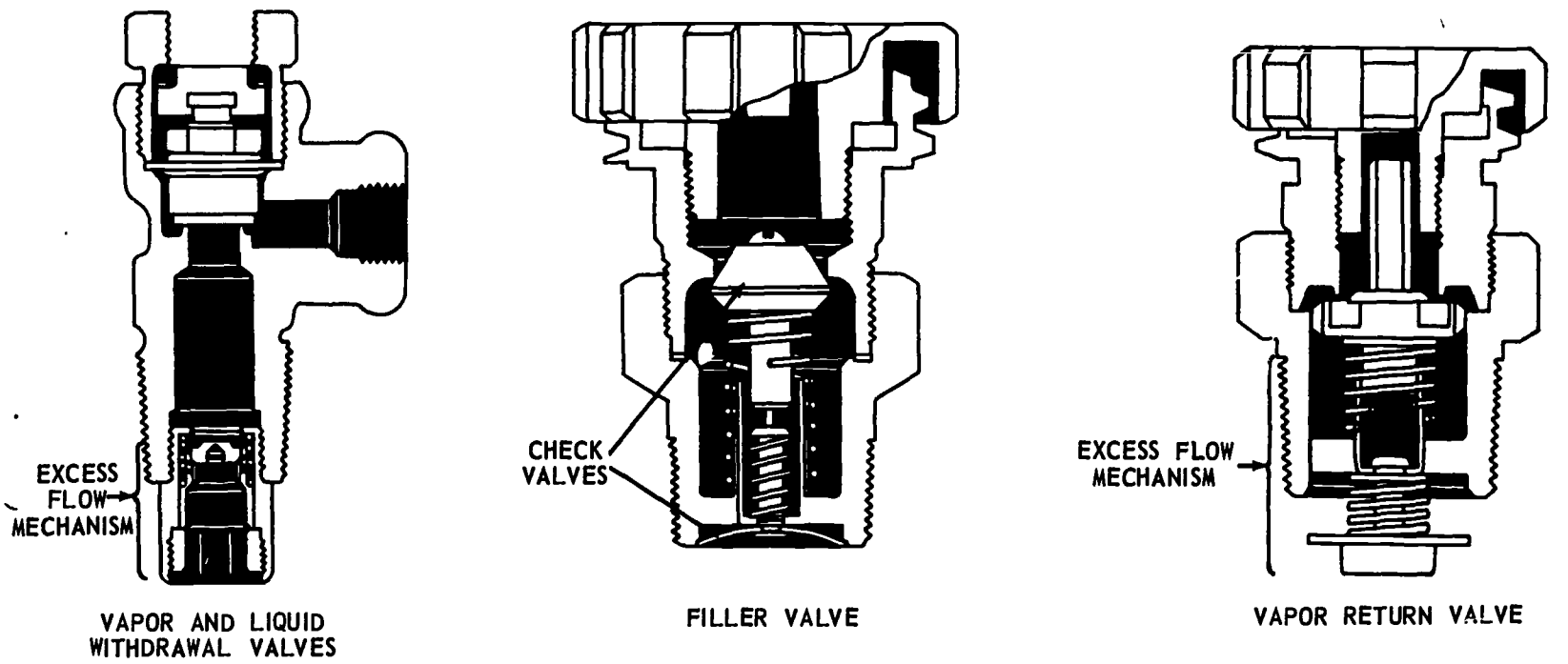

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Fig. 6 — LP-Gas Fuel Tank Valves

7. Never fill an LP-gas fuel tank more than 80% full.

8. LP-gas exhaust smoke can fool you—it doesn't smell bad. But it still contains some carbon monoxide. Be sure to ventilate the area before you start or operate an LP-gas engine.

9. When stopping the engine, always close both the vapor and liquid withdrawal valves. Leave the valves closed until the engine is to be started again.

10. Before taking LP-gas equipment indoors, check the state or local regulations. For your own safety, follow the rules.

11. LP-gas expands when heated. If the machine must be taken indoors for service in cold weather, be sure the tank is as near empty as possible. Otherwise, the fuel in the tank may expand until the safety valve opens.

12. Ventilation is a must when LP-gas equipment is indoors. Open doors and windows as wide as possible. Or use blowers or fans placed near the floor where vapors might collect if a leak developed. Protect against sparks or fires by using explosion-proof motors, switches, and conduits.

FUEL TANK, VALVES, AND GAUGES

The LP-gas fuel tank must be strong and heavy to withstand the pressure of its fuel.

The fuel tank is never filled completely full of liquid fuel because room must be left for vapors and expansion.

The fuel tank also has these valves and gauges:

- **Liquid Withdrawal Valve**
- **Vapor Withdrawal Valve**
- **Safety Relief Valve**
- **Liquid Level Gauge**
- **Filler Valve**
- **Vapor Return Valve**
- **Fuel Gauge**

LIQUID WITHDRAWAL VALVE pulls liquid fuel from the bottom of the tank for normal engine operation.

VAPOR WITHDRAWAL VALVE pulls vapor from the top of the tank for starting the engine.

Both of these valves have safety devices called excess flow mechanisms (see at left in Fig. 6). The valves automatically shut off when too much fuel is flowing out. If a leak develops in the system, the valve instantly closes and permits only a small amount of gas to flow.

SAFETY RELIEF VALVE will open if pressure in the tank becomes too high.

LIQUID LEVEL GAUGE tells when the tank is 80% full during filling of the tank. This assures that space is left for vapors. By opening the gauge, the level can be checked. Before the 80% fill, vapor will issue from the gauge. When the 80% fill is reached, a spray or liquid will issue. Caution must be taken, however, not to leave the gauge open during filling.

FILLER VALVE (Fig. 6) has a double check valve which prevents fuel from escaping when the filler hose is disconnected or accidentally breaks.

VAPOR RETURN VALVE (Fig. 6) permits vapor to return to the storage tank as the fuel tank is filled. This equalizes the pressures and makes it easier to fill the tank. An excess flow mechanism (shown) automatically closes if flow through the vapor return line is too much. This protects against escape of gas if the return line is broken or detached.

FUEL GAUGE tells the level of fuel in the tank. (For details, see below.)

FUEL GAUGES

Two types of fuel gauges are used for LP-gas fuel tanks:

- **Magnetic**
- **Electrical**

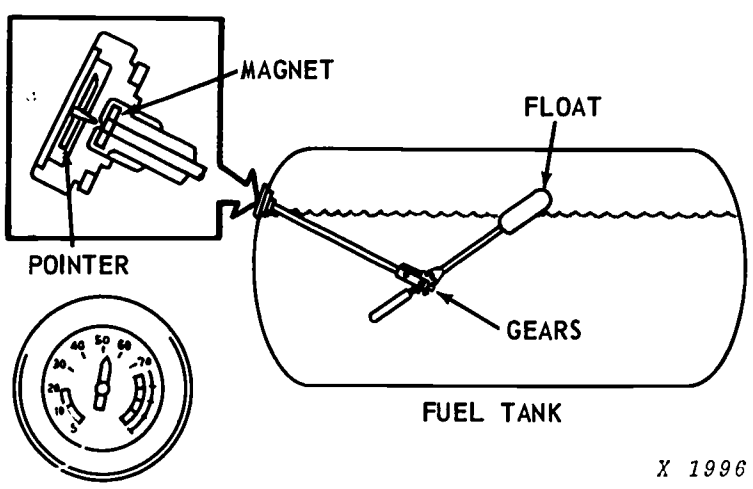

Fig. 7 — Magnetic Fuel Gauge

MAGNETIC fuel gauges (Fig. 7) use a float in the tank attached by a pivoting shaft to a magnet. As the float rises and falls with the fuel level, it rotates the magnet, which operates another magnet on the gauge. This moves the point to indicate the amount of fuel on the face of the gauge.

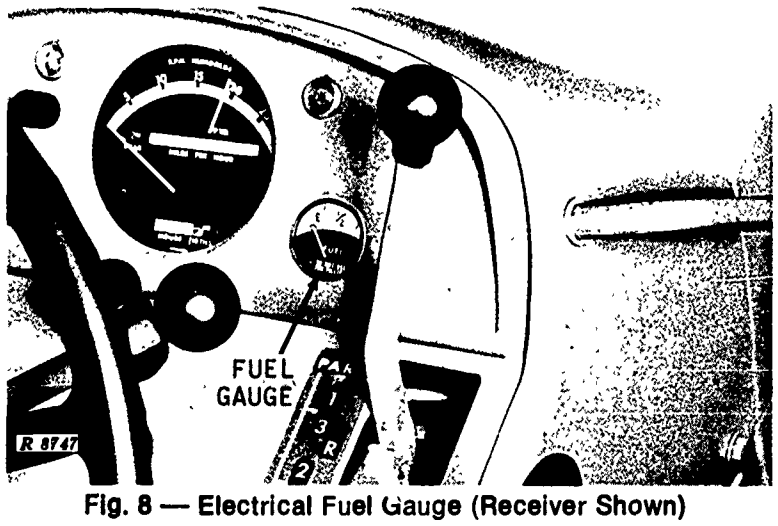

Fig. 8 — Electrical Fuel Gauge (Receiver Shown)

ELECTRICAL fuel gauges are similar to gasoline gauges. Details are given in Chapter 3. A sender located on the fuel tank signals a receiver (Fig. 8) on the machine instrument panel.

AUXILIARY FUEL CONNECTION

This connection allows a portable fuel tank to be attached for moving the machine without filling the main fuel tank. The connection is usually made at the fuel strainer.

SERVICING FUEL TANK, VALVES, AND GAUGES

Be sure that you are familiar with all rules and regulations before servicing LP-gas equipment.

Two rules are important here:

1) Never service the fuel tank except to remove and install valves or gauges.

2) Never service the valves or gauges except to remove and install them or to replace caps or dust covers.

Replacing Parts

If a valve or gauge is damaged or worn and must be replaced, first empty all fuel from the tank to remove the pressure. If possible, *do this outdoors by running the engine until all fuel is exhausted.* If not possible, consult your local LP-gas distributor for the approved method in your locality for emptying the tank.

When replacing a valve, use a small amount of Permatex or similar sealer on the threads. Install

the valve and tighten securely. Test for leaks by using soapy water. **Never use an open flame.**

For other information, refer to the engine Technical Manual.

FUEL STRAINER

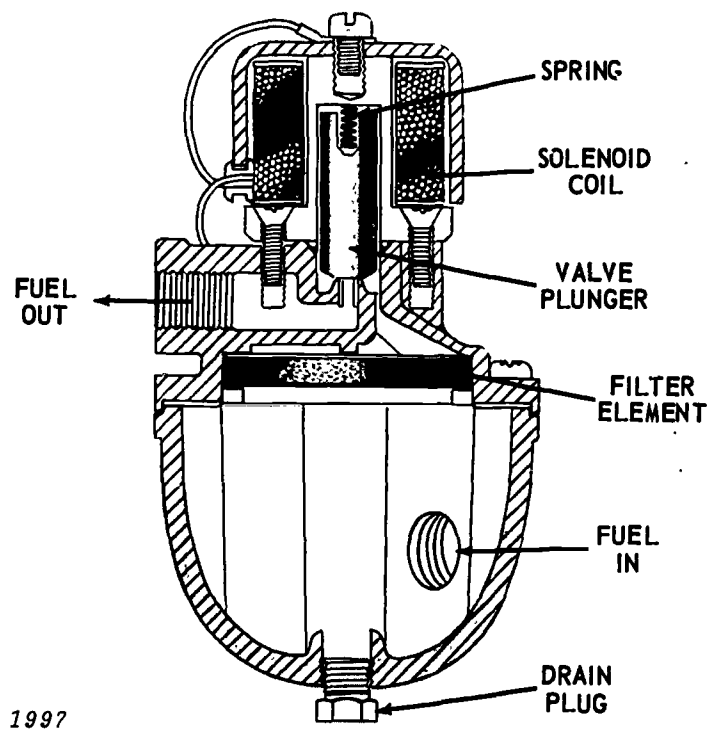

Fig. 9 — LP-Gas Fuel Strainer

The fuel strainer (Fig. 9) is located between the fuel tank and the converter.

The fuel strainer has two functions:

1) Strains fuel to clean it.

2) Shuts off fuel when system is not operating.

The STRAINER has stages including a screen, a felt filter, a chamois filter (to remove water), and another screen. A sediment bowl with drain plug collects the foreign matter.

The SHUT-OFF is an electrical solenoid coil (Fig. 9). When the engine ignition is turned on, the solenoid magnetizes the valve plunger and opens it, allowing fuel to flow. When the ignition is turned off or fails, the valve closes automatically. Pressure of fuel holds it tightly on its seat.

SERVICING THE FUEL STRAINER

If the fuel strainer frosts up, its filter element is probably clogged and needs cleaning. *Before attempting to clean the strainer, make sure both withdrawal valves are closed, the engine is cold, and the lines and strainer are emptied of gas.*

To clean the strainer, first remove the drain plug (Fig. 9) and drain out foreign matter. Follow instructions on blowing out the strainer.

To clean the strainer parts, see the engine Technical Manual.

If the solenoid fails, it may show up as follows: When the ignition is turned on, gas fails to flow to the converter. In this case, the valve plunger may be stuck or restricted.

CONVERTER

The converter does two things:

- **Heats the liquid fuel to vaporize it**
- **Reduces pressure of the vapor**

The liquid fuel must be converted to vapor before the engine can use it. The pressure must also be cut so the carburetor can handle it.

The converter has two chambers separated by a wall (See Fig. 10).

The *heat exchanger chamber* is divided into two spiral passages—one for fuel, the other for engine coolant.

The *low-pressure chamber* contains fuel vapor under low pressure.

HEAT EXCHANGER CHAMBER

Liquid fuel under pressure enters the converter through the *high-pressure valve* (Fig. 10) and passes into the spirals of the heat exchanger where it rapidly changes to a vapor.

The liquid fuel is vaporized because of the heat available in the adjacent coolant passages. Heat from the engine coolant is absorbed through the walls as the fuel vaporizes. This constant heat prevents the converter from freezing up and slowing down the vaporization.

No heat is required before the engine coolant is warmed up because the engine is started on vapor from the top of the fuel tank.

As the fuel vaporizes, pressure builds up and pushes on the flexible *diaphragm* (Fig. 10). This diaphragm is connected to the *high-pressure valve* as shown. When pressure reaches a preset point, it overcomes the spring pressure and closes the valve. This seals the fuel vapor in the heat exchanger.

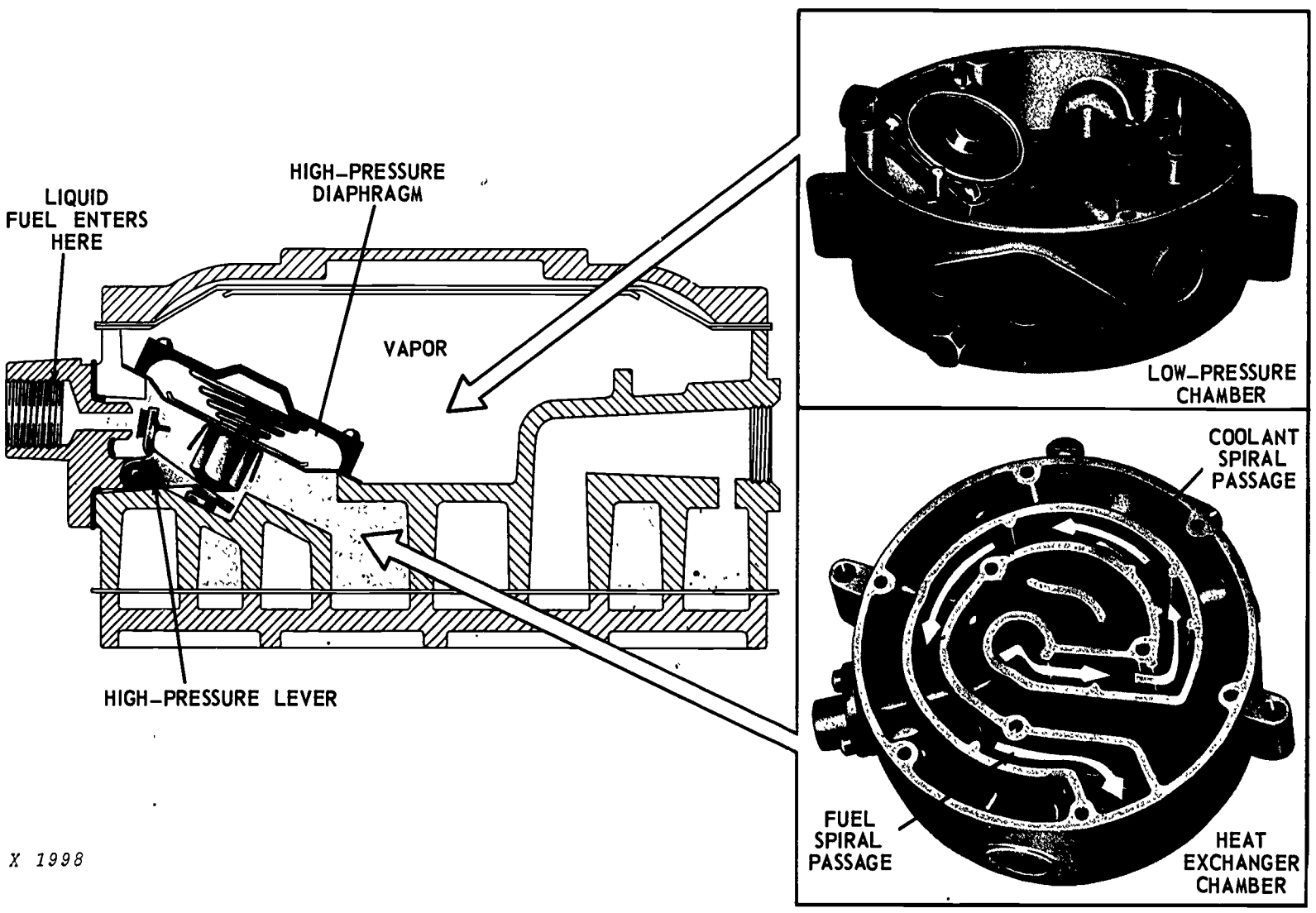

Fig. 10 — LP-Gas Converter

LOW-PRESSURE CHAMBER

The second chamber of the converter is connected to the heat exchanger by a *low-pressure valve* (Fig. 11). This valve is held closed until opened by its *lever.*

The lever is actuated by a large flexible diaphragm as shown.

Operation is as follows:

When the engine piston is on the intake stroke, it draws gas (through the carburetor) from the low-pressure chamber, reducing the pressure beneath the large diaphragm to slightly below atmospheric pressure.

Since the other side of the diaphragm is vented to atmospheric pressure, the diaphragm is pushed

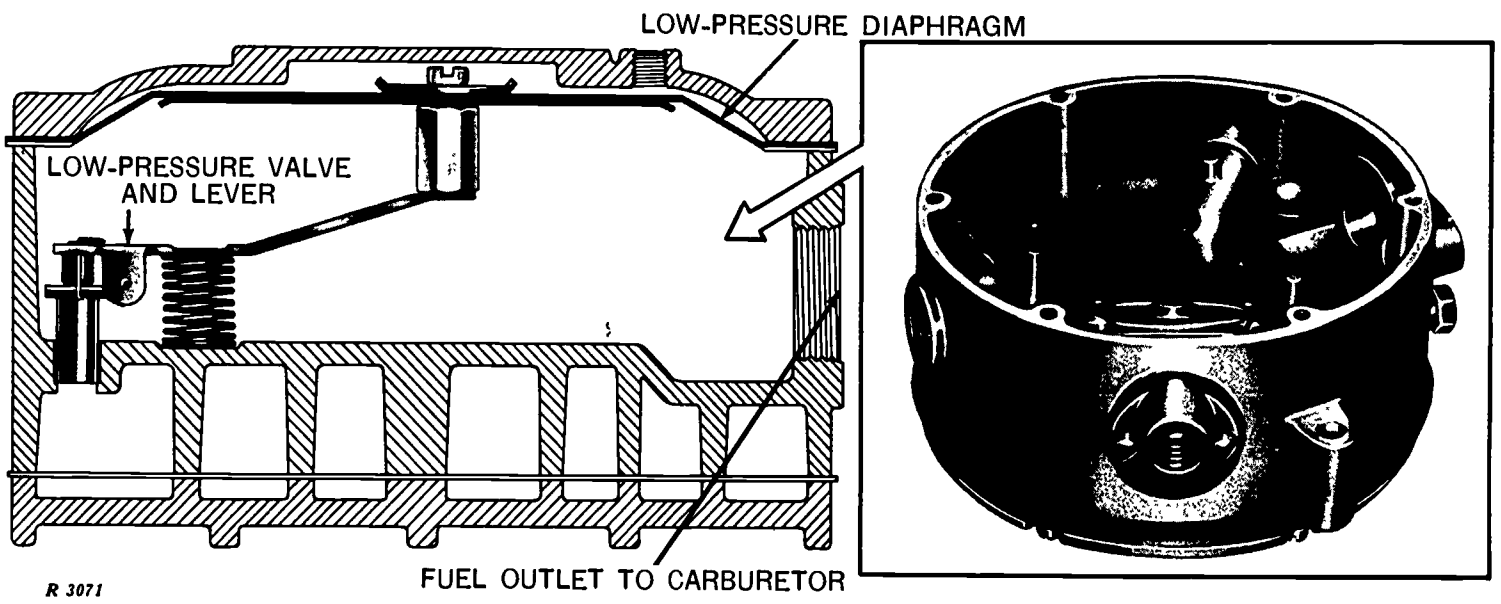

Fig. 11 — Low-Pressure Chamber of Converter

down. As it moves downward, it actuates the low-pressure valve lever, opening the low-pressure valve and permitting gas from the heat exchanger to enter the low-pressure chamber. From here the gas goes to the carburetor and then into the engine cylinder.

When the engine intake valve closes and the "demand" for gas momentarily ceases, pressure on both sides of the large diaphragm becomes equal, and the spring again closes the low-pressure valve.

Since some gas has been drawn from the heat exchanger, pressure in the chamber is reduced, permitting the high-pressure valve spring to push the high-pressure diaphragm down and open the high-pressure valve.

Liquid fuel again flows into the heat exchanger, where it vaporizes, and again builds pressure, closing the valve.

PRECAUTION AGAINST FREEZING OF CONVERTER

If the converter should ever freeze up, an expansion device is built into the back cover (Fig. 12).

When the coolant freezes, it expands out into spirals in the back cover, pushing the flexible gasket with it. This avoids damage to the converter.

A drain plug at the bottom of the converter allows coolant to be drained out to prevent freezing. If the cooling system is drained, also drain the converter. Also disconnect the water inlet and outlet lines.

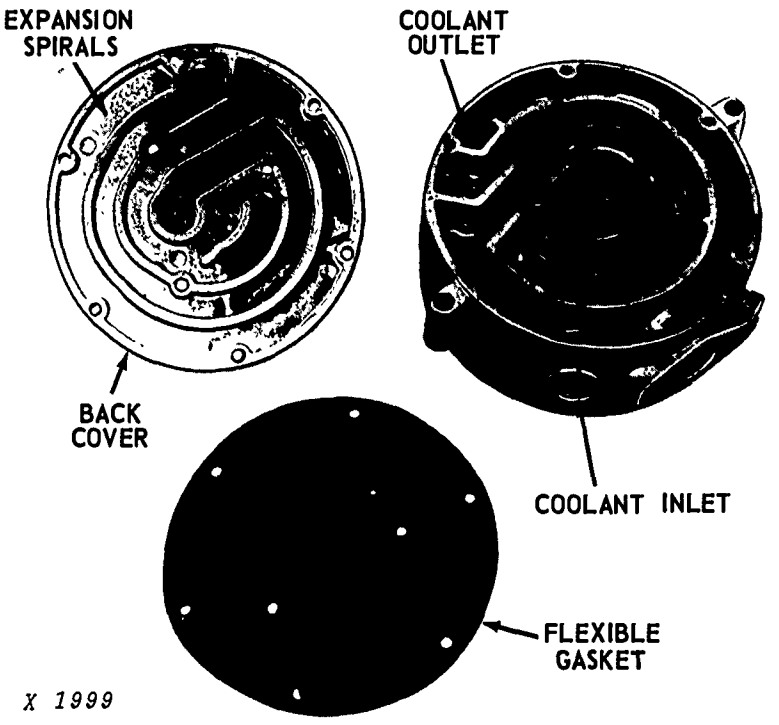

Fig. 12 —Expansion Device To Protect Converter If It Freezes Up

PROBLEMS OF ENGINE AIR PULSATIONS AFFECTING CONVERTER

In some four-cylinder engines, the air pulsations from the cylinders will affect the low-pressure diaphragm in the converter.

If the diaphragm works in unison with the engine intake, the flow of fuel vapor from the converter will be erratic.

A regulator valve (Fig. 13) can be used to prevent this. The valve in effect helps the diaphragm to "breathe" normally.

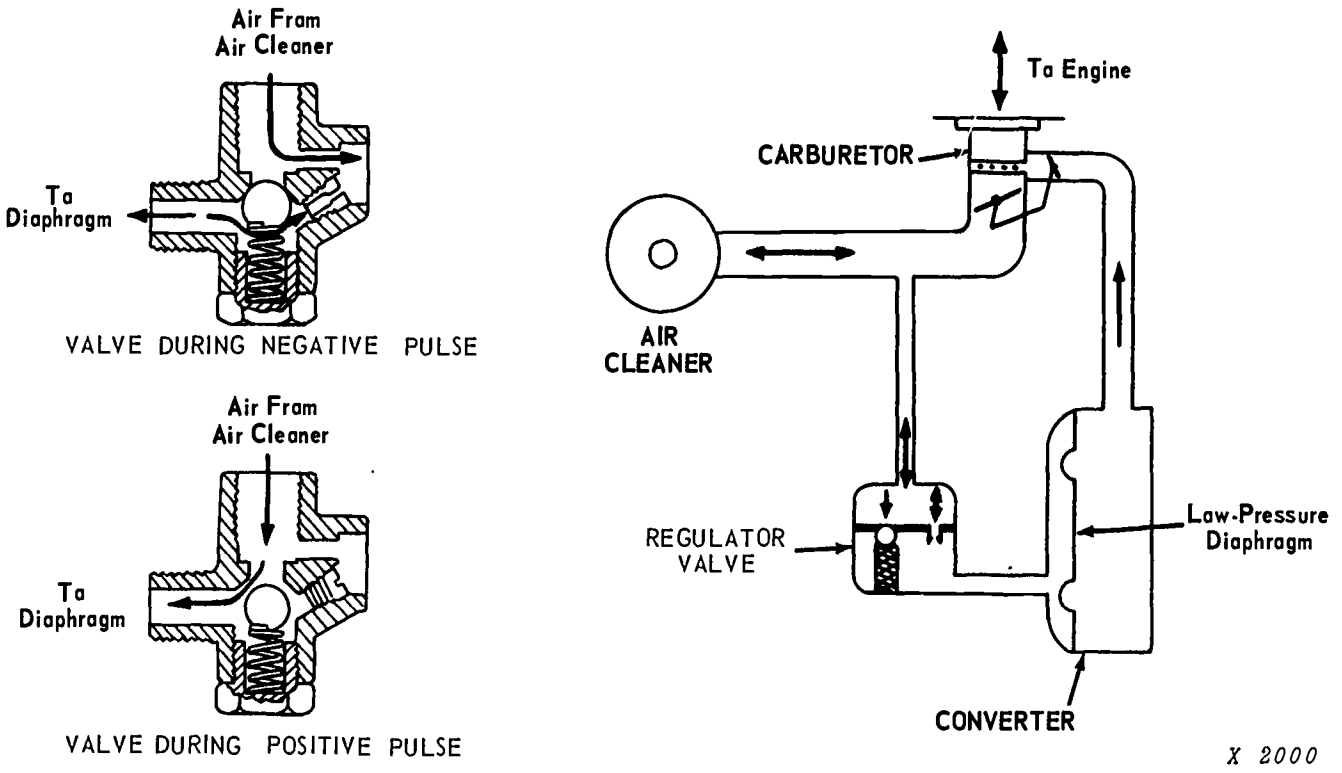

Fig. 13 — Regulator Valve For Stabilizing Converter Against Engine Air Pulsations

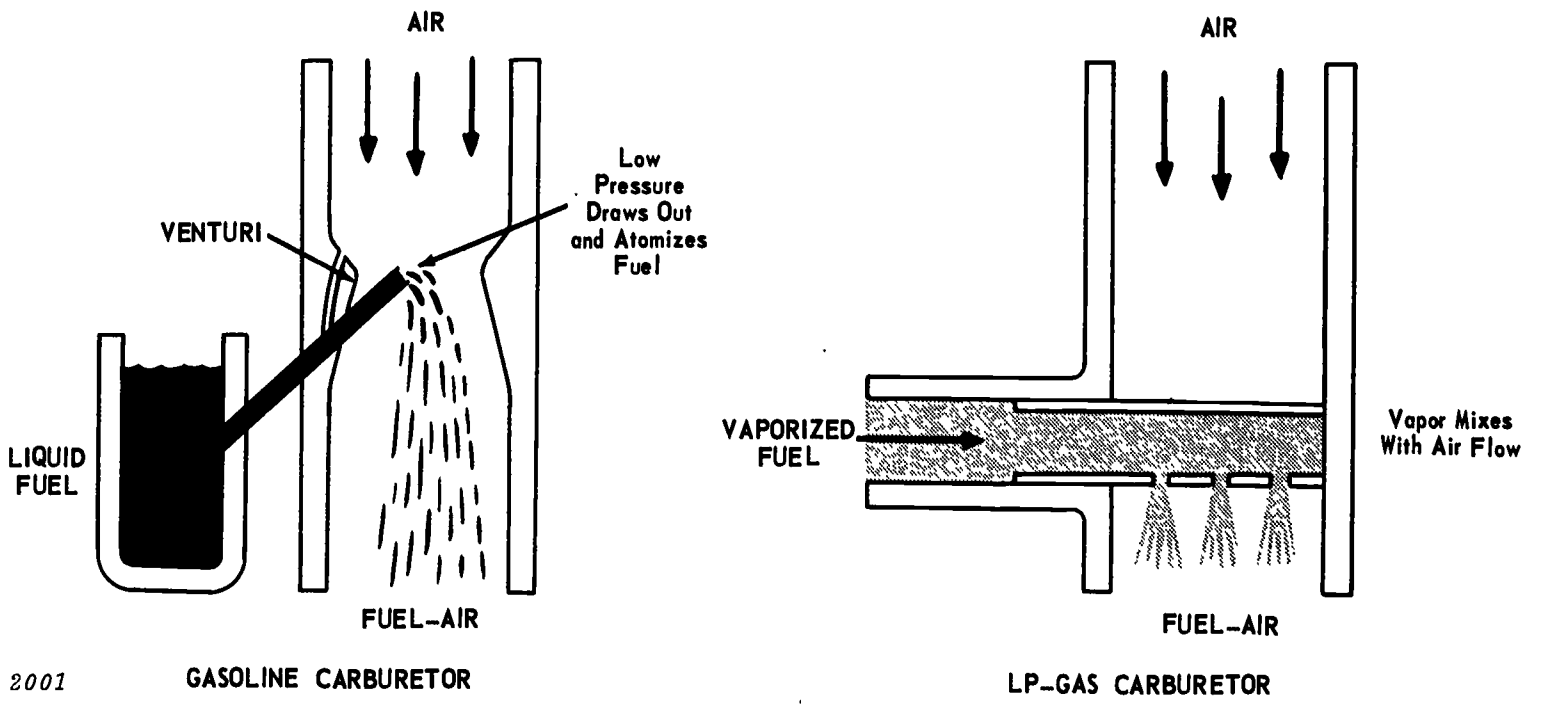

Fig. 14 — Fuel-Air Mixing Of Gasoline Vs. LP-Gas Carburetors

During positive pulses, the valve moves to direct pressure to the atmospheric side of the diaphragm as shown. This overcomes the pulse from inside the diaphragm, keeping the low-pressure valve open for normal operation.

During negative pulses, the diaphragm is allowed to breathe at air inlet pressure through the orifice in the regulator valve as shown.

The regulator valve ball is operated by air pressure changes.

SERVICING THE CONVERTER

The converter is constructed so that it will seldom cause trouble, providing clean fuel is used in the tank and clean, soft water in the cooling system.

If the converter frosts up when the engine is cold, it is probably due to a leaking high-pressure valve caused by dirt under the valve seat.

If frosting occurs when the engine is hot it is probably due to poor coolant circulation through the heat exchanger.

To check the converter for leaks, turn on the ignition switch and open the vapor withdrawal valve. Then remove the radiator cap and check the coolant for bubbles, which would mean that the converter has a leaking gasket.

For details on converter service, see the engine Technical Manual.

CARBURETORS

The LP-gas carburetor must mix fuel vapor with air in the proper ratio for each speed and load of the engine.

The LP-gas carburetor does much the same job as gasoline models (Chapter 3). The main difference is that when fuel enters the LP-gas model, it is a *vapor,* while in the gasoline it is a *liquid.*

Since the fuel is already a vapor, the LP-gas carburetor does not need a fuel supply system built in. Nor does it need a *venturi* to vaporize fuel, although some models based on gasoline principles do have one.

Fig. 14 compares the two carburetors. Note that the gasoline venturi creates a low pressure area needed to draw out and atomize the liquid fuel. LP-gas is already atomized (a vapor) so only a metered mixing with air is needed.

Let's look at a modern LP-gas carburetor (Fig. 15).

The cutaway view shows an updraft model, but downdraft models are also used.

The **metering valve** varies the amount of fuel vapor entering the carburetor.

The **spray bar** takes the fuel vapor and mixes it with air flow coming in from the bottom left in Fig. 15.

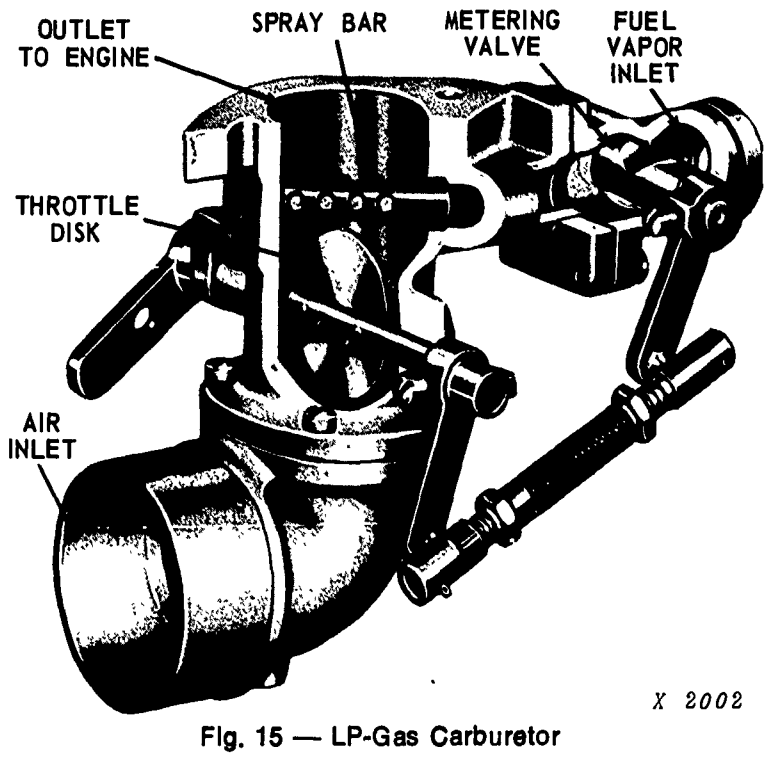

Fig. 15 — LP-Gas Carburetor

A **load adjusting screw** (see Fig. 19) gauges the fuel vapor through the spray bar at full throttle for the best engine power.

The **throttle disk** controls the incoming air and works with the metering valve to get the best fuel-air mixture for each load and speed.

OPERATION

Both the metering valve and throttle disk are operated by the engine throttle (Fig. 16).

At low idle speeds, they close down to limit the fuel-air mixture fed to the engine (see at left).

At fast idle speeds, the valve and disk open up to feed more fuel-air to the engine (see at right).

In both cases, the partial vacuum created in the engine cylinder by the intake stroke is what draws the fuel-air mixture into the engine.

At full speeds, fuel flow is limited at the spray bar by 1) a pressure drop created around the bar which restricts the air stream, and 2) the load adjusting screw (not shown) which restricts the fuel stream. This prevents too rich a mixture from reaching the engine.

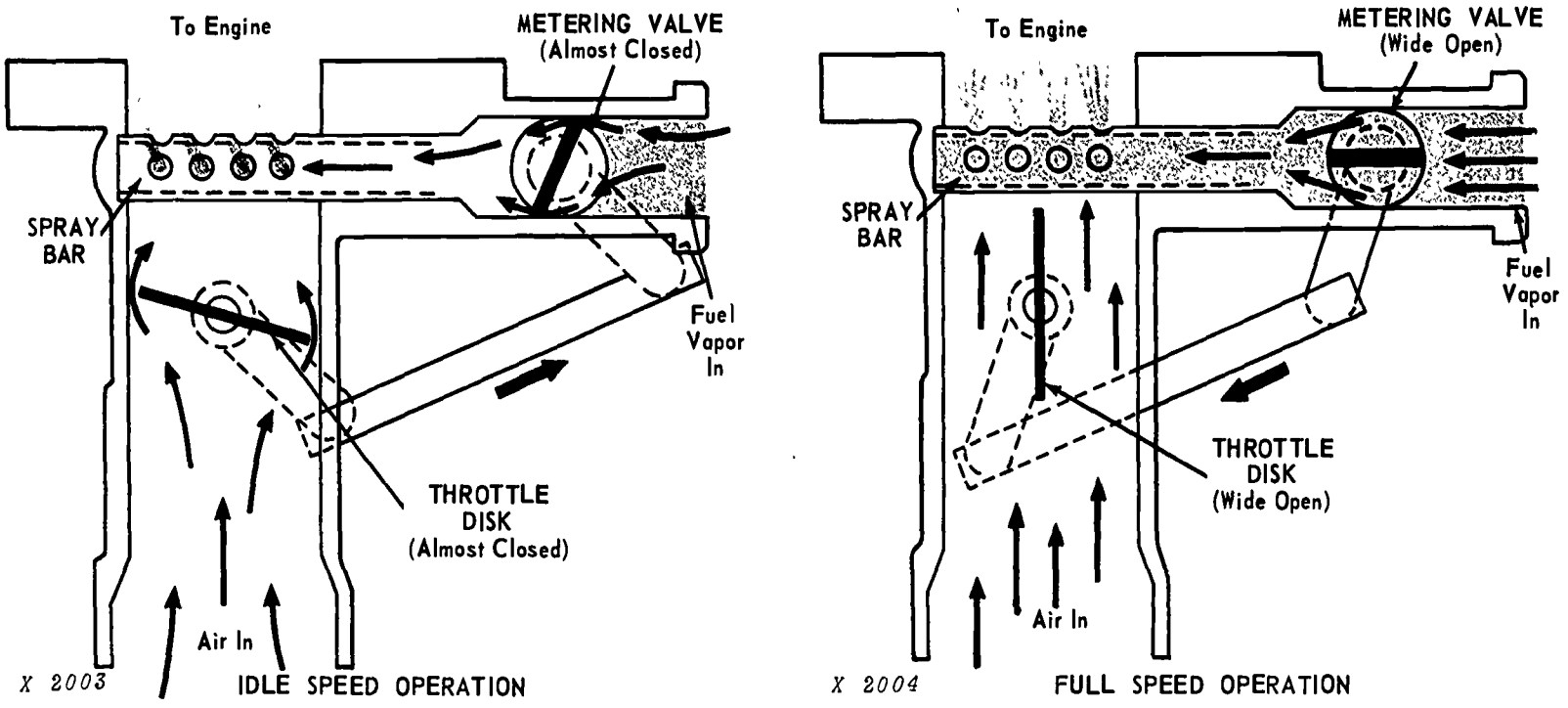

Fig. 16 — Metering Valve And Throttle Disk Operate Together

Metering Valve Operation

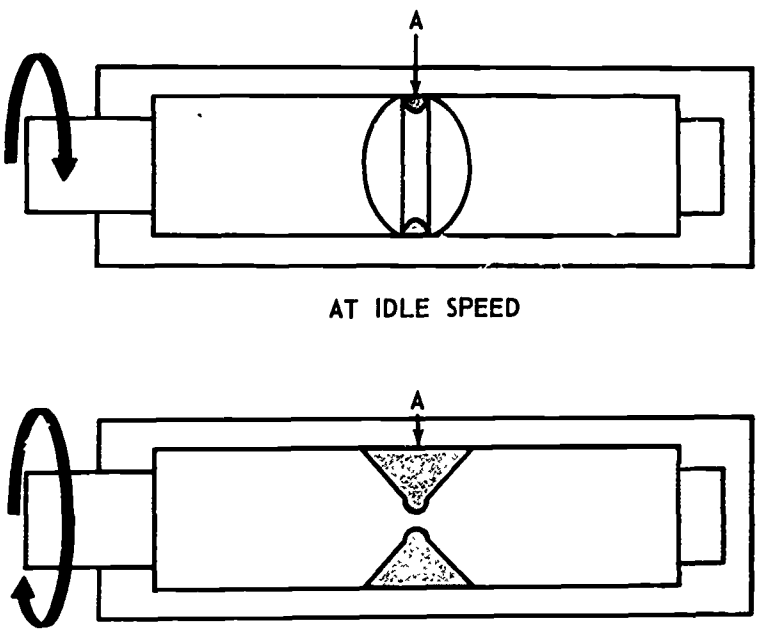

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Fig. 17 — Metering Valve Positions

The metering valve rotates in its bore to control the size of the fuel inlet (Fig. 17).

At idle speeds, its cam area almost fills the inlet passages (A).

At full speeds, the valve is rotated until the thin part of the cam faces the inlet, allowing full flow of fuel vapor to the engine.

Spray Bar Operation

Fig. 18 shows the spray bar in full speed position.

Incoming air flows through the bar and hits a restriction—the spray bar. This deflects the air and accelerates it, creating a pressure drop (similar to the venturi in gasoline carburetors).

The pressure drop above the spray bar helps to draw the fuel vapor out of the holes in the bar and mix it fully with the air.

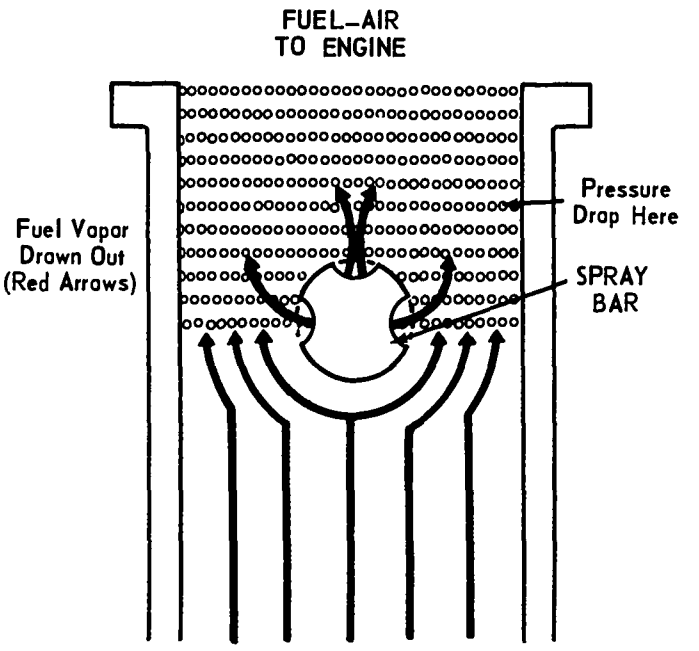

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Fig. 18 — Spray Bar Operation (End View)

CARBURETOR MAINTENANCE

Refer to Chapter 3, page 3-16, for a list of "Maintenance Tips and Precautions for Carburetors".

LP-gas carburetors do not use floats, but most of the other rules apply

CARBURETOR ADJUSTMENTS

The carburetor must be adjusted for smooth, economical operation of the engine.

However, remember that engine speed adjustments and ignition timing both affect and are affected by carburetor adjustments. Don't change one without checking the other!

Most LP-gas carburetors have these basic adjustments:

- **Idle Speed Adjustment**
- **Idle Fuel Adjustment**
- **Full-Load Fuel Adjustment**

These adjusting points are shown on the typical carburetor in Fig. 19.

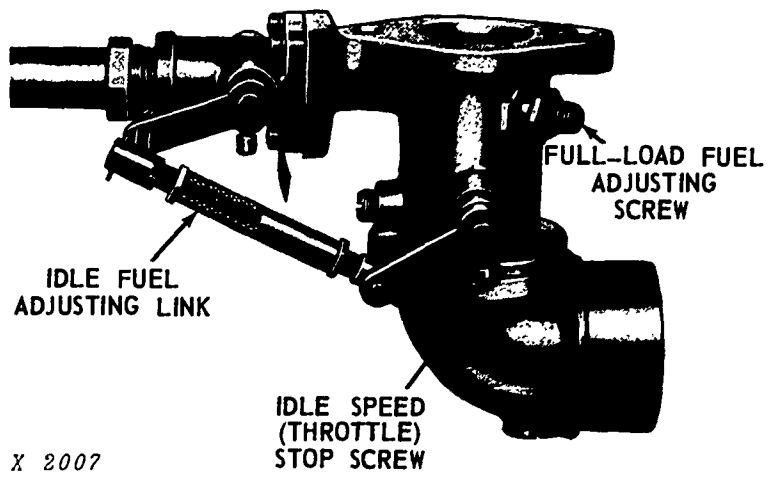

Fig. 19 — Adjusting Points On Typical LP-Gas Carburetor

Adjusting The Carburetor

For details, see the engine Technical Manual. Here is a general guide:

1. Warm up the engine fully.

2. Adjust the *idle speed* at the throttle stop screw (Fig. 20). Normally adjust with the throttle disk closed and try to get the slowest engine idling without stalling or "roughening." See the engine Technical Manual for the recommended idle rpm.

3. Adjust the *idle fuel* mixture at the adjusting link (Fig. 20). With the engine at slow idle, turn the link until the engine begins to stall . . . then turn the other way until the engine idles smoothly.

4. If necessary, readjust the *idle speed* (step 2).

5. Adjust the *full-load fuel* mixture for good economy under load. For safety, load the engine but keep the machine stationary (as with a dynamometer). Be sure the throttle disk is wide open. Adjust by turning in the full-load fuel adjusting screw (Fig. 20) until the engine starts to lose power . . . then back it out until the engine picks up speed and runs smoothly.

NOTE: This adjustment has no effect unless the engine is at full throttle under load and the throttle disk is wide open.

6. Check the operation of the speed control or governor mechanisms. If they are erratic or overspeed, adjust them. See Chapter 9, "Governing Systems".

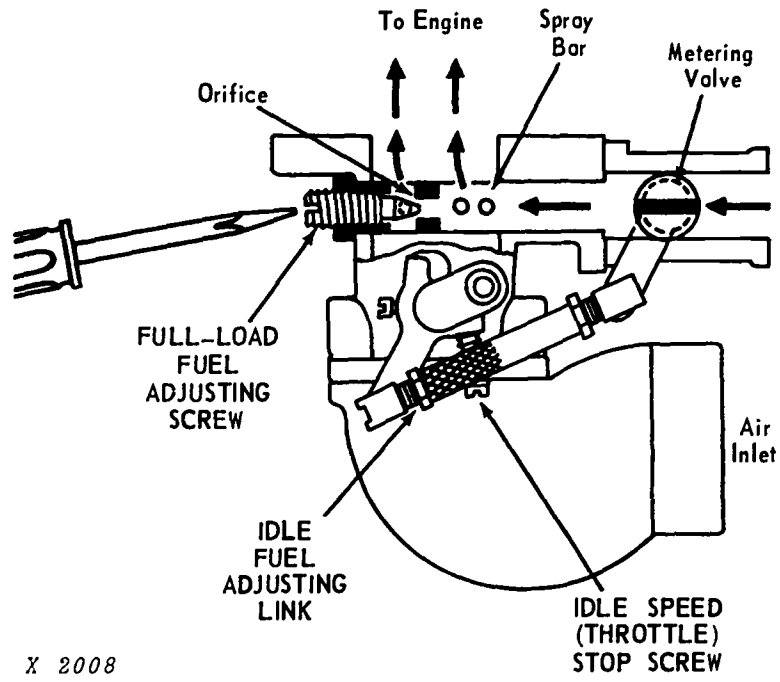

Fig. 20 — Adjustments Of LP-Gas Carburetor

OTHER LP-GAS CARBURETORS

Early carburetors for LP-gas engines were similar to gasoline carburetors and used the venturi principle (Chapter 3).

However, modern LP-gas carburetors have been developed for the special requirements of LP-gas —vapor instead of liquid fuel, etc.

For this reason, we have covered only a typical modern version of an LP-gas carburetor.

SUMMARY: LP-GAS FUEL SYSTEMS

Here is a summary of LP-gas information:

HOW GASOLINE ENGINES ARE MODIFIED FOR LP-GAS

Where recommended, gasoline engines can be modified for LP-gas as follows:

1) Compression ratio is raised to about 10 to 1.

2) Ignition timing or spark plug gap is reset (because LP-gas burns slower).

3) A converter is added to vaporize fuel.

4) A special LP-gas carburetor is used.

5) An unheated intake manifold is often installed (since LP-gas is already vaporized during intake).

6) Engine valve clearances may be changed.

OTHER FACTORS IN USING LP-GAS

Air Cleaners

Too-heavy oil in the air cleaner can be a problem with LP-gas engines. The result is a restriction in air intake which overchokes the carburetor and "floods" the engine.

Crankcase Oil

LP-gas is know to burn "cleaner" than other fuel but this has led to the notion that the engine oil will last much longer.

This is not true, however. The old oil gets thicker with use regardless of how dirty it is, resulting in lack of lubrication and loss of power from the friction. Also, the additives may wear out before the oil itself.

Always follow the operator's manual on when to change the engine oil and filters.

LP-Gas As A Fuel

Regardless of the special rules and equipment, LP-gas can be a practical fuel. Here are some facts:

1. LP-gas is a clean-burning fuel.

2. As a result, there is less crankcase dilution of oil.

3. LP-gas is more economical in many areas.

4. Theft of LP-gas is rare—tanks are sealed.

5. Evaporation is less with LP-gas—again, the tanks are sealed.

LP-GAS TROUBLE SHOOTING CHARTS

Refer to the engine Technical Manual for all repairs suggested below.

HARD STARTING

1. Improperly blended fuel—See fuel dealer.

2. Over-priming—See operator's manual.

3. Improper starting—See operator's manual.

4. Fuel strainer solenoid failed—Check electrical circuit.

5. Air vent on converter plugged—Open it.

6. Defective low-pressure diaphragm in converter —Replace diaphragm.

7. Carburetor metering valve or linkage binding—Repair or replace.

LOSS OF POWER

1. Throttle not opening fully—Check governor and throttle linkage.

2. Air vent on converter restricted—Open it.

3. Clogged fuel strainer—Clean the strainer as recommended.

CAUTION: Do not clean the strainer while the engine is running or when near an open flame.

4. Liquid fuel outlet on tank clogged—Clean it.

5. Excess-flow valves (vapor and liquid) closed, indicated by frosting at withdrawal valve—Reset by closing valves and opening slowly.

6. Fuel strainer frosted, meaning restriction due to dirt, or water, or to stuck valves—Clean, or replace valves.

7. Lean fuel mixture caused by restricted or altered fuel hose or pipes—Replace with new approved parts.

8. Converter high-pressure valve sticking—Remove valve assembly. Clean, and reinstall. Be sure valve is free.

9. Low-pressure valve in converter restricted—Check for free flow of fuel as recommended. Clean valve as necessary.

10. Defective or ruptured diaphragm—Replace it.

11. Carburetor badly adjusted or metering valve binding—Adjust carburetor, free up or replace metering valve.

12. Air leak between carburetor throttle body and air horn—Replace gasket or tighten screws.

POOR ECONOMY (Also See "Power Loss")

1. Tank not properly filled—Fill as recommended in operator's manual.

2. Improper carburetor adjustment—See operator's manual.

3. Wrong fuel—See fuel dealer.

4. Metering valve worn or damaged—Replace with a new valve.

FREEZE-UP OF CONVERTER

Freeze-ups during normal operation are usually due to **lack of water circulation** through the converter. Causes may be:

1. Low coolant level in the radiator—Fill radiator

2. Defective water pump—Repair it.

3. Thermostat removed—Install thermostat.

4. Water circulation reversed—Inlet water pipe connected at wrong point on converter.

5. Restriction in coolant pipes or converter—Clean or replace.

6. Operating engine on liquid fuel before coolant is warm—Warm up engine on vapor.

FROST ON FUEL STRAINER OR WITHDRAWAL VALVES

Frost on **fuel strainer** *is caused by:*

1. Dirt, water, or other restrictions—Clean the strainer.

2. Excess flow mechanism in withdrawal valve closed—Clean or replace valve.

Frost on **withdrawal valves** *is caused by:*

1. Excess flow mechanism in valve closed—Reset by closing valve and opening slowly.

2. Water in fuel tank (if this is cause, ice will form on liquid withdrawal valve and frost will be present between valve and strainer)—Empty filler hose of gas and flush out with antifreeze solution as recommended.

ROUGH IDLING

1. Improper carburetor throttle rod or drag link adjustment—Readjust.

2. Defective carburetor-to-manifold gasket—Tighten cap screws or replace gasket.

3. Converter-to-carburetor fuel hose leaking—Replace it.

4. Dirty or wrong type of spark plugs—Clean or replace.

5. Metering valve in carburetor binding—Remove and clean or replace.

POOR IDLE SPEED ACCELERATION

1. Diaphragm punctured—Replace it.

2. Lean fuel mixture due to restriction in fuel inlet hose—Replace hose.

3. Wrong carburetor idle adjustment—Adjust as recommended.

LACK OF FUEL AT CARBURETOR

NOTE: To check, press primer (if used) at converter with throttle in wide open position. An audible hiss should be heard if fuel is flowing.

1. No fuel supply—Fill tank if necessary.

2. Liquid or vapor withdrawal valve closed—Open valve.

3. Fuel lines kinked, bent, or restricted—Check fuel lines.

4. Broken or loose electrical wiring connections on fuel strainer—Repair.

5. Fuel strainer clogged—Clean it. See operator's manual.

ENGINE STOPS WHEN SPEED CONTROL LEVER IS MOVED TO SLOW IDLE

1. Slow idle speed incorrectly adjusted—See operator's manual.

2. Converter-to-carburetor hose leaking—Replace.

3. Carburetor gasket leaking—Replace, and tighten cap screws securely.

4. Converter back cover gasket leaking—Replace gasket.

OVERHEATING

1. Too-lean fuel mixture—See operator's manual for carburetor adjustment.
2. Clogged radiator—Clean.
3. Defective Water pump—Repair.
4. Overloaded engine—Reduce load.
5. Incorrect ignition timing—Check timing.
6. Slipping fan belt—Adjust.

FUEL SEEPING INTO WATER PASSAGES IN CONVERTER

The transfer of fuel into the water passages in the converter is caused by failure of the back cover gasket.

To check, remove radiator cap, turn ignition switch on, and watch for bubbles or water blowing out of the radiator filler neck. If so, replace the gasket.

TEST YOURSELF

QUESTIONS

True or False?

1. "In both gasoline and LP-gas engines the fuel is a vapor when it reaches the carburetor."_____
2. "LP-gas is liquefied by putting it under high pressure."_____
3. "Frosting of LP-gas components is usually caused by a restriction."_____
4. "Always fill the LP-gas fuel tank completely full."_____
5. "Change the ignition timing when converting an engine from gasoline to LP-gas."_____
6. "Keep the doors and windows closed in winter to prevent freezing of LP-gas equipment."_____
7. "The converter changes liquid fuel to vapor and raises its pressure."_____

ANSWERS

1. False. LP-gas is a vapor when it reaches the carburetor, but gasoline is a liquid.
2. True.
3. True.
4. False! Never fill more than 80% full to allow room for vapor.
5. True.
6. False. Ventilate areas around LP-gas equipment, or use fans and blowers.
7. False. The converter changes liquid to vapor but it **lowers** the pressure.

DIESEL FUEL SYSTEMS / CHAPTER 5

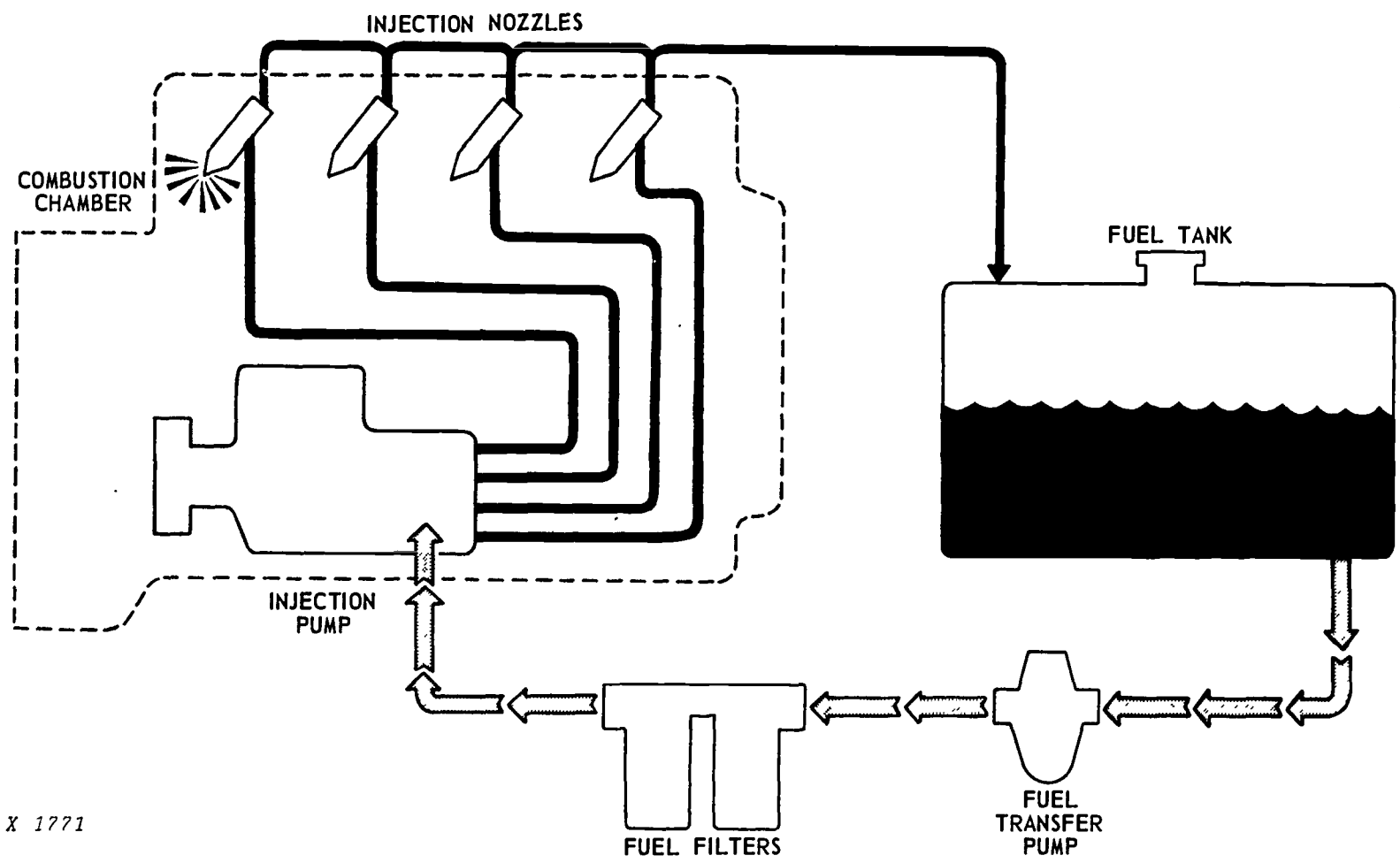

Fig. 1 — Diesel Fuel System (Distributor Type Shown)

INTRODUCTION

The prime job of the diesel fuel system is to inject a precise amount of atomized and pressurized fuel into each engine cylinder at the proper time.

Combustion in the diesel engine occurs when this charge of fuel is mixed with hot compressed air. No electrical spark is used (as in the gasoline engine).

The major parts of the diesel fuel system are:

- **Fuel Tank—stores fuel**
- **Fuel Transfer Pump—pushes fuel through filters to injection pump**
- **Fuel Filters—clean the fuel**
- **Injection Pump—times, measures, and delivers fuel under pressure to cylinders**
- **Injection Nozzles—atomize and spray fuel into cylinders**

Fig. 1 shows these parts in a basic system.

OPERATION

In operation, fuel flows by gravity pressure from the FUEL TANK to the Transfer Pump (Fig. 1).

The TRANSFER PUMP pushes the fuel through the FILTERS, where it is cleaned.

The fuel is then pushed on to the INJECTION PUMP where it is put under high pressure and delivered to each Injection Nozzle in turn.

The INJECTION NOZZLES atomize the fuel and spray it into the Combustion Chamber of each cylinder.

Later we will tell in detail how each part of the system works.

WHAT FUEL INJECTION MUST DO

The diesel fuel injection system must:

1. *Supply the correct quantity of fuel.*
2. *Time the fuel delivery.*
3. *Control the delivery rate.*
4. *Break up or atomize the fuel.*
5. *Distribute fuel evenly through the cylinder.*

Let's take a closer look at these requirements.

Correct Fuel Quantity—The fuel system must supply the exact amount of fuel to each cylinder, each and every time.

Fuel Delivery Timing—Fuel delivered too early or too late during the power stroke causes a loss of power. Fuel must be injected into the cylinder at the instant maximum power can be realized.

Delivery Rate—Smooth operation from each cylinder depends on the length of time it takes to inject the fuel. The higher the engine speed the faster the fuel must be injected.

Fuel Atomization—The fuel must be thoroughly mixed with the air for complete combustion. For this reason the fuel must be broken up into fine particles.

Fuel Distribution—The fuel must be spread evenly in the cylinder to unite with all the available oxygen. This makes the engine run smoothly and develop maximum power.

FUEL TANK

There are many different sizes and shapes of fuel tanks. Each size and shape is designed for a definite requirement. Here are some of them:

Capacity—The tank must be capable of storing enough fuel to operate the engine for a reasonable length of time.

Size—The size, of course, depends on the capacity needed. It also depends on the space on the machine available for the tank.

Shape—The shape of the tank can be altered to conform to the space available on the machine. For example, it can be either tall or short, round or square. This may allow for more fuel capacity in a restricted space.

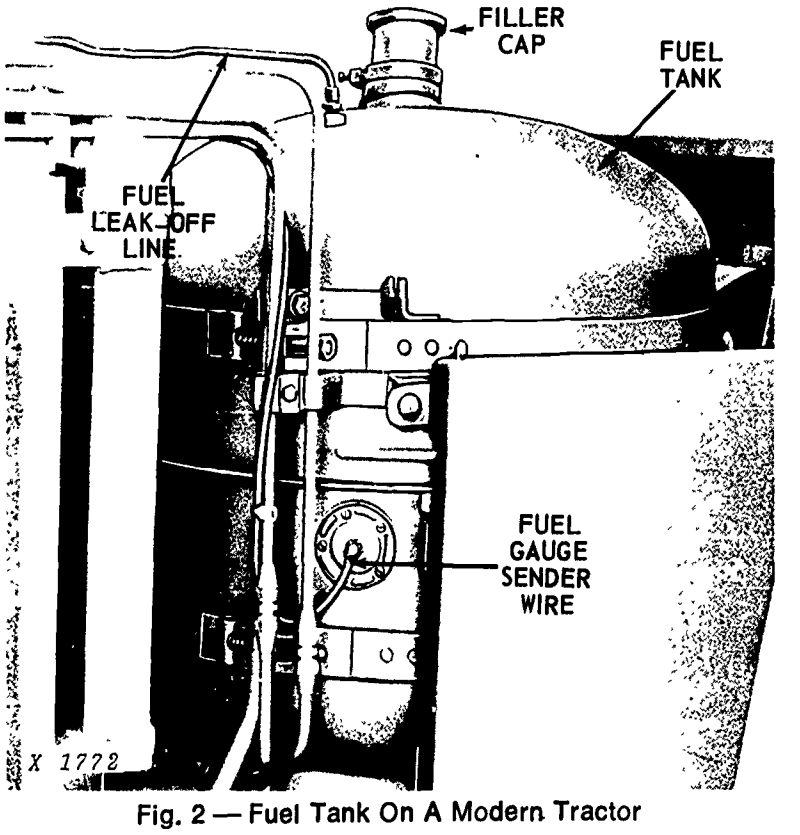

Fig. 2 — Fuel Tank On A Modern Tractor

Venting—The tank must be closed to prevent dirt from entering, yet it must also be vented to allow air to enter, replacing the fuel used.

Outlets—Three tank openings are also required—one to fill, one to discharge and one for draining. Sometimes another opening is used for leak-off fuel returned from the injection system.

FUEL TANK SERVICE

Leaks, condensation, and dirt are about the only problems of the fuel tank.

CAUTION: Cleaning or repairing a fuel tank can be dangerous. Sparks, smoking, or an open flame is hazardous in the area where the tank is cleaned or repaired.

Removing The Tank

The tank should be removed from the machine for repairing or checking for leaks.

Cleaning The Tank

After the tank is drained, clean it with water or steam.

1) Flush the tank with hot water until all fuels and vapors are removed.

2) Dry the tank with compressed air.

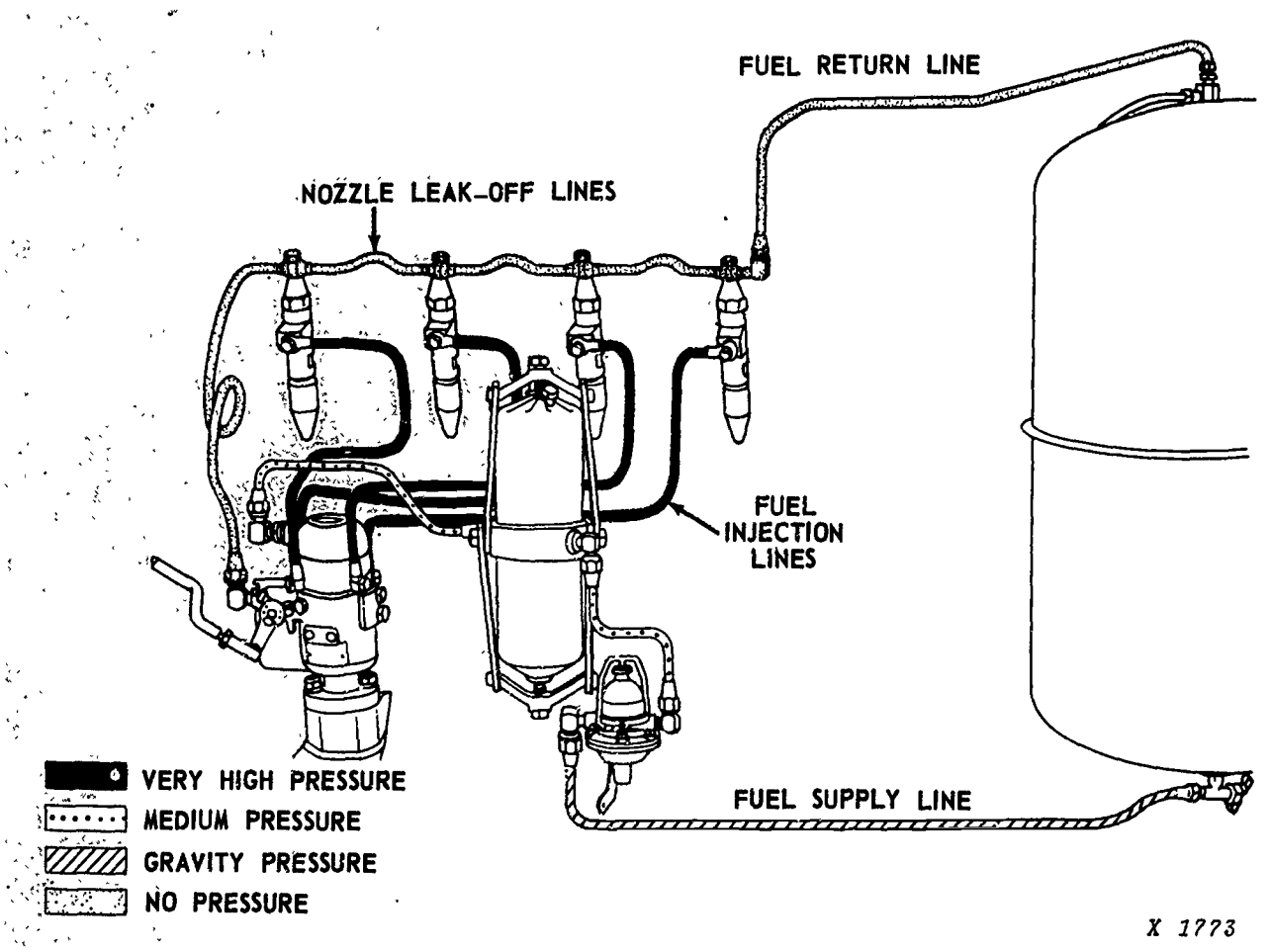

Fig. 3 — Fuel Lines In A Diesel Fuel System

Inspecting Tank for Leaks

Use one of two methods to find leaks in the fuel tank:

1) Wet method

2) Air pressure method

WET METHOD

Plug fuel outlet tightly. Dry entire outer surface of tank thoroughly with compressed air and a clean, dry rag. Place tank so that all surfaces may be easily seen, such as setting it on top of blocks. Then fill tank with water. Insert end of air hose in filler neck and apply approximately 3 pounds air pressure against water. Examine tank surfaces for moist spots where water may have been forced through.

AIR PRESSURE METHOD

Plug filler neck and attach an air hose to fuel outlet. Submerge fuel tank in clean water and apply approximately 3 pounds of air pressure. Draw a ring around each spot on fuel tank where bubbles appear. These bubbles indicate leaks in the tank that need repairing.

Repair Of Fuel Tanks

Refer to the section in Chapter 3 titled "Repair of Fuel Tanks". Be sure to observe all the precautions on filling the tank with water and venting it before welding.

FUEL GAUGES

Refer to Chapter 3 of this manual for information on fuel gauges.

FUEL LINES

The types of diesel fuel lines are:

Heavy-Weight Lines—for very high-pressure fuel between the injection pump and the nozzles (Fig. 3).

Medium-Weight Lines—for light or medium fuel pressures between the tank and injection pump.

Light-Weight Lines—for little or no fuel pressure of leak-off fuel from the nozzles to the tank or pump.

The heavy fuel injection lines should all be approximately the same length for proper injection timing in most systems. Note in Fig. 3 how some of the injection lines are shaped; this is done so that all the lines are of the same length.

SERVICING FUEL LINES

Periodically inspect the fuel lines for loose connections, breaks, or flaws. Any leak will pinpoint these failures.

Fig. 4 — Tightening Line Connections To Avoid Bending The Lines

Keep the line connectors tight—but not too tight. Tighten until snug, but don't strip the threads. To avoid bending the lines, use only one hand with two wrenches as shown in Fig. 4.

When replacing a fuel line, be sure to use an identical line in size, shape, and length. The **inside** diameter is very critical in injection lines.

FUEL TRANSFER PUMPS

Simple fuel systems use gravity or air pressure to get fuel from the tank to the injection pump.

On modern high-speed diesel engines, a fuel transfer pump is normally used. This pump, driven by the engine, supplies fuel automatically to the diesel system. The pump often has a hand primer lever for bleeding air from the system.

OPERATION, TESTING, AND SERVICING

Refer to Chapter 3 for details on fuel transfer pumps. Also consult the machine Technical Manual for complete procedures and specifications.

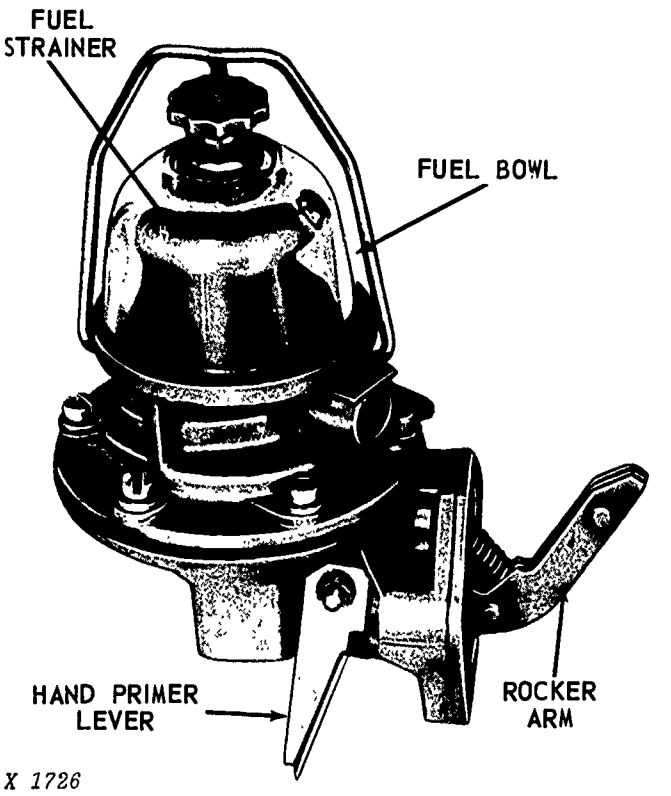

Fig. 5 — Fuel Transfer Pump (Diaphragm Type)

FUEL FILTERS

Fuel filtration is very important in diesel operation:

- **Diesel fuels tend to be impure**
- **Injection parts are precision-made**

As a result, diesel fuel must be filtered not once, but several times in most systems.

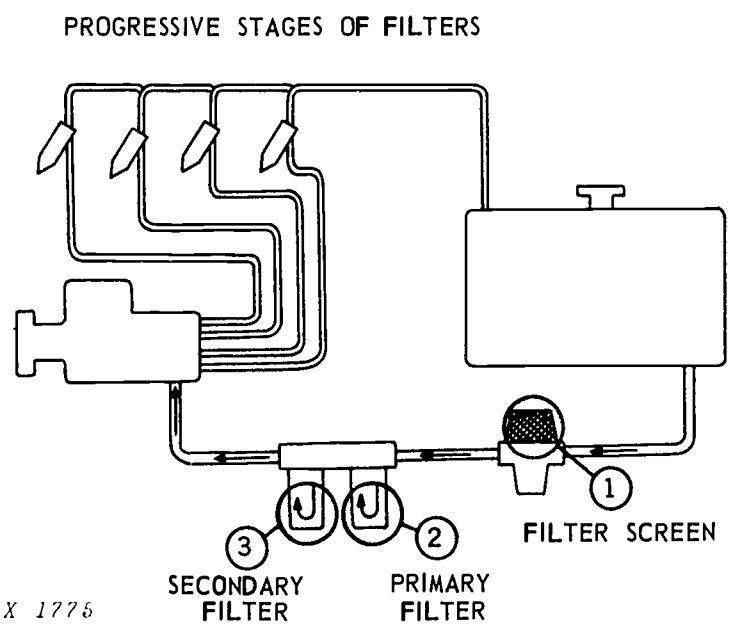

Fig. 6 — Diesel Fuel Must Be Filtered Thoroughly

A typical system (Fig. 6) might have three stages of progressive filters:

1. Filter Screen At Tank Or Transfer Pump—removes large particles.

2. Primary Filter—removes most small particles.

3. Secondary Filter—removes tiny particles.

Some systems also have a "final" filter as a "watch dog" for the system.

Most diesel filters have a water trap where water and heavy sediment can settle and be drained.

TYPES OF FILTERS

Filtration removes suspended matter from the fluid. Some filters will also remove soluble impurities.

Filtration can be done in three ways:

- **Straining**
- **Absorption**
- **Magnetic Separation**

STRAINING is a mechanical way of filtering. It uses a screen which blocks and traps particles larger than the openings. The screen may be of wire mesh for coarse filtering or of paper or cloth for finer filtering.

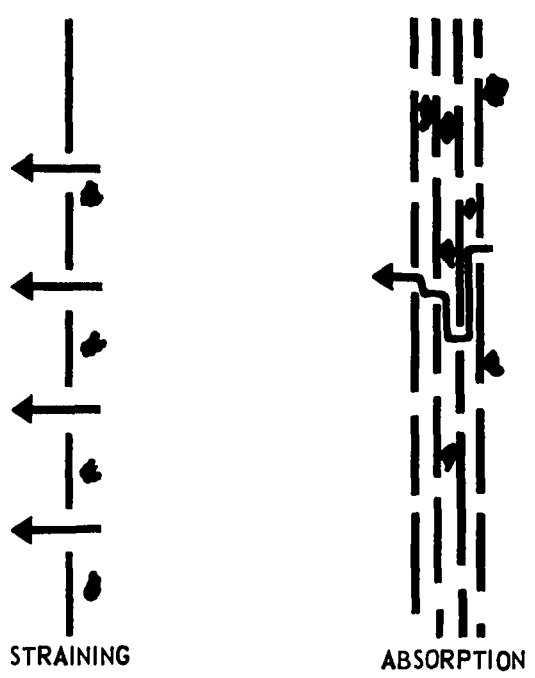

Fig. 7 — Types of Fuel Filtering

ABSORPTION is a way of trapping solid particles and some moisture by getting them to stick to the filter media—cotton waste, cellulose, woven yarn, or felt.

MAGNETIC SEPARATION—is a method of removing water from the fuel. By treating a paper filter with chemicals, water droplets can be formed and separated when they drip into a water trap. (The filter also removes solid particles by one of the other methods of filtration.)

FUEL FLOWS IN DUAL FILTERS

Dual filters may operate in two ways:

- **Series**
- **Parallel**

In SERIES FILTERS, *all* of the fuel goes through *one* filter, then through the *other*.

In PARALLEL FILTERS, part of the fuel goes through *each* filter.

Advantages of Series and Parallel Filters

Series filters clean the fuel better because the second filter can pick up dirt missed by the first one.

However, *parallel filters* can move the fuel through faster and keep it cooler.

SERVICING FILTERS

While the fuel filters help to clean the fuel, they are not meant to clean up dirty fuel from a bad fuel supply.

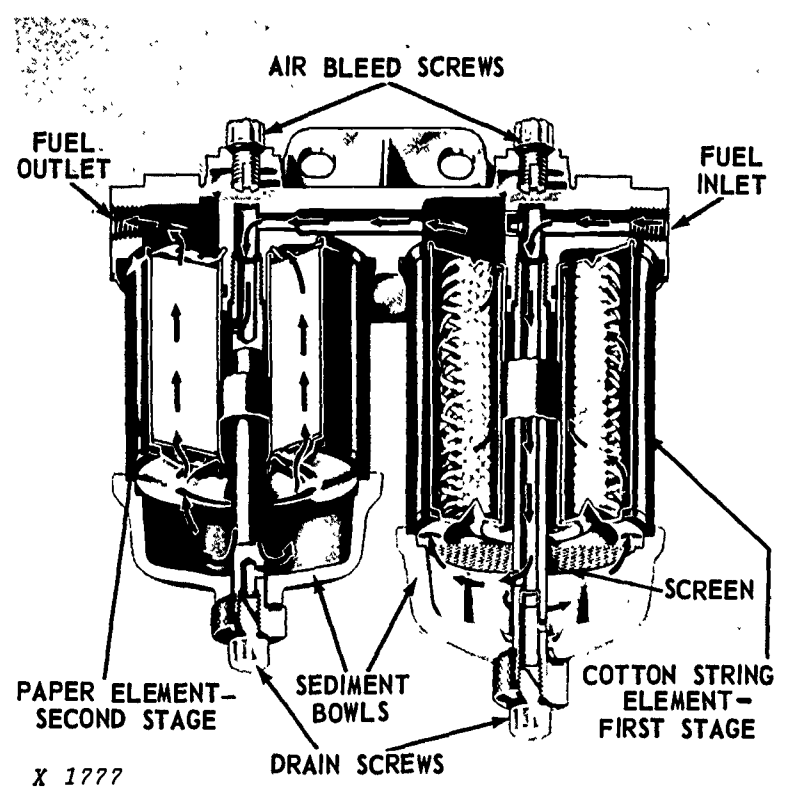

Fig. 8 — Fuel Filters (Dual Series-Type Shown)

During normal operation, the filter elements should be changed at regular intervals as recommended in the operator's manual.

Change the filter elements more often when operating in unusual conditions such as extreme dust or dirt.

On series filters, normally change the first-stage more frequently than the second-stage filter.

Check the water traps under the filter at frequent intervals. Drain out the water and sediment which collects there.

FUEL INJECTION SYSTEMS

The pump-and-nozzle combination which finally delivers the fuel is the heart of the diesel fuel system.

Let's repeat what we said earlier about what fuel injection must do:

1. *Supply the correct quantity of fuel.*
2. *Time the fuel delivery.*
3. *Control the rate of delivery.*
4. *Atomize the fuel.*
5. *Distribute fuel in the combustion chamber.*

These jobs are all handled by the pump-nozzle team.

But in the various systems, the jobs are handled in different ways.

Because the engine operates at variable loads and speeds, the pump-nozzle should be able to vary the quantity, timing, and rate of fuel delivery.

Let's look at the types of injection systems and see how well they are able to perform these tasks.

TYPES OF INJECTION SYSTEMS

Some early diesel engines used compressed air to blow fuel into the cylinders. But today's high-speed engines use a form of *mechanical* or *solid fuel injection*.

There are three major types:

- **Common Rail System**
- **Accumulator System**
- **Jerk Pump System**

The COMMON RAIL is an older system and keeps constant fuel pressure in a header that serves the nozzles. The pump and/or the nozzles are mechanically actuated by revolving cams. The quantity of fuel injected depends completely on how long the valve stays open.

In ACCUMULATOR SYSTEMS, the quantity of fuel injected can be varied regardless of pump speed by using an adjustable spring or a hydraulic accumulator to control the fuel pressures.

In JERK PUMP SYSTEMS, the pump times, meters, and forces the fuel at high pressures through the nozzles. The quantity and duration of fuel injected at various speeds are controlled better with this system. For this reason, the jerk pump system is widely used on modern engines.

Let's look at each system in more detail.

COMMON RAIL SYSTEM

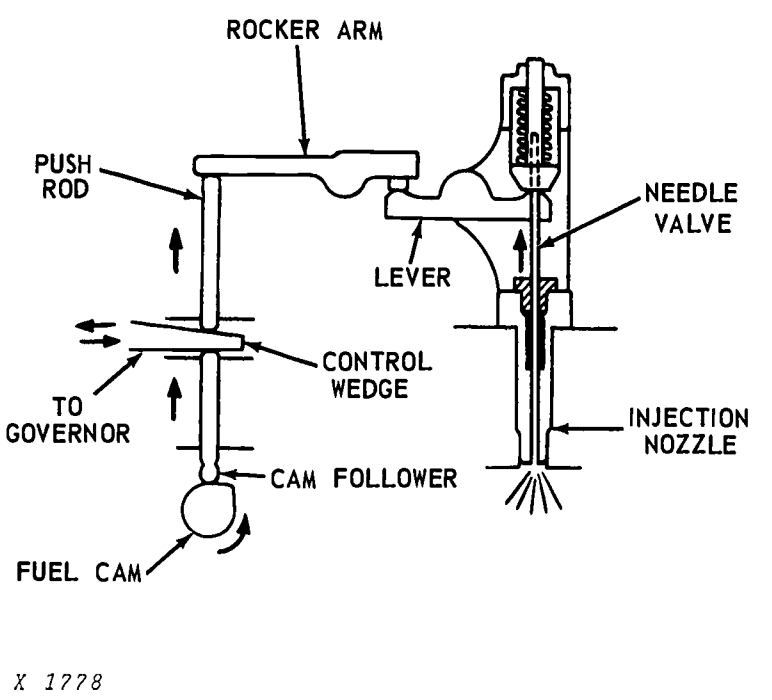

Fig. 9 — Common Rail Injection System

This system has a high-pressure, constant-stroke and constant-delivery pump which discharges into a common rail, or header, to which each injection nozzle is connected by tubing.

A spring-loaded bypass valve on the header maintains a constant pressure in the system, returning all excess fuel to the fuel tank.

The injection nozzles are operated mechanically, and the amount of fuel injected into the cylinder at each power stroke is controlled by the lift of the needle valve.

The operation of the injection system is shown in Fig. 9.

The fuel cam lifts the push rod; this motion is transmitted to the needle valve through the rocker arm and intermediate lever; the fuel area above the needle valve seat is connected at all times with the fuel header.

When the needle valve is lifted from its seat, the fuel is admitted to the combustion space through the small holes drilled in the injector tip, below the valve seat. Passing through these tiny holes, the fuel is divided into small streams which are broken up or atomized.

The amount of fuel injected is controlled by a control wedge (Fig. 9) which changes the lash of the fuel valve. When the wedge is pushed to the right, the valve lash is decreased. The motion of the cam follower will then be transmitted earlier to the push rod, the fuel needle will be opened earlier, closed later, and its lift will be slightly greater. Therefore, more fuel will be admitted per cycle.

When the wedge is pulled out, to the left, the valve lash is increased. The needle valve will be lifted later and closed earlier, and less fuel will be admitted.

The position of the control wedge is changed either by the governor, by hand, or by both.

The fuel injection pressure is adjusted to suit the operating conditions by changing the spring pressure in a bypass valve. Fuel injection pressures from 3200 psi to about 5000 psi are used at rated load and speed, depending upon the type of engine.

To reduce the pressure fluctuations in the system, due to the intermittent fuel discharge from the pumps and withdrawals by the fuel valves, the volume of the fuel in the system is increased by attaching to the fuel header an additional fuel container called the *accumulator* which has a relatively large capacity.

The common rail system is not suitable for high-speed, small-bore engines, because it is difficult to control accurately the small quantities of fuel injected into the cylinders at each power stroke.

ACCUMULATOR SYSTEM

The quantity of fuel injected per stroke can be varied regardless of pump speed in the accumulator system.

Regulating is by spring pressure or by hydraulic pressure (accumulator).

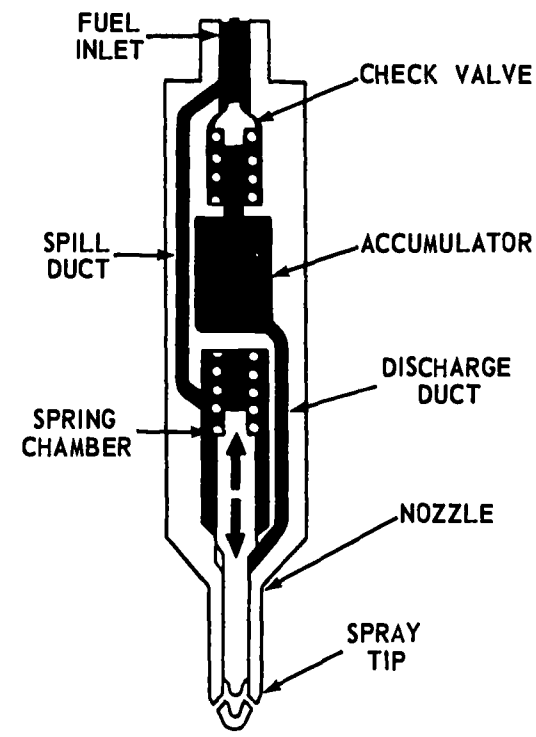

Fig. 10 — Nozzle In Accumulator System

A cam-driven pump sends fuel through the nozzle check valve into the accumulator as well as through the spill duct into the spring chamber (Fig. 10).

When the pump is too full and starts to bypass fuel, the nozzle check valve closes (as inlet pressure drops).

Fuel in the spring chamber is then vented through the spill duct back to the pump, while fuel now trapped in the accumulator passes through the discharge duct to the nozzle.

Since accumulator pressure is higher than the nozzle opening pressure, the nozzle valve lifts and injects fuel.

Injection stops when the accumulator pressure drops to the nozzle closing pressure.

The maximum injection pressure depends upon the accumulator volume and the quantity of fuel metered to it by the pump. Therefore, it is *independent* of the pump speed and nozzle orifices.

In summary, **the quantity of fuel injected per stroke can be varied in the accumulator system.**

JERK PUMP SYSTEM

In this system, both the quantity of fuel injected and its duration can be controlled better. Most all modern diesel systems are of this type.

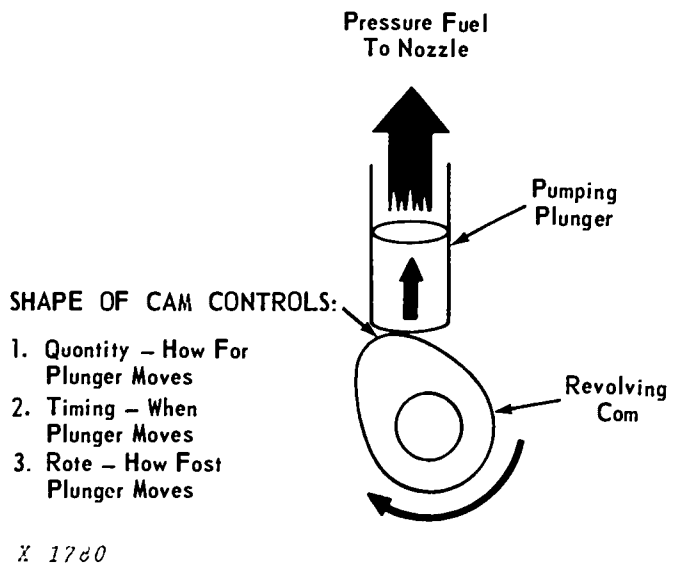

Fig. 11 — Plunger And Cam Principle Of Jerk Pumps

Jerk pumps operate on the **plunger and cam** principle (Fig. 11). As the cam revolves, it moves the plunger up and down, pumping fuel out to the nozzle.

The shape of the cam controls three things:

1. *Fuel Quantity—how far the plunger moves.*
2. *Timing—when the plunger moves.*
3. *Rate of Delivery—how fast the plunger moves.*

For example, if the revolving cam in Fig. 11 had a longer lobe, it would move the plunger farther, pumping a larger **quantity** of fuel.

If the cam lobe were thicker, it would move the plunger sooner, changing the **timing** of the plunger stroke.

If the cam lobe were thinner, the plunger would raise and lower faster, changing the **rate** of fuel delivery.

By adjusting these three factors—*fuel quantity, timing, and rate of delivery*—modern injection pumps can serve the engine better than the other systems we've discussed.

MODERN INJECTION PUMPS

As we said, modern injection pumps are almost all jerk pumps which use the plunger and cam method of fuel injection.

The injection pump-nozzle team can work in many ways. In a four-cylinder engine (Fig. 12), there are four major ways of injecting fuel:

- **Individual pump and nozzle for each cylinder**
- **Pumps in common housing, nozzles for each cylinder**
- **Combined pump and nozzle for each cylinder**
- **One distributor pump serving nozzles for several cylinders**

The last method, using the *distributor pump,* is most common for modern high-speed engines of small and medium sizes.

For this reason, we will use the *distributor pump* in our example of how an injection pump works, and how it is serviced.

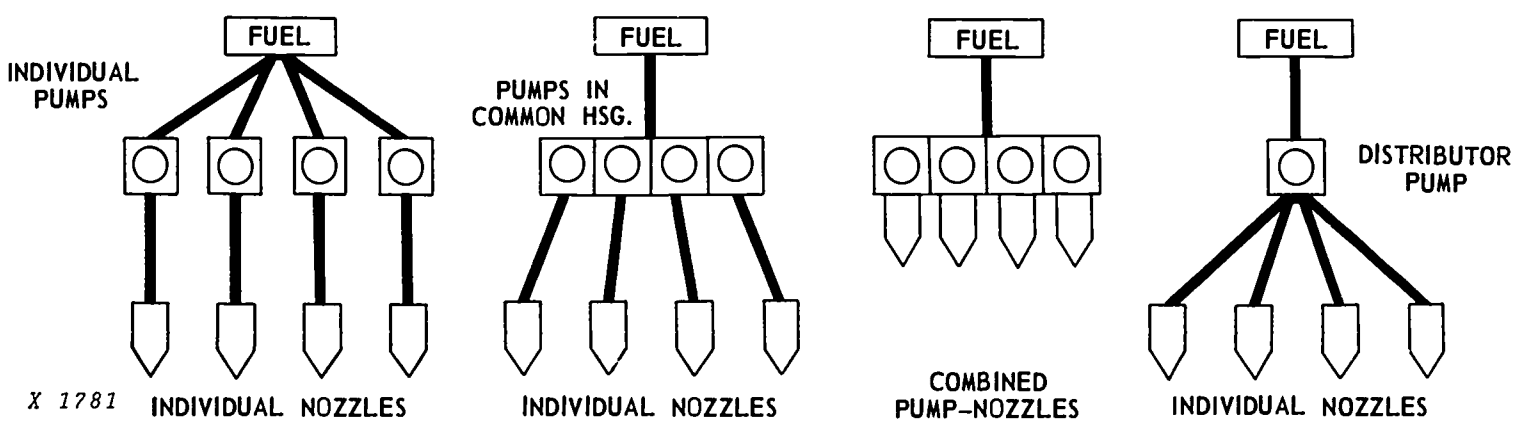

Fig. 12 — Four Ways Of Injecting Fuel In A Four-Cylinder Engine

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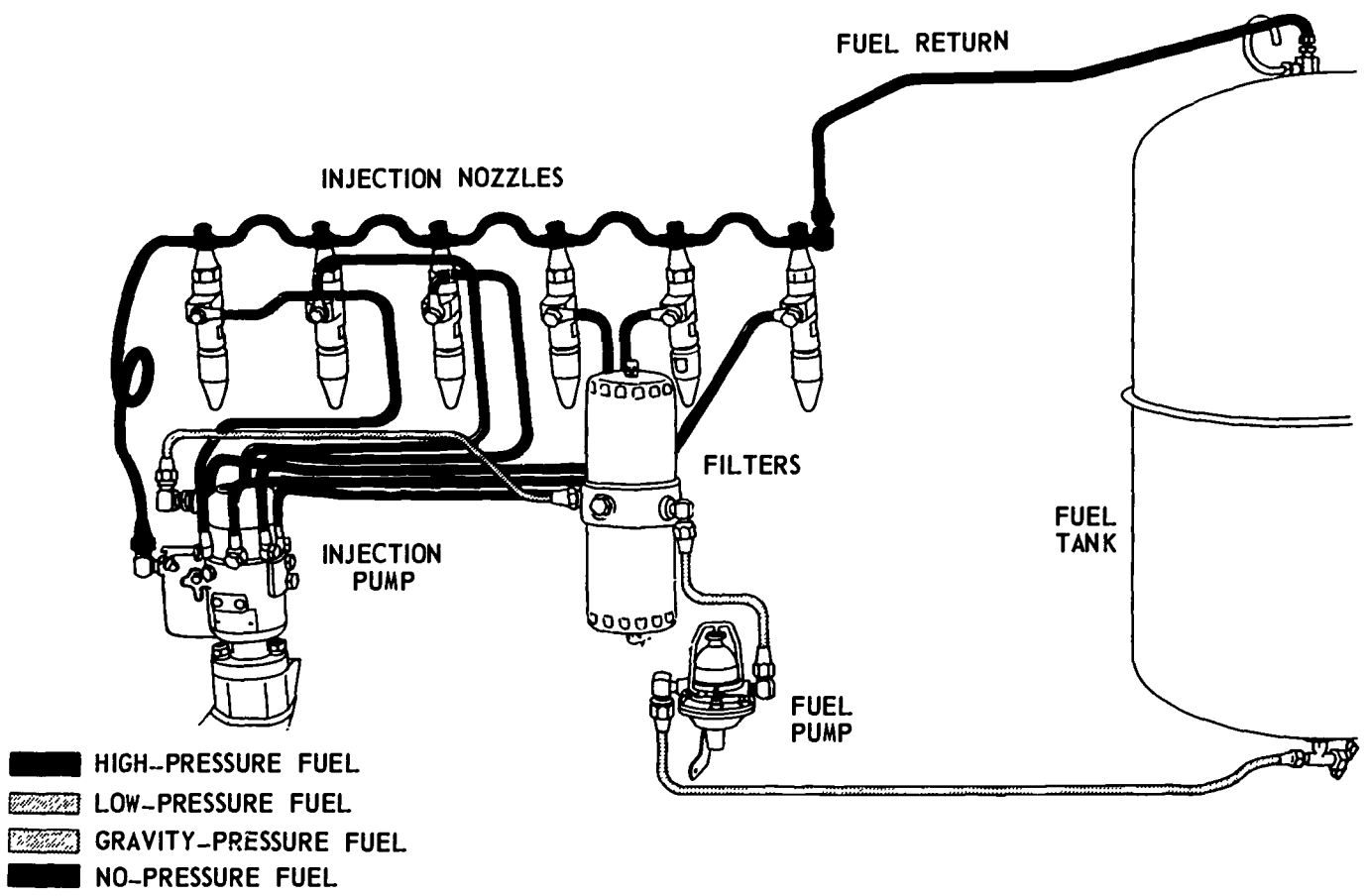


Fig. 13 — Distributor-Type Injection System

DISTRIBUTOR INJECTION PUMP

The *distributor* injection system normally uses one pump to distribute fuel to all cylinders.

This system is well suited for multi-cylinder engines.

It combines the precision and accuracy of individual pump systems with the economy and capacity of a common rail system.

The result is a centralized system which can satisfy all the requirements of multi-cylinder engines.

A complete distributor injection system is shown in Fig. 13. One injection pump feeds six nozzles.

Let's take a detailed look at a typical distributor injection pump.

MAIN PARTS OF THE PUMP

The main parts of the pump as shown in Fig. 14 are:

1. *Drive Shaft*
2. *Distributor Rotor*
3. *Transfer Pump*
4. *Pumping Plungers*
5. *Internal Cam Ring*
6. *Hydraulic Head*
7. *End Cap*
8. *Governor*
9. *Automatic Advance*
10. *Drive Adapter*

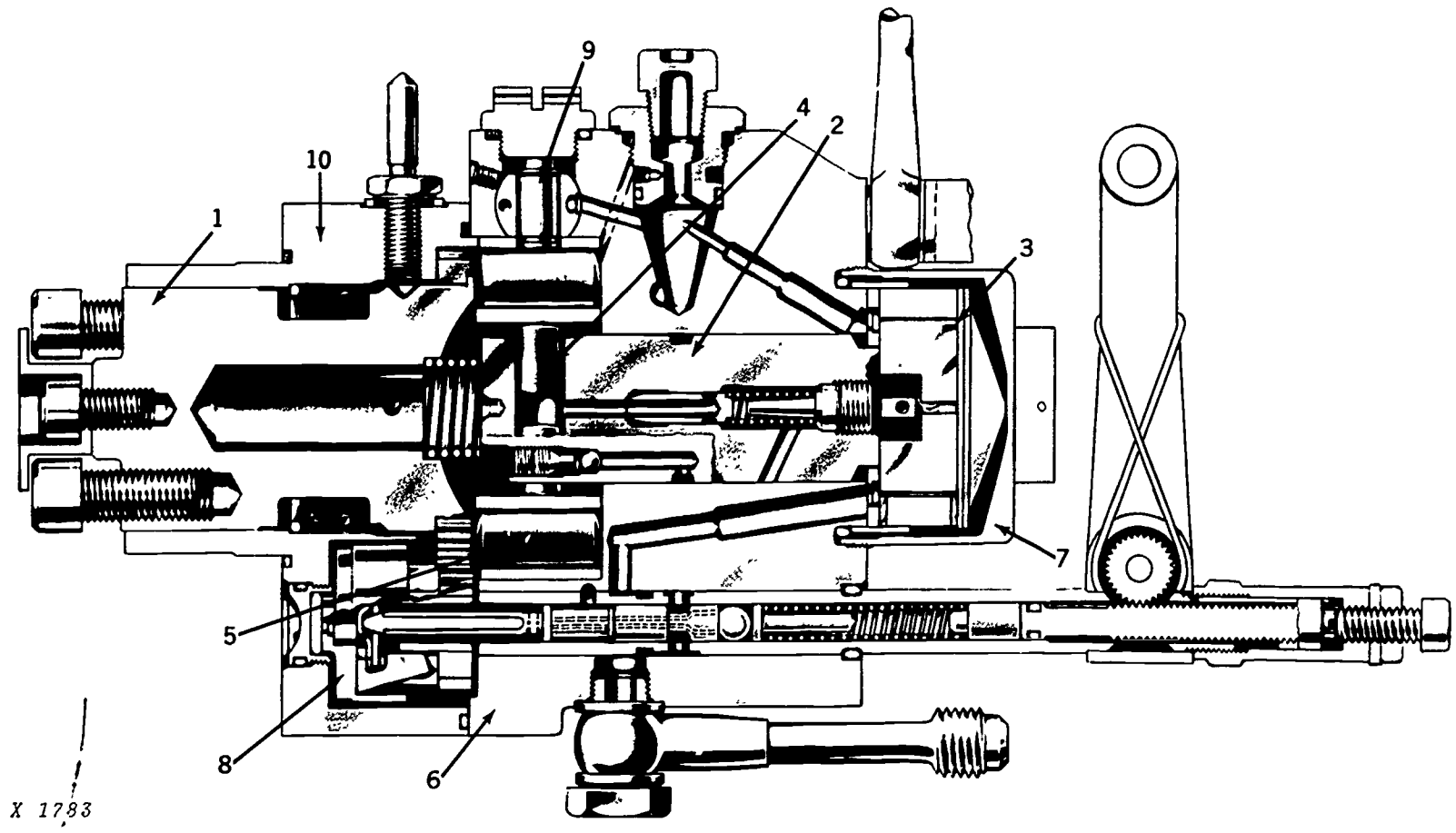


Fig. 14 — A Distributor Injection Pump In Cutaway View

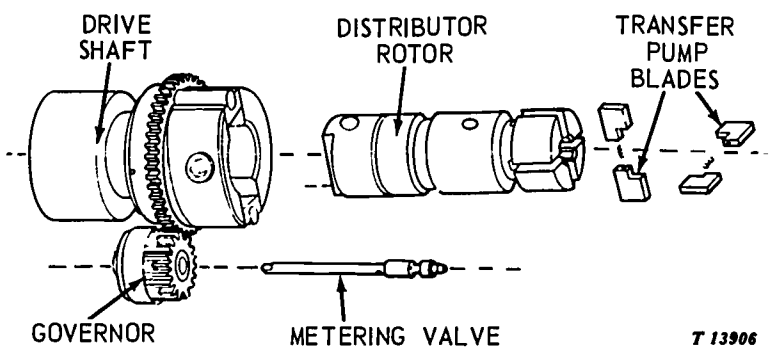


Fig. 15 — Main Rotating Parts Of Injection Pump

The main rotating components are the drive shaft, distributor rotor, transfer pump blades, governor, and metering valve (Fig. 15).

FUEL FLOW

Fuel is drawn from the tank and filters through the pump inlet by the vane-type fuel transfer pump (Fig. 16).

Pressurized fuel from the top of the transfer pump flows to the centrifugal air separation cavity. Transfer pump output and pressure increase with speed. Air entering the system is driven off with a small quantity of fuel through the orifice and back to the inlet.

A port in the air separator conducts fuel to the automatic advance. Fuel for charging is carried through a passage at the bottom of the air separator, through a pressure regulating device to the governor sleeve.

The lateral position of the metering valve is controlled by the throttle lever and governor weights. This varies the flow of charging fuel through the sleeve.

Charging fuel flows to an annulus on the rotor, through an inlet ball check valve to the pumping cylinder.

When a discharge port in the rotor registers with the proper head outlet, rollers contact the cam ring lobes and push the pumping plungers together.

As the fuel is pressurized, the inlet check valve closes and fuel trapped between the plungers is delivered to the nozzle.

The pump is self-lubricated by its own fuel. The fuel fills the entire pump and is pressurized by the housing pressure regulator.

This housing pressure also helps to separate and drive off trapped air.

FUEL TRANSFER PUMP

The vane-type fuel transfer pump consists of a stationary liner and spring-loaded blades which are carried in slots of the rotor (Fig. 17).

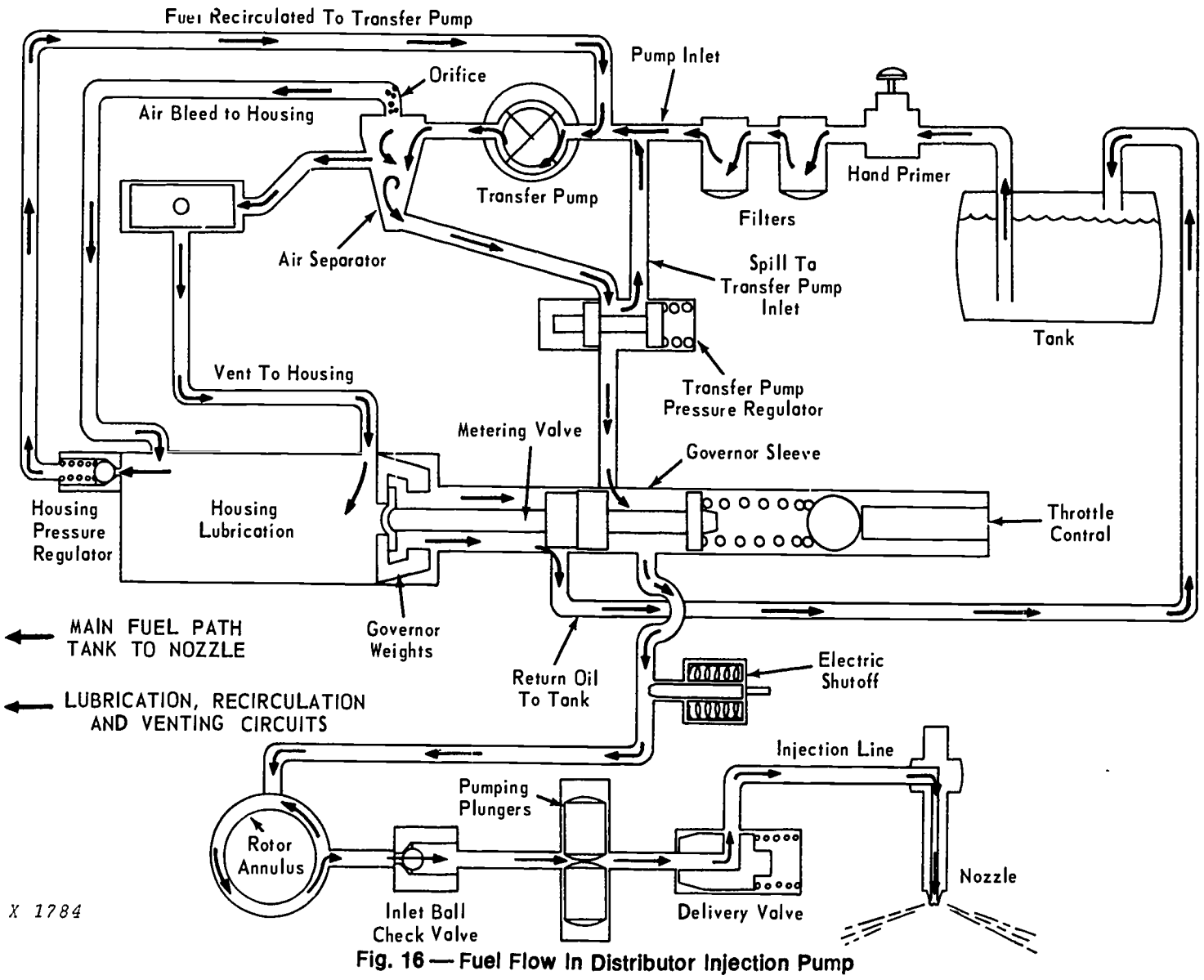


Fig. 16 — Fuel Flow In Distributor Injection Pump

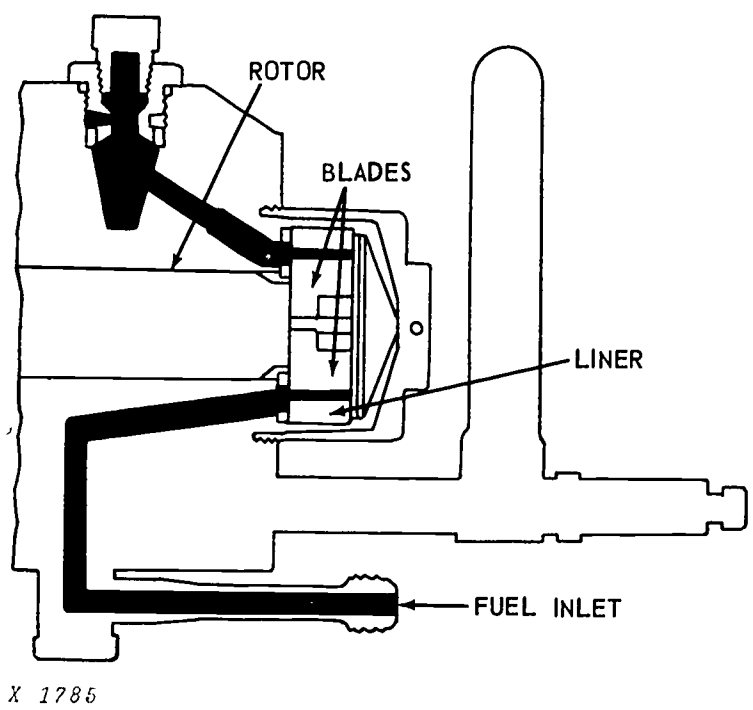


Fig. 17 — Fuel Transfer Pump

Since the inside diameter of the liner is eccentric to the rotor axis, rotation causes the blades to slide in the rotor slots. This blade movement changes the volume between the blade segments.

Fig. 18 illustrates the pumping principle. In diagram A, blade movement causes a volume increase in the quadrant between blades 1 and 2. At this time the quadrant is in registry with the inlet slot in the lower rotor retainer.

The increasing volume causes fuel to be pulled through the inlet slot into the transfer pump liner. Volume between the two blades continues to increase until blade 2 passes out of registry with the inlet slot.

In diagram B, the rotor has turned to a position where movement of blades 1 and 2 is negligible and volume between them is not changing. The fuel between the blades is simply being carried to the top of the liner.

As blade 1 passes the edge of the outlet slot (diagram C) the liner pushes blades 1 and 2 in a direction opposite to their movement in diagram A. The volume between the blades is reduced and pressurized fuel is pushed through the outlet slot to the air separator. Volume between the blades continues to decrease, pressurizing the fuel in this quadrant, until blade 2 passes the outlet slot.

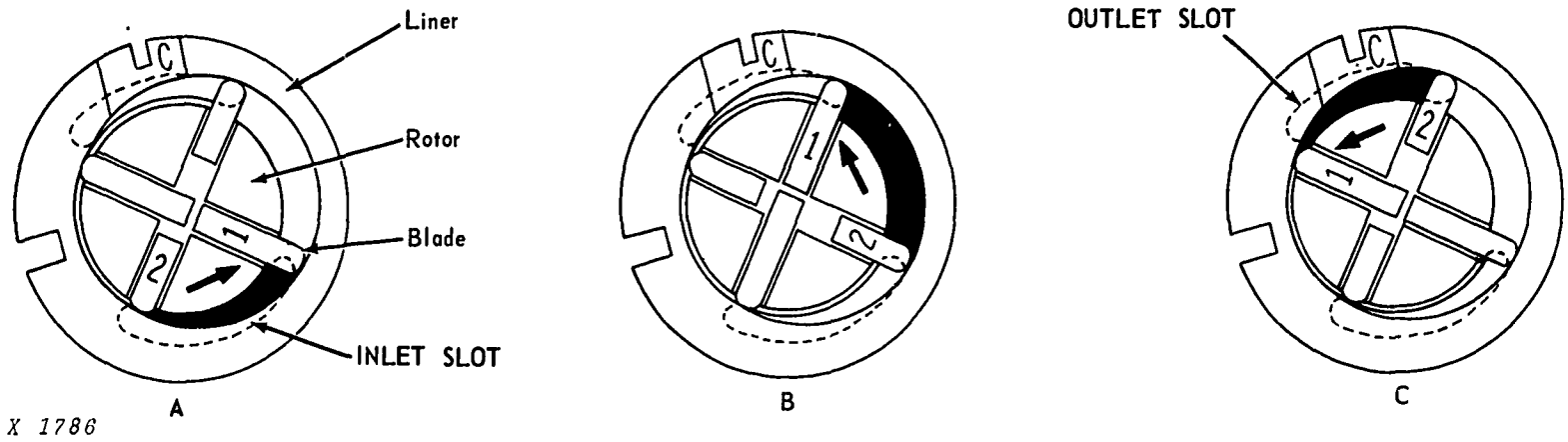


Fig. 18 — Pumping Action Of Fuel Transfer Pump

Transfer pump output and pressure increase as pump speed increases. Since displacement of the pump exceeds injection requirements, a large percentage of fuel will be recirculated through a pressure regulating valve back to the inlet side of the transfer pump (Fig. 16).

CENTRIFUGAL AIR SEPARATION AND RETURN OIL

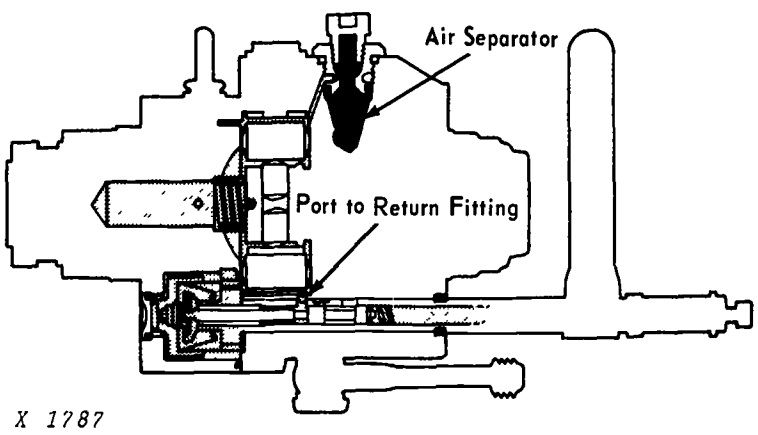


Fig. 19 — Air Separation And Return Oil Circuit

Pressurized fuel from the transfer pump enters the air separator cavity in the top of the hydraulic head at high velocity (Fig. 19).

If air enters the pump, it remains in the center of this cavity while centrifugal force swirls the heavier fuel outward. Trapped air is purged through an orifice in the air bleed plug.

A small quantity of fuel flows through an orifice and into the pump drive housing as shown in blue (Fig. 19).

This fuel fills the housing and lubricates the drive shaft, ring gear, cam rollers and shoes, and governor components. Clearance between the forward metering valve land and sleeve permits a small amount of fuel into the governor sleeve. This fuel flows through a drilled passage in the valve to lubricate the governor spring components.

A port in the sleeve directs fuel through a head passage to the return fitting and back to the fuel tank. The flow of return fuel cools the pump and carries air purged in the separator to the tank where it will dissipate.

TRANSFER PUMP PRESSURE REGULATION

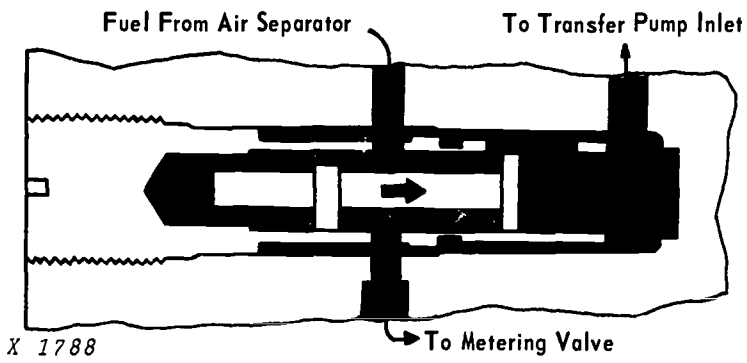


Fig. 20 — Pressure Regulating Valve For Transfer Pump

Air-free fuel is ported from the bottom of the air separator to a pressure regulator in the front of the hydraulic head (Fig. 20).

The fuel flows around a reduced diameter of the sleeve and enters the sleeve through drilled ports. At the same time fuel flows through a head passage to the governor sleeve and metering valve.

Fuel pressure within the regulator sleeve pushes the regulating piston rearward against regulating spring force. As the regulating land of the piston opens a spill port (or slot), excess fuel bypasses back to the transfer pump inlet.

Pressure is adjusted by turning the threaded sleeve in its bore. Turning the sleeve in raises the pressure, while turning the sleeve out lowers pressure.

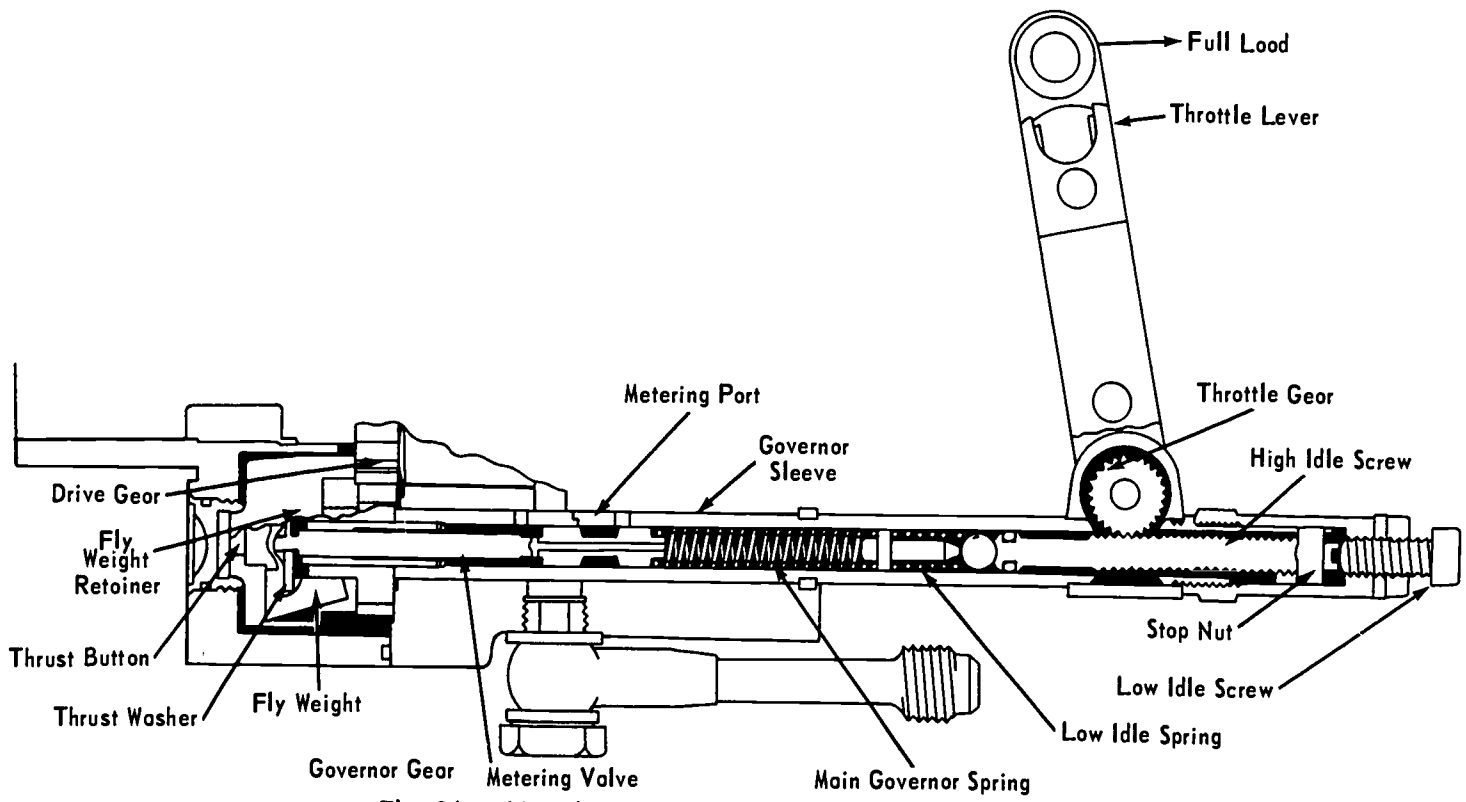


Fig. 21 — Metering And Governing Mechanisms

METERING AND GOVERNING

The quantity of fuel delivered to the pumping cylinder is controlled by the metering valve position in the governor sleeve (Fig. 21).

Fuel enters the sleeve through a tapered inlet port which is partially restricted by the valve metering land. Forward movement of the valve increases port opening and metered fuel flow; rearward movement decreases it.

The centrifugal governor, driven by the drive gear, gets its energy from the flyweights pivoting on their outer edges in the retainer (Fig. 21). Centrifugal force tips them outward, moving the thrust washer and metering valve rearward. The force on the metering valve is balanced by a compression-type governor spring, mechanically controlled by the throttle lever.

Moving the throttle lever to the full load position rotates the throttle gear. The rack-and-pinion of the gear and high idle screw moves the screw forward in the sleeve. Acting through the ball, the screw fully compresses the low idle spring above idling speeds and exerts a compression load on the main governor spring.

Full Load Metering

When the engine is running under full load, the governor spring force overcomes the weights and they are collapsed (Fig. 22, top).

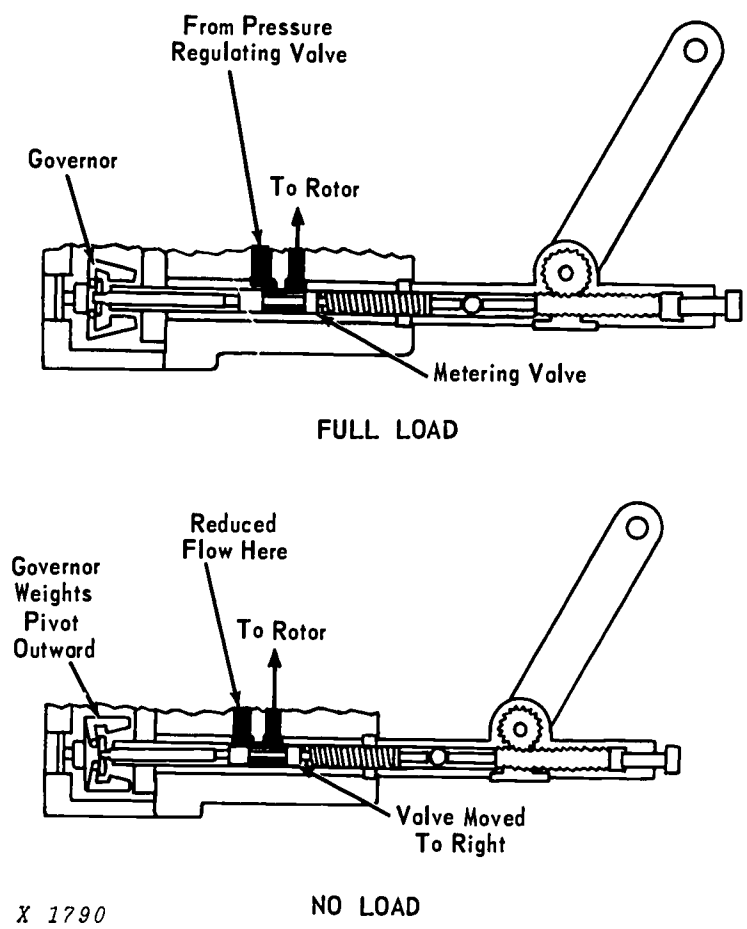


Fig. 22 — Governor And Metering Valve In Operation

The metering valve is held forward in the sleeve, allowing full opening of the inlet port and a high metered flow of fuel.

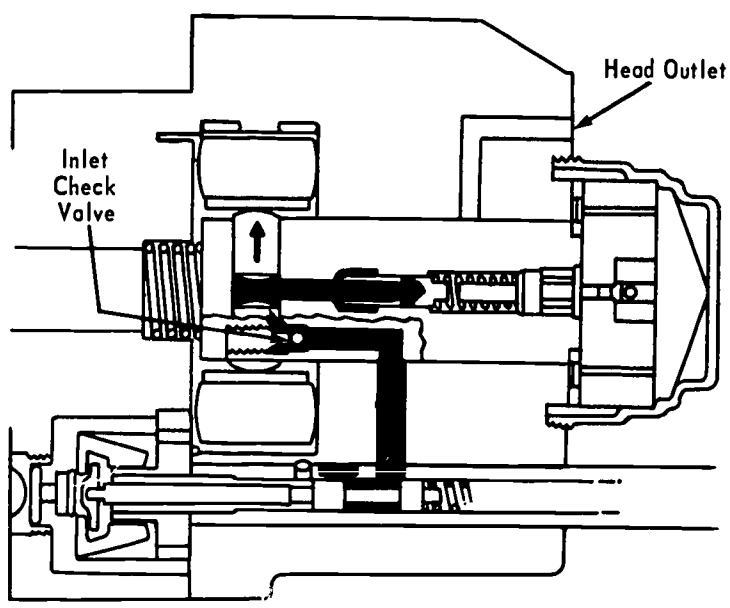
High Idle Metering (No-Load)

When the load is removed from the engine and the speed increases, the weights pivot outward in the retainer, overcoming the spring load. This pushes the metering valve rearward, reducing the inlet port opening area. Metered flow past the valve decreases until the spring load is balanced. See lower part of Fig. 22.

Low Idle Metering

A slight movement of the throttle lever compresses only the low idle spring. Although engine speed is low, the governor weights are allowed to pivot outward because they are opposed only by the comparatively low force exerted by this spring. The metering land allows only a slight port opening and reduced metered flow for low idle operation.

CHARGING OF FUEL



X 1791

Fig. 23 — Charging Of Fuel

Fuel from the metering valve is directed through a head passage to the rotor annulus. While the rollers are between cam lobes, fuel flow from the annulus opens the inlet check valve to charge the pumping cylinder (Fig. 23).

The plungers move outward a distance proportionate to the amount of fuel required for injection on the following stroke. If only a small quantity of fuel is admitted into the pumping cylinder as at idling, the plungers move out very little.

To limit the plunger travel and, consequently, the maximum fuel delivery, an adjustable leaf spring contacts the edge of the roller shoes (Fig. 24). Only when the engine is operating at full load will the plungers move to the outer position.

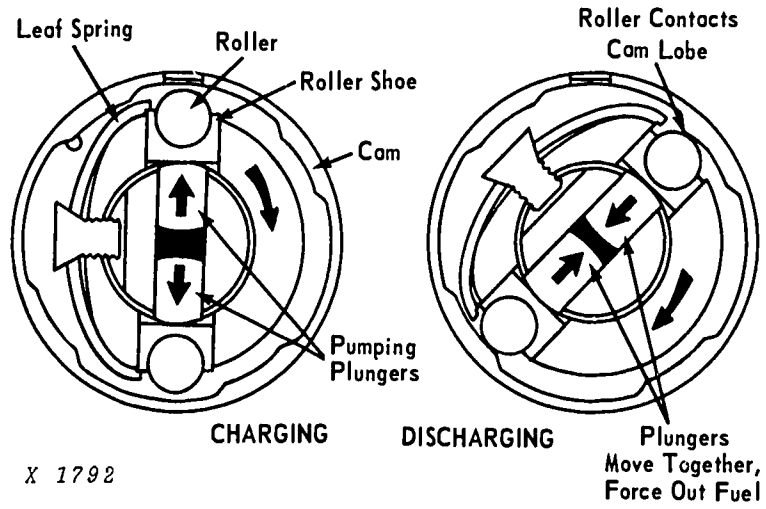


Fig. 24 — How The Pumping Plungers Are Actuated By The Rollers Working On The Cam

Note in Fig. 23 that during the charging cycle the rotor discharge port is not in registry with any head outlets to nozzles.

DISCHARGING FUEL

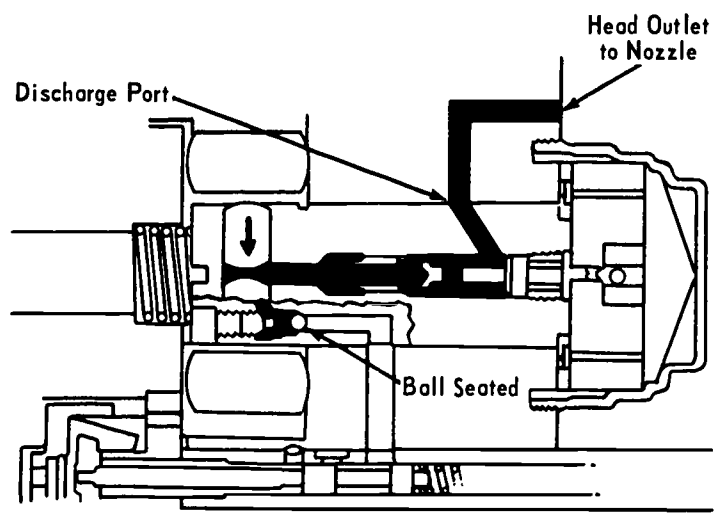


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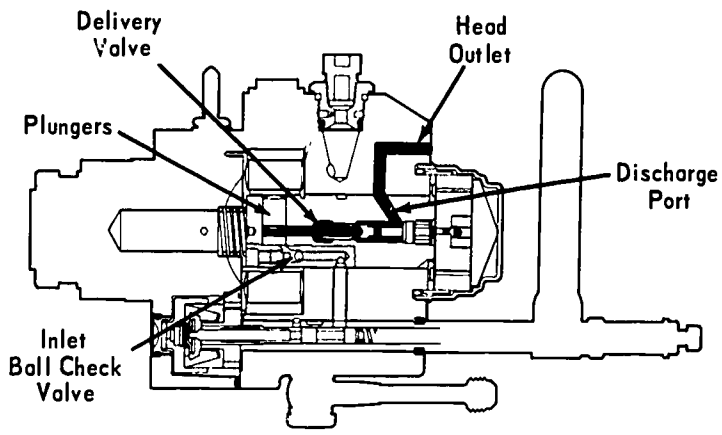
Fig. 25 — Discharging Of Fuel To Nozzle

Rotation of the rotor aligns the discharge port with one of the head outlets. Then the rollers contact opposing lobes on the cam forcing the plungers together (Fig. 24). Pressure between the plungers seats the ball check valve, isolating the charging circuit.

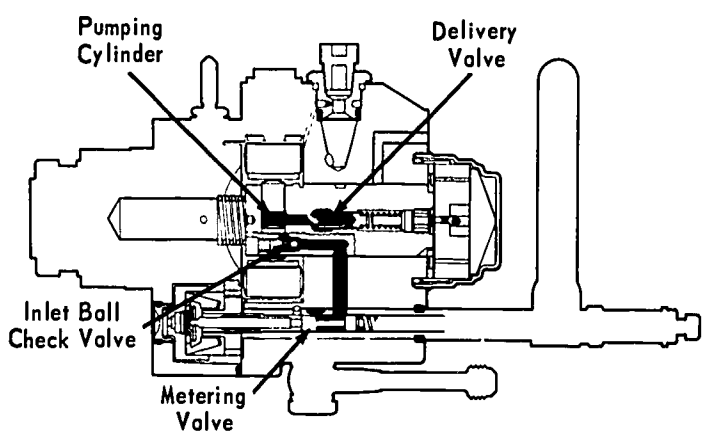
As a result, fuel at high pressure flows through the rotor passage, delivery valve, and out the discharge port to the nozzle.

Delivery continues until the rollers pass the highest point on the cam lobes and then are allowed to move outward again. The pressure in the rotor passage is quickly relieved, allowing rapid closing of the nozzle. This prevents dribbling of fuel into the combustion chamber.

DELIVERY VALVE OPERATION



DELIVERY VALVE OPEN (INJECTING)



X 1794 DELIVERY VALVE CLOSED (RETRACTING)

Fig. 26 — Delivery Valve

The delivery valve (Fig. 26) controls the fuel retraction which follows each injection stroke.

When injection starts, fuel pressure moves the delivery valve slightly out of its bore and adds the volume of its displacement to the enlarged cavity of the rotor occupied by the delivery valve spring. This displaces a similar volume of fuel in the spring cavity before delivery through the valve ports starts.

At the end of injection, pressure on the plunger side of the valve is quickly reduced by outward movement of the plungers. Spring force and line pressure close the valve.

As the valve closes, fuel rushes back out of the injection line to fill the volume left by the retreating delivery valve. Valve length determines the amount of retraction from the line.

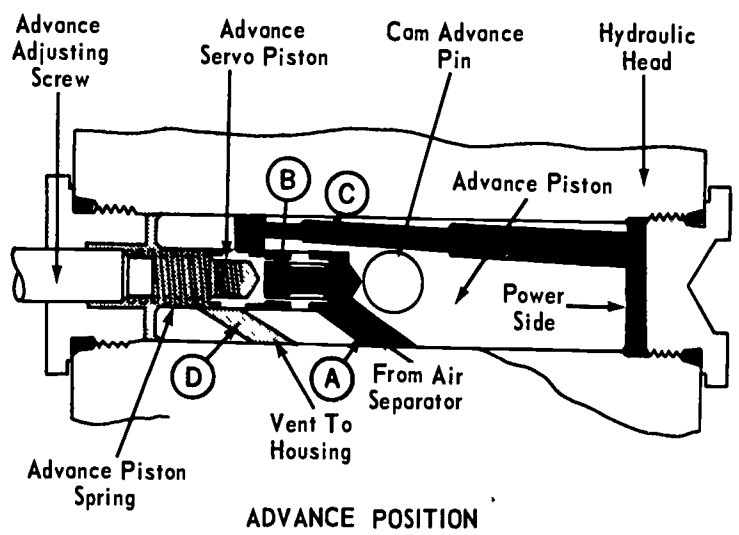
Further rotation of the rotor closes the discharge port and the remaining line pressure is trapped.

Since the single valve serves all lines, retraction will not vary between cylinders, resulting in smooth operation at all speeds and loads.

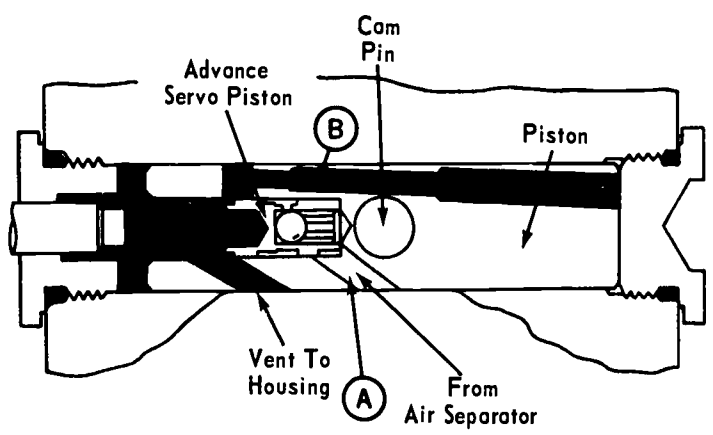
AUTOMATIC SPEED ADVANCE

Some distributor pumps have a speed advance mechanism. This automatically varies the injection timing in response to different engine speeds. The result is more power and better combustion at all loads and speeds.

The speed advance is a hydraulic servo-mechanism, operated by fuel pressure from the transfer pump.



ADVANCE POSITION



X 1795 RETARD POSITION

Fig. 27 — Automatic Speed Advance In Operation

The advance piston, located in a bore at the top of the hydraulic head, engages the cam advance through the pin and advances the cam when fuel pressure moves the piston opposite to the direction of rotor rotation (Fig. 27).

Advance Operation (Fig. 27, Top)

Fuel enters the advance piston from the air separator through passage "A". Increasing transfer pump pressure pushes fuel through the check valve in the piston.

At the same time, the advance servo piston moves in its bore against spring force until the land on the piston opens port "B". Fuel then flows through port "B" and passage of "C" to the power side of the advance piston.

Fuel pressure pushes the advance piston opposite to the direction of rotor rotation, advancing the injection timing in response to the increasing engine speed.

Two passages (D), in the advance piston, vent fuel to the housing from the spring side of the servo and advance pistons as they move, preventing hydraulic lock.

Retard Operation

When transfer pump pressure decreases, the ball check is returned to its seat and the servo piston moves back in its bore, closing port "B". See Fig. 27, bottom.

Fuel flow to the power side of the advance piston ceases. Further movement of the servo piston moves the land past port "B" venting fuel from the power side of the advance piston to the housing and the cam advance mov to a retarded position.

Piston travel in either direction is limited by contact with the piston plugs.

Speed advance is adjusted at the screw shown at the top in Fig. 27.

SUMMARY: DISTRIBUTOR INJECTION PUMPS

Several models of distributor pumps are used on modern diesel engines. We have selected only one type to show operation.

However, basic operation is similar on all these pumps. One pump feeds several nozzles and a plunger and cam mechanism pumps the fuel.

Now let's review the basic service needed for distributor injection pumps.

INTRODUCTION TO INJECTION PUMP SERVICE

Remember these points when servicing an injection pump:

1) Disassemble and inspect the injection pump only if there is a clear sign it is malfunctioning.

2) Be sure to trouble shoot the fuel system and pinpoint the failure before you begin to service a component. (See the "Trouble Shooting" section at the end of this chapter.)

3) The pump is a precision instrument and can be easily damaged by careless service.

4) Only a qualified mechanic with the proper tools should disassemble or service the injection pump.

5) The story which follows is not meant as a detailed instruction for servicing and testing the injection pump. The Technical Manual will provide this information.

SERVICING AND TESTING THE PUMP

To perform quality service on an injection pump, you need these items:

1. A clean, well-lighted work area isolated from the rest of the shop.

2. Tools that are clean and in good condition. (Many injection pumps require special tools for servicing.)

3. Accurate test equipment as prescribed by the pump's Technical Manual.

4. Technical publications that give detailed service procedure and specifications for the particular pump.

Service Procedures

Remember, the services described here are general and are only for a *typical* injection pump.

Get detailed service and specifications from the pump Technical Manual.

Prior to removal, clean the pump exterior and the area around it.

A word of caution—**never spray a warm pump with cold water during operation.** This could cause the pump to seize. Steam cleaning can also harm the pump at these times.

When removing injection lines from the pump, cap the lines as well as the pump ports to prevent dirt from entering.

Inspection Of Pump Parts

1. Sticking parts may have a coating of light varnish on them. If so, use a soft brush and lacquer thinner to remove it.

2. Some matching parts such as rotors and hydraulic heads must be replaced as a set. (The fit on some of these parts is so close that heat from your hand will expand them enough to temporarily make them oversize.)

3. Replace all seals and gaskets regardless of their condition. Use special tools and lubricants where recommended.

4. Flush all parts in clean fuel as they are reassembled.

Testing and Adjusting The Injection Pump

The only proper method of testing the injection pump is with an injection pump test stand (Fig. 28). Since each tester has its own set of instructions, be sure to follow them.

After the pump is connected to the tester, run it for 10 minutes. This will warm the pump and bleed air, through loosened injection lines.

LEAKAGE TEST

With all connections tight, run the pump at full-load rated speed for several minutes. Clean the pump exterior and dry it with compressed air. Then check the exterior for any leaks and repair, if necessary.

VACUUM TEST

The vacuum test used on some pumps helps determine if air is being drawn into the pump.

With the fuel supply cut off, the test gauge should read a specified number of inches of mercury (Hg). If it doesn't, there is an air leak.

TRANSFER PUMP PRESSURE TEST

Transfer pump pressure is tested at various speeds. The correct pressures are given in the pump specifications.

FUEL DELIVERY TEST

Graduated glass tubes in the pump test stand measure the fuel at various speeds. The amount of fuel injected into the test tubes is recorded at various speeds and the average is compared to specifications.

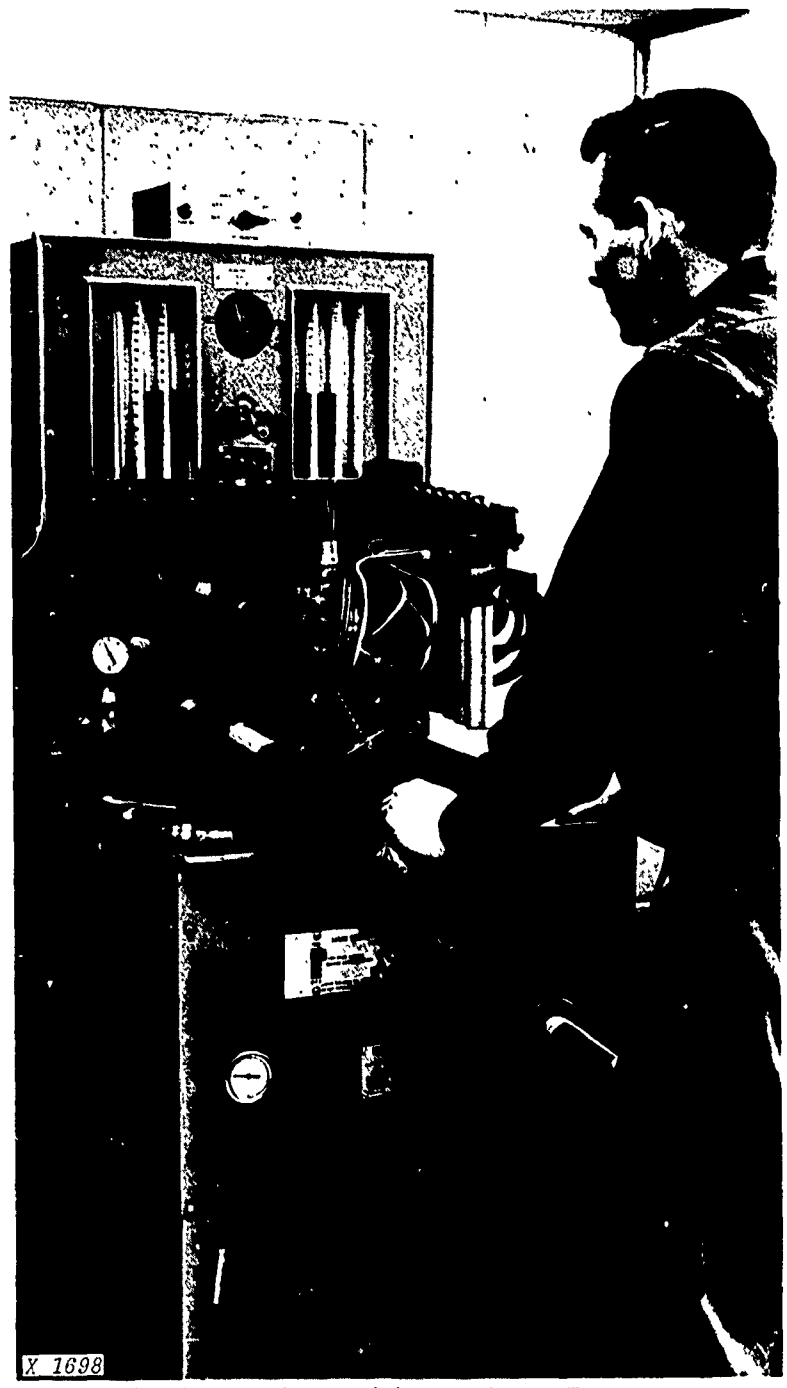


Fig. 28 — Using An Injection Pump Test Stand

IDLE ADJUSTMENT

Slow and fast idle adjustments can also be made to specifications on most test units. Once these adjustments are made, the pump is ready to install on the engine.

TORQUE CONTROL ADJUSTMENT

If the pump is equipped with a torque adjustment, make it while the pump is on the test stand.

Installing And Timing The Pump

When installing the pump, be sure it is timed to the engine. Various timing tools are used to line up the pump with the engine.

The advance mechanism (if used) should also be adjusted after the pump is installed. This will prevent misfiring or loss of power during engine operation.

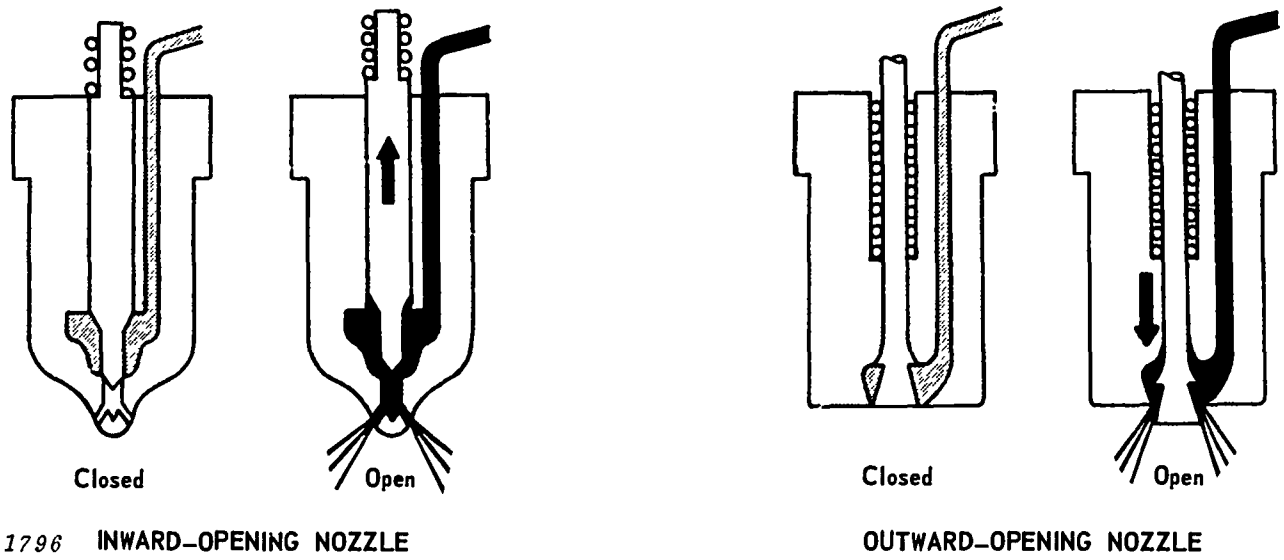


Fig. 29 — Nozzles Compared

INJECTION NOZZLES

The injection nozzle must do two jobs:

1) Atomize the fuel for better combustion

2) Spread the fuel spray to fully mix it with air

In addition, all nozzles in multi-cylinder engines must inject fuel equally for smooth power.

TYPES OF NOZZLES

Nozzles are simple devices. They use a spring to oppose fuel pressure until the right instant for injecting fuel, when the nozzle valve opens. The opening pressure usually can be adjusted.

Most nozzles today are **closed** types—that is, the fuel pressure acts on only one side of the nozzle valve.

Closed-type nozzles are classified as follows:

INWARD-OPENING NOZZLES

- *Differential Pressure*
- *Hole Type*
- *Pintle Type*
- *Pintaux Type*

OUTWARD-OPENING NOZZLES

- *Poppet Type*
- *Pintle Type*
- *Multi-Orifice Type*

In INWARD-OPENING NOZZLES, the fuel pressure acts on the lower end of the valve, moving it inward to release a fuel spray (Fig. 29). A spring at the upper end of the valve is normally adjusted to set the opening pressure.

In OUTWARD-OPENING NOZZLES, the fuel pressure acts on the valve only in the direction of flow (Fig. 29). Since combustion chamber pressures tend to close the valves, the opening pressure is relatively low. No fuel leak-off is required.

Let's discuss each nozzle under the two broad types—inward- and outward-opening.

INWARD-OPENING NOZZLES

Differential pressure nozzles are operated hydraulically. When fuel pressure to the nozzle rises to the set level, the nozzle valve opens against spring pressure and injects fuel. As pressure drops again, the valve closes and injection stops. The valve shown at left in Fig. 29 operates like this. This nozzle can be adjusted by spring tension for accurate operation.

Hole-type nozzles provide some extra features. The number and size of the spray holes can be varied for the exact spray pattern needed. These nozzles are best for engines with open combustion chambers.

Pintle-type nozzles use a tapered valve which seats in a single orifice in the valve body (see at right in Fig. 29). The pintle type is fairly simple but produces a hollow spray and is not as versatile as the hole type.

Pintaux-type nozzles are a variation on the pintle type. An extra hole is added in the head to spray out fuel at an angle during low engine speeds. This gives an aid for starting the engine (as in cold weather). The extra hole is angled toward the "hottest" part of the combustion chamber for faster firing.

OUTWARD-OPENING NOZZLES

In all these valves, the opening pressures are fairly low, as explained above.

A **poppet-type nozzle** that opens outward sprays with a fine vapor, but has too little penetration for most diesels.

A **pintle-type nozzle** that opens outward is shown at right in Fig. 29. Fuel pressure acts on the tapered head to unseat the valve at a preset pressure. As the valve moves, the extra shoulder is exposed to fuel pressure, causing the valve to open rapidly for a good spray without dribbling fuel. This nozzle is fairly simple and very lightweight.

Multi-orifice nozzles are a variation on the pintle type. The pintle fits closely on its seat and when it starts to move the fuel sprays out a ring of holes instead of past the pintle and out the head.

OPERATION OF A TYPICAL NOZZLE

Let's see how a typical nozzle works. In Fig. 30 we show a differential-pressure nozzle which opens inward.

Parts Of The Nozzle

The nozzle body contains the moving parts—the valve and spring.

Nozzle opening pressure is controlled by the adjusting screw on the valve spring.

How far the valve moves when injecting fuel is controlled by the lift adjusting screw.

How The Nozzle Works

Metered fuel at high pressure from the pump enters the fuel inlet (Fig. 30).

This fuel surrounds the nozzle valve and forces the valve from its seat at a preset pressure. A measured amount of fuel then sprays out the tip into the engine combustion chamber at high velocity.

As the fuel is injected, pressure drops and the spring is able to close the valve very rapidly.

A small amount of fuel leaks past the nozzle valve and lubricates the working parts.

The excess lubricating fuel is removed from the top of the nozzle at the fuel leak-off and returns to the tank.

SERVICE AND TESTING OF NOZZLES

Injection nozzles are precision parts operating rapidly in conditions of heat and pressure, so they can fail.

Usually, nozzle failure is caused by dirt clogging the orifices and passages. This can be easily remedied by thorough cleaning.

However, a nozzle does not have to stop injecting fuel completely to be considered a failure. On the next page is a list of causes of nozzle failures.

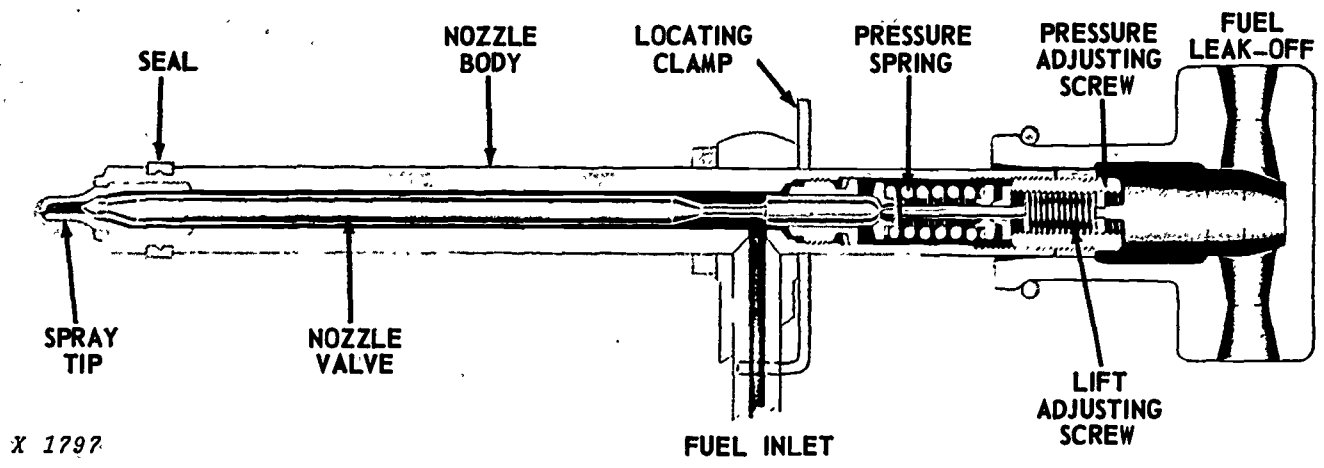


Fig. 30 — Typical Injection Nozzle Which Opens Inward and Operates By Pressure Differences

Nozzle Trouble Shooting Chart

Problem	*Possible Cause*
Nozzle opens at wrong pressure	Wrong spring pressure adjustment
	Broken spring
Nozzle will not open	Plugged orifices (spray tip only)
Poor spray pattern	Plugged or chipped orifices (spray tip only)
	Chipped or broken pintle end
	Deposits on pintle seat
	Chipped pintle seat
Poor misting fuel	Plugged or chipped orifices (spray tip only)
	Valve not free
	Cracked tip
Valve operates erratically	Valve spring misaligned
	Spring broken
	Deposits on pintle seat
	Bent valve
	Distorted body
Valve will not operate	Valve spring misaligned
	Spring broken
	Varnish on valve
	Deposits in seat area (pintle tip only)
	Bent valve
	Valve seat eroded or pitted
	Distorted body
Too much fuel leaks off	Valve guide wear
Too little fuel leaks off	Varnish on valve
	Not enough clearance between valve and guide

Removing The Nozzles

First clean the area around the nozzle. Next, remove and cap the injection and leak-off lines. Then remove the nozzles from the engine. (Some nozzles may require a special tool for removal).

Cleaning The Nozzles

Soak the entire nozzle assembly in clean solvent or fuel after discarding the outer seals. Clean the spray tip and nozzle body with a **brass** wire brush. **Never use emery cloth or a steel wire brush to clean nozzles as the precision tips will be damaged.**

Testing Of Nozzles

When testing the nozzles, always follow the Technical Manual.

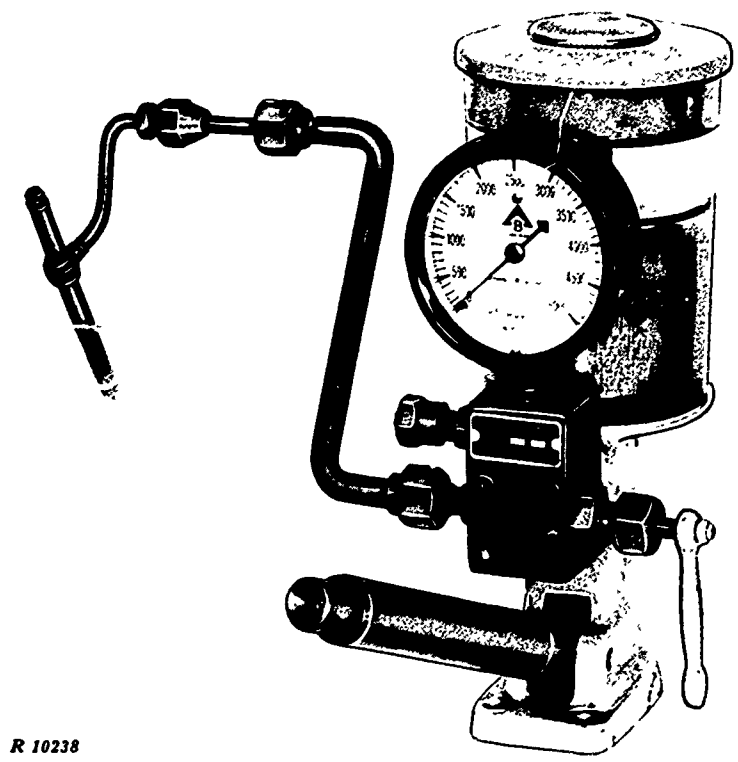


Fig. 31 — Nozzle Tester

A nozzle tester is used in making these tests (Fig. 31). It is a high-pressure hand pump which forces fuel through the nozzle. Usually the nozzle is tested for three things:

1) Chatter and spray pattern

2) Opening pressure

3) Valve leakage

A word of caution when using this type of tester: The fuel comes out of the nozzle at extremely high-pressure—which can penetrate clothing and skin and cause injury. Always keep the nozzle pointed away from you or, better yet, enclose it in a transparent beaker as shown in Fig. 31.

After the nozzle is attached to the tester, flush out the nozzle by rapidly pumping the tester (with the gauge closed).

Spray Pattern Check

Check the spray pattern first. The fuel should be finely atomized and distributed evenly. There should be no stream or large visible drops.

If the spray pattern is poor, look for a clogged or eroded orifice or a bent valve.

Opening Pressure Test

The pressure needed to open or "crack" the nozzle is checked by pumping the tester steadily until the tester gauge needle falls rapidly. Check this pressure reading against the specifications.

If the pressure is too low, a weak or broken spring might be the cause or the spring pressure may need adjustment.

If the pressure is too high, the tip may be plugged or the valve may be binding in the valve guide.

Summary: Testing Of Nozzles

If all tests prove that the nozzle is working okay, don't disassemble the nozzle any further.

If the tests show a failure, the nozzle must then be disassembled, inspected, cleaned or repaired.

Introduction To Nozzle Service

1) All nozzles require careful handling. See your nozzle or engine Technical Manual for the exact service procedures.

2) All nozzles require a special tool kit to perform any service. Never attempt to service them without it.

3) When working on several nozzles, DO NOT mix nozzle parts.

Cleaning Nozzle Parts

Most nozzle servicing is just cleaning off carbon and dirt deposits. A good soaking in clean solvent will remove much of the residue. Usually, a **brass** wire brush will clean off the remainder. **DO NOT use a steel wire brush.** It can scratch smooth surfaces or erode the spray orifices (Fig. 32).

Fig. 32 — Nozzle Orifices Eroded By Use Of A Steel Wire Brush For Cleaning

Special tools from the nozzle kit are often needed to clean internal seats, orifices, and passages. For example, the tiny spray orifices in some nozzles tips are very critical in size and require special gauged cleaning wires.

Inspecting Nozzle Parts

Normal wear on valve parts can be ignored unless it is causing the valve to fail.

Inspect the parts primarily for abnormal wear, chipped edges, scratches, misalignment, and broken parts. The trouble shooting chart on page 5—20 gives you an idea of where to look for them.

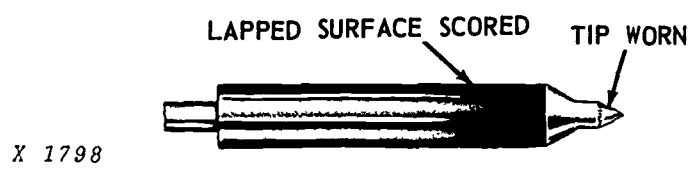


Fig. 33 — Nozzle Valve Damaged Beyond Repair

A magnifying glass will help in inspection.

Repair Of Nozzles

If cleaning does not correct the nozzle failure, replace the defective parts.

Examine parts closely because some nozzle parts can be salvaged. For example:

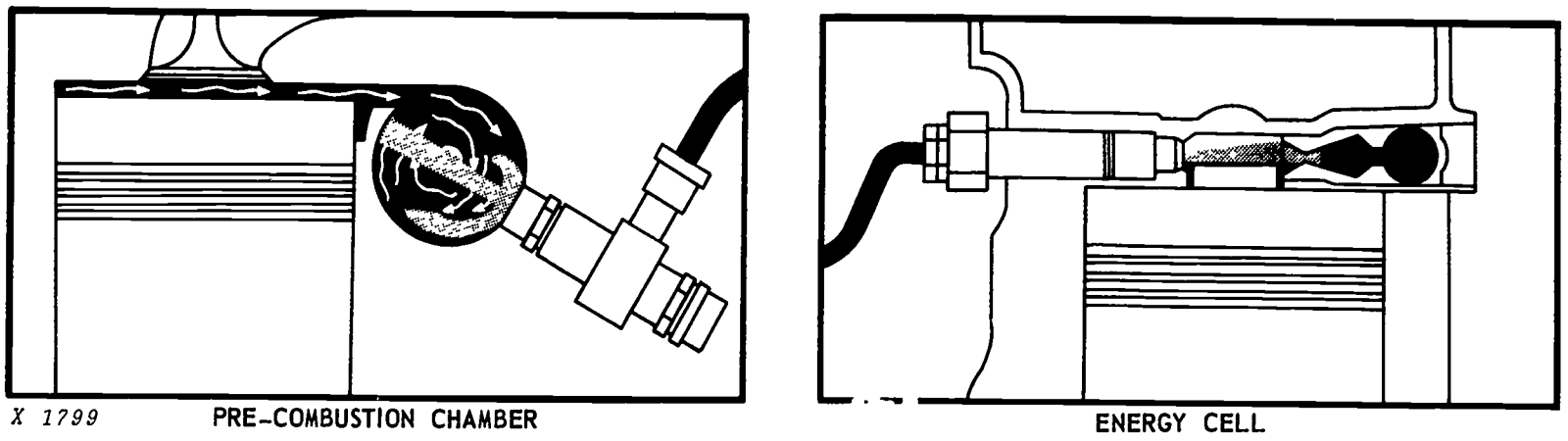


Fig. 34 — Combustion Chambers

1) If the valve in some types of nozzles is sticking and it is not bent, a little polish or lapping compound around the valve guide area may be all that is needed.

2) Other nozzle parts may also be corrected by lapping their surfaces to remove tiny scratches or burrs. Always be careful when lapping any parts to avoid excess wear on the parts.

Parts that are chipped, broken or badly bent should be replaced. If damage is extensive, replace the entire nozzle.

NOTE: Some nozzle parts are sold as matched sets. In this case, replace both parts if either one is damaged.

Reassembly Of Nozzles

Flush each part in clean fuel before reassembly. Then place it on the nozzle tester for retesting.

Any spring pressure adjustment is usually made before retesting.

If the tests still show a malfunction, then the nozzle will have to be serviced again.

COMBUSTION CHAMBERS

We have already mentioned that the injection nozzle and its atomization helps the fuel to mix with the air. However, the piston crown and cylinder head design also play an important part in mixing fuel and air.

In "open" combustion chambers (a chamber in which all fuel and air are confined to one area) the piston crown is concave like a saucer. The chamber is then like half a ball. The piston comes close to the cylinder head and makes it easier for the fuel to spray evenly into the chamber. The concave in the piston crown also sets up a turbulence of the compressed air. This speeds up the air and makes it easier to mix with the fuel.

OTHER TYPES OF COMBUSTION CHAMBERS

In some small, high-speed diesel engines, the combustion is too slow and without help all the fuel would not be burned.

These engines use specially designed chambers to compensate for this combustion loss. The chambers are of three basic types:

- **Turbulence Chambers**
- **Precombustion Chambers**
- **Energy Cell Chambers**

TURBULENCE CHAMBER—The fuel is injected into a small spherical chamber connected to the cylinder. The chamber is shaped to produce a high turbulent condition. As the piston starts the compression stroke, the air is forced into the chamber, setting up a rotary motion. Near the top of the piston stroke, the fuel is injected into the swirling air and good mixing results.

PRECOMBUSTION CHAMBER—It is similar to the turbulence chamber. However, only part of the air charge is forced in. When the fuel starts to burn with an insufficient amount of air, it ignites, forcing the burning fuel into the cylinder. At this velocity, the fuel readily mixes with the remaining air during combustion.

ENERGY CELL—The energy cell is similar in appearance to the air cell. However, the fuel is forced into the energy cell and combustion takes place there. The piston forces this air in during the compression stroke. At the end of the stroke the nozzle sprays fuel across the top of the piston toward the energy cell. About one-half of the fuel is burned in the main chamber at this time and forces the remaining fuel into the energy cell. Fuel and air mix and ignite in the cell, then blow out into the main chamber. The turbulence created by combustion in the energy cell mixes and ignites

any remaining fuel and air in the main chamber. In this case, combustion occurs in *three* different stages, which completes the burning of the fuel.

The chamber and cells we have just described are special devices and are not used on most engines.

GENERAL PROBLEMS OF DIESEL COMBUSTION

The primary goal of the diesel fuel system is to deliver fuel to the engine cylinder for combustion.

However, good combustion depends on four conditions:

1. The fuel must be good-quality and the correct type.

2. The fuel must be finely atomized.

3. There must be high temperatures.

4. The fuel and air must be completely mixed.

Let's look at each of these briefly.

CORRECT TYPE OF FUEL

Diesel fuel is graded for various types of engine service. Always follow the operator's manual for the engine when selecting the fuel.

Other factors are sulfur content, water and sediment content, and pour point.

The cetane number is also important as a measure of the ignition quality of diesel fuel—at what pressure and temperature the fuel will ignite and burn.

ATOMIZING THE FUEL

The injection nozzle atomizes the fuel, which helps the fuel mix with the air. However, the nozzle also helps to make a **vapor** of the fuel.

Vaporizing the fuel is important. **Remember, only a gas or vapor will burn readily.** In this case, the heat of the compressed air vaporizes the fuel. But, because so little time is allowed for combustion, the fuel particles must be as small as possible so that they will vaporize faster.

This does not mean that the fuel becomes a gas and this gas mixes with the air and then ignites. Actually, each fuel particle absorbs heat and then throws off vapor. The vapor then mixes with the nearest air molecule and ignites. All the combined fuel vapor-air particles do not ignite at the same time. However, the speed of this process is so fast that it appears that they do.

HIGH TEMPERATURES NEEDED FOR COMBUSTION

We learned in Chapter 1 that the heat generated by compressed air does the same job that the spark does in a gasoline engine. The amount of heat is determined by the compression ratio of the engine, the size of the cylinders and the efficiency of the cooling system. Diesel engines with small cylinders have a *higher* compression ratio than a gasoline engine; and the higher the compression, the more heat for combustion.

In summary: Higher diesel compression = more heat = combustion without a spark.

STARTING THE DIESEL ENGINE

Since the diesel engine depends on heat in the combustion chamber for ignition of the fuel, starting the engine in cold weather may be a problem.

Many diesel engines are started in cold weather with starting aids. These aids may be in one of two forms:

1) A highly volatile vaporized liquid (direct injection systems only).

2) An electrical "glow" plug which preheats the combustion chamber.

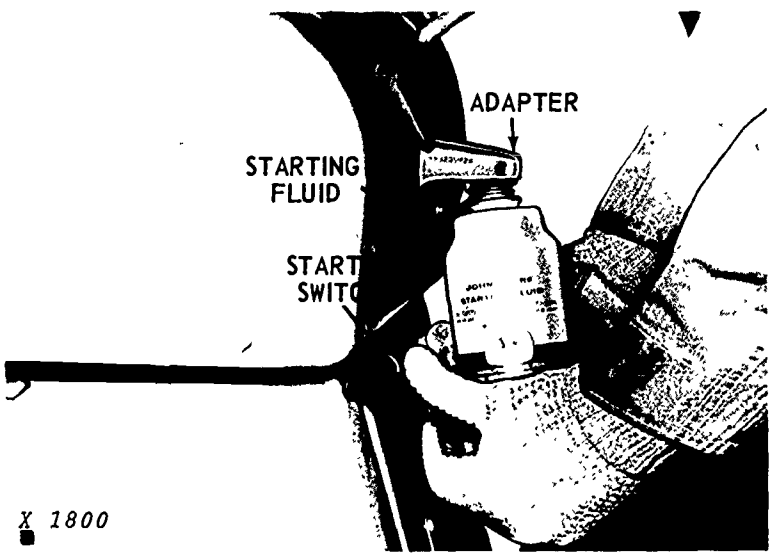


Fig. 35 — Injecting Starting Fluid For Cold-Weather Starting Of Diesel Engine

Since **ether** has a low ignition point, the heat generated in the combustion chamber is able to ignite it. Heat from this ignition then ignites the fuel-air mixture and normal combustion takes place. Once the engine is started, ether is no longer necessary.

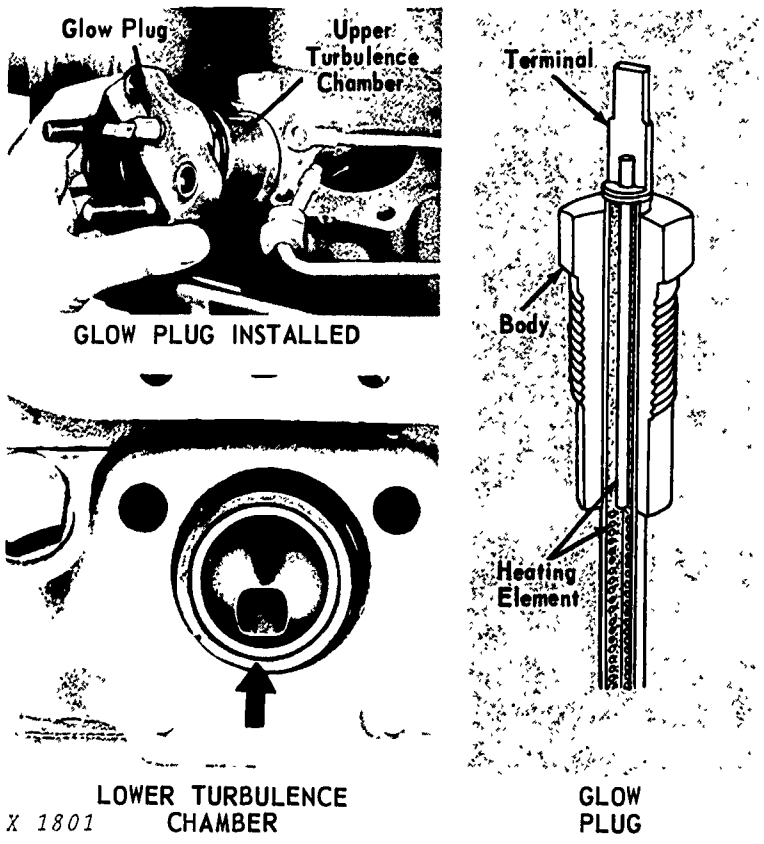


Fig. 36 — "Glow" Plug For Cold Weather Starting Of Diesel Engine

The *"glow" plug* fits into a small tubulence chamber in the engine head (Fig. 36). The injection nozzle is also in this chamber. While starting the engine, the "glow" plug is turned on. The heat from the "glow" plug ignites the fuel-air mixture. Heat generated by this combustion is then able to ignite the mixture in the turbulence chamber and continue the combustion process without the aid of the "glow" plug.

Be careful when using either of these devices. Always follow the operator's manual for recommended procedures and precautions.

BLEEDING AIR FROM DIESEL FUEL SYSTEMS

When the diesel fuel system has been opened or has run dry, a lot of air gets into the system. If this air is left in the lines, it may form an air lock which will prevent fuel from reaching or going through the injection pump. Result: the engine may not start or it may misfire and lose power.

Be sure to bleed the system to remove this trapped air before operating the engine.

Here is a general guide to bleeding the system:

1. Fill the fuel tank with the proper diesel fuel.
2. Open the fuel shut-off valve at the tank.

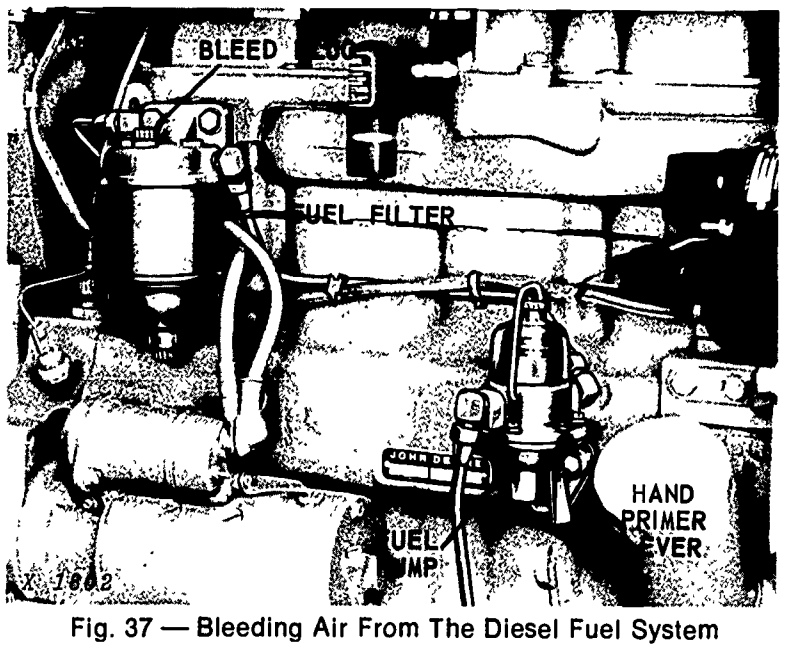


Fig. 37 — Bleeding Air From The Diesel Fuel System

3. Loosen the bleed plug on the fuel filter (Fig. 37). Pump the primer lever on the fuel pump until a solid stream of fuel (free of air bubbles) flows from the opening. (If the primer lever will not pump fuel and no resistance is felt at upper end of stroke, turn the engine with the starter to change the position of fuel pump cam.) Tighten the plug. On engines with dual filters, repeat the bleeding operation on the other filter. When bleeding is completed, be sure to leave the primer lever at lowest point of its stroke.

If the vapor lock is still present after bleeding air from the filter bleed plug, you will also have to bleed the injection lines.

4. Hold the injection line nuts with a wrench and loosen the injection lines on at least two injection nozzles. Crank the engine until fuel without foam flows around the connectors. Tighten the line connections carefully. Avoid bending the line connection. Tighten the lines only until snug and free of leaks.

CAUTION: Loosen injection line connectors only one turn to avoid excessive spray.

TROUBLE SHOOTING THE DIESEL FUEL SYSTEM

Since we have already tested and serviced the individual components, we will only give general trouble shooting for the whole system here.

This chart only has causes of typical failures for the diesel fuel system. For trouble shooting on the complete engine, refer to the charts on Chapter 11, "Diagnosis and Testing of Engines".

ENGINE WILL NOT START, STARTS HARD, OR MISFIRES

1. No fuel in tank; leaky or clogged supply line or filter; water in fuel.

2. Fuel transfer pump not functioning.

3. Air lock in injection pump.

4. Governor linkage to pump loose or broken.

5. Drive shaft or key sheared; pump plungers or distributor seized.

6. Delivery valves not seating properly due to dirt or broken springs.

7. Pump out of time.

8. Nozzles not functioning because of stuck valves or plugged orifices.

ENGINE WILL NOT IDLE SMOOTHLY

1. Governor idling adjustment not set properly or throttle linkage worn.

2. Pump rack or control sticky or stuck; stuck plunger.

3. Nozzle opening pressure incorrect; stuck nozzle valves.

4. Pump out of calibration, loose control sleeves; leaky delivery valves.

ENGINE SMOKES AND KNOCKS

1. Pump out of time.

2. Dirty or fouled nozzles; valves stuck open; opening pressure too low.

3. Fuel stop setting incorrect so that fuel delivery is excessive.

ENGINE LACKS POWER

1. Pump timing retarded.

2. Pump plungers or distributor worn.

3. Faulty nozzles.

4. Governor out of adjustment.

TEST YOURSELF

QUESTIONS

1. True or false? "Diesel combustion takes place when fuel and hot air are ignited by a spark."

2. Why is the distributor injection system best suited for multi-cylinder engine?

3. How is the distributor injection pump lubricated?

4. (Fill in the blanks.) Injection nozzles are simple mechanisms; they use _____ pressure to oppose _____ pressure.

5. What kind of a brush should be used to clean deposits from nozzles?

6. How does fuel flow through two series filters as compared to two parallel filters?

7. Which type of filters clean fuel the best?

ANSWERS

1. False. No spark is used in a diesel engine. Instead, air is compressed until it heats up and ignites the injected shot of fuel.

2. Because one pump can serve all the cylinders.

3. By the diesel fuel circulating through it during operation.

4. First blank—"spring". Second blank—"fuel".

5. Use a **brass** wire brush. Never use a steel brush as it will scratch the precision tips and erode the spray orifices.

6. In **series** filters, all the fuel goes through one filter, then through the other. In **parallel** filters, part of the fuel goes through each filter.

7. The **series** filters clean fuel the best because the second filter can pick up dirt missed by the first one.

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INTAKE AND EXHAUST SYSTEMS / CHAPTER 6

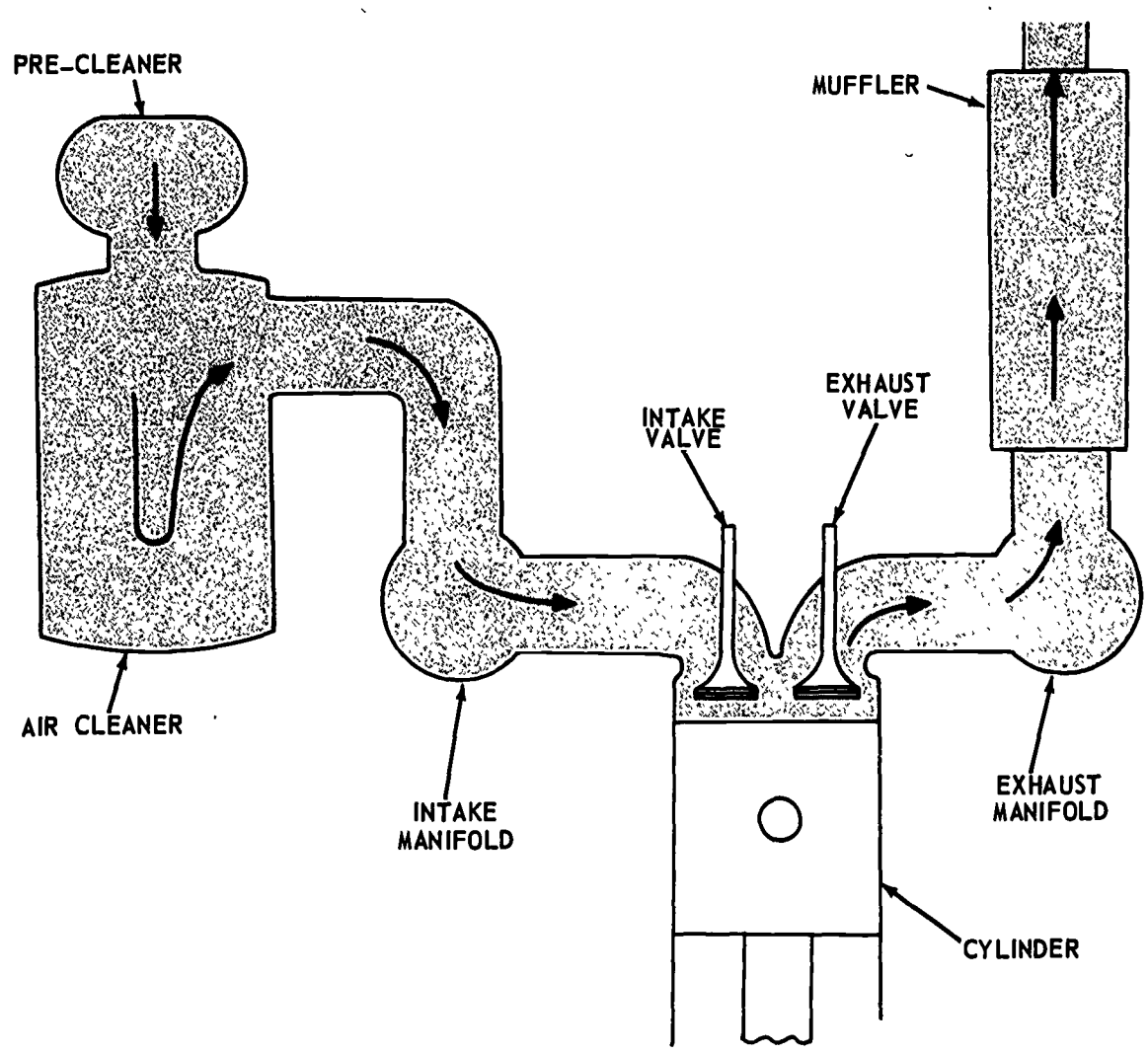

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Fig. 1 — Intake And Exhaust System

The intake system carries the fuel-air mixture into the engine, while the exhaust system carries exhaust gases away.

AIR INTAKE SYSTEMS

The air intake system supplies the engine with the proper quantity of clean air, at the correct temperature, mixed with the right amount of fuel for best combustion.

There are two basic types of air intake systems:

1) Cylinder Feed

2) Crankcase Feed

CYLINDER FEED—Fuel is mixed with air as it passes through the carburetor. This fuel-air mixture is passed into the cylinder through the intake valve.

CRANKCASE FEED—Some two-cycle engines (see Chapter 1) draw the fuel-air mixture into the crankcase before it is moved, under pressure, into the cylinder.

The intake system consists of:

- **Air cleaners, pre-cleaners**
- **Supercharger (if used)**
- **Intake manifold**
- **Carburetor air inlet**
- **Intake valves**

AIR CLEANERS filter dust and dirt from the air passing through them enroute to the carburetor. Pre-cleaners prevent larger particles from reaching the air cleaner and plugging it.

SUPERCHARGERS increase horsepower by packing more air or fuel-air mixture into the engine cylinders than the engine could take in by itself.

INTAKE MANIFOLDS transport the fuel-air mixture (air only on diesel engines) to the engine cylinders.

CARBURETORS mix incoming air with fuel in the proper proportion for combustion.

INTAKE VALVES admit air to diesel engines and the fuel-air mixture to spark-ignition engines. See Chapter 2 for engine information.

AIR CLEANERS

Clean air is essential to satisfactory performance and long engine life. The air cleaner must be able to remove fine materials such as dust and blown sand as well as chaff, or lint from the air.

A cleaner must also have a reservoir large enough to hold material taken out of the air so operation over a reasonable period of time is possible before cleaning and servicing is necessary.

A buildup of dust and dirt in the air cleaner passages will eventually choke off the air supply, causing incomplete combustion and heavy carbon deposits on valves and pistons.

Multiple air cleaner installations are sometimes used where engines are operated under extremely dusty air conditions or where two small air cleaners must be used in place of a single large cleaner.

The most common types of air cleaners are:

1) Pre-cleaners

2) Dry type cleaners

3) Dry element type cleaners

4) Viscous-impingement cleaners

5) Spiral rotor type cleaners

6) Oil bath type cleaners

(1) PRE-CLEANERS

Pre-cleaners are usually installed at the end of a pipe extended upward into the air from the air cleaner inlet. This places them in an area relatively free of dust.

Pre-cleaners are simple devices which remove larger particles of dirt or other foreign matter from the air before it enters the main air cleaner. This relieves much of the load on the air cleaner and allows longer intervals between servicing.

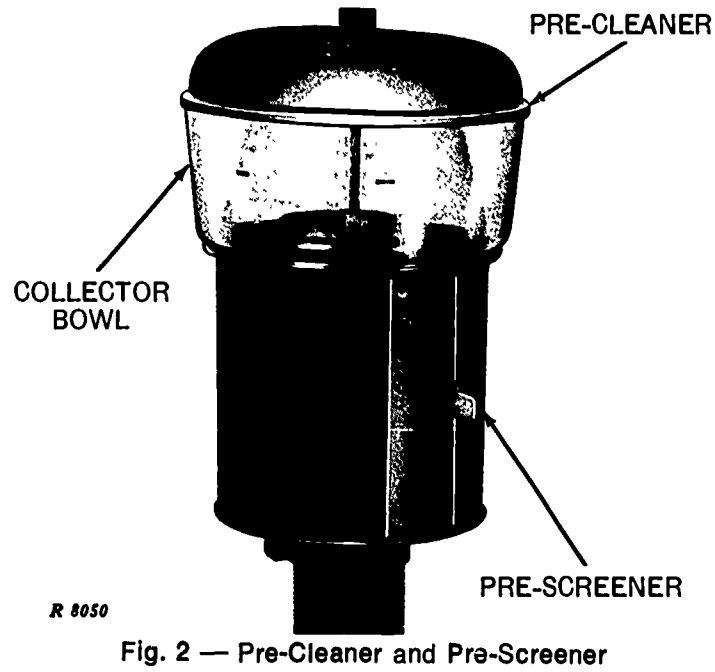

Fig. 2 — Pre-Cleaner and Pre-Screener

Most pre-cleaners have a *pre-screener* which prevents lint, chaff, and leaves from entering the air intake.

(2) DRY TYPE AIR CLEANERS

Dry type cleaners are attached directly to the carburetor or manifold. They are only used on engines in which the demand for air is small.

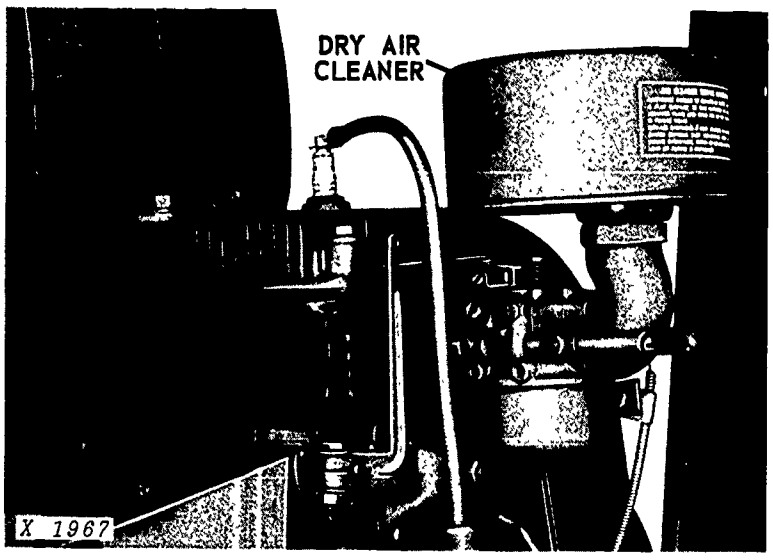

Fig. 3 — Simple Dry Air Cleaner

Dry type air cleaners or filters (Fig. 3) clean the air by passing it through layers of cloth or felt. It is most effective in removing larger dirt particles from the air and is used mostly on small engines.

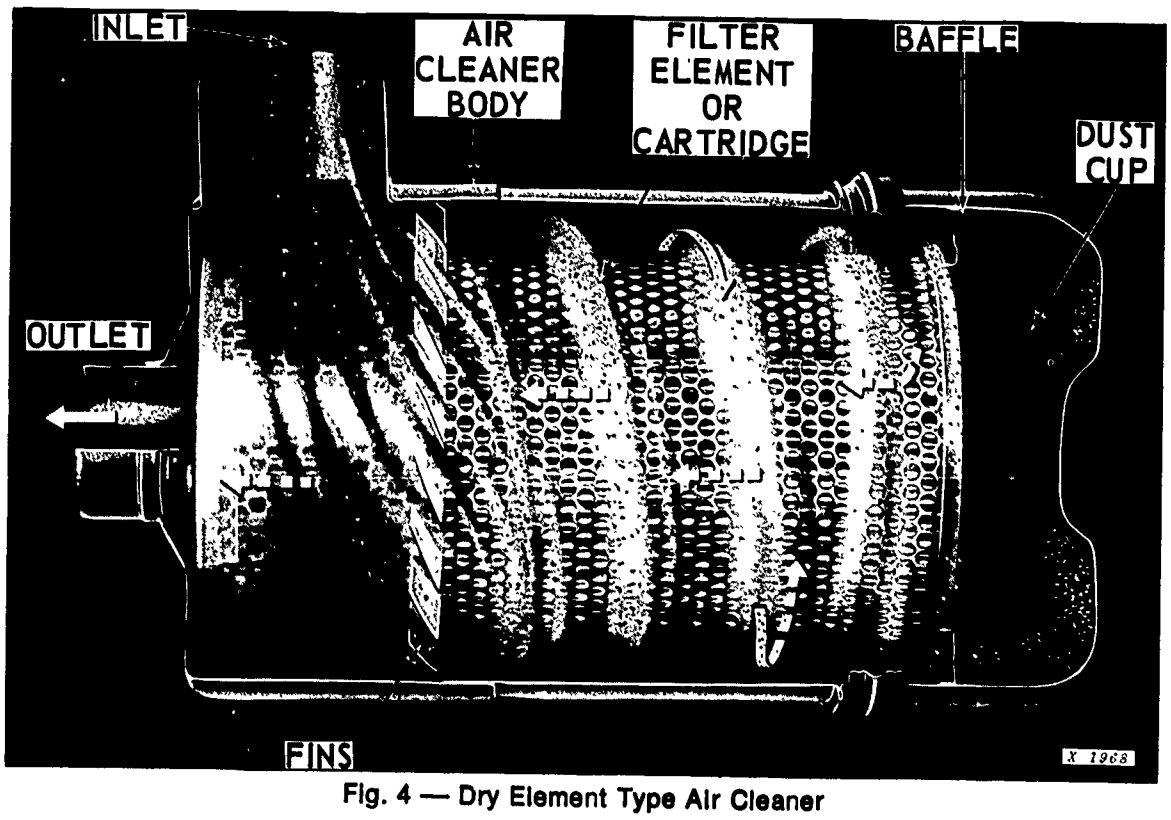

Fig. 4 — Dry Element Type Air Cleaner

(3) DRY ELEMENT TYPE AIR CLEANERS

Dry element type cleaners are attached directly to the carburetor or manifold. They provide filtering on a bigger scale than dry type filters, and include a reservoir for storing filtered dirt.

The dry element type air cleaner is used on many farm and industrial engines.

Cleaning is done by a replaceable paper cartridge.

This type of cleaner is popular because it is small, lightweight, efficient and may be mounted in any position.

As the element becomes clogged, a restriction indicator may be used to tell when the cleaner needs servicing.

In operation, air enters the cleaner through the inlet tube and is forced into a high-speed centrifugal motion by tilted fins on the element (Fig. 4).

As the air circulates around the element, 90 percent of the dirt is separated from the air and is carried through a slot in the baffle into the dust cup. Here it is collected for easy removal.

The remaining dirt is removed as the air flows through the filter element and the outlet to the engine.

(4) VISCOUS-IMPINGEMENT AIR CLEANERS (Automotive Type)

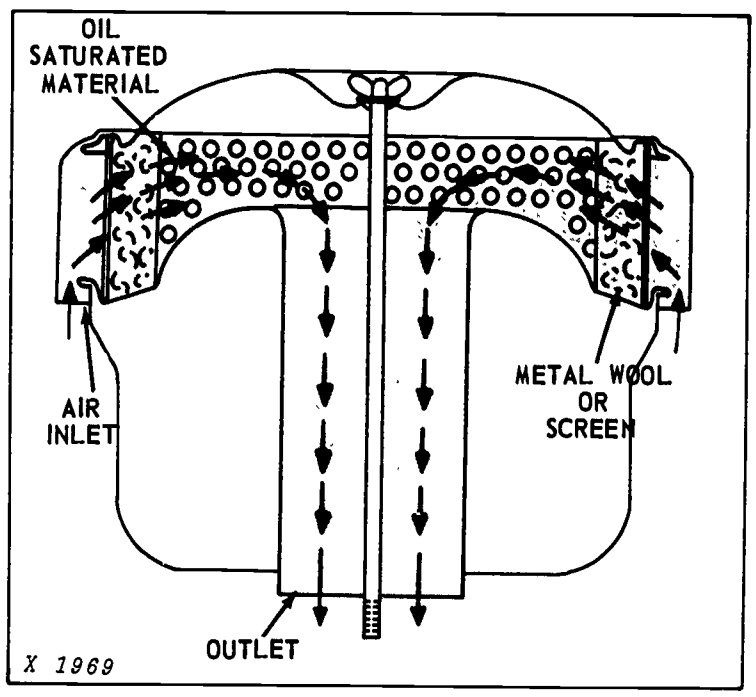

Fig. 5 — Viscous-Impingement Air Cleaner

In **viscous-impingement air cleaners** (Fig. 5), the air flows through a maze of metal wool, wire or screens saturated with oil.

This type is used for automotive applications where dust conditions are relatively light. The lower portion of the unit acts as a hollow chamber to quiet the air intake noise.

Viscous-impingement type air cleaners are now normally used only on small engines. They utilize an oil-impregnated element for filtering.

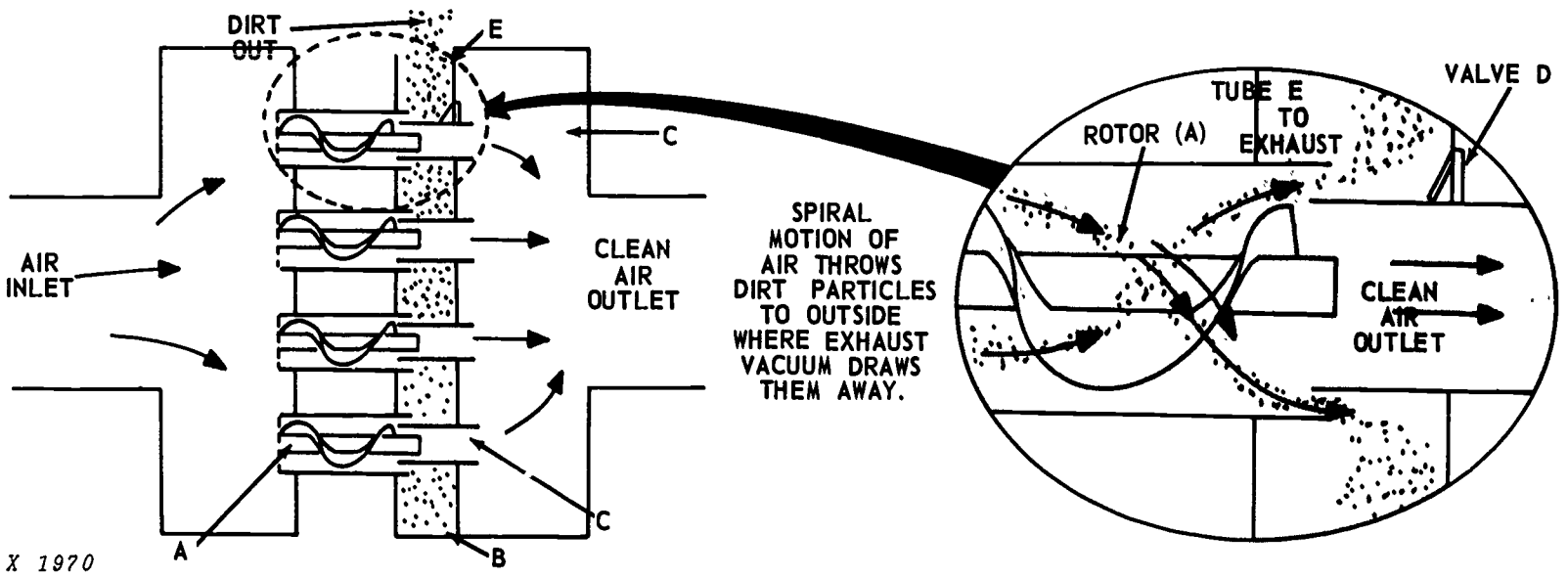

Fig. 6 — Spiral Rotor Air Cleaner

(5) SPIRAL ROTOR AIR CLEANERS

Fig. 6 illustrates a recent innovation in air intake systems—the **spiral rotor air cleaner.**

It consists of a number of spiral rotors (A) installed in tubes in the air inlet. These tubes protrude into a compartment (B).

Smaller tubes (C) extend into the larger tubes. The smaller tubes lead to the main air inlet.

A valve (D) allows air to flow out of the main air cleaner inlet compartment but not into it.

The tube (E) connects compartment (B) to the muffler assembly. The muffler provides a constant vacuum, or suction.

Air passing through the tubes is spun by the rotors, causing the dirt particles to be thrown against the walls of the larger tubes and drawn off by the exhaust vacuum at (E).

Clean air passes on through the smaller tubes to compartment (C) and the main air outlet.

(6) OIL BATH AIR CLEANERS

Light-duty oil bath air cleaners (Fig. 7) have a wire screen element inside a housing containing oil.

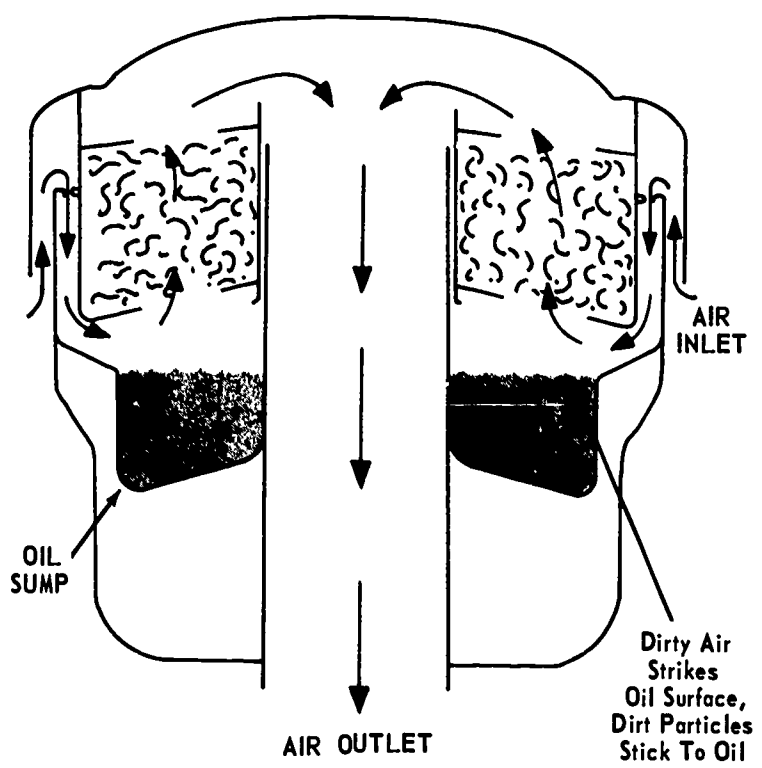

Fig. 7 — Light-Duty Oil Bath Air Cleaner And Silencer

Incoming air reverses when it strikes the surface of the oil, causing most of the dirt to become trapped by the oil and settle out in the sump.

The air then passes upward through the screen element where more dust, and suspended oil, is removed and drains back into the sump.

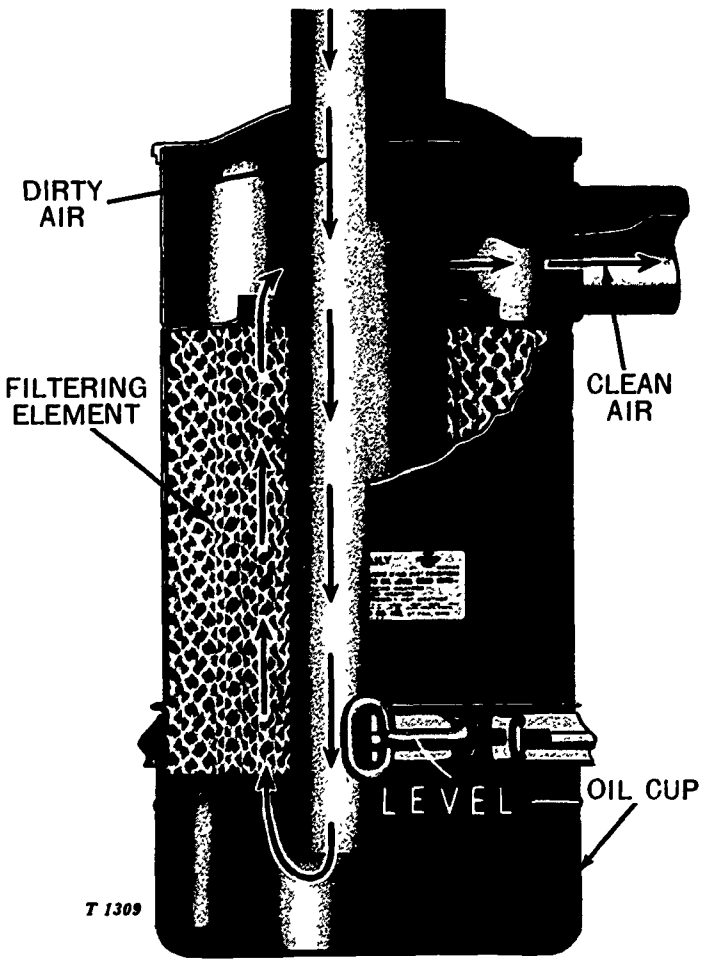

Fig. 8 — Medium-Duty Oil Bath Air Cleaner

Medium-duty oil bath air cleaners (Fig. 8) direct incoming air down through the center tube into the inner oil cup. At the bottom of the tube the direction of air flow is reversed, causing most of the dirt to become trapped by the oil and settle out in the sump.

Dirt which was not trapped and some oil from the inner oil cup are carried into the main cleaner element (composed of metal wool or screen material). Oil trapped here gradually flows back into the cup, carrying the dirt with it. Dirt settles out of the oil into the area surrounding the inner cup; the oil moves back to the inner cup.

The space above the main element in the air cleaner acts as a silencer to subdue intake noise.

Some medium-duty air cleaners are fitted with an oil trap. This trap catches the oil which otherwise would be thrown out of the cleaner when the engine backfires.

Heavy-duty oil bath air cleaners (Fig. 9) operate the same as medium-duty filters.

Air flows through the air inlet hood or the precleaner down through the air tube into the oil cup. At the bottom of the tube, the direction of the air flow is reversed and most of the dirt becomes trapped by the oil.

A separator screen and metal wool packing prevent oil and dirt from leaving the air cleaner.

The dirt-bearing oil drains to the center of the cleaner oil cup where it is picked up by the incoming air, causing it to flow in a looping pattern.

However, on each loop, some of the oil flows over the edge of the inner cup, carrying dirt with it. The dirt settles out of the oil in the area surrounding the inner cup. The oil then flows back into the inner cup.

Clean air leaves the cleaner through the outlet tube as shown.

AIR SILENCERS

Air silencers eliminate the noise caused by the pulsations of incoming air created by the engine blower. A screen between the air cleaner and the blower housing keeps out foreign matter.

An open space at the air outlet end of the air cleaner housing also acts as an intake air silencer.

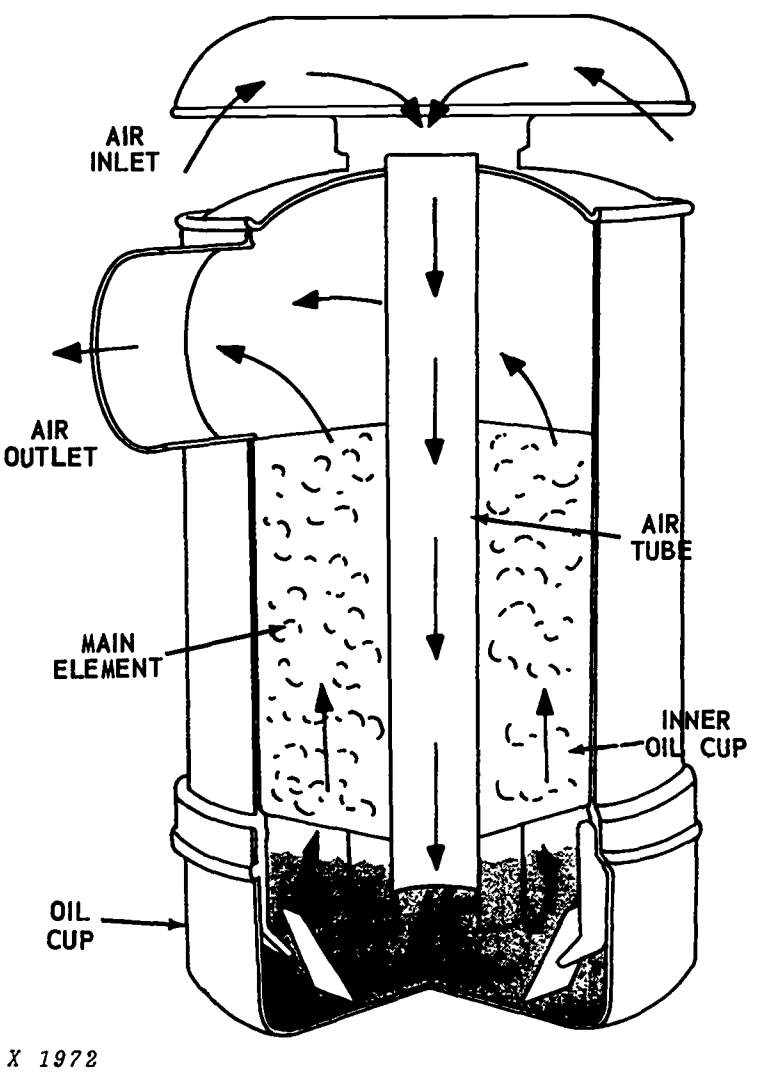

Fig. 9 — Air Flow Through Heavy-Duty Oil Bath Air Cleaner

AIR CLEANER MAINTENANCE

Air cleaner efficiency depends upon proper maintenance and service.

Oil bath cleaners must be properly maintained or the oil cup will become filled with sludge, preventing the screens and elements from cleaning the air properly.

This will restrict air flow to the engine (it will cause the same effect as choking the engine) and may allow unclean air to enter.

Restricted air flow through the air cleaner will eventually cause incomplete combustion, increased carbon formation and crankcase dilution.

Leaks in the connecting pipes, loose hose connections, or damaged gaskets which permit dust-laden air to enter the engine, can defeat the efficiency of the air cleaner.

Dirty air going directly into an engine cylinder is abrasive and will cause premature wear of moving parts.

Use the following maintenance rules for good air cleaner operation:

1. Keep air cleaner-to-engine connections tight.

2. Keep air cleaner properly assembled so all joints are oil and air tight.

3. Make careful periodic inspections of the entire air intake system. Repair damaged parts at once. Enough dust-laden air can pass through an almost invisible crack over a period of time to severely damage the engine.

4. Inspect cleaner frequently under dusty conditions. Dust collections on the element gradually restricts the air flow and decreases engine efficiency.

5. Service oil bath cleaners often enough to prevent oil from becoming thick with sludge.

6. Use correct quality of oil. Keep oil at the proper level in the cup. **Do not overfill.**

NOTE: Oil from an overfilled cup can be drawn into an engine. This oil acts as fuel in a diesel engine over which there is no control and can cause the engine to run away (overspeed), resulting in severe damage.

AIR CLEANER SERVICE

No hard and fast rule can be given for servicing an air cleaner since this depends upon the type of cleaner, air condition, and type of application.

Normal service intervals are designated by the manufacturer, but frequent inspection can tell whether or not this is adequate for the conditions under which the engine is operated.

A cleaner operating in severe dust conditions will require more frequent service than one operating in clean air.

Always refer to the operator's manual for service information.

Pre-Cleaner and Pre-Screener Service

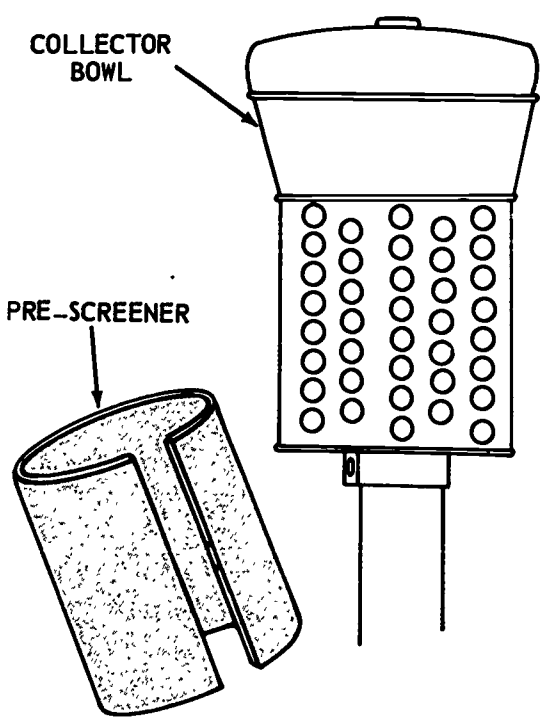

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Fig. 10 — Pre-Cleaner And Pre-Screener

Remove the pre-screener (Fig. 10) and blow or brush off any accumulation of lint, chaff, or other foreign matter.

Some pre-cleaners use a removable collector bowl. Remove and thoroughly clean it.

If too much dirt is allowed to collect, the pre-cleaner becomes clogged and a greater load is placed on the main cleaner.

Dry Type Air Cleaner Service

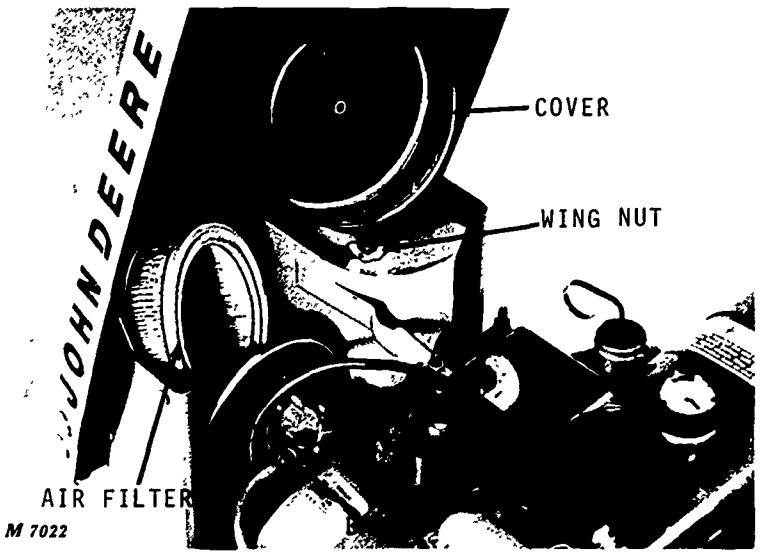


Fig. 11 — Simple Dry Type Air Cleaner

Remove the filter element and shake vigorously to remove most of the dust. Use compressed air or a vacuum cleaner to complete the job.

Wash the element with water and detergent if it is excessively dirty. Dry with compressed air.

Replace the element if it is too dirty to clean, has been damaged, has been washed not more than six times or has been in service for one year.

CAUTION: Never wash dry element in fuel oil, gasoline or solvents. Do not oil element.

Viscous-Impingement Type Air Cleaner Service

Remove the filter element and clean by soaking in solvent. Swish the element up and down in the solvent to thoroughly clean it. Dry with compressed air.

After cleaning and drying, immerse the element in engine oil and hang up to allow excess oil to drip out.

Wipe out the inlet tube with a lint-free cloth.

Install the element, making sure that all connections are air-tight.

Light-Duty Oil Bath Air Cleaner Service

Remove the cleaner assembly from the air inlet pipe. The upper section of the cleaner contains the metal wool or screen filtering element. The lower section is made up of the oil cup and inlet tube.

Clean the filter element by soaking it in solvent or diesel fuel. Flush the loosened dirt out with solvent.

Clean the oil cup with solvent and wipe out the inlet tube with a clean, lint-free cloth. **Never** use cotton waste to wipe the center tube.

Fill oil cup to level line with clean engine oil. Assemble and install on engine.

Medium-Duty Oil Bath Air Cleaner Service

Fig. 12 — Medium-Duty Oil Bath Air Cleaner

Remove the oil cup, pour out the oil, remove the sediment, and thoroughly clean the cup.

Inspect the under surface of the fixed element for a collection of lint, trash, or other foreign matter. If any of these are present, the cleaner should be removed and cleaned.

To clean, soak the element in solvent to loosen accumulated dirt. Flush thoroughly by running solvent through the element from the air inlet end. Allow excess solvent to drip out. Blow out with compressed air.

CAUTION: Never attempt to clean the element with a steam cleaner. The force of the steam cannot be maintained throughout the element and will only force the dirt to the center of the element.

Wipe out the center tube with a clean lint-free cloth.

Inspect the inside of the air cleaner-to-manifold pipe for accumulation of oil and dirt. Remove the pipe and clean it, if necessary.

Install the air intake pipe and air cleaner on the engine. Attach oil trap to cleaner.

Fill oil cup to level line with the same weight and quality of oil as used in the engine. Install cup on cleaner. *Be sure that it is tightly secured in position with a leak-proof joint.*

Also be sure all joints are air-tight.

Heavy-Duty Oil Bath Air Cleaner Service

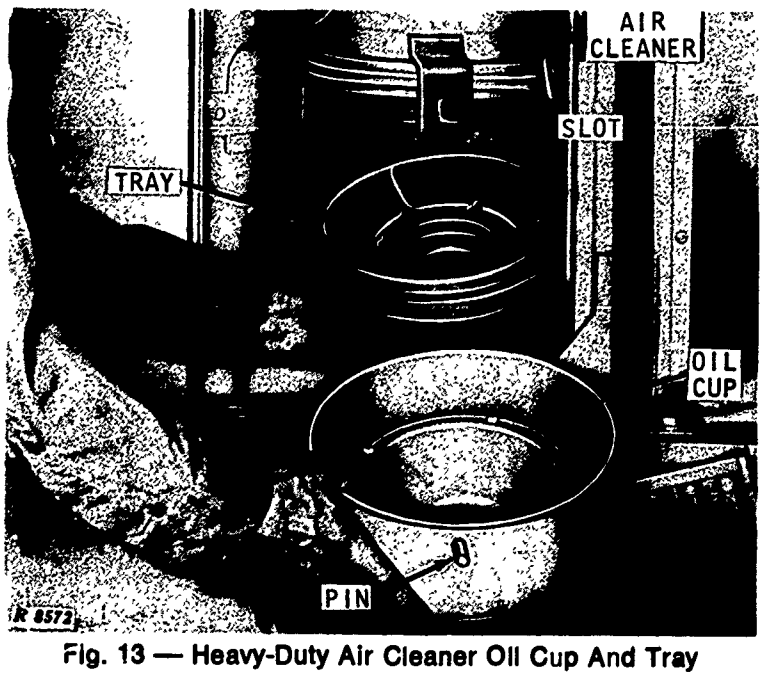


Fig. 13 — Heavy-Duty Air Cleaner Oil Cup And Tray

Remove and clean oil cup and tray. Refer to "Medium-Duty Oil Bath Air Cleaners Service."

If filter element is dirty enough to restrict air flow, remove the air cleaner and soak or run solvent through in the opposite direction that air normally passes.

Reinstall air cleaner. Fill oil cup to proper level with oil of the correct weight and quality and install cup and tray on the air cleaner.

Check all tubes and joints to be sure they are tight.

Since air cleaners vary in construction, always follow the instructions in the operator's manual for the particular cleaner being serviced.

In some heavy-duty air cleaners a collector screen, attached to the inlet tube, will be visible. Remove by loosening the wing nuts and rotating the tray to unlock it from the tube. In other models, (Fig. 13), the screen rests on the lip of the inner cup and is not secured by wing nuts.

This screen catches chaff and other foreign matter. Clean the screen each time the air cleaner is serviced.

Some screens may be separated for dirt and lint removal.

Wash screens in solvent and blow out with compressed air.

When a clean screen is held up to the light, an even pattern of light should be visible. If not, repeat the cleaning operation or replace the screen.

NOTE: The fixed elements of heavy-duty air cleaners are self-cleaning. However, it may be necessary to remove and clean these elements periodically. See the operator's manual for complete information.

OIL TRAP

An oil trap prevents oil from blowing out when an ignition engine backfires.

Remove and clean the oil trap each time the air cleaner is serviced.

Dry Element Type Air Cleaner Service

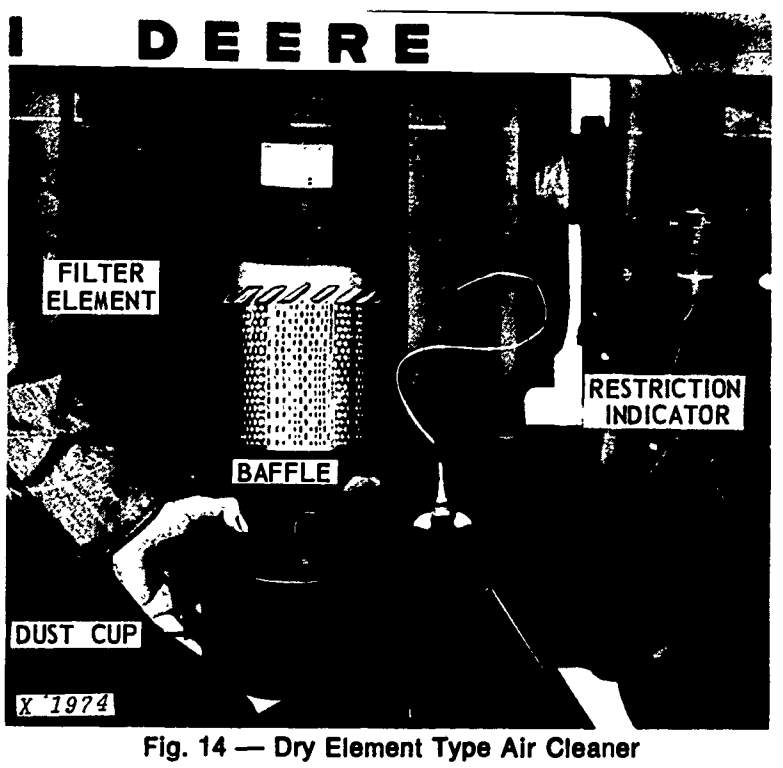


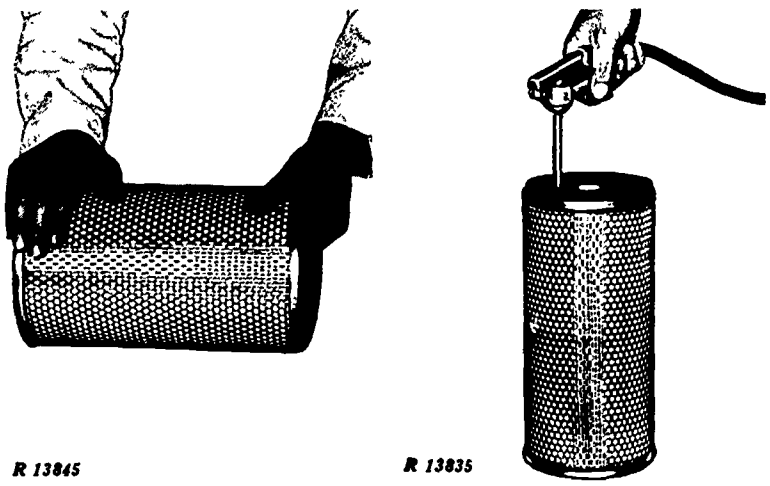
Fig. 14 — Dry Element Type Air Cleaner

When the engine smokes too much or loses power, there may be a restriction in the dry air cleaner.

Clean air filter element at the following times:

1) Units with restriction indicator: Clean element whenever indicator signal tells of a restriction.

2) Units without indicator: Clean element at recommended intervals—more often during dusty or unusual operation.



Patting The Element Blowing The Element

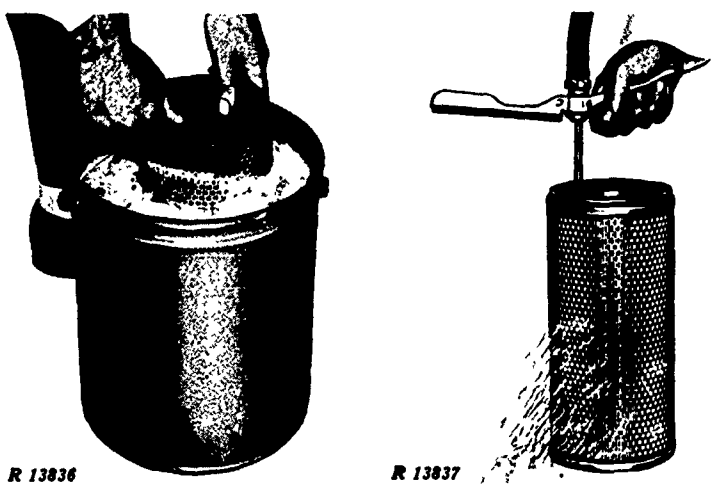
Fig. 15 — Cleaning The Dry Element

Dusty Element: Remove filter element and install new one if possible. If not, tap element on heel of hand to remove dust. NOT ON A HARD SURFACE. Rotate element while tapping it.

If tapping does not remove the dust, use a dry element compressed air cleaning gun (pressure not to exceed 100 psi) to clean the element (Fig. 15). Direct clean dry air up and down pleats, blowing from inside to outside.

CAUTION: BE CAREFUL NOT TO RUPTURE THE ELEMENT. Do not try to clean off outside of air cleaner with an air hose.

To clean with water: First blow out dirt with compressed air as described above. Then attach garden hose to cleaning gun and flush remainder of dirt from inside to outside of element. Allow element to dry.



Washing The Element Rinsing The Element

Fig. 16 — Washing And Rinsing The Dry Element

Oily Or Sooty Elements: Blow dust from element with compressed air or flush with clean water. Soak and gently agitate element in a solution of lukewarm water and commercial filter element cleaner or an equivalent nonsudsing detergent. (Fig. 16).

Rinse element thoroughly with clean water from hose (Fig. 16) having maximum pressure of 40 psi or less. Shake excess water from element and allow it to air dry (requires 24 hours or longer). Protect from freezing. Keep a spare element to use while the washed one is drying.

CAUTION: Never wash a dry element in fuel oil, gasoline, or solvent. Never use compressed air to dry the element.

After cleaning the element, inspect it for damage by placing a light inside it. Discard any element that shows the slightest damage.

Inspect filter element gasket for damage. Replace element if gasket is damaged or missing.

IMPORTANT: Replace the filter element:

(1) If damaged.

(2) After a recommended service period (such as one year).

(3) When attempts to clean it fail.

Thoroughly clean inside of cleaner body with a clean, damp cloth. Install element in cleaner body, gasket and fin end first. Be sure gasket is in place.

Draw cover tight on cleaner. *Reset restriction indicator* (if used).

DUST UNLOADING VALVE SERVICE

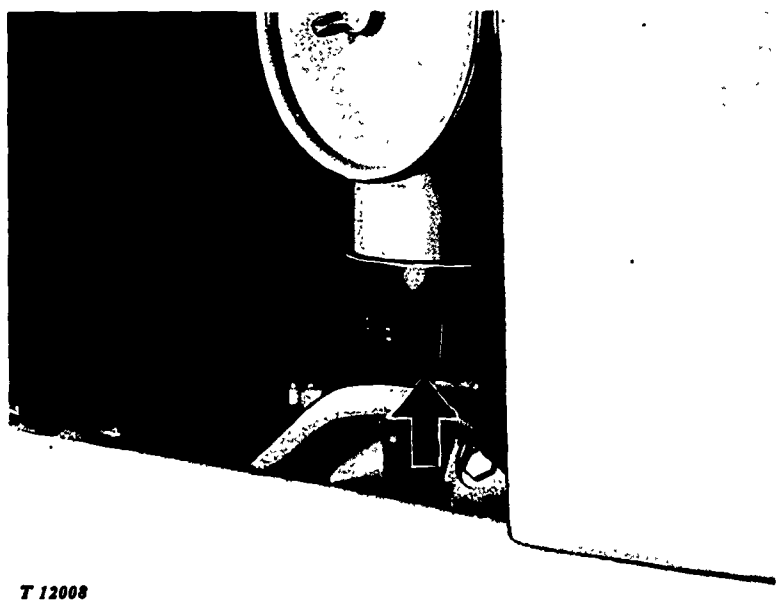


Fig. 17 — Air Cleaner Dust Unloading Valve

Inspect rubber dust unloading valve (if used) for cracks, clogging, or deterioration (Fig. 17). Clean or replace if necessary.

INTAKE MANIFOLDS

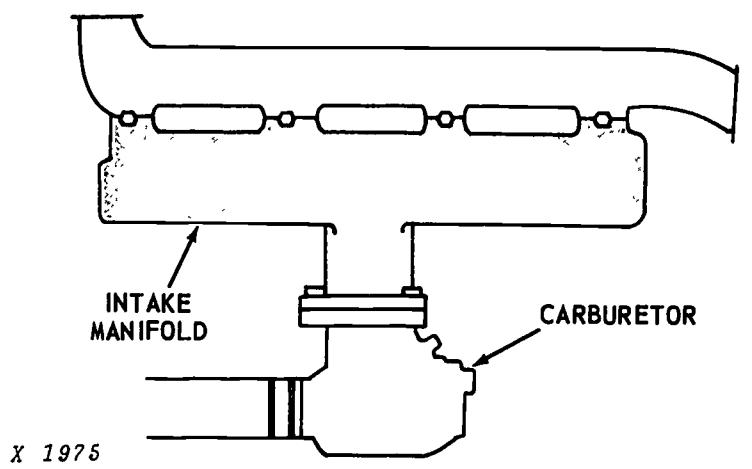


Fig. 18 — Typical Intake Manifold

The fuel-air mixture is carried from the carburetor to the engine intake valves by the manifold.

Diesel engine intake manifolds are similar to spark-ignition engine manifolds except that they do not require heat and are usually located on the side of the engine opposite the exhaust manifold.

LP-gas fuel vaporizes at 44 degrees below zero so a mixing valve is used instead of a carburetor.

Even though heat transfer from the exhaust manifold is not required to vaporize fuel, the same intake system (following the carburetor) may be used for LP-gas as for gasoline systems.

Fig. 18 illustrates a typical engine manifold. Heat is supplied either by having the exhaust manifold touch the intake manifold at various spots or by having exhaust passages built into the intake manifold.

INTEGRAL INTAKE MANIFOLDS

The intake manifold is an *integral* part of the cylinder head on some engines.

The advantages of this are:

1) The intake passages are surrounded by the engine coolant and the incoming air is warmed before entering the engine cylinders.

2) There are fewer joints, requiring fewer gaskets, and so less danger of leakage.

However, *external* intake manifolds have the advantage of being easier to remove when repairs are necessary.

CRANKCASE INTAKE

Two-cycle engines (see Chapter 1) ordinarily provide intake through the crankcase (Fig. 19). The carburetor is located directly on the crankcase.

On the most simple engines, the fuel-air mixture is drawn into the engine each time the piston moves upward on the compression stroke.

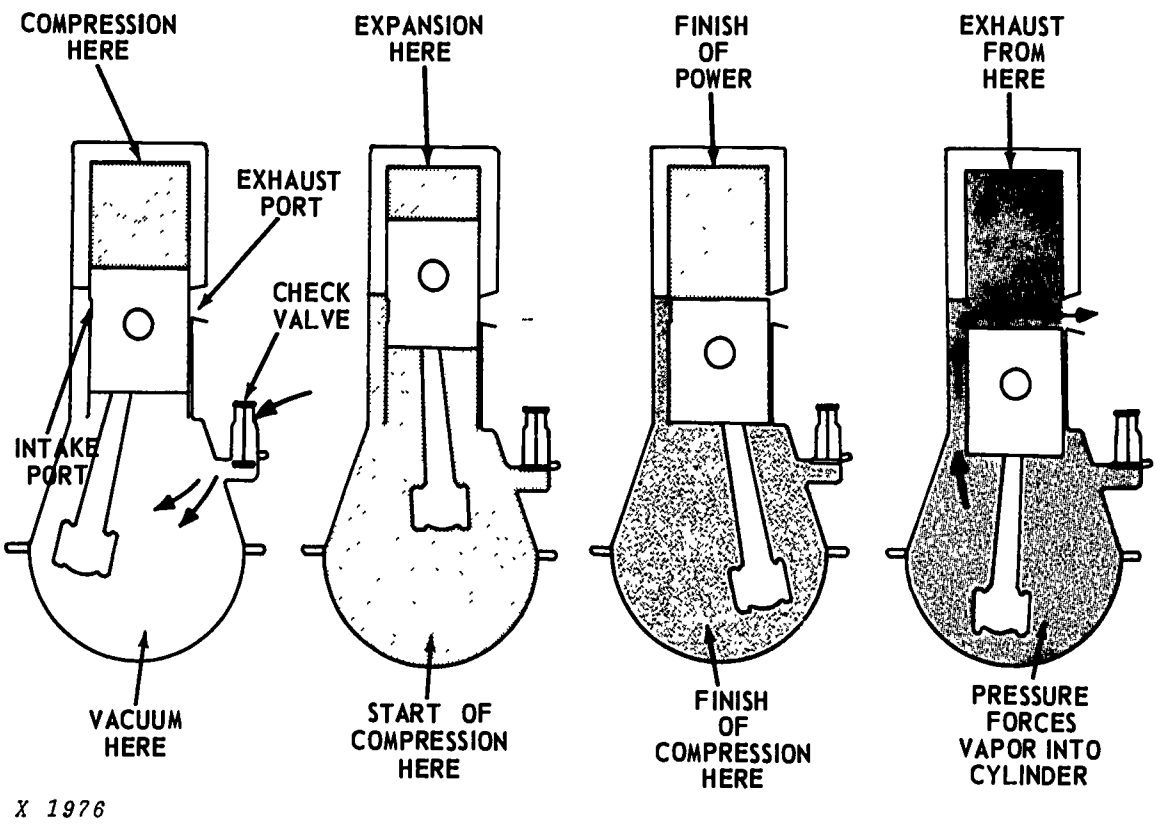


Fig. 19 — Crankcase Intake System

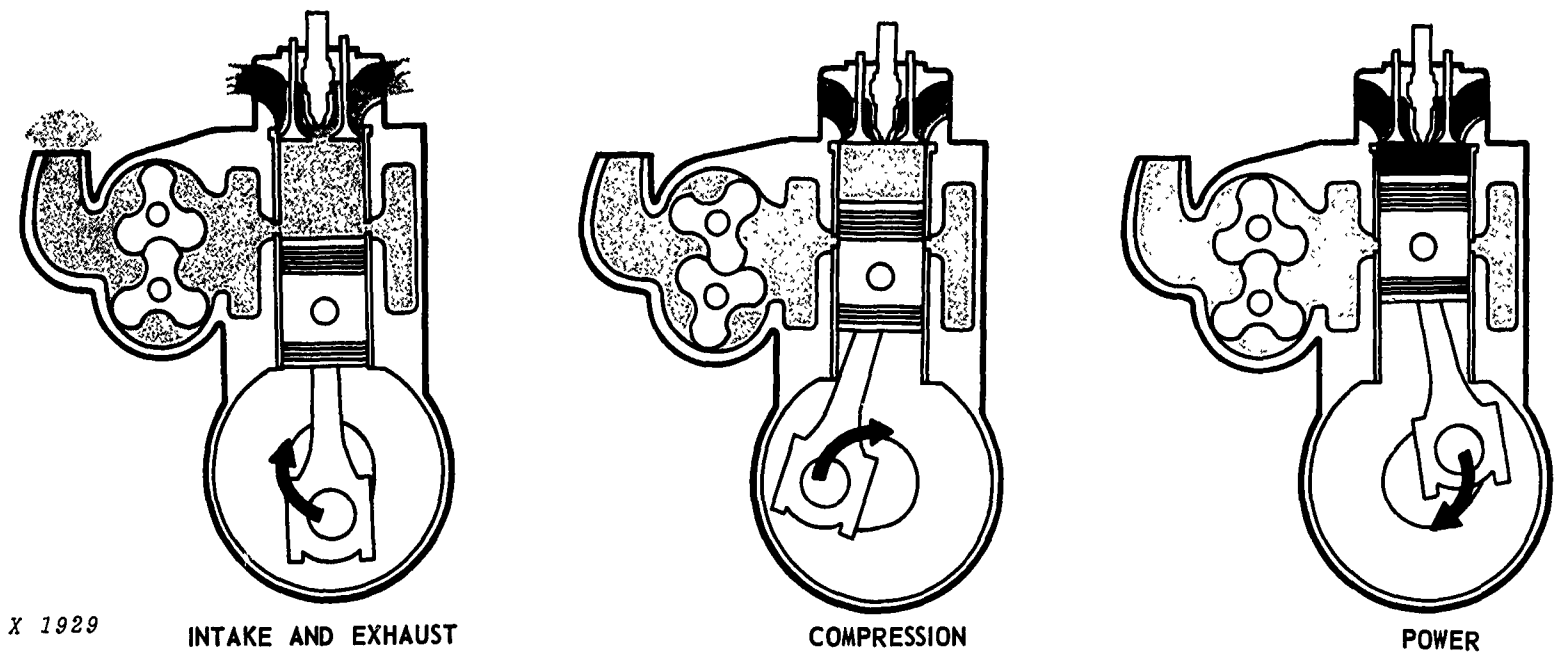


Fig. 20 — One-Valve Two-Cycle Engine With Blower

A check valve (Fig. 19) prevents the vapor from being forced back out the carburetor on the power stroke.

As the piston moves downward on the power stroke, pressure is built-up in the crankcase until the *intake port* and *exhaust port* are uncovered.

The pressurized vapor flows into the cylinder, forcing the burned gases out the exhaust port.

The action of the crankcase is two stage: **vacuum** to pull in fuel-air; **compression** to push this mixture into the cylinder.

ONE-VALVE TWO-CYCLE ENGINE

Another type of two-cycle engine is one which uses a Roots type blower or supercharger and a single exhaust valve (Fig. 20).

The Roots is a positive displacement blower which compresses air by trapping it at the inlet port between the rotor lobes and the housing, as the impellers turn. When the trapped air reaches the outlet port, it is forced out of the blower into the engine. The same amount of air is trapped between the lobes with each turn, regardless of impeller speed.

The fuel-air mixture is forced directly into the cylinder each time the piston moves downward far enough to uncover the intake port. The single valve releases exhaust gases during the exhaust portion of the power/exhaust stroke (Fig. 20). The crankcase is never pressurized on this type of engine.

MANIFOLD HEAT CONTROL VALVE

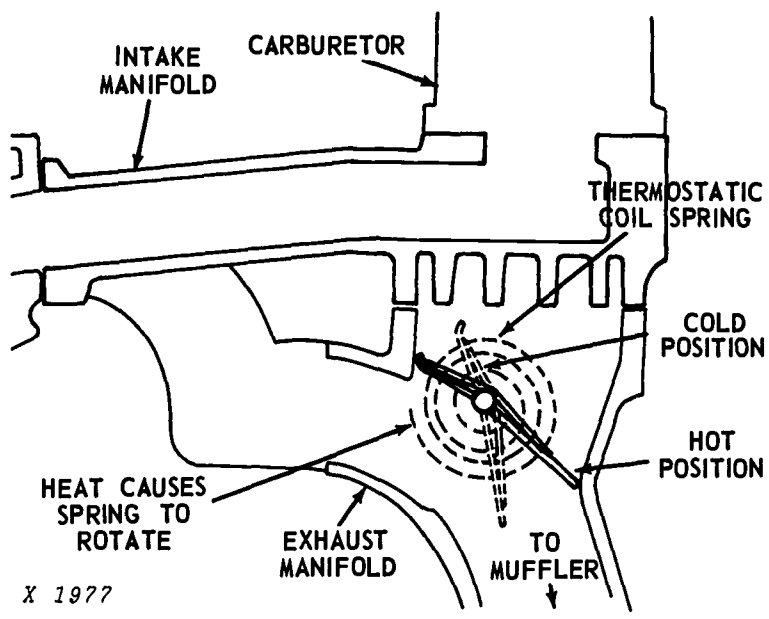


Fig. 21 — Heat Control Valve And Spring

Several types of thermostatic heat control valves are used to direct exhaust gases against some area of the intake manifold when the engine is cold, and deflect gases away from the intake manifold when the engine has warmed up. See Fig. 21.

The thermostatic bimetallic coil spring holds the valve open until exhaust heat causes it to expand. Force from the expanding spring closes the valve and shuts off heat to the intake manifold.

Acids from the burned fuel, together with heat from the gases tend to seize the valve. Use a special heat-control lubricating oil to keep the valve free at all times.

DIESEL ENGINE MANIFOLDS

Diesel engines do not require heat from the exhaust manifold to assist in keeping intake fuel vaporized, since fuel is injected directly into the cylinder as required.

For this reason, diesel intake and exhaust manifolds are usually separated.

SERVICE OF INTAKE MANIFOLDS

Check the intake manifold for restrictions and air leaks. Inspect intake passages of integral manifolds by removing the cylinder head. Replace warped manifolds.

EXHAUST SYSTEMS

The exhaust system collects exhaust gases from the engine and carries them away. This system:

1) Removes heat

2) Muffles engine sounds

3) Carries away burned and unburned gases

The exhaust system consists of:

- **Exhaust valve**
- **Exhaust manifold**
- **Turbocharger (if used)**
- **Muffler**

EXHAUST VALVES seal the burning gases within the cylinder until most of the energy has been expended, then open so the cylinder can clear before the next fuel-air charge is admitted. See Chapter 2.

EXHAUST MANIFOLDS receive burned gases from each cylinder and carry them away from the engine. Some heat from the exhaust manifold is used on gasoline engines to maintain the intake manifold at the proper temperature.

TURBOCHARGERS use exhaust gases to drive the intake supercharger.

MUFFLERS carry away exhaust gases and heat, and muffle engine noise.

EXHAUST MANIFOLD

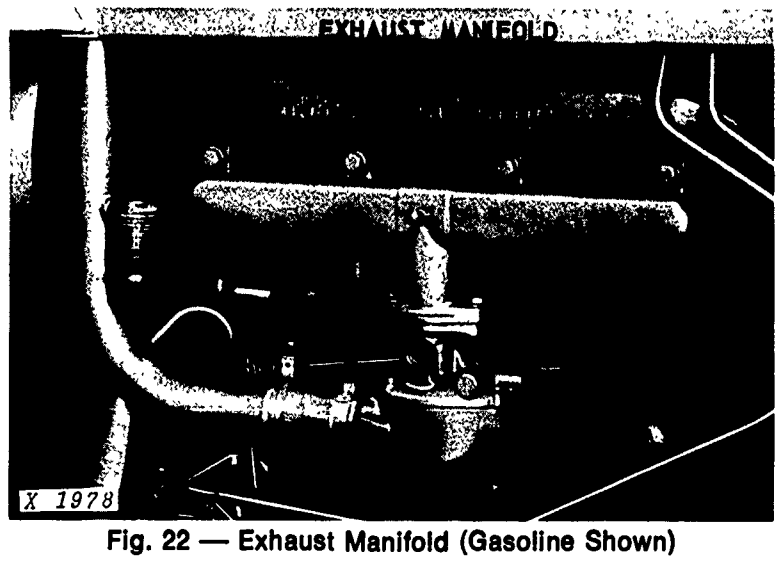


Fig. 22 — Exhaust Manifold (Gasoline Shown)

Exhaust manifolds (Fig. 22) collect the spent gases from the engine cylinders and conduct them to the muffler or to some other location away from the engine.

The exhaust ports in the engine and the passages in the exhaust manifold are large to allow free flow and expansion of the escaping gases. This is important as it permits better scavenging of the engine cylinders.

If any burned gases are left in the cylinders following the exhaust stroke, the amount of fuel-air mixture which can be taken in on the next intake stroke is limited. This reduces engine power and increases fuel consumption.

Exhaust Manifold Service

Keep inner surfaces of the passages free of carbon buildup. Remove by scraping, with carbon solvent, or a combination of both.

MUFFLERS

There are two common types of mufflers:

- **Straight-through**
- **Reverse-flow**

STRAIGHT-THROUGH mufflers (Fig. 23) consist of a perforated inner pipe enclosed by an outer pipe roughly three times larger in diameter. The space between the pipes is sometimes filled with a sound-absorbing and heat-resistant material.

REVERSE-FLOW mufflers (Fig. 23) are hollow chambers using short pieces of pipe and baffles to force the exhaust gases to travel a back-and-forth path before being discharged.

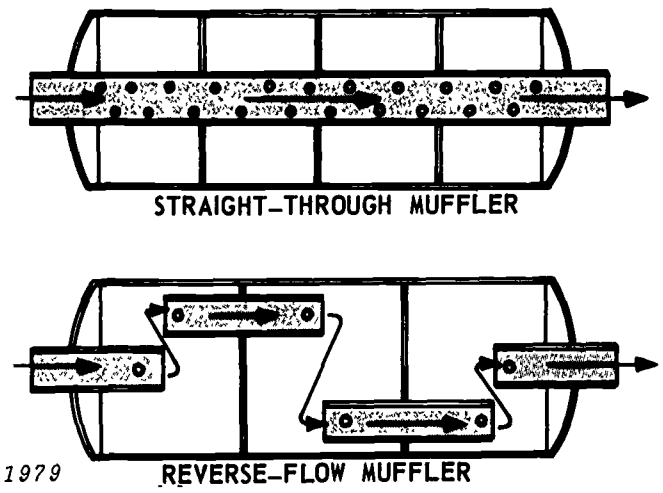


Fig. 23 — Mufflers — Two Types

The muffler acts as an expansion chamber, reducing the noise of the spent gases.

It also serves as a spark arrester, to eliminate fire hazards when operating near combustible material.

Muffler Service

Exhaust systems are designed to provide the least amount of restriction. Excessive restrictions cause back-pressure, resulting in incomplete cylinder scavenging. This, in turn, causes loss of power and increased fuel consumption.

It has been estimated that each 2 psi of back pressure causes a loss of about 4 engine horsepower.

CAUTION: One of the products of combustion is carbon monoxide. This is a deadly, odorless, poisonous gas. Provide good ventilation anytime the engine is operating.

The entire system must also be free of leaks. When they do occur, repair immediately. This is particularly true when the engine is in a machine equipped with a cab or other enclosure.

SUPERCHARGERS

The power delivered by an internal combustion engine is determined by the amount of fuel and air which can be packed into each cylinder. The more fuel-air mixture, the more power the engine develops.

A **supercharger** is a type of *air pump*. Located either ahead of or behind the carburetor, it gives an engine a higher overall compression than it would normally have.

It does this by taking air from the atmosphere, compressing it and packing it into the engine cylinders.

Pumping air into an engine also aids in getting exhaust gases out. This too results in more efficient combustion.

A NOTE ON SUPERCHARGER "KITS"

Installing a supercharger on most engines *will* increase horsepower by about 30%.

But adding a supercharger will also cause:

- **A 51% increase in peak cylinder pressure.**
- **Much higher cylinder temperatures.**
- **Increased air intake volume.**
- **Increased wear on the engine and drive components.**
- **Increased oil consumption.**

Before mounting a supercharger on an engine, make certain it also has been equipped with the following:

1) Heavy-duty engine and drive components

2) Larger cooling system

3) Larger lubrication system

4) Bigger air cleaner

TWO TYPES OF SUPERCHARGERS

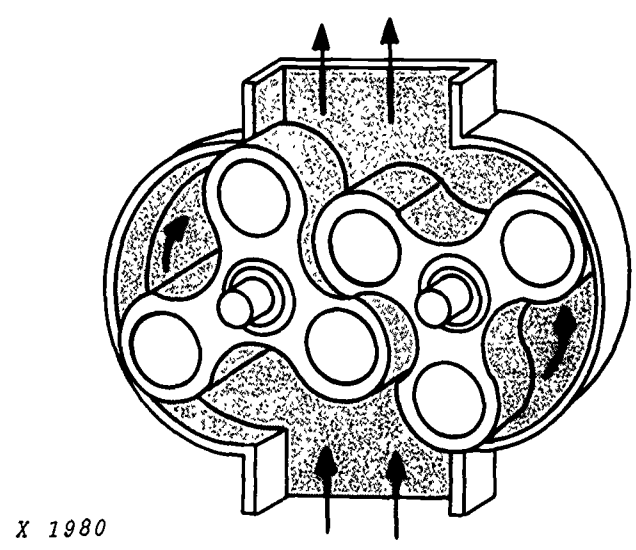


Fig. 24 — Roots-Type Supercharger

Roots-type superchargers or blowers (Fig. 24) are positive-displacement compressors. They resemble oil pumps in design.

In operation, air enters the housing due to rotation of the rotors and passes between the lobes of the rotors and housing.

The air is then forced out through the outlet opening of the unit.

This type of blower is either chain, belt or gear driven.

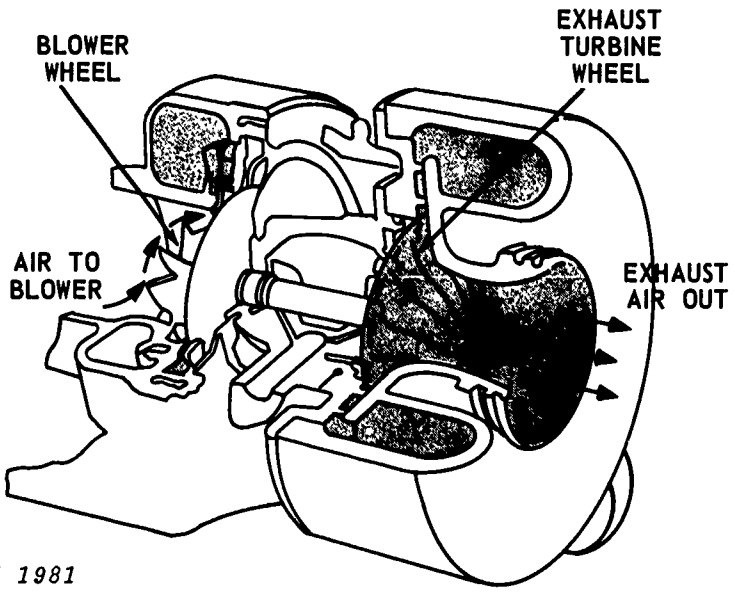


Fig. 25 — Centrifugal-Type Supercharger (Turbocharger Shown)

Centrifugal-type superchargers (Fig. 25) have an impeller rotating at high speed inside a housing. Normal speed is about 30 times engine speed.

The impeller moves air by "flinging" it off the tips of the impeller blades.

This type may be driven by the engine or engine exhaust, or by a separate motor. The advantage of a separately driven supercharger is that it does not use engine power.

Centrifugal-type superchargers are less expensive, require less maintenance, and do not make as much noise as Roots type units.

The **turbocharger,** an exhaust-driven centrifugal type supercharger, is most commonly used.

TURBOCHARGERS

The turbocharger (shown in Fig. 25) consists of a centrifugal compressor, a center housing which supports the rotating assembly, bearings and seals, turbine and compressor housings, and a drive turbine.

The drive turbine and compressor are mounted on a common shaft but usually are in separate housings (Fig. 25). On some turbochargers, they are mounted in a common divided housing.

The turbocharger is mechanically independent of the engine it serves. It is connected to the engine only by the exhaust pipe and intake manifold. It may be served by the engine oil lubrication system.

Because of the heat, turbine parts are made of heat-resisting material. In some cases water jackets are provided for cooling.

No controls are required with diesel engines; speed, air quantity, and charging pressure follow engine load and speed changes.

Turbochargers for spark-ignition engines require controls (if located ahead of the carburetor) to maintain correct fuel-air ratio for all operating conditions.

The turbocharger is propelled by high-pressure exhaust gases from the engine. All of the exhaust gases discharge into the turbine housing and push against the turbine wheel, causing it to rotate.

The exhaust then passes into the atmosphere through the regular engine exhaust system.

Turbochargers operate at a very high speed. This can range from 40,000 to 100,000 rpm or more.

SUPERCHARGERS FOR TWO-CYCLE ENGINES

An air pump of some type must be used on two-cycle engines to provide scavenging. (On four-cycle engines, this is done by the exhaust and intake strokes.)

There are three methods of providing this scavenging through a direct engine coupling. They are:

1) Crankcase scavenging

2) Power-piston scavenging

3) Pump or blower scavenging

Crankcase scavenging is used when the fuel-air vapor enters the engine through the crankcase (Fig. 26).

Each downward movement of the piston compresses the vapor within the crankcase until the intake port or valve opens.

The compressed vapor then escapes into the cylinder at a pressure nearly equal to atmospheric pressure.

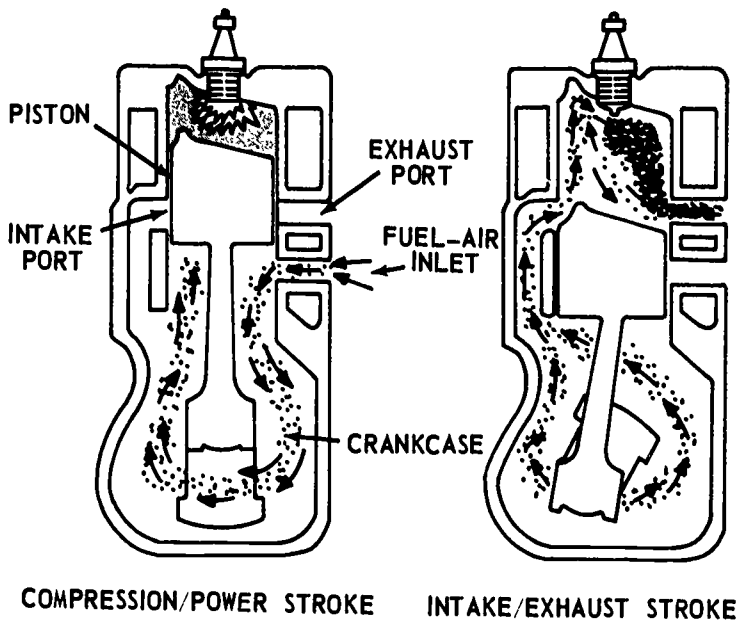


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Fig. 26 — Crankcase Scavenging In Two-Cycle Engine

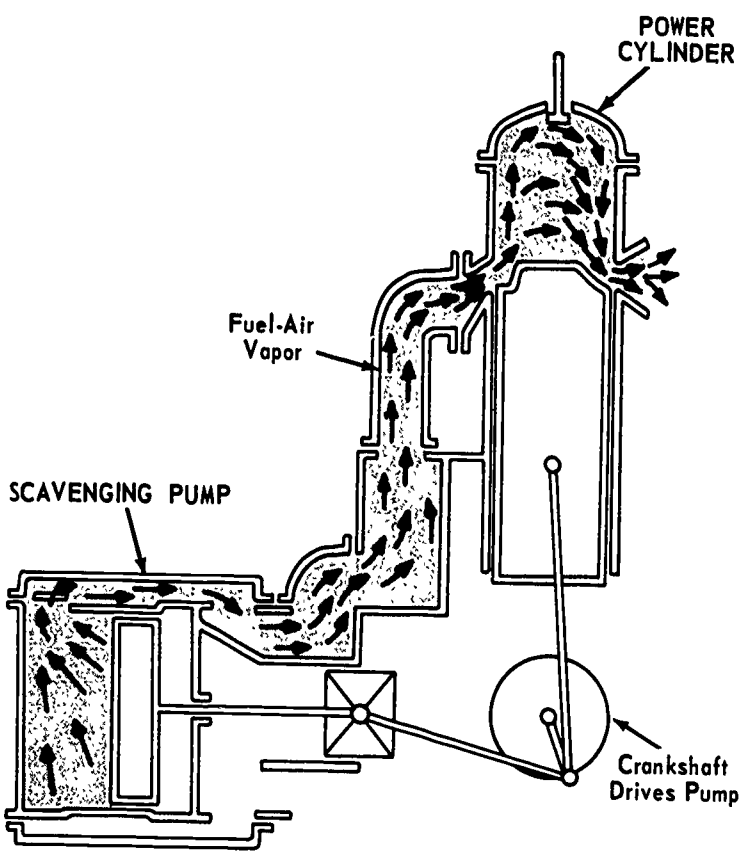

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Fig. 27 — Power-Piston Scavenging

Power-piston scavenging uses a separate piston and cylinder, driven by the engine crankshaft, to push the vapor into the cylinder as the intake port or valve opens (Fig. 27).

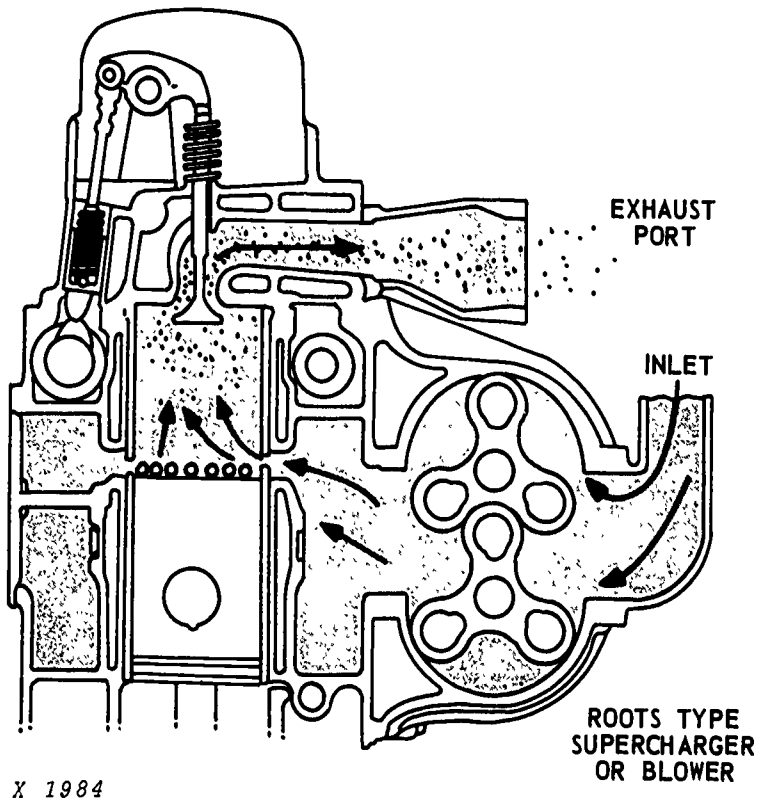

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Fig. 28 — Positive-Displacement Blower

With **blower scavenging,** a positive-displacement rotary blower, driven by the engine, compresses the fuel-air vapor into an air chamber surrounding the intake ports.

This type of blower has an advantage over an engine-driven centrifugal blower because it delivers practically the same amount of air per revolution regardless of speed or working pressure.

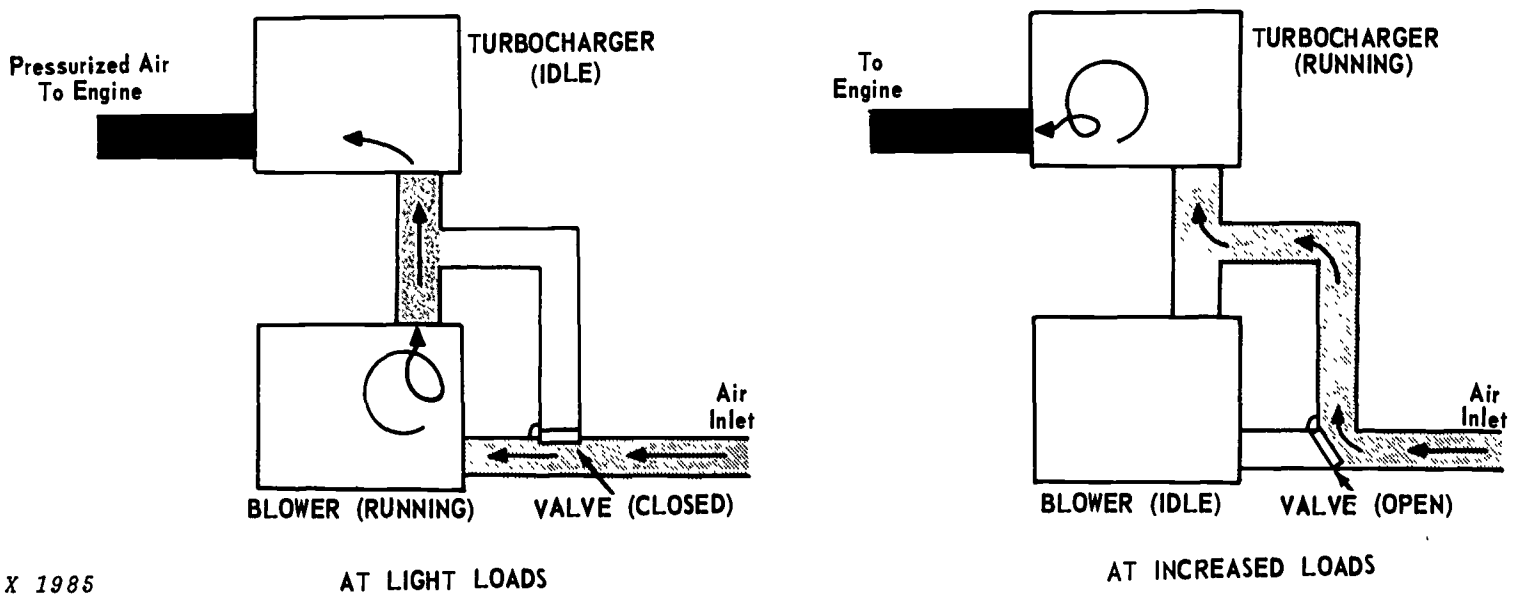
Scavenging Pump And Turbocharger

A turbocharger may be used in addition to the regular scavenging system. In this case the air drawn into the scavenging pump or blower is compressed to scavenging pressure in the normal manner and then passed to the turbocharger where it is raised to supercharged pressure (See Fig. 29).

At light loads when there is little energy available to drive the turbocharger, the mechanically-driven blower alone puts the scavenging air into the cylinders.

At increased loads, the turbocharger speeds up and sucks in so much air that its inlet pressure drops to atmospheric level, causing the blower check valve to open (Fig. 29).

At this engine speed, the blower becomes unloaded (saving engine power) and the turbocharger enters the load range where it alone can provide scavenging *and* supercharging.



X 1985 AT LIGHT LOADS AT INCREASED LOADS

Fig. 29 — Scavenging Pump And Turbocharger

Under the most favorable conditions the engine starting air contains enough energy to start the turbocharger and also supply enough combustion air to burn the fuel.

However, usual practice today is to equip the turbocharger with some method for supplying additional scavenging air while the engine is being started and while it is running at slow speed.

Two of the methods are:

1) Mechanical—At starting and slow speeds both the blower and turbocharger are driven from the crankshaft. When speed picks up, the drive coupling disconnects and the turbocharger operates on exhaust gas only.

2) Jet Air Starting—Used only for starting when high pressure air is available. Air is blown through jets into the turbocharger turbine or compressor. Air passing through the compressor passes on into the engine to assist in scavenging.

Intercoolers

Because a supercharger warms the air it handles —due to compression—an "intercooler" is often used between the supercharger and the engine. Cool air has more density than warm air so a greater *weight* can be packed into the cylinder—increasing the supercharging effect.

Special Instructions For Turbocharged Engines

Follow these special operating instructions when operating a turbocharged engine.

1. After starting the engine do not accelerate or apply load until there is positive indication of oil pressure.

2. After starting during cold weather, allow the engine to run five minutes at half throttle to insure oil pressure at the turbocharger before putting the engine under load.

3. Before stopping the engine, allow it to run at near slow idle speed for a few minutes to allow internal engine temperature to normalize. Failure to do this can damage the turbocharger (as well as the engine) due to distortion and "coking" of the oil in the passages.

4. Should the engine stall when operating at normal operating temperature, restart it immediately to prevent "temperature soaking" of the turbocharger. The turbocharger gets hot in operation. If stopped or stalled, oil in the center section may "coke", causing oil passages to clog.

Caution: *When transporting a turbocharged engine in an open conveyance, cover the exhaust outlet to prevent entrance of foreign matter and possible rotation of the turbocharger. Rotation of the turbocharger could damage the rotor bearings due to lack of lubrication.*

When the engine is not operating, cover the exhaust outlet to prevent entrance of water or other foreign matter.

Lubrication Of Turbochargers

The center housing may contain lubrication passages through which engine oil, under pressure, is directed to the journal bearings and thrust washers. It may also contain fittings for oil inlet and outlet connections.

If the unit has floating sleeve type bearings, they provide oil clearance between the bearing and

housing as well as oil clearance between the bearing and the shaft. When the turbocharger is operating, this allows the bearing to turn as the shaft rotates.

Since all parts of the rotating assembly are protected by a film of oil, no metal contact occurs. Consequently no wear occurs. If a constant supply of clean oil is supplied to the unit, bearing life will be indefinite.

All clearances in the turbocharger are controlled by closely maintained machine tolerances of detailed parts. This makes it imperative that only clean engine oil be supplied to the unit.

Service And Maintenance Of Turbochargers

DAILY INSPECTION

1. Inspect the mounting and connections of the turbocharger to be certain they are secure and there is no leakage of oil or air.

2. Check the engine crankcase to be sure there is no restriction to air flow.

3. Operate the engine at approximate rated output and listen for unusual turbocharger noise. If a shrill whine (other than normal) is heard, stop the engine immediately. The whine means that the bearings are about to fail. Remove the turbocharger for inspection.

NOTE: Do not confuse the whine heard during "run down", as the engine stops, with a bearing failure during operation.

Other unusual turbocharger noises could mean improper clearance between the turbine wheel and housing. If such noises are heard, remove the turbocharger for inspection. See the engine Technical Manual.

4. Check the turbocharger for unusual vibration while engine is operating at rated output. If necessary, remove the turbocharger for inspection.

5. Check engine under load conditions. Excessive exhaust smoke indicates incorrect fuel-air mixture. This could be due to engine overload or turbocharger malfunction.

6. Inspect and service air cleaner according to instructions in the operator's manual.

INSPECTION OF PARTS

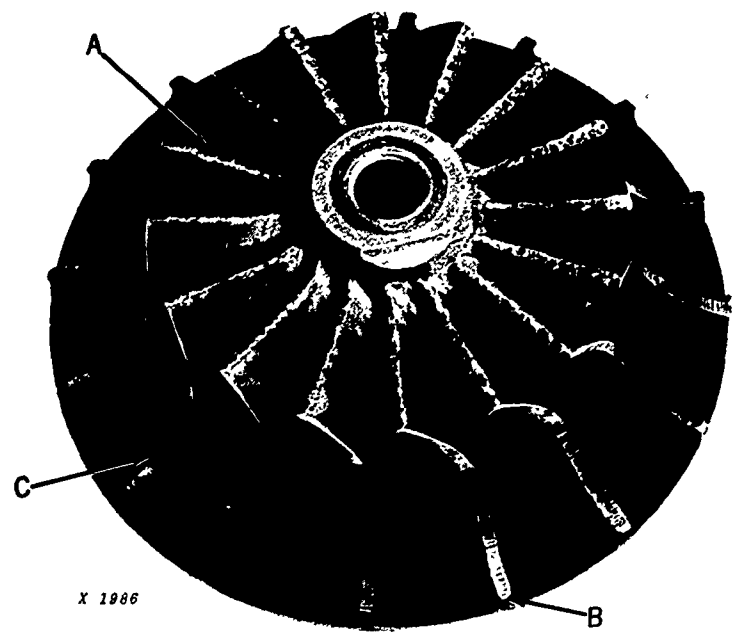


Fig. 30 — Damaged Impeller

If the impeller appears as shown in Fig. 30, or has any of the conditions given below, replace it.

A. Leading edges of impeller badly nicked.

B. Bearing failure and heavy seal wear due to rotating assembly imbalance.

C. Inlet section of compressor housing rough and pitted.

Any of the conditions listed can be caused by the following:

A. Leaks in connections of joints.

B. Loose material left in ducting.

C. Loose wire particles from air cleaner.

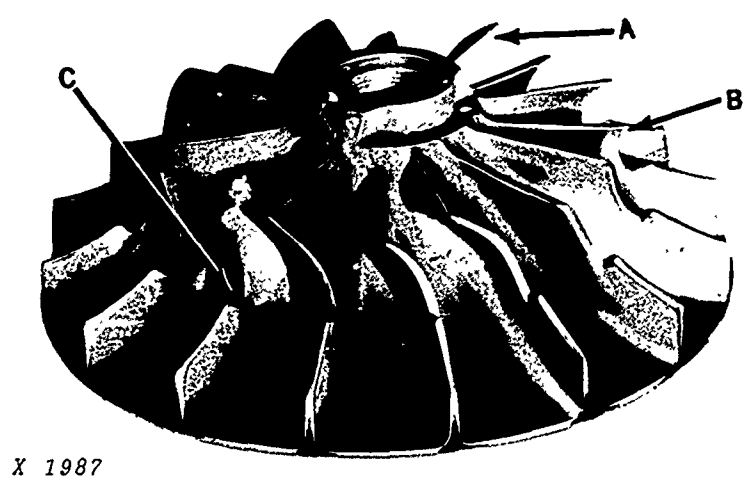


Fig. 31 — Eroded Impeller

If the impeller appears as illustrated in Fig. 31, replace it.

The conditions shown in Fig. 31 are:

A. Nicked leading edges.

B. Blade tips thinned from peening.

C. Blade contour deeply eroded.

These conditions can be caused by the following:

A. Loose connections at joints of air cleaner or ducting.

B. Dry type paper element split.

C. "Channeling" in oil bath air cleaner.

If carbon deposits are evident on the turbine wheel, remove the housing and clean as instructed above.

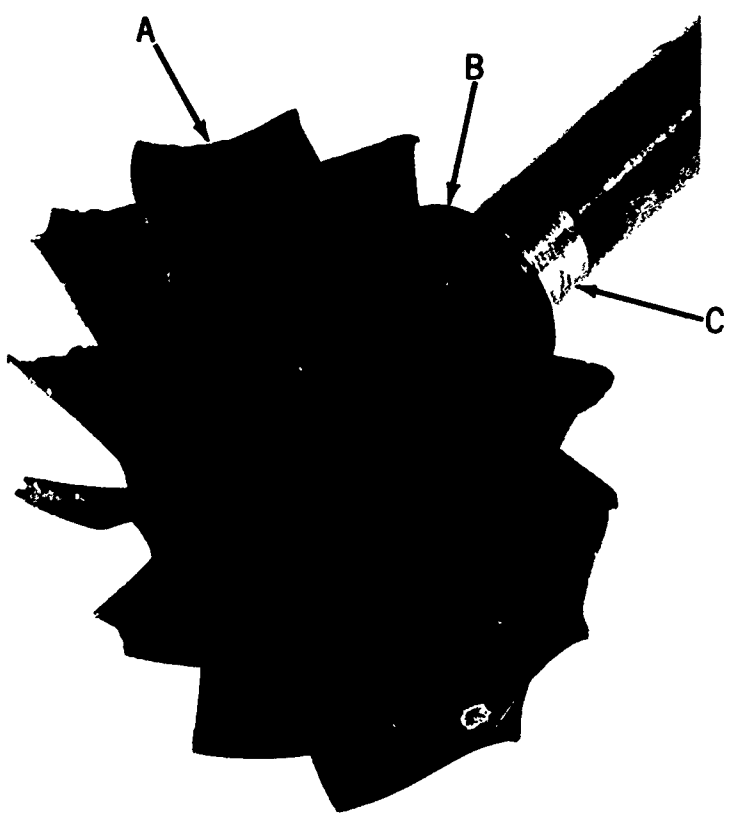


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Fig. 32 — Damaged Turbine Wheel

If the turbine wheel appears as shown in Fig. 32, replace it.

A. Blade tips chewed and battered.

B. Bearing material adhered to shaft journals. More pronounced on turbine end.

C. Shaft is discolored, (blued) especially on the turbine end.

D. Bearings pounded into bore.

These conditions can be caused by the following:

A. Piston breakage.

B. Value breakage.

C. Loose material left in manifold.

D. Broken injector tips.

See the engine Technical Manual for disassembly instructions.

Trouble Shooting of Turbochargers

As has been explained, most turbocharger failures start in some other area of the engine. The turbocharger is a relatively simple device and, if properly serviced, will operate with little or no attention.

TURBOCHARGER TROUBLE SHOOTING CHART

Trouble	*Possible Cause*	*Remedy*
Noisy operation or vibration.	Bearings not being lubricated.	Supply required oil pressure. Clean or replace oil line. If trouble persists, overhaul the turbocharger.
	Leak in engine intake or exhaust manifold.	Tighten loose connections or replace manifold gaskets.
Engine will not deliver rated power.	Clogged manifold system.	Clear all ducting.
	Foreign matter lodged in compressor, impeller, or turbine.	Disassemble and clean.
	Excessive buildup in compressor.	Thoroughly clean compressor assembly. Clean air cleaner and check for leaks.

TURBOCHARGER TROUBLE SHOOTING CHART (Continued)

Trouble	*Possible Cause*	*Remedy*
Engine will not deliver rated power (cont.)	Leak in engine intake or exhaust manifold.	Tighten loose connections or replace manifold gaskets.
	Rotating assembly bearing seizure.	Overhaul turbocharger.
Oil seal leakage.	Failure of seal.	Overhaul turbocharger.
	Restriction in air cleaner or air intake creating suction.	Remove the restriction.

TESTING THE AIR INTAKE SYSTEM

When the air flow into the engine is restricted, there is more vacuum or suction in the cylinders. This can cause oil to be sucked up around the valves and pistons and so increase oil consumption.

The test given here will tell if there is a restriction in the air intake system.

INTAKE VACUUM TEST (DIESEL ENGINES)

Test as follows:

1. Warm up the engine.

2. *On engines with restriction indicators,* remove the indicator, install a pipe tee fitting and reinstall the indicator. Connect the gauge to the tee fitting.

3. *On engines without restriction indicators,* connect the gauge to the intake manifold.

4. Set engine speed at fast idle and note the reading on the gauge. **Too high a reading means that there is a restriction in the air intake system.** Check the engine Technical Manual for correct specifications.

5. On engines with restriction indicators, check the operation of the indicator. Use a board or metal plate to very slowly cover the air intake opening. Note the action of the indicator in relation to the reading on the gauge. If the indicator does not operate properly, replace it.

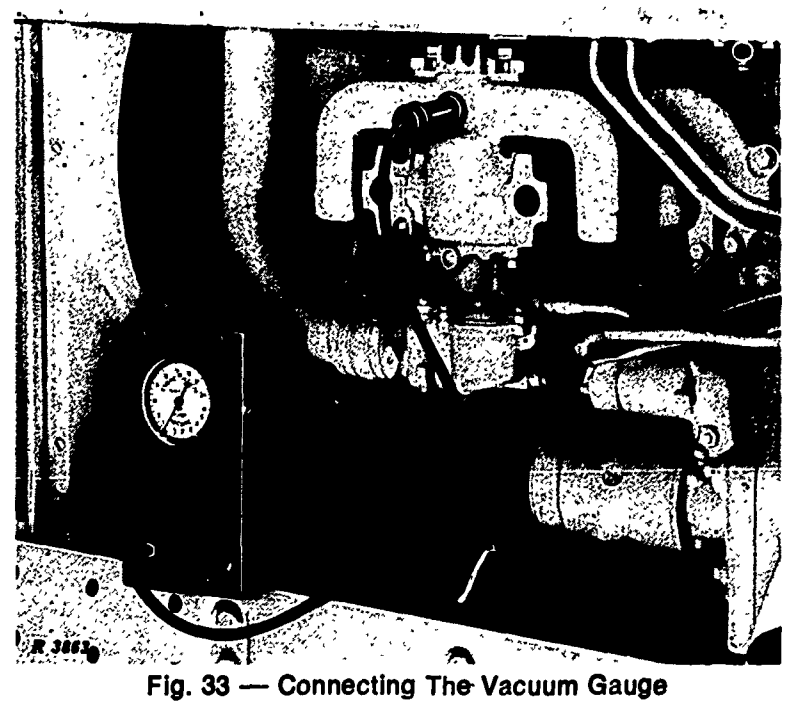

Fig. 33 — Connecting The Vacuum Gauge

MANIFOLD DEPRESSION TEST (SPARK-IGNITION ENGINES)

Use a vacuum gauge calibrated in inches of mercury to perform this test.

1. Connect the vacuum gauge to the intake manifold (Fig. 33).

2. Warm up the engine and operate it at idle speed.

3. Note the reading on the vacuum gauge. Check the engine Technical Manual for exact specifications.

4. Interpret the gauge reading as follows:

- **If the reading is steady and low,** loss of power in all cylinders is indicated. Possible causes are late ignition, bad valve timing, or loss of compression at valves or piston rings. A leaky carburetor gasket will also cause a low reading.

- **If the needle fluctuates steadily,** a partial or complete loss of power in one or more cylinders is indicated. This can be due to an ignition defect, or loss of compression due to stuck piston rings or a leaky cylinder head gasket.

- **Intermittent needle fluctuation** indicates occasional loss of power due to an ignition defect or a sticking valve.

- **Slow needle fluctuation** is usually caused by improper carburetor idle mixture adjustment.

- **A gradual drop in the gauge reading** at idle engine speed indicates back pressure in the exhaust system due to a restriction.

Be very careful in analyzing abnormal readings since the gauge readings can indicate more than one thing.

TEST YOURSELF

QUESTIONS

1. What are the two basic types of air intake systems?

2. What are the two types of superchargers? Which type delivers the same amount of air per revolution at all engine speeds?

3. What are the three parts of the exhaust system?

4. What three things does the exhaust system do?

ANSWERS

1. Cylinder feed and crankcase feed.

2. Roots and centrifugal. The Roots type is a positive displacement pump and provides the same amount of air per revolution, regardless of engine speed. The centrifugal type is most efficient at high speeds.

3. Manifold, exhaust pipe, muffler.

4. Removes heat, muffles sound, carries away exhaust gases.

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LUBRICATION SYSTEMS / CHAPTER 7

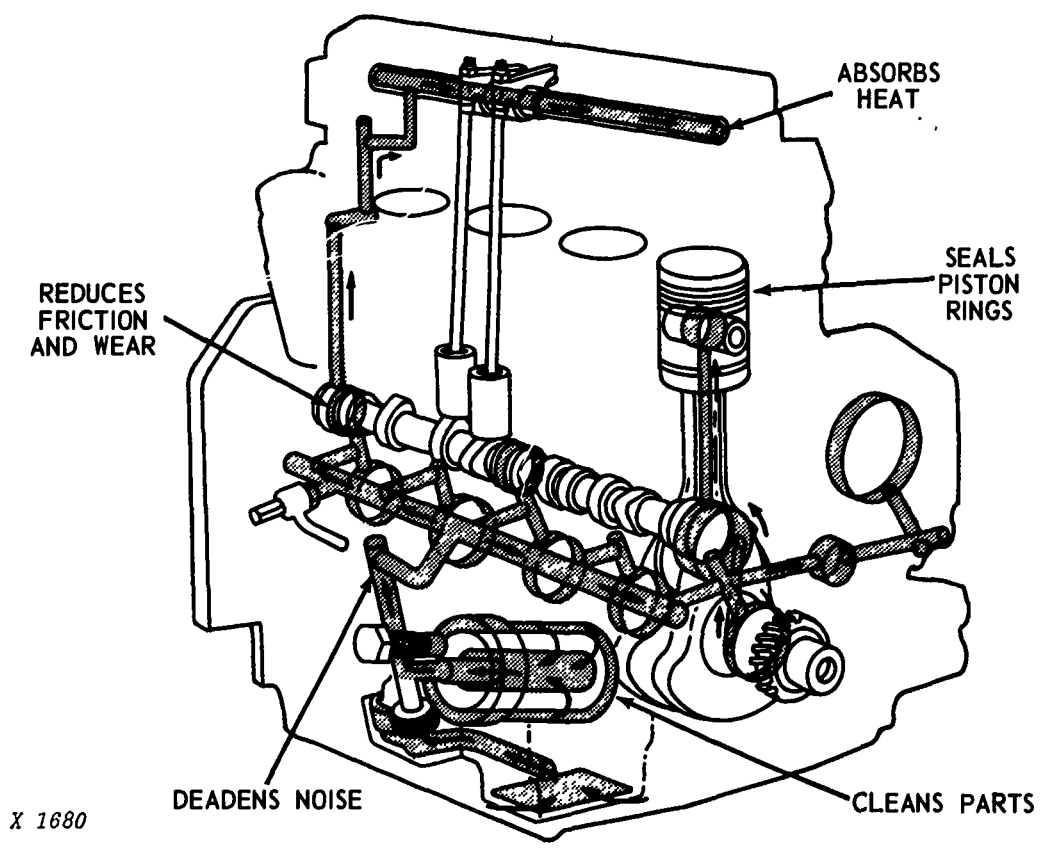

Fig. 1 — Lubrication System for Typical Engine

INTRODUCTION

The lubrication system does these jobs for the engine:

1) **Reduces friction between moving parts**
2) **Absorbs and dissipates heat**
3) **Seals the piston rings and cylinder walls**
4) **Cleans and flushes moving parts**
5) **Helps deaden the noise of the engine**

With lubricating oil, the system is able to perform all these jobs at once; without it, the engine would soon wear out or burn up.

TYPES OF LUBRICATION SYSTEMS

Engine lubrication systems may be classified as:

- **Circulating Splash**
- **Internal Force Feed and Splash**
- **Full Internal Force Feed**

The type of system used depends largely upon the size and design of the engine.

Let's discuss each system in detail.

CIRCULATING SPLASH SYSTEM

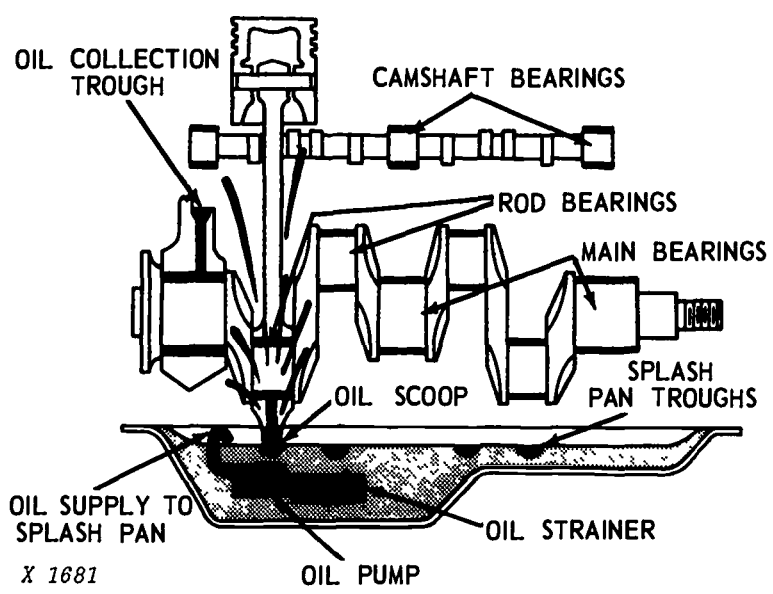

Fig. 2 — Circulating Splash System

In the **circulating splash system,** an oil pump supplies oil to a splash pan located under the crankshaft (Fig. 2). As the connecting rods revolve, scoops on the ends of the rods dip into troughs in the splash pan, creating the oil splash.

The splashing oil lubricates the moving parts nearby. Other parts are lubricated by oil splash which builds up in collecting troughs and is gravity fed through channels or lines.

The upper parts of the cylinders, pistons, and pins are lubricated more by oil mist than by the oil splash itself. This mist is created as the connecting rods spin.

The circulating splash system must have:

1) Proper oil level in the pan

2) Suitable oil for good splashing

There must be enough oil in the troughs of the splash pan for the connecting rods to splash. The oil pump must be working properly to provide this oil.

Because the oil must splash and flow freely, heavy oil will not work. Use only oil of the viscosity recommended by the engine manufacturer.

INTERNAL FORCE FEED AND SPLASH SYSTEM

In the **internal force feed and splash system,** the pump forces oil directly to a main oil gallery in the engine block rather than to a splash pan.

From the main oil gallery, the oil is forced through passages to the main bearings, connecting rod bearings, camshaft bearings, rocker arm shaft, filter, and pressure sending unit.

The oil escaping from the bearings creates a mist which also lubricates the upper cylinder walls, pistons, and pins.

Pressure of the lubricating oil can usually be adjusted in these systems.

FULL INTERNAL FORCE FEED SYSTEM

The **full internal force feed system** goes one step farther than the system above. Oil is forced not only to the crankshaft bearings, rocker arm shaft, filter and pressure sending unit, but also to the piston pin bearings.

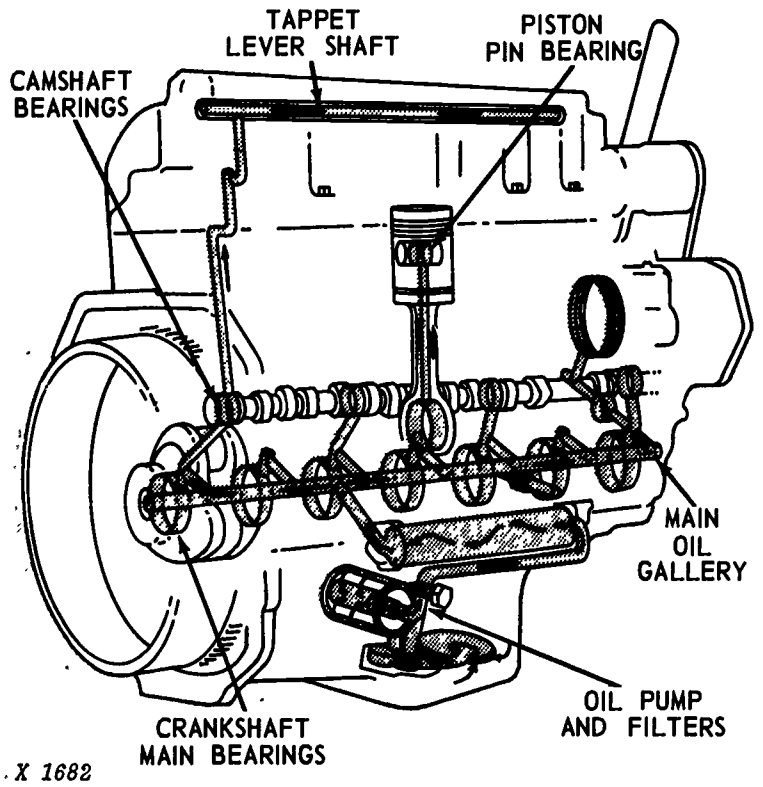

Fig. 3 — Full Internal Force Feed System

The piston pin bearings are lubricated through drilled passages in the connecting rods (Fig. 3). The cylinder walls and pistons are lubricated by oil escaping from the piston pin bearings or the connecting rod bearings.

The force feed system has one prime need: **good oil pressure.**

As the force feed system requires oil to be pumped long distances and through many passages, sufficient oil pressure is required. The required pressure for most engines is 25-40 psi, but it may go as high as 65 psi.

OIL PUMPS

Pumps for engine lubrication are usually one of two types:

- **External Gear Pumps**
- **Rotor Pumps**

The external gear type is the most common.

Normally, the oil pump is mechanically driven by the engine. Usually, the external gear pump is driven from the camshaft, while the rotor type is driven from the crankshaft. In some large engines, an electric motor is used to drive an auxiliary pump.

EXTERNAL GEAR PUMP

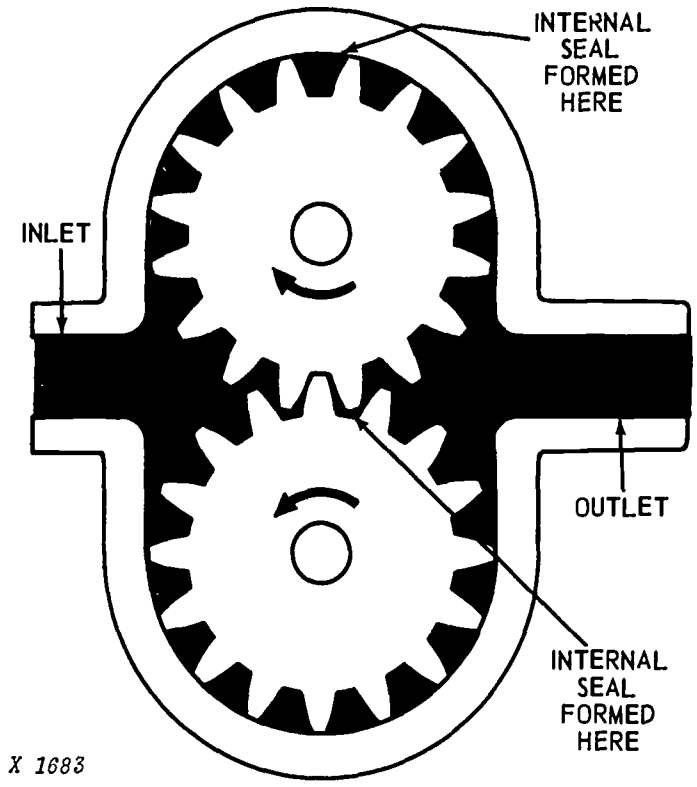

Fig. 4 — External Gear Pump

The **external gear pump** has two gears in mesh, closely fitted inside a housing (Fig. 4). The drive shaft drives one gear, which in turn drives the other gear. The machined surfaces of the outer housing are used to seal the gears.

As the gears rotate and come out of mesh, they trap inlet oil between the gear teeth and the housing. The trapped oil is carried around to the outlet chamber. As the gears mesh again, they form a seal which prevents oil from backing up to the inlet. The oil is forced out at the outlet and sent through the system.

ROTOR PUMP

The **rotor pump,** which is a variation on the *internal* gear pump, is also relatively simple in design. An inner rotor turns inside a fixed rotor ring (Fig. 5).

In operation, the inner rotor is driven inside the rotor ring. The inner rotor has one less lobe than the ring, so that only one lobe is engaged with the outer ring at any one time. This allows the other lobes to slide over the outer lobes, making a seal to prevent back-up of oil.

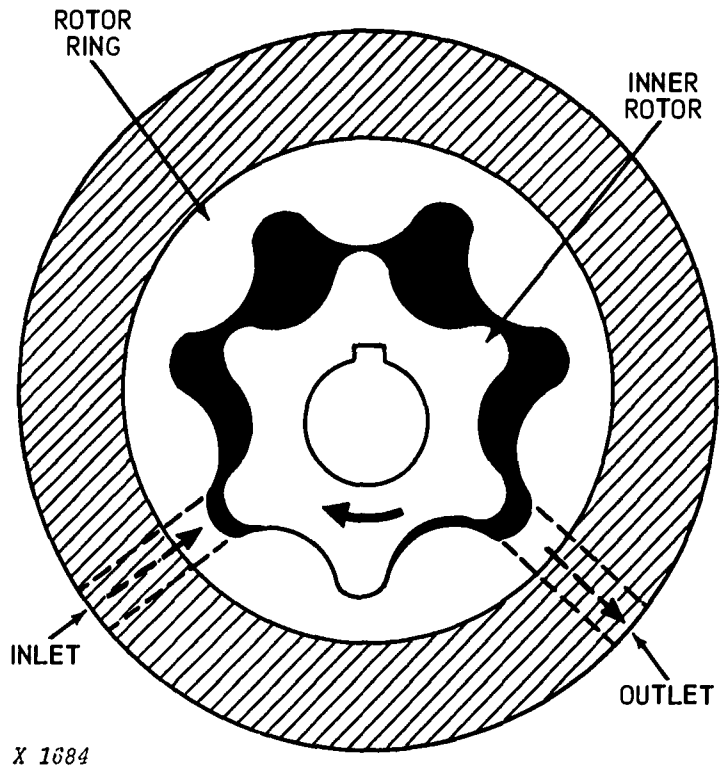

Fig. 5 — Rotor Pump

As the lobes slide up and over the lobes on the outer ring, oil is drawn in. As the lobes fall into the ring's cavities, oil is squeezed out.

SERVICING OIL PUMPS

When servicing an oil pump, be careful not to damage the mounting surfaces of either the housing or cover. Many pumps do not use a gasket, and these machined surfaces form the only seal.

Check the machined surfaces of the pump housing and cover for warping. They must be perfectly flat if they are to seal.

In an external gear pump, most wear will occur between the teeth of the gears.

In a rotor pump, most wear will occur between the lobes on the inner rotor and the lobes on the rotor ring.

Use a micrometer to measure the widths of these parts. Check the results against the specifications for the pump.

Also measure the pump drive shaft and compare it with the specifications.

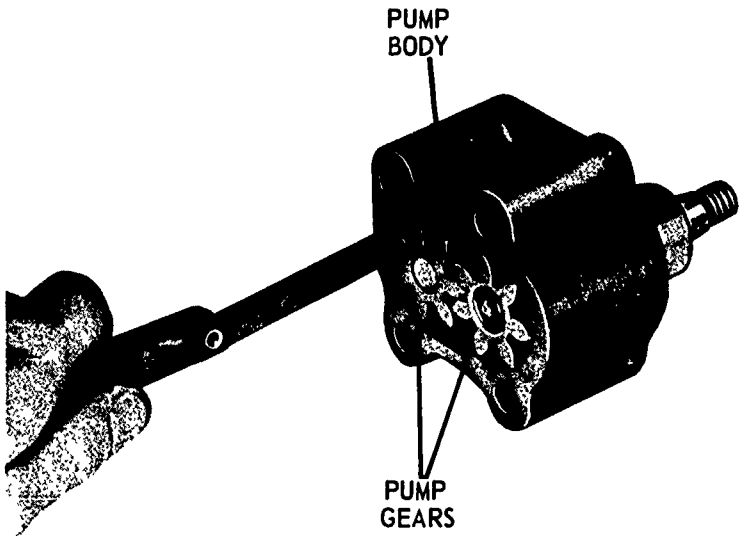

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Fig. 6 — Measuring Clearance Between Pump Gears and Housing

With the gears mounted in the housing, use a feeler gauge to measure the clearance between the gears and the housing (Fig. 6). If the clearance is more than specifications, replace the gears.

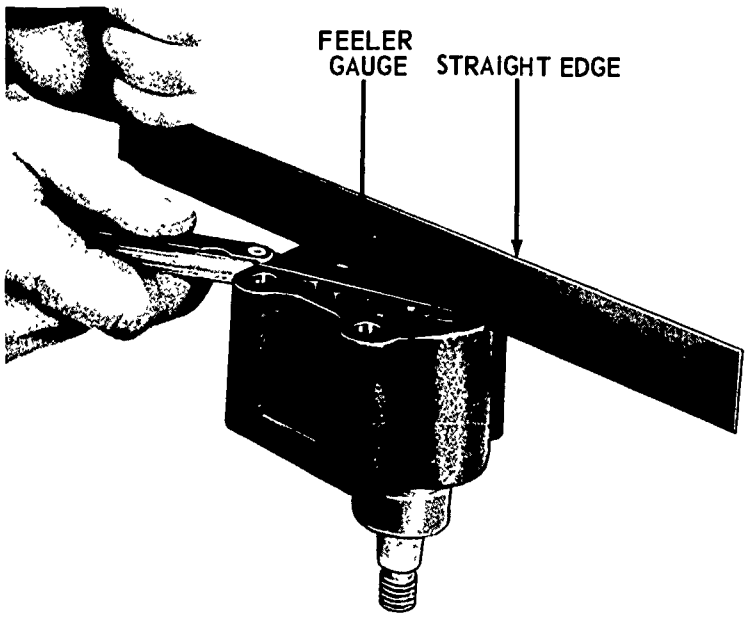

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Fig. 7 — Measuring Clearance Height of Pump Gears

Place a straight edge across the top of the pump housing (to represent the cover) and measure the clearance between the gears and the straight edge (Fig. 7). If the clearance is excessive, replace the gears.

Almost all pumps use a screen over the inlet to strain out foreign material. Where possible, remove the screen from the inlet pipe, and clean both with a solvent. Use compressed air to dry the parts.

Inspect all bushings in the housings and replace those with excessive wear.

OIL FILTERS AND FILTRATION SYSTEMS

Oil contamination reduces engine life more than any other factor. To help combat this, oil filters are designed into all modern engine lubrication systems.

There are two basic types of filters—**surface** and **depth** and they are used in two basic types of filtering systems—**bypass** and **full flow.** Some large engines use a combination bypass and full flow filtering system.

Let's look first at the two types of filters, then at the two types of filtering systems.

TYPES OF FILTERS

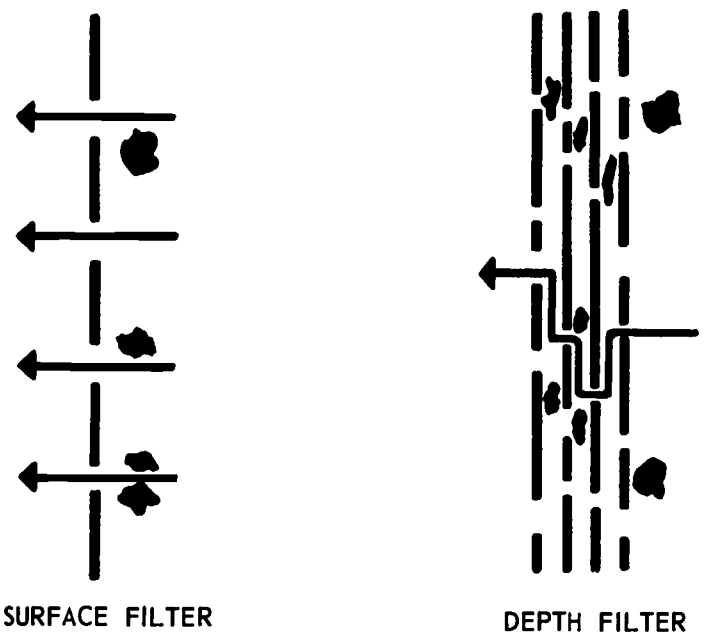

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Fig. 8 — Surface and Depth Filters Compared

Filters are classified as either **surface**-type filters or **depth**-type filters depending on the way they remove dirt from the oil (Fig. 8).

SURFACE FILTERS have a single surface that catches and removes dirt particles larger than the holes in the filter. Dirt is strained or sheared from the oil and stopped outside the filter as oil passes through the holes in a straight path. Many of the large particles will fall to the bottom of the reservoir or filter container, but eventually enough particles will wedge in the holes of the filter to prevent further filtration. Then the filter must be cleaned or replaced.

A surface filter may be made of fine wire mesh (Fig. 9), stacked metal or paper disks, metal rib-

bon wound edgewise to form a cylinder (Fig. 10), cellulose material molded to the shape of the filter, or accordian-pleated paper (Fig. 11).

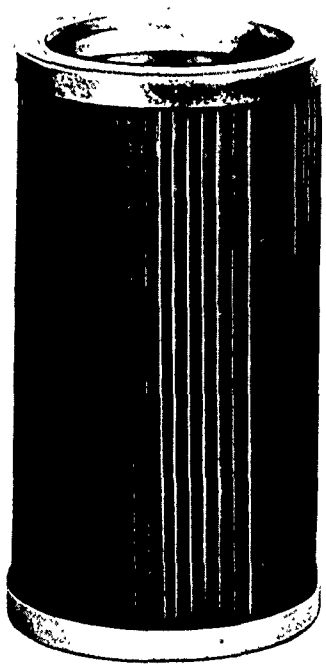

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Fig. 9 — Wire Mesh Filter

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Fig. 10 — Metal Edge Filter

DEPTH FILTERS, in contrast to the surface type, use a large volume of filter material to make the oil move in many different directions before it finally gets into the lubrication system. The filter made of cotton waste shown in Fig. 12 is an example of a depth filter.

Depth filters can be classified as either absorbent or adsorbent, depending on the way they remove dirt.

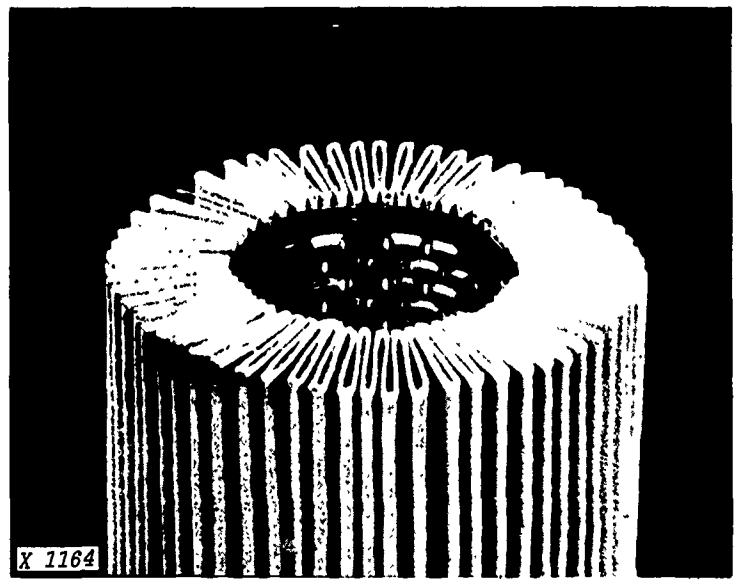

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Fig. 11 — Pleated Paper Filter

Absorbent filters operate mechanically like a sponge soaking up water. Oil passes through a large mass of porous material such as cotton waste, wood pulp, wool yarn, paper or quartz, leaving dirt trapped in the filter. This type of filter will remove particles suspended in the oil and some water and water soluble impurities.

Adsorbent filters operate the same way as absorbent filters but also are chemically treated to attract and remove contaminant. This filter may be made of charcoal, chemically-treated paper or fuller's earth. It will remove contaminating particles, water soluble impurities and, because of its chemical treatment, will also remove contamination caused by oil oxidation and deterioration. Adsorbent filters may also remove desirable additives from the oil and for this reason are not often used in lubrication systems.

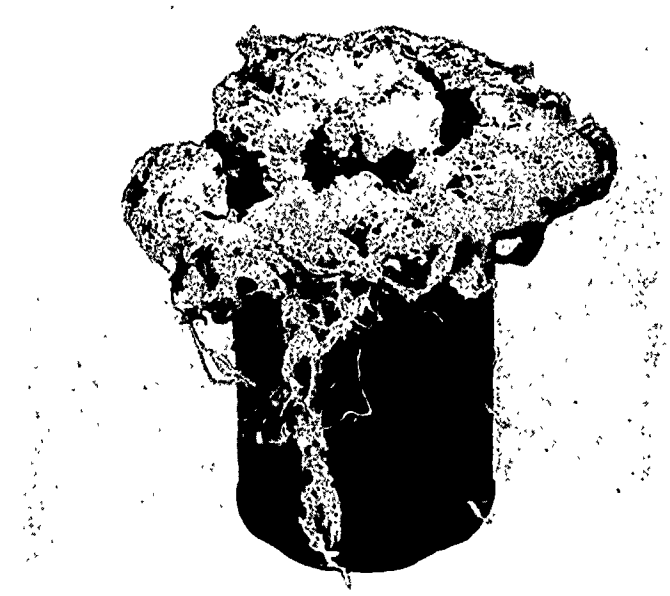

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Fig. 12 — Depth Filter — Cotton Waste Type

DEGREES OF FILTRATION

In addition to the type of filter, the degree of filtration is also important to a lubrication system.

It is the degree of filtration that tells just how small a particle the filter will remove. The most common measurement used to determine degree of filtration is a micron (one micron is approximately 0.00004-inch or 40 millionth of an inch). To get an idea of how big a micron really is, 25,000 particles of this size would have to be laid side by side to total just one inch.

The smallest particle that can normally be seen with an unaided eye is about 40 microns, so much of the dirt that is filtered out of lubrication system is invisible.

Some filters, such as those made of wire mesh, may allow particles as big as 150 microns to pass. Although they do not provide as fine a cleaning action as some other types of filters, wire mesh offers less resistance to oil flow and is often used on pump inlet lines to prevent the possibility of starvation.

A filter will pass small solids and stop larger ones but the actual amount of filtering done is difficult to determine. Because the material that is stopped by the filter is not taken away continuously, the size of the openings in the filter will usually decrease with use.

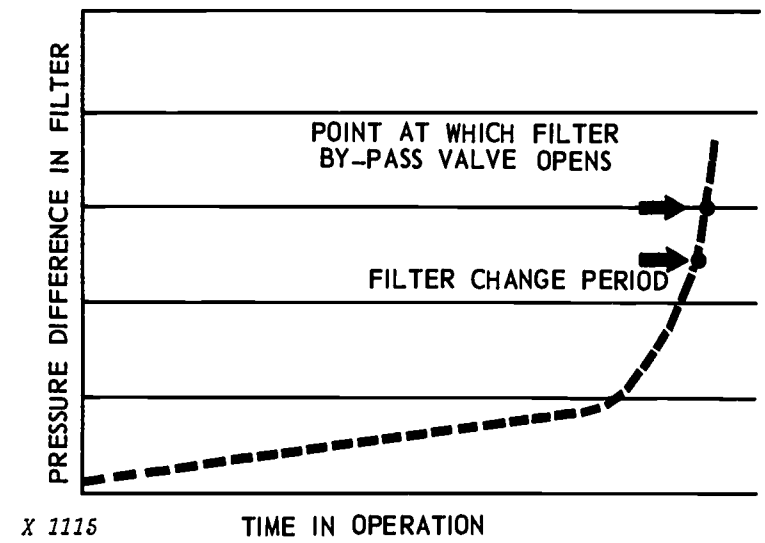

Fig. 13 — Life of a Filter Element

Two or more particles smaller than the holes in the filter may approach at the same time and become wedged in the hole. The result is that the hole will now remove dirt particles far smaller than it would when new. As more dirt wedges in the filter, the holes become smaller and eventually are plugged solid.

Fig. 13 shows the gradual reduction in the size of the filter pores until, near the end of filter life, the pressure difference between the inside and outside of the filter rises sharply. At this point, the filter stops operating and should be replaced.

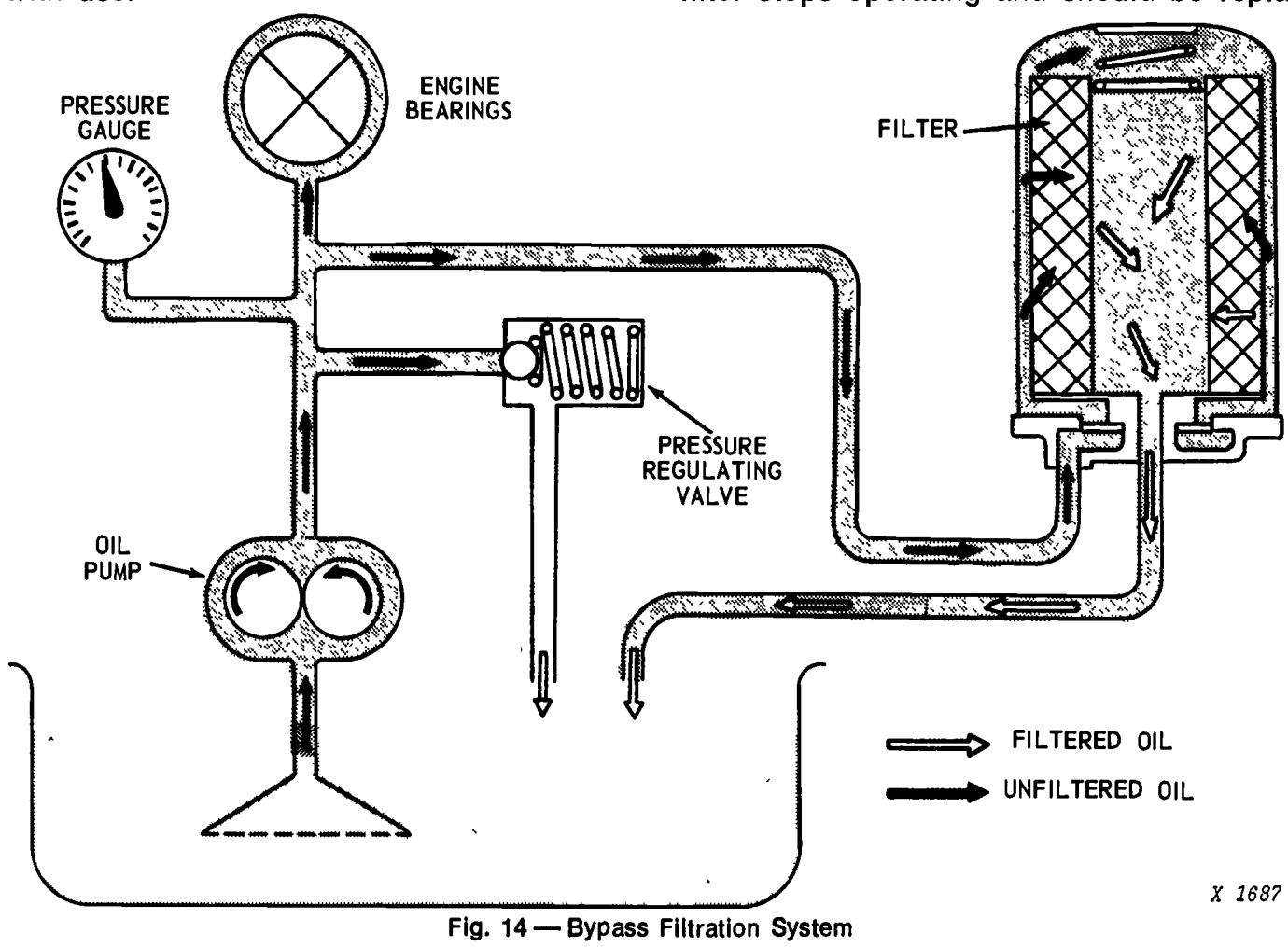

Fig. 14 — Bypass Filtration System

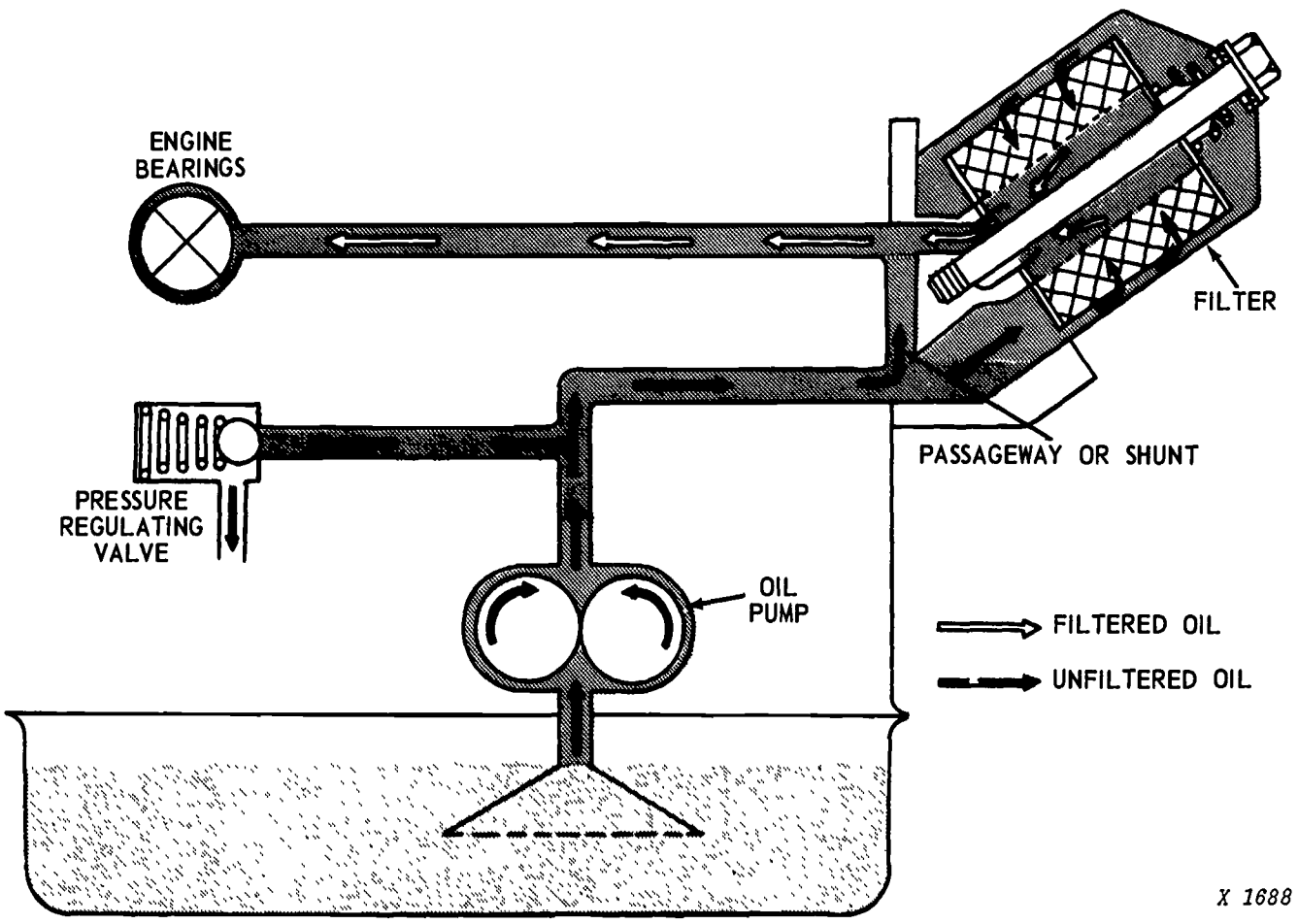

Fig. 15 — Shunt-Type Filtration System

Now Let's look at the two types of filtration systems—**bypass** and **full flow.**

BYPASS FILTRATION SYSTEM

In the **bypass** filtration system (Fig. 14) there are two separate oil flows, one to the bearings and one to the filter.

In this system, five to ten percent of the oil delivered by the pump is routed or *bypassed* to the filter instead of the bearings. After filtering, the oil is returned to the crankcase. This system is sometimes called a "partial flow" system as only part of the supply oil is filtered at one time.

The volume of oil bypassed through the filter is initially controlled by a restriction in the filter outlet. However, as the flow passages become clogged, the volume of oil through the filter is reduced. This, of course, reduces the volume of filtered oil being returned to the crankcase. Because of the two separate oil flows, the oil pressure at the bearings is constant regardless of the condition of the filter.

This means that the filter and the oil must be changed regularly to prevent loss of filtering.

Shunt-Type System

The **shunt-type** filtration system (Fig. 15) is a variation of the bypass system. In this case, there is only *one* oil flow to the filter. Within the filter case, part of the oil goes through the filter to the bearings while the remainder is shunted directly to the bearings.

Initially, the volume of filtered oil is greater than the shunted oil. But as the filter becomes clogged, less and less filtered oil reaches the bearings, until finally no oil is filtered. This causes a pressure loss at the bearings, since the oil passes through only the shunt opening. However, this reduced pressure is sufficient to provide oil for the engine bearings.

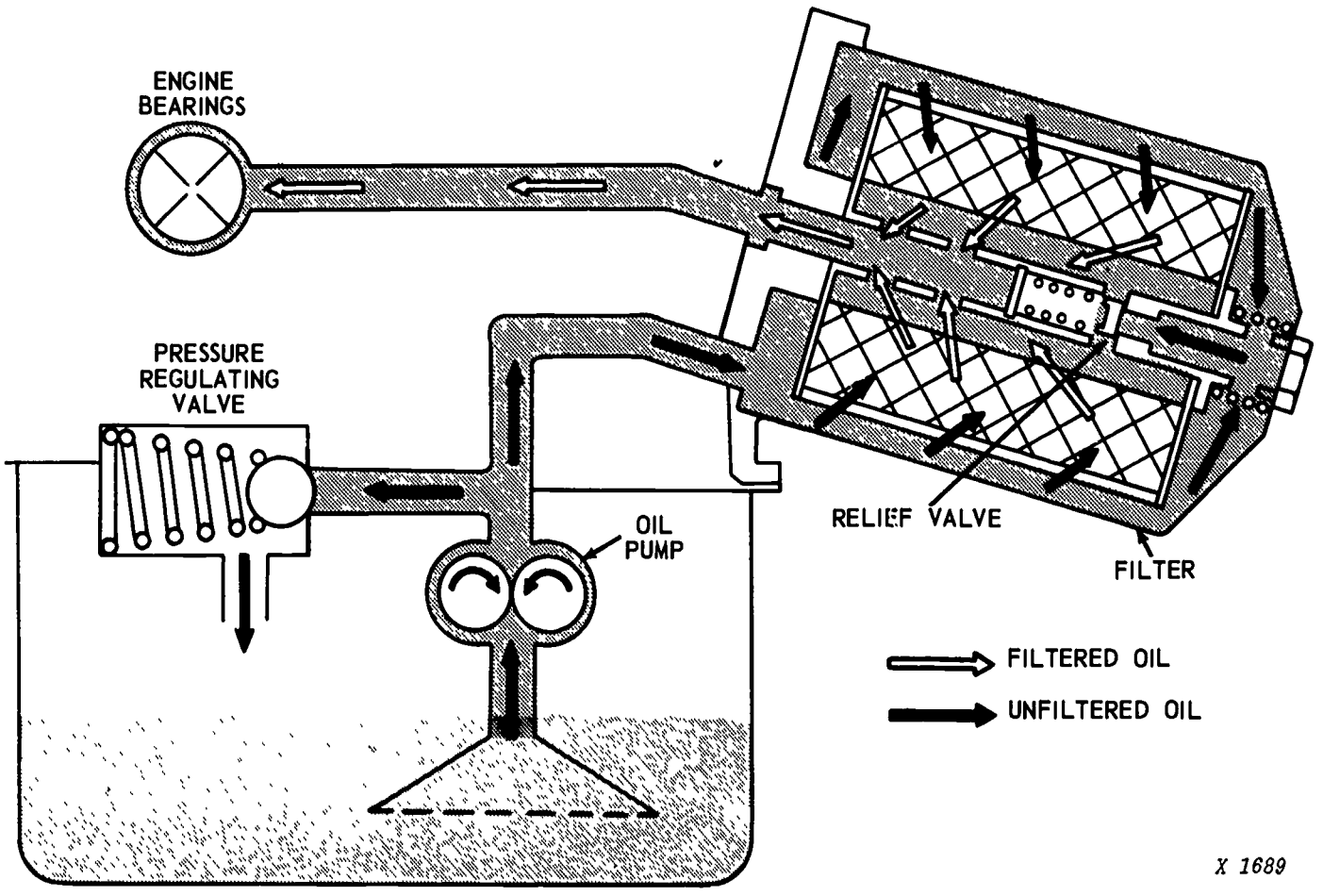

Fig. 16 — Full Flow Filtration System

FULL FLOW FILTRATION SYSTEM

In the **full flow** filtration system, (Fig. 16) there is only one oil flow—from the pump, to the filter, and then to the bearings. A pressure gauge and pressure regulating valve are used just as in the bypass system.

Notice the relief valve, within the filter. When the filter is new, there is very little pressure drop through the filter. However, if the filter gets clogged, the resulting pressure will open the relief valve and allow unfiltered oil to bypass to the bearings. This relief valve may be located in the base of some filter housings.

SERVICING OF OIL FILTERS

Most engines today use a replaceable oil filter element.

The filter may be enclosed in a disposable housing with a permanent base.

Service for these filters is simple—replace it at the regular intervals specified by the engine manufacturer (Fig. 17).

If the filter element is contained in a removable housing, use a solvent to clean the housing and the mounting base. Dry thoroughly with compressed air. Likewise, clean and dry the relief valve if it is removable.

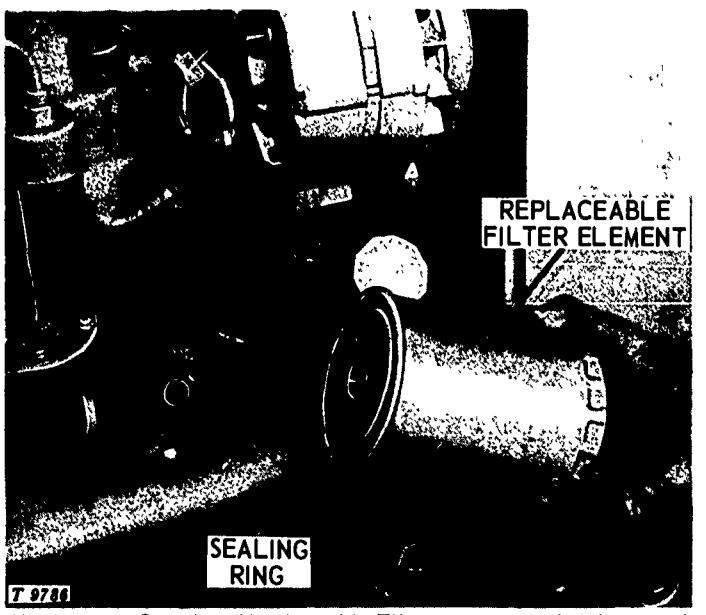

Fig. 17 — Service Engine Oil Filters at Regular Intervals

Edge-type metal filters should be cleaned with solvent and a soft brush. Hard varnish-like deposits may be removed by soaking the filter overnight in a strong solution of lye water. Flush the filter thoroughly after soaking to remove the loosened particles.

When servicing any filter, use new gaskets and seal rings. *Tighten the housing firmly,* **but not too tightly.** Run the engine until oil pressure registers and check for leaks. Leaks are caused by the housing being too loose or the gasket installed improperly.

Often the crankcase oil is changed at the same time as the filter is serviced. This assures both a clean oil supply and filter for the lubricating system.

CAUTION: Many full flow filters have a special by-pass valve. Replace them only with a genuine duplicate of the original filter.

LUBRICATING VALVES

Valves have two uses in the lubrication system:

- **To regulate oil pressure**
- **To bypass oil at filters and oil coolers**

The operation of the valve is the same in either case.

Basically, the valve has a poppet held in place over an opening by a spring.

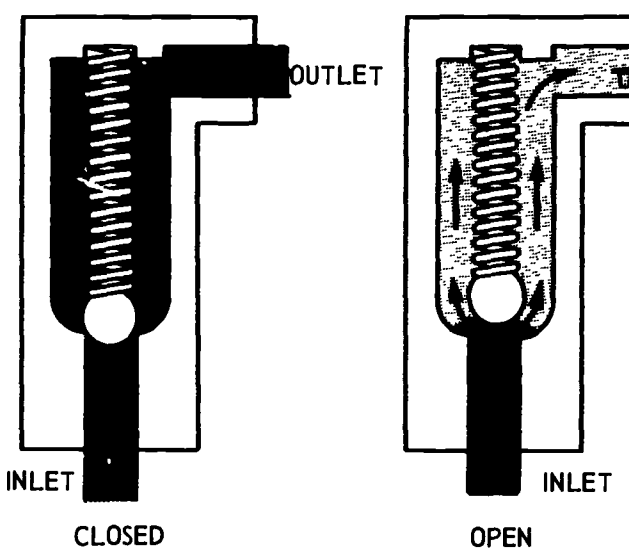

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Fig. 18 — Operation of Lubricating Valve

As shown in Fig. 18, the valve is **closed** when the spring tension is greater than the oil pressure at the inlet. The spring tension holds the poppet securely in position.

The valve **opens** when pressure at the oil inlet exceeds that of the spring. This pushes the poppet off the inlet hole and oil flows through the valve.

Now let's see how this valve is used.

OIL PRESSURE REGULATING VALVES

The oil pressure regulating valve maintains the correct pressure in the lubrication system regardless of the engine speed or the temperature of the oil. Most regulating valves are adjustable.

Most oil pumps can push out more oil than needed for engine lubrication. At idling speeds, or on older engines, this is no problem. But what happens to the excess oil when the engine is new and operating properly?

This is where the **pressure regulating valve** does its job. When the oil pressure exceeds the valve setting, the valve opens and returns the excess oil to the crankcase.

The regulating valve is usually connected to the main oil gallery through passages in the block. However, it may be a part of the oil pump.

CHECKING AND ADJUSTING OIL PRESSURE

Before checking the engine oil pressure, always check the condition of the oil filter. A dirty filter will drop the pressure reading.

Many engines have tapped holes in the block as oil pressure test points. On other engines, the oil pressure sending unit hole is used for testing.

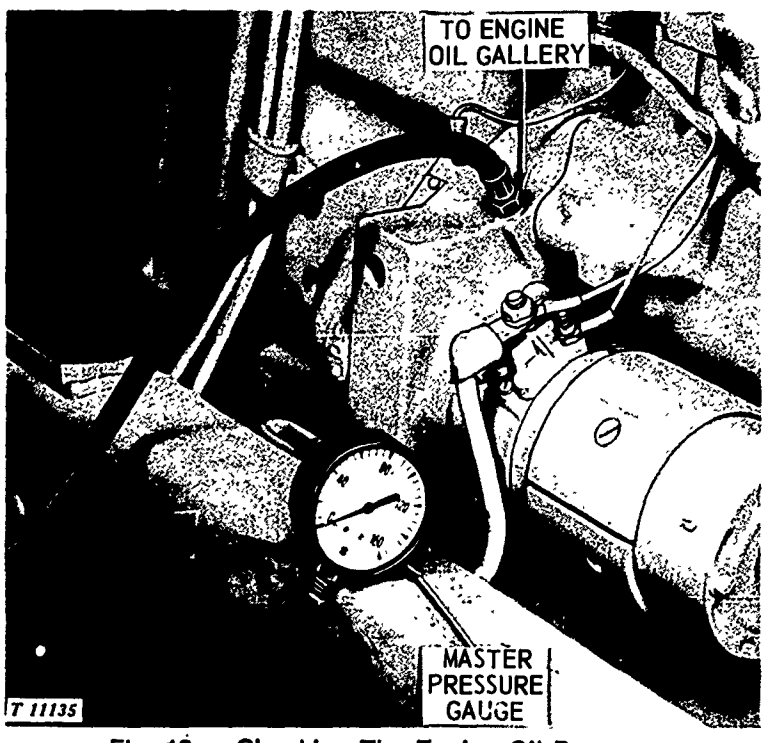

Fig. 19 — Checking The Engine Oil Pressure

Install a master gauge as shown in Fig. 19. Start and run the engine at fast-idle speed. When the engine is warmed up to operating temperature, record the pressure reading on the gauge. Compare this reading with the specifications for the engine.

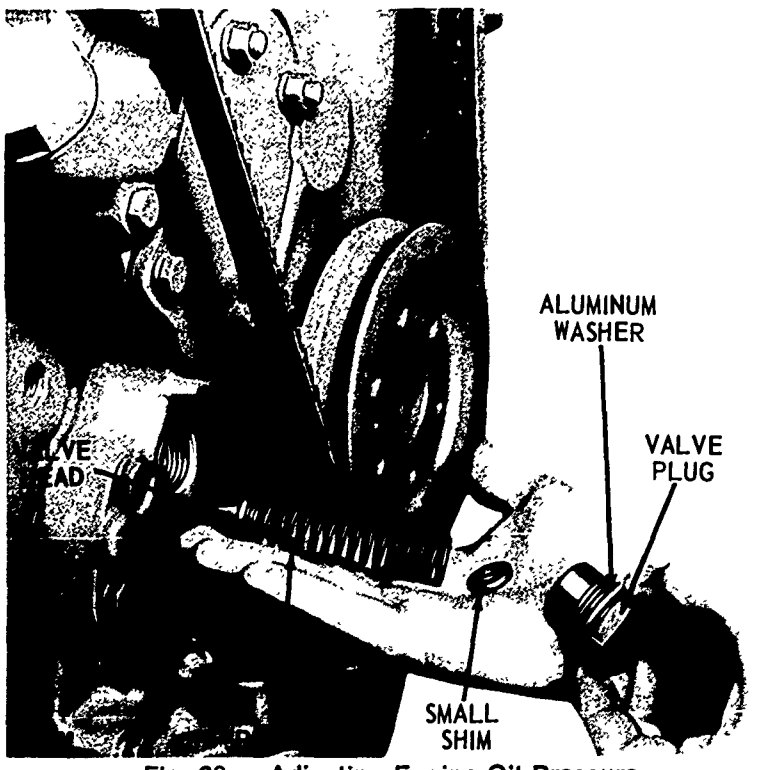

Fig. 20 — Adjusting Engine Oil Pressure (Shim-Adjusted Valves)

For adjusting pressure, shims and washers are used in some regulating valves (Fig. 20).

To raise pressure, shims are added behind the spring to increase the tension of the spring. This in turn increases the setting at which the valve will open.

To lower pressure, shims are removed to decrease the tension of the spring and allow the valve to open at a lower setting.

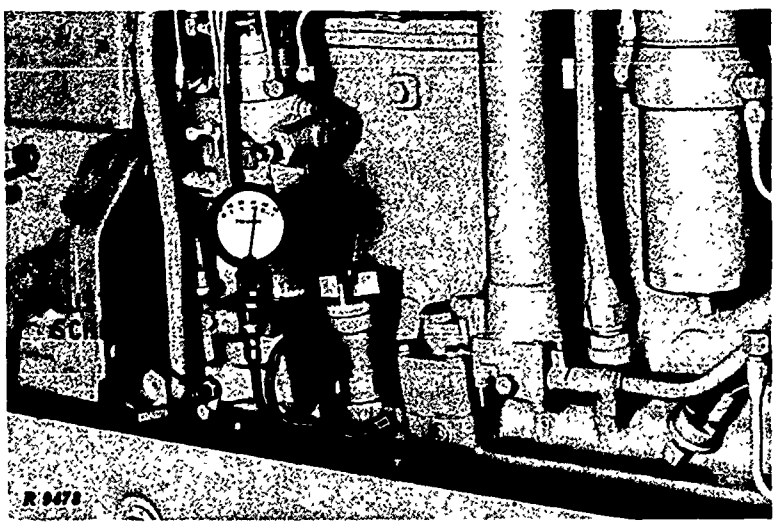

Fig. 21 — Adjusting Engine Oil Pressure (Screw-Adjusted Valves)

Some regulating valves are adjusted by an adjusting screw (Fig. 21). Normally, turn the screw in to increase the spring tension and the pressure setting. Turn the screw out to decrease the pressure setting.

CAUSES OF TOO-LOW ENGINE OIL PRESSURES

1. *Oil level in crankcase too low*
2. *Oil in crankcase too thin*
3. *Worn engine bearings*
4. *Worn oil pump*
5. *Filter or pump leaks*
6. *Regulating valve spring failed*
7. *Regulating valve needs adjustment*

For remedies, see Chapter 11, "Diagnosis and Testing".

CAUSES OF TOO-HIGH ENGINE OIL PRESSURES

1. *Oil in crankcase too heavy*
2. *Defective pressure gauge or sender*
3. *Stuck regulating valve*
4. *Regulating valve needs adjustment*

For remedies, see Chapter 11, "Diagnosis and Testing".

FILTER BYPASS VALVES

Every filter in a full flow lubrication system must have a **bypass** valve. This valve bypasses oil around the filter when the filter becomes clogged.

In the full flow system, all of the oil delivered by the pump passes either through the filter to the bearings or through the pressure regulating valve to the crankcase. Let's see what would happen if a bypass valve were not provided.

As the filter becomes completely clogged, pressure would build up on the inlet side of the filter (see Fig. 16). This would cause the pressure regulating valve to open completely, allowing all of the oil to return directly to the crankcase. Result—a burned-up engine.

The bypass valve, then, is a safety device to ensure that the oil, filtered or dirty, will get to the bearings. The valve is usually set to open before the filter becomes completely clogged.

Fig. 22 shows the filter bypass valve in two locations—inside the filter and in the filter mounting pad.

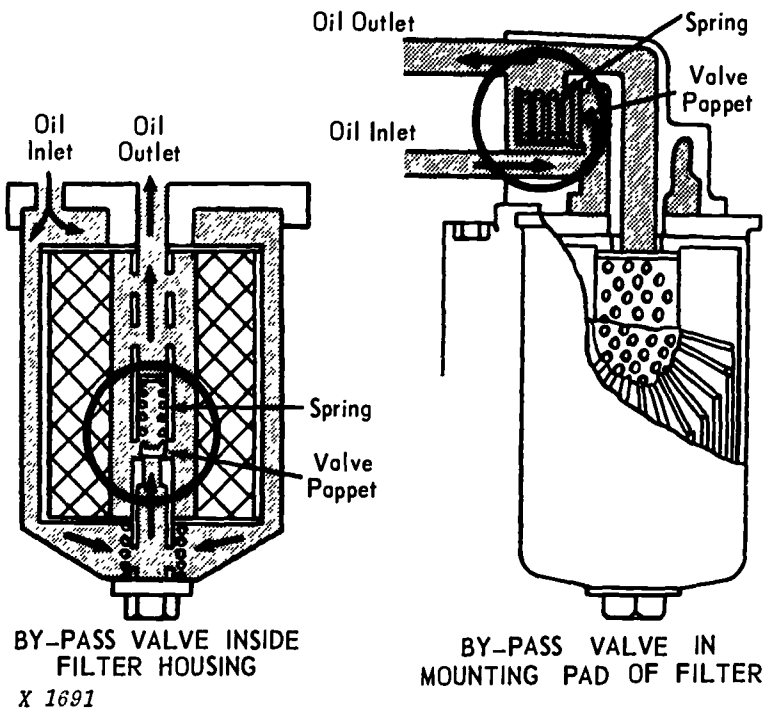

Fig. 22 — Filter Bypass Valves — Two Locations

Many of the "spin-on" filter elements have the bypass built into the element.

When replacing a filter, **be sure to use only the recommended filter.** Another type may not have the built-in bypass valve.

Bypass valves are often used with oil coolers for the same reason that they are used with filters. If the oil cooler becomes clogged, oil flows through the valve and back into the lubrication system.

SERVICING OF LUBRICATING VALVES

Most important in servicing of lubricating valves is to clean them. Where possible, completely disassemble the valve and wash the parts in solvent. Clean the bore in which the valve slides. Use compressed air to dry the parts.

Use a spring tester to check the strength of the spring. A broken or weakened spring will cause the valve to open at a much lower setting.

Inspect the valve poppet for wear and nicks that might cause it to hang up in the bore. *It is very important that the valve slides freely in the bore.*

Some regulating valves use a bushing in the bore as the seat for the poppet. Inspect the seat for wear and replace it if necessary.

Always check and adjust the engine oil pressure after servicing a lubricating valve.

OIL COOLERS

Lubrication systems of many engines use an oil cooler to help dissipate the heat created by the engine. Most coolers are of the water-to-oil cooling type, using engine coolant to dissipate heat from the oil.

The oil cooler may be mounted **internally** in the crankcase or **externally** on the outside of the engine block.

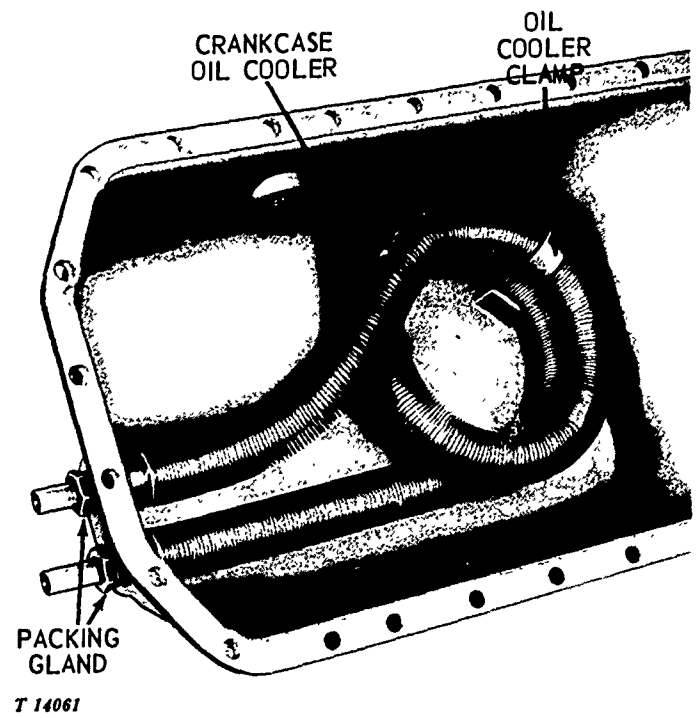

Fig. 23 — Internal Oil Cooler in Crankcase

When the cooler is mounted in the crankcase (Fig. 23), coolant is pumped by the water pump through the cooler to the radiator of the cooling system. The heat of the oil in the crankcase is conducted through the fins of the cooler and is absorbed by the coolant. The heat is then dissipated in the radiator.

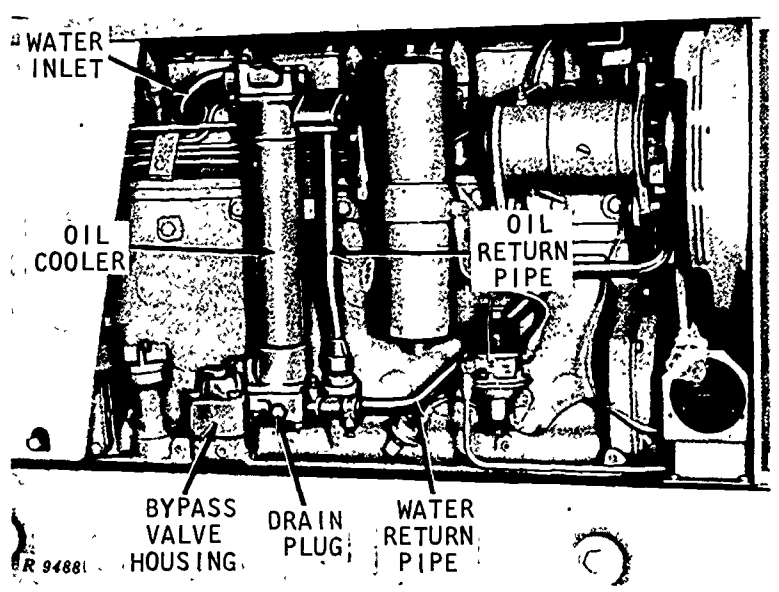

Fig. 24 — Oil Cooler Mounted Outside Engine

When the cooler is mounted externally (Fig. 24), both coolant and lubricating oil are pumped through it.

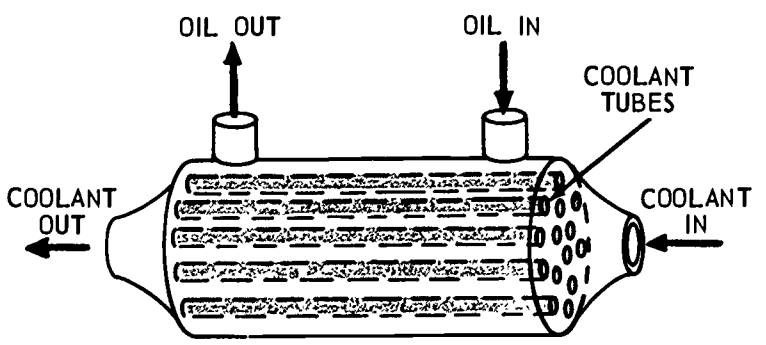

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Fig. 25 — Operation of Engine Oil Cooler

As shown in Fig. 25, coolant flows through the tubes in the cooler and oil circulates around the tubes. Heat from the oil is conducted through the tubes to the coolant which carries it to the radiator for dissipation.

A similar cooler uses a small radiator core, instead of tubes within the housing. The oil is pumped through the core and the coolant is circulated around it.

A bypass valve is used with some oil coolers to assure circulation of the oil if the cooler should become clogged.

MAINTENANCE OF OIL COOLERS

Normal maintenance of the cooling system (Chapter 8) will keep the oil cooler passages clean.

When cleaning the lubrication system, remove the cooler and clean the oil passages with a solvent.

When assembling or installing an external cooler, use new gaskets and be sure the cap screws are tight.

OIL PRESSURE INDICATING SYSTEMS

A pressure indicating system is essential for monitoring the lubrication system. These systems may be classified as:

- **Mechanical**
- **Electrical**

MECHANICAL INDICATING SYSTEMS

The **mechanical** indicating system uses a Bourdon tube gauge which is attached by tubing to the pressure source. This is usually the main oil passage in the engine block.

The basic components of the Bourdon tube gauge are a tube made of spring bronze or steel and a pinion and sector mechanism (Fig. 26). One end of the tube is permanently attached to the pressure inlet of the gauge. The other end is attached to the pinion and the sector mechanism.

Oil pressure inside the tube tends to straighten the tube out. This movement acts upon the pinion and sector mechanism, causing the pointer to rotate on the face of the gauge. The pressure, in psi, can be read directly on the gauge.

Maintenance

1) If a mechanical gauge will not register pressure, loosen the oil line at the engine block (but do not remove it).

2) If oil leaks from the connection while the engine is running, there is pressure in the lubricating system. This means the trouble is in the oil line of the gauge itself.

3) Check the oil line for leaks. The pressure must get to the gauge before it can register.

4) If you suspect that the gauge is defective, replace it with one that is known to be accurate. If the new gauge works correctly, this proves that the original is defective.

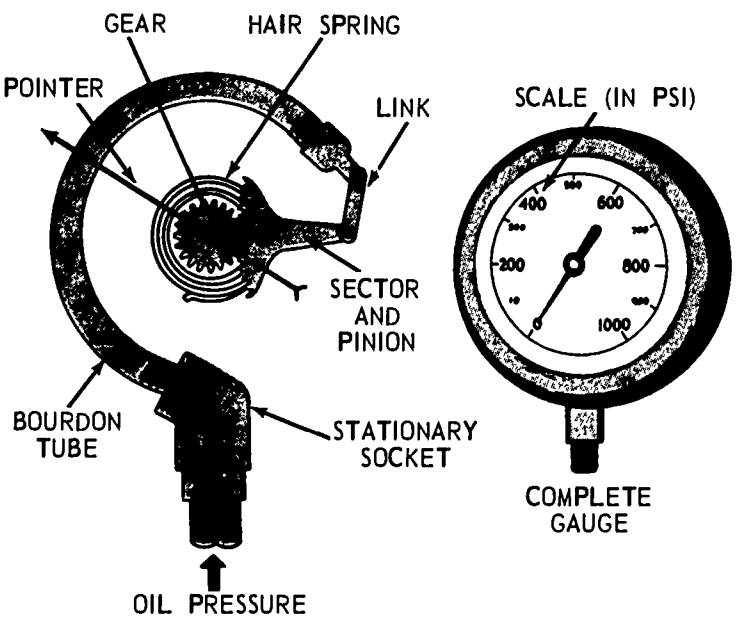

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Fig. 26 — Bourdon Tube Oil Gauge

ELECTRICAL INDICATING SYSTEMS

An **electrical** oil pressure indicating system has two parts:

1) Sending unit—at pressure source

2) Indicating gauge—on control panel

The **sending unit,** actuated by the pressure of the lubricating oil electrically actuates the indicating unit. The two units are connected together by a single wire, and both must be grounded.

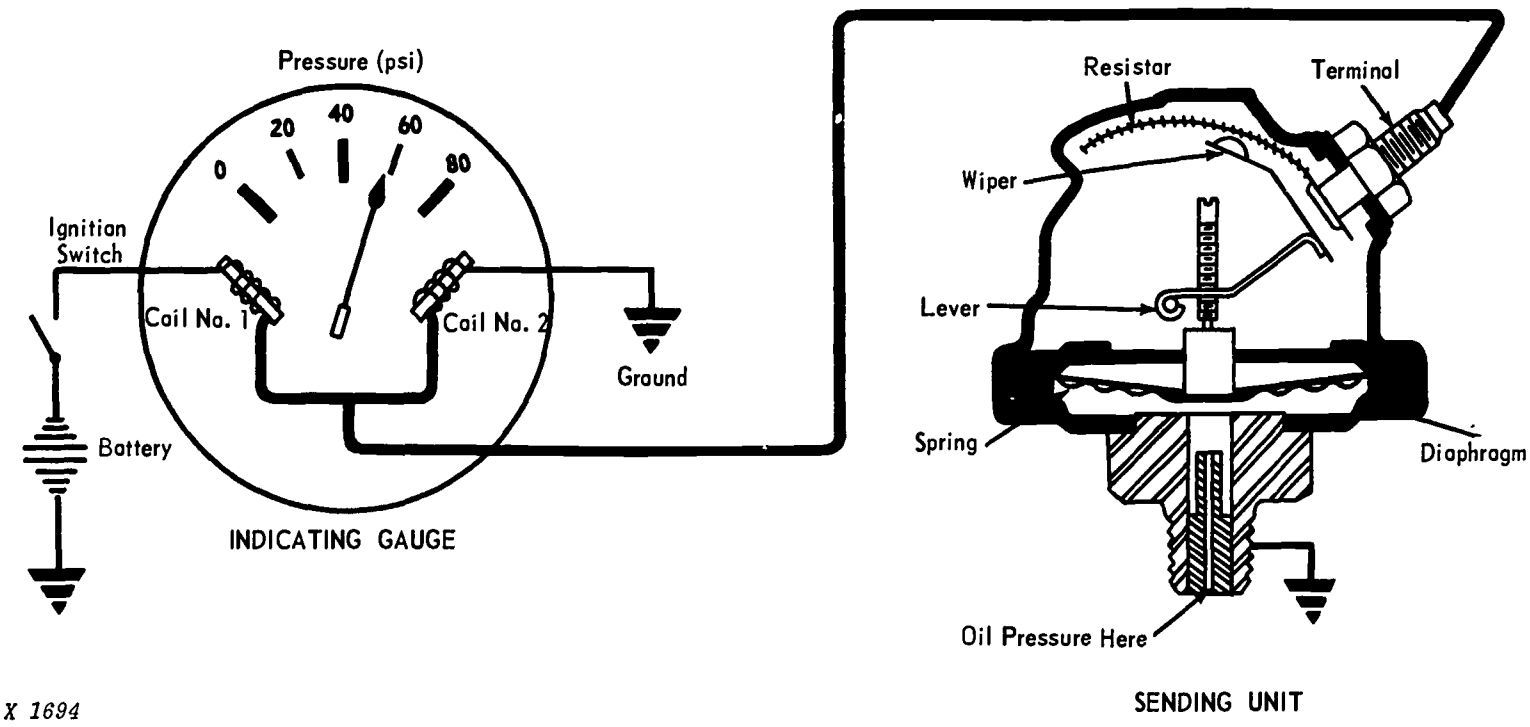

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Fig. 27 — Electromagnetic Coil System For Indicating Oil Pressure

There are three kinds of electrical indicating systems:

- **Electromagnetic coil type**
- **Heating coil type**
- **Pressure switch type**

Let's look at the operation of each one.

Electromagnetic Coil System

The **sending unit** of the electromagnetic system consists of a resistor, a sliding contact called the wiper, an actuating lever, and a spring-loaded diaphragm enclosed in a housing (Fig. 27).

The pressure of the lubricating oil works against the diaphragm causing the lever to move. The movement of the lever changes the position of the wiper which varies the resistance of the resistor.

The **gauge** contains two coils and an armature with a pointer. The magnetic fields of the two coils creates another field which controls the rotation of the armature. This, in turn, controls the rotation of the pointer on the face of the gauge.

Current flows from the battery to coil No. 1 in the gauge as shown, then through a parallel circuit to coil No. 2 and to the resistor in the sending unit.

As pressure against the diaphragm in the sending unit changes, the resistance of the resistor also changes. The change of the current in coil No. 2 causes its magnetic field to be stronger or weaker than that of coil No. 1.

The armature, of course, is attracted to the stronger of the two fields.

Heating Coil System

The **sending unit** of the heating coil system has a heating coil wound around a bimetal strip. (See upper diagram in Fig. 28.) The pressure of the lubricating oil deflects the diphragm, causing the contact to close. The current flowing through the coil then creates heat.

The heat deflects the bimetal strip until the contact is opened. The bimetal then cools and returns to its original position, again closing the circuit. This cycle of closing and opening, heating and cooling is repeated continuously.

The **gauge** contains a similar heating coil wound around a bimetal strip. This coil is connected in series with the coil in the sending unit. As the coil of the sending unit heats up, so does the coil of the gauge. The bimetal strips in each unit then deflect at the same time.

The pointer of the gauge is linked to the bimetal strip in the gauge. The deflection of the bimetal strip causes the pointer to rotate on the face of the gauge.

As oil pressure increases, the diaphragm of the sending unit is deflected more (see lower diagram in Fig. 28). A greater amount of current is then required to heat the bimetal strip enough to open the contact. The increased current in the coil of the gauge, likewise, causes a greater deflection of the bimetal strip in the gauge. This, in turn, causes the pointer to register the increased oil pressure.

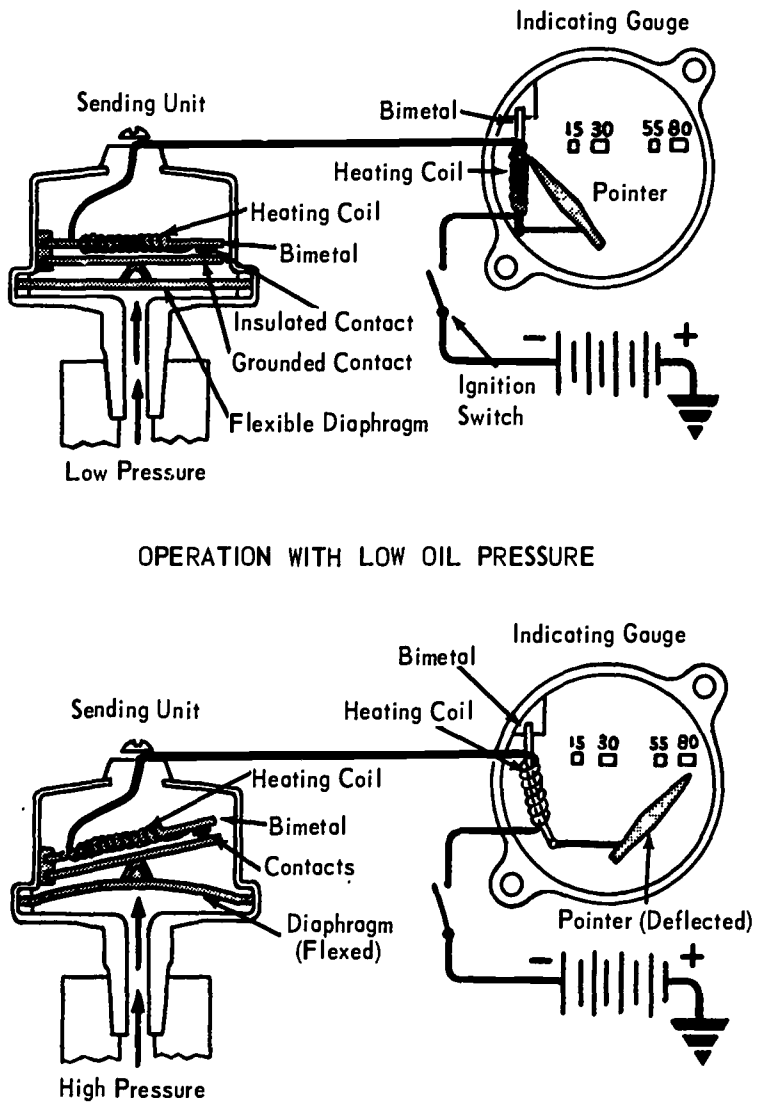

Fig. 28 — Heating Coil System for Indicating Oil Pressure

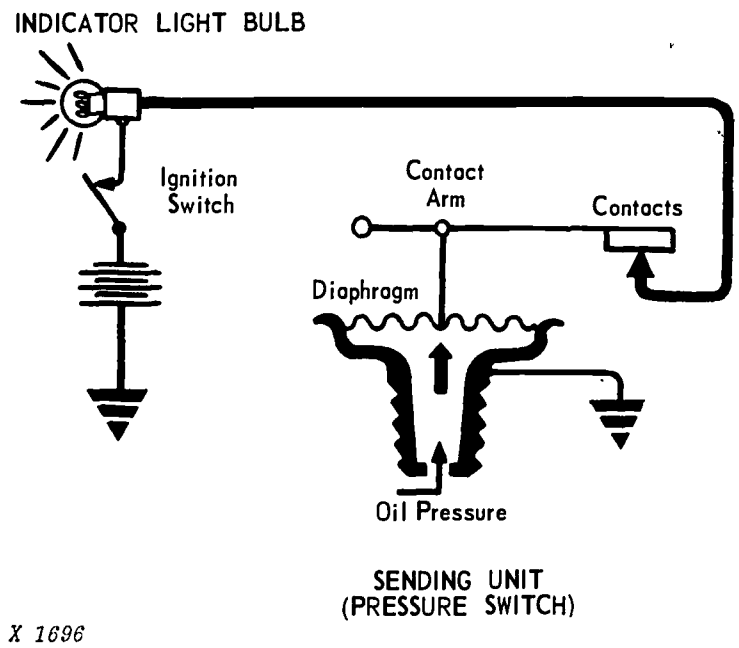

Fig. 29 — Pressure Switch System for Indicating Oil Pressure

Pressure Switch System

The pressure switch system is quite different from the electromagnetic coil and heating coil types.

A sending unit is used, but a light bulb is used as the indicator rather than a gauge (Fig. 29). This system can only warn of low oil pressure, it cannot tell the actual pressure of the system.

Basically, the sending unit consists of a set of contacts and a diaphragm. When the ignition switch is on and before the engine is started, the contacts are closed and the indicating bulb is lit.

When the engine is started and as the oil pressure builds, the diaphragm is pushed up. This separates the contacts and breaks the circuit, causing the bulb to go out.

If the oil pressure drops, the resulting deflection of the diaphragm will close the contacts and again complete the circuit. The lighted bulb warns that the pressure of the lubrication system has dropped below the low pressure setting.

Maintenance

Look for these things when servicing an electrical oil pressure indicating system:

1. *Poor grounds*
2. *Broken or poor connections*
3. *Defective units*

Specific tests vary with the different types of units. See the engine technical Manual for details.

CONTAMINATION OF OIL

Oil contamination will reduce engine life more than any other factor. Some sources of contamination are obvious while others are not.

Let's review some of these sources of contamination and what can be done about them.

1) The most obvious source of contamination is the **storing and handling of the oil** *itself (see Fig. 30). If at all possible, store lubricants in a clean, enclosed storage area. Keep all covers and spouts on containers when not in use. These practices not only keep dirt out of the oil, but also reduce condensation of water caused by atmospheric changes.*

2) Another obvious source is **dust that is breathed into the engine** *with combustion air. It is very important that the air cleaner be cleaned or replaced regularly. At the same time, clean or replace the breather on the oil filler. See Chapter 6 for details.*

3) A major source of contamination is a **cold engine.** *When the engine is cold, its fuel burning*

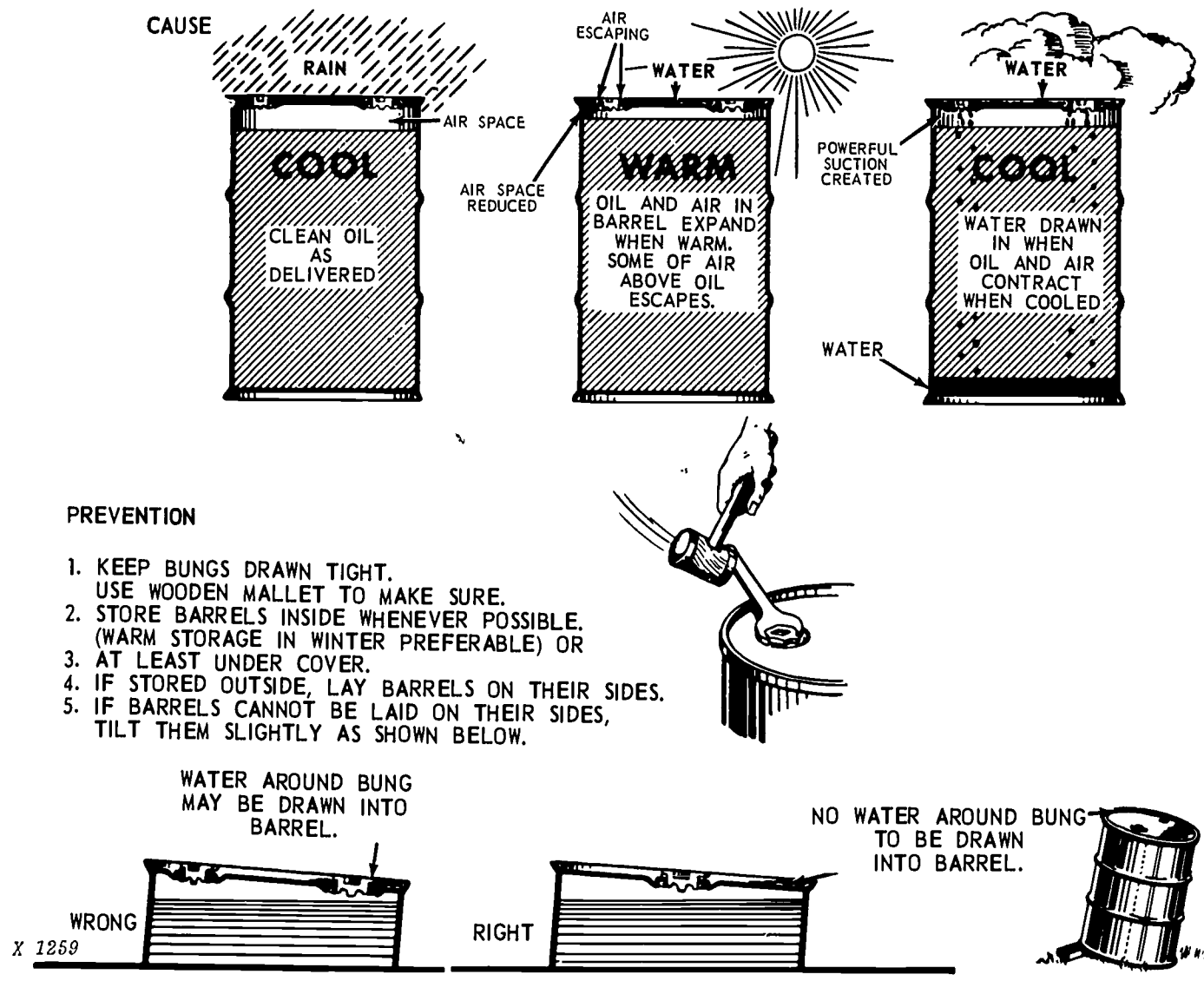

Fig. 30 — Storage Practices Which Prevent Contamination of Oil

efficiency is greatly reduced. Partially burned fuel blows by the piston rings and into the crankcase. Oxidation of this fuel in the oil forms a very harmful varnish which collects on engine parts (Fig. 31). An overchoked or misfiring engine will also create this contamination from unburned fuel.

Water created by a cold engine contaminates the oil too (Fig. 32). Water vapor, a normal product of combustion, tends to condense on cold cylinder walls. This condensation is also blown by the rings into the crankcase. The engine must warm up before this condensation problem is eliminated.

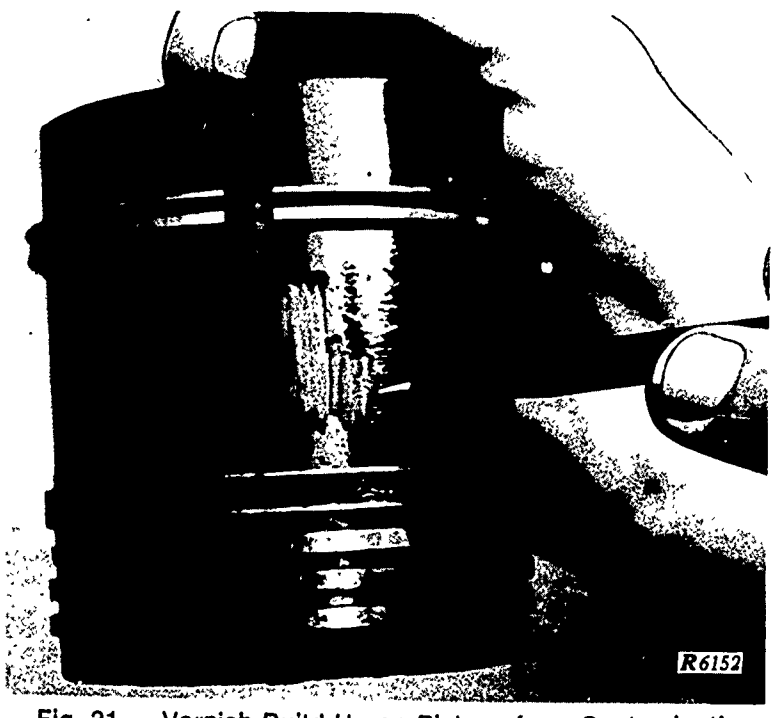

Fig. 31 — Varnish Build-Up on Pistons from Contamination by Fuel

Fig. 32 — Ice in Crankcase Following Cold Engine Operation

Water not only causes rusting of steel and iron surfaces, but it can combine with oxidized oil and carbon to form sludge. This sludge can very effectively plug oil screens and passages.

Contamination from a cold engine can be prevented by:

(a) Properly warming up the engine before applying a load.

(b) Making sure the engine is brought up to operating temperature each time it is used.

(c) Using the proper thermostat to warm up the engine as quickly as possible.

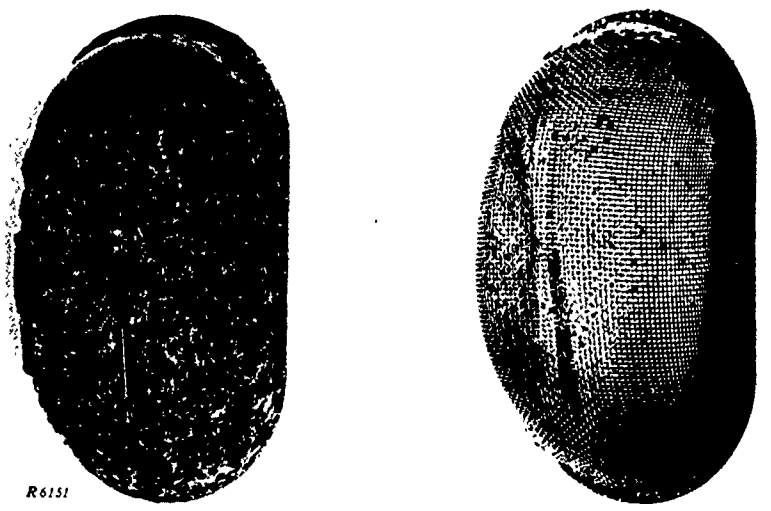

Fig. 33 — Antifreeze in Crankcase Will Create Sludge

4) **Antifreeze** *can be another sludge-forming source of contamination (Fig. 33). To guard against antifreeze contamination:*

(a) Torque head bolts to specifications during an overhaul.

(b) Use a cooling system sealer when filling the cooling system.

(c) Guard against detonation and improper use of starting fluids in diesel engine (both can result in head gasket damage).

Other problems which causes oil contamination are:

5) **Oxidation** *is not an obvious source of contamination, but it is a very real one. Oxidation occurs when the hydrocarbons in the oil combine with oxygen in the air to produce organic acids. Besides being highly corrosive, these acids create harmful sludges and varnish deposits.*

6) **Carbon** *particles are another contaminant created by the normal operation of the engine. The particles are created when oil around the upper cylinder walls is burned during combustion. Excessive deposits can cause the piston rings to stick in their grooves.*

7) **Engine wear** *also creates a contaminant. Tiny metal particles are constantly being worn off bearings and other parts. These particles tend to oxidize and deteriorate the oil.*

All sources of contamination cannot be eliminated. **What, then, can be done to protect the engine?**

PROTECTING THE ENGINE AGAINST OIL CONTAMINATION

Start by using a good-quality oil which has additives. Additives are put in the oil for a specific reason, based on the service expected for the oil.

Here are some of the important **additives:**

ANTI-CORROSION ADDITIVES protect metal surfaces from corrosive attack. These work with oxidation inhibitors.

OXIDATION INHIBITOR ADDITIVES keep oil from oxidizing even at high temperatures. They prevent the oil from absorbing oxygen, thereby preventing varnish and sludge formations.

ANTI-RUST ADDITIVES prevent rusting of metal parts during storage periods, downtime, or even overnight. They form a protective coating which repels water droplets and protects the metal. These additives also help to neutralize harmful acids.

DETERGENT ADDITIVES help keep metal surfaces clean and prevent deposits. Particles of carbon and oxidized oil are held suspended in the oil. The suspended contaminants are then removed from the system when the oil is drained. Black oil is evidence that the oil is helping to keep the engine clean by carrying the particles in the oil rather than letting them accumulate as sludge.

However, remember that **additives eventually wear out.**

To prevent this, drain the oil *before* the additives are completely depleted.

Also service all the filters at regular intervals.

Finally, keep the fuel, cooling, and ignition systems in good condition so that the fuel is efficiently burned.

OIL CONSUMPTION

Some oil consumption is natural during normal operation of internal combustion engines.

As we have already learned, lubricating oil provides a seal between the piston rings and cylinders. It is only natural that during the combustion process some of this sealing oil is burned up.

Excessive oil consumption can be caused by several conditions.

To properly diagnose the problem, follow this procedure:

1) First be sure the correct weight and grade of oil for the type of service and climate is being used. Oil that is too thin may "flood" the piston rings, while the oil that is too thick may "starve" the rings.

2) Be sure the engine has run long enough **under load** *to insure that the rings have had a chance to seat. Some variation in oil consumption can be expected during break-in, but it should be stabilized before 250 hours of operation. If not, assume that a problem exists and correct it at once. (See Chapter 2 for "Engine Break-In".)*

3) Check the engine oil pressure and, if necessary, adjust the pressure regulating valve. High engine oil pressure can cause oil consumption by flooding the rings and valves with oil. Also check the crankcase breather. A plugged breather can increase the crankcase oil pressure.

4) Check for external oil leaks. What appears to be a small oil leak can add up to a considerable loss of oil. Drops of oil lost externally can add up to quarts of oil between oil change periods. Check the front and rear oil seals, all gaskets, and the filter attaching points.

5) Check for engine blow-by. Watch the fumes expelled through the crankcase vent tube. Fumes should be barely visible with the engine at fast idle with no load. If possible, compare the blow-by with that of identical engines. This can be a guide to determine if the blow-by is excessive.

Excessive blow-by indicates that piston rings and cylinder liners have worn to the point where the rings cannot seal off the combustion chambers. An overhaul with new rings is then required. New or reconditioned pistons and liners may also be necessary.

6) If blow-by is not excessive, check to see if the oil is being lost through the valve guides. A generous supply of oil is usually maintained in the rocker arm area to lubricate the rocker arms, valve stems, and valve guides.

As shown in Fig. 34, gravity, inertia, vacuum, and an atomizer effect all combine to force oil down between the valve stem and guide. Valve guide seals are usually used to prevent excessive oil from entering the combustion chambers. If these seals become defective, they create a definite oil consumption problem.

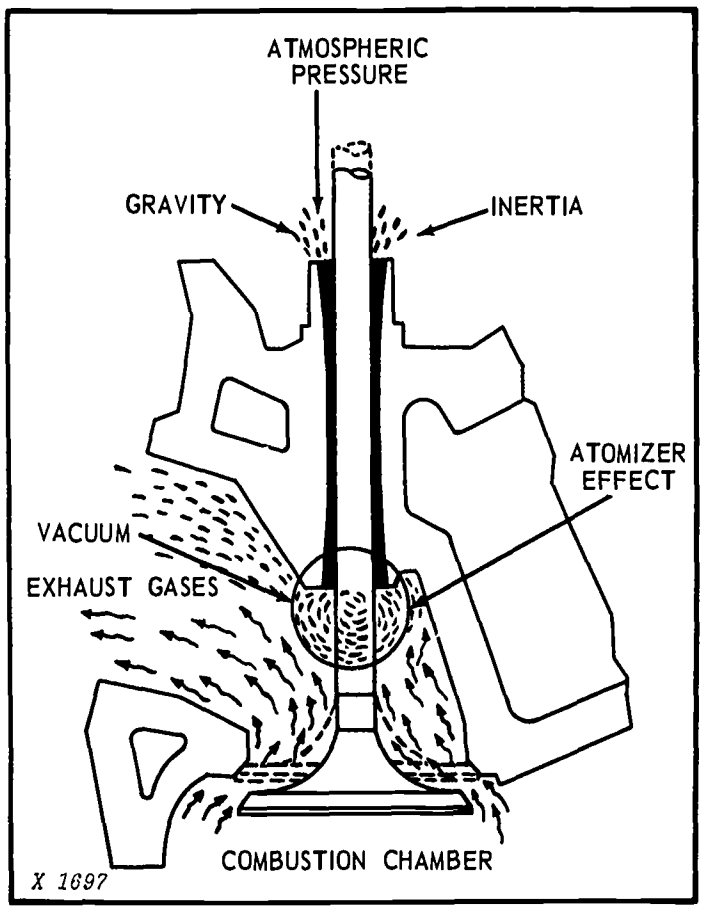

Fig. 34 — Problems Which Cause Oil Loss Through Valve Guides

To check for this condition, start the engine and warm it up. Let it idle slowly for ten minutes. Then remove the cylinder head, and inspect the valve ports and the undersides of the valve heads. If these are wet with oil, the oil has been drawn through the valve guides.

At the same time, check the piston heads. If they are wet, the oil has been drawn past the piston rings. If excessive blow-by has indicated worn rings, this procedure can be used to confirm it.

7) Worn connecting rod bearings can also contribute to oil consumption. When worn, the bearings throw an excess of oil onto the cylinder walls. The action of the piston forces part of this excess oil into the combustion chambers where it is burned.

8) Excessive engine speeds are another common cause of oil consumption. Observe the fast idle limits set by the manufacturer.

CRANKCASE VENTILATION

During normal operation, unburned fuel vapor and water vapor are created in the engine. If allowed to condense, these vapors become contaminating

liquids that drain into the crankcase. The purpose of the ventilation systems is to circulate fresh air through the engine to carry away these harmful vapors.

As with all ventilating systems, there must be:

1) An air inlet

2) An air and vapor outlet

3) A means of circulating air between the two

The oil filler cap is probably the most common inlet. A small air cleaner built into the cap filters the air as it is drawn into the system. Some systems use the main air cleaner as the inlet.

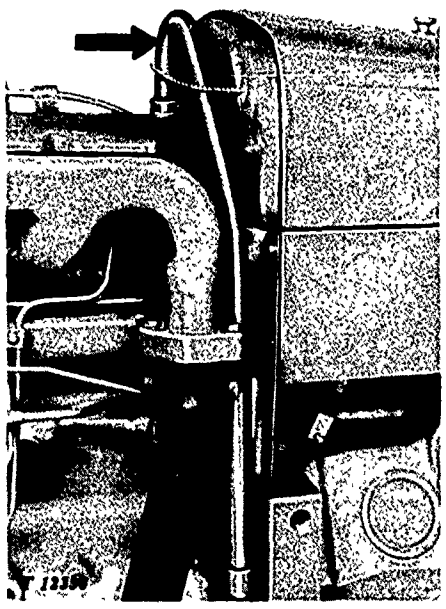

Fig. 35 — Crankcase Vent Tube

The use of a vent tube is one means of circulating the air through the system (Fig. 35). As the machine moves, the air moving past the tube opening creates a lower pressure than that at the breather. Air in the engine naturally flows to this low pressure area, and the tube becomes an outlet for the system. Some vent tubes use a wire mesh screen to filter oil particles out of the vapor.

INTAKE MANIFOLD VENTILATION SYSTEM

The intake manifold can serve the double function of circulating the air and being the vent outlet. In this type of ventilation system, a tube connects the crankcase to the intake manifold. The intake vacuum draws the air through the engine, into the manifold, into the cylinders, and out the exhaust system. A ventilation valve is used to regulate the flow of air into the manifold.

At full throttle speed, there is maximum vapor in the crankcase and minimum vacuum in the intake manifold. The valve is help open by the spring, permitting full air flow through the system.

At idle speed, there is minimum vapor in the crankcase and maximum vacuum in the manifold. As the pressure of the air is greater than that of the vacuum, the spring is compressed and the valve is closed. Air flow is restricted by the bleed hole in the valve.

Some ventilating valves do not have a bleed hole. This design eliminates the possibility of a backfire traveling through the ventilating system to the crankcase.

VENTILATION SYSTEM WITH CIRCULATING PUMP

Another type of system uses a vane or impeller pump to circulate the air. The air is taken from the main air cleaner and pumped through the engine. The outlet can be either a vent tube or the intake manifold.

SERVICING THE VENTILATION SYSTEM

Begin with the inlet when servicing the ventilation system. If the oil filler cap is the inlet, periodically clean it with a solvent. If the main air cleaner is the inlet, service it regularly as recommended by the engine manufacturer.

If the system uses a ventilating valve, service it regularly. Some manufacturers recommend cleaning the valve with solvent, while others recommend replacing the valve rather than cleaning it.

If a vent tube is used in the system (Fig. 35), periodically remove and clean it with a solvent. If a filter is used with the vent tube, be sure to clean it too.

CHANGING ENGINE OIL

The statement that "oil doesn't wear out" is false. Oil loses many of its good lubricating qualities as it gets dirty and its additives wear out.

Acid formations, sludge, varnish, and engine deposits contaminate oil and make it unfit for continued use.

On the other hand, just because crankcase oil is black, doesn't mean it's time for an oil change.

Additives in the oil are supposed to clean and hold deposits in suspension for removal when the oil is drained.

Change the oil sometime **before** *the additives wear out which protect the engine against sludge.* For the average person, this time is practically impossible to determine. That's why the best policy is to follow the manufacturer's recommendations on oil and filter changes.

New or rebuilt engines require oil and filter changes after a specified break-in period. Performing this service on time is very important since foreign materials accumulate in the oil at a faster rate during initial operation than later when the engine is broken in.

When changing the oil and filter on any engine, always warm up the engine first. This way the contaminants and foreign materials are mixed with the oil and are drained out with it.

Replacing some oil filters requires installing new gaskets or sealing rings. Be sure the sealing surfaces on the engine and filter are clean.

After installing the filter and filling the engine with oil, run the engine and check for possible filter leaks.

Keep a record of all oil and filter changes to be sure of regular engine service.

TEST YOURSELF

QUESTIONS

1. Name any three of the five jobs which the lubrication system does for the engine.

2. What does a bypass valve do for a full flow lubrication system?

3. What does a good lubricating oil contain which helps to prevent rust, corrosion, oxidation, and foaming?

4. True or false? "Oil doesn't wear out".

ANSWERS

1. Any three of these: 1) Reduces friction; 2) absorbs heat; 3) seals the piston rings; 4) cleans and flushes moving parts; 5) helps deaden the noise.

2. Bypasses oil around the filter if the filter clogs. This assures a supply of lubricating oil to the engine at all times.

3. Additives.

4. False. Oil loses many of its good lubricating qualities as it gets dirty and its additives wear out.

COOLING SYSTEMS / CHAPTER 8

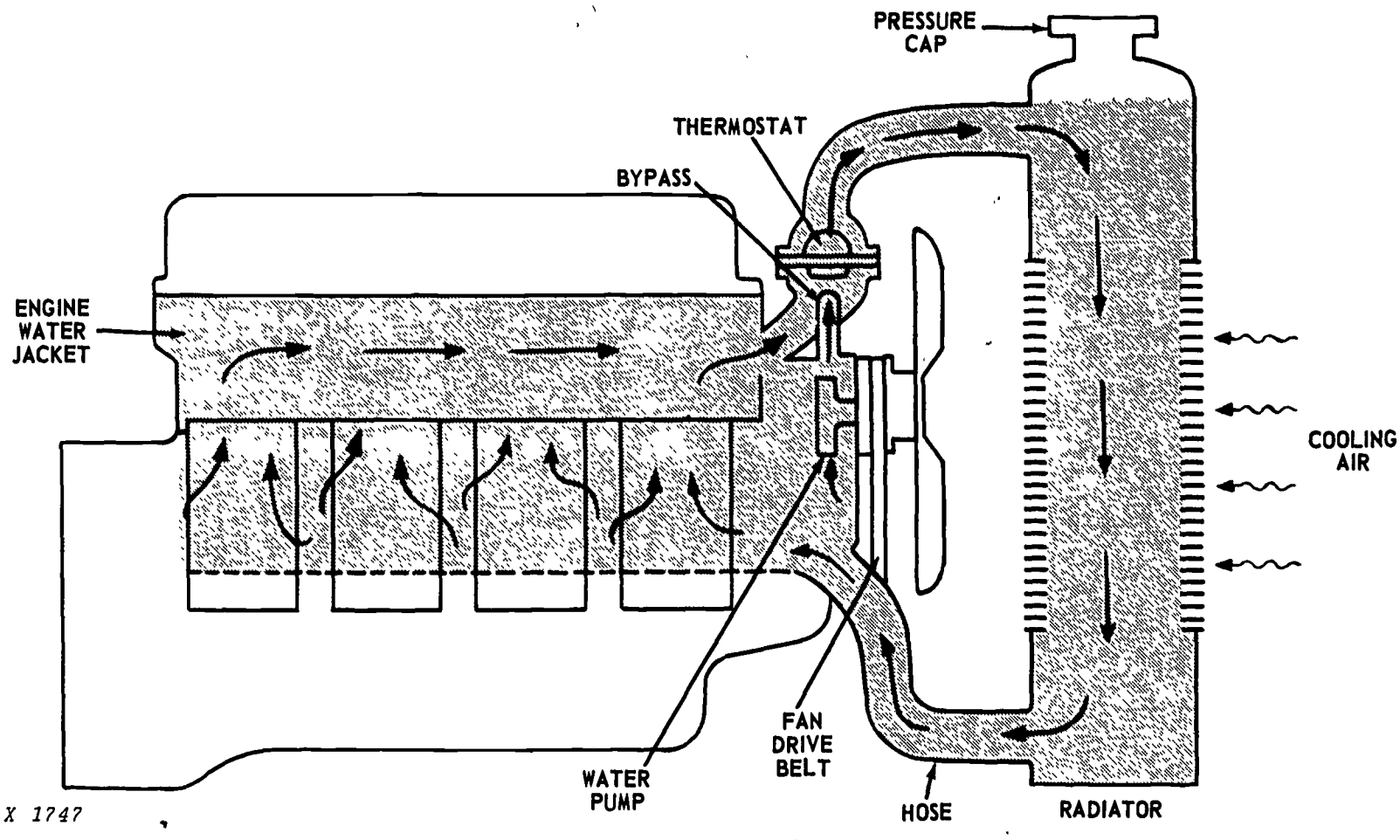

Fig. 1 — Liquid Cooling System

INTRODUCTION

The engine cooling system does two things:

1) Prevents overheating

2) Regulates temperatures

OVERHEATING could burn up the engine parts. Some heat is necessary for combustion, but the engine generates too much heat. So the cooling system carries off the excess heat.

REGULATING TEMPERATURES keeps the engine at the best heat level for each operation. During starting, the engine must be warmed up faster. During peak operations, the engine must be cooled.

Running the engine too hot can cause:

- *Preignition*
- *Detonation*
- *Knock*
- *Burned pistons and valves*
- *Lubrication failure*

Running the engine too cold can cause:

- *Unnecessary wear*
- *Poor fuel economy*
- *Accumulation of water and sludge in the crankcase*

TYPES OF COOLING SYSTEMS

Two types of cooling systems are used in modern engines:

- **Air Cooling System—uses air passing around the engine to dissipate heat.**
- **Liquid Cooling System—uses a liquid to cool the engine and air to cool the liquid.**

AIR COOLING is used only on small engines as it is difficult to route air to all the heat points of larger engines. Metal baffles, ducts, and blowers are used to aid in distributing air.

LIQUID COOLING normally uses water as a coolant. In cold weather, antifreeze solutions are added to the water to prevent freezing. The water circulates in jackets around the cylinders and other friction parts. As heat radiates, it is absorbed into the water, which then flows to the radiator. Air flow through the radiator cools the water and so dissipates heat into the air. The water then recirculates into the engine to pick up more heat (Fig. 1).

Complete information on *air* cooling systems is given in the *Fundamentals of Service* manual, *"Lawn and Garden Service."*

In this chapter we will cover only the *liquid* cooling systems used on most modern engines.

LIQUID COOLING SYSTEMS

A liquid system (Fig. 1) consists of the following:

- **Radiator and Pressure Cap**
- **Fan and Fan Belt**
- **Water Pump**
- **Engine Water Jacket**
- **Thermostat**
- **Connecting Hoses**
- **Liquid or Coolant**

The RADIATOR is one of the major components of any liquid cooling system. It is here that heat in the coolant is released to the atmosphere. It also provides a reservoir for enough liquid to operate the cooling system efficiently.

The FAN forces cooling air through the radiator core to more quickly dissipate the heat being carried by the coolant in the radiator.

The WATER PUMP circulates the coolant through the system. The pump draws hot coolant from the engine block and forces it through the radiator for cooling.

Some engines have distribution tubes and some have transfer holes which direct extra coolant flow to "hot" areas, such as exhaust valve seats.

CONNECTING HOSES are the flexible connections between the engine and other parts of the cooling system.

The THERMOSTAT is a heat-operated valve. It controls the flow of coolant to the *radiator* to maintain the correct operating temperatures.

The FAN BELT transmits power from the engine crankshaft to drive the *fan* and *water pump.*

COOLANT is the liquid that circulates through the cooling system carrying heat from the *engine water jacket* into the *radiator* for transfer to the outside air. The coolant then flows back through the engine to absorb more heat.

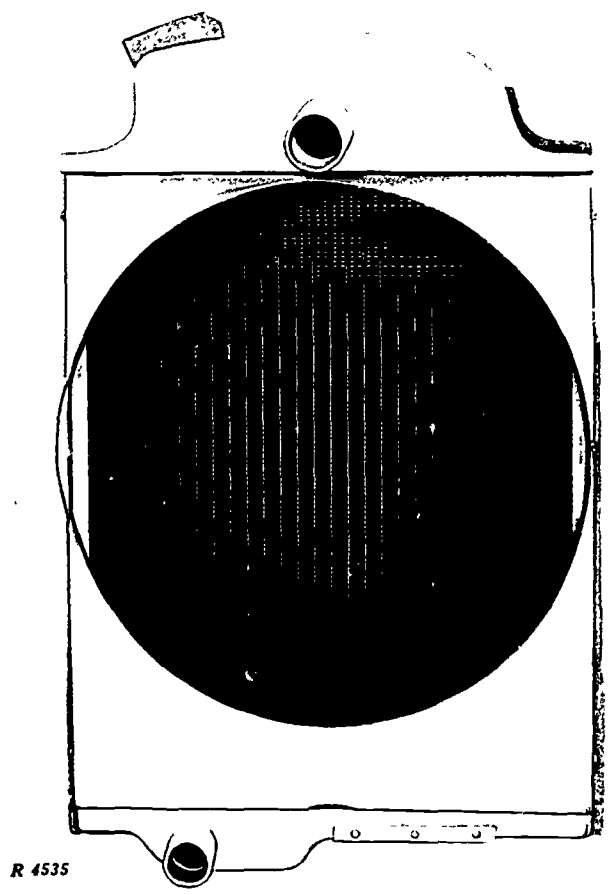

Fig. 2 — Typical Radiator

RADIATORS

Two types of radiators are used in liquid cooling systems:

- **Cellular-Type Core Radiators—used where air speeds are high and resistance to air flow must be low, as in aircraft or racing cars.**
- **Tubular or Tube-and-Fin Type Core Radiators—used in most other machines.**

In both types of radiators, coolant from the engine enters the radiator by way of the top tank, then passes down through a series of small tubes surrounded by fins and air passages.

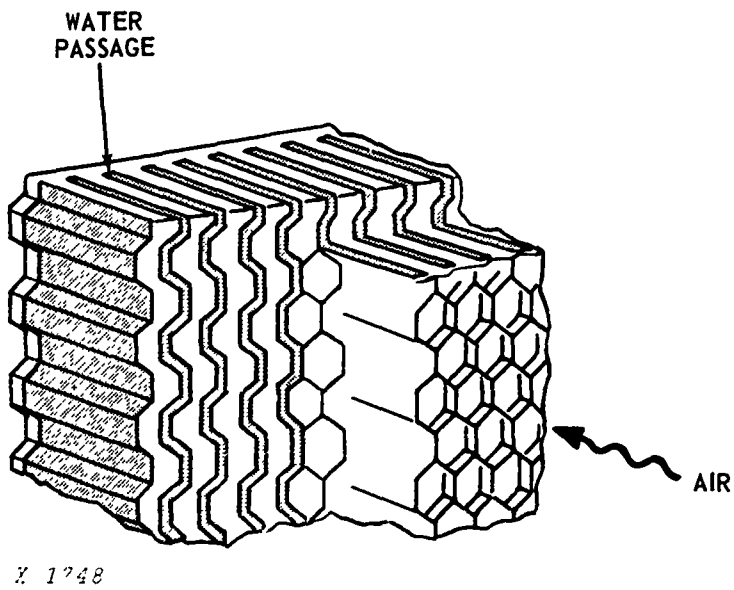

Fig. 3 — Cellular-Type Core Radiator

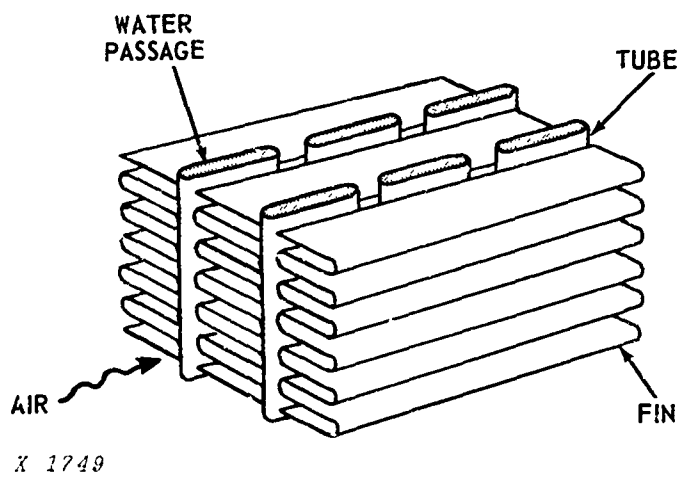

Fig. 4 — Tube and Fin-Type Core Radiator

Figs. 3 and 4 illustrate how air flowing around the fins and tubes removes the heat.

Cooled liquid reaching the bottom tank is picked up by the water pump to repeat the cycle.

TESTING THE RADIATOR

Because most modern cooling systems are pressurized, all of the components must be tight and in good condition before the system can operate properly.

Overheating and **loss of coolant** will result unless pressure in the system is maintained.

Test the entire cooling system before servicing it.

Install a *pressure tester* on the radiator according to the manufacturer's instructions (Fig. 5).

With the tester installed, carefully inspect the *radiator, water pump, hoses, drain cocks,* and *cylinder block* for leakage.

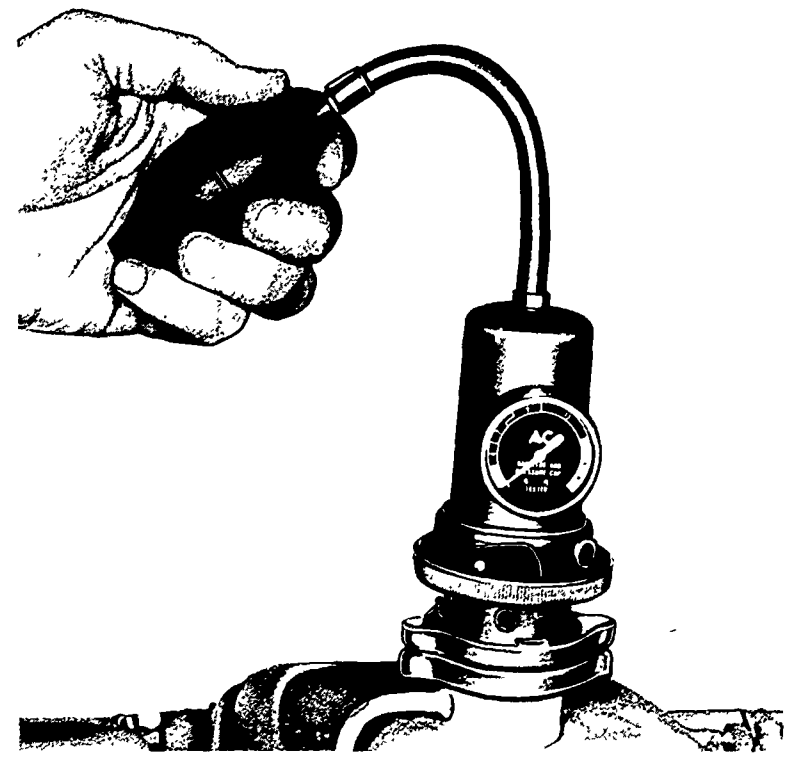

Fig. 5 — Radiator Pressure Test

Mark all leaks plainly to help locate them when repairs are made.

SERVICING THE RADIATOR

NOTE: Repairs should be done only by experienced radiator repairmen.

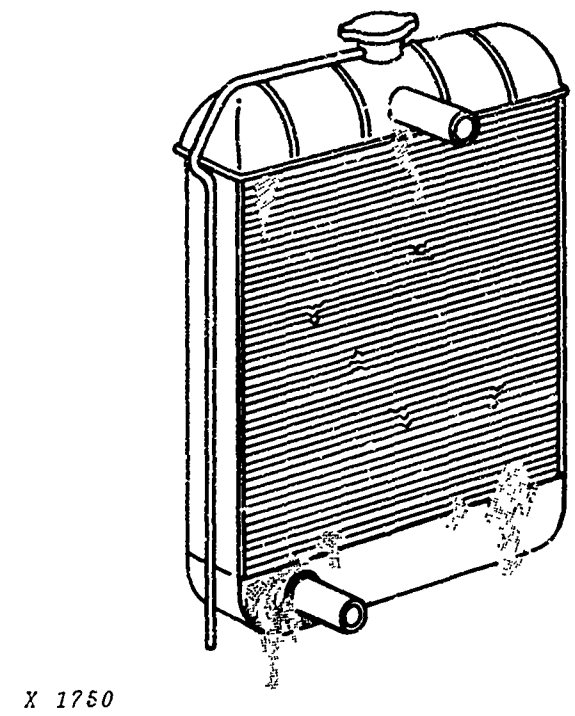

Fig. 6 — Damaged Radiator

Inspect the radiator for bent fins (Fig. 6). Inspect the tubes for cracks, kinks, dents, and fractured seams.

If radiator leaks and source of leak cannot be determined visually, test it as follows:

1. Install radiator cap. Plug overflow tube and outlet pipe and attach air hose to inlet connection.

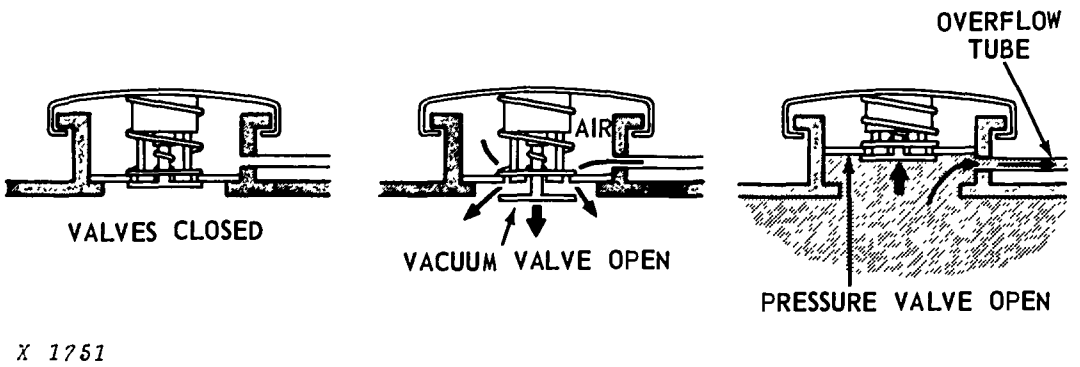

Fig. 7 — Pressure Control Radiator Cap

2. Fill radiator with compressed air (not more than 7 to 10 psi, depending upon size of radiator) and submerge in a tank of water.

3. Look for bubbles which tell the location of leaks.

Straighten any bent fins. Repair leaks by soldering, after thoroughly cleaning surfaces. Inspect rubber cushion washers. Replace as necessary.

RADIATOR CAP

The pressure system permits operating the engine at a higher temperature without boiling the coolant or losing it v evaporation.

An increase in pressure of one pound psi will raise the boiling temperature of pure water about 3°F.

A special *radiator cap* is required on most modern cooling systems. The cap has two functions:

- **Allows atmospheric pressure to enter the cooling system.**
- **Prevents coolant escape at normal pressures.**

A *pressure valve* (Fig. 7) in the cap permits the escape of coolant or steam when the pressure reaches a certain point.

The *vacuum valve* (Fig. 7) in the cap opens to prevent a vacuum in the cooling system.

Hotter operation is desirable for efficient combustion and for evaporating contaminants from the crankcase.

CAUTION: Always remove the radiator cap slowly and carefully to avoid a possible fast discharge of hot coolant.

TESTING THE RADIATOR CAP

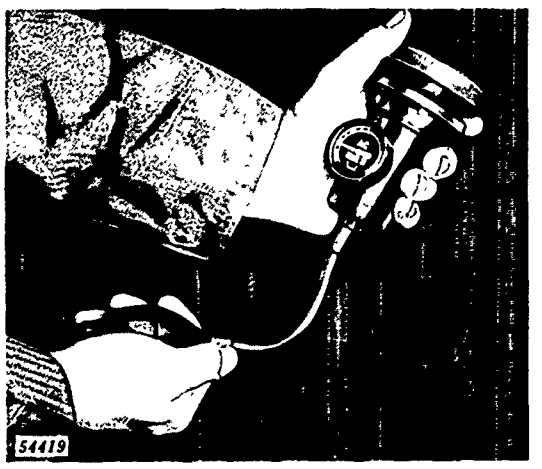

Fig. 8 — Testing The Radiator Cap

A radiator and pressure cap tester (Fig. 8) can be purchased from local tool jobbers. Use instructions with the tester to see if the radiator cap can build and hold pressure.

If the pressure cap is defective, replace it. A radiator cap cannot be repaired.

To prevent damage to the cooling system from either excessive pressure or vacuum, check both valves periodically for proper opening and closing pressures. Service or replace the cap as required.

FAN AND FAN BELTS

The cooling system fan is usually located between the radiator and engine, mounted on the front of the engine block. The fan is generally driven by a V-belt from the engine crankshaft.

The fan can be either a **suction**-type or a **blower**-type (Fig. 9), depending upon the design of the system.

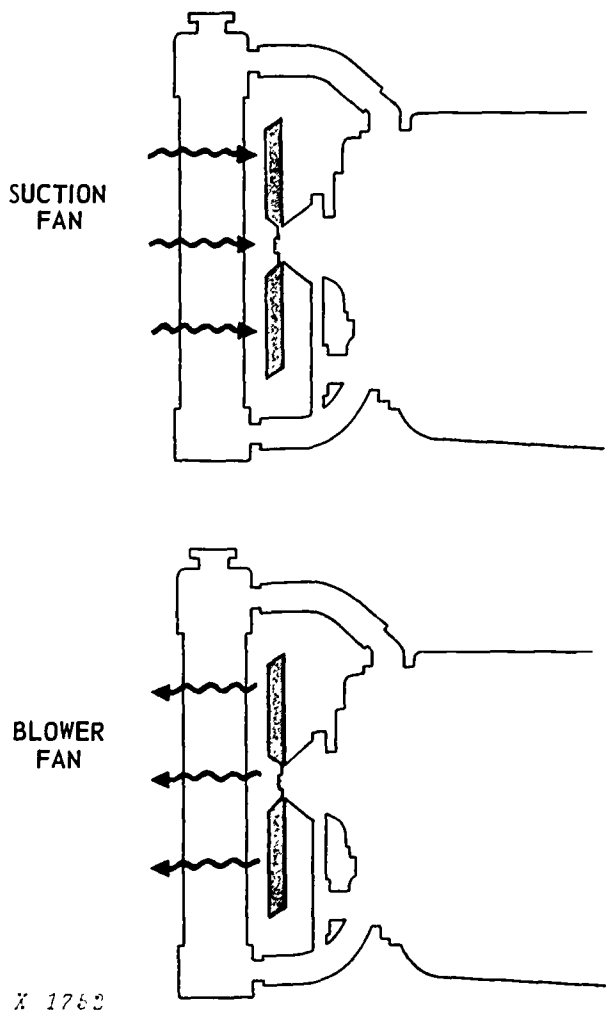

Fig. 9 — Fans—Two Types

- **Suction-type fans** *pull air through the radiator and push it over the engine. This design permits the use of a smaller fan and radiator than is required for blower-type fans. It is used when machine motion aids air movement through the radiator.*

- **Blower-type fans** *pull air across the engine, then push it through the radiator. They are used in slow-moving machines, and on machines where harmful materials might be drawn into the radiator with a suction-type fan.*

When the engine runs, the fan pulls air across the radiator core to cool the liquid in the radiator. The ideal location of the fan is approximately 2-½ inches from the radiator core.

SERVICING THE FAN

The only service on the fan is to be certain the fan blades are straight and are far enough from the radiator so they do not strike the core.

Bent blades reduce the efficiency of the cooling system and throw the fan out of balance.

FAN BELT

The fan belt should be neither too tight nor too loose.

Too tight a belt puts an extra load on the fan bearings and shortens the life of the bearings as well as the belt.

Too loose a belt allows slippage and lowers the fan speed, causes excessive belt wear and leads to overheating of the cooling system.

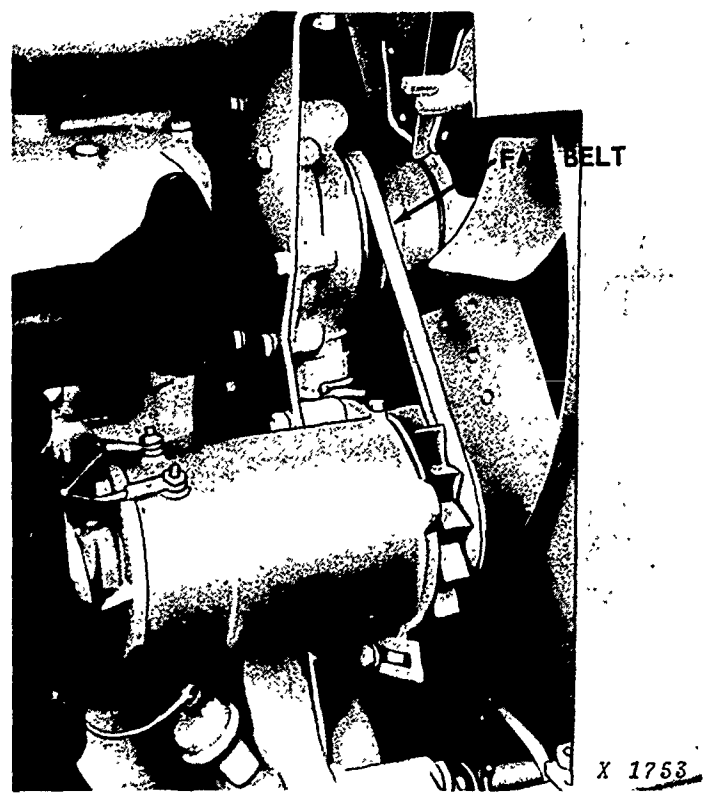

Fig. 10 — Adjusting Fan Belt Tension

The condition of the belt and its tension should be checked periodically. Adjust fan belt tension as specified by the manufacturer (Fig. 10).

WATER PUMP

The water pump is normally a *centrifugal* type and might be called the "heart" of the cooling system (Fig. 11).

When the pump fails to circulate the coolant, heat is not removed from the engine and overheating damage may occur.

Some pumps turn at 4,000 revolutions a minute and pump as much as 125 gallons of coolant per minute.

Most pumps today have self-lubricated, sealed ball bearings.

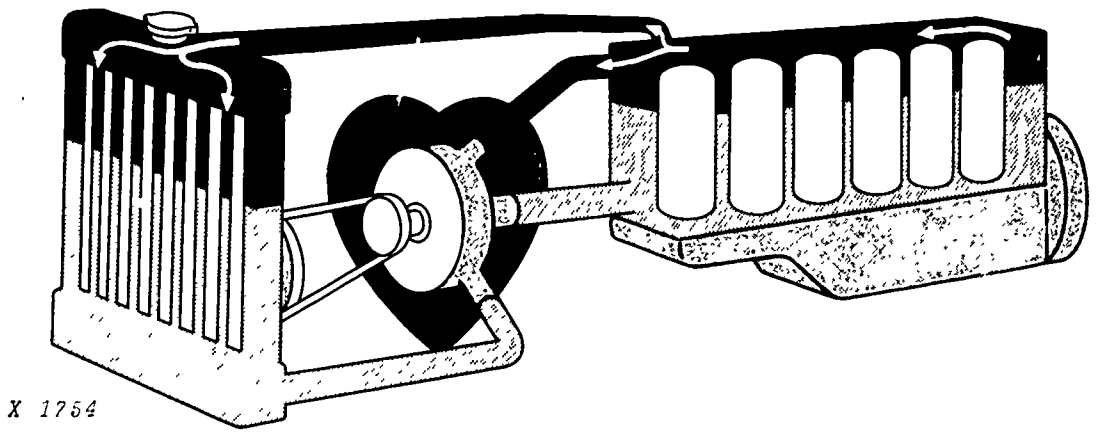

Fig. 11 — Water Pump

TESTING AND SERVICING WATER PUMPS

A typical water pump is made up of a *housing, impeller,* and *shaft* (Fig 12).

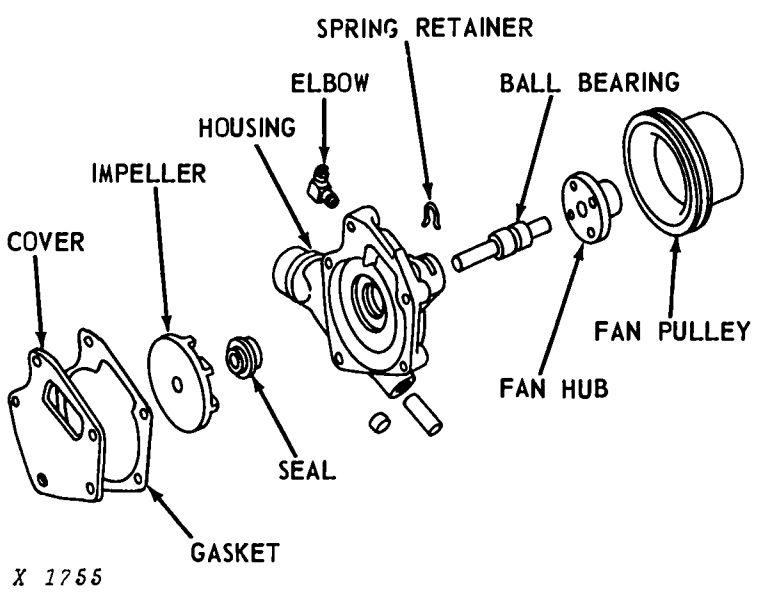

Fig. 12 — Water Pump Disassembled

When inspecting a pump, check for leaks in the housing, broken or bent vanes on the impeller, and damaged seals and bearings. Replace all damaged parts.

Always install new seals and gaskets when reassembling the pump.

ENGINE WATER JACKET

The engine cylinder block and head both usually contain passages for coolant to flow around the cylinders and valves. Together, they make up the *water jacket.*

The water jacket holds only a small amount of the total coolant. The advantages of this are:

- *Rapid engine warm-up—while the thermostat is closed*
- *Efficient cooling—when the thermostat opens*

NOTE: As coolant is heated in the engine block, dissolved minerals separate out in solid form and coat the metal surfaces. The thicker this coating, the less heat transferred from the engine to the coolant. Prevent rust by adding anti-rust compounds each time coolant is changed.

COOLANT FILTER

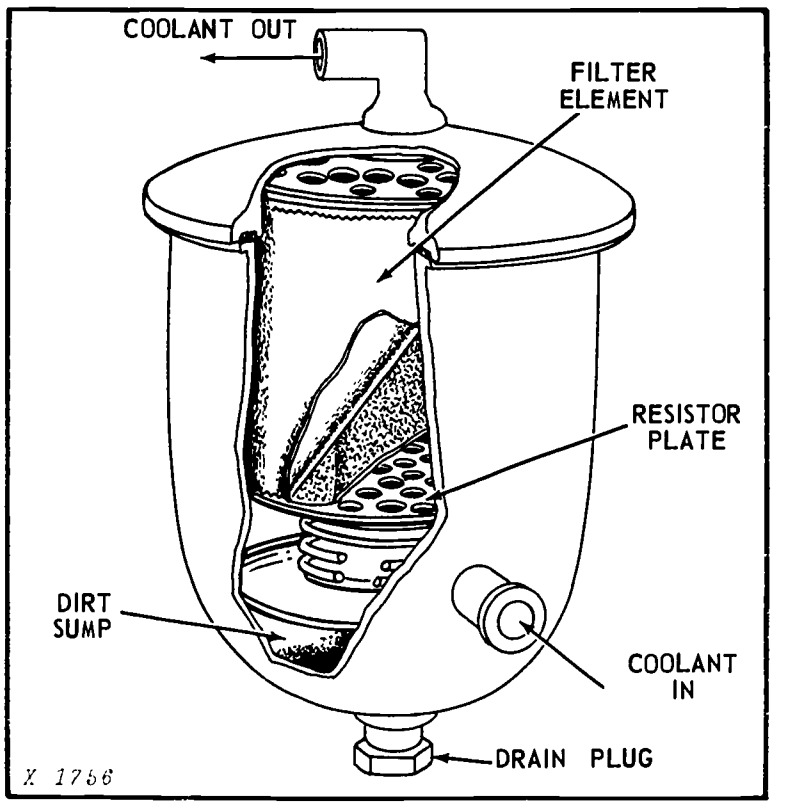

Fig. 13 — Coolant Filter

Some engines now use a filter in the cooling system (Fig. 13). The coolant filter softens the water and removes dirt. As a result, the system dissipates heat better and the working parts wear longer.

The coolant filter in Fig. 13 has a replaceable filter element. As dirt collects, it settles into a sump at the bottom of the filter where it can be drained out periodically.

Chemicals in the filter element and resistor plates soften the water by removing corrosives. This keeps the radiator and water jackets free of scale.

Another chemical in the element dissolves into the water to alkalize it just enough to prevent acid corrosion of the metal parts.

Rust inhibitors are also placed in the filter element to dissolve into the water and form a rust-proof film on the metal surfaces of the cooling system.

The filter shown is a bypass type. If it clogs, all water will pass through the engine.

Antifreeze solutions are not harmed by the coolant filter.

COOLANT FILTER MAINTENANCE

Periodically service the filter:

1) Drain out sediment from the lower sump.

2) Replace the filter element.

THERMOSTATS

The thermostat provides automatic control of engine temperature at the correct level. This is necessary in order to get the best performance from an engine.

Only a small part of the engine's cooling capacity is required under the light loads, even during warm weather.

During warm-up the thermostat remains closed (Fig. 14). The water pump circulates coolant through the engine water jacket only, by way of the bypass.

The engine quickly warms up to its operating temperature before the thermostat opens.

When the thermostat opens, hot coolant flows from the engine to the radiator and back.

High-temperature thermostats, which open at 180°F, improve engine operation, reduce crankcase sludging and corrosive wear of engine parts.

An engine operating in this temperature range is hot enough to:

- *Improve combustion*
- *Burn impurities out of oil in crankcase*
- *Thin oil to provide good lubrication*

Do not use low-boiling-point alcohol or methanol antifreeze with high-temperature thermostats.

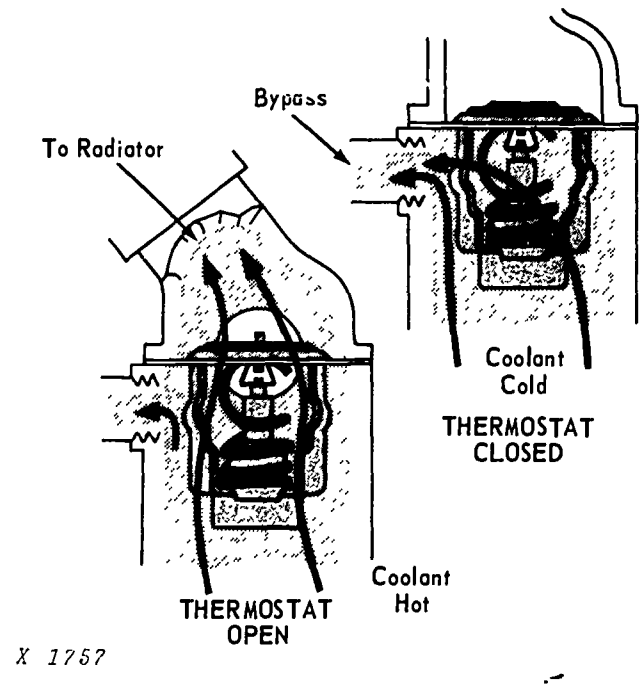

Fig. 14 — Cooling System Thermostat

When the thermostat is not operating properly, the engine may run too hot or too cold. Overheating may damage the thermostat so the valve will not function properly. Rust can also interfere with thermostat operation.

Always keep the thermostat in good working condition.

Never operate the engine without a thermostat.

Always use the thermostat design specified for the make and model of engine being used.

TYPES OF THERMOSTATS

Two types of thermostats are used:

- **Bellows-type**
- **Bimetallic-type**

The BELLOWS-TYPE consists of a short length of circular corrugated copper tube closed at both ends and filled with a liquid having a low boiling point (ether).

In the illustration shown in Fig. 15, the thermostatic valve is located directly above the bellows. The elasticity of the bellows holds the valve closed when the water is cold. The water pump does not create enough pressure to force the valve open.

The BIMETALLIC-TYPE of thermostat consists of a spiral of bimetallic strip. This is a strip of steel welded to a strip of bronze. Bronze expands more when heated than steel does, and as the temperature of the water surrounding the spiral rises, the spiral uncoils and opens the valve.

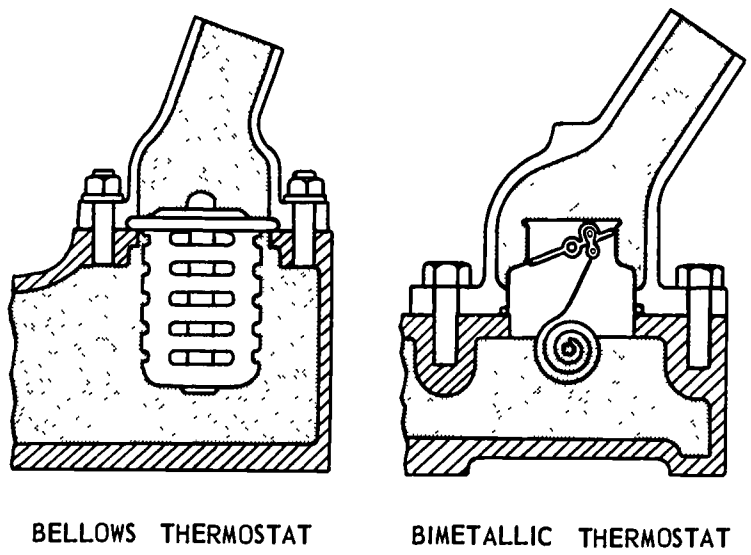

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Fig. 15 — Types of Thermostats

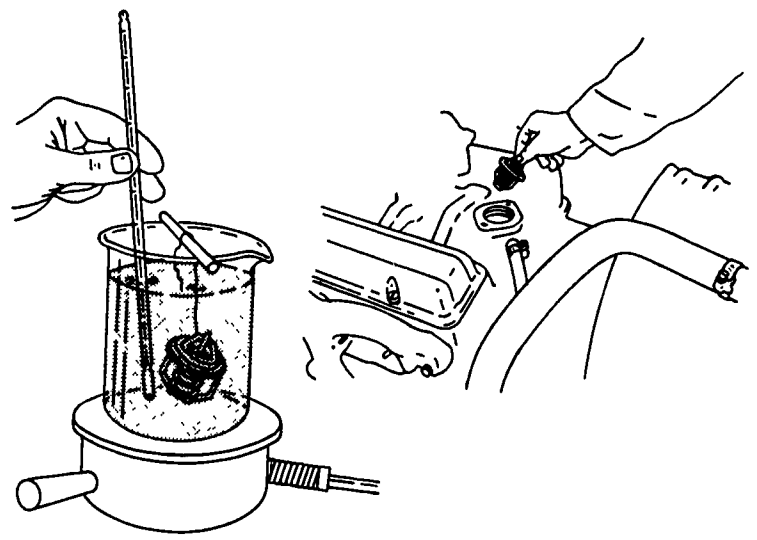

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Fig. 16 — Testing A Thermostat

INSPECTION AND TESTING OF THERMOSTATS

If a thermostat is broken or corroded, discard it.

If it is not of the proper temperature and type, as indicated on an application chart, replace it. The number stamped on it is the approximate temperature that it will reach before starting to open.

- *Never use a high-temperature thermostat with an alcohol-base antifreeze.*
- *Never use a bellows thermostat in high-pressure cooling systems (9 pounds or higher).*

Test the thermostat as follows:

1. Suspend the thermostat and a thermometer in a container of water (Fig. 16). Do not let them rest against the sides or bottom.

2. Heat and stir the water.

3. The thermostat should begin to open at the temperature stamped on it, plus or minus 10°F. It should be fully open (approximately ¼-inch) at 22°F above the specified temperature.

4. Remove thermostat and observe its closing action.

5. If the thermostat is defective, discard it.

INSTALLING THERMOSTATS

When installing a thermostat in the engine water jacket, position the thermostat with the expansion element toward the engine.

Some thermostats are marked with arrows that point to the radiator or to the engine block, or are marked "top" or "T". "Front" is indicated on some models. **The frame must not block the water flow.**

To prevent leakage, clean the gasket surfaces on the thermostat. Use a *new* gasket; normally it need not be cemented.

When the outlet casting and gasket have been properly located, tighten the nuts evenly and securely.

COOLING SYSTEM HOSES

Flexible hoses are used in connecting cooling system components because they stand up under vibration better than rigid pipes do. However, hoses have weak points, too.

Radiator hoses can be damaged by air, heat and water in two ways:

- **Hardening or cracking**—*destroys flexibility, causes leakage, and allows small particles of rubber to jam the radiator.*
- **Softening and swelling**—*produces lining failure and hose rupture.*

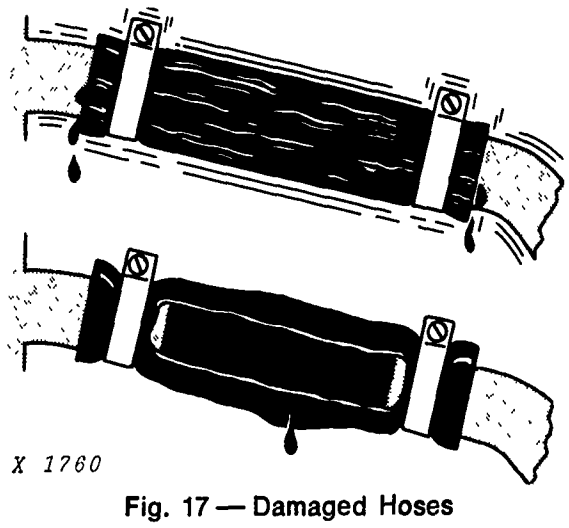

Fig. 17 — Damaged Hoses

Replace hoses often enough to be sure they are always pliable and able to pass coolant without leakage.

Examine hoses at least twice a year for possible replacement or tightening.

Check any reinforcing springs inside the hoses for corrosion.

Fig. 18 — Interior Of Damaged Hose

Hoses can deteriorate on the inside and still appear all right on the outside (Fig. 18).

When hoses are removed, check them for wear. Hoses may harden and crack, allowing the system to leak, or they may soften and then collapse. A softened hose may also collapse during high-speed operation or restrict circulation enough to cause overheating.

The quality of the hose will affect its service life more than the cooling liquid. **Use only the best hoses available.**

INSTALLING HOSES

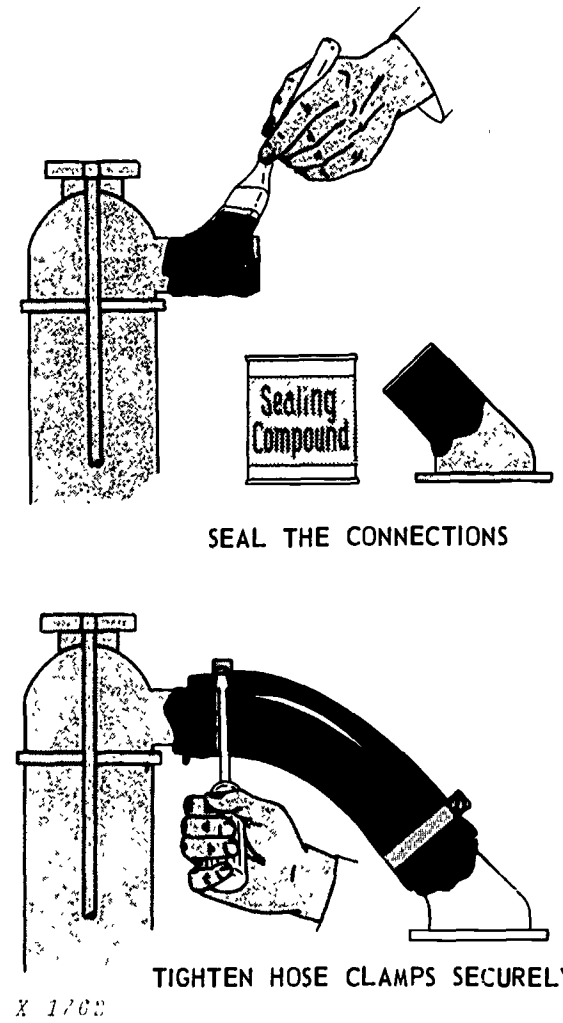

Fig. 19 — Connecting Hoses

Clean the pipe connections and apply a thin layer of non-hardening sealing compound when installing hoses (Fig. 19).

Locate the hose clamps properly over the connections as shown to provide a secure fastening. A pressurized cooling system will blow off an improperly installed hose.

OTHER RUBBER COMPONENTS

Heat and water can also damage other rubber sealing parts, such as the rubber seals in water pumps and O-rings which seal the lower end of wet cylinder sleeves.

Damage or improper installation of these parts will result in serious coolant leakage.

COOLING LIQUID

Water is a good coolant because:

- *It is plentiful and readily available*
- *It absorbs heat well*
- *It circulates freely at all temperatures between its freezing and boiling points (32°F to 212°F).*

But water has the following disadvantages:

- *It freezes readily when cold*
- *It boils and evaporates when hot*
- *It may corrode metal parts*
- *It may cause deposits in water jackets*

Modern pressurized systems overcome the low boiling temperature of water, and additives can offset many of its harmful properties.

Antifreeze is used to reduce the high freezing point of water.

PREPARING THE SYSTEM FOR USE

WARM WEATHER OPERATION

1. Fill with soft water whenever available.
2. Add a reliable brand of radiator sealer if required.
3. Add a can of rust inhibitor.
4. Keep system filled to a level midway between the radiator core and bottom of filler neck.

COLD WEATHER OPERATION

1. Fill with a mixture of antifreeze (with rust inhibitor) and water for protection against freezing to the lowest temperature anticipated.
2. Add a reliable brand of radiator sealer if required.
3. Run engine several minutes after thermostat opens to circulate coolant.
4. Recheck system for leaks.

ANTIFREEZE SELECTION

Use only one of these types of antifreeze:

- **Alcohol base**
- **Ethylene glycol base**

Modern engines usually operate at a temperature above the boiling point of alcohol so the permanent type (ethylene glycol) is recommended by most engine manufacturers.

The term "Permanent antifreeze" means only that the solution will not boil away at normal engine operating temperatures and does not mean that it is good for use for more than one season.

SERVICING THE COOLING SYSTEM

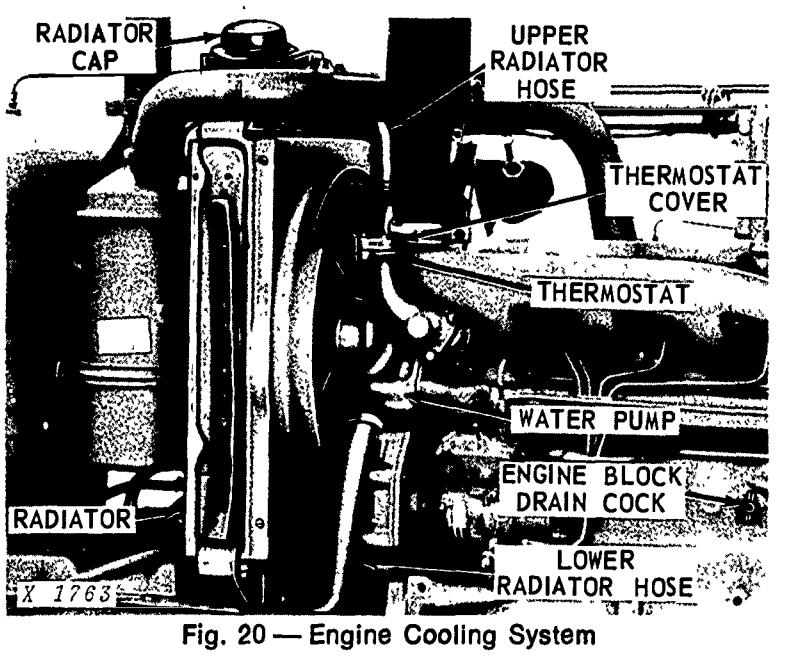

Fig. 20 — Engine Cooling System

Correct cooling system servicing is vital for a smooth-running engine.

Overheating is the big danger. It can be caused by:

- *Clogging of cooling system*
- *Lack of coolant*
- *Defective water pump or thermostat*

Check the coolant level and temperature frequently. Service the entire cooling system at least *twice a year.*

CLEANING THE COOLING SYSTEM

Efficient operation of the cooling system requires an occasional cleaning, particularly at seasonal changes when antifreeze solution is added or removed.

Several methods of cleaning the system are available, the proper one depending upon the amount of corrosion present in the system.

RUST-PROOFING THE SYSTEM

Rust is formed by corrosion of iron parts:

IRON + WATER + OXYGEN = RUST

Make it a rule to check the cooling liquid spring and fall.

FOR BEST COOLING SYSTEM PERFORMANCE, DRAIN THE SYSTEM AT LEAST ONCE A YEAR.

Use a *cooling system cleaner* if the liquid drains out rusty. Otherwise, use a *radiator flush* or *plain water*. Corrosion inhibitors do not clean out rust already formed.

In the spring, if the antifreeze is drained, renew the rustproofing by adding a reputable anti-rust compound to a filling of fresh water, or by installing a new filling of antifreeze.

Regardless of the summertime practice, corrosion protection can best be provided in winter by inhibitors built into the antifreeze coolant.

ADDING RUST INHIBITORS OR FRESH ANTIFREEZE TO USED SOLUTIONS WILL NOT RESTORE FULL STRENGTH CORROSION PROTECTION. SOME MIXTURES MAY EVEN DO HARM.

Some manufacturers recommend the year-round use of a highly inhibited antifreeze coolant. However, remember that the service life of the inhibitor may be drastically reduced as the machine gets older and the coolant may have to be replaced more often.

Some of the specific factors involved are:

- *Accumulation of contaminants, including rust and corrosion products.*
- *Dilution with water required to replace leakage losses, and possible absorption of air and exhaust gases.*

For these reasons, be sure to:

1. *Check the cooling system and coolant periodically.*
2. *Maintain at least a 25% solution concentration year-round for adequate corrosion protection.*
3. *Install new antifreeze coolant at least once each year.*

RUST CLOGGING

Rust clogging is a fairly common cause of cooling system trouble. It can be avoided entirely by periodic rustproofing and cleaning when necessary.

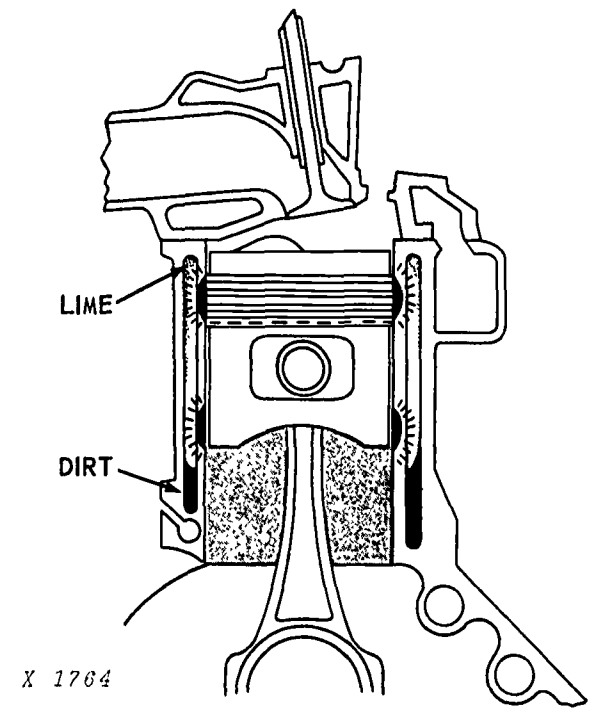

Fig. 21 — Mineral Deposits

The most common clogging materials are:

- **Rust**
- **Scale**
- **Grease**
- **Lime**

Rust accounts for 90% of the clogging. It forms on the walls of the engine water jacket and other metal parts.

Grease and oil enter the system through:

- *Cylinder head joint*
- *Water pump*
- *Leaking oil cooler*

Coolant circulation loosens rust particles which settle in the water jacket and build up in layers inside the radiator water tubes.

As the rust layer becomes thicker it keeps cutting down heat transfer from the radiator until the engine overheats and boiling starts in the water jacket.

This boiling stirs up more rust in the block and forces it into the radiator—eventually clogging it.

MINERAL DEPOSITS

Mineral deposits form rapidly at hot spots in the engine (Fig. 21).

Overheating, knock, and eventually engine damage can result from the build-up of rust and mineral scale on the water side of the combustion chamber (Fig. 21).

To avoid excessive formation of rust or scale deposits:

1. *Keep the cooling system free of leaks.*

2. *Avoid adding too much hard water.*

3. *Maintain full-strength corrosion protection at all times.*

COOLING SYSTEM CLEANERS

Well-maintained cooling systems seldom, if ever, require corrective cleaning.

However, if periodic rustproofing or other mechanical preventive maintenance is neglected, deposits will build up and cleaners must be used to restore cooling capacity.

Use a cleaner to remove:

- *Hard rust deposits*
- *Scale*
- *Grease*

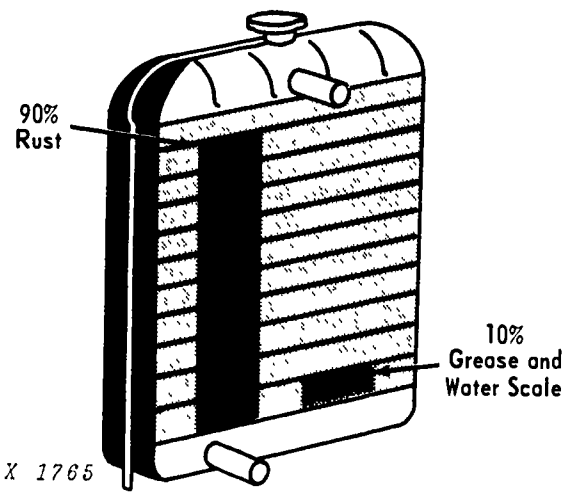

Fig. 22 — Rust In Clogging Material

Iron rust and water scale build up together in the cooling system. Clogging material is usually made up of grease, rust and water scale, but is *90% iron rust.*

Remove both hard rust-scale and grease with a double-action cleaner. It is harmless to cooling system metals and hose connections when used according to directions.

If rust and grease are not completely neutralized and flushed out, they can destroy the corrosion inhibitors in later fills of antifreeze or anti-rust solutions.

NOTE: Some radiators are made of aluminum or other metals which may be affected by certain compounds used for immersion cleaning. Follow manufacturers' instructions for cleaning these radiators.

FLUSHING THE COOLING SYSTEM

Incomplete flushing, such as hosing out the radiator, closes the thermostat and prevents thorough flushing of the water jacket. For complete flushing, take the following steps.

1. Fill the system completely with fresh water.

2. Run the engine long enough to open the thermostat (or remove the thermostat).

3. Open all drain points to drain the system completely.

Clean out the *overflow pipe* and remove insects and dirt from *radiator air passages, radiator grille* and *screens.*

Also check the thermostat, radiator pressure cap, and the cap seat for dirt or corrosion.

COOLING SYSTEM LEAKAGE

Leakage is the most common problem in a cooling system. During the winter it can involve the loss of valuable antifreeze.

But leakage actually does increase during the winter due to *metal shrinkage* and *cooling system pressure.*

Air pressure leakage testers can be helpful in locating external leaks but they cannot be depended upon to locate small combustion leaks.

Only practical experience enables a serviceman to tell whether the location and size of a leak can be corrected with a sealing solution.

All leakage exposed to combustion pressures must be repaired mechanically.

Following instructions when using sealing solutions. Some sealing solutions react chemically with antifreeze and rust inhibitors, and seriously affect coolant performance.

Radiator Leakage

Most radiator leakage is due to mechanical failure of soldered joints. This is caused by:

- *Engine vibration*

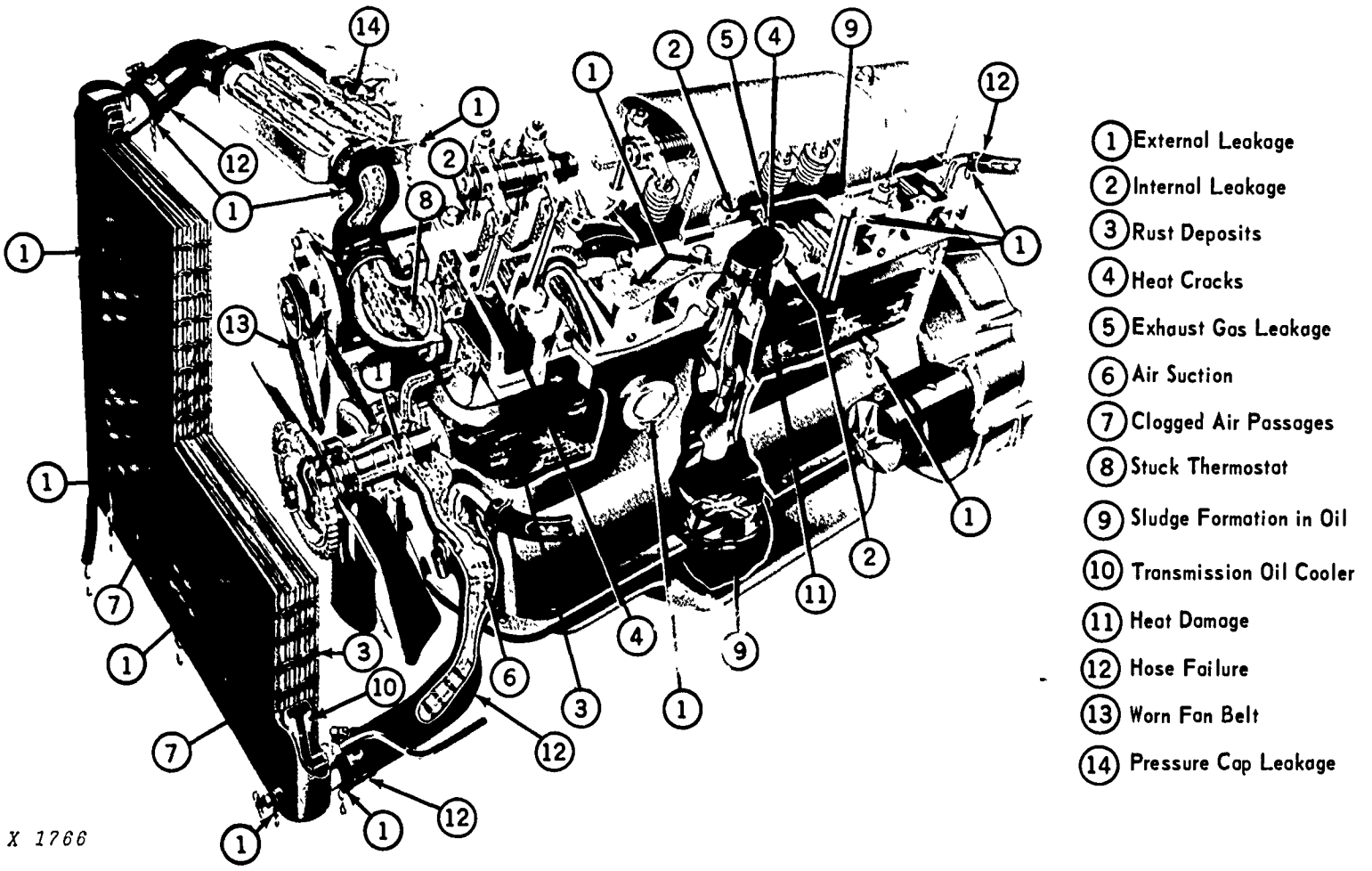

Fig. 23 — Maintenance Problems Of the Cooling System

- *Frame vibration*
- *Pressure in the cooling system*

Examine radiators carefully for leaks before and after cleaning. Cleaning may uncover leakage points already existing but plugged with rust.

White, rusty or colored leakage stains indicate previous radiator leakage. These spots may not be damp if water or alcohol is used since such coolants evaporate rapidly, but ethylene glycol antifreeze shows up because it does not evaporate.

Always stop any radiator leakage before installing antifreeze coolant.

Leakage Outside Engine Water Jacket

Inspect the engine cylinder block before and after it gets hot while the engine is running.

Leakage of the engine block is aggravated by:

- *Pump pressure*
- *Pressurized cooling systems*
- *Temperature changes of the metal*

Remember: Small leaks may appear only as rust, corrosion or stains, due to evaporation.

Watch for these trouble spots:

1. **Core-Hole Plugs.** Remove old plug. Clean plug seat, coat with sealing compound. Drive new plug into place with proper tool.

2. **Gaskets.** Tighten joint or install new gasket. Use sealing compound when required.

3. **Stud Bolts And Cap Screws.** Apply sealing compound to threads.

Water Jacket Leakage Into Engine

Coolant leaks into the engine through:

- *A loose cylinder head or sleeve joint*
- *A cracked or porous casting*
- *The push rod compartment*

Water or *antifreeze* mixed with *engine oil* will form **sludge** which causes:

1) Lubrication failure

2) Sticking piston rings and pins

3) Sticking valves and valve lifters

4) Extensive engine damage

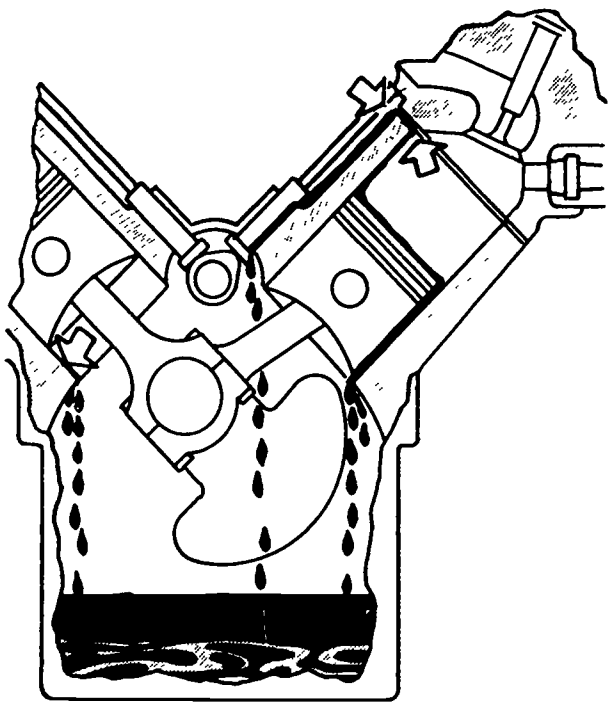

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Fig. 24 — Water Jacket Leakage Into Engine

The amount of damage depends upon *the amount and duration of leakage, service procedures,* and *seasonal operating conditions.*

High-temperature thermostats let the engine heat remove moisture (formed from blow-by) from the crankcase.

Head gasket leakage is more likely to occur in winter than summer because of more metal contraction and expansion in winter.

Give special attention to the cylinder head joint gasket no matter what type or material.

An improperly installed gasket can cause:

- *Coolant and oil leakage*
- *Overheating*

It may be necessary to pressurize the cooling system and tear down part of the upper part of the engine to find a coolant leak in the push-rod compartment.

Replacing Head Gaskets

To replace a cylinder head gasket:

1. Use only a new gasket designed for this particular engine.

2. Make sure the head and block surfaces are clean, level and smooth.

3. See Chapter 2 for details.

IMPORTANT: Leading engine manufacturers strongly recommend the use of torque wrenches to tighten cylinder heads.

Always follow the engine manufacturers' instructions on cylinder head bolt tension and order of tightening.

OVERHEATING DAMAGE

In modern high-performance engines, the intense heat of combustion can cause engine components such as valves, pistons and rings to operate near their critical temperature limits—even when the cooling system is operating normally.

Overheating severely affects the lubrication of the engine. High metal temperatures can destroy the lubricating film, accelerate oil breakdown, and cause formation of varnish.

These in turn may cause:

1) Excessive wear

2) Scoring

3) Valve burning

4) Seizure of moving parts

Continued operation above the normal temperature range may result in:

- *Lubrication failure*
- *Heat distortion*
- *Engine knocking*

Cylinder heads and engine blocks are often warped and cracked (Fig. 25) by terrific strains set up in the metal by overheating, especially when followed by rapid cooling.

Hot spots in an overheated engine can cause engine knocking. If allowed to continue, knocking results in:

1) "Blown" head gaskets

2) Damaged pistons

3) Ring and bearing failure

See Chapter 2 for details.

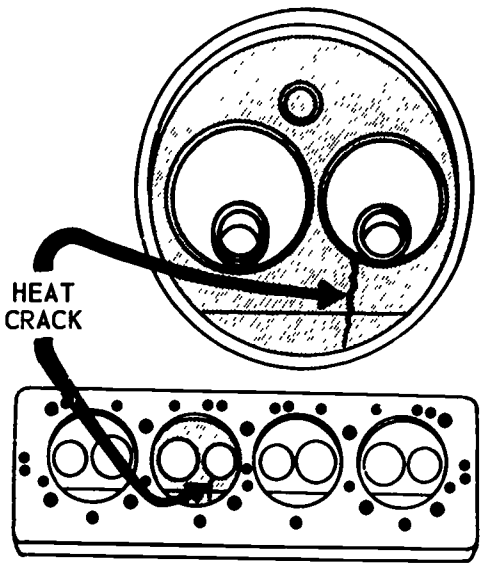

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Fig. 25 — Cracks Caused By Overheating

EXHAUST GAS LEAKAGE

A cracked head or a loose cylinder head joint allows hot exhaust gas to be blown into the cooling system under combustion pressures; even though the joint may be tight enough to keep liquid from leaking into the cylinder.

The cylinder head gasket itself may be burned and corroded by escaping exhaust gases.

Exhaust gases dissolved in coolant destroy the inhibitors and form acids which cause corrosion, rust and clogging.

Excess pressure may also force coolant out the overflow pipe.

Testing For Exhaust Gas Leakage (Blow-By)

1. Warm up the engine and keep it under load.

2. Remove the radiator cap and look for excessive bubbles in the coolant (Fig. 26).

3. Either bubbling or an oil film on the coolant is a sign of blow-by in the engine cylinders.

NOTE: Make this test quickly, before boiling starts, since steam bubbles give misleading results.

CORROSION IN THE COOLING SYSTEM

Water solutions will corrode the cooling system metals when they are not protected by inhibitors added to water for summer operation.

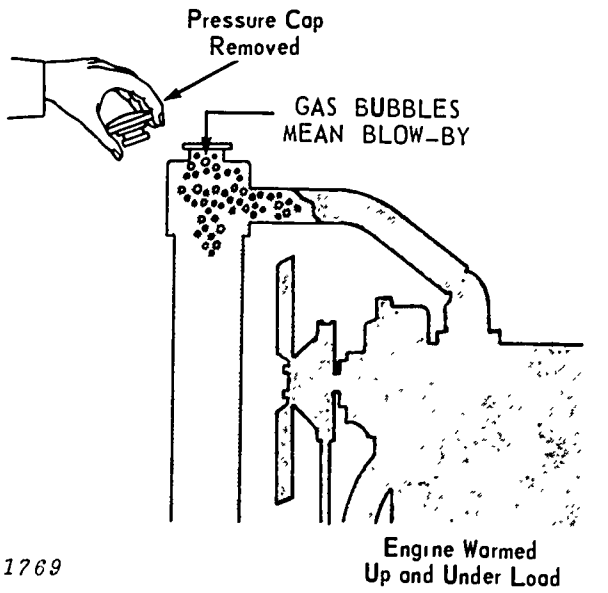

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Fig. 26 — Test For Exhaust Gas Leakage (Blow-By)

Corrosion coating on metal surfaces reduces heat transfer at the walls of the engine water jacket and in the tubes of the radiator even before clogging occurs.

Galvanic action is a form of corrosion which can occur when two different metals (in contact) are suspended in a liquid which will carry a current.

It is similar to what happens in a battery when electric current flows from one area to another, removing metal from one electrode and depositing it on another in the process.

Galvanic corrosion or direct attack by the coolant will affect the following metals in the cooling system: stainless steel, brass, solder, aluminum, and copper.

AERATION IN COOLING SYSTEM

Aeration, or mixing of air with water, speeds up the formation of rust and increases corrosion of cooling system metals.

Aeration may also cause:

- *Foaming*
- *Overheating*
- *Overflow loss of coolant*

Air may be drawn into the coolant because of:

1) A leak in the system

2) Turbulence in the top tank

3) Too-low coolant level

Check the cooling system for exhaust gas leakage and air suction when you find these conditions:

- *Rusty Coolant*
- *Severe Rust Clogging*
- *Corrosion*
- *Overflow losses*

Testing For Air In The Cooling System

If air leaks in the cooling system are suspected, the following checks can be made.

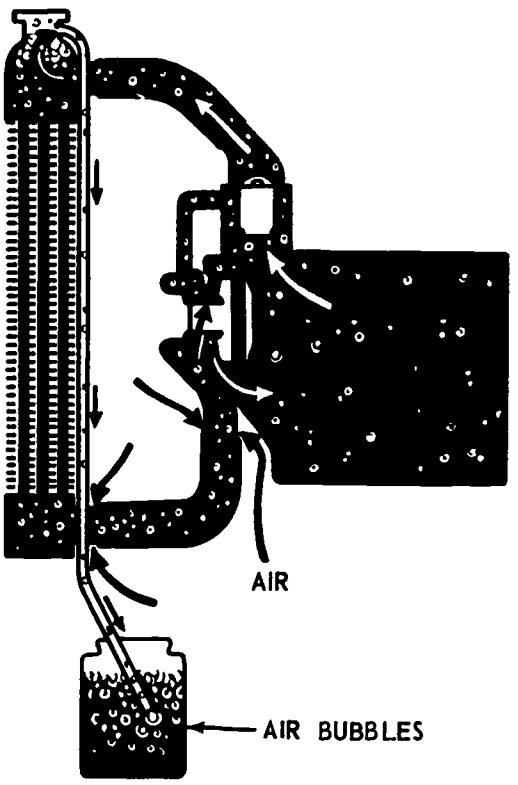

Fig. 27 — Testing For Air In Cooling System

1. Adjust coolant to correct level.
2. Replace pressure cap with a plain, air-tight cap.
3. Attach rubber tube to lower end of overflow pipe. Be sure radiator cap and tube are air tight.
4. With transmission in neutral gear, run engine at high speed until temperature gauge stops rising and remains stationary.
5. Without changing engine speed or temperature, put end of rubber tube in bottle of water.
6. Watch for a continuous stream of bubbles in the water bottle, showing that air is being drawn into the cooling system (Fig. 27).

TEST YOURSELF

QUESTIONS

1. What are the eight parts of the liquid cooling system?

2. (True or false?) "Permanent antifreeze should be changed every season."

3. What is the basic difference between a BELLOWS-Type Thermostat and a BIMETALLIC-Type?

4. What part of the cooling system could be referred to as the "heart" of the system?

5. (True or false?) "Thermostats are not required when operating the engine in hot weather."

ANSWERS

1. Radiator, radiator cap, fan and fan belt, water pump, engine water jacket, thermostat, connecting hoses, liquid or coolant.

2. True.

3. The BELLOWS-type consists of a short length of circular corrugated copper tube closed at both ends and filled with a liquid having a low boiling point.

The BIMETALLIC-type of thermostat consists of a spiral of bimetallic strip. This is a strip of steel welded to a strip of bronze.

4. Water pump.

5. False.

GOVERNING SYSTEMS / CHAPTER 9

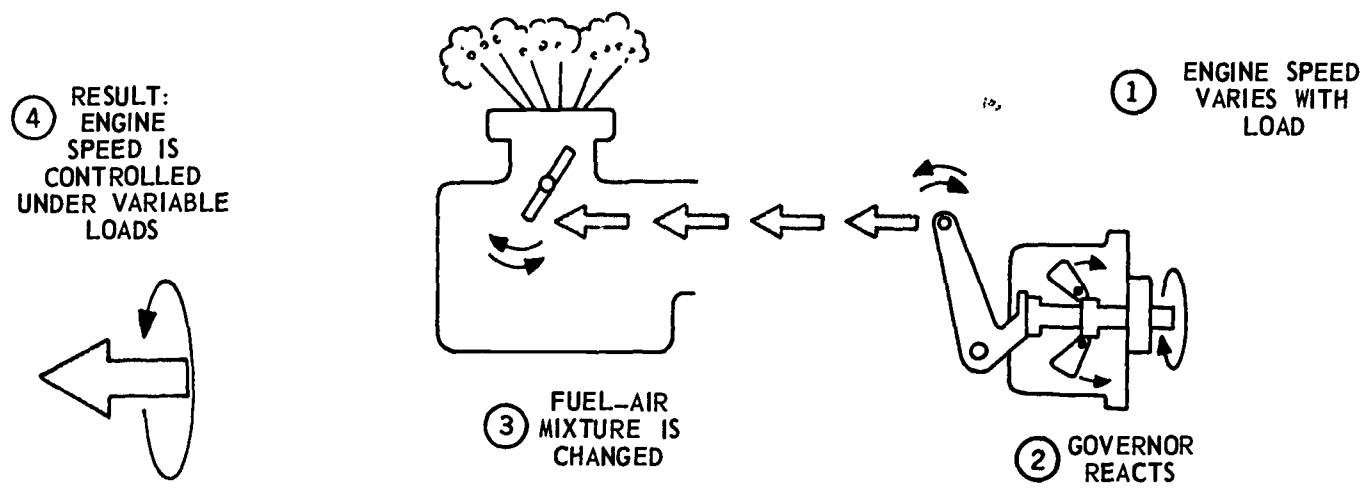

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Fig. 1 — Governing System (Gasoline Engine With Centrifugal Governor Shown)

INTRODUCTION

The *governor* is a device that automatically controls the speed of an engine under varying loads.

Governors can do any of three jobs:

- **Maintain a selected speed**
- **Limit the slow and fast speeds**
- **Shut down the engine when it overspeeds**

Note in Fig. 2 how the governor keeps the engine at a constant speed when the tractor is going both uphill and downhill.

Most modern governors are the centrifugal spring-loaded type and adjust fuel intake according to demand on the engine (Fig. 1). Others use a vacuum to control a throttle valve.

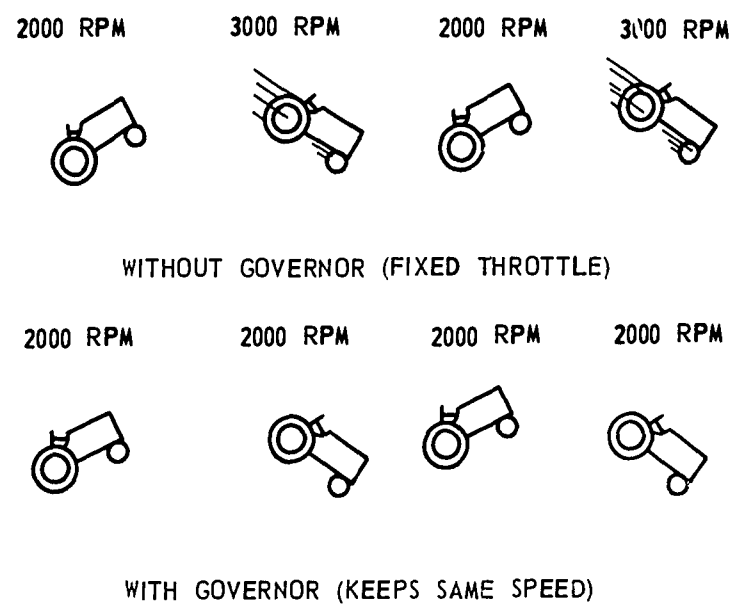

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Fig. 2 — What The Governor Does For The Engine

FEATURES OF GOVERNORS

Let's discuss some of the main features of governing:

Stability—to maintain a desired engine speed without fluctuations. Indicated by the number of corrective movements the governor makes and the time required to correct engine speed for a given load change.

Lack of stability will result in *hunting*, or oscillations due to over-correction. Too much stability will result in a *dead-beat* governor, or one that does not correct sufficiently.

Another term for this ability of the governor to keep a steady speed is *isochronous* governing.

Sensitivity—the percent of speed change required to produce a corrective movement of the fuel-control mechanism.

Promptness of Response—the time in seconds required for movement of the fuel control from no-load to full-load position.

Speed Drift—a very gradual deviation of the main governed speed above or below the desired governed speed.

Work Capacity—the work which the governor can perform to overcome the resistance in the fuel controls, expressed in inch-pounds or foot-pounds.

Load-Limit Changer—an adjustable device for limiting maximum fuel flow to the engine, thus limiting power output to any desired maximum value.

Speed Changer—a device for adjusting the speed-governing system to change engine speed, or power-output relationship, with other engine generator units when in parallel operation. Normally this can be adjusted while the engine is in operation.

Speed-Regulation Changer—a device by which the steady speed regulation (speed droop) can be adjusted while the engine is in operation.

Speed Droop—All mechanical governors and some hydraulic governors have permanent speed droop and are non-isochronous because the engine's steady speed is slightly different at different speeds.

Speed droop is the variation in governor rotating speed from no load to full load (sometimes referred to as *steady-state speed regulation).*

Speed droop refers to a change in the steady speed when the load on an engine is reduced from rated output to zero output, without adjustment of the governor. It is usually expressed as a percent of rated speed.

For example: An engine equipped with a governor which has been set for a no load speed of 2,000 rpm will not run this fast under load. The difference between the governor setting (no load speed) and full load speed is called *speed droop.* This difference may be as much as 10 percent less than the no load speed.

In this example, no load speed will be 2,000 rpm but all engine speeds under partial loads will be somewhat less than this and full load speed will drop down to 1,800 rpm.

Speed droop is useful in preventing overshooting or hunting by the governor when the engine loads change.

Now let's discuss the governing of engines in two parts—first spark-ignition, then diesel.

GOVERNING OF SPARK-IGNITION ENGINES

Governing of spark-ignition engines is more critical than for diesel engines. This is partly due to the design of the air and fuel control system, but chiefly to:

- *The small variation in fuel-air ratio which is permissible.*
- *The metering lag of nearly one cycle for complete response to governor action.*

The governor quickly feels a reduction in speed, and increases fuel to the engine about one cycle before air is supplied. This results in erratic operation.

If the engine over-speeds, a quick reduction in fuel causes the engine to misfire. Therefore, the governor response must be slow enough to ignore quick speed variations caused by occasional misfiring, yet be sensitive to the sustained speed changes resulting from variations of load.

Most gasoline engines use a *throttle* governor.

The throttle governor permits the engine to fire steadily regardless of the load but varies the charge of fuel-air and so the intensity of the combustion. This speeds up or slows down the engine to allow for different loads.

The governor actuates a throttle valve in the intake passage between the carburetor and the engine manifold (see Fig. 1). The position of the throttle valve at any given time controls the mixture to the engine (see Chapter 3 for details).

The two most common types of throttle governor systems are:

- **Automatic or vacuum governors**
- **Centrifugal governors**

Let's discuss each type.

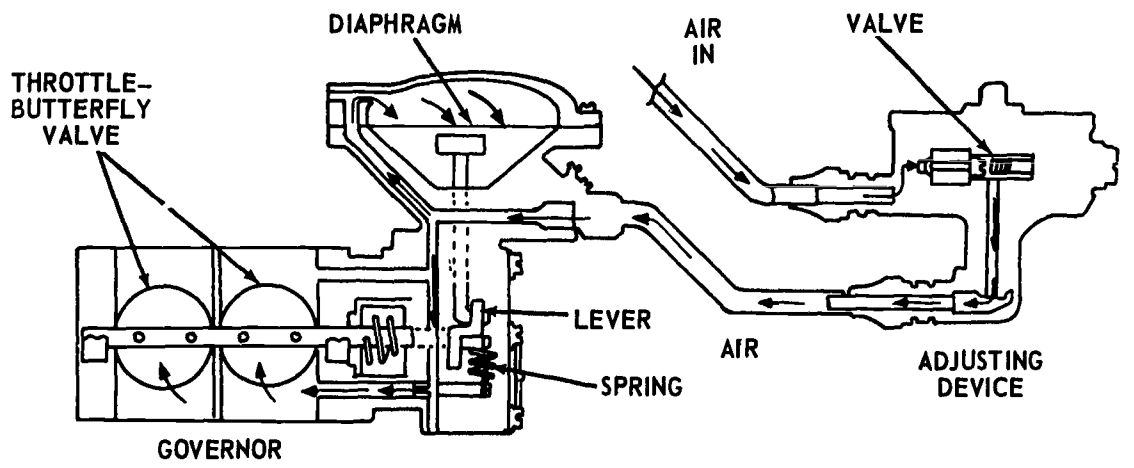

Fig. 3 — Vacuum Governor

AUTOMATIC OR VACUUM GOVERNORS

Many farm and industrial machines are equipped with a governor for maintaining a set maximum operating speed.

An automatic or vacuum governor is used for this purpose (Fig. 3). Located between the carburetor and the intake manifold, it has no mechanical connection to any other parts of the engine.

This type of governor consists of a housing and a throttle-butterfly valve connected to a cam-and-lever mechanism that is spring-controlled.

The unit operates by closing the throttle-butterfly valve, causing a decrease in the fuel flow, as engine speed and suction increase.

When engine speed and suction decrease, the spring opens the throttle-butterfly valve and the fuel flow increases.

A simple adjustment of spring tension maintains the desired speed range.

Efficient operation of this governor depends largely upon precise machining, freedom of movement of the parts, and proper installation and adjustment of the engine.

CENTRIFUGAL GOVERNORS

The centrifugal governor has two weights, called flyweights, suspended on a weight carrier, which is mounted on the governor shaft (Fig. 4). The governor is driven directly from the engine.

As the governor shaft rotates, the weights are thrown outward by centrifugal force, pushing a thrust sleeve against the governor fork which in turn actuates the governor lever and, through governor-to-carburetor linkage, controls the amount of fuel and air supplied to the engine (Fig. 4).

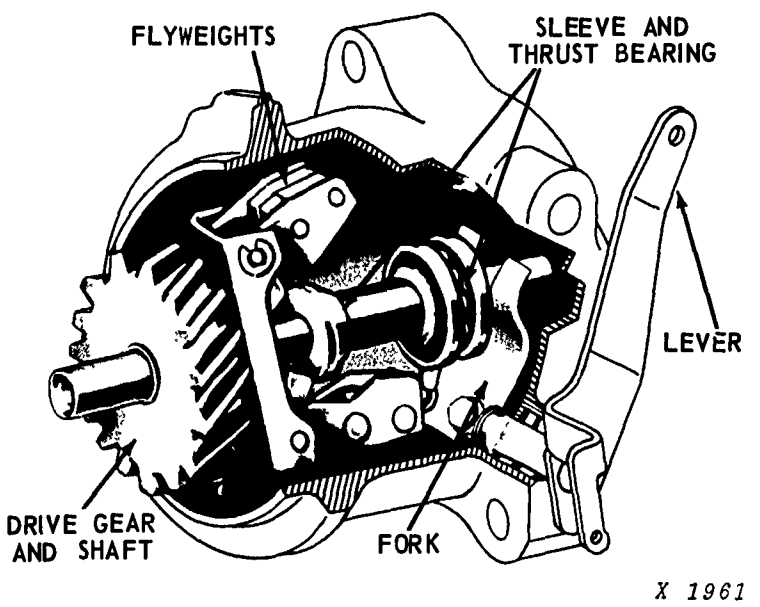

Fig. 4 — Cutaway Of Centrifugal Governor

This control of fuel-air mixture keeps the engine at the desired speed under varying loads.

The governor is linked to the hand throttle and will maintain any engine speed, unless the engine is over-loaded.

The centrifugal force of the weights decreases as the speed falls and the speeder spring pushes them inward until a new balance point is reached (Fig. 5). For any given speed, the flyweights will always take a definite position a certain distance from the axis of rotation.

"Hunting" Of Centrifugal Governors

A problem with centrifugal governors is *hunting*.

Frequently when an engine is first started or after it is warmed up and is working under load, its speed will become uneven or irregular. The engine speeds up quickly, the governor suddenly responds, the speed drops quickly. The governor again suddenly responds, the speed drops quickly, the governor responds again, and the action is repeated. This is known as *hunting*.

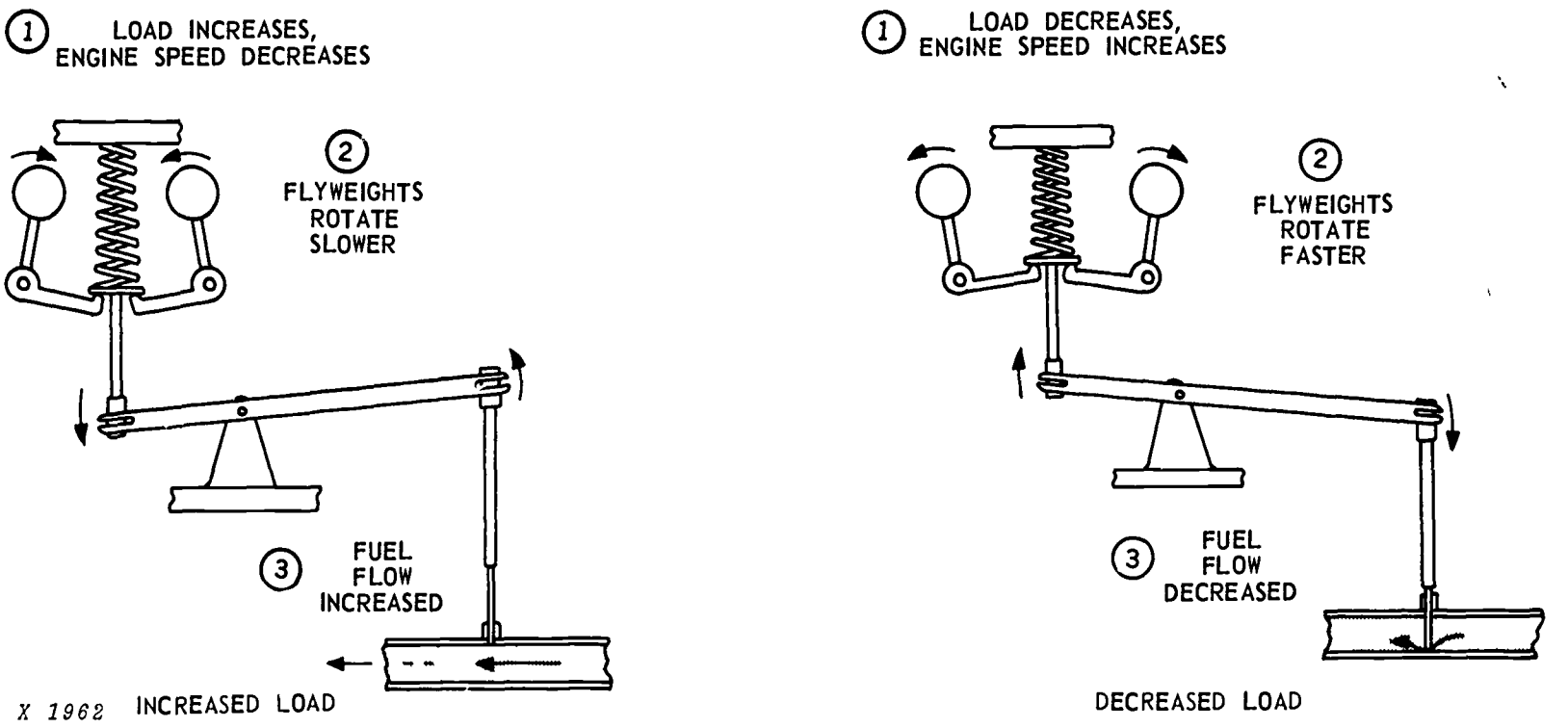

Fig. 5 — Operation Of Centrifugal Governor

Hunting is usually caused by the wrong *carburetor adjustment* and can be corrected by making the mixture either slightly leaner or slightly richer. The governor itself may also cause hunting by being too stiff or by striking or binding at some point so that it fails to act freely.

GOVERNOR LINKAGE AND ADJUSTMENT

Remember these two points when connecting or adjusting the governor to the engine:

1) **Amount of work**—*Governors are capable of doing a specified amount of work, say 8 foot-pounds, when moving through full control travel.*

2) **Speed droop**—*Governors may have an adjustable speed droop up to 10 percent for full control travel.*

If the linkage is set to give full control of fuel during one-quarter of governor lever travel, the governor can do only one-quarter of its maximum work. So the maximum speed droop obtainable will be *one-quarter* of *rated* maximum.

For smoother operation of the engine, change the lengths of the governor and fuel control rods so that 70 to 80 percent of full governor lever travel is used between no load and full load. This means that the governor can perform 70 to 80 percent of its work rating.

MAINTENANCE OF GOVERNOR

The two chief requirements for trouble-free operation of a governor are:

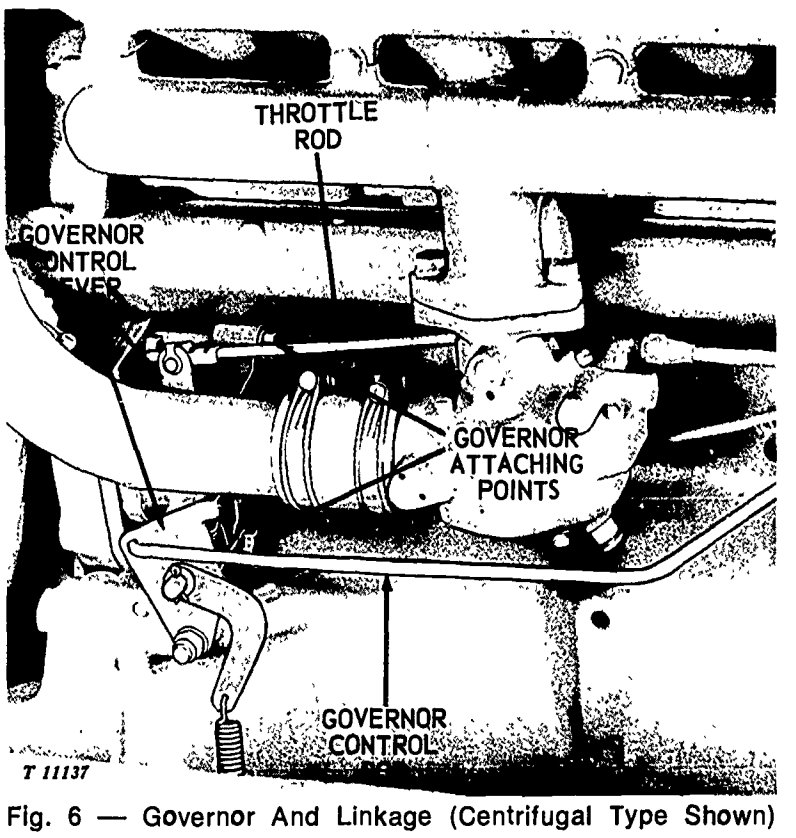

Fig. 6 — Governor And Linkage (Centrifugal Type Shown)

- **Vibration-free drive**
- **Cleanliness of moving parts**

The governor is a sensitive device which demands a non-fluctuating speed drive with no vibration. This is the reason why many governors are driven through a spring or rubber coupling to smooth out any roughness in the engine drive.

The smoothest governor drive is obtained through gearing from the crankshaft. The free end of the camshaft will give the roughest drive, the greatest variation in speed, and the most vibration.

GOVERNING OF DIESEL ENGINES

The principles of governing a diesel engine are the same as for gasoline engines, but there are several different ways in which governors perform their jobs:

- **Mechanical**—a speed measuring device, which directly actuates the linkage to the throttle.
- **Hydraulic**—the speeder rod actuates a small valve controlling fluid under pressure; this fluid operates a piston or "servo-motor" which actuates the throttle.
- **Variable speed**—maintains any selected engine speed from idling to maximum speed.
- **Over-speed**—shuts down the engine in case it runs too fast. It is only a safety device.
- **Torque converter regulator**—controls the maximum speed of the output shaft of a torque converter attached to an engine, independently of engine speed.
- **Pressure regulator**—used on any engine driving a pump, to maintain a constant inlet or outlet pressure on the pump.
- **Load control**—adjusts the amount of load applied to the engine to suit the speed at which it is set to run. This actually improves fuel economy and reduces engine strain when the engine is not under load.
- **Electric load sensing**—detects variations in the electrical load and quickly adjusts fuel quantity to match. This governor is most generally used in electrical power plants.
- **Electric speed**—controls speed by measuring the frequency in cycles-per-second of the electrical current produced by a generator driven by the engine.

MECHANICAL GOVERNORS (DIESEL)

Mechanical governors provide full fuel for starting when the speed control lever is in the idle or run position. Immediately after starting, the governor moves the injector rack to the position required for idling.

Mechanical governors are simple centrifugal types, with fuel moving parts. They work best when engine speed is not critical.

Disadvantages are:

1) *Dead Band*—the change in speed the engine must make before the governor makes a corrective movement of the throttle. Caused mainly by friction.

2) *Speed Droop*—the change in governor speed required to cause the throttle rod to move from full-open to full-closed or full-closed to full-open.

Types Of Mechanical Governors

The two types of mechanical governors are:

- *Speed Limiting*—used when a maximum and minimum speed plus manually-controlled intermediate speed is required.
- *Speed Varying*—used for a near-constant engine speed under varying loads, with speeds adjustable by the operator.

HYDRAULIC GOVERNORS (DIESEL)

Hydraulic governors have more parts and are generally more expensive than mechanical governors. They can also be made isochronous because they are more sensitive and have greater power to move the fuel control mechanism than mechanical governors.

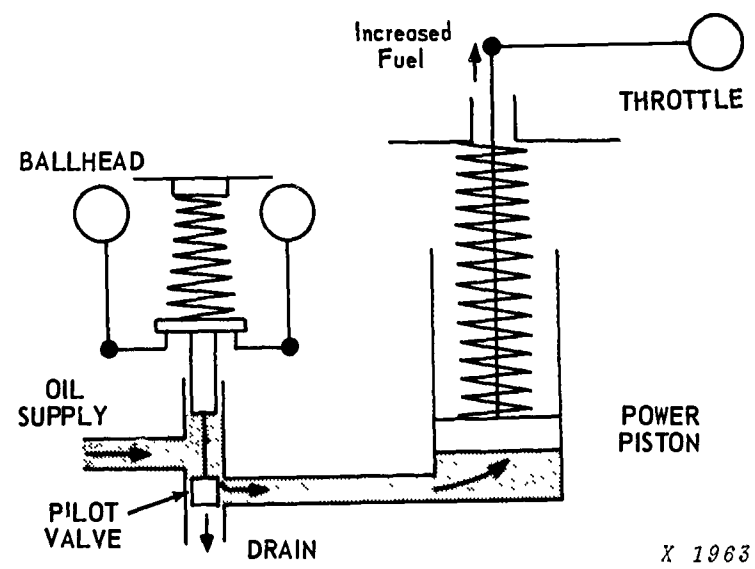

Fig. 7 — Hydraulic Governor (Diesel)

The power which moves the engine throttle does not come from the speed measuring device of hydraulic governors. Instead, it comes from a hydraulic power piston or "servo-motor". This is a piston which is acted upon by oil under pressure to operate the throttle (Fig. 7).

The speed measuring device is attached to a small port valve as shown. This valve slides up and down in a bushing containing ports which control the oil flow to the piston.

The force needed to slide the port valve is very small. Therefore, a small ballhead is able to control a large amount of power in the piston.

The engine should be equipped with a separate over-speed governor to prevent a runaway should the governor fail.

Hunting Of Hydraulic Governors

A basic fault of hydraulic governors is that they have a tendency to "hunt." The cause is the unavoidable time delay between the time the governor acts and the engine responds. The engine cannot instantly come back to the speed called for by the governor.

For example: If the engine speed is below the governor control speed, the pilot valve moves the power piston or servo-motor to increase the fuel flow.

By the time the speed has increased to the control setting so that the port valve is centered and the power piston or servo-motor dropped, the fuel has already been increased too much, but the engine continues to speed up.

This overspeed opens the port valve the other way to decrease the fuel, but by the time engine speed falls to the right level, the fuel control has again traveled too far. The engine over peeds, and the whole cycle is repeated continuously.

To overcome "hunting", *speed droop* must be provided (Fig. 8).

VARIABLE SPEED GOVERNORS

A variable speed governor can control the engine speed at different settings between minimum and maximum. It resembles a constant-speed governor in its ability to hold the engine at steady speed. The difference is that the operator can adjust the governor to maintain any desired steady speed.

Speed adjustment is obtained in most variable speed governors by changing the spring force that resists the centrifugal force of the flyweights (see Fig. 4).

ISOCHRONOUS GOVERNORS

Governors which hold steady speeds are classed as constant speed governors. The only truly constant speed governors are *isochronous governors.*

An isochronous governor is able to maintain a constant speed without changing it. It does this by employing *speed droop* to give stability while fuel intake is being corrected.

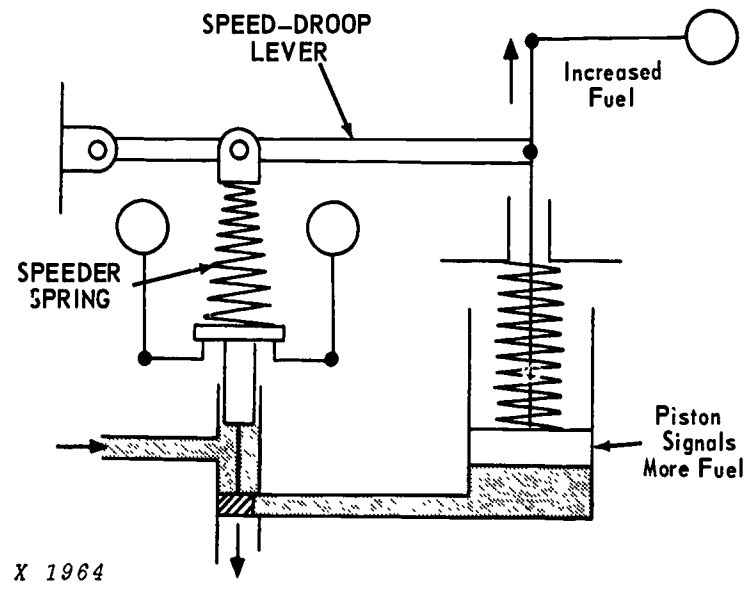

Fig. 8 — Hydraulic Governor With Adjustable Speed Droop

OVER-SPEED GOVERNORS

Over-speed governors are safety devices which protect engines from damage due to over-speeding.

When an engine is equipped with a regular speed governor, the over-speed governor will function only if the regular governor fails to operate. The over-speed governor merely slows the engine down while allowing it to keep on running at a safe speed.

Over-speed governors use a preloaded spring to over-balance the centrifugal force of the flyweights.

When the maximum speed is passed, centrifugal force overcomes the spring and activates the fuel controls which slow down the engine.

TORQUE CONVERTER GOVERNORS

A *torque converter governor* is used on a torque converter in conjunction with the engine governor.

This governor takes its speed reading from the output shaft of the torque converter.

Engine speed is governed by the engine converter as long as the torque converter speed is below its maximum level.

But if the torque converter overspeeds, its governor reduces the engine fuel and keeps converter speed from rising further.

PRESSURE REGULATING GOVERNORS

Pressure regulating governors are used on pipeline pumps to insure a constant pumping pressure.

An ordinary variable speed governor can be converted into a pressure regulating governor by adding a device which varies the speed setting of the governor in accordance with the pumping pressure.

The pumping pressure acts on a piston or diaphragm, balanced by a spring connected to a speed adjusted on the governor. If the pressure drops below the set level, the resulting movement of the diaphragm moves the speed adjuster to increase the speed.

When the speed is increased, the engine runs faster and pumping pressure is increased. When pumping pressure rises, engine speed is reduced; causing the pressure to return to normal.

LOAD LIMITING GOVERNORS

Load limiting governors prevent the loss of engine speed due to heavy loading by limiting the load to the capacity of the engine. They cannot always be used because it is not always practical to limit the load.

A prime application of load limiting is on diesel-electric locomotives. Here the load limit device is attached to the governor, which, when the governor terminal shaft reaches the maximum safe fuel position, operates an electric control, reducing the output of the electric generator.

The electric control is a rheostat, which is used to reduce generator excitation. This reduces the load on the engine enough to permit it to run at full speed and develop full power.

Load limiting governors are required when a series of various capacity engines are working together. The governor limits the fuel consumed by each engine to utilize its full power capability without the danger of overloading any of the others.

LOAD CONTROL GOVERNORS

Load control governors maintain the engine speed required and adjust the load limiting device in such a manner that the amount of load applied to the engine is the amount predetermined as suitable for each speed.

When partial power is required, the engine not only runs at a reduced speed, but also uses less fuel per stroke. This greatly reduces engine strain.

ELECTRIC LOAD-SENSING GOVERNORS

Electric load-sensing governors find their greatest use in electric power generating plants where an absolutely *stable frequency* must be maintained regardless of wide, rapid changes in load.

Load-sensing governors have an advantage over speed governors because they can divide the load among several generating units. Using this method, governors in all engines can be set for the same speed, and the load-sensing elements can be adjusted so the engines will always share the load, per their capacities, through the entire load range.

In operation, electric load-sensing governors detect changes in the load and adjust the fuel supply to maintain the same engine speed under the new load. They are able to respond faster to load changes than speed governors because *the load change itself, directly operates the governor mechanism.*

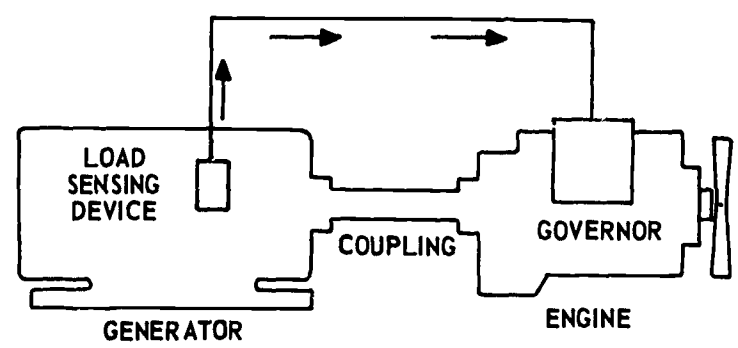

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Fig. 9 — Governor With Load Sensing

An electric load-sensing device consists of an electric network connected to an engine-driven generator (Fig. 9). The network measures the generator load and controls a solenoid within the governor which operates the fuel control mechanism.

Load-sensing governors always include *speed-sensing* and *load-sensing* elements since the speed would gradually float away from normal (due to the fact that "normal" is constantly changing), if the engine fuel were not controlled.

ELECTRIC SPEED GOVERNORS

Electric speed governors respond to engine speed by measuring the frequency of the electric current produced by the generator. When the measuring network notes that the frequency has departed from normal, it delivers an electric signal to the

solenoid which operates the fuel control mechanism. The frequency measuring network replaces the flyweights and speeder spring used on mechanical governors.

MALFUNCTIONS OF GOVERNORS

Governors are relatively trouble-free, but need adjusting, servicing, etc.

Listed below are a few of the symptoms and causes of governor problems.

I. Erratic Engine Operation, Hunting, or Misfiring

Possible Cause	*Possible Remedy*
1. Governor idle spring missing or adjusted incorrectly.	1. Replace or adjust spring.
2. Governor control spring worn or broken.	2. Remove and replace.
3. Governor not operating —parts worn, sticking, binding, or incorrectly assembled.	3. Disassemble and inspect parts.
4. Wrong governor spring.	4. Remove and replace with proper spring.
5. Governor high idle adjustment incorrect.	5. Adjust governor to diesel pump specifications.
6. Governor adjusting screw not properly adjusted.	6. Adjust governor screw.

II. Engine Idles Erratically

1. Governor idle spring missing or adjusted incorrectly.	1. Replace or adjust spring.
2. Governor not operating —parts worn, sticking, binding, or incorrectly assembled.	2. Disassemble and inspect parts.
3. Wrong governor spring.	3. Remove and replace with proper spring.

III. Engine Not Receiving Fuel

1. Governor not operating —parts worn, sticking, binding, or incorrectly assembled.	1. Disassemble and inspect parts.

IV. Engine Does Not Develop Full Power Or Speed

1. Governor not operating —parts worn, sticking, binding, or incorrectly assembled.	1. Disassemble and inspect parts.
2. Wrong governor spring.	2. Remove and replace with proper spring.
3. Governor adjusting screw not properly adjusted.	3. Adjust governor screw.

SUMMARY: GOVERNORS

Here are some key facts that will help you understand governors:

1. A governor is a speed-sensitive device that controls the speed of an engine under varying loads.

2. Governors can do any of three jobs:

a. Maintain a selected speed

b. Limit the slow and fast speeds

c. Shut down the engine before it overspeeds

3. Isochronous governors maintain a constant engine speed independent of load requirements.

4. Governor speed droop is a change in the steady-state of speed.

5. Speed drift is a gradual deviation from desired governor speed.

6. A speed changer is a device for adjusting the speed governing system to change engine speed.

7. A governor's two functions are: to measure speed and to operate the throttle.

8. The two most common types of throttle governors are automatic or vacuum, and centrifugal.

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9. The different types of diesel engine governors are: mechanical, hydraulic, variable speed, over-speed, torque converter, pressure regulator, load control, electric load-sensing, and electric speed.

10. Hydraulic governors are more expensive and have more parts than mechanical governors but are more sensitive to speed changes.

11. Variable speed governors maintain any selected engine speed from idle to maximum speed.

12. Over-speed governors are safety devices for controlling maximum engine speed.

13. A torque converter governor controls the maximum speed of the output shaft of a torque converter attached to an engine, independently of the engine speed.

14. A load control converter adjusts the amount of load applied to the engine to match the speed at which it is set to run.

15. A pressure regulator governor is used on any engine driving a pump for maintaining a constant pump pressure.

TEST YOURSELF

QUESTIONS

1. What are the three jobs which governors can do?

2. What is speed droop?

3. What is an isochronous governor?

ANSWERS

1. Governors can do any of three jobs: maintain a selected speed, limit the slow and fast speeds, or shut down the engine when it overspeeds.

2. Speed droop is the change in governor speed required to cause the throttle rod to move from full-open to full-closed or full-closed to full-open.

3. Constant speed governors are isochronous governors. An isochronous governor is able to maintain a constant speed without correcting it.

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ENGINE TEST EQUIPMENT AND SERVICE TOOLS / CHAPTER 10

INTRODUCTION

Fig. 1 — Good Test Equipment Does The Job Better And Faster

Many tools are available today for servicing engines, but they all have one purpose—to help the serviceman do his job better and faster.

Two general types of engine tools are used:

- **Testing Tools — to diagnose the engine**
- **Servicing Tools — to fix the engine**

Testing tools help to find out what must be done, while servicing tools help to do the actual service.

Here are the tools we will cover:

TESTING TOOLS	SERVICING TOOLS
Cylinder Compression Tester	*Valve Refacer*
Cylinder Bore Gauge	*Valve Seat Grinder*
Ring Groove Wear Gauge	*Valve Spring Compressor*
Piston Pin Bore Gauge	*Valve Guide Reamer*
Plastigage	*Valve Guide Knurling Tool*
Valve Spring Tester	*Cylinder Ridge Reamer*
Injection Nozzle Tester	*Cylinder Liner Puller*
Injection Pump Tester	*Cylinder Reboring Bar*
Dynamometer	*Cylinder Deglazer*
Water Manometer	*Piston Ring Groove Cutter*
Vacuum Gauge	*Piston Ring Groove Cleaning Machine*
Exhaust Smoke Analyzer	*Piston Knurling Tool*
Ignition Coil Meter	*Piston Ring Expander*
Distributor Tester	*Piston Ring Compressor*
Engine Analyzer	*Piston and Rod Aligner*
Spark Plug Tester	*Carburetor Service Tools*
Spark Plug Gap Gauge	*Injection Nozzle Tools*
Power Timing Light	*Nozzle Cleaning Kit*
Battery Hydrometer	
Oil Pressure Gauge	
Thermostat Tester	
Radiator and Cap Tester	

Fig. 2 — Servicing Tools Help To Fix The Engine After It Is Tested

TESTING TOOLS

Before servicing the engine, test it to locate the problem. Here are the prime tools you will need.

CYLINDER COMPRESSION TESTER

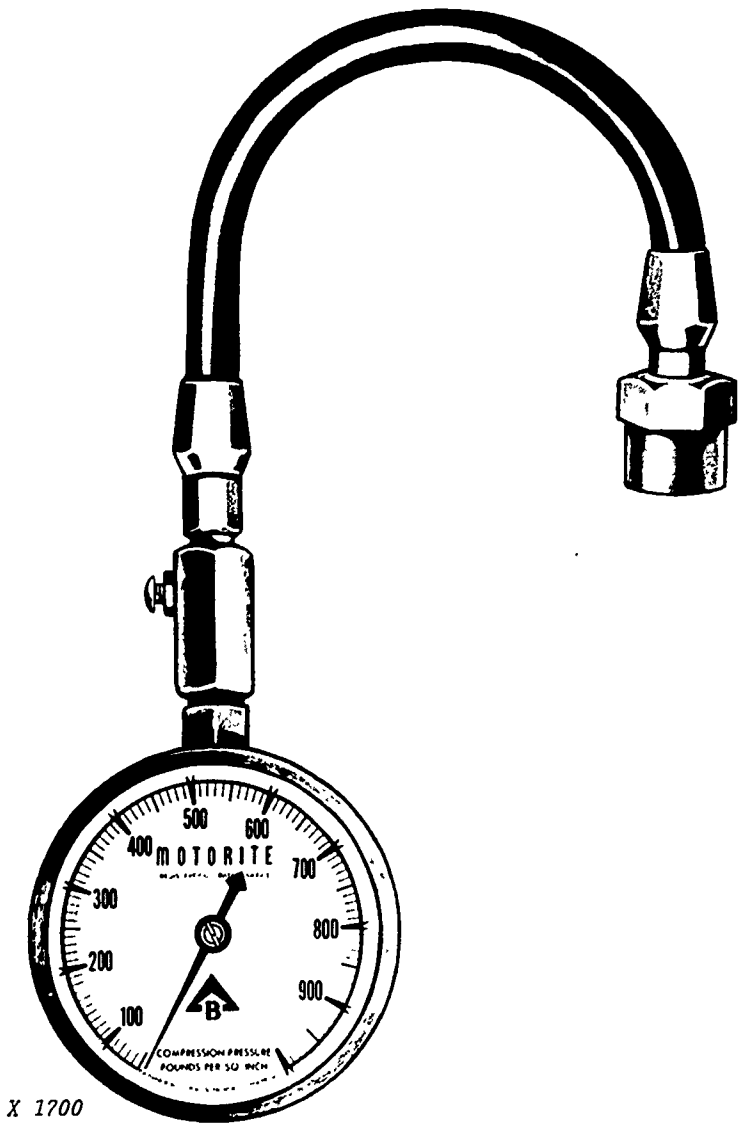

Fig. 3 — Cylinder Compression Tester

Use a cylinder compression tester to check the compression of each cylinder. Poor compression indicates bad piston rings or valves.

CYLINDER BORE GAUGE

The cylinder bore gauge (Fig. 4) checks the roundness and taper of a cylinder or cylinder liner bore. You can also use it to find the exact amount of oversize needed for honing or reboring cylinders.

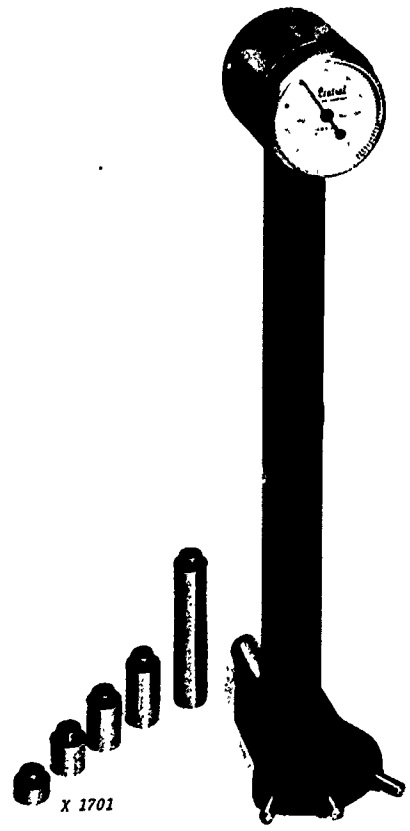

Fig. 4 — Cylinder Bore Gauge

RING GROOVE WEAR GAUGE

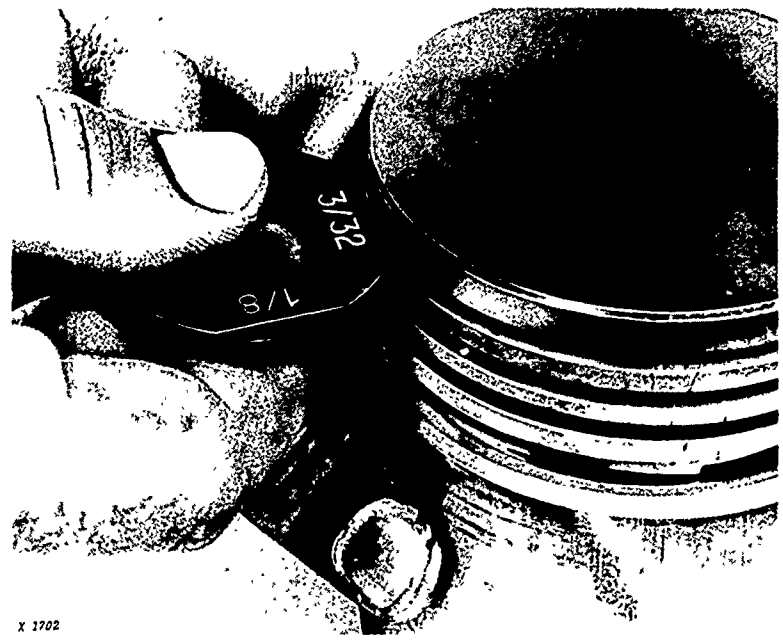

Fig. 5 — Ring Groove Wear Gauge

Use a wear gauge to make a fast check for wear in the piston ring grooves. Gauges are available for both regular and keystone grooves.

NOTE: A new piston ring and a feeler gauge can also be used to measure ring groove wear.

PISTON PIN BORE GAUGE

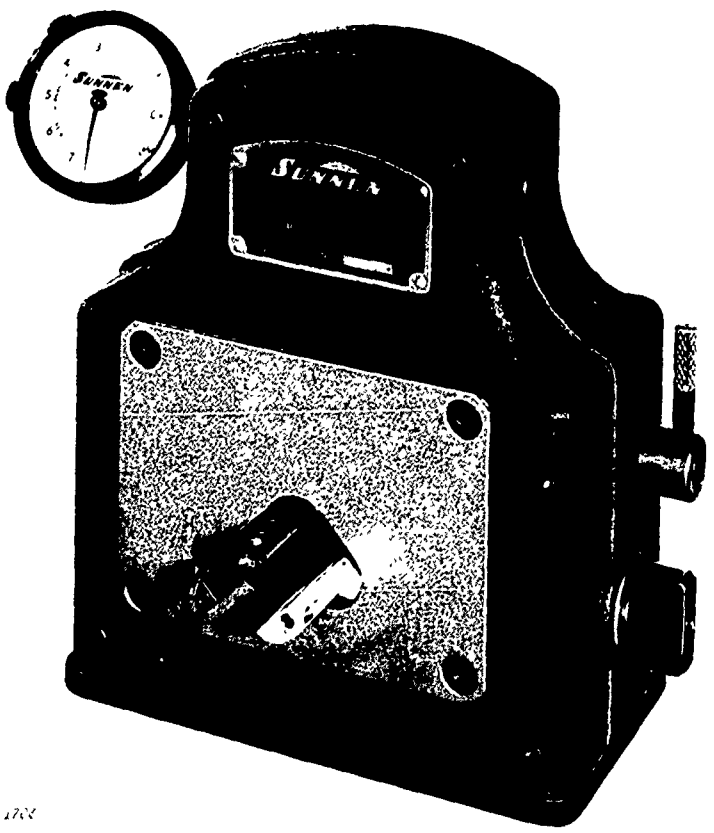

Fig. 6 — Piston Pin Bore Gauge

A piston pin hole gauge is used to measure piston pin bores for precision pin fits. The gauge shown in Fig. 6 can also be used to measure bores in the journal end of piston rod.

PLASTIGAGE

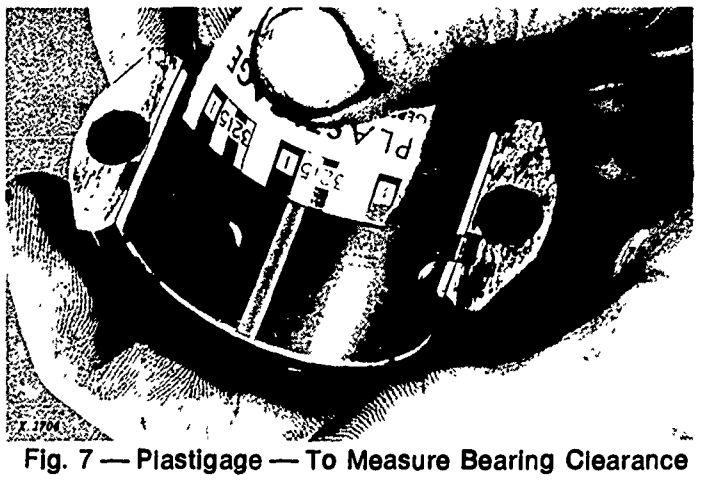

Fig. 7 — Plastigage — To Measure Bearing Clearance

Using "Plastigage" is a fast and accurate way to check engine bearing clearance. Determine clearance by crushing the "Plastigage" between the bearing and the crankshaft, and then comparing it with a graduation scale provided with the package.

VALVE SPRING TESTER

Use the valve spring tester to check the strength of valve springs in service (Fig. 8).

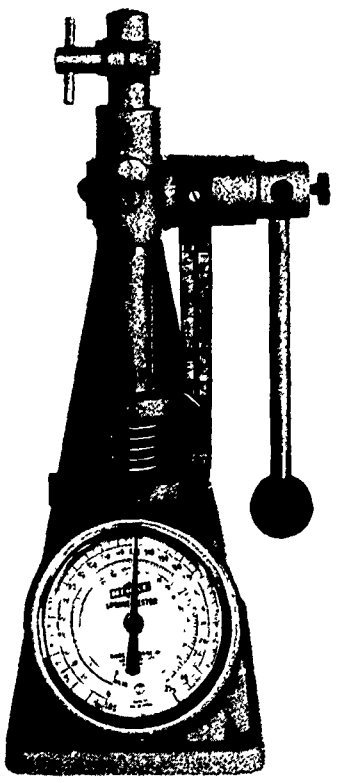

Fig. 8 — Valve Spring Tester

INJECTION NOZZLE TESTER (Diesel)

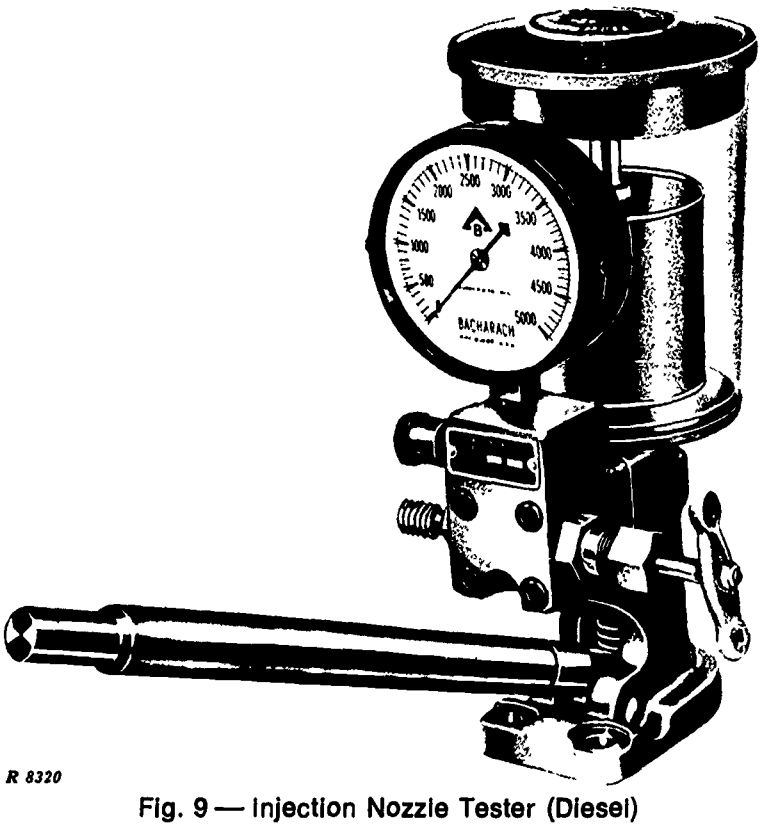

Fig. 9 — Injection Nozzle Tester (Diesel)

An injection nozzle tester will check the condition of:

1) *Needle valve and seat within the nozzle.*
2) *Spray pattern of the nozzle tip.*
3) *Cracking pressure of the nozzle.*
4) *Leak-off through the nozzle.*
5) *Nozzle valve lift.*

INJECTION PUMP TESTER (Diesel)

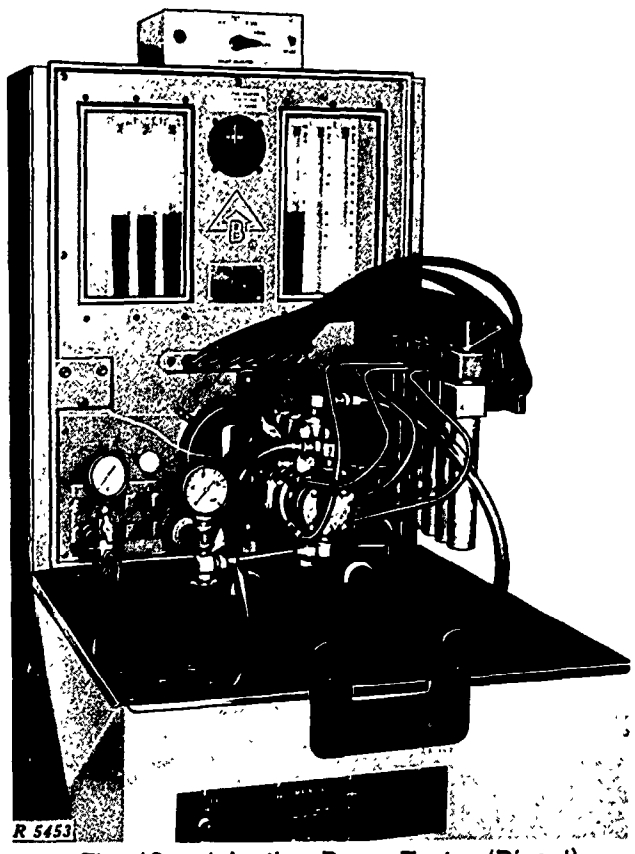

Fig. 10 — Injection Pump Tester (Diesel)

An injection pump tester is essential to properly test and calibrate a diesel fuel injection pump. The tester shown in Fig. 10 is used to test leakage, vacuum, pressure, and delivery. It is also used to make idle and torque control adjustments.

DYNAMOMETER

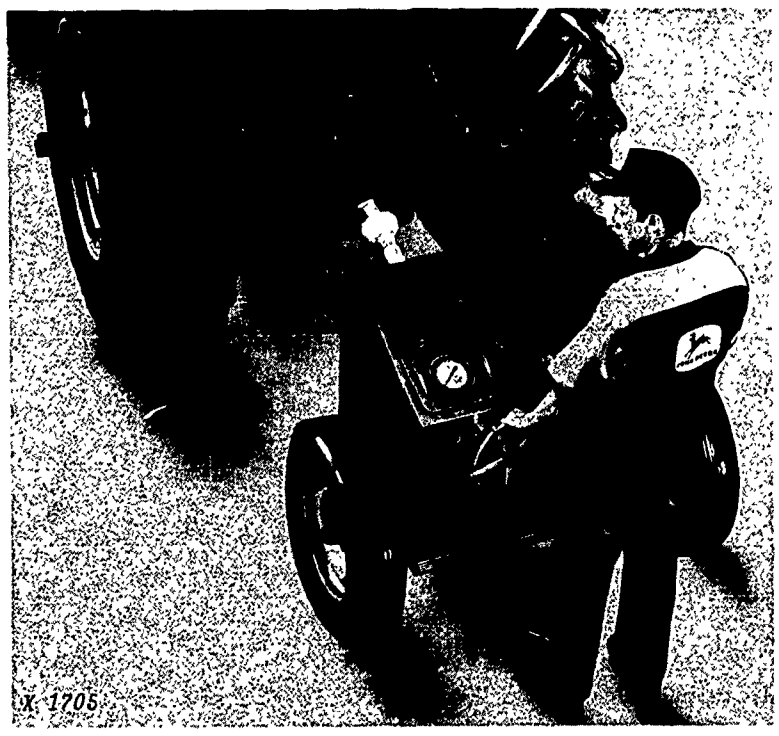

Fig. 11 — Dynamometer

Measure engine horsepower and fuel consumption with a dynamometer (Fig. 11). The results will tell you if the engine efficiency can be restored by a tune-up or whether reconditioning is required.

WATER MANOMETER

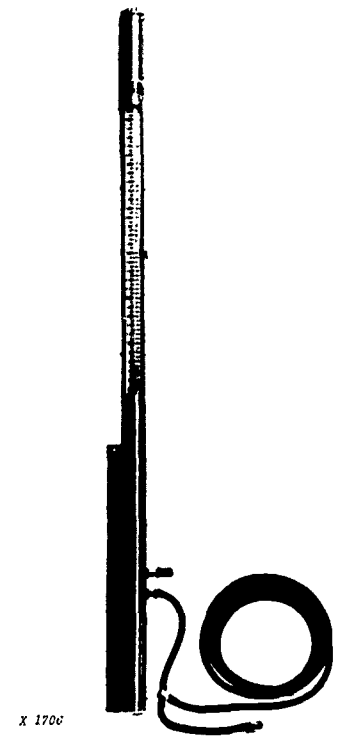

Fig. 12 — Water Manometer

Use a water manometer to check the air intake system of an engine. High depression readings indicate a restriction. A vacuum gauge calibrated in inches of water can also be used to make this check.

VACUUM GAUGE

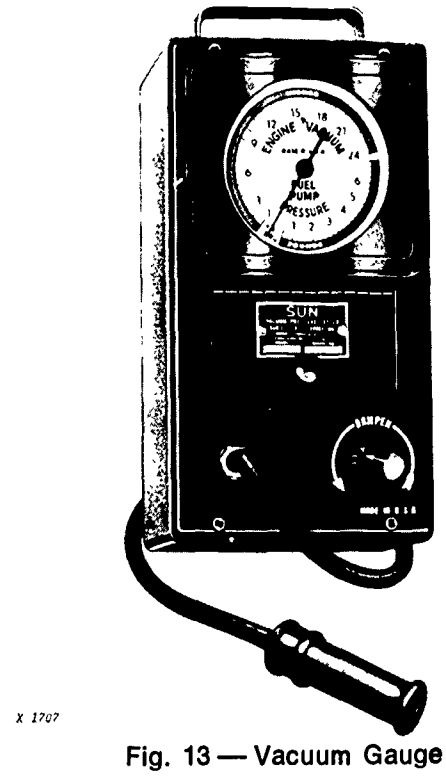

Fig. 13 — Vacuum Gauge

A vacuum gauge, calibrated in inches of mercury, will help determine the condition of an engine. Various malfunctions can be identified by how they cause the gauge to react. The gauge shown in Fig. 13 has an auxiliary scale to check fuel pump pressure.

EXHAUST SMOKE ANALYZER

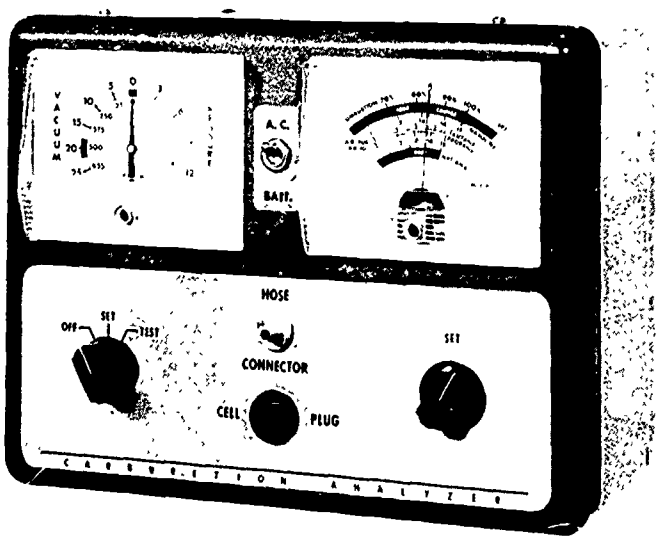

Fig. 14 — Exhaust Smoke Analyzer

An exhaust analyzer is used to check carburetor performance, combustion efficiency, and air-fuel ratio. The model shown in Fig. 14 includes a vacuum gauge.

IGNITION COIL AND CONDENSER METER

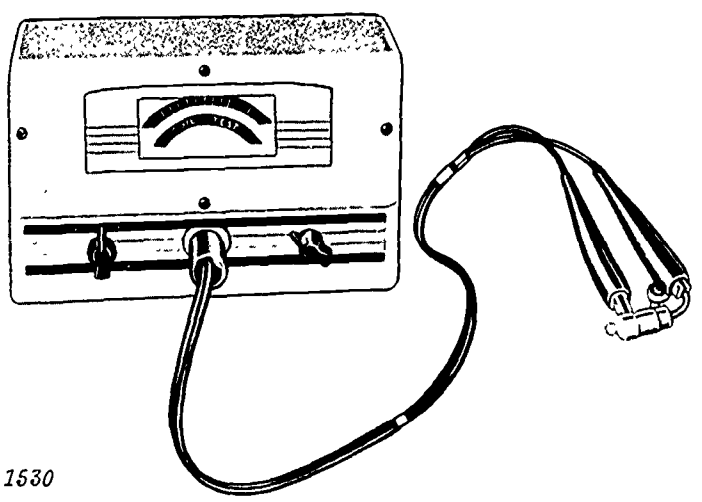

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Fig. 15 — Ignition Coil and Condenser Meter

This combination tester checks the condition of the coil and condenser in the ignition system.

DISTRIBUTOR TESTER

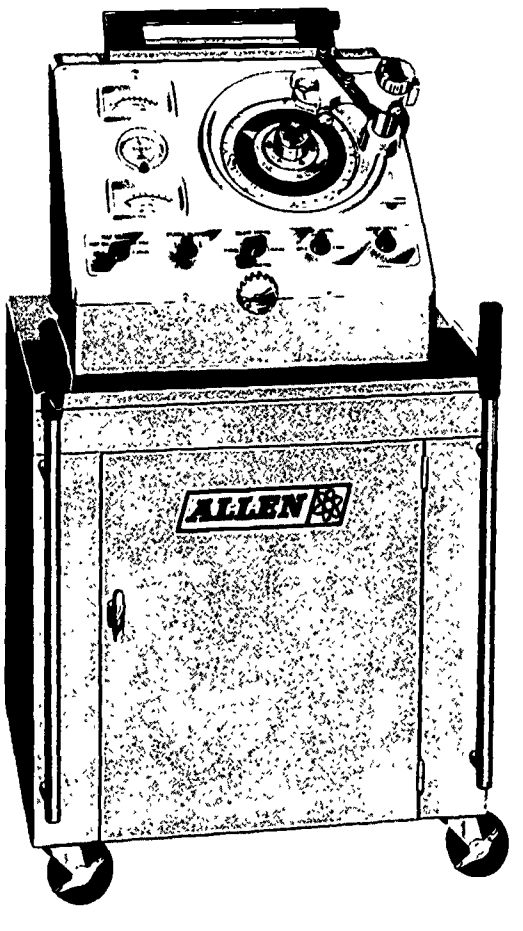

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Fig. 16 — Distributor Tester

The all-purpose distributor tester shown in Fig. 16 will test:

- **Centrifugal advance**
- **Vacuum advance**
- **Cam dwell angle**
- **Variations in cam lobes**
- **Breaker point contact resistance**
- **Breaker point synchronization**
- **Breaker point operation**
- **Breaker arm spring tension**
- **Vacuum chamber condition**
- **Distributor shorts**
- **Excessive wear**
- **Distributor high-speed performance**

These testers are also known as "synchrographs." Bench models of the tester are also available.

ENGINE ANALYZER (Spark-Ignition)

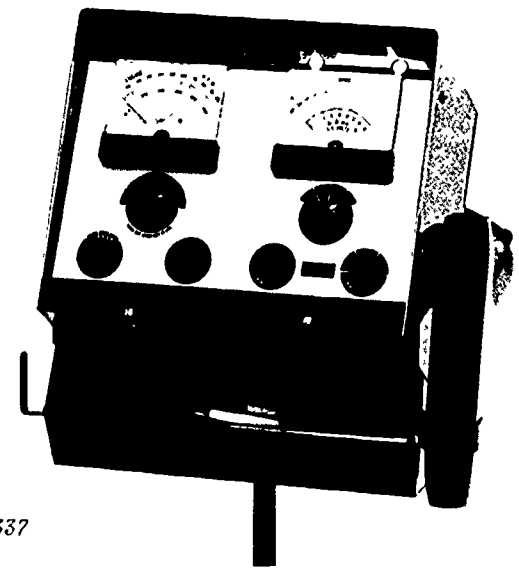

Fig. 17 — Spark-Ignition Engine Analyzer

The spark-ignition engine analyzer can be used to test the entire ignition system:

- **Point resistance**
- **Cam angle**
- **Basic timing**
- **Generator voltage**
- **Starting motor voltage**
- **Mechanical condition of distributor**

SPARK PLUG TESTER

Use this tester to check the condition of spark plugs. Most of these testers are also equipped to clean the plugs.

SPARK PLUG GAP GAUGE

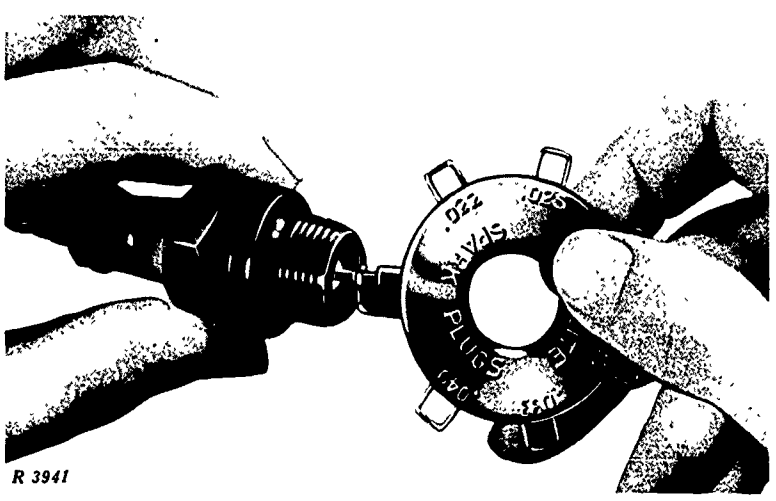

Fig. 18 — Spark Plug Gap Gauge

Use a spark plug gap gauge to check and set the gap between spark plug electrodes. A plug can't do a good job unless it is set to exact engine specifications.

POWER TIMING LIGHT

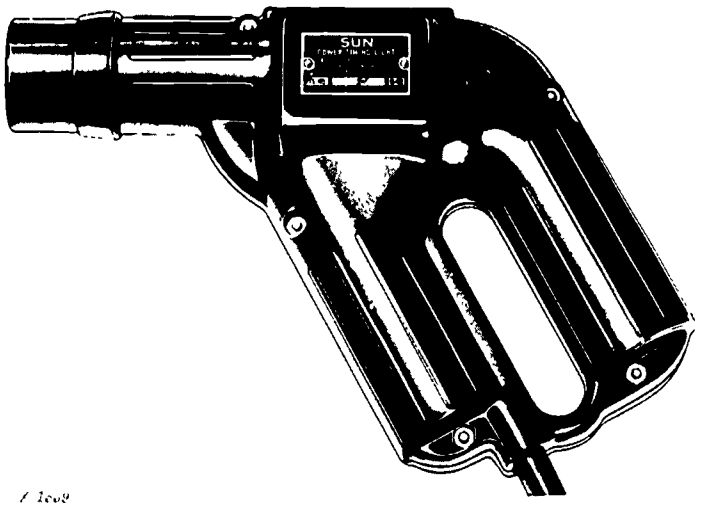

Fig. 19 — Power Timing Light

Use the power timing light to check the ignition timing while the engine is running.

BATTERY HYDROMETER

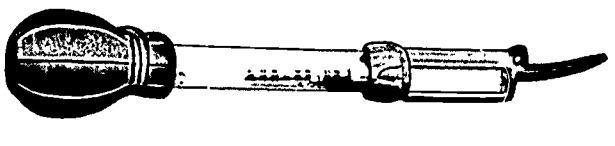

Fig. 20 — Battery Hydrometer

Use the hydrometer to check the specific gravity of the battery. All good hydrometers have a thermometer built in.

NOTE: Other electrical tools are listed in the FOS manual on "Electrical Systems."

OIL PRESSURE GAUGE

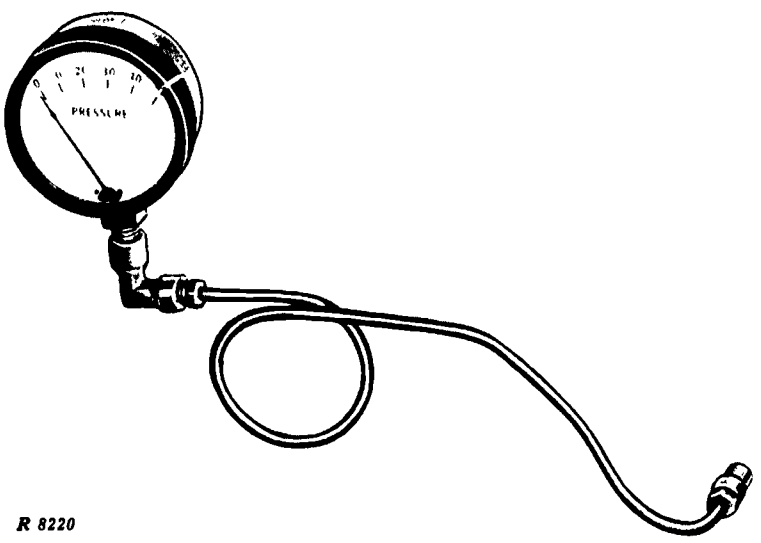

Fig. 21 — Oil Pressure Gauge

As most engine lubricating systems now use an oil pressure indicating light, an oil pressure gauge is required to check the system pressure. A typical gauge with fittings is shown in Fig. 21.

THERMOSTAT TESTER

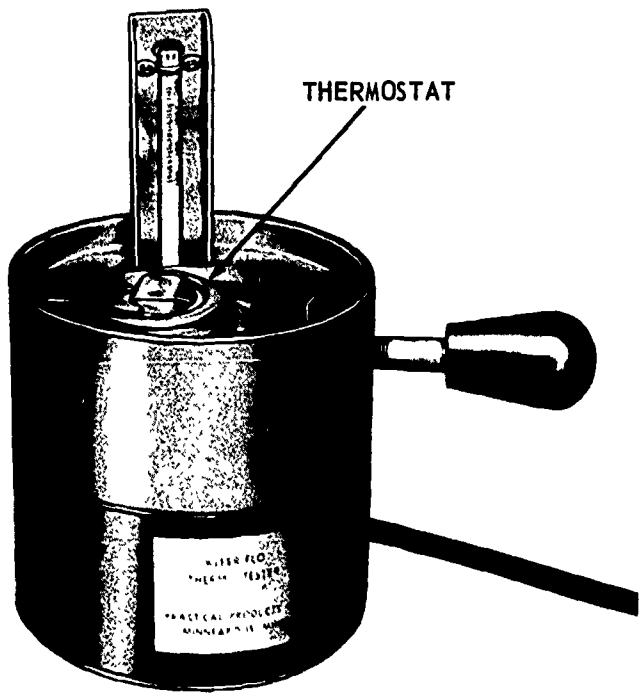

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Fig. 22 — Thermostat Tester

A thermostat tester is used to check the temperature at which a thermostat valve starts to open. This is an important check because the proper engine operating temperature is maintained by the thermostat.

RADIATOR AND CAP TESTER

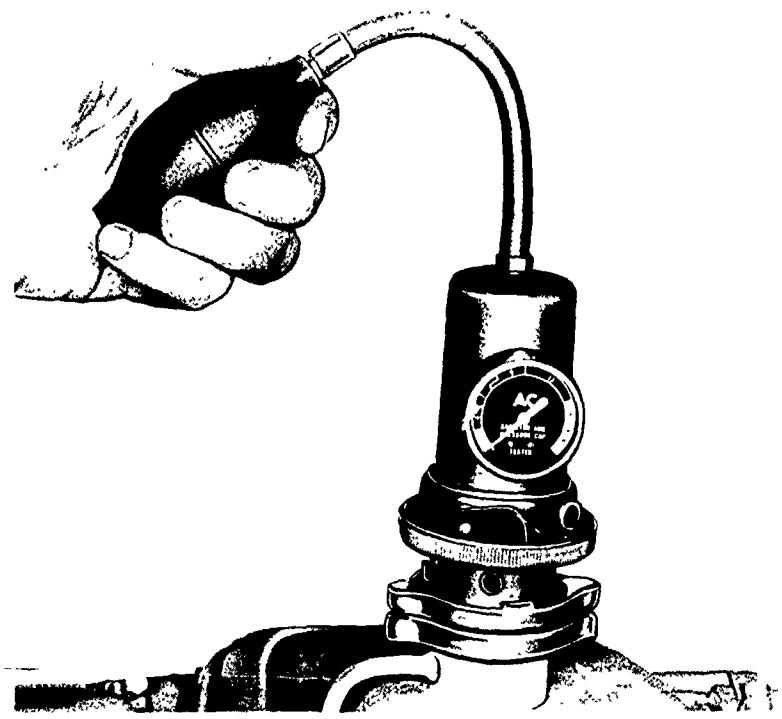

Fig. 23 — Radiator and Cap Tester

This tester is used to check the radiator and radiator cap for leaks and for correct opening pressure. An efficient pressure cooling system must be free from leaks. In Fig. 23, the tester is being used to check the radiator cap.

SERVICING TOOLS

After the engine is tested and diagnosed, service it using the proper tools. Here is a list of the major ones.

VALVE REFACER

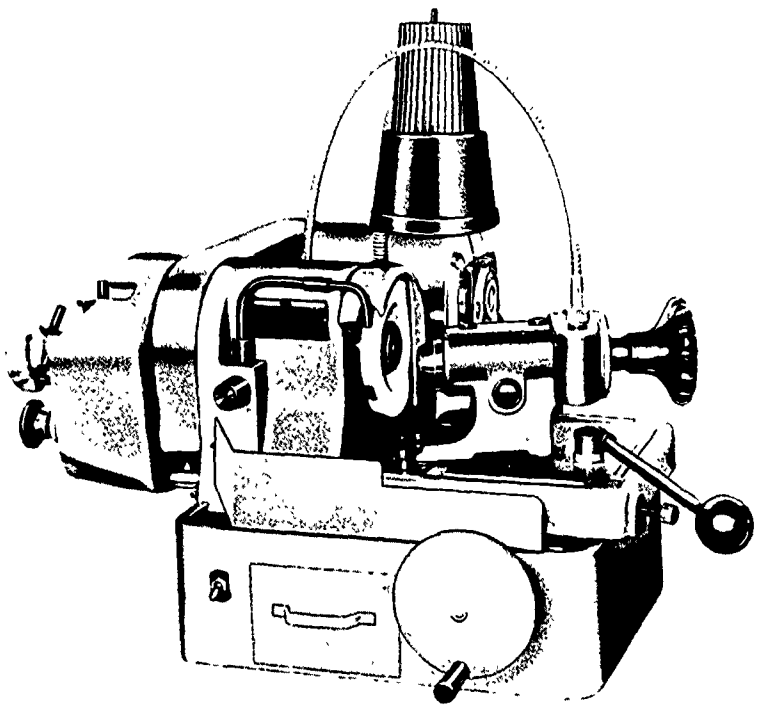

Fig. 24 — Valve Refacer

A valve refacer is used to grind an exact angle on the face of a valve. The accuracy of this machine is critical as the angle of the valve face must match the angle of the valve seat.

VALVE SEAT GRINDER

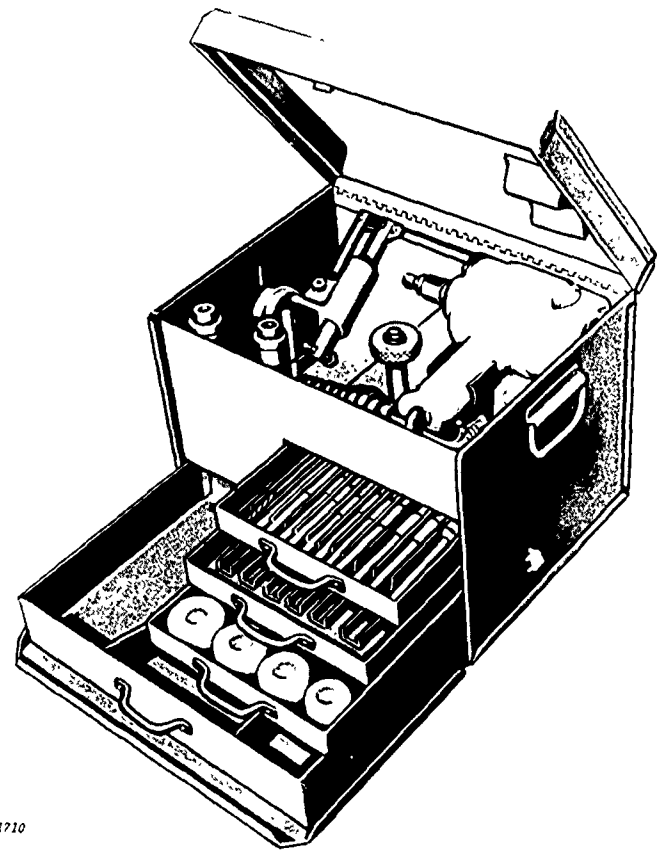

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Fig. 25 — Valve Seat Grinder

The valve seat grinder (Fig. 25) is used to reseat the valves. Both rough and finish grinding stones are required.

VALVE SPRING COMPRESSOR

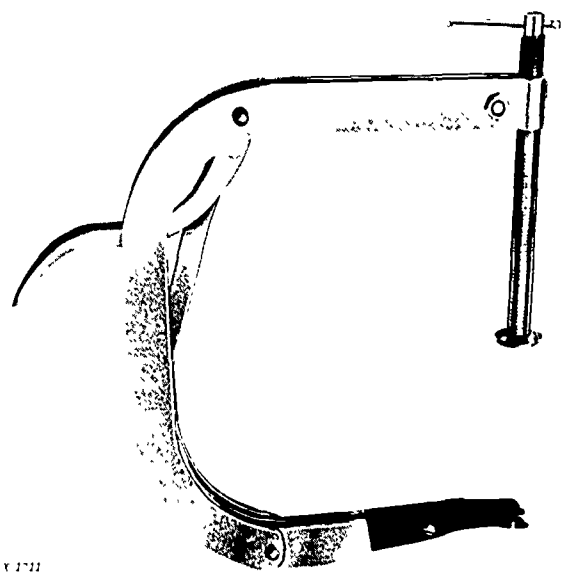

Fig. 26 — Valve Spring Compressor

This tool is used to compress the spring when removing or installing a valve. Various types of spring compressors are available.

VALVE GUIDE REAMER

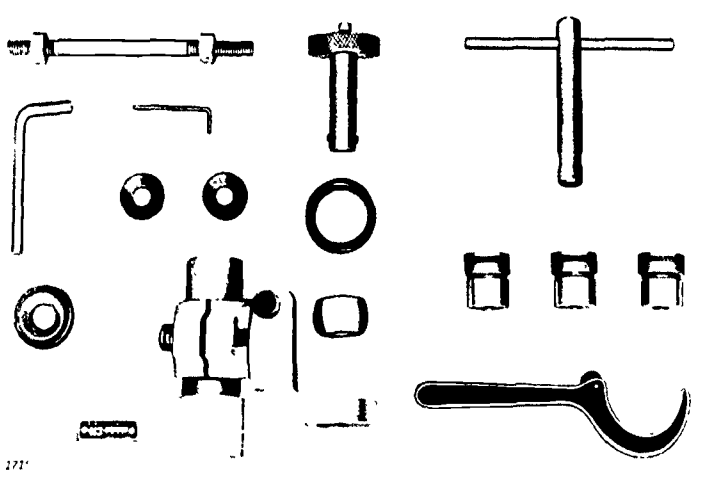

Fig. 27 — Valve Guide Reamer

Use a valve guide reamer to ream out old guides so that new guides can be used. This is also an ideal tool for cleaning carbon from guides.

VALVE GUIDE KNURLING TOOL

A worn valve guide can be re-sized with a valve guide knurling tool. This tool upsets the metal from the sidewalls toward the center of the bore. The bore is then reamed to accept a standard valve.

CYLINDER RIDGE REAMER

Fig. 28 — Cylinder Ridge Reamer

Use a cylinder ridge reamer to remove the ridges found at the end of the ring travel at the top of a cylinder or liner. Pistons can then be easily and safely removed.

CYLINDER LINER PULLER-INSTALLER

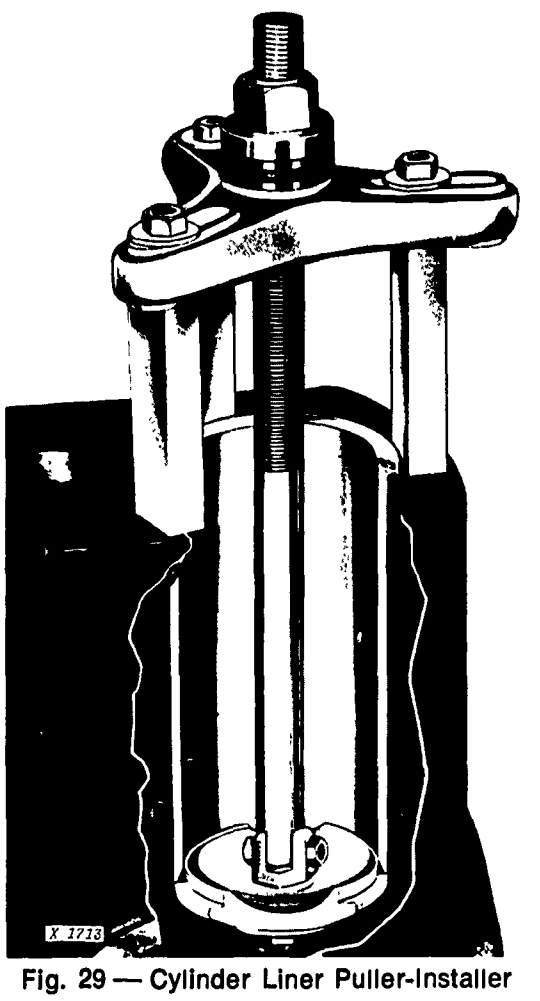

Fig. 29 — Cylinder Liner Puller-Installer

Removal and installation of cylinder liners or sleeves is easier and quicker with a puller-installer (Fig. 29).

Both hydraulic and manual models are available. A great variety of engines can be serviced by using different adapter plates.

CYLINDER REBORING BAR

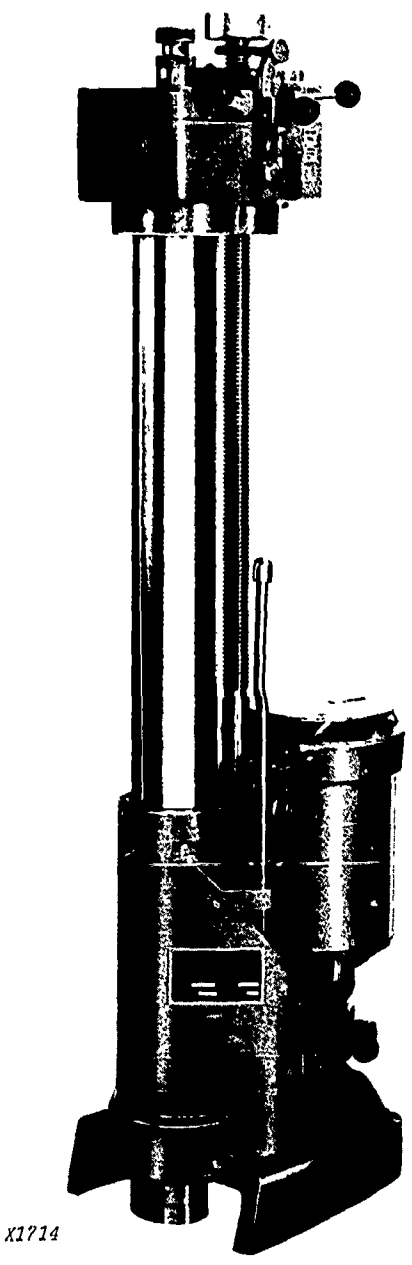

Fig. 30 — Cylinder Reboring Bar

A reboring bar is used to machine the cylinders of large engines which have integral cylinders.

This boring operation is necessary if oversize pistons are to be used.

A typical reboring machine is shown in Fig. 30.

CYLINDER DEGLAZER

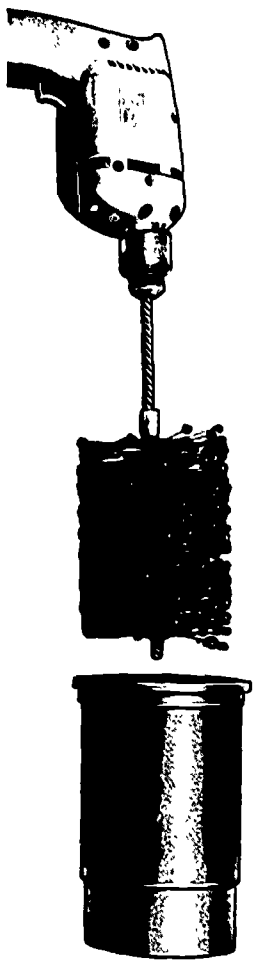

Fig. 31 — Cylinder Deglazer

Use a cylinder deglazer to deglaze and finish the cylinder or cylinder liner bore. Stone, pad, and brush type deglazers are available for use with an electric drill. The brush type shown in Fig. 31 does an excellent job.

PISTON RING GROOVE CUTTING TOOL

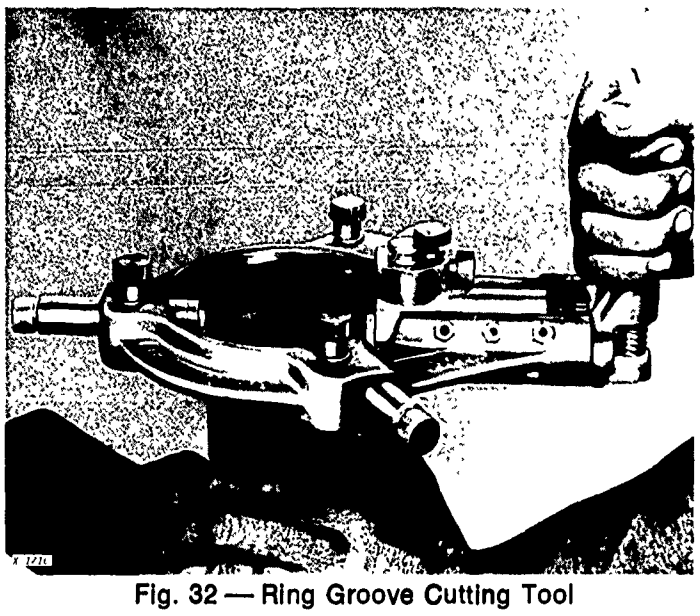

Fig. 32 — Ring Groove Cutting Tool

Worn piston ring grooves on some pistons can be machined with a ring groove cutting tool. New standard width rings can then be used with flat steel spacers.

PISTON RING GROOVE CLEANING MACHINE

Glass bead cleaning has proven successful in cleaning piston ring grooves. The machine uses air blasting with glass beads and avoids scratching, as with hand scraping. Chemical soaking with a recommended piston cleaner is another good way to clean pistons.

PISTON KNURLING TOOL (Automotive Engines)

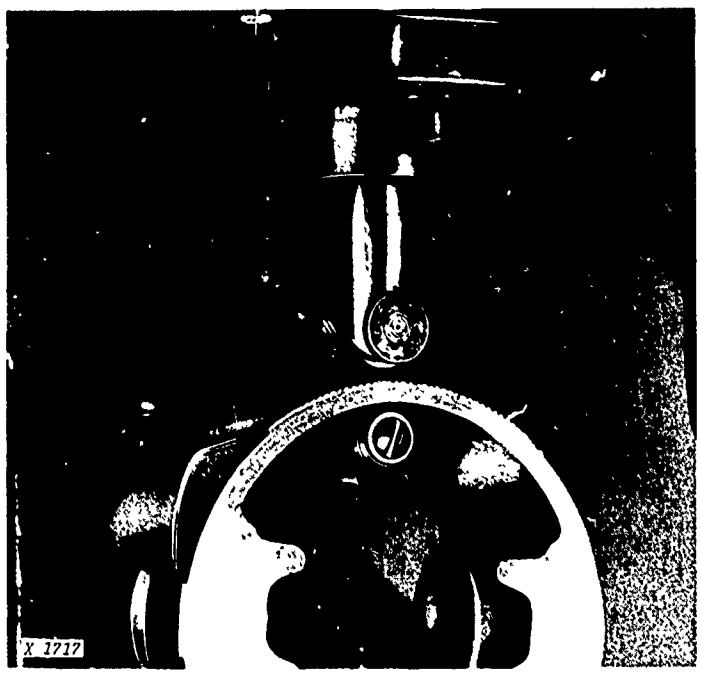

Fig. 33 — Piston Knurling Tool (Automotive Engines)

A piston knurling tool is used to resize automotive pistons. This tool increases the diameter of a piston by displacing the metal of the skirt thrust faces.

PISTON RING EXPANDER

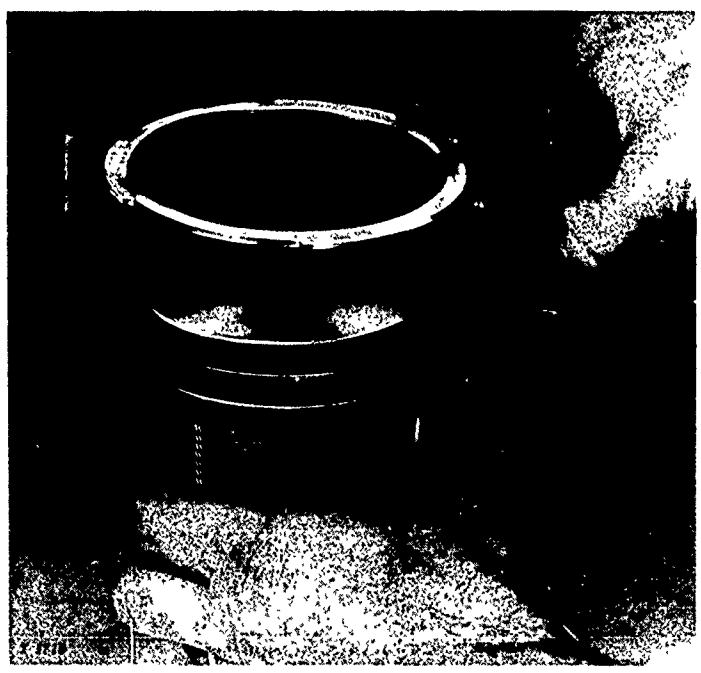

Fig. 34 — Piston Ring Expander

Use a piston ring expander to remove and install piston rings without damaging them. The expander should limit the ring opening so that rings are not stretched or broken.

PISTON RING COMPRESSOR

Fig. 35 — Piston Ring Compressor

Use a piston ring compressor to compress the rings when installing pistons into the cylinders. This prevents breaking the rings.

PISTON AND ROD ALIGNING TOOL

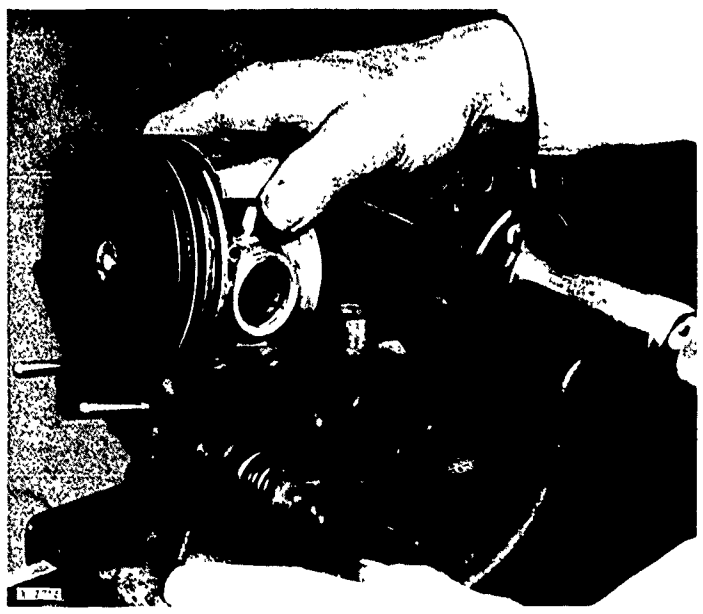

Fig. 36 — Piston and Rod Aligning Tool

A piston and rod aligning tool is used to check the piston and connecting rod alignment. Bending bars and clamps are provided to correct any bend, twist, or offset in the rod.

CARBURETOR SERVICE TOOLS (Spark-Ignition Engines)

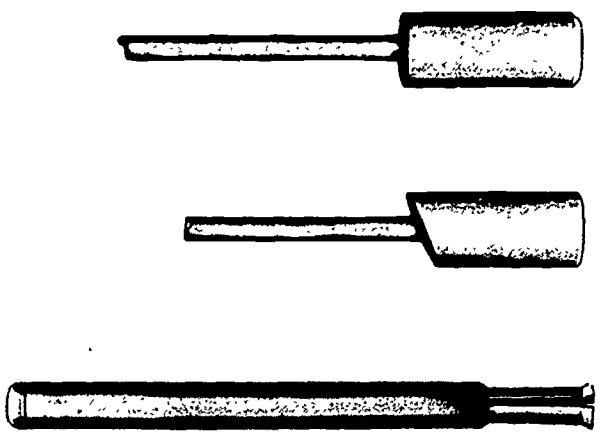

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Fig. 37 — Carburetor Service Tools

Special tools are available to service most gasoline and LP-gas carburetors. Tools are usually designed for one particular carburetor, and some carburetors require more tools than others.

INJECTION NOZZLE REMOVAL TOOLS (Diesel)

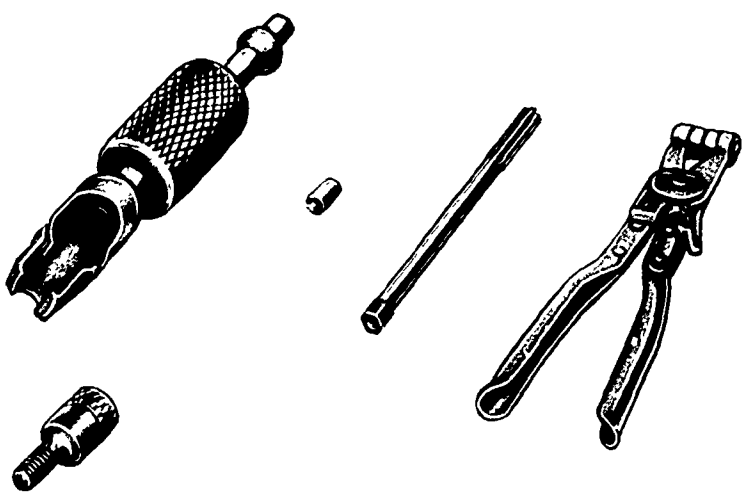

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Fig. 38 — Injection Nozzle Removal Tools (Diesel)

Removal and installation kits are available for some injection nozzles. A typical kit includes hose clamp pliers, nozzle puller, bore cleaning tool, and a guide.

INJECTION NOZZLE CLEANING KIT (Diesel)

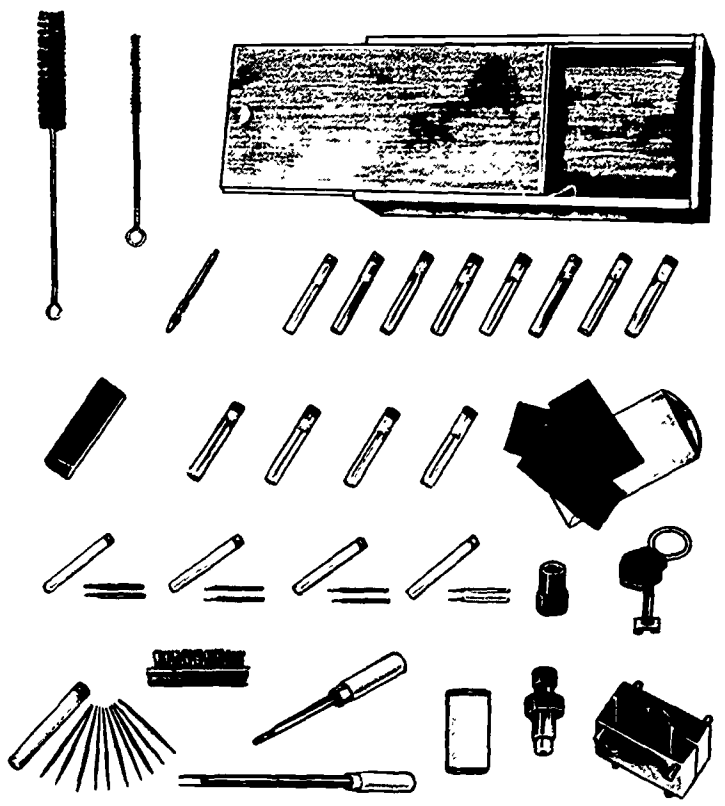

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Fig. 39 — Injection Nozzle Cleaning Kit (Diesel)

Cleaning kits are usually designed to service just one particular make of nozzle. These kits contain such items as cleaning wires, brushes, drills, and lapping compounds.

X 1723

Fig. 40 — Special Tools For Each Engine Are Also Needed To Completely Equip The Service Shop

SUMMARY

Most of the tools we have listed can be used for any engine. However, there is another category of tools that we have not covered—the **Special Tools** designed for each engine.

Be sure that your shop has all the special tools needed to service the models of engines you normally work on. These tools are listed in the Technical Manual for each engine.

The tools we have shown in this chapter are basic to almost all engines. Some are simple tools, others complex testers. Yet each one, regardless of size or cost, is designed to make your job easier and faster.

TEST YOURSELF

QUESTIONS

1. What are the two major types of engine tools?
2. Which type of tool is normally used first?
3. What other category of tools is not covered in this chapter?

ANSWERS

1. *Testing* tools and *servicing* tools.
2. *Testing* tools, which locate the trouble which the servicing tools are then used to help correct.
3. *Special tools* designed for servicing each model of engine.

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DIAGNOSIS AND TESTING OF ENGINES / CHAPTER 11

INTRODUCTION

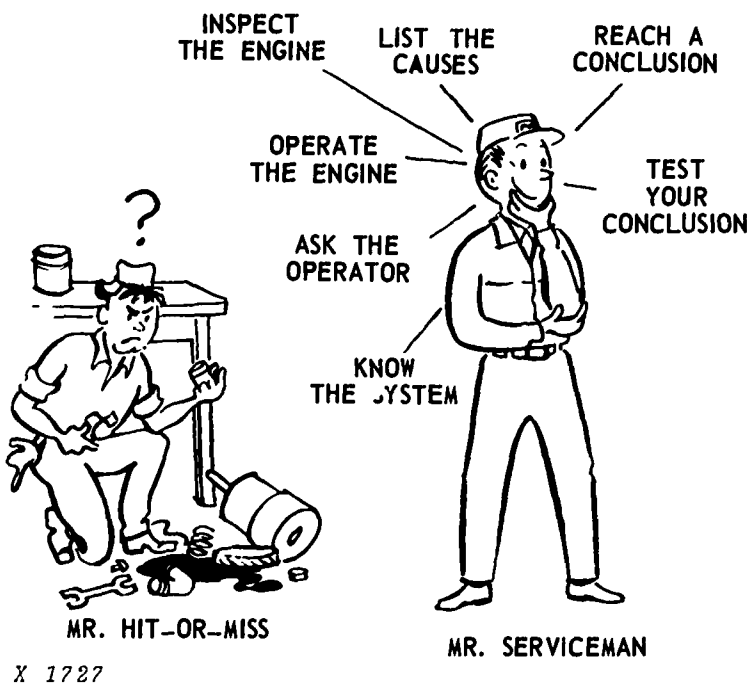

Fig. 1 — Which Would You Rather Be?

Mr. Hit-or-Miss or Mr. Serviceman—which would you rather be? Both have the title of Serviceman but don't be fooled by that.

Mr. Hit-or-Miss is a parts exchanger who dives into an engine and starts replacing parts helter-skelter until he finds the trouble—*maybe*—after wasting a lot of the customer's time and money.

Mr. Serviceman starts out by using his brain. He gets all the facts and examines them until he has pinpointed the trouble. Then he checks out his diagnosis by testing it and *only then* does he start replacing parts.

Mr. Hit-or-Miss is fast becoming a man of the past. What dealer can afford to keep him around at today's prices?

With the complex systems of today, diagnosis and testing by Mr. Serviceman is the only way.

SEVEN BASIC STEPS

A good program of diagnosis and testing has seven basic steps:

1. **Know the System**
2. **Ask the Operator**
3. **Inspect the Engine**
4. **Operate the Engine**
5. **List the Possible Causes**
6. **Reach a Conclusion**
7. **Test Your Conclusion**

Let's see what these steps mean.

1. KNOW THE SYSTEM

Fig. 2 — Know The System

In other words, "Do your homework." Study the engine Technical Manuals. Know how the engine works, how it can fail, and the three basic needs—*fuel-air mixture*, *compression*, and *ignition*.

Keep up with the service bulletins. Read them and then file in the proper place. The solution to your problem may be in this month's bulletin.

You can be prepared for any problem by knowing the engine.

2. ASK THE OPERATOR

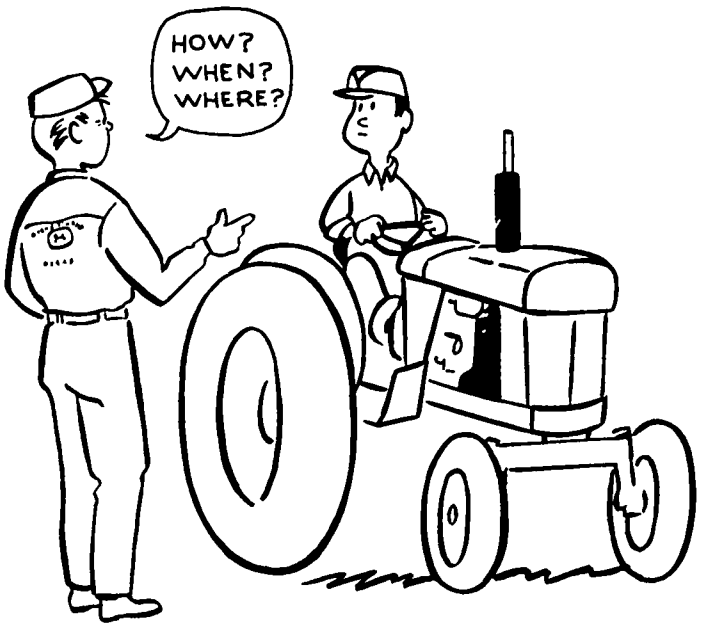

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Fig. 3 — Ask the Operator

A good reporter gets the full story from a witness —the operator.

He can tell you how the engine acted when it started to fail; what was unusual about it.

What work was the engine doing when the trouble occurred? Was the trouble erratic or constant?

What did the operator do after the trouble? Did he attempt to repair it himself?

Ask how the engine is used and when it was serviced. Many problems can be traced to poor maintenance or abuse of the engine.

Be tactful but get the full story from the operator.

3. INSPECT THE ENGINE

Go over the engine and inspect for all the things listed in Fig. 4.

Use your eyes, ears, and nose to spot any "tips" to the trouble.

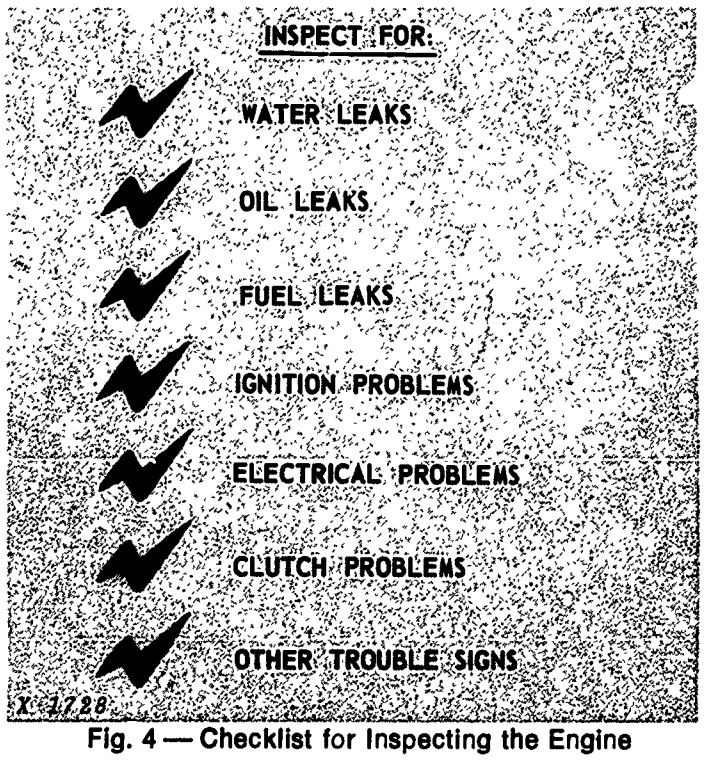

Fig. 4 — Checklist for Inspecting the Engine

- *Look for* **water leaks** *at the radiator, water pump, hoses, and around the cylinder head casket.*

- *Check for* **oil leaks** *at the oil pan, drain plugs, and gaskets. Also inspect around crankshaft bores, oil seals, and tappet cover. Look inside the flywheel housing for signs of oil.*

- *Look for* **fuel leaks** *at the tank, lines, filters, and pumps. Also check for restrictions or evidence of water in the fuel.*

- *Inspect for* **ignition problems** *such as: Loose or bare wires, cracked distributor cap, shorted wires at plugs.*

- *Check for* **electrical problems** *like these: battery corroded, sulfated, or low on water; battery cables loose or corroded; low charge in battery.*

- *Inspect for* **clutch problems** *which might affect the engine. Free travel should be adequate.*

- *Look for* **other trouble signs** *which could lead to future problems if not corrected early.*

In general, look for anything unusual. *Keep a list of all the trouble signs.*

4. OPERATE THE ENGINE

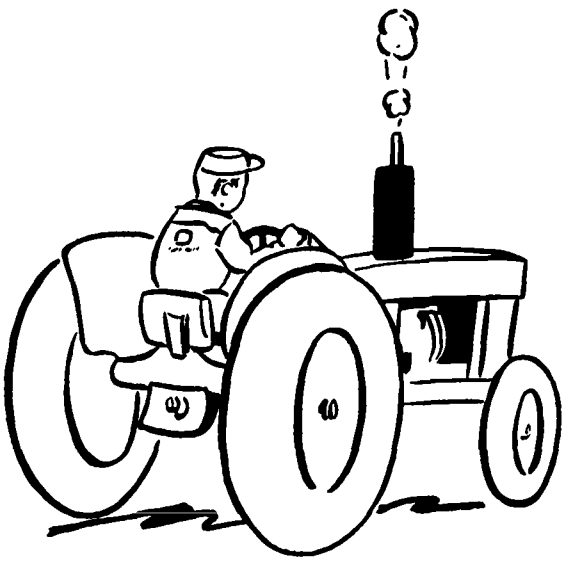

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Fig. 5 — Operate The Engine

If the engine can be run, start it and warm it up. Then run it through its paces. Don't completely trust the operator's story—check it yourself.

Test the engine on a dynamometer. This is the only way to get a full picture of the engine's condition. For details, see "Testing The Engine."

If a dynamometer is not available, look, smell, and listen for engine problems:

- *Are the gauges reading normal?*
- *Hear any funny sounds? Where? At what speeds?*
- *Smell anything? Any signs of unusual exhaust smoke? Are the breathers smoking?*
- *How do the engine controls work?*
- *How is the power under load?*
- *Does the engine idle okay?*

Use your common sense to find out how the engine is operating.

5. LIST THE POSSIBLE CAUSES

Now you are ready to make a list of the possible causes of the engine's troubles.

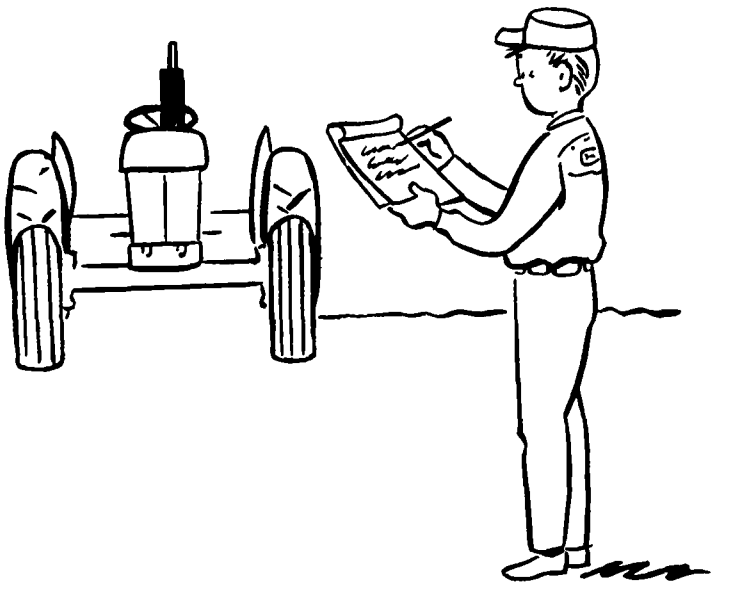

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Fig. 6 — List The Possible Causes

What were the signs you discovered while inspecting and operating the engine?

- *Did the engine lack power?*
- *Any smoke from the crankcase vent?*
- *Did the engine run too hot or too cold?*
- *How was th oil pressure?*

Which of the signs tell you the most likely cause, which is second, etc.?

Are there any other possibilities? (One failure often leads to another.)

6. REACH A CONCLUSION

Look over your list of possible causes and decide which are most likely and which are easiest to verify.

Use the Trouble Shooting Charts at the end of this chapter as a guide.

Reach your decision on the leading causes and plan to check them first—after making the easy checks.

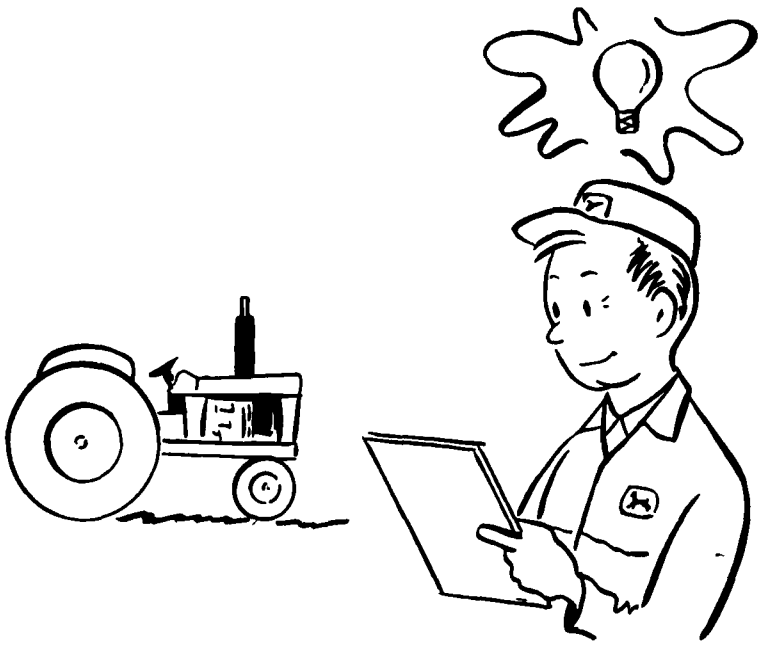

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Fig. 7 — Reach A Conclusion

7. TEST YOUR CONCLUSION

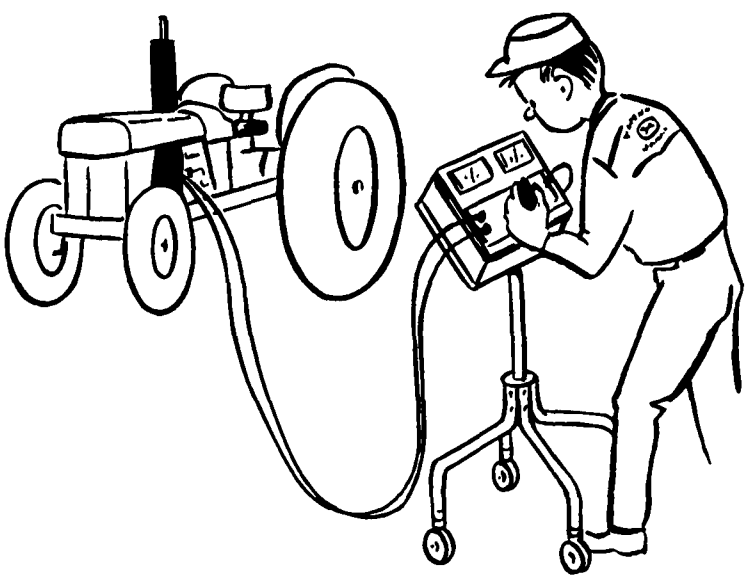

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Fig. 8 — Test Your Conclusion

Before you start repairing the system, test your conclusions to see if they are correct.

Many of the items on your list can be verified without further testing.

Maybe you can isolate the problem to one system of the engine—lubrication, cooling, etc.

But the location within the system may be harder to find. This is where testing tools can help.

The next part of this chapter will tell how to test the engine and locate failures.

But first let's repeat the seven rules for good trouble shooting:

1. **Know the System**
2. **Ask the Operator**
3. **Inspect the Engine**
4. **Operate the Engine**
5. **List the Possible Causes**
6. **Reach a Conclusion**
7. **Test Your Conclusion**

TESTING THE ENGINE

The use of engine test equipment is most effective once the failure has been isolated to one system or area of the engine.

Chapter 10 lists all the testing tools needed for normal engine trouble shooting. Other chapters of this manual show how to use most of this equipment.

DYNAMOMETER TEST

A complete dynamometer test is the best way to trouble shoot the engine.

Remember, however, the engine must be reasonably well-tuned to pass the dynamometer tests.

If the engine was tested on a dynamometer, the following tests should have been made and the results listed:

1. *Engine horsepower*
2. *Exhaust smoke analysis*
3. *Fuel consumption*
4. *Crankcase blow-by*
5. *Air cleaner restriction*
6. *Oil pressure*
7. *Battery condition*
8. *Alternator or generator output*
9. *Clutch operation*

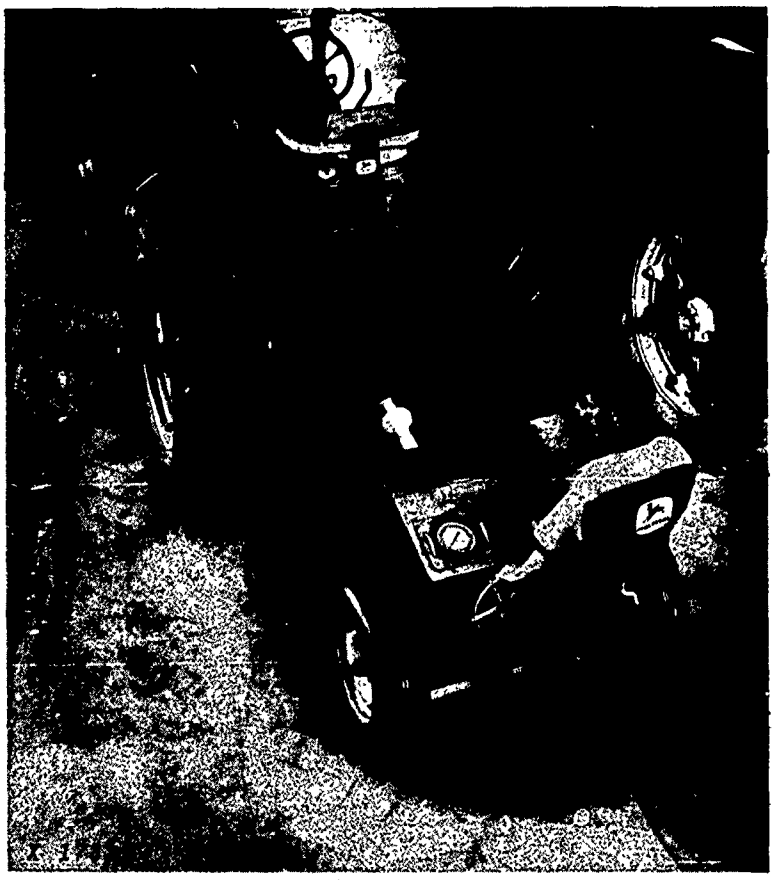

Fig. 9 — Dynamometer Test

Refer to Chapter 10 for the testing equipment used in the above tests. Chapter 12 gives a general guide to the tests.

Compare the test results with the correct readings given in the engine Technical Manual.

ENGINE HORSEPOWER

Horsepower is the fundamental measure of engine efficiency.

Three basic things are needed for the engine to produce horsepower:

- **Fuel-air mixture**
- **Compression**
- **Ignition**

A good supply of AIR is essential to engine combustion. The air cleaner must be kept clean and the air intake system kept free of restrictions.

There must be a good supply of FUEL. The tank, lines, filters, and pumps must be open and clean.

COMPRESSION must be adequate. Low compression can be from bad valves, leaking head gaskets, or blow-by at the pistons. In a diesel engine, compression is extra vital because the heat of compression rather than a spark is what ignites the fuel.

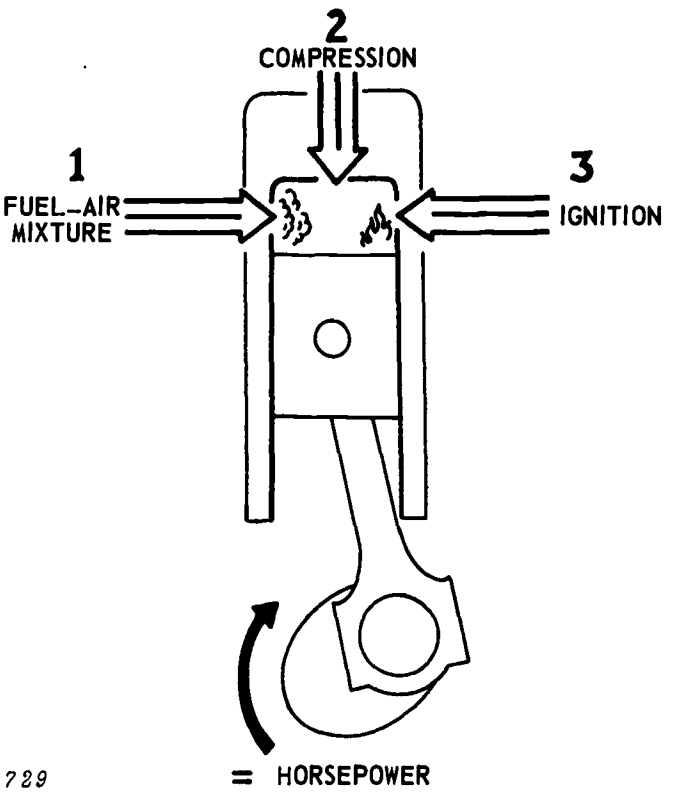

Fig. 10 — Three Basic Things Are Needed To Produce Engine Horsepower

IGNITION must be adequate and properly timed. In spark-ignition engines, the battery and ignition circuit are vital in producing a strong and timely spark for ignition. In diesel engines, the injection pump must be timed properly.

Unless all three—*fuel-air, compression, and ignition*— are doing their job in the right sequence, engine horsepower will be low.

The basic dynamometer test will tell you whether the engine is low on horsepower. Further tests will isolate the cause to one of the three major areas.

MECHANICAL PROBLEMS

Beyond the problems of engine efficiency, there are many *mechanical* things which can cause an engine to fail.

Here are a few of the basic problems and their likely results:

Loose Bearings—can increase oil consumption, create noise, cause eventual failure of bearings and damage to crankshaft.

Worn Valve Guides—can increase oil consumption, eventually cause valves to fail.

Worn Pistons and Rings—also increase oil consumption, cause loss of compression and power.

Worn Camshaft Lobes—loss of power because valves open too late and close too early.

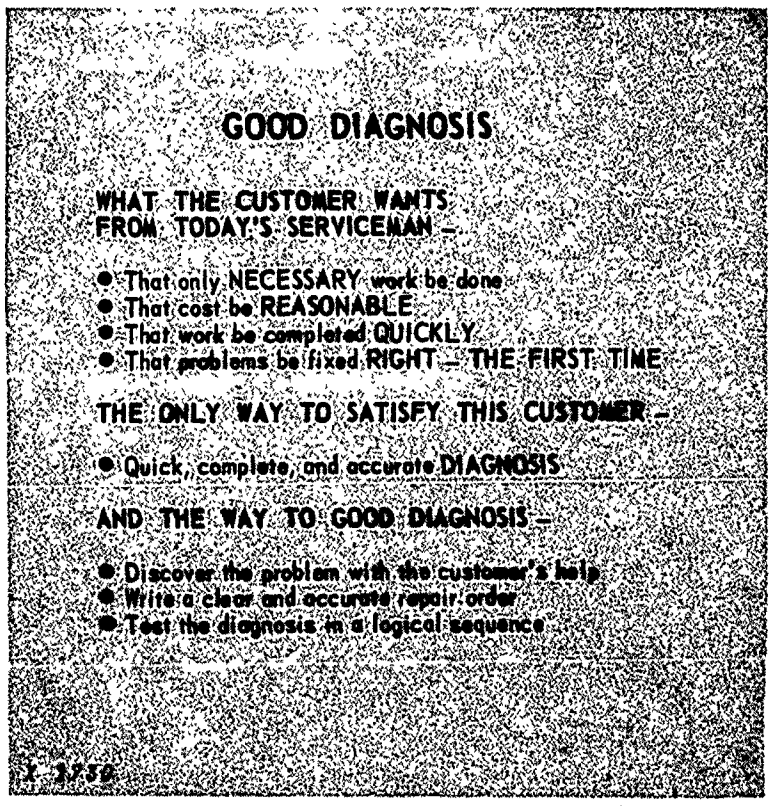

Fig. 11 — The Serviceman's Guide To Good Diagnosis

SUMMARY: TESTING THE ENGINE

The tests we have given you are only basic guidelines.

Once you start testing actual engines, use the engine Technical Manual for detailed tests and test results.

And remember that the best testing tools have no value unless the man at the controls knows how to interpret the results.

TROUBLE SHOOTING CHARTS

Use the charts on the following pages to help in listing all the possible causes of trouble when you diagnose and test an engine.

Once you have located the cause, refer to the chart again for the possible remedy.

Some of the problems are discussed in detail following each chart.

Other chapters of this manual give more details on diagnosing a particular component.

Also use the Technical Manual for each engine for specific tests and specifications.

1. ENGINE HARD TO START OR WILL NOT START

No Fuel or Improper Fuel

Fill tank. If wrong fuel, drain and fill with proper fuel.

Water or Dirt in Fuel or Dirty Filters

Check out fuel supply. Replace or clean filters.

Air in Fuel System (Diesel)

Bleed air from the system.

Low Cranking Speed

Charge or replace battery, or service starter as necessary.

Poor Timing

Check distributor or injection pump timing.

Defective Coil or Condenser (Spark-Ignition)

Replace coil or condenser.

Pitted or Burned Distributor Points

Clean or replace points.

Cracked or Eroded Distributor Rotor (Spark-Ignition)

Replace rotor.

Distributor Wires Loose or Installed in Wrong Order (Spark-Ignition)

Push wires into sockets. Install in correct firing order.

Defective or Wrong Spark Plugs (Spark-Ignition)

Replace Plugs.

Poor Nozzle Operation (Diesel)

Clean, repair, adjust, or replace.

Liquid Fuel in Lines (LP-Gas)

Always turn on the vapor valve when starting the engine.

Too-Heavy Oil in Air Cleaner (LP-Gas)

Use correct weight of oil.

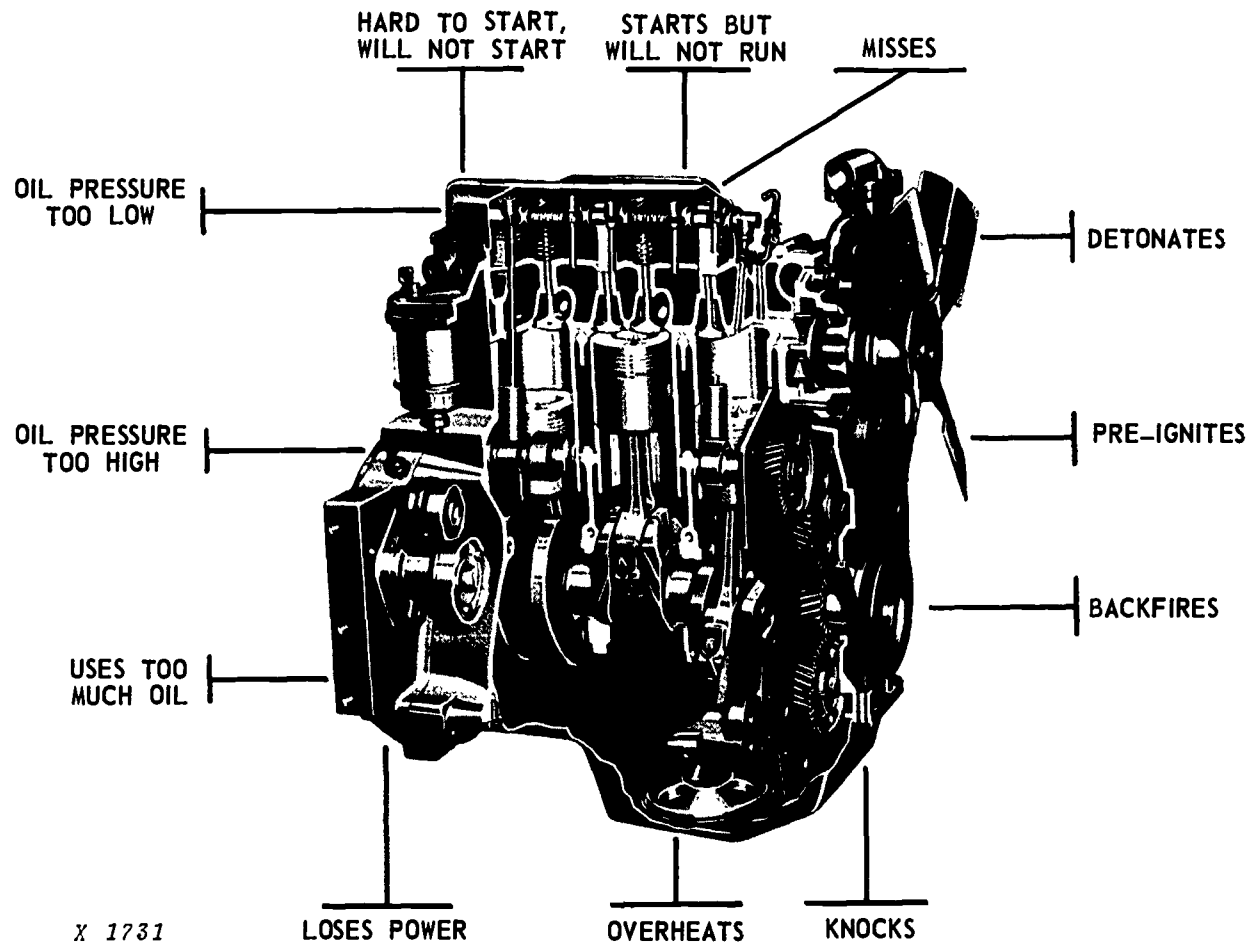

Fig. 12 — The Major Engine Trouble Shooting Problems

Fuel Problems

In *spark-ignition engines,* the **volatility** of the fuel has much to do with the starting ability of the engine.

NOTE: Volatility is what causes the fuel to vaporize for combustion.

Liquid gasoline or LP-gas must be in vapor form to mix with the air when it is taken into the engine.

If the flash point of the fuel is too low, not enough vapor is formed to mix with the air for easy ignition.

NOTE: Flash point is the temperature at which vapor from the fuel will ignite.

In *diesel engines,* since ignition is from the heat of compression, the **flash point** of the fuel affects the ability of the engine to start.

Generally speaking, the lower the grade of diesel fuel, the higher the flash point. This means that as the grade of fuel is lowered, the heat created in the engine must be hotter. This can contribute to hard starting.

Low Cranking Speed

Low cranking speed is a result of 1) low charge in the battery, 2) a defective battery or terminal connection, or 3) binding in the starter or engine.

In spark-ignition engines, when any of these conditions exist, so much of the battery voltage is used by the starter in cranking the engine that the remaining voltage is not sufficient to create an ignition spark.

If, while cranking the engine, the voltage of a 12-volt battery falls below 9 volts, the battery is either defective or needs recharging.

In diesel engines, when the battery is low or defective, the starter cannot turn the engine fast enough to create enough heat within the cylinders to provide ignition.

Also, worn starter bearings can allow the armature to drag on the field poles. This results in low cranking speed and more voltage drop at the battery.

Any binding within the engine will produce the same effect as starter drag.

It is also possible that the battery cables are too small or the terminals are corroded. In this case, the resistance of the cable is too high to carry the amount of current required to crank the engine at the proper speed.

Defective Coil or Condenser (Spark-Ignition)

When either the coil or condenser is defective, not enough spark will be created to start the engine.

Pitted or Burned Distributor Points (Spark-Ignition)

When the distributor points become pitted or burned, their ability to conduct current is impaired. This results in a poor spark from the ignition coil.

Poor Nozzle Operation (Diesel)

The nozzles must be in good operating condition. If they are partially clogged or if the cracking pressure is low, much of the fuel is injected in a solid stream. This will cause hard starting.

Too-Heavy Oil in Air Cleaner (LP-Gas)

Too-heavy oil in the air cleaner restricts the flow of air through the air cleaner, resulting in a choking action at the carburetor. This, in turn, creates a fuel-air mixture in the engine which is too rich to burn.

2. ENGINE STARTS BUT WILL NOT RUN

Fuel Problems—Dirt, Air Restrictions, Or Clogged Filters

Check fuel supply, bleed system (diesel), check for line restrictions, or clean or replace filters and screens.

Carburetor Idle Fuel Needs Adjustment

Adjust correctly.

Defective Coil or Condenser (Spark-Ignition)

Replace.

Defective Ignition Resistor or Key Switch (Spark-Ignition)

Replace resistor or key switch.

Fuel Problems

When the flow of fuel to the engine is restricted, not enough fuel can get to the engine to keep it running. See Group 1 for details.

Ignition Coil and Condenser (Spark-Ignition)

In some instances a coil or condenser will provide a spark to start the engine. Then, after the engine starts, due to a loose connection or internal short, it will not keep on running. Also a coil or condenser may function when cold and then fail when heated.

Defective Ignition Resistor Key Switch (Spark-Ignition)

When the key switch is turned to crank the engine, full battery voltage is placed on the ignition coil for easier starting. When the key switch is released, the ignition current flows through a resistor, limiting the coil voltage to about 6 volts. So, if the resistor is burned out or has a loose connection, the engine will not continue to run when the key switch is released.

3. ENGINE MISSES

Water or Dirt in Fuel

Drain and refill with clean fuel.

Gasoline in Diesel Fuel

Drain and refill with proper fuel.

Dirty Spark Plugs or Faulty Cables (Spark-Ignition)

Clean or replace plugs. Replace cables.

Cracked Distributor Cap (Spark-Ignition)

Replace Cap.

Carburetor Not Adjusted Correctly (Spark-Ignition)

Adjust carburetor.

Air in Fuel System (Diesel)

Bleed the system.

Poor Nozzle Operation (Diesel)

Clean and check nozzle spray pattern.

Faulty Injection Pump (Diesel)

Check and calibrate the fuel injection pump.

Nozzles Not Seated Properly in the Cylinder Head (Diesel)

Reposition nozzles and tighten retaining screws to specified torque.

Gasoline in Diesel Fuel

Gasoline in diesel fuel can cause the engine to miss. The reason is this: The diesel fuel flowing through the nozzle provides lubrication for the nozzle valve. Gasoline does not have this lubricating quality and the valve sticks, causing misfiring. In many cases the nozzle valve will be scored and need replacement.

Air in Fuel System (Diesel)

Air in the diesel fuel system can cause the engine to miss. Fuel cannot be compressed while air can be. Consequently, if there is a bubble of air in the system, the air will compress and no fuel will be injected.

Nozzles Not Seated Properly (Diesel)

It is very important that the nozzles be correctly installed. They should seat squarely on the seating surface and the retaining clamp cap screws or nuts be tightened to the specified torque.

If the nozzle clamp is too loose, the nozzle will leak. This causes a build-up of carbon around the nozzle, making it very difficult to remove. In addition, the escape of burning gases will cause the nozzle to overheat, and the nozzle valve to stick, causing the cylinder to misfire.

4. ENGINE DETONATES (Gasoline)

Wrong Type of Fuel

Use fuel of correct octane.

Detonation of Gasoline Engine

Detonation in an engine is usually recognized by sharp "pinging" in the engine cylinders and erratic firing. The engine appears to be working against itself.

In gasoline engines, detonation is usually caused by the use of fuel with too-low octane rating.

NOTE: The **octane rating** *of a fuel is its ability to avoid detonation or "self ignition". The higher the octane rating, the more the mixture can be compressed without detonation when it burns.*

Detonation is "an explosion with sudden violence". When the compressed fuel mixture in the cylinder is ignited, instead of burning evenly across the combustion chamber, the entire charge literally explodes. This is partially due to the heat of compression. That is to say, when the mixture starts to burn and the pressure starts to rise, the entire charge ignites. This action is very harmful to the engine.

5. ENGINE PRE-IGNITES (Gasoline)

Distributor Timed Too Early

Retime distributor.

Distributor Advance Mechanism Stuck

Free up and test.

Carbon Particles in Cylinder

Remove carbon.

Faulty Spark Plugs or Spark Plug Heat Range Too High

Install proper plugs.

Pre-Ignition Of Gasoline Engines

Pre-ignition is the ignition of the fuel mixture before the proper time. Its effect on the engine is similar to that of detonation.

Pre-ignition can be caused by incandescent particles of carbon in the cylinder which will ignite the mixture as the heat rises due to compression.

If the distributor advance mechanism sticks in the advanced position, at certain engine speeds the spark will occur too early.

Pre-ignition can be caused by spark plugs which are eroded at the electrodes or by plugs with too high a heat range. In either case, the electrodes become red hot and the action is the same as that caused by incandescent carbon particles.

6. ENGINE BACKFIRES (Spark-Ignition)

Spark Plug Cables Installed Wrong

Install in correct firing order.

Carburetor Mixture Too Lean

Adjust carburetor for correct mixture.

Backfiring Of Gasoline And LP-Gas Engines

When the spark plug wires are incorrectly installed, the spark will not occur in the cylinder at the right time. This can cause backfiring.

Engine backfiring can also be caused by a too-lean carburetor mixture. A lean fuel mixture is a slow-burning mixture and may still be burning when the intake valve opens and admits a new charge.

7. ENGINE KNOCKS

Improper Distributor or Injection Pump Timing

Check and time correctly.

Worn Engine Bearings or Bushings

Replace.

Excessive Crankshaft Endplay

Adjust to specification.

Loose Bearing Caps

Tighten caps.

Foreign Matter in the Cylinder

Remove.

Knocking Of Engines

When an engine knocks, there is one of two causes:

1) Mechanical Interference Of Parts. The parts are striking each other due to loose parts, worn bearings, or a loose bolt or other object loose in the cylinder. The remedy is to repair the engine at once.

2) Improper Adjustment Of Timing, Fueling, Or Poor Fuels. If the ignition or injection timing is bad, the engine gets "out of rhythm" and so knocks. Using the wrong fuels can also cause knocking, especially with low-octane gasoline. The remedy is either using proper fuels or readjusting the timing or fuel settings.

8. ENGINE OVERHEATS

Defective Radiator Cap

Install new gasket or replace the cap.

Radiator Fins Bent or Plugged

Straighten fins or clean out dirt.

Defective Thermostat

Replace.

Loss of Coolant

Check for leaks and correct.

Loose Fan Belt

Adjust.

Cooling System Limed Up

Use good scale remover to clean, then flush.

Overloaded Engine

Adjust load.

Faulty Engine Timing

Time distributor or injection pump correctly.

Distributor Advance Mechanism Stuck (Spark-Ignition)

Free up and lubricate.

Engine Low on Oil

Add oil to the proper level or change oil.

Wrong Type of Fuel

Use correct fuel.

Overheating Of Engines

RADIATOR CAP

The radiator cap must be in good condition so that it does not leak. The pressure cap allows pressure to build up in the cooling system and this allows the boiling point of the coolant to rise.

Using the pressure cap thus prevents the coolant from boiling away in hot weather or during heavy loads.

RADIATOR

Foreign matter between the fins of the radiator core or bent fins can cause overheating.

THERMOSTAT

If the thermostat develops a leak or sticks closed, it stops the circulation of coolant through the radiator core. This will cause overheating.

ENGINE OVERLOADED

Overloading an engine often causes the peak firing pressure in the cylinders to be too high, creating more heat. The overload causes the engine speed to slow and the piston does not move in the cylinder as fast as it does under normal load. This can also contribute to overheating.

FAULTY ENGINE TIMING

When the ignition is timed too late, a normal engine load becomes an overload. This is because the engine does not develop as much power. Even if the load is light, the engine may still run hot, due to the late firing.

DISTRIBUTOR ADVANCE MECHANISM STUCK (Spark-Ignition)

If the distributor advance mechanism should stick in the retarded position, it has the same effect on the operation of the engine as late timing.

ENGINE LOW ON OIL

One of the functions of the oil in the engine is to help carry off the heat created in the cylinders. If the oil level is too low, if the oil pressure is too low, or even if the oil is too heavy, not enough oil will be circulated to carry off the heat of combustion. This can lead to overheating.

WRONG TYPE OF FUEL

Using the wrong type of fuel in an engine can cause overheating. As the fuel detonates or does not burn efficiently, loss of engine power also results.

9. LACK OF POWER

Air Cleaner Dirty or Otherwise Obstructed

Clean and check main element for restriction.

Restricted Air Flow in Intake System

Clean intake hoses and tubes.

Restriction in Fuel Lines or Filters

Disconnect line at carburetor or injection pump and check it. Remove any restriction. Also check filters.

Wrong Type of Fuel

Use correct type.

Frost at Fuel-Lock Strainer (LP-Gas)

Clean strainer.

Governor Binds (Spark-Ignition)

Free up and lubricate. Adjust if necessary.

Valve Failure

Recondition.

Incorrect Valve Tappet Clearance

Adjust.

Low Engine Speed

Adjust.

Crankcase Oil Too Heavy

Use correct weight of oil.

Low Compression

Check for leaky valves or worn or stuck piston rings. Replace or recondition.

Improper Hitching or Belting of Machine

Adjust or correct as required.

Incorrect Timing

Check and time correctly.

Faulty Carburetor, Float Level Too Low, Plugged Orifices, or Wrong Fuel Adjustment

Clean and repair.

Wrong Spark Plugs (Spark-Ignition)

Replace with proper plugs.

Distributor Points Burned (Spark-Ignition)

Replace and adjust.

Incorrect Camshaft Timing

Retime.

Low Operating Temperature

Check thermostat.

Faulty Injection Pump Delivery (Diesel)

Service pump.

Lack Of Power

AIR CLEANER

If the air cleaner is dirty or the air passages obstructed the engine will not receive enough air to develop its horsepower.

FUEL LINES

When the flow of fuel through the fuel lines is restricted the engine cannot get enough fuel to develop its power.

FROST AT FUEL-LOCK STRAINER (LP-GAS)

Frost at the fuel-lock strainer restricts the flow of gas, resulting in a power loss.

GOVERNOR BINDS (Spark-Ignition)

When there is binding in the governor, the action will be slow. Engine speed is pulled down before the governor can react to increase the fuel supply to carry the load.

WRONG TYPE OF FUEL

See Group 4 above.

LOW COMPRESSION

Leaky valves or blow-by at the pistons result in low compression. As a result, the burning of fuel in the cylinders cannot produce enough pressure to develop full power.

VALVE CLEARANCE

Valve adjustment can affect the compression pressure. If the adjustment is too tight the valve cannot entirely close, allowing leakage.

If the valve clearance is too great the valve opens late and closes early. This results in it not being open long enough for complete intake of air or air-fuel mixture of complete expulsion of exhaust gases.

TOO-HEAVY CRANKCASE OIL

Many times, when an engine is consuming too much oil, the operator will change to a heavier weight. This can affect the power output of the engine due to the increased drag on the moving parts.

IMPROPER HITCHING OR BELTING

Improper hitching or adjustment of equipment behind a tractor or other machine can result in an apparent loss of engine power. Actually the improper hitching really results in increasing the load on the machine.

Raising or lowering the hitch point can change this load.

For example, by correctly hitching a tool to the drawbar, a tractor may be able to operate in a higher transmission gear range.

Improper belting can also reduce the ability of the engine to pull its load.

If the driven pulley is too large, the engine can handle the load easily enough but the driven machine speed will be too slow.

If the driven pulley is too small, the machine speed will be too fast and much more engine power will be required to operate it.

10. ENGINE USES TOO MUCH OIL

Crankcase Oil Too Light

Use correct weight of oil.

Worn Pistons and Rings

Recondition.

Worn Valve Guides or Stem Oil Seals

Replace.

Loose Connecting Rod Bearings

Replace bearings.

External Oil Leaks

Eliminate leaks.

Internal Oil Leaks

Locate and correct.

Oil Pressure Too High

Adjust to specifications.

Engine Speed Too High

Adjust to specifications.

Crankcase Ventilator Pump Not Working

Repair or replace.

Restricted Air Intake or Breather

Remove the restriction.

Restricted Oil Return Passage From Valve Cover

Remove the restriction.

Engine Using Too Much Oil

PISTONS AND RINGS

Worn pistons and rings can cause an engine to use too much oil. Reconditioning is normally required.

However, many other conditions can cause excessive oil consumption, as given below.

VALVE GUIDES

Worn valve guides can be a cause of oil consumption. Every time the piston goes down in the cylinder it creates a partial vacuum. To equalize this vacuum, air tries to enter the cylinder. If the valve guides are worn, this leaves an opening for the air to enter. As it enters it carries oil from around the valve stem with it.

VALVE STEM OIL SEALS

Some engines are equipped with valve stem oil seals, usually on the intake valves. These seals prevent loss of oil at this point. If worn, these seals can make the engine use oil.

LOOSE CONNECTING ROD BEARINGS

When the bearings are worn, more oil is pumped through them. As a result, more oil than needed is thrown into the cylinder from the crankshaft. The extra oil escapes past the piston and rings.

Much the same action occurs when the engine oil pressure is too high.

LEAKAGE

External leaks can usually be seen and corrected. These include leaks at the crankshaft rear bearing, crankshaft front oil seal, valve cover gasket, and cylinder head gasket.

Internal leaks are not so easily detected. Generally, the engine must be disassembled while carefully checking points at which leakage could occur.

When an internal leak is causing oil consumption, it will usually be found that the leak is located so that the escaping oil strikes the crankshaft. This results in too much oil being thrown into the cylinders.

CRANKCASE VENTILATING PUMP

Most ventilating pumps draw in air, mix it with oil and force the mixture into the engine crankcase, pushing out vapors.

When the pump fails, the oil is drawn into the air intake and then on into the engine.

To find if the ventilating pump is at fault, remove the air intake pipe. If the pump is defective, the inside of the pipe will be oily.

Another method of checking the pump is to remove the pipe between the pump and the air intake pipe. Be sure to cap both openings.

Then fill the engine crankcase with a measured amount of oil and operate the engine under load for four or five hours. Drain the oil and measure it. If too much oil is lost, the engine is using oil and the vent pump is not the cause.

RESTRICTED AIR INTAKE SYSTEM

When the air flow into the engine is restricted, there is more vacuum or suction in the cylinders. This results in increased suction around the valve stems and pistons and rings and can cause excessive oil consumption.

RESTRICTED OIL RETURN PASSAGE FROM VALVE COVER

When this passage is restricted, the oil collects in the valve tappet area. Much of this oil enters the engine around the valve stems.

11. OIL PRESSURE TOO HIGH

Stuck Relief Valve

Free up valve.

Oil Pressure Too High

This condition rarely occurs unless it has been deliberately set too high.

However, if the relief valve sticks closed, the oil pressure will be too high.

Other possible causes could be a defective pressure gauge or sending unit.

12. OIL PRESSURE TOO LOW

Worn Bearings

Replace engine bearings.

Poor Relief Valve Seating

Replace valve, valve seat or both.

Too-Light Oil

Use correct weight of oil.

Worn Oil Pump

Repair.

Engine Low on Oil

Fill to proper level.

Loose Connections or Leaking Seals at Oil Filter, Pump, or Oil Cooler

Tighten connections or replace seals.

Oil Pressure Too Low

Worn bearings, poor relief valve action, loose connections, or leaking seals can all contribute to low oil pressure.

Any of these items allow the escape of so much oil that the pump cannot keep up the pressure.

WORN OIL PUMP

When the oil pump becomes worn, the oil tends to recirculate within the pump, preventing a pressure build-up.

TOO-LIGHT OIL

Oil is actually composed of many tiny globules. The heavier the oil, the larger the globules.

Therefore, a lighter oil with smaller globules can flow more freely through the bearings and other openings.

While lighter oil provides better lubrication, using *too* light an oil can contribute to high oil consumption.

However, do not attempt to eliminate excessive oil consumption by using a heavier oil than recommended.

TEST YOURSELF

QUESTIONS

1. List the seven basic steps for good trouble shooting.

2. During which of the seven steps should you begin replacing parts?

3. What test is the most comprehensive way to tell the condition of the engine?

4. What three basic things are needed for the engine to run?

ANSWERS

1. Know the system, 2) Ask the operator, 3) Inspect the engine, 4) Operate the engine, 5) List the possible causes, 6) Reach a conclusion, 7) Test your conclusion.

2. During **none** of these steps. Do all these things *before* you begin repairing the engine.

3. The dynamometer test.

4. Fuel-air mixture, compression, and ignition.

ENGINE TUNE-UP / CHAPTER 12

INTRODUCTION

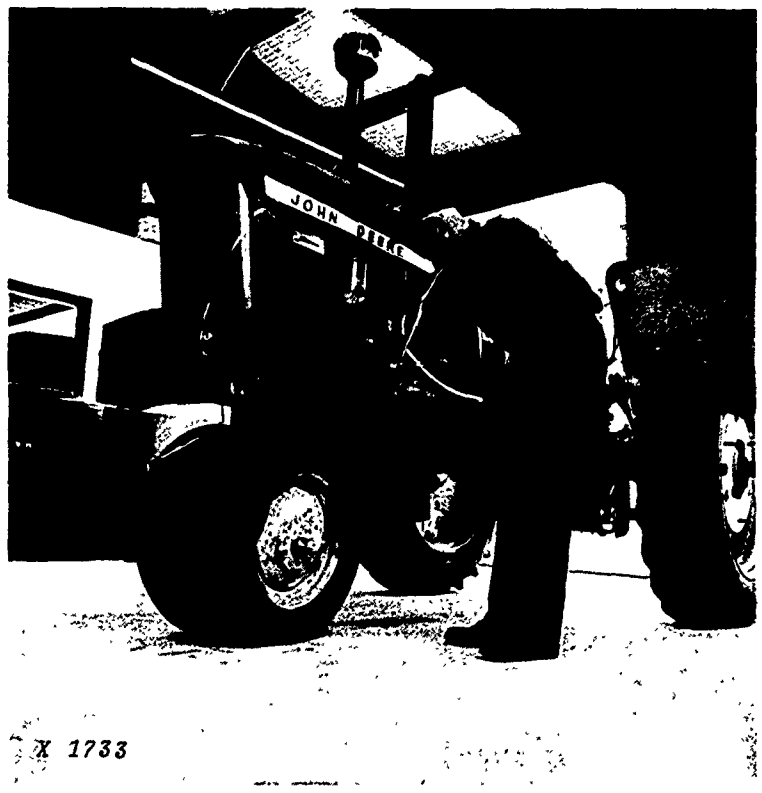

Fig. 1 — Tune-Up Is Making Checks And Minor Adjustments

WHAT IS TUNE-UP?

Tune-up is the process of making checks and minor adjustments to improve the operation of the engine.

Tune-up is also **preventive maintenance.** Troubles can be caught early and prevented by checking out the engine before it actually fails.

WHEN SHOULD AN ENGINE BE TUNED?

Regularly! The intervals for tune-up may vary from 500 to 1000 hours or seasonally, depending upon the operating conditions. But **regularity** is the key to maintaining the engine so that major problems are prevented.

A badly worn engine cannot be tuned up. This is why the engine must first be tested to see if:

1) A tune-up will restore it, or

2) Major overhaul is needed.

Let's go through this visual inspection first and then we'll see how tune-up follows it.

VISUAL INSPECTION

By inspecting the engine before you tune it, you can learn a lot about its general condition.

Check out the following items:

1. OIL AND WATER LEAKAGE

Inspect the engine for any oil or water leaks. If the engine has been using too much oil, this often means an external oil leak. If the engine overheats, look for leaks in the cooling system.

2. ELECTRICAL SYSTEM

Inspect the **battery** for corrosion, cracked case, or leaks at the cell covers.

Remove the cell caps and examine the tops of the battery plates. If they are covered with a chalky deposit, this means one of three things:

1) Electrolyte level has been too low.

2) Battery charge has been too low, causing sulfation.

3) Battery was charged at too high a rate, boiling out water.

Fig. 2 — Visual Inspection Tells You Whether To Tune It Or Overhaul It

Any of these conditions can reduce the life of the battery. If they have gone too far, the battery must be replaced.

Check the **battery cables and connections** for damage and looseness.

Be sure the cables are the right size. Many complaints of poor starting can be traced to battery cables that are too small.

To check for this, operate the starter with the engine cold. If the battery cable gets hot, the cable is probably too small.

Inspect the **wiring harnesses.** If they are too oil-soaked, frayed, or corroded, replace them.

On spark-ignition engines, check the **distributor** for a cracked cap, excessive grease, or other damage.

Check the operation of the alternator or generator **indicator light.** It should light when the starter switch is turned on.

Failure to light can be due to a burned-out bulb, an incomplete circuit, or the alternator or generator is not producing current. (Lack of current to the battery will show up a discharged battery.)

If the oil pressure indicator light does not go out when the engine is running, check for low or no oil pressure, or a short circuit.

Stop the engine at once and find the cause.

Lack of engine oil pressure can result in failure of expensive parts inside the engine due to lack of lubrication.

VISUAL INSPECTION CHECKLIST

- ☐ **OIL AND WATER LEAKAGE**
- ☐ **ELECTRICAL SYSTEM**
  - **Battery**
  - **Cables**
  - **Wiring**
  - **Indicator Lights**
- ☐ **COOLING SYSTEM**
  - **Water in Crankcase**
  - **External Leaks**
  - **Clogging**
- ☐ **AIR INTAKE SYSTEM**
  - **Air Leaks**
  - **Restrictions**
- ☐ **FUEL SYSTEM**
  - **Leaks**
  - **Restrictions**
  - **Clogged Filter**
- ☐ **STEAM CLEANING**

3. COOLING SYSTEM

Wait until the engine has been idle for several hours and the crankcase oil is cold; then loosen the crankcase drain plug and carefully turn it out to see if any water seeps out. If water is present, locate the cause of the cooling system leak.

Inspect the cooling system for leaks, deteriorated hoses, bent or clogged radiator fins, slipping fan belt, or any other condition which could result in improper cooling.

4. AIR INTAKE SYSTEM

Inspect the air intake system for possible leaks or restrictions. If the proper amount of clean air does not reach the engine, performance and durability will be affected.

5. FUEL SYSTEM

Check the fuel system for leaks and for bent or dented lines, which might cause a restriction.

Check the fuel transfer pump sediment bowl. On diesel engines, inspect the fuel filters for dirt, water, or other foreign matter.

6. STEAM CLEANING

After checking for leaks, steam clean the engine. This not only helps to recondition the engine, it makes tune-up easier and troubles easier to spot.

DYNAMOMETER TEST

If possible, test the engine on a dynamometer *before* it is tuned. This test gives you the horsepower output and fuel consumption of the engine as it is. This will help you to determine if a tune-up can restore the engine or whether an overhaul is needed.

Good performance by the engine depends on these basic things:

1) An adequate supply of clean air and fuel

2) Good compression

3) Proper valve and ignition timing for good combustion

Failure or low performance on any of these factors makes it impossible to fully restore the engine.

Therefore, if the dynamometer test shows that any of these three factors is bad, the engine will have to be reconditioned.

Make the dynamometer test as follows:

1. Connect the engine to the dynamometer using the manufacturer's instructions.

2. Operate the engine at about one-half load until the coolant and crankcase oil temperatures are up to normal. (This will take about 30 minutes—*but is very important to a good test.)*

3. Gradually increase the load on the engine until its speed is reduced to rated load speed as given in the engine Technical Manual.

4. Read the horsepower on the dynamometer.

5. Compare the horsepower with that given in the engine Technical Manual.

However, do not expect engines to always equal these specifications. But if the engine rates much lower than normal, this is a signal that service is needed.

While the engine is operating under load, note the outlet of the crankcase ventilating system. If too much vapor appears, also remove the crankcase oil filler cap.

Fig. 3 — A Typical Dynamometer Test

If an excessive amount of vapor or smoke appears here as well as at the vent, there is blow-by in the engine cylinders and they must be reconditioned before the engine will perform at its best.

NOTE: Instruments are available to measure the flow of air and gases through the crankcase ventilating system.

The normal rate of engine vapor flow is specified in the engine Technical Manual.

Any increase in flow over the specified amount indicates crankcase blow-by.

If the blow-by is excessive, recondition the engine for good operation.

Even though the engine develops its rated horsepower using a normal amount of fuel, a tune-up may still improve its efficiency. Consider both hours of operation and the conditions under which the engine has been operated. It is far more economical in the long run to tune the engine *before* a lack of performance makes it mandatory.

Most manufacturers suggest a regular period of operation between tune-ups.

ENGINE TUNE-UP

For proper engine tune-up, use the sequence listed in the following chart.

A detailed description of each operation follows the chart.

NOTE: The numbers in the "Item" column refer to numbered groups in the detailed instructions. For best results and time savings, follow the sequence given in the tune-up charts.

TUNE-UP CHART

Item No.	*Operation*	*Gasoline*	*Diesel*	*LP-Gas*
1	**AIR INTAKE AND EXHAUST SYSTEM**			
	Clean out precleaner (if used)	X	X	X
	Remove and clean air cleaner	X	X	X
	Swab out inlet pipe in air cleaner body	X	X	X
	Inspect exhaust system and muffler	X	X	X
	Check crankcase ventilating system for restrictions	X	X	X
2	**BASIC ENGINE**			
	Recheck air intake for restrictions	X	X	X
	Check radiator for air bubbles or oil indicating compression or oil leaks	X	X	X
	Cylinder head gasket leakage	X	X	X
	Retighten cylinder head cap screws	X	X	X
	Adjust valve clearance	X	X	X
	Check compression pressure in each cylinder	X	X	X
3	**IGNITION SYSTEM (Spark-Ignition Engines)**			
	Spark Plugs			
	Clean, test, and adjust spark plugs	X		X

TUNE-UP CHART (Continued)

Item No.	Operation	Gasoline	Diesel	LP-Gas
	Ignition Coil			
	Test ignition coil	X		X
	Check for proper coil connections	X		X
	Distributor			
	Check the following items:			
	Cap and rotor	X		X
	Condenser	X		X
	Breaker Points	X		X
	Point gap (cam dwell)	X		X
	Breaker point spring tension	X		X
	Lubrication	X		X
	Distributor timing	X		X
4	**FUEL SYSTEMS**			
	Check fuel lines for leaks or restrictions	X	X	X
	Clean fuel pump sediment bowl	X	X	X
	Test fuel pump pressure	X	X	
	Check and clean LP-gas fuel-lock strainer (observe caution)			X
	Drain carburetor sump			X
	Check radiator for LP-gas leaking from converter into cooling system			X
	Drain gasoline carburetor, clean inlet strainer	X		
	Check carburetor choke disk operation	X		X
	Check speed control linkage	X	X	X
	Service diesel fuel filters		X	
	Check diesel injection pump		X	

TUNE-UP CHART (Continued)

Item No.	Operation	Gasoline	Diesel	LP-Gas
	Check and clean diesel injection nozzles		X	
	Bleed diesel fuel system		X	
	Check diesel injection pump timing		X	
5	**LUBRICATION SYSTEM**			
	Check operation of pressure gauge or light	X	X	X
	Service oil filter	X	X	X
	Check condition of crankcase oil	X	X	X
	Check engine oil pressure	X	X	X
6	**COOLING SYSTEM**			
	Check water pump for leaks and excessive shaft endplay	X	X	X
	Inspect radiator hoses	X	X	X
	Clean and flush cooling system	X	X	X
	Test thermostat and pressure cap	X	X	X
	Test radiator for leaks	X	X	X
	Check condition of fan belt	X	X	X
7	**ELECTRICAL SYSTEM**			
	Battery			
	Clean battery, cables, terminals, and battery box	X	X	X
	Tighten battery cables and battery hold-down	X	X	X
	Apply petroleum jelly to battery posts and cable clamps	X	X	X
	Check specific gravity of electrolyte and add water to proper level	X	X	X
	Make "light load" test of battery condition	X	X	X

TUNE-UP CHART (Continued)

Item No.	Operation	Gasoline	Diesel	LP-Gas
	Generator or Alternator			
	Check belt tension	X	X	X
	Test alternator or generator output	X	X	X
	Starting Circuit			
	Check safety starter switch	X	X	X
	Check current draw of starting motor	X	X	X
8	**CLUTCH FREE TRAVEL**			
	Check free travel at clutch pedal or lever	X	X	X
9	**DYNAMOMETER TEST**			
	Use a dynamometer to check engine performance	X	X	X
	Use an exhaust analyzer while engine is on test to check for accurate carburetor adjustment	X		X

DETAILED TUNE-UP PROCEDURES

The following pages have detailed instructions for the checks and adjustments given in the tune-up chart.

The chart is divided into groups and each group is numbered. This number matches the number given in the detailed procedures which follow.

Where specifications are required, always refer to the engine Technical Manual for details.

1. AIR INTAKE AND EXHAUST SYSTEM

Pre-Cleaner

Check the pre-cleaner bowl for collected foreign matter (Fig. 4). Clean the bowl whenever three-fourths inch of dirt collects in the bowl.

Check the pre-cleaner screen (if used) and clean if necessary.

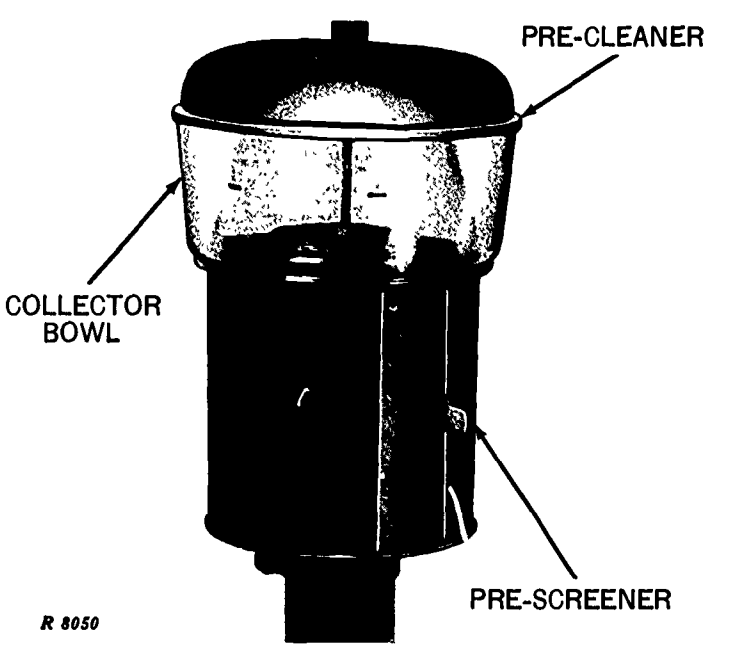

Fig. 4 — Pre-Cleaner and Screen

Air Cleaner (Dry Type)

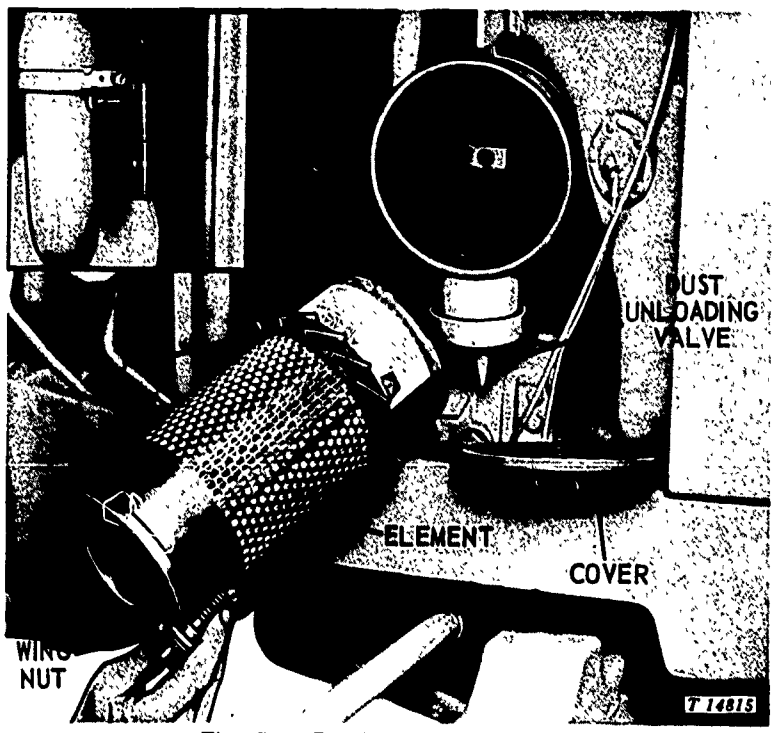

Fig. 5 — Dry-Type Air Cleaner

Remove and check the dry cleaner element (Fig. 5). If the element is ruptured or the seal is damaged, replace it.

Most dry elements can be recleaned a few times before they must be replaced. Two cleaning methods are used: One is for *dusty elements*. The other is for *oily or sooty elements*. See the machine operator's manual for details.

CAUTION: Never wash dry elements in gasoline, fuel oil, or solvents. Do not oil the element unless instructed.

Check the operation of the restriction indicator and dust unloading valve (if used). Flex the valve to clean out debris. Also wipe out the inside of the air cleaner housing. If the cleaner has a dust cup, clean it.

Install the cleaner element (usually fins first as shown) and *tighten it securely*. This will prevent air leaks past the end of the element. Then install the cover on the air cleaner housing.

Air Cleaner (Oil Bath Type)

Remove the oil cup from the air cleaner (Fig. 6). Pour the oil from the cup and clean the cup.

Clean the tray or oil trap (if used). Swab out the air intake tube.

If the main cleaner element is extremely dirty, remove it and clean by dashing it up and down in a pail of solvent. *Do not use steam cleaning equipment*. It is impossible to force the steam through

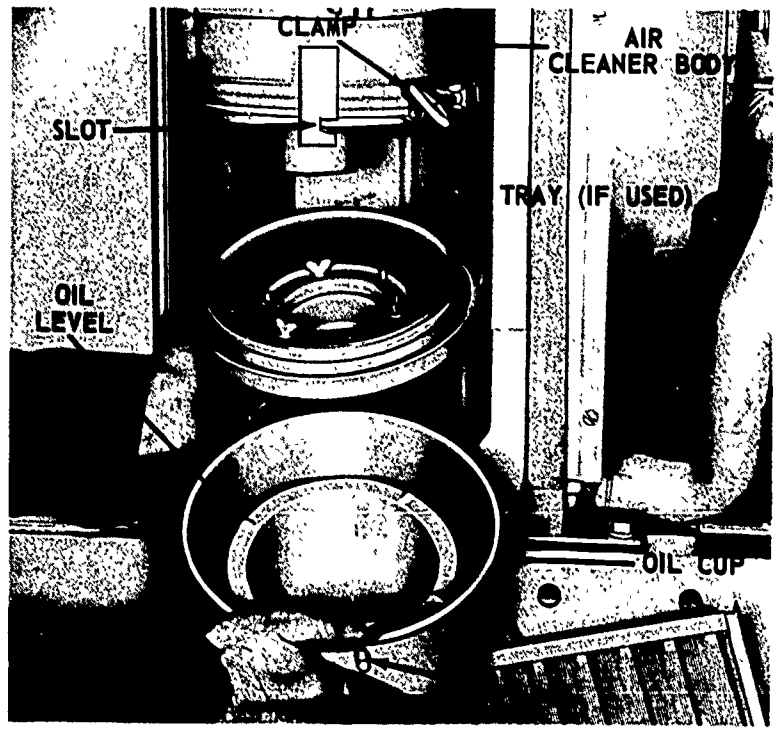

Fig. 6 — Oil Bath Air Cleaner

the element and so the dirt stays at the center of the element.

Install the oil trap or other parts removed. To assure *clean air*, check to see that all connections are tight and leak-proof.

Fill the oil cup to proper level with the correct amount of *new* oil of the same weight as is used in the engine. *Do not overfill the cup*. Install the oil cup and tighten it securely.

CAUTION. Never check the air cleaner with the engine running.

Exhaust System

Check the exhaust system for leaks. Leaks at the engine can be dangerous to the operator when the engine is used with an enclosed machine.

Check the exhaust pipe and muffler for restrictions which could prevent the free flow of exhaust gases.

Crankcase Ventilating System

Check for restrictions which could prevent free air flow through the crankcase ventilating system. Lack of ventilation causes sludge to form in the engine crankcase. This can cause clogging of oil passages, filters, and screens, resulting in expensive damage to the engine.

2. BASIC ENGINE

Air Intake System

A further check of the air intake system should now be made. Do this with a water manometer or vacuum gauge calibrated in inches of water.

NOTE: If the diesel engine, on the dynamometer test, produced a reasonable amount of horsepower and the air cleaner appears to have been regularly serviced, this operation can be omitted. However, on diesel engines which have air cleaners equipped with restriction indicators, check the operation of the indicator against the gauge.

INTAKE VACUUM TEST (Diesel Engines)

Test as follows:

1. Warm up the engine.

2. *On engines with restriction indicators,* remove the indicator, install a pipe tee fitting, and reinstall the indicator. Connect the gauge to the tee fitting.

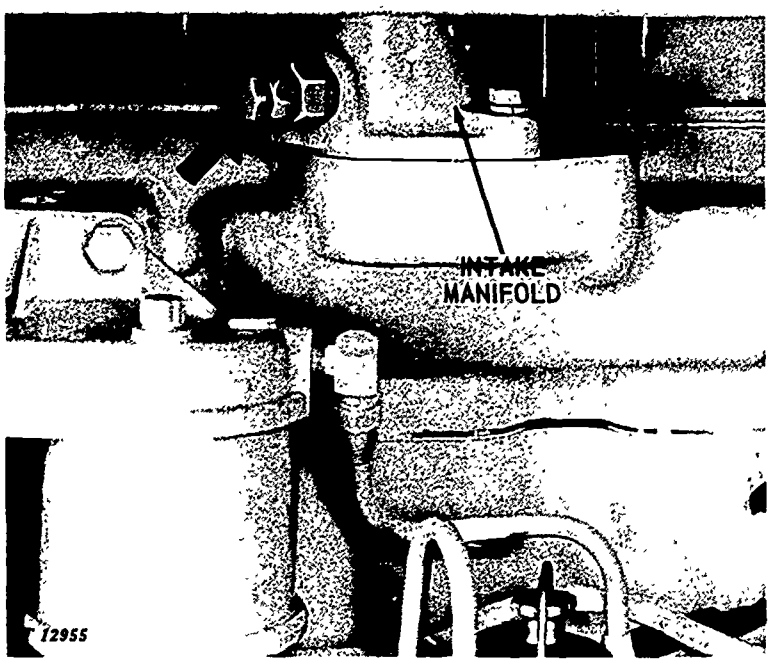

Fig. 7 — Manometer or Gauge Connection Point

3. *On engines without restriction indicators,* connect the gauge to the intake manifold (Fig. 7).

4. Set the diesel engine speed at fast idle and note the reading on the gauge. Too high a reading means that there is a restriction in the air intake system. Check the engine Technical Manual for correct specifications.

5. On engines with restriction indicators, check the operation of the indicator. Use a board or metal plate to very slowly cover the air intake opening. Note the action of the indicator in relation to the reading on the gauge. If the indicator does not operate properly, replace it.

MANIFOLD DEPRESSION TEST (Spark-Ignition Engines)

Much can be learned about the internal condition of a spark-ignition engine by checking the intake manifold depression between the carburetor and the engine. Use a vacuum gauge calibrated in inches of mercury.

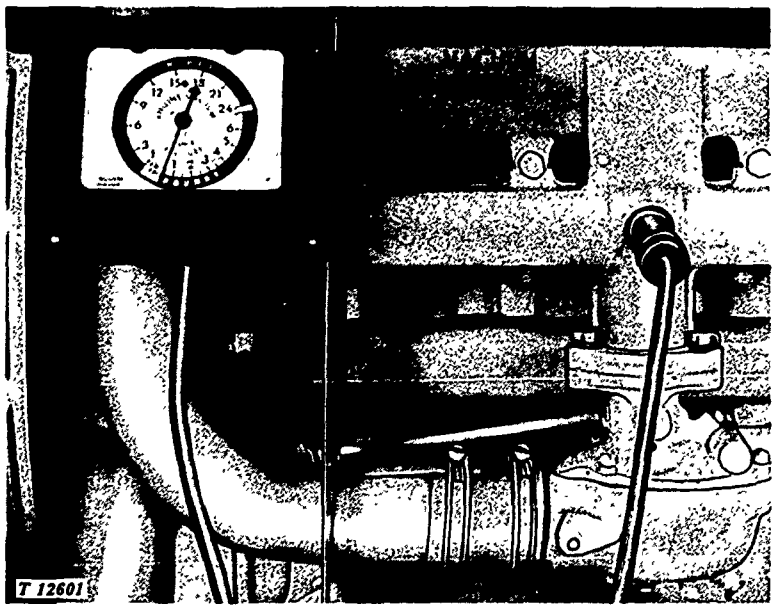

Fig. 8 — Manifold Vacuum Test (Spark-Ignition Engines)

1. Connect the vacuum gauge to the intake manifold (Fig. 8).

2. Warm up the engine and operate it at idle speed.

3. Note the reading on the vacuum gauge. Check the engine Technical Manual for exact specifications.

4. Interpret the gauge reading as follows:

- **If the reading is steady and low,** loss of power in all cylinders is indicated. Possible causes are late ignition, bad valve timing, or loss of compression at valves or piston rings. A leaky carburetor gasket will also cause a low reading.

- **If the needle fluctuates steadily,** a partial or complete loss of power in one or more cylinders is indicated. This can be due to an ignition defect, or loss of compression due to stuck piston rings or a leaky cylinder head gasket.

- **Intermittent needle fluctuation** indicates occasional loss of power due to an ignition defect or a sticking valve.

- **Slow needle fluctuation** is usually caused by improper carburetor idle mixture adjustment.

- **A gradual drop in the gauge reading** at idle engine speed indicates back pressure in the exhaust system due to a restriction.

Since the gauge readings can indicate more than one fault, be very careful in analyzing abnormal readings.

Cylinder Head Gasket Leaks

With the engine running at idle speed and at operating temperature, *carefully* remove the radiator cap and check for bubbles or oil at the surface of the coolant.

If bubbles appear, cylinder pressure is leaking past the cylinder head gasket (or LP-gas is leaking from the converter into the engine coolant). Replace the head gasket or repair the converter.

If oil is present, it can be leaking past the cylinder head gasket or leaking from an engine oil cooler. Determine the cause and correct it.

Cylinder Head Cap Screw Tightness

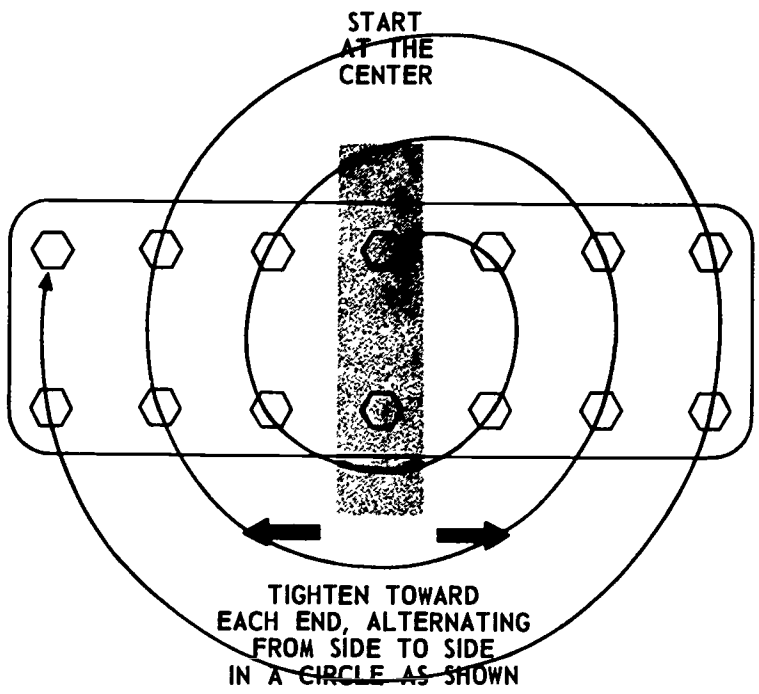

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Fig. 9 — Sequence For Tightening Cylinder Head Cap Screws

While the engine is hot, loosen each cylinder head cap screw and retighten to specified torque.

The key to proper sequence in tightening cylinder heads is to work from the center outward on alternating sides of the head in a circle as shown in Fig. 9. However, use the exact sequence given in the engine specifications.

NOTE: A film of oil under the head of each cap screw will assure better tightening.

IMPORTANCE OF USING A TORQUE WRENCH

Many servicemen do not realize the importance of using a torque wrench to tighten cap screws or nuts. This is particularly true on cylinder head cap screws or nuts. They say, "I know when a screw is tight." But they don't realize the importance of tightening each screw *to the same tension.*

Unevenly tightened cylinder head cap screws can distort the valve seats (causing leakage) or the cylinder head or block surfaces (which could result in cylinder head gasket failure).

Valve Tappet Clearance

Check the clearance on the engine valves (Fig. 10). This is the distance between the end of the tappet lever and the end of the valve stem when the piston is at "top dead center".

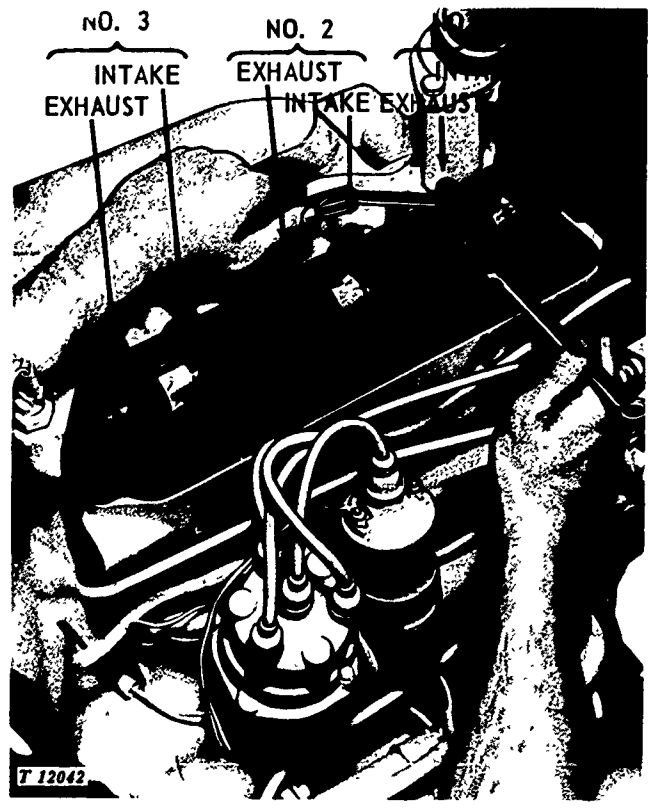

Fig. 10 — Adjusting Valve Tappet Clearance

Turn the engine to "top dead center" of the No. 1 (front) cylinder. Many engines have a timing mark on the front pulley or a timing pin on the flywheel to set the engine at "TDC."

Adjust the clearance on the two valves for the No. 1 cylinder to specifications. Use a feeler gauge as shown in Fig. 10 to check the setting.

Turn the engine until the next piston comes up to "top dead center" and adjust the valve clearances for that cylinder.

Keep on turning the engine until all the valves are adjusted. The sequence will vary for 3-, 4-, and 6-cylinder engines.

THE IMPORTANCE OF ACCURATE VALVE CLEARANCE

The importance of accurate valve adjustment cannot be too highly stressed.

If there is not enough valve clearance, the valve may not entirely close, resulting in loss of compression or burned exhaust valves.

If the valve clearance is too great, the valve opens late and closes early. Thus the valve does not remain open long enough to allow the full charge of air or fuel-air mixture to enter the cylinder. This results in a loss of engine efficiency.

Compression Test

Weak compression results in loss of horsepower and poor engine performance. This is even more true in diesel engines which depend upon the heat of compression to ignite the fuel in the cylinders.

Check the engine compression as follows:

1) Warm up the engine to operating temperature.

2) Remove the spark plugs or injection nozzles.

3) Connect a pressure gauge to the cylinder port (Fig. 11).

4) *On spark-ignition engines,* be sure that both carburetor throttle and choke valves are in the wide open position. Disconnect the ignition coil-to-distributor wire at the distributor. Ground the wire by placing it in contact with some part of the engine.

5) *On diesel engines,* the air intake system has no throttle valve, so merely be sure that the engine speed control is in the "stop" position.

6) Turn the engine with the starter until the pressure gauge registers no further rise in pressure. It is a good practice to count the number of compression strokes (indicated by movement of the gauge needle) and check each cylinder with the same number of strokes. The engine must be at full cranking speed to get a good reading.

7) Check the pressure reading against the engine Technical Manual.

8) If the compression is very low, apply oil to the ring area of the piston through the openings. Do not use too much oil to avoid getting oil on the valves. Then check the compression again.

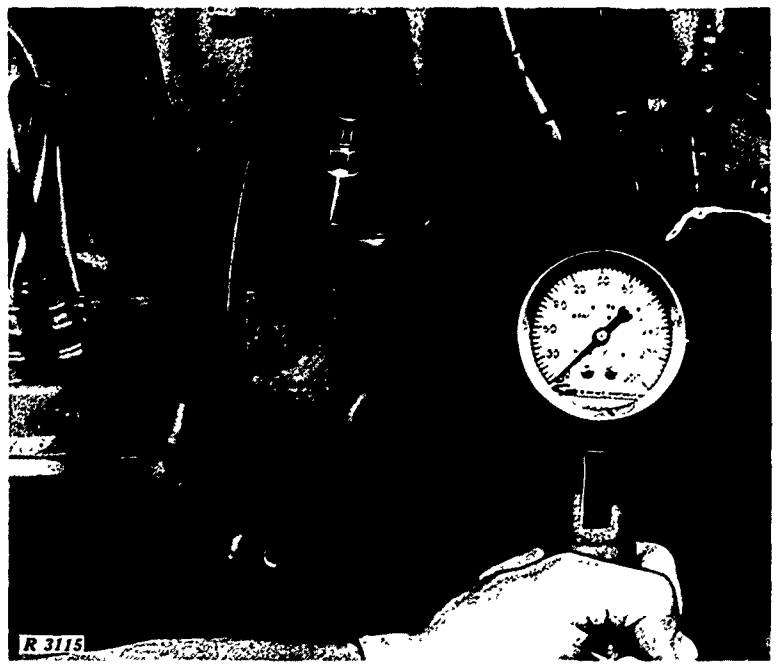

Fig. 11 — Checking Engine Compression

9) Judge the compression readings as given below.

JUDGING THE ENGINE COMPRESSION READINGS

All cylinder pressures should be about the same—this is most important. Variations are usually limited to about 10 percent of the full reading.

If compression is too low, the engine must be reconditioned before a tune-up can be effective.

If compression in one cylinder is higher than the others, the other cylinders need reconditioning.

Altitude affects compression pressures. Normally there is about a 4 percent loss for every 1000 feet of altitude above sea level. Pressures given are normally for about 1000 feet above sea level.

Compression pressures are affected by the **cranking speed** of the engine. Therefore, be sure the batteries are in good condition and fully charged when making a compression test.

HOW COMPRESSION AFFECTS ENGINE PERFORMANCE

Horsepower in an engine is created by the expansion of gases in the cylinder caused by the burning of a mixture of fuel and air.

For example, in a spark-ignition engine, peak firing pressures are roughly four times higher then compression pressures. In an engine with 160 psi compression pressure, peak firing pressure will be approximately 640 psi.

If the pressure is only 150 psi in each cylinder when checked, there is approximately a nine percent loss in horsepower. This, of course, is a loss of engine efficiency and results in higher operating costs.

In diesel engines, peak firing pressures do not rise as high, comparatively, as in spark-ignition engines. They are about double that of the compression pressure.

This is because diesel engines only take in air. The fuel is then sprayed into the hot air in the cylinder.

There is less pressure rise but the peak pressure is maintained over a longer period of time. This gives the diesel engine its greater "lugging" ability.

These principles are shown in Fig. 12. Note that while firing pressure rises very rapidly in the spark-ignition engine, it also falls off very rapidly. In diesel engines, the pressure rises, is maintained over a longer period of time, and then falls off.

Causes of Poor Compression

1. *Worn cylinders*
2. *Worn piston rings*
3. *Leaking gaskets*
4. *Worn pistons*
5. *Leaking valves which can be caused by:*
   a. *seats burned*
   b. *valves burned*
   c. *valve springs weak or broken*
   d. *valve stem warped or sticking in valve guide*
6. *Loose spark plug*
7. *Loose cylinder head bolts*
8. *Warped cylinder head*
9. *Broken connecting rod*
10. *Not enough valve tappet clearance*

For remedies, see Chapter 2 of this manual.

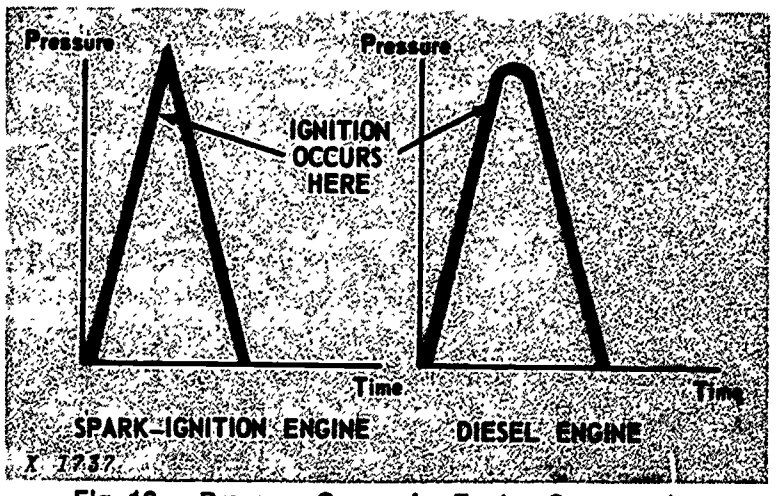

Fig. 12 — Pressure Curves for Engine Compression

3. IGNITION SYSTEM (SPARK-IGNITION ENGINES ONLY)

An oscilloscope is an instrument used to electronically check the performance of the ignition system. It is fast, accurate, and often pinpoints troubles which might be overlooked.

Details on servicing the ignition system are given in the FOS-20 Manual on "Electrical Systems." Here we will only outline the ignition services as they relate to engine tune-up.

Spark Plugs

Close inspection of the spark plugs can reveal much about the condition of the engine.

Black sooty plugs may be caused by:

1) Engine operated at too low a temperature

2) Fuel-air mixture too rich

3) Heat range of plug too cold

4) If plug is oily—engine consuming oil

Eroded plugs—insulator chipped or blistered from heat.

May be caused by:

1) Heat range of plug too hot.

2) Carburetor adjusted too lean, resulting in too much heat in the engine cylinders.

Good plugs *will be relatively free of both deposits and erosion.* This means that the plug is operating properly and is serviceable.

It is a good practice to replace all the spark plugs during tune-up if there is any question of their condition. Engine operation can be seriously affected by dirty or eroded plugs.

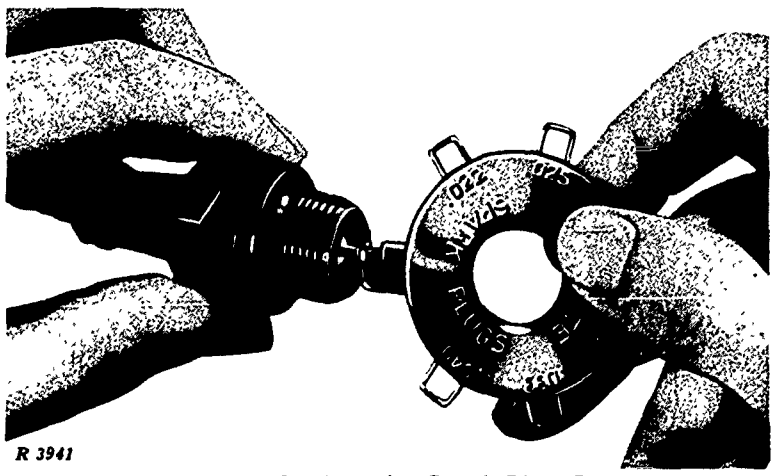

Fig. 13 — Setting The Spark Plug Gap

If the plugs are serviceable, file the electrode surfaces flat and square and adjust the point gap (Fig. 13) as specified in the engine Technical Manual.

After the spark plugs have been cleaned and adjusted, check them with a spark plug tester. Replace any which are doubtful.

When installing plugs, use a new gasket and tighten to exactly the specified torque. *This is important.*

If plugs are not tight enough, the plug can overheat because heat cannot be transferred to the cooling system.

If too tight, the thread area of the plug may stretch. This increases the point gap, resulting in hard starting and poor engine operation under load.

Ignition Coil

Use a reliable meter to check the ignition coil.

If the performance is doubtful, replace the coil. Refer to the Technical Manual for tests and specifications.

Check the coil for proper connections.

Use this rule of thumb:

On negative-ground system, the negative (—) primary terminal is connected to the distributor.

On positive-ground systems, the postitive (+) primary terminal is connected to the distributor.

Distributor

TESTING

If possible, the distributor should be checked out on a distributor tester. Testing the distributor often locates troubles which would otherwise not be found.

CAP AND ROTOR

Remove the distributor cap, rotor, and housing cover. Wipe clean with a rag. Make sure any vent holes in the cap are open. Inspect the posts in the cap for erosion.

Check the rotor for severe erosion at the end of the metal contact. Erosion at this point widens the gap between the end of the rotor and the posts in the distributor cap. This puts an excessive load on the ignition coil and can cause the coil to fail. It also affects engine starting and operation.

Detach the wires from the distributor cap. The ends of the wires may have been burned away, causing a gap which could result in failure of plugs to fire. This makes the engine hard to start.

When installing the wires into the cap, be sure they are pushed all the way in.

Replace any spark plug wires which have cracked, burned, or worn insulation. Here again, leakage of the high-tension current can affect engine operation.

CONDENSER

Use a reliable meter to check the condenser. Refer to the engine Technical Manual for tests and specifications.

BREAKER POINTS

Examine the condition of the breaker points. If they appear burned, replace them. If there is a spur on one contact surface, a corresponding pit will be found on the other.

If the surfaces are clean and are a light gray in color, merely use a point contact file to true up the surfaces. It is not necessary to remove the pit from one surface, but the spur should be removed.

After the breaker points have been filed or when new points are installed, be sure that the contact surfaces meet squarely. This assures a full flow of primary current when the points are in contact.

If the points do not meet squarely, resistance to the flow of primary (low-tension) current results. This can reduce the primary flow until the coil output is affected, resulting in poor engine operation.

NOTE: Before installing the points, check the operation of the automatic spark advance mechanism (if used). Turn the breaker cam in the normal direction of rotation. It should operate freely without evidence of binding. If not, find the cause and correct it. See the engine Technical Manual for information.

Apply a small amount of cam lubricant to the breaker cam. **Avoid using too much lubricant.** If the grease gets on the contacts, they may be burned.

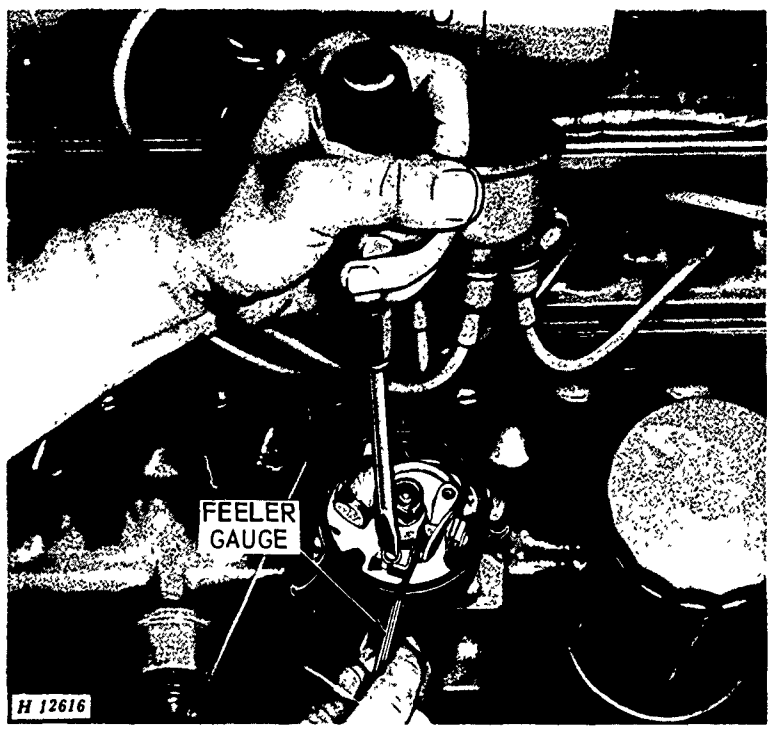

Fig. 14 — Adjusting The Distributor Point Gap

Adjust the distributor breaker point gap (Fig. 14). Follow the instructions in the engine Technical Manual. Also use a reliable meter to check the cam dwell.

Cam dwell is the period of time the breaker points remain closed until they open to create the spark. If the point gap is too wide, the points may not remain closed long enough for complete build-up of the magnetic field in the ignition coil. This can result in a weak spark and poor engine performance. If the point gap is too small, the points will not remain open long enough for complete collapse of the field. This can cause burning of the points and also a weak spark.

Check the tension of the breaker point spring. The tension should be within the limits given in the engine Technical Manual. If necessary, adjust by bending the spring.

Breaker point tension is very important. If the tension is too great, the rubbing block on the movable point will wear too fast. This will change the cam dwell and affect engine operation. If the tension is too weak, the movable point will bounce, causing erratic engine operation.

On distributors which require lubrication, lubricate according to instructions in the engine Technical Manual.

Reassemble the distributor. Be sure all connections are tight and that the spark plug wires are pushed all the way into their sockets.

DISTRIBUTOR TIMING

Check the timing of the distributor to the engine. Use a distributor timing light.

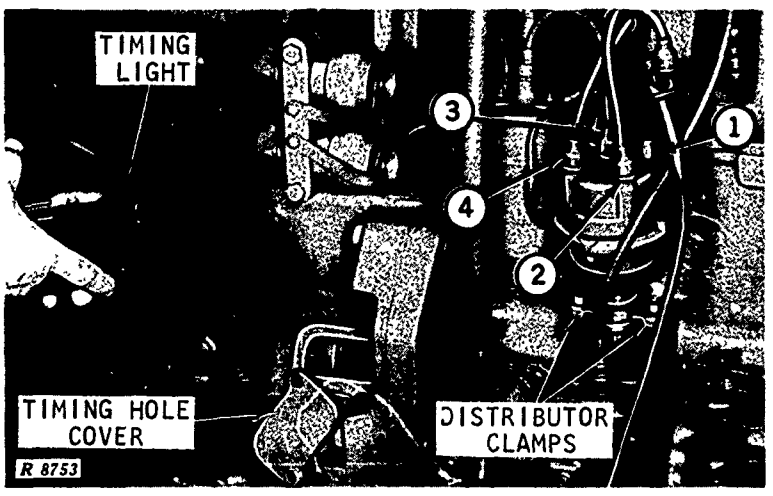

Fig. 15 — Timing The Distributor

Here is a general guide to distributor timing:

1. Start the engine and warm it up.

2. Stop the engine and connect the timing light as instructed in the engine Technical Manual. Also locate the timing marks on the engine.

3. Start the engine and operate it as specified.

4. Observe the flash of the timing light when the spark occurs. It should happen when the timing marks on the engine are lined up.

5. If necessary, loosen the distributor mounting and rotate the distributor until the flash occurs at the right instant.

Rotating the distributor in the direction of cam rotation will delay the spark, while rotating it in reverse will advance the spark.

6. Recheck the timing after the distributor mount is tightened again.

Timing the distributor to the engine should be done with great accuracy. The reason for this can be seen in Fig. 16.

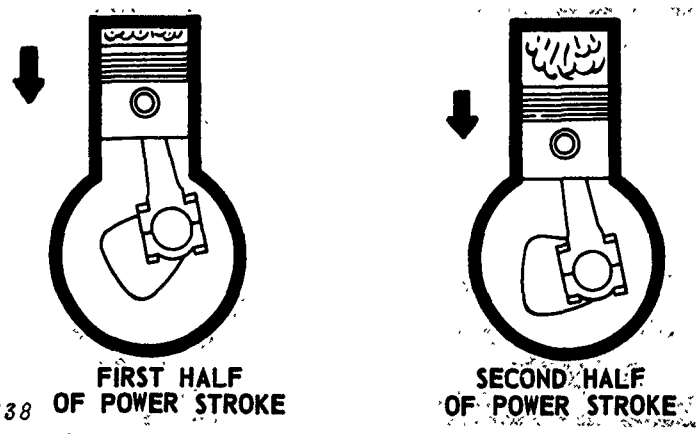

Fig. 16 — Connecting Rod Position In Relation To Crankshaft

In a spark-ignition engine the most power from combustion occurs while the piston is traveling the *first* half of its power stroke. This is because the connecting rod is angled in relation to the crankshaft. The left-hand drawing in Fig. 16 shows why this is true. Notice how the connecting rod drives the crankshaft more directly than during the second half of the power stroke (shown at the right).

If the ignition timing is late, full expansion of the gases will not occur while the piston is within the most effective area of its stroke. This results in a loss of horsepower and greater operating costs.

If the timing is too early, too much expansion takes place before the piston reaches top dead center of its compression stroke and the engine literally works against itself. The result is excessive "pinging", loss of horsepower, and higher operating costs.

4. FUEL SYSTEMS

Fuel Lines

Check fuel lines for leaks or restrictions. Leaking fuel not only is a fire hazard but it gathers dirt and wastes fuel.

CHECKING LP-GAS SYSTEM FOR LEAKS

Use a soap solution or liquid leak detector to coat all parts of the LP-gas system to check for leaks. Pressurize the system and look for bubbles which indicate a gas leak.

CAUTION: Observe all safety rules when working on LP-gas fuel systems (see Chapter 4).

Fuel Transfer Pump

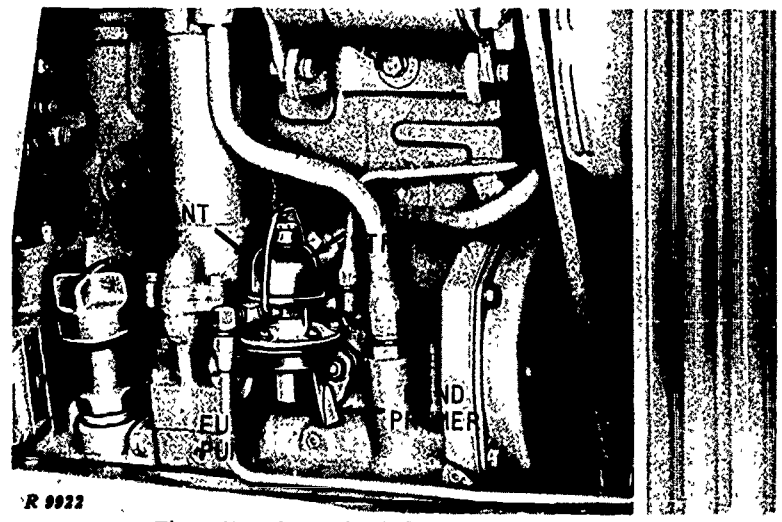

Fig. 17— A Typical Fuel Transfer Pump

Remove and clean the fuel pump sediment bowl and strainer (Fig. 17).

TESTING FUEL TRANSFER PUMP PRESSURE

Install a tee fitting at the fuel pump outlet and connect a low-pressure test gauge. Then operate the engine and check the fuel pressure.

NOTE: On diesel engines, the hand primer lever can be used to build up the pump pressure and to fill the system after service.

Be careful to avoid too-high pressures. In spark-ignition engines there is a tendency, especially on rough terrain, for the fuel to be forced by the carburetor float valve. This causes the fuel level in the carburetor to be too high, resulting in excess fuel consumption.

If the fuel pump has a line filter, service it as instructed in the engine Technical Manual.

Check and clean the LP-Gas fuel-lock strainer using the precautions in Chapter 4.

Carburetor Sump (LP-Gas)

Drain the LP-gas carburetor sump using precautions (see Chapter 4).

Converter (LP-Gas)

Test the LP-gas converter for leaks as follows:

Turn on the starter switch and open the vapor withdrawal valve. Then remove the radiator cap and check the coolant for bubbles caused by a leaky converter gasket. If bubbles are present, service the converter.

Carburetor (Gasoline)

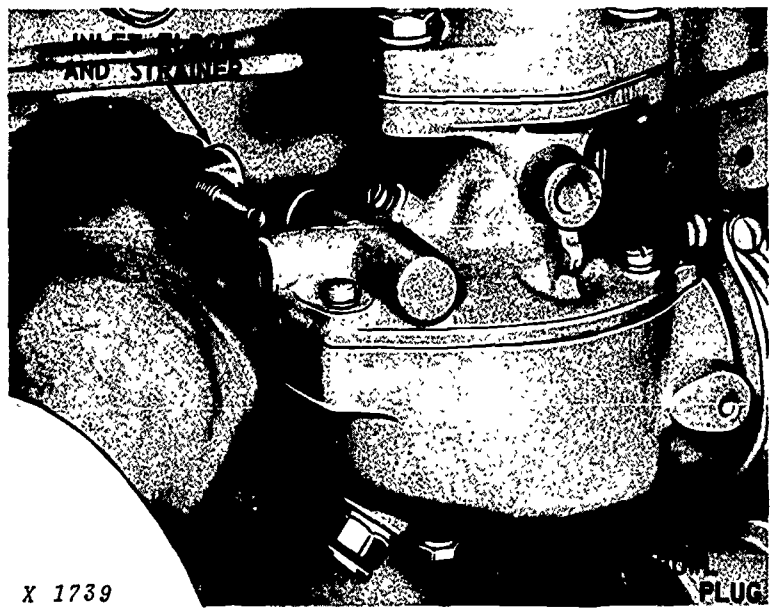

Fig. 18 — Gasoline Carburetor

Remove the drain plug at the bottom of the carburetor bowl (Fig. 18) and drain out any water or sediment in the bowl. After draining, replace the drain plug.

Remove and clean the carburetor fuel inlet strainer. Flush the strainer with gasoline to remove any dirt which may have worked through it.

If the engine has been in long or severe service, remove and clean the carburetor. Disassemble and clean the metal parts by immersing them in a carburetor cleaning solution. When clean, blow out all passages and dry the parts with compressed air. When reassembling, use a new carburetor repair kit.

In operation, the carburetor float needle and seat wear. This raises the fuel level in the carburetor bowl and increases fuel consumption. It is false economy to "make do" when new parts will soon pay for themselves in reduced operating costs.

After the carburetor is installed, check the choke disk for proper operation. When the choke is applied, the disk should be centered in the bore and should entirely close the opening. When the choke is open, the disk should be parallel with the opening.

Carburetor fuel adjustment should also be checked later when the engine is tested on the dynamometer.

Speed Control Linkage

Check the adjustment of the linkage between the speed control lever and the injection pump or carburetor.

Be sure that all linkage operates freely through its entire range. Any binding will cause erratic operation of the engine.

Fuel Filters (Diesel)

Diesel fuel must be clean and free from water. Many cases of injection pump or nozzle failure can be traced to dirt or water in the fuel.

Take special care to avoid contamination of diesel fuel—from the supplier, through storage, to the fuel tank, and the injection system.

Loss of engine horsepower can also be traced to dirty fuel filters.

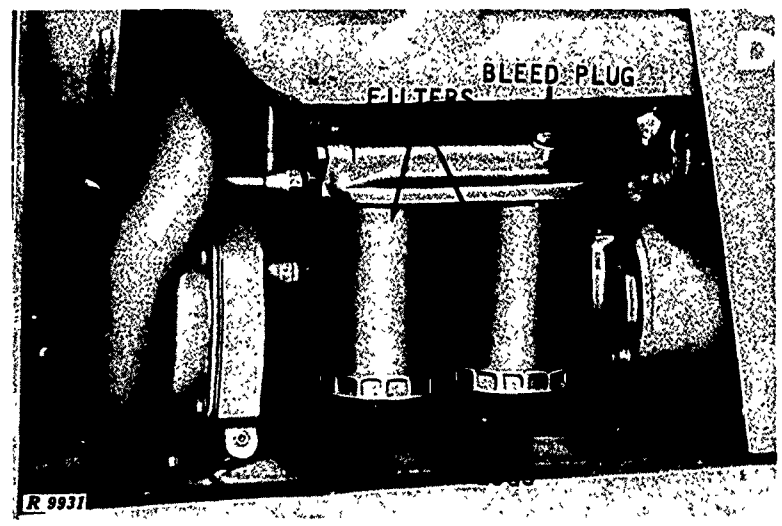

Fig. 19 — Diesel Fuel Filters (Dual Stages Shown)

Special fuel filters are installed in most diesel fuel systems (Fig. 19) but they cannot perform well if they are not properly serviced.

Replace or clean the fuel filters during tune-up.

If the filter has a drain plug (Fig. 19), loosen it and drain out any water or sediment.

If water is present, be sure to service the filter. Also find out and eliminate the source of water in the fuel.

On dual-stage filters, if the first-stage filter is extremely dirty or water-soaked, also service the second-stage filter.

Injection Pump (Diesel)

During major engine service, the injection pump should be removed, cleaned, inspected, and calibrated on an injection pump test stand.

However, it is a good practice to remove the pump and check it during a complete tune-up, if a test stand is available.

Testing the pump assures that it is operating properly and helps to locate malfunctions which affect engine performance and cause high fuel consumption. It can also reveal whether or not the pump calibration has been tampered with to increase engine horsepower.

Never calibrate the pump to inject more fuel than specified in the engine Technical Manual. The engine is designed to produce its rated horsepower at a certain rate of fuel consumption. Any change in this rate puts an undue strain on the working parts of the engine. This can cause early engine failure and always results in higher operating costs.

Excessive smoke from the exhaust is one sign that the injection pump is calibrated too high.

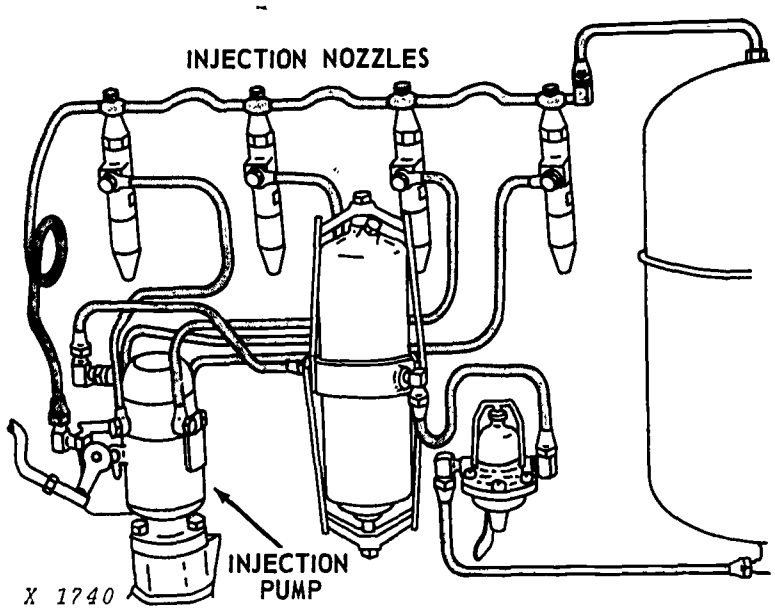

Fig. 20 — Diesel Fuel Injection Pump and Nozzles

Injection Nozzles (Diesel)

During major engine service, the injection nozzles should be removed, cleaned, and tested using a nozzle tester (see Chapter 5).

During a complete tune-up, it is also a good practice to remove and service the nozzles.

Three factors are of prime importance in nozzle operation:

1) **Cracking pressure.** All nozzles should be about equal. Too low—fuel will not be atomized.

2) **Condition of spray tips.** The orifices should be clean and not eroded.

3) **Spray pattern.** The fuel should be finely atomized and spread in an even spray pattern. A bad spray pattern can actually erode metal from the top of the piston.

Engines operated with bad nozzles often have low horsepower and excessive exhaust smoke.

Bleeding Air From The Fuel System (Diesel)

After servicing, always bleed air from the diesel fuel system. This will prevent "lock" in the high-pressure injection system.

Usually the fuel transfer pump has a primer lever which helps force air bubbles out of the system at various bleed plugs and loosened connections (see Chapter 5).

When all air is bled from the system, the engine will start normally and run without missing.

Timing The Injection Pump (Diesel)

In a diesel engine the start of fuel injection occurs *before* the piston reaches "top dead center" of its compression stroke. This is necessary because it takes time for the burning fuel to build up pressure.

Therefore, the pump is timed so the expanding gases reach peak pressure at about the time the piston reaches "top dead center".

If injection is timed too early, expansion occurs before the piston reaches top dead center and the engine is literally working against itself. This results in horsepower loss and decreased engine efficiency.

If injection is timed too late, expansion occurs late, and much power is lost because the connecting rod has a poor angle to the crankshaft. (See the drawing at right in Fig. 21.)

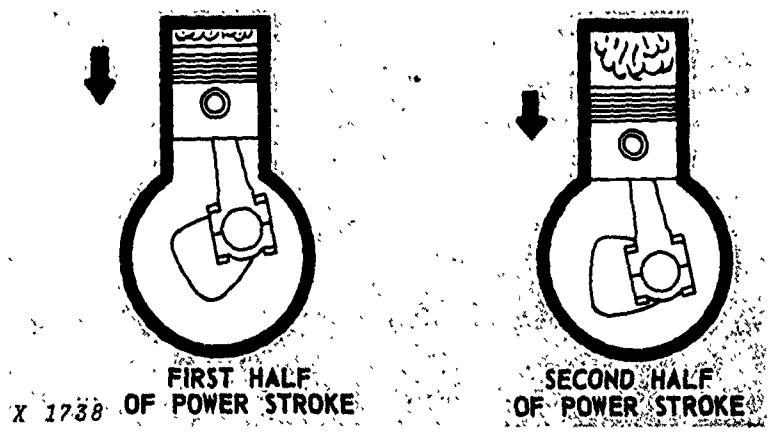

Fig. 21 — Connecting Rod Position In Relation To Crankshaft

When the injection is correctly timed, the connecting rod drives the crankshaft more directly and gets full power as shown at left in Fig. 21.

5. LUBRICATION SYSTEM

Pressure Gauge or Indicator Light

Check the operation of the pressure gauge or light. Turn on the starter switch to check, then start the engine and check during operation. See the engine Technical Manual for service information.

Oil Filter

Replace the engine oil filter during tune-up.

If the filter is extremely dirty, consider these likely problems:

1. The crankcase oil has not been changed often enough.

When oil is used too long in an engine, much of its detergent qualities are neutralized and it can no longer do its job. Either change the oil more often or use a higher quality of oil.

2. The oil is of the wrong quality.

Check the engine Technical Manual for the correct quality and weight of oil to use.

3. Water or antifreeze is in the oil.

Water in the oil is one cause of excessive sludge. Water can leak into the crankcase from around the cylinders through a sand hole in the cylinder block casting, or past the cylinder head gasket. If water is present in the oil, determine the cause and correct it.

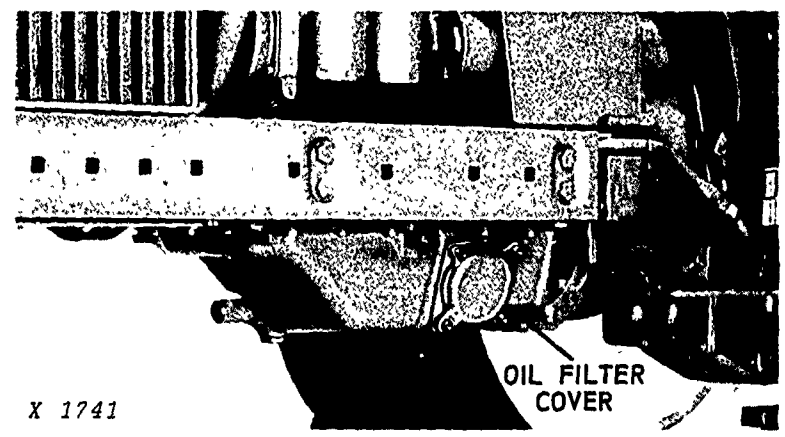

Fig. 22 — A Typical Internal Oil Filter Which Is Replaced During Service

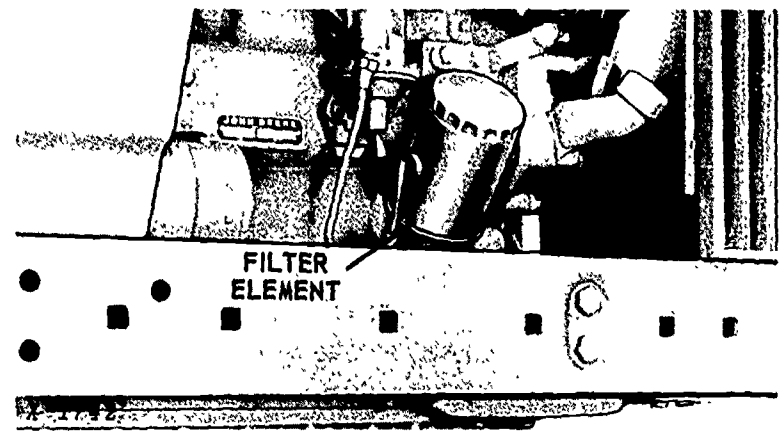

Fig. 23 — A Typical Screw-On Oil Filter Which Is Replaced During Service

Anti-freeze can enter the crankcase in any of the above ways. However, anti-freeze poses much more of a problem than plain water.

- *It forms a deposit on the pistons and rings, causing rings to stick and pistons to score.*
- *It can cause main and connecting rod bearings to fail.*
- *It forms a deposit on all surfaces throughout the engine and can cause severe damage to all moving parts.*

If the engine has been run too long with antifreeze in the oil, disassemble the engine. Clean all parts thoroughly and replace any that are damaged.

Crankcase Oil

Remove the oil dipstick and examine the condition of the crankcase oil.

Oil in the engine has a variety of functions:

1) Oil's prime purpose is to provide lubrication between the moving parts. This prevents wear and possible damage.

2) Oil assists in carrying off heat generated within the engine. The oil is cooled to some extent by the flow of air around the crankcase. Some engines are provided with special coolers to cool the oil. The cooled oil is pumped around the bearing surfaces and thrown around the inside of the engine. This helps to dissipate the engine heat.

3) Oil acts as a seal around the piston rings. Oil not only lubricates the pistons and rings, it also acts as a seal between the piston and rings, preventing loss of compression.

4) Oil neutralizes acids and prevents corrosion. Modern oils contain additives which neutralize acids formed during combustion and so prevent corrosion within the engine.

5) Oil prevents depositing of sludge in the engine. Additives in the oil also enable it to hold in suspension dirt and grit which otherwise would be deposited within the engine as sludge.

From this summary we can see how important it is to use the correct oil.

If the crankcase oil is extremely dirty or contains water or antifreeze, etc., drain and replace it, then correct the other causes.

Refer to the engine Technical Manual for draining procedures and for the correct quality and weight of oil to use.

Oil Pressure

Check the engine oil pressure using a master gauge.

1. Operate the engine until the oil is warmed up to normal. (Also be sure the filter is clean.)

2. Stop the engine and connect a master gauge (Fig. 24) to the engine block (normally where the pressure sending unit is attached.)

3. Run the engine at the specified speed and check the oil pressure against the listing in the Technical Manual.

4. If oil pressure is too high or low, adjust it as instructed in the Technical Manual.

PROBLEMS WITH LOW OIL PRESSURE

Operate the engine at slow idle speed. If the pressure is *very low*, check for one of these three problems:

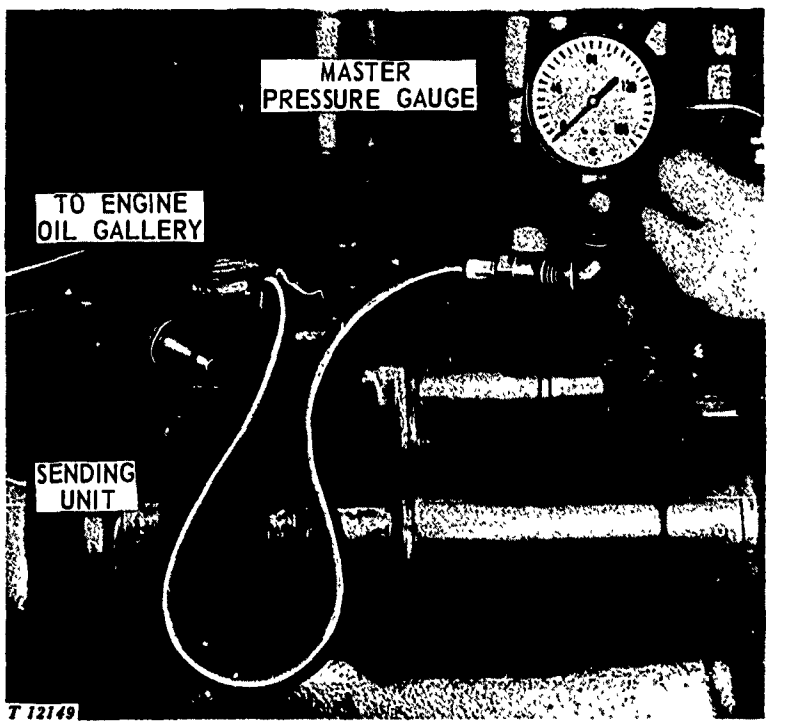

Fig. 24 — Checking Engine Oil Pressure With A Master Gauge

1) Using too-light oil. Check for correct weight.

2) Stuck oil pressure relief valve. Dirt on the valve seat can prevent it from closing. Check and clean the valve and seat.

3) Worn-out bearings on the crankshaft or camshaft. Too much oil escapes past worn parts, lowering oil pressure. In this case, recondition the bearings.

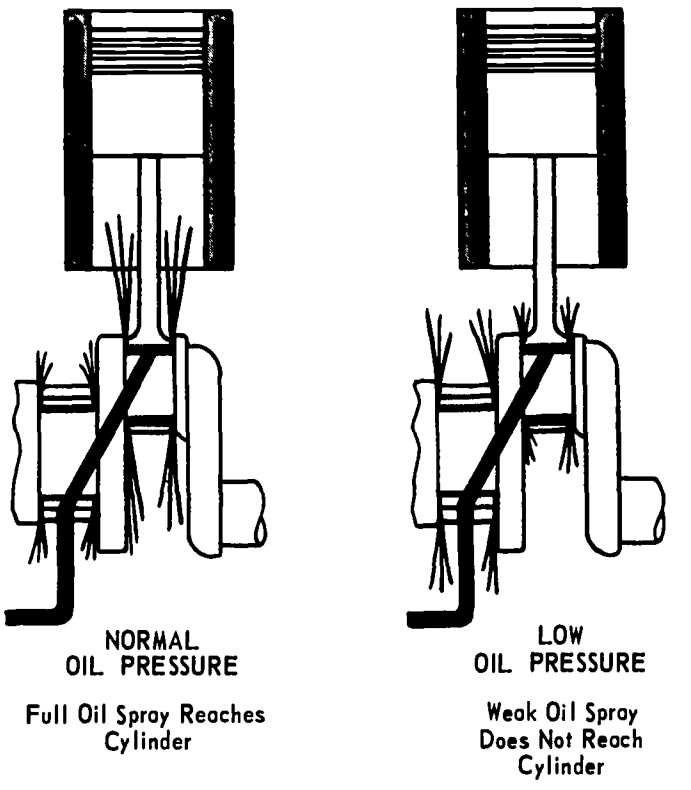

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Fig. 25 — Low Oil Pressures Mean Lack of Lubrication

Too-low oil pressures can cause the pistons and bearings to wear faster. This is because not enough oil reaches the cylinders for good lubrication (Fig. 25).

6. COOLING SYSTEM

Water Pump

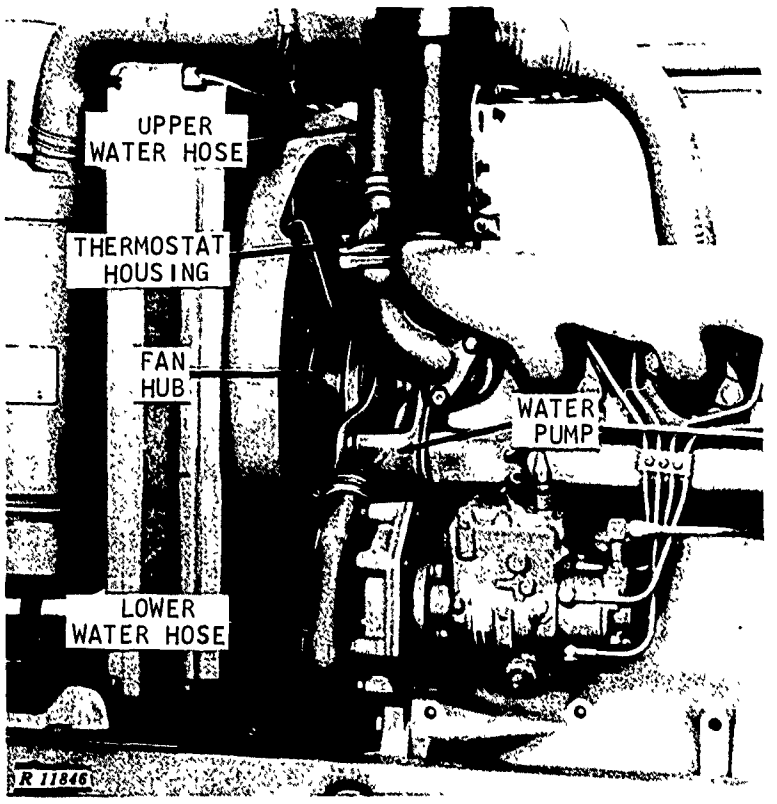

Fig. 26 — Water Pump and Thermostat Housing

Inspect the water pump (Fig. 26). If the pump is leaking or has too much endplay in its shaft, remove the pump and repair it as instructed in the engine Technical Manual.

Radiator Hoses

Inspect radiator hoses for signs of leakage or rot. Be sure that the inside lining of hoses has not become "mushy". This restricts the flow of water. Replace hoses as necessary.

Cleaning and Flushing the Cooling System

1. Run the engine long enough to stir up any rust or sediment in the cooling system.

2. Drain the cooling system. Detach the thermostat housing and remove the thermostat. Reinstall the housing.

3. Fill the cooling system with water and run the engine long enough to warm the water and stir up any rust or sediment.

4. Stop the engine and drain the system at once before the rust or sediment settles.

5. Fill the system with a solution of water and a good commercial radiator cleaner.

6. Install the radiator cap and run the engine until the solution is thoroughly warmed. Place a cardboard over the front of the radiator core for faster warm-up.

7. After several minutes, drain out the solution, fill with clean soft water, start the engine, and let the water circulate for a few minutes.

8. Condition the system with a recommended antifreeze (winter) or a coolant conditioner which inhibits rust (summer). Also add a water pump lubricant (when recommended).

Thermostat

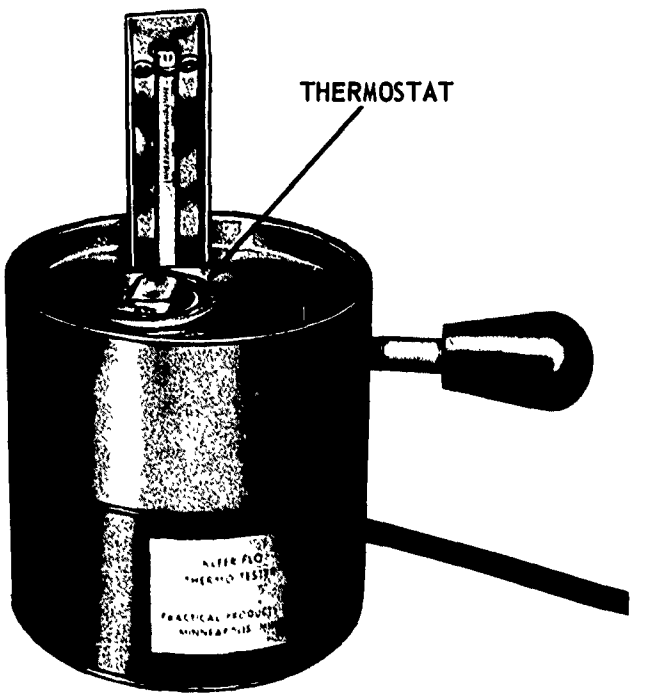

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Fig. 27 — Testing The Thermostat

Test the action of the thermostat (Fig. 27). If it does not open at the temperature given in the engine Technical Manual or is otherwise defective, replace it.

The thermostat is the key factor in cooling the engine.

When the engine is cold, the thermostat is closed. This confines the circulation of the coolant to within the cylinder block, resulting in faster warm-up.

When the engine is warmed up, the thermostat opens to bypass just enough coolant into the radiator core to maintain the proper temperature in the engine cylinder block.

If the thermostat ever sticks shut or fails to open, coolant in the cylinder block will soon overheat which may damage the engine.

If the thermostat opens at too low a temperature or does not close, the engine will not warm up properly and its efficiency will be lost.

Radiator

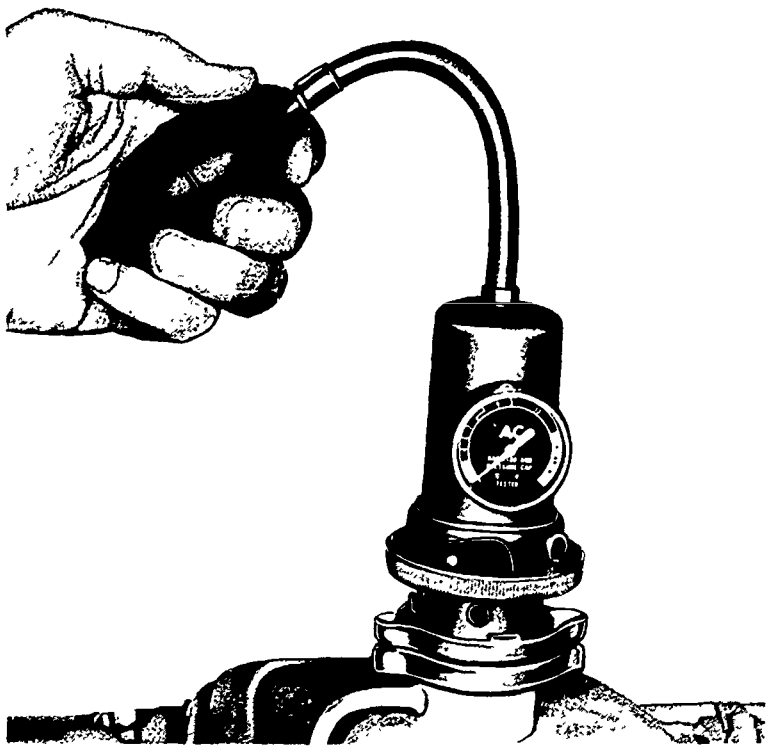

Fig. 28 — Testing Radiator For Leaks

Check the radiator for leaks using a pressure tester as illustrated in Fig. 28. *Avoid applying too much pressure.* A maximum of 15 to 25 psi should be sufficient.

If any leaks are observed, repair them. See Chapter 8 for details.

Examine all air passages in the radiator core. Blow out any chaff or dirt and straighten any bent fins.

Clean all chaff or dirt from the radiator screens.

Radiator Cap

Use a reliable tester to test the radiator cap (Fig. 29). The pressure valve should open at a certain pressure (see engine Technical Manual for specifications).

If the pressure valve does not open as specified or leaks before reaching opening pressure, replace the gasket or the whole cap as necessary.

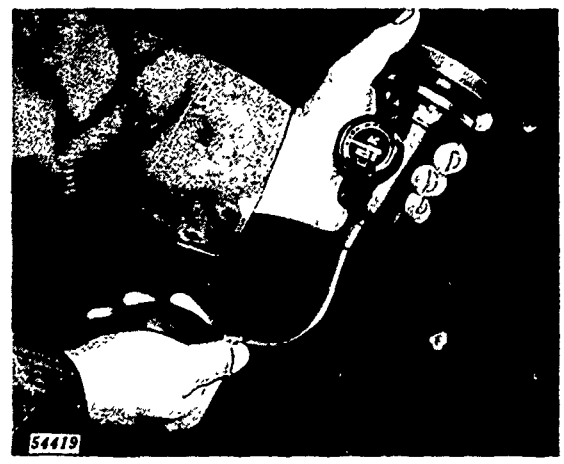

Fig. 29 — Testing Pressure Cap

Be sure that the cap and radiator are free from leaks. The pressure cap permits pressure to build up in the cooling system and so raises the boiling point of the coolant to approximately 230°F. This prevents boiling away of the coolant which would occur at a lower temperature. The pressure cap also prevents loss of coolant through the overflow when traveling over rough terrain.

Fan Belt

Check the fan belt for excessive wear, cracks, or other signs of damage. Replace the belt if any of these conditions exist.

Fan belt tension is checked later during generator inspection.

7. ELECTRICAL SYSTEM

Servicing of electrical systems is covered in the FOS-20 manual on "Electrical Systems". Refer to that manual for details on the tune-up procedures given here.

Batteries

CLEANING THE BATTERIES

Use a stiff brush and a water and soda solution to thoroughly clean the batteries. Rinse off the batteries with clean water.

If the battery terminals are corroded, disconnect and clean them. Clean the battery posts and the insides of the connectors so they make good electrical contact.

Be sure the batteries are properly installed.

Use petroleum jelly on the battery posts and connectors to prevent corrosion.

TESTING THE SPECIFIC GRAVITY

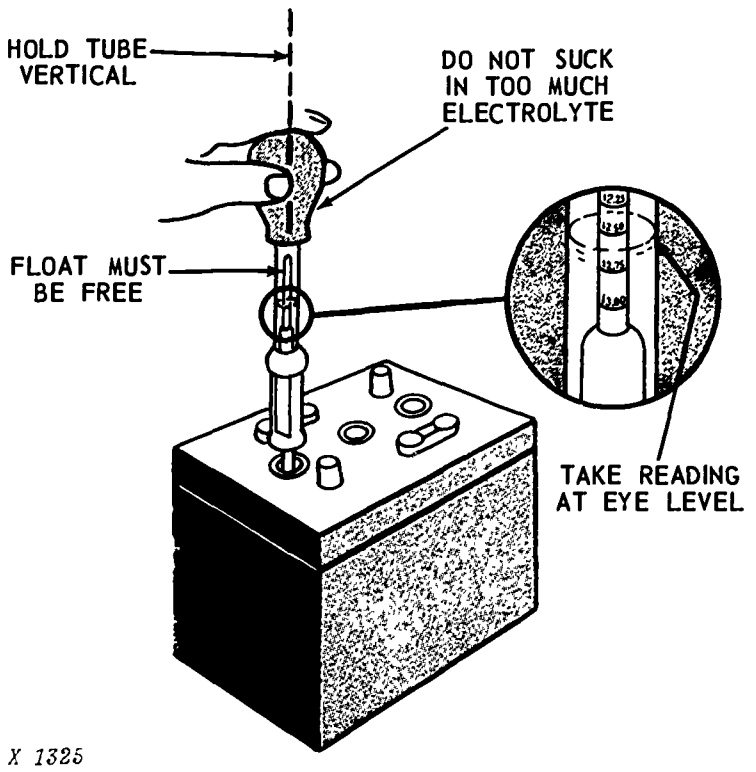

Fig. 30 — Testing The Battery Specific Gravity

Use an accurate battery hydrometer to check the specific gravity of the electrolyte in each battery cell (Fig. 30).

If the specific gravity of the electrolyte is low, it suggests undercharging.

If the specific gravity shows the battery is fully charged but the electrolyte level is low, the battery may have been charged at too high a rate. This will be discussed later.

ADDING WATER TO BATTERIES

Fill each battery cell to the proper level. Battery waters are listed below in the order of their quality.

1. *Distilled water*
2. *Water from a dehumidifier or from defrosting*
3. *Rain water*
4. *Tap water*

The first two waters are best since they contain no minerals.

The third is not so good because rain water can collect minerals from the air.

The fourth is least desirable since it contains chlorine and carbonates which can shorten the life of the battery.

CAUTION: Avoid adding too much water to the batteries during freezing weather unless the engine is run long enough to mix the water with the electrolyte. Unmixed water can freeze and burst the battery.

LIGHT LOAD TEST OF BATTERIES

Make a "light load" test of the batteries to determine their condition.

Recharge or replace the batteries if they fail any part of the "light load" test.

Alternator or Generator

CHECKING BELT TENSION

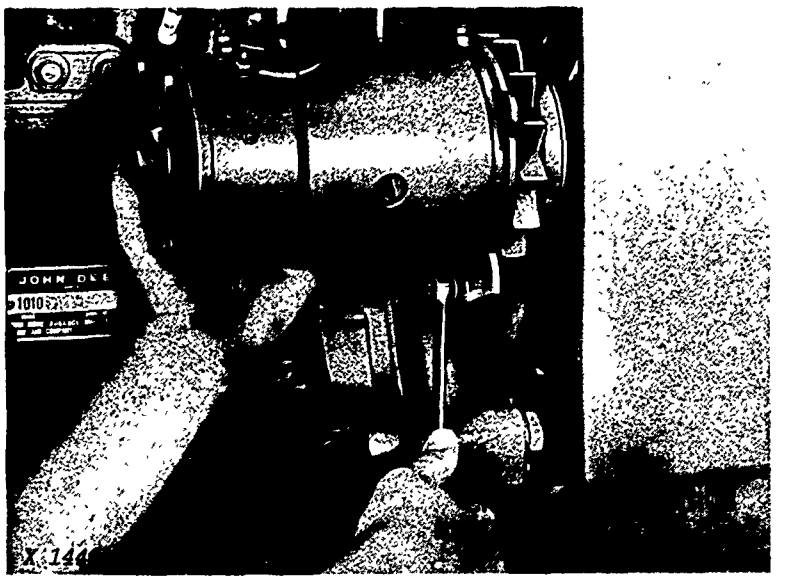

Fig. 31 — Belt Tension Adjustment

Check belt for proper tension. Fig 31 shows a typical belt installation. Refer to the engine Technical Manual for the correct tension and how to adjust it.

TESTING GENERATING OUTPUT

Check the output of the alternator or generator. Refer to the engine Technical Manual for details.

CAUTION: Follow the manual procedure exactly. Making a wrong connection can severely damage an alternator.

Starting Circuit

SAFETY STARTER SWITCH

Some machines use a safety starter switch to prevent starting the engine when the machine is in gear.

Check the operation of the switch by operating the gear shift and trying to start the engine. Refer to the engine Technical Manual and replace or adjust the safety switch as necesssary.

STARTING MOTOR

With the engine warmed up, check the ampere draw of the starting motor.

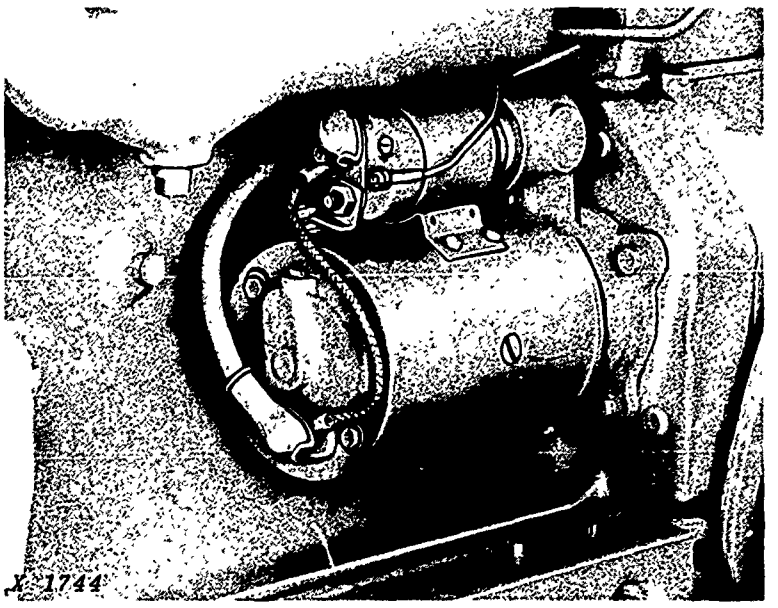

Fig. 32 — Typical Starting Motor

Disconnect the battery cable from the starting motor and use an ammeter connected as instructed in the engine Technical Manual. Record the amperage draw and check it against the specifications.

If the ampere draw is too high, look for worn starter bearings or some drag in the engine.

8. CLUTCH FREE TRAVEL

Clutch free travel is the distance the pedal travels before it starts to disengage the clutch from the engine flywheel.

Too little clutch free travel may cause the clutch release bearing to operate continuously, resulting in early failure.

Too much free travel may cause the clutch to slip and wear out faster.

To check free travel, pull the pedal down until you feel a contact at the flywheel. Measure this distance as shown in Fig. 33 and check it against the engine Technical Manual. If necessary, adjust as specified.

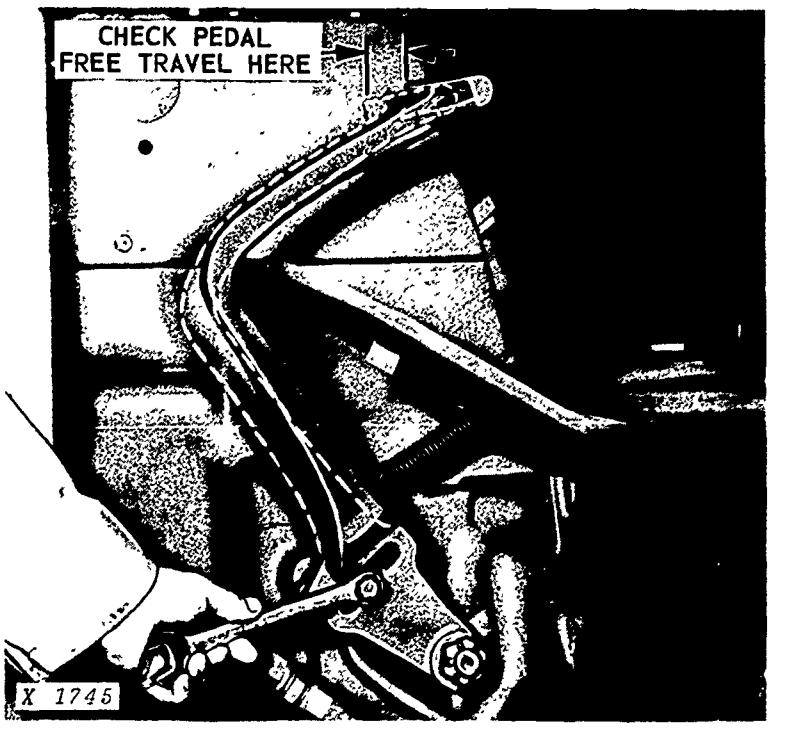

Fig. 33 — Clutch Free Travel Adjustment

9. DYNAMOMETER TEST

The dynamometer test is the final check of overall engine performance. It will tell you whether the tune-up has been adequate. Compare it with the dynamometer test made *before* tune-up.

Test for the following things:

1. **Engine Horsepower**
2. **Exhaust Analysis**

   Smoke analysis (diesel)

   Carburetor adjustment (spark-ignition)
3. **Fuel Consumption**
4. **Crankcase Blow-By**

Most dynamometer manufacturers have instruments to be used with the dynamometer for checking the above items.

Use the engine Technical Manual for procedures and specifications.

NOTE: If the engine fails to produce the desired horsepower, and an air cleaner restriction test was not made at the beginning, make one now. It is possible that an air restriction is causing the loss of horsepower.

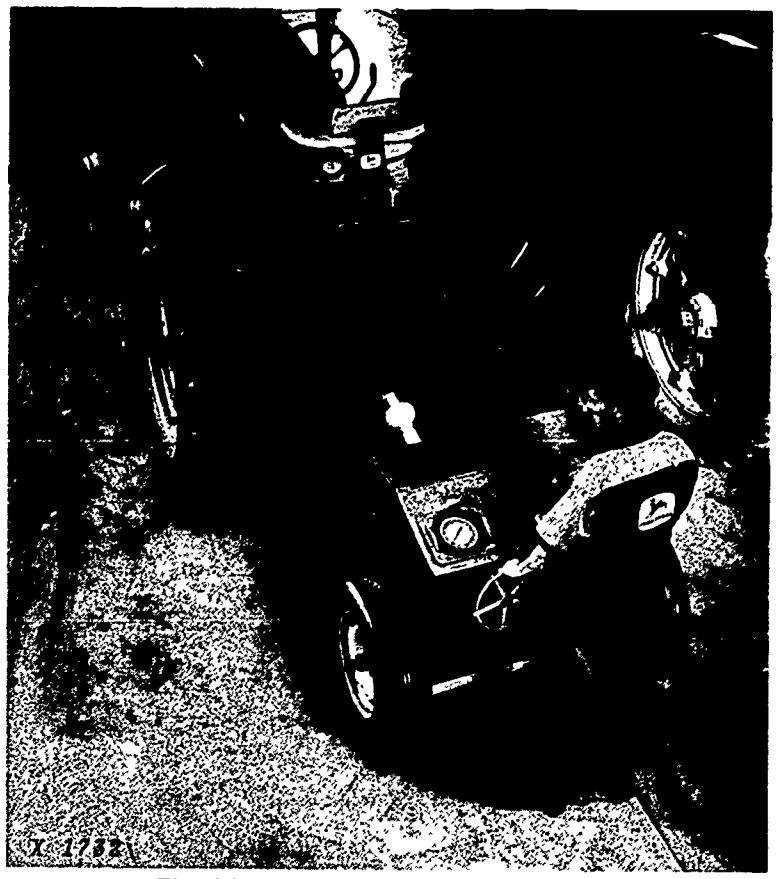

Fig. 34 — A Typical Dynamometer Test

A completely tuned engine should pass the dynamometer test with no problems.

However, the engine should not put out *more* horsepower than it was designed for. Tampering with the engine to get extra horsepower will shorten engine life and raise operating costs. It may also void the engine warranty.

SUMMARY: ENGINE TUNE-UP

Tune-up of an engine may seem like a long and expensive ordeal.

Actually, most of the items can be checked in a minute or two.

But why check out so many items if the engine has not actually failed?

The answer is that **tune-up is preventive maintenance.**

Before the engine fails, we keep it tuned up so that causes are corrected early, and possible causes are prevented.

Tune-up catches the problems early—in the shop, not in the field.

Shop costs are much cheaper than field costs, and by scheduling the tune-up during a lull in operation, costly downtime at peak periods is prevented.

WHY REGULAR TUNE-UP PAYS

Tune-Up Will Not Restore A Badly Worn Engine – Only Major Overhaul Will

BUT:

- Tune-up Improves The Engine
- And Also Prevents Later Problems

HOW?

- Catching Problems Early Means Fewer Service Calls In The Field
- Shop Service Is Cheaper Than Field Calls
- And Shop Service Can Be Scheduled To Avoid Peak Operations

RESULTS:

- Tune-Up Means That The Engine Is Ready To Go
- And Is Dependable For Long, Productive Hours

X 1746

Fig. 35 — Why Regular Tune-Up Pays

Tune-up means that the engine is ready to go and the operator can depend on it for some long and productive hours on the job.

TEST YOURSELF

QUESTIONS

1. True or false? "A badly worn engine can be restored by a complete tune-up."
2. Before tuning up an engine, what should be done?
3. When should dynamometer tests be made?

ANSWERS

1. False. Tune-up can restore an engine which needs minor checks and adjustments, but it cannot make up for overdue repairs. Only a major overhaul can do that.

2. A *visual inspection* should be made to find out the condition of the engine and to see whether a tune-up or an overhaul is necessary.

3. Both **before** and **after** engine tune-up. Testing before tune-up gives an idea of the engine's condition and whether tune-up will do the job. Testing after tune-up gives a final check of engine performance to see if the tune-up has been successful.

DEFINITIONS OF TERMS AND SYMBOLS

A

ABRASION—Wearing or rubbing away of a part.

ADDITIVE—A substance added to oil to give it certain properties. For example, a material added to engine oil to lessen its tendency to congeal or thicken at low temperatures.

AIR CLEANER—A device for filtering, cleaning, and removing dust from the air admitted to an engine.

ANTIFREEZE—A material such as alcohol, glycerin, etc., added to water to lower its freezing point.

ANTIFRICTION BEARING—A bearing constructed with balls, rollers or the like between the journal and the bearing surface to provide rolling instead of sliding friction.

ARC WELDING—A method of utilizing the heat of an electric current jumping an air gap to provide heat for welding metal.

ASME—American Society of Mechanical Engineers.

ATMOSPHERIC PRESSURE—The weight of the air at sea level; about 14.7 lbs. per square inch; less at higher altitudes.

B

BACK-FIRE—Ignition of the mixture in the intake manifold by flame from the cylinder such as might occur from a leaking inlet valve.

BACKLASH—The clearance or "play" between two parts, such as meshed gears.

BACK-PRESSURE—A resistance to free flow, such as a restriction in the exhaust line.

BAFFLE OR BAFFLE PLATE—An obstruction for checking or deflecting the flow of gases or sound.

BALL BEARING—An anti-friction bearing consisting of a hardened inner and outer race with hardened steel balls interposed between the two races.

BEARING—A part in which a journal, pivot or the like turns or moves.

B.H.P. (Brake Horsepower)—A measurement of the power developed by an engine in actual operation. It subtracts the F.H.P. (friction losses) from the I.H.P. (pure horsepower).

BLOW-BY—A leakage or loss of compression past the piston ring between the piston and the cylinder.

BOILING POINT—The temperature at which bubbles or vapors rise to the surface of a liquid and escape.

BORE—The diameter of a hole, such as a cylinder; also to enlarge a hole as distinguished from making a hole with a drill.

BRAZE—To join two pieces of metal using a comparatively high-melting-point material. An example is to join two pieces of steel by using brass or bronze as a solder.

BREAK-IN—The process of wearing in to a desirable fit between the surfaces of two new or reconditioned parts.

BURNISH—To smooth or polish using a sliding tool under pressure.

BUSHING—A removable liner for a bearing.

BY-PASS—An alternate path for a flow of air or liquid.

C

CALIBRATE—To determine or adjust the graduation or scale of any measuring instrument.

CALORIFIC VALUE—A measure of the heating value of fuel.

CALORIMETER—An instrument to measure the amount of heat given off by a substance when burned.

CALORY—The metric measurement of the amount of heat required to raise 1 gram of water from zero degrees to 1 degree Centigrade.

CAM-GROUND PISTON—A piston ground to a slightly oval shape which under the heat of operation becomes round.

CAMSHAFT—The shaft containing lobes or cams to operate the engine valves.

CARBON MONOXIDE—Gas formed by incomplete combustion. Colorless, odorless, and very poisonous.

CARBONIZE—The process of carbon formation within an engine, such as on the spark plugs and within the combustion chamber.

CARBURETOR—A device for automatically mixing gasoline fuel in the proper proportion with air to produce a combustible vapor.

CARBURETOR "ICING"—A term used to describe the formation of ice on a carburetor throttle plate during certain atmospheric conditions.

CETANE—Measure of ignition quality of diesel fuel—at what pressure and temperature the fuel will ignite and burn.

CHAMFER—A bevel or taper at the edge of a hole.

CHASE—To straighten up or repair damaged threads.

CHOKE—A device such as a valve placed in a carburetor air inlet to restrict the volume of air admitted.

COMBUSTION—The process of burning.

COMBUSTION CHAMBER—The volume of the cylinder above the piston with the piston on top center.

COMPRESSION—The reduction in volume or the "squeezing" of a gas. As applied to metal, such as a coil spring, compression is the opposite of tension.

COMPRESSION RATIO—The volume of the combustion chamber at the end of the compression stroke as compared to the volume of the cylinder and chamber with the piston on bottom center. Example: 8 to 1.

CONDENSATION—The process of a vapor becoming a liquid; the reverse of evaporation.

CONNECTING ROD—Rod that connects the piston to the crankshaft.

CONTRACTION—A reduction in mass or dimension; the opposite of expansion.

CONVECTION—A transfer of heat by circulating heated air.

CONVERTER—As used in connection with LP-Gas, a device which converts or changes LP-Gas from a liquid to a vapor for use by the engine.

CORRODE—To eat away gradually as if by gnawing, especially by chemical action, such as rust.

COUNTERBORE—To enlarge a hole to a given depth.

COUNTERSINK—To cut or form a depression to allow the head of a screw to go below the surface.

CRANKCASE—The lower housing in which the crankshaft and many other parts of the engine operate.

CRANKCASE DILUTION—When unburned fuel finds its way past the piston rings into the crankcase oil, where it dilutes or "thins" the engine lubricating oil.

CRANKSHAFT—The main drive shaft of an engine which takes reciprocating motion and converts it to rotary motion.

CRANKSHAFT COUNTER-BALANCE—A series of weights attached to or forged integrally with the crankshaft to offset the reciprocating weight of each piston and rod.

CRUDE OIL—Liquid oil as it comes from the ground.

CU. IN.—Cubic Inch.

CYLINDER—A round hole having some depth bored to receive a piston; also sometimes referred to as "bore" or "barrel."

CYLINDER BLOCK—The largest single part of an engine. The basic or main mass of metal in which the cylinders are bored or placed.

CYLINDER HEAD—A detachable portion of an engine fastened securely to the cylinder block which contains all or a portion of the combustion chamber.

CYLINDER LINER—A sleeve or tube interposed between the piston and the cylinder wall or cylinder block to provide a readily renewable wearing surface for the cylinder.

D

DEAD CENTER—The extreme top or bottom position of the crankshaft throw at which the piston is not moving in either direction.

DENSITY—Compactness; relative mass of matter in a given volume.

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DETERGENT—A compound of a soap-like nature used in engine oil to remove engine deposits and hold them in suspension in the oil.

DETONATION—A too-rapid burning or explosion of the mixture in the engine cylinders. It becomes audible through a vibration of the combustion chamber walls and is sometimes confused with a "ping" or spark "knock."

DIAGNOSIS—In engine service, the use of instruments to "trouble shoot" the engine parts to locate the cause of a failure.

DIESEL ENGINE—Named after its developer, Dr. Rudolph Diesel. This engine ignites fuel in the cylinder from the heat generated by compression. The fuel is an "oil" rather than gasoline, and no spark plug or carburetor is required.

DILUTION—See Crankcase Dilution.

DISPLACEMENT—See Piston Displacement.

DISTORTION—A warpage or change in form from the original shape.

DOWEL PIN—A pin inserted in matching holes in two parts to maintain those parts in fixed relation one to the other.

DOWN-DRAFT—A type of carburetor in which the fuel-air mixture flows downward to the engine.

DRAWBAR HORSEPOWER—Measure of the pulling power of a machine at the drawbar hitch point.

DYNAMOMETER—A test unit for measuring the actual power produced by an engine.

E

ECCENTRIC—One circle within another circle but with a different center of rotation. An example of this is a driving cam on a camshaft.

ECONOMIZER—A device installed in a carburetor to control the amount of fuel used under certain conditions.

ENERGY—The capacity for doing work.

ENGINE—The prime source of power generation used to propel the machine.

ENGINE DISPLACEMENT—The sum of the displacement of all the engine cylinders. See Piston Displacement.

EVAPORATION—The process of changing from a liquid to a vapor, such as boiling water to produce steam. Evaporation is the opposite of condensation.

EXHAUST GAS ANALYZER—An instrument for determining the efficiency with which an engine is burning fuel.

EXHAUST MANIFOLD—The passages from the engine cylinders to the muffler which conduct the exhaust gases away from the engine.

EXPANSION—An increase in size. For example, when a metal rod is heated it increases in length and perhaps also in diameter. Expansion is the opposite of contraction.

F

F.H.P. (Friction Horsepower)—A measure of the power lost to the engine through friction or rubbing of parts.

FILTER—(Oil, Water, Gasoline. Etc.)—A unit containing an element, such as a screen of varying degrees of fineness. The screen or filtering element is made of various materials depending upon the size of the foreign particles to be eliminated from the fluid being filtered.

FLASH POINT—The temperature at which an oil, when heated, will flash and burn.

FLOATING PISTON PIN—A piston pin which is not locked in the connecting rod or the piston, but is free to turn or oscillate in both the connecting rod and the piston.

FLOAT LEVEL—The height of the fuel in the carburetor bowl, usually regulated by means of a suitable valve or float.

"FLUTTER" OR "BOUNCE"—In engine valves, refers to a condition where the valve is not held tightly on its seat during the time the cam is not lifting it.

FLYWHEEL—A heavy wheel in which energy is absorbed and stored by means of momentum.

FOOT-POUND (Ft.-Lb.)—This is a measure of the amount of energy or work required to lift one pound a distance of one foot.

FOUR-CYCLE ENGINE—Also known as Otto cycle, where an explosion occurs every other revolution of the crankshaft; a cycle being considered as ½ revolution of the crankshaft. These strokes are (1) intake stroke; (2) compression stroke; (3) power stroke; (4) exhaust stroke.

FUEL KNOCK—Same as Detonation.

G

GAS—A substance which can be changed in volume and shape according to the temperature and pressure applied to it. For example, air is a gas which can be compressed into smaller volume and into any shape desired by pressure. It can also be expanded by the application of heat.

GEAR RATIO—The number of revolutions made by a driving gear as compared to the number of revolutions made by a driven gear of different size. For example, if one gear makes three revolutions while the other gear makes one revolution, the gear ratio would be 3 to 1.

GLAZE—As used to describe the surface of the cylinder, an extremely smooth or glossy surface such as a cylinder wall highly polished over a long period of time by the friction of the piston rings.

GLAZE BREAKER—A tool for removing the glossy surface finish in an engine cylinder.

GOVERNOR—A device to control and regulate speed. May be mechanical, hydraulic, or electrical.

GRIND—To finish or polish a surface by means of an abrasive wheel.

H

HEAT EXCHANGER—Sometimes used to describe a Vaporizer.

HEAT TREATMENT—A combination of heating and cooling operations timed and applied to a metal in a solid state in a way that will produce desired properties.

HONE—An abrasive tool for correcting small irregularities or differences in diameter in a cylinder.

HORSEPOWER (HP)—The energy required to lift 550 lbs. one ft. in one second.

HOT SPOT—Refers to a comparatively thin section or area of the wall between the inlet and exhaust manifold of an engine, the purpose being to allow the hot exhaust gases to heat the comparatively cool incoming mixture. Also used to designate local areas of the cooling system which have attained above average temperatures.

I

I.D.—Inside diameter.

IDLE—Refers to the engine operating at its slowest speed with a machine not in motion.

I.H.P. (Indicated Horsepower)—"Pure" horsepower as measured in the combustion chamber before friction and other losses are subtracted.

IN.—Inch.

INERTIA—A physical law which tends to keep a motionless body at rest or also tends to keep a moving body in motion; effort is thus required to start a mass moving or to retard or stop it once it is in motion.

INHIBITOR—A material to restrain some unwanted action, such as a rust inhibitor which is a chemical added to cooling systems to retard the formation of rust.

INJECTION PUMP (Diesel)—A device by means of which the fuel is metered and delivered under pressure to the injector.

INJECTOR (Diesel)—An assembly which receives a metered charge of fuel from another source at relatively low pressure, then is actuated to inject the charge of fuel into a cylinder or chamber at high pressure and at the proper time.

INPUT SHAFT—The shaft carrying the driving gear, such as in a transmission by which the power is applied.

INTAKE MANIFOLD—The passages which conduct the fuel-air mixture from the carburetor to the engine cylinders.

INTAKE VALVE—A valve which permits a fluid or gas to enter a chamber and seals against exit.

INTEGRAL—The whole made up of parts.

INTERNAL COMBUSTION—The burning of a fuel within an enclosed space.

J

JOURNAL—A part or support within which a shaft operates.

K

KEY—A small block inserted between the shaft and hub to prevent circumferential movement.

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KEYWAY OR KEYSEAT—A groove or slot cut for inserting a key to hold a part on a shaft, etc.

KNOCK—A general term used to describe various noises occurring in an engine; may be used to describe noises made by loose or worn mechanical parts, preignition, detonation, etc.

KNURLED—Displacing metal on the wall of a piston to increase the diameter of the piston (on automotive engines).

L

LACQUER—A solution of solids in solvents which evaporate with great rapidity.

LAPPING—The process of fitting one surface to another by rubbing them together with an abrasive material between the two surfaces.

L-HEAD ENGINE—An engine design in which both valves are located on one side of the engine cylinder.

LINER—Usually a thin section placed between two parts, such as a replaceable cylinder liner in an engine.

LP-GAS, LIQUEFIED PETROLEUM GAS—Made usable as a fuel for internal combustion engines by compressing volatile petroleum gases to liquid form. When so used, must be kept under pressure or at low temperature in order to remain in liquid form, until used by the engine.

M

MANIFOLD—A pipe or casting with multiple openings used to connect various cylinders to one inlet or outlet.

MANOMETER—A device for measuring a vacuum. It is a U-shaped tube partially filled with fluid. One end of the tube is open to the air and the other is connected to the chamber in which the vacuum is to be measured. A column of Mercury 30 in. high equals 14.7 lbs. per square in. which is atmospheric pressure at sea level. Readings are given in terms of inches of Mercury.

MECHANICAL EFFICIENCY (Engine)—The ratio between the indicated horsepower and the brake horsepower of an engine.

MICROMETER—A measuring instrument for either external or internal measurement in thousandths and sometimes tenths of thousandths of inches.

MISFIRING—Failure of an explosion to occur in one or more cylinders while the engine is running; may be a continuous or intermittent failure.

MOTOR—This term should be used in connection with an electric motor and should not be used when referring to the *engine* of a machine.

M.P.H.—Miles per hour.

MUFFLER—A chamber attached to the end of the exhaust pipe which allows the exhaust gases to expand and cool. It is usually fitted with baffles or porous plates and serves to subdue much of the noise created by the exhaust.

N

NEEDLE BEARING—An antifriction bearing using a great number of thin rollers.

O

OCTANE—Measurement which indicates the tendency of a fuel to detonate or knock.

O.D.—Outside diameter.

OIL PUMPING—A term used to describe an engine which is using an excessive amount of lubrication oil.

OTTO CYCLE—Also called four-stroke cycle. Named after the man who adopted the principle of four cycles of operation for each explosion in an engine cylinder. They are (1) intake stroke, (2) compression stroke, (3) power stroke, (4) exhaust stroke.

P

PEEN—To stretch or clinch over by pounding with the rounded end of a hammer.

PETROLEUM—A group of liquid and gaseous compounds composed of carbon and hydrogen which are removed from the earth.

PINION—A small gear having the teeth formed in the hub.

PISTON—A cylindrical part closed at one end which is connected to the crankshaft by the connecting rod. The force of the expansion in the cylinder is exerted against the closed end of the piston, causing the connecting rod to move the crankshaft.

PISTON COLLAPSE—A condition describing a collapse or a reduction in diameter of the piston skirt due to heat or stress.

PISTON DISPLACEMENT—The volume of air moved or displaced by moving the piston from one end of its stroke to the other.

PISTON HEAD—That part of the piston above the rings.

PISTON LANDS—Those parts of a piston between the piston rings.

PISTON PIN—The journal for the bearing in the small end of an engine connecting rod which also passes through piston walls; also known as a wrist pin.

PISTON RING—An expanding ring placed in the grooves of the piston to seal off the passage of fluid or gas past the piston.

PISTON RING EXPANDER—A spring placed behind the piston ring in the groove to increase the pressure of the ring against the cylinder wall.

PISTON RING GAP—The clearance between the ends of the piston ring.

PISTON RING GROOVE—The channel or slots in the piston in which the piston rings are placed.

PISTON SKIRT—That part of the piston below the rings.

PORT—The openings in the cylinder block for valves, exhaust and inlet pipes, or water connections. In two-cycle engines, the openings for intake and exhaust.

PREIGNITION—Ignition occurring earlier than intended. For example, the explosive mixture being fired in a cylinder as by a flake of incandescent carbon before the electric spark occurs.

PRESS-FIT—Also known as a force-fit or drive-fit. This term is used when the shaft is slightly larger than the hole and must be forced into place.

P.S.I.—A measurement of pressure in Pounds per Square Inch.

PUSH ROD—A connecting link in an operating mechanism, such as the rod interposed between the valve lifter and rocker arm on an overhead valve engine.

R

RACE—As used with reference to bearings; a finished inner and outer surface in which or on which balls or rollers operate.

RATED HORSEPOWER—Value used by the engine manufacturer to rate the power of his engine, allowing for safe loads, etc.

RATIO—The relation or proportion of one number or quantity to another.

REAM—To finish a hole accurately with a rotating fluted tool.

RECIPROCATING MOTION—A back and forth movement, such as the action of a piston in a cylinder.

ROCKER ARM—In an engine a lever located on a fulcrum or shaft, one end on the valve stem, the other on the push rod.

ROLLER BEARING—An inner and outer race upon which hardened steel rollers operate.

ROTARY MOTION—A circular movement, such as the rotation of a crankshaft.

ROTOR—Rotating valve or conductor for carrying fluid or electrical current from a central source to the individual outlets as required.

R.P.M.—Revolutions per minute.

RUNNING-FIT—Where sufficient clearance has been allowed between the shaft and journal to allow free running without overheating.

S

S.A.E.—Society of Automotive Engineers. This group sets the standards for much engine design.

SAFETY FACTOR—The degree of surplus strength over and above normal requirements which serves as insurance against failure.

SAND BLAST—To clean a surface by means of sand propelled by compressed air.

SCALE—A flaky deposit occurring on steel or iron. Ordinarily used to describe the accumulation of minerals and metals accumulating in an engine cooling system.

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SCORE—A scratch, ridge or groove marring a finished surface.

SEAT—A surface, usually machined, upon which another part rests or seats. For example, the surface upon which a valve face rests.

SHIM—Thin sheets used as spacers between two parts, such as the two halves of a journal bearing.

SHRINK-FIT—Where the shaft or parts are slightly larger than the hole in which it is to be inserted. The outer part is heated above its normal operating temperature or the inner part chilled below its normal operating temperature and assembled in this condition; upon cooling an exceptionally tight fit is obtained.

SLIDING-FIT—Where sufficient clearance has been allowed between the shaft and journal to allow free running without overheating.

SLIP-IN BEARING—A liner made to precise measurements which can be used for replacement without additional fitting.

SLUDGE—A composition of oxidized petroleum products along with an emulsion formed by the mixture of oil and water. This forms a pasty substance and clogs oil lines and passages and interferes with engine lubrication.

SOLID INJECTION—The system used in diesel engines where fuel as a fluid is injected into the cylinder rather than a mixture of fuel and air.

SOLVENT—A solution which dissolves some other material. For example, water is a solvent for sugar.

SPLINE—A long keyway.

SPOT WELD—To attach in spots by localized fusion of the metal parts with the aid of an electric current.

SQ. FT.—Square feet.

SQ. IN.—Square inch.

STRESS—The force or strain to which a material is subjected.

STROKE—The distance moved by the piston.

STUDS—A rod with threads cut on both ends, such as a cylinder stud which screws into the cylinder block on one end and has a nut placed on the other end to hold the cylinder head in place.

SUCTION—Suction exists in a vessel when the pressure is lower than the atmospheric pressure; also see Vacuum.

SUPERCHARGER—A blower or pump which forces air into the cylinders at higher-than-atmospheric pressure. The increased pressure forces more air into the cylinder, thus enabling more fuel to be burned and more power produced.

SYNCHRONIZE—To cause two events to occur at the same time. For example, to time a mechanism so that two or more sparks willl occur at the same instant.

T

TACHOMETER—A device for measuring and showing the rotating speed of an engine.

TAP—To cut threads in a hole with a tapered, fluted, threaded tool.

TAPPET—The adjusting device for varying the clearance between the valve stem and the cam. May be built into the valve lifter in an engine or may be installed in the rocker arm on an overhead-valve engine.

T.D.C.—Top dead center (of a piston).

T-HEAD ENGINE—An engine design wherein the inlet valves are placed on one side of the cylinder and the exhaust valves are placed on the other.

THERMAL EFFICIENCY—A gallon of fuel contains a certain amount of potential energy in the form of heat when burned in the combustion chamber. Some of this heat is lost and some is converted into power. The thermal efficiency is the ratio of work accomplished to the total quantity of heat in the fuel.

THERMOSTAT—A heat-controlled valve used in the cooling system of an engine to regulate the flow of water between the cylinder block and the radiator.

THROW—The distance from the center of the crankshaft main bearing to the center of the connecting rod journal.

TIMING GEARS—Any group of gears which are driven from the engine crankshaft to cause the valves, ignition and other engine-driven accessories to operate at the desired time during the engine cycle.

TOLERANCE—A permissible variation between the two extremes of a specification of dimensions. Used in the precision fitting of mechanical parts.

TORQUE—The effort of twisting or turning.

TORQUE WRENCH—A special wrench with a built-in indicator to measure the applied turning force.

TROUBLE SHOOTING—A process of diagnosing or locating the source of the trouble or troubles from observation and testing. Also see Diagnosis.

TUNE-UP—A process of accurate and careful adjustments to obtain the best engine performance.

TURBINE—A series of angled blades located on a wheel against which fluids or gases are impelled to rotate a shaft.

TURBULENCE—A disturbed, irregular motion of fluids or gases.

TWO-CYCLE ENGINE—An engine design permitting a power stroke once for each revolution of the crankshaft.

U

UP-DRAFT—A carburetor type in which the mixture flows upward to the engine.

V

VACUUM—A perfect vacuum has not been created as this would involve an absolute lack of pressure. The term is ordinarily used to describe a partial vacuum; that is, a pressure less than atmospheric pressure; in other words a Suction.

VACUUM GAUGE—An instrument designed to measure the degree of vacuum existing in a chamber.

VALVE—A device for opening and sealing the cylinder intake and exhaust ports.

VALVE CLEARANCE—The air gap allowed between the end of the valve stem and the valve lifter or rocker arm to compensate for expansion due to heat.

VALVE FACE—That part of a valve which mates with and rests upon a seating surface.

VALVE GRINDING—Also called valve lapping. A process of lapping or mating the valve seat and valve face usually performed with the aid of an abrasive.

VALVE HEAD—The portion of the valve upon which the valve face is machined.

VALVE-IN-HEAD ENGINE—Same as Overhead Valve Engine.

VALVE LIFTER—A push rod or plunger placed between the cam and the valve on an engine; is often adjustable to vary the length of the unit.

VALVE MARGIN—On a poppet valve, the space or rim between the surface of the head and the surface of the valve face.

VALVE SEAT—The matched surface upon which the valve face rests.

VALVE SPRING—A spring attached to a valve to return it to the seat after it has been released from the lifting or opening means.

VALVE STEM—That portion of a valve which rests within a guide.

VALVE STEM GUIDE—A bushing or hole in which the valve stem is placed which allows lateral motion only.

VANES—Any plate, blade or the like attached to an axis and moved by or in air or a liquid.

VAPORIZER—A device for transforming or helping to transform a liquid into a vapor; often includes the application of heat.

VAPOR LOCK—A condition wherein the fuel boils in the fuel system forming bubbles which retard or stop the flow of fuel to the carburetor.

VENTURI—Two tapering streamlined tubes joined at their small ends so as to reduce the internal diameter.

VIBRATION DAMPER—A device to reduce the torsional or twisting vibration which occurs along the length of the crankshaft used in multi-cylinder engines; also known as a harmonic balancer.

VISCOSITY—The resistance to flow of an oil.

VOLATILITY—The tendency for a fluid to evaporate rapidly or pass off in the form of vapor. For example, gasoline is more volatile than kerosene as it evaporates at a lower temperature.

VORTEX—A whirling movement of mass of liquid or air.

W

WRIST PIN—The journal for the bearing in the small end of an engine connecting rod which also passes through piston walls; also know as a Piston Pin.

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ABSTRACT - Developed by Deere and Company for use as a training manual for shop trainees or as a reference source for experienced mechanics, this manual contains information on understanding and servicing electrical systems. Arranged in a step-by-step manner, the first two chapters contain basic information on electricity and equipment, followed by five chapters detailing the working parts of various circuits, and concluding with two chapters discussing general maintenance of the complete system. Chapters are: (1) Electricity: How It Works, (2) Testing Tools and Equipment, (3) Storage Batteries, (4) Charging Circuits, (5) Starting Circuits, (6) Ignition Circuits, (7) Lighting and Accessory Circuits, (8) General Maintenance, and (9) Diagnosis and Testing of Electrical Systems. Definitions of terms and symbols as well as a subject index are included. A comprehensive color slide set of the line drawings and photographs illustrating the text is available from the source of availability indicated for the document. Related documents are available as VT 010 754, VT 010 755 and VT 010 756 (all in this issue). (SB)

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FOS

Fundamentals of Service Electrical Systems

JOHN DEERE

VT010757

TO THE READER

PURPOSE OF THIS MANUAL

The main purpose of this manual is to train the reader so that he can understand and service electrical systems with speed and skill. Starting with "how it works," we build up to "why it fails" and "what to do about it." This manual is also an excellent reference for the trained mechanic who wants to refresh his memory on electricity. It has been written in a simple form using many illustrations so that it can be easily understood.

APPLICATION OF ELECTRICITY IN THIS MANUAL

"Electricity" is a broad field. But in this manual, the prime interest is in electricity as it is commonly used to produce work on the farm and in industry.

HOW TO USE THIS MANUAL

This manual can be used by anyone—experienced mechanics and shop trainees, as well as vocational students and interested laymen.

By starting with the basics, build your knowledge step by step. Chapter 1 covers the basics—"how it works;" Chapters 3 through 7 go into detail about the working parts of the various circuits. Chapters 8 and 9 return to the complete system in terms of general maintenance, "why it fails," and how to remedy these failures.

Persons not familiar with basic electricity should start at Chapter 1 and study the chapters in sequence. The experienced man can find what he needs on the "Contents" page.

OTHER MANUALS IN THIS SERIES

We, at John Deere, are preparing a series of these manuals called "Fundamentals of Service," or "FOS."

Other manuals in the FOS series are:

- **Hydraulics**
- **Engines**
- **Power Transmitting Systems**
- **General Information**

We hope to expand this library in the future to fulfill the needs of our dealer's servicemen, as well as vocational students and interested laymen.

ACKNOWLEDGEMENTS

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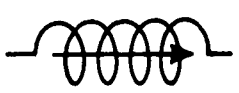
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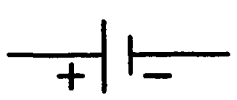

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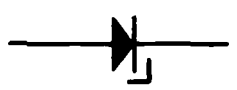
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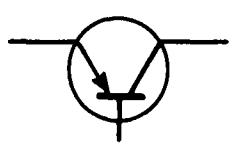
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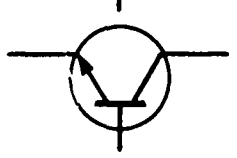
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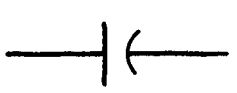
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ELECTRICITY — How It Works / CHAPTER 1

INTRODUCTION

In this chapter we will cover the basics of electricity:

- **The Nature of Electricity**
- **What Is Electricity?**
- **Basic Electrical Circuits**
- **Three Types of Electrical Circuits**
- **Measuring Current, Voltage, and Resistance (Ohm's Law)**
- **Conductors**
- **Semiconductors**
- **Magnetism**
- **Electromagnetism**
- **Electromagnetic Induction**
- **Capacitors**

Let's discuss each of these subjects in detail.

THE NATURE OF ELECTRICITY

Electricity is the flow of electrons from atom to atom in a conductor.

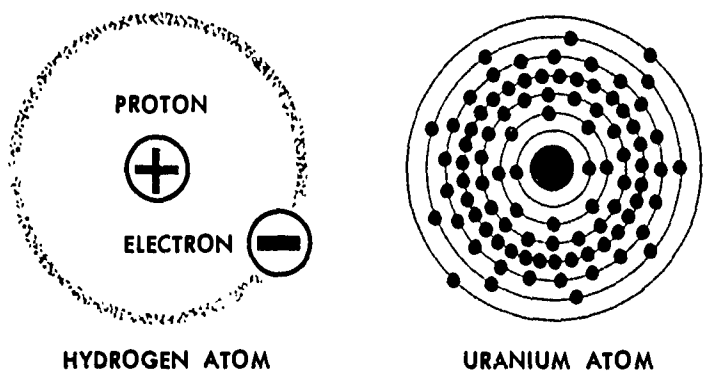


Fig. 1—All Matter Is Made Up of Atoms

To understand this, let's look at the smallest unit of all matter—the **atom** (Fig. 1). All atoms have particles called **electrons** in orbit around a core of **protons.**

The simplest element is hydrogen. As shown, its atom has a single electron in orbit around a core of one proton.

One of the most complex elements is uranium. It has 92 electrons in orbit around a core of 92 protons.

Each element has its own atomic structure.

But each atom of an element has an *equal number of protons and electrons.*

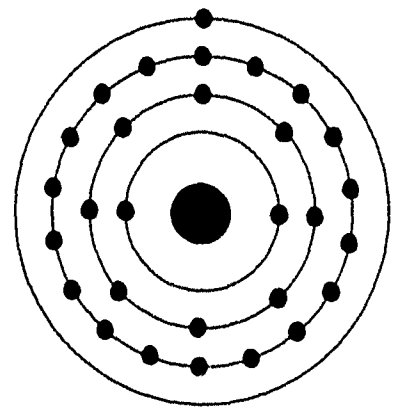


Fig. 2—Structure of a Copper Atom

The element copper is widely used in electrical systems because it is a good conductor of electricity.

The reasons for this can be seen in Fig. 2. The copper atom contains 29 protons and 29 electrons. The electrons are distributed in four separate shells or rings.

But notice that the outer ring has only one electron. This is the secret of a good conductor of electricity.

Elements whose atoms have less than four electrons in their outer rings are generally good **conductors.**

Elements whose atoms have more than four electrons in their outer rings are poor conductors and are called **insulators.**

The fewer electrons in the outer ring of conductors are more easily dislodged from their orbits by a low voltage to create a flow of current from atom to atom.

In summary:

- **Atoms have electrons in orbit around a core of protons.**

- **Each atom contains an equal number of electrons and protons.**
- **The electrons occupy shells or rings in which they orbit around the core.**
- **Atoms which have less than four electrons in their outer rings are good conductors of electricity, as with copper.**

WHAT IS ELECTRICITY?

We have seen that atoms contain particles called protons and electrons.

These particles have a potential force:

- **Protons = positive (+) charges**
- **Electrons = negative (—) charges**

The protons in the core attract the electrons and hold them in orbit. Since the positive charge of the protons is equal to the negative charge of the electrons, the atom is electrically *neutral.*

However, this neutral charge can be altered. If electrons are attracted away from an atom, the atom becomes (+) charged and the collection of electrons taken away becomes a (—) charge. Thus:

- **Negative (—) Charged atoms = too many electrons**
- **Positive (+) Charged atoms = too few electrons**

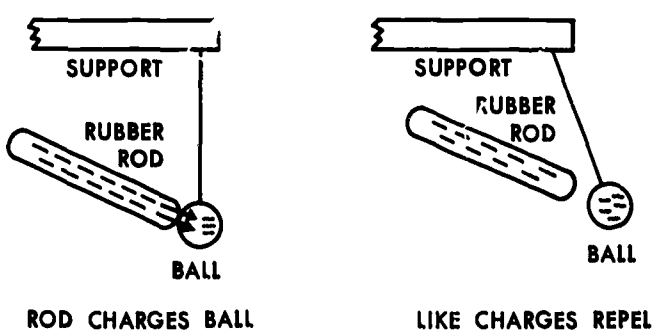


Fig. 3—Like Charges Repel

Let's show this transfer of electrons in an experiment (Fig. 3).

When a rubber rod is rubbed with wool, electrons are removed from the wool and collected on the rod. The wool now has too few electrons—is (+) charged. And the rod has too many electrons—is (—) charged.

Now let's touch the rubber rod to a pith ball and remove the rod (Fig. 3). What happens is that some of the extra electrons on the rod move onto the ball. The ball then becomes (—) charged while the rod also retains part of its (—) charge.

When the rod is moved toward the ball again, the ball swings away from the rod as shown.

In other words, *like charges repel.*

In the experiment, both charges were negative. If both charges are positive, the same thing occurs.

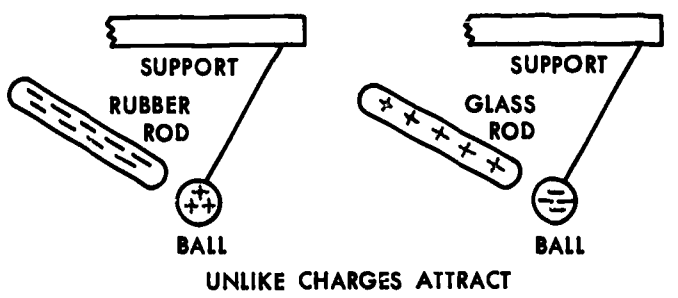


Fig. 4—Unlike Charges Attract

What happens if we move a (—) charged rod toward a (+) charged ball?

Fig. 4 shows that the ball will move toward the rod, and be attracted to it. (In the same way, a (+) charged rod will attract a (—) charged ball.)

In other words, *unlike charges attract.*

In summary:

- **Electrons can be made to leave their atoms in some materials.**
- **A force such as friction is needed to cause electrons to leave their atoms.**
- **Like charges repel and unlike charges attract.**

Now let's look at what happens in a conductor such as a copper wire when it has a negative charge at one end and a positive charge at the other end (Fig. 5).

Copper wire contains billions of atoms with electrons. We have shown only a few atoms with only the single electron in the outer ring illustrated.

What happens is that an electron at the (+) end is attracted to the (+) charge there and leaves its

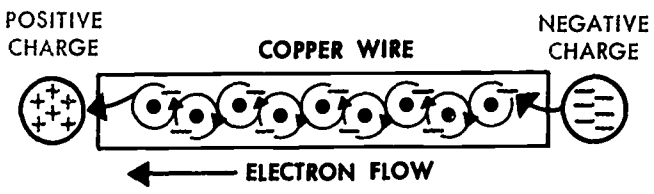


Fig. 5—Flow of Electrons in a Conductor

atom. This atom in turn is (+) charged because it now has too few electrons. So it attracts an electron from its neighbor. The neighbor in turn receives an electron from the next atom and so on.

The net result is a movement of electrons through the wire from the negative (—) end to the positive (+) end.

This flow or current of electrons will continue as long as the positive and negative charges are maintained at each end of the wire (unlike charges attracting each other).

This is dynamic electricity at work and leads us to conclude: ELECTRICITY IS THE FLOW OF ELECTRONS FROM ATOM TO ATOM IN A CONDUCTOR.

INTRODUCTION TO CURRENT, VOLTAGE, AND RESISTANCE

When electricity goes to work, we are dealing with three basic factors:

- **Current**
- **Voltage**
- **Resistance**

These terms are basic to the understanding of electricity as we'll see now.

CURRENT

The flow of electrons through a conductor is called a **current** and is measured in **amperes.**

One ampere is an electric current of 6.28 billion *billion* electrons passing a certain point in the conductor in one second (Fig. 6).

Thus, current is the *rate* of electron flow and is measured in amperes or electrons per second.

You can compare this with hydraulics where the flow of oil in a pipe is measured in gallons per minute.

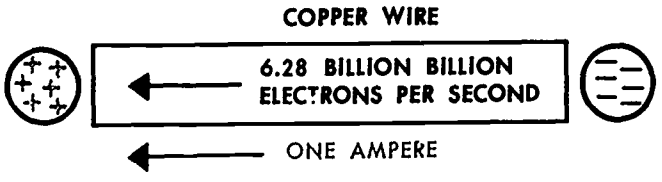


Fig. 6—How Current Is Measured

VOLTAGE

Voltage is the force that causes a flow of current in a conductor. This depends on the difference in the charges at each end of the conductor.

Voltage can be generated by a storage battery using chemicals, or by a generator using mechanical means. Voltage is a *potential* force and can exist even when there is no current flow in a circuit.

A storage battery, for example, may have a potential of 12 volts between its (+) and (—) terminal posts, and this potential exists even though no current-consuming devices are connected to the posts.

Thus, voltage can exist without current, but current cannot exist without the "push" of voltage.

Fig. 7—Voltage

Voltage is produced between two points when a positive charge exists at one point and a negative charge exists at the other point (Fig. 7).

The greater the charges at each point, the greater the voltage. (In other words, the greater the lack of electrons at the (+) end, the greater the excess of electrons at the (—) end.)

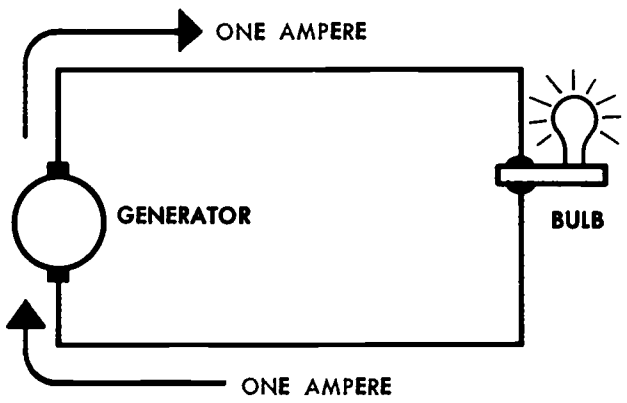


Fig. 8—The Generator as an Electron Pump

Look at a battery or generator as an electron pump (Fig. 8). The generator, for example, will supply a continuous flow of electrons (current) through the light bulb connected to it. The movement of electrons is continuous: In the generator, if one ampere of current is leaving, one ampere is entering to keep a constant flow of current.

INTERESTING SIDELIGHTS

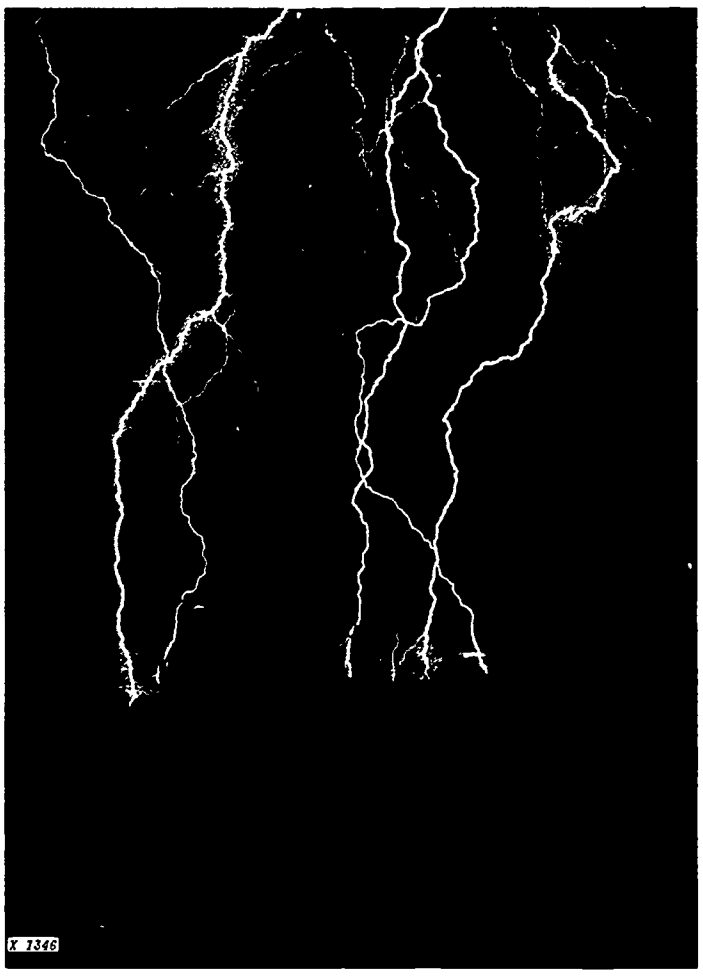
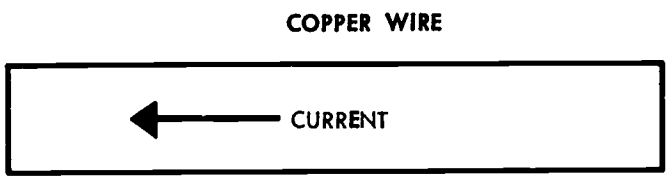


Fig. 9—Lightning During an Electrical Storm

Man uses voltage and current in controlled amounts. But nature often puts on a show during electrical storms where the voltage and current "get out of control" (Fig. 9).

The voltage between the earth and a storm cloud may be over one million volts before lightning strikes. The release of this much energy is what can cause vast damage during a bad storm.

RESISTANCE



RESISTANCE AND CURRENT CREATE HEAT

Fig. 10—Resistance to the Flow of Current in a Conductor

All conductors offer some **resistance** to the flow of current. Resistance is caused by:

1. Each atom resisting the removal of an electron due to attraction toward the core.

2. Collisions of countless electrons and atoms as the electrons move through the conductor.

The collisions create resistance and cause heat in the conductor.

The basic unit of resistance is the **ohm.** One ohm is the resistance that will allow one ampere to flow when the potential is one volt.

This is an expression of Ohm's Law. (See later in this chapter.) Resistance is often shown by the symbol Ω ; thus 5 Ω means five ohms.

BASIC ELECTRICAL CIRCUITS

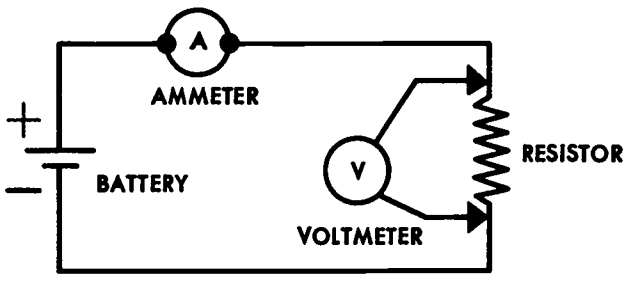


Fig. 11—A Basic Electrical Circuit

A basic electrical circuit has three parts:

- **Voltage Source such as a battery**
- **Resistor such as a light bulb**

- **Conductors such as copper wires to connect the circuit**

The basic gauges for testing an electrical circuit are: an *ammeter* to measure the current, and a *voltmeter* to measure the voltage between any two points in the circuit. (These will be covered in more detail in Chapter 2.)

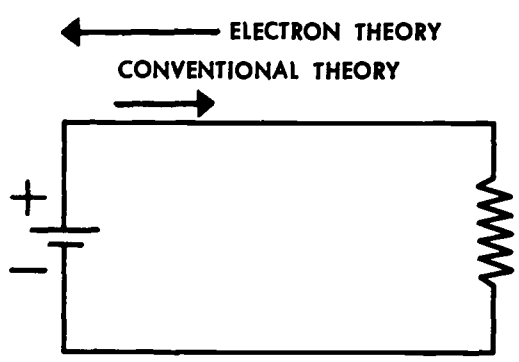


Fig. 12—Two Theories of Current Flow in a Circuit

There are two ways to describe current flow in a circuit:

- **Conventional Theory — flow is from (+) terminal of source, through circuit, to (−) terminal of source.**
- **Electron Theory — flow is from (−) terminal of source, through circuit, to (+) terminal of source.**

Since either theory can be used, we will use the more popular **conventional theory** (+ to −) in the remainder of this manual.

HOW TO MEASURE CURRENT, VOLTAGE, AND RESISTANCE (OHM'S LAW)

Ohm's Law is used to figure out the current (I), the voltage (E), and the resistance (R) in a circuit.

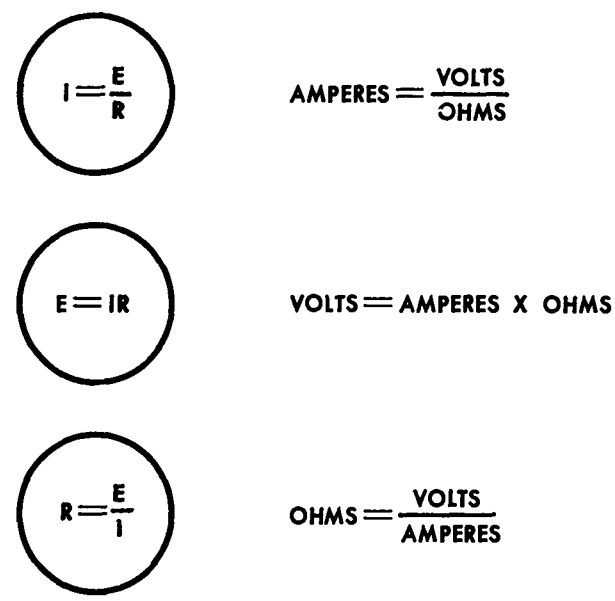


Fig. 13—Ohm's Law—The Three Formulas

Ohm's Law can be expressed in three different ways (Fig. 13). When any two quantities are known, the third can be calculated as shown.

We will use these formulas when describing "Electrical Circuits—Three Types," which follows.

ELECTRICAL CIRCUITS — THREE TYPES

The three types of electrical circuits are:

- **Series Circuits**
- **Parallel Circuits**
- **Series-Parallel Circuits**

These circuits are compared in Fig. 14.

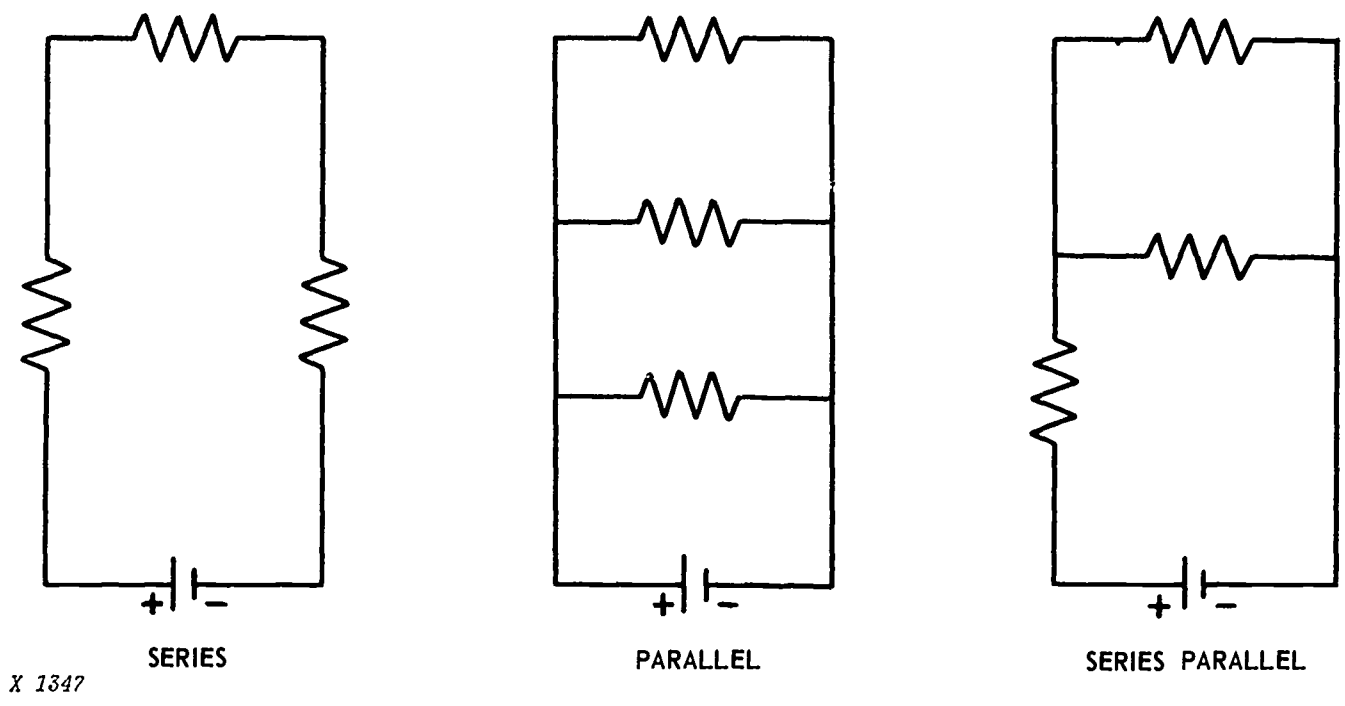


Fig. 14—Electrical Circuits—Three Types

Series Circuits have several resistors connected so that current can flow along only one path.

Parallel Circuits have more than one path for current to flow. The resistors are side-by-side and provide separate routes for current.

Series-Parallel Circuits have some resistors connected in series and some in parallel as shown in Fig. 14.

SERIES CIRCUITS

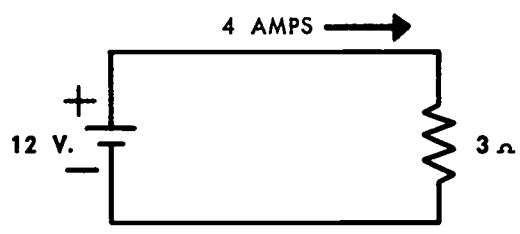


Fig. 15—A Basic Series Circuit

A basic **series circuit** may have a three-ohm (3 Ω) resistor connected to a 12-volt battery. See Fig. 15.

To find the current, use Ohm's Law, where $I = \frac{E}{R} = \frac{12}{3} = 4$ amperes, or 4 amps.

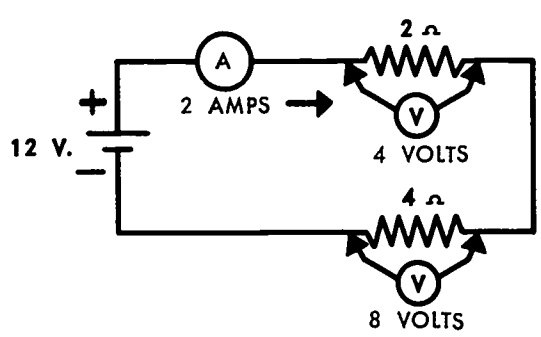


Fig. 16—Series Circuit with Two Resistors

Another series circuit is shown in Fig. 16. This circuit has a two-ohm resistor and a four-ohm resistor connected to a 12-volt battery.

In a series circuit, the total circuit resistance is equal to the sum of all the resistors. In this circuit, the total circuit resistance is $4 + 2 = 6$ ohms. The current from Ohm's Law is: $I = \frac{E}{R} = \frac{12}{6} = 2$ amperes.

Voltage across the two-ohm resistor can be figured using Ohm's Law: thus $E = IR = 2 \times 2 = 4$ volts. For the four-ohm resistor, $E = 2 \times 4 = 8$ volts. These values are called the **voltage drops,** and the sum of all voltage drops in the circuit must equal the source voltage, or $4 + 8 = 12$ volts.

As shown in Fig. 16, an ammeter connected in the circuit will read two amps, and a voltmeter connected across each resistor will read four volts and eight volts.

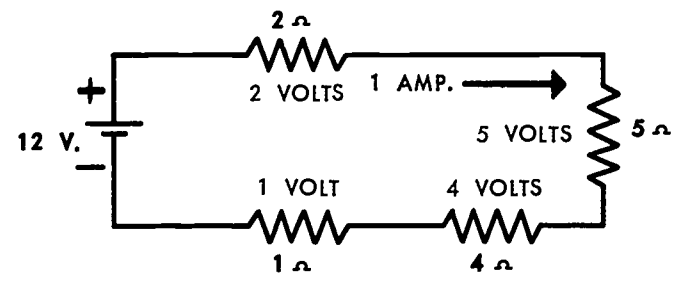


Fig. 17—Series Circuit with Four Resistors

Another series circuit having four resistors is shown in Fig. 17. The total circuit resistance is 12 ohms and the current is one ampere, with the voltage drops across each resistor as shown.

In summary, **series circuits** have the following features:

1. The current through each resistor is the same.

2. The voltage drops across each resistor will be different if the resistances are different.

3. The sum of the voltage drops equals the source voltage.

PARALLEL CIRCUITS

In a **parallel circuit,** the voltage drop across each resistor is equal to the potential of the current source since there is a separate path for current to flow through each resistor. This means:

1. The voltage across each resistor is the same.

2. The current through each resistor will be different if the resistance values are different.

3. The sum of the separate currents equals the total current in the circuit.

The parallel circuit in Fig. 18 has a six-ohm and a three-ohm resistor connected to a 12-volt battery. The resistors are in parallel with each other, since the battery voltage (12 volts) flows across each resistor.

The current through each resistor or branch of the circuit can be figured using Ohm's Law. For the

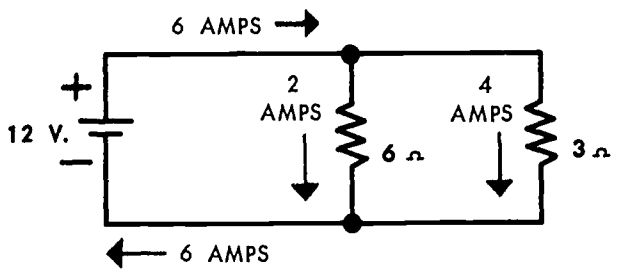


Fig. 18—Parallel Circuit with Two Resistors

six-ohm resistor, $I = \frac{E}{R} = \frac{12}{6} = 2$ amps. For the three-ohm resistor, $I = \frac{12}{3} = 4$ amps. The total current supplied by the battery is $2 + 4 = 6$ amps. The *equivalent resistance* of the entire circuit has to be two ohms, since $R = \frac{E}{I} = \frac{12}{6} = 2$ ohms. This value for any two resistors in parallel is equal to the product divided by the sum, or in this case $\frac{6 \times 3}{6 + 3} = \frac{18}{9} = 2$ ohms.

SERIES-PARALLEL CIRCUITS

A *series-parallel circuit* is shown in Fig. 19. Note that the 2 Ω resistor is in series with a parallel combination (the three- and six-ohm ones).

The total current in this circuit is equal to the total voltage divided by the total resistance. Find the total resistance of Fig. 19 as follows: the two parallel resistors equal only two ohms $\left(\frac{6 \times 3}{6 + 3} = 2\right)$ as explained above.

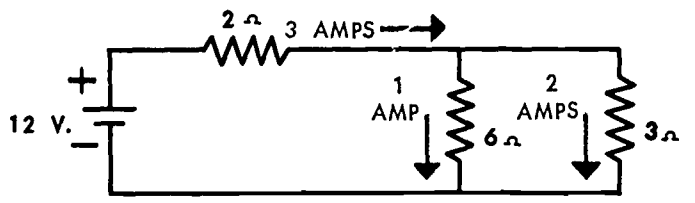


Fig. 19—Series-Parallel Circuit

Add this two ohms to the other two-ohm resistor because they are in series. This gives a circuit resistance of four ohms. The total current, therefore, is $I = \frac{12}{4} = 3$ amps.

With three amps flowing through the two-ohm resistor nearest the battery, the voltage drop across this resistor is $E = IR = 3 \times 2 = 6$ volts, leaving six volts across the parallel six- and three-ohm resistors.

The current through the six-ohm resistor is $I = \frac{E}{R} = \frac{6}{6} = 1$ amp, and through the three-ohm resistor is $I = \frac{6}{3} = 2$ amps.

Total current is the sum of these two current values or $1 + 2 = 3$ amps.

CURRENT FLOW IN SERIES AND PARALLEL CIRCUITS

We have learned from Ohm's Law that there is a definite relationship between current, voltage, and resistance in an electrical circuit.

Now let's see how this applies to series and parallel circuits with a given resistance.

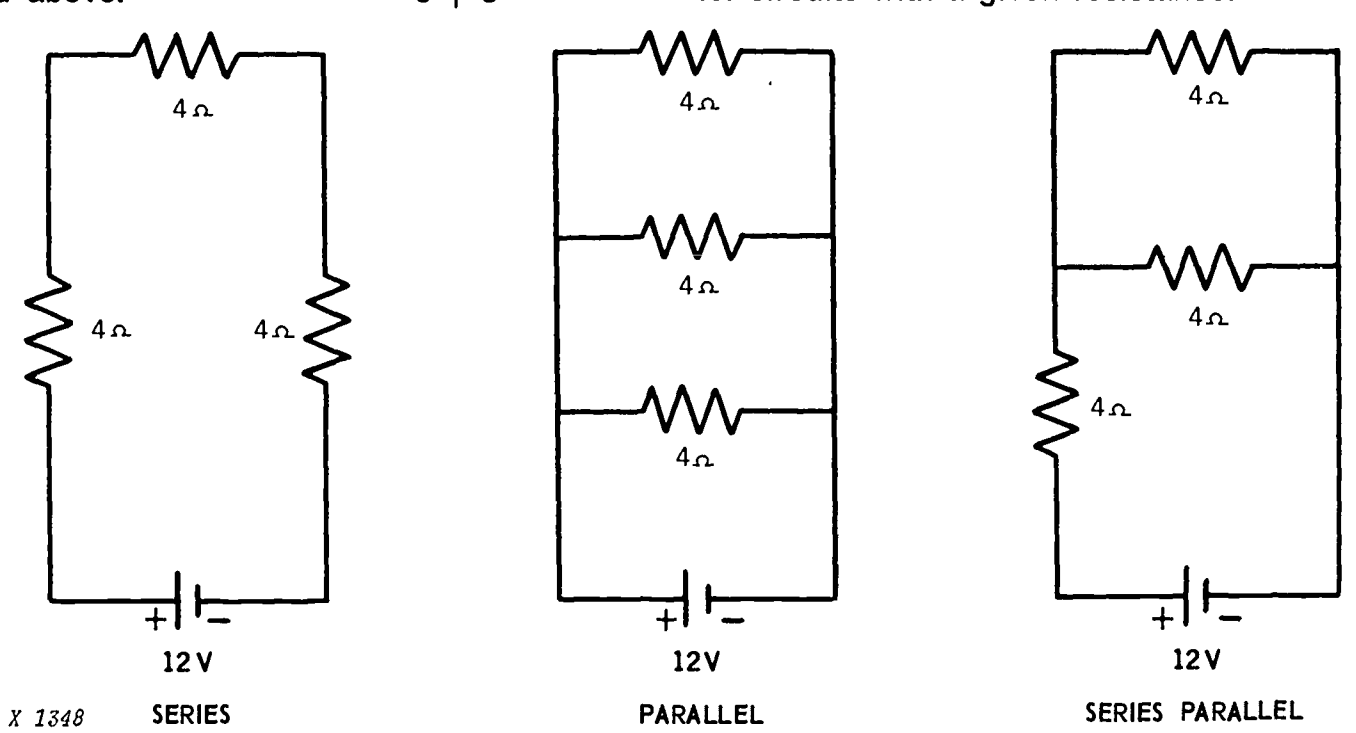


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Fig 20.—Current Flow in Series and Parallel Circuits

Each type of circuit shown in Fig. 20 has three four-ohm resistors. What is the total current flow in each case?

In the *series* circuit there is only one path for the current to flow, so the total resistance is 12 ohms. Therefore, current $= \frac{\text{volts}}{\text{ohms}} = \frac{12}{12} = 1$ amp for the circuit.

In the *parallel* circuit there are three different paths for current, each with 12 volts of force. Since current for each resistor $= \frac{\text{volts}}{\text{ohms}} = \frac{12}{4} = 3$ amps, the total current is 3 (amps) $\times$ 3 (resistors) $= 9$ amps for the circuit.

In the *series-parallel* circuit the total resistance is 4 ohms plus the resistance of the parallel resistors $(\frac{4 \times 4}{4 + 4} = \frac{16}{8}) = 2\ \Omega$ or a total of $4 + 2 = 6$ ohms.

Therefore, current $= \frac{\text{volts}}{\text{ohms}} = \frac{12}{6} = 2$ amps for the circuit.

What does this mean for the design of electrical circuits?

- **Series circuit = high resistance**
- **Parallel circuit = low resistance**
- **Series-parallel circuit = medium resistance**

CONDUCTORS

We have seen that materials having less than four electrons in the outer ring of their atoms are good **conductors** of electricity.

The reason is that these few outer electrons are easily dislodged from their orbits by a low voltage to create a flow of current.

Most metals are good conductors. Since *copper* is most widely used, let's talk about it.

All conductors offer some resistance to the flow of current. A copper wire must be selected which has an acceptable amount of resistance for the needs of the circuit.

Fig. 21 shows a circuit which has two headlamps connected to a 12-volt battery with two copper wires each having a resistance of 0.1 ohm. If each headlamp has a resistance of two ohms, in parallel they offer $\frac{2 \times 2}{2 + 2} = \frac{4}{4} = 1$ ohm.

So the total circuit resistance is $1 + 0.1 + 0.1$ ohms, and the current is $I = \frac{E}{R} = \frac{12}{1.2} = 10$ amps.

The voltage drop in each wire is $E = IR = 10 \times 0.1 = 1$ volt, or two volts total for both wires.

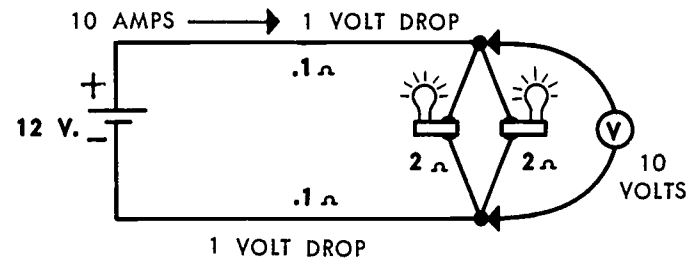


Fig. 21—Resistance in a Conductor (Copper Wire)

The voltage left to operate the headlamps, or load, is 10 volts, since the sum of the voltage drops must equal the source voltage, or $1 + 10 + 1 = 12$ volts.

The copper wire "robs" the headlamps of two volts, leaving 10 volts across the headlamps to provide illumination.

This example shows the effect of wiring resistance on the operation of a circuit.

The wiring used in any circuit must allow sufficient voltage across the load for proper operation.

Resistance in a copper wire depends upon:

1) the length of the wire.

2) the cross-sectional area of the wire.

3) the temperature of the wire.

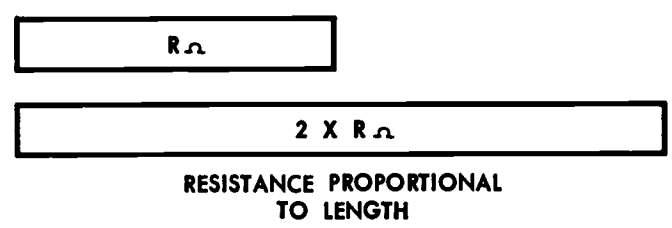


Fig. 22—A Longer Wire Creates More Resistance

If the length of a wire is doubled, the resistance between the wire ends is doubled (Fig. 22). In other words, the longer the wire, the greater the resistance between the wire ends.

If the cross-sectional area of a wire is reduced by half, the resistance for any given length is doubled (see Fig. 23). That is, the smaller the wire, the more will be the resistance, and the larger the wire, the less will be the resistance.

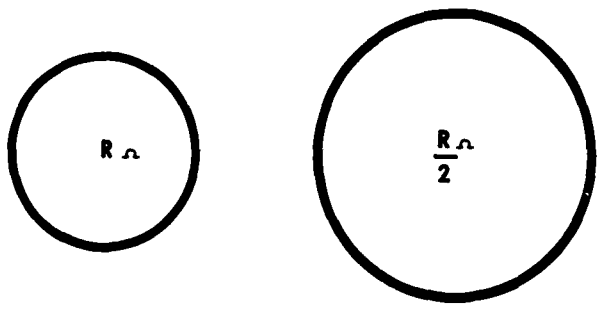


Fig. 23—A Smaller Wire Creates More Resistance

In any circuit, the smallest wire that will not create too much voltage drop is normally used to reduce costs.

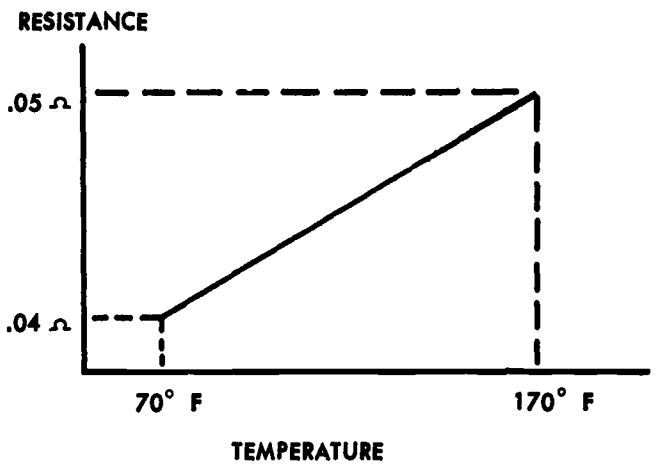


Fig. 24—A Hotter Wire Creates More Resistance

As the temperature rises in a copper wire, the resistance increases.

Fig. 24 shows an example of a 10-ft. length of wire having a resistance of .04 ohm at 70° F.

At 170° F., the resistance is .05 ohm, or an increase of 25 percent.

Excessive resistance in the wiring from normal heat can hinder the performance of electrical equipment. This is why the selection of the proper wiring is so important.

Heat is developed in any wire carrying current because of the normal resistance in the wire. If the wire gets too hot, the insulation will be damaged.

In summary:

- **The longer the wire the greater the resistance.**
- **The smaller the wire the greater the resistance.**
- **The hotter the wire the greater the resistance.**

SEMICONDUCTORS

As we just learned, conductors have less than four electrons in the outer rings of their atoms, while insulators have more than four electrons.

Semiconductors are elements which have just four electrons in the outer ring of their atoms. They are neither good conductors nor good insulators. Most common of the semiconductors are silicon and germanium.

Semiconductors are used for diodes and transistors in electrical circuits.

Let's see how the basic elements work first, and then we'll go inside the diodes and transistors.

HOW SEMICONDUCTORS ARE MADE

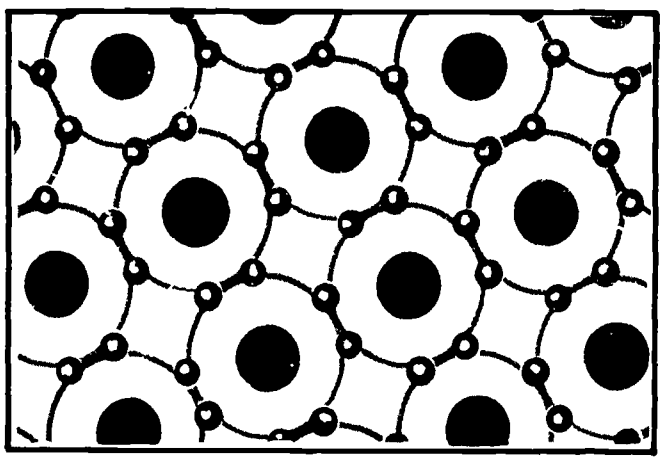


Fig. 25—Silicon Formed as Insulator by Covalent Bonding

Silicon crystal for semiconductors is made by **covalent bonding** (Fig. 25). This means that the electrons in the outer ring of one silicon atom join the electrons of other silicon atoms so that the atoms share electrons in their outer rings. Now each atom really has eight electrons in its outer ring as shown. This creates a very good insulator since there are now more than four electrons in the outer ring.

The silicon crystal is then "doped" by adding other materials.

Two elements commonly used to dope the silicon are phosphorous and antimony. Both of these elements have five electrons in their outer ring. Covalent bonding occurs but there is one electron left over (see Fig. 26). This electron is called a "free" electron which can be made to move through the material very easily. Any material having an extra electron is called a negative or **"N" type material.**

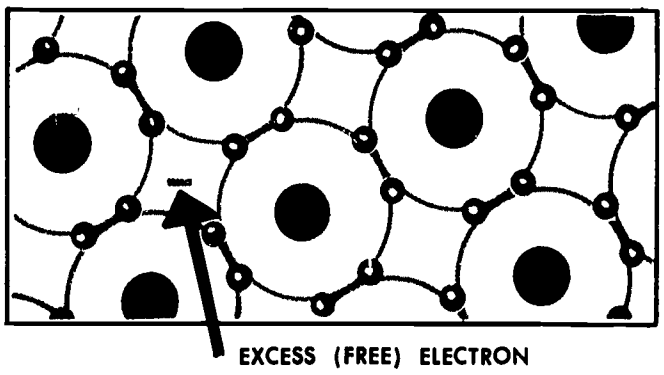


Fig. 26—Use of Phosphorus to "Dope" Silicon for "N" Type Material

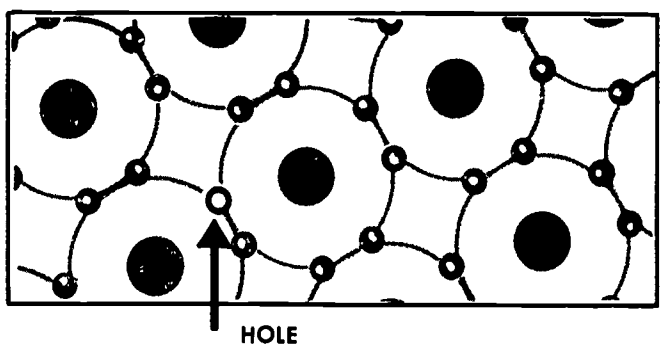


Fig. 27—Use of Boron to "Dope" Silicon for "P" Type Material

Two other elements commonly used to dope the silicon crystals are boron and indium. These elements have only three electrons in their outer ring. Covalent bonding occurs but there is a shortage of one electron for complete bonding. The resulting void is called a *hole* (Fig. 27). This hole can be considered as a positive charge of electricity. Materials lacking this electron and having this hole are called positive or **"P" type material.**

To understand semiconductors, think of this hole as a positive (+) current carrier, just like the electron in a negative current carrier. The hole can move from atom to atom, just as an electron can move from atom to atom.

In summary:

- **Semiconductors are made by covalent bonding.**
- **This is joining atoms which then share electrons.**
- **The result is a good insulator.**
- **But also a free electron ("N" type material).**
- **Or a voided electron, or hole ("P" type material).**
- **Either "N" or "P" material is a current carrier, moving electrons from atom to atom.**
- **Semiconductors have special uses in diodes and transistors.**

HOW SEMICONDUCTORS OPERATE

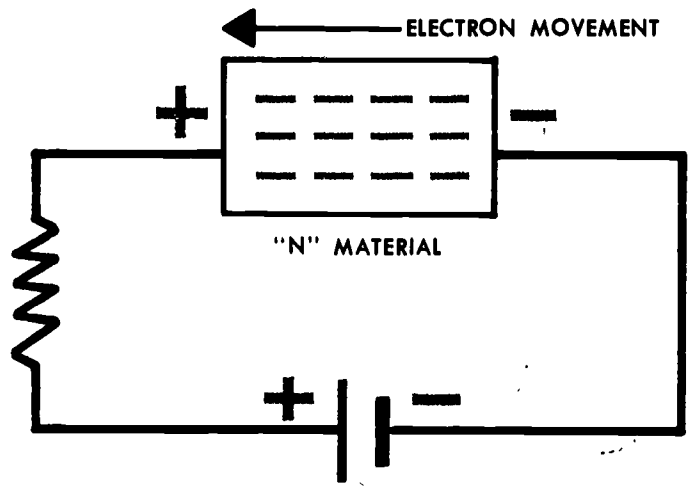


Fig. 28—Electron Movement in Circuit with "N" Type Material

The current flow in "N" type material is shown in Fig. 28. By connecting a voltage source such as a battery to the material, an electron current will flow through the circuit. This current is the movement of the excess of "free" electrons through the material and is very similar to what occurs in a copper wire.

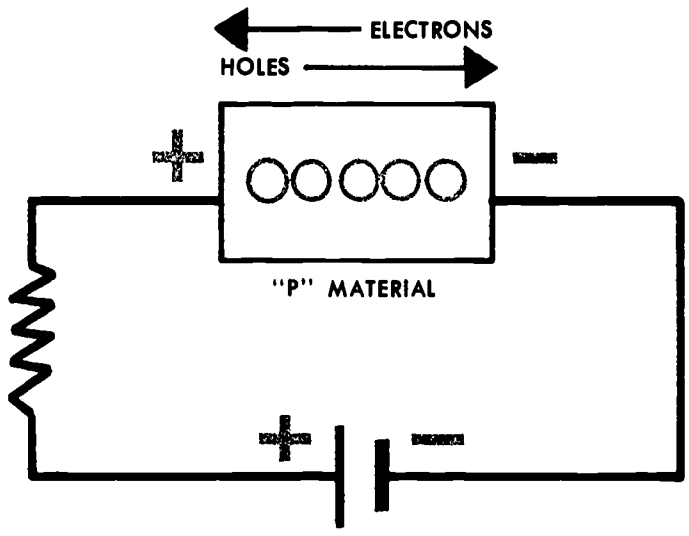


Fig. 29—Movement of Holes in Circuit with "P" Type Material

The current flow in "P" type material is shown in Fig. 29. But here the current is a movement of the positively charged holes. This hole movement works as shown in Fig. 30.

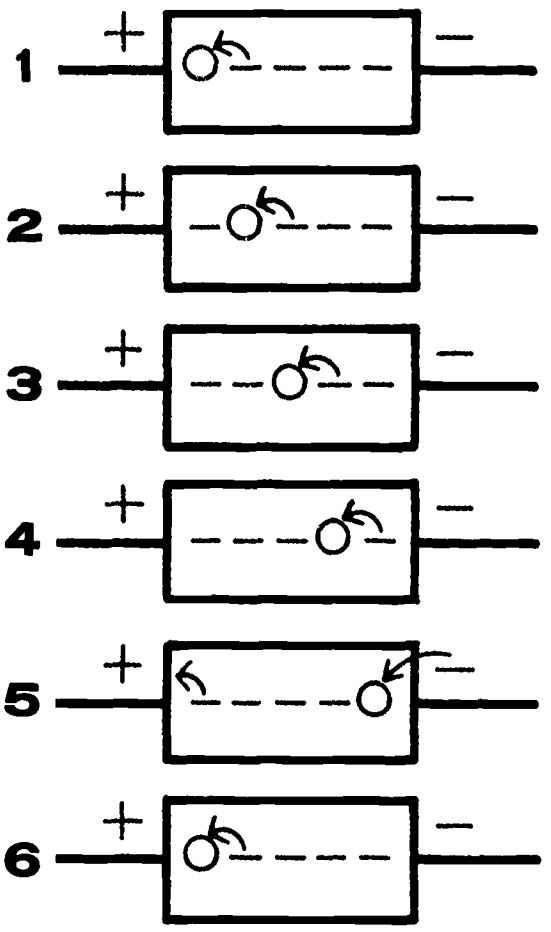


Fig. 30—Hole Movement in "P" Type Material

Notice how the (+) battery terminal in No. 1 attracts the (—) electrons in the material (unlike charges attracting). Similarly, the (—) battery terminal will repel the electrons. So an electron from one of the covalent bonds will move to the left toward the (+) terminal, and will fill one of the holes near the terminal. This movement of an electron leaves behind a hole. The positively charged hole, then, has moved to the right, toward the (—) battery terminal. This process continues and the hole keeps moving to the right until it nears the (—) connection at the semiconductor. At this time, the hole is filled by an electron which leaves the (—) wire connected to the semiconductor, and the (+) wire removes an electron from the semiconductor at the other end. (See No. 5 in the illustration.) The process is then ready to repeat itself.

The continuous movement of holes from the (+) terminal to the (—) terminal can be looked upon as current flow in "P" type material, and occurs when the battery voltage causes the electrons to shift around in the covalent bonds.

The hole movement occurs only *within* the semiconductor, while electrons flow through the entire circuit.

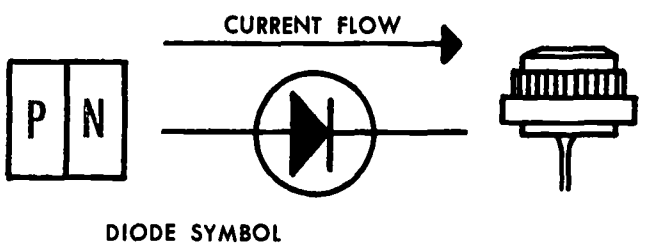
The hole movement theory will help us to understand how diodes and transistors operate, which follows.

In summary:

- **Outside voltage causes a current flow in the "N" or "P" material of semiconductors.**
- **In "N" material, current flow is the movement of "free" (—) electrons.**
- **In "P" material, current flow is the movement of (+) charged holes.**

Next we'll show how semiconductors are used in diodes and transistors.

DIODES



ELEMENT	ATOMIC NUMBER	NUMBER OF PROTONS	NUMBER OF ELECTRONS	VALENCE RING ELECTRONS
Boron (B)	5	5	5	3
Silicon (Si)	14	14	14	4
Phosphorus (P)	15	15	15	5

Fig. 31—Diode

A **diode** is an electrical device that will allow current to pass through itself in *one direction only.*

How Diodes Are Made

A diode is formed when two semiconductor materials are joined, one of "N" type material, the other of "P" type. In diodes, the "N" material is usually phosphorus-doped silicon, while the "P" material is usually boron-doped silicon.

The basic construction of a diode is shown in Fig. 32.

"N" and "P" materials attract each other but are kept stabilized by positive and negative ions on each side. (An ion is an atom having a shortage or an excess of electrons.) The ions "pull back" on the free electrons and the holes to prevent them from crossing the junction.

The net result is a stabilized condition *with a deficiency of electrons and holes at the junction area.*

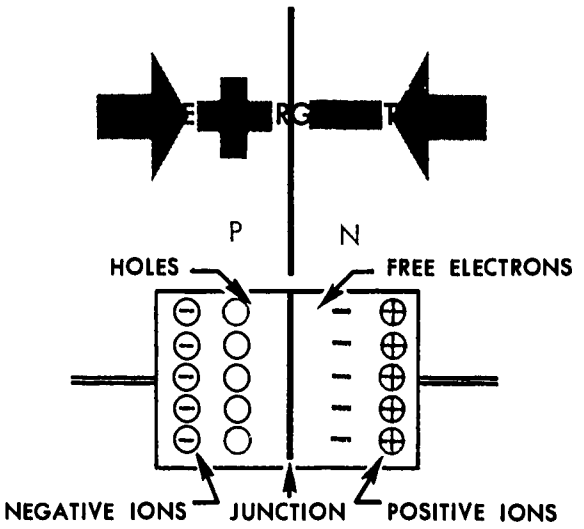


Fig. 32—Construction of a Diode

How Diodes Operate

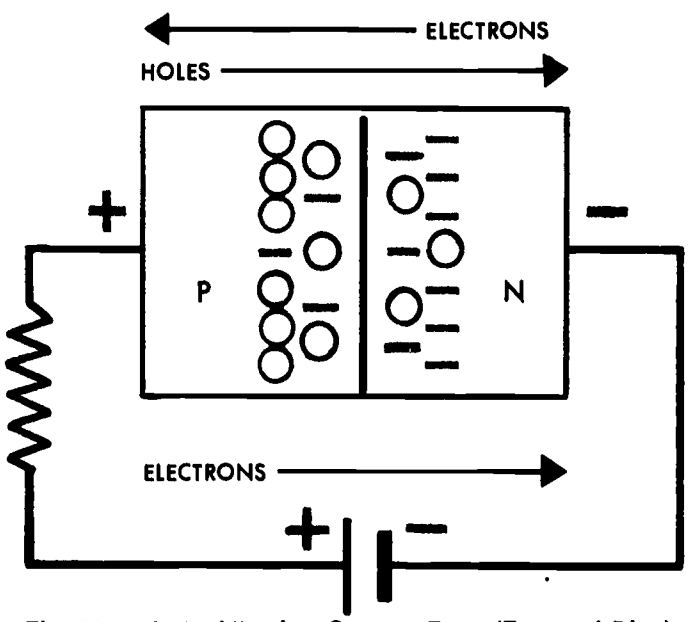


Fig. 33—Diode Allowing Current Flow (Forward Bias)

Now let's activate the diode by connecting a battery to it (Fig. 33). The negative battery voltage will repel the electrons in the "N" material, while the positive battery voltage will repel the holes in the "P" material. With sufficient voltage, electrons will move from the negative terminal of the battery across the junction to the positive battery terminal and so create a flow of current. Also, the positive holes will move through the "P" material and through the junction as described above.

The battery maintains the current flow, but for current to flow through the semiconductor, there must be holes present at the junction *into which electrons can move.*

Fig. 33 shows a **forward bias** connection of the semiconductor. This (—) to "N" and (+) to "P" connection creates the repelling action of the battery voltage which causes electrons and holes to congregate at the junction in large numbers—necessary for current flow through a diode.

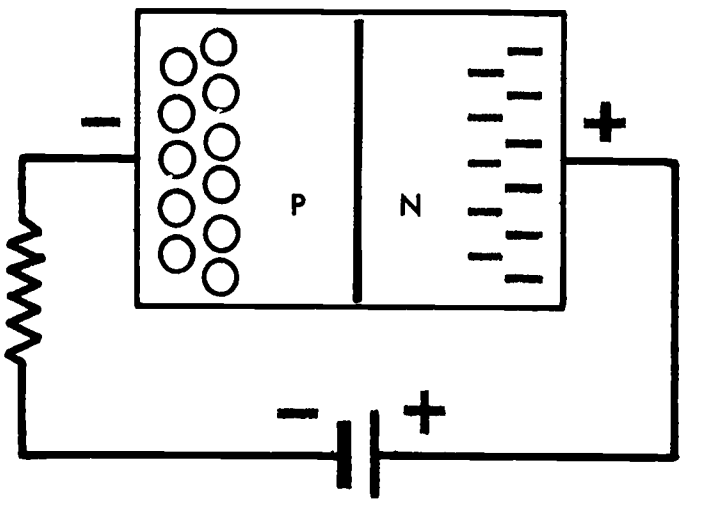


Fig. 34—Diode Blocking Current Flow (Reverse Bias)

Now let's see what happens when we reverse the battery connections (Fig. 34). As shown, the (+) of the battery attracts electrons away from the junction, while the (—) of the battery attracts the holes away from the junction. The result: no current flow.

This type of battery connection is called **reverse bias,** which causes the diode to block current flow.

In summary:

1. The diode will allow current to flow if the voltage across the diode causes electrons and holes to congregate at the junction area. (Forward Bias)

2. The diode will not allow current to flow if the voltage across the diode causes the junction area to be void of electrons and holes. (Reverse Bias)

Let's repeat a statement already made in this chapter. For electrons to move into the "P" material, there must be holes present in the "P" material near the junction *into which the electrons can move.* The reasons for the hole theory now becomes more apparent, as this theory provides a convenient means of explaining how a diode blocks or prevents current flow.

A complete description of diodes as used in alternators is given in Chapter 4.

Diode Leakage Current

When a reverse bias voltage is connected to a diode, it may be true that a small current will flow through the diode in the reverse direction, but the reverse current is very, very small.

If the voltage across the diode is increased, a value eventually will be reached called the *maximum reverse voltage* of the diode. At this voltage, the covalent bond structure will break down and a

sharp rise in reverse current will occur. If the reverse current is sufficient in magnitude and duration, the diode will be damaged due to excessive heat.

Diodes are selected, of course, with an adequate maximum reverse voltage rating so that damaging reverse currents will not normally occur during operation.

Zener Diode

The zener diode is a specially designed type of diode that will conduct current in the reverse direction. The primary feature of this type of diode is that it is very heavily doped during manufacture —the large number of extra current carriers (electrons and holes) allows the zener diode to conduct current in the reverse direction without damage if proper circuit design is used. The zener diode symbol is shown in Fig. 35.

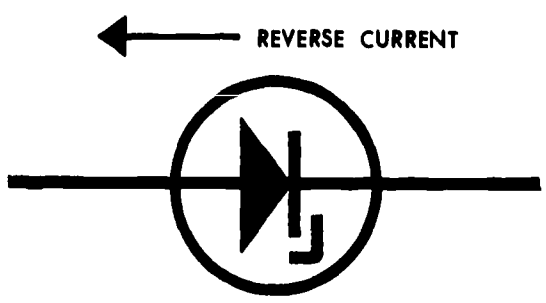


Fig. 35—Zener Diode

What makes the zener diode unique is that it will not conduct current in the reverse direction below a certain predetermined value of reverse bias voltage. As an example, a certain zener diode may not conduct current if the reverse bias voltage is below six volts, but when the reverse bias voltage becomes six volts or more, the diode suddenly conducts reverse current. This type of diode is used in control circuits.

Diode Types and Uses

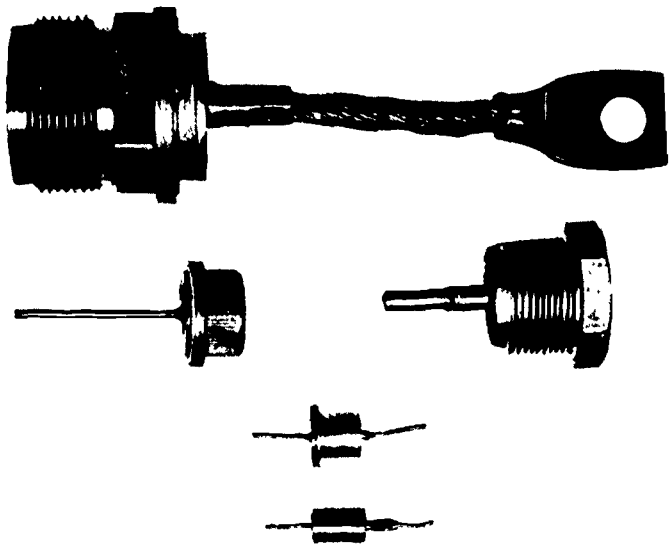


Fig. 36—Diodes Used in Electrical Circuits

Some of the diodes used on electrical equipment are shown in Fig. 36.

The smaller diodes are used in control circuits such as regulators, while the larger diodes are used in alternators.

Summary: Diodes

In summary:

- **Diodes control current by allowing it to pass through in one direction only.**
- **They are made by joining "N" and "P" semiconductor materials.**
- **Forward bias = allowing current to flow.**
- **Reverse bias = stopping flow of current.**
- **Zener diodes are special devices that will conduct current in reverse—above a certain voltage.**

TRANSISTORS

A **transistor** is an electrical device that is used in circuits to control the flow of current. It operates by either allowing current to flow or not allowing it to flow.

How Transistors Are Made

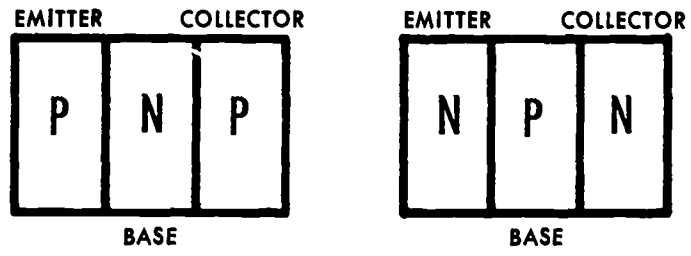


Fig. 37—Basic Parts of Transistors

A transistor is usually formed by adding a second section of "P" type material to the PN junction used for diodes. This results in the PNP transistor (Fig. 37).

The "P" material on the left is called the emitter, the "N" material in the center is the base, and the "P" material on the right is called the collector.

NPN transistors can also be formed, but the PNP types are most common in modern farm and industrial uses.

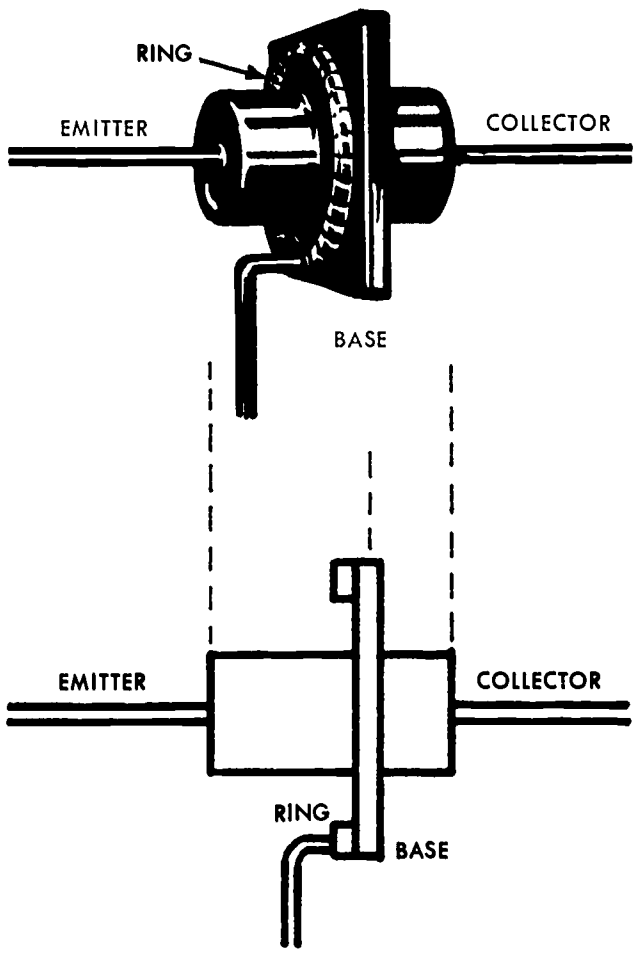


Fig. 38—Construction of a Transistor

The base of a transistor is very thin (Fig. 38). A metallic ring is attached around the base and this is connected to the circuit. By this design, the distance between the emitter and the collector is shorter than the distance between the emitter and the base ring. This gives the transistor its unusual operation as we'll see now.

How a Transistor Operates

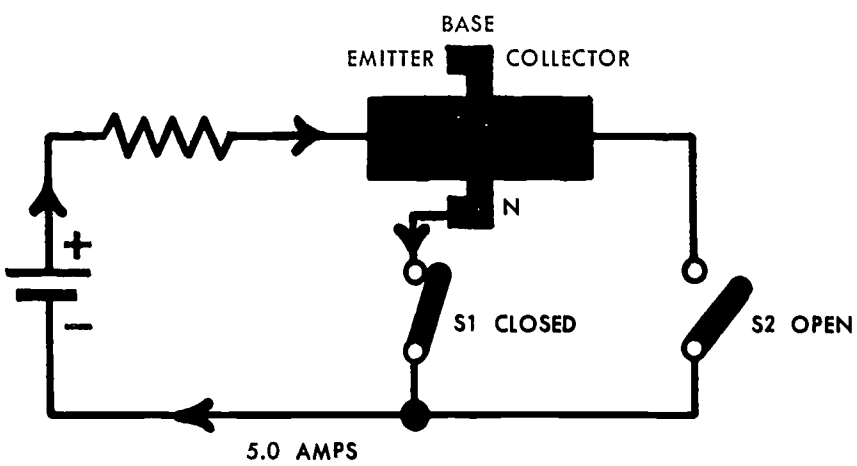


Fig. 39—Transistor in Circuit with Switch S2 Open

In Fig. 39, we have connected a battery to a PNP transistor. With switches S1 closed and S2 open, current will flow through the emitter-base of the transistor. With switch S2 open, the collector will not operate, and the circuit is a simple PN junction diode (through emitter-base) connected to the battery in the forward bias direction (as in Fig. 33).

At this point, we should recall a definition of current flow—the movement of electrons from atom to atom in a conductor. Under this definition, the electrons in this circuit flow from the negative battery terminal through the base-emitter back to the positive side of the battery. However, to better understand the operation of a PNP transistor, we must accept hole movement as a theory of current flow, and apply this theory to the PNP transistor.

Using the hole movement theory, the current flow in the transistor is a movement of holes through the "P" material to the "N" material. This movement of holes can be looked upon as current flow, and this theory simplifies the explanation of how a transistor works.

Let's assume that the emitter-base current is five amperes.

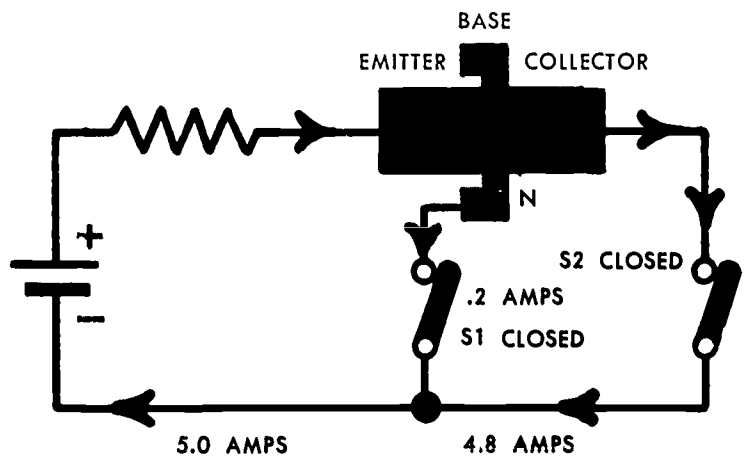


Fig. 40—Transistor in Circuit with Switches Closed

When switch S2 is closed, a rather startling thing happens (Fig. 40). The total current remains at five amperes, but now most of the current leaves the transistor through the collector circuit. The current through the collector is 4.8 amperes, and the base current has been reduced to 0.2 ampere. The reasons for this are as follows:

Because the transistor is arranged so that the emitter-collector are closer together than the emitter-base ring, most of the holes that are injected into the base by the emitter travel on into the collector due to their velocity. Also, the negative potential at the collector attracts the positive holes from the base into the collector.

In the example shown, the collector current is 24 times the base current. This factor is called the *current gain*.

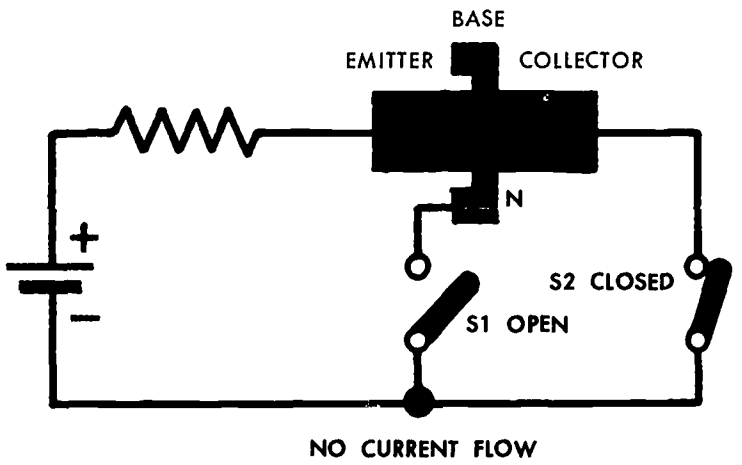


Fig. 41—Transistor in Circuit with Switch S1 Open

An important observation is that with switch S2 closed and switch S1 open, no appreciable current will flow (Fig. 41). The reason for this is that with the base circuit open, there are no holes being injected into the base from the emitter, and so there are no holes in the base which can be attracted by the negative battery potential into the collector. Furthermore, the negative battery potential at the collector attracts the holes in the collector away from the base-collector junction area and the resistance across the base-collector junction becomes very high. Although the emitter and collector are joined, opening switch S1 effectively "shuts off" the transistor so that no appreciable current flows.

An NPN transistor operates in the same way as a PNP transistor, with current flow consisting of a movement of electrons (instead of holes) from the emitter to the base and collector.

The significant thing about a transistor is that *by controlling a small base current, a much larger collector current can also be controlled.*

Uses of Transistors

One of the major uses of transistors in machine electrical systems is in the transistorized regulator. For details, see Chapter 4 on "Charging Circuits."

Symbols for Transistors

The most common symbols for transistors used in circuits is shown in Fig. 42. The line with the arrow is the emitter, the heavy line is the base, and the line without an arrow is the collector. Note that the arrow points in the direction of conventional current flow; that is, from positive to negative in the external circuit.

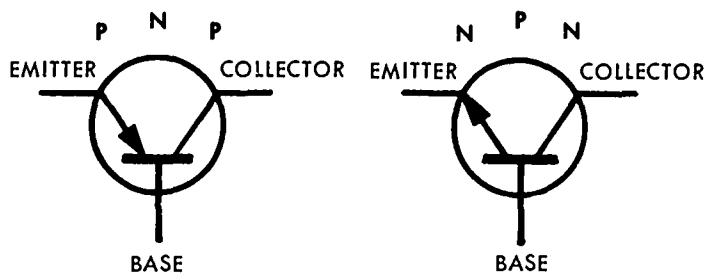


Fig. 42—Symbols for Transistors

As we said, it is convenient to look upon current flow in the PNP transistor as a movement of holes, and in the NPN transistor as a movement of electrons. Although the electrons move against the arrow in the NPN transistor, this is not contradictory as it is easier to visualize the current carriers (electrons) as being emitted by the emitter into the base and collector.

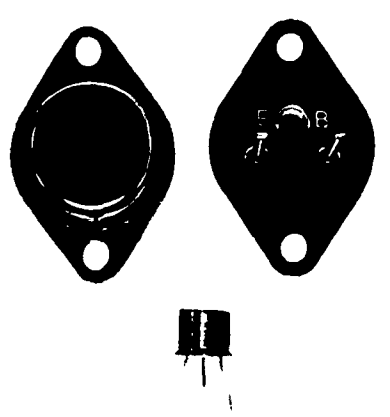


Fig. 43—Transistors Used in Electrical Circuits

Summary: Transistors

In summary:

- **Transistors control the current in a circuit.**
- **They either allow current to flow or stop it.**
- **Most are constructed of "PNP" semiconductor materials.**
- **P = emitter, N = base, P = collector.**
- **Other transistors are of the "NPN" type.**
- **Transistors control a small base current.**
- **But also control a much larger collector current.**
- **Example: transistorized regulators (see Chapter 4).**

MAGNETISM

The effects of magnetism were first observed when fragments of iron ore called lodestone, found in nature, were seen to attract other pieces of iron (Fig. 44).

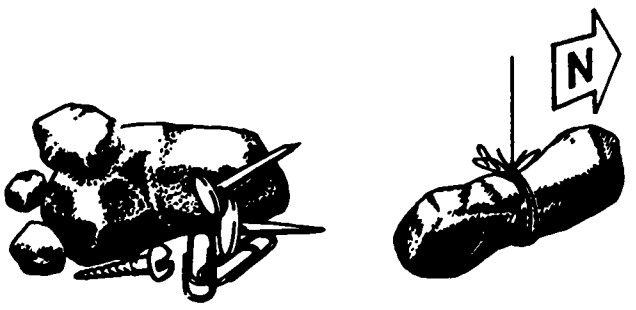


Fig. 44—Magnetism

It was further discovered that a long piece of this iron ore suspended in air would align itself so that one end always pointed toward the North Pole of the earth. This end of the iron bar was called the north pole, or **N pole,** and the other end the south or **S pole.** Such a piece of iron ore was called a **bar magnet.** This principle became the basis for the compass, which has been used as an aid in navigation for over 1000 years.

MAGNETIC FIELDS

Further study of the bar magnet revealed that an attractive force was exerted upon bits of iron or iron filings even though the iron filings were some distance away from the bar magnet. From this it was clear that a force existed in the space close to the bar magnet. This space around the magnet in which iron filings are attracted is called the field of force or **magnetic field.**

The magnetic field is described as invisible lines of force which come out of the N pole and enter the S pole.

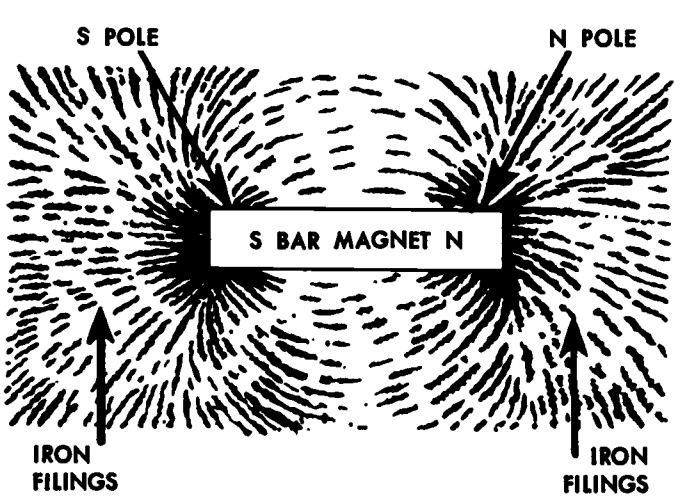


Fig. 45—Magnetic Field of a Bar Magnet

The theory of magnetic lines of force can be dramatically shown by sprinkling iron filings on a piece of paper resting on top of a bar magnet. When the paper is lightly tapped by hand, the iron filings line up to form a clear pattern around the bar magnet (Fig. 45).

The pattern shows that the lines of force are heavily concentrated at the N and S poles of the magnet, and then spread out into the surrounding air between the poles. The concentration or number of lines at each pole is equal, and the attractive force on the iron filings at each pole is equal. Notice that the force of attraction on bits of metal is greatest where the concentration of magnetic lines is greatest. For a bar magnet, this area is next to the two poles.

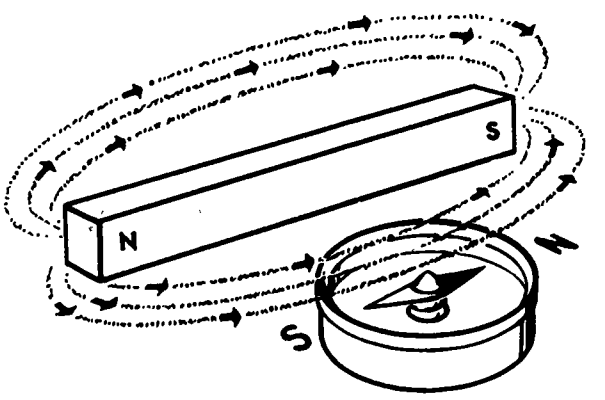


Fig. 46—Magnetic Lines of Force Come Out of N Pole and Enter S Pole

We have said that the lines of force always leave the N pole and enter the S pole of a magnet. When a small compass needle, which is a small bar magnet, is located in the magnetic field of a strong bar magnet, the compass needle will align itself so it is parallel with the lines of force of the bar magnet (Fig. 46). This alignment takes place because the strong magnetic lines from the bar magnet must enter the S pole and leave the N pole of the compass needle.

We can also see that the unlike poles of the two magnets are attracted towards each other.

To demonstrate further the force of attraction between the unlike poles of two magnets, a force of attraction is seen to exist between two bar magnets lying end to end with an N and S pole facing each other (Fig. 47). The force of attraction increases as the two magnets are moved closer together.

If, on the other hand, the magnets are aligned so the N poles or the S poles face each other, a force of repulsion is seen to exist between the two magnets, and this repulsion increases as the two magnets are moved closer together.

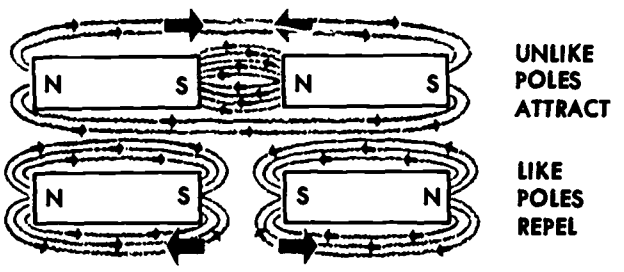


Fig. 47—Magnetic Forces between Poles of Bar Magnets

From these experiments, a fundamental law of magnetism can be stated:

Unlike poles attract each other and like poles repel each other.

THEORIES OF MAGNETISM

Exactly what magnetism is, and how it exerts a field of force, can best be explained by either one of two theories.

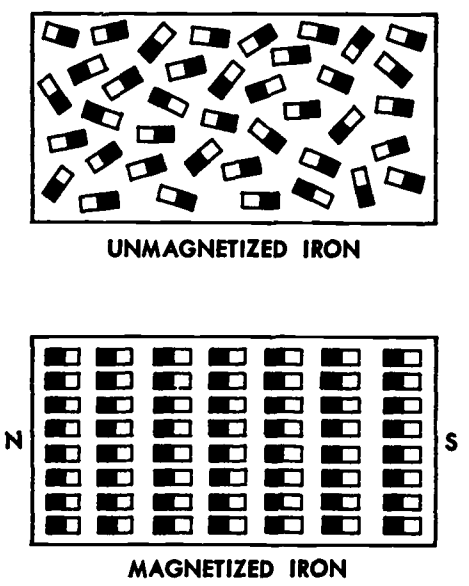


Fig. 48—First Theory of Magnetism—Particles Are Aligned

Theory No. 1 states that a magnet is made up of a very large number of small magnetized *particles*. When a bar of iron is not magnetized, the small magnetic particles are arranged in a random manner (Fig. 48). But when the bar of iron becomes a magnet, the magnetic particles are aligned so that their individual effects add together to form a strong magnet.

Theory No. 2 about magnetism concerns the *electron*. The electron has a circle of force around it, and when the electron orbits are aligned in a bar of iron so that the circles of force add together, the bar of iron is magnetized.

While iron is one of the better known magnetic materials, remember that some materials are non-magnetic since they never exhibit any of the properties of magnetism. Some of the non-magnetic materials are wood, paper, glass, copper, and zinc.

HOW MAGNETS ARE MADE

An ordinary iron bar can be converted into a magnet in a number of different ways.

One method is to stroke the iron with another piece of iron that has already been magnetized. The effect of inducing magnetism into the iron bar is called **magnetic induction.**

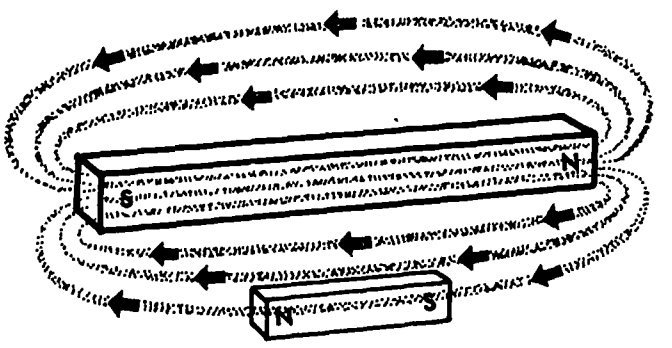


Fig. 49—Magnetic Induction of an Iron Bar

Another method of magnetic induction is simply to place an iron bar in a strong magnetic field (Fig. 49). The lines of force in the field passing through the iron bar will cause the bar to become a magnet as long as it is located in the field. If the bar is withdrawn from the field of force, and if its composition is such that it retains some of its induced magnetism, it is then said to be permanently magnetized and is called a **permanent magnet.**

Most permanent magnets are made of hard metals composed of alloys, since soft metals will not retain much of their magnetism. Some of the more common alloys are nickel-iron and aluminum-nickel-cobalt.

Fig. 50—Forming a Horseshoe Magnet

Permanent magnets are found in many shapes including the horseshoe magnet which concentrates the lines of force at the two poles in a small area (Fig. 50). Magnets of this type are widely used in voltmeters and ammeters, which are covered in Chapter 2.

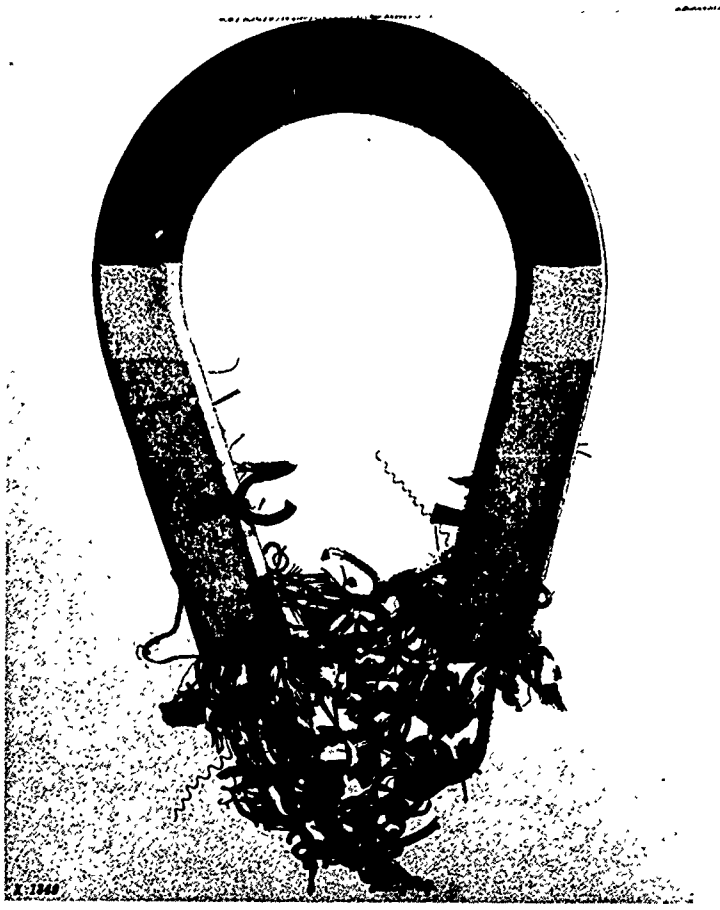


Fig. 51—Horseshoe Magnet Picking Up Iron Filings

The most effective way of inducing a high level of magnetism in a material to form a permanent magnet is by the principles of electromagnetic induction. This principle is covered in a section which follows.

SUMMARY: MAGNETISM

In summary:

- **Every magnet has an N and S pole, and a field of force surrounding it.**
- **Magnetic materials are acted upon when located in a field of force.**
- **Unlike poles attract and like poles repel.**
- **An unmagnetized piece of iron can become a magnet through induction.**

ELECTROMAGNETISM

It was not until the year 1820 that *the relation between electricity and magnetism* was discovered. Before this time it was generally believed that magnetism existed only in the lodestone or iron ore found in nature, and there was no relationship at all between electricity and magnetism.

An experiment with a compass and a wire carrying current revealed the connection between electricity and magnetism. When the compass was held over the wire, the needle turned so it was crosswise of the wire (Fig. 52). Since the only thing

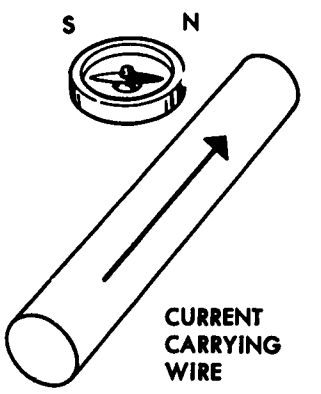


Fig. 52—Electric Current Creates Its Own Magnetic Field

known that would attract a compass needle was magnetism, it was obvious that *the current in the wire created a magnetic field around the wire.*

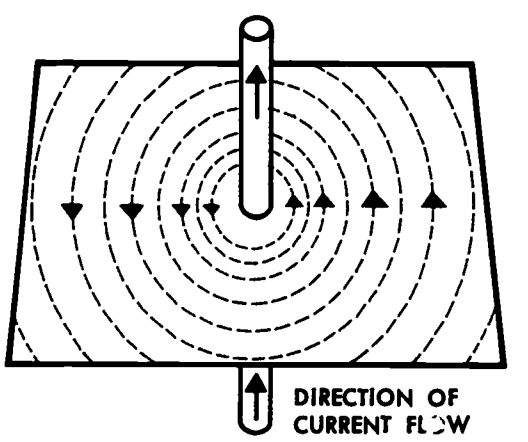


Fig. 53—Shape of Magnetic Field Around Wire Carrying a Current

The nature of the magnetic field around the wire is revealed when the current-carrying wire is run through a piece of cardboard, and iron filings are sprinkled on the cardboard. The iron filings align themselves to show a clear pattern of concentric circles around the wire (Fig. 53). The circles are more concentrated near the wire than farther away. Although the iron filings on the cardboard show only the pattern in one plane, remember that the concentric circles extend the entire length of the current-carrying wire.

In Fig. 54, when current is flowing in a wire in the direction indicated by the cross, the N pole of a compass needle will always point in one direction However, when current is flowing in the wire in the opposite direction as indicated by the dot, the north pole of the compass needle reverses and points in the opposite direction.

Since the needle always has a tendency to align itself so magnetic lines, or flux lines, enter its S pole and leave its N pole, we can conclude:

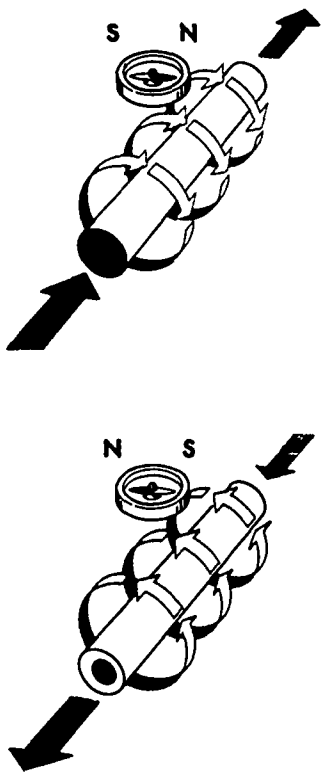


Fig. 54—Magnetic Lines Change Direction When Current Is Reversed

Magnetic lines have direction, and change direction when the current flow changes in the wire from one direction to another.

The Right Hand Rule for a Straight Conductor can be used to find the direction of the lines of force around the wire.

Fig. 55—Right Hand Rule Shows Direction of Lines of Force in a Straight Conductor

To apply the rule, grasp the wire with the thumb extended in the direction of conventional current flow (positive to negative); the fingers will then point in the direction in which the lines of force surround the conductor (Fig. 55). These lines of force are always at right angles to the conductor, and the compass needle confirms the direction as determined by the Right Hand Rule.

Unlike the flow of electrons in a conductor, which actually move, the magnetic lines of force do not move or flow around the wire; instead they merely have direction as indicated by their effect upon the compass needle.

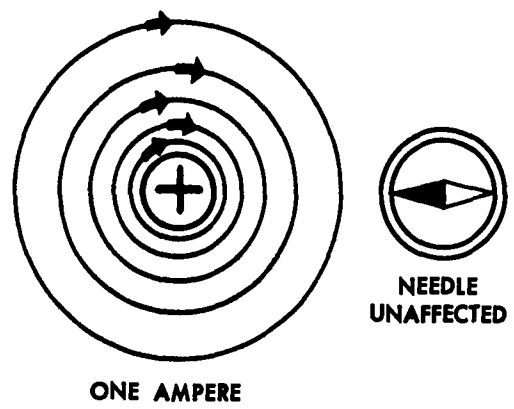


Fig. 56—More Current Creates a Stronger Magnetic Field

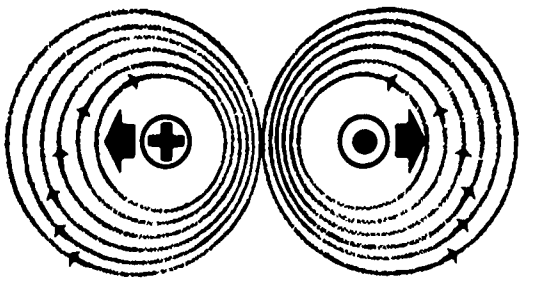
The number of lines of force, or strength of the magnetism, increases as the current through the conductor is increased.

If a compass is moved farther away from the conductor, a point finally is reached where the compass is unaffected by the field (Fig. 56). If the current is then increased, the compass needle will be affected and will again indicate the direction of the magnetic field as shown.

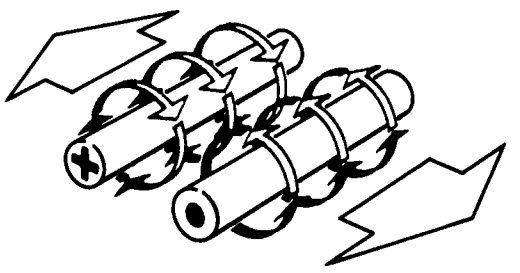
The number of lines of force, and the area around the conductor which they occupy, increase as the current through the conductor increases.

In other words:

More current creates a stronger magnetic field.



STRONG FIELD BETWEEN CONDUCTORS



CONDUCTORS TEND TO MOVE APART

Fig. 57—How Conductors Are Affected By Strong Magnetic Fields

If two adjacent parallel conductors are carrying current in opposite directions, the direction of the field is clockwise around one conductor and counterclockwise around the other (Fig. 57). The lines of force are more concentrated between the conductors than on the outside of the conductors. The force lines between the two wires add together to form a strong magnetic field. Under this condition, the two wires will tend to move apart, leading us to conclude:

A current-carrying conductor will tend to move out of a strong field and into a weak field.

MOTOR PRINCIPLE

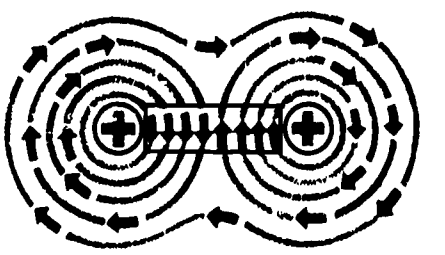
Fig. 58—Principle of the Starting Motor

In Fig. 58, two conductors are placed on an armature located between a strong N and S pole, and the conductors are made to carry current in opposite directions. The result is that a strong and a weak field are formed on opposite sides of each conductor as shown.

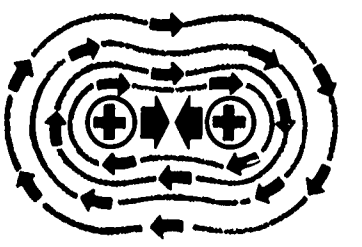
By the Right Hand Rule, current flowing into the top conductor will form magnetic lines on the underneath side of the conductor that add to the lines of the N and S poles. The conductor will then tend to move upward or clockwise into the weakened field.

Similarly, current flowing out of the lower conductor forms a strong field on top and a weak field underneath, causing the conductor to move downward or clockwise.

Thus, a rotation is caused by the current flowing in the conductors. This is the principle of the starting motor (Fig. 58). For details, see Chapter 5.



MAGNETIC FIELD BETWEEN CONDUCTORS CANCELS OUT



CONDUCTORS TEND TO MOVE TOGETHER

Fig. 59—How Conductors Are Affected By Weak Magnetic Fields

A different condition exists when two parallel conductors are carrying equal currents in the *same* direction (Fig. 59). A magnetic field, clockwise in direction, will be formed around each conductor, with the magnetic lines between the conductors opposing each other in direction. The magnetic field between the conductor is canceled out, leaving essentially no field in this area. The two conductors will then tend to move toward each other; that is, from a strong field into a weak field.

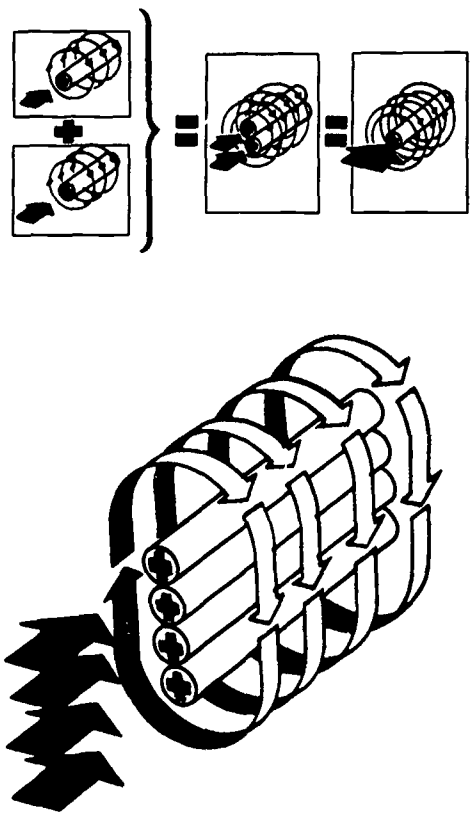


Fig. 60—How Two or More Adjacent Conductors Increase the Magnetic Field

Two conductors lying alongside each other carrying equal currents in the same direction create a magnetic field equivalent to one conductor carrying twice the current (Fig. 60).

When several more conductors are placed side by side, the magnetic effect is increased as the lines from each conductor join and surround all the conductors.

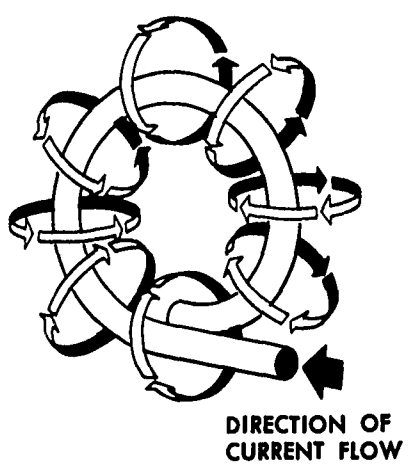


Fig. 61—Conductor in a Single Loop Has No Increase in Magnetic Field

A straight current-carrying wire when formed into a *single* loop has the same magnetic field surrounding it as when it was straight (Fig. 61).

Using the Right Hand Rule, we can see that all the lines of force enter the inside of the loop of wire on one side, and leave the other side as shown. The lines of force are concentrated inside the loop. A single loop of wire carrying current is called a **basic electromagnet.**

HOW ELECTROMAGNETS WORK

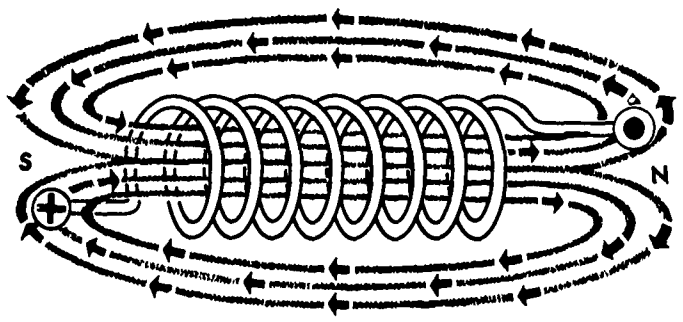


Fig. 62—Conductor in Several Loops Multiplies the Magnetic Field

But what happens when a current-carrying wire is wound into a *number* of loops to form a coil as shown in Fig. 62? Now the resulting magnetic field is the sum of *all* the single loop magnetic fields added together, since this is the same as several conductors lying side by side carrying current in the same direction.

With lines of force leaving the coil at one end and entering at the other end, a north and south pole are formed at the coil ends the same as in a bar magnet.

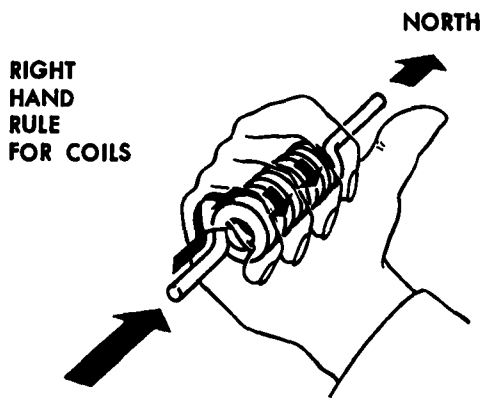
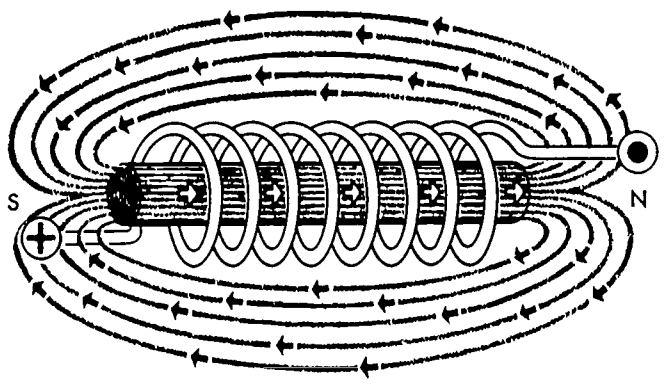


Fig. 63—Right Hand Rule for Coils

To find polarity of the coil ends, apply the Right Hand Rule for Coils by grasping the coil with the fingers pointed in the direction of current flow; the thumb will then point toward the N pole of the coil as shown in Fig. 63. If the current direction through the coil is reversed, the polarity of the coil ends will also reverse.



IRON CORE INCREASES FIELD STRENGTH

Fig. 64—Use of Iron Core to Increase Field Strength of Coil and Form an Electromagnet

When a coil is wound over a core of magnetic material such as iron, the assembly becomes a usable **electromagnet** (Fig. 64).

The strength of the magnetic field at the N and S poles is increased greatly by adding the iron core. The reason for this increase is that air is a very poor conductor of magnetic lines, while iron is a very good conductor. Relatively speaking, the use of iron in a magnetic path may increase the magnetic strength by 2500 times over that of air.

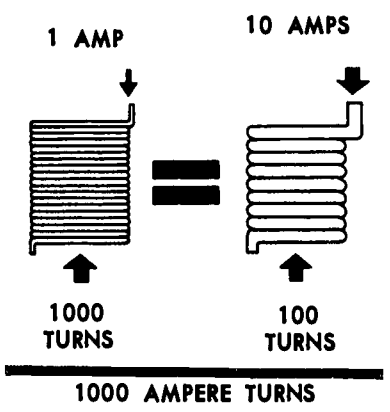


Fig. 65—Strength of Electromagnet Depends Upon Turns of Coil

The strength of the magnetic poles in an electromagnet is directly proportional to the number of turns of wire and the current in amperes flowing in the coil as shown in Fig. 65.

An electromagnet having one ampere flowing through 1000 turns and another electromagnet having 10 amperes flowing through 100 turns will each create 1000 ampere-turns, which is a measure of the magnetic field strength. The attraction on magnetic materials located in the magnetic field of each of these electromagnets will be the same.

Fig. 66—Electromagnet Picking Up Junk Metal

Just as electric current flows through a closed circuit, so do the lines of force created by a magnet occupy a closed magnetic circuit. Since the same number of lines that come out of the N pole must also enter the S pole, a complete circuit must be present for each magnetic field.

The resistance that a magnetic circuit offers to lines of force, or flux, is called **reluctance.** The reluctance is comparable to resistance in an electrical circuit.

There is an equation for an electromagnetic circuit that is similar to Ohm's Law for the electric circuit. This equation is:

Number of Magnetic Lines is Proportional to:

$$\frac{\textit{Ampere-Turns}}{\textit{Reluctance}}$$

Two facts related to this equation are important to us here:

1) The number of magnetic lines, or strength of the field, is directly proportional to the ampere-turns. In an electromagnet, more current through the coils means greater field strength.

2) The number of lines or field strength is inversely proportional to the reluctance; that is, if the reluctance increases the field strength decreases. Since most magnetic circuits consist of iron and short air gaps, the reluctance of such a series circuit is equal to the iron reluctance added to the air gap reluctance.

The effect of an air gap on the total reluctance of a circuit is very pronounced. This is true because air has a much higher reluctance than iron.

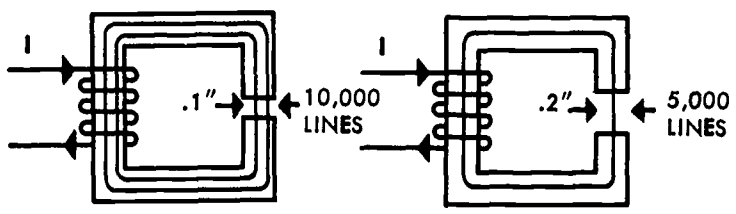


Fig. 67—Effect of Air Gap on Reluctance of a Circuit

To illustrate this fact, consider a magnetic circuit with a short air gap that has a field of strength of 10,000 lines of force (Fig. 67). If the length of the air gap is doubled, the reluctance will almost double, and the field strength will be reduced to approximately 5,000 lines of force. Although the air gap represents only a very short segment of the total magnetic path, increasing the air gap from, say, 0.1 inch to 0.2 inch may cut the field strength almost in half.

SUMMARY: ELECTROMAGNETISM

In summary:

- **Electricity and magnetism are related, because a magnetic field is established around a conductor that is carrying current.**
- **An electromagnet has an N pole at one end and an S pole at the other end of the iron core, much like a bar magnet.**
- **Every magnetic field has a complete circuit that is occupied by its lines of force.**
- **An electromagnetic field gets stronger as more current flows through its coils.**

ELECTROMAGNETIC INDUCTION

When a conductor is moved across a magnetic field, a voltage is induced in the conductor. This principle is called **electromagnetic induction,** and is defined as *the inducing of voltage in a conductor that moves across a magnetic field.*

HOW VOLTAGE IS INDUCED

To show this, move a straight wire conductor across the magnetic field of a horseshoe magnet (Fig. 68). Connect a sensitive voltmeter to the ends of the wire and the needle will register a small voltage as the wire is moved across the magnetic field.

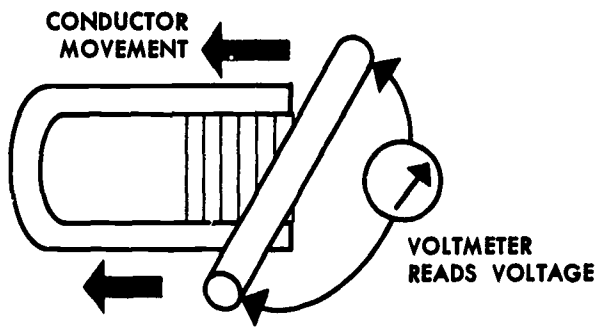


Fig. 68—Moving Conductor Across Magnetic Field—Voltage Is Induced

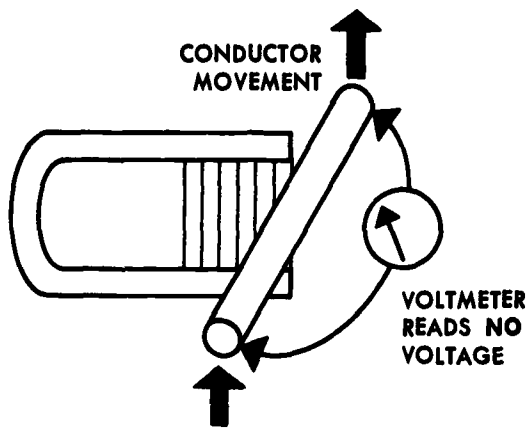


Fig. 69—Moving Conductor Parallel to Magnetic Field—No Voltage Is Induced

However, if the wire is moved *parallel* with the lines of force, no voltage will be induced (Fig. 69). *The conductor must cut across the lines of force in order to induce a voltage.*

We have observed that voltage has polarity; that is, positive and negative poles. We have also stated that current flows from the positive terminal of a voltage source through the external circuit and then back to the negative terminal of the source.

Now we can also see that a wire cutting across a magnetic field also becomes a source of electricity, and must have a positive and negative end, just like a battery.

However, unlike the battery, we will now see that the polarity at the ends of the wire can change. This polarity depends upon the relative direction of wire movement and the direction of the magnetic field.

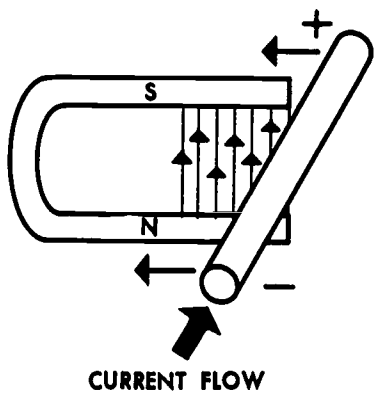


Fig. 70—Finding Polarity at Ends of a Conductor

To determine the polarity at the ends of a conductor and the consequent direction of current flow, consider a straight wire moving to the left across a magnetic field as shown in Fig. 70. With this direction of motion, the magnetic lines are striking the wire on the left side, and this side of the wire is called the *leading* side.

By applying the Right Hand Rule for an Induced Voltage, the voltage polarity and current flow direction can be determined as follows: Grasp the conductor with the fingers on the leading side of the wire, and pointed in the direction of the magnetic lines of force. The thumb will then point in the direction of current flow.

In Fig. 70, current is seen to flow into the page, or away from the reader, as indicated. This means that the polarities at the wire ends must be as shown in order to meet the condition that current flows from the positive side of a source through the external circuit and returns to the negative side of the source.

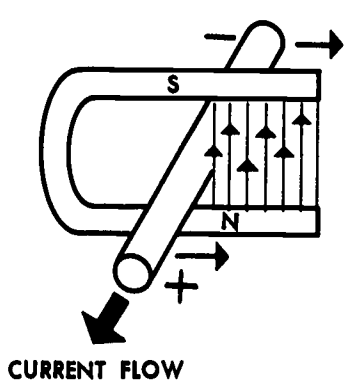


Fig. 71—Reversed Polarity in a Conductor

When the direction of motion of the conductor is changed to move toward the right, the right side of the conductor becomes the leading side (Fig. 71). By applying the Right Hand Rule, the current is seen to reverse its direction from Fig. 70, and to flow out of the page or toward the reader. This means that the voltage polarities at the wire ends have reversed.

In the previous examples, if, instead of moving the wire to the left, we move the magnetic field to the right across a stationary conductor, the same voltage and current flow will be induced in the wire. The same holds true for moving the field to the left across the conductor, because in each case the leading side of the conductor and the magnetic field direction are unchanged. Therefore, we can conclude: *A voltage will be induced in a conductor cutting across a magnetic field when there is relative motion between the two. Either the conductor can move, or the magnetic field can move.*

MAGNITUDES OF INDUCED VOLTAGE

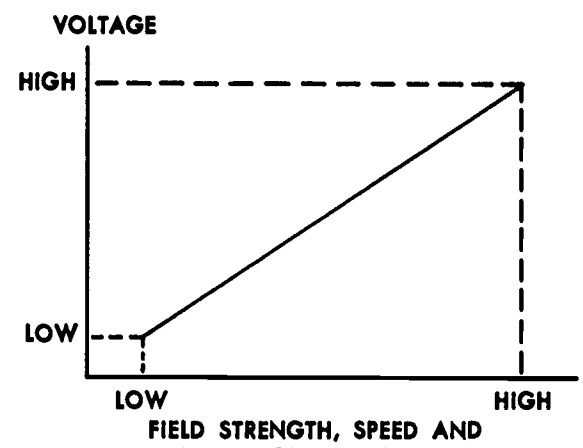


Fig. 72—Factors Which Determine the Magnitude of Induced Voltage

Now that we have observed the factors that determine the polarity of the induced voltage and the direction of current flow, let's consider the factors that determine the magnitude of the induced voltage (Fig. 72). These factors are:

1. *The strength of the magnetic field.*

2. *The speed at which lines of force are cutting across the conductor.*

3. *The number of conductors that are cutting across the lines of force.*

If the magnetic field is made stronger, such as by using a larger horseshoe magnet, more lines of force will be cut by the conductor in any given interval of time and the induced voltage will be higher.

If the *relative motion* between the conductor and magnetic field is increased, more lines of force will be cut in any given interval of time and so the voltage will be higher.

If the straight wire conductor is wound into a coil which is then moved across the field, all the loops of wire are in series and the voltage induced in all the loops will add together to give a higher voltage.

To summarize:

- **Stronger magnetic field = more induced voltage**
- **Faster relative motion = more voltage**
- **More conductors in motion = more voltage**

METHODS OF INDUCING VOLTAGE

There are three ways in which a voltage can be induced by electromagnetic induction:

- **Generated Voltage**
- **Self-Induction**
- **Mutual Induction**

Let's discuss each form of induction.

GENERATED VOLTAGE

A direct-current generator operates by moving conductors across a stationary magnetic field to produce voltage and current.

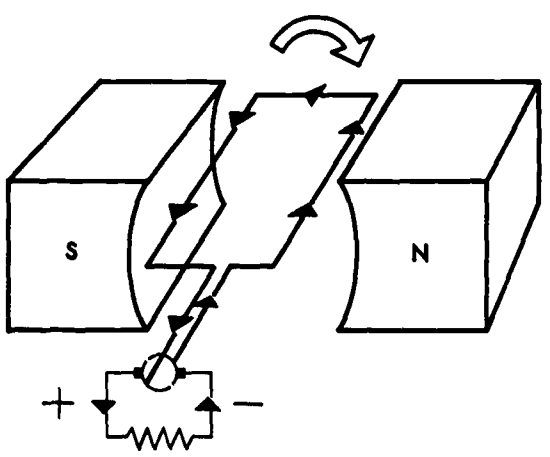


Fig. 73—Basic D.C. Generator

To show this, take the most basic type of d.c. generator where a single loop of wire is rotating between the N and S poles of a magnetic field (Fig. 73).

By applying the Right Hand Rule for Induced Voltage to both sides of the wire loop, current is seen to flow in the direction indicated, and the voltages induced in the wire loop give a coil voltage that appears at the two commutator segments attached to the wire ends. The current then flows through brushes riding on the commutator to the external circuit. The voltage polarities are as shown.

Another application of the principle of generated voltage is the alternating-current generator, or alternator, where the magnetic field is made to cut across stationary conductors in order to produce voltage and current.

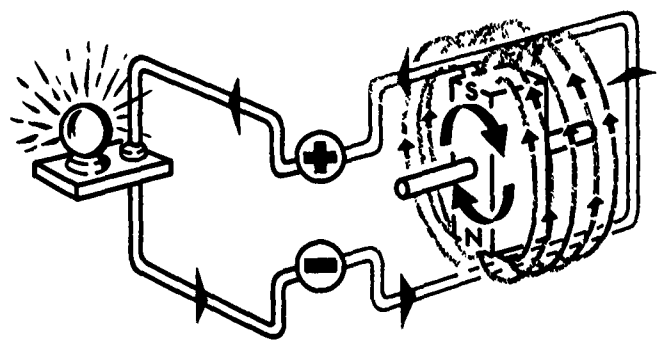


Fig. 74—Basic Alternator (A.C. Generator)

Fig. 74 shows the most basic type of alternating current generator, with a rotating magnetic field cutting across stationary conductors that are mounted on the generator frame.

By applying the Right Hand Rule, with the rotating field position as shown, current will flow through the conductor in the direction indicated with the voltage polarities.

The voltage induced in a conductor by physically moving the conductor or the field is referred to as **generated voltage.** This principle is used in d.c. generators and in alternators, both of which are covered in detail in Chapter 4.

SELF-INDUCTION

Self-induction is the induction of a voltage in a current-carrying wire when the current in the wire itself is changing.

Earlier in this chapter we used a separate magnetic field provided by a horseshoe magnet to generate voltage in a conductor. In self-induction no separate field is used; instead the magnetic field created by a changing current through the wire itself is seen to induce a voltage in the wire. Hence, the voltage is **self-induced.**

The reason that a voltage is induced in a wire carrying a changing current is this: Since the current creates a magnetic field in the form of concentric circles around the wire which expand and contract as the current increases and decreases, these magnetic circles cut across the conductor and thereby induce a voltage in the conductor. Since there is relative motion between the field and conductor, the condition necessary for inducing a voltage has been met.

Self-Induction in a Coil

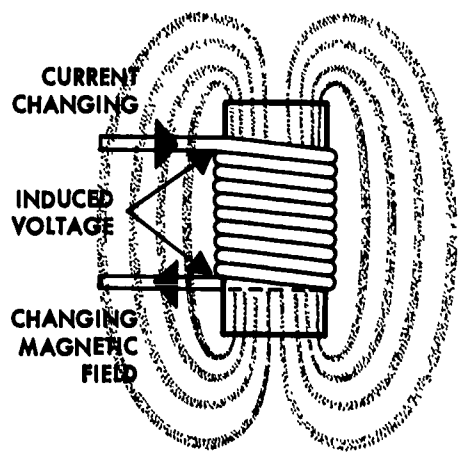


Fig. 75—Self-Induction in a Coil

Let's take a coil of wire with the turns wound tightly together over an iron core (Fig. 75). When the current increases in one loop the expanding magnetic field will cut across some or all of the neighboring loops of wire; thus inducing a voltage in these loops. The coil of wire wound over an iron core is often called an **inductor,** and possesses the property of **inductance** which causes a voltage to be induced in the coil when the current is changing.

Polarity of Induced Voltage in a Coil

Now, let's make a statement that determines the voltage polarity of the self-induced voltage in a conductor or coil of wire, and then explain this statement more fully.

The polarity of an induced voltage will oppose a change in the current that produced it.

"Change in current" refers to current which is either increasing or decreasing in value.

Fig. 76 shows a circuit containing a coil of wire (inductor).

After the switch is closed, the current increases from zero to its maximum value of, say, four amperes. During this time a voltage will be induced in the inductor in a direction opposing the increasing current; *the inductor itself becomes a source of voltage that attempts to prevent the current from increasing in the circuit.*

To oppose the increasing current, the inductor will have to generate a voltage in a direction opposite to the battery current, hence the polarity at A is positive (+) and at B is negative (−). The induced voltage opposes the change in current; that is, the induced voltage tries to maintain the "status quo" and keep the battery current at zero when the switch is closed.

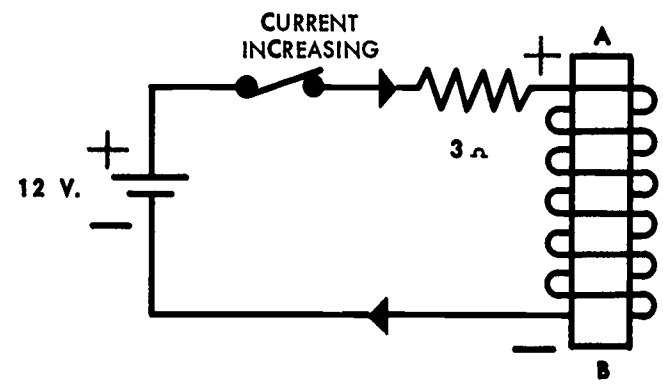


Fig. 76—Self-Induction in a Circuit When Current Increases

The induced voltage polarities at the coil are therefore as shown.

However, the battery current in time overcomes the inductive effect of the coil, and reaches its final steady value of four amperes.

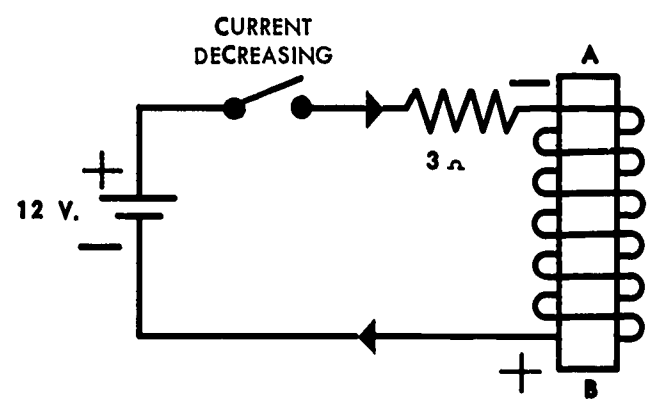


Fig. 77—Self-Induction in a Circuit When Current Decreases

When the switch is opened (Fig. 77), the current decreases from four amperes to zero. This changing current induces a voltage in the coil that again tries to maintain the "status quo" or to keep the current flow at four amperes. The polarity of the induced coil voltage, therefore, must be as shown, because the coil attempts to supply current in the same direction as originally supplied by the battery. It attempts to keep the current flow at the four-ampere value, and this may cause the switch to arc when it is opened.

Note that the induced voltage polarity for any direction of current flow is determined by whether the current is increasing or decreasing. For example:

	Induced Voltage	
	A	**B**
Current Increasing (Fig. 76)	+	−
Current Decreasing (Fig. 77)	−	+

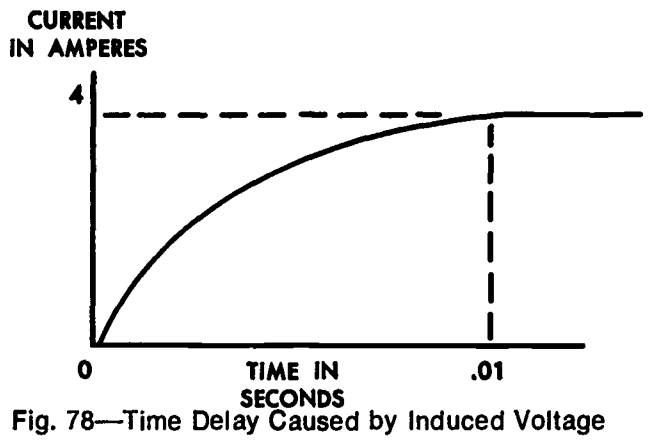


Fig. 78—Time Delay Caused by Induced Voltage

Although the inductive voltage tries to prevent any change in current value, the effects of the battery voltage and the closed or open switch in time cause the current to reach a constant value. The induced voltage, however, does cause a time delay while the current reaches its final value after the switch is closed or opened (Fig. 78).

Consider first the case when the switch is closed. Due to the inductive effect of the coil the current slowly rises to its maximum value of four amperes. When the final current of four amperes is reached, there is no changing magnetic field, no induced voltage, and the resistor alone acts to establish the final current value. Ohm's Law applied to this circuit gives the final current value of four amperes; or 4 amperes $= \frac{12 \text{ volts}}{3 \text{ ohms}}$

There is a certain amount of energy stored in an inductive coil when current is flowing through it. This energy is directly related to the amount of current (I) and the inductance of the coil, whose symbol is (L). The inductance of any coil is determined primarily by the number of turns of wire, their spacing, and the type of material used in the core of the coil. The amount of energy stored in a coil is given by the following equation:

$$\textit{Coil's energy} = \frac{\textit{Inductance} \times \textit{current} \times \textit{current}}{2} = \frac{L \times I \times I}{2}$$

This equation shows that the higher the inductance and the higher the current, the greater will be the energy stored in the coil.

Use of Self-Induction in Ignition Circuit Coils

A standard ignition circuit operates on the principle of energy stored in the primary winding of an ignition coil. When the distributor contacts open, the current suddenly drops to zero, and from the energy equation the energy in the coil suddenly drops to zero. Some of this energy is transferred by mutual induction (see the next section) to the secondary winding of the ignition coil, and the energy is dissipated in the form of an arc across the spark plug. In an ignition circuit, the time delay in build-up of primary winding current when the distributor contacts close is very important.

If the contacts open before the final maximum value of current is reached, the energy stored in the coil (see the energy equation) is reduced, making less energy available to fire the plug.

Although the inductance of the ignition coil may cause a time delay of only a fraction of a second, this interval of time must be closely correlated with the time the distributor contacts are closed. (See Chapter 6 for more details on ignition circuits.)

MUTUAL INDUCTION

If a changing magnetic flux created by current flow in one coil cuts across the windings of a second coil, a voltage will be induced in the second coil.

This induction of voltage in one coil because of a changing current in another coil is called **mutual induction.**

Mutual Induction in Coils

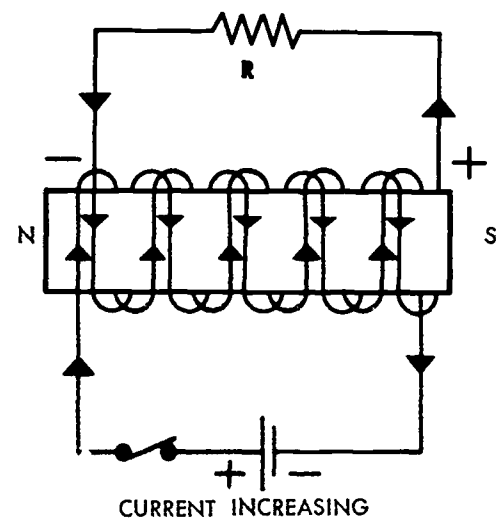


Fig. 79—Mutual Induction in Primary and Secondary Coils

Fig. 79 illustrates the principle of mutual induction in a circuit where the blue winding (the secondary) is wound over an iron core, while the red winding (the primary) is wound over the blue winding.

When the switch is closed, current will increase in the primary, and the expanding lines of force will cut across the secondary, causing a voltage to be induced in the secondary.

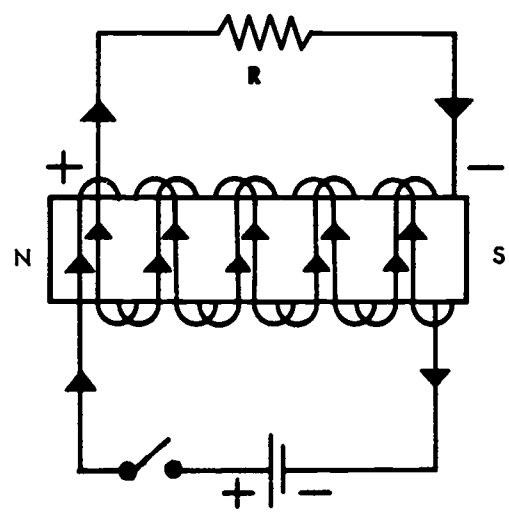
Similarly, when the switch is opened, the sudden decrease in current in the primary will induce a voltage in the secondary. The blue secondary winding then becomes a source of voltage, and will supply current to resistor R.

Finding Polarity of Induced Voltage in Secondary Coil

The polarity of the induced voltage in the secondary can be determined in a number of different ways.

One of the simplest methods is to observe the direction of current in the primary, and note that the current direction in the secondary must oppose any change in the primary current. Thus when the primary current is increasing, the secondary current must flow in the opposite direction around the core in order to oppose the increase, and the secondary voltage polarity is established as shown in Fig. 79.

However, if the primary current is decreasing, the secondary current must flow in the same direction around the core in order to oppose the change; that is, to attempt to keep the flux in the core from changing. The secondary polarity is then as shown in Fig. 80.



CURRENT DECREASING

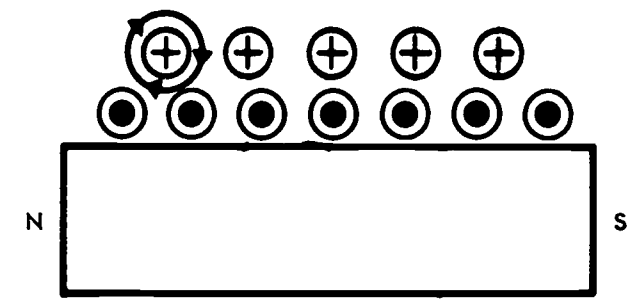
Fig. 80—Polarity in Coils with Primary Current Decreasing

An alternate method of finding the secondary induced voltage polarity is to use the Right Hand Rule for an Induced Voltage. Taking a lengthwise cross-sectional view of the assembly, when current increases in the primary, the circular lines of force expand and strike the secondary on the top side.

By using the Right Hand Rule for an Induced Voltage, the current flow direction is determined as shown in Figs. 81 and 82.

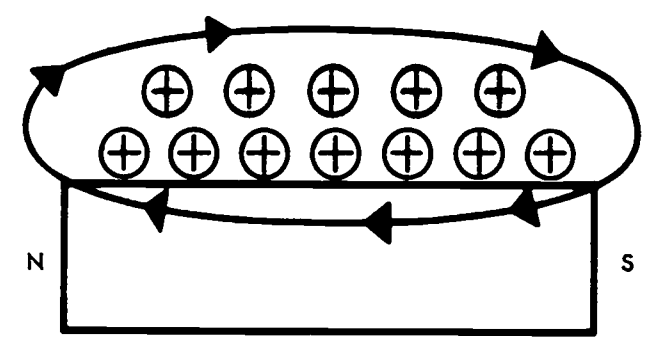
As stated above, the two coils carry current in opposite directions around the core when the primary current is increasing (Fig. 81).

When the primary current decreases (Fig. 82), the circular lines of force strike the secondary windings on the underneath side, and the current flows in both coils in the same direction around the core. The voltage polarity is determined accordingly, with current coming out of the secondary positive terminal and returning to the negative terminal.



CURRENT INCREASING

Fig. 81—Finding Polarity of Secondary Voltage When Current Is Increasing



CURRENT DECREASING

Fig. 82—Finding Polarity of Secondary Voltage When Current Is Decreasing

The magnitude of the voltage induced in the secondary winding is determined primarily by the number of turns in the primary and in the secondary.

The ignition coil uses the principles of mutual induction in its primary and secondary windings. (See Chapter 6 for details.)

SUMMARY: ELECTROMAGNETIC INDUCTION

In summary:

- **Electromagnetic induction is inducing voltage in a conductor that moves across a magnetic field.**
- **Conductor must cut *across* the field, not move parallel to it.**
- **Conductor and field must be moving in relation to each other.**
- **Faster relative motion = more voltage induced.**
- **More conductors in motion = more voltage.**
- **Stronger magnetic field = more voltage.**

- **Three ways of inducing voltage are generated voltage, self-induction, and mutual induction.**
- **Generated voltage by relative motion is used in generators and alternators.**
- **Self-induction creates its own voltage by a change of current in the conductor (as in the primary of ignition coils).**
- **Mutual induction occurs when changing current in one coil induces voltage in a second coil (as in the two windings of ignition coils).**

CAPACITORS

A capacitor (or condensor) is made by separating two metal plates with a thin insulating material such as paper, mica, or air. See Fig. 83.

Fig. 83—Capacitor

When the two metal plates are connected to a source of voltage, the capacitor exhibits the property of **capacitance** (stores up energy). The symbol for capacitance is C, and the unit of measure is the farad, or micro-farad. The greater the area of the plates, and the shorter the distance between them, the greater will be the capacitance.

HOW A CAPACITOR WORKS

Fig. 84 explains the action of a capacitor in a circuit. Remember that the metal plates in all capacitors are insulated from ea ;h other. Since the plates are insulated, it would seem that no current will flow in this circuit. This is indeed the case, *except* at the instant of time when the switch is closed. When this is done, the voltage across the plates will suddenly change from zero to 12 volts. Let's see how this works.

When the switch is closed, electrons will leave the battery and gather on the capacitor negative plate as shown in Fig. 84. This plate will then have an excess of electrons. At the same time, electrons will leave the other plate and cause this plate to become positively charged. It is important to note that the electrons flow through the circuit but *not* through the insulating material separating the two plates.

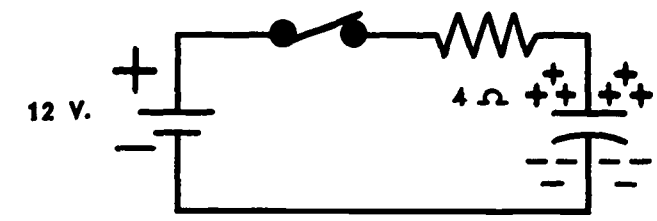


Fig. 84—Capacitor in a Circuit with Switch Closed

As the two plates become negatively and positively charged, a voltage appears across the plates. Remember that a voltage between two points is the direct result of a difference in charge between the two points. As more and more electrons accumulate on the negative plate and leave the positive plate, the voltage across the plates approaches the battery voltage. When the capacitor voltage equals the battery voltage, the flow of electrons will stop. The equation giving the amount of charge on a capacitor is:

Charge = Capacitance × Voltage.

Thus the higher the capacitance and applied voltage, the greater will be the charge on the capacitor.

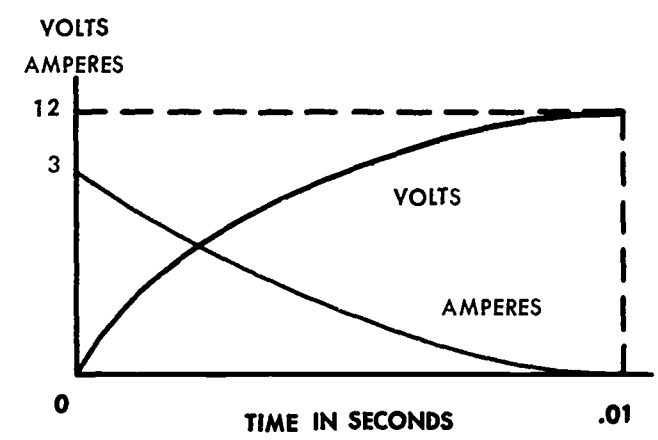


Fig. 85—Curves Showing Current and Voltage for Capacitor Plates

The curves showing the flow of current into, and the voltage across, the capacitor plates are shown in Fig. 85.

At the very instant the switch is closed, the initial current is determined by the resistor R in the circuit, or $I = \frac{E}{R} = \frac{12}{4} = 3$ amperes. Initially the capacitor acts like a short circuit, since only the resistor R limits the initial current flow. As the charge on the plates increases, the capacitor voltage increases to oppose the battery voltage, and the current decreases with time. Finally the current flow stops completely when the capacitor voltage is equal and opposite to the battery voltage.

The time needed for the current to reach a zero value may be only a fraction of a second. Although this time interval may seem very short, it can be of major importance in electrical systems where voltages are changing at extremely rapid rates.

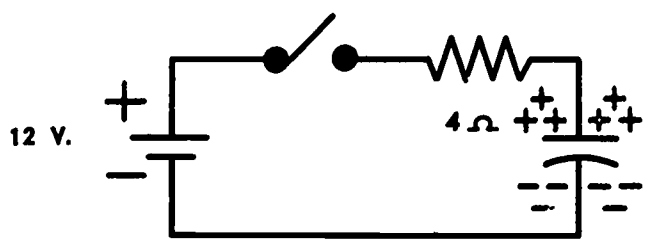


Fig. 86—Capacitor in Circuit with Switch Open

If the switch is suddenly opened, the charge of the capacitor will remain (Fig. 86). The accumulated charge represents stored energy, and a capacitor has the ability to store a charge. The amount of energy stored is represented by the formula:

$$Energy = \frac{Capacitance \times Voltage \times Voltage}{2}$$

Thus, the higher the capacitance and voltage the higher the energy stored in the capacitor. In time the charge will leak off the plates through the insulating material and surrounding air, reducing the charge to zero.

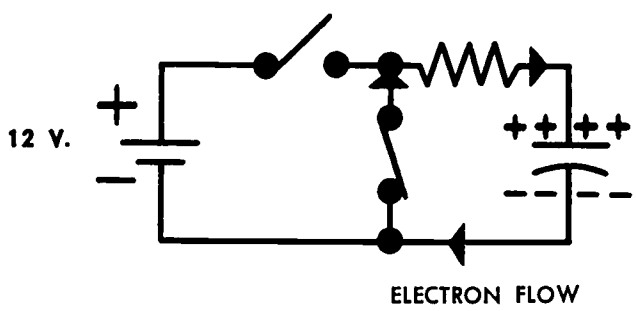


Fig. 87—Capacitor in Circuit with Two Switches

By adding another switch to the circuit, the energy stored in the capacitor may be used to send a current through the resistor (Fig. 87). When the switch is closed, a momentary surge of current will flow through the resistor until the charge on the two plates is equal. The initial current will be $I = \frac{E}{R} = \frac{12}{4} = 3$ amperes, since the capacitor voltage is 12 volts. As the electron flow continues, the voltage across the plates decreases, until finally the current value is zero. Again, the time interval may be only a fraction of a second.

The operation of capacitors can be summarized:

1. A capacitor as it builds up a charge develops a counter voltage across the plates.

2. The capacitor has the ability to store a charge, or to store energy.

3. Current flows only during the very short time when the capacitor plates are either charging or discharging.

USES OF CAPACITORS

Capacitors used in machine electrical circuits usually consist of a roll of two layers of thin metal foil separated by a very thin sheet of insulating material. The assembly is then sealed in a metal can.

Capacitors of this type are used primarily to perform either one of two functions in an electrical circuit, as follows.

The characteristic of a capacitor to act initially like a short circuit when a sudden difference in voltage is applied across its plates makes it ideally suited to "trap" or temporarily store electrical energy that otherwise could damage electrical components.

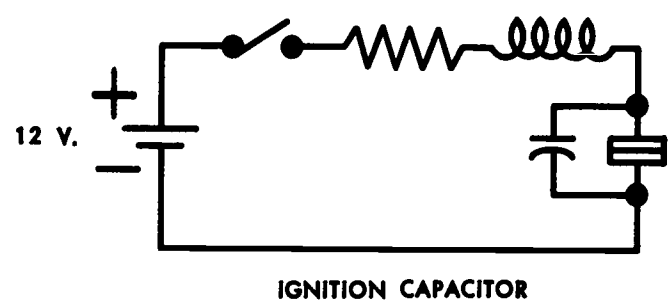


Fig. 88—Capacitor in Ignition Circuit

To illustrate, consider an ignition circuit in which a capacitor is connected across the distributor contact points (Fig. 88).

When the contacts separate a high voltage is induced in the ignition coil primary winding because of self-induction. This high voltage causes the capacitor plates to charge when the contacts first separate; the capacitor acts initially like a short circuit and current flows into the capacitor to minimize arcing at the contacts.

High voltages originating when a circuit is opened may exist for a very short interval of time, such as 1/1,000,000 of a second, and are called **transient voltages.**

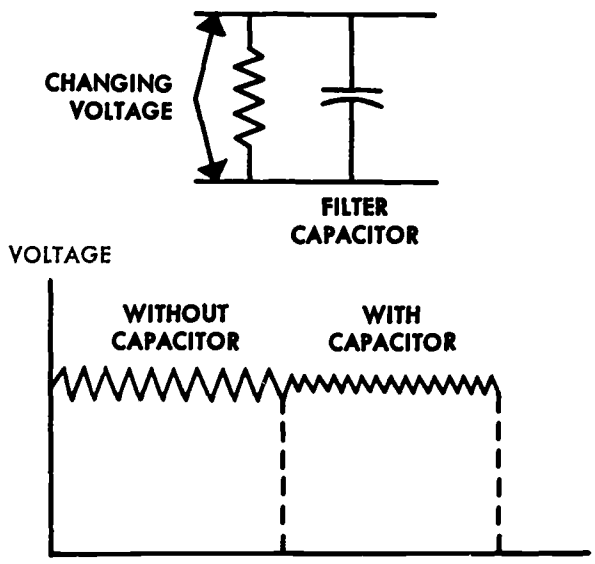


Fig. 89—Filter Capacitor

Another application where the capacitor is used to reduce the magnitude of changing voltages is in regulators, where a constantly changing voltage needs to be "smoothed out" to a more constant voltage. A capacitor used in this way is connected across the changing voltage, and is called a **filter capacitor** (Fig. 89).

Besides reducing the magnitude of changing or transient voltages, capacitors are used in ignition amplifiers to store a charge of electricity until the charge can be transferred to another part of the circuit.

The uses of the capacitor in charging and ignition circuits are covered in more detail in Chapters 4 and 6 of this manual.

SUMMARY: CAPACITORS

In summary:

- **A capacitor (or condensor) is made of two metal plates separated by thin insulation.**
- **A capacitor can store energy.**
- **A capacitor can build up a counter voltage across its two plates.**
- **Current flows between the plates only at the moment when the plates are either charging or discharging.**
- **At other times the plates are insulated.**
- **Capacitors can be used to store harmful energy for a moment (as to prevent arcing of distributor points).**
- **Another use is to "smooth out" changing voltages (as in regulators).**

TEST YOURSELF

QUESTIONS

1. Electricity is the flow of _____ from atom to atom in a _____.

2. Elements whose atoms have less than four electrons in their outer rings are generally good _____.

3. Like charges _____, while unlike charges _____.

4. The flow of electrons through a conductor is called a current. The *rate* of flow of the current is measured in _____. The *force* of the current is measured in _____. The *resistance* of the conductor to this current is measured in _____.

5. What are the three basic types of electrical circuits?

6. Which of the basic circuits is used if a high resistance is required? Which is used if a low resistance is required?

7. True or false? "The hotter the wire, the less the resistance to current flow."

8. Name two electrical components which use semiconductors.

9. What is the basic difference in operation between a diode and a transistor?

10. What are the two parts of a basic electromagnet?

11. Match the method of inducing voltage below with the component which uses this method:

a. Generated voltage	1. Primary winding of ignition coil
b. Self-induction	2. Secondary winding of ignition coil
c. Mutual induction	3. Alternator

(Answers on following page.)

ANSWERS

1. First blank — "electrons." Second blank — "conductor."

2. "Conductors."

3. First blank—"repel." Second blank—"attract."

4. First blank—"amperes." Second blank—"volts." Third blank—"ohms."

5. Series circuits, parallel circuits, and series-parallel circuits.

6. Answer to first question—"series circuit." Answer to second question—"parallel circuit."

7. False. A hotter conductor offers *more* resistance to current flow.

8. Diodes and transistors.

9. A diode allows current to pass through but in only one direction. A transistor allows current to either pass through or stops it.

10. A *coil* of wire wound over a soft *iron core.*

11. a—3; b—1; c—2.

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ERIC

TESTING TOOLS AND EQUIPMENT / CHAPTER 2

INTRODUCTION

Fig. 1—Electrical Testing in a Service Shop

To test and diagnose electrical systems with speed and skill, good test equipment and procedures are a must.

In this chapter, we will give a general story on the use of testing tools and the basic testing of circuits. Other chapters will give details on actual test hook-ups, and the final chapter has detailed testing of the whole system.

At the end of this chapter, the testing tools needed in a service shop are shown and described.

USE OF TEST METERS

The use of test meters is an essential aid in diagnosing troubles in an electrical circuit.

If the values of voltage, current and resistance are not measured with suitable test meters, only a guess can be made as to what type of defect exists in the circuit.

NOTE: Modern testers often combine the voltmeter, ammeter, and ohmmeter features in one test unit, such as in a battery-starter tester. (See "Testing Tools and Equipment" later in this chapter.)

VOLTMETERS

Most voltmeters are of the moving coil type which have a permanent horseshoe magnet and a movable coil. Current flowing through the movable coil reacts with the permanent magnetic field, causing the coil to turn against a slight spring tension. The relative movement of the coil is in direct proportion to the amount of current flowing in the coil, which in turn is proportional to the amount of voltage to which the voltmeter is connected. A pointer attached to the coil moves across a scale calibrated in volts to indicate directly the value of the voltage being measured.

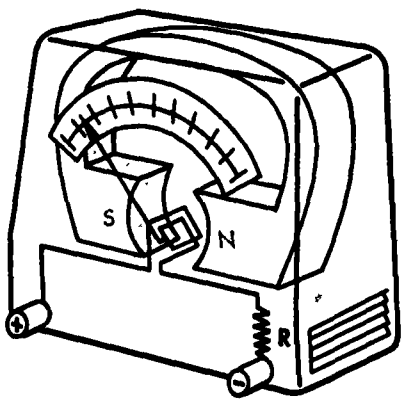

Fig. 2—Voltmeter

Because the moving coil in the voltmeter is very small and sensitive, the current through the coil must be limited to safe values. To do this, voltmeters are constructed with an internal resistor in series with the coil to limit the current to a safe value. The voltmeter scale is calibrated accordingly to indicate the true voltage.

The voltmeter resistance is often printed on the face of the meter, and is usually specified in ohms-per-volt. If the voltmeter resistance is 1,000 ohms per volt, and the 20-volt scale on the meter is being used, the voltmeter internal resistance is $1{,}000 \times 20 = 20{,}000$ ohms.

Voltmeters having a choice of scales have a selector knob to insert different resistor values in series with the moving coil. The selector knob would choose an internal resistance of 10,000 ohms for a 10-volt scale, thus adhering to the 1,000 ohms-per-volt specification.

Voltmeters are connected across (in parallel with) the voltage to be measured (see Fig. 3). Since the voltmeter has a high resistance, adding this component to the circuit will change the total circuit current very little, and the voltage reading will indicate the true voltage present without the meter in the circuit.

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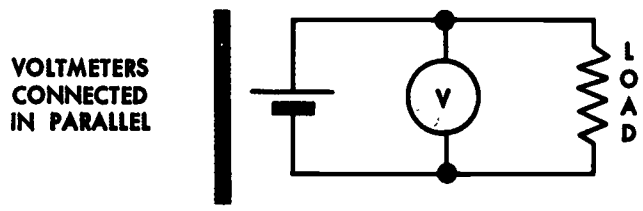

Fig. 3—Connect Voltmeter in Parallel

AMMETERS

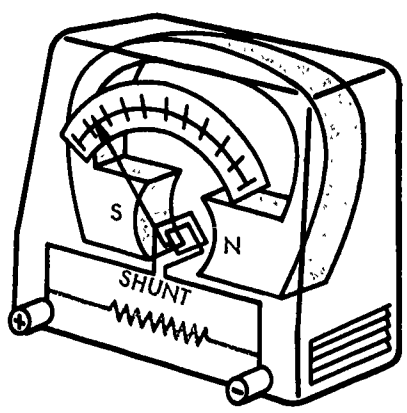

Fig. 4—Ammeter

Ammeters may also be of the moving coil type, and differ from voltmeters in that a low-resistance shunt is used internally or externally in place of a high resistance. The shunt is connected in parallel with the moving coil, and conducts the major part of the current being measured, leaving only a small portion to flow through the moving coil. The ammeter scale is calibrated in amperes to indicate the total circuit current, since the pointer deflection is directly proportional to the total current flow in the circuit.

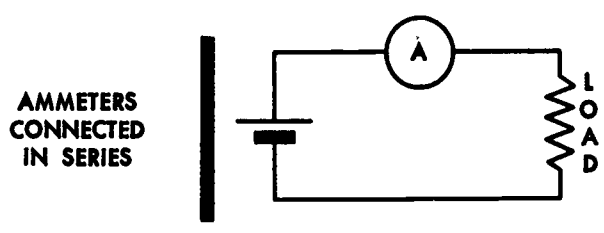

Fig. 5—Always Connect Ammeter in Series

Since the ammeter has a very low resistance, it must be connected in series in the circuit, and NEVER across the voltage source. If connected across the voltage source, such as a battery, the meter may be instantly damaged. Having a very low resistance, an ammeter connected in series does not add resistance to the circuit that would alter the true current flow.

OHMMETERS

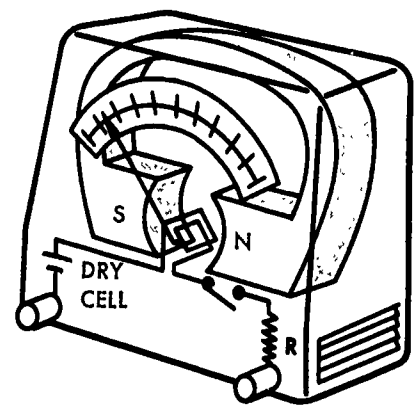

Fig. 6—Ohmmeter

An ohmmeter also may be of the moving coil type, and contains a resistor and dry-cell battery connected internally to the moving coil. When the ohmmeter is connected to a resistor, the current flow through the moving coil is directly related to the value of the resistor, and the scale is calibrated accordingly to show the resistance value in ohms.

Ohmmeters should never be connected to an external source of voltage, as the meter movement may be damaged.

BASIC TESTING OF CIRCUITS

Testing the system usually means using meters to locate three basic failures:

- **Open or Break**
- **Ground**
- **Short**

An OPEN is a break or interruption in the circuit such as a wire that has come loose, or a slipped connection that is not making contact.

A GROUND occurs when any part of the wiring circuit inadvertently is touching the vehicle frame. A ground involves accidental or unintentional contact between copper and the iron frame.

A SHORT occurs when copper touches copper, such as when wiring insulation between two wires fails and the wiring makes contact.

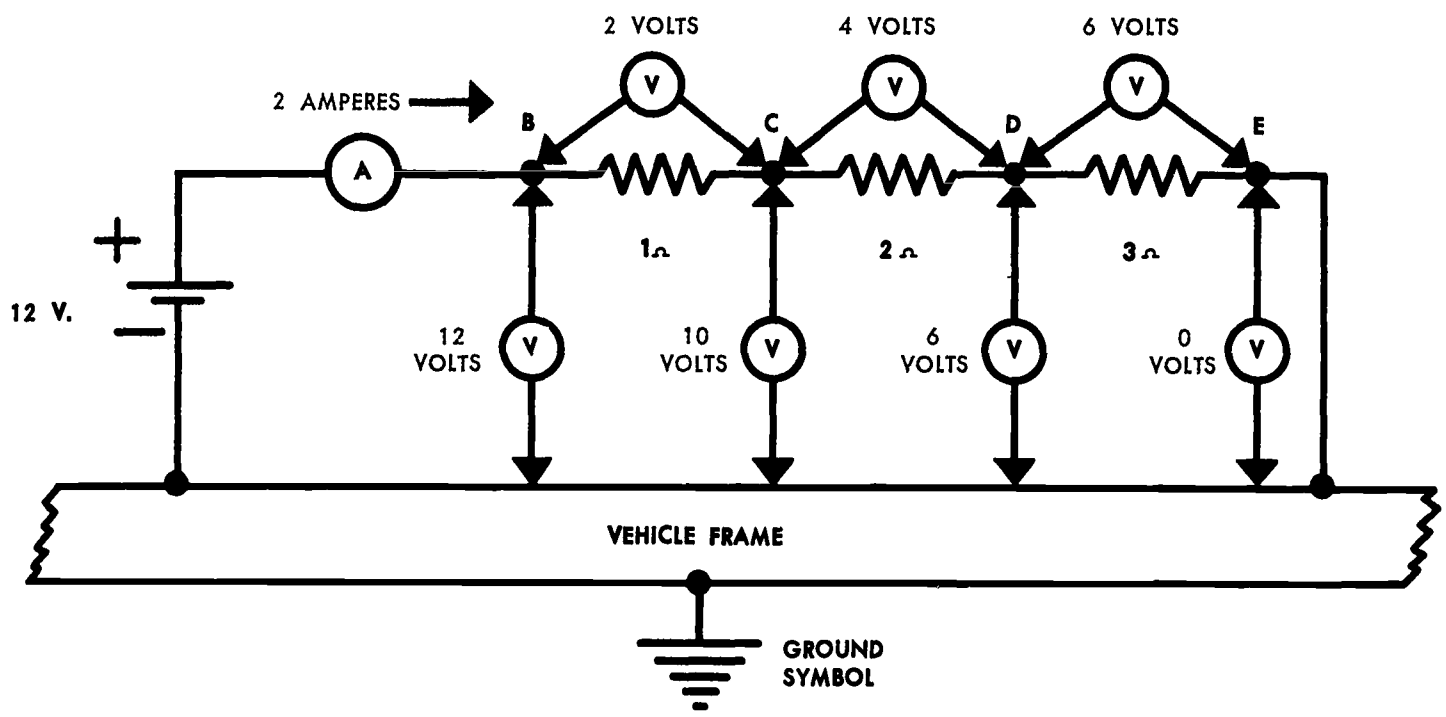

Fig. 7—Normal Test Meter Readings when Testing a Typical Circuit for Opens, Grounds, or Shorts

TESTING CIRCUITS FOR FAILURES

To test for the three basic failures, connect an ammeter and a voltmeter in the circuit at the different locations shown in Fig. 7.

If no part of the circuit is open, grounded, or shorted, the meters should read as shown in Fig. 7.

If any part of the circuit is open, the ammeter would read zero current.

If the open occurred in the one-ohm resistor, a voltmeter connected from C to ground would read zero.

However, if the voltmeter is connected instead to points B and C, the reading will be 12 volts. The reason is that the battery, ammeter, voltmeter, two-ohm resistor, and three-ohm resistor are all connected together to form a series circuit.

The two-ohm and three-ohm resistor have very little effect on the high-resistance circuit, and reduce the current flow through the high resistance voltmeter very little, hence the pointer deflects to indicate 12 volts.

To illustrate this type of 12-volt meter reading further, if the two-ohm resistor were to become open instead of the one-ohm resistor, a voltmeter connected from point C to ground would indicate 12 volts, since the one-ohm resistor in series with the high resistance of the voltmeter has negligible effect.

If an open should occur between point E and ground, a voltmeter connected from points B, C, D, or E to ground will read 12 volts. A voltmeter connected across any one of the resistors, from B to C, C to D, or D to E, will read zero volts, because no voltage drop occurs with no current flow as indicated by a zero reading on the ammeter.

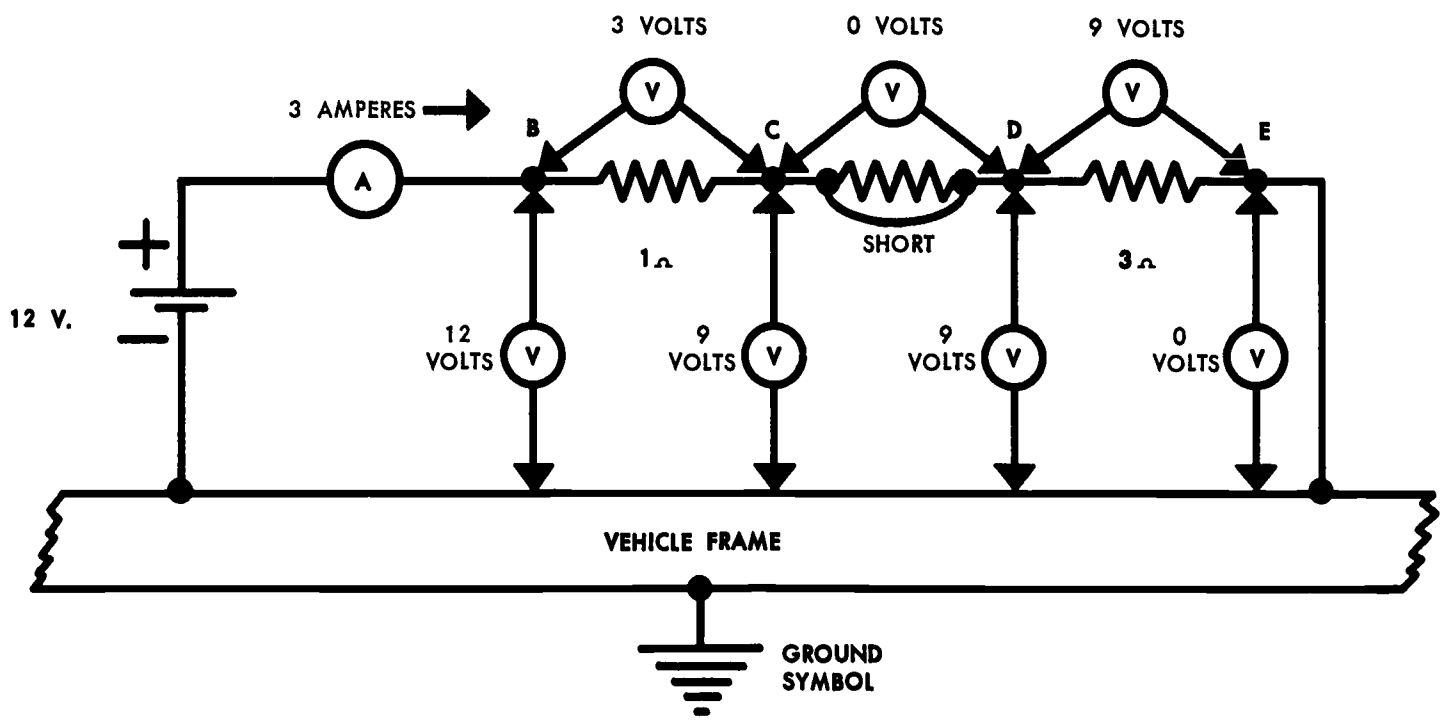

Fig. 8—Test Meter Readings in Typical Circuit when Two-Ohm Resistor Is Shorted

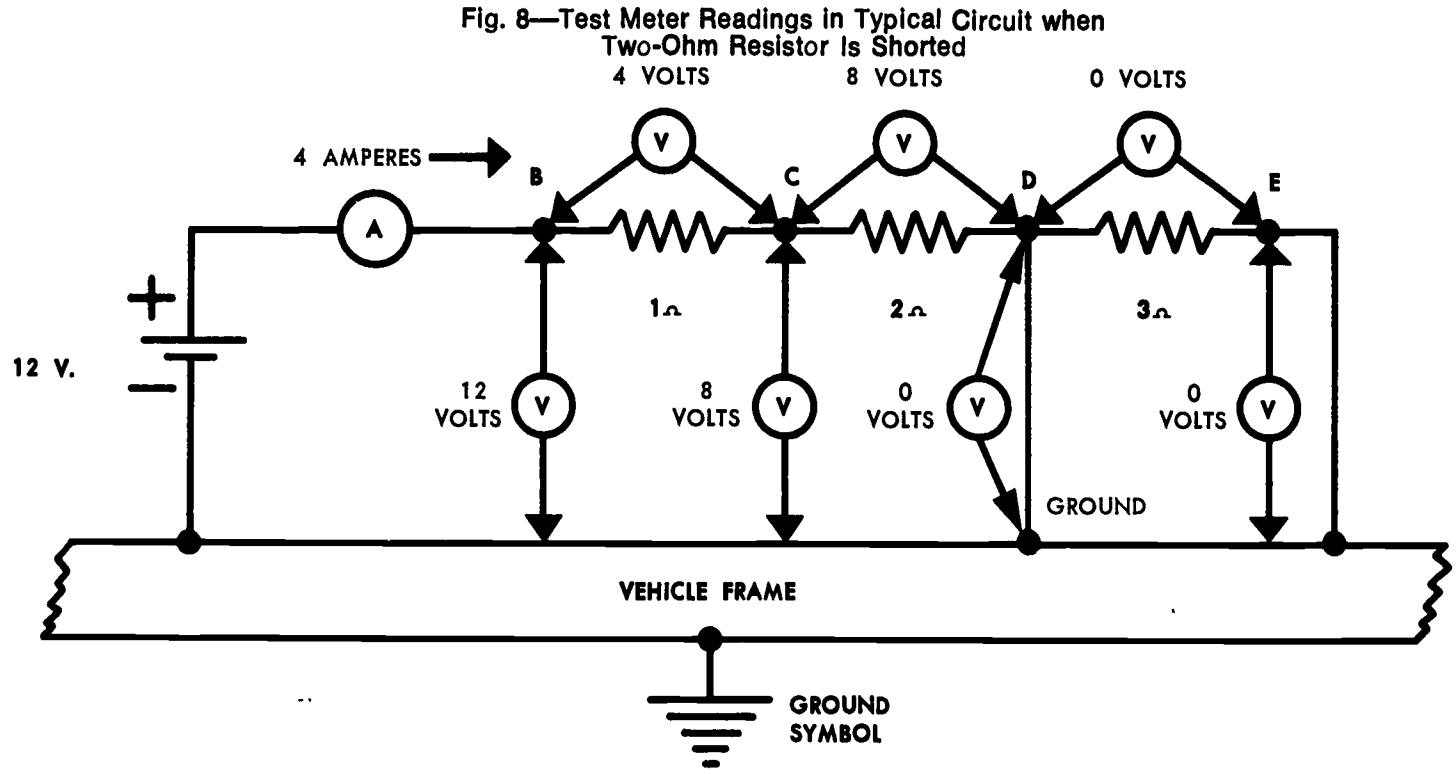

Fig. 9—Test Meter Readings in Typical Circuit when Point D Is Grounded

Fig. 8 shows what would happen if the two-ohm resistor should become completely shorted. The ammeter will read three amperes, since $I = \frac{E}{R} = \frac{12}{1+3} = 3$ amperes. The other voltmeter readings will be as shown. The application of Ohm's Law will verify these readings.

Fig. 9 shows what would happen if point D should become grounded. The ammeter will read $I = \frac{12}{4} = 4$ amperes. No current will flow through the three-ohm resistor, and a voltmeter connected to the various points will give readings as illustrated.

These examples show how a voltmeter and ammeter may be used to check for defects in a circuit.

An ohmmeter also may be used, with the 12-volt battery disconnected, to measure the ohmic values of each resistor. A high reading indicates an open or poor contact inside the resistor, and a low or zero reading indicates a partial or complete short circuit.

The service technician who has a good knowledge of electrical fundamentals, and knows how to use test meters, will soon find that this job becomes much easier.

Testing and diagnosis of the various circuits is given in each chapter of this manual. Basic testing of the complete system is covered in Chapter 9.

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TESTING TOOLS AND EQUIPMENT

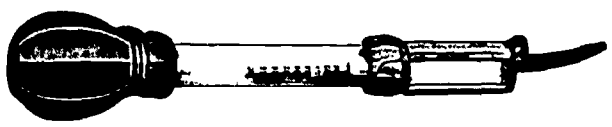
To test and diagnose electrical systems with speed and skill, good test equipment is a must.

The testing equipment shown here will give you a balanced group of aids in testing and trouble shooting.

In each case, we have shown only one example from the many models available.

Also remember that this is not a complete listing; many other tools are useful for auxiliary tests.

HYDROMETER

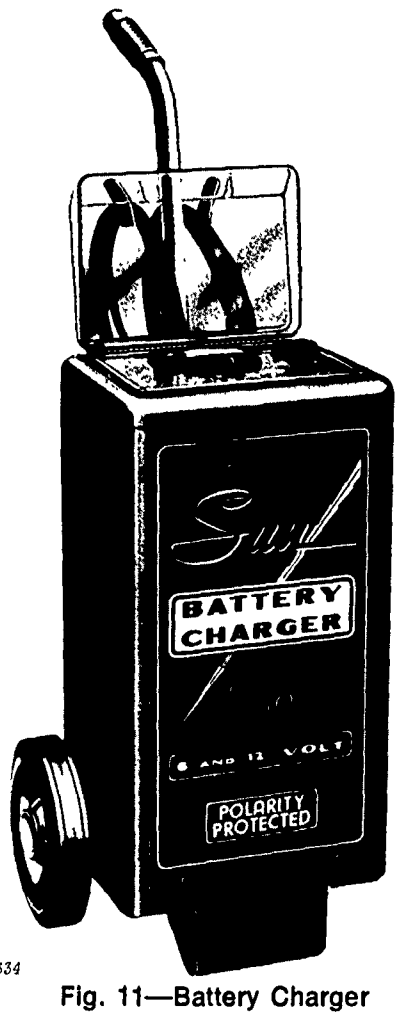


R 458

Fig. 10—Hydrometer

Use the hydrometer to check the specific gravity of the battery electrolyte. All good hydrometers have a thermometer built in.

BATTERY CHARGER



X 1334

Fig. 11—Battery Charger

The battery charger in Fig. 11 will fast or slow charge and is polarity protected to prevent damage if connected wrong.

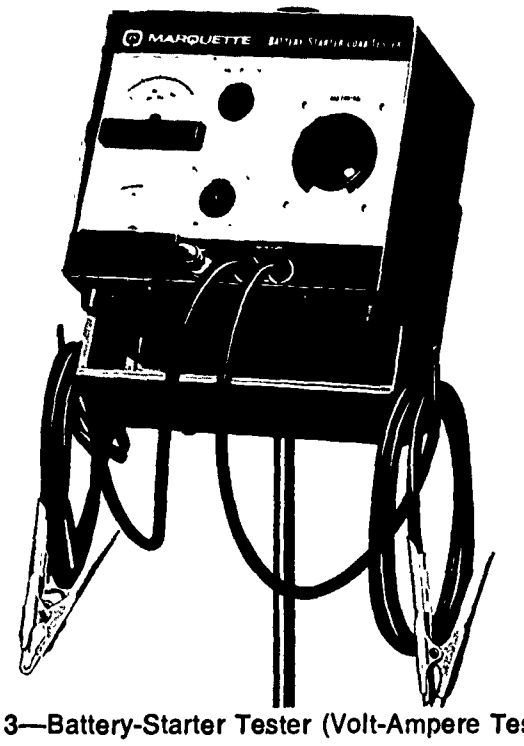
BATTERY TESTER

X 1335

Fig. 12—Battery Tester

The battery tester shown in Fig. 12 has a "20-second" test for battery condition. It also has a built-in cell tester. (Prod-type cell load testers are also available as a separate tool.)

BATTERY-STARTER TESTER (Volt-Ampere Tester)



X 1336

Fig. 13—Battery-Starter Tester (Volt-Ampere Tester)

This tester has a **voltmeter,** an **ammeter,** and a battery **cell tester** in one unit. It provides complete test data for storage batteries and starting circuits.

NOTE: Other volt-ampere testers are available. Voltmeters should have a range of 0 to 50 volts. Ammeters, with proper shunt, should have a range of 0 to 500 or 1,000 amperes.

SPARK-IGNITION ENGINE ANALYZER

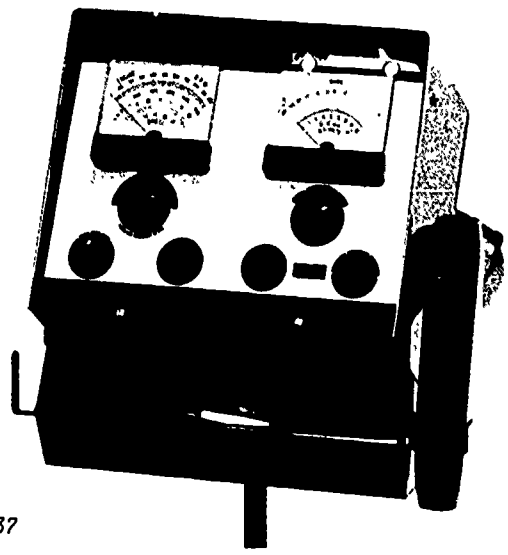


Fig. 14—Spark-Ignition Engine Analyzer

The spark-ignition engine analyzer can be used to test the entire ignition system, the point resistance, the cam angle, basic timing, generator voltage, cranking voltage, and the mechanical condition of the distributor.

DISTRIBUTOR TESTER

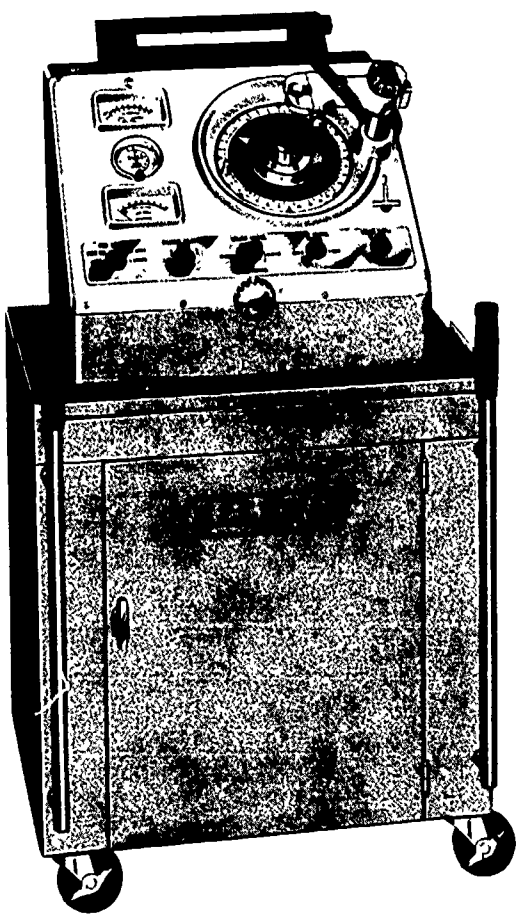


Fig. 15—Distributor Tester

The all-purpose distributor tester shown in Fig. 15 will test centrifugal advance, vacuum advance, dwell angle, variations in cam lobes, breaker contact resistance, point synchronization, breaker point operation, breaker arm spring tension, and vacuum chamber condition. It will also detect shorts and grounds, excessive wear, and will check the high-speed performance of all distributors.

Bench models of the tester are also available. These testers are also known as "synchrographs."

POWER TIMING LIGHT

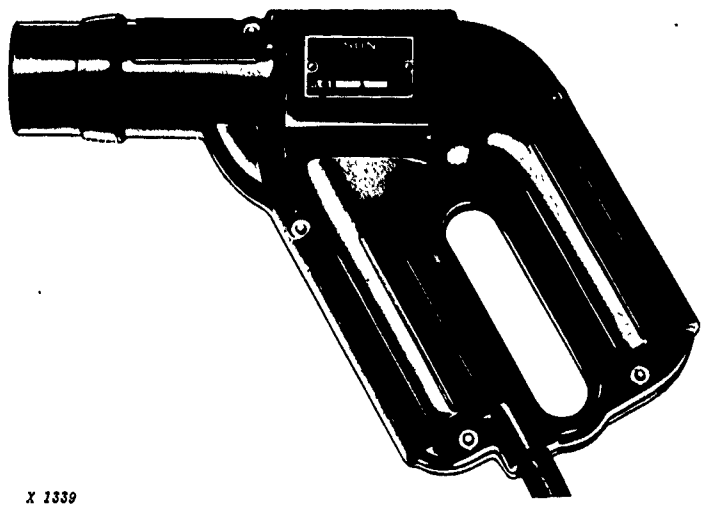


Fig. 16—Power Timing Light

Use the power timing light to check the ignition timing while the engine is running.

SPRING TENSION GAUGE

Fig. 17—Spring Tension Gauge

This gauge will measure the tension of brush springs on starters and generators.

ARMATURE COMMUTATOR TURNING AND UNDERCUTTING TOOL

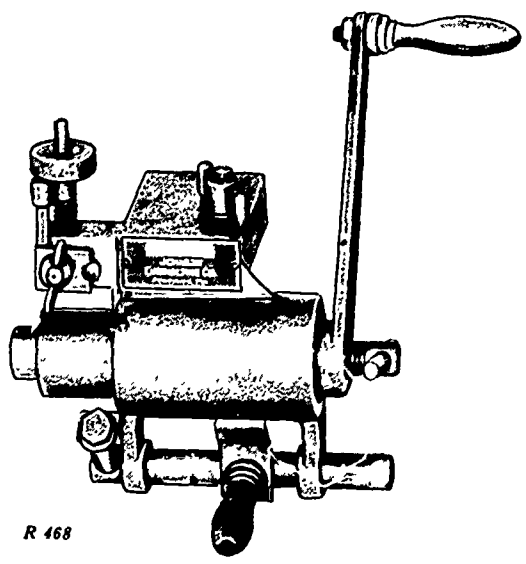


Fig. 18—Armature Commutator Turning and Undercutting Tool

Use this tool to true up armature commutators and to undercut the commutator segments on starters.

GAUGES

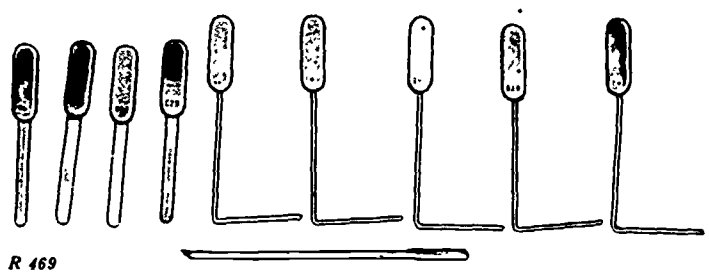


Fig. 19—Gauges

These gauges are useful when making various adjustments on voltage regulators, distributors, and other components.

ALTERNATOR SERVICE TOOLS

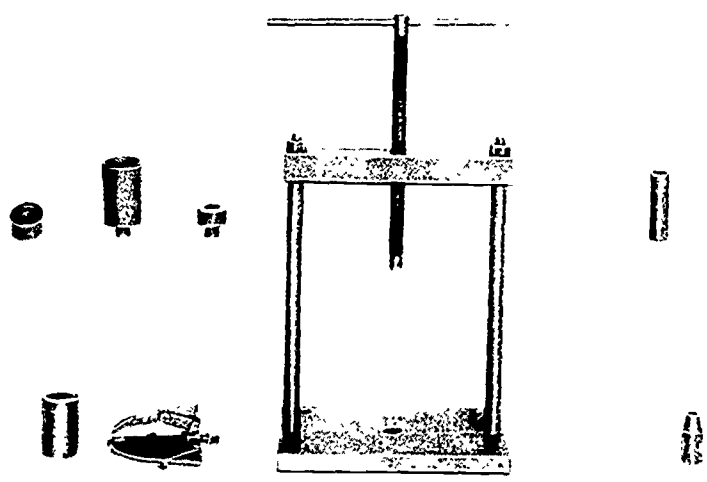


Fig. 20—Alternator Service Tool Set

Use the tool set shown in Fig. 20 when repairing alternators. The various tools allow you to quickly and safely disassemble the alternator and assemble it again.

ARMATURE TESTER

Fig. 21—Armature Tester

The armature tester will check all generator and starter armatures for grounds, shorts, and continuity. This growler-type unit will also test for grounds and continuity of field coils, relays, regulator circuits, and other components.

ALTERNATOR TESTER

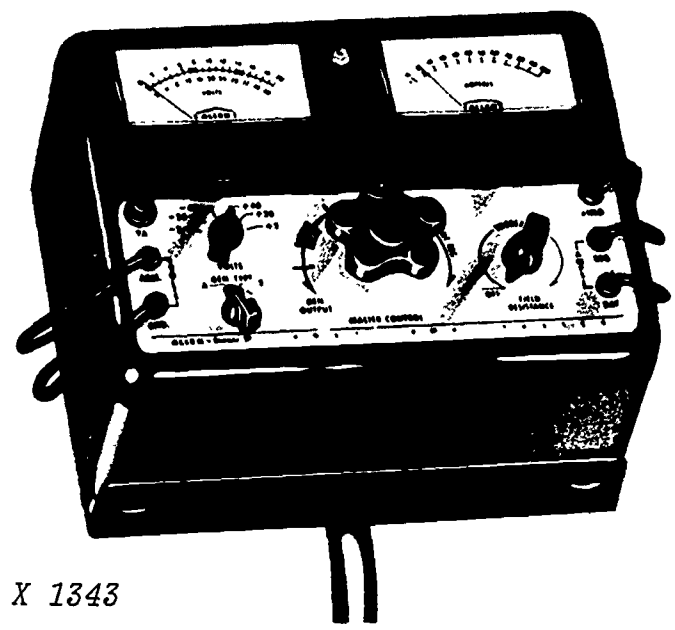


Fig. 22—Alternator Tester

The volt-amp alternator tester shown in Fig. 22 allows you to test generators, alternators, and regulators. The features include a push button for checking alternator field relay voltages and for checking voltage settings of double-contact voltage regulators.

ALTERNATOR DIODE TESTER

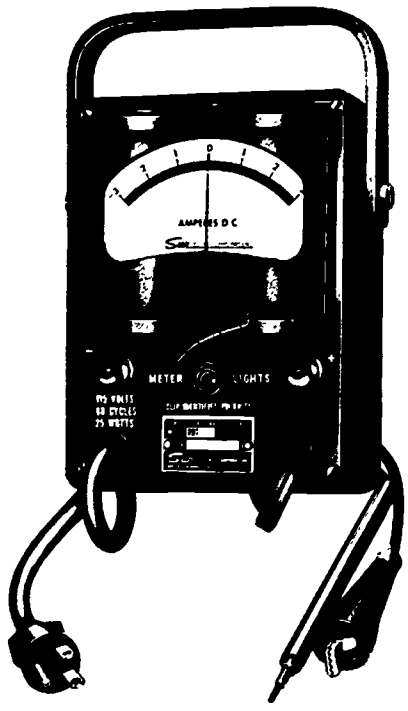


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Fig. 23—Alternator Diode Tester

Use the alternator diode tester shown in Fig. 23 to test plate- or diode-type rectifiers. It will test diodes either "in" or "out" of the alternator and will show whether they are good, open or shorted.

GENERATOR-ALTERNATOR-REGULATOR TESTER

This tester (Fig. 24) combines all these tests in one unit: alternator tests, generator mechanical condition, field coil current draw, generator output, cut-out relay action, closing voltage, opening amperage, voltage limit setting, current regulator operation, current limit setting, and complete voltage regulator tests.

SUMMARY: TESTING TOOLS AND EQUIPMENT

Many of the testers shown in this section are deluxe models which combine many of the features of older, simpler testers.

However, with today's complex systems and high labor costs, it pays to have better test equipment—saves time and money and improves performance.

TEST YOURSELF

QUESTIONS

1. What are the three basic electrical test meters?

X 1345

Fig. 24—Generator-Alternator-Regulator Tester

2. (True or false?) "Many modern testers combine the three basic test meters in one unit."

3. Voltmeters are connected into the circuit in _____ while ammeters are connected in _____." (Fill in the blanks with "series" or "parallel.")

4. Match the three basic failures of circuits below with the correct descriptions.

a. Open or Break	1. A wire touching metal
b. Ground	2. Two bare wires touching
c. Short	3. A loose wire

ANSWERS

1. Voltmeter, ammeter, and ohmmeter.
2. True. An example is the battery-starter tester shown in this chapter.
3. First blank—"parallel." Second blank—"series."
4. a—3; b—1; c—2.

STORAGE BATTERIES / CHAPTER 3

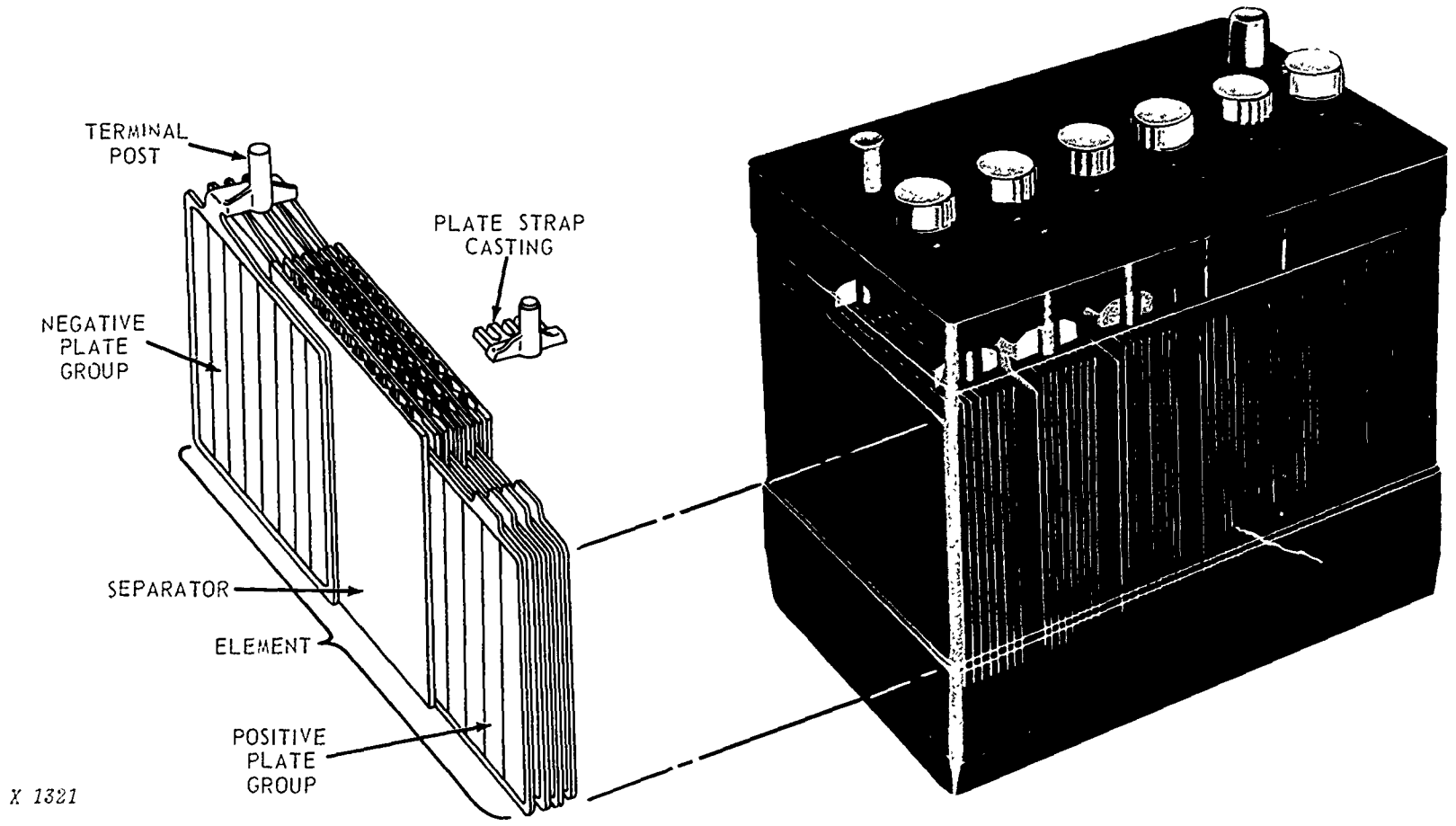

Fig. 1—Construction of a Storage Battery

WHAT A BATTERY DOES

The battery stores energy for the complete electrical system.

On demand, the battery produces a flow of direct current for the devices connected to its terminals.

Battery current is produced by a chemical reaction between the active materials of the *plates* and the sulfuric acid in the battery fluid or *electrolyte*.

After a period of use, the battery becomes discharged and will no longer produce a flow of current. However, it can be recharged by making an outside direct current flow through it in the opposite way from that which current flows out.

In normal operation, the battery is kept charged by current input from the generator or alternator.

For good operation, the battery must do three jobs:

- **Supply current for starting the engine.**
- **Supply current when the demand exceeds the output of the charging system.**
- **Stabilize the voltage in the system during operation.**

HOW A BATTERY IS CONSTRUCTED

The battery is made up of a number of individual **cells** in a hard rubber case (Fig. 1).

The basic units of each cell are the **positive** and **negative plates.**

These plates hold the active materials in flat grids. Charged negative plates contain spongy lead (Pb) which is grey in color. Charged positive plates contain lead peroxide ($Pb\ O_2$) which has a chocolate brown color.

A **plate group** is made by welding a number of similar plates to a plate strap. (See Fig. 1.)

Plate groups of opposite polarity are interlaced so the negative and positive plates alternate. Negative plate groups normally have one more plate than the positive groups. This keeps negative plates exposed on both sides of the interlaced group.

FOS—20 (Mar—68) Litho in U.S.A.

Each plate in the interlaced plate group is kept apart from its neighbor by porous separators as shown in Fig. 1. The separators allow a free flow of electrolyte around the active plates. The resulting assembly is called an **element.**

After the element is assembled, it is placed in a cell compartment of the battery case.

On a soft-top battery, cell covers are installed next. Then the cell connectors are welded between the intermediate terminal posts of adjoining cells. In this way the cells are connected in **series.** Finally the top of the battery case is sealed.

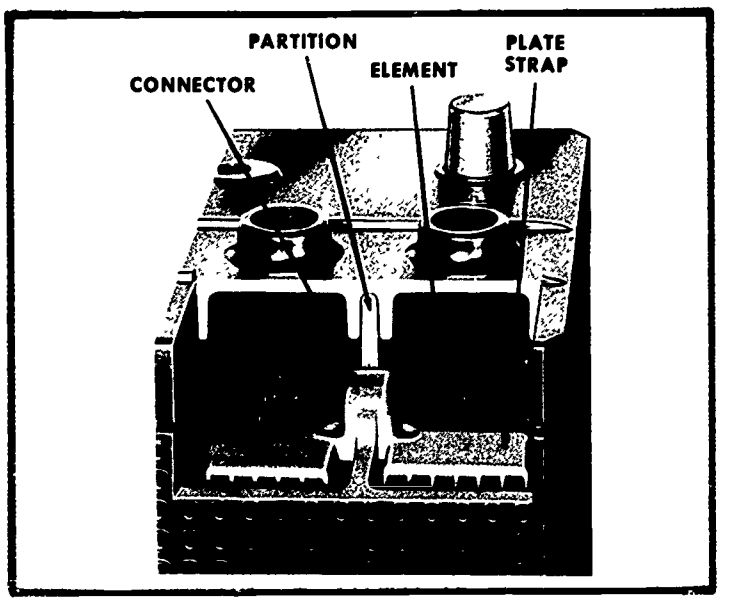

Fig. 2—Hard-Top Battery with One-Piece Cover

Hard-top batteries have one-piece cell covers which reduce the formation of corrosion on top of the case (Fig. 2). These batteries have cell connectors which pass through the partitions between cells. The connectors and partitions are sealed so that electrolyte will not transfer between cells. This improves battery performance, since the cell connections are shorter and the cover is more acid-tight.

The main battery terminals are the **positive** and **negative posts.** The positive terminal is larger to help prevent the danger of connecting the battery in reverse polarity.

Vent caps are located in each cell cover. The caps have two purposes: 1) They close the openings in the cell cover through which the electrolyte level is checked and water is added; 2) They provide a vent for the escape of gases formed when the battery is charging.

Each cell in a storage battery has a potential of about two volts. Six-volt batteries contain three cells connected in series, while 12-volt batteries have six cells in series (Fig. 3, top diagram).

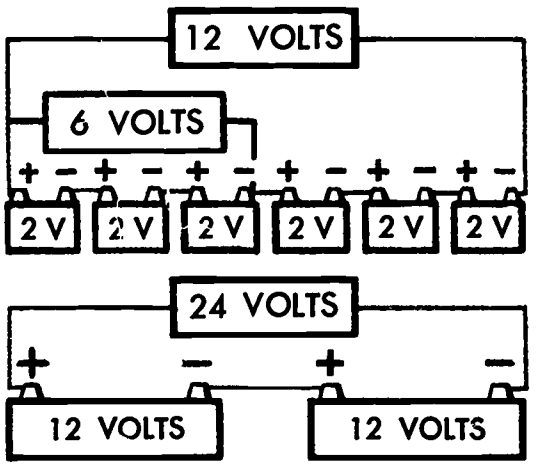

Fig. 3—Battery Cells and Batteries Connected in Series

For higher voltages, combinations of batteries are used. An example is where two 12-volt batteries are connected in series to serve a 24-volt system (Fig. 3, bottom diagram).

In summary:

- **The battery is made up of cells.**
- **Each cell has positive and negative plates.**
- **Similar plates are welded into plate groups.**
- **The plate groups are interlaced but separated.**
- **This allows a free flow of electrolyte around the active plates.**
- **The resulting assembly is an element—one for each battery cell.**
- **Each cell is connected in series.**
- **Main terminals — (+) and (−) — connect all cells.**
- **Six-volt batteries have three cells in series.**
- **Twelve-volt batteries have six cells in series.**
- **For higher voltages, two or more batteries are connected.**

HOW A BATTERY WORKS

The battery produces current by a chemical reaction between the active materials of the unlike plates and the sulfuric acid of the electrolyte (Fig. 4).

While this chemical reaction is taking place, the battery is **charging.** After most of the active ma-

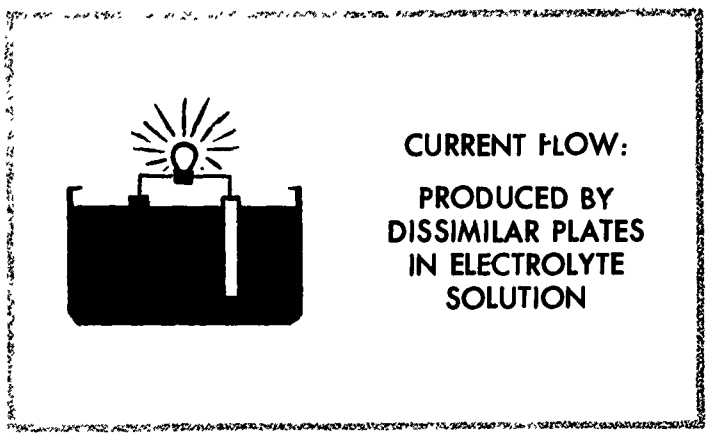

Fig. 4—How a Battery Produces Current Flow

terials have reacted, the battery is **discharged.** It must then be recharged before use.

We'll discuss these two cycles, but first let's see what the electrolyte is made of.

ELECTROLYTE SOLUTION

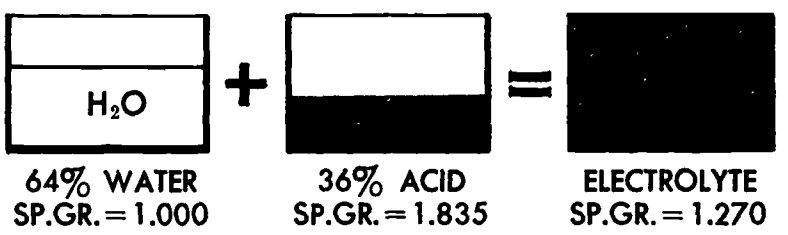

Fig. 5—Battery Electrolyte

The **electrolyte** in a fully charged battery is a concentrated solution of sulfuric acid in water (Fig. 5). It has a specific gravity of about 1.270 at 80° F.—which means it weighs 1.270 times more than water. The solution is about 36% sulfuric acid (H_2SO_4) and 64% water (H_2O) as shown.

The voltage of a battery cell depends upon the chemical difference between the active materials and also upon the concentration of the electrolyte.

DISCHARGE CYCLE OF BATTERY

When the battery is connected to a complete circuit, current begins to flow from the battery. The **discharge** cycle begins.

This current is produced by a chemical action as follows:

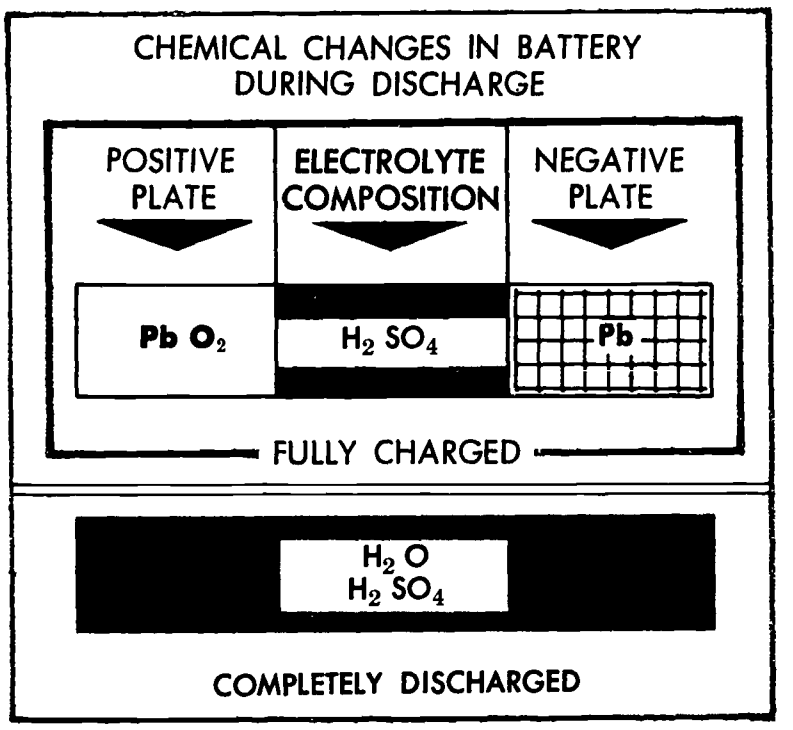

Fig. 6—Chemical Action of the Battery

The lead peroxide (PbO_2) in the positive plate is a compound of lead (Pb) and oxygen (O_2). Sulfuric acid is a compound of hydrogen (H_2) and the sulfate radical (SO_4) which in turn, is a compound of sulfur (S) and oxygen. Oxygen in the positive active material combines with hydrogen from the sulfuric acid to form water (H_2O). At the same time, lead in the positive active material combines with the sulfate radical, forming lead sulfate ($PbSO_4$). See Fig. 6.

A similar reaction takes place at the negative plate where lead (Pb) of the negative active material combines with the sulfate radical to form lead sulfate ($PbSO_4$). Thus, lead sulfate is formed at both plates as the battery is discharged, while the sulfuric acid in the electrolyte is replaced by water.

Note that the material in the positive plates and negative plates becomes similar chemically during discharge, as the lead sulfate accumulates. This condition accounts for the loss of cell voltage, since *voltage depends upon the difference between the two materials.*

As the discharge continues, dilution of the electrolyte and the accumulation of lead sulfate in the plates eventually brings the reactions to a stop. For this reason the active materials never are completely exhausted during discharge. At low rates of discharge the reactions are more complete than at high rates since more time is available for the materials to come in contact. When the battery can no longer produce the desired voltage, it is said to be discharged. It must be recharged by a suitable flow of direct current from some external source before it can be put back in service.

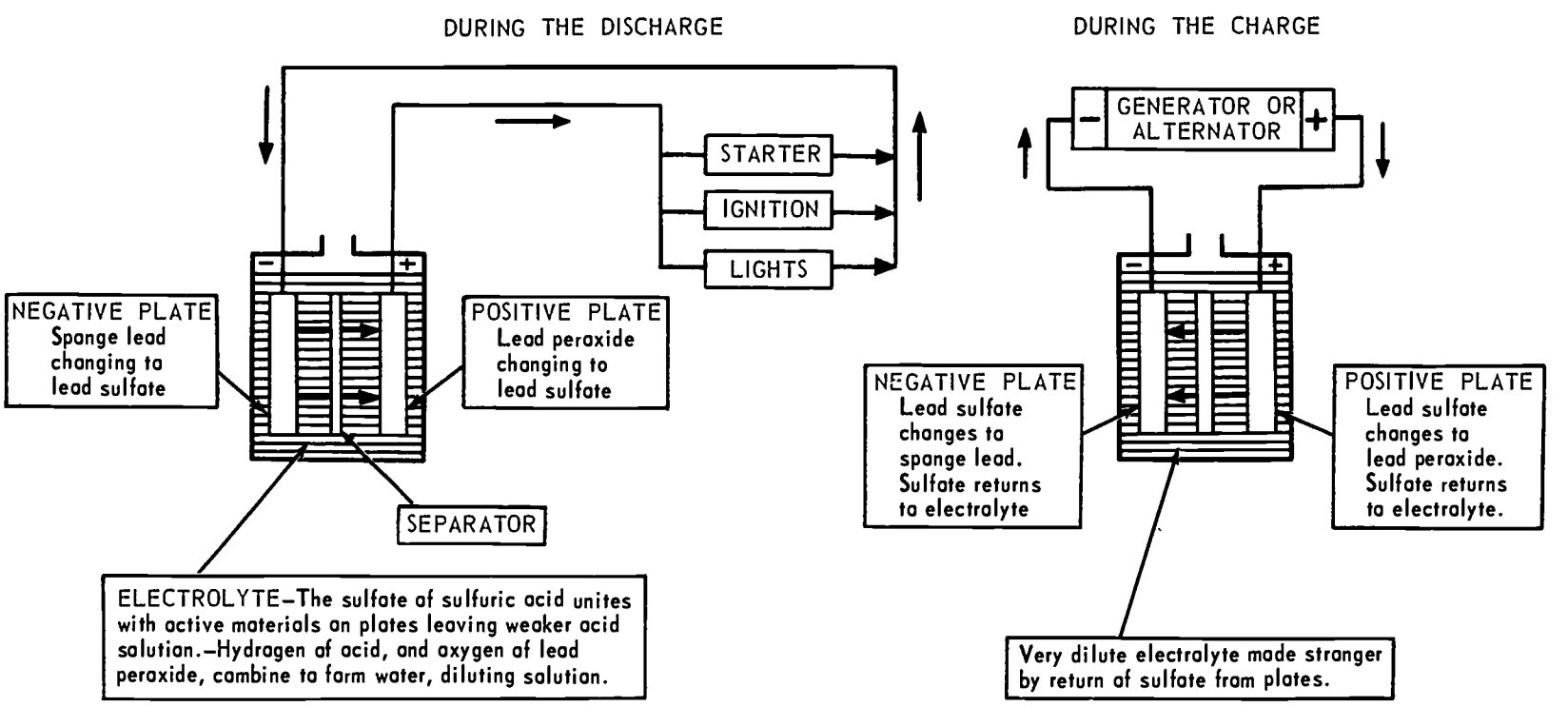

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Fig. 7—Chemical Action in Battery During Discharge and Charge Cycles

In summary, refer to Fig. 7 for a diagram of the complete discharge cycle of the battery.

CHARGING CYCLE OF BATTERY

The chemical reactions which go on in the battery cell during charge are essentially the reverse of those which occur during discharge. See Figs. 7 and 8.

The lead sulfate on both plates is split up into Pb and SO_4, while water (H_2O) is split up into hydrogen to form H_2SO_4 or sulfuric acid. At the same time the oxygen enters into chemical combination with the lead at the positive plate to form PbO_2 or lead peroxide.

These reactions demonstrate the important fact that water actually takes part in the chemistry of a lead-acid storage battery.

It is interesting to note that the specific gravity of the electrolyte decreases during discharge for two reasons—sulfuric acid (which is "heavier" than water) is used up and water is formed. Conversely, when the battery is charged, the specific gravity of the electrolyte increases—sulfuric acid is formed and water is used up.

When checking the specific gravity of the electrolyte after the battery has been fast charged, the reading may continue to rise for some time because the newly-formed acid requires time to diffuse from the plates into the electrolyte. Therefore,

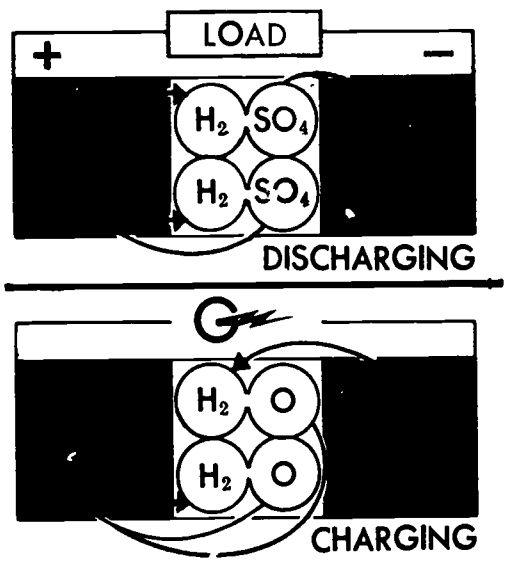


Fig. 8—Chemical Action in the Battery While Discharging and Charging

a specific gravity reading taken while the electrolyte is full of gas will be erroneously low. Conversely, higher specific gravity readings will be obtained as the gas is dissipated from the electrolyte. This situation often leads to the mistaken impression that specific gravity is still rising after charging has been discontinued, when this is not always true.

We have noted that water plays an important part in the chemical action of a storage battery. The purity of water for battery use has always been a controversial subject, but always resolves to the fact that distilled water is the best. Water with impurities hurts the life and performance of a battery.

In summary:

- **The battery produces current by chemical action.**
- **This chemical action charges the battery.**
- **As chemical action fails, the battery discharges.**
- **Chemical action is between lead plates and electrolyte fluid.**
- **Electrolyte is sulfuric acid in water.**
- **More acid in electrolyte = higher charge.**
- **Higher charge = heavier electrolyte.**
- **"Specific gravity" measures weight of electrolyte.**

THE BATTERY AND THE CHARGING CIRCUIT

The battery is the heart of the electrical system. It plays its role in the operation of the starting, charging, ignition, and accessory circuits.

However, the battery is really part of the charging circuit.

In operation, the battery works in cycle with the generator or alternator (Fig. 9). This happens as follows:

1) The battery supplies current to the system, and becomes discharged.

2) The generator sends reverse current to the battery, recharging it.

3) The voltage regulator limits the voltage from the generator to a safe value which does not overcharge the battery at high speeds.

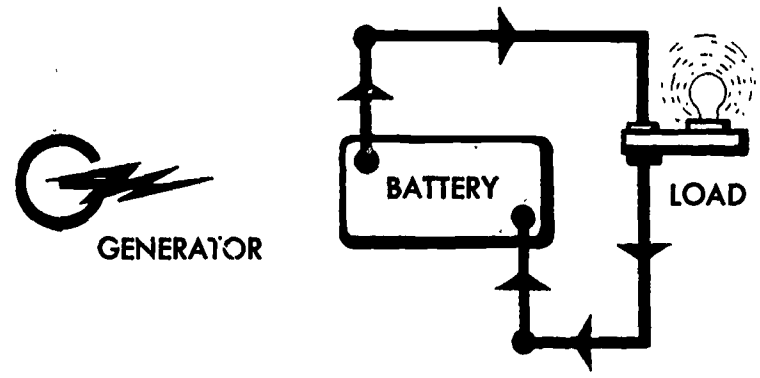
The charging cycle is different at various engine speeds.

When the engine is shut off, the battery alone supplies current for the accessory circuits.

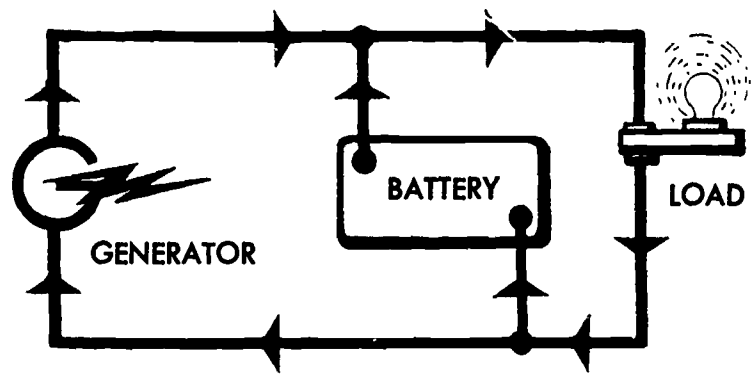
At low speeds, both the battery and generator may supply current.

At higher speeds, the generator may take over and supply enough current to operate the accessories and also recharge the battery.

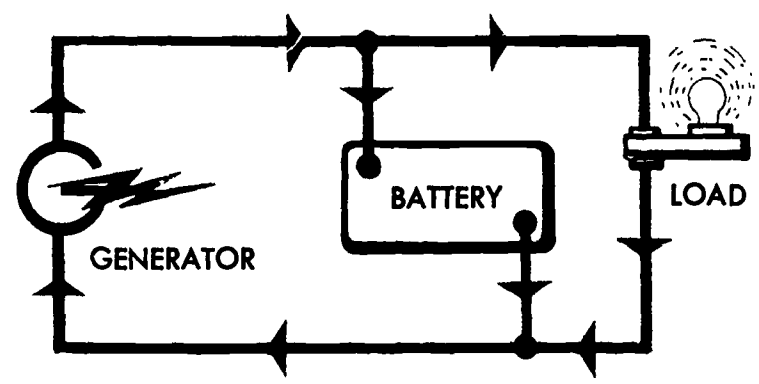
This charging cycle is more fully explained in Chapter 4, "Charging Circuits."



BATTERY SUPPLYING LOAD CURRENT



GENERATOR AND BATTERY SUPPLYING LOAD CURRENT



GENERATOR SUPPLYING LOAD CURRENT AND CHARGING BATTERY

Fig. 9—The Battery and the Charging Circuit

TYPES OF BATTERIES

There are two types of batteries:

- **Dry-charged**
- **Wet-charged**

The difference between the two depends upon the way they are sent out from the factory.

DRY-CHARGED BATTERIES

A dry-charged battery contains fully-charged elements. But it contains no electrolyte until it is activated for service in the field. Therefore, it leaves the factory in a dry state. Once activated in the field, it is essentially the same as a wet-charged battery.

At the factory, the battery elements are specially charged as follows: A direct current is passed through the plates while immersed in an electrolyte of dilute sulfuric acid. The fully-charged plates are then removed from the electrolyte, washed in water, and completely dried. The battery is then assembled.

A dry-charged battery retains its state of full charge as long as moisture is not allowed to enter the cells.

If stored in a cool, dry place, this type of battery will stay factory-fresh and will not become "shelf worn" prior to use.

Activating Dry-Charged Batteries

The activation of a dry-charged battery is done in the field either by the warehouse or dealer.

To make sure the proper electrolyte is used and the battery is properly activated, many manufacturers furnish a packaged electrolyte for their dry-charged batteries along with instructions for placing the battery into service. These instructions must be carefully followed.

Under normal conditions, activate dry-charged batteries as follows:

1. Remove the seals from the battery cell openings and remove the vent caps.

2. Carefully fill each cell with the approved electrolyte to the proper level (usually at the bottom of the filler neck). Examine the vent caps to be sure they are open and install the caps.

3. Check the specific gravity with a hydrometer and record the corrected reading. (See "Battery Testing.")

4. Using a date code ring, gently stamp the date code on the battery. See Fig. 28.

5. Allow the battery to stand for a few minutes, then recheck the level of electrolyte in each cell. If necessary, add electrolyte—not water.

6. As a precaution, check the open-circuit voltage of the battery. (See "Battery Testing.") As a general rule, place a 12-volt battery in service if it tests 12 volts or more, charge it first if it tests 10-12 volts, and consider it defective if it tests less than 10 volts.

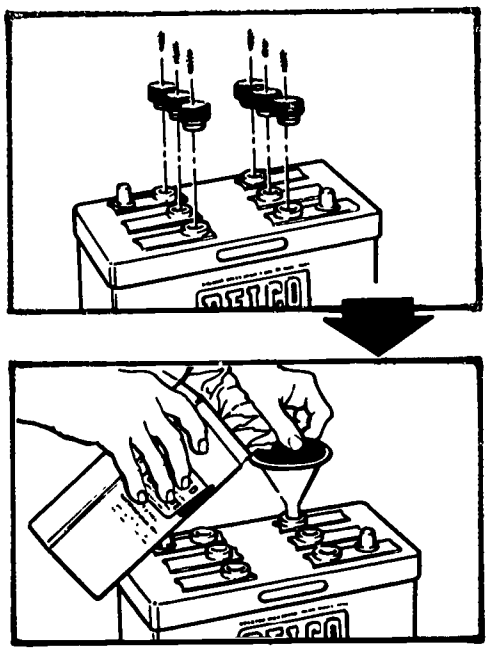


Fig. 10—Activating Dry-Charged Batteries

7. As a final test, check the specific gravity of the electrolyte again. If the reading shows more than a 30-point drop (0.030) from the previous reading, charge the battery.

8. It is a good practice, if time permits, to slow charge a freshly-activated battery. This assures that the user receives a fully-charged battery. Always charge a newly-activated battery if the machine will not be run for at least one hour.

9. After the battery has been in service, add only approved water. **Do not add acid.**

10. Once in use, keep the battery serviced and charged just like a conventional wet-charged battery.

Dry-charged batteries should be stored in a cool, dry place with low humidity. Also be sure the temperature is between 60° and 90° F. Under these conditions, a battery can be stored for several years and keep a good charge. Under bad conditions, the battery may lose its charge in several weeks.

What is the advantage of dry-charged batteries? The prime advantage is that they do not sulfate and corrode during long storage like wet-charged batteries.

One disadvantage is that acids must be handled and it is difficult to give the battery a good quality check before shipment.

WET-CHARGED BATTERIES

Wet-charged batteries contain fully-charged elements and are filled with electrolyte at the factory. A wet-charged battery will not maintain its charged condition during storage, and must be recharged periodically.

During storage, even though the battery is not in use, slow reaction takes place between the chemicals inside the battery which causes it to lose charge. This reaction is called **self-discharge.**

The rate at which self-discharge occurs varies directly with the temperature of the electrolyte. A fully charged battery stored at room temperature of 100° F. will be almost completely discharged after a storage period of 90 days. The same battery, stored at 60° F. will be only slightly discharged after 90 days.

Wet-charged batteries, therefore, should be stored in as cool a place as available, as long as the electrolyte does not freeze.

A wet battery which is kept fully charged will not freeze, while a discharged battery can freeze. For example, a discharged battery with a specific gravity of 1.100 will freeze at 18° F. whereas a fully-charged battery with a specific gravity of 1.260 is never in danger of freezing, unless it is 75° *below* zero. See chart below.

CHART SHOWING WHEN ELECTROLYTE FREEZES AT VARIOUS SPECIFIC GRAVITIES

Condition of Battery	*Specific Gravity of Electrolyte*	*When Electrolyte Freezes (Temp. Degrees F.)*
Discharged	1.100	+18°
	1.140	+ 8°
	1.180	− 6°
	1.220	−31°
Fully-charged	1.260	−75°

Sulfated Batteries

Wet-charged batteries which are stored for long periods of time without recharging may be permanently damaged by the oxidation of the positive plate grid wires and the formation of lead sulfate crystals in the plates which become dense and hard.

If the sulfate crystals are not too dense and hard, the battery may be restored to normal service by applying a slow charge rate for a longer than normal period. However, if the sulfate crystals are excessively hard and dense, the battery can never be restored to a normal operating condition, regardless of the rate or time of the charge.

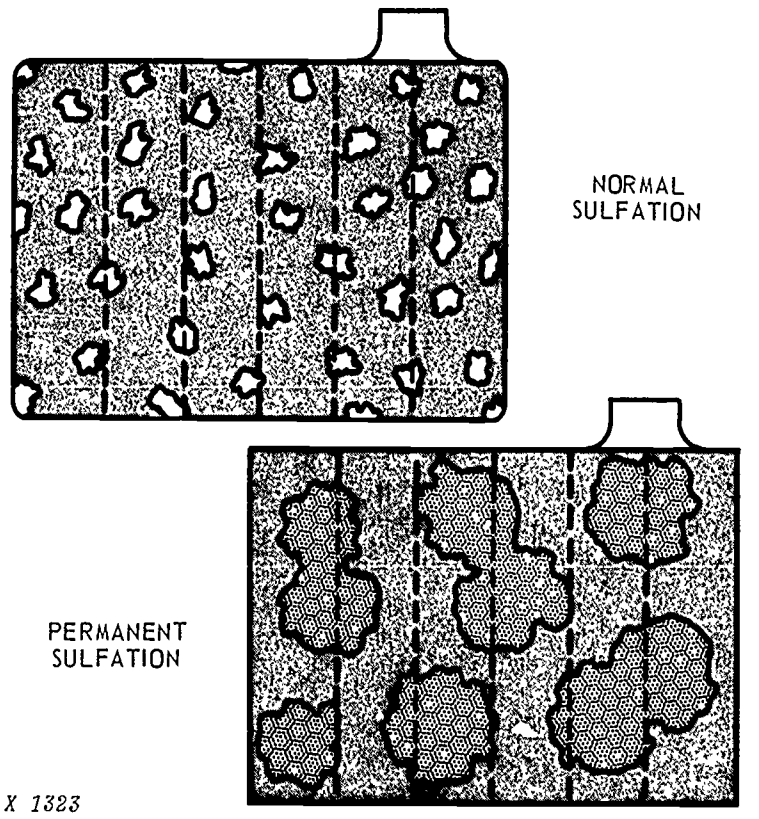


Fig. 11—Sulfation of Battery Plates

Sulfation is caused by the chemical reaction in the battery discharge and was discussed earlier in this chapter. Both plates become lead sulfate ($PbSO_4$) and the acid is converted to H_2O; no further reactions can take place and a discharged battery results.

If this condition is allowed to exist for a long enough period of time (30-90 days), the lead sulfate will harden and cause a sulfated battery (Fig. 11).

The hard sulfate deposit on the plates is extremely difficult to break down. Charging at high rates will only cause extreme heating, because the plates will tend to reject much of the current. Even the normal rate of charge is high for sulfated batteries. *For sulfated batteries, therefore, recharge at ½ the normal rate, or approximately ½ ampere per positive plate per cell.*

For example, a typical 6-volt battery has 12 negative and 11 positive plates per cell. If the battery is sulfated, recharge at a slow rate.

How long will it take to recharge a sulfated battery? This depends on the degree of sulfation, the state of battery charge, and the battery age. Charge at a rate which will not allow the electrolyte temperature to exceed 120° F. and charge until the specific gravity of all cells indicates fully-charged battery. This may take 60 to 100 hours

when sulfation is extremely bad. If the specific gravity has not reached the normal full charge in this time, replace the battery.

While in storage, wet-charged batteries should be brought to full charge every 30 days, to guard against sulfation. Batteries removed from equipment during the winter should receive the same care or be stored under cool conditions.

Trickle-type charges have been developed to produce a charging rate measured in milli-amperes which is just sufficient to offset the losses due to self-discharge.

NOTE: Do not use trickle chargers for more than sixty days. Very low charging rates for long periods can cause permanent damage to the positive plate grids.

A word about "warm" storage of batteries: Remember, you don't do a wet battery a "favor" by keeping it warm during storage . . . in fact, the best bet is to store the battery in as cold a place as possible, as long as the electrolyte doesn't freeze. In general, *store batteries in a cool, dry place.*

CHECKING ELECTROLYTE LEVEL IN BATTERY CELLS

Periodically check the level of the electrolyte in the battery cells. This should be done at least every week during steady operation of the system.

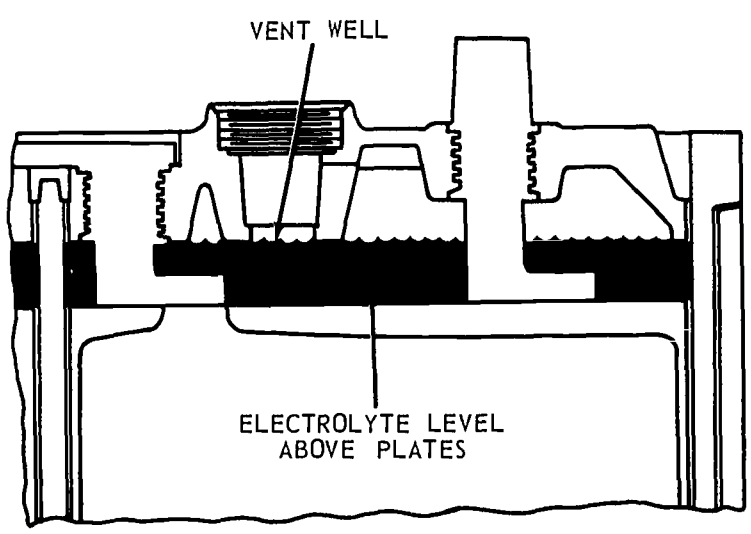


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Fig. 12—Proper Level of Electrolyte in Battery Cells

Proper level is normally to the bottom of the filler neck (so that the tops of the battery plates are covered). (See Fig. 12.) *Do not overfill.*

Use only distilled water in the battery. If not available, be sure to use clean, soft water. *Avoid hard water.*

NEVER ADD ACID TO THE BATTERY unless electrolyte is lost by spilling.

Always wait until after checking specific gravity before you add water to the battery. This will assure a true reading. If level is too low to check specific gravity, add water, operate in circuit for a few minutes to mix water and electrolyte, then check.

In freezing weather, never add water to the battery unless it will be operated immediately to allow proper mixing of water with electrolyte.

TESTING THE BATTERY

Testing the battery will tell you whether the battery is usable, requires recharging, or should be replaced. Regular periodic testing provides a means of anticipating battery failure. To test the condition of the battery, use the following tests:

- **Visual inspection—for general condition.**
- **Specific gravity test—for battery charge.**
- **Light load voltage test—for comparing cell voltages.**
- **High rate discharge test—for internal condition.**

VISUAL INSPECTION

A simple visual inspection of the battery will often prove valuable in locating a possible cause of failure.

For example, many conditions are easily noted, such as damage due to excessive tightness or looseness of the hold-down clamps, distorted, cracked, or leaky case or cell vent caps, evidence of overflowing electrolyte, or heavy deposits of dust on the top of the battery. Any of these can contribute to battery failure.

If necessary, check out your visual diagnosis with further battery tests.

TEST EQUIPMENT REQUIRED

The basic instruments required for battery testing are:

(1) A hydrometer with thermometer for temperature corrections.

(2) A low-reading voltmeter.

(3) A high-rate discharge battery tester.

Always use a hydrometer with thermometer when making specific gravity tests, since specific gravity readings vary with changing temperatures due to expansion and contraction of the battery electrolyte.

SPECIFIC GRAVITY TEST

The state of battery charge is indicated by the specific gravity or weight of the battery electrolyte.

The strength of the electrolyte varies directly with the state of charge of each cell.

To find out how much energy is available from the battery, you need only find out what percentage of sulfuric acid remains in the electrolyte. One of the simplest and most reliable ways to do this is to measure the specific gravity or weight of the solution.

Specific gravity can be measured very quickly by means of a battery hydrometer with a thermometer for temperature correction.

Hydrometers are calibrated to measure specific gravity correctly at an electrolyte temperature of 80° F.

To determine a corrected specific gravity reading when the temperature of the electrolyte is other than 80°: **Add** to the hydrometer reading four gravity points (0.004) for each 10° **above** 80° F. **Subtract** four gravity points (0.004) for each 10° **below** 80° F.

This compensates for expansion and contraction of the electrolyte at temperatures above or below the standard.

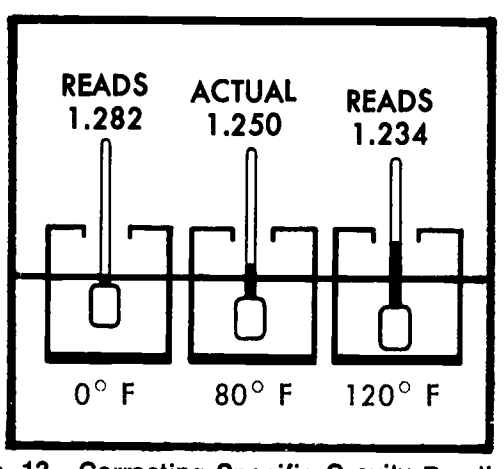

Fig. 13—Correcting Specific Gravity Readings to Allow for Temperatures

For example, a specific gravity reading of 1.234 is obtained at 120° F. Since this reading was taken with the electrolyte temperature 40° above the standard, a total of 16 (4 × 4) gravity points (0.016) is added, giving a corrected reading of 1.250. See Fig. 13.

As a further example, suppose a reading of 1.282 is obtained at 0° F. This reading was taken with the electrolyte temperature 80° below the standard. Therefore, a total of 32 (8 × 4) gravity points (0.032) is subtracted, giving a corrected reading of 1.250.

Batteries used in tropical or arctic regions are special cases. In tropical areas, use 1.225 as a full charge adjusted reading. In arctic regions, use 1.280 as a full charge reading. This allows for the special operating conditions and assures maximum performance under stress of heat or cold.

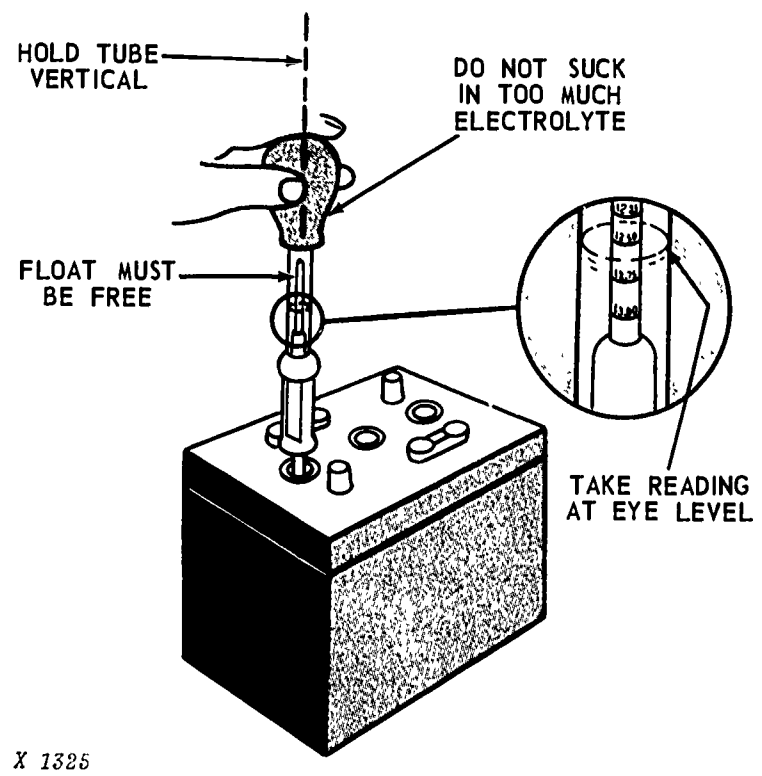

Fig. 14—Checking Specific Gravity of Battery with Hydrometer

Using the hydrometer, test the specific gravity of each cell (Fig. 14). Be sure the hydrometer float is suspended freely in the liquid, not touching the walls, top, or bottom of the tube. Also be sure that your eye is at the level of the liquid when the reading is taken. Readings taken at a sharp angle are generally inaccurate.

If the liquid level is too low to check, add distilled or filtered water to the cells and charge the battery long enough to assure complete mixing of the water and electrolyte, then check with the hydrometer.

When checking specific gravity of a battery which has been gassing freely, allow sediment to settle or gas to escape from the sample before taking the reading.

- **Specific gravity should read from 1.215 to 1.270 (corrected for 80° F. electrolyte temperature).**
- **The variation in readings between cells should be no more than 0.050.**

If the readings are not within the specified range, do the following:

If Specific Gravity Is Less Than 1.215

When the specific gravity reading is less than 1.215 (after correction for temperature), the battery may be in satisfactory condition although its state of charge is low. Charge the battery before making further tests. (See later in this chapter for details.)

If Specific Gravity Is Above 1.270

When the specific gravity reading is above 1.270 (after correction for temperature), the battery may be in satisfactory condition although it is above full charge. In use, its specific gravity should return quickly to the normal 1.215-1.270 range. Make further tests to be more certain of the battery condition.

If More Than 0.050 Variation Between Cells

A difference of more than 50 specific gravity points (0.050) between cells indicates an unsatisfactory battery condition. This may be due to unequal consumption of electrolyte in the cells caused by an internal defect, short circuit, improper activation, or deterioration from extended use. The battery should normally be replaced.

NOTE: Specific gravity readings do not always give a true indication of the state of charge of a battery. If water has been added recently or acid has been lost through accident or leakage, the reading will indicate a lower state of charge than is actually the case. Therefore, never use specific gravity readings alone to decide the condition of a battery.

Specific Gravity Reading (Adjusted)	State of Charge
1.260 Sp. Gr.	*100% Charged*
1.230 Sp. Gr.	*75% Charged*
1.200 Sp. Gr.	*50% Charged*
1.170 Sp. Gr.	*25% Charged*
1.140 Sp. Gr.	*Very Little Useful Capacity*
1.110 Sp. Gr.	*Discharged*

The table above shows the state of charge of a typical battery at various specific gravity readings.

Specific Gravity Cell Comparison Test (Hard-Top Batteries with One-Piece Covers)

Hard-top batteries with one-piece covers should not be tested for voltage one cell at a time. Therefore, some of the tests which follow cannot be made on these batteries. To compare cells on batteries with one-piece covers, use the procedure above for checking the specific gravity of each battery cell.

Then compare the cell readings and judge the condition of the battery by the rules given above for the specific gravity test.

LIGHT LOAD VOLTAGE TEST

Use this test as a quick check for comparing cell voltages. Make the test before the battery is charged; otherwise, defective cells may give a false reading and pass the test.

Do not make this test on batteries with one-piece covers as you will damage the cover. Instead, use the "Specific Gravity Cell Comparison Test" above.

Use a low-reading voltmeter with a 0.01 volt per scale division to make the light load test.

Proceed as follows:

1. First check the electrolyte level in each cell. If necessary, adjust the proper level using distilled water.

2. Remove the surface charge from the battery by operating the starter for three seconds (150-ampere load if battery is off machine). If the engine starts up, stop it immediately.

3. Place a light load on the battery by turning on the headlights (or use a 10-ampere load if battery is off machine).

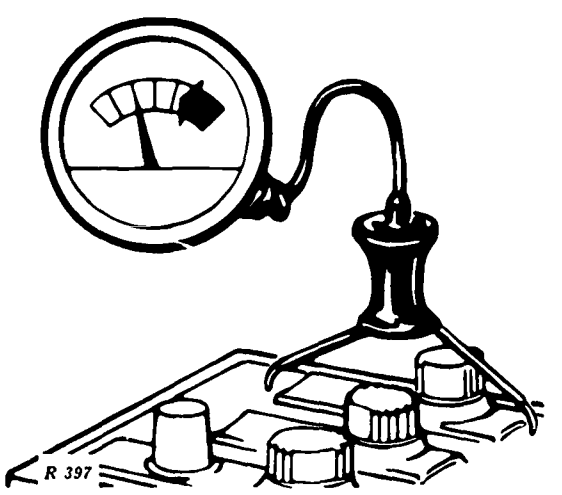

Fig. 15—Checking Cell Voltages with Voltmeter

4. After one minute and with lights or load still on, check the voltage of each cell using the voltmeter (Fig. 15). Place the prods across the (+) and (−) terminals of each cell as shown. Note the exact voltages, but remember only the highest and lowest cell readings.

5. Interpret the cell voltages as follows:

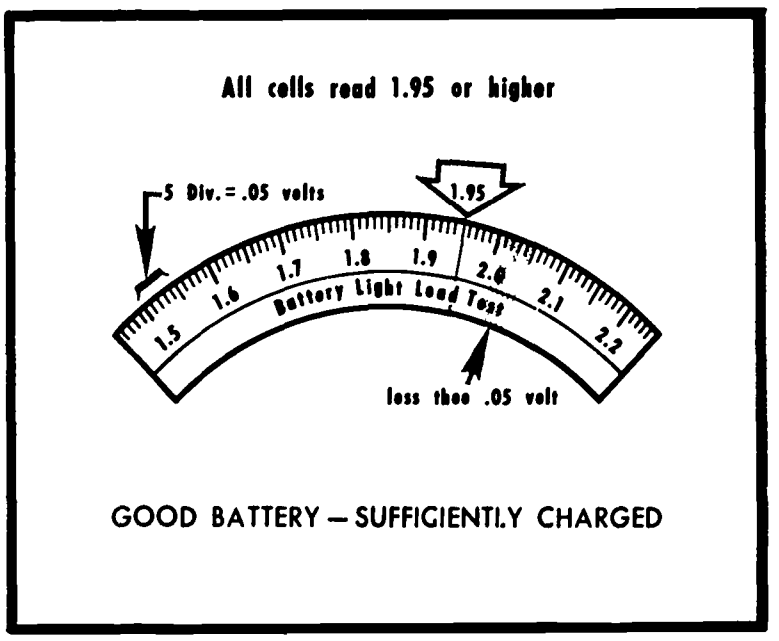

Fig. 16—All Cells Read 1.95 or Higher

- If all cells read 1.95 volts or higher and the difference between cells is less than 0.05 volt (5 divisions), the battery is good and sufficiently charged.

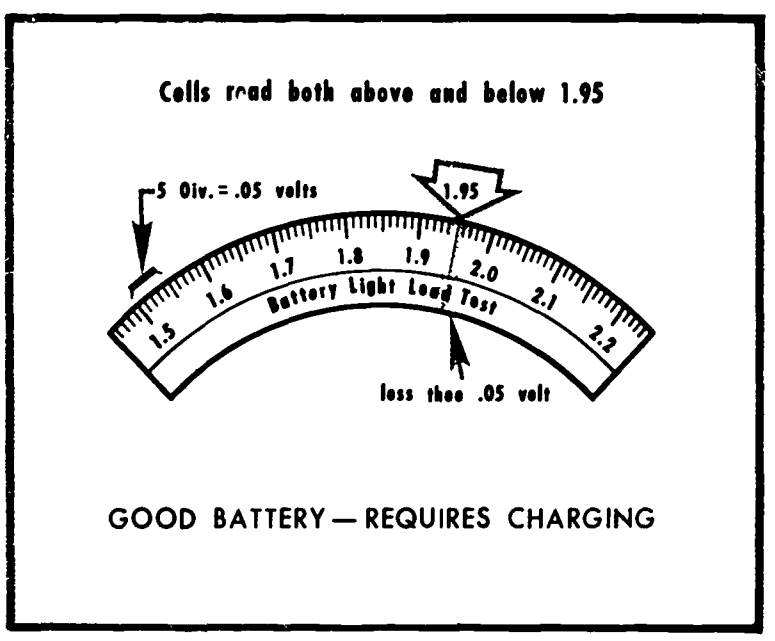

Fig. 17—Cells Read Both Above and Below 1.95

- If cells read both above and below 1.95 volts but the difference between the cells is less than 0.05 volt, the battery is good, but needs charging (Fig. 17).
- If any cell reads 1.95 volts or more and *there is a DIFFERENCE of 0.05 volts or more between cells,* the battery should be replaced (Fig. 18). It is either defective, damaged, or worn out.
- If all cells read less than 1.95 volts, the battery charge is too low to test accurately (Fig. 19). Boost-charge the battery and repeat the tests.

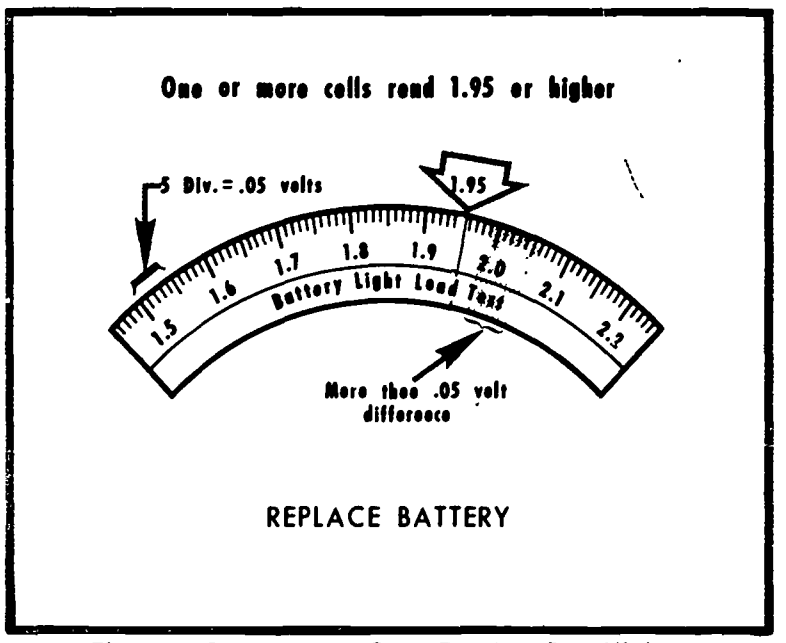

Fig. 18—One or More Cells Read 1.95 or Higher

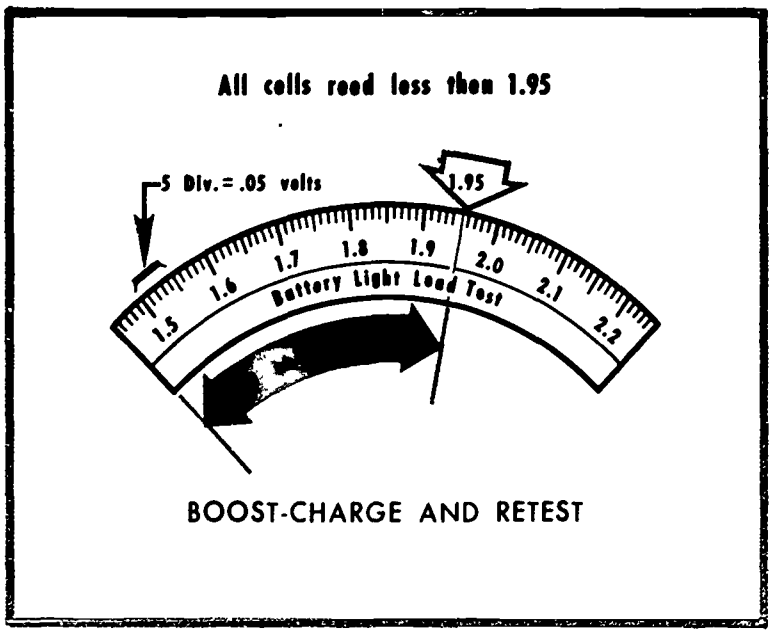

Fig. 19—All Cells Read Less Than 1.95

Boost-charge all 12-volt batteries rated at 100 ampere-hours or less at 50 amps for 20 minutes (1000 ampere-minutes). Charge all other batteries, both 6- and 12-volt, at 60 amps for 30 minutes (1800 ampere-minutes).

If the charger will not charge 60 amps, charge at the highest rate available until the battery has been charged 1800 ampere-minutes. For example, highest charger rate is 40 amps; then charge battery at 40 amps for 45 minutes (40 amps × 45 mins. = 1800 ampere-minutes).

If none of the battery cells come up to 1.95 volts after the first boost-charge, give the battery a second boost-charge.

Replace any batteries which do not come up to 1.95 volts after a second boost-charge.

If the battery is good after boosting, recharge it fully by the slow charge method before placing it in service.

PREDICTING BATTERY LIFE

When the battery is new, all cells are in good condition and the voltage difference between cells is about zero or is negligible.

But as the battery gets months or years of service, the voltage difference between cells is greater. This is normal, for all batteries are perishable.

However, when the maximum difference in cell voltages reaches 0.05 volts, the battery is worn out and should be replaced.

The light load voltage test given above will predict the time when the battery will eventually wear out and fail. Use this test at periodic intervals to plot the wear of the battery and to predict its eventual failure.

HIGH-RATE DISCHARGE TEST

When a battery is known to be in good condition, its discharge performance can be measured by the specific gravity test. However, this check gives no hint of other factors that may cause a battery to perform badly.

To be sure of a battery's ability to deliver current under load, give it a high-rate discharge test. This test shows the internal conditions that might not otherwise be detected.

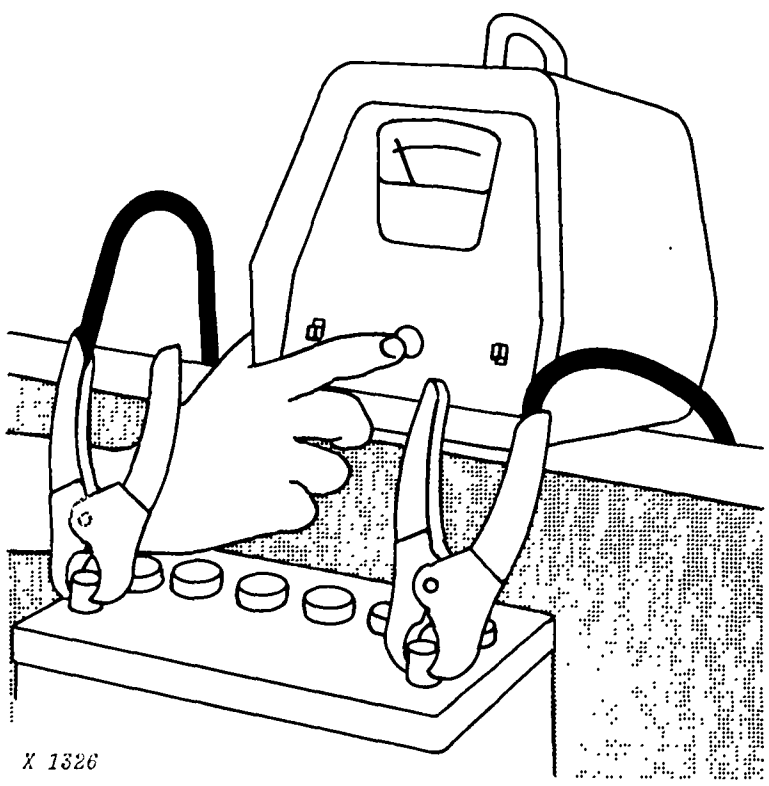

Fig. 20—High-Rate Discharge Battery Tester Connected to Battery

The test is made by using a high-rate discharge battery tester (Fig. 20).

This instrument is primarily a high-capacity fixed or variable resistance through which the battery may be discharged at a known rate, voltmeter readings taken, and comparisons made. Terminal voltage under load is used as the standard of performance.

The following conditions must exist before this test is made:

(1) Battery specific gravity must not be less than 1.215 at 80° F. Otherwise, erratic or unreliable readings will result.

(2) Battery temperature must be between 70° F. and 90° F. Terminal voltage does not remain constant but actually decreases as the temperature of the battery drops below this range. For example, the terminal voltage of a 12-volt battery at 80° F. under load might be as high as 10.8 volts, while the terminal voltage of the same battery under the same load at 0° F. would be only 8.4 volts.

Note the ampere-hour capacity of the battery, which is normally printed or stamped on the case. For a 6-volt battery, apply a fixed load in the test of twice this capacity. For a 12-volt battery, apply a fixed load of three times this capacity.

Testing the Complete Battery

Connect the high-rate discharge tester to the battery as shown in Fig. 20. Be sure to follow the manufacturer's instructions.

Discharge the battery under the fixed load for approximately 20 seconds, then read the terminal voltage.

If the battery is in satisfactory condition, the terminal voltage reading should remain *above 4.5 volts* for a 6-volt battery or *above 9 volts* for a 12-volt battery.

If the terminal voltage falls below this value, the battery is defective or it is not as fully charged as the specific gravity reading indicated in the specific gravity test.

To be sure of the battery condition, carefully charge it and repeat the test.

Replace the battery if it is defective.

Testing Individual Cells

If the high-rate discharge test of the complete battery leaves doubt as to the battery condition, a cell test can be made—on all batteries with exposed cell connectors.

This test checks the individual cell voltage under load. It is similar to the light load test but in this case the fixed load used in the complete battery load is applied to the battery cells. Use a high-rate discharge cell tester with a low-reading voltmeter in making the test.

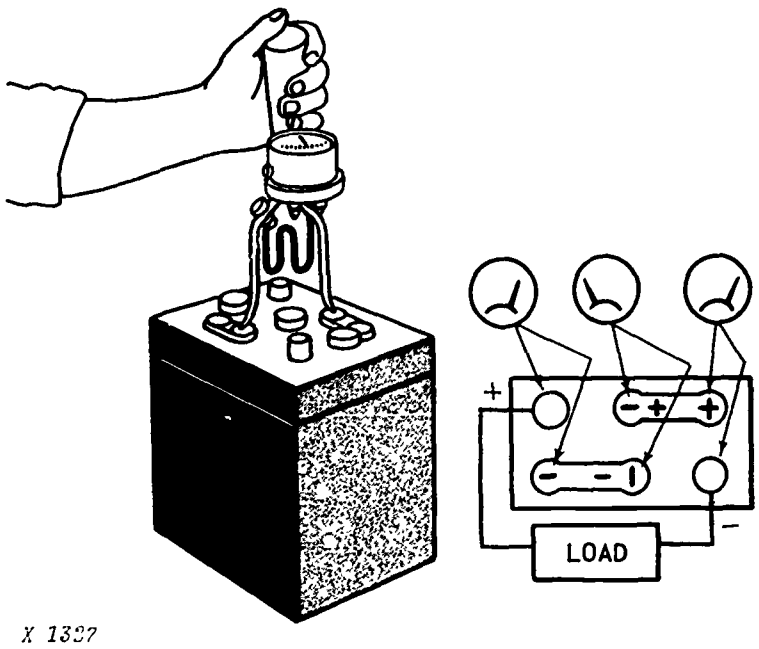

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Fig. 21—Cell High-Rated Discharge Test

Place the test prods of the voltmeter across the positive (+) and negative (−) terminals of any one cell (Fig. 21).

Note the voltage reading. Place the prods across the terminals of other cells in the same way.

A difference in reading of more than 0.20 volt between cells is usually an indication of electrical defect in the battery.

To be certain, carefully charge the battery and repeat the test.

If the variation cannot be eliminated by recharging, replace the battery.

SUMMARY: TESTING OF BATTERIES

Remember these key facts when testing batteries:

- **In general, if all cells of a battery test the same, the battery is good. If all are low, the battery usually only needs recharging.**
- **If there is a real difference between cells, the battery generally must be replaced. Specific gravity should not vary more than 0.050 between all cells. Voltages should not vary more than 0.050 volts between all cells under a light load test.**

The chart in Fig. 22 shows the basic test results from our section on battery testing.

BATTERY TESTING CHART

TEST RESULTS	CONDITION	CORRECTIVE PROCEDURE
GRAVITY TEST GRAVITY BETWEEN 1.215–1.270	CHARGED	MAKE HIGH RATE DISCHARGE TEST
GRAVITY BELOW 1.215	DISCHARGED	RECHARGE; MAKE HIGH RATE DISCHARGE TEST
MORE THAN 50 GRAVITY POINTS (0.050) VARIATION BETWEEN CELLS	(a) SHORTED CELL (b) ACID LOST (c) OLD BATTERY	REPLACE
LIGHT LOAD TEST MORE THAN 0.050 VOLTS VARIATION BETWEEN CELLS	(a) SHORTED CELL (b) SULFATED CELL (c) OLD BATTERY	REPLACE
HIGH RATE DISCHARGE TEST* MINIMUM TERMINAL VOLTAGE: 4.5 VOLTS FOR 6-VOLT BATTERY 9.0 VOLTS FOR 12-VOLT BATTERY	(a) DISCHARGED (b) OLD BATTERY	RECHARGE REPLACE

*Ampere Load Should Equal 2 x Amp-Hr Rating for 6-Volt Batteries and 3 x Amp-Hr Rating for 12-Volt Batteries.

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Fig. 22—Battery Testing Chart

CHARGING THE BATTERY

The amount of electrical current a battery can produce is limited by the amount of chemical reaction which can take place within it.

When chemical reaction in a battery has ended through defect or long use, the battery is discharged and can no longer produce a flow of electrical current.

The battery can be recharged, however, by causing direct current from an outside source to flow through it in a direction opposite to that in which it flowed out of the battery.

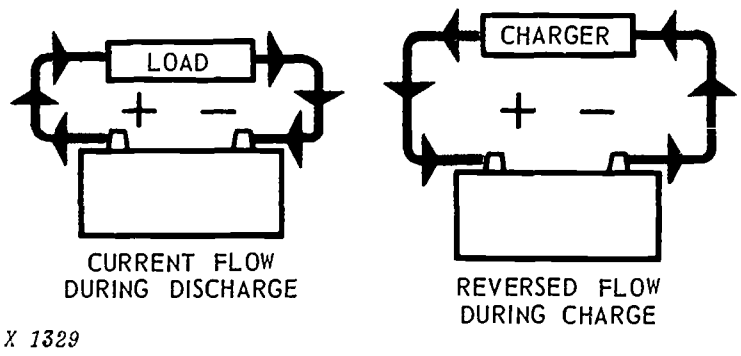


Fig. 23—Current Flow During Discharge and Charge of Battery

During discharge, current flows from the positive (+) terminal of the battery, through the circuit, and back into the battery at the negative (−) terminal (Fig. 23). Within the battery, current flow is from the negative to the positive terminal.

To recharge the battery, this flow of current is reversed as shown, restoring the chemicals in the battery to their active state.

The battery then becomes charged and ready to produce electrical current again. The chemical action which takes place within a battery during discharging and charging is explained earlier in this chapter.

Batteries can be recharged in two ways:

- **Fast Charging**
- **Slow Charging**

A battery that is in satisfactory condition but requires recharging will accept a large amount of charging current without undesirable effect. This type of battery may be charged quickly at a high rate with a battery *fast charger*.

A battery that becomes sulfated, however, will not accept a high rate of charging current without possible damage. Its sulfated condition provides increased resistance to current flow within the battery. Flow of a high rate of charging current through this resistance creates heat, which can result in warping of the plates, boiling of the electrolyte, and eventual damage to the separators. Cell caps and covers and the battery case may be damaged or distorted.

A battery in this condition must be charged over a long period at a low rate. In this manner, sulfate formation on the plates will be gradually broken down and the battery returned to its normal charged state.

The reaction of the battery itself to fast charging will indicate the amount of charging current it can accept without damage. Never allow the battery electrolyte to heat up above 120° F.

If the battery is sulfated, use a fast charger and reduce the charging rate or *slow charge* it. For details, see "Sulfated Batteries" earlier in this chapter.

FAST CHARGING

Fast charging gives the battery a high charging rate for a short period of time.

Connect the battery fast charger to the battery. Be sure to follow the manufacturer's instructions for using the charger. A portable-type charger is shown in Fig. 24.

Remove the battery and, if necessary, fill the cells with distilled water to the level recommended by the manufacturer.

Set the charging rate at approximately 70 amperes for a 6-volt battery or at approximately 40 amperes for a 12-volt battery and start the charger.

After the charger has operated for at least three minutes, note the electrolyte. If it gasses excessively, the battery is sulfated and the charging rate must be reduced to prevent possible damage. Reduce the charging rate until the electrolyte produces comparatively few bubbles but gassing has not stopped entirely. Replace the cell caps.

Charge at the established rate until the battery is fully charged.

If the battery is badly sulfated, even the lowest established rate of fast charging will result in excessive gassing. When this occurs, slow charge the battery. (See following.)

A more accurate method of determining the correct fast charging rate is by using a voltmeter.

After the battery has been connected to the fast charger, connect the voltmeter across the main terminals of the battery. Charge at full rate for at least three minutes, then note the voltmeter reading.

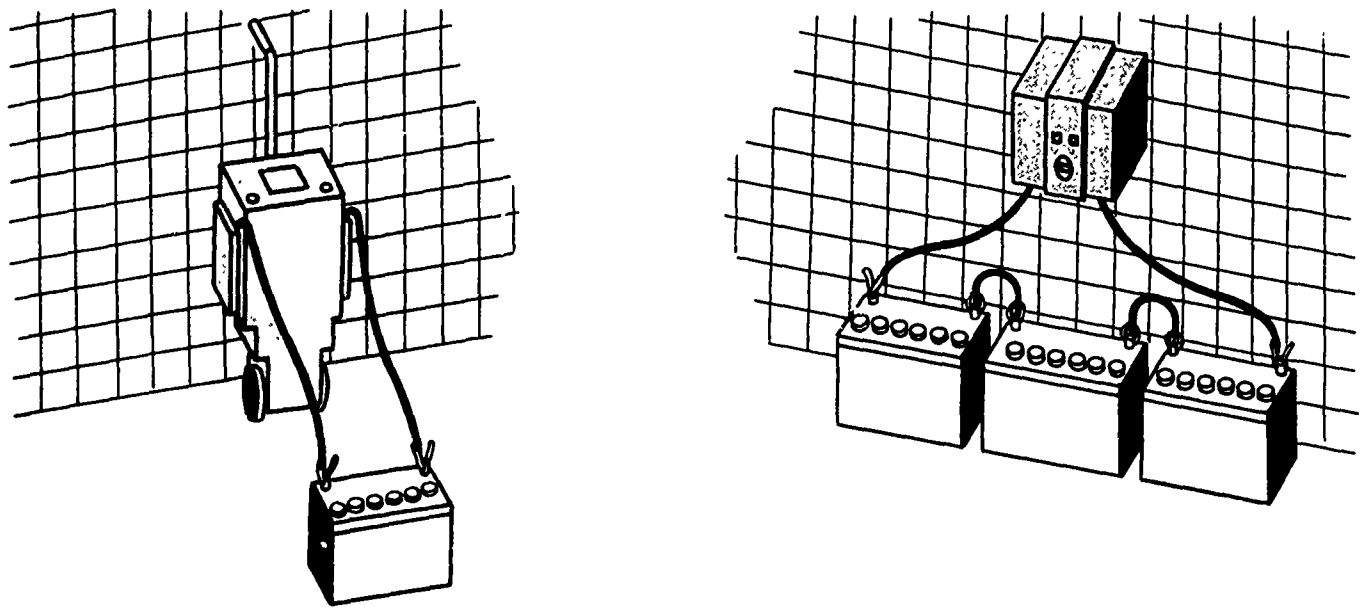


Fig. 24—Battery Charging

If the reading is above 7.75 volts for a 6-volt battery or 15.5 volts for a 12-volt battery, the charging rate must be reduced to prevent possible damage. Reduce the setting on the charger gradually until the voltage starts to drop on the meter. Charge at the rate when the voltage drop occurs until the battery is fully charged. If the battery is badly sulfated, even the lowest rate of the fast charger will not result in a voltage drop. When this occurs, slow charge the battery.

The battery is fully charged when three consecutive hydrometer readings, taken at hourly intervals, show no rise in specific gravity.

The normal high-rate, fast-charging period is from 1½ to 3 hours. Of course, if fast charging is employed at a lower rate, a longer period of time will be required. If the cells do not respond to charging at the proper rate within 24 to 48 hours, the battery is probably unfit for service.

Be sure to remember that fast charging a battery does not completely charge it. The battery is usually about 80% charged after the fast-charging cycle. Finish the charge by *slow* charging unless the battery is being put into immediate service.

Make sure the electrolyte is still at the proper level after charging.

SLOW CHARGING

A battery that is badly sulfated will not accept fast charging without possible damage. So these batteries must be charged at a slow rate.

Be sure to follow the manufacturer's instructions for using the charger.

Charge the battery at a low rate (7% of the battery ampere-hour rating or less) for an extended period of time until fully charged. When charging several batteries in series (Fig. 24), charge at the rate of the *smallest* battery in the line.

A battery is considered fully charged when three consecutive hydrometer readings, taken at hourly intervals, show no rise in specific gravity.

The normal slow-charging period is from 12 to 24 hours.

If a battery's specific gravity has not reached the normal full-charge range (1.215 to 1.270) within 48 hours of slow charging, replace the battery.

Badly sulfated batteries, however, may take from 60 to 100 hours to recharge completely.

SUMMARY: CHARGING OF BATTERIES

Remember these key facts when charging batteries:

1. Batteries are charged by reversing their flow of current using an outside power source.

2. There are two ways to recharge batteries: fast charging and slow charging.

3. If a battery is sulfated, use a fast charger but reduce the charging rate.

4. If the battery is badly sulfated and will not accept a fast charge, use the slow charging method.

5. If fast charging is used, never exceed 40 amps for a 12-volt battery or 70 amps for a 6-volt battery. Avoid heating up the battery electrolyte above 120° F.

6. To assure a fully charged battery, follow the fast charge with a slow charge.
7. After charging, always make sure the electrolyte is at the proper level in each cell.

BALANCING BATTERIES (24-Volt Split-Load Systems)

Four 6-volt batteries or two 12-volt batteries are sometimes connected in series to furnish 24 volts to the starting system. The lights and other electrical equipment then operate on two 12-volt circuits. Each circuit uses half of the batteries. These circuits are connected so the electrical load is nearly balanced between the batteries.

In normal service, the two sets of batteries should stay equally charged. However, if one side uses more water than the other, plug a small lamp bulb into an outlet socket in the circuit of the batteries using more water. This should put enough load on this side to remedy the problem.

Another unbalanced condition may occur when more than a normal load is imposed on one half of the batteries through an outlet socket.

The method used to connect the batteries places them "in balance"; that is, the rate of discharge from all batteries is approximately the same provided that accessories used with the outlet socket, such as auxiliary lights, do not draw more than, say, 3 amperes. Thus the life of all batteries will be approximately the same. Auxiliary lights or other electrical equipment which draw up to 7 or 8 amperes can be used for short periods of time without materially affecting the batteries.

However, if auxiliary electrical equipment which draws more amperes is used for long periods, the batteries will be thrown out of balance and the life of those on one side will be affected. This is because the current drawn from this side is greater than that from the other, which results in failure to maintain the batteries at proper charge.

One method of correcting this condition is to install an extra outlet socket to the other side.

The outside electrical load should then be alternated between the two outlet sockets as the battery charges demand. Or, when the first pair of batteries become low in charge, disconnect the outlet socket wire from one pair and connect it to the other pair.

Under these unusual conditions, pay strict attention to the charge of the batteries at all times so the load can be switched when one pair of batteries becomes low in charge.

CAPACITY RATING OF BATTERIES

The two most common battery ratings are:

- **20-hour Rating (at 80° F.)**
- **Cold Rating (at 0° F.)**

The *20-hour rating* gives the *lighting and accessory load capacity* of the battery.

The *cold rating* gives the *cranking load capacity* of the battery.

The *20-hour rating* is made in a laboratory with the battery fully charged and temperatures at 80° F. The battery is discharged for 20 hours at a constant rate. At the end, the battery must have an average cell voltage of 1.75 volts or above. The battery is rated by the amperage it can supply under these conditions. For example, a battery supplying 3 amps would be given a 60 ampere-hour rating (3×20). A battery which can supply 6 amps would be rated as a 120 ampere-hour model.

The *cold rating* is obtained by discharging a fully charged battery at 0° F. at a constant rate of 150 or 300 amperes depending upon the voltage and the ampere-hour rating of the battery. The rating is then given in two values: 1) the voltage obtained after 5 or 10 seconds of discharge; 2) the time in minutes required for the battery to reach the end voltage of the test. For example, a 12-volt battery having a 10-second voltage rating of 7.6 volts at 300 amperes will maintain a voltage of 7.6 volts or higher for 10 seconds. Also, the same battery having a time rating of 2 minutes will operate under the above conditions for 2 minutes before the terminal voltage falls to the end voltage which may be 5.0 volts for this particular battery. The higher the 10-second voltage rating and the higher the time rating, the greater will be the cranking capacity of the battery.

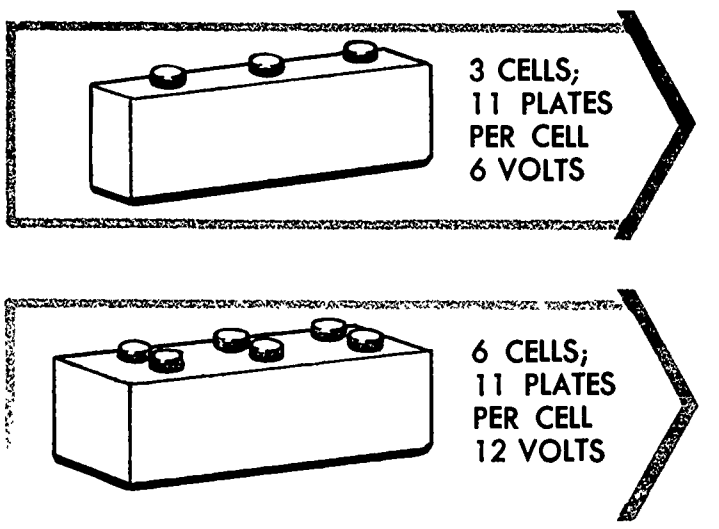


Fig. 25—Comparing 6-Volt and 12-Volt Batteries

Plates Per Cell	No. of Cells	Battery Voltage	Ampere Hour Rating	20 Hour Discharge Rate in Amperes	Battery Voltage After 20 Hours
11	3	6	70	3.5	5.25
11	6	12	70	3.5	10.5

Fig. 26—6-Volt and 12-Volt Batteries Compared

Let's compare the ratings of 6-volt and 12-volt batteries. Fig. 25 shows two of these batteries. The 6-volt battery has three cells, while the 12-volt one has six identical cells. However, while adding three cells, the 12-volt model still has a rating of 70 ampere-hours, the same as the 6-volt battery. See the chart in Fig. 26.

But there is one big difference between the two batteries. This is in the voltage at which current is supplied to the batteries. Since power = voltage × amperes, the power of the 12-volt battery is twice that of the 6-volt battery.

For example, when the battery voltage is 12 volts and the discharge rate is 3.5 amperes, the power output is 42 watts (12 volts × 3.5 amperes = 42 watts). The 6-volt battery power output at the same discharge rate, however, is only 21 watts (6 volts × 3.5 amperes = 21 watts).

The important point to note is that the 6- and 12-volt batteries may have the same ampere-hour rating, but the 12-volt battery is capable of producing two times the amount of power as the 6-volt battery.

SELECTION OF BATTERIES FOR REPLACEMENT

When replacing batteries, be sure to replace the battery with one at least equal in size to the original.

For cold weather starting, the battery must be big enough for the cranking job.

Fig. 27 shows how the load on the battery gets bigger when it is colder. At 20 below zero, the battery has only 30% of its full cranking capacity. At the same time, a greater load is put on the battery by the colder engine when starting.

In effect, *at cold temperatures the battery is "smaller" while the engine is "larger."*

If the replacement battery is smaller than the original, the engine will surely be harder to start in cold weather.

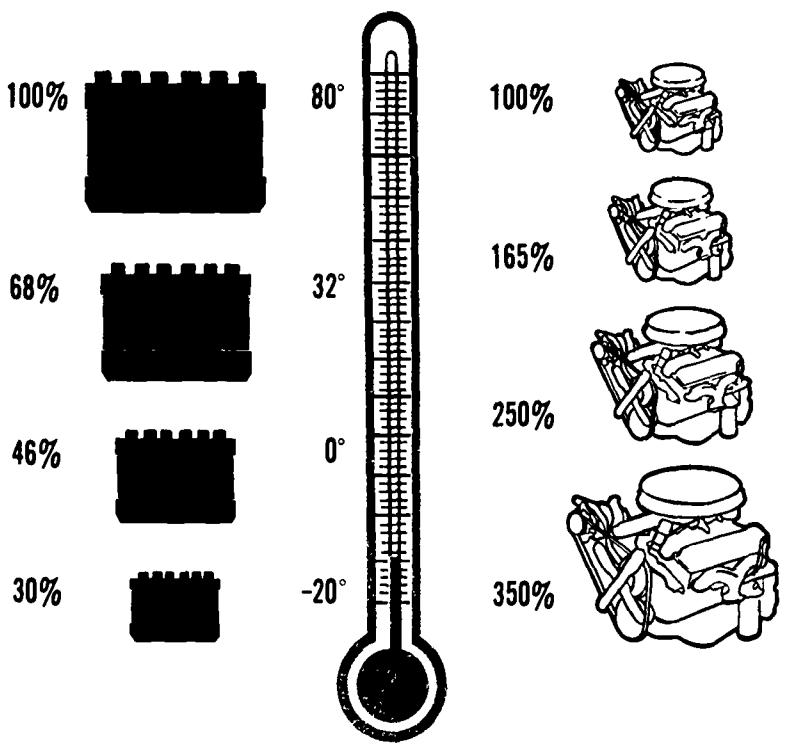


Fig. 27—How Cold Weather Affects the Battery and the Engine When Starting

A *larger* battery than the original may be needed if added accessories put a larger load on the battery.

An extra-output generator may be the answer in cases where electrical loads are excessive or when operating mostly at idle speeds. This will help keep the battery charged and increase its service life.

The cheapest battery is not always the best buy for replacement. For example, three batteries in the same group size may vary in price, but they also vary in ampere-hours rating, in construction, and in warranty period. Divide the price by the months of warranty, and you may find the most expensive batteries are really the cheapest, per month of expected service.

A final word on replacing batteries: One out of every four batteries returned for warranty have nothing wrong with them except that they are discharged. *Be sure to trouble-shoot the battery before you replace it.*

BATTERY REMOVAL AND INSTALLATION

Remove the battery as follows:

1) Note carefully the location of the positive (+) terminal so that the battery is installed in the same way.

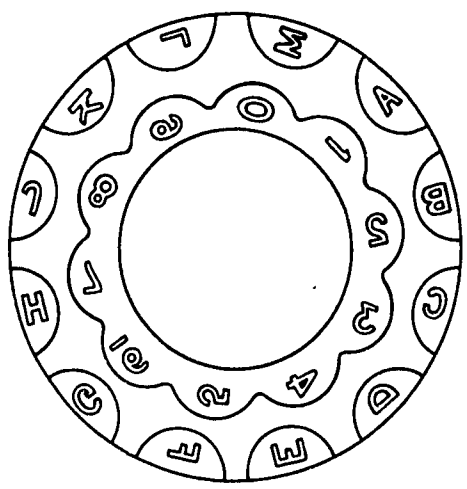
2) Disconnect the ground terminal first. Use only a box end wrench to loosen clamps on terminals. Remove clamps using a screw-type puller. Do not hammer on the battery posts.

3) Remove the battery and inspect the battery tray and hold-downs for dirt or corrosion. Clean any corroded part with ammonia solution or baking soda (¼ pound added to a quart of water).

4) Check cables for worn or frayed insulation. Replace cable or bolts if corroded.

Install the battery as follows:

1) Be sure the battery is fully charged.



X 1331

Fig. 28—Date Coding Ring for New Batteries

2) On new batteries, gently stamp the date on the top of the battery using a universal coding ring (Fig. 28). As shown, the 12 letters in the outer part of the ring are for the months, while the ten figures in the inner part of the ring identify the year. Example: B7 = February, 1967.

3) Set the battery in place, using a lifting strap if necessary. Make sure the battery is resting level in its tray.

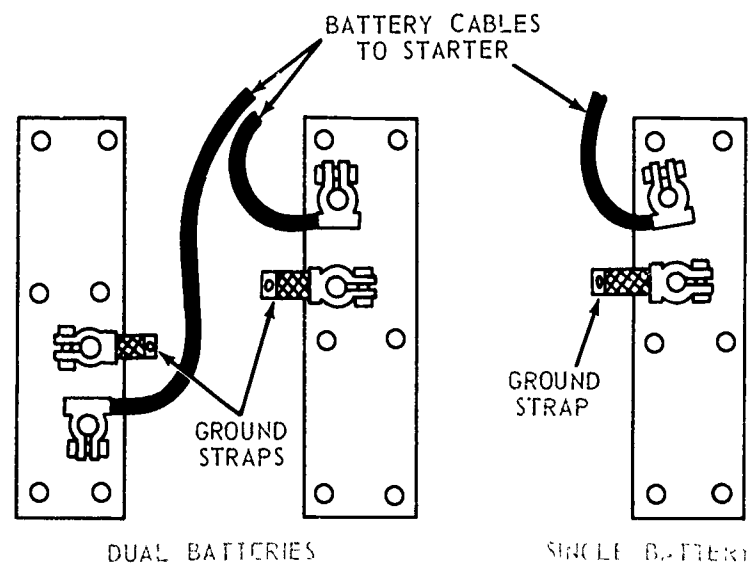
4) Tighten the hold-down nuts **evenly** until the battery is secure. Do not overtighten as this will distort or crack the battery case.

5) Clean the battery terminals and cable clamps with a wire brush before attaching the clamps. This will assure a good contact. Coat the terminals with petroleum jelly to prevent corrosion. Never paint the terminal posts.

6) Check for the correct polarity of the battery. The ground may be to the positive or negative pole, depending upon the system. **Reversed polarity can damage the system.** Note that the positive battery terminal post is larger than the negative post—match it with the larger cable clamp. Wait until last to connect the grounded cable or strap to avoid short circuits. On alternator-equipped machines, before connecting the last cable or ground strap, momentarily touch it against the battery post. With all switches and accessories off, no spark should occur. If it does occur, check for reversed battery polarity, improper alternator connections, or defective electrical equipment.

7) Tighten the clamps on the battery terminals. Use a box end wrench carefully to avoid twisting the battery terminal posts.

8) On generator-equipped machines, AFTER the battery is connected and BEFORE starting the engine, POLARIZE THE DC GENERATOR. (See Chapter 4.) NEVER ATTEMPT TO POLARIZE ALTERNATOR-equipped machines.



X 1332

Fig. 29—Installation of Typical Batteries

WHAT AFFECTS BATTERY LIFE

Periodic service has the best effect on battery life. In contrast, neglect and abuse will shorten the life of the battery.

Besides periodic cleaning of the battery top, posts, and cable clamps, the four key factors in battery life are:

- **Electrolyte Level**
- **Overcharging**

- **Undercharging**
- **Cycling**

Let's discuss each of these factors briefly.

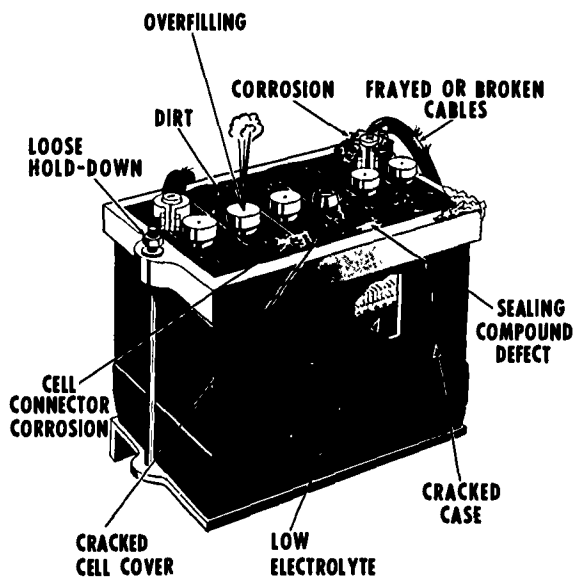


Fig. 30—Things Which Affect the Life of the Battery

ELECTROLYTE LEVEL

Keeping up the level of electrolyte in each battery cell is the most basic step in long battery life.

UNDERFILLING causes the electrolyte to become too concentrated, making the plates deteriorate more rapidly. The low level also exposes the tops of the plates, which harden and become chemically inactive.

OVERFILLING causes electrolyte to spill out, corroding the battery posts and cell covers.

Normally water is the only part lost from the battery electrolyte. This loss of water is due to evaporation, especially in hot weather and while charging the battery. Be sure to use distilled water if available. Otherwise, use only clean, soft water.

The correct level of electrolyte is always above the tops of the cell plates, which is usually to the bottom of the cell filler neck.

OVERCHARGING

Overcharging causes a loss of water in the cells by separating the electrolyte into hydrogen and oxygen gases. The gas bubbles wash active materials from the plates, and reduce the battery capacity.

If the battery uses too much water, check it for overcharging.

Overcharging also causes the battery to heat up inside and oxidates the positive plate grids, resulting in a loss of cell capacity and early failure.

UNDERCHARGING

A battery which stays undercharged will become sulfated. The sulfate normally formed in the plates will become dense, hard, and chemically irreversible if allowed to remain in the plates for long periods. The lowered gravity levels then make the battery more likely to freeze.

In cold weather, undercharged batteries often fail to crank the engine because of their lack of reserve power.

CYCLING

A cycle consists simply of a discharge and recharge. If operating conditions subject the battery to heavy and repeated cycling, its life will be shortened as cycling causes the positive plate's active material to shed and fall to the sediment tray in the bottom of the battery.

While the battery is perishable and will eventually wear out, be sure to remember that its life can be prolonged with a reasonable amount of care.

OTHER FACTORS IN BATTERY LIFE

If the battery hold-downs are loose, the battery will bounce around in its tray. This may cause the case to crack or cause internal damage to the elements.

If the hold-downs are too tight, this can also damage the battery by warping the case.

Dirt and corrosion will damage the battery case and may cause a dangerous short circuit.

Frayed or broken battery cables may also create a short circuit. (See "Safety Rules for Batteries," which follows.)

SAFETY RULES FOR BATTERIES

1. To avoid injury from a spark or short circuit, DISCONNECT THE BATTERY GROUND STRAP when working on any part of the electrical system or engine. This will also prevent accidental starting.

2. Disconnect the battery cable before fast charging the battery in the machine. This is especially important with a-c charging systems where the alternator can be damaged.

3. When removing the battery, disconnect the battery ground strap first. When installing the battery, wait until last to connect the ground strap.

4. NEVER REVERSE THE POLARITY OF THE BATTERY CONNECTIONS. In general, systems with d-c charging have positive (+) grounds, while systems with a-c charging have negative (−) grounds. Reversing the polarity may damage some components and wiring in the system.

5. DO NOT ATTEMPT TO POLARIZE THE ALTERNATOR on a-c circuits after connecting the battery. No polarization is needed. Any attempt to do so may damage the alternator, regulator, or circuits.

6. If booster batteries are used to help start the engine, be sure to connect them properly. Connect the (−) terminal of the booster battery to the (−) terminal of the machine battery, and connect the (+) terminals to each other.

7. When using booster batteries, prevent fire hazards as follows: a) When possible, use equipment with a switch in the line connecting the booster battery to the machine battery. b) Always "rock" the connector clips to make sure they are secure. c) If only jumper cables are available, always connect the machine battery first; then when connecting the booster battery, be very careful in handling the cable clips. When disconnecting, always break the connection at the booster battery first.

8. Never use a fast charger as a booster to start an engine.

9. When connecting a fast charger to a battery in a machine, be very careful. First remove the battery ground strap to prevent fire hazards.

10. Do not lay metal tools or other objects across the battery as this may create a short circuit.

11. GAS FROM BATTERY ELECTROLYTE IS FLAMMABLE: Keep all sparks and fires away from the battery. When charging the battery, gas is created more rapidly. Be sure the room where batteries are charged is well-ventilated.

12. BATTERY ACID IS HARMFUL ON CONTACT with the skin or most materials. If acid spills, here are some first aid tips to minimize the damage: a) Remove immediately any clothing on which acid spills. b) If acid contacts the skin, rinse the affected area with running water for 10 to 15 minutes. c) If acid ever splashes into the eyes, force the lids open and flood the eyes with running water for 10 to 15 minutes. Then see a doctor at once. Don't use any medication or eye drops unless prescribed by the doctor. d) To neutralize acid spilled on the floor, use one of the following mixtures: One pound of baking soda in a gallon of water, or one pint of household ammonia in a gallon of water. e) Acid from the battery can also damage the paint and metal surfaces of the machine. Avoid overfilling the battery cells and protect the battery when necessary.

TEST YOURSELF

QUESTIONS

1. (True or false?) "The specific gravity of a fully charged battery is the same regardless of the temperature of the electrolyte."

2. Battery electrolyte is made up of _____ and _____ _____.

3. (True or false?) "Dry-charged batteries are activated at the factory."

4. If you test a battery and find that the specific gravity is 1.200 in all cells, what should you do?

5. If you test a 6-volt battery for light load voltage and get cell readings of 1.96, 1.93, and 1.94, what should you do?

6. The two methods of charging batteries are _____ charging and _____ charging.

7. Which method of charging should be used on badly sulfated batteries?

ANSWERS

1. False. Specific gravity readings must be adjusted for temperature.

2. Battery electrolyte is made up of *water* and *sulfuric acid*.

3. False. They are activated in the field by the dealer or customer just prior to use.

4. Recharge the battery. Then test it again.

5. Recharge the battery. The difference between cells is less than 0.05 volts, so the battery is probably good. However, two cells are below 1.95, showing a need for recharging.

6. The two methods of charging batteries are *slow* charging and *fast* charging.

7. Slow charging.

CHARGING CIRCUITS / CHAPTER 4

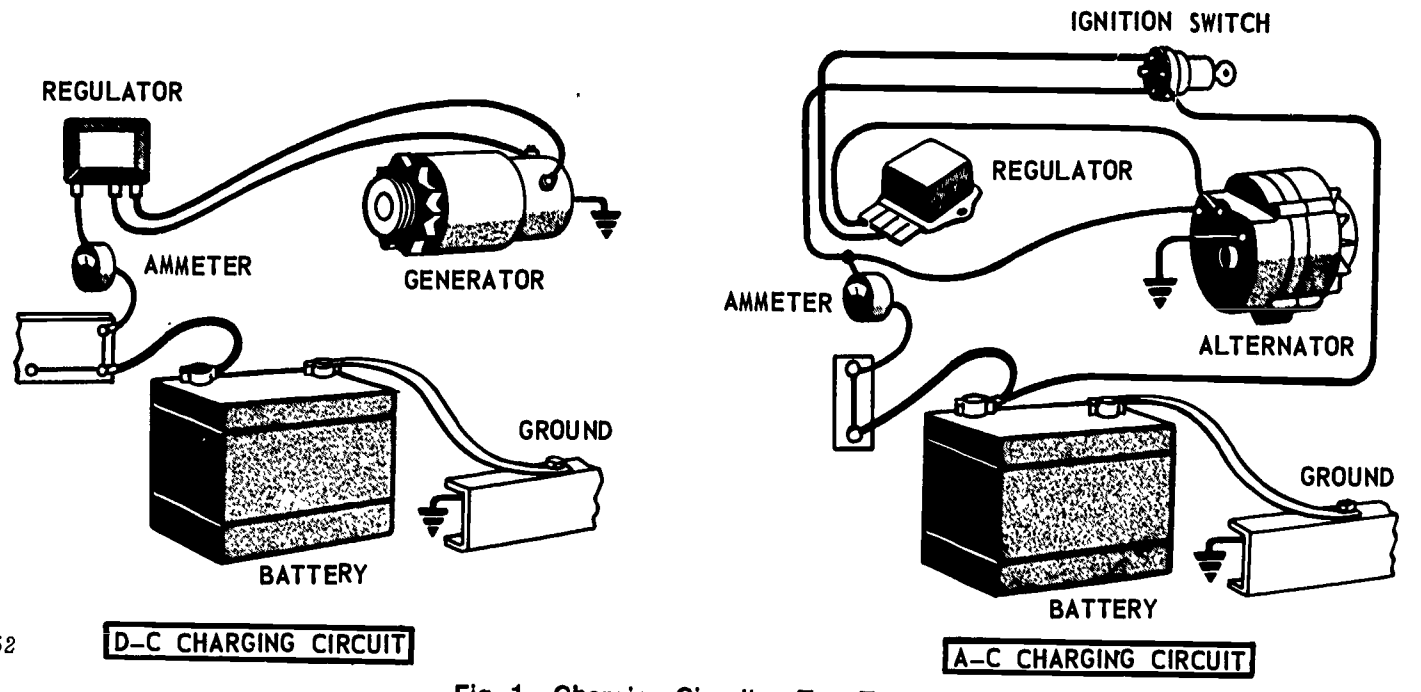


Fig. 1—Charging Circuits—Two Types

INTRODUCTION

The charging circuit does two jobs:

- **Recharges the battery**
- **Generates current during operation**

There are two kinds of charging circuits:

- **D.C. Charging Circuits (Use Generators)**
- **A. C. Charging Circuits (Use Alternators)**

Both circuits generate an alternating current (a.c.). The difference is in the way they rectify the a.c. current to direct current (d.c.)

D.C. CHARGING CIRCUITS have a *generator* and a *regulator* (Fig. 1).

The *generator* supplies the electrical power and rectifies its current mechanically by using commutators and brushes.

The *regulator* has three jobs: 1) opens and closes the charging circuit; 2) prevents overcharging of the battery; 3) limits the generator's output to safe rates.

A.C. CHARGING CIRCUITS have an *alternator* and a *regulator* (Fig. 1).

The *alternator* is really an a.c. generator. Like the generator, it produces a.c. current but rectifies it electronically using diodes. Alternators are generally more compact than generators of equal output, and supply a higher current output at low engine speeds.

The *regulator* in a.c. charging circuits limits the alternator voltage to a safe, preset value. Transistorized models are used in many of the modern charging circuits.

OPERATION OF CHARGING CIRCUIT

All charging circuits operate in three stages:

- **During starting—battery supplies all load current**
- **During peak operation—battery helps generator supply current**
- **During normal operation — generator supplies all current and recharges battery**

In both charging circuits, the *battery* starts the circuit when it supplies the spark to start the engine. The engine then drives the generator (or alternator) which produces current to take over the operation of the ignition, lights and accessory loads in the whole system.

The battery also helps out during peak operation when the electrical loads are too much for the generator (or alternator).

But once the circuit is started, the generator (or alternator) is the "work horse" which gives current to the ignition and accessory circuits.

The generator supplies this current as long as the engine is speeded up and running. When the engine slows down or stops, the battery takes over part or all of the load.

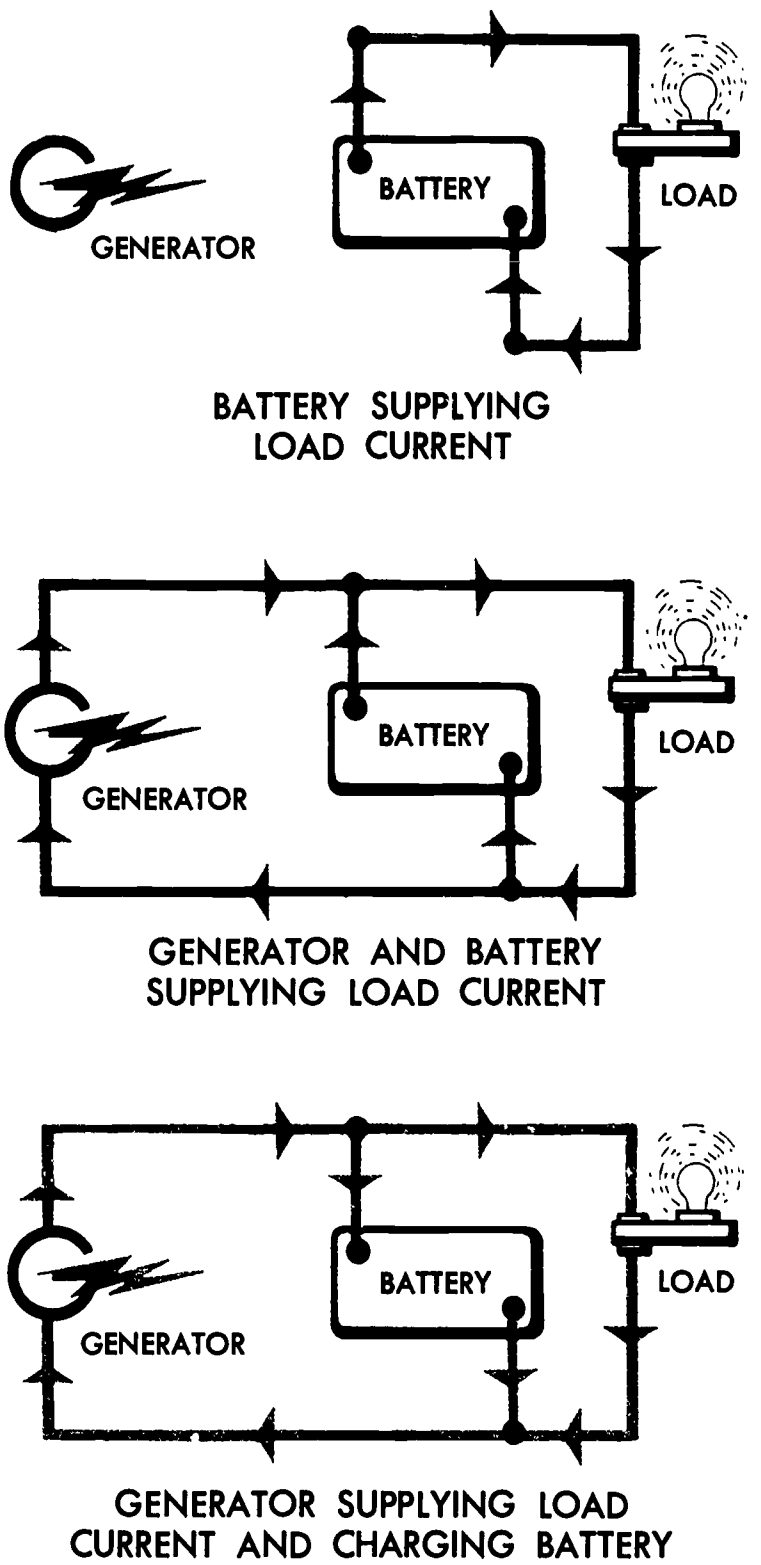


Fig. 2—Charging Circuit in Operation—Three Stages

Operation of the charging circuits during the three stages is illustrated in Fig. 2.

The top illustration shows operation while starting the engine.

The middle diagram shows what happens during peak electrical loads when the battery helps the generator.

The lower diagram shows the system during normal operation when the generator supplies all power for loads and also recharges the battery.

In the rest of this chapter, let's look at each charging circuit by itself, first the parts of **d.c. circuits.**

GENERATORS

The *generator* is the heart of the *d.c.* charging circuit.

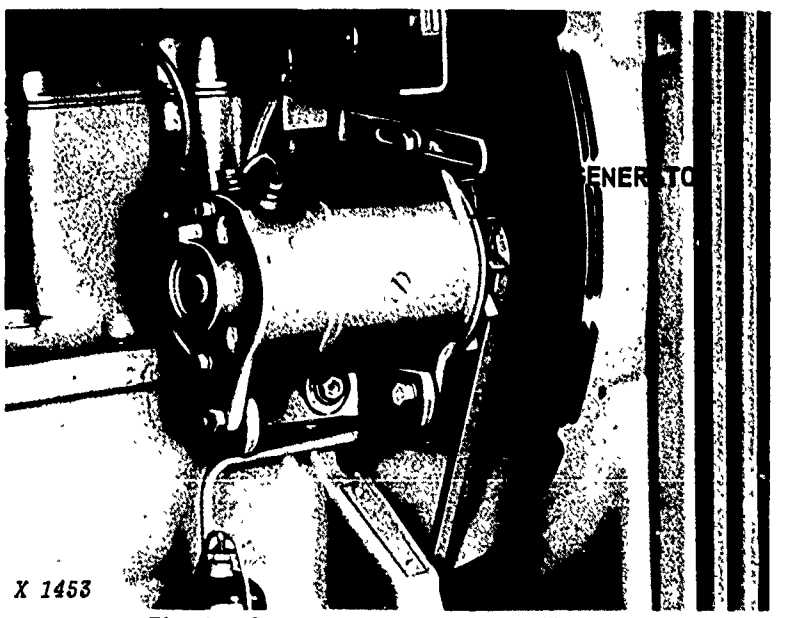


Fig. 3—Generator on a Modern Tractor

BASIC OPERATION OF GENERATOR

The generator produces electrical power by means of *electromagnetic induction* (Chapter 1).

This is moving a conductor through a stationary magnetic field.

Let's build up a simple generator and explain each function.

The basic generator (Fig 4) has two parts:

- **Armature—rotating wire loop (the conductor)**
- **Magnetic poles—stationary magnetic field**

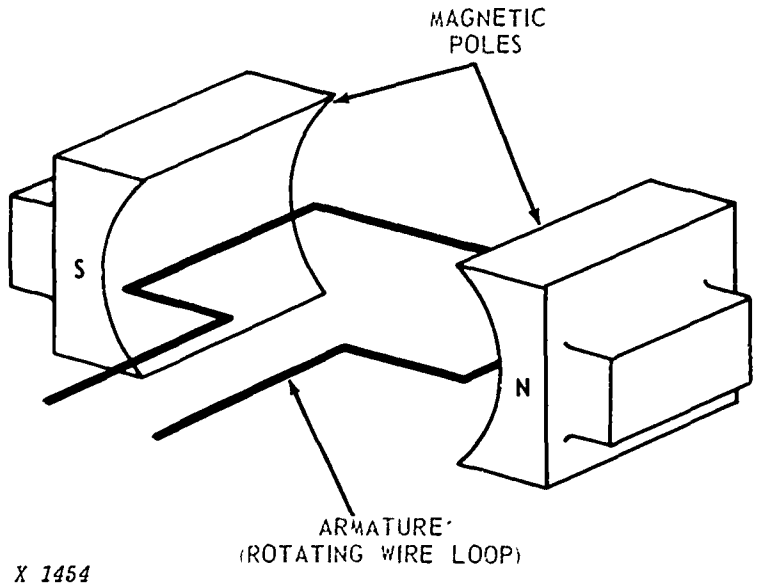


Fig. 4—The Basic Parts of a Generator

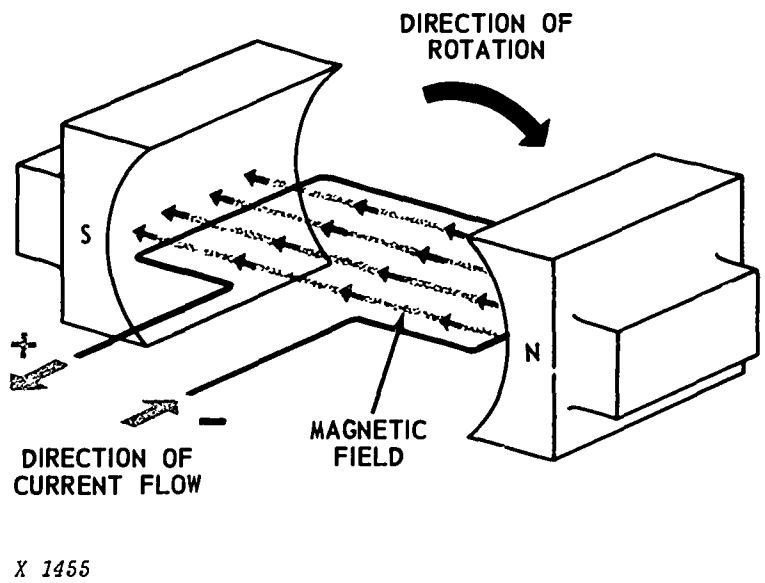


Fig. 5—Basic Generated Voltage

Now let's set the basic generator in motion (Fig. 5).

As the armature rotates through the magnetic field of the poles, voltage is generated.

Using the Right Hand Rule, we can see that the voltage comes toward us on the left side in Fig. 5, and flows away from us on the right side.

By the Conventional Theory, this means that the left end of the armature loop is positive (+) while the right end is negative (−).

For current to flow, we must add three more parts (Fig. 6).

Let's connect the ends of the armature loop to a ring called a *commutator.*

Next we need some *brushes* to contact the commutator and some *wires* to connect the brushes to a load.

Now we have completed the circuit and current will flow.

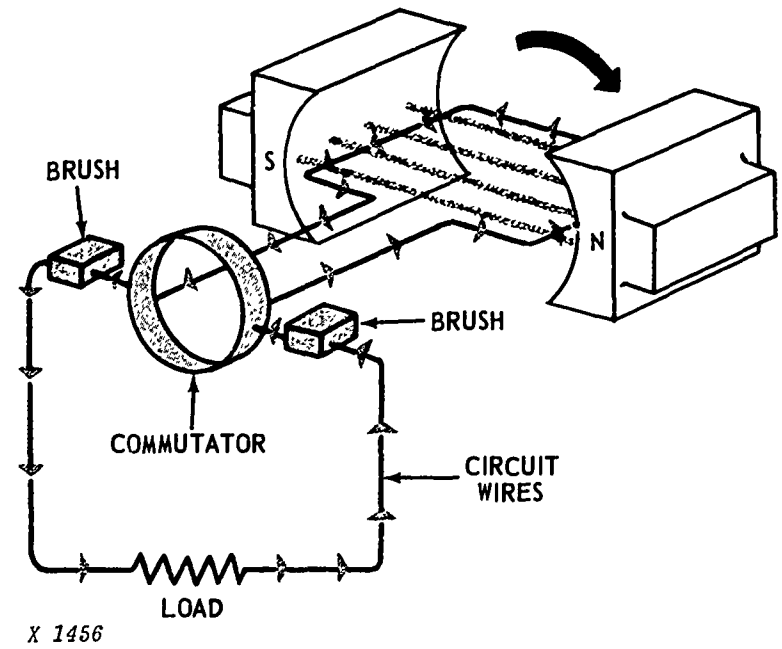


Fig. 6—Basic Current Flow in Generator

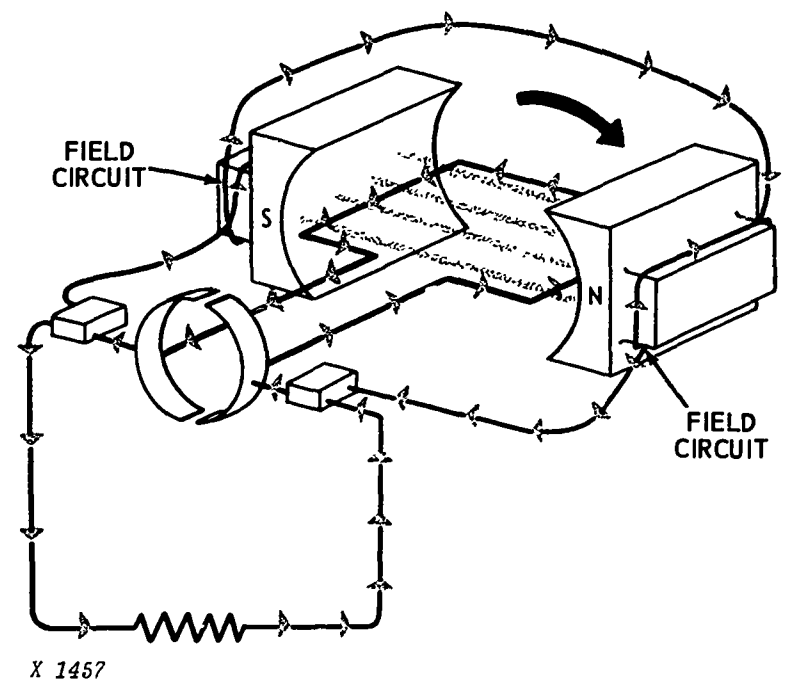


Fig. 7—Complete Parts of Basic Generator

To insure a strong current and proper flow, we must add one more feature (Fig. 7).

The magnets by themselves are weak and create a weak field. The result is that the voltage induced is low.

To remedy this, let's wind the wire conductors around the magnets as shown in Fig. 7.

Now by attaching the wires to the brushes, the current is used to strengthen the magnetic field between the poles. This wiring is called the **field circuit** of the generator.

This completes our basic generator.

ERIC

HOW THE GENERATOR CONVERTS A.C. TO D.C. CURRENT

So far our basic generator has produced an alternating current.

This is because the armature **reverses** the polarity of the current and so changes the direction of current flow on each side of the loop as it rotates (Fig. 8).

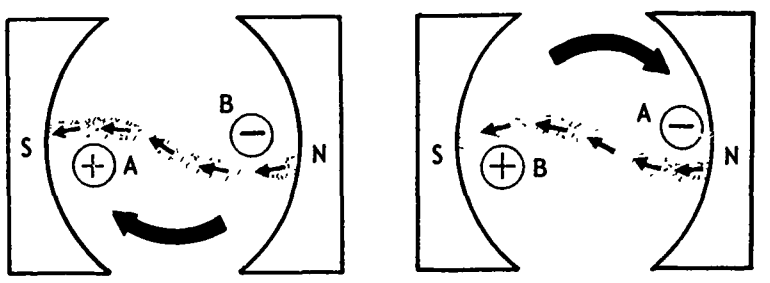


Fig. 8—How the Polarity of the Armature Changes during Each Revolution

During the first half of its revolution in Fig. 8, the top of armature side A cuts through the magnetic field first, while the bottom of side B is first to cut the field. Using the Right Hand Rule, we find that current flows "toward" side A and "away from" side B. The Conventional Theory (−to+) then gives us the polarities shown: (+) for A, and (−) for B.

During the second half of the revolution, the top of side B is the leading edge, while the bottom of side A is leading. Again using the rules, we find that B is now (+), while A is (−).

So we see that the *armature loop ends reverse polarity during each revolution.*

The result: **alternating current.**

How do we convert this a.c. current to d.c.?

Getting this a.c. current to flow to the load in the same direction (d.c.) is the job of the commutator and brushes (Fig. 9).

Twice during each rotation, the armature is vertical to the magnetic field as shown. Here the armature loop is not passing *through* the field and so no voltage is generated at this instant. This is the static **neutral point.**

The commutator is split into two parts with the open areas matching the neutral point of the armature as shown. This means that there is a gap as the commutator passes the brushes. Past this point the other half of the commutator contacts the brushes, *reversing the current flow at the same time as the rotating armature reverses its polarity.*

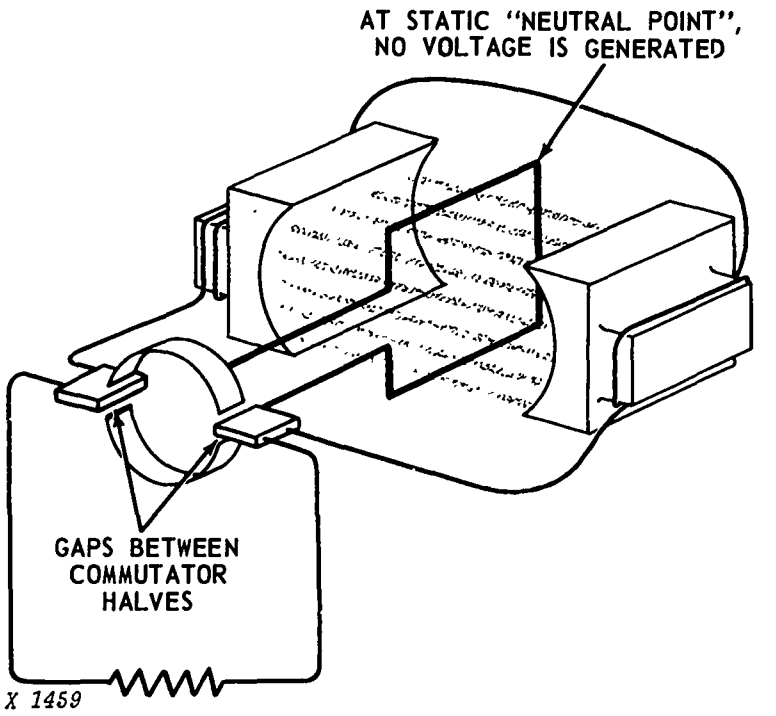


Fig. 9—How Generator Converts A.C. to D.C. Current

The result: **direct current.**

This is how the generator converts a.c. current to d.c. current.

As we saw in Chapter 1, three factors decide how much voltage is generated:

1. *The strength of the magnetic field.*
2. *The number of wire conductors on the armature.*
3. *The speed of the armature.*

SUMMARY: HOW A GENERATOR WORKS

In summary:

- **Moving a conductor through a stationary field = basic generator.**
- **Basic generator = armature (rotating) + magnetic poles (fixed).**
- **Circuit is completed through commutator and brushes.**
- **Field circuit windings strengthen the magnetic poles.**
- **Split commutator converts a.c. to d.c. current.**

Now let's look at the generator parts in more detail.

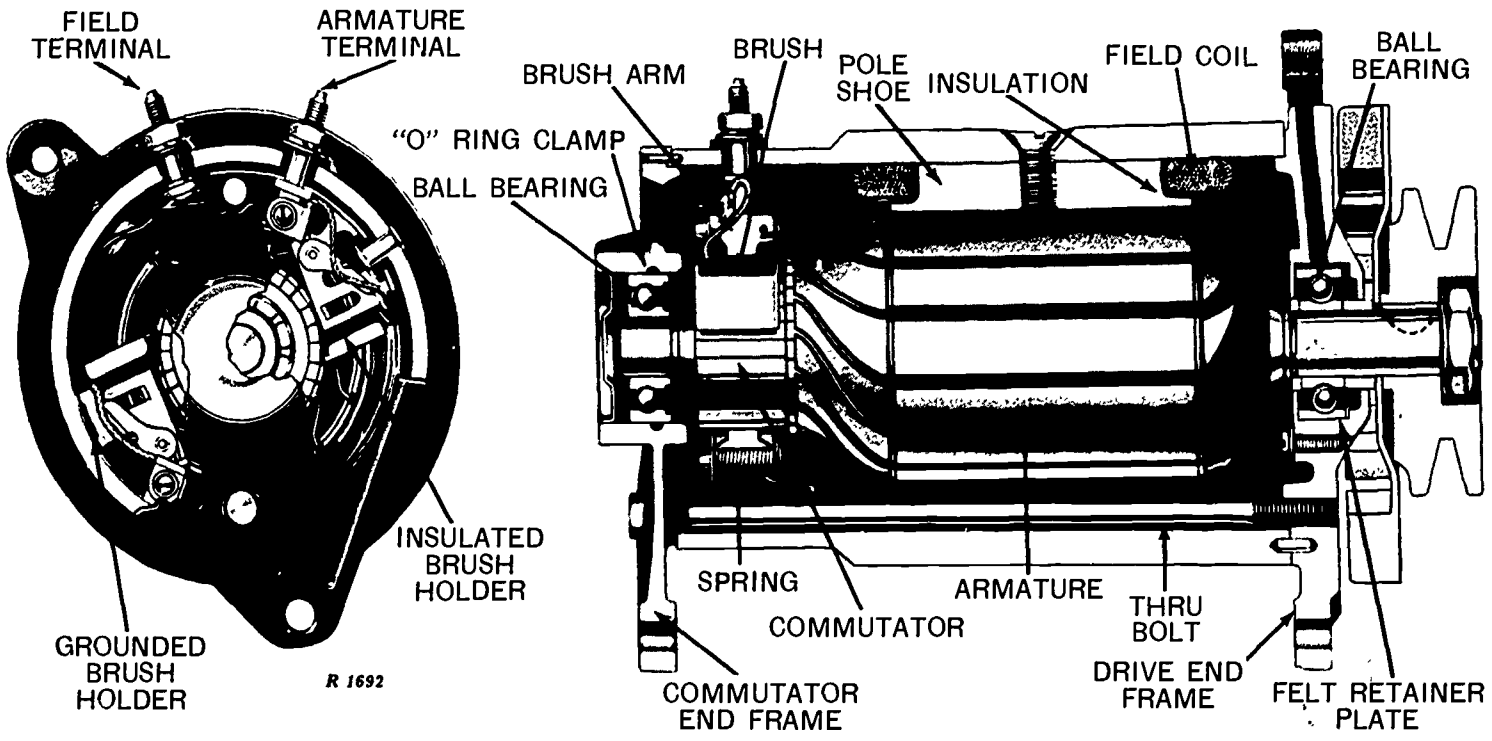


Fig. 10—D.C. Generator in Cutaway View

ARMATURE

The armature is not just one wire loop or conductor, but many wire conductors. This means that a greater voltage is developed.

These conductors are wound around a core of soft laminated iron sections as shown in Fig. 10. The sections are then attached to the armature drive shaft.

The laminated iron sections are used in place of a solid core of iron to reduce heat. A solid iron core would generate unwanted voltage within itself. This would result in current flow called "eddy currents" which create excessive heat.

COMMUTATOR

The commutator must have a section to match each wire section of the armature.

So the commutator ring is composed of many sections or bars. (See Fig. 10.) Mounted on the end of the armature drive shaft, each section or bar is held together and separated from the adjacent bar by an insulating material. The ends of each wire conductor are connected to two adjacent commutator bars.

BRUSHES

The brushes are made of various materials, depending on the output needs of the generator. Fixtures in the generator hold the brushes so that their ends rub or ride on the commutator ring. Usually, spring pressure forces the brushes against the ring as the brushes wear.

POLE SHOES

The pole shoes are permanent magnets, fixed to the inside of the generator housing. Set directly across from each other, the two opposing poles set up a weak magnetic field.

FIELD CIRCUIT

The first circuit is composed of one wire conductor wound around both poles many times. One end of the wire is attached to the brush; the other end of the field circuit terminal.

HOUSING

All generator components are enclosed in a metal housing. Most generator housings have openings at both ends. This allows air to pass through and cool the generator. On the pulley end of the drive shaft, there is usually a fan to force the air to circulate.

AUXILIARY UNITS

Three external units are an important part of generator operation.

We will briefly discuss these units now and cover them more extensively later in this chapter.

Cutout Relay

As you know, the generator recharges the battery as well as supplies current to the rest of the electrical system. To recharge the battery, a circuit must run from the generator to the battery. However, if this circuit was complete when the

generator was *not* operating, the battery would discharge through the generator.

To prevent this, an automatic switch called a *cutout relay* is installed in the circuit. While the generator is operating, the switch is closed and the circuit is complete. When the generator is stopped, the switch opens the circuit.

Voltage Regulator

Voltage developed by the generator will go as high as necessary to overcome any resistance in the circuit. If resistance is high, voltage will be high, while low resistance means low voltage. But if voltage is too high, the field and load circuits may be damaged.

The generator cannot control the amount of voltage it produces. Therefore, an external unit called a *voltage regulator* is used in the field circuit. It has a shunt coil and contact points to control the strength of the magnetic field, thus limiting the voltage generated.

Current Regulator

Excessive current flow is caused by too little resistance and can also cause heat damage to the armature.

A *current regulator* is installed in the load circuit to control this current flow. This unit is very similar to the voltage regulator above.

Both the voltage regulator and current regulator are used, but while one is working the other is not. They never work at the same time.

All three units—cutout relay, voltage regulator, and current regulator—are usually housed together in one assembly.

ARMATURE REACTION

We have said that commutation takes place when the armature is in the "neutral" position. This is true of a one-loop armature (Fig 9).

However, an actual armature has more than one loop. In this case, "one loop at a time" is in the neutral position. Therefore, commutation occurs between the commutator sections connected to that loop. The other loops are still generating voltage.

In describing the "neutral point," we said that it is perpendicular to the path of the magnetic field. It is obvious, then, that if the path of the field should change, the neutral position would also change. Therefore, the brush position would also have to be changed.

To see why, let's return to the basic operation for a moment.

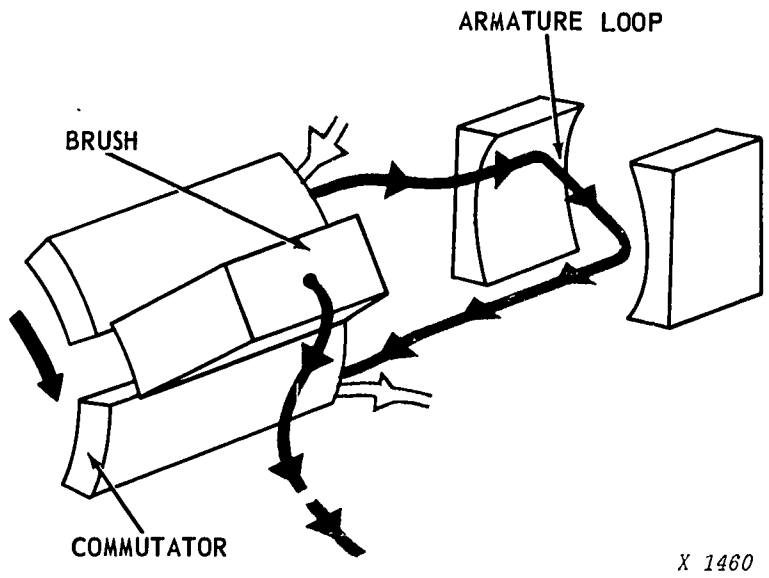


Fig. 11—Brush-Commutator Circuit (Normal Operation)

Remember that when the generator is producing voltage and current, the brush is in contact with the commutator section. This contact is like a completed circuit.

To get commutation, the commutator section beneath the brush is replaced by the section following it. In a sense, the circuit between the first section and the brush is broken—an open circuit.

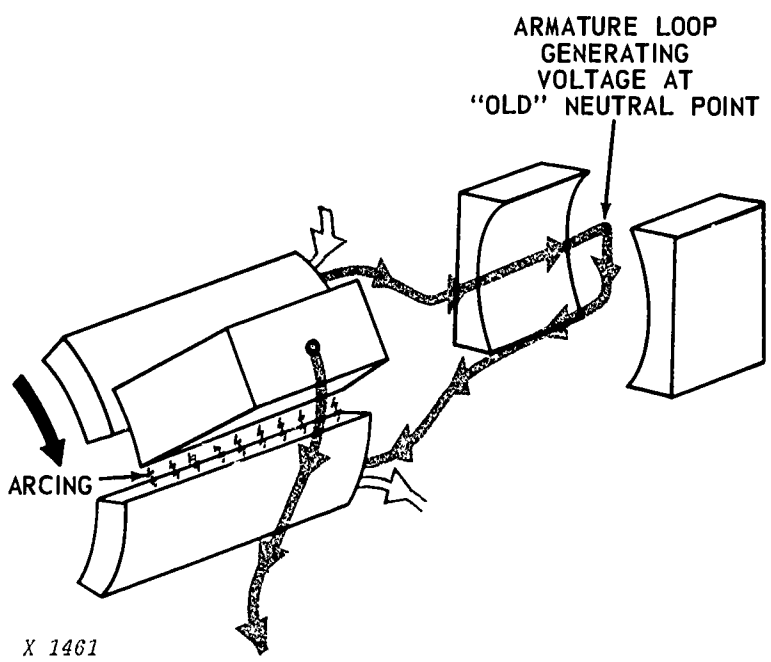


Fig. 12—Arcing Occurs When Neutral Point Is Changed

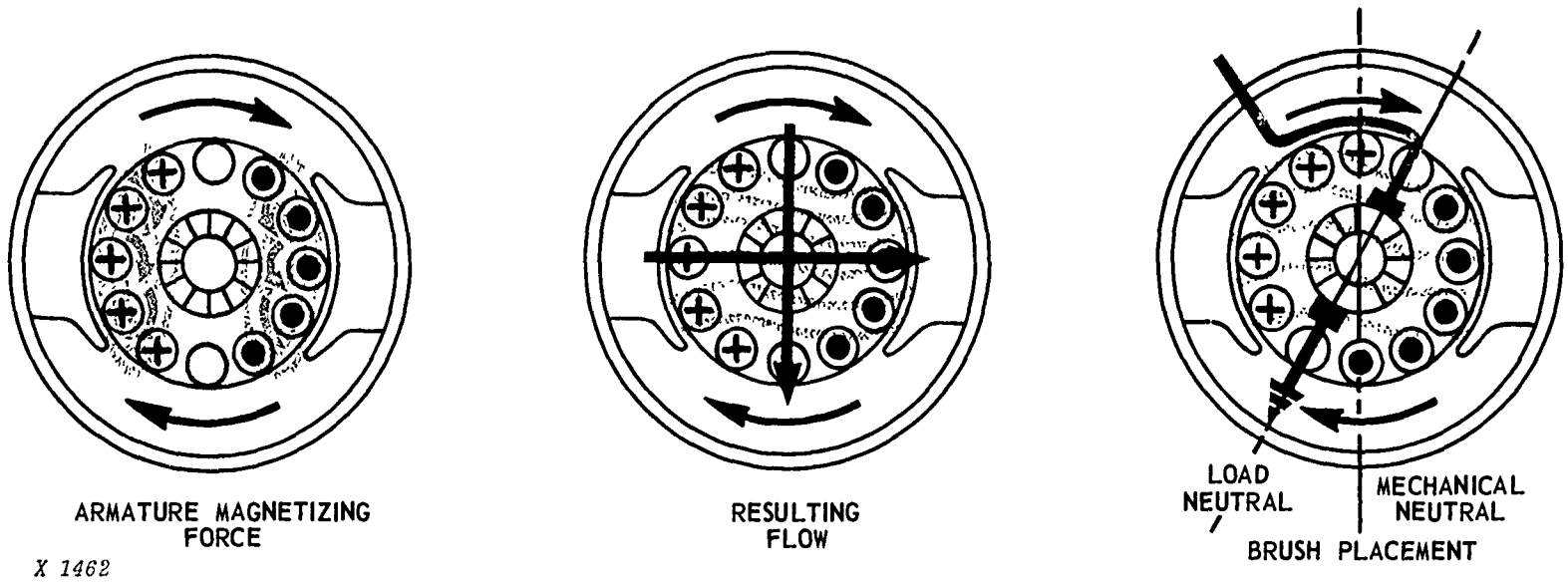


Fig. 13—Armature Reaction

During normal operation, no voltage is generated in the loop attached to the commutator section at the time the connection is broken. However, if the voltage and current flow are still in that loop at this time, a spark or arc will appear between the brush and commutator section (Fig. 12).

This arcing is caused by the current which is attempting to cross between the section and brush. The duration of the arc is quite short because of the low voltage and rapidly expanding distance between brush and section. However, severe arcing will damage the brushes and commutator.

However, the brushes are set directly over the open area at the moment when the armature loop is in neutral position (Fig. 12).

But if the magnetic field path is distorted, the armature loop will conduct current during the commutation. The result: **arcing.**

Distortion of the magnetic field as shown really exists. This distortion is caused by the magnetic field set up around the armature conductors acting with the magnetic field of the poles. It is called **armature reaction.**

Fig. 13 shows the sequence of the armature reaction which distorts the field and how the brushes are placed to counteract it.

The illustration at left shows the magnetic field surrounding the coils of the armature that results when current flow is established in these coils. Remember that all the load current flows through the conductors of the armature, and the greater the current flow the greater will be the strength of the surrounding magnetic field.

The center diagram in Fig. 13 shows the magnetic field formed after combining the magnetic field of the armature with the field of the pole pieces. The change in the path of the magnetic field changes the neutral position to a new position under load.

To counteract this, the brushes must be located at the **load neutral** rather than at the **mechanical neutral.** This is shown at right in Fig. 13. The load neutral is located ahead of the mechanical neutral during rotation as shown. At a constant speed and load, the new load neutral is the ideal commutating point. However, with varying speeds and loads, the load neutral point is constantly charging. For this reason a brush position is selected which will be the *best average location* that will create the least arcing at the brush under normal operating conditions.

TYPES OF GENERATORS

Basically, all generators are alike. They all use the basic parts we have described.

However, there are variations, each using the basic components in different ways or quantities.

The different types of generators are:

- **Shunt—standard for most uses**
- **Third Brush—needs no current regulator**
- **Interpole—provides battery commutation**
- **Bucking Field—for changing loads and speeds**
- **Split Field—for low speeds but high loads**

Let's discuss each type of generator.

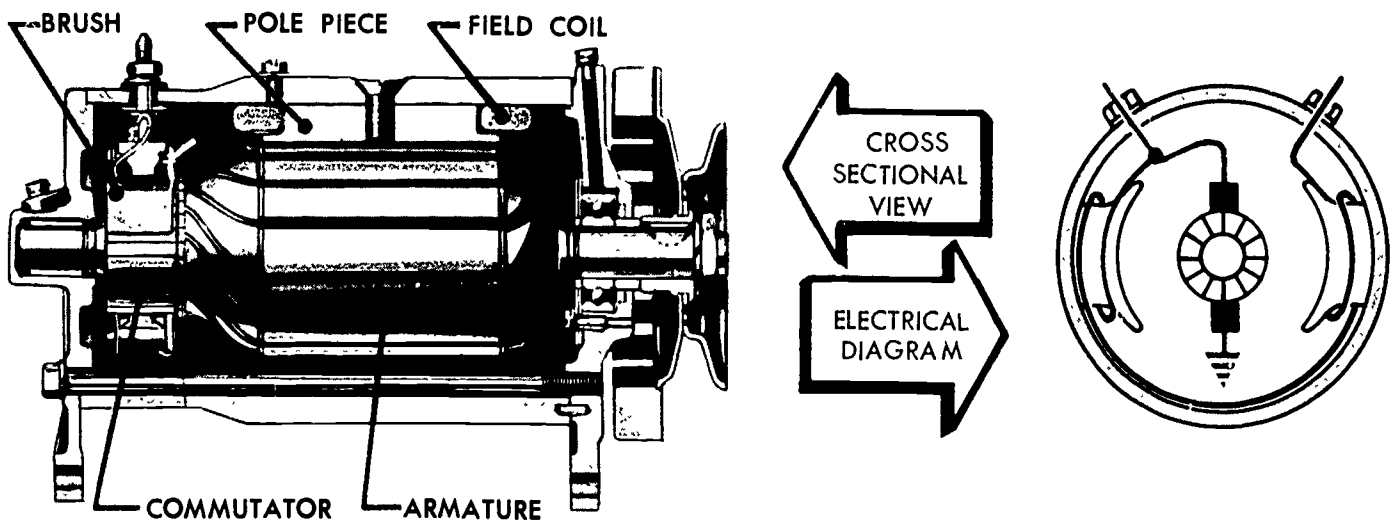


Fig. 14—Shunt Generator

SHUNT GENERATOR

The **shunt generator** is similar to the basic generator we described earlier. It is a two-pole, two-brush unit with an armature, a commutator, and field and load circuits (Fig. 14).

Operation is also the same: Voltage is produced by an armature rotating through a magnetic field, current is sent through the commutator into the field and load circuits, via the brushes.

A shunt generator uses an external voltage regulator to control the field circuit. The name "shunt" refers to the field coil which is in parallel with the armature.

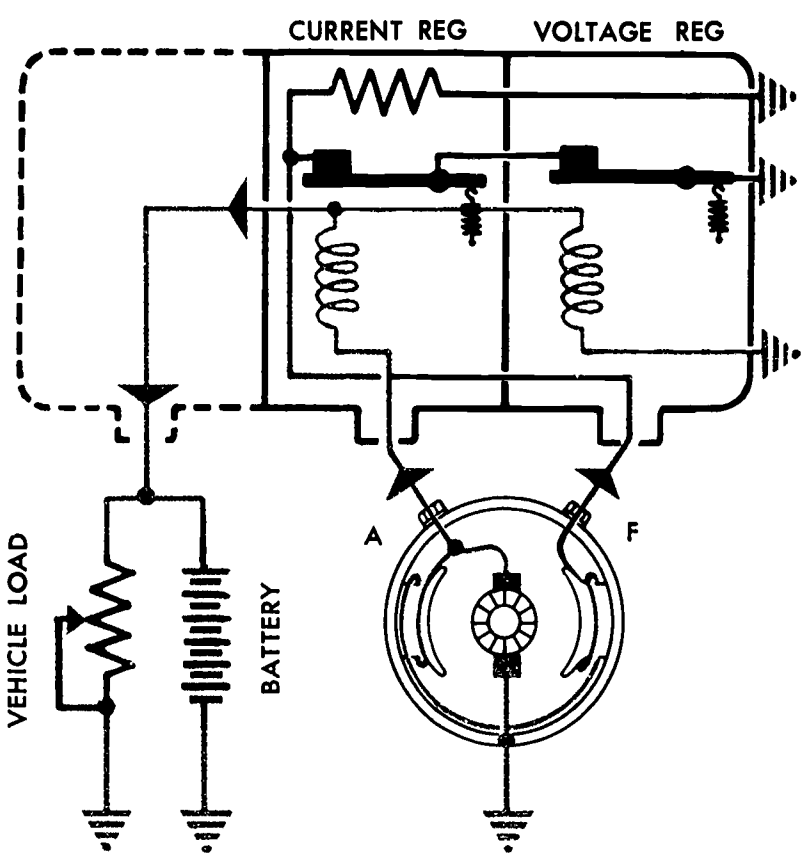


Fig. 15—Generator Field Circuit

The generator field circuit is shown in Fig. 15.

In this circuit the voltage regulator points are located *after* the field coils. The field circuit is grounded on one end at the generator regulator. The other end is attached to the insulated brush inside the generator. This circuit is called an "A" circuit.

NOTE: Some generators have field circuits in which the regulator points are located before the field coils and the field coils are grounded inside the generator. These models are called "B" circuit generators. They are not used on farm and industrial machines at the present time. In this chapter we will cover only the common "A" circuit generators.

THIRD BRUSH GENERATOR

The **third brush generator** has three brushes instead of two, and uses another means of controlling the flow of current.

The two main brushes, insulated and grounded, are positioned at the neutral point on the commutator to obtain the maximum voltage. The third brush is placed between the other two which means that it picks up less than maximum voltage.

As you can see in Fig. 16, the two main brushes (shown in red) are in the load circuit. The third brush (shown in blue) is connected to the field coil.

On most units the third brush position is adjustable as shown. By moving the brush toward the insulated brush, voltage is increased across the field circuit. Moving it away from the main brush decreases the voltage.

When a third brush is used, current is controlled in two ways:

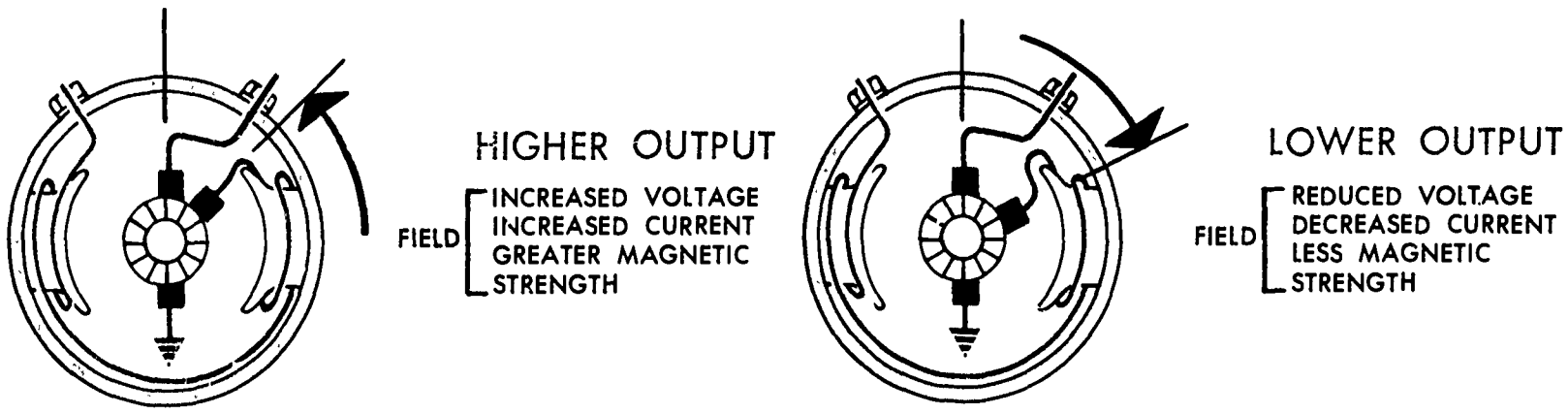


Fig. 16—Third Brush Generator Output Adjustments

1) The third brush picks up less voltage; therefore, less current flows through the field circuit. This means a weaker magnetic field.

2) At greater loads and speeds, the magnetic field is more distorted. So fewer lines of force are cut by the armature. This means that less voltage and current are developed in the field circuit and coils.

Since the field circuit controls the generator current output, no outside current regulator is needed. A voltage regulator is still needed; however, if the capacity of the generator is greater than the electrical load.

At one time, the third brush generator was widely used in the automotive industry. It is relatively simple in design and by shifting the third brush, its output can be controlled. It can also reach its peak output at medium speed.

Today, however, the demands of electrical power have increased. Often the third brush generator cannot meet these demands. Though it reaches its peak at medium speed, power begins to decrease at higher speeds. For this reason it is now used primarily on slow speed equipment that has a low power requirement.

INTERPOLE GENERATOR

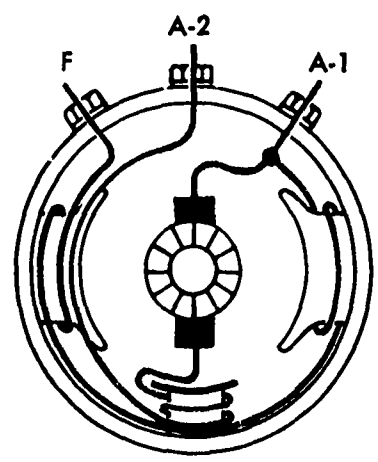


Fig. 17—Interpole Generator

The **interpole generator** is quite similar to the shunt model, but has an extra magnetic pole shoe (Fig 17). This changes the operation and solves a problem of locating the brushes at load neutral on the shunt generator.

Earlier we explained that the best commutation took place when the armature was at the "neutral point." We also told how, because of magnetic field distortion, an ideal commutation point for all loads could not be reached.

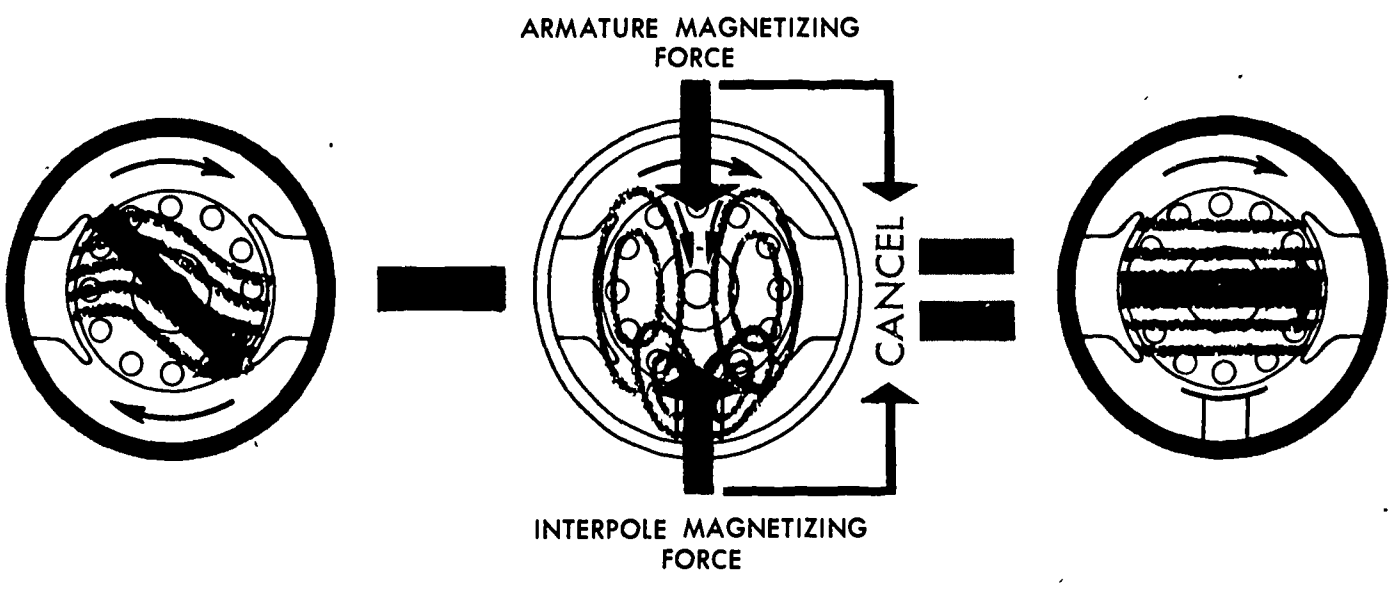


Fig. 18—Interpole Generator in Operation

This is true except when using the interpole generator. By adding another pole shoe, the distortion of the magnetic field is corrected.

By installing this extra magnet between the other two shoes, *the distorted magnetic field created by the current flow through the armature is neutralized.*

The interpole is wound with heavy copper wire since all armature current flow goes through this coil. The number of coil turns is calculated to produce enough ampere turns in the opposite direction to offset the magnetic field created by the armature.

Now the magnetic field lines are again in a straight line as shown at right in Fig. 18. The best commutation point is again at the "neutral" or "**mechanical** neutral point" and the brush position is matched to this.

Besides providing the ideal commutation point, the interpole generator can greatly increase the brush life over a non-interpole generator.

BUCKING FIELD GENERATORS

The **bucking field generator** is another variation on the standard shunt generator. But it can develop the voltage for high current at very low speeds.

Actually, getting a high current at low speeds is comparatively easy. (The problem is to control excessively high voltage at high speeds.)

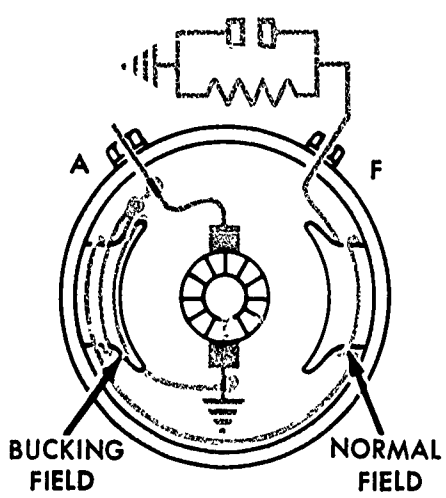


Fig. 19—Bucking Field Generator

To control the high voltage, a "bucking" field coil is used (Fig. 19). This coil is a high-resistance conductor wound around one pole shoe and connected across the brushes as shown. The coil is connected in reverse of the main field circuit. This produces a magnetic effect which *opposes* the normal magnetic field.

At low speeds, the bucking field has little or no effect on the magnetic field and the generator is able to produce high voltage and current.

As speed increases, the bucking field magnetism becomes greater and reduces the magnetic field lines of force. With a reduced field, the armature's voltage is lowered and the voltage output of the generator drops.

In effect, the bucking field circuit helps the voltage regulator to control voltage. It reduces the residual magnetism in the pole shoes while the regulator controls the magnetism and current flow in the field circuit.

Although the bucking field generator is able to provide adequate electrical power at low speeds, its primary use is in a system that has a wide variation in speed.

SPLIT FIELD GENERATOR

Some generator uses require a high power output at slow speeds for long periods of time.

These systems are usually on buses, farm machines, etc., that operate at low speeds or sit with the engine idling.

The **split field generator** works for these operations.

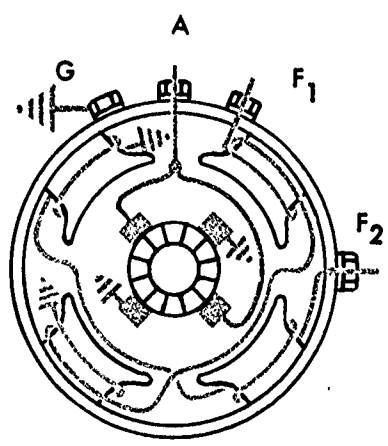


Fig. 20—Split Field Generator

The split field generator has an extra set of pole shoes and brushes (Fig. 20).

By doubling the shoes and brushes, a stronger magnetic field is created. This gives the extra voltage for low-speed charging and load current.

Generator output is doubled by separating the two fields and using a voltage regulator for each field.

Yet, each field circuit receives only the normal voltage and current so no damage is done to the regulators.

Summary: Types of Generators

Let's review the types of generators:

1. **Shunt**—used as a standard generator for most normal operations.

2. **Third Brush**—eliminates the use of a current regulator. Is relatively easy to change third brush position and control the output. Used in systems with low speed and low load requirements.

3. **Interpole**—provides a better commutation point and extends brush life.

4. **Bucking Field**—used where there is a wide variation of load and speed requirements.

5. **Split Field**—used in systems with low speed, but high load requirements.

USES OF GENERATORS

Why is one generator used for one application, but not in another?

We have already touched on the uses of generators when discussing the various types.

Now let's go a little deeper and see the *why* of generator applications.

Here are the key factors in selecting a generator:

- **Power requirements**
- **Operating conditions**
- **Service and maintenance needs**
- **Drive ratio—pulley to generator**

Below we'll discuss each of these factors.

Power Requirements

One of the most important factors to consider is the power requirements. The best rule is to select a generator that can provide 10 to 20 percent more than the total load requires. The extra output can be used to recharge the battery even when full load output is required. Also, the total load requirements would not take into consideration momentary load demands such as cranking motor, cigarette lighter, and other accessories.

Operating Conditions

Operating conditions are another prime consideration in generator selection.

Extremely dirty or damp conditions often require that the generator be fully enclosed, and the output of an enclosed generator is sharply reduced compared to a ventilated one of the same size.

High temperatures around the generator can add to the heat developed within the generator and reduce the output as well.

Service and Maintenance Needs

The type of service required of the generator and the type of maintenance on it are important factors, too.

The generator may be subject to long use at high, low, or variable speeds and loads.

The cost of repair parts, the length of service they give, and the ease in which they can be replaced are also important.

Drive Ratio—Pulley to Generator

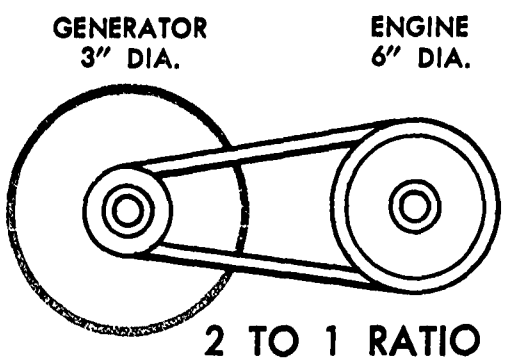


Fig. 21—Example of Drive Ratio—Engine to Generator

The drive ratio between the engine pulley and generator is also quite critical (Fig. 21). Armature speed is determined by this ratio.

A high armature speed may cause damage by developing more voltage than the regulator can handle. A low speed may not provide the necessary voltage output.

The drive ratio also affects the operation of the cutout relay switch. Due to varying idle speeds, the relay should be actuated at speeds of 100 rpm below or above idle speeds.

If the relay is set to operate at a *precise* idle speed, the relay points will constantly open and close due to this variation. The relay points would soon burn up in this kind of operation.

Summary: Uses of Generators

In summary:

- **Total load + 10-20 percent = size of generator required.**
- **Dirty or damp conditions = enclosed generator required.**
- **Heat conditions = ventilated generator required.**
- **Engine-to-generator pulleys = critical drive ratio.**
- **Drive ratio = speed of generator rotation.**
- **Too fast rotation = too much voltage for regulator.**
- **Too slow rotation = not enough voltage output.**

TESTING AND SERVICING OF GENERATORS

Like any other piece of equipment, generators are subject to failures and disorders.

To discover just what in particular ails them, there are several tests that can be made on the basic generator.

First, you should always test the complete circuit before removing the generator to the bench. This will insure that the generator is actually the "sick" member of the charging circuit team.

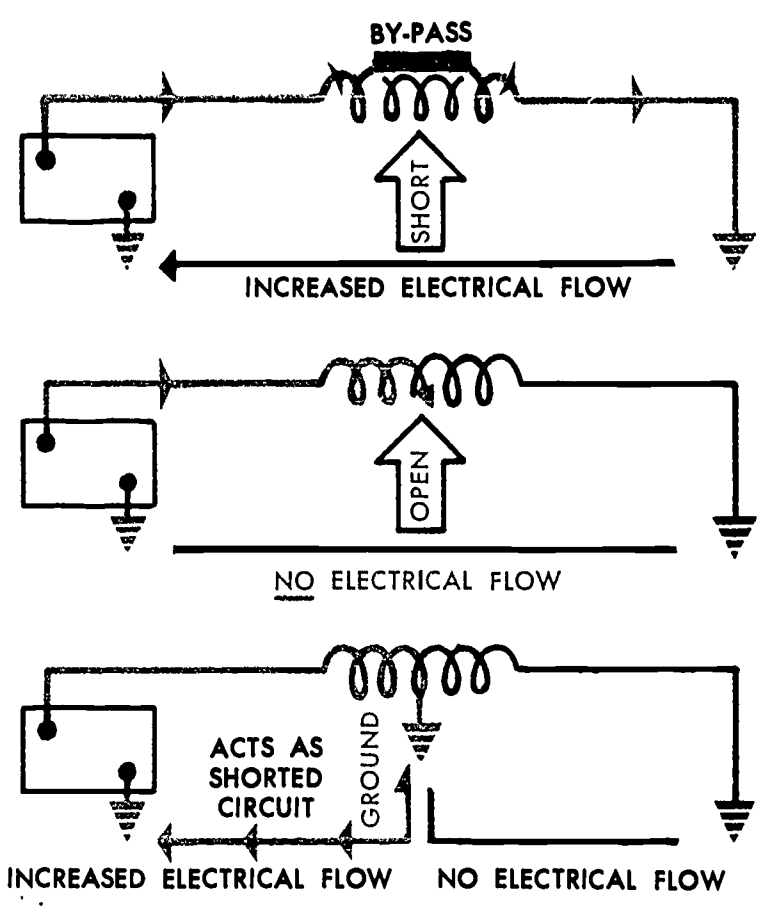


Fig. 22—Basic Failures of Electrical Circuits

Types of Failures

The four basic electrical failures are:

1. *Short Circuits*—These are unwanted connections, usually copper-to-copper, that allow current to bypass all or part of the circuit. (See Fig. 22, top.)

2. *Open Circuits*—These are breaks in the circuit which cause extremely high resistance. Usually no current will flow through an open circuit.

3. *Grounded Circuits*—These are unwanted connections that bypass all or part of the circuit from the insulated side to the grounded side of the circuit; usually a copper-to-iron connection.

4. *High-Resistance Circuits*—These are usually caused by poor or corroded connections, and frayed or damaged wires, all of which create greater resistance in the circuit. See Fig. 23.

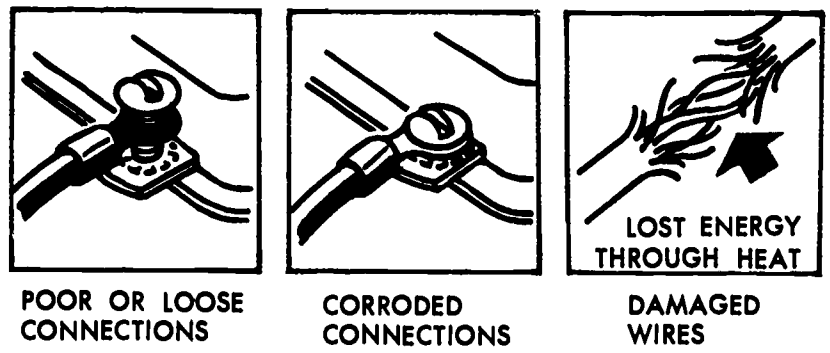


Fig. 23—Causes of High Resistance

After you have isolated the cause of the problem as a "sick" generator, test it thoroughly out of the circuit. The tests can tell you which component in the generator is failing.

To perform these tests, several types of testing units are necessary. Each test may require just one or a combination of these units.

However, one item is necessary for nearly all the tests—the manufacturer's Technical Manual for the machine. This manual is kept up-to-date and lists all the generator specifications plus servicing and repair procedures. If in doubt, always consult the Technical Manual. We will only give general specifications here.

Generator Output Test

A generator output test is an overall test which generally tells which internal component is malfunctioning.

To test the output, connect the units as shown in Fig. 24.

1. Connect an ammeter and switch in series with a battery to the generator output terminal.

FOS—20 (Mar—68) Litho in U.S.A.

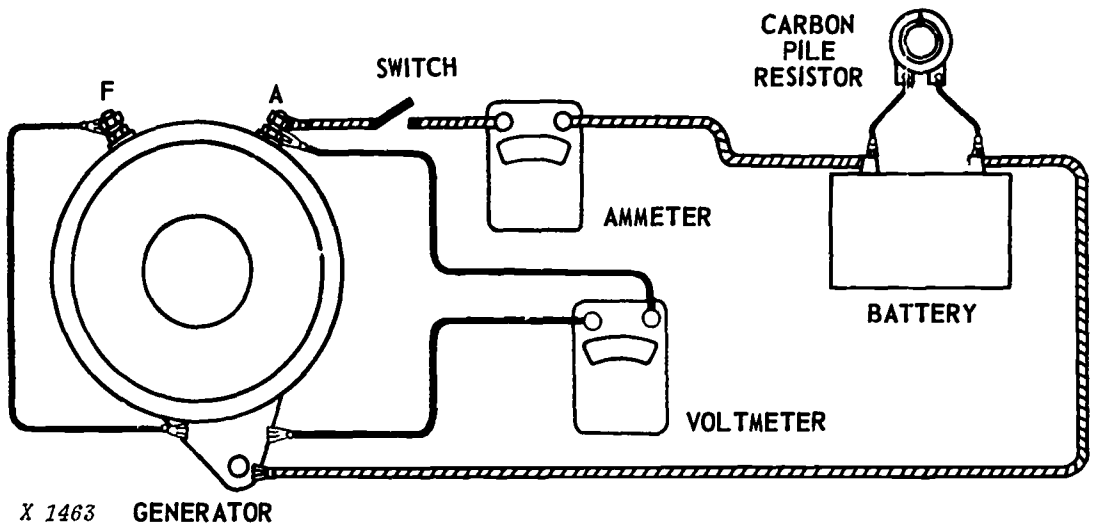


Fig. 24—Testing the Generator Output

2. Connect a voltmeter from the generator output terminal to ground as shown.

3. Connect a carbon pile across the battery.

4. Connect a jumper lead to the generator field terminal.

5. Operate the generator to obtain battery voltage and close the switch.

6. Speed up the generator to its rated value, adjust the carbon pile to obtain the specified voltage, and compare the current output with the generator specifications.

7. If the generator output is below par, disassemble it for further testing.

NOTE: The output test shown in Fig. 24 is for the common "A" circuit generator. For "B" circuit models, a different test hookup is used.

Generator Trouble Shooting Chart

Below is a general list of generator failures and their possible causes.

NO OUTPUT

Sticking brushes

Dirty or corroded commutator

Loose connections

Grounded, shorted, or open armature

Grounded, shorted, or open field circuit

Grounded terminals

EXCESSIVE OUTPUT

Grounded or shorted field circuit

VARIABLE OR LOW OUTPUT

Loose or worn drive belts

Low brush spring tension

Dirty or burned commutator

Eccentric or worn commutator

Partial grounded, shorted, or open armature

Partial grounded, shorted, or open field circuit.

NOISY GENERATOR

Loose mounting

Loose pulley

Worn or dirty bearings

Improperly seated brushes

From this list, make the easy checks first. A good visual check of all the components may help you to catch the more obvious causes of failures such as:

Loose or broken lead wires—dirty or worn brushes — improperly seated brushes — broken brush springs — worn or glazed commutator — loose pulley — copper-to-copper contact of conductors in either the armature or field circuit (shorted) — broken conductors in the armature or field circuits (open) — copper-to-iron contact of conductors in either the armature or field circuit (grounded).

If these failures are not visible or cannot be corrected, then make detailed tests on each component.

These component tests are given on the following pages.

Armature Tests

Four possible failures of the armature are:

1. *Open armature circuits.*
2. *Shorted armature.*
3. *Grounded armature.*
4. *Dirty or worn commutator.*

Let's review each of these failures.

OPEN ARMATURE CIRCUITS

An open circuit in the armature will cause severe arcing at the brushes and commutator. Another indication is when it requires twice the rated speed to attain the specified voltage and current.

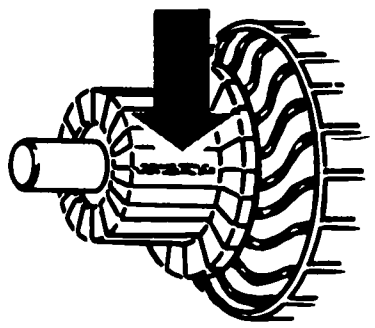


Fig. 25—Checking for Open Circuit in Armature

The broken winding can be found by inspecting the commutator (Fig. 25).

The trailing edge of the bar attached to the open loop will usually be badly burned as shown.

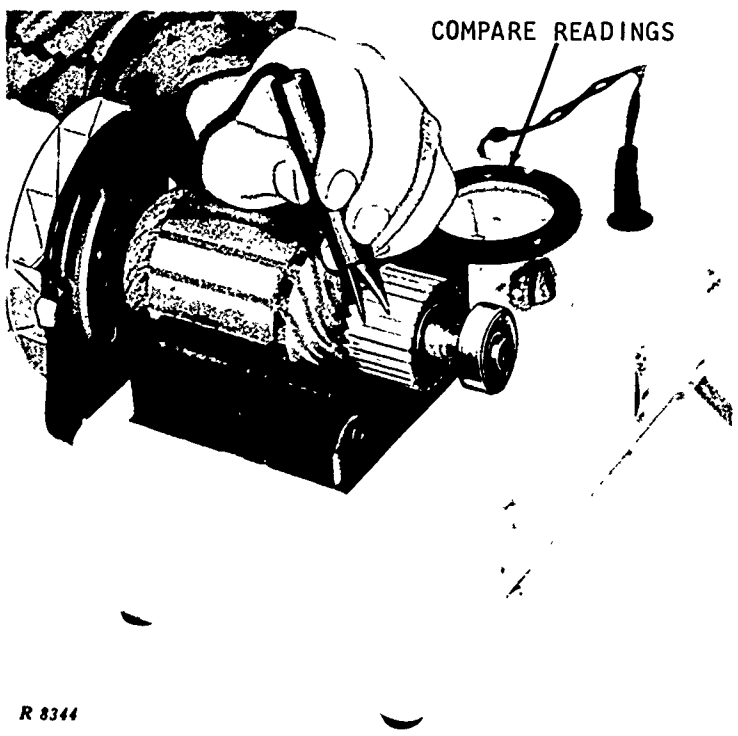


Fig. 26—Testing Armature for Open Circuit

Another method of finding the broken loop is with a combination test unit and growler (Fig. 26).

Place the test prods of the unit on two adjacent commutator bars. Rotate the armature to get the highest meter reading and record the reading.

Then turn the armature slightly and check two other bars. If one reading is lower than the others, that circuit is open.

SHORTED ARMATURE

Another cause of low generator output is a short-circuited armature. If the armature loops are touching each other, they set up a closed circuit and very little current can get to the external load circuit. The more loops shorted, the higher the speed required to obtain voltage and current. Long use of a shorted armature can create damage from overheating.

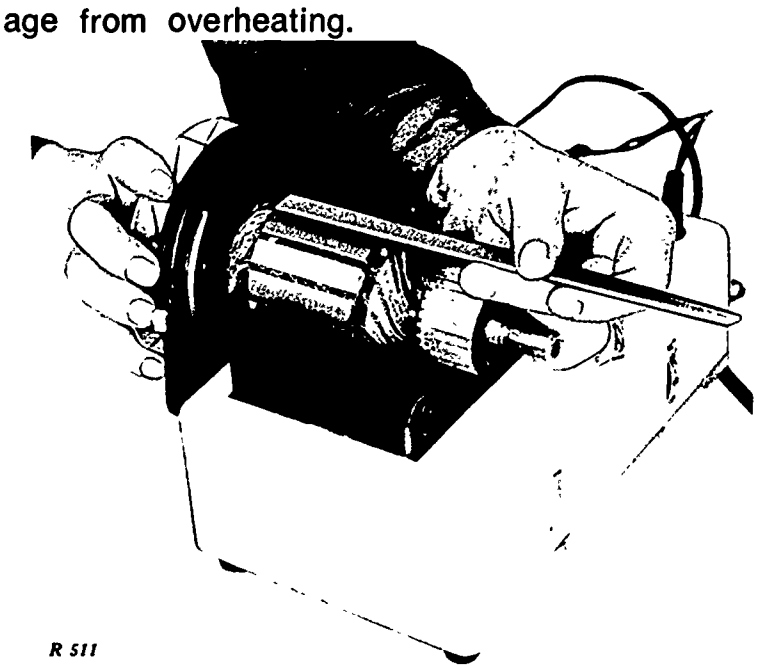


Fig. 27—Testing for Shorted Windings

Shorted windings can be found with the growler test unit (Fig. 27). The growler has an oscillating magnetic field which cuts across the armature loops, creating voltage and current flow through the shorted loops.

By holding a strip of metal such as a hacksaw blade over the armature and slowly rotating the armature in the growler, the magnetic field set up by the shorted windings will attract and release the metal strip. This will tell you that the armature is shorted.

GROUNDED ARMATURE

A grounded armature is another source of current loss. The armature is grounded when the winding is in contact with the ground. This bypasses the external load circuit and, since the grounded connection has low resistance, the remaining voltage is very low.

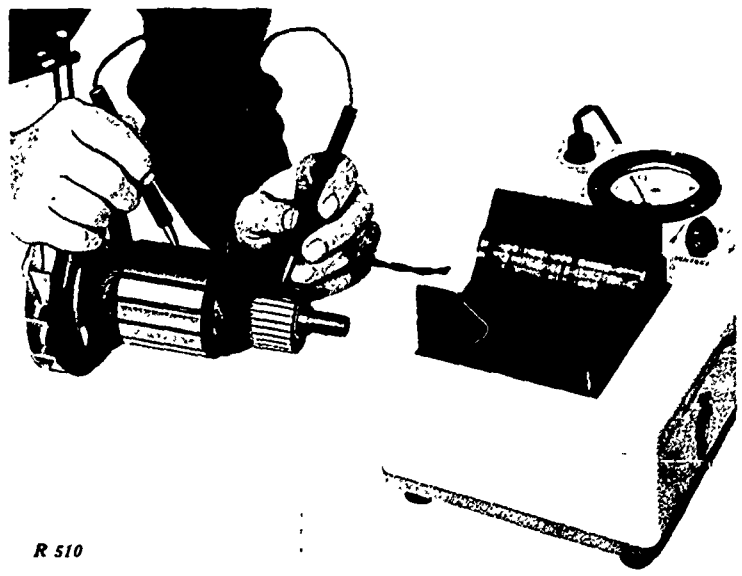


Fig. 28—Testing for Grounded Armature

To find a grounded armature, use the test lamp on the growler, if equipped (Fig. 28). Or use a separate test lamp.

Place one test prod on the metal of the armature and the other prod on the commutator. If the lamp lights, the winding is grounded.

DIRTY OR WORN COMMUTATOR CAUSING ARMATURE FAILURE

A dirty or oxidized commutator can cause symptoms that appear as if the armature were shorted or grounded.

Foreign material packed between the commutator bars can offer a path for current flow, thus shorting the armature loops.

A corroded commutator can prevent brush contact, thus prohibiting voltage development.

RECONDITIONING THE COMMUTATOR

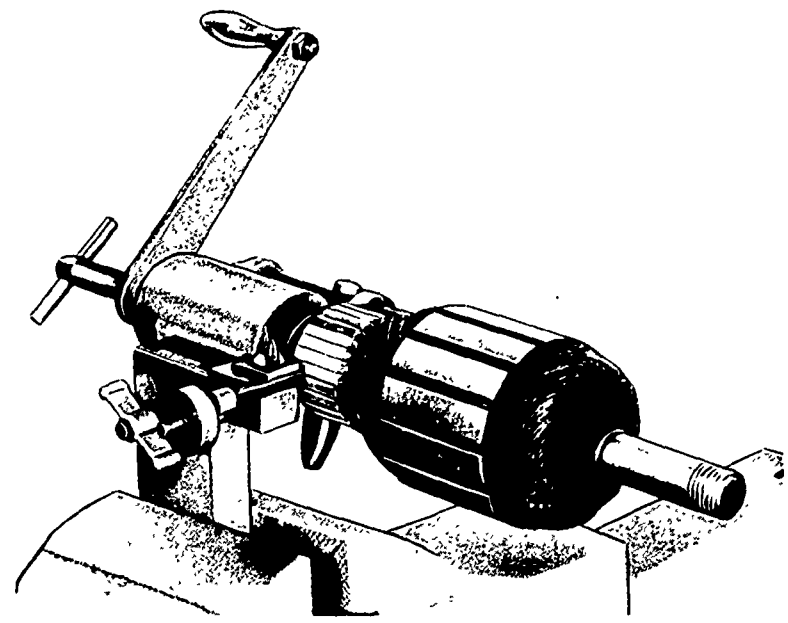
To correct this, turn down the commutator with an armature lathing tool (Fig. 29).

Also be sure to undercut the material between each bar as shown. This will prevent rapid brush wear due to bouncing or arcing brushes.

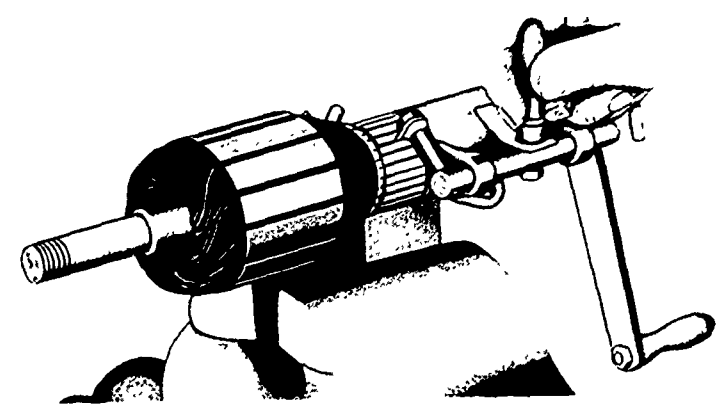
Use a strip of No. 00 sandpaper to polish the commutator. *Do not use emery cloth.*

Armature Repair

The commutator can be turned down with the proper tools. The armature, however, is seldom rewound in cases of shorts, opens, or ground.



X 1464 TOOL FOR TURNING DOWN COMMUTATOR



X 1465 UNDERCUTTING MICA ON COMMUTATOR

Fig. 29—Reconditioning the Commutator

Normally, it is replaced with another armature. Of course, if the proper tools and qualified personnel are available, then it can be repaired.

Field Circuit Tests

Like the armature, the field circuit can fail due to open, grounded, or shorted coils. It can also fail because of high resistance.

OPEN FIELD CIRCUITS

A broken coil or *open circuit* in the field circuit stops current flow.

This means the magnetic field cannot be strengthened and the amount of developed voltage is dependant on residual magnetism. This voltage is too low to supply the battery.

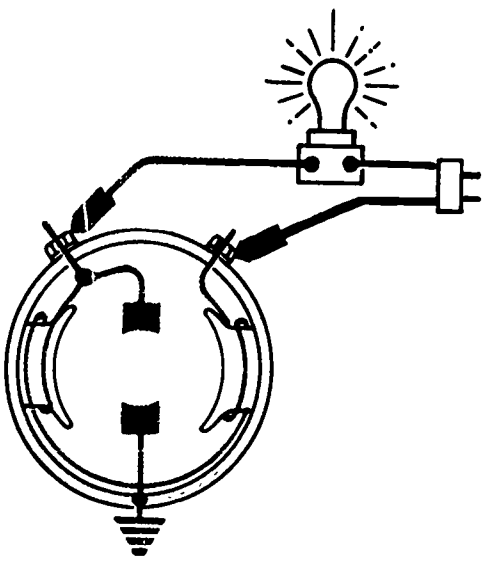


Fig. 30—Testing for an Open Field Circuit

Use a test lamp to find an open field circuit. Touch the prods of the lamp to the generator as shown in Fig. 30. If the lamp does not light, the field circuit is open. In this case, look for a broken wire in the coils or leads.

GROUNDED FIELD CIRCUIT

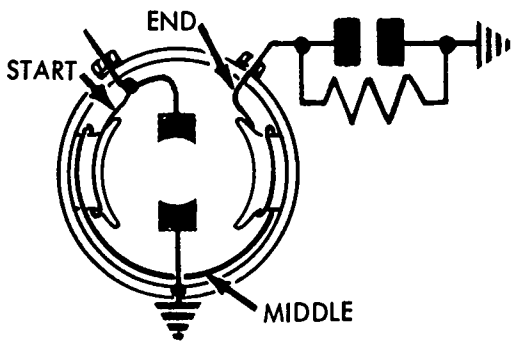


Fig. 31—Locating a Grounded Field Circuit

A *grounded field circuit* will have a different effect on generator output depending on where the ground is located (Fig. 31).

Let's assume that all circuits start at the insulated brush.

If the circuit is grounded before the coils, there will be no current flow through them. Therefore, the magnetic field will not be strengthened and no voltage will develop. In this case the armature will also be grounded since the field circuit is connected to the armature circuit.

If the field is grounded at the middle, the circuit will still build up voltage. However, with less resistance in the field circuit, more current will flow. The ground will bypass the regulating points and regulator resistance and there will be no control over voltage or current.

If the circuit is grounded after the coils, the circuit will react similar to the ground at the middle and there will be no control over voltage.

TESTING FOR A GROUNDED FIELD CIRCUIT

A test lamp is used to find out if the field circuit is grounded. All *intended* ground connections of the field circuit must be disconnected.

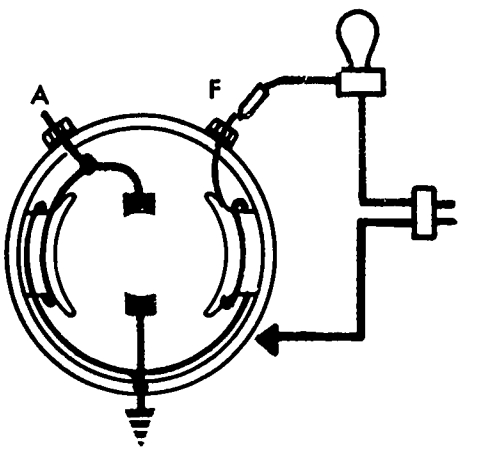


Fig. 32—Testing for Grounded Field Circuit

Place the prods of the test lamp as shown in Fig. 32.

If the lamp lights, the field circuit is grounded. Add this information to what is known about the effect a grounded circuit has on generator output, and you should be able to locate the grounded wire.

For a grounded circuit, either replace the field windings or repair them by reinsulating, revarnishing, and retaping.

SHORTED FIELD CIRCUIT

A *shorted field circuit* may cause excessive current flow. The number of shorted coils cuts resistance and so creates a higher current flow. This higher current can burn and oxidize the regulator points, creating an open circuit.

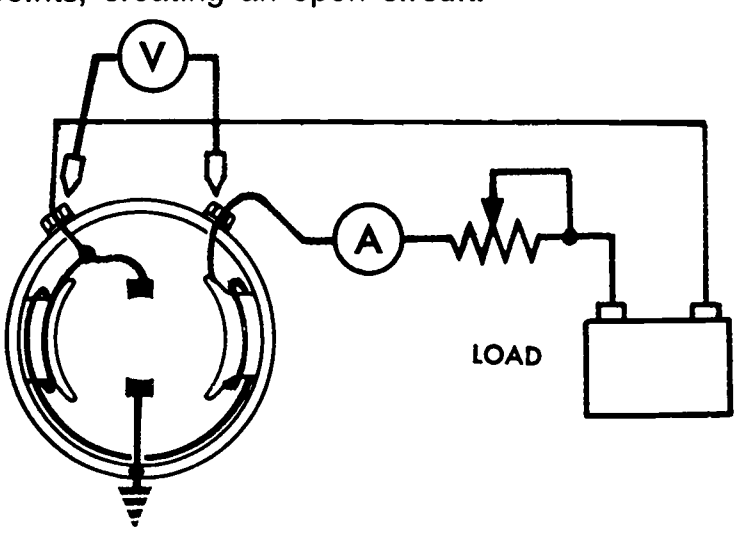


Fig. 33—Locating a Shorted Field Circuit

Use a volt-ampere tester with a 100-amp variable resistance unit for this test. Refer to the machine Technical Manual for the proper test readings.

1. Follow the test unit manual for the proper connections. (Fig. 33 shows a general hookup for the field circuit.)

2. Adjust the variable resistance unit so that the voltmeter reads the specified voltage as given by the technical manual specifications.

3. Measure the current flow by the ammeter. It should be the same as the Technical Manual specifications. Any difference between the reading and specifications, either way, indicates a bad field circuit.

If the current flow is more than specified, the field circuit is shorted.

If the current flow is less than specified, there is high resistance (a damaged wire or loose connection) in the field circuit. This high resistance cuts the magnetic field strength and so reduces the generator output.

In either case, repair or replacement of the field circuit coils is required. Fig. 34 shows a typical set of generator field coils.

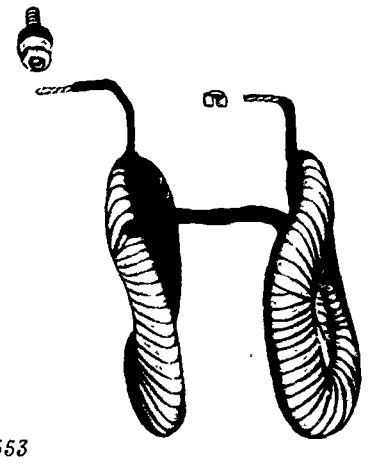


Fig. 34—Field Circuit Coils

Brush Testing

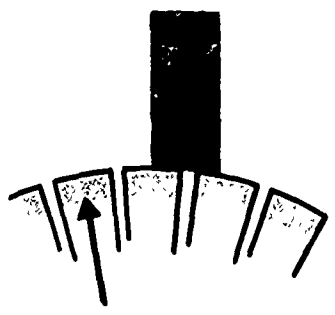


Fig. 35—Copper Oxide Film on Commutator

During normal operation a copper oxide film is formed on the commutator (Fig. 35). This film reduces the friction between the brushes and commutator. At low or no current loads, the film can be worn away by the brushes and the brushes will then chatter.

Continual brush chatter can loosen the brush lead, forming a high-resistance connection. Current will then follow an easier path through the brush surface and brush holders. This can eventually lead to burned brushes, brush holders, and brush arms.

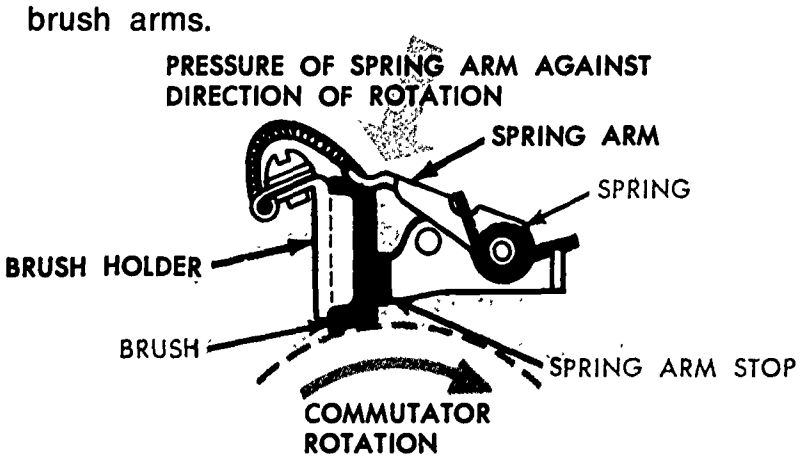


Fig. 36—Brush Arm Stop

A brush arm stop prevents the brush arm from pressing on the brush when the brush is worn away. However, the main purpose of the stop is to prevent the arm from scoring the commutator. But if the brushes are checked regularly for wear, this should never happen.

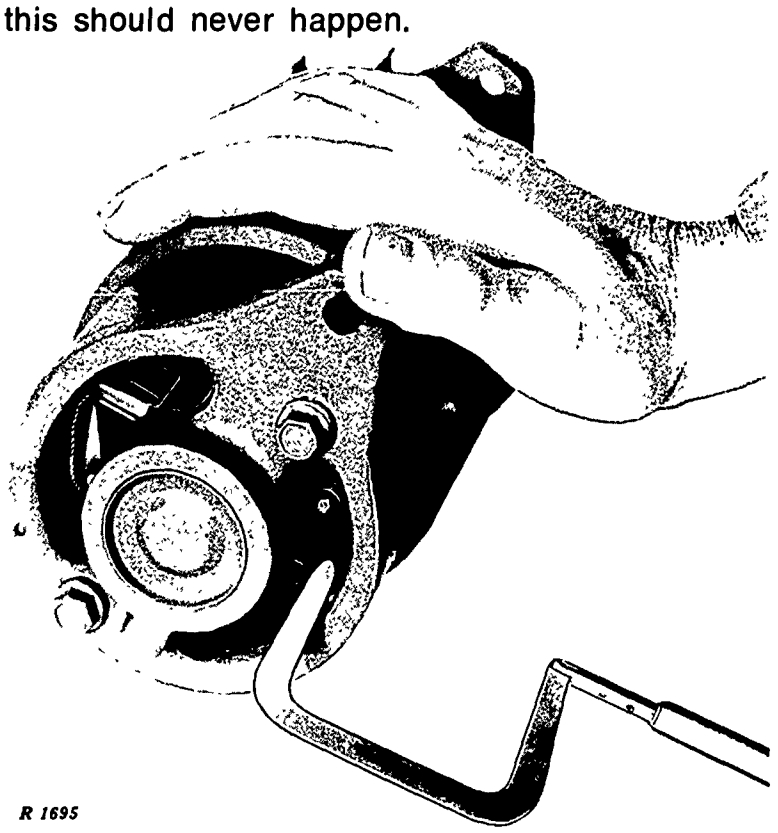


Fig. 37—Checking Brush Spring Tension

Brush arm spring tension should be checked during generator repair (Fig. 37). The Technical Manual can give you the proper tension specifications. Be sure to measure tension at a point as close to the middle of the brush as possible.

Too little tension will cause the brushes to bounce and arc at high speeds. Too strong a tension will cause excessive friction and brush wear.

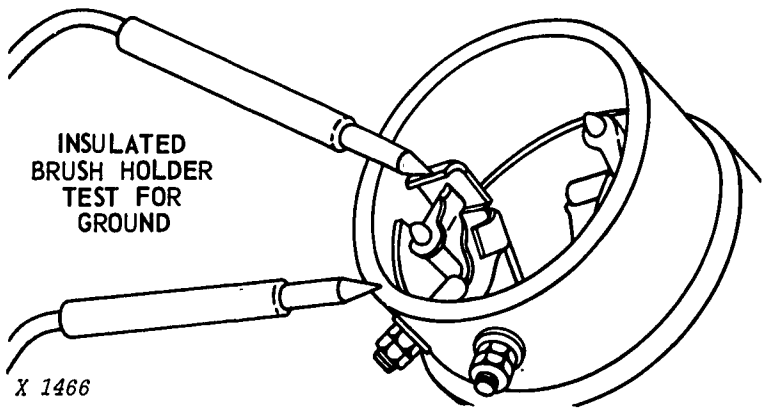


Fig. 38—Electrical Check of Brush Holders

To check for grounds, or opens on the brush holders, use a test lamp (Fig. 38).

Place the test prods across the *grounded* brush holder and the frame to check for opens. The lamp should light. If it does not, the brush holder is insulated from the frame and the circuit is open.

Place the lamp across the *insulated* brush holder and frame to check for grounds. The lamp should not light. If it does, a ground is indicated at the frame and the brush holder is grounded at this point.

Replacing Brushes

Replace the brushes when they have worn to one-half of their original length. When replacing brushes, be sure that a brush seat is obtained across the thickness of the brush. *A 25 percent contact area is satisfactory.*

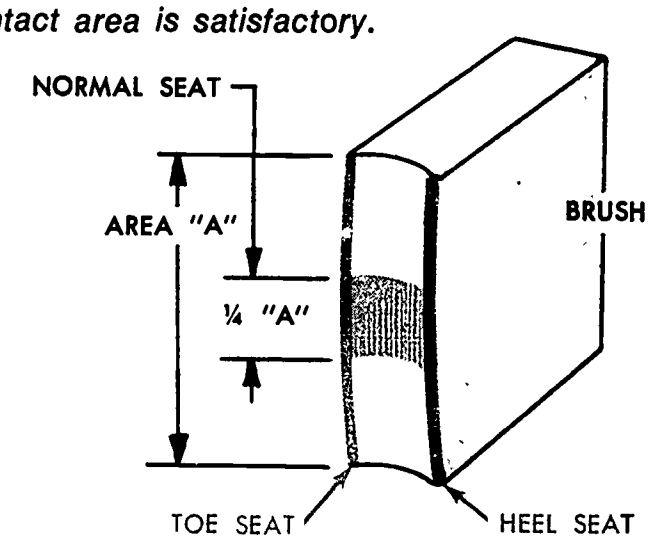


Fig. 39—Seating of Brush for Good Contact

If the brush seats only on the edges, this is not satisfactory regardless of whether it is a 25 percent contact.

Fig. 39 shows in color the bad heel and toe seats at the edge of the brush. The grey area at the center of the brush is a good seat. Seating on the edges will change the neutral position and severe arcing can occur.

Use seating stones or compounds to get a perfect fit between the brushes and the commutator.

POLARITY OF THE GENERATOR

Polarity is the direction of current flow through the generator. It is determined by the magnetic pole shoes. If the polarity of the pole shoes is changed, current flow will also change, regardless of whether other conditions change or not. Therefore, by changing pole polarity the generator can supply load current in either direction.

Pole shoe polarity is determined by the magnetism of the field coils the last time current passed through the coils. Anytime a current flows through the field coils, it sets the pole shoe polarity until the next time current flows.

This sets up a potential trouble spot. When working on or testing the generator you can accidentally change pole polarity. Even a slight current through the coils can do it.

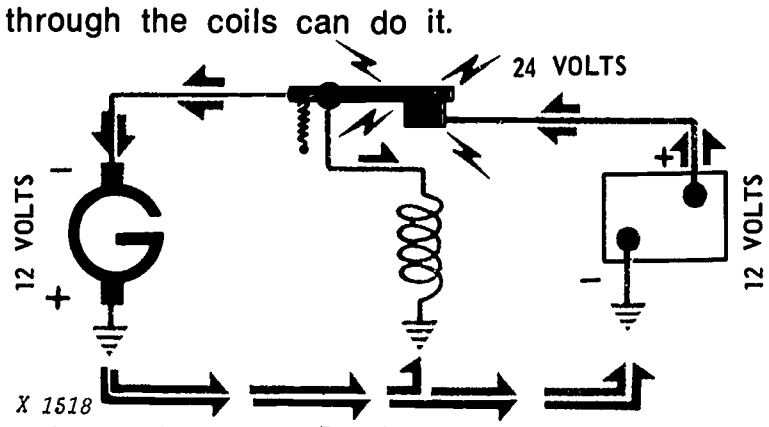


Fig. 40—How Reverse Polarity in Generator Damages the Charging Circuit

The damage does not occur until the generator, with a polarity opposite that of the battery, is put back into the charging circuit (Fig. 40).

When this is done, the generator builds up voltage and closes the cutout relay points. This, in effect, puts the battery in series with the generator and their voltages are added together. This high voltage across the points (about twice the system voltage) can create high current and enough heat to weld the points together as shown.

However, this damage does not happen immediately. The instant the points close, voltage is about the same on both sides of the relay coil. Since there is little difference in voltage, very little current will flow and spring tension opens the points.

But generator voltage will again close the points and the cycle is repeated. Because this action repeats very rapidly, heat and arcing will finally cause the points to weld together.

When the points do weld together, the battery and the generator are connected at all times. The low resistance in the generator allows the battery to continue to discharge into the generator. This develops a high current which creates enough heat to burn the armature, ruining it.

In summary, **after any service, polarize the d.c. generator.**

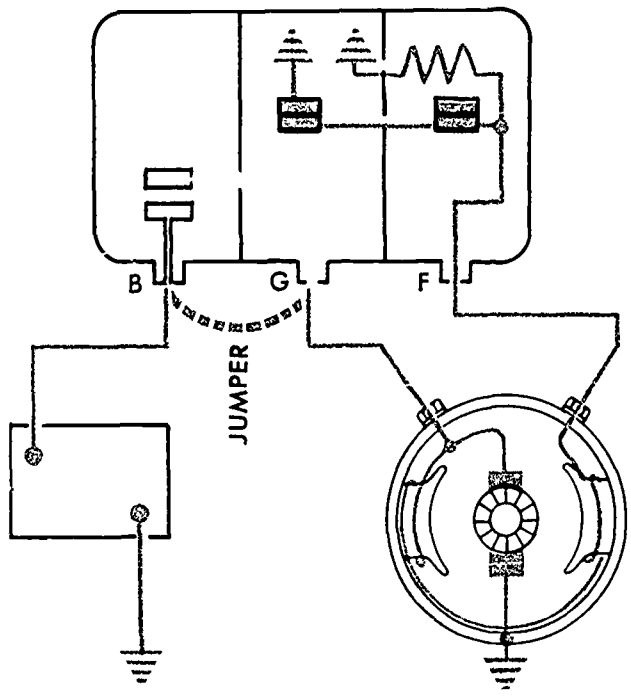


Fig. 41—Polarizing the Generator

Polarize the generator by connecting a jumper lead from the insulated side of the battery to the armature terminal as shown in Fig. 41. The battery, generator and regulator grounds must be connected. Just a touch of the generator lead between the "BAT" and "GEN" terminals of the regulator will cause current to flow in the proper direction in the field coils. A flash or arc will be noted when the lead is removed.

On high-voltage generators it is best to insulate the brushes. This will allow current to flow only through the field coils.

Summary: Polarity of Generators

The correct polarity of the d.c. generator is very important. A good rule to follow is to pass current through the field coils in a direction that will have the grounded side of the coils connected to the grounded side of the battery.

GENERATOR REGULATORS

The **d.c. regulator** is the *control for the generator.* Otherwise, the generator would produce too much current and voltage at high speeds. Or the battery would discharge back through the generator at low speeds.

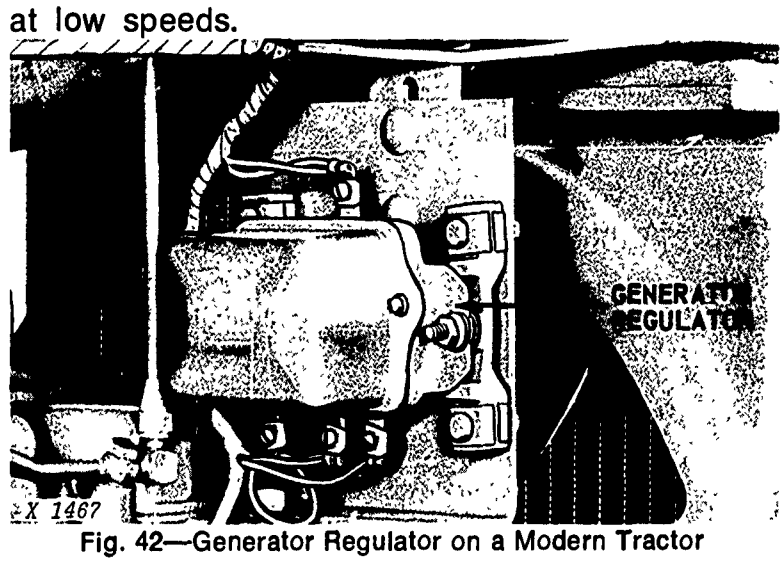


Fig. 42—Generator Regulator on a Modern Tractor

The "regulator" is really a combination of three functions:

- **Cutout Relay**
- **Voltage Regulator**
- **Current Regulator**

The CUTOUT RELAY (Fig. 43) *prevents battery discharge.* It closes the circuit between the generator and battery when the generator starts charging and breaks the circuit when the generator stops charging.

The VOLTAGE REGULATOR limits the *voltage* output of the generator and so prevents overheating.

The CURRENT REGULATOR limits the *current* output of the generator.

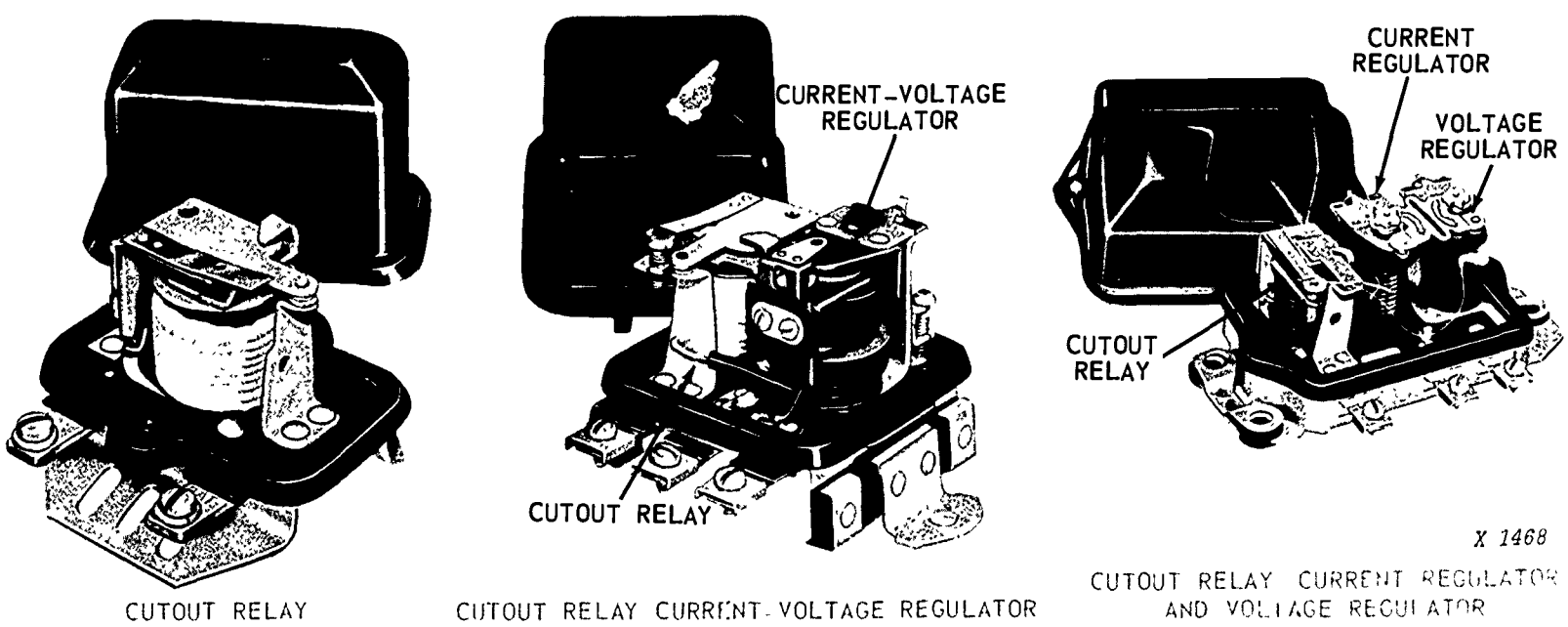


Fig. 43—Generator Regulators—Three Types

The last two regulators work at separate times as we'll see later. Both control the generator's output by varying the strength of its magnetic field.

Regulators may have one, two or three of these features combined in one unit (Fig. 43).

All three of these devices operate by electromagnetism and are very similar in operation and appearance.

Let's see how each specific function works in the charging circuit.

CUTOUT RELAY

The main purpose of the cutout relay is to open and close the circuit between the generator and the battery.

The cutout relay operates, as do all the regulator units by **electromagnetic induction.** What happens is that current flow through a coil of wire wound around an iron core magnetizes the core. The strength of this magnetism is determined by the strength of the current and the number of turns in the coil.

NOTE: The voltage and current regulators also operate on this same principle.

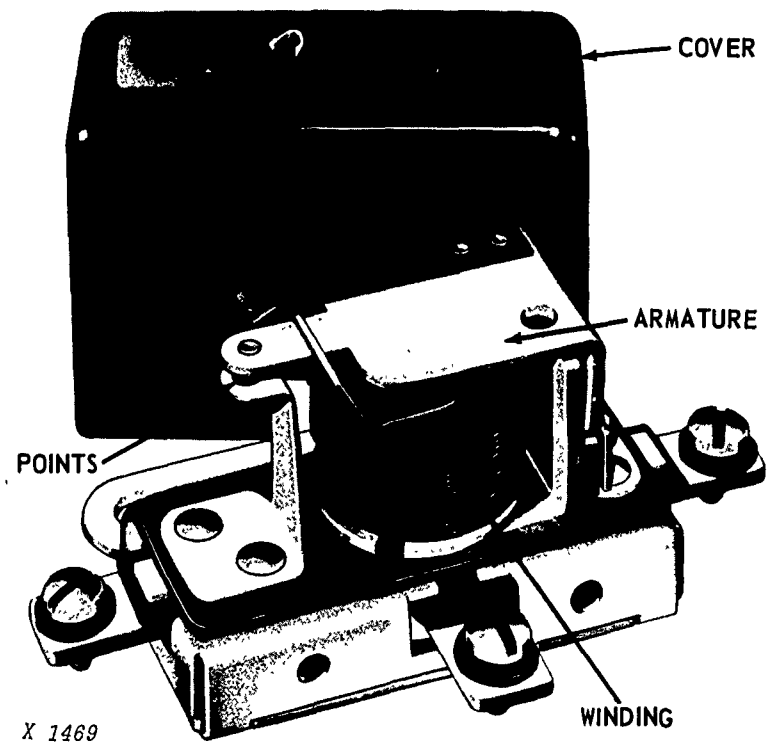


Fig. 44—Cutout Relay

Fig. 44 illustrates the physical features of the cutout relay. The relay consists of: two windings, one heavy and one fine, one iron core, a hinged flat metal piece called the armature and a stationary contact point.

The **heavy** winding, called the current or **series winding,** is wound around the core. One end is attached to the relay armature and the other end is connected to the charging circuit.

The **fine** winding is the voltage or **shunt winding.** One end is also attached to the relay armature. The other end is connected across the generator so that generator voltage is impressed on it at all times.

The relay armature is mounted above the core, but does not touch it. It is hinged at the back and is held away from the core by spring tension.

A contact point on the armature is aligned directly above the stationary contact point, which is connected to the battery by wire.

Operation of Cutout Relay

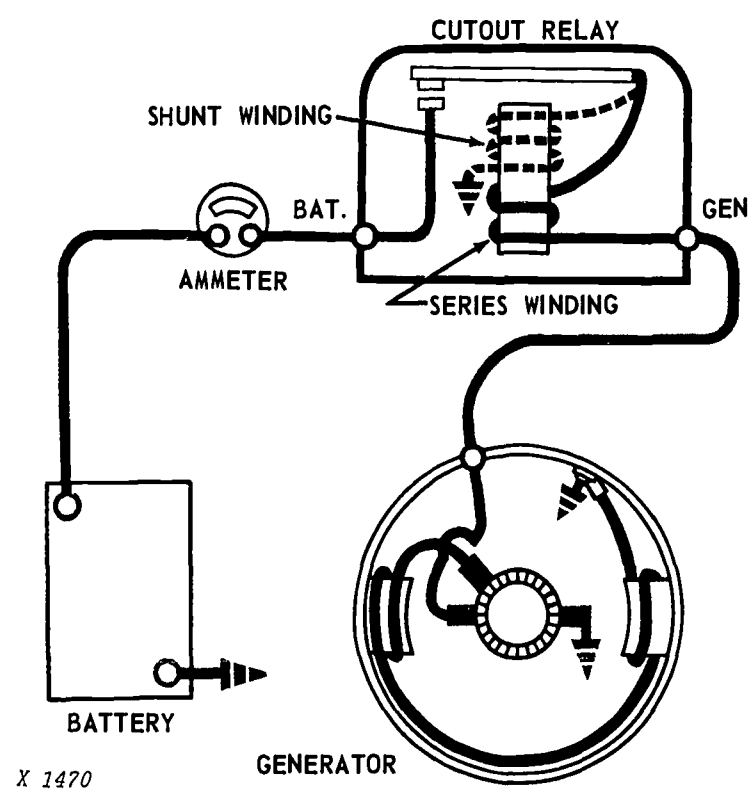


Fig. 45—Cutout Relay in Charging Circuit

As the generator builds voltage, current flows through the cutout windings, creating a magnetic field in the core. This magnetism pulls the armature toward the core and the two contact points close. The circuit between battery and generator is completed. Current then flows through the series winding to the battery (Fig. 45).

When the generator slows or stops, battery voltage becomes greater than generator voltage. Current then begins to flow from the battery to the generator.

With current flow reversed, polarity of the series winding is reversed. The shunt winding polarity remains the same, however.

The two opposing fields reduce the strength of the magnetism and the armature point is released

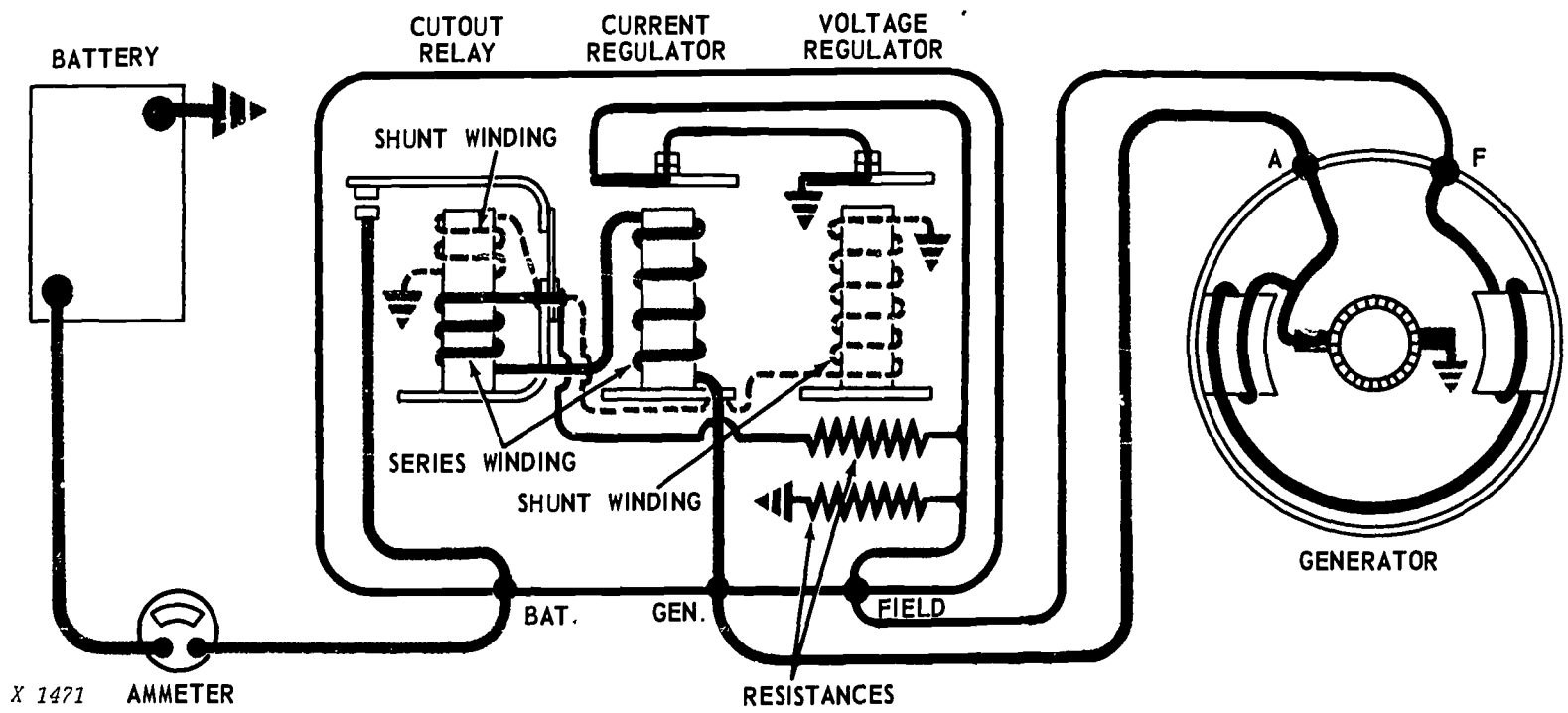


Fig. 46—Voltage Regulator with Single Winding

from the stationary contact point by spring action. This opens the circuit and stops current flow from the battery to the generator, and so prevents battery discharge.

VOLTAGE REGULATOR

As we said earlier in this chapter, the voltage regulator's main function is to regulate the generator magnetic field. In this way, the voltage build up in the generator is controlled.

The appearance of the voltage regulator is similar to the cutout relay. Like the relay, it has an iron core, flat hinged armature, and stationary contact point.

However, the position of some of these components is different, as are the type and number of windings on some models.

The armature is hinged on top, and the armature contact point is directly below the stationary contact point. Spring tension holds the points together when the regulator is not operating, and is provided by an adjustable spiral spring at the back of the regulator.

The hinge on the voltage regulator armature is made of two thermostic materials to allow for changing temperatures. This causes the regulator to regulate at a higher voltage when cold.

Types of Voltage Regulators

Two types of windings are used on standard voltage regulators.

- **Single Winding**
- **Accelerator Winding**

The SINGLE WINDING type has only *a shunt* winding of fine wire (Fig. 46.) This winding is connected across the generator. When the generator reaches a specified voltage as determined by the regulator, the magnetic field created by current flow through the winding draws the armature contact point away from the stationary contact. This opens the contact circuit and inserts resistance into the generator field circuit. The result is a reduction of voltage and current output in the generator.

Reducing the voltage and current reduces the magnetic attraction in the shunt winding. This allows the spring to pull the armature point back into contact with the stationary point. The generator field circuit is then grounded and voltage and current increases to the preset point.

The cycle then starts over again and is repeated many times a second. This is the method used in regulating generator voltage to a predetermined value.

The second type of regulator is the ACCELERATOR WINDING type (Fig. 47). It is equipped with the same components as the first type and has an added winding called an accelerator winding. This is a *series* winding of heavy wire.

Operation is basically the same as the first type except at a faster rate of speed.

In a sense, the series winding or coil, connected to the generator field circuit, helps the shunt winding create a stronger magnetic field faster. This draws the two points out of contact quicker.

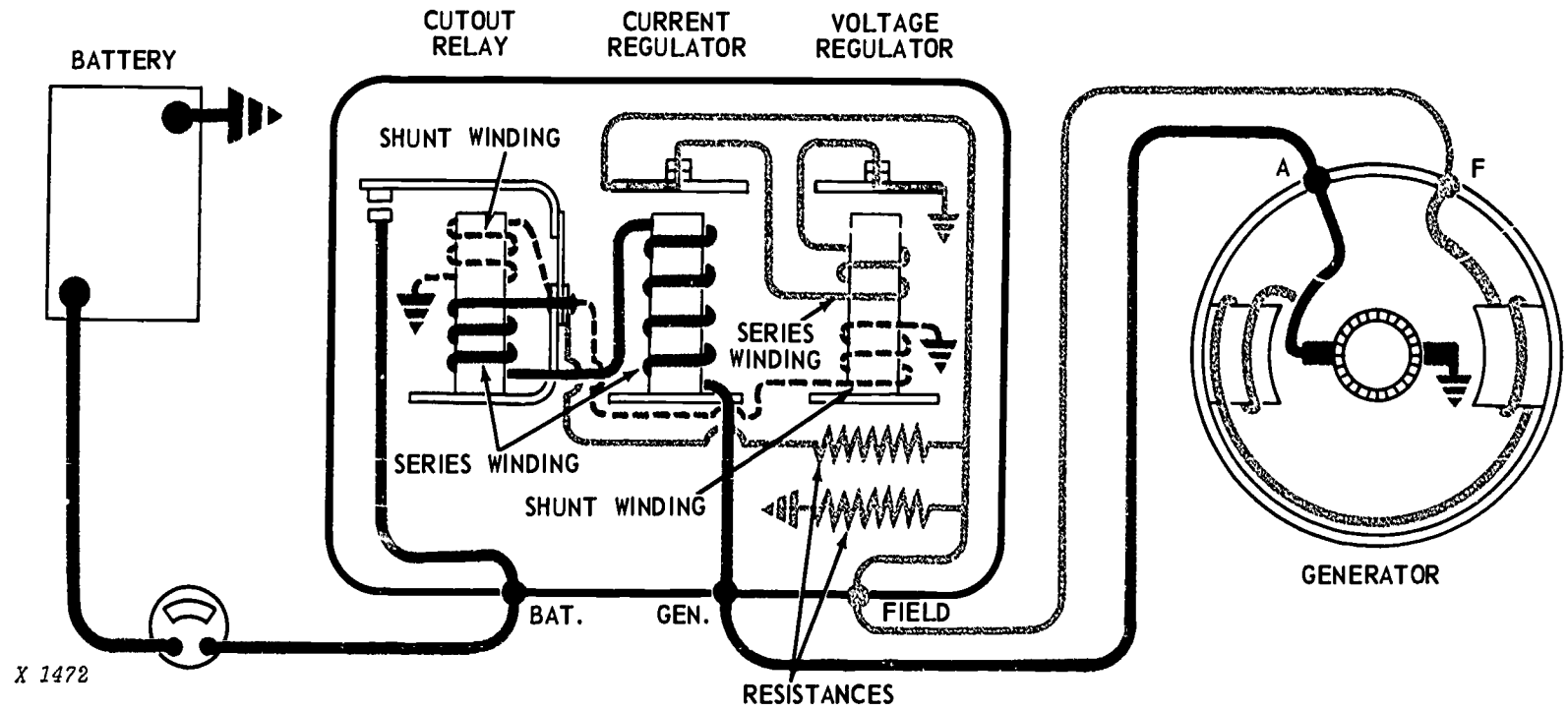


Fig. 47—Voltage Regulator with Accelerator Winding

The same speed causes the series coil magnetic field to collapse faster. When the armature point is suddenly released, it closes the circuit with the stationary point. The cycle is again repeated at a fast rate.

Voltage regulated in this manner allows the generator to supply varying amounts of current as needed by the battery and load circuits.

CURRENT REGULATOR

The **current regulator** controls the *current* output of the generator.

The current regulator looks the same as the single-winding voltage regulator. However, the current regulator winding is a *series* coil of heavy wire. The coil is connected into the generator armature or load circuit and carries the entire generator current output.

During a heavy load, such as a discharged battery and use of electrical accessories, voltage may not increase enough to actuate the voltage regulator. In these cases, the generator output will continue to increase to meet this demand. To limit this output to a safe point, the current regulator steps in.

As the output reaches a point as determined by the regulator, the magnetism of the regulator series coil draws the armature point toward the coil assembly. This breaks the contact between the two points. Resistance is then inserted into the generator field circuit and so the generator output is reduced.

This reduced output cuts the magnetism in the current regulator coil. Spring tension then draws the points back into contact and the generator field is directly connected to ground. The output again increases and the cycle is repeated as long as there is a heavy load.

As soon as the load is reduced (the battery is fully charged or the accessories are turned off) the voltage will increase. The *voltage* regulator then operates and gradually reduces the output. With the voltage regulator operating, there is no need for current regulation and the current regulator points remain in contact.

When one regulator is working, the other is not. Both will not operate at the same time.

HOW THE THREE REGULATORS WORK TOGETHER

Now that we have described the three generator regulators separately, let's take a look at the three operating as a unit.

Fig. 48 shows the three regulators in one unit operating in the charging circuit.

Shown in red are the series windings of the cutout relay and current regulator. In dashed red are the shunt windings in the cutout relay and voltage regulator. And in blue are shown the field circuit and the resistors.

When the generator begins to operate, it must recharge the battery. Two of the three units, the cutout relay and current regulator, perform in this operation.

The current flows from the generator armature into the series coil of the current regulator. From there it flows into the relay series coil, through the closed relay contact points and into the battery.

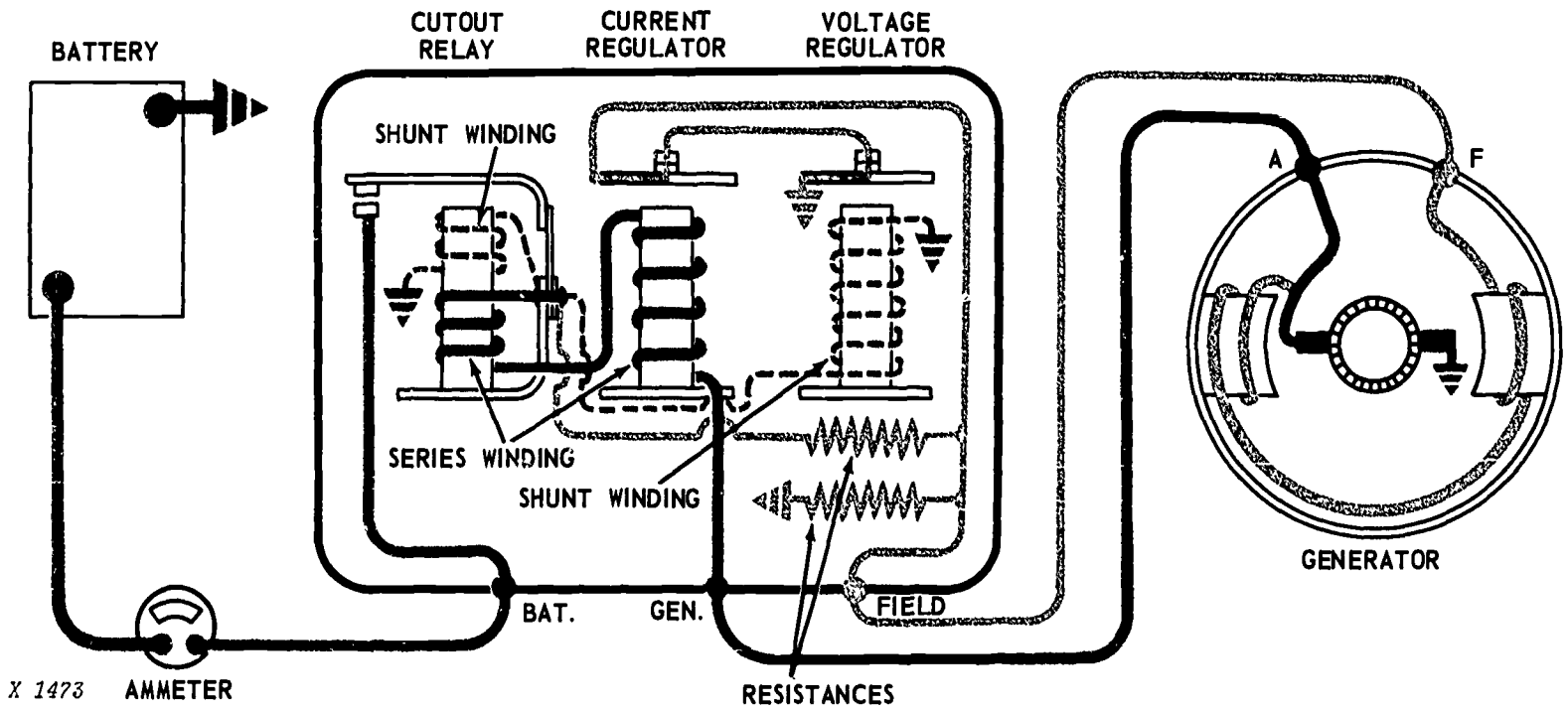


Fig. 48—Operation of All Three Generator Regulator Units

When the battery has been satisfied or the load has been reduced, less current flows and the voltage rises. Then the voltage regulator goes into action, controlling generator field current and voltage.

When the engine stops, current from the battery flows back through the cutout series winding and reverses the polarity of its magnetic field. This causes the cutout points to open and disconnect the generator from the battery.

REGULATOR RESISTORS

The regulator also uses two common resistors. Both are fixed beneath the base of the regulator.

One resistor is inserted into the field circuit when either current or voltage regulator is used.

The second resistor is placed between the regulator field terminal and cutout relay frame.

The resistors are used to reduce a sudden voltage surge in the field coils caused by opening contacts. This prevents excessive arcing at the contact points.

VARIATIONS ON BASIC REGULATORS

As we said earlier, the three regulators are combined as units in some uses.

Let's discuss the major variations.

Current-Voltage Regulator

This unit combines the current and voltage regulators into one regulating unit (Fig. 49).

It is an economical means of controlling both generator voltage and output simultaneously.

However, the current-voltage regulator is limited to machines having low electrical load.

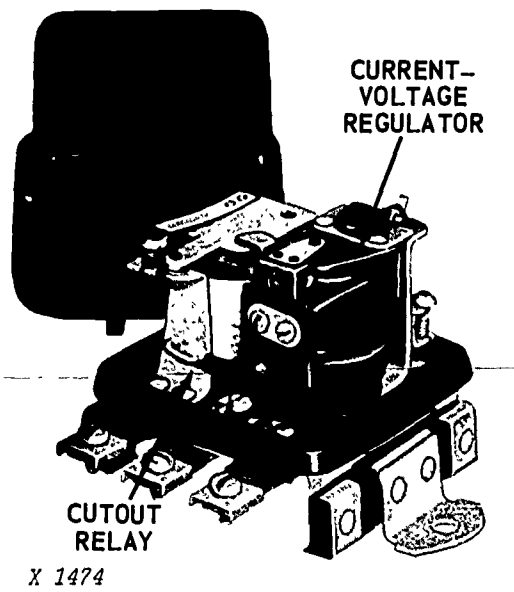


Fig. 49—Current-Voltage Regulator

As you can see in Fig. 49, this regulator also has a cutout relay. Basically this is a standard type cutout relay we discussed earlier in this chapter.

In many respects, the current-voltage regulator unit of this regulator is similar to the voltage regulator in a standard 3-unit regulator. It is equipped with a hinged armature, iron core, stationary contact point, and adjustable spiral spring.

The major differences between this unit and other regulators are the number of windings and their operation.

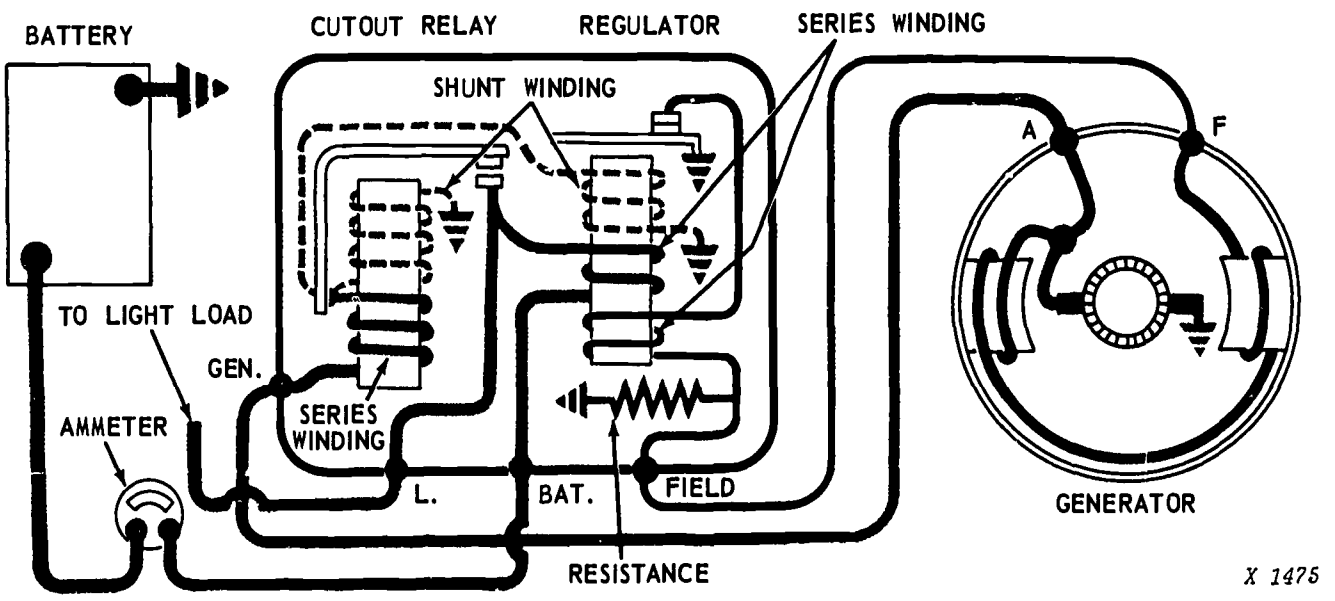


Fig. 50—Current-Voltage Regulator Operation

The current-voltage regulator employs *three windings*—a shunt and *two* series (Fig. 50). The shunt winding is of fine wire and is connected across the generator to receive generator voltage at all times. One series winding is of heavy wire and connected to the charging circuit. The other series winding is of a relatively heavy wire and is connected in series with the generator field circuit when the regulator contact points are closed.

In Fig. 50, the shunt winding in the cutout relay and the current-voltage regulator unit are shown in dashed red. The charging circuit series windings are shown in solid red. The field circuit series winding is shown in blue.

OPERATION OF CURRENT-VOLTAGE REGULATOR

As generator voltage builds, it causes current to flow through the cutout relay and into the regulator charging circuit winding and on into the battery. At the same time, voltage sensed in the regulator shunt winding causes some current to flow in it.

The two magnetic fields created by this current draw the regulator armature toward the iron core and opens the contact points. Field current is now diverted to ground through a resistor. This causes a drop in generator voltage and output.

A voltage drop, of course, reduces current flow through the windings and the magnetic field is weakened. Spring tension is then able to pull the armature point back into contact with the stationary point. This completes the field circuit and again the generator voltage and current output increase. This cycle is repeated many times a second as long as the generator and regulator are operating.

The field current series winding acts as an accelerator winding in that it helps to speed up the regulating cycle. When the regulator points are closed, field current flows through this winding, creating another magnetic field.

This added magnetic force helps to open the points faster. However, when the points open, field current flow stops and this field suddenly collapses. This, in turn, reduces the total magnetism enough to close the points quickly. The result is a faster regulator armature action rate.

In this way, the regulator controls *both* the generator voltage and current output.

One feature of current-voltage regulator operation is that as the charging rate increases, regulated voltage drops. This means that the higher the current flow to the battery, the lower the regulated voltage and vice-versa.

CURRENT-VOLTAGE REGULATOR TERMINALS

We have mentioned that this unit is limited to use in low-output, low load systems. An example is a diesel engine whose load requirements are only for battery recharging and occasional starting.

However, we don't want to rule out the ability of the current-voltage regulators to control more load than this. Because of another feature, it can handle some extra load such as lights or ignition.

The added feature is the extra terminal which this unit has (Fig. 51). It is a *load terminal,* mounted on the base of the regulator, where the battery terminal is on a 3-unit regulator. The "L" stamped on the terminal stands for "load."

The load terminal is connected to the stationary point of the cutout relay. It allows current from the generator to be diverted to a load, such as

lights or ignition, without first passing through the current-voltage regulator. As a result, this current has no effect on the operating voltage and the regulator is only affected by current to and from the battery.

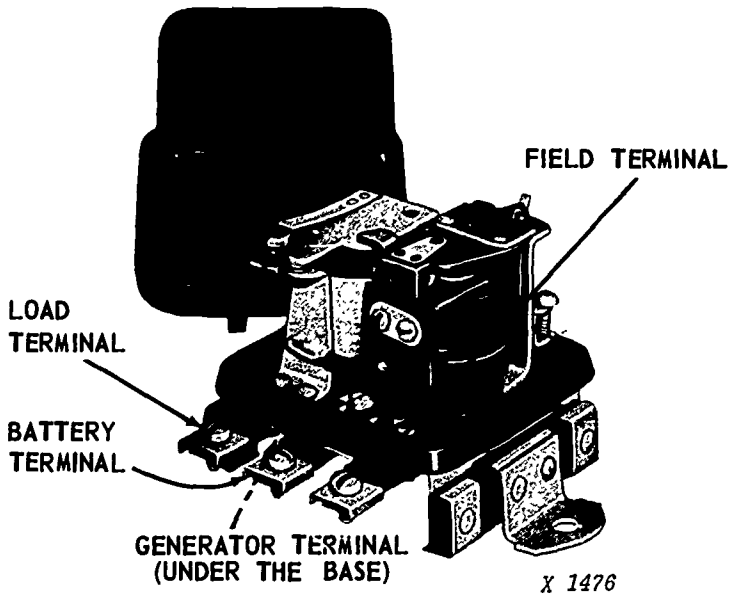


Fig. 51—Terminals on Current-Voltage Regulator

When the generator is not working and the lights are used, battery current will flow through the regulator winding and the "L" terminal to load. Any load that exceeds the generator output must be connected to the battery in the system.

Heavy-Duty Regulators

The heavy-duty regulator is very similar to the 3-unit standard regulator. It is usually used with a high output or split field generator.

This type of installation is usually found on heavy equipment, such as trucks, where high loads in a wide range of speeds are required.

Heavy-duty regulators have special features such as double contact points, fiber insulating brackets on the stationary points, and added resistors for better control.

Double Contact Generator Regulator

The cutout relay and current regulator parts of this unit are the same as used on the standard 3-unit regulator.

However, the voltage regulator is different from the standard voltage regulator. It has an extra set of contact points. One of the points is on an extra armature which is over one of the stationary contact points. The other point is on the top of stationary contact point frame.

During normal operation the lower set of contact points operate like those on a standard voltage regulator.

But during high generator speeds and low loads, the voltage control shifts to the upper set of points. This connects the normally grounded end of the field circuit to the generator output circuit, shorting out the coils to control the generator voltage.

TESTING AND ADJUSTING THE D.C. REGULATOR

Before testing and adjusting the d.c. regulator, take these preliminary steps:

1) Check out the whole charging circuit to isolate the component which is failing.

2) Start with a **visual** *check of the circuit components, lead wires, and connectors.*

3) Then make an **electrical** *check, using a voltmeter, ammeter, tachometer, and resistance unit.*

Preliminary Test Procedures

Once the problem has been traced to the regulator, take the following preliminary steps and precautions:

1. First make sure that the specified regulator is being used—one that is of the proper polarity. Most regulators are stamped on the base with a "P" for positive or "N" for negative.

2. Clean the contact points and make any minor adjustments outlined by the regulator or machine technical manual. Quite often this will correct the regulator problem.

3. Mechanical tests and adjustments should be made with the battery disconnected and the regulator out of the circuit.

CAUTION: Never close the cutout relay points by hand while the battery is connected. High current flow from the battery can damage the regulator.

4. Electrical checks and adjustments can be made with the regulator in or out of the circuit. However, the checks must be made with the regulator in operating position and the regulator cover in place.

5. Be sure to warm up the regulator to normal operating temperature before making the electrical tests. Do this by operating the regulator for 15 minutes with a ¼-ohm resistance in series with the battery. The regulator cover must also be in place. No electrical load other than ignition should be used during testing.

6. Speeds during the tests should be as specified by the Technical Manual.

7. The circuit must be polarized after each test or adjustment and before the engine is started. To do this, connect a jumper wire, momentarily, between the battery and generator regulator terminals.

8. Be sure to use the regulator service manual or the machine's Technical Manual. It will list all the necessary specifications and testing and adjustment procedures. A complete knowledge of the regulator components and operation is also necessary. Quite often an improper adjustment will do more damage than no adjustment at all.

9. Though the regulator can be electrically adjusted on the machine, it is better to remove it and its generator to the bench for servicing.

The first part of this chapter listed some general problems caused by a malfunctioning generator. Unfortunately, a faulty regulator can also create these same problems.

Let's assume that we have checked and found the generator and battery operating properly. Now we'll see how the *regulator* can cause these problems.

Regulator Trouble Shooting Chart

LOW CHARGING RATE—
FULLY CHARGED BATTERY

Regulator operation is normal.

LOW OR NO CHARGING RATE—LOW BATTERY

Low regulator setting. Burned or oxidized contact points, or open series circuit in the regulator.

HIGH CHARGING RATE—
FULLY CHARGED BATTERY

Improper voltage regulator setting. Defective voltage regulator unit, or grounded generator field circuit in the regulator.

HIGH CHARGING RATE—LOW BATTERY

Regulator operation is normal.

Sequence of Testing Regulator Units

The generator regulator should be tested and adjusted in the following sequence:

- *Check the voltage regulator first.*
- *Next check the cutout relay.*
- *Check the current regulator last of all.*

Always remember to bring the regulator units up to operating temperature. This gives the best testing results.

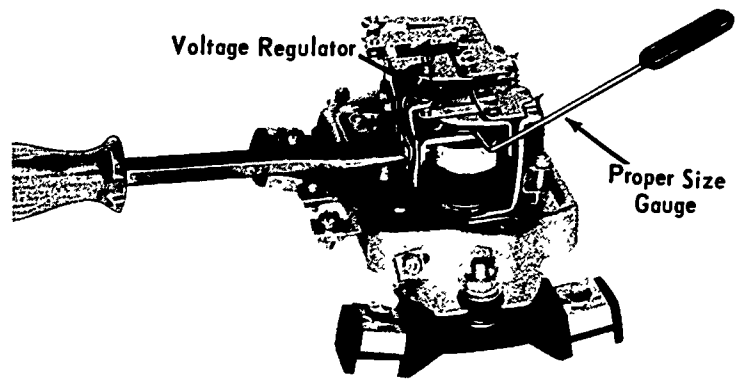
Voltage Regulator Tests and Adjustments

Two tests—air gap distance and voltage setting —are performed on the voltage regulator.

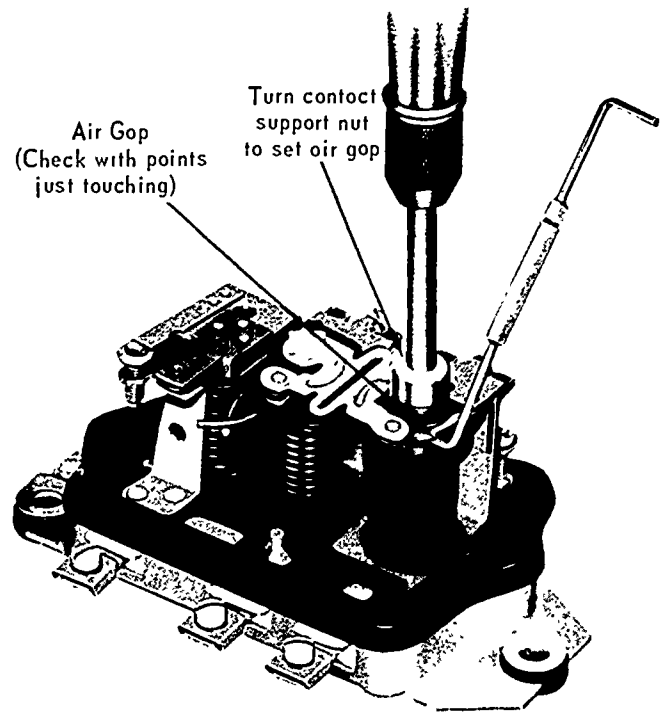
AIR GAP TEST

The *air gap* between the regulator armature and windings is an important mechanical adjustment. Remember that the air gap in a magnetic circuit acts as a *resistance*. Therefore, the greater the gap between armature and windings, the more magnetic force and so current needed to draw the armature down.

To measure the air gap, push down on the armature until the points are just touching. Then measure the gap between the armature and the core. The distance should be as specified by the Technical Manual.



STANDARD VOLTAGE REGULATOR X 1477



X 1478 POST-TYPE VOLTAGE REGULATOR

Fig. 52—Checking and Adjusting Air Gap in Voltage Regulators

Adjust the gap as shown in Fig. 52. On some regulators, a screw post at the top of the unit is adjusted to lengthen or shorten this distance.

VOLTAGE SETTING TEST

There are two methods for checking the voltage setting:

1) Fixed resistance method

2) Variable resistance method

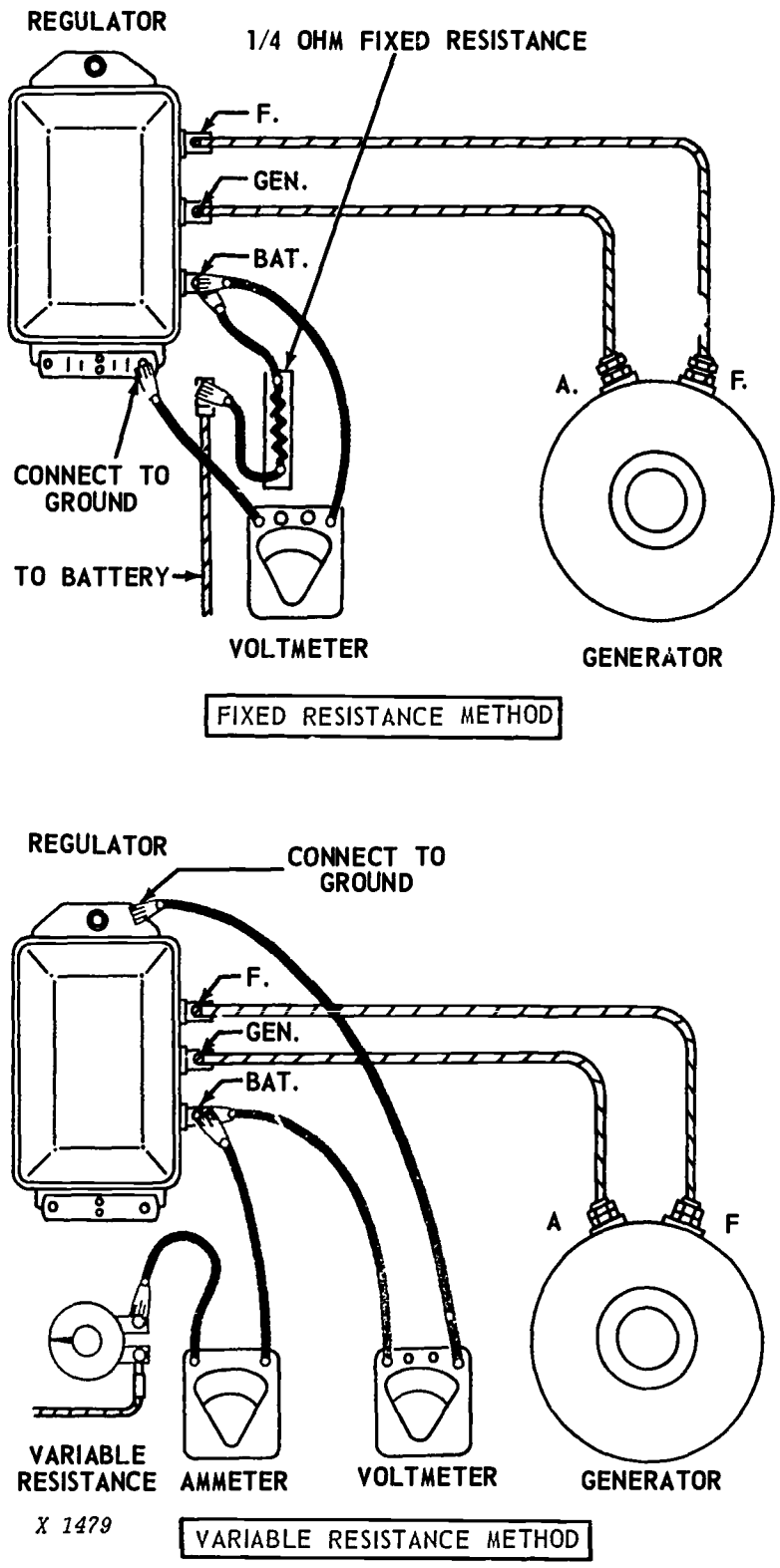


Fig. 53—Checking the Voltage Setting of Voltage Regulator

Fig. 53 shows how to make either check. Details are given below.

Fixed Resistance Method

1. Insert a ¼-ohm fixed resistor into the charging circuit at the battery terminal. (See Fig. 53, top.)

2. Connect a voltmeter from the battery terminal to ground.

3. Operate the circuit for 15 minutes at specified speed to warm it up. (See step 5 of "Preliminary Test Procedures.")

4. Cycle the generator by one of two methods: a) Slow it down until voltage drops to about ¼ of rated value. Then increase speed and note the voltage reading. b) Or cycle the generator by inserting a variable resistance into the field circuit. Slowly increase resistance until voltage drops to about ¼ of rated value. Decrease the resistance and note the voltage reading.

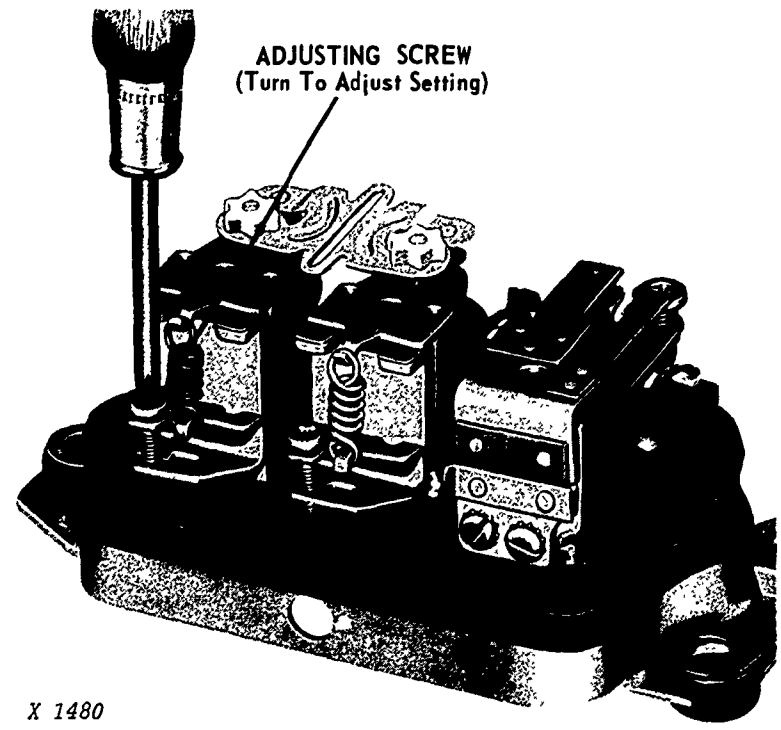


Fig. 54—Voltage Setting Adjustment

5. Adjust the voltage setting by turning the adjusting screw as shown in Fig. 54. If the adjusting screw is turned to its limits, it may be necessary to bend the spring support. However, do this very carefully.

Final adjustment should always be made by increasing the spring tension. If the setting is too high, adjust the unit below the specified value and then bring it back to this value by increasing the spring tension.

After each adjustment and before taking a reading, replace the cover and cycle the generator.

Variable Resistance Method

1. Connect a variable resistor and an ammeter into the charging circuit at the battery terminal. (See Fig. 53, bottom.)

2. Connect a voltmeter from the battery terminal to ground.

3. Start generator and adjust resistor to get a current flow of not more than 10 amperes. Operate the generator at specified speed to warm it up. (See step 5, "Preliminary Test Procedures.")

4. Cycle the generator as described in step 4 of fixed resistance method above.

5. Adjust the voltage setting as described in step 5 of the fixed resistance method.

ADJUSTING VOLTAGE FOR TEMPERATURE

The voltage reading should be corrected to allow for the ambient temperature around the regulator. See the machine Technical Manual.

A typical correction for a 12-volt regulator is 0.15 volts for every 10 degrees over or under 125° F. Add to the reading if over, or subtract if under 125° F.

For a 6-volt regulator, the correction factor may be 0.075 volts. On 24-volt regulators, 0.3 volts is a typical correction.

On voltage regulators with an accelerated winding or a series current winding, test at a specified amperage output because the windings affect the voltage of the test.

Cutout Relay Tests and Adjustments

There are three checks and adjustments on the cutout relay:

1) Air gap

2) Point opening

3) Closing voltage

The point opening and air gap tests must be made with the battery disconnected from the regulator.

AIR GAP CHECK

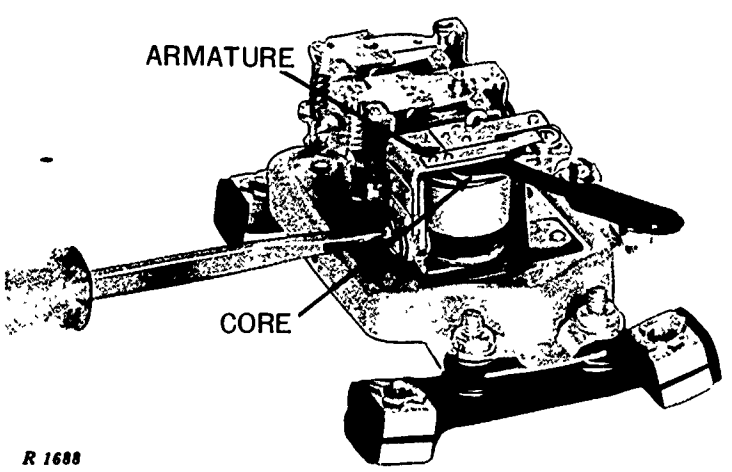


Fig. 55—Air Gap Adjustment of Cutout Relay

Push the cutout armature down until the points are just touching. Measure the air gap between the armature and the center of the core using a feeler gauge (Fig. 55). Adjust the air gap as shown. Raise or lower the armature as needed and make sure the points are aligned. Tighten the screws after adjustment.

POINT OPENING CHECK

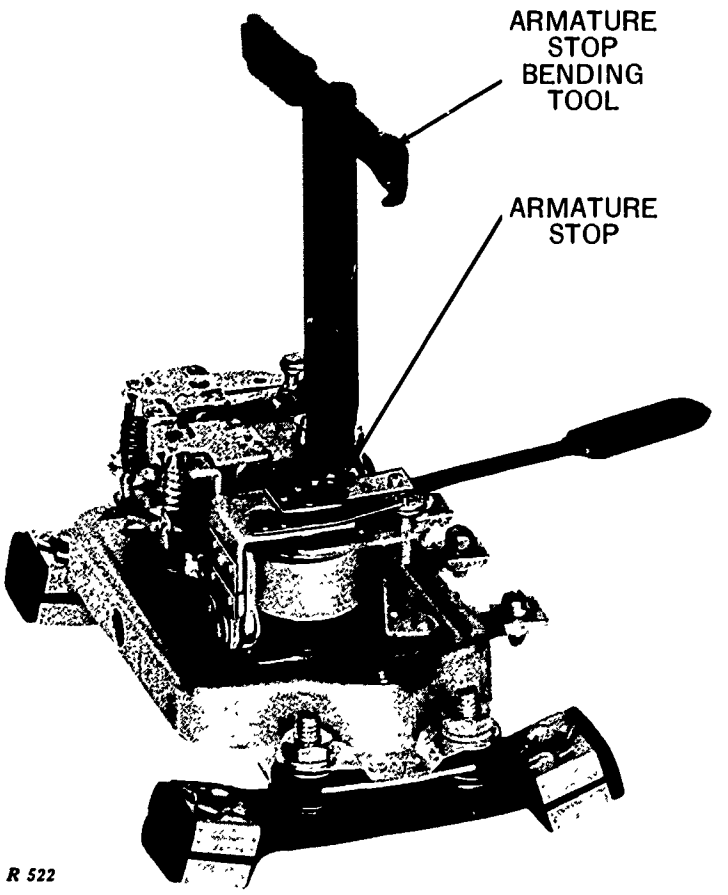


Fig. 56—Point Opening Check

Check the point opening and adjust by bending the armature stop with a tool as shown in Fig. 56.

CLOSING VOLTAGE CHECK

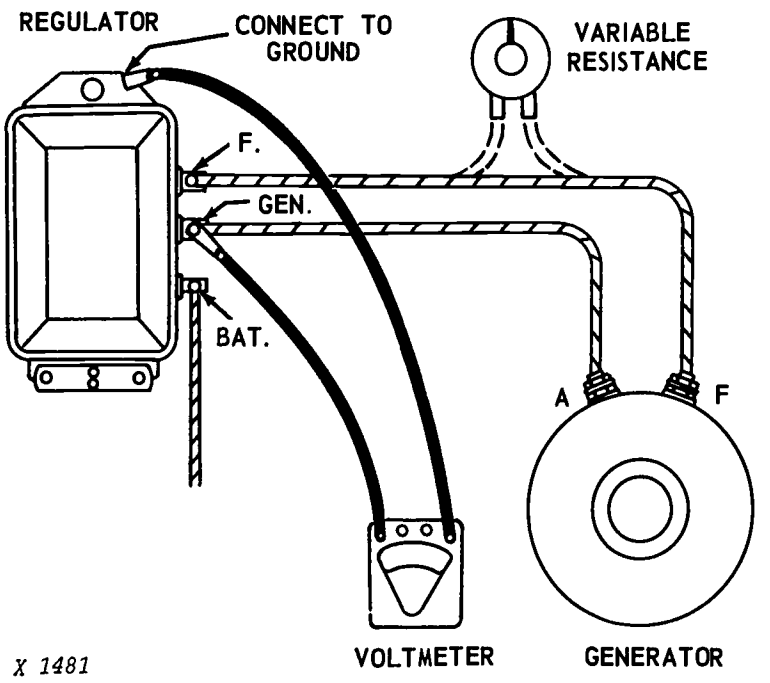


Fig. 57—Checking Closing Voltage of Cutout Relay

Connect a voltmeter between the generator terminal and ground (Fig. 57). Slowly increase the generator speed and note the relay closing voltage. Decrease the speed and make sure the points open (with the battery connected).

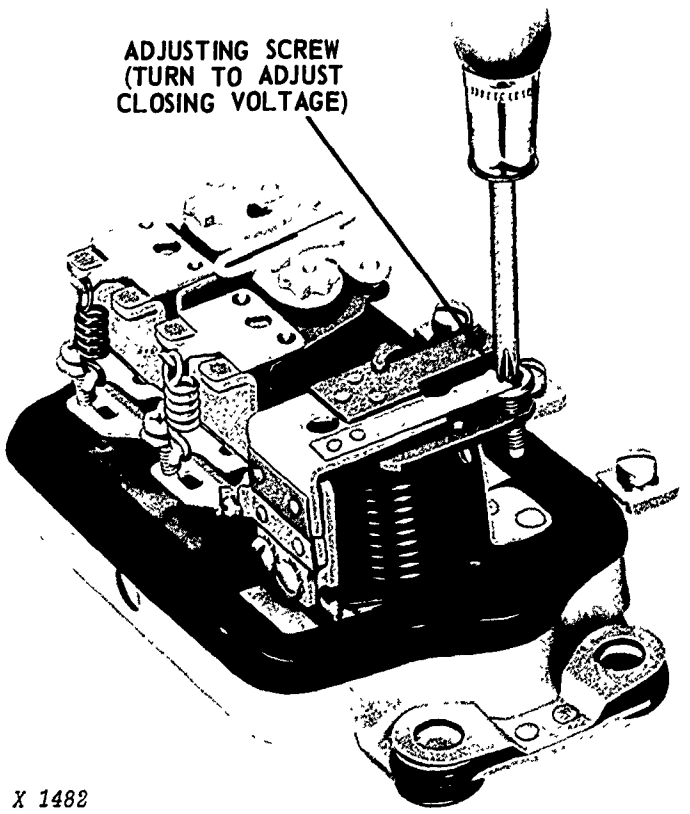


Fig. 58—Adjusting Closing Voltage of Cutout Relay

Adjust the closing voltage as shown in Fig. 58. Turn the screw clockwise to increase the setting.

Current Regulator Tests

Two checks are required on the current regulator:

1) Air gap

2) Current setting

AIR GAP CHECK

The air gap is tested and adjusted in the same manner as the voltage regulator air gap (see above).

CURRENT SETTING CHECK

Most current regulators have a temperature compensation. For these units, make the following test by the "load method."

1. Connect an ammeter into the charging circuit as shown in Fig. 59.

2. Turn on all accessories and connect an additional load across the battery (such as a bank of lights) to drop the system voltage about 1 volt below the voltage regulator setting.

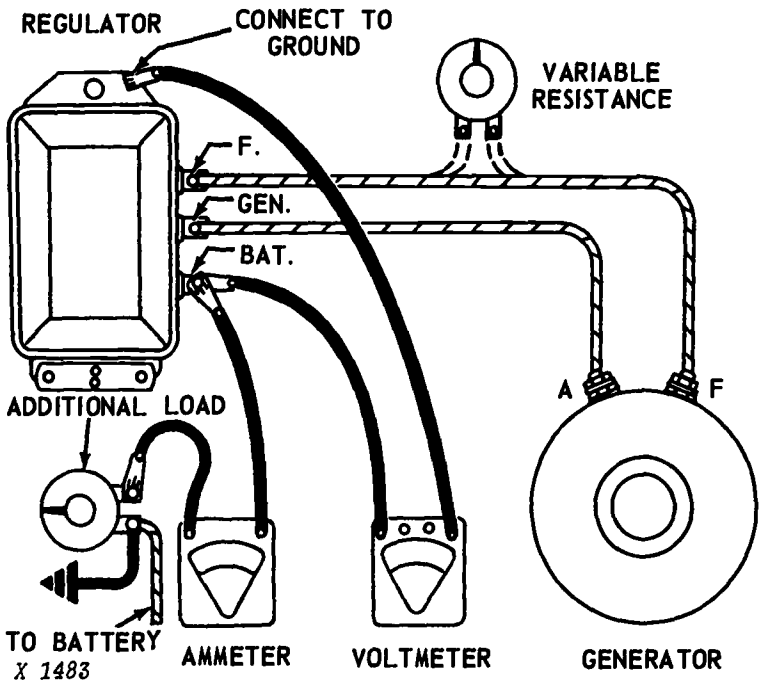


Fig. 59—Checking Current Setting of Current Regulator

3. Operate the generator at specified speed to warm it up. (See step 5 of "Preliminary Test Procedures.")

4. Cycle the generator and note the current setting.

5. Adjust the setting in the same way as for voltage setting. (See Fig. 54.)

Before slowing down the generator, be sure to remove the extra load. This will prevent overloading of the wiring.

Cleaning Contact Points

A great majority of regulator problems can be eliminated by a simple cleaning of the regulator points.

On positive-grounded regulators, the contact points that require the most attention are located on the current regulator armature and on the stationary contact point of the voltage regulator. *On negative-grounded regulators,* the other contact will require the most attention.

It is not necessary to have a flat surface on the points. However, it is necessary to remove all the oxidation.

Use a spoon or riffler file to remove the oxides until pure metal is exposed (Fig. 60).

Follow this with a thorough washing with trichlorethylene or a similar non-toxic solution. Wash by dampening a strip of lint-free cloth and drawing it between the points.

To clean the points it is necessary to remove the upper contact support as shown.

Other smaller contact points of soft alloy do not oxidize, but they may be cleaned with a crocus cloth and then washed.

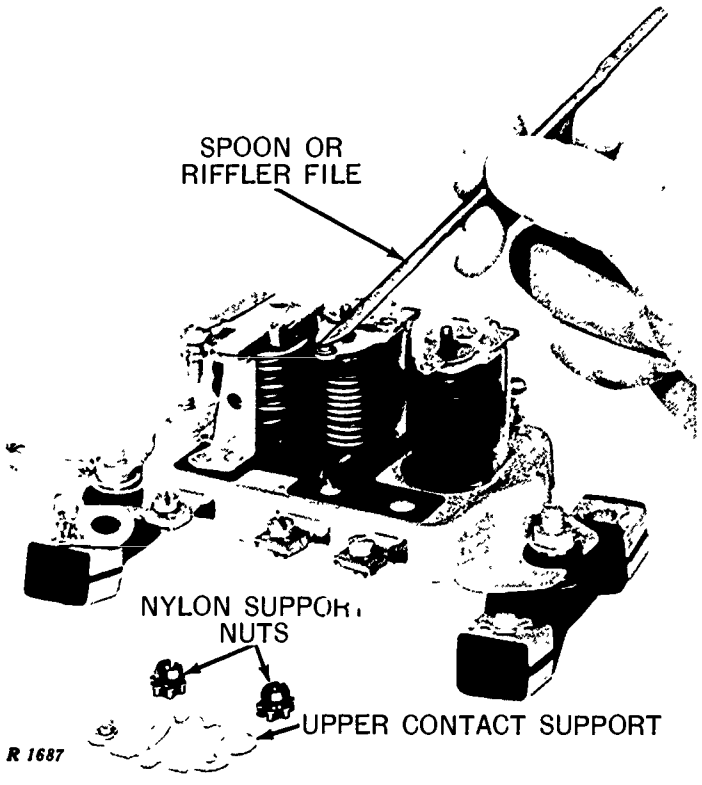


Fig. 60—Cleaning the Regulator Contact Points

CAUTION: Never use emery cloth or sandpaper to clean the contact points. However, No. 400 grit silicone carbide paper or cloth may be used.

Voltage Regulator Settings for Abnormal Operation

The perfect voltage regulator setting will keep the battery at or near full charge with a minimum use of water. The specified voltage value is usually satisfactory for average conditions. However, the operating conditions may be above or below the average. Therefore, it is sometimes necessary to adjust for abnormal conditions.

Two conditions indicate that special adjustment of the voltage regulator is necessary:

1. If the battery uses too much water at normal setting, reduce the voltage regulator setting 0.2 or 0.3 volt. Check to see if this is an improvement over a reasonable length of time. Repeat this adjustment until the battery remains charged with a minimum use of water. Remember that any reduction of the voltage requires a reduced cutout relay setting.

2. If the battery stays undercharged (¾ charge or less), increase the voltage regulator setting by 0.3 volt. Repeat until the battery is fully charged with a minimum use of water. When increasing the voltage setting, avoid a high setting that could damage lights or other electrical equipment during cold weather operation.

Always make sure that the battery is in top operating condition before making any of the above adjustments.

Now we must turn to the parts of the **a.c. charging circuit.**

ALTERNATOR

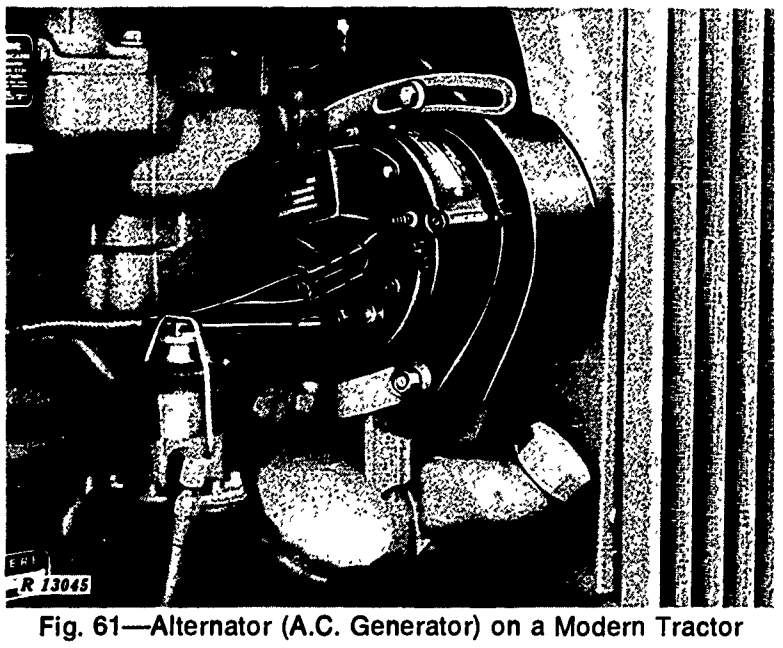


Fig. 61—Alternator (A.C. Generator) on a Modern Tractor

The **alternator** is the heart of the **a.c.** charging circuit.

Basically an alternator is like a generator. It converts mechanical energy into electrical energy.

We might say the alternator is an a.c. generator.

The difference is in the way the alternator rectifies its current to d.c. for the system. The alternator does this *electronically* using diodes.

Alternators are generally more compact than generators and can supply a higher current at low engine speeds.

In recent years, there has been more use of electrical accessories at low or idle engine speeds.

The alternator can best supply this output and for this reason a.c. charging circuits are used more today.

BASIC OPERATION OF ALTERNATOR

First let's compare the basic principles:

- **Generators—moving conductor through stationary field = voltage**
- **Alternators—moving field across stationary conductor = voltage**

Now let's see how the alternator works.

Fig. 62 shows a wire loop and a magnetic field, the same parts we saw earlier in the basic generator.

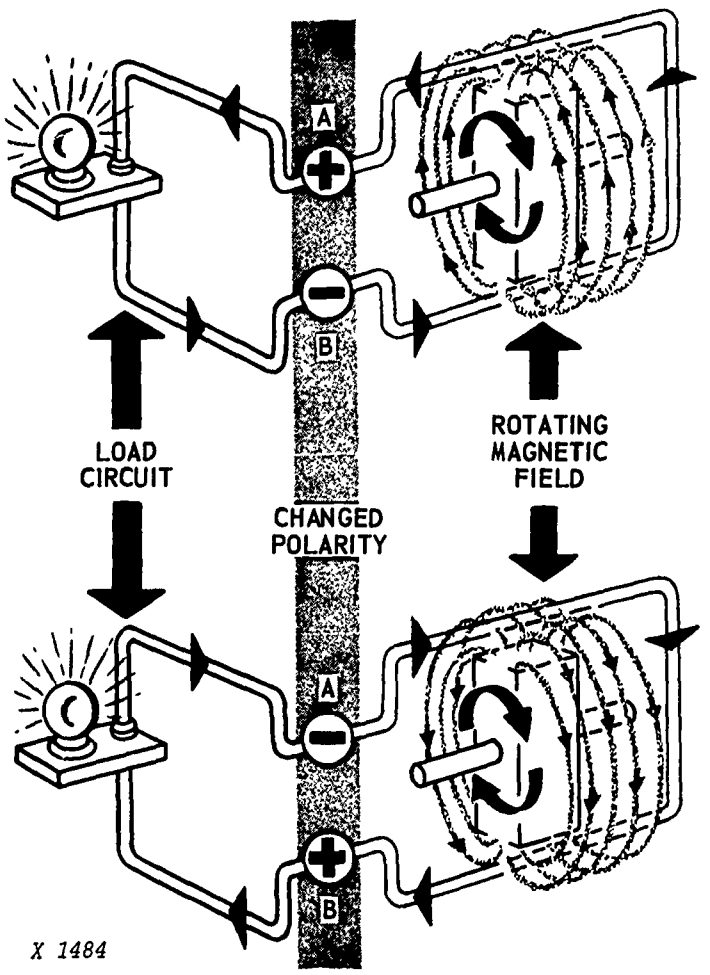


Fig. 62—Basic Alternator Operation

But now the wire loop is *stationary,* while the magnetic field is *rotating.*

The magnetic field (blue circles) is supplied by a bar magnet. (See N—S poles.)

The wire loop (in red) is connected to the charging circuit and its load (the light bulb.)

Let's start the operation. As the magnet rotates, its field cuts across the wire loop, inducing voltage. Since we have closed the loop circuit, current will flow. But in what direction?

This brings us back to another law of induction —magnetic lines of force leave the north pole of a magnet and enter its south pole.

In the upper diagram in Fig. 62, if the S pole is next to the upper part of the loop during that half-revolution, current will flow as shown by the red arrows. The same direction is induced by the lower N pole on that side of the loop.

Since current flow is from positive to negative, the end of the upper loop is (+) while the lower end is (−) as shown.

Now let's go to the second half of the revolution as shown in the lower diagram in Fig. 62.

The bar magnet has reversed poles and so the direction of current flow has reversed. This changes the polarity of the loop ends—the top one is now (−) while the bottom one is (+) as shown.

In summary: With each revolution, current flows from loop to load, first in one direction and then in the other. This is **alternating current** and the reason why the **alternator** is so named.

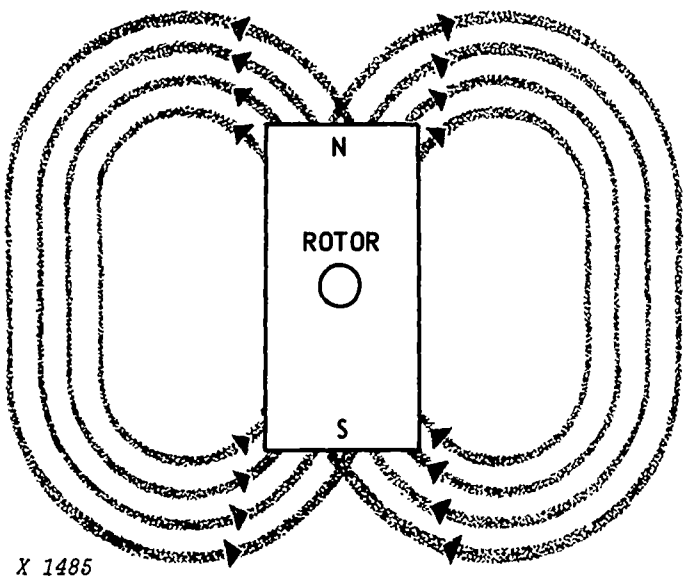


Fig. 63—Magnetic Lines of Force in Basic Alternator

To see how voltage is generated, see how the magnetic field surrounds the rotating bar magnet (or rotor) in Fig. 63.

The magnetic lines are stronger and more concentrated at the center of each pole (N and S). As they fan out from the center, the lines are less concentrated and so weaker. However, they still have some force and generate voltage in the pattern shown in blue.

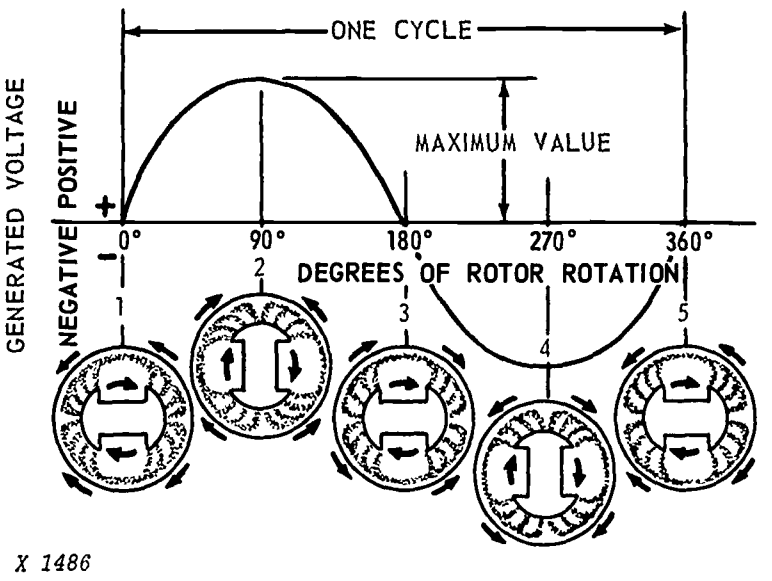


Fig. 64—Pattern of Generated Voltage during Each Alternator Revolution

Now let's turn the rotor for a full revolution and see the pattern of generated voltage (Fig. 64).

In the first position of the rotor shown at left, the rotor magnet is horizontal to the loop. No voltage is generated because the magnetic field is not cutting the loop.

As the rotor turns to position 2, the weaker outer edge of the field begins to generate some voltage. This voltage gradually increases until the magnet is in line with the loop. At this point, the strongest parts of the field are directly beneath and above the two halves of the loop. Generated voltage is strongest at this point.

As the rotor turns to position 3 in Fig. 64, the field strength decreases and generated voltage is reduced to zero. The magnet is again horizontal at this point.

Then as the second-half rotation begins (4) the stronger portions of the field come into play on the loop. Voltage reaches its peak again when the magnet is vertical or in line with the loop. Now, however, the pole positions are reversed and the direction of current flow through the loop is also reversed.

Now we can see that the only time voltage is not generated is when the magnet is horizontal to the loop. This is similar to the d.c. generator armature when it is in the *neutral position.*

The strength of generator voltage depends upon two factors:

1) If the magnetic field is made stronger, then more lines of force cut across the loop, inducing greater voltage.

2) If the rotor magnet is speeded up, the lines of force will cut faster and voltage will increase.

HOW THE ALTERNATOR CONVERTS A.C. TO D.C. CURRENT

So far our basic alternator produces an *alternating* current. But if this current is to be used for electrical systems, it must first be converted to *direct* current.

Diodes are the keys to rectifying this current in alternators. These devices were covered in Chapter 1 under "Semi-conductors."

Reviewing that section will help you understand its use in the alternator. However, for our purpose here, remember this:

The diode is an electrical device that allows current to flow through in only one direction.

In Fig. 65, we have placed a diode in the wire loop circuit of our basic alternator. The arrow in the symbol points in the direction that the diode will conduct current.

In the upper illustration we have the same basic circuit as covered in Fig. 62, except for the diode

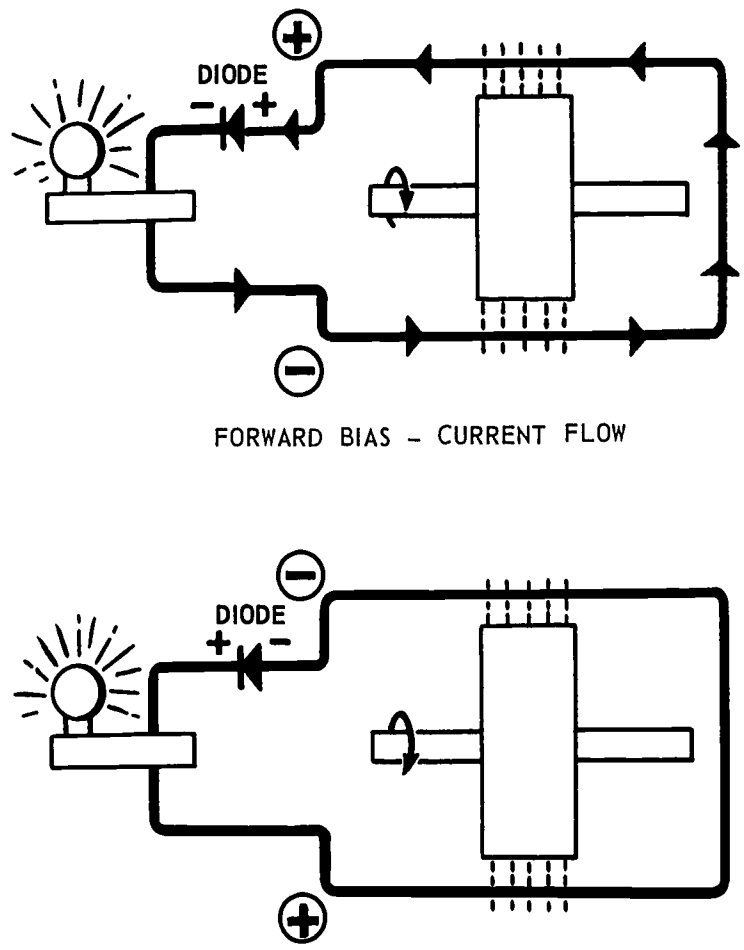


Fig. 65—Use of Diode in Basic Alternator Circuit

now in the circuit. However, current will still flow because the diode has a **forward bias** and allows current to pass in the direction shown.

In the lower illustration in Fig. 65, the polarity of the alternator circuit has reversed. Normally, the direction of current flow would also be reversed. But with the diode in the circuit, current cannot flow because the diode stops it. Therefore, no current flows and the diode is said to have a **reverse bias.**

As a result, the alternating current has been converted to direct current by the diode.

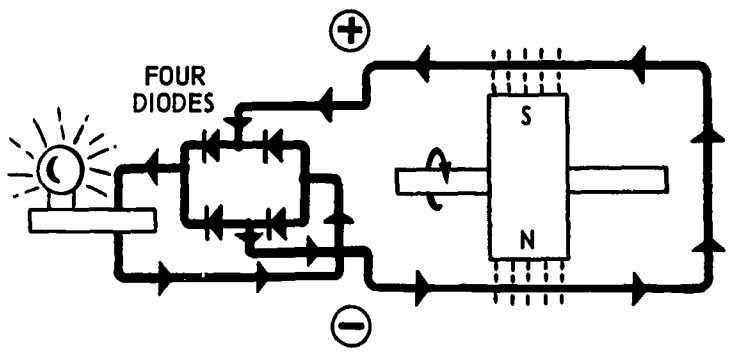
Actually, the alternator is producing current during only half of its cycle and the full output is not being produced. Therefore, an alternator with a single diode provides what is called half-wave rectification and is not practical.

We can use this same alternator to provide full-wave rectification and obtain nearly full output. This is done by using *four* diodes instead of just one (Fig. 66).

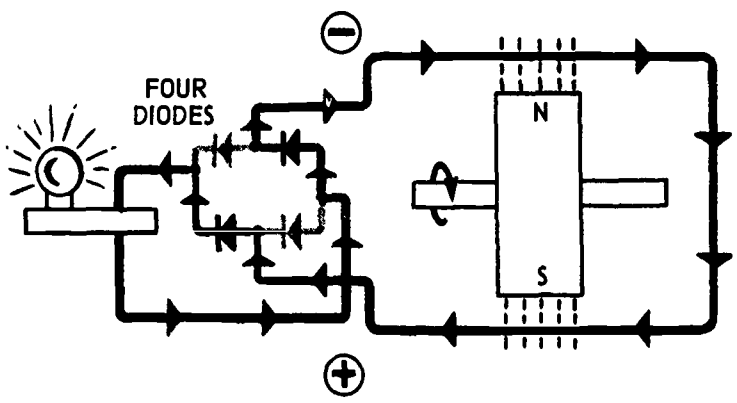
Now during its full cycle the alternator conducts current to the load. Even though the polarity reverses in the lower diagram, the circuit goes through two diodes as d.c. current. (Later in this section we will c ver the work of diodes in more detail.)

This completes the basics of how an alternator works.

Now let's look at the parts of an actual alternator in more detail.



FORWARD POLARITY – CURRENT FLOW



REVERSE POLARITY – CURRENT STILL FLOWS

X 1488

Fig. 66—Current Rectified for Full Wave Using Four Diodes in Alternator

THE PARTS OF THE ALTERNATOR

Alternators can be divided into three main units:

- **Rotor Assembly—magnetic field which rotates.**
- **Stator Assembly—conductors which are stationary.**
- **Rectifier Assembly—diodes which change a.c. to d.c. current.**

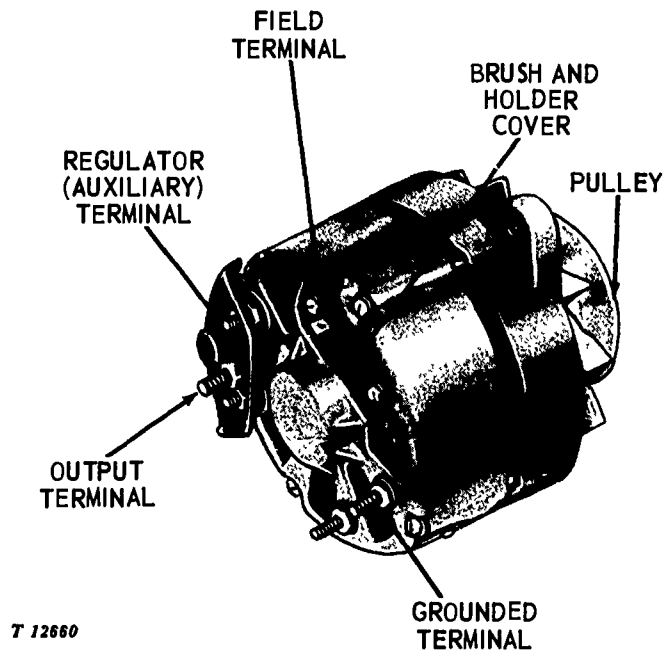


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Fig. 67—Complete Alternator

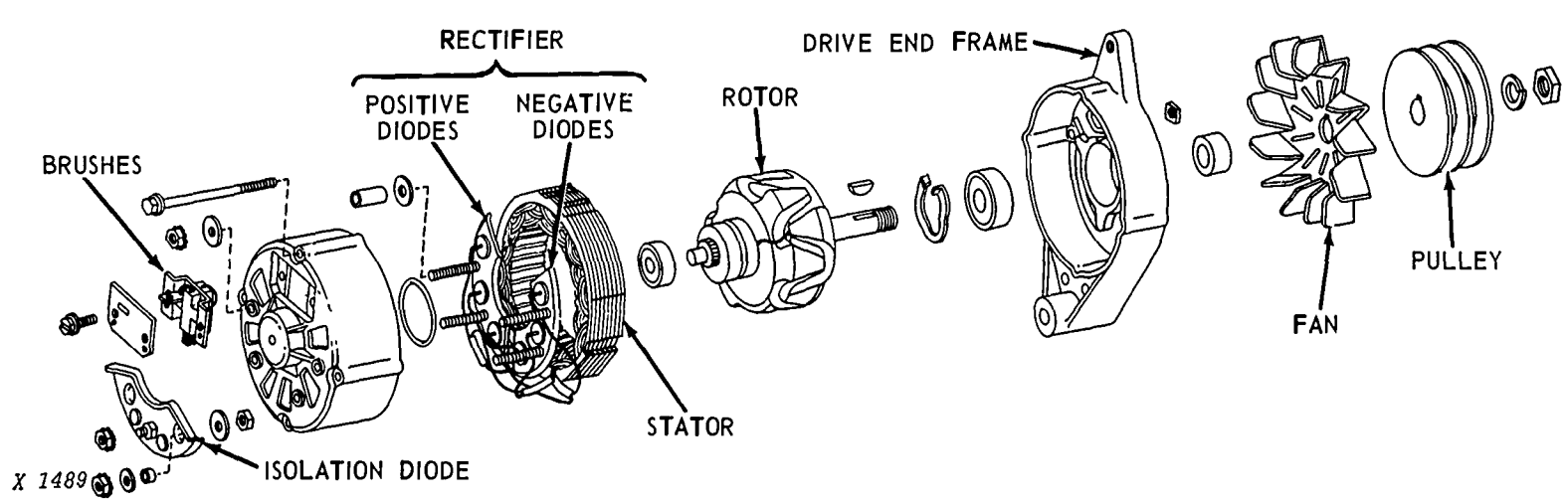
Fig. 68 shows the parts of a typical alternator. The three main units are labeled in red.

ROTOR ASSEMBLY

The **rotor assembly** does the same job as the field coil and pole shoe assembly in the d.c. generator. The difference is that the rotor assembly revolves while the field coil and pole shoe assembly is stationary.

The rotor assembly consists of a *wire coil* wrapped around an *iron core* and mounted on a *rotating shaft* (Fig. 68). The coil is enclosed between two interlocking soft iron sections. The ends of the coil are connected to two *slip rings* mounted on one end of the shaft.

Small *brushes* ride on the slip rings. One of the brushes is connected to ground. The other is insulated and connected to the alternator field terminal. This terminal is connected through the regulator and the ignition switch to the battery.



X 1489

Fig. 68—Exploded View of a Typical Alternator

When the ignition switch is turned on a small amount of current from the battery flows through the regulator to the insulated brush, through one of the slip rings, into the coil, out through the other slip ring and the other brush to ground.

The current through the coil creates a magnetic field which makes the rotor a rotating multi-pole magnetic field. Each finger on the iron section becomes a magnetic pole.

The rotor poles do not retain magnetism—unlike the generator's pole shoes. Direct current from the battery must flow through the rotor coil to magnetize the poles *before* the alternator will start to charge.

The rotor or alternator field is, therefore, *externally* excited.

STATOR ASSEMBLY

The **stator assembly** does the same job as the armature in a d.c. generator. However, the stator is fixed while the armature rotates.

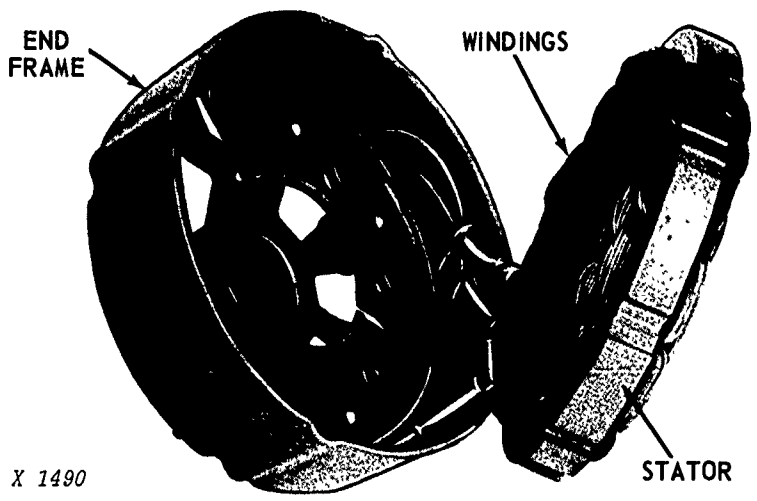


Fig. 69—Stator Assembly

The stator assembly is a laminated soft *iron ring* with three groups of *coils* or *windings* in the slots (Fig. 69). Each group is made up of from 8 to 16 coils, depending on the design.

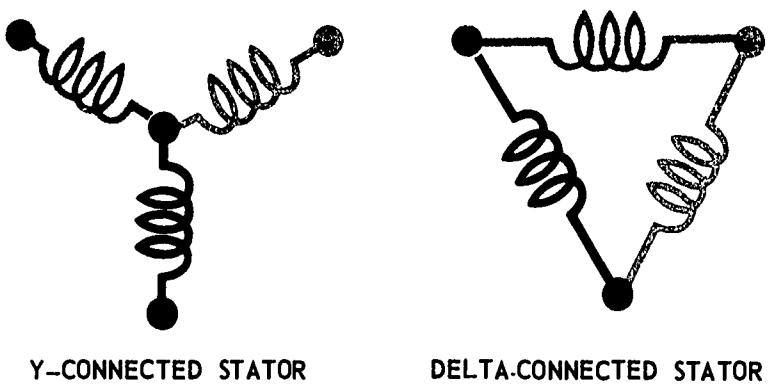


Fig. 70—Two Connections of 3-Phase Stator Windings

One end of each stator winding is connected to a positive and negative diode. (We will cover the diode installation later.)

The other ends of the stator windings can be connected by either one of two ways:

- **Y-Connected Stator Windings**
- **Delta-Connected Stator Windings**

The delta-connected alternator may be used for heavy-duty operations where lower voltage, but higher amperage is needed.

The Y-connected alternator usually provides a higher voltage and a moderate amperage. *The Y-connected type is most widely used on modern farm and industrial machines.*

HOW VOLTAGE IS GENERATED BY THE ALTERNATOR

The basic alternator that we used to explain operation had a single wire loop of winding. For all practical purposes, this loop could be considered a stator with one group of windings. Therefore, this type of alternator is a single-phase alternator.

The three groups of windings in a standard alternator do the same work as the one group in a single-phase alternator. This alternator, then, is a **3-phase** alternator.

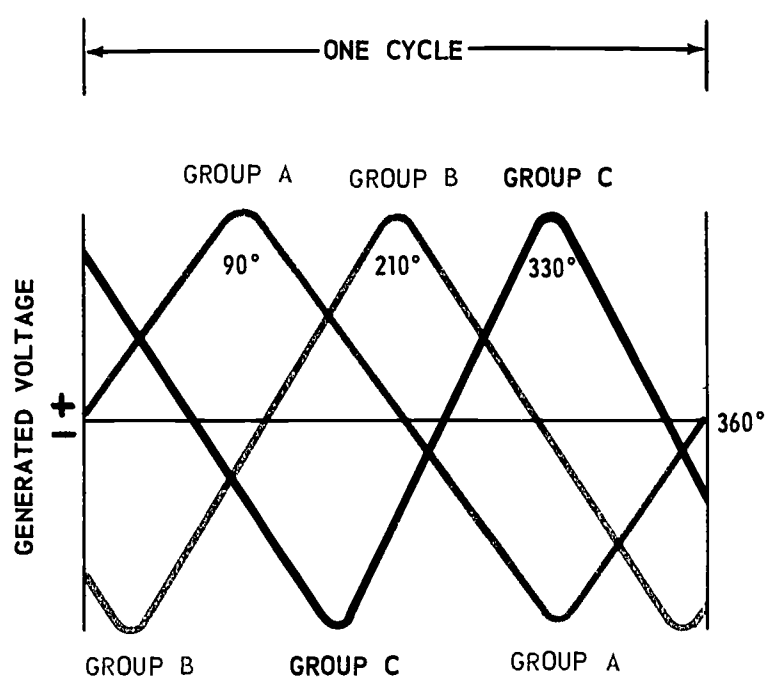
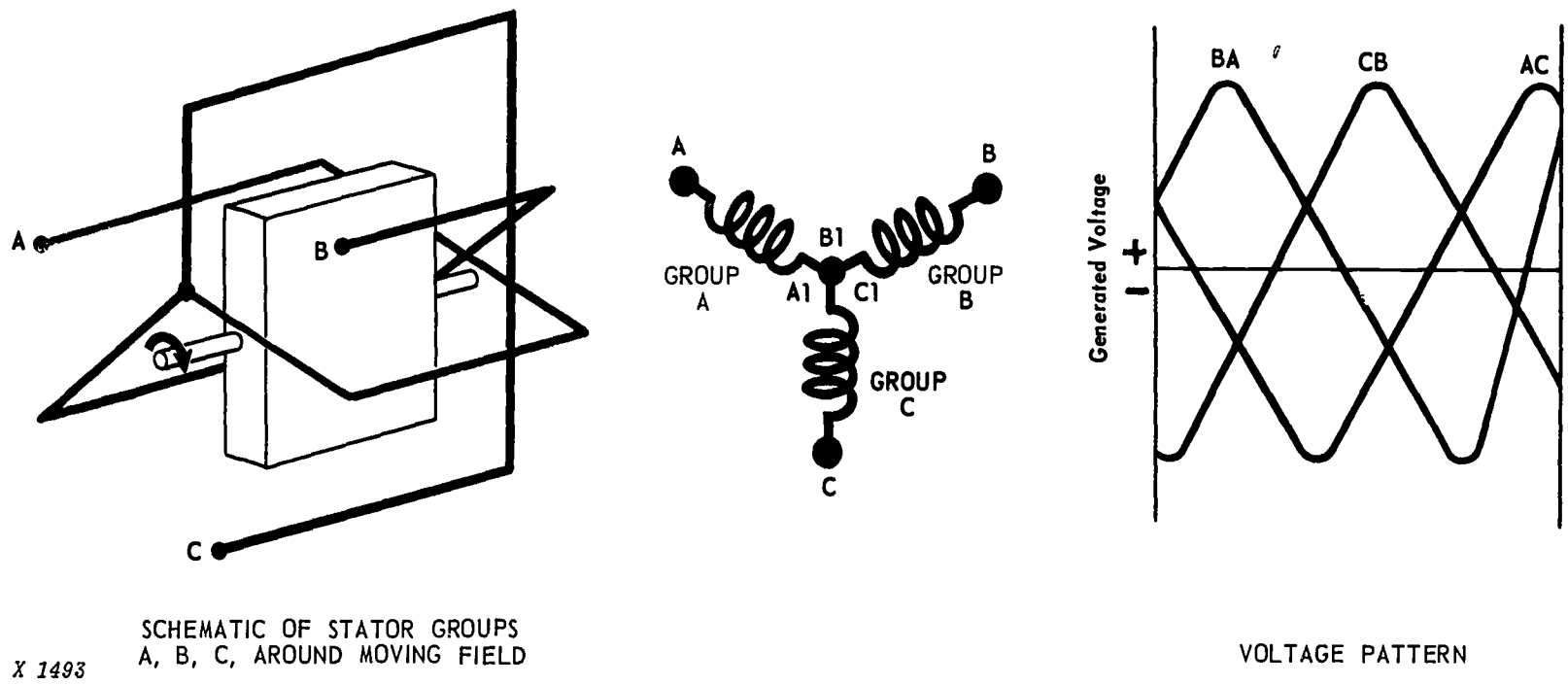


Fig. 71—Voltage Pattern of Windings in 3-Phase Alternator

There are two reasons why *three* groups of windings are used in alternators:



SCHEMATIC OF STATOR GROUPS A, B, C, AROUND MOVING FIELD

X 1493

VOLTAGE PATTERN

Fig. 72—Phase Voltage Pattern for Y-Connection of Alternator Windings

1) **To provide a more constant voltage.** As you can see in Fig. 71, the voltage and current output reach their peak only twice in each revolution. The time spent developing voltage means varying degrees of generated voltage between peaks and thus a pulsating alternating current.

When two more groups spaced 120 degrees apart are added, they will also generate voltage. However, because the voltage of each group will reach its peak 120 degrees after the last group, the voltage output is smoother as shown.

2) **For greater voltage and more output.** This second reason for three groups of windings can be seen in Fig. 72.

By connecting the stator groups in a "Y," voltage is still generated in each group, and each reaches its peak at different times. However, they no longer supply individual voltage, for all three are connected in *series*.

Basically, this means that as the field builds voltage in one loop it is still generating voltage in the preceding group. Since the two groups are connected in series, *their voltages are added together.* The amount of this combined voltage will be almost one-fourth larger than the peak voltage of any one group.

As you can see in Fig. 72, we no longer separate loop voltage, but instead, combine the group voltages or as they are called — *phase voltages.* Therefore, instead of loop voltages—A, B, and C as shown in Fig. 71, we now have phase voltages BA, CB, and AC as shown in Fig. 72.

RECTIFIER ASSEMBLY (DIODES)

To convert the a.c. to d.c. current, the rectifiers or **diodes** are used.

In a 3-phase alternator, six diodes are mounted at the slip ring end of the alternator housing (Fig. 73). Three negative diodes are mounted in the end frame or in a heat sink bolted to the end frame. Three positive diodes are mounted in the heat sink which is insulated from the end frame.

NOTE: On negative-grounded alternators, the positive diodes are mounted in the insulated heat sink. On positive-grounded alternators, the negative diodes are mounted in the insulated heat sink.

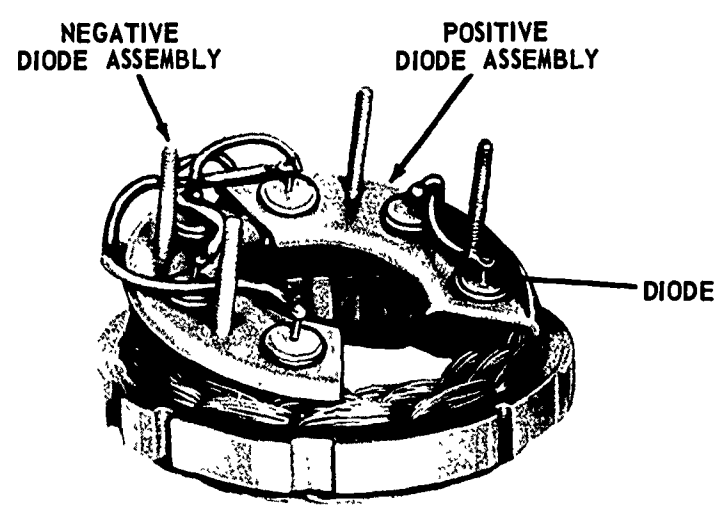


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Fig. 73—Diode Assemblies in Alternator

To understand the diodes, first remember these two points:

1) Alternating current flow is produced by the rotor-stator combination. That is, during half the rotor revolution, current flow in the stator phases is in one direction. In the other half, flow is in opposite direction.

2) Current flow from the alternator output terminal is always the same direction—direct current.

This means that during each phase of a revolution, two diodes are used to convert a.c. to d.c. current—one positive diode and one negative diode.

Let's number each diode 1 through 6. The even-numbered diodes (2, 4, 6) are positive, while the odd-numbered ones (1, 3, 5) are negative.

The chart below shows which diodes are being used during each of six phases of revolution.

Phase of Revolution	Diodes Used *Pos. Neg.*
1	2 and 3
2	2 and 5
3	4 and 5
4	4 and 1
5	6 and 1
6	6 and 3

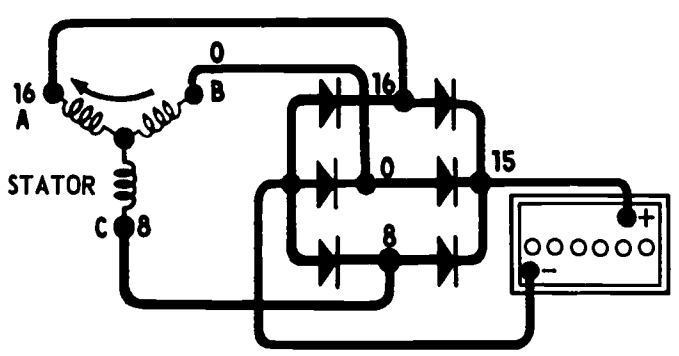


Fig. 74—Current Flow in Phase One of Rotor Revolution ("Y" Connection Shown)

To see the current flow through the stator and the six diodes during phase 1, refer to Fig. 74.

The maximum voltage is being produced across stator terminals BA. This means that the current flow is from B to A in the stator winding during this period, and through the diodes as illustrated.

Let's assume that the peak voltage from B to A is 16 volts. This means that the potential at B is zero volts, and the potential at A is 16 volts.

Meanwhile, the voltage from C to B is minus 8 volts. This means that the potential at C is 8 volts as shown, since C to B, or 8 to zero, represents a minus 8 volts. This checks out, since A to C, or 16 to 8, represents minus 8 volts.

If we assume a drop of one volt in the conducting diodes, the voltage potentials are as noted by each diode.

Only two of the diodes (shown in red) will conduct current, since these diodes are the only ones in which current can flow in the forward direction. The others will not conduct current during this phase *because they are reverse biased.*

For example, the lower right-hand diode is reverse biased by 15 volts (15 − O = 15). *This biasing of the individual diodes by the stator determines how current flows in the stator-rectifier combination.*

Throughout phase 1, the current flows as indicated, because the bias direction across the diodes does not change. The voltage may vary, but not enough to change the bias direction of a diode.

During phase 2 (not shown), the maximum voltage changes from BA to CA in the stator. This causes two other diodes to conduct voltage.

With each new phase, the pole positions of the stator changes and causes a different pair of diodes to conduct current as shown in the chart above.

Isolation Diode

Some alternators use an extra diode assembly in the circuit. This diode is called the *isolation diode.*

Its primary function is to act as an automatic switch between the battery and alternator. It will block any current flow from the battery back to the alternator and regulator when the alternator is not operating.

The isolation diode is mounted in a heat sink metal frame. (See Fig. 68.) (Two diodes in parallel are used on some high-amperage alternators.)

Because all output passes through this diode, high temperatures can be expected. For this reason, the diode and frame are mounted on the slip ring end frame to allow free circulation of air around it.

The charge indicator light is placed in parallel with the isolation diode and connected between the regulator terminal and the ignition switch.

It supplies the initial current to the regulator to excite the rotor field. This is shown when it lights up while starting the engine.

The isolation diode and the charge indicator lamp operate as follows:

1. *With the ignition switch off,* there is no voltage at either end of the indicator lamp. The light is out and the isolation diode blocks current from the battery to the alternator.

2. *When the ignition switch is turned on,* voltage is applied to the one side of the indicator light. This will cause a small amount of current to flow through the regulator to the rotor field and this causes the indicator light to glow.

3. *Once the rotor field is excited and the engine starts rotating,* voltage is generated in the stator windings and the output through the rectifiers steadily increases.

4. *Soon the generated voltage exceeds the voltage potential of the battery.* At this time the indicator light goes out and the voltage regulator takes control of field voltage and current.

VARIATIONS ON ALTERNATOR DESIGN

While basically every alternator is the same, there are two main variations for different uses:

- **Open-Type Alternators**
- **Closed-Type Alternators**

Let's look at these designs briefly.

Open-Type Alternators

The open-type alternator has openings in its housing for better air circulation. A fan mounted on the pulley end of the rotor shaft helps circulate air to cool the inner parts of the alternator.

Closed-Type Alternators

The closed-type alternator is completely encased, except for the pulley and fan assembly and its terminals.

It is designed for use in extremely dusty conditions or in areas where a spark might ignite combustable material. However, it is still necessary to cool these units by either of two methods.

1) Air cooling

2) Oil cooling

AIR-COOLED ALTERNATORS

The first method of cooling is by circulating air. The fan is driven by the drive pulley and forces air around the sealed housing. The housing itself is made of light-weight aluminum which helps to dissipate the heat. The housing may also be ribbed or finned for better circulation of air.

OIL-COOLED ALTERNATORS

The other method of cooling is by circulating oil through the interior of the alternator.

The oil-cooled type is usually confined to use in stationary electrical systems. This design also eliminates the brush and slip ring assemblies.

SUMMARY: OPERATION OF ALTERNATORS

In summary:

- **An alternator is an a.c. generator.**
- **It rectifies current to d.c. using diodes.**
- **Voltage is generated by a moving field in a stationary conductor.**
- **This is reverse of generator principle.**
- **Alternator = rotor (moving) + stator (fixed) + rectifier (diodes).**
- **Rotor-stator produces a.c. current.**
- **Rectifier diodes convert current to d.c.**
- **Open-type alternators = air cooling for hot conditions.**
- **Closed-type alternators = dust-free operation, but must be cooled.**

TESTING OF ALTERNATORS

General Testing

Many of the general testing procedures and precautions that applied to the d.c. generator also apply to the alternator.

1. Make sure that all components, especially the alternator, are the exact models specified for the machine.

2. Make a complete *visual* check of all leads, wires, connections, etc., to find possible loose connections, broken wires, worn brushes and dirty slip rings.

3. Use a recommended testing procedure to make a complete *circuit check* of all the circuit components. This will isolate the problem. This will isolate the problem.

4. In testing or repairing the alternator, follow the recommended testing and service procedures and specifications. These will be found in the alternator service manual or the machine technical manual.

5. Disassemble the alternator only as far as necessary to make adjustments or repairs.

6. The following list of tools and test equipment are generally used:

a. Machine or alternator Technical Manual for reference use.

b. Normal and special tools as noted by the Technical Manual.

c. Ammeter.

d. Voltmeter.

e. Ohmeter (1½ volt)

f. Variable carbon pile resistor.

g. Test lamp in series with 12-volt battery.

NOTE: A 110-volt test lamp can be used, but NOT to test diodes or any components while they are connected to the diodes. Use the lamp with extreme care.

Precautions for Alternator Testing

Below is a list of general precautions which must be taken prior to and during alternator tests:

1. Before disconnecting the battery or alternator from the circuit, satisfy yourself that the proper polarity is observed.

2. Before installing the battery or alternator, BE SURE THAT PROPER POLARITY IS OBSERVED. Turn off all switches and accessories. Then, before connecting the battery ground strap, momentarily touch it to the battery post. No sparks should occur.

3. Disconnect the battery ground strap when using or connecting a battery charger if you are not sure the charger is safe for an alternator charging circuit.

4. Never operate the alternator on open circuit. All three components of the circuit must be connected.

5. Never short or ground the alternator terminals unless instructed.

6. When making alternator tests in the circuit, be sure battery is in good condition and fully charged for control of alternator output with an external load.

7. NEVER ATTEMPT TO POLARIZE AN ALTERNATOR. To do so will damage the rectifying parts of the unit.

Failure to take the above precautions can result in damage to the regulator, the rectifier diodes, or other parts of the alternator.

General Diagnosis of Alternators

The following chart can help you to locate malfunctions within the alternator charging circuit.

At the end of this chapter we will relate these alternator problems to the whole charging circuit.

Below each problem is listed the most likely causes.

Alternator Trouble Shooting Chart

ALTERNATOR FAILS TO CHARGE

1. Alternator belt loose.

2. Open or high resistance in charging circuit.

3. Worn or defective brushes.

4. Malfunctioning regulator.

5. Open isolation diode.

6. Open rotor field coil.

LOW OR UNSTEADY CHARGING RATE

1. Belt loose.

2. Open or high resistance in the charging circuit.

3. Open, worn, or defective brushes.

4. Faulty regulator.

5. Shorted or open rectifier diode.

6. Grounded or shorted rotor field coil.

7. Open, grounded, or shorted stator windings.

EXCESSIVE CHARGING RATE

1. Loose alternator or regulator connections.

2. Malfunctioning regulator.

NOISY ALTERNATOR

1. *Defective or worn belt.*
2. *Misaligned belt or pulley.*
3. *Loose pulley.*
4. *Worn bearings.*
5. *Shorted rectifier diodes.*

From this list, make the easy checks first. A good visual check of the charging components may help you to catch the more obvious causes of failures.

Alternator Bench Testing

As you can see, most of the problems listed in the chart can be caused by any one of the charging circuit components. This means that a *complete* circuit check must be made to isolate the faulty component.

Once you have located the problem in the alternator itself service the alternator on the bench.

Disassembly of Alternator

First disconnect the battery ground cable. Then disconnect the wires and drive belt from the alternator and remove the alternator from the machine. Select a clean, well-lighted work area for alternator service.

Prior to disassembly, take all the pre-test precautions. Also, remember that the alternator should be disassembled only as far as necessary to correct the problem.

For detailed procedures, refer to the alternator or machine technical manual. Here we will dismantle a standard alternator to give you only the *general* procedures.

REMOVING MAIN PARTS

1. On alternators equipped with an isolation diode, remove this assembly.

2. On some alternators, the regulator is mounted directly on the alternator housing. In this case, remove the mounting screws and wiring leads and lift off the regulator.

3. The brush assembly may be either a separate unit or part of the slip ring end frame. If it is separate unit, remove the mounting screws and any wire leads. Then tilt it slightly at the top and slip it out of its cavity (Fig. 75).

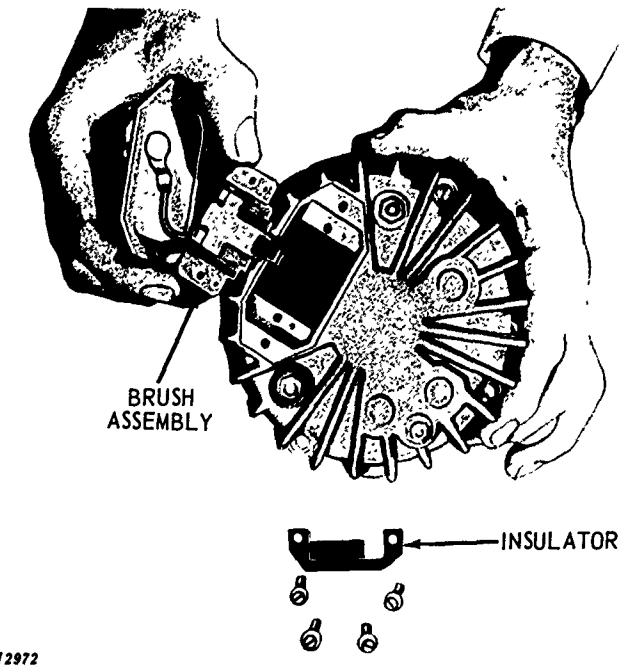


Fig. 75—Removing the Brush Assembly

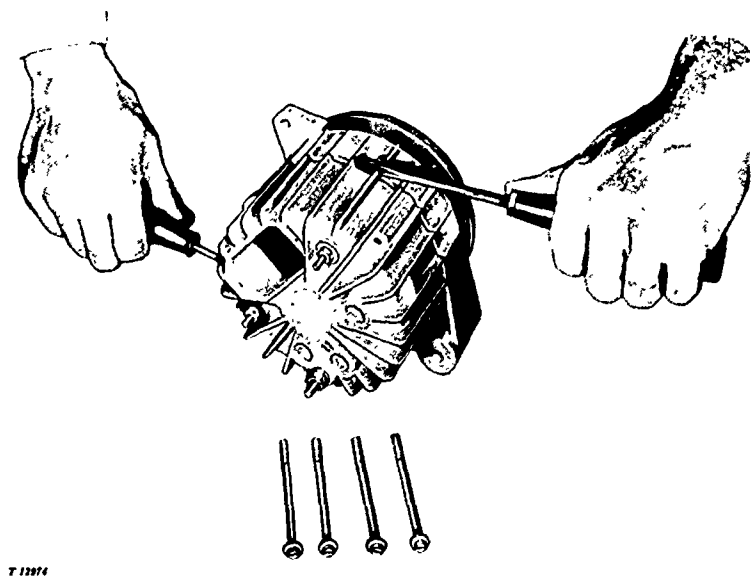
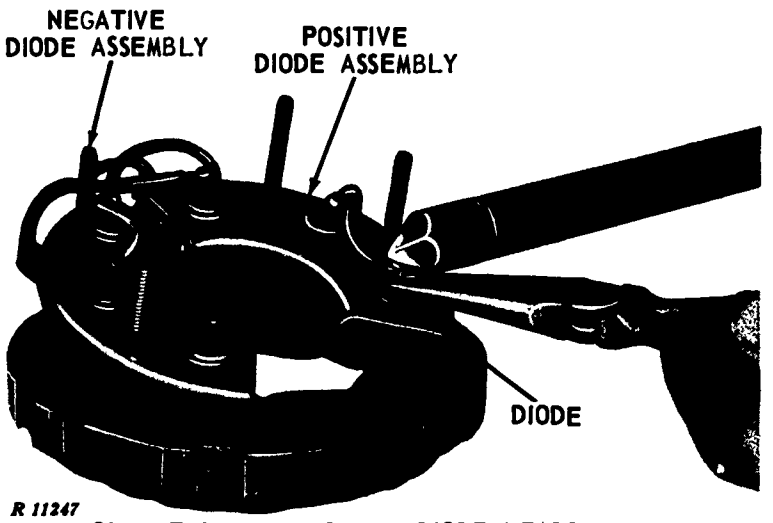


Fig. 76—Removing the Slip Ring End Frame

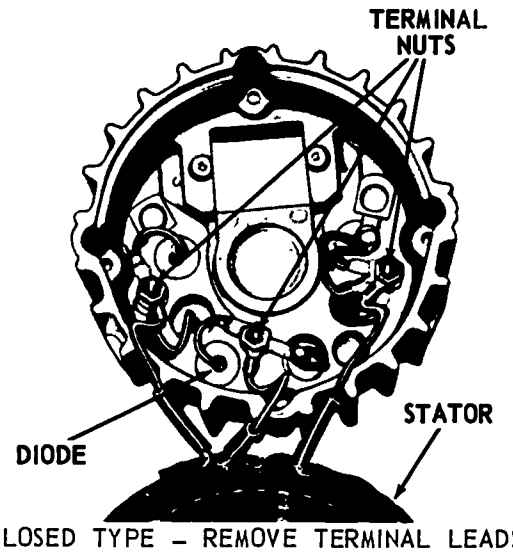
4. Separate the slip ring end frame, rectifier diode assembly, and stator from the drive end frame and rotor. Do this by removing the long through bolts. Slip screwdrivers in the slots between the drive end frame and stator (not more than 1/16-inch—any deeper may damage the stator windings). Then gently pry the stator loose (Fig. 76).

5. To remove the slip ring end frame from the diode and stator assemblies, remove the lock nuts, insulators, and insulating washers from the diode terminal posts.

CAUTION: Notice the position of the insulators before removing them. They must be replaced in the same order.



OPEN TYPE – UNSOLDER DIODE LEADS



CLOSED TYPE – REMOVE TERMINAL LEADS

Fig. 77—Removing Diode Assemblies

6. On closed-type alternators, separate the diode assembly from the stator by removing the stator leads from the screw terminals (Fig. 77).

On open-type alternators, the stator leads must be unsoldered from the diodes to separate the two assemblies (Fig. 77).

SOLDERING AND UNSOLDERING DIODE LEADS (OPEN-TYPE ALTERNATORS)

When soldering or unsoldering diodes, be sure to grip the diode lead with a pair of needle-nosed pliers between the connection and the diode. The pliers will act as a heat sink and prevent heat damage to the diode hermetic seal.

Also, avoid bending the diode lead if possible. If the lead must be bent, use two pliers. Place one between the diode and the bend and use the other pliers to bend the lead very carefully.

IMPORTANT: Diodes will be ruined if the hermetic seal at the diode lead is broken.

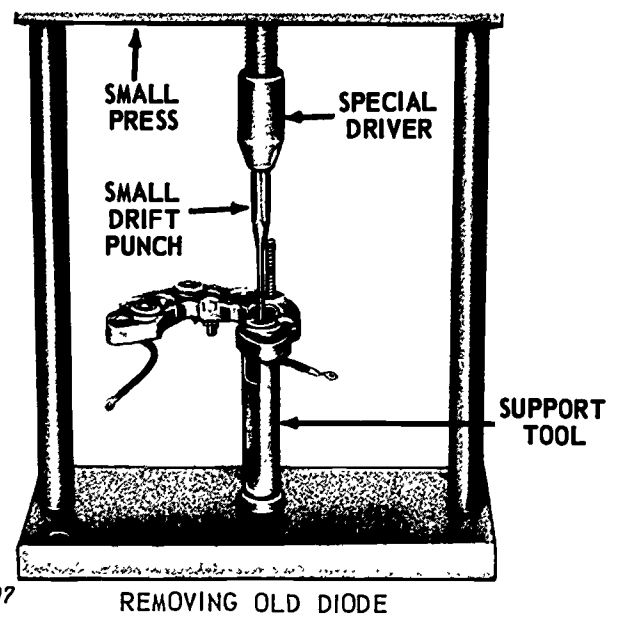
When soldering a diode lead, use a solder containing 60 percent tin and 40 percent lead.

CAUTION: Never use an acid-core solder. Use only a rosin-core solder.

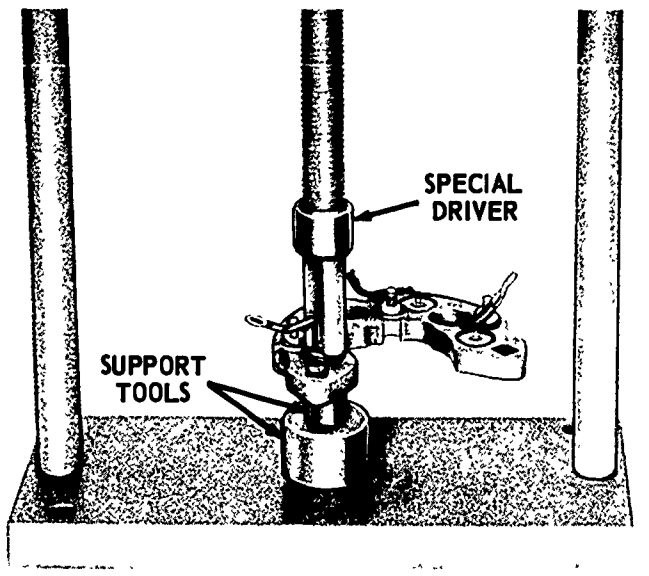
REPLACING DIODES

On some closed-type alternators, individual diodes may be replaced by pressing the faulty diode out of the plate and pressing a new one in (Fig. 78). On other alternators, replace the whole positive or negative diode plate assembly.

IMPORTANT: Be sure to replace a diode with one of the same type. Positive diodes are marked in red, while negative ones are marked in black.



REMOVING OLD DIODE



INSTALLING NEW DIODE

Fig. 78—Replacing Individual Diodes (Closed-Type Alternators Only)

REMOVING BEARINGS

The rear bearing on the slip ring of the rotor shaft need not be removed unless it must be replaced. The front bearing need not be pressed off the

shaft unless the drive end frame is to be removed. Be sure to use the recommended pullers and presses for these jobs.

Testing the Individual Components

The tests given here are only general outlines to give you an idea of what tests should be performed on actual electrical components. The alternator service manual or machine Technical Manual will give you the detailed tests and specifications.

Testing the Brushes

First make a visual check of the brushes and leads. If the brushes are worn down to an exposed length of ¼-inch or less or are otherwise defective, replace the entire brush assembly.

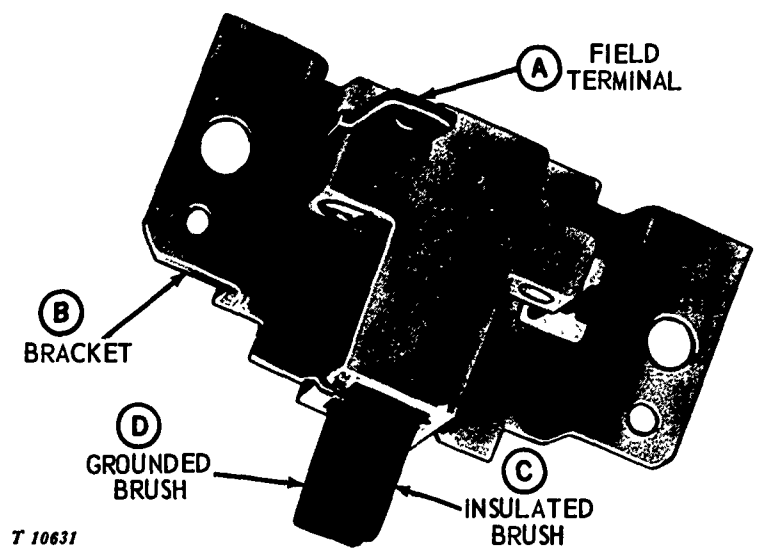


Fig. 79—Visual Check of Brush Assembly

An *insulation test* can be made by connecting an ohmmeter or test lamp to the field terminal (A) and assembly bracket (B). (See Fig. 79.) Resistance should be high or the test lamp should not light. If not, brush assembly is shorted and must be replaced.

A *brush continuity test* is made by connecting an ohmmeter to the field terminal (A) and a brush (C). The resistance should be zero.

While making the tests, wiggle the brushes and leads to locate poor connections or intermittent grounds. Grounds can be located by connecting the ohmmeter to the bracket (B) and the field terminal (A). Resistance should be infinite.

Testing the Diodes

Test the diodes in two steps:

1) Test the diodes before they are disconnected from the stator.

2) If a malfunction appears during this test, disconnect the suspected diode and retest the others.

The first indication of a faulty diode may be a humming or growling sound heard while the alternator is operating. At the same time, the alternator will usually have a low output.

Use a commercial diode tester, a 1½-volt ohmmeter or a test lamp connected in series to a 12-volt battery to test the diodes. *Never use a 110-volt test lamp to test the diodes.*

Some commercial diode testers will check the diodes in one step.

TESTING DIODES WITH OHMMETER

When using a 1½-volt ohmmeter, do the following:

1. Connect one ohmmeter lead to the diode case and the other lead to the diode lead.

2. Note the ohmmeter reading.

3. Now reverse the ohmmeter leads and note the reading.

4. A good diode will give a high and a low reading.

After testing each group of diodes, compare the ohmmeter readings. If the high and low readings on all the diodes are the same, the diodes are good. If even a slightly different reading is obtained for one diode, it is probably defective. Disconnect it and recheck the diodes.

TESTING DIODES WITH TEST LAMP

If a test lamp in series with a 12-volt battery is used, place one test probe on the base of the diode and the other probe on the diode lead. Then reverse the probes.

The lamp should light in one direction, but not the other. If the lamp lights in both directions, one or more of the diodes in the group is shorted. If the lamp does not light in either direction, all of the diodes are open. Disconnect the diodes from the stator and test them one at a time to locate the shorted diode.

TESTING DIODES WITH ALTERNATOR DIODE TESTER

A commercial diode tester usually has its own directions. Follow that testing procedure when checking out diodes.

When replacing diodes, remember their polarity. **Positive diodes are marked in red, negative diodes in black.**

Testing the Stator Assembly

Again, a visual inspection may uncover some defects in the stator windings. For example, shorted windings are usually discolored.

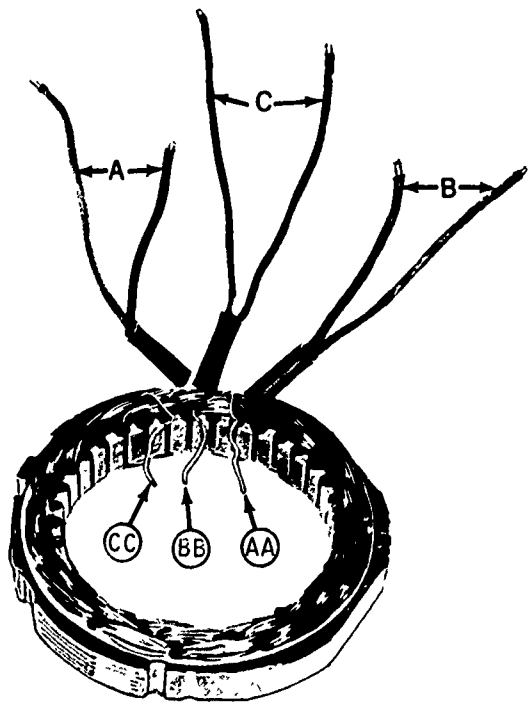


Fig. 80—Testing the Stator Assembly ("Y" Connected Stator Shown)

To test the stator, first disconnect the stator leads from each other as shown in Fig. 80.

If a 110-volt test lamp or an armature tester is used, disconnect the diodes from the stator to prevent damage to the diodes.

To check for open circuits, place the test lamp probes between points A and AA, B and BB, C and CC. The lamp should light up.

To check for grounded windings, place one test lamp probe on the metal frame. Place the other probe first on point A, then on point B, and then on point C. The lamp should not light at any of the three points.

In testing for shorted phase windings, connect the test lamp between points A and B, then B and C, and then C and A. The lamp should not light.

A very sensitive testing unit is needed to find a short circuit between two separate phase coils. Therefore, if all the other components check out okay, then replace the stator.

Testing the Rotor Assembly

The rotor should be tested for grounds with an armature tester, a 12-volt test lamp, or a 110-volt test lamp. However, use caution when using an armature tester or a 110-volt lamp.

When using a test lamp, place one of the probes on the slip ring and the other probe on the rotor coil.

If the lamp lights, the rotor is grounded.

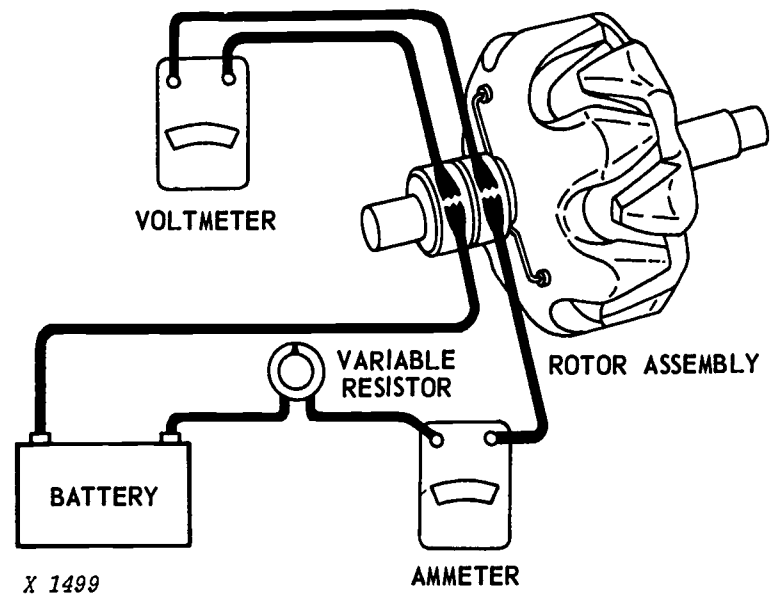


Fig. 81—Testing the Rotor Assembly

To check the rotor for shorted or open windings, connect a voltmeter to the slip rings (Fig. 81). Then connect an ammeter in series with a variable resistor to the slip ring and 12-volt battery as shown. Set the variable resistor to maximum resistance. Connect the other slip rings to the battery and adjust the resistor to obtain full battery voltage.

Caution: *Do not remove the wire from the slip ring at this time as it will cause an arc, damaging the slip ring surface and requiring clean-up.*

Rotor field current draw should equal the amount specified for the applied voltage. For example, it should be between 2.0 to 2.5 amperes at 12.4 volts.

Shorted windings are indicated by excessive current draw, open windings by no current draw at all.

If the slip rings are scored, turn them in a lathe until they just clean up. If desired, polish them sparingly with No. 00 sandpaper or No. 400 grit silicon carbide paper.

Assembly of Alternator

Reassembly of the alternator is generally just the reverse of disassembly.

However, observe the pre-test precautions again and use the specific directions for assembly given in the machine Technical Manual.

ALTERNATOR REGULATORS

The *a.c.* **regulator** is the *control for the alternator.* Otherwise, the alternator would produce too much voltage.

The regulator does this by placing a resistance in the field circuit which reduces current flow to the alternator rotor. This is much the same principle as used by the regulator in d.c. charging circuits.

How is the a.c. regulator different from the d.c. regulator?

1. No current regulator is needed, since the alternator limits its output by setting its own opposing field during operation.

2. The a.c. regulator is often only a voltage regulator.

There are special cases where combination regulator or field relay units are used for a.c. circuits, but these are not basic to our present story. (See later under "Other Types of Alternator Regulators.")

TRANSISTORIZED REGULATOR

The most popular a.c. regulator is **transistorized.** It is a fully electronic unit composed of resistors, diodes, Zener diode, transistors and thermistors. These components are usually in a sealed case. (See Fig. 82.) This eliminates the need for adjustments or the chance of failure due to dirt or moisture.

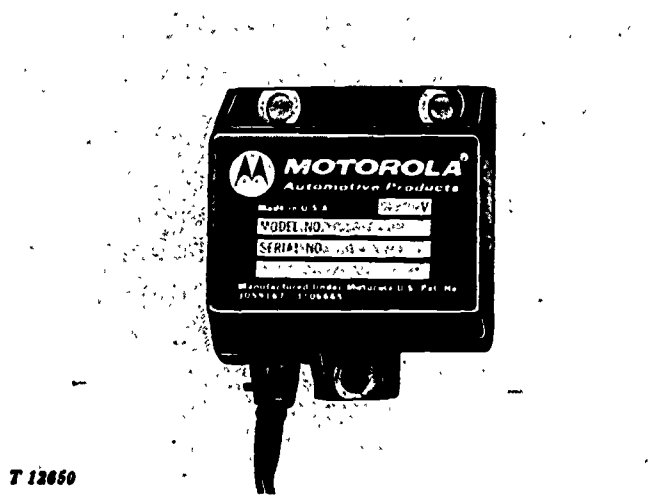


Fig. 82—Transistorized Regulator

This regulator has several components new to this chapter. For the basic operation of these devices, see Chapter 1. Here we will only give a basic description:

1. **Resistors**—Devices made of wire or carbon which present a resistance to current flow.

2. **Zener Diode**—A diode which is connected in a reverse bias and below a certain voltage works like the usual diode. However, beyond a predetermined voltage, the Zener diode will conduct reverse current.

3. **Transistor**—Semi-conductors which control the flow of current in the circuit by either allowing it to flow or stopping it.

4. **Thermistor**—A temperature-compensated resistor. The degree of its resistance varies with the temperature.It controls the Zener diode so that a higher system voltage is produced in cold weather, when needed.

Operation of the Transistorized Regulator

Basically, the a.c. regulator has three jobs:

1. Allow battery current to excite the alternator field coils.

2. Shut off battery current once alternator voltage has built up.

3. Control charging voltage at safe values during operation.

Physical appearance will vary between different types of regulators. The actual components (diodes, transistors, etc.) within the regulator may vary both in number and type as well. However, the goal of all regulators is the same. For this reason, we give the following example of a *typical* regulator and take you through its operation step by step.

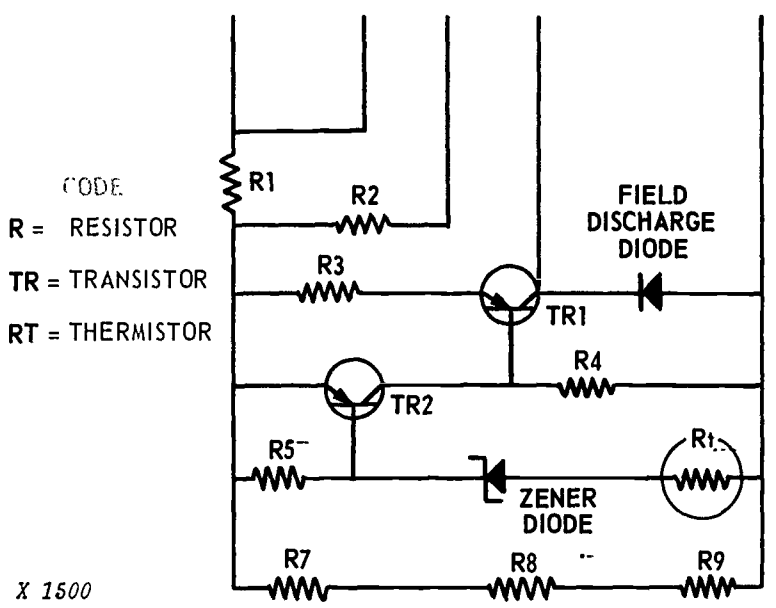


Fig. 83—Circuit of Transistorized Regulator

Fig. 83 shows a diagram of the regulator. The three primary components are TR1 or the *power transistor,* TR2 or the *drive transistor,* and the *Zener diode.* The other resistors and the field discharge diode are aides to the three main devices.

Let's see how the regulator works.

HOW THE REGULATOR WORKS DURING STARTING

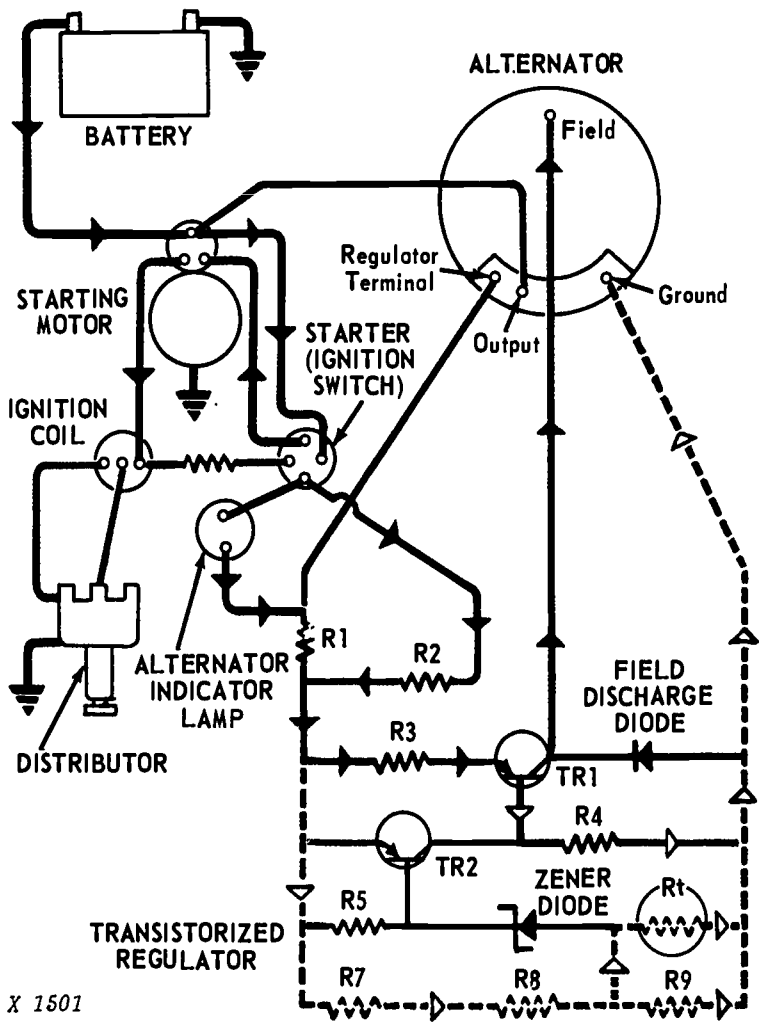


Fig. 84—Operation of Transistorized Regulator during Starting

When the starter switch is turned on, the circuit is completed (Fig. 84). Battery current flows to the starter solenoid and to the starter (ignition) switch as shown by the red lines. The starter solenoid sends the current on to the ignition coil, while the starter switch sends current to the alternator indicator lamps and to the regulator.

As the current flows into the regulator, different voltage values govern the course of the current. The voltage across resistors R7 and R8 for instance, is below the Zener diode critical or "break down" voltage. Therefore, the voltage felt at the base of TR2 is the same as the voltage at its emitter. So the current cannot flow through TR2 (as shown by the blue lines).

Thus the voltage drop across the emitter-base of TR1 allows current flow from its emitter through its base and collector. The collector current then goes on to excite the alternator field (vertical red line). At the same time a slight amount of current flow travels to the alternator ground as shown by the dotted red line.

HOW THE REGULATOR WORKS DURING ENGINE OPERATION

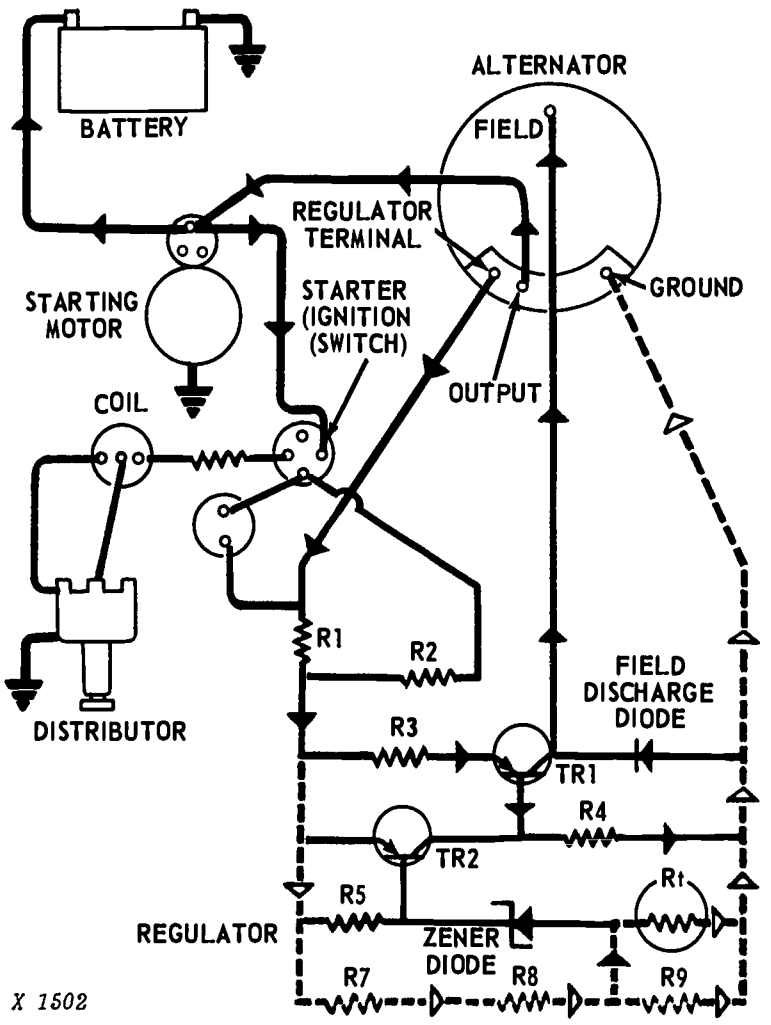


Fig. 85—Operation of Regulator—Transistor TR1 Turned On

The early part of engine operation is similar to the starting period above except that as the engine speeds up the alternator field around the rotor generates voltage which flows out to supply loads. However, the voltage values are still the same and transistor TR1 still conducts the current to the alternator field as shown by the vertical red line.

As the engine operates and load requirements begin to decrease, the alternator voltage builds up (Fig. 86). This causes the voltages across the resistors to also increase. Then the voltage across R7 and R8 becomes greater than the Zener diode critical voltage. The Zener diode immediately "breaks down," allowing current to flow through in a reverse direction. This "turns on" transistor TR2 and so current is able to flow through TR2's emitter-base and collector.

When current flows through TR2, the voltage at the base of TR1 is equal to or greater than at its emitter. This prevents current from flowing through TR1 to the alternator field. This collapses the field and reduces the output of the alternator, protecting the circuit.

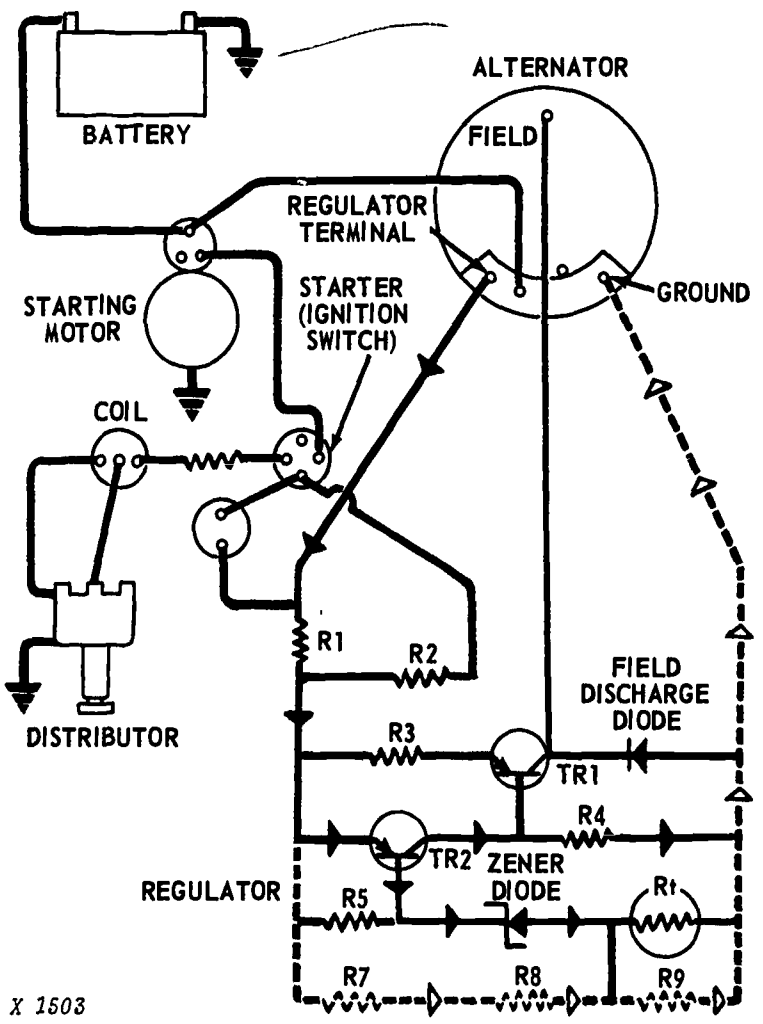


Fig. 86—Operation of Regulator—Transistor TR2 Turned On

The system voltage then drops below the critical voltage of the Zener diode and it stops conducting. This turns off TR2 and turns on TR1 and current again flows to the alternator field. This operation is repeated many times a second.

In effect, the two transistors act as switches controlling the voltage and alternator output.

Note the *field discharge diode* in Fig. 86. This diode prevents damage to transistor TR1.

When TR1 turns off, the alternator field current cannot drop immediately to zero, because the rotor windings cause the current to continue to flow.

Before the current flow reaches zero, the system voltage and regulator start current flow again. However, the decreasing field current flow induces a high voltage and this can damage the transistor.

The purpose of the field discharge diode is to divert the high voltage away from the transistor.

Testing and Repairing the Transistorized Regulator

First make a complete circuit check to isolate the faulty component. Take all the normal precautions for safety.

For a general diagnosis, use the checks given earlier in the alternator testing section. Then make the more specific tests which follow.

For a particular test procedure, always follow the machine Technical Manual. The following test is an example of the type usually made on a transistorized regulator. Since the regulator is only used to control voltage, the voltage test is all that is required.

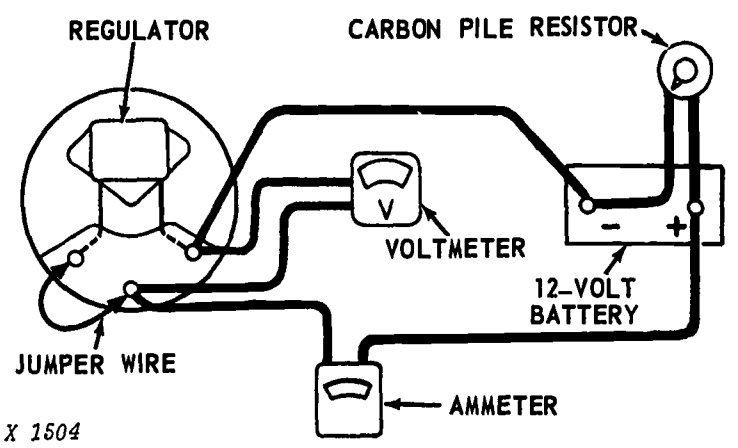


Fig. 87—Voltage Test for Transistorized Regulator

VOLTAGE TEST

1. This test can be performed either on or off the machine. Use an alternator that is known to be in good repair. Set up the test circuit shown in Fig. 87.

2. Connect a voltmeter to the alternator ground and output terminals as shown. Be sure to use a voltmeter with an accuracy within 0.1 volts.

3. Start the engine and insert a load of about 10 amps (use lights, motors, carbon pile resistors, etc.)

4. Operate the circuit for about 15 minutes to stabilize the temperature of the regulators. Measure and record the temperature about one inch from the regulator case.

5. Compare the voltmeter reading with the voltage specifications listed in the machine Technical Manual. Do not forget to adjust the reading for the temperature recorded above.

ADJUSTMENT AND REPAIR

Some transistorized regulators have an adjusting screw for changing the operating voltage for different conditions.

Since most transistorized regulators are sealed units, they offer no means of repair. Therefore, they must be replaced if they are faulty. But at the same time this type of regulator is usually more reliable than other kinds.

OTHER TYPES OF ALTERNATOR REGULATORS

As popular as the fully transistorized regulator is, it is not the only regulator used. A 3-unit vibrating contacts regulator, similar to the unit used with d.c. charging circuits can be used. A 2-unit vibrating contacts regulator consisting of a field relay (similar to a cutout relay) and double vibrating contact points voltage regulator can also be employed. A single unit consisting of just a double vibrating contacts voltage regulator is a third usage. All three of these types have been used in the past and are, in some cases, still in use today.

Transistor Vibrating Contacts Regulator

This combination of old and new, so to speak, has been effectively used in some a.c. charging circuits.

A typical model has a *circuit breaker* to protect the alternator in case of shorts, grounds, or reverse polarity. A *voltage regulator* controls a *transistor* which in turn energizes the alternator field. *Diodes* are used as safety devices to protect the regulator. *Resistors* also aid in controlling the circuit.

DIAGNOSIS AND TESTING OF CHARGING CIRCUITS

In this chapter we have strongly suggested that you begin by testing the complete charging circuit. The checks given here should be done before any of the component tests given earlier in this chapter. A circuit check will isolate the failing component.

In this section we will cover charging circuit problems, diagnosis and testing of the circuit on the machine, and any adjustments on the complete circuit.

In some cases, we may repeat something that has been mentioned previously. However, this will refresh your memory on the importance of the information.

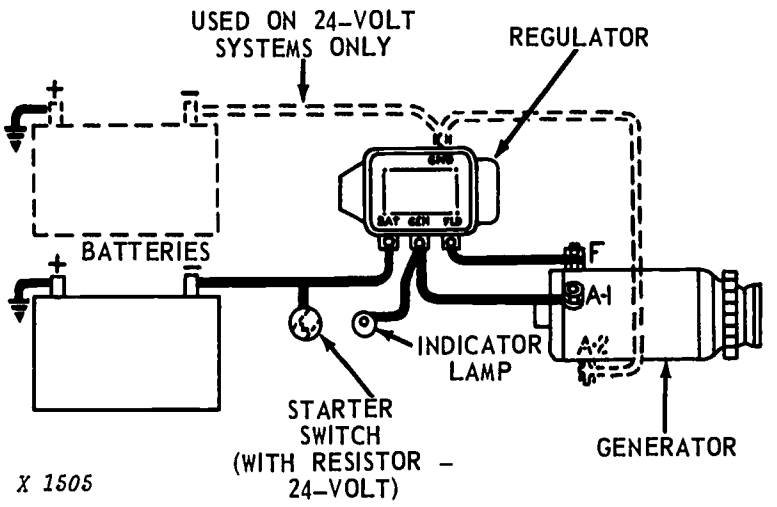


Fig. 88—Typical D.C. Charging Circuit

TROUBLE SHOOTING OF CHARGING CIRCUITS

When using this chart, assume that the battery is in good operating condition. (Battery problems are covered in Chapter 3.)

Problem	Possible Cause
1. Low Battery Output	a. Faulty Regulator—A.C. or D.C.
	b. Faulty Generating Unit—A.C. or D.C.
	c. Slipping Drive Belt—A.C. or D.C.
2. Low Generating Output	a. Slipping Drive Belt—A.C. or D.C.
	b. Poor Lead Connections—A.C. or D.C.
	c. High Circuit Resistance—A.C. or D.C.
	d. Cutout Relay Malfunction—D.C.
	e. Faulty Regulator Circuit Breaker—A.C.
	f. Regulator Diode Malfunction—A.C.
	g. Regulator Transistor Malfunction—A.C.
	h. Oxidized Regulator Points—A.C. or D.C.
	i. Open Isolation Diode — A.C.
	j. Shorted Field Circuit Windings—A.C. or D.C.
	k. Open Diodes—A.C.

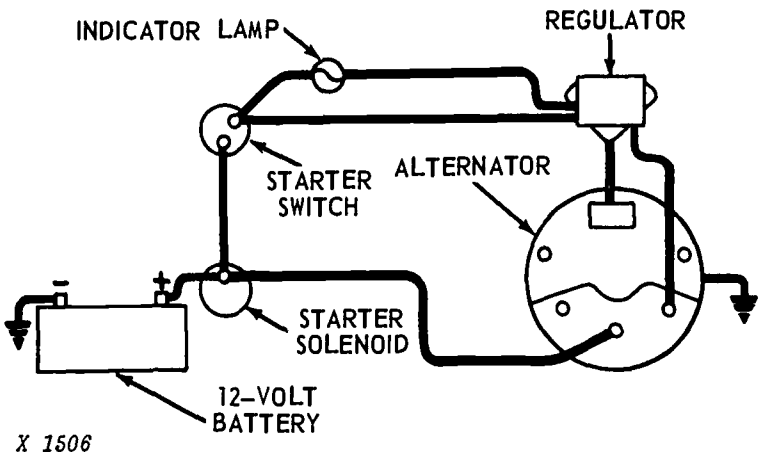


Fig. 89—Typical A.C. Charging Circuit

3. Excessive Output

a. Faulty Regulator—A.C. or D.C.

b. Grounded Field Terminal —D.C.

c. High Voltage Regulator Setting—A.C. or D.C.

d. High Temperature — A.C. or D.C.

e. Shorted Regulator Transistor—A.C.

f. Shorted or Open Alternator Diode—A.C.

4. Noisy Generating Unit

a. Defective Bearings — A.C. or D.C.

b. Loose Mounting—A.C. or D.C.

c. Shorted Diode—A.C.

d. Open Diode—A.C.

e. Brush Chatter—D.C.

5. Battery Uses Too Much Water

a. Regulator Setting Too High—A.C. or D.C.

b. Faulty Regulator—A.C. or D.C.

6. No Generating Output

a. Sticking Brushes—D.C.

b. Loose or Open Connections—A.C. or D.C.

c. Grounded, Shorted, or Open Armature—D.C.

d. Grounded, Shorted, or Open Field Circuit—D.C.

e. Grounded Terminals — D.C.

f. Dirty or Corroded Commutator—D.C.

g. Open Diodes—A.C.

h. Open Stator Windings — A.C.

i. Open Rotor Windings — A.C.

j. Faulty Regulator Circuit Breaker—A.C.

k. Faulty Cutout Relay—D.C.

l. Faulty Current Regulator —D.C.

m. Faulty Voltage Regulator —D.C.

n. Open Transistor—A.C.

o. Open Isolation Diode — A.C.

SAFETY RULES

Before we start the circuit tests, let's quickly review some of the precautions that have been mentioned in the previous sections of this chapter.

D.C. Circuits

1. Polarize the circuit after each test or adjustment.

2. Be sure the battery is in good operating condition before making any tests or adjustments.

3. Disconnect the battery ground cable when removing the generator or battery.

4. Never immerse the circuit components in a cleaning solution.

A.C. Circuits

1. Never attempt to polarize the circuit.

2. Be sure the battery is in good operating condition before making any tests or adjustments.

3. Never operate the alternator in an open circuit.

4. Never short or ground the alternator terminals.

5. Do not disconnect the voltage regulator while the alternator is running.

6. Disconnect the negative battery cable first when removing the alternator or battery.

7. Do not use acid-core solder on the alternator terminals. Use only a rosin-core solder.

8. Never immerse the circuit components in cleaning solution.

TESTING THE D.C. CHARGING CIRCUIT

Remember that these are general tests performed on a circuit which has a standard shunt-type generator and a 3-unit regulator. The battery should be considered in good operating condition for these tests.

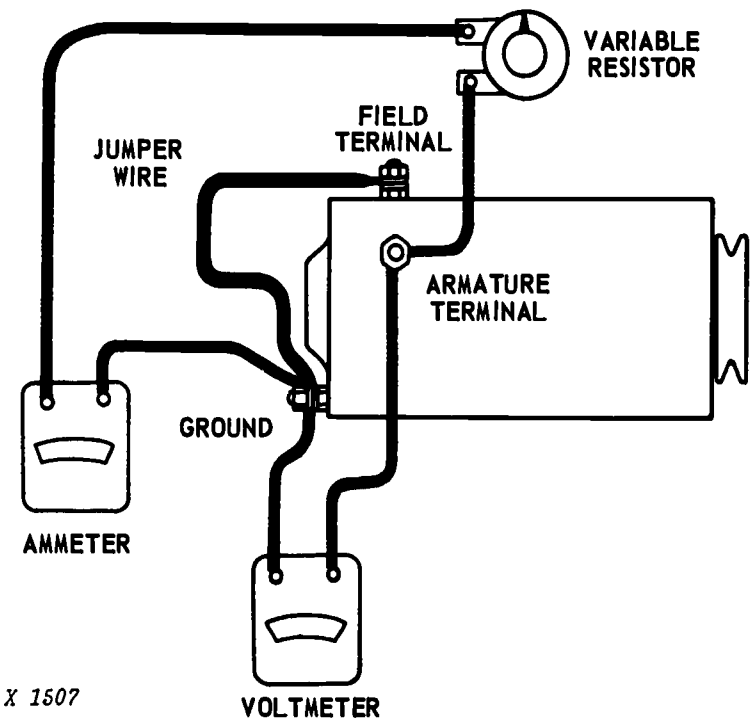


Fig. 90—Generator Output Test (12-Volt Circuit)

Generator Output Test

The test equipment you should have for this test are: *an ammeter, a voltmeter, a tachometer, a variable resistor and a jumper wire.*

You will notice that we have shown this equipment in its basic form. An electrical testing unit as shown in Chapter 2 may combine them all into one unit. If this is the case, follow the tester's instructions in making test connections.

TEST PROCEDURE

1. Make a visual check of all wire leads, connections, and brushes.

2. Disconnect the leads to the generator armature and field terminals.

3. Connect the voltmeter and ammeter in series with the variable resistor to the generator armature terminal and to ground.

4. Connect the jumper wire to the generator field terminal and to ground.

5. Adjust the variable resistor for the least resistance.

6. Operate the engine at the specified speed.

7. Adjust the variable resistor to obtain the specified voltage. (For example, 14-volts for a 12-volt circuit, or 28.5 volts in a 24-volt circuit.)

The generator output should be as specified. For example: 20 amps for a 12-volt circuit, or 10 amps for a 24-volt circuit.

If the results are not what is specified, the generator is faulty. Remove the generator from the circuit and make further tests.

If the test shows a good generator, reconnect the leads to the terminals and polarize the generator.

Resistance Tests

As is shown in Fig. 91, we are again performing this on a 12-volt circuit. Because these tests are given as examples of the type of tests used, you will need to consult the machine Technical Manual for particular testing connections, procedures, and specifications.

TESTING PROCEDURE

1. Connect the ammeter to the regulator battery terminal and to the wire disconnected from this terminal.

2. Connect a jumper wire to the generator field terminal and to ground.

3. With all accessories off, run the engine at a speed that will produce a 10-amp charging rate. *(DO NOT exceed 10 amps in a 24-volt circuit.)*

4. Measure the voltage at the following points:

a. From the generator armature terminal to a pin connector in the negative battery post.

b. From the generator frame to the regulator base.

c. From the generator frame to the grounded battery post.

5. Disconnect the jumper wire and turn on the lights. Continue the 10-amp charging rate. If you must lower the battery voltage to get the 10-amp charging rate, use a heavy-duty carbon pile resistor connected to the battery.

6. Check the voltage from the generator field to the regulator field terminal.

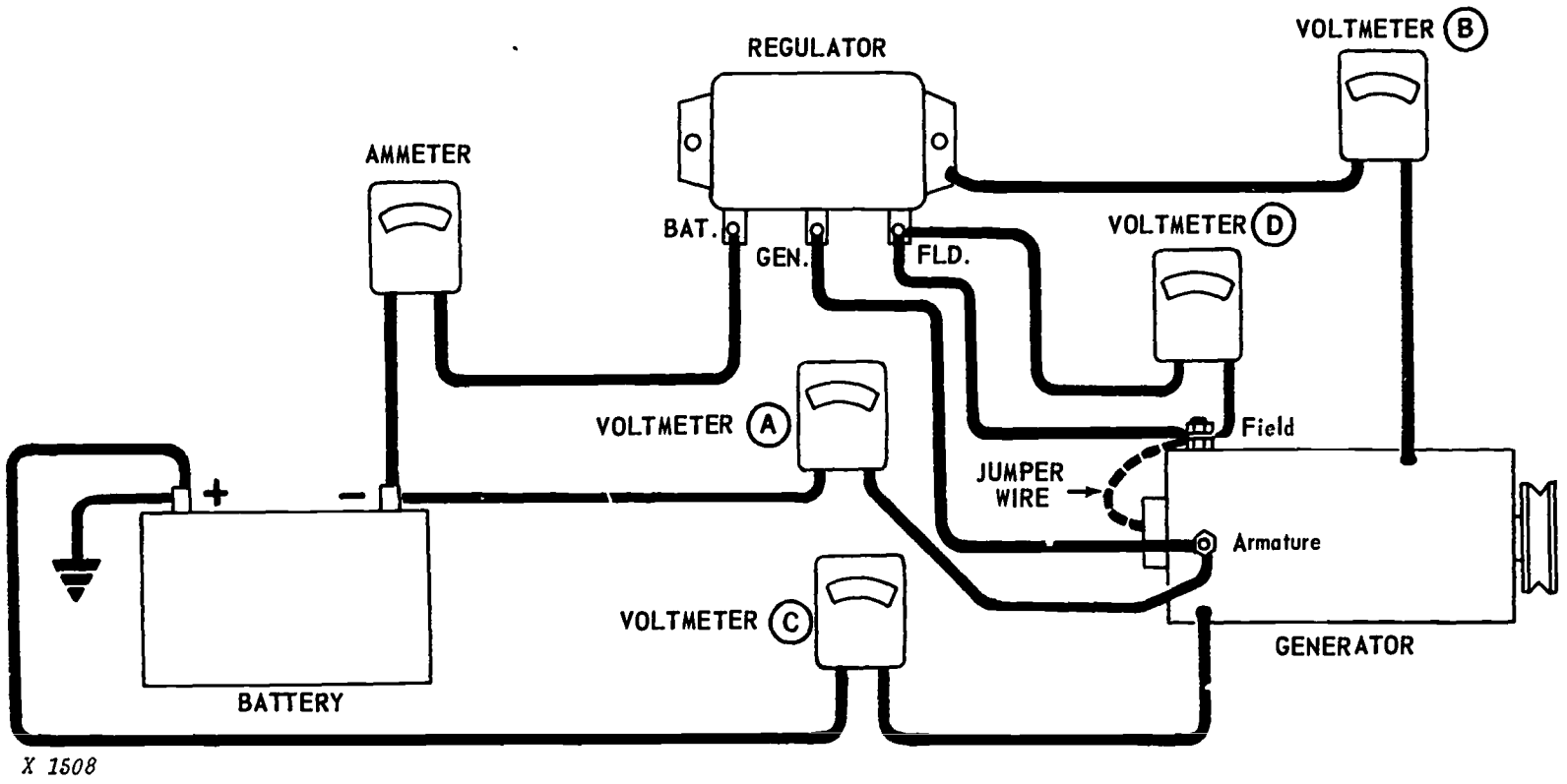


Fig. 91—Wiring Resistance Tests (12-Volt Circuit)

JUDGING THE TEST RESULTS

If the voltage readings are too high, check out each circuit component individually.

If the readings are normal, reconnect the regulator lead and polarize the generator.

Regulator Tests

OXIDIZED REGULATOR POINTS TEST

1. Connect the ammeter into the circuit as shown in Fig. 92.

2. Run the engine at a speed capable of producing 8 amps with all lights on.

3. Connect a jumper wire as shown in Fig. 92.

JUDGING THE TEST RESULTS

If the ammeter reading increases more than two amps, the regulator points are oxidized.

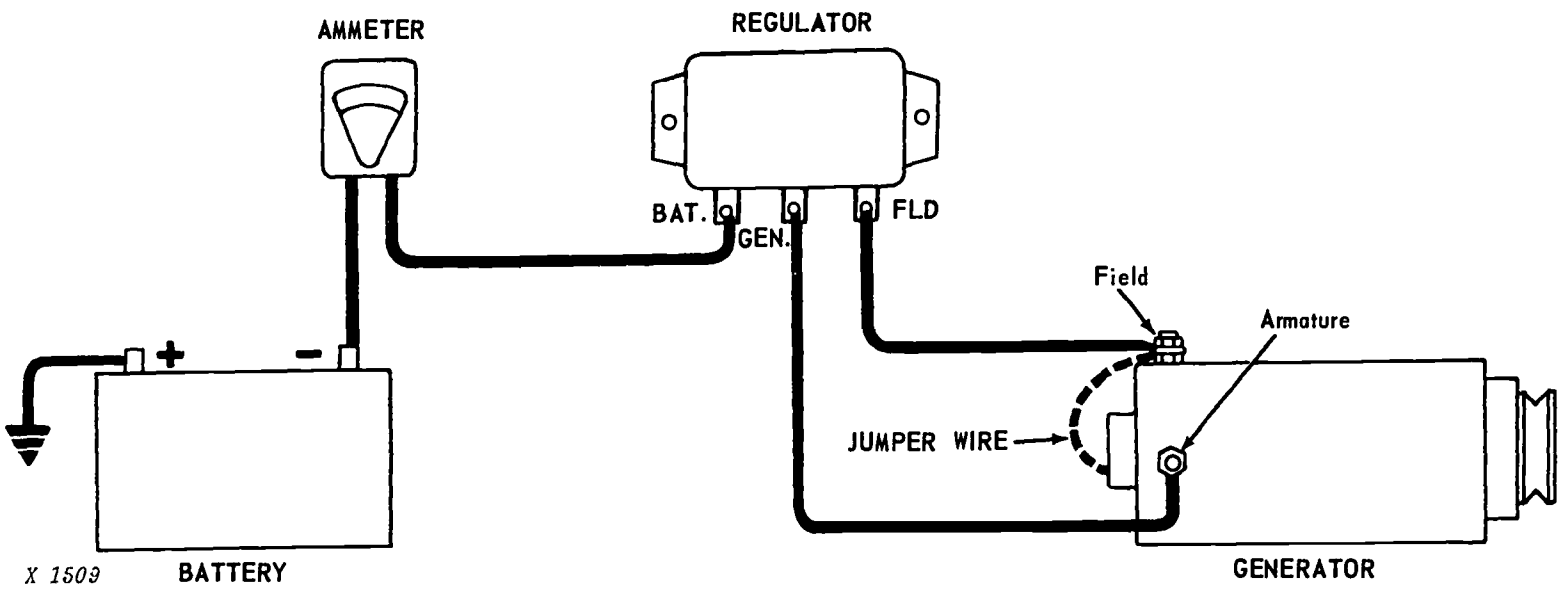


Fig. 92—Regulator Test Connections—Checking for Oxidized Points

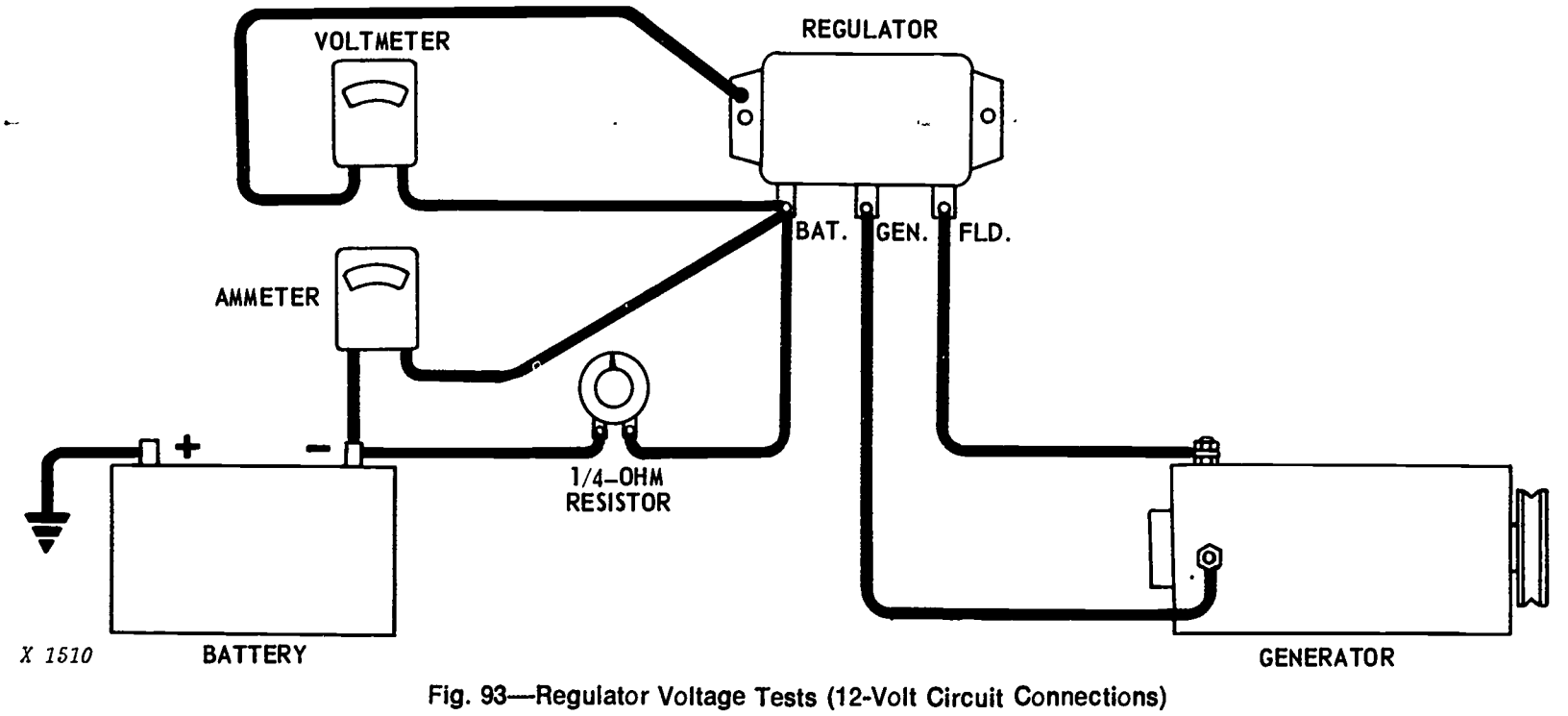


Fig. 93—Regulator Voltage Tests (12-Volt Circuit Connections)

REGULATOR VOLTAGE TESTS

1. Disconnect the battery wire from the regulator battery terminal.

2. Connect the voltmeter and a ¼-ohm resistor as shown in Fig. 93. (On regulators with accelerator windings, use the specified resistor only.)

3. Run the engine for 15 minutes to reach the regulator operating temperature.

4. Stop and restart engine to cycle the generator.

5. Run the engine at the specified speed (for example, 1900 rpm).

6. Check the voltmeter reading and the operating temperature of the regulator. Compare these readings with the specifications, such as the examples listed below:

Temperature	Correct Voltage (12-Volt Circuit)
85° F.	*14.2-15.0 volts*
105° F.	*14.0-14.7 volts*
125° F.	*13.8-14.5 volts*
145° F.	*13.5-14.1 volts*

JUDGING THE TEST RESULTS

If the specifications are not met, check the voltage regulator unit of the regulator more closely.

REGULATOR CURRENT TEST

Test instrument connections for this test are given in Fig. 93.

Test Procedure

1. Disconnect the battery wire from the regulator battery terminal.

2. Connect the voltmeter and ammeter as shown in Fig. 93. (Do not connect the ¼-ohm resistor.)

3. Start the engine several times to lower the battery voltage.

4. Turn on all lights and run the engine at the specified speed.

5. The voltmeter reading should be 1 volt below the voltage regulator setting.

6. The ammeter reading should be as specified. For example, 18.5 to 21.5 amps on a 12-volt circuit.

JUDGING THE TEST RESULTS

Make further tests on the current regulator portion of the regulator if this test is unsatisfactory.

TESTING THE A.C. CHARGING CIRCUIT

In the following test examples, an open-type alternator and a transistorized regulator are used.

We remind you again to follow the precautions that we have given. To ignore them will only increase the chance of damaging the electrical components or injuring yourself.

The test equipment must be accurate and in good condition.

The instruments needed for these tests are:

1. Voltmeter

2. Ammeter

3. Variable Resistor

4. Jumper Wire

Before making any electrical tests, satisfy yourself that all leads are firmly connected and in good repair. Also check the alternator drive belt tension.

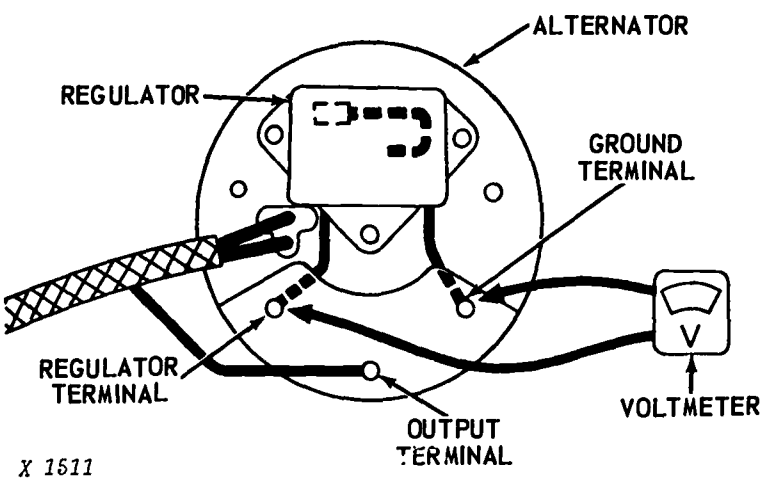


Fig. 94—Voltmeter Test Connections

Test No. 1

1. Connect the voltmeter as shown in Fig. 94.

2. With the engine, ignition key switch, and accessories off, the voltmeter should read less than 0.1 volt.

JUDGING THE TEST RESULTS

A high reading indicates a shorted isolation diode or ignition key switch.

Test No. 2

1. Under the same conditions as Test No. 1, turn the ignition key switch on.

2. The voltmeter reading should be between 2 and 3 volts.

JUDGING THE TEST RESULTS

A high reading could be caused by a high resistance in the alternator field, defective brushes, or a defective regulator.

A low reading might indicate a shorted alternator field, a defective regulator, or an open circuit.

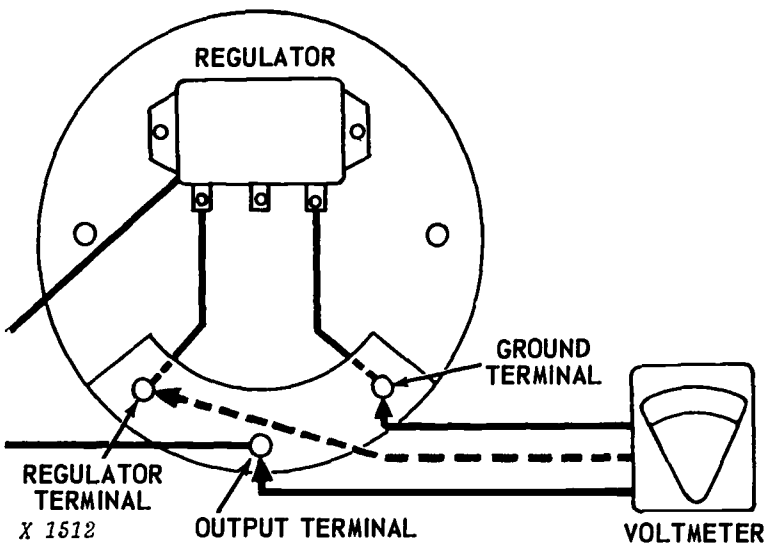


Fig. 95—Voltmeter Connections

Test No. 3

1. First, leave the voltmeter connected to the ground terminal and regulator terminal of the alternator (Fig. 95).

2. With the engine running and the key switch on but all accessories off, the voltmeter should read more than 15 volts.

3. Move the voltmeter lead from the regulator terminal to the output terminal. The voltmeter should read 1 volt less.

JUDGING THE TEST RESULTS

If the regulator terminal voltage is correct and the output terminal is the same as battery voltage, then an isolation diode is open.

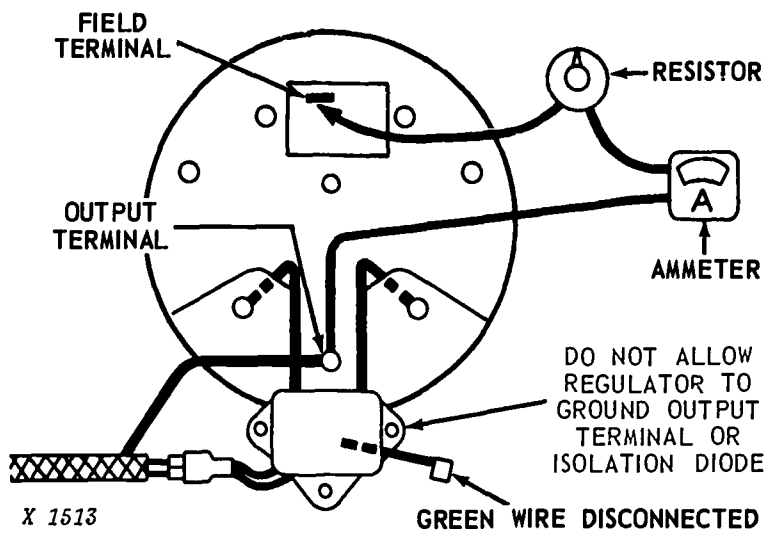


Fig. 96—Ammeter Connections

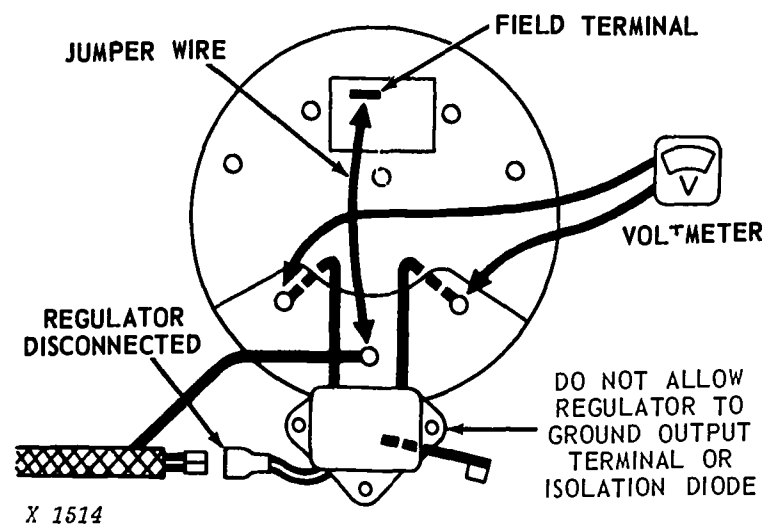


Fig. 97—Jumper Wire and Voltmeter Connections

Test No. 4

This test is usually performed if Test No. 2 indicated a malfunction.

1. With the engine and switch off, disconnect the regulator-to-alternator field terminal wire (Fig. 96). Let the regulator hang on the wires connected to the regulator and ground alternator terminals. Be very careful in how the regulator hangs. Do not allow it to ground on the output terminal.

2. Connect the ammeter in series with a variable resistor to the field terminal and output terminal.

3. With all resistance eliminated, the ammeter should read 2.0 to 2.5 amps with the alternator cold.

JUDGING THE TEST RESULTS

A high reading indicates a shorted field winding or brushes.

A low reading means a high resistance in the brushes or slip ring, or an open circuit in the field windings.

Test No. 5

1. Connect the voltmeter and jumper wire as shown in Fig. 97.

2. Run the engine at a specified speed—for example, 800 rpm.

3. This should give a voltmeter reading of 15 volts. *Do not allow voltage to go above 16.5 volts.*

Overall Test Evaluation

If test No. 5 proved to be satisfactory, but test No. 3 voltage was below specifications, the regulator is probably at fault.

If test No. 5 voltage was low, but tests No. 2 and 4 were satisfactory, the alternator is probably faulty.

WIRING RESISTANCE TEST

If the alternator and regulator operate properly, then check the wiring.

Test Procedure

1. Make a quick visual check of the lead connections and wires.

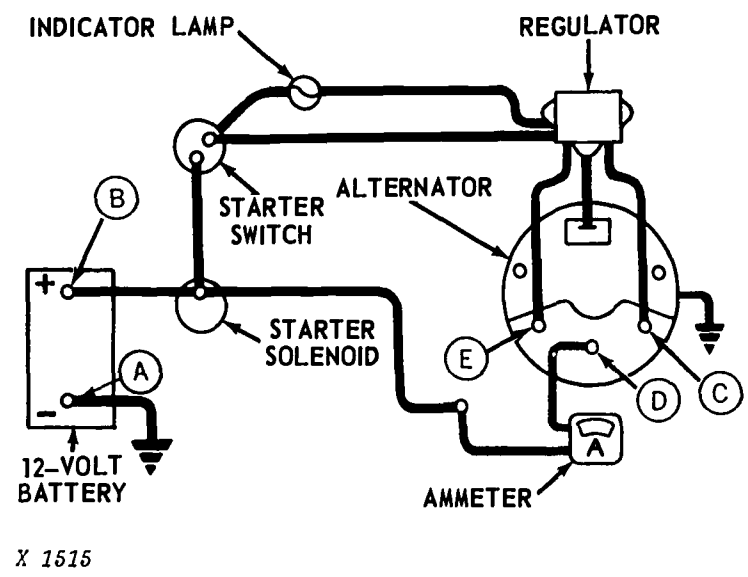


Fig. 98—Wiring Test Points

2. Disconnect the battery ground strap and connect the ammeter as shown in Fig. 98.

3. Run the engine to obtain a 10-amp charging rate.

4. Check with a voltmeter the voltage at different points shown in Fig. 98.

5. The voltage between these points should be as listed in the chart below.

Test Points	Max. Voltage
A-C	*0.3 volts*
B-D	*0.3 volts*
B-E	*1.3 volts*

JUDGING THE TEST RESULTS

A high reading indicates a high resistance in the wiring or components.

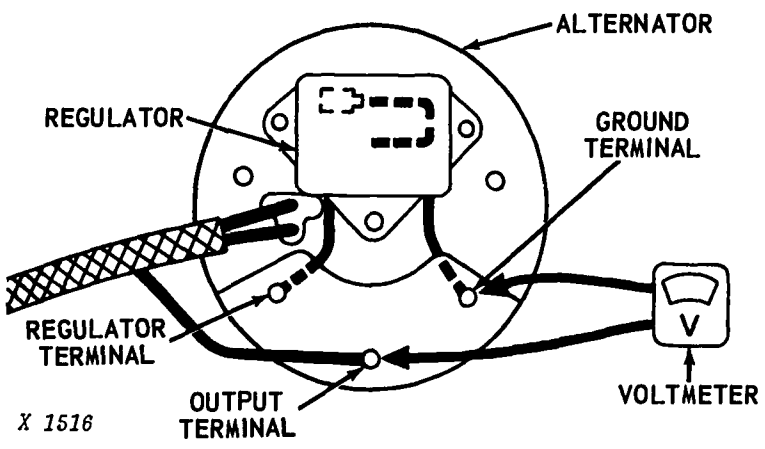


Fig. 99—Regulator Test Connections

Regulator Testing Procedure

1. Connect the voltmeter as shown in Fig. 99. Use an accurate voltmeter—one that will measure to within plus or minus 0.1 volts.

2. Run the engine to obtain a 10-amp charging rate for about 15 minutes to stabilize the regulator temperature.

3. Measure the regulator temperature about one inch from the regulator and check the voltmeter reading.

4. Compare the reading with the chart below.

Temperature	Correct Voltage (12-Volt Circuit)
40° F.	*14.4-14.9 volts*
60° F.	*14.3-14.7 volts*
80° F.	*14.2-14.6 volts*
100° F.	*14.0-14.4 volts*
120° F.	*13.8-14.3 volts*
140° F.	*13.6-14.1 volts*

JUDGING THE TEST RESULTS

If the voltage is not within limits, the regulator is faulty.

TEST YOURSELF

QUESTIONS

1. What are the two main jobs of all charging circuits?

2. True or false? "D.c. charging circuits generate a direct current while a.c. charging circuits generate an alternating current."

3. Match each item on the left below with the correct item on the right.

a. During starting	*1.* Generator supplies all current and recharges battery
b. During normal operation	*2.* Battery supplies all load current
c. During peak operation	*3.* Battery helps generator supply current

4. What are the two main parts of a basic generator?

5. How is the current generated by these two parts?

6. Fill in the blanks with "generator" or "alternator." A moving field in a fixed conductor describes a(n) _____. A moving conductor in a fixed field describes a(n)_____.

7. Name the three main units of an alternator.

8. Which of these units contains diodes?

9. What is the purpose of the diodes?

10. True or false? "Never polarize an alternator."

11. What is the most popular type of alternator regulator?

(Answers on next page.)

ANSWERS

1. 1) Recharge the battery, and 2) generate current during operation.

2. False. Both circuits generate an alternating current (a.c). The difference is in the way that rectify the a.c. current to d.c. current.

3. a—2; b—1; c—3.

4. An *armature* and *magnetic poles* (or field).

5. By moving the armature or conductor through the magnetic field.

6. First blank — "alternator." Second blank — "generator."

7. Rotor assembly, stator assembly, and rectifier assembly.

8. The rectifier assembly.

9. The diodes convert a.c. to d.c. current.

10. True. This might damage the rectifier unit.

11. The transistorized model.

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STARTING CIRCUITS / CHAPTER 5

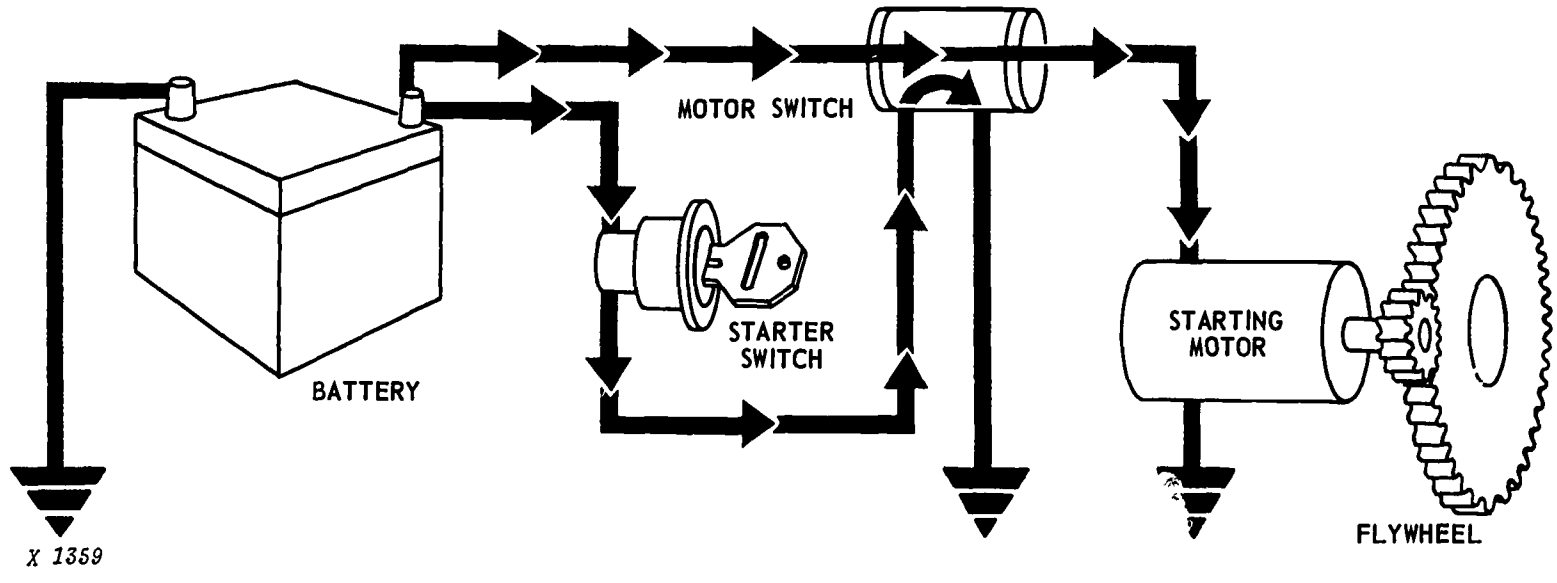

Fig. 1—Basic Starting Circuit

HOW THE STARTING CIRCUIT WORKS

The starting circuit converts electrical energy from the battery into mechanical energy at the starting motor to crank the engine.

A basic starting circuit has four parts:

1. The BATTERY supplies energy for the circuit.

2. The STARTER SWITCH activates the circuit.

3. The MOTOR SWITCH engages the motor drive with the engine flywheel.

4. The STARTING MOTOR drives the flywheel to start the engine.

How do these parts work together as a team?

The starting circuit is shown in operation in Figs. 2, 3, and 4.

When the starter switch is activated by the operator (Fig. 2), a small amount of electrical energy flows from the battery to the solenoid and back to the battery through the ground circuit.

As the solenoid gets this power from the battery, it moves the solenoid plunger and engages the pinion with the flywheel (Fig. 3). The plunger also closes the switch inside the solenoid between the battery and starting motor, completing the circuit and allowing a large amount of electrical energy to flow into the starting motor.

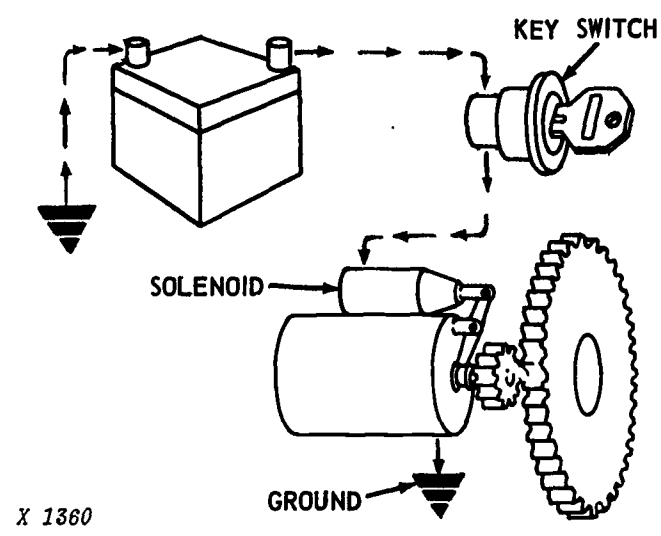

Fig. 2—Starting Circuit in Operation: 1) As the Starter Switch Is Activated

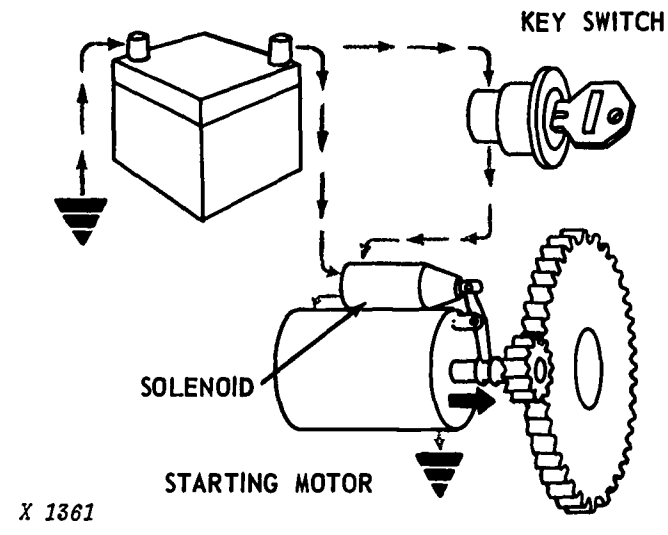

Fig. 3—Starting Circuit in Operation: 2) Starting Motor Engages Flywheel

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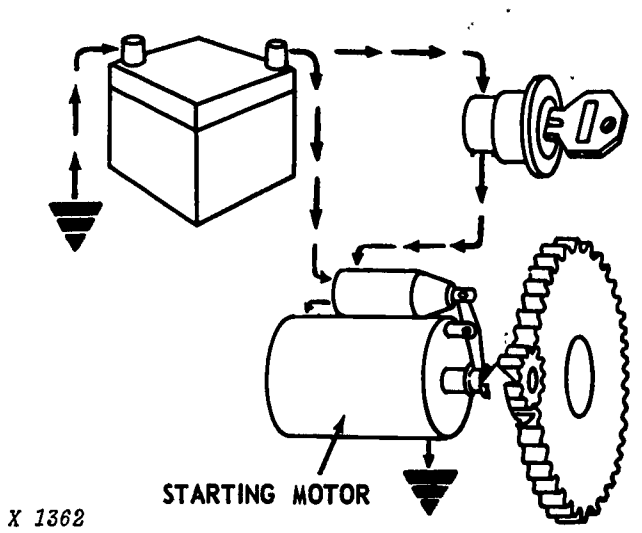

Fig. 4—Starting Circuit in Operation: 3) Starting Motor Cranks Engine

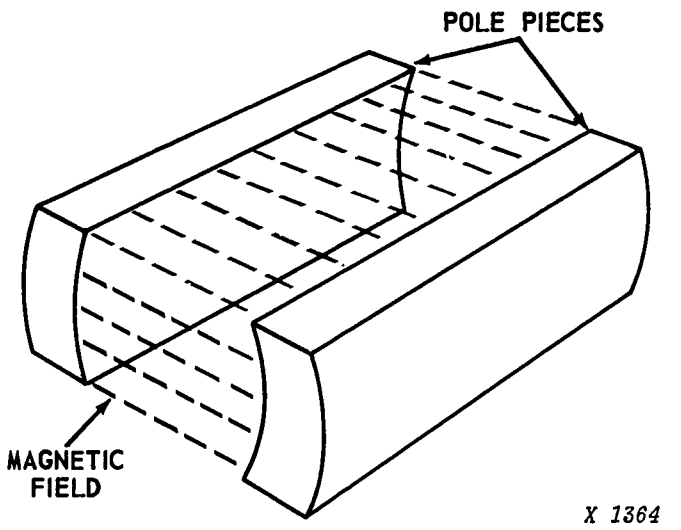

Fig. 5—Pole Pieces and Their Magnetic Field

The starting motor takes the electrical energy from the battery and converts it into rotary mechanical energy to crank the engine (Fig. 4).

The battery is covered in Chapter 3 since it serves the whole electrical system. But remember that the battery is the source of power for starting the engine.

In our typical system, we have used a solenoid switch as an example. Motors can use other types of switches as we'll see later.

Now let's take a closer look at the starting motor itself.

HOW A STARTING MOTOR WORKS

The starting motor does the actual job of cranking the engine. It is a special type of electric motor:

1) It is designed to operate for short intervals under great overload.

2) It produces very high horsepower for its size.

The basic starting motor has a **solenoid,** a **field frame assembly,** an **armature,** and a **drive mechanism.**

Let's see how these parts work to convert electrical energy from the battery into mechanical energy to crank the engine.

First consider the **pole pieces** in the field frame assembly of the starting motor as the ends of a magnet (Fig. 5). The space between these poles is called the magnetic field.

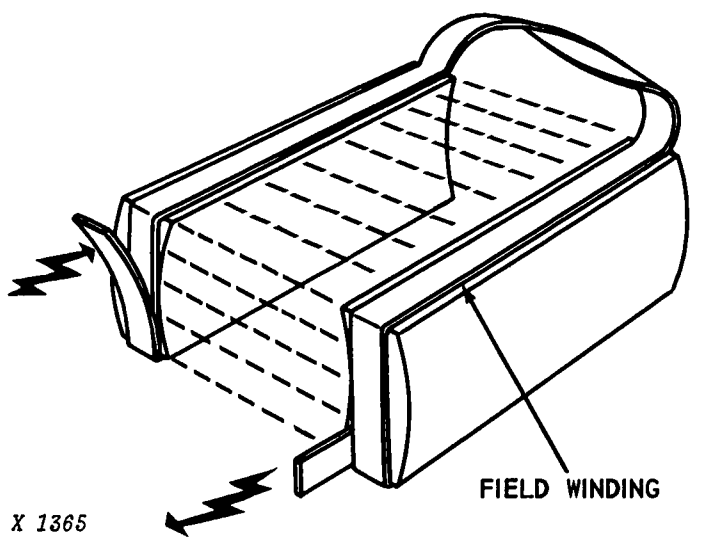

Fig. 6—Field Winding Added to Pole Pieces

If a wire, called a **field winding,** is wrapped around these pole pieces and current is passed through it, the strength of the magnetic field between the pole pieces is increased (Fig. 6).

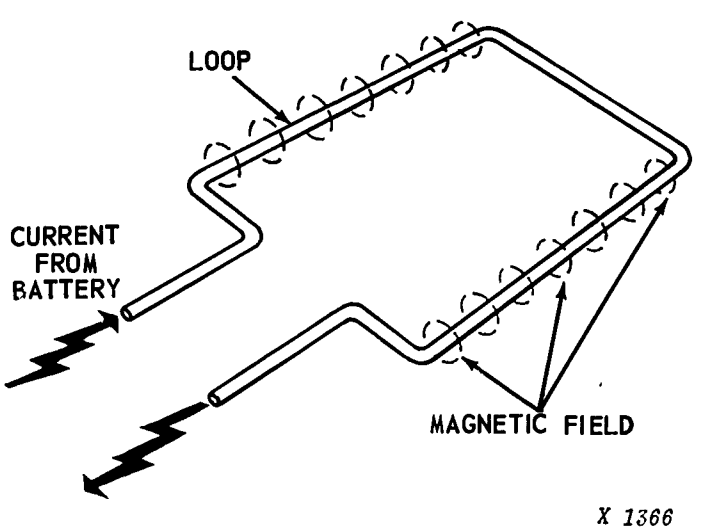

Fig. 7—Loop of "Live" Wire and Its Magnetic Field

Now let's consider a loop of wire (Fig. 7). When we feed electrical energy from the battery into this loop, a magnetic field is also formed around the wire.

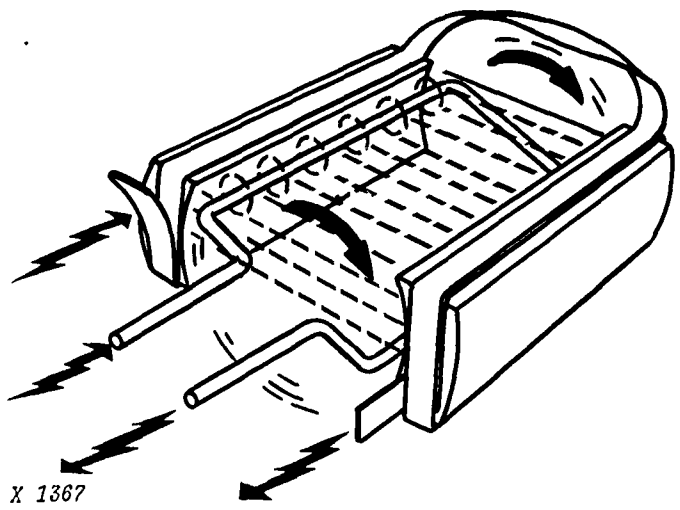

Fig. 8—Loop of Wire Placed in Field between Poles

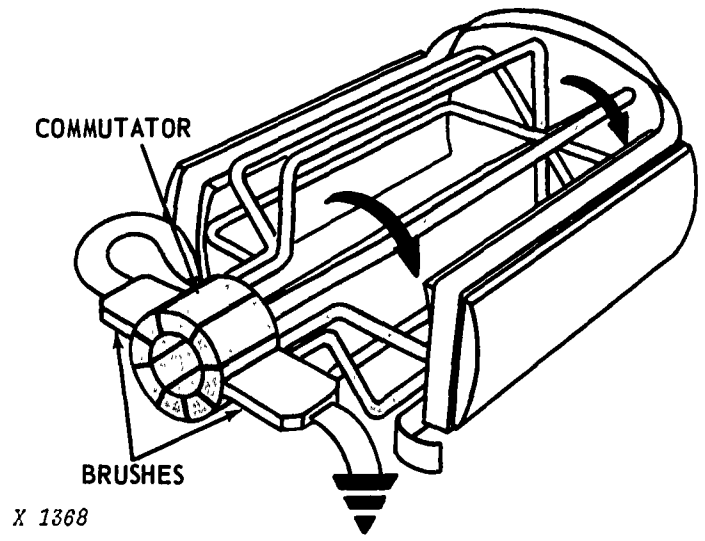

Fig. 9—Armature for Starting Motor

If we place the loop of wire in the magnetic field between the pole pieces and pass current through the loop, we have the makings of a simple **armature** (Fig. 8). The magnetic field around the loop and the field between the pole pieces repel each other, causing the loop to turn.

In an actual armature we use more loops (Fig. 9). By attaching separate metal segments to the ends of each loop, we form a simple contact surface called a **commutator.** When we feed electrical energy to the commutator through sliding contacts called **brushes,** the repelling or kicking action causes a continuous rotation. All starting motors use this basic principle to develop useful mechanical energy.

Every starting motor has brushes, an armature, field windings, pole pieces, and a drive mechanism (Figs. 10 and 11).

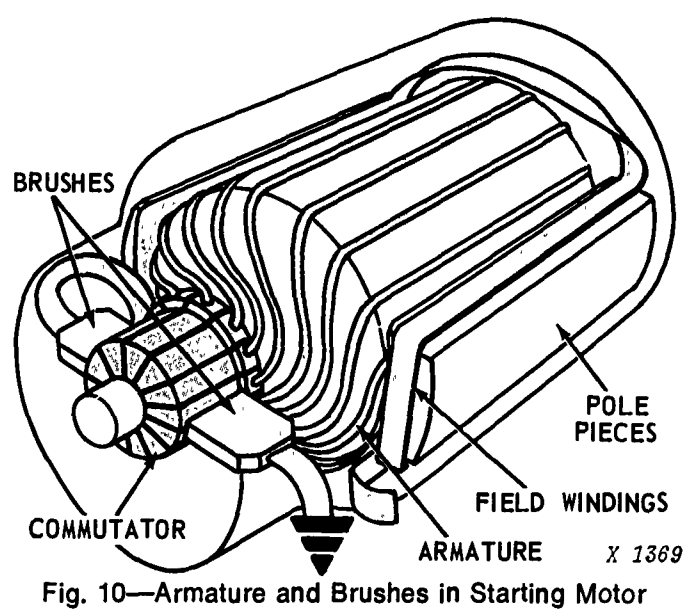

Fig. 10—Armature and Brushes in Starting Motor

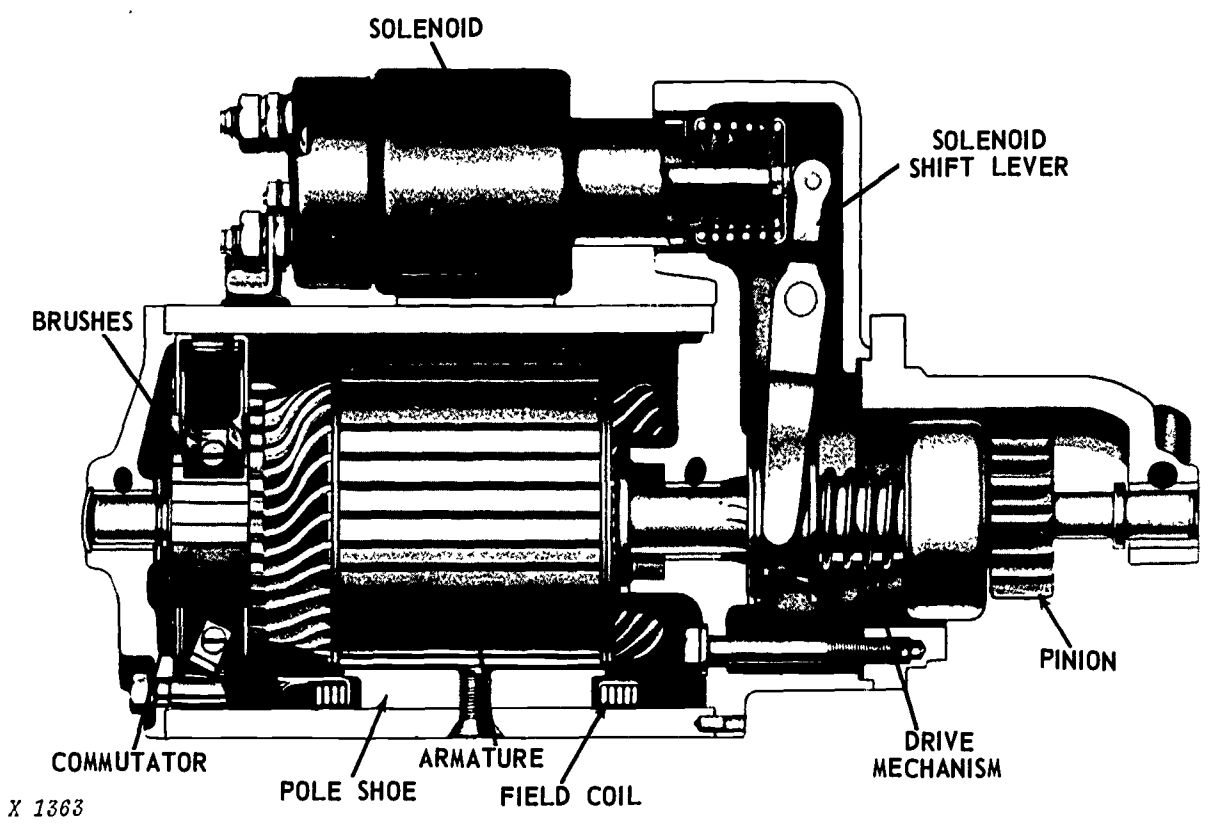

Fig. 11—Cutaway View of a Starting Motor

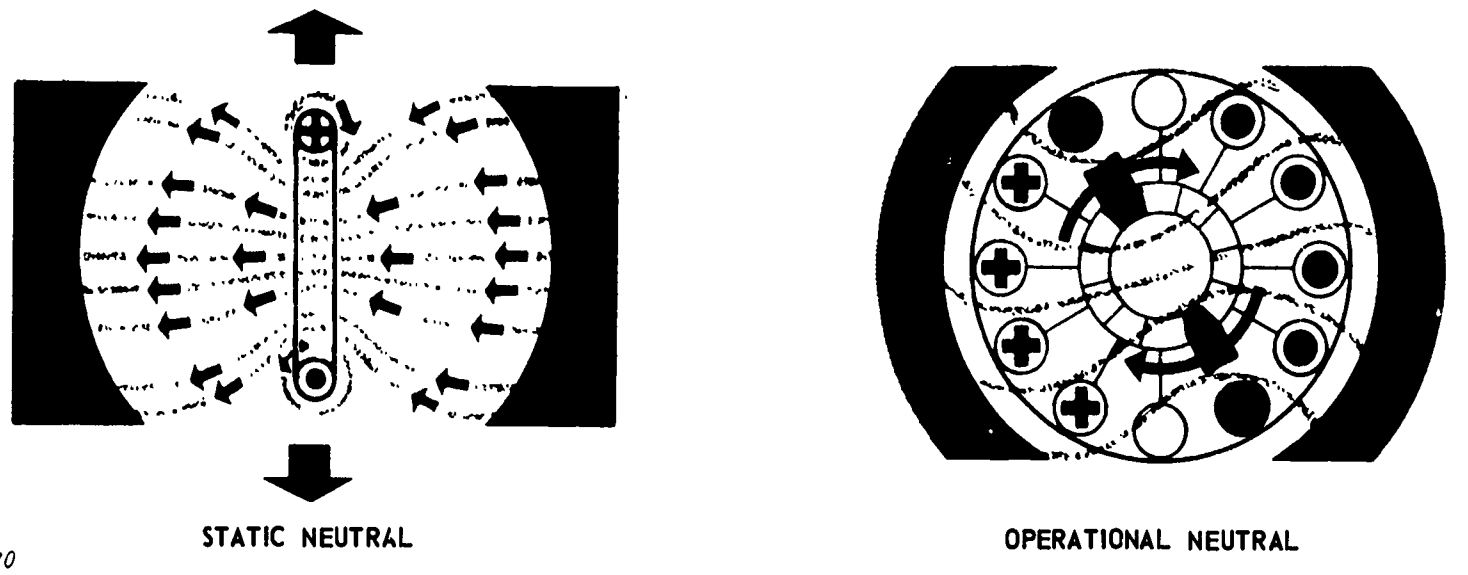

Fig. 12—Static Neutral Point of Rotating Armature

Let's build on the basics of Chapter 1 and explain more about the repelling action of the brushes and the armature which makes the starting motor operate.

In Chapter 1 we discussed the behavior of magnetic fields around a conductor when current is passing through. The principles we covered there are the basis for the operation of the starting motor.

As the armature rotates (Fig. 12) the sides of its loops reach a point shown when they are as far out of the magnetic field as possible. This is the "static neutral point" and is always halfway between the pole pieces of the motor. Current must be changed at this point to keep the same turning force.

The reversal of current is done every half-turn by the commutator. It works as follows: When the armature moves, so does the commutator. By the time the left-hand side of the armature has swung around to the north pole, the commutator segments will have reversed their connections with the brushes. Current will then flow in the *opposite* direction in the armature windings. This change of current flow would cause the armature to reverse, but since the windings have made a half-turn while the commutator changed connections, the force exerted on the armature will continue its rotation.

So, to keep rotating the motor, the current flow must be reversed every half-turn of the armature. This keeps the magnetic lines of force acting in the same direction.

The **static neutral point** is always *halfway* between the pole shoes and is the point where the direction of current must be changed to maintain a turning force in the same direction. This is true whether the motor has two, four or six poles. However, *when current flows through the armature windings* creating another magnetic field, *the normal field between the pole shoes is distorted.* Since lines of force may be assumed not to cross each other, the *neutral point is* therefore *shifted.* The motor brushes are shifted back from the static neutral point to an **operational** neutral (against the direction of rotation) to prevent excessive arcing and to obtain more efficient operation.

The main point is that the magnetic field of the armature DISTORTS the field of the pole shoes and SHIFTS THE NEUTRAL POINT TO A NEW POSITION. To match this, the motor brushes are mounted back at the new position.

SUMMARY: HOW A STARTING MOTOR WORKS

To summarize:

1) A current-carrying conductor, formed in a loop and mounted on a shaft, will cause the shaft to rotate when placed inside a magnetic field. The result: a basic starting motor.

2) If the direction of current flow in the loop is reversed as the loop passes the neutral position, the loop and shaft will keep on rotating. This is the way a starting motor is kept running.

3) It follows that to increase the power of the motor, more loops of conductors connected in series with an equal number of commutator segments are needed.

4) It also follows that increasing the strength of the magnetic field will affect the turning power of the motor, and will be directly related to the number of field poles and the number of ampere turns on each pole.

5) Basically the starting motor is a series-wound, direct-current electric motor designed to provide high power for a short time using current from a storage battery. Most starting motors have two, four, or six field poles with windings, a wound armature with a commutator, and two, four or six brushes.

TYPES OF STARTING MOTORS

Starting motors can be typed in several ways:

- **Type of Motor Circuit**
- **Type of Armature**
- **Type of Switch Control**
- **Type of Motor Drive**

Let's compare the types of starting motors as given above.

STARTING MOTOR CIRCUITS

All starting motors have a stationary member **(field)** and a rotating member **(armature).** The field windings and the armature are usually connected so that all current entering the motor passes through both the field and the armature. This is the motor circuit.

The brushes are a means of carrying the current from the external to the internal circuit — in this case from the field windings to the armature windings.

The brushes are carried in brush holders. Normally, half the brushes are grounded to the end frame while the other half are insulated and are connected to the field windings.

Starting motors have three main types of *field circuits:*

- **Series-wound**
- **Compound-wound**
- **Parallel-wound**

Most field windings are SERIES-WOUND. That is, the field windings are paired so that the current flows through one pair of windings to an insulated brush, and through the other pair of field windings to a second insulated brush.

Some field windings have a limited speed for starting smaller gasoline engines. These motors are COMPOUND-WOUND. In this case, three field windings are in series while a fourth is shunted.

A third type of field winding is PARALLEL-WOUND. This circuit is used for high output starting of large diesel engines. By placing the field windings in parallel, extra current for heavy-duty use is obtained.

As we said, the field circuits of most starting motors are series-wound. Let's discuss those first, and then bring in the other two types of circuits.

SERIES-WOUND FIELD CIRCUITS

Four-Pole—Two-Coil Circuits

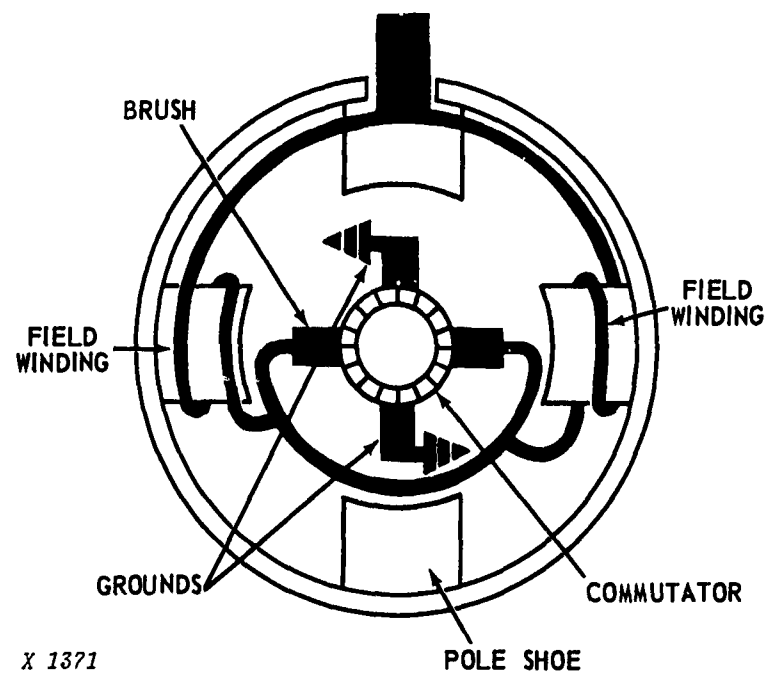

Fig. 13—Four-Pole—Two-Coil Series-Wound Motor

As shown in Fig. 13 some starting motors have four pole shoes and only two field windings.

Before looking at the circuit, we should understand the polarity of the pole shoes.

Using the right-hand rule for coils (see Chapter 1) we can see that when the starting motor is in operation, the face of the pole shoe with the field winding has a north polarity. The magnetic lines of force pass from this pole to the pole without windings, through the frame, and back to the original pole to complete the magnetic circuit.

In all starting motors the adjacent pole shoes are of opposite polarity, providing a north, south, north, south sequence around the frame. These magnetic lines of force passing from pole to pole cause four magnetic paths through the armature windings.

The field circuit in Fig. 13 is the series-wound type. This provides a four-pole action with only two field windings.

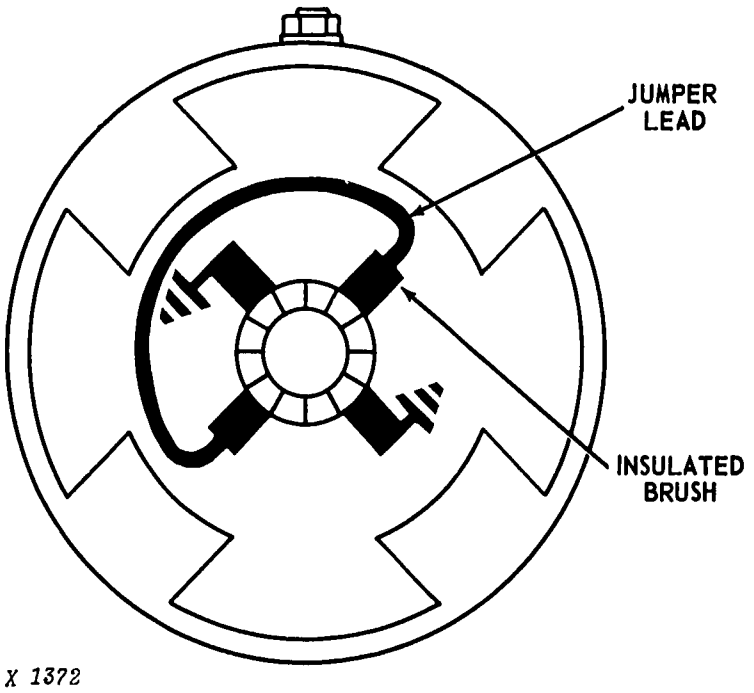

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Fig. 14—Motor Brushes Equalized by Jumper Leads

As a rule, all of the insulated brushes are connected together with jumper leads (Fig. 14) so that voltage in all the brushes is equalized. Without this, the result could be arcing and burning of commutator bars, insulating the brush contacts from the commutator surface. Once the brush contacts are insulated, the continuous current flow is interrupted and the motor stops.

Four-Pole—Four-Coil Circuits

Now that we have seen the basic series-wound starting motor, let's add field windings to the two bare poles. By doing so we create a four-pole, four-coil field circuit (Fig. 15).

By adding two field windings to the pole shoes we create more ampere turns of low resistance, resulting in a stronger magnetic field. Stronger fields produce greater torque, so we get more starting power from the four-coil motor than from the two-coil motor.

This field circuit has four pole windings and four brushes. The field windings are paired off so that half the current flows through one pair of field windings to one of the insulated brushes, and the current in the other pair of field windings flows to the other insulated brush.

The four-coil, four-pole field circuit is often used for smaller gasoline and diesel engines. The stronger four-coil fields produce the torque required to turn over these engines.

However, a diesel engine starts by compression and heat while a gasoline engine starts by spark ignition. The speed of the armature on the diesel engine is not restricted because faster compression creates more heat and aids combustion. On the other hand, the gasoline engine has a lower compression, and normally starts easier. Because

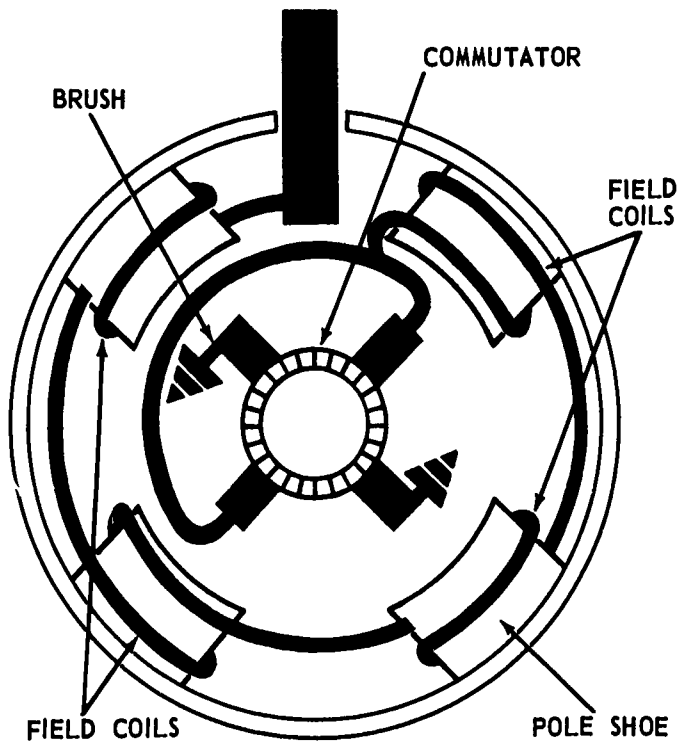

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Fig. 15—Four-Pole—Four-Coil Series-Wound Motor

it is easier to turn over, we must control the armature speed to prevent extremely high free speeds. This is done by adding a shunt for a **compound-wound** circuit (see next page).

Six-Pole—Six-Coil Circuits

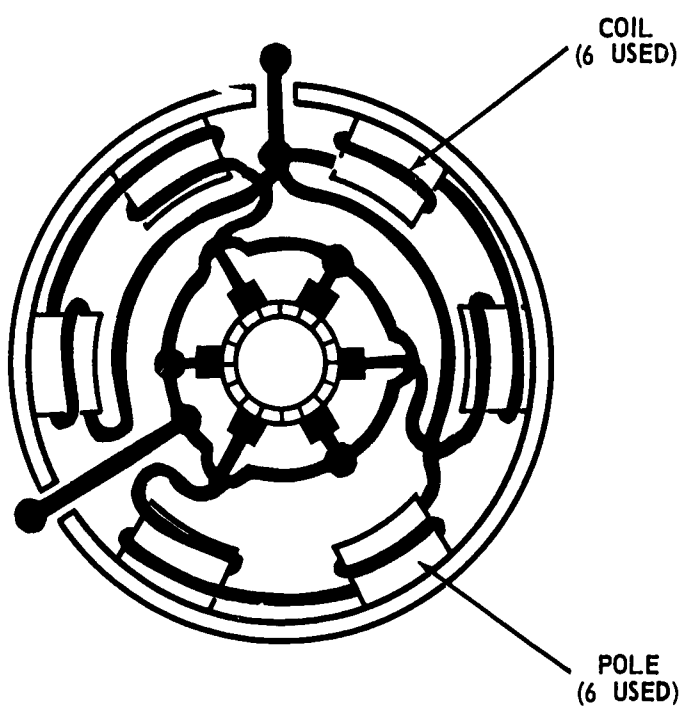

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Fig. 16—Six-Pole—Six-Coil Series-Wound Motor

The six-pole, six-coil field circuit is illustrated in Fig. 16. This type of starting motor is designed for heavy-duty service. Here the current is split three ways instead of two, as in a four-pole circuit. The result is that one-third of the current flows through each pair of field windings to one of the three

insulated brushes. In this way we increase the number of circuits through the starting motor, keeping resistance low so that higher current can flow to develop more horsepower for starting the engine.

COMPOUND-WOUND FIELD CIRCUITS

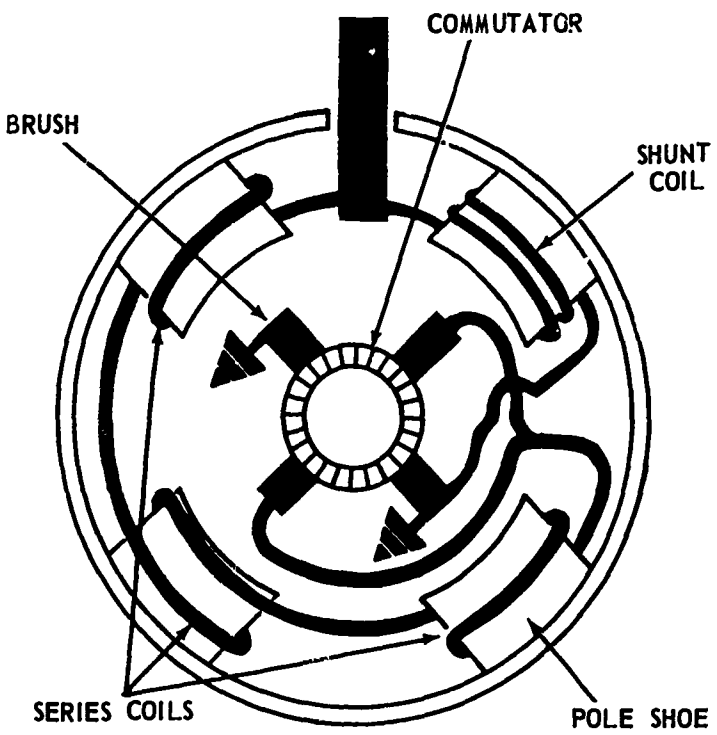

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Fig. 17—Compound-Wound Motor

We can see that this field circuit has a four-pole, four-coil arrangement. However, in this application we want to prevent too-high armature speeds. To limit armature speed at a point where the greatest torque is produced, one or more of the poles is wound as a shunt. A circuit with a shunt is **compound-wound.**

In Fig. 17 three poles are wound in series while the fourth pole is wound as a shunt with many turns of small high-resistance wire. During starting, the shunt creates a magnetic force similar to the force provided by each of the field windings. But the magnetic strength of the shunt remains constant and does not vary with speed. So the speed of the armature, revolving through this strong magnetic field, creates a greater counter-voltage, limiting current flow and so the top free speed. This protects the gasoline engine while starting as explained above.

PARALLEL-WOUND FIELD CIRCUITS

The field circuit shown in Fig. 18 is a four-pole, four-coil circuit similar to those we have seen before. But this particular circuit has been developed recently for large diesel engines. In the past, large diesel engines required 24-volt starting motors for dependable starting. Because of 12-volt lighting and charging circuits, the 24-volt starting circuit required the installation of complicated wir-

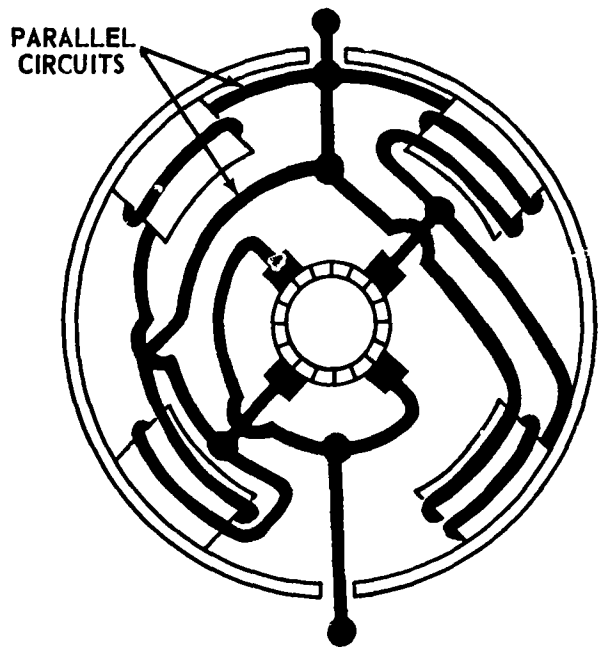

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Fig. 18—12-Volt High-Output Starting Motor Circuit

ing circuits to satisfy both needs. The new 12-volt **high output** starting motor is the answer. It simplifies installation and maintenance since it permits operation of the whole starting circuit on the conventional 12-volt system.

However, the high-output starting motor circuit needs extra power from the batteries to produce the output required by large engines. Reducing the motor voltage from 24 to 12 volts means that the circuit must carry about twice the current to provide the same output. This is usually done by retaining the same number of batteries that were used in series on the 24-volt starting system, but connecting them in parallel. This gives the increased current at 12 volts.

How does this high-output starting motor work? Let's start with the fact that the power (watts) produced by a starting motor is equal to the product of voltage and current flow:

Watts = Voltage × Current

The high-output starting motor, which operates at twelve volts, must be able to carry the increased current to produce the same amount of power or watts as a 24-volt starting motor.

For example, if a 24-volt starting motor will carry 500 amps of current, the watts produced would be 12,000. If the high-output starting motor is to operate at a lower voltage (twelve volts), the current flow must be almost doubled to develop the same output as the 24-volt motor. For example, 12 volts and 1000 amps of current will produce 12,000 watts, the same power output as the 24-volt motor.

The increased current flow in the high output motor requires a different type of field winding circuit than the normal 12-volt motor. The four-coil, four-pole starting motor circuit in Fig. 18 is the high output circuit. It differs from the previous circuits shown in that *the field windings are in parallel instead of series-wound. This parallel circuit in the field windings permits the increased current flow needed at a reduced battery voltage.*

ARMATURES FOR STARTING MOTORS

We have referred to the armature often in order to understand the field pole and field winding circuit.

The armature is the main drive of the motor and converts electrical energy into mechanical energy. The field windings and the armature windings produce mechanical *rotary* motion. In Fig. 19 we see the armature in the starting motor circuit.

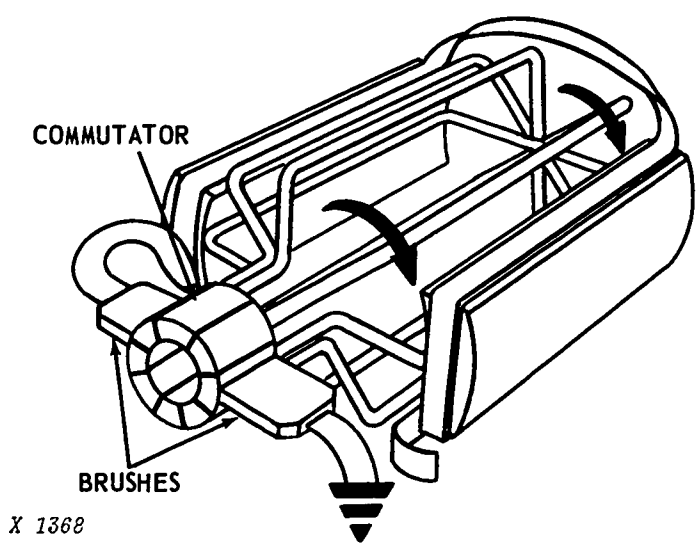

Fig. 19—The Armature in the Starting Motor Circuit

The armature must be wound to conform to the magnetic fields provided by the field poles. In a simple two-coil, two-pole unit, each armature winding is connected to one segment of the commutator. And all windings in the armature are connected in series.

Current flows into the typical armature as follows:

Two brushes are placed on opposite sides of the commutator as shown in Fig. 19. The brushes are wide enough to contact two or more segments of the commutator at each moment. As current flows into the brushes, it flows through all the armature windings except those shorted out by the two brushes. Since both ends of a winding contact a brush at the same time, the winding is shorted out in the commutating position. This provides two separate and parallel paths for the current to follow. Current flows in the same direction in all conductors passing before the pole pieces, but the direction of current flow changes at the neutral position as the armature turns up and out of the magnetic field between the pole pieces.

WAVE- AND LAP-WOUND ARMATURES

WAVE-WOUND armatures have only two paths for current flow.

LAP-WOUND armatures have as many paths as there are pole pieces.

The lap-wound armature is connected in series and divided into individual paths to permit large amounts of current to flow through it. This increased current capability is the reason the lap-wound armature is used in the high output starting motor we described earlier in this chapter.

SWITCHES FOR STARTING MOTORS

We learned earlier that starting motors convert electrical energy into mechanical energy. Now let's see how the **switch** performs a mechanical job electromagneticaily, and completes the circuit from the battery to the starting motor.

Starting motors can use four types of switches:

- **Manual Switch**
- **Magnetic Switch**
- **Solenoid Switch**
- **Series-parallel Switch**

Let's talk about each one.

MANUAL SWITCHES

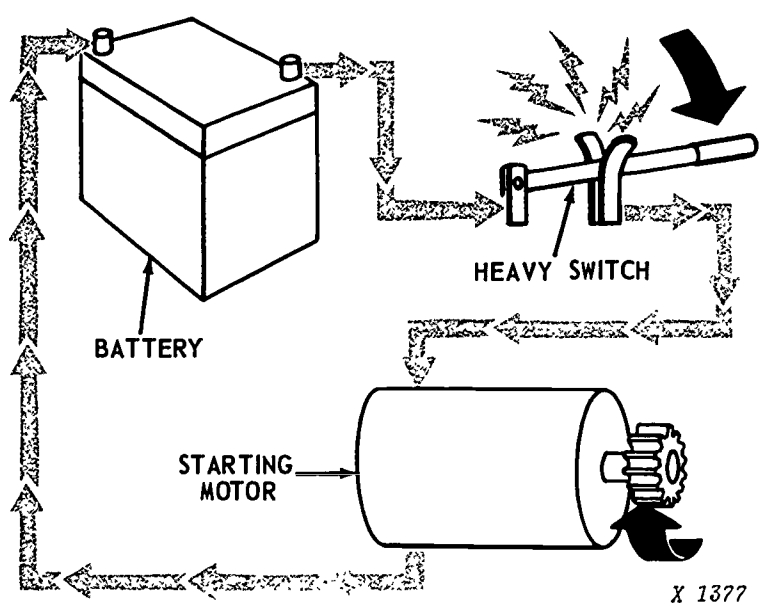

Fig. 20—A Manual Switch

A manual switch performs a mechanical operation by the simple closing of switch contacts. Opera-

tion of this type of switch closes a circuit or opens a circuit as in turning an electric light on and off. A simple manual switch is shown in Fig. 20.

The manually operated starting switch may be mounted where it is directly accessible to the operator, or it may be mounted on the starting motor and made accessible by various devices such as a hand lever.

MAGNETIC SWITCHES

To understand the magnetic switch and later on the solenoid switch, we must review the fundamentals of an electromagnet.

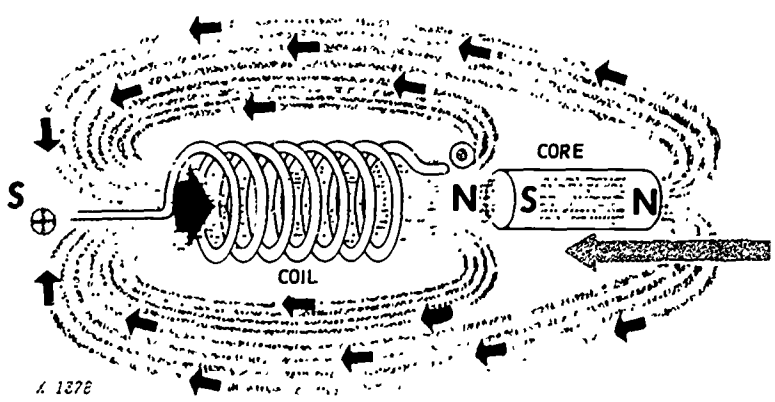

Fig. 21—Polarity of an Electromagnet

We learned in Chapter 1 that a magnetic field is made stronger by placing a soft iron core in a coil. We also learned that the polarity of the core is the same as for the coil. If the core has freedom to move, and is placed at one end of the coil in Fig. 21, it will also assume the polarity of the coil. Therefore, the adjacent poles are of opposite polarity, and the core is drawn into the center of the coil when current flows through the coil. As soon as current stops flowing, the field collapses and the core is free to move away from the coil. This is the principle of the magnetic and solenoid switches.

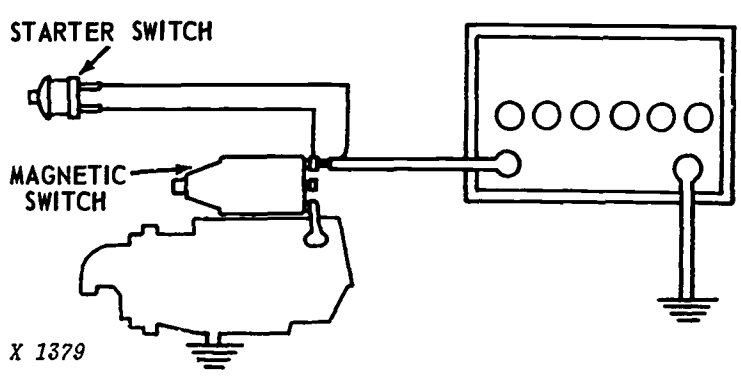

Fig. 22—Magnetic Switch Circuit

The *magnetic switch* is mounted on the starting motor frame like some manual switches. It is operated by a magnetic coil energized directly from the battery through a "start" control on the starter switch (Fig. 22).

The magnetic switch works as follows:

It has many turns of small high-resistance wire wound around a hollow core. Floating in the core is a plunger with one end acting as a contact between the two main switch terminals. These terminals are connected in series with the starting motor. Normally, a small coil spring holds the plunger away from the main terminal contacts.

When the circuit to the coil is closed, a strong magnetic field is created in the core, causing the plunger to overcome the spring tension and complete the circuit between the terminal contacts. When the core contacts the terminals, the main circuit to the starting motor is completed and the engine is turned over.

When the control circuit is opened at the starter switch, the magnetic field collapses and the spring forces the plunger to its original position, opening the starting motor circuit. The motor then stops turning.

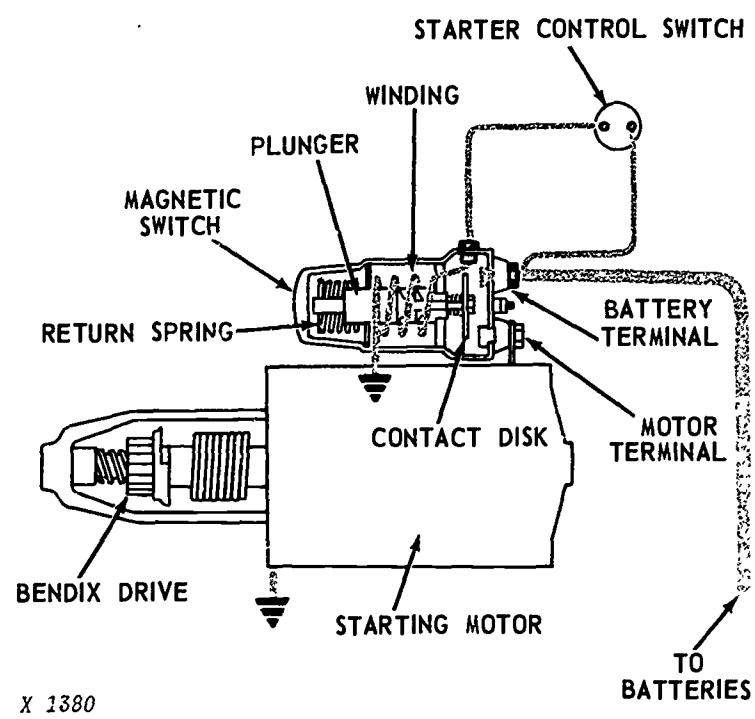

Fig. 23—A Typical Magnetic Switch Circuit

Magnetic switches are normally used with Bendix drives since there is no mechanical shifting action provided with this switch.

A Bendix drive with a magnetic switch is shown in Fig. 23.

SOLENOID SWITCHES

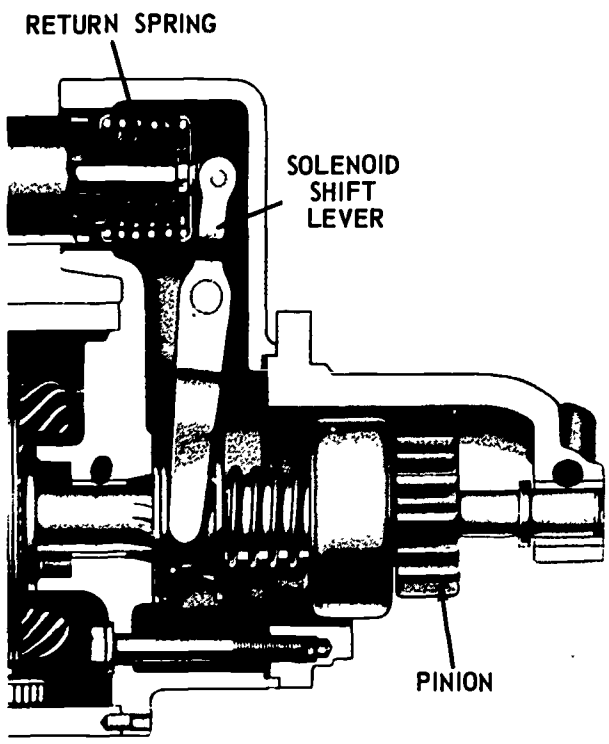

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Fig. 24—Solenoid Shift Lever

The solenoid switch is very similar to a magnetic switch, but in addition to closing the circuit, the solenoid provides a mechanical means of shifting the starting motor pinion into mesh with the flywheel ring gear (Fig. 24).

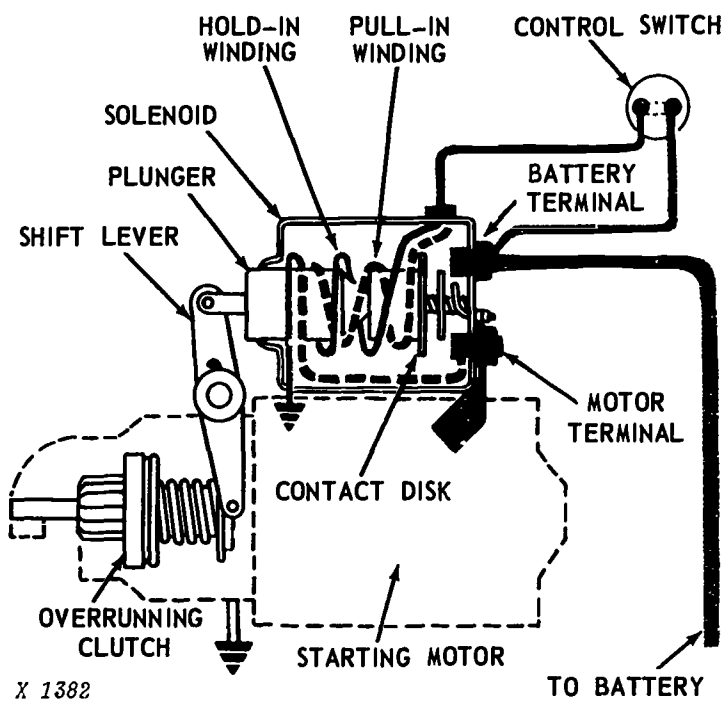

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Fig. 25—Solenoid Circuit

The solenoid circuit is shown in Fig. 25.

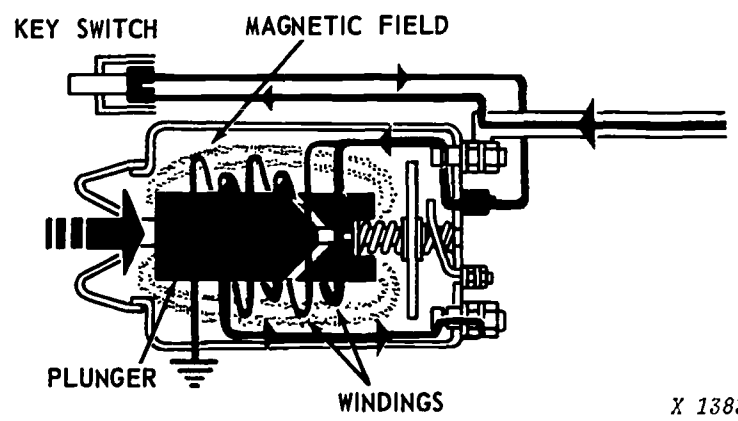
The solenoid switch has two coils of wire wound in the same direction.

The **"pull-in" winding** is made up of *heavy* wire connected to the motor terminal of the solenoid and through the motor to ground.

The **"hold-in" winding** has an equal number of turns of *fine* wire with one end connected to ground.

These coils are energized directly from the battery through the "start" position on the starter switch.

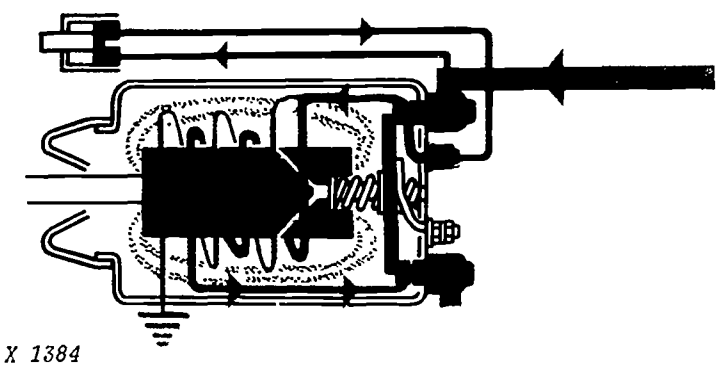
In Figs. 26, 27, and 28 we will show how the solenoid switch operates from the moment the operator turns the starter switch.



X 1383

Fig. 26—Solenoid Plunger Starting to Move as Starter Switch Is Turned On

When the operator turns the starter switch, current flows to the starter solenoid (Fig. 26). Since the solenoid coils are wound in the same direction, current flows in the same direction, creating a strong magnetic field which pulls the plunger into the field as shown. The initial plunger movement engages the drive pinion with the flywheel ring gear.



X 1384

Fig. 27—Motor Engaged and Cranking the Engine

Further movement of the plunger closes the switch contact points within the solenoid (Fig. 27). This permits a heavy flow of current from the battery into the starting motor to crank the engine.

Inside the solenoid the closing of the points shorts out the heavy "pull-in" winding, leaving only the fine "hold-in" winding energized during the starting period. The initial flow of current through the "pull-in" winding is of very short duration. The flow of current through the "hold-in" winding continues as long as the control circuit is closed.

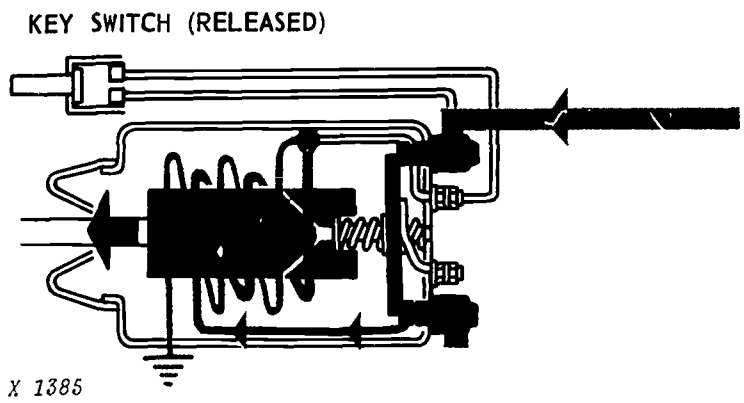


Fig. 28—Motor Disengages as Key Switch Is Released

When the engine begins to run and the starter switch is released, several things happen quickly (Fig. 28).

First, current through the starter switch to the solenoid is cut off. Then a strong return spring pushes out the solenoid plunger, breaking the circuit from the battery to the starting motor and simultaneously pulling the pinion out of mesh.

Inside the solenoid, what has happened is this: When the starter switch opened the circuit, the two solenoid windings became connected in series and were energized from the motor terminal.

The current then flowed in a reverse direction in the "pull-in" winding, but continued in the same direction as before through the "hold-in" winding, since it is grounded. Since the number of turns in the two windings are equal, the ampere flow is equal, and the direction of flow is opposite, the magnetic field of one coil opposes that of the other, causing an immediate collapse of the magnetic field. Therefore, spring tension quickly moves the plunger back to its original position.

Solenoid Switch Mountings

Solenoid switches are mounted in two ways:

- **Coaxial Mounting—enclosed in the motor housing.**
- **External Mounting—"piggyback" on the motor housing.**

The solenoids do the same basic job with either mounting.

In the COAXIAL mounting, the solenoid switch is completely enclosed and the windings are around the armature shaft. (These solenoids have no "pull-in" windings.) Coaxial mountings are primarily used for adverse conditions or where space is not available for the bulkier "piggyback" arrangement. A coaxial starter is shown in Fig. 29. In the EXTERNAL mounting, an open or enclosed shift lever is used to actuate the pinion. An external solenoid model is shown in Fig. 30.

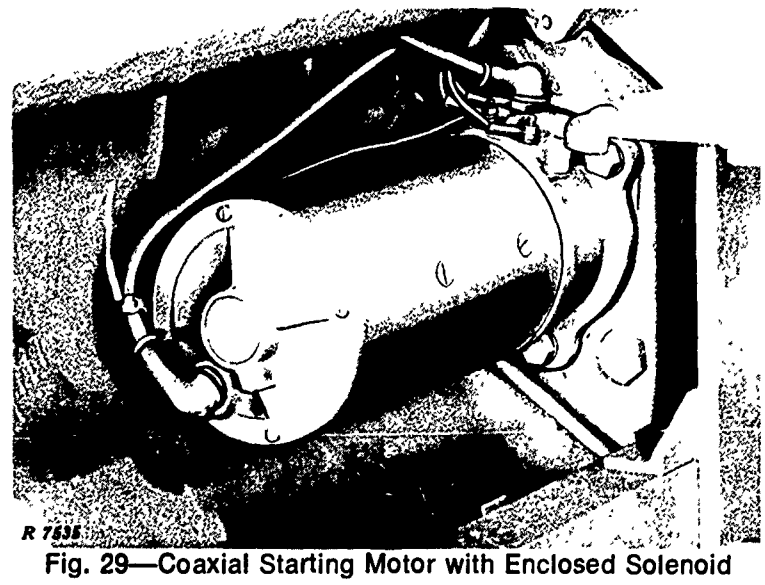


Fig. 29—Coaxial Starting Motor with Enclosed Solenoid

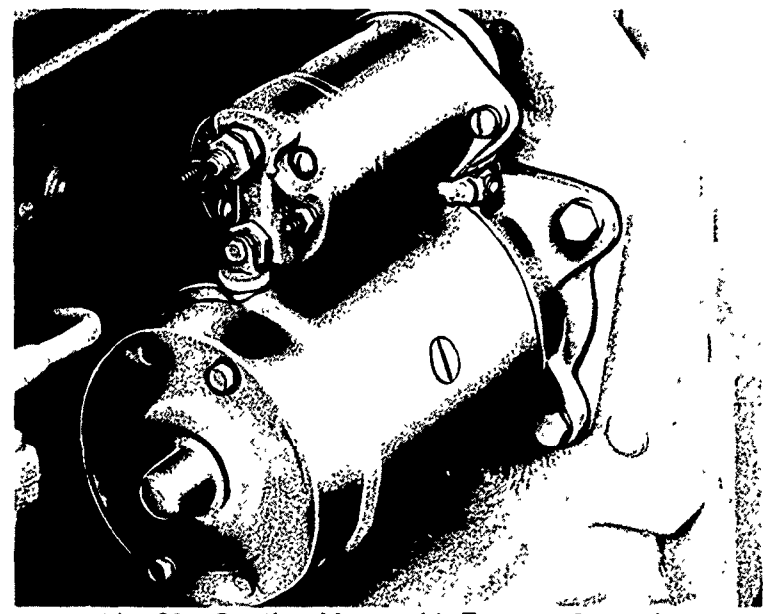


Fig. 30—Starting Motor with External Solenoid

SERIES-PARALLEL SWITCHES

A higher voltage in the starting circuit may be needed on some heavy-duty engines, especially diesel models.

Cold weather starting and other adverse conditions also draw more heavily on the starting circuit.

In some cases the high output starting motor can handle these conditions on a 12-volt circuit.

But in other cases, higher voltage starting motors must be used. By using a 24-volt battery supply, much higher starting speeds can be produced under heavy loads.

However, since lighting circuits have not yet been developed which meet highway regulations with 24-volt systems, special provisions for lighting must be made.

The **series-parallel switch** is one solution to this problem. This makes it possible to connect two 12-volt batteries in *parallel* for normal operation, but to connect the batteries in *series* through the switch during starting. This gives adequate power for starting the engine.

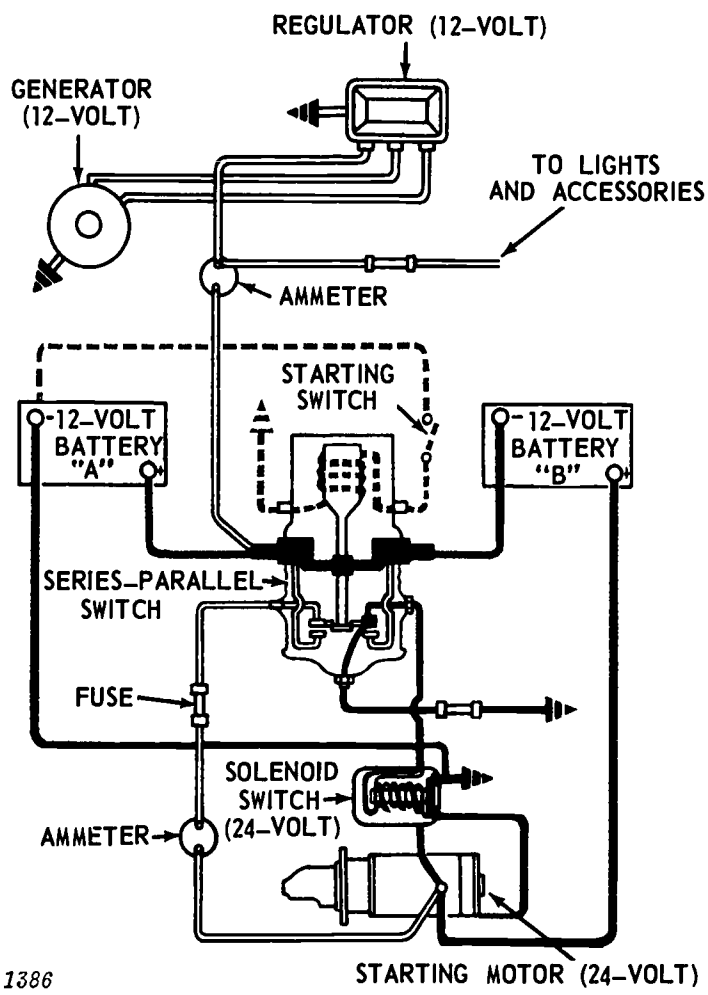


Fig. 31—Series-Parallel Swith for 24-Volt Starting Motor Operation

Fig. 31 shows a series-parallel switch for a 24-volt starting circuit. The series connection between the two batteries and the starting motor is shown in solid red. The starter solenoid circuit is shown in solid blue.

Operation during starting is as follows:

As the starting switch is closed, the solenoid coil within the series-parallel switch is energized (dashed red circuit) creating a magnetic force which attracts the series-parallel switch plunger. The plunger closes the two main switch terminals and connects the two batteries in series with the starting motor.

At the same time the solenoid circuit is completed by a set of points mechanically closed by the series-parallel switch plunger. This completes the battery-to-starting motor circuit and the starter turns over.

After the engine is started and the starting switch is released, the two batteries become connected in parallel when the series-parallel switch goes into a neutral position. (See Fig. 44.) This permits operation of the machine's electrical equipment at a normal system voltage of 12 volts.

STARTING MOTOR DRIVES

After electrical power is transmitted from the battery through a switch to the starting motor, some type of connection is needed to put this energy to work.

The last link in the starting circuit is the starting motor **drive.** The drive makes it possible to use the mechanical energy produced by the starting motor.

Let's learn more about these drive mechanisms and see what some of them look like.

INTRODUCTION

The starting motor armature revolves at a relatively high speed to produce turning power. Since the turning speed required to start an engine is comparatively slow, the starting motor is equipped with a small drive pinion which meshes with the teeth of the flywheel ring gear. The result is a gear reduction with the armature revolving as much as twenty times for every revolution of the flywheel. This permits the starting motor to develop high armature speeds and considerable power while turning the engine over at a lower speed.

But when the engine starts, it speeds up immediately and may soon reach as high as 2000 rpm. This is too fast for the starter and would result in damage to the armature.

To prevent this, starter drives are used. These are devices on the end of the armature shaft which mesh the drive pinion with the ring gear on the flywheel, and then prevent the starting motor from overspeeding after the engine has started.

TYPES OF DRIVES

There are two basic ways in which starter drives are engaged:

- **Inertia Drives**
- **Electromagnetic Drives**

On an INERTIA DRIVE, the pinion gear is weighted on one side to aid in its initial rotating motion. The Bendix drive is a type of inertia drive.

ELECTROMAGNETIC DRIVES are shifted in or out of mesh by the magnetic field of the switch. The Overrunning Clutch, Dyer Drive, and Sprag Clutch Drive are electromagnetic types.

BENDIX DRIVE

The Bendix drive depends upon inertia of the counterweight pinion and acceleration of the armature to move the pinion into mesh with the flywheel. This is shown in Fig. 32.

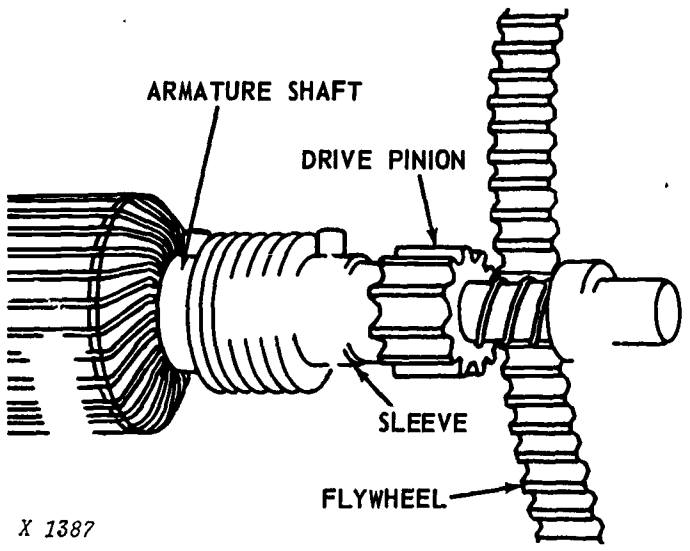


Fig. 32—Bendix Drive Engaging Flywheel as Engine Is Cranked

The Bendix drive is normally out of mesh and separated from the flywheel ring gear.

When the starting switch is closed and the battery voltage is fed to the motor, the armature shaft accelerates rapidly. The pinion gear, due to inertia created by the counter-weight, runs forward on the revolving screw sleeve until it meets or meshes with the flywheel gear (Fig. 32).

In other words, the Bendix drive uses inertia of the pinion and high starting speed of the armature shaft to move the pinion into mesh with the flywheel.

When the pinion becomes fully meshed, its forward motion stops, locking the pinion to the rotating armature shaft. The spring cushions the shock as the rotating armature starts to turn the flywheel.

This spring also acts as a cushion while cranking the engine against compression. In addition, it dampens the shock on the gear teeth during meshing or when there is a backfire of the engine.

All parts are now rotating as a unit, turning the engine over as shown in Fig. 33.

When the engine starts the flywheel rotates faster than the armature shaft, causing the pinion to turn in the opposite direction on the screw and spin itself out of mesh (Fig. 34). This prevents the engine from driving the starting motor at an excessive speed.

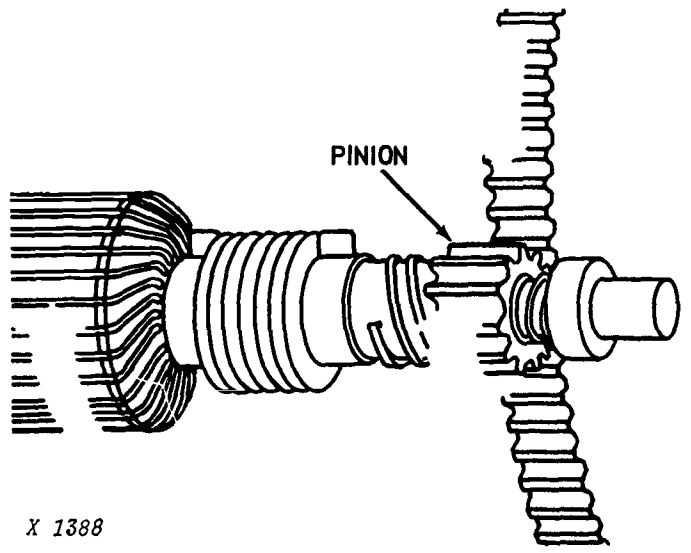


Fig. 33—Bendix Drive Pinion Fully Meshed

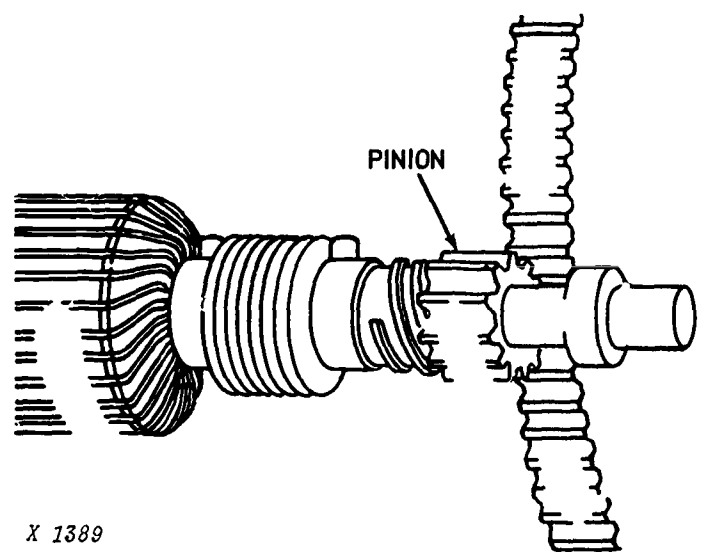


Fig. 34—Bendix Drive Pinion Spinning Out of Mesh After Engine Starts

The centrifugal effect of the weight on one side of the pinion, when spun from the flywheel, holds the pinion to the sleeve in an intermediate position until the starting switch is opened and the motor armature comes to rest.

For as long as the operator keeps the motor energized with the engine running, the motor will free speed. This is why the starter switch should be released immediately after the engine has started.

Certain precautions must be observed in operating a Bendix-type starting motor. If the engine backfires with the pinion in mesh with the engine flywheel, and the starting motor operating, a terrific stress is placed on the parts. This is because the motor armature attempts to spin the drive pinion in one direction while the engine, having backfired, turns the drive pinion in the opposite direction. This clash of opposing forces sometimes breaks or "wraps up" the Bendix spring.

Engine ignition timing should be checked and corrected to overcome backfiring.

Damage may also occur when the engine starts, throwing the Bendix drive pinion out of mesh with the engine flywheel teeth. When the engine is coming to rest it often rocks back, or rotates in reverse, for part of a revolution. If the operator attempts to re-engage the drive pinion at the instant the engine is rocking back, serious damage will result. As in a backfire, it may break the drive housing or "wrap up" the Bendix spring.

To prevent this, the operator should always wait at least five seconds between attempts to crank so that the engine stops turning.

Variations on Bendix Drives

Another Bendix drive known as the "folo-thru" has a detent pin which locks the drive in the cranking position to prevent disengagement on false starts. This pin is thrown out by centrifugal force when the engine runs and the pinion then disengages.

Some heavy-duty cranking motors use a *friction-clutch type* Bendix drive. This type of drive functions in much the same manner as other Bendix drives. However, it uses a series of spring-loaded clutch plates, instead of a drive spring, which slip momentarily during engagement to relieve shock.

OVERRUNNING CLUTCH DRIVE

Now let's take a look at one of the most widely used drive mechanisms, the *overrunning clutch* (Fig. 35). It allows positive meshing and demeshing of the drive pinion with the flywheel.

The overrunning clutch uses a shift lever to actuate the drive pinion. The pinion, together with the overrunning clutch mechanism, is moved endwise along the armature shaft and into, or out of, mesh with the flywheel. The shift lever may be either manual or operated by a *solenoid*. Operation is given below.

As we learned earlier, the drive pinion is normally out of mesh and separated from the flywheel ring gear. When the starting switch is closed, current flows to the solenoid, closing the switch circuit. As the solenoid switch closes, the shift lever moves the pinion into mesh and completes the circuit to the starting motor. If the pinion and the flywheel teeth meet, instead of meshing, the spring-loaded pinion rotates the width of one-half tooth and drops into mesh as the armature starts to rotate.

When the armature shaft rotates during cranking, small rollers become wedged against the clutch collar attached to the pinion. This wedging action

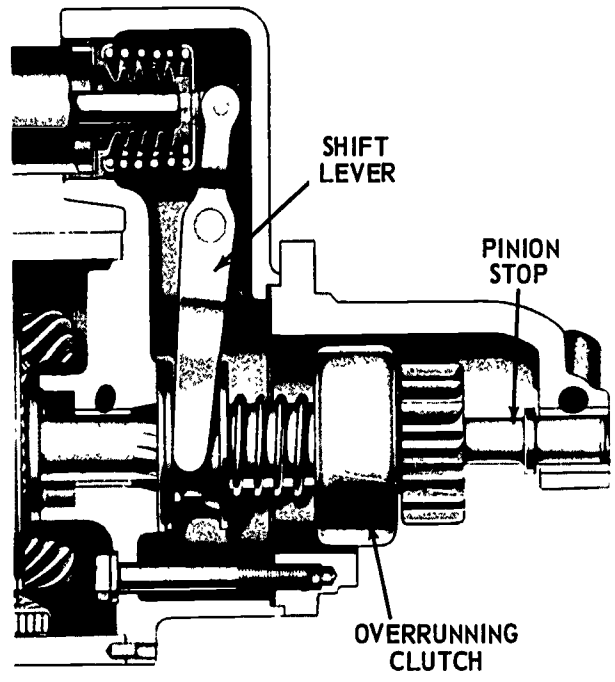


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Fig. 35—Overrunning Clutch Drive

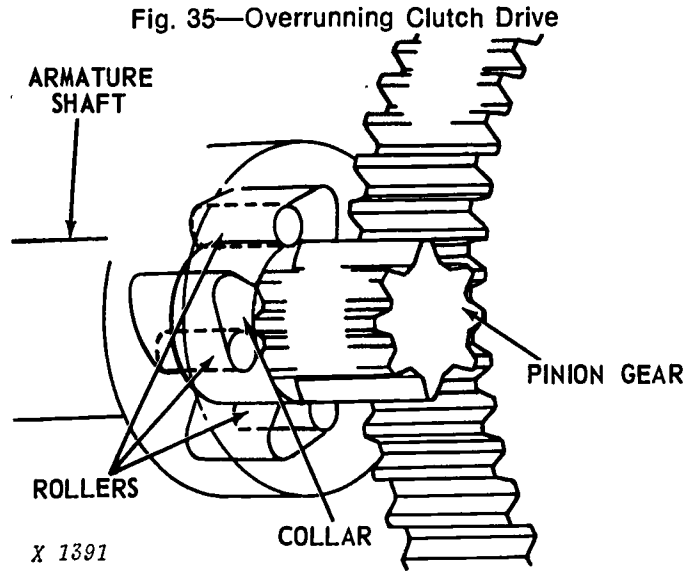

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Fig. 36—Overrunning Clutch Drive Engaged

locks the pinion gear to the armature shaft and causes the pinion to rotate with the shaft, as shown in Fig. 36.

When the engine starts, the flywheel spins the pinion gear faster than the armature, releasing the rollers and unlocking the pinion from the armature shaft. The pinion, still meshed with the flywheel, overruns safely and freely until the switch is opened and the shift lever pulls the pinion out of mesh. This feature prevents the armature from being driven at excessive speed by the engine.

DYER DRIVE

The Dyer Drive is a special drive mechanism that provides positive meshing of the drive pinion with the flywheel, *before the cranking motor switch is closed and the armature begins to rotate.*

This action eliminates the clashing of pinion teeth with flywheel teeth, as well as the possibility of broken or burred teeth on either gear.

The Dyer drive is used on heavy-duty applications where it is important that the pinion be engaged before rotation begins. Engagement of the pinion while in motion is impossible because of the high horsepower developed and the acceleration of the armature when the starting circuit is completed.

The Dyer drive works as follows:

Movement of the motor shift lever forces the shift sleeve and pinion endways along the armature shaft so that the pinion engages the flywheel.

Further movement of the shift lever then closes the starting motor switch and the engine is turned over.

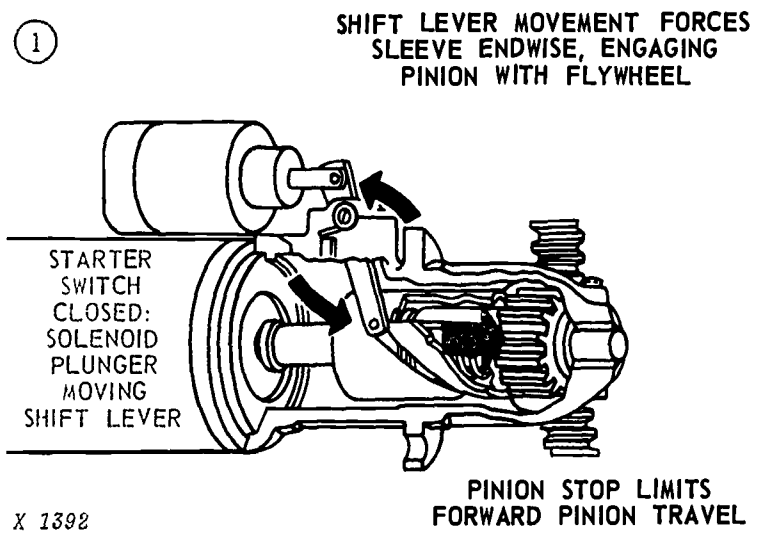

Fig. 37—Dyer Drive in Operation: 1) Solenoid Plunger Moving Shift Lever

The pinion, fitting loosely on the armature shaft splines, rotates freely while the pinion guide is forced to rotate forward on the spiral splines. The rotation of the pinion guide is transmitted to the pinion by two lugs on the pinion guide. The pinion rotates freely, without any forward movement, until alignment of the gear teeth takes place. Then it is thrust forward into mesh as shown in Fig. 37.

The pinion stop limits the forward movement of the pinion. As the shift lever completes its travel, it closes the starting motor switch, linked mechanically to the shift lever.

The motor armature then begins to rotate. This rotates the sleeve back, away from the pinion to its original position as shown in Fig. 38.

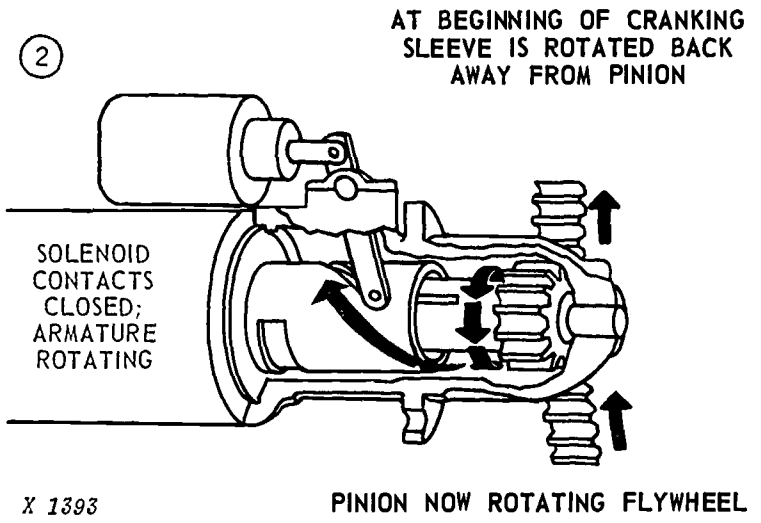

Fig. 38—Dyer Drive in Operation: 2) Armature and Pinion Rotating Flywheel

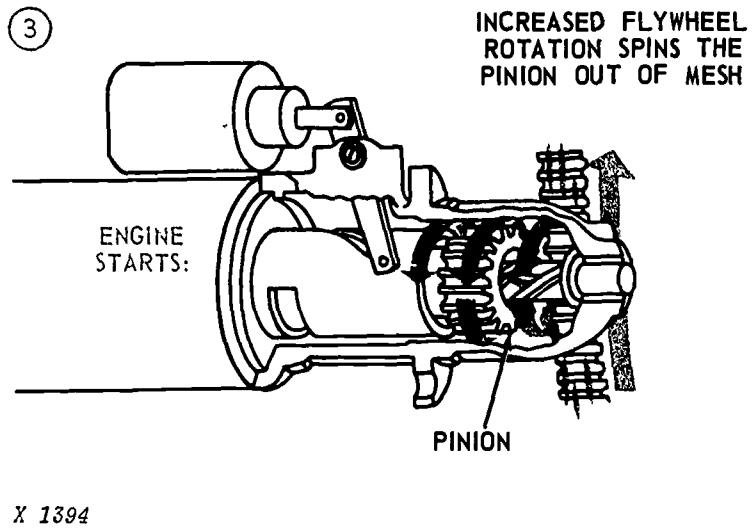

Fig. 39—Dyer Drive in Operation: 3) Flywheel Spinning Pinion out of Mesh

The instant that the engine starts, the flywheel attempts to drive the pinion faster than the armature is turning. Then both the pinion and the pinion guide are spun out of mesh with the ring gear (Fig. 39). The pinion guide drops into the milled section of the shaft splines, locking the pinion out of mesh.

It is impossible to start another cranking cycle without completely releasing the shift lever. The lever must drop all the way back to the "at rest" position.

On any automatic disengaging drive, it is always good policy to wait five seconds after a false start before attempting another start. In this period of time the engine will be at complete rest, and damage to the drive mechanism due to improper meshing is less likely to occur.

SPRAG CLUTCH DRIVE

The Sprag Clutch Drive is constructed and operates like the Overrunning Clutch Drive, except that a series of sprags, replace the rollers between

the shell and sleeve. The sprags are held against the shell and sleeve surfaces by a spring. This assembly is then splined to the armature shaft with a stop collar on the end of the sleeve. See Fig. 40.

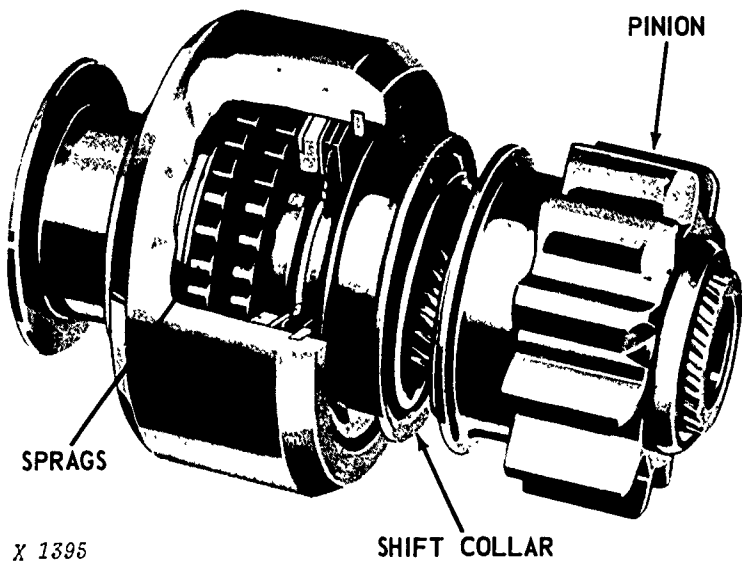

Fig. 40—Sprag Clutch Drive

Operation is as follows:

Movement of the shift lever against the collar causes the entire clutch assembly to move endways along the splined shaft, and the pinion teeth to engage the ring gear. If a clash of teeth should occur, continued movement of the shell and spiral splined sleeve causes the pinion to rotate and clear the teeth. The compressed meshing spring then forces the pinion into mesh with the ring gear. If the pinion does not clear before the two retainer cups meet, shift lever movement is stopped by the retainer cups and the operator must start the engagement cycle over again. This prevents closure of the switch contacts to the motor with the pinion not engaged, which would result in damage due to spinning meshes. On the second attempt, the pinion will engage in a normal manner.

With the pinion engaged and the switch closed, torque is transmitted to the pinion through the sprags. The sprags tilt slightly and are wedged between the shell and sleeve. When the engine starts, the ring gear drives the clutch faster than the armature, and the sprags tilt in the opposite direction to allow the pinion and sleeve to overrun the shell and armature. To avoid prolonged overrunning, the starting switch should be opened as soon as the engine starts.

The Sprag Clutch Drive is used primarily on larger starting motors to carry the high torque required to turn over high-compression engines.

STARTING CIRCUITS

A TYPICAL STARTING CIRCUIT

A typical starting circuit consists of a low resistance cable connection from the storage battery, through a control switch, to a direct-current starting motor.

The return circuit is to the battery, through the engine block and the frame of the vehicle.

Because of the large amount of current used to operate the starting motor, large cables are used. All connections must be clean and tight to prevent high resistance or voltage drop.

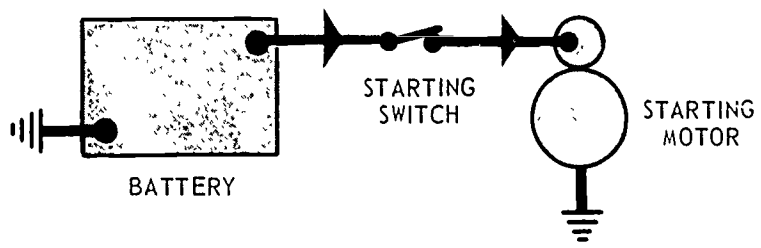

Fig. 41—A Typical Starting Circuit (12-Volt)

Closing the switch completes the starting circuit (Fig. 41).

Current will flow from the battery, through the cable, across the switch contacts, through the starting motor fields and armature, and back to the battery through ground.

SPLIT LOAD CIRCUIT

We learned earlier that diesel engines and similar heavy-duty engines require high-output starting motors. We also learned that regulation lighting systems have not been developed for 24-volt systems.

Let's look at two methods used to provide this extra starting power, as well as adequate lighting.

The first method is the 24-volt **split load** circuit illustrated in Fig. 42.

This circuit is called *split load* because the lights and accessories are split as equally as possible with each half connected to a 12-volt circuit.

The right-hand light circuit draws current from battery "A" and the left-hand circuit draws current from battery "B."

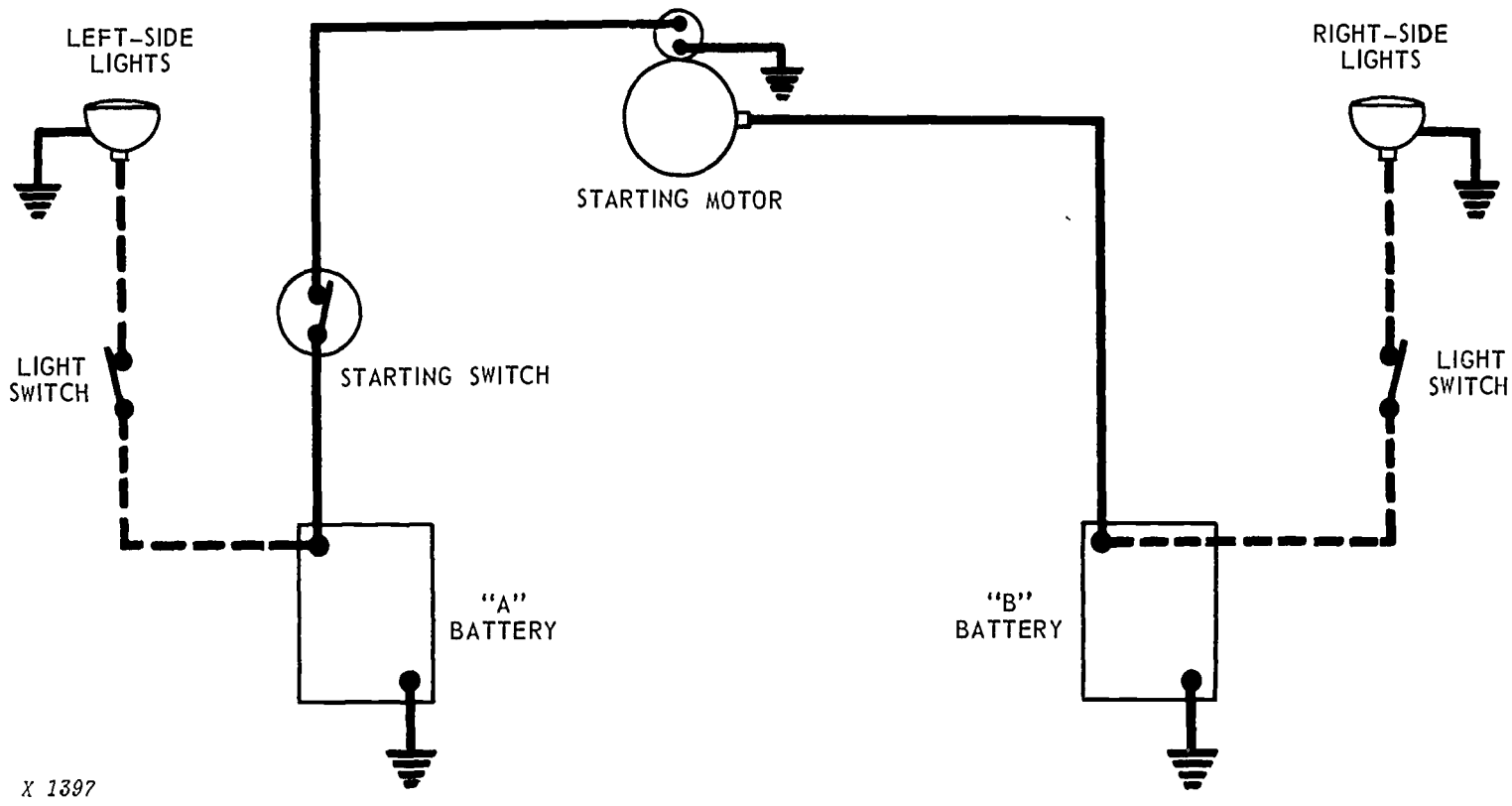

Fig. 42—Split Load Circuit (24-Volt)

The batteries and lights of each circuit are connected to a common ground, completing the circuit to the source. The vehicle frame and engine block are often used as the ground, and actually become part of the circuit.

When the switch in the starting circuit is closed, the vehicle frame becomes part of a series circuit between batteries "A" and "B" so that enough voltage and current is supplied to the 24-volt starting motor. The starting motor and the starting circuit are insulated so that none of the components in the circuit are attached to a common ground, allowing the circuit to be completed at the terminal of "B" battery.

Although the batteries are in series, the left- and right-hand lighting circuits remain split.

If the light switches are closed as shown, each light circuit will draw current from the battery it is connected to during starting. Each light circuit will operate as it did when the starting switch was in the "run" position. (The light switches are shown in the closed position for illustration purposes only. Better starting performance is obtained by starting with the lights off.)

For details on the batteries used with split load circuits, see Chapter 3.

NOTE: Some split-load circuits have four six-volt batteries instead of two twelve-volt ones. In this case, two batteries operate each 12-volt circuit.

SERIES-PARALLEL CIRCUIT

Another method of using two 12-volt batteries to provide 24-volt starting is the **series-parallel** switch shown in Fig. 43.

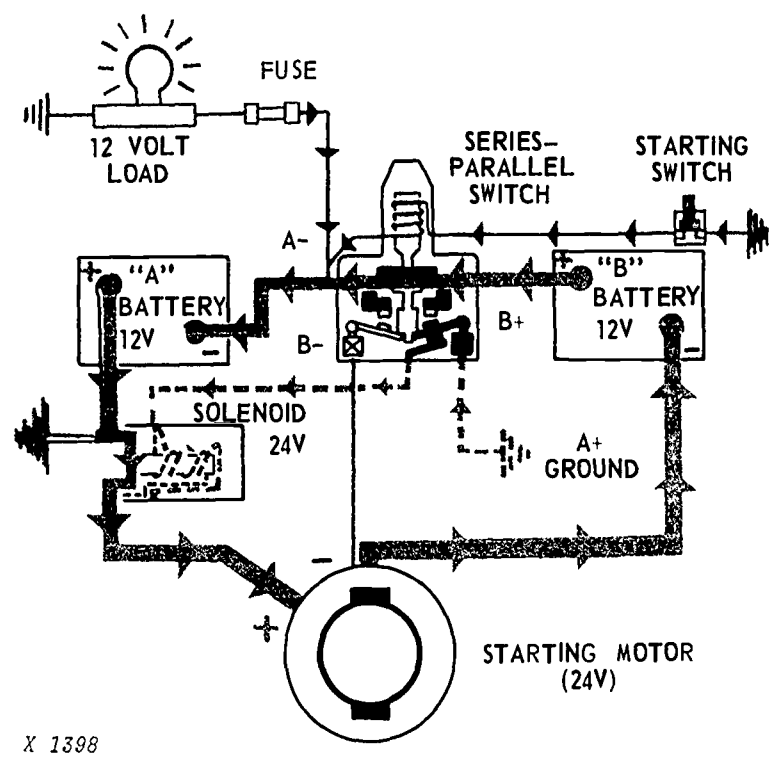

Fig. 43—Series-Parallel Circuit during Starting (24-Volt)

In Chapter 1 we learned about series and parallel circuits. We know that two 12-volt batteries connected in series will provide increased voltage while the current flow remains the same.

This applies directly to the series-parallel starting circuit. When the starting switch is closed, the series-parallel switch is actuated, connecting the terminals between "A" and "B" batteries as shown. We now have an insulated series circuit to the starting motor giving the 24 volts required.

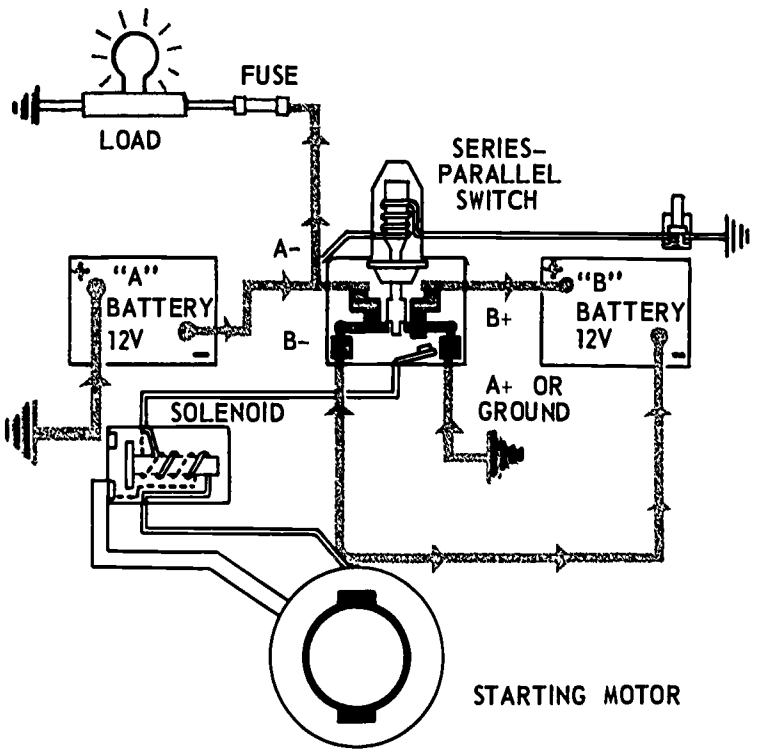

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Fig. 44—Series-Parallel Becomes Parallel Circuit (12-Volts) After Starting

As soon as the engine starts and the starting switch is opened, the series-parallel switch also opens. This breaks the series connection between the batteries and provides a parallel circuit like the one shown in Fig. 44.

The starting switch operates as follows: The plunger moves up, opening the ground circuit for the 24-volt solenoid, which stops current flowing to the starting motor. As the plunger moves on up it opens the series connection.

Until recently, a 12-volt starting motor could not produce the torque required to start diesel and other high-performance engines. But the 12-volt *high-output* starting motor provides the features common to 24-volt starting motors, and may be used to replace the 24-volt systems we have covered. (The 12-volt high-output motor circuit is shown in Fig. 18.)

TESTING AND DIAGNOSING THE STARTING CIRCUIT

We have seen how each part of the starting circuit works and how the parts operate as a whole.

Now we will look at the main troubles and how to test, diagnose, and remedy them.

Let's start with the complete starting circuit on the machine.

We should locate the trouble first, before we start removing components.

Several checks, both visual and electrical, can be made to isolate the trouble before removing any part of the circuit. Many times a component is removed from the machine only to find that it is not defective after making reliable tests.

Therefore, be sure to make the following tests before removing a component from a defective starting circuit.

TESTING THE STARTING CIRCUIT

Let's begin with the **battery.** The battery is the source of energy for all vehicle electrical systems. Therefore, it is also important to the starting circuit.

If the battery is less than three-quarters charged, accurate tests cannot be made in the starting circuit due to below par operation of the entire circuit. It is vital to the testing of starting circuit problems to have the battery fully charged and free of shorted or dead cells. Placing the test points of a voltmeter across the battery posts will indicate the charged condition of the battery while the engine is turning over. If the battery cannot provide the voltage required it must be recharged or replaced before the circuit can be checked. (For details, see Chapter 3.)

If the battery is eliminated as a possible cause of starting circuit problems, inspect all clamps and **connections** in the circuit for corrosion and tighten them if necessary. Now we can continue our tests on the starting circuit.

When the starting switch in the circuit is closed, we can expect one of five things to occur if the starting circuit is defective:

1. Nothing happens—there is no "click" indicating that the solenoid contacts closed.

2. An audible "click" in the solenoid is heard, but the starting motor does not operate.

3. The starting motor is running but the engine does not turn over.

4. The starting motor turns over the engine slowly or erratically.

5. The engine starts but the starting motor drive does not disengage from the flywheel.

We can check out these five cases as follows:

Case No. 1: *We closed the starting switch and nothing happened.* This indicates that current is not reaching the solenoid and the switch contacts are not closing to complete the circuit. We can suspect then that the problem lies in that part of the circuit leading up to the solenoid, or in the solenoid.

To check this diagnosis, connect a jumper lead from the battery post to the switch terminal of the solenoid. (Be sure that the machine is not in gear.) If the engine starts the circuit is open somewhere between the battery and the solenoid. However, if the solenoid switch does not close, the solenoid is defective. Perform tests on the solenoid as covered later in this chapter.

Case No. 2: *The solenoid contacts "clicked" but the starting motor did not operate.* This indicates that the circuit problems lie within the starting motor. If the solenoid switch contacts close, and the switch begins to "chatter," an open circuit exists in the hold-in winding of the solenoid. In any case, the starting motor should be removed and tested as covered later in this chapter. (On 24-volt motors, a defective solenoid return wire could also cause the above symptom.)

Case No. 3: *The starting motor ran but did not turn over the engine.* We know that the starting motor is getting enough current to operate. The problem, then, is either in the shifting of the drive assembly into mesh, a broken armature shaft, or a dirty or faulty drive assembly. These causes require disassembly of the starting motor and proper service or repair.

Case No. 4: *The starting motor turned the engine over slowly or erratically.* The problem may be in the starting motor or in the drive assembly. Before removing the motor, a voltage drop test should be made. A voltage drop test will locate any high-resistance connections or shorted or grounded windings which would affect starting motor efficiency. This test is made with a voltmeter while the engine is turning over. With test points on the insulated BATTERY POST and the starting motor terminal, the voltage drop generally should not exceed 0.3 volts. With test points on the battery ground post and the starter frame, the voltage drop in the ground circuit usually should not exceed 0.1 volts. (On 24-volt motors, the return circuit is insulated and the voltage drop should be less than 0.3 volts.)

If no high-resistance connections are detected, the pinion drive and the flywheel ring gear can be inspected by removing the starting motor. If either gear is damaged, it must be replaced. If they are not damaged, the starting motor must be disassembled and tested.

Case No. 5: *The engine starts but the motor drive does not disengage from the flywheel.* This indicates a defect in the drive mechanism, the solenoid pull-in windings, solenoid contacts, or solenoid control circuit which will not allow the drive to disengage. The starting motor or the circuit should be serviced.

Summary: In each of these cases the trouble can be located without extensive circuit testing. Once the trouble has been found, follow the test procedures for the component as outlined later in this chapter.

Below is a brief list of general diagnosis tips for tests on the complete starting circuit.

HOW TO DIAGNOSE STARTING CIRCUIT FAILURES

Starting switch is on but no operation.

Look for an open circuit, defective starting switch, or starter safety switch, poor connections, open solenoid windings, stuck drive plunger or pinion.

Solenoid contacts close but starting motor does not operate.

Brushes are sticking, worn, or have weak spring tension. Commutator bars are dirty, burned, worn, pitted, or rough. Armature or field windings or the armature bearings are defective.

Starting motor operates but engine does not turn over.

Drive assembly not meshing. Dirty or faulty drive assembly. Drive pinion or flywheel ring gear damaged. Broken armature shaft.

Motor drive pinion does not move out of mesh.

Solenoid switch is defective. Drive assembly dirty or damaged. Armature shaft dirty or damaged.

SUMMARY: TESTING AND DIAGNOSING THE STARTING CIRCUIT

We have now covered testing and diagnosis of the complete starting circuit.

All of these checks should be made *before* removing any components for repair.

Next we will cover the testing and servicing of the various components of the starting circuit, once they are pinpointed as possibly defective.

Let's begin with the starting motor.

TESTING AND SERVICING STARTING MOTORS

Once you have tested the complete circuit and find that the starting motor may be defective, make the tests given here to confirm your diagnosis.

TESTING MOTOR BEFORE DISASSEMBLY

The tests below should be made before the starting motor is disassembled.

Preliminary Checks

Even before you remove the starting motor, inspect it.

Listen for the grinding of clashing teeth when the starting motor drive is engaged, and for a squealing or rattling noise when the motor drive is released from the flywheel. These are indications of a dry or worn drive mechanism.

Look at the starting motor. Are there any loose mounting bolts? Remove the commutator end frame and check for burned commutator bars, high mica, worn brushes, or an oily commutator and brushes. These can all cause inadequate starting and must be corrected before further testing of the motor.

Be sure to check the motor also for freedom of movement. Both the pinion gear and the armature must be free to move during the no-load test below.

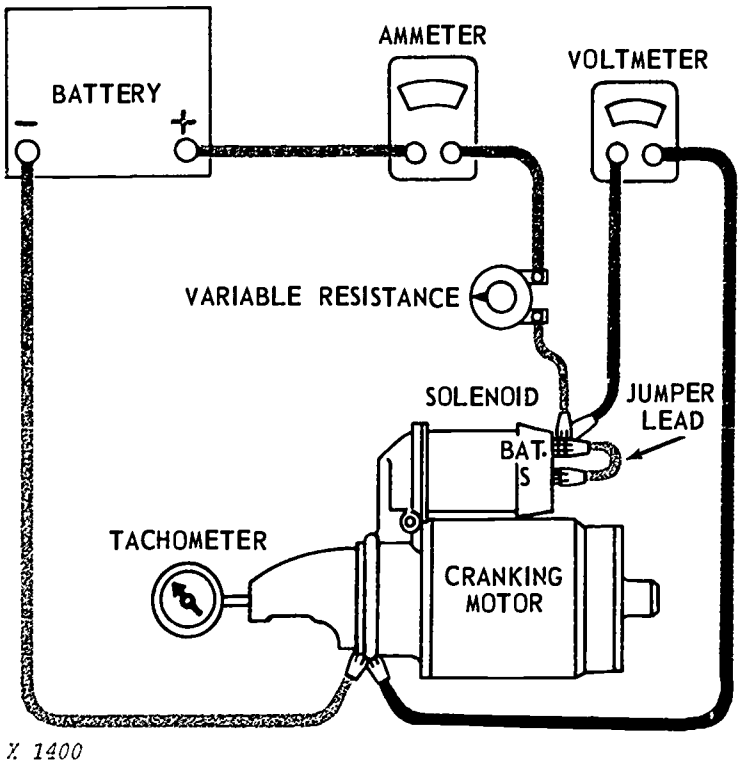
Check the pinion for freedom of operation by turning the shaft. If the pinion turns freely, turn the pinion and check the armature operation. If the armature drags, look for tight, dirty, or worn bearings, a bent armature shaft, or a loose pole shoe screw. In this case, disassemble the starting motor immediately. The no-load test may damage the starting motor if the armature does not turn freely.

No-Load Test

The no-load test is the basic check of the starting motor's internal condition.

To perform a no-load test, connect the starting motor to a fully charged battery (Fig. 45).

Insert an ammeter capable of measuring several hundred amperes, and a variable resistor between the battery and the starting motor. (If the technical manual specification is for basic motor only, connect the jumper wire between the "S" terminal and the battery post so the solenoid current draw is not measured.) Connect the voltmeter to the starting motor terminal and frame. Place a jumper lead between the battery terminal and the "S" terminal on the solenoid to complete the test circuit. Place a tachometer on the end of the armature to measure armature speed.



X 1400

Fig. 45—No-Load Test Circuit

When the leads are connected to the battery terminals, current flows to the starting motor. The variable resistor is used to obtain the specified operating voltage of the starting motor. Do this by varying the resistor until the proper reading is on the voltmeter. When the specified voltage is attained, read the ammeter for the current drawn, and the tachometer for the armature speed. Compare these readings with the Technical Manual specifications for the starting motor being tested.

How to Interpret the No-Load Test Results

Take the no-load test readings and judge them by the possible results and causes given below.

1. *Rated current draw and no-load speed* indicates a normal starting motor condition.

2. *Low free speed and high current draw indicates:*

a. Too much friction—Tight, dirty, or worn bearings, bent armature shaft or loose pole shoes allowing armature to drag.

b. Shorted armature—This can be checked on a growler after disassembly.

c. Grounded armature or fields — Check further after disassembly.

3. *Failure to operate with high current draw indicates:*

a. A direct ground in the terminal or fields.

b. "Frozen" bearings (this should have been determined when turning the armature by hand).

4. *Failure to operate with no current draw indicates:*

a. Open field circuit. This can be checked after disassembly by inspecting internal connections and tracing circuit with a test lamp.

b. Open armature coils. Inspect the commutator for badly burned bars after disassembly.

c. Broken brush springs, worn brushes, high insulation between the commutator bars or other causes which would prevent good contact between the brushes and commutator.

5. *Low speed and low current draw indicates:*

a. High internal resistance due to poor connections, defective leads, dirty commutator or an open field circuit.

6. *High free speed and high current draw* indicate shorted fields. If shorted fields are suspected, replace the field winding assembly and check for improved performance.

NOTE: The lock-torque or resistance test has also been used when diagnosing starting motor troubles. However, this test requires more specialized equipment and meters of greater range. Of greater importance, however, is the fact that these tests cannot provide any information not available during the no-load test. A thorough no-load test will usually give all of the required data without an extra testing.

DISASSEMBLY OF THE MOTOR

General

Now that we have completed the no-load test and interpreted the results, let's assume the starting motor does not perform per the specifications. This requires disassembly and further testing of the motor.

Normally the starting motor should be disassembled only as far as necessary to repair or replace the defective parts. But to show the procedures, we will completely disassemble and assemble *a typical starting motor with an externally-mounted solenoid switch.* As a precaution, wear safety glasses while doing this job.

As the starting motor is disassembled, clean each part and inspect it for excessive wear or damage. An overall inspection should be made during disassembly. Things which are easy to do during disassembly are: 1) checking bearings for proper clearance, roughness or galling, 2) removing oil and dirt from insulation, and 3) inspecting the condition of the insulation.

Separating the Motor

The first step in disassembling the starting motor is to remove the commutator end frame. Mark the position of the end frame and the main frame with chalk before removal to aid in aligning the parts when reassembled. While removing the end frame, note the location of the brush assembly.

Brushes may be located in the end frame—be careful during removal of these—or they may be located in the main frame. While removing the end frame, check the brushes to see if they slide freely in their holders and make full contact on the commutator. **Brushes worn to half their original length or less should be replaced.**

The second step in disassembly is to disconnect the solenoid (externally-mounted). After removing the fasteners to the main frame and the drive housing, the solenoid can be removed along with the main frame assembly.

Removal of the main frame will expose the armature and commutator. The commutator should be checked for evidence of excessive arcing, discoloration or excessive wear. If it is only slightly dirty, glazed or discolored, cleaning with No. 00 or 000 sandpaper will restore the commutator to a serviceable condition. NEVER USE EMERY CLOTH TO CLEAN A COMMUTATOR.

If the commutator is worn or rough, however, it should be turned on a lathe and the mica undercut. (See machine technical manual for depth to undercut.) At this point the armature can also be inspected for rough bearing surfaces, and rough or damaged splines.

The solenoid shift lever must be disconnected from the drive housing to separate the armature and drive housing. In doing so, the complete armature shaft is exposed along with the drive mechanism. When the drive housing is removed, inspect it for cracks, and check the bearing for excessive wear. Remove any rust, paint or grease from the housing flange before reassembly.

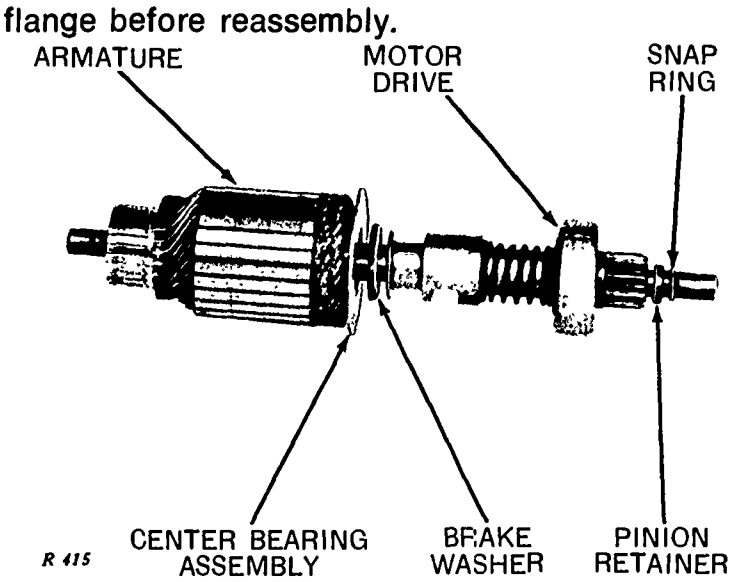


Fig. 46—Armature and Drive Assembly

With the overrunning clutch drive and armature shaft exposed as in Fig. 46, make a visual inspection for damage due to overheating.

Overheating occurs if the starting switch is not released as soon as the engine begins to operate, causing the drive pinion to remain in mesh and overrun the armature. Clutch mechanisms can withstand this for only a brief time before the lubricant gives out and they seize, causing excessive armature speeds. Look for galling of clutch bearings under the drive pinion, and bluing or deposits of bearing material on the armature shaft. If this is evident, replace the armature.

Checking the Overrunning Clutch Drive

After inspecting the motor, check the drive mechanism. Simply turn the clutch by hand to find out whether the drive slides freely on the splines. Replace the drive if it does not move freely. The pinion should turn smoothly in one direction and lock when turned *slowly* in the other direction. Replace the pinion if it is excessively worn or damaged.

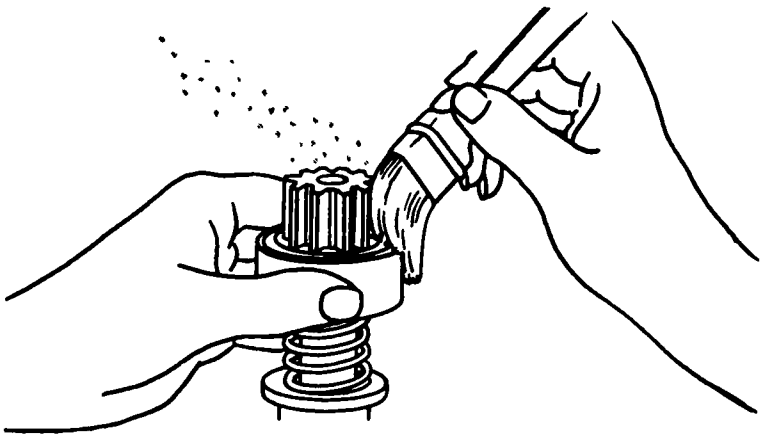


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Fig. 47—Cleaning an Overrunning Clutch

Never clean the overrunning clutch by any high-temperature or grease-removing methods. This removes the lubricant originally packed in the clutch and causes rapid clutch failure. The overrunning clutch can be wiped or brushed clean with a solvent as shown in Fig. 47, but should never be submerged since it cannot be repacked with grease.

Checking the Bendix Drive

The spiral threads on the Bendix drive sleeve should be free of dirt and grease. If the pinion teeth are badly burred, chipped or otherwise damaged, replace the pinion and shaft assembly.

Distorted drive springs can cause breakage of the motor drive housing. When the drive spring is distorted as shown in Fig. 48, replace it. When installing a new spring, always use new locks on the screws. Be sure to lock the screws securely and apply a thin coat of oil to the spiral threads.

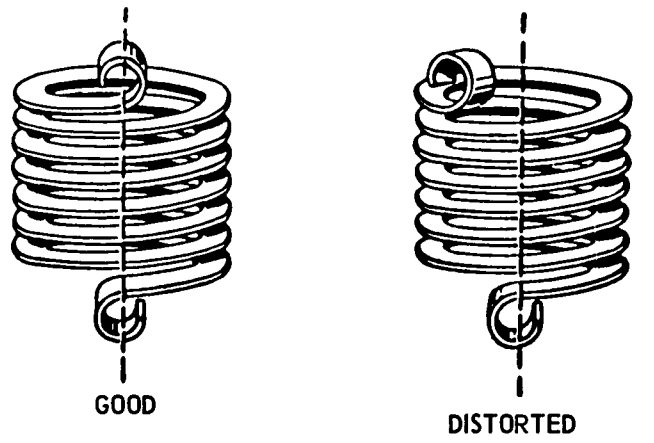

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Fig. 48—Bendix Drive Springs

Checking the Dyer and Sprag Drives

The Dyer and Sprag drives vary with the application. This means varied cleaning procedures, lubrication requirements, and adjustments. Consult the machine's Technical Manual before cleaning these drive mechanisms.

Removing the Drives

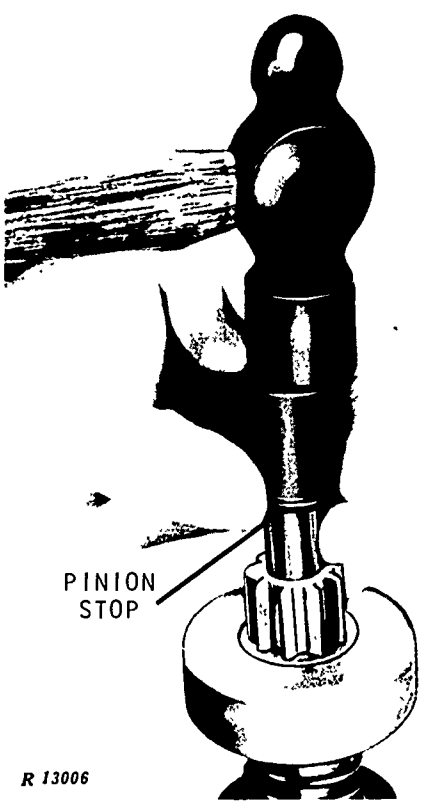

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Fig. 49—Removing Pinion Stop

To separate the drive from the armature shaft, the pinion stop must be removed. When removing the drive assembly, use a pipe coupling or suitable metal cylinder to drive the pinion stop toward the armature core and reveal the snap ring (Fig. 49). After removing the snap ring, the drive assembly will slide off the armature shaft.

TESTING AND SERVICING THE MOTOR COMPONENTS

When the starting motor has been disassembled, inspect the motor parts in preparation for component testing.

General inspection helps to locate trouble spots which could cause later failures of the motor.

Mechanical failures, such as worn bushings, bent armature shafts, worn brushes or worn motor drive, are common troubles. Except for these, **starting motor failures are generally caused by one of the following:**

OPEN-CIRCUITED WINDING—This occurs due to a broken wire, poorly-soldered connection, or a disconnection at a terminal. The result is usually no operation or a decrease in starting ability.

GROUNDED WINDING—This occurs when insulation becomes defective and a bare winding wire contacts the metal of the armature, frame, or field poles. This usually results in failure of the motor to operate.

SHORT-CIRCUITED WINDING—This occurs when insulation becomes defective and the winding coils contact adjacent coils, resulting in decreased motor cranking power.

Testing and Reconditioning the Armature

When the no-load test shows a low armature speed and a high current draw, the armature should be tested for opens, grounds, and short circuits. If the armature is tested, perform all of the tests given below.

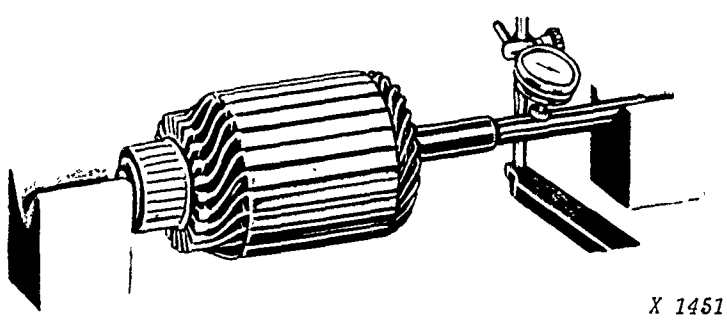

Fig. 50—Checking Armature Shaft for Straightness

Before testing, check the armature shaft for straightness. A bent armature shaft will allow the armature to drag, resulting in reduced starting performance and increased current draw.

To check, put the shaft in a lathe or rest in V-blocks and check the shaft with a dial indicator as shown in Fig. 50. Replace a bent or damaged shaft.

OPEN CIRCUIT TEST

If the armature shaft is straight, test it for open circuits in the commutator.

Open circuits are usually caused by too-long starting periods. The most likely place for an open circuit or loose connection to occur is at the commutator riser bars. Poor connections cause arcing and burning of the commutator bars as the starting motor is operated.

If the commutator bars are not too badly burned, they can often be repaired by resoldering or welding the leads in the riser bars (using rosin flux) and turning down the commutator to remove the burned material. The insulation should usually be undercut. Refer to "Reconditioning Armature," later in this chapter.

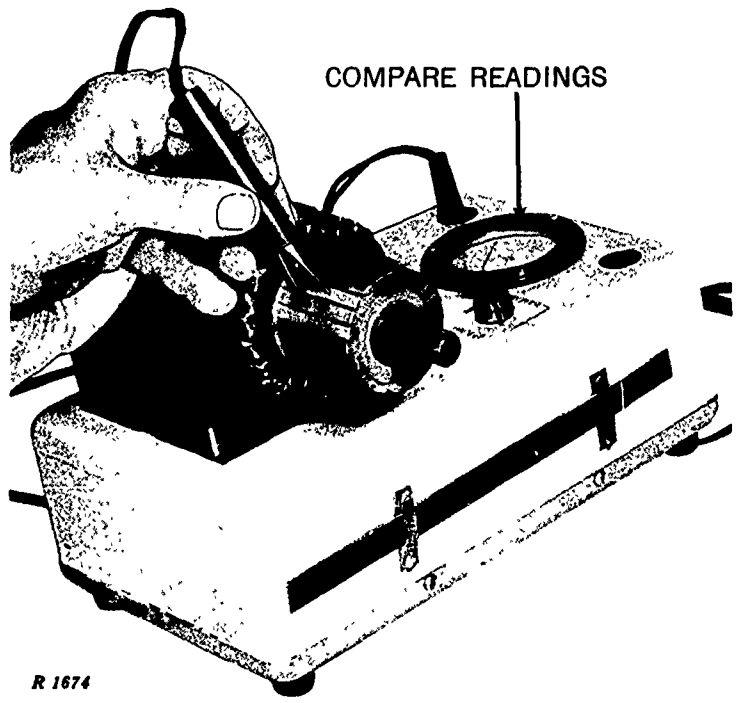

Fig. 51—Testing Armature for Open Circuits

A growler is shown in Fig. 51 with the armature mounted for testing open circuits. Use a two-pronged tester and span the adjacent commutator bars as illustrated. Slowly rotate the armature back and forth to get the maximum reading. If necessary, adjust the voltage control so that the meter hand rests about midway on the scale.

Voltage readings should read approximately the same as each commutator bar is tested with the adjacent bar. Wide deviations in readings will indicate an open circuit.

If an open circuit exists in the armature that cannot be located or repaired, the armature must be replaced.

GROUND TEST

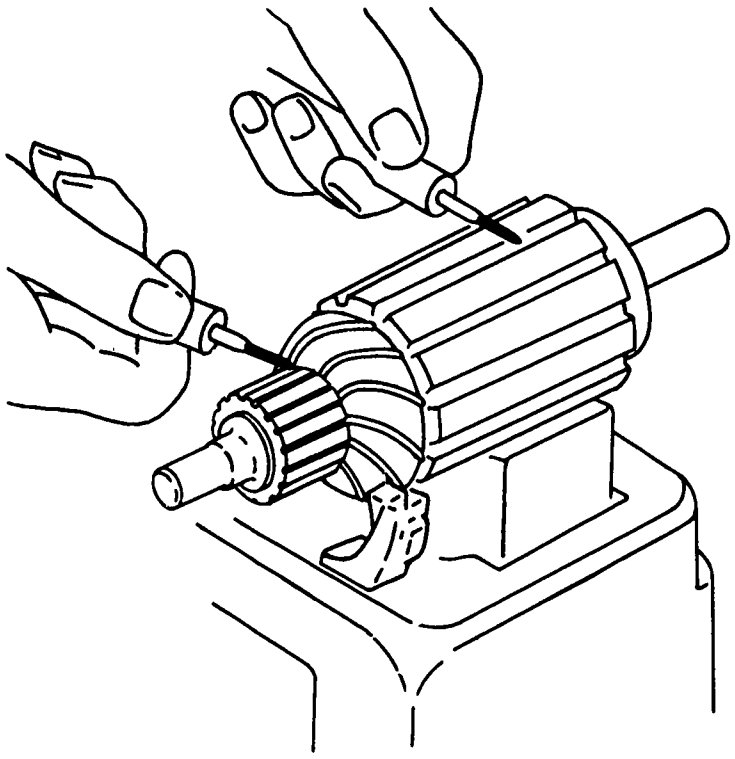

Fig. 52—Testing Armature for Grounds

When testing for grounds, place one test point on the iron core of the armature and the other test point on the copper commutator (Fig. 52). We are checking for connections between the copper and iron core which would cause a grounded armature. The test lamp should not light while making this test. If it does light, a winding is grounded and the armature must be rewound or replaced.

SHORT CIRCUIT TEST

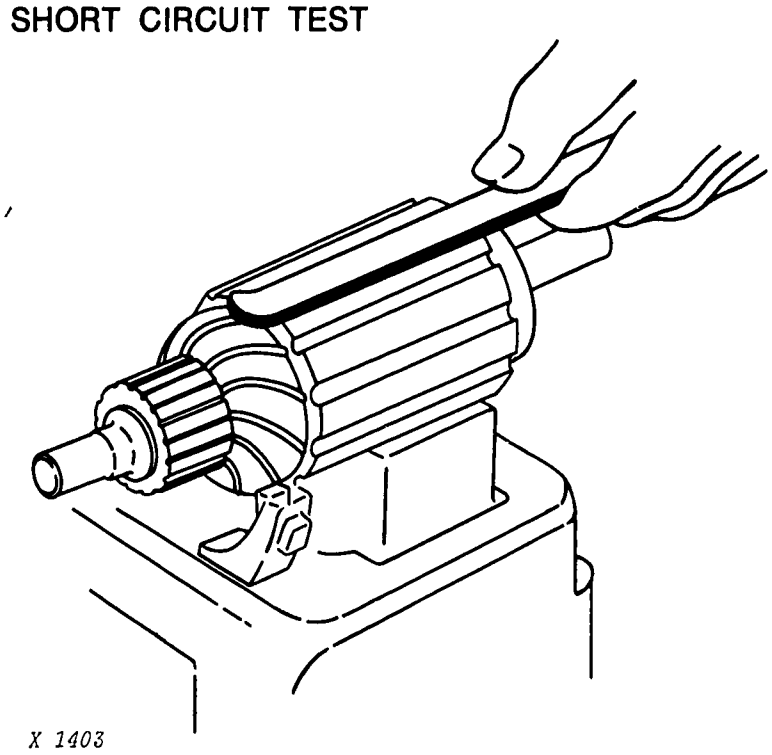

Fig. 53—Testing Armature for Short Circuits

An indication of a shorted armature is a burned commutator bar. To verify this, place the armature on a growler as shown in Fig. 53 and test it.

With the growler turned on, place a thin strip of steel or a hacksaw blade on the armature as it is slowly rotated. If the metal strip vibrates over a winding, that winding is short circuited.

Short circuited windings are sometimes caused by metal in the commutator bridging the gap from one commutator bar to the next. By removing the bridged metal, this condition can be corrected. However, if this does not correct the short, replace the armature.

RECONDITIONING THE ARMATURE

If tests indicate that the armature is suitable for service, turn the commutator down and undercut it before the starting motor is assembled.

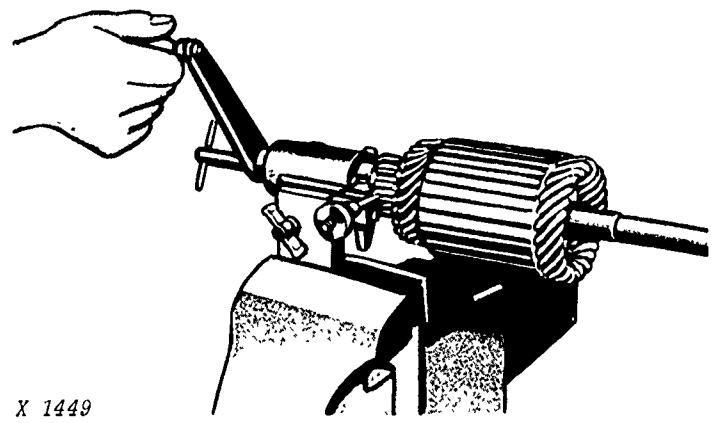

Fig. 54—Turning Down the Commutator

To turn down a commutator, use a suitable tool, such as the one illustrated in Fig. 54. If a tool specifically for turning commutators is not available, the commutator can be turned down on a lathe. In either case, remove only enough metal to "true up" the commutator.

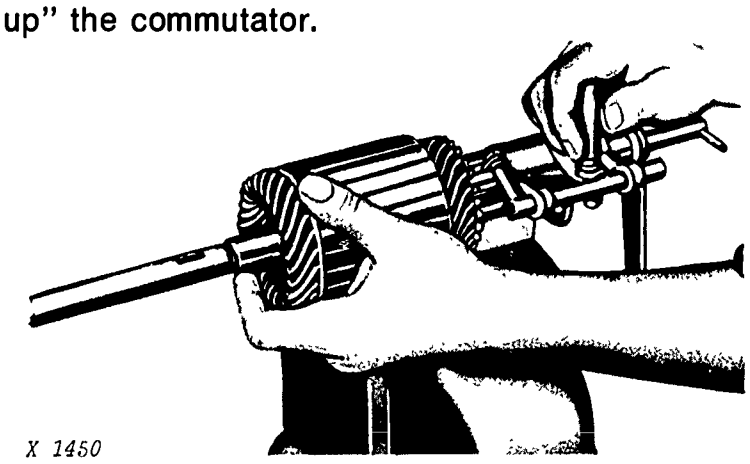

Fig. 55—Undercutting Mica on Commutator

On some starters, after "truing" the commutator, undercut the mica between the commutator bars. A tool used for this purpose is shown in Fig. 55. If a tool for undercutting is not available, use a hacksaw blade with the sides of its teeth ground to the same width as the distance between commutator bars. An undercutting tool is preferred, however, since it can provide more accurate and consistent reconditioning.

Always consult the starting motor specifications before reconditioning the armature. Most high-output starting motor armatures should *not* be undercut after the commutator is turned down.

Testing and Servicing Field Windings

Field windings should be checked for grounded wiring and open circuits while the armature is removed. Grounded wiring is caused by the copper wiring touching the steel case due to worn insulation or trapped metal between a winding and the case.

Before testing the field windings in a compound-wound starting motor, separate the shunt field winding lead from the series field winding lead. By doing this the shunt is eliminated from the circuit during the tests for grounds and open circuits.

GROUNDED CIRCUIT TEST

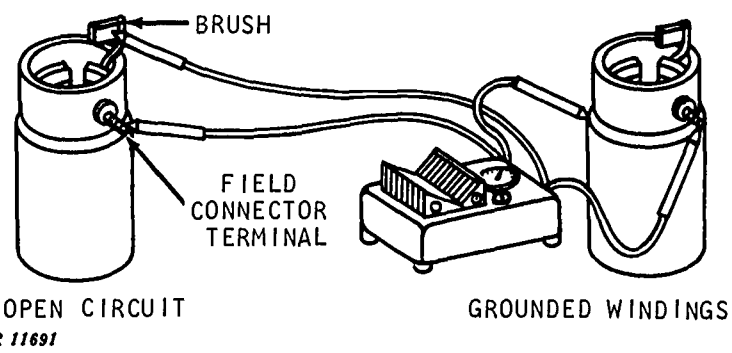

Fig. 56—Testing Field Windings

To test for a grounded circuit, first disconnect the field winding ground connections. Then connect one test point to the field frame and the other to the field connector (Fig. 56).

If the test lamp lights, the field windings are grounded. Field windings may be repaired or replaced if faulty.

OPEN CIRCUIT TEST

An open circuit test can also be made with a test lamp. If the test lamp does not light with the test points applied at the ends of the windings, the field winding circuit is open and current cannot flow through them.

When testing 24-volt starting motors, two sets of terminals are tested when checking for open circuits. Place one test point on the input terminal of the starting motor and the other test point on the winding as we did before. Test the second set of field windings by moving the test point from the winding to the insulated terminal.

SHORT CIRCUIT TEST

Because of the low resistance in the field windings there is no satisfactory test for short-circuited field windings. If the starting motor does not perform after all other tests have been made and no defects found, a short circuit can be suspected. It usually shows up in the no-load test as high ampere draw and high free speed.

REPLACING FIELD WINDINGS

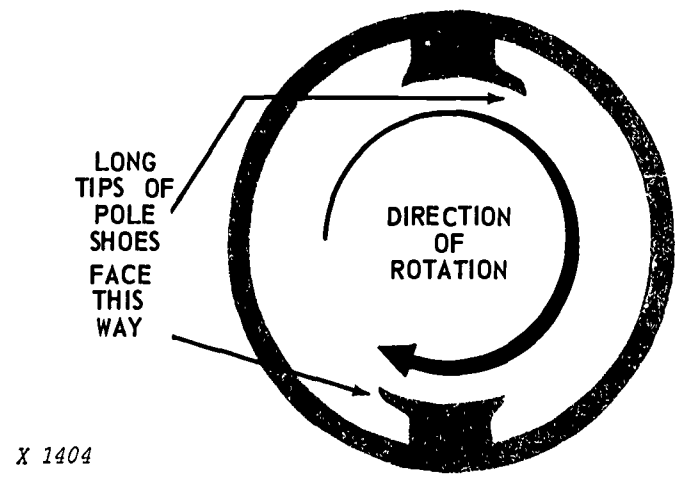

Fig. 57—Assembling Pole Shoes in Armature

If the field windings must be removed for repair or replacement, use a pole shoe spreader and pole shoe screwdriver. Be careful in replacing the field windings to prevent grounding or shorting them as they are tightened into place.

When the pole shoe has a long tip on one side, assemble it in the direction of armature rotation as shown in Fig. 57.

Testing and Servicing Brushes

Before assembling the starting motor, the brushes should be inspected and tested. To test the insulated brush holders, connect one test point to the brush holder and connect the other test point to the motor frame. The test lamp should not light. If all of the brush holders are insulated, the test lamp should light when connected to opposite brush holders but should not light when connected to adjacent brush holders or from any brush holder to the frame. Repair or replace the brush holder if tests indicate faulty brush holders. **Always use matched sets when replacing the brushes.**

On some motors, the brushes are soldered to the field coils instead of using mechanical fasteners. To replace these brushes, cut off the brush leads at the points where they are attached to the field coils. The ends of the coils must then be prepared for soldering on the new brush lead assemblies.

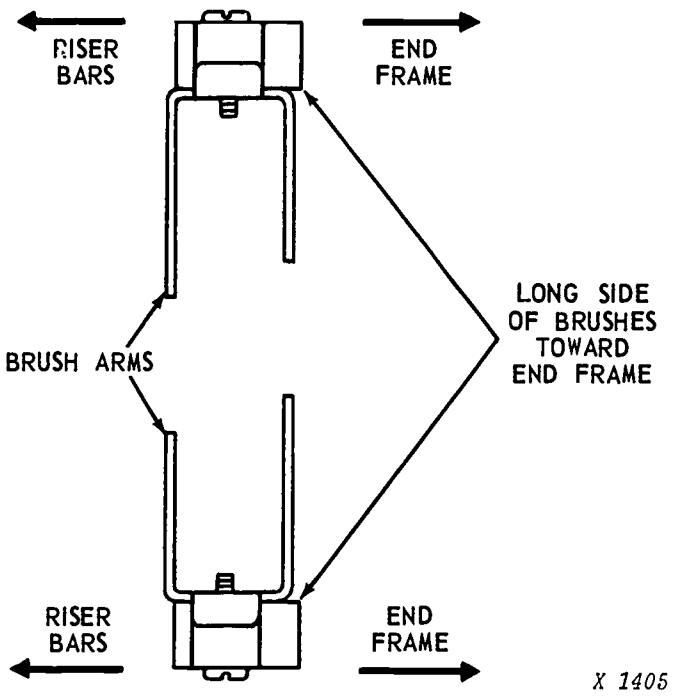

Fig. 58—Assembling Brushes to Brush Arm

Assemble all brushes to the brush arms so the long side of the brush is toward the commutator end frame as shown in Fig. 58. Otherwise the brushes may come in contact with the riser bars.

When soldering leads, it is good practice to solder the **back** sides of the coils so that the connection will not rub the armature. The ends of the coils should be thoroughly cleaned by filing or grinding off the old brush lead connections. Varnish should be removed only as far back as necessary to make the solder connections. Using rosin flux, the leads may then be soldered to the field coils, making sure that they are in the same position as the original brush holders. If the leads are overheated, solder will run on them and they will no longer be flexible.

To replace grounded brush assemblies, remove the old brush holders, the same as insulated brushes, and then attach the new assemblies to the frame. If the brush holder assemblies have retainers, peen the screws with a hammer so that the nuts cannot vibrate loose during engine operation.

When the field coil and brush assembly is reassembled in the frame, recheck the frame and field assembly with a test lamp to make sure that the soldered connection is not touching the frame and grounding the fields.

SPRING TENSION

The brushes should make good, clean contact with the commutator and should have the proper spring tension. They must also have freedom of movement so they can follow the commutator.

Never allow brush spring tension to fall below the specified limits. Starting motor brushes carry a high current, so good contact between the brush and the commutator will cut resistance. Most brush springs test above the specified tension but since the starting motor is used intermittently, this is not objectionable. Weak or distorted springs, or springs that show evidence of overheating, rust or excessive wear should be replaced. Check the spring tension of most brushes during assembly of the starting motor. (See later in this chapter.)

Servicing Bushings

COMMUTATOR END FRAME BUSHING

The bushing in the commutator end frame should be inspected for wear or damage. An excessively worn bushing will allow the armature to drag on the pole shoes.

The bronze bushings in the starting motor are oil-impregnated and should need no added lubrication. They should be lubricated when the motor is disassembled; at this time a few drops of light engine oil may be placed on each bushing before reassembly. *Be careful so that no oil reaches the commutator.*

In some cases, the bushing is lubricated by a felt wick. To replace a lubricated bushing, do the following:

REPLACING LUBRICATED BUSHINGS

Remove the oil plug so that the oil wick can be removed. Then drive the expansion plug out of the housing. Note the depth of the old bushing; drive it out, and press the new bushing in to the same depth as the original.

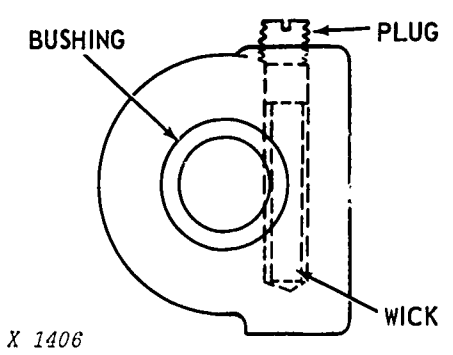

Fig. 59—Rebushing Diagram

After the new bushing is in place, use a drill the same size as the oil wick hole to drill the bushing (Fig. 59). Remove the burrs and clean out the oil wick hole before testing the bushing with the respective bearing surface of the armature. If the armature does not turn freely, ream the bushing.

The bushing can collapse when installing a prelubricated or absorbent bronze type. To prevent this, use the proper bushing arbor to obtain a correct bearing fit. The arbor is usually several ten-thousandths larger than the armature shaft. If the prelubricated bushing is undersized after installation, burnish it to size (polish by friction or rubbing). *Avoid reaming* (cutting excess metal away) if possible.

DRIVE HOUSING AND CENTER BEARING BUSHINGS

If the drive housing bushing or the center bearing bushing is worn, replace it. Loose-fitting center bearings are normal. The loose fit allows easier bushing alignment. When replacing the bushing, follow the same steps used to replace the commutator end frame bushing.

Before assembling the armature shaft with the drive mechanism, lubricate the armature shaft with a light coat of SAE 10 engine oil. Using a heavier oil may cause failure of the drive to mesh at low temperature.

When assembling motors having a center bearing, lubricate the center bearing in the same way and slide the bearing and washers onto the armature shaft ahead of the drive assembly. (Use a graphite-type starting motor lubricant as recommended.)

ASSEMBLY OF MOTOR

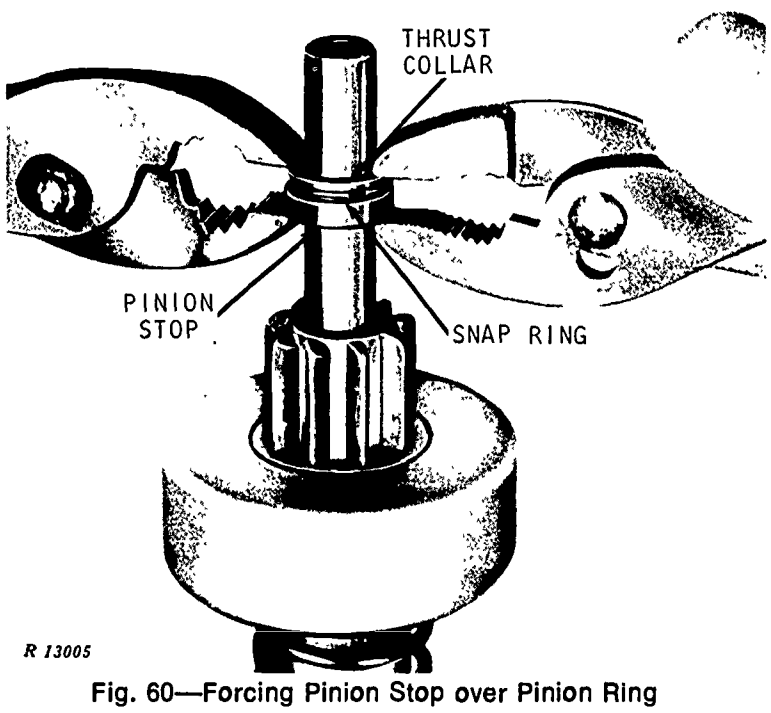

Fig. 60—Forcing Pinion Stop over Pinion Ring

Place the drive assembly on the armature shaft and slide the pinion stop onto the shaft with the cupped surface facing the open end of the shaft. Install the snap ring and squeeze it so it fits into the groove on the armature. Slide the thrust ring onto the shaft and position the pinion stop and washer next to the snap ring as shown in Fig. 60. By using two pairs of pliers, force the pinion stop over the snap ring.

With the thrust collar on the armature shaft, lubricate the bushing surface in the drive housing with the starting motor lubricant. Then guide the armature and solenoid shift lever into the drive housing. Secure the lever with the pivot screw and move the lever back and forth. The shift lever and drive assembly should move freely in both directions.

If the starting motor has a center bearing, secure it to the drive housing after checking the shift lever.

Refer to the machine Technical Manual for drive assembly tests on coaxial or heavy-duty starting motors.

Next, install the solenoid gasket, the return spring and the solenoid. Before attaching the solenoid to the drive housing, use a recommended sealing compound between the solenoid flange and the starting motor main frame.

Install the main frame and guide the brushes onto the commutator, being careful not to damage the brushes or the brush holders. After the main frame is installed, hold down the brush holders to align the brushes with the commutator and tighten the brushes.

Seating the Brushes

If new brushes were installed while servicing the starting motor, they may require seating before completing assembly.

To seat the brushes, wrap a piece of No. 00 or 000 sandpaper around the commutator so that the exposed end is trailing when the armature is turned in the running direction. The sandpaper should be one-eighth inch wider than the commutator and one inch longer than needed to reach around the commutator. Turn the armature clockwise as viewed from the drive end of the starting motor. Do not turn the armature for too long. A few turns will seat the brushes without too much brush wear. Be sure to remove all dust and abrasive particles.

Checking Brushes

We have learned that improper contact of the brushes with the commutator can cause faulty motor performance. Therefore, on most motors it is good practice to make one final check before completing assembly. That test is for spring tension on the brushes. (On some heavy-duty motors, this test is not recommended.)

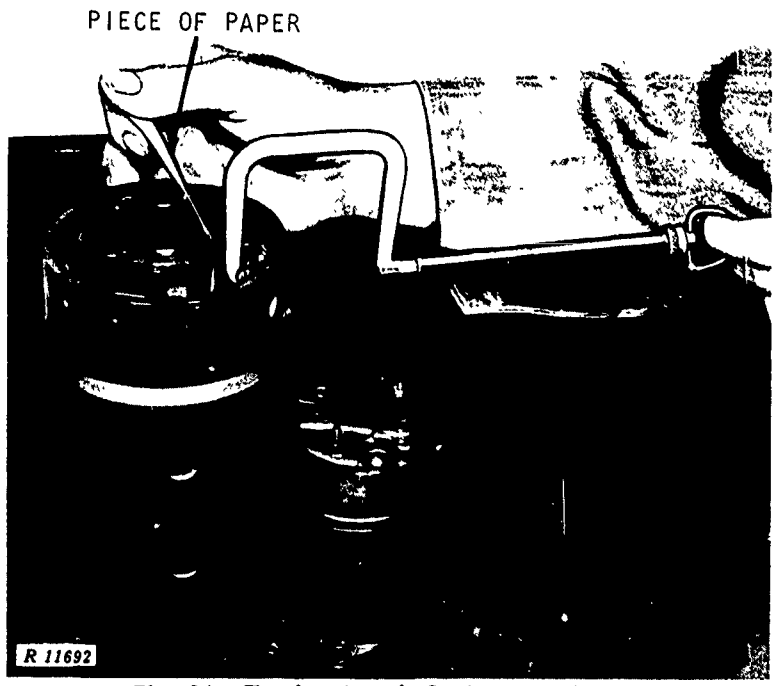

Fig. 61—Testing Brush Spring Tension

To test brush spring tension, place a strip of paper under the brush and hook a brush spring tension scale on the head of the brush attaching screw as shown in Fig. 61. By pulling the spring tension scale on a line parallel to the brush, we can obtain a reading at the point where the brush releases the strip of paper. Consult the motor specifications in the technical manual, since spring tension ratings vary with different starting motors. To adjust the tension of the brushes, bend the springs or holders.

Completing Assembly of Motor

To complete assembly, lubricate the bushing in the commutator end frame with a starting motor lubricant and slide it onto the armature shaft. Arrange the brush leads so that the thru bolts will clear them and align the register marks on the main frame and the commutator end frame. Install the thru bolts and tighten the commutator end frame. Lubricate the oil reservoirs with a light SAE 10 engine oil.

Checking Pinion Clearance

The pinion clearance test is made to check for proper assembly of the starting motor and excessive wear in the shift linkage. Many starting motors have no provision for pinion adjustment. As a result, always refer to the machine technical manual for details on pinion adjustments. If the pinion is not adjustable, the drive shift assembly must be replaced when it becomes worn or faulty.

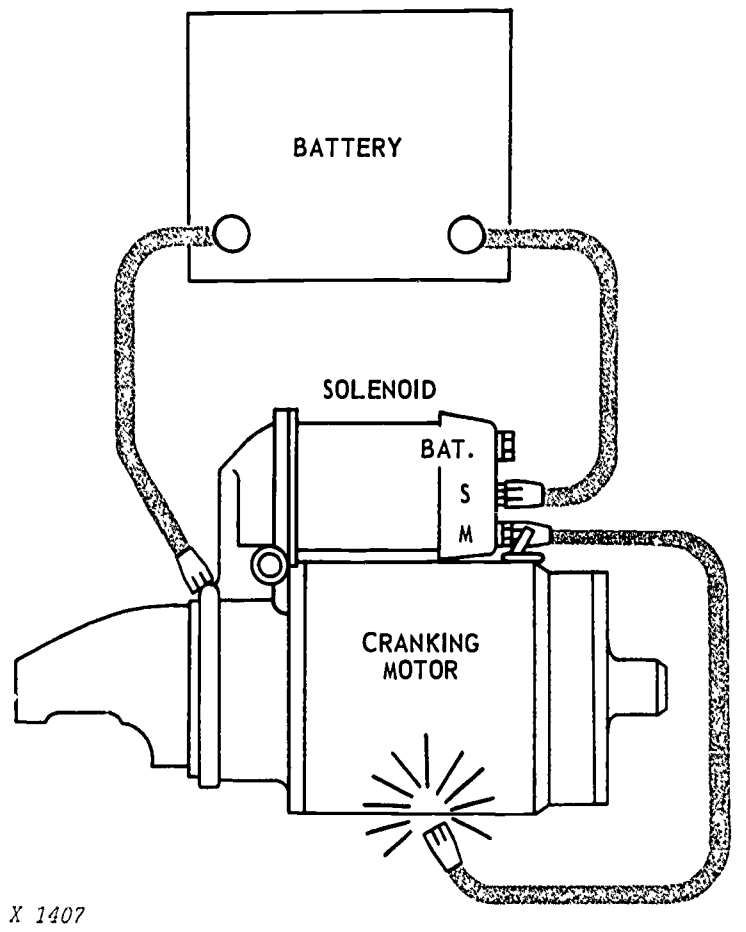

Fig. 62—Circuit for Testing the Pinion Clearance

To check pinion clearance, disconnect the field coil connector from the solenoid motor terminal (Fig. 62). Then connect a battery, of the same voltage as the solenoid, from the solenoid switch terminal to the solenoid frame or ground terminal. Momentarily connect a jumper lead from the solenoid motor terminal to the solenoid frame or ground terminal to shift the drive into starting position. It will remain there until the battery is disconnected. Now the pinion clearance can be checked as given on the next page.

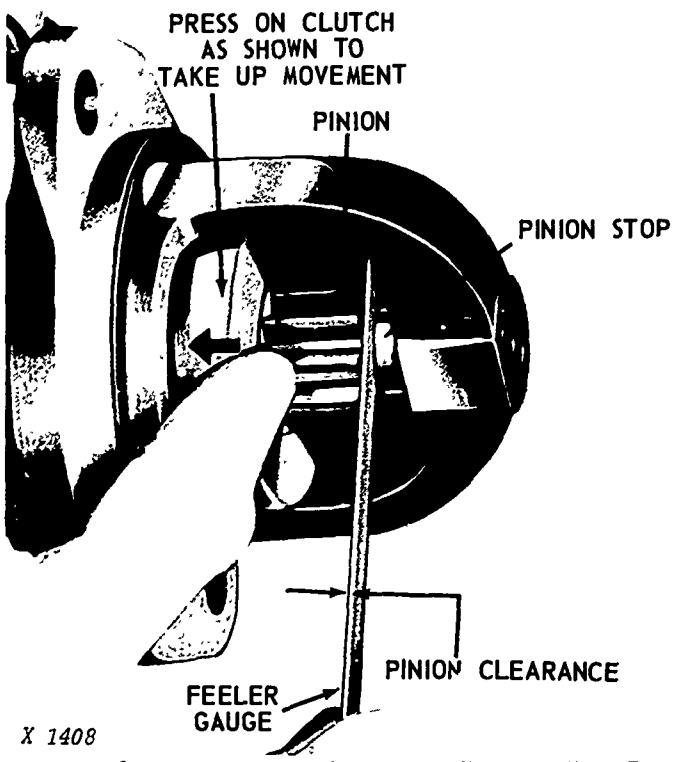

Fig. 63—Checking Pinion Clearance (Intermediate-Duty Clutch Motor Shown)

Check the pinion clearance by pressing the pinion or drive towards the commutator to take up slack movement and measuring the clearance between the pinion and pinion stop as shown in Fig. 63. The correct pinion clearance will vary for different motors. Consult the machine Technical Manual for specific readings and procedures.

Final Assembly Check

It is good practice to give an overhauled starting motor a no-load test. If current draw is too high, two or three raps with a rawhide hammer will often help align the bearings and free up the armature.

PERIODIC MAINTENANCE OF STARTING MOTORS

Check the starting motor periodically during operation on the vehicle. This will help to eliminate failures due to neglect. Abnormal service which requires many daily starts, operation in dusty or very humid climates, or operation in arctic or tropical temperatures, all put an added strain on the starting circuit and tend to wear the parts more rapidly. Under these conditions, inspect the motor more frequently.

Keep the battery serviced to be sure of current for starting. Check the specific gravity of the battery electrolyte at regular intervals. Inspect the cables and connections and keep them clean and tight.

To prevent overheating, NEVER operate the starting motor for MORE THAN 30 SECONDS AT A TIME without pausing a few minutes to cool it off. (Always consult the machine technical manual for the exact safe period.)

Thrown solder is an indication that the motor has been overheated by too-long operation. This abuse may cause open circuits to develop at the commutator bars, resulting in burnt-out bars. Each time an open-circuited bar passes under a brush, severe arcing occurs and the bar soon becomes badly burned. If the bars are not severely burned when the starting motor is serviced, the commutator may be repaired by resoldering the leads and turning down the commutator.

Always keep the starting motor mounting tight and be sure the drive is in good condition. The condition of the drive can be checked by operating the starting motor two or three times while noting the action of the drive. The motor may have to be removed to actually examine the drive.

On clutch-type motors, operating the motor also serves as a check on the freedom of shift lever operation.

The high output starting circuit, especially, must be kept in good condition to get maximum performance from the high output motor. Refer to the machine Technical Manual for circuit maintenance and specifications when servicing these circuits.

As a final step in periodic maintenance, lubricate the starting motor by adding a few drops of light engine oil to the visible hinge cap oilers. The bearings in many starting motors are of the oilless type, but they require oiling when the motor is reassembled.

TESTING OF SWITCHES

No starting motor service is complete unless the switch is checked out.

The allowable resistance (or voltage drop) of the switch contacts will vary with the machine. See the Technical Manual.

TESTING MANUAL SWITCHES

A general inspection will indicate whether the manual switch is serviceable or faulty.

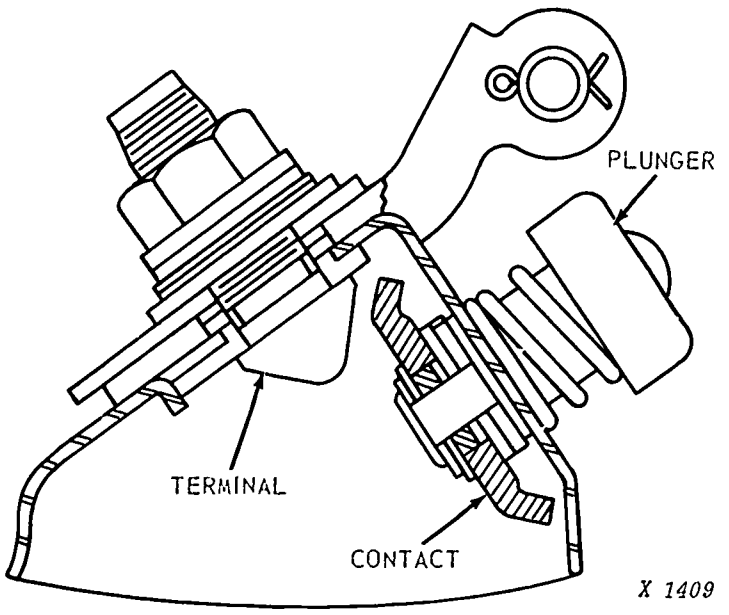

Fig. 64—Manual Switch

If the switch has a bypass ignition terminal, check it to be sure that contact is made as the switch button is pushed in. The ignition terminal should be in good condition, and if there is doubt it should be replaced. If the terminal stud is burned or bent, it should also be replaced; however, if it is not, remove any burrs with a file, and polish the contacts with No. 00 sandpaper. Install new insulators when the switch is replaced on the starting motor.

TESTING SOLENOID SWITCHES

Solenoid switches can be tested in two ways:

- **Hold-in winding test**
- **Pull-in winding test**

NOTE: Some service manuals do not list test specifications separately for each winding. In these cases use the service manual procedures and test both windings at once. Note the ammeter reading at the end of its swing upward. Then test the hold-in winding separately.

To test the solenoid windings separately, use the test circuit shown in Fig. 65 and proceed as follows.

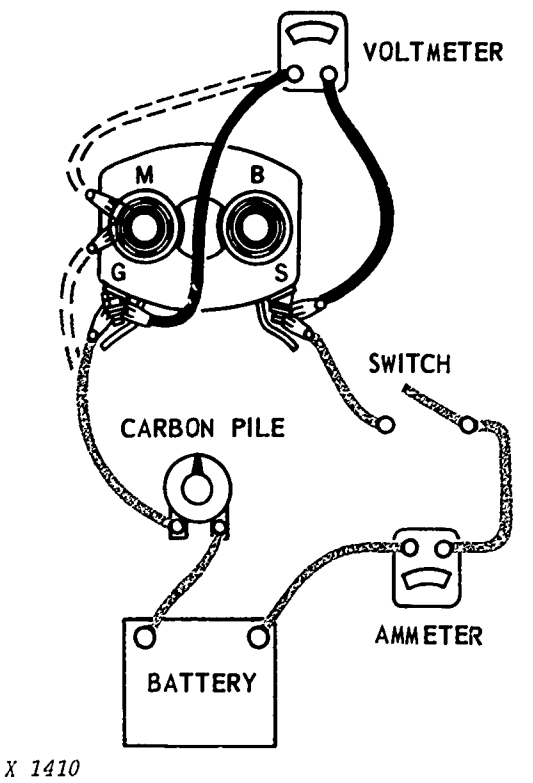

Fig. 65—Testing Solenoid Winding

The test circuit is made by connecting a battery, a switch, a carbon pile, an ammeter, and a voltmeter to the solenoid as shown. Disconnect all leads from the solenoid and connect the test leads to the solenoid switch terminal (S) and to either the ground or the second switch terminal (G).

Testing Hold-in Winding

To test the hold-in winding, adjust the carbon pile to obtain the specified voltage for solenoid operation. (If voltage cannot be reached, disconnect carbon pile and connect the battery to the solenoid ground or second switch terminal (G).) Then compare the ammeter reading with the specification in the machine Technical Manual.

Evaluate the test readings as given below under "Evaluating Test Readings."

Testing Pull-in Winding

To test the pull-in winding, disconnect the voltmeter lead from the ground terminal (G) and connect it to the motor terminal (M). Also disconnect the battery from the ground terminal (G) and connect it to the motor terminal (M).

Adjust the carbon pile for proper voltage and compare the ammeter reading with the Technical Manual specification for the pull-in winding.

NOTE: To prevent overheating, do not leave the pull-in winding energized for more than 15 seconds. Remember that the current draw will decrease as the winding heats up.

Evaluate the ammeter readings for the pull-in winding as given below.

Evaluating Test Readings for Both Windings

1. Too-high ammeter readings mean shorted or grounded circuit.

2. Too-low ammeter readings mean excessive resistance.

3. No ammeter reading at all means the circuit is open.

If the short, ground, high resistance, or open cannot be located under the switch cover, then the switch windings are defective and must be replaced.

TESTING MAGNETIC SWITCHES

A magnetic switch can be checked in the same way as the solenoid by connecting the test leads to the main switch terminals, shown by the red circuit in Fig. 65.

If the switch is in good condition, the plunger will close the main switch contacts.

If the action is slow or the plunger does not operate, take an ammeter reading of the current drawn by the coils.

1. Ammeter readings higher than specified mean a shorted or grounded wire.

2. A low reading means excessive resistance.

3. No reading means that there is an open circuit in the coils.

Most magnetic switches are sealed, so any of the above conditions mean that the switch must be replaced.

TEST YOURSELF

QUESTIONS

1. (Fill in the blanks.) "In a basic starting circuit, the _____ supplies the energy to the _____ _____ which drives the engine flywheel. The circuit is activated by a _____."

2. What are the three main types of starting motor circuits?

3. True or false? "The coaxial-mounted solenoid switch is on the outside of the motor housing."

4. What is the basic test of the starting motor's internal condition?

5. Replace motor brushes worn to (¾—½—¼—⅓) their original length.

6. When cleaning the commutator, which material should be used? a. Emery cloth. b. No. 00 sandpaper. c. A smooth mill file.

7. (Fill in the blanks.) "To prevent _____, never operate the starting motor for more than _____ at a time without pausing for a few minutes."

ANSWERS

1. First blank—"battery." Second blank—"starting motor." Third blank—"switch."

2. Series-wound, compound-wound, and parallel-wound.

3. False. The coaxial mounting is enclosed in the motor housing.

4. The no-load test.

5. ½.

6. b. No. 00 sandpaper.

7. First blank—"overheating." Second blank—"30 seconds."

IGNITION CIRCUITS / CHAPTER 6

INTRODUCTION

The ignition circuit creates the spark which ignites fuel and powers the gasoline or LP-Gas engine.

To do this, the ignition circuit must:

1) Step up low to high voltage surges

2) Time these surges to the engine

The ignition circuit (Fig. 1) has these parts:

- **Ignition Coil**
- **Condenser**
- **Distributor**
- **Spark Plugs**

The COIL transforms the low voltage from the battery to a high voltage for producing a spark.

The CONDENSER collapses the magnetic field in the coil to produce a high voltage. In doing this it also protects the distributor points against arcing.

The DISTRIBUTOR does three things: 1) Opens and closes the primary circuit, causing the coil to produce high voltage surges, 2) Times these surges to engine rotation, and 3) Directs each high-voltage surge to the proper spark plug.

The SPARK PLUGS ignite the fuel-air mixture within each cylinder of the engine.

The **battery** or the **charging circuit** is the initial power source for the voltage in the ignition circuit, while the **ignition switch** turns on the circuit when it cranks the engine.

HOW THE IGNITION CIRCUIT WORKS

The ignition circuit must take low voltage from the battery and create high voltage to fire the engine. It must do this very accurately and very rapidly—100 or more times per second.

Let's see how the circuit does this complex job.

The ignition circuit has two separate circuits:

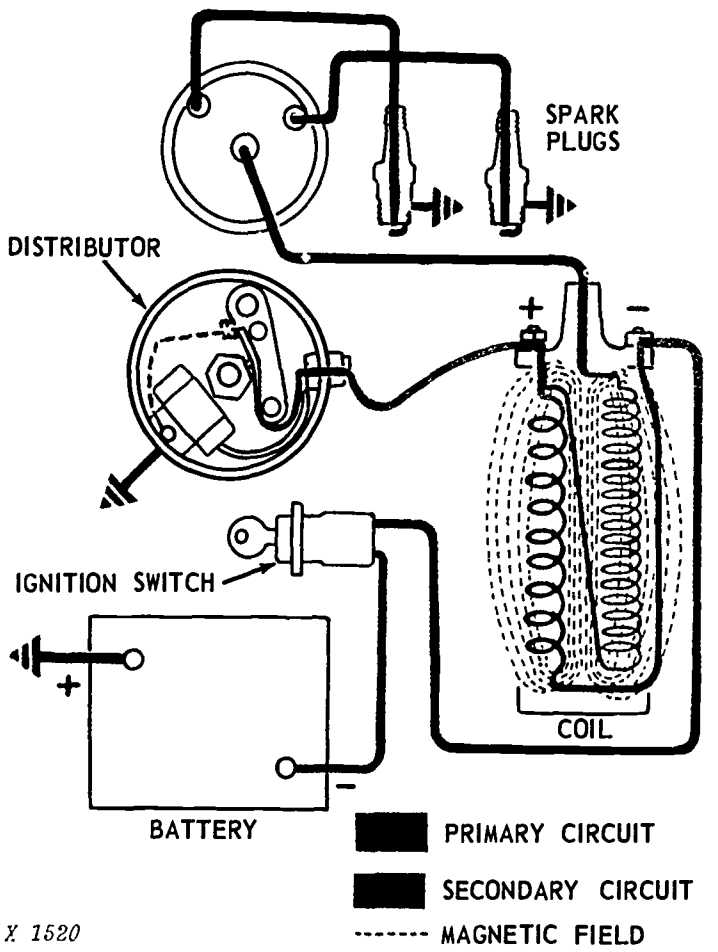

Fig. 1—Ignition Circuit

- **Primary—low-voltage circuit**
- **Secondary—high-voltage circuit**

The PRIMARY CIRCUIT is the path for low-voltage current from the power source. Fig. 1 shows this circuit in red. It includes these parts:

1) Coil Primary Winding

2) Distributor Contact Points

3) Condenser

The SECONDARY CIRCUIT is the high-voltage path for current stepped up by the coil. Fig. 1 shows this circuit in blue. It includes these parts:

1) Coil Secondary Winding

2) Distributor Rotor

3) Distributor Cap

4) Spark Plugs

Now let's take these circuits and see how they work.

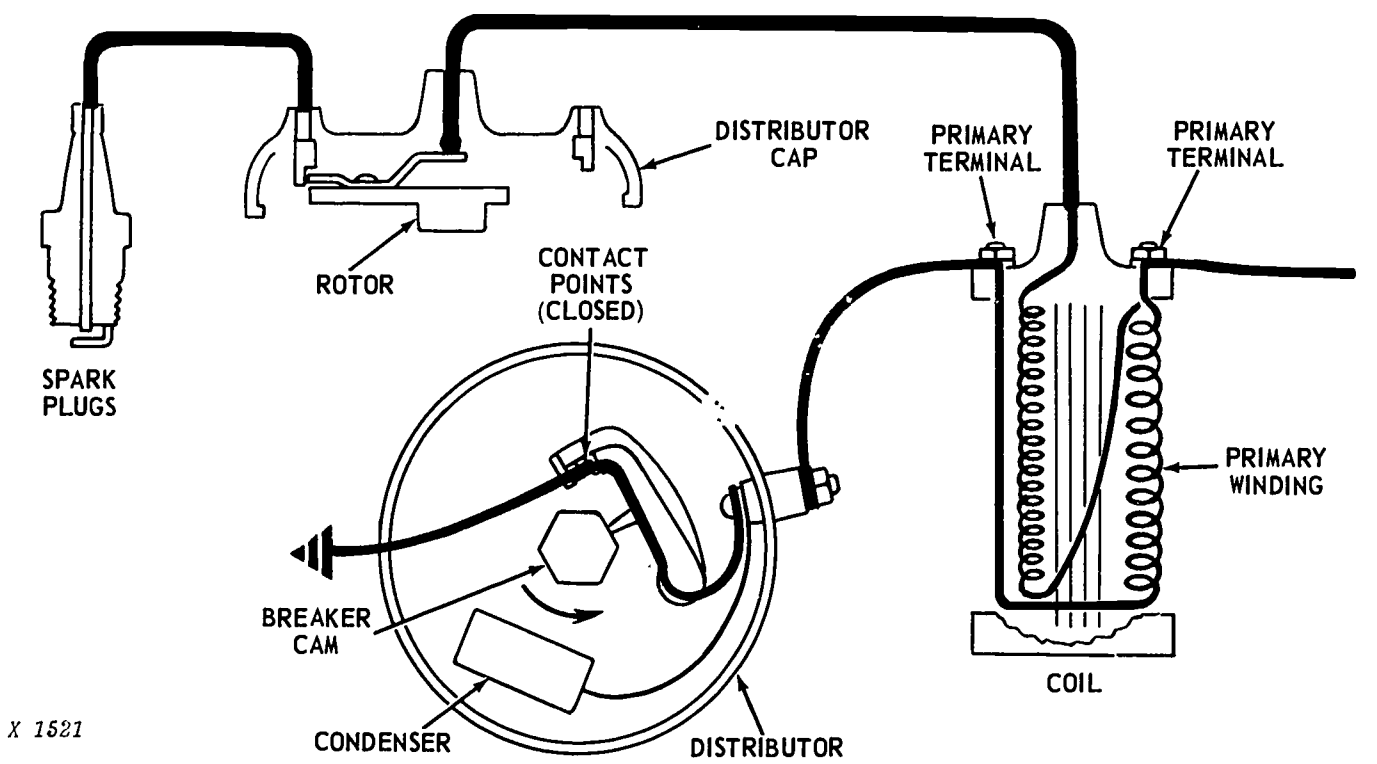

Fig. 2—Operation Before The Distributor Points Open

To simplify, let's divide the operation into two parts—before the distributor points open and after they open.

OPERATION BEFORE THE DISTRIBUTOR POINTS OPEN

Before the engine is started, the distributor points are closed (Fig. 2).

But when the ignition switch is turned on, current flows from the battery into the *primary* windings of the coil as shown in red.

This current creates a magnetic field around the winding.

From the primary winding, the current—at low voltage—simply travels through the closed distributor points and back to ground.

OPERATION AFTER THE DISTRIBUTOR POINTS OPEN

As the engine rotates in starting, it drives the distributor shaft and the breaker cam.

When the breaker cam opens the distributor points, the second phase of ignition begins (Fig. 3).

As the points open, they open the primary circuit and divert the flow of current to the condenser, then stop flow in the primary circuit.

Stopping this flow causes the magnetic field around the primary winding to collapse very quickly.

This collapse induces a voltage in the conductor which causes current to flow.

In this case, the collapsing field further collapses across the *secondary* winding and induces voltage in it also.

But because the secondary is much "stronger" winding, a higher voltage is induced there—from 4,000 to 20,000 volts.

This surge of high voltage "pushes" current through the secondary winding and the high-tension terminal into the distributor cap as shown in red in Fig. 3.

The rotor inside the distributor cap turns and contacts a spark plug terminal, directing the voltage "surge" to the correct plug through insulated cables.

At the spark plug, current flows down the center electrode, jumps the gap, and creates the spark

This whole cycle happens from 100-300 times a second, depending on the speed of the engine.

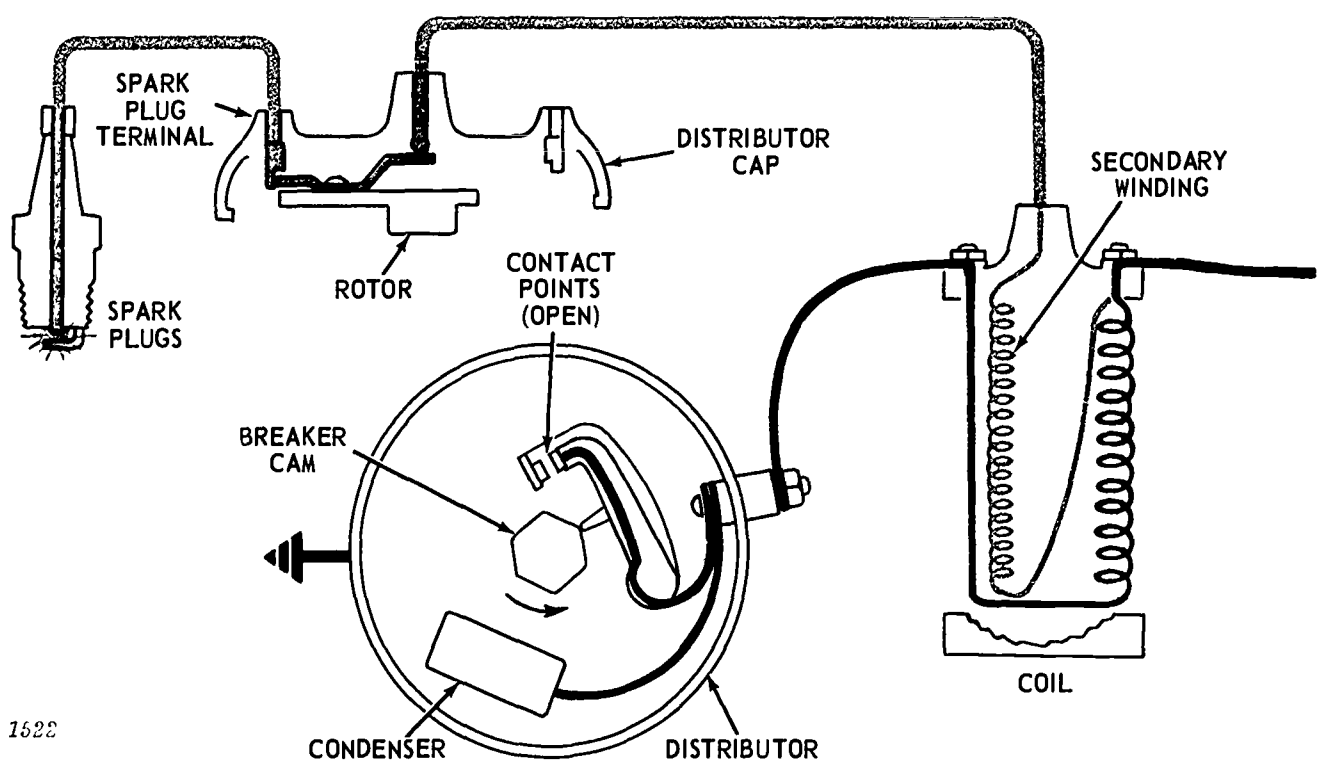

Fig. 3—Operation After The Distributor Points Open

Now that we know the basic operation of the ignition circuit, let's see how each component works.

IGNITION COIL

You have already seen the three main parts of the ignition coil, the **primary** and **secondary windings,** and the **high-tension terminal.** Now let's see how these parts of the coil induce the high voltage surge.

The center of the coil is a soft iron **core.** (Fig. 4). The **secondary winding** of fine wire is wrapped around this core. One end of the secondary winding is connected to the **high-tension terminal.**

The **primary winding** of heavy wire is wrapped around the secondary winding. The two ends of the primary winding are attached to the primary terminals in the coil cap. One of these terminals is connected to the power source; the other is connected to the distributor points.

A shell of laminated material is placed around the windings and core as shown. The core, windings, and shell are then encased in a metal container. The container is filled with either oil or insulating material and hermetically sealed with the coil cap. The cap is made of a molded insulating material with the two primary terminals and one high-tension terminal molded into it.

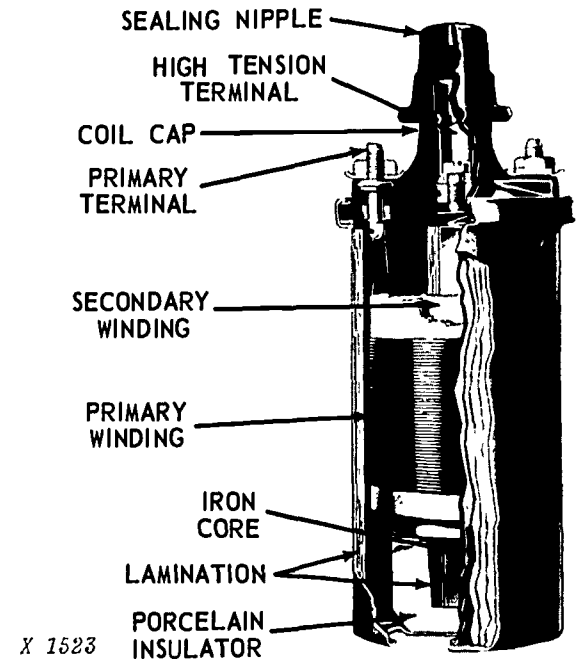

Fig. 4—Ignition Coil

OPERATION OF COIL

The ignition coil is a pulse transformer that steps up the low voltage from the battery as we explained above.

Let's discuss some other factors of coil operation.

The magnetic field around the primary winding does not reach its full potential at once. A moment of time is needed to build up the field strength.

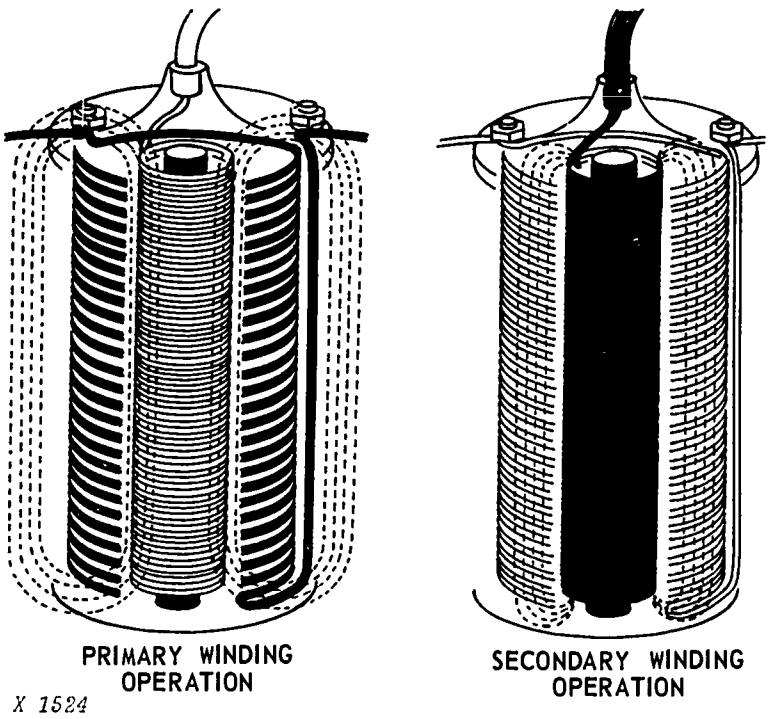

Fig. 5—Operation of Coil

This is because the field induces a momentary counter-voltage in the primary winding. The counter-voltage opposes current flow and must be overcome by circuit voltage so that current flow and field strength can increase.

Only a small fraction of a second is involved, but this build-up time is important: At high speeds, the distributor points are closed for a very short time. If no allowances are made, the current flow and the magnetic field will never reach their full potential. And since the field is not strong enough, it will never induce a high voltage surge when it collapses.

Another factor to consider is the voltages induced in the winding. We have already mentioned that primary winding voltage is much less than secondary winding voltage. However, the primary winding voltage does have some effect. It helps to charge the condenser faster and thus stops the current flow faster in the primary circuit.

Voltage in the secondary winding may go as high as 20,000 volts. However, it will only go as high as needed to cause the current to jump the spark plug gap.

Jumping the gap creates another reaction which helps in ignition operation. By jumping the gap, the secondary circuit is completed. Then a magnetic field is created around the secondary winding. This field partly stops the field collapse around the primary winding. The voltage induced by the primary winding field in the secondary winding is then reduced to a level which sustains the spark for short periods of time.

TESTING THE COIL

Many electrical system problems can be caused by more than one failing component. In the ignition circuit, it is even harder to find a failure because faulty parts are not the only causes that must be considered.

If the ignition coil is faulty, expect some of the following problems:

1. *The engine will not start.*
2. *The engine is hard to start.*
3. *The engine misfires on a warm humid day.*
4. *The engine suddenly stops.*

Of course, some of these problems can be caused by other failures than in the coil.

Coil Tests

1) Make a *visual* check of the ignition circuit to find broken leads, broken or loose connections, or possible cracks or broken components.

2) Make a complete *electrical* check of the circuit to isolate the faulty component.

Polarity of the Coil

Wrong polarity of the coil is not a serious problem, but can cause damage over a long period of time. A coil that is wrongly connected to the power source and the distributor will require an extra 4000 to 8000 volts to create the spark.

The wrong coil polarity makes the center electrode of the spark plugs have the wrong polarity. This can cause misfiring as the voltage required to jump the spark gap increases.

Fig. 6 illustrates the proper coil connections.

On negative-ground systems, the **negative** primary terminal is connected to the distributor.

On *positive-ground systems,* the **positive** primary terminal is connected to the distributor.

Most coils have the polarity signs imprinted in the cap by each terminal.

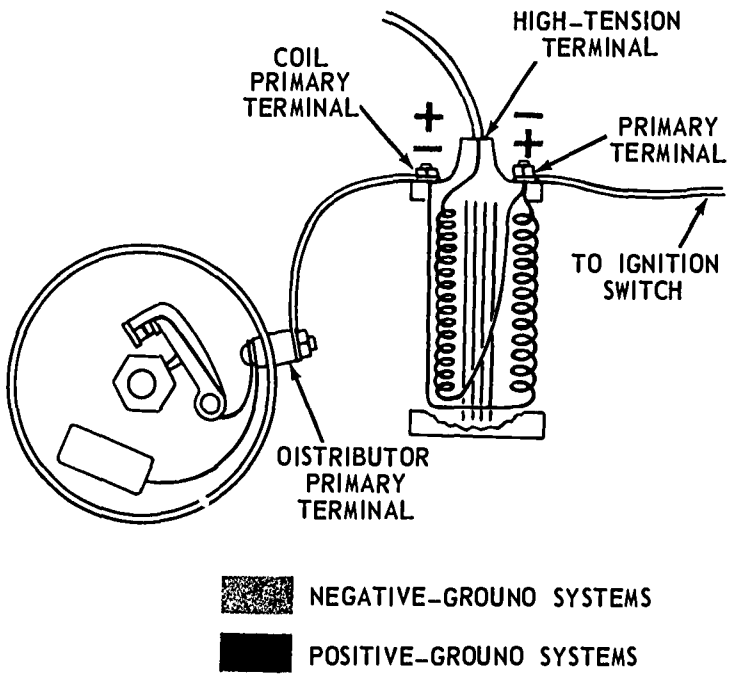

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Fig. 6—Correct Polarity of the Coil

Electrical Tests on the Coil

Most well-equipped shops have an electrical service tester that can be used to test many of the ignition circuit components. When testing the coil with one of these testers, follow the recommended test procedures.

Basically, the ignition coil is tested for its voltage strength. Two methods are generally used:

1) The spark gap tester method

2) The meter tester method

TESTING COIL WITH SPARK GAP TESTER

The spark gap tester is connected into the ignition circuit, usually off the high-tension terminal of the coil. When the distributor points open, a spark jumps a gap in the tester. This gap is adjustable. In this way, the distance the spark is able to jump determines the strength of the coil voltage.

When using this tester, you must have a good coil for a comparison. Both the good coil and the coil being tested must be of the same temperature and use identical test leads.

With the spark gap tester, many variables enter into the test results. These include altitude, temperature, and atmospheric conditions.

Because the test procedures differ between the different models of this tester, follow the manufacturer's recommendations.

TESTING COIL WITH METER-TYPE COIL TESTER

This type of tester may be part of an electrical servicer or just a single unit (Fig. 7). It may also be capable of testing the condenser for shorted, open, or grounded coil windings.

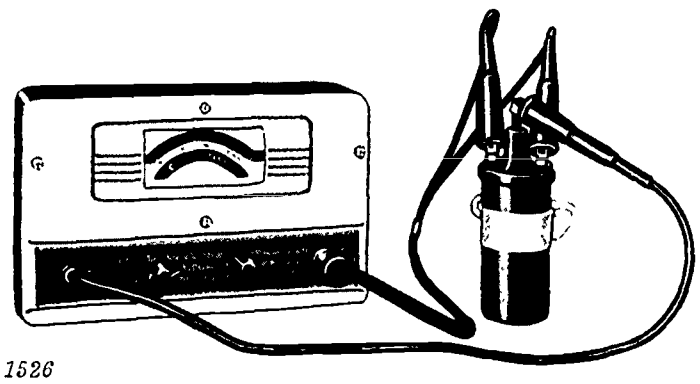

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Fig. 7—Meter-Type Coil Tester

The tester uses a graded meter to show the condition of the coil. The meter may have two scales —one scale marked "Bad—Fair—Good"; the other scale marked in numbers from one to ten. The "ten" side of one scale usually corresponds with the "good" range in the other scale.

For each model of meter tester, follow the tester's instructions.

NOTE: Of the two types of testers, the meter-type coil tester is more accurate because it is not affected by other variables.

Testing Coil for Grounded Windings

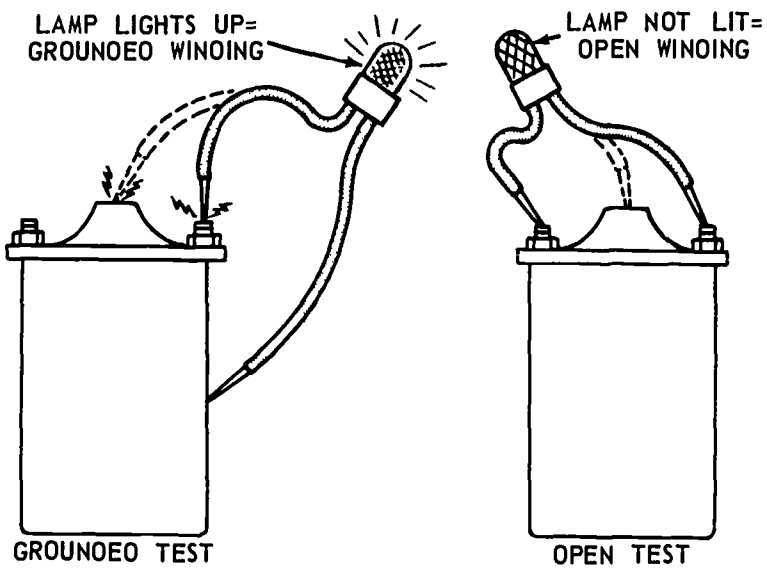

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Fig. 8—Testing Coil for Grounded or Open Windings

To test the windings, a test lamp and probes are used (Fig. 8).

To find a grounded primary or secondary winding, place one of the probes on a clean part of the coil case. Place the other probe on the primary terminal or the high-tension terminal as shown in Fig. 8.

If the lamp lights or a spark appears on contact, the windings are grounded.

On some insulated or two-wire systems, this test doesn't apply to the secondary winding. However, the test can always be used on the primary windings.

Testing Coil for Open Windings

To test for an open *primary* winding, place the test lamp probes on the two primary terminals (Fig. 8).

If the lamp does not light, the winding is open.

To test for an open *secondary* winding, place one probe on the high-tension terminal and the other probe on the primary terminal. Rub the probes over the terminals.

No sparking indicates an open winding. (If the windings are okay, a light sparking should occur but the lamp will not light).

SERVICING THE COIL

The only service required on the coil is to keep the terminals and connections clean and tight. The coil itself should also be kept reasonably clean.

Rubber nipples on the high-voltage terminal help in preventing "tracing" or leakage of current across the exposed surfaces.

There is no repair on the coil. If it is cracked or has bad wiring, it must be replaced. A crack in the coil cap breaks the hermetic seal and allows moisture to enter the coil.

IGNITION CONDENSER

The *condenser* prevents arcing at the distributor points when they begin to open.

Excess current flows into the condenser until the points are safely separated.

The coil is controlled by the opening and closing of the distributor points. However, the points cannot do this job alone because:

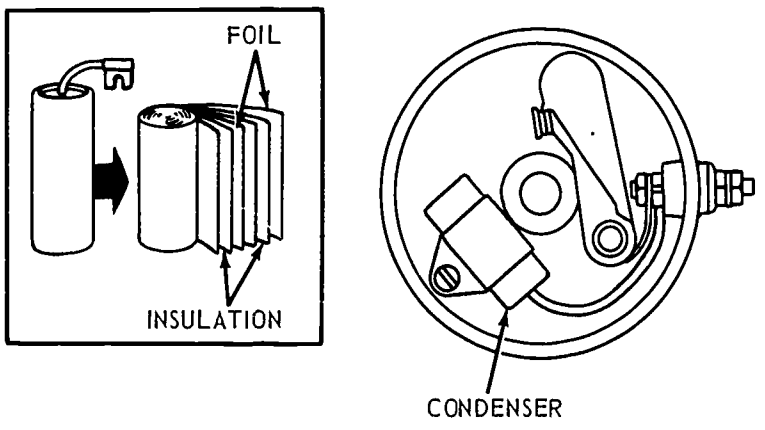

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Fig. 9—Condenser Installed On Distributor

1. The points open and close mechanically—a fairly slow action.

2. The points open only a short distance.

3. Voltage within the coil can become very high.

Without a condenser, what happens is this:

1. Induced voltage in the coil primary gets too high and pushes current across the gap—burning the points.

2. Current flow does not stop quick enough, and the field collapses too slowly. So the secondary voltage is too low and no high-voltage surge is produced to fire the spark plug.

The condenser helps eliminate these problems by both absorbing the "arc" current and helping to induce a higher voltage for the spark plugs.

CONSTRUCTION OF THE CONDENSER

The condenser (Fig. 9) is mounted in the distributor and is connected across the points.

The condenser is made up of two foil plates which are insulated from each other with a special paper. The plates and the paper are wrapped around an arbor to form a winding. Each plate has a wiring lead—one connected to the condenser case and other connected to the main wiring lead. The whole assembly may be encased in metal or epoxy.

OPERATION OF THE CONDENSER

The condenser provides a place for current to flow as the distributor points separate. This current flowing into the condenser prevents an arc between the points.

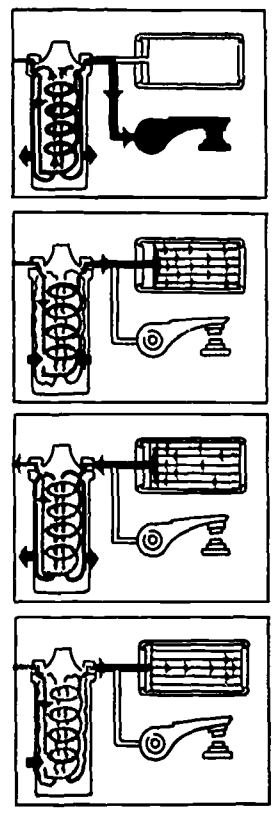

Fig. 10—Operation of the Condenser

Fig. 10 explains the operation of the condenser.

The condenser holds only a limited amount of current. It fills up or is "charged" very quickly. This stops the current flow in the primary winding. Then the field around the winding collapses, inducing voltage in both the primary and secondary windings. The greatest voltage, of course, is induced in the secondary winding.

The voltage induced in the primary winding causes a current to flow in the primary winding. This current also helps to charge the condenser, which creates still more opposition to current flow, producing a further collapse of the field and high voltage.

The voltage keeps on rising to try to force the current to flow. But by this time the points are far enough apart so that the voltage never "pushes" current across the gap.

All arcing is not eliminated, however. In spite of the condenser, arcing does occur during the first millionth of a second that the points separate. But it is a small spark much like the one produced when a wiring connector is pulled apart.

TROUBLE SHOOTING THE CONDENSER

Listed below are the problems that can be caused by a faulty condenser.

Problem	Cause
Engine cranks, but won't start	*Faulty condenser*
Engine runs, but misses on all cylinders	*Faulty condenser*
Pitted distributor points	*Wrong-capacity condenser*
Burned distributor points	*High resistance in the condenser*

Remember that some of these problems may be caused by other faulty components. Only a complete circuit check will finally pinpoint the cause of the problem.

TESTING THE CONDENSER

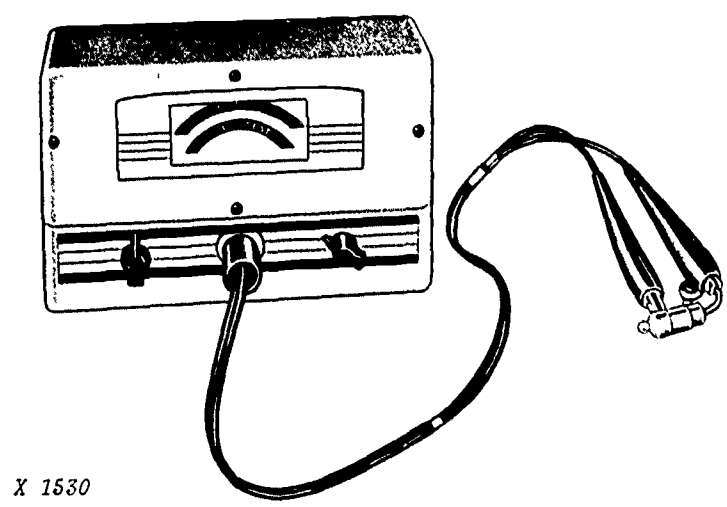

Fig. 11—Testing the Condenser

Generally, use a special condenser tester or a combination coil-condenser tester to check the condenser (Fig. 11).

Check these four things:

1. Grounded or shorted condenser. This is usually caused by the breakdown of the insulation between the condenser plates. This prevents the operation of the condenser.

2. Low insulation resistance. This permits the charge to leak from one plate to another. This is usually caused by moisture which weakens the insulation and prevents the condenser from holding a charge.

3. High series resistance. This can be caused by a defective condenser lead or a poor connection in the condenser. Only a condenser tester that is capable of making a high-frequency test can find this condition.

4. Proper condenser capacity. The capacity is the amount of charge that the condenser can take. Capacity is determined by the area of the plates and by the insulating materials. If the capacity is too low, the points will turn and collect deposits. If capacity is too high, the efficiency of the spark is reduced at high speeds (see Fig. 12). As shown, material can build-up on the points or be removed according to the system. Normally the spark capacity won't change in service.

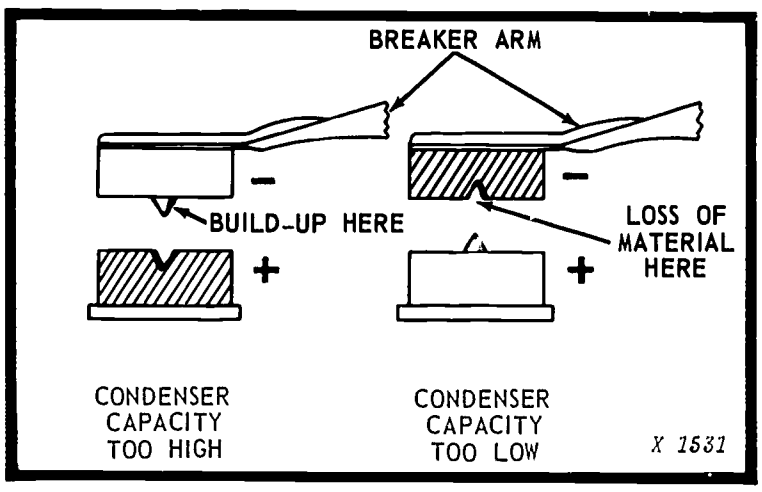

Fig. 12—How Capacity of the Condenser Affects the Distributor Points

REPAIRING THE CONDENSER

The condenser is not repairable. If it fails, replace it.

IGNITION DISTRIBUTOR

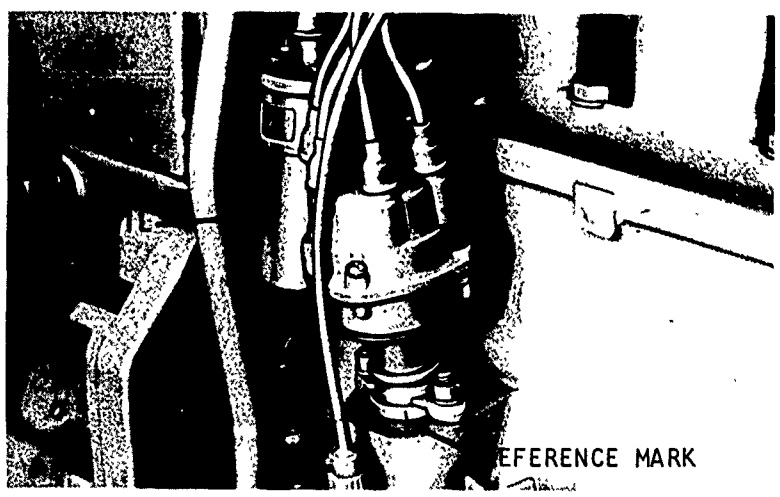

Fig. 13—Ignition Distributor

The distributor does three jobs:

- **Opens and closes the primary circuit**

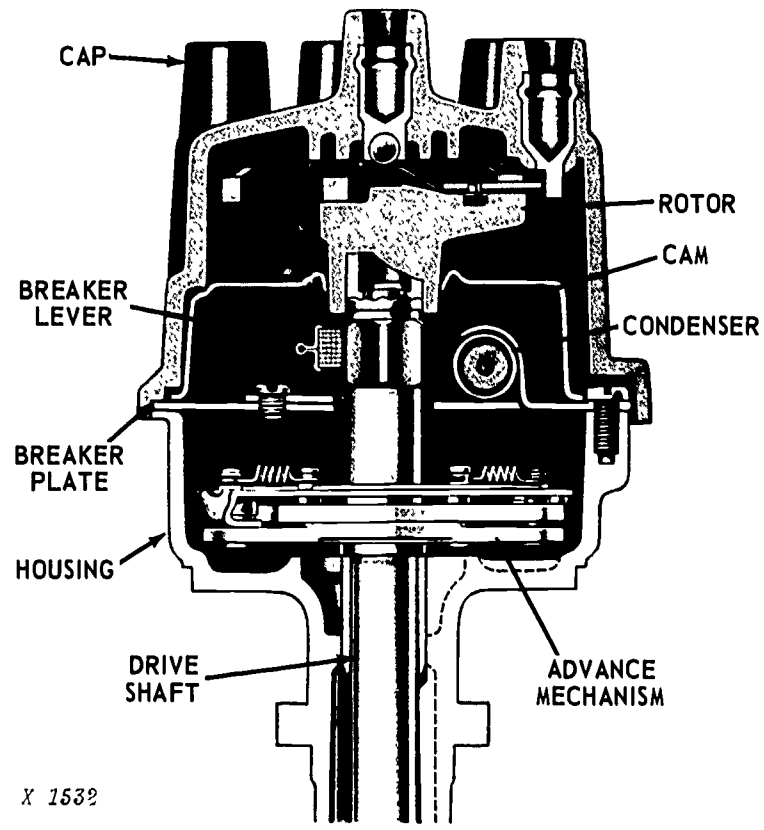

Fig. 14—Cutaway of Distributor

- **Times the high voltage surges**
- **Delivers current to the spark plugs**

Fig. 14 shows the parts of the distributor. We can put all the distributor parts into three groups:

Primary Circuit Operation	Timing	Delivery
• *drive shaft*	• *drive shaft*	• *drive shaft*
• *breaker cam*	• *breaker cam*	• *rotor*
• *breaker plate*	• *centrifugal advance*	• *cap*
• *contact points*	• *contact points*	

Let's see what each of these distributor parts do and then we'll see how they operate.

Drive Shaft—is driven at one-half engine speed by the engine camshaft. It drives the centrifugal advance mechanism, the breaker cam, and the rotor.

Breaker Cam—is slip-mounted on the drive shaft and pinned to the centrifugal advance. As you can see in Fig. 14, the cam has lobes or corners—one for each engine cylinder. As the cam rotates, each lobe pushes against the contact point breaker lever, opening the contact points.

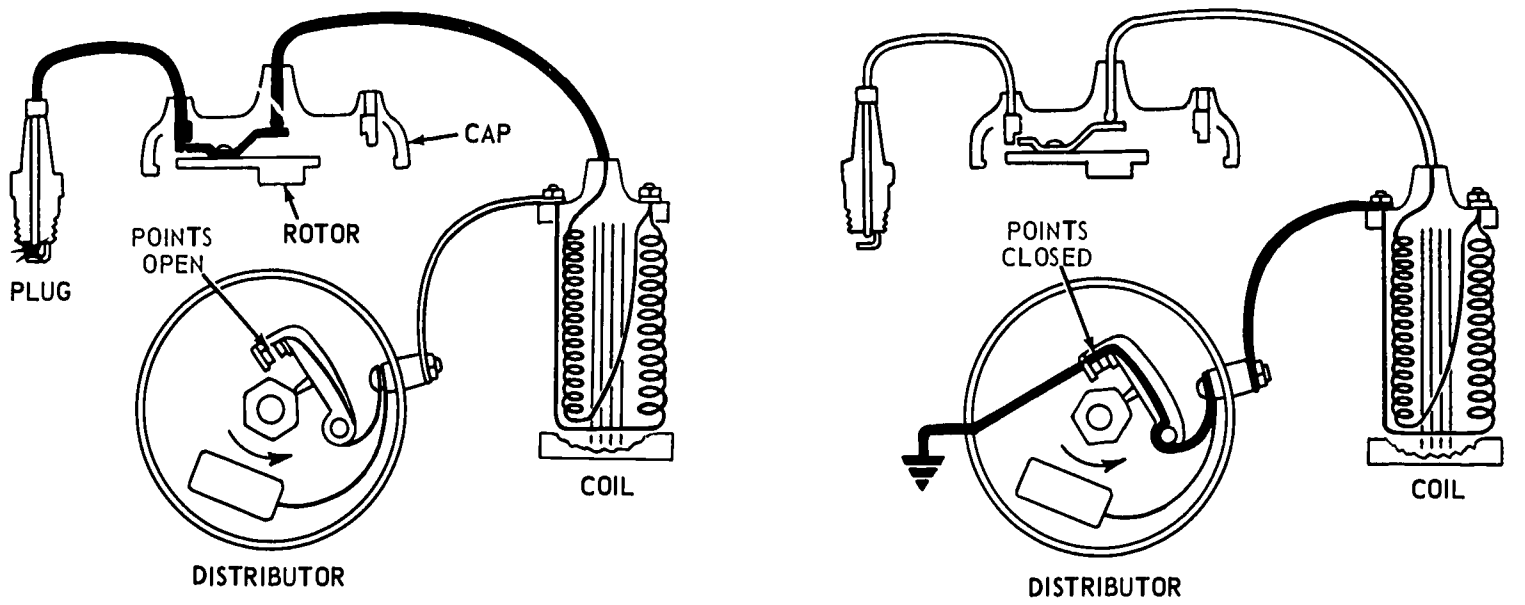

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Fig. 15—Basic Operation of the Distributor

Breaker Plate—is a mounting for the contact points and condenser. It also has a terminal which connects the points and condenser into the primary circuit.

Contact Points Assembly—two contact points, a breaker lever and a breaker lever spring. All three are mounted on a base which is attached to the breaker plate. The two points are usually made of tungsten. One is fixed to the base. The other is attached to the breaker lever and aligned with the first. The breaker lever is mounted on a pivot pin to the assembly base. The lever is made of metal with a nylon or bakelite rubbing block which contacts the breaker cam lobes. The breaker lever spring is attached to the breaker lever. The spring holds the lever to the cam after each cam lobe passes the rubbing block.

Rotor—is mounted on the upper part of the breaker cam. A flat side of the rotor hub fits on a flat side of the cam. In this way the rotor will fit in only one position. On the top of the rotor, a spring metal piece is in contact with the center terminal of the distributor cap. A rigid piece completes the circuit to each spark plug terminal in the cap as the rotor turns. The rotor itself is molded of a plastic material which makes it a good insulator.

Distributor Cap—is also molded of a plastic material. Brass or copper contact inserts are embedded in the cap. These contacts are equally spaced around the cap and lead to the spark plug terminals in the top of the cap. A carbon button in the center of the cap contacts the rotor and leads to the center high-voltage terminal in the top of the cap. The cap is notched into the housing to prevent a wrong installation.

Later we will cover another feature of the distributor—the advance mechanism.

OPERATION OF THE DISTRIBUTOR

As the drive shaft turns, the breaker cam lobe pushes the breaker lever rubbing block. This action opens the contact points, stopping the current flow in the coil primary circuit. See at left in Fig. 15.

The collapsing field and the resulting high-voltage surge in the coil's secondary winding forces current into the center terminal of the distributor cap as shown in red. The distributor rotor picks up this current and delivers it to the proper spark plug to fire the engine.

Meanwhile, the distributor cam lobe has moved away from the rubbing block and spring tension brings the points back into contact (see at right in Fig. 15). The primary circuit is again complete and current flows until the next lobe opens the points. The cycle then repeats itself.

In this way a spark is created as each lobe of the cam opens the contact points. The entire cycle for each spark takes place at a very high speed.

CENTRIFUGAL ADVANCE MECHANISM

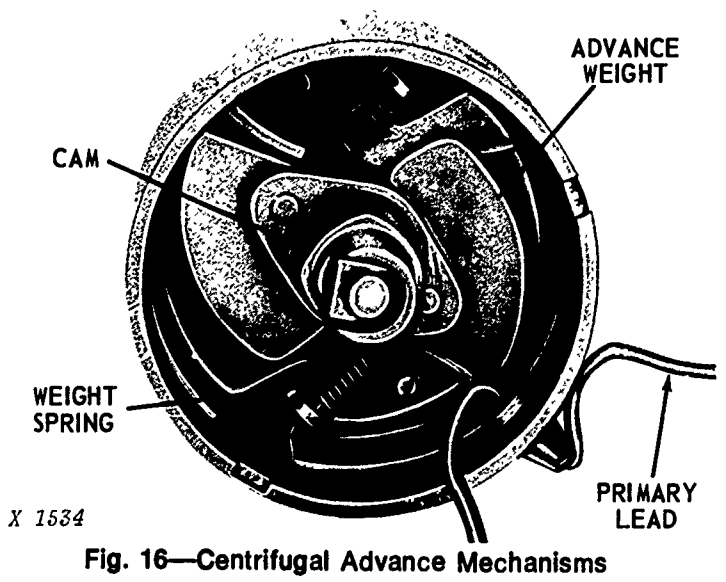

Fig. 16—Centrifugal Advance Mechanisms

Basically, an advance mechanism is a device which times the spark to occur at a certain time as determined by engine speed. Why is a spark advance necessary?

The distributor must deliver the spark to the engine when it is most effective. This is determined by the position of the piston and the time required to ignite the fuel-air mixture in the cylinder.

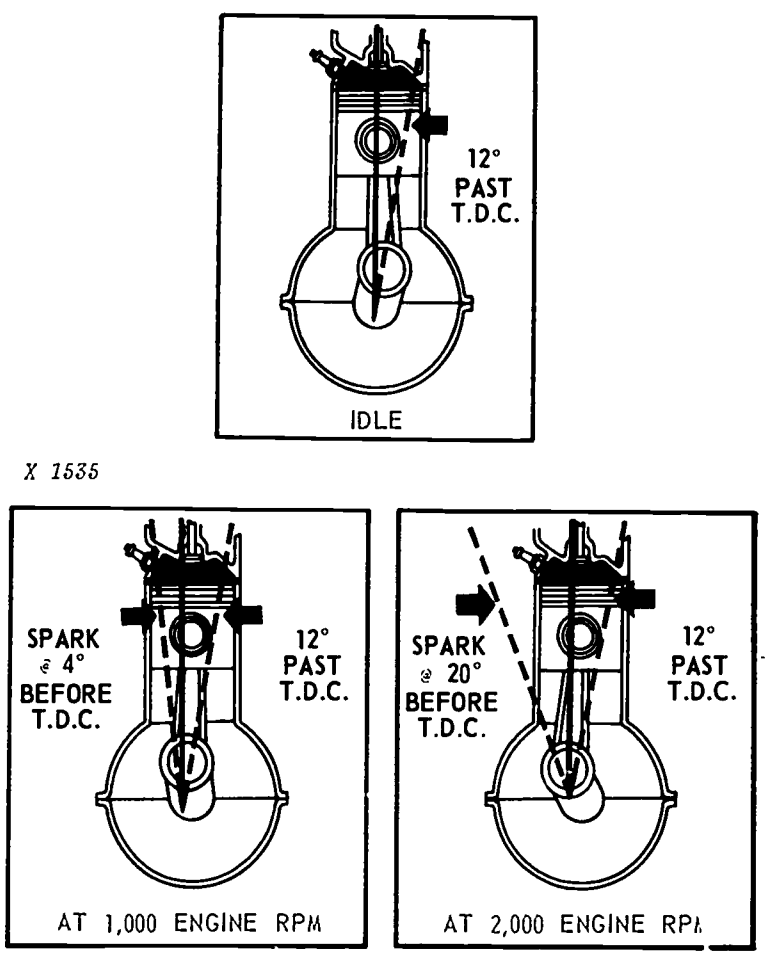

Fig. 17—Spark Timing of the Engine Combustion

Let's assume that the engine piston must be at 12 degrees past top dead center to get the full force from combustion. See Fig. 17. The 12 degrees past top dead center stays the same regardless of the engine speed.

Let's also assume that it takes 0.002 second to reach the full force of combustion, and that at 1000 revolutions-per-minute (rpm) the piston would travel 16 degrees during this time. Therefore, the spark must come at 4 degrees *before* top dead center.

Now if we double the engine speed to 2000 rpm, the distance the piston would travel is also doubled to 32 degrees. The spark must then occur at *20* degrees *before* top dead center to get maximum power.

What the **advance mechanism** does is to adjust the distributor timing to allow for speed changes so that the spark will occur at the right time.

The most popular advance mechanism is the **centrifugal advance.** This device has two weights, a weight base, and two springs.

The weight base is part of the distributor drive shaft. The springs are connected to the base, while the weights are placed on the base. The distributor breaker cam has two pins which connect it to the springs and weights. The pins also set in slots in the base.

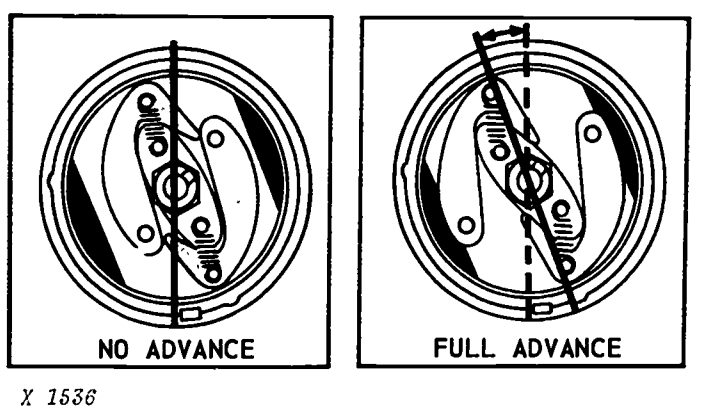

Fig. 18—Operation of Centrifugal Advance

At idle speeds the breaker cam is "pinned" to the base and rotates with the drive shaft. The cam lobes then open the points at a preset time—such as 4 degrees before top dead center.

As the engine speeds up, centrifugal force throws the weights out against spring tension (Fig. 18). This turns the breaker cam so the cam lobes are now striking the breaker lever earlier. Therefore, the contact points open ahead of time.

The higher the speed, the further the weights are thrown out. And the further the weights are thrown, the more they turn the breaker cam and the more the spark is advanced.

When the engine slows down, the springs return the breaker cam and weights to their original position.

VACUUM ADVANCE MECHANISM

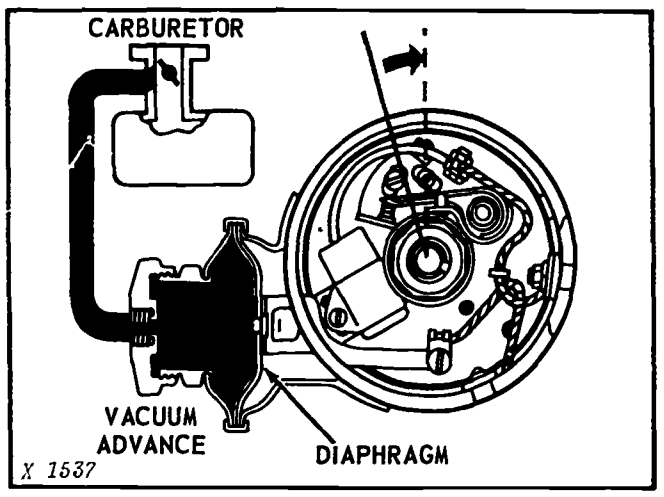

Fig. 19—Vacuum Advance Mechanism

For greater fuel economy, an extra advance mechanism is used on some distributors. This is the **vacuum advance** (Fig. 19).

A vacuum can develop in the engine intake manifold, allowing less fuel and air into the cylinder. Since a lean fuel-air mixture will burn slower, ignition must take place sooner in the cycle than even the centrifugal advance can provide. So a vacuum advance is used to advance the spark still further.

The vacuum advance uses an air-tight diaphragm connected to an opening in the carburetor by a vacuum passage (Fig. 19). The diaphragm is connected by linkage to the distributor housing or the breaker plate.

When a vacuum at the intake manifold draws air from the diaphragm chamber, it causes the diaphragm to rotate the distributor breaker plate in the opposite direction of drive shaft rotation. This moves the breaker lever to contact the breaker cam lobes sooner and thus advances the spark.

EXTRA-DUTY FEATURES OF DISTRIBUTORS

There are extra design features that can be added to a distributor. They may provide a needed service or can increase the reliability. The following is a list of these features:

- **Screw-type distributor cap terminals**
- **Distributor caps and rotors made of mica**
- **Built-in distributor shaft lubrication**
- **Flexible shock-absorbing drive gears**
- **Breaker cam lubricator**
- **Tungsten-tipped rotor**
- **Heavy-duty contact points**
- **Dust sealing cover on breaker compartment**
- **Elastic terminal nipples**

TESTING AND ADJUSTING THE DISTRIBUTOR

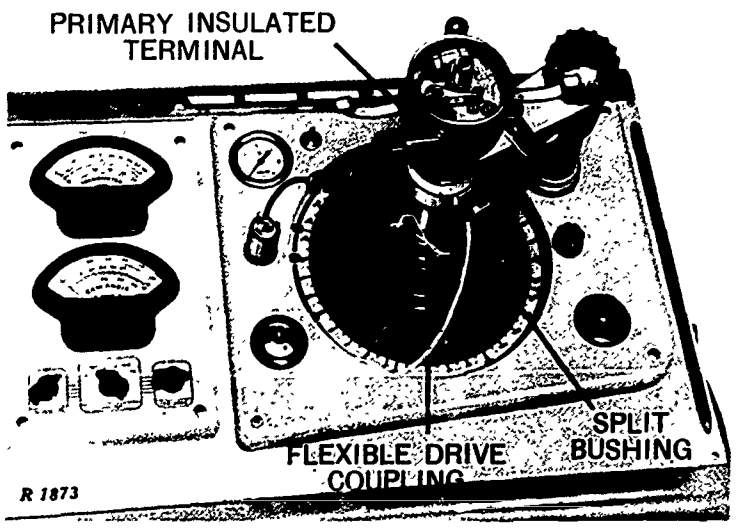

Fig. 20—Distributor Tester

Electrical tests on the distributor are usually made with a tester such as the one shown in Fig. 20. This unit is called a syncrograph and can test most of the distributor operations.

Mechanical tests such as a spring tension and point opening distance are also performed on the distributor. These tests usually call for the use of mechanical test instruments such as a spring gauge, feeler gauge, or micrometer.

The most important test you can make is a good *visual* check. Often many physical failures such as cracks, loose terminal connections, burned points, etc. will be discovered during this check.

Failures of Distributors

Because the distributor plays an important part in the operation of both the primary and secondary circuits, any failure of the distributor will directly affect the ignition circuit and engine operation.

Checking Distributor Caps

A visual check is usually the only "test" performed on the cap.

First, wipe the distributor cap clean. Never clean the cap with a degreasing solution.

Check the cap for the following:

- *Carbon paths*
- *Cracks and chips*
- *Eroded spark plug contacts*
- *Worn center terminal carbon button*

Let's discuss these failures of the cap.

CARBON PATHS

Carbon paths are burnt areas on the distributor cap. Since carbon is a conductor, these burnt areas provide an easy path for current leakage between terminals or between the terminals and ground.

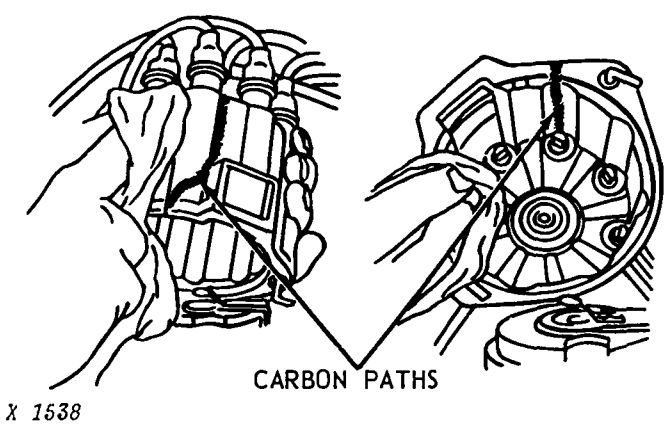

Fig. 21—Carbon Paths on Distributor Caps

Carbon paths can be formed on the outside of the cap by an accumulation of dirt (Fig. 21). Dirt will retain moisture and thus conduct a current. Current leakage, usually from the center terminal to a retaining clip, will create a carbon path. Once the path is formed, it will continue to conduct current.

Carbon paths inside the cap are usually found between the spark plug terminals or between the terminals and a grounded surface. They are caused by moisture and arcing in the cap.

A distributor cap with a carbon path must be replaced. This is because the path will continue to conduct current, especially in damp weather. Eventually, it will burn through the cap.

CRACKS AND CHIPS

Cracks and chips allow moisture and dirt into the cap and breaker lever area. Carbon paths as well as burnt points, breaker cam lobe wear, and arcing can be caused by this. Caps with cracks or chips must also be discarded.

TERMINAL WEAR

Spark plug insert terminals that are eroded will widen the gap between the rotor and the inserts. As the gap increases, secondary voltage requirements also increase, resulting in less spark at the spark plug. These gaps also promote arcing and resulting carbon path. A cap with eroded inserts must also be replaced.

Servicing The Distributor Cap

The distributor cap should be kept clean. The wiring leads should fit tight in the terminals. The use of elastic nipples over the center terminal and spark plug terminals can reduce some of the problems of dirt and moisture.

Distributor Rotor Checks

The rotor should be checked for cracks or chips and for erosion on the tip of the rigid contact.

Check the rotor spring contact for proper tension against the distributor cap carbon button. Too little tension can create a gap between the contact and button. Too much tension can cause excessive wear. Be careful when bending the spring to adjust the pressure.

Always replace a chipped or cracked rotor.

Distributor Breaker Cam Check

Check the cam lobes periodically for excessive wear and lack of lubrication. Worn lobes will not open the points enough to create a strong spark.

The lobes can be checked visually. However, the syncrograph is the best way to check for cam wear.

The point openings as caused by the breaker cam should be evenly spaced within plus or minus one degree. For example, a four-lobe cam should open the points every 90 degrees, a six-lobe cam every 60 degrees, etc.

Wear on the cam is usually caused by abrasive material such as dirt in the breaker plate area. Replace an excessively worn cam.

Centrifugal Advance Checks

The centrifugal advance should turn freely, check this by turning the breaker cam in the direction of rotation and then releasing it. The advance springs should return the cam to its original position without sticking.

Use a distributor tester to check the centrifugal advance operation.

1) Set the distributor into the tester and drive it at various specified speeds.

2) At each test speed, note the amount of advance. It should be within plus or minus one degree of specifications.

3) When the highest specified speed is reached, speed up for a moment, then return to zero.

4) While returning the speed to zero, check each test speed again. The centrifugal advance should be the same.

5) If the advance is excessive during both acceleration and deceleration, the advance springs are too weak or the wrong springs are installed.

6) If the advance is too little during both acceleration and deceleration, the springs are too tight.

7) If the advance is slow during acceleration but fast during deceleration, the advance weights are sticking.

8) In any case, new springs may be needed or the weights may need cleaning and a light oiling to free them. On some distributors, spring tension can be adjusted by bending the outer spring support.

Distributor Drive Shaft Checks

If you suspect the drive shaft is worn or out-of-line, check for:

- *A worn carbon button in the distributor cap*
- *One side of the breaker cam excessively worn*
- *Engine misfiring*

Check the shaft alignment on a syncrograph tester (Fig. 22). While the distributor is driven by the tester at a specified speed, the distributor case is physically shaken.

If the test shows variations in the firing positions, the shaft or bushings are worn.

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Fig. 22—Checking The Distributor Drive Shaft

Testing and Adjustment of Distributor Contact Points

The contact points are the key to good timing.

Check the contact points assembly for these things:

- *Pitted contact points*
- *Burned points*
- *Worn rubbing block*
- *Alignment of points*
- *Worn breaker lever pivot post*
- *Tension of breaker lever spring*
- *Gap of contact points*
- *Angle of cam (dwell)*

PITTED CONTACT POINTS

A visual inspection will usually reveal pitted or rough contact points. However, points in this condition are not necessarily worn.

During normal operation, material may transfer from one point to another. The transferred material will appear rough and gray in color. However, the points will have a *greater* contact area than when they were new. For this reason, don't replace the points until the build-up is over 0.020 inch.

Sometimes pitted points can be reconditioned by removing them and honing each surface smooth and flat. You need not remove all the pits. To clean the points, use a few drops of lighter fluid on a strip of lint-free cloth. Then pull a dry strip through the points to remove the residue. BE CAREFUL when using lighter fluid. **Do not use emery cloth or sandpaper to clean the points.**

During a tune-up, however, replace pitted points to assure good operation.

BURNED CONTACT POINTS

Burned points are usually caused by either high voltage, oil deposits, foreign material, a defective condenser or improper point adjustment.

High voltage cause a high current flow through the points. This heats up the points and rapidly burns them.

Oil or crankcase vapors can seep up through the distributor and deposit on the points, causing them to burn. Look for a smudgy oil line beneath the points.

If the point opening gap is too small, the points will be closed for too long. Then even an average current flow through the points will be too high, burning the points.

WORN RUBBING BLOCK

Rubbing block wear is not a usual cause of trouble. Normally the contact points will wear out before the rubbing block wears enough to affect operation.

In some extreme cases, abrasive foreign material has caused rubbing block wear.

ALIGNMENT OF POINTS

To see if the contact points are aligned, use a distributor tester. With the distributor operating at 1000 rpm, you should be able to see a slight arc between the points.

If the points are aligned, the arc will appear in the *center* of the points when seen from above and from the side.

WORN BREAKER PLATE PIVOT POST

If this pivot post is loose or worn, replace the breaker plate. A worn or loose post will cause the rubbing block and breaker lever to ride erratically on the breaker cam. (On some distributors, the pivot post is part of the contact point assembly. Replace this assembly if the post is loose or worn.)

CHECKING TENSION OF BREAKER LEVER SPRING

Spring tension can be tested with the distributor on or off the distributor tester.

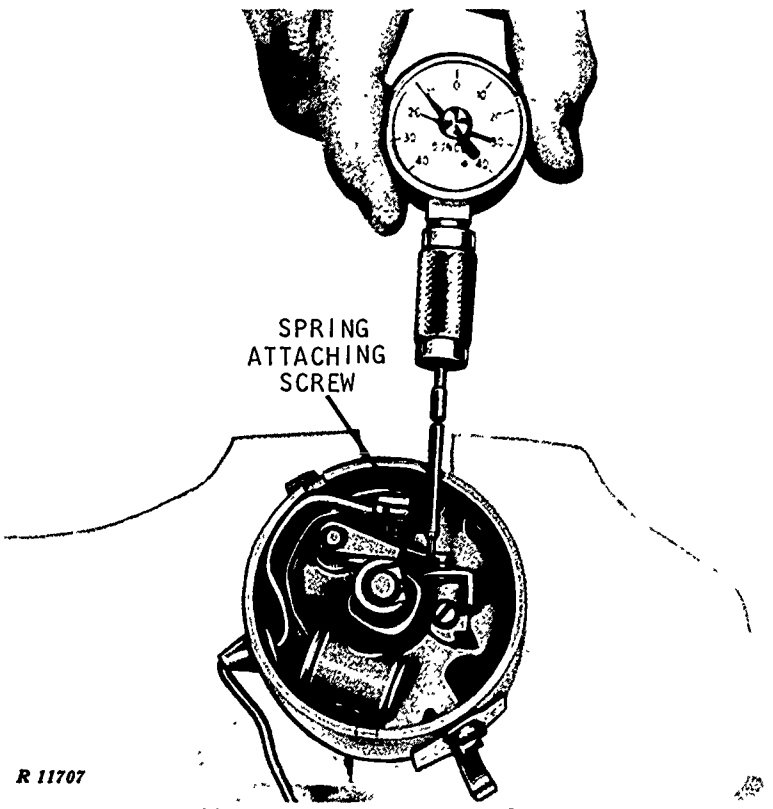

Fig. 23—Checking Breaker Lever Spring Tension

Use a tension tester placed on the movable point and pull it at right angles to the breaker lever (Fig. 23). The instant the points separate, note the reading on the tester.

Since the distributor tester can "show" the instant the points separate, using it will aid in this test.

Proper breaker spring tension is important. Excessive tension can cause the rubbing block, breaker cam and contact point to wear. Too little tension can allow the points to bounce at high speeds, causing arcing, burned points, and engine misfire.

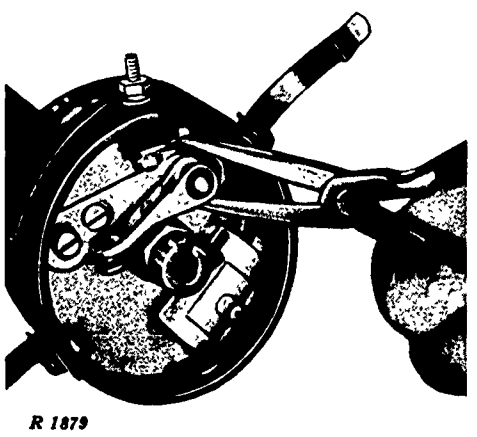

Fig. 24—Adjusting Tension of Breaker Lever Spring

Adjust the breaker spring by bending it toward the breaker lever (to decrease tension) or away from the level (to increase tension). See Fig. 24. Some springs can also be adjusted by sliding the spring in or out under the attaching screw.

CHECKING CONTACT POINT GAP

The distance the points open and the length of time that they stay open are important in distributor operation.

Too wide a point gap will cause the points to open sooner and stay open longer. This will limit build-up time in the coil and the coil will not produce enough voltage for a spark at high speed.

Too narrow a point gap will allow the points to be closed longer, causing the rubbing block to wear and the points to burn.

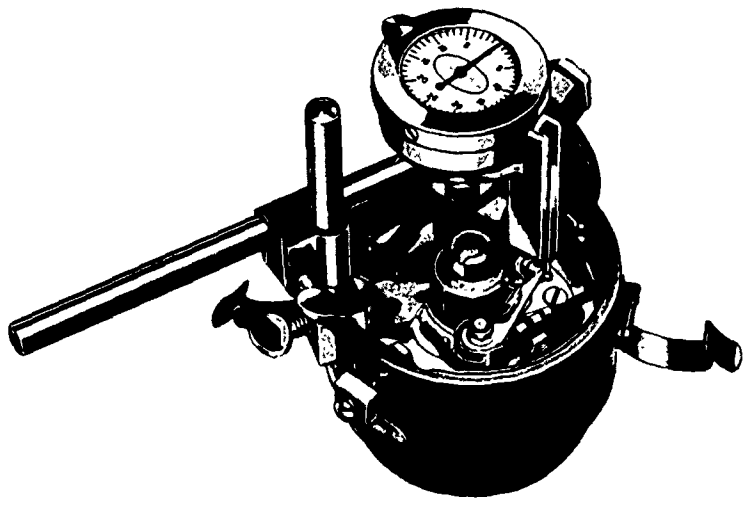

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Fig. 25—Checking Contact Points Gap

A feeler gauge can be used to set the gap on new points. However, old points that are serviceable but are also pitted should not be set with a feeler gauge. The gauge will only measure the *high spots* on the points and so will not give a true picture of the gap.

Therefore, to check old contact points, use a dial indicator (Fig. 25).

CHECKING CAM ANGLE (DWELL)

The *cam angle* is the number of degrees that the breaker cam rotates from the time the points close until they open again (Fig. 26). As the cam angle increases, the point gap decreases, and vice versa.

Too little cam angle can cause engine to misfire at high speed.

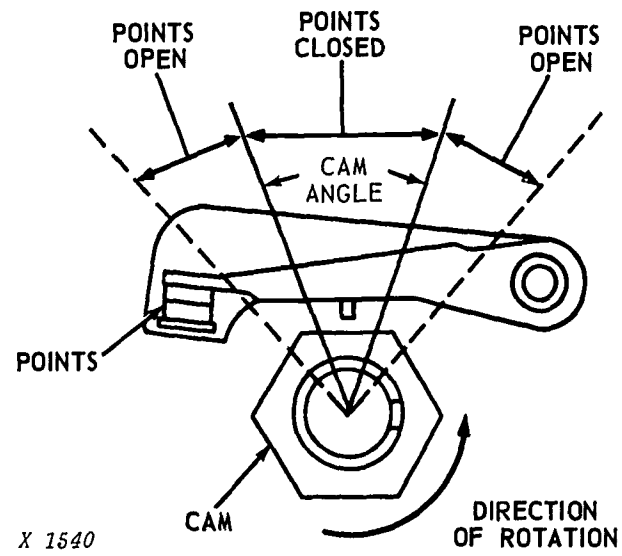

Fig. 26—Cam Angle (Dwell)

Too much cam angle allows the points to close for too long, causing burned points.

Use the dwell meter on the distributor tester to check the cam angle. Then adjust the points to the specified dwell angle.

If the cam angle reading on the meter varies more than two degrees, look for a worn drive shaft or bushings.

If the cam angle and point gap cannot both be set to specifications at the same time, check for these problems:

- *Improper spring tension*
- *Wrong contact point assembly*
- *Worn breaker cam*
- *Points not following cam at high speeds*
- *Bent drive shaft*

SERVICING THE DISTRIBUTOR

This section will give you a general idea of the services which the distributor may require.

In all disassembly, repair, testing, and servicing, follow the machine Technical Manual or the manufacturer's recommendations.

1. Disassemble the distributor only as far as necessary to make repairs or tests.

2. When removing the distributor from the engine, set the No. 1 cylinder at top dead center after the compression stroke. Mark the rotor position on the distributor housing and drive gear. This will allow you to turn the crankshaft while the distributor is off the engine.

3. If necessary, clean the contact points by honing or cleaning them. (See earlier under "Pitted Contact Points".) **Do not use emery cloth or sandpaper to clean the points.** Abrasive material will embed in the points, causing them to arc and burn.

4. Some breaker cams are self-lubricated. Others require a light coating of high-temperature lubricant on the hubs.

5. Some distributors require a few drops of light engine oil on the pivot post at certain intervals.

6. **Avoid too much lubrication of the distributor.** Excess oil may get on the contact points, causing them to burn.

TIMING THE DISTRIBUTOR

After service, the distributor must be timed or "geared" to the engine.

Good timing assures that a spark will occur when it will do the most good during the compression stroke of the piston.

The centrifugal advance has already been set to insure a spark at various speeds. Now we must time the basic spark without the advance mechanism.

There is no hard and fast rule on when this spark should occur. It depends upon the engine design and specifications. It might have to occur before top dead center, at top dead center, or even after top dead center.

The best method of timing the distributor is with a timing light (Fig. 27).

1. Connect the timing light to the No. 1 spark plug wire.

2. Locate the engine timing marks, usually on the flywheel or crankshaft pulley. Normally this mark turns beside a stationary mark on the engine block as shown.

3. Run the engine at its rated speed.

4. Hold the timing light over the timing marks. The light should flash at the instant the two timing marks are aligned. (The flash tells when the No. 1 cylinder fires.)

5. Adjust the distributor timing by loosening the distributor mount and turning the distributor slightly until the spark or flash occurs at the right moment.

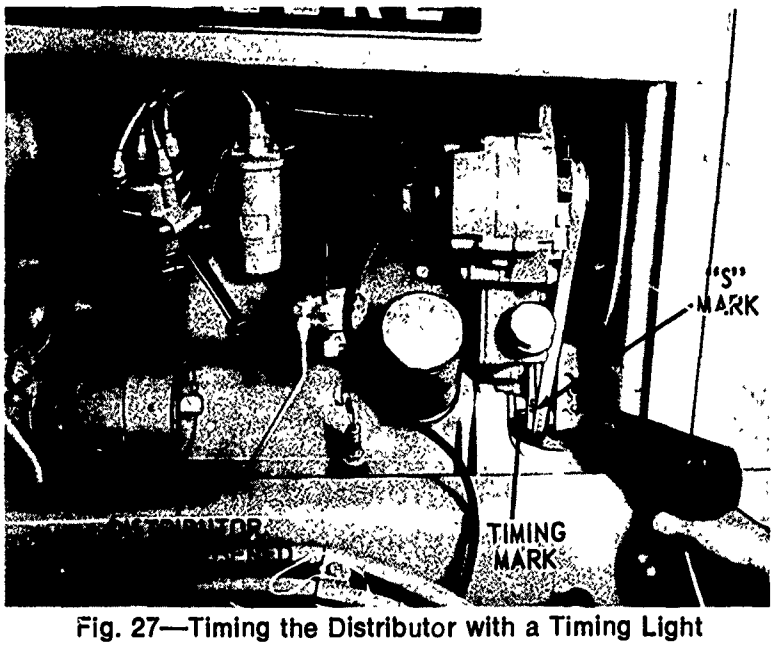

Fig. 27—Timing the Distributor with a Timing Light

6. Tighten the distributor mounting and recheck the timing.

The Importance of Timing

Improper timing can affect engine performance in several ways.

For example, if the spark occurs a little late, a distinct loss of power will result. In this case, the piston has traveled part way on its downward power stroke without the aid of the combustion force. Part of the combustion power is then lost and the engine may also overheat.

However, a late spark is not as bad as an advance spark. When the spark occurs too soon, it ignites the fuel-air mixture, resulting in a combustion force. But the combustion power then *opposes* the *upward* travel of the piston, causing a knocking or "pinging" sound. This sound means that great force is being placed on the piston, pins, rings, and connecting rods as it tries to overcome the power of combustions.

If you have an advance spark while using a low-octane fuel, another problem occurs. Normally, the spark ignites the fuel around the spark plug and the resulting flame travels across the combustion chamber. With low-octane fuel, part of the fuel is ignited by the advance spark and part of it is ignited by compression heat on the *other side* of the chamber. The two resulting combustion forces meet head-on and a sharp "ping" is heard. This force can be strong enough to punch a hole through the piston head. With low-octane fuels, the timing should be retarded to allow for the slower burning of the fuel.

Remember: Improper timing can cause loss of power and damage to engine parts.

SPARK PLUGS

The spark plug ignites the fuel-air mixture in the engine cylinder.

We have learned that there is no current flow in an open circuit. In most cases this is true. However, if the opening in the circuit is small and a strong voltage is present, the circuit can still be completed. In this case, the strong voltage is able to force the current to jump the opening or gap, thus completing the circuit. This is the principle of the spark plug.

OPERATION OF SPARK PLUGS

The plug has two conductors or **electrodes.** One is connected by wire to the distributor cap and the other is connected to ground. The other end of each electrode is separated by a small opening or **gap** from the other.

The high-voltage surge induced in the coil causes a current to flow from the coil to the distributor cap and through a cable to one of the spark plug electrodes. This current then jumps the gap to the other electrode and on to ground. By jumping the gap, the current has completed the circuit and continues to flow.

Completing the circuit is of secondary importance, however. The important fact is that when the current jumps the gap, a *spark* is created. This is the final goal of the ignition circuit.

After all the ignition action, the current jumping the gap to create the spark seems rather simple. However, creating a controlled spark is a different story and this story is told in the construction of the spark plug.

CONSTRUCTION OF SPARK PLUGS

Although the spark plug has no moving parts, each of its parts is designed for a specific purpose. For this reason, many types of spark plugs are available.

Fig. 28 shows the parts of a typical spark plug. Basically, all spark plugs have the same parts; only the design is different. Let's have a look at the parts of the spark plug.

Outer Shell

Each spark plug has a steel outer shell. The top of the shell is hex-shaped for tightening the plug when installing it. The lower part of the shell is threaded and screws into the cylinder head. The grounded electrode extends out from the lower part of the shell.

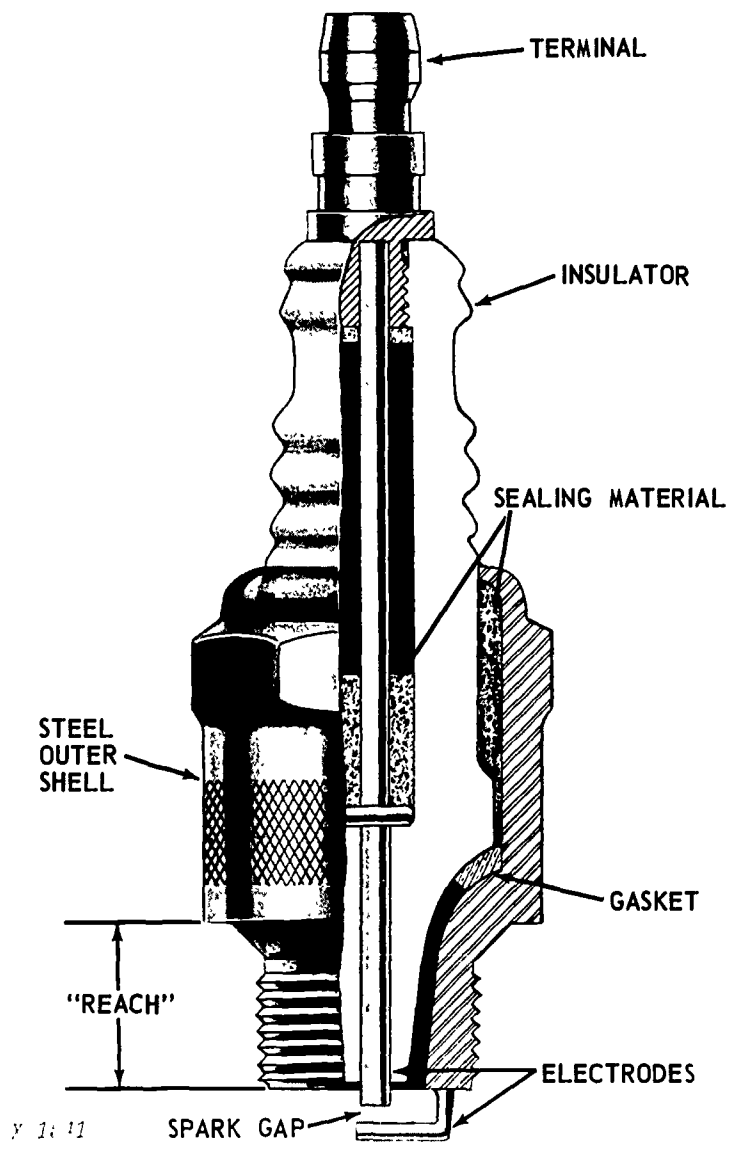

Fig. 28—Spark Plug Construction

A gasket slips over the threaded portion of the plug and rests against the flange at the bottom of the upper part of the shell. The gasket serves two purposes—it seals the plug against compression loss and provides a path for the transfer of heat to the cooling system.

A gasket is not always used. Some spark plugs use a tapered seat instead of a flat flange and this replaces the gasket.

The distance from the flange to the end of the plug threads is called the **reach** (Fig. 28). The reach of a spark plug is very important in plug selection. A plug with two long a reach will extend too far into the combustion area. Not only will the plug run hotter, but it also can be damaged when hit by a piston or valve. A plug with two short a reach will run cold and cause misfiring due to fouled electrodes.

The thread diameter may vary according to the size of the spark plug hole in the cylinder head.

The engine Technical Manual can give you the exact spark plug specifications for each engine.

Spark Plug Insulator

The insulated core or *insulator* is mounted in the outer shell. The outer end carries the spark plug terminal. It is usually made of such insulating materials as white ceramic or porcelin.

The insulator is held in position and shielded from the outer shell by an inside gasket and sealing compound (Fig. 28).

Besides holding the center electrode, the insulator is a shield for the electrode so that current will flow only through the electrode. It must also withstand extreme heat and cooling and vibrations.

The exposed upper portion of the insulator must be kept clean to prevent current from leaking out. Many plugs have ribbed insulators to discourage this dirt build-up.

Spark Plug Electrodes

The *electrodes* are usually made of a metal alloy to withstand constant burning and erosion.

The *center electrode* extends through the insulator. One end is connected to a stud screwed into the top of the insulator. The other end extends out the nose or cone of the insulator. The electrode is held in position in the insulator by a sealing compound.

The *grounded electrode* is attached to the outer shell. It has a slight bend so that the end is directly beneath the end of the center electrode.

The gap between the two electrodes is the prime factor in plug operation. *This gap must be set to exact engine specifications.*

If the gap is too narrow, the spark will be weak and fouling and misfiring is the result.

Too wide a gap may work okay at low speeds, but at high speeds or loads it will strain the coil, resulting in misfire.

The surfaces of the two electrodes at the sparking point or gap should be parallel and have squared corners. This gives the current a better "jump" across the gap.

HEAT RANGE OF PLUGS

The heat range of a spark plug is as important as the gap setting. In fact, the various heat ranges of different spark plugs are used to classify them.

The term **heat range** refers to the plug's ability to transfer the heat at the firing tip to the cooling systems of the engine. This is determined by the **distance the heat must travel.**

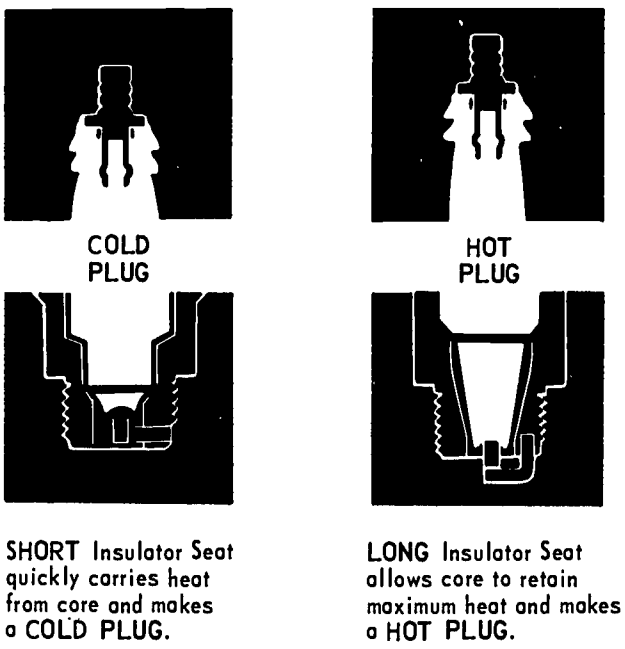

Fig. 29—Heat Range Of Spark Plugs

As you can see in Fig. 29, the end of a plug insulator that has a long nose or cone is further from the cooling system. Therefore, heat at the end will travel further. This type of plug will then run *hot.*

The end of a short insulator cone is closer to the cooling system and heat will transfer faster. A plug with a short insulator cone will then operate *cooler.*

Engine design and operating conditions will decide which type of spark plug—hot or cold—should be used. Generally, an engine which operates at fast speeds or heavy loads, and thus hotter, will require a **cold** plug so that the heat will transfer faster. On the other hand, a **hot** plug will be used in an engine that operates at low or idle speeds most of the time. Hot plugs will burn off the deposits that occur in this type of operation. For normal engine operations, a plug that falls somewhere between *hot* and *cold* is used (Fig. 30).

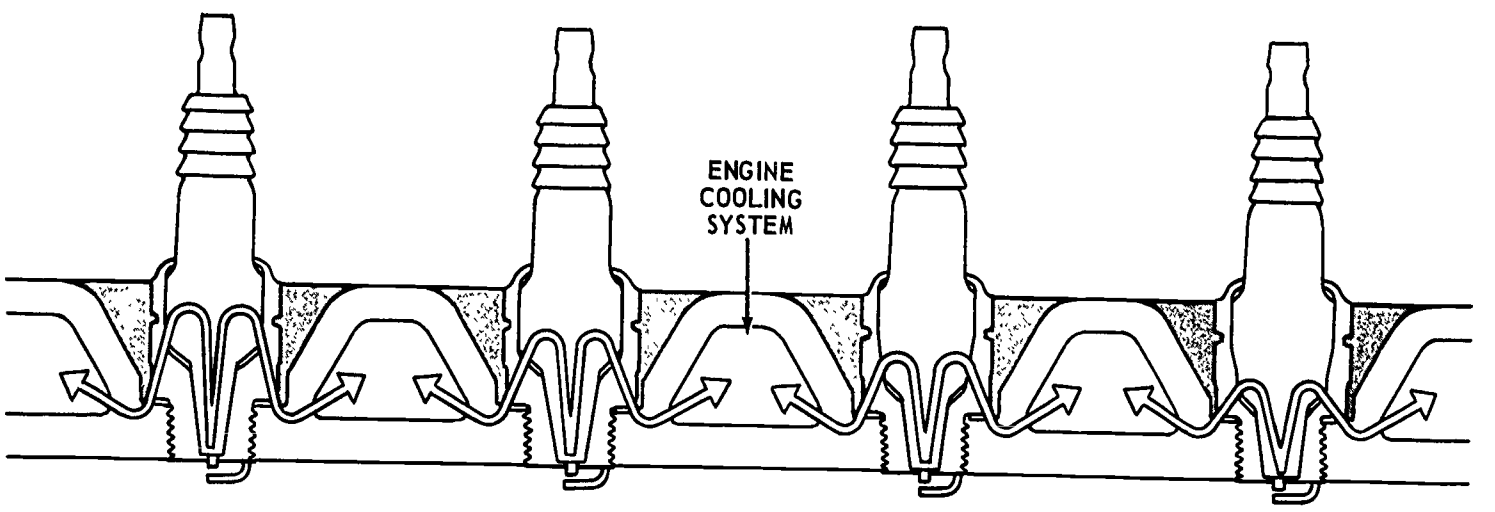

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Fig. 30—Spark Plugs of Various Heat Ranges

SPECIAL TYPES OF SPARK PLUGS

As we have said, there are many variations on the standard spark plug. In addition, there are several kinds of spark plugs that are unique in design and that suit a special application. We will briefly describe some of these plugs for you.

Resistor-Type Plugs

Resistor-type plugs have a resistor between the terminal and center electrodes. These plugs are used to avoid radio and television static generated via the ignition circuit.

Auxiliary-Gap Plugs

This plug gives extra protection against fouling in cooler operations. They are useful when deposits can short out the current, preventing a spark. The gap is placed *with-in* the center electrode and holds in the voltage that could be drained off by the shorting deposits.

Surface-Gap Plugs

This plug eliminates the grounded electrode. The spark fires across the insulator tip between the center electrode and the shell. This also gives fouling protection. However, it is used only in special high-voltage systems.

Insulator-Tip Plugs

These plugs have the insulator tip extended further into the combustion area. By doing this, the tip is said to be cooled by the incoming fuel-air mixture and cleaned of deposits by the hot exhaust gases.

REMOVING AND INSTALLING SPARK PLUGS

Observe these practices when removing and installing plugs:

1) Pull the wire from the plug by grasping the terminal, **not** by pulling on the wire.

2) After loosening the plug but before removing it, always clean the area around the spark plug by blowing, wiping, or brushing. (Be sure to protect your eyes). This will prevent dirt from falling into the cylinder after removal.

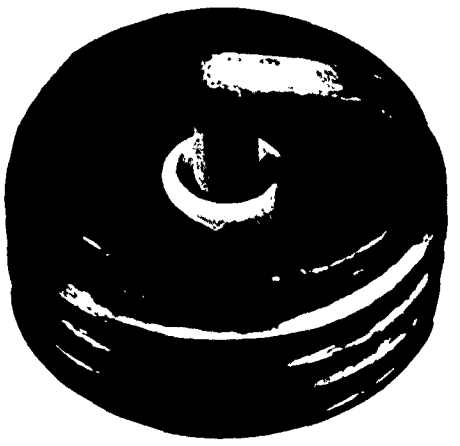
3) Use a deep-well socket to remove the spark plugs. Also remove the gaskets with the plugs (if used).

4) If the plugs are to be reused, be sure to note which cylinder each came from. The condition of the spark plug can tell you a lot about the operation of a particular cylinder.

5) When replacing spark plugs, it is best to **replace all of them** at the same time.

6) When installing spark plugs with gaskets, be sure the gaskets are in place. The gaskets act as a seal to prevent loss of compression around the plug. Without a gasket, the reach of the plug would also change, affecting plug operation.

7) Remember another point on gaskets: Most manufacturers recommend installing new gaskets with both new and reconditioned spark plugs. This is due to the crush of a used gasket which might prevent adequate sealing. However, always remove the old gasket from the spark plug. **Never use both the old and the new gaskets.** Here again, spark plug reach is affected.



X 1548 NORMAL OPERATION

X 1549 CARBON FOULING

X 1544 OIL FOULING

X 1550 DEPOSIT FOULING

Fig. 31—Spark Plug Failures—Normal and Fouled Plugs

8) Tighten the spark plugs as specified and connect the spark plug wires to the proper plugs. If a torque wrench is not available, tighten the plug until you feel it seat, then turn it ½ to ¾ turn more. (With steel gaskets, tighten ¼-turn after seating).

TESTING AND SERVICING OF SPARK PLUGS

A visual inspection will usually tell the condition of the spark plugs. However, for an electrical check, use a spark plug analyzer and follow its test instructions.

Spark Plug Failures—General

The first sign of failing plugs is when the *engine misfires.*

Faulty plugs are not the only cause of engine misfire nor are the plugs usually the original cause. But when the engine misfires, check the condition of the plugs.

The two main failures of spark plugs are:

- **Fouled plugs (dirty deposits on tips)**
- **Eroded plugs (badly burned tips)**

FOULED PLUGS around the electrodes and tip can result from *lack of heat* to burn off the deposits at the firing point.

ERODED PLUGS are caused by *too much heat* at the firing point.

These plug failures are caused by many things as we'll see now.

Remember that the spark plug can tell you many things about the condition of the engine.

Spark Plug Failures—Fouled Plugs

Pictures of fouled plugs are shown in Fig. 31.

For comparison, a plug in *normal operation* is shown at the top left in Fig. 31. A normal plug will have brown to greyish-tan deposits and a slight wear on the electrodes. This indicates good adjustments of the engine.

A spark plug having this appearance can be cleaned, regapped, and reinstalled.

An *oil-fouled plug* is shown at the top right in Fig. 31. Wet, oily deposits with a slight electrode wear can mean that oil is getting into the combustion area. It can be caused by overfilling the engine crankcase, excessive clearance on the valve stem guides, or broken or poorly seated piston rings. Plugs in this condition can usually be degreased, cleaned, and reinstalled. If the oily deposits are more than shown, the plug should be replaced.

A *carbon-fouled plug* is shown at bottom left in Fig. 31. This plug has dry, fluffy, black deposits. These can be caused by too "rich" a fuel-air mixture or a clogged air cleaner, or by reduced voltage from faulty components in the circuit. After the cause has been corrected, this type of plug can usually be cleaned, regapped, and reinstalled.

A *deposit-fouled plug* is pictured at bottom right in Fig. 31. Red, brown, yellow, and white powdery deposits are usually the by-products of combustion and come from fuel and lubricating oil additives. These powdery deposits are usually not harmful. However, they can cause intermittent misfire at high speeds or heavy loads. If the insulator is heavily coated, replace the plug.

Hard, sandy deposits (not shown) can be caused by a faulty air cleaner or an engine operating in extremely dusty conditions. Replace these plugs.

Plug fouling can be caused by a "cold" plug being used in an engine that operates at low or idle speeds most of the time. Heat is dissipated so quickly that it does not have time to burn the excessive deposits from the firing point. So the deposits build up and the engine misfires.

Spark Plug Failures—Erosion and Breakage

Erosion can be caused by the use of a "hot" spark plug in an engine operating at fast speeds or heavy loads. The extreme heat is not dissipated to the cooling system fast enough, resulting in burned or blistered insulator tips and badly eroded electrodes.

Pre-ignition is another cause of plug erosion (see at left in Fig. 32). Hot spots in the combustion chamber including hot carbon deposits, hot spots in the piston head or cylinder walls, extreme hot valve edges, or hot electrodes can cause pre-ignition. (Pre-ignition is the firing of the fuel-air mixture by a hot spot before the spark occurs.) Pre-ignition can cause blistered insulators and eroded electrodes as shown.

A lean fuel-air mixture can also cause erosion.

The wrong coil polarity can cause the grounded electrode to erode or "dish out" as shown at the center in Fig. 32.

Broken insulator tips and broken electrodes can be caused by three things:

1. Broken insulator tips might be caused by heat shock (see at right in Fig. 32). This is when there is a rapid increase in tip temperature under severe operating conditions. It can usually be prevented by allowing an adequate warm-up period at low speeds and by having the correct timing and the proper octane fuel.

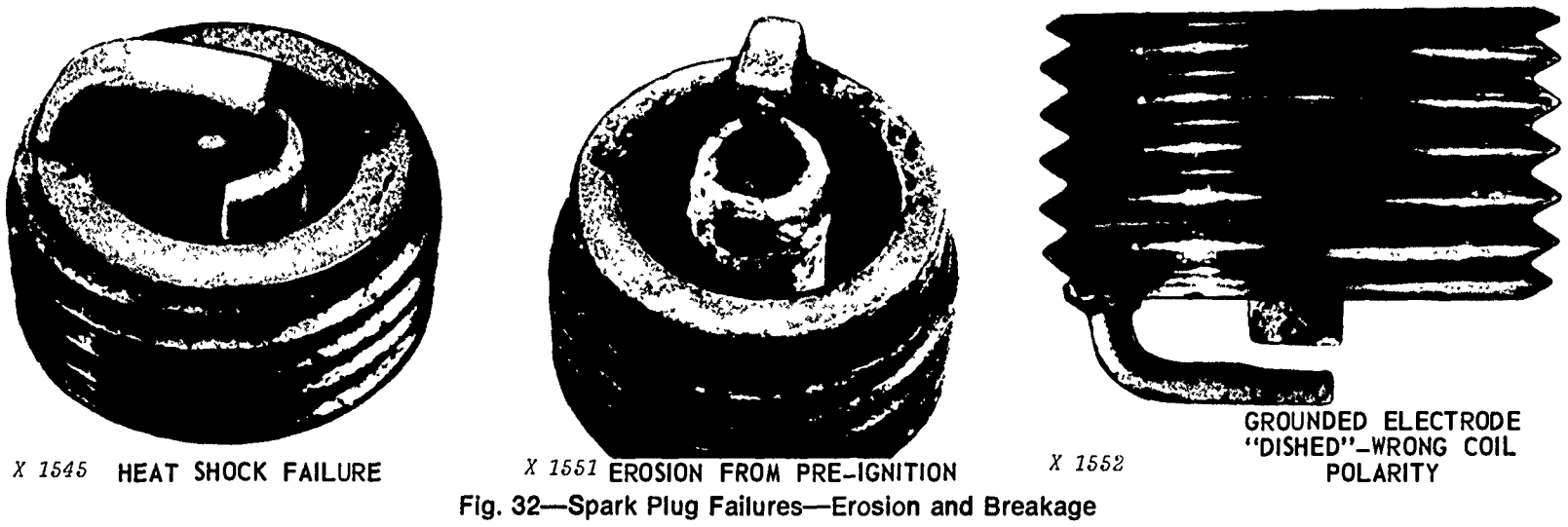


Fig. 32—Spark Plug Failures—Erosion and Breakage

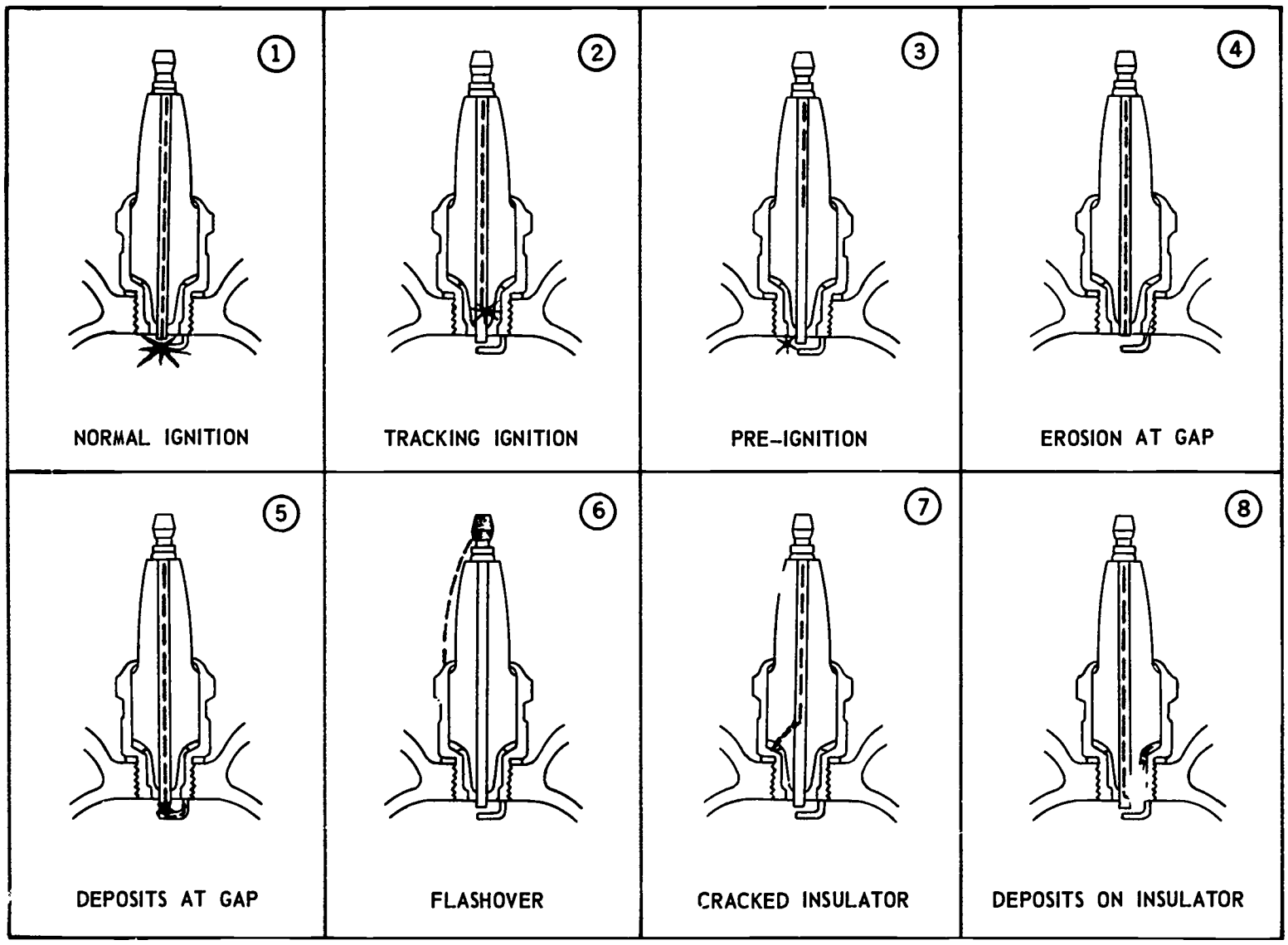


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Fig. 33—Spark Plug Misfires

2. The tip can be broken by mishandling during gap adjustment, particularly if an attempt is made to bend the center electrode.

3. The tip and the electrodes can be broken if they are hit by the piston or valves. Using a spark plug with the correct reach will solve this problem.

Replace spark plugs with electrode and tip erosion or breakage.

Causes of Spark Plug Failures

In nearly every case of spark plug failure, the cause must be corrected before new or reconditioned spark plugs are installed. Otherwise, servicing will again be needed in a short time.

Fig. 33 illustrates what takes place in a faulty spark plug during ignition. The numbered statements below tell what causes the misfirings.

1. *Normal ignition* occurs when a spark of adequate energy is delivered at the correct instant across the electrode gap as shown.

2. *Tracking ignition* occurs when the spark, jumping from one deposit "island" to another, ignites the fuel charge at some point along the insulator nose. The effect is to retard ignition timing.

3. *Pre-ignition* occurs when some surface in the combustion chamber becomes hot enough to fire the fuel-air mixture before the spark occurs.

4. *Bad erosion* of the plug electrodes may prevent voltage from jumping the gap.

5. *Deposits* may have bridged the gap so that the coil voltage is drained away without a spark occurring.

6. *Flashover* is caused by moisture or dirt or by a worn out terminal boot. This allows voltage to short across the outside of the insulator.

7. *Cracks* in the plug insulator may allow high voltage to short circuit to the ground.

8. *Deposits* formed on the *insulator* surface may drain away voltage.

SPARK PLUG SERVICING

Spark plug service has three steps:

- **Inspection**
- **Cleaning**
- **Gap adjustment**

Most engine Technical Manuals recommend a specific time interval for ignition services. Follow this timetable very closely.

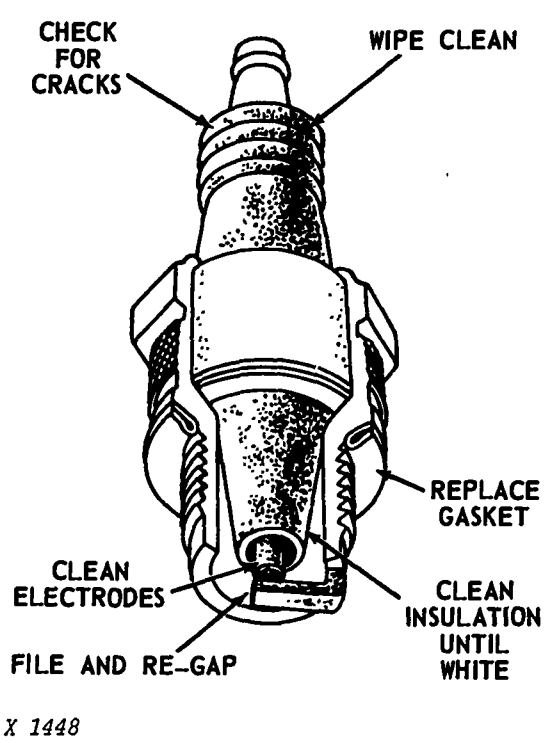

Fig. 34—Maintenance of Spark Plugs

Inspection of Spark Plugs

When inspecting the plugs, look for the normal abnormal wear we have just described. Th decide whether to recondition or replace t plugs.

Remember, if one plug is replaced, all the plugs should be replaced to get the full advantage of new plug performance and economy. This is not applicable, of course, if unusual conditions cause premature failure to just one in a fairly new set of plugs.

Normally, replace the whole set of plugs after long intervals of use. Normal wear can double the voltage requirements of a spark plug even in a short period of time.

Cleaning of Spark Plugs

There are two types of spark plug cleaning machines that do an acceptable job of removing deposits from the insulator and electrodes. One unit uses an abrasive compound and *air blast* to clean the insulator and electrodes. The other machine uses a strong *liquid cleaner* to do the same job.

Make a careful inspection, however, after using an abrasive blast machine to insure that all abrasive particles have also been removed. Engine damage could result if they were left on the plugs.

NOTE: Do not use a power wire brush to clean the plugs. Most makers of plugs do not recommend this.

Badly fouled plugs should be replaced. It is doubtful sand blasting or liquid cleaning will remove all the deposits from such plugs.

Clean the threads with a wire hand brush or a powered soft wire brush wheel.

Wet oily plugs may require cleaning with a petroleum solvent before abrasive cleaning.

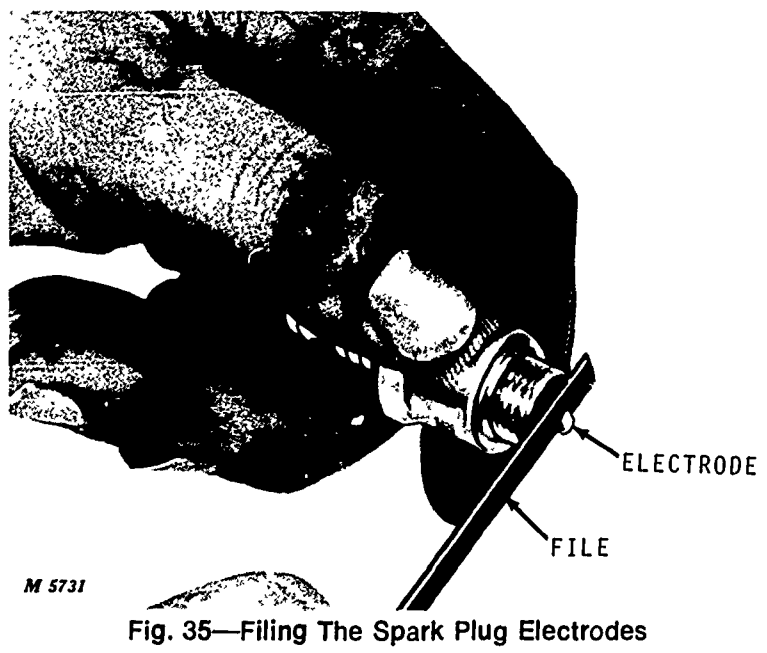

Fig. 35—Filing The Spark Plug Electrodes

Before gapping the electrodes, file them with a small point file to flatten their surface at the firing point and square up the edges (Fig. 35). Squaring the surface edges can reduce voltage requirements, even more than if the plugs are only cleaned.

Adjusting Spark Plug Gaps

Whether the plug is new or used, always check the gap before you install the plug.

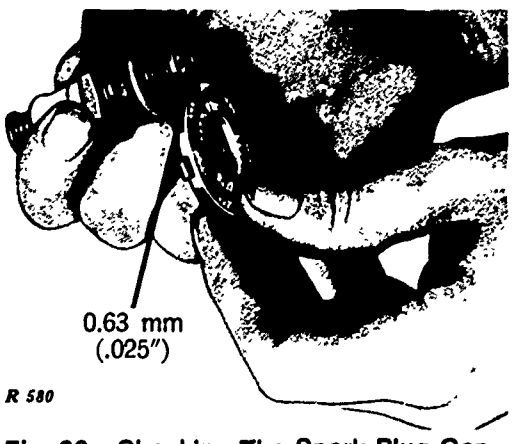

Fig. 36—Checking The Spark Plug Gap

Use a *wire* spark plug gauge to check the gap (Fig. 36).

The wire gauge will give a true gap reading even if the electrode surface is not flat.

If the gap is far too wide, the plug may need replacing.

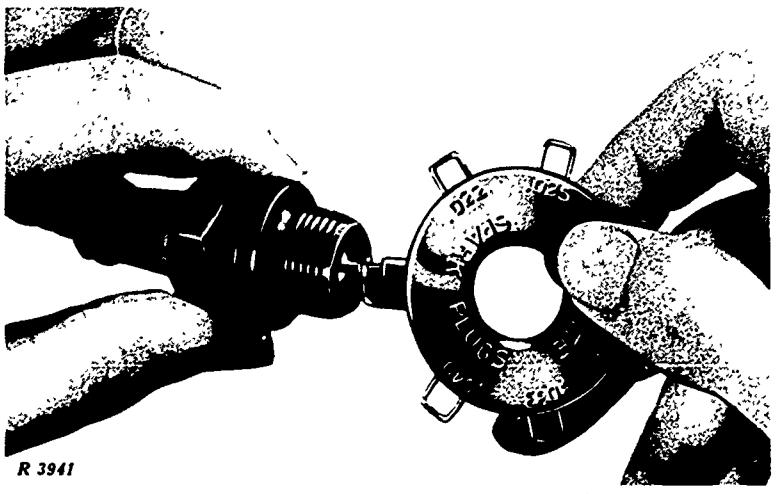

Fig. 37—Adjusting The Spark Plug Gap

Use a bending tool to adjust the gap to specifications (Fig. 37). (Often the bending tool is part of the wire gauge as shown.)

After adjusting, check to be sure the electrode surfaces are parallel.

Never bend the center electrode. Doing so may crack or break the insulator tip.

IGNITION WIRING

The type of wiring used in the ignition circuit is important as well as its condition.

Light wiring is used in the **primary** circuit because of the relatively low voltage.

Heavy wire or cables are used in the **secondary** circuit (coil to distributor cap, distributor cap to spark plugs) because they are subject to high voltage. High-voltage wires usually have metal terminal ends: female and male on the spark plug cables, male on the coil-to-distributor cap cable.

Some ignition circuits have an ignition **resistor** in the form of a special *resistance wire*. When the engine is running, the resistor wire is in series with the coil and reduces the voltage at the coil to normal operating voltage. To provide a better spark when starting, however, the resistor wire is bypassed and a stronger battery voltage is applied at the cable.

SERVICING WIRES AND CABLES

Connections should always be kept clean and tight.

The wires themselves should be kept clean and free of oil which could rot the insulation.

Periodically, check the wiring for cracked or broken insulation and loose connections.

When installing high-voltage wires, *do not let them touch a ground or each other.*

TESTING AND DIAGNOSING THE IGNITION CIRCUIT

Ignition tests are usually made with an ignition analyzer—either the oscilloscope of meter types (see Chapter 2).

Many of these tests can also be made with all components in place on the machine.

Follow the test procedures given with the analyzer, and consult the engine Technical Manual for the expected readings.

TROUBLE SHOOTING CHART FOR IGNITION PROBLEMS

Engine operating problems can be caused by many things, both mechanical and electrical. The chart below lists some of the engine problems and how they can be caused by a faulty ignition circuit.

Problems	Cause
1. Lack of power	a. Incorrect timing b. Pitted distributor points
2. Hard starting	a. Weak spark
3. Engine overheats	a. Advance mechanism sticking
4. Engine knocks	a. Incorrect timing
5. Engine backfires	a. Advance mechanism sticking
6. Engine pre-ignition	a. Faulty spark plugs
7. Engine misfires	a. Dirty spark plugs b. Faulty cables c. Incorrect distributor point gap
8. Engine uses too much fuel	a. Fouled spark plugs b. Incorrect timing
9. Engine runs irregular	a. Faulty ignition
10. Slow acceleration	a. Advance mechanism sticking b. Defective coil or condenser c. Faulty distributor points
11. Engine will not start	a. Faulty coil b. Faulty condenser c. Faulty distributor points d. Coil high tension wire out of socket e. Cracked distributor rotor f. Faulty spark plugs g. Incorrect timing h. Spark plug cables installed incorrectly
12. Engine starts but will not continue to run	a. Faulty coil b. Faulty condenser c. Faulty distributor points
13. Poor ignition of fuel	a. Incorrect spark plug gap b. Dirty spark plugs c. Faulty cables d. Incorrect timing e. Faulty distributor points f. Faulty condenser g. Defective coil h. Cracked distributor cap or rotor i. Defective wiring

CHECKING OUT IGNITION PROBLEMS

Once the cause of the problem has been isolated to the ignition circuit, check each component to find the faulty one.

We have already described the tests that are made on the components. Usually, they can be made with the unit on or off the machine. To refresh your memory, we will now give you a brief list of items to check.

Visual Inspection

Check for:

1. Loose or broken connections and cables

2. Cracked coil cap

3. Cracked or broken distributor cap and rotor

4. Carbon paths on and in distributor cap

5. Burned, pitted, or worn distributor points

6. Worn distributor breaker cam and breaker lever rubbing block wear

Electrical Tests

Check these items:

1. Coil for grounded, shorted, or open windings and coil polarity

2. Condenser for leakage, series resistance, and capacity

3. Cam angle (dwell) of distributor

4. Timing of distributor

5. Spark plug strength. (Check this by removing the coil high-tension cable from the distributor cap

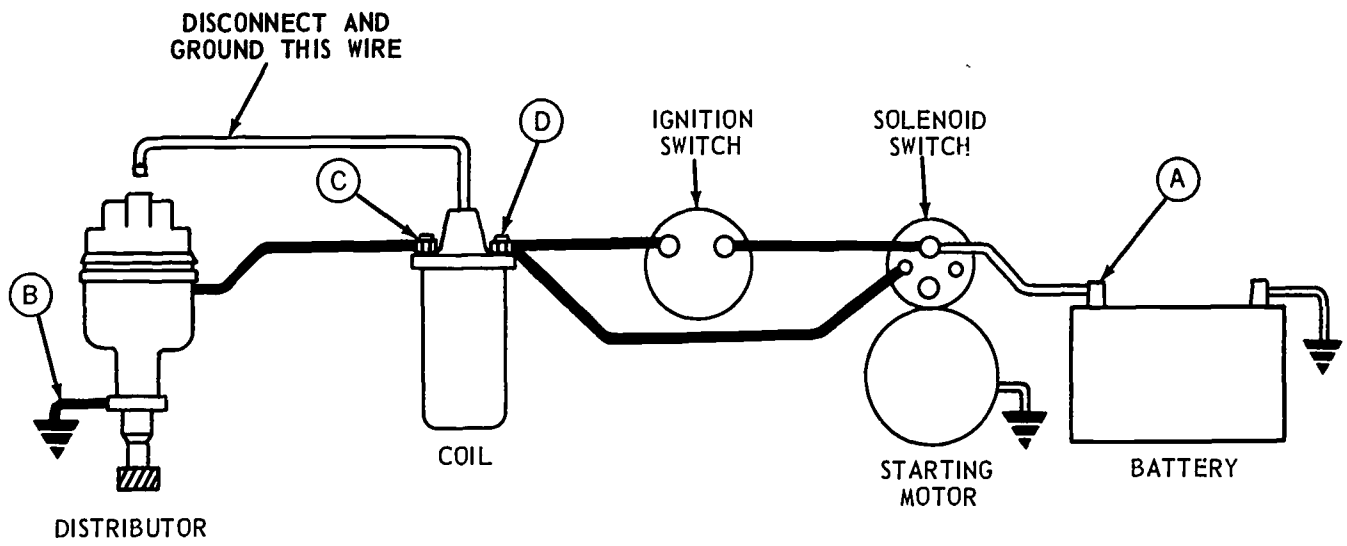

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Fig. 38—Ignition Circuit Test Points (For a Typical 12-Volt Negative-Ground Circuit)

and holding it ¼-inch from the engine while cranking. If a good spark appears, the trouble is probably in the distributor cap or rotor, or the spark plugs or cables.)

6. Ignition circuit for high resistance, open circuits, and grounds. See Fig. 38 and the following instructions for details on this test.

GENERAL TEST OF IGNITION CIRCUIT

1. Use a voltmeter with a range of 0.1 to 20 volts.

2. Make all tests with lights and accessories off.

3. An example of the test results on a typical 12-volt negative-ground electrical system is given in the chart below.

SUMMARY: SERVICING THE IGNITION CIRCUIT

By performing periodic servicing of the ignition circuit, making all adjustments, and operating the engine within the specified limits, the ignition circuit should give long, dependable service.

IGNITION CIRCUIT TEST RESULTS

Voltmeter Connected to Points (Fig. 38)	*Ignition Switch Position*	*Distributor Breaker Points Position*	*Voltmeter Reading If Circuit In Good Condition*
A—D	Cranking	.....	1 volt (max.)
B—D	Cranking	.....	10 volts (approx.)
B—D	On	Open	Battery voltage
B—D	On	Closed	4.8 volts (approx.)
B—C	On	Closed	0.2 volt (max.)
B—D	On	.....	7.6 volts (approx.) at 1000 engine rpm

TEST YOURSELF

QUESTIONS

1. What is the final goal of the ignition circuit?

2. Name the four basic parts of an ignition circuit.

3. Match the items below:

a. Primary circuit	1. High voltage
b. Secondary circuit	2. Low voltage

4. What does an advance mechanism do for a distributor?

5. True or false? "Use emery cloth or fine sandpaper to clean the distributor points."

6. What is the difference between fouled and eroded spark plugs? Which is caused by too much heat? Which by too little heat?

ANSWERS

1. The spark which ignites the engine fuel.

2. Coil, condenser, distributor, and spark plug.

3. a—2; b—1

4. Times the sparks to occur at the correct time for the engine speed and piston cycles.

5. False. Remove and hone them or clean with a lint-free cloth and lighter fluid.

6. Fouled plugs have dirty deposits on their tips, while eroded plugs have badly burned tips. Too much heat causes eroded plugs, while lack of heat causes fouled plugs.

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LIGHTING AND ACCESSORY CIRCUITS / CHAPTER 7

INTRODUCTION

This chapter covers all the extra equipment which completes the electrical system on modern machines.

We have covered the basic system in the preceding chapters on batteries and charging, starting, and ignition circuits.

Now let's fill in the remainder of the system with the lighting and accessory circuits.

This chapter will cover the following acessories in the order shown:

- **Lighting Circuits (including Lamps, Circuit Breakers, and Fuses)**
- **Wiring Harnesses**
- **Electromagnetic Clutches**
- **Gauges**
- **Meters**
- **Horns and Buzzers**
- **Relays**
- **Solenoids**
- **Switches**
- **Electric Motors**
- **Cigarette Lighters**
- **Flame Rods**
- **Transformers**
- **Glow Plugs (for Diesel Engines)**

We will describe each accessory and give a brief story on testing and maintaining it in its circuit.

LIGHTING CIRCUITS

Lights are used on most all farm and industrial machines. They are required by the local government for night driving or towing in most areas. To avoid trouble, know your local regulations.

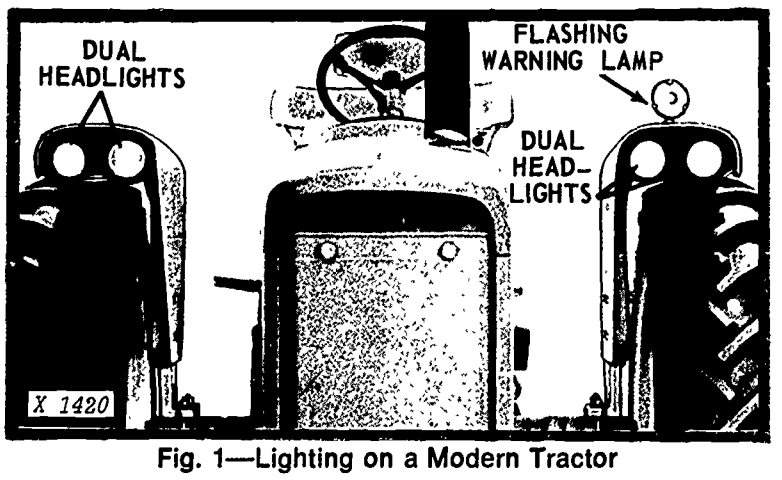

Fig. 1—Lighting on a Modern Tractor

On modern tractors, the lights are often two or four headlights and one taillight.

In addition, a flashing warning lamp is required in some states. This lamp warns other traffic that a slow-moving vehicle is on the road.

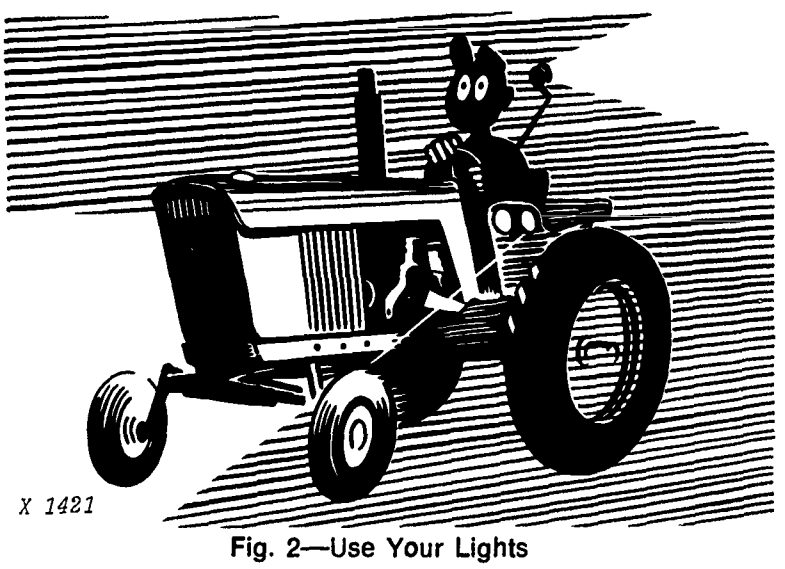

Fig. 2—Use Your Lights

On many farm implements, special lighting is used for night work in the field. On a self-propelled combine, for example, a special flood light is used to light up the area where the grain is being cut and fed into the combine. Another flood light shows the operator when the grain tank is full of grain.

LAYOUT OF THE LIGHTING CIRCUIT

The lighting circuit is normally a part of the complete electrical system. It operates on power from the battery with help from the charging circuit.

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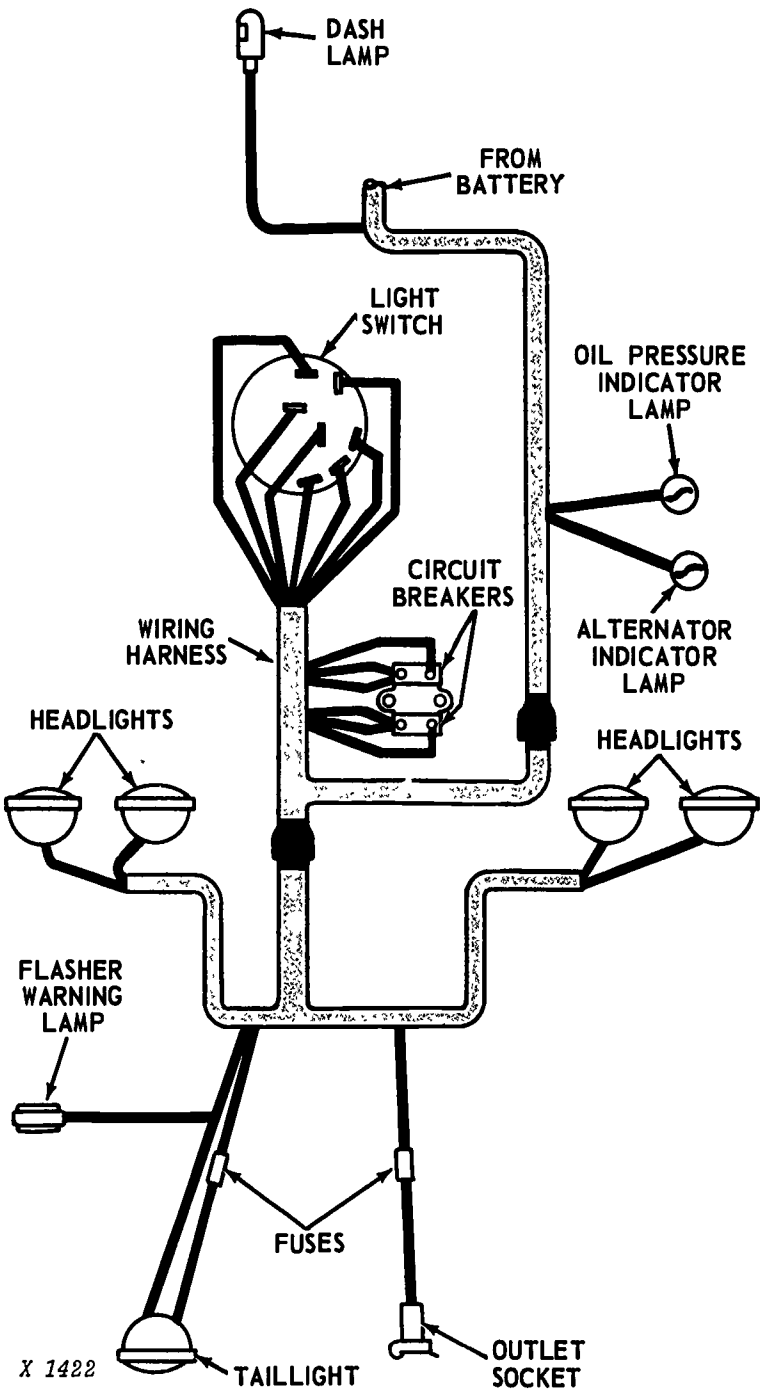


Fig. 3—Layout of a Typical Lighting Circuit

The parts of a typical lighting circuit are shown in Fig. 3. They are the various **lamps** which are operated by a **light switch** connected by the **wiring harness.** Other accessories shown are an electrical outlet socket and indicator lamps. The circuit is protected from a current overload by the **circuit breakers** and a **fuse.**

On most machines, the starter switch must be turned on before the lights can be operated by the light switch. Also some machines have indicator lamps which light up when the starter switch is turned on and then go out when the engine is running, showing that the generator, oil pressure, etc. are normal.

On machines with two or four batteries, a "split-load" lighting circuit is sometimes used. This divides the load equally between both batteries when the lights are turned on. (For details on balancing batteries in "split-load" systems, see Chapter 3.)

LAMPS

Lamps used for lighting of modern machines are:

- **Sealed-beam units (for headlights and flood lamps)**
- **Light bulbs (for other lights)**

SEALED-BEAM UNITS

Headlights and flood lamps are normally sealed-beam units.

The headlights throw out a high-intensity beam and should always be dimmed when approaching a vehicle at night.

Adjusting Headlights

When headlights are used on public roads, be sure they are adjusted so that the glare of the lights will not shine into the eyes of approaching drivers.

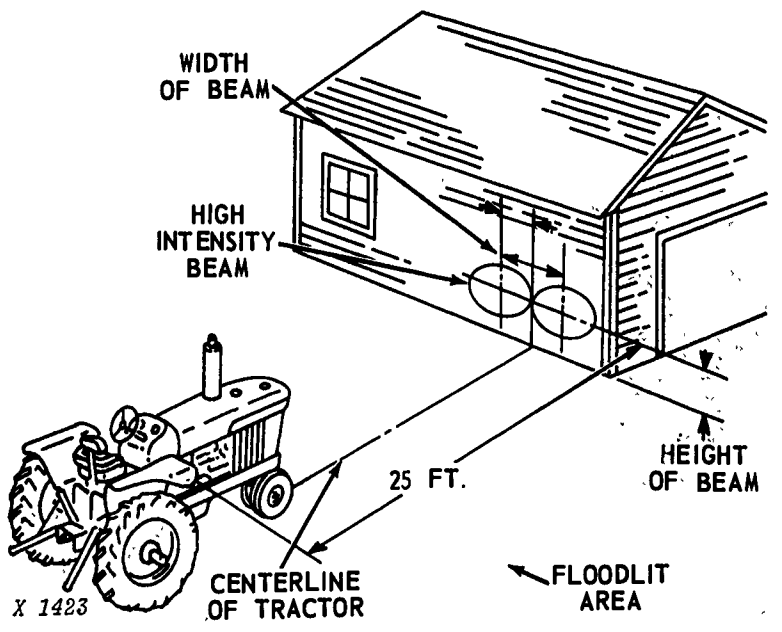


Fig. 4—Adjusting Headlights

Fig. 4 shows how to adjust the headlights on a typical tractor.

Position the tractor as shown on level ground and directly facing a wall 25 feet away.

Turn the headlights on "bright" and check the height of the beams on the wall. The centers of the light beams should be 1-4 feet high, depending upon the height of the tractor headlights. Keep the intense part of the beams *at least* 5 inches below the center of the light from which it comes.

The headlights should also be parallel to the tractor centerline. Look down the center of the

tractor hood and see if the centers of the beams are at equal distances from the centerline (about four feet apart or two feet off center on most tractors).

On tractors with dual headlights, also check the outer flood lamps on "dim" to see that they shine downward and outward to illuminate the desired area as shown in Fig. 4.

To adjust the lights, loosen the lamp mounting bracket and rotate them as desired. Then retighten the mounting bracket. **Remember: Only the lamp mounting bracket is adjustable—not the sealed-beam unit itself.**

On other machines with headlights mounted higher than those on a tractor, always adjust the lamps downward far enough to avoid glare to oncoming traffic.

LIGHT BULBS

Miscellaneous lights such as taillights, dash lamps, and indicator lamps are normally equipped with single- or double-contact bulbs.

When replacing bulbs, make sure the replacement is of the same style and part number as the old one. Otherwise, the system can be damaged or the bulb may burn out rapidly.

Special light bulbs for special lighting effects may be required for some taillights, flasher lamps, or indicator lamps.

Indicator lamps are often used in place of gauges for generator, oil pressure, and temperature checks.

If the indicator lamp lights up or glows while the engine is running, this shows a failure in the system being monitored. For example, an oil pressure light may glow when the engine is low on oil.

When an indicator lamp comes on, be sure to stop the engine at once and check out the possible causes. But also remember that a burnt-out indicator lamp never lights up, even while the engine burns!

FAILURES OF LAMPS

Failure of lamps may be caused by a defective unit, a broken wire, a disconnected wire, a corroded connection, a switch failure or an open circuit breaker.

To check a light bulb, visual inspection is best. A good bulb will be clear while a burnt-out bulb may be dark. Where the bulb glass is not dark, the filament wire will be visible. If it is broken, the bulb is defective.

To check a lighting circuit, test the faulty part for voltage drop. For details on making voltmeter tests, see Chapter 2.

If the voltage is correct but the lamp is dim, look for a poor wiring connection between the lamp and the main wiring harness.

If there is no voltage across the lamp, look for a broken wire, poor contact in the light switch, or a disconnected wiring connector. Replace or repair any defective parts.

If the lights all go out suddenly, check for a tripped circuit breaker or a blown fuse. For details, see "Circuit Breakers" and "Fuses" which follow in this chapter.

FLASHING LAMPS

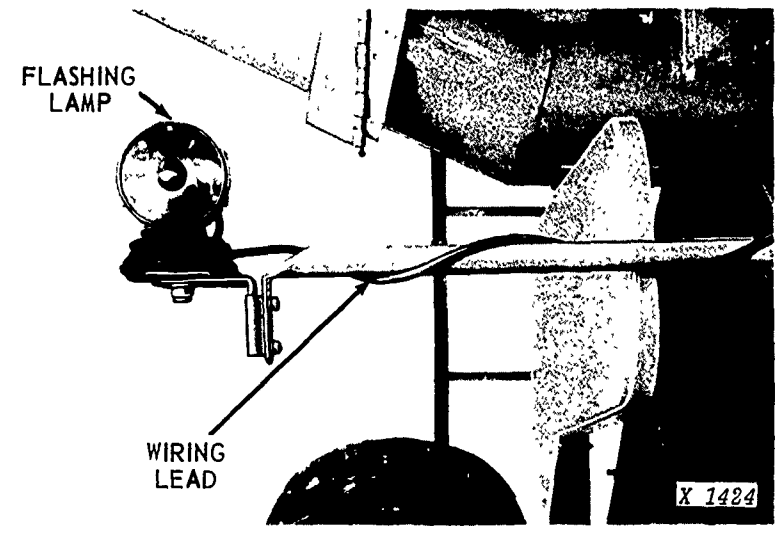


Fig. 5—Flashing Lamp

When a flashing warning lamp is prohibited by local regulations, disconnect the flasher unit and the short wire connected to the flasher. (See the operator's manual.) If you want to burn the warning lamp continually, connect the wire from the lamp directly into the lighting circuit wiring harness.

CIRCUIT BREAKERS

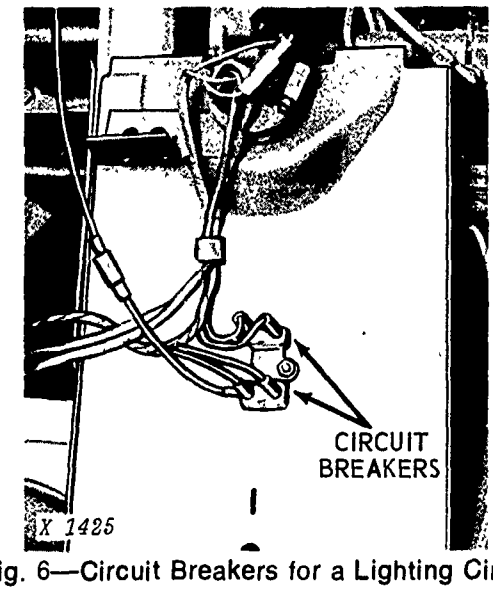


Fig. 6—Circuit Breakers for a Lighting Circuit

A circuit breaker protects an electrical circuit from current overload. The breaker acts as a switch and opens when the current passing through the circuit exceeds the rated level. The breaker may close automatically after a period of time, after the switch is shut off, or when the current drops to its rated capacity.

The breaker may also be closed manually. Both automatic and manual reset circuit breakers are used in electrical systems.

In general, circuit breakers are used when heavy loads may be instantly placed on the circuit.

To check for a defective circuit breaker, use an ohmmeter or a voltmeter. If an ohmmeter is used, a good circuit breaker will show zero resistance.

A defective breaker will show full resistance. If a voltmeter is used, and the circuit breaker is defective, the battery side will show voltage and the load side will not.

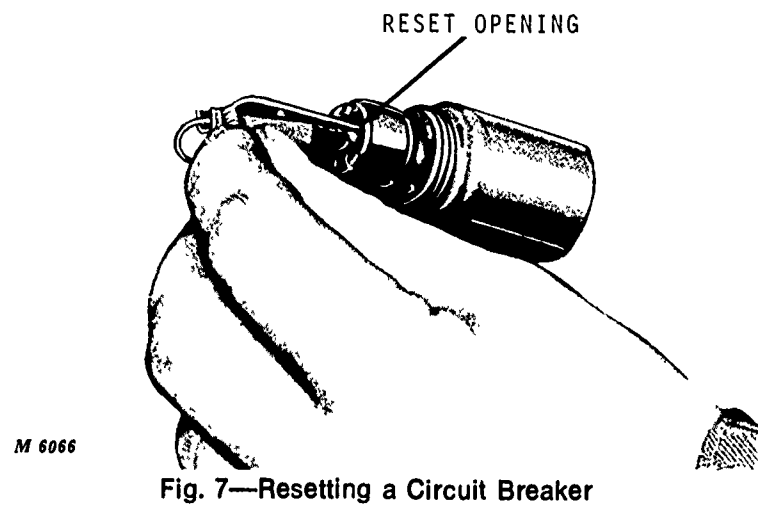


Fig. 7—Resetting a Circuit Breaker

Some circuit breakers are equipped with a reset opening. When the breaker trips, it may be reset by inserting a small wire in the opening and pushing against the spring tension (Figure 7).

FUSES

Fuses protect an electrical circuit from current overload. When too much current passes through the circuit, the fuse blows, breaking the flow of current and preventing damage to the circuit.

A fuse consists of a fine wire or thin metal strip enclosed in glass or fire-resistant material. Most fuses used for modern farm and industrial equipment are small replaceable types. They have a contact on each end and are held in place in a fuseholder or panel. The holder is usually a two-piece tube which can be easily separated for installing or replacing fuses (Fig. 7). The fuse panel is a plastic or fiber board which contains many fuses. The panel keeps the fuses in one place and aids in fuse replacement.

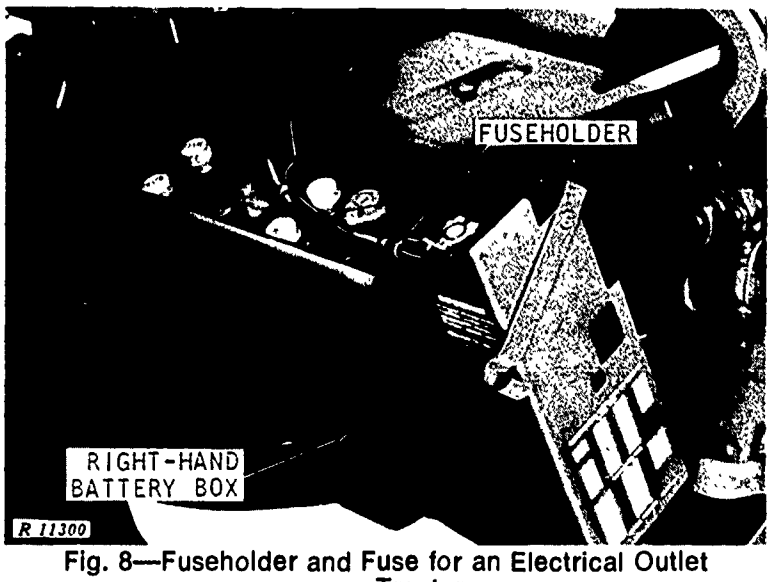


Fig. 8—Fuseholder and Fuse for an Electrical Outlet on a Tractor

Blown fuses are usually caused by:

1. A short circuit in the electrical circuit caused by defective wiring or a defective component (lights, motor, etc.).

2. An overload in the circuit caused by a surge of electricity passing through the circuit.

3. Poor contacts in the electrical circuit or the components.

4. Overheating in the circuit caused by overloads or poor contacts.

5. Use of incorrect size fuses in the circuit.

6. Fuse located too near a hot area such as an engine or a heater.

7. Vibrations near the fuse, causing the contacts to come loose.

Types of Fuses

Two types of fuses are widely used in machine electrical circuits:

- **Quick-blowing fuses**
- **Slow-blowing fuses**

A QUICK-BLOWING fuse blows instantly whenever a too-heavy load occurs.

A SLOW-BLOWING fuse will allow an overload for a short period before it blows.

The slow-blowing type is most commonly used.

How to Tell What Caused a Fuse to Blow

By looking at a blown fuse, you can often tell what failure in the circuit caused it to blow.

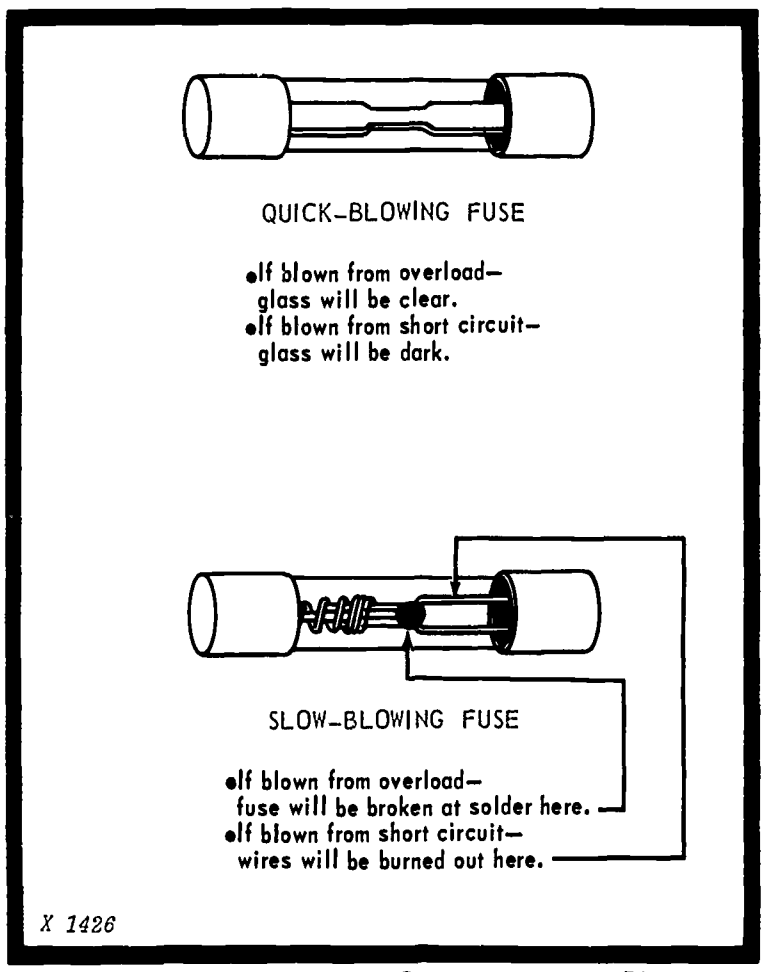


Fig. 9—How to Tell What Caused a Fuse to Blow

Fig. 9 shows a general check for causes of blown-out fuses—whether from overload or from a short circuit.

QUICK-BLOWING FUSES:

If an *overload*—glass case will be clear because fuse link overheats and simply melts away.

If a *short circuit*—glass will be dark, stained by the fuse link which suddenly "burns up".

SLOW-BLOWING FUSES:

If an *overload*—fuse link will break at solder, which has melted.

If a *short circuit*—fuse link will break at small wires because of sudden heat.

Remember that a fuse is meant to protect against overloads. It will also protect against short circuits, but these are abnormal and should be repaired at once.

If a quick-blowing fuse tends to blow out frequently due to small overloads, replace it with a slow-blowing type of the same size.

If the fuse still keeps on blowing, the circuit is overloaded and is not meant to handle the loads being placed on it.

Always replace a blown fuse with one of the same size.

Never use a fuse with a higher amperage rating as it may result in serious damage to the circuit it protects.

FUSIBLE LINK

A *fusible link* is another way to protect a wiring harness from damage by inserting a short length of smaller gauge wire in the circuit. If the circuit is accidentally grounded, the heavy overload melts the fusible link first and prevents the wiring harness from being burnt.

The fusible link is usually a 5-inch length of wire that is four wire gauges smaller than the wire gauge in the circuit that is being protected.

Always position the fusible link so that it has a sagging loop. Then when the wire melts, the melted ends at the bottom of the loop will fall apart and prevent further melting of the insulation. Do not position the link vertically because the heat would travel up the wire and might cause the wire insulation to burn.

See the machine Technical Manual for fusible link locations and specifications.

FUSES AND CIRCUIT BREAKERS—THE APPLICATIONS

Fuses are cheaper but are not reusable. So they are used mainly in circuits where "blow outs" from heavy loads are not common.

Circuit breakers are more expensive but can be reset without replacement. So they are used in heavy-duty circuits where sudden heavy loads are expected.

WIRING HARNESSES

A wiring harness is the trunk and branches which feed the electrical circuit. Wiring leads from one part of the circuit enter the trunk or sheath, joining other wires, and then emerge at another point in the circuit (Fig. 10). The harness sheath is normally made of rubber, cloth, electrical tape, or plastic tubing.

Be careful when installing a wiring harness. The harness must not interfere with moving parts of the machine. Also make certain that the clips which hold the harness do not pinch through the harness and cut the wires. This can cause a short in the circuit.

Individual wires in a harness may be replaced by cutting off the defective wire at each end of the harness. Discard the removed ends of the wire. Run the new wire around the harness; do not try to thread the wire through the harness. Place the new wire in clips with the harness or attach to the harness with electrical tape.

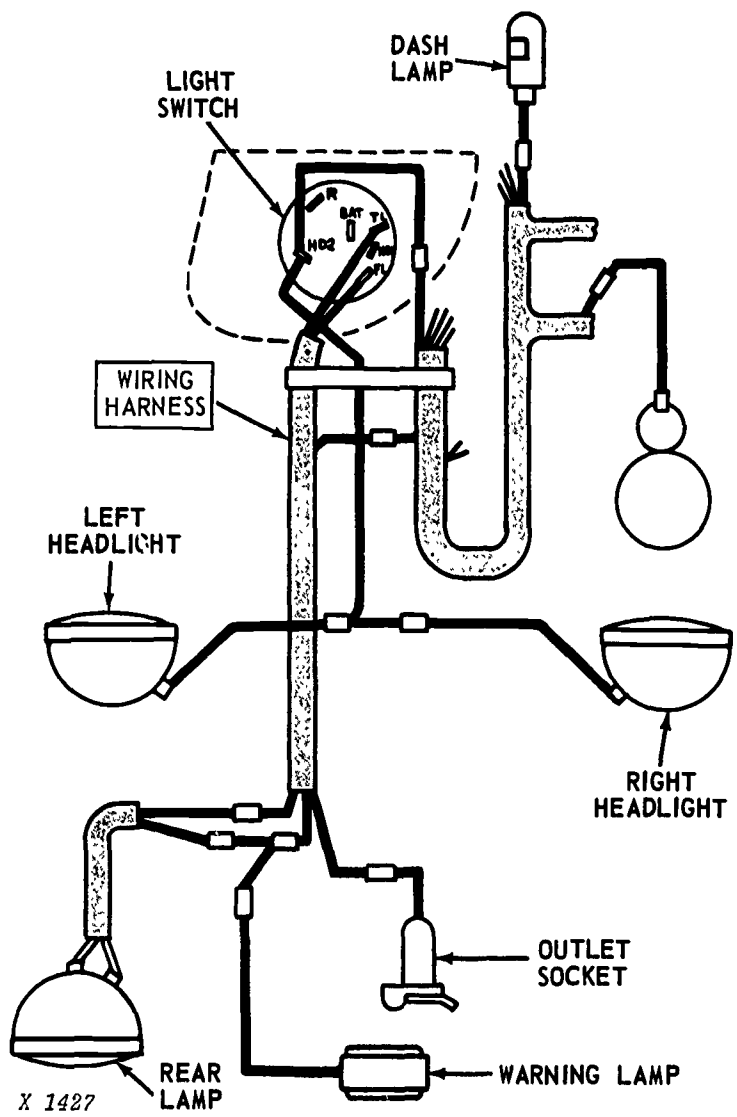


Fig. 10—Wiring Harness

The proper gauge or size of an electrical wire depends upon:

1. *Total **length** of the wire in circuit.*

2. *Total **amperes** that the wire will carry.*

But when replacing a defective wire in a circuit, remember:

Always use the same gauge of wire for replacement. Never use an undersized wire as it will not carry the required load and will overheat.

TESTING AND DIAGNOSIS OF WIRING

In Chapter 2, we said that a wiring circuit may fail in three ways: 1) *open or break,* 2) *ground,* 3) *short.*

The chart below tells you how to test for each of these three failures.

The right-hand column gives the test results you can expect if the wiring has failed.

WIRING TEST CHART

Type of Failure	*Test Unit and Expected Results If Wiring Failed*
Open (broken wire)	Ohmmeter — Infinite resistance at other end of wire. Infinite to adjacent wire. Infinite to ground. Voltmeter—Zero volts at other end of wire.
Ground (bare wire touching frame)	Ohmmeter — Zero resistance to ground. Infinite to adjacent wire. May or may not be infinite to other end of wire. Voltmeter—Instead of testing, normally look for blown fuse or tripped circuit breaker.
Short (rubbing of two bare wires)	Ohmmeter — Zero resistance to adjacent wire. Infinite to ground. Zero to other end of wire. Voltmeter—Voltage will be read on both wires.

ELECTROMAGNETIC CLUTCHES

An electromagnetic clutch is an electric magnet device which stops the operation of one part of a machine while the other part of the unit keeps on operating.

One use of an electromagnetic clutch is on a grain combine where it is desirable to stop the cutting operation and yet continue the separation and cleaning operations (see Fig. 11).

The clutch consists of a field coil assembly, rotor unit, face plate, condenser, and operating switch.

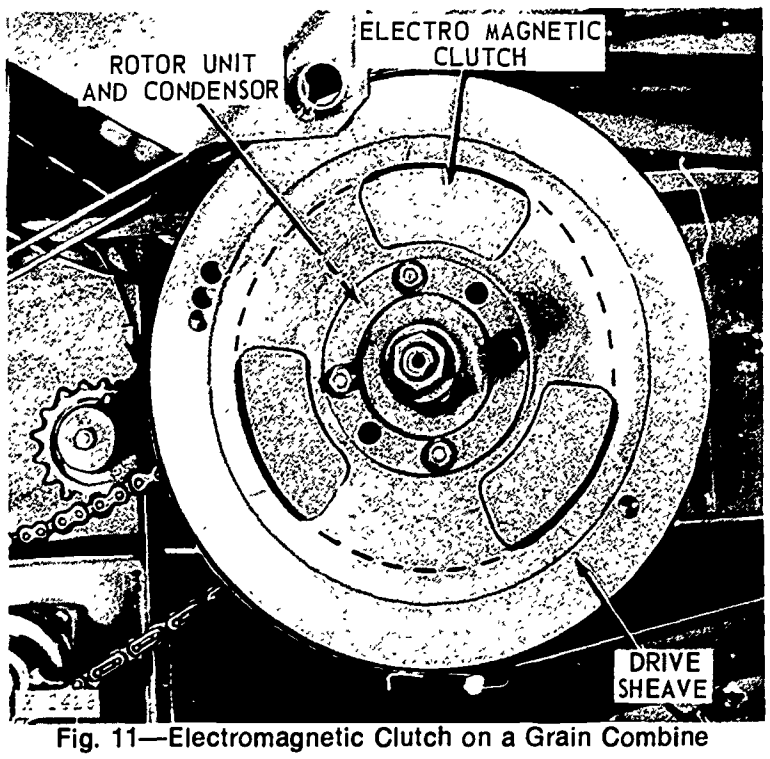


Fig. 11—Electromagnetic Clutch on a Grain Combine

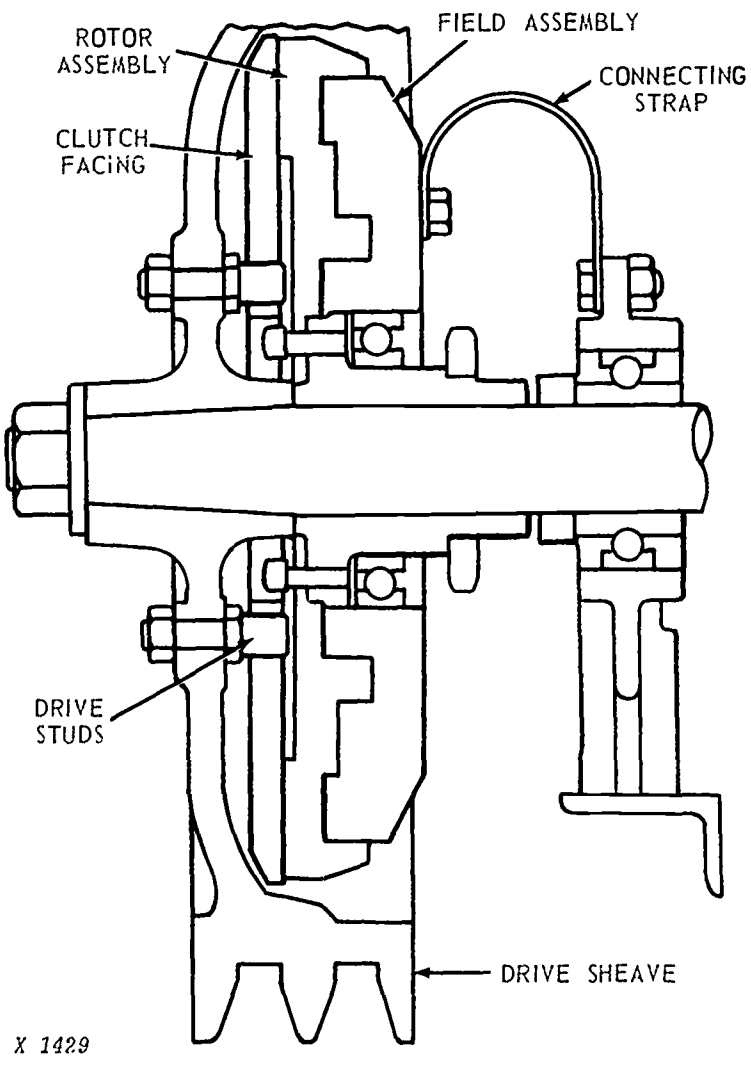


Fig. 12—Operation of Electromagnetic Clutch

The basic theory of electromagnetism is covered in Chapter 1. The clutch works as follows:

When the switch is actuated, current through the field coil inside the rotor assembly sets up a magnetic field which draws the face plate against the clutch facing on the rotor assembly. (The face plate is free to slide on the drive studs of the mechanism.) Power is then transmitted from the drive pulley through the face plate, rotor, and hub to the drive mechanism.

When the switch is operated again, the magnetic field is collapsed. The face plate is freed from the rotor and the transmission of power to the mechanism is instantly stopped.

TESTING AND DIAGNOSIS

If the clutch suddenly loses power and fails to function, it is probably due to a failure in the electrical circuit.

First check all electrical connections, wires, switch, and circuit breaker in the switch. If these components are okay, then check the voltage to the field and the amperage of the field.

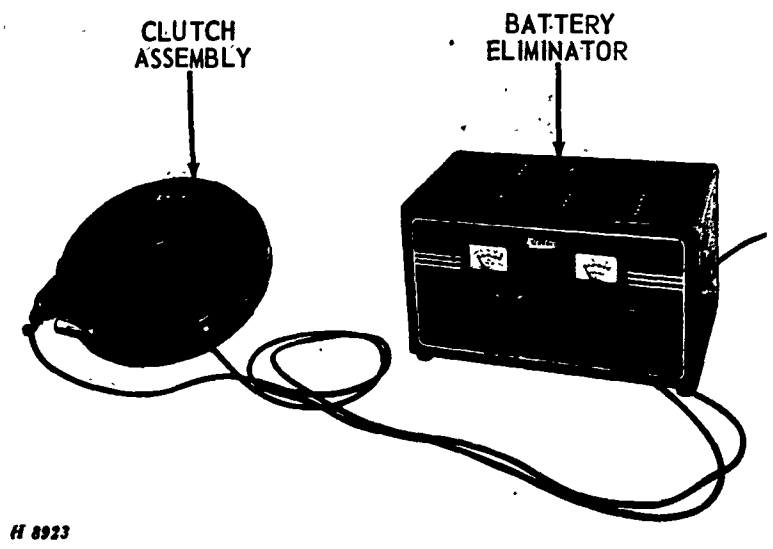


Fig. 13—Checking Field Coil with Battery Eliminator

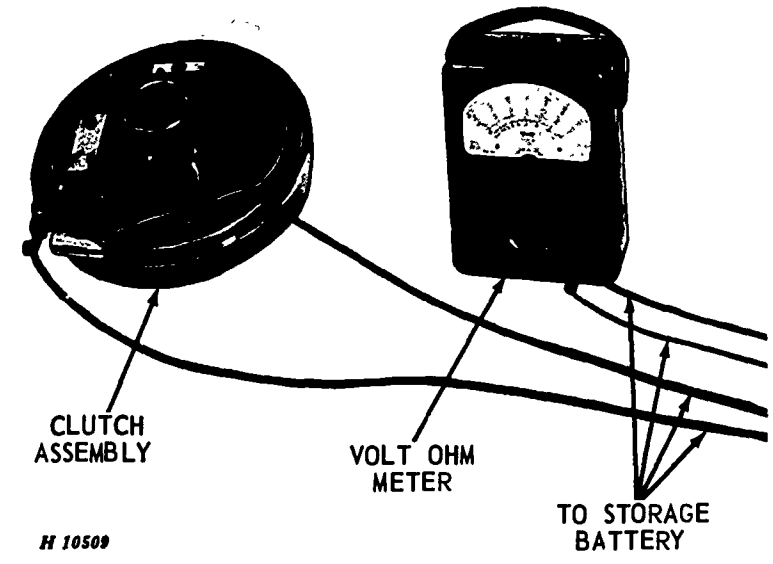


Fig. 14—Checking Field Coil with Volt-Ohmmeter

To check the voltage to the field, the amperage of the field or the resistance of the field, use a battery eliminator or a storage battery and a volt-ohmmeter with a 0 to 15 volt scale and a 10 amp scale. (See Figs. 13 and 14.) Check the individual specifications on each clutch for the correct voltage input, amperage and resistance.

The condenser on an electromagnetic clutch is used to absorb the surge of high voltage when the clutch is disengaged. This prevents arcing and burning out of the electric clutch switch.

If the condenser seems defective, the best check is to install a new condenser and see if this remedies the problem. If not, check the rest of the circuit for defects.

If the electromagnetic clutch is equipped with a capacitor and it seems defective, the best check is a direct replacement of the capacitor.

If diodes are used in the clutch, they may be checked with a diode tester or an ohmmeter. When using an ohmmeter, be sure it has 1½ volts or less to avoid damaging the diodes.

A **good diode** *will have infinite resistance in one direction and zero resistance in the other direction.*

A **defective diode** *will show zero resistance or infinite resistance in both directions.*

GAUGES

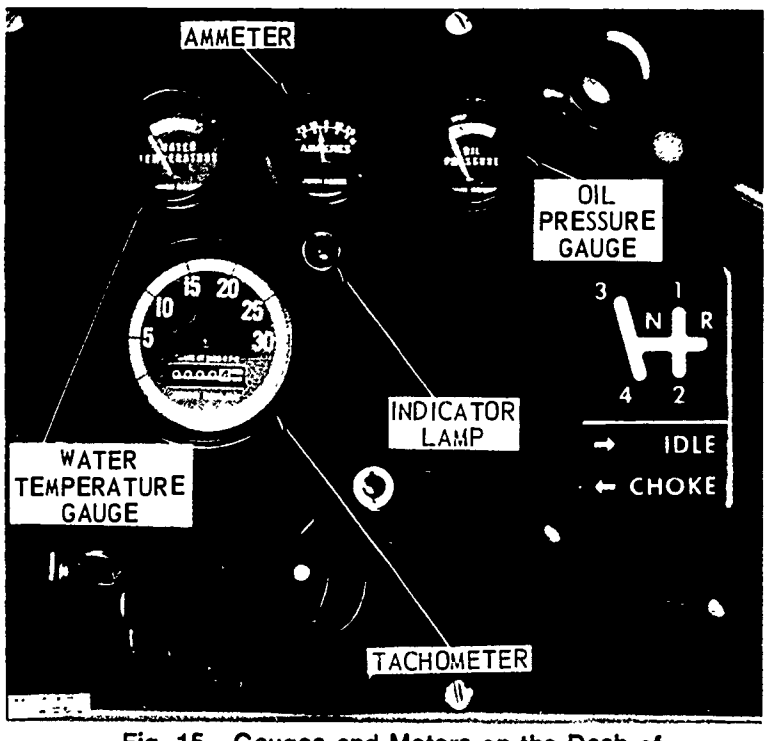


Fig. 15—Gauges and Meters on the Dash of a Modern Machine

Gauges are used on modern machines to keep the operator informed on the various functions of the machine systems. Examples of these gauges are: fuel gauge, water temperature gauge, and oil pressure gauge. (See Fig. 15.)

The fuel gauge is controlled by a sending unit located in the fuel tank and the water temperature gauge and oil pressure gauge are controlled by sending units located in the engine radiator and cylinder block.

The sending units are all variable resistance types and operate the gauges in the following manner: The higher the water temperature, oil pressure, or level of fuel, the lower (or higher) the resistance in the sending unit. This change in resistance causes more (or less) current to pass through the connecting wire to the gauge coil, which in turn causes a new reading on the gauge.

NOTE: Resistance in gauges is normally affected as follows: 1) Fuel and pressure gauges: higher level=higher resistance in gauge coils. 2) Temperature gauges: higher temperature=lower resistance in gauge coil.

TESTING AND DIAGNOSIS OF GAUGES

Fig. 16 shows the circuits for three common gauges.

Diagnose the failures of gauges as given below.

If a gauge does not register, the cause could be:

1. *Lack of current to the gauge.*
2. *Poor ground connection.*
3. *Connecting wire grounded to implement.*
4. *A defective sending unit or gauge.*

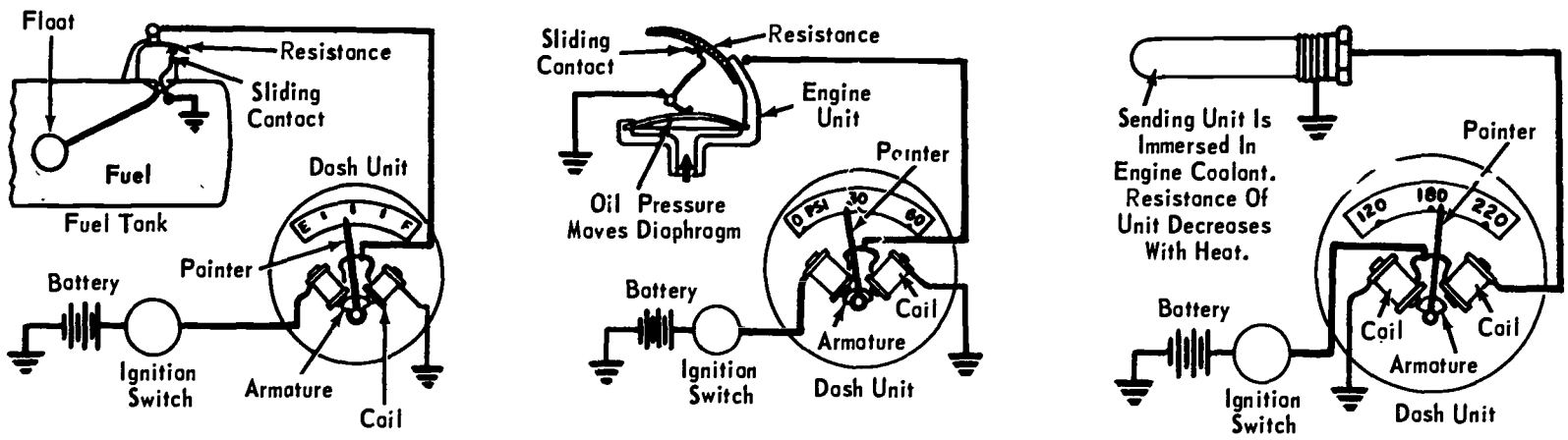
If a gauge consistently registers too high, the cause could be:

1. *Poor connection between gauge and connecting wire.*
2. *Broken connecting wire.*
3. *Poor ground at sending unit.*
4. *Failure of gauge or sender, usually the sender.*

To test a gauge, use a commercial gauge tester. Follow the manufacturer's instructions closely.

If a commercial gauge tester is not available, substitute a new gauge and make sure it is satisfactory. A new sending unit may also be installed to check or to replace a defective unit.

Indicator lamps often use small light bulbs which "glow" to tell of a failure.



X 1431 FUEL GAUGE OIL PRESSURE GAUGE OIL TEMPERATURE GAUGE

Fig. 16—Three Gauges and Their Circuits

If these lamps do not glow when starting the engine, first check for a defective bulb. Then, if necessary, check out the other causes given above.

METERS

AMMETERS

The ammeter is an instrument for measuring the strength of an electric current in terms of amperes. (See Fig. 15.)

Normally the ammeter is connected directly to the regulator to measure the flow of current through the electrical system.

A typical low-cost ammeter consists of a moving magnet with attached needle placed close to a conductor between the ammeter terminals. Current flow through the conductor creates a magnetic field that deflects the moving magnet and causes the needle to deflect away from zero on the meter scale.

If an ammeter does not register correctly, replace it with a new ammeter. Do not attempt to repair a defective ammeter.

VOLTMETERS

Voltmeters are used to indicate the voltage of the electrical input in a circuit.

A typical low-cost voltmeter consists of a needle attached to a moving iron vane placed inside two stationary coils. The coil winding is parallel with the needle pivot and one winding tends to keep the needle at zero while the other tends to move the needle to the full-scale deflection.

Voltmeters are connected in parallel with the voltage to be measured. Since the voltmeter has a high resistance, adding this component to the circuit will change the total circuit current very little, and the voltage reading obtained shows the true voltage present without the meter in the circuit.

If a voltmeter does not function properly, a new voltmeter must be installed. A defective voltmeter cannot be repaired.

ELECTRIC HOUR METER

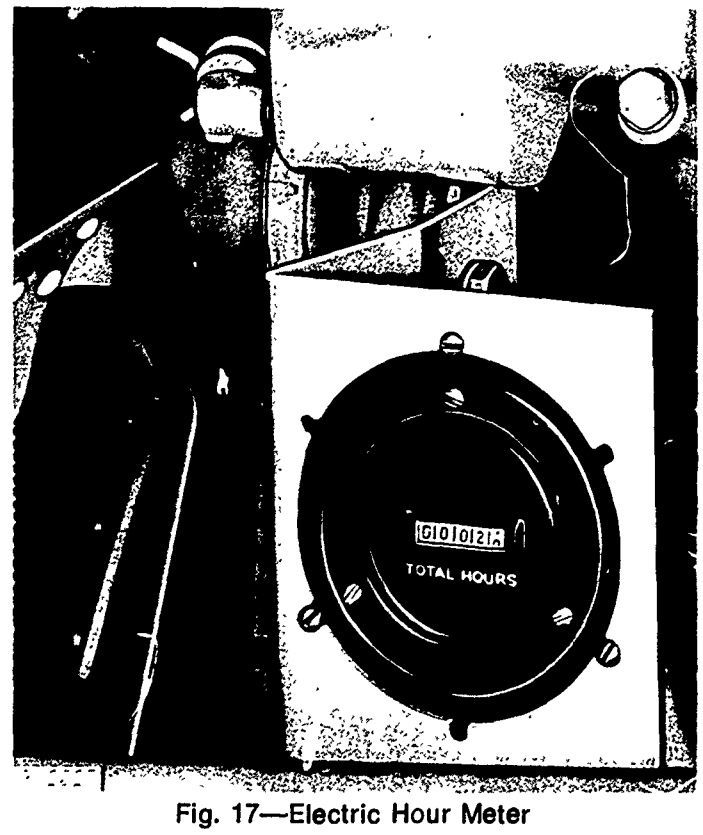


Fig. 17—Electric Hour Meter

Electric hour meters are used to show the operating time of a machine while the engine is operating at its rated speed.

The hour meter records the time in hours and only operates when the engine is running.

Do not attempt to repair a defective hour meter or its sending unit. When they fail, new components must be installed.

MOISTURE METER

Fig. 18—Moisture Meter

The moisture meter is a portable electronic device used to measure the moisture content of grain (Fig. 18). In grain drying, the moisture content is the percentage (by weight) of water in the grain.

Moisture in the grain is measured by penetrating the sample with high frequency radio waves. The effect the grain has on the radio waves varies with the amount of moisture. This is measured electronically by observing the change required to rebalance the meter when the grain is added. Because the waves penetrate the grain, the surface condition of the grain or mixed wet and dry grain will not affect the accuracy of the meter.

The moisture meter is accurately calibrated at the factory and should provide accurate measurements for years of normal use. To insure accuracy and long life, avoid exposing the meter to rain and excessive dampness. When out of the carrying case, keep the meter covered with the plastic cover except when in use.

The electronic circuit cannot be repaired by a radio or television repairman or any other local electronic repair shop without destroying the factory calibration. Never remove the case from the meter. If the moisture meter fails, return it to the factory where it can be repaired and accurately calibrated.

Some parts of the meter can be replaced in the field. In case of breakage or loss, the plastic index band, knobs, scales, grain cup, small weight, and drawer can be replaced.

HORNS AND BUZZERS

Horns and buzzers are used on machines as signaling and warning devices.

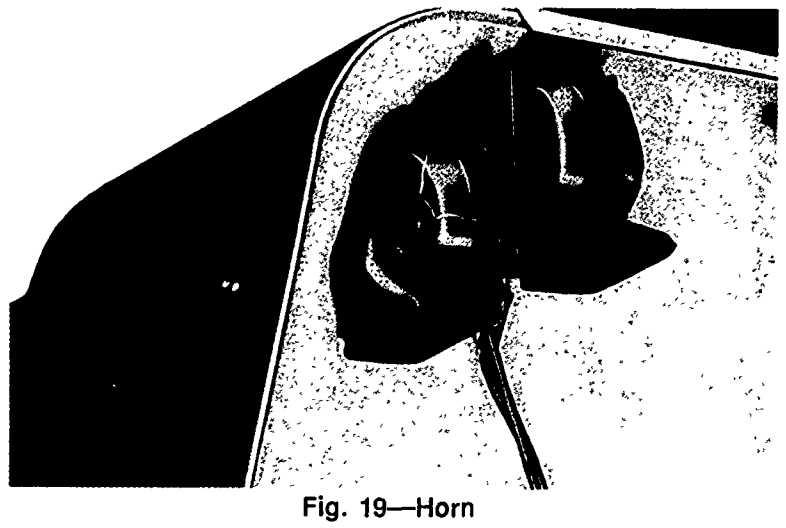


Fig. 19—Horn

For example, on some grain combines, two different horns are used. One horn is used as a "call horn" to call the truck to the combine for unloading the grain tank when it is full of grain. The other horn is a signal device located inside the combine separator to warn the operator when the separator is overloading.

On farm and industrial tractors, horns are used to warn pedestrians and other vehicles that a moving machine is in the area. Horns are also used to warn the operator of some equipment when the engine is heating up.

Horns and buzzers are the same in design and operation. The only difference is in the sound. This is achieved by the use of different air columns. In a horn the air column is formed into a compact seashell form. This shape produces the maximum volume from the sound generated by the diaphragm.

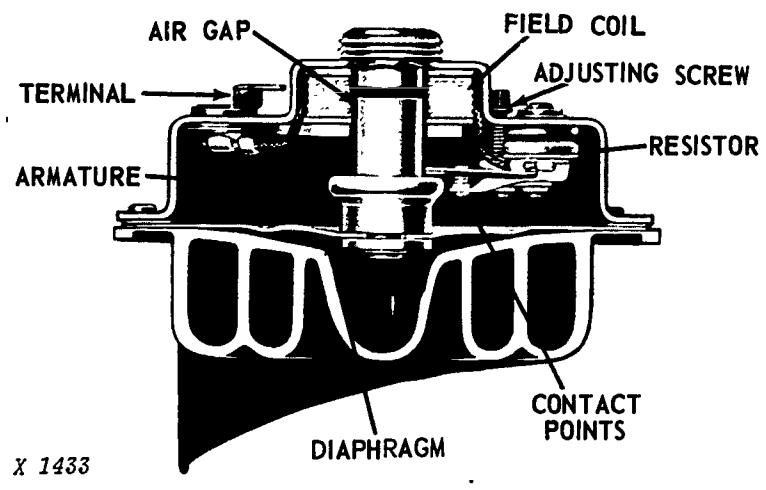


Fig. 20—Cutaway View of Horn

Two types of horns or buzzers may be used: The **type S air-tone horn** is shown in Fig. 20. The **type C air-tone horn** is similar to a type S horn except that it is smaller in size and does not have a resistor.

The horn or buzzer has a vibrating power unit to actuate a diaphragm which produces the sound as a warning signal.

When energized, current flows through the field coil to the contact points, then to the ground. The field coil magnetic field pulls the armature into the field coils, moving the diaphragm and opening the contact points. Opening the points de-energizes the field coil and the spring force of the diaphragm pulls the armature from the field coils, closing the points. This cycle is repeated 360 times per second on a low-note horn and 450 times per second on a high-note horn.

The adjusting screw (Fig. 20) controls the time of point opening, which in turn controls current draw and frequency.

On a type S horn, the resistor connected across the contact points reduces the arcing of the points.

TESTS AND ADJUSTMENTS

CAUTION: Do not turn the horn adjusting screw more than ¼-turn. To do so may damage the horn.

Before adjusting the horn, check the available voltage when the current draw is 10 amps. Adjusting the horn to compensate for excessive voltage drop will shorten the service life of the horn.

If the horn fails to operate with normal voltage, energize the horn and tap it lightly. If the horn now operates, the horn contacts were probably held open by a foreign particle. The horn should continue its normal operation when it is re-energized.

If the contacts are open as a result of wear, it will be necessary to tap the horn again after it is re-energized. A rough current adjustment can be made by turning the adjusting screw ¼-turn counterclockwise.

To make further tests, connect an ammeter and a voltmeter to the horn.

Apply voltage to the horn and check the readings as follows:

1. No current indicates a broken lead or open circuit due to overheating. Overheated horns have the usual odor of burned insulation and should be replaced. On type C horns, no current flow also indicates open contacts. Turn the adjusting screw counterclockwise and recheck the horn.

2. On type S horns, a reading of approximately 2.5 amps indicates open contact points and that current is flowing through the horn resistor only. Turn the adjusting screw counterclockwise and recheck the horn.

3. A reading of approximately 20 to 25 amps indicates that the contact points are not opening. Turn the adjusting screw clockwise. One-quarter turn clockwise is usually enough unless the horn has been tampered with.

4. When the horn is operating, adjust the current draw to the horn specifications in the machine Technical Manual. Turn the adjusting screw clockwise to decrease current. Turn the adjusting screw only 1/10 turn at a time.

RELAYS

Relays are really electrical switches which open and close a circuit. However, they are automatic.

A relay is basically a winding around an iron core, and an armature mounted over the core and winding. A contact point on the armature is aligned with a contact point on a stationary support so that when the winding is energized, the armature moves to open or close the contacts.

There are many different types of relays. These types are covered here:

- **Solenoid relays**
- **Cutout relays**
- **Horn relays**
- **Tell-tale relays**

Let's discuss each relay in detail.

SOLENOID RELAYS

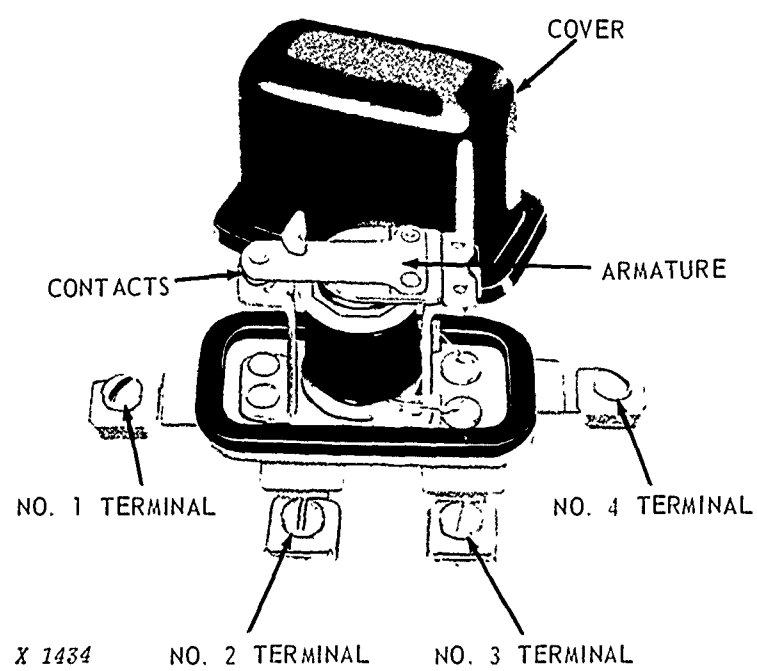


Fig. 21—Solenoid Relay (Cover Removed)

A solenoid relay prevents the starting motor from operating while the engine is running. It is an optional feature (Fig. 21).

Operation of Solenoid Relays

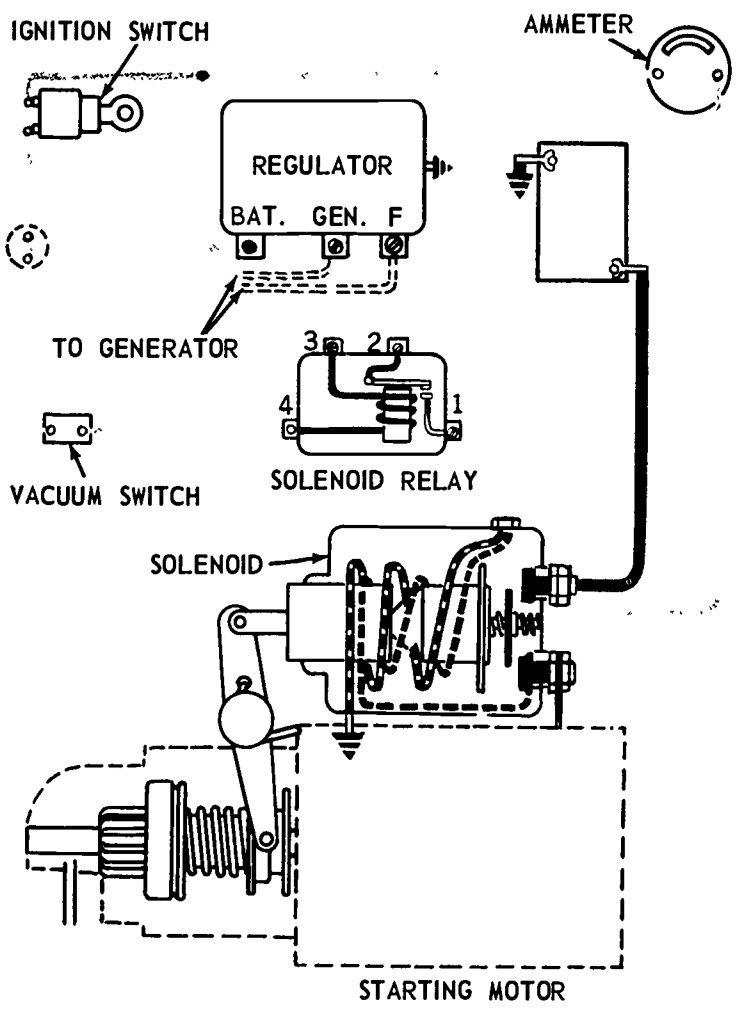


Fig. 22—Solenoid Relay in Typical Starting Circuit

When the ignition switch is closed to start the engine, current flows from the battery through the ammeter, ignition switch, neutral safety switch, vacuum switch, solenoid relay winding, and then through the generator and the ground circuit back to the battery. (See Fig. 22.) The neutral safety switch and vacuum switch are added protection and may not be used in some applications.

When the solenoid relay winding is energized, the relay contacts close, connecting the starting motor solenoid windings to the battery. This completes the circuit and causes the starting motor to operate.

When the engine starts, the build-up of generator voltage opposes battery voltage so that the current flow through the solenoid relay winding is stopped. The solenoid relay contacts then open, disconnecting the starting motor solenoid from the battery.

This breaks the circuit to the starting motor and the motor stops operating. This action occurs even though the ignition switch remains closed, and so prevents the starting motor from operating while the engine is running.

Checking the Solenoid Relay

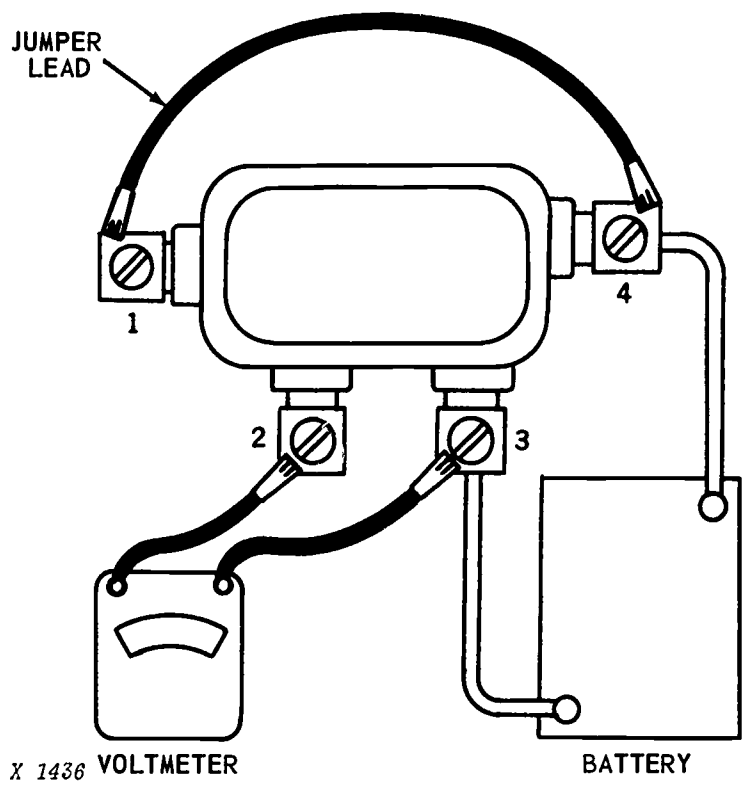


Fig. 23—Checking the Solenoid Relay

To check the relay, connect a battery to the No. 3 and No. 4 terminals, a jumper lead from the No. 4 to the No. 1 terminal, and a voltmeter from the No. 2 to the No. 3 terminal. (See Fig. 23.)

If the contacts are closed, the voltmeter will read battery voltage.

If the relay is defective and should be replaced the voltage reading will be zero.

CUTOUT RELAYS

The cutout relay is used to close the circuit between the generator and the battery when the generator voltage is high enough to charge the battery. It also opens the circuit when the generator slows or stops to prevent the battery from discharging through the generator.

Since the cutout relay is a part of the charging circuit, it is covered in detail in Chapter 4 under "Generator Regulators."

HORN RELAY

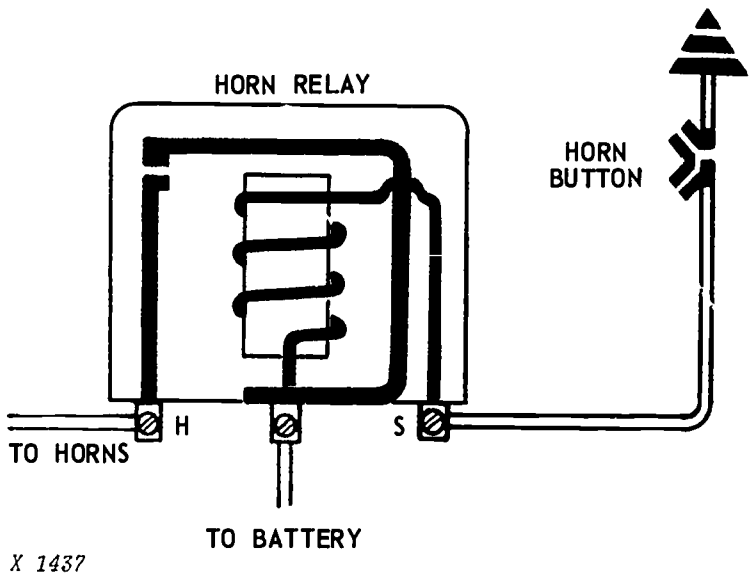


Fig. 24—Horn Relay Circuit

The function of the horn relay is to close the circuit between the horn and the battery when the horn button is pressed. A typical horn relay circuit is shown in Fig. 24.

When the horn button is pressed, the circuit from the battery is completed through the horn relay winding to ground and then back to the battery. The magnetism created in the winding by the current pulls the armature toward the core, closing the contacts. This completes the circuit between the horns and battery and causes the horn to operate. When the horn button is released, the flat spring on the back of the relay armature pulls the contacts apart.

NOTE: A light-duty horn relay may also be used as an indicator lamp relay to ground the indicator lamp when starting the machine so that the operator can see whether the indicator lamp will still light.

Checking the Horn Relay

To check the horn relay, connect a voltmeter from the relay horn terminal to ground, and use a jumper lead to ground the relay terminal which connects to the horn button.

The voltmeter will read battery voltage if the points are closed. If the voltmeter reads zero volts, the contacts are not closed, and the relay is defective and must be replaced.

TELL-TALE RELAY

The tell-tale relay is used with an indicator light to tell whether an electrical circuit is working properly.

For example, a tell-tale relay may be used on a machine in connection with a small indicator light on the dash to show whether a particular unit on the vehicle is functioning.

The relay consists of a series winding with a few turns of heavy wire on an iron core. Over this is mounted an armature containing a contact point. This contact point is directly above a stationary contact.

Tell-Tale Relay Operation

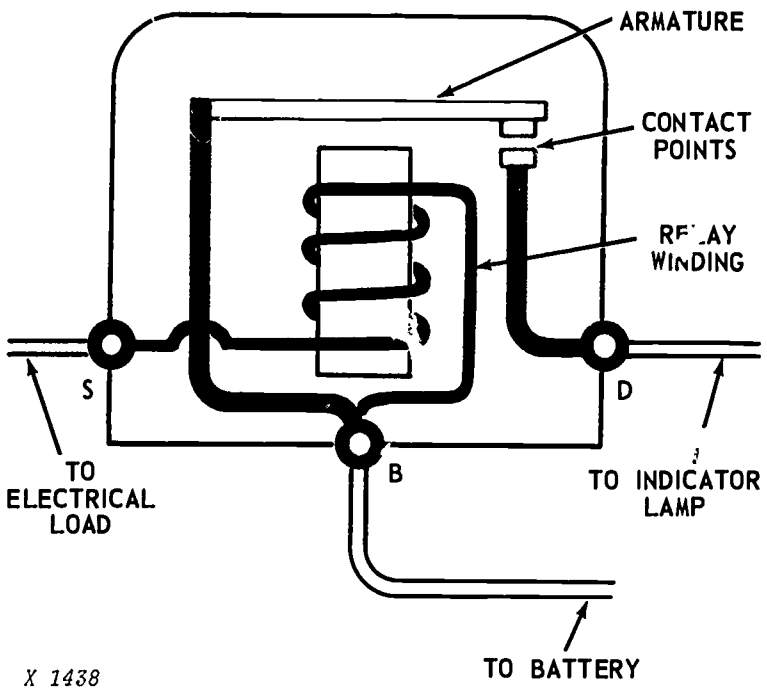


Fig. 25—Tell-Tale Relay Circuit

Fig. 25 shows a typical wiring circuit for a tell-tale relay.

When an electrical load of predetermined value is connected through the tell-tale relay winding to the battery, current flows through the relay winding. This creates a magnetic field which pulls the armature toward the core so that the relay contact points close. This connects the indicator lamp to the battery and so the lamp lights up.

If any part of the load circuit is not functioning properly, a reduced current will flow through the relay winding, allowing the relay contact points to open. As a result the indicator lamp will go out, telling the operator that something is wrong in the circuit.

NOTE: Some tell-tale relays are designed so that the indicator lamp lights up when the electrical units are not working rather than when they are.

Some tell-tale relays require the following adjustments: air gap, point opening, and operating amperage of the contact points. The air gap and point opening are checked and adjusted the same as in the cutout relay (Chapter 4).

Testing the Amperage of Tell-Tale Relay

To measure the amount of current required to operate the tell-tale relay, connect an ammeter into the circuit at the terminal of the relay which is connected to the unit being operated. Also connect a variable resistance in series at the terminal of the relay which is connected to the battery. Close the signal lamp switch and slowly reduce the resistance until the relay operates, noting the ammeter reading.

If necessary, adjust the operating amperage by bending the armature spring post. Bend it up to increase the spring tension and the operating amperage and bend it down to decrease the amperage.

NOTE: Each model of tell-tale relay is designed for use with a specific number and size of bulb (or bulbs). Use of higher candle-power bulbs or more bulbs than specified will cause excessive contact point burning in the relay. The use of smaller candle-power bulbs or fewer bulbs than specified may result in failure of the relay points to close when these bulbs are turned on so that the indicator lamps will not burn. Find out the correct size and number of bulbs to be used with the relay for good operation.

PROTECTORELAY

Another type of relay is the Protectorelay, which is used on some crop dryers. This relay prevents burner operation or flow of fuel whenever safe operation is not assured.

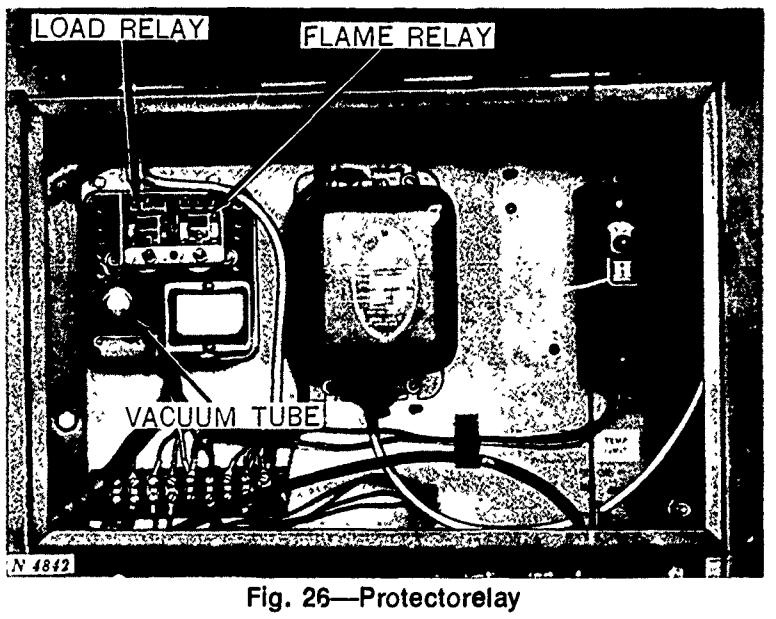


Fig. 26—Protectorelay

A Protectorelay includes a flame relay, a load relay, and a vacuum tube (Fig. 26). The vacuum tube serves both as an amplifier and a detector for the passage of electrical current in the flame sensing system. The relays inside the Protectorelay are actually cutout relays and operate in the same way.

SOLENOIDS

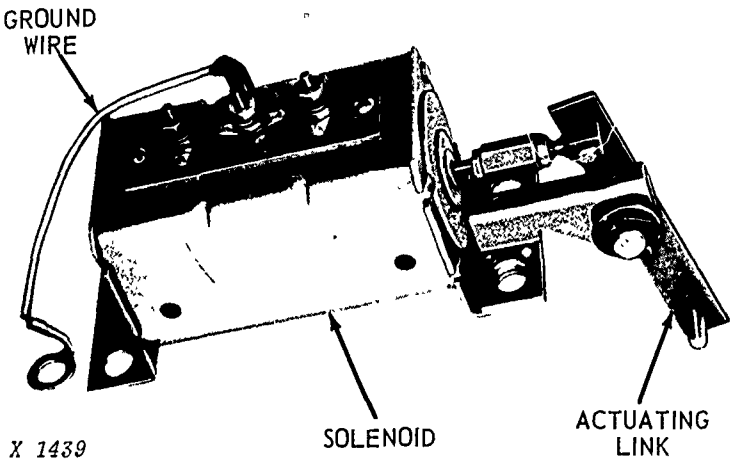


Fig. 27—Solenoid for Hillside Combine Leveling Valve

Solenoids and solenoid switches are designed to do mechanical jobs by means of electromagnets.

Examples are fuel shutoff solenoids, fuel injection pump solenoids, and leveling shutoff switches as used on hillside grain combines.

Solenoids of this type are basically contacts and windings around a hollow cylinder containing a movable core, coil, or plunger.

When the winding is energized by the battery through an external control circuit, the plunger is pulled inward, giving the necessary mechanical movement.

Most solenoids and solenoid switches operate in only one direction. However, in the case of the solenoid on a hillside combine leveling valve, the solenoid has two windings which operate the plunger in both directions.

TESTING OF SOLENOIDS

Test a solenoid as follows:

1. Ground the main solenoid terminal to the solenoid base.

2. Connect a source of variable voltage (a battery and a variable resistance) in series with an ammeter between the solenoid base and the solenoid control switch or control terminals.

3. Connect a voltmeter between the same two points.

4. Slowly increase the voltage and note the current draw at the voltage specified in the solenoid test specifications.

Most solenoids and solenoid switches are sealed units and must be replaced if defective.

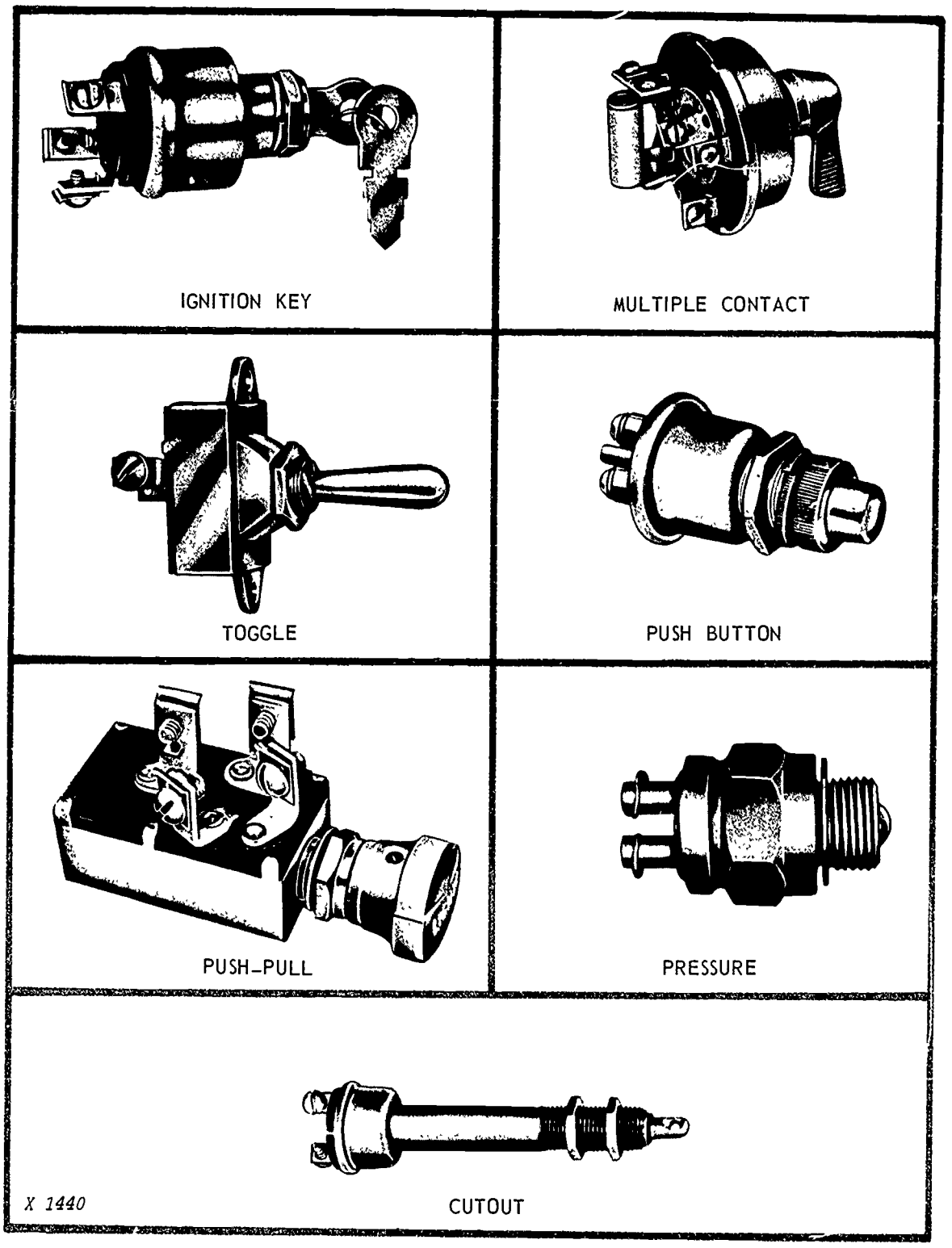


Fig. 28—Types of Switches

SWITCHES

A switch is a device which opens, closes, or directs an electrical circuit.

Fig. 28 shows some of the many types of switches used to control modern electrical systems.

All switches do basically the same job. The difference is in the way they are operated. Below are listed the major types:

- **Ignition Key**
- **Toggle**
- **Push-Pull**
- **Cutout**
- **Multiple Contact**
- **Push Button**
- **Twist**
- **Pressure**

IGNITION KEY SWITCHES must have a key inserted before they can be operated. Used for starting switches because of safety and to avoid theft of the machine.

TOGGLE SWITCHES are simple on-off flip switches. Used to control small auxiliary circuits.

PUSH-PULL SWITCHES are usually on-off switches. Used for two-way control as of a simple lighting circuit.

CUTOUT SWITCHES are used to break an electrical circuit as during emergencies. May be actuated manually or automatically.

MULTIPLE CONTACT SWITCHES may use a knob or a key which is turned to various positions to make or to break contact with different circuits. Used for complex circuits such as combination lighting or for variable speed control of a fan or heater.

PUSH BUTTON SWITCHES are momentary switches which are moved in only one direction to open or close a circuit. Used for simple jobs such as sounding a horn or buzzer.

TWIST SWITCHES give the same on-off control as push-pull types, except that they give a rotary action. Used for two-way or two-speed control of simple circuits such as windshield wipers.

PRESSURE SWITCHES are operated by an outside force from oil, water, air, or gas. Usually they are spring-type units which open or close a circuit automatically in response to pressure. Often these switches are used as sending units for oil pressure lamps, etc.

An example of a push-pull switch is the starter safety switch (Fig. 29). This switch is used to assure that a machine is in neutral before the engine can be started. The switch is normally activated by the movement of the gear shift mechanism when the transmission is placed in neutral. This closes the switch and allows the starting circuit to turn over the engine for starting. When the machine is in any gear, the switch is not contacted and stays open, preventing an engine start.

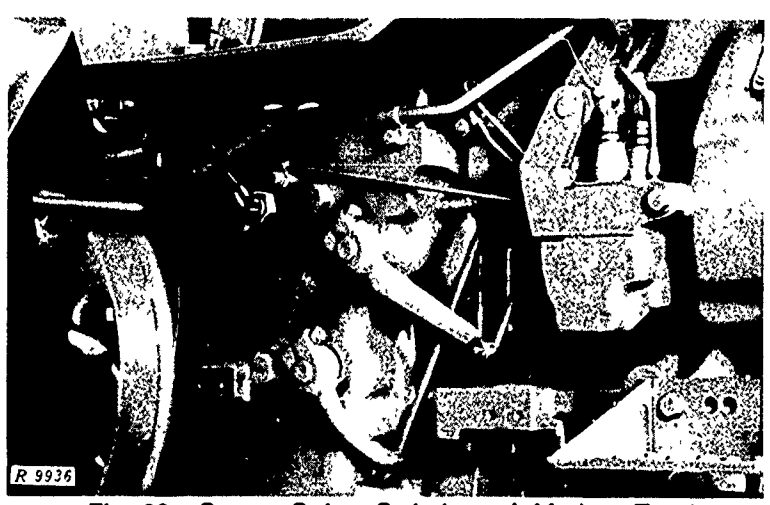


Fig. 29—Starter Safety Switch on A Modern Tractor

The starter safety switch is usually a ball and spring mechanism. The ball is moved by a gear shifter and compresses the spring, activating the switch.

A variation on the twist switch is the ROTARY SWITCH. This switch is often used with a fan to complete a circuit when the fan reaches a certain speed. It also shuts off when the fan drops below this speed.

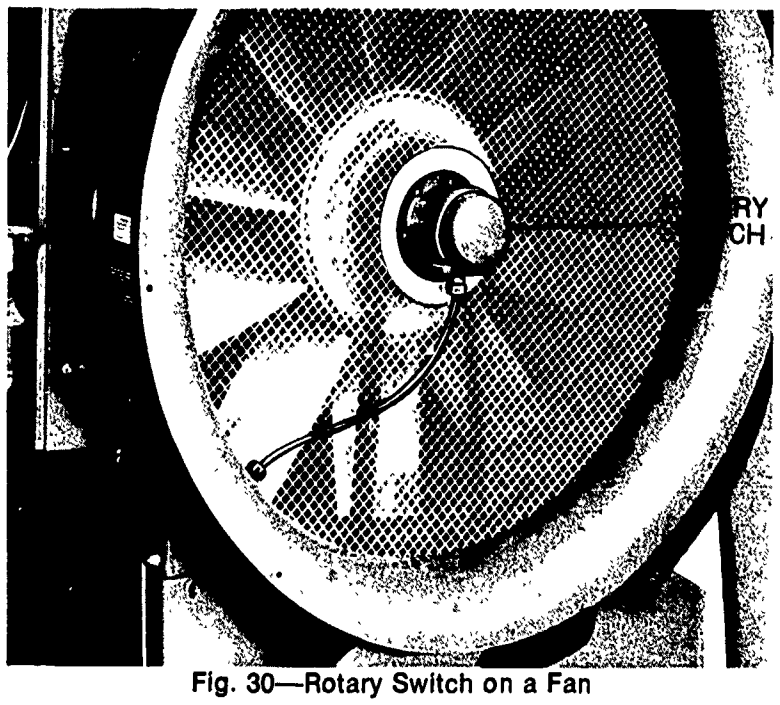


Fig. 30—Rotary Switch on a Fan

A good example of a rotary switch is one that is used with the fan on a crop dryer (Fig. 30). When the fan reaches a predetermined speed, the rotary switch will activate, completing an electrical circuit to the gas burner. This assures that the fan is always running before the burner starts. When the fan slows down, it will again activate the switch, shutting off the burner. Thus the switch is a protective device against possible failure of the fan and consequent heat build-up.

Another special type of switch is the "MICRO-SWITCH." It is a miniature unit activated by a light pressure with a small amount of travel. It usually has three terminals: a "C" common terminal to which one wire is connected; a "NO" or normally open terminal, to which the other wire is connected if the circuit is open except when the switch is depressed; and an "NC" or normally closed terminal for another wire if the circuit is closed except when the switch is depressed.

Another switch that is smaller yet is the REED SWITCH. In this switch, the contacts are tiny reeds of metal that are actuated by a magnetic field to close or open the circuit. The reed switch may be a sealed unit and the magnetic windings may also be enclosed in the switch, making it a tiny relay about one-eighth inch in diameter and three-eighth inch long.

Miniature switches of the "micro-switch" and reed switch varieties are widely used in the electronics field.

SERVICING OF SWITCHES

If a switch is defective, always replace it with a new switch. **Do not try to repair a defective switch.** It is usually cheaper and safer to replace it.

IMPORTANT: Always be sure to replace a defective switch with a switch of the same electrical rating. A switch with too high or too low a rating can burn out an electrical circuit.

ELECTRIC MOTORS

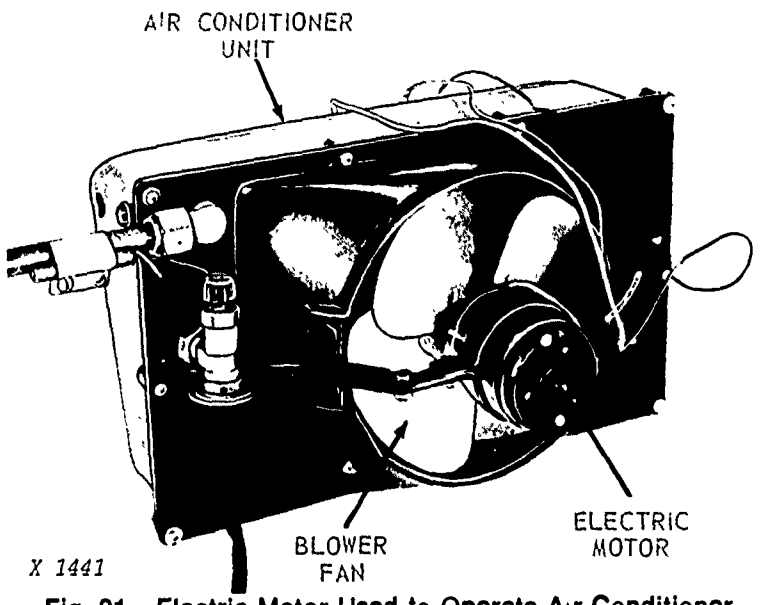


Fig. 31—Electric Motor Used to Operate Air Conditioner Blower Fan

Small d.c. electrical motors are used to perform auxiliary functions on some machines. For example, motors are used to operate air conditioner blower, ventilating and heating fans, and windshield wipers. (See Fig. 31.)

Small electric motors operate on the same principle as a starting motor. Refer to Chapter 5 for complete theory and operation.

If the proper equipment is not available, take defective motors to a good electrical shop for servicing.

CIGARETTE LIGHTERS

The cigarette lighter contains a heating element which contacts the electrical circuit when the lighter is pushed in. This causes the element to heat up and glow. The element will remain heated long enough to permit lighting a cigarette or cigar.

The lighter employs a circuit breaker to cut off the electrical current to the lighter element when it has heated to its peak.

Failure of the cigarette lighter may be caused by a broken wire, disconnected wire, burned-out element, defective lighter shell, or a tripped circuit breaker.

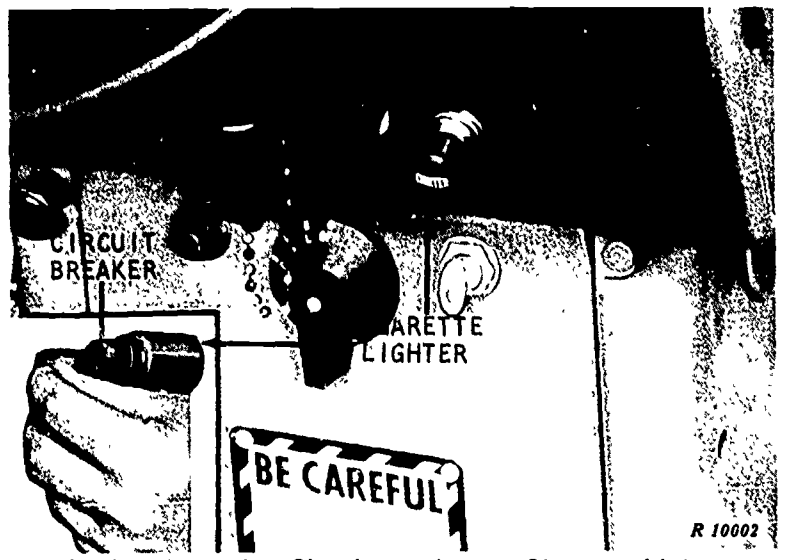


Fig. 32—Resetting Circuit Breaker on Cigarette Lighter

Some circuit breakers on lighters are equipped with a reset opening (Fig. 32). If the lighter fails to operate, the circuit breaker may be open and must be reset.

To do this, insert a small wire in the small hole in the end of the lighter as shown and push in against the spring tension.

If a lighter has a burned-out element or a defective shell, these parts must be replaced.

FLAME RODS

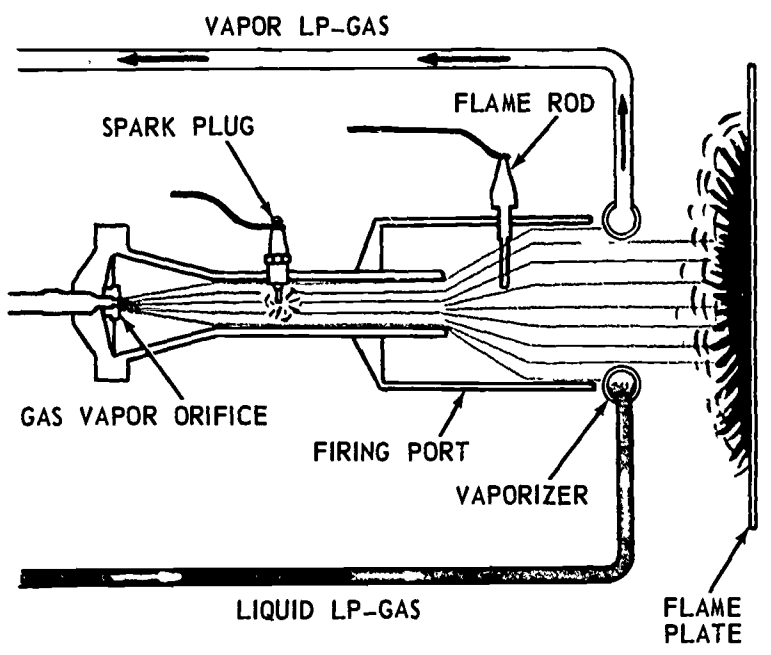


Fig. 33—Flame Rod in Operation

A flame rod is a device used in a gas-fired crop dryer to sense the presence of flame in the dryer. The flame rod is located in the firing port (Fig. 33) and works as follows:

A-c electrical current is fed from the Protectorelay (see earlier in this chapter) to a flame rod which is in direct contact with the normal burner flame. The flame completes the electrical circuit between the rod and the ground (the flame plate and firing port). However, because of the relatively small size of the flame rod compared with the ground, the current is rectified, or converted to d-c. This small d-c current flow indicates "flame" and signals the Protectorelay to hold the solenoid valves open. But if the flame loses contact with the rod, the circuit is broken and the solenoid valves are de-energized within 2 to 4 seconds. Thus the supply of gas to the burner is stopped as soon as the flame goes out.

Short circuits or high resistance grounds cannot simulate the presence of a flame. A component failure within the system has the same effect as a loss of flame.

These are truly "safety shutdowns" as there is no attempt at automatic restarting.

The burner must be restarted manually after the cause of the shutdown is corrected.

For service of flame rods, see the crop dryer operator's manual. Also see the proper manuals for operation of the complete dryer and its LP-Gas and electrical systems.

TRANSFORMERS

Transformers are used to increase or decrease the electrical voltage from the circuit to a specific unit.

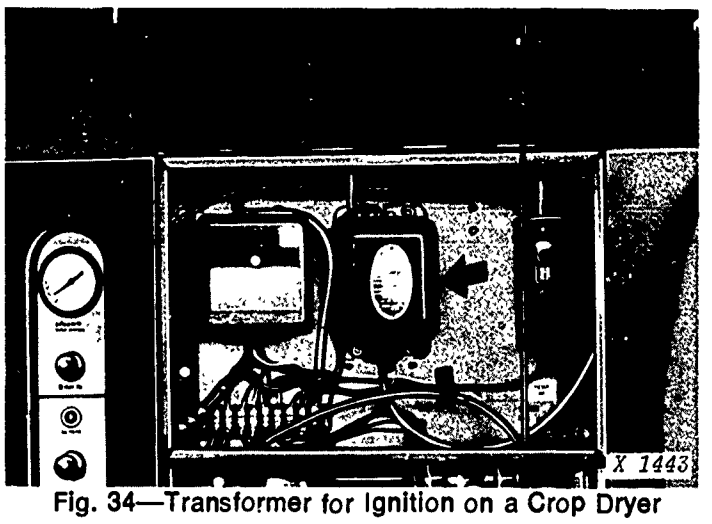


Fig. 34—Transformer for Ignition on a Crop Dryer

For example, on crop dryers, a transformer is used to increase the voltage to a spark plug which ignites the dryer flame (Fig. 34). It is called an ignition transformer.

The transformer cannot be repaired. If defective, it must be replaced.

GLOW PLUGS

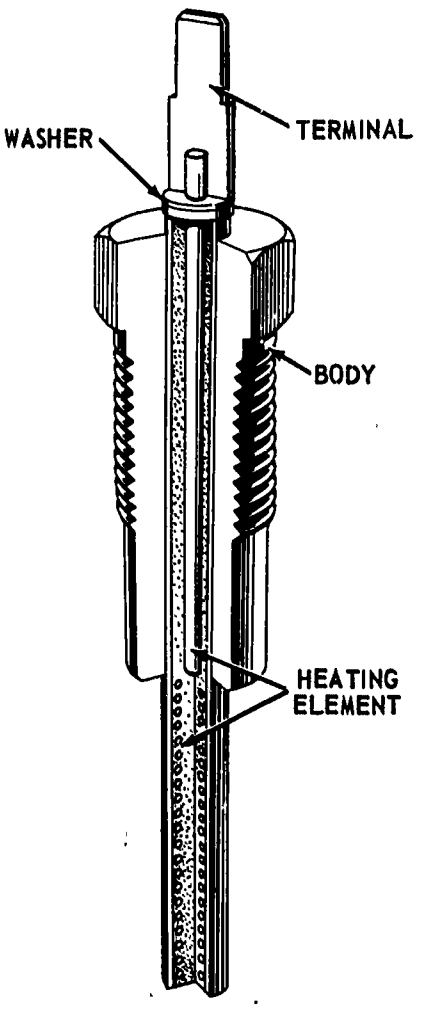


Fig. 35—Glow Plug for Diesel Engine

Some diesel engines have electrical pre-heating devices called glow plugs (Fig. 35). They are used as a starting aid when starting a cold engine and are mounted in the precombustion chamber of each cylinder.

TESTING GLOW PLUGS

Glow plugs are tested most accurately with the use of an ammeter.

1. Remove the wiring leads from all the glow plugs.

2. Connect the ammeter in series between the glow plug terminal and the lead wire.

3. A glow plug should be replaced if the amperage is either too low or too high. (See the machine specifications.)

Check each glow plug by this method. If all glow plugs check out to be too low, but the readings on them are equal, the starter switch or wiring harness is probably at fault.

TEST YOURSELF

QUESTIONS

1. What is the difference between a circuit breaker and a fuse? Which is used where heavy loads are instantly placed on the circuits? Which is normally replaced after it activates?

2. True or false? "Horns and buzzers are basically the same in design and operation and only differ in the sound they make."

3. Relays are electrical switches which _____ open and close a circuit. (Fill in the blank with "manually" or "automatically".)

4. True or false? "Switches can normally be repaired when they fail."

ANSWERS

1. A *circuit breaker* is a protective switch which trips when excess current passes through its circuit, and is reset manually or automatically. A *fuse* is a protective element which "blows out" when current gets too high. Circuit breakers are used where heavy loads are instantly placed on the current, while fuses are normally replaced after they activate.

2. True.

3. Automatically.

4. False. It is usually cheaper and safer to replace a switch than to repair it.

GENERAL MAINTENANCE / CHAPTER 8

INTRODUCTION

Maintaining the electrical system is not difficult—many of the components require little or no maintenance. However, there are parts that are extremely important, and some of these are often neglected. Regular maintenance takes little time and effort, and can prevent many problems.

Other chapters in this manual give you detailed descriptions of electrical components, as well as diagnosis and testing procedures. This chapter will be confined to regular maintenance—the care that will keep the system operating properly and insure a long service life.

STORAGE BATTERIES

The battery is the heart of the electrical system. It is perishable, but with the proper care you can keep it operating for the longest possible time.

Here are the most common causes of poor battery performance or failure:

- **Low electrolyte level**
- **Low specific gravity**
- **External damage, dirt, and corrosion**
- **Faulty connections**

Let's take a closer look at these.

CHECKING THE ELECTROLYTE LEVEL

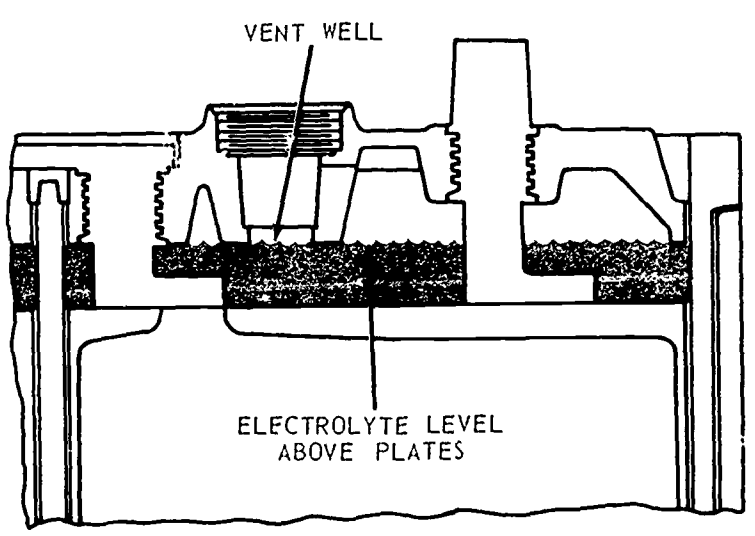


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Fig. 1—Proper Level of Battery Electrolyte

Once a week, or after 50 hours of operation, make sure the electrolyte level is above the battery plates (Fig. 1). If the level is low, add water to each cell until the level rises to the bottom of the split ring in the vent well.

IMPORTANT: If the battery electrolyte level is allowed to stay low, the charging circuit will not work properly. Also, the battery plates will dry, and permanent damage may result.

Don't add water you wouldn't drink! **If distilled water is available, use it.** But remember that even using hard water is better than allowing the electrolyte level to get low.

Don't overfill—you'll lose electrolyte.

CHECKING THE SPECIFIC GRAVITY

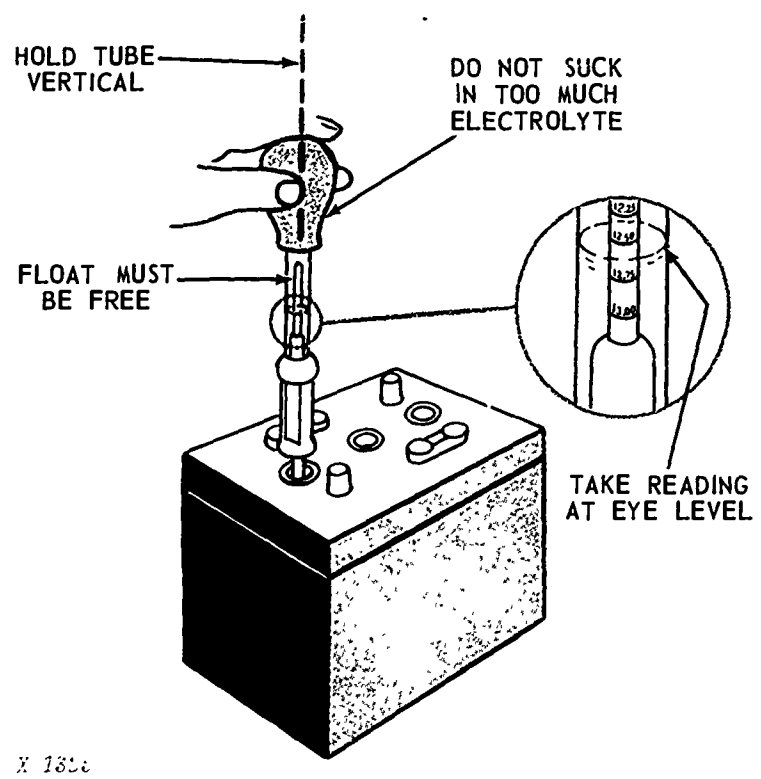

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Fig. 2—Checking the Specific Gravity

The specific gravity reading tells you the battery charge. Check periodically using an accurate hydrometer (Fig. 2). Readings should be from **1.215 to 1.270,** corrected per the electrolyte temperature as described in Chapter 3.

Never allow the specific gravity to fall below 1.215. Keep the battery at full charge to prevent sulfation and get longer service life.

On the other hand, don't overcharge the battery. A sign of this is when the battery uses too much water.

PREVENTING DAMAGE TO BATTERIES

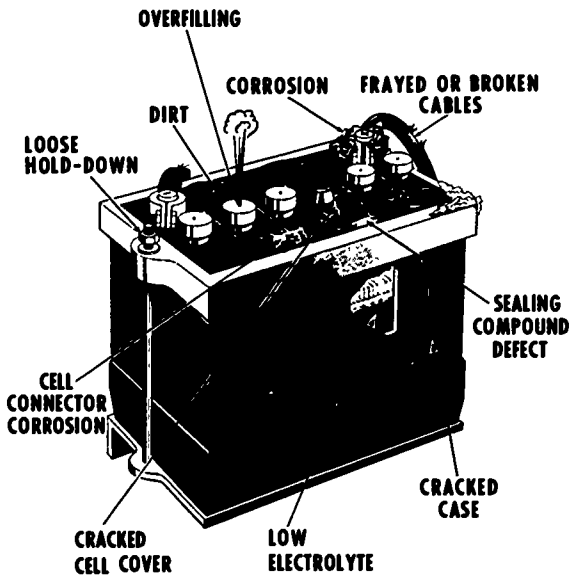


Fig. 3—Maintenance Problems with Batteries

When you service the battery, always check for external damage (Fig. 3). A broken case or cracked cell cover will result in battery failure. Battery hold-down clamps must be tight enough to hold the battery securely, yet not so tight as to warp the case.

KEEPING THE BATTERY CLEAN

If acid film and dirt are present on the top of the battery, current will flow between the terminals, causing slow discharge. Use dilute ammonia or baking soda and water solution to clean the battery, flush with clear water. But keep the vent plugs tight so that none of the solution gets into the cells.

REMOVING CORROSION

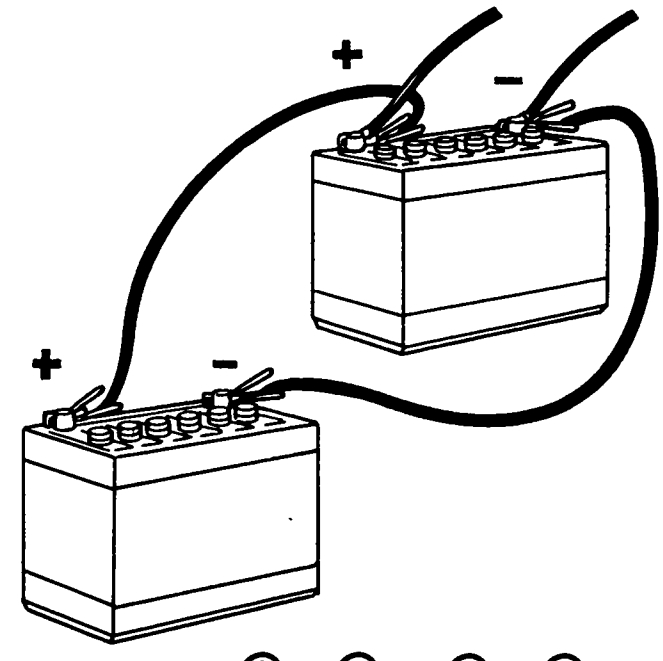
Corrosion on battery terminals will interfere with current flow. Remove with a wire brush. Don't overlook corrosion on the battery carrier—this will accelerate corrosion growth on the battery.

When disconnecting the battery cables for cleaning, disconnect the ground strap first to prevent arcing. After cleaning apply a coat of petroleum jelly to terminals and cable clamps to prevent further corrosion.

CHECKING THE BATTERY CONNECTIONS

Poor battery connections will impede the flow of current. Clamps should hold cables firmly to battery terminals. If necessary, remove some metal from the clamp jaws to insure a snug fit when tightened.

When connecting booster batteries, be sure to connect positive to positive poles, and negative to negative poles (Fig. 4).



X 1445 CONNECT ⊕ TO ⊕ AND ⊖ TO ⊖

Fig. 4—Proper Way to Connect Booster Batteries

D.C. CHARGING CIRCUITS

GENERATOR

For detailed description, testing, and servicing of the d.c. generator, refer to Chapter 4 of this manual.

Aside from periodic lubrication and keeping the drive belt in proper adjustment, the generator requires no regular maintenance.

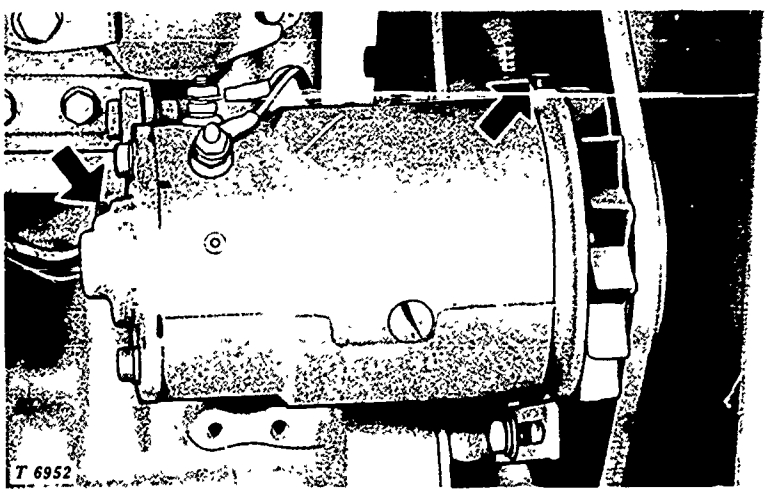


Fig. 5—Generator Oil Cups

Every 200 hours, add SAE 10W or SAE 5W-20 oil to both front and rear generator oil cups (Fig. 5). Only 8 to 10 drops are required. **Do not over lubricate!** This can cause more damage to electrical components than a lack of lubrication.

Don't forget to check the generator belt tension at this time (Fig. 6). The amount of flex at a certain tension is specified by the manufacturer.

Also note the condition of the belt. Excessive wear or glazing may mean replacement is necessary.

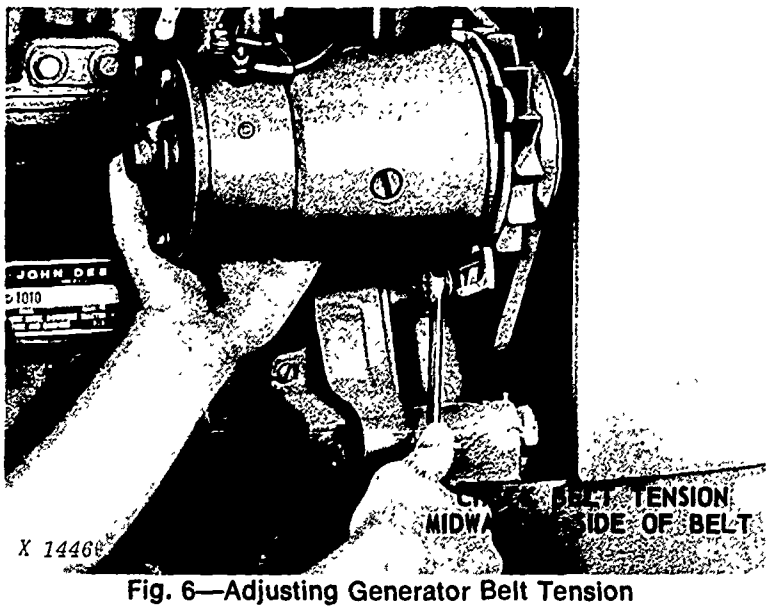


Fig. 6—Adjusting Generator Belt Tension

Remember that a V-belt shoud ride on the **sides** of the pulley grove—not on the bottom. If the belt bottoms in the pulley, it is either too tight or excessively worn.

If the generator brushes are visible, examine the commutator and brushes for dirt, oil, wear, and other defects.

REGULATOR

For complete instructions covering the generator regulator, refer to Chapter 4.

The regulator requires no periodic maintenance.

On a **d.c.** charging circuit, however, the **generator must be polarized** after the generator starting motor, or battery has been disconnected for any reason.

Before starting the engine, momentarily touch a jumper lead to both the "GEN" and "BAT" terminals of the regulator. This will establish correct polarity. Failure to do this may damage the regulator or the wiring.

A.C. CHARGING CIRCUITS

A.c. charging circuits are covered in detail in Chapter 4.

ALTERNATOR

Most alternators need no regular maintenance. Bearing lubricant is sealed in at the factory—no further lubrication is required.

Check the alternator fan belt for proper tension.

Also note whether belt is worn or glazed, or bottoming in the pulley, and replace belt if necessary.

Loose or slipping belts can cause the battery to run down.

REGULATOR

The regulator normally requires no maintenance. For service and testing, see Chapter 4.

SAFETY RULES FOR A.C. CHARGING CIRCUITS

To prevent damage to the a.c. or alternator charging circuit, remember:

1. Disconnect the battery ground straps when working on the alternator or regulator. Damage could occur if terminals are accidentally grounded.

2. NEVER POLARIZE THE ALTERNATOR. Never ground an alternator or regulator terminal, or connect a jumper wire to any terminal (unless recommended for a test).

3. If the alternator or regulator wiring is disconnected, connect it properly before connecting batteries.

4. Never disconnect or connect any alternator or regulator wiring with batteries connected or with alternator operating.

5. Always connect batteries or boosters in the correct polarity. Most a.c. electrical systems are NEGATIVE-grounded.

6. Don't use a battery charger as a booster to start the engine.

7. Never disconnect the batteries when the engine is running and the alternator is charging.

STARTING CIRCUITS

Periodically check for corroded or loose terminals on the starting motor. Most starting motors require no other regular maintenance. (Some models may have armature shaft wicks that need regular oiling.) See Chapter 5 for complete information.

IGNITION CIRCUITS

Ignition circuits are covered in detail in Chapter 6.

DISTRIBUTOR

Every 500 hours, check the condition of the distributor contact points. Rough or pitted contacts must be replaced when metal transfer is excessive.

Clean the points with a few strokes of a clean contact file. Don't try to remove all roughness—just scale or dirt. Never use emery cloth or sandpaper —particles will embed in the points and cause them to burn.

If the points are burned, find the cause before operating the machine. Contact point burning could be caused by one or more of the following:

- **Too-high voltage**
- **Presence of oil or other foreign material**
- **Defective condenser**
- **Improper point adjustment**

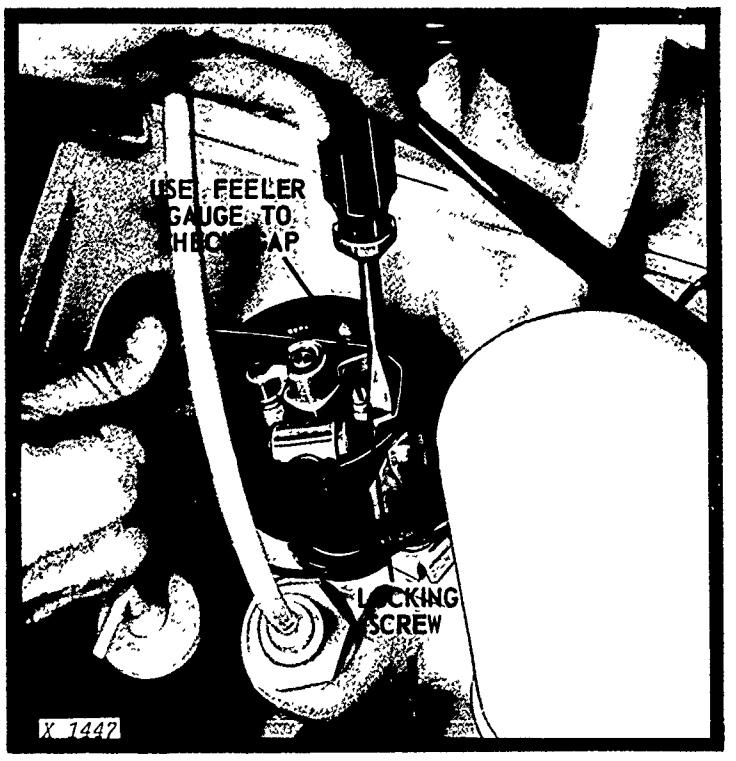


Fig. 7—Adjusting Distributor Point Gap

Check the distributor point gap periodically (Fig. 7). For the correct gap, see the machine Technical or Operator's Manual.

Also check the timing of the distributor. If it seems erratic, adjust as given in Chapter 6.

Inspect the distributor cap. If you find defects, replace the cap. Some of these defects are: cracks, chips, carbon tracks, worn or corroded tower inserts, or worn or damaged rotor button. If the cap is still serviceable, clean it before installing.

Periodically lubricate the distributor cam, using only a TRACE of cam lubricant or high-temperature grease. **Too much lubricant will ruin the distributor points.**

Some distributors also have an oil wick in the top of the cam (Fig. 8). In this case, place 4 or 5 drops of SAE 30 oil on the wick.

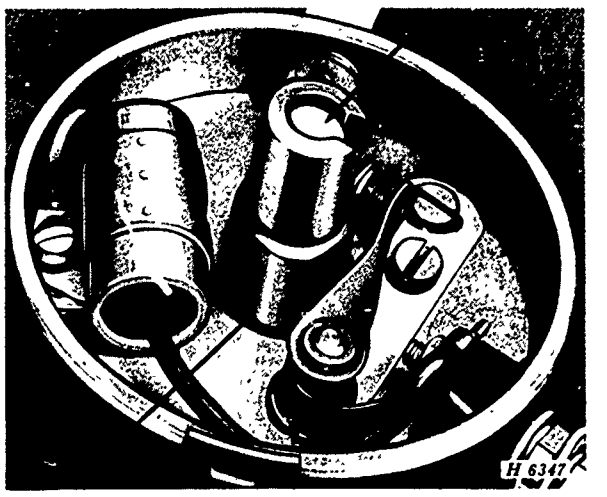


Fig. 8—Lubricating the Distributor

IGNITION COIL

Ignition coils don't require service—but check the coil for damage or carbon tracks.

SPARK PLUGS

For the complete story on spark plugs, refer to Chapter 6, which covers description, installation and testing.

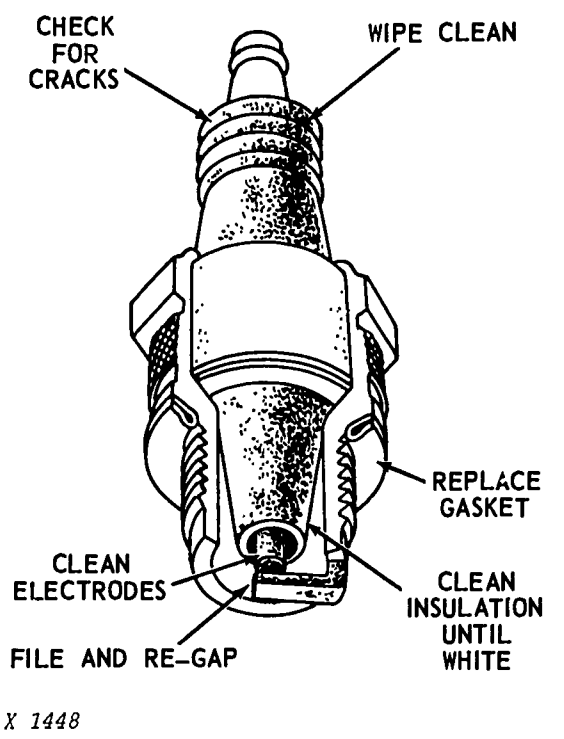


Fig. 9—Spark Plug Maintenance

Periodically check the external condition of the spark plugs (Fig. 9).

Look for carbon tracks or dirt which might contribute to poor performance.

If the ceramic insulator is cracked, the plug must be replaced.

When replacing plugs, remember:

- **Use the right plug.**
- **Gap the plug as specified.**
- **Install properly, using a new gasket.**
- **Tighten the plug to the specified torque.**

WIRING

When servicing electrical components, take the time to check all wiring.

Loose or corroded connections can contribute to poor performance, as can cracked or damaged insulation.

These conditions cause excessive voltage drops in the system because of high resistance.

Unless the connections are tight and wiring is in good condition, batteries may be undercharged and the spark plugs will misfire.

Also check the protective boots on the secondary ignition circuit. These can become cracked or oil-soaked, causing low ignition voltage. Carbon tracks inside the boots also permit current leakage. Replace faulty boots.

TEST YOURSELF

QUESTIONS

1. (Fill in the blanks.) When connecting booster batteries, connect positive terminals to _____ terminals.

2. True or false? "After disconnecting any part of the a.c. charging system, always polarize the alternator."

3. What difficulties can be caused by faulty wiring or poor connections?

4. Why is it necessary to remove acid film and dirt from the battery top? Why remove corrosion?

ANSWERS

1. Positive.

2. False. NEVER polarize an alternator. On the other hand, a d.c. generator-equipped system MUST be polarized.

3. Faulty wiring or poor connections cause high resistance and excessive voltage drop. Batteries will not charge properly, and spark plugs may not fire.

4. Acid film and dirt on the battery will allow current to leak between terminals. Corrosion will impede current flow to the system.

DIAGNOSIS AND TESTING OF ELECTRICAL SYSTEMS / CHAPTER 9

INTRODUCTION

"We've had some faulty regulators lately, so that must be your problem. We'll replace the regulator!"

"I don't really see what the owner's maintenance program has to do with trouble shooting!"

"I never talk to the operator. He might know more about electrical systems than I do."

Here are three statements you might hear from "experienced" trouble shooters in a shop. Then again, maybe they aren't trouble shooters.

Regulator problems on the last job do not mean that the regulator is bad in every situation. What if the alternator had failed or a wiring lead was broken? The customer cannot afford the time and expense of replacing parts when he's not sure the part is bad or requires replacement. That first quotation above wasn't made by a trouble shooter —it was made by a hit-or-miss parts replacer.

Is maintenance a key to trouble shooting? It certainly is. Problems are soon caused if the electrolyte level in a battery is never checked, or if the generator drive belt tension is never checked. The second quotation above couldn't have been made by a trouble shooter, because he is overlooking the effects of poor maintenance.

What was being done when the equipment broke down? Is the problem erratic, or does it happen every time? What was done after the breakdown? These are a few of the questions that can be answered by talking to the operator. These answers help the trouble shooter to recreate the problem and accurately diagnose the cause. The third quotation was not made by a trouble shooter either. In fact, he doesn't even know the system he's working on.

Then what is a good trouble shooter?

Before answering this, let's realize that the electrical systems of today require diagnosis and testing at a minimum of cost. Equipment breakdown means a loss of time and money for the operator-owner, and we cannot expect the owner to absorb the extra cost due to poor trouble shooting.

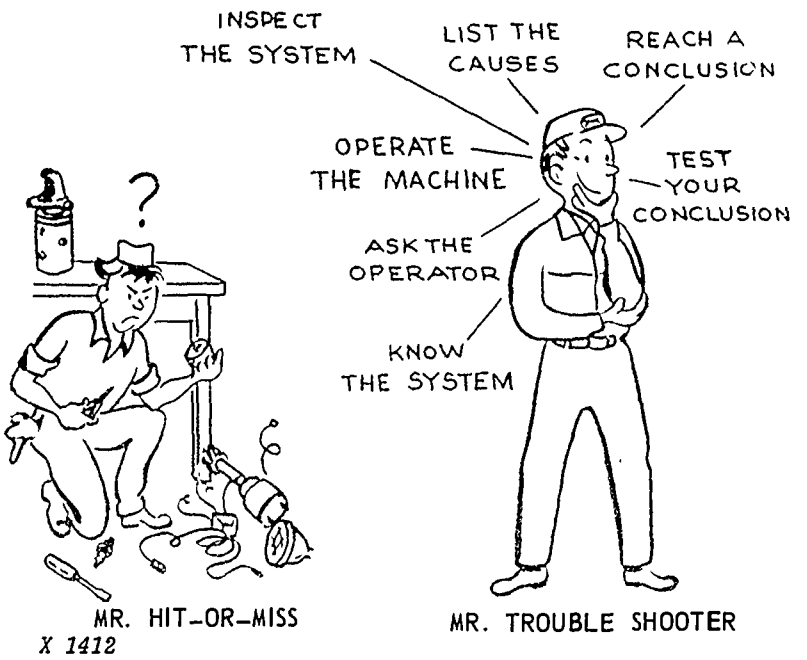


Fig. 1—Which Would You Rather Be?

So a good trouble shooter starts out by using *common sense*. He gets all the facts and examines them until he has pin-pointed the trouble. Then he checks out his diagnosis by testing it. And only then does he start replacing parts.

With the complex systems of today, diagnosis and testing is the only way.

SEVEN BASIC STEPS

A good program of diagnosis and testing has seven basic steps:

1. **Know the System**
2. **Ask the Operator**
3. **Inspect the System**
4. **Operate the Machine (If Possible)**
5. **List the Possible Causes**
6. **Reach a Conclusion**
7. **Test Your Conclusion**

We now have a formula for a trouble shooter:

TROUBLE SHOOTER = COMMON SENSE + SEVEN BASIC STEPS.

Now let's see what these seven basic steps mean.

1. KNOW THE SYSTEM

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Fig. 2—Know the System

In other words, do your homework. Find out all you can about the machine's electrical system. Is it a positive or negative-grounded system? Is the starting system 12 or 24 volts? Answers to these and many other questions are in the machine Technical Manual. Study this manual, especially the diagrams of the system. Schematics are an important tool—you should know how to read them. The glossary at the end of this book explains the various terms and symbols used in electrical diagrams. Study them and be able to recognize them at a glance.

Be familiar with the key specifications for the system, given at the end of each section or group in the machine Technical Manual.

Keep up with the latest service bulletins. Read them and then file. The problem on your latest machine may be in this month's bulletin, giving the cause and remedy.

You can be prepared for any problem by knowing the system.

2. ASK THE OPERATOR

A good reporter gets the full story from a witness —the operator.

What work was the machine doing when the trouble was noticed? Is the trouble erratic or consistent? What did the operator do after the breakdown? Did he try to fix the trouble himself?

These are just a few of the many questions a good trouble shooter will ask the operator. Often a passing comment by the operator will provide the key

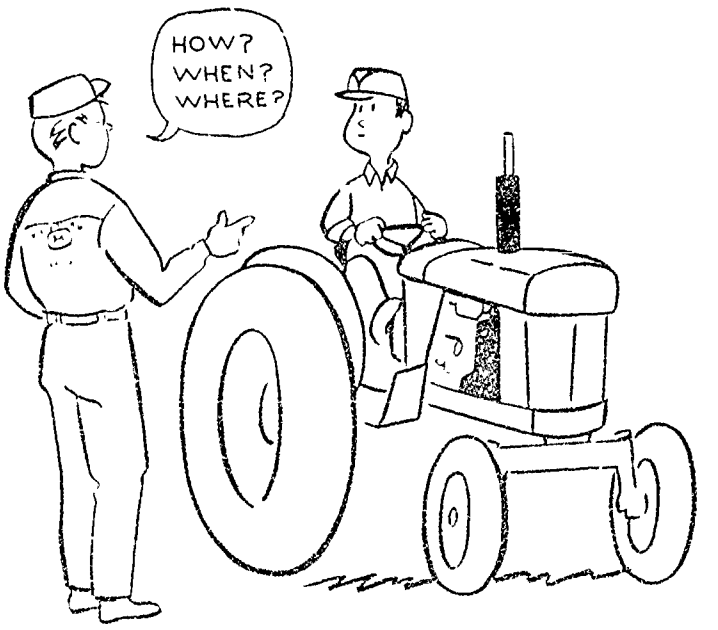

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Fig. 3—Ask the Operator

to the problem. For example, he may have tried to adjust or repair some of the electrical system components. Perhaps he attempted to "jump start" the machine and damaged the alternator, or reversed the polarity of the system.

Ask about how the machine is used and when it was serviced. Many problems can be traced to poor periodic maintenance programs or abuse to the machine.

3. INSPECT THE SYSTEM

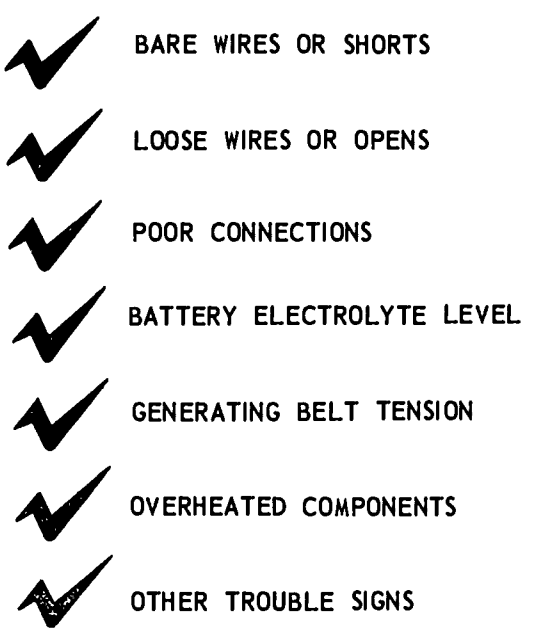

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Fig. 4—Checklist for Inspecting the Electrical System

Carefully inspect the electrical components for "tips" on the malfunction. Check to see if the machine can be operated without further damaging the system.

Always check these items before turning on switches or running the machine:

- *Look for bare wires that could cause grounds or shorts and dangerous sparks. Shorted wires can damage the charging system.*
- *Look for loose or broken wires. In the charging system, they can damage the regulator.*
- *Inspect all connections, especially battery connecting points. Acid film and dirt on the battery may cause current flow between the battery terminals, resulting in current leakage. Check the battery ground strap for proper connection.*
- *Check the battery electrolyte level. Continued loss of electrolyte indicates overcharging.*
- *Check the generator or alternator drive belt tension.*
- *Inspect for overheated parts after the machine has been stopped for awhile. They will often smell like burnt insulation. Put your hand on the alternator or regulator. Heat in these parts when the machine has not been operated for some time is a sure tip-off to charging circuit problems.*

In general, look for anything unusual.

Many electrical failures cannot be detected even if the machine is started. Therefore, a systematic and complete inspection of the electrical system is necessary.

Many times the problem can be detected without turning on the switch or starting the machine.

While inspecting the electrical system, make a note of all trouble signs.

4. OPERATE THE MACHINE (IF POSSIBLE)

If your inspection shows that the machine can be run, first turn the starting switch to the accessory position. Try out the accessory circuits—lights, cigarette lighter, etc. How do each of these components work? Look for sparks or smoke which might indicate shorts.

Turn the starting switch to the "on" position. The indicator lights should glow. (Some lights will also glow when the switch is in the "start" position.)

Now start the machine. Check all gauges for good operation, and see if the system is charging or discharging.

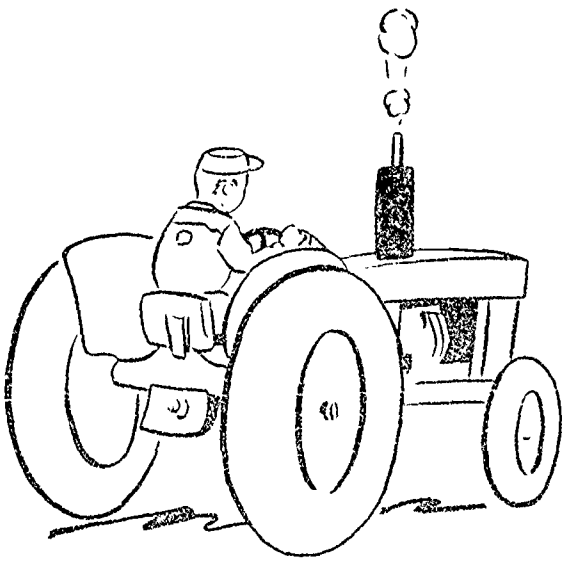

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Fig. 5—Operate the Machine (If Possible)

5. LIST THE POSSIBLE CAUSES

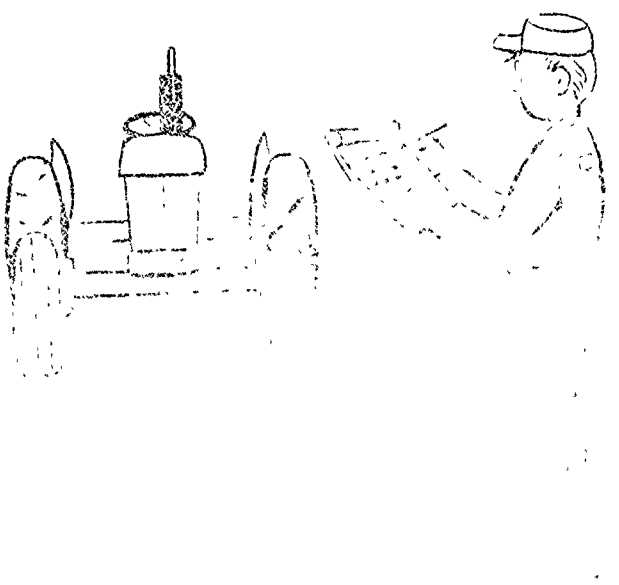

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Fig. 6—List the Possible Causes

Now we are ready to make a list of the possible causes.

What were the signs you found while inspecting the machine? What is the most likely cause?

Are there other possibilities? Remember that one failure often leads to another.

6. REACH A CONCLUSION

Look over your list of possible causes and decide which are most likely and which are easiest to verify.

Use the Trouble Shooting Charts at the end of this chapter as a guide.

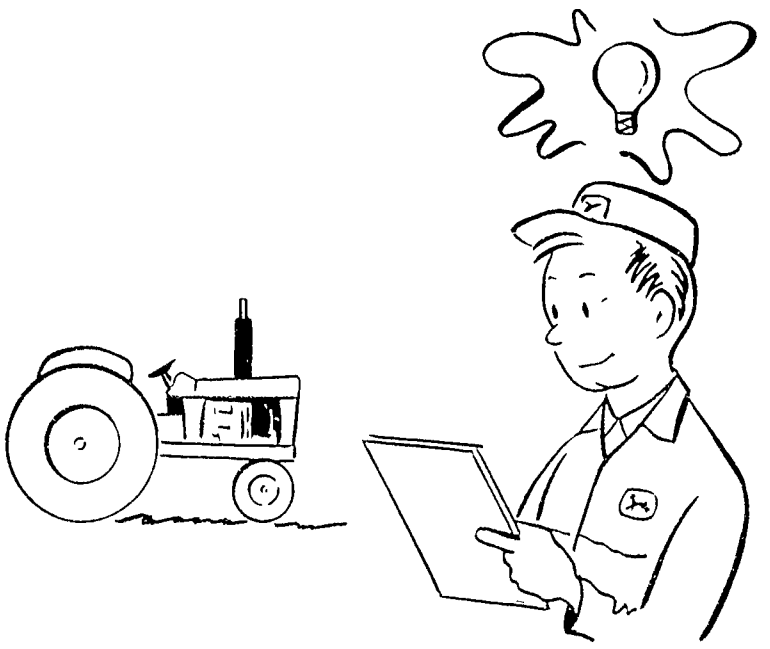

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Fig. 7—Reach a Conclusion

7. TEST YOUR CONCLUSION

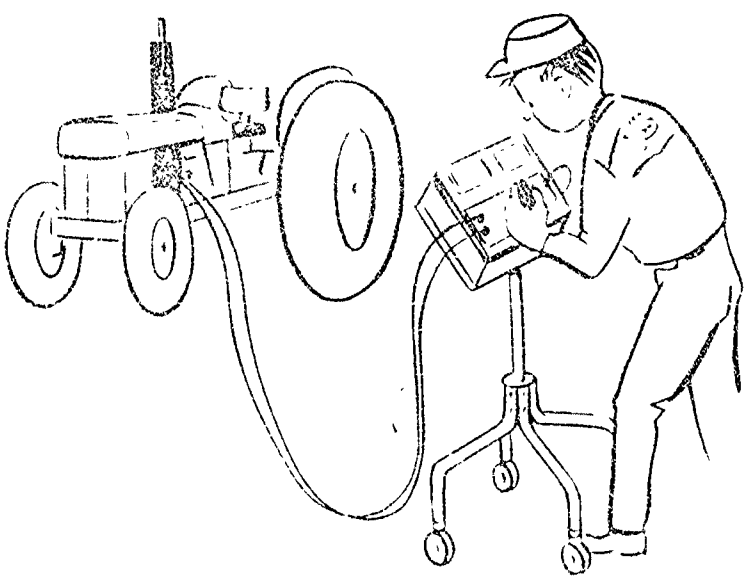

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Fig. 8—Test Your Conclusion

Before you repair the system, test your conclusions to see if they are correct.

Many of the items can probably be verified without further testing. Maybe you can isolate the problem to a particular circuit, but not to an individual component. This is where test instruments will help you further isolate the trouble spot.

The next part of this chapter will tell you how to test the system and locate troubles.

But first let's repeat the seven rules for good trouble shooting:

1. **Know the System**
2. **Ask the Operator**
3. **Inspect the System**
4. **Operate the Machine (If Possible)**
5. **List the Possible Causes**
6. **Reach a Conclusion**
7. **Test Your Conclusion**

TESTING THE SYSTEM

The use of electrical test equipment is most effective after the failure has been isolated to a particular circuit in the system.

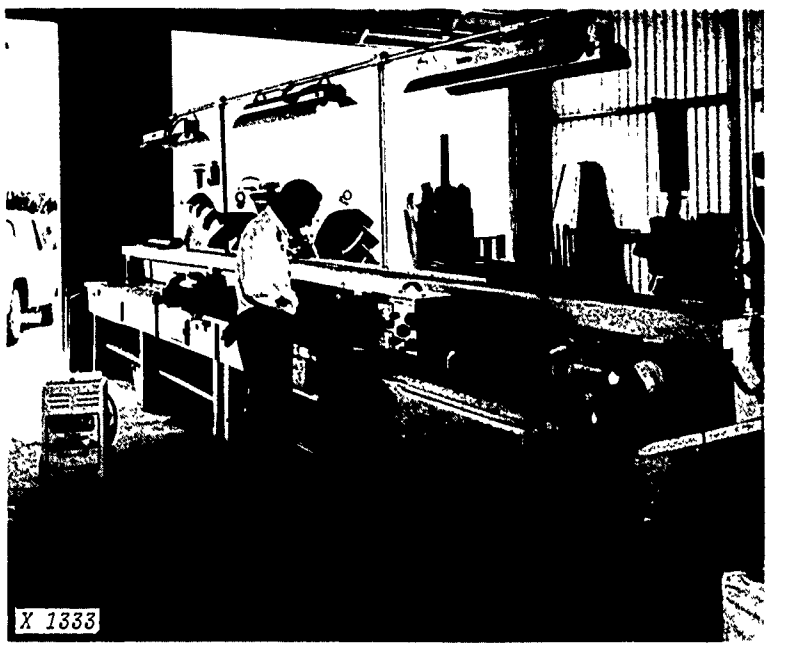

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Fig. 9—Electrical Testing in a Dealer Shop

Chapter 2 lists all the test equipment required to test circuits and components. Instruction manuals are also furnished with these special tools. Study this information and take all precautions. Improper use of test equipment can damage the electrical components.

Other chapters of this manual have sections on testing of components and circuits:

Chapter 3—Storage Batteries

Chapter 4—Charging Circuits

Chapter 5—Starting Circuits

Chapter 6—Ignition Circuits

Chapter 7—Lighting and Accessory Circuits

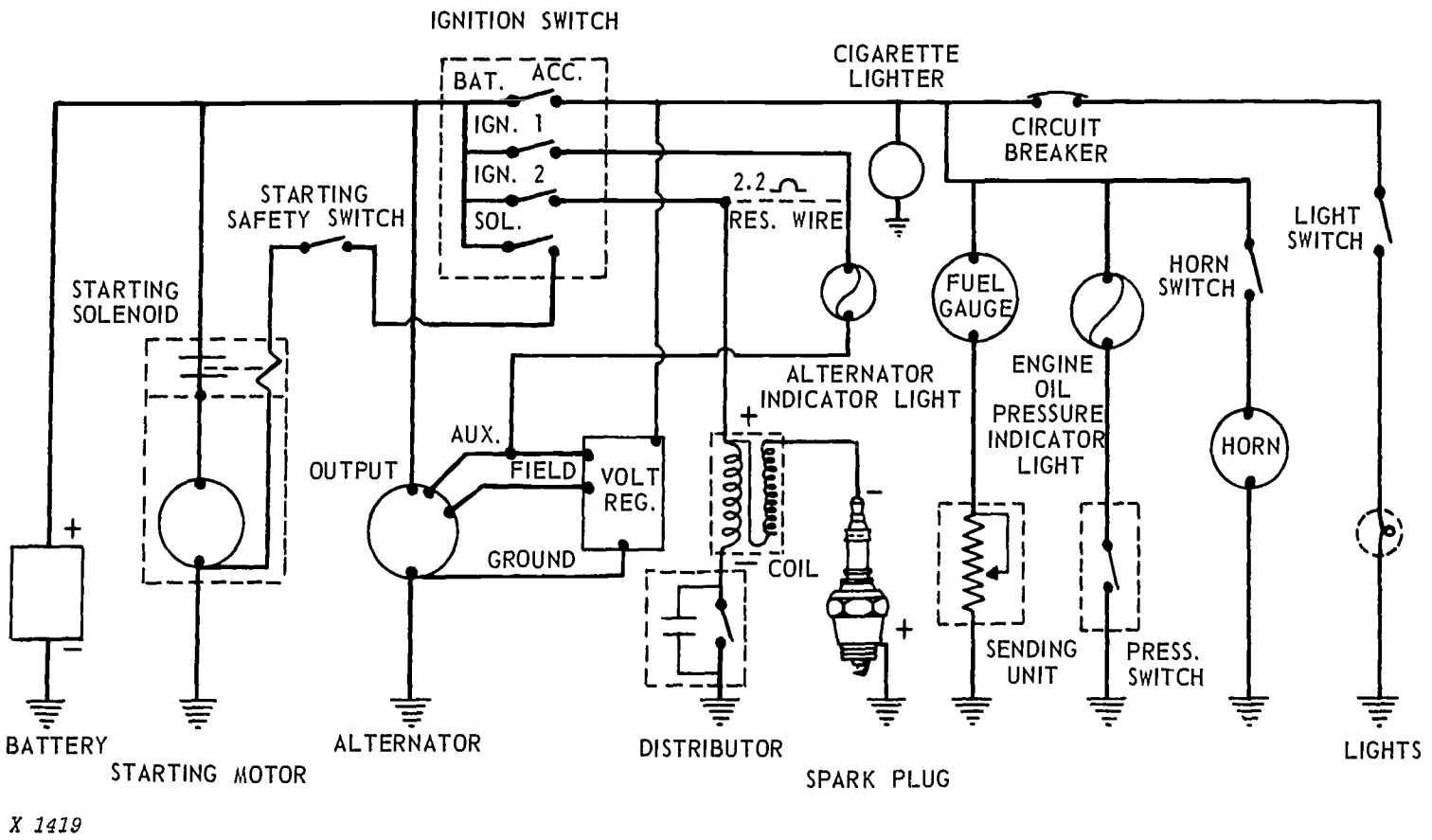

Fig. 10—Layout of "Problem" Electrical System

REMEMBER THE BATTERY!

The battery is a prime factor in each circuit of any electrical system. However, it is often overlooked while trouble shooting the system.

Before you begin most circuit tests, remember to do the following.

- **Check battery electrolyte level.**
- **Look for corroded terminals.**
- **Check for acid film and dirt on top of battery.**
- **Check battery polarity.**
- **Test the charge of the battery.**

For all battery tests, see Chapter 3.

TESTING PROCEDURES

Most problems with electrical systems require the same basic reasoning. Let's see how a good trouble shooter approaches an electrical problem and isolates the cause.

A sample problem is given below, and a schematic of the system is shown in Fig. 10.

Problem

When the serviceman arrived on the scene, the first thing he did was locate the operator, ask him what had happened, and if he had noticed anything unusual about the machine's operation.

"The battery was 'run-down' yesterday morning after the machine had been idle overnight," said the operator. "So we started it with a slave battery. The alternator indicator light was okay—it stayed off during operation. We started the unit several times during the day without a slave battery. But this morning we tried to start it and it was discharged again."

After talking to the operator, the serviceman felt that a visual inspection would be helpful since the unit had not yet been started.

As he checked the battery, he noticed that the electrolyte level was only slightly low. The battery terminals were not corroded and all connections were tight. Further inspection of the wiring did not provide any clues, either.

Before starting the unit the serviceman checked the charging circuit. When he placed his hand

on the alternator he had a clue. The alternator was warm. Not extremely hot or smoking, just moderately warm. This could possibly be the cause of the problem. A warm alternator in a case like this could mean that current is flowing in the alternator field circuit.

Since there didn't seem to be anything unusual that would hinder starting, the serviceman made an operational check of the unit. During this check he kept in mind the warm alternator.

When he turned the starting switch on and checked the dash gauges, the engine oil pressure light was on, but it was very dim. This could be expected, since battery voltage was low. However, the alternator indicator light was out. This could be another clue to the malfunction. If the alternator light was out, current might be flowing in the charging circuit.

The service man asked the operator if he had noticed whether or not the light came on at all while starting. He hadn't noticed. But, even if it didn't come on, the machine still operated.

At this point the serviceman felt that he could make a tentative conclusion. He knew that a shorted isolation diode in the alternator would discharge the battery even if the machine was idle. Also, he had two exact clues to a shorted diode: *1) the warm alternator, and 2) the indicator light that would not light.*

To test his conclusion, the serviceman turned the switch off and, using a voltmeter, found that there was battery voltage at the alternator auxiliary terminal. (See Fig. 10.) This condition is not normal and is usually caused by a shorted isolation diode.

To clearly pinpoint the isolation diode as the problem, the serviceman asked the operator to start the machine.

Using a slave battery, he checked the voltage drop across the isolation diode. During normal operation there is a 1-volt drop across this diode. However, the test indicated no voltage drop at all.

This confirmed the serviceman's conclusion and pinpointed the trouble. He replaced the isolation diode and then rechecked the voltage. The reading was normal, so the problem was corrected.

After correcting the problem, the serviceman made a second inspection of the charging circuit to be sure that other parts were not damaged.

He then checked out the battery before starting the unit and returning it to normal operation.

Summary

Did you notice how the serviceman used the seven basic trouble shooting steps? Let's review the sequence of the story and look for these steps.

The first thing the trouble shooter did was to **Ask the Operator.** He kept in mind the machine operation and the symptoms of the malfunction. The trouble shooter did not assume the operator was correct, but tactfully double checked the operator's comments. Checking the indicator light was a good example of this.

The trouble shooter then **Inspected the System,** for it was during this inspection that he got his first clues to the problem. To show the importance of inspecting the system, notice that the trouble shooter was able to reach a tentative conclusion without even starting the machine.

While inspecting the system, the trouble shooter checked on whether he could **Operate the Machine** without further damage. Although he did not actually start the unit, he knew that it could be successfully and safely started.

There are many ways of **Listing Possible Causes.** This trouble shooter made a mental list as he came across clues to the malfunction.

We should also point out that the trouble shooter **Knew the System.** When he same upon a clue, he was able to recognize the cause and effect as well as how one symptom was related to another. Because of his knowledge of the system, the trouble shooter was able to reach a tentative conclusion from his clues.

The last of our seven basic steps is **Testing Your Conclusion.** The trouble shooter did not assume that his first test had pinpointed the cause. He made an extra test to satisfy himself that there was only one trouble spot and that it was definitely the cause of the trouble. Only after getting positive proof did he replace the isolation diode.

We can see from the example that the **seven basic steps** fall easily into place during trouble shooting. Proper trouble shooting can save the machine owner time and money. The time spent in replacing many parts suspected of being faulty can be better utilized in diagnosis. Through proper diagnosis, the trouble spot can be quickly identified. Then time can be spent in correcting the problem without wasting time and money.

TROUBLE SHOOTING CHARTS

Use the charts on the following pages to help in listing all the possible causes of trouble when you begin diagnosis and testing of the electrical system.

Once you have located the cause, check the item in the chart again for the possible remedy.

When you have pinpointed the problem to one circuit or component, refer to the other chapters of this manual for more details.

The Technical Manual for each machine supplements all these charts by giving more detailed and specific causes and remedies.

BATTERIES

LOW BATTERY OUTPUT

High Resistance in Circuit.
Check for resistance with voltmeter. See machine Technical Manual for maximum permissible voltage drop.

Low Electrolyte Level.
Add distilled water to proper level.

Low Specific Gravity.
See "Undercharged Battery."

Defective Battery Cell.
Replace battery.

Cracked or Broken Battery Case.
Replace battery.

Low Battery Capacity.
Always replace battery with one of adequate capacity.

BATTERY USES TOO MUCH WATER

Cracked Battery Case.
Replace battery.

Overcharged Battery.
See "High Charging Circuit Voltage." (A shorted cell in a 24-volt system may cause other batteries to be overcharged.)

LOW BATTERY CHARGE

Excessive Loads from Added Accessories.
Remove excessive loads.

Excessive Engine Idling.
Idle engine only when necessary.

Lights or Acessories Left On.
Be sure electrical switches are off before leaving machine.

Continuous Drain on Battery.
Check for leakage on dirty battery top. Disconnect battery ground and connect voltmeter between the ground battery terminal and a good ground. (On a 24-volt split-load system, also place voltmeter in the series connection between batteries to test for defective circuits that are not grounded. Disconnect circuits until ground or shorted component is located.)

Faulty Charging Operation.
See "Low Charging Circuit Voltage" or "Low Charging Circuit Output."

CHARGING CIRCUITS

LOW CHARGING CIRCUIT VOLTAGE

High Resistance in Charging Circuit Connections.
Check voltage drop to locate resistance. Be sure to use pin connector at battery to locate resistance between battery post and battery cable.

Defective Wiring.
Check voltage drop in wire to locate broken wire strands or undersized replacement wire.

Low Amperage Output of Generator or Alternator.
See "Low Charging Circuit Output."

Poor Regulator Ground.
Clean regulator ground connection.

Dirty Voltage Regulator Contact Points.
Clean points or replace regulator. (Broken resistors will cause excessive pitting of contact points.)

Regulator Out of Adjustment.
Adjust to specifications.

Dirty Cutout Relay Points.
Clean points or replace regulator.

Defective Regulator.
Replace regulator.

Open-Circuited Isolation Diode in Alternator.
Replace isolation diode assembly.

LOW CHARGING CIRCUIT OUTPUT

Slipping Drive Belts.
Adjust belt tension.

Excessively Worn or Sticking Brushes.
Repair or replace. Check commutator or slip rings.

Dirty or Out-of-Round Commutator or Slip Rings.
Clean commutator or slip rings.

Grounded Field Circuit (24-Volt, Split-Load System).
Repair or replace defective component.

NOTE: This defect places continuous drain on battery.

Dirty Current Regulator Contact Points.
Clean points or replace regulator.

Defective Diodes in Alternator.
Replace diode or diode plate assembly.

Defective Electrical Windings in Generator or Alternator.
Repair or replace windings. (If alternator stator windings are defective, be sure regulator will control alternator voltage.)

HIGH CHARGING CIRCUIT VOLTAGE

Grounded Generator Field Wire or Field Terminal.
(Does not apply to 24-volt generator on split-load system.)

Repair or replace wire or terminal.

High Resistance at Alternator-Regulator Connections.
Clean and tighten connections.

Defective Alternator Regulator.
Replace regulator.

Faulty Regulator.
Check and clean voltage regulator points is necessary. Adjust voltage regulator. Replace regulator if it does not respond to adjustment.

EXCESSIVE GENERATOR OUTPUT (A.C. CIRCUITS)

Grounded Generator Field Wire or Field Terminal.
(Does not apply to 24-volt generator on split-load system.)

Repair or replace wire or terminal.

Faulty Current Regulator in Generator Regulator.
Check and clean current regulator points if necessary. Adjust current regulator. Replace regulator if it does not respond to adjustment.

NOISY GENERATOR OR ALTERNATOR

Defective or Badly Worn Drive Belt.
Replace belt. Adjust to proper tension.

Generator Brushes Not Seated.
Seat brushes with No. 00 sandpaper or brush seating stone.

Generator Commutator Needs Reconditioning.
Turn and undercut commutator.

Worn or Defective Bearings.
Replace bearings.

Loose Mounting or Loose Drive Pulley.
Tighten mounting and pulley.

Misaligned Drive Belt or Pulley.
Check pulley condition. Align pulley.

Alternator Rectifier Shorted or Open.
Replace diode or diode plate assembly.

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BUZZING IN ALTERNATOR-REGULATOR FIELD RELAY (A.C. CIRCUITS)

Open Negative Diode in Alternator Causing Reduced Voltage to Relay Winding.
Replace rectifier assembly.

STARTING CIRCUITS

SLUGGISH STARTING MOTOR OPERATION

Low Battery Charge.
Charge battery and check specific gravity. If battery does not respond to charging, install a new one.

High Resistance in Circuit.
Clean and tighten all connections. Repair or replace faulty wiring.

Defective Starting Motor.
Service and repair starting motor where necessary.

Starting Motor Bearings Dry.
Lubricate bearings with oil of proper viscosity.

Excessive Engine Drag Due to Tight Bearings.
Recheck engine overhaul procedures. If problem still exists after break-in period, test and service starting circuit.

Extremely Cold Weather.
Warm up engine or battery before starting the engine.

Too-High Engine Oil Viscosity.
Drain oil and replace with lower viscosity oil as recommended.

STARTING MOTOR WILL NOT OPERATE

Low Battery Charge.
Charge battery and check specific gravity. If battery does not respond to charging, install a new battery.

Starter Safety Switch Open.
Put shift lever in neutral or park position.

Improperly Adjusted or Defective Starter Safety Switch.
Adjust or replace switch.

Defective Starting Switch.
Replace switch.

High Resistance in Starting Circuit or Defective Wiring.
Clean and tighten all connections and replace faulty wiring.

Faulty Solenoid Switch on Starting Motor.
Repair or replace switch.

Faulty Starting Motor.
Service and repair motor.

STARTING MOTOR SOLENOID SWITCH FLUTTERS

Low Battery Charge.
Charge battery and check specific gravity. If battery does not respond to charging, install a new battery.

High Resistance in Circuit.
Clean and tighten all connections and replace faulty wiring.

Open Circuit in Starter Solenoid Hold-in Winding Circuit.
Repair or replace solenoid or wires.

IGNITION CIRCUITS

MISFIRING OF ENGINE

Improper Spark Plugs Heat Range.
Replace with "hotter" or "colder" plugs as required.

Worn Spark Plug Electrodes or Dirty Spark Plugs.
Clean, file and regap plugs. Replace if necessary.

Defective Spark Plug.
Replace Spark Plug.

Incorrect Distributor Timing.
Reset timing.

Insufficient High-Tension Voltage Available to Spark Plug.
See "Low Available Voltage at Spark Plug," below.

Cold Starting Conditions.
Warm engine or battery before starting.

LOW AVAILABLE VOLTAGE AT SPARK PLUG

Worn or Improperly Spaced Distributor Points.
Reset point gap.

Dirty, Burned, or Pitted Points.
Clean or replace points.

Defective Condenser (Leakage, Shorts, High Resistance, or Wrong Capacity).
Replace condenser.

Dirt or Moisture in Distributor Cap.
Clean distributor cap.

Cracked Rotor or Distributor Cap.
Replace cap or rotor.

Too-Wide Distributor Rotor Gap.
Replace rotor. Replace cap if deep path is worn on contacts.

Paint Covering Ignition Cables.
Remove paint. Replace defective wiring if necessary.

Faulty Spark Plug Cables.
Replace faulty cables.

Defective Ignition Coil.
Replace coil.

Loose Coil Tower—High Tension Cable or Primary Coil Leads.
Clean and tighten all connections. Replace faulty wiring.

Cracked Coil Cap or Carbon Tracks on Cap.
Clean and tighten all connections. Replace faulty parts.

Defective Wiring.
Check all connections. Replace faulty wiring.

Low Battery Charge.
Charge battery and check specific gravity. If battery does not respond to charging, install a new battery.

High Resistance in Resistor Wire to Coil.
Replace resistor wire.

BROKEN OR CHIPPED DISTRIBUTOR CAP

Cocked Distributor Cap.
Replace distributor cap and install correctly.

HIGH-RESISTANCE CORROSION ON DISTRIBUTOR CAP TERMINALS

Arcing Inside the Cap Tower Due to Exposed Leads.
Push all leads snugly into cap towers.

FLUTTER OR "FANNING" OF IGNITION TIMING MARKS WHEN TIMING

Excessive Wear in Bushing or Distributor Drive Train.
If flutter exceeds 3 degrees, replace worn parts.

BUILD-UP OF MATERIAL ON DISTRIBUTOR POINTS

Over-Capacity Condenser: *Causes build-up of metal on stationary contact with negative-grounded battery, or on movable contact with positive-grounded battery.*

Replace with condenser of proper capacity.

Under-Capacity Condenser: *Causes build-up of metal on movable contact with negative-grounded battery, or on stationary contact with positive-grounded battery.*

Replace with condenser of proper capacity.

EXCESSIVE WEAR ON DISTRIBUTOR CONTACT POINTS

Improper Method of Cleaning Points.
Use contact file, crocus cloth, or lint-free tape to clean points.

EXCESSIVELY CONTAMINATED DISTRIBUTOR POINTS

Improper Cam Lubricant or Too Much Lubricant.
Use proper amount of specified lubricant.

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Excessive Lubrication of Breaker Plates or Distributor Advance Mechanism.
Use proper amount of lubricant.

Clogged Oil Filter Breather Cap.
Clean breather cap.

Clogged Filters in Crankcase Vent Pipe.
Clean filters.

Worn Drive Shaft Bushing Letting Oil Fumes Enter Distributor.
Replace bushing.

ARCING AND BURNING OF DISTRIBUTOR CONTACT POINTS

Loose Lead or High Internal Resistance in Condenser.
Tighten lead or replace condenser.

Improper Method of Cleaning Distributor Points.
Use proper contact file and polish with stone or crocus cloth. Use lint-free tape to clean parts.

Points Improperly Adjusted.
Readjust points.

Oil or Other Foreign Material on Contacts.
Clean and remove all foreign material. Correct the cause (see "Excessively Contaminated Distributor Points").

High Voltage Due to Faulty or Improperly Adjusted Voltage Regulator.
Adjust voltage regulator. Replace unit if faulty.

Shorted By-Pass Resistor.
Replace resistor.

DAMAGE TO METAL TERMINALS IN DISTRIBUTOR CAP DUE TO ARCING

Ignition Cable Leads Loose.
Clean terminals. Push leads snugly into cap towers. Replace cap if erosion is severe.

LIGHTS AND ACCESSORIES

DIM LIGHTS

High Resistance in Circuit or Poor Ground on Lights.
Clean and tighten all connections. Replace faulty wiring.

Low Battery Charge.
Charge battery and check specific gravity. If battery does not respond to charging, install a new battery.

Defective Light Switch or Starting Switch.
Replace switch.

Defective Battery Ground Wire (24-Volt Split-Load System).
Repair or replace ground wire.

LIGHTS BURN OUT PREMATURELY

Excess Voltage Due to Faulty Regulator or Ground Wire on Alternator or Generator "F" Terminal.
Adjust or replace regulator. Replace faulty wiring.

Defective Battery Ground Wire (24-Volt Split-Load System).
Repair or replace ground wire.

GENERATOR OR ALTERNATOR INDICATOR LAMP GLOWS DIMLY OR INTERMITTENTLY

Excessive Resistance in Battery Lead to Generator Regulator.
Clean and tighten all connections. Replace faulty wiring.

Excessive Internal Resistance in Generator Regulator.
Clean and adjust cutout relay contact points.

Excessive Internal Resistance in Alternator Regulator.
Replace regulator.

Defective Generator or Alternator.
Service or replace unit.

OIL PRESSURE INDICATOR LAMP WILL NOT LIGHT

Burnt-Out Bulb.
Replace bulb.

Open Circuit or Excessive Resistance in Wiring.
Clean and tighten all connections. Replace faulty wiring.

Defective Lamp Body.
Replace lamp body.

Faulty Oil Pressure Switch.
Replace switch.

OIL PRESSURE LAMP REMAINS ON WITH STARTING SWITCH OFF

Defective Lamp Body.
Replace lamp body.

Grounded Wire to Oil Pressure Switch.
Repair or replace wiring.

Faulty Oil Pressure Switch.
Replace switch.

TEST YOURSELF

QUESTIONS

1. Give the seven basic steps for good trouble shooting.

2. During which of the seven steps should you begin replacing parts?

3. What electrical component should be checked out even before testing most circuits?

ANSWERS

1. 1) Know the system, 2) Ask the operator, 3) Inspect the system, 4) Operate the machine, 5) List the possible causes, 6) Reach a conclusion, and 7) Test your conclusion.

2. During *none* of these steps. Do all these things *before* you start repairing the system.

3. The *battery*. It is a prime factor in all the circuits and must be in good order or the whole-system will be affected.

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DEFINITIONS OF TERMS AND SYMBOLS

A

ALTERNATOR—A device which converts mechanical energy into electrical energy. For details, see Chapter 4 on "Charging Circuits."

ALTERNATING CURRENT (A.C.)—A flow of electrons which reverses its direction of flow at regular intervals in a conductor.

AMMETER—An instrument for measuring the flow of electrical current in amperes. Ammeters are usually connected in series with the circuit to be tested.

AMPERE—A unit of measure for the flow of current in a circuit. One ampere is the amount of current flow provided when one volt of electrical pressure is applied against one ohm of resistance. The ampere is used to measure electricity much as "gallons per minute" is used to measure water flow.

AMPERE-HOUR—A unit of measure for battery capacity. It is obtained by multiplying the current (in amperes) by the time (in hours) during which current flows. For example, a battery which provides 5 amperes for 20 hours is said to deliver 100 ampere-hours.

ARMATURE—The movable part of a generator or motor. It is made up of conductors which rotate through a magnetic field to provide voltage or force by electromagnetic induction. The pivoted points in generator regulators are also called armatures.

ARTIFICIAL MAGNETS—A magnet which has been magnetized by artificial means. It is also called, according to shape, a bar magnet or a horseshoe magnet.

ATOM—A particle which is the smallest unit of a chemical element. It is made up mainly of electrons (minus charges) in orbit around protons (positive charges).

B

BENDIX DRIVE—One type flywheel engaging device for a starting motor. It is said to be mechanical because it engages by inertia. See Chapter 5 for details.

BREAK—See "Open."

BRUSH—A device which rubs against a rotating slip ring or commutator to provide a passage for electric current to a stationary conductor.

C

CAPACITOR—A device which stores an electrical charge. Commonly used for storing a-c voltage spikes.

CHARGE—To restore the active materials in a battery by the passage of direct current through it.

CIRCUIT—A continuous, unbroken path along a conductor through which electrical current can flow from a source, through various units, and back to the source.

CIRCUIT BREAKER—A device to protect an electrical circuit from overloads. The breaker acts as a switch and opens when the current passing through the circuit exceeds the rated level. Some circuit breakers must be reset manually; others may reset automatically after a period of time or when the current drops to the rated capacity. Also see "Fuse."

COIL (IGNITION)—A transformer which steps up voltage to produce ignition sparks.

COLD RATING—The cranking load capacity of a battery at low temperatures.

COMMUTATOR—A device for reversing the direction of current flowing through the conductors of the rotating armature in a motor or for assuring a one-direction (d.c.) flow of current from a generator

CONDENSER—An automotive term which describes a capacitor.

CONDUCTOR—A substance or body through which an electrical current can be transmitted. Elements which are good conductors have less than four electrons in the outer rings of their atoms. Also see "insulator."

CONVENTIONAL THEORY—The theory which states that the direction of current flow is from positive to negative in a circuit. This manual follows this theory regarding the direction of current flow.

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CURRENT—Movement of electricity along a conductor. Current is measured in amperes.

CURRENT FLOW—The flow or movement of electrons from atom to atom in a conductor.

CYCLING—The process by which a battery is discharged and recharged.

D

DIODE—An electrical device that will allow current to pass through itself in one direction only. Also see "Zener diode."

DIRECT CURRENT (D.C.)—A steady flow of electrons moving steadily and continually in the same direction along a conductor from a point of high potential to one of lower potential. It is produced by a battery, generator, or rectifier.

DISCHARGE—To remove electrical energy from a charged body such as a capacitor or battery.

DISTRIBUTOR (IGNITION)—A device which directs the ignition of an engine.

DYER DRIVE—One type of flywheel engaging mechanism in a starting motor. See Chapter 5.

E

ELECTRICAL FIELD—The region around a charged body in which the charge has an effect.

ELECTRICITY—The flow of electrons from atom to atom in a conductor.

ELECTROCHEMICAL—The relationship of electricity to chemical changes and with the conversions of chemical and electrical energy. A battery is an electrochemical device.

ELECTROLYTE—Any substance which, in solution, is dissociated into ions and is thus made capable of conducting an electrical current. The sulfuric acid-water solution in a storage battery is an electrolyte.

ELECTROMAGNETIC CLUTCH—An electromagnetic device which stops the operation of one part of a machine while other parts of the unit keep on operating.

ELEMENT—(1) Any substance that normally cannot be separated into different substances. (2) The completed assembly of a battery consisting of negative plates, positive plates, and separators mounted in a cell compartment.

ELECTROMAGNET—A core of magnetic material, generally soft iron, surrounded by a coil of wire through which electrical current is passed to magnetize the core.

ELECTROMAGNETIC FIELD—The magnetic field about a conductor created by the flow of electrical current through it.

ELECTROMAGNETIC INDUCTION—The process by which voltage is produced in a conductor by varying the magnetic field so that lines of force cut across the conductor.

ELECTROMOTIVE FORCE—The force which tends to cause a flow of electricity. It may be compared to the pressure which causes water to flow through a pipe. Electromotive force is measured in volts.

ELECTRON—A tiny particle which rotates around the nucleus of an atom. It has a negative charge of electricity.

ELECTRON THEORY—The theory which explains the nature of electricity and the exchange of "free" electrons between atoms of a conductor. It is also used as one theory to explain direction of current flow in a circuit.

F

FUNDAMENTAL LAW OF MAGNETISM—The fundamental law of magnetism is that unlike poles attract each other, and like poles repel each other.

FUSE—A replaceable safety device for an electrical circuit. A fuse consists of a fine wire or a thin metal strip encased in glass or some fire-resistant material. When an overload occurs in the circuit, the wire or metal strip melts, breaking the circuit. Also see "Circuit Breaker."

G

GENERATOR—A device which converts mechanical energy into electrical energy. See Chapter 4 for details.

GRID—A wire mesh to which the active materials of a storage battery are attached.

GROUND—A ground occurs when any part of a wiring circuit unintentionally touches a metallic part of the machine frame.

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GROUNDED CIRCUIT—A connection of any electrical unit to the frame, engine, or any part of the tractor or machine, completing the electrical circuit to its source.

GROWLER—A device for testing the armature of a generator or motor.

H

HYDROMETER—An instrument for measuring specific gravity. A hydrometer is used to test the specific gravity of the electrolyte in a battery.

I

INDUCTANCE—The property of an electric circuit by which an electromotive force (voltage) is induced in it by a variation of current either in the circuit itself or in a neighboring circuit.

INDUCTOR—A coil of wire wrapped around an iron core.

INSULATOR—A substance or body that resists the flow of electrical current through it. Also see "Conductor".

ION—An atom having either a shortage or excess of electrons.

ISOLATION DIODE—A diode placed between the battery and the alternator. It blocks any current flow from the battery back through the alternator regulator when the alternator is not operating.

L

LINES OF FORCE—Invisible lines which conveniently illustrate the characteristics of a magnetic field and magnetic flux about a magnet.

M

MAGNET—A body which has the property of attracting iron or other magnets. Its molecules are aligned. See Chapter 1.

MAGNETIC FIELD—That area near a magnet in which its property of magnetism can be detected. It is shown by magnetic lines of force.

MAGNETIC FLUX—The flow of magnetism about a magnet exhibited by magnetic lines of force in a magnetic field.

MAGNETIC INDUCTION—The process of introducing magnetism into a bar of iron or other magnetic material.

MAGNETIC LINES OF FORCE—Invisible lines which conveniently illustrate the characteristics of a magnetic field and magnetic flux about a magnet.

MAGNETIC MATERIAL—Any material to whose molecules the property of magnetism can be imparted.

MAGNETIC NORTH—The direction sought by the north pole end of a magnet, such as a magnetic needle, in a horizontal position. It is near the geographic north pole of the Earth.

MAGNETIC SOUTH—The opposite direction from magnetic north towards which the south pole end of a magnet, such as a magnetic needle, is attracted when in a horizontal position. It is near the geographic south pole of the Earth.

MAGNETIC SWITCH—A solenoid which performs a simple function, such as closing or opening switch contacts.

MAGNETISM—The property inherent in the molecules of certain substances, such as iron, to become magnetized, thus making the substance into a magnet.

MOLECULE—A unit of matter which is the smallest portion of an element or compound that retains chemical identity with the substance in mass. It is made up of one or more atoms.

MOTOR—A device which converts electric energy into mechanical energy. See Chapter 5 for details.

MUTUAL INDUCTION—Occurs when changing current in one coil induces voltage in a second coil.

N

NATURAL MAGNET—A magnet which occurs in nature, such as a lodestone. Its property of magnetism has been imparted by the magnetic effects of the Earth.

NEGATIVE—Designating or pertaining to a kind of electricity. Specifically, an atom that gains negative electrons is negatively charged.

NEUTRON—An uncharged elementary particle. Present in all atomic nuclei except the hydrogen nucleus.

NON-MAGNETIC MATERIAL—A material whose molecules cannot be magnetized.

O

OHM—The standard unit for measuring resistance to flow of an electrical current. Every electrical conductor offers resistance to the flow of current, just as a tube through which water flows offers resistance to the current of water.

One ohm is the amount of resistance that limits current flow to one ampere in a circuit with one volt of electrical pressure.

OHMMETER—An instrument for measuring the resistance in ohms of an electrical circuit.

OHM'S LAW—Ohm's Law states that when an electric current is flowing through a conductor, such as a wire, the intensity of the current (in amperes) equals the electromotive force (volts) driving it, divided by the resistance of the conductor. The flow is in proportion to the electromotive force, or voltage, as long as the resistance remains the same.

OPEN OR OPEN CIRCUIT—An open or open circuit occurs when a circuit is broken, such as by a broken wire or open switch, interrupting the flow of current through the circuit. It is analogous to a closed valve in a water system.

OVERRUNING CLUTCH—One type of the flywheel engaging portion of a starting motor. See Chapter 5.

P

PARALLEL CIRCUIT—A circuit in which the circuit components are arranged in branches so that there is a separate path to each unit along which electrical current can flow.

PERMANENT MAGNET—A magnet which retains its property of magnetism for an indefinite period.

PLATE—A solid substance from which electrons flow. Batteries have positive plates and negative plates.

POLARITY—A collective term applied to the positive (+) and negative (−) ends of a magnet or electrical mechanism such as a coil or battery.

POLE—One or two points of a magnet at which its magnetic attraction is concentrated.

POLE SHOES—Permanent magnets fastened to the inside of a generator or motor housing.

POSITIVE—Designating or pertaining to a kind of electricity. Specifically, an atom which loses negative electrons and is positively charged.

PRINCIPLE OF TURNING FORCE— Explains how magnetic force acts on a current-carrying conductor to create movement of an armature, such as in an electric motor. See Chapter 1.

PROTON—A particle which, together with the neutron constitutes the nucleus of an atom. It exhibits a positive charge of electricity.

R

RECTIFIER—A device (such as a vacuum tube, commutator, or diode) that converts alternating current into direct current.

REGULATOR—A device which controls the flow of current or voltage in a circuit to a certain desired level.

RELAY—An electrical switch which opens and closes a circuit automatically.

RELUCTANCE—The resistance that a magnetic circuit offers to lines of force in a magnetic field.

RESISTANCE—The opposing or retarding force offered by a circuit or component of a circuit to the passage of electrical current through it. Resistance is measured in ohms.

RESISTOR—A device usually made of wire or carbon which presents a resistance to current flow.

ROTOR—The rotating part of an electrical machine such as a generator, motor, or alternator.

RIGHT-HAND RULE—A method used to determine the direction a magnetic field rotates about a conductor, or to find the north pole of a magnetic field in a coil. See Chapter 1.

S

SELF-INDUCTION—Voltage which occurs in a coil when there is a change of current.

SEMICONDUCTOR—An element which has four electrons in the outer ring of its atoms. Silicon and germanium are examples. These elements are neither good conductors nor good insulators. Semiconductors are used to make diodes and transistors.

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SENDING UNIT—A device, usually located in some part of an engine, to transmit information to a gauge on an instrument panel.

SEPARATOR—Any of several substances used to keep one substance from another. In batteries a separator separates the positive plates from the negative plates.

SERIES CIRCUIT—A circuit in which the parts are connected end to end, positive pole to negative pole, so that only one path is provided for current flow.

SERIES—PARALLEL CIRCUIT—A circuit in which some of the circuit components are connected in series and others are connected in parallel.

SHORT (OR SHORT CIRCUIT)—This occurs when one part of a circuit comes in contact with another part of the same circuit, diverting the flow of current from its desired path.

SHUNT—A conductor joining two points in a circuit so as to form a parallel circuit through which a portion of the current may pass.

SLIP RING—In a generator, motor, or alternator, one of two or more continuous conducting rings from which brushes take, or deliver to, current.

SOLENOID—A tubular coil used for producing a magnetic field. A solenoid usually performs some type of mechanical work.

SPARK PLUGS—Devices which ignite the fuel by a spark in a spark-ignition engine.

SPECIFIC GRAVITY—The ratio of a weight of any volume of a substance to the weight of an equal volume of some substance taken as a standard, usually water for solids and liquids. When a battery electrolyte is tested the result is the specific gravity of the electrolyte.

SPRAG CLUTCH DRIVE—A type of flywheel engaging device for a starting motor. See Chapter 5.

STATOR—The stationary part of an alternator in which another part (the rotor) revolves.

STORAGE BATTERY—A group of electrochemical cells connected together to generate electrical energy. It stores the energy in a chemical form. See Chapter 3.

SULFATION—The formation of hard crystals of lead sulfate on battery plates. The battery is then "sulfated."

SYNCHROGRAPH—An all-purpose distributor tester.

T

TACHOMETER—An instrument for measuring rotary speed; usually revolutions per minute.

TEMPORARY MAGNET—A magnet which loses its property of magnetism quickly unless forces act to re-magnetize it.

THERMISTOR—A temperature-compensated resistor. The degree of its resistance varies with the temperature. In some regulators, it controls a Zener diode so that a higher system voltage is produced in cold weather, when needed.

TRANSISTOR—An electrical switch device constructed of semi-conducting materials that is used in circuits to control the flow of current. It operates by either allowing current to flow or not allowing it to flow.

TWENTY-HOUR RATING—The accessory capacity of a battery.

V

VISCOSITY—The internal resistance of a fluid, caused by molecular attraction, which makes it resist a tendency to flow.

VOLT—A unit of electrical pressure (or electromotive force) which causes current to flow in a circuit. One volt is the amount of pressure required to cause one ampere of current to flow against one ohm of resistance.

VOLTAGE—That force which is generated to cause current to flow in an electrical circuit. It is also referred to as electromotive force or electrical potential. Voltage is measured in volts.

VOLTMETER—An instrument for measuring the force in volts of an electrical current. This is the difference of potential (voltage) between different points in an electrical circuit. Voltmeters are connected across (parallel to) the points where voltage is to be measured.

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W

WATT—A unit of measure for indicating the electrical power applied in a circuit. It is obtained by multiplying the current (in amperes) by the electrical pressure (in volts) which cause it to flow. That is: watts = amperes × volts.

WATT-HOUR—A unit of electrical energy. It indicates the amount of work done in an hour by a circuit at a steady rate of one watt. That is, watt-hours = ampere-hours × volts.

WIRING HARNESS—The trunk and branches which feed an electrical circuit. Wires from one part of the circuit enter the trunk, joining other wires, and then emerge at another point in the circuit.

Z

ZENER DIODE—A special diode that will conduct current in the reverse direction when the voltage becomes higher than a predetermined voltage.

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ABSTRACT - Developed by an associate professor of farm management and vocational agriculture in consultation with subject-matter specialists, teacher educators, supervisors, and teachers, this pamphlet will assist vocational agriculture teachers in supervising student farming programs. Efficiency measures are provided in list form for: (1) beef, dairy, and feeder cattle, (2) poultry, (3) sheep, (4) swine, and (5) corn, soybeans, oats, and wheat. Provided in tabular form are a schedule of land values by soil productivity ratings and a preliminary report on corn, soybean, wheat, and oat yields by counties in Illinois for 1969. The material can be used as a text or reference for high school or adult education students who have an agricultural interest and occupational objectives. An earlier version, "Standards for Measures of Efficiency for 1966," is available as VT 004 283 (AIM Spring 1968). (SB)

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STANDARDS FOR MEASURES OF EFFICIENCY FOR 1969

Efficiency Measure	Calves sold	Calves fed out
Beef Breeding:		
1. Percent calf crop	90	90
2. Weight produced per cow (lb.)	520	825
3. Returns/$100 feed	$170	$155
4. Average price received	26.50	26.50
5. Feed cost/cwt. gain	15.50	17.00
6. Lb. feed per cwt. gain		
a. Grain	60	285
b. Protein and minerals	15	30
c. Total concentrates	75	315
d. Hay and dry roughage	570	410
e. Corn and other silage	130	260
f. Pasture (days)	52 da.	35 da.
7. Death loss: % of weight produced	4.6	3.8

	Average farms	Without pasture*
Dairy:		
1. Milk per cow (lb.)	11,700	12,200
2. Butterfat per cow (lb.)	430	455
3. Returns above feed per milk cow	$360	$380
4. Returns/$100 feed	$215	$215
5. Average price of milk (per cwt.)	$5.05	$5.05
6. Feed cost/unit production	$18.70	$19.30
7. Lb. feed per unit production (1,000 lb. milk or 100 lb. weight)		
a. Grain	310	295
b. Protein and minerals	60	65
c. Total concentrates	370	360
d. Hay and dry roughage	340	325
e. Hay silage	390	480
f. Corn and other silage	720	910
g. Pasture (days)	6 da.	0 da.
8. Death loss: % of weight produced	8.4	7.8

*and assuming 500 pounds more milk per cow.

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	Steer Calves (Purchased Under 500 lb.)	Yearling Steers (Purchased 500-750 lb.)
Feeder Cattle Enterprises:		
1. Gain per animal per day (lb.)	1.8	1.8
2. Returns/$100 feed	$140	$135
3. Average price received	28.00	28.00
4. Average price paid	32.00	29.00
5. Feed cost/cwt. gain	18.50	20.00
6. Lb. feed per cwt. gain		
a. Grain (corn--on basis of shelled weight)	565	610
b. Protein and minerals	55	60
c. Total concentrates	620	670
d. Hay	120	150
e. Corn and other silage	650	750
f. Pasture (days)	2.0 da.	2.5 da.
7. Death loss: Percent of weight produced	2.0	1.9
8. Returns above feed cost per head	$37.00	$35.00

	Under 1000 Hens	1000 Hens and Over
Poultry: (Laying flocks)		
1. Eggs per hen	192	228
2. % egg production	54	62
3. Returns above feed per hen	$ 1.75	$ 2.60
4. Returns/$100 feed	$145	$185
5. Average price of eggs	.36	.37
6. Average price per pound	.08	.07
7. Feed cost per unit (1 doz. eggs or 1.5 lb. weight)	.20	.17
8. Lb. feed per unit Total concentrates	6.0	5.0

	Average Farms	High Farms
Sheep: (Native flocks)		
1. % lamb crop	120	135
2. Returns/$100 feed	$140	$160
3. Average farm price for wool (excluding gov't payment)	.37	.42
4. Average price for sheep	26.00	27.50
5. Feed cost/cwt. produced	18.00	17.00
6. Lb. feed per cwt. produced		
a. Concentrates	280	220
b. Hay	620	550
c. Pasture (days)	40	40
7. Death loss: % of weight produced	16	10

	Average Farms	High Farms	Feeder Pigs (Averages)
Swine			
1. Pigs farrowed per litter	9.0	9.3	---
2. Pigs weaned per litter	7.3	7.6	---
3. Returns above feed per litter	$160	$195	---
4. Returns/$100 feed	$195	$230	$140
5. Average weight of hogs sold (lb.)	237	235	---
6. Average price received	$ 21.25	$ 22.25	$ 21.50
7. Feed cost/cwt. gain	11.00	10.00	10.80
8. Lb. feed per cwt. gain			
a. Farm grains	345	290	360
b. Commercial feeds	70	65	60
c. Total concentrates	415	355	420
d. Pasture (days)	.5 da.	.5 da.	.4 da.
9. Death loss: % of weight produced	1.3	1.2	1.9
10. Average price paid (per cwt.)	---	---	$ 40.00
11. Average weight purchased	---	---	55

	Corn		Soybeans		Oats		Wheat	
	Average Farms	High Farms	Average Farms	High Farms	Average Farms	High Farms	Average Farms	High Farms
1. Yield per acre			See attached		sheet			
2. Hours per acre	5.0	3.5	5.0	3.5	2.5	1.5	2.5	1.5
3. Labor cost per acre	Multiply above hours by average rate used per hour							
4. Machinery cost/A.*	$17.50	$14.50	$13.50	$11.00	$9.00	$7.00	$9.00	$7.00
5. Crop returns/A.	Multiply yield standard by price							
6. Value of production/A.	Same as above. Differences in actual records occur when inventory changes affect "crop returns per acre."							
7. Average Illinois farm prices:								
Year	$1.14		$2.51		$.60		$1.20	
June-Aug.					.58		1.16	
Oct.-Nov.	1.09		2.36					

*Figured on the basis of detailed costs.

Note: Hours on crops include both direct and indirect labor. Indirect hours are those used for such things as repairing machinery and cribs, care of machinery, hauling manure, and general farm upkeep. Indirect hours usually make up about 30 percent of total hours.

SCHEDULE OF LAND VALUES BY SOIL PRODUCTIVITY RATINGS -- 1969

The following estimates of land value are for bare land; that is values for buildings, fences, tile, and location of site are not included. These values can be used to determine the interest charge on land used for crop enterprises. The soil productivity ratings are those for a low level of management. These land values are for record analysis purposes only and have been adjusted to a 1958-1959 basis. The 1958-59 base values were multiplied by 1.59 in estimating the 1969 values.

Soil ratings	1958-59 Base values	1969 Values	Soil ratings	1958-59 Base values	1969 Values
100	$505	$803	45	$199	$316
95	487	774	40	178	283
90	465	739	35	158	251
85	440	700	30	143	227
80	412	655	25	130	207
75	380	604	20	120	191
70	345	549	15	112	178
65	311	494	10	104	165
60	280	445	5	98	156
55	251	399			
50	223	355			

LAND TAXES: An estimate to determine this part of the land charge for crop enterprises can be made by multiplying 1.3% by the above land values.

NOTE:

These standards were estimated from current prices and costs, along with production and physical inputs from previous years. The standards are based on results obtained by account-keeping farmers. Teachers may wish to have this information as a means of comparing these standards with students' results or with those of farmers in record-keeping classes.

No results are given here for measures of size of enterprise. Such comparisons can be made among students having enterprises of the same kinds. Teachers should, of course, use their judgment as to how many of the measures of efficiency to expect individual students or classes to complete.

Prepared by J. H. Herbst

Vocational Agriculture Service
434 Mumford Hall
Urbana, Illinois 61801

November 1, 1969

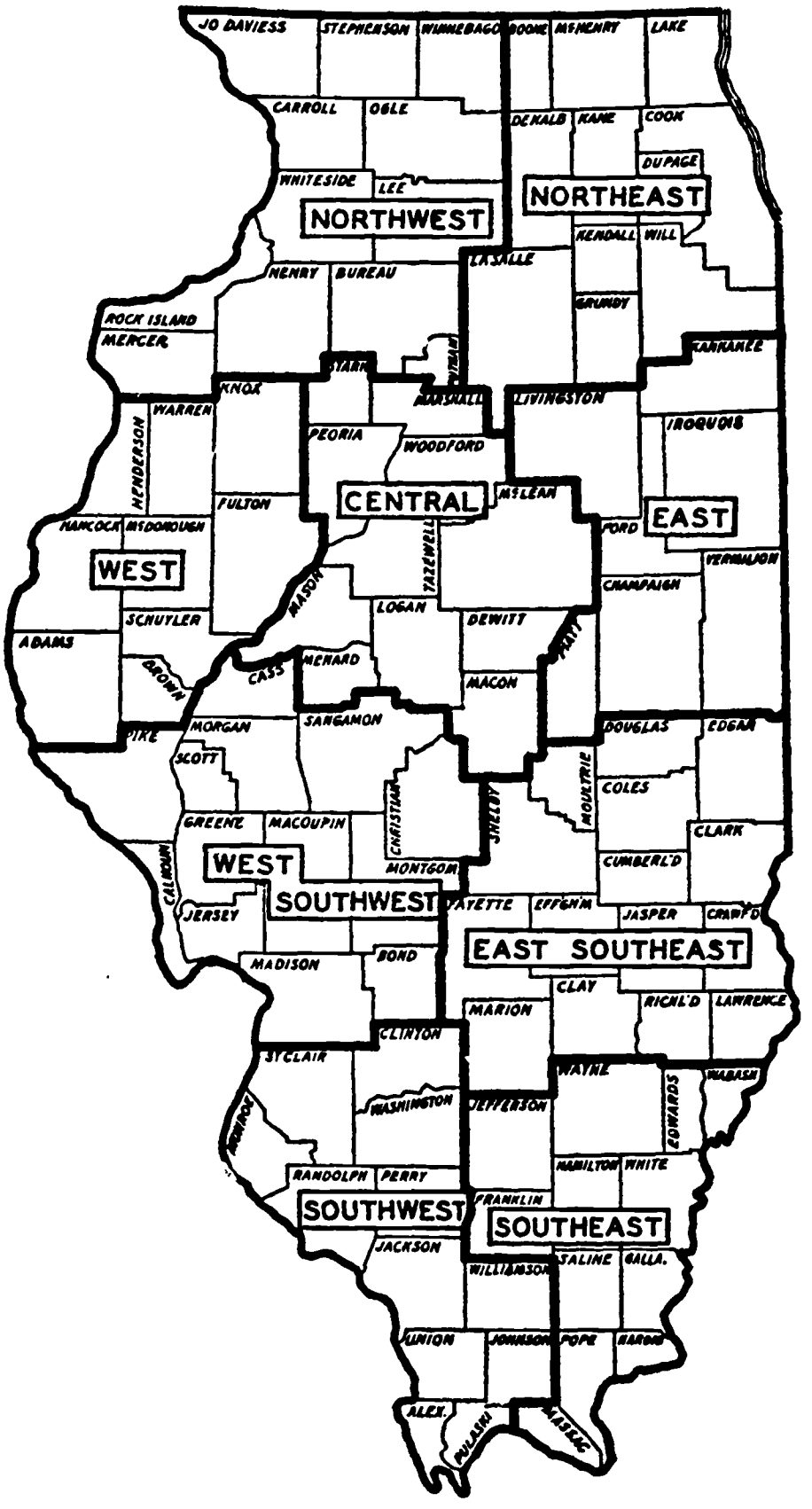
ILLINOIS PRELIMINARY CROP YIELD REPORT

At this time, crop-yield data are not available for all crops by counties; therefore, the yields are shown by crop reporting districts. You can refer to the map on the reverse side of this sheet to find which district applies to your area.

Yields of Principal Crops, by Districts and State, Illinois, 1968 and 1969 a/

District and state	Corn		Soybeans		Wheat		Oats	
	1968	1969	1968	1969	1968	1969	1968	1969
	(Yield per acre harvested for grain - bushels)							
Northwest	97	102	34	34	39	39	70	63
Northeast	91	94	33	31	39	41	71	64
West	92	89	34	33	37	36	62	61
Central	90	110	35	38	38	45	63	64
East	89	109	33	35	38	47	60	62
W. Southwest	90	96	33	34	36	38	54	47
E. Southeast	85	93	29	31	36	39	56	57
Southwest	70	71	26	25	34	33	45	37
Southeast	69	66	23	23	32	32	36	37
Illinois	89	97	31.5	32.5	36.0	37.5	66	62

a/ From the Illinois Cooperating Crop Reporting Service, Springfield, Illinois.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FORD
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A Suggested Instructional Guide in Cosmetology.

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ABSTRACT - Developed by a committee of cosmetology instructors, this teacher's guide outlines a program to prepare students as cosmetologists or beauticians, emphasizing the knowledge needed to pass a State Board Examination and obtain a license. The 120-hour course includes first the general concept and objectives followed by a four-column outline including specific concepts, skills, related information and suggested student participation for 12 units of instruction concerning the techniques of cosmetology and five units of instruction concerning shop operation and management. Suggested number of hours are given for each unit as well as percent emphasis that each unit should receive for those schools planning a program longer than 120 hours. General program objectives are discussed and job descriptions in cosmetology are outlined for 20 occupations requiring a license and five occupations not requiring a license. A bibliography of textbooks and references, manuals, bulletins and pamphlets, magazines and periodicals, films, and charts and audiovisual devices is included. The teacher for this program should be a licensed cosmetology instructor. (SB)

VT 010 771

ED0 45856

A SUGGESTED INSTRUCTIONAL GUIDE IN

Cosmetology

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FOREWORD

The training in cosmetology as a part of vocational education has undergone great expansion in recen years. Occupational programs are meeting the need for trained, competent, personnel through improvement of facilities and program offerings.

This *Suggested Instructional Guide in Cosmetology* embraces all of the present essential instructiona content to prepare candidates for New York State licensure. It is hoped that some flexibility or moderat changes in emphasis will always allow for preparation of current competent workers to enter this growing field of personal services.

The material in this publication was prepared by a curriculum committee of experienced cosmetology teachers. Serving on the project were Mrs. Anne McCarthy, Sarah J. Hale Vocational High School, New York City; Mrs. Mary Morris, Sewanhaka High School, Floral Park; Mrs. Elise Wedel, Potter Road Center, Erie County BOCES; Mrs. Josephine Piani, Woodrow Wilson Vocational High School, Jamaica; and Mrs. Frances Ptak, Suffolk County BOCES #2.

The curriculum project was conducted at State University College at Oswego. Dr. Gordon McMahon, Director of the Division of Vocational Technical Education at the College, acted as general coordinator.

The material was reviewed by and valuable suggestions were received from Miss Florence Wall, Consultant on cosmetology and former professor of cosmetology chemistry at New York University.

This project was initiated by Nelson J. Murbach, Chief, Bureau of Trade and Technical Education (retired) and C. Thomas Olivo, Director, Division of Industrial Education (retired). Miss Blanche Nechanicky, Associate in Industrial Education, worked with the curriculum committee and provided general guidance and direction. Earl Hay, Supervisor of Vocational Curriculum, worked with the committee and helped prepare the manuscript for publication.

This instructional guide in Cosmetology is being distributed to all schools offering vocational education so their teachers may review it and adapt it to existing programs. Any constructive suggestions concerning this material should be forwarded to the Bureau of Secondary Curriculum Development for consideration in a revised edition.

Gordon E. Van Hooft
Chief, Bureau of Secondary Curriculum Development

William E. Young
Director, Curriculum Development Center

TO THE TEACHER

This *Suggested Instructional Guide in Cosmetology* was developed as a guide to assure quality programs throughout the State. It includes material helpful to teachers and administrators for programs in any type of school. It is not a course of study, as each school should prepare its own to meet the needs of the local school situation.

Although some schools will have longer programs than others, the Guide indicates the essential instructional units, with a suggested number of hours assigned to each. This assignment of hours is important when students change schools and their work must be evaluated for transfer of credit.

The format used for presenting the instructional content includes a descriptive general concept of each essential instructional unit, with objectives to be attained under each. The 4-column outline points out some of the more specific concepts to be taught, the skills and related information for developing these concepts, and some suggested student participation.

The teacher should think in terms of concepts which will help the students develop more understanding and judgment essential to a service industry. Skills are learned by students observing teachers demonstrate them step-by-step, after which the students practice the procedures. With continual change in designs and techniques, the beautician must be flexible and change her methods within the concepts she has learned.

This instructional guide resulted from the need for updating curriculum materials developed in the past years. All of these materials and the current license requirements of the Department of State were considered in this revision.

M E M O R A N D U M

Revised 5/69

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DATE: March 24, 1970

RE: (Author, Title, Publisher, Date) Bureau Secondary Curriculum Development

A Suggested Instructional Guide in COSMETOLOGY

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OBJECTIVES OF THE COSMETOLOGY PROGRAM

GENERAL OBJECTIVES

The general objective of the cosmetology curriculum is to prepare students as general operators, called cosmetologists or beauticians, for which graduates must pass a State Board Examination and obtain a license to indicate their ability in competent and safe practice. Before applying for the licensing examination the student must develop proficiency in all the manipulative skills of the trade, as well as acquire enough technical knowledge to be a competent worker if employed by a shop owner, or for possible private practice as a beautician. The student should also be provided the opportunity to develop the business, personal, and social qualities necessary for success in this work and to be a well-adjusted member of society.

Students who do not indicate enough competency to complete the entire program and prepare for taking the State Board Examination should not be selected for it. There are, however, opportunities for students who wish to take positions as manicurists, wig stylists,receptionists, or assistant managers for which State licensing is not required.

Graduates should be encouraged to take advanced training in specialized fields where promotional opportunities exist.

SPECIFIC OBJECTIVES

To prepare young people for a specific field of employment

To help meet the continuous demand for licensed cosmetologists in an industry that is constantly progressing and expanding

To provide students with the opportunity to develop the personal and social qualities necessary for giving service to others and becoming well-adjusted members of society

To develop in the trainees an awareness of their responsibility to maintain and continually improve the standards of the cosmetology industry

To provide students with the opportunity to progress in their chosen field

To teach the skills and related trade knowledge of hairdressing and cosmetology so that, commensurate with their ability, young people will be able to obtain employment to the mutual satisfaction of themselves and their employers

To enable the students to successfully pass the New York Department of State Hairdressing and Cosmetology examination

To correlate and develop an understanding of the related science with practical work so students will use judgment in giving beauty service and will safeguard the health of workers and patrons

To teach the importance of observing safety precautions in all phases of the trade

To assist the students in making satisfactory vocational adjustments when they enter the trade

To give students motivation for progress in their field and guidance in the opportunities available for postgraduate training for advancement in the hairdressing and cosmetology industry

To assist the students to communicate intelligently using correct speech patterns

To encourage an awareness of the aesthetic values inherent in hairdressing and cosmetology, in order to stimulate and develop creative and artistic ability

To encourage and develop analytical thinking so the students may develop into competent and productive workers and knowledgeable citizens

To develop the ability to function effectively as both a producer and a consumer

To develop responsible and favorable interpersonal and group relationships

To instill in the students an awareness of the productive and social values of self-discipline

To develop acceptable work habits

JOB DESCRIPTIONS IN COSMETOLOGY

The following job descriptions provide guidance for the qualifications of workers in several branches of cosmetology.

JOBS REQUIRING LICENSE

General Operator A general operator is trained to perform all beauty services. The duties of the general operator include:

preparation of needed materials

performing as required: shampoo; manicure and pedicare; hairstyling; haircutting; scalp, hair,and facial treatments; makeup; eyebrow-shaping; hair coloring; permanent waving; and hair-straightening

Specialist A general operator particularly proficient in one area may become a specialist. The chief specializations are hair styling, hair coloring, face and scalp care, makeup, permanent waving, straightening hair, and styling of hair pieces.

Hairstylist A good hairstylist holds a prestigious position in the beauty industry. A stylist must have excellent creative and artistic ability as well as superior skill. Some of the larger salons have their own training centers, but most stylists further their technical mastery by advanced specialized training in this particular field. There are excellent opportunities for hair stylists as demonstrators, shop specialists, and stylists for movie studios, the theater, and television.

Television and Stage Makeup Specialist Special training is required for the application of makeup for actors in television and on the stage. The specialist must know every phase of makeup for both daytime and evening wear, for photographic, television, and theatrical work.

Demonstrator (Manufacturer's representative) A demonstrator must have a sound basic knowledge of the hair and skin as well as the ability to express herself fluently. The job of demonstrating and selling a particular manufacturer's product is attractive to some people because it generally involves travel. Demonstrators are usually trained by the manufacturers who employ them.

Research Technician Assistant Assistant technicians are employed by manufacturers in the cosmetic industry to test laboratory products for practical use. Skill in all the treatments that may be required for the type of product to be tested is necessary for such positions.

Hospital Beauty Service Operator A growing specialized branch of the cosmetic industry is beauty care for hospitalized patients. The skills of a general operator, plus training in bedside techniques are required for this position.

Shop Manager A person who has experience as a general operator as well as executive ability may become a shop manager. The duties of a manager include:

- determining shop policies
- selecting and supervising personnel
- insuring satisfactory relations between the shop and the patrons
- purchasing and distributing supplies
- keeping records of shop personnel and finances
- providing for the upgrading of operators
- managing publicity

Shop Owner Cosmetology is one occupation that seems to encourage its practitioners to go into business for themselves. Successful proprietorship requires a fair amount of capital, good business sense, and the ability to maintain satisfactory relations with coworkers and patrons.

Teacher A licensed cosmetologist may enter the field of education in either the public vocational high schools or the private trade schools. Qualifications vary in different states. Entrance examinations are usually required.

JOBS NOT REQUIRING LICENSE

Manicurist In New York State a manicurist does not (at the present time) have to be licensed. Job opportunities for manicurists exist in barber shops as well as beauty salons.

Receptionist A large salon requires the services of a receptionist. She must have a pleasing personality, neat appearance, and a good command of the language. The duties of the receptionist include:

- making and keeping records of patrons' appointments
- greeting patrons
- assigning patrons to operators
- acting as cashier and bookkeeper
- keeping records of permanent waves, hair dyes, and other treatments.

Cosmetician (Salesperson) Extensive training as a cosmetologist is not required for selling cosmetics. However, knowledge of facial care and of the basic ingredients in cosmetics will assist the individual to sell with a greater degree of assurance. Manufacturers of cosmetics usually train salespersons in necessary technical knowledge and the selling points of their products.

Dispensary Clerk or Maid In large salons or establishments, supplies required for various treatments may be in the charge of a dispensary clerk who furnishes them to the operators on request. The clerk may also assist in the preparation of materials for the operators' use.

Wig Stylist In recent years the use of hair pieces has become increasingly popular. Many large salons maintain a wig-servicing department and employ specialists skilled in the cutting, cleaning, and styling of wigs.

EMPLOYMENT OUTLOOK

According to the 1960 U.S. Population Census, more than 300,000 persons were employed as hairdressers and cosmetologists. Thousands of jobs for beauty operators can be expected to become available each year during the rest of the 1960's and 1970's. Employment is expected to expand rapidly,and opportunities will continue to exist for both full- and part-time workers.

REQUIRED UNITS OF INSTRUCTION

To meet the needs of various local cosmetology programs in the State a percentage formula is suggested to indicate the proportionate amount of time to be devoted to each unit for the development of skills (including theory) and the necessary related instruction. An approved program should include all the units listed below with the suggested number of hours. Schools offering longer programs may be more interested in the percentage emphasis for each unit than the number of hours. The unassigned time may be used for extra tests and evaluation, clinical practice, or for enrichment in units requiring current emphasis.

Years of experience have indicated that the suggested number of hours in each unit need to be completed by students before they can successfully pass the State Board Licensing Examinations in both written and practical work. Students missing some instruction because of unavoidable absences should be provided with the opportunity to make it up under a competent instructor in proper facilities.

Units of Instruction	Percent Emphasis	Suggested Number of Hours
Care of Hands and Feet	7%	70
Shampoos and Colorless Rinses	6%	60
Care of Hair and Scalp	3%	30
Permanent Waving	8%	80
Hair Straightening	8%	80
Hair Shaping	6%	60
Hair Styling	20%	200
Haircoloring	14%	140
Hair Pieces	2%	20
Facial Treatments	6%	60
Removal of Superfluous Hair	1%	10
Professional Makeup	2%	20
Shop Operation and Management	5%	50
Unassigned for Tests and Evaluation, Review, and Enrichment	12%	120

Unit CARE OF HANDS AND FEET Minimum Hours 70

GENERAL CONCEPT

Manicuring, the care of the hands and nails, has always been an important branch of cosmetology. The operator must have the ability to give a good manicure in an efficient and systematic way. The operator's own hands and nails should reflect her ability and skill in manicuring. A neat, well groomed appearance helps to instill in the patron a confidence in the operator. A patron who is pleased and satisfied with the work of the manicurist often becomes a regular patron for other beauty services.

This unit deals with all of the services involved in improving the appearance of the hands and nails including the basic manicure, reconditioning manicure, massage of hands and arms, repair of nails, and the application of artificial nails.

Pedicare is a specialized service offered by some salons. Unkept toenails and rough, harsh heels detract from the loveliness of the feet.

OBJECTIVES

To acquire knowledge and skill in the basic procedure involved in giving a professional manicure

To develop the ability to identify nail abnormalities and to understand the procedure and benefits of a reconditioning manicure

To develop skill in the application of artificial nails and to appreciate the value of "the little extra touch." The application of artificial nails constitutes a highly specialized service. The teaching of this service may be left to the discretion of the teacher

To develop the skill of repairing a split or broken nail and to recognize the advantages of this service to the patron and to the shop owner

To introduce the procedure and advantages of an electric manicure

To acquire the skills necessary for proper pedicare (footnote page 14)

To appreciate the value of, and acquire skill in massage of hands and arms

UNIT CARE OF HANDS AND FEET
Manicuring

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The patron should be comfortable during the service	Discuss: . Proper techniques: - Greet patron - Seat patron correctly	Discuss: . The importance of manicuring as an introductory service	Demonstrate: . Techniques discussed
Basic knowledge of materials used and efficient utilization of time can help avoid fatigue	. Prepare table - Sterilize tools - Place tools correctly - Arrange materials and supplies - Seating arrangement of patron and operator	. Tools - Type and quality - Sterilizating and care . Composition of nail cosmetics - Polish remover - Cuticle solvents - Nail lacquer . Evaluation of brand name products . Safety measures . Sterilization and sanitation - Use of germicides and antiseptics . Histology of the nail - Composition - Function - Structure - Normal growth Review: . Elementary bacteriology . Prevention of infection	Practice: . Correct setting of the manicure table Prepare: . Table sterilizer Student Project: . Develop a chart listing the chemical composition and purpose of each product . Show how acetone dissolves rayon . Test cuticle remover for potassium hydroxide
A perfect manicure depends on the skill and knowledge of the operator	Demonstrations: . Use of polish remover . Use of emery board . Use of pusher . Use of orangewood stick . Use of nipper . Remove polish . Shape nails . Soak hand . Clean free edge . Soften and lift cuticle . Trim cuticle . Wash hands	Visual Aids: . Plastic model of nail to explain each structure . Wall chart of nail structure . Diagram of nail shapes Related Art Principles: . Shape of nails . Hand proportion and shapes . Safety precautions	Return Demonstration: . Use instruction sheet step by step Student Project: . Select a series of advertisements from popular magazines that illustrate the hands and nails . Include at least five variations of nail shapes . Label and identify each pictu

UNIT CARE OF HANDS AND FEET
Manicuring

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Color is the final beautification of the nail	. Application of polish: - Cover entire nail - Hair line tips - Form moons	Related Art Principles: . Color range of nail polishes . Skin tones . Current fashion trends . Color selection	Practice: . Application of polish
The condition of the manicuring tray reflects the efficiency of the operator	. Care of the manicure tray: - Cleanliness - Thin nail polish When Why How - Clean bottle tops	Observe: . Effects of air on nail polish . Action of nail-dry spray on polish Lead Discussion: . Why polished nails chip . Difference between polish remover and polish thinner	Preparation of manicure tray: . Thinning nail polish . Cleaning bottles
Tactful suggestions by the manicurist can lead to the sale of related services and cosmetics	Discuss and Illustrate: . Appropriate conversation with patron	Suggestive Sales Approach: . Lipstick to match polish . Polish for home repair . Hand lotions . Reconditioning manicure . Repair of nail . Pedicare . Artificial nails	Student Project: . Develop a sales presentation to be given to class . Use color charts to match shades of polish and lipstic

UNIT CARE OF HANDS AND FEET
Nail Repair, Artificial Nails

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
A split or broken nail can be a disaster. The operator who knows how to solve this problem gains the patron's immediate respect	Demonstrate: . Nail repair . Prepare surface of nail . Prepare paper . Apply adhesive . Safety precautions	Review: . Supplies required . Causes of split or broken nails . Necessity for careful reading of manufacturer's instructions . Advantages - Preventive measure - Protective measure	Discuss: . Use of manufacturer's information sheets . Practice procedure . Occasions that make nail repairs essential
Beautifully shaped nails can be applied	Discuss: . Types of artifical nails - Liquid nail builders - Ready-made plastic nails	Introductory Information: . Need for artificial nails . Various types . Leading manufacturers	Compare and Discuss: . Manufacturers information sheets . Discuss the differences - manufactured products
A liquid nail builder creates the illusion of a natural nail	Demonstrate: . Preparation of - Materials - Nails . Procedure - Follow manufacturer's instructions	. Composition of liquid nail builders . Determine price of: - Complete service - Individual nail . Advantages . Disadvantages	Practice: . Preparation of materials . Procedure
Long nails can be achieved quickly and easily by applying artificial plastic nails	Demonstrate: . Preparation of - Materials - Nails . Method of application	. Composition of: - Nails - Adhesive . Safety precautions	Practice: . Preparation of materials . Procedure

UNIT CARE OF HANDS AND FEET
Reconditioning Manicure

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Beautifully manicured nails require smooth, well-groomed hands to complete their appearance	Review: . Basic manicure . Basic hand and arm massage	Review: . Causes of dry skin - Disorders - Abnormalities . Effect of dry skin on the patron - Mentally - Socially . Effects on the skin and nails of specialized hand creams and lotions	Examine: . Hands and nails for disorder and abnormalities
A few new techniques are added when giving a reconditioning manicure	Demonstrate: . Preparation of supplies . Care and use of electric heater . Procedure	Discuss: . Why the use of water is avoided . When to recommend a reconditioning manicure . Corrective cosmetics used Observe: . Results of manicure . Appearance and texture of the skin . Appearance of the nails . Introduction to extra services - Hand and arm massage - Facial treatment Advantages: . Satisfied patron . Remunerative . Evaluation of reconditioning manicure	Practice: . Preparation of table . Practice procedures . Safety precautions . Cleaning up . Care of heater Experiment: . Rub hands against face and stockings after manicure Discuss: . The texture of the skin on th hands before and after a manicure . The operator's reaction to giving the manicure

UNIT CARE OF HANDS AND FEET
Hand and Arm Massage

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
A massage of the hands and arms is relaxing; it relieves fatigue and softens and soothes the skin	Demonstrate: . Preparation of table - Supplies required . Preparation of patron - Sanitation - Protection of clothing	Discuss: . Relaxing effects of massage . Stimulation of circulation . Purpose of movements used	
Hands and arms that are red, rough, and dry from external causes should be massaged with special creams	Review: . Preparation of patron . Preparation of table Demonstrate: . Application of cream . Removal of cream	Discuss: . Causes of dry skin . Effect of cleansing and emollient creams . The appearance and texture of the hand and arm after treatment	Purpose of Creams and Lotions: . Type . Effect . Use
A knowledge of the structure of the hand and arm is the basis for the massage	Demonstrate: . Manipulations	. Anatomy of hand and arm - Bones - Muscles - Nerves - Motor points	Student Project: . Identify anatomical parts illustrated on wall chart . Identify parts of student's hand and arm

NIT CARE OF HANDS AND FEET
Electric Manicure

PECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
o the patron who desires "something different," an electric manicure has immediate appeal	Demonstrate: . Preparation of table . Use of each mechanical attachment and safety practices for each - Emery wheel - Cuticle brush - Chamois buffer	Introduction of the Electric Manicure Machine: . Advantages - Saves time - Smooth finish . Disadvantages - Some patrons object to machine Discussion: . Psychological effects . Patron's reaction . Operator's reaction . Sales approach	Review: . Manicure procedure Practice: . Manicure using an electric manicure machine Form Judgments On: . Values to salon . Values to patron

UNIT CARE OF HANDS AND FEET
Pedicare*

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Well-groomed feet are pretty feet	Demonstrate: . Preparation of tools and supplies . Sanitary precautions . Preparation of patron - Care of clothing - Sanitary precautions - Position of patron . Examination of the feet . Safety precautions . Techniques of - Shaping toenails - Softening cuticle - Cleaning toenails - Applying polish	Elicit: . Asthetic value of well-groomed feet and nails . Limitations of pedicare in relation to work done by the chiropodist . Recognition of common disorders - Athlete's foot - Callouses - Corns - Ingrown nails	Compare and Discuss: . Tools and supplies used in manicuring . Supplies used in foot care Student Practice: . Follow step-by-step procedure using an instruction sheet of "The Complete Pedicare"
A complete pedicare is soothing and relaxing and provides a feeling of luxury	Demonstrate: . Applying cream to foot . Massage manipulations . Removing cream . Applying astringent Review: . Applying polish	Review: . Theory of massage . Effects of - Stroking - Compression - Rotary movement	Performance test on complete uni Evaluate: . The physiological and estheti qualities of a pedicare
Prestige salons feature pedicare		Discuss: . Profitable aspects of giving pedicare . Compute cost of time and labor against value of offering extra services, increased retail sales, and added income	Develop: . An advertising throw-away for introducing patrons to a pedicare List: . Cosmetics which can be suggested to patron for home ca of the feet and nails

*The term pedicare is used in this publication in place of pedicure. A pedicure is the responsibility of a chiropodist. Care, but not treatment, of the feet may be provided by a cosmetologist.

Unit SHAMPOOS AND COLORLESS RINSES Minimum Hours 60

GENERAL CONCEPT

A shampoo has hygienic and psychological benefit. It provides the effects of a massage and gives the patron a satisfied feeling. A person's hair and scalp must be free of dandruff and soil to maintain a beautiful and healthy appearance. The shampoo must be given properly for a patron to have confidence in the operator.

A rinse is an important accessory to a professional shampoo. Bleaches, tints, soap shampoos, and hard water deprive the hair of its natural luster, makes it unmanageable, or leaves it extremely dry.

This unit deals with the nature and effects of various types of shampoos and rinses to fit the individual patron's needs. The importance of personal and public hygiene is stressed.

OBJECTIVES

To appreciate the importance of personal and hygienic care of the hair and scalp

To develop skill in professional methods of shampooing

To introduce the use of various types of shampoos in common use, and specialized shampoos for artificially colored hair

To develop knowledge and skill in the accepted methods of cleansing hair and scalp without water

To recognize abnormal conditions of the hair and scalp and to develop judgment in the selection of the various types of commercial shampoos available for the alleviation of these conditions

UNIT SHAMPOOS AND COLORLESS RINSES

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Preparation of a soap solution is basic to a shampoo	Demonstrate: . Preparation of soap solution . Assembling of supplies	Discuss: . Types of soap concentrates - Granules - Beads - Flakes - Jelly - Liquid . Cost of supplies Demonstrate: . Use of equipment . Preparation of shampoo soap	Practice: . Preparing shampoo . Labeling shampoo . Arranging supplies
Thorough brushing of the hair is an integral part of a good shampoo	Demonstrate: . Preparation of patron - Remove jewelry - Place towel - Adjust cape . Brush and comb the hair - Comb to remove tangles - Method of brushing	Discuss: . Benefits of brushing	Practice: . Combing tangles from partner hair and scatter brushing
The patron must be physically and mentally comfortable	Demonstrate: . Adjustment of shampoo chair - Position patron at shampoo sink	Discuss: . Protection of patron's clothing, jewelry . Patron's preferences as to - Water temperature - Vigor of manipulation	Practice: . Preparing patron . Adjusting chair
Good techniques constitute the difference between simply washing the hair and a professional shampoo	Demonstrate: . Application of shampoo - Correct position of operator - Regulate temperature of water - Wet hair with spray . Manipulations during shampoo	Discuss: . Effects of soap shampoo on the hair and scalp . Hygiene - Personal - Public	Observe: . Slide films Practice: . Give a complete shampoo

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
(Cont'd.)	. Rinse to remove shampoo . Test for cleanliness . Placement of towel around head . Readjustment of chair following shampoo	Observe: . Posture of operator . Position of patron . Cleanliness of hair and scalp . Timing	
The completion of a shampoo depends upon the service that is to follow	Demonstrate: . Removal of excess moisture . Sanitation - Leave booth clean and in order for next service . Sterilize brush and comb		Analyze results: . Models report on - Personal comfort during shampoo - Appearance of hair and scalp after shampoo . Operators report on - Procedure - Reactions

UNIT SHAMPOOS AND COLORLESS RINSES
Specialized Shampoos

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
A liquid dry shampoo may be given as a special service to the patron who cannot have her hair wet	Demonstrate: . Procedure for liquid dry shampoo for hair and scalp - Method of applying - Procedure for drying	Explain: . Liquid dry shampoo . Composition - Uses - Effect on hair and scalp - Limitations . Safety precaution for flammable liquids - Use - Storage Discuss: . Psychological effect on patron - Advantages - Disadvantages . Use of liquid dry shampoo for cleaning hairpieces	Observe: . Appearance of hair and scalp before and after shampoo Test: . Effects of dry cleaning liqui on swatch of hair coated wit oil
A knowledge of the various conditioning shampoos offered by cosmetic manufacturers is essential	Demonstrate: . Commercial dandruff remover shampoo	Discuss: . Types of detergents - pH values - Natural (soap) - Synthetic - Soapless oil Show film: . Illustrate structure of sebaceous glands	Test: . Detergent for - Alkaline reaction - Acid reaction
Know your products and how to use them	Review: . Basic shampoo techniques . Read and interpret manufacturers' instructions	Discuss: . Cost of materials . Service charge for conditioning shampoos in beauty salons . Types of specialized shampoos available	Student Project: . Develop a chart using ads fro trade ournals, newspapers, c magazines depicting various types of commercial shampoos and the manufacturers' claim . Develop a sales approach for recommending conditioning shampoos

.:T SHAMPOOS AND COLORLESS RINSES
Specialized Shampoos

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The operator should be alert to the individual needs of a patron with bleached and/or tinted hair	Demonstrate: . Shampoo techniques for bleached and/or tinted hair . Corrective shampoo on color streaked hair	Discuss: . Loss of artificial coloring from hair shaft - Causes - Effects Suggestive Sales Approach: . Need . Additional cost . Effect Introduce Types of Specialized Shampoos Available for: . Bleached . Tinted . Streaked hair	Discussion: . Determine type of shampoo required Analyze: . Color before and after shampoo . Experimental shampoo (Using a pastel blonde as mode - Shampoo one half of head with soap or oil shampoo - Shampoo one half of head with the proper specialize shampoo Student Project: . Make a chart of various specialized shampoos, name of manufacturer, and respective claims Observe: . Effects of conditioning shampoos: . Ease of comb-out . Appearance of hair . Appearance of scalp

Unit CARE OF HAIR AND SCALP Minimum Hours 30

GENERAL CONCEPT

An expert hair stylist can create a more beautiful coiffure on lustrous, healthy hair than on hair of poor quality. Therefore, it is in the best interest of both patron and operator to keep the patron's hair and scalp in good condition at all times.

A cosmetologist must be able to recognize abnormal conditions of the hair and scalp and develop the judgment to decide which condition may be aided by a hair or scalp treatment and which conditions should be referred to a dermatologist. The trainee must also become aware of the therapeutic value of a good scalp massage.

This unit deals with the anatomy of the head, recognition of hair and scalp disorders, and the various types of hair and scalp treatments.

OBJECTIVES

To develop manipulative skills and routines for effective scalp massage

To develop ability to recognize normal and abnormal conditions of scalp and hair

To develop judgment in determining and recommending the necessary treatment for the hair and scalp

UNIT CARE OF HAIR AND SCALP
Scalp Care

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Lovely, healthy hair is always admired	Demonstrate: . Preparation of supplies . Preparation of patron . Combing out tangles . Sectioning hair	Review: . Structure of hair and scalp Illustrate: . Common scalp disorders - Recognition of infectious orders . *Pediculosis Capitas* - Treatment Review: . Elementary bacteriology . Methods of sanitation	Student Project: . List scalp and hair disorder caused by internal physical conditions Oral Report: . Methods of tactfully informi patron of the presence of *Pediculosis Capitas* Review: . Sanitary precautions . Sterilization
Brushing is important to hair beauty	Demonstrate: . Preparation of supplies . Positioning operator . Techniques of brushing . Sterilization of comb and brush	Discuss and Illustrate: . Hair brushes - Sizes and shapes - Types of bristles . Purpose of brushing in sections . Effects of brushing on the hair and scalp . Scalp sensitivity . Importance of rhythm	Practice: . Techniques of brushing hair in sections . Sterilizing comb and brush
A relaxed patron is a happy patron	Demonstrate: . Manipulations of - Back - Back of neck - Scalp - Shoulders	Discuss: . Anatomy of the head . Physiological effects of massage . Types of movements . Reasons for each type of movement . Relationship of rhythm to massage . Motor points . Finger positions Prepare: . Series of charts - one for each movement . Instruction sheets Lead Discussion on: . Model's reaction to massage . Student's reaction to massage	Return Demonstration Study Proper Sequence of Movemen in Massage of Scalp

.:T CARE OF HAIR AND SCALP
Corrective Treatments for Scalp

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Lustrous hair will result from a healthy scalp	Review: . Sectioning the hair Demonstrate: . Application of ointment . Application of tonic	Discuss: . Composition of products for scalp and hair - Tonics - Ointments . Reasons for selection and use of ointments and tonics . Need for judging correct amount of tonic or ointment to be used Trade Mathematics: . Computation of time . Cost of materials . Charge for service Emphasize: . Safety factors . Sterilization	Determine: . Correct type and amount of material to use Practice: . Use of materials on members o class
The operator must be able to recognize the cause of the patrons' problem		Discuss: . Recognition of scalp disorders . Basic cause or causes of disorder . Scalp and hair disorders which may be treated in a beauty salon . Scalp and hair disorders which should be referred to a dermatologist	Student Project: . Examine a split hair under th microscope . Sketch and explain observatio Discuss: . Personal experiences with hair and scalp disorders . The importance of examining the scalp for disorders in relation to other services such as permanent waving or haircoloring

UNIT CARE OF HAIR AND SCALP
Corrective Treatments for Scalp

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Scalp disorders cause great embarrassment or discomfort to the patron Some disorders can be aided or relieved by scalp treatments	Review Techniques of: . Preparation of patron . Brushing hair . Routine of massage . Application of appropriate tonic, oil, or ointment . Shampoo techniques for removing corrective ointment and oil	Discuss: . Variations in the routine of treatment according to the condition of the hair and scalp, the products themselves, and the recommendations of the manufacturers . Amount of time recommended between treatments . Maintaining the patron's confidence in the operator's competency	Student Project: . Choose at least two commercia scalp ointments and tonics used and compare the manufacturers' claims
Heat increases the effectiveness of a scalp treatment	Demonstrate: . Electrical appliances used for treatment - Strong emphasis should be placed on the safety operation . Use of steamer . Use of therapeutic lights Use of Vibrator: . High frequency current - Direct application - Indirect application . Safety measures and sterilizing techniques for electrical equipment	Present: . Principles underlying the use of various appliances . The beneficial effects and limitations of each appliance Discuss: . The effect of heat or electricity on the patron . Availability and use of electrical equipment in the average beauty salon	Student Project: . Examine and handle electrical appliances . Observe all safety features List: . Five scalp disorders and recommend the most desirable scalp treatment for each

NIT CARE OF HAIR AND SCALP
Hair Reconditioning Treatments

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The condition of the patron's hair reflects the knowledge and skills of her beautician	Demonstrate: . Preparation of supplies . Preparation of hair . Application of cream . Adjustment of heating cap . Safety measures	Examine: . Damaged hair for - Appearance - Resiliency Review: . Hair structure - Texture - Elasticity - Porosity . Causes of damaged hair - Physical - Chemical - Systemic - Coating substances . Composition of conditioners - Oil base - Cream base . Effects of conditioners on the hair shaft . Variation in procedures for a cream-base conditioner, an oil base conditioner, and a protein conditioner	Observe: . Condition of model's hair to determine if a conditioner treatment is advisable or necessary . Condition of the hair before the treatment and after the treatment Student Project: . Using trade publications, make a list of commercial conditioners, manufacturers' clain type of base Evaluate: . Commercial products Return Demonstration Clinical Practice
The various types of hair conditions must be recognized for proper treatment	Examine: . Appearance and texture of scalp and hair . Test hair for damage . Common problems requiring conditioning shampoos - Appearance - Resiliency - Breakage	Review: . Function and structure of sebaceous glands . Internal cause of abnormal scalp conditions Discuss: . External causes of abnormal scalp conditions - Physical - Chemical . Recognition of normal hair and scalp	Student Project: . Prepare a microscope slide wi damaged hair - Observe structure

JNIT CARE OF HAIR AND SCALP
Hair Reconditioning Treatments

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The patron who has bleached or tinted hair has a special need for conditioning treatments		Discuss: . The importance of hair conditioners as a preventive measure as well as a corrective treatment . When it is advisable to eliminate the use of the heating cap . Which product or products will be most beneficial for each specific problem . Effects of bleach and tint on the hair shaft . Removal of coating substances . Effects of oil base conditioner . Effects of heat	Examine: . Bleached and/or tinted hair . Determine condition . Recommend proper treatment Discuss: . The need for a series of treatments or periodic treat ments
A series of conditioning treatments will usually insure correction	Discuss and Demonstrate: . Fast conditioning treatments	Discuss: . The value and need of a series of treatments to help alleviate a minor condition . Discuss need, cost, and expected results with patron in advance . Suggest products for supplementary home treatments if advisable . Recommended period of time between treatments	Discuss: . Sales techniques for suggesti instant conditioning treatment to busy patron List and Evaluate: . At least five commercial instant conditioners

Unit ~~PERMANENT WAVING~~ Minimum Hours 80

GENERAL CONCEPT

The truly admired woman is one who looks her best at all times. Her coiffure follows fashion trends, but is designed just for her. For many women this image is easily achieved. However, the woman with straight or stringy locks needs assistance from her hairdresser.

During the fashion era of curly hair, the permanent wave service was the business backbone of the beauty salon. However, with the spread of the home permanent wave and the vogue for the sleek, sophisticated look, the permanent wave service began to lose prestige.

Under the guidance of modern research, new lotions and techniques have developed permanent waving today into as individualized a service as coiffure designing. The degree of permanent curl can now range from a slight bend or body wave to one of luxuriant curliness.

This unit will provide the student with standard and modern techniques for permanent waving. An appreciation of the importance of permanent waving as a specialized professional service will be developed.

OBJECTIVES

To develop the skills and basic theory involved in modern permanent waving

To acquire judgment in the selection of the permanent waving solutions and rods most suitable for type and texture of the hair to be waved

To develop the ability to correct hair problems resulting from a poorly administered permanent wave

To develop an acquaintance with the products and techniques recommended by the leading manufacturers of permanent wave materials

JNIT PERMANENT WAVING
Cold Wave

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The shape and structure of hair can be changed		Discuss and Illustrate: . Theory of hair structure . Chemical composition of hair . Structure of keratin molecule . Composition of cold wave solutions and neutralizers . Chemical reaction of cold waving solution and neutralizer on the hair shaft Prepare: . Instruction sheets on reduction and oxidation process	Review: . Physical structure of hair . Hair porosity . Hair elasticity . Hair texture List: . Basic chemical terms and definitions Diagram: . Molecular structure of hair Experiment: . Place a sample of hair in processing solution overnight . Have students analyze results Discuss: . Effects of moisture on the hai shaft . Allow students to smell a bottle of processing solution . Identify another familiar product having the same odor . The similarity of cold wave solutions, hair straightening creams, and depilatories. . The possibilities of operators developing dermatitis venenata
Scalp abrasions or skin sensitivity can be dangerous	Demonstrate: . Preparation for a cold permanent - Arrange materials - Prepare patron . Examination of scalp for abrasions . Proper shampoo technique	Review: . Scalp disorders . pH value of shampoo Develop: . Reasons for using special shampoo and technique . When to towel dry	Student Project: . Examine five scalps . Determine in each case whether a permanent wave can be given

UNIT PERMANENT WAVING
Cold Wave

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
(Cont'd.)		. Reasons why preshampoos are sometimes omitted . Caution to be used with scalp abrasions Discuss: . The desired result depends on proper hair shaping	Discuss: . Precautionary measures
A smooth wind insures a beautiful foundation	Review: . Towel drying . Machine drying Demonstrate: . Basic sectioning of hair - Number of sections - Size . Application of processing lotion . Winding techniques - Sectioning - End papers and/or white wool crepe - Securing rod . Safe practices Compare: . Results of an uneven wind with an even wind . The relationship between the size of the rod and the size of the curl	Illustrate: . Reasons for both vertical and horizontal sectioning . Various sizes of cold wave rods Review: . Proportion . Angle Discuss: . Results of tension . Hair breakage . Pull burn . Solution collecting on scalp	Observe: . Flip charts . Note sequence of operations Evaluate: . Film slides on cold waving Review: . Texture of hair . Porosity of hair . Elasticity of hair . Condition of hair Experiment: . Stretch a single hair . Observe physical change
The success of a permanent wave depends on the knowledge and judgement of the operator	Demonstrate: . Method of taking a test curl - Select size of section - Select rod size - Wind curl - Time curl	Discuss: . Variety of cold wave lotions - Types - Strength	Student Project: . List the permanent wave products of various manufacturers; the selection of lotions offered by each manufacturer; the price ranges; and the claims of each commercial product

JNIT PERMANENT WAVING
Cold Wave

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
(Cont'd)	- Unwind and evaluate - Rewind curl . Safety precautions	. The effects of cold wave solutions on the - Skin (operator and patron) - Nails (operator) . The texture and conditioning of the hair and the amount of curl desired determine the strength of the lotion used . Factors which determine proper processing time - Effect of overprocessing - Effect of underprocessing Discuss: . Reasons for hair breakage - Amount of tension - Strength of solution - Excessive lotion lodged under fasteners	Evaluate: . The advantages and disadvantages of several different commercial products Discuss: . The price of permanent waves in beauty salons
Proper neutralizing is the final step	Demonstrate: . Prepare neutralizer (if necessary) . Apply neutralizer - Instant - Timed . Rinse (if required) . Remove rods . Use safe procedures	Review: . Molecular theory of hair structure . Composition of neutralizer . Chemical reaction of neutralizer . Variety of cold wave neutralizers - Types - Methods of application - Timing requirements . Manufacturers' recommendations . Safe contact with skin and hair	Student Project: . Fasten two pencils together with three rubber bands at top and bottom and one in middle . Observe strength of pencils, and firmness of banding . Cut top and bottom rubber band . Observe how pencils can now be rearranged . Cut remaining band, so that pencils fall apart . Compare the analogy to the S-S linkage of the hair If all bands are broken and not reformed hair will lose its flexibility and strength and break off Review: . Complete cold wave procedure . Safe procedures

UNIT PERMANENT WAVING
Cold Wave

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The hair style determines the sectioning pattern to be used	Demonstrate: . Stylized methods for sectioning: - Relation between the style desired and the selection and placement of rods	Explain: . Difference between a body wave and a standard permanent wave . Reasons for permanent waving of only those areas deemed necessary Review: . Size of rods . Strength of solution	Student Project: . Choose at least four differe hair styles . Develop a permanent wave pattern to suit each style and identify the size of rods to be used with the pattern Field Trip: . Trade shows . Visit various permanent wave booths . Observe sectioning patterns, winding techniques, and sales approaches of the demonstrators . Report findings . Evaluate reports Observe: . Films or slides on cold wavin . Demonstration by manufacturer representative
Keeping records is an integral part of the permanent waving service	Illustrate: . Record card - Information required - Use of card - Types of cards	Review: . Importance of record cards - Legal instrument - Reference - Mailing list - Check or inventory - Price . Record card content - Date - Operator's name - Type of solution - Processing time - Results of wave - Patron's reaction	Discuss: . Information record on card . Evaluate amount of informatio necessary Clinical Practice: . Fill out record card for each permanent wave given

'NIT PERMANENT WAVING
Correction Wave

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Problem hair offers a challenge to the knowledge and skill of the operator	Demonstrate: . Bleached hair - Size of sections - Winding techniques . Resistant hair - Size of sections - Winding techniques	Analyze: . Most common types of problem hair - Bleached hair - Resistant hair - Extremely fine hair - Old permanent wave on ends - Dry, brittle hair - Hair that is partially bleached or tinted Explain: . Methods of treating each problem . Examine the hair for - Condition - Texture - Porosity - Cause of problem - Desired result	List: . Familiar permanent wave problems and ways of solving them Discuss: . The value of knowing how to handle problem hair to - The operator - The patron - The shop owner Analyze: . The basic principles of permanent waving and hair structure and how most problems can be solved
The patron does not have to struggle with a poor permanent wave	Demonstrate: . Method of relaxing overprocessed or tightly-curled hair - Shampoo hair - Apply processing lotion to desired sections or complete head - Rinse - Neutralize	Explain: . Methods of - Relaxing hair curled too tightly - Aiding overprocessed hair - Aiding underprocessed hair - Handling a Re-do wave Review: . Causes of each problem . Characteristics of overprocessed hair - When dry - When wet . Effectiveness and protective qualities of reconditioning creams	Clinical Practice List: . Causes of overprocessed hair . Causes of underprocessed hair

UNIT PERMANENT WAVING
Corrective Wave

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
A busy cash register doesn't always mean profits		Determine: . Cost of products . Cost of labor . Cost of service . Cost of waste . Overhead charges Direct discussion: . Sales approach - Thorough knowledge of the qualities of the products featured in the salon . Effective presentation of this knowledge to patron	Discuss: . How to handle a patron with a complaint . Should an operator discuss th work of another operator or salon? . Profit derived from a single permanent wave Student Project: . Develop a sales approach - To a patron who is undecide as to the price permanent wave she desires - To a patron who wants the cheapest permanent wave in the salon - To a patron who has bleache or tinted hair - To a patron who requires corrective work . Present sales demonstration to class

UNIT PERMANENT WAVING
Machineless (optional)

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The patron allergic to cold wave solutions can still enjoy lasting curls	Display and Demonstrate: . Machineless equipment and small tools - Felt protectors - Spacers - Rods - Smoothing pin . Demonstrate each step required Demonstrate: . Preparation and arrangement of supplies . Sections . Vertical . Horizontal (overall pattern for the head) . Use of felt protectors . Use of spacer . Techniques of winding	Discuss: . Purpose of permanent waving with heat . Effect of alkaline solutions on the hair . Effect of heat and cold on the hair . Variations in the strength of the solutions . Function and composition of pad for machineless waving . Review elasticity, porosity, and texture of hair Review: . Techniques of hair shaping in relation to permanent waving . Size of sections in relation to thickness, texture of hair, and degree of curl desired by patron . Effect of size of rod, thickness of hair strand, strength of lotion, and steaming time on the finished permanent wave	Discuss: . Developments in the types of solutions used, from the mil alkaline solutions to the thioglycolates . Why some salons still give machineless permanent waves Experiment: . Effect of moisture on machineless pad
Skill plus knowledge is the formula for avoiding mistakes	Demonstrate: . Making test curls - Apply machineless pad - Remove pad - Cool the hair - Remove the rods, spacer, and felts . Preventive measures against pull- and heat-burns	Discuss: . Purpose of test curls . Where to give test curls . Factors that determine processing time for test curls . Winding tension . Machineless products available . Possible unsatisfactory results - Frizzy ends - Uneven waves - Loose waves - Breakage of hair Review: . Value of reconditioning treatments on dry, brittle hair . Necessity of keeping records	Return Demonstration Evaluate: . The completed test curl Student Project: . Determine cost of machineless wave based on - Cost of supplies - Cost of labor - Overhead costs . Compare cost of cold wave and machineless wave Discuss: . Effects of cream rinse on permanent waves which are too tight

Unit HAIR STRAIGHTENING Minimum Hours 80

GENERAL CONCEPT

As current fashion decrees hair styles that emphasize contour and design instead of excessive curl, the patron with extremely curly hair has a definite problem. However, this condition can be temporarily corrected by either a physical or a chemical method. This unit deals with accepted procedures in straightening hair, the methods available, the composition of the chemical relaxers, as well as techniques for suggesting this service.

OBJECTIVES

To develop the special skills required for temporary straightening of hair

To develop the skill required to wet-style pressed hair and to introduce the various products available for this service

To develop the skill required to produce the croquignole marcel curl and the thermal curl as styling techniques for pressed hair.

To understand the methods of application and develop skill in the use of chemical hair straighteners

Notes: It is advisable to practice the techniques involved on a weft, until a degree of proficiency has been achieved

UNIT HAIR STRAIGHTENING
Hair Pressing

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Quality equipment demands professional care	Demonstrate: . Types of pressing combs . Cleansing thermal irons and combs . Operation of heater . Testing temperature of pressing comb . Method of testing temperature of thermal iron . Storage of equipment	Discuss: . History of straightening of hair . Care and cleanliness of the equipment used - Pressing comb - Marcel thermal iron - Heater . Safety measures Display and Discuss: . Pressing combs - Quality and prices - Sizes - Types . Marcel thermal irons - Quality and prices - Sizes - Types of handles . Types of heaters . Points to observe when choosing equipment	Return Demonstration: Quiz of Safety Precautions: Identify Parts of Iron:
Excessively curly hair must be correctly prepared before it can be pressed	Demonstrate: . Shampoo technique . Drying hair . Sectioning techniques - Basic sections - Subsectioning . Applying pressing cream	Emphasize: . Importance of clean hair and scalp preceding pressing treatment Explain: . Various methods of sectioning according to texture of hair	Practice: . Correct sectioning techniques . Estimate amount of pressing cream to be used
A temporary pressing treatment not only removes excessive curl but also leaves the hair soft and lustrous	Demonstrate: . Pressing techniques - Sectioning - Manipulation of pressing comb - Manipulation of wrist and hand	Discuss: . Factors to be considered - Texture of hair - Elasticity of hair - Flexibility of scalp . Structure of tightly-curled hair - Physical change in hair shaft	Practice: . Manipulation of hot comb on weft to improve hand and wri . Sectioning and pressing model hair

NIT HAIR STRAIGHTENING
Hair Pressing

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
(Cont'd.)		Discuss: . Effects of moisture on hair . Effects of heat on hair . Precautionary measures . Treatment of minor scalp burns . Advantages and disadvantages of a soft press	Experiment: . Observe a hair heated gently in a test tube . Draw conclusions of effect of heat on hair
Wiry hair may require a hard press	Demonstrate: . Procedure for a hard press . Use of pressing comb . Use of marcel iron	Explain: . Variations between a hard press and a soft press . Type of hair requiring a hard press . Composition and action of pressing creams . Problem heads requiring special care - Tinted and bleached - Gray hair - Fine, woolly hair - Porous hair . Effect of reconditioning treatments . Importance of frequent reconditioning treatments	Student Report: . Read book on hair pressing . Read articles in trade journals on hair pressing
Pressed hair needs an occasional retouch	Demonstrate: . Touchup techniques - Use small iron for hairline sections	Discuss: . Results of excessive heat . Amount of pressure . Hair breakage problems . Accidental burns - First aid treatments	Return Demonstration

UNIT HAIR STRAIGHTENING
Wet Setting of Pressed Hair

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The patron who desires the latest in hair fashion will prefer a "wet set"	Demonstrate: . Preparation of hair - Application of waving cream - Amount of tension required - Use of rollers - Drying hair	Explain: . Types of gels, creams, lotions, and conditioners . Variations in drying time - Hair texture - Hair condition - Hair porosity - Hair elasticity Discuss and Compare: . Croquignole, marcel, and wetting of hair - Advantages - Disadvantages	Return Demonstration
Sleek or bouffant wet setting gives the hair a chic finish	Present: . Comb-out techniques - Back-combing - Brush teasing - Shaping - Use of hair spray		Student Project: . Duplicate styles in trade journals

JNIT HAIR STRAIGHTENING
Croquignole Marcel on pressed hair

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Manipulative skills are required for the correct formation of a thermal curl	Demonstrate: . Techniques of holding roll open and closed . Inserting iron . Forming curl . Manipulating iron to form curl . Guiding hair strand . Roll and click technique . Completing the curl . Cooling hair	Discuss: . Origin of name . Comparison of thermal curls with bob curls . Sizes of irons - Small or bobby iron - Medium - Jumbo or bouffant iron . Temperature of irons - Effect of heat on hair - Effect of natural moisture - Control temperature of iron . Importance of dexterity in fingers and wrist . Safety precautions . First Aid	Practice: . Exercise techniques - Forming curls with cold iron - Forming curls with hot iron on weft - Follow instruction sheets step-by-step Discuss: . Safety and first aid Student Project: . Use instruction sheet to follow procedure for State Board pattern for thermal curling
A croquignole marcel or thermal curl can be used to practice a variety of styles	Demonstrate: . Formation of a croquignole curl - Basic sectioning . Comb-out techniques - Brush hair - Shape hair into desired style - Form line and contour - Spray finished style	Discuss: . Importance of uniform sectioning . Interlocking of curls . Hair texture and section size . Pattern of sectioning for desired style	Student Project: . Thermal curl an entire head - Comb out into three differe styles . Croquignole marcel curl an entire head - Comb out into three differe styles

JNIT HAIR STRAIGHTENING
Chemical Method

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Chemical hair relaxing has become a popular service	Demonstrate: . Methods of procedure, sodium hydroxide type - Prepare supplies - Section hair - Apply base - Apply relaxer to root area - Smooth out relaxer - Apply relaxer to hair ends - Rinse out relaxer - Apply neutralizer shampoo - Apply stabilizer	Review: . Molecular structure of hair . Texture . Elasticity . Effects of moisture on hair Discuss: . Chemical composition of products used - Neutralizer - Stabilizers . Why heat may not be used . Variations in timing and tension required . Relationship between composition and action of cold wave lotion and hair relaxers . Safety in use of chemicals - Chemical burn - Scalp irritation - Allergic reaction - Condition of hair - Hair breakage . Importance of following manufacturer's instructions Advantages: . Permits wet styling . Longer lasting Disadvantages: . Skin irritations . Hair damage Commercial products available:	Student Project: . Become familiar with products . Handle jars, read labels . Check consistency of products Practice: . Techniques of applying cream shampoo . Consultation with patron befo service . Following manufacturer's instructions . Clinical practice Compare: . Hair straightening products advertised in trade journals
An accurate record of each chemical hair relaxing treatment must be kept	Prepare: . Sample record card . Sample release statement	Elicit Response: . Information to be listed on a record card	Student Project: . Fill out sample record card

UNIT HAIR STRAIGHTENING
Chemical Method

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
(Cont'd.)		. Value of record cards to - The patron - The operator - The salon owner Review: . Porosity and elasticity of hair Discuss: . Causes of hair breakage . Condition of hair . Prevention of hair breakage Discuss: . Value of reconditioning treatments . Pros and cons of hair-relaxing treatment versus hairpressing treatment . Value of operator knowing all branches of the trade - Economic - Prestige . Average cost of straightening service	Discuss: . Value of records Committee Report: . Information on chemical relaxers - Products - Procedure - Pros and cons of each type of chemical relaxers - Trade benefits - Safety

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Unit HAIR SHAPING Minimum Hours 60

GENERAL CONCEPT

Trends in coiffures change yearly. Despite change, the most important element in styling is the correct shaping of the hair. A well-designed haircut serves to shape the hair to the contour of the head, enhancing the patron's appearance. Hair shaping is the professional term used to indicate the process involved in shortening, thinning, and tapering the hair to the desired contour. The shaping of hair is a service that requires judgment and imagination as well as knowledge of the texture, quality, and quantity of hair. Good judgment combined with mechanical skill will instill in the patron a feeling of confidence and trust in the operator's ability to plan and carry out a style designed just for her. This unit deals with the techniques involved in hair shaping and the related art principles that may be utilized to develop creative ability and judgment.

OBJECTIVES

To acquire skill in the correct use of the basic tools of hair shaping

To understand the importance of expert shaping as a foundation for hair-styling and permanent waving

UNIT HAIR SHAPING

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
A masterful use of the scissors can achieve balance and proportion	Discuss and Demonstrate: . Parts of the scissors . Parts of the thinning shears . Position of fingers . Opening and closing of scissors . Cutting . Holding the comb and scissors . Safety precautions	Introduce: . Types of implements - Scissors - Thinning shears - Haircutting comb - Clipper . Importance of correct - Shaping and balance - Proportion . Terminology - Effilating - Slithering - Blunt cut - Taper	Practice: . Techniques of cutting hair List: . Safety precautions in hair-cutting . Develop vocabulary list and definitions of haircutting terms
Correct sectioning is an invaluable aid to the beginner	Demonstrate: . Five-section technique for basic shaping . Basic sectioning - Guide line - Nape section - Crown section - Top section - Side sections Explain: . Sterilization of metal implements . Preparing the patron	Discuss: . Importance of sectioning - Use wall chart	Practice: . Basic sectioning to develop accuracy and skill Return Demonstration Observe Slides On: "Dry Haircut With Scissors" Evaluate Techniques Illustrated
How, when, why, and where to shape is the key to good haircutting	Demonstrate: . Basic haircut on hair of medium length. Stress importance of shaping to the contour	Analyze: . Relationship of hair shaping to hair styling - Style desired by patron - Length of hair desired in each section - Line and movement of style - Analysis of individual patron Body structure Shape and size of head Contour of head, neck, and features	Student Project: . Give basic haircut

UNIT HAIR SHAPING

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The decision to thin or not to thin requires expert judgment	Demonstrate: . Locating areas of bulk . Sectioning . Manipulating thinning shears . Thinning techniques Demonstrate: . Thin and shape one side of a model's head . Comb into a flowing line	Explain: . Shaping and thinning - Difference between types of hair that require thinning . Purpose of thinning . Importance of thinning . Combining, shaping, and thinning Discuss: . Compare the difference in appearance and bulk between each half of the model's head	Observe: . The difference between the thinned side and the bulky side
The professional skillfully uses varied tools and techniques	Demonstrate: . Parts of the razor . Techniques of handling razor and comb . Razor shaping . Sectioning . Angle at which strand is held . Pressure of stroke . Angle of blade on strand to - Thin - Taper - Blunt	Explain: . Care of the razor . Sterilization of razor Discuss: . Relationship of angle at which razor is held to the amount of hair to be tapered or thinned . Advantages of razor shaping Explain: . Why razor shaping is done on moist hair . The degree of elasticity in wet hair . Why overly-saturated hair becomes heavy . The danger of misjudging desired length and effect on finished shaping	Return Demonstration: . Cut sample strand on weft with razor List: . Advantages . Disadvantages Observe slides: . "Razor Haircutting" Experiment: . Take two sample strands of hair . Have one dripping wet, the other one correctly moistened . Allow students to stretch and measure each strand to illustrate that very wet strand will stretch more than the correctly moistened one
Expertly tapered and thinned hair behaves and falls into line when the patron combs her own hair	Review: . Basic shaping techniques - Sectioning of hair . Thinning techniques using - Thinning shears - Haircutting shears - Razor	Review: . Safety precautions	Review: . Basic sectioning . Safety precautions . Use of each technique

UNIT HAIR SHAPING

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The tapered neckline serves as a foundation for many styles	Demonstrate: . Tapered neckline - Position of hand, comb, and scissors . Techniques of tapering . Manipulation of scissors and comb . Shingle haircut . Cleaning neck area - Use of clippers - Use of scissors - Use of razor	Discuss: . Removal of bulk . Relationship of the shingle to men's and boys' haircuts . Need for constant practice to develop skill . Direction of hair growth at nape area	Practice: . Tapering necklines . Shingle technique
A stylized shape is in each new fashion trend	Demonstrate: . Current trends	Discuss and Compare: . Current and past trends . The relationship of previous trends to present trends . Similarities between trends . Adapting past trends to the present fashions	Panel Report: . "Haircutting, Past and Present; Trends and Techniques"

UNIT HAIR SHAPING
Cutting Children's Hair

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The children of today become the patrons of tomorrow	Discuss: . Shape of head . Texture of hair . Growth patterns - Natural - Cowlicks Demonstrate: . Measure length of hair in each basic section . Finished style must not depend on any type of setting or curling	Discuss: . Psychology of approach - Obtain child's confidence - Alleviate child's fear - Reward for good behavior - Build child's pride in being well-groomed . Age differences Explain: . Importance of correct shaping of children's hair from a practical point of view . Age of child . Parents' preference . Ease in home care Discuss: . Relationship of length of hair to region of head	Individual Report: . "How to Put a Child at Ease" Student Project: . Compile and label a group of pictures illustrating various children's hairstyles for difficult age groups - Age 1 to 4 - Age 5 to 9 - Age 10 to 13 Determine: . The correct length of hair required for each section on the head in order to achieve each style selected

Unit HAIRSTYLING

Minimum Hours 200

GENERAL CONCEPT

All phases of hairdressing and hairstyling are dependent upon a thorough knowledge of fundamental skills, familiarity with the principles of line and design, and a creative imagination. In order to become an outstanding hairstylist, a firm foundation and complete mastery of the basic skills are necessary. In hairstyling the artistic imagination combines the basic forms of styling to produce becoming coiffures. This unit deals with such basic factors as the mechanical processes required for forming curls and waves, and the composition and effect of the supplies used. The related art principles in the techniques of styling and comb-out are included. This unit stresses the importance of the complete mastery of fundamental techniques and procedures.

OBJECTIVES

To understand that the basic qualities of a good curl are few, but vital, and should be mastered

To master the techniques involved in the use of rollers, and to become familiar with the variety of styles that can be achieved with them

To develop the art of shaping wet hair into an artistic wave pattern

To develop the ability to combine basic hairstyling techniques to produce a style pattern

To develop the skill required for artistic comb-outs

UNIT HAIRSTYLING

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The mannequin is always an available model	Demonstrate: . Care of the mannequin - Combing hair - Wetting hair - Securing the net - Drying the hair Demonstrate: . Correct techniques for forming various kinds of parts	Explain: . Types and use of mannequins . Wave set solutions - Purpose - Effect of moisture on the elasticity of hair - Effect of heat on hair Discuss and Illustrate: . Optical illusions that may be created by different angles and lengths of parts . Relationship of part to - Contour of head - Shape of features - Shape of face - Cowlicks and swirls - Hairline	Return Demonstration: Practice: . Different types of partings
The type of foundation or base used for each curl serves a definite purpose	Demonstrate: . Evenly divided rows of curls, each approximately same size . Variations in size of curls depending on desired style	Show and Explain: . Curl foundations or bases - Square - Oblong - Triangular - Arc . Sectioning - Texture of hair - Size of section - Amount of hair . Relationship of base used to finish a style	Practice: . Formation of different curl foundations
A curl, whether it be sculpture or pin, consists of three parts: Base Stem Ends	Demonstrate Basic Curl Techniques: . Ribbon wind from scalp to ends of hair - Comb hair - Stretch hair - Form curl - Secure curl ends	Illustrate: . Related art . Geometric forms Discuss: . Various types of curls . Why and when each type is used	Practice: . Formation of curls, stressing achievement of skill and speed

UNIT HAIRSTYLING

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
(Cont'd.)	. Loop wind from ends to scalp - Hold strand - Loop end - Roll curl - Secure curl . Cascade (standup) - Support - Shape - Secure curl		
As the stem goes, so goes the curl	Demonstrate and Discuss: . Forward curl - Stem direction - Position of curl - Correct angle in relation to hairline . Reverse curl . Various stem direction	Discuss: . Related art - Line - Functional design . Effects achieved	Experiment: . Determine various effects achieved by combing directional curls
A sculpture curl setting lends itself to a variety of comb-outs	Demonstrate: . Comb-out techniques - Use of pomade - Use of brush - Use of styling comb - Placement of hair - Use of hairspray	Effects Achieved by Placement of Curl and Stem Direction	Student Project: . Have a styling contest . Plan and execute a simple style using directional curls and various bases . Students select winner
High, wide, and handsome results are obtained from roller styling	Demonstrate: . Sectioning - Width of roller determines width of base - Length of roller determines length of section - Direction of roller . Placement of hair on roller - Spread hair evenly - Angle at which strand is held - Wind (tension)	Discuss and Illustrate: . Types of rollers - Kind - Size . Relationship of roller size to style . Relationship of direction of roller to style - Vertical - Horizontal - Forward - Reverse	Return Demonstration

UNIT HAIRSTYLING

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
(Cont'd.)	- Position roller on base - Secure roller . Use of end papers or wool crepe . Various method of securing roller - Pins - Clips - Picks	Discuss: . How angle at which hair is held affects strength and durability of curl	Practice: . Winding rollers with and without end papers . Directional winding of rollers
A variety of styles may be created with the use of rollers	Show and Demonstrate: . Varied patterns - Combination of rollers and pin curls Comb-out Techniques: . Teasing - brush and comb - Back-combing - Feathering - Lacing - Foundation (buildup) . Smoothing . Shaping Review: . Use of pomade . Use of brush . Use of styling comb . Use of hair spray	Discuss: . Advantages and disadvantages of roller settings Review: . Related art principles - Height - Width - Silhouette - Dimension - Forms - Illusion	Student Projects: . Reproduce patterns of roller styles from trade journals . Reproduce an historical hairstyle . Using the same silhouette, design and execute a modern adaptation
Waving is a basic technique of artistic hairstyling	Review: . Preparation of mannequin - Wet hair - Comb free of tangles - Part hair . Demonstrate - Prepare patron for wet work - Apply lotion - Mold hair in correct direction	Explain: . History of finger waving - Present status . Fingerwave lotion - Composition - Purpose	Return Demonstration

UNIT HAIRSTYLING

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Artistry in the use of the fingers and comb will produce a beautiful wave	Demonstrate: . Form right-going wave - Position of operator - Hold comb - Form a ridge - Drop a ridge . Form left-going wave . Combine left and right to form a complete wave . Match a ridge . Match a wave . Form a shadow wave at crown . Wave entire head of hair . Finish ends of hair	Discuss: . Types of hair best suited to fingerwaving . Hair texture . Lines of natural hair growth . Elasticity of wet hair . Relationship of hair parting to contour of head . Shapes and sizes of heads Discuss and Illustrate: . Need for constant practice to develop finger dexterity and waving skill . Reason for constant combing	Observe and Compare: . Model 1 - hair properly combed and stretched during formation of wave . Model 2 - hair not correctly combed and stretched
The harmonious blending of ridges and curls completes the contour	Review: . Ridge formation Demonstrate: . Form ridge curl - Sectioning for curl - Formation - Placement . Comb-out technique	. Styling patterns that require the use of ridge curls Define Terminology: . Carved curls . Backup curl . Stretch base	Student Project: . Select styling patterns from trade magazines . Execute style selected
Wide, deep, and flowing lines lend beauty to many styles	Demonstrate: . Skip wave pattern - Shape hair - Form ridge - Form and secure ridge curls - Form second ridge - Complete	Discuss: . Related art . Symmetry . Illusion of depth	Return Demonstration

UNIT HAIRSTYLING

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Hairstyling is a combination of mechanical skills artistically used to create an illusion of beauty	Demonstrate: . Model analysis - Facial contour - Body structure - Shape of head - Texture, length, and condition of hair . Current trends - Selection of style - Combination of techniques used . Review comb-out techniques	Discuss: . Suitability of style - Body structure - Age - Occupation	Student Project: . Select a model - Design and sketch a suitable style - Execute style on model - Evaluate results

Unit HAIRCOLORING Minimum Hours 140

GENERAL CONCEPT

The art of haircoloring is an ever-changing and challenging subject. Today's demand for expert haircolorists stems from the age-old axiom that "the luxuries of one generation become the necessities of the next." In our fashion-conscious civilization, haircoloring is rapidly becoming a necessity for most women. Men are also becoming aware of the values of haircoloring. The natural pigment of the hair can be lightened, brightened, rinsed, tinted, and toned. There are many diversified haircoloring products on the market today, including one to satisfy the patron's slightest whim or need.

The term "haircoloring" here means any change in the shade of the hair either by bleaching to a lighter shade or changing the shade by temporary or permanent colorings.

Today, patrons need and demand proficient haircolorists who are thoroughly acquainted with the complete range of haircoloring products from the leading manufacturers, and their various methods of application. The operator must be able to analyze the patron's needs and/or desires, the quality, texture, and pigmentation of the hair, and the health and condition of the scalp. The proficient operator must also possess a thorough knowledge of color harmony and have or develop a discerning eye for color variations. Training and background are necessary for the haircolorist to develop the ability to consult with and advise a patron. One of the most important aspects of haircoloring services is winning the patron's confidence in the judgment and skill of the haircolorist.

This unit provides a broad introduction to the field of haircoloring. However, for the operator to develop competence in this area, advanced training and practice will be required. The wise operator will take advantage of the numerous courses offered, free of charge, by leading manufacturers of haircoloring products.

OBJECTIVES

To understand and evaluate temporary and permanent haircoloring products and their respective effects upon the hair

To acquire knowledge of the theory of hair bleaching and to understand when the rapid decolorizing process is needed

To be aware of the many problems that may arise and methods used for correcting them

To develop the ability to advise a patron on individual haircoloring needs

UNIT HAIRCOLORING

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
For the conservative patron who desires a dash of color or a highlighting effect, temporary coloring is advised	Discuss: . Preparation of supplies . Methods of application . Safety precautions Demonstrate: . Various methods of application	Discuss: . Types and composition of temporary rinses . Effect of the combined certified color and acid base on hair . Why some types of hair absorb a rinse more quickly than others . Lasting quality of color . Selecting a shade - Relationship between the natural shade of the patron's hair and the shade desired . Advantages of color rinses . Limitations of color rinses . Series of tone - Drab shades - Red or gold shades - Silver and grey shades . Cost analysis - Labor plus supplies - Price of service - Profit to shop owner Evaluate: . Rinse formula variations - Water-mixed rinses - Rinses requiring direct application Display: . Charts of range of colored rinse - Selection by personal preference	Discuss: . Importance of reading manufacturer's instructions Student Project: . Apply color rinse on hair samples of varying textures and porosity - Vary timing List: . Uses of temporary colored rinses . Select rinse most satisfactory for model . Check and discuss results . Read labels on various types of rinses . Compare information Review: . Liquid measurements Experiment: . Check results . Place a piece of yellowed white wool in bluing rinse - Check results
Temporary color is an accessory for special occasions	Demonstrate: . Effects produced by clever use of color spray . Use of crayons	Evaluation: . Use and composition of - Colored hair spray - Crayons	Student Project: . Design a hair style using colored spray for a dramatic effect . Use crayon in clinical practice

UNIT HAIRCOLORING

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Semipermanent coloring is best for the discriminating patron who desires a subtle change of color	Demonstrate: . Patch test - Prepare supplies - Prepare skin - Apply coloring . Safety precautions	Discuss: . Composition of semipermanent colorings . Necessity for a patch test . Federal Food and Drug Act requirements . Features of semipermanent hair colorings . Types of semipermanent colorings - Intensifying gray - Covering gray - Adding color and highlights to natural shades of hair	Compare: . Temporary colorings and semipermanent colorings Student Project: . Give patch test . Observe results Library Assignment: . Do research on Federal Pure Food and Drug Act
A rinse may be suggested to the patron who wants to hide gray but who does not want a tint	Demonstrate: . Precautionary measures - Examine scalp - Protect clothing - Wear gloves . Selection and arrangement of supplies . Application techniques - Follow manufacturer's instructions . Mixing colors to develop shades	Illustrate and discuss: . Color range . Ash shades . Gold and warm shades . Variations in timing . Advantages and limitations of this series . Mixing two or more colors to produce individualized shadings Discuss: . Problems that can arise - Build up of color - Change to a lighter shade - Change to a darker shade - Application to newly permanent-waved hair Consult: . Color charts	Evaluate: . Preliminary test of hair strand Return Demonstration Clinical Practice List: . Advantages of this service to patron and salon owner - Economic - Time-saving - Social Discuss: . Why these problems may arise and how they can be corrected Field Trips: . To hair coloring centers . To trade shows Develop: . Techniques for subtle selling of semipermanent rinses Student Project: . Prepare several rinses and apply

UNIT HAIRCOLORING

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Gray hair can be charming and sophisticated	Review: . Application techniques . Precautionary measures Discuss and demonstrate . The blending and mixing of various shades	Discuss: . Purpose of the silver series . Effect on hair shaft . Select shade - Determine percentage of gray - Determine patron's preference of tone . Variations in timing to achieve desired effect . Suggestions and hints for - Refresher treatments - Extremely yellowed hair - Permanently waved hair . Sales techniques - Advantages of the silver series . Initial cost compared with upkeep . Display and use color guide selector charts	Field Trip: . To trade show Return Demonstration Compare: . Temporary and (semipermanent) silver series
Drab hair can be brightened	Demonstrate: . Preparation of supplies . Pre-shampoo . Application of coloring lotion . Follow manufacturer's instructions . Removal of semipermanent colorings	. Specialized purpose of this series - Advantages - Limitations . Range of shades . Selection of shade . Removal of coloring - When - Why . Compare costs, quality, and selection of available commercial products	Recognize: . Problem heads . Methods of correcting problems . How this service can be an introduction to tinting services Elicit: . How to blend and mix colors for a desired effect
Records are a vital part of the hair coloring service	Demonstrate: . Preparation of a sample record card	Discuss: . Importance of keeping a record of coloring service - To the patron - To the operator - To the salon owner	Assignment: . Develop a list of good reasons for keeping records . Fill out a record card for each coloring service given in the school shop

UNIT HAIRCOLORING

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Haircoloring has developed from use of vegetable roots and leaves to the magic of modern chemistry	Demonstrate: . Use blotter test to illustrate oxidation of aniline Derivative tint . Test for predisposition or patch test	Discuss: . History of haircoloring Show Samples and Discuss: . Coating-type tints - Vegetable - Metallic compounds . Penetrating-type tints - Aniline derivative tints Discuss: . Aniline derivative tints - Chemical composition - Source - Related compounds - Ingredients - Common names . Use of hydrogen peroxide as - Oxidizing agent - Bleaching agent	Review: . Federal Food, Drug, and Cosmetic Act Panel Report: . "The Historical Development of Hair Coloring" Experiment: . Prepare sample strands using Egyptian Henna and aniline tint . Compare and analyze results Study Wall Chart: . "Destructive Distillation" Student Project: . Prepare sample strands using various shades of tints . Give a test for predisposition . Observe results
A change in the color of her hair heightens a woman's spirit and beauty	Demonstrate: . Preparation of patron . Sectioning of hair . Apply tint to virgin head with applicator . Applying tint to virgin head with brush	Discuss: . Color analysis . Consultation with patron . Selection of shade . Types - Shampoo tints - Permanent tints - Toners Review: . Hair characteristics - Porosity - Elasticity - Texture	Student Project: . Use manufacturer's color chart to select shade desired Practice: . Application of tint with brush (using water) . Application of tint with applicator using fingerwave lotion

UNIT HAIRCOLORING

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The new growth requires attention	Demonstrate: . Retouching tint - Size of partings - Technique of application - Blending tint to ends of hair . Safety precautions	Review: . Record card - Results of patch test - Pertinent information Discuss: . Effects of overlapping Elicit: . Reasons why women (and men) would want to color their hair	Practice: . Retouch using brush . Retouch using applicator bottle and cream rinse
The patron should be advised of the upkeep, time, and cost involved		Discuss: . Consulting services - Approach - Attitude - Cost - Ethics	Student Project: . Establish a haircoloring consultant service in the clinic

UNIT HAIRCOLORING
Toners

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Subtle shades of high-fashion blonding are achieved by the use of toners	Review: . Decolorizing of hair . Test for predisposition . Strand test to determine final shade . Examination of scalp	Illustrate: . Range of shades of toners Discuss: . Purpose of toning . Selection of shades - Complexion tones - Pigmentation of hair - Amount of decolorization - Need for additional lightening treatments - Products available	Student Project: . Study color charts . Evaluate and choose shades that are complimentary to patron
Custom-created shades are obtained by the artful mixing of colors	Demonstrate: . Arranging materials . Preparing patron . Preparing and applying prelightener . Taking strand test . Removing prelightener . Towel-drying hair . Applying toner to root of hair . Blending toner through entire strand . Testing for color development . Rinsing and shampooing . Safety precautions Review: . Tint record card	Explain: . Mixing of colors to produce desired shade . Use of drabbers Discuss: . Degrees of porosity . Lasting quality of toners . Importance of recording accurate data	Student Project: . Develop a color chart using hair swatches of various shades
A frequent retouch will freshen color	Review: . Bleach retouch . Predisposition test . Preparation of patron and materials . Use of electrical equipment to speed up action	Present Film: . "Bleach, Retouch and Toner" Review: . Hair porosity	Student Projects: . Observe film . Develop a list of the "do's and don'ts" of tinting and toning Clinical Work

UNIT HAIRCOLORING
Toners

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
(Cont'd.)	Demonstrate: . Application of bleach and toner retouch		
Delicate blonde shades require special care	Demonstrate: . Method of restoring color that has faded	Discuss effects of: . Chlorine . Sun . Detergents . Oxidation . Preventive care	Experiment: . Use swatches of toned hair to illustrate damaging effects . Observe and compare

UNIT HAIRCOLORING
Corrective Treatments

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Careful analysis is needed for solving color problems	Demonstrate: . Analyzing of problem - Condition of hair - Color variations - Desired shade . Method of correction	Discuss: . Type of problems - Resistant hair - Overporous hair - Discoloration - Fading - Red shades - Dark streaks - Permanently waved hair - Chemically straightened hair	Experiment: . Examine samples of damaged hair under microscope . Compare with samples of normal hair Review: . Patch test Return Demonstration When Possible
It is important to be progressive, to know and to use new products	Demonstrate: . Preliminary strand test - Need for fillers - Selection of filler - Condition of hair - Effects of filler . Safety precautions	Discuss: . Function of fillers - Reconditioning - Shading . Uses - To correct condition of hair . Various trade products	Student Project: . Report on pertinent articles in trade magazines . Use color selector to determine classification of shade
Tint removers make rapid changes in color easier	Demonstrate: . Selection and preparation of materials to be used . Patron preparation . Procedure for removing color - Coating tints - Aniline derivative tints . Follow manufacturer's directions step-by-step . Safety precautions	Discuss: . Materials to be used . When tint removal is necessary - For coating tints - For aniline derivative tints . Chemical composition . Amount of tint to be removed . Safety precautions - Effect on hair - Uneven removal - Follow manufacturer's directions for retinting . Advantages . Limitations . Disadvantages	Experiment: . Tint sample strands of hair . Prepare solution of tint remover . Process strands . Evaluate results Review; . Chemistry of tint removers . Obtain instruction sheets from various manufacturers . Compare claims and instructions . Fill out record card
It is the prerogative of every patron to change her mind	Demonstrate: . Preparing materials . Selecting shade . Applying filler	Discuss: . Condition of scalp and hair . Natural shade of hair . How to select coloring for desired shade desired	Review: . Patch test . Use of fillers

UNIT HAIRCOLORING
Corrective Treatments

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
(Cont'd.)	. Timing contact . Testing strand of hair . Blending tint . Shampooing . Safety precautions	. Skin coloring -Natural pigmentation . Consultation with patron - Advisability - Effects of change - Special care - Need for repeated treatment	Student Project: . Prepare record card . Cut hair sample before and after tint-back . Evaluate: - Color - Condition . Use color charts Return Demonstration When Possible

UNIT HAIRCOLORING
Eyebrow and Lash Tinting

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
To be beautiful, brows and lashes should harmonize with hair and skin tones	Demonstrate: . Preparation of supplies . Preparation of patron . Applying eye shield discs . Applying base solution . Applying developer solution . Washing eyebrows and lashes . Removing stains	Discuss: . Type of coloring - Permanent . Chemical composition - Metallic salt (silver nitrate) . Color range - Black - Brown - Light brown . Art principles - Selection of shade . Important precautions - Use of solution - Avoid friction on skin	
	. Safety precautions	Elicit: . Benefits of this service . Reason for not using aniline derivative	Discuss: . Use . Advantages

UNIT HAIRCOLORING
Bleaching

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
For feminine appeal unsightly hair should be made inconspicuous	Demonstrate: . Preparation of patron - For a lip bleach - For an arm bleach - For a leg bleach . Arrange supplies . Prepare bleaching mixture . Apply bleach . Time bleaching process . Remove bleach . Complete treatment . Safety precautions Demonstrate: . Application techniques for lip, arm, and leg bleach services	Discuss: . History of bleaching . Theory of bleaching . Chemical composition and effects of - Hydrogen peroxide - Ammonia water - White henna . Timing variations according to - Color of hair - Strength of bleaching mixture . Chemical bleaches used . Sales approach - How and when to suggest this service . Advantages of using powdered bleaches for this service	Experiment: . Place hair strands into white henna, ammonia water, and peroxide solution . Note change of color . Record and discuss results Return Demonstration
A good cosmetologist knows the scientific principles involved in each service she renders	Demonstrate: . Use of a hydrometer to test strength of peroxide . Types of hydrogen peroxide - Liquid - Cream . Various strengths - Percentage and volume - Proper storage of solutions	Discuss: . Theory of natural pigmentation . Formation . Range of shade Display: . Chart of structure of skin - Point out the *stratum mucosum*, and explain that the *melanoblasts* are located there . Chart of structure of hair - Point out presence of *melanin* in the cortex Discuss: . Strength of bleaches . Correct storage to prevent decomposition . Effects of oxidation on natural pigment in hair shaft . Oxidation time in relation to degree of lightening desired . Composition of - Neutral oil bleaches	Student Project: . Smell sample oil bleach - Rub some between fingers . Discuss reactions . Record odor as ammonium oleate . Identify carrier as sulfonated oil Observe and evaluate: . Film slides on bleaching

UNIT HAIRCOLORING
Bleaching

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
(Cont'd.)		- Colored oil bleaches - Drab oil bleaches Elicit: . The meaning of "certified color"	
The prospect of becoming a blonde excites and stimulates the patron	Demonstrate: . Preparation of patron . Examination of scalp . Check condition of hair . Arrangement of supplies . Preparation of bleach formula . Strand test for degree of lightening . Method of application to virgin hair - Section hair - Apply bleach to hair shaft first - Time application - Apply bleach to root area - Time, test, remove bleach	Discuss reasons for: . Strand testing . Examining scalp . Applying bleach to hair shaft first . Increasing oxidation by heat . Slowing of oxidation by cold air . Relation of developing time to color desired . Emphasize safety precautions . Following manufacturer's instructions - Mixing - Timing	Return Demonstration: . Using soap chips Student Project: . Make out record cards . Give strand tests of hair - Vary timing . Collect six swatches of hair - Prepare three commercial oil bleaches - Vary timing - Note results
Dark roots are unsightly	Review: . Preparation of patron . Preparation of bleach and supplies . Safety precautions . Method of application - Section hair - Apply bleach to new growth only - Time - Test - Remove bleach	Compare: . Effects achieved with the use of colored oil bleaches . The use of the applicator bottle and brush Discuss: . Advantages of oil bleach - Used as a presoftener - Used as a prebleach - Used as a lightener - Used for corrective work . Disadvantages - Possibility of skin sensitivity - Limitations of lightening action	Return Demonstration: . Using soap chips List: . Commercial bleaches advertised in trade publications

UNIT HAIRCOLORING
Bleaching

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The creation of delicate blonde tones depends on effective prelightening	Review: . Methods of applying bleach for virgin hair and retouches Demonstrate: . Method of applying rapid bleach to virgin hair - Removal of a rapid bleach - Safety precautions . Method of retouch application . Correct use of heating devices to speed up the decolorizing process	Discuss and Illustrate: . Composition of - Accelerators (boosters) - Powdered rapid bleach - Creme rapid bleach . Effect of rapid bleaches on the hair shaft - Decoloring - Hair strength . The stages of decolorizing . Judgment in the use of boosters - When - Why - How often . Factors that influence timing Discuss: . Problems related to bleaching . Effects of overbleaching . Uneven lightening of shade . Hair breakage . Degrees of weakness . Factors that determine choice of lightener - Natural color - Degree of lightening desired - Condition of hair	Student Project: . Write report on - History of the development of hair bleaching preparations Experiment: . Prepare regular white henna bleach and a name brand of rapid bleach in separate bowl . Apply white henna bleach to a small area on one forearm and rapid bleach to other forearm . Compare and discuss results . Place sample strand in rapid bleach solution . Allow to remain for long period . Remove sample . Test for - Elasticity (breakage) - Hair strength . Place bleached strand under microscope . Compare bleached sample with normal sample of hair Review: . Reconditioning treatments as a preventive as well as a corrective measure Student Project: . Obtain haircoloring manuals from the leading commercial firms . Compare and evaluate the bleach preparations offered by the manufacturers

UNIT HAIRCOLORING
Bleaching

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Frosting, tipping,or streaking gives an intriguing fashionable effect	Note: . The preliminary preparations are the same for all treatments Demonstrate: . Aluminum foil method - Prepare foil squares - Section hair into 1 inch squares - Use a weaving motion to pick up strands of 6 to 10 hairs - Place foil underneath strands, apply bleach, fold foil - Time contact with bleach - Strand test - Rinse hair and shampoo thoroughly . Tipping by cap method - Secure cap over head - Pull hair loosely through holes with crochet hook - Apply bleach - Wrap head in aluminum foil or plastic cap - Time contact with bleach - Rinse thoroughly - Remove cap - Shampoo Emphasize: . Safety measures Demonstrate: . Method of streaking hair - Section and separate strands to be lightened - Place aluminum foil beneath strand - Apply bleach one-half inch from scalp	Define and Identify Terms: . Frosting . Tipping . Streaking . Stripping Discuss: . Advantages of these services - Profit for salon - Prestige of operator - Glamorizes Patron	Discuss: . Name variations used in advertising these services Elicit: . Familiar terminology Compare: . Terminology with correct trade definitions Return Demonstration: . Using white henna . Using cream rinse . Using soap flakes and water to stimulate bleach Student Project: . Test several samples of different types of hair in different bleaches for varying lengths of time - Use 24 hair samples - Use oil, cream,and powder bleach - Time for one-half,and one hour intervals . Evaluate results - Mount samples - Record observations

UNIT HAIRCOLORING
Bleaching

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Artificial color can be removed with a rapid bleach	Review: . Preparation of patron Demonstrate: . Method of application - Complete - Partial	Discuss: . Advantages and disadvantages of using rapid bleaches for tint removal and/or correcting dark streaks . Reaction of bleach on metallic coated hair . Removal of metallic substances from the hair shaft before attempting to bleach	Clinical Practice

Unit HAIR PIECES Minimum Hours 20

GENERAL CONCEPT

What started as a fad has developed into a major economic part of the beauty industry. The patron can now indulge her every fashion whim. She no longer has to be embarrassed by thinning, straggly, or unruly hair. The possibilities for variety of color and hairstyle offered by the use of hair pieces are limitless. Servicing and selling of hair pieces offer the alert cosmetologist an opportunity to expand services and realize extra profits. This unit covers all aspects of this branch of services from the selection of the postiche to the finished product.

OBJECTIVES

To understand the basic differences in the various types of wigs and hair pieces available

To develop skill in selection, shaping, and styling of postiches

To develop the art of fitting and adjusting a wig

To learn the various safe methods used in cleaning and drying wigs

To develop skill in the specialized comb-out techniques pertinent to the styling of hair pieces

To develop skill and judgment in the coloring of hair pieces

To develop artistry in the use of hair pieces

UNIT HAIR PIECES

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Learn to recognize quality in hair pieces	Examine and Compare: . Variations in wigs - Quality of hair - Texture of hair - Length of hair . Type of base - Material used - Workmanship - Pattern . Construction - Machine-made - Semihandmade - Completely hand-ventilated Demonstrate: . Burn test to determine - Human hair - Animal hair - Synthetic hair	Discuss: . History of hair pieces . Types of hair pieces - Handmade - Machine-made . Origin of hair - European - Asiatic - Synthetic - Blend of human and animal . Color range . Price range of hair pieces	Student Project: . Examine and evaluate several hair pieces Experiment: . Test several sample strands . Determine whether wig hair tested is synthetic or human
Color can be matched, blended or changed to create a new personality	Demonstrate: . Matching color using - Three samples of patrons hair - Color selector for hair-pieces . Blending of colors . Choosing a new color - Complimentary shades - High-fashion shades	Discuss: . Variations in shades of hair . Matching textures . Highlights . Selection of shade . Advantages of hair pieces - Necessity - Fashion trends	Student Project: . Select three hair samples from various sections of patron's head . Compare with wig color selector chart . Choose correct hair piece to be ordered
Proper use of the tape measure is necessary to assure proper fit and patron satis-faction	Demonstrate: . Measuring head - Around head - Hairline to nape - Ear to ear across forehead - Ear to ear over crown - Temple to temple - Nape of neck . Recording measurements on chart	Review: . Linear measurement	Student Project: . Measure partner's head . Record measurements

UNIT HAIR PIECES

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The wig must fit the block	Demonstrate: . Using canvas blocks - Size - Identify front and back - Secure clamp . Mounting wig on canvas block - Center wig on block - Center front of wig - Secure at temples . Placing of T-pins - Front - Sides - Nape	Discuss: . The importance of using the correct size of block . Relationship of finished style to correct centering on block	Practice: . Select block of correct size . Mount wig . Secure wig
The life of hair pieces depends upon careful cleaning and handling	Demonstrate: . Cleaning hair piece (human hair) - Immersing in cleaner - Use of soft brush . Preparation of block . Drying techniques - Airing - Mounted on block and brush - Cool air (dryer) . Removing tangles - Cream rinse - Use of tangle comb . Safety precautions - Some liquids are flammable - Keep away from heat and heat rays - Ventilation of room	Discuss: . Dry cleaning products - Chemical content - Variety of products . Cleaning - Methods of cleaning - Protection of foundation - Frequency of cleaning . Commercial dryers . Conditioning hairpieces - When needed - Treatments necessary - Service charge	Student Project: . List the reasons and advantages of using liquid dry shampoos . Compute the cost of labor and materials in relation to the cost of their service Practice: . Cleaning and conditioning a hair piece
A wig can be fitted by stretching, shrinking, or by making tucks in foundation	Demonstrate: . Stretching a wig - Use block one size oversize - Mark desired size on block	Compare: . Shapes of heads and shapes of wigs . Related art - Form - Concave - Convex	Student Project: . Compare size and contour of three heads . Record differences in measurements

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
(Cont'd.)	- Wet foundation with hot water - Stretch to size - Rewet if necessary - Place T-pins one inch apart - Style hair - Dry thoroughly on block - Safety precautions Review protection of foundation Preparation of block . Shrinking a wig - Use block one size smaller - Mark desired size on block - Wet foundation with hot water - Place T-pins one inch apart - Rewet - Dry thoroughly before styling - Review safety precautions . Tucking a wig - Place wig on head - Pin tucks - Remove wig - Stitch tucks	Discuss: . Reasons for ill-fitting wigs . Selection of technique to be used - Shrinking - Stretching - Tucking . Elasticity of foundation . Effect of moist heat . Shrinking and stretching - Advantages - Limitations . Shapes of heads . Needs for tucking wigs . Placement of tucks . Techniques of tucking - Inside tucks - Outside tucks - Hand - Machine	. Select a wig for each head . Analyze needs for sizing . Determine method to be used . Custom-fit wig - Tucks may be removed or adjusted
Classic lines are created by proper shaping	Demonstrate: . Shaping a wig on a block - Place wig on patron's head to select style and determine length - Review use of razor and thinning shears - Mounting on block - Section hair in circular or angular pattern - Dampen hair - Remove bulk	Discuss: . Stylized cuts . Necessity for texturing hairline . Art principles - Proportion - Balance - Dimension and silhouette Review: . Importance of centering wig on block . Advantages of razor shaping . Tapering	Practice on Wig: . Placement of wig on model . Selection of style and length . taking measurements . Recording measurements on card . Shaping a wig

UNIT HAIR PIECES

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
(Cont'd.)	. Shaping wig on head - Keep wig on patron's head - Secure with chin strap	Discuss: . Taking accurate measurements . Protecting wig base	
There is an art to styling a wig	Demonstrate: . Styling a wig . Setting techniques - Choice of rollers - Direction of rollers and sculpture curls - Use of clips and T-pins . Review drying of wigs . Combing-out - On block - Shape hair - Modified teasing . Adjusting on head - Covering hairline - Above hair line . Smooth style to contour of head and face	Review and Discuss: . Quality and texture of hair . Type of set required - Tight - Loose . Effects of various sized rollers and pin curls Explain: . Comb-out techniques - Brush - Mold - Tease . Safety precautions - Avoid excessive teasing - Avoid rough handling	Student Project: . Refer to fashion magazines . Select two hair styles adaptable to wigs . Diagram each style . Set a style on wig and comb-out
A change of color lends variety to hair pieces	Demonstrate: . Tinting a hair piece - Determine color desired - Select type of hair coloring Permanent Semipermanent Temporary - Test on hair strand - Prepare wig block - Prepare tint or rinse - Start at crown - Avoid netting (if possible) - Shampoo (if required) on block - Apply bleach	Review: . Origin and types of hair . Conditioning . Porosity - Use of fillers - Type of tints Explain: . Effects of oxidation on hair . Effects of chemicals on foundation Discuss: . Protection of foundation . Blending hair evenly . Responsibility of salon owner and operator	Student Project: . Examine wig or hair piece to be tinted . Make strand tests and analyze results . Select shade and method . Tint hair piece . Bleach a hair piece . Fill in record card

UNIT HAIR PIECES

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
A wiglet is a versatile hair fashion accessory	Review: . Setting techniques for wigs Demonstrate: . Secure wiglet on block . Form sculpture curls - Dry - Comb-out . Secure wiglet on head . Form curl base - Secure wiglet - Blend natural hair - Spray	Display and Discuss: . Types of wiglets - Falls - Switches - Bangs - Ponytail - Demicoif - Cluster curls . Types of bases - Waffle - Cone - Wire - Round - Oval . Variations in - Length of hair - Amount of hair - Size of base	Review: . Color selection . Matching . Shaping wig . Styling wig Practice: . Setting wiglet . Securing wiglet . Combing (to blend natural hair with wiglet)
Accessories are necessary for proper wig care		Display: . Accessories for hair pieces and wigs - Luggage - Canvas wig blocks and clamps - Styrofoam block and stand - Wiglet block and strand - Wig spray - Wig conditioners - Wig perfume - Wig pins (T-pins) - Display mannequins	List: . Accessories available for wigs and hair pieces . Evaluate the need for each . Compute cost of wig accessories

GENERAL CONCEPT

The beneficial effects of massage have long been known to mankind. Ancient civilizations developed the techniques of massage into an art and a science. Many of the basic movements used in facial treatments today may have been handed down to us from Hippocrates, the Greek physician who taught the value of massage, correct diet, and fresh air as aids to healthful living. The secret of success in correct massage is absolute relaxation in both patron and operator. A quiet, restful atmosphere with special provision for the patron's complete comfort should be provided. The operator must be gentle,yet firm and assured,when giving a massage. An understanding of psychology as well as a knowledge of the anatomy of the parts of the head being treated are necessary.

This unit deals with the theory of massage, the histology of the skin, anatomy of the head, common disorders and diseases of the skin, and the accessories used in facial massage.

OBJECTIVES

To recognize the physical and psychological effects of massage

To provide an introduction to anatomy and the scientific study of the skin as a basis for effective understanding of skin care

To develop the manipulative skills necessary to give an effective massage

UNIT FACIAL TREATMENTS

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The outward beauty of the skin often reflects the individual's health		Review: . Characteristics of normal skin: - Function - Structure - Pigmentation Discuss: . Body Systems - Skeletal - Muscular - Nervous - Circulatory	Observe Film: . "The Human Skin" Diagram: . Cross section of the epidermis Observe Film Slides: . "Nine Basic Systems of the Body" Discuss: . Interdependence of body systems . Relationship of various systems to the health and beauty of the skin Assignment: . Write report on any one of the body systems
Professional preparation creates a relaxing atmosphere	Demonstrate and Discuss: . Preparation of supplies - Sanitary precautions - Safety precautions . Preparation of patron - Care of clothing - Protection of hair - Position of patron . Working position of operator . Safety precautions . Forming and adjusting towel turban	Discuss: . Requirements for a facial booth . Variations in preparation according to type of salon or extent of service . Extent of operator's responsibility for the care of patron's clothing and jewelry	Return Demonstration Discuss: . Effect of a quiet, restful, atmosphere
Expert finger stimulation and soothing creams are the secrets of an improved skin	Demonstrate: . Procedure for facial massage - Application of creams - Removal of creams	Explain: . Technical terms . Purpose of massage . Effects of massage . Effects of heat and cold on skin . Motor points	Discuss Composition and Function of: . Creams . Astringents . Lotions . Products for blemishes

UNIT FACIAL TREATMENTS

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
(Cont'd.)	- Routine of facial movements - Application of lotion . Each type of massage movement Emphasize: . Safety precautions	Discuss: . Importance of rhythm, continuity, and direction in facial movements for forehead, eyes, checks, nose, chin, mouth, neck, and back Present: . Individual charts showing position of fingers and direction of movement	. Complete facial step-by-step procedure Research: . Obtain information on preparation of creams Student Project: . Select a standard formula for cold cream . Make cream according to formula Performance Test: . Give complete facial

UNIT FACIAL TREATMENT
Packs and Masks

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Facials are relaxing and beneficial	Review: . Plain facial treatment including removal of emollient cream	Review: . Structure of the skin . Skin condition - Excessively dry - Excessively oily . Function of sebaceous glands of skin	Review: . Plain facial massage . Functions of the sebaceous glands
Packs are popular accessories to massage	Demonstrate: . Clay pack - Protect eyes - Apply pack - Allow to dry - Remove with water and warm towel - Apply astringent - Safety precautions	Discuss: . Differences between packs and masks in: - Composition - Application . Purposes . Effects and benefits	Return Demonstration Discuss and Evaluate: . Reactions to application of mask
A hot oil mask is advised for a dry skin inclined to wrinkle	Review: . Plain facial treatment, including removal of cleansing cream Demonstrate: . Oil mask - Saturate gauze and place on whole face - Protect eyes - Use heat lamp - Remove gauzes - Apply routine facial movements - Complete the facial - Observe safe practices	Explain: . Preparation for hot oil mask - Gauze - Heat lamp - Formula used . Purpose and benefits of mask . Effects of various types of oil	Return Demonstration Discuss: . Smoothness of skin . Appearance of skin Student Project: . Develop sales approach for - Salon treatments - Sale of specialized creams for home use

UNIT FACIAL TREATMENT
Correction of Simple Conditions

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
To treat or not to treat requires knowledge and judgment	Demonstrate: . Examine skin for - Lesions - Pustules - Inflammation - Rash - Comedones - Milia . Treatment for oily skin . Blackhead treatment - Cleanse - Soften - Remove - Sterilize . Treatment for dry skin - Cleanse - Use of special creams - Use therapeutic lamp - Use of special oils . Treatment for acne - Use of medicated soap - Use of medicated creams - Use of high-frequency current . Use of special lotions . Specialized treatments for oily and dry skin conditions	Discuss: . Skin conditions - Causes - Types - Inflammatory - Infections (contagious) - Pigmentation disorders - Congenital - Allergy Illustrate: . Chart listing common disorders, their cause, and suggested salon treatment . Disorders of sebaceous glands - Oily skin - Dry skin - Comedones - Milia . Acne conditions of various types . Disorders of sudoriferous glands - Hyperidrosis - Miliaria Rubra	Discuss: . How infections are spread . Type of disorders that must not be treated in a salon . Tact in advising patron to see a physician Discuss: . Sales presentation that includes discussing and advising patron on her problem . Selection of creams and lotions for each condition Discuss: . Adolescent acne . Cause and treatment of teenage skin problems Observe and Report on Film Strip: . "So You Have Acne" Discuss: . Sale of creams and lotions for home use

Unit REMOVAL OF SUPERFLUOUS HAIR Minimum Hours 10

GENERAL CONCEPTS

Unwanted, unsightly hair is a common problem. The patron who has this problem will usually turn to a beautician for advice and treatment, realizing that this service is a very delicate one which should be performed by a professional person trained in this particular skill. Many new products designed for professional use are now available and many salons offer temporary hair-removal treatments as a special service.

The cosmetologist who wishes to specialize in electrolysis (permanent removal of hair) must take additional training and be licensed to perform this work.

OBJECTIVES

To be aware of the problem of superfluous hair and to understand the various preparations and methods that may be used to correct it

To develop skill in each method of superfluous hair removal

To place special emphasis on the development of the operator's judgment for evaluating the various methods used in removing hair and the advantages and disadvantages of each

UNIT REMOVAL OF SUPERFLUOUS HAIR

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Unwanted hair may be removed temporarily and effectively from the face, arms, and legs by depilation	Demonstrate: . Use of cream depilatory - Prepare patron - Give skin test - Apply depilatory - Remove depilatory . Safety precautions	Review: . Types of body hair Discuss: . Methods of removal - Depilation - Epilation - Electrolysis . Advantages and disadvantages of each method of removal . Chemical composition of depilatories	Test: . Products observed on television commercials, in magazines Evaluate: . Validity of claims
Hair can be removed for a longer period of time by epilation	Demonstrate: . Epilation (soft or hard wax) . Preparation of patron - Wash area - Apply talc - Melt wax if necessary - Apply wax - Remove wax - Safety precautions	Discuss: . Composition of wax epilators . Areas of body on which wax can be used: - Eyebrows - Face - Hairline - Arms - Legs	Outline: . Basic procedure for different products Review: . Tweezing

Unit PROFESSIONAL MAKEUP Minimum Hours 20

GENERAL CONCEPT

Professional makeup is a specialized branch of beauty service. On a professional level, it has been confined to the more exclusive beauty salons, television, photographic,or movie studios. However, with the present day emphasis on intricate eye cosmetics and the shop owner's realization of an additional source of income, the number of salons offering makeup services has increased.

Every cosmetologist should be able to advise the patron on makeup as well as on appropriate hairstyling and coloring. This blending of beauty of face and hair will provide the patron with a new confidence and assurance that only an improved appearance can give.

The study of makeup is a fascinating one which provides an outlet for the creative ability of the cosmetologist.

This unit covers the artifices used in creating an illusion of facial beauty.

OBJECTIVES

To provide a knowledge of the composition of facial cosmetics, and the artistic application of makeup for day and evening wear

To acquire ability to minimize facial defects through the use of corrective makeup

To develop the art of applying artificial eyelashes and an appreciation of their dramatic effect (optional)

To introduce different types of cosmetics used in theatrical work (optional)

UNIT PROFESSIONAL MAKEUP

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The artifices of ancient civilization have been supplemented with modern research	Demonstrate: . Preparation of - Face powder - Lipstick	Review: . History of cosmetics . Ancient trends and theories - Egyptian - Greek - Roman . Renaissance trends and theories - French - English - Italian . Modern trends & theories - The 1920's - The 1940's - The 1960's Discuss: . Cosmetic chemistry - Chemical and physical changes in matter - Chemical compounds - Basic chemical terms - Organic compounds - Emulsions - Suspensions - Powders - Pastes - Lotions - Eye makeup preparations . Range of colors	Field Trip: . To museum to study cosmetics and beauty supplies used through the ages Panel Report: . "Beauty Through the Ages" Study Assignment: . Develop chart to categorize types and composition of the various cosmetics
The total effect, not the individual cosmetic, should be admired	Analyze: . The basic structure and shape of the face Demonstrate: . Measuring a face - Overall length - Length and width of forehead - Width of temple area	Discuss: . Purpose of cosmetics - To emphasize - To conceal . Suitability - Individual's natural coloring - Age of patron - Day or evening wear - Choice of cosmetics - Personality of patron - Current trends related to the needs and personality of the patron	Discuss: . Subtle use of cosmetics as opposed to the "painted look" Student Project: . Using trade journals or popular publications, complete a booklet on proper makeup for various age groups, occasions, and current trends

UNIT PROFESSIONAL MAKEUP

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
(Cont'd.)		- Balance and proportion . Effects of artificial lighting on color Discuss: . Ways and means of determining which cosmetics are needed or desirable for different type models . The relationship between the patron's natural coloring, current fashion trends, and suitable colors	
The skillful application of cosmetics is truly an art	Demonstrate: . Preparation of supplies . Preparation of patron . Application of makeup - Base - Eye Shadow - Eye liner - Eyebrow pencil - Mascara - Rouge - Lipstick - Powder	Discuss: . Cosmetics required . Special accessories - Eyebrow brush - Lipstick brush . Sterilizing precautions . Review Board of Health rules pertaining to use of brushes, makeup, and supplies in beauty salons . Related art principles - Shadows - Outline - Illusions	Review: . Cleansing of skin Display: . Comparison charts that depict the results of correct makeup versus incorrect makeup Observe: . Demonstration by cosmetic manufacturer's representative Student Project: . Makeup a model in class and have other students analyze the finished product
Professional assistance is required for the correct selection of cosmetics	Demonstrate: . Selection of cosmetic shades - For daytime wear - For evening wear	Review: . Choice of cosmetics - Types - Colors - Manufacturers - Nonallergenic preparations . Art principles - Color harmony - Optical illusion	Field Trip: . Visit a cosmetic manufacturer, if possible, to observe - Raw materials used - Processes employed - Quality of cosmetic ingredients . Attend trade show demonstrations

UNIT PROFESSIONAL MAKEUP

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
(Cont'd.)		- Balance and proportion . Effects of artificial lighting on color Discuss: . Ways and means of determining which cosmetics are needed or desirable for different type models . The relationship between the patron's natural coloring, current fashion trends, and suitable colors	

UNIT PROFESSIONAL MAKEUP
Eyelashes and Eyebrows (optional)

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Artificial eyelashes can accentuate the natural beauty, color, and depth of the eyes	Demonstrate: . Application of a single eyelash - Arrange supplies - Dip hair into adhesive - Place on lid - Repeat for each lash - Trim lashes to desired length - Apply eyeliner . Application of strip eyelashes - Measure length - Trim - Apply adhesive - Place on eyelid	Discuss: . Advantages of the individually applied lashes - Natural effect - Cost of supplies - Cost of professional service . Advantages of strip eyelashes - Resale item - Cost low - The patron can apply the lashes	Demonstration: . Using photographs of stage and screen stars illustrate the various effects that can be achieved with artificial eyelashes Compare and Discuss: . The effect of each method of eyelash application . Cost of each service in a beauty salon . Estimate the shop income derived from each service and the prestige value of such services to the beauty salon
Attractive appearance of the eyebrows is part of good grooming	Demonstrate: . Tweezing: - Preparation of supplies - Preparation of patron - Procedure Brush brows Apply cream Apply eye pads Manipulate tweezer Apply astringent - Safety precautions - Sanitary precautions	Discuss and Compare: . Methods of epilation - Tweezing - Waxing . Advantages of each method . Disadvantages of each method	Review: . Hair structure Develop: . Definition of epilation Analyze: . Natural eyebrow line . Safety precautions
Line and color can be used to improve the shape of the brow	Demonstrate: . Use of eyebrow pencil - To modify natural line - To fill in sparse brow - To correct misshaped brow - To create a new line . Use of brush-on eye cosmetics	Personalized Shaping: . Demands of fashion . Facial types - Round - Long - Square - Triangular . Types of eyes - Close-set - Wide-set	Practice: . Using eyebrow pencil to sketch lines desired Discuss: . Variety of products available Compare: . Style trends of eyebrows over the years

UNIT PROFESSIONAL MAKEUP
Eyelashes and Eyebrows (optional)

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
(Cont'd.)		. Types of eyebrow lines - Low arch - High arch - Angular . Discuss relationship of eyebrow line to eyeglasses	
Suggesting extra service can be an asset to the patron, operator, and salon owner	Demonstrate: . Sales approach	Discuss: . Necessity for service - Compliment facial features - Build patron confidence . Cost of service . Time allotment . Extra sales	Student Project: . Serve as a consultant to another class member

UNIT PROFESSIONAL MAKEUP
Specialized Services (Optional)

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The lights used in filming movies or television distort ordinary colors	Demonstrate: . Enlargement of eyes for TV, movies, or photography . Preparation of material . Safety precautions	Discuss: . Effects of various types of lighting on makeup - Variations in color - Reflections - Protection of skin - Melting of makeup . Colors recommended for lighting conditions . Necessity for balance between size of eyes and mouth . Use of lip gloss	Review: . All makeup application techniques Practice: . Making up a model for television - Simulate stage lighting Discuss: . Compare the appearance of the makeup application under normal lighting and strong lighting
Creating a stage character requires specialized cosmetics	Demonstrate: . Preparation of supplies . Application of grease paint . Application of powder with a brush . Techniques of creating the illusion of youth by removing - Wrinkles - Puffy eyes - Bloodshot eyes - Wrinkles in forehead - Aged mouth - Aged jowls - Aged eyebrows - Bright eyes - Scars	Review: . Determine character type to be represented . Principles of - Light - Shadow - Emphasis . Greasepaint colors - When to use - Why selected - How used . Introduce supplies (small tools and makeup) used exclusively for theatrical work Discuss: . Requirements of the stage, television, and cinema union	Review: . All makeup techniques Student Project: . Makeup two different character types Field Trip: . To a television studio or movie set

SHOP OPERATION AND MANAGEMENT

In addition to the required units of instruction all students should be provided with information concerning getting a job as well as advancing in that job.

Some students will find employment in the cosmetology field as receptionists or dispensary clerks. Others will aspire to be owners or managers of a salon.

The following material should be integrated where appropriate in the required units of insturction.

Unit GUIDE FOR EMPLOYMENT

GENERAL CONCEPT

The demand for skilled beauty operators has increased steadily. Statistics indicate that this field of service will continue to increase and expand. The ultimate goal of all students enrolled in the Cosmetology course is full-time employment in a well-paying position that provides opportunities for advancement.

It is essential that every student be taught the interpersonal relationships involved in the job interview, ethical employer-employee behavior, and laws governing and protecting the worker.

OBJECTIVES

To acquire the knowledge for proper procedure in a job interview

To understand the personal behavior necessary to get along with people on the job

To be aware of employer-employee responsibilities

To become acquainted with laws governing the employee and employer

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The future is in your hands	Discuss: . Types of jobs available in the Cosmetology industry - General operator - Specialist - Positions which require a license - Positions which do not require a license . Abilities required for each field of specialization - Technical skills - Personal qualifications	Personal Evaluation: . Trade background . Personal background . Likes and dislikes . Personality problems . Getting along with people . Ultimate goals Discuss: . Ability required - All-round trade and technical background . Personality required - Personality traits necessary to get along with Patrons Coworkers Employer Manager Receptionist	Student Project: . Write a report of self-evaluation, including ambitions and long-range plans List: . Personality traits necessary to get along with people in a beauty salon Write: . An essay on the "Admirable Qualities of a Person I Know"
Fruitful endeavor and ethical behavior are foundations for a happy life		Discuss: . Obligation of employee - Efficient work - Punctuality - Loyalty - Integrity . Obligation of employer - Observe laws Wages Hours Compensation Licensing - Provide proper facilities - Provide proper work experiences - Honor contractual or verbal agreements . Ethics - Resigning from job - Giving advance notice - Waiting until sucessor is available - Value of acquiring favorable employment record	Oral Report: . "What I Would Contribute to a Job and What I Would Expect in Return"

UNIT GUIDE FOR EMPLOYMENT

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Know where the jobs are and how to get them	Demonstrate: . Methods used to seek employment: - Classified section of newspapers - Telephone technique - Use of résumé - Direct approach . Proper method of filling out applications for employment Dramatize Approach to: . School placement counselor . Receptionist . Shop owner . Employment office personnel - N.Y. State employment offices - Private employment offices	Discuss: . Employment opportunities - Local areas - Department stores - Large city salons . Advantages and disadvantages of each Correct Dress: . A well-groomed look . Correct makeup . Clothing suitable for the occasion Attitude and Behavior: . Toward prospective employer - Voice and poise - Show of confidence in ability . Toward tryout period	Student Project: . Check want ads in local papers . List the various types and localesof jobs . Complete an employment application . Show examples of proper dress for business - Use magazines for illustrations . Observe filmstrips on charm and personality . Role play proper approach to employer . Prepare materials necessary for a job "tryout"
A résumé should be a word picture	Demonstrate: . Preparing a résumé: - Vital statistics - Educational background - Work experiences - Occupational goals	Discuss: . Format for résumé of necessary information - Develop sample format - Need for brevity	Student Project: . Prepare résumé for prospective employer
Before accepting a position consider all factors		Evaluate working conditions: . Environment - Modern - Clean . Employer . Personnel . Transportation . Monetary compensation - Salary - Commission - Gratuities . Working hours - Minimum Wage and Hour Law	Send for and Review Booklet: ."Minimum Wage and Hour Law," N.Y.S. Department of Labor

Unit RECEPTIONIST

GENERAL CONCEPTS

The first contact most prospective patrons have with a salon is at the reception desk. A receptionist should create a favorable image for the salon. She must have a pleasing personality, be well-groomed, have a pleasant voice and a good command of the English language.

Proper management of the appointment desk will create better labor-management relationships. The receptionist not only has full control of the appointment desk but must make judgments in booking the operators, taking into consideration the compatibility of the patron and operator, operator's idiosyncracies, ability in specialized areas, and personal popularity.

A competent receptionist can advance to the position of manager. As a manager she will be responsible for sales and services, buying supplies, daily bookkeeping, banking monies, supervising the boutique (if one exists) and will generally be an aid to a shop owner who is a creative artist but not always a good business person.

OBJECTIVES

To understand the responsibilities of the receptionist

To develop the methods used for handling cash transactions

To be aware of the desirable personality traits required for this position

To develop sales techniques for cosmetic supplies and services

To provide job experiences for those students who do not wish to become operators but who enjoy the surroundings of a beauty salon.

UNIT RECEPTIONIST

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
First impressions are often lasting ones	Illustrate: . Greeting patron . Checking services to be rendered . Assigning to proper operator	Discuss: . Appearance of receptionist . Manner . Voice . Poise . Attitude . Initiative	Practice: . Greeting two or more prospective patrons
The appointment book is the key to efficiency	Demonstrate: . Handling of appointment book . Time breakdown . Across-the-desk appointments	Prepare: . Duplicate page in appointment book to be used as an instruction sheet Discuss: . Time allotted to various services (when booking appointments the speed of the operator should be considered) . Patron preferences of operator . Handling time conflicts . When to assign patron to another operator	Practice: . Making appointments on practice sheet for prospective patrons Project: . Prepare an appointment schedule for five operators for a week
Answering the telephone must be handled with skill	Demonstrate: . Telephone techniques - Greeting patron - Recording information accurately - Closing remarks	Discuss: . Booking an appointment - Quality of voice - Attention to patron - Repeat patron's request to ensure accuracy	Student Project: . Members of class call receptionist for appointments . Tactfully handle the problem of having two patrons request the same operator for the same time
The handling of complaints must be done with tact		Illustrate: . Solving patron's complaints - Over the desk - On the telephone . Using tact . Showing courtesy . Helpful attitude . Presenting alternate solutions . When and if to involve operator as manager	List: . Possible complaints . Manner to be used in handling problems

UNIT RECEPTIONIST

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
A sales slip is record of services rendered	Demonstrate: . Preparation of sales slip . Use of sales slip . Recording information for referral	Review: . Nature of cash transactions . Use of charge accounts Discuss: . Allotting numbers to operators to facilitate tallying . When to fill out sales check . Types of sales checks - Service - Cosmetic sales . Computation of sales tax	Student Project: . Make up sample sales slip for - Services - Cosmetics . Determine tax . Compute total . Write to N.Y.S. Department of Taxation for "Sales Tax Table"
The cash register tape is your best record	Demonstrate: . Operating register . Use of cash drawer . Making change	Discuss and Illustrate: . Computing change . Tallying the register . Preparing tally sheet . Making entry in daily record book	Practice: . Making change . Preparing tally sheet from daily sales checks
Selling involves more than handing a product over the counter	Demonstrate: . The receptionist's role in selling services or products across the desk . Selling extra services while booking specific services	Discuss: . Psychology of selling . Approach to patron - The "soft sell" - The "hard sell" . Suggested approach . Sales technique Stress: . Importance of knowledge of product . Effectiveness of product . Validity of claims . Ability to demonstrate product	Student Project: . Prepare a sales talk for a particular product . Attempt to sell a product to members of the class Analyze: . Effectiveness of technique

Unit DISPENSARY CLERK

GENERAL CONCEPT

A successful school shop or beauty salon must maintain a well organized, functional dispensary. The dispensary clerk must know how to reduce concentrates, mix formulas, arrange stock, take inventory, sterilize tools, and prepare service trays for the operators. She must also be familiar with the local and State sanitary codes pertinent to a beauty salon.

A good dispensary clerk has another role to fulfill, that of general assistant to the manager and/or the other operators. Success in any chosen capacity depends not only on fulfilling the mechanical aspects of a job, but on the extra service or help that can be offered.

This unit deals with the duties, responsibilities, and importance of a good dispensary clerk.

OBJECTIVE

To develop correct habits for efficient procedures in the care of the dispensary and to become aware of the value of a good dispensary clerk

To develop an understanding of the need for sanitation

To become familiar with local and State sanitary codes

Note: Each student should spend part of each semester in the dispensary to develop needed skills and an appreciation of the need for an efficient flow of supplies to the operators

UNIT DISPENSARY CLERK

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The dispensary is the supply depot around which the operation of a school shop or salon revolves	Show layout of supplies in school dispensary	Discuss: . Required basic supplies . Small tools . Equipment	List: . Products and equipment necessary for a dispensary
Dispensary supplies should be arranged for ease of handling incoming and outgoing supplies and to facilitate inventory	Demonstrate: . Efficient arrangement - Products - Small tools - Equipment . Correct labeling	Discuss and Identify: . Flammable materials . Location of bulk products . Supplies used daily . Storage of chemicals - Safety precautions - Effects of temperature and humidity - Pressurized containers	Student Project: . Check labels against content of bottles and jars List: . Dispensary safety rules and regulations
Concentrates must be correctly mixed to maintain their efficiency	Demonstrate: . Preparation of solutions - Sanitizing - Quaternary-ammonium compounds - Shampoos - Fingerwave lotions - Rinses . Labeling of all supplies	Review: . Weights and measurements - Liquid measure - Dry measure - Ratio and proportion	Review: . Basic measurements . Concepts of weights and measures
A clean dispensary is mandatory for health, sanitation, and good order	Demonstrate: . Good housekeeping habits - Sanitizing of tools and equipment - Techniques of cleaning Glass Metals Wood Plastics	Discuss: . Bacteriology - Types of bacteria - Reproduction and growth of bacteria . Sanitary codes - Local - State . Methods of sanitizing - Physical - Chemical . How infectious and communicable diseases are spread	Student Project: . Fill jars and bottles . Apply labels . Set up sanitizing equipment . Observe and report on filmstrip "Type and Growth of Bacteria" Panel Discussion: . Physical versus chemical methods of sterilizing

UNIT DISPENSARY CLERK

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
A good dispensary clerk saves the operator's time and labor	Illustrate: . Preparation of service tray - Required supplies - Correct arrangement - Quantities needed	Illustrate: . Cost of labor per hour . Relationship between income, running expenses, and profit	Discuss and Evaluate: . Loss of income due to waste of supplies, time, and labor . Value of a profitable salon to both the operator and owner
A pleasantly mannered dispensary clerk adds to the rapport of those in the shop	Practice: . Voice control . Restraint of manner . Service to others	Discuss: . Correct manners - Courteous approach - Tone of voice - Helpful attitude . Anticipating the needs of the operators	Dramatize: . Role of dispensary clerk working with others in the shop . Discuss reactions to presentation
A continuous inventory must be maintained	Demonstrate: . Checking supplies . Organizing inventory record keeping system	Discuss: . Types of inventory records - Daily - Weekly - Monthly . Values of an accurate inventory . Pitfalls of an inaccurate inventory	Student Project: . Devise a sample method of keeping a continuous inventory

Unit SHOP OWNER

GENERAL CONCEPT

Cosmetology as a career offers many opportunities which include the ownership of a beauty salon.

The roles and responsibilities of a shop owner are varied. He must know the State laws regulating the practice of cosmetology. He must have the ability to hire and direct personnel. It is imperative that he keep abreast of changes in the field in order to maintain a contemporary salon. The needs of the patron and operator must be constantly studied and revised.

This unit deals with the financial responsibilities and problems involved in salon ownership.

OBJECTIVES

To consider the factors involved in opening a salon

To understand the necessity for compatible interpersonal relationships

To understand how to furnish and staff a salon

To be aware of all government regulations

To understand the financial and moral responsibilities involved

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Opening a beauty salon requires careful planning		Discuss: . Individual ownership - Complete independence - Full responsibility . Partnership - Shared responsibility with one or more persons . Corporate ownership Elicit: . The advantages and disadvantages of each type of ownership Discuss: . Capital investment - Amount required - Amount available - Mortgages - Down payment - Interest payments . Shop location - Nearness to transportation - Turnover of transient trade - Situated on or near busy shopping area - Near new housing development - Possibilities for expansion - Buying an established salon - Zoning laws	List: . Advantages and disadvantages of individual and partnership ownership Discuss: . Methods of acquiring business capital Estimate: . Cost of opening a beauty salon Oral report: . "Desirable locations and reasons for their selection"
Profits cannot be "creamed off the top"		Discuss: . Overhead - Salaries - Cost of space - Utilities Electricity Heat Telephone - Equipment Cost to acquire Depreciation Upkeep	Discuss: . Cost of rent in relation to - Size of shop - Desirability of location Average Salaries for: . All- round operator . Haircolorist . Manicurist . Hair stylist

UNIT SHOP OWNER

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
(Cont'd.)		- Services Linen Supplies - Taxes Renew: . Insurance protection	
Bank loans are a part of every business		Discuss: . Examples of business loans Review: . Bank loans - Interest rates - Time span . Dealer loan - Interest rates - Time span . Math - Principle and interest	Research: . Investigate interest rates in local banks . Compare home mortgages and business mortgages
Regular hours will increase efficiency		Discuss: . Business hours - Location - Clientele - Hours kept by other local salons - Number of operators	Field Trip: . Visit local salons in various areas . Check hours in local department stores, shopping centers, neighborhood salons Discuss: . Reasons for difference in hours
The salon interior should reflect the personality of the owner	Demonstrate: . Shop layout and design - Sinks - Drying areas - Dressing tables - Manicure tables - Receptionist desk - Reception area - Dispensary	Discuss: . Importance of layout in terms of - Pleasant atmosphere - Efficiency Well-organized Accessibility of materials - Psychology of color To be decorative To soothe	Student Project: . Lay out a salon on graph paper . Make a shop model using cardboard furniture . Check trade magazines for layouts in color

UNIT SHOP OWNER

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
(Cont'd.)		To serve as a background for patrons - Illustrate related art The color wheel Illusions which color can create Harmony Blending - Choice of equipment Dryers Steamers Sinks	Discuss: . Color schemes which would be suitable for a salon . Furniture in the school salon - Suitability - Durability . List and evaluate: - Equipment being used in the cosmetology classes
Lighting can create a mood as well as reveal true hair color	Demonstrate: . How lighting can affect hair color - Natural light - Artificial light	Discuss: . Lighting - Reception area Indirect - Salon work area Fluorescent - Hair coloring area Daylight	Discuss: . Need for special lighting in various areas of salon
Good plumbing can save time, money, and annoyance		Discuss: . Need for licensed plumber to install proper plumbing for - Booth - sinks - Supply room - sinks - Restroom	Investigate: . State laws regulating plumbing and restroom requirements
Purchase of inferior supplies will result in waste and dissatisfied patrons		Review: . Purchasing supplies - How to select a jobber - Manner of payment - Delivery . Trade math - Discount - Percentage	List: . Supplies needed for a specific area in - Haircoloring - Permanent waving Compare: . Various means of payment - Advantages and disadvantages of each

UNIT SHOP OWNER

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
The price charged for a service should be computed by overhead and honest evaluation of service	Demonstrate: . How to make a price list: - Different formats - Different types	Discuss: . Determining price policy - Overhead - Locale - Competition in same area	List: . Typical prices . Discuss personal experiences in salons - Prices charged - Services rendered
An operator's salary should be commensurate with experience, ability, and the services		Discuss: . Salaries governed by - Minimum Wage and Hour Law - Supply and demand - Experience of operator - Ability to produce . Manor of compensation - Salary - Commission - Percentage - Gratuities Illustrate: . Why one operator earns more than another - Work produced - Extra sales - Close booking	Review: . Minimum Wage and Hour Law Evaluate: . Advantages and disadvantages of - Salaries - Salary and commission - Percentage basis Write Essay: . "How I Can Become a Highly Productive Operator"
Keen judgment is essential in the hiring of personnel		Discuss: . Factors to evaluate - Appearance - Personality - Types of experience - Ability through "Tryout"	Write Essay On: . "Qualities to Look for When Hiring an Operator"
Word-of mouth is considered the best advertising medium in cosmetology, but other means should be explored	Demonstrate: . Advertising layout - Newspaper - Magazines - Direct mail - Posters	Discuss: . Value of advertising media - Newspaper - Magazines - Television - Radio - Fashion shows - Direct mail	Student Project: . Prepare a poster, advertising services rendered in school clinic . Obtain beauty salon advertisements from local newspapers - Compare and evaluate

UNIT SHOP OWNER

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Ethical business practices can build confidence and increased patronage		Discuss: . Code of ethics - Fair and courteous treatment to all - Respect for rights and opinions of others - Loyalty to employees - Honesty in fulfilling all obligations - Maintenance of good reputation . Professional Organizations	List and Discuss: . Business practices that must be considered - Ethical - Unethical

Unit SHOP MANAGER

GENERAL CONCEPT

An efficient general operator often serves as a part-or full-time manager. A good manager is the nucleus of a successful salon. The decor, cleanliness of the salon, morale, personnel, inventory, promotion of good will, interpersonal relationships, advertising, and record keeping are only some of the manager's responsibilities and duties. This position also demands a knowledge of Federal, State, and local laws.

This unit deals with varies responsibilities and duties involved in managing a beauty shop.

OBJECTIVES

To develop an understanding of the importance of interpersonal relationships

To develop an awareness of the many and varied responsibilities of the shop manager

To understand the economic and financial structure of a successful salon

UNIT SHOP MANAGER

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
A beauty salon should be attractive and efficient		Discuss: . Shop layout and design - Efficiency - Convenience - Dispensary and storage - Mobility	Project: . "My Future Salon" Student Project: . Select illustrations of salon interiors from trade magazines
Visual displays are enticing and persuasive	Demonstrate: . Window display materials - Style pictures - Cosmetics - Draping material - Signs - Design for type of display window . Arrange display	Discuss: . Window display location - Type of display window - Proportion and balance - Display materials - Frequency of display change - Advantages of correct display	Observe and Discuss: . Display windows of 2 beauty salons . Prepare a shadow box display - Apply art principles discussed
Point of sales displays increase salon income	Demonstrate: . Arrangement of cosmetic display in display area, reception room, show case, booths, or styling areas	Discuss: . Purpose of cosmetic displays - To increase cosmetic sales - Source of commission - Service to patron . Types of cosmetic displays - Lighted show cases - Booth shadow boxes or shelves . Necessity for frequent change of displays	Student Project: . Prepare bulletin boards . Practice setting up a cosmetic display
The shop manager must be acquainted with the local, State, and Federal laws		Discuss: . Local and State laws . Licenses - Operator - Shop - Booth rental . Health codes . Zoning regulations	Review: . Hairdressing and cosmetology license . Health codes Student Project: . Prepare sample license application

UNIT SHOP MANAGER

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
Insurance has many facets		Discuss . Insurance - Liability - Malpractice - Fire and burglary	Discuss: . Protection afforded by insurances
Employee fringe benefits are responsibility of management		Discuss: . Social Security . Unemployment insurance . Workman's Compensation Insurance . Disability insurance	Discuss: . Employee benefits provided by management
Gross earnings depend upon initiative		Discuss: . Payroll - Salary - Commissions - Gratuities - Tax deductions - Social Security Review trade math	Review: . Minimum Wage and Hour Law Student Project: . Make out sample payroll . Prepare pay envelope . Estimate - Gross pay - Commissions - Deductions - Net pay
A profitable salon is well organized		Discuss: . Condition and appearance of shop . Managing appointment desk . Ordering supplies - Determining amounts to be ordered - Evaluating new products - Package deals - Trade discounts	Review: . Receptionist unit . Dispensary unit Trade Math: . Methods of payment . Discounts . Determining amounts to be ordered

UNIT SHOP MANAGER

SPECIFIC CONCEPTS	CONTENT WITH TEACHING SUGGESTIONS		STUDENT PARTICIPATION
	DEVELOPMENT OF SKILLS	DEVELOPMENT OF THEORY AND RELATED INFORMATION	
A calm atmosphere results from good interpersonal relationships		Discuss: . Interpersonal relations - Operator-patron - Operator-coworkers - Operator-manager . Shop ethics: - Courteous and friendly service to all patrons - Honest and fair treatment of all patrons - Cooperation among coworkers - Observance of proper work habits	Practice: . Operator-patron relations Write an Essay On: . "How to Develop a Clientele"

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ABSTRACT - To assist secondary school officials in developing and maintaining strong business education programs, this handbook presents essential information about business and distributive education programs for high school students and for adults in New York State. Approved business subjects are listed as well as requirements for different kinds of state business diplomas, the approved major business sequences, suggested special business programs, and sequences for small high schools. Recommendations are made concerning the scheduling of vocational business subject offerings, cooperative and work experience programs, business and distributive education clubs, and means of improved cooperation between guidance and business education departments. Registered and approved private business schools, 2-year colleges, 4-year colleges, and universities offering business education courses in New York State are briefly described but not listed. (CH)

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THE STATE EDUCATION DEPARTMENT
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INTRODUCTION

This handbook for business and distributive education is intended to be an administrative manual. It attempts to present in one publication all the information about the business and distributive education programs in New York State which is considered essential for administrative and guidance purposes. It includes a list of the approved business subjects, the requirements for the different kinds of State business diplomas, the approved major business sequences, suggested special business programs and sequences for small high schools, and many other important types of information which should be of special interest to school administrators and guidance personnel as well as business teachers.

The present-day New York State business education program is the result of years of experience and experimentation. The suggestions contained in this handbook, therefore, are intended to be of definite assistance to secondary school officials in developing and maintaining strong business education programs designed to meet varying local requirements and conditions. The handbook contains a minimum of descriptive material, an earnest effort having been made to present factual information helpful to busy school officials.

Particular attention, however, should be given to the administrative considerations relative to business and distributive education subjects and their suggested scheduling so that maximum educational values may be attained. It is advisable to offer some of the vocational business subjects on a double-period basis and it is strongly recommended that this suggestion be adopted in order to assure business students of the attainment of marketable skills and knowledges as well as adequate opportunities to develop businesslike attitudes and ideals. Offering these vocational business subjects on a single-period basis is almost certain to result in limited educational values and less occupational ability.

Schools should take advantage of the many part-time employment opportunities now available in offices and stores in order to develop effective co-operative work-experience programs. Co-operative students working in offices and stores under the supervision of the school may earn up to two units of Regents or local school credit. These students also develop greater maturity and independence as the result of earning their own spending money.

Inquiries regarding the availability of Federal aid for high school business and distributive education classes should be directed to the Bureau of Business and Distributive Education.

This handbook recommends means of improved co-operation between the guidance of business education departments. It strongly urges the development of effective counseling programs respecting the business education courses and diploma requirements. It also suggests special recognition for student improvement and achievement, business and distributive education clubs, as well as several other ideas that tend to aid in the development of superior business education programs.

Directors of adult education and others responsible for courses for adults will be interested in the sections on business and distributive education courses. These sections are intended to be of definite assistance in the development of strong business education programs at the adult level.

Descriptive information regarding the registered and approved private business schools in the State is included. Information regarding 2-year colleges, 4-year colleges, and universities offering business education courses is provided for the convenience of guidance counselors and school officers.

This handbook attempts to answer most of the administrative questions that arise in initiating, expanding, and enriching business and distributive education programs. However, if there are questions that have not been fully answered, the staff of the Bureau of Business and Distributive Education will welcome requests for additional detailed information. If the services of a member of the supervisory and professional staff will be helpful in solving problems in this area, administrators should not hesitate to write or telephone for advisory assistance. The staff of the Bureau of Business and Distributive Education welcomes all opportunities to be of service to local school systems and administrative officers.

JOHN E. WHITCRAFT, *Chief*
Bureau of Business and Distributive Education

JOSEPH R. STROBEL
Assistant Commissioner for Instructional Services (Vocational Education)

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PART I

BUSINESS AND DISTRIBUTIVE EDUCATION PROGRAMS FOR NEW YORK STATE SECONDARY SCHOOLS

APPROVED BUSINESS SUBJECTS

SUBJECT	REGENTS CREDIT	YEAR OFFERED
Bookkeeping 1	1	10, 11, 12
Bookkeeping 2[1]	1, 1½	11, 12
Business arithmetic[1]	1	10, 11, 12
Business law[1]	1	11, 12
Business management[2]	½	11, 12
Distribution 1	1	11, 12
Distribution 2	1	12
Introduction to business	1	9, 10
Machine transcription	1	11, 12
Office experience	½, 1, 1½, 2	11, 12
Office practice 1	½ or 1	11, 12
Office practice 2	½ or 1	12
Salesmanship[2]	½	11, 12
Secretarial practice	1, 1½	12
Shorthand 1	1	10, 11
Shorthand 2[1]	1	11, 12
Shorthand, personal-use	½	10, 11, 12
Store experience	½, 1, 1½, 2	11, 12
Transcription[1]	½	11, 12
12th-year vocational business practice	1	12
Typewriting 1[1]	1	10, 11, 12
Typewriting, introductory	½	9, 10, 11, 12
Typewriting, personal	½	11, 12

[1] Regents examination subject.
[2] Local syllabus should be approved by the Bureau of Secondary Curriculum Development.

APPROVAL OF SPECIAL BUSINESS SUBJECTS

The syllabus or outline of a business and distributive education course offered for Regents or local school diploma credit should be approved by the Bureau of Secondary Curriculum Development of the State Education Department.

Most business courses are based on the officially-approved syllabuses published and distributed by the Department. However, other special courses may be taught and Regents and local school diploma credit granted if the syllabuses or outlines have been approved by the Bureau.

The list of business subjects on page 3 contains the titles of all the approved courses based on officially approved syllabuses. However, some courses in the list, such as business management and salesmanship, are based on locally prepared outlines which have been approved by the Department, on the recommendation of the Bureau of Business and Distributive Education.

To secure the approval of a special subject, a definite detailed outline of the course should be submitted by the principal of the school before the end of the term in which the course is being offered. Each outline should be accompanied by the Department's application form. Application blanks and information concerning the approval of special business subjects may be obtained from the Bureau.

Outlines for special business subjects which have been officially approved will be loaned on request to local school authorities by the Bureau of Business and Distributive Education to assist them in preparing their own special syllabuses.

ADMINISTRATIVE CONSIDERATIONS RELATIVE TO BUSINESS AND DISTRIBUTIVE EDUCATION SUBJECTS

Bookkeeping

Most students in grades 10 and above who are interested in electing 1 year of bookkeeping probably should be permitted to do so. The bookkeeping syllabus is extremely flexible and provides that certain topics be taught at the acquaintanceship level. Problems, exercises, laboratory materials, and practice sets with business papers, therefore, should take into consideration the needs, interests, and abilities as well as vocational objectives of individual students.

The final weeks of the first-year course might well be devoted to practice sets and related business papers. Several different practice sets should be used at this time to provide for individualization of instruction.

Students who have made a reasonable effort in bookkeeping 1 should receive credit for the course. Only those students who show a strong interest and potential vocational capacity in bookkeeping or who expect later to study accounting in a college or university should be encouraged to elect the second-year course. Bookkeeping 2 presents a challenge to students of average and above-average ability.

Bookkeeping 2 carries either 2 or 2½ units of Regents credit because of the optional double-period arrangement. The additional or laboratory period does not require an equal amount of outside preparation. This explains the assignment of but one-half unit of Regents credit to the practice period. The second period should be devoted to the solution of practical bookkeeping problems and should not be used for preparing homework assignments. These problems and practice sets should take into consideration the types of bookkeeping activities carried on in the local community.

Business Arithmetic

Business arithmetic is a 1-year, 1-unit subject usually scheduled in the 10th year. It is required for several vocational business diplomas and is included in a number of the major sequences. Business arithmetic also satisfies the 1-unit mathematics requirement for the State Regents diploma. The Regents examination is based on the Department's syllabus in business arithmetic.

Business Law

This is a two-semester subject. Principals will note in the suggested programs that business law is scheduled for the 11th year; however, it may be desirable to offer it in the 12th year.

Business Management

This is a one-semester, one-half unit subject. In preparing the syllabus for this subject, local school authorities in many communities will wish to include a number of consumer education units based on local needs.

Teachers should obtain a copy of the Bureau's publication, *Handbook for Teachers of Business Management.*

Distributive Education

Distribution 1 and 2 plus store experience are the core of the New York State distributive education program. However, local communities now have the choice of offering a curriculum in distribution with or without on-the-job work experience. (See page 23.) Some communities will find it advisable to offer only a 1- or 2-year course in distribution with or without provision for store experience.

Local school authorities may wish to include one semester of distribution 1 in the summer school program so that a student may earn one-half unit of credit during the summer term.

Economics and Economic Geography

Economics and economic geography have been integrated into social studies education and are omitted from the list of approved business subjects.

Introduction to Business

It is important that this subject be taught by a well-prepared and certificated teacher of business subjects. Because of the nature of this subject, it should be offered only to 9th or 10th grade students. Regents credit for introduction to business may not be granted to 11th and 12th year students without special permission from the Bureau of Business and Distributive Education.

Machine Transcription

This is a two-semester, 1-unit subject for which typewriting is a prerequisite. It is designed to prepare students for beginning posi-

tions as machine transcribers. This type of position is increasing in importance in a number of New York State communities. A syllabus, a special manual, and job instruction sheets for use in connection with the teaching of machine transcription are available from the Bureau of Business and Distributive Education.

Office Practice

This is a vocational business subject that provides clerical, filing, and business machine preparation for the numerous office positions frequently classified as clerical office occupations — positions of a nonstenographic and nonbookkeeping nature. Typewriting is a prerequisite to office practice 1.

This subject should not be offered in schools employing less than two full-time business teachers or graduating less than 40 students each year. For approval of the course, the school should provide the minimum equipment listed on pages 16-18 in the office practice syllabus. This required equipment is adequate for teaching 20 students in each section on a rotation basis.

If only 1 year of office practice is to be offered as a 12th year terminal course, it is strongly recommended that it be scheduled on a double-period basis in order to provide adequate time for the development of marketable skills. The other scheduling possibilities shown on page 14 in the syllabus are as follows:

Order	*Recommended in This Order*	*Units*
1.	Double period with no outside assignment for 1 year of study or two semesters (360 periods)	1
2.	Single period for 1 year or two semesters (180 periods) plus one additional period daily of out-of-class work (180 periods) or a total of 360 periods	1
3.	Single period with no outside assignment for 1 year or twc semesters (180 periods)	½
4.	Double period with no outside assignment for one semester (180 periods)	½

Note: It will be noted that office practice for just one-half unit of credit cannot be used in any of the 3-unit major sequences. If only one-half unit is earned, it may be used as a group III elective. Two separate one-half unit courses in office practice may be combined to make 1 unit of credit for major sequence or special diploma credit purposes.

Salesmanship

This is a one-semester, one-half unit subject. In preparing the syllabus for this subject, local school authorities will wish to include a number of locally important consumer education units.

Teachers should obtain a copy of the Bureau's publication, *Idea Stimulators for Use in Teaching Salesmanship.*

Secretarial Practice

The major objective of secretarial practice is the preparation of advanced shorthand students for secretarial work. It provides a definite opportunity to integrate the study of English fundamentals, shorthand transcription, advanced typewriting, and the various other secretarial knowledges and skills.

Secretarial practice may be scheduled as follows:

Order	*Recommended in This Order*	*Units*
1.	Consecutive double period basis for 8 or 10 periods a week for one school year or two semesters with no outside preparation.....	1
2.	Single period basis for one school year or two semesters with an equal amount of outside preparation.....	1
3.	One period daily of supervised secretarial work within the school may be substituted for the second period of the regular double period. Students should be rotated in various school offices to insure a variety of worthwhile practical secretarial experiences.....	1
4.	Consecutive double period basis for 8 or 10 periods a week for one school year or two semesters with one period of outside preparation	1½

Shorthand

Ordinarily only average and above-average students in grades 10 and above should be permitted to study shorthand 1. For the most effective guidance, a special effort should be made to encourage students to remain in shorthand 1 for at least the first semester. These students may be granted one-half unit of credit to be used in group III for State or local diploma purposes. Students who desire to discontinue the study of shorthand and who are still interested in business employment are eligible for such courses as machine transcription, office practice, and distribution 1. Only those students who can profit from additional instruction in this field should continue with shorthand 2 and transcription.

Shorthand, Personal-Use

This is a one-semester, one-half unit subject. It should be organized for college-bound sophomores, juniors, and seniors who desire skill in taking notes in college lectures and comparable presentations.

Transcription

This subject is required of all stenographic majors. It is a one-half unit Regents credit subject which requires four or five periods of instruction and practice a week for one school year. A State syllabus is available. Transcription should be assigned to the typewriting or secretarial practice classroom. Ideally it should be scheduled for the year in which shorthand 2 is taught. If shorthand 1 and transcription are offered in the 11th year, the first semester of transcription might well be devoted to the development of additional skill in typewriting. The second semester may then be devoted to the development of the other transcription skills.

12th-Year Vocational Business Practice

This is a terminal subject designed especially for the small high schools — schools offering not more than eight periods of instruction in business subjects each year and with an enrollment of not more than 150 students in grades 9–12. One unit in typewriting and one other 1-unit business subject are prerequisites. Because of the nature of the subject, principals should write to the Bureau of Business and Distributive Education for information concerning it. A State syllabus is available.

Typewriting 1

This subject carries 1 unit of Regents credit. The minimum time requirement for typewriting is four or five periods a week for one school year plus extra typing practice. Typing practice may be provided on an informal basis — students using available machines during their free periods, and before and after school. Typewriting is a prerequisite of shorthand 2 and transcription, machine transcription, office practice 1, and 12th-year vocational business practice.

Typewriting, Introductory

Introductory typewriting is a one-half unit course meeting four or five times a week for one semester, or two or three times a week for two semesters.

Introductory typewriting emphasizes the development of basic techniques and typing skills with limited familiarity in typing some of the more common typewriting applications. Students who demonstrate above-average skills may be permitted to transfer (or be eligible to enroll later) into the second semester of typewriting 1 if they desire to develop additional typewriting proficiencies.

Introductory typewriting is open to any student in grades 9–12 desiring to learn the fundamentals of touch typewriting. Credit may be used in group III of the diploma requirements for either a Regents or local diploma. This course is primarily intended for nonbusiness students in grades 9–10.

Typewriting, Personal

This is a one-semester, one-half unit subject. It should be organized as an accelerated course open only to the more able students in grades 11 or 12 who are nonbusiness majors.

This course emphasizes those knowledges and skills needed by students preparing for college or for those desiring practical typewriting skills considered essential in handling everyday business communications.

VOCATIONAL STENOGRAPHIC CURRICULUM

The successful completion of the following business subjects together with such other subjects as are required for graduation[1] should equip students to accept beginning stenographic positions immediately upon graduation. Principals of registered secondary schools may issue the Regents State Diploma with special endorsement in business subjects to students who complete this curriculum.

This curriculum should challenge students of average and above-average ability.

	Units
Introduction to business	1
Typewriting 1[2]	1
Shorthand 2 years[2]	2
Transcription[2]	½
Secretarial practice[3]	1
Business law[2]	1
	6½

Note: Schools enrolling fewer than 150 students in grades 9–12 and employing only one business teacher should not attempt to offer the complete vocational stenographic curriculum outlined above. However, if there are clerical employment opportunities in the area, the special vocational business curriculums for the small high schools should be considered. These curriculums are outlined on pages 33–34.

Vocational Stenographic Curriculum A

9TH YEAR	10TH YEAR	11TH YEAR	12TH YEAR
Introduction to business	Shorthand 1 Typewriting 1	Shorthand 2 Transcription Business law	Secretarial practice[3]

Recommended 12th-year elective — Bookkeeping 1

[1] See *Administrator's Handbook of the Secondary School Curriculum of New York State.*

[2] To be eligible for a State high school diploma, the passing of the Regents examination in this subject is required.

[3] See page 8 for recommended methods of scheduling secretarial practice.

Vocational Stenographic Curriculum B

9TH YEAR	10TH EAR	11TH YEAR	12TH YEAR
Introduction to business	Typewriting 1	Shorthand 1 Advanced typewriting and transcription Business law	Shorthand 2 Secretarial practice[1]

[1] See page 8 for recommended methods of scheduling secretarial practice.

VOCATIONAL BOOKKEEPING CURRICULUM

The successful completion of the following business subjects together with such other subjects as are required for graduation[1] should equip a student to accept beginning bookkeeping-clerical positions immediately upon graduation. These subjects may also stimulate an interest in professional accountancy as a career. Principals of registered secondary schools may issue the Regents State Diploma with special endorsement in business subjects to students who complete this curriculum.

This curriculum should challenge students of average and above-average ability.

	Units
Introduction to business	1
Business arithmetic[2]	1
Typewriting 1[2]	1
Bookkeeping 2 years[2]	2 or 2½
Business law[2]	1
	6 or 6½

Note: This complete curriculum should be taught only in those schools located in employment areas in which beginning bookkeeping-clerical positions are available and in which the enrollment in bookkeeping 2 compares favorably with enrollments in other advanced secondary school subjects.

Vocational Bookkeeping Curriculum A

9TH YEAR	10TH YEAR	11TH YEAR	12TH YEAR
Introduction to business	Business arithmetic Typewriting	Bookkeeping 1 Business law	Bookkeeping 2[3]

Recommended 12th-year elective — Office Practice 1

[1] See *Administrator's Handbook of the Secondary School Curriculum of New York State.*

[2] To be eligible for a State high school diploma, the passing of the Regents examination in this subject is required.

[3] Single or double period.

VOCATIONAL OFFICE PRACTICE CURRICULUM

The greatest number of employment opportunities in offices is in the clerical area. The successful completion of the following business subjects together with such other subjects as are required for graduation[1] should equip a student to accept clerical office positions immediately upon graduation. The office practice curriculum, if organized in accordance with the suggestions contained in the State syllabus, should meet the vocational needs and interests of students with widely varying abilities. Principals of registered secondary schools may issue the Regents State Diploma with special endorsement in business subjects to students who complete this curriculum.

	Units
Introduction to business	1
Business arithmetic[2]	1
Typewriting[2]	1
Bookkeeping 1	1
Office practice 1	½ or 1
Office practice 2	½ or 1
Business law[2]	1
	6 or 7

Note: Only those high schools employing two or more teachers of business subjects and located in communities employing large numbers of clerical office workers should offer the complete vocational office practice curriculum.

Vocational Office Practice Curriculum A

9TH YEAR	10TH YEAR	11TH YEAR	12TH YEAR
Introduction to business	Business arithmetic Typewriting	Business law Office practice 1[3]	Bookkeeping 1 Office practice 2[3]

[1] See *Administrator's Handbook of the Secondary School Curriculum of New York State.*

[2] To be eligible for a State high school diploma, the passing of the Regents examination in this subject is required.

[3] Double periods recommended.

VOCATIONAL MACHINE TRANSCRIPTION CURRICULUM

Increasing numbers of employment opportunities in offices involve the use of transcribing machines. The successful completion of the following business subjects together with such other subjects as are required for graduation[1] should equip a student to accept beginning office positions which involve the use of transcribing machines. This curriculum should meet the vocational needs and interests of students with widely varying abilities. Principals of registered secondary schools may issue the Regents State Diploma with special endorsement in business subjects to students who complete this curriculum.

		Units
Introduction to business		1
Typewriting 1[2]		1
Business arithmetic[2]	1	1
or		
Bookkeeping 1	1	
or		
Business law[2]	1	
Machine transcription		1
Secretarial practice	1	1
or		
Office practice	1	
or		
12th-year vocational business practice	1	
		5

[1] See *Administrator's Handbook of the Secondary School Curriculum of New York State.*

[2] To be eligible for a State high school diploma, the passing of the Regents examination in this subject is required.

Vocational Machine Transcription Curriculum A

9TH YEAR	10TH YEAR	11TH YEAR	12TH YEAR
Introduction to business	Typewriting 1	Machine transcription	Secretarial practice[2] or Office practice[3] or 12th-year vocational business practice[4]
	Business arithmetic[1]	Business law[1]	
	Bookkeeping 1[1]		

[1] Any one of business arithmetic or bookkeeping 1 or business law.
[2] See page 8 for recommended methods of scheduling secretarial practice.
[3] Double periods recommended.
[4] Write to the Bureau of Business and Distributive Education for information concerning this subject.

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VOCATIONAL DISTRIBUTIVE EDUCATION CURRICULUM

The successful completion of the following business subjects together with such other subjects as are required for graduation[1] should equip a student to accept an entry level position immediately upon graduation. Principals of registered secondary schools may issue the Regents State Diploma with special endorsement in business subjects to students who complete this curriculum.

This curriculum will meet the vocational needs and interests of students with widely varying abilities. The wide range and large number of job opportunities in distributive occupations create a demand for employees with many different kinds of abilities.

		Units
Introduction to business		1
Business arithmetic[2]		1
Typewriting[2]		1
Business law[2]	1	1
or		
Bookkeeping 1	1	
Distribution 1		1
Distribution 2		1
		6

Note: This curriculum should be taught in those schools located in areas where available part-time employment opportunities are extremely limited or where transportation problems, and other related considerations minimize the practicality of a co-operative work experience program for distributive occupations.

Vocational Distributive Education Curriculum

9TH YEAR	10TH YEAR	11TH YEAR	12TH YEAR
Introduction to business	Business arithmetic Typewriting	Distribution 1 Business law or Bookkeeping 1	Distribution 2

[1] See *Administrator's Handbook of the Secondary School Curriculum of New York State.*

[2] To be eligible for a State high school diploma, the passing of the Regents examination in this subject is required.

VOCATIONAL CO-OPERATIVE DISTRIBUTIVE EDUCATION CURRICULUM

This curriculum enables students to obtain graduation credit, gain practical experience, and earn money in part-time positions while still in school and prepares them for full-time employment following graduation. Because of the wide range and large number of job opportunities in retail, wholesale, and service establishments, students with widely varying abilities can benefit from completing this curriculum. The following business subjects together with such other subjects as are required for graduation[1] are included. Principals of registered secondary schools may issue the Regents State Diploma with special endorsement in business subjects to students who complete this curriculum.

	Units
Introduction to business	1
Business arithmetic[2]	1
Business law[2] or Bookkeeping 1	1
Distribution 1	1
Distribution 2	1
Store experience	½, 1, 1½ or 2
	5½, 6, 6½ or 7

Note: School communities in which there are large numbers of part-time retail, wholesale, and service positions should seriously consider the establishment of the vocational co-operative distributive education curriculum.

Vocational Co-operative Distributive Education Curriculum

9TH YEAR	10TH YEAR	11TH YEAR	12TH YEAR
Introduction to business	Business arithmetic	Distribution 1 Business law or Bookkeeping 1	Distribution 2 Store experience[3]

Recommended 10th-year elective — Typewriting 1

[1] See *Administrator's Handbook of the Secondary School Curriculum of New York State.*

[2] To be eligible for a State high school diploma, the passing of the Regents examination in this subject is required.

[3] See page 26.

GRADUATION CREDIT FOR DISTRIBUTIVE OCCUPATIONS EXPERIENCE

Store-experience requirement for graduation credit:

An average of 15 hours a week for one school year — 1 unit; for one-half school year — one-half unit. Graduation credit is granted on the following basis:

1. Students must be employed an average of 15 hours a week in an approved distributive occupation (retail, wholesale, or service establishment).
2. *Plan A.* In a co-operative distributive education program covering two school years, one regular class period a day is devoted to instruction in distribution.

   Plan B. In a co-operative distributive education program covering one school year, two regular class periods a day are devoted to distribution and/or related instruction.

   Plan C. In a 1-year co-operative distributive education program organized for students who have completed 2 units of credit in such subjects as bookkeeping, business arithmetic, business law, distribution, salesmanship, textiles, merchandising, or advertising, an average of one regular class period a day is devoted to vocational instruction in distribution.
3. Students in the co-operative class should be employed in those distributive occupations which provide a maximum variety of meaningful on-the-job experiences.
4. Distributive occupations experience gained during vacation periods may be applied toward graduation credit if done under the continued supervision of a properly certificated teacher-co-ordinator during such vacation periods.
5. When distribution 1 is the only distributive education subject offered in a vocational co-operative distributive education curriculum, it should be organized on a co-operative basis with students meeting the 15 hour average minimum weekly store experience requirement.

CO-OPERATIVE OFFICE SKILLS — VOCATIONAL WORK-EXPERIENCE CURRICULUMS

These curriculums enable students to obtain graduation credit, gain practical experience, and earn money in part-time office positions while still in school. They also prepare students for full-time employment following graduation. The following business subjects together with such other subjects as are required for graduation[1] are included in these curriculums. Principals of registered secondary schools may issue the Regents State Diploma with special endorsement in business subjects to students who complete any one of these curriculums.

Note: School communities in which there are large numbers of part-time office positions should seriously consider the establishment of one or more of the co-operative office skills curriculums.

	Units
Typewriting[2]	1
Shorthand 2 years[2]	2
Transcription[2]	½
Secretarial practice	1
Office experience	½ or 1
	5, 5½

Vocational Stenographic Curriculum C
(Co-operative Office Skills)

9TH YEAR	10TH YEAR	11TH YEAR	12TH YEAR
	Shorthand 1	Shorthand 2	Secretarial practice[3]
	Typewriting	Transcription	Office experience[4]

Recommended electives:
9th year — Introduction to business
11th year — Business law

[1] See *Administrator's Handbook of the Secondary School Curriculum of New York State.*
[2] To be eligible for a State high school diploma, the passing of the Regents examination in this subject is required.
[3] See page 8 for recommended methods of scheduling secretarial practice.
[4] See page 31.

or

	Units
Typewriting 1[1]	1
Business arithmetic[1]	1
Bookkeeping 2 years[1]	2 or 2½
Office experience	½ or 1
	4½, 5, 5½

Vocational Bookkeeping Curriculum B
(Co-operative Office Skills)

9TH YEAR	10TH YEAR	11TH YEAR	12TH YEAR
	Typewriting 1	Bookkeeeping 1	Bookkeeping 2[2]
	Business arithmetic		Office experience[3]

Recommended electives:
9th year — Introduction to business
11th year — Office practice 1 or business law

or

	Units
Typewriting 1[1]	1
Bookkeeping 1	1
Business arithmetic[1]	1
Office practice	1, 1½ or 2
Office experience	½ or 1
	4½, 5, 5½, 6

Vocational Office Practice Curriculum B
(Co-operative Office Skills)

9TH YEAR	10TH YEAR	11TH YEAR	12TH YEAR
	Typewriting 1	Bookkeeeping 1	Office practice 2[4]
	Business arithmetic	Office practice 1[4]	Office experience[3]

Recommended 9th-year elective — Introduction to business

[1] To be eligible for a State high school diploma, the passing of the Regents examination in this subject is required.
[2] Single or double period.
[3] See page 31.
[4] Double period recommended.

or

	Units
Typewriting 1[1]	1
Business arithmetic[1] or Bookkeeping 1 or Business law[1]	1
Machine transcription	1
Secretarial practice or Office practice or 12th-year vocational business practice	1
Office experience	1
	5

Vocational Machine Transcription Curriculum B
(Co-operative Office Skills)

9TH YEAR	10TH YEAR	11TH YEAR	12TH YEAR
	Typewriting 1	Machine transcription	Secretarial practice[3, 4] or Office practice[3, 4] or 12th-year vocational business practice[3,4]
	Business arithmetic[2]	Business law[2]	
	Bookkeeping 1[2]		

Recommended 9th-year elective — Introduction to business

[1] To be eligible for a State high school diploma, the passing of the Regents examination in this subject is required.
[2] One unit of bookkeeping I or business arithmetic or business law.
[3] Double period recommended.
[4] One unit of secretarial practice or office practice or 12th-year vocational business practice.

GRADUATION CREDIT FOR OFFICE EXPERIENCE

Work-experience requirement for graduation credit:

An average of 15 hours a week for one school year — 1 unit; for one-half school year — one-half unit. Graduation credit is granted on the following basis:

1. Students must be employed an average of 15 hours a week in an approved office skills occupation.
2. In a co-operative program covering two school years, one regular class period a day is devoted to vocational instruction.
3. In a co-operative program covering one school year, two regular class periods are devoted to vocational and/or related instruction.
4. If students in the co-operative office skills program have completed 2 units of credit in such subjects as bookkeeping, business arithmetic, business law, typewriting, shorthand and transcription, machine transcription or office practice, one regular class period a day is devoted to vocational office skills instruction.
5. Office experience gained during vacation periods may be applied toward graduation credit if done under the continued supervision of a properly certificated teacher-co-ordinator during such vacation periods.

VOCATIONAL BUSINESS CURRICULUMS FOR THE SMALL HIGH SCHOOL

(150 pupils or fewer in grades 9–12)

High schools having one fully certificated teacher of business subjects and in which eight or fewer periods of instruction in business subjects are being taught each year and which enroll 150 pupils or fewer in grades 9–12 should consider these curriculums. This is especially true if there are general clerical office job opportunities in the employment area. One of the following groups of subjects together with such other subjects as are required for graduation[1] are included.

		Units
Introduction to business		1
Business arithmetic[2, 3]	1	2
Bookkeeping 1[3]	1	
Business law[2, 3]	1	
Typewriting 1[2]		1
12th-year vocational business practice[4]		1
		5

Small High School Vocational Business Curriculum A

9TH YEAR	10TH YEAR	11TH YEAR	12TH YEAR
Introduction to business	Business arithmetic[3] Bookkeeping 1[3] Typewriting 1	Business law[3]	12th-year vocational business practice[4]

[1] See *Administrator's Handbook of the Secondary School Curriculum of New York State.*

[2] To be eligible for a State high school diploma, the passing of the Regents examination in this subject is required.

[3] Any two of business arithmetic, bookkeeping 1, or business law.

[4] Write to the Bureau of Business and Distributive Education for information concerning this subject.

or

	Units
Introduction to business	1
Shorthand 2 years[1]	2
Transcription[1]	½
Typewriting 1[1]	1
Business law[1] (optional)	1
12th-year vocational business practice[2]	1
	5½ or 6½

Small High School Vocational Business Curriculum B

9TH YEAR	10TH YEAR	11TH YEAR	12TH YEAR
Introduction to business	Typewriting 1	Shorthand 2	12th-year vocational business practice[2]
	Shorthand 1	Transcription Business law (optional)	

Principals of registered secondary schools may issue the Regents State diploma with special endorsement in business subjects to pupils who complete either of these curriculums.

[1] To be eligible for a State high school diploma, the passing of the Regents examination in this subject is required.

[2] Write to the Bureau of Business and Distributive Education for information concerning this subject.

NONVOCATIONAL BUSINESS CURRICULUM

This curriculum should be available as the basic business education (nonvocational) program in most of the secondary schools in New York State. The following business subjects together with such other subjects as are required for graduation[1] are included.

	Units
Introduction to business	1
Business arithmetic[2]	1
Bookkeeping	1
Salesmanship[3]	½
and	
Business management[3]	½ } 1
or	
Distribution 1	1
Business law[2]	1
	5

Nonvocational Business Curriculum

9TH YEAR	10TH YEAR	11TH YEAR	12TH YEAR
Introduction to business	Business arithmetic	Business law	Bookkeeping 1 Salesmanship[3] and Business management[3] or Distribution 1

Recommended 10th-year elective — Typewriting 1

[1] See *Administrator's Handbook of the Secondary School Curriculum of New York State.*

[2] To be eligible for a State high school diploma, the passing of the Regents examination in this subject is required.

[3] The local syllabus must be approved by the Department.

MAJOR BUSINESS SUBJECT SEQUENCES

Students who desire a concentration in business subjects less than a complete vocational curriculum should consider the following major business subject sequences which may be used to satisfy the group II requirements for the nonbusiness form of the State Regents High School Diploma. A late edition of the *Administrator's Handbook of the Secondary School Curriculum of New York State* should be consulted for the additional subjects required for graduation.

Only those State Regents High School Diplomas may bear a special endorsement in business subjects which meet the curriculum requirements outlined on pages 12–35 of this handbook.

Nonvocational Major Sequences

(1)	(2)	(3)
Introduction to business Business arithmetic Business law	Introduction to business Salesmanship and business management Business law or Business arithmetic	Business arithmetic Salesmanship and business management[1] Business law

(4)	(5)	(6)
Bookkeeping 1 Salesmanship and business management[1] Business law or Business arithmetic	Business arithmetic Bookkeeping 1 Business law	Introduction to business Typewriting 1 Business law

[1] Distribution 1 may be substituted for salesmanship and business management as shown in vocational major sequence number 20.

Vocational Major Sequences

(7)

Typewriting 1
Bookkeeping 1
Bookkeeping 2

(8)

Business arithmetic
Bookkeeping 1
Bookkeeping 2

(9)

Shorthand 1[1]
Shorthand 2
Transcription
Secretarial practice

(10)

Typewriting 1
Bookkeeping 1
Office practice
(1 unit)

(11)

Typewriting 1
Office practice
(2 units)

(12)

Typewriting 1
Machine transcription
(1 unit)
Secretarial practice

(13)

Typewriting 1
Machine transcription
(1 unit)
Office practice
(1 unit)
or
Office experience
(1 unit)

(14)

Shorthand 1[1]
Shorthand 2
Transcription
Office experience
(1 unit)

(15)

Typewriting 1
Office practice
(1 unit)
Office experience
(1 unit)

(16)

Bookkeeping 1
Bookkeeping 2
Office experience
(1 unit)

(17)

Bookkeeping 1[1]
Office practice
(1 unit)
Office experience
(1 unit)

(18)

Distribution 1
Distribution 2
Store experience[2]
(1 unit)

(19)

Distribution 1
Business law
or
Bookkeeping 1
Store experience
(1 unit)

(20)

Distribution 1
Bookkeeping 1
or
Business
arithmetic
or
Business
law
} 2 units

(21)

Distribution 1
Business arithmetic
Store experience
(1 unit)

[1] Students choosing this major sequence must also complete as an elective: typewriting (1 unit).

[2] Bookkeeping 1, business arithmetic, or business law may be substituted for store experience.

Major Sequences for the Small High School

(150 pupils or fewer in grades 9-12)

(22)

Introduction to business
Typewriting 1
12th-year vocational business practice

(23)

Typewriting 1
Bookkeeping 1
12th-year vocational business practice

(24)

Typewriting 1
Business law
12th-year vocational business practice

(25)

Typewriting 1
Machine transcription (1 unit)
12th-year vocational business practice

(26)

Typewriting 1
Shorthand 1 or abbreviated longhand
12th-year vocational business practice

(27)

Typewriting 1
Business arithmetic
12th-year vocational business practice

(28)

Typewriting 1
Office experience (1 unit)
or
Store experience (1 unit)
12th-year vocational business practice

(29)

Typewriting 1
Salesmanship and business management or
Distribution 1
12th-year vocational business practice

BUSINESS SUBJECT ELECTIVES AND MAJOR SEQUENCES IN NONBUSINESS DIPLOMAS

All business subjects not requiring prerequisites are available as electives to all interested high school students provided the subjects are studied in the year or years suggested in this handbook.

Students interested in curriculums other than business but who desire more than one or two business subject electives may want to consider one of the major sequences outlined on pages 37–39.

The nonvocational major sequences provide interested students with a broad background of business information.

The vocational major sequences, while not as comprehensive as the vocational curriculums, should provide sufficient occupational competence to enable students to accept full-time or part-time beginning office or distributive positions. These skills might enable students to defray some of their expenses in connection with attendance at schools following high school graduation.

The vocational major sequences, of course, do not provide the varieties of skills nor the promotional potential gained by students who complete the vocational curriculums.

BUSINESS SUBJECTS IN COMBINATION WITH OTHER SUBJECT AREAS

Major sequences in which business subjects are combined with other subject areas such as agriculture, home economics, trade and technical education, and the like, will be approved for State Regents Diploma purposes with the mutual agreement of the separate State Education Department units involved.

The Bureau of Business and Distributive Education has made tentative plans with the Bureaus of Agriculture and Home Economics regarding combination major sequences. Similar plans are to be worked out with a number of other departmental units.

The State Education Department welcomes opportunities to assist local school authorities in developing combination major sequences which will be of value to their students.

COMBINATION BUSINESS EDUCATION — COLLEGE PREPARATORY PROGRAMS

A survey of the colleges in New York State indicates that more than 100 of these colleges will admit a New York State high school graduate with a Regents diploma who has completed 4 to 6 units of business subjects of a total of 18–20 units, providing the student's grades are high enough to meet their entrance requirements and all other entrance requirements have been met satisfactorily.

Suggested Combination Programs

For a girl interested in entering college to obtain a liberal arts education or to become a business teacher or a secretary, the following high school program is suggested:

9th year	10th year	11th year	12th year
English	English	English	English
Social studies	Social studies	Social studies	Social studies or elective
General science or Earth science or Biology	Biology or elective	Elective	Elective
Mathematics 9	Mathematics 10	Business law	Secretarial practice
Introduction to business	Typewriting 1	Shorthand 1	Shorthand 2 and transcription

For boys or girls interested in accounting, real estate, banking, business management, insurance, marketing, retailing and related occupations, or business teaching, the following program is recommended:

9th year	10th year	11th year	12th year
English	English	English	English
Social studies	Social studies	Social studies	Social studies or elective
General science or Earth science or Biology	Biology or elective	Elective	Elective
Mathematics 9	Mathematics 10	Bookkeeping 1	Bookkeeping 2 or distribution 1
Introduction to business	Typewriting 1	Business arithmetic	Business law

Deviations from the above programs can be planned to meet specific needs of individual students.

Students completing these programs should be able to compete in the Regents scholarship examinations since the programs include mathematics 9 and 10 and biology.

CO-OPERATION BETWEEN GUIDANCE AND BUSINESS DEPARTMENTS

Few Exploratory Business Courses

Since few schools offer exploratory business courses in the seventh and eighth grades, it seems highly desirable for the business and guidance departments to co-operate in familiarizing *all eighth grade students,* and as far as possible their parents, with the business program offered in grades 9–12.

This acquaintanceship should take place prior to the time students outline their educational program beginning with grade 9. All students should be given the opportunity to become familiar with the educational possibilities inherent in the special vocational business curriculums, the nonvocational business curriculum, the major sequences, and the business subject electives, along with the other high school offerings.

A Suggested Plan for the Eighth Year

A business teacher or a guidance counselor might spend several class periods discussing the business program with all of the eighth grade students sometime before these students make their plan sheets for the ninth year and their tentative plans for grades 10, 11, and 12.

These discussions should probably include at least the following items:

1. A review of each of the special vocational business curriculums available with some reference to job opportunities in the employment area open to students completing each of the special business curriculums. If time permits, some general information should be given about each of the business subjects.
2. The nonvocational business curriculum and the major sequences should be explained in order that students may understand that these sequences *are not intended to prepare them for jobs.* With the possible exception of the work experience sequences and a limited number of other sequences that develop marketable skills, these sequences are intended to provide a background of business information.
3. The values of certain business subjects as electives, especially personal typewriting, should be carefully explained. In this connection, *all* of the approved business subjects which require no prerequisites may be considered electives.
4. *Eighth-grade students interested in taking business subjects* should be encouraged to establish a tentative objective — either *vocational* or *nonvocational.* They should, if possible, include introduction to business in their ninth-year program. Tenta-

tive 10th-, 11th-, and 12th-year subjects might well be selected at the same time in terms of their over-all objective.

It is suggested that these plans and subsequent revisions of them be approved by the parents.

A Suggested Plan for the Ninth Year

1. All ninth-grade students should be given data regarding job requirements, remuneration, working conditions, and related matters as they pertain to various types of business employment. This material might be covered in the ninth grade social studies unit on occupational information or in regular classes in group guidance which include occupational information.

   It is suggested that the business department chairman, the teacher or teachers of introduction to business, and the social studies teachers work co-operatively in developing a strong unit for the social studies program that will ensure that accurate up-to-date information on business occupations is available for use in teaching the unit on occupations. This information should reflect both local and area occupational needs and opportunities, along with State and national trends.

   In those schools where regular classes in group guidance are scheduled, the business department chairman or the teacher or teachers of introduction to business should work with the counselors in accomplishing the goals set forth in the foregoing paragraph.
2. In the ninth year, the teacher of introduction to business should review the tentative plans of each student in connection with the guidance unit of the course.

   This guidance unit in introduction to business should not overlap the unit suggested for the social studies course. This should be an enriched unit that adds selected knowledges and skills beyond those learned in the social studies unit. It should provide valuable information tailored to the education, social, and vocational needs of students who are likely to follow a business career.

   Pages 112 to 117 of the *Introduction to Business Syllabus* suggest a number of worthwhile guidance activities. This section of the syllabus should be covered as late as possible during the year, but before the students are required to make their plans for the 10th year.

There should be very close co-operation between the guidance department and the business department in order that the business teacher's day-to-day knowledge of each student may be used to supplement the information in the student's cumulative record. This information might well be of two types:

1. An evaluation of the student's interests, aptitudes, and abilities in the subject matter areas

2. Reports concerning such personal qualities of the student as co-operativeness, loyalty, refinement, speech, poise, health, personal appearance, and the like

The qualitative placement of students is a function of the entire school system. In this light, close co-operation between the business department and the guidance services should be enlisted to provide the individual student with job opportunities in which he can utilize to the maximum his skills and abilities.

Suitable variations of these suggestions will occur to business teachers and guidance counselors. It is hoped that these suggested plans will be of some help to schools not now using such methods to the end that all students in the early secondary school years and their parents may become acquainted with the offerings of the business department in grades 9 through 12 whether for vocational, non-vocational, or elective purposes.

RECOGNITION OF IMPROVEMENT AND ACHIEVEMENT

Possibly the best single reward for improvement and achievement is the individual's knowledge of a job well done coupled with frequent commendation by the teacher.

For business teachers who want to develop their own award system, a sample certificate is shown below.

Although the sample shown is for typewriting, special certificates can be prepared for other subjects.

This type of local certificate can be duplicated using school equipment. A very attractive award can be developed by using heavyweight, high-grade paper combining two or more colors. The school colors may be appropriate if they duplicate well.

CERTIFICATE OF ACHIEVEMENT

Typewriting

Your School
Your Town, New York

Business Education Department

This is to certify that on....., 19.....

.....attained the speed of.....

WORDS PER MINUTE for.....minutes with a total of.....
errors.

....
Principal Business Teacher

The certificates may be awarded in class, in the regular school assemblies, or possibly in the special assemblies sometimes held for all-school awards.

In any event, these awards should be given with a degree of frequency that will provide continuous encouragement to students. *Certificates should be given to students for improvement as well as for achievement.*

An album can be designed to hold the certificates. This might have an attractive, colorful cover with the school's name, monogram, or other special insignia. The album pages should be contrasting stock in order to give the certificates an attractive mounting base. Such an album could be used when applying for a position.

It is further suggested that teachers obtain the loan packet from the Bureau of Business and Distributive Education, entitled *Motive-Incentive Plans for Business Education Subjects.*

A special bulletin dealing with awards is also available from the Bureau.

BUSINESS AND DISTRIBUTIVE EDUCATION CLUBS

Business education clubs offer an excellent opportunity for students to develop qualities of leadership and the ability to co-operate with others. At the same time, the students learn a great deal about the special field of business which is of particular interest to them.

A business education club enables students to meet and to become acquainted with business leaders in the community, to attend business luncheons and banquets, to plan field trips to local offices and stores, and do many other things that will encourage them to become more actively interested in better social, political, community, and family life. A business education club provides an excellent opportunity for students to develop initiative and responsibility in carrying out worthwhile projects benefiting the club members, the school, business, industry, the church, and many social and community agencies.

A local, State, or nationally affiliated business or distributive club has many potential educational values only a few of which are:

1. The stimulation and promotion of greater interest in all phases of business and distributive education
2. The improvement of public relations among teachers, students, and business people
3. The development of greater skill and confidence in students in their associations with business people
4. The improvement in morale of business teachers and students
5. The development of more interesting and practical classroom procedures
6. The opportunity for improvement in the social knowledges and skills of students through various types of social activities
7. The opportunity to succeed and excel afforded some students who may not be succeeding too well in their regular classwork
8. The encouragement to use a variety of community resources which may further the business education of members
9. The development of group and individual guidance and counseling procedures through a variety of club activities
10. The enlistment of student co-operation and participation in improving standards in the school's vocational business courses

The Distributive Education Clubs of New York (DECNY) is the State-level affiliate of DECA with from 85 to 100 active clubs in New York State. There are also about 30 to 40 active chapters of Future Business Leaders of America (FBLA) in New York State. Detailed information concerning these youth programs may be obtained by contacting the staff of the Bureau of Business and Distributive Education. For assistance in learning more about establishing and operating business and distributive education clubs, the

Bureau of Business and Distributive Education has prepared a loan packet containing information and other related materials. This loan packet is available for use upon written request to the Bureau.

Bulletin No. 114 (Revised), also available from the Bureau, should be of assistance to teachers interested in club activities.

SPECIAL EQUIPMENT AND FACILITIES FOR BUSINESS SUBJECTS

The suggested minimum equipment for each of the business and distributive education subjects, where special equipment is required, is listed in some detail in the State syllabus for that particular subject.

The brochure, *A Pictorial Guide To Aid in Planning Business and Distributive Education Classrooms and Facilities,* which contains photographs, floor plans, and other information, also contains comparable suggestions.

These publications are available from the Bureau of Business and Distributive Education.

PUBLICATIONS

A comprehensive selection of publications — syllabuses, bulletins, booklists, and manuals — is available from the Bureau of Business and Distributive Education.

The bulletins are concerned for the most part with professional and administrative matters. A few bulletins deal with subject matter.

Schools interested in obtaining these publications should request a copy of Bulletin No. 69.

PART 2

ADULT BUSINESS AND DISTRIBUTIVE EDUCATION PROGRAMS

ERIC

ADULT BUSINESS AND DISTRIBUTIVE EDUCATION

History and Growth

Interest and participation in adult business and distributive education has increased to the point where it is an important part of most public school business programs. The history of adult business education dates back at least to 1851 when bookkeeping was one of the seven classes for adults taught in the public schools of Buffalo. Shortly after 1900, typewriting and shorthand courses were added to the few adult programs then in existence. At that time, "Americanization" and "commercial" education were the main subjects taught in night schools which were the forerunners of modern adult education.

In the period from 1944–45 to 1962–63 the number of communities which scheduled adult business education classes increased from 31 to 500. The enrollment in adult business subjects in this same period increased from 7,866 to more than 90,000. Instead of classes only in typewriting, shorthand, and bookkeeping, today courses are offered in almost every phase of modern business.

Philosophy

Adult business and distributive education is based on the psychological principle that learning is a continuous process and that it does not end with the completion of one's formal education. To meet this need for continual learning, most schools in the State have provided adult education programs which include courses in business education.

Teacher Certification

Any teacher certificated to teach in the elementary or secondary schools of the State is eligible to teach classes of adults. District and city superintendents of schools will supply and approve applications for the certification of teachers of adults and send them to the Division of Teacher Education and Certification. Lay teachers, who by their business experience or education are qualified to teach adult classes, may teach up to and including six classes without being certificated. Lay teachers who teach more than six sessions in any one school year must be certificated by the Division of Teacher Education and Certification.

Federal aid is available for classes in distributive education which qualify under the Regulations of the Commissioner of Education. See the section on Adult Distributive Education, page 55.

Bureau Services

The Bureau of Business and Distributive Education is responsible for the supervision of all adult business education classes in the public schools. A professional member of this Bureau's staff will be pleased to assist any director of adult education, business department chairman, or business teacher in solving problems concerning adult business education.

Other services of this Bureau to strengthen the adult business education programs are: preparation of suggested course outlines; development of promotional material for use at the local level; preparation of teaching aids for instruction of adults; in-service instruction of teachers in modern adult education philosophy and methods; conducting workshops for directors of adult education; arranging programs for meetings of teachers of adults; supervisory visits with teachers, directors of adult education, principals, and superintendents; and assistance in procuring lay teachers.

It is realized that adult business education is in its infancy. As the program matures, changes in supervision and teaching techniques will be necessary. Automation and other technological advances undoubtedly will have their effects on the nature and scope of the program as well as on instructional methods. The New York State program of adult business education is extremely flexible. Directors of adult education should make every effort to expand and modernize their lists of courses so that their business education programs will continue to meet the ever-increasing needs of the adult population.

Aims and Objectives

The aims and objectives of adult business education were clearly stated in the 1938 "Regents Inquiry:"

1. To provide vocational education for initial employment
2. To upgrade present workers
3. To fill in gaps in one's education

These objectives are still valid and have not been challenged as to their worthiness.

Adult Courses in Business Education

To encourage schools to accomplish the first two of these objectives, a number of business courses have been suggested to directors of adult education, business department chairmen, and business teachers. Some of the strictly vocational business subjects suggested are:

Typewriting
Alphabetic shorthand
Symbolic shorthand
Vocational bookkeeping
Small business bookkeeping
Machine transcription
Business machines
Accounting
Machine accounting
Business data processing
Keypunch operation
Switchboard operation
Public speaking for business
Professional secretarial courses:
  Secretarial accounting
  Law for secretaries
  Business administration for secretaries
  Human relations for secretaries
  Secretarial skills and procedures

The third objective, filling in the gaps in one's education, has the largest potential market. Almost every adult has a desire and need for education along general business lines. Often no opportunity was available in his formal education for obtaining the kind of business information needed in modern everyday living. To meet these varying needs, a wide range of subjects and courses have been taught successfully. Below is a list of some of the most typical of these general business courses:

Social security and you
Life insurance
Law everyone should know
Investments
Income tax preparation
Business arithmetic
Business English
Planning a home
Business for homeowners
Consumer buying
Family finance
Telephone techniques
Typewriting for personal use
Alphabetic shorthand
Estate planning

What Is Adult Distributive Education?

Distributive education is concerned with preparing for employment people engaged in the distribution of products of farm and factory at retail and wholesale levels, and those who work in the service trades.

As the various phases of distribution have become more specialized there has been a growing recognition of the education needs of those engaged in this field.

Distributive education is instruction in any of the various phases of (1) the marketing, distribution, or selling of goods and (2) the selling of services (such as insurance and real estate) other than strictly professional services. Students may be directly engaged in selling or in nonselling merchandising activities. They may be employed on the management, supervision, or worker levels.

Adult Courses in Distribution

A wide variety of adult distributive education courses covering many different phases of the distributive process are being taught in New York State adult schools. The following list includes some of these and is typical of the types of work which may be covered in this field. These courses are of various lengths. The Bureau of Business and Distributive Education has prepared course outlines for those marked by an asterisk which are available upon request.

*Retail selling
*Mathematics of merchandising
*Small business management
*Bookkeeping for owners of small businesses
*Seasonal pre-employment training for salespeople
*How to conduct a business conference
Real estate (for agents and brokers)
Real estate appraisal
Insurance (for agents and brokers)
Credits and collections
Communications for retail management
Speech for sales supervisors
Salesmanship
Textiles
Advertising
Display
Retail food store management
Real estate appraisal
*Sales promotion

*Service station management
*Pre-Christmas training for salespeople
*Control and planning functions
*Buying and merchandising problems
*Waiter-waitress training

Federal Aid for Adult Distributive Education

Courses for adults in the distributive fields may qualify for Federal aid. Inquiries should be made to the Bureau of Business and Distributive Education.

Promotion and Development of Adult Distributive Education Courses

In school systems offering a day high school co-operative program, the distributive education teacher-co-ordinator could well be the logical person to organize and co-ordinate the distributive education phases of the adult education program.

In setting up an adult distributive education program, an advisory committee composed of local merchants and business people can be of great assistance. The chamber of commerce and/or other local retailing group representatives should be contacted and encouraged to assist in developing courses which meet the needs of local distributive businesses.

This Bureau would be happy to provide assistance in any phase of development of adult courses in distribution.

PART 3

REGISTERED AND APPROVED PRIVATE BUSINESS SCHOOLS

REGISTERED AND APPROVED PRIVATE BUSINESS SCHOOLS

Introduction

Public and private school administrative officers, high school principals, and guidance counselors should be familiar with the standards and business education programs offered in registered and approved private business schools. These types of business schools offer instruction in vocational business subjects to young people who have completed 2 years of high school education or who are 17 years of age. However, most of the students in the registered and approved private business schools are high school graduates who wish to prepare themselves for business employment of various types.

Private business schools in New York State are not required by law to be licensed, registered, or approved by the State Education Department. However, most of the very best of these schools apply annually for State recognition in the form of registration or approval. Private business schools have been registered on an annual basis for many years. It was not until 1946, however, that the Department also decided to approve certain highly specialized business schools in order that they might accommodate veterans who wish to take advantage of the so-called GI Bill of Rights.

State Supervision

The Bureau of Business and Distributive Education carefully supervises the activities of the registered and approved private business schools. The Bureau supervisor in charge of such schools visits them frequently. He serves in an advisory capacity regarding finances, equipment, advertising policies, curriculum revision, and the employment and salaries of teachers. By means of this supervisory as well as advisory service, the Bureau believes it is rendering a service to the public by assuring it that instruction in the registered and approved business schools is of good quality.

The registered private business schools offer a variety of courses which prepare students to become efficient secretaries, stenographers, accountants, and general clerks. The standard courses given in most of these schools are as follows:

Accountancy	Secretarial
General clerical	Stenographic

The approved schools specialize in the following business education courses:

Preparation for State CPA examination
Preparation for State real estate examination
Preparation for State insurance examination
Special business machines courses
Key punch and machine accounting
Computer programing

Requirements for Registration or Approval

It should be of interest to public and private school officers to understand that no private business school will be registered or approved on an annual basis unless it possesses adequate resources, occupies a satisfactory building and rooms, has established a reputation for fair and honest dealing with its students and the public, maintains satisfactory equipment, employs a faculty of teachers whose preparation has not been less than that required of teachers engaged in similar work in the public schools, offers an approved program of business subjects, and does not accept for instruction students who are less than 17 years of age who have not completed the 10th year of the regular secondary school course of study. Furthermore, no private business school shall be registered by the Department unless it employs at least two full-time day school teachers and in addition a proprietor, director, or principal who serves in that capacity or as a teacher on a full-time basis and who has had adequate experience in school administration.

The Department requires that each year registered and approved private business schools must supply the Bureau of Business and Distributive Education with copies of all advertising literature including catalogues, pamphlets, circulars, and the like. The Bureau staff is very careful that private business school advertising does not by statement, illustration, or omission mislead or tend to mislead the public. Such objectional literature may be the basis of action leading to the forfeiture of registration or approval. Approved private business schools also supply the Department with an annual statistical and financial report.

Aims and Objectives

Its principal aim is vocational in that it prepares students for immediate employment in various types of office positions.

Another aim of the registered and approved private business school relates to placement. Most of these schools offer their graduates lifetime placement service so that graduates may return to the school for employment assistance many years after the completion of their program of study.

Methods of Instruction

The methods of instruction in the registered and approved private business schools are readily adapted to meet the educational needs of students with varying occupational interests, differing degrees of physical and emotional maturity, and dissimilar aptitudes and abilities. Both large and small group class instruction is available depending on the nature of the courses being taught. Students needing individualized assistance have the opportunity to benefit from this type of instruction. Most schools have available the most modern mechanical and electronic teaching aids in addition to the latest editions of textbooks and other teaching materials.

Tuition—Methods of Payment

Tuition charges in the well-operated and successful registered and approved private business schools are reasonable. Usually they are payable by the month. This arrangement enables a student to terminate a program of instruction as soon as he has completed the subjects in his course and developed business skills to the required degree.

Education for Both Academic and Business Graduates

To the graduate of the academic department in a high school, the registered and approved private business schools offer a thorough, concentrated business education program. To graduates of high schools who studied some business subjects but who have not completed a vocational business curriculum or sequence, they offer intensive training and finishing of the specialized skills which were initiated in the high school. In other words, they enable the student to attain vocational performance standards established by most successful business organizations before he begins his employment.

Refresher Courses

Many graduates of public and private secondary schools attend registered and approved private schools for refresher courses and to

prepare for opportunities for advancement. The private business school program of instruction can be adapted easily to the needs of students interested in taking refresher courses. These schools offer very satisfactory programs in both the day and evening sessions.

Adult Evening School Program

The adult education program in the well-operated registered and approved private business school varies from year to year in terms of changing employment and social conditions. The wide variety of evening courses permits each student considerable choice in selecting the most suitable courses.

List of Registered and Approved Private Business Schools

A list of the registered and approved private business schools is prepared annually. Copies are sent to school officials and guidance counselors.

Additional copies of the list can be obtained by writing to the Bureau of Business and Distributive Education.

PART 4

2-YEAR COLLEGES, 4-YEAR COLLEGES, AND UNIVERSITIES

2-YEAR COLLEGES, 4-YEAR COLLEGES, AND UNIVERSITIES

Highly specialized business education curriculums are offered at the collegiate level in several of the State University 2-year agricultural and technical institutes, in some of the locally-sponsored 2-year community colleges, in some State-supported 4-year institutions of higher education, and in many privately-supported colleges and universities.

General information regarding the colleges, operated and supervised by the State University of New York, is contained in a publication entitled, *State University of New York, Summary Bulletin,* which can be secured by writing to the State University of New York, 8 Thurlow Terrace, Albany, New York 12201.

For specific information regarding a particular college, its curriculums, tuition charges, etc., one should write directly to the college. The address of these colleges can be found in the *Summary Bulletin* mentioned above; or it may be found in *Organization and Institutions of The University of the State of New York, Handbook 24,* which can be secured from the Publications Distribution Unit, State Education Department, Albany, New York 12224.

For specific information regarding the available opportunities for advanced business education in the privately-supported colleges and universities of the State of New York, one should write directly to the individual institutions. The addresses of these institutions may be found in *Organization and Institutions of The University of the State of New York, Handbook 24,* or by writing to the Office of the Assistant Commissioner for Higher Education, State Education Department, Albany, New York 12224.

Planning for College in New York State is another booklet which has been prepared to provide some of the more important information for an individual looking forward to attendance at a college in New York State. This publication is available also from the office of the Assistant Commissioner for Higher Education, State Education Department, Albany, New York 12224.

New York State residents interested in information concerning the Scholar Incentive Program, Regents College Scholarships, Regents College Teaching Fellowship Program, and Regents Scholarships for Professional Education in Medicine, Dentistry, and Nursing should write to the Regents Examination and Scholarship Center, State Education Department, Albany, New York 12224.

New York State residents may receive assistance in attending any approved college, graduate or professional school, or any postsec-

ondary institution in the world by borrowing funds with a Higher Education Assistance Corporation guarantee from participating lenders such as: commercial and savings banks, loan associations, credit unions, and pension funds. For information write to the Higher Education Assistance Corporation, 111 Washington Avenue, Albany, New York 12210.

VT 010 774
Bookkeeping Motivation Devices. Service Bulletin No. 10.

Mountain-Plains Business Education Association, Corpus Christi, Tex.
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Executive Secretary, Mountain-Plains Business Education Association, Del Mar College, Corpus Christi, Texas 78404.
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ABSTRACT - Devices to motivate bookkeeping students include: (1) Bookkeeping Puzzlegrams, (2) Hidden Terms, (3) Scramblegram, (4) Illustration of Debit and Credit Concept, (5) Work Sheet Preparation Game, (6) Incomplete Statements, (7) Bookkeeping Cycle Chart, (8) Closing Time Posters, (9) Depreciation Visualized, (10) "ACE" and "LIP" Accounts, (11) "ALP" and "ICE" Accounts, (12) Arithmetic Quickies, and (13) Flash Card Ideas. Examples of the devices and suggestions for their use are included. (SB)

VT 010 774

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Bookkeeping Motivation Devices

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MOUNTAIN-PLAINS BUSINESS EDUCATION ASSOCIATION

SERVICE BULLETIN NO. 10

1967

VT01077

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Mountain-Plains Business Education Association

Fall, 1967

The Mountain-Plains Business Education Association Service Bulletin No. 10 contains a number of devices that may help to stimulate students in their study of bookkeeping. They represent some of the "plus" values that go with good teaching--not cure-alls. Some are new, others not so new. Some are original; most are not. These examples, of course, represent only a few of the motivating devices that can be used or devised as learning aids in the teaching of bookkeeping.

The contents include the following:

Bookkeeping Puzzlegram	1,2,3
Hidden Terms	4
Scramblegrams	5
Illustration of Debit and Credit Concept	6
Work Sheet Preparation Game	7
Incomplete Statements	8
Bookkeeping Cycle Chart	9
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"ALP" and "ICE" Accounts	13
Arithmetic Quickies	14
Flash Card Ideas	14

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BOOKKEEPING PUZZLEGRAM

Instructions: Here's a game for bookkeepers! Fill in the puzzlegram with the words that fit the definitions given below. The words to match the definitions must contain the number of letters indicated in the sub-headings. Two words are already included. You start from there. Work from the diagram form, selecting words of a certain number of letters as needed from the definitions given. Each word entered will give you clues to other words. Check off definitions as used. Each word is used only once.

3-Letter Word

1. Term used to describe the date that a note becomes payable

4-Letter Words

1. Any device, such as a folder or cabinet, in which business papers are systematically arranged
2. An act of selling
3. The journal is a _____ of original entry
4. A written promise to pay a certain amount of money at a definite time
5. The percentage amount paid for the use of money is referred to as the interest _____
6. To acquire by labor or service

5-Letter Words

1. That section in the back of the bookkeeping text which contains an alphabetical list of terms and topics included in the book
2. Term used to describe accounts shown in the assets section of the balance sheet which are deducted from normal asset accounts; i.e., allowance for depreciation (This term also indicates subtraction)
3. The kind of stock that does not have a value for each share printed on the stock certificate
4. One side of a sheet in the bookkeeping text (plural)

6-Letter Words

1. Gain
2. Numeral given each account to aid in identifying and locating the account
3. Term used to describe the type of corporation surplus resulting from the regular operations of the business
4. Increases in proprietorship resulting from the operation of the business
5. A group of accounts

7-Letter Words

1. Cost of operating a business (This term is already recorded in the puzzlegram. Do not enter it again.)
2. An itemized statement of merchandise bought or sold with the date, terms, method of shipment, and the cost
3. That part of the insurance premium which has been used during the fiscal period--the opposite of prepaid
4. Term used in describing accounts which record income, cost, and expense items. Such accounts are closed into the profit and loss account at the end of each period
5. A book in which the original record of a transaction is recorded
6. Term used to describe insurance premiums paid in advance

8-Letter Words

1. The fundamental bookkeeping _____
2. Money paid for the use of money
3. To subtract or deduct--the effect of a credit to an asset account

9-Letter Words

1. The situation existing when more money has been withdrawn from the bank than was placed on deposit
2. The decrease in the value of a wasting asset, such as a coal mine, because of exhaustion or consumption (This term is already recorded in the puzzlegram. Do not enter it again.)
3. The amount of money stated in a note. This is also called the "face"

10-Letter Word

1. A business form on which is recorded the receiving or giving of credit, cash, or merchandise. For example, a customer who returns defective goods will usually receive from the seller a credit _____

KEY:

3-Letter Word
1. due

4-Letter Words
1. file
2. sale
3. book
4. note
5. rate
6. earn

5-Letter Words
1. index
2. minus
3. nopar
4. pages

6-Letter Words
1. profit
2. number
3. earned
4. income
5. ledger

7-Letter Words
1. expense
2. invoice
3. expired
4. nominal
5. journal
6. prepaid

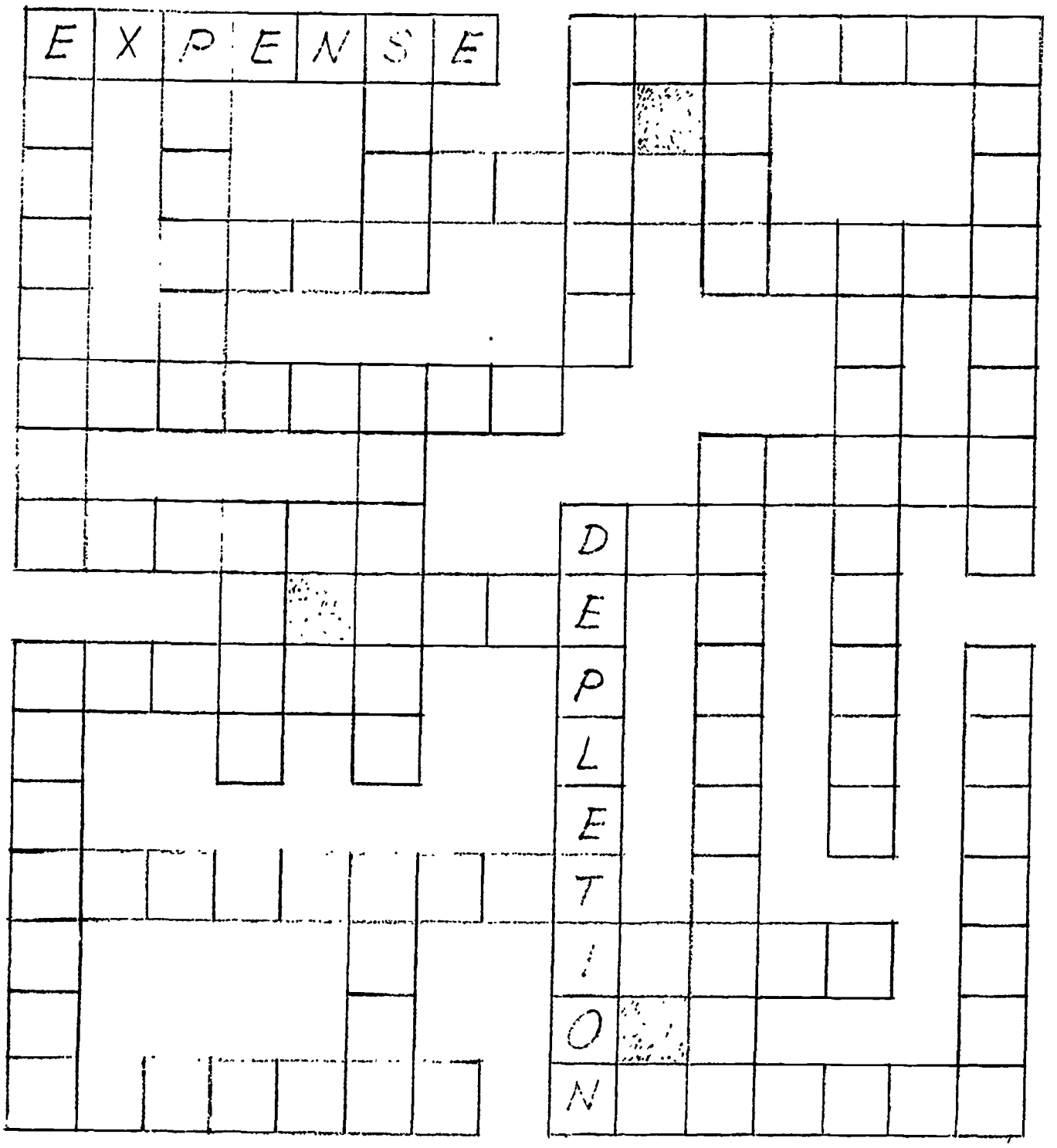
8-Letter Words
1. equation
2. interest
3. decrease

9-Letter Words
1. overdraft
2. depletion
3. principal

10-Letter Word
1. memorandum

ERIC 178

PUZZLEGRAM FORM



HIDDEN TERMS

Learning bookkeeping terminology may be stimulated by constructing a series of sentences containing hidden bookkeeping terms, such as the following:

1. After many hours of work she etched the beautiful picture.
2. Mary asked, "Did Bud get the job he was wanting?"
3. You must abide by the law as set forth in our constitution.
4. "We will adjourn almost immediately," proclaimed the president.
5. Bill chewed the tobacco until he saw his father coming.
6. John was thrown out standing only two feet from the bag.
7. After he was hurt, the other players led Gerald off the field.
8. The coach was not elated over the costly victory, as the star player was seriously injured.
9. Vincent Price did not elect to star in the new picture.
10. The Wilsons were spending the season at their winter estate.
11. "Stop arguing and play ball," shouted the umpire.
12. The golf pro fitfully paced back and forth as he waited for the final match.
13. The little tot almost fell off the swing.
14. The acre already in clover was not eroding.
15. "Miss Smith, may I present Bing Ross, our new president."

The above statements, as well as similar ones, may be duplicated (without the underscoring) and given to the students with instructions to discover as many bookkeeping terms as possible. As hidden terms are discovered they should be discussed or defined, so that the finding of terms does not become a meaningless activity. Having a student give the definition of a term discovered, without naming it, may enable the slower student to discover the term without being told where it is located. This technique may also be adapted to chalkboard use. A single sentence may be placed on the board or a flash card at the beginning of the study of a new topic containing the hidden term to provide a springboard for class discussion.

SCRAMBLEGRAMS

Directions: In the left hand column below there are twenty definitions and in the right hand column there are twenty scrambled bookkeeping terms. The definitions and the scrambled words are not in the same order. Unscramble the bookkeeping terms and match each with its corresponding definition. The terms may be matched by letter with the number definitions in the first column, or on a separate sheet the terms may be listed and numbered to correspond with the definitions.

Definitions	Scrambled Terms
1. Left hand side	a. tessas
2. Things owned	b. ditcre
3. The process of transferring journal entries to the ledger	c. getbud
4. Money paid for the use of money	d. btedi
5. Length of time between preparation of financial statements	e. gerled
6. The net result when expenses are larger than income	f. ssol
7. Right hand side	g. terinest
8. A group of accounts	h. ourlanj
9. An amount owed	i. ingkeepbook lecyc
10. Costs of operating a business	j. itprof
11. The card that a depositor signs when opening a checking account at the bank	k. wingdra
12. The owner of a business	l. torproriep
13. Goods on hand	m. penexses
14. An estimate of income and expenditures for a future period of time	n. ancbale shete
15. Person to whom a business sells	o. venintory
16. An itemized statement showing what is owned, what is owed, and the net worth on a given date	p. mertocus
17. A book in which transactions are recorded one after another in the order in which they occur	q. bilitylia
18. The entire process or routine applicable to a fiscal period	r. topsing
19. Gain	s. naturesig darc
20. Name of account showing the withdrawals of the proprietor	t. calfis perdio

KEY:

1-debit (d)
2-assets (a)
3-posting (r)
4-interest (g)
5-fiscal period (t)
6-loss (f)
7-credit (b)
8-ledger (e)
9-liability (q)
10-expenses (m)
11-signature card (s)
12-proprietor (l)
13-inventory (o)
14-budget (c)
15-customer (p)
16-balance sheet (n)
17-journal (h)
18-bookkeeping cycle (i)
19-profit (j)
20-drawing (k)

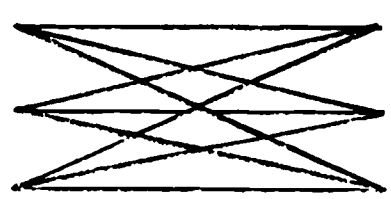
THE CONCEPT OF DEBIT AND CREDIT

The concept of debit and credit and the demonstration of the possible effect of a change in one type of account upon others can be improved by using a device similar to the one given below. Students should be required to prepare and illustrate the different types of transactions mentioned in the nine squares shown in the illustration. Only the better students will be able to illustrate all cases. This type of exercise may furnish a basis for class discussion.

(1) ASSET INCREASE ASSET DECREASE	(2) ASSET INCREASE LIABILITY INCREASE	(3) LIABILITY DECREASE ASSET DECREASE
(4) ASSET INCREASE CAPITAL INCREASE	(5) LIABILITY DECREASE LIABILITY INCREASE	(6) LIABILITY DECREASE CAPITAL INCREASE
(7) CAPITAL DECREASE ASSET DECREASE	(8) CAPITAL DECREASE LIABILITY INCREASE	(9) CAPITAL DECREASE CAPITAL INCREASE

THE CONCEPT OF DEBIT AND CREDIT

The information shown in the nine squares above may be expressed as follows:

INCREASES IN ASSETS		DECREASES IN ASSETS
DECREASES IN LIABILITIES		INCREASES IN LIABILITIES
DECREASES IN CAPITAL		INCREASES IN CAPITAL

WORK SHEET PREPARATION

Unusual problems add variety and interest to the learning of bookkeeping. The following one illustrates a method by which students may be motivated in the preparation of the work sheet. This problem, as well as others contained in the bulletin, may be adjusted to various learning stages of the bookkeeping class. The correct answer or grand total is given in the problem, and failure to obtain this figure indicates that an error has been made and stimulates the student to find that error. The correct numbers have been underlined and the totals given in this example

Directions: Assume that the following problem is a ten-column work sheet with headings as indicated below. Circle the numbers of the columns in which each of the accounts listed should appear on the completed work sheet. Then add the numbers together for each account and place the total at the right. These totals added should give the grand total figure of 201.

TRIAL BALANCE	ADJUSTED TRIAL BALANCE	BALANCE SHEET
1. Debit	5. Debit	9. Debit
2. Credit	6. Credit	10. Credit
ADJUSTMENTS	INCOME STATEMENT	
3. Debit	7. Debit	
4. Credit	8. Credit	

Sample - Delivery Expense	1	2	3	4	5	6	7	8	9	10	13
Cash	1	2	3	4	5	6	7	8	9	10	15
Accounts Receivable	1	2	3	4	5	6	7	8	9	10	15
Supplies	1	2	3	4	5	6	7	8	9	10	19
Merchandise Inventory	1	2	3	4	5	6	7	8	9	10	22
Accounts Payable	1	2	3	4	5	6	7	8	9	10	18
A. B. Jones, Capital	1	2	3	4	5	6	7	8	9	10	18
Sales	1	2	3	4	5	6	7	8	9	10	16
Purchases	1	2	3	4	5	6	7	8	9	10	20
Rent Expense	1	2	3	4	5	6	7	8	9	10	13
Miscellaneous Expense	1	2	3	4	5	6	7	8	9	10	13
Supplies Used	1	2	3	4	5	6	7	8	9	10	15
Net Income	1	2	3	4	5	6	7	8	9	10	17
Total											201

NOTE: The above technique may be used as a self-check method in the classification of accounts with columns for assets--current and fixed; liabilities--current and fixed; etc.

INCOMPLETE STATEMENTS

A series of incomplete statements may be used to stimulate interest and promote learning in various phases of bookkeeping. These statements, either as oral drills, flash card exercises, or written fill-ins, are ideally suited to the financial statements. Here are a few illustrative sentences that might be used with the income statement and the special journals.

Income Statement:

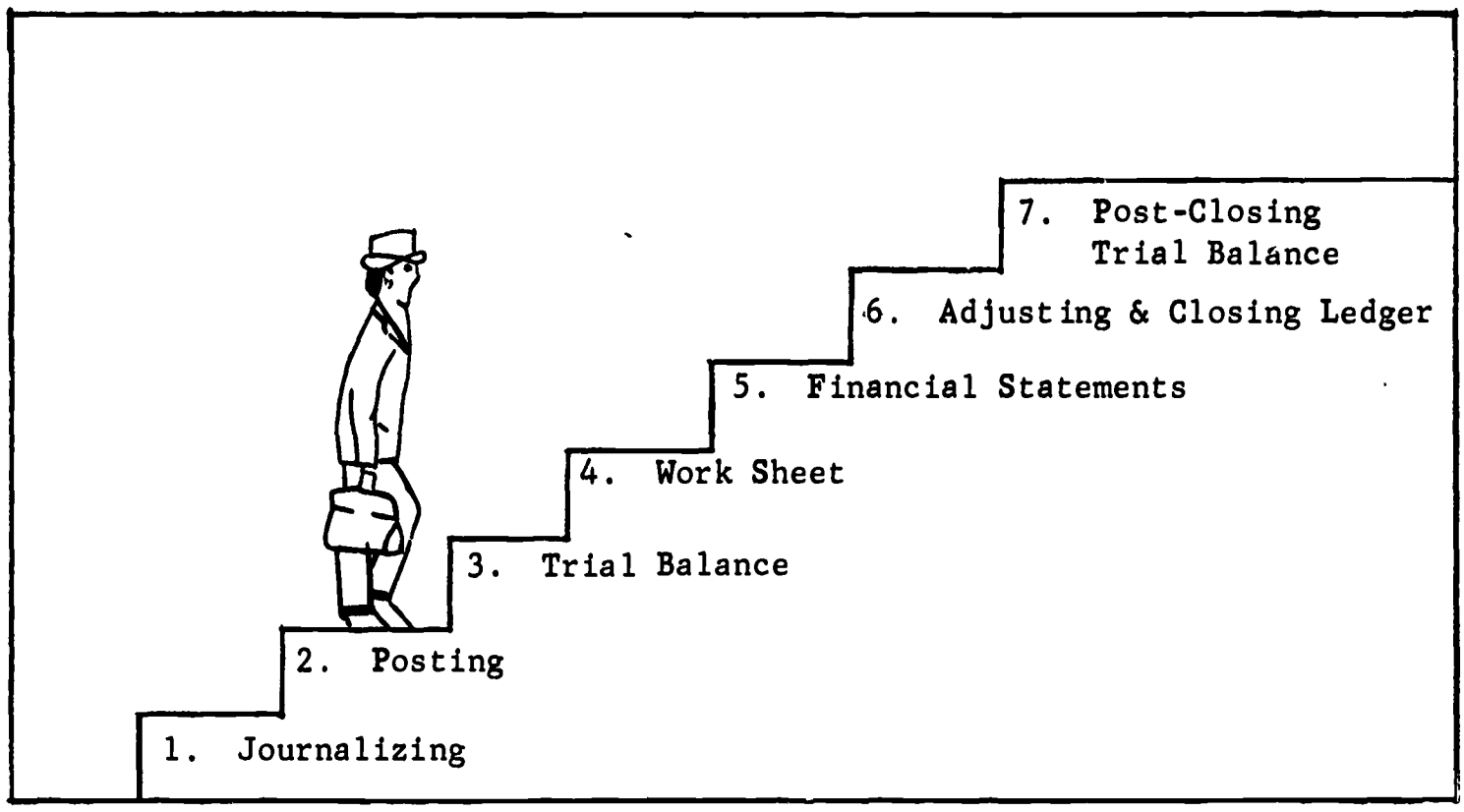
1. Sales minus Sales Returns and Allowances equals _____.
2. Beginning Merchandise Inventory plus Purchases equals _____.
3. The total cost of Merchandise Available for Sale minus the ending Merchandise Inventory equals _____.
4. Net Sales minus the Cost of Merchandise Sold equals _____.
5. Gross Profit minus Operating Expenses equals _____.
6. Operating Expenses minus Gross Profit equals _____.

Journals:

1. At the end of the fiscal period the total from the Purchases Journal is posted as a debit to the _____ account, and as a credit to the _____ account.
2. The total of the Sales Journal is posted as a debit to _____ and as a credit to _____.
3. The customer's name is recorded in the Sales Journal in the column headed _____.
4. The total of the cash receipts for the period is posted from the Cash Receipts Journal to _____.
5. The balance of cash on hand from a previous period is entered in the Cash Receipts Journal in the column headed _____.
6. The total of the Accounts Payable column in the Cash Payments Journal is posted as a _____ to the _____ account.

THE BOOKKEEPING CYCLE

A large poster showing the steps in the bookkeeping cycle may help prevent students from losing sight of this complete process while they are involved with routine details and transactions. A cut-out of the "bookkeeper" may be moved from step to step as students progress through the cycle.

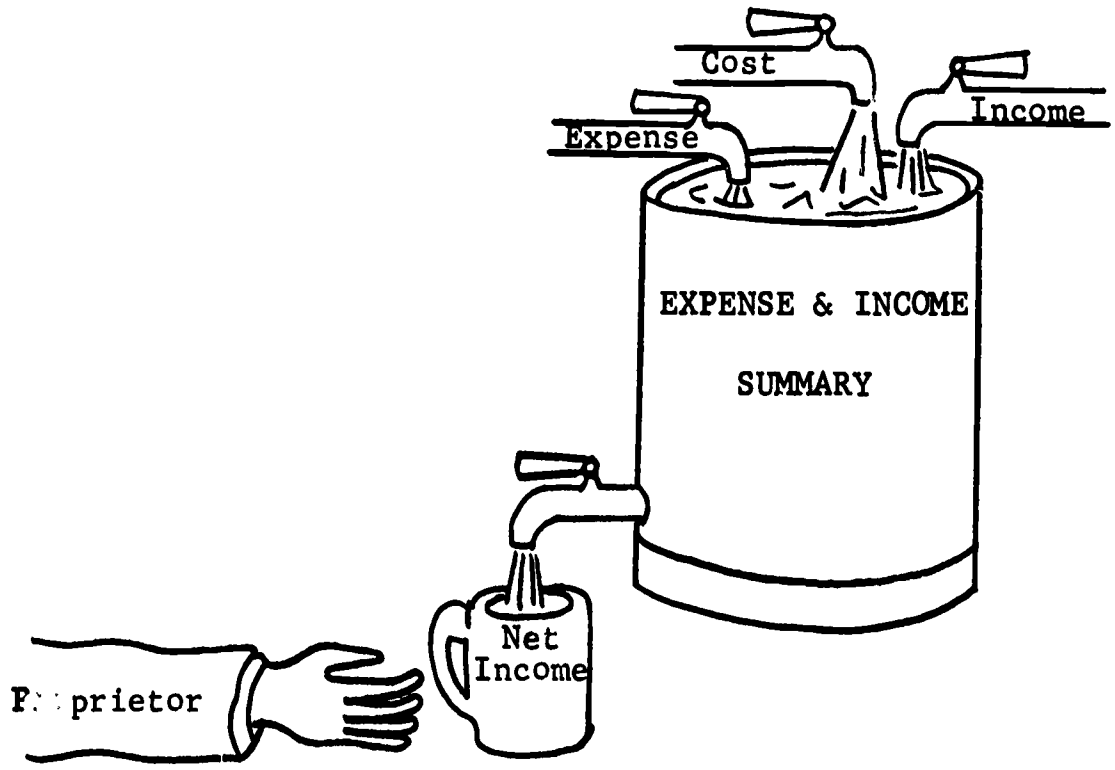


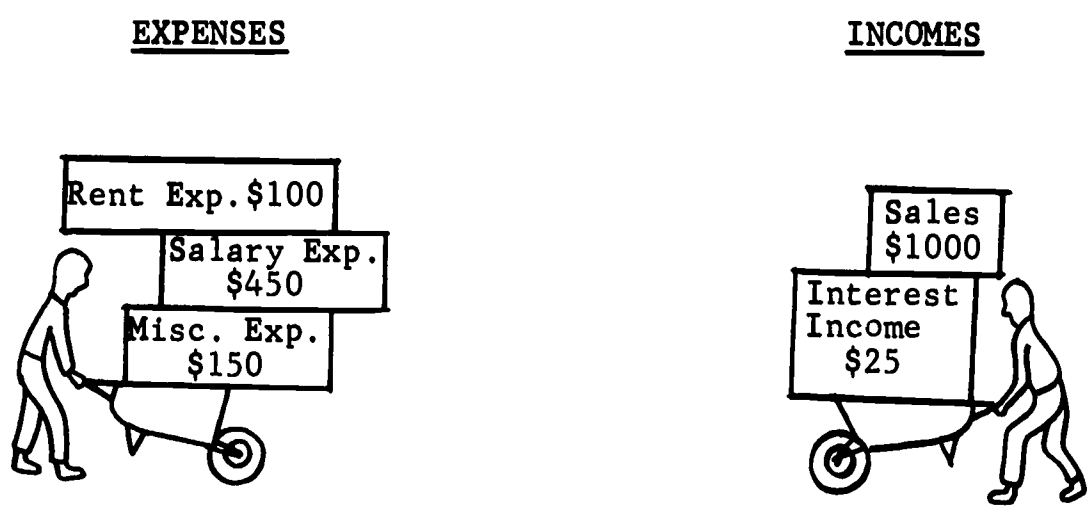
<u>What is done</u>:

1. Analyzing business transactions into debit and credit elements and recording them in books of original entry
2. Transferring, sorting, and summarizing journal entries in the ledger accounts
3. Testing the equality of debits and credits in the ledger accounts
4. Making necessary adjustments and compiling balance sheet and income statement information
5. Preparing the income statement and the balance sheet from the work sheet
6. a. Journalizing and posting the adjusting entries
   b. Journalizing and posting the closing entries
   c. Balancing and ruling the accounts
7. Proving the accuracy of closing the books by testing the equality of debits and credits in the ledger accounts which remain open

CLOSING TIME POSTERS

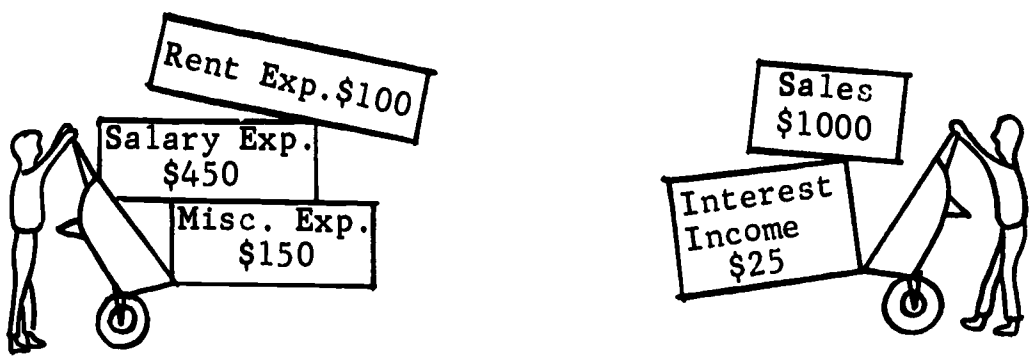
Closing time is roundup time. A few attractive and colorful posters such as the two shown may materially aid in getting across to the students a rather difficult concept. Any fledgling artists in class?



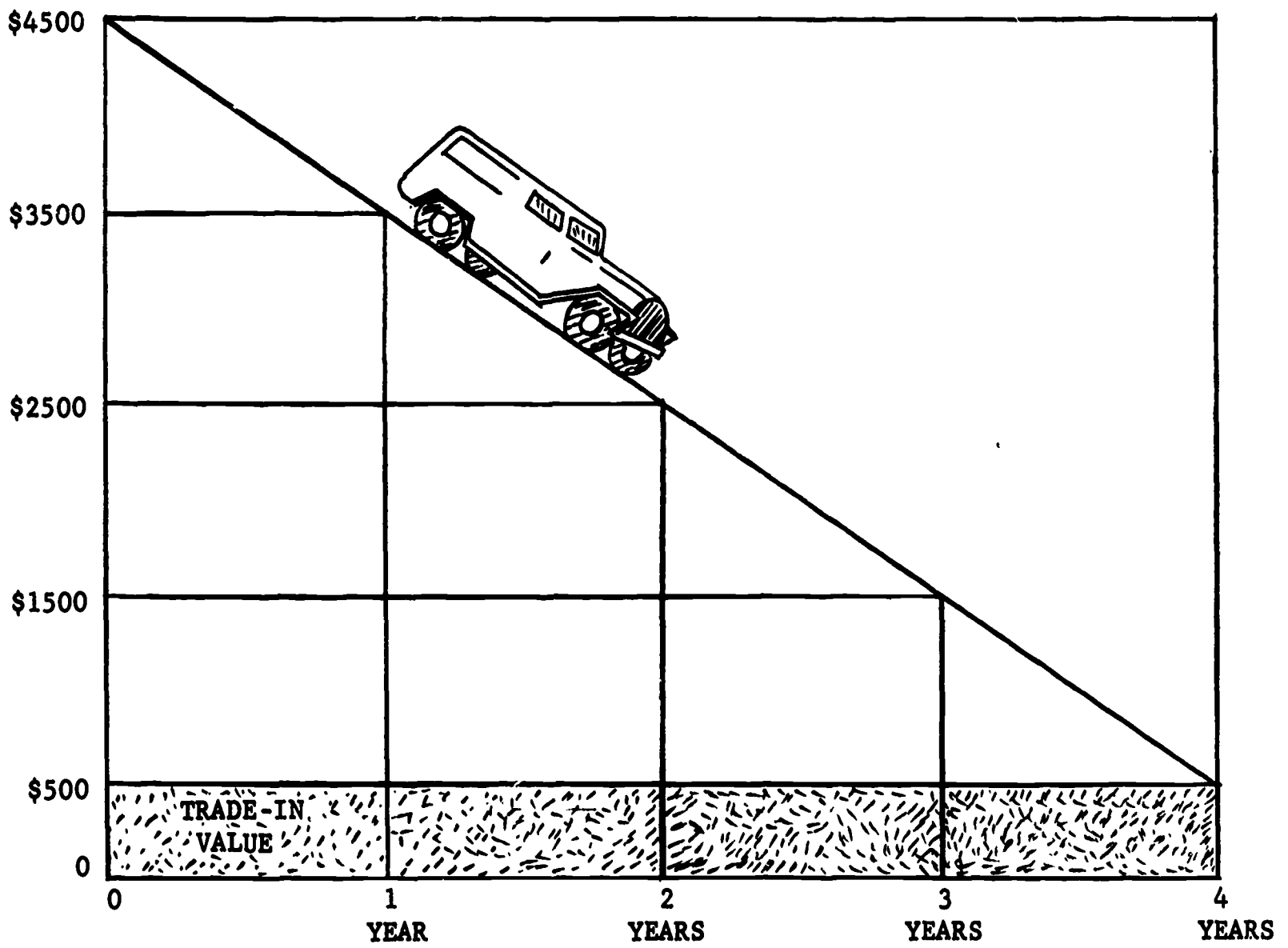


DUMPING AREA

EXPENSE AND INCOME SUMMARY



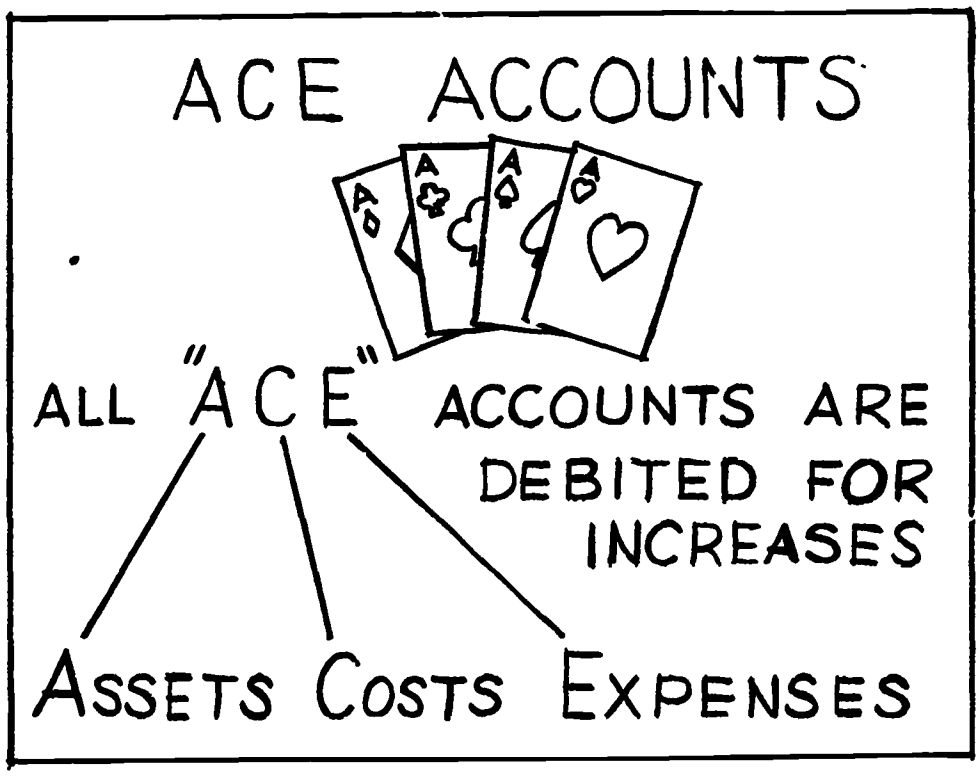
DEPRECIATION



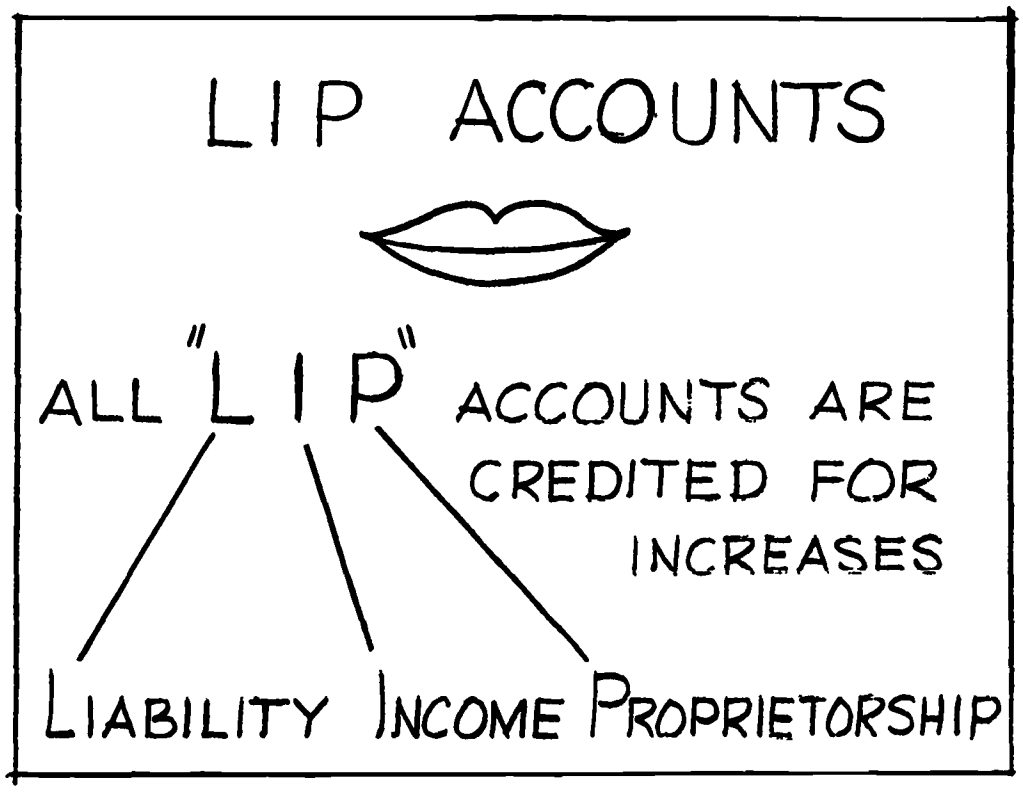
$$\frac{\text{Purchase Price - Scrap or Trade-In Value}}{\text{Estimated Life in Years}} = \text{Annual Depreciation}$$

"ACE" AND "LIP" ACCOUNTS

The first letters of the words assets-costs-expenses spell **ACE**. All the student has to remember is that all **ACE** accounts are debited for increases. An illustration showing the aces in a deck of cards with the appropriate notation tends to fix this concept in the student's mind.



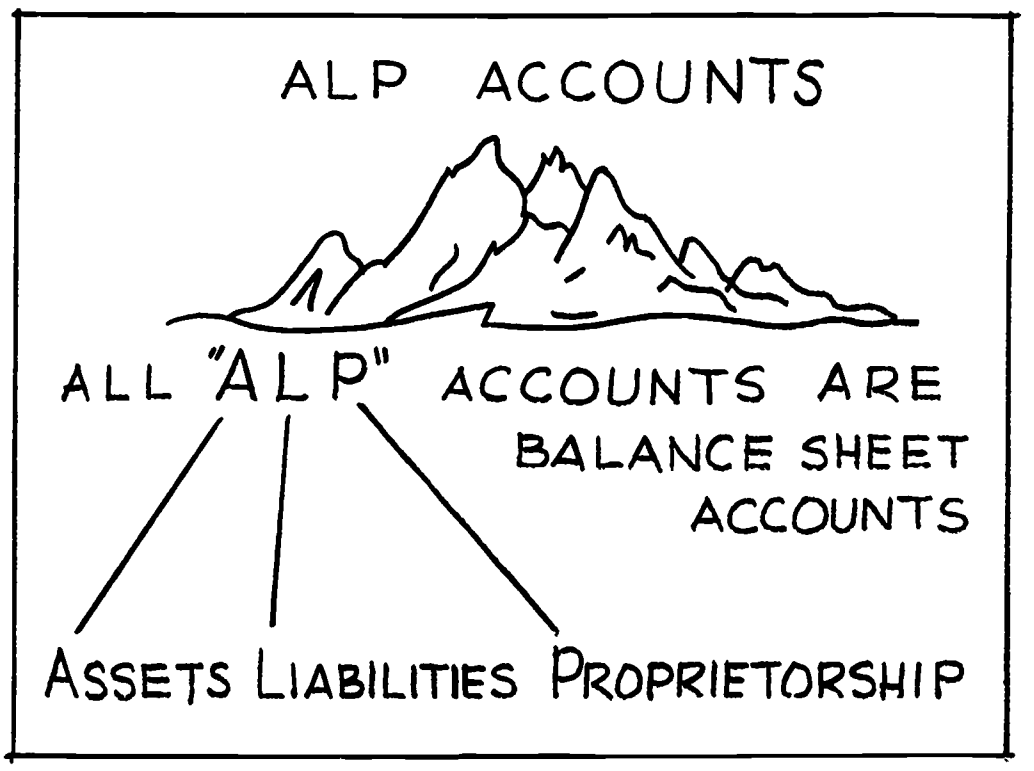
The first letters of the terms liabilities-income-proprietorship form the word **LIP**. Accounts in these three groups are credited for increases; therefore, remember the fact that **LIP** accounts are credited for increases and debited for decreases.

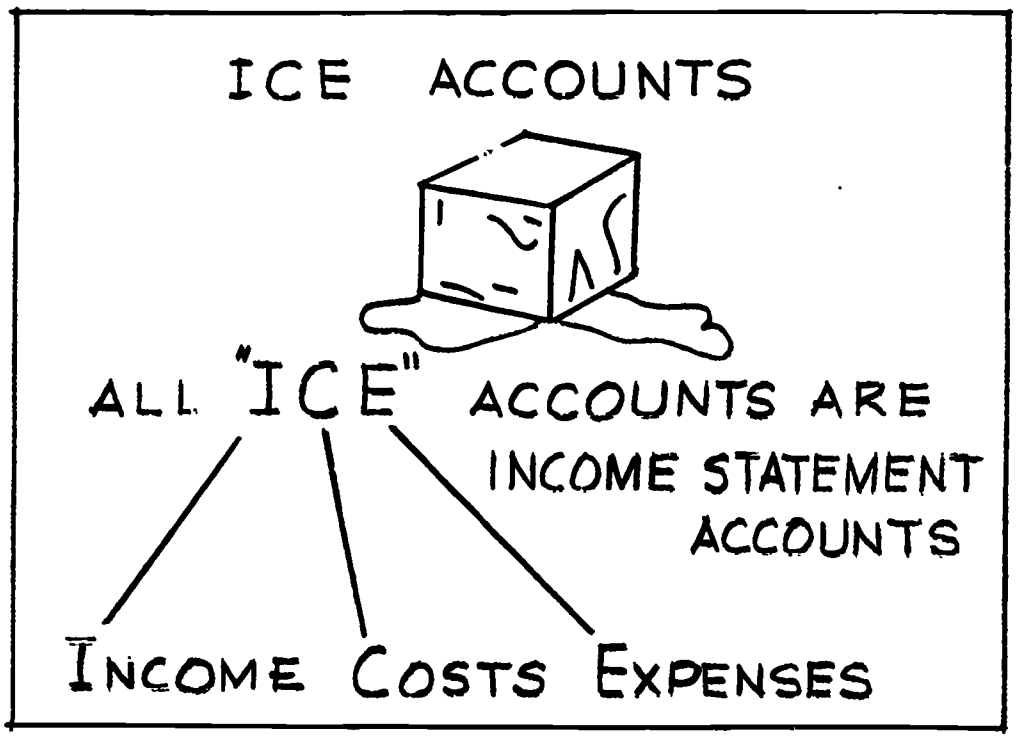


"ALP" AND "ICE"

Here is another mnemonic device that may be helpful in getting students to understand the difference between real or permanent accounts and nominal or temporary accounts. The word ALP is made up from the first letters of the terms asset, liability, and proprietorship. Such accounts are as permanent and real as the Alps Mountains. On the other hand, the word ICE contains the first letter of the terms income, cost, and expense. Since ice melts away, the ICE accounts can be considered temporary.

Later in the closing process, the teacher can point out that as the ice on the Alps melts, some of the particles adhere to the mountains and become a part of the permanent land structure, just as the temporary accounts may make additions to the permanent accounts.





ARITHMETIC QUICKIES

A few moments spent on various types of arithmetic drills at the beginning of the class period, especially early in the course, will be time well spent. Often all that most of your students need is a bit of a refresher. You might try

"Bouncing Addition." String a series of one-digit numbers across the chalkboard. With a pointer, bounce from one number to another in an even time beat while having the students, aloud, in unison, cumulatively add the numbers.

"Count Off." Ask students to count off by a certain number, such as by 2's, 3's, or 4's. You might start with the number 3 and ask students to count by 4's as their turn comes in rapid staccato fashion--3, 7, 11, 15, 19, etc.

"Addition Facts." There are 81 basic addition facts from 1 + 1 to 9 + 9 and only 36 of these whose sums exceed 10. Systematically review these with your students in unison drill by using the chalkboard and/or flash cards. From these progress to three and four number combinations as well as some double number drills.

Addition should probably be emphasized more than the other basic arithmetic processes because of its frequency of use in the bookkeeping class; however, don't overlook the possibility of using similar types of drills for subtraction, multiplication, and division. Previewing the "interest problem" before the class studies interest-bearing notes may minimize your teaching headaches in this area, too.

FLASH CARDS

Why not use flash cards for a quick review? Make cards with the different accounts listed on them, such as cash, accounts receivable, expense, etc. The cards may be used for drill or review purposes. As each card is held up briefly for the class to observe, the students are asked to identify, either orally in unison or on paper, one of the following:

1. The classification of the account.
2. Whether the account has debit or credit balance.
3. Whether the account is increased by a debit or a credit entry.
4. Whether the account is decreased by a debit or a credit entry.
5. On which financial statement the account appears.

The cards may be run through several times, with students identifying a different point each time.

VT 010 775
Typewriting. Service Bulletin No. 1.

Mountain-Plains Business Education Association, Corpus Christi, Tex.

MF AVAILABLE IN VT-ERIC SET.
Executive Secretary, Mountain-Plains Business Education Association, Del Mar College, Corpus Christi, Texas 78404.
PUB DATE - ND 5p.

DESCRIPTORS - *BUSINESS EDUCATION; *RESOURCE MATERIALS; *TYPEWRITING; *TEACHING TECHNIQUES

ABSTRACT - Suggestions in this pamphlet for typewriting teachers are listed under these topics: (1) encouraging good posture, (2) checking typewriter table height, (3) checking for proper lighting, (4) using a demonstration stand, (5) having students chart their progress, (6) using a positive approach in teaching, (7) conducting interesting classes, and (8) making typewriters available for personal use. (SB)

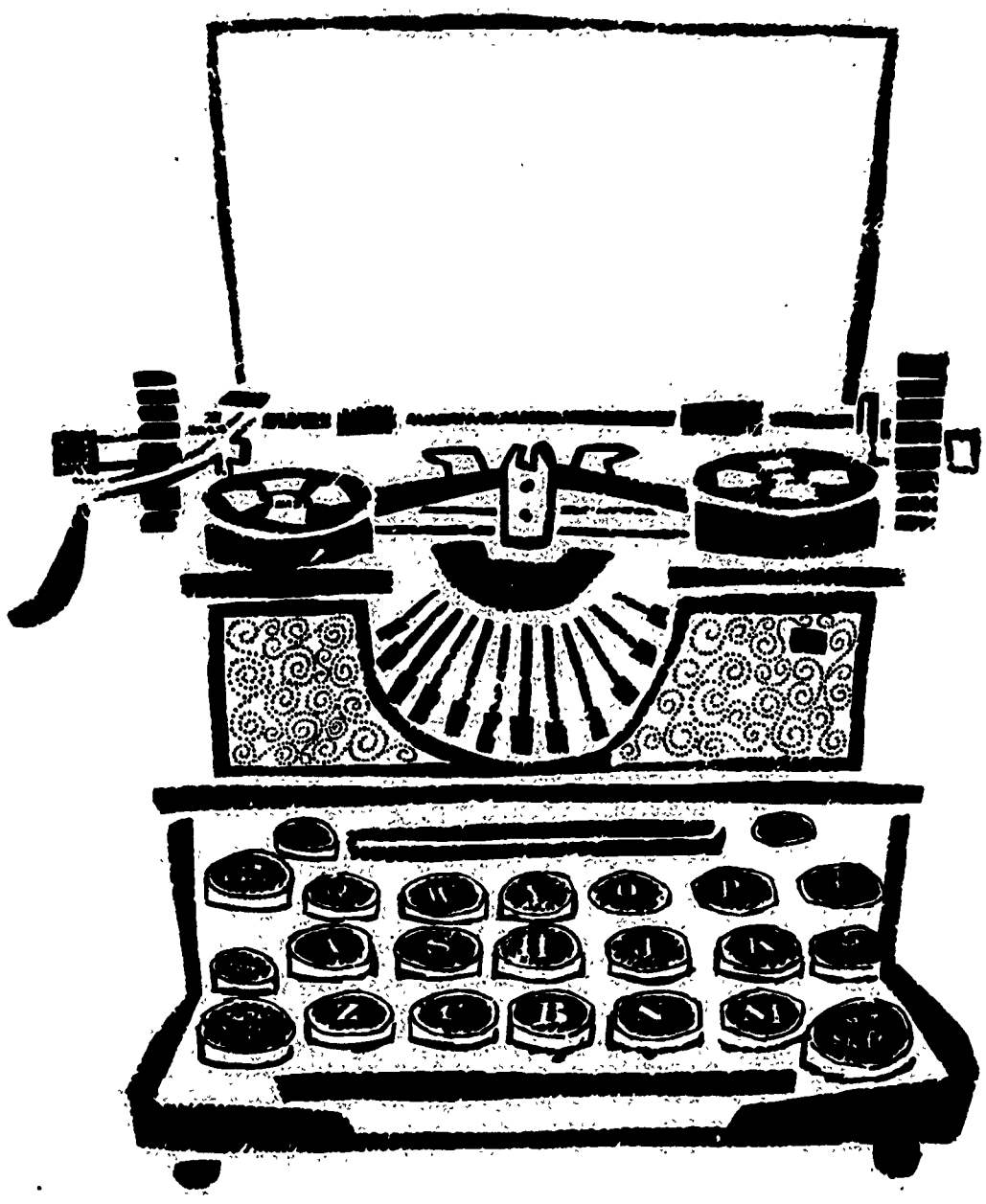
VT 010 775

ED0 45856

Mountain-Plains Business Education Association

Service Bulletin no. 1

TYPEWRITING



VT010775

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ENCOURAGE GOOD POSTURE

1. Textbook illustrations are good.
2. Sit erect, body slightly forward from hips.
3. Feet flat on the floor.
4. Body 8 - 10 inches from typewriter and slightly to the right.
5. Arms should be on the same slope as the keyboard, fingers curved.

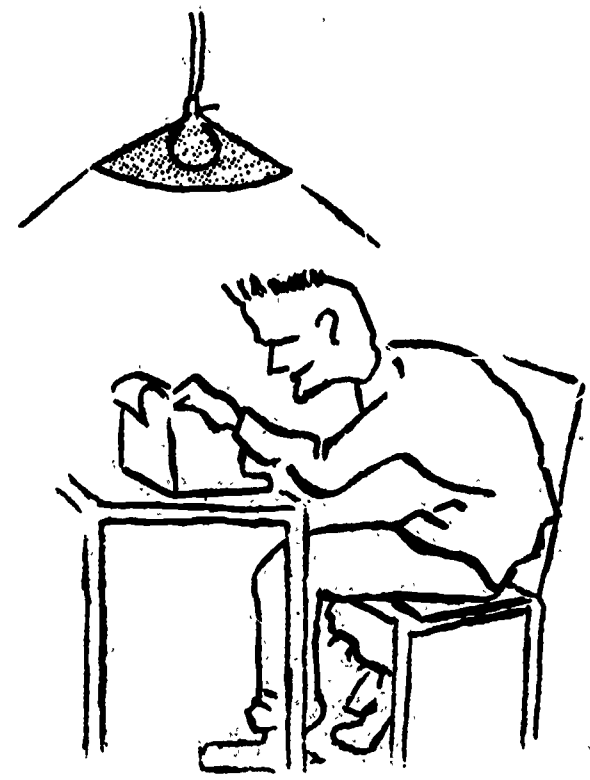
GOOD POSTURE LEADS TO BETTER TYPING!

CHECK HEIGHT OF TABLES

1. Provide 26-28-29-30 in. tables. 26 in. tables are too low for many students.
2. If the table is the right height, forearms will be approximately the same slope as the keyboard. There should be approximately 12" from seat to table top.
3. Methods of solving table heights:
   (a) Blocks under legs
   (b) Angle irons or metal extensions
   (c) Lift boxes on the tables themselves
4. Height of chair can be adjusted by small foot rests. (Grocery boxes)

IMPROPER TABLE HEIGHTS CAUSE FATIGUE, POOR POSTURE, IMPROPER WRIST AND ARM ANGLES, AND FAULTY TECHNIQUES!

CHECK PROPER LIGHTING



1. For proper lighting, 50 foot-candles of light should be available at each typewriting table.
2. A representative of the local electric company will be glad to measure the light.
3. Requests for improvement in lighting should be supported with facts and figures.
4. Lighting can be improved by rearranging tables.
5. Do not use window shades except in cases of direct sunlight.

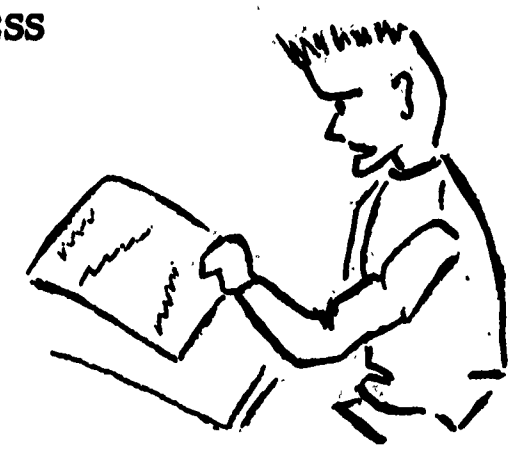
POOR LIGHTING LEADS TO EYESTRAIN, FATIGUE, TENSION, ERRORS, AND LOSS OF INTEREST!

USE A DEMONSTRATION STAND

1. Plan demonstrations carefully.
2. Demonstrate only one new technique at a time.
3. Allow ample time for practice by students.
4. Repeat demonstrations when necessary.
5. Commercially manufactured demonstration stands are advertised in our professional periodicals.
6. A wooden box on the teacher's desk may be used for demonstrating.

DEMONSTRATION STANDS GIVE THE STUDENT AN OPPORTUNITY TO SEE AND HEAR THE DEMONSTRATION!

HAVE STUDENTS CHART INDIVIDUAL PROGRESS



1. Individual charts of student's progress are a good motivating device.

2. Better results are obtained if the records are in terms of words-a-minute and errors-a-minute, rather than net words.

3. Records on the individual charts should be for short timings at first--later for longer timed writings.

INDIVIDUAL CHARTS ARE HELPFUL TO THE TEACHER IN SPOTTING QUICKLY THOSE STUDENTS WHO NEED SPECIAL HELP!

USE POSITIVE APPROACH

1. A teacher's major responsibility in class is to see that unnecessary tensions do not develop.

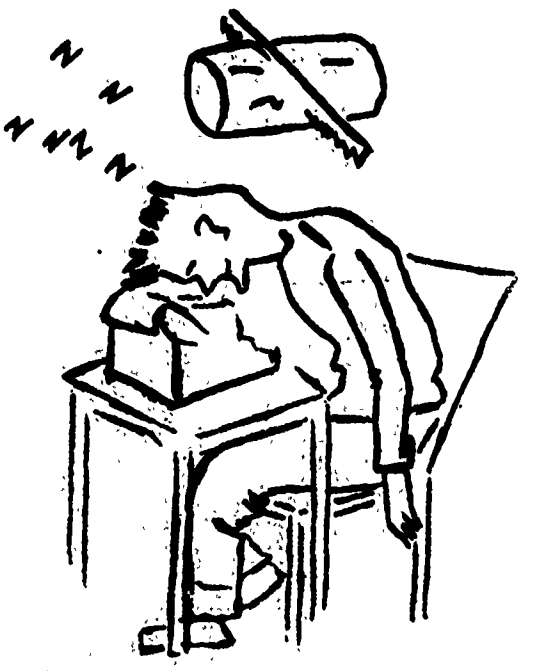
2. Too much tension results in lack of progress in a skill course.

3. A teacher's attitude as well as approach can create tension in a class.

4. Make students aware that beginners are not expected to be competent typists rather than using threats of failure in class.

A POSITIVE APPROACH IN CLASS WILL ENABLE THE STUDENT TO GAIN A FEELING OF SUCCESS AND TO DEVELOP A FRIENDLY ATTITUDE TOWARD THE SUBJECT!

KEEP TYPING CLASSES INTERESTING



1. Avoid the tendency in typewriting to develop a standard teaching plan.

2. Don't allow your typing class to become monotonous to the students.

3. Occasionally, try some new--or different--procedure in your typewriting class.

4. Professional periodicals contain suggestions on teaching devices and procedures.

5. The development as well as the retention of interest is important.

INTEREST IS A SIGNIFICANT FACTOR IN THE SUCCESS OF EVERY STUDENT IN TYPEWRITING!

MAKE TYPEWRITERS AVAILABLE FOR PERSONAL USE

1. While taking typing, as well as after, a student should have a typewriter available for personal use if possible.

2. Keep typing room open for student use before and after school and at other times when the room is not in use.

3. Impress on students that it is a privilege to use the typewriters.

REMEMBER THAT STUDENTS WILL WANT TO USE THE MACHINES FOR PERSONAL USE AND WILL APPRECIATE THE OPPORTUNITY TO DO SO!

VT 010 776
Your Business Teaching. Service Bulletin No. 6.

Mountain-Plains Business Education Association, Corpus Christi, Tex.
MF AVAILABLE IN VT-ERIC SET.
Executive Secretary, Mountain-Plains Business Education Association, Del Mar College, Corpus Christi, Texas 78404.
PUB DATE - ND 7p.

DESCRIPTORS - *BUSINESS EDUCATION; *RESOURCE MATERIALS; *AUDIOVISUAL AIDS; *TEACHING TECHNIQUES

ABSTRACT - This pamphlet contains suggestions for effective use in business classes of these audiovisual aids: (1) bulletin board, (2) chalkboard, (3) flash cards, (4) films and filmstrips, (5) flannel board, and (6) overhead and opaque projectors. Sources of films and filmstrips are listed. (SB)

VT 010 776

ED0 45856

VISUALIZING

Your BUSINESS TEACHING

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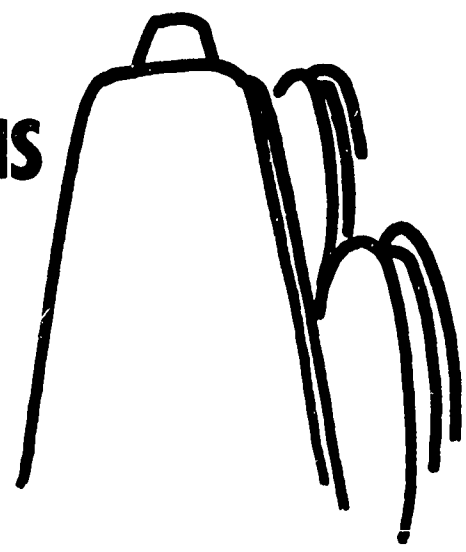

SERVICE
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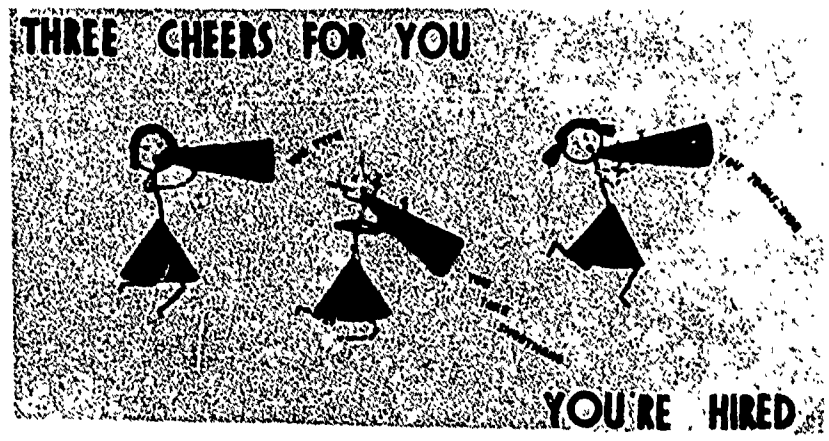


BULLETIN BOARD

FOR BETTER BULLETIN BOARD DISPLAYS

1. Locate the bulletin board in a place where it will receive both adequate attention and lighting.

2. Change the material on the bulletin board frequently--at least every two weeks if possible.

3. Present a single important idea correlated with the regular classroom activities.

4. Provide a focal point of interest--a colored design, a caption in large letters, or some other items that will be eyecatching.

5. Use an effective color scheme. The color of letters should contrast sharply with the background.

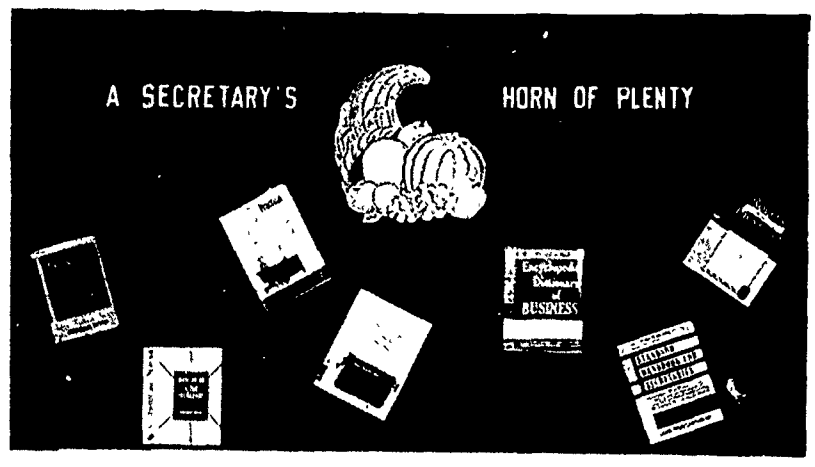
6. Select inexpensive bulletin board materials. Many large companies supply attractive, informative materials.

7. Consider using student assistance in the preparation of bulletin board displays.

8. To ensure the timeliness of displays keep a bulletin board calendar.

SIX STEPS IN PLANNING AND SETTING UP A BULLETIN BOARD DISPLAY

1. Decide on a subject
2. Work out a caption
3. Gather the material
4. Plan the arrangement
5. Plan the lettering
6. Execute and evaluate

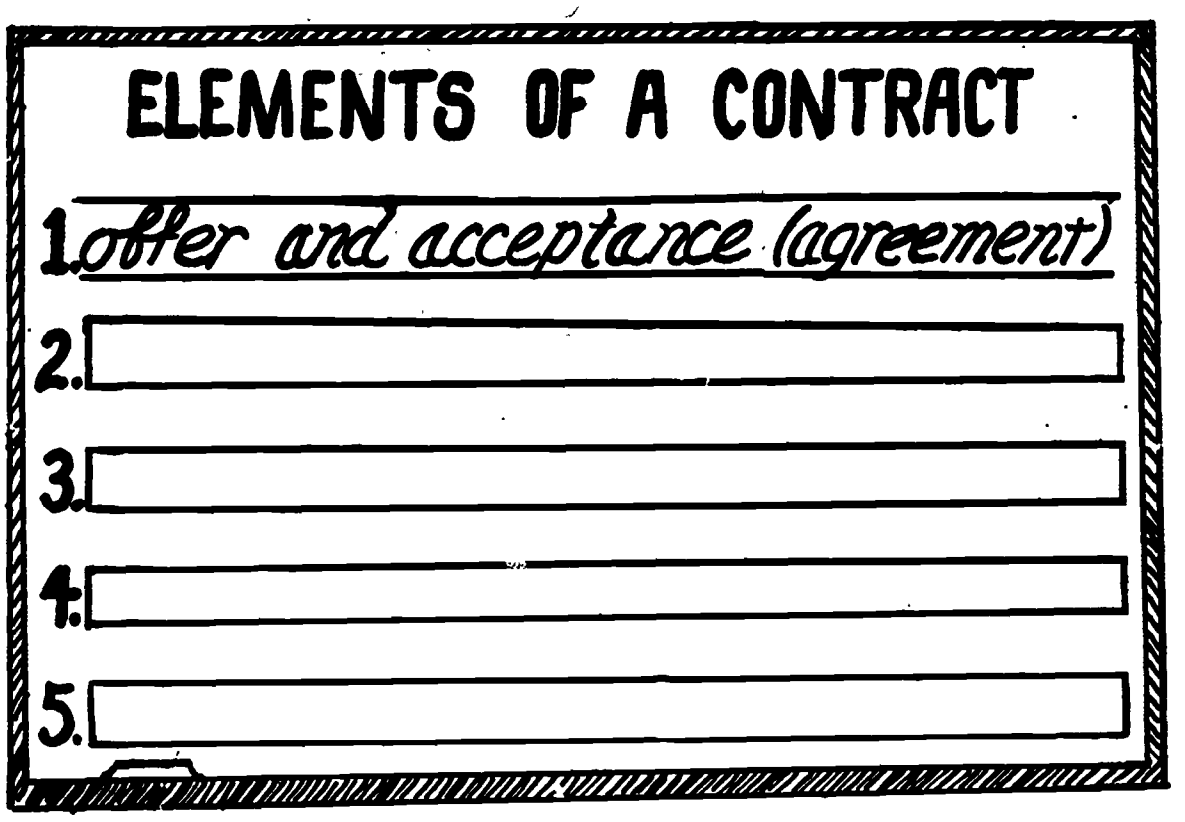


CHALKBOARD

FOR EFFECTIVE CHALKBOARD DEMONSTRATIONS

1. Use it frequently
2. Have forms ready before class
3. Don't crowd and make wording simple
4. Include COLORED chalk in your presentations
   In bookkeeping try green for assets, red for liabilities and yellow for proprietorship
5. When lines are necessary use:
   a. A music staff liner
   b. Dampen the board and draw the lines for semi-permanency
   c. An ice pick for permanency

HAVE YOU TRIED THE STRIPPING TECHNIQUE?



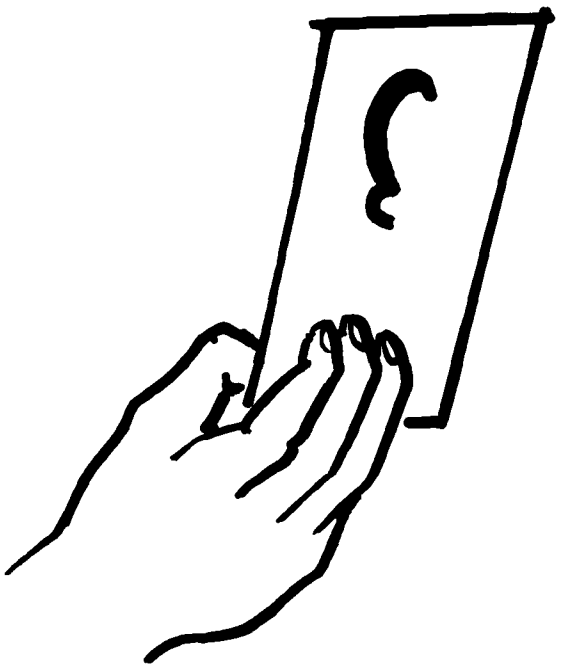
1. Items are written on the board and covered with strips of paper fastened to the chalkboard with scotch tape.

2. The teacher either discusses a point or asks a question and then tears off the strip displaying the correct answer.

3. Gradually all the points or answers are revealed to the students.

ITS EFFECTIVE, INTERESTING AND EASY TO DO

FLASHCARDS



FOR CLASSROOM PRESENTATIONS IN

BOOKKEEPING

1. Use large flashcards when explaining assets, liabilities and proprietorship. Have students hold up the correct classification as you indicate accounts.
2. Either give or have the students prepare cards with the titles of ledger accounts. After reading an oral transaction instruct the students to hold up in his left hand the name of the account to be debited and in the right hand the account title to be credited.

SHORTHAND

1. Use large 5" x 9" flashcards to introduce or review shorthand brief forms, phrases and words for rapid classroom drills.
2. Smaller cards containing brief forms, phrases and words in shorthand can be prepared for use by individual students.

TYPEWRITING

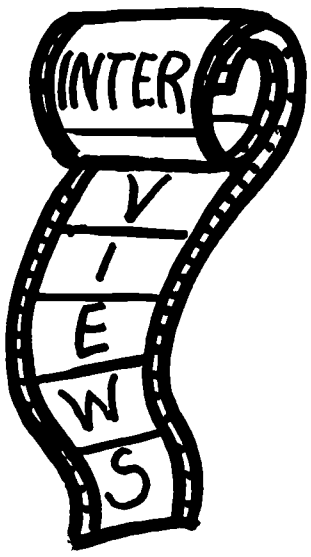
1. Instead of dictating two and three letter words print them on 5" x 9" cards at least 3½" high.
2. Flash each card for approximately a two second count.
3. Include enough to complete a 60 space line.
4. Stress the use of more difficult letters.
5. Use after students finish learning the alphabet.

OTHER BUSINESS SUBJECTS

Flashcards can be used for drillwork in such other business subjects as Business Mathematics, Business Law, General Business, etc.

FOR EFFECTIVE FLASHCARD PREPARATION

1. Use heavy posterboard; for variations consider dark paper with white ink.
2. For best printing results use India ink in black or other colors with speedball lettering pens.
3. Make the words or characters large enough for all to see.



SUGGESTIONS FOR EFFECTIVE FILM USAGE

1. Teacher Planning
   a. Select and order film.
   b. Preview film.
   c. Check equipment prior to classroom showing.

2. Prepare Students
   a. Points of information to look for in film.
   b. Consider pretest on essential items to be covered in film.

3. Show Film
   a. As an introduction to a topic.
   b. Concurrently with a unit being presented.
   c. As a unit review.

4. Follow-up Procedures or Evaluation
   a. Discussion of essential points by instructor and student.
   b. Administer test on essential points.

SOURCES OF FILMS AND FILMSTRIPS

Educational Film Guide prepared by H. W. Wilson Company, 950 University Avenue, New York, New York. It contains the most complete list of films currently available for sale, rental, or free loan in the United States classified by subject, title and source.

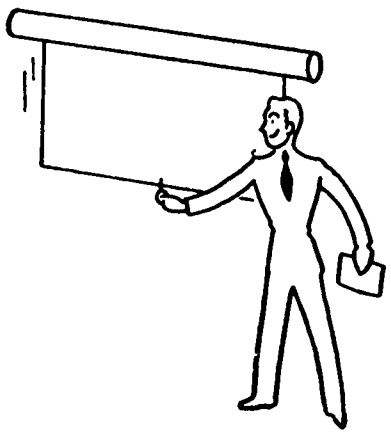
Educators Guide to Free Films is a listing of sponsored films for free loan classified by subject, title, and source, and is an annual publication of Educators Progress Service, Randolph, Wisconsin.

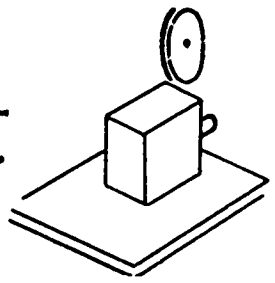
A Directory of 16 mm. Film Libraries published annually by the U. S. Office of Education and available from Superintendent of Documents, Washington, D. C. It is a comprehensive list of film libraries from which films may be ordered, classified by state and community.

Business Education Films, 4607 16th Avenue, Brooklyn 4, New York. A listing of over 160 rental films for business education.

One Hundred Selected Films in Economic Education, published by the Joint Council on Economic Education, 2 West 46th Street, New York 36, New York.

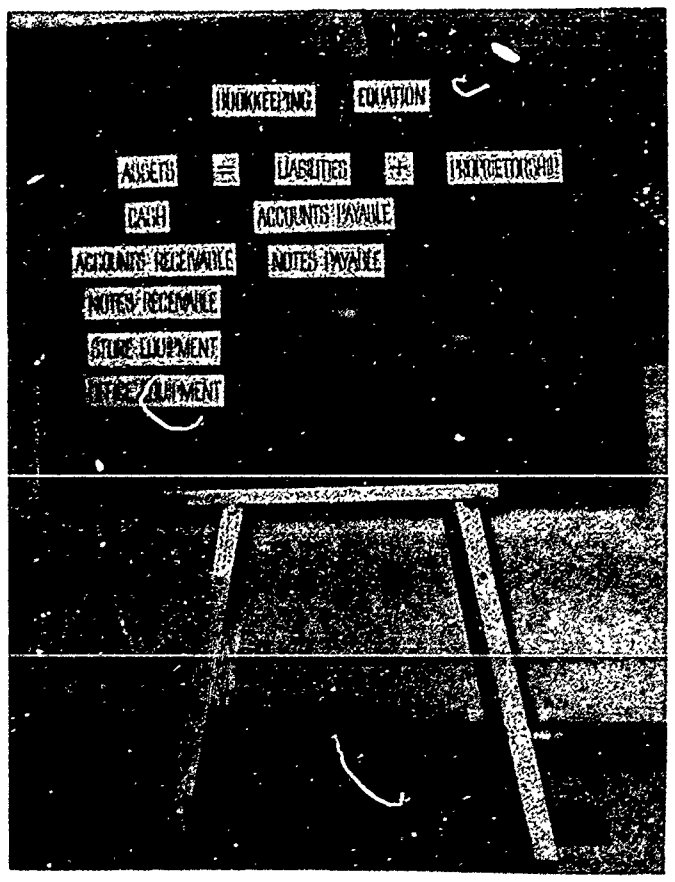
Visual Aids for Business and Economic Education, Monograph 92, published by Southwestern Publishing Co., Cincinnati, Ohio.





FILMS and FILMSTRIPS

FLANNEL BOARD



EQUIPMENT FOR A FLANNEL BOARD DEMONSTRATION

1. Easel so that the flannel or felt board is in full view of everyone in the class.

2. A piece of one-half inch plywood 36" x 48" covered with flannel or felt.

   a. Yellow or green material if a light background is desired.
   b. Black or blue material for a dark background.

3. Coarse sandpaper or commercial flak to be pasted or sprayed on the back of the objects, letters or cards, so they adhere to the flannel or felt. Flannel cut-out letters or objects can also be used.

POSSIBLE CLASSROOM USES

1. Introduce the keyboard letters in a beginning typewriting class.

2. Present the parts of various business letter styles.

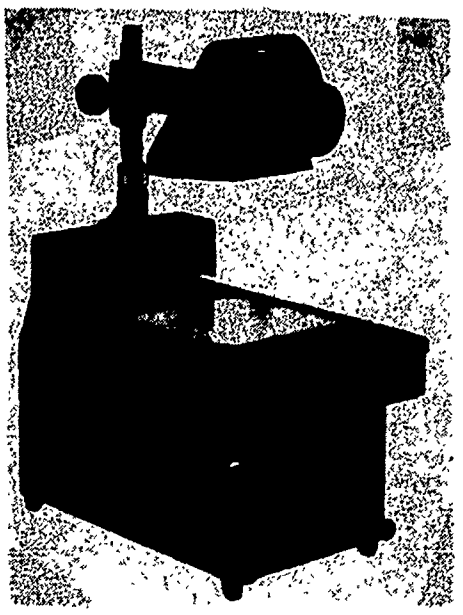
3. Identify and summarize the steps in posting from the journal to the ledger.

4. Review brief form characters in shorthand

5. The line relationship of a business organization.

6. Emphasize the points of a class discussion.

PROJECTORS



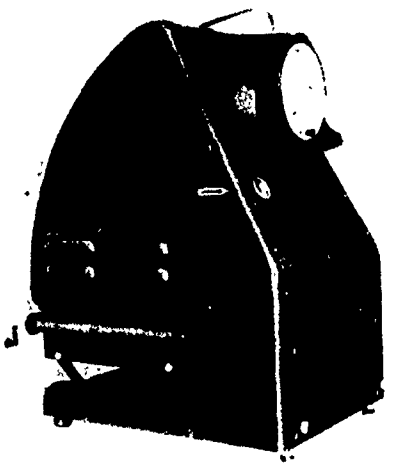
OVERHEAD

ADVANTAGES

1. Materials can be prepared in advance saving classroom time for discussion and demonstration. Some textbook publishers have prepared transparency forms especially in bookkeeping.
2. Instructor faces class as he writes on acetate transparencies.
3. Materials and forms may be filed and reused in subsequent years.
4. Eliminates the problem of trying to "save" material on a limited chalkboard.
5. Room need not be darkened during the presentation.
6. Colored grease pencils or acetograph inks may be used for more effective demonstration.

READ: Business Education Forum, March, 1963, pages 18 and 27, and Journal of Business Education, February, 1963, pages 198-200 for practical suggestions on using an Overhead Projector.

OPAQUE



PRACTICAL SUGGESTIONS FOR CLASSROOM USE

1. A wide variety of materials--photographs, illustrations, charts, forms, etc.--can be projected which would not be available otherwise. Pictures and charts can be mounted or the open magazine or book may be inserted in the projector.

2. It can be used to transfer any outline material--chart, diagram, map, etc.--to the chalkboard or to a sheet of cardboard or paper. In shorthand, brief form cards can be prepared in this way.

3. Student work (minus names) may be projected, when found desirable, for criticism and correction.

4. Colored pictures can be shown with their original brilliancy.

SEE: Business Education World, March, 1963 for possible makes of projectors available.

VT 010 904
Burkhardt, Martin E.

Farm Machinery Safety for the Institutional Farm.

State Univ. of New York, Cobleskill. Agricultural and Technical Coll.
MF AVAILABLE IN VT-ERIC SET.
PUB DATE - Dec69 16p.; Paper for Presentation at the Annual Farm Meeting for State Institution Farmers (Cobleskill, N.Y., Dec. 3-5, 1969).

DESCRIPTORS - *AGRICULTURAL MACHINERY; MANUALS; *AGRICULTURAL MACHINERY OCCUPATIONS; TRACTORS; ADULT FARMER EDUCATION; EQUIPMENT; FARM MECHANICS (OCCUPATION); *FARM MANAGEMENT; *AGRICULTURAL SAFETY; SAFETY; *ACCIDENT PREVENTION

ABSTRACT - Prepared by an associate professor of agricultural engineering technology, this paper is designed to aid institutional farm managers in accident prevention by increasing their awareness and knowledge of safety standards and practices related to the selection, operation, and maintenance of farm machinery and equipment. Topics covered include vehicle identification, noise control, power take-off accident prevention, tractor overturn prevention and protection, and a safety program for the institutional farm. Lists of safety rules for tractor operation, films promoting safety in farm machinery operation, and other resources for developing farm safety programs are appended. The bulletin also includes a bibliography. (AW)

VT 010 904

ED0 45856

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16p *

FARM MACHINERY SAFETY

for the

INSTITUTIONAL FARM

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By

Martin E. Burkhardt, Associate Professor
Agricultural Engineering Technology Department

For

Annual Farm Meeting for State Institution Farmers
State University of New York
Agricultural and Technical College
Cobleskill, New York
December 3-5, 1969

VT010904

PREFACE

This paper has been prepared to expand on an oral presentation at the meeting of Institutional Farmers. It is by no means a complete discussion of the Farm Machinery Safety problem on the Institutional Farm.

Appreciation is expressed to Leon J. Urben, Manager-Farm Department, National Safety Council, Chicago, Illinois, for materials and information provided; to Richard G. Pfister, Extension Agricultural Safety Engineer, Michigan State University, East Lansing, Michigan, for slides of the Slow Moving Vehicle Emblem used in the oral presentation; to John Deere Company, Syracuse, New York, and International Harvester Company, Albany, New York, for films showing protection afforded by protective frames, also used in the oral presentation; and to Congressman Samuel S. Stratton, Washington, D. C., for his letter and copy of H.R. 680.

"The agricultural tractor, which is the forerunner of agricultural mechanization, must be identified as a dangerous farm machine. This is in great part due to severity of accidents associated with its use in so many different ways by nearly all members of the farm family. It is driven by men, women, children, the young and old, the strong and weak, and serves not only as the power and pulling force on the farm but as a substitute for an auto, a truck, or a horse - - i.e., it will do everything from pulling the plow to chasing cows, towing produce to market, hauling passengers, and giving grandchildren and visitors a ride." This description of the agricultural tractor is provided by L. W. Knapp, Jr., Director of the Accident Prevention Laboratory at the University of Iowa.[1]

Perhaps you can simplify this description on your farm but be careful. You will very probably oversimplify the situation. Agriculture in 1968 was second only to the construction industry when accidental work deaths were counted in the United States. There were 2600 deaths among the four million workers in agriculture in 1968 and 220,000 disabling injuries. All industries accounted for 14,300 deaths and 2.2 million disabling injuries in the same period. Between 1958 and 1968, a time when numbers of agricultural workers was declining, the accidental death rate increased 14 percent.[2] Clearly, agriculture must undertake safety programs to reduce these losses.

As an Institution Farmer, you have a great deal at stake in the safe operation of machinery and equipment on your farm. As a starting point, let us consider a few of the economic benefits of safe farming.

1. Reduction of labor turnover. The experience of a dead or disabled employee does not put seeds in the field or crops in the barn. Good help develops over years of experience and no training program can quickly replace it. Labor turnover involves a search for that hard to find able help and then the process of training the new man to do the job according to accepted standards on your farm.

2. Reduction of time lost from productive work. The dollar value of this loss will vary with the season but at any time it is costly. Surveys in the states of Ohio and Michigan in 1967 and 1968 respectively showed the average number of days lost per disabling accident as 10.6 and 15.8 days. The reported average costs of these accidents were $218 and $238 respectively. These values included medical costs, costs of hired replacement labor, and property damage.[2]

3. Reduction of machine down time. Every accident, whether injurious or not, results in unnecessary machine down time. This can be costly in terms of late plantings, increased harvest losses, weather damage, etc.

4. Reduction of liability insurance premimums. Whether or not your insurance company actually reduces the premimum for a good safety record is of little importance. What is important is the fact that insurance premimums are based on the costs of accidents by the company's customer so a safety record may simply prolong the next inflationary premimum increase. Which ever is the case, you stand to gain from a safe operation.

5. Reduction in workmen's compensation costs. Compulsory workmen's compensation laws of New York State have just recently been extended to cover workers in agriculture. The cost of this program, too, is related to safe operations.

6. Improved worker efficiency and morale. The monetary value of this benefit of safe operations cannot be measured in dollars but surely the worker who knows his employer is concerned about his safety to the extent of stressing safety in operation, care, and repair of machinery and in the selection and purchase of new equipment, will work more efficiently and effectively.

7. Reduction of time lost by employees other than the injured. This is the time lost by employees assisting the injured, repairing the machine, investigating the accident and writing up reports, etc.

In addition to the economic stake which you have in the safe operation of machinery on your farm, you have a legal and a moral interest.

1. You may be the final authority in the selection of a piece of equipment to be leased or purchased for use on your farm. Certainly you are consulted. It is probably your decision whether or not that new tractor will be equipped with a protective frame. Or the new machine will have the safer but more expensive drive-line. You are then in a position that could subject you to legal action in a contributory sense.

2. The State of New York carries liability insurance to protect you against these claims but does it pay for your lost wages, or time lost in your own defense, or the expenses involved in court appearances? Even if it paid all of these, there is no insurance to pay for that mental anxiety associated with the questions you will ask yourself about what you could have done to prevent a tragic loss.

3. As an Institutional Farmer you are in a position to set good leadership examples for the communities and rural areas you serve. You should be among the first to accept new ideas and to demonstrate the latest in safe practices.

In subsequent sections of this paper we will take a look at vehicle identification, noise control, power take-off accident prevention, tractor overturn protection, and some ideas you may be able to use in developing an active safety program for the institutional farm.

VEHICLE IDENTIFICATION

In the early 1960's, Kenneth A. Harkness of the Department of Agricultural Engineering at Ohio State University undertook a project to develop an emblem that would enable motorists to identify slow moving farm equipment on the highway during both daylight and dark.[2] Identification had to be made early enough to permit the operators of high speed vehicles to take defensive action.

From this early work the American Society of Agricultural Engineers in co-operation with the National Safety Council developed a Standard for "The Slow Moving Vehicle Identification Emblem" which was adopted in 1966. The identification emblem consists of a flourescent yellow-orange traingle with a dark, red reflective border. The yellow-orange flourescent triangle is for daylight identification. The reflective border defines the shape of the flourescent color in daylight and becomes a hollow red triangle in the path of motor vehicle headlights at night."[3]

Section 375.36 of the Vehicle and Traffic Law of New York State refers to the adoption of the Slow Moving Vehicle Emblem for use in New York State effective September 1, 1969. The law will not become mandatory until 1972. At the present time the Commissioner's Office is drawing up the requirements of the law with regard to the types of vehicles required to carry the emblem, the mounting locations, etc.

Many states have adopted definition and mounting specifications of the ASAE Standard.[3] "Slow-moving vehicles are defined as vehicles which normally travel at rates of speed slower than regular vehicular traffic (vehicles which have a maximum travel speed of less than 25 miles per hour...) The emblem shall be mounted point up in plane perpendicular to the direction of travel plus or minus 10 degrees. It shall be placed centrally at the rear of the vehicle, unobscured, and 2 to 6 feet above the ground measured from the lower edge of the emblem." The New York State law will probably take similar form and these specifications may be used in the interim period.

NOISE CONTROL

Noise has been defined as any unwanted sound. It may be a tractor engine under load or it may be a Strauss Waltz from your neighbor's stereo phonograph at 3 o'clock in the morning. Either way it is noise if you don't want to hear it.

The University of Nebraska reports that noise produced by all makes and models of more than 50 tractors tested was sufficient to damage the hearing nerves.[5] These were not old tractors with poor mufflers. These were standard Nebraska Tractor Test models.

Fifteen hundred entering freshmen were tested at the University of South Dakota and South Dakota State University in a project to study hearing losses. It was found that 1 in 5 to 1 in 10 young men with farm backgrounds had impaired hearing attributable to machinery noise. This is 3 to 4 times the national average for the same age group.[5]

Loss of hearing may be temporary, permanent, or a combination of temporary and permanent but damage to hearing nerves is permanent. It is not temporary and can not be cured. The tolerance of individuals to noise varies and the damage produced may not show up immediately. Dr. Samuel Rosen, emeritus professor at Mount Sinai Hospital and School of Surgery in New York City is quoted as saying "You may forgive the noise, but your body never will."[6]

Noise does not have to be damaging to the hearing nerves to have an injurious effect on a person's health through tensions built up by the irritation. Some doctors believe that noise may actually cause high blood pressure and bring on ulcers.[6]

Tractors are not the only source of noise on the farm. Elevators, fans, blowers, the garbage-disposal, or the ventilating fan over the kitchen range are just a few of the other sources of potentially damaging noises.

The American Academy of Opthalmology and Otolaryngology gives the following as three danger signals of noises injurious to the ear.[5]

1. When noise drowns out otherwise communicable speech.
2. When there is prolonged ringing or noise sensations in the ears after working in noisy conditions for several hours.
3. A hearing loss which muffles speech tones after working in a noisy environment, but which disappears after several hours.

Industry in recent years has become very much concerned with noise and the employee's hearing. No small part of this concern has come from employee legal actions to recover damages for hearing losses claimed to be the result of their noisy jobs. Many industries require hearing tests on a new employee before he begins working on a job and may further require periodic checks to guard against losses. In some industries ear plugs or muffs may be provided to control the noise level. Considerable effort is being expended in the design of tractor cabs which isolate the operator from the noises of the machine. There are other things that can be done to reduce noise levels around the farm: moving parts can be lubricated, loose bolts can be tightened, mufflers and exhaust systems can be kept in good repair, the source of the noise may be isolated and insulated to keep it from the areas in which employees work.

You may expect eventual legislation in this area to cover workers in agriculture but until then, keep the three points given above in mind and provide protection for your employees. At least, make them aware of the dangers so that they may protect themselves.

POWER TAKE-OFF ACCIDENT PREVENTION

The power take-off mechanism used to power stationary and mobile farm equipment requires cautious consideration. Practically every PTO accident involves the entanglement of clothing in the rapidly revolving shaft. Power transmitted through the shaft is of such magnitude that there is very little possibility of stalling the tractor engine and the rotational speed of the shaft, 540 rpm or on late model tractors 1000 rpm, makes disentanglement impossible.

Knapp provides the following as possible sequels to PTO entanglement.[1]

1. The clothing yields, freeing the man without injury.
2. The clothing yields with minimal trauma (injury), such as friction burns, scrapes and sprains and bruises.
3. The clothing yields and removes loose skin in the scrotal region.
4. The clothing yields following wedging of the victim's body in or against the machine with severe trauma, such as lacerations, broken bones, dismemberment of the extremities, or strangulation.

5. The clothing does not yield and the body of the victim is rotated around the shaft with extensive mutilation and early death.

Old clothing will yield more easily than new clothing and therefore accident severity may be less serious. However, old clothing is more apt to be loose fitting and frayed and therefore more likely to become entangled with the PTO.

An analysis of 110 PTO accidents occurring between 1962 and 1964 was made by the Institute of Agricultural Medicine at the Univeristy of Iowa. The four Tables reproduced here are from Bulletin 11 of the Institute of Agricultural Medicine.[1] The Tables show the PTO equipment in use at the time of the 110 accidents, the parts of the PTO which entangled the victim's clothing, the types of clothing worn, and the type and location of injuries sustained.

TABLE 1: PTO EQUIPMENT BEING USED AT THE TIME OF THE ACCIDENT

Equipment	No. Accidents (sub-total)	Total
Stationary		44
Grinders and hammer mills	18	
Elevators		
1. PTO	13	
2. Tumbling rods	8	
Post hole diggers	2	
Other	3	
Semi-Stationary		27
Silage wagons	10	
Auger wagons	8	
Sprayers	7	
Other	2	
Non-Stationary		29
Corn pickers	11	
Combines	4	
Mowers	3	
Manure spreaders	3	
Other	8	

TABLE 2
Segement of PTO Which Entangled Victim's Clothing

Part	Number
Bolts, cotter pins, pins, nails	42
Spring-loaded pin	30
Grease fitting	9
Smooth shaft	4
End of stub shaft	4
Universal joint	11
Unknown	8

TABLE 3
Entanglement by Type of Clothing Worn by Victims

Clothing 1st entangled	Number
Overalls and/or coveralls	55
Western jeans	15
Wash pants	5
Other	17

TABLE 4: TYPE AND LOCATION OF INJURIES

Location of Fractures		Location of Lacerations	
Upper extremities	12	Upper extremities	7
Lower extremities	18	Lower extremities	34
Ribs	10	Other	9
Other	5	Total	50
Total	45		

Severe abrasions and bruising	29
Shoulder dislocation	7
Denuding of testes and penis	6
Brain damage	5
Amputations	
Lower extremity	3
Upper extremity	2
Other injuries	15

Developments in shielding of the PTO have made significant progress since it was introduced as a standard item on some 1921 tractors. In the beginning an unshielded shaft was used. Some of these can still be found around the farm and they are extremely hazardous to the operator. The first shields took the form of an inverted U-trough often called a tunnel shield. Much difficulty was encountered in getting these units to telescope after they had been bent up a little through normal use. Result was that the shield eventually ended up behind the barn and the operator was back to no protection.

The integral shield with its bell-shaped ends partially covering the universal joints was a vast improvement and is the standard today for shielding between the tractor and implement master shields. Master shields are often restricted from providing full protection by the need for flexibility, an example is the unloading wagons where the PTO is swung to the side for fastening on the wagon front panel when not in use. A portion of the universal joint is unprotected and the opportunity for clothing entanglement still exists. The American Society of Agricultural Engineers is currently working on a new Standard to provide "Full Shielding of Power Drive Lines For Agricultural Implements and Tractors".[3]

As an Institutional Farmer, you should be sure that your employee's are using all of the power drive line protective devices provided by the manufacturer and that they are aware of the inherent hazards. The newest shields do not yet appear to be the ultimate in operator protection but all shields in proper working condition afford some protection for the operator.

TRACTOR OVERTURN PREVENTION AND PROTECTION

More than 1000 persons are killed each year in farm tractor accidents and 6 in 10 of these fatalities involve tractor overturn.[7] Tractors overturn either to the side or to the rear and are the result, usually, of operator error or hazards in the operating environment.

Overturn to the side is usually associated with high speed turns, crossing steep slopes or ditches, carrying front-end loaders to high, uneven braking, hauling heavy loads down a steep hill, or striking hidden obstacles or holes in the field.

Overturn to the rear is usually associated with pulling heavy loads uphill, high hitching, too large drawbar loads, attempts to climb steep embankments, or

freeing a tractor stuck in the mud.

The National Safety Council, in a study covering thirteen states between 1960 and 1965, found that 58 percent of the fatalities involved tractor upset. This does not include another 6 percent killed in motor-vehicle collisions.[8]

Studies of tractor accident fatalities by the Institute of Agricultural Medicine and the National Safety Council point to the utility of overturn protection on tractors. In the opinion of the Institute analysis of 77 highway accidents investigated during the 1960 Iowa harvest season, three-quarters of the fatalities would not have occurred if the operator had had overturn protection.[1]

Another detailed study of 172 tractor accidents in the United States and Canada found that "Provision of overturn protection, with use of seat belts, could have prevented 93 of 100 tractor overturn fatalities that were studied..."[2] This study was carried further to determine the safe operating practices and equipment changes that could have prevented the accidents.

"The most needed safe operting practices were: stay clear of ditches, embankments, holes (42 cases), do not permit others to ride and keep children away (33 cases), and reduce speed when turning, crossing slopes, and on rough, slippery, or muddy ground and roads (28 cases). The equipment changes needed were: provision of a means for safe transport of a rider (23 cases), and provision of a rear-view mirror (11 cases)."[2]

A recent survey of farmer concern for overturn protection showed 40 percent were 'very concerned' about upsetting a tractor themselves and over 50 percent were 'very concerned' about having a member of their family involved in a tractor upset. One-third of the respondents reported they, or members of their family, had upset a tractor.[9]

With regard to legislation requiring some form of overturn protection on agricultural tractors, it appears to be only a matter of time. Several European countries already have regulations including Sweden (the first), Norway, Denmark, Finland, England, Wales, and Scotland. In the United States, Congressman Stratton of New York introduced a bill, H. R. 680, in the House of Representatives on January 3, 1969, to amend the National Traffic and Motor Vehicle Safety Act of 1966 to require safety standards for tractors used for agricultural purposes.[10] The bill specifically included 'standards for roll bars and safety harnesses'.

As an amendment to the legislation extending the National Traffic and Motor Vehicle Safety Act of 1966 to 1972, the bill was defeated but a softer amendment was passed which requires the Secretary of Transportation to conduct a study of farm tractor accidents and report in April 1970. You can look for more activity on this matter in Congress but satisfactory protective devices are available from machinery manufacturers and you should be including them in the purchase of any new tractors without waiting for legislation.

A SAFETY PROGRAM FOR THE INSTITUTIONAL FARM

The institutional farm should follow the lead of other industries of hazardous occupations and have a planned safety program. The plan need not be detailed but, as with the planting and harvest of crops, the task has to be scheduled into the overall operation. There are many forms that a safety program for the institutional farm could take. The following is provided for your thought and consideration and for your help in developing a program that adapts itself well to your operations.

It certainly is not, in my opinion, necessary to schedule a formal session, say of half an hour duration, on a regular weekly basis. You may already have scheduled a weekly meeting with your farm crews to discuss activities for the week and lay out the work that has to be accomplished. A few minutes of these sessions could advantageously be spent in consideration of safe operating practices.

Safety is one of those things that we all know affects us and as a result some people may consider a safety program an insult ot their intelligence. This certainly is not the case as we all need reminders, but to help you avoid the unpleasant flak from these individuals, use a subtle approach which will provide the necessary information but without calling it a safety meeting. For example, before you put men on a new tractor, have your dealer representative spend a half hour or so discussing with them the various controls on the tractor and how it should be operated. Scheduling this for early in the morning before the dew is off the grass will not seriously affect your operations and the dividends returned may be great. You will never know when a life has been saved.

Your machinery company representative along with your own preparation in reading the Machine Operator's Manual can provide crews with valuable training. You should be striving to train machine operators not tractor drivers. This effort will result in safer operation, more efficient operation both in terms of hours in the field and percent of crop harvested, and it will prevent many of the unnecessary breakdowns. If you are the farm manager, you don't have the time to plant the grain, bale the hay, and pick the corn. You have to have well qualified help to relieve you for managerial duties. This kind of help can only be developed through training, and the quickest way is to attack training on a planned basis rather than rely on hit-or-miss methods.

Formal training programs have been developed that may serve as guides. Examples are the 4-H Tractor Driving Program available from your County Extension Service and the Tractor Overturn Prevention and Protection (TOPP) Program available from the National Safety Council.

The use of safety reminders is a most effective way of informally promoting safety. Use a centrally located bulletin board for posting notices as well as for displaying safety posters, cartoon quips emphasizing safety, and slogans which you may develop. You might try a slogan-of-the-week contest. Post a new slogan every week and, as you talk with your employees individually during the week, ask them what is this week's slogan. The first employee you find with the answer should receive a small reward for his observation. This effort will provide a subtle reminder of a safety idea(a primary objective) and will, in addition, tell you which employees are observing the bulletin board for information which you have placed there.

Appended to this paper are (A) one of the lists of safety rules provided in the TOPP Program material; (B) a partial list of films available that promote safety for you and which would be most useful in your safety efforts during the off-season when somewhat longer sessions can be held on a weekly basis; and (C) a listing of some of the other resources you may draw on to develop an active safety program on your farm.

SUMMARY

Accidents on farms are costly in many ways; loss of life, loss of time, loss of crop, to name just a few. The two most obvious hazards are tractor overturn and the tractor PTO but there are more subtle hazards, too, such as injury to the hearing nerves. As an institutional farmer on a large farm with numerous employees and a public image, you must give safety significant emphasis in your operations. Use easy-to-learn safe practices such as knowing the machine and reading the warnings provided by the manufacturer.

National Safety Council, in the introduction to their TOPP program, give four measures that will lead to a general improvement in operator performance and a lower frequency of accidents. These four measures are listed below because they apply to the operation of all machinery.[11]

1. Train inexperienced operators.
2. Orient operators to characteristics of new or unfamiliar equipment.
3. Keep information flowing on potential hazards of tractor operation and appropriate safe practices.
4. Impress upon operators their responsibility to abstain (or restrain others) from tractor operations if physically or mentally unable to perform them safely.

Mr. Leon Urben, Manager of the Farm Department of the National Safety Council, has pretty well summed up the situation in the following statement. "When you consider the farm manager's stake in safety you should not overlook the fact that complying with health and safety standards (presumably in the offing if they are to determine what is healthy and safe environment) is not going to be cheap. Neither is a law suit following an injury and we can't forget that if we are to attract qualified labor to agriculture we must improve working conditions (air conditioned tractor cabs, etc.). Safety is indeed becoming a real management concern to a degree hardly envisioned as little as ten years ago."[12] In his comment concerning health and environment, he is referring to legislation pending in Congress.

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10. Copy of H. R. 680 provided by Congressman Samuel S. Stratton, House of Representatives, Congress of the United States, Washington, D. C.

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APPENDIX A - YOU'LL DO TRACTOR JOBS RIGHT IF YOU DO THEM SAFELY

WATCH FOR, AVOID THESE TRACTOR TIPPERS:

- Stumps, logs
- Rocks
- Holes, ruts, cave-ins
- Gullies, ditches, embankments
- Other machinery, junk

SLOW DOWN WHEN:

- Turning
- Ground is rough, muddy, soft, slick
- Near, alongside or crossing ditches, embankments
- Working on slopes
- Pulling heavy, high, swaying or unstable loads
- Plant growth or darkness hides view

MATCH LOAD TO TRACTOR:

- Hitch to drawbar set low, NOT to axle or frame
- Load too big can cause upset--if tractor can't handle it safely lighten load or use bigger tractor
- Apply power slowly when starting heavy loads
- Add front weight for towing heavy two-wheel vehicles
- Add rear weight for front end loader
- Set wheels wide as practical

USE ROAD SENSE:

- Stop before entering or crossing road
- Signal intentions to slow, stop, turn
- Keep your eyes on road ahead
- Have good lighting and SMV emblem
- Shift to lower gear up or down hills

DO YOURSELF A FAVOR:

- Shut off-power before unclogging or servicing machines
- Keep children off and away from machinery
- Refuel when engine is cool. No smoking!
- Keep tractor clean and properly serviced
- Be fit to drive this tractor safely, today, everyday

PREVENT ACCIDENTS! SEE the hazard! KNOW the defense! ACT in time!

APPENDIX B - FILMS AVAILABLE FOR SAFETY PROMOTION (16mm sound)

Suppliers Key Notation:

AC - Allis-Chalmers Mfg. Co.
Dept. 1816
Box 512
Milwaukee, Wisconsin 53201

AF - Association Films Inc.
600 Grand Avenue
Ridgefield, New Jersey 07657

CU - Film Library
Roberts Hall
Cornell University
Ithaca, New York 14850

IH - International Harvester Company
P. O. Box 1809
Albany, New York 12201
Attn: W. E. Bragg, Supervisor-Product Knowledge

IS - Visual Instruction Service
Iowa State University
Ames, Iowa 50010

JD - John Deere Company
P. O. Box 585
Syracuse, New York 13201
Attn: J. E. Hoyt, Sales Promotion Manager

SM - Safety Education Division
Sellstrom Manufacturing Company
Sellstrom Industrial Park
P. O. Box 355
Palatine, Illinois 60067

SS - Syracuse Safety Service, Inc.
1108 Spring Street
Syracuse, New York 13208

SU - State University Film Service
135 Western Avenue
Albany, New York 12203

APPENDIX B

Film Title	Cat. No.	Time	Color	Cost	Key
Subject: Eye Protection					
Don't Push Your Luck			X	Free	SS
It's Up To You	NS-2112	10 min.	X	$2.65	IS
The Window To Your Soul		28 min.	X	Free	SM
Subject: Farm Machinery Safety					
Hands Off (corn picker)	NS-3325	19 min.	X	$3.25	IS
Make It A Safe Harvest	NS-1468	18 min.	X	$5.00	IS
Mowing Lesson For Charlie (lawn)	NS-4287	8 min.	X	$1.65	IS
Subject: Farm Tractor Safety					
Farm Tractor Safety		18 min.	X	$2.00	CU
Farm Tractor Safety, A Family Affair		22 min.	X	$2.00	CU
Roll Gard Safety		10 min.	X	Free	JD
Within The Frame Of Safety		8 min.	X	Free	IH
Subject: Fire Protection					
Fire On The Farm	S-485	12 min.	X	$3.50	AF
Fire Power (handling gasoline)		17 min.		$1.00	CU
Until The Fire Department Arrives	S-530	5 min.	X	$3.50	AF
Use Of Portable Fire Extinguishers			X	Free	SS
Subject: First Aid					
First Aid Now		26 min.	X	Free	CU
First Aid Now	S-638	28 min.	X	Free	AF
First Aid On The Spot	HPE- 72	10 min.		$2.00	SU
Rescue Breathing		21 min.		$1.00	CU
Subject: General Farm					
How To Avoid Muscle Strains	NS- 325	14 min.	X	$0.85	IS
Knowing 's Not Enough	SU- 485	28 min.	X	Free	AF
Safe Farming U.S.A.		5 min.	X	Free	AC
Safety In The Shop	NS-2006	12 min.		$1.55	IS
Subject: Pesticide Safety					
Health Hazards Of Pesticides	NS-4516	15 min.	X	$0.85	IS
Prescription For Safety	NS-4346	19 min.	X	$0.85	IS
Safe Use Of Pesticides		21 min.	X	$1.50	CU

APPENDIX C - OTHER RESOURCES FOR SAFETY PROGRAM MATERIALS

Farm Division National Safety Council 425 N. Michigan Avenue Chicago, Illinois 60600	- for publications, promotional kits, and information
National Committee on Safety Education 1201 Sixteenth Street, N. W. Washington, D. C. 2000	- for list of publications and materials
Local Electric Utility	- for speakers and training programs
Major Oil Companies	- for publications and speakers
Farm Machinery Companies	- for Operator's Manuals, films, and speakers
Land Grant College Extension Service	- for publications, speakers, and organizational help
Insurance Company Representatives	- for speakers, and materials

MB/mas
12/2/69

VT 011 142
Morrison, Leger R.
Typewriting for Business; Typewriting by a Whole (Gestalt) Method. Teacher's Manual and Key.

Programs for Achievement in Reading, Inc., Providence, R.I.
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Programs for Achievement in Reading, Inc., Abbott Park Place, Providence, Rhode Island 02903 ($2.50).
PUB DATE - 68 65p.

DESCRIPTORS - *TEACHING GUIDES; *TYPISTS; *TYPEWRITING; *OFFICE OCCUPATIONS EDUCATION; BUSINESS EDUCATION; BUSINESS SKILLS; CLASSROOM MATERIALS; *TEACHING METHODS

ABSTRACT - The manual briefly outlines for the teacher the philosophy of the Gestalt method and gives helpful suggestions on grading, testing, and methods of presenting the material to the student. It includes a tentative time schedule, class exercises and problems, and testing and grading suggestions. This manual is part of a set that includes a student text (VT 011 145) and timed writings (VT 011 143), both in this issue, and a workbook of blank forms, available from the source listed above. (JS)

VT 011 142

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TEACHER'S MANUAL AND KEY

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TYPEWRITING FOR BUSINESS

Typewriting by a Whole (Gestalt) Method

by Leger R. Morrison, Ed.D., Professor of Education, Bryant College, Providence, R.I.

VT 011 142

Programs for Achievement in Reading, Inc., Abbott Park Place, Providence, Rhode Island.

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It is disquieting to some teachers to use a new textbook and to try a new method of teaching, especially if one has felt secure with the old method and the old textbook for the past ten or so years.

This textbook, developed after a study of the psychology of learning, offers a more natural method of learning to type. This will be evident after the first few weeks of instruction.

The more you use these materials and the more familiar you become with the principles of psychology on which they are based, the more proficient you will become in their use.

The Point of View

Students are sometimes presented with poorly structured learning situations in which the end (the perfect copy) appears to them to be more important than the means (techniques employed). If a situation calls for the application of a skill which they do not as yet possess or if other means appear to be superior to the skill they possess at the time, the job may get done, but bad habits may be developed in the process. Giving students certain types of production work too soon and testing students too soon—putting them under pressure too early in the semester—can break down within an hour many habits that took weeks to develop to their present stage.

The most important part of the entire keyboard is the alphabet and the marks of punctuation, because mastery of the letter keyboard in terms of good hand position and a high degree of overlearning will facilitate the development of accuracy and speed on that which is next in importance, namely, the numbers and symbols on the upper bank of keys.

If the student learns to minimize hand motion, learns to make the tips of the fingers do most of the reaching, and develops the muscles in the fingers sufficiently to stroke keys rapidly, much can be accomplished when the numbers and symbols are introduced, particularly if the student has developed habits that do not have to be broken down and retaught properly.

The degree of skill in the manipulation of keys by touch will be proportional to the amount of time spent in taking timed speed writings. Little or no increase in speed will result when the student spends almost all of his time doing such production work as centering and tabulation. Furthermore, many more production problems can be solved within a given time if the student has already developed a high degree of skill in manipulating the keys by touch before a great deal of production work is required of him.

It is suggested that centering and tabulation not be introduced during the first two weeks of typewriting. If students must be graded at midsemester, centering can be introduced about two weeks before the test and reviewed for a few days before introducing simple tabulation problems. The midsemester grade could consist of simple problems on centering and tabulation. This would comprise a production grade, which could account for one-half or two-thirds of the midsemester grade.

The other one-half or one-third of the grade could be based on 3-minute timed writings that appear at the end of each lesson. Since most of these tests are more difficult than ordinary timed writings, this should be considered in grading so that there will be a distribution of A's, B's, C's, etc.

The final grade for the semester can be based in part on special timed writings supplied to the teacher by the publisher. The production grade could be based on (1) a letter, an envelope, and a form to be enclosed and (2) a more difficult tabulation problem.

PRODUCTION 1/2; SPEED 1/2

Midsemester grade

85 centering
75 tabulation
2)160
80 production = 1/2
84 speed = 1/2
2)164
82 midsemester

Final grade

84 letter
80 tabulation
2)164
82 production = 1/2
85 speed = 1/2
2)167
84 final grade

PRODUCTION 2/3; SPEED 1/3

Midsemester grade

85 centering
75 tabulation
84 speed
3)244
81 midsemester grade

Final grade

84 letter
80 tabulation
85 speed
2)249
83 final grade

Classroom Atmosphere

Develop a calm, relaxed, cheerful, and encouraging classroom atmosphere. Let students know when they are doing well.

Coordination

Very few persons have extremely poor coordination, but those who have this handicap need almost daily encouragement and attention. Never mention anything about poor coordination. Give a brief word of encouragement to the slower learners and praise them individually whenever you personally observe any improvement.

Some of the fast learners will be typing the beginning drills at 20 to 30 words a minute and will know that they are doing well. Some of them will take the time to tell you how well they are doing. You can mention, "I hope that you will keep this excellent rate of speed up on every new drill."

Praise

When you praise students, let them know what you are praising them for, such as, "I like the way so many of you are reaching for the shift key by extending the little finger and keeping the other three fingers right in the center of the home keys." This is also an opportune time to point out what they can do to improve.

Things that Can Be Done Before the Course Begins

Disregard those notes on the history of the typewriter, or place them on the bulletin board if you believe some students may be interested in reading them.

Take down the keyboard chart that is above the chalkboard in front of the room. If new typewriters are being purchased, encourage the purchase of typewriters with lettered keyboards.

Check the typewriters for mechanical defects. Tag them and try to have them repaired at least a week before school starts.

There should be no blank charts on which students are asked to fill in the letters of the keyboard. There should be no charts on which students are asked to name forty parts of the typewriter.

Be sure to have a good stop watch for carriage-return drills and for short timed writings. An alarm timer for longer timed writings should also be available. A satisfactory stop watch is one that has a long hand that makes one revolution in 30 seconds and a small hand that registers the minutes. The hands return to zero by depressing a side button, and successive depressions of the crown will stop and start the watch.

Planning a Time Schedule for the Semester

The teacher will probably want to plan a tentative overall time schedule for the semester. Once the semester is under way, the plan can be adjusted.

First, it may be a good idea to reserve a certain number of days for essential testing and to determine how many days can be devoted to the all-important development of keyboard-manipulation skill. The illustration that follows is hypothetical. Each teacher should develop his own plan to fit his particular situation.

Let us assume the teacher will devote the last five days prior to a marking period to timed writings. One day is reserved for reviewing tabulation problems and one day for a tabulation test. One day is reserved for reviewing centering problems and one day for a centering test. This accounts for nine days.

If there are two marking periods a semester, eighteen days can be set aside for what is called testing. Actually the giving of timed writings is not a testing period. It is actually a learning period rather than a testing period in the normal sense of testing.

Then the teacher can examine the textbook and plan on the number of days that he wishes to devote to the drills emphasizing each key. Tentative dates may be written in pencil next to the letters and numbers on page 5 of the Teacher's Manual.

If it is a twelve-week course that meets five days a week (sixty periods), eighteen periods will be devoted to testing, and forty-two periods will remain for other work. Perhaps the teacher will decide to introduce a new letter daily and then allow one day for each drill on the number keys. Teachers who are not required to hand in grades at midsemester may decide to devote more time in developing higher rates of speed on the letter keyboard.

When time is limited, it is not necessary to spend the same amount of time on every sentence in a lesson, nor is it necessary to type the entire lesson after the introduction of a new letter.

The teacher may, for example, have the students type as much as possible on the sentences that reinforce the learning of a new letter. He may wish to assign another page for homework, and the following day he may wish to use a test at the end of a particular letter to get some idea of the degree of mastery achieved.

Students who have 60-minute periods will be able to accomplish more than students who have 35-minute typewriting periods. The extra time can be used profitably to increase the degree of mastery of each lesson, which will result in greater retention and more positive transfer of learning.

It should be pointed out that one of the primary considerations in the hypothetical time schedule is grading at midsemester and at the end of the semester. This is not the most desirable time schedule for efficient learning, especially if the students have less than an hour's practice a day. The ultimate results would be better if more time could be spent on each drill emphasizing a particular letter in order to insure a greater degree of overlearning.

Obviously high levels of typewriting skill are not developed by "covering" a keyboard. The keyboard can be "covered" in a couple of hours, a practice that would violate what we know about the way that people learn most effectively. There is a great difference between "covering" a keyboard and developing good typewriting skill.

The teacher who because of a constricted time schedule has the students type from only one or two pages of the drills emphasizing a particular letter may want to return to the beginning of the book and give more practice and longer timings on each lesson, particularly on those pages that were previously bypassed or on which little time was spent. In this review the teacher can stress the fundamentals in the proper order and give individual guidance to those who need it most.

If typewriting consisted only of "covering" a keyboard, many a typewriting course would have ended abruptly when in the 1940's one magazine writer after another tried to outdo his predecessors by reducing the time needed to present or cover all keys on the keyboard.

A book containing about twice as many drills similar to and including those that appear on pages 1 through 85 will be published within a few months by Programs for Achievement in Reading, Inc. That book will consist of such drills only.

Daily Practice

Every effort should be made to have typewriting five days a week. It is undesirable to teach typewriting two days a week or three days a week. Of course, typewriting skill is best developed when there is daily practice. After the students have typed all drills in the textbook, encourage them to type their assignments for other classes and to put their skill to use preparing a school newspaper or typing the yearbook.

TENTATIVE TIME SCHEDULE FOR SEMESTER

Page	Letters	Date
1	a s d l .	
2	k	
3	h	
4		
5	f	
6	g	
7		
8	? ;	
9	i	
10		
11	t	
12		
13		
14	Test 1	
15	e	
16		
17	Test 2	
18	Test 3	
19	r	
20		
21	Test 4	
22	o	
23		
24	Test 5	
25	w	
26		
27	Test 6	
28	Test 7	
29	v	
30		
31	Test 8	
32	m	
33		
34	Test 9	
35	c	
36		
37	Test 10	
38	p	
39		
40	Test 11	
41	b	
42		
43	Test 12	
44	n	
45		
46	Test 13	
47	u	
48		
49	Test 14	
50		
51	Test 15	
52	q	
53		
54	Test 16	

Page	Letters	Date
55	j	
56		
57		
58	x	
59		
60	Test 17	
61	y	
62		
63	Test 18	
64	z	
65		
66	Test 19	

Page	Numbers Symbols
67	8 '
68	4
69	$ 7
70	& 2
71	"
72	9 -
73	3 #
74	
75	
76	0 ( )
77	
78	5
79	% 6 _
80	
81	/ *
82	
83	½ ¼
84	¢
85	@

Introduce centering
Review centering
Test on centering
Introduce tabulation
Review tabulation
Test on tabulation
Timed writings
Tabulation problems
Review of tabulation
Test on tabulation
Introduce letters
Review letters
Test on letters
Timed writings

Maintaining Skill Versus
Developing Higher Levels of Skill

If only 10 to 15 minutes of timed writings are given a day, it can be expected that whatever speed has been attained previously can be maintained; however, at least 25 minutes of actual typing under timed conditions (1- and 2-minute timed writings, for example) are desirable in order to develop higher levels of skill. This means that if students are given from 3 to 5 minutes at the beginning of a period to review the previous day's drill and are given a 3- to 5-minute tryout period to practice new sentences containing only those keys that were previously introduced, it will take careful budgeting of time to give 1-, 2-, 3-, and 5-minute writings that will total 25 minutes of actual typing under timed conditions in a 55-minute period.

The first day the student types, it is not important whether the line space regulator is set for single or double spacing or whether the students have their margins set for a line of a specific length. On the first day there is no need to teach such things as the arrangement of supplies at the work station, straightening of paper, names of scales on the typewriter, explaining the difference between pica and elite type, etc.

Avoid wasting time explaining parts of the typewriter. Show the students now to put the paper into the machine and begin to type the first sentence. Show them how to use the mechanisms as they are needed, for example, to insert a sheet of paper. Let them use these mechanisms and see how they function; then gradually identify the parts by name.

The right margin stop can be moved to the extreme right. Only the left margin stop need be set, and that stop may be set at any point between 5 and 25. The student can follow your directions and throw the carriage after each line he types. The carriage throw may be called for after two or three sentences have been typed on a line. The setting of margin stops can be taught when the first paragraphs are introduced or on the third or fourth day of class.

It takes less than a minute to demonstrate and to instruct the students on the way to insert the paper so that the printing position will be about 1 inch from the top of the sheet.

The first day of class the teacher may have time to introduce the first three or perhaps the first seven sentences, and is a good idea to spend a second day on that first page. There may be late entrants, and these late entrants can be taught separately. Repeat the first day's instruction for late entrants while the other students are given short timed writings or short tryout periods.

At the beginning of a period before taking attendance, the teacher can start the class by saying, "First, I will give you a 3-minute tryout period on the first eight sentences. If you are able to type all of them before I call time, start over."

It is a good idea to review the previous day's work whenever time is available before beginning on today's work, especially before a new key is to be introduced.

The first couple of days are the teacher's busiest, but instruction should not be rushed. Perhaps there will be enough time to cover the first three or perhaps the first seven sentences the first day of class. How many will be covered depends on the length of the period, how many times each sentence is typed, etc. There is no need to rush. On the second and third days many more sentences can be typed and retyped within a period.

The First Day

The first day in class may be your busiest day. Good planning can make it a productive day. Motivation can be high if after that first class your students can tell their parents and friends, "I typed sentences in class today."

Take care of the routine details efficiently so that you will be free to teach. Here are a few suggestions for the beginning teacher.

Have enough typewriting paper for those students who do not bring paper to class. As soon as the first few students are seated, circulate two blank seating charts simultaneously—one on the left side of the room and one on the right side. If you plan to assign students to seats, circulate the seating charts the second day or make out the chart before class and seat the students accordingly.

To prepare an alphabetical list of students, pass out 3 by 5 cards so that students can write their names, last name first. Enlist student help. Ask a student to distribute the cards and ask another to distribute the paper.

Avoid Doing the Unnecessary

Very few parts of the typewriter need to be identified during that first class. The few parts that will be used can be named. To save time, show the students at the demonstration stand how to place the paper into the typewriter as you instruct them: "Place a sheet of paper behind the long rubber roller, or cylinder, and turn this knob on the right until the paper appears in the printing position. I have turned the knob that controls this cylinder enough so that I can type about an inch from the top of the sheet. Then place this long rod with two rubber rollers, known as a paper bail, down over the paper. Now we are ready to type, and the first thing we will type is a complete thought."

Once the student has made use of certain parts of the typewriter and knows how they function, these parts can then be labeled verbally. It is undesirable to dwell on nomenclature and the memorizing of definitions for parts of the machine. It is not important that first day whether the machines are set for single or double spacing.

The students are eager to learn to type, and the process should be initiated as early in the first class period as possible. When parts of the typewriter are essential in doing that particular day's work and the student experiences how the parts function, that is the time to learn the names of these parts.

How does one start? How does a teacher present that first lesson? Here are a few suggestions.

Positioning Hands on Home Keys

Say to the class: "Place the little finger of the left hand on the a key and let the other three fingers fall naturally over the three adjacent keys, the s, d, and f keys.

"Place the little finger of the right hand on the semicolon and let the other three fingers fall naturally over the l, k, and j keys.

"Notice that you are on the second bank of keys and that there are two uncovered keys in the center. There is one uncovered key to the right of the little finger of the right hand. Now we are ready to type. Watch me as I point to the fingers we will use in typing our first sentence. "[1]

Then the teacher raises his left hand, palm facing the board in front of the room so that the students can see the back of his left hand. As he points with his right hand, the teacher says slowly, "We will type: dad adds all, and these are the fingers we will use. Watch as I point to them. Try to remember them."

Pause for a second or two after calling each letter and pointing to the proper finger:

"d a d space	(Emphasize spacing with the right thumb by raising the right hand high and by making an inward movement with the thumb; then
"a d d s space; all spacing is done with the thumb of the right hand.	
"a l l	(Then the teacher turns his head slightly, holds the right hand up and stationary, palm facing the board. With his left hand he points to his right hand, l finger, and continues.)
"Watch me as I repeat it slowly."	(The teacher again raises the left hand and points with the index finger of the right hand.)
"d a d right thumb-space	
"a d d s space	(Again the teacher emphasizes by moving the right thumb in the air.)
"a l l right thumb-space.	(Then the teacher turns his head and points to the appropriate finger of the right hand.)
"Now we will try it together. If you are in doubt, watch me as you type dad adds all. Ready to type!	(The teacher repeats slowly as he points to the appropriate fingers.)

[1]If the keyboards are unlettered, there are several ways to direct the placement of the hands on the home keys. Students can be told, "Look at the second bank of keys closest to you and place the little finger of the left hand on the key to the far left of that second bank. Let the other three fingers fall naturally over the three adjacent keys. Leave the next two keys to the right uncovered and place the right index finger on the next key. Let the other three fingers fall onto the three adjacent keys. Notice that there is one uncovered key to the right of the little finger of the right hand."

Another way to do it is to draw circles on the board (ⓐⓢⓓⓕOOⓙⓚⓛⓢO) and to place your fingers on the proper keys as you give directions similar to those in the preceding paragraph. As soon as all hands are in position to type, erase the circles.

"d a d right thumb-space

"a d d s right thumb-space

"a l l space. Now we will try that once more together."

(And the teacher again demonstrates. Then the teacher allows the students to try it at their own rate a few times.)

"Type this at your own pace a few times. It is important that you keep your eyes on the textbook and look only at the word that you are typing. Begin."

(While the students practice, the teacher walks around the room and helps and encourages those who need assistance. Check to see that they are spacing with the right thumb.)

"Now we will learn to type the period after the word <u>all</u>. We are going to type:

a l l .

(The teacher raises one hand and then the other and points to the proper fingers; then he demonstrates at the typewriter on the demonstration stand as he tells the students exactly how to do it.)

"With the l finger, reach down to the period, which is located slightly to the right and one bank down. Keep the j and k fingers in position and stroke the period. The stroke is not finished until the follow-through is made and the finger is again positioned over the l key. Do not be concerned with the ; finger when the l finger is typing the period. Anchor the j finger, not the ; finger, when reaching for the period.

"Try it again:

a l l .

(If the students are using electric typewriters, it may be necessary to tell them to raise the k finger slightly so they won't accidentally depress the k key.)

"Space twice after a period; space with the thumb of the right hand—one, two.

"It is important that the finger reach directly to the center of the key. The stroke should be made directly in the center of the period key, not around the rim, but directly in the center. The j and k fingers should stay directly in the center of the j and k keys.

"Try it again:

a l l period space space

a l l period space space

"Now let's try the sentence with the period. Ready!

(The teacher goes through the sentence with the students. Then the students are given the opportunity to type on their own for perhaps 1 or 2 minutes. After that the teacher demonstrates how to make a capital D. It is a good idea to take this part slowly and to have the students do it in four steps.)

The teacher can say something like this: "On the count of one, extend the little finger of the right hand over the shift key. Keep the j-k-l fingers in position. Notice you have to extend the little finger.

"On the count of two, depress the shift key with the little finger of the right hand.

"On the count of three, stroke the D.

"On the count of four, return the little finger to its home base over the ; key. Then type: a d and space. Now let's type the capital D together.

"One, extend the little finger of the right hand over the shift key. Two, depress the shift key and hold it in that position. Three, stroke the D. Four, return the little finger of the right hand to the ; key.

"Let's try it again together. One, extend; two, depress; three, D; four, return to the ; key; a d space a d d s space a l l period space space.

"Next, capitalize Dad several times. Ready! (Omit the count.) Reach, depress, D, return, a d space.

"Try it on your own a few times.

"Now type the entire sentence. You will have approximately 1 minute. Begin!"

"Now we will try the second sentence. Watch as I point to the fingers again and try to remember these keys as long as you live. Ready!"

After the teacher goes through the sentence and points at the fingers once, the students can then type on their own. It is good to remind them that there should be two spaces after a period at the end of a sentence. Then the students can be given a minute or two to type the third sentence and a minute or two to type the fourth sentence, and so on, until the class ends.

The student should be reminded that he has typed a complete sentence during his first period (or first few minutes) of instruction and that this is the same pattern which occurs in business letters and in messages of various kinds.

The student should be given the feeling that he has accomplished something during that first class, as well as during all typewriting classes. He will be aware of his improvement from day to day because from the second day on he will have at least one basis for judging his progress. He will be timed daily, and he will know every time he figures the number of words he typed within a given time just how well he is progressing.

During the first few days the student will want to know a little more than his score. It could be discouraging to a beginner if his neighbor is typing 20 words a minute while he is typing only 5 words a minute. To give the student a reference point and a general basis for comparison, tell the class that 5 words a minute is average, 6 wam is above average, and 7 wam is superior for that first day of timings (second day of class). This will help to prevent anxiety and undue tension, since most students will do at least that well.

It is likely that almost the entire class will be able to type 25 strokes (5 standard words) within 60 seconds on the second day. Many will type much faster, but the idea is to make certain the slowest typist has a feeling of success in his early attempts. With a sufficient amount of overlearning on each lesson, the slowest learners can become good typists.

The teacher may wish to raise those averages by 1 word a minute every day for each of the next ten hours of practice in class.

Locating the Home Keys Without Looking

On the second day you may wish to have the students practice positioning the hands on the home keys without looking. The exercise may be repeated for several days to emphasize the importance of locating the home keys by touch whenever the typist throws a manual typewriter carriage or whenever he resumes his typing after an interruption.

Start by having them place their hands on the home row and then reach with the left hand as if to return the carriage. Now have them return the left hand to the home keys without looking. Then students should learn to check whether the left hand is properly repositioned on the home keys without looking at the keyboard.

The teacher can guide the student by saying, "Place your hands on the home row. Close your eyes. Contact the carriage-return lever with your left hand and return the left hand over the home keys. Without looking, converge the two index fingers to see whether there are two uncovered keys in the center. Return the index fingers to the home keys. Try it again.

"Watch me as I demonstrate. The left hand goes up and down with a circular motion. Fingers brace the index finger as contact is made with the carriage return lever. The left hand is repositioned over the home keys. This is done without looking away from the textbook.

"Now you try it. Up, strike, return; check the position of the fingers on the home keys without looking. Converge the two index fingers. Try it again. (Directions are repeated.)

"Now take a look at your hands on the home position. Notice that you are on the second bank of keys. There are two banks of keys above the home row. There are two uncovered keys in the center, and there is one uncovered key to the right of the little finger of the right hand. When you converge the two index fingers to cover the two uncovered keys in the center, you can sense the two fingers touching.

"Close your eyes; take both hands off the keyboard. Now feel the frame of the typewriter and then the space bar; go up one bank of keys and onto the second bank of keys. Position your fingers on the home row. Then extend the little finger of the right hand to the right and touch the uncovered key. Converge the two index fingers and touch the uncovered keys in the center. Try it by yourself a few times."

Some teachers may prefer to teach positioning of the hands in another way, namely, by telling the student to place the hands on the home position, fingers curved, and to let the wrists sag until the palms of the hands rest against the frame of the typewriter. The student is then told to remember the point of contact of the palms against the frame of the typewriter.

The student then practices placing his fingers directly on the home key by having the palms of the hands contact the frame of the typewriter, which positions the curved fingers on the second bank of keys. The student touches thumbs in the air and may also be taught to touch the uncovered keys on the home row in the manner described previously. Of course the student is told to raise his hands from the frame of the typewriter before he begins to type.

Overlearning and Variety

There are many ways to insure overlearning that will result in maximum retention and maximum positive transfer of learning. It is really a feature of the book that the drills have been constructed with the principle of overlearning in mind.

To insure a greater degree of overlearning, it is desirable to repeat the sentences many times and to maintain interest and effort at a high level. A few of the ways that the time interval can be varied and the task can be varied are:

1. To repeat the same sentence for two or three 1-minute writings and to have the student compute his score on the better or best timed writing.

2. To give a short writing in which the student types, let us say, the first eight sentences (as far as a horizontal line) and starts again from the beginning if he completes all eight sentences. The first two such writings may be for 1 minute, the next two writings for 2 minutes, etc.

3. To give longer writings in which the student is instructed to type the entire page and to start from the beginning again if he should complete the page before time is called.

Knowledge of Progress

On the second day of class the teacher may wish to give 1-minute writings and show the student how to figure his gross words a minute. Since every drill the student types has a word count, the student will have this means of measuring his progress daily.

A student is usually interested in setting a new record; and whenever he types one word a minute faster than he did on any previous timing, for him this is a new record. The main emphasis should be on what he can do today that he could not do yesterday or last week and not on what he can do in relation to the fastest typist in the class. No harm is likely to result, however, by giving the student a general idea of how he is doing in relation to the group average.

The teacher can also inform the student of his progress in terms of desirable and undesirable typewriting habits (techniques) that he is developing. The typescript is but one evidence of progress in the early stages of skill development. It is the all-important how (the techniques) that the teacher must observe.

What are the techniques the student employs? What specific desirable or undesirable habits are being developed? For example, the student who develops the bad habits of taking the entire hand away from its position over the home keys, looking for the shift key, depressing the shift key with the wrong finger, then looking for the next key to be typed may, according to this typescript, appear to have learned to type correctly; but the bad habits that he has developed need far more attention than his typescript.

Since the teacher of beginners is more concerned with the way they are typing than he is with what appears on paper, his time is best employed by observing the techniques that the students are using during the typewriting period and by guiding the students through demonstration and by verbal means in the process of proper habit formation.

One of the features of the textbook drills is that after the first day only one new key is introduced at a time; and while the student is typing the many sentences containing this new key, the teacher has many opportunities to view each student individually to see that desirable habits are being formed.

It is a waste of time and energy to labor over the papers during the first semester. In the very early stages most of the errors are accidental and incidental to the techniques being developed. However, the teacher may want to collect all papers at the end of each period and take a few minutes to get a general idea of how the class is doing. This will be relatively easy since the students will have been instructed to proofread their work and encircle the errors.

Figuring the Score Serves More Than One Purpose

While the primary purpose of figuring a score is to inform the student of his progress, another purpose is to give him a few seconds to relax. Short pauses after every second or third writing to figure the score are sufficient. If the score is figured after every writing, time is wasted counting rather than typing. Once the students understand the scheme used in figuring the typing rate, it will take just a glance to figure a score. Occasionally ask for a show of hands so that you can stay informed on the progress of the class: "How many typed 20 words a minute with no more than one error?"

Some teachers may prefer to ask for only one show of hands at the end of the period, in which case the student can be instructed to write his score in the margin every time it is figured so that he can report his best score for the day.

Figuring Words Typed

If a student types the same sentence repeatedly, he multiplies the number given under the Approximate Words column by the number of complete lines typed; then he counts the number of vertical markers up to the last word typed in the incomplete line and adds that to his total. If an additional three or four strokes (3/5 or 4/5 of a standard word) were typed, he adds one word to the total gross words; otherwise, he drops the fraction (1/5 or 2/5 of a standard word).

If the timed writing lasted more than 1 minute, total gross words are divided by the number of minutes to find the number of gross words typed a minute.

Cumulative Paragraph

When a series of sentences are typed as though they were arranged in paragraph form, the student uses the figure given in the Cumulative Paragraph column. To find his score, the student takes the figure next to the last complete line typed. He then counts the markers up to the last word typed on the incomplete line and adds that number to the total words taken from the previous line. A fraction of a standard word above 1/2 counts as one word; otherwise the fraction is dropped.

Some teachers may want their students to follow the copy line for line, especially if the students are beginners. Other teachers may want students to type these sentences in paragraph form. When a typist is sitting near several typewriters that are in operation, it is difficult to know which typewriter bell is ringing. When there is only one typewriter in operation, even in an otherwise noisy office, this is not a problem.

Responding to false cues, such as the ringing of someone else's bell, leads to unnecessary tension and is undesirable. Consequently, it is better to allow students to type line for line. Use of the margin release key can be taught later in the course. Furthermore, pondering over a particular rule for word division during a timed writing is neither the best way to learn word division nor the best way to spend the time that should be devoted to the development of rapid serial responses.

Several Cumulative-Paragraph Columns

The cumulative-paragraph word count is given in several columns to simplify finding the number of words typed when the teacher wishes to give short writings on different parts of the page and to give longer writings on the entire page. For example, on a page that has three groups of sentences divided by horizontal lines, the teacher may give three 1-minute writings on the first group of seven sentences, three 1-minute writings on the second group, and three writings on the third group. Then three 3-minute writings may be given on the entire page. The student can compare his score on his best 1-minute writing with his score on his best 3-minute writing. With the aid of three word counts, no time is wasted in finding scores.

Another variation of the above is to start with a 3-minute writing, followed by nine intensive 1-minute writings, and ending with another 3-minute writing, all on the same copy. The score on the last writing can then be compared with the score on the first writing to see whether there is improvement.

Encouragement

The student who will need a great deal of encouragement is the one who has poor coordination.

In order to encourage a class of beginners during the first few days that they are figuring their gross words a minute, ask them to raise their hands if they have grossed 5 words a minute or more. Then increase the number of gross words by one every day or so until a speed of about 15 words a minute is reached within ten class periods.

On the fourth day you can ask, "How many typed 7 words a minute? 9 words a minute? 11 words a minute?" Students may be told that 7 words is a good average, 9 words is above average, and 11 words is superior. Or—depending on the group, the length of typewriting periods, the amount of practice, etc.—one could have a less graduated scale: 7 words, average; 8 words, above average; and 9 words, superior.

To make them conscious of accuracy, ask, "How many typed with no more than one error? two errors?" Mention that, in general, when they make no more than one error a minute while they are learning, they are doing very well.

During the first few weeks it is probably better not to ask for the highest number of words typed. Some beginners will type 15 to 20 or more words a minute within a few days. Set a minimum number of words which approximately one-half to three-quarters of the class can attain and make your own classification of "very good," "above average," and "superior," because what these averages will be for each class depends on the number of minutes of typewriting a student has each day, as well as many other factors.

Some students who appear to get a slower start do, with encouragement in the first few weeks, make remarkable gains and become very good typists.

Introducing a New Key

Whenever a new key is introduced, a word containing that new letter may be chosen from the first sentence. The teacher demonstrates the proper way to stroke the new key and emphasizes the follow-through. The teacher gives brief instructions, gives the students an opportunity to imitate his typewriting motions, observes the students as they type a sentence containing the new key, and redirects their efforts by making the same points with the choice of different words.

The ideal stroke of each of the twenty-six letter keys differs in some way from every other stroke, yet the general principles one should keep in mind in developing these strokes are the same. When there are alternate ways of doing something, the teacher should encourage the better technique. The student also goes through a similar general procedure when he first initiates the reach to and the stroking of a new key.

When a new key is being introduced, the teacher can instruct the student to look at the exact location of the key on the keyboard. Next, the student should extend the appropriate finger over the center of the key and stroke the key with a pulling action toward the palm of the hand and return the finger to its home base or home-row position.

For example, the teacher can say: "We will now learn the exact location of the h in relation to the right index finger as we type the word has. Take a good look at the h key and extend the right index finger until it is over the center of the h, approximately 1/4 inch over the key, and start a pulling stroke that will follow a U-shaped path. The stroke will have been completed only when the finger has traveled back over the j. Do not move your right hand to the left. Do not let your fingers stop over the h or between the h and the j after you have typed the h. Your fingers should return to the j key and stay directly over the center of the j key.

"As you reach to the h key, notice its exact location in relation to the j. Try to make this register in your memory so that you will remember it for life.

"Look carefully at your fingers as we type the word has a few times. Now look at your textbook and try never to look back for that key."

The first lesson will perhaps require more energy, more explanation, and more demonstration than the presentation of any other lesson in which new keys are introduced. After the first two days you will find that you have more time during the timed writings and during the minutes devoted to review and tryouts to observe the students individually and to guide them individually with brief cues and clues. You will also have more time to assist a student when he has mechanical difficulty with his typewriter.

When the students enter the room, they should know exactly what to practice and should start immediately. Try to give them the opportunity daily to review for a few minutes whatever letter was typed the day before.

You can say, "You will have a 3-minute tryout period on page___. Try to type the entire page. (This is a good time to take attendance and to write and attach tags to typewriters in need of repair.)

Before the class enters the room, list three or four key words or pointers on the chalkboard, such as

Keep these things in mind as you type page__:

1. A sharp blow directed at the center of the key.
2. Eyes on the copy.
3. Wrists off the frame.
4. Fingers curved.

Vary the wording and/or list of checkup pointers from day to day.

1. Align the center of your body with the j key.
2. Fix your eyes on the word you are typing.
3. Make your stroke directly in the center of the key.
4. The stroke is completed only when the follow-through takes the finger back over its home base.

Occasionally vary the instructions slightly. For example, "Type each line until you have typed it twice without error. The two perfect lines do not have to be in succession. However if you make an error in a line, finish typing that line before you attempt to retype a perfect line."

A similar assignment of five perfect lines may be given if there is an out-of-class practice assignment or when a student has to do a makeup assignment after missing a class.

Special Drill

If the teacher observes that the students are not returning the little finger to the home key after pressing the shift key, he may wish to give the students a special drill in order to give them intensive practice. The teacher can tell the students to close their eyes and to type the following capitals as he calls them out—each followed by a semicolon and a space:

A; S; F; D; F; S; and so on.

All capitals called in succession should be typed with the same hand. Before introducing capitals typed by the opposite hand, the students should be alerted to that fact. The teacher who wants to find out whether students are confused and gives random capitals typed by one hand and then the other will, especially in the early stages, do just that—cause confusion. What is likely to result is both retroactive inhibition and negative transfer of learning.

The teacher can also make up his own drill for capitals typed with the right hand and have the students type a lowercase a after each capital letter.
For example:

La Ia Ha La Ka and so on.

Only those capitals that have been practiced previously in drills should be called out by the teacher. Drills such as these are not used to introduce capitals to students; but they are used only occasionally during the semester when the teacher wants to remind the students of correct technique and wants them to re-establish proper habits, such as returning the little finger to the home key. This drill and the ones designed to encourage a set toward speed on high-frequency words are about all of the special drills that are needed.

Constantly Switching to Different
Makes of Typewriters Retards Progress

It is a good idea to keep the student on the same typewriter or at least on the same make of typewriter for as long as possible. If a student is taking four semesters of typewriting, introduce him to the new machines in the last semester. Once he uses the new machine, allow him to practice on it a sufficient number of weeks to attain a fair degree of mastery.

If the student has the opportunity to practice outside of class, which it is hoped he will have, tell him not to go ahead of the class in the textbook. He can profit most by practicing the lesson covered that day in class.

Rhythm

Let the learner develop his own natural typewriting rhythm. There is no need to attempt to develop the unnatural metronomic rhythm in typewriting. In fact, as the typist reaches the higher speeds, it is likely to do more harm than good.

Some combinations the learner will type twice as fast as other combinations. This is so because of many factors, such as the physical makeup of the hand, the position of the keys on the typewriter, the sequence of letters typed, etc.

The typist can develop greater speed on such combinations as the and the word ending -ment than he can on saw or was. His natural typewriting rhythm, if it is of any consequence to label it, is closer to a rippling rhythm rather than a metronomic rhythm.

Recurring Errors by Advanced Typists

The way to develop control at the high speeds is to practice at high speeds. If errors are made on a particular word, the problem is not solved by slowing down to one-fourth of one's speed and painstakingly reaching for each stroke. This avoids the problem, but it does not improve one's skill.

As the typist advances in his skill, he should practice a particularly difficult word by itself a few times and also in the context of the word that precedes it and the word that follows it. As he types the three-word combination, the typist should be alert to exactly what happens to the timing of his strokes and other factors that cause the error. Then he should keep in mind the adjustment he has to make in order to perfect his coordination at the higher speeds. He can begin his practice at a speed at which he makes no error and gradually increase his speed.

Developing a Set Toward Speed

Occasionally when the teacher feels that the students should develop a set toward speed, a drill may be given in which the teacher paces the typists by calling for the carriage to be returned, let us say, every 8 seconds. The student sees the object as typing that sentence and only that sentence within the 8-second interval, which he usually feels he can do because it is for such a short interval of time.

While pacing typists in this way usually results in a greater effort toward speed, it also appears to disrupt the typing of other materials for a day or so. These carriage-return drills are beneficial and should be used occasionally.

It is suggested that the teacher choose a range of three suitable speeds for his particular class from the chart given below. For example, if an intermediate class is typing at about 45 words a minute, the teacher could select a sentence of 8 words in length and call "return" every 9 seconds for 1 minute. This sentence may be repeated for another minute.

Then the carriage return can be called every 8 seconds (60 wam) and then every 7 seconds (68 wam). Time is called at the end of every minute. If too few students can keep up the pace, the sentence may be repeated or a more suitable range of speeds chosen.

Introducing the Carriage-Return Drill

The carriage-return drill can be introduced in this way: "Today I am going to pace you as you type sentence No. 10. Every 7 seconds I will call the word 'return' (or 'throw' if students have manual typewriters). If you type the entire sentence each time before I call 'return,' you will be typing at the rate of 54 gross words a minute.

"Return your carriage on the call whether you have finished typing the sentence or not. If you finish typing the sentence before I call the word 'return,' wait until I give you the signal to return your carriage.

"Try to keep up. Ready, sentence No. 10, go!"

With some groups the teacher may wish to start carriage-return drills on the five sentences at the bottom of page 28. With other groups the teacher may wish to start as soon as the class reaches page 12 or page 13.

To time carriage-return drills accurately, it is desirable to have a stop watch on which one can easily read the 5-second intervals, 6-second intervals, etc.

WORDS A MINUTE IF INTERVAL IS FOR:

Words in Sentence	10 Sec.	9 Sec.	8 Sec.	7 Sec.	6 Sec.
*4	24	27	30	34	40
4½	27	30	34	38	45
5	30	33	38	43	50
5½	33	37	41	47	55
6	36	40	45	51	60
6½	39	43	49	55	65
7	42	47	53	62	70
7½	45	50	56	64	75
8	48	53	60	68	80
8½	51	57	64	72	85
9	54	60	68	77	90
9½	57	63	71	81	95
10	60	67	75	85	100
10½	63	70	79	89	105
11	66	73	83	94	110
11½	69	77	86	98	115

*If the sentence is 4 standard words in length, calling the carriage return every 10 seconds paces the typist at 24 words a minute.

Automatizing High-Frequency Combinations

Another way to develop a set for speed is to have the students type such word combinations as this is it or just one high-frequency word at a time, such as this. The teacher can mention to the students that he would like to hear them type the word this so that is sounds like one stroke. The teacher calls out the word this, pauses, calls it again, pauses, etc., gradually shortening the pause until the entire class types the word at a fast rate. The teacher mentions to the students, "You are to think only of how to get those four keys through the typebar guide as rapidly as you can."

The idea is to let them relax for a second before the word this is called out again. The stragglers will be quite evident the first few times that you call out the word. Mention that you heard four strokes, and not "one," if the word isn't being typed rapidly.

If manual typewriters are being used, the teacher may want to show the students how sluggishly a typebar returns to its resting place when a key is pushed and how rapidly a key bounces off the platten and returns when properly stroked in the center. Proper stroking can reduce substantially the number of times typebars jam even when the coordination is not perfect.

Then the students may type this is it and pause momentarily after each repetition. The teacher selects appropriate words and phrases from the sentences students will work on after this drill is over. For example, students could profit greatly by typing the word the, which is the trigraph of highest frequency as well as the word of highest frequency in the English language. There is no great benefit to be derived from typing a word that has little value, such as syzygy, but there can be a great deal of benefit derived from typing and for the repeatedly after all of these letters have been introduced in the drills.

Number and Symbol Drills

The numbers and symbols are introduced on pages 67 through 85. The numbers are introduced as they would appear in their most common forms in business communications. Numbers are introduced in context, and the sentences illustrate the rules for the expression of numbers.

There is variety in the number and symbol drills, for there are three types of sentences: (1) those that introduce a number and give intensive practice on that number, (2) those that are suitable for 1-minute timed writings, and (3) those that are intended to help the student concentrate on the idea and to relax as he types slightly below his best speed.

The teacher may wish to comment briefly on the rules illustrated by these sentences. The first sentence is "There is an error in line 8 on page 8." The teacher may tell the student that line and page are in lowercase because they are minor divisions and that the line number and the page number are always expressed in figures.

The teacher can demonstrate how the k finger is merely straightened to make the reach to the 8 key if the fingers are properly curved. There should be no forward movement of the hand; only the finger makes the reach. The follow-through that takes the finger back to the k key should be emphasized.

In the fourth sentence the teacher can point out that dimensions are expressed in figures and that the word by, not the x, should be used in a business letter. Students can be given

two or three 1-minute writings on each sentence. Accuracy in typing numbers should be stressed. When students type sentences containing numbers and symbols, ask for a show of hands to find out whether they typed a sentence for a minute with no more than one error.

Direct reaches should be made to the numbers. Do not use indirect associations to teach the numbers, such as the pipe-organ method in which the learner associates the order of the keys from left to right with the numerical sequence of the numbers or "we-23" drills; such practices are contrary to good psychology.

Timed Writings

It is recommended that during the week before a marking period ends, five days be devoted to the giving of timed writings. These writings give the student many opportunities to measure the skill he has developed thus far and are an excellent learning experience. Use one or, at most, two timed-writing copies during a class period so that the student will get the repetitive practice that will help him develop the serial responses necessary to type at higher rates of speed.

If a one-page test is used, the student can start on a different paragraph each time he takes another timed writing during that class period. If two tests or two pages are used, then the student can start on alternate copy each time he takes another timed writing. In this latter case, though, if he completes one page before time is called, he types from the other page.

It is important not to give writings on copy that contains letters or symbols that have not been practiced in class drills. If all letters have not been introduced and it is mandatory that a grade be given, then use the tests in the textbook. The textbook tests, which emphasize a particular letter, are usually far more difficult than ordinary typewriting tests.

Characteristics of Tests Furnished by Publisher

Suitable copy for timed writings, especially for beginners, should contain a vocabulary that is common to business, should be set up in typescript, should be punctuated properly, should have common speech patterns, and should have words spelled correctly. Avoid tests that have such outdated spellings as air mail, per cent, worth while, and week end. Avoid tests that follow a style of punctuation that is inconsistent with a business style. Some published tests have words of such low frequency that the typist rarely encounters them in a practical typewriting situation. Some tests cause a typist to pause because of the peculiar phrasing; some have incorrect end-of-line divisions; some are so printed that they test the eyesight rather than the ability to type

Tests can and should be good learning devices that also indicate progress or performance at a particular time. On the other hand, tests with incorrect spellings, incorrect punctuation, incorrect end-of-line divisions, etc., are poor learning devices.

Midsemester and End-of-Semester Writings

The teacher may wish to give 3-minute writings at midsemester and 5-minute writings at the end of the semester. The same five or ten test copies can be used in both weeks of timings. Then progress can be compared.

When a two-week interval takes place between the original testing and the retesting on the same copy, the copy itself does not give the student an advantage. There seems to be little or no carry-over effect when approximately two weeks elapse between the use of the copy initially and again during the retesting.

The teacher can give the student a chance to encircle his errors as soon as time is called, and the student can figure his net words a minute. The teacher then collects the good timed writings immediately. A writing may be considered "good" if it contains no more than one error for each minute of the test. The students cross out the bad writings, and these are collected at the end of the period. A student who wishes his test to be rechecked and counted for a grade must pass his test in as soon as he has corrected it, that is, before the next timed writing is given.

If a student's midsemester or final speed grade will consist of his five highest writings, once he has passed in five acceptable writings, he should be told to pass in only those writings that are better than his previous fifth best.

Typing the Copy Line for Line

Have the student, especially the beginner, follow the copy line for line. The student should be encouraged to keep his eyes on the copy. If he hears ringing bells from neighboring typewriters, he is likely to respond by looking up to see whether it is his carriage that is nearing the end of the line. When the student gets in the habit of looking away from the copy for that reason, he finds it easy to look away from the copy for other reasons. The problem becomes nonexistent by having the student, especially the beginner, follow the copy line for line.

Moreover, it is easier to correct timed writings that have been typed line for line. Missing lines are easily detected by placing the test copy next to the student's copy. Lines that are too short or too long are obvious.

Testing Before a Marking Period

If it is necessary for a teacher to give a midsemester grade, then perhaps the grade can consist of the average of grades received (1) on a simple centering test, (2) on a simple tabulation test, and (3) on the average net words a minute typed on several timed writings, perhaps the average of three 3-minute timed writings.

The end-of-semester grade can be the average of three test grades, namely, the average of grades received on a more advanced tabulation problem, on a simple letter test, and on the average of three 5-minute timed writings.

Grading

There are several ways of weighting the speed and the production grades. One way is to count the speed grade as one-half and to count the average of the tabulation and centering tests as one-half of the midsemester grade.

Similarly, one-half of the final grade for the first semester can consist of a speed grade. The tabulation and letter tests can count as the remaining one-half of that final grade.

Another way to do it is to count each of the tests as one-third of the midsemester grade and each of the tests as one-third of the final grade for the semester.

Grading Scheme A

Midsemester

85 centering 1/3
78 tabulation 1/3
87 speed 1/3
3)250
83 midsemester average

Grading Scheme B

Midsemester

85 centering 1/4
78 tabulation 1/4
87 speed 1/4
87 speed 1/4
4)337
84 midsemester average

Announcing the Test

Announce the test a few days before it is to be given. Tell the students what supplies they will need. Students should write their names in longhand on all sheets and may crease all sheets before coming to class. On the day of the test no time will be wasted before starting the test.

Practice Test

You may wish to give a short practice test a day or two before the test for a grade. Motivation is high, and it is a good time to reteach the fine points when there is heightened receptivity.

Tests May Be Given Early or Late in Semester

The simpler centering and tabulation tests are numbered 1 through 6 and may be given anytime after the students have practiced page 19 and have been taught to center and to tabulate.

Progress Tests A through D are more advanced and include tests on centering, tabulation, and a letter. These advanced tests, some of which call for the typing of numbers, may be given anytime after page 79 has been practiced.

Tailor Your Tests to Suit Your Class

You may prefer to make up similar tests for your students. Change the directions to suit your class. Make up your own grading scheme. If you do not know what to expect from your group, find the average raw score on the typing test and have that equal the average grade in your school then scale the grades above and below that point.

Correcting centering and tabulation tests is time-consuming. When you announce a test, you may wish to inform the students that there will be three parts to the test but only one part will be counted for a grade. Tell them that it is important that they do their best on all parts, since they will not know ahead of time which part will count.

Time each part of the test individually. When only one part of the test counts, it is probably fairer to count the second or third part, since some students may have changed to a different typewriter for the test because of a faulty backspacer, for example.

Checking Horizontal and Vertical Placement

The basis for considering a line correctly centered horizontally for testing purposes is given on page 96 of the textbook. If two or more letters jut out, that line is marked wrong.

You must decide whether to give full credit for a problem that is one line off center vertically. (Some believe it is more desirable to have a problem placed higher—about ½ inch higher—than the exact center of the sheet rather than having it placed exactly in the center. Nevertheless, the preference for an above-center placement should not enter into consideration in a beginner's centering or tabulation test.)

ERIC 179

PROBLEMS 1-6
Page 86

TAKE STATE TESTS
THIS FALL
TESTS HELD
AT
FLAGG HALL

FALL SALE
Desks
Desk Sets

She sees
that he left
at least
half
the desk sets.

She shall state
the date
that
she held
the health test.

He shall
take the test
at
the steel desk.

He held
that the state
shall set
the legal age.

PROBLEMS 1-2
Page 88

ALL ATHLETES
TITLE FIGHT
AT
FLAGG
FIELD
STATE TITLE AT STAKE

FIFTH FALL SALE
East Hall
GIFT IDEAS
Dishes
Desk Sets
Health Aids
Hats
DETAILS AT DESK

PROBLEMS 3-4
Page 88

DIET DIGEST
Eight Health Ideas
Detailed Health Diets
Feast
As Fat Fades

STATE TITLE FIGHT
AT
FLAGG FIELD
HAL TASKA
FIGHTS
AL LITTLE
TELL ALL LADIES
GIFTS AT GATE

PROBLEMS 5-6
Page 88

FIFTH FALL SALE
HELD AT FLAGG HALL
STILL DELIGHTS ALL
ALL DADS GET GIFTS

ALL DELEGATES
Ada Hall
States Her Ideas
Assist All Aged
State Legal Aid
State Health Tests

PROBLEM 7-8
Page 88

ALL AGED

State Legal Aid

State Health Tests

FILE AT DESK

STATE TITLE

AT STAKE

EIGHT FIGHTS LISTED

DATE SET

GET DETAILS AT DESK

PROBLEMS 1-2
Page 90

FIRST | TEST

set	first
test	date
fail	test
fall	flat
delighted	if
all	get
it	right

FALL GIFT SALE

desk	dishes
desk sets	sheets
files	health aids
headsets	health sets
flags	hats

PROBLEM 3
Page 90

TEST LIST

little	life	file
side	filled	steel
⇨ itself	like	sheets
fee	estate	dead
feet	head	ahead
stated	tell	date

PROBLEM 4
Page 90

FIRST GIFT LIST

desk	glasses
desk files	dishes
desk sets	salad plates
steel safes	fitted sheets
⇨ steel files	health aids
headsets	health sets
flags	felt hats
saddles	ties
skis	shirts
slide files	field glasses

PROBLEM 5
Page 90

LAST TEST LIST

agree	referred	rather
dealer	desires	red
street	regards	letters
filled	tire	larger
reader	series	started
rather	share	rest
greater	fair	dear
read	assist	ageless

PROBLEMS 1-8
Page 97

FILING SYSTEMS
Alphabetic
Numeric
Geographic
Subject

Law I
Economics
Principles of Accounting
Economic Geography
English Composition I

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Accumulated Depreciation
Mortgage Notes Payable

TELEPHONE TECHNIQUES
Answer Promptly
Use Pleasant Greeting
Identify Office and Yourself
Take Notes
Let Called Hang Up First

TERMS OF LOGIC
Premise
Vagueness
Categorical Proposition
Impromptu Definition
Syllogism
Generalization
Scientific Method

PROBLEMS 1-4
Part 2, Page 97

FILING SYSTEMS

ALPHABETIC

NUMERIC

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LAW I

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FORMS OF WRITTEN COMMUNICATION

LETTER

TELEGRAM

INTEROFFICE MEMORANDUM

CURRENT ASSETS

TEMPORARY INVESTMENTS

RETAINED EARNINGS

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TELEPHONE TECHNIQUES

ANSWER PROMPTLY

USE PLEASANT GREETING

⇨ IDENTIFY OFFICE AND YOURSELF

TAKE NOTES

LET CALLED HANG UP FIRST

TERMS OF LOGIC

PREMISE

VAGUENESS

CATEGORICAL PROPOSITION

IMPROMPTU DEFINITION

SYLLOGISM

GENERALIZATION

SCIENTIFIC METHOD

PROBLEMS 1-2
Page 99

EXERCISE
TO
IMPROVE
Muscle Tone
Muscular Strength
Muscular Endurance
Flexibility
Efficiency of Your Heart

ANNUAL
SUMMER CLEARANCE
SALE
SUITS
COATS
DRESSES
ENDS JULY 31

PROBLEMS 3-4
Page 99

SCHEDULE OF EVENTS
at
WHITMARSH COLLEGE
on the
third of May
nineteen hundred and seventy
at the
EMERSON FIELDHOUSE
Rome, Georgia

ANNOUNCING
FOREVER LASTED SEVEN YEARS
Available
At All Bookstores

PROBLEMS 5-6
Page 99

Brown College
Lecture Committee
presents
DR. JOHN MAYER
Thursday, May 1
STUDENT ACTIVITIES AUDITORIUM
Admission Free
PUBLIC INVITED

NEW ENGLAND STATES

Maine

New Hampshire

Vermont

Massachusetts

Connecticut

Rhode Island

PROBLEMS 7-8
Page 99

AUTOMATIC PROGRAMMING

COBOL

ALGOL

FORTRAN

DYNAMO

ELECTRONIC DATA PROCESSING

AUXILIARY EQUIPMENT

Collator

Accounting Machine

Summary Punch

Interpreter

ELECTRONIC DATA PROCESSING

RECORDING METHODS

Key Punching

Prepunching

Mark Sensing

Port-A-Punch

For the Luxury Vacation

of a Lifetime

Come to

THE INCOMPARABLE

RIO ISLAND

Enjoy Free Golf Daily

TABULATION

is	illustrated
in	this
exercise	with
two	columns
and	with
six	spaces
between	columns

HOODS WORN BY FACULTIES

Arts and Letters	White
Accountancy	Drab
Economics	Copper
Law	Purple
Pedagogy	Light Blue
Philosophy	Blue
Theology	Scarlet

PROBLEMS 3-4
Page 102

FIRMS EMPLOYING YATES GRADUATES

Aetna Life Insurance	Hartford
American Airlines	Boston
Dun & Bradstreet	New York
General Electric	Providence
Bell Telephone	Greenville

CENTERED TITLE

one	margin	stop
and	two	tabs
have	been	set
in	this	tabulation

PROBLEMS 5-6
Page 103

TABULATION

set	the	left
margin	stop	and
two	tab	stops
before	you	begin
to	tabulate	this
short	tabulation	exercise

CENTERED TABLE

some	tables	are	read
across	one	line	at
a	time	and	other
tables	are	read	from
top	to	bottom	one
column	at	a	time

TYPES OF BONDS

called	prior line	registered
coupon	sinking fund	debenture
serial	first mortgage	convertible
income	general mortgage	municipal
extended	consolidated mortgage	collateral

TABULATION

considers	running	together
the	longest	word
in	each	column
plus	six	spaces
between	columns	and
centers	that	run-on

THE UNITED STATES OF AMERICA

Alabama	Louisiana	Ohio
Alaska	Maine	Oklahoma
Arizona	Maryland	Oregon
Arkansas	Massachusetts	Pennsylvania
California	Michigan	Rhode Island
Colorado	Minnesota	South Carolina
Connecticut	Mississippi	South Dakota
Delaware	Missouri	Tennessee
Florida	Montana	Texas
Georgia	Nebraska	Utah
Hawaii	Nevada	Vermont
Idaho	New Hampshire	Virginia
Illinois	New Jersey	Washington
Indiana	New Mexico	West Virginia
Iowa	New York	Wisconsin
Kansas	North Carolina	Wyoming
Kentucky	North Dakota	

PROBLEM 10
Page 104

PERSISTENTLY MISSPELLED WORDS

exaggerated	laboratory	incidentally
recommendation	indispensable	privilege
specialty	attorneys	occurrence
benefited	superintendent	sizable
⇨ occasionally	occur	exorbitant
extraordinary	occurred	quantities
fulfill	typing	all right
publicly	facsimiles	disappointment
noticeably	transferable	accidentally
pamphlets	accommodate	separately

PROBLEM 11
Page 104

TERMS OF LOGIC

Premise	Hypothesis
Vagueness	Categorical Proposition
⇨ Ambiguity	Impromptu Definition
Deduction	Scientific Method
Syllogism	Generalization
Induction	Equivocation

PROBLEM 12
Page 104

LARGEST CITIES IN THE UNITED STATES

(According to Population in 1960)

Rank	City	State
1	New York	New York
2	Chicago	Illinois
3	Los Angeles	California
4	Philadelphia	Pennsylvania
5	Detroit	Michigan
6	Baltimore	Maryland
7	Houston	Texas
8	Cleveland	Ohio

PROBLEM 13
Page 104

TWO-COLUMN TABLE

Countries	Capitals
United States	Washington
Canada	Ottawa
Mexico	Mexico City
France	Paris
Great Britain	London
Italy	Rome
Turkey	Ankara
Switzerland	Berne
Spain	Madrid

PROBLEMS 1-2
Page 106

ANNOUNCING

An Exclusive

Prepublication Offer

THE SEARCH FOR WISDOM

by

FAY NASH

VACATION

IN

BEAUTIFUL HAWAII

FOUR WEEKS

for

less than

a thousand dollars

PROBLEMS 3-4
Page 106

WHITMARSH

STUDENT DIRECTORY

AVAILABLE IN BOOKSTORE

EVENING SCHOOL

CLASSES CANCELED

MARCH 11

Parking Ban

in

City of Boston

R. C. WEST COMPANY

A N N U A L P I C N I C

C H O P M I S T H I L L

B U S E S L E A V E

AT NOON

FROM

C R O W N H O T E L

WHITMARSH

S P R I N G F O R M A L

March

Twenty-first

GRAND BALLROOM

A M B A S S A D O R H O T E L

A N N O U N C I N G

An Exclusive

Prepublication Offer

T H E S E A R C H F O R W I S D O M

by

F A Y N A S H

PROBLEM 2
Part 2, Page 106

VACATION

IN

BEAUTIFUL HAWAII

FOUR WEEKS

for

less than

a thousand dollars

PROBLEM 3
Part 2, Page 106

WHITMARSH

STUDENT DIRECTORY

AVAILABLE IN BOOKSTORE

PROBLEM 4
Part 3, Page 106

EVENING SCHOOL

CLASSES CANCELED

MARCH 11

Parking Ban

in

City of Boston

PROBLEM 5
Part 3, Page 106

R. C. WEST COMPANY

ANNUAL PICNIC

CHOPMIST HILL

BUSES LEAVE

AT NOON

FROM

CROWN HOTEL

PROBLEM 6
Part 3, Page 106

WHITMARSH

S P R I N G F O R M A L

March

Twenty-first

GRAND BALLROOM

A M B A S S A D O R H O T E L

PROBLEM 1
Page 109

TO: Mr. Paul Burke, Office Manager
Engineering Building, Fifth Floor

May 25, 19--

FROM: Mrs. Ester Pearson
Administration Office

SUBJECT: Interoffice or Intraorganization Memos

When a message is sent from one member of a company or organization to another member within that company or organization, it is usually set up in the form of a memorandum. The memorandum can be thought of as another letter style, although there are many possible variations in arrangement to suit individual situations.

Memorandums, then, are most frequently used for intraorganization correspondence, that is, correspondence between departments or between persons within an organization. The correspondents may be located in the same building or may be thousands of miles away in branch offices, branch factories, etc., of that organization.

While most memos are intraorganization and are frequently referred to as interoffice memos, occasionally the memo style is used for correspondence outside the organization.

E. P.

you

PROBLEM 2
Page 109

TO: Dr. Arthur Parks
Director, Health Service

May 26, 19--

FROM: Mrs. Charles Watson
Correspondence Department

SUBJECT: Interoffice or Intraorganization Memos

In general, a memo does not have the attractive appearance of some of the well-known letter styles, and it is usually a cheaper and efficient way of communicating. Frequently there is no need for a printed, engraved, or typewritten heading or letterhead.

One can type a memo without being concerned whether the message is long, medium, or short, since a 6-inch line or a 1-inch margin may be used regardless of length. Few machine adjustments are needed. More can be added to the message after the typist has started typing, for there is no resetting of margins required to accommodate longer messages. The typist can type the message as it is dictated without having to be concerned about resetting margins if the message happens to be longer than initially anticipated.

Time and space are saved by not typing a salutation and complimentary close. Frequently it is necessary to type only the person's name in the TO line. In a large company a person's business title or the name of the department or the number of the floor on which his office is located may be added in the TO section. When a company has many branch offices, the name of the office is typed after the person's name.

C. W.

you

PROBLEM 3
Page 109

TO: Mr. Ralph Freeman
New York Office

May 27, 19--

FROM: Mrs. Helen Taylor
Vice-President

SUBJECT: Interoffice or Intraorganization Memos

Here are some of the features of the form illustrated by this memo: The SUBJECT line is typed on line 7. The left margin stop was set in 12 spaces from the left edge of the paper; the right margin stop was set in 12 spaces from the right edge of the paper. Whether elite or pica type is used, it is quite all right to use 12 spaces for the margins of a memo. One generalization to observe is that no margin of a memo should be less than 1 inch.

The TO line appears in a most convenient place for the messenger to read. The DATE line is in a good position for the file clerk to read. The position of the DATE line gives the memo a squarish appearance. Since the date is backspaced from the right margin, it is a visual guide that may be used in judging carriage returns in order to keep the right margin more even, especially when decisions have to be made with regard to end-of-line word divisions. Placing the date in the upper-right position saves space for two additional message lines, which may be of some value when memos are typed on half sheets.

Only one tab has to be set for all indentions. That tab is set 2 spaces after the colon following the SUBJECT line. When the DATE line is the only line to the right, it is not necessary to type the word DATE. This means that when the TO line is long, it is less likely to crowd into the word DATE.

H. T.

you

PROBLEM 4
Page 109

TO: Mr. Sam Hunt, Sales Department
Mr. Leo Bond, Art Department
Mr. Dan Lee, Credit Department

May 28, 19--

FROM: Mr. Russell Burke

SUBJECT: Interoffice or Intraorganization Memos

When the decision for the choice of setup is left up to you, the style illustrated by this memo is a good one to follow. Your teacher may require you to follow a specific style for testing purposes, and your future employer may have certain preferences based on the needs of particular situations.

Sometimes the four introductory lines of a memo appear blocked at the left margin; sometimes the DATE line is at the top; sometimes the DATE line appears between the FROM line and the SUBJECT line.

Leave 2 blank lines between the SUBJECT line and the message, although some prefer to leave 3 blank lines. The paragraphs in this memo are indented in alignment with the information in the introductory lines. Some prefer to indent the paragraphs 5 spaces; some prefer no paragraph indentions.

If the FROM line has the name of a department and no dictator's name, the dictator may wish to have his name typed, or he may wish to sign his name. Ordinarily the dictator's initials are typed to the right of the center. Some dictators may wish to write their initials, in which case the typist's initials are typed 4 spaces below the message at the left margin.

An enclosure notation is placed under the typist's initials; carbon copy notations appear under the typist's initials or under the enclosure notation if there is one. Enclosures should be securely attached to the memo; and if it is not possible to attach the enclosures, place the memo and the enclosures in an envelope.

In general, memos should be typed on full sheets. Half sheets may get lost in a file folder or make a file messy; full sheets are usually easier to handle. Little is saved by using half sheets or odd-sized sheets. Occasionally when memos are to be posted on crowded bulletin boards, space may be saved by the use of half sheets.

Some offices have printed stationery for memos. The words TO, FROM, DATE, and SUBJECT are printed. Some offices provide printed headings bearing the name of the originating office for use whenever they write memos to branch offices. Some offices have the writer's name printed on the FROM line. Colored stationery is sometimes used for memos going to branch offices, whereas plain paper is used for memos to be delivered by messenger.

R. B.

you

LETTER 1
Page 126

TYPEWRITING IMPROVEMENT ASSOCIATION

Founded in 1952

New York, New York 10027

April 2, 19--

Mr. John Price
5 Case Road
Bath, Maine 04530

Dear John

There are more than one hundred words in this letter. All the letters that you will type this week will have at least one hundred words. No letter will have more than two hundred words.

Set your left margin at the middle line on the left side of the chart. Set your right margin two or three spaces after the middle line on the right side of the chart. Type today's date and Mr. Price's name four lines below the date.

The words in this letter were chosen with care. Most of the words were taken from a special list and are the best that you can practice. Notice that there is not one comma in the body of the letter.

Yours very truly

Robert J. Porter
President

you

NATIONAL INSURANCE COMPANY

348 South Street

Canton, Ohio 44701

April 2, 19--

Mr. Harry Price
3 Case Road
Bath, Maine 04530

Dear Harry

Subject: Commas Before For, And, Nor, But, Or, Yet (FANBOY)

Most of the words in this letter were taken from a special list, and a few others were chosen to complete thoughts. There are more than one hundred words in this letter, but there are fewer than two hundred words.

Every one of these sentences has a comma in it, but you need to know only one rule in order to put the commas in the right place. There are two ideas in each sentence, and one of the six words given in the FANBOY list joins the first idea to the second. It will be well for you to overlearn this rule, for you will need to apply it in most of the letters that you will type.

You may wish to type from this copy, or you may wish to type from the notes that you will take.

Yours very truly

Robert J. Porter
President

you

AMERICAN SHIPPING COMPANY

38 High Avenue

Gary, Indiana 46401

April 3, 19--

Mr. John Lowe
22 High Road
Bath, Maine 04530

Dear John

Subject: Commas Before For, And, Nor, But, Or, Yet (FANBOY)

There is a need to review the typing of the comma before words that join two ideas, and that is the reason for this letter. One of the FANBOY words joins the first clause to the second, and the same rule applies to all of the sentences in this letter. You could place a period at the end of the first clause, and you would have a complete thought. The second clause is also a complete thought, but a joining word in the FANBOY list tells us that we should place a comma before the word that joins both clauses.

It is well for you to master this rule, for the rule that you will be taught for the semicolon is based on this comma rule.

There is not one comma in the first main clause in any of the above sentences, nor is there a comma in the second main clause of any sentence in this letter.

Yours very truly

Robert J. Porter
President

you

LETTER 4
Page 128

THE WRIGHT COMPANY

1358 Central Street

Tampa, Florida 69102

April 4, 19--

Miss Mae Reed
11 High Road
Dallas, Texas 75221

Dear Mae:

Subject: Commas Before Nor and Yet (FANBOY)

This is not the first letter in this series, nor is this the last letter that you will have to help you type commas in the right place.

None of the sentences in the body of this letter has less than two ideas in it, nor is any one of these sentences to be typed without a comma in it.

This letter does not have enough words in it to be typed in the large box on the chart, nor is it to be typed in the small box.

Most of the words in this letter were taken from a special list, yet not all of them are in that list.

You will not see a second clause that begins with yet or nor very often, yet it is a good idea for you to know when these words need to have commas before them.

Yours very truly,

Robert J. Porter
President

you

LETTER 5
Page 128

HOME FINANCE COMPANY

17 Sunset Avenue

Omaha, Nebraska 69102

April 4, 19--

Mr. John Little
22 West Avenue
Ogden, Utah 84401

Dear John:

Subject: Commas in a Series

Our class will type copies of letters that have one, two, or three hundred words in them. These are known as short, medium, and long letters. Small, medium, and large boxes that appear on a chart are guides for the person who types one of these letters. Copies of these charts appear in typing books, may be drawn by you, or may be obtained free of charge by writing to some firms.

Put a comma before the last and, or, or nor in listed words. A comma is placed before the last and, or, or nor to make sure that the meaning is clear. Follow this closed style when you type legal papers, business letters, and official papers.

Take this letter in your notebook as I read it to you, type two copies, and then read your typed copy to see that you made no comma errors.

Yours very truly,

Robert J. Porter
President

you

NATIONAL LIFE INSURANCE

436 Hill Avenue

Miami, Florida 33101

April 6, 19--

Miss Jane Young
8 Autumn Place
Ames, Iowa 50010

Dear Jane:

Subject: Commas in Sentences Beginning with As, If, and When

If you read many business letters, you will notice that the writers often express a thought by starting with as, if, or when. As a matter of fact, one of these three words is at the beginning of most clauses and other expressions that come before a main clause. When you type a sentence that begins with as, if, or when, place a comma before the main clause.

When an as, if, or when clause follows the main clause, do not separate the clauses with a comma. As you can see by comparing this sentence with the opening sentence of this letter, no comma separates the if clause from the main clause if the main clause comes before the if clause.

If you would like to type letters in less time from your notes, learn these three cue words and be ready to type the comma when you see any one of them at the beginning of a sentence.

Yours very truly,

Robert J. Porter
President

you

When the student types this letter, he may ask about the division of the word sentence, which is the last word in the letter. The general guide is to avoid dividing the last word in any paragraph, especially in the last paragraph of any communication, such as a letter, memorandum, report, etc. Since this may necessitate widening or narrowing the margins and retyping the page in order to avoid the end-of-paragraph division, the typist should consider the relative importance of the communication, as well as the cost involved in retyping it.

JONES-DOW, INC.

185 Main Street

Dallas, Texas 75221

April 16, 19--

Filene's
1414 Abbe's Lane
Fall River, Massachusetts 02722

Gentlemen:

Subject: Apostrophe--Singular Possessives

There was a day's delay in mailing this year's report. The bank's figures did not agree with our Company's balance for the month of May. Our Company's Accounting Department worked until ten o'clock last Friday to find the error.

It was John's guess that a bookkeeper's handwriting caused the error. Monday's entries were made by one bookkeeper. That bookkeeper's seven looked like a four. Posting was another bookkeeper's job.

Thursday's and Friday's overtime work cost our Company about a thousand dollars. Mr. Near's suggestion, which was received in this morning's mail, is that we buy a machine that will make the bookkeeper's work easier and more accurate.

Please let me know whether Johnson's ad in this morning's Mirror has been called to our Purchasing Manager's attention. I think that Johnson's prices are lower than the prices quoted by Harry Gray's firm.

Yours very truly,

Robert J. Porter
President

you

LETTER 8
Page 130

THE NATIONAL PAPER COMPANY

957 Park Street

Newark, New Jersey 07102

April 18, 19--

Men's Faculty Club
22 Servicemen's Drive
Alton, Illinois 62002

Gentlemen:

Subject: Apostrophe--Possessive of Plural Words

The women's club asked two of the men's clubs whether they were interested in helping to supervise children's games. We received prompt replies from both men's clubs that they were happy that we had asked them to take part in this undertaking. There were one hundred men's signatures added to the list of women's signatures.

All those who will supervise children's games this summer will be notified at least one week before they are to work. Every Monday a list of the women's names will be posted on the bulletin board, and a list of the men's names will be posted every Friday. The women's club has several books on children's games. These books will be sent to the two men's clubs on Friday.

The only "workmen's compensation" is the pleasure one gets from seeing children enjoy themselves in a constructive way.

Yours very truly,

Robert J. Porter
President

you

LETTER 9
Page 130

THE OHIO REALTY COMPANY

1586 Webster Street

Akron, Ohio 44309

July 17, 19--

Mr. Roy Moore
88 Johnson Avenue
Boston, Massachusetts 02109

Dear Mr. Moore:

Subject: Titles of Company Officials in Apposition

Mr. Lee Holmes, our local agent, wrote to Mr. Ray Place, our vice-president, last week and told him that Mr. Paul Greene, our sales manager, and Mr. Dan Day, our general manager, are planning to meet Mr. Kenneth Summers, our New England representative, at a luncheon in Maine on July 10.

On July 15 Mr. George Reed, our chief accountant, and Mr. Lou Little, our chief auditor, will meet Mr. Leo Young, president of Manpower Company, and Mr. John Summers, personnel director of Jones Personnel Agency, at the Crown Hotel in Providence.

I gave your letter to Mr. Harry James, our office manager, on June 10. He has asked Mr. James Winters, our resident, and Mr. Bill Teller, our executive secretary, and Mr. Ray Lee, one of our branch managers, to answer your questionnaire.

Very truly yours,

Robert J. Porter
President

you

INTERNATIONAL PRINTERS

148 Appleton Road

Boston, Massachusetts 22301

July 28, 19--.

Mr. Ray W. Miles, District Manager,
98 Park Avenue,
Ames, Iowa 50010.

Dear Mr. Miles:

When most business letters were written in longhand, the indented form was popular. There was no additional effort involved in indenting, and the setup made it easier for the reader to recognize the paragraph beginnings and the parts of the letter.

Since the indented style is usually accompanied by closed punctuation, it does take more of the typist's time than any other style. It should be pointed out, however, that mixed punctuation may be used with the indented style.

This style projects the image of an older, a more conservative, and perhaps a more dignified and well-established institution.

The indented style, as well as the closed punctuation, is hardly ever used today.

Sincerely yours,

INTERNATIONAL PRINTERS,

Allen P. Davis,
President.

APD:TYP

GENERAL PRODUCTS, INC.

598 Twelfth Avenue

Utica, New York 13503

April 17, 19--.

Professor John Lane,
1584 Webster Street,
Boston, Massachusetts 02109.

Dear Professor Lane:

Subject: Apostrophe--Plural Possessives.

There were two days' delay in mailing our companies' reports. Three banks' figures did not agree with our companies' balances for the month of May. Our companies' accountants worked overtime to find the errors.

Our accountants found that two bookkeepers' poor handwriting caused the errors. Two new girls were hired to do some of our regular bookkeepers' work while they went on a two weeks' vacation. When Mary and Alice returned from their vacations, they had to post two weeks' entries. Some of the beginners' figures were misleading. Ten hours' overtime work cost us about a thousand dollars.

Mr. Near tells me that we can expect at least twenty years' service from the machine that he showed us last week, and it will make our bookkeepers' work easier and more accurate. His company will send a man to give two weeks' instruction without charge, and there is a five years' guarantee on all parts. None of our companies is more than a two hours' drive from a National Business Machines office.

Yours very truly,

Robert J. Porter,
President.

you

CHECK 95
Page 160

Endorsement of check by payee acknowledges receipt in full for items noted hereon, and it is agreed that it shall not be otherwise applied.

FICTITIOUS FEDERAL SAVINGS AND LOAN ASSOCIATION
Providence, Rhode Island 02906

Date	Description	Account No.	Net Amount
8/19/--	Partial withdrawal Mr. Paul M. Dodge 232 Twelfth Street New York, New York 10016		188 82

Detach before depositing

FICTITIOUS FEDERAL SAVINGS AND LOAN ASSOCIATION
Providence, Rhode Island 02906

No. 95 57-12 / 116

August 19, 19--

PAY TO THE ORDER OF Mr. Paul M. Dodge--- $188.82

One Hundred Eighty-eight and 82/100*** DOLLARS

THIRD NATIONAL BANK
Sacramento, California

Robert S. Andrews
Secretary-Treasurer

⑆0115⑈0012⑆

CHECKS 1-3
Page 160

No. 1 $225.86
Date July 29 19--
To David N. Littlefield TV & Appliance Store
For television set

Balance	850.95
Amt. Deposited Date 7/15/--	300.00
Total	1150.95
Amt. This Check	225.86
Balance	925.09

FOLSOM CORPORATION

No. 1 136

July 29, 19-- 57-1 / 115

PAY TO THE ORDER OF David N. Littlefield --- $225.86

Two Hundred Twenty-five and no/100 *** DOLLARS

THIRD NATIONAL BANK
Sacramento, California

James J. Parks AUTH. SIG.

⑆0115⑈000 1⑆

No. 2 $20.00
Date August 19 19--
To Registry of Motor Vehicles
For No. 115516G102970

Balance	925.09
Amt. Deposited Date Total	
Amt. This Check	20.00
Balance	905.09

FOLSOM CORPORATION

No. 2 137

August 19, 19-- 57-1 / 115

PAY TO THE ORDER OF Registry of Motor Vehicles --- $20.00

Twenty and no/100 *** DOLLARS

THIRD NATIONAL BANK
Sacramento, California

James J. Parks AUTH. SIG.

⑆0115⑈000 1⑆

No. 3 $75.75
Date August 19 19--
To Robert A. Gray
For office supplies

Balance	905.09
Amt. Deposited Date Total	
Amt. This Check	75.75
Balance	829.34

FOLSOM CORPORATION

No. 3 138

August 19, 19-- 57-1 / 115

PAY TO THE ORDER OF Robert A. Gray --- $75.75

Seventy-five and 75/100 *** DOLLARS

THIRD NATIONAL BANK
Sacramento, California

James J. Parks AUTH. SIG.

⑆0115⑈000 1⑆

PROBLEM 1
Page 171

Original – Accompanies shipment
Duplicate – Accounting Department (pink)
Triplicate – Salesman's Copy (green)
Quadruplicate – File Copy (yellow)

FOR TYPEWRITER USE

Standard Snap

OUR FIRM NAME PRINTED HERE
Our Address
Our Phone

INVOICE NO. 521

INVOICE DATE 7/18/--

SOLD TO
Supply Officer
Construction Battalion Center
Davisville, Rhode Island 02852

SHIPPED TO
Fields Point
Building 3

Our Order No.	Your Order No.	Salesman	Terms	Date Shipped	Shipped Via
511	N62573/ 697A/AOB	Clark	2/10, n/30	7/19/--	Our Truck

QUANTITY	STOCK NUMBER/DESCRIPTION	PRICE	AMOUNT
1	Sprocket shaft		95.75
2	Seal kits (inner)	43.82	87.64
2	Spring assemblies	1.75	3.50
2	Boots	1.50	3.00
6	Locks	.15	.90
	TOTAL AMOUNT DUE		193.79

ORIGINAL

PROBLEM 2
Page 171

Original – Accompanies shipment
Duplicate – Accounting Department (pink)
Triplicate – Salesman's Copy (green)
Quadruplicate – File Copy (yellow)

FOR TYPEWRITER USE

Standard Snap

OUR FIRM NAME PRINTED HERE
Our Address
Our Phone

INVOICE NO. 549

INVOICE DATE 9/1/--

SOLD TO
Essex Chemical Corporation
525 South Bend Road
Burlington, New Jersey 08016

SHIPPED TO
Essex Chemical Corporation
34 Railroad Avenue
Maywood, New Jersey 07607

Our Order No.	Your Order No.	Salesman	Terms	Date Shipped	Shipped Via
13498	423	Tate	n/30	8/31/--	Arrow Transport

QUANTITY	STOCK NUMBER/DESCRIPTION	PRICE	AMOUNT
7 tons	Sulphuric acid, 66 degrees	23.20	162.40
	3% SALES TAX		4.87
	TOTAL AMOUNT DUE		167.27

ORIGINAL

PROBLEM 3
Page 171

Original – Accompanies shipment
Duplicate – Accounting Department (pink)
Triplicate – Salesman's Copy (green)
Quadruplicate – File Copy (yellow)

FOR TYPEWRITER USE

Standard Snap

OUR FIRM NAME PRINTED HERE
Our Address
Our Phone

INVOICE NO. 13499

INVOICE DATE 8/31/--

SOLD TO
Rhee Chemical, Inc.
639 Belvidere Boulevard
Somerville
Massachusetts 02143

SHIPPED TO
Rhee Chemical, Inc.
Metal Division
3 Outlook Avenue
Lynn, Massachusetts 01903

Our Order No.	Your Order No.	Salesman	Terms	Date Shipped	Shipped Via
13499	424	Tate	2/10, n/30	8/31/--	Your Truck

QUANTITY	STOCK NUMBER/DESCRIPTION	PRICE	AMOUNT
30 Carboys	Sulphuric Acid 98%	27.00	810.00
	Carboy Charge	15.00	450.00
	SUBTOTAL		1,260.00
	5% SALES & USE TAX		40.50
	TOTAL AMOUNT DUE		1,300.50

ORIGINAL

PROBLEM 4
Page 171

Original – Accompanies shipment
Duplicate – Accounting Department (pink)
Triplicate – Salesman's Copy (green)
Quadruplicate – File Copy (yellow)

FOR TYPEWRITER USE

Standard Snap

OUR FIRM NAME PRINTED HERE
Our Address
Our Phone

INVOICE NO. 6499

INVOICE DATE 8/29/--

SOLD TO
Standard Dixie Stores
1498 Sunrise Boulevard
Orlando, Florida 32802

SHIPPED TO Same

Our Order No.	Your Order No.	Salesman	Terms	Date Shipped	Shipped Via
6499	342	Towson	1/10, n/30	8/29/--	All States Corp.

QUANTITY	STOCK NUMBER/DESCRIPTION	PRICE	AMOUNT
1 Carton	24/4 oz. Allford Baking Powder	2.40	2.40
3 "	48/10 oz. " " "	4.50	13.50
6 "	6/5 lb. " " "	5.70	34.20
	(Some follow the practice of leaving 1 blank line between different categories of items.)		
7 "	6/2 lb. Country Club Baking Powder	3.40	23.80
2 "	4/10 lb. " " " "	7.10	14.20
	SUBTOTAL		88.10
	3% SALES TAX		2.64
	TOTAL AMOUNT DUE		90.74

ORIGINAL

PROGRESS TEST 1

CENTERING

(Do not write on this sheet.)

Instructions: You will need four half sheets, two full sheets, and a typewriting eraser. You may crease the sheets in the center. Write your name at the top of each sheet.

When you complete Part 1, turn it face down on your desk; then start typing Part 2, then Part 3, etc. Neat erasures will not be counted as errors. Move your carriage to the far left or right whenever you erase.

Your grade will be based on the number of correct exercises completed. For example, one complete and correct exercise may equal D, two complete and correct exercises may equal C, three complete and correct exercises may equal B, and four complete and correct exercises may equal A. You may start each exercise over as many times as you wish. Type on one side of the paper only. Each problem must be on a separate sheet.

Two points will be deducted for each incorrectly typed word. If you have more than five uncorrected errors on any problem, you will receive no credit for that problem. There is to be no borrowing once the test begins. You will have approximately thirty minutes.

Part 1 Center vertically on a half sheet. Center each line horizontally. Double-space the entire problem.

Her father
agrees
as regards this.

Part 2 Center vertically on a half sheet. Center each line horizontally. Single-space the entire problem.

The girl
heard
her father
read
the first
three letters.

Part 3 Center vertically on a half sheet. Center each line horizontally. Double-space the entire problem.

The state
held
a sale.
State
the date
the state held
the sale
at
Earl Hall.

Part 4 Center vertically on a full sheet. Center each line horizontally. Double-space the entire problem.

State
the date
that she left
the state.
She
sees that
Ella has set
the date.
He shall tell Ed
as he takes these sets.

PROGRESS TEST 2

CENTERING

(Repeat the instructions that appear on Progress Test 1.)

Part 1 Center vertically on a half sheet. Center each line horizontally. Double-space the entire problem.

The third street
is
as large
as the first.

Part 2 Center vertically on a half sheet. Center each line horizontally. Single-space the entire problem.

Her father
regrets
that the rate
is
rather dear.

Part 3 Center vertically on a half sheet. Center each line horizontally. Double-space the entire problem.

Three girls
read
the letter
after
he read
the address.
I
read it
last.

Part 4 Center vertically on a full sheet. Center each line horizontally. Double-space the entire problem.

This is his
last
flight.
Kit said
that this is
the
last kit.
Kit did
this list last.
This is his list.

PROGRESS TEST 3

CENTERING

(Repeat the instructions that appear on Progress Test 1 except for one paragraph. Substitute the following for the third paragraph:

Your grade will be based on the number of correct exercises completed. For example, two complete and correct exercises may equal D, three complete and correct exercises may equal C, four complete and correct exercises may equal B, and five complete and correct exercises may equal A. You may start each exercise over as many times as you wish. Type on one side of the paper only. Each problem must be on a separate sheet.)

Part 1 Center vertically on a half sheet. Center each line horizontally. Double-space the entire problem.

I
heard
the girl
read
the first
letter.

Part 2 Center vertically on a half sheet. Center each line horizontally. Single-space the entire problem.

Her father
reads
a
great deal.
He read
the
third letter.

Part 3 Center vertically on a half sheet. Center each line horizontally. Double-space the entire problem.

The
state held
a
sale at
Earl Hall.
State
the date
the state
held the sale.

Part 4 Center vertically on a full sheet. Center each line horizontally. Double-space the entire problem.

Her
address
is here.
It is the
third street.
The girl heard
the third
address.
Her father
read the date.

Part 5 Center vertically on a full sheet. Center each line horizontally. Triple-space the entire problem.

The girl heard that
her father read
the address
after he
read
the
letters.
Date these
tests; take these.
He feels that she left
at least half
the test.

PROGRESS TEST 4

CENTERING

(Repeat the instructions that appear on Progress Test 1 except for one paragraph. Substitute the following for the third paragraph:

Your grade will be based on the number of correct exercises completed. For example, two complete and correct exercises may equal D, three complete and correct exercises may equal C, four complete and correct exercises may equal B, and five complete and correct exercises may equal A. You may start each exercise over as many times as you wish. Type on one side of the paper only. Each problem must be on a separate sheet.)

Part 1 Center vertically on a half sheet. Center each line horizontally. Double-space the entire problem.

Taska
had that
last fall.
This is
his
list.

Part 2 Center vertically on a half sheet. Center each line horizontally. Single-space the entire problem.

This is
the
first task.
I
shall
add these.

Part 3 Center vertically on a half sheet. Center each line horizontally. Double-space the entire problem.

Three
girls
read the
letter
last.
I
read the
address
after he read
it.

Part 4 Center vertically on a full sheet. Center each line horizontally. Double-space the entire problem.

Is
that girl first?
The girl
at the far
right
is first. That
first girl
is right.

Part 5 Center vertically on a full sheet. Center each line horizontally. Triple-space the entire problem.

The
girl
heard
the first
address; her
father heard the
third address at three.
Her father heard that
the third street is
as large as
the first
street.

PROGRESS TEST 5

TABULATION

(Repeat the instructions that appear on Progress Test 1.)

Part 1 Test on Two-Column Table. Center the following table on a half sheet. Leave six spaces between columns. Single-space except after the heading.

FIRST LIST

high	state
fill	if
idea	his
heart	I
large	take
age	has

Part 2 Test on Three-Column Table. Center the following table on a half sheet. Leave six spaces between columns. Single-space.

health	said	relate
itself	had	rather
degree	as	self
three	that	till
little	it	straight

Part 3 Test on Three-Column Table. Center the following table on a half sheet. Leave six spaces between columns. Double-space except after the heading.

THIRD LIST

is	last	leather
Alaska	silk	health
he	sail	itself
detail	this	feather
are	like	straight
disease	dark	address
the	hair	degree

Part 4 Test on Five-Column Table. Center the following table on a full sheet. Leave six spaces between columns. Double-space except after the heading.

LAST LIST

relate	great	idea	health	itself
till	as	degree	that	sir
Dallas	light	straight	rather	sight
address	leather	it	are	disease
is	has	little	letters	fill
still	I	father	he	take
feather	state	age	dress	if
had	agree	heart	sail	either
three	his	said	least	her

PROGRESS TEST 6

TABULATION

(Repeat the instructions that appear on Progress Test 1.)

Part 1 Test on Two-Column Table. Center the following table on a half sheet. Leave six spaces between columns. Single-space except after the heading.

FIRST LIST

health	relate
itself	rather
degree	self
three	till
little	straight

Part 2 Test on Three-Column Table. Center the following table on a half sheet. Leave six spaces between columns. Single-space.

high	father	state
fill	either	if
idea	least	his
heart	light	I
large	eight	take
age	there	has

Part 3 Test on Three-Column Table. Center the following table on a half sheet. Leave six spaces between columns. Double-space except after the heading.

THIRD LIST

I	air	star
if	thread	tree
his	red	rail
has	feather	held
age	sir	sell
as	herself	less
it	her	late
had	Dallas	feet

Part 4 Test on Five-Column Table. Center the following table on a full sheet. Leave six spaces between columns. Double-space except after the heading.

LAST LIST

degree	the	these	last	itself
letters	is	state	age	fill
health	are	least	like	either
relate	it	agree	his	said
address	air	little	if	had
straight	as	still	that	this
rather	has	dress	till	eight
disease	he	light	idea	silk
leather	her	large	high	father
Alaska	at	great	I	three

PROGRESS TEST A

(Do not write on this sheet.)

Instructions: You will need at least six half sheets--two for each part of the test. Write your name at the top of each half sheet. If you complete the exercise, hand it in to your teacher; then type the exercise again from this test copy on a half sheet. Do this until you hear the signal to stop. No erasing.

Part 1 (_ minutes). Center each of the following problems vertically on a half sheet. Center each line horizontally. Capitalize as shown. Single-space. Do not type the numbers in parentheses; they indicate the number of blank lines that should follow each typed line.

```
COLLEGES (3)
Barrington
Bryant
Salve Regina
Pembroke
Providence
Rhode Island (2)
Brown University
University of Rhode Island
```

```
TWENTIETH CENTURY (2)
  Airplane Flight
    1903 (2)
      Nuclear Chain Reaction
        1942 (2)
          Earth Satellite
            1957
```

Part 2 (_ minutes). Center each of the following problems vertically on a half sheet. Center each line horizontally. Capitalize as shown. Single-space. Do not type the numbers in parentheses; they indicate the number of blank lines that should follow each typed line.

```
PROBLEM ONE (3)
HOLIDAYS (2)
ARMISTICE DAY
November 11 (1)
CHRISTMAS
December 25 (1)
MEMORIAL DAY
May 30
```

```
PROBLEM TWO (2)
HOLIDAYS (1)
  COLUMBUS DAY
    October 12 (1)
  THANKSGIVING
    November (1)
  INDEPENDENCE DAY
    July 4
```

Part 3 (_ minutes). Center each of the following problems vertically on a half sheet. Center each line horizontally. Spread-center the lines shown in all capitals. Double-space. Do not type the numbers in parentheses; they indicate the number of extra blank lines that should follow each typed line.

```
LIBRARIES (2)
FOX POINT BRANCH
Wickenden Street (1)
PROVIDENCE PUBLIC
Empire Street (1)
ROCHAMBEAU
Hope Street
```

```
COMPETENCIES (2)
        Economic
          Social
        Personal
          Family
       Political
```

PROGRESS TEST B

(Do not write on this sheet.)

Instructions: You will need four half sheets and two full sheets. You may crease the sheets in the center. Write your name at the top of each sheet. If you complete the exercise, hand it in to your teacher; then type the exercise again from this test copy on another sheet. Do this until you hear the signal to stop. No erasing. If you make errors, you will score higher if you continue on the same sheet rather than starting on a new sheet. Only one part of the test will be graded; do your best on each part.

Part 1 Test on Two-Column Tables (_ minutes). Center each of the following tables on a full sheet. Leave six spaces between columns. Double-space except after the subtitle.

MODERN COLOR CODE
(USED TO DISTINGUISH FACULTIES)

ARTS AND LETTERS	WHITE
COMMERCE AND ACCOUNTANCY	DRAB
LAW	PURPLE
LIBRARY SCIENCE	LEMON
PEDAGOGY	LIGHT BLUE
PHILOSOPHY	BLUE
SCIENCE	GOLDEN YELLOW

AMERICAN INTERCOLLEGIATE CODE
(VELVET TRIMMING INDICATES FACULTY)

ECONOMICS	COPPER
HUMANITIES	WHITE
ORATORY	SILVER GRAY
PEDAGOGY	LIGHT BLUE
PHARMACY	OLIVE GREEN
PUBLIC ADMINISTRATION	DRAB
THEOLOGY	SCARLET

Part 2 Test on Three-Column Tables (_ minutes). Center each of the following tables on a half sheet. Leave six spaces between columns. Double-space except after the title.

1957 SOVIET SATELLITES

Comparison	First	Second
Weight	184 pounds	1,120 pounds
Altitude	560 miles	923 miles
Speed	18,000 mph	17,840 mph
Circuit time	96.2 minutes	103.7 minutes
Launched	October 4	November 3

PERCENT OF DICTATORS

Writer's Speed	Can Take	Cannot Take
130	98	2
120	95	5
110	85	15
100	75	25
90	60	40
80	40	60

Part 3 Test on Five-Column Tables (_ minutes). Center each of the following tables on a half sheet. Leave six spaces between columns. Double-space except after the title.

EDUCATIONAL TELEVISION

	Series	Time	Station	Channel
Daily	Sunrise Semester	6:00	WHDH	5
Saturday	David Susskind	9:00	WGBH	2
Sunday	Face the Nation	11:30	WPRI	12
Sunday	Meet the Press	1:00	WJAR	10

EDUCATIONAL TELEVISION

	Series	Time	Station	Channel
Daily	Sign-On Seminar	6:15	WBZ	4
Daily	TV Classroom	6:25	WJAR	10
Sunday	The 20th Century	6:00	WPRI	12
Sunday	Creative Person	9:00	WGBH	2
Tuesday	Mathematics	6:00	WGBH	2

PROGRESS TEST C

(Do not write on this sheet.)

Instructions: You will need four half sheets and two full sheets. You may crease the sheets in the center. Write your name at the top of each sheet. If you complete the exercise on the left, turn it face down on your desk; then type the exercise on the right on another sheet. Do this until you hear the signal to stop. No erasing. If you make errors, you will score higher if you continue on the same sheet rather than starting on a new sheet. Only one part of the test will be graded; do your best on each part.

Part 1 Test on Two-Column Tables (_ minutes). Center each of the following tables on a full sheet. Leave six spaces between columns. Double-space except after the title.

CHAPTER TITLES OF THE SYNTOPICON

CUSTOM AND CONVENTION	QUALITY
GOOD AND EVIL	REASONING
LIFE AND DEATH	RELATION
MEMORY AND IMAGINATION	RELIGION
NECESSITY AND CONTINGENCY	REVOLUTION
PLEASURE AND PAIN	TEMPERANCE

MEN'S DORMITORIES

Hall	Street
Barber	Cooke
Comery	Waterman
Gardner	Young Orchard
New	Charles Field
Parks	Cooke
Scott	Angell

Part 2 Test on Three-Column Tables (_ minutes). Center each of the following tables on a half sheet. Leave six spaces between columns. Double-space except after the title.

TRAIT RATING CHART

Adaptability	Courage	Desire for Improvement
Alertness	Courtesy	Executive Ability
Appreciation	Foresight	Dependability
Common Sense	Efficiency	Gratitude
Cooperation	Enthusiasm	Initiative

THE GREAT IDEAS

Angel	Chance	Form
Animal	Change	Habit
Art	Courage	Honor
Beauty	Desire	Idea
Being	Duty	Law
Cause	Fate	Order

Part 3 Test on Four-Column Tables (_ minutes). Center each of the following tables on a half sheet. Leave six spaces between columns. Double-space except after the title.

CHAPTER TITLES OF THE SYNTOPICON

Aristocracy	Definition	Element	Experience
Astronomy	Democracy	Emotion	Family
Citizen	Dialectic	Eternity	God
Constitution	Education	Evolution	Government

TRAIT RATING CHART

L-O	P-R	S	T-W
Loyalty	Patience	Self-control	Tact
Memory	Poise	Self-judgment	Thoroughness
Morality	Punctuality	Sense of Humor	Thrift
Neatness	Resourcefulness	Sociability	Unselfishness
Open-mindedness	Responsibility	Sympathy	Willingness

PROGRESS TEST D

(Do not write on this sheet.)

Instructions: You will need at least one half sheet, two full sheets, a typewriting eraser, and a letter-placement chart. You may crease the half sheets in the center.

Move your carriage to the far left or right whenever you erase. Neat erasures will not be counted as errors. There is to be no borrowing once the test begins. Start over as many times as you wish; however, budget your time so that you will complete a good copy of each of the three parts of this test within approximately thirty minutes. Raised capitals are errors.

Part 1--Centering. Center vertically on a half sheet. Center each line horizontally. Capitalize as shown. Double-space the entire problem.

MOTIVATION
Needs
Goals
Level of Aspiration
Personality
Set
Reward and Punishment
Interests and Attitudes

Value: 20 points
-2 for each typing error
-2 for each line off center
More than 3 errors: -20 points

Part 2--Tabulation. Tabulate this problem on a full sheet. Leave six spaces between columns. Double-space except after the title. Center vertically.

WOMEN'S DORMITORIES

Hall	Located
Allan	Young Orchard Avenue
Bryant	Hope Street
Carroll	Young Orchard Avenue
Curtis	Charles Field Street
Eldridge	Charles Field Street
Governor Dyer	Power Street
Harriet	Charles Field Street
Rita Hoey	Charles Field Street
Salisbury	Young Orchard Avenue
Stowell	Young Orchard Avenue

Value: 30 points
-2 for each typing error
-3 for vertical centering
-5 for horizontal centering
More than 4 errors: -30 points

Letter--Value: 50 points
-2 for each typing error
-4 for vertical centering
-5 for horizontal centering
More than 6 errors: -50 points

Part 3--Letter. Type this letter in the extreme block style for Mr. Dwight James, President of James College. Type his name and title below the complimentary close. The letter is to be mailed to Mr. Robert Lynn, Secretary, Rae High School Student Council, Hollywood, Florida 33020. There are 121 standard words in the body of the letter. No letterhead is required.

Dear Mr. Lynn: Anyone's work may improve through practice. No one's work can improve without it. To save time in learning a skill, seek someone else's guidance. It is not a matter of seeking just anybody's advice, for guidance may be bad as well as good.

Part of that guidance lies in the teacher's ability to do the task in such a way that it will help the learner see the goal. As a learner, try to imitate your teacher's techniques. Another part of the teacher's job is to teach the learner the ways and means by which to guide his own learning.

Both teacher and learner gain by asking each other's opinion. Very truly yours,

VT 011 143
Timed Writing, No. 1-7.

Programs for Achievement in Reading, Inc., Providence, R.I.
MF AVAILABLE IN VT-ERIC SET.
Programs for Achievement in Reading, Inc., Abbott Park Place, Providence, Rhode Island 02903 (no charge).
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DESCRIPTORS - *CLASSROOM MATERIALS; *TYPEWRITING; *TYPISTS; *OFFICE OCCUPATIONS EDUCATION; INSTRUCTIONAL MATERIALS; BUSINESS EDUCATION; BUSINESS SKILLS; *TESTS

ABSTRACT - These timed writings were prepared as classroom materials to be used in teaching beginning and advanced typewriting as part of a set that includes a student text (VT 011 145) and a teacher's manual (VT 011 142), both in this issue, and a workbook of blank forms, available from the source listed above. (JS)

VT 011 143

ED0 45856

(1)
8p*

TIMED WRITING, NO. 1 - 7

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VT011143

MARGINS:
PICA--7 and 77
elite--16 and 86

TIMED WRITING NO. 1

C1

MOTIVATION THROUGH KNOWLEDGE OF PROGRESS

	Words
Many years ago I played sports all year round. At times it was	13
fun to learn the skills one needs to play the game, and there were	26
times when it was hard work. The test of all our drill work came on	40
the day or night of a game. In one sport there were as many as two	54
hundred fans for each man who was in the game. Most of the fans	67
cheered most of the time. We heard their loud praise when we played	80
well, and they told us to forget our errors. They were with us	93
whether we won or lost, for they knew we were doing all we could to	107
play well and to learn to play better.	115
Today we are learning a new skill. There is no large crowd of	127
fans to cheer us on. In fact, our coach has to teach one or two	140
hundred learners a year. He cannot take the place of all those fans.	154
He works in every way known to him to try to give you the will to	168
learn and to keep on trying from day to day.	177
Your coach knows that it is good for you to know whether or not	190
you are learning well. There are no cheers from the crowd when you do	204
well; no crowd sees you as you learn this skill. Your coach tries to	218
make your progress known to you by giving you a basis for judging your	232
work. He wants to help you set goals so that you will know what you	246
are aiming to do. For this reason he wants to help you set one goal	260
that you can strive to reach each day and a goal that you can try to	273
reach by the end of the course.	280
If your work is timed and you are taught how to find your score,	293
you have a way of telling whether or not you are learning well. If	307
you know that you can do something on this day that you could not do a	321
few days ago, it will tend to spur you on to try to do something	334
tomorrow that you cannot do today.	341

1 2 3 4 5 6 7 8 9 10 11 12 13 14

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MARGINS: PICA--7 and 77
elite--16 and 86

TIMED WRITING NO. 2

TYPING—A MODERN TOOL OF LITERACY

Words

The young man and the young woman who take part in the world of 13
business today know that typed thoughts and typed labels are a needed 27
part of almost all important business undertakings. These young 40
people also find that typed thoughts and typed labels can be of great 54
use to them in their homes as well as outside of their homes. 66
Let us follow the path taken last weekend by a recently married 79
couple, Ray and Mary Green, as they took care of their personal 92
affairs so that we can see what part typing played in some of their 106
activities. At about eight in the morning they walked to a corner 119
drugstore on one of the main streets of the city and chose their 132
breakfasts from a menu that was typed on Friday afternoon. After 145
breakfast they walked to the drug counter. The man who waited on 158
them placed their prescription next to the typewriter and typed a 172
label for the bottle and one card for the files in case this couple 185
wishes to ask for the same drug at some future date. Ray paid for 199
the drug with his weekly paycheck, which bears his typewritten name. 213
Ray and Mary then walked to a nearby college library, and Ray 225
proofread the term paper Mary had typed for him last night. Ray has 239
been attending classes on Saturdays so that he will be ready for a 252
promotion. He believes, as the founders of his firm believed, that 266
the future belongs to those who prepare for it. 276
Mary made use of the time she spent in the library by studying 288
for a test from her typewritten lecture notes. Mary is now taking 302
subjects that she has always wanted to take but could not, because 315
the rigid courses of study offered at the high schools she attended in 329
the past did not allow courses of her own choosing. In fact, typing 343
is one of the courses Mary chose to take at the college three years 357
ago, and she has found many uses for her typing skill since that time. 371

1 2 3 4 5 6 7 8 9 10 11 12 13 14

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MARGINS:
PICA--7 and 77
elite--16 and 86

TIMED WRITING NO. 3

TYPING—A MODERN TOOL OF LITERACY
(Continued)

	Words	Writings 2 & 3
On their way to class they read the typewritten notices on the	13	384
bulletin boards. In his first class of the day, Ray noticed that his	27	398
professor referred to a set of typewritten lecture notes. Mary was	40	411
glad to see that her test was in typescript.	49	420
On the way home from class they stopped in to pay a doctor's	62	433
bill, and they noticed that the doctor's secretary was typing the	75	446
bills that were to be sent out at the end of the month. The secre-	88	459
tary told Ray that the doctor was not in but that he had asked her to	102	473
give Ray a list of the foods he was to avoid eating as well as	115	486
suggestions that should help his condition. The doctor had to repeat	129	500
these routine directions so many times in the past that he decided to	143	514
have a few hundred copies run off from one typewritten master copy.	157	527
When they arrived home, Mary typed a weekly letter to her folks;	170	541
and she made one carbon copy for the home file. She then typed a few	184	555
letters to her friends in California and looked up their addresses in	198	569
a typed card file. This small card file has the names and addresses	212	582
of all the people to whom Ray and Mary are likely to write during the	226	596
year. Ray and Mary started the card file when they sent out their	239	610
wedding invitations, and they use it every year to send out cards at	253	623
Christmas time and on other special occasions. Then Mary typed a new	267	637
recipe on a card and filed it in another small box. She then went to	281	651
the large filing cabinet and placed these cards where she will be	294	665
able to find them quickly and easily whenever she needs them. The	307	678
typewritten headings on the folders make filing a simple task.	320	690

1 2 3 4 5 6 7 8 9 10 11 12 13

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MARGINS:
PICA--7 and 77
elite--16 and 86

TIMED WRITING NO. 4

HOW TO GET THINGS DONE

	Words
Few of us stop to think how large a part of our lives is made up	13
of small things. The way we do the small things shows in a clear way	27
what we shall do and say and how we shall act when we face the big	40
things in life. No one can all at once change the way he thinks and	54
acts and works. What he does now is based in large part on what he	68
has done in the past. If all through his life he has worked with	81
care, then he need not fear how he will act when he takes up a new	94
kind of work. He will face that new work with a sure sense that he	108
can do what he is asked to do in the way he is asked to do it.	121
What a man is now is just the sum of what he has been in the	133
past. Each act, each thought, each word we say and hear, each scene	147
we look at leaves its mark in some way on our minds. Most of those	160
things, of course, soon pass out of mind, and we pay no heed to them.	174
At the same time those who know how the mind works know, too, that	188
what we hear and see and say and do leaves its mark deep down in our	202
lives. We may not know that it is there, but some day it may be a	215
sight or a sound or a word or an act of the past that comes to the	228
front of our minds and pops out when we least look for it.	240

1 2 3 4 5 6 7 8 9 10 11 12 13

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MARGINS:
PICA--7 and 77
elite--16 and 86

TIMED WRITING NO. 5

HOW TO GET THINGS DONE
(Continued)

Words

Now, this fact that we are a part of all that we have seen and 13
heard and done in the past has its good side. If we had to think of 26
each small act that we are called on to do each day, we would have no 40
time or strength left to deal with what we face now. Let us say that 54
each day we would have to stop to think how to comb our hair or lace 68
our shoes or put on our clothes or do all the things that should call 82
for no thought at all. We would take up so much time with those 95
things that all else would have to go by the board. Of course, we 109
take these things as they come; they are a part of us, and we do not 122
stop to think of them at all. Our minds are thus freed for what lies 136
in front of us right now. We have learned to do these small things 150
with no fuss or waste of time; hence we just do them and get them out 164
of the way so that we can go on to face the new facts with which we 178
now have to deal. 181

You have heard some say that they have no time for this or that 194
and that they have so much to do all the time that their hours are 208
filled to the brim. If you could find out how they spend their time, 222
you would learn that they waste much of it on things they should have 236
learned to do in a way that calls for no thought at all. They find it 250
hard to make up their minds. They fuss and they fume; they go here, 264
and they go there. They do not seem to know what a waste it is not to 278
get done with one thing and then take up the next. They have four or 292
five things on deck all the time; and when they come to the end of the 306
day, they find that the things they wished and hoped to do have not 320
been done at all. 323

1 2 3 4 5 6 7 8 9 10 11 12 13 14

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MARGINS:
PICA--5 and 79
elite--14 and 88

TIMED WRITING NO. 6

One of our young and great orchestra leaders was asked how he was able to accomplish so much when he was so beset by major problems and poor working conditions. He answered by quoting a world-famous jazz musician who was asked how he became outstanding. The jazz musician told him, "Man, you're only as great as the obstacles you overcome."

Words

That is what learning is, namely, the overcoming of obstacles. One 14
of the essential conditions of learning is that there be an obstacle. In 28
other words, when there is no obstacle to overcome, no learning can take 43
place. If you were to examine all theories of learning, this is one of 57
the three conditions on which there is complete agreement. So remember 72
well that if you ask someone to remove the obstacle, you are asking him to 87
remove the possibility of learning. 94

There are some people who think that this would be a better world to 108
live in if there were no obstacles. It is probably closer to the truth to 123
say that life is not possible without problems. These same people also 137
think that if it is impossible to remove an obstacle in life, at least it 152
may be possible to go around it and avoid the situation completely. 166

Imagine a track meet at which all of the participants in the high 179
jump walk under the bar or run to one side of a pole. Or suppose that all 194
of the participants complained that the bar was too high for them and sup- 209
pose they continued to complain until the bar was lowered to one foot or 224
less so that all of them could then walk over it. There is little or no 238
skill involved in walking over a bar that is on the ground. Just as the 253
bar is the obstacle which requires that a skill be developed so that one 268
can jump over it at higher and higher heights, so is the number of words 282
to be typed in a minute the obstacle to be overcome in developing type- 297
writing skill. 300

1 2 3 4 5 6 7 8 9 10 11 12 13 14

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MARGINS:
PICA--5 and 79
elite--14 and 88

TIMED WRITING NO. 7

1 2 3 4 5 6 7 8 9 10 11 12 13 14

	Words
A good runner does not say that a mile is too long and ask that the	14
course be made shorter so that he can run it in less than four minutes;	28
rather he asks more of himself so that he can run the full distance in	42
less and less time. In other words, he does not ask or pray for a lighter	57
burden, but rather he asks or prays for a stronger back with which to	71
overcome the obstacles. He will have to change the way he thinks and acts	86
as he works his way toward his goal. He must have the will to try again	101
and again and again until all of the obstacles have been overcome.	114
How does one learn to change the way he thinks or the way he does	128
something in order to do it more efficiently? Better still, what can you	142
do in order to type more efficiently? The first thing to do is to make	157
sure that you know just what the obstacle is. This means that you will	171
need to know well what it is that you are doing wrong and what you must	186
do in order to do it right.	191
The next thing to do is to make sure that you know just what you need	205
to do in order to overcome the obstacle that stands in the way of your	220
progress. It is a good idea to ask someone who knows how to perform the	234
act well to show you how to do it.	241
Then you must have the will to try. Human nature is such that one is	255
not likely to jump over seven feet on the first try, nor is one likely to	270
type ninety or more words a minute after a few attempts. There are too	285
many obstacles to overcome before one can hope to attain such a high level	300
of skill. So try and try another time and another time and another, for,	314
man, you are only as great as the obstacles you overcome.	326

1 2 3 4 5 6 7 8 9 10 11 12 13 14

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Morrison, Leger R.
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ABSTRACT - This student manual was developed by a professor of education for beginning and advanced typewriting students. The first half of the manual, which is set up in a notebook format for easy use at the typewriter, is devoted to learning the keys. The remainder of the document covers technical details such as tabulation and centering, and the format and style which should be used for various types of business letter, memorandums and invoices. Instructors, illustrations, drills, problems, and tests facilitate the learning process. This manual is part of a set which also includes a teachers manual (VT 011 142) and timed writings (VT 011 143), both in this issue, and a workbook of blank forms, available from the source listed above. (JS)

VT 011 145

ED0 45856

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TYPEWRITING FOR BUSINESS

Typewriting by a whole (Gestalt) method

by Leger R. Morrison, Ed.D., Professor of Education, Bryant College, Providence, R.I.

VT 011 945

Programs for Achievement in Reading, Inc. / Abbott Park Place / Providence, Rhode Island

2

TYPEWRITING FOR BUSINESS

Typewriting by a Whole (Gestalt) Method

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To my wife, Lucia

ERIC

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PREFACE

In the fall of 1949 I attended a lecture by Dr. Hamden L. Forkner, now Professor Emeritus, Teachers College, Columbia University, in which Doctor Forkner very briefly illustrated some very challenging ideas with regard to methods of teaching stenography. This was the beginning of what became an intense curiosity on my part in the psychology of learning and methods of teaching.

Later, under Doctor Forkner's guidance, I examined several methods of teaching shorthand in the light of psychological principles of learning, and it was during this study that I began to see some of the implications of Gestalt psychology for the teaching of stenography, reading, typewriting, bookkeeping, and other areas of learning.

When I had completed my work at Teachers College in 1953 and returned to the classroom, I began to develop and use materials very similar to those in the first part of this book. Student reaction and student accomplishment were very encouraging. Initially the materials for the teaching of typewriting by a whole (Gestalt) method were used only with students who had had no previous typewriting instruction whatever. Years later some of the materials in this book and additional materials not included in this edition were used in advanced typewriting classes. One typical end-of-course remark is, "Why weren't we taught by this method from the very beginning?"

Some of my former teacher-education students who had listened to a few lectures on Gestalt psychology began to employ a whole method of teaching typewriting, and it was they who informed the publisher that I had authored these materials.

I have been asked to keep this edition compact; a larger section of materials useful in developing higher levels of skill on the letter, number, and symbol keyboard will be published within a few months. These drills have been used with advanced typewriting classes, as well as with beginning classes, to teach the fundamentals of keyboard-manipulation skills.

While I have not discussed with Doctor Forkner the implications and specific applications of Gestalt psychology to the teaching of typewriting, I am deeply grateful to him for the lifelong interest he helped me to develop in the psychology of learning and methods of teaching.

I wish to thank Mr. Ralph S. Handy, Professor of English, Bryant College, for reading a large part of the manuscript and for his many helpful suggestions.

My thanks are also due to Mr. Kenneth L. Short, who helped to organize the exercises in the last section of this book.

Leger R. Morrison

Bryant College
Providence, Rhode Island

1. Sit slightly to the right of the typewriter; that is, the center of your body should be directly in line with the j key.

2. Bend forward from the small of the back until your shoulder blades are about 2 inches from the back of the chair.

3. Your body should be about 8 inches from the frame of the typewriter. Spread the fingers of your right hand, place the end of the little finger against the frame of the typewriter, and move your body forward until it is against the end of your thumb. The body should always be about one handspan (8 inches) away from the typewriter.

Your teacher will instruct you concerning the placement of the hands on the home row: asdf jkl;

L finger reaches down and to the right to type the period.

Keep the j and k fingers anchored on the j and k keys as the l finger reaches for the period. As soon as the period key has been properly activated, return the finger over the l key and the ; finger over the ; key. Do not be concerned about the ; finger when the l finger is typing the period. Anchor the j finger, not the ; finger, when reaching for the period.

Use the thumb of the right hand to strike the center of the space bar with a quick downward and inward motion. Do not rock the hand when striking the space bar.

Space twice after the period at the end of a sentence.

To type the capital D:
1. Extend the little finger of the right hand until it covers the center of the right shift key. Keep the j-k-l fingers directly in the center of those keys. (A less desirable technique is to keep the j finger anchored and to allow the other fingers to spread.)
2. Depress the shift key. Learn to raise the k and l fingers slightly, if necessary, so that these keys won't be depressed accidentally.
3. Type the capital D.
4. Return the little finger from the shift key to its home base over the ; key.

If typebars jam, go into the type basket with both hands and gently untangle the typebars.

Use the paper release when removing paper from the typewriter.

SENTENCES

		New Keys	Strokes	Approx. Words	Cum. Par.	Cum. Par.
	dad adds all					
1	Dad adds all.	a s d D l . shift	13	2½	3	
2	Al adds all.	A	12	2½	6	
3	Al adds all ads.		16	3	9	
4	Dad adds all ads.		17	3½	13	
5	Add all dads. Add Al.		22	4½	18	5
6	Add all. Add all ads.		22	4½	23	9
7	Add as all dads add.		20	4	27	14

SUPPLEMENTARY SENTENCES

S1	A lad adds all.	15	3	3	
S2	Al adds as a lad adds.	22	4½	8	
S3	A lad adds. All dads add.	26	5	14	
S4	Al adds all as Dad adds all.	28	5½	20	
S5	Dad adds all as Al adds all.	28	5½	26	6
S6	Add all as ads. Al adds all as ads.	36	7	33	13
S7	Al adds all ads as Dad adds all ads.	36	7	41	21

PROBLEM 1

Prepare an invoice from the information furnished by our Shipping Department and figure the total.

Sold to Supply Officer, Construction Battalion Center, Davisville, Rhode Island 02852.

Invoice No. 521; dated 7/18/--; shipped to Fields Point, Building 3.

Our order No. 511; customer's order No. N62573/69/A/AOB; salesman is Clark; terms are 2/10, n/30; shipped 7/19/-- by our truck.

1	Sprocket shaft		95.75
2	Seal kits (inner)	43.82	87.64
2	Spring assemblies	1.75	3.50
2	Boots	1.50	3.00
6	Locks	.15	.90

PROBLEM 2

Prepare an invoice and figure the total amount due from the information furnished by our Sales Department.

Sold to the Essex Chemical Corporation, 525 South Bend Road, Burlington, New Jersey 08016. Fill in the following information: Invoice No. 549; dated September 1, 19--; shipped to Essex Chemical Corporation, 34 Railroad Avenue, Maywood, New Jersey 07607.

Our order no. 13498; customer's order no. 423; salesman is Tate; terms are n/30; shipped August 31, 19--; shipped via Arrow Transport.

Shipped 7 tons sulphuric acid, 66 degrees, @23.20. There is a 3% sales tax; total amount due should be 167.27.

PROBLEM 3

Prepare an invoice and figure the total amount due from the information furnished by our Sales Department.

Sold to Rhee Chemical, Inc., 639 Belvidere Boulevard, Somerville, Massachusetts 02143.

Invoice No. 13499; dated August 31, 19--; shipped to Rhee Chemical, Inc., Metal Division, 3 Outlook Avenue, Lynn, Massachusetts 01903.

Our order no. 13499; customer's order no. 424; salesman is Tate; terms are 2/10, n/30; shipped August 31, 19--; shipped via your truck.

The order is for 30 carboys of sulphuric acid, 98%, @ 27.00; there is a carboy charge of 15.00 each. There is also a 5% sales and use tax; total amount due should be 1,300.50.

PROBLEM 4

Prepare an invoice to Standard Dixie Stores, 1498 Sunrise Boulevard, Orlando, Florida 32802. Our Sales Department gave us the following information: Invoice No. 6499; dated August 29, 19--; shipped to the same address.

Our order no. 6499; customer's order no. 342; salesman is Towson; terms are 1/10, n/30; shipped August 29, 19--, via All States Corp.

Compute all amounts for the following items:
1 carton 24/4 oz. Allford Baking Powder @2.40;
3 cartons 48/10 oz. Allford Baking Powder @4.50;
6 cartons 6/5 lb. Allford Baking Powder @5.70;
7 cartons 6/2 lb. Country Club Baking Powder @3.40;
2 cartons 4/10 lb. Country Club Baking Powder @7.10. There is a 3% sales tax; total amount due should be 90.74. Leave a blank line to separate Allford Baking Powder from Country Club Baking Powder.

Align the center of your body with the j key.

Curve the fingers sufficiently when they are based on the home row. When the fingers are properly curved, one can straighten the j finger, for example, and reach to the center of the 7 key, which is located on the highest bank of keys, without any noticeable forward movement of the hand.

Wrists should be off the frame of the machine while you are manipulating the keys.

When shifting for the capital letters on this page, extend the little finger of the right hand until it is poised over the center of the right shift key. Hand, arm, and elbow should not move. The shift key should be held down until the capital letter has been typed; otherwise the capital letter will print too high or have a part missing.

After you have typed the capital A or D, return the little finger of the right hand immediately from the shift key to its usual position over the ; key.

Sensitize the tips of the fingers to the center of the keys. While awaiting the signal to begin typing, move the fingers back and forth slightly, barely grazing the keys until each finger is directly in the center of the groove of each home key. Do this whenever you are awaiting the signal to begin typing.

When stroking a key, use a quick, pulling stroke directed toward the palm of the hand. The stroke is not complete until there is a follow-through which returns the finger to its original position over the home key.

SENTENCES

		New Key	Approx. Words	Cum. Par.	
1	Ask a dad.	k	2	2	
2	All lads ask Al.		3	6	
3	Ask Dad. Ask all dads.		4½	11	
4	A lad asks Dad.		3	14	
5	Ask all lads. Al asks.		4½	19	
6	Al asks all dads.		3½	23	Cum. Par.
7	All lads ask all dads.		4½	28	5
8	Dad asks all dads.		3½	32	9
9	Al asks all as Dad asks all.		5½	38	15
10	Ask as all dads ask.		4	42	19
11	Ask all as all add.		4	46	23
12	A lad asks. All lads ask.		5	52	29
13	All dads ask all lads.		4½	57	34
14	Ask all lads as Al asks all.		5½	63	40
15	A lad asks Dad as lads ask all dads.		7	70	47
16	Al asks all lads as all lads ask all dads.		8½	79	56

1 2 3 4 5 6 7 8

Cum. Par. 5 10 16 24 33

WARMUP DRILL

asdf ;lkj asdf ;lkj asdf ;lkj asdf ;lkj

Original – Accompanies shipment
Duplicate – Accounting Department (pink)
Triplicate – Salesman's Copy (green)
Quadruplicate – File Copy (yellow)

FOR TYPEWRITER USE

Standard Snap

OUR FIRM NAME PRINTED HERE
Our Address
Our Phone

INVOICE NO. 512

INVOICE DATE 7/22/--

SOLD TO
R M Equipment Company
151 Houghton Street
Providence, Rhode Island 02906

SHIPPED TO
R M Equipment Company
122 Second Street
Fairview, New York 12601

Our Order No.	Your Order No.	Salesman	Terms	Date Shipped	Shipped Via
512	5034	Hodgdon	2/10, n/30	7/22/--	Consolidated Freight

QUANTITY	STOCK NUMBER/DESCRIPTION	PRICE	AMOUNT
2	Track assemblies	682.90	1,365.80
12	Bottom rollers	95.62	1,147.44
2	Top rollers	63.80	127.60
2	Seals	1.51	3.02
	Adjusting screw		42.00
	SUBTOTAL		2,685.86
	5% SALES & USE TAX		134.29
	TOTAL AMOUNT DUE		2,820.15

ORIGINAL

Invoices prepared on billing machines contain many abbreviations, and periods are usually omitted from these abbreviations. Since the customer is familiar with the characteristics of the product and has used some of the terms when ordering the product, he is likely to understand the abbreviations readily.

Although in the above illustration commas have been used to separate hundreds from thousands, some prefer to leave a space (as is done automatically on a billing machine) to show the separation; others write all amounts without any separation or comma.

The illustration shows a blank line above the subtotal and one above the total. When invoices are prepared on billing machines, lines are made at the foot of the column before subtotaling and totaling.

When you repeat a line, always keep your eyes on the word in your textbook that you are typing. Do not look at the paper in your typewriter even though you are retyping the same line.

Long fingernails can interfere with the development of ideal stroking habits. Those with long fingernails are likely not to curve the finger properly and are likely to strike the keys with a flat stroke. Flat-fingered strokes mean more hand movement when reaches are made to upper and lower banks of keys. When nails are too long and fingers are properly curved, the long nails are likely to hook the keys when the hands are kept low and strokes are pulled toward the palm of the hand. Recut the nails every three or four days so that the white band at the tip of the fingernail is about 1/16 of an inch.

SUPPLEMENTARY SENTENCES

		Approx. Words	Cum. Par.	Cum. Par.	Cum. Par.
S1	A sad lad asks all dads.	5	5		
S2	Dad adds all as Al asks.	5	10		
S3	Ask Ada as all lads add.	5	15		
S4	A dad asks. All dads ask.	5	21		
S5	Dad adds all as a lad asks.	5½	27	6	
S6	Ask a lad. Dad asks a lad.	5½	33	11	
S7	Ask a dad as Al adds all ads.	6	39	18	
S8	Al asks Dad. All lads ask Dad.	6	45	24	
S9	Ask a sad lad. Ask all sad lads.	6½	52	31	7
S10	All dads ask Dad as all lads ask Al.	7	60	39	14
S11	Al asks all lads. Dad asks all lads.	7½	68	47	22
S12	Dad asks all lads as all dads ask a lad.	8	76	55	31

1 2 3 4 5 6 7 8

Type h with the j finger. The h key is directly to the left of the j key. Take a good look at the location of the h key and watch your finger as you type the word hall. Remember always that whenever reaches are made to keys not on the home row, the fingers do the reaching, not the hands. So extend the j finger to the left to a position over the h key, making certain that you do not move the k-l-; fingers from the home keys. The hand does not move toward the h key at all. Once the index finger has been positioned about ¼ inch over the h key, snap the finger back toward the palm of the hand and in a U-shaped path until the follow-through takes the finger back to its home base over the j key.

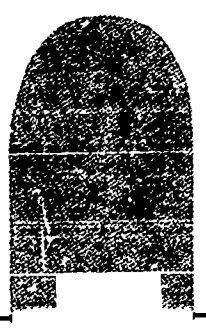
Too powerful a blow on the manual typewriter keys is not so serious as pushing the keys during the awkward stage one goes through while developing skillful stroking.

*Depress the left shift key with the a finger, type the capital H, and return both fingers to the home keys as you practice Hal several times.

SENTENCES

		New Key	Approx. Words	Cum. Par.
1	Dad has a hall.	h	3	3
2	Ada shall ask.		3	6
*3	Hal adds a salad.	H	3½	10
4	Ada shall ask Hal.		3½	14
5	Ada has Hal ask all lads.		5	20

1 2 3 4 5



INVOICES

An invoice is an itemized list of goods or services that is prepared by the seller and sent to the purchaser. The invoice usually shows the price of the goods or services and the terms of the sale.

In large business firms invoices are usually typed on billing machines. Invoices are usually typed on printed forms, but they may be typed on plain paper.

While printed invoices have about the same basic general headings printed on them, some firms prefer a particular size sheet, an arrangement suited to their own needs, and a required number of copies to suit their purposes.

The distinction frequently made between an invoice and a bill is that an invoice is an itemized statement that covers one transaction or one delivery, is dated the day of the sale, and is usually mailed to the customer. The invoice accompanies the goods on c.o.d. sales or when the customer picks up the goods. In other words, an invoice is an itemized record or statement of a single transaction; it describes items and lists prices and terms of the sale.

A bill is a statement that itemizes (usually in less detail than an invoice) various services and transactions and shows payments on account and the balance due. Some firms bill monthly. For example, a monthly statement, or bill, may be sent on May 1 that shows the one balance due on a dozen invoices for goods purchased from January through March. It may show three invoice amounts for April, partial payments made, and the balance due.

General considerations:

1. Whenever possible, the longest entries in any column should be at least two spaces from any vertical line.

2. No dollar sign is used in the amount columns.

3. Single spacing is standard, but it is permissible to double-space if there is room.

4. Number columns are aligned at the right.

5. One blank line is left before typing SUBTOTAL and TOTAL AMOUNT DUE. These terms begin at a point vertically aligned with the "D" in the printed caption DESCRIPTION.

6. Invoices are usually mailed in window envelopes. Therefore, fold the invoice in half with the address on the outside facing you.

To type the illustrated invoice:

1. Move the margin stops to the outside and clear the tab stops.

2. Either set the left margin to center the first column or set the stop so that the column will end two or three spaces before the vertical line.

3. This form permits the setting of one tab stop for the address and the descriptions; set that tab stop two or three spaces after the vertical line.

4. Set tab stops for the points most often used in the last two columns.

Practice the following steps as you review the capital H and type the word Hal:
1. Extend the little finger of the left hand until it is poised directly over the center of the left shift key. Keep the f-d-s fingers in the center of those keys.
2. Depress the shift key.
3. Stroke the capital H with the j finger.
4. Return the little finger from the left shift key to the a key.

You will have many opportunities to determine how you are progressing. After you have taken a few timed writings, your teacher will instruct you to encircle and count your errors and to count the number of words you typed within a given time. Encircle the entire word. An incorrectly typed word is counted as one error regardless of the number of letters incorrectly typed in that word. An extra space between words or no space between words counts as an error.

Write your score in the margin of your typewritten paper and encircle the score. For example, (10-1) means that 10 gross words a minute were typed and 1 error was made. When your typewriting skill increases, your teacher will show you how to figure net words a minute.

Space twice after a period at the end of a sentence when another sentence starts on the same line. When the period is the last stroke typed at the end of a line, throw the carriage without spacing after the period.

SENTENCES

		Approx. Words	Cum. Par.	Cum. Par.
1	Hal shall add a hall.	4	4	
2	Hal has had all halls.	4½	9	
3	Hal has a dad. Ask Dad.	5	14	
4	Hal had Ada ask all dads.	5	20	
5	All dads shall add a hall.	5	25	5
6	Hal shall ask as a dad asks.	5½	31	11
7	Hal shall ask as all lads ask.	6	38	18
8	Dad shall add all as all lads ask all dads.	6	47	27

SUPPLEMENTARY SENTENCES

		Approx. Words.	Cum. Par.	Cum. Par.
S1	Dad has a sad lad.	3½	4	
S2	Dad had Al add all.	4	8	
S3	Hal has had a hall.	4	12	
S4	Dad has had Hal add ads.	5	17	
S5	Dad has had Hal add a hall.	5½	23	6
S6	Al has a salad. Hal has had a salad.	7½	31	13
S7	Dad shall ask Hal as Hal adds a hall.	7½	39	21
S8	Al shall add all halls as all lads ask Al.	8½	48	30

WARMUP DRILL

asdf ;lkj asdf ;lkj asdf ;lkj asdf ;lkj

Harper-Walsh Company

INCOME STATEMENT

For Six Months Ended June 30, 19--

SALES		$24,750.00
DEDUCT COST OF GOODS SOLD:		
Merchandise Inventory, Jan. 1, 19-- . .	$18,450.00	
Purchases	9,093.50	
Merchandise Available for Sale	$27,543.50	
Merchandise Inventory, June 30, 19-- .	13,561.90	
Cost of Merchandise Sold		$13,981.60
GROSS PROFIT ON SALES		$10,768.40
DEDUCT EXPENSES:		
Salary Expense	$ 1,800.00	
Advertising Expense	411.38	
Rent Expense	650.00	
Delivery Expense	715.30	
Depreciation Expense	185.00	
Total Expenses		$ 3,761.68
NET PROFIT, BEFORE TAXES		$ 7,006.72

Shifting is always done with the little finger of the hand opposite the one typing the capital letter. Before you type the second sentence, type the word Fall several times.
1. Depress the right shift key with the ; finger.
2. Type the capital F and return the little finger from the right shift key to the ; key.

Complete the word Fall.

Keep your eyes on the copy next to your typewriter. Do not read from copy that is in your machine, even though you are typing a sentence you have already typed. More specifically, your eyes should be focused on the word which you are now typing. Do not try to read several words ahead of the word that you are now typing, for this is likely to cause transposition errors. Your eyes are capable of traveling from the typed word to the next word much faster than is necessary to read properly for typewriting purposes.

Whenever you return the carriage, reposition all fingers on the home row without taking your eyes away from this copy.

Hug the home keys. Do not allow the index fingers to fly up a couple of inches off the home keys when the weaker fingers are stroking the a-s-;-l keys. Make an effort to keep the index fingers as close to the keys as possible.

	SENTENCES	New Key	Approx. Words	Cum. Par.	Cum. Par.
1	Al had a fall.	f	3	3	
2	Fall as Al falls.	F	3½	7	
3	Al has had a fall.		3½	11	
4	Fall as Dallas falls.		4	15	
5	Add half as Al adds half.		5	21	
6	Al shall add half a hall.		5	26	
7	A lad falls. A dad falls.		5	32	5
8	Al shall add all fall ads.		5	37	11
9	All shall fall as Al falls.		5½	43	17
10	Hal has half. Ada had half.		5½	49	23
11	Dallas shall fall as Al falls.		6	56	29
12	All shall add fall ads all fall.		6½	62	36
13	Al shall fall as all shall fall.		6½	69	43
14	Al shall add half as all add half.		7	76	50
15	Hal has half. Sal shall add a half.		7	84	58
16	All ask Al as Al shall add all fall ads.		8	92	66
17	Al falls. All fall. Al asks as all fall.		8½	101	75
18	Dad has half a salad. Hal shall add half.		8½	110	84

1 2 3 4 5 6 7 8

Paul Doe, C.P.A.

BALANCE SHEET

May 31, 19--

ASSETS

Cash	$ 150.00	
Furniture	1,359.00	
Library	853.00	
Office Machines	475.00	
Supplies	58.00	
TOTAL ASSETS		$2,895.00

LIABILITIES

Accounts Payable	$ 50.00	
Notes Payable	300.00	
TOTAL LIABILITIES		$ 350.00

PROPRIETORSHIP

Paul Doe, Capital, May 1	$2,105.00	
Net Profit	440.00	
Paul Doe, Capital, May 31		$2,545.00
TOTAL LIABILITIES AND PROPRIETORSHIP		$2,895.00

It is normal to make errors while you are learning. Most of these are chance errors and are nothing to be overly concerned about. During the introductory lessons the techniques that are being developed are more important than what appears on the paper.

Align the center of your body with the j key.

Keep fingers curved.

Hug the home keys.

Keep both wrists off the frame of the typewriter when typing.

Space with the right thumb only.

Return the carriage without taking the eyes away from the copy.

SUPPLEMENTARY SENTENCES

		Approx. Words	Cum. Par.	Cum. Par.
S1	All lads fall.	3	3	
S2	Ada falls as Al falls.	4½	8	
S3	Alf shall add fall ads.	4½	13	
S4	Ask Al as all lads fall.	5	18	
S5	A lad shall add half a salad.	6	24	6
S6	Al shall add all fall salad ads.	6½	31	13
S7	Al has half a hall. Alf has half.	7	38	20

1 2 3 4 5 6

Type g with the f finger. Extend the f finger to the right until it is poised about ¼ inch above the center of the g. Then with a sharp, pulling stroke toward the palm of the hand and following a U-shaped path, follow through until the f finger rests on the f key. Look at your f finger as you type the word flag several times. Note the direction, exact distance, and path the finger must travel and begin to develop the muscular control that is required to type the g and return the f finger quickly to its home position. Keep the a-s-d fingers in the grooves of the home keys.

Use the paper release as you remove the paper from the machine.

SENTENCES

		New Key	Approx. Words	Cum. Par.	Cum. Par.
1	A lad has a flag.	g	3½	4	
2	Dad had all flags.		3½	8	
3	Dad has a glad Al.		3½	12	
4	Ada has all flags.		3½	16	
5	A hall has all flags.		4	20	4
6	A glad Alaska adds a flag.		5	26	10
7	Al has as glad a dad as Hal has.		6½	33	17
8	Hal has a dad half as glad as Dad.		7	40	24

1 2 3 4 5 6

Lee's Print Shop

B A L A N C E S H E E T

July 31, 19--

A S S E T S

Cash	$ 200.00	
Printing Equipment	3,800.00	
Delivery Equipment	2,000.00	
Supplies	1,830.00	
TOTAL ASSETS		$7,830.00

L I A B I L I T I E S

Accounts Payable	$1,000.00	
Notes Payable	850.00	
TOTAL LIABILITIES		$1,850.00

O W N E R ' S E Q U I T Y

Ray Lee, Capital, July 1	$4,050.00	
Net Profit	1,930.00	
TOTAL OWNER'S EQUITY		$5,980.00
TOTAL LIABILITIES AND OWNER'S EQUITY		$7,830.00

After you have typed the capital A, return the little finger of the right hand immediately from the right shift key to its usual position over the ; key.

Always make the finger seek the center of a key whether that finger is based on a home key or whether it is stroking a key located elsewhere.

If you have the opportunity to practice after class, whether for ten minutes or for an hour, always work on the lesson practiced in your last class. Do not go ahead to a new letter. The more you overlearn the present lesson, the easier you will find succeeding lessons. Also, your ultimate progress will be better if you make it a practice to overlearn the very lesson you had in your last class. When your serial responses become more rapid, more accurate, and more automatic, you are overlearning. You cannot type a lesson too many times. Type with the same careful thought and attention after class as you do in class.

You will benefit more from your out-of-class practice if you type on a typewriter of the same make and model — preferably the same typewriter — that you use in class than if you type on a machine with different key tension, different keyboard slope, different position of service mechanisms, etc.

SENTENCES

		Approx. Words	Cum. Par.	Cum. Par.
1	A glad Al shall add.	4	4	
2	A glad lad has a flag.	4½	9	
3	Al has had half a glass.	5	14	
4	Al has all fall gas ads.	5	19	
5	A glad lad has all flags.	5	24	
6	Al flags as a glass falls.	5	30	5
7	Add a flag. Add all flags.	5½	35	11
8	A flag falls as a glass falls.	6	42	18
9	Al shall add all fall gas ads.	6	48	24
10	Al flags all lads as glass falls.	6½	55	31

1 2 3 4 5 6

SUPPLEMENTARY SENTENCES

S1	Dad adds a glass.	3½	4	
S2	All halls had glass.	4	8	
S3	Dad adds half a glass.	4½	13	
S4	Add a glass. Dad has a glass.	6	19	
S5	A flag shall fall as Al falls.	6	26	
S6	Add half a glass as Al asks Hal.	6½	32	7
S7	Alaska has a flag. Dallas has a flag.	7½	40	15
S8	Ada has half a glass. Add half a glass.	8	49	23
S9	A glad Al shall add a flag. All glad lads add flags.	10½	60	36
S10	Al shall add fall gas ads as all glad lads add flags.	10½	71	45

1 2 3 4 5 6 7 8 9 10

FINANCIAL STATEMENTS

A balance sheet and an income statement may be single-spaced or double-spaced and may have additional blank lines as shown in the illustrations. Two or three spaces are left between money columns. These financial statements may be typed with or without leaders. Control the touch when you type leaders; an otherwise attractive statement will look bad if it is perforated with leaders.

Leaders may be solid or spaced (one space after every period). If the first leader is typed on an even number, then all other leaders must be typed on even numbers.

On the illustrated financial statements the leaders extend through the first money column. To determine whether all leaders will be on even or on odd spaces, read the carriage-position indicator after you align the printing point with the *last digit in the first money column.* If the last digit in the first money column is on 65, let us say, then all leaders should be typed on odd spaces. Always leave one space (two spaces in some cases when spaced leaders are used) at the beginning of a line of leaders and at least two or more spaces at the end of a line of leaders.

TYPING DOUBLE LINES

When you type double lines in the amount column, use the ratchet-release lever. Follow these steps: (a) type a single line with the underscore, (b) return to the beginning of the line, (c) pull the ratchet-release lever, (d) keep your eyes on the line already typed as you roll the paper up about 1/16 of an inch, (e) type another line under the first line, (f) return the ratchet-release lever to its original position, and (g) return the carriage.

Your machine is no longer on a between-line position. You can roll the paper back to any line previously typed, and your machine is in perfect alignment to type over any word or to continue to type on any line.

Type the question mark with the little finger of the right hand and depress the left shift key with the a finger. All other fingers should remain positioned over the home keys. Both little fingers should return immediately to the home keys after the question mark has been typed.

Space twice after the question mark.

Space once after the semicolon.

	SENTENCES	New Key	Approx. Words	Cum. Par.	Cum. Par.	Cum. Par.
1	Shall Al add a flag?	S ?	4	4		
2	Has Al a flag?		3	7		
3	Had Al had a flag?		3½	11		
4	Shall Al add half a glass?		5	17		
5	Shall Al ask as a glad lad?		5½	23	6	
6	Shall Al ask as a flag falls?		6	29	12	
7	Has Al as glad a dad as Hal has?		6½	36	19	
8	Ada had a flag. Has Hal had a flag?		7	43	26	
9	Has Al half as glad a lad as Hal has?		7½	51	34	8
10	Shall Ada Hall Ask? Shall Al ask Ada?		7½	59	42	16
11	Has Ada half a glass? Has Al had half a glass?		9½	69	52	25
		New Key				
12	Ask Al; ask Hal; ask Dad.	;	5	5		
13	Add a flag; add a glass.		5	10		
14	Al has a gash; Al had a fall.		6	17		
15	Dad had a flag; Al had a flag.		6	23		
16	Al has a flag; Dallas has a flag.		6½	30	7	
17	Dad has a glad lad; Al has a glad dad.		7½	38	15	
18	Dad had a fall ad; all dads had fall ads.		8	47	23	

1 2 3 4 5 6 7 8 9

"On demand" or nothing is written on line 2 when no specific time for payment is intended.

If the note reads, "I promise to pay" and is signed by two or more persons, they are jointly and severally liable. (If it reads, "We promise," they are jointly liable.)

$80,000.00 Providence, Rhode Island, June 1, 19--

-afterdate I promise to pay to

the order of Michelle M. Murray***

***Eighty Thousand and - no/100 Dollars

at Old Colony Trust Company, Providence, Rhode Island.

Value received

Dan S. Parks

No. 7 Due

Grace G. Parks

Note No. 7 is a negotiable instrument. Note No. 8 is NONnegotiable. The "Pay to ____ " in No. 8 means pay to Ray O'Connell and only to Ray O'Connell. It is NONnegotiable.

$952.00 Providence, Rhode Island, June 2, 19--

Thirty days afterdate we promise to pay to

Ray O'Connell***

Nine Hundred Fifty-two and no/100 Dollars

at Rhode Island Cooperative Bank, Providence, Rhode Island

Value received

Lawrence W. Wright

No. 8 Due July 2, 19--

Priscilla S. Wright

SUMMARY OF THE CHARACTERISTICS OF A PROMISSORY NOTE:

1. written (longhand, typewritten, or by other means of visible impressions–but NEVER ORAL)
2. signed by the maker
3. contains an unconditional promise to pay (and never such conditions as "when Russia liberates Hungary" or "when Longshot wins the Kentucky Derby.")
4. must be a specific sum in money (and United States money in the U. S.)
5. payable at a fixed or determinable future time or on demand
6. payable to bearer or to order
7. payable to a party called the payee

It will take hundreds of trials and weeks of conscientious effort to perfect the rapid, coordinated stroking of the keys. Some suggestions may be of help to you. Keep the hands relatively stationary; that is, do not move the hands up and down; do not move the hands forward and backward when reaching to a non-home-row bank of keys.

Let the tips of the fingers do most of the reaching, not the hand. When you stroke a key, raise the finger about 1/4 to 3/8 of an inch above the key and snap the finger toward the palm of the hand.

The combination of a slight blow at the center of the key and the friction from the ball of the finger—particularly the part of the finger located about 1/4 to 3/8 of an inch from the nail—will enable you to develop a powerful stroke—rapid and accurate.

Too many unguided beginners poke rather than stroke keys. They develop poor technique by raising the hand and letting the weight of the hand push the key down. They strike a key—rather than stroke it—as though they were poking a finger through an eggshell. Some incorrectly rock the hand, instead of holding the hand steady. Stroking speed and power come from finger movements and not from bouncing forearms or bouncing wrists.

Type i with the k finger. The stroke is not completed until the follow-through takes the finger to its home position over the k key. Look at your fingers as you type the word skill several times with the intent of remembering the i stroke for life.

* When you type the capital I, shift with the a finger and return that little finger home immediately after you have typed the capital I.

SENTENCES

		New Key	Approx. Words	Cum. Par.	Cum. Par.
1	Sid has his skill.	i	3½	4	
2	Al did fill his glass.		4½	9	
*3	I said I did add a skill.	I	5	14	
4	Al did fill half his glass.		5½	20	
5	I said I did; Al said I did.		5½	26	
6	I said I did fill his glass.		5½	32	
7	Is Sid ill? Shall I add his?		6	38	6
8	All I said is Al has his skill.		6	45	13
9	I said I shall aid if Al fails.		6	51	19
10	Al had his fill; fill his glass.		6½	58	26
11	All I said is I did fail his dad.		6½	65	33
12	Sid had as high a skill as I had.		6½	72	40
13	I said I shall fail if Al has aid.		7	79	47	Cum. Par. 7
14	Al said his dad did fail if I did.		7	86	54	14
15	Al is ill. I shall fail if Al fails.		7½	94	62	22
16	Al said I did fail. Ask if Al is ill.		7½	102	70	30
17	Al had high skill. Al did aid his dad.		8	110	78	38
18	All said Al has his skill. Is his sail high?		9	120	88	48

1 2 3 4 5 6 7 8 9

PROMISSORY NOTES

James and Marie Powers purchased land from John and Alice Clay. Mr. and Mrs. Powers made a written promise to pay (a personal uote payable) Mr. and Mrs. Clay, or either one of them, the sum of $4,000 an money on November 12, 19--, plus 6 percent interest for the time expired.

$4,000.00 Providence, Rhode Island, March 9, 19--

On or before November 12, 19--**** *after date* we *promise to pay to*

the order of John R. Clay and/or Alice M. Clay***

***Four Thousand and - no/100 *Dollars*

at Providence, Rhode Island, with interest at 6% per annum.

Value received

James J. Powers
James J. Powers

No. 5 *Due* November 12, 19--

Marie M. Powers
Marie M. Powers

It is better to write "On or before November 12, 19--" rather than "Two hundred and forty-eight days" after date...

If James Powers dies, Marie is liable for the full amount.

$80,000.00 Providence, Rhode Island, May 20, 19--

Ninety days*** *after date* we *promise to pay to*

the order of Barbara West***

***Eighty Thousand and - no/100 *Dollars*

at New York City Bank, with interest at 5% a year.

Value received

Robert K. Powers
Robert K. Powers

No. 6 *Due* August 18

James J. Powers
James J. Powers

It is not enough for the money to be in the mails on the due date; the money must be in Mr. McLaughlin's hands on August 18.

"Value received" indicates that it is a binding contract—that more than a vergal agreement has transpired between the parties involved.

To set a stop for a 5-space paragraph indention, follow this procedure:

1. Clear the entire tab rack by (a) pressing down on the carriage-release lever and moving the carriage to the extreme right, (b) holding down the tab clear key, and (c) returning the carriage all the way to the left.
2. Release the tab clear key.
3. Tap the space bar five times and then press down on the tab set key.
4. Return the carriage and operate the tabulating mechanism to see that it is operating properly. If your machine has a tab key, depress the key with the little finger while you keep the index finger anchored on its home key. If your machine has a tab bar, depress the bar with either index finger. On most typewriters the tab key and tab bar must be held down until the carriage comes to a complete stop.

SENTENCES

		Approx. Words	Cum. Par.	Cum. Par.
1	I said I shall if Al has his skill.	7	7	
2	Aid his skill; Al did aid his skill.	7	15	
3	I did fill his hall if I said I did.	7	22	
4	Shall I fail Al if his skill is high?	7½	30	
5	I said I shall aid if Al has his skill.	8	38	
6	I said I shall aid his dad if Al is ill.	8	47	8
7	I said I shall fail if Al has all his skill.	9	56	17
8	Shall I aid if his dad is ill? His dad is ill.	9½	66	27
9	Al said I did aid his dad. Al did fail his dad.	9½	72	37

1 2 3 4 5 6 7 8 9

MARGINS:
PICA--12 and 72
elite--21 and 81

PARAGRAPHS

New Key
Tab Set

	Words		Words
I said his dad is ill. His dad has high skills. Did	11		
his dad aid his skill? Al said his dad did aid his skill.	22		
Al said his skill is high. Al is glad his skill is high.	34	Words	
I shall fill his glass if I fail. I shall fail if Al	45	11	
has half his skill. Al said his skill is as high as his	56	22	
sail. I said I shall fail if Al has his skill.	66	32	Words
His sail is high. His flag is as high as his sail. I	77	43	11
did fail. I did fill his glass. I did fail if I said I	88	54	22
did. I did fill his glass if I said I did. All said Al had	101	66	34
all his skill.	104	69	37

1 2 3 4 5 6 7 8 9 10 11 12

PROMISSORY NOTES

Do not use Mr. O'Connell's title before his name.

Mr. O'Connell may transfer this note to someone else by endorsing it.

The one to whom the money will be paid is known as the payee.

Several possible positions and forms for the representation of cents are illustrated.

$125,000.00 Providence, Rhode Island, December 17, 19--

One year *after date* I *promise to pay to*

the order of Joseph J. O'Connell***

***One Hundred and Twenty-five Thousand and - - - - - - - - - - - - - - - no/100 *Dollars*

at First National Bank of Providence, with interest at 6% a year.

Value received

No. 3 *Due* December 17, 19--

James J. Powers

James J. Powers

"date of maturity" or "due date"

If this note is due on a Sunday, it is payable on the next business day, Monday, December 18, 19--.

The person promising to pay is called the maker. A promissory note must be signed by the maker.

The words "on demand" may be used when no specific date or time is mentioned. However, a note is deemed payable on demand when no time for payment is expressed.

Cross out "after date" whenever these words do not apply.

$18,000.00 Providence, Rhode Island, June 10, 19--

On demand*** *after date* I *promise to pay to*

the order of Bearer***

Eighteen Thousand and no/100 *Dollars*

at Industrial Bank, East Greenwich, Rhode Island.

Value received

No. 4 *Due* _____

James J. Powers

James J. Powers

If either the words "to the order of" or "to bearer" do not appear on the note, the note is nonnegotiable, which means that it cannot be endorsed and transferred to someone else for cash. Also, in promissory notes use the words "On demand" or "Payable on demand"; if no time of payment is mentioned, it is payable on demand. (Save the words "on sight" for bills of exchange.)

When a new key is introduced, concentrate on its location and the direction and distance the finger has to travel. Look at your finger when you first initiate the reach to the key and type a word requiring that finger reach. Let the end of the finger do most of the reaching, not the hand.

To develop a muscular memory that will help you to type accurately, be keenly aware of what it feels like when you make the reach and stroke the key. Concentrate on this with the idea of remembering it so that you will never have to look for this key in the future. Try to register in memory what it feels like to reach for a key when the hand is in a fixed position.

When the hand incorrectly follows the finger to the y key, for example, the h is a target requiring a downward and backward movement of the hand. If the entire hand is then moved to type the m, the h appears to be a moving target because the entire hand has to move in a left oblique direction to cover the h. The hand has to move in a different direction to type the h when a different one of the seven keys typed by that index finger precedes the typing of h. This makes it more difficult to type accurately.

On the other hand, if the hand is kept in a fixed position, the target key is always in the same location in relation to the hand; that is, since the hand will remain stationary, the reach to a non-home-row key will always be in the same direction — aiming for a fixed target. This leads to greater accuracy.

	SENTENCES	New Key	Approx. Words	Cum. Par.	Cum. Par.
1	Sit still if it fits.	t	4	4	
2	Light fills this hall.	L	4½	9	
3	Add this ad if it fits.		4½	14	
4	It is light if it is his.		5	20	
5	List it if it still fits.		5	25	
6	This is its last fall ad.	T	5	30	
7	At last this is his list.		5	36	
8	Did Kit talk at that hall?	K	5	41	5
9	It is still his last talk.		5	47	11
10	This is high if it is his.		5	53	17
11	List its last ad this fall.		5½	58	22
12	This is his list till fall.		5½	64	28
13	This did fit his last talk.		5½	70	34
14	At that hall Kit talks last.		5½	76	40
15	It is light; it is still his.		6	82	46
16	Sit still if this talk lasts.		6	88	52
17	That is it; that is his list.		6	95	59
18	I shall list it if this is it.		6	101	65
19	Sit still as I light this gas.		6	107	71

1 2 3 4 5 6

Cum. Par.

PROMISSORY NOTES

A promissory note is a written promise to pay at a specified future date and at a specified place. Assume that you are Mr. Powers and that you owe $800 to Mr. Ray T. Grant and promise to pay Mr. Grant, the payee, on June 5 in the Columbus Trust Company of Barrington.

payee

You are typing this note in Providence.

$800.00 Providence, Rhode Island, March 5, 19--

Three months after date I promise to pay to

the order of Ray T. Grant***

Eight Hundred and no/100 Dollars

at Columbus Trust Company of Barrington, with interest at 6% a year.

Value received

No. 1 Due June 5, 19-- James J. Powers

James J. Powers

This note must be paid on the due date.

This note must be paid in the bank named, which is located in Barrington.

maker

Short-term notes are usually made for thirty, sixty, or ninety days; however, some notes are made payable "on demand."

Put hyphens or three asterisks after every amount you type. Begin writing the words close to the left margin to discourage anyone from attempting to raise the amount.

$600.00 Providence, Rhode Island, April 13, 19--

Thirty days after date I promise to pay to

the order of Henry L. Foley***

Six Hundred and no/100 Dollars

at First National Bank, Providence, R. I., with interest at 6% a year.

Value received

No. 2 Due May 13 James J. Powers

James J. Powers

Type the word this several times. Start out slowly and increase your speed on each successive attempt. Pause momentarily after each word to relax and to think of how you can coordinate the movements on your next attempt to type it even faster. Try to type this so that it will sound like one continuous stroke rather than four separate strokes.

Practice each word in if this is it individually until it sounds like "one stroke." Pause momentarily after each try. Then try all four words and pause after each attempt. Try to increase your speed every time you type it. Eventually you will reduce the cues necessary to elicit automatic responses.

SENTENCES

		Approx. Words	Cum. Par.	Cum. Par.
1	This is its last ad this fall.	6	6	
2	List it last if it is still high.	6½	13	
3	This lad has hats that still fit.	6½	20	
4	Sit still if it is his last talk.	6½	27	
5	This is its last flight till fall.	7	34	
6	Light this gas. Light this light.	7	42	
7	List it if it fits. It still fits.	7	49	7
8	Kit has that task. That task lasts.	7	57	15
9	It is said that this list is his last.	7½	65	23
10	This till is light. This till fits it.	8	73	31
11	This is still high. It is still light.	8	81	39

1 2 3 4 5 6 7

MARGINS:
PICA--12 and 72
elite--21 and 81

By setting the margins at 12 and 72 if you have pica type or at 21 and 81 if you have elite type, these paragraphs will be approximately centered horizontally (from left edge of the paper to the right edge).

PARAGRAPHS

	Words	Words
This is it; this is his list. This staff is glad that	11	
this list lists all ads last. Kit had this list last fall.	23	
This is his last list. I shall list this last ad this fall.	35	
Shall I list all ads till fall?	42	
Light this hall. Light this hall light. I shall light	53	11
this light last. This is a light task. This light is high.	65	23
This light falls high. This hall light is high. Add this	77	35
light.	78	37

1 2 3 4 5 6 7 8 9 10 11 12

Before you type on a ruled line, adjust the check so that the ruled line is in the underscore position.

Those who cash checks question anything that looks like an alteration on a check; therefore, no erasures are permitted.

Write the amount in figures as close to the dollar sign as possible to prevent anyone from inserting another figure between the dollar sign and the number When you type the amount in words, begin at the left end of the line so that the amount cannot be changed by adding words at the beginning of the line.

CHECK 95

Write check No. 95 for $188.82 to Mr. Paul M. Dodge, 232 Twelfth Street, New York, New York 10016. This is a partial withdrawal from his savings account, No. 43687. Type the attached voucher first.

ILLUSTRATION OF CHECK STUB AND CHECK

No. 1 $ 225.86
Date July 29 19--
To David N. Littlefield
T.V. & Appliance Store
For television set

Balance	850.95
Amt. Deposited	300.00
Date 7/15/-- Total	1150.95
Amt. This Check	225.86
Balance	925.09

FOLSOM CORPORATION

No. 1

July 29 19--

57-1
115

PAY TO THE ORDER OF David N. Littlefield --- $225.86

Two Hundred Twenty-five and no/100 *** DOLLARS

THIRD NATIONAL BANK
Sacramento, California

Treasurer

⑆0115⑈000⑆

CHECK 1

As treasurer of the Folsom Corporation, you are authorized to sign all checks.

Assume that all check stubs are bound in a checkbook; therefore, fill out the stub in longhand and then type the illustrated check, No. 1.

CHECK 2

Fill out the stub in longhand and then type a check for $20 to the Registry of Motor Vehicles. This is to register a salesman's car, vehicle No. 115516G102970, for the coming year.

CHECK 3

Type a check for $75.75 for office supplies purchased; use the current date; make it payable to Robert A. Gray.

SENTENCES

As a general guide, your accuracy is good if you can hold your errors down to about one error a minute. If you are making no errors, try for greater speed.

		Approx. Words	Cum. Par.	Cum. Par.
1	Kit is glad that this is still his hall.	8	8	
2	This is his hat if it fits this tall lad.	8	17	
3	This half is light. At last it is light.	8	25	
4	This talk is light. List his light talks.	8½	36	
5	Kit said his list is last. This is his list.	9	44	
6	Half that list is his. That is still his half.	9½	53	10
7	This is it; this is his. This is still his list.	10	64	20
8	That hat fits this lad. It is his hat if it fits.	10	74	30
9	Is this it? This is it. Is it still his? It is.	10	84	41
10	That lights this hall light; this lights all lights.	10½	95	51

1 2 3 4 5 6 7 8 9 10

MARGINS:
PICA--12 and 72
elite--21 and 81

PARAGRAPHS

	Words	Words
Shall I talk last? Talk last if this is said. List	11	
Kit last; list his talk last. Talk till Kit talks. Ask Kit	23	
if his talk lasts till it is light.	30	
Taska did talk at that hall last fall. Taska did his	41	11
task. Taska did fill that hall last fall. Taska has that	53	23
last talk.	55	25
List all talks this fall. List this light talk if it	66	36
fits. This staff said that this last list shall last all	78	47
fall. Taska shall talk last at this hall this fall.	88	58

1 2 3 4 5 6 7 8 9 10 11 12

Endorsement of check by payee acknowledges receipt in full for items noted hereon, and it is agreed that it shall not be otherwise applied.

FICTITIOUS FEDERAL SAVINGS AND LOAN ASSOCIATION
Providence, Rhode Island 02906

Date	Description	Account No.	Net Amount
7/21/--	Partial withdrawal Mr. Lloyd E. Wentworth 859 Reed Avenue Portland, Maine 04101	22181	717 00

Detach before depositing

B 50881

FICTITIOUS FEDERAL SAVINGS AND LOAN ASSOCIATION
Providence, Rhode Island 02906

No. 94 57-12/116

July 21 19 --

PAY TO THE ORDER OF Lloyd E. Wentworth --- $717.00

Seven Hundred Seventeen and no/100*** DOLLARS

THIRD NATIONAL BANK
Sacramento, California

Robert S. Andrews
Secretary-Treasurer

⑆0115⑈0012⑆

VOUCHER CHECK

A voucher check has two parts, the check proper and a voucher, which will be separated before the check is cashed. A record of the specific reason for the issuance of the check is typed on the voucher section.

The detachable section is a convenience to the one receiving payment. For example, an employee who receives a voucher check can, when he cashes his check, count the amount the teller in the bank gives him and compare it with the amount written on the voucher in case he does not recall the exact amount. The canceled check is the best receipt for the one who issued the check. Some firms type a carbon.

Do not use the person's title on the Pay to the order of line. Do type his title on the voucher. The attached voucher is designed to be folded back at the perforated line (keeping the typewritten name and address on the outside) before inserting it into a window envelope. If you type the address within the marked section, the complete address will be visible through the window of the envelope.

MARGINS:
PICA--12 and 72
elite--21 and 81

TEST 1

	Words	Words
It is his list. Kit did this list last. This is his	11	
last list till fall. List this light last. Shall I add	22	
this last list?	25	
It is said that his staff did this half. Is it still	36	
his list? It is; it is said that this is still his list.	47	
Assist his staff this fall. I shall assist this staff this	59	
fall.	60	
List all hats. List this hat last. List it last if it	72	11
fits this lad. Is this it? That is it. This hat fit this	83	23
lad last fall. It still fits this lad. This is his fit.	95	35
It is said that Hal is glad that this is still his hat.	106	46
This is his hat if it fits. That last hat is his; it	117	57
fits this lad. That light hat is his. That light hat fits	129	69
this lad.	131	71
This is it; this is his talk. His last talks did fill	143	82
this hall. List this talk last. This is his last talk this	155	94
fall. Add this last list. This last list fits his talk.	166	106
It is this staff that said his talks shall last till fall.	178	118

1 2 3 4 5 6 7 8 9 10 11 12

KEY

(1) Did he make a profit of 6 1/6¢ on each sale?

(2) Add ½ and ¼. OR Add 1/2 and 1/4. (This latter form may be better to insure legibility when many carbon copies are being typed.)

(3) He won $3,500!

(4) The pamphlet is entitled "Less Fatigue."

(5) See it now--tonight--if it is possible.

(6) Order 450 books @ 50¢ each.

(7) It is sold at Peck & Peck.

(8) The rate is 3%.

(9) Buy 6# of the #2 grade.

ERIC

	SENTENCES	New Key	Approx. words	Cum. Par.	Cum. Par.
1	She sees the sale.	e	3½	4	
2	She held the least.		4	8	
3	Ed sees the fall sale.	E	4½	13	
4	She let Ella take all sets.		5½	19	
5	She left Ed at the fall sale.		6	25	
6	She held the test at the half.		6	31	
7	She let Ethel talk at the half.		6	38	
8	Tell Ella that he held the test.		6½	45	7
9	Tell Ethel she shall sell the set.		7	52	14
10	Take the desk. She sees the desk.		7	59	21
11	The state shall set the legal age.		7	66	28
12	Tell all that he shall take the set.		7	74	36
13	She shall let Ella sell the desk set.		7½	82	44
14	Let Ella take half these health sets.		7½	89	51
15	Sell the test. Sell the health test.		7½	97	59
16	Let Ella take half these health sets.		7½	105	67
17	He feels that all the states take less.		8	113	75
18	She feels that Ella has left the state.		8	121	83
19	She shall see less. She left the sale.		8	130	92

1 2 3 4 5 6 7

MAY BE INTRODUCED ANYTIME AFTER PAGE 85.

NUMBER PRACTICE

DIRECTIONS: Type each of these sentences several times before you take the symbols test on the lower half of this page.

1 He was president of the class of '88.

2 Use figures when you type 4 pounds, 44 cents, and 4 mills.

3 He will pay interest on this note for 7 years 7 months and 7 days.

4 He will buy 822 gallons next week for less than 22 cents a pint.

5 Passengers on Flight 19 will leave from Gate 9 at 9:29 p.m.

6 Nos. 13, 33, and 39 may be written #13, 33, and 39 in tabulations.

7 I have elite type since the margin scale reads from o to 120.

8 Bill is 5 years 5 months and 15 days old and lives at 55 Main Street.

9 Last year we won by a score of 16-6 and this year by a score of 6-1.

10 Use figures when you type 6 tons, 16 degrees, and 61 yards.

DIRECTIONS: This is an exercise to see whether you can substitute the correct symbol for each underscored word. Type this exercise on a 4 by 6 card (begin on line 4) or on a 3 by 5 card (begin on line 1) to emphasize the fact that it would be proper to use these symbols to save space on file cards for your own office records. It would be incorrect, for example, to use symbols in sentences 1, 6, 8, and 9 if these sentences appeared in a business letter. Type the sentences and not not the numbers in parentheses; then check your work with the key on the next page. If you do not have a card, use the 4 by 6 card outline on page 41 of your Workbook.

(1) Did he make a profit of <u>six and one sixth cents</u> on each sale <u>question mark.</u>

(2) Add <u>one half</u> and <u>one quarter</u>.

(3) He won <u>three thousand five hundred dollars exclamation mark</u>.

(4) The pamphlet is entitled <u>quote</u> Less Fatigue <u>unquote</u>.

(5) See it now <u>dash</u> tonight <u>dash</u> if it is possible.

(6) Order 450 books <u>at</u> 50 <u>cents</u> each.

(7) It is sold at Peck <u>and</u> Peck.

(8) The rate is 3 <u>percent</u>.

(9) Buy 6 <u>pounds</u> of the <u>number</u> 2 grade.

MARGINS:
PICA--12 and 72
elite--21 and 81

PARAGRAPHS

Double-space.

If you are instructed to center these three paragraphs vertically (up and down) on a full sheet of paper, begin typing on line 24.

If you are asked to center these three paragraphs vertically on a half sheet of paper, begin typing on line 7.

	Words	Words	Words
She left these health tests. Let Ethel take the state	11		
health tests. She shall take the health tests. Set the	22		
date. Ed sees that she has set the date.	31		
She shall see Ed at the sale. Ed shall sell the desk	42	11	
at the sale. He shall sell the desk; he shall sell the	53	22	
health sets; he shall sell the desk sets. He shall let all	65	34	
lads talk at the sale.	70	39	
She tells Ella she shall sell the test. She held the	81	50	11
test at the desk. Sell the health test that she held at the	93	62	23
desk. Sell all dated health tests.	100	69	30

1 2 3 4 5 6 7 8 9 10 11 12

SENTENCES

		Approx. words	Cum. Par.	Cum. Par.
1	He held that the state shall set the legal age.	9½	10	
2	She held the sale at the half. She talks less.	9½	19	
3	She shall tell Ed as he sells these health sets.	9½	29	
4	She has the health test. Sell Ed the health test.	10	40	
5	Take all health sets. She shall sell a health set.	10	50	
6	She shall state that she takes all the state tests.	10	61	10
7	She let Ella state the date she held the health test.	10½	72	21
8	She sells the test. She left the test; take the test.	11	83	33
9	She shall sell the desk set. Sell the desk; take less.	11	95	44
10	Tell Ella as she sells the test. She left half these sets.	12	107	56

1 2 3 4 5 6 7 8 9 10 11

March 21, 19--

Leave 1 blank line after the date and omit the salutation when space is at a premium on a postal card. It is usually desirable to double-space a message of 2 or 3 lines. Leave 1 blank line between the message and the complimentary close.

Before typing the sender's name, leave 1 blank line; or if the card is to be signed, leave whatever space is necessary to accommodate the signature.

EXECUTIVE SECRETARIES, INC.

you

No return address is needed on the address side when the sender's name and address are typed beneath the message or when a heading that contains this information is typed above the message.

Sometimes it is desirable to type the sender's address under his name at the end of the message rather than to use the return-address section of the address side of the card. Such a practice is efficient when messages are duplicated on many cards.

March 22, 19--

While it is highly desirable to have ½-inch margins on all sides of the postal card, it may be necessary to narrow the top and bottom margins to 2 blank lines.

There are ways of crowding when the message is long. For example, leave no blank lines between paragraphs. Omit the salutation and the complimentary close. Narrow all margins but keep at least ¼-inch margins. Place the return address on the address side of the card. Use elite type.

As mentioned previously, when the message is long, the narrowest margin that may be used is a ¼-inch margin all around. Of course, one should not have a margin less than ½ inch unless it is absolutely necessary.

you EXECUTIVE SECRETARIES, INC.

If the message side is to be duplicated, it may be appropriate to type the return address on line 3 and to block it with the date ½ inch from the right edge of the card as shown below.

52 Main Street
Rome, Ga. 30161
October 18, 19--

Notice that it is possible to crowd 12 message lines on a postal card. On a crowded card the reference initials may be placed 1 blank line below the last message line.

SENTENCES

		Approx. Words	Cum. Par.
1	She had set the date. She held the fall sale.	9	9
2	He shall tell Ed as he takes these health sets.	9½	19
3	Let Ella see half the health set. Take the set.	9½	29

1 2 3 4 5 6 7 8 9

MARGINS:
PICA--12 and 72
elite--21 and 81

TEST 2

	Words		Words
Ella left these. She left all health tests at the	10		
desk. Let Ella tell the state the date that she left the	22		
state. She shall at least let Al take the health test. She	34		
shall set the date. Tell Al he shall take the health test.	46		
He shall take the health test at the steel desk. Take the	58		
health test.	61	Words	
Al left. He left the test. He left the health test at	72	11	
the desk. Ethel has the health test. She held the test as	84	23	
he left the desk. Take the test. Tell Ella that he left	96	35	
the health test at the desk. She shall state the date that	108	47	
she held the health test. At least she let Al take the	119	58	
health test.	121	61	Words
Get the health test. All shall take the health test.	132	72	11
Ethel shall take the health test. Tell Ethel she shall set	144	84	23
the date. State the date all shall take the health test.	156	95	36
All shall take the health test at these desks. Date all	167	107	46
health tests.	170	109	48

1 2 3 4 5 6 7 8 9 10 11 12

March 20, 19--

Set the left margin stop ½ inch from the left edge of the postal card--6 elite spaces or 5 pica spaces. Then backspace ½ inch from the right edge of the postal card and set the right margin stop.

Date all cards on line 3. Begin the date from the center of the card or have it end flush with the right margin. Always leave at least 1 blank line after the date.

EXECUTIVE SECRETARIES, INC.

you

Many cards need no signature, in which case 1 blank line is left between the message and the closing.

Ordinarily 3 blank lines are left for a signature when one is called for, although it is permissible to leave only 2 blank lines when the card is crowded. Type the reference initials.

March 20, 19--

Keep a copy of a message sent on a postal card. take a plain sheet of standard size paper, trace the outline of a postal card with a pencil, and type a rough draft of the message with the traced outline.

A glance at the completed rough draft will give you a basis for making adjustments to attain better placement on the postal card. The rough draft then becomes the file copy. It is less likely to be lost in the file than is a small card.

EXECUTIVE SECRETARIES, INC.

you

A postal card measures 5½ inches by 3¼ inches. Usually the return address is typed on the address side and begins on line 3. It is almost always blocked ½ inch from the left edge of the card. Block the return address even though the address is indented.

Single-space all return addresses and all addresses of 4 or more lines.

Double-space 3-line addresses.

MARGINS:
PICA--12 and 72
elite--21 and 81

TEST 3

	Words	Words
Ed states that he held the sale. Tell all that he held	11	
the sale. Tell all that he left the sale. He left the	22	
state. State the date he left the state. Ella held a sale.	35	
She held the fall sale as he left the state. She set all	46	
the dates.	48	
She states that he left at least half the health sets.	60	
She shall sell all sets. The state sells these health sets;	72	
see the health sets at all sales. See Ed as he sells the	83	
health sets; he sells these health sets all fall.	93	
She feels he left at least half the health tests. She	105	11
sees that he had set the date. She states that Ethel takes	117	23
all health tests. She shall set the date. Let Ethel take	128	35
the health tests.	132	38
She sees that Ethel has set the date. She shall ask	143	49
Ethel the date. She shall tell at least half the states.	154	61
Tell Ethel as she takes the health tests. Get set; take all	167	73
the health tests. Date all tests.	174	80

1 2 3 4 5 6 7 8 9 10 11 12

SENTENCES

		Approx. Words	Cum. Par.
1	Take less; let Ella take at least a set.	8	8
2	She held the sale as he left at the half.	8	17
3	Tell Ella Ed set the date. Get the date.	8	25
4	Ed shall take all sets. Test these sets.	8	34

1 2 3 4 5 6 7 8

POSTAL CARD

Alexander Washington
3111 Memorial Drive, S.W.
Atlanta, Georgia 30303

THIS SIDE OF CARD IS FOR ADDRESS

1 blank line
2 blank lines
International Business Machines
Corporation
180 South Main Street
Providence, Rhode Island 02903

Attention Parts Department

½ 1 2 3 4 5

Occasionally, long address lines may make it necessary to start farther to the left of the OF.

Start return address on line 3 and ½ inch from left edge of card, that is, 6 spaces for elite type and 5 spaces for pica type.

Start address on line 12, which is 3 lines below printed line, and backspace 5 or 6 from center of card.

Across:	5½ inches
Elite:	66 spaces
Pica:	55 spaces

Top to bottom: 19 lines or 3¼ inches.

Single-space all return addresses.

When typing postal cards purchased before January 7, 1958, block the address under OF in the printed line THIS SIDE OF CARD FOR ADDRESS. This positions the beginning of the address about ½ inch (5 pica backspaces or 6 elite backspaces) from the horizontal center of the card.

Double-space a 3-line address; single-space addresses of 4 or more lines.

Do not use abbreviations in the address except "D. C." for "District of Columbia."

Mrs. Alice Rusk
88 Washington Boulevard
Danbury, Conn. 06810

Industrial National Bank

111 Westminster Street

Providence, Rhode Island 02903

The new 1958 5-cent postal cards no longer have the printed line THIS SIDE OF CARD FOR ADDRESS. Therefore, start the address on line 12, about ½ inch to the left of center.

The personal title, such as *Mr.* or *Mrs.* is usually omitted in the return address. However, type the title *Mrs.*

Block the return address, abbreviate if you wish, and type the Zip number 3 spaces after the state.

SENTENCES

		Approx. Words	Cum. Par.
1	She states that he left Ella at the hall.	8	8
2	Date all these tests; take all these tests.	8½	17
3	She left these. She left half; he left less.	9	27
4	The state held less steel; he held less steel.	9	36

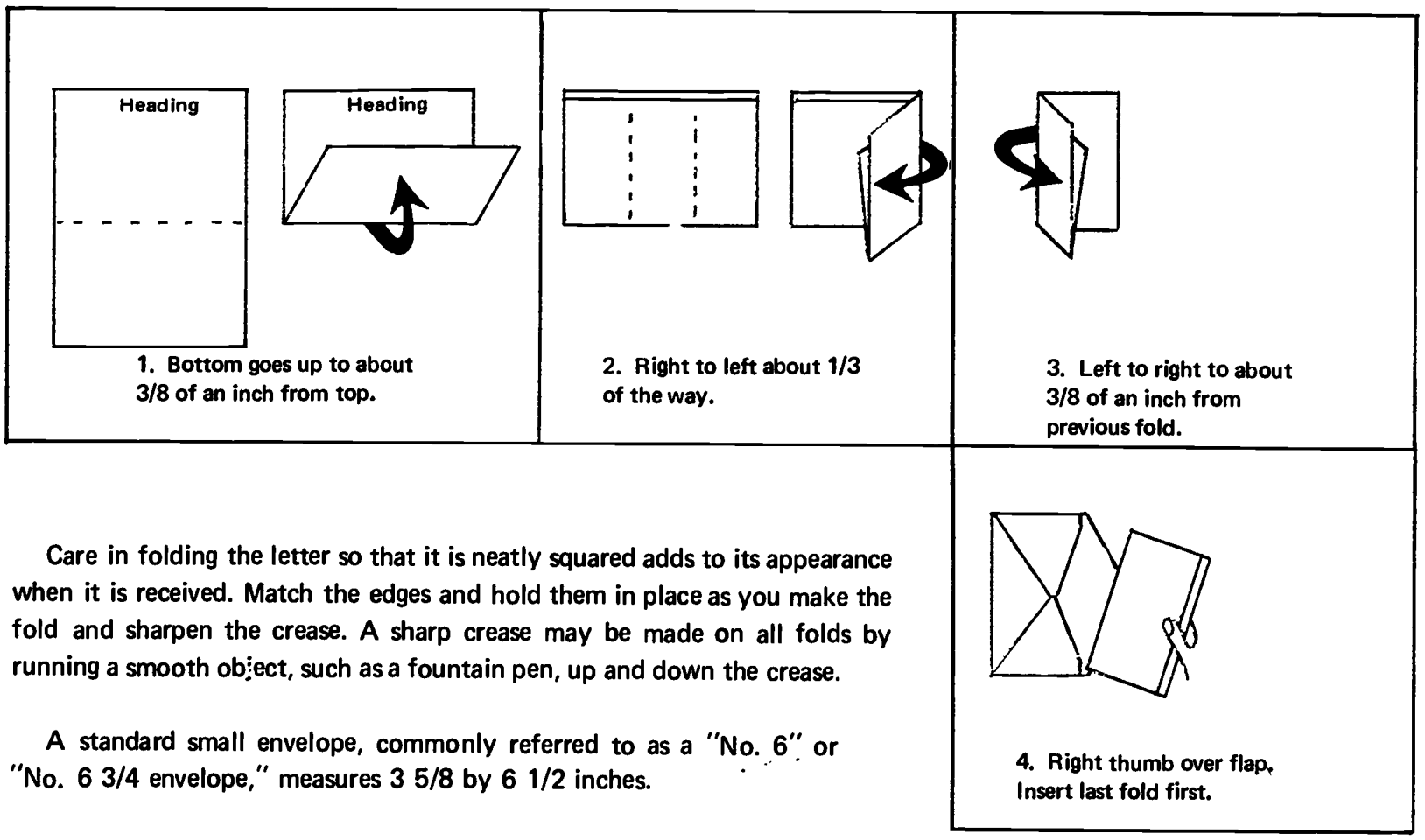
1 2 3 4 5 6 7 8 9

		New Key			
5	This girl is first.	r	4	4	
6	Rate all letters.	R	3½	8	
7	Sell his third list.		4	12	
8	Take the third right.		4	17	
9	Rate his dealers high.		4½	22	Cum. Par.
10	Rate this dealer high.		4½	26	5
11	Fill hers right after his.		5	32	10
12	Her dealer held all tires.		5	38	16
13	Here are her three letters.		5½	43	22
14	Tire dealers like this tire.		5½	49	28
15	Her list is a little higher.		5½	55	34
16	List his three legal rights.		5½	61	40
17	All three skills are higher.		5½	67	46
18	This large tire is like hers.		6	74	52

Cum. Par.: 6, 12, 18, 24

1 2 3 4 5

Folding a standard size (8 1/2 by 11) letter sheet for insertion in a No. 6 3/4 envelope, which is a standard small-size envelope.



1. Bottom goes up to about 3/8 of an inch from top.

2. Right to left about 1/3 of the way.

3. Left to right to about 3/8 of an inch from previous fold.

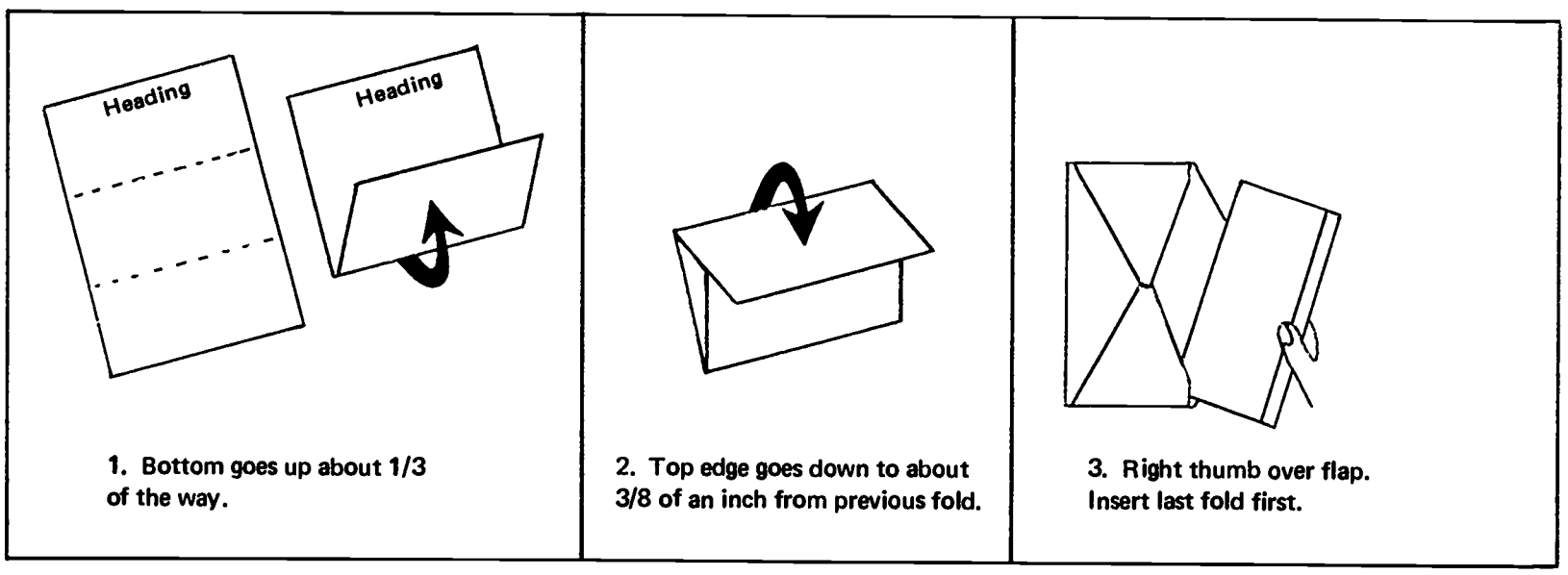
4. Right thumb over flap. Insert last fold first.

Care in folding the letter so that it is neatly squared adds to its appearance when it is received. Match the edges and hold them in place as you make the fold and sharpen the crease. A sharp crease may be made on all folds by running a smooth object, such as a fountain pen, up and down the crease.

A standard small envelope, commonly referred to as a "No. 6" or "No. 6 3/4 envelope," measures 3 5/8 by 6 1/2 inches.

A standard large envelope, commonly referred to as "No. 10 envelope," measures 4 1/8 by 9 1/2 inches.

Folding a standard size (8½ by 11) letter sheet for insertion in a No. 10 envelope.



1. Bottom goes up about 1/3 of the way.

2. Top edge goes down to about 3/8 of an inch from previous fold.

3. Right thumb over flap. Insert last fold first.

SENTENCES

		Approx. Words	Cum. Par.	Cum. Par.
1	Dr. R. Read is right. All life is dear; her life is dear.	11½	12	
2	The third girl is fair. The third girl is the right girl.	11½	24	
3	This dealer still rates higher. The right dealer is first.	12	36	
4	The first girl had the right start. Her skills are higher.	12	48	
5	This dealer read all rates. That girl read his first list.	12	60	12
6	Her life is here. Hers is a great life. Her life is great.	12	73	24
7	The first letter is higher; retail dealers like this letter.	12	85	37

1 2 3 4 5 6 7 8 9 10 11 12

MARGINS:
PICA--12 and 72
elite--21 and 81

PARAGRAPHS

	Words	Words
List all tires. Sell his right tire. Trade this right	11	
tire. Trade his tire. This retail dealer is after his	22	
trade. Tell her his tire dealer is here. Tell her his	34	
address. The dealer shall tell her his address. This	45	
address is right. This retail dealer shall tell her his	56	
address.	58	
The first girl is right. The first girl is all right.	69	11
This rate is high. This rate is fair. His rate is still	81	23
higher. All rates are high. That rate is rather high.	92	34
This rate is higher. Tell her all rates are higher.	102	44
This dealer read that this rate is rather dear. This	113	55
retail dealer likes this rate. This retail dealer likes the	126	68
higher rate. The rate this dealer likes is rather high.	137	79

1 2 3 4 5 6 7 8 9 10 11 12

DIRECTIONS: Type addresses 1 through 5 on No. 6 envelopes (Workbook pages 24 and 25) and addresses 6 through 10 on No. 10 envelopes (Workbook pages 26, 27, and 28).

RETURN ADDRESSES	SPECIAL POSTAL SERVICE	NOTATIONS	ADDRESSES
1. Joseph P. Turner 1865 Lebannon Street Hartford, Connecticut 06101		Personal	Dr. James T. White President, Essex Junior College 8 Williams Avenue Windsor, Connecticut 06095
2. Edwin R. Newton 7854 Newbury Boulevard Youngstown, Ohio 44501	Registered		Dr. Warren R. Swift 1189 Briggs Street Akron, Ohio 44309
3. Alice E. Hunt 5 Seymour Street Tulsa, Oklahoma 74101	Registered		Miss Janice Brooks 818 Meadow Lane Tulsa, Oklahoma 74101
4. Thomas A. Taylor 758 Harrison Lane Ogden, Utah 84401	Airmail	In care of Miss Mary Wynn	Mr. and Mrs. Ralph Dodd Apartment 4 98 Smith Street Miami, Florida 33101
5. Mrs. William M. Pierce 1185 Autumn Place Cleveland, Ohio 44101		Attention Sales Manager	Fred I. Marsh & Company 47 Industrial Boulevard Canton, Ohio 44701
6. Mrs. Frances W. Gates 480 Kearney Street Ames, Iowa 50010			Public Trust Company East Side Branch 919 Commercial Building Fall River, Massachusetts 02722
7. Kenneth R. Palmer 23 University Place Portland, Maine 04101	Airmail	Hold for Arrival	Mrs. William A. Abbott Williams Hotel 19 Beach Drive Oakland, California 94615
8. David E. Bowen 89 South Main Street Dover, Ohio 44622 Address Correction Requested	Airmail	c/o Mr. James Conway	Mr. Lee Clark 613 Mechanic Boulevard Omaha, Nebraska 68102
9. Earl N. Douglas 567 Greenville Avenue Utica, New York 13503	Special Delivery	Attention Mr. Dave Bond	Bond, Lewis, Carter, and Fisher Attorneys-at-Law 619 Professional Center Rye, New York 10580
10. Dr. Sam S. Andrews 59 Elmwood Avenue Camden, New Jersey 08101			Professor Carl M. Davidson Cumberland Junior College 154 High Street [illegible] 02100

MARGINS:
PICA--12 and 72
elite--21 and 81

TEST 4

	Words	
The girl left her letter here at three. This is her	11	
third letter. Here is his letter. Tell her she left all	22	
letters here. I heard the girl read the first letter. I	34	
heard her after the half. This retail dealer likes this	45	
letter. All dealers shall read this letter.	54	
The third letter starts like the first letter. Her	65	
dealer read the third letter. Her dealer reads a great	76	
deal like she reads. She held her letter higher.	86	
Tell her that her dealer is here. See her dealer. Her	97	
dealer has all letters. There are his letters. Retail	108	
dealers like his third letter. Read this letter first.	120	
This dealer shall retail all tires.	127	Words
This is her first list; her third list is right. Start	138	11
this third list. Retail dealers like her third list. Start	150	23
this third list a little higher. Start his list right here.	163	36
Read all three lists. Start this third list later.	173	46
Shall I start his third list higher? Start it higher.	184	57
Start his first list higher. Start this letter higher. All	196	69
shall start higher.	200	73
This street is higher. This is the right street. The	212	85
trade hall is there. This trade hall is high. The retail	223	96
dealers like this trade hall. Retail dealers did fill this	235	108
trade hall.	238	111

1 2 3 4 5 6 7 8 9 10 11 12

Clyde Bradley, 2d
1216 Eisenhower Street, N.W.
Washington, D. C. 20013

(2) SPECIAL DELIVERY

(3) District Director of Internal Revenue

Providence

Rhode Island 02906

Attention Mr. Roy Jones

57 elite spaces (center)

Total of 115 elite spaces

This is a No. 10 envelope and measures 4 1/8 by 9 1/2 inches.

1. Type the RETURN ADDRESS ½ inch from the left edge on line 3.

2. AIRMAIL, REGISTERED, FIRST CLASS, and SPECIAL DELIVERY are typed on line 9 or 10 and end about ½ inch from the right edge of the envelope, which is where the right edge of a well-placed stamp is.

   Spreading A I R M A I L and typing it in red are ways of catching the postal clerk's eye when a plain envelope is used.

3. Type the first line of the address on line 14. Estimate the HORIZONTAL center, backspace 5, and set a margin stop.

   Write the city on the second line and the state on the third line instead of using only two lines.

4. The typist may wish to (a) place the attention notation 2 or 3 lines below the address or (b) before inserting the envelope may make a light pencil mark at the lower left corner about ½ inch from the bottom to indicate the position of the special notation. The pencil line is erased after the envelope has been removed from the typewriter.

   Special notations are typed ½ inch from the left edge of the envelope and are thus aligned vertically with the return address. Prefer to type special notations last, for slippage may occur on some machines when trying to turn the cylinder knob counterclockwise to lower the envelope in the machine, particularly when the bottom edge of the envelope has been rolled up too far.

Align the body with the j key.

When typing the o, keep the j-k fingers anchored. The l and s fingers are our least dexterous, and a special effort is required to develop the muscles sufficiently to achieve decent strokes with these fingers. Use a pull stroke; that is, snap the l finger toward the palm of the hand as you stroke the o key. The follow-through should take the finger back over the l key. Keep the j-k fingers as close to those home keys as possible as you stroke the o.

Do not be concerned if the ; finger makes a sympathetic movement and goes slightly off home base when you stroke the o as long as you keep the j-k fingers as close to those home keys as possible.

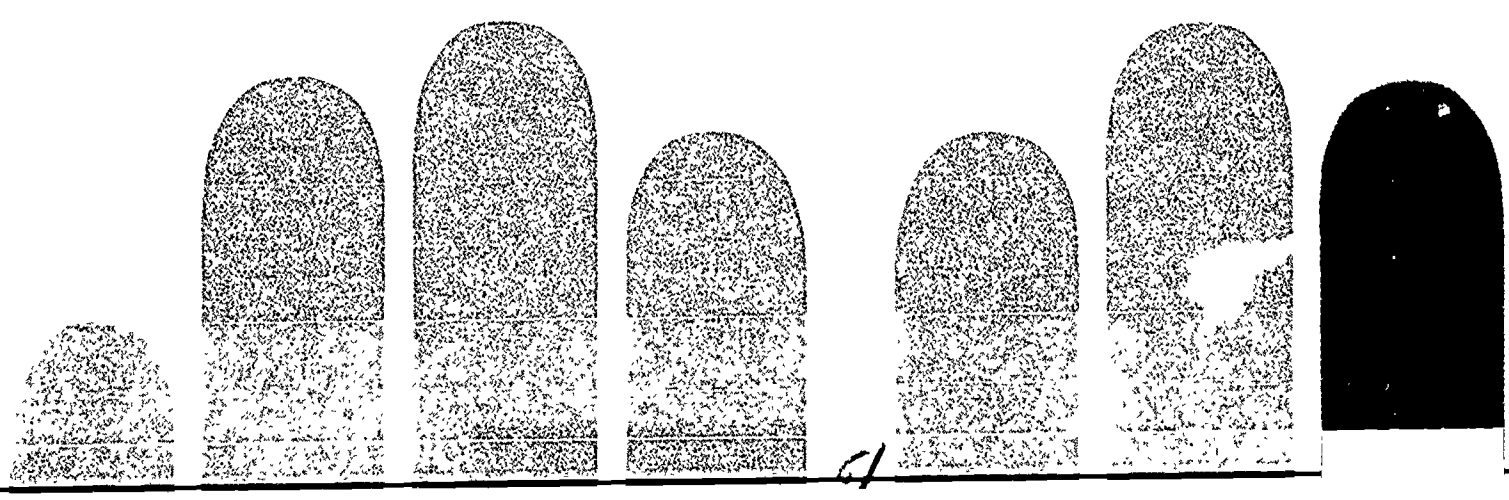
Try to maintain as stationary a hand position, including height of hand, in the high-priority center of the keyboard as possible. This means that whenever possible, preference is given to anchoring index fingers rather than little fingers. Anchored fingers should hug the center of those keys.

One characteristic of a good hand position is that the knuckles are on an almost even keel. Conversely, it is undesirable to have the knuckles of index fingers raised at a 45-degree angle to the knuckles of the little fingers. When anchoring is done on the little fingers only, some typists develop the poor practices of tilting the hand, striking keys with the side of the finger rather than with the ball of the finger, raising index fingers off the keys by as many as 2 or 3 inches, and rotating the inner part of the hand. This makes accuracy more difficult to attain.

SENTENCES

		New Key	Approx. Words	Cum. Par.	Cum. Par.
1	Ask for old gold.	o	3½	4	
2	Al told her to order.		4	8	
3	Look for a good road.		4	13	
4	Go to the other door.	G	4	17	
5	She told her to do so.		4½	22	
6	Look for good folders.		4½	27	
7	Does it look that old?		4½	32	
8	Order all of the goods.	O	4½	37	5
9	Those doors go together.		5	42	10
10	It is too good for this.		5	47	15
11	I shall order good food.		5	52	20
12	Look for his other store.		5	58	26
13	The other girl took a loss.		5½	64	32
14	His order is to sell short.		5½	69	37	6
15	He told her to order a lot.		5½	75	43	11
16	Offer this lot or the other.		5½	81	49	17
17	Does she look too old to go?		5½	87	55	23
18	She sold food to this store.		5½	93	61	29
19	The old offer is still good.		5½	99	67	35

1 2 3 4 5



Lloyd Pearson
123 Hope Street
Providence, R. I. 02906

RETURN ADDRESS

Type the return address ½ inch from the left edge of the envelope and on line 3.

Personal Service
Sears, Roebuck and Co.
201 Brookline Avenue
Boston, Massachusetts 02115

Start on line 12, which is below the vertical center.

Attention: Mr. William Foster

line 20
line 21

Edith McCall, M.D.
575 110th Street
New York, New York 10026

When the street name is expressed in figures, leave *two* spaces or use the dash between the building number and the street name.

Mr. Chalmer T. Washington
Treasurer, Best & Best
1181 173rd Street
New York, New York 10032

Treasurer was placed on the second line to give better balance to the address.

The Reverend Robert I. Shaw
1216 Eisenhower Street, N.W.
Washington, D. C. 20013

No space follows a period *within* an abbreviation unless it is a person's initials or the abbreviation for a state.

SPECIAL DELIVERY--AIRMAIL

Mr. Carl Crane, Manager

1317 Roosevelt Street, West

Chicago, Illinois 60607

The abbreviation *N.W.* is used to indicate the section (Northwest) of the city. Use *S.E., N.E., S.W., N.W.;* but spell the words *North, East, South,* and *West.*

MARGINS:
PICA--12 and 72
elite--21 and 81

PARAGRAPHS

	Words		
He is good; he sold these lots. He is so good that he	12		
sold all those other lots together. He sold those lots for	25		
a dollar or so a foot. Look for all of the short lots or	38		
for all of the other lots he sold to her.	46	Words	
He told her to look for other good lots. He told her	58	12	
this lot is too short. This short lot sold at a loss of a	71	25	
dollar or so a foot. He sold other short lots; he took a	83	37	
loss. Does this total loss look good to her? Those lots	96	50	
are too good to sell at a loss. Those lots sold for half a	109	63	
dollar or so a foot.	113	77	Words
It is so good to go together to look for good lots.	126	80	12
Offer his short lots for this good lot or offer a dollar a	139	92	25
foot for this good lot. That is a good offer. Did he offer	152	106	38
this other lot for sale? The other lot is sold.	162	115	48

1 2 3 4 5 6 7 8 9 10 11 12

SENTENCES

		Approx. Words	Cum. Par.
1	He told her that he is to look for old folders.	9½	10
2	She does go to the old store to order good food.	9½	20
3	I shall sell those lots for a dollar or so a foot.	10	30
4	He shall total all goods sold if he is told to do so.	10½	41
5	He sold this old store; he also sold the other old store.	11½	53

1 2 3 4 5 6 7 8 9 10 11

Henry Douglas
2118 Twelfth Street
Washington, D. C. 20008

Mr. Roy Thompson
Apartment 3
1040 West 108th Street
New York, New York 10024

In care of Mr. Mihran Costikyan

Spell names of streets from *one* through *twelve*; use figures for 13th Street, 14th Street, on up.

If the *In care of* line contains the name of a person and the letter is addressed to another person, type the *In care of* line in the lower left corner. However, if one of the first lines contains the name of a company or corporation, it is all right to make the second line of the address the *In care of* line.

Lloyd Moore
c/o Mr. Charles Gates
P.O. Box 218
Scituate, Rhode Island 02904

Power Companies
Room 1108-E
1271 Avenue of the Americas
New York, New York 10020

Attention Advertising Department

The title *Mr.* (or *Miss*) is not used in the return address. However, other titles *are* used.

If there is an ATTENTION LINE in the letter, there should be an ATTENTION LINE on the envelope.

Thumb-space three times before typing the Zip number.

Double-space a three-line address.

Harriet Palmer
P.O. Box 40
East Providence, R. I. 02914

A I R M A I L

Miss Dorothy Bailey
Rural Box 1024
Rural Route 3
San Antonio, Texas 78205

c/o Mrs. Russell S. Meyers

Single-space a four-line address.

When an envelope is addressed to a person (as contrasted with a company or corporation), it is better to type the *In care of* notation in the lower left corner.

MARGINS:
PICA--12 and 72
elite--21 and 81

TEST 5

	Words	Words
This folder is too good for this order file; look for	11	
the old folder. The old folder does hold all of those old	23	
orders.	24	
She does look for good folders to hold those old	34	
orders. He told her to look for all of the old folders. He	46	
told her to store all of those old file folders too. These	58	
old file folders do hold all of his orders. He sold the	70	
other old folders to other food stores. Those old folders	82	
do hold together.	85	
Offer good folders to those old stores. This is a good	97	11
store to go to for good folders. This is also a good store	109	23
to go to for good desk sets.	114	29
She sold those good tools to all of those old stores.	125	40
He told her that he sold those old tools to other stores.	137	52
He sold old tools to this food store. I shall go to all	148	63
stores for this tool or order it.	155	70
Store all of the good tools. Hold these tools for this	166	81
store. This store shall hold all good tools till all other	178	93
tools are sold. Look for this tool and also look for that	190	105
tool. I shall look for old stores to sell to.	200	114

1 2 3 4 5 6 7 8 9 10 11 12

Roy Anderson
123 Hope Street
Providence, R. I. 02906

Type the RETURN ADDRESS ½ inch from the left edge on line 3.

Mr. Edward Powell

11 Davis Street

Fall River, Massachusetts 02722

(This is a No. 6 envelope and measures 6 1/2 by 3 5/8 inches.) Type the first line of the ADDRESS on line 12, which is below the vertical center.

Estimate the HORIZONTAL center, backspace 5, and set a margin stop.

Total of 78 elite spaces

39 elite spaces (center)

Earl Johnson
82 Davis Boulevard
New Haven, Conn. 06508

The address may be blocked or indented. Typists oftentimes follow the style used in the inside address.

No longer is it necessary to type *After 5 days return to* above the return address. This is understood and will be done automatically by the Post Office Department.

Mrs. Marjorie S. Robinson

91 Blackstone Boulevard

Ogden, Utah 84401

Some typists indent the RETURN ADDRESS. When typewritten, a blocked style is more efficient.

John C. Smith
1156 Jefferson Avenue
Auburn, Maine 04210

Address Correction Requested

If the party to whom you are writing has moved, the Post Office Department will forward first-class mail to the new address but will not inform you of the new address UNLESS *Address Correction Requested* appears under the return address. If you write this notation, the Post Office Department will send you a form with the new address and charge you 10 cents.

Mr. Frank B. Jones
2416 Front Street
SAINT LOUIS
MISSOURI 06315

Align the center of your body with the j key.

To type the w, poise the s finger about ¼ of an inch above the center of the w key and use a pulling motion toward the palm of the hand. The follow-through should carry the s finger over that home key. Keep the f-d fingers anchored to those home keys.

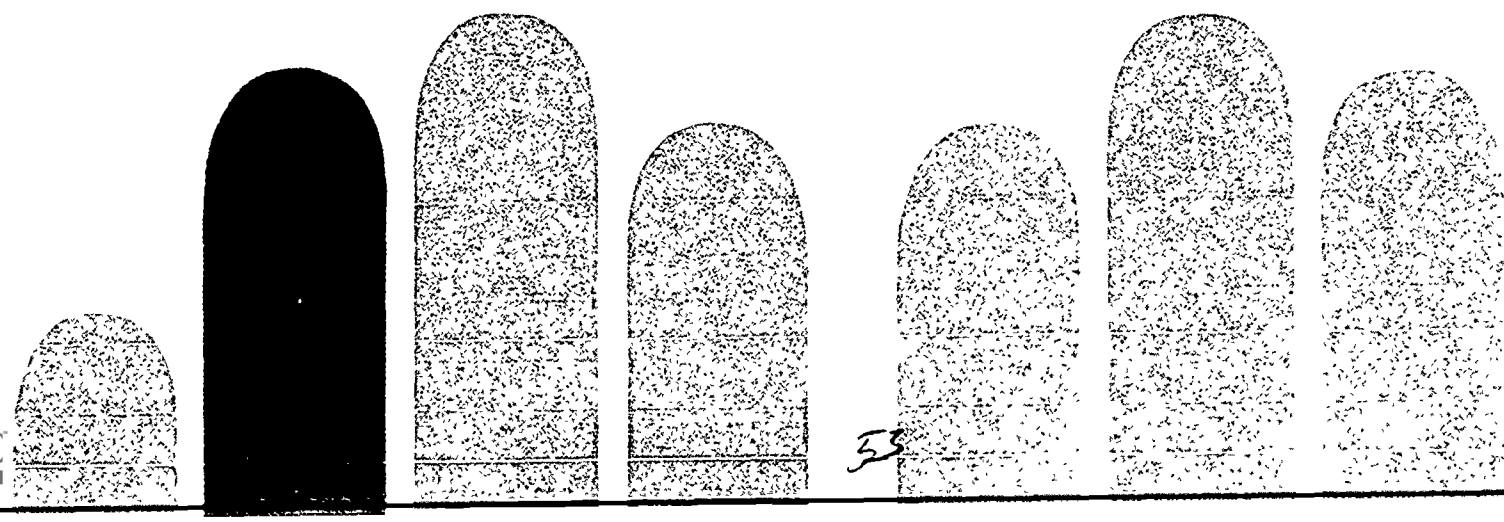
SENTENCES

		New Key	Approx. Words	Cum. Par.
1	I will show her how we work.	w	5½	6
2	Whose work is this?	W	4	10
3	Will we show two?		3½	14
4	Whose work will he see?		4½	19
5	With whose show was he?		4½	24
6	Who was with that girl?		4½	29
7	Few wish to look for work.		5	34
8	Where will we walk? Walk forward while we talk.		9½	45
9	Who saw how we work? We will show her how we work.		10	55

MARGINS:
PICA--12 and 72
elite--21 and 81

PARAGRAPHS

	Words
What will he write with this week? Will he waste	10
a whole week?	13
We who saw well saw how it works; it writes well.	23
He saw how well it writes.	28
Write his will with it if it writes well. We wish	39
to show her how well it writes. We will all see whether	50
it writes well.	53



ADDRESSING ENVELOPES

When several envelopes of the same size are to be addressed, one does not take the time to count the exact number of lines to the first line of the address. Try the following to see how simple it is to estimate quickly and still be quite accurate in placement.

1. Insert a No. 6 envelope, make the top edge flush with the top of the aligning scale, and count twelve spaces from the top. (If an envelope is not handy, use a sheet of paper.)

2. Observe how much (fraction of an inch) the top edge of the envelope extends beyond the top of the paper bail. Retain the mental image of that fraction of an inch which protrudes beyond the top of the paper bail.

3. Use the paper release and remove the envelope. Reinsert the envelope. Without counting, twirl the cylinder knob to position the envelope for the first line of the address.

4. To see how accurate the vertical placement is, count the number of clicks as you roll back to the top edge of the envelope.

To estimate the horizontal placement of the address:

1. Move the carriage freely as you look at the typebar guide in relation to the left and right edges of the envelope.

2. When you have estimated the center, backspace five spaces and set the left margin stop.

Type the illustrated envelopes that appear on the next three pages. Use the simulated envelopes on Workbook pages 24 through 28. Then in the margins to the right of the envelopes you have typed, type the information that appears in the textbook.

SENTENCES

		Approx. Words	Cum. Par.	Cum. Par.
1	Who will show her how to write his will?	8	8	
2	We who work with that show will do well.	8	16	
3	We will show the girl where he will work.	8	25	
4	We will show his work to the whole world.	8	34	
5	He will walk forward with two show girls.	8	42	
6	This is how we will show the whole world.	8	51	
7	His wish was to work with those who write.	8½	60	
8	We will talk with those who wish to write.	8½	68	8
9	We will show the whole world what is right.	8½	77	17
10	We will do half; we will do this half well.	8½	86	26
11	With what show did he work two whole weeks?	8½	95	35
12	I wish those who worked well were with her.	8½	104	44
13	The girl who saw how we work is still here.	8½	113	53
14	She will write to tell her how well we work.	9	123	63
15	He will tell her whether he likes this show.	9	132	72
16	We who do this worthwhile work will do well.	9	141	81
17	We will walk to the well with the two girls.	9	150	90
18	We will write this worthwhile law this week.	9	159	99
19	Show her how we will work together this week.	9	169	109
20	Those who wish to do so will work with water.	9	178	118
21	We wish to show her how we will walk forward.	9	188	128
22	He wrote his will while he was with the show.	9	197	137

1 2 3 4 5 6 7 8 9

Note: Type the date on line 14 or 2 lines below letterhead, whichever is lower.

This sheet may be used as a backing sheet.

LETTER–PLACEMENT CHART

	Short	Average	Long	Two-Page
Words in letter	Under 100	100-200	200-300	Over 300
Length of line PICA margins elite margins	4 inches 22 and 62+ 27 and 75+	5 inches 17 and 67+ 21 and 81+	6 inches 12 and 72+ 15 and 87+	6 inches 12 and 72+ 15 and 87+
Date to address	8 lines	6 lines	4 lines	4 lines

SENTENCES

		Approx. Words	Cum. Par.
1	What will he write with this week?	7	7
2	The whole world will like that show.	7	15
3	He will talk while we show the list.	7	22
4	Her wish was to work where he worked.	7½	30
5	Those who wish to work will walk. Few will look for work this week.	13½	44
6	What will we work with this week? We will show her how well we work.	14	58
7	Those who write well will work here. We will show her how few work well.	14½	73

1 2 3 4 5 6 7 8 9 10 11 12 13 14

MARGINS:
PICA--12 and 75
elite--21 and 84

TEST 6

	Words
The girls who saw how we work are still here. We wish	11
to show Lois Law how we will work with her. She will work for	24
Will White for a while. He will show her what we wish to do.	36
Will White will tell her who will work with her while we	48
write the other show. He will tell her whether she will work	60
two or three weeks. Wish her well with her work.	70
He will tell her how well we work together. We wish to	81
show others how well we work. Where will I work this week?	93
Work with Will White. All who were with Will White saw	105
how well he works.	109
Where will those two girls work while we show Lois Law	120
his work? We who were with her saw how well she works.	131
What work will he do this week?	138

1 2 3 4 5 6 7 8 9 10 11 12

Qualifications of Audrey Perreault
(Continued)

PREFER TO TEACH

Shorthand | Office Machines | Typewriting

SECRETARIAL ABILITIES

Shorthand: 140 words a minute
Typewriting: 85 words a minute
Office Machines (working knowledge):

Burroughs Calculator	Comptometer
Monroe Calculator	Mimeograph
Ediphone	Duplicator
Dictaphone	Bookkeeping Machine

SPECIAL QUALIFICATIONS

Speak and write French
Play the piano
Can direct glee club

REFERENCES

Miss E. Doris Locke
Athens Senior High School
Athens, Georgia 30601

Dr. Robert J. Morey
Brown College
Rome, Georgia 30161

Mr. Frank A. Williams
President and General Manager
Peach & Webb Company
271 Westminster Street
Rome, Georgia 30161

MARGINS:
PICA--7 and 80
elite 16 and 89

TEST 7

	Words	
We who saw how well Will White works wish he were with this show.	13	
We who saw the whole show will talk with Will White while the others see	28	
the show. We will ask Will whether he will write a show for Lola Low.	42	
Few writers write as well as Will White does.	52	
Those who saw the whole show liked it. I wish all those who saw	65	
the whole show were still here. Look at the show while we work.	78	
Will we work two whole weeks if Will White writes the show? Will	91	
we work where he wishes? Will he write the whole show while we work	105	
here? It will take two whole weeks to see other writers. Those who	119	
wished to work last week were with those who wish to write this show	133	
with Will. How good was his last show?	141	Words
I wish Will White had two or three whole weeks to work with other	154	13
writers. We will waste a whole week if we wait for other writers to	168	27
work with Will.	171	30
Will we work this week? Will the others waste a week too? We who	185	44
work this week will write the whole show with Will White. Those who	199	58
wish to do so will work with Lola Low for a week or two if the weather	213	72
is good. We will walk to work if the weather is good.	224	83
Lola Low will work with the show girls for a week while we write	237	96
the show with Will White. Her wish is to work with the show girls for a	252	111
whole week. She also wishes to work with the writers for a whole week.	266	125
I wish Lola has good weather for two whole weeks. I will show her	280	139
how we will work together. Those show girls who work with Lola for a	294	153
week will work two weeks if the weather is good.	304	163

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Qualifications of

AUDREY PERREAULT

Candidate for the position of

TEACHER

PERSONAL

Name:	Audrey F. Perreault
Address:	18 River View Drive, Bath, Maine 04530
Telephone:	245-9026
Age:	21
Marital Status:	Single

EDUCATION

High School:	Albany High School, Albany, Georgia
Course:	Commercial
Graduation:	19--
College:	Brown College, Rome, Georgia
Degree:	Bachelor of Science in Business Education
Major:	Secretarial Sciences
Graduation:	Will be graduated August 3, 19--

EXPERIENCES

Practice teaching September 7, 19--, to February 3, 19--, at the Athens High School, Athens, Georgia, under the supervision of Mr. John L. Does, principal, and Miss E. Doris Locke, supervising teacher.

BUSINESS EXPERIENCES

Secretary to English instructor at Brown College for two years; secretary to professor of shorthand and psychology; assisted in organizing data and the preparation of a report of a study on the interrelationships between typewriting efficiency and fatigue.

TEACHER'S CERTIFICATE

Will receive a Statement of Eligibility for a certificate to teach secretarial sciences, bookkeeping and allied subjects, and social business subjects from the State Department upon graduation.

QUALIFIED TO TEACH

Shorthand	Typewriting	Office Machines
Bookkeeping	Filing	Business Arithmetic

and other allied subjects

SENTENCES

		New Key	Approx. Words	Cum. Par.	Cum. Par.
1	I have to serve this reserve.	v	6	6	
2	Serve this reserve. Serve all.		6	12	
3	Several will have high averages.		6½	19	
4	All reserves do have good averages.		7	27	
5	All reserves will have high averages.		7½	34	
6	Advise this reserve to give all averages.		8	43	
7	Advise all reserves to have high averages.		8½	52	
8	Advise this reserve. Give his average too.		8½	61	9
9	Serve with reserves who have high averages.		8½	70	18
10	This reserve will have to give his average.		8½	79	27
11	Give this average to all reserves who serve.		9	88	36
12	Give high averages to all reserves who serve.		9	97	45
13	Reserves with high averages still have to serve.		9½	107	55
14	This reserve will serve; this reserve will save.		9½	117	65

1 2 3 4 5 6 7 8 9

WARMUP SENTENCES

She has to do all of it. — 5

He has to do all of it if he does it. — 7½

1 2 3 4 5 6 7

When you write your own letter of application, compose it so that it will reflect your own individuality. You may wish to consult several reference works, select the ideas that seem to be most appropriate, and adapt them to your own situation.

It may take several attempts under the guidance of your teacher of correspondence or your teacher of English and your teacher of typewriting to compose an outstanding letter and to set it up attractively.

18 River View Drive
Bath, Maine 04530
March 5, 19--

Dr. Edward R. Swanson
Superintendent of Schools
525 Park Lane
Willimantic, Connecticut

Dear Doctor Swanson:

Will you please consider me an applicant for a teaching position in the Business Department of the Willimantic School Department should one become available.

My personal data sheet, which outlines my qualifications and lists my references, is enclosed. Additional data will be gladly furnished at your request.

I should like very much to have the opportunity to talk with you about the possibility of my employment in the Willimantic school system.

Sincerely yours,

(Miss) Audrey Perreault

afp

Enclosure

MARGINS:
PICA--7 and 77
elite--16 and 86

PARAGRAPHS

	Words	Words
I have to advise all reserves. I advise all reserves to save.	13	
All reserves who serve do have high averages. I give high averages.	26	
I have good reserves. I have his average. Give this reserve his	40	
average. This reserve will have high averages.	49	
Advise all reserves to serve well. All reserves will have to	62	12
give. Advise all reserves to give. I have told several to give.	75	26
To give is to serve.	79	30

SUPPLEMENTARY SENTENCES

		New Key	Approx. Words	Cum. Par.	Cum. Par.
S1	Save all five of his votes.		5½	5	
S2	Tell Dave to save his vote.		5½	11	
S3	Have I advised her to leave?		5½	17	
S4	Visit all reserves who serve.	V	6	23	
S5	I have overlooked this average.		6	29	
S6	I advise all who have to serve.		6	36	
S7	Serve those who give live shows.		6½	43	
S8	His visit will give votes to Dave.		7	50	7
S9	Have I ever sold all five to Dave?		7	57	14
S10	He will give this reserve his vote.		7	64	21
S11	Did he ever serve with this reserve?		7	72	29
S12	Advise this reserve to save his vote.		7½	80	37
S13	Reserves who have to serve will visit.		7½	88	45

65

TRANSCRIPTION IMPROVEMENT ASSOCIATION

Founded in 1952

New York, New York 10027

Business Administration Department
Drake College
1 Young Orchard Avenue
Providence, Rhode Island 02906

January 9, 19--

Attention: Mr. John Bryant

Gentlemen:

Subject: Positions of Parts of Business Letters

If you were to leave the usual number of blank lines between the parts of this business letter, it would not be possible to type the entire letter on one page. One purpose of this letter is to give you practice in omitting the space or allowing less space between the parts of a letter.

Type the date just below the top line on the attached letter-placement guide. There should always be at least one blank line between the letterhead and the date.

Another purpose of this letter is to show the order in which some of the less frequently used parts are typed. Notice the position of the attention line, the subject line, the enclosure notation, the notation of carbon copies, and the postscript.

This letter was typed on an elite machine; you may have a pica typewriter. It is possible for you to fit this same letter on one page by making a few additional adjustments. Leave two blank lines for the signature in place of three. Make one paragraph out of the second and third paragraphs. It is also possible, though not desirable, to combine the first three paragraphs. The variable line spacer may be used to leave half a blank line between the paragraphs and the parts of the letter instead of a full line.

Yours very truly,

TRANSCRIPTION IMPROVEMENT ASSOCIATION

RPorter/you
Enclosure
Copy to Mr. Harry Gray

President

P.S. When you are not trying to crowd a long business letter on one page, it is good form to leave one blank line between the parts of the letter, with two exceptions. Leave three blank lines between the date and the address and three blank lines between the firm name and the dictator's title.

MARGINS:
PICA--7 and 77
elite--16 and 86

TEST 8 (Supplementary)

	Words	Words
Who will advise all reserves? He likes to advise all reserves	13	
who serve. How will he ever advise all reserves? I have to list	25	
all reserves who will serve.	31	
This reserve is average. This reserve will serve. List all	43	
reserves with high averages who wish to serve. Do all five old	56	
reserves wish to serve with Dave? I advised all five to serve.	69	
This gives old reserves who have high averages the will to serve.	82	
All five good reserves will have to visit with Dave.	92	
Did he ever overlook this reserve? Will he ever serve? All	105	
reserves will have to serve. Average his low averages; also average	119	
his high averages. I will have a low average; he will have a high	132	
average. A high average will serve this reserve well.	143	
I advised this reserve to vote. Did he ever overlook his vote?	156	13
This reserve will vote if he serves. I have told several to vote.	169	26
Several will have to vote with Dave. Several who have voted will	183	40
advise Dave to vote too.	188	45
Advise this reserve to vote. This reserve will vote. Vote	200	57
with this reserve.	204	61
All five old reserves will have to vote. Five old reserves	216	73
will vote with Dave. Visit Dave to save all five good votes. Five	230	87
good votes will save this show. Visits to five old reserves will	243	100
save this vote. All reserves who serve well will vote also.	255	112

1 2 3 4 5 6 7 8 9 10 11 12 13

NATIONAL PRODUCTS COMPANY

108 University Avenue

New York, New York 10001

March 21, 19--

Mr. Charles Lawrence
32 State Street
Providence, Rhode Island 02906

Dear Mr. Lawrence:

SUBJECT: Enumeration with Numbers Spelled

All enumerations within letters that you have typed thus far have started with figures or letters within parentheses or were followed by periods. This letter illustrates a style of enumeration that differs in three ways from those you have been typing:

First, the numbers in the enumerations are spelled out; they are not as eye-catching as figures followed by a period and two spaces.

Second, the subordinate paragraphs are indented the same number of spaces as the main paragraphs; hence the enumeration does not have the pronounced emphasis of the hanging-number style.

Third, this illustration does not have cut-in margins, which further de-emphasizes the enumeration.

Occasionally the illustrated style may be desirable; for example, if a letter is to be read to an audience, the visual effects of figures, cut-in margins, and hanging numbers are of little importance.

Yours very truly,

President

you

	SENTENCES	New Key	Approx. Words	Cum. Par.	Cum. Par.
1	Who made more?	m	3	3	
2	Mail me a small meter.	M	4½	8	
3	I made more room for him.		5	13	
4	Time him from home to home.		5½	19	
5	Take some of them to market.		5½	25	
6	Make more room for the mail.		5½	31	
7	Order all materials from him.		6	37	
8	His mother is Mrs. M. M. Small.		6	44	7
9	Mr. Small sold this farm to him.		6½	50	13
10	It seems to me I am almost home.		6½	57	20
11	Some of them made this material.		6½	64	27
12	Some of them order his materials.		6½	71	34
13	Mail them to me or to his mother.		6½	78	41
14	I made him look from home to home.		7	85	48
15	Let Miss Small order more material.		7	93	56
16	He made him sell from home to home.		7	100	63
17	Time me while I read this material.		7	107	70
18	Mrs. Small made most of them for me.		7	115	78
19	I made them from some good material.		7	123	86

1 2 3 4 5 6 7

THE OHIO REALTY COMPANY

1586 Webster Street

Akron, Ohio 44309

March 16, 19--

Mr. James White
1785 Park Avenue
New York, New York 10027

Subject: Extreme Block Style Containing an Enumeration

Thus far two of the illustrations of the hanging-number style of enumeration that you have typed in this series have had the right and left margins cut in five spaces. This letter illustrates the extreme block style, which some prefer to call a pure block style. This style eliminates the need to set up tab stops for indentions and does not require the typist to be concerned about cutting in the margins.

The following two points should be kept in mind:

1. The date must be typed at the left margin.

2. All lines of the numbered items must begin at the left margin and must end at the same point as the main paragraphs.

In this letter the enumerated sentences have been emphasized (1) by numbering them and (2) by leaving a blank line before and after each numbered sentence.

Yours very truly,

President

DIC:YOU
Airmail

P.S. With some letter styles, the postscript is either (1) indented the same number of spaces as the main paragraphs are indented or (2) blocked at the margin. With the extreme block style, the postscript is always blocked at the left margin.

MARGINS:
PICA--7 and 77
elite--16 and 86

PARAGRAPHS

	Words
Mrs. Small made me some small items to sell. Most small items	13
sold well. Mrs. Small will mail this item to him. Mrs. Small made	26
me mail two small items.	31
I made Mr. Small some items to market. He took some items with	44
him. It is time to mail more items. Mail him more items this week.	58
Let him order more items from time to time.	67
It took time to mail this item to him. Ask them to market some	80
small item for him. This item is made from time to time. Some of	94
them sell this item. This item is made from his material. Mr. Small	108
sold this item to him. Who made this item?	116

1 2 3 4 5 6 7 8 9 10 11 12 13

SENTENCES

		Approx. Words	Cum. Par.	Cum. Par.
1	Look to him for more work from time to time.	9	9	
2	Take me this time. Make room for his mother.	9	18	
3	He sold him some materials from time to time.	9	28	
4	To make more small items with me is his wish.	9	37	
5	Time me while I walk home. Ask him the time.	9	46	
6	Let Miss Small order more material this time.	9	56	9
7	I miss mail from him. I miss him most of all.	9	65	19
8	Her mother mailed some material from her home.	9	75	28
9	I will miss some of them. He made me miss him.	9½	85	38
10	Tell him more. I shall make more room for him.	9½	95	48
11	Mr. Small sold her this same item for her home.	9½	104	58

1 2 3 4 5 6 7 8 9

71

GENERAL PRODUCTS, INC.

598 Twelfth Avenue

Utica, New York 13503

March 7, 19--

Mr. James White
1785 Park Avenue
New York, New York 10027

Dear James:

Subject: Numbered Paragraphs with Indented Main Paragraphs

Here are a few guides to the use of style named in the Subject line and the reasons for them:

1. Whenever the main paragraphs are indented, you may either indent or block the subordinate paragraphs. This letter illustrates indented main paragraphs and indented subordinate paragraphs.

2. When only the first line of a subordinate paragraph is indented, the enumerated material is not emphasized as much as it would be if all lines were blocked and the numbers were hanging in the margin.

3. Although it is permissible to number or to letter subordinate paragraphs, our office favors the use of numbers when there is only one set of symbols needed in the enumeration.

To review, the materials in the subordinate paragraphs are emphasized by numbering them. Another way to place even more emphasis on the subordinate paragraphs is to block the subordinate paragraphs two spaces after the periods following the numbers.

Yours very truly,

President

LRM:YOU
Copy to Mr. Wheeler

PS The postscript is indented five spaces to make it consistent with the paragraph indentions.

MARGINS:
PICA--7 and 77
elite--16 and 86

TEST 9

	Words
We make good homes. I will show them more homes. We sell small	13
farms; we sell small homes. Work with him while Mrs. Small sells this	27
home for him. Her home is small; she likes a small home.	39
I made him sell his home. Some of these homes are small; almost	52
all of them seem small. This home is small for him. Go with him from	66
home to home. Mr. Small sold this home to him. This time Mr. Small	80
sold me more homes. Mr. Small sold them this large home.	92
Some of them walk from home to home. His mother sold them most	105
of those homes. Look for more small homes. Mrs. Small made me look	118
for a home. Ask him to show me some smaller homes. Ask him to show	132
me more of them. Show me two small homes tomorrow. See me tomorrow;	146
I will have more time tomorrow. Meet me at this same time.	158
He makes smaller homes. How small will he make them? He seems	171
to make good homes. Tell me how to make them. Ask him to show me how	185
he makes them. This will take some time from his other work. It	199
takes some time to make these rooms look small. What matters most is	213
to make them well. He told me to make them small or to make them	226
large.	227
This room seems small; that room is smaller. Give them more	239
room; make this room large. Look to him for some work from time to	253
time. More work from him makes more work for all of them. Order some	267
materials from him.	271

1 2 3 4 5 6 7 8 9 10 11 12 13 14

NATIONAL STATIONERY PRODUCTS

1578 View Street

Peoria, Illinois 61601

March 7, 19--

Mr. James White
1785 Park Avenue
New York, New York 10027

Dear James:

Subject: Numbered Subparagraphs with Modified Block Letters

You have been told that the style our office prefers in typing enumerations would be illustrated and that the reasons for these choices would be stated. The choices are based on two principles:

1. An important consideration is clarity. It should be easy for the reader to pick out any of the numbers. This is done by making the numbers outstanding, that is, by increasing the amount of white space around the numbers. A double space between enumerations makes each enumeration stand out. Enumerations highlight each point and make it easier for the reader to grasp the ideas.

2. Another consideration is consistency. With the extreme block letter, all lines of the enumeration begin at the left margin. With a modified block letter, margins are cut in, the hanging-number style is used, and subparagraphs are blocked two spaces after the period following the number.

Assume that you are working in an office in which the styles and variations shown are favored and other styles are not acceptable. Although you are going to use the styles favored in this office and become aware of the reasons for these choices, you should keep in mind that your next employer may prefer other styles for other good reasons.

Very truly yours,

Robert J. Porter
President

you

SENTENCES		New Key	Approx. Words	Cum. Par.	
1	Which call is his?	c	3½	4	
2	Call this stock room.	C	4	8	
3	Come home to check his card.		5½	14	
4	Take care of this local case.		6	20	
5	I come from school each time.		6	27	
6	Each call comes to this office.		6	35	Cum. Par.
7	Come while I check this record.		6	40	6
8	Call the school for his record.		6	46	13
9	Check his card with his record.		6	53	19
10	Come to school with his record.		6	60	26
11	This check will cover his costs.		6½	66	33
12	He claims he did charge this call.		7	74	40	Cum. Par.
13	Call his office to check all facts.		7	81	47	7
14	Call all districts; call all offices.		7½	89	55	15
15	Which record will come to this office?		7½	97	63	23
16	Call him at school. Call his director.		8	105	71	31
17	Record this check if I call his office.		8	113	80	39

1 2 3 4 5 6 7

ENUMERATIONS (Modified Block)

AMERICAN SHIPPING COMPANY

38 High Avenue

Gary, Indiana 46401

March 1, 19--

Mr. James White
1785 Park Avenue
New York, New York 10027

Dear James:

Subject: Enumerations in Letters

Sometimes it is desirable to number a series of paragraphs, sentences, or items in the body of a letter. The act of listing items one after the other and numbering the series is known as enumerating. The purpose of this series of letters is to

(1) choose a few of the many possible forms in which enumerations may be typed,

(2) give you some reasons for the choices, and

(3) give you practice in typing at least five letters.

Notice that the above enumeration could have been typed as one sentence with a comma after each member of the series and without numbers. However, numbering and leaving a blank line after each member in the series have some advantages over the other method. The advantages will be mentioned in the following letters.

Yours very truly,

President

LRM:YOU

	SENTENCES	Approx. Words	Cum. Par.		Cum. Par.
1	The school office will check all facts.	8	8		
2	Do come to class. Come with his record.	8	16		
3	Come to this school to check his record.	8	25		
4	Come to class. Come if I call his office.	8½	33		
5	Call each home. I shall call each school.	8½	42		
6	Which check is which? Which check is his?	8½	51		
7	Call a local director or call all colleges.	8½	60		
8	I record local calls. Call for local service.	9	70	9	
9	Call his office if he comes to cash his check.	9	79	19	
10	Come if he calls. Come with cash or charge it.	9½	89	29	
11	Call his college. Call while I cash his check.	9½	99	38	
12	Record his call. Take care of this local call.	9½	109	48	
13	Come to record his claim. Come with his class.	9½	118	58	
14	Call each school. Call me at this local office.	9½	128	68	
15	He received all checks. Come to cash his check.	9½	138	78	10
16	Call each office. Call the school for his card.	9½	148	88	20
17	Do come to school. Come to school with his card.	10	159	98	30
18	Call for his record. Call while I cash his check.	10	169	109	40
19	Each school received more cash to cover all costs.	10	179	119	51
20	He took care of local calls. Call a local college.	10	190	129	61
21	Call his committee. Mr. Case will call his office.	10	200	140	72

1 2 3 4 5 6 7 8 9 10

77

Mr. John Price 2 January 9, 19--

At the left margin on line 7, type the name of the person or firm to whom the letter is being written. Backspace from the right-hand margin and type the date. Either center the page number between the name and the date or move the carriage to the scale center and type the figure 2. 317 335 350 363

Leave two blank lines between the heading and the next part of the body of the letter. 377 380

The information in this letter is to guide you in typing the first two-page letter in this course. There are other ways to arrange parts of such letters. Your teachers and employers may suggest to you the variations that they prefer. 393 408 424 427

Yours very truly,

Robert J. Porter
President

you

MARGINS:
PICA--7 and 77
elite--16 and 86

TEST 10

	Words	Words
Which claims come to this office? Record all claims that come to	13	
this office. The school office will check all claims.	24	
Check this claim with this service call. Record this claim while	38	
I call his office. He records all claims. Charge this service call	51	
to his college. Call to claim credit.	59	
This check will cover his costs. Call his office if this check	72	
will cover all costs. The local colleges will cash all checks I	85	
receive.	87	
Each will come to cash his check. Come if he receives his check;	100	
come with his check. Come to me to cash his check; I cash all checks.	115	
Call all colleges. This check will cover all costs.	125	
Which call cost him more? The stock room did call his office to	138	13
ask which call cost more. Local calls do cost him less. I received	152	27
his call. To which office shall I charge this call?	163	36
His office took care of local calls. Call his office. He claims	176	51
that local calls will cost more come fall.	185	59
Local calls will cost more. Charge him for local calls. Charge	198	73
this service call. This service call cost him more.	209	83
Which call is a cash call? Record this service call. Charge	221	96
this service call to that school. Record this cash call; also record	235	110
this charge call.	239	113

1 2 3 4 5 6 7 8 9 10 11 12 13 14

TRANSCRIPTION IMPROVEMENT ASSOCIATION

Founded in 1952

New York, New York 10027

January 9, 19--

Mr. John Price
South Hall
1 Young Orchard Avenue
Providence, Rhode Island 02906

Dear Mr. Price:

Subject: Two-Page Letters

When there are three hundred or more words in the body of a letter, 13
it is a long letter that is to be typed on two pages. There are about four 29
hundred words in the body of this letter. 37

Set your left margin on the line at the extreme left of the chart. 50
Set your right margin on the line at the extreme right of the chart. 64

Type today's date just below the top line on the chart. Mr. Price's 78
name is to be typed four spaces below the date. 88

Make two light pencil marks in one of the margins of this letter. Draw 102
one line about one inch from the bottom of the page and draw the other line 117
about two inches from the bottom of the page. When you notice the first 132
pencil mark in the margin, that is the time to think of the best way to end 147
the first page. 150

Try to end the first page with the end of a paragraph. Do not divide 164
a paragraph that has only three lines. If there are four or more lines in 179
a paragraph, divide it so that there are at least two lines on the first 194
page and at least two lines on the second page. 203

One thing to keep in mind is that there should always be a margin of 217
at least one inch at the bottom of the first page. It is all right to leave 233
seven, eight, or more lines as a bottom margin. 242

Use plain paper for the second sheet. Use paper of the same color and 256
quality as the first page. 262

Certain information is of value to the file clerk when the second page 276
is separated from the first. For this reason the name of the addressee, 291
the page number, and the date should appear at the top of the second page. 306

SENTENCES		New Key	Approx. Words	Cum. Par.	Cum. Par.
1	Some people paid his price.	p	5½	6	
2	The people keep this power.		5½	11	
3	He hopes he paid this price.		5½	17	
4	Help her to keep this place.		5½	23	
5	I paid for all parts shipped.		6	30	
6	With help we shipped this part.		6	36	
7	With help we shipped this post.		6	43	6
8	Please make this his special post.	P	7	50	14
9	We hope the post office paid well.		7	57	21
10	Please help her to price this part.		7	65	28
11	We hope the hospital post paid well.		7	72	36
12	We hope to keep this hospital report.		7½	80	44
13	Help the hospital to keep prices low.		7½	88	51
14	I hope to help her to price this part.		7½	96	59
15	Special help with parts is appreciated.		8	104	68
16	The hospital paid these people to help.		8	112	76
17	These people were paid for all reports.		8	120	84
18	She paid this price to keep this report.		8	129	92

1 2 3 4 5 6 7 8

Cum. Par.
8
16
24
32
40
49

SIMPLIFIED
Style Letter 6

Body: 214 aw
267 sw

THE NATIONAL PAPER COMPANY

957 Park Street

Newark, New Jersey 07102

May 2, 19--

Mr. Ray Poe
2 Main Street
Akron, Ohio 14001

SOME FEATURES OF SIMPLIFIED LETTER STYLE

Of the six letter styles illustrated in this book, the last one to have been developed is the simplified letter style, sometimes referred to as the NOMA simplified letter style. More than twenty years ago the National Office Management Association, known as the Administrative Management Society since 1964, recommended this simplified letter style for business letters.

The style resembles the extreme block style and omits the salutation and the complimentary close. The simplified style makes use of the Subject line, typing it in all capitals without the word Subject. At least two blank lines are left above and below the Subject line. The inside address is typed at least three blank lines below the date and may be positioned to adapt to a window envelope.

The dictator's name is typed in all capitals, and at least three blank lines are allowed above his name for his signature. The "cc" is omitted from the carbon copy notation, which appears under the reference initials.

Periods are omitted after the numbers in enumerations; numbers are followed by two spaces. The lines in enumerated paragraphs are blocked under the first letter of the first word.

In addition to simplifying the form, they recommend that special care be given to conciseness, tone, freshness of expression, and simplicity of language.

ROBERT C. WHEELER, MANAGER

you

MARGINS:
PICA--7 and 77
elite--16 and 86

PARAGRAPHS

	Words
We hope to complete part of this report. Complete all pages of	13
this report. Please show him the complete report. He appreciates	26
complete reports. He appreciates copies of this report. He paid for	40
copies of this report. Some people appreciate copies of this report.	54
The post office will keep three copies.	62

1 2 3 4 5 6 7 8 9 10 11 12 13

SENTENCES

		Approx Words	Cum. Par.	Cum. Par.
1	Keep these people pleased. Help keep prices low.	10	10	
2	Please post this letter. I appreciate this help.	10	20	
3	He appreciates complete reports of parts shipped.	10	30	
4	That hospital paid well. Keep that hospital post.	10	41	
5	Please help her to part with this hospital report.	10	51	
6	Keep the period. Some people appreciate this help.	10	62	
7	Post those copies. Help her to complete this page.	10	72	
8	We shipped this post. Please help the post office.	10	83	10
9	Report he shipped all posts. Keep his paid checks.	10	94	21
10	Please make this part. Help her to price this part.	10½	104	32
11	He copies this report. We hope to keep this report.	10½	115	43
12	Help the people at this hospital to keep prices low.	10½	126	53
13	Keep this place. Please tell him to keep his place.	10½	137	64
14	Post to this page. Please keep copies of this page.	10½	148	75

1 2 3 4 5 6 7 8 9 10

OVERHANGING PARAGRAPH
OR HANGING INDENTION
with mixed punctuation
Style Letter 5

Body: 126 aw
138 sw

THE WRIGHT COMPANY

1358 Central Street

Tampa, Florida 33602

August 25, 19--

Mr. George R. Nason
156 North Avenue
Berkeley, California 94704

Dear Mr. Nason:

START each paragraph at the left margin to set up a letter in the overhanging-paragraph style.

START all other lines five spaces in from the left margin.

START every paragraph with the same word if you wish to create a special effect. For example, if you wish to impress the name of your product in the reader's mind, the repetition of the brand name in the overhanging position may help to do this.

START with an underlined word or with a word in all capitals. If you do not wish to underline the overhanging word or to type it in all capitals, then you may wish to indent the following lines enough to expose the entire word rather than to indent the standard five spaces.

Sincerely yours,

THE WRIGHT COMPANY

James M. Eastman
President

JME:TYP

TEST 11

Longest line: 72 spaces

	Words
I priced all parts; I shipped this part. With her help I shipped	13
this part. Post this price. Please complete this price list. Please	27
post the old prices. Some people have paid this price.	39
Please help her to complete this report. Keep at this report.	51
Complete two copies. He appreciates complete reports of parts shipped	66
to the post office. We shipped this part. Please keep this receipt.	80
Please keep a complete file of receipts for all parts shipped to that	94
hospital.	96
All past hospital posts paid them well. Keep this hospital post.	109
This hospital post is a post of power. Keep this post; keep this power.	124
Please keep the hospital here. We hope this program will please some	138
people. Keep two copies of this program. Keep these copies.	150
I hope to complete all parts of this special hospital report. Keep	164
part of this page. Keep this part. Post this part to this page. Keep	178
this page. Keep copies of this report. Complete three copies; keep two	193
copies. He does appreciate complete reports of parts shipped to the	207
hospital. Please show these people copies of this report.	219
Please keep copies of this page with this price list. Please help	232
the hospital to keep copies of all pages. We hope to help these people	246
with this hospital report. Please help the hospital make copies of all	261
pages.	262

1 2 3 4 5 6 7 8 9 10 11 12 13 14

DIRECTIONS for letters 10 and 11. Study Style Letter 4, the indented style. Type Letters 10 and 11 in this style with closed punctuation. Address the simulated envelope on the back of each letterhead.

LETTER 10

Date, Mr. Ray W. Miles, District Manager, 98 Park Avenue, Ames, Iowa 50010, Dear Mr. Miles: When most business letters were written in longhand, the indented form was popular. There was no additional effort involved in indenting, and the setup made it easier for the reader to recognize the paragraph beginnings and the parts of the letter. ¶ Since the indented style is usually accompanied by closed punctuation, it does take more of the typist's time than any other style. It should be pointed out, however, that mixed punctuation may be used with the indented style. ¶ This style projects the image of an older, a more conservative, and perhaps a more dignified and well-established institution. ¶ The indented style, as well as the closed punctuation, is hardly ever used today. Sincerely yours, International Printers, Allen P. Davis, President.

Body: 113 aw
140 sw

LETTER 11

Date, Professor John Lane, 1584 Webster Street, Boston, Massachusetts 02109, Dear Professor Lane: Subject: Apostrophe–Plural Possessives There were two days' delay in mailing our companies' reports. Three banks' figures did not agree with our companies' balances for the month of May. Our companies' accountants worked overtime to find the errors. ¶ Our accountants found that two bookkeepers' poor handwriting caused the errors. Two new girls were hired to do some of our regular bookkeepers' work while they went on a two weeks' vacation. When Mary and Alice returned from their vacations, they had to post two weeks' entries. Some of the beginners' figures were misleading. Ten hours' overtime work cost us about a thousand dollars. ¶ Mr. Near tells me that we can expect at least twenty years' service from the machine that he showed us last week, and it will make our bookkeepers' work easier and more accurate. His company will send a man to give two weeks' instruction without charge, and there is a five years' guarantee on all parts. None of our companies is more than a two hours' drive from a National Business Machines office. Yours very truly, Robert J. Porter, President.

Body: 181 aw
199 sw

NOTE: *In this letter the writer refers to two companies, two beginners, and two bookkeepers.*

	SENTENCES	New Key	Approx. Words	Cum. Par.	Cum. Par.
1	The book is back.	b	3½	4	
2	Bill sells more books.	B	4½	8	
3	Both will be possible.		4½	13	
4	This big book sold best.		5	18	
5	Be home before he is back.		5	24	
6	Bill had both problems right.		6	30	
7	Will members keep both books?		6	36	6
8	Will members keep both bills?		6	43	12
9	Keep back. Time both members.		6	49	19
10	He paid bills for both members.		6	56	25
11	Who is able to sell both books?		6	62	32
12	Both members paid a while back.		6	69	38
13	Bill said both will be possible.		6½	76	45	Cum. Par. 7
14	Bill paid bills for all members.		6½	82	52	13
15	Both did come back with problems.		6½	89	59	20
16	Will both books be like this book?		7	97	66	28
17	Members look for possible problems.		7	104	74	35
18	His problems are still big problems.		7	112	81	43

1 2 3 4 5 6 7

INDENTED
with closed punctuation
Style Letter 4

Body: 118 aw
139 sw

THE STYLERIGHT COMPANY

1800 Grand Avenue

Omaha, Nebraska 69102

August 5, 19--.

Miss Loretta C. Anderson,
1918 Twelfth Avenue,
Akron, Ohio 44309.

Dear Miss Anderson:

This letter is an example of the indented style with closed punctuation. The date line may occupy any one of three positions. It may be centered, may be backspaced from the right margin, or may be started at the center.

All indentations--the paragraphs, inside address, closing lines--are ordinarily indented five spaces. Paragraphs may be indented ten spaces or even begin at the center.

Ordinarily the complimentary close is begun at the center. However, since the firm name is indented five spaces and the title is indented an additional five spaces, it may be necessary to begin the complimentary close farther to the left of center so that no line will go beyond the right margin stop.

Yours very truly,

THE STYLERIGHT COMPANY,

Clyde W. Jackson,
Manager.

CWJ:TYP

MARGINS:
PICA--7 and 77
elite--16 and 86

PARAGRAPHS

	Words	Words
Show me both books; show me both bills. Bill is able to mail	12	
both books. The problem is to bill both members. Bill said it might	16	
be possible for both members to come back with both books.	38	
Both members will come back. Bill has to see both members. Ask	51	
Bill to come back with both members. Ask both members to sell little	65	
books or big books. Little books sell better.	75	
His big book is back. Bill does like this book of problems best.	88	13
Both of his problems will be like this problem.	98	23
Show both members of the School Board both books. Better books	111	36
are possible. It will be possible for both members to come back with	125	50
both books before he does. Both members of the School Board will be	139	64
home before Bill. Bill said it might be possible to sell both books.	153	78

1 2 3 4 5 6 7 8 9 10 11 12 13 14

SENTENCES

		Approx. Words	Cum. Par.	Cum. Par.
1	This big book is best. Sell his best book to both members.	12	12	
2	It is possible to be home before he is back with both books.	12	24	
3	Bill said it will be possible to mail both books to members.	12	37	
4	Take some books back. Bill paid this bill for both members.	12	49	
5	Her book of problems is best. Bill does like this book best.	12	62	12
6	Members took both books to school. Members keep these books.	12	74	25
7	Bill is able. Will both of his problems be like this problem?	12½	87	38
8	Bill has this book of problems. Place it below this big book.	12½	100	51

1 2 3 4 5 6 7 8 9 10 11 12

DIRECTIONS for Letters 7 through 9. Study the arrangement in Style Letter 3, the modified block; then type Letters 7 through 9 in this style with mixed punctuation. Type the simulated envelope on the back of each letterhead.

LETTER 7

Date, Filene's, 1414 Abbe's Lane, Fall River, Massachusetts 02722, Gentlemen: Subject: Apostrophe—Singular Possessives There was a day's delay in mailing this year's report. The bank's figures did not agree with our Company's balance for the month of May. Our Company's Accounting Department worked until ten o'clock last Friday to find the error. ¶ It was John's guess that a bookkeeper's handwriting caused the error. Monday's entries were made by one bookkeeper. That bookkeeper's seven looked like a four. Posting was another bookkeeper's job. ¶ Thursday's and Friday's overtime work cost our Company about a thousand dollars. Mr. Near's suggestion, which was received in this morning's mail, is that we buy a machine that will make the bookkeeper's work easier and more accurate. ¶ Please let me know whether Johnson's ad in this morning's Mirror has been called to our Purchasing Manager's attention. I think that Johnson's prices are lower than the prices quoted by Harry Gray's firm. Yours very truly, Robert J. Porter, President.

Body: 141 aw
171 sw

LETTER 8

Date, Men's Faculty Club, 22 Servicemen's Drive, Alton, Illinois 62002, Gentlemen: Subject: Apostrophe—Possessive of Plural Words The women's club asked two of the men's clubs whether they were interested in helping to supervise children's games. We received prompt replies from both men's clubs that they were happy that we had asked them to take part in this undertaking. There were one hundred men's signatures added to the list of women's signatures. ¶ All those who will supervise children's games this summer will be notified at least one week before they are to work. Every Monday a list of the women's names will be posted on the bulletin board, and a list of the men's names will be posted every Friday. The women's club has several books on children's games. These books will be sent to the two men's clubs on Friday. ¶ The only "workmen's compensation" is the pleasure one gets from seeing children enjoy themselves in a constructive way. Yours very truly, Robert J. Porter, President.

Body: 142 aw
161 sw

LETTER 9

Date, Mr. Roy Moore, 88 Johnson Avenue, Boston, Massachusetts 02109, Dear Mr. Moore: Subject: Titles of Company Officials in Apposition Mr. Lee Holmes, our local agent, wrote to Mr. Ray Place, our vice-president, last week and told him that Mr. Paul Greene, our sales manager, and Mr. Dan Day, our general manager, are planning to meet Mr. Kenneth Summers, our New England representative, at a luncheon in Maine on July 10. ¶ On July 15, Mr. George Reed, our chief accountant, and Mr. Lou Little, our chief auditor, will meet Mr. Leo Young, president of Manpower Company, and Mr. John Summers, personnel director of Jones Personnel Agency, at the Crown Hotel in Providence. ¶ I gave your letter to Mr. Harry James, our office manager, on June 10. He has asked Mr. James Winters, our president, and Mr. Bill Teller, our executive secretary, and Mr. Ray Lee, one of our branch managers, to answer your questionnaire. Very truly yours, Robert J. Porter, President.

Body: 134 aw
156 sw

TEST 12

Longest line: 75 spaces

	Words	Words
Bill is back. Bill has problems with his big book; his big book is	14	
too big. This big book is his best book. Bill did his best possible work.	29	
Will this big book be sold below his cost? There will be problems. It	43	
will be possible to sell his better book or both books below his cost.	57	
It will be possible for Bill to show both members his best book of	71	
problems. Show his big book also. Bill said it might be possible to sell	86	
both books. I like both books; both books are good books. Will both books	101	
be sold?	103	
Bill sold his best book of problems. Bill does like this book best.	117	
Bill sold his best book below his cost. Mail this big book before I go	131	
back. Mail that bill with this book. The bill is below this big book.	146	
Will it be possible to sell both books for Bill before I come back?	160	14
It will be possible to sell both books of problems. This member took both	175	29
books. This member likes both books. Bill her or bill me for both books.	190	44
Members work with books; members come for books. Both members took	203	58
a book. Bill them for both books. Either bill both members or bill this	218	72
member.	220	74
Bill has small problems; he likes big problems. Mr. Book has small	234	88
problems. Big problems are possible. Look for possible problems. This	248	102
problem is possible; that problem is possible; both are possible problems.	263	117
It is best to keep both books for possible problems.	274	128

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

91

MODIFIED BLOCK
with mixed punctuation
Style Letter 3

Body: 168 aw
185 sw

TYPEWRITING IMPROVEMENT ASSOCIATION

Founded in 1952

New York, New York 10027

December 10, 19--

Mr. John Greene
121 Main Street
Bath, Maine 04530

Dear Mr. Greene:

It is a pleasure to answer the questions you asked in your letter of December 7. I have done my best to fill in all the blanks on your questionnaire.

According to a survey made more than ten years ago, the style of letter tnat was most used then, the modified block, is illustrated by this letter. The survey sampled the letters of more than two hundred business firms. This style (the modified block) is still very popular, as is the semiblock.

I do agree with you that one of the most useful things a typist learns is how to set up and type mailable letters. Our students type at least ten letters in their first course in typewriting. They make further use of their typewriting skills during the second semester by typing more than thirty letters that they compose.

Next week I can meet with you any afternoon between three and six o'clock. Please feel free to call on me for help and advice of any kind.

Very truly yours,

Robert J. Porter
President

RJP:YOU

	SENTENCES	New Key	Approx. Words	Cum. Par.	Cum. Par.
1	Hand her one of these plans.	n	5½	6	
2	Now I can find another note.	N	5½	12	
3	Send an additional list of bonds.		6½	19	
4	He is sending an additional bond.		6½	26	
5	I know that he sold another bond.		6½	33	
6	Hand her this plan and this note.		6½	40	
7	She cannot own a plan of her own.		6½	47	7
8	An additional loan is not needed.		6½	54	14
9	Do not change this line this soon.		7	61	21
10	I can find no change in this plan.		7	68	28
11	I can plan once the line is shown.		7	75	35
12	Soon we will send this new notice.		7	83	43
13	Find the plans and then thank her.		7	90	50
14	I want this kind and not that one.		7	97	57
15	He sold one bond and then another.		7	104	64
16	Soon he will hand in another note.		7	111	71
17	He has an additional bond on hand.		7	119	79
18	Soon he will need one for his hand.		7	126	86

1 2 3 4 5 6 7

DIRECTIONS for Letters 4 through 6. Study the setup of the semiblock letter style, Style Letter 2, on page 127. Then type Letters 4 through 6 in the semiblock style with mixed punctuation; address the simulated envelope on the back of each letterhead.

LETTER 4

Date, Miss Mae Reed, 11 High Road, Dallas, Texas 75221, Dear Mae: Subject: Commas Before Nor and Yet (FANBOY) This is not the first letter in this series, nor is this the last letter that you will have to help you type commas in the right place. ¶ None of the sentences in the body of this letter has less than two ideas in it, nor is any one of these sentences to be typed without a comma in it. ¶ This letter does not have enough words in it to be typed in the large box on the chart, nor is it to be typed in the small box. ¶ Most of the words in this letter were taken from a special list, yet not all of them are in that list. ¶ You will not see a second clause that begins with yet or nor very often, yet it is a good idea for you to know when these words need to have commas before them. Yours very truly, Robert J. Porter, President.

Body: 145 aw
133 sw

LETTER 5

Date, Mr. John Little, 22 West Avenue, Ogden, Utah 84401, Dear John: Subject: Commas in a Series Our class will type copies of letters that have one, two, or three hundred words in them. These are known as short, medium, and long letters. Small, medium, and large boxes that appear on a chart are guides for the person who types one of these letters. Copies of these charts appear in typing books, may be drawn by you, or may be obtained free of charge by writing to some firms. ¶ Put a comma before the last and, or, or nor in listed words. A comma is placed before the last and, or, or nor to make sure that the meaning is clear. Follow this closed style when you type legal papers, business letters, and official papers. ¶ Take this letter in your notebook as I read it to you, type two copies, and then read your typed copy to see that you made no comma errors. Yours very truly, Robert J. Porter, President.

Body: 147 aw
151 sw

LETTER 6

Date, Miss Jane Young, 8 Autumn Place, Ames, Iowa 50010, Dear Jane: Subject: Commas in Sentences Beginning with As, If, and When If you read many business letters, you will notice that the writers often express a thought by starting with as, if, or when. As a matter of fact, one of these three words is at the beginning of most clauses and other expressions that come before a main clause. When you type a sentence that begins with as, if, or when, place a comma before the main clause. ¶ When an as, if, or when clause follows the main clause, do not separate the clauses with a comma. As you can see by comparing this sentence with the opening sentence of this letter, no comma separates the if clause from the main clause if the main clause comes before the if clause. ¶ If you would like to type letters in less time from your notes, learn these three cue words and be ready to type the comma when you see any one of them at the beginning of a sentence. Yours very truly, Robert J. Porter, President.

Body: 159 aw
163 sw

MARGINS:
PICA--7 and 77
elite--16 and 86

PARAGRAPHS

	Words
Her plan is in; thank her now. Hand her this personal note of	13
thanks. I think I can change a line or two in this note. Change that	27
line and change one word in this line. Do not change another line.	40
He cannot take on additional work. He needs additional training.	54
He knows it and knows it well. He is following this training plan.	67
He will then go to another training school. He plans to send in an	81
application. I need one person with good training.	91
Hand him another one of these plans. This one is not done; that	105
one is done. There is one change on this plan. Notice the change and	119
then send this plan to his new training school.	128

1 2 3 4 5 6 7 8 9 10 11 12 13 14

SENTENCES

		Approx. Words	Cum. Par.	Cum. Par.
1	I know that he can find new plans; I know that I cannot.	11	11	
2	Hand in this new note now and hand in another note soon.	11	23	
3	I can hand her this plan. I know it cannot change soon.	11	35	
4	We cannot and do not wish to change this plan this soon.	11	46	
5	He cannot go now; I know he cannot go now. I know I can.	11½	58	
6	He is sending this new plan. I know it need not be done.	11½	70	12
7	Soon he will hand in a plan for this new training school.	11½	82	23
8	Change one of these plans and then send it with this note.	11½	94	35
9	I cannot find the plan. He is sending an additional plan.	11½	106	47
10	He can find work once he wants to. What kind does he want?	12	118	60

1 2 3 4 5 6 7 8 9 10 11

95

SEMIBLOCK
with mixed punctuation
Style Letter 2

Body: 128 aw
150 sw

THE NATIONAL BOOK COMPANY

281 Commerce Street

Detroit, Michigan 48233

December 14, 19--

Mr. Edward Davidson, Jr.
575 110th Street
New York, New York

Dear Mr. Davidson:

This is a semiblock letter. Half of the letter is blocked, and half is indented; that is, the body is indented, and the address and signature sections are blocked.

The date may be centered, may be backspaced from the right margin, or may be started at the center. The paragraphs are indented five spaces, although some typists prefer to indent them ten spaces.

The closing lines are started at the center. Occasionally the closing lines are typed to end flush with the right margin.

The semiblock style is an attractive letter layout, especially when the date ends flush with the right margin.

The sample letter you are now typing uses mixed punctuation, which calls for a colon after the salutation and a comma after the complimentary close.

Very sincerely yours,

President

DIC/you
Enclosure
Airmail

MARGINS:
PICA--7 and 77
elite--16 and 86

TEST 13

	Words	
I can find his note; then I can list all notes on this long sheet.	13	
I will also send this note once I know the kind of work he wants. One	28	
has to know what he wants; then one has to know when he wants it sent.	42	
His agent will also thank her once he sees this bond and this new note.	56	
Once again he will want to hand her this plan and this note.	68	
He and I can plan new loans; then I can find plans for his new	81	
training school. Now and then bonds will be sold for an addition to	95	
his new training school. I think that his agent will want to know when	109	
to send this bond. She is enclosing the following list and is also	123	
enclosing a long personal note and an additional plan. Thank her now	137	
for enclosing the long list of bonds.	145	Words
I can find his new note and then list all notes on this long	157	12
sheet. I know he is enclosing new plans for an addition to this new	171	26
training school. Note that he is following this training plan and is	185	40
doing well.	187	42
Hand her this plan when I thank her. His agent will also thank	200	55
her when he sees this note and this new plan. He knows when to change	214	70
this plan. Now and then he needs to find new plans.	225	80
His agent is on another list. We think he is doing fine work.	238	93
Notice the fine work he is doing since he went in training. He can	251	107
find work when he wants to.	257	112

1 2 3 4 5 6 7 8 9 10 11 12 13 14

LETTERS

There are two kinds of letter-placement charts in the Workbook, pages 5 and 20. Your teacher will recommend one of these charts. (These charts also appear on pages 124 and 146 of the textbook.)

Use the letter-placement chart as a backing sheet and type the extreme block letter shown in Style Letter 1, page 123. Type your own letterhead on page 7 in the Workbook and center the three-line letterhead on lines 8, 10, and 12. After you have completed the letter, type the name of the parts in the margin of your letter.

WORD COUNT GIVEN FOR UNARRANGED LETTERS

At the end of each of the unarranged letters that you will be asked to set up, the count of *actual words* in the body of the letter is given before the abbreviation *aw*. The count of *standard words* is given before the abbreviation *sw*. (Five strokes, including spaces, count as one *standard word*.)

Once you know the number of words in the body of a letter, refer to the letter-placement chart; it informs you where to set your margin stops.

DIRECTIONS for Letters 1 through 3. Examine the style in Style Letter 1 on page 123, the extreme block. Type three letters in the extreme block style with open punctuation. Use the letterheads in your Workbook, pages 8 through 10. Type the simulated envelope on the back of each letter.

LETTER 1

Date, Mr. John Price, 5 Case Road, Bath, Maine 04530, Dear John, There are more than one hundred words in this letter. All the letters that you will type this week will have at least one hundred words. No letter will have more than two hundred words. ¶ Set your left margin at the middle line on the left side of the chart. Set your right margin two or three spaces after the middle line on the right side of the chart. Type today's date and Mr. Price's name four lines below the date. ¶ The words in this letter were chosen with care. Most of the words were taken from a special list and are the best that you can practice. Notice that there is not one comma in the body of the letter. Yours very truly, Robert J. Porter, President.

Body: 121 aw
123 sw

LETTER 2

Date, Mr. Harry Price, 3 Case Road, Bath, Maine 04530, Dear Harry, Subject: Commas Before For, And, Nor, But, Or, Yet (FANBOY) Most of the words in this letter were taken from a special list, and a few others were chosen to complete thoughts. There are more than one hundred words in this letter, but there are fewer than two hundred words. ¶ Every one of these sentences has a comma in it, but you need to know only one rule in order to put the commas in the right place. There are two ideas in each sentence, and one of the six words given in the FANBOY list joins the first idea to the second. It will be well for you to overlearn this rule, for you will need to apply it in most of the letters that you will type. You may wish to type from this copy, or you may wish to type from the notes that you will take. Yours very truly, Robert J. Porter, President

Body: 140 aw
135 sw

LETTER 3

Date, Mr. John Lowe, 22 High Road, Bath, Maine 04530, Dear John, Subject: Commas Before For, And, Nor, But, Or, Yet (FANBOY) There is a need to review the typing of the comma before words that join two ideas, and that is the reason for this letter. One of the FANBOY words joins the first clause to the second, and the same rule applies to all of the sentences in this letter. You could place a period at the end of the first clause, and you would have a complete thought. The second clause is also a complete thought, but a joining word in the FANBOY list tells us that we should place a comma before the word that joins both clauses. ¶ It is well for you to master this rule, for the rule that you will be taught for the semicolon is based on this comma rule. ¶ There is not one comma in the first main clause in any of the above sentences, nor is there a comma in the second main clause of any sentence in this letter. Yours very truly, Robert J. Porter, President.

Body: 158 aw
157 sw

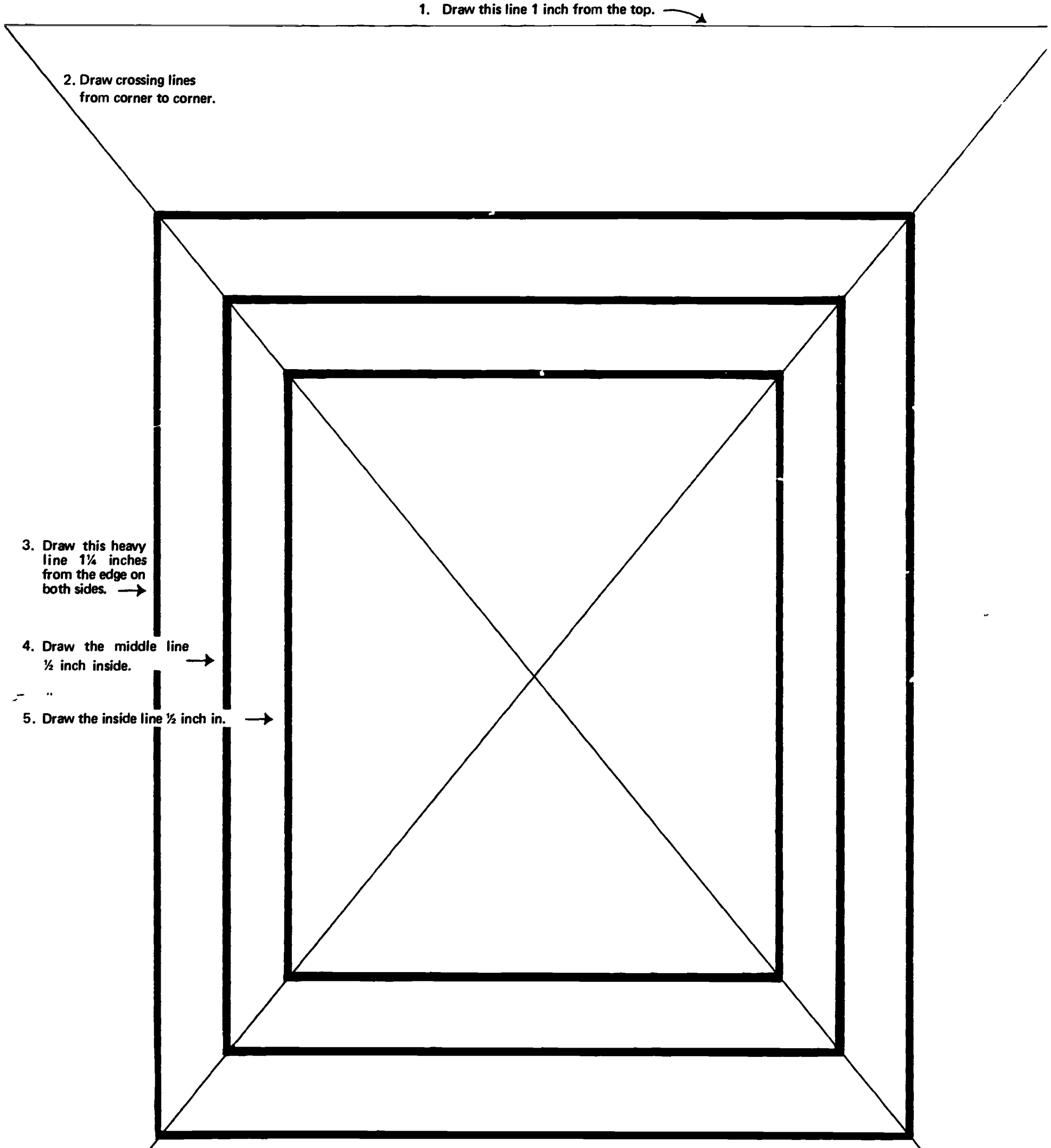
	SENTENCES	New Key	Approx. Words	Cum. Par.	
1	He could go without us.	u	4½	5	
2	Put us out of business.		4½	10	
3	Tell us about his future.		5	15	
4	This group is up at four.		5	21	
5	Our future should be good.		5	26	
6	Send us his account number.		5½	32	Cum. Par.
7	All of us would do without.		5½	38	6
8	I must show them our number.		5½	44	12
9	The amount due us is due now.		6	50	18
10	We must give them our number.		6	56	24
11	This group must be up at four.		6	63	31
12	This account must be our last.		6	69	37
13	We should number our accounts.		6	75	43
14	All of us number our accounts.		6	82	50
15	He told us about his business.		6	88	56
16	Four could be paid this amount.		6	95	63
17	Four of us value our education.		6	101	69
18	He found about him four groups.		6	108	76

1 2 3 4 5 6

Cum. Par.

6 13 19 26 32 39

If you misplace your chart, make your own chart .



LETTER-PLACEMENT CHART

	SENTENCES	Approx. Words	Cum. Par.		Cum. Par.
1	All such business must go through this office.	9	9		
2	Continue to put that number under this number.	9	19		
3	He must continue to issue some new regulations.	9½	29		
4	Much of our education will continue to help us.	9½	39		
5	This insurance building has four numbers on it.	9½	48		
6	Such customers paid a premium for good products.	9½	58		
7	All groups should go through with this purchase.	9½	68		
8	List the amounts he paid us for group insurance.	9½	78		
9	His account is not due until this account is due.	10	89	10	
10	Our customers should make full use of our product.	10	99	20	
11	This group of ours is building four new buildings.	10	109	31	
12	This group of ours puts a high value on education.	10	120	41	
13	Our account is still due. What about his account?	10	130	52	
14	This amount is due. Our future could be up to him.	10	141	62	
15	Our business sold four used books to her on account.	10½	152	73	
16	Our customers should come in during the annual sale.	10½	162	84	11
17	Education is our business; our future should be good.	10½	173	95	22
18	All of us put this group of students through college.	10½	184	106	33
19	All four students should have put this course to use.	10½	195	117	44
20	Her group cannot use our products until further notice.	11	207	128	55
21	We should be through with our course within four weeks.	11	218	140	66
22	Our business school used this building for all courses.	11	230	151	78

1 2 3 4 5 6 7 8 9 10 11

CHART–TEC COMPANY

123 Hope Street
Providence, Rhode Island 02906

DIRECTIONS

Words	Short Letter
1-49	Date begins just inside smallest box.
50-99	Date begins 3 spaces (½ inch) above smallest box.

Medium Letter

100-149	Date begins just inside middle box.
150-199	Date begins 3 spaces (½ inch) above middle box.

Long Letter

200-249	Date begins inside largest box.

Note: Begin the inside address 4 spaces below the date.

LETTER-PLACEMENT CHART

MARGINS:
PICA--7 and 77
elite--16 and 86

TEST 14

	Words	Words
I should have found this enclosure: Our regular annual insurance	13	
premium is due. Such amounts must be paid when due. He should have	27	
paid our insurance premium for us. We should take out this amount for	41	
all insurance premiums.	46	
He should work with us until he is through with our account. He	59	
could and should account to us for all purchases until the building is	73	
up. He could use our business form and put the amount due us on this	87	
first line.	90	
All notices should go out to our customers. It is a pleasure to	103	
give full value to our customers. Show all of our customers our four	117	
buildings and talk about our course. All of our customers should take	131	
this course. This course is given to our customers without charge.	145	
Notice of this course should go out to our customers. It is our	158	13
pleasure to continue sending all issues of annuals to our customers.	172	27
Much of our business is from this group. Meet our customers	184	39
during the annual sale. All four of our customers should come into	198	53
this building during the annual sale. Our number should be on this	211	66
building. Put that number on this building.	220	75
We must number our products. This product should be put to use	233	88
in this building. Further production of this product should be put	247	102
off until the annual insurance premium is paid.	256	112

1 2 3 4 5 6 7 8 9 10 11 12 13 14

EXTREME BLOCK
with open punctuation
Style Letter 1

Body: 155 aw
182 sw

TYPEWRITING IMPROVEMENT ASSOCIATION

LETTER-HEAD

Founded in 1952

New York, New York 10027

DATE August 5, 19--

INSIDE ADDRESS
Standard Electric Company
818 Tenth Avenue
San Francisco, California 94101

SALUTATION Gentlemen

BODY

This letter has eight basic parts. After you have typed the letter, type the name of each part in the margin next to the part it identifies.

The extreme block style is illustrated by this letter. No tabular stop is needed, since all lines begin at the left margin. This style has the advantage of requiring fewer mechanical manipulations; it is efficient. However, it is unbalanced to the left; it has the outline of a bell standing on end.

To some it has a monotonous appearance. It gives some the impression that the emphasis was on production and that a few extra seconds could not be devoted to creating a well-balanced page.

Others believe it has that look of efficiency and that it has a more modern appearance than many other styles.

Two forms of punctuation seem appropriate for the extreme block style--open and mixed punctuation. Open punctuation is illustrated in this letter.

COMPLIMENTARY CLOSE

Sincerely yours

TYPEWRITING IMPROVEMENT ASSOCIATION

NAME AND TITLE
Robert J. Porter
President

REFERENCE INITIALS RJP:TYP

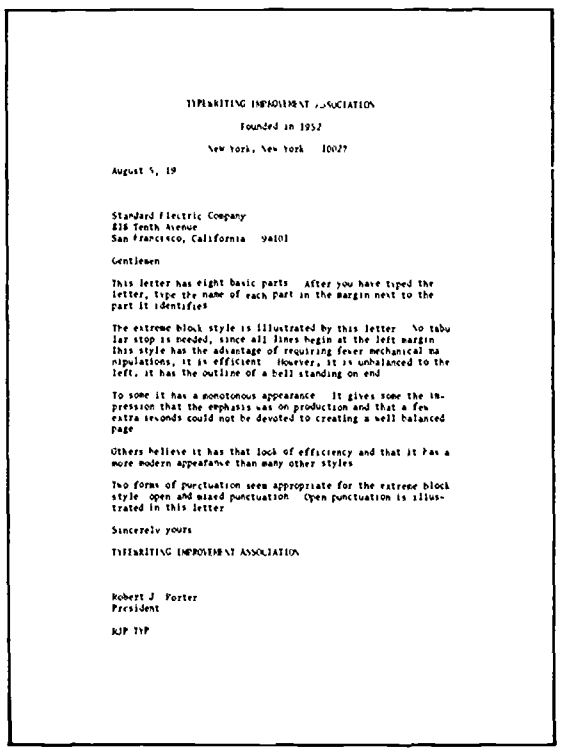
	SENTENCES	New Key	Approx. Words	Cum. Par.	Cum. Par.
1	Business is up, and production is up.	,	7½	8	
2	We could, I am sure, number all accounts.		8	16	
3	Our account is due, and this amount is due.		8½	25	
4	This group is without such help, of course.		8½	34	
5	Of course, he should be through about four.		8½	43	
6	This group, I am sure, sold us four buildings.		9	53	
7	Of course, all of us should value his account.		9	62	9
8	Some of us, I am sure, must value an education.		9½	72	19
9	Our account is not due, but his account is due.		9½	82	29
10	All of us should purchase this product, of course.		10	92	39
11	Insurance is a must, and four of us paid the premium.		10½	103	50
12	Of course, all of us should have found this building.		10½	114	61
13	This issue must be found, and all but four were found.		11	126	73
14	This group must go without us, for I value our business.		11	137	84
15	All of us, I am sure, continue to purchase such products.		11½	149	96
16	Education is a must, and all of us must value an education.		12	161	108
17	He must be found, for he could purchase our four buildings.		12	173	120
18	All of us could use more products now, but we must go without.		12½	186	133

1 2 3 4 5 6 7 8 9 10 11 12

105

LETTER STYLES

EXTREME BLOCK
with open punctuation



TYPEWRITING IMPROVEMENT ASSOCIATION

Founded in 1952

New York, New York 10027

August 5, 19

Standard Electric Company
818 Tenth Avenue
San Francisco, California 94101

Gentlemen

This letter has eight basic parts After you have typed the letter, type the name of each part in the margin next to the part it identifies

The extreme block style is illustrated by this letter No tabular stop is needed, since all lines begin at the left margin This style has the advantage of requiring fewer mechanical manipulations, it is efficient However, it is unbalanced to the left, it has the outline of a bell standing on end

To some it has a monotonous appearance It gives some the impression that the emphasis was on production and that a few extra seconds could not be devoted to creating a well balanced page

Others believe it has that look of efficiency and that it has a more modern appearance than many other styles

Two forms of punctuation seem appropriate for the extreme block style open and mixed punctuation Open punctuation is illustrated in this letter

Sincerely yours

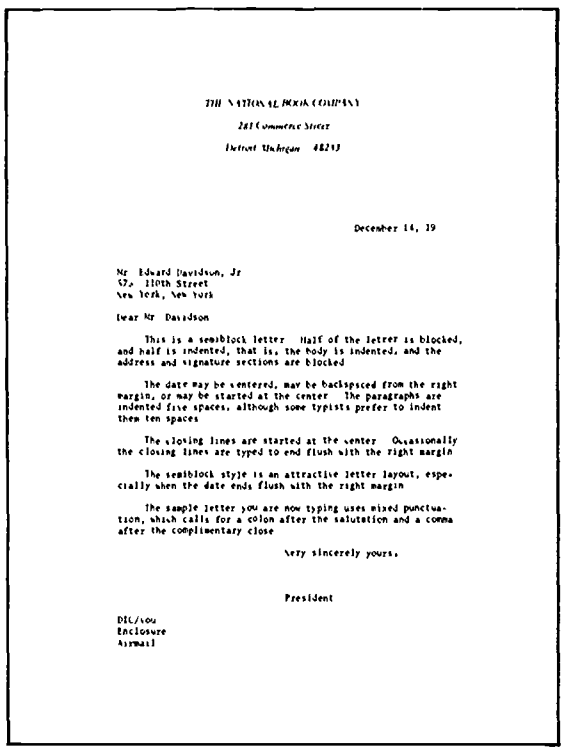
TYPEWRITING IMPROVEMENT ASSOCIATION

Robert J Porter
President

RJP TYP

Style Letter 1

SEMIBLOCK
with mixed punctuation



THE NATIONAL BOOK COMPANY

281 Commerce Street

Detroit Michigan 48243

December 14, 19

Mr Edward Davidson, Jr
572 110th Street
New York, New York

Dear Mr Davidson

This is a semiblock letter Half of the letter is blocked, and half is indented, that is, the body is indented, and the address and signature sections are blocked

The date may be centered, may be backspaced from the right margin, or may be started at the center The paragraphs are indented five spaces, although some typists prefer to indent them ten spaces

The closing lines are started at the center Occasionally the closing lines are typed to end flush with the right margin

The semiblock style is an attractive letter layout, especially when the date ends flush with the right margin

The sample letter you are now typing uses mixed punctuation, which calls for a colon after the salutation and a comma after the complimentary close

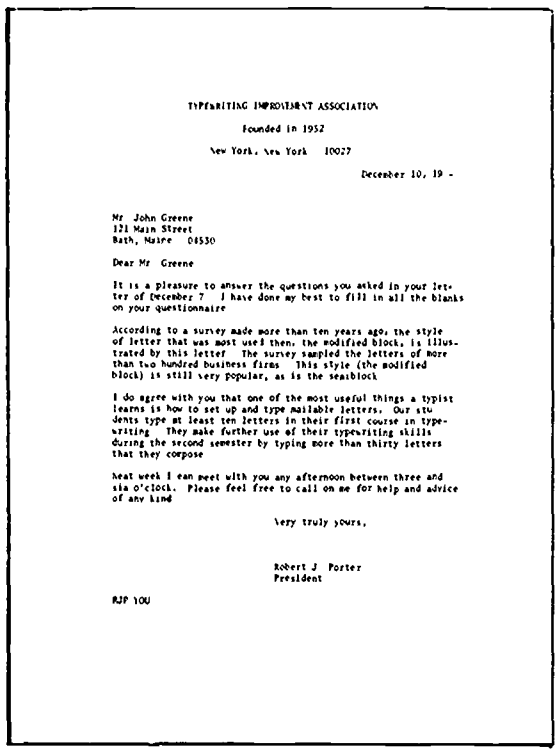
Very sincerely yours,

President

DIC/vou
Enclosure
Airmail

Style Letter 2

MODIFIED BLOCK
with mixed punctuation



TYPEWRITING IMPROVEMENT ASSOCIATION

Founded in 1952

New York, New York 10027

December 10, 19 -

Mr John Greene
121 Main Street
Bath, Maine 04530

Dear Mr Greene

It is a pleasure to answer the questions you asked in your letter of December 7 I have done my best to fill in all the blanks on your questionnaire

According to a survey made more than ten years ago, the style of letter that was most used then, the modified block, is illustrated by this letter The survey sampled the letters of more than two hundred business firms This style (the modified block) is still very popular, as is the semiblock

I do agree with you that one of the most useful things a typist learns is how to set up and type mailable letters. Our students type at least ten letters in their first course in typewriting They make further use of their typewriting skills during the second semester by typing more than thirty letters that they compose

Next week I can meet with you any afternoon between three and six o'clock. Please feel free to call on me for help and advice of any kind

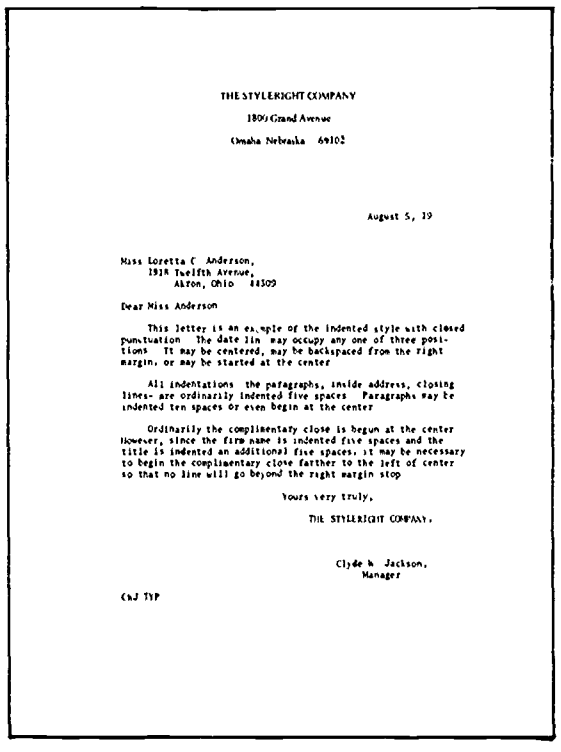
Very truly yours,

Robert J Porter
President

RJP YOU

Style Letter 3

INDENTED
with closed punctuation



THE STYLERIGHT COMPANY

1806 Grand Avenue

Omaha Nebraska 68102

August 5, 19

Miss Loretta C Anderson,
1918 Twelfth Avenue,
Akron, Ohio 44309

Dear Miss Anderson

This letter is an example of the indented style with closed punctuation The date line may occupy any one of three positions It may be centered, may be backspaced from the right margin, or may be started at the center

All indentations the paragraphs, inside address, closing lines- are ordinarily indented five spaces Paragraphs may be indented ten spaces or even begin at the center

Ordinarily the complimentary close is begun at the center However, since the firm name is indented five spaces and the title is indented an additional five spaces, it may be necessary to begin the complimentary close farther to the left of center so that no line will go beyond the right margin stop

Yours very truly,

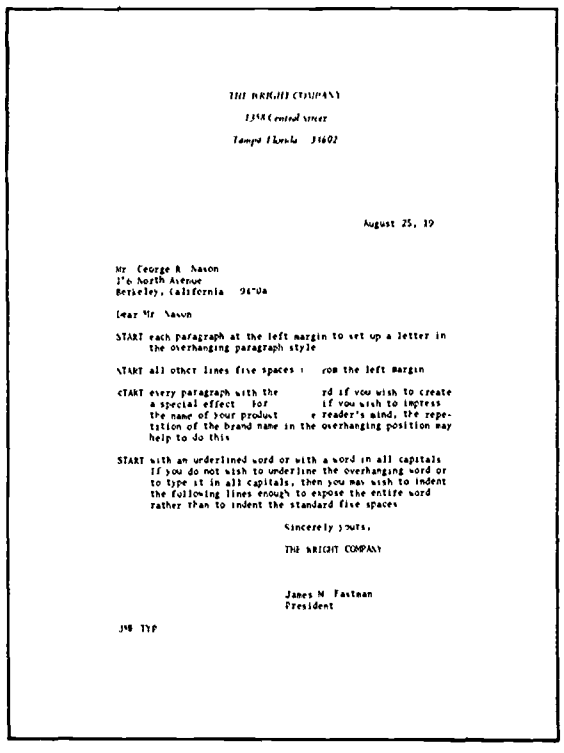
THE STYLERIGHT COMPANY,

Clyde K Jackson,
Manager

CKJ TYP

Style Letter 4

OVERHANGING PARAGRAPH
with mixed punctuation



THE BRIGHT COMPANY

1358 Central Street

Tampa Florida 33602

August 25, 19

Mr George R Nason
176 North Avenue
Berkeley, California 94704

Dear Mr Nason

START each paragraph at the left margin to set up a letter in the overhanging paragraph style

START all other lines five spaces from the left margin

START every paragraph with the word if you wish to create a special effect for if you wish to impress the name of your product on reader's mind, the repetition of the brand name in the overhanging position may help to do this

START with an underlined word or with a word in all capitals If you do not wish to underline the overhanging word or to type it in all capitals, then you may wish to indent the following lines enough to expose the entire word rather than to indent the standard five spaces

Sincerely yours,

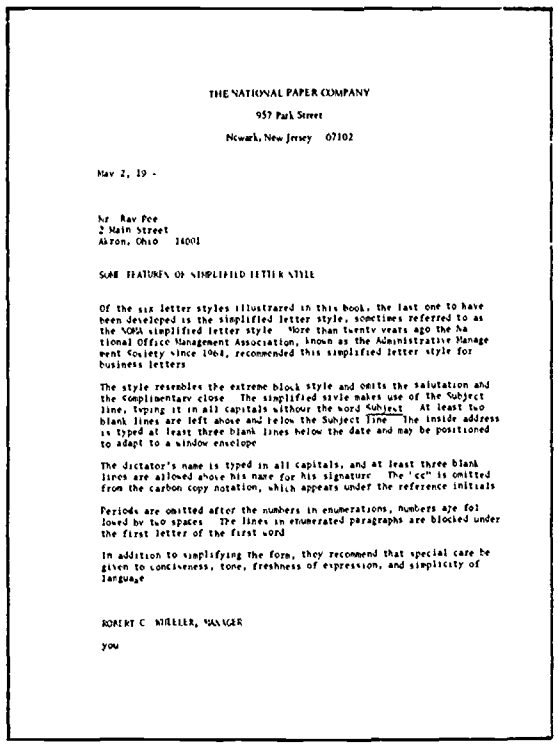
THE BRIGHT COMPANY

James M Eastman
President

JME TYP

Style Letter 5

SIMPLIFIED



THE NATIONAL PAPER COMPANY

957 Park Street

Newark, New Jersey 07102

May 2, 19 -

Mr Ray Poe
2 Main Street
Akron, Ohio 44001

SOME FEATURES OF SIMPLIFIED LETTER STYLE

Of the six letter styles illustrated in this book, the last one to have been developed is the simplified letter style, sometimes referred to as the NOMA simplified letter style More than twenty years ago the National Office Management Association, known as the Administrative Management Society since 1968, recommended this simplified letter style for business letters

The style resembles the extreme block style and omits the salutation and the complimentary close The simplified style makes use of the Subject line, typing it in all capitals without the word Subject At least two blank lines are left above and below the Subject line The inside address is typed at least three blank lines below the date and may be positioned to adapt to a window envelope

The dictator's name is typed in all capitals, and at least three blank lines are allowed above his name for his signature The "cc" is omitted from the carbon copy notation, which appears under the reference initials

Periods are omitted after the numbers in enumerations, numbers are followed by two spaces The lines in enumerated paragraphs are blocked under the first letter of the first word

In addition to simplifying the form, they recommend that special care be given to conciseness, tone, freshness of expression, and simplicity of language

ROBERT C WHEELER, MANAGER

you

Style Letter 6

ERIC Full Text Provided by ERIC

MARGINS:
PICA--7 and 77
elite--16 and 86

TEST 15

Words

Insurance is a must for our customers, and group insurance is a 13
must for us. Tell our customers to purchase more insurance through 26
us, and our president should purchase more group insurance. 38
All of us, I am sure, number our accounts. This number, which is 52
his account number, must be found, of course. His insurance premium 66
is due, and this amount is due. This amount is due us, and our future 80
looks good. 82
Our agent should purchase four of his used books, and our used 95
books must be sold. All of us could stock more used books, but we 108
must go without such books during our current building period. We 122
should be through with our current building program within four months 136
or so, and purchases of used books for our business should be put off 150
until then. 152
All of us, I am sure, purchase premium products through her. Of 165
course, without her this group cannot find out about our account. The 180
amount due must be paid, or four groups will go out of business. Put 194
it off until further notice, for our account is not due until the 207
annual sale. 209
All of us should value his business. Of course, he used all four 223
of our products. He told us much about our products. His future with 237
us, I am sure, could be up to us. 244

1 2 3 4 5 6 7 8 9 10 11 12 13 14

107

16 MAILING NOTATION

A mailing notation—such as *Airmail, Registered,* or *Special Delivery*—typed on the letter is a reminder to the secretary or the typist to type the notation on the envelope and to see that adequate postage is affixed. Also, the notation on the file copy may be the only record available for quick reference in the future.

17 CARBON COPY NOTATION

A "cc" (carbon copy) notation is the sender's record of those who were to receive copies; the notation also informs the addressee of the persons to whom copies were sent.

Some forms of the notation are:

```
cc Mr. Dale        cc:  Mr. Hunt        CC Mr. Fine
   Mr. Law              Mr. Lane           Mr. Miles


CC--Miss Kane      c.c. INI             C.C. Mr. A. Stone
    Mrs. Case           NLY                 Mr. J. Stone
```

Place a check mark in front of the name of the person to whom each carbon copy is to be sent.

If a letter is reproduced without carbon paper, type *Copy to Mr. Dana.*

18 POSTSCRIPT

A postscript is a sentence or a brief paragraph added at the end of a letter. A postscript can be very effective if it is used to emphasize an important idea. It should not be used to record a thought that came to mind after the letter had been typed.

Type a postscript one blank line below the last notation or, in the absence of notations, under the reference initials. Block it or indent it as you did all other paragraphs in that letter. Begin the paragraph with *P.S., PS, PS:,* or *PS—* or omit the letters *PS.*

ORDER OF NOTATIONS AND POSTSCRIPT

```
DIC:YOU
Enclosure:  Check

cc:  Mr. Ray Grant
     Miss Sue Lord

     P.S.  Notations and a...
may require....
```

```
DIC/you
Enclosure:  Card
Special Delivery

cc Mr. Bob Hunt
   Mr. Dan Dodd

     PS  One illustration...
to see in a way....
```

	SENTENCES	New Key	Approx. Words	Cum. Par.	
1	That question is required.	q	5	5	
2	Also, request more equipment.		6	12	
3	Additional equipment is requested.		7	19	
4	We question both equipment requirements.		8	27	
5	All requested equipment is not required.		8	36	
6	Request more help; also, request equipment.		8½	45	Cum. Par.
7	We plan to question equipment requirements.		8½	54	9
8	Question this request; number this request.	Q	8½	63	18
9	Some question our one equipment requirement.		9	72	27
10	Without question more equipment is required.		9	81	36
11	Some question all new equipment requirements.		9	90	46
12	One question is about equipment requirements.		9	100	55	Cum. Par.
13	Request more equipment; number this equipment.		9	109	65	9
14	Should we question those equipment requirements?		9½	119	75	19
15	Request some equipment; then question his request.		10	130	85	30
16	Request good equipment if new equipment is required.		10½	141	96	41
17	Our question about equipment requirements is required.		11	152	107	52
18	Ask his question; then question equipment requirements.		11	163	118	63

1 2 3 4 5 6 7 8 9 10 11

Unnecessary capitalization may be so attention-getting that it distracts the reader from the message. It is not in good taste to scream at the reader by typing in red, using solid capitals, and underscoring all at the same time.

Whenever an attention line is used, the salutation is *Gentlemen* whether the firm is composed of men and women or exclusively of men. And it matters not whether a man's or a woman's name appears in the attention notation.

If a firm is composed exclusively of women, then the salutation is *Mesdames* or *Ladies.*

(13) SUBJECT LINE

The subject line serves the purpose of a heading that previews the content of the message. Therefore, it logically belongs just above the body of the letter. It aids the secretary who opens the mail to sort it for delivery. It aids both sender and receiver who file by subject.

One blank line is left above and below the subject line. Illustrations of the arrangement and horizontal placement of the subject line are given in the discussion of the attention line.

(14) COMPANY NAME

The firm name, if used, is usually typed in all capitals one blank line below the complimentary close. Leave three blank lines after the firm name for the signature.

In some letter styles the firm name begins at the center of the sheet. If the firm name is long, guard against allowing it to extend beyond the right margin stop. If in doubt as to its length, backspace the long firm name from the right margin and start as far left of the center of the sheet as necessary.

(15) ENCLOSURE NOTATION

An enclosure is anything placed into the envelope in addition to the letter. (This is not so in military correspondence, however.) It may be a check or a leaflet or another sheet that is attached to the letter itself.

An enclosure notation typed below the reference initials reminds the person who inserts a letter into an envelope to insert the enclosures also. It aids the one who opens the envelope by reminding him to look for the enclosures.

Sometimes the main purpose of a letter is to send one or more enclosures. Anything that is done to simplify and make more efficient the recipient's work is an act of courtesy as well as a good business practice. Here are some suggestions:

1. Type the word *Enclosure* in full.
2. Give a one- or two-word description and number each enclosure.
3. Write in pencil (so that it can be erased) in the upper right-hand corner of the enclosure itself the number you assign to it, as #2

EXAMPLES:

```
Enclosures:                    Enclosure:  List
     1.  Check
     2.  Leaflet
     3.  Invoice
```

Some of the many forms of enclosures are:

Enclosure	Enclosures 2	Enc. Check
Encl.	Enclosures--3	Enclosures
Enc.	Three Enclosures	Check
2 Enclosures	Enclosure: Card	Booklet
2 enclosures	Check Enclosed	3 Encs.
Enclosures (3)	Enc. (3)	3 encls.

The older practice of leaving one blank line between the enclosure notation and the reference initials is now giving way to writing the notation directly under the initials.

In military correspondence the word is spelled *Inclosure.* Both spellings are acceptable; however, be consistent. Do not type "is enclosed" in the body of the letter and then type "Inclosure" in the notation.

MARGINS:
PICA--7 and 77
elite--16 and 86

PARAGRAPHS

	Words	Words
Some request more equipment; most request some equipment; all	12	
request good equipment. Notice the equipment requirements; then	25	
request some equipment. Request equipment from him; also, question	39	
him about equipment requirements. We question some equipment	51	
requirements.	54	Words
Question equipment requirements or equipment costs. Please	66	12
question me about equipment requirements. Our question concerning	80	25
equipment requirements is a good question. Request good equipment	93	39
if some equipment is required. State equipment requirements on this	107	53
request form.	110	56

1 2 3 4 5 6 7 8 9 10 11 12 13

SENTENCES

		Approx. Words	Cum. Par.	Cum. Par.
1	Other equipment is required. Request more good equipment.	11½	12	
2	Either question this equipment or question this requirement.	12	24	
3	Question equipment requirements or question equipment costs.	12	36	
4	We question both requests concerning equipment requirements.	12	49	
5	Request all questions concerning equipment requirements now.	12	61	
6	This question is required. Some request more good equipment.	12	74	12
7	Some requested more equipment. Little equipment is required.	12	86	25
8	Its equipment is required. Please question this requirement.	12	99	38
9	Question equipment regulations; also, request some equipment.	12	112	50

1 2 3 4 5 6 7 8 9 10 11 12

When an attention line and a subject line are used in the same letter, it is a good idea, though not mandatory, to arrange them in similar styles and to place them in parallel horizontal positions. With some letter styles there is some choice of horizontal positioning of these lines; with other letter styles only one position is proper.

BLOCKED LINES

Attention: Mrs. Doris May

Gentlemen:

Subject: Landscape Concept of Office Design

CENTERED LINES

Attention Mr. Bill Dodd

Gentlemen:

Subject: Landscape Concept of Office Design

LINES INDENTED AS PARAGRAPHS

Attention of the Vice President

Gentlemen:

Subject: Landscape Concept of Office Design

THREE-LINE SUBJECT NOTATION

Attention--Mrs. Grace Hale

Gentlemen:

Subject--Claim 19W60078
Policyowner R. Roy
Date of Loss 12/29/--

UNDERLINED NOTATIONS

Attention: Claims Department

Gentlemen:

Subject: The Significance of Premium Rates and Factors Considered in Determining Rates

The attention and subject lines are sometimes underlined or typed in all capitals to draw attention to these notations. If these lines are the most important parts of the letter, perhaps this is justified. However, both of these notations have blank lines above and below them and are sufficiently outstanding.

MARGINS:
PICA--7 and 77
elite--16 and 86

TEST 16

	Words	
Without question this equipment meets our requirements. This	12	
equipment is required. Work on required equipment. Number the	25	
equipment. More equipment is required. Request more equipment.	38	
Request equipment from him. Request some good equipment.	50	
Question this new equipment requirement. Find the equipment	62	
requirements. Number these equipment requirements. We should	75	
question the equipment requirements. Question equipment requirements	89	
during our meeting.	93	Words
Question all requirements. Number this question; also, request	106	13
more questions. Keep the question about equipment requirements. I	119	26
could question the equipment requirements. Request four lists of	133	40
equipment requirements. Which question is required? Question this	146	53
requirement. Request additional questions concerning equipment	159	66
requirements. Question equipment requirements while we question	172	79
equipment costs.	175	82

1 2 3 4 5 6 7 8 9 10 11 12 13

SENTENCES

		Approx. Words	Cum. Par.
1	This equipment meets our requirements. Request some questions.	12½	13
2	Additional equipment is required. Also, request good equipment.	13	26
3	Some requested low requirements. We question some requirements.	13	39
4	Some requested high requirements; more requested low requirements.	13	53

1 2 3 4 5 6 7 8 9 10 11 12 13

The "bcc" (blind carbon copy) notation is not to be confused with a "cc" (carbon copy) notation, which goes under the reference initials and appears on the original as well as on all other copies. A letter may have a "bcc" and a "cc" notation. Make certain that you prepare enough carbons for all who should receive carbons, in addition to a file copy.

(10) PERSONAL NOTATION

The *personal notation* on the envelope states to all who read it that only the addressee is to open the letter. *Personal* is typed on the envelope whether *Confidential* or *Personal* appears on the letter.

In the letter, type *Personal* or *Confidential* about three lines above the inside address. Underlining is optional.

On the envelope *Personal* is typed in the lower left corner.

(11) REFERENCE LINE

Some large organizations file by numbers. For example, a letter received from the United States Army would have a number, each digit of which stands for a broad or a specific topic. The combination of numbers identifies the subject matter discussed in the letter. These numbers appear in a *reference line.*

Large organizations have such lines as *When replying, please refer to, In replying, refer to, File No. 1111,* and IN REPLY REFER TO 2003-981B5.

If the firm you work for keeps numerical files, type the file number next to the printed reference line, which may be a printed line in the letterhead. If no reference line is printed, type the file number, or the line and the number, four spaces below the date. Follow whatever the practice is in your office. There is no need to underline and no need to put that line in all capitals.

When you answer an incoming letter that bears a reference line (as would a letter from the Veterans Administration, for example) type the same number in your SUBJECT line whether asked to do so or not. It will help those who receive your letter.

If your office has its own file reference number, place it below the incoming file reference number.

EXAMPLE: Subject: Your File 952-B42
Our Job 9861

(12) ATTENTION LINE

An attention line is actually a part of the address, since it further pinpoints the recipient. An attention line, which appears on the envelope as well as on the letter, may direct a letter to an individual or to a department. In large companies it speeds delivery.

The question is often raised as to the reason for an attention line: "Why not address it to an individual directly by putting his name on the first line of the address?"

A letter addressed to a person may go unopened for a long time if his duties, vacation, transfer to another branch, permanent separation from the company, illness, etc., take him away from the office. An attention line says to the firm addressed, "I'd like Mr. Jones to look after the business at hand. If Mr. Jones is away, please have the person assigned to assume his duties take care of this matter without hesitation."

	SENTENCES	New Key	Approx. Words	Cum. Par.	
1	Take just good jobs.	j	4	4	
2	Just our subject took the job.	J	6	11	
3	Just his subject is about jobs.		6	17	
4	Just give our subject this job.		6	24	
5	Just show our subject this job.		6	30	
6	Our subject held just this job.		6	37	Cum. Par.
7	Our subject just held both jobs.		6½	44	7
8	Subject him to just this subject.		6½	51	14
9	Just subject him to this subject.		6½	58	21
10	Most subjects just like this job.		6½	65	28
11	Most subjects just need this job.		6½	72	35
12	Subject them to just this subject.		7	79	42
13	Just subject them to this subject.		7	86	49
14	Just list all jobs; just do this job.		7½	94	57
15	Price just this job; just do this job.		7½	102	65
16	Just fill this job; just plan that job.		8	110	73
17	Just take this job; just plan that job.		8	118	81
18	Just check this job. Just do big jobs.		8	126	89

1 2 3 4 5 6 7

ERIC

Cordially yours,

Dorothy A. Pine

Mrs. Dorothy A. Pine
Vice-President

Yours very truly,

(Mrs.) Alice R. Miles

Alice R. Miles, Ph.D.
Research Consultant

Very sincerely yours,

John Day

John Day, President

Yours very sincerely,

Helen J. Scott

(Mrs. Thomas A. Scott)
Legal Department

8

IDENTIFICATION NOTATION
(Reference Initials)

An identification notation usually consists of the dictator's initials followed by the typist's initials. These reference intials are useful wher ver a question arises about who did what and why.

One blank line precedes the reference notation unless the initials are purposely raised to preserve a 1-inch bottom margin.

If the letter is signed by someone other than the dictator or typist, another set of initials is added in the middle, and a separation mark or space is used between sets of initials.

Infrequently a number is used instead of initials to identify the typist. Sometimes the dictator's last name is spelled in full, as when there are two dictators in the same office with the same set of initials. Here are a few forms:

DIC:TYP	HIS/yrs	YOU	RSmith/urs	DADSr/you
DIC/5	HIS min	sec	tch:stu	SONJr/you

If the dictator's name is typed under his signature, the reference initials may be those of the typist only. However, it is quite proper to type the dictator's initials in all cases.

9

BLIND CARBON COPY

The recipient of the original copy, the addressee, is to be kept "blind" to the fact that others will receive carbon copies. Therefore, remove the original, reinsert the carbon pack, and at the left margin type the notation on line 7:

```
bcc Mr. Smith          bcc Research Department
    Mr. Roberts            Sales Department
    Mrs. Andrews           Engineering Department
```

SENTENCES

		Approx. Words	Cum. Par.	Cum. Par.	Cum. Par.
1	Take just one subject or just this job.	8	8		
2	Just do all jobs; just number this job.	8	16		
3	Just list the jobs. Just do three jobs.	8	25		
4	Just place this subject; just find a job.	8	33		
5	Just change jobs. Change jobs just once.	8	42		
6	Just check our jobs. Just find small jobs.	8½	51		
7	Just find this job. Just ask this subject.	8½	60		
8	Just price this job; just continue that job.	9	69		
9	Take just one subject; just know this subject.	9	79	9	
10	Just find a job; just hand our subject this job.	9½	89	19	
11	This job is subject to change; just change jobs.	9½	99	29	
12	Just help this subject; check just this subject.	9½	109	39	
13	Just find this subject; just check this subject.	9½	119	49	
14	Just notice this subject. Just use this subject.	10	129	60	
15	Just find this subject jobs. Just keep four jobs.	10	139	70	
16	Just name both subjects; just offer both subjects.	10	150	80	10
17	Just keep this subject. His subject is just a job.	10	160	91	21
18	Just make a job. Just offer both subjects this job.	10½	171	102	32
19	Our subject knows just this job. Take just this job.	10½	182	113	43
20	Just find another job. Just subject him to this job.	10½	193	124	54
21	Our subject just did this job. Just call our subject.	11	204	135	65
22	Just take one subject. His subject is just about jobs.	11	216	146	76

1 2 3 4 5 6 7 8 9 10 11

117

(5) BODY

In most business letters the body, or message, is single-spaced. One blank line is left between paragraphs.

To aid letter readers, keep paragraphs fairly short. For example, in a letter containing about 150 words, there should be at least three or four paragraphs.

When the body of very short letters is double-spaced throughout, always indent paragraphs. Paragraphs are usually indented five spaces and occasionally ten spaces. On rare occasions paragraphs are begun at the center of the sheet.

A fairly even right margin can enhance the appearance of the letter. Once you have determined the margins, try to end your lines no more than two or three spaces beyond or short of the right margin. Consult a good reference work so that your end-of-line word divisions will be desirable ones.

(6) COMPLIMENTARY CLOSE

To terminate his message, the writer chooses an appropriate (but standard) phrase which expresses slight praise or regard for the addressee. These signing-off words are known as the *complimentary close.*

Capitalize only the first word of the complimentary close. The style of letter determines whether the complimentary close starts at the left margin or at the center of the sheet.

One blank line is left above the complimentary close.

(7) DICTATOR'S NAME AND TITLE

For the signature allow three blank lines above the dictator's typewritten name or title if his name is not typed. A sprawly signature may require one or more additional blank lines.

Never type *Mr.* or any other title before a man's name. *Miss,* which is assumed if omitted, may be typed with or without parentheses unless she prefers to write it in longhand before her signature.

If *Mrs.* is typewritten before the dictator's given name (Christian name), only *Mrs.* is placed within parentheses, as *(Mrs.) Jane Lee.*

If *Mrs.* is typewritten before the husband's given name, the whole line is enclosed within parentheses, as *(Mrs. Harry Lee).* If she prefers, a married woman may write *(Mrs.)* in parentheses before her signature.

EXAMPLES:

Yours sincerely,

George S. Moore

George S. Moore
Secretary-Treasurer

Cordially yours,

Chalmer C. Taylor

Chalmer C. Taylor

Sincerely yours,

Hope S. Sweet

Hope S. Sweet
Director of Personnel

Yours very truly,

Anna M. Briggs

(Mrs.) Anna M. Briggs, M.D.

SENTENCES

		Approx. words	Cum. Par.	Cum. Par.
1	This subject just did both jobs. Just number both jobs.	11	11	
2	Just program this job. Our subject just likes this job.	11	23	
3	Just his subject is a job. Subject him to just this job.	11½	35	
4	Our subject likes just this job. Just time this subject.	11½	47	
5	Just go from subject to subject. Just list all subjects.	11½	58	
	Our subject just did both jobs. Just thank this subject.	11½	70	12
7	Most subjects like just this job. Just go from job to job.	12	82	24
8	Subjects just want old jobs, important jobs, and good jobs.	12	95	36
9	Our subjects just found jobs. Just take additional subjects.	12	107	49

1 2 3 4 5 6 7 8 9 10 11 12

MARGINS:
PICA--7 and 77
elite--16 and 86

SUPPLEMENTARY PARAGRAPHS

	Words	Words
List all subjects. His subject is about jobs. List all jobs;	13	
number all jobs. Do this job. Most subjects like this job. Give	26	
us jobs; give them jobs. This job is a good job; that job is not.	39	
Some subjects like that job. Subjects just want good office jobs.	53	
He just paid us for this job. Just one subject is on the job.	66	
Just hope this is a good job. Just sell these jobs to our subjects.	79	
This subject will keep both jobs. He lost this job. Most	91	12
subjects like the job. Just subject them to good office jobs. Just	105	26
help this subject with that job. Work on this job. Time this job.	119	39
Go from job to job; list the jobs; just mail the list.	130	50

1 2 3 4 5 6 7 8 9 10 11 12 13

NUMBERS IN ADDRESS

Separate house numbers from street numbers with two spaces or with a dash.

	421 110th Street	OR	421 110 Street		22 42d Court	OR	22 42 Court
OR	421--110th Street	OR	421--110 Street		22--42d Court	OR	22--42 Court

Write apartment, building, house, Zip, and rural-route numbers in figures with one exception. *One* as a house number is frequently spelled out to make it clear, as *One Madison Avenue.*

Apartment 32	4321 Wright Building	R.D. or R.F.D. 3
Room 1234	105-110 Johnson Avenue	P.O. Box 114

As shown in the examples above, no commas are used with large numbers in any of the categories mentioned. Also, do not use *No.* or # in any of the above cases.

STREET NAMES

Use words for street names *First* through *Twelfth*; use figures for street names numbered 13 and above.

NO TWO-LINE ADDRESSES

Make three lines out of two-line addresses by typing the city and the state on separate lines.

Mr. Norman Hill
Corpus Christi
Texas 78403

ZIP CODE NUMBER

Type the Zip number three spaces after the name of the state in the inside address.

4 SALUTATION

The *salutation* is a greeting that is made up of introductory words of the letter; it is placed on a line by itself. One blank line is always above and below the salutation. The salutation always begins at the left margin.

Capitalize the first word, all titles, and nouns in the salutation.

EXAMPLES:

Dear Sir:
Dear Mr. Lowe:
Dear Doctor Dodge:
My dear Sir:
My dear Mr. Price:
My dear Doctor West:

(mixed or closed punctuation illustrated)

The salutation must agree with the first line of the inside address; that is, if the letter is addressed to one person, the salutation must "greet" one person. If it is addressed to a firm, the greeting must be appropriate.

Whenever an attention line is used, the salutation is *Gentlemen, Mesdames,* or *Ladies.* Such a letter should be addressed to a firm or to some other organization.

	SENTENCES	New Key	Approx. Words	Cum. Par.	Cum. Par.
1	Tax all. This tax is not extra.	x	6½	7	
2	Our tax book is next to this box.		6½	14	
3	This box held our extra equipment.		7	21	
4	If this box is going next, tell me.		7	28	
5	His tax on this next item is extra.		7	36	
6	Keep this box; he paid for this box.		7	43	
7	He is next; he paid extra to go next.		7½	51	8
8	Next, tell him about work experience.		7½	59	15
9	Our experience with this tax is good.		7½	67	23
10	Not all experience is good experience.		7½	75	31
11	Box all extra copies of this tax form.		7½	83	39
12	Take him next; he has work experience.		7½	91	47
13	This old box is for our next shipment.		7½	99	55
14	The call box is next to that building.		7½	107	63
15	Our tax form is next to the small box.		7½	115	71
16	Give him extra help with his next book.		8	123	79
17	He will be doing extra work next month.		8	131	88
18	In this box is an extra income tax form.		8	139	96

1 2 3 4 5 6 7 8

Cum. Par. 8 15 23 31 39 47 55 63 71 79 88 96

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Rarely is it necessary to put the name of the state and the Zip number on a fourth (separate) line. Occasionally, very short letters are typed on paper that is 5½ inches wide, and it is desirable to give better balance to the inside address by dividing an otherwise long last line.

Mr. Dan Day
51 Fourth Avenue
Elizabeth City, North Carolina 27909

Mr. Dan Day
51 Fourth Avenue
Elizabeth City
North Carolina 27909

ABBREVIATIONS

A firm name in the inside address should be spelled and punctuated exactly as it appears in that firm's letterhead, and it should contain only those abbreviations that appear on that firm's letterhead.

Do not take the liberty of changing anything, such as spelling out an *Inc.* or *Co.* Do not add or omit an apostrophe or change *&* to *and.* Type the firm name with initial capitals, even though it appears in solid capitals in their letterhead; this is not considered to be a change.

In general, one should spell in full in business letters as a courtesy to the reader. However, some abbreviations are proper in the inside address.

1. Abbreviate a personal title, as *Mr., Mrs.,* and *Dr.* (when the first name or initial is given).

2. Abbreviate the addressee's name (for example, *Chas.* for *Charles)* only if he abbreviates it.

3. Abbreviate *Jr., Sr., 2d,* and *3d* after a person's name.

4. Abbreviate *D.C.* for *District of Columbia,* but spell out all other state names. No space follows a period *within* an abbreviation unless it is a person's initials or the abbreviation for a state.

5. Abbreviate sections of a city, such as *N.E., N.W., S.E.,*and *S.W.*; but spell out *North, East, South,* and *West.*

6. Abbreviate degrees, such as *M.D., Ed.D.,* and *Ph.D.*

7. Abbreviate *Co., Ltd., Inc.,* and use the ampersand (&) only if they appear that way in the letterhead.

8. A period normally following an abbreviation is retained regardless of the style of punctuation used. For example, do not drop the period after *Inc.* because open punctuation is used.

9. Abbreviate *St.* and *Ste.* (for *Saint* and *Sainte*) for cities and towns in all states.

Many dictionaries spell *Saint* and *Sainte* in full in main entries. A *St.* dictionary listing might divert the dictionary user who is looking at the second letter for his alphabetical cue. Therefore, follow the guide in the preceding paragraph.

MARGINS:
PICA--7 and 77
elite--16 and 86

PARAGRAPHS

	Words
To tax or not to tax, this is our next question. Our experience	11
with this tax is good. This tax is high; next month this tax will go	27
up.	28
Work next to him or next to them. Make extra copies of the long	41
tax form. Making extra copies of this tax form is extra work. Show	55
her our next income tax problem. Next, come with all tax information.	69

1 2 3 4 5 6 7 8 9 10 11 12 13 14

SENTENCES

		Approx. Words	Cum. Par.	
1	Which box is going next? This small box is next.	10	10	
2	List her school experience or his work experience.	10	20	
3	Extra copies of the long tax form are in this box.	10	31	
4	Next, tell him about our experience with this tax.	10	41	
5	I shall tax his next home. His extra list is next.	10	52	
6	Next, put extra copies of our tax form in this box.	10	62	Cum. Par.
7	Box this extra equipment and make out this tax form.	10½	73	11
8	Tax his next call. Next month do not tax his calls.	10½	84	21
9	His next list is extra. His tax form is next to it.	10½	95	30
10	Put extra copies in this box. Sell all extra copies.	10½	106	43
11	Box some items. Doing extra work is good experience.	10½	117	54
12	Our next show is next month. I need work experience.	10½	128	65

1 2 3 4 5 6 7 8 9 10

(2) DATE LINE

The *date line* may occupy any one of four horizontal positions, depending on the style of letter used. The date may (a) begin at the left margin, (b) be centered, (c) end at the right margin, or (d) begin at the center of the paper. A particular letter style may restrict the date to one horizontal position; another letter style may allow for two or three different horizontal positions for the date.

Some generalizations apply to all date lines:

1. There should always be at least one blank line between the bottom of the letterhead and the date.

2. Do not type the date higher than line 14 on a standard size sheet.

3. With the most commonly used domestic civilian style (April 6, 19--), spell the name of the month *in full,* place a comma after the day, and type the year in full. Government and military correspondence follows a different style (6 April 19--). which is also used by some business firms. This latter style is also used in many foreign countries.

4. Do not use ordinal signs—such as *d, nd, rd, st,* or *th*—after the day.

The letter-placement chart will direct you to the proper vertical positioning of the date.

(3) INSIDE ADDRESS

The *inside address* consists of the name and address of the person or firm to whom you are writing.

MAKING LENGTH OF LINES MORE EQUAL

Avoid unusually long and short lines in the inside address. The length of lines can be somewhat equalized by placing a business title (a) on the first line after the name, (b) on a second line before the firm name, or (c) on the second line by itself.

```
(a) Mr. Ray J. Dodd, President        (b) Mr. William C. Moorehead
    Franklin Insurance Company            President, R. C. Lamb Company

                    (c) Dr. Anthony R. Summersgill
                        Superintendent of Schools
```

Divide *long firm names.* If the inside address is blocked, indent the continuation line five spaces.

```
International Business
     Computer Corporation
44 International Avenue
New York, New York   10001
```

If the inside address is indented, block the continuation line with the preceding line.

```
Mr. Harold C. Clarke, Manager
     International Business
     Computer Corporation
          44 International Avenue
              New York, New York   10001
```

MARGINS:
PICA--7 and 78
elite--16 and 87

TEST 17

Words

Who is next? Am I next, or is he next? Go next. Fill this box. 13

This box is next. This box is an extra one. His tax is in this box. 27

This tax is our next job. His tax on extra equipment is high. Mail 41

this tax book next. 45

Our work experience is good. List his work experience. All 57

extra help must have good work experience. Next, list her school 71

experience. Next, make out this tax form. An extra income tax form 84

is in this box. 88

Our experience with the local tax is good, and all extra copies of 101

our tax form are in this next file box. Next time work next to us and 115

put some extra copies in this box; call next month and work next month. 130

We shall tax his next home. Tax them next. This tax will go up 143

next month. Tax our next one. Next, file her income tax. Next, file 157

all tax information. 161

Has he paid the hospital tax, the income tax, the school tax, or 175

the local tax? Check his tax. His tax is low; our tax is high. His 189

extra copies are in this file box. Next, put this tax form in this 202

box; an extra form is also in this box. 210

Mail extra copies of this income tax form and all tax information. 224

An extra list, an extra book, and an extra form are in this box. This 238

list is next. Next, do her income tax. 246

1 2 3 4 5 6 7 8 9 10 11 12 13 14

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BUSINESS LETTERS

EIGHT BASIC PARTS

A business letter usually contains the following eight parts:

1. Letterhead
2. Date line
3. Inside address
4. Salutation
5. Body
6. Complimentary close
7. Dictator's name and title
8. Reference initials

The eight basic parts are identified in the left margin of the first letter that you will type. Once you have typed the illustrated letter, type the names of the parts in the margins of your letter. After you have typed several letters, you may wish to refer to this section to obtain answers to questions that may arise.

LESS COMMON PARTS

A business letter may also contain one or more of the following:

9. Blind carbon copy notation
10. Personal notation
11. Reference line
12. Attention line
13. Subject line
14. Company name
15. Enclosure notation
16. Mailing notation
17. Carbon copy notation
18. Postscript

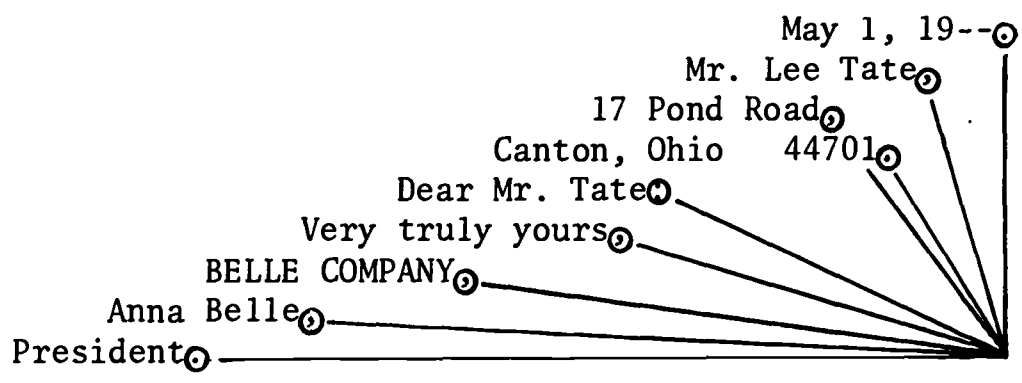
FORMS OF LETTER PUNCTUATION

There are three forms of punctuation: (a) mixed, (b) open, and (c) closed.

Mixed punctuation calls for two special marks of punctuation—a colon after the salutation and a comma after the complimentary close.

Open punctuation means that no special mark of punctuation is used.

Closed punctuation calls for the following punctuation:



The notations—carbon, enclosure, identification, and mailing—are not closed with any marks of punctuation.

1

LETTERHEAD

A *letterhead* is a sheet of engraved or printed stationery, which usually gives the name, address, telephone number of the company, and the nature of its business. Some letterheads also contain slogans and the names and titles of company officers. A heading (excluding the date) usually has a depth of no more than 2 inches, which is 12 lines from the top.

	SENTENCES	New Key	Approx. Words	Cum. Par.	Cum. Par.
1	Her company pays cash.	y	4½	5	
2	Type a copy of the reply.		5	10	
3	Type a copy of her reply.		5	15	
4	They always type a reply.		5	21	
5	Type a copy of this reply.		5	26	
6	Today this money is yours.		5	32	
7	Today this policy is yours.		5½	40	6
8	You always pay for quality.	Y	5½	44	11
9	They have not sold any today.		6	50	18
10	That is why I type every copy.		6	56	24
11	Call every city; call any day.		6	63	30
12	They may type her policy today.		6	69	37
13	Pay by check any day of this year.		7	76	44
14	May they be happy with this policy.		7	84	52
15	She may type a policy for my office.		7	91	59
16	Your city has to supply this county.		7	99	67
17	Your days are many and may be happy.		7	107	70
18	Copy every policy. Sell every copy.		7	114	82

1 2 3 4 5 6 7

CARBON COPIES

It is customary to make carbon copies of all outgoing letters. To prepare a carbon copy, place the last copy sheet (plain paper, usually onionskin paper) on the desk and place the carbon paper, glossy side down, directly on the plain paper. Add a plain sheet and carbon sheet for each additional copy that is desired. Then place the printed letterhead, face up, on top of the last carbon sheet.

Insert all sheets into the typewriter so that the letterhead faces you. Then check the inserted sheets to see that the dull side of the carbon is facing you.

Bulky carbon packs are sometimes difficult to insert. One way to keep the top and side edges of all sheets even as they are inserted is to fold a slip of paper (3 or 4 inches wide) in half and to slip the top of the carbon pack into the center of the creased slip. As you insert the carbon pack, the folded slip of paper prevents slippage of sheets. Remove the slip as soon as the cylinder has been rolled forward sufficiently to release it.

Another variation of this is to insert the slip only, folded edge first, and to get it caught by rolling the cylinder forward two or three notches. The carbon pack is then inserted into the folds of the slip and held there as the cylinder is rolled forward.

ERASING

It is more convenient to erase an error when it is positioned near the top of the cylinder. If the error is on the upper two-thirds of the sheet, turn the paper up about four notches and move the carriage to the extreme left or right (use margin release) so that the eraser bits can fall, be brushed, or be blown clear of the typewriter. If the error is on the bottom third of the sheet, roll the paper back until the error is at the top of the cylinder.

To prevent slippage as you erase, press the paper against the culinder with your fingertips, being careful not to touch the typescript with either hand. Smudgy streaks also result when heavily inked typescript is brushed.

To prevent making a hole in the paper, use circular strokes or at least change the direction of the strokes as soon as you see too much paper wear in one spot.

ERASING CARBON COPIES

Erase the error on the last carbon copy; then place a slip of paper between the shiny side of the last carbon and the first copy you erased. Erase the second copy from the back of the pack; put it back; place another slip of paper between that copy and the shiny side of the next copy, etc. If you leave edges of the slips extended an inch or so beyond the copies, all slips can be pulled out at once and are not likely to be forgotten.

The disadvantage of this technique is that as each error is erased, some of the carbon will be rubbed off onto the slip sheet.

Another technique is to place a card directly behind the paper (and point) being erased. The same card is used behind each sheet as it is erased. No carbon is removed from the carbon paper by this technique.

Some prefer to put a 3 by 5 card behind each sheet and to leave all cards there until all erasing has been done. The disadvantage of a card (or cards) is that the typist presses against the card to hold the paper in place while erasing. The stiff card acts as a lever, and slippage of paper may result.

CHOICE OF ERASER

Rubber erasers range from the very hard, gritty, almost sandpapery rubber to the medium and to the soft rubber, with many in-between grades. Paper also comes in various grades of hardness—from the inexpensive flimsy sheet to the heavy, strong, and hard-surfaced sheet. Errors are made on heavily inked ribbons and on ribbons that deposit little ink on the paper. If one has at least three types of erasers handy, choosing the most appropriate tool will make erasing easier and neater.

In general, soft erasers are useful in erasing heavily inked words, carbon copies, and typescript on flimsy paper or on newer-type erasable bond paper. A soft eraser is also helpful in feathering the rough edges when a hard eraser has "dug out" the error. Well-sharpened hard erasers are good to erase the edges of letters that are close to good letters.

Rubber erasers dry out with age, lose some of their abrasive quality, and leave a shadow around the erasure.

Guard against having eraser waste fall directly into the type basket; eraser bits cause sluggish keys, high repair costs, and shorten typewriter life.

MARGINS:

PICA--7 and 77
elite--16 and 86

PARAGRAPHS

	Words	Words
Type a copy of this policy and type my new policy. Always copy	13	
the amount of money; always copy the month. Type her reply today.	26	
Type many copies of her reply immediately. He may make a copy of	39	
every policy. They type well. They will type my list. They may type	54	
some reports.	56	
All city employees are happy with our system. This year you sold	70	13
many products to city employees. Today they told us why the supply is	84	27
low this year. You have not sold any today. They say you have an	97	41
opportunity to change our system.	104	48
City employees always pay for quality. I see why they pay for	117	60
quality. They pay by check only. Payments are made promptly. All	131	74
they do say is that city employees are happy with our system. City	144	88
employees were not always happy with the old system.	155	98

1 2 3 4 5 6 7 8 9 10 11 12 13 14

SENTENCES

		Approx. Words	Cum. Par.	Cum. Par.
1	See us any day. They may take as many as four days to reply.	12	12	
2	All city employees are happy. They say your city plan works.	12	25	
3	They are probably happy with the city plan. They may see us.	12	38	
4	They pay for property by check. They may purchase my property.	12½	51	13
5	If they pay by check only, they will probably pay more promptly.	13	64	26
6	All they do say is that city employees are happy with our system.	13	77	39

1 2 3 4 5 6 7 8 9 10 11 12 13

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ALIGNING TO TYPE OVER A WORD

Type the word elite. Notice the distance between the top of the aligning scale and the word elite. Notice also how the letters in elite align vertically with the white vertical lines on the aligning scale. Backspace to the i in elite; use the V-shaped typebar guide as a sight and see how the i aligns at the printing point, because now you will use the paper release and remove the paper from the typewriter.

Reinsert the paper. Align the bottom of the previously typed word, elite, with the top of the aligning scale. With the aid of the typebar guide, sight the printing point and move the paper so that the i will be in line with the printing point. If you prefer, use any aid that helps you, such as moving the word over the top of the white vertical lines on the aligning scale. When you feel confident that you have the proper alignment, type over the same word.

Type the word elite lightly three times in different places on the paper. Remove the paper, reinsert it, and type over these three words. Practice this until you can superimpose without detectable signs of ever having disturbed the paper.

ALIGNING TO TYPE A MISSING LETTER

Type the word elite with the center letter missing, as el te. Remove the paper; reinsert it; fill in the i. Is the i properly aligned?

Type the following, remove the paper, reinsert it, and fill in the missing letters: el te e ite eli e

CROWDING LETTERS

In this sentence the word elite has been crowded into four spaces. This brief exercise is to familiarize you with two ways to control the carriage to permit fractional spacing (instead of uniform spacing) and the crowding of letters that appear evenly spaced.

In general, an electric-typewriter carriage is moved by hand to type between normal spaces; a manual-typewriter carriage is moved by hand or by holding the backspacer key part of the way down. With practice you will learn to gauge the amount of tension you need to put on the backspacer key in order to move the carriage back a fraction of a space. (If your typewriter has a half-space key, your teacher will show you how to use it if it seems useful in certain situations; or if you have an IBM Selectric, your teacher will show you how to nudge the element.)

STEPS

1. e e Type e; thumb-space twice; type e again.
2. e i e Move carriage by hand; align printing point with center of e's; type i.
3. eli e Align printing point with center between e and i and type the l.
4. elite Align printing point with center of i and e and type the t.

SPREADING LETTERS

In this sentence the word error occupies six spaces; three letters occupy the four spaces between the first and last letters.

STEPS

1. e1234r Type e; thumb-space four times; type r.
2. e r r Align printing point with center between e and r and type r.
3. e ror Align printing point with center between r and r and type o.
4. error Align printing point with center between e and r and type r.

You are now acquainted with a few techniques used to crowd and spread the letters of a word. Try these techniques with words of various lengths. Sometimes it is necessary to erase an adjacent word and to crowd or spread both words.

MARGINS:
PICA--7 and 77
elite--16 and 86

TEST 18

	Words
If you do pay them, pay them soon. Pay for this year only. They	13
always supply her company with quality products. They supply us from	27
day to day. They always supply the city. They supply the city with	41
quality products.	45
Today supply that company with quality products. They always pay	58
us promptly when a payment is due. They pay by check only. They want	72
my property. They may see us today.	80
Her company sold his property to the city. The city pays by	92
check only. Payments are made promptly. That is our new city policy.	106
That is why today our city will probably pay more promptly for his	120
property. Many are probably happy about our city plan.	131
I am happy today. The city may wish to purchase my property.	143
Sell your property to the city. The city wants your property.	156
That company does keep its employees for many years; it pays them	169
promptly every month. Many payments came by mail today. Her company	183
pays us promptly when a payment is due.	191
Today you say city employees are happy. This city probably pays	205
its employees well. They make nothing but money day in, day out. All	219
city employees are happy about this policy. Every city will have an	233
opportunity to check your system immediately.	242

1 2 3 4 5 6 7 8 9 10 11 12 13 14

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All Correspondents
Page 3
July 30, 19--

Some offices have printed stationery for memos. The words TO, FROM, DATE, and SUBJECT are printed. Some offices provide printed headings bearing the name of the originating office for use whenever they write memos to branch offices. Some offices have the writer's name printed on the FROM line. Colored stationery is sometimes used for memos going to branch offices, whereas plain paper is used for memos to be delivered by messenger.

G. M. S.

you

DIRECTIONS: Prepare four memorandums, each on a full sheet. Use the first three paragraphs of the preceding three-page memorandum for your first memo. Then type the other three memos as indicated in the left margin of the long memorandum.

Type the dictator's initials in all capitals to the right of center and type your initials in lowercase letters at the left margin as shown in the illustration above.

The information for the introductory lines is given below. Use the same subject notation, "Interoffice or Intraorganization Memos," on all memos.

MEMO 1

DATE: May 25, 19--

TO: Mr. Paul Burke, Office Manager
Engineering Building, Fifth Floor

FROM: Mrs. Esther Pearson
Administration Office

MEMO 2

DATE: May 26, 19--

TO: Dr. Arthur Parks
Director, Health Service

FROM: Mr. Charles Watson
Correspondence Department

MEMO 3

DATE: May 27, 19--

TO: Mr. Ralph Freeman
New York Office

FROM: Mrs. Helen Taylor
Vice-President

MEMO 4

DATE: May 28, 19--

TO: Mr. Sam Hunt, Sales Department
Mr. Leo Bond, Art Department
Mr. Dan Lee, Credit Department

FROM: Mr. Russell Burke

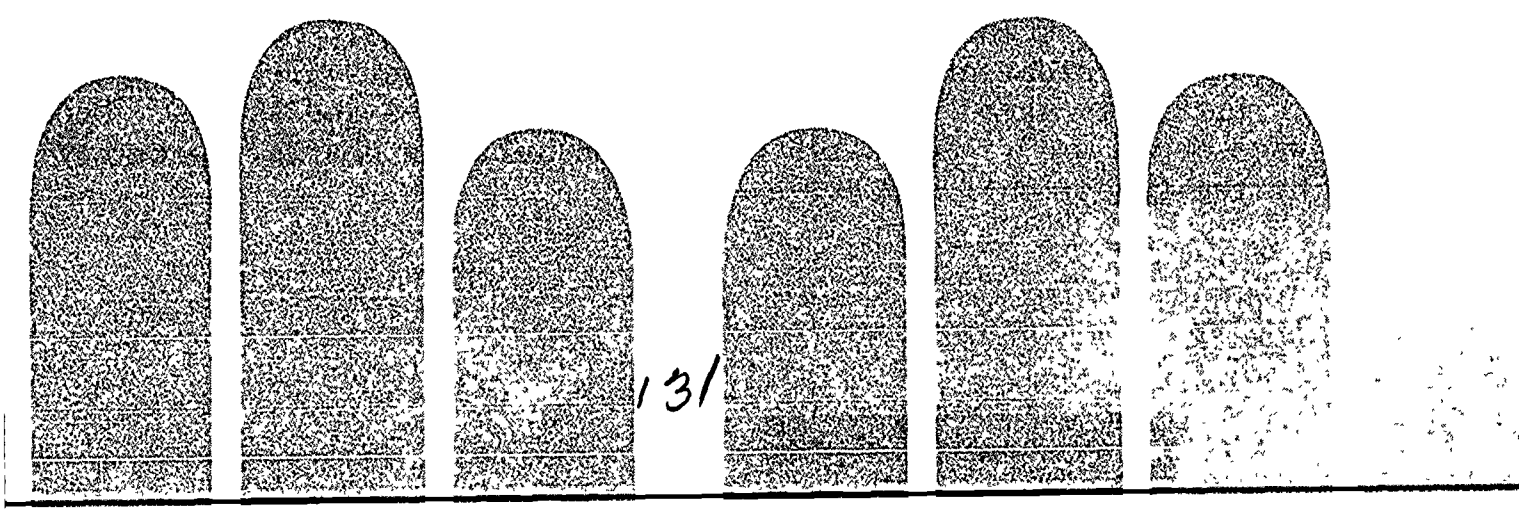
Prepare a copy for each person addressed, as well as a file copy. Place a check mark before the name of the person to whom each copy is to be sent.

NOTE: Some prefer to drop all personal titles in front of names on memos.

	SENTENCES	New Key	Approx Words	Cum. Par.	Cum. Par.	Cum. Par.
1	Buy the small size.	z	4	4		
2	More organizations should go.		5	10		
3	All organizations will change.		6	17		
4	His organization can continue.		6	23		
5	Find his size. Send his size.		6	29		
6	Take his size. Keep his size.		6	36		
7	Which size is this organization?		6½	43	7	
8	Check his size. Order his size.		6½	49	13	
9	Check his size; mail us his size.		6½	56	20	
10	Find an organization of this size.		7	63	27	
11	Notice his size. Record his size.		7	71	35	
12	Send us his size. I sold his size.		7	78	42	
13	One size is right. Sell this size.		7	85	49	7
14	This size will do. Make this size.		7	93	57	15
15	They want his size. Note his size.		7	100	64	22
16	Size this paper. Size up this job.		7	108	72	29
* 17	My size is here. They sell size 11.		7	115	79	37
18	List all organizations of this size.		7	123	87	45

1 2 3 4 5 6 7

* To type the figure 1, use the letter-l key, which is conveniently located on the home row, even though your typewriter may have a figure-l key located to the left of the 2 key on the upper row. Since the home-row stroke eliminates the long reach with the little finger, it is easier, faster, and is not so likely to induce errors. By using the key that is in the same position on all makes of typewriters, there will not be the hesitation that is likely to occur when one types on a typewriter that has a figure-1 key on the upper row and then types on a typewriter that does not have that key.



The position of the DATE line gives the memo a squarish appearance. Since the date is backspaced from the right margin, it is a visual guide that may be used in judging carriage returns in order to keep the right margin more even, especially when decisions have to be made with regard to end-of-line word divisions. Placing the date in the upper-right position saves space for two additional message lines, which may be of some value when memos are typed on half sheets.

Only one tab has to be set for all indentions. That tab is set 2 spaces after the colon following the SUBJECT line. When the DATE line is the only line to the right, it is not necessary to type the word DATE. This means that when the TO line is long, it is less likely to crowd into the word DATE.

End of third memo.

Fourth memo begins here.

When the decision for the choice of setup is left up to you, the style illustrated by this memo is a good one to follow. Your teacher may require you to follow a specific style for testing purposes, and your future employer may have certain preferences based on the needs of particular situations.

Sometimes the four introductory lines of a memo appear blocked at the left margin; sometimes the DATE line is at the top; sometimes the DATE line appears between the FROM line and the SUBJECT line.

Leave 2 blank lines between the SUBJECT line and the message, although some prefer to leave 3 blank lines. The paragraphs in this memo are indented in alignment with the information in the introductory lines. Some prefer to indent the paragraphs 5 spaces; some prefer no paragraph indentions.

If the FROM line has the name of a department and no dictator's name, the dictator may wish to have his name typed, or he may wish to sign his name. Ordinarily the dictator's initials are typed to the right of the center. Some dictators may wish to write their initials, in which case the typist's initials are typed 4 spaces below the message at the left margin.

An enclosure notation is placed under the typist's initials; carbon copy notations appear under the typist's initials or under the enclosure notation if there is one. Enclosures should be securely attached to the memo; and if it is not possible to attach the enclosures, place the memo and the enclosures in an envelope.

In general, memos should be typed on full sheets. Half sheets may get lost in a file folder or make a file messy; full sheets are usually easier to handle. Little is saved by using half sheets or odd-sized sheets. Occasionally when memos are to be posted on crowded bulletin boards, space may be saved by the use of half sheets.

MARGINS:
PICA--7 and 77
elite--16 and 86

PARAGRAPH

	Words
He went from organization to organization. His size is here.	12
Show him size 11. Here is his size. They sold his size. They sell	26
his size. They sell size 11. Bring us his size. They have my size.	40
My size is here. Bring me my size.	47

1 2 3 4 5 6 7 8 9 10 11 12 13

SENTENCES

		Approx. Words	Cum. Par.	
1	Make some this size. I like this size.	8	8	
2	Keep our organization down to this size.	8	16	
3	Mail them size 11. Show them this size.	8	25	
4	I know of one organization of this size.	8	33	
5	This size is good. Keep them this size.	8	42	
6	This organization should send your size.	8	50	
7	This size is fine. Keep some this size.	8	58	
8	Look for this size. Mail her this size.	8	67	Cum. Par.
9	Make size 1 or size 11. Send us my size.	8	75	8
10	More important than size is organization.	8	84	17
11	He went from organization to organization.	8½	93	26
12	Local organizations will increase in size.	8½	102	35
13	Size up four members of this organization.	8½	110	43
14	Does he have an organization of this size?	8½	119	52
15	Size up members of national organizations.	8½	128	61

1 2 3 4 5 6 7 8

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TO: All Correspondents March 30, 19--

FROM: Gloria Mae Swanson

SUBJECT: Interoffice or Intraorganization Memos

When a message is sent from one member of a company or organization to another member within that company or organization, it is usually set up in the form of a memorandum. The memorandum can be thought of as another letter style, although there are many possible variations in arrangement to suit individual situations.

Memorandums, then, are most frequently used for intraorganization correspondence, that is, correspondence between departments or between persons within an organization. The correspondents may be located in the same building or may be thousands of miles away in branch offices, branch factories, etc., of that organization.

First memo ends here.

While most memos are intraorganization and are frequently referred to as interoffice memos, occasionally the memo style is used for correspondence outside the organization.

Second memo starts here.

In general, a memo does not have the attractive appearance of some of the well-known letter styles, and it is usually a cheaper and efficient way of communicating. Frequently there is no need for a printed, engraved, or typewritten heading or letterhead.

One can type a memo without being concerned whether the message is long, medium, or short, since a 6-inch line or a 1-inch margin may be used regardless of length. Few machine adjustments are needed. More can be added to the message after the typist has started typing, for there is no resetting of margins required to accommodate longer messages. The typist can type the message as it is dictated without having to be concerned about resetting margins if the message happens to be longer than initially anticipated.

Time and space are saved by not typing a salutation and complimentary close. Frequently it is necessary to type only the person's name in the TO line. In a large company a person's business title or the name of the department or the number of the floor on which his office is located may be added in the TO section. When a company has many branch offices, the name of the office is typed after the person's name.

End of second memo

Third memo starts here

Here are some of the features of the form illustrated by this memo: The SUBJECT line is typed on line 7. The left margin stop was set in 12 spaces from the left edge of the paper; the right margin stop was set in 12 spaces from the right edge of the paper. Whether elite or pica type is used, it is quite all right to use 12 spaces for the margins of a memo. One generalization to observe is that no margin of a memo should be less than 1 inch.

The TO line appears in a most convenient place for the messenger to read. The DATE line is in a good position for the file clerk to read.

MARGINS:
PICA--7 and 77
elite--16 and 86

TEST 19

Words

Our organization is small. Notice the small size of this 12
organization. I like the small size of this organization. Keep 25
this organization down in size. Check all organizations of this 38
size. Give to organizations of this size. 46
Your organization is large in size. I know of three or four 59
organizations of this size. This world organization is large in 72
size. An organization of this size is important. An organization 85
of this size could set policies. Many organizations of this size 98
make loans. Many organizations of this size loan to us. I work 111
with organizations of this size. 118
Give our organization hope. This organization has hope. Can 130
this organization claim? Show this organization how. 141

1 2 3 4 5 6 7 8 9 10 11 12 13

SENTENCES

	Approx. Words	Cum. Par.
This organization is small; that organization is large.	11	11
This organization can help. Work with this organization.	11½	23
That organization is old. That organization will change.	11½	35
This organization sold them. Most organizations know this.	12	47
Our organization is large. His organization is of like size.	12	60
Our organization will size up members of local organizations.	12	72
The national organization will size up the local organization.	12½	85

1 2 3 4 5 6 7 8 9 10 11 12

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PART 1 Double-space. Center each problem vertically and horizontally on a separate half sheet. Spread only those lines that have an S in parentheses. Capitalize as shown in the problem.

PROBLEM 1

ANNOUNCING (S)
An Exclusive
Prepublication Offer
THE SEARCH FOR WISDOM (S)
by
FAY NASH (S)

PROBLEM 2

VACATION (S)
IN
BEAUTIFUL HAWAII (S)
FOUR WEEKS (S)
for
less than
a thousand dollars

PROBLEM 3

WHITMARSH
STUDENT DIRECTORY (S)
AVAILABLE IN BOOKSTORE

PROBLEM 4

EVENING SCHOOL (S)
CLASSES CANCELED (S)
MARCH 11
Parking Ban
in
City of Boston

PROBLEM 5

R. C. WEST COMPANY
ANNUAL PICNIC (S)
CHOPMIST HILL (S)
BUSES LEAVE (S)
AT NOON
FROM
CROWN HOTEL (S)

PROBLEM 6

WHITMARSH
SPRING FORMAL (S)
March
Twenty-first
GRAND BALLROOM
AMBASSADOR HOTEL (S)

PART 2 Triple-space. Center Problems 1 through 3 on full sheets. Spread only those lines that have an S in parentheses. Capitalize as shown in the problem.

PART 3 Triple-space. Center Problems 4 through 6 on full sheets inserted lengthwise in the typewriter. Spread only those lines that have an S in parentheses. Capitalize as shown in the problem.

SENTENCES New Key: 8

		Words	Cum. Par.
1	There is an error in line 8 on page 8.	8	8
2	He needs a size 8 shoe. He likes the style shown on page 8.	12	20
3	It is our sincere hope that you will enjoy this series of world events.	14	35
4	This lot is 88 by 88 feet. The porch is 8 by 8 feet.	11	46
5	We ordered 888 books and received 88.	7	54
6	This is to let you know that you may ask us for one or two of these books.	15	69
7	There are 888 men in that building.	7	76
8	After the first of next month Grade 8 will be in Room 8.	11	88
9	Live to do good, and you will never tire of your employment.	12	100
10	I was told that he lives at 88 Green Street, Bath, Maine 18181.	12	112
11	On the 8th of May he took 8 pounds.	7	120
12	Each year some books are lost and must be paid for by those who lost them.	15	135
13	We ordered 188 pairs of size 8 shoes and received 88 pairs.	12	147
14	The trip took 8 hours 8 minutes and 18 seconds.	9	157
15	He lives most who lives for others.	7	164
16	Eleven 8's equal 88; ten 88's and 8 equal 888.	9	174
17	He was graduated March 8 in the Class of '88.	9	183
18	If at first you don't succeed, you're running about average.	12	196
19	The apostrophe takes the place of a letter in don't, that's, he's, hasn't, doesn't, isn't, I'm, and you're.	21	217
20	Last year's batting average won't earn this year's runs.	11	229

1 2 3 4 5 6 7 8 9 10 11 12 13 14

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SPREAD CENTERING

```
13        S P R E A D   H E A D I N G S   A T T R A C T
15    S P R E A D   A N D   C E N T E R E D   H E A D I N G S
17                  A R E   A N
19        E Y E - C A T C H I N G   D E V I C E
```

1. Notice that there is one space in between the letters of a word.
2. Notice that there are three spaces between words.
3. When you practice the above exercise, begin on line 13.

To spread-center:

1. Begin from the center of the sheet and backspace once for each letter and each space in the line.
2. Disregard the last letter.
3. Begin typing at the point to which you have backspaced.
4. Thumb-space once after every letter and three times between words.

SENTENCES	New Key: 4	Words	Cum. Par.
1	One day's delay is not so bad as two days' delay.	10	10
2	These students' marks are posted for each day's timed writings.	13	23
3	We do not know who will die, but we do know how many will die each year.	14	38
4	Fifty minutes' practice will increase a typist's rate by one word.	13	51
5	Do you want a dollar's worth or two dollars' worth?	10	62
6	Luck has a peculiar habit of favoring those who don't depend on it.	13	76
7	I find the J's, K's, L's, R's, and F's easy to type.	10	87
8	Classes will meet at six o'clock and at nine o'clock.	11	98
9	No one is rich enough to be without a neighbor.	9	107
10	He told us he will sell us 44 boxes for about 4 cents a box.	12	120
11	It was 44 degrees at eight o'clock, and it is now 84 degrees.	12	132
12	This is order No. 444. They will like style No. 44.	10	143
13	Do not open the book that is on your table until I tell you to do so.	14	157
14	Use figures when you type 4 pounds, 44 cents, and 4 mills.	12	169
15	Ask for four 4 by 4's that are 4 feet 4 inches long.	10	180
16	There is a small one in one room and a large one in the other.	12	193
17	The entry is on folio 4. He is 4 years and 4 months old.	11	205
18	This book measures 4 by 4 inches; the other measures 14 by 14 by 4 inches.	15	220
19	The reward of a thing well done is to have done it.	10	231
20	Tell him that Train 44 leaves Track 4 at 4:14 p.m.	10	241

1 2 3 4 5 6 7 8 9 10 11 12 13 14

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PROBLEM 10

PERSISTENTLY MISSPELLED WORDS

exaggerated	laboratory	incidentally
recommendation	indispensable	privilege
specialty	attorneys	occurrence
benefited	superintendent	sizable
occasionally	occur	exorbitant
extraordinary	occurred	quantities
fulfill	typing	all right
publicly	facsimiles	disappointment
noticeably	transferable	accidentally
pamphlets	accommodate	separately

PROBLEM 11

TERMS OF LOGIC

Premise	Hypothesis
Vagueness	Categorical Proposition
Ambiguity	Impromptu Definition
Deduction	Scientific Method
Syllogism	Generalization
Induction	Equivocation

MAY BE INTRODUCED ANYTIME AFTER PAGE 79.

CENTERING A COLUMN HEADING

A column heading is centered in relation to the longest line or item in that column.

To center a column heading, (a) find the difference between the longest item in the column and the column heading, (b) divide the difference by 2, and (c) round off a fraction.

Salesman-----6 ÷ 2 = 3
Robert Russell

Indent shorter line three spaces:

123Salesman456
Robert Russell

Total Sales
$500- 1 ÷ 2 = ½

Indent shorter line one space:

Total
Sales
$500

7.5%----5 ÷ 2 = 2½
Surcharge
$328----5 ÷ 2 = 2½

Indent shorter lines three spaces:

7.5%
Surcharge
$328

PART 4 Center each table on a full sheet. Leave one blank line between the main title and the secondary title. Leave two blank lines between the secondary title and the column headings. Double-space the body of the table and thumb-space six times between columns.

PROBLEM 12

LARGEST CITIES IN THE UNITED STATES
(According to Population in 1960)

Rank	City	State
1	New York	New York
2	Chicago	Illinois
3	Los Angeles	California
4	Philadelphia	Pennsylvania
5	Detroit	Michigan
6	Baltimore	Maryland
7	Houston	Texas
8	Cleveland	Ohio

PROBLEM 13

TWO-COLUMN TABLE

Countries	Capitals
United States	Washington
Canada	Ottawa
Mexico	Mexico City
France	Paris
Great Britain	London
Italy	Rome
Turkey	Ankara
Switzerland	Berne
Spain	Madrid

SENTENCES New Keys: $ 7

		Words	Cum. Par.
1	Will it cost $4 or $8. The check is for $41.	9	9
2	Send $4 a week until you have paid $88.	8	17
3	He sees that your car is just right and ready to go when you want it.	14	32
4	The Class of '44 willed $888 to the Class of '48.	10	42
5	The four 4 by 4's will cost $4 each.	7	49
6	Everything has its beauty, but not everyone sees it.	10	60
7	Please make out a check for $8 as soon as you can.	10	71
8	I should like to know whether you received our check for $84.	12	83
9	I am glad to say that we were able to find the $8 error.	11	95
10	How can we do this without giving up those things that we hold dear?	14	109
11	The $4.11 includes a tax of 11 cents.	7	117
12	Train 7177 will leave on Track 77 at 7:47 a.m.	9	126
13	He found the discount for 1 year 7 months and 7 days.	11	137
14	We do not know how long the cold war will stay cold.	10	148
15	Did he say that the score is 7 to 1 or 8 to 1?	9	158
16	Read Section 4 on page 4 and Sections 7 and 8 on pages 17 and 18.	13	171
17	The first element of success is the determination to succeed.	12	184
18	If you wish to leave a top margin of 1 inch, start typing on line 7.	14	198
19	We have been married exactly 7 hours 7 minutes and 17 seconds.	12	210
20	The first job of his new wife will be to set up these dishes.	12	223

1 2 3 4 5 6 7 8 9 10 11 12 13

PART 2 Center each table on a half sheet. Leave two blank lines between the title and the body of the table. Double-space the body of the table and thumb-space six times between columns.

PROBLEM 5

TABULATION

set	the	left
margin	stop	and
two	tab	stops
before	you	begin
to	tabulate	this
short	tabulation	exercise

PROBLEM 6

CENTERED TABLE

some	tables	are	read
across	one	line	at
a	time	and	other
tables	are	read	from
top	to	bottom	one
column	at	a	time

PROBLEM 7

TYPES OF BONDS

called	prior line	registered
coupon	sinking fund	debenture
serial	first mortgage	convertible
income	general mortgage	municipal
extended	consolidated mortgage	collateral

PROBLEM 8

TABULATION

considers	running	together
the	longest	word
in	each	column
plus	six	spaces
between	columns	and
centers	that	run-on

PART 3 Center each table on a full sheet. Leave two blank lines between the title and the body of the table. Double-space the body of the table and thumb-space six times between columns.

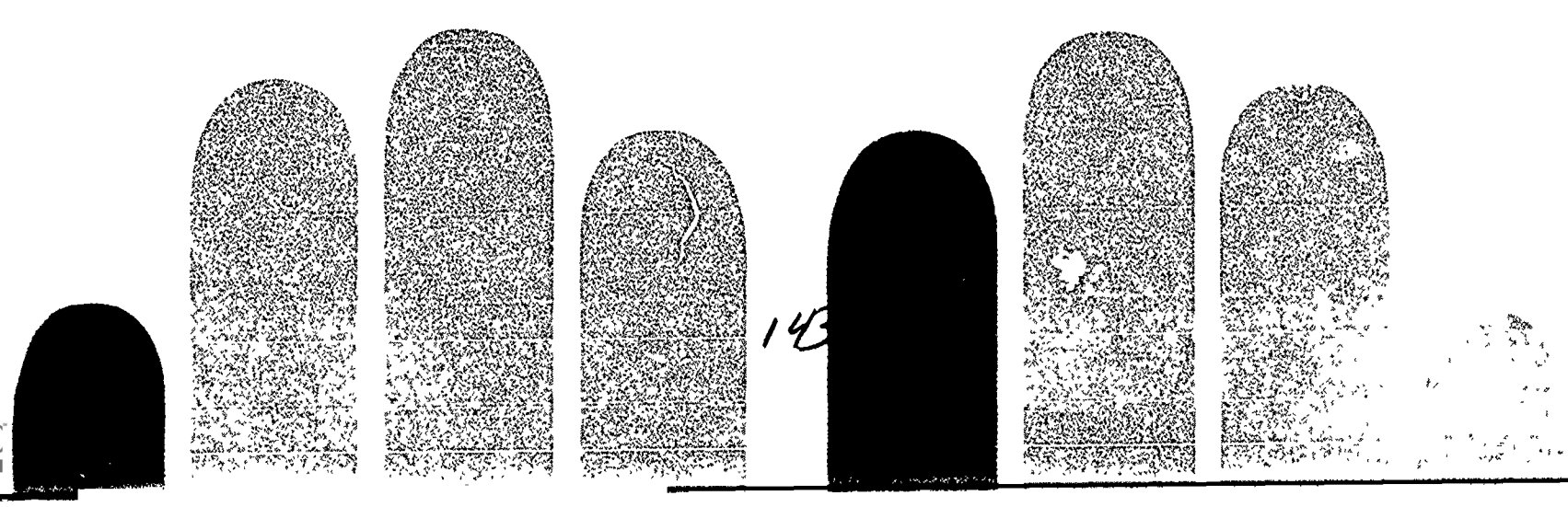
PROBLEM 9

THE UNITED STATES OF AMERICA

Alabama	Louisiana	Ohio
Alaska	Maine	Oklahoma
Arizona	Maryland	Oregon
Arkansas	Massachusetts	Pennsylvania
California	Michigan	Rhode Island
Colorado	Minnesota	South Carolina
Connecticut	Mississippi	South Dakota
Delaware	Missouri	Tennessee
Florida	Montana	Texas
Georgia	Nebraska	Utah
Hawaii	Nevada	Vermont
Idaho	New Hampshire	Virginia
Illinois	New Jersey	Washington
Indiana	New Mexico	West Virginia
Iowa	New York	Wisconsin
Kansas	North Carolina	Wyoming
Kentucky	North Dakota	

SENTENCES	New Keys: & 2	Words	Cum. Par.
1	There is a Cherry & Webb store in Providence.	9	9
2	Both Cherry & Webb Company and Peck & Peck use the ampersand.	12	22
3	No one can take better care of your car than the men who work here.	13	36
4	Please make out a check to Jones & Sons, Inc., for $7.	11	47
5	The report from Dun & Bradstreet indicates that he is a poor credit risk.	15	62
6	He is not going to do this if he does not have the time.	11	73
7	Write Taylor & Green, Lord & Moss, Jones & Sons, Inc., exactly as they appear on the letterheads.	19	93
8	Will you please stop at Ann & Hope on your way to Stop & Shop.	12	106
9	The man who believes is the man who achieves.	9	115
10	The New England Telephone & Telegraph Company will not issue any more stock.	15	131
11	Figure the interest for 2 years 2 months and 12 days.	11	142
12	He who watches the clock will always be one of the hands.	11	154
13	On April 22 we will send you 221 pens.	8	162
14	We will buy 8,222 gallons for less than 22 cents a quart.	11	174
15	I had the normal human feeling of not wanting to be out of step.	13	187
16	Note that line 1 is divided by line 2 in Schedule E.	10	198
17	It is 2 yards 2 feet 7 inches long and 4 yards 2 feet 7 inches wide.	14	212
18	The best way for climbing higher is to remain on the level.	12	224
19	The file clerk tells me that Circular 21 supersedes this one.	12	236
20	If your machine has elite spacing, there are 12 spaces to an inch.	13	250

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15



WHITMARSH COLLEGE APPLICANTS

(Interviewed May 16, 19--)

Student	Major	Overall Rating
Bowen, Helen L.	Marketing	A
Lee, Carl S.	Accounting	B
Morgan, Warren P.	Management	B
Wright, Kenneth R.	Economics	A

33 lines available
-15 lines used
2)18
9 starting line

PART 1 Center each table on a half sheet. Leave two blank lines between the title and the body of the table. Single-space the body of the table and thumb-space six times between columns.

PROBLEM 1

TABULATION

is	illustrated
in	this
exercise	with
two	columns
and	with
six	spaces
between	columns

PROBLEM 2

HOODS WORN BY FACULTIES

Arts and Letters	White
Accountancy	Drab
Economics	Copper
Law	Purple
Pedagogy	Light Blue
Philosophy	Blue
Theology	Scarlet

PROBLEM 3

FIRMS EMPLOYING YATES GRADUATES

Aetna Life Insurance	Hartford
American Airlines	Boston
Dun & Bradstreet	New York
General Electric	Providence
Bell Telephone	Greenville

PROBLEM 4

CENTERED TITLE

one	margin	stop
and	two	tabs
have	been	set
in	this	tabulation

SENTENCES	New Key: "	Words	Cum. Par.
1	I am happy to see that I did not get a rewrite on Job 12.	11	12
2	He lost a copy of Invoice 282 and had to make out another one.	12	24
3	An investment in knowledge always pays the best interest.	11	36
4	We received a dividend of $22.42 on Policy No. 7887242.	11	48
5	Do you know whether he checked all of the items in Order 21?	12	60
6	A pound of pluck is worth a ton of luck.	8	68
7	The shipping weight of six tubes is 1 pound 2 ounces.	11	79
8	"Yes," he said, "I want to learn."	7	87
9	The pamphlets are entitled "Punctuation," "Tabulation," and "Centering."	14	101
10	He that wants hope is the poorest man alive.	9	111
11	She always says "He don't" instead of "He doesn't."	10	121
12	John said, "Type 'Without recourse' on the back of this check; then we will have no future liability."	20	142
13	Some people get their exercise by jumping to conclusions.	11	154
14	Ten copies of the enclosed booklet, "Quality Matters," will be mailed to you.	15	169
15	The enclosed pamphlet, "The Coming Year," will help you plan your program.	15	185
16	The lawyer who named his daughter "Sue" was carrying things a little too far.	15	200
17	We have received four copies of your brochure entitled "Your Next Letter."	15	216
18	Your dictionary lists "traveler's check," but it is commonly spelled "travelers check" in business.	20	236

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

145

3. Column headings are typed with initial capitals and follow the rules for the capitalization of titles. Column headings are underscored and centered in relation to the longest item in that column. Two blank lines separate the column headings from the secondary title.

4. Unless asked to do otherwise, use six spaces between columns. This keeps the tabulation fairly compact and easy for the eye to read across.

5. Look for the longest item in each column, which includes the column heading. Run the longest item in each column into the next (a run-on) and add six spaces for each between-column gap in the tabulation. From the center, backspace once for every two spaces in the run-on (longest items plus six between columns). Disregard an odd letter at the end of the run-on when backspacing. Set the left margin stop at the point to which you have backspaced.

6. Thumb-space for the longest item in the first column plus six between-column spaces and set a stop.

7. Thumb-space for the longest item in the second column plus six between-column spaces and set another tab stop.

8. Thumb-space for the longest item in the last column except for the very last letter. Do not move the carriage. *You can now check the accuracy of the margins without typing a stroke.* Use another sheet of paper as a measuring device. Place the lower left edge of the paper at the printing point, letting the right edge extend to the right. Make a light pencil mark on your measuring sheet to match the right edge of the paper in the typewriter to the printing point. If you are off more than one space, it will be obvious and you can then retrace your steps in paragraphs 5 through 8.

9. After typing the third column heading, you may wish to reset the tab stop to center the column.

ROUGH DRAFT

Preparing a rough draft of a totally disorganized tabulation problem, such as a problem that appears in paragraph form, usually leads to greater accuracy and thereby saves time. Even a longhand draft is helpful in visualizing the overall setup, in counting for vertical centering, in backspacing for horizontal centering, and in reducing the number of factors to be considered in preparing the final copy.

To speed the typing of a rough draft: (See illustrated draft on the following page.)

1. Type the main title, secondary title, first column heading, and all items in the first column at the left margin. By capitalizing, typing parentheses, and underscoring, you will reduce the number of factors to be kept in mind when typing the final copy.

2. Since the longest item in the first column is now obvious, thumb-space six times after the longest line and reset the left margin stop at that point.

3. Type the column heading and all items in that column at the left margin.

4. Thumb-space six times beyond the longest item in the second column, reset the left margin stop, and type all items in the third column.

You now have a work sheet on which to make notations if you wish. If the tabulation problem appears on a printed copy and is fairly well organized, there may be no need for a rough draft.

SENTENCES New Keys: 9 -

		Words	Cum. Par.
1	Capitalize "The" when it is a part of the name.	9	10
2	"Don't give up," we urged; "you can succeed."	9	19
3	I shall always be glad to hear from you and your wife.	11	30
4	Numbers 1 to 49 are assigned to large cities by the American Bankers Association.	16	47
5	It is 79 degrees in this room and 19 degrees out of doors.	12	59
6	He works from 9 a.m. until 9 p.m.	7	66
7	This typewriter sold for $149.49 in 1949.	8	74
8	It does not matter where you write or what you write about.	12	87
9	Passengers on Flight 199 will leave from Gate 9 at 9:29 p.m.	12	99
10	His subtotals are 19, 79, 129, 149, and 819.	9	108
11	As long as there is human life, there will be books.	10	119
12	Rails touched a low of 129.19 and came back to close the week at 149.91.	14	134
13	He revised Chapter 7 in Book V, Chapter 2 in Book VI, and Chapter 9 in Book VII.	16	150
14	I have a feeling that all your works are related to each other.	13	163
15	About 9 percent of the people are left-handed.	9	173
16	At the end of the first half of the game, the score was 9-2.	12	185
17	As soon as he returns, ask him for 9 four-cent stamps.	11	196
18	Many have the itch, but few are willing to scratch.	10	207
19	Sell these shares as soon as there is a 9-point rise above today's closing prices.	16	224
20	There are 49 Royal typewriters in Room 1, 49 in Room 2, and 44 in Room 9.	15	239

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

TABULATION

Data are frequently systematically arranged in parallel columns for easy reference. These tabular arrangements are referred to as tables. A table is usually typed across with the use of the left margin stop for the first column and a tab stop for each of the following columns.

A table usually has a title—such as MULTIPLICATION TABLE, FOREIGN WEIGHTS AND MEASURES, TELEPHONE DIRECTORY OF BRANCHES—and sometimes has a secondary title, such as (From 1 to 12).

When there are several tables in a work, as may be the case in a report, a heading such as TABLE 1, TABLE 2, etc., is centered one blank line above the main title.

This is an illustration of a three-column table. It is centered vertically and horizontally on a half sheet of paper (5½ by 8½ inches) and is in elite type.

1 WHITMARSH COLLEGE APPLICANTS

2 (Interviewed May 16, 19--)

3 Student	Major	Overall Rating
Bowen, Helen L.	Marketing	A
Lee, Carl S.	Accounting	B
Morgan, Warren P.	Management	B
Wright, Kenneth R. 4	Economics	A

CENTERED RUN-ON INCLUDES: Wright, Kenneth R.AccountingOverall-----6-----6

Examine the previous illustration and observe the following:

1. The main title is centered and typed in all capitals.

2. The secondary title is typed with initial capitals. The first word and all other words are capitalized except conjunctions, prepositions, and articles. There is one blank line between the main title and the secondary title.

SENTENCES New Key: 3 #

		Words	Cum. Par.
1	The check is for $33.13.	5	5
2	This book measures 3 by 3 by 3 inches.	8	13
3	The meeting began at 3 p.m. and ended at 8 p.m.	9	23
4	There is no other country like it in the world.	9	33
5	In 13-1 the 13 refers to Cincinnati; the 1 refers to the First National Bank.	15	48
6	Measure the distance in inches between points 1 and 3.	11	60
7	Let me know when he arrives and tell him that I shall be very glad to see him.	16	76
8	He walked from 13th Street to 112th Street in less than two hours.	13	89
9	The tests will be given on the 2d, 3d, and 23d of June.	11	101
10	You can't get rid of a bad temper by losing it.	9	110
11	The payments are due on the 2d, 13th, and 23d of January.	11	122
12	Ratios of 3 to 1 or 4 to 1 are expected.	8	131
13	We have to do more than we have in the past three years.	11	142
14	No. 33 is typed #33 in routine work.	7	150
15	Nos. 13, 33, and 39 may be written #13, 33, and 39 in tabulations.	13	163
16	There is no space between the # sign and the 1.	9	173
17	He is not going to do this the way I asked him to do it.	11	185
18	In tabulations write 33# for 33 pounds.	8	193
19	There is no space between the 33 and the # sign.	10	203
20	In routine work 33 pounds is written 33#.	8	212

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Do not be concerned that the problem is not exactly in the vertical center. The slightly higher placement is done intentionally. Some believe that it is more pleasing to the eye to look at a slightly higher placement than one that is low or directly in the vertical center. In this book it is suggested that you round off all fractions connected with any type of centering. Some people prefer to drop all fractions.

ADJUSTING THE PAPER BEFORE CENTERING

Since most problems will call for horizontal centering whenever vertical centering is required, adjust the paper for the horizontal centering point first. Then before you start to count the number of lines down, align the top edge of the paper flush with the top edge of the aligning scale. When the paper needs to be rolled up or down less than one full line, unlock the variable line spacer by pressing the button located in the center of the left cylinder knob.

PROBLEM 1

EXERCISE
TO
IMPROVE
Muscle Tone
Muscular Strength
Muscular Endurance
Flexibility
Efficiency of Your Heart

PROBLEM 2

ANNUAL
SUMMER CLEARANCE
SALE
SUITS
COATS
DRESSES
ENDS JULY 31

PROBLEM 3

SCHEDULE OF EVENTS
at
WHITMARSH COLLEGE
on the
third of May
nineteen hundred and seventy
at the
EMERSON FIELDHOUSE
Rome, Georgia

PROBLEM 4

ANNOUNCING
FOREVER LASTED SEVEN YEARS
Available
At All Bookstores

PROBLEM 5

Brown College
Lecture Committee
presents
DR. JOHN MAYER
Thursday, May 1
STUDENT ACTIVITIES AUDITORIUM
Admission Free
PUBLIC INVITED

PROBLEM 6

NEW ENGLAND STATES
Maine
New Hampshire
Vermont
Massachusetts
Connecticut
Rhode Island

PROBLEM 7

AUTOMATIC PROGRAMMING
COBOL
ALGOL
FORTRAN
DYNAMO

PROBLEM 8

ELECTRONIC DATA PROCESSING
AUXILIARY EQUIPMENT
Collator
Accounting Machine
Summary Punch
Interpreter

PROBLEM 9

ELECTRONIC DATA PROCESSING
RECORDING METHODS
Key Punching
Prepunching
Mark Sensing
Port-A-Punch

PROBLEM 10

For the Luxury Vacation
of a Lifetime
Come to
THE INCOMPARABLE
RIO ISLAND
Enjoy Free Golf Daily

SENTENCES **REVIEWED:** # Tab set and tab key

		Words	Cum. Par.
1	The # sign is used in tabulations but not in sentences in letters.	13	13
2	Nowadays it takes 5 cents to say your 2 cents' worth on a penny postcard.	15	28
3	They knew much more than I did, and I wanted to learn all I could.	13	42
4	One way to make the ! is to type the apostrophe, backspace, and type the period.	16	58
5	In telling her age, a woman is often shy in more ways than one.	13	71
6	The difficult we do right away; the impossible takes a little longer.	14	86
7	We need the right drill for the right pupil at the right time.	12	98

8 **DIRECTIONS:** **Clear all tab stops. Set the left margin at 19 and the tabs at 28, 48, and 56.**

91#	#9 nails	3#	#19 nails
13#	#9 wire	7#	#19 screws
19#	#9 tacks	8#	#19 tacks

9	If the preceding exercise is centered, you have a pica typewriter.	13	112

10 **DIRECTIONS:** **Clear all tab stops. Set the left margin at 27 and the tabs at 36, 56, and 64.**

91#	#9 nails	3#	#19 nails
13#	#9 wire	7#	#19 screws
19#	#9 tacks	8#	#19 tacks

11	If the preceding exercise is centered, you have an elite typewriter.	14	126
12	The numbers and weights are as follows: #9 odometer, 27#; #7 odometer, 27#; #4 hour meter, 4#; #7 hour meter, 3#; #8 power pulley, 414#; #8 power pulley, 441#; #9 radiator curtain, 7#; #7 radiator curtain, 7#.	42	168

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

VERTICAL CENTERING

Vertical centering refers to the placement of typewritten material midway between the top and bottom edges of the paper.

A standard sheet of paper measures 11 vertical inches (from top edge to bottom edge). Six single-spaced lines can be typed on a vertical inch of paper whether it is a pica-type machine or an elite-type machine, which means that 66 lines (11 x 6) are available on a standard sheet and 33 lines on a half sheet.

The following illustration shows 15 lines (8 typewritten and 7 blank lines) placed in the vertical center of a half sheet, which has 33 available lines. The top and bottom margins are about equal. An explanation is given below.

1 inch	line 1
	line 2
	line 3
	line 4
	line 5
	line 6
	7
	8
EXERCISE	9
	10
TO	11
	12
IMPROVE	13
	14
Muscle Tone	15
	16
Muscular Endurance	17
	18
Muscular Strength	19
	20
Flexibility	21
	22
Efficiency of Your Heart	23
	24
	25
	26
	27
	28
	29
	30
	31
	32
	33

Solution:

```
 8  typewritten lines
+7  blank lines
15  lines used

33  available
-15 lines used
2)18 remaining for 2 margins
 9  starting line
```

TO CENTER VERTICALLY:

1. Count the number of lines used, which refers to the number of typewritten lines plus the number of blank lines between the typewritten lines (15 in the above illustration).

2. Subtract total lines used from total lines available (33 for a half sheet).

3. Divide by 2 for approximately equal top and bottom margins and round off any fraction (33 - 15 = 18 ÷ 2 = 9).

REVIEWED: # Tab set and tab key

DIRECTIONS: Move the margin stops to the extreme right and left. Clear all tab stops. Center your carriage. Backspace 11 times. Set your left margin stop. Tap out on the space bar the longest line in the first column and an additional 6 spaces for the space between columns. Set a tab stop. If you are instructed to type the introductory line, use the margin release to get beyond the left margin stop and start at 10 on the scale.

1 We have an adequate supply of the following parts:

#9 Odometer	27#
#7 Odometer	27#
#3 Hour meter	3#
#7 Hour meter	3#

DIRECTIONS: Move the margin stops to the extreme right and left. Clear all tab stops. Center your carriage. Backspace 14 times. Set your left margin stop. Tap out on the space bar "#9 Radiator curtain" and an additional 6 spaces for the space between columns; set a tab stop.

2 Please send us the price of each of the following parts:

#8 Power pulley	414#
#2 Power pulley	411#
#9 Radiator curtain	7#
#7 Radiator curtain	7#

DIRECTIONS: Move the margin stops to the extreme right and left. Clear all tab stops. Center your carriage. Backspace 26 times. Set your left margin stop. Tap out on the space bar "#8 Windshield wiper" and an additional 6 spaces for the space between columns; set a tab stop.

3 The numbers and weights of the parts you requested are as follows:

#7 Defroster fan	Factory installation	4#
#8 Windshield wiper	Field installation	2#
#3 Cab heater	Factory installation	9#
#9 Exhaust rain cap	Factory installation	2#
#4 Tail light	Field installation	4#

When centering by backspacing, errors are sometimes made when one loses count of the pairs, when the eyes unintentionally "jump" a letter, or when one is distracted momentarily from the line being centered, perhaps to look at a part of the typewriter to be certain it is functioning properly.

One may find it easier to keep his place when reading pairs of letters by saying to himself the first letter of each pair as the backspacer is pushed down and by saying the second letter of the pair as the backspacer goes up, as

CENTERING A TITLE

backspace → 1 2 3 4 5 6 7 8

MAY BE INTRODUCED ANYTIME AFTER PAGE 64

First, center each line horizontally and single-space. Leave one blank line after each problem.

Next, double-space; center each line horizontally; type all lines in CAPITAL LETTERS. Leave two blank lines after each problem.

To type a word or a line in SOLID CAPITALS, depress the shift lock, which is above one or both shift keys.

To release the lock, depress either shift key. On some machines, only one of the shift keys releases the shift lock.

PROBLEM 1
FILING SYSTEMS
Alphabetic
Numeric
Geographic
Subject

PROBLEM 2
Law I
Economics
Principles of Accounting
Economic Geography
English Composition I

PROBLEM 3
TERM PAPER
Preface
Table of Contents
Chapters
Bibliography
Appendix

PROBLEM 4
PARTS OF A CONTRACT
Offer
Acceptance
Consideration
Legal Object
Competent Party
Legal Form

PROBLEM 5
FORMS OF WRITTEN COMMUNICATION
Letter
Telegram
Interoffice Memorandum

PROBLEM 6
Current Assets
Temporary Investments
Retained Earnings
Accumulated Depreciation
Mortgage Notes Payable

PROBLEM 7
TELEPHONE TECHNIQUES
Answer Promptly
Use Pleasant Greeting
Identify Office and Yourself
Take Notes
Let Called Hang Up First

PROBLEM 8
TERMS OF LOGIC
Premise
Vagueness
Categorical Proposition
Impromptu Definition
Syllogism
Generalization
Scientific Method

After you have been taught to center vertically (page 99), you may be asked to center each of the above problems horizontally and vertically on a half sheet or on a full sheet and to single-space, double-space, or triple-space.

SENTENCES New Keys: 0 ( )

		Words	Cum. Par.
1	This room is 20 by 30 feet. That room is 10 by 20 feet.	11	11
2	Spring arrived at 10:21 a.m. on the 20th of March.	10	22
3	Time is the one thing we all have; our success depends upon how we use it.	15	37
4	I have pica type because the margin scale reads from 0 to 100.	12	50
5	I have elite type because the margin scale reads from 0 to 120.	13	63
6	A woman who tells you she won't be a minute is usually telling the truth.	15	78
7	In 420 the 4 means the Fourth Federal Reserve District.	11	89
8	In 420 the 2 refers to Branch No. 2 of the Federal Reserve Bank.	13	102
9	The sum of 10 and 40 and 30 and 40 and 80 is 200.	10	113
10	We shall be glad to send you a dozen just as soon as we receive another shipment.	16	129
11	If your machine has pica spacing, there are 10 spaces to an inch.	13	143
12	When there are under 100 words in the body, it is known as a short letter.	15	158
13	When there are 100 to 200 words in the body, it is known as a medium letter.	15	173
14	I have been trying to tell you how to answer all questions.	12	186
15	I think the main thing is to call before you go to see him.	12	198
16	When there are 200 or more words in the body, it is known as a long letter.	15	213
17	The number sign (#) is used in routine work and tabulations.	12	226
18	The number sign (#) is not used in ordinary work.	10	236
19	These abbreviations appeared in the letter: Ph.D (Doctor of Philosophy), M.D. (Doctor of Medicine), Ed.D. (Doctor of Education).	26	262

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

2. Backspace once for every two strokes as you say:
   BA CK SP AC Espace HA LF

3. Type this line.

Center the remaining five lines; then remove the paper from your machine and check the accuracy of your work.

To check the accuracy of centered lines:

1. Fold the paper in half lengthwise and make a sharp crease by running your fingernail up and down the fold.

2. Hold the paper up to the light to see whether more than one letter juts beyond the shorter end of the overlapping typewritten line.

3. If no more than one letter juts out, the line is considered to be accurately centered. If two or more letters jut out, this is considered an error for classwork and for testing purposes. If there are more than one but not quite two letters jutting out, it is acceptable but indicates that it is likely the backspacing was not started from the exact center.

Setting the paper guide at zero and using 42 or 51 as the center of a standard size sheet may be an adequate way to center horizontally in most situations. Attempts at exact centering are sometimes thwarted, however, because some paper guides are jarred out of position by carriage returns or are intentionally or unintentionally moved from the zero position by other typists.

Sometimes a typist curls the paper as he pushes it too firmly against the paper-edge guide, or he does not put the paper against the paper-edge guide. A typist may insert the paper crooked and may move the paper into an undesirable position while adjusting it, which causes the "centered" line to be off two spaces for each space the paper is out of position.

A secondary purpose of the following discussion is to describe how the position of the paper guide may be checked.

USE OF THE CREASED SHEET IN HORIZONTAL CENTERING FOR LEARNING AND TESTING PURPOSES

Allowing the learner to use a creased sheet and to type the period in the center of the crease is a concrete way to help him visualize the exact printing point of a particular typewriter, as well as helping him to see how to line up exactly the crease with that printing point. Your teacher may encourage you to use this technique while you are learning and while you are testing.

Follow these steps:

1. Fold a sheet of paper exactly in half lengthwise and crease it. Make it a sharp crease by running your fingernails or a pen up and down the crease.

2. Insert the sheet into the typewriter. Move the carriage so that the carriage-position indicator points to 42 (pica) or 51 (elite) on the scale.

3. If necessary, use the paper release and move the sheet so that the center of the crease is directly in line with the printing point.

4. Type the period. If the period is not in the center, backspace once, use the paper release, and adjust the paper. If necessary, you can then adjust the paper-edge guide against the left edge of the sheet.

If you type the period, be sure you backspace to the centering point before you begin to center a line. The centering procedure then follows the steps mentioned on the backing sheet, namely:

5. Backspace *once* for every *two* spaces in the line you are centering. A space between words is counted as a space for the purpose of backspacing.

6. If there is one letter left over at the end of the backspacing, disregard the odd letter. Type the line.

It takes longer to prepare to center by the creased-sheet technique than by the guideline backing-sheet technique. Creasing and typing the period are done only during the learning and testing phases in order to obtain maximum accuracy. Of course, in a business situation the same accuracy may be obtained by placing a creased sheet at the top of the original to measure, drawing a light pencil guide mark at the center of the original, aligning the mark with the printing point, and then erasing the light pencil line.

SENTENCES	Words	Cum. Par.
1 All our accountants type (1) memorandums, (2) statements, and (3) letters.	15	15
2 We are concerned about (1) attitudes, (2) skills, and (3) grooming.	13	29
3 The greater the obstacle, the more glory in overcoming it.	12	41
4 Our test will consist of (1) centering, (2) tabulation, and (3) letter placement.	16	57
5 In our office we use the number sign (#) on the cards we type for our files.	15	73
6 You may use Form 1040W if your income is made up of (1) salary and wages and (2) not more than $200 of dividends and interest.	25	98
7 The secret of life is not to do what you like but to like what you do.	14	113
8 The key words are (1) head, (2) heart, (3) hands, and (4) health.	13	126
9 The pound sign (#) saves time and space on our ordinary office records.	14	141
10 High heels were invented by a woman who had been kissed on the forehead.	14	156
11 Their key words are (1) faith, (2) hope, (3) charity, and (4) fidelity.	14	170
12 Some attorneys insist that prices be typed in words and repeated in figures.	15	186
13 You may adjust the touch from light (at setting 1) to very firm (at setting 7).	16	205
14 Name (1) four scales, (2) four levers, and (3) seven keys on this typewriter.	15	218
15 More people are run down by gossip than by automobiles.	11	229
16 As previously mentioned (see page 2), we want people who can type.	13	243
17 He strives (1) to do his own thinking and (2) to work cooperatively with others.	16	259

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

DIRECTIONS: Set a tab for a 5-space indention.

18 The new features are the		5
(1) half-space key,		9
(2) total tab clear lever, and		15
(3) page gage.	17	18

1 2 3 4 5 6

HORIZONTAL CENTERING

In some classes the teacher will decide to postpone the introduction of centering until after the letter keyboard has been introduced (page 64); therefore, it is possible that the preceding exercises on centering and tabulation will be bypassed. If you have done the previous centering and tabulation, you will find the basic ideas repeated here and, in addition, more detailed explanations.

HORIZONTAL CENTERING WITH THE USE OF A BACKING SHEET

To center horizontally, one must place half of the typewritten line to the left of the center of the sheet and half to the right. In other words, horizontal centering refers to balancing a word or line by typing it an equal distance from the left edge and from the right edge of the paper; thus the amount of white space to the left of the typewritten line equals the amount of white space to the right.

Before you begin centering, clear all tab stops and move the margin stops well out of the way.

If you are going to center many lines, set a tab stop at the center point to simplify locating the center of the sheet quickly. However, if you are centering only one or two lines, as in the case of a tabulation problem, the tab stop could go unnoticed and cause errors in tabulating.

You will be shown two of the easiest and most accurate ways to center horizontally. Follow one of these ways when you are tested on horizontal centering and when you are doing assignments. By being exact, it will make it possible for you and your teacher to tell whether you know exactly how to center or whether through a combination of errors you accidentally center a line occasionally. Following definte steps also makes it easy to trace the source of any incorrect procedure.

Please read the directions on the "Guideline for Horizontal Centering," copies of which appear on page 87 and in your Wookbook, page 1. With the use of the Workbook backing sheet or a plain sheet on which you have drawn a centered line, follow the directions and do the centering problem given below.

To type a word or a line in SOLID CAPITALS, depress the shift lock, which is above one or both shift keys.

To release the lock, depress either shift key. On some machines, only one of the shift keys releases the shift lock.

```
CENTERING A TITLE
 BACKSPACE HALF
       FOR
 LEFT OF CENTER
OTHER HALF TYPED
       TO
 RIGHT OF CENTER
```

To center the line CENTERING A TITLE:

1. Set the carriage at the centering point—pica 42; elite 51. The guideline on the backing sheet should be moved to match the exact center at the printing point.

2. Backspace once for every two strokes as you say:
   CE NT ER Gspace Aspace TI TL (and disregard E).

3. Type the line.

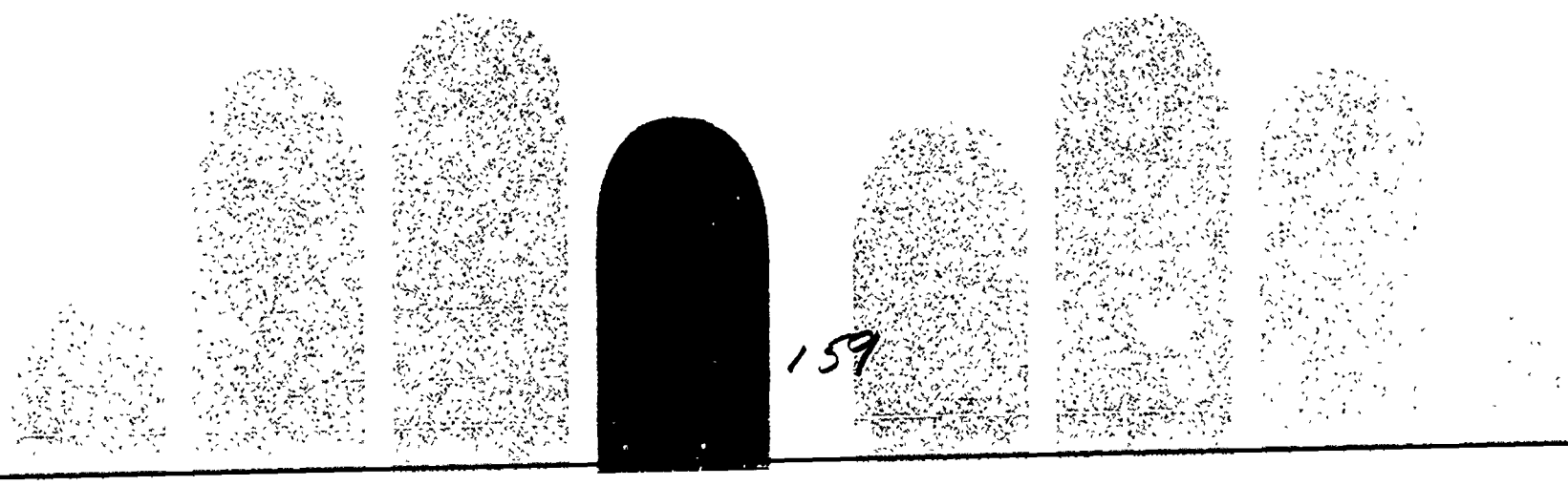
To center the line BACKSPACE HALF:

1. Reset the carriage at the centering point.

SENTENCES New Key: 5

		Words	Cum. Par.
1	To leave a 1-inch margin at the top of your paper, begin typing on line 7.	15	15
2	There are either twenty-one or twenty-two keys in the two top rows.	13	29
3	It is better to light one candle than to curse the darkness.	12	41
4	He is either twenty-eight or twenty-nine years of age.	11	52
5	He is looking for the forty-three beans in his cup of coffee.	12	65
6	People who are grateful are usually good.	8	74
7	The plane arrives at three-fifteen and leaves at five-fifteen.	12	86
8	There were ninety-nine men who made the same statement.	11	98
9	May I say a few words in answer to his question.	10	108
10	I wonder whether ninety-eight of them actually thought for themselves.	14	122
11	It is a guide book you will be glad to have on hand and refer to from time to time.	17	139
12	Ray lives at 855 Main Street, Bath, Maine 04530, which is two blocks from 955 Main.	17	156
13	Use figures when you type 5 tons, 55 degrees, and 15 yards.	12	168
14	Blessed are those who go around in circles, for they shall be called big wheels.	16	185
15	In 57-1 the 57 is the state number for Rhode Island.	10	196
16	The numbers 50-99 are state numbers; each of these numbers represents a state.	16	212
17	We ought not to be as we are; we can be better if we really want to be.	14	226
18	A 3 by 5 card will fit in this file box.	8	235
19	In 57-33 the 33 refers to the Rhode Island Hospital Trust Company.	13	248
20	It has been a pleasure for us to have this chance to come here and see your work.	16	265

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16



159

elite
6-inch line
16 - 86

THIS MEMORANDUM MAY BE INTRODUCED AFTER PAGE 22. **See Workbook page 4.**

TO: Earl O. Olds October 10, 19--

FROM: Rose Hall

SUBJECT: Old File Folders

This store has old file folders that are good for order files. Those old folders do hold together. Those folders are good folders that hold all of those old orders. I store all of those old file folders here. Order old file folders here.

This store also has other good folders. Ask for Rose. I shall take orders for all file folders. Old folders sell three for half a dollar. All other folders sell three for a dollar. This is a good offer. Tell Harold Olds that all other stores order too little or too late to get this offer.

E. R. H.

als

PICA
6-inch line
12 - 72

TO: Earl O. Olds October 10, 19--

FROM: Rose Hall

SUBJECT: Old File Folders

This store has old file folders that are good for order files. Those old folders do hold together. Those folders are good folders that hold all of those old orders. I store all of those old file folders here. Order old file folders here.

This store also has other good folders. Ask for Rose. I shall take orders for all file folders. The old folders sell three for half a dollar. All other folders sell three for a dollar. This is a good offer.

E. R. H.

als

SENTENCES

New Keys: % 6

		Words	Cu P.
1	Discounts of 10%, 10%, and 10% are equal to a single discount of 27.1%.	14	1
2	His costs were as follows: books, 1%; tuition, 40%; room and board, 59%.	15	2
3	It is not the hours we put in but what we put in the hours that really counts.	16	4
4	He received trade discounts of 5%, 10% and 20% and a cash discount of 2%.	15	6
5	The tax was raised 2% two years ago, 5% last year, and 8% this year.	14	7
6	A good salesman is one who convinces his wife she looks fat in a fur coat.	15	9
7	You may use the % symbol in the following: 2% 20 days, net 30 days.	14	10
8	His costs were 1% for books; 49% for room, board, and tuition; and 50% in lost wages.	17	12
9	Every person should have the chance to achieve the best that is in him.	14	13
10	Yes, type "5 percent" in ordinary letters and "5%" in tabulations.	13	14
11	He bought common stock at 66 a share and sold it later at 86.	12	16
12	Books pertaining to business are found in the 650 series in our library.	14	17
13	The victory of success is half won when one gains the habit of work.	14	19
14	Trade discounts of 25%, 10%, and 20% are equal to a single discount of 46%.	15	20
15	If you are interested in industrial management, look at the 658.3 series.	15	22
16	The number 657 is on all accounting books in our library.	11	23
17	In 1967 it was estimated that the cost of a 250-word business letter was $2.49.	16	24
18	Books on advertising are numbered 659.1 in our library.	11	26
19	We need a file box for the 3 by 5 cards and fifty 4 by 6 cards.	13	27
20	List on page 1 a $600 exemption for yourself and a $600 exemption for your wife.	16	29
21	Refer to the Encyclopedia Americana and the Encyclopedia Britannica.	14	30

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

elite
6-inch line
16 - 86

MAY BE INTRODUCED ANYTIME AFTER PAGE 19. See Workbook page 3.

TO: All Retail Tire Dealers September 30, 19--

FROM: R. R. Hall

SUBJECT: Tire Rates

All tire dealers like this tire. Dr. R. A. Read rates this tire high. This tire sells at a higher rate. This rate is fair. Retail dealers like this higher rate; all retail dealers shall retail all tires.

He shall read his letter at the trade hall. Take the third right at High Street. This street is higher. This is the right street. The trade hall is there. The trade hall is high. The retail dealers like this trade hall. Last fall retail dealers did fill this trade hall.

R. R. H.

alr

PICA
6-inch line
12 - 72

TO: All Retail Tire Dealers September 30, 19--

FROM: R. R. Hall

SUBJECT: Tire Rates

All tire dealers like this tire. Dr. R. A. Read rates this tire high. This tire sells at a higher rate. This rate is fair. Retail dealers like this higher rate; all retail dealers shall retail all tires.

He shall read his letter at the trade hall. Take the third right at High Street. This street is higher. This is the right street. The trade hall is there. The trade hall is high. The retail dealers like this trade hall. Last fall retail dealers did fill this trade hall.

R. R. H.

alr

SENTENCES	REVIEWED: - (hyphen) now used to make the dash (--)	Words	Cum. Par.
1	Time reported that 90 percent of college students have IQs above 110.	14	14
2	I am glad to see that you also read the April issue of the Reader's Digest.	15	29
3	Let us make sure that we are marching with them and not against them.	14	44
4	Two contracted words are hasn't and doesn't.	9	53
5	The apostrophe takes the place of a letter in don't.	10	64
6	Don't just itch for success; scratch for it.	9	73
7	A good unabridged dictionary is Webster's Third New International Dictionary.	15	89
8	Write to the Superintendent of Documents for a copy of the Style Manual.	14	103
9	We do subscribe to Dun & Bradstreet's Ratings and Reports.	12	115
10	If at first you do succeed, try something harder.	10	126
11	Do not underscore the punctuation mark following Style Manual.	12	138
12	These subjects--English, typewriting, and accounting--helped Jim to get his first job.	17	156
13	These characteristics--namely, research, creativeness, and leadership--are needed.	16	173
14	It is better to place the dash at the end of the line rather than at the beginning.	17	190
15	One-syllable words--for example, through, planned, and spelled--should not be divided at the end of a line of typing.	23	213
16	Never divide a four-letter word--for example, only, into, and rely--at the end of a line.	18	231
17	Never divide after the first letter of a word--for example, a-bout, e-nough, and o-mitted--at the end of a line of typing.	24	256
18	Type two hyphens for the dash; do not leave a space before or after the dash.	15	272
19	Abbreviations--for example, U.S.S.R., Y.W.C.A., and NATO--should not be divided.	16	288
20	NOMA, AWOL, SOS, IOU--all are typed with no periods and no spaces between letters.	16	305

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

163

elite
6-inch line
16 - 86

THIS MEMORANDUM MAY BE INTRODUCED AFTER PAGE 19.

TO: R. A. Little September 30, 19--

FROM: R. R. Hall

SUBJECT: Higher Tire Rates

The first girl is right. List all tires. List all rates. This rate is high. This rate is fair. Tell her his tire dealer is here. His rate is still higher. Tell her his address.

Tell her this retail dealer is after his trade. Tell her all rates are higher. This rate is rather high; it is fair. His retail tire dealer has a still higher rate.

His dealer read that his rate is rather dear. His retail dealer likes his rate. The rate his dealer likes is rather high.

R. R. H. ← Dictator's initials to the right of center

Typist's Initials → alr

PICA
6-inch line
12 - 72

TO: R. A. Little September 30, 19--

FROM: R. R. Hall

SUBJECT: Higher Tire Rates

The first girl is right. List all tires. List all rates. This rate is high. This rate is fair. Tell her his tire dealer is here. His rate is still higher.

Tell her this retail dealer is after his trade. Tell her all rates are higher. This rate is rather high; it is fair. His retail tire dealer has a still higher rate. His dealer read that his rate is rather dear. His retail dealer likes his rate. His retail dealer likes the higher rate. The rate his dealer likes is rather high.

R. R. H.

alr

SENTENCES	New Keys: / *	Words	Cum. Par.
1	These boards are 1 3/8 inches thick.	7	7
2	The diagonal (/) is used in typing fractions that are not on the keyboard.	15	23
3	We urge you to do whatever you can to help all boys and girls live better lives.	16	39
4	I typed "and/or" three times in a legal document.	10	49
5	I hereby name John Law and/or Ed Lawyer as my executors.	11	61
6	The sum of 10 3/8 and 10 24/32 is 21 1/8.	8	69
7	Some of us are like a fence; we run around a lot without getting anywhere.	15	85
8	In letters type the date June 12, 1968, instead of 6/12/68.	12	97
9	A card must not be larger than 3 9/16 by 5 9/16 inches to be mailed as a postcard.	16	114
10	The man who does his job well tones up the whole society.	11	125
11	Jim abbreviated the date to 4/5/68 on the 3- by 5-inch card.	12	138
12	The difference between 5 2/5 and 7 3/5 is 2 1/5.	10	148
13	It is my hope that with your help we can do our part in helping others help themselves.	17	166
14	Your transcripts will be rejected for any of the following incorrect end-of-line divisions: 9:21/a.m.; Mr./Jones; 222/feet; No./414; May/2, 1968; 10/percent; 1414/Main Street; S. A./Dunn, Ph.D.; S. A. Dunn,/Ph.D.; should/n't, Jack/F. Kenny.	48	214
15	One of the best ways to prepare for the future is to begin right now.	14	228
16	In business letters express the terms as follows: 2% 20 days, net 30 days or 2/20; n/30 or 2/20, net 30 or 2 percent 10 days, net 30 days.	28	256
17	Do not use more than three asterisks (*, **, ***) to indicate footnotes.	14	271

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

165

FOLLOW THESE DIRECTIONS WHEN YOU TYPE THE MEMORANDUMS ON THE NEXT THREE PAGES AND ON PAGES 107 through 109.

Set left margin stop

line 7 TO:

FROM:

SUBJECT:

Leave 2 blank lines

Set a tab stop 2 spaces after the colon after SUBJECT. Tabulate to the same point for all paragraphs.

Set right margin stop 2 spaces beyond

September 30, 19--

REVIEWED: - * / Tab set and tab key

DIRECTIONS: Single-space; type the first line and then set a tab stop ten spaces beyond the hyphens. Type carefully; no erasures are permitted on checks.

			Words	Cum. Par.
1	Pay to the order of Barbara B. Briggs, Treasurer ---	$689.00		12
	Six Hundred Eight-nine and no/100 ***		20	20
2	Pay to the order of Russell Bailey ---	$950.00		29
	Nine Hundred Fifty and no/100 ***		16	36
3	Pay to the order of Clyde Walker ---	$2,500.00		45
	Two Thousand Five Hundred ***		15	51
4	Pay to the order of Henry M. Murray	$3,888.00		61
	Three Thousand Eight Hundred Eighty-eight and no/100 ***		21	72
5	Pay to the order of Thomas J. Wriston ---	$10,750.00		82
	Ten Thousand Seven Hundred Fifty and no/100 ***		20	94
6	Pay to the order of Ruth W. Watson, Treasurer ---	$95,089.00		104
	Ninety-five Thousand Eighty-nine and no/100 ***		22	114
7	Pay to the order of Lloyd L. Lewis, Secretary ---	$150,000.00		126.
	One Hundred Fifty Thousand and no/100 ***		20	134
8	Pay to the order of Victor Dodd ---	$2,055,000.00		144
	Two Million Fifty-five Thousand and no/100 ***		19	153
9	Pay to the order of Arthur B. Curtis, Receiver ---	$3,900,000.91		166
	Three Million Nine Hundred Thousand and 91/100 ***		23	176
10	Pay to the order of Clyde L. Scott, Receiver ---	$4,853,796.52		188
	Four Million Eight Hundred Fifty-three Thousand Seven Hundred Ninety-six and 52/100		29	205
11	Pay to the order of Ross-Jones, Incorporated ---	$ -(97¢)		217
	Only ninety-seven cents ***		18	223

SENTENCES

12	In the last few days there have been some good and some bad events.	13	14
13	Women drivers can be very healthy and still take a turn for the worse.	14	28
14	Wisdom is knowing when to speak your mind and when to mind your speech.	14	43

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

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MAY BE INTRODUCED ANYTIME AFTER PAGE 19.

Steps in doing tabulation problem:

1. Move the margin stops well out of the way and clear all tab stops.

2. To center vertically:

	lines available
Count and subtract	lines used (including title)
Divide by 2	

Center title horizontally on this line. Since horizontal centering is involved, use the backing sheet "Guideline for Horizontal Centering."

3. (a) Find the longest word in each column. As shown in the illustration on the previous page, center the longest words together:

hesitatedelegate$-----6 and (b) backspace *three* more times so that you can leave *six* spaces between columns.

4. Set the left margin stop at the point to which you have backspaced. This is the point at which the first column will start.

5. Thumb-space *once* for every letter in the longest word in the first column and *once* for each of the *six* spaces between columns.

6. Set a tab stop at the point reached. This is where the second column begins.

PART 1 Single-space the body of the table. Center each table vertically and horizontally on a half sheet. Leave two blank lines after the title.

PROBLEM 1

FIRST TEST

set	first
test	date
fail	test
fall	flat
delighted	if
all	get
it	right

PROBLEM 2

FALL GIFT SALE

desk	dishes
desk sets	sheets
files	health aids
headsets	health sets
flags	hats

PROBLEM 3

TEST LIST

little	life	file
side	filled	steel
itself	like	sheets
fee	estate	dead
feet	head	ahead
stated	tell	date

PART 2 Double-space the body of the table. Center each table vertically and horizontally on a full sheet. Leave two blank lines after the title.

PROBLEM 4

FIRST GIFT LIST

desk	glasses
desk files	dishes
desk sets	salad plates
steel safes	fitted sheets
steel files	health aids
headsets	health sets
flags	felt hats
saddles	ties
skis	shirts
slide files	field glasses

PROBLEM 5

LAST TEST LIST

agree	referred	rather
dealer	desires	red
street	regards	letters
filled	tire	larger
reader	series	started
rather	share	rest
greater	fair	dear
read	assist	ageless

SENTENCES

New Key: ½ ¼

		Words	Cum. Par.
1	Three line spaces equal ½ inch.	6	6
2	The size of a standard sheet of paper is 8½ by 11.	10	17
3	The only time you mustn't fail is the last time you try.	11	28
4	The size of a half sheet is 8½ by 5½.	7	36
5	He changed the ½ to 1/2 because the other fraction in the sentence was 3/4.	15	51
6	There is no philosophy by which a man can do a thing when he thinks he can't.	15	67
7	If you wish to leave ½ inch of blank space after the date on a letter or ½ inch for a signature, single-space four times and type on the fourth line.	30	97
8	He centers his page numbers ½ inch from the bottom of the page.	13	110
9	Do not drive as if you own the road; drive as if you own the car.	13	124
10	Six elite spaces equal ½ inch. Five pica spaces equal ½ inch.	12	136
11	If you wish to bind your term paper at the left, add ½ inch to the left margin.	16	153
12	Add ½ and 1½ and ½ and 1½; multiply the answer by ¼; then divide by 1¼.	14	167
13	Only when all fractions are ½ and/or ¼ do you use the ½ and ¼ key.	13	181
14	I am sure that he will be glad to help you get the facts.	11	193
15	A government postal card is 5½ by 3¼ inches.	9	202
16	Write a letter to that company for three ¼-inch pipes in 3¼-foot lengths.	15	217
17	The size of a baronial sheet is 5½ by 8½. The size of a monarch sheet is 7¼ x 10½.	17	234
18	He told me his ideas, and they seem to agree with what we have been trying to do.	16	251
19	Last week that man traded his 3¼-ton truck for a new 4¼-ton truck.	13	264
20	The 1/2 and 1/4 are more legible on the fifth carbon copy than the ½ and ¼.	15	280

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

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MAY BE INTRODUCED ANYTIME AFTER PAGE 19.

TABULATION

Tabulation is the systematic arrangement of items in parallel columns for ready reference. These tabular arrangements are referred to as tables. A table is usually typed across with the use of the left margin stop for the first column and a tabulator stop for each of the following columns. A table usually has a title, which is typed in all capital letters.

This is an illustration of a two-column table. It is centered vertically on a half sheet of paper (5½ by 8½ inches) and is in elite type.

```
                                                  1
                                                  2
                                                  3
                                                  4
                                                  5
                                                  6
                                                  7
                                                  8
                  (1) FIFTH TEST                  9
                      (2)                         10
                                                  11
                Athlete       assists             12
                                                  13
                fall          ads                 14
                                                  15
                all           delight             16
                                                  17
                state         delegates           18
                                                  19
                its           flag                20
                                                  21
                hesitate (3)  less                22
                                                  23
                list          detailed            24
                                                  25
                                                  26
                                                  27
                                                  28
                                                  29
                                                  30
                                                  31
                                                  32
                                                  33
```

CENTERED RUN-ON INCLUDES: hesitatedelegates$-----6

1. The title is centered and typed in all capitals.

2. Leave two blank lines after titles, which means to turn the cylinder knob forward (clockwise) three clicks.

3. Unless asked to do otherwise, use six spaces between columns. This keeps the table fairly compact and easy to read across even when the body of the table is single-spaced.

SENTENCES	New Key: ¢	Words	Cum. Par.
1	In order to learn the ¢ key, type the information on this page.	13	13
2	In business letters type "6 cents" instead of using the ¢ sign.	13	26
3	If you wish to join us in this effort, we hope that you will send what you can now.	17	43
4	I am going to type the following in order to learn the ¢ key. Government postal cards, 5¢ each; by airmail, 8¢ each; double or reply cards, 5¢ each portion; business reply cards, 7¢ each; by airmail, 10¢ each; business reply envelopes, 2¢ collection fee added to ordinary rate.	55	98
5	You may be sure that you will have our full support and that of the other nations.	16	115
6	There is a big difference between 25¢ and .25¢, 50¢ and .50¢ and 90¢ and .90¢.	16	131
7	The .25¢, .50¢, and .90¢ mean 25/100 of a cent, 50/100 of a cent, and 90/100 of a cent and do not mean 25¢, 50¢, and 90¢.	24	156
8	You need to know how to deal with this in a way that will be of the greatest good.	16	172
9	While letters to Canada and Mexico cost 6¢ an ounce, letters to all other countries cost 13¢ for the first ounce and 8¢ for each additional ounce.	29	202
10	While single postcards to Canada and Mexico cost 5¢, single postcards to all other countries cost 8¢.	20	222
11	We who have signed this letter have a great faith in you and what you can do.	15	238
12	In addition to regular postage for first-class mail, the fees for special delivery are as follows: Up to 2 pounds, 30¢; over 2 and up to 10 pounds, 45¢; over 10 pounds, 60¢.	34	273

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

VERTICAL CENTERING

Vertical centering refers to the placement of typewritten material midway between the top and bottom edges of the paper.

A standard sheet of paper measures 8½ inches from left edge to the right edge of the sheet. It measures 11 vertical inches (from top to bottom of the sheet). Six single-spaced lines can be typed on a vertical inch of paper, which means that 66 typewritten lines will fit on 11 vertical inches whether it is a pica-type machine or an elite-type machine; 33 typewritten lines will fit on a half sheet.

TO CENTER VERTICALLY:

1. Count the number of lines used, which refers to the number of typewritten lines plus the number of blank lines between the typewritten lines (interlines). In the example to the right five lines are used.

2. Subtract total lines used from total lines available.

3. Divide by 2 (for equal top and bottom margins) and round off any fraction.

Do not be concerned that the problem is not exactly in the vertical center. The slightly higher placement is done intentionally.

EXAMPLE:

```
1  TYPEWRITTEN LINE
2      (blank line)
3  TYPEWRITTEN LINE
4      (blank line)
5  TYPEWRITTEN LINE
```

66 lines available (on 8½ by 11 sheet inserted upright)
−5 lines used
2)61
30½ = 31 Start typing on line 31.

ADJUSTING THE PAPER BEFORE CENTERING

Since most problems will call for horizontal centering whenever vertical centering is required, adjust the paper for the horizontal centering point first. Then before you start to count the number of lines down, align the top edge of the paper flush with the top edge of the aligning scale. When the paper needs to be rolled up or down less than one full line, unlock the variable line spacer by pressing the button located in the center of the left cylinder knob.

PART 1 Single-space. Center each problem vertically and horizontally on a half sheet.

PROBLEM 1

```
ALL ATHLETES
TITLE FIGHT
AT
FLAGG FIELD
STATE TITLE AT STAKE
```

PROBLEM 2

```
FIFTH FALL SALE
East Hall
GIFT IDEAS
Dishes
Desk Sets
Health Aids
Hats
DETAILS AT DESK
```

PROBLEM 3

```
DIET DIGEST
Eight Health Ideas
Detailed Health Diets
Feast
As Fat Fades
```

PROBLEM 4

```
STATE TITLE FIGHT
AT
FLAGG FIELD
HAL TASKA
FIGHTS
AL LITTLE
TELL ALL LADIES
GIFTS AT GATE
```

PART 2 Double-space. Center each problem vertically and horizontally on a half sheet.

PROBLEM 5

```
   FIFTH FALL SALE
HELD AT FLAGG HALL
STILL DELIGHTS ALL
ALL DADS GET GIFTS
```

PROBLEM 6

```
ALL DELEGATES
Ada Hall
States Her Ideas
Assist All Aged
State Legal Aid
State Health Tests
```

PROBLEM 7

```
ALL AGED
State Legal Aid
State Health Tests
FILE AT DESK
```

PROBLEM 8

```
STATE TITLE
AT STAKE
EIGHT FIGHTS LISTED
DATE SET
GET DETAILS AT DESK
```

SENTENCES New Key: @

		Words	Cum. Par.
1	My boss typed me a note on a card that read, "Order 400 erasers @ 15¢ each."	15	15
2	Since most tabulations have a unit-cost column, the @ key is seldom used.	15	30
3	We are waiting for a word from you that you would like to have one at no cost to you.	17	48
4	Do not use the ¢ and @ signs in your transcripts; use cents and at instead.	15	63
5	We can save space by typing the ¢ and @ symbols, but it is better to make these clear to the reader by spelling cents and at than to save a little time and space.	32	96
6	It is important to list his name and number as well as the time and date of the call.	17	113
7	Do not use the ¢ and @ signs in typing letters, but you may use them in typing interoffice memorandums, bills, and invoices.	25	138
8	In telegrams do not use the ¢ and @ symbols; write cent or cents and at.	14	153
9	His job is to find out whether the right thing is being done.	12	166
10	The @ means at; type the word at and not the @ in the letters that you write.	15	181
11	If you have a typewritten rough draft of your 25-page term paper, you can expect to pay an expert typist $19.45 for an original and two carbon copies.	30	212

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

12 **DIRECTIONS:** Type a rough draft of the information given below in order to learn the ¢ and @ key. Then set this bill up in proper form. Use two headings: Supplies and Typing. Use other suitable headings in order to avoid repeating the ¢ and @ signs unnecessarily. Set tab stops.

25 original sheets @ 2¢ each, 50¢; 50 sheets for carbon copies @ 1¢ each, 50¢;
20 sheets of carbon paper @ 5¢ each, $1; 3 notebook covers @ 25¢ each, 75¢;
15 double-spaced originals @ 50¢, $7.50; 10 double- and single-spaced originals
@ 62¢, $6.20; 50 carbon copies @ 6¢ each, $3; total, $19.45. 58 270

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

GUIDELINE
FOR
HORIZONTAL CENTERING

HORIZONTAL CENTERING WITH THE USE OF A BACKING SHEET

1. Place this sheet in back of the sheet on which you will type. Notice that the vertical line in the center of this backing sheet may be seen through the first sheet.

2. Insert both sheets into the typewriter. Center the carriage at 42 if you have pica type or at 51 if you have elite type.

3. If necessary, use the paper release and move the sheets so that the center line is at the printing point of the centered carriage.

4. Backspace once for every two spaces in the line you are centering. A space between words is counted as a space while backspacing.

5. If there is one letter left over at the end of the backspacing, disregard that odd letter.

6. Begin typing at the point to which you have backspaced. That line will be centered horizontally.

If you should misplace this sheet, just draw up your own centering guideline on a clean sheet.

TABULATION

considers	running	together
the	longest	word
in	each	column
plus	six	spaces
between	columns	and
centering	that	run-on

MAY BE INTRODUCED ANYTIME AFTER PAGE 15.

HORIZONTAL CENTERING

As you are reading this line, your eyes are traveling horizontally across this sheet of paper. Horizontal centering refers to a word or line centered in relation to the left edge and the right edge of the paper. A 6½-inch typewritten line centered on a sheet 8½ inches wide would have equal side margins of 1 inch.

Please read the directions on the "Guideline for Horizontal Centering," copies of which appear on the next page and in your Workbook. With the use of the Workbook backing sheet or a plain sheet on which you have drawn a centered line, follow the simplified directions and do the centering problems given below.

To type a word or a line in SOLID CAPITALS, depress the shift lock, which is above one or both shift keys.

To release the lock, depress either shift key. On some machines, only one of the shift keys releases the shift lock.

PART 1 Single-space. Center each line horizontally. Leave one blank line after each problem.

To center the line TAKE STATE TESTS:

1. Set the carriage at the centering point—pica 42; elite 51.
2. Backspace once for every two strokes as you say:
   TA KE SpaceS TA TE SpaceT ES TS
3. Type the line.

To center the line THIS FALL:

1. Reset the carriage at the centering point.
2. Backspace one for every two strokes as you say:
   TH IS SpaceF AL (and disregard last L).
3. Type this line.

PROBLEM 1

TAKE STATE TESTS
THIS FALL
TESTS HELD
AT
FLAGG HALL

PROBLEM 2

FALL SALE
Desks
Desk Sets

PROBLEM 3

She sees
that he left
at least
half
the desk sets.

PROBLEM 4

She shall state
the date
that
she held
the health test.

PROBLEM 5

He shall
take the test
at
the steel desk.

PROBLEM 6

He held
that the state
shall set
the legal age.

PART 2 After you have been taught to center vertically (page 88), you may be asked to center each of the preceding problems horizontally and vertically on a half sheet or on a full sheet and to single-space, double-space, or triple-space.

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ABSTRACT - This student manual was developed by business education and reading personnel to help students achieve success in learning shorthand. The manual begins with a phonetics evaluation test and is followed by six lessons that review consonant blends, diphthongs, and other areas of phonics. The manual was prepared on the workbook format including exercises for classroom use or home assignments. This material can be used in any shorthand class as a brief review or as an extensive study of phonics. An accompanying teacher's manual is available as VT 011 152 (also in this issue). (JS)

VT 011 151

ED0 45856

PHONICS REVIEW FOR SHORTHAND

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INTRODUCTION

Because all shorthand systems have their basis in phonics, your progress in learning shorthand can be affected by your knowledge of phonics. That's the reason for this book—to review the principles and fundamentals of phonics so that you can learn shorthand better and faster.

Before you begin your review, it might be wise to take a few minutes to evaluate your knowledge of this basic skill. The test below has been provided for that purpose, so that you can determine where you are strong and where you are weak in phonics.

PHONICS EVALUATION TEST

Directions: Your teacher will give you instructions for taking the Phonics Evaluation Test which appears on pages 1, 2, and 3. Listen carefully to the instructions and follow them exactly. Avoid distractions—listen carefully to each word.

	I	II	III	IV	V
1.	shy	rest	cellar	fist	cold
2.	make	gold	cent	same	cap
3.	slam	brown	them	get	gentle
4.	sat	coat	girl	kind	just
5.	center	ham	kid	then	men
6.	not	mill	hill	mat	ale
7.	set	man	nail	halt	nose
8.	call	yell	but	play	pan
9.	much	want	sick	van	pack
10.	sat	call	drop	zebra	dump
11.	joy	kiwi	clock	story	glad
12.	bear	fair	brown	plain	blue
13.	glad	gift	green	climb	shut
14.	blow	pelt	sled	pray	play
15.	fine	free	flat	throw	phone
16.	blind	twine	but	bring	drop
17.	green	cloth	cab	drag	cry

18.	glory	quiet	grade	slid	gird
19.	fox	first	free	fly	plucks
20.	brown	dwell	play	dory	drop
21.	slow	chief	she	dish	sad
22.	lens	swell	smart	snow	chop
23.	catch	close	cinch	shrink	chop
24.	snap	fault	small	sold	melts
25.	sling	spot	proof	flop	swell
26.	wet	help	wrong	huff	why
27.	tree	sort	thing	dress	tear
28.	praise	plum	freeze	fly	phone
29.	phone	plan	pony	round	pry
30.	tree	rough	the	phone	frozen

31.	lax	sud	gib	ten	cot
32.	low	sue	say	tea	die
33.	tar	fir	far	for	par
34.	cue	sew	fee	tow	sat
35.	sin	fun	lad	net	not
36.	bet	not	sun	den	gal
37.	sir	fur	ter	jar	mor
38.	pal	bet	lip	tot	cup
39.	bee	toe	boy	say	eye
40.	cod	sit	pen	pup	nap
41.	cur	far	for	car	par

42.	may	sew	see	pot	lie
43.	mor	car	for	ter	jar
44.	fed	pay	due	woe	sup
45.	bar	her	sir	for	bur

46.	foot	moon	lawn	loud	foil
47.	soon	coil	taut	town	loud
48.	news	loud	maul	bald	pond
49.	salt	bout	loud	soil	soon
50.	home	loon	book	news	rout
51.	luck	lawn	fuel	soon	turn
52.	town	soil	feud	salt	dawn
53.	dawn	pond	join	town	torn
54.	foul	fuel	down	boil	dawn
55.	rein	foot	paws	torn	boys

56.	part	near	fair	fire	ever
57.	mine	high	cart	like	crier
58.	dime	sing	climb	sign	kind
59.	bold	coal	hole	colt	only

60.	zymn	lnss	fy

PHONICS REVIEW

The study of phonics is the study of speech sounds. We use phonics when we associate the letters of the alphabet with their sounds and when we combine these sounds to form words.

The lessons in this book cover everything you need to know in phonics. Many examples have been used to help you understand the lessons and hundreds of practice exercises have been provided to ensure thorough learning.

Complete the lessons in this book thoughtfully and carefully. You'll discover that a solid foundation in phonics fosters success in shorthand.

LESSON ONE

Exercise A: The letters **C** and **G** have a soft and a hard sound. The soft **C** is sounded like an **S** and a soft **G** is sounded like a **J**. The hard **C** is sounded like a **K** and the hard **G** has its own sound. These letters usually have their soft sound before **E, I,** and **Y.** Their sounds are hard before **A, O,** and **U.**

In the exercise below, 28 words have been listed. Copy each word putting it into its proper column. Study the examples before you begin.

Examples: Soft C: cent **Soft G:** gentle **Hard C:** cup **Hard G:** gas

gay	cut	cyst	camp	good	gypsy	circle
gun	game	gone	curl	color	cigar	certain
gem	gist	goat	coal	guard	cereal	general
cab	curb	cell	germ	giant	civics	German

Soft C	Hard C	Soft G	Hard G

Exercise B: When we write a word phonetically, we write the word exactly the way it sounds. For example, the word *graphics* phonetically would be written *grafix*. The following words have been listed along with their phonetic spellings. The sound of the **G** or **C** has been omitted. Fill in the exact sound you hear: **C** will be either **S** or **K**. **G** will be **J** or **G**.

censorship	..... ensership	gain	.....an	coalesce	.....oales
gullible	. .... .ulib'l	cable	.....ab'l	gypsum	.....ipsum
caliber	... .. .aliber	gin	.....in	coerce	.....ours
guidance	.....idans	gyrate	.....irat	gaping	.....aping
calculate	.. alkulat	cipher	.....ifer	culminate	.....ulminat
Gibraltar	.....ibrolter	gore	.....or	certificate	.....ertifikat
galvanize	....alvaniz	germ	....urm	germinate	.....urminat
cajole	.....ajol	cyst	..... ist	gallery	.....aleri
centralize	.....entraliz	code	..... od	cadence	.....adens
gesticulate	.....estikulat	cinch	. .....inch	geometric	.....eometrik
cumulate	..... umulat	gauge	.....aj	gymnasium	.....imnazium
cellulose	.....elulos	column	.....olum	circular	.....urkuler
giblet	. .....iblet	gout	..... out	cynic	.....inik

Exercise C: The letter **Y** has both a consonant sound and a vowel sound. When **Y** sounds like a vowel, it sounds like the vowel **i**. As a vowel, **Y** can be either long or short. In the exercise below, copy each word putting it into its proper column. Study the examples before you begin.

Examples: Consonant Y: yes **Vowel $\overline{Y}$ (long):** cr$\overline{y}$ **Vowel $\breve{Y}$ (short):** cit$\breve{y}$

my	dye	yarn	youth	young	syringe	namely
yet	July	yell	hurry	nylon	system	rhythm
you	hymn	lynch	yacht	style	bygone	cypress

Consonant Y	Vowel $\overline{Y}$ (long)	Vowel $\breve{Y}$ (short)
. .....	.....	.....
... .	.....	.....
.....	.....	.....
.. ..	.....	....
. ...	.....	.....
.. ..	.....	.....
....	.....	.....

Exercise D: The following words have been listed along with their phonetic spellings. The **Y** has been omitted. Fill in the sound you actually hear. You will fill in $\bar{Y}$ (long vowel, $\breve{Y}$ short vowel), or **y**. The first two have been done for you. Indicate whether the i you fill in is long (—) or short (⏑).

gymnastic	j $\breve{i}$mnastik	fly	fl ...	signify	signif ..
exemplify	egzemplif $\bar{i}$	spry	spr....	typical	t .. pikal
hypnotism	h pnotiz'm	ethyl	eth .. l	python	p .. thon
prototype	protot .. p	yawn	. .on	crystal	kr .. stal
syllable	s ...lab'l	yes	... es	system	s . stem
dynamic	d ...namik	lyre	l .. r	hydrant	h ..drant
physical	f....zikal	yoke	....ok	mystical	m ...stikal
youthful	.. .oothfool	larynx	lar....ngks	shyness	sh .. ness
plywood	pl ...wood	nylon	n ...lon	psychological	s .. kolojikal
foreyard	for .. ard	rhyme	r ...m	synchronize	s .. ngkroniz

LESSON TWO

Exercise A: Consonant blends are combinations of two or three consonants which, when pronounced, blend into one sound. Here are the common consonant blends:

bl: blue	**cr: cry**	**fr: free**	**pl: play**	**scr: scribble**	**tr: try**
br: bring	**dr: drop**	**gl: glad**	**pr: print**	**spr: sprig**	**sp: spin**
cl: clay	**fl: flat**	**gr: grab**	**sc: scoop**	**sn: sneeze**	**sm: smoke**

In the exercise which follows, you are to fill in blends to make words. Before each blend word is a clue word. Use the clues to help you find the correct blend to fill in. Study the examples first.

Examples: bird: ..b .luejay fabric: c. .loth soup: ..b roth

scrape: .. .. atch	get ready: ....epare	exchange: .. . . ade
bird: ....arrow	backbone: ....ine	color: ... ... ue
food: ....ead	go up: ....imb	polished: .... . .ooth
chart: ....aph	punish: .... ank	frighten: . .. .are
color: ....ay	terror: ....ight	smash: ....eak
pieces: .... .aps	shut: ... .ose	clasp: ....ap
spray: .... inkle	pull: ....ag	tool: ill
fire: .... ame	color: ....ack	paste: . .. ...ue
sniff: ....ell	airship: ....ane	accurate: . . ....ue
color: ....own	break: ....ash	injury: .... ain
clever: ....art	insect: .... . .ea	biology: ....ience
insect: ....y	season: ....ing	gift: ....esent

stream: .... eek
shine: .... .. ow
sleepy: .... . owsy
wash: ....ub
mitten: .... .. ove
tiny: .... . . all
journey: ....ip
wind: .... eeze
sleet: .... ow
clothing: .... ess
liberty: ....eedom
cost: ....ice
bird: ....ow

crawl: ....eep
flatten: ....ush
rail: ....ack
dish: ....ate
not wet: ....y
country: ....azil
wheat: ....ain
enough: .... . . enty
tool: ....iers
fruit: ....um
light meal: ....ack
clothing: ....ouse
reptile: .... ake

country: ....ance
not stale: .. . .esh
award: ....ize
tree: .. .. uce
pilot: ....ier
country: ....itain
insect: ....icket
say: ....eak
tool: ....ewdriver
screech: ....eam
seize: ....atch
happy: ....ad
not dirty: ....ean

Exercise B: Digraphs are two-letter combinations which make a new sound. The new sound is different from either of the two letters:

ch: chop **ph: phone** **sh: shoe** **th: the** **wh: why**

In the exercise which follows, you are to fill in blends to make words. Use the clue words to help you as you did in Exercise A.

hut: ....ack
bird: .. . .easant
form: ....ape
melt: .... . aw
name: ....ilip
seat: ....air
yell: ....out
lash: ....ip
fish: ....ark
close: .. . ... ut

vessel: ....ip
infant: ....ild
carve: ....ittle
idea: ....ought
grain: ....eat
ghost: ....antom
beard: ....iskers
color: ....ite
robber: ....ief
rotate: . . . irl

islands: ....ilippines
animal: ....ipmunk
not long: ....ort
coldness: ill
inexpensive: ....eap
playhouse: ....eater
attack: . .. .arge
picture: .... otograph
that place: ....ere
young hen: ....icken

Exercise C: Complete the following exercise by filling in the proper digraph.

.....eck	.....oose	....ange	. . ..ief	. .. .ysician	.....rough
.....ank	.....armacy	.....obia	.....rase	.....reaten	..... . arter
..... .enomenon	.....irty	.....adow	..... .orough	.....enever	..... .rewd
.....ether	.....arity	.....eory	.. .. ..allow	.. ..allenge	. ..... ance
.....ipment	.....isper	.....ich	..... .om	..... ilosophy	.....onetic

LESSON THREE

Exercise A: The letters **A, E, I, O,** and **U** are vowels. Vowels have long and short sounds. Vowel sounds also change when followed by the letter **R.**

	A	E	I	O	U
Long Vowels:	ate	he	dime	so	use
Short Vowels:	sat	end	if	hat	sun
Vowels with R:	car	her	girl	for	hurt

In the sentences which follow, you are to fill in the vowel sounds to make words. The word, of course, must make sense in the sentence. Study the examples first.

Examples: H.o.ld on so you won't fall. H..e is my uncle.
We go to church to pr..ay. I am f.ive years old.

Snow is c....ld.
Mother has change in her p.....se.
S....y your name.
Take off your h....t and coat.
F....ll the pail with water.
Look at m.....
What a c....te doll!
The m.....derer will be hanged.
Dr....ve the car.
I'm gl... d you could come.
The school t.....m ends in June.
Cl....se the door.
St..... . the soup until it boils.
H....t the ball with the bat.
Call me on the ph....ne.
The c ...t purrs softly.
Obey the r....les.
Put the p....t on the stove.
The boy tripped and f ...ll.
Mud is d..... .ty.
Run h ...me at noon.
Don't dr....p that dish.
Farmers need f .....tile soil.
Have some m..... e to eat.
He is l....ft-handed.
We flew in a pl. .ne.
M.. .il the letter.

Turn the p....ge and read.
A birthday c.....d came in the mail.
Who's n....xt in line?
Pl....y the game.
Sh.... is my sister.
Please s....t down.
R....w the boat.
Digging is h.....d work.
Are your hands cl....an?
The .....tist painted the scene.
My arm is s..... ..e where I fell.
B.....ds fly south every winter.
We f ...d the dog meat.
I bit my l .p.
The letter began "Dear S....."
Do you like c.... ...n on the cob?
Whistle a t....ne.
Wash your h....nds and face.
Put your shoes ...n.
Fire b. . .. ns.
A compass needle points n.. .....th.
The sun is sh....ning.
Dad smokes a p....pe.
The sk. ... ..t matches her blouse.
The girl tore her dr....ss.
Every sentence has a v .....b.
L . .e down and rest.

Drink your hot t....a.
Were you h.....t when you fell?
Ten comes after n....ne.
Ice c ...bes are cold.
Answer the l.....tter
Tools will r....st outdoors.
Get gas at the s.....vice station.
Look at the top sp....n.
How f..... did you walk?
Soap makes s ...ds.
T..... n around and face front.
S....ve your money in a bank.
Your answ ..... is wrong.
The key fits this l....ck.
Rain helps flowers gr....w.
I caught a f....sh in the lake.
Drive the c..... safely.
The s ...n is shining.

A dog's f..... keeps him warm.
Girls play with d....lls.
Toothpaste comes in a t....be.
Cows go into the b.....n at night.
The sun rises in the ....ast.
Eat your m....at and gravy.
G .....ls wear dresses.
I like corn on the c....b.
May comes before J....ne.
That d....ll knife won't cut.
G.....ms are spread by sneezing.
Let's play h....de and seek.
Take a bath in the t....b.
What a beautiful m.....ning.
Bring your p....d and pencil.
Use your knife and f.....k to eat.
Put a new b....lb in the lamp.
Candy costs five c....nts.

Exercise B: Fill in long or short vowels to make words. Place the appropriate mark over the vowels to indicate whether they are long (—) or short (⏑). The first sentence has been done for you.

To receive your c.ŏpies of our .ĭnteresting mă.gazine, jŭ.st dr.ŏ.p your ch.ĕ.ck in the mail.

Please s....gn the affid....vit wh....le it is before you.

Our ....gent has comp.. .led several det....iled reports on pr... mium rate incr....ases.

...mproved t....lephone serv....ce h....s been resp....nsible for b....tter business relations.

You m....y borr....w up to $3,000 at the l....w interest figure of 6 per cent.

The Accounting Department w....ll subm....t the b....lance sheet at the n....xt Board of Dir....ctors meeting.

F....ve thousand ....nits of your order will b.. . shipped with n.... further del....y.

Our hot....l offers . ..xcellent b....nquet fac....lities for your cl....b or organization.

Your l....tter of F....bruary 16 h....s been g....ven careful cons. .deration.

The n....me of the beneficiary is incorrectly st....ted.

Your broker c.. .n sugg....st the b....st ....nv....stments in st ...cks and b. ..nds.

We appreciate your fr....nk cr....tic....sm of our del ..very service.

The qu....t ...tions on our pr....ce list will b ... rev. ..sed on M .. y 6.

Considerable t.. .me has elapsed since Mr. Hart compl....ted his man ...script.

The m....nuf. ..cturer will pay the tr....nsportation charges ....n adv....nce.

The C....stomer Service Department sp....cializes in the sel....ction of g....fts.

The encl....sed envel....pe is for your conv....nience.

S ...veral of our st.. .ff m....mbers w....sh to att.. .nd the c.. .nference.

...f n ...cessary, h ...ve the r....quis....tion sl....p approved by the department h....ad.

The s .. lesmen's conference will be p....stp....ned until Friday.

You have .. nly to wr....te us for inform.. .tion on your f....vorite v....c ...tion spot.

Prod ...ction m ...st be ....ncreased to meet the d....adline.

A d....scount of 2 per c....nt is allowed for payment w....thin t....n days.

W.... ....se the f....nest quality bond p ...per in all our public....tions.

"Advanced Office Proc....dures" is a booklet des .. gned for the busy executive.

The w ...tness to the accident w....ll t....stify for the def....ndant.

The ....nnual Furn ...ture Sale beg....ns S....ptember 20.

Proofr... ad ... ach letter carefully before t ...king it out of the typewr....ter.

Our c... mpetent accountants are experts in h... ndling ....ncome t....x pr....blems.

Mr. Tilman is w....ll qualified for the pos....tion of br....nch m....nager.

The d....vid .. nd to c....mmon st....ckholders will be :.. ssued Nov....mber 15.

Did you rec ...ive a n....tice for p.. .yment of your ....verdue account?

In the sp....ces prov....ded list the ....tems by stock numbers.

Our sales r... pres ...ntatives ....perate ....n a comm ...ssion bas ...s.

Protect your s ...vings by ....pening an account tod....y.

LESSON FOUR

Exercise A: These letter combinations blend to make a new sound when spoken:

Diphthongs: au:auto **oy**:boy **oi**:point **oo**:boot **oo**:look **ou**:house

Vowel & Consonant Combinations: air:fair **al**:ball **ew**:new **aw**:draw **ow**:brown

Complete the sentences which follow by filling in the appropriate letters.

Don't splash in the p.....l.

The cr..... was planning mutiny.

The children slid d.....n hill.

It weighs four pounds, two .....nces.

That sweater is all w.....l.

He nearly dr.....ned in deep water.

I want two p.....nds of meat.

Animals eat r..... meat.

B.....l some water for tea.

Sit in that ch ..... .

Children go to sch..... .l to learn.

Pennies are made of copper all ....

Crops won't grow in p.....r soil.

Corn needs fertile s.....l to grow.

A restless baby ann.....s his mother.

A carpenter works with w.....d.

I kn..... him right away.

Children play with t..... .s.

Come when mother c .....ls.

That st.....way goes up.

J.....n the Boy Scouts.

Ch..... your food well.

The m .....n shines on a clear night.

The dentist pulled his t.....th.

C.....s give milk.

There's not a cl.....d in the sky.

The carpenter s... ....ed the wood.

The barber cuts h.....

It is .....most nine o'clock.
Baby is starting to cr..... ..l.
Put cups and s .. ....cers on the table.
He c .....ght the ball.
.....l the noisy hinge.
The lion licked his p ....
L . .... d noises disturb me.
I need a new p .... of shoes.
P.. . . se for a while and rest.
There are only a f ..... left.
I said to do it n .....
I thr..... the ball to him.
Birds fly s .....th in winter.
Read a new b .. ..k every week.

That answer is f.....se.
The flood c .....sed much damage.
Fresh bread tastes g.....d.
Don't make n.....se in the library.
Please pass s .....t and pepper.
The king's family is r ..... alty.
The batter hit the b .....l.
A new br .....m sweeps clean.
A cr .... . d of people gathered.
Christmas is a j .....ful time.
Breathe that fresh ..... .
The rocket was l..... nched successfully.
On the farm, we rise at d . ... .n.

Exercise B: The following word parts are vowel and consonant combinations which are repeatedly used and easily recognized:

Word Parts: **igh**:night **ind**:kind **old**:fold

Complete these sentences by filling in the appropriate word parts.

Raise your r..... ... t hand.
Be k .. . . to animals.
The druggist s . .. ... me medicine.
F.... . .. the paper in half.
The sun shines br.. .. ...tly.
A m .. . . ..ty man was Paul Bunyan.
The .... man was feeble.
H.. .... .. your breath under water.
Birds use their wings for fl .. . ...t.
The spotlights bl . ...ed me.

Don't w..... . .. the clock too tight.
The b. .... ing of that book is loose.
Don't go; I've changed my m . ...
Hands get c . . . .. . without gloves.
The sun gives l.. ..... .t to the earth.
The story was t..... . . over and over.
This small collar is too t... . .. .t.
Gr . . .. some meat for hamburgers.
The ring is made of g ... ...
Can you f. ... . . your way in the dark?

Exercise C: This is a review of all the preceding pages with an emphasis on Lesson Four. The phonetic spellings of the sounds in this lesson are:

aw:ô	**au:ô**	**al:ôl**	**air:âr**
law:lô	auto:ôtō	ball:bôl	fair:fâr
draw:drô	cause:kôs	salt:sôlt	stair:stâr
lawn:lôn	taught:tôt	alter:ôlter	chairs:châr s
oi:oi	**oy:oi**	**oo:ōo**	**oo:ŏo**
soil:soil	boy:boi	boot:bōot	foot:fŏot
coin:koin	toys:tois	tooth:tōoth	cook:kŏok
noise:nois	enjoy:enjoi	cool:kōol	hood:hŏod

ou:ou	ow:ou	ew:ū	igh:ī
loud:loud	cow:kou	new:nū	high:hī
house:hous	down:doun	few:fū	sigh:sī
bounty:bountī	fowl:foul	blew:blū	right:rīt

ind:īnd	old:ōld
mind:mīnd	cold:kōld
wind:wīnd	fold:fōld
blind:blīnd	sold:sōld

Write the following words phonetically. Be sure to use markings over the vowels when necessary to indicate their value. The first two have been done for you.

brew	brū	groom	.....
caught	kôt	brightness	.....
choice	.....	count	.....
flight	.....	molding	.....
joyful	.....	pawn	.....
hair	.....	curfew	.....
binding	.....	halt	.....
gown	.....	bloom	.....
account	.....	appointment	.....
crook	.....	boldness	.....
hindsight	.....	hawk	.....
alternate	.....	wood	.....
scowling	.....	proof	.....
compound	.....	flaw	.....
authentic	.....	hoist	.....
slight	.....	almost	.....
amount	.....	augment	.....
townhall	.....	resound	.....
boyhood	.....	coil	.....
findings	.....	fewer	.....
airtight	.....	awning	.....
book	.....	hew	.....
lighting	.....	destroy	.....
alter	.....	chairman	.....

LESSON FIVE

Exercise A: When there is only one vowel in a word or syllable, it is usually short:

Examples: ăt ĕgg ĭn ŏn ŭp

făn hĕlp-er pĭll frŏg dŭck

In the exercise below, fill in the blanks with short vowels to make words. A clue word is given to help you choose the correct vowel. Study the examples again before you begin.

ill: s ..ck	color: r....d	meal: s....pper
baby: ....nfant	gun: p. ..stol	fall: dr....p
coat: j. .cket	fruit: ....pple	pool: p....nd
tool: dr....ll	strange: ....dd	bird: r....bin
repair: m ...nd	meal: l .. nch	top: l ...d
not sharp: d ...ll	stone: r....ck	rug: m ...t
sleep: r....st	timber: l....mber	animal: c....t
bag: s . .ck	penny: c ...nt	quiz: t....st
sheep: l mb	fruit: l . .mon	steal: r....b
slice: c....t	lawn: gr ...ss	fruit: pl....m

Exercise B: A vowel ending a word or syllable is usually long. Study the examples and then complete the exercise which follows.

Examples: hē nō vē-tō pū-pil tī-ger

thread: f. ..ber	infant: b....by	leave: g....
melody: m....sic	animal: l... on	not busy: ....dle
prize: tr. ..phy	make: cr. ..ate	pupil: st....dent
savage: br.. tal	hidden: s ...cret	myself: m....
empty: v ...cant	cipher: zer....	lawful: l....gal
bird: r... ven	not shut: .. .pen	woman: l ...dy
quiet: s. .lent	aviator: p ...lot	name: t....tle
work: l....bor	depot: st....tion	give: d....nate
flower: t ...lip	often: fr....quent	last: f....nal
engine: m . .tor	splendid: s ...perb	sacred: h ...ly

Exercise C: When a short word ends in **E**, the inside vowel is usually long. Study the examples and then complete the exercise which follows.

Examples: ate scene time toe cute

month: J....ne	employ: ....se	coin: d me
give up: c....de	rock: st .. ne	rodents: m ...ce
topic: th....me	string: tw .. ne	impolite: r . de
built: m....de	message: n.. .te	shaft: p ...le
range: st....ve	contest: r ...ce	flower: r... se
stack: p ...le	arrived: c... me	dislike: h ...te
melody: t .. ne	regulation: r... le	elect: v. ..te
distribute: m....te	plot: sch ...me	eat: d .. ne
shut: cl....se	chew: b... te	crippled: l.. me
monkey: ....pe	glass: p ..ne	gown: r....be

Exercise D: Write the following words phonetically indicating long and short vowels. The first one has been done for you.

meditate	mĕdĭtāt	polite	
comment		campaign	
dictate		satisfy	
tariff		concrete	
prepaid		donate	

Exercise E: When there are two vowels together in a word or syllable, usually the first vowel is long and the second one is silent. Study the examples and complete the exercise which follows.

Examples: paint meal load suit feet

annoyance: n .... sance	lift: r . .. . se	brook: str .. . . m
avenue: str .. . . t	server: w .. . .. . ter	tracks: r . .. . . ls
injury: br .... se	color: gr .... n	warmth: h .... t
ache: p . .. . n	apple: fr .... . . t	chair: s .. . .. t
birds: g ... . se	animal: g .. . . .. t	animal: sh ... . p

carriage: c .... ch	voyage: cr .... se	clothing: s .... t
shore line: c .... st	touch: f l	letter: m l
highway: r .... d	insect: b	suds: f .... m
rob: st l	fruit: p .... ch	instruct: t .. . . ch
bucket: p l	cleanser: s .... p	wheat: gr .... n

Exercise F: The vowel combination **EI** usually follows the double vowel rule (Exercise E, above) when the letter **C** comes before it; that is, when **EI** follows **C**, the **E** is long and the **I** is silent. When **EI** appears without **C**, it has the sound of long **A**. When **IE** is used in a word, the **I** is silent and the **E** is long (just like **EI** following **C**). Study these examples:

Examples:	**EI** following **C:**	ceiling	receive
	EI without **C:**	eight	vein
	IE:	field	chief

Copy these words putting them into the proper columns, below:

brief	niece	deceit	weight	conceit	neighbor
reign	weigh	sleigh	shield	believe	conceived
skein	conceive	eighty	achieve	perceive	receiving
rein	piece	belief	receipt	deceive	perceived
feign	thief	relief	freight	grieving	perceiving

EI following **C**	**EI** without **C**	**IE**
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....

Exercise G: Write these words phonetically:

dealer		complaint	
leave		chief	
suit		coal	
loan		accede	
siege		feign	

Exercise H: The following words have been broken into syllables. Pronounce each one carefully and write it phonetically. The first one has been done for you. Notice that the **e** in **beginning** has the sound of short i (ˇ). Look for this same sound in other words.

address	ad dress	ădrĕs
employees	em ploy ees	
accommodate	ac com mo date	
training	train ing	
reach	reach	
dinner	din ner	
waiver	waiv er	
increase	in crease	
yield	yield	
maintain	main tain	
defensive	de fen sive	
reigning	reign ing	
proceed	pro ceed	
read	read	
beginning	be gin ning	bĭgĭnĭng
receivership	re ceiv er ship	
floating	float ing	
raise	raise	
excellent	ex cel lent	
teaching	teach ing	
timber	tim ber	
colleague	col league	
claim	claim	
receipt	re ceipt	
placement	place ment	

Exercise I: Vowels before double consonants are usually short. Study the examples and then go on to the exercise. From the list of words below, copy *only* those which follow this rule and contain a short vowel before the double consonant. Write them on the lines provided.

Examples: sŭpper, hĕlmet, bănded, ĕnter, cŏnflĭct, fĭst

lick	foam	trace	tulip	hobby
demon	hill	soft	lesson	sister
husband	dollar	donkey	rudder	music
sand	mule	motive	dizzy	brass
basket	life	minor	equal	deal
native	lion	hunt	stone	safe

....

....

....

....

....

Exercise J: When an ending, or suffix, is added to a word ending with a consonant, the consonant is doubled. Study the examples and then go on to the exercise. In the exercise, add the endings to the words given and write the complete word in the space provided.

Example:	**Word**		**Suffix**		**Double Consonant**
	run	+	er	becomes	runner
	lug	+	age	becomes	luggage
	wrap	+	ed	becomes	wrapped

ton + age becomes	.....	scan + ing becomes	.....
drug + ist becomes	.....	person + el becomes	.....
leg + ings becomes	.....	forgot + en becomes	.....
regret + ably becomes	.....	bat + er becomes	.....
pet + ed becomes	.....	knot + ed becomes	.....
patrol + ed becomes	.....	sup + er becomes	.....
wag + ed becomes	.....	flat + en becomes	.....
remit + ance becomes	.....	commit + ee becomes	.....
grip + ing becomes	.....	set + ing becomes	.....
sad + est becomes	.....	hop + ing becomes	.....

LESSON SIX

Exercise A: A syllable is a word or part of a word having one sound. Study the examples and then go on to the exercise below. From the list of words, copy *only* those which are syllables, only those which contain a vowel sound. List them in the space provided.

Examples:	Syllables:	zam	et	vus	in	fyt	ash
	Not Syllables:	mpn	bgt	cmd	ssn	rls	ng

bi	cir	clt	quo	vich	ghtnd
jck	zwmm	be	aard	tmsl	gyve
ic	gts	fy	ncs	gio	pds
lac	luc	ssnt	lps	lnss	rbl
gld	ghang	hah	hon	ft	lbs

....

....

....

Exercise B: When one consonant comes between two vowels in a word, the word is divided before the consonant. Study the examples and then divide the 30 words below into syllables. Write the words on the lines provided using hyphens (-) to separate the syllables as shown in the examples.

Examples: labor: la-bor super: su-per

meter: me-ter nature: na-ture

aback	.....	nation	.....	quota	.....
above	.....	Japan	.....	remote	.....
basin	.....	license	.....	rumor	.....
because	.....	local	.....	cement	.....
climate	.....	minor	.....	total	.....
divide	.....	notice	.....	vacant	.....
even	.....	ocean	.....	water	.....
frozen	.....	over	.....	zero	.....
grocer	.....	paper	.....	silent	.....
hero	.....	private	.....	final	.....

Exercise C: When two consonants come between two vowels, the word is divided between the consonants. Study the examples and then divide the following words into syllables.

Examples: helmet: hel-met window: win-dow
seldom: sel-dom yellow: yel-low

rabbit		differ		number	
garden		envoy		often	
fender		effort		pebble	
basket		husband		puddle	
tablet		hurry		quarter	
mission		inner		rubber	
center		jitters		sergeant	
master		kidnap		happy	
market		linger		venture	
curtain		margin		yankee	

Exercise D: When **LE** ending a word is preceded by a consonant (except **CK**), the word is divided before the consonant. Study the examples and exceptions and then divide the following words into syllables.

Examples: single: sin-gle rubble: rub-ble
noble: no-ble cattle: cat-tle
Exceptions: knuckle: knuck-le trickle: trick-le

able		jungle		tangle	
bubble		kettle		twinkle	
circle		little		whistle	
candle		maple		uncle	
dimple		needle		turtle	
eagle		purple		rifle	
fondle		rumble		bugle	
gentle		rustle		spindle	
handle		couple		hustle	
idle		sample		staple	

Exceptions:

cackle	tickle	crackle .....
pickle	buckle	heckle .....
sickle	shackle	tackle .....

Exercise E: Complete each word by filling in the proper **LE** ending.

possi	multi.....	mira.....	enti	a	med .....
princi	assem	audi.....	exam	sad.....	lia .....
dispensa	strug	obsta	vehi	an.....	bat .....
incredi.....	eligi.....	forci.....	capa	set.....	cy .....
responsi.....	rectan.....	fick	peo	tri	mid .....

Exercise F: When a suffix has been added to a word, it is usually regarded as a separate syllable. Study the examples and then divide the following words into syllables.

Examples: hunter: hunt-er harmless: harm-less
lately: late-ly curling: curl-ing

adding	kindest	vender .....
boyish	lengthen	waitress .....
cashier	muddy	youngster .....
dreamy	onward	zipper .....
evening	placement	endless .....
foolish	quickly	massive .....
golden	righteous	graphic .....
heater	sadder	falsehood .....
illness	therefore	trainee .....
joyous	upright	artist .....

Exercise G: Write the root word in the blank provided. The first one has been done for you.

respectfully	respect	concerning	.....
predictable	.....	faithful	.....
employer	.....	regardless	.....
definitely	.....	embarrassment	.....
allowance	.....	promptness	.....

Exercise H: When **ED** is added to a word ending in **D** or **T**, it becomes a separate syllable. When **ED** is added to all other words, the words remain one syllable.

Examples:	waited: wait-ed	walked: walked
	tested: test-ed	called: called
	jetted: jet-ted	stopped: stopped

Some of these words can be hyphenated; others cannot. Leave blank the space next to the words which remain one syllable. Study the examples carefully.

tested	.....	raided	.....	dented	.....
packed	.....	jailed	.....	wasted	.....
lashed	.....	warmed	.....	painted	.....
hatched	.....	bounced	.....	cared	.....
lasted	.....	knotted	.....	grasped	.....
bounded	.....	knocked	.....	rushed	.....
dropped	.....	mailed	.....	flooded	.....
manned	.....	flashed	.....	gifted	.....
counted	.....	halted	.....	jotted	.....
throbbed	.....	seated	.....	scored	.....

Exercise I: Words of more than two syllables are divided according to these same rules. Study the examples first and divide the following words.

Examples:	accidentally: ac-ci-den-tal-ly	circulated: cir-cu-lat-ed
	encirclement: en-cir-cle-ment	repercussion: re-per-cus-sion

acquaintance	.....	unshackled	.....
battery	.....	sketchiness	.....
chartered	.....	tangible	.....
drillmaster	.....	understatement	.....
flirtatiously	.....	vindictive	.....
renewal	.....	workmanship	.....
glimmering	.....	uncollected	.....
antiseptic	.....	conservationist	.....
gubernatorial	.....	divided	.....
identification	.....	antisocial	.....

Exercise J: Separate these words into syllables. If a word cannot be divided, leave the space blank. Review thoroughly the rules before starting.

community	.....	foster	.....
exterminator	.....	susceptible	.....
romantic	.....	maple	.....
margin	.....	plentiful	.....
fizzled	.....	countless	.....
renewal	.....	whimsical	.....
shockingly	.....	needle	.....
flaked	.....	fickle	.....
native	.....	infinite	.....
seldom	.....	rapped	.....
actor	.....	elite	.....
social	.....	plotted	.....
outwardly	.....		

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ABSTRACT - This teacher's edition was developed by business education and reading personnel to assist the shorthand teacher in reviewing those areas of phonics useful to students learning shorthand. The review begins with a phonetics evaluation test complete with instructions for administering, scoring and interpreting. Following the evaluation test is a series of six lessons with exercises and solutionswhich may be completed in class or as home assignments. Teaching time for the entire unit may be a few days or several weeks depending on teaching objectives and the level of instruction. The review was prepared on a workbook format for flexibility in teaching and is available in a student edition as VT 011 151 (also in this issue. (JK)

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PHONICS REVIEW FOR SHORTHAND

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VT 011 152

PROGRAMS FOR ACHIEVEMENT IN READING

Abbott Park Place **Providence, Rhode Island**

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TEACHER'S GUIDE

This book consists of six lessons, each containing several exercises Preceeding Lesson One, on page 1, 2, and 3 is a phonics evaluation test. Instructions for administering, scoring, and interpreting the test are given below.

The lessons in this book are all of a workbook format. Each lesson is segmented into exercises which allow for considerable flexibility in teaching. Each exercise contains specific explanations and instructions for completing that exercise.

Students can complete the lessons in class or at home, as the instructor sees fit. The work may be condensed into a few days or extended over several weeks. This Teacher's Edition contains the correct answers to all the exercises.

No attempt has been made to cover the entire field of phonics. What is covered here is meant to be a review of those areas of phonics which can be of help in learning shorthand.

ADMINISTERING THE PHONICS EVALUATION TEST

Instructions:

Have students open to page 1, and give these instructions:

1. "For each number, 1 through 60, I will read a word. You will look at the five words next to that number and select a word in one of the columns which has the same sound and underline it.

2. "For the first 30 numbers, you will look for and underline a word which begins with the same sound as the word I read. Don't be misled by the sound of the whole word; listen just for the beginning sound.

3. "Here's the first one: Opposite No. 1, underline one of the five words which has the same beginning sound as cist, cist.

"No. 2: underline the word with the same beginning sound as colt, colt. (continue below):

3 gym	17 crag
4 gust	18 grid
5 hem	19 flee
6 nill	20 dray
7 malt	21 shad
8 pall	22 snell

9 wick	23 chose
10 sump	24 smile
11 cloy	25 spoof
12 blare	26 whelp
13 glut	27 tress
14 pled	28 phase
15 frat	29 prone
16 brine	30 that

"For the next 15 items, numbers 31 through 45, listen for the middle letter or sound. No. 31 is bog, bog. (continue below):

32 lee	39 tay
33 sir	40 nip
34 sue	41 fur
35 fen	42 pie
36 but	43 per
37 for	44 foe
38 tap	45 far

"For numbers 46 through 55, you'll again be listening for the middle sound. (continue below):

46 hood	51 tool
47 lawn	52 foit
48 down	53 dowd
49 bald	54 bowl
50 hewn	55 poym

"For numbers 56 through 59, listen for the sound of the last three letters. (continue below):

56 nair	58 bind
57 sigh	59 hold

"Finally, for the last one, number 60, I want you to underline the group of letters which is not a syllable or which does not contain a vowel sound."

CORRECTING THE PHONICS EVALUATION TEST

Instructions:

"I will read the number of the column which has the right answer. If you have not underlined the word in the column I give you, your answer is wrong. When your answer is wrong, circle the word, and underline the correct word."

1 III	16 IV	31 V	46 I
2 V	17 V	32 IV	47 III
3 V	18 III	33 II	48 II
4 III	19 IV	34 I	49 I
5 II	20 V	35 IV	50 IV
6 I	21 III	36 III	51 IV
7 II	22 IV	37 V	52 II
8 V	23 V	38 I	53 IV
9 II	24 III	39 IV	54 V
10 I	25 II	40 II	55 V
11 III	26 V	41 I	56 III
12 V	27 I	42 V	57 II
13 I	28 V	43 IV	58 V
14 V	29 V	44 IV	59 I
15 II	30 III	45 I	60 II

IDENTIFYING INDIVIDUAL PHONIC WEAKNESSES

Numbers 1 through 30 measure the student's knowledge of initial consonants, blends, and digraphs. Errors on these items indicate that the student needs to give special emphasis to Lessons One and Two.

Numbers 31 through 45 measure vowel sounds. Errors here mean special emphasis on Lesson Three.

Numbers 46 through 59 measure diphthongs, vowel and consonant combinations, and word parts. These are covered in Lesson Four.

Number 60 is a syllabication item. Nothing definite can be learned from one item, of course, but this is an important skill for all students. Lesson Six covers Syllabication.

INTRODUCTION

Because all shorthand systems have their basis in phonics, your progress in learning shorthand can be affected by your knowledge of phonics. That's the reason for this book—to review the principles and fundamentals of phonics so that you can learn shorthand better and faster.

Before you begin your review, it might be wise to take a few minutes to evaluate your knowledge of this basic skill. The test below has been provided for that purpose, so that you can determine where you are strong and where you are weak in phonics.

PHONICS EVALUATION TEST

Directions: Your teacher will give you instructions for taking the Phonics Evaluation Test which appears on pages 1, 2, and 3. Listen carefully to the instructions and follow them exactly. Avoid distractions—listen carefully to each word.

	I	II	III	IV	V
1.	shy	rest	cellar	fist	cold
2.	make	gold	cent	same	cap
3.	slam	brown	them	get	gentle
4.	sat	coat	girl	kind	just
5.	center	ham	kid	then	men
6.	not	mill	hill	mat	ale
7.	set	man	nail	halt	nose
8.	call	yell	but	play	pen
9.	much	want	sick	van	pack
10.	sat	call	drop	zebra	dump
11.	joy	kiwi	clock	story	glad
12.	bear	fair	brown	plain	blue
13.	glad	gift	green	climb	shut
14.	blow	pelt	sled	pray	play
15.	fine	free	flat	throw	phone
16.	blind	twine	but	bring	drop
17.	green	cloth	cab	drag	cry

18.	glory	quiet	grade	slid	gird
19.	fox	first	free	fly	plucks
20.	brown	dwell	play	dory	drop
21.	slow	chief	she	dish	sad
22.	lens	swell	smart	snow	chop
23.	catch	close	cinch	shrink	chop
24.	snap	fault	small	sold	melts
25.	sling	spot	proof	flop	swell
26.	wet	help	wrong	huff	why
27.	tree	sort	thing	dress	tear
28.	praise	plum	freeze	fly	phone
29.	phone	plan	pony	round	pry
30.	tree	rough	the	phone	frozen

31.	lax	sud	gib	ten	cot
32.	low	sue	say	tea	die
33.	tar	fir	far	for	par
34.	cue	sew	fee	tow	sat
35.	sin	fun	lad	net	not
36.	bet	not	sun	den	gal
37.	sir	fur	ter	jar	mor
38.	pal	bet	lip	tot	cup
39.	bee	toe	boy	say	eye
40.	cod	sit	pen	pup	nap
41.	cur	far	for	car	par

42.	may	sew	see	pot	lie
43.	mor	car	for	ter	jar
44.	fed	pay	due	woe	sup
45.	bar	her	sir	for	bur

46.	foot	moon	lawn	loud	foil
47.	soon	coil	taut	town	loud
48.	news	loud	maul	bald	pond
49.	salt	bout	loud	soil	soon
50.	home	loon	book	news	rout
51.	luck	lawn	fuel	soon	turn
52.	town	soil	feud	salt	dawn
53.	dawn	pond	join	town	torn
54.	foul	fuel	down	boil	dawn
55.	rein	foot	paws	torn	boys

56.	part	near	fair	fire	ever
57.	mine	high	cart	like	crier
58.	dime	sing	climb	sign	kind
59.	bold	coal	hole	colt	only

60.	zymn	lnss	fy

PHONICS REVIEW

The study of phonics is the study of speech sounds. We use phonics when we associate the letters of the alphabet with their sounds and when we combine these sounds to form words.

The lessons in this book cover everything you need to know in phonics. Many examples have been used to help you understand the lessons and hundreds of practice exercises have been provided to ensure thorough learning.

Complete the lessons in this book thoughtfully and carefully. You'll discover that a solid foundation in phonics fosters success in shorthand.

LESSON ONE

Exercise A: The letters **C** and **G** have a soft and a hard sound. The soft **C** is sounded like an **S** and a soft **G** is sounded like a **J**. The hard **C** is sounded like a **K** and the hard **G** has its own sound. These letters usually have their soft sound before **E**, **I**, and **Y**. Their sounds are hard before **A**, **O**, and **U**.

In the exercise below, 28 words have been listed. Copy each word putting it into its proper column. Study the examples before you begin.

Examples: Soft C: cent **Soft G:** gentle **Hard C:** cup **Hard G:** gas

gay	cut	cyst	camp	good	gypsy	circle
gun	game	gone	curl	color	cigar	certain
gem	gist	goat	coal	guard	cereal	general
cab	curb	cell	germ	giant	civics	German

Soft C	Hard C	Soft G	Hard G
cyst	cab	gem	gay
cell	cut	gist	gun
cigar	curb	germ	game
cereal	camp	giant	gone
civics	curl	gypsy	goat
circle	coal	general	good
certain	color	German	guard

Exercise B: When we write a word phonetically, we write the word exactly the way it sounds. For example, the word *graphics* phonetically would be written *grafix*. The following words have been listed along with their phonetic spellings. The sound of the **G** or **C** has been omitted. Fill in the exact sound you hear: **C** will be either **S** or **K. G** will be **J** or **G.**

censorship	s ensership	gain	g an	coalesce	k oales
gullible	g ulib'l	cable	k ab'l	gypsum	j ipsum
caliber	k aliber	gin	j in	coerce	k ours
guidance	g idans	gyrate	j irat	gaping	g aping
calculate	k alkulat	cipher	s ifer	culminate	k ulminat
Gibraltar	J ibrolter	gore	g or	certificate	s ertifikat
galvanize	g alvaniz	germ	j urm	germinate	j urminat
cajole	k ajol	cyst	s ist	gallery	g aleri
centralize	s entraliz	code	k od	cadence	k adens
gesticulate	j estikulat	cinch	s inch	geometric	j eometrik
cumulate	k umulat	gauge	g aj	gymnasium	j imnazium
cellulose	s elulos	column	k olum	circular	s urkuler
giblet	j iblet	gout	g out	cynic	s inik

Exercise C: The letter **Y** has both a consonant sound and a vowel sound. When **Y** sounds like a vowel, it sounds like the vowel i. As a vowel, **Y** can be either long or short. In the exercise below, copy each word putting it into its proper column. Study the examples before you begin.

Examples: Consonant Y: yes **Vowel $\bar{Y}$** (long): cr$\bar{y}$ **Vowel $\breve{Y}$** (short): cit$\breve{y}$

my	dye	yarn	youth	young	syringe	namely
yet	July	yell	hurry	nylon	system	rhythm
you	hymn	lynch	yacht	style	bygone	cypress

Consonant Y	Vowel $\bar{Y}$ (long)	Vowel $\breve{Y}$ (short)
yet	my	hymn
you	dye	lynch
yarn	July	hurry
yell	nylon	syringe
youth	style	system
yacht	bygone	namely
young	cypress	rhythm

Exercise D: The following words have been listed along with their phonetic spellings. The **Y** has been omitted. Fill in the sound you actually hear. You will fill in $\bar{\imath}$ (long vowel, $\breve{\imath}$ short vowel), or **y**. The first two have been done for you. Indicate whether the **i** you fill in is long (—) or short (⏑).

gymnastic	j $\breve{\imath}$ mnastik	fly	fl $\bar{\imath}$	signify	signif $\bar{\imath}$
exemplify	egzemplif $\bar{\imath}$	spry	spr $\bar{\imath}$	typical	t $\breve{\imath}$ pikal
hypnotism	h $\breve{\imath}$ pnotiz'm	ethyl	eth $\breve{\imath}$ l	python	p $\bar{\imath}$ thon
prototype	protot $\bar{\imath}$ p	yawn	y on	crystal	kr $\breve{\imath}$ stal
syllable	s $\breve{\imath}$ ab'l	yes	yes	system	s $\breve{\imath}$ stem
dynamic	d $\bar{\imath}$ namik	lyre	l $\bar{\imath}$ r	hydrant	h $\bar{\imath}$ drant
physical	f $\breve{\imath}$ zikal	yoke	yok	mystical	m $\breve{\imath}$ stikal
youthful	yoothfool	larynx	lar $\breve{\imath}$ ngks	shyness	sh $\bar{\imath}$ ness
plywood	pl $\bar{\imath}$ wood	nylon	n $\bar{\imath}$ lon	psychological	s $\bar{\imath}$ kolojikal
foreyard	for y ard	rhyme	r $\bar{\imath}$ m	synchronize	s $\breve{\imath}$ ngkroniz

LESSON TWO

Exercise A: Consonant blends are combinations of two or three consonants which, when pronounced, blend into one sound. Here are the common consonant blends:

bl: blue	**cr: cry**	**fr: free**	**pl: play**	**scr: scribble**	**tr: try**
br: bring	**dr: drop**	**gl: glad**	**pr: print**	**spr: sprig**	**sp: spin**
cl: clay	**fl: flat**	**gr: grab**	**sc: scoop**	**sn: sneeze**	**sm: smoke**

In the exercise which follows, you are to fill in blends to make words. Before each blend word is a clue word. Use the clues to help you find the correct blend to fill in. Study the examples first.

Examples: bird: b l uejay	fabric: c l oth	soup: b r oth
scrape: s c r atch	get ready: p r epare	exchange: t r ade
bird: s p arrow	backbone: s p ine	color: b l ue
food: b r ead	go up: c l imb	polished: sm ooth
chart: g r aph	punish: s p ank	frighten: s c are
color: g r ay	terror: f right	smash: b r eak
pieces: s c r aps	shut: c l ose	clasp: s n ap
spray: s p r inkle	pull: d r ag	tool: d r ill
fire: f l ame	color: b l ack	paste: g l ue
sniff: s m ell	airship: p l ane	accurate: t r ue
color: b r own	break: s m ash	injury: s p r ain
clever: s m art	insect: f l ea	biology: s c ience
insect: f l y	season: s p r ing	gift: p r esent

stream: c r eek	crawl: c r eep	country: F r ance
shine: g l ow	flatten: c r ush	not stale: f r esh
sleepy: d r owsy	rail: t r ack	award: p r ize
wash: s c r ub	dish: p l ate	tree: s p r uce
mitten: g l ove	not wet: d r y	pilot: f l ier
tiny: s m all	country: B r azil	country: B r itain
journey: t r ip	wheat: g r ain	insect: c r icket
wind: b r eeze	enough: p l enty	say: s p eak
sleet: s n ow	tool: p l iers	tool: s c r ewdriver
clothing: d r ess	fruit: p l um	screech: s c r eam
liberty: f r eedom	light meal: s n ack	seize: s n atch
cost: p r ice	clothing: b l ouse	happy: g l ad
bird: c r ow	reptile: s n ake	not dirty: c l ean

Exercise B: Digraphs are two-letter combinations which make a new sound. The new sound is different from either of the two letters:

ch: chop **ph: phone** **sh: shoe** **th: the** **wh: why**

In the exercise which follows, you are to fill in blends to make words. Use the clue words to help you as you did in Exercise A.

hut: s h ack	vessel: s h ip	islands: P h ilippines
bird: p h easant	infant: c h ild	animal: c h ipmunk
form: s h ape	carve: w h ittle	not long: s h ort
melt: t h aw	idea: t h ought	coldness: c h ill
name: P h ilip	grain: w h eat	inexpensive: c h eap
seat: c h air	ghost: p h antom	playhouse: t h eater
yell: s h out	beard: w h iskers	attack: c h arge
lash: w h ip	color: w h ite	picture: p h otograph
fish: s h ark	robber: t h ief	that place: t h ere
close: s h ut	rotate: w h irl	young hen: c h icken

Exercise C: Complete the following exercise by filling in the proper digraph.

ch eck	ch oose	ch ange	th ief (ch)	ph ysician	th rough
th ank	ph armacy	ph obia	ph rase	th reaten	ch arter
ph enomenon	th irty	sh adow	th orough	wh enever	sh rewd
wh ether	ch arity	th eory	sh allow	ch allenge	ch ance
sh ipment	wh isper	wh ich	wh om	ph ilosophy	ph onetic

LESSON THREE

Exercise A: The letters **A, E, I, O,** and **U** are vowels. Vowels have long and short sounds. Vowel sounds also change when followed by the letter **R.**

	A	E	I	O	U
Long Vowels:	ate	he	dime	so	use
Short Vowels:	sat	end	if	hat	sun
Vowels with R:	car	her	girl	for	hurt

In the sentences which follow, you are to fill in the vowel sounds to make words. The word, of course. must make sense in the sentence. Study the examples first.

Examples: H o ld on so you won't fall.
We go to church to pr ay.
H e is my uncle.
I am f ive years old.

Snow is c old.
Mother has change in her p urse.
S ay your name.
Take off your h at and coat.
F ill the pail with water.
Look at m e.
What a c ute doll!
The m urderer will be hanged.
Dr ive the car.
I'm gl ad you could come.
The school t erm ends in June.
Cl o se the door.
St ir the soup until it boils.
H it the ball with the bat.
Call me on the ph one.
The c at purrs softly.
Obey the r u les.
Put the po t on the stove.
The boy tripped and f e ll.
Mud is d ir ty.
Run ho me at noon.
Don't dro p that dish.
Farmers need f er tile soil.
Have some m or e to eat.
He is l eft-handed.
We flew in a pl ane.
M ail the letter.

Turn the pa ge and read.
A birthday car d came in the mail.
Who's n ext in line?
Pl a y the game.
She is my sister.
Please s it down.
R ow the boat.
Digging is h ar d work.
Are your hands cle an?
The ar tist painted the scene.
My arm is s or e where I fell.
B ir ds fly south every winter.
We fe d the dog meat.
I bit my li p.
The letter began "Dear S ir ."
Do you like c or n on the cob?
Whistle a tu ne.
Wash your h a nds and face.
Put your shoes o n.
Fire b urns.
A compass needle points n orth.
The sun is sh ining.
Dad smokes a pi pe.
The sk ir t matches her blouse.
The girl tore her dr e ss.
Every sentence has a v er b.
Li e down and rest.

Drink your hot tea.
Were you hurt when you fell?
Ten comes after nine.
Ice cubes are cold.
Answer the letter
Tools will rust outdoors.
Get gas at the service station.
Look at the top spin.
How far did you walk?
Soap makes suds.
Turn around and face front.
Save your money in a bank.
Your answer is wrong.
The key fits this lock.
Rain helps flowers grow.
I caught a fish in the lake.
Drive the car safely.
The sun is shining.

A dog's fur keeps him warm.
Girls play with dolls.
Toothpaste comes in a tube.
Cows go into the barn at night.
The sun rises in the east.
Eat your meat and gravy.
Girls wear dresses.
I like corn on the cob.
May comes before June.
That dull knife won't cut.
Germs are spread by sneezing.
Let's play hide and seek.
Take a bath in the tub.
What a beautiful morning.
Bring your pad and pencil.
Use your knife and fork to eat.
Put a new bulb in the lamp.
Candy costs five cents.

Exercise B: Fill in long or short vowels to make words. Place the appropriate mark over the vowels to indicate whether they are long (—) or short (⏑). The first sentence has been done for you.

To receive your c ŏpies of our ĭnteresting mă gazine, jŭ st drŏp your chĕck in the mail.
Please sī gn the affidāvit whīch it is before you.
Our āgent has compī led several detāiled reports on prēmium rate increāses.
Īmproved tēlephone servĭce hās been respŏnsible for bĕtter business relations.
You māy borrōw up to $3,000 at the lōw interest figure of 6 per cent.
The Accounting Department wĭll submĭt the bălance sheet at the nĕxt Board of Dirĕctors meeting.
Fīve thousand ūnits of your order will bē shipped with nō further delāy.
Our hotĕl offers ĕxcellent bănquet facĭlities for your clŭb or organization.
Your lĕtter of Fĕbruary 16 hăs been gĭven careful consĭderation.
The nāme of the beneficiary is incorrectly stāted.
Your brokerăge suggĕst the bĕst ĭnvĕstments in stŏcks and bŏnds.
We appreciate your frănk crĭtĭcĭsm of our delĭvery service.
The quōtātions on our prĭce list will bē revĭsed on Māy 6.
Considerable tī me has elapsed since Mr. Hart complēted his manūscript.
The mănufăcturer will pay the trănsportation charges ĭn advănce.
The Cŭstomer Service Department spĕcializes in the selĕction of gĭfts.
The enclōsed envelōpe is for your convēnience.
Sĕveral of our stăff mĕmbers wĭsh to attĕnd the cŏnference.

I f n ecessary. h a ve the r equis i tion sl ip approved by the department h e ad.
The s alesmen's conference will be p o stp o ned until Friday.
You have only to wr i te us for inform a tion on your fa vorite v ac a tion spot.
Prod u ction m ust be increased to meet the d eadline.
A d iscount of 2 per c e nt is allowed for payment w i thin t e n days.
W e use the fi nest quality bond p a per in all our public ations.
"Advanced Office Proc e dures" is a booklet des i gned for the busy executive.
The w i tness to the accident w i ll t e stify for the def endant.
The Annual Furn iture Sale beg i ns S e ptember 20.
Proofr e ad e ach letter carefully before ta king it out of the typewr i ter.
Our c o mpetent accountants are experts in h a ndling income ta x pr o blems.
Mr. Tilman is w e ll qualified for the pos i tion of br anch m a nager.
The d ivid e nd to c o mmon st o ckholders will be issued Nov e mber 15.
Did you rec e ive a n o tice for pa yment of your overdue account?
In the sp aces provi ded list the items by stock numbers.
Our sales r e pres e ntatives operate o n a comm i ssion bas is.
Protect your s avings by o pening an account toda y.

LESSON FOUR

Exercise A: These letter combinations blend to make a new sound when spoken:
Diphthongs: au:auto **oy**:boy **oi**:point **oo**:boot **oo**:look **ou**:house
Vowel & Consonant Combinations: air:fair **al**:ball **ew**:new **aw**:draw **ow**:brown

Complete the sentences which follow by filling in the appropriate letters.

Don't splash in the p oo l.
The cr ew was planning mutiny.
The children slid d ow n hill.
It weighs four pounds, two ou nces.
That sweater is all w oo l.
He nearly dr ow ned in deep water.
I want two p ou nds of meat.
Animals eat r aw meat.
B oi l some water for tea.
Sit in that ch air .
Children go to sch oo l to learn.
Pennies are made of copper all oy .
Crops won't grow in p oo r soil.
Corn needs fertile s oi l to grow.

A restless baby ann oy s his mother.
A carpenter works with w oo d.
I kn ew him right away.
Children play with toy s.
Come when mother c al ls.
That st air way goes up.
J oi n the Boy Scouts.
Ch ew your food well.
The m oo n shines on a clear night.
The dentist pulled his t oo th.
C ow s give milk.
There's not a cl ou d in the sky.
The carpenter s aw ed the wood.
The barber cuts h air .

It is al most nine o'clock.
Baby is starting to cr aw l.
Put cups and s au cers on the table.
He c au ght the ball.
Oi l the noisy hinge.
The lion licked his p aw .
L ou d noises disturb me.
I need a new p air of shoes.
P au se for a while and rest.
There are only a f ew left.
I said to do it n ow .
I thr ew the ball to him.
Birds fly s ou th in winter.
Read a new b oo k every week.

That answer is f al se.
The flood au sed much damage.
Fresh bread tastes g oo d.
Don't make n oi se in the library.
Please pass s al t and pepper.
The king's family is r oy alty.
The batter hit the b al l.
A new br oo m sweeps clean.
A cr ow d of people gathered.
Christmas is a joy ful time.
Breathe that fresh air .
The rocket was l au nched successfully.
On the farm, we rise at d aw n.

Exercise B: The following word parts are vowel and consonant combinations which are repeatedly used and easily recognized:

Word Parts: **igh:**night **ind:**kind **old:**fold

Complete these sentences by filling in the appropriate word parts.

Raise your r igh t hand.
Be k ind to animals.
The druggist s old me medicine.
F old the paper in half.
The sun shines br igh tly.
A m igh ty man was Paul Bunyan.
The old man was feeble.
H old your breath under water.
Birds use their wings for fl igh t.
The spotlights bl ind ed me.

Don't w ind the clock too tight.
The b ind ing of that book is loose.
Don't go; I've changed my m ind .
Hands get c old without gloves.
The sun gives l igh t to the earth.
The story was t old over and over.
This small collar is too t igh t.
Gr ind some meat for hamburgers.
The ring is made of g old .
Can you f ind your way in the dark?

Exercise C: This is a review of all the preceding pages with an emphasis on Lesson Four. The phonetic spellings of the sounds in this lesson are:

aw:ô	**au:ô**	**al:ôl**	**air:âr**
law:lô	auto:ôtō	ball:bôl	fair:fâr
draw:drô	cause:kôs	salt:sôlt	stair:stâr
lawn:lôn	taught:tôt	alter:ôlter	chairs:châr s

oi:oi	**oy:oi**	**oo:ōo**	**oo:ŏo**
soil:soil	boy:boi	boot:bōot	foot:fŏot
coin:koin	toys:tois	tooth:tōoth	cook:kŏok
noise:nois	enjoy:enjoi	cool:kōol	hood:hŏod

ou:ou	ow:ou	ew:ū	igh:ī
loud:loud	cow:kou	new:nū	high:hī
house:hous	down:doun	few:fū	sigh:sī
bounty:bountī	fowl:foul	blew:blū	right:rīt

ind:īnd	old:ōld
mind:mīnd	cold:kōld
wind:wīnd	fold:fōld
blind:blīnd	sold:sōld

Write the following words phonetically. Be sure to use markings over the vowels when necessary to indicate their value. The first two have been done for you.

brew	brū	groom	grōōm
caught	kôt	brightness	brītnĕs
choice	chois	count	kount
flight	flīt	molding	mōldĭng
joyful	joifŏŏl	pawn	pôn
hair	hâr	curfew	kurfū
binding	bīndĭng	halt	hôlt
gown	goun	bloom	blōōm
account	ăkount	appointment	ăpointmĕnt
crook	krŏŏk	boldness	bōldnĕs
hindsight	hīndsīt	hawk	hôk
alternate	ôlternāt (năt)	wood	wŏŏd
scowling	skouling	proof	prōōf
compound	kŏmpound	flaw	flô
authentic	ôthĕntĭk	hoist	hoist
slight	slīt	almost	ôlmōst
amount	ămount	augment	ôgmĕnt
townhall	tounhôl	resound	rēsound (rĭzound)
boyhood	boihŏŏd	coil	koil
findings	fīndĭngs	fewer	fūer
airtight	ârtīt	awning	ônĭng
book	bŏŏk	hew	hū
lighting	līting	destroy	dĕstroi
alter	ôlter	chairman	chârmăn

LESSON FIVE

Exercise A: When there is only one vowel in a word or syllable, it is usually short:

Examples: ăt ĕgg ĭn ŏn ŭp

făn hĕlp-er pĭll frŏg dŭck

In the exercise below, fill in the blanks with short vowels to make words. A clue word is given to help you choose the correct vowel. Study the examples again before you begin.

ill: s *i*ck	color: r*e* d	meal: s*u* pper
baby: *i*nfant	gun: p *i*stol	fall: dr *o* p
coat: j *a*cket	fruit: *a* pple	pool: p *o* nd
tool: dr*i* ll	strange: *o* dd	bird: r *o*bin
repair: m*e* nd	meal: l*u* nch	top: l*i* d
not sharp: d*u* ll	stone: r *o*ck	rug: m *a*t
sleep: r*e* st	timber: l*u* mber	animal: c*a* t
bag: s *a*ck	penny: c *e* nt	quiz: t *e*st
sheep: l *a*mb	fruit: l *e*mon	steal: r *o* b
slice: c*u* t	lawn: gr *a*ss	fruit: pl *u*m

Exercise B: A vowel ending a word or syllable is usually long. Study the examples and then complete the exercise which follows.

Examples: hē nō vē-tō pū-pil tī-ger

thread: f*i* ber	infant: b*a* by	leave: g *o*
melody: m*u* sic	animal: l*i* on	not busy: *i*dle
prize: tr *o*phy	make: cr*e* ate	pupil: st*u* dent
savage: br*u* tal	hidden: s*e* cret	myself: m *e*
empty: v *a* cant	cipher: zer *o*	lawful: l *e* gal
bird: r*a* ven	not shut: *o* pen	woman: l*a* dy
quiet: s *i*lent	aviator: p *i*lot	name: t *i*tle
work: l *a* bor	depot: st*a* tion	give: d *o* nate
flower: t *u*lip	often: fr *e* quent	last: f *i*nal
engine: m *o* tor	splendid: s *u*perb	sacred: h*o* ly

Exercise C: When a short word ends in **E**, the inside vowel is usually long. Study the examples and then complete the exercise which follows.

Examples: ate scene time toe cute

month: J u ne	employ: use	coin: d i me
give up: c e de	rock: st o ne	rodents: m i ce
topic: th e me	string: tw i ne	impolite: r u de
built: m a de	message: n o te	shaft: p o le
range: st o ve	contest: r a ce	flower: r o se
stack: p i le	arrived: c a me	dislike: h a te
melody: t u ne	regulation: r u le	elect: v o te
distribute: m e te	plot: sch e me	eat: d i ne
shut: cl o se	chew: b i te	crippled: l a me
monkey: a pe	glass: p a ne	gown: r o be

Exercise D: Write the following words phonetically indicating long and short vowels. The first one has been done for you.

meditate	mĕdĭtāt	polite	pōlīt
comment	kŏmĕnt	campaign	kămpān
dictate	dĭktāt	satisfy	sătĭsfī
tariff	tărĭf	concrete	kŏnkrēt
prepaid	prēpād	donate	dōnāt

Exercise E: When there are two vowels together in a word or syllable, usually the first vowel is long and the second one is silent. Study the examples and complete the exercise which follows.

Examples: paint meal load suit feet

annoyance: n u i sance	lift: r a i se	brook: str e a m
avenue: str e e t	server: w a i ter	tracks: r a i ls
injury: br u i se	color: gr e e n	warmth: h e a t
ache: p a i n	apple: fr u i t	chair: s e a t
birds: g e e se	animal: g o a t	animal: sh e e p

carriage: c o a ch	voyage: cr u i se	clothing: s u i t
shore line: c o a st	touch: f e el	letter: m a i l
highway: r o a d	insect: b e e	suds: f o a m
rob: st e a l	fruit: p e a ch	instruct: t e a ch
bucket: p a i l	cleanser: s o a p	wheat: gr a i n

Exercise F: The vowel combination **EI** usually follows the double vowel rule (Exercise E, above) when the letter **C** comes before it; that is, when **EI** follows **C**, the **E** is long and the **I** is silent. When **EI** appears without **C**, it has the sound of long **A**. When **IE** is used in a word, the **I** is silent and the **E** is long (just like **EI** following **C**). Study these examples:

Examples:	**EI** following **C**:	ceiling	receive
	EI without **C**:	eight	vein
	IE:	field	chief

Copy these words putting them into the proper columns, below:

brief	niece	deceit	weight	conceit	neighbor
reign	weigh	sleigh	shield	believe	conceived
skein	conceive	eighty	achieve	perceive	receiving
rein	piece	belief	receipt	deceive	perceived
feign	thief	relief	freight	grieving	perceiving

EI following **C**	**EI** without **C**	**IE**
conceive	reign	brief
deceit	skein	niece
receipt	rein	piece
conceit	feign	thief
perceive	weigh	belief
deceive	sleigh	relief
conceived	eighty	shield
receiving	weight	achieve
perceived	freight	believe
perceiving	neighbor	grieving

Exercise G: Write these words phonetically:

dealer	dēler	complaint	kŏmplānt
leave	lēv	chief	chēf
suit	sūt	coal	kōl
loan	lōn	accede	ăksēd
siege	sēj	feign	fān

Exercise H: The following words have been broken into syllables. Pronounce each one carefully and write it phonetically. The first one has been done for you. Notice that the **e** in **beginning** has the sound of short i (ŭ). Look for this same sound in other words.

address	ad dress	ădrĕs
employees	em ploy ees	ĕmploiēz
accommodate	ac com mo date	ăkŏmōdāt
training	train ing	trānĭng
reach	reach	rēch
dinner	din ner	dĭner
waiver	waiv er	wāver
increase	in crease	ĭnkrēs
yield	yield	yēld
maintain	main tain	māntān
defensive	de fen sive	dĭfĕnsĭv
reigning	reign ing	rānĭng
proceed	pro ceed	prōsēd
read	read	rēd
beginning	be gin ning	bĭgĭnĭng
receivership	re ceiv er ship	rĭsēvershĭp
floating	float ing	flōtĭng
raise	raise	rāz
excellent	ex cel lent	ĕxsĕlĕnt
teaching	teach ing	tēchĭng
timber	tim ber	tĭmber
colleague	col league	kŏlēg
claim	claim	klām
receipt	re ceipt	rĭsēt
placement	place ment	plāsmĕnt

Exercise I: Vowels before double consonants are usually short. Study the examples and then go on to the exercise. From the list of words below, copy *only* those which follow this rule and contain a short vowel before the double consonant. Write them on the lines provided.

Examples:	sŭpper hĕlmet		bănded ĕnter		cŏnflĭct fĭst
lick	foam	trace	tulip	hobby	
demon	hill	soft	lesson	sister	
husband	dollar	donkey	rudder	music	
sand	mule	motive	dizzy	brass	
basket	life	minor	equal	deal	
native	lion	hunt	stone	safe	

lick	*dollar*	*rudder*
husband	*soft*	*dizzy*
sand	*donkey*	*hobby*
basket	*hunt*	*sister*
hill	*lesson*	*brass*

Exercise J: When an ending, or suffix, is added to a word ending with a consonant, the consonant is doubled. Study the examples and then go on to the exercise. In the exercise, add the endings to the words given and write the complete word in the space provided.

Example:	**Word**		**Suffix**		**Double Consonant**
	run	+	er	becomes	runner
	lug	+	age	becomes	luggage
	wrap	+	ed	becomes	wrapped

ton + age becomes	*tonnage*	scan + ing becomes	*scanning*
drug + ist becomes	*druggist*	person + el becomes	*personnel*
leg + ings becomes	*leggings*	forgot + en becomes	*forgotten*
regret + ably becomes	*regrettably*	bat + er becomes	*batter*
pet + ed becomes	*petted*	knot + ed becomes	*knotted*
patrol + ed becomes	*patrolled*	sup + er becomes	*supper*
wag + ed becomes	*wagged*	flat + en becomes	*flatten*
remit + ance becomes	*remittance*	commit + ee becomes	*committee*
grip + ing becomes	*gripping*	set + ing becomes	*setting*
sad + est becomes	*saddest*	hop + ing becomes	*hopping*

LESSON SIX

Exercise A: A syllable is a word or part of a word having one sound. Study the examples and then go on to the exercise below. From the list of words, copy *only* those which are syllables, only those which contain a vowel sound. List them in the space provided.

Examples:	Syllables:	zam	et	vus	in	fyt	ash
	Not Syllables:	mpn	bgt	cmd	ssn	rls	ng

bi	cir	clt	quo	vich	ghtnd
jck	zwmm	be	aard	tmsl	gyve
ic	gts	fy	ncs	gio	pds
lac	luc	ssnt	lps	lnss	rbl
gld	ghang	hah	hon	ft	lbs

bi	cir	be	quo	vich
ic	luc	fy	aard	gio
lac	ghang	hah	hon	gyve

Exercise B: When one consonant comes between two vowels in a word, the word is divided before the consonant. Study the examples and then divide the 30 words below into syllables. Write the words on the lines provided using hyphens (-) to separate the syllables as shown in the examples.

Examples: labor: la-bor super: su-per
meter: me-ter nature: na-ture

aback	a-back	nation	na-tion	quota	quo-ta
above	a-bove	Japan	Ja-pan	remote	re-mote
basin	ba-sin	license	li-cense	rumor	ru-mor
because	be-cause	local	lo-cal	cement	ce-ment
climate	cli-mate	minor	mi-nor	total	to-tal
divide	di-vide	notice	no-tice	vacant	va-cant
even	e-ven	ocean	o-cean	water	wa-ter
frozen	fro-zen	over	o-ver	zero	ze-ro
grocer	gro-cer	paper	pa-per	silent	si-lent
hero	he-ro	private	pri-vate	final	fi-nal

Exercise C: When two consonants come between two vowels, the word is divided between the consonants. Study the examples and then divide the following words into syllables.

Examples: helmet: hel-met window: win-dow

seldom: sel-dom yellow: yel-low

rabbit	rab-bit	differ	dif-fer	number	num-ber
garden	gar-den	envoy	en-voy	often	of-ten
fender	fen-der	effort	ef-fort	pebble	peb-ble
basket	bas-ket	husband	hus-band	puddle	pud-dle
tablet	tab-let	hurry	hur-ry	quarter	quar-ter
mission	mis-sion	inner	in-ner	rubber	rub-ber
center	cen-ter	jitters	jit-ters	sergeant	ser-geant
master	mas-ter	kidnap	kid-nap	happy	hap-py
market	mar-ket	linger	lin-ger	venture	ven-ture
curtain	cur-tain	margin	mar-gin	yankee	yan-kee

Exercise D: When **LE** ending a word is preceded by a consonant (except **CK**), the word is divided before the consonant. Study the examples and exceptions and then divide the following words into syllables.

Examples: single: sin-gle rubble: rub-ble

noble: no-ble cattle: cat-tle

Exceptions: knuckle: knuck-le trickle: trick-le

able	a-ble	jungle	jun-gle	tangle	tan-gle
bubble	bub-ble	kettle	ket-tle	twinkle	twin-kle
circle	cir-cle	little	lit-tle	whistle	whis-tle
candle	can-dle	maple	ma-ple	uncle	un-cle
dimple	dim-ple	needle	nee-dle	turtle	tur-tle
eagle	ea-gle	purple	pur-ple	rifle	ri-fle
fondle	fon-dle	rumble	rum-ble	bugle	bu-gle
gentle	gen-tle	rustle	rus-tle	spindle	spin-dle
handle	han-dle	couple	cou-ple	hustle	hus-tle
idle	i-dle	sample	sam-ple	staple	sta-ple

ERIC

Exceptions:

cackle	cack-le	tickle	tick-le	crackle	crack-le
pickle	pick-le	buckle	buck-le	heckle	heck-le
sickle	sick-le	shackle	shack-le	tackle	tack-le

Exercise E: Complete each word by filling in the proper **LE** ending.

possi ble	multi ple	mira cle	enti tle	a ble	med dle
princi ple	assem ble	audi ble	exam ple	sad dle	lia ble
dispensa ble	strug gle	obsta cle	vehi cle	an kle (gle)	bat tle
incredi ble	eligi ble	forci ble	capa ble	set tle	cy cle
responsi ble	rectan gle	fick le	peo ple	tri ple (fle)	mid dle

Exercise F: When a suffix has been added to a word, it is usually regarded as a separate syllable. Study the examples and then divide the following words into syllables.

Examples: hunter: hunt-er harmless: harm-less
lately: late-ly curling: curl-ing

adding	add-ing	kindest	kind-est	vender	vend-er
boyish	boy-ish	lengthen	length-en	waitress	wait-ress
cashier	cash-ier	muddy	mud-dy	youngster	young-ster
dreamy	dream-y	onward	on-ward	zipper	zip-per
evening	eve-ning	placement	place-ment	endless	end-less
foolish	fool-ish	quickly	quick-ly	massive	mass-ive
golden	gold-en	righteous	right-eous	graphic	graph-ic
heater	heat-er	sadder	sad-der	falsehood	false-hood
illness	ill-ness	therefore	there-fore	trainee	train-ee
joyous	joy-ous	upright	up-right	artist	art-ist

Exercise G: Write the root word in the blank provided. The first one has been done for you.

respectfully	respect	concerning	concern
predictable	predict	faithful	faith
employer	employ	regardless	regard
definitely	definite	embarrassment	embarrass
allowance	allow	promptness	prompt

Exercise H: When **ED** is added to a word ending in **D** or **T,** it becomes a separate syllable. When **ED** is added to all other words, the words remain one syllable.

Examples: waited: wait-ed walked: walked
tested: test-ed called: called
jetted: jet-ted stopped: stopped

Some of these words can be hyphenated; others cannot. Leave blank the space next to the words which remain one syllable. Study the examples carefully.

tested	test-ed	raided	raid-ed	dented	dent-ed
packed		jailed		wasted	wast-ed
lashed		warmed		painted	paint-ed
hatched		bounced		cared	
lasted	last-ed	knotted	knot-ted	grasped	
bounded	bound-ed	knocked		rushed	
dropped		mailed		flooded	flood-ed
manned		flashed		gifted	gift-ed
counted	count-ed	halted	halt-ed	jotted	jot-ted
throbbed		seated	seat-ed	scored	

Exercise I: Words of more than two syllables are divided according to these same rules. Study the examples first and divide the following words.

Examples: accidentally: ac-ci-den-tal-ly circulated: cir-cu-lat-ed
encirclement: en-cir-cle-ment repercussion: re-per-cus-sion

acquaintance	ac-quaint-ance	unshackled	un-shack-led
battery	bat-ter-y	sketchiness	sketch-i-ness
chartered	char-tered	tangible	tan-gi-ble
drillmaster	drill-mas-ter	understatement	un-der-state-ment
flirtatiously	flir-ta-tious-ly	vindictive	vin-dic-tive
renewal	re-new-al	workmanship	work-man-ship
glimmering	glim-mer-ing	uncollected	un-col-lect-ed
antiseptic	an-ti-sep-tic	conservationist	con-ser-va-tion-ist
gubernatorial	gu-ber-na-to-ri-al	divided	di-vid-ed
identification	i-den-ti-fi-ca-tion	antisocial	an-ti-so-cial

Exercise J: Separate these words into syllables. If a word cannot be divided, leave the space blank. Review thoroughly the rules before starting.

community	com-mu-ni-ty	foster	fos-ter
exterminator	ex-ter-mi-na-tor	susceptible	sus-cep-ti-ble
romantic	ro-man-tic	maple	ma-ple
margin	mar-gin	plentiful	plen-ti-ful
fizzled	fiz-zled	countless	count-less
renewal	re-new-al	whimsical	whim-si-cal
shockingly	shock-ing-ly	needle	nee-dle
flaked		fickle	fick-le
native	na-tive	infinite	in-fi-nite
seldom	sel-dom	rapped	
actor	ac-tor	elite	e-lite
social	so-cial	plotted	plot-ted
outwardly	out-ward-ly		

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ABSTRACT - This resource manual suggests teaching aids for adult classes in office machines. Suggested aids include films, texts, tapes, charts, kits and practice sets, programed materials, and transparencies and are categorized under such headings as (1) filing, (2) key punch, (3) data processing, (4) typewriting, and (5) duplicating. A directory of the sources is provided. (JS)

VT 011 169

OFFICE MACHINES RESOURCE MATERIALS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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for Adult Programs in Business and Distributive Education

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1970

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Foreword

Resource materials afford the instructor opportunities to stimulate interest and make the learning process more meaningful. This guide has been developed to acquaint the instructor of office machines with some of the materials that will permit him to do a more effective and satisfying job of teaching. This is not to be considered an exhaustive list nor interpreted as an official list of titles recommended by the State Education Department.

Appreciation is expressed to William C. Bahn, Jr., instructor of business education at the Colonie Central High School, for his efforts in compiling these resource materials. Assistance relating to content was provided by Eugene P. Whitney and Ronald W. Wing, Associates in the Bureau of Business and Distributive Education. The project was coordinated, edited, and prepared for publication by Nelson S. Maurer, Associate in the Bureau of Continuing Education Curriculum Development.

HERBERT BOTHAMLEY, *Chief*
Bureau of Continuing Education
Curriculum Development

WILLIAM E. YOUNG, *Director*
Curriculum Development Center

Message to the Instructor

There are numerous materials available to the instructor of office machines that will help him add new dimensions to the learning process and thus better meet the needs of individual trainees. This publication is designed to acquaint the instructor with some of the instructional aids available in the several areas of office machines. Many of the textbooks and other items listed are for individuals with average ability.

Requests for any materials should be made directly to the publisher or producer. Addresses are listed in the Directory. Most items are for sale, but usually examination copies may be obtained from publishers when requested on official stationery. Items that may be rented are so indicated along with the source or sources. This is not an exhaustive source list so the specific item may be available at places other than those listed. Articles that are free are also noted and should be requested directly from the source listed.

New instructional aids are constantly being produced. Many times these items are listed in such publications as *The Balance Sheet*, *Business Education World*, and *Journal of Business Education*. Use the latest editions of *Educators Guide to Free Films*, *Free Filmstrips*, *Free Tapes*, and *Free and Inexpensive Learning Materials* as sources for additional teaching aids.

An instructor should not avoid using equipment for instructional purposes because he has had no previous experience with it. Generally, manufacturers' representatives are glad to demonstrate their equipment and supply operator manuals and instructional aids.

Instructors are encouraged to communicate to the Bureau their comments regarding the usefulness of the publication and to suggest additional materials that might be included in a subsequent revision.

HOBART H. CONOVER, *Chief*
Bureau of Business and Distributive Education

JOHN E. WHITCRAFT, *Director*
Division of Occupational Education

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Instructional Materials

Adding and Calculating

Texts

Agnew, P. L. & Cornelia, N. J. *Office machines course;* 3d ed. New Rochelle, N.Y. South-Western Publishing Co. 1962.

_____ & Pasewark, W. R. *Full-keyboard adding-listing machine course;* 3d ed. New Rochelle, N.Y. South-Western Publishing Co. 1963.

_____ *Key-driven calculator course;* 4th ed. New Rochelle, N.Y. South-Western Publishing Co. 1962.

_____ *Rotary calculator course;* 4th ed. New Rochelle, N.Y. South-Western Publishing Co. 1962.

_____ *Ten-key adding-listing machine and printing calculator course;* 3d ed. New Rochelle, N.Y. South-Western Publishing Co. 1963.

_____ & others. *Clerical office practice;* 4th ed. New Rochelle, N.Y. South-Western Publishing Co. 1967.
Office work assignments and printed tests available.

Archer, F. C. & others. *General office practice;* 3d ed. New York, N.Y. Gregg Division, McGraw-Hill Book Co. 1968.
Workbook and printed tests available.

Automatic printing calculator. Chicago, Ill. Victor Comptometer Corp. 1965.

Texts

Barron, A. E. & Taylor, J. R. *Clerical office training.* Englewood Cliffs, N.J. Prentice-Hall, Inc. 1963.
Job Book 1, 2, and printed tests available.

Divisumma 24; 30 lesson practice course. New York, N.Y. Olivetti Underwood Corp. 1963.
Student answer sheets available.

Dool, J. J. *Business machine exercises.* Englewood Cliffs, N.J. Gregg Division, McGraw-Hill Book Co. 1964.

Fasnacht, H. D. & others. *How to use business machines;* 3d ed. New York, N.Y. Gregg Division, McGraw-Hill Book Co. 1969.

Friedman, Sherwood, & Grossman, Jack. *Applied clerical practice;* 2d ed. New York, N.Y. Pitman Publishing Corp. 1962.
Workbook available.

_____ *Modern clerical practice;* 3d ed. New York, N.Y. Pitman Publishing Corp. 1968.
Workbook available.

Giordano, Albert. *Business machine calculation volume I; adding machines and printing calculators.* Englewood Cliffs, N.J. Prentice-Hall, Inc. 1964.

_____ *Business machine calculation volume II, rotary calculators.* Englewood Cliffs, N.J. Prentice-Hall, Inc. 1964.

Adding and Calculating

Texts

Full-keyboard adding machine. Chicago, Ill. Victor Comptometer Corp. 1966.

Klein, A. E. *Full-keyboard adding machine office practice course in six lessons.* New York, N.Y. Remington Rand Office Machines, Division of Sperry Rand Corp. 1960.

Math-adding machine practice course. New York, N.Y. Olivetti Underwood Corp. 1968.

Meehan, J. R. *How to use the calculator and the comptometer;* 5th ed. Hightstown, N.J. Gregg Divison, McGraw-Hill Book Co. 1964.

_____ *Using the rotary calculator in the modern office.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1965.

_____ **& Kahn, Gilbert.** *How to use adding machines—ten key, full key, printing calculator.* Englewood Cliffs, N.J. Gregg Division, McGraw-Hill Book Co. 1962.

Pactor, Paul. *Printing calculator course.* New York, N.Y. Pitman Publishing Corp. 1969.

_____ **& Johnson, M. M.** *Comprehensive business machines course;* rev. ed. New York, N.Y. Pitman Publishing Corp. 1968.

_____ *Full-keyboard adding machine course;* rev. ed. New York, N.Y. Pitman Publishing Corp. 1968.

_____ *Key-driven calculator course;* rev. ed. New York, N.Y. Pitman Publishing Corp. 1968.

Texts

_____ *Rotary calculator course;* rev. ed. New York, N.Y. Pitman Publishing Corp. 1968.

_____ *Ten-key adding machine course;* rev. ed. New York, N.Y. Pitman Publishing Corp. 1968.

Ten-key adding machine. Chicago, Ill. Victor Comptometer Corp. 1965.

Turner, D. R. *Office machines operator;* 3d ed. (Civil Service Tests) New York, N.Y. Arco Publishing Co., Inc. 1967.

Walker, A. L. & others. *How to use adding and calculating machines;* 3d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1967.

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Programed Instruction

Full-keyboard adding machine. Dayton, Ohio. National Cash Register Co. Purchase - Local NCR office.
Explains how to operate the full-keyboard adding machine.

Ten-key adding machine. Dayton, Ohio National Cash Register Co. Purchase - Local NCR office.
Presents the touch system of operating the machine.

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Kits and Practice Sets

Agnew, P. L. *Machine office practice.* New Rochelle, N.Y. South-Western Publishing Co. 1959.
Presents a series of practical business problems using such business forms as checks, sales slips, deposit tickets, invoices, and time cards.

Kits and Practice Sets

Industry application studies. New York, N.Y. Olivetti Underwood Corp.
A series of booklets that presents business oriented case studies illustrating solutions to common arithmetic problems in a variety of industries.

Pactor, Paul. *Business machines projects.* New York, N.Y. Pitman Publishing Corp. 1960.
Contains nearly 2,500 problems which can be completed on an adding or calculating machine.

Presentation kit of Marchant calculator material. New York, N.Y. SCM Corp.
Provides a teaching aid for Models CM, 316, and 505. Each kit contains a teacher's guide, wall chart, tests and answer books, machine instruction book and sheets, problem book, and certificate of accomplishment.

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Instructor and Trainee Aids

Burroughs adding machine shortcuts. Detroit, Mich. Burroughs Corp.
Shows how an operator can become proficient at shortcutting. Practice problems are provided.

Teacher's portfolio. Chicago, Ill. Victor Comptometer Corp.
Suggests the number of pieces of equipment, required length of course, and a method of rating students. Includes an adding and calculating machine aptitude test which can be reproduced.

Instructor and Trainee Aids

Your keys to Victor educational services. Chicago, Ill. Victor Comptometer Corp.
Describes material and services available to educators.

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Films

Ten-key adding machine. National Cash Register Co. 30 min. sound. color. Free - Local NCR office.
Shows the method of operation and work performed by the machine.

Full-keyboard adding machine. National Cash Register Co. 30 min. sound. color. Free - Local NCR office.
Shows the method of operation and work performed by the machine.

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Filmstrips

Ten-key touch training course. Gregg Division, McGraw-Hill Book Co.
A series of 25 filmstrips used in training touch operation on all electric 10-key adding machines. Used with a controlled-reader-type projector.

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Transparencies

Clerk-typist. Visual Products Division. 3M Co.
A series of 17 units that presents the responsibilities of the clerk-typist.

Adding and Calculating

Charts

The automatic calculator. Friden, Inc.
Explains the operation of the automatic calculator and how it is used in different kinds of businesses. A teacher's discussion guide accompanies the chart.

Display charts. Monroe International. color.
A series of charts that depicts modern electronic and rotary calculators and adding machines against visually interesting sites in the United States, Europe, and the Orient.

Divisumma 24 Keyboard. Olivetti Underwood Corp. color.
Shows the Divisumma 24 keyboard.

Office machines posters. Gregg Division, McGraw-Hill Book Co.
A series of posters that depicts the parts and use of the more popular office machines.

Rotary Calculator. Monroe International.
Presents the LA-7 Rotary Calculator on one side and the CSAE Rotary Calculator on the reverse side.

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Tapes

Ten-key business machine. Educational Research Associates.
A series of nine tapes that gives intergrated lessons for learning every operation of the machine.

Data Processing

Texts

Bookkeeper-account clerk; 3d ed. (Civil Service Tests) New York, N.Y. Arco Publishing Co., Inc. 1965.

Boynton, L. D. & others. *Basic bookkeeping and accounting.* (Adult and Continuing Education Series) New Rochelle, N.Y. South-Western Publishing Co. 1968.

_____ *20th century bookkeeping and accounting advanced course;* 23d ed. New Rochelle, N.Y. South-Western Publishing Co. 1968.
Working papers and study guide available.

Carr, T. D. *Bookkeeping machine operator instructional manual.* Wahpeton, N. Dak. Alexander's Valley Stationery. 1966.

Clow, C. A. & others. *Gregg accounting, advanced course;* 2d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.
Working papers and study guides available.

Electrosumma 24CR duplex machine posting course. New York, N.Y. Olivetti Underwood Corp. 1967.

Electrosumma 22CR machine posting course. New York, N.Y. Olivetti Underwood Corp. 1967.

Texts

Freeman, M. H. & others. *Accounting 10/12.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.
Working papers and study guide available.

Janis, Arthur, & Miller, Morris. *Fundamentals of modern bookkeeping.* New York, N.Y. Pitman Publishing Corp. 1965.

Kahn, Gilbert. *Business data processing basic principles and applications.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1966.

Nelson, D. S. & Woods, R. S. *Accounting systems and data processing.* New Rochelle, N.Y. South-Western Publishing Co. 1961.

Randall, C. B. & Burgly, S. W. *Systems and procedures for business data processing;* 2d ed. New Rochelle, N.Y. South-Western Publishing Co. 1968.

Robichaud, Beryl. *Understanding modern business data processing.* Gregg Division, McGraw-Hill Book Co. 1966.

Kits and Practice Sets

Clow, C. A. & others. *Punched-card data processing system practice set.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1970.
Presents a sales and payroll procedure. Correlated with Part 4 of *Accounting 10/12.*

Pactor, Paul. *Bookkeeping machines practice set.* New York, N.Y. Pitman Publishing Corp. 1961.
Introduces the posting operations of a bookkeeping machine.

Saunders, G. D. & Luskin, B. J. *Data processing: a practice set.* Athens, Ohio. McBee Systems. 1965.
Provides basic ideas and concepts of data processing.

Wanous, S. J. & Wanous, E. E. *Automation office practice.* New Rochelle, N.Y. South-Western Publishing Co. 1964.
Acquaints the student with the functions and procedures of automated data processing.

Wigge, B. S. & Wood, Merle. *Payroll systems and procedures.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1970.
Correlated with *Accounting 10/12.*

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Instructor and Trainee Aids

Bookkeeping instruction in the 20th century. Monograph No. 118. New Rochelle, N.Y. South-Western Publishing Co. 1967.
Traces the history of bookkeeping instruction from 1900.

Instructor and Trainee Aids

Introduction to automatic business data processing. Albany, N.Y. New York State Education Department, Bureau of Secondary Curriculum Development. 1965.
Gives activities that can be used in bookkeeping courses to show automated data processing.

Musselman, V. A. & Hanna, J. M. *Teaching bookkeeping and accounting.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1960.
Provides techniques for teaching bookkeeping and accounting.

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Films

The green light. Willard Pictures, Inc. 1968. 14 min. sound. color. Rent - Business Education Films.
Shows how information is handled by computers and related equipment.

NCR 160 bookkeeping machine. National Cash Register Co. 25 min. sound. color. Free - Local NCR office.
Describes the main features and the operation of the machine.

Once upon a punched card. IBM. 1964. 9 min. sound. color. Free.
Explains the basic principles of punched card accounting.

Response to the challenge. National Cash Register Co. 15 min. sound. color. Free - Local NCR office.
Discusses the development of the NCR 400 accounting machine.

Weaknesses of unprotected written records. National Cash Register Co. 20 min. sound. color. Free - Local NCR office.
Portrays the losses that can occur through the use of hand posted records.

Filmstrips

The EDP feasibility study. Bank Administration Institute. 1964. 15 min. sound. color. Free.
Portrays steps a bank should investigate before converting from conventional bookkeeping to electronic data processing.

Guest folio revenue. National Cash Register Co. 35 min. sound. color. Free - Local NCR office.
Points out some of the weaknesses found in motel hand posting systems and visits an installation utilizing a NCR 52 Motel Posting Machine. Used with an automatic sound filmstrip projector (DuKane type or similar).

The closing phase of bookkeeping. South-Western Publishing Co. 1968.
Tells how to prepare a six-column work sheet and explains the recording, posting of closing entries, balancing, and rulings for each kind of general ledger.

The opening phase of bookkeeping. South-Western Publishing Co. 1968.
Shows the opening of a set of books for a small motel business.

The recording phase of bookkeeping. South-Western Publishing Co. 1968.
Tells how to use T accounts to analyze transactions into debits and credits.

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Transparencies

Bookkeeping. Tecnifax Corp.
A series of 60 transparencies that covers a complete bookkeeping course.

Transparencies

Bookkeeping. United Transparencies, Inc.
A series of 11 transparencies that shows procedures for various bookkeeping systems.

Bookkeeping and accounting. South-Western Publishing Co.
A series of 22 transparencies correlated with *20th Century Bookkeeping and Accounting,* 23d ed.

Bookkeeping and accounting. Visual Products Division. 3M Co.
A series of transparencies that illustrates various business, banking, and accounting forms.

Business data processing fundamentals. Gregg Division, McGraw-Hill Book Co. color.
A series of 32 transparencies that covers common language media and mechanical and electronic data processing.

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Charts

Accounting charts. Gregg Division, McGraw-Hill Book Co.
A series of five charts correlated with *Accounting 10/12.*

Bookkeeping and accounting charts. South-Western Publishing Co.
A series of eight charts correlated with *20th Century Bookkeeping and Accounting,* 23d ed.

Bookkeeping machine chart. Olivetti Underwood Corp.
Shows the posting of accounts receivable using a machine.

Data processing charts. Teaching Aids Inc.
A series of charts showing the use of data processing equipment.

Duplicating

Texts

Agnew, P. L. & others. *Clerical office practice;* 4th ed. New Rochelle, N.Y. South-Western Publishing Co. 1967.

Archer, F. C. & others. *General office practice;* 3d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

Barron, A. E. & Taylor, J. R. *Clerical office training.* Englewood Cliffs, N.J. Prentice-Hall Inc. 1963.

Friedman, Sherwood, & Grossman, Jack. *Applied clerical practice;* 2d ed. New York, N.Y. Pitman Publishing Corp. 1962.

_____ *Modern clerical practice;* 3d ed. New York, N.Y. Pitman Publishing Corp. 1968.

Straub, L. L. & Gibson, E. D. *Liquid duplicating systems.* Dubuque, Iowa. William C. Brown Co. 1960.

_____ *Stencil duplicating systems.* Dubuque, Iowa. William C. Brown Co. 1960.

Techniques of mimeographing. Chicago, Ill. A. B. Dick Company, Inc. 1968.

Verry, H. R. & Wright, G. H. *Microcopying methods;* 2d ed. New York, N.Y. Focal Press Inc. 1967.

Programed Instruction

Preparing stencils and masters. Anaheim, Calif. Litton Instructional Materials, Inc. 1966.
Presents rules for proper preparation and correction of mimeograph stencils, fluid duplication, and multilith masters.

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Kits and Practice Sets

Systems training kits - general duplicating. Cleveland, Ohio. Addressograph Multigraph Corp.
Emphasizes how the offset process fulfills the needs of an office for copies and discusses the various types of office duplicating.

Systems training kit - order-invoice writing. Cleveland, Ohio. Addressograph Multigraph Corp.
Illustrates the benefits derived by applying multigraph methods to simplify paperwork procedures.

Systems training kit - procedures order writing. Cleveland, Ohio. Addressograph Multigraph Corp.
Provides an effective and sound foundation for a typical production order system.

Systems training kit - purchase order writing. Cleveland, Ohio. Addressograph Multigraph Corp.
Illustrates how multigraph methods can streamline and simplify the purchasing procedure.

Instructor and Trainee Aids

A course designed for training offset duplicator operators. Cleveland, Ohio. Addressograph Multigraph Corp. 1966.

Fundamentals of mimeographing. Edited by R. N. Cansler. Chicago, Ill. A. B. Dick Co., Inc. 1967.

Fundamentals of offset. Edited by R. N. Cansler. Chicago, Ill. A. B. Dick Co., Inc. 1966.

A graphic arts course outline. Cleveland, Ohio. Addressograph Multigraph, Corp.
Outlines the suggested content for a graphic arts course.

Graphic arts training in schools. Cleveland, Ohio. Addressograph Multigraph Corp. 1963.

Graphic communications . . . not just a job but a career. Cleveland, Ohio. Addressograph Multigraph Corp.
Describes the types of employment available in graphic communications.

Graphic communications — the student — the program — the opportunities. Cleveland, Ohio. Addressograph Multigraph Corp.
Describes the types of employment and opportunities available to those who enter the field of graphic communications. Explains the four basic elements of graphic communications.

How to make a paste-up layout for your Gestefax. Yonkers, N.Y. Gestetner Corp.
Describes materials and methods for preparing a layout for the Gestefax.

Instructor and Trainee Aids

Instructive Masters. Chicago, Ill. A. B. Dick Company, Inc.
Describes in four lessons the spirit duplicating process, the preparation of the spirit master unit, the operation of the fluid duplicator, and the various uses for fluid duplicators.

Learning how to use the Ditto D-10 and D-20. Chicago, Ill. Ditto Division, Bell and Howell Co.
Provides materials for teaching students how to use the direct process of duplicating.

Making a good impression on your master. Cleveland, Ohio. Addressograph Multigraph Corp.

Offset course outline. Chicago, Ill. A. B. Dick Company, Inc.
Gives teaching suggestions for a course in offset duplicating.

Preparing copy for camera. Cleveland, Ohio. Addressograph Multigraph Corp. 1961.

Stencil typing hints. Yonkers, N.Y. Gestetner Corp.
Gives hints for the typing of stencils.

Teacher's guide for training offset duplicator operators. Cleveland, Ohio. Addressograph Multigraph Corp.
Correlated with the charts and reference materials presented in *A Course Designed for Training Offset Duplicator Operators.*

Duplicating

Films

Duplicating by the spirit method. Bailey Films, Inc. 1961. Rent - Business Education Films, Syracuse University Film Library, Indiana University Audio-Visual Center.
Demonstrates the preparation of a master carbon, methods of making changes and corrections, and machine operation and care.

A matter of some urgency. A. B. Dick Co. 19 min. sound. color. Free.
Shows proper duplicating and copying procedures.

Mimeographing techniques. Bailey Films, Inc. 1958. 15 min. sound. color. Rent - Business Education Films, Syracuse University Film Library, Indiana University Audio-Visual Center.
Demonstrates the complete process of typing a stencil from cleaning and adjusting the typewriter to the use of the mimeoscope for hand lettering.

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Filmstrips

The fluid duplicator. A. B. Dick Co. 15 min. sound. color.
Explains the operation of the fluid duplicator.

The master. A. B. Dick Co. 15 min. sound. color.
Describes the fluid duplicating process.

The mimeograph. A. B. Dick Co. 24 min. sound. color.
Explains the operation of the mimeograph.

Offset and you. A. B. Dick Co. 8 min. sound. color.
Traces the history of lithography from the litho stone to present day offset.

Filmstrips

The stencil. A. B. Dick Co. 22 min. sound. color.
Describes the procedure for preparing a stencil.

Techniques of modern offset. A. B. Dick Co. sound. color.
A series of seven filmstrips that covers the complete offset process.

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Charts

How to operate the Ditto D-30 and D-31. Ditto Division, Bell and Howell Co.
Gives operating instructions for each machine.

Multilith offset 1250 machine feature charts. Addressograph Multigraph Corp.
A series of charts that illustrates features, attachments, and adjustments of the machine.

Offset machine model 320. A. B. Dick Co.
Shows the operating parts of the machine.

Offset machine model 350/360. A. B. Dick Co.
Points out the operating parts of the machine.

Operator's guide - multilith inks. Addressograph Multigraph Corp.
Helps the operator diagnose and remedy some of the various ink problems.

Filing

Texts

Agnew, P. L. & others. *Secretarial office practice;* 7th ed. New Rochelle, N.Y. South-Western Publishing Co. 1966.

_____ *Clerical office practice;* 4th ed. New Rochelle, N.Y. South-Western Publishing Co. 1967.

Archer, F. C. & others. *General office practice;* 3d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

Barron, A. E. & Taylor, J. R. *Clerical office training.* Englewood Cliffs, N.J. Prentice-Hall, Inc. 1963.

Bassett, E. D. & others. *Business filing and records control;* 3d ed. New Rochelle, N.Y. South-Western Publishing Co. 1964.

Cadwallader, L. H. & Rice, S. A. *Principles of indexing and filing;* 4th ed. Baltimore, Md. H. M. Rowe Co. 1968.

File clerk. (Civil Service Tests) New York, N.Y. Arco Publishing Company, Inc. 1961.

Friedman, Sherwood, & Grossman, Jack *Applied clerical practice;* 2d ed. New York, N.Y. Pitman Publishing Corp. 1962.

_____ *Modern clerical practice;* 3d ed. New York, N.Y. Pitman Publishing Corp. 1968.

Texts

_____ *Secretarial practice.* New York, N.Y. Pitman Publishing Corp. 1968.

Gregg, J. R. & others. *Applied secretarial practice;* 6th ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

Guthrie, M. R. *Alphabetic indexing;* 3d ed. New Rochelle, N.Y. South-Western Publishing Co. 1964.

Kahn, Gilbert, & others. *Progressive filing;* 8th ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

_____ *Workbook exercises in alphabetic filing.* 2d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1961.

Selden, W. H. & others. *Filing and finding.* Englewood Cliffs, N.J. Prentice-Hall, Inc. 1962.

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Programed Instruction

Fahrner, W. F. & Gibbs, W. E. *Basic rules of alphabetic filing.* New Rochelle, N.Y. South-Western Publishing Co. 1965.

Kits and Practice Sets

Bassett, E. D. & others. *Filing office practice;* 3d ed. New Rochelle, N.Y. South-Western Publishing Co. 1964.
Provides a set of 64 cards that have four names on each card permitting the filing of 256 names in four card filing jobs.

Filing practice set. Baltimore, Md. H. M. Rowe Co. 1966.
Gives practice in filing minature letters and cross reference sheets alphabetically and then geographically.

Kahn, Gilbert, & others. *Gregg quick filing practice.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1965.
Presents in 25 lessons the basic rules of indexing and filing.

_____ *Progressive filing practice set.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.
Contains card guides for alphabetic, numeric, and geographic filing systems; correspondence guides and folders for alphabetic, numeric,and subject filing systems; a practice instruction manual booklet containing instructions, examples, and procedures for working with the practice materials.

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Instructor and Trainee Aids

Fundamental Rules for filing. Jamestown, N.Y. Art Metal, Inc.
Explains filing tools, five basic methods of filing, filing tips, cross reference, and rules of alphabetizing.

Films

Filing procedures in business; 2d ed. Coronet Films. 1965. 14 min. sound. color. Rent - Business Education Films, Syracuse University Film Library, Indiana University Audio-Visual Center.
Shows a step-by-step breakdown of the procedures of record keeping in a modern office.

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Filmstrips

Filing course. Gregg Division, McGraw-Hill Book Co.
A series of 25 filmstrips that contains separate exercises and problems and may be used with any standard textbook or practice set. Used with a skill-builder-type projector.

Filing, finding, and follow-up. McGraw-Hill Text-Films. 1959. 10 min. sound. color. Rent - Business Education Films.
Shows how the office worker can arrange her filing for easy work and effective followup.

Progressive filing series. McGraw-Hill Text-Films. 1961. sound. color. Rent - Business Education Films.
A series of four filmstrips that describes efficient filing procedures. Correlated with *Progressive Filing* by Kahn, Yerian, and Stewart.

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Transparencies

Clerk-typist. Visual Products Division. 3M Co.
A series of 17 units that presents the responsibilities of the clerk-typist.

Keypunch

Texts

Awad, E. M. *Automatic data processing principles and procedures.* Englewood Cliffs, N.J. Prentice-Hall, Inc. 1966.

_____ *Business data processing;* 2d ed. Englewood Cliffs, N.J. Prentice-Hall, Inc. 1968.

Hanson, Peggy. *Keypunching.* Englewood Cliffs, N.J. Prentice-Hall, Inc. 1966.

IBM card punch training on the IBM Selectric typewriter and IBM 26 card punch machine — student text. New York, N.Y. IBM Corp. 1965.

IBM card punch training on the IBM Selectric typewriter and IBM 26 card punch machine — teacher's manual. New York, N.Y. IBM Corp. 1965.

Pactor, Paul, & Kargilis, George. *Card punch machine operation book 1.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

_____ *Card punch machine operation book 2.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

_____ *Card punch simulator operation.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

Tabulator operator — IBM. (Civil Service Tests) New York, N.Y. Arco Publishing Co., Inc. 1965.

Texts

Van Ness, R. G. *Principles of punched card data processing;* rev. ed. Elmhurst, Ill. Business Press. 1967.

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Programed Instruction

Kahn, Gilbert. *Business data processing basic principles and applications.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1966.
Gives basic principles and applications in a programed manner.

Programed instruction text - UNIVAC 1701/1710 keypunch. New York, N.Y. Univac Division, Sperry Rand Corp. 1968.
Gives the nomenclature, directions, and problems for keypunching.

Punched card data processing principles - 24-26 Card Punch/56 Verifier operation examination. New York, N.Y. IBM Corp. 1964.
Provides a test for the material presented in the *Operation Text.*

Punched card data processing principles - 24-26 Card Punch/56 Verifier operation illustrations. New York, N.Y. IBM Corp. 1964.
Furnishes detailed illustrations and explanations for card punching.

Programed Instruction

Punched card data processing principles — 24-26 Card Punch/56 Verifier operation notebook. New York, N.Y. IBM Corp. 1964.
Provides a notebook where the student can record the procedures for card punching and the operation of the card punch machine.

Punched card data processing principles — 24-26 Card Punch/56 Verifier - operation text. New York, N.Y. IBM Corp. 1964.
Correlates card punching and verifying with the use of the IBM 24 Card Punch, the IBM Printing Card Punch, and the IBM 56 Card Verifier.

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Kits and Practice Sets

Bux, W. E. *Key-punch training course.* New Rochelle, N.Y. South-Western Publishing Co. 1966.
Assists in building a vocational skill in the operation of an IBM 024, 026, and 029 Card Punch.

Saunders, G. D. & Luskin, B. J. *Data processing: a practice set.* Athens, Ohio. McBee Systems. 1965.
Provides units based on the systems, procedures, and text material contained in the practice set.

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Instructor and Trainee Aids

Card punch course. New York, N.Y. IBM Corp.
Gives suggestions for developing a course and instructional materials.

Instructor and Trainee Aids

Card punch - operator aptitude test. New York, N.Y. IBM Corp.
Provides a method of grouping students of similar abilities.

Horn, Jack. *Computer and data processing dictionary and guide.* Englewood Cliffs, N.J. Prentice-Hall, Inc. 1966.
Gives the meaning of terms and expressions used in data processing.

Instruction manual for Royal keypunch training tandem. Hartford, Conn. Royal Office Typewriters.
Provides a set of drills to help the student learn and master the numeric card punch keyboard.

Key punch machine operation and automatic business data processing. Albany, N.Y. New York State Education Department, Bureau of Secondary Curriculum Development. 1965.
Suggests a course of study in automatic business data processing.

Keypunch operation. Albany, N.Y. New York State Education Department, Bureau of Continuing Curriculum Development. 1968.
Gives a course outline with teaching suggestions for keypunch operation.

Practical methods. Athens, Ohio. McBee Systems.
Describes new developments in the field of automation as well as new services and products provided by McBee. Teachers may request to be placed on mailing list.

Instructor and Trainee Aids

A selected annotated bibliography of instructional materials for automatic business data processing. Bulletin No. 184. Albany, N.Y. New York State Education Department, Bureau of Business and Distributive Education. 1968.
Lists classroom instructional materials and references on various aspects of automatic data processing.

The teaching of automated data processing in the high school. Monograph No. 116. New Rochelle, N.Y. South-Western Publishing Co. 1967.
Gives guidelines for developing an instructional program in data processing.

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Films

Data processing: introductory principles. Sterling Films. 1968. 14 min. sound. color. Rent - Business Education Films.
Introduces the card as it is used in punched card data processing. Shows the organization of the card into rows, columns, and zones, and describes how the card is divided into fields to accomodate specific jobs.

Printing card punch. Sterling Films. 1968. 13 min. sound. color. Rent - Business Education Films.
Follows a card through the entire process of recording data on the keypunch machine.

Programming the key punch. Sterling Films. 1968. 13 min. sound. color. Rent - Business Education Films.
Shows the preparation of several different program cards and the function of the star wheels.

Filmstrips

Automation in today's modern office. Friden, Inc. 20 min. silent. color. Free.
Shows the evolution of office automation in nontechnical terms.

Basic data processing. Friden, Inc. 20 min. silent. color. Free.
Describes data processing at the source in easy-to-follow, step-by-step methods.

Basic punch card series of lesson films. Audio Vision, Inc.
A series of 16 color filmstrips prepared in programed instruction format and based on IBM's course, Punched Card Data Processing Principles.

Card punch training course. Gregg Division, McGraw-Hill Book Co.
A series of 12 filmstrips used in training touch operation of the card punch machine. Used with a skill builder type projector.

Challenge of electronic data processing. Bank Administration Institute. 10 min. sound. color.
Explains the development of modern-day data processing techniques, how computers work, and how they can be applied to helping banks with their record keeping requirements.

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Transparencies

Business data processing fundamentals. Gregg Division, McGraw-Hill Book Co.
A series of 32 transparencies that covers common language media and mechanical and electronic data processing. Correlated with Part 4 of *Accounting 10/12.*

Keypunch

Transparencies

Data processing. Visual Products Division, 3M Co.
A series of four volums that presents the theory and operations of data processing equipment without the need for expensive equipment.

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Charts

Data processing charts. Teaching Aids Inc.
A series of charts that illustrates the use of data processing equipment for business needs.

IBM Selectric keyboard with simulated keypunch chart. Teaching Aids Inc.
Shows the IBM Selectric keyboard with simulated keypunch.

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Tapes

Operator training course 24-26 Card Punch machine. Marsh-Pierce Corp.
A series of seven tapes that provides basic instruction and practice in operating the card punch machine.

Machine Transcription

Texts

Agnew, P. L. & others. *Clerical office practice;* 4th ed. New Rochelle, N.Y. South-Western Publishing Co. 1967.

Anderson, Ruth, & others. *Word finder;* 3d ed. Englewood Cliffs, N.J. Prentice-Hall, Inc. 1968.

Archer, F. C. & others. *General office practice;* 3d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

Barron, A. E. & Taylor, J. R. *Clerical office training.* Englewood Cliffs, N.J. Prentice-Hall, Inc. 1963.
Job Book 1, 2, and printed tests available.

Carey, C. B. *Business speller and vocabulary-builder;* 2d ed. New York, N.Y. Pitman Publishing Corp. 1960.

Clerk-steno transcriber; 3d ed. (Civil Service Tests) New York, N.Y. Arco Publishing Co., Inc. 1967.

Crank, D. H. & others. *Words: spelling, pronunciation, definition, and application;* 5th ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1962.

Friedman, Sherwood, & Grossman, Jack. *Applied clerical practice;* 2d ed. New York, N.Y. Pitman Publishing Corp. 1962.

Texts

_____ *Modern clerical practice;* 3d ed. New York, N.Y. Pitman Publishing Corp. 1968.

Kahn, Gilbert, & Mulkerne Donald. *How do you spell it?* New York, N.Y. Doubleday and Co., Inc. 1965.

Kramer, Edward. *How to punctuate a business letter;* 3d ed. New York, N.Y. Pitman Publishing Corp. 1968.

Lamb, M. M. *Word studies;* 5th ed. New Rochelle, N.Y. South-Western Publishing Co. 1963.

Leslie, L. A. *20,000 words, spelled and divided;* 5th ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1965.

Reinger, Charles. *Correct spelling.* Baltimore, Md. H. M. Rowe Co. 1963.

_____ *English for business use.* Baltimore, Md. H. M. Rowe Co. 1964.

_____ *Practical English drills.* Baltimore, Md. H. M. Rowe Co. 1960.

_____ *Practical punctuation drills.* Baltimore, Md. H. M. Rowe Co. 1960.

Schachter, Norman. *English the easy way;* 3d ed. New Rochelle, N.Y. South-Western Publishing Co. 1969.

Smith, Kellogg, & Steele, Leighton. *Proper punctuation.* New York, N.Y. Doubleday and Company, Inc. 1962.

West, Leonard. *300 commas.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1964.

Machine Transcription

Programed Instruction

Brendel, L. A. & Leffingwell, Elsie. *English usage drills and exercises.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.
Provides a review of the fundamentals of English grammar.

_____ & Near, Doris. *Punctuation drills and exercises.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.
Gives a review of the fundamentals of English grammar.

_____ *Spelling drills and exercises: programmed for the typewriter.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1964.
Provides review of the fundamentals of spelling.

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Kits and Practice Sets

Cleary, J. B. *English style skill builders a self-improvement kit for transcribers and typists.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1967.
Assists students to improve their skills in those areas of language usage, punctuation, spelling, and office procedures considered essential by employers and supervisors.

Complete instructor's kit. Long Island City, N.Y. DeJur-Amsco Corp.
Contains six manuals and four tapes covering machine transcription.

Dictaphone legal transcription course. New York, N.Y. Dictaphone Corp.
A series of 27 belts dealing with general law, corporate law, litigation, real estate, and wills and estates. A transcription textbook is available.

Kits and Practice Sets

Dictaphone Medical transcription course. New York, N.Y. Dictaphone Corp.
A series of 10 belts acquainting secretaries with medical terms, prefixes, and suffixes.

Dictaphone New York State machine transcription course. New York, N.Y. Dictaphone Corp.
A series of 28 belts consisting of 180 letters in varying degrees of difficulty.

Dictaphone secretarial practice course. New York, N.Y. Dictaphone Corp.
A series of 18 belts containing exercises from the areas of general business, transportation, communications, and entertainment. Other materials consist of a transcription textbook, a portfolio of teaching aids, and tests to determine a student's progress.

Edison Envoy secretarial training program. West Orange, N.J. Thomas A. Edison Industries.
A series of 16 tapes providing familiarization and use of the machines.

Edison Voicewriter legal secretarial training program. West Orange, N.J. Thomas A. Edison Industries.
A series of 14 tapes covering terms commonly used by a legal secretary.

Edison Voicewriter medical secretarial training program. West Orange, N.J. Thomas A. Edison Industries.
A series of 14 tapes covering the terms commonly used by a medical secretary.

Edison Voicewriter secretarial training program. West Orange, N.J. Thomas A. Edison Industries.
A series of eight disks covering familiarization and use of the machine.

Kits and Practice Sets

Gray Executive Transmission Center legal secretarial training course. Tecumseh, Mich. Gray Dictation Systems.
A series of 27 belts covering most of the words and phrases used throughout the legal profession.

Gray Executive Transmission Center secretarial course. Tecumseh, Mich. Gray Dictation Systems.
A series of 20 belts dealing with dictation equipment and covering instruction in punctuation and grammar.

Gray medical terminology in 30 days. Tecumseh, Mich. Gray Dictation Systems.
A series of 15 belts providing training for a medical secretary.

Gray New York State machine transcription course. Tecumseh, Mich. Gray Dictation Systems.
A series of 50 belts consisting of 180 letters in varying degrees of difficulty.

Gregg shorthand course. New York, N.Y. Dictaphone Corp.
A series of 60 belts that provides practice at various speeds of dictation.

IBM dictation equipment training belts. New York, N.Y. International Business Machines.
A series of 20 belts covering machine machine transcription techniques; business terminology; office communications; and fundamentals of spelling, punctuation, grammar, and word division.

Kits and Practice Sets

Norelco legal transcription and dictation course. Mountain View, Calif. Western Tape, Division of Educational Products Co.
A series of five cartridges that emphasizes legal correspondence, legal documents, and court documents.

Norelco machine transcription course. Mountain View, Calif. Western Tape, Division of Educational Products Co.
Provides an understanding of machine transcription.

Norelco medical transcription course. Mountain View, Calif. Western Tape, Division of Educational Products Co.
A series of eight cartridges that emphasizes medical-surgical terminology.

Norelco New York State machine transcription course. Mountain View, Calif. Western Tape, Division of Educational Products Co.
A series of 13 cartridges consisting of 180 letters, in varying degrees of difficulty.

Stenocord dictation for tomorrow's secretary. Cambridge, Mass. The Atwell Co.
A series of six belts that provides a wide range of transcribing experience in such fields as education, transportation and shipping, television, advertising, banking, sales, insurance, credit and collections, adjustments, legal, medical, and engineering.

Stenocord medical transcription course series A. Cambridge, Mass. The Atwell Co.
A series of 10 belts that introduces the terminology used in several fields of medicine.

Machine Transcription

Kits and Practice Sets

Stenocord New York State machine transcription course. Cambridge, Mass. The Atwell Co.
A series of 35 belts consisting of 180 letters in varying degrees of difficulty.

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Instructor and Trainee Aids

Bad letters be hanged! New York, N.Y. Mutual Life Insurance Company of New York.
Suggests ways to improve the writing of business letters by avoiding certain phrases and words.

How to spell it. New York, N.Y. Remington Rand Office Machines.
Lists the correct spelling and syllabication of 500 often used and misspelled words.

Speak when you write . . . Hartford, Conn. Connecticut Mutual Life Insurance Company.
Illustrates how to use clear and simple words for stereotypes.

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Films

Grammar: verbs and ways we use them. Coronet. 1957. 11 min. sound. black and white. Rent - Business Education Films, Syracuse University Film Library.
Calls attention to verb forms and what verbs do in sentences.

Improve your punctuation. Coronet. 1959. 10 min. sound. black and white. Rent - Business Education Films.
Explains the punctuation difficulties associated with the comma, semicolon, colon, question mark, and quotation marks.

Films

The secretary: transcribing. Coronet. 1966. 11 min. sound. color. Rent - Business Education Films, Syracuse University Film Library.
Demonstrates transcription techniques such as handling of shorthand notes, proper layout, making corrections, proofreading, handling nondictated letters, and the use of a transcribing machine.

Who wrote that? Connecticut Mutual Life Insurance Co. 13 min. sound. black and white. Free - Association Films, Inc.
Shows the five C's of good business letters: clarity, conciseness, coherence, completeness, content.

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Filmstrips

Using parts of speech. Jam Handy Org. 1963. silent. color.
A series of seven filmstrips that presents the correct usage of each part of speech by using meaningful visualization and student participation in varied and interesting exercises.

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Charts

Garbled grammar. J. Weston Walch.
A series of 15 charts that explains important points of grammar.

History of language. J. Weston Walch.
A series of 20 charts that traces the development of language from the Phoenicians through Latin, French, German, Spanish, and English, down to language at the United Nations.

Charts

You don't say! J. Weston Walch.
A series of 15 charts illustrating poor sentence structure.

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Tapes

Grammar - punctuation dictation tapes. Western Tape, Division of Educational Products Co.
A series of five tapes covering grammar and punctuation usage.

Letter writing for the office. Educational Research Associates.
A series of 12 tapes covering word selection and phrases and sentence and paragraph development.

Medical-dental terminology. Educational Research Associates.
A series of 11 tapes giving attention to scientific environment, as well as root word, prefix, and suffix relationships.

Office style dictation tapes. Western Tape, Division of Educational Products Co.
A series of three tapes introducing various techniques and idiosyncrasies of dictators.

Speed development tapes. Western Tape, Division of Educational Products Co.
A series of three tapes using the pyramid-building plan to develop fast writing responses, theory review, and enlarged vocabulary.

Vocabulary - letter dictation tapes. Western Tape, Division of Educational Products Co.
A series of three tapes emphasizing troublesome vocabulary.

Related Office Skills

Texts

Agnew, P. L. & others. *Secretarial office practice;* 7th ed. New Rochelle, N.Y. South-Western Publishing Co. 1966.

_____ *Clerical office practice;* 4th ed. New Rochelle, N.Y. South-Western Publishing Co. 1967.

Andrews, M. E. *About her.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

_____ *About him.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

_____ *It's up to you.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.

_____ *The job you want.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

_____ *You pay for it.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.

_____ *You said it.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.

Archer, F. C. & others. *General office practice;* 3d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

Barron, A. E. & Taylor, J. R. *Clerical office training.* Englewood Cliffs, N.J. Prentice-Hall, Inc. 1963.

Texts

Becker, E. R. & Rollason, P. N. *The high paid secretary.* Englewood Cliffs, N.J. Prentic-Hall, Inc. 1967.
Assists the ambitious secretary in attaining the top positions.

Beginning office worker; 5th ed. (Civil Service Tests) New York, N.Y. Arco Publishing Co., Inc. 1967.

Bredow, Miriam. *Medical secretarial procedures;* 5th ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1966.

Civil service handbook; 4th ed. (Civil Service Tests) New York, N.Y. Arco Publishing Co., Inc. 1965.

Clerk GS 1-4; 8th ed. (Civil Service Tests) New York, N.Y. Arco Publishing Co., Inc. 1967.

Famularo, Joseph, & Atkinson, Phillip. *Executive profile: a young man's guide to business success.* Gregg Division, McGraw-Hill Book Co. 1967.

Fisher, Robert. *Intensive clerical and civil service training;* 4th ed. New Rochelle, N.Y. South-Western Publishing Co. 1968.

Friedman, Sherwood, & Grossman, Jack. *Applied clerical practice;* 2d ed. New York, N.Y. Pitman Publishing Corp. 1962.

Texts

Friedman, Sherwood, & Grossman, Jack. *Modern clerical practice;* 3d ed. New York, N.Y. Pitman Publishing Corp. 1968.

_____ *Secretarial practice.* New York, N.Y. Pitman Publishing Corp. 1960.

Gregg, J. R. & others. *Applied secretarial practice;* 6th ed. New York, N.Y. Gregg Division, McGraw-Hill Book Co. 1968.

Loeb, R. H., Jr. *Manners at work.* New York, N.Y. Association Press. 1967.

Lynott, M. L. *PBX and telephone technique.* Long Beach, Calif. Mary Lynott. 1967.

MacGibbon, E. G. *Fitting yourself for business;* 4th ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1961.

Morrison, Phyllis. *Getting the right job.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.

_____ *Making the most of your skills.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.

_____ *Making the most of yourself.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.

_____ *Opportunities in today's office.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.

Newton, Roy, & Green, H. H. *How to improve your personality;* 3d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1963.

Texts

Russon, A. R. *Business behavior;* 3d ed. New Rochelle, N.Y. South-Western Publishing Co. 1964.

Sferra, Adam, & others. *Personality and human relations;* 2d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1961.

Strony, M. S. & others. *The secretary at work;* 3d ed. Gregg Division, McGraw-Hill Book Co. 1966.

Tolman, Ruth. *Charm and poise for getting ahead.* Bronx, N.Y. Milady Publishing Co. 1967.

Turner, D. R. *Telephone operator;* 3d ed. New York, N.Y. Arco Publishing Co., Inc. 1967.

Uggams, Leslie. *The Leslie Uggams beauty book.* Englewood Cliffs, N.J. Prentice-Hall, Inc. 1966.

Whitcomb, Helen, & Cochran, Betty. *Charm for miss teen.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.

_____ & Lang, Rosalind. *Charm: the career girl's guide to business and personal success.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1964.

_____ *Charm for the modern woman.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

_____ & Whitcomb, John. *Strictly for secretaries;* rev. ed. Hightstown, N.J. McGraw-Hill Book Co. 1965.

Wood, M. W. & McKenna, Margaret. *The receptionist.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1966.

Kits and Practice Sets

Archer, F. C. & others. *Office cashiering practice set.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.
Gives support to the traditional office practice program.

_____ *Stock control practice set.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.
Provides simulated stock control experience.

_____ & Stewart, J. R. *Model office practice set.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.
Provides simulated office experience.

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Instructor and Trainee Aids

The girl with the halo. New York, N.Y. Olivetti Underwood Corp.
Introduces many secretarial do's and don'ts in a most unusual format.

How to be a super secretary. New York, N.Y. Remington Rand Office Machines.
Calls attention to qualifications that are important for secretaries.

The perfect secretary. Pittsfield, Mass. Eaton Paper Co.
Gives helpful hints on grooming, personality development, and typing.

Secretaries on the spot. Kansas City, Kans. National Secretaries Association.
Suggests ways of improving ones efficiency as a secretary.

Instructor and Trainee Aids

Secretary's story. Glen Cove, N.Y. Columbia Ribbon and Carbon Manufacturing Co., Inc.
Traces the history of the secretary from the time of the scribes in ancient Babylonia to the present.

The successful secretary. Hartford, Conn. Royal Office Typewriters.
Suggests successful office practices.

Suggestions for programs of office practice and procedures. New Rochelle, N.Y. South-Western Publishing Co.
Provides assistance with programs of office practice and procedures.

Teacher's manuals. Bronx, N.Y. Milady Publishing Co.
Offers suggestions for charm and personality improvement.

You as a secretary. Hartford, Conn. Royal Office Typewriters.
Gives career guidance information.

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Films

The extra step. U.S. Civil Service Commission. 30 min. color. Free - U.S. Civil Service Commission.
Shows the ways that office employees should deal with the public.

From eight to five. Auburn University. 1963. 20 min. sound. color. Rent - Indiana University Audio-Visual Center.
Describes various situations in performing their day-to-day duties.

Films

Getting a job. Encyclopaedia Britannica Educational Corp. 1954. 16 min. sound. black and white. Rent - Syracuse University Film Library.
Explains how to secure lists of prospects and how to use the personal history, the application, and the letter of recommendation.

Help wanted - secretary. General Electric. 1969. 18 min. sound. color. Rent - Business Education Films.
Illustrates the satisfactions possible from doing an excellent job as a secretary.

If an elephant answers. New York Telephone Co. 1967. 26 min. sound. color. Free - New York Telephone Co., New York State Department of Commerce.
Shows how a call to an office sets off a series of frustrating and amusing incidents which may have been avoided by the proper use of the telephone.

Manner of speaking. New York Telephone Co. 1962. 28 min. sound. color. Free - New York Telephone Co., New York State Department of Commerce.
Describes how poorly handled telephone calls can result in bad customer relations.

People are just people. National Cash Register Co. 18 min. sound. color. Free - Local NCR office.
Illustrates the five human weaknesses of laziness, carelessness, indifference, forgetfulness, and temptation and shows how these weaknesses can cause losses in business.

Films

The secretary: a normal day. Coronet. 1966. 11 min. sound. color. Rent - Business Education Films, Syracuse University Film Library.
Takes a secretary through a normal day in a modern office as she makes appointments, greets visitors, processes mail, supervises files, organizes a business trip, takes dictation, and transcribes.

Shorthand: see how they write. University of Wisconsin. 1966. 16 min. sound. black and white. Rent - Business Education Films, Syracuse University Film Library.
Demonstrates the Gregg method of shorthand.

The successful secretary. Royal Office Typewriters. 1968. 13 min. sound. color. Rent - Business Education Films.
Describes better ways to do the job in various secretarial situations.

Take a letter from A to Z. Gregg Division, McGraw-Hill Book Co. 1968. 15 min. sound. color. Rent - Business Education Films, Syracuse University Film Library.
Shows the opportunities in the secretarial profession.

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Filmstrips

How does your future look. Association Films. 16 min. sound. color.
Prepares high school girls for careers where appearance and a pleasing personality measure success.

Related Office Skills

Filmstrips

Just a secretary. Educational Activities, Inc. 1966. 11 min. sound. color. Rent - Business Education Films.
Gives a clear and up-to-date presentation of what business expects from its secretaries and explores the multiple duties and responsibilities of the position.

Preparing for work. University of Minnesota. color.
A series of 14 filmstips that deals with important vocational problems and aims to develop positive attitudes toward employment.

Secretarial training series. McGraw-Hill Text-Films. Rent - Business Education Films.
A series of 12 filmstrips that gives practical advice on how to improve secretarial skills and how to get along with others in the office.

Teaching slides. Milady Publishing Co.
Contains over 250 slides (35mm.) which may be purchased as an entire set, or as individual series to fit a charm program.

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Transparencies

Charm transparencies. Gregg Division, McGraw-Hill Book Co.
A series of transparencies that illustrates feminine problems of face and form and their solutions for good grooming.

Clerk-typist. Visual Products Division. 3M Co.
A series of 17 units that presents the responsibilities of the clerk-typist.

Transparencies

How to find a job. Tecnifax Corp.
A series of seven transparencies that gives information on where to look for a job, how to present personal and educational data, and how to use forms associated with employment.

I want a job. United Transparencies Inc.
A series of 15 transparencies that deals with the basic information needed to secure a job.

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Charts

Facial shape charts. Milady Publishing Co.
A series of five charts that shows hairstyle selection and makeup.

Great American businessmen. J. Weston Walch.
A series of 18 charts that gives the life story and picture of American businessmen.

Opportunities through business education. J. Weston Walch.
A series of 20 charts that calls attention to the opportunities available to those who have participated in the business education program.

Personality, ugh! Poster Visual Aids.
A series of six charts that indicates desirable personal traits that aid in working and getting along with others.

Secretarial do's and don'ts. J. Weston Walch.
A series of 18 charts that illustrates common suggestions for the secretary.

Charts

Stories about business. J. Weston Walch.
A series of 20 charts that explains the development and success of various American businesses.

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Tapes

Charm. Educational Research Associates.
A series of 16 tapes that gives a well-balanced, common sense approach to charm with applications to every day living, as well as on-the-job references.

Letter writing for the office. Educational Research Associates.
A series of 12 tapes emphasizing the methods of composing business letters.

Secretarial practice. Educational Research Associates.
A series of lectures on all major topics pertinent to secretarical practice.

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Records

Secretarial training records. Gregg Division, McGraw-Hill Book Co.
A series of 12 records that shows the importance of developing a desirable office personality.

Special Office Equipment

With the rapid advances being made in office business equipment, it is very possible that a teacher will find, available for instructional purposes, many different types of equipment with which he is not familiar.

Examples of such equipment include:

Friden, Inc.
- Add-Punch Adding Machine/ Tape Punch
- Flexowriter

IBM Corp.
- Magnetic Tape Selectric Typewriter
- Selectric Composer

McBee Systems
- Codetronic Auto-Punch

National Cash Register Co.
- Adding Machine Data-Input Model

Varityper Corp.
- VariTyper

The teacher should not avoid using equipment simply because he has had no previous experience with it. A demonstration; operator manuals; and instructional aids such as films, filmstrips, and charts may be secured from the local manufacturer's representative. Using these resources, the teacher should be able to prepare adequate instructional materials for most any equipment and thereby broaden the experiences available to the trainees.

Typewriting

Texts

Altholz, Gertrude. *Modern typwriting practice;* 3d ed. New York, N.Y. Pitman Publishing Corp. 1962.

Blendon, E. G. & Nalepa, B. H. *Quick survey in forms typing.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

Connelly, M. E. & Porter, L. J. *Typing speed builder.* Englewood Cliffs, N.J. Prentice-Hall, Inc. 1962.

Edmondson, F. W. *Medical typing;* 3d ed. New York, N.Y. G. P. Putnam's Sons. 1965.

Grubbs, R. L. & Weaver, D. H. *Typing improvement practice;* electric edition. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.

_____ *Typing improvement practice;* manual edition. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.

_____ & White, J. L. *Sustained timed writings;* 3d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.

Hansen, K. J. *Progressive typing speed practice;* 3d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

Hossfield G. L. & Nelson, Julius. *Brief typing;* 2d ed. rev. Baltimore, Md. H. M. Rowe Co. 1966.

Texts

Leslie, Louis, & Pepe, P. S. *Typing simplified one year course.* New York, N.Y. American Book Co. 1960.

Lessenberry, D. D. & others. *20th century typewriting advanced course;* 9th ed. New Rochelle, N.Y. South-Western Publishing Co. 1962.

_____ *20th century typewriting complete course;* 9th ed. New Rochelle, N.Y. South-Western Publishing Co. 1967.

_____ *20th century typewriting first-year course;* 9th ed. New Rochelle, N.Y. South-Western Publishing Co. 1967.

_____ *Basic typewriting* (Adult and Continuing Education Series) New Rochelle, N.Y. South-Western Publishing Co. 1965.

Liles, Parker, & others. *Typing mailable letters;* 2d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

_____ *Typing mailable letters: projects in placement, punctuation, proofreading, and production.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1960.

Lloyd, A. C. & Hosler, R. J. *Personal typing;* 3d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

_____ & others. *Typing power drills;* 2d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1965.

Typewriting

Texts

Lloyd, A. C. & others. *Typing skill drives.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1960.

MacClain, L. F. & Dame, F. J. *Typewriting techniques and short cuts;* 3d ed. New Rochelle, N.Y. South-Western Publishing Co. 1961.

Mulkerne, D. J. & Andrews, M. E. *Civil service tests for typists.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

Nanassy, L. C. & others. *Personal typing.* New York, N.Y. Pitman Publishing Corp. 1969.

Pepe, P. S. *Personal typing in 24 hours;* 4th ed. Hightstown, N.J. McGraw-Hill Book Co. 1965.

Perkins, E. A. & others. *Practice for professional typing.* Hightstown, N.J. McGraw-Hill Book Co. 1968.

Practice for clerical, typing and stenographic tests (Civil Service Tests) New York, N.Y. Arco Publishing Co., Inc. 1965.

Reed, C. A. & others. *Comprehensive typewriting complete course.* Boston, Mass. Allyn and Bacon, Inc. 1964.

_____ *Comprehensive typewriting first course.* Boston, Mass. Allyn and Bacon, Inc. 1964.

Reinger, Charles. *Rowe typing;* 6th ed. Baltimore, Md. H. M. Rowe Co. 1967.

_____ *Typewriting speed tests;* 3d ed. Baltimore, Md. H. M. Rowe Co. 1960.

Texts

Root, K. B. & Byers, E. E. *Medical typing practice;* 2d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.

Rowe, J. L. *Typing for accuracy;* 6th ed. Baltimore, Md. H. M. Rowe Co. 1967.

_____ & Etier, Faborn. *Typing drills for speed and accuracy;* 3d ed. Hightstown, N.J. Gregg Division, Mc-Graw-Hill Book Co. 1966.

_____ & others. *Gregg typing, keyboard course.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1966.

_____ *Gregg typing 191 series book 1, general typing;* 2d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1967.

_____ *Gregg typing 191 series book 2, vocational office typing;* 2d ed. Hightstown, N.J. McGraw-Hill Book Co. 1967.

Scott, W. E. & others. *Modern basic typewriting;* 2d ed. New York, N.Y. Pitman Publishing Corp. 1962.

Siegfried, W. *Typing medical forms.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Company. 1968.

Stenographer-typist, GS-1 through GS-7. (Civil Service Tests) New York, N.Y. Arco Publishing Co., Inc. 1967.

Stokes, P. A. *Today's typing;* 5th ed. Bethesda, Md. Global Publishing Corp. 1968.

Thompson, J. M. *101 typewriting timed writings;* 2d ed. New Rochelle, N.Y. South-Western Publishing Co. 1961.

Texts

Wanous, S. J. *Personal and professional typing;* 3d ed. New Rochelle, N.Y. South-Western Publishing Co. 1967.

_____ **& Wanous, E. E.** *Basic typewriting drills;* 4th ed. New Rochelle, N.Y. South-Western Publishing Co. 1968.

Winger, F. E. & others. *Gregg typing 1.* (A Continuing Education Text-Kit) Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1965.

_____ *Gregg typing 2.* (A Continuing Education Text-Kit) Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1966.

_____ **& Weaver, D. H.** *Gregg tailored timings;* electric edition. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.

_____ *Gregg tailored timings;* manual edition. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.

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Programed Instruction

Brendel, L. A. & Leffingwell, Elsie. *English usage drills and exercises.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.
Provides a review of the fundamentals of English grammar.

Brendel, L. A. & Near, Doris. *Punctuation drills and exercises.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.
Gives a review of the fundamentals of English grammar.

Programed Instruction

_____ *Spelling drills and exercises.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1964.
Provides a review of the fundamentals of spelling.

Centering and tabulating practices for typists. Anaheim, Calif. Litton Instructional Materials, Inc. 1966.
Indicates how to properly position paper in the machine and to center material, both vertically and horizontally, on regular and odd size paper.

Ferguson, M. A. & Nalepa, B. H. *Basic Gregg typing/1.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.
Provides a program for underachievers.

_____ *Basic Gregg typing/2.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.
Provides a program for underachievers.

Manuscript arrangement for typists. Anaheim, Calif. Litton Instructional Materials, Inc. 1966.
Shows the proper form for bound and unbound manuscripts.

Practices in typing the business letter. Anaheim, Calif. Litton Instructional Materials, Inc. 1966.
Explains the placement of the standard parts of the block and the modified block style business letter, for both the pica and elite machines.

Proofreading the typed manuscript. Anaheim, Calif. Litton Instructional Materials, Inc. 1966.
Shows the use of the common editing symbols, rules for correct spacing following punctuation marks, and the use of underlines or quotation marks with titles are presented.

Kits and Practice Sets

Agnew, P. L. & Atkinson, P. S. *Typewriting office practice;* 4th ed. New Rochelle, N.Y. South-Western Publishing Co. 1968.
Gives office typing experience.

Anderson, R. I. & Porter, L. J. *130 Basic typing jobs;* 2d ed. Englewood Cliffs, N.J. Prentice-Hall, Inc. 1964.
Contains typing jobs taken from actual business offices.

Cleary, J. B. *English style skill builders: a self-improvement kit for transcribers and typists.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1967.
Helps to improve skills in those areas of language usage, punctuation, spelling, and office procedures that employers and supervisors consider essential.

Frisch, V. A. & Handal, J. S. *Applied office typewriting: a practice set in clerical typing;* 3d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.
Assists in developing business competency in clerical typing.

Grahm, Milton, & others. *Legal typewriting* (Kit). Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1968.
Gives a general background in preparing many types of legal documents as well as an understanding of legal terminology.

Reigel, C. E. & Perkins, E. A. *Executive typewriting.* Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1966.
Provides an opportunity to work with difficult and advanced materials.

Kits and Practice Sets

Reigner, Charles. *Office typing;* rev. Baltimore, Md. H. M. Rowe Co. 1966.
Provides actual business office jobs.

Rosen, Steve, & others. *Practical office typewriting.* New York, N.Y. Pitman Publishing Corp. 1969.
Gives a practical one-semester course in all the major typing duties of office employees.

Sandry, Ester. *Typewriting office practice.* New York, N.Y. Pitman Publishing Corp. 1961.
Furnishes an opportunity to work from handwritten copy, corrected or rough draft, partly typed and partly handwritten material; to take dictation at the typewriter; to compose letters; and to solve arithmetic problems.

Sass, Ester. *Advanced typing projects.* New York, N.Y. Pitman Publishing Corp. 1968.
Gives experience in typing problems based on an office typist's most common duties.

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Instructor and Trainee Aids

A brief history of the typewriter. New York, N.Y. Remington Rand Office Machines.
Traces the development of the typewriter.

Diatype program. Columbus, Ohio. Scientific Advances, Inc.
Enables a student to find and correct his own typing problems.

Instructor and Trainee Aids

Electric keyboard mastery. Hartford, Conn. Royal Office Typewriters.
Helps the manual typist to transfer to the electric typewriter.

Electric typing methods for the teacher. Hartford, Conn. Royal Office Typewriters.
Presents a step-by-step procedure for teaching the beginning student on the electric, transferring from manual to electric, and transferring from electric to manual.

Finger dexterity drills. Hartford, Conn. Royal Office Typewriters.
Develops finger dexterity through the use of warm-up, corrective, and finger strengthing drills; alphabetic words and sentences; alternating finger; and high speed drills.

Friedman, Sherwood, & Grossman, Jack. *Handbook for typists;* 2d ed. New York, N.Y. Pitman Publishing Corp. 1962.
Serves as a reference book or instruction aid for typists at home, at school, or at the office.

History of the typewriter. New York, N.Y. Olivetti Underwood Corp.
Traces the development of writing and of the typewriter.

History of the typewriter. Hartford, Conn. Royal Office Typewriters.
Describes the highlights leading from the quill pen to the precision writing machine of today.

Instructor and Trainee Aids

House, C. R. & Skurow, Samuel. *Typewriting style manual.* New Rochelle, N.Y. South-Western Publishing Co. 1968.
Covers centering, business letter styles, manuscripts, tabulation, capitalization, punctuation, and other areas pertaining to style. Correlated with *20th Century Typewriting,* 9th ed. by Lessenberry, Crawford, and Erickson.

The IBM Executive electric typewriter program. New York, N.Y. International Business Machines Corp.
Helps the typist to obtain maximum performance from the IBM Executive Typewriter.

The IBM Selectric. . . An introductory course. New York, N.Y. International Business Machines Corp.
Acquaints the typist with the operation and use of the IBM Selectric.

Kee-Type-Trainer. Baltimore, Md. Kee, Inc.
Provides an electronic visual training aid consisting of a fully automated simulated typewriter keyboard, a central console, and tear-proof tapes. The tapes cause letters on the display board to light up at a rate of speed predetermined by the teacher.

Lamb, M. M. *Your first year of teaching typewriting;* 2d ed. New Rochelle, N.Y. South-Western Publishing Co. 1959.
Presents the beginning teacher's view of typewriting.

Office style typing. Chicago, Ill. Ditto Division, Bell and Howell Co.
Gives experience in the kind of work that a beginning typist would perform.

Instructor and Trainee Aids

Office style typing. New York, N.Y. Olivetti Underwood Corp.
Gives practical experience covering the typist's work day.

Practices and preferences in teaching typewriting. Monograph 117. New Rochelle, N.Y. South-Western Publishing Co. 1967.
Discusses patterns of typewriting instruction, keyboard mastery, skill building techniques, and evaluation.

Royal timed typing tests for speed forcing. Hartford, Conn. Royal Office Typewriters.
Presents four typing tests, each test counted for one-five-and ten-minute timings.

Russon, A. R. & Wanous, S. J. *The philosophy and psychology of teaching typewriting.* New Rochelle, N.Y. South-Western Publishing Co. 1960.
Discusses the important problems, principles, and procedures in the teaching of typewriting.

A secretary's day in the office of Lenox China. Trenton, N.J. Lenox Inc.
Gives practice in centering, tabulation, rough drafting, proofreading, margin setting, speed, and auxiliary skills.

Some typing authorities speak; 2d ed. Englewood Cliffs, N.Y. Prentice-Hall, Inc. 1963.
Presents twelve topics by authorities in business education for the experienced as well as the inexperienced typing teacher.

Instructor and Trainee Aids

Teacher's guide to transfer lessons from IBM Selectric typewriter to manual typewriter. New York, N.Y. International Business Machines.
Helps to facilitate the transfer from the electric typewriter to the manual typewriter.

Tips to typists. New York, N.Y. SCM Corp.
Contains many typing do's and don'ts, as well as typing short-cuts and other valuable suggestions.

25 typing shortcuts. New York, N.Y. Remington Rand Office Machines.
Illustrates 25 ways for improving performance at the typewriter.

Typewriter application manual. New York, N.Y. Olivetti Underwood Corp.
Gives information on all factors affecting the production and quality of typewritten work.

Typing do's and don'ts. Hartford, Conn. Royal Office Typewriters.
Gives helpful suggestions for improving manual and electric typing techniques.

West, L. J. *Acquisition of typewriting skills.* New York, N.Y. Pitman Publishing Corp. 1968.
Provides a method book that maintains the best of traditional techniques while suggesting improved methods and materials based on the latest educational and psychological research.

White, J. F. & Shank, B. C. *Teaching typewriting.* Portland, Maine. J. Weston Walch. 1964.
Discusses the organization of the typewriting room, equipment, teaching methods, techniques of motivation, evaluation, and visual aids.

Films

First step typing. Sterling Films. 1968. 12 min. sound. color. Rent - Business Education Films.
Demonstrates the purpose and correct handling of the various manipulative parts of the typewriter.

Impressions. IBM. 1964. 11 min. sound. color. Free - IBM.
Describes the variety of typewriting supplies which work together to create the desired impressions.

Posture and the keyboard. Sterling Films. 1968. sound. color. Rent - Business Education Films.
Shows the importance of good posture.

Remedial typing. Sterling Films. 1968. 11 min. sound. color. Rent - Business Education Films.
Shows that the most common typing errors result from poor posture and finger positioning, a bad striking action and carriage return, unrhythmic typing, and a generally careless attitude.

Right at the typewriter. IBM. 1962. 27 min. sound. black and white. Free - IBM.
Illustrates posture, stroking, letter forms, carbon copies, carbon paper, typing of forms, ribbons, and stencils.

Typewriter techniques. Sterling Films. 1968. 12 min. sound. color. Rent - Business Education Films.
Describes the function and purpose of several of the manipulative parts of the machine, and shows the various hand and finger position for numbers.

Films

Typing skills: building speed. Coronet Films. 1966. 12 min. sound. color. Rent - Business Education Films, Syracuse University Film Library.
Indicates how practice will improve work attitudes, typing patterns, speed, and confidence.

Typing skills: daily job techniques. Coronet Films. 1966. 13 min. sound. color. Rent - Business Education Films, Syracuse University Film Library.
Illustrates ways to increase such typing skills as organizing one's desk; grouping similar jobs; and applying proper techniques in typing envelopes, stencils, and reports.

Typing techniques. Sterling Films. 1968. 12 min. sound. color. Rent - Business Education Films.
Shows various typing techniques such as correcting errors, handling carbons, lining up, typing of envelopes, and realining an interrupted letter.

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Filmstrips

Keyboard reinforcement. Gregg Division, McGraw-Hill Book Co. 1969.
A series of six filmstrips that provides a variety of keyboard exercises. Used with a skill-builder-type projector.

Skill development, electric machines. Gregg Division, McGraw-Hill Book Co. 1969.
A series of six filmstrips that provides exercises on the electric machine. Used with a skill-builder-type projector.

Filmstrips

Skill development, manual machines. Gregg Division, McGraw-Hill Book Co. 1969.
A series of six filmstrips that provides exercises on the manual machine. Used with a skill-builder-type projector.

Typewriting series. McGraw-Hill Text-Films.
A series of 14 filmstrips that shows the correct use of the typewriter and important typing techniques.

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Transparencies

Clerk-typist. Visual Products Division, 3M Co.
A series of 17 units that presents the responsibilities of the clerk-typist.

Typing transparencies. Gregg Division, McGraw-Hill Book Co.
A series of transparencies that covers the keyboard and fundamentals of production.

Typewriting transparencies. South-Western Publishing Co.
A series of 92 transparencies that covers most aspects of typing.

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Charts

The case of the new, new ribbon. Poster Visual Aids.
Shows the steps to change a ribbon.

Charts

Key location guides. H. M. Rowe Co.
Shows individual key locations for either the manual or the electric typewriter.

Keyboard diagram electric typewriter. Royal Office Typewriters.
Illustrates the keyboard of the electric typewriter.

Keyboard diagram manual typewriter. Royal Office Typewriters.
Shows the keyboard of the manual typewriter.

Posture wall chart. Royal Office Typewriters.
Shows correct posture at the typewriter.

Progress chart. Royal Office Typewriters.
Provides space for recording speed and accuracy ratings for a class of 40 typing students.

Scriptor operative parts. Olivetti Underwood Corp.
Illustrates the operative parts of the electric typewriter.

Tap Tapnik, the satellite man, and his typing techniques . . . Poster Visual Aids.
Emphasizes 13 fundamental typing techniques.

Touch-master five operative parts. Olivetti Underwood Corp.
Illustrates the operative parts of the manual typewriter.

Typewriting speed charts. South-Western Publishing Co.
Available to schools using any of the South-Western Publishing Company typewriting textbooks.

Charts

Typewriter wall charts. Business Equipment Manufacturers Association.
Distributes keyboard wall charts for major manufacturers of manual and electric typewriters.

Typewriting wall charts. Teaching Aids Inc.
A series of 20 charts that covers many aspects of typing.

Typing do's and duds. Poster Visual Aids.
A series of 12 charts that illustrates typing techniques and good work habits.

Typing habits, ugh! Poster Visual Aids.
A series of six charts that emphasizes desirable typing habits that will aid the typist to become an efficient office worker.

Typing picture posters. Gregg Division, McGraw-Hill Book Co.
A series of 12 posters that shows various letter styles, the proper positioning of the address on the envelope, long and short reports, the personal letter, the business letter, and card styles.

Typing progress chart. Olivetti Underwood Corp.
Highlights typing speed by enabling the teacher to record the typing speed progress of up to 30 students. Consists of one chart.

Typing wall chart. Gregg Division, McGraw-Hill Book Co.
Provides the keyboard on one side and the reverse side may be used for a projection screen.

Tapes

Fundamentals of Production. Gregg Division, McGraw-Hill Book Co.
A series of 12 tapes that covers lessons 24-28 of *Gregg Typing 191 Series Book 1 General Typing,* 2d ed.

Keyboard course. Gregg Division, McGraw-Hill Book Co.
A series of 12 tapes that covers lessons 1-24 of *Gregg Typing 191 Series Book 1 General Typing,* 2d ed. and *Gregg Typing, Keyboard Course.*

Typewriting tapes. South-Western Publishing Co.
A series of 15 tapes that presents lessons 1-30 of *20th Century Typewriting,* 9th ed.

Typewriting tapes. Special tapes correlated with *20th Century Typewriting,* 9th ed. are available for:

EFI equipment from—
Electronic Futures, Inc.
57 Dodge Avenue
North Haven, Connecticut 06473

Ediphone equipment from—
Dolbey and Co.
23372 Victory Parkway
Cincinnati, Ohio 45206

Norelco equipment from—
Western Tape, Division of
Educational Products Co.
2273 Old Middlefield Way
P. O. Box 69
Mountain View, California 94040

Typing skill drives. Gregg Division, McGraw-Hill Book Company.
A series of 10 tapes that assists the student to increase speed and reduce the number of errors.

Typewriting

Tapes

Typing. Educational Research Associates.
A series of 74 tapes that provides the first year lessons in *20th Century Typewriting*, 9th ed.

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Records

Keyboard drills and exercises. Gregg Division, McGraw-Hill Book Co.
A series of 20 records that provides instruction for mastering the typewriter keyboard. Correlated with *Gregg Typing 191 Series Book 1 General Typing*, 2d ed.

Rhythm records, accelerated speed. Gregg Division, McGraw-Hill Book Co.
A series of 10 records that builds speed two words a minute on each three-minute side.

Typewriting rhythm records, 16-60 Series. Gregg Division, McGraw-Hill Book Co.
A series of 12 records that builds speed with 3 one-minute timings, each two-wam faster than the previous one.

Miscellaneous Reference Materials

General

Douglas, L. V. & others. *Teaching business subjects;* 2d ed. Englewood Cliffs, N.J. Prentice-Hall, Inc. 1965.
Presents methods of teaching different subjects in the field of business education.

Harms, Harm, & Stehr, B. W. *Methods in vocational business education;* 2d ed. New Rochelle, N.Y. South-Western Publishing Co. 1963.
Discusses the vocational value of business subjects.

Nolan, C. A. & others. *Principles and problems of business education;* 3d ed. New Rochelle, N.Y. South-Western Publishing Co. 1967.
Considers the general principles of business education.

Tonne, H. A. *Principles of business education;* 4th ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1969.
Deals with the various aspects of teaching business subjects.

_____ & others. *Methods of teaching business subjects;* 3d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1965.
Discusses techniques of teaching in the field of business education.

General

White, J. F. & Dewar, T. I. *Successful devices in teaching clerical practice.* Portland, Maine. J. Weston Walch. 1959.
Presents over 300 tested ideas for teaching typing, letter writing, simple record keeping, use of business machines, filing, and communications. Over 100 business educators contributed their best teaching methods to this book.

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Periodicals

Balance sheet. South-Western Publishing Co. 5101 Madison Rd. Cincinnati, Ohio 4522. Monthly - Sept. to May.
Provides a forum for the discussion of problems of interest to the classroom teacher. Teachers may request to be placed on mailing list.

Business education world. Gregg Division, McGraw-Hill Book Co. 330 West 42nd St. New York, N.Y. 10036. Monthly - Oct. to Apr.
Gives timely topics of interest for the classroom teacher. Many issues contain award tests in a specific area of business education. Teachers may request to be placed on mailing list.

Journal of business education. Robert C. Trethaway. 34 North Crystal St. East Stroudsburg, Pa. Monthly - Oct. to May.
Presents articles on all phases of business education.

Miscellaneous Reference Materials

Periodicals

What's new in business education. Prentice-Hall, Inc. Englewood Cliffs, N.J. 07632. Annual - fall.
Provides information about new Prentice-Hall publications, authors in the field of business education, and topics of interest to classroom teachers. Teachers may request to be placed on mailing list.

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Dictionaries and Word Books

Hamburger, Edward. *A business dictionary.* Englewood Cliffs, N.J. Prentice-Hall, Inc. 1967.
Gives definitions for more than 2,100 business terms and ideas.

March, F. A. & March F. A., Jr. *March's thesaurus and dictionary of the English language.* New York, N.Y. Doubleday & Co., Inc. 1968.
Provides a full unabridged and comprehensive thesaurus with dictionary definitions giving the shades of meaning among the various synonyms, antonyms, and other words.

Roget, P. M. *Roget's international thesuarus;* 3d ed. New York, N.Y. Thomas Y. Crowell Co. 1962.
Gives different words to fit an idea.

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Secretarial Handbooks

Doris, Lillian,& Miller, B. M. *Complete secretary's handbook;* 2d ed. Englewood Cliffs, N.J. Prentice-Hall, Inc. 1960.
Explains and illustrates how to do every single job on which the secretary's success depends.

Secretarial Handbooks

The new world secretarial handbook. Edited by A. E. Klein. Cleveland, Ohio. World Publishing Co. 1968.
Describes the role of the professional secretary in Part I. Fundamental procedures and techniques are covered in Part 2. Advanced procedures and techniques are discussed in Part 3, and guides to grammar and effective communication are found in Part 4.

Flynn, Patricia. *The complete secretary.* New York, N.Y. Pitman Publishing Corp. 1965.
Provides ready answers to the daily needs of the secretary. Describes such secretary's responsibilities as setting up a letter, making travel arrangements, and personal-business duties. Provides spelling, grammar and punctuation, and English usage guides.

Gavin, R. E. & Hutchinson, E. L. *Reference manual for stenographers and typists;* 3d ed. Hightstown, N.J. Gregg Division, McGraw-Hill Book Co. 1961.
Answers the puzzling questions of those who work with words. Also contains the details for preparing an acceptable business letter.

House, C. R. & Koebele, A. M. *Reference manual for office personnel;* 5th ed. New Rochelle, N.Y. South-Western Publishing Co. 1970.
Present tips on typing, letter placement, letter mechanics, tabulation, grammar, punctuation, spelling aids, and word division.

Whalen, D. H. *The secretary's handbook.* New York, N.Y. Harcourt, Brace & World, Inc. 1968.
Covers the typing of manuscripts and office reports, letter mechanics, grammar and word usage, postal information, and reference sources.

Style Books

A manual of style; 12th ed. Chicago, Ill. University of Chicago Press. 1969.
States clear and simple guidelines for preparing and editing copy in a form that follows the creation of a book from start to finish.

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ABSTRACT - Developed by home economics teachers and teacher educators under the direction of state program specialists, this curriculum guide is for teacher use in planning programs at the beginning (Home Economics I), intermediate (Home Economics II), advanced (special interest courses), and co-educational (family living) levels. Section I includes the philosophy of the home economics program and implications of this philosophy for the classroom. Implications for the classroom are also given for adolescent development and behavior patterns and for the changing patterns for family living. Section II, which is color-coded, contains a scope and sequence chart, time allotment, suggested course titles and descriptions, and general objectives and basic generalizations for these areas: (1) human development and the family, (2) housing, (3) management and family economics, (4) food and nutrition, (5) clothing and textiles, and (6) personal and family health. (SB)

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HOME ECONOMICS CURRICULUM GUIDE FOR HAWAII

SECTION I

INFORMATION FOR TEACHERS IN PLANNING
HOME ECONOMICS PROGRAMS

SECTION II

SCOPE & SEQUENCE OF THE
HOME ECONOMICS PROGRAM

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HOME ECONOMICS EDUCATION SECTION

State of Hawaii
Department of Education
Office of Instructional Services
Vocational, Post-High & Adult Education Branch

1967

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FOREWORD

Curriculum development is a continuous process. As changes take place in society, and especially in the case of Home Economics Education where home and family living patterns are greatly affected by the rapid technological and scientific advances of recent years, the need for constant change in curriculum emphases becomes ever so evident.

With the above philosophy in mind and in view of the challenge which faces Home Economics Education in Hawaii today to keep its rightful place in the total secondary school curriculum, the Home Economics Curriculum Guide has been fully revised.

The first part, Section I, of the Guide considers: (1) some beliefs about the Home Economics Education program and some ways home economics teachers implement these beliefs; (2) developmental tasks and characteristic concerns of adolescents and their implications for the home economics program; and (3) the changing patterns for family living. Section II of the Guide is the new design for the total Home Economics Education program for Hawaii. It is developed in terms of general objectives and basic generalizations.

This Guide will be the basis for further curriculum development in Home Economics Education in that the material presented here shall serve as a point of reference for the resource materials which will be developed for the various phases of home and family living.

It is the hope of the administration that home economics teachers will rise to the occasion and relate the material in this Guide to the particular pupils with whom they work.

RALPH H. KIYOSAKI, SUPERINTENDENT

PREFACE

The home economics teachers and members of the teacher education staff together with the State Program Specialists have been working for the past several years toward a revision of the home economics curriculum for secondary schools in Hawaii. In a series of conferences and workshops on the various islands, this group with the help of administrators and district staffs accomplished the work presented in this publication.

The Hawaii Home Economics Curriculum Guide is the first in a proposed new series of curriculum materials to be revised or developed for enriching the learning of home economics students. This Guide offers many suggestions to the home economics teacher to help her (1) implement her beliefs about home economics programs; (2) better understand growth needs of pupils as a basis for planning learning experiences in home economics classes; (3) become aware of the many changes that are taking place in home and family living patterns which need to be considered in planning effective programs; (4) determine the new direction for home economics education.

Administrators of schools may find helpful suggestions for evaluating their home economics program and for planning changes or revisions in course offerings.

Appreciation is extended to those who participated in the preparation of this Guide and to all administrators who encouraged and supported the revision program.

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ALBERT J. FEIKER, Director
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Education Branch

INTRODUCTION

Home economics is the field of knowledge and service primarily concerned with strengthening family life. It synthesizes knowledge drawn from its own research, from the sciences (physical, biological, and social) and the arts and applies this knowledge to improving the lives of families and individuals.

The over-all goal of the home economics education program in Hawaii schools is to improve home and family living for all individuals in order to strengthen family life. The clearest new direction for home economics is to help people identify and develop certain fundamental competences that will be effective in personal and family living regardless of the particular circumstances of the individual or family.

*Fundamental to effective living are the competences to:**

- *establish values which give meaning to personal, family, and community living; select goals appropriate to these values*
- *create a home and community environment conducive to the healthy growth and development of all members of the family at all stages of the family cycle*
- *achieve good interpersonal relationships within the home and within the community*
- *nurture the young and foster their physical, mental, and social growth and development*
- *make and carry out intelligent decisions regarding the use of personal, family, and community resources*
- *establish long-range goals for financial security and work toward their achievement*
- *plan consumption of goods and services -- including food, clothing, and housing -- in ways that will promote values and goals established by the family*
- *purchase consumer goods and services appropriate to an overall consumption plan and wise use of economic resources*
- *perform the tasks of maintaining a home in such a way that they will contribute effectively to furthering individual and family goals*
- *enrich personal and family life through the arts and humanities and through refreshing and creative use of leisure*
- *take an intelligent part in legislative and other social action programs which directly affect the welfare of individuals and families*
- *develop mutual understanding and appreciation of differing cultures and ways of life, and co-operate with people of other cultures who are striving to raise levels of living*

*Committee on Philosophy and Objectives of Home Economics, "Home Economics New Directions," American Home Economics Association.

Home economics educators are challenged to focus instruction on development of these competences and to plan for an effective progression of educational objectives from one level to another.

The revised curriculum in home economics has taken into consideration changing knowledge, judgments of relevancy, universality of knowledge, priority of kinds of knowledge and the needs of the times. Reflected in this Guide is the definite trend toward more structuring and organization of the subject matter of home economics particularly of the basic concepts and broad generalizations of the field. Related to this trend is the emphasis on the ability to think in the development of concepts and generalizations. An increased awareness of cognitive behavior in the preparation for home and family living is apparent in the new design.

The home economics in-service program for the past few years has concentrated on the new direction for home economics education. Participation in the revision and development of the new curriculum design was an avenue used for studying the new direction. Subject matter specialists and leaders in research were constantly called upon to assist in the development of the Guide. It is therefore, with a great deal of pride that we present the 1967 revision of the HOME ECONOMICS CURRICULUM GUIDE FOR HAWAII as our new design, the result of effective professional cooperation.

Special appreciation is extended to Dr. Alberta Hill, Professor of Home Economics Education from Iowa State University and formerly Program Specialist in the U. S. Office of Education, for her guidance in the development of the curriculum design. For the reactions and suggestions that were received from teachers, school and district administrators, and district curriculum staff members, we express our gratitude.

Emiko I. Kudo

Emiko I. Kudo, Program Specialist

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HOME ECONOMICS CURRICULUM GUIDE

Section I

INFORMATION FOR TEACHERS IN PLANNING HOME ECONOMICS PROGRAMS

SOME BELIEFS ABOUT THE HOME ECONOMICS PROGRAM AND SOME WAYS HOME ECONOMICS TEACHERS IMPLEMENT THESE BELIEFS

An effective Home Economics program is built on a sound philosophy or beliefs concerning its purposes. The beliefs may change with new concepts concerning the purposes and goals of the program, the recognition of the developmental and emotional needs of individuals, changes in patterns of family living, and the influence of research. With these changes and needs in mind, the following beliefs with their implications have been developed to aid teachers plan effective learning experiences for Home Economics students.

BELIEFS	IMPLICATIONS
We believe that: Home economics education should help individuals learn to cope with changing situations which affect the individual, family and community.	Be alert to information -- local, national or international -- which indicates economic or social changes that will affect family living. Provide interesting and meaningful learning experiences to help pupils keep abreast with these changes.
An effective home economics program includes those values, understandings, and abilities important to home, family and community living.	Include all areas of homemaking in the program. Choose learning experiences that will develop manipulative, managerial and social abilities as they relate to home, family-community living. Use pupil-teacher planning to clarify values.
Home economics education contributes toward the fulfillment of the goals of education in general.	Increase awareness of cognitive behavior in helping students deal with daily life situations. Incorporate experiences to help pupils develop and improve communicative skills.
Curriculum should be challenging, interesting and meet the needs and abilities of the student.	Identify student needs. Develop concepts and generalization to facilitate decision-making.
Home economics education should explore occupations which utilize home economics knowledge and skills.	Develop personal qualities and attitudes important for securing and holding a job. Provide learning opportunities which will develop interest in some basic skills necessary to enter an occupation.

BELIEFS	IMPLICATIONS
Since the family is the basic unit in our society, education for home and family life should be made available to all individuals at every stage of human development.	Provide instruction based on the needs of all family members and provide experiences that will make such instruction more meaningful to each individual. Encourage students to continue family life education.
Family traditions and cultures can contribute to effective family and community living.	Provide opportunities for students to become familiar with and appreciate different cultural patterns. Encourage students to value their cultural heritage.
The FHA is an integral part of the home economics education program.	Make the school and community aware of the part the FHA program plays in the development of students. Enrich the home economics program with FHA activities.
The home economics program should be planned and evaluated cooperatively.	Involve school and community in planning and evaluating the home economics program. Interpret the home economics program to school and community.
Management, creativity and professional growth contribute to effective teaching.	Plan for professional growth. Keep abreast with trends and new techniques. Participate in professional organizations.
Homes and families are the basic resources of the strength and welfare of our society.	Emphasize the primary importance of the child-rearing role of parents. Emphasize the changing and interchanging roles within the family. Provide opportunities for democratic participation in school and community activities. Develop a sense of responsibility for the welfare of the community.

UNDERSTANDING THE PUPIL THROUGH A STUDY OF DEVELOPMENTAL TASKS*

Air pilots have discovered that when they reach a certain strata in the atmosphere, the air currents will give momentum to their speed. In like manner, a home economics teacher who becomes thoroughly familiar with the needs of home economics students at the different stages of growth will find that keying instruction to these developmental needs will give momentum to learning. Disregarding these needs makes teaching more difficult and learning less effective for home economics students.

The development of the individual from birth throughout life is marked by tasks or central problems which he meets in stages of development. Each stage is characterized by behavior that can be recognized. We, as teachers, need to be able to recognize these characteristics at grade levels, identify them and understand what they mean.

We need to plan cooperatively and to provide learning experiences suited to the grade level that will help the student grow toward a mature and healthy personality. These experiences should be provided in all phases of home and family living which he meets as a family member. An understanding of the characteristic concerns of students at different grade levels is essential for planning a program in home economics and developing curriculum materials.

*Havinghurst, Rubert J., Developmental Tasks and Education, 1948, University of Chicago Press, Chicago, Illinois

White House Conference Material.

DEVELOPMENTAL TASKS & CHARACTERISTIC CONCERNS OF ADOLESCENTS & THEIR IMPLICATIONS FOR THE HOME ECONOMICS PROGRAM

DEVELOPMENTAL TASK	CHARACTERISTICS OF BEHAVIOR PATTERNS	IMPLICATIONS
Achieving new and more mature relations with age-mates of both sexes.	Early Adolescence:	
	Seeks approval and acceptance of peers of both sexes.	Provide opportunities for work and social experiences involving both boys and girls.
	Desires to conform to peer standards and at the same time be unique.	Provide experiences and knowledge of acceptable behavior.
		Provide opportunities for accomplishment that can be recognized by peers.
	Shows sensitivity and fear of situations which make him ridiculous.	Provide for socially satisfying experiences.
		Encourage and guide pupils into recognizing their strengths.
	Shows evidences that girls mature physically and socially earlier than boys; girls are more interested in boys than boys in girls.	Help pupils to understand physiological changes and differences in rate of maturity of the sexes.
	Middle Adolescence:	
	Develops new relations with age-mates of both sexes.	Provide opportunities for recreation and wholesome social activities with members of the opposite sex.
	Is developing poise and self assurance.	
	Is beginning to be concerned about others.	
	Bids for popularity.	

DEVELOPMENTAL TASK	CHARACTERISTICS OF BEHAVIOR PATTERNS	IMPLICATIONS
Developing and achieving socially responsible behavior.	Early Adolescence:	
	Yields to "gang" behavior without thought of consequences.	Help them to understand that responsibilities will be given when consequences can be assumed.
	Influenced by family and friends.	Help determine acceptable social behavior.
	Middle Adolescence:	
	Exhibits gang behavior.	Help students understand the responsibilities and consequences of social behavior.
	Wants social acceptance.	Provide social experiences for decision making.
	Late Adolescence:	
	Resistant to adult cultural values and accepted behavior patterns.	Help students understand the need for social maturity.
	Is aware of the need for social acceptance and responds to social discipline.	Help students examine and determine values which are important to responsible acceptable conduct in our society.

DEVELOPMENTAL TASK	CHARACTERISTICS OF BEHAVIOR PATTERNS	IMPLICATIONS
Achieving a masculine or feminine role.	Early Adolescence:	
	Shows embarrassment in discussing own growth and development.	Provide appropriate sex education. Help pupils to understand that individuals mature at different rates; that changes are only natural in the process of growing up.
	Desires to make himself attractive.	Help pupils to groom and dress to emphasize good features and minimize the less desirable features. Help students to see the direct correlation between diet and figure, skin condition and health problems. Emphasize hygiene and skin care.
	Begins to show interest in the opposite sex.	Plan organized activities of mixed groups.
	Middle Adolescence:	
	Preoccupied with acceptance by members of the opposite sex.	Help students recognize standards of acceptable behavior and dress.
	Desires to emphasize his masculinity or her femininity.	
	Late Adolescence:	
	Is concerned in achieving social adequacy.	Provide experiences to develop confidence and poise.
	Desires to assume a more mature role.	Provide opportunities to identify the roles of man and woman in our society.

DEVELOPMENTAL TASK	CHARACTERISTICS OF BEHAVIOR PATTERNS	IMPLICATIONS
Accepting one's physique and using the body effectively.	Early Adolescence:	
	Shows disproportion of growth; is awkward.	Help students understand that rapid and uneven growth during this period is normal.
	Is concerned about body changes.	Help students understand body changes.
	Shows interest in appearance.	Provide learning experiences in all areas relating to appearance.
	Has short attention span.	Plan activities that involve doing.
	Middle Adolescence:	
	Is deeply concerned about appearance.	Help students understand the motivation for and the effect of adornment and dress.
		Help students develop self-confidence.
		Help students to accept himself and emphasize strengths.
	Has skin problems that are common.	Help with diet and cleanliness.
	Late Adolescence:	
	Achieves muscular coordination and poise.	Emphasize the importance of maintaining physical health.
	Accepts physical changes	

DEVELOPMENTAL TASK	CHARACTERISTICS OF BEHAVIOR PATTERNS	IMPLICATIONS
Achieving emotional independence of parents and adults.	Early Adolescence:	
	Desires privileges of adults.	Assist them to use their initiative, make choices, assume responsibilities, make decisions, and evaluate own progress.
	Begins to show conflict and tension.	
	Tries to prove that he is growing up.	Allow them to develop and maintain own classroom behavior standards.
	Needs to plan to do work as an individual and as a group.	Plan school work and home experiences cooperatively.
		Provide for individual and committee work.
	Is confused when home, peer and school standards conflict.	Help students to understand that conflicts may occur because of differences in values.
	Middle Adolescence:	
	Desires more freedom to make choices but at the same time wants help from parents and/or adults.	Help students understand themselves and parents better.
	Late Adolescence:	
	Asserts independence from family, but often returns to parents for moral support.	Help students understand their parents' point of view and problems.
	Responds to influence of teacher or group leader more than to parents.	Provide guidance which is warm and understanding.
	Has more confidence in own ability to make decisions.	

DEVELOPMENTAL TASK	CHARACTERISTICS OF BEHAVIOR PATTERNS	IMPLICATIONS
Achieving assurance of economic independence.	Early Adolescence:	
	Is interested in earning and spending money.	Help students understand the various possibilities of earning money.
	Middle Adolescence:	
	Is aware of the value of money.	Help students understand planned spending.
		Help students develop and acquire or improve skills and accept responsibilities of part-time work.
	Strives to achieve a measure of economic independence.	Provide guidance for purchases of personal items.
	Late Adolescence:	
	Shows definite awareness of the value of money.	Emphasize consumer education.
		Help students learn to live within their means.
		Encourage savings for achieving future goals.
	Is more independent in earning and spending money.	Explore job opportunities.
	Shows some awareness of family finances.	Evaluate family needs and wants.

DEVELOPMENTAL TASK	CHARACTERISTICS OF BEHAVIOR PATTERNS	IMPLICATIONS
Selecting and preparing for an occupation.	Early Adolescence:	
	Has some concern about the future.	Encourage students to develop many interests. Suggest occupations which utilitize skills and understandings learned in home economics.
	Middle Adolescence:	
	Is interested in occupations that seem glamorous and exciting.	Help students select and prepare for careers appropriate to individual interests and abilities.
	Late Adolescence:	
	Prepares in some way a plan for after high school vocations.	Present career information both non-professional and professional.
	Becomes interested in school work in relation to a career.	Encourage work experiences.
	Is interested in discovering his potentials.	

DEVELOPMENTAL TASK	CHARACTERISTICS OF BEHAVIOR PATTERNS	IMPLICATIONS
Preparing for marriage and family life.	Early Adolescence:	
	Wants family security.	Emphasize family finances and economics.
	Has interest in younger children.	Help students understand developmental stages of children and in turn better understand themselves.
	Shows interest in some household tasks.	Provide opportunities and experiences in caring for the home and family.
	Middle Adolescence:	
	Falls in and out of "love."	Provide opportunities for group activities involving both sexes.
	Explores possibilities for future mates.	Provide adequate sex education.
	Is concerned about the appearance of their home and family members.	Help students develop pride in their home and family.
	Late Adolescence:	
	Is interested in steady dating, selecting a mate and marriage.	Help students understand dating customs, manners and problems of courtship.
		Help students understand factors essential for a successful marriage.
		Help students develop values essential to family life.
		Emphasize responsibilities of parenthood.
	Chooses friends and dates because of special qualities.	Consider qualities desired in friends and future mates.

DEVELOPMENTAL TASK	CHARACTERISTICS OF BEHAVIOR PATTERNS	IMPLICATIONS
Developing intellectual skills and concepts necessary for civic competence.	Early Adolescence:	
	Seeks status with others.	Help students recognize that there is dignity in work. Help students recognize the worth of all individuals.
	Middle Adolescence:	
	Wants responsibilities. Will work hard when there is a purpose; however, may be unstable in judgment.	Provide opportunities for assuming responsibilities under guidance, in school and community activities.
	Late Adolescence:	
	Shows interest in world affairs; anxious about the future.	Provide opportunities for participation in civic activities and give some freedom of choices or decisions. Provide opportunities for students to practice democratic living. Develop an understanding of problems and basic needs of other countries.

DEVELOPMENTAL TASK	CHARACTERISTICS OF BEHAVIOR PATTERNS	IMPLICATIONS
Acquiring a set of values and an ethical guide for behavior.	Early Adolescence:	
	Is aware of family differences.	Provide opportunities for an understanding of family differences and similarities.
	Middle Adolescence:	
	Is searching for ideals and standards.	Help students acquire values that are essential for harmonious living.
		Help students to be diplomatic and yet maintain courage of their convictions.
	Is aware of the Golden Rule.	Help students to understand and appreciate respect.
	Late Adolescence:	
	Begins to develop his own philosophy of life.	Help students identify their values to realize why values are important for civilized living in the family, community, and the world.
		Help students realize that their moral convictions are important to them.
		Provide adequate knowledge on the effects of alcohol and smoking.
		Discuss morality as related to one's conscience.
	Is concerned about his place in society.	Help students to set goals or determine own ideals.

CHANGING PATTERNS FOR FAMILY LIVING

Education for home and family living, in order to be effective, must consider the families of the students. To guide the most effective learning, it is important to know a cross section of culture patterns, family customs and traditions so that the needs and opportunities of students are related to the home, thus insuring a more family-centered program.

Psychological, sociological and technological changes within the last decade have created new patterns of living. Customs and traditions have received less emphasis and a greater integration of cultural patterns is evident. A home economics teacher needs to develop deeper insight into the problems occurring as a result of these changes which created different cultural patterns for home and family living. Students need to be helped to cope with changes in order to become well-adjusted citizens of the community.

The following analysis of trends in society with their implications offer many suggestions to the home economics teacher for curriculum planning.

I. TECHNOLOGICAL AND SCIENTIFIC DEVELOPMENT

TRENDS	IMPLICATIONS
Rapid increase in technological and scientific knowledge resulting in more and better consumer goods.	Learn about and investigate new consumer products. Understand scientific principles applicable to new product. Emphasize proper use and care of new consumer products.
Automation.	Develop security through plans for retraining. Plan for constructive use of time. Emphasize family relationships.
Scientific advances to promote health.	Identify recent research findings pertaining to health and welfare of individuals. Explore community resources.
Rapid advancement in transportation and communication.	Emphasize the importance of communicative skills. Develop an appreciation of other cultures. Relate own culture with that of others. Develop better international understandings. Explore new consumer goods from distant markets. Broaden horizons to enrich life and living. Be aware of the role home economists' play in space research. Relate space research findings to the consumer.

II. SOCIO-ECONOMIC CHANGES

TRENDS	IMPLICATIONS
Larger income; increased spending power by adults and teenagers.	Improve consumer practices for present and future decision making. Weigh values to achieve individual goals.
Increased information through various media.	Develop an awareness of the many media of communication. Evaluate information critically.
Wider use of credit buying.	Develop awareness of advantages and disadvantages of credit plans.
Shorter working hours; increased leisure time.	Emphasize wise management of personal resources. Plan for constructive and creative use and organization of leisure time.
Longer life span.	Recognize the importance of planning for security in senior years. Understand the problems of the aged.
Younger marriages.	Understand the economics and management in relation to the family unit. Educate for marriage and parenthood. Emphasize child care and development. Be informed of available professional family guidance services.

II. SOCIO-ECONOMIC CHANGES

TRENDS	IMPLICATIONS
Increased mixed marriages.	Develop an awareness of situations which may arise from mixed marriages.
Increased assimilation of cultures.	Emphasize the importance of retaining or fusing the better qualities of the different cultures.
The role of each family member is less defined.	Adjust to changes in personal and family living. Recognize responsibilities of each family member.
Increased number of working mothers; more younger children cared for by others.	Emphasize management so that homemaking and gainful employment can be combined successfully. Establish healthy family relationships. Develop standards for acceptable care of children. Prepare for job opportunities in child care centers.
Increased family mobility, concentration of population and job opportunities	Adjust to changing living conditions.
Increased education.	Explore vocations and professions. Train for employment in specialty fields with provisions for retraining when necessary. Pursue higher forms of education. Utilize all communication media, modern facilities and other resources. Take advantage of educational opportunities in the community and schools.

III. POLITICAL, GOVERNMENT AND CIVIC DEVELOPMENT

TRENDS	IMPLICATIONS
Increased government control for consumer protection.	Provide up-to-date information on government regulations to protect the consumer.
More government participation and assistance.	Identify government assistance available and how it affects the individual.
	Explore availability of government sponsored recreational and educational programs.
Increase of suburban centers with own civic and community responsibilities.	Participate in community activities.

HOME ECONOMICS CURRICULUM GUIDE

Section II

SCOPE AND SEQUENCE OF THE HOME ECONOMICS PROGRAM

SCOPE AND SEQU

AREAS	BEGINNING LEVEL (HOME ECONOMICS 1–8th Or 9th Grade)	
HUMAN DEVELOPMENT AND THE FAMILY	6-10 Wks Total development of the individual as influenced by the family. Influences of the peer group on the adolescent. Roles of an adolescent in a family unit.	Influences upon the c Functions and respon Methods, functions ar tions.
HOUSING	3-5 Wks Influence of housing on the physical, social, and emotional development of individuals and families. Psychological effects of design in housing. Application of safety principles in the home. Responsibilities of individual members to the family and to the community for home maintenance. Management of a livable space.	Individual and family housing. Relationship of spatia terests, and activit Selection and arrang on knowledge of
MANAGEMENT AND FAMILY ECONOMICS	2-3 Wks Time and money management opportunities and responsibilities. Decision-making and the three stages of management: plan, control, evaluate. Organization as a way to carry out activities. Availability of resources and the range of choice. Values as guides for developing goals.	Interaction of factors Involvement related t cisions. Values, goals and sta Aim and effect of org Created routine proc tating managem Reappraisal and adju plans. Effective communicati Effectiveness of orgar Perception of availab of individuals and Anticipated outcomes
FOOD & NUTRITION	7-9 Wks Adequate nutrition to maintain health. Physical and chemical factors affecting food. Health and safety measures in handling food in the home. Organization related to meal management.	Physiological and ps tion. Physical and chemic food. Production, processin food as they affec Effects of discriminatir Management of re preparing and ser
CLOTHING & TEXTILE	7-9 Wks Significance of clothing to the early adolescent. Relationship of beauty and personal satisfaction through clothing. Utilization of textile product related to clothing.	Social, psychological Reflection of the princ Appearance, comfort Relationship of perso tion of clothing.
PERSONAL AND FAMILY HEALTH	May be included in other units; correlate with Health Program in school.	Effects of chronic an Responsibilities invol

SEQUENCE OF HOME ECONOMICS EDUCATION IN HAWAII

INTERMEDIATE LEVEL (HOME ECONOMICS II)	ADVANCED LEVEL (SPECIAL INTEREST COURSES)
7-10 Wks es upon the development of an individual and family. s and responsibilities of the family in the community. , functions and importance of intra-family communica-	1 Semester Roles & responsibilities of family members to meet family needs. Functions and responsibilities of families in child-rearing. Conditions in the home and their effect on child-rearing. Influence of guidance in child-rearing.
3-5 Wks al and family living as influenced by form and use of ing. ship of spatial organization to housekeeping tasks, in- is, and activities. and arrangement of furnishings and equipment based nowledge of design, preferences, and needs.	1 Semester Effect of family housing goals on neighborhood and community development. Decision-making related to housing selection. Influence of technological developments on housing and furnishings. Housing design and its relationship to the family life cycle. Economic factors involved in the maintenance of the home.
3-5 Wks on of factors influencing managerial behavior. nent related to acceptance of and satisfaction with de- ns. goals and standards reflected in management. l effect of organization. routine procedures and coordinated activities for facili- g management. sal and adjustment of procedures in implementation of s. communication in implementing plans. ness of organization and optimal use of resources. on of available resources and the management potential dividuals and families. d outcomes and organizational processes.	1 Semester Conditions in society as they influence stability and/or change of resources. Consumer action and government protection for welfare of families. Family economy in the larger economy. Decision-making reflecting degrees of rationality. Perception of goals and goal achievement. Advantages and disadvantages inherent in alternatives. Risk and uncertainty of decisions. Different forms or combinations of resources yielding similar satisfactions. Alternative costs of the use of resources. Family-cycle and the changes in the demands made upon resources.
6-7 Wks gical and psychological factors influencing food selec- and chemical processes used in altering the nature of on, processing, preservation, distribution, and storage of as they affect the consumer. f discriminating choices in food purchases. ment of resources to facilitate planning, purchasing, aring and serving of food.	1 Semester Cultural and socio-economic influences of foods. Specific functions of each nutrient in the human body. Technological developments in the food industry and their effect on family living. Regulations governing sale and use of food for the protection of individuals and families. Effects of agricultural practices and marketing on supply, distribution and consumption of food. Aesthetic and creative expression in food preparation and serving.
6-7 Wks psychological and physiological aspects of clothing. n of the principles of design in clothing. ance, comfort and performance affected by construction. ship of personal and family values and goals to selec- of clothing.	1 Semester Interrelationship of clothing and culture. Clothing and textiles in the economy. Clothing as a medium for artistic perception, expression and experience. Physical and chemical properties of textiles and their effect on performance. Management of resources to meet clothing needs. Responsibilities of the consumer in relation to textiles and clothing.
1-2 Wks of chronic and convalescent patients in the home. s involved in the care of the sick at home.	1 Semester Relationship of health to family living. Health and safety measures in preventing illnesses and accidents. Relationship of pre-natal and post-natal care to the health and welfare of babies and mothers. Home nursing related to the family economy. Effective procedures in home nursing. Value of home nursing in civil defense.

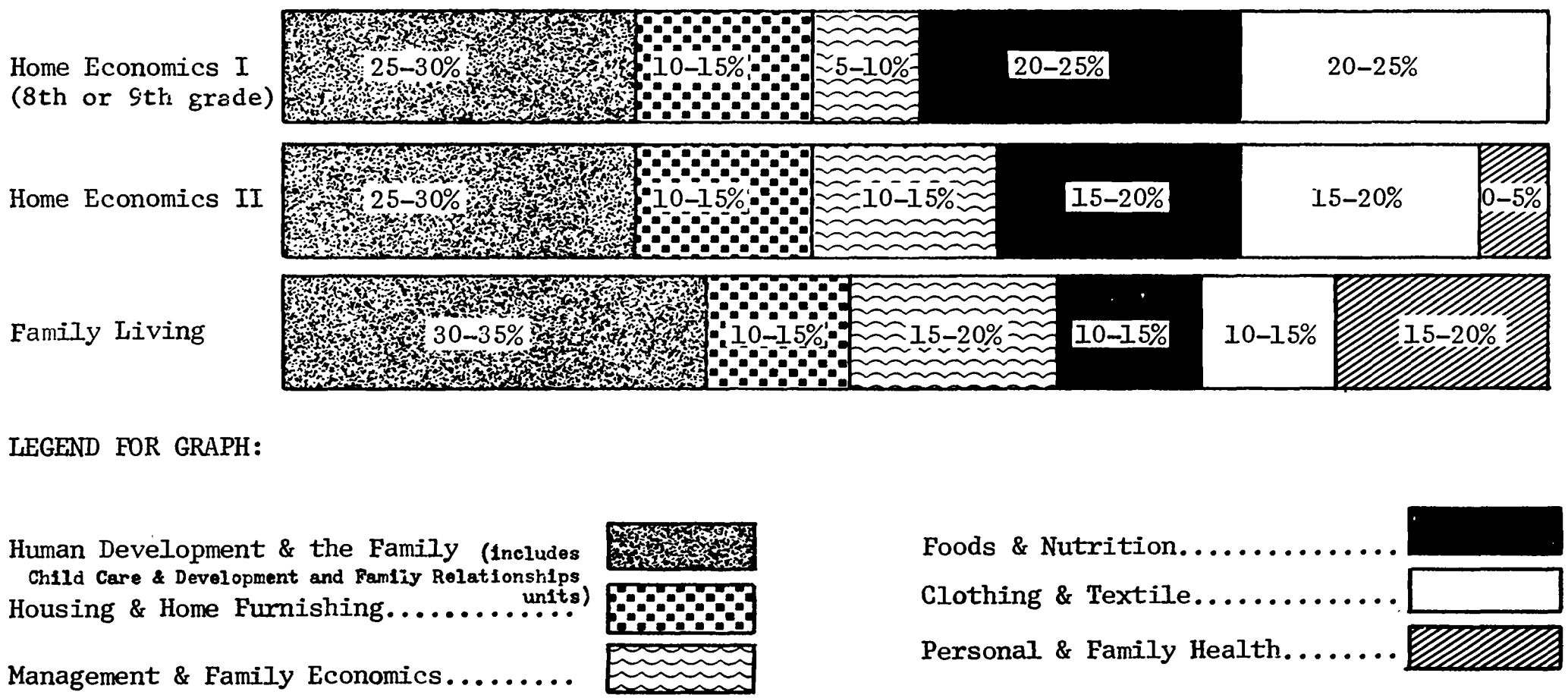
TION IN HAWAII

ADVANCED LEVEL (SPECIAL INTEREST COURSES)	FAMILY LIVING (Co-educational)
1 Semester nsibilities of family members to meet family needs. responsibilities of families in child-rearing. the home and their effect on child-rearing. uidance in child-rearing.	6-12 Wks Maturation of the individual as expressed by creativity in decision-making. Societal influences on the family. Culture and its effect on the family.
1 Semester ly housing goals on neighborhood and community nt. ng related to housing selection. technological developments on housing and fur- gn and its relationship to the family life cycle. ors involved in the maintenance of the home.	2-4 Wks Application of goals, values, and standards in selecting the form and use of housing. Relationship of environment, design, materials, construction and resources to quality of housing. Effect of governmental regulations on housing. Financing policies and procedures related to housing. Rational housing decisions based on knowledge of new products and changes in design, materials and construction.
1 Semester society as they influence stability and/or change es. on and government protection for welfare of fam- ny in the larger economy. ng reflecting degrees of rationality. goals and goal achievement. nd disadvantages inherent in alternatives. rtainty of decisions. ns or combinations of resources yielding similar ns. sts of the use of resources. and the changes in the demands made upon re-	4-6 Wks Stages of family life cycle and the effect or influence upon availability of and demand on resources. Demands and expectations of society as they relate to management problems. Family organization and goal achievement. Effective elements in home management and managerial behavior.
1 Semester socio-economic influences of foods. ons of each nutrient in the human body. developments in the food industry and their effect living. overning sale and use of food for the protection of s and families. icultural practices and marketing on supply, dis- nd consumption of food. d creative expression in food preparation and	2-4 Wks Values and attitudes affecting family food practices.
1 Semester ip of clothing and culture. xtiles in the economy. a medium for artistic perception, expression and chemical properties of textiles and their effect on ce. of resources to meet clothing needs. s of the consumer in relation to textiles and	2-4 Wks Clothing related to social attitudes and values.
1 Semester f health to family living. fety measures in preventing illnesses and accidents. of pre-natal and post-natal care to the health and babies and mothers. related to the family economy. in home nursing. nursing in civil defense.	3-6 Wks Physical, mental and emotional health in family living. Functions and responsibilities of families in meeting community health problems. Effects of alcohol and narcotics on individuals and families. Role of community health agencies.

ERIC

RECOMMENDED PERCENTAGE OF TIME FOR EACH AREA OF HOME & FAMILY LIVING

IN GENERAL HOME ECONOMICS IN THE SECONDARY SCHOOLS.



SUGGESTED COURSE TITLES & DESCRIPTIONS BASED ON THE TOTAL DESIGN

GENERAL HOME ECONOMICS COURSES OFFERED IN A SEQUENCE ON A YEAR BASIS

Home Economics I

Primarily an orientation program required of all girls which includes all phases of family living: Human development and the family, management and family economics, housing, food and nutrition, and clothing and textiles offered as the first general course in home economics. The focus is on the adolescent in the family.

Home Economics II

A sequentially developed general home economics course offered as an elective to interested students. Learning experiences have more depth in each phase of family living and the focus is expanded to the total family unit.

GENERAL HOME ECONOMICS COURSE WITH NO PREREQUISITES FOR A SEMESTER

Family Living

Family Living is a comprehensive co-educational course concerned with the family in this changing society. (This course is designed for senior boys and girls.) The primary emphasis is on preparation for home living after graduation--further education, employment and marriage. Focus is on personal adjustment, preparation for marriage and preparation for parenthood. Particular importance is placed on the development of wholesome attitudes toward marriage and a successful family life.

SPECIAL INTEREST COURSES OFFERED ON A SEMESTER BASIS FOR INTERESTED PUPILS

(It is recommended that students have at least one year of General Home Economics before enrolling in these courses. Where boys who have had no home economics choose to enroll in these courses, it is advisable to group them separately from the girls.)

Child Care and Development (Human Development and the Family)

Designed to establish an awareness of the basic functions and responsibilities of child rearing in families. Through actual experiences with children in the school situation, favorable conditions for the development and guidance of young children are created for observation and study.

Family Relationships (Human Development and the Family)

Emphasis on the shared roles and responsibilities of family members to reach family goals. The importance of communicating among and between family members, both verbal and non-verbal, to establish healthy human relations. Study of research findings in human development and the family.

Housing and Home Furnishing

Decision-making in housing and home furnishing, considering personal and family goals; technological developments relating to housing; and repair and maintenance of the home as they affect the beauty, safety and economic value of property.

Home Management and Family Economics

Techniques and knowledge needed for the management of the home in the complex society of today; reappraisal of our traditional ideas as a basis for decision-making; consumer action and government protection for welfare of families; alternative costs of the use of resources.

Family Foods

Relationship of food and nutrition (significance, nature and provision) to family living. Cultural and socio-economic influences of food are stressed. Activities in food preparation and serving are included.

Family Clothing

The study of clothing is expanded beyond the clothing unit in the general home economics course. The interrelationship of clothing and culture and clothing and textiles in the economy are included. Emphasis is on management of all the resources available in relation to meeting clothing needs of the family. Construction of garments is part of this course. Students enrolling in this course should not elect another clothing course for credit.

Personality and Dress

This is a clothing course especially designed to meet the needs of girls and boys who are not interested in making garments but want to be able to effectively meet their personal clothing needs immediately after graduation, be it for college or business. Basic concepts of clothing are emphasized including the physiological, psychological and social aspects of clothing. Students enrolling in this course should not elect another clothing course for credit.

Home Nursing

Emphasis is placed on the relationship of good health to family living and human relations. Prevention of illness and accidents in the home, and the principles of care of the sick and injured when they do occur. Responsibilities of individuals and families for community health. Prenatal and post-natal care are also included.

AN OVERVIEW OF THE CURRICULUM DESIGN

The general design of the curriculum for Home Economics Education in Hawaii is built on general objectives and basic generalizations. General objectives are listed for the beginning, intermediate, and advanced levels and for the Family Living course with identified basic generalizations (content, body of knowledge or basic concepts) for each objective in all of the home economics subject areas.

The basic generalizations used in this guide are from the conceptual structure for each subject area in home economics: Human Development and the Family, Housing, Management & Family Economics, Food & Nutrition, and Textile & Clothing. In the development of the conceptual structure by national curriculum committees, particular effort was made to provide accommodations for new and changing knowledge, to fit in all the academic disciplines related to the subject area, to verify the relevancy of each piece of knowledge for the present times and to confirm the universality of the facts. Subject matter specialists and leaders in research participated in structuring and organizing the subject matter of home economics. Hawaii's curriculum committees used the national committees' outlines to establish the conceptual structure for each subject area in home economics for Hawaii's programs.

In planning teaching-learning experiences with this material as a guide, many of the general objectives and basic generalizations will need to be broken down to a series of more specific statements. This guide is developed in this way to facilitate comprehension of the meaning of, and relationship among objectives, content and learning experiences and to encourage methods of teaching which provide learners an opportunity to discover meanings (concepts) and relationships (generalizations).

It is hoped that these concepts collectively will meet the announced purpose of education in Hawaii. How much time and priority a learning should have against other learnings and how much sophistication is planned for comprehension will depend upon the abilities of the pupils.

GENERAL OBJECTIVES IN THE AREA OF HUMAN DEVELOPMENT & THE FAMILY

(Child Care & Development and Family Relationships)

BEGINNING LEVEL	INTERMEDIATE LEVEL	ADVANCED LEVEL	FAMILY LIVING
Be able to identify the influences of the family on the individual's development.	Be able to analyze influences which affect the process of socialization of the individual.	Be able to assume the roles and responsibilities of a family member to meet identified individual and family needs.	Be able to identify and develop mature behavior. Be able to use more creativity in decision-making.
Be able to discriminate the influences of peer group on an adolescent's attitude and interest.	Be able to recognize the shared roles and responsibilities of the family and community to meet the individual's needs.	Become aware of the basic functions and responsibilities of child rearing in a recognized unit of society.	Be able to recognize the complexity of socialization as affected by rapid changes.
Become aware of the different roles of the adolescent in a family unit.	Be able to apply communicative skills in intra-family relationships.	Be able to create a favorable atmosphere in the home for human growth and development. Be able to guide the successful development of a child.	Be able to interpret the effect of cultural patterns on the family.

GENERAL OBJECTIVES IN THE AREA OF HOUSING

BEGINNING LEVEL	INTERMEDIATE LEVEL	ADVANCED LEVEL	FAMILY LIVING
Be able to understand that housing provides a setting for the development of individuals and families. Become aware of the psychological effect of space and design in housing on the individual. Be able to recognize the importance of safety in housing as it relates to families. Be able to recognize the responsibility of families for maintaining their homes and the surrounding area. Become aware of the ways in which design and materials used in home furnishings affect their use and care.	Be able to recognize ways in which housing influences individual and family living. Be able to comprehend the relationship of space and its organization to the physiological, psychological and social needs of the family. Be able to recognize art principles as tools in selecting and arranging furnishings and equipment for the home. Be able to develop criteria for the selection of furnishings and equipment.	Be able to identify those family housing goals which affect neighborhood and community development. Be able to relate personal and family goals to housing selection. Become aware of technological developments relating to housing and furnishings. Be able to relate housing design to the needs and wants of the family. Be able to recognize the importance of proper care, repair and maintenance of the home.	Be able to identify and use family goals to determine the form and use of housing. Be able to comprehend the relationship between and among environment, housing design, materials, construction and resources in the quality of housing. Become aware of government regulations pertaining to housing. Acquire basic knowledge of financing policies and procedures related to housing which affect decisions. Be able to make rational housing decisions based on technical knowledge and scientific inquiry.

GENERAL OBJECTIVES IN THE AREA OF MANAGEMENT AND FAMILY ECONOMICS

BEGINNING LEVEL	INTERMEDIATE LEVEL	ADVANCED LEVEL	FAMILY LIVING
Be able to identify the past use of own money and compare the spending patterns when planned and unplanned. Become aware of the process of decision-making in spending own money and time. Be able to realize and accept the need for organization in carrying out activities in the amount of time available. Be able to identify the many kinds of resources available and the wide range of choices for selecting a scheme of action. Be able to identify, understand and illustrate use of personal values as guides for selecting a scheme of action.	Be able to apply principles and process of decision-making to make and carry out some decisions regarding the use of personal and family resources. Be able to analyze organizational plans for routine procedures and activities to determine factors that facilitate management.	Be able to analyze the present societal conditions which influence the stability and/or change in availability and use of resources for consumption planning. Be able to comprehend and accept responsibilities as individuals and families to provide for their own welfare through consumer action. Be able to analyze the degree of rationality reflected in decision-making regarding resources and consumption. Be able to organize effectively for consumption planning and management through optimal use of resources and effective communication. Be able to comprehend and use different forms or combinations of resources which yield similar satisfactions. Be able to analyze changes in the family life cycle that affect the availability of and demands made upon resources.	Be able to comprehend how each stage of the family life cycle affects resources needed and demands upon resources. Be able to explain how the family economy affects and is affected by the larger economy. Be able to apply principles of management for family goal achievement at different stages. Be able to plan adjustments in family resources to meet the changing demands of the various stages in family life. Be able to make judgments on the basis of scientific inquiry and technical knowledge to reduce risk and uncertainty in decision-making.

GENERAL OBJECTIVES IN THE AREA OF FOOD AND NUTRITION

BEGINNING LEVEL	INTERMEDIATE LEVEL	ADVANCED LEVEL	FAMILY LIVING
Be able to recognize the relationship of an adequate diet to health and general well-being.	Be able to recognize the factors that influence food selection.	Be able to realize the many different roles of food in society.	Be able to make decisions about food, considering family values, attitudes and resources.
Be able to comprehend that sensory qualities, nutri tive value, and safety of foods may be altered by the physical and chemical environment.	Be able to identify the sensory qualities of food related to its chemical and physical composition.	Be able to comprehend and apply nutrition knowledge in the development of food patterns for family members.	Be able to realize the significance of food as related to cultural influences.
Be able to apply health and sanitary principles when handling food and equipment.	Become aware of the various methods used in food processing and their relationship to the consumer.	Be able to relate technological advances in the food industry to home and family living trends.	
Be able to recognize the influence of organization on efficiency in meal management.	Develop discrimination in selecting and purchasing food and food products.	Be able to relate changes in agricultural practices to supply, distribution and consumption of food.	
	Acquire knowledge and skill pertinent to the management of resources in meeting family food needs.	Develop awareness of government standards and regulations for the protection of consumers.	
		Be able to express creativity through food for personal and family satisfaction.	

GENERAL OBJECTIVES IN THE AREA OF TEXTILE AND CLOTHING

BEGINNING LEVEL	INTERMEDIATE LEVEL	ADVANCED LEVEL	FAMILY LIVING
Be able to recognize that clothing may influence behavior and reflect attitudes and values. Be able to realize that beauty and personal satisfaction may be attained through clothing. Become aware of the relationship of textile products to utilization in clothing.	Be able to recognize that clothing contributes to one's self confidence and security. Be able to identify the physiological need for clothing. Be able to apply principles of design in clothing. Be able to realize that appearance, comfort, and performance of clothing are affected by construction. Be able to relate personal and family values and goals to clothing selection and use.	Be able to recognize the variations in clothing which exists within and among cultures and understand the influences causing these variations. Be able to relate the textiles and clothing industry to the economy. Be able to utilize the elements of art to create and express meanings, feelings, and ideas through clothing. Develop some understanding of the physical and chemical characteristics of textiles related to clothing. Be able to identify and manage available resources to meet clothing needs. Develop awareness of the responsibilities of the clothing consumer in our society.	Be able to make decisions about clothing, considering family values, goals and resources.

GENERAL OBJECTIVES & BASIC GENERALIZATIONS FOR THE BEGINNING, INTERMEDIATE AND ADVANCED LEVELS AND FAMILY LIVING IN:

HUMAN DEVELOPMENT & THE FAMILY
(Child Care & Development and Family Relationships)

BEGINNING LEVEL

General Objectives	Basic Generalizations
Be able to identify the influences of the family on the individual's development.	To the extent that an individual's developmental needs are met consistently and in an atmosphere of emotional warmth and love, he seems to develop a basic trust in himself and in the world around him.
	Attitudes, beliefs, values and needs influence and are influenced by a person's perception, interpretation and behavior.
	The primary functions of families are to meet basic needs of their members and to prepare individuals for existence in society.
	The human organism is an open, dynamic system constantly taking in stimulation from its environment, and constantly behaving in response to the stimulation; such behavior in turn, affects and changes the environment.
	Every individual is confronted with frustration in meeting needs and develops ways of adjusting to such situations.
Be able to discriminate the influences of peer group on an adolescent's attitude and interest.	Each person's behavior is influenced by attitudes, values and interpretations of his environment that he has accumulated through his experiences.
	Values are learned from early and continued experiences with peer groups.
	Certain critical periods seems to occur throughout the life span during which an individual's total development, or some aspect of it, is particularly sensitive to environmental influences.
	Environment can be controlled.
	Favorable adjustments are more easily made with positive environmental influence.

HUMAN DEVELOPMENT & THE FAMILY

Beginning Level

General Objectives	Basic Generalizations
Become aware of the different roles of the adolescent in a family unit.	In most societies a primary influence upon the individual's role within his family is his age and sex.
	Modeling is a particularly effective technique in learning roles, attitudes and values.
	Roles, attitudes and values are also learned from concrete accomplishments.
	One's interpretation of his role and of the roles of other family members influences his interaction within the family.
	A person is helped to become a distinctive personality when he has a significant place in the family group.
	Each family member affects and is affected by the family.

HUMAN DEVELOPMENT & THE FAMILY

INTERMEDIATE LEVEL

General Objectives	Basic Generalizations
Be able to analyze influences which affect the process of socialization of the individual.	Socialization results from a continued interaction of the individual and his environment. Since very individual, every family, and every society is unique in many ways, the process of socialization is partly different for each individual. The rapid pace of technological changes has implications for cultural changes. Situations conducive to development of self-respect are those in which the individual is valued as a person of intrinsic worth and dignity. The sense of self grows gradually and continually as the individual participates in an ever-widening environment. The more fully developed an individual's assets the more useful and satisfied he is likely to be. Individuals resist change.
Be able to recognize the shared roles and responsibilities of the family and community to meet the individual's needs.	Each family is part of a society and affects and is affected by various aspects of society. Families and communities share the responsibility for offering youth opportunities for education, for maintaining physical and mental well being, for recreation, and for protection from danger. To the extent that an individual's developmental needs are met as they occur, he is free to move toward his fulfillment as a person. An individual develops toward his fulfillment through opportunities his environment provides.

HUMAN DEVELOPMENT & THE FAMILY

Intermediate Level

General Objectives	Basic Generalizations
	Technological changes, advances in science and improved communications and transportation have resulted in other social agencies assuming some of the responsibilities traditionally performed by the family.
	Society is made of man-made institutions; many are created for the purpose of furthering individual growth while others actually hinder growth.
Be able to apply communicative skills in intra-family relationships.	An optimal atmosphere for the socialization process in our society seems to provide a combination of affection and control which is adequately communicated.
	It is important that families socialize in an atmosphere of openness.
	Well planned leisure time can enrich the oneness of the family group.
	Each stage of the family life cycle brings new roles, problems, satisfactions, adjustments and relationships.
	The needs of every individual within a family unit are both parallel and reciprocal.
	Interaction among family members is influenced by expectations of the role of oneself and others in the family.

HUMAN DEVELOPMENT & THE FAMILY

ADVANCED LEVEL

General Objectives	Basic Generalizations
Be able to assume the roles and responsibilities of a family member to meet identified individual and family needs.	Social changes resulting from technological advances, political strategy, and newly emerging or absorbed ideologies place strain on cohesion within and between families. Certain roles of man and woman in the family are not as sharply differentiated today as they were in the past. The role of each family member is less defined. Religious beliefs are sometimes impediments to real understanding of the nature of things.
Become aware of the basic functions and responsibilities of child rearing in a recognized unit of society.	In all known societies there is a recognized unit that assumes the functions of child learning, child rearing, and regulation of behavior. An individual personality is developed and influenced by his family and family culture. The family is usually the recognized unit that assumes the function of rearing and bringing up children and regulating their behavior. Family units have similar functions in relation to the upbringing of their children and preparing them for their place in society.
Be able to create a favorable atmosphere in the home for human growth and development.	In our society families usually offer the best way of fostering affection, warmth, understanding, feeling of loyalty, responsibility, respect and consideration for other people. The family can offer what is essential to guard the emerging personality and to protect and conserve the mental health of the individual. A child gains security from his environment when roles are clear.

HUMAN DEVELOPMENT & THE FAMILY

Advanced Level

General Objectives	Basic Generalizations
	If the family anticipates the individual's emotional needs, it may provide adjustment opportunities.
	Individual potentialities develop under favorable conditions, but neglect, abuse, and deprivation may produce atypical patterns.
Be able to guide the successful development of a child.	Development is life-long; periods of acceleration and deceleration may occur in each phase of development as well as in qualitative transformation.
	Each individual is unique in his pattern and rate of development.
	Each phase of development is built upon the previous experiences of the individual.
	Understanding growth and development is necessary to effectively guide the successful development of an individual.
	Appropriate learning experiences stimulate individual development.
	Recognizing the developmental needs of the individual at each phase is imperative.
	There may be periods of turbulence and regression which make adjustments difficult.
	When one aspect of development is taking place at an accelerated rate, other aspects may seem to be on a plateau.

HUMAN DEVELOPMENT & THE FAMILY

FAMILY LIVING

General Objectives	Basic Generalizations
Be able to identify and develop mature behavior.	A mature adult will overcome problems and difficulties with his environment, shows a certain unity of personality, and is able to perceive the world and himself realistically. Self-comprehension usually comes as a by-product of comprehending the world in general. Maturation is influenced by stimulation. One characteristic of maturity is the realistic acceptance of the limitation of resources. Maturation is a change in structure that cannot be measured in amount by means of a standard measuring scale, but can be appraised by reference to an orderly sequence of qualities, features, or stages.
Be able to use more creativity in decision-making.	Creativity is the capacity to innovate, invent, or reorganize experiences in ways new to the individual. Every individual has a certain amount of ability to create. Creativity can be developed or suppressed depending on the environment. One facet of maturity may be expressed through creativity. In the process of self-development the individual builds up a set of values which are important criteria for his decision-making. Decisions are made within a framework of values subtly imparted from infancy. Value systems are developed as a person's needs are being met as he thinks about and reacts to his experiences, and as he adjusts to change.

HUMAN DEVELOPMENT & THE FAMILY

Family Living

General Objectives	Basic Generalizations
	Some of the most influential and compelling values are held subconsciously.
	The more accurately one perceives his values, the greater the ease in choosing among alternatives of action.
	An individual's background of experiences influences his decision-making.
	A thorough knowledge of resources, values and social expectations will free one to be creative in decision-making.
Be able to recognize the complexity of socialization as affected by rapid changes.	When individuals understand change and have some methods and resources for coping with it, they can be a force in determining the direction of change.
	Education should fo us on developing an inquiring mind.
	Increased family mobility and concentration of population and job opportunities give impetus to assimilation of cultures.
	An awareness of situations which may arise from mixed marriages makes adjustments less difficult.
	Preparation for employment in specialty fields is important, but provisions for retraining wherever necessary will be even more important.
	Automation has changed the housing, homemaking and recreation in family life.
	Longer life spans make an understanding of the problems of the aged very important.

HUMAN DEVELOPMENT & THE FAMILY

Family Living

General Objectives	Basic Generalizations
	The task of socialization becomes more complex in societies where there is rapid social change.
	Individuals must be alert to information--local, national or international--which indicates economic or social changes that will affect family living.
	Desirable emotional and social development is encouraged when an individual is free to develop his potential and to adjust to new experiences and situations.
	The rapid pace of technological changes has implications for cultural change.
	Change generally occurs first in the material aspects of culture which in turn produces change in the non-material culture.
	One's knowledge of all aspects of his way of life increases with the understanding of people of other cultures.
	Socialization of different generations contributes to variations in attitudes, beliefs, and practices.
	The human organism has a great capacity for physical, mental and social self-repair and adaptability.
	Self-improvement begins with the identification of the ruling culture and a recognition of the need for improvement.
	Self-improvement requires long-range goals and plans-of-action along with willingness and determination.
	Capacity of the individual plays a role in self-improvement.

General Objectives	Basic Generalizations
Be able to interpret the effect of cultural patterns on the family.	Cultural patterns are transmitted from one generation to another primarily through the family. Cultures differ in what they consider acceptable behavior. The differences in cultural values and beliefs held by families may enrich society as a whole. There are more similarities in family patterns within a culture than there are in family patterns of different cultures. Although much of education takes place in the community, the home continues to transmit the cultural patterns and heritage. Every known society has values which give direction to behavior and meaning to life. Interrelationships in society help create individual attitudes of life and values. New or old ideologies should be studied in light of values held by individuals and families. The values by which an individual lives find roots in cultural experiences. Families should be helped continuously to evaluate their behavior in the light of their cultural mandates.

GENERAL OBJECTIVES & BASIC GENERALIZATIONS FOR THE BEGINNING, INTERMEDIATE AND ADVANCED LEVELS AND FAMILY LIVING IN:

HOUSING

BEGINNING LEVEL

General Objectives	Basic Generalizations
Be able to understand that housing provides a setting for the development of individuals and families.	Housing provides the setting for the physical and emotional development of individuals and families. The community in which the family lives may contribute to a stronger and happier family relationship. Order and beauty in the home are important to physical, mental and emotional health. Housing may contribute to the social development of individuals by providing a setting for interaction between family members and other people.
Become aware of the psychological effect of space and design in housing on the individual.	The amount of space and its organization affect the psychological and social reactions of people. Space or lack of space affects people in different ways. Physical environment within the home may influence social behavior of family members.
Be able to recognize the importance of safety in housing as it relates to the individual and families.	Safety of individuals and families is influenced by safety features and procedures in a home. Application of safety principles is an important factor in minimizing home accidents. A sense of security is developed when safety features such as burglar and fire alarms are built into the home.
Be able to recognize the responsibility of families for maintaining their homes and the surrounding area.	Poor upkeep and maintenance create an undesirable reaction to what is considered a choice neighborhood. Each family can contribute to better the environment of the neighborhood.

HOUSING

Beginning Level

General Objectives	Basic Generalizations
Become aware of the ways in which design and materials used in home furnishings affect their use and care.	Efficiency in equipment is affected by design, construction, materials, intallation, suitability for the job, maintenance and skill with which the equipment is operated. Equipment will better serve the function for which it was designed when use and care directions are understood and followed. Management related to housing involves decisions regarding the allocation of human and material resources to obtain, maintain, and use the dwelling. Decisions regarding the choice of home furnishings may affect the maintenance required and their use. The ease of caring for a home and its furnishings is influenced by the kind and quality of materials used.

HOUSING

INTERMEDIATE LEVEL

General Objectives	Basic Generalizations
Be able to recognize ways in which housing influences individual and family living.	Housing enables man to satisfy some of his physiological, psychological and social needs. A family dwelling facilitates essential activities of family life. A home which meets the needs for various social functions of family members may contribute to the unity of the family.
Be able to comprehend the relationship of space and its organization to the physiological, psychological and social needs of the family.	Spatial organization, architectural design and location of the dwelling influence the ease or difficulty of housekeeping tasks and the type of activities engaged in by the individual and family. Different families need different organization of space in the home because of varying interests and activities. Effective use of family activity centers is often dependent upon location and available equipment. The social development of an individual and a family is determined to some extent by their housing. The amount of space required for a given activity is determined by work habits, body movements required in executing the task and the number and size of people engaged in the activity.
Be able to recognize art principles as tools in selecting and arranging furnishings and equipment for the home.	Design is the process of organizing the basic elements of line, form, shape, texture and color. It is not always necessary to follow principles of design; personal expression through line, color, shape, and texture add individuality to the home. Personal taste need not be dictated by rules. The use of art principles such as balance, harmony, rhythm, emphasis, proportion, and scale are means of design organization. The trend is to use them as tools rather than rules in the home.

HOUSING

Intermediate Level

General Objectives	Basic Generalizations
Be able to develop criteria for the selection of furnishings and equipment.	Selection of interior furnishings and equipment are based on needs, personal preferences and one's concept of design. Convenience, comfort, flexibility, durability and cost of maintenance are major factors to consider in selecting furniture. Accessories express individual personality and interests and add to the decorative plan of the room. Appropriate equipment selected by an individual or a family facilitates household tasks. Family composition, values, goals, standard of living, available funds, and space influence furnishings and equipment acquired.

HOUSING

ADVANCED LEVEL

General Objectives	Basic Generalizations
Be able to identify those family housing goals which affect neighborhood and community development.	The family affects the neighborhood and its environment and in turn is affected by the neighborhood and its environment. The neighborhood one lives in reflects the type of families which comprise the neighborhood. Housing and the surroundings may be status symbols for individuals and families. The values of individuals and families, their standards, their ways of living, and their preferences affect the neighborhood environment. Standards in a residential area are likely to change as people with different values move to the neighborhood. Family values affect the neighborhood and the neighborhood is affected by the family values. Neighborhood and community developments reflect the social organization and cultural values of citizens. Services, facilities and utilities used by the community affect the ways by which an individual or family satisfies its housing needs and wants. The availability of parks, playgrounds, schools, churches and shopping centers is an important factor in selecting a home. Modern urban and suburban families demand public services and facilities for their homes such as water, gas and/or electricity, police and fire protection, street lighting, paved streets and sidewalks, adequate drainage and sewer system.

HOUSING

Advanced Level

General Objectives	Basic Generalizations
Be able to relate personal and family goals to housing selection.	The extent to which an individual or family can satisfy housing wants and needs depends upon the available income and the ability to manage resources. The advantages and disadvantages of buying or renting are related to the needs, wants, and resources of a particular individual or family. The decision to own or rent a dwelling requires weighing advantages and disadvantages from the immediate and long-term viewpoints. Job stability or mobility of family members can be a deciding factor in purchasing or renting a dwelling. Understanding of financial procedures provides a basis for decisions.
Become aware of technological developments relating to housing and furnishings.	Science and technology make it possible for man to regulate environmental conditions within the home by controlling temperature and humidity, providing adequate and appropriate light, controlling noise and odors and developing aesthetic qualities in all aspects of the dwelling. Rational decisions in selection of equipment and furnishings depend on the user's knowledge of new products and changes in design, materials and construction.
Be able to relate housing design to the needs and wants of the family.	The design of housing is affected by individual and family life cycles, locality and site, the materials available and the construction methods used. Human factors which influence form and use of housing are: individual and family needs, values, attitudes, aesthetic and educational levels, abilities and skills. The size of the family, the ages and activities of family members are determining factors in selecting a dwelling. If the family has highly developed aesthetic values they will seek this characteristic in a home or alter the home to provide this quality.

HOUSING

Advanced Level

General Objectives	Basic Generalizations
	The aesthetic characteristic of housing affects the mental well-being of the family.
	Whether or not housing satisfies an individual's or family's desire for privacy depends upon such things as the site, the neighborhood, placement of the house on the lot, and arrangement of space within the house.
Be able to recognize the importance of proper care, repair and maintenance of the home.	Maintenance of housing affects the beauty, safety and economic value of property.
	Regular check-ups and maintenance reduce costly repairs.
	Maintenance costs may be minimized by following the manufacturer's directions for the use and care of furnishings and equipment.
	The willingness and ability of family members to do some construction of the dwelling and to improve and maintain the property are means of extending income.
	Each family member's contribution in helping to maintain the house and yard are means to extend family income.

HOUSING

FAMILY LIVING

General Objectives	Basic Generalizations
Be able to identify and use family goals to determine the form and use of housing.	Housing standards are influenced by incomes, values, attitudes, and housing knowledge.
	The short and long term goals, vocations and avocations of family members influence the kind of housing desired.
	Housing needs are affected by climatic, geographic and economic factors; family size, compositions and styles of life; and by health, education, roles, values, and attitudes of individual family members.
Be able to comprehend the relationship between and among environment, housing, design, materials, construction and resources in the quality of housing.	Quality of housing is related to the quality of design, materials, and methods of construction.
	Quality of materials and construction determine the life of a house.
	Landscaping adds to the beauty, function, and economic value of housing and relates a house to its site and neighborhood.
	Costs of dwellings vary according to structural design, construction standards, materials used and location.
	Environmental factors which influence form and use of housing are social, economic, cultural, technological, physical, political and government.
	Socio-economic factors often influence the kind of housing found in certain areas.
	The kind and size of housing a family can secure is influenced by the amount of money available and its purchasing power.
Become aware of government regulations pertaining to housing.	The size, design, construction standards and cost of housing are affected by zoning ordinances and building codes.

HOUSING

Family Living

General Objectives	Basic Generalizations
	Development and expansion or deterioration and reduction of housing units in a community are affected by policies and activities of federal, state and local agencies.
	Urban development and slum clearance programs are designed to provide more adequate and desirable housing for low-income families.
	Government financing policies and practices set standards as to the quality of materials, construction, and physical characteristics required for granting loans.
	FHA and similar government agencies provide low interest and long-term financing for building and/or repairing property. This type of financing makes it possible for many families to build or improve their homes without undue hardship.
Acquire basic knowledge of financing policies and procedures related to housing which affect decisions.	Understanding of financing procedures and costs provides a basis for making rational decisions in obtaining housing.
	The purchaser of a home should have a thorough knowledge of interest computation, closing cost, taxes, terms of loan, and insurance.
	Housing financing is an integral part of financial management and requires making rational decisions.
	Financing policies and practices affect quality of the physical characteristics of the house, its materials, and construction.
	The cost of credit for housing is affected by the rate of interest and length of amortization period.

HOUSING

Family Living

General Objectives	Basic Generalizations
Be able to make rational housing decisions based on technical knowledge and scientific inquiry.	Knowledge of the availability and characteristics of materials and building processes provides a basis for making rational decisions concerning housing. Rational decisions in selection of equipment and furnishings depend on the user's knowledge of new products and changes in design, materials, and construction. The amount and kind of material and workmanship account for some of the differences in quality of equipment and furnishings. Private and government agencies, mass media and educational institutions are sources of information and assistance for the selection, use and care of equipment and furnishings.

MANAGEMENT AND FAMILY ECONOMICS

BEGINNING LEVEL

General Objectives	Basic Generalizations
Be able to identify the past use of own money and compare the spending patterns when planned and unplanned.	Demands and expectations of society present management opportunities and responsibilities to individuals and families. Pressures to buy goods and services make management of resources necessary.
Become aware of the process of decision-making in spending own money and time.	The process of decision-making includes (1) understanding the problems, (2) identifying own values, (3) seeking facts which apply to the situation, (4) considering different solutions, and then, (5) reaching the conclusion which is the basis for selecting the plan to be followed. Decision-making underlines the three stages of management: planning, controlling and evaluating.
Be able to realize and accept the need for organization in carrying out activities in the amount of time available.	Organization is the way in which individuals and families carry out activities. The effectiveness of organization or planning is generally consistent with best use of resources.
Be able to identify the many kinds of resources available and the wide range of choices for selecting a scheme of action.	Quantity and variety of available resources influence choice. Human resources such as knowledge, abilities, skill, talents, attitudes, energy and personality traits of family members influence the uses of such non-human resources as money, time, equipment and community facilities.
Be able to identify, understand and illustrate use of personal values as guides for selecting a scheme of action.	Values are the ideals and principles by which we live. Goals are aims and objectives that grow out of our values. Values and goals serve as guides in the use of resources. Personal and family values may vary with different situations. Selection of a proposed method, procedure or scheme of action from alternatives is planning based on values.

MANAGEMENT AND FAMILY ECONOMICS

INTERMEDIATE LEVEL

General Objectives	Basic Generalizations
Be able to apply principles and process of decision-making to make and carry out some decisions regarding the use of personal and family resources.	Decisions are affected by interaction of the components of managerial behavior. Management of resources rather than the amount of resources available is often responsible for the number of goals achieved and the total satisfactions of a family or individual. Values, goals and standards are interrelated as motivation influencing decision-making. Responsibilities and pressures can force decisions that individuals are required to carry through regardless of personal feeling without sacrificing one's principles. Satisfactory decisions may involve family members in different ways at different times. The involvement of all members of a group in decision-making contributes to acceptance of and satisfaction with the decision. Satisfactory family and personal relationships are often the solution to many of the most difficult home management problems; likewise, satisfactory home management makes for better relationships.
Be able to analyze organizational plans for routine procedures and activities to determine factors that facilitate management.	Individuals' and families' organization differ in aim and effect. Individuals and families may facilitate management by creating routine procedures and coordinating activities. Implementation of plans may involve reappraisal and adjustment of procedures to meet changing conditions. Standing plans facilitate the performance of routine tasks if they are evaluated and revised for changing situations.

MANAGEMENT AND FAMILY ECONOMICS

Intermediate Level

General Objectives	Basic Generalizations
	Plans may incorporate more than one decision.
	The perception of available resources enhances the management potential of individuals and families.
	The community resources available for use by families are dependent upon local social, political and economic conditions.
	Organization to execute family plans implies a responsibility for maintaining a balance among resources employed.

MANAGEMENT AND FAMILY ECONOMICS

ADVANCED LEVEL

General Objectives	Basic Generalizations
Be able to analyze the present societal conditions which influence the stability and/or change in availability and use of resources for consumption planning.	Conditions in society influence stability and/or change in availability and use of resources. Conditions in society are: socio-economical changes, scientific-technological improvements, political government and civic development. Individual and family choices influence and are influenced by market conditions and marketing practices. The use of credit affects the general economy in many ways in that the borrower's purchasing power is increased. The price of an article or service is directly related to its availability and demand.
Be able to comprehend and accept responsibilities as individuals and families to provide for their own welfare through consumer action.	Individuals and families have the responsibility to provide for their welfare beyond the basic expectations of and protection provided by society. Consumer directed action and government protection contribute to the general welfare. Government agencies provide some protection to the consumer through control of labeling, advertising, adulteration, frauds and regulations of weights and measures.
Be able to analyze the degree of rationality reflected in decision-making regarding resources and consumption.	Rational decisions represent choices of rationality. Decision-making reflects degrees of rationality. Decision-making is learned through experiences and understanding of the problems. Decision-making is based on one's values to realize one's goals.

MANAGEMENT AND FAMILY ECONOMICS

Advanced Level

General Objectives	Basic Generalizations
	Decisions of individuals and families reflect differences in the perception of goals and goal achievements.
	Clarification of personal values and goals enables one to consciously work toward fulfillment of them when making decisions.
	A decision made on the basis of the most important goal and of available resources tends to bring satisfaction.
	Disadvantages as well as advantages are usually inherent in alternatives chosen or discarded.
Be able to organize effectively for consumption planning and management through optimal use of resources and effective communication.	Planning is the selection of a proposed method, procedure or scheme of action from alternatives.
	The optimal use of resources varies with differences in families and situations and poor management cannot be compensated by additional resources.
	The use of resources for any purpose has alternative costs. The alternative cost of resources is the real cost.
	The evaluating of a resource in terms of other resources or managerial activities clarifies its contribution to management.
	The way in which plans are communicated may affect their implementation.
	A clear idea of the material to be transmitted facilitates communication.
	Ability to communicate effectively within the family, or in any group is a valuable resource in building understanding and cooperation.

FOOD AND NUTRITION

INTERMEDIATE LEVEL

General Objectives	Basic Generalizations
Be able to recognize the factors that influence food selection.	Food habits and preferences are a product of complex interactions among physiological and psychological satisfactions associated with food, beliefs about foods, and economic resources. Non-nutritional as well as nutritional factors play important roles in food selection. The primary satisfactions provided by eating include the relatively immediate sensory and physiological effects it produces and the psychological meanings it has acquired. The association of food with intimacy from the day of birth may make it a means of non-verbal communication of love or indifference, acceptance or rejection, and other emotional feelings. People are likely to accept a wide variety of foods if they have wide experience, knowledge, and appreciation of foods and if their environment reinforces positive rather than negative attitudes. Food habits are generally formed in early childhood. Adults should set good examples in the practice of good nutrition. People should try new foods in a spirit of adventure and try to accept new flavors. Food habits like other behavior patterns are subject to deliberate modification by those who are motivated to change and act accordingly but are highly resistant to direct attempts to change. An individual's food habits may be such an integral part of his personality complex that efforts to change may damage his capacity to function effectively.

MANAGEMENT AND FAMILY ECONOMICS

FAMILY LIVING

General Objectives	Basic Generalizations
Be able to comprehend how each stage of the family life cycle affects resources needed and demands upon resources.	The family life stages are: Beginning — Establishment years -- achieving feminine and masculine role. Expanding — Child-bearing and preschool School children Teenagers Contracting — Child Launching - Empty Nest Middle Years Aging The changes accompanying family life stages influence the availability of resources and the demands made upon them. Early and late stages in the family life cycle will usually require less resources than the middle stage when most resources are required.
Be able to explain how the family economy affects and is affected by the larger economy.	The family economy affects and is affected by the larger economy. Standard of living may vary from time to time and place to place. Family economic activities influence general economic growth and stability. Efficient production (high quality -- low cost) raises our level of living. Total income and/or goods and services for consumption are influenced by individual and family productivity.

MANAGEMENT AND FAMILY ECONOMICS

Family Living

General Objectives	Basic Generalizations
Be able to apply principles of management for family goal achievement at different stages. and Be able to plan adjustments in family resources to meet the changing demands of the various stages in family life.	Management by individuals and families reflect differences in values, goals, and standards. Goals are aims and objectives that grow out of our values. Short term goals may be ends in themselves or stepping stones to long range ones. The reality of goals is affected by the assessment of resource potential. Goals need to be realistic and should be selected with regard to the family's values, the availability of resources, and all the demands of these resources. Clarification of personal values and goals enables one to consciously work toward fulfillment of them. Decisions made on the basis of the most important goal and of available resources tend to bring satisfaction.
Be able to make judgments on the basis of scientific inquiry and technical knowledge to reduce risk and uncertainty in decision-making.	Risk and uncertainty of decisions vary with people and situations. Mistakes in decision-making can be learning experiences. Development of sound judgment and technical knowledge will lesson the risk involved in decision-making.

FOOD AND NUTRITION

BEGINNING LEVEL

General Objectives	Basic Generalizations
Be able to recognize the relationship of an adequate diet to health and general well-being.	The knowledge that nutrition is related to health, longevity, and general well-being has unfolded through centuries of human experience; nutrition has developed into a science that changes and expands with the additional findings of research. All life is composed of and requires combinations of elements which are known as nutrients; they are utilized to form and maintain tissues or sustain activity. Food is the source of the nutrients. Inadequate, excessive or unbalanced intake of nutrients may be detrimental to health. The amount and kind of nutrients needed by individuals vary and are influenced by heredity, age, sex, size, activity, climate and physical and emotional state. Adequate nutrition can be attained with many combinations of foods commonly available throughout the world. No single food pattern is essential to health. Nutritional knowledge helps the individual evaluate food fads, fallacies, and sensational claims which may be harmful to health and even lead to economic problems. Basic to the development and evaluation of adequate food patterns is knowledge of the nutrients needed by the body and their sources in available foods.
Be able to comprehend that sensory qualities, nutritive value, and safety of foods may be altered by the physical and chemical environment.	The sensory qualities, nutritive value, and safety of foods may be altered by the physical and chemical environment. Changes in food are affected by temperature, kind of manipulation, and the presence of water, oxygen, and other chemical substances, and are usually interrelated and influenced by time.

FOOD AND NUTRITION

Beginning Level

General Objectives	Basic Generalizations
	Food storage and preservation methods are designed to retain or enhance the initial nutritive value, safety, and sensory qualities of food. These are through the control of natural maturing processes, the growth of contaminating micro-organisms, a variety of chemical reactions and of physical changes.
Be able to apply health and sanitary principles when handling food and equipment.	Safety of food is determined by procedures used in the production and processing of food, and by the sanitary measures used in the handling and storing of food in the market and in the home.
	The health and safety of individuals may be protected by proper methods of preparation, storage and service of food.
Be able to recognize the influence of organization on efficiency in meal management.	The organization of activities in providing food for the family involves planning and coordination of resources and family demands.
	Performance of routine tasks according to a plan, designed to be used again and again, facilitates planning, preparing and serving food.

FOOD AND NUTRITION

INTERMEDIATE LEVEL

General Objectives	Basic Generalizations
Be able to recognize the factors that influence food selection.	Food habits and preferences are a product of complex interactions among physiological and psychological satisfactions associated with food, beliefs about foods, and economic resources. Non-nutritional as well as nutritional factors play important roles in food selection. The primary satisfactions provided by eating include the relatively immediate sensory and physiological effects it produces and the psychological meanings it has acquired. The association of food with intimacy from the day of birth may make it a means of non-verbal communication of love or indifference, acceptance or rejection, and other emotional feelings. People are likely to accept a wide variety of foods if they have wide experience, knowledge, and appreciation of foods and if their environment reinforces positive rather than negative attitudes. Food habits are generally formed in early childhood. Adults should set good examples in the practice of good nutrition. People should try new foods in a spirit of adventure and try to accept new flavors. Food habits like other behavior patterns are subject to deliberate modification by those who are motivated to change and act accordingly but are highly resistant to direct attempts to change. An individual's food habits may be such an integral part of his personality complex that efforts to change may damage his capacity to function effectively.

FOOD AND NUTRITION

Intermediate Level

General Objectives	Basic Generalizations
	Sensory qualities and psychological factors of foods such as flavor, texture, temperature, and appearance serve to identify foods and characterize preferences.
Be able to identify the sensory qualities of food related to its chemical and physical composition.	A few foods are pure chemical compounds but most foods are complex systems made up of many chemical compounds.
	Similarities in physical structure and chemical composition of foods are the basis for their classification.
	Appearance, texture, flavor, and temperature-sensory qualities that influence the acceptability of food products depend upon the physical and chemical properties of the food.
	The inherent color of food is determined by the presence of naturally occurring or chemically produced pigments and those physical properties of the food itself.
	The texture of a food is dependent upon the physical and chemical structure of its components.
	Flavor is determined by the chemical composition of a food and is enhanced by small amounts of many different compounds.
Become aware of the various methods used in food processing and their relationship to the consumer.	Physical processes commonly employed to alter the nature of food include: heating by conduction, radiation, and internal generation; cooling; evaporating; dialyzing; dissolving; emulsifying; crystallizing; agitating; fractionating; and comminuting.
	Research continually extends our understanding of, and ability to control, the nature of food and its behavior.
	The storage life, geographic distribution, and the variety of food products can be increased by processing food in various ways such as refining, preserving and manufacturing of new products.
	Food processing is a highly complex science involving various methods to produce attractive, safe and palatable products for consumer use.

FOOD AND NUTRITION

Intermediate Level

General Objectives	Basic Generalizations
Develop discrimination in selecting and purchasing food and food products.	Discrimination is required to select those foods that contributes a balance of nutrients to the daily diet and yet fulfill non-nutritive requirements of daily meals such as food budgets, family traditions, and individual preferences.
	Meal planners should strive to obtain the optimum food value for the money expended.
	An individual's knowledge of nutrition contributes to a wider freedom of choice among foods in attaining adequate nutrition.
	A wide range of choices in foods which supply the needed nutrients are available.
	Firmly established traditions may interfere with wise choices of foods, and may result in nutritional deficiency.
	Rational choice becomes more difficult as the number of food products and ways of merchandising them increases.
	Comparisons of products should be made through the use of factual information on labels and from government food standards.
	Final choice is influenced by resources available and by individual preferences.
	Consumer's choices determine marketing practices, prices and the qualities of foods in the market.
	Informed consumers, making rational and discriminating choices in the purchase of food, can influence the functioning of the market to serve consumer interests and improve the effective use of resources.
	Intelligent use of resources and planned purchasing eliminate impulse buying.

FOOD AND NUTRITION

Intermediate Level

General Objectives	Basic Generalizations
Acquire knowledge and skill pertinent to the management of resources in meeting family food needs.	Use of resources for household food production is influenced by (a) the values (nutritive and non-nutritive), placed on foods; (b) the time required for home production and for purchasing commercial products; (c) availability of commercial products of desired quality; (d) skills and abilities of household workers; (e) equipment and supplies available; (f) purchasing power; and (g) relative cost of home-produced and commercial goods, and personal satisfaction from producing goods. The choice of which resource to use in providing food for the family depends upon the quantity of each resource available, the cost of the alternatives and their effectiveness in producing the desired results, and the ability of the user to employ the resources for the purpose desired. In planning menus, it is of considerable importance that the amount of time and work required to prepare and serve these meals be considered. Good health of the family depends on eating nutritious meals; and therefore, the family's food money must be spent with care so as to get full value from it. The resources available for meeting personal and family food needs include personal capacities, available goods, and services, and purchasing power.

FOOD AND NUTRITION

ADVANCED LEVEL

General Objectives	Basic Generalizations
Be able to realize the many different roles of food in society.	Specific foods, methods of preparation and serving, and times at which foods are eaten, acquire symbolic meanings associated with religious beliefs and ceremonies, social usages, status, ethnic and family traditions, maturity levels, and masculine and feminine roles.
	The role of food as a socializer, as an aid to breaking down communication barriers, and as a symbol of hospitality and friendliness, further justifies an appropriate use of resources.
	The kinds of foods, the way they are prepared, their combination in meals, and even the manner in which they are served and eaten characterize the food customs that are unique to a country or region.
	The provision of food in areas of scarcity affects the physical, economic, and psychological status of people and carries political implications.
	A wide acceptance of food by the individual can mean easier adaptability to varied social environments and differing economic circumstances, and increased likelihood of obtaining adequate nutrition and pleasure from food.
Be able to comprehend and apply nutrition knowledge in the development of food patterns for family members.	Individuals have need for all nutrients but their differences in ability to store nutrients influence the kind, amount, and timing of intake needed for the most effective utilization of food.
	All nutrients are used by the body to build and maintain tissues and to regulate body processes. The various tissues and body processes have characteristic nutrient needs.

Advanced Level

General Objectives	Basic Generalizations
	Combinations of substances used by living organisms are protein, fats, carbohydrates, minerals, vitamins, and water.
	The major constituents of foods are protein, fats, carbohydrates and water.
	The minerals and vitamins are present in small quantities.
	Each nutrient has specific functions, and also influences the functioning of other nutrients.
	Each nutrient serves at least one of the following general functions when taken into the body; 1) it yields heat and energy; 2) it builds and renews body tissue; or 3) it regulates body processes of various types.
	Each nutrient has its own specific function to perform, but many nutrients must be functioning at the same time in order that the links in the nutrition process are formed at the right time.
	The source of energy for growth, maintenance, and bodily activity is provided by the oxidation of fats, carbohydrates, and protein.
	Foods which are sources of energy do not necessarily contain essential nutrients -- vitamins, minerals, and proteins (foods -- sugar, solid vegetable shortening).
	Proteins are the only nutrients that can be used to build muscle tissue but some protein may be oxidized to provide energy.
	Vitamins help in making energy from carbohydrates, fats and proteins available to the body.

FOOD AND NUTRITION

Advanced Level

General Objectives	Basic Generalizations
	The digestion, absorption, and utilization of food are interrelated processes influenced by the physical and chemical nature of the foods ingested, the physical and emotional state of the individual, and the interactions of the various nutrients in the metabolic process.
Be able to relate technological advances in the food industry to home and family living trends.	Technological advances and current sociological trends promote developments in food processing, acceptance of a variety of food forms and changes in patterns of consumption.
	Technological developments in the food industry bring with them parallel needs for changed procedures in food handling, storage, and preparation.
	Food preservation by freeze-dry method eliminates need for refrigeration and when properly prepared very nearly resumes original weight, color and palatability.
	Irradiation of foods by means of gamma rays destroys micro-organisms in food and keeps perishable foods fresh longer.
	As more services are built into foods the control of industry over the kinds and quality of food increases and that of the home decreases.
	People are selecting convenience foods and accepting their quality because of the built-in services.
	Convenience foods can add variety and versatility to meals.
	Convenience foods save time for other activities.
	Selection of these foods depend on the individual's experiences and knowledge.

FOOD AND NUTRITION

Advanced Level

General Objectives	Basic Generalizations
	Food habits of individuals change as a result of indirect influences, such as changes in supply due to advances in production, technology and distribution; economic resources; and the educational, social and cultural environment.
	When there is a scarcity of arable land and increase in population density, the discovery and use of new sources of food become increasingly important.
	Such methods as chemical synthesis of foods, undersea farming, hydroponics and scientific advances in better utilization of foods now being produced increase food supply.
Be able to relate changes in agricultural practices to supply, distribution and consumption of food.	Changes in agricultural practices, in technological developments, marketing, and in size and composition of population affects per capita supply, distribution, and consumption of food.
	Farmers have increased productivity through application of science in their work.
	Genetic factors and agricultural practices may influence the chemical composition and physical structure of raw foods.
Develop awareness of government standards and regulations for the protection of consumers.	Federal, state and local agencies work toward the protection and guidance of consumers in their purchase of certain foods.
	These agencies certify wholesomeness and freedom from adulteration, establish standards of identity, require truthful labeling and prohibit false standards in advertising.
	The support and cooperation of informed citizens increase the effectiveness of government and private agencies in improving the quality, safety, and quantity of the food supply.

FOOD AND NUTRITION

Advanced Level

General Objectives	Basic Generalizations
	Federal agencies have been attempting to determine whether the addition to a food of certain nutrients or other components serves a useful purpose and to prepare definitions and regulations under which such additives may be used.
	Legislation controls the use of chemicals in the production of food.
Be able to express creativity through food for personal and family satisfaction.	Participation in planning, preparing, and serving meals can be a source of pleasure and satisfaction, and can provide an opportunity for aesthetic and creative expression.
	Experimental cookery develops and expresses creativity.
	The planning, preparing and serving of food can be one of the many leisure-time activities for the family and its members.
	Skill in food planning and preparation can be used to satisfy family values and goals, and for gainful employment.
	Regular family meals are a social experience for the family and a means for developing satisfying family relationship.
	Men are assuming more responsibility in the management of family meals.
	Proper food planning and preparation may result in gainful use of released time and energy.
	Special skills in food planning and preparation are saleable.

FOOD AND NUTRITION

FAMILY LIVING

General Objectives	Basic Generalizations
Be able to make decisions about food, considering family values, attitudes and resources.	The attitude and information of the meal planner toward food and nutrition influences the nutritional adequacy of the food served. Knowledge of the composition of foods and of the nutritional needs of the body will help one to choose the right foods for promoting good health and vitality. The health, the appearance, the vitality, and even the mental alertness of the members of the family depend greatly upon the food eaten daily. Food habits and preferences are a product of complex interactions among physiological and psychological satisfactions associated with food, beliefs about foods, and economic resources. Family income and food budgets may affect the choice of food. Food habits and preferences may be influenced by social status. Participation in social activities involving food can contribute to the individual's sense of security in various situations. Family food costs will vary with the size and composition of the family, the value they place on food, and the resources available. Rational choice becomes more difficult as the number of food products and ways of merchandising them increases. Comparisons of products should be made through the use of factual information on labels and from food standards. Final choice is influenced by resources available and by individual preferences.

Family Living

General Objectives	Basic Generalizations
	While wise management can reduce the amounts of money needed for food there is a practical minimum below which it becomes increasingly difficult to acquire adequate nutrition and to provide culturally accepted variety in food. The lower the food budget, the more important it is to plan meals carefully and to shop for foods prudently. Variety in food is limited when funds for food are below the practical minimum.
Be able to realize the significance of food as related to cultural influences.	The kinds of foods, the way they are prepared, their combination in meals, and even the manner in which they are served and eaten characterize the food customs that are unique to a country or region. Long established eating customs tend to create permanence and solidarity. Eating together is a symbol of goodwill in many cultures. Eating is a social rite among many peoples. The adequacy of the food supply in other parts of the world has an effect upon people everywhere. Scarcity of food may contribute to unrest and war. Provisions of food may influence international relations. Peoples who have survived and thrived throughout the ages are those who have managed to eat nutritious food.

TEXTILE AND CLOTHING

BEGINNING LEVEL

General Objective	Basic Generalizations
Be able to recognize that clothing may influence behavior and reflect attitudes and values.	Clothing is related to group identification and group behavior. Clothing often reflects social stratification because attitudes and clothing practices may differ at the various socio-economic levels. Clothing becomes a less reliable indicator of social class or economic status as similar kinds of clothing become increasingly available to all persons. Clothing is used in defense or enhancement of the self. Clothing reflects an individual's self-concept. Clothing is a cue to personality; it conveys an impression of what the individual is, does, believes. An individual uses clothing as a cue in forming impressions of others. Impressions made by appearance and dress have greater impact in limited contact situations. In order to create desired impressions through dress, the individual needs to be aware of the meaning dress communicates to others. Taste in dress refers to sets of values used by an individual or a society in making critical judgments or fine discriminations.
Be able to realize that beauty and personal satisfaction may be attained through clothing.	Clothing may be a source of beauty and personal satisfaction. Clothing may be a means through which the components of art are perceived, illustrated, and experienced. The extent to which component parts of a garment are compatible determines the functional and aesthetic value of the garment.

TEXTILE AND CLOTHING

Beginning Level

General Objective	Basic Generalizations
Become aware of the relationship of textile products to utilization in clothing.	Textiles are products of fiber and/or yarn, fabric construction, and finish. Garments are combinations of textile and apparel materials, design, and construction. The finished textile will give more satisfactory service when the characteristics of the fabric are compatible with intended end use. The suitability of a textile product for its intended use is dependent upon the nature of the textile, its design, and its construction. The utilization of a textile product is related to the care needed and the facilities available for providing that care. The type of care needed by the product will be determined by the nature of the textile, construction, and ornamentation.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Development of Pattern Sections	Review previous lesson (kimono sleeve).
	Elicit from students techniques in developing kimono sleeve.
	Demonstrate and explain the stand and roll line of shawl collar.
	Stress accuracy in developing facing for collar.
	Demonstrate and explain facing is not to conform with waist style.
	Discuss seam allowance around shawl collar.
	Ask students to explain slash and spread method for gathers.
	Stress accuracy when reshaping edges.
	Elicit from students method of planning gores at back skirt.
	Elicit from students the advantage of a facing in one with sleeve (around arm).
	Stress safety precautions when using tools.
	Elicit from students the pattern symbols and markings.
D. Application	Stress importance of grain lines.
	Students proceed to draft shawl collar and short kimono sleeve, applying skills taught.
	Check students work and give individual instruction where necessary.
	Summarize and discuss next lesson.
E. Assignment	Require students to draft the kimono sleeve in their notebook using $\frac{1}{2}$" scale slopers.

SESSION # 22

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
RAGLAN SLEEVE DRESS	Briefly review previous lesson.
A. Introduction	Display a visual aid chart illustrating the following style style concepts: 1. short raglan sleeve with shoulder dart 2. V-neckline 3. stand roll shawl collar with neck seam 4. yoke on front skirt 5. skirt and waist, feature soft un-pressed pleats Have students interpret the style features. Discuss wearability of style.
B. Draft	With students participation develop dress style. Stress accuracy in marking the slopers. Demonstrate and explain formula for set-in type of raglan sleeve. (Ref. #8, Page 56) Emphasize accuracy in measuring. Elicit from students the technique of planning sleeve cuff. Elicit from students the method of planning slash lines for neck pleats. Review dart manipulation.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Development of Pattern Sections	Demonstrate and explain method of: 1. preparing sleeve 2. placing of yokes to sleeve. 3. shaping Stress accuracy in marking sections. Emphasize accuracy in shaping back and front waist. Elicit from students the technique to slash and spread to allow skirt pleats. Stress accuracy in re-shaping upper edge. Elicit from students pattern symbols and markings. Stress safety precautions when using tools.
D. Application	Students proceed to draft and develop raglan sleeve dress applying skills taught in this lesson. Check and observe: 1. planning of sleeve 2. accuracy in measuring and shaping Help where needed. Summarize and discuss next lesson.
E. Assignment	Require students to draft lesson in notebook $\frac{1}{4}$" scale. Ask students to select illustrations of cowl neckline in preparation for next lesson.

SESSION # 23

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
COWL NECKLINE DRESS	Check homework
A. Introduction	Use a visual aid chart and a finished garment to illustrate soft drapes (cowls): 1. high neck cowl 2. low neck cowl 3. square cut-out cowl with stay 4. underarm cowl Give a mimeograph sheet to students illustrating the four cowls. Discuss with students: 1. various cowls 2. uses 3, fabric suitable 4. grain line
B. Draft	Develop draft with students at demonstration table, Ref. #8, page 34. Ask students to describe method of achieving folds. Stress accuracy when planning neckline. Emphasize the importance of the underbodice.
C. Development of Cowl Neckline and Variations	Stress accuracy of grain line. Review dart manipulation. Elicit from students methods of allowing for facings. Demonstrate and explain, square cut-out cowl with stay. Emphasize importance of stay.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
D. Application	Students proceed to draft cowl neckline. Check each step and give individual instruction where necessary. Summary and review.
E. Assignment	Require students to bring in a fitting of the cowl neckline.

SESSION # 24

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
UNDERARM COWL DRESS	Check students homework
	Evaluate students' progress.
A. Introduction	Briefly review previous lesson on cowl neckline.
	Place a finished garment illustrating the underarm cowl.
B. Draft	At demonstration table, develop with students the draft of the underarm cowl.
	Elicit from students the technique of planning folds and slashing and spreading.
C. Development	Stress accuracy in measuring.
	Emphasize grain line.
	Elicit from students technique of developing under-bodice.
D. Application	Students proceed to draft and develop the underarm cowl, applying skills taught.
	Check each step and give help where necessary.
	Summarize and review.
E. Assignment	Require students to draft the variations of cowls in their notebooks (neckline and underarm).

SESSION # 25

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
DOLMAN SLEEVE DRESS	Briefly review Session #20 (Kimono Sleeve).
	Display finished garment on the dress form illustrating a Dolman sleeve.
	Use a visual aid chart illustrating variation of Dolman sleeve - (Wing sleeve, Raglan effect).
	Elicit from students the concept of the Dolman sleeve.
A. Draft	Review Lesson #20.
	Elicit from students steps involved in planning draft.
	Emphasize position of slopers.
B. Development of Dolman Sleeve Pattern Variations	Demonstrate and emphasize the lower armhole.
1. Dolman Sleeve	Elicit from students techniques in slashing and spreading for sleeve comfort.
	Stress shoulder line.
	Emphasize notches and grain lines. (Ref. #8, Page 53)
2. Wing Sleeve	Using the same draft with colored pencil, demonstrate and explain armhole line.
	Elicit from students the technique used in planning notches around armhole.
	Demonstrate and explain technique used to develop wing sleeve.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Students proceed to draft Dolman sleeve applying skills taught in this lesson. Check: 1. planning of draft 2. accuracy in measuring 3. accuracy in shaping Give individual instruction where necessary. Summarize and review variations of sleeve.
D. Assignment	Require students to draft lesson in notebook.

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SESSION # 26

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
RAGLAN EFFECT DOLMAN SLEEVE	At this stage, student should be able to apply the skill used to develop a kimono in the development of a raglan effect Dolman sleeve. Distribute to each student an illustration of the raglan effect kimono sleeve. Inform students to plan draft and development of the raglan effect dolman sleeve, based on the skills they have learned from previous lesson. Check the following: 1. proper position of slopers 2. concept of raglan shape 3. accuracy in shaping 4. increase of underarm length 5. pattern symbols and markings 6. proper use of and handling of tools 7. pattern completion Evaluate students' progress. Summarize and review test.
A. Assignment	Discuss next lesson. Require students to bring in the fitting of the raglan effect Dolman sleeve.

SESSION # 27

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
FULL LENGTH DRESS SLOPER, BACK AND FRONT	Check students' homework.
	Briefly review Session # 2 (measurements).
A. Introduction	Display a visual aid chart illustrating one-piece dresses.
	Elicit from student the sloper needed to develop one-piece dresses.
	Ask students the technique of measuring a dress length.
B. Developing Full Length Sloper	Develop draft at the blackboard. (Ref. 8, Page 27)
	Elicit from students the slopers needed to develop full length sloper.
	Elicit from students the techniques of measuring.
	Stress accuracy.
C. Application	Students proceed to develop one-piece dress sloper applying skills taught.
	Check and give individual instruction where necessary.
	Summarize and discuss next lesson.
D. Assignment	Require students to bring in muslin fitting of full length sloper to check on dress form.

SESSION # 28

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
PRINCESS LINE DRESS WITH A FLY-FRONT CLOSING	Check students' homework. Briefly review previous lesson. Use a finished garment to illustrate style features.
A. Introduction	Have students identify each style feature: 1. Princess line (Review dart manipulation) 2. fly-front (closing at center front) 3. shawl collar with notch Discuss with students: 1. fabric suitable 2. figure types 3. neckline 4. variations
B. Draft	At demonstration table encourage students to participate in developing draft. Stress accuracy in marking around full length slopers. Emphasize the importance of accuracy in measuring. Elicit from students the technique used in planning princess lines. Review Session #7 (center front closing). Review Session #21 (shawl collar). Stress safety when using tools. (Ref. #16, Page 186)

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Development of Pattern Sections	Elicit from students technique used in eliminating the side dart. Demonstrate and explain the techniques used in measuring for the fly-front closing. Allow students to determine: 1. width of collar (plan notch) 2. size of buttons 3. amount of fullness at hemline 4. width of hem Stress accuracy in measuring. Elicit from students technique used to develop shawl collar. Stress accuracy in marking grain lines. Ask students to name pattern symbols and markings.
D. Application	Students proceed to develop princess line dress, applying skill taught. Check and give individual instruction where necessary. Summarize and discuss next lesson.
E. Assignment	Require students to bring in illustrations of the princess kimono sleeve for next lesson.

SESSION # 29

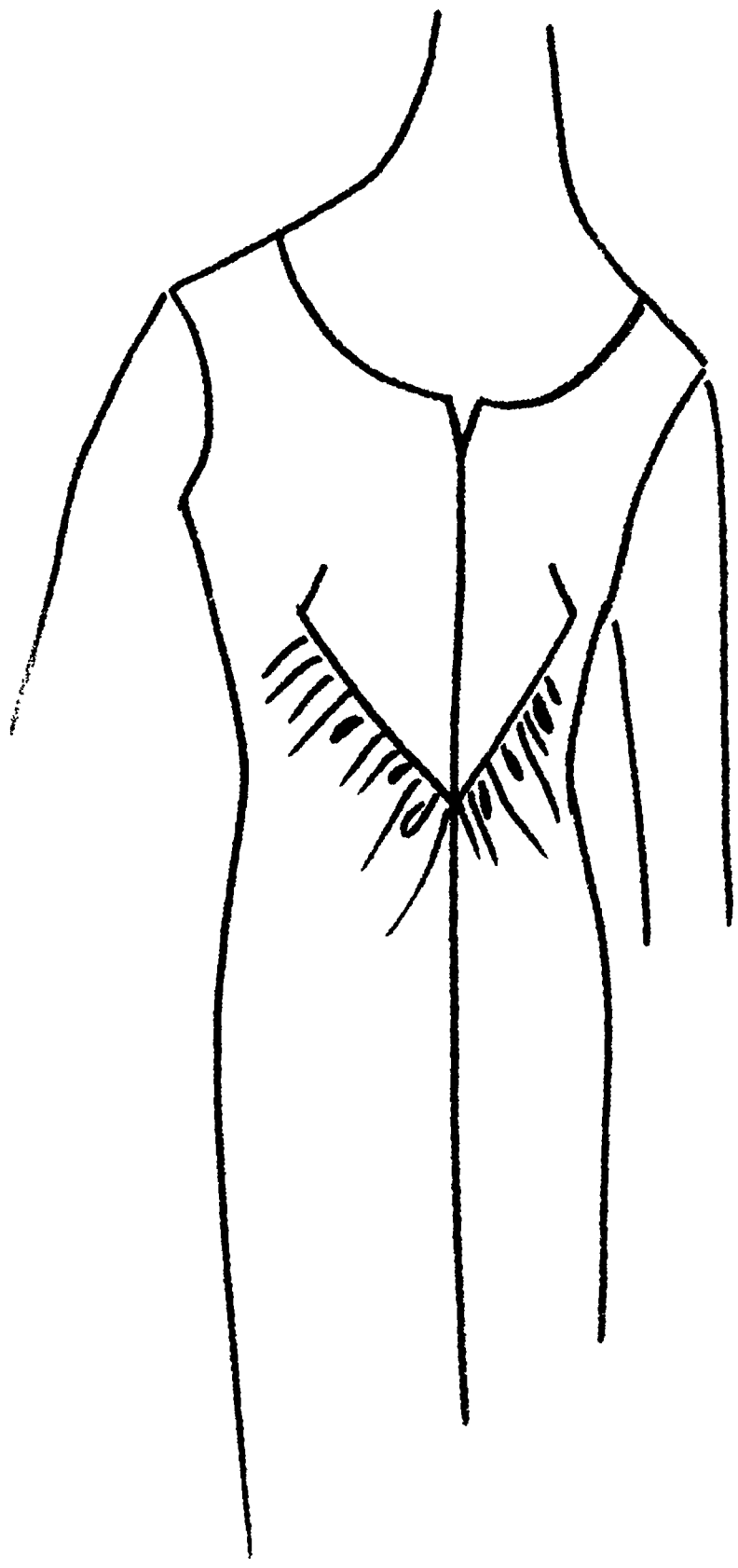
CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
PRINCESS-LINE KIMONO SLEEVE DRESS	Discuss (illustration) homework.
A. Introduction	Display finished garment on the figure illustrating: 1. the princess kimono sleeve (short) 2. bateau neckline 3. godets inserted in seam line Prepare mimeograph sketch for students' use. Have students identify style concepts.
B. Draft	Draft the princess kimono at demonstration table. Stress accuracy in marking around slopers. Elicit from students the technique of planning princess line. Encourage student participation. Allow students to plan neckline. (Ref. #5, Pg. 16)
C. Development of Pattern Sections	Demonstrate and explain the technique of placing center back and center front sections on the sleeve cap. Stress accurate measurements. Emphasize and explain importance of adding more lift to underarms. Demonstrate and explain formula for planning godets at hem line. Stress measurements involved. (Ref. #9, Pg. 129) Elicit from students method of planning hem allowance. Review Session # 9 (facings).

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
D. Application	Students proceed to draft and develop princess kimono sleeve applying skills taught. Check each step and give help where needed. Summarize and discuss next lesson.

SESSION # 30

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
AFTERNOON ONE-PIECE DRESS	Check students' homework.
A. Introduction	Put a finished garment on the figure illustrating the following style concepts: 1. scoop neckline 2. center front seam 3. skirt gathered to diagonal line 4. waist and skirt on opposite grain line Refer to illustration #3 which follows this session.
B. Draft	Ask students to identify style features. Demonstrate and develop style with students at demonstration table. Stress accuracy in marking one-piece sloper. Have students explain the technique of planning style lines. Demonstrate and explain the importance of closing darts for a fluid style line. Elicit from students the method of planning slash lines for gathers. Stress the importance of the direction of slash line. Discuss accuracy in measuring. Stress safety precautionswhen using tools.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Development of Pattern Sections	Elicit from students the formula for allowing gathers. Emphasize the importance of the width of the fabric. Elicit from students the technique used in reshaping the open edge. Stress importance of grain line. Review placement of notches (to hold gathers in place).
D. Application	Students proceed to develop one piece dress, applying skills taught in this lesson. Check: 1. planning of style line 2. direction of slash lines 3. formula for gathers 4. reshaping at the slash lines Summarize and discuss next lesson.
E. Assignment	Require students to bring in a fitting of dress style.



Afternoon one-piece dress

Illustration #3

for

session #30

SESSION # 31

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
TORSO DRESS (Circular Skirt Pleated or Flare)	Check students' homework. Have students compare fittings.
A. Introduction	Use a visual aid chart to illustrate the various types of circular skirts: 1. flare 2. sunburst pleating 3. pleating in various width Put finished agrment on figure illustrating torso line dress. Discuss and explain how the skirt styles are applied to the torso line dress. Discuss suitable fabrics. Allow students to make comparisons.
B. Planning Skirt	Discuss and explain the mathematical formula for achieving a full circle. Demonstrate and expalin the principal of a circle. Elicit from students formula for achieving pleats. Stress accuracy in measuring.
C. Drafting & Developing Torso Line	At demonstration table develop with students the torso line dress. Elicit from students the technique of planning torso line. (Ref. #6, Pg. 182) Ask students to expalin the new position of dart. (Review dart manipulations). Elicit from students method of planning facing (neck and armhole in one).

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
D. Application	Students apply skills taught and develop the torso line dress. Check and give individual instruction where necessary. Summarize and prepare class for next lesson.
E. Assignment	Require students to draft the torso line dress and circular skirt variations in their notebooks, using $\frac{1}{4}$" scale slopers.

SESSION # 32

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
DRESS WITH YOKE AND SLEEVE-IN-ONE	Briefly review previous lesson.
A. Introduction	Give to each student a mimeograph sheet illustrating style features: 1. yoke in one with gathered sleeve 2. convertible collar 3. yoke shaped Refer to illustration #4 which follows this session. Elicit from students the identity of the style features.
B. Draft	At demonstration table develop dress style with students' participation. Elicit from students technique of planning position for the front and back yoke. Review gathered sleeve. Demonstrate and explain how to divide the sleeve in the center. Explain technique of applying back and front yoke to sleeve. Stress accuracy in measuring. Elicit from students the method of planning convertible collar. Review previous lesson (dart manipulation).
C. Development of Pattern Sections	Demonstrate and explain why the under-arm length is increased, whenever sleeve cap circumference is reduced. (Ref. #8, Pg. 57) Elicit from students the pattern symbols and markings. Stress accuracy in using L-square rulers.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
D. Application	Students proceed to develop yoke and sleeve in one, applying skills taught in lesson. Check each step and help where necessary. Summarize and prepare for next lesson.
E. Assignment	In preparation for next lesson require students to bring to class an illustration of coat dresses, single and double breasted.

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Dress with yoke and sleeve in one piece.

Illustration #4

Session #32.

SESSION # 33

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
COAT DRESS A. Introduction	Discuss homework and display a finished garment on the figure illustrating the style features: 1. double breasted front 2. yoke and side panel in one piece 3. inside pockets and flaps inserted in front seams 4. shawl collar 5. short kimono sleeve Elicit from students the style features. Discuss suitable fabrics.
B. Draft	At demonstration table draft the coat dress style. (Ref. #6, Pg. 193). Elicit from students the proper slopers needed. Question students on the techniques of measuring the extension lap. Ask students to explain the method of planning the center front panel. Allow students to plan pockets. Review Session #21 (short kimono sleeve) shawl collar. Stress accuracy in using L-square ruler.
C. Development of Pattern Sections	Elicit from students the technique used to complete the pattern. Emphasize the importance of grain line and notches. Stress safety precautions when using tools.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
D. Application	Students proceed to draft the coat dress, applying skills taught. Observe students at work and give individual instruction where necessary. Summarize and prepare for next lesson.
E. Assignment	Require students to draft the coat dress style in their notebook using $\frac{1}{4}$" scale slopers.

SESSION # 34

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
EMPIRE DRESS	Check students' ho ework
A. Introduction	Prepare illustration sheets, for students use, illustrating the following style features: 1. Empire line 2. bias fold at Empire line 3. Epaulet Sleeve 4. traight band collar Discuss with students figure type for Empire line. Allow students to identify style features.
B. Draft	With students participation, draft and develop the Empire dress and style features. Demonstrate and explain technique used to plan position of back and front shoulder yoke. (Reference #8, Page 52) Stress accuracy in measuring and placing notches correctly. Review (dart manipulation). Demonstrate and explain the technique used to plan the Empire line. Stress safety when using tools.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Developing Pattern Sections	Demonstrate and explain the technique used in: 1. preparation of sleeve 2. applying shoulder yoke Stress accuracy in measuring. Elicit from students the width of collar band and Empire fold. Emphasize the importance of the grain line on: 1. collar band 2. Empire fold Demonstrate and explain the reshaping of skirt darts.
D. Application	Have studentsproceed to draft the epaulet sleeve applying skills taught. Observe and check drafts. Summarize and lead to next lesson.
E. Assignment	Require students to bring in illustration of stand-up and roll collars.

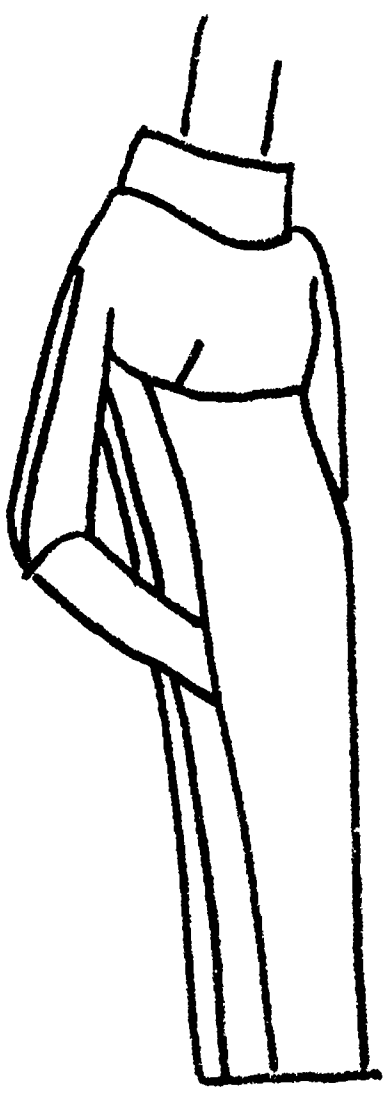
SESSION # 35

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
SLIM LINE DRESS	Discuss homework.
A. Introduction	Display a finished garment on the figure illustrating the following style concepts: 1. scoop neckline with bias cut collar 2. short sleeves cut in one with yoke 3. button closing at center back 4. inside pockets at front seam line See illustration #5 which follows this session. Discuss suitable fabrics. Allow students to identify the style concepts.
B. Draft	With student participation draft and develop the slim line dress. Elicit from students the technique used to plan: 1. position of yoke (Review Session #32) 2. scoop neckline Stress accuracy in measuring . Question students about the technique used to plan a center back closing.
C. Development of Pattern Sections	Elicit from students the method of planning the inside pocket at the front seam. Review Session #3 (inside pocket at seam). Stress accuracy in planning opening for (inside pocket). Demonstrate and explain the technique used to plan the bias cut collar: 1. accurate measuring of neckline 2. determining the width of collar 3. stress importance of grain line of collar

CONTENT OUTLINE	TEACHING SUGGESTIONS& METHODS
D. Application	Have students plan and develop: 1. collar 2. yoke 3. inside pockets Check and observe pattern completion. Summarize and prepare for next lesson.
E. Assignment	Require students to plan and develop draft of slim line dress with bias cut collar in their notebooks using $\frac{1}{4}$" scale.

Slim line dress with bias cut collar

Illustration #5



Session #35

SESSION # 36

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
REVIEW AND TEST (SLEEVELESS DRESS)	At this stage students should be able to apply skills learned in previous lesson. Display a finished garment on the figure and give individual sketches to students illustrating the following style trends: 1. bateau neckline 2. shaped band collar 3. Sleeveless 4. darts hidden in style line 5. welt pockets on front skirt Ask students to draft and develop the given style. Using the basic skills and techniques taught in previous lessons, check: 1. correct use of slopers 2. accuracy in planning neckline 3. technique in planning collar 4. application of dart manipulation 5. placement of pockets 6. pattern completion: pattern symbol grain line notches seam allowance Summarize by having students evaluate work. Discuss each step and cite strengths and weaknesses. Encourage additional study and practice to overcome weaknesses.

SESSION # 37

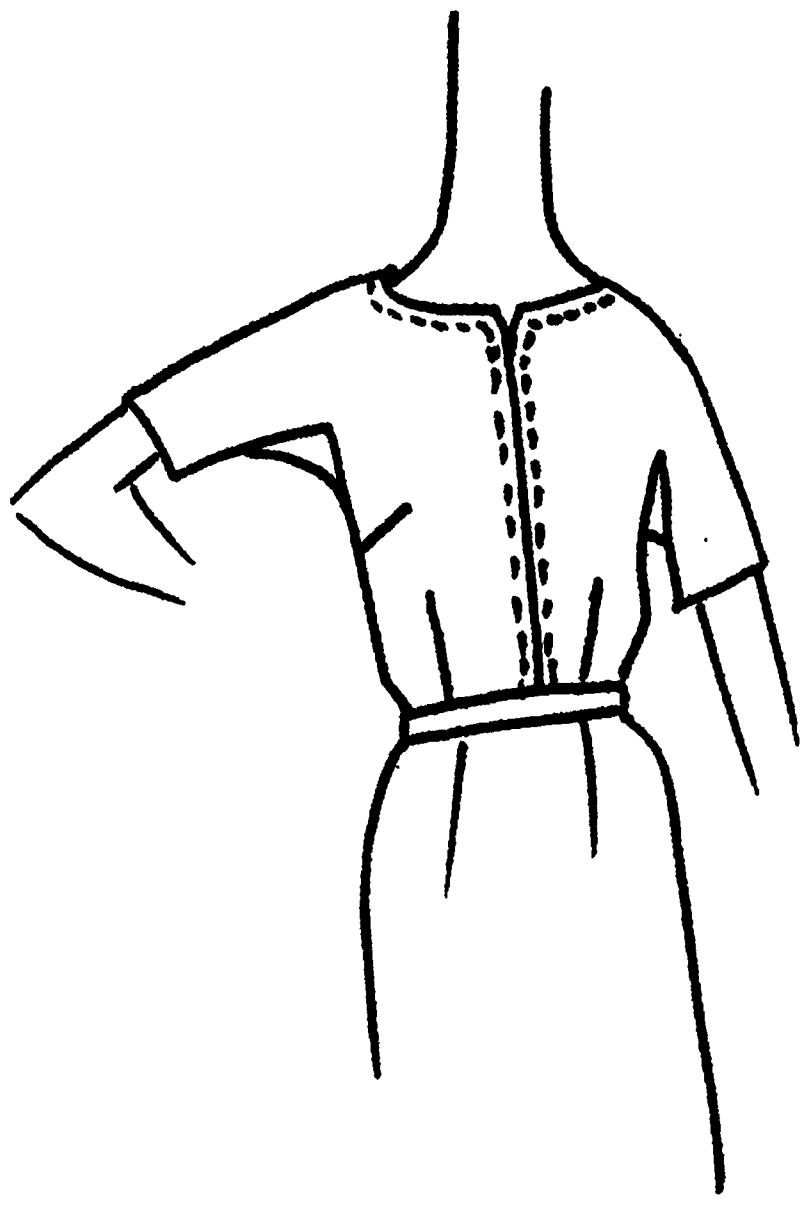
CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
KIMONO SLEEVE DRESS WITH GUSSETS	Check homework Evaluate students' progress.
A. Introduction	Display a visual aid chart illustating various kimono sleeves: 1. plain kimono 2. raglan effect kimono 3. styled armhole kimono 4. princess kimono 5. kimono with gusset See illustration #6 which follows this session. Discuss the various kimono sleeves. Allow students to make comparisons. Display a finished garment illustrating: 1. kimono sleeve with gusset 2. bateau neckline 3. center front waist slot seam
B. Draft	At demonstration table, develop the draft of the kimono sleeve with gusset. Elicit from students the slopers necessary to draft kimono sleeve with gusset. Demonstrate and explain the technique of planning the gusset slash positions, on the back and front waist. Emphasize accuracy in measuring. Using colored pencil demonstrate and explain the seam allowance at the gusset positions. Reference #10, page 303.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Development of Pattern Sections	Demonstrate and explain the technique used in pivoting at point of gusset slash lines. Stress importance of increasing shoulder length. Reference #8, page 59. Demonstrate and explain slot seam. Stress accuracy in using L-square ruler. Emphasize safety when using tools.
D. Application	Students proceed to draft and develop the kimono sleeve with gusset applying skills taught in this lesson. Check the following: 1. position of slopers 2. position of gusset slash lines on the back and front. Give individual instruction where necessary. Summarize and prepare for next lesson.
E. Assignment	Require students to bring in the fitting of the kimono sleeve with gusset.

Kimono sleeve with gussets

Illustration
#6

Session
#37



SESSION # 38

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
KIMONO SLEEVE WITH GUSSET (Continued)	Check homework
A. Introduction	Discuss and compare students' work. Display a finished garment illustrating a kimono sleeve in stripe fabric. Prepare sheets for students' use illustrating kimono sleeve in striped fabric. Briefly review previous Session #37 (kimono sleeve with gussets)
B. Draft	At demonstration table draft the kimono sleeve. Elicit from students the slopers needed. Demonstrate and explain the technique used in: 1. preparing sleeve 2. pivoting back sloper to sleeve 3. applying front sloper to sleeve Relate to stripes, checks, plaids. Emphasize accuracy in using L-square ruler and measuring. Reference #10, page 309, 311, 313. Demonstrate and explain the technique used in planning gusset lines for striped fabrics.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Development of Pattern Sections	Emphasize and explain importance of notches at shoulder and elbow line.
	Demonstrate and explain method used in matching stripe lines.
	Emphasize accuracy when transferring stripe line of waist to gusset. Reference #10, page 315.
	Demonstrate and explain the gusset can be cut in two pieces.
D. Application	Students proceed to develop the kimono sleeve (for striped fabrics) applying skills taught.
	Check students work and give individual instruction where necessary.
	Summarize and prepare for next lesson.
E. Assignment	Require students to bring in a fitting in striped fabric of the kimono sleeve.

SESSION # 39

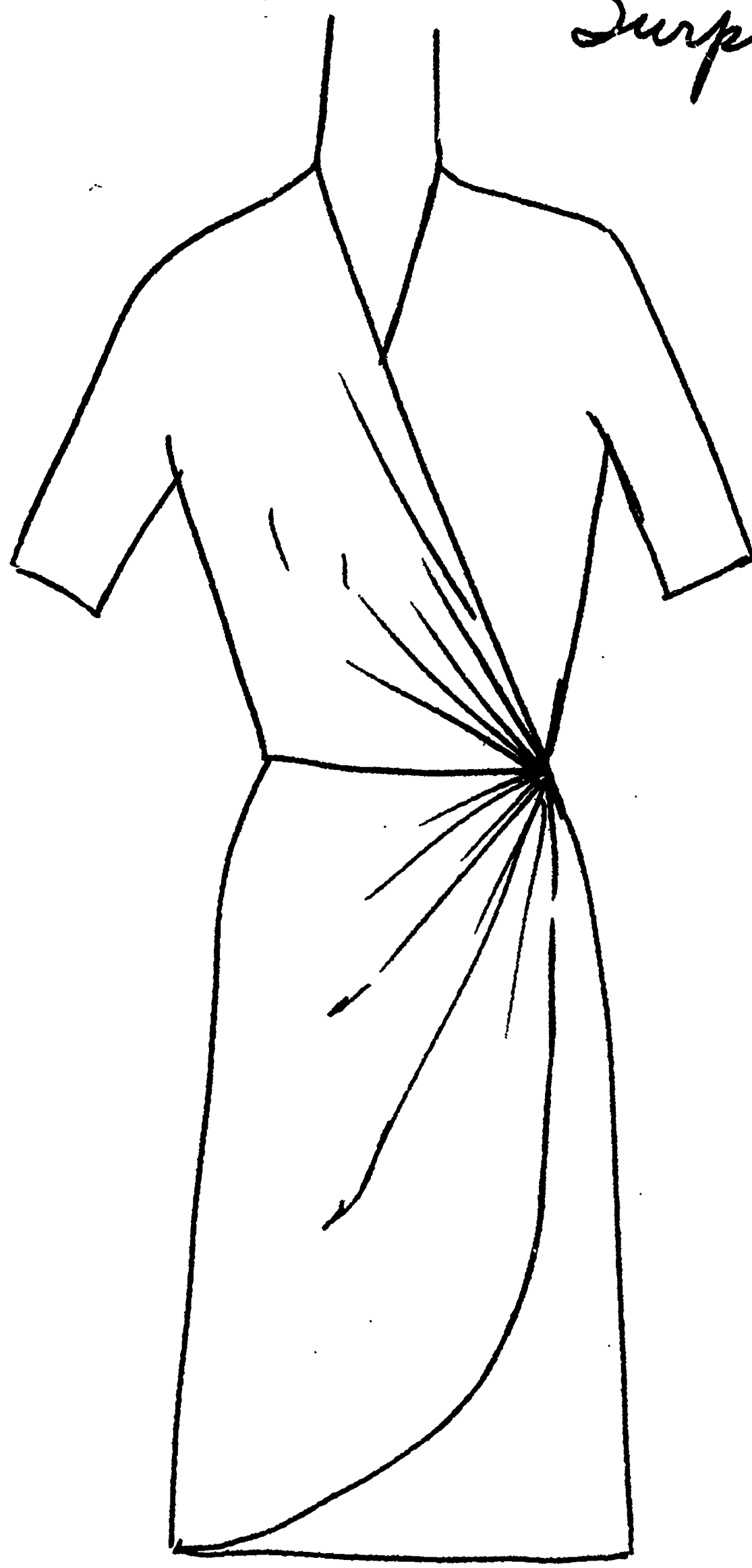
CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
SURPLICE DRESS	
A. Introduction	Check homework Discuss and compare students' work. Display a finished garment or a sketch on the figure illustrating the following style features: 1. short kimono sleeve with gusset 2. draped surplice front waist 3. draped surplice front skirt See illustration #7 which follows this session. Elicit from students the identity of style features.
B Draft	Discuss suitable fabrics. At demonstration table develop short kimono sleeve with gussets. Review previous session (Kimono Sleeve with Gussets). Emphasize accuracy in measuring. Demonstrate and explain technique in planning surplice front waist and skirt. Elicit from student the technique in planning slash line.
C. Development of Pattern Sections	Review Slash and Spread Elicit from students the formula for gathers. Stress safety when using tools. Demonstrate and explain the technique used to plan the facing-in-one with the surplice front. Elicit from student the technique used to plan the facing on a shaped surplice skirt. Question students on the pattern symbols and markings.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
D. Application	Students proceed to develop the draped surplice dress, with short kimono sleeve with gusset applying skills taught in this lesson. Check and give inidvidual instruction where necessary.
E. Assignment	Summarize and prepare for next lesson. Require students to plan draft of short kimono sleeve with gusset in their notebook $\frac{1}{4}$" scale slopers.

Surplice Front

Illustration #7

Session #39



SESSION # 40

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
AFTERNOON DRESS WITH FLARED TIERS	Briefly review previous lesson (draped bodice and skirt).
A. Introduction	Prepare illustration sheets for students use of the dress style (flared tiers). Elicit from students the style features: 1. keyhole neckline (bead embroidery) 2. circular cape sleeve 3. skirt (hip flared tiers) Discuss suitable fabrics and figure types for this style.
B. Draft	Demonstrate the dress style at the table with students' participation. Elicit from students the technique used to plan the keyhole neckline. Stress accuracy in measuring. Demonstrate and explain the method of preparing the front waist for bead embroidery (allowing for shrinkage). Demonstrate and explain the technique used in planning the skirt tiers.
C. Development of Pattern Sections	Review Session #31 (Circular Flare). Elicit from students the technique used to prepare the flared tiers. Discuss edge finish and apply to above. Demonstrate and explain that the technique used to prepare flared tiers can be applied to the sleeve (circular cape sleeve). Stress accuracy in measuring.
D. Application	Students proceed to draft and develop the afternoon dress applying skills taught in this lesson.

SESSION # 41

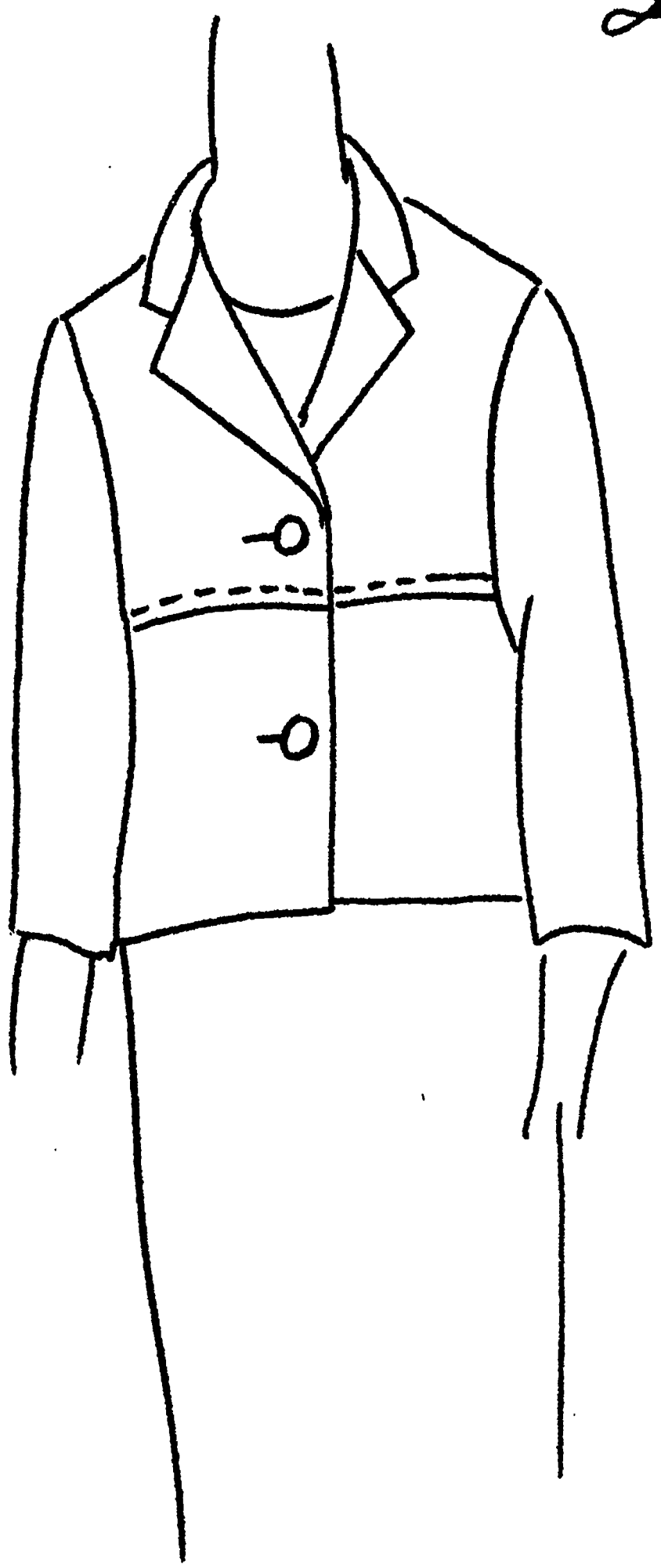
CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
JACKET-NOTCHED COLLAR	Check homework and review.
A. Introduction	Display a finished garment illustrating the notched collar. See illustration #8 which follows this session. Elicit from students the wearing apparel suitable for the notched collar. Discuss suitable fabrics for jackets.
B. Drafting the Notched Collar	At demonstration table draft the notched collar.
C. Jacket Slopers	Demonstrate and explain the technique in developing jacket slopers from hip-length sloper. Stress need for accuracy in measuring. Elicit from student the length of jacket. Demonstrate and explain the formula used to draft the notched collar. Use Reference #8, page 42. Emphasize: 1. accuracy in folding roll line 2. accuracy in tracing Demonstrate the technique used to style notched collar.
D. Developing Pattern Sections	Demonstrate and explain technique used in tracing the collar sections. Emphasize: 1. accuracy 2. grainlines 3. the top collar and lapel facing are slightly larger Explain interfacings

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
D. Developing Pattern Sections (Continued)	Demonstrate and explain developing of jacket lining. Stress accuracy in measuring and making the necessary allowances. Elicit from students the pattern symbols and markings.
E. Application	Students proceed to draft and develop notched collar, applying skills taught in this lesson. Check: 1. use of formula 2. accurate measuring and tracing 3. grainlines 4. pattern completion Give help where needed. (Give group or individual instruction when necessary).
F. Assignment	Summarize and prepare for next lesson. Require students to construct a fitting illustrating the notched collar. Require students to draft the notched collar in their notebook using $\frac{1}{4}$" scale slopers.

Jacket with Notch Collar

Illustration #8

Session #41



SESSION # 42

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
JACKET SLEEVE	Briefly review previous lesson.
	Check homework.
A. Introduction	Use a visual aid chart illustrating the tailored two-piece sleeve.
	Briefly review basic sleeves.
B. Drafting	At the demonstration table draft the tailored two-piece sleeve.
	Explain and demonstrate method of developing jacket sleeve sloper from dress sleeve sloper.
	Demonstrate and explain the technique used to draft the tailored two-piece sleeve in reference #8, page 60.
	Emphasize accuracy in measuring.
	Explain and stress importance of notches.
	Stress accuracy when folding sleeve.
	Using colored pencil outline each section on draft.
C. Development of Pattern Sections	Stress accuracy in tracing and allowing seam allowance.
	Elicit from students the technique of measuring for the sleeve hem.
	Explain and demonstrate method used in developing sleeve lining.
	Stress accuracy in measuring.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
D. Application	Students proceed to draft and develop the tailored two-piece sleeve applying skills taught. Check and give individual instruction where necessary. Summarize and discuss next lesson.
E. Assignment	Require students to construct a fitting of the tailored two-piece sleeve, and insert into jacket armhole. Require students to draft tailored two-piece sleeve in their notebooks using $\frac{1}{4}$" scale sleeve sloper.

SESSION # 43

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
COAT (double breasted)	Check homework.
A. Introduction	Display a finished garment and a visual aid chart illustrating the coat style. Elicit from students the identity of the coat style: 1. double breasted 2. notched collar with rounded edges 3. 3/4 tailored two-piece sleeve with cuff 4. easy fitting Discuss uses and fabrics suitable for coat style. Demonstrate at table with student participation.
B. Drafting	Demonstrate and explain the technique used to develop coat sloper from the jacket sloper. Review session #33 (double breasted). Demonstrate and explain technique used to construct a loose fitting coat. Briefly review session #41 (notched collar). Elicit from student the technique used to construct the notched collar with rounded edges. Stress accuracy in measuring. Question students for the method of drafting the tailored two-piece sleeve. Allow students to plan sleeve cuff.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Developing Pattern Sections	Elicit from students the technique used to develop the collar and lapels. Elicit from students the pattern symbols and markings.
D. Application	Students proceed to draft and develop coat style applying skills taught. Check and give individual instruction where necessary. Summarize and discuss next lesson.
E. Assignment	Require students to draft the coat style in their notebook using $\frac{1}{4}$ scale slopers. In preparation for next lesson require students to bring in illustrations of variations of culottes styles.

SESSION # 44

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
CULOTTES	Discuss assignment (culotte style).
A. Introduction	Use a visual aid chart illustrating various culotte styles. Display a pattern company's chart illustrating the technique of taking measurements for the crotch depth. Discuss uses of the culottes.
B. Measuring Crotch Depth	Demonstrate and explain technique used to determine crotch depth length. Allow students to measure each other.
C. Drafting	Elicit from students slopers used to develop culottes pattern. Demonstrate and explain the technique used to draft culottes pattern using the skirt sloper. Emphasize accuracy in measuring: 1. crotch depth line 2. formula on back and front 3. shaping Reference #8, page 62. At demonstration table with student participation, demonstrate draft of culottes using the one-piece dress sloper. Elicit from students crotch depth length. Question students for the formula. Emphasize and explain the technique of shaping crotch depth line.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
D. Developing Pattern Sections	Demonstrate and explain technique used to plan inverted pleat at center back and at center front. Stress accuracy in using L-square ruler and measuring. Allow students to plan square neckline and buttonhole pocket. Elicit from students the pattern symbols and markings.
E. Application	Students proceed to draft and develop the culottes dress pattern applying skills taught in this lesson. Check and give individual instruction where necessary. Summarize and discuss next lesson.
F. Assignment	Require students to draft the culottes pattern in their notebooks using $\frac{1}{4}$" scale slopers.

SESSION # 45

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
TROUSERS	Briefly review previous lesson.
A. Introduction	Display a visual aid chart illustrating various types of trousers. Prepare sheets for students use illustration (two legged sportswear). Use Reference #8, page 61. Discuss the various types of trousers.
B. Drafting the Trouser Slopers	Elicit from the students the measurements needed to develop trousers such as: 1. wasit 2. hip 3. full length 4. crotch depth Demonstrate and explain the technique of drafting the trousers. Review previous lesson #44 (crotch measurement). Explain the difference in the front crotch measurement when making trousers. Use Reference #10, page 127. Emphasize accuracy in measuring. Stress accuracy in using L-square ruler Using colored chalk to illustrate on board the various length of two-legged sportswear.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Require student to draft trouser pattern applying skills taught in this lesson. Check the following: 1. accuracy in measuring 2. using correct formula 3. accuracy in using L-square ruler Give help where necessary. Summarize and review.
D. Assignment	Require students to draft the trousers in their notebook using $\frac{1}{4}$" scale measurements. Require students to bring in illustrations of cape styles in preparation for next lesson.

SESSION # 46

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
CAPE WITH HOOD	Discuss assignment (cape styles).
A. Introduction	Display a finished garment illustrating the cape style with a hood. Elicit from students the various silhouettes of cape styles (width and length).
B. Drafting	Elicit from students the slopers needed to draft the cape. Demonstrate and explain the technique used to draft the cape style. Use Reference #8, page 69. Elicit from students the measurements needed to draft the hood: 1. neck measurement 2. width of top head 3. height of head Use Reference #8, page 70. Stress accuracy in measuring.
C. Developing Pattern Sections	Demonstrate and explain the technique used for additional fullness. Indicate technique used for striped fabric (allowing stripe to match at shoulder seam). Stress accuracy in measuring. Demonstrate and explain the technique used for the hood in striped fabric.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
D. Application	Students proceed to draft the cape and hood pattern, applying skills taught. Check and give individual instruction where necessary.
E. Assignment	Require students to draft cape and hood in their notebooks using $\frac{1}{4}$" scale slopers. Prepare for next lesson by telling students that a review for the final examination will be included in the next lesson.

SESSION # 47

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
REVIEW LESSON	Use a selected garment to review the highlights of the course in preparation for the final examination.
A. Introduction	Prepare an information sheet on sketch interpretation. The garment features: 1. kimono back, raglan effect kimono front 2. draped asymmetric skirt
B. Dress Style Development	Review by demonstration, discussion and illustration: 1. sketch interpretation 2. kimono sleeve 3. dart manipulation 4. surplice concept 5. facings 6. slash and spread 7. notches and grainlines
C. Application	Students construct a pattern of the style displayed on form. Observe work in progress and check for: 1. sketch interpretation 2. application of learned principles and development 3. pattern completion a. grain lines b. pattern symbols c. notches 4. trade techniques 5. use of tools 6. safety practices Summarize lesson. Urge students to review their notes in preparation for final examination.

SESSION # 48

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
FINAL EXAMINATION	Distribute final examination. Check condition of shop and equipment. Observe test in progress. Check: 1. sketch interpretation 2. neatness and accuracy 3. observation of safety rules 4. use of tools and equipment 5. pattern development and completion 6. students' knowledge of related information 7. trade techniques 8. transfer of learning Use scoring sheet to record students' progress.

SESSION # 49

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
CRITICISM AND EVALUATION	Review final examination.
A. Course and Final Examination Review	Encourage students to evaluate their own work and that of others.
	Use remaining time to allow students to question previous lessons, and to clarify any unsolved problems.
	Emphasize students' strengths and weaknesses.
	Discuss methods of retaining assets and of overcoming weaknesses.

VT 011 237

Women's Wear, Elementary Patternmaking. Suggested Content Outline and Teaching Guide.

New York City Board of Education, Brooklyn, N.Y. Evening Trade Schools
New York State Education Dept., Albany. Div. of Industrial and Occupational Extension Education

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ABSTRACT - Prepared by a trade school teacher, this guide is for use in teaching an elementary patternmaking course consisting of 50 2-hour sessions to apprentices and journeymen employed in the apparel industry. Course objectives, sample lesson plan, references, content outlines, and teaching suggestions are given for each session. The guide also includes 25 illustrations. The advanced patternmaking guide is available as VT 011 236 (also in this issue). (SB)

VT 011 237

ERIC

ED0 45856

SUGGESTED CONTENT OUTLINE AND TEACHING GUIDE

WOMEN'S WEAR,

P A T T E R N M A K I N G,

Elementary

U.S. DEPARTMENT OF HEALTH, EDUCATION
& WELFARE
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PREFACE

This teaching guide, Women's Wear, Elementary Patternmaking, is one in a series which has been prepared for the instruction of apprentices and journeymen all of whom are employed in the apparel industry.

Other teaching guides in this series have been prepared in the areas of Costume Sketching, Draping, Trade Dressmaking, Garment Machine Operating, Foundation Garment Manufacturing, Tailoring and Millinery.

The development of this course outline and teaching guide is the work of Alfred A. Arena, who is currently teaching at the Evening School of Fashion Industries, and at the Fashion Institute of Technology.

FOREWORD

This guide was written to assist both the regularly licensed teacher and the skilled craftsman of industry who may be selected to teach the subject. Since skilled workers may not necessarily be familiar with methods of instruction, the teaching guide makes an attempt to meet their pedagogical needs.

The project was initiated by the Board of Education of the City of New York, Evening Trade School Division, at the request of Michael M. Katzoff, Principal of the High School of Fashion Industries. The writing was done under the direction and supervision of Henry J. Burfeind, Coordinator of Evening Trade Schools, and Vincent A. Troiano, Assistant Coordinator in charge of curriculum construction.

The guide was approved for instructional purposes by the following personnel who are currently employed in evening trade schools in administrative and supervisory capacities: Theresa S. Fanelli and Gaetana Valenti, Evening School of Fashion Industries; Gilda G. Amendola, Jane Addams Evening Trade School; Rose Garretson, Sarah J. Hale Evening Trade School.

The material was reviewed and approved by the Advisory Board for Vocational and Extension Education (Eli Cohen, Chairman; Louis Cenci, Executive Secretary). It was also approved by the Fashion Crafts Educational Advisory Commission (Nicholas Parker, Chairman).

A C K N O W L E D G E M E N T S

The personnel involved in the production of this teaching guide express their appreciation to the Superintendent's Office of the Board of Education of the City of New York for its encouragement and support in this work.

Similarly, gratitude is also acknowledged to The State Education Department, Division of Industrial and Occupational Extension Education, for its leadership and cooperation in this endeavor, both of which are necessary for the satisfactory completion of a project of this magnitude.

Appreciation is also expressed to Matthew Schoenwald, Manager of the Undergarment and Negligee Workers Union, Local No. 62 for editing this material and to Constantine Philippas and Walter R. Schoff, production technical advisers who are currently employed at the Printing Trades Evening School.

PATTERNMAKING

Elementary

COURSE OBJECTIVES

1. To develop in students an understanding of the basic concepts and principles fundamental to women's wear patternmaking.

2. To enable students to learn the basic skills, practices and terminology fundamental to the apparel industry.

3. To develop an awareness of safe practices with tools and equipment used in patternmaking, and the intelligent use of materials.

4. To enable students to acquire knowledge of the various techniques of interpreting a sketch in relation to developing a pattern according to professional procedures and standards.

5. To develop the concept of grain and handling properties of fabric in relation to patternmaking.

6. To teach accepted trade standards of workmanship with stress on requirements of industry in the matter of placement.

7. To familiarize students with all areas of garment development.

8. To motivate the students to keep abreast of the latest techniques and methods of patternmaking.

SUGGESTIONS FOR THE USE OF THIS OUTLINE

This course in Elementary Patternmaking is arranged according to sessions. Each session represents a two-hour period of instruction. The entire course is comprised of 50 sessions or a total of 100 hours.

The outline lends itself to the following uses:

1. The sequence of lessons proceeds according to the problem and procedure a craftsman encounters in a trade shop. It adheres to the pedagogical principle of learning from the simple to the complex.

2. In most instances the new overlaps the old, providing an automatic review at the outset of each new lesson and adhering to the principle of learning through repetition.

3. It enhances instruction as it stresses the teaching points that should be emphasized by the teacher.

4. It allows the teacher the time to offer individual or small group instruction.

From the outset of the course the class produces live work. The projects developed are comparable to those in industry and reflect problems that would be encountered in industry.

References suggested for each lesson are numbered to correspond with the references listed on the following page.

The lesson presentations are enriched if the teacher utilizes the 25 suggested illustrations which are appropriately placed throughout this guide.

REFERENCES

1. OCCUPATIONAL OUTLOOK IN THE GARMENT INDUSTRY
   U. S. Government Printing Office, Washington, D. C.

2. TEACHERS' MANUAL

3. FUNDAMENTAL PRINCIPLES OF PATTERNMAKING FOR MISSES AND WOMEN'S GARMENTS
   Irving E. Curtis
   I. E. Curtis
   17 Walnut Court
   South Orange, N.J.

4. PRACTICAL DRESS DESIGN
   Mabel D. Erwin
   MacMillan Company

5. FUNDAMENTALS OF PATTERNMAKING FOR WOMEN'S APPAREL - BOOK 1- FOUNDATION PATTERNS - BOOK 11 - STYLE PATTERNS
   Ester Kaplan Plvnik
   Pattern Publications
   Cold Spring Harbor, N.Y.

6. MODERN PATTERN DESIGN
   Harriet Pepin
   Funk and Wagnalls Co., N.Y.

7. HOW TO DESIGN YOUR OWN DRESS PATTERNS
   Adele P. Margolis
   Hanover House, N.Y.

8. THE THEORY OF FASHION DESIGN
   Helen L. Brockman
   John Wiley and Sons, N.Y.

9. SCHOOL SHOP SAFETY MANUAL

10. DRESS DESIGN-DRAPING AND FLAT PATTERNMAKING
    Marion S. Hillhouse and Evelyn A. Mansfield
    Houghton Mifflin Co., N.Y.

11. FLAT PATTERN METHODS
    Norme R. Hollen
    Burgess Publishing Co.
    428 South 6th Street
    Minneapolis, Minn. 55415

12. DESIGNING APPAREL THROUGH THE FLAT PATTERN
    Ernestine Kopp, Vittorina Rolfo, Beatrice Zelin
    Fairchild Publications, Inc , N.Y.

SUGGESTED SAFETY INSTRUCTION

Every student must receive general safety instruction before she is permitted to do any shopwork. Specific safety instruction is given by the teacher during demonstration lessons or in the course of individual instruction.

A written test must be conducted following instruction in general safety. No student may be permitted to begin shopwork until she has passed the test with 100%. A notation that a student has received this instruction is to be made on the student's permanent record card.

SPECIMEN ITEMS FOR GENERAL SAFETY INSTRUCTION

1. A student entering the shop has three major responsibilities:

   a. to herself.

   b. to her fellow students

   c. to the shop equipment

2. Habitual carelessness or non-observance of safe behavior and practices is sufficient for denial of shopwork Industry wants a safe, not a careless worker.

3. Think and be alert, follow instructions and always be careful. Bear in mind that most injuries are painful, some incapacitating.

4. When in doubt, ask the teacher. Do not rely upon another student.

5. Report any injury, no matter how slight, to the teacher at once.

6. Observe fire drill and air raid procedures. Explain school regulations.

NOTE

The foregoing items for teacher-student discussion will indicate to the teacher the nature of the contents she should prepare for complete coverage of the subject as it relates to the activity.

The Outline started here should be expanded by the teacher according to the particular requirements of the shop.

SPECIMEN DEMONSTRATION LESSON PLAN

The first basic requirement for successful instruction is planning. The presentation of an effective lesson will depend to a large extent on your ability to plan in advance. The aim of the lesson and your means of attaining it must be determined before you meet your class.

The following outline is a sample which indicates all of the steps a successful teacher should follow:

AIM

a. Teacher's ... Tools, equipment, teaching aids, charts, etc.

b. Student's . . Reading assignment, pens, pencils, previous jobs.

c. Motivation . Connect the new with the old. Interest the student in the need of the lesson.

Arouse curiosity.

Emphasize personal gain.

PRESENTATION

Outline the principles, skills and practices to be learned step by step. Complete the lesson aim, listing each operation in the proper order of performance.

Be sure to include safety instruction whenever the need arises.

APPLICATION

Provide immediate opportunity for the students to put to use the knowledge and skills learned. The student should spend the greater part of the time applying, or practicing, that which he has been taught.

SUMMARY

Provide a review which will indicate to what extent the aim of the lesson has been achieved. Prepare key questions in advance.

ASSIGNMENT

A definite and appropriate assignment is a logical outcome of the demonstration, or lesson, to provide further application of the knowledge and skill learned.

REFERENCES

Give titles of books, booklets, and manuals, citing authors, chapters, and pages to which reference is made.

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5.	Basic One Piece Sleeve Sloper
6.	Forming Oaktag Slopers
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8.	Basic Skirt Sloper (Continued)
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10.	Concept of Dart Manipulation on Skirt Front: 3 Positions, Curved Darts
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12.	Division of Basic Dart on Bodice Front: 4 Positions
13.	Division of Basic Dart on Skirt Front and Sleeve
14.	Decorative and Structural Darts on Bodices
15.	Decorative and Structural Darts on Skirt Front
16.	Application of Dart Manipulation to Dart Tucked Bodices
17.	Application of Dart Manipulation to Dart Tucked Skirts
18.	Application of Dart Manipulation to Gathered Neckline Bodice
19.	Application of Dart Manipulation to Blouson Bodice
20.	Application of Dart Manipulation to Gathered Skirts
21.	Application of Dart Manipulation and Concept of Added Fullness to Sleeves

SESSION	TOPIC
	Review and Testing
23.	Converting Darts to Seamlines: Princess Line Bodices
24	Converting Darts to Seamlines: Princess Line Bodices; Variations
25.	Converting Darts to Seamlines: 6 Gore Slim Skirt; Waistline Facings
26.	Yokes - Structural and Decorative on Upper Bodice
27.	Yokes - Structural and Decorative on Lower Bodice and Upper Skirt
28.	Necklines, Garment Openings, Facings: Symmetric and Asymmetric Necklines
29.	Set-in Flat Fitting Collars: Peter Pan, Shawl, Sailor
30.	Set-in Stand or Roll Collars: Peter Pan, Shawl, Sailor, Convertible
31.	Set-in Stand Up Collars: Mandarin, Wing, Stovepipe
32.	Set-in Collar Variations: Bias Roll, Cape, Roll-fitted
33.	Collars-in-one with Front: Tailored Shawl
34.	Collars-in-one with Front: Tailored Notch
35.	Slashing and Spreading for Cowls: Necklines
36.	Slashing and Spreading for Cowls: Skirts
37.	Circular Skirts: Full, Half, Yoke and Circular Skirt, Dirndl Circular
38.	Circular Sleeves: Shirtwaist, Bell, Lantern, Push-up, Leg-o-mutton
39.	Inverted Pleated Skirts with Pockets: 6 Gore Flare Skirt, Slim Skirt with Kick Pleat
40.	Pleated Skirt Variations: Skirts Pleated to Waist and Hip Measurements, Pleated Flounce

SESSION	TOPIC
41.	Pleated Bodices: Pleated Front, Back with Yoke and Pleats, Tucked Front
42.	Short Sleeves-in-one with Bodice: Kimono, Kimono with Dropped Shoulder, Cap Sleeve
43.	Long Sleeves-in-one with Bodice: Basic Kimono Sloper, Kimono with One and Two Piece Gusset
44.	Short Sleeves Using Part of Bodice: Epaulet, Dolman, Raglan
45.	Long Sleeves Using Part of Bodice: Raglan, Yoke and Shirtwaist Sleeve
46.	Review Lesson
47.	Review Lesson (Continued)
48.	Final Examination
49.	Criticism and Evaluation
50.	Summary, Shop Security, Certificates

SESSION #11

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
ORGANIZATION AND ORIENTATION	Introduction - Welcome
	Class organization Registration card Attendance card Roster Attendance sheet
	School rules and regulations Fire and shelter drills Attendance and punctuality Certificate requirements Diploma requirements
A. Scope of Course	Discuss with students the fundamental principles of women's wear garment patternmaking.
B. Tools and Safety	Describe and illustrate by demonstration the tools required, and the specific safety rules regarding these tools.
	Adminster safety test.
C. Notebooks	Explain the need for a notebook which is to be kept in 1/4 or 1/8 scale.
	Emphasize the fact that these notebooks will serve as an excellent reference work for the Advanced Patternmaking Course, and for reviewing previous work.
D. Related Information	Discuss the employment possibilities in the garment industry; current salaries and opportunities for advancement.
	References: #1 #2 #6, page 112 #7, page 18 #9

LION # 2

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
BASIC BACK BODICE SLOPER	Students select dress form.
A. Introduction	Discuss related information on dress form such as : 1. size ranges 2. types of forms 3. safety Reference #4, pages 6 and 7. #8, page 120. Describe which areas of clothing industry use different forms
B. Measuring Form for Back Bodice	Using different colored tapes, indicate on the dress form the various areas and positions that are to be measured. Reference #3, page 11. Refer to illustration #1. Demonstrate proper use of tape measure. Stress importance of accuracy when measuring or applying measurements. Indicate how darts are used to shape a garment by molding fabric on form. Reference #7, page 22 and 23.
C. Drafting Back Sloper	Demonstrate squaring of lines, using "L" square. Illustrate on board. Reference #3, page 13 Caution students on safe use of square. Students should be aware of the association of the dress form measurements as applied to the drafting. Form draft on board in large scale, using similar colored chalk as tapes used on form. References: #3, pages 11, 13, 14 #8, pages 134, 135.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
D. Application	Have students draft the bodice back. Supervise and check for squaring of lines and accuracy of measurements. Summarize and prepare students for next lesson.

SUGGESTED METHOD OF TAPING BACK DRESS FORM

(VISUAL AID FOR OBTAINING MEASUREMENTS)

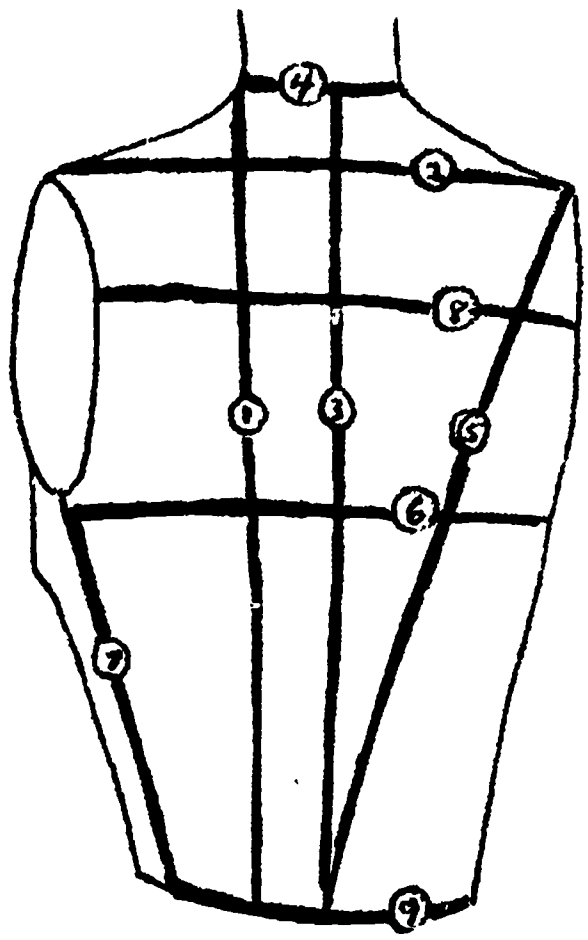


Illustration #1

1. Full Length Position (Red Tape)
2. Width Across Shoulders (Yellow Tape)
3. Center Back Length (Green Tape)
4. Back Neck (White Tape)
5. Shoulder Slope (Blue Tape)
6. Full Body Width (Orange Tape)
7. Side Length (Black Tape)
8. Width Across Shoulders (Pink Tape)
9. Waist (Light Green Tape)

SESSION # 3

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
BASIC FRONT BODICE SLOPER	Review the dress form and previous lesson.
A. Introduction	Stress the importance of accuracy in measuring. Emphasize the function of the waist-line dart, relating it to the low and high points of the body. Indicate other parts of the body that would require dart fittings, using visual aid of dress form or human. Reference #7, pages 22 and 23.
B. Measuring Form for Front Bodice	Using similar colored tapes as back, indicate on the dress form the various areas and positions that are to be measured. Reference #3, page 12. Refer to illustration #2 Review use of tape measure. Side seam length is obtained by measuring back bodice draft.
C. Drafting Front Sloper	Review squaring of lines. Emphasize the association of measure-ments taken on the dress form to the draft. Draft on board, or white paper, in larger scale, using colored chalk. (See previous lesson.)
D. Application	Have students draft the bodice front. Observe and check work in progress. Check: 1. squaring of lines 2. accuracy of measurements Summarize and prepare students for next lesson. Ask students to bring in muslin. References: #3, page 12, 16 #2 #8, pages 132, 133

SUGGESTED METHOD OF TAPING FRONT DRESS FORM

(VISUAL AID FOR OBTAINING MEASUREMENTS)

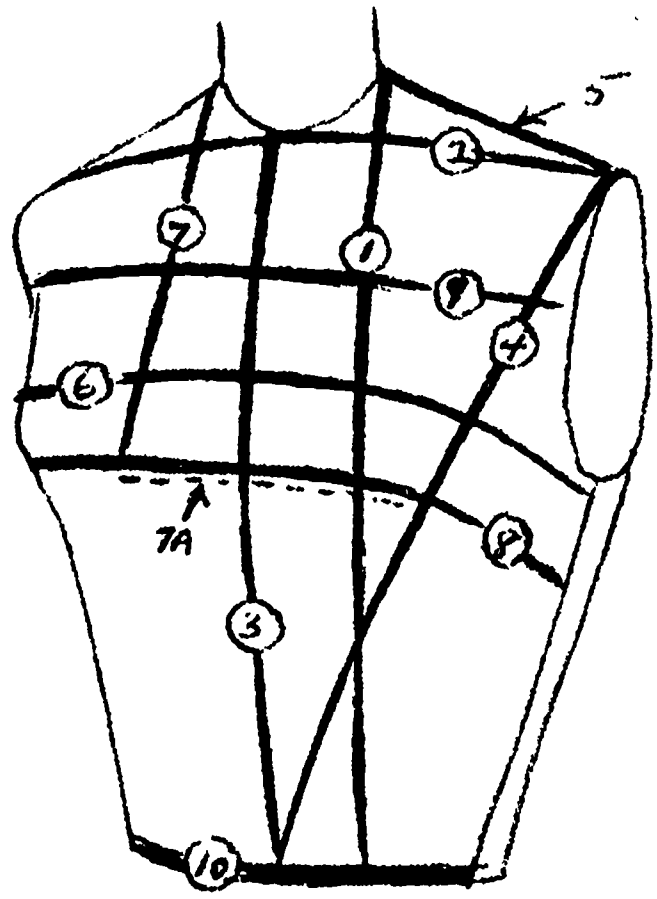


Illustration #2

1. Full Length (Red Tape)
2. Width Across Shoulders (Yellow Tape)
3. Center Front Length (Green Tape)
4. Shoulder Slop (Blue Tape)
5. Shoulder Length (Light Blue Tape)
6. Body Width (Orange Tape)
7. Breast Point Position From Shoulder (Purple Tape)

7A. Breast Point to Breast Point (Purple Tape)

8. Full Body Width (Light Orange Tape)
9. Width Across Chest (Pink Tape)
10. Waist (Light Green Tape)

SESSION # 4

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
TRANSFERRING BACK AND FRONT BODICE DRAFTS	Review previous lesson.
A. Introduction	Explain fabric grain lines.
	Locate on fabric the selvage, length, cross and bias grins. Reference #8, pages 121, 122, 123.
B. Transferring Drafts to Muslin	Explain how to block and press muslin.
	Review use of carbon tracing paper and tracing wheel.
	Stress safety.
	Illustrate use of curve rule.
	Stress importance of tracing sloper for right side of form and explain why.
	Explain trueing of lines.
	References: #3, pages 15 and 17 #7, pages 106 and 107
	Discuss and illustrate seam allowances.
	Caution students to allow enough seams.
C. Fitting Muslin on Forms	Demonstrate pinning of muslin.
	Emphasize importance of grain.
	Caution students against "tight" fittings. Explain.
	Illustrate marking techniques.
	Recommend that students pin and fit a back and front muslin together.
	Illustrate crossmarks.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
D. Transferring Slopers to Kraft Paper	Illustrate and discuss the various papers used in patternmaking and when they would be used: 1. kraft 2. steel tag 3. manila or jute 4. permaplast Illustrate folding of darts; emphasize and explain reasons for folding and tracing darts. Reference #10, page 12 Observe and check armhole measurements. Emphasize that back armhole is larger than front.
E. Application	Students transfer fittings to paper. Observe and check for: 1. accuracy of fit 2. marking techniques 3. proper grainlines 4. accuracy of placement on paper Review and summarize. Prepare students for next lesson by discussing standard body measurements for sleeve drafting. References: #3, pages 15 and 17 #7, pages 106 and 107 #10, pages 18 and 30

SESSION # 5

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
BASIC ONE-PIECE SLEEVE SLOPER	Review briefly government standard measurements and body measurements.
A. Obtaining Measurements	Use pre-determined government standards, or armscye and bodice sloper measurements to determine: 1. cap height 2. bicep circumference 3. wrist circumference 4 underarm length 5. elbow circumference References #3, page 22 #8, pages 204, 205 Illustrate, by use of a visual aid, the various arm areas measured. Refer to illustration #3
B. Drafting Sleeve Sloper	Emphasize importance of accuracy of measurements. Review squaring of lines. Draft sleeve, in larger scale, on board. Review grainline, illustrate how grain hangs on sleeve: vertical grain hangs straight and perpendicular to the floor: The horizontal grain is parallel to the floor. Explain necessity for elbow dart or ease. References #3, page 23 #8, pages 208 to 211
C. Completing Sleeve Draft	Illustrate importance of balancing sleeve by folding down center. Have students check shape of sleeve cap; stress back armhole is higher than front. Clarify need for trueing underarm seam and length.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
D. Transferring Sleeve Draft to Muslin	Review preparation of muslin. Illustrate proper placement of sloper onto muslin, observing grain. Review seam allowances, crossmarks and notches.
E. Fitting Muslin Sleeve into Bodice	Illustrate pinning of sleeve. Caution students on distribution of cap gathers. Indicate placement of armhole notches. Explain reason for forward shoulder notch.
F. Application	Students develop the sleeve sloper. Observe and check for: 1. grainlines 2 accuracy of squaring 3. accuracy of measurements 4. trueing of lines 5. position of notches Summarize lesson and review for next lesson. References: #3, pages 23 and 24 #7, pages 105-109 #12, pages 221-226

VISUAL AID FOR OBTAINING ARM MEASUREMENTS

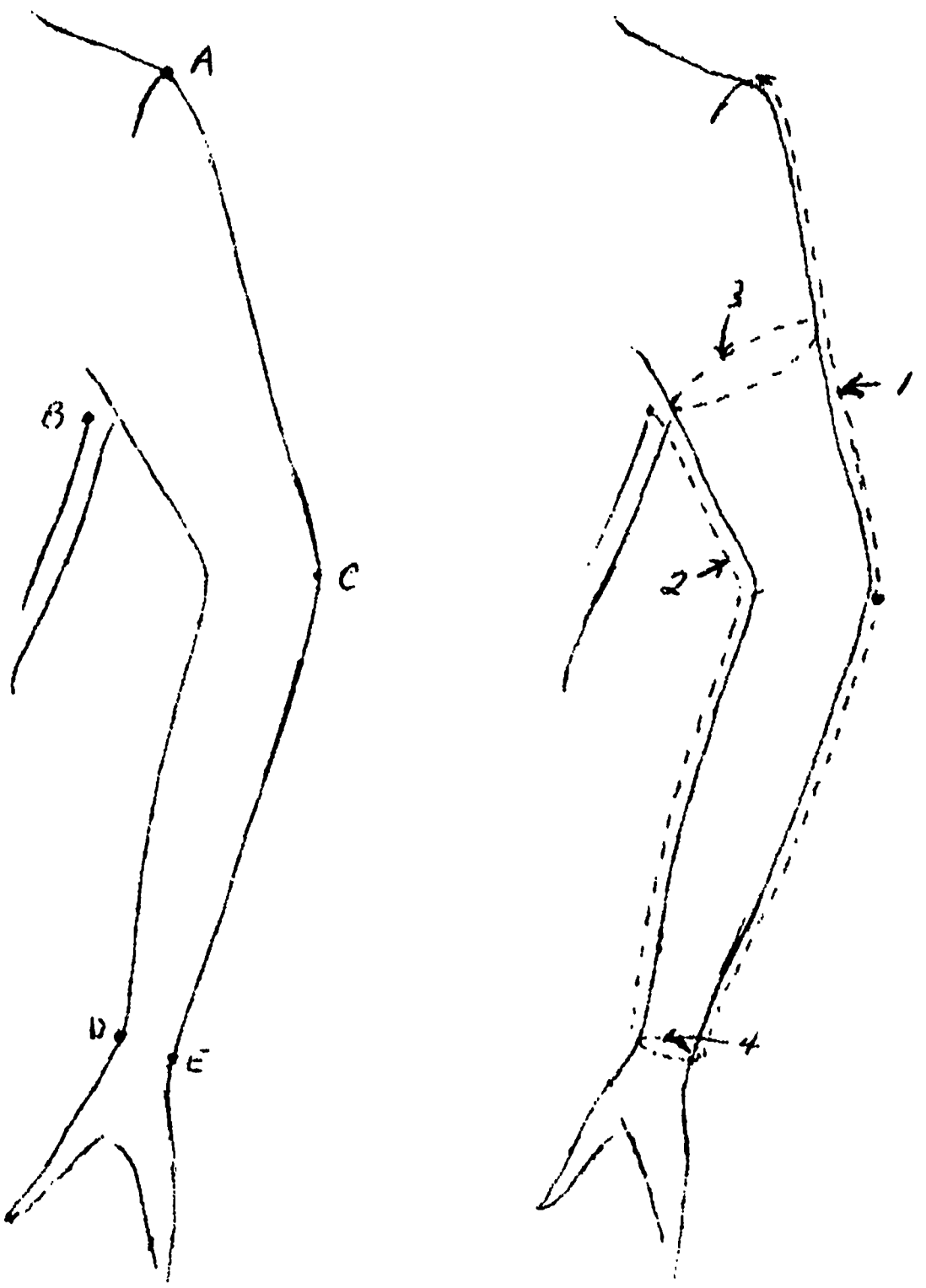


Illustration #3

A. Shoulder Tip Point
B. Armpit
C. Elbow
D. Inside Wrist
E. Back of Wrist

1. Overarm Length
2. Underarm Length
3. Biceps
4. Wrist

SESSION # 6

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
FORMING STEEL TAG (OAKTAG) SLOPERS BODICE FRONT, BACK AND SLEEVE	
A. Introduction	Show the various types of steel tag paper. Caution students to ascertain all corrected lines, corssmarks, etc.
B. Tracing Corrected Fitted Drafts	Observe and check that drafts are placed smoothly on length of paper. Indicate that back and front drafts should face. Caution students to correct all traced lines with ruler and curve rule. Illustrate on board to impress upon students the necessity for squaring: 1. Center front waistline 2. Center back waistline and neck 3 Side seams at armholes Caution students to trace all markings.
C. Cutting Slopers	Discuss and define: 1. Shears 2. Scissors 3. Snips Demonstrate techniques of cutting steeling and patterns.
D. Completing Slopers	Illustrate on board to explain pattern symbols: 1. Grainline 2. Size 3. Cutting information 4. Pattern identification Reference: #7, page 29, figure 12. Demonstrate notching techniques. Explain purpose of notches.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
E. Application	Have student apply lesson transferring slopers to oaktag. Observe and check work in progress. Check for: 1. trueing of lines after tracing 2. accuracy of squaring 3. cutting of patterns 4. proper notches 5. accurate grainlines 6. pattern symbols Summarize and review. Motivate for next lesson by discussing body and standard measurements for skirt sloper drafting.

SESSION # 7

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
BASIC SLOPER SKIRT FRONT AND BACK	Review Lesson #3.
A. Introduction	Review standard measurements and body measurements. Illustrate by use of size range charts.
B. Measuring Dress Form	Indicate with colored tape, the various areas of the form to be measured: 1. front waist 2. front hip 3 back waist 4. back hip 5. length Reference: #8, page 129 #3, page 18 Have students measure each other. Emphasize the difference between dress form and human measurements. Using completed skirt as visual aid, indicate use of darts at high and low points. Reference: #11, page 118
C. Drafting Slopers	Demonstrate on board, using colored chalk. Use larger scale. Keep chalk same color as tape used on form. Illustrate use of hip curve rule. Review folding of darts. Caution students on correct folding of darts and shaping of side seam. Reference: #3, page 19 #8, pages 130, 131

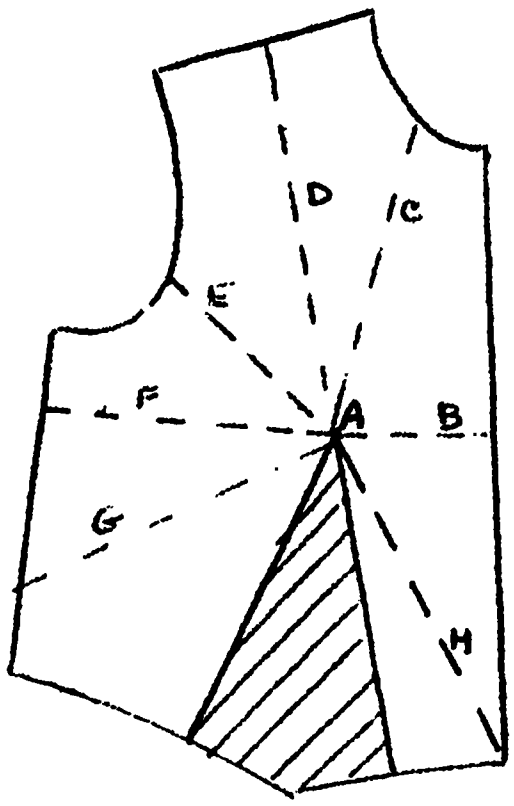
SESSION # 8

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
BASIC SLOPER SKIRT FRONT AND BACK (Continued)	Review Lesson #4.
A. Transferring Drafts to Muslin	Review blocking, pressing and preparation of muslin. Illustrate on board the effects on a finished skirt due to improper grain placement. Reference: #7, page 109, figure 119a, b, c
B. Fitting Muslin	Review fitting and marking procedures. Remind students to be cautious about tight fittings. Stress the reason for hip ease, using model as a visual aid. Reference: #7, pages 109, 110, 112
C. Transferring Fittings to Steeltag	Review Lesson #6.
D. Application	Have students apply lesson, drafting and fitting the skirt sloper. Observe and check for: 1. accuracy of measurements and squaring 2. proper placement of drafts on muslin 3. proper fitting 4. accuracy of transfer to oaktag 5. cutting of slopers

SESSION # 9

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
CONCEPT OF DART MANIPULATION BODICE FRONT	Review purpose of darts. References: #10, page 4 #12, page 13 Illustrate on board the various dart positions.
A. Introduction	Reference: Illustration #4. Stress the fact that darts must radiate from the high point to an outside line. Explain, using an illustration of a circle, the principle of obtaining a shape from a flat surface. Emphasize the structural aspect of the waistline dart by showing how a sewn dart assumes a shape. Refer to Illustration #5. Stress reasons for dart manipulation, i.e. : 1. style 2. grain 3. preparation for stylized patterns To illustrate how style and grain are affected by dart placement, use striped fabric fittings of bodices featuring different dart placements.
B. Draft	Demonstrate on table, the slash and spread method for manipulatinf the bust dart to the underarm and neck positions. References: #7, pages 24, 25 Using overhead projector and transparencies, demonstrate the pivoting method of manipulating the bust dart.

POSITIONS ON FRONT BODICE FOR DART PLACEMENT



A. High Point (Apex of Bust)

B. Center Front

C. Neckline

D. Shoulder

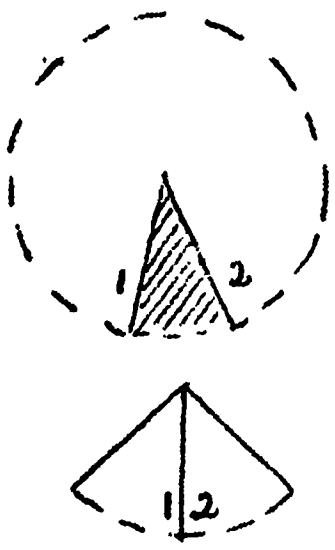
E. Armhole

F. Underarm

G. French

H. Center Front Bias

Illustration #4



A dart is a seam made by joining the two edges of a triangular section removed to shape a flat piece of cloth so that it conforms to a round shape.

A cone is a good example. The shaded section is removed. When lines 1 and 2 meet, the flat circle is forced to assume the shape of a cone.

Illustration #5

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
	If not available, demonstrate on blackboard using colored chalk. References: #3, page 28 #12, pages 23, 25, 27, 31 Stress the importance of the pivot point, and angles of the darts. Discuss the reason for shortening darts. References: #7, page 28 #10, page 6 Illustrate on board the method of shortening darts. Refer to Illustration #6 Review folding of darts. Stress the fact that the shape of the wide end of a dart is determined by the angle formed by the dart and the seamline from which originates. Illustrate various dart shapes by folding and tracing different darts.
C. Application	Students are to use the pivot method to form 5 basic dart positions. Observe and check work in progress. Check: 1. Pivoting from correct point 2. Method of marking around pattern 3. Shortening of darts 4. Folding of darts

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
D. Assignment	Have students form 2 bodice styles not included in the original five formed in class. Stress the importance of muslin fittings, and encourage students to bring in muslin fittings of the dart manipulations. Summary of lesson - Emphasize that darts must always extend from the high point under consideration to an outside line. Motivate for next lesson by demonstrating on form a skirt style with waistline darts shifted to the hip.

HOW TO SHORTEN A DART

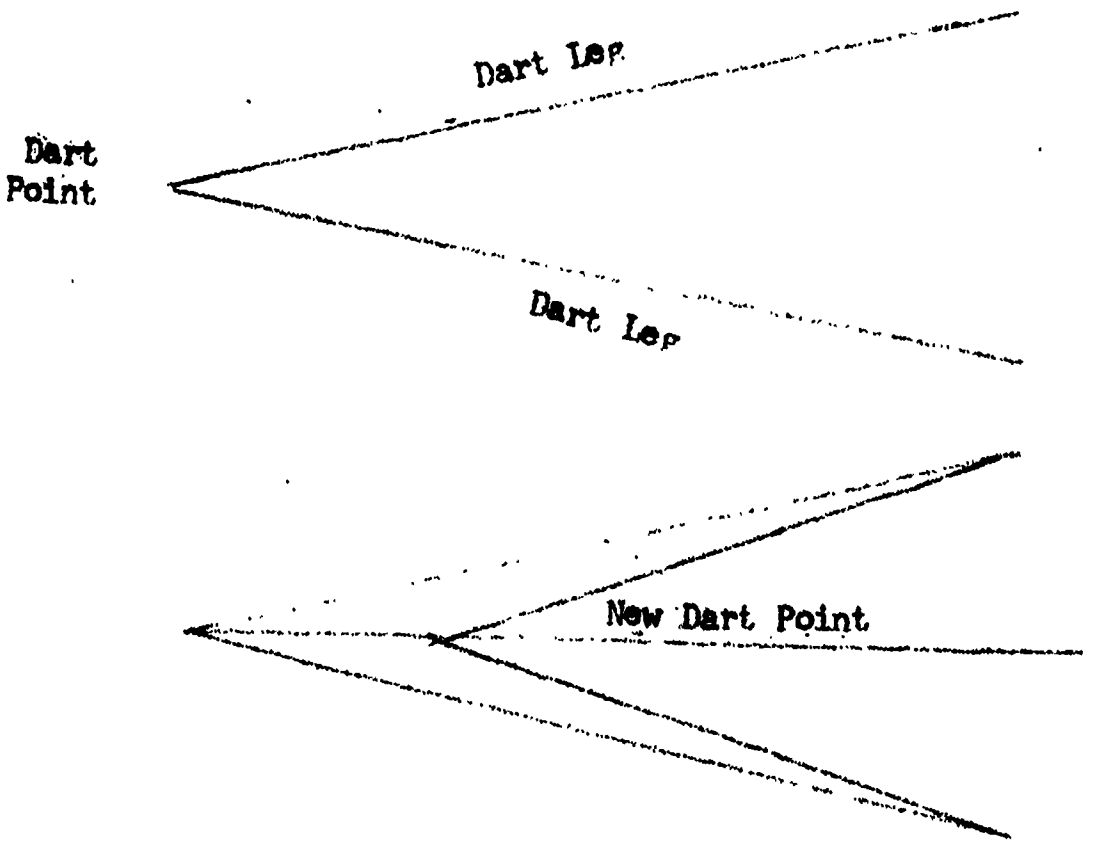
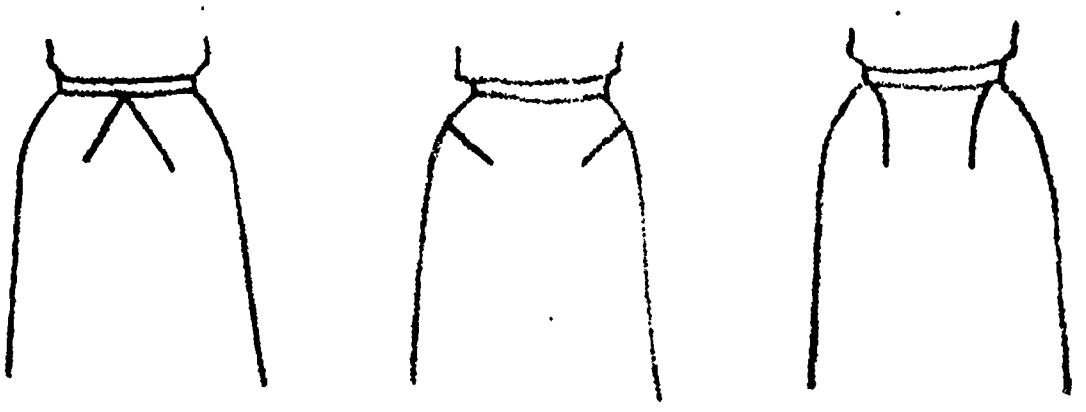


Illustration #6

POSSIBLE DART POSITIONS ON SKIRT FRONT



Center Front Hip Curved

Illustration #7

SESSION # 10

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
CONCEPT OF DART MANIPULATION SKIRT FRONT	Review previous lesson.
	Collect and check assignment.
	Review briefly the two methods of dart manipulation.
A. Introduction	Illustrate on board the various positions for skirt waistline dart manipulation.
	Refer to Illustration #7.
	Demonstrate on form by draping muslin to show the shifting of the waistline dart to the hip.
	Stress that dart manipulation affects style, not fit.
	Remind students about the pivot point.
	Reference: #10, page 121, 122.
B. Draft: Skirt Front	Demonstrate on board and table the slash and spread method for forming a skirt front with darts originating from the hip.
	Illustrate on board, with colored chalk, the pivoting method of forming the same style.
	Review the importance of folding and tracing darts.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Illustrate on board, or supply a muslin fitting of a skirt style featuring center front bias darts. Encourage students to use pivot method, whenever possible, to form draft. Students apply principle learned to this style variation. Observe and check for: 1. Pivoting procedures 2. Tracing methods 3. Folding and tracing of darts 4. Completion of pattern Summary of lesson. Stress the advantages of pivoting to slashing. Prepare students for next lesson by eliciting from them how a dart might be manipulated on other pattern sections.

SESSION # 11

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
CONCEPT OF DART MANIPULATION SLEEVE	Review previous lesson. Provide a muslin fitting of a sleeve with elbow dart moved to lower edge. Use a facing of contrasting color. Reference: #10, page 96 #3, page 52
A. Introduction	Illustrate on blackboard, or supply a sketch of the sleeve style desired. Elicit from students the two methods of dart manipulation. Stress the function of darts.
B. Draft: Sleeve	Demonstrate on board, using colored chalk, the pivoting method of manipulating the elbow dart. Demonstrate the alternate method of slashing and spreading flat on the table, using colored marking pens. Introduce sleeve facings, refer to the color contrast muslin fitting. Stress notches. Reference: #10, page 93.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Students form pattern of sleeve and facing, using pivoting method. Offer individualized instruction. During student application check for: 1. proper pivoting method 2. accuracy of tracing 3. planning and development of facing 4. correct seam allowances 5. pattern information Summarize lesson by stressing the basic concept of dart manipulation: Darts, regardless of their position must be manipulated from the high point under consideration.
D. Assignment	Motivate students to apply principle of elbow dart manipulation to sleeve cap, by assigning this sleeve style as a home project. Review principle of dart manipulation, and prepare students for next lesson by sketching on board two bodices that feature division of dart control. Reference: #10, page 14.

SESSION # 12

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
DIVISION OF BASIC DARTS	Review previous lesson. Check assignment.
BODICE FRONT	Pin on dress forms muslin fittings that feature the following darts: 1. waistline and shoulder 2. waistline and neck
A. Introduction	Compare the above muslins to the patterns formed in the basic dart manipulations Elicit from students the advantages of dividing the basic dart control. Reference: #7, page 33 Discuss how the students would form these patterns before demonstrating.
B. Draft: Bodice Front	Demonstrate the slash and spread method of dividing the dart control. Reference: #7, pages 32, 33 Question students on the purpose of shortening the darts. Determine the direction of folding darts. Have two students attempt to demonstrate the pivoting method on the board. Reference: #10, pages 10, 11

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Encourage students to employ the pivoting method while forming patterns of bodice fronts that feature darts at the: 1. waistline and armhole 2. waistline and center front Observe and check for: 1. method being used 2. correct procedures 3. proper shortening of darts 4. folding and tracing of darts 5. seam allowances 6. pattern information Summarize and review lesson.
D. Assignment	Copy illustration #8 onto blackboard. Question students on the method that would be used to form a pattern of the bodice style illustrated. Students are to submit a finished pattern and muslin fitting of the bodice. Prepare students for next lesson by showing illustrations of skirt front styles that feature division of dart control.

BODICE FEATURING NECKLINE AND CENTER FRONT BIAS DART

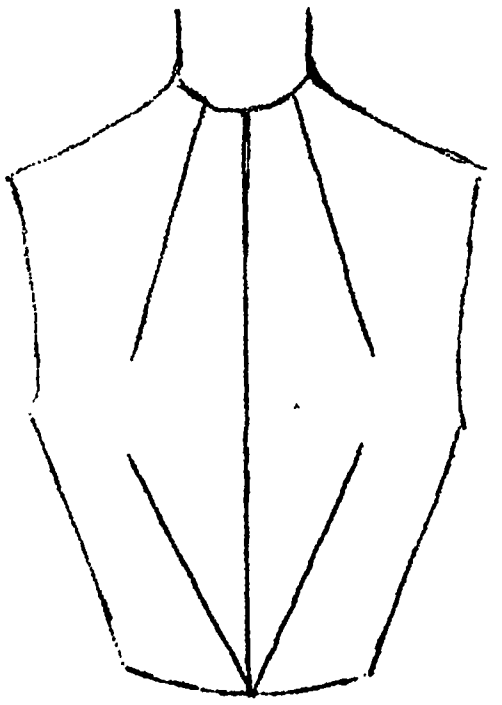
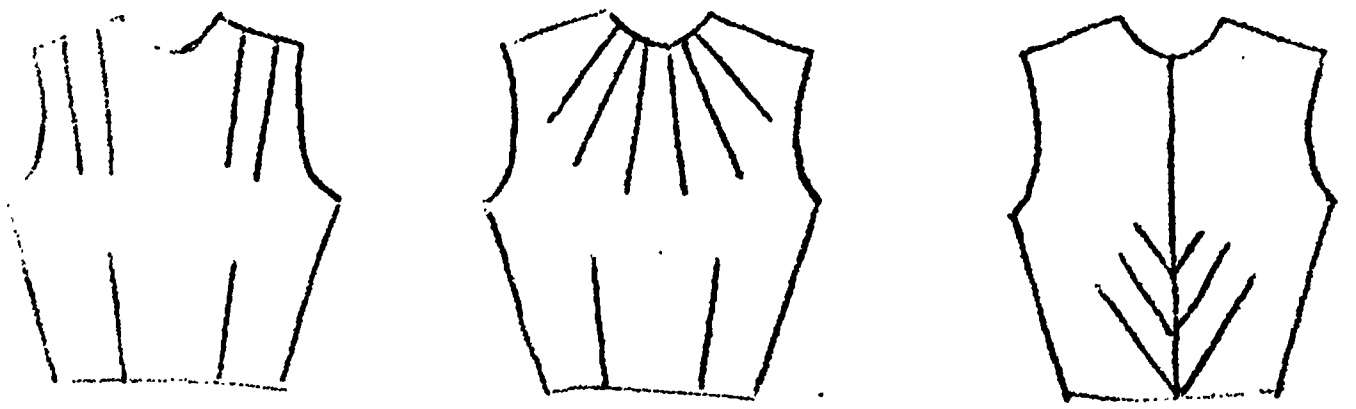


Illustration #8

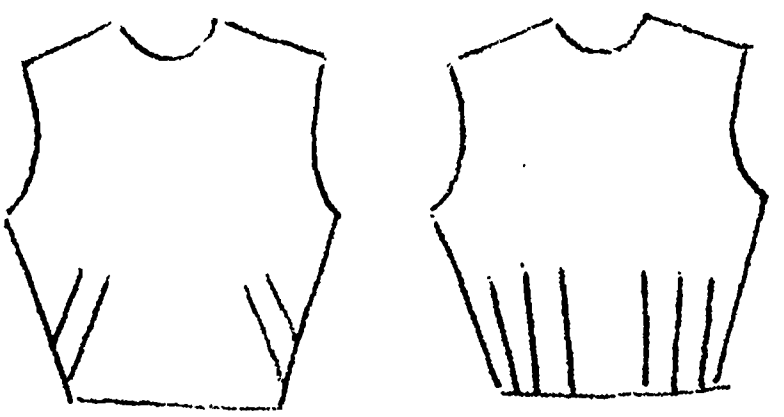
ILLUSTRATION OF STYLIZED BODICES



Parallel Shoulder Darts

Neckline Darts

Center Front Bias Darts



Parallel French Darts

Multiple Waistline Darts

Illustration #9

SESSION # 13

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
DIVISION OF BASIC DARTS SKIRT FRONT AND SLEEVE	Review and discuss homework assignment.
	Review desirability of division of dart control.
	Use muslin fitting of skirt with 3 waistline darts.
A. Introduction	Compare the muslin fitting of the skirt front with one waistline dart to the new fitting.
	Elicit from students, on the basis of comparison, which fits better, and why.
B. Draft: Skirt Front	Draft on table, using colored pencils.
	Illustrate on board the various methods that can be used, i.e.:
	1. removing waistline dart, then slashing and spreading
	2. tracing dart, then dividing into 3 new darts
	Use colored paper to demonstrate this technique.
	Review folding and tracing of darts.
	Illustrate the adjustment required at the waistline.
	Reference: #4, page 123, figure 148
	Emphasize that the basic dart may be rearranged in any position radiating about the high point.
	Stress the fact that the same procedure can be used in sleeve drafting.
	Demonstrate quickly the same "re-drawing" principle applied to the sleeve sloper.
	Reference: #3, page 45 #4, page 78

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	As an application, encourage students to form variations of the same principle on skirt front or back. Observe work and check for: 1. pivoting procedures 2. measurements 3. planning of new dart positions 4. folding and tracing of darts 5. completed pattern Summarize lesson and review: reasons for division of darts.
D. Assignment	Students should form a draft of a sleeve pattern with 3 elbow darts. Urge them to complete a muslin fitting. Prepare students for next lesson by displaying muslin fittings and sketches of stylized bodices. Refer to illustration #9.

SESSION # 14

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
DECORATIVE AND STRUCTURAL DARTS	Briefly discuss previous lesson. Check assignment.
STYLIZED BODICES	Elicit from students the definitions of: 1. decorative 2. structural
A. Introduction	Distribute mimeographed sheets of stylized bodices. Display illustrations of bodice styles. Pin on forms muslin fittings of bodices. Check if any student is wearing a garment featuring an interesting dart treatment. Explain how: 1. the basic dart can be both structural and decorative 2. decorative darts are added by slashing and spreading Reference: #10, page 31, figure 1 Review principle of curved darts.
B. Draft: Bodices	Demonstrate, on table, the slash and spread method of drafting two differen+ stylized bodices. Illustrate on board the following: When forming stylized darts, the new dart lines must always touch the line of an existing dart. To do this, it may be necessary to pivot all or part of the basic dart to a different area Refer to Illustration #10.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
	Demonstrate quickly the pivoting method of drafting the same bodices.
	Using a blackboard illustration, indicate the area that is included in the pivoting.
	Reference: #10, page 30.
	Review dart manipulations.
	Caution students to keep decorative darts narrow.
	Emphasize the fact that if the structural dart does not provide sufficient room for decorative darts, slashing and spreading is necessary.
	Impress on students the point that multiple darts do not emanate from the same high point.
	Stress the necessity for adjusting seam lines after darts have been folded and traced.
	Reference: #13, page 6
C. Application	Provide illustrations for stylized bodices that are different than those demonstrated.
	Encourage students to use the slash and spread method to form the bodice styles.
	Caution students to be careful when and where they place the basic waist dart.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
	Observe and check work in progress Check for: 1. manipulation of basic dart 2. placement of style lines 3. method of slashing 4. folding of darts 5. correction of seam lines 6. pattern information Summary of lesson. Elicit from students the following: 1. difference between decorative and functional darts 2. why is dart manipulation used to form stylized bodices? 3. why must decorative darts be narrow? 4. when is slashing and spreading used?
D. Assignment	Request students complete muslin fittings at home. Encourage students to develop variations of these stylized bodices by illustrating some possibilities on the board. Review lesson by answering students' questions. Motivate for next lesson by eliciting from students which other pattern sections could use stylized dart treatments. Refer to, and remind students of the division of dart control on skirt fronts.

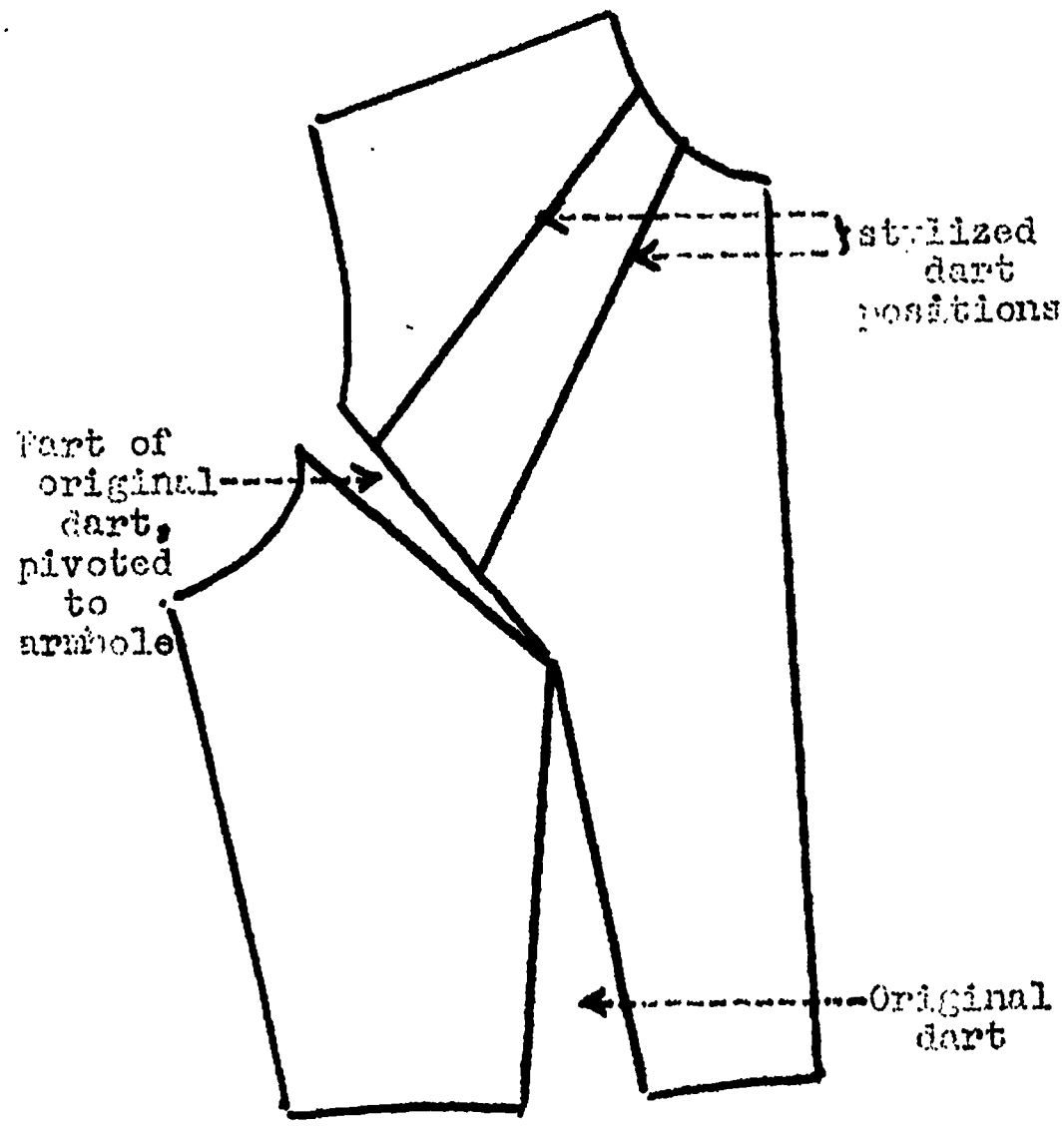


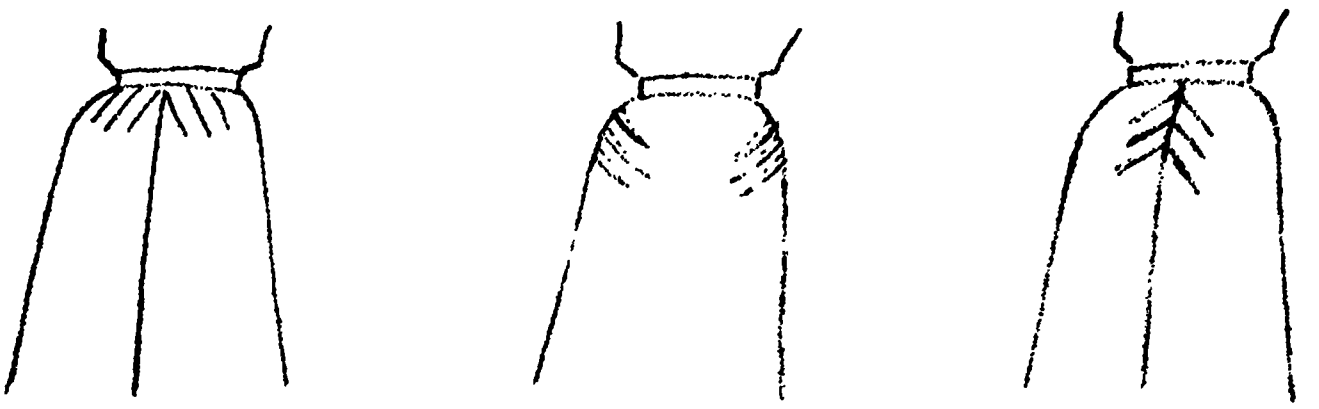
ILLUSTRATION # 10

SESSION # 15

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
DECORATIVE AND STRUCTURAL PARTS SKIRT FRONT	Review previous lesson.
	Check muslin fittings assigned in previous lesson.
A. Introduction	Pin muslin fittings of skirt fronts that have division of waistline dart control.
	Refer to Illustration #11
	Prepare mimeographed sheet of skirt front styles, or illustrate on board. (Illustration on board should be completed before students enter room.)
	Demonstrate by draping, the method of obtaining the skirt front effect desired.
	Stress how the waistline dart is being used in a different manner.
B. Draft: Skirt Fronts	Demonstrate by drafting, the slash and spread method of forming two skirt front styles.
	Illustrate the pivoting method that would be used for the same two styles.
	Elicit from students the advantages of slashing and spreading over pivoting when forming these styles.
	References: #4, page 123 #10, pages 122, 123
	Stress the folding and trueing of darts.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Students form a pattern of a skirt style not previously demonstrated. Using mimeographed illustration, sketch on board, or muslin fitting. Observe work in progress and check for: 1. planning of slash lines 2. folding of darts 3. trueing of lines 4. direction of darts 5. tracing of lines 6. seam allowances 7. pattern information Summarize lesson and review: 1. slashing and spreading method 2. pivoting procedures 3. styling of darts
D. Assignment	Suggest to students to design a skirt front that uses a stylized dart treatment. Have them form a pattern and muslin fitting of that original design. Motivate students for next lesson by suggesting other forms of dart control, i. e.: 1. gathers 2. dart tucks 3. pleats

DIVISION OF DART CONTROL ON SKIRT FRONT



3 Waistline Darts | Curved Hip Darts | Center Front

Illustration #11

FRONT SHOULDER DART TUCKS

(INSIDE GARMENT VIEW)

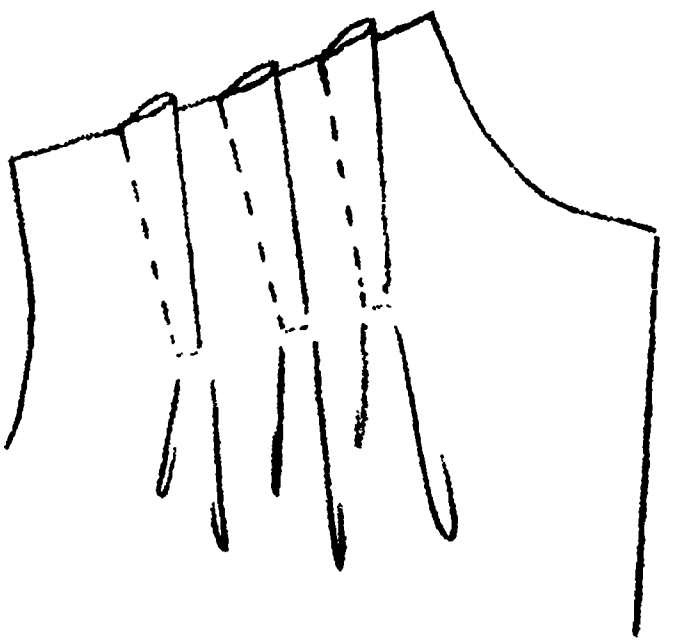


Illustration #12

SESSION # 16

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
APPLICATION OF DART MANIPULATION DART TUCKS	Review previous lesson. Review and check assignment. Display on forms, muslin fittings that point up use of dart tucks.
A. Introduction: Bodice Front and Back	Sketch on blackboard an illustration of a dart tuck. Refer to Illustration #12 Define "dart tuck". Review briefly the principle of bust dart manipulation.
B. Draft	Demonstrate on table, using slash and spread and pivoting techniques. Form a pattern for a front bodice with shoulder and waistline dart tucks: back bodice with waistline dart tucks only. Caution students to pivot front waistline dart to underarm Ask students why this is done. (Placing dart at side seam prevents interference with planning of style tucks.) Reference: #3, page 29 Stress parallel tuck designing. Emphasize the principle of returning to high point area when planning and slashing. Demonstrate alternate pivoting method. Indicate planning of crossmarks for length of tucks.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
	Refer to slashing and spreading principle when spreading the pattern for larger tucks and more fullness.
	Describe the difference in fit obtained if pattern is slashed and spread.
	Demonstrate the folding of dart tucks.
	Caution students to correct the waistline and shoulder seam before tracing.
	Illustrate marking and notching of dart tucks.
	Remind students that same procedure is used for forming back waistline dart tucks.
	Stress notching of matching seams.
	Develop neck and armhole facings.
C. Application	Students form pattern of back and front waist.
	Observe and check for: 1. initial planning of draft a. pivoting of waistline dart b. planning of style tucks 2. slashing and spreading 3. folding, tracing and marking of dart tucks 4. pattern completion and information.
	Summary and review. Discuss the possibility of using the re-drawing method for planning dart tucks.
D. Assignment	Encourage students to form a bodice front pattern that features center front dart tucks.
	Suggest that a muslin fitting be brought in for checking.
	Motivate for next lesson by placing on a form a skirt style with waistline dart tucks.

SESSION # 17

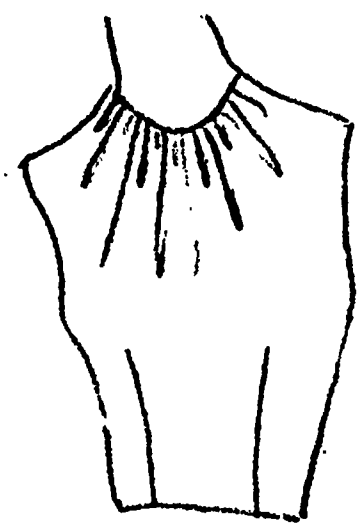
CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
APPLICATION OF DART MANIPULATION DART TUCKS	Review definition of dart tuck. Check and collect assignment. Review principles of dart division on skirts. Elicit from students the methods of forming dart tucks.
A. Introduction: Skirt Front and Back	Pin to form a muslin fitting of a dart tucked skirt. Locate and show sketches of skirts using dart tucks. Prepare a visual aid on blackboard, by using colored chalk, the re-drawing method of dividing waistline darts. Reference: #4, page 123, figure 148
B. Draft	Demonstrate on table, using colored marking pens, the slashing and spreading method of forming waistline dart tucks on skirt front and back. Relate and compare the pivoting of the waistline dart to basic dart manipulation and to the previous lesson. Review and compare the concept of dart division to the planning of multiple style tucks. Elicit from students the method of planning the initial draft for style tucks. Relating demonstration to previous lesson, encourage students to discuss how they would develop the pattern. Obtain from students the techniques for: 1. folding and tracing dart tucks 2. marking and notching techniques 3. sewing dart tucks

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
	Explain why it would be advisable to slash and spread when forming skirt dart tucks. (additional fullness) Develop waistline facings. Stress notches and placement of grainlines. Indicate seam allowances.
C. Application	Students apply lesson by forming pattern of a complete skirt. Observe work in progress and check for: 1. initial draft planning 2. techniques used for forming dart tucks 3. pattern development and completion, including facings. Summarize and review lesson. Stress the preliminary pivoting and draft planning.
D. Assignment	Display a muslin fitting of a sleeve that has a cap with dart tucks. Urge students to employ pivoting and slashing and spreading to form a pattern of the sleeve style. Remind them to spread the cap for additional fullness. Prepare students for next lesson by showing a muslin fitting of a bodice that employs gathers. If possible, use an actual garment that is being worn by a student. Include also, some sketches of gathered garments.

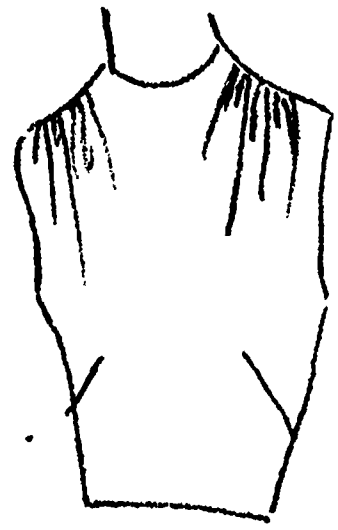
SESSION # 18

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
APPLICATION OF DART MANIPULATION GATHERS ON NECKLINE	Review dart tucks. Collect assignments. Elicit from students the difference between dart tucks and gathers.
A. Introduction	Display a small piece of fabric that has been machine gathered. Furnish muslin fittings of gathered bodices. Distribute mimeographed sheets of gathered bodices. Refer to Illustration #13.
B. Draft	Draft a gathered bodice pattern, demonstrating on table. Use colored pencils or marking pens. Use a bodice style that will require slashing and spreading for added fullness, i.e.: Front bodice with neckline gathers and waistline dart. Stress the importance of placing part of the waistline dart in another area of the pattern before planning slash lines for gathers. Refer to and review Lesson #14. Plan neckline facing. Stress importance of notches for control of gathers. Reference #12, page 69 Impress upon students that slash lines must extend to an outside line for a dart line. Elicit from students the reason for planning additional fullness. Discuss fabric characteristics for determining fullness.

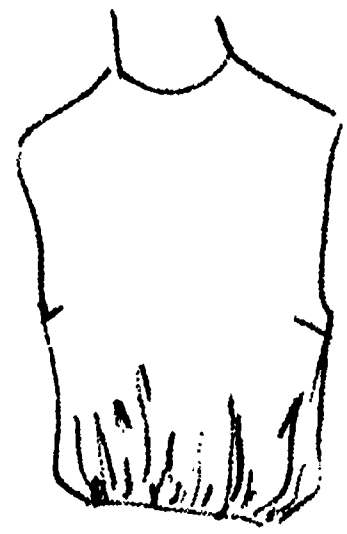
SUGGESTED GATHERED BODICE STYLES



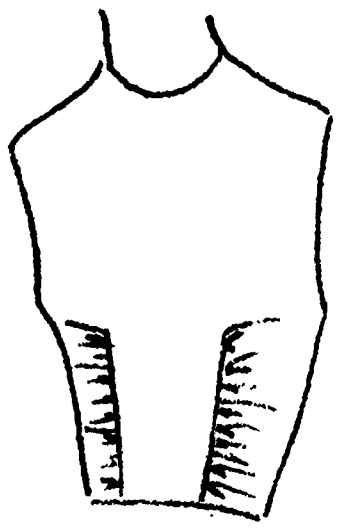
Neckline Gathers
Waist Dart



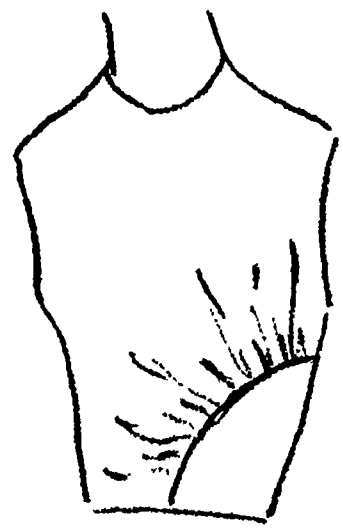
Shoulder Gathers
French



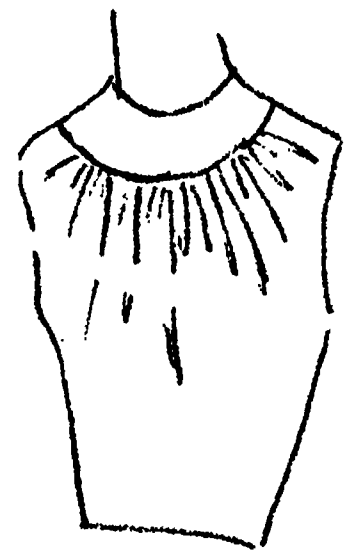
Waistline Gathers
(Blouson)
Underarm Dart



Side Gathers From
Dart



Gathers From Style
Line



Gathers Below A
Yoke

Illustration #13

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
APPLICATION OF DART MANIPULATION GATHERS ON NECKLINE	
B. Draft (Continued)	Stress the development and completion of the neck facing before slashing. Ask students to suggest recommendations for methods of developing of the pattern. Illustrate on board, as well as on draft, the shaping of the seam line after spreading. Refer to Illustration #14 Caution students to shorten waistline dart. Back pattern is basic scoper. Demonstrate completion of pattern. Emphasize that darts on all pattern pieces can be adapted to gathers.
C. Application	Students apply lesson to form a gathered neckline bodice. Observe and check work in progress Check for: 1. manipulation of dart 2. planning of slash lines 3. notches 4. slashing and spreading 5. amount of fullness added 6. trueing of lines 7. completion of patterns Summary of lesson. Review reasons for dart manipulation and slashing and spreading.
D. Assignment	Urge students to form a pattern of a bodice front that features gathers in a different area. Remind students to apply dart manipulation, if necessary. Preparation for next lesson: Ask students to bring in illustrations of garments that feature unusual treatment of gathering.

CORRECTING SHAPE OF SEAM LINE AFTER SPREADING

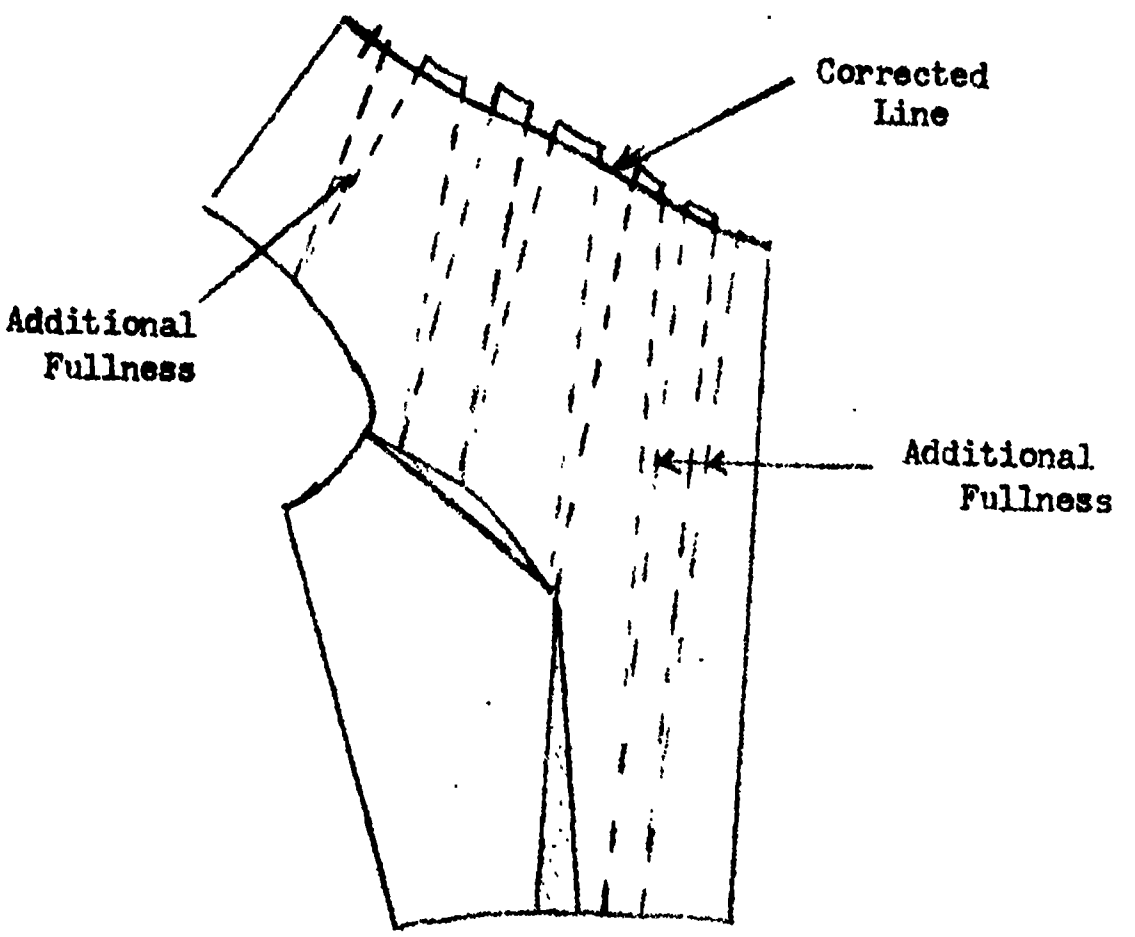


Illustration #14

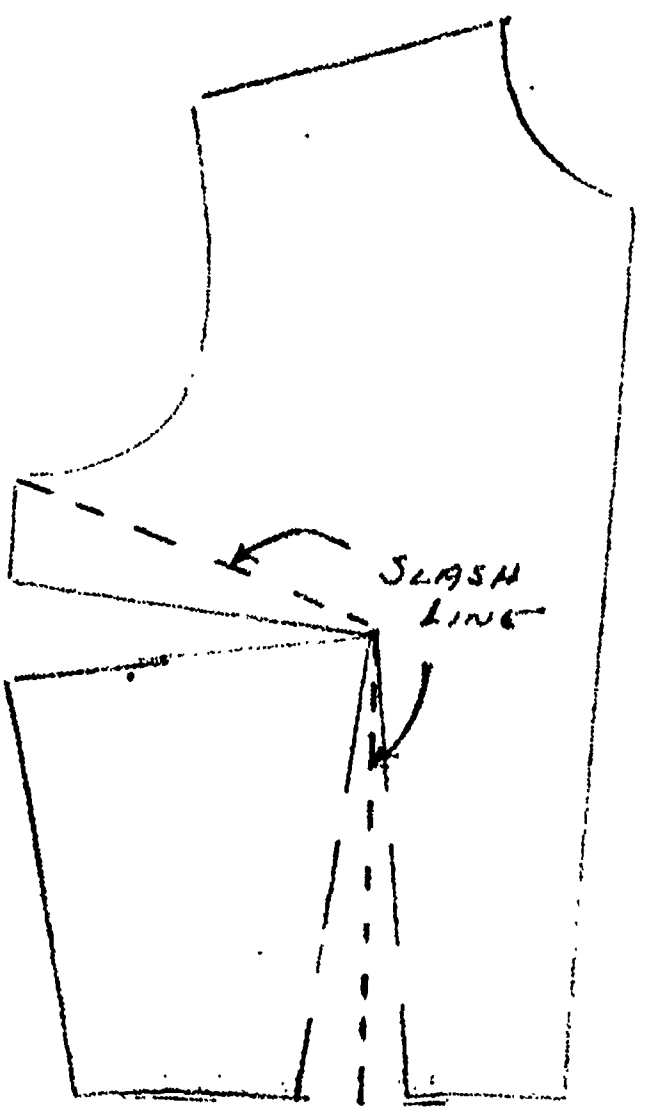


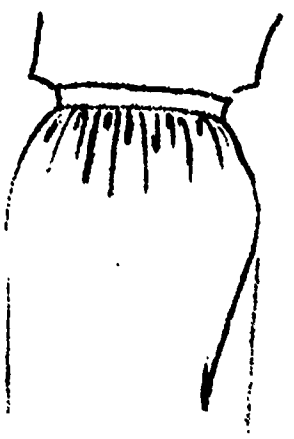
Illustration #15

SESSION # 19

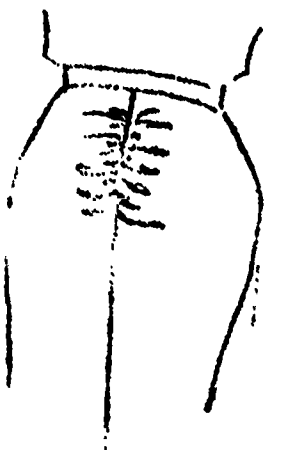
CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
APPLICATION OF DART MANIPULATION BLOUSON BODICE	Check homework assignment: if necessary, demonstrate on blackboard the draft of the bodice assigned. Illustrate on board the blouson style to be formed. Supply a muslin fitting of style desired.
A. Introduction	Elicit from students how the blouson effect is obtained: 1. use of dart 2. slashing and spreading Determine if underarm dart fitting is necessary.
B. Draft: Bodice - Front	Draft on table, using basic sloper. Remind students to pivot part of waistline dart to underarm. Plan and develop neck and armhole facings. Caution students to use notches, and determine grainlines. Indicate position for slashline for added fullness: to avoid increasing pattern width across bust, plan slash line as shown on Illustration #15. Caution spreading of draft until side seam is almost on straight grain. Question students on why length is being added to pattern, as well as width. Explain to students how a blouson effect is obtained.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Draft: Bodice - Back	Review front draft.
	Stress fact that slash lines are planned same as front.
	Caution students to keep amount of spreading equal to front.
	Review facings, notches and grainlines.
	Elicit from students different methods of controlling the waistline gathers.
D. Application	Students apply lesson and form pattern of blouson style bodice.
	Observe work in progress and check for: 1. notch placement 2. planning of slash lines 3. spreading for fullness 4. addition of length 5. completion of pattern
	Summarize lesson; Review by drawing on board the basic draft, illustrating pivoting and slash line placement.
E. Assignment	Request students to submit a made-up muslin of the pattern completed in class.
	Prepare students for next lesson by asking them to suggest skirt styles that would look best with a blouson bodice.

SUGGESTED SLIM SKIRT STYLES FOR APPLICATION OF DART MANIPULATION (GATHERS)



Waistline Gathers



Center Front Gathers

Illustration #16

VARIATIONS OF SLIM SKIRT STYLES

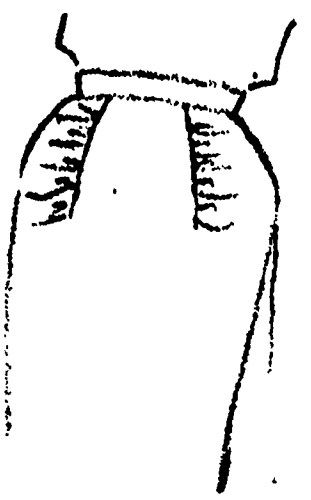


Illustration #17

SESSION # 20

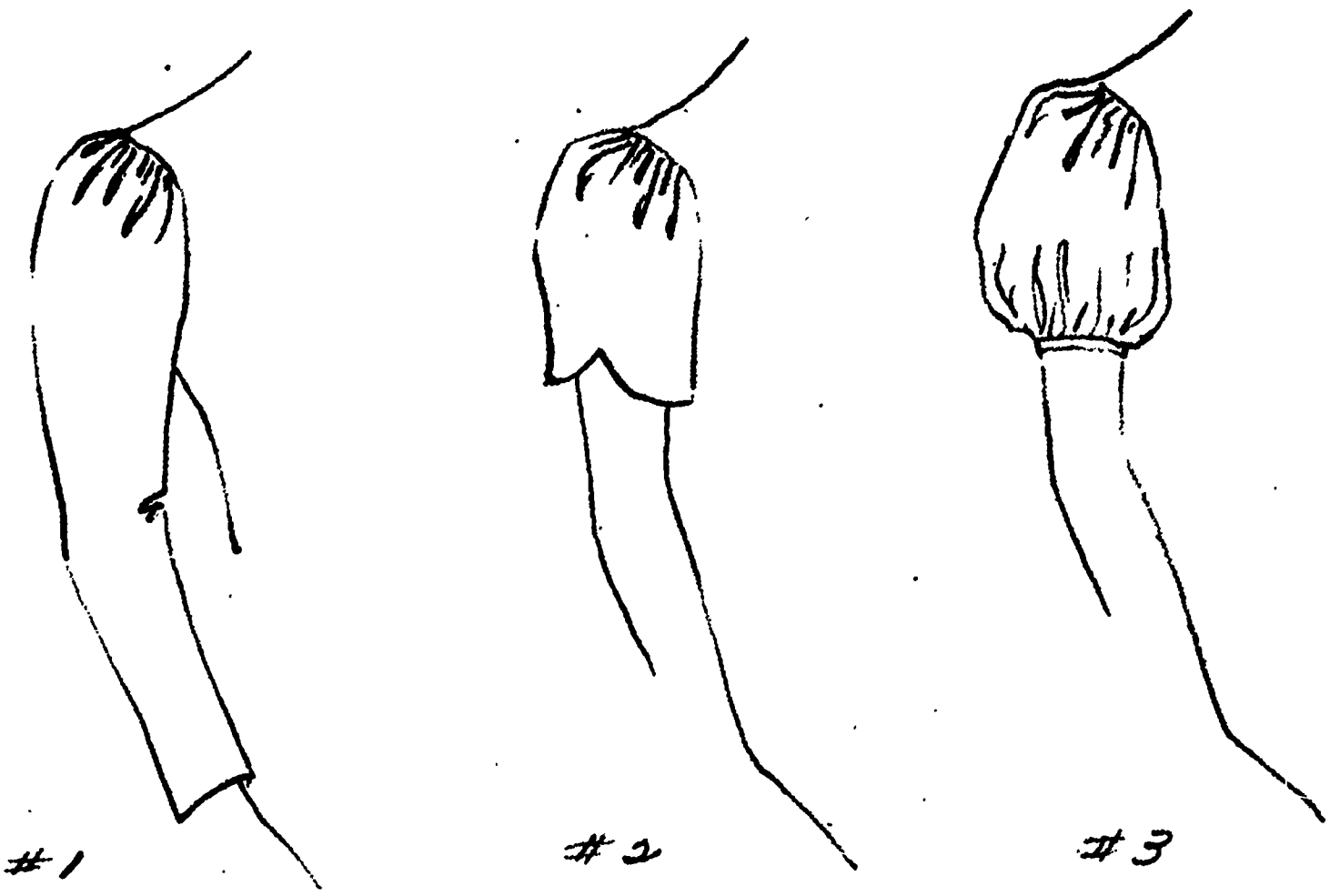
CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
APPLICATION OF DART MANIPULATION GATHERS ON SKIRT	Check muslin fittings of previous lesson. Review definition of gathers. Elicit from students the items to be stressed when slashing and spreading. Distribute illustrations of two skirt styles.
A. Introduction	Refer to Illustration #16 Have students select the skirt style that would look best with the blouson bodice. Compare the slim skirt styles with illustrations of full gathered skirts. Have students interpret the methods used to achieve the different silhouettes.
B. Draft: Skirt: Gathered Waistline	Demonstrate by drafting on table. Use colored pencils to indicate slash lines for additional fullness. Stress placement of slash lines. Explain how to determine the amount of additional fullness desired. Reference #10, page 41. Discuss the relationship of fabrics and silhouette desired to amount of gathers. Elicit from student the types of skirt closings. Plan garment opening. Question students on use of notches and grainlines. Notch waistband or blouson bodice to skirt waistline Demonstrate other methods of controlling gathers: 1. waistline tape guide 2. facings Review Pattern Completion

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Draft: Skirt: Center Front Gathers	Review Lesson #10 On board, form draft of skirt. Use colored chalk. Remind students to pivot waist dart to center front. Indicate slash positions on illustration. Stress importance of notching for control of gathers. Caution on amount of spreading for additional fullness. Review briefly waistbands and facings. Elicit from students the reason for horizontal or vertical placement of slash lines.
D. Application	Students apply lesson to either skirt style, or a variation of style. Caution them about: 1. use of notches 2. placement of style lines 3. amount of spreading for gathers. Summarize lesson. Review briefly the principle of slashing and spreading to add fullness.
E. Assignment	Offer students the choice of completing a muslin fitting of the pattern completed in class, or forming a pattern of a skirt style variation. Refer to Illustration #17 Prepare students for next lesson by displaying sleeve styles that feature gathers.

SESSION # 21

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
APPLICATION OF DART MANIPULATION AND ADDED FULLNESS - GATHERED SLEEVES	Review previous lesson and eheck assignment. Display various sleeve muslin fittings that use gathers. Show illustrations of gathered sleeves.
A. Introduction	Have students compare fittings. Elicit from them how gathers were obtained: 1. dart manipulation 2. slash and spread
B. Draft	Draft, on table or on board the styles illustrated on Illustration #18. Demonstrate #1 on the blackboard. Illustrate how the principles of dart manipulation is used to obtain the cap gathers. Reference #7, page 197. Emphasize with colored chalk, the reshaping of the cap, adding length. With colored chalk, plan the wrist facing. Colored chalk will help emphasize the placing of notches and grainlines. Stress the shoulder notch. Demonstrate on table, the drafting of sleeve #2. Question students as to procedure for forming this sleeve. Use slash and spread method to form sleeve. Caution against slashing through opposite end.

GATHERED SLEEVES



Long, Fitted Gathered Cap

Short, Gathered Cap

Short Puff Gathered Cap and Lower Edge

Illustration #18

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	Have students determine amount of fullness to be added. Refer to previous lesson. Stress the reason for adding length to the cap. Plan style line and facing for lower edges, using colored pencils for emphasis Review notches and grainlines. Elicit from students how the same draft can be used to form a dart tucked cap. Demonstrate how to perfect the sleeve cap line. Review purposes of armhole and cap notches. Reference #10, pages 98 and 99 # 3, page 47 Demonstrate sleeve #3, using slash and spread method. Compare slashing and spreading techniques to sleeve #2. Review shaping of cap. Stress shaping of lower edge. Compare sleeve band to waist band. Reference #3, page 37 #7, page 207

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Students apply lesson, forming patterns for all 3 sleeves demonstrated. Observe work in progress and check for: 1. slashing and spreading procedures 2. shaping techniques 3. notch placement 4. pattern completion Summary of lesson. Review difference between elbow dart manipulation and slashing and spreading. Emphasize that both principles can be applied on the same pattern section.
D. Assignment	Students should be encouraged to complete work at home and form muslin fittings of at least two sleeve styles. Review by answering questions. Motivate students for next lesson by showing muslin fittings that feature princess style lines. Ask students to consider how dart manipulation is applied to these bodices.

SESSION # 22

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
REVIEW AND TESTING APPLICATION OF DART MANIPULATION	Collect and check homework. At this stage students should be able to apply skills learned in previous lessons. Administer a short written examination covering: 1. safety (general and specific) 2. measurements 3. dart manipulation 4. division of darts 5. forms of dart control 6. definitions 7. pattern completion As a practical examination, distribute individual sketches of styles underlining the principles, concepts and techniques covered. Students are to form completed patterns of the given styles. Stress accuracy, craftsmanship and neatness. Stress the transfer of learned principles and concepts to different styles. Evaluate each student's progress. Summarize and prepare for next lesson.

SESSION # 23

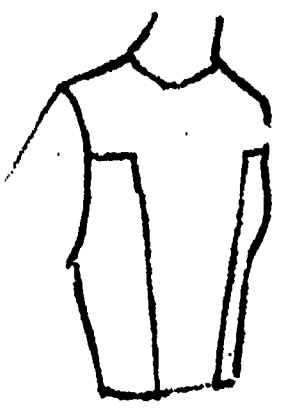
CONTENT OUTLINE	TEACHING SUGGESTIONS AND METHODS
CONVERTING DARTS TO SEAMLINES PRINCESS LINE BODICES	Review examination.
	Using colored tape on dress form, indicate the princess line from shoulder and from armhole.
A. Introduction	Supply mimeographed sketches of princess style line bodices and variation.
	Display muslin fittings or garments that are styled with princess lines.
	Elicit from students the fact that princess lines are an application of dart manipulation.
	Stress that the princess line is a dart equivalent, and must extend over the high point being considered.
B. Draft	Demonstrate the basic princess line (from shoulder) on the blackboard.
	Using colored chalk, illustrate pivoting of waistline dart.
	Using contrast color, show the shortening of darts, notches, grainlines.
	Elicit from students how the bodice pattern would be completed.
	Reference #10, pages 34 and 35 # 3, page 30
	Demonstrate back bodice on board, reviewing techniques used on front.
	Using contrasting color chalk, illustrate how darts are eliminated.
	Demonstrate the princess line from armhole on table.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	Using colored marking pens, indicate style line planning on sloper before pivoting dart. Indicate notch positions. Demonstrate the forming of a curved armhole dart by pivoting. Stress reason for planning grainline <u>after</u> pivoting. Elicit from students the reasons for shortening darts before completing patterns. On back, stress necessity of using slash and spread method to eliminate back shoulder dart. Reference #3, page 30 #10, pages 38, 39
C. Application	Students apply lesson, forming patterns of both bodice styles. Observe work in progress and check for: 1. pivoting 2. grainline and notch placement 3. shortening of darts 4. pattern completion Summarize lesson. Stress basic rules concerning princess lines: 1. application of dart manipulation 2. dart equivalent
D. Assignment	Request that students complete work at home, and form muslin fittings. Prepare students for next lesson by urging them to bring in illustrations of princess style-line variations.

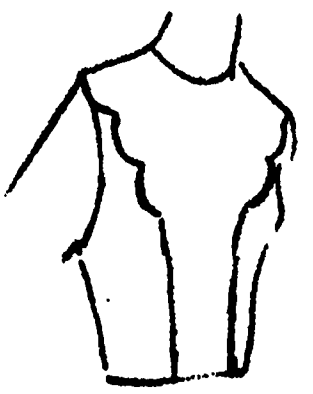
SESSION # 24

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
CONVERTING DARTS TO SEAMLINES PRINCESS LINE BODICES - VARIATIONS	Check patterns and muslin fittings of previous lesson. Check illustrations of style variations.
A. Introduction	Illustrate on board some variations of princess lines. Refer to Illustration #19 Question students on basic rules concerning princess lines. Use colored tape to illustrate on dress form, the style lines to be formed.
B. Draft	Demonstrate on board the princess line squared from armhole. Use colored chalk to stress pivoting of dart. Elicit information from students and review placing of notches and grainlines. Question students on pattern completion. Have two students demonstrate on board the drafting of the scalloped princess line. Elicit from balance of class suggestions and criticism. Demonstrate third variation on table. Elicit from students the following information: 1. reason for bust dart 2. placing of style line 3. grainlines and notches Compare this last variation to the princess line from armhole. Stress reasons for differences.

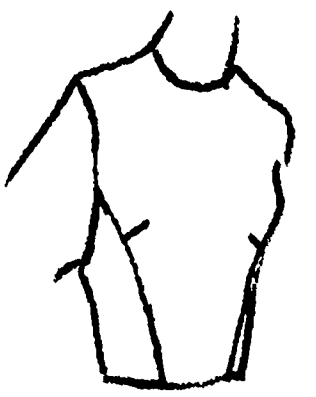
SUGGESTED PRINCESS LINE VARIATIONS



Squared From Armhole



Scalloped



With Bust Dart

Illustration #19

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Students apply lesson and form two patterns of princess lines. Observe progression of work. Check for: 1. placement of darts 2. style lines 3. notches and grainlines 4. pattern completion Summarize and review lesson. Stress use of the princess line as a dart equivalent.
D. Assignment	Encourage students to form a front bodice featuring a princess variation not formed in class. Review and prepare for next lesson by requesting students to suggest other pattern sections that might employ this principle.

SESSION # 25

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
CONVERTING DARTS TO SEAMLINES 6 GORE SLIM SKIRT	Check assignment. Review previous lesson. Elicit from students how the princess line principle can be adapted to skirts.
A. Introduction	Reference #7, Page 58 Show illustrations of gored skirts. Display muslin fittings of skirt and sleeve.
B. Draft	Demonstrate skirt draft on board. Use colored chalk to determine the gore line. Darken dart area with contrast chalk. Ask students to determine notch and grainline positions. Question students on pattern completion. Elicit from students how to use the same principle for sleeves. Reference #7, Page 198, Figure 233. Review placement of grainline. Review waistline and sleeve facing.
C. Application	Students apply lesson and form the 6 gore skirt. Caution them on necessity of curving dart point after tracing. Summary of lesson. Compare skirt gore formation to the bodice princess lines. Elicit from students how the same principle is involved in both.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
D. Assignment	Review Lesson #21. Encourage students to form a 6 gore skirt pattern, to check transfer of learning. Have student form a 2 piece sleeve that features gathers. Reference #7, Page 213, Figure 252. Reference #10, Page 142, Figure 7. Review and prepare students for next lesson by showing illustrations of garments with yokes.

SESSION # 26

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
YOKES - STRUCTURAL AND DECORATIVE BODICE STYLES	Review and check assignment. Display on dress forms three bodice fittings: 1. yoke as a style line only 2. yoke as a structural line 3. partial yoke
A. Introduction	Show illustrations of garments with yokes. Reference #4, Pages 56 and 60. Elicit from students a definition of "yoke". Question students on the difference between structural and decorative yokes. Stress that structural yokes conceal darts in seams. Question students on similarity of yokes to princess lines and gores. Reference #7, Pages 52 and 53. Using construction paper, demonstrate on forms the various types of bodice yokes to be made.
B. Draft	Demonstrate on table, using colored marking pens, the drafting of yoke bodices. Stress uses of yokes: 1. elimination of darts 2. control fullness 3. design reasons

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	Elicit from students the placement of notches and grainlines. Demonstrate structural yoke bodice. Illustrate basic draft on board. Encourage students to suggest methods of planning. Elicit from students techniques of forming the completed pattern. Demonstrate on table the partial yoke bodice. Explain differences in pattern development Stress use of notches. Indicate differences in seam allowances. Relate briefly the sewing problems encountered with a partial yoke. Discuss grain of fabric and yoke styles. Demonstrate a back yoke bodice, stressing the elimination of the shoulder dart. Question students on how to form gathers below yoke

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Students apply lesson to bodice yoke patterns Observe work in progress and check for: 1. yoke styling 2. placement of notches and grain lines 3. development of pattern 4 pattern completion Summarize and review lesson, stressing: 1. yoke as a divisional line 2. yoke as style feature 3. application of dart manipulation in yoke seam.
D. Assignment	Students should be urged to combine principles of dart tucks and division of dart control to form a pattern of an original yoke bodice. As an alternate assignment, a variation of a structural yoke bodice could be developed. Prepare students for next lesson by using colored fabrics or construction paper to indicate on forms the midriff yoke and skirt yoke References: #3, Pages 31 and 32 #7, Pages 56 and 57 #8, Pages 169 to 172

SESSION # 27

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
YOKES - STRUCTURAL & DECORATIVE LOWER BODICE AND UPPER SKIRT	Check and review assignment. Review purposes of yoke.
	Tape on forms the midriff and hip areas to represent the yokes to be demonstrated.
A. Introduction	Reference #8, Page 173 #13, Page 29
	Sketch on board the midriff and hip yoke styles that are to be formed.
	Question students whether these yokes are structural, decorative or both.
B. Draft	Demonstrate on table the draft of a midriff bodice. Reference #10, Pages 52 and 53.
	Have students suggest drafting methods.
	Caution students to close waistline dart before styling yoke.
	Question placement of notches.
	Explain necessity for "tightening" yoke.
	Request students to explain how gathers are formed
	Question students on pattern completion.
	Draft pattern of skirt front with fitted hip yoke
	Allow students to offer information on how to form the draft.
	Question students on method of drafting back.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	Review waistbands.
	Illustrate on form an example of a contour belt.
	Elicit from students the fact that this is an example of a narrow, structural yoke
C. Application	Students apply lesson by forming a pattern of a skirt style that features a yoke and panel combined.
	Review briefly Lesson #25 for gore development.
	Summarize lesson. Observe and check work in progress
D. Assignment	Have students complete unfinished work.
	Recommend that a muslin fitting be brought in completed.
	Encourage the more advanced student to prepare a pattern and muslin of a midriff yoke bodice.
	Prepare students for next lesson by featuring various necklines on garments being worn by students.

SESSION # 28

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
NECKLINES, GARMENT OPENINGS, FACINGS	Review previous assignment and lesson. Point out different necklines on garments worn by students.
A. Introduction	Distribute illustrations of neckline styles. Reference #4, Page 48. Display on form muslin fittings of symmetric and asymmetric styles, with facings of contrast color. Use style tape to illustrate on forms neckline styling. Stress the importance of considering back bodice when styling front. On form, display a muslin having a front garment opening. Reference #10, Pages 24 and 25. Prepare an information sheet on planning extensions.
B. Draft	Demonstrate on board, using colored chalk, the styling of three symmetric and one asymmetric neckline. Elicit from students why styling an asymmetric neckline requires a complete bodice. Darken facing areas with contrast color chalk. Illustrate on board the planning of extensions. Stress rule for planning extensions.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	With compass and colored chalk, indicate placing of buttonholes. Draft, on table, bodices with different necklines. Demonstrate and discuss: 1. fitted facings 2. shaped facings 3. shaped bias facings 4. bias facings 5. facings-in-one 6. separate facings 7. interfacings Reference # 7, Pages 145-154 Reference #10, Pages 58 and 59. Discuss "Two-Layer" method. Question students on "tightening" low necklines. Demonstrate a raised neckline. Discuss novelty opening.
C. Application	Students apply lesson by forming complete patterns of symmetric and asymmetric neckline bodices. Have them include a back bodice opening on one pattern. Encourage them to style original necklines. Observe progression of work and check for: 1. styling 2. planning of extensions and facings 3. placement of notches and grainlines 4. matching of shoulders.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application (Continued)	Summarize lesson by referring to illustrations on board and questioning students on: 1. styling 2. extensions 3. facings
D. Assignment	Students should be encouraged to form muslin fittings of patterns completed in class. Review and prepare for next lesson by eliciting from students the names of collar styles illustrated on board.

SESSION # 29

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
SET IN FLAT FITTING COLLARS PETER PAN, SHAWL, SAILOR	Check muslin fittings of neckline styles. Briefly review previous lesson. Display on forms, the various flat fitting collars cut in fabric or construction paper.
A. Introduction	Distribute illustrations of collar styles. Reference #13, Page 105. Prepare an illustration for collar terminology and definitions. Refer to Illustration #20. Elicit from students that the flat fitting collar fits flat on the shoulder. Emphasize that the shape of the collar neckline determines the amount of roll. Sketch on board, the relationship of the 3 types of collar neckline shapes. Reference #10, Page 69. Demonstrate by drafting on table the flat fitting Peter Pan collar. Use colored pencils to indicate: 1. overlapping of shoulders at armhole 2. style lines 3. extension 4 facings 5. notches 6 lowering of neckline Discuss reason for overlapping shoulder.

COLLAR PARTS

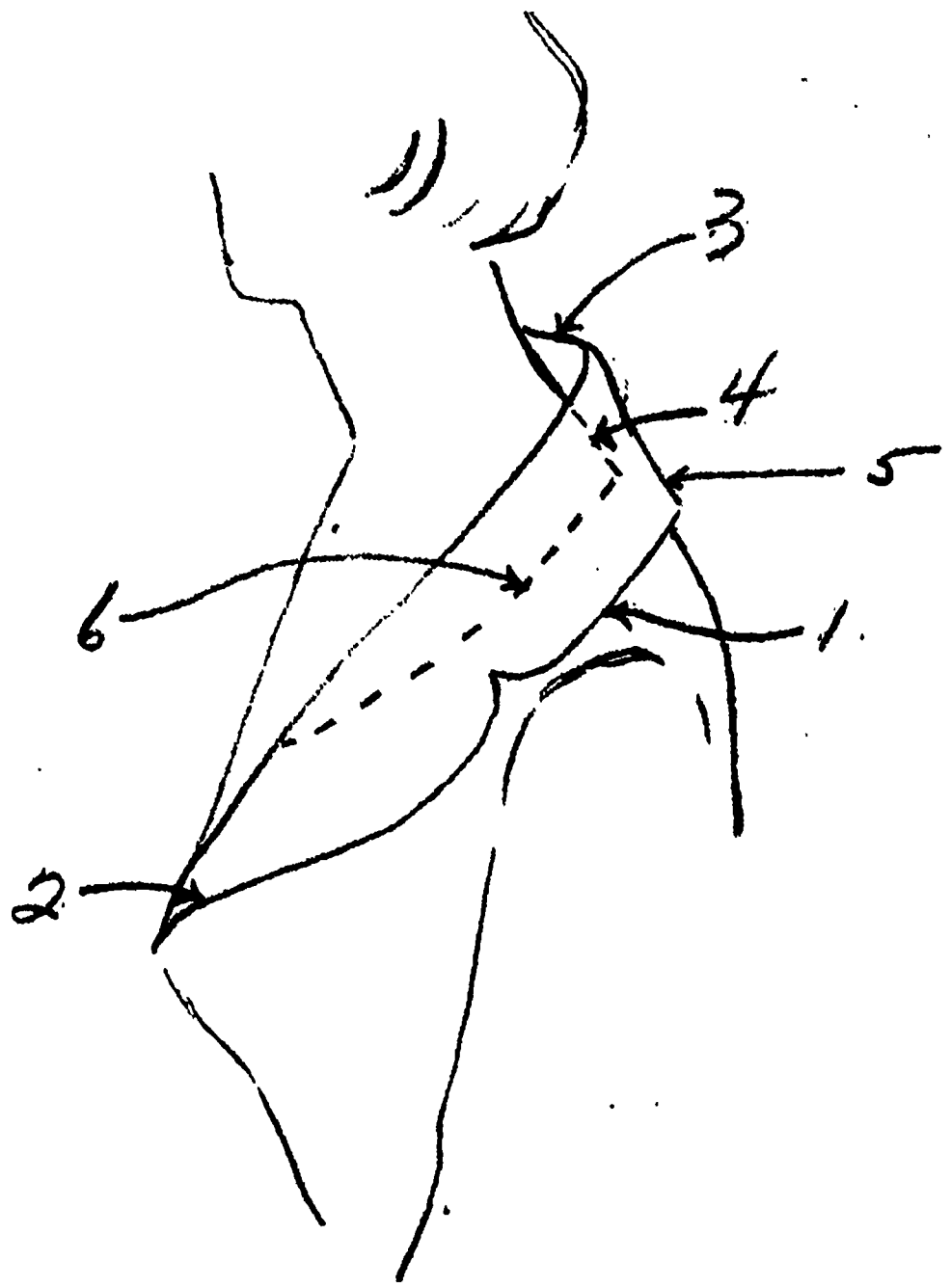


Illustration #20

1. Style Line
2. Break
3. Roll Line
4. Stand
5. Fall
6. Neckline

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
A. Introduction (Continued)	Elicit from students: 1. collar planning to center front 2 notch positions on collar 3. extension 4. reason for lowering neckline Demonstrate the development of undercollar. Stress the reason for adjustment of outer edge of undercollar. Illustrate how basic draft can be used to form puritan or bertha collar. Elicit from students the draft planning of the flat fitting shawl collar. Compare planning to Peter Pan draft Stress shoulder overlapping. Discuss reason for planning breakpoint to extension Review undercollar development. Recommend that students use same draft to form sailor collar. Reference #3, Pages 36 and 37. Question students on draft development and completion. Discuss interfacings

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHOD
C. Application	Students are to apply lesson and form complete patterns of a Peter Pan and either shawl or sailor bodice. Observe work in progress and check for: 1. collar styling 2. extension planning 3 collar notching, especially shoulder 4. undercollar adjustment 5. facings Summarize lesson. Discuss suggestions for applying collars to bodice.
D. Assignment	Suggest that students form a pattern and fitting of a flat collar variation. Illustrate some variations on the board. Reference #4, Page 106. Prepare for next lesson by comparing muslin fittings of flat fitting and roll collars.

SESSION # 30

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
SET-IN ROLL OR STAND COLLARS PETER PAN, SHAWL, SAILOR, CONVERTIBLE	Check assignment Review briefly the previous lesson. Compare muslin fittings of the roll collar to the flat fitting.
A. Introduction	Prepare an illustration on board of the back view of a stand Reference #3, Page 38. Illustrate on board the comparison of flat and roll collar neckline shapes. Discuss collar names and type of fit. Reference #7, Page 170.
B. Draft	Demonstrate on board, the planning of back Peter Pan collar. Use larger scale and colored chalk for emphasis. Elicit from students the location of the: 1. stand 2. collar neckline 3. sloper neckline 4. collar shoulder Duplicate draft on table using regular sloper Question students in lowering of front neckline Plan front of collar, stressing measurement of collar and bodice neckline.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	Caution students to correct shape of style line and neckline. Review collar shoulder notch. Review pattern completion and undercollar development. Remind students that same draft could be used to develop other collar styles. Demonstrate on board and table the sailor collar. Use techniques similar to drafting the Peter Pan. Stress the differences: 1. planning back 2. styling to extension 3. comparing necklines Elicit from students how this same draft could be used to form the shawl collar. Review briefly pattern development and completion. Reference #3, Pages 38 and 39 #12, Pages 171-181 Demonstrate the convertible collar.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Students should form complete patterns of a roll Peter Pan bodice, and a variation of the foll shawl collar bodice. Stress accuracy of measurements and styling. Observe work in progress and check for: 1. styling 2. placement of back collar onto front 3. accuracy of measurements 4. correction of lines 5. pattern development and completion. Summarize and review lesson.
D. Assignment	Students should complete work not finished in class. Encourage more advanced students to form variations of these collars. Prepare for next lesson by demonstrating on a form the draping of a straight band collar.

SESSION # 31

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
SET-IN STAND-UP COLLARS MANDARIN, WING, STOVEPIPE	Briefly review previous lesson.
	Collect and check assignment.
	Illustrate the stand-up collars on board.
A. Introduction	Distinguish, by comparison of fittings, the difference between the one piece and shaped mandarin
	Display a fitting of a wing or dandy collar.
	Illustrate the comparison of the neckline shape of stand-up collars to the preceding ones.
	Demonstrate how to measure the sloper neckline by referring to dress form.
B. Draft	Demonstrate on blackboard, in larger scale, the drafting of the one piece mandarin
	Reference #12, Page 159.
	Discuss reason for curving front neckline.
	Explain pattern completion.
	Elicit from students the reason for forming a shaped mandarin.
	On table, draft a shaped mandarin, stressing the curving of upper edge.
	Question students about notch placement.
	Discuss design problems concerning these collars.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	Reference #10, Page 77.
	Explain by demonstrating on blackboard, the drafting of the wing collar.
	Stress that the only difference in the drafting occurs in the shaping of the collar.
	Form a stovepipe collar for a lowered neckline.
	Stress the necessary shaping
	Question students on facing requirements for all collars.
	Discuss and determine grainlines.
C. Application	Provide a muslin fitting of a revers neckline.
	Urge students to apply principles learned to form a complete pattern of a revers neckline
	Reference #13, Page 113.
	Summarize lesson by stressing the similarity in drafting the 3 different collar types.
	Review lesson, question the reason for shaping a mandarin collar.
	Prepare for next lesson by displaying fittings of collars-in-one.

SESSION # 32

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
SET-IN COLLAR VARIATIONS BIAS ROLL, CAPE, ROLL-FITTED	Check muslin fittings of revers neckline.
	Review briefly previous lesson on collars.
	Question students briefly on the collars formed.
A. Introduction	Display muslin fittings of the collars to be formed
	Prepare an information sheet on set-in collar variations.
B. Draft	Demonstrate on board the method of drafting the rippled cape collar.
	Compare this collar to the flat-fitting collars.
	Elicit from students how and why this collar would ripple when on the body.
	Question students why this would be considered a flat-fitting collar.
	Demonstrate briefly, on table, the fitted cape collar.
	Caution students on grain lines and notches.
	Using colored pencils and chalk, demonstrate on the board and table, the roll-fitted collar.
	Explain the differences between the medium roll of this collar and the full roll collar of regular stand collars.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B Draft (Continued)	Stress how to obtain the flat fitting front.
	Sketch on board, some variations of the roll-fitted collar.
	Reference #7, Pages 185 and 186.
	Demonstrate the full-roll bias collar (turtle-neck)
	Explain why it is necessary to raise the neckline.
	Elicit from students the advantage of making this collar in one-piece.
	Question students on how to obtain a bias collar with tie.
	Reference #10, Pages 78 and 79.
C. Application	Encourage students to form complete patterns of variations of the collars demonstrated.
	Observe and check work in progress.
	Summarize lesson.
D. Assignment	Have students complete work not finished in class. Urge students to form muslin fittings.
	Prepare students for next lesson by comparing muslin fittings of set-in collars to collars-in-one.

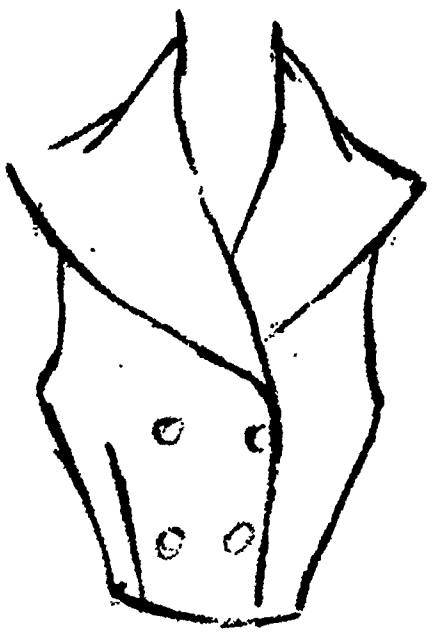
SESSION # 33

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
COLLARS-IN-ONE WITH FRONT TAILORED SHAWL COLLAR	Check assignment. Briefly review previous lesson.
A. Introduction	Display fittings of the basic shawl collar and variations. Distribute information sheet of collar-in-one illustrations. Reference #4, Page 111. Determine the category of collars-in-one in relation to set-in collars. Reference #10, Page 84. Review collar terminology.
B. Draft	Using marking pens demonstrate on table the draft of the basic shawl collor-in-one. Stress the shifting of 1/2" of the waistline dart to the center front. Explain how the collar stand is obtained, comparing it to the stand set-in shawl collar. Illustrate the styling of the lapel. Question students about buttonhole extensions. Caution students about the width of outer edge of collar. Discuss the reasons for a dart at the neckline: 1. better fit 2. softer rolls Demonstrate on a muslin fitting the dart pick-up position on the lapel.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	Review the planning of the facing Elicit from students the adjustment necessary on the facing. Determine the grainline and notches. If time permits, demonstrate the drafting of a wide shawl collar variation. Refer to Illustration #21.
C. Application	Students form the pattern of the basic shawl collar. The more advanced student should be encouraged to form a variation of the style demonstrated. Observe work in progress. Check for: 1. planning of stand 2. styling of lapel 3. accuracy of measurements 4. development and completion of pattern. Summarize lesson. Elicit from students how the draft of this collar could be used to form a flat fitting sailor collar-in-one.
D. Assignment	Students are to complete work not finished in class. Encourage students to form muslin fittings. Stress the necessity of muslin fittings to: 1. adjust width of outer edge 2. form dart fitting in lapel. Review and prepare for next lesson by displaying illustrations of the tailored notch collar.

SUGGESTED VARIATIONS OF SHAWL COLLAR

Notched Shawl



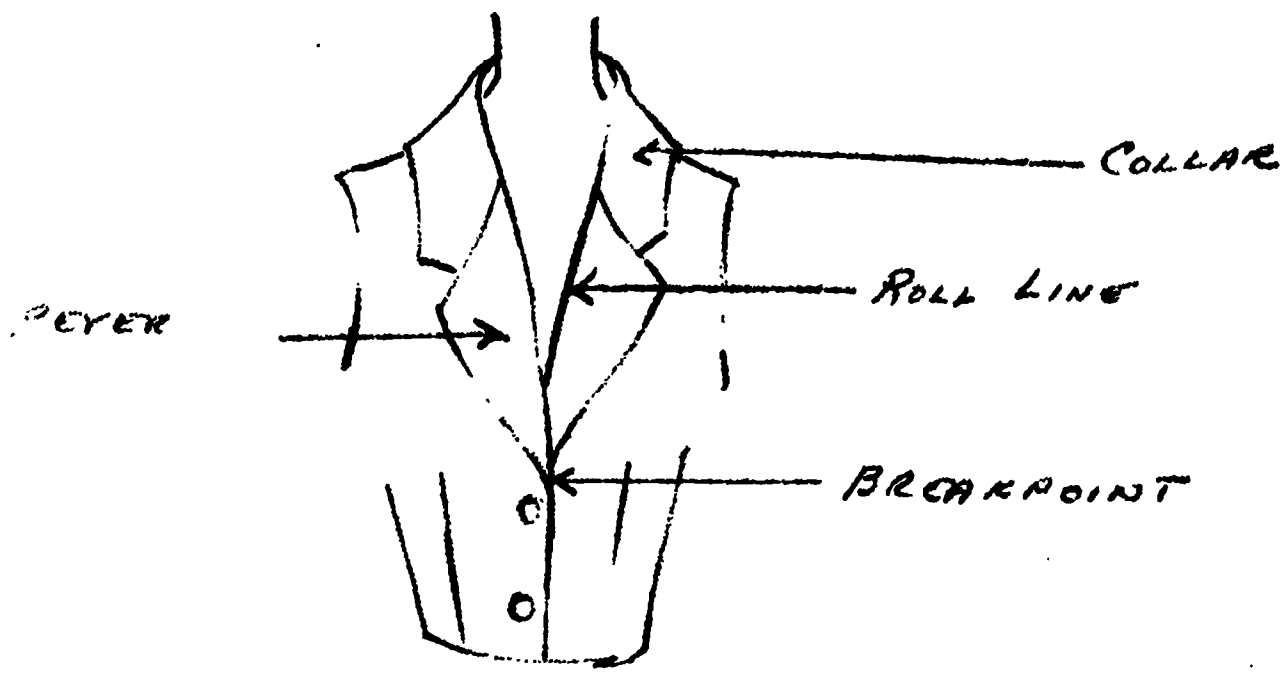
Cape

Illustration #21

SESSION # 34

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
COLLARS-IN-ONE WITH FRONT TAILORED NOTCH COLLAR	Review previous lesson. Check completed work.
A. Introduction	Display a muslin fitting of a tailored notch collar bodice. Distribute an illustrated sheet of notched collar styles. Refer to Illustration #22. Elicit from students the fact that this collar is similar to that on a man's suit jacket. Compare this collar to the shawl collar-in-one. Stress the similarities and differences.
B. Draft	Demonstrate by drafting on table, the plan of the collar. Use colored marking pens to emphasize items such as: 1. roll line 2. revers 3. stand Question planning of the stand, relating it to previous lesson. Stress the planning of ease for outer edge of collar. Discuss the methods of styling the collar Demonstrate how to obtain more ease on outside of collar. Elicit from students placement of notches. Stress notch at breakpoint.

TAILORED NOTCH COLLAR AND VARIATIONS



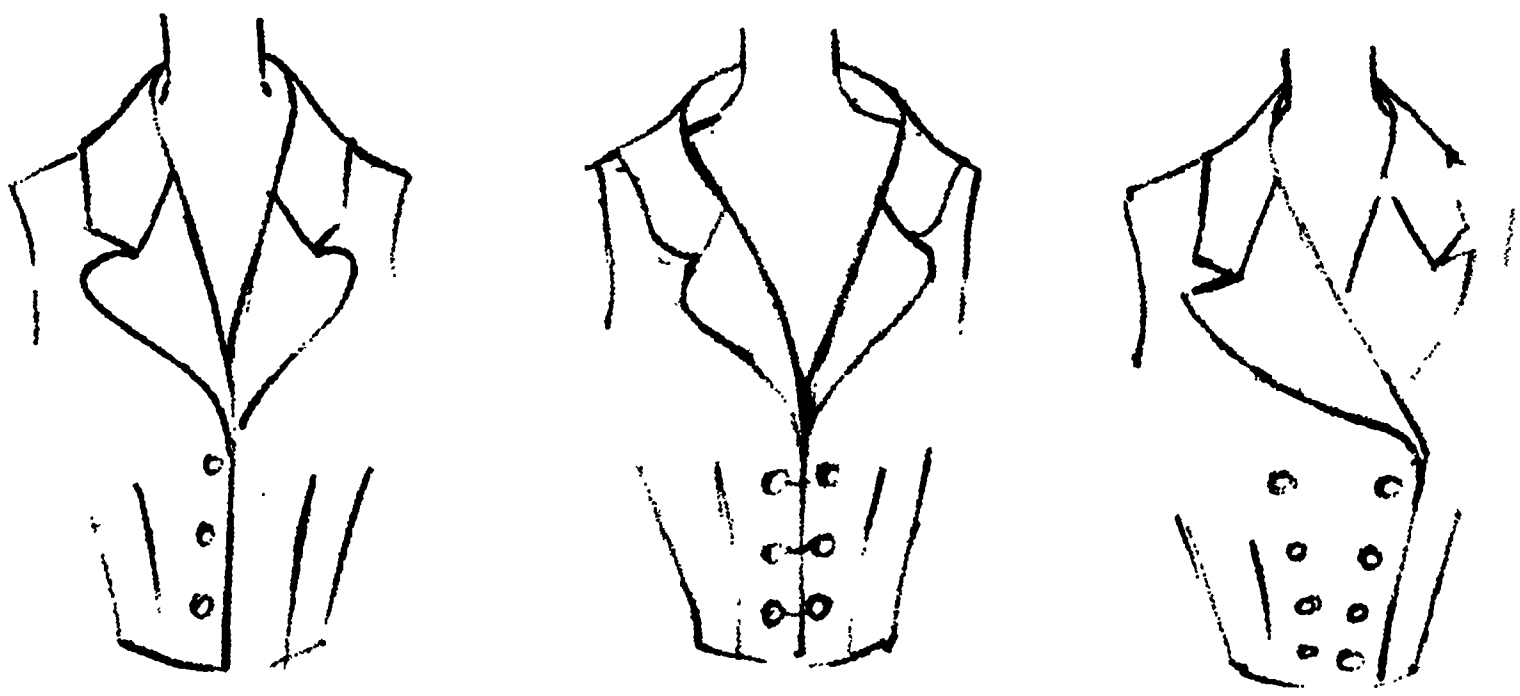


Illustration #22

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	Question students on development of pattern sections. Review adjustment requirement on front facing. Explain undercollar development and adjustment: 1. one piece - straight grain 2. two piece - bias grain Discuss interfacings. Remind students to develop a back neck facing. Demonstrate, if time allows, a low tailored notch variation.
C. **Application**	Allow students to complete a pattern of the high and low notched collar. Caution students on accuracy of measurements and on styling. Observe progression of work. Check for: 1. development of stand 2. revers styling 3. planning of uppercollar 4. notch placement 5. development and completion of pattern sections. Summarize lesson. Review reason for: 1. two piece bias undercollar 2. adjustment of facing Explain tailoring processes for constructing a tailored notch collar.
D. **Assignment**	Students are to form a muslin fitting of the pattern formed in class. Motivate students for next lesson by displaying draped bodice styles.

SESSION # 35

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
SLASHING AND SPREADING FOR COWLS NECKLINES	Review previous lesson. Check muslin fittings of notch collars. Display muslin fittings of cowl necklines: 1. high cowl 2. low cowl 3. pleated cowl 4. yoke cowl
A. Introduction	Explain the historical background of the cowl: the monk's hood of the Middle Ages. Elicit from students the names of suitable fabrics for cowls. Review the slashing and spreading principle to add fullness.
B. Draft	Demonstrate by illustrating on board a simple high cowl neckline Use colored chalk to show the forming of the 90° angle. Stress the necessity of pivoting part of dart to center front to gain width at neckline. Discuss the reason for using a neckline facing in one. Elicit from students why the bias grain should be used with cowl patterns. Demonstrate by drafting on the table a cowl with a lowered neckline. Stress the importance of the waistline striking the vertical line of the square. Reference #6, Page 35.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	Caution students on the placing of the drape lines. Question students about forming the cowl on a 90° angle. (To add length and width for the necessary draped folds.) Demonstrate the method of correcting the shoulder and neckline. Discuss the type of neckline facing required. Review the planning of bias grainlines. Elicit from students the process of drafting a back cowl. Show how a plain back pattern and neck facing would be drafted. Demonstrate a draft for a pleated cowl neckline.
C. Application	Refer to the muslin fitting of a yoke cowl. Discuss the importance of fitting cowls in batiste or lightweight muslin. Discuss the advantage of a yoke cowl: 1. lower bodice remains on straight grain 2. no fullness in lower bodice 3. style factors Caution students to apply the principle of the square when forming a pattern of the yoke cowl bodice Observe work in progress.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application (Continued)	Check for: 1. planning of neckline and drape lines on draft 2. forming of 90° angle 3. slashing and spreading of draft 4. placement of draft and squared lines 5. development of neckline facings 6. pattern completion (bias grainline) Summarize lesson by relating the slashing and spreading principle to previous lessons that used the same principle for adding gathers, dart tucks, etc.
D. Assignment	Students form patterns and batiste fittings of cowl neckline bodice styles. Discuss the sewing procedures for developing draped cowls: 1. use of weights 2. linings 3. thread tacks. Prepare students for next lesson by suggesting that they consider ways of using this principle of slashing and spreading to develop skirt cowls.

SESSION # 36

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
SLASHING AND SPREADING FOR COWLS SKIRTS (Continued)	Review previous lesson. Check assignment. Display muslin fittings of cowl draped skirts. Discuss the style possibilities of cowls on skirts and other pattern sections.
A. Introduction	Illustrate on board, skirts with: 1. deep cowls at side 2. simple cowl Compare skirt cowl development to Session #17. Reference #7, Pages 140-142.
B. Draft	Demonstrate by drafting on the board, a simple skirt cowl. Using colored chalk indicate the formation of the 90° angle from side seam to waistline. Elicit from students the placement of grainline and fold position. Caution students on necessity of skirt lining as a stay for the drape. Explain why a facing would be required for the lower edge. Demonstrate, on the table, a skirt with deep cowl side drapes.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	Using colored pencils, indicate how the waistline darts would be eliminated. Emphasize the re-shaping of the side seams. Stress the reason for eliminating the side seam when drafting. Elicit from the students the position of the drape lines. Caution students not to cut through lines when slashing. Allow students to suggest how to use the 90° angle to form the cowls. Demonstrate how to correct the hemline and waistline. Review the planning of the lower edge facing, grain and notches. Review the placement of grainlines and notches. Remind students to plan a skirt lining. Indicate to students that the same procedure can be used to form a cowl draped sleeve. Demonstrate on the board the draft for a cowl sleeve.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Students form a pattern of a deep side cowl skirt. Remind them to form a waistline facing. Stress the use of the 90° angle. Observe work in progress and check for: 1. initial draft planning 2. planning of drapes 3. formation of 180° angle 4. placement of draft after slashing 5. pattern development and completion Summarize lesson by pointing out the similarities in drafting all cowls. Stress the use of the "L" square.
D. Assignment	Students are to complete skirt pattern Ask students to use batiste rather than muslin to test cowl drapes. Remind students that experimentation with fittings will be necessary to achieve desired affects. To prepare students for the next lesson, encourage them to consider the different geometric shapes that pattern sections assume. Ask them to consider particularly the rectangle formed by the skirt sloper, and how it changes to assume other shapes.

SESSION # 37

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
CIRCULAR SKIRTS	Review previous lesson. Collect and check assignment. Prepare a visual aid of ciecular skirt styles.
A. Introduction	Display muslin fittings of: 1. full circle skirt 2. half circle skirt 3. yoke and circular flare skirt 4. dirndl circular flare skirt Illustrate on board: 1. 90° angle 2. 180° angle 3. 360° angle. Discuss the concept of circularity. Elicit from students the different amount of sweep achieved by various angles. Compare the 90° formation of cowl fullness to circular skirt planning. Review briefly the principle of adding extra fullness for gathers. Review the following terms: 1. sweep 2. hem 3 flare 4. gathers
B. Draft	Demonstrate on the table a draft of a circular flare skirt with shaped hip yoke. Review Lesson #27. Explain the pivoting of waistline darts to flare.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	Elicit from students the skirt silhouette achieved.
	Indicate to students how the basic rectangular skirt achieves circularity.
	Stress the importance of forming the yoke first.
	Elicit from students the notch placement.
	Form right angles for full circle.
	Stress that the planning of slash lines affects the fall of the folds after spreading
	Question the type of circular skirt that will develop when using two 90° angles.
	Elicit from students the methods of completing the pattern pieces.
	On board, drawing 90° angles, stress the formula method of forming circle skirts.
	Use colored chalk to indicate the various waistlines developed.
	Caution students to measure and adjust waistline.
	Discuss reason for making the waistline smaller.
	Elicit from students when the slash and spread or formula methods can be used.
	Sketch on board the pattern shapes that would result from dirndl flare.
	Compare straight fullness to circular.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	Question students on hem allowances Review briefly waistline facings and waistbands.
C. Application	Students apply lesson to form the pattern for an original circular flare skirt with shaped hip yoke. Stress importance of: 1. pivoting waistline darts to flare 2. development of the 90° angle 3. planning of slash lines Observe work in progress and check for: 1. method of slashing and spreading 2. pattern development and completion Allow students to apply formula method to produce a full circle, 3/4 and 1/2 circle skirts. Summarize lesson: Stress: 1. accuracy of measuring with formula method 2. importance of slashed sections placed flat when spreading.
D. Assignment	Students complete work not finished in class. Encourage the development of 1/2 scale dirdnl flare patterns. Urge students to form muslin fittings. Prepare students for next lesson by questioning students on the possibilities of developing circularity on other pattern sections.

SESSION # 38

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
CIRCULAR SLEEVES: SHIRTWAIST, BELL, LANTERN, PUSH-UP, LEG-O-MUTTON	Review formula method of forming circle skirts.
	Check assignment.
	Prepare an information sheet of sketches.
	Illustrate the various sleeve styles and cuffs.
A. Introduction	Display muslin fittings of circular flare sleeves and compare the effect achieved to circular flare skirts.
	Review the principles of angles to determine flare.
	Briefly review the concepts of slashing and spreading.
B. Draft	Demonstrate by drafting on table, the shirtwaist sleeve.
	Explain the reason for lowering the back quarter of sleeve.
	Discuss sleeve openings.
	Form the barrel cuff (sleeve band).
	Using the shirtwaist sleeve, demonstrate the pivoting method on blackboard of forming a bell sleeve.
	Indicate with colored chalk, the position of slash lines and the amount of spreading that develops.
	Refer to Illustration #23

FORMING THE BELL SLEEVE

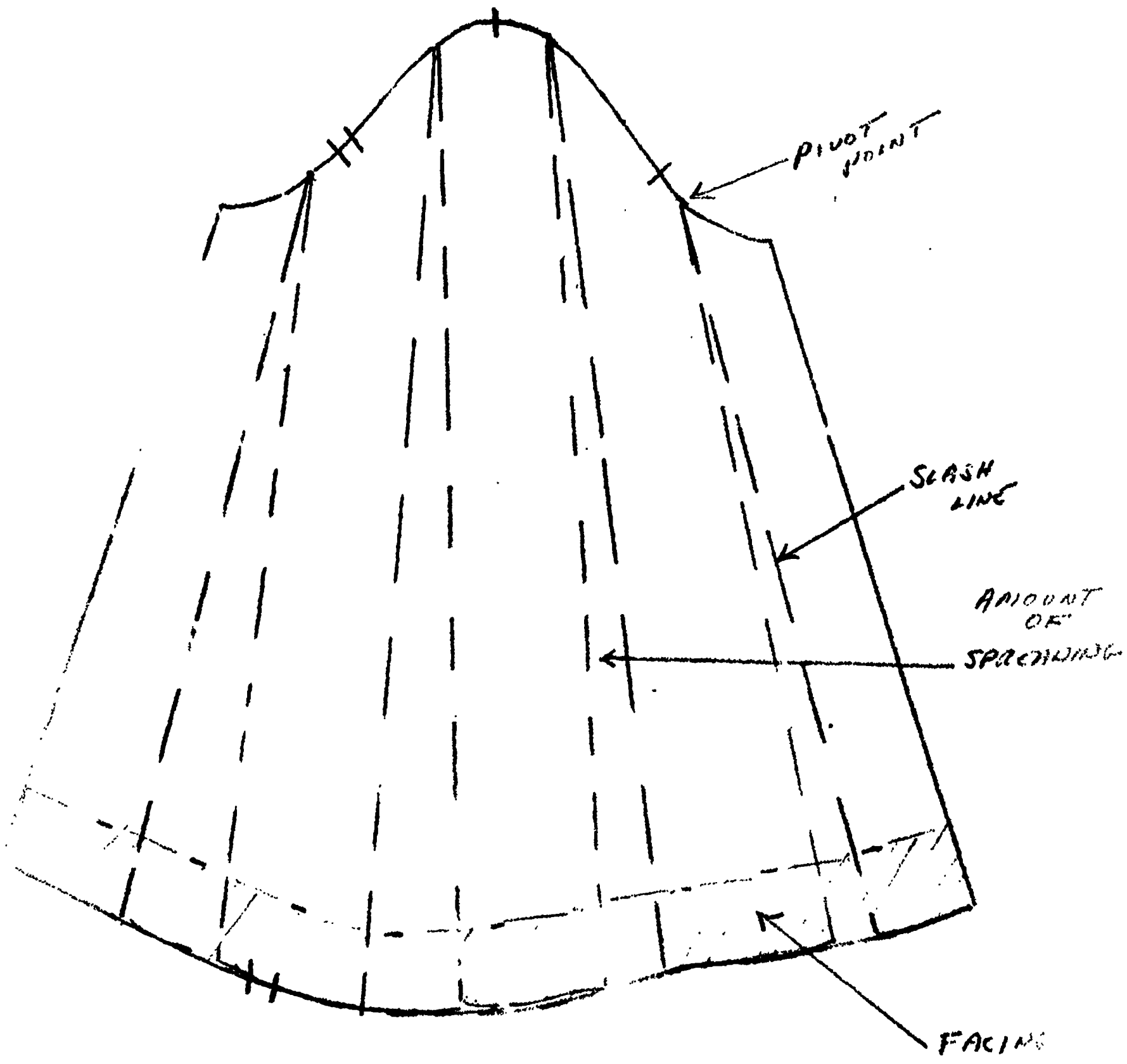


Illustration #23

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	Elicit from students the: 1. shaping of lower edge 2. facing and notch planning. Stress reason for spreading more at back section of pattern. Refer to Illustration #23. Repeat the drafting of the bell sleeve on the table, this time using the slash and spread method. Compare the 2 methods of achieving the same pattern. Develop the bell sleeve to a 1/4 circle push-up sleeve. Question students on the angle to be used. Show how larger angles can be used to form fuller circles. Point out the circularity principle in adapting the shirtwaist to bell to 1/4 circle sleeve. Explain the function and development of a sleeve casing. Reference #3, Page 50. Demonstrate the long lantern sleeve. Review the principle of removing darts. Use colored pens to indicate style lines. Elicit from students the placement of notches.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	Use slash and spread method to form pattern. Stress the importance of matching circumferences on upper and lower sections. Reference #7, Page 218. Illustrate on board how the same style effect can be achieved in a balloon. skirt. Discuss sleeve linings for desired silhouette. Question students on forming a short lantern sleeve. Sketch the draft on the board. Demonstrate the leg-o-mutton sleeve. Stress the contrast between shapes of upper and lower section. Point out the development of circularity in the sleeve cap. Stress the similarity of this sleeve cap to the short sleeve with gathered cap. Elicit from students the similarity of the short puff sleeve to straight flare.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Students form the shirtwaist sleeve sloper They also develop and complete the push-up sleeve and the lantern sleeve. Observe progress of work. Check for: 1. draft planning 2. spacing of slash lines 3. spreading procedures 4. matching of seams 5. development and completion. Summarize lesson by reviewing on board how the initial rectangularly shaped sleeve sloper changes through additions of fullness to achieve circularity.
D. Assignment	Students complete patterns and muslin fittings. Prepare students for next lesson by illustrating pleated skirt styles.

SESSION # 39

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
INVERTED PLEATED SKIRTS WITH POCKETS	Review previous lesson. Check assignment.
A. Introduction	Display muslin fittings of skirt styles featuring pleats and pockets Distribute illustrations of pleated skirts with pockets. Illustrate on board, the basic side pleat and label. Refer to Illustration #24. Demonstrate, by folding paper, the box and inverted pleat. Elicit from students the fact that the pleats are variations of the basic pleat. Explain the difference between pleats and tucks. Elicit from students the similarities and differences between slashing and spreading for circularity and for pleats.
B. Draft	Demonstrate the drafting of the 6 gore skirt on the table. Have students determine the gore lines. Illustrate the method of adding flare to a gore seam Review elimination of dart in a seam. Illustrate the planning of the non-parallel pleat extensions on flare lines. Explain parallel and non-parallel pleat planning.

BASIC SIDE PLEAT

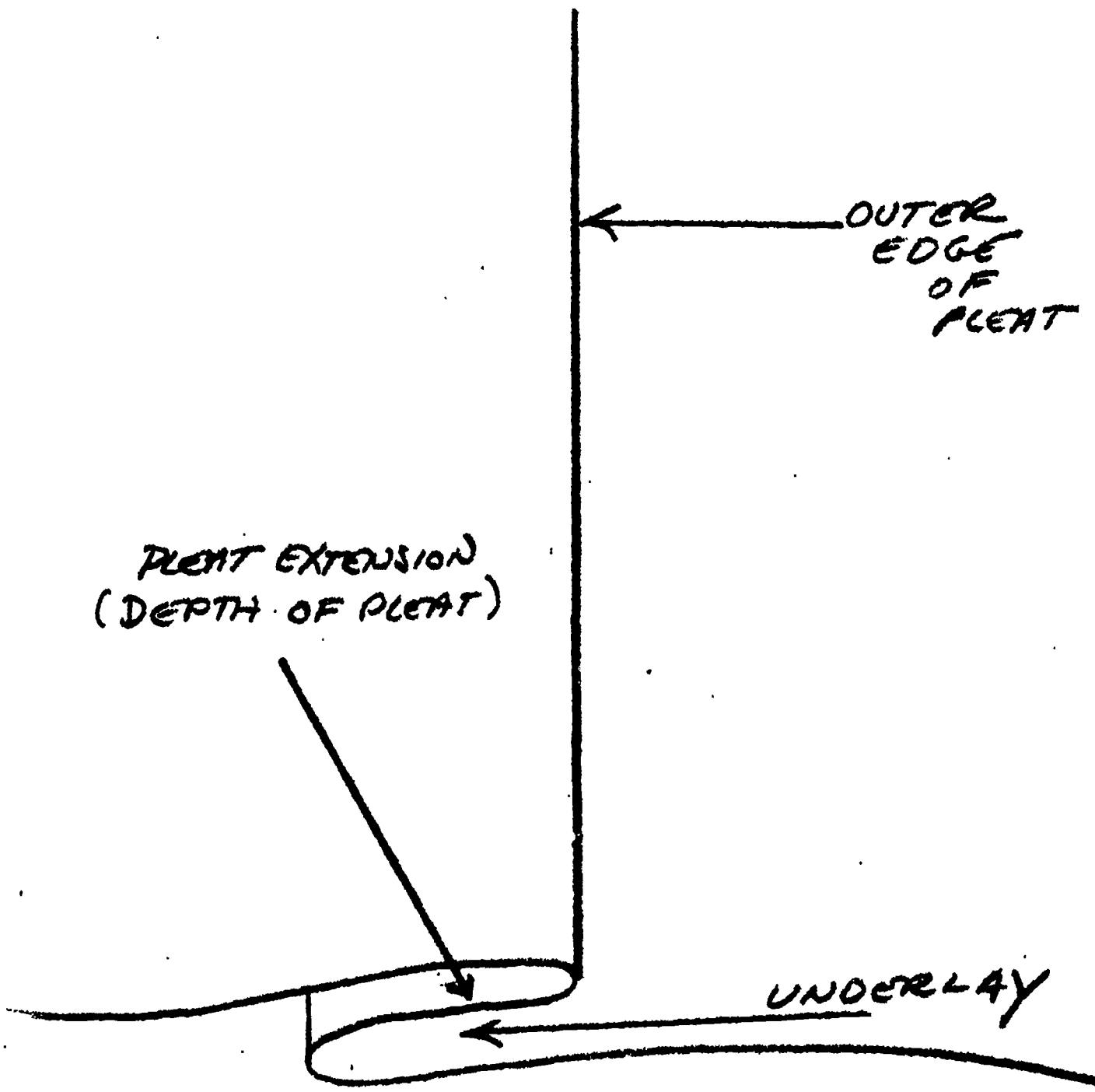


Illustration #24

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	Demonstrate the patch pocket. Stress marking of patch pockets. Develop the pattern sections, stressing the completion of: 1. gores with pleat extension 2. underlays 3. pocket. Review waistline facings and waistbands. Demonstrate draft of slim skirt with raised waistline, kick pleat and seam pockets. Caution students to shape waistline section. Explain reason for kick pleat. Review the non-parallel pleat method, and reason for its use. Elicit from students the category to which kick pleats belong. Plan extension to entire length of center edge of skirt. Explain why. Demonstrate planning of seam pocket. Stress notches and grainlines. Discuss the procedures of cutting this pattern in fabric. Reference #10, Page 151. Elicit from students the methods of developing and completing patterns. Explain why this waistline facing differs from others. Discuss construction techniques of skirt styles.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Students form a complete pattern of the 6 gore flare inverted pleat skirt. Encourage students to apply these principles to differently styled gore skirts. Urge students to develop original patch pockets styles. Observe work in progress. Check for: 1. planning of gores 2. placement of grainlines and notches 3. planning of pleat extension 4. development and completion of pattern pieces. Summarize lesson. Review by stressing that pleats: 1. add fullness and are a design feature 2. are variations of the side pleat 3. can be formed by parallel and non-parallel methods.
D. Assignment	Students are to complete all patterns and muslin fittings. As a review, sketch on board the newly learned principle of adding flare to a gore seam. Motivate students for next lesson by displaying illustrations of other pleated skirt styles.

SESSION # 40

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
PLEATED SKIRT VARIATIONS	Review previous lesson. Check assignment. Display on forms or illustrate: 1. skirt with box pleated shaped flounce 2. unpressed side pleated skirt to waistline 3. side pleated skirt fitted above hipline.
A. Introduction	Prepare an information sheet on pleating to hip measurement. Reference #10, Page 153. Compare previous fittings of skirts with separate pleat underlays to current project. Elicit from students the terminology of pleat construction.
B. Draft	Demonstrate the planning of style lines for the flounced skirt on the board. Use colored chalk and indicate notches. Duplicate the same draft on the table. On flounce draft, stress: 1. guide line for spreading 2. planning of pleats 3. interpretation of style line Demonstrate forming a one-piece box pleated flounce. Caution students to fold pleats before tracing style line.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	Question students on how to develop a gartered flounce from the same draft. Review on board, the development of a circular flare flounce. Have students compare the box pleated flounce to the circular. Question students on pattern development and completion. Demonstrate on board the drafting of a skirt to waistline measurements. Stress the importance of considering fabric width to determine pleats. Review draping properties of fabric grain. Illustrate on board the ratio method of planning pleats. Remind students to add ease to basic waistline measurements. Discuss construction techniques of all around pleated skirts. Review possibility of using this same draft for a dirndl skirt. Sketch on board, skirt style variation that could employ principles learned with flounce development. Discuss briefly the drafting of these styles.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Encourage students to form a variation of a box pleated flounced skirt. Urge the more advanced student to use the information sheet to form a pattern of a skirt pleated to hip measurement. Observe progression of work. Check for: 1. planning of pleats 2 development of pleat extensions and underlays 3. folding and tracing of pleats 4. pattern development and completion. Summarize lesson by comparing: 1. slashing and spreading for pleats and circles 2. alternate (ratio) method of pleating. Discuss briefly machine pleating. Prepare for next lesson by discussing possibilities of horizontal pleating in bodices.

SESSION # 41

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
PLEATED BODICES	Review previous lesson Check assignment
A. Introduction	Display on forms: 1. bodice with pleated front 2. back bodice with yoke and pleats 3. tucked front bodice Show illustrations of bodices that features horizontal as well as vertical pleats. Review the difference between tucks and pleats. Encourage students to suggest design possibilities for pleated bodices. Elicit from students the possibility of using pleats for structure as well as decoration.
B. Draft	Demonstrate the drafting of a pleated front bodice. Omit the tracing of the bust dart. Explain the planning of the pleat positions. Stress location of guide lines. Caution students to number draft sections before slashing. Demonstrate on board and on draft the division of the waist dart on to the pleat lines. Demonstrate spreading for pleats by matching guide lines. Point out the folding of pleat lines from shoulder to bust and bust to waistline.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (continued)	Elicit from students the necessity for folding and tracing seamlines. Question students on pattern completion. Elicit from students why the pleats are narrower at waistline. Demonstrate the drafting of a back bodice with yoke and pleats. Review yoke styling and elimination of shoulder dart in yoke seam. Plan the lower bodice by using the alternate method of pre-pleating paper. Demonstrate various pleats. Explain how these pleats could be converted to tucks. Demonstrate by pleating paper, the horizontal pleated front bodice with waist gathers. Review tucking development. Discuss pre-tucking on fabric before pattern drafting. Explain "sloping" methods and how they affect pattern development. Elicit from students, and demonstrate the application of pleats to a sleeve style.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Students apply lesson and form a pleated front back and sleeve. Stress the use of facings, notches, grainlines. Observe work in progress. Check for: 1. draft planning 2. pleat formation 3. pattern development and completion Summarize lesson by drawing on board how the waistline dart remains structural with decorative pleats. Review the slashing and spreading and pre-pleating method for froming pleats. Question the use of pleated drafts for gathers.
D. Assignment	Students complete all unfinished work. Stress importance of muslin fittings. Motivate for next lesson by showing illustrations of sleeve styles that are formed using part of the bodice.

SESSION # 42

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
SHORT SLEEVES-IN-ONE WITH BODICE	
A. Introduction	Check assignment. Review previous set-in sleeves formed: 1. short puff 2 shirtwaist Explain, by comparing muslin fittings, the difference between set-in sleeves and sleeves-in-one. Discuss the fitting properties of the two different types. Prepare an information sheet of illustrations. Discuss the historical background of the kimono sleeve. Illustrate on board the rectangular shape of kimono sleeves.
B. Draft	Demonstrate by drafting on board the short kimono sleeve pattern. Stress the squaring of the underarms and to obtain overarm seam. Discuss sleeve facing-in-one. Draft the cap sleeve on table. Elicit from students how this sleeve is a shorter variation of the kimono. Question students on facings. Illustrate a modified cap sleeve and armhole on the board.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	Reference #7, Pages 245, 247. Stress notches and grainlines. Demonstrate by drafting, a pattern of a kimono with dropped shoulder. Review circular flare principle Apply circular flare to lower sleeve. Explain similarities in all three sleeves formed. Stress that these kimono sleeves are loose-fitting.
C. Application	Students apply lesson to form the short kimono sleeve bodice and one other that had been demonstrated. Observe work in progress. Check for: 1. placement of slopers when drafting sleeves 2. squaring of lines 3. facings development 4. pattern development and completion. Summarize and review lesson. Motivate for next lesson by displaying muslin fittings of long kimono sleeves.

SESSION # 43

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
LONG SLEEVES-IN-ONE WITH BODICE	
A. Introduction	Review previous lesson.
	Check assignment.
	Compare muslin fittings of long kimono sleeves to previously developed short sleeves.
	Explain, by comparing fittings, why a gusset is important.
	Discuss various types of gussets.
	Sketch the gusset shapes on board.
	Discuss the fit achieved with and without gussets.
B. Draft	Demonstrate on table the drafting and development of the basic kimono sleeve sloper (without gusset).
	Explain the reasons for spreading at shoulders.
	Discuss forming of wide or narrow sleeves.
	Stress adjustment of back side seam to avoid pulls.
	Caution against adding more than $\frac{1}{4}$" to shoulder.
	Demonstrate the forming of the over-arm seam.
	Discuss different preferences for planning this seam.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (continued)	Elicit from students the placement of notches. Use the basic sloper to form a pattern. Indicate on the same draft how a kimono sleeve with stylized armhole can be formed. Demonstrate on table how the basic sloper is adapted for a kimono with gusset. Review the reason for desiring a gusset and the fit achieved. Expalin why a maximum of 45° for pivoting the sleeve is allowed. Reference #12, page 299 Illustrate on board the method of determining the new underarm. Stress the trueing and matching of overarm and underarm seams. Illustrate on board and on draft how to obtain the gusset slash line. Join the one piece and two piece gusset. Demonstrate on the fitting the advantages of a two piece gusset. Discuss briefly a gusset with dart.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Students apply lesson and form a pattern for a long kimono sleeve with two piece gusset. Stress the importance of forming a complete pattern with facings, garment openings, etc. Observe work in progress. Check for: 1. pivoting of sleeve 2. adjustment of underarm 3. planning position and development of gusset 4. pattern development and completion Summarize lesson. Illustrate on board a sketch of a kimono bodice with stylized gusset. Reference #12, page 307 Briefly illustrate on board how this variation would be formed.
D. Assignment	Students are to complete pattern and form a muslin fitting. Encourage the more advanced student to develop the variation sketched on board. Prepare students for next lesson by sketching on board sleeves that are formed by using part of the bodice.

SESSION # 44

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
SHORT SLEEVES USING PART OF BODICE	
A. Introduction	Review previous lesson.
	Check assignment. If time permits demonstrate the development of the kimono with stylized gusset.
	Display on forms, fittings of: 1. short epaulet (strap shoulder) sleeve with turn back cuff 2. short dolman sleeve 3. short raglan with circular flare cuff.
	Compare the fit of these sleeves to the set-in sleeves and kimono sleeves. Elicit from students which category of sleeves fits best.
B. Draft	Demonstrate on board the drafting of the epaulet sleeve.
	Use colored chalk to demonstrate the epaulet styling and notch placement.
	Caution students to limit width of epaulet to 3" to obtain proper fit on cap of sleeve.
	Discuss methods of removing sleeve cap ease.
	Elicit from students why ease should be removed.
	Demonstrate on the table the placement of the epaulet onto the sleeve.
	Emphasize position of center sleeve notch.

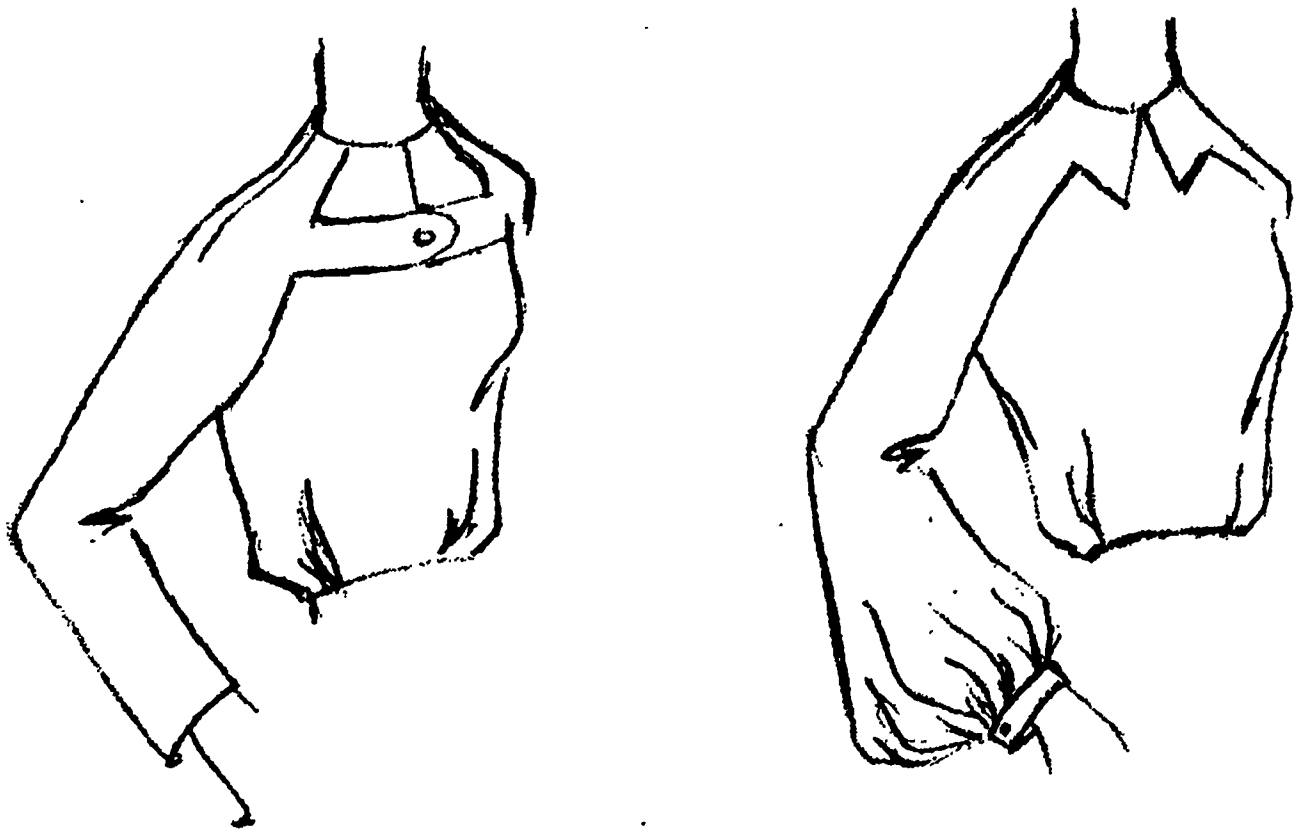
CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (Continued)	Develop sleeve cuff.
	Allow students to determine methods of pattern completion.
	Compare the epaulet styling to yokes.
	Discuss why the fit of this sleeve would be similar to a set-in sleeve.
	Demonstrate on board the drafting of a short Dolman sleeve.
	Have students compare the bodice styling to the epaulet sleeve draft.
	Illustrate the placement of sleeve stressing the necessity of maintaining equal side seams
	Use chalk to indicate the armhole styling.
	Elicit from students the notch positions and sleeve grainline.
	Elicit from students the difference between this bodice and the kimono.
	Caution students to match underarm curves.
	Form the "hidden gusset", in sleeve underarm
	Explain reason for "hidden gusset", and compare it to the set-in gusset.
	Question students on methods to be used to develop and complete pattern.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Students form complete patterns of the sleeve styles demonstrated. Observe progression of work. Check: 1. placement of epaulet on sleeve 2. turn-back cuff development 3. Dolman sleeve placement 4. "hidden gusset" development 5. pattern completion. Summarize lesson by reviewing gussets. Explain why the epaulet sleeve did not require the "hidden gusset".
D. Assignment	Students are to complete patterns and muslin fittings. Urge students to form Dolman sleeves with stylized armholes. Motivate students for next lesson by showing illustrations of raglan sleeves. Indicate raglan sleeves on garments being worn in class.

SESSION # 45

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
LONG SLEEVES USING PART OF BODICE	
A. Introduction	Check assignment Review previous lesson. Display fittings of: 1. raglan sleeve with shoulder dart fitting 2. yoke and shirtwaist sleeve Show illustrations of bodices featuring variations of these sleeves. Refer to illustration #25. Point out that the fit of the raglan is similar to the set-in sleeve. Question students on why these sleeves are similar to those formed in previous lesson.
B. Draft	Demonstrate by drafting on table the raglan sleeve. Use colored pencils to illustrate the shifting of the back shoulder dart to neck. Relate this method to dart manipulation. Establish the raglan line. Determine notch positions. Demonstrate the placing of the raglan sections. Explain the removal of cap ease. Illustrate on board as well as draft the shoulder dart development. Explain how the shoulder dart results in a better fitting curve.

BODICES WITH SLEEVE VARIATIONS



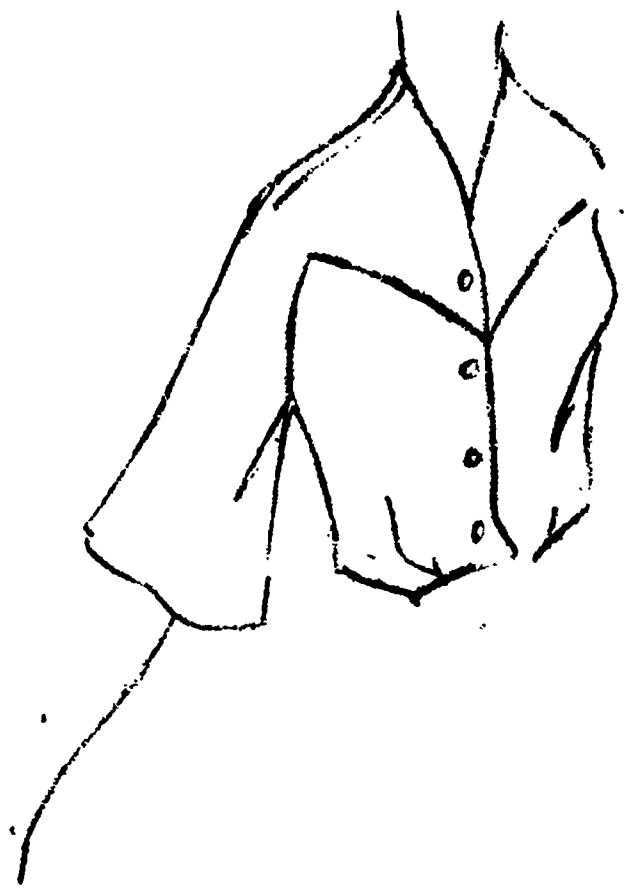


Illustration #25

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
B. Draft (continued)	Discuss reason for pivoting part of waistline dart to raglan style line. Review reason for "hidden gusset". Elicit from students method of forming gusset. Illustrate on board and draft the shaping of the underarm seam. Stress importance of matching curves and underarm seams. Question students on how to form the overarm seam. Stress shaping and notches. Elicit from students methods of completing pattern. Demonstrate the drafting of the yoke and shirtwaist sleeve. Review by illustrating on board, the shirtwaist sleeve. Remind students that this yoke and sleeve is similar to the raglan. Elicit from them the steps for drafting this sleeve. Demonstrate sleeve on board discussing the similarities to the raglan. Stress: 1. difference with yoke styling to raglan 2. "hidden gusset" 3. pivot part of waistline dart to yoke seam

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Students apply lesson and form patterns of both sleeve styles demonstrated. Observe progression of work. Check for: 1. styling of raglan and yoke 2. placing of bodice sections onto sleeve 3. development of "hidden gusset" 4. shaping of shoulder and overarm seams 5. notch placement 6. pattern completion Summarize lesson. Stress the similarities of sleeves using part of bodice. Emphasize the necessity of gussets.
D. Assignment	Students complete all patterns and form muslin fittings. Prepare for next lesson by telling students that a review for the final examination will cover the next two sessions.

SESSION # 46

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
REVIEW LESSON	Check previous assignment.
A. Introduction	Use a selected garment to review the highlights of the course in preparation for the final examination. Prepare an information sheet on sketch interpretation. Reference #7, Pages 263 - 266. Select a garment to include: 1. stand or roll collar 2. raglan or yoke and sleeve in one with cuff treatment 3 application of dart manipulation 4. form of dart control 5. front opening 6. yoke 7. skirt gores with pleats
B. Waist and Sleeve Development	Review by demonstration, discussion or illustration: 1. dart manipulation 2. forms of dart control 3. methods and uses of slashing and spreading 4. raglan sleeves 5. similarities of sleeves in various categories 6. flat fitting and roll collars 7. facings 8. sketch interpretation 9. grain lines and notches.

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
C. Application	Students form a pattern of a style displayed on form. Observe work in progress. Check for: 1. sketch interpretation 2. application of learned principles to pattern drafting and development 3. accuracy and neatness 4. pattern completion: a. seam allowances b. grain lines c. notches d. pattern information Summarize lesson and prepare for next lesson by encouraging students to review their notes.

SESSION # 47

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
REVIEW LESSON (Continued)	Stress the importance of sketch interpretation.
A. Skirt Development	Review by demonstration, discussion and illustration. 1. dart manipulation 2. forms of dart control 3. gore and flare planning 4. pleats and underlays 5. skirt openings 6. waist bands and facings.
B. Application	Students form a pattern of a skirt style displayed on a form. Observe work in progress and check same items as in Session #46. Summarize lesson by evaluating students' work. Encourage students to evaluate each other's work. Prepare students for final examination by encouraging them to review their notes and last project.

SESSION # 48

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
FINAL EXAMINATION	Distribute final examination. Check condition of shop and equipment. Observe test in progress. Check: 1. sketch interpretation 2. neatness and accuracy 3. observation of safety rules 4. use of tools and equipment 5. pattern development and completion 6. students' knowledge of related information 7. trade techniques 8. transfer of learning Use scoring sheet to record students progress.

SESSION # 49

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
CRITICISM AND EVALUATION	Review final examination.
	Encourage students to evaluate each other's work.
	Review by demonstrating on board or from the development of the pattern.
	Stress the areas that proved most difficult.
	Use remaining time to allow students to question previous lessons, and to clarify any unsolved problems.
	Emphasize students' strengths and cite weaknesses. Explain how to eliminate weaknesses through additional study and practice.

SESSION # 50

CONTENT OUTLINE	TEACHING SUGGESTIONS & METHODS
SUMMARY SHOP SECURITY	Summarize entire course.
	Instill awareness of need for further study and experience.
	Advise students to register for the next semester.
Certificates	Issue certificate to students who have: 1. fulfilled attendance requirements (refer to Teachers Manual) 2. satisfactorily completed required work.
	Secure shop. Coordinate this activity with other teachers who use the shop (day and evening school).

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ABSTRACT - Prepared by the Consumer and Food Economics Research Division of the Agricultural Research Service, this budgeting guide contains information and sample planning charts for: (1) Steps in Making a Budget, (2) Carrying Out the Budget, and (3) Using Consumer Credit. A list of other available pamphlets is included. (SB)

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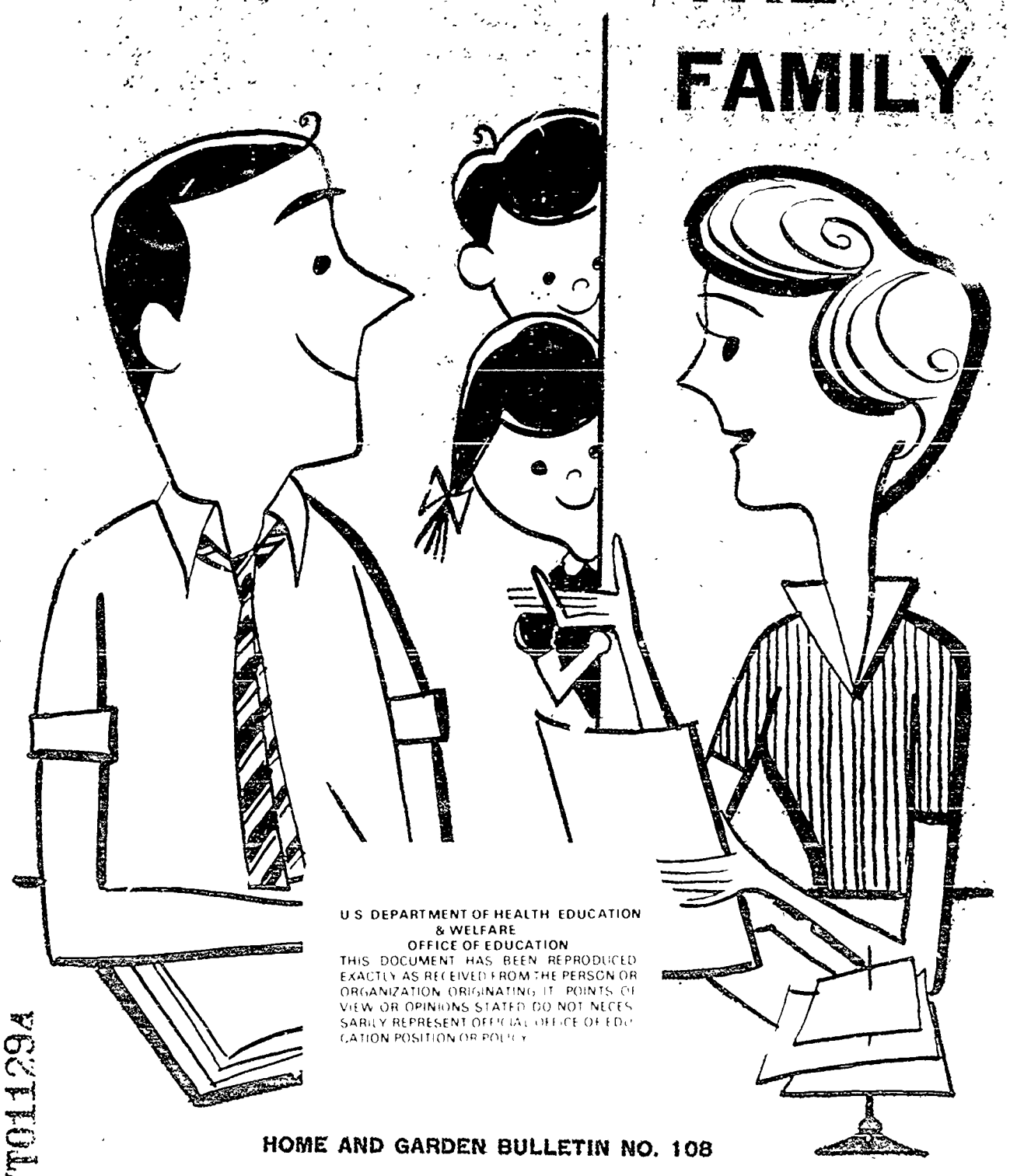
A GUIDE TO BUDGETING FOR THE FAMILY



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HOME AND GARDEN BULLETIN NO. 108

U.S. DEPARTMENT OF AGRICULTURE

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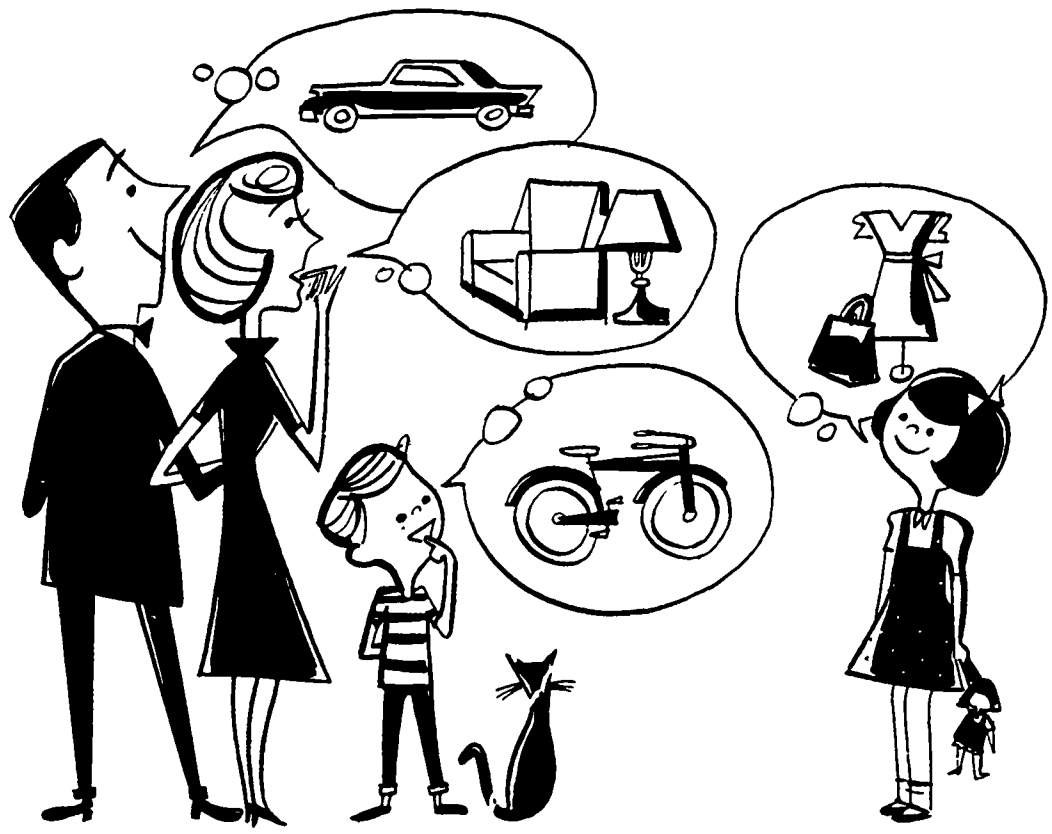


A GUIDE TO BUDGETING FOR THE FAMILY

A budget—or spending plan—is a tool to help you spend money wisely and reach your family's goals. A budget can help cut out inefficient spending and give your family more for its money. Of course, preparing a budget takes planning, and following a budget takes determination. You'll need cooperation from the whole family.

To be workable, your budget should be tailored for your own family; it should be adapted to your family's needs and income.

This bulletin tells how to develop and follow a spending plan that you can use to make your dollars respond to the wishes of your family. It includes sample forms that may be helpful. It also gives basic information about how to use consumer credit wisely.

You'll find it easier to keep track of your budget if you use a family financial record book. The book should not be expensive or elaborate—a looseleaf notebook is excellent for this purpose. Several types of financial record books are available in variety and stationery stores.

Make your forms for recording expenses and income simple. Adjust the various forms given in this bulletin to your family's needs; then transfer them to your record book.

STEPS IN MAKING A BUDGET

Determining Goals

The first step in making a spending plan is to set your goals. What does your family really need and want? You must know this before you can work out the details of a budget.

Let the entire family in on the discussion of goals, if the children are old enough to take part. Consider all suggestions so everyone will be satisfied with the results. Try to keep goals realistic in relation to present and estimated future income. Decide which goals are most important, giving priority to those that will benefit the whole family.

You may find it helpful to think first about your long-term goals—those you hope to reach in 10 or 20 years, perhaps, or even longer. Next decide your aims for the more immediate future—the next 5 years, for example. Then list your goals for the coming year. This way, your budget will include some savings toward long-term and intermediate goals, and you will not let immediate goals push your other goals aside.

Be as specific as possible in setting goals. Your family may decide its long-term goals are a debt-free home, education for children, and savings for retirement. For the coming 5-year period, goals might be buying a car, making a downpayment on a home, and buying an automatic washer and dryer. Goals for this year might be reducing debts, starting a reserve fund, and buying a vacuum cleaner.

Goals change, of course, as the size, age, and income of the family change. For example, a young couple works to establish and furnish its home. The family with growing children tries to provide adequate food, clothing, and housing, with some extras. After children leave home, the parents concentrate on completing financial arrangements for retirement years.

When you have decided on your goals, write them in your record book or other convenient place. You will want to refer to them as you plan your budget.

Here is a way to list your family's goals:

Long-term goals:

_____

_____

_____

Goals for the next 5 years:

_____

_____

_____

Goals for this year:

_____

_____

_____

Estimating Income

The next step in making a budget is estimating your family's income. Before you can plan wisely, you need to know how much money you will have during the planning period.

A family budget may cover any convenient budget period. Most budgets are for 12 months; they may coincide with the calendar year, school year, tax year, or a special period.

If this is your first budget, you may want to set up a 3-month trial plan. After you see how your plan works, you can revise it to cover a longer period.

Use the form on this page as a guide to figuring your total family income. Write down all funds that you expect to receive during the planning period. Start with fixed amounts that members of your family get regularly—wages, salaries, social security benefits, pensions, allowances, and any other payments.

Then put down the variable income that you anticipate—interest from savings accounts and bonds, dividends from stocks, rents, gifts, and money from other sources.

When your earnings are irregular, base your estimate on your previous income and current prospects. If your income fluctuates sharply—as it may for seasonal workers, salesmen on commission, farmers and other self-employed people—play it safe by making two estimates. Work out the smallest and largest figures you can reasonably expect. Plan first on the basis of the low income figure. Then consider how you will use additional amounts.

Estimated Income for_____

Item	Amount
Wage or salary of—	
Husband	$_____
Wife	_____
Net profit from business, farm, or profession	_____
Interest, dividends	_____
Other	_____
Total	$_____

Estimating Expenses

After you have figured how much your income will be for the planning period, it is time to estimate your expenses.

If you have records of family spending, they can serve as a basis for your budget. List items of

expense that your family had, with the amount you spent for each item. Include fixed payments, contributions, and other predictable expenditures.

If you do not have records, you may be able to recall some of your previous expenses. Checkbook stubs, receipts, and old bills can serve as reminders. This may be all the guide you need in estimating your expenses.

If you are new at budgeting, you may want to start by finding out where your money goes. Keep a record of current spending for 2 or 3 months. A sample form to help you keep an account of your spending is given on page 11.

Use your records to help you decide whether to continue your present pattern of spending or to make changes.

If you are satisfied with what your dollars have given your family in the past, allow similar amounts in your estimates for the spending plan.

If you are not satisfied with what you got for your money last year or last month, look at your spending critically. Until you study your records, you may be unaware of overspending and poor buying habits.

Be realistic in revising your allowances for expenses. Resolve to cut out shopping sprees, bargains you don't need, and overuse of credit.

Of course, you will need to plan for new situations and changing conditions. For example, a child entering a new school may have increased expenses, or your property tax rate may go up.

Plan your large expenses so that they are spaced at intervals over several years. If your son gets a suit this year, your daughter may have to wait until next year for a winter coat. New curtains may take turns with baby needs, weekend trips, or a TV set.

Keep your estimates of expenses where you can refer to them as necessary.

If your income is quite low, you will need to plan carefully to take care of your immediate needs and pay your current bills. It may be unrealistic or impossible to include long-term goals in your budget as described in this bulletin.

You may get help in financial planning from your extension home economist. In many cities and counties, community service organizations also offer this service.

Setting Up a Budget

You are now ready to set up your spending plan. Remember to base your budget on the goals, income, and expenses of your own family.

A sample form for your family spending plan is shown on page 5. Change this budget form by adding or deleting categories to suit your family's needs.

Work on one section of the budget at a time. Examples of forms you might use to obtain tentative figures for some sections are shown on pages 6 and 7. When you are satisfied with your figures, put them in your spending plan.

Set-asides

The best way to have money available for major expenses and future goals is to set aside money regularly.

The secret is to earmark the money *before* you spend your income. If you wait until the end of the week or month, you may have nothing left to set aside.

By setting aside a planned amount every pay period, you have greater flexibility in managing your money.

Keep your set-aside funds separate from your other funds so you won't be tempted to spend them impulsively. If possible, put them in a savings account or in Government bonds, where they will earn interest.

When you start to budget, you will want to designate a small amount of money for emergencies. Of course, one way to protect your family against major disasters is to take out insurance. But every family has frequent minor crises—too small to be covered by insurance, but too large to be absorbed into a day-to-day budget. Examples might be a blown-out tire, an appliance that needs replacing, a child's broken arm.

Decide how large a cushion you want for meeting emergencies. Work out the amount you need to set aside each year and each month and enter this on the form on page 6.

If your fund reaches the figure you have allowed for emergencies, you can start saving for something else.

Consider your future goals. Assign a dollar cost to each one and set the date you hope to achieve it. Next translate the dollar costs into the amount that must be saved each

Plan for Family Spending

Income, set-asides, and expenses		Amount per month
Total income		$_____
Set-asides:		
Emergencies and future goals		$_____
Seasonal expenses		_____
Debt payments		_____
Regular monthly expenses:		
Rent or mortgage payment	$_____	
Utilities	_____	
Installment payments	_____	
Other	_____	
Total		_____
Day-to-day expenses:		
Food and beverages	$_____	
Household operation and maintenance	_____	
Furnishings and equipment	_____	
Clothing	_____	
Personal	_____	
Transportation	_____	
Medical care	_____	
Recreation and education	_____	
Gifts and contributions	_____	
Total		_____
Total set-asides and expenses		$_____

month. Remember that interest on your savings will help them grow.

Transfer the figures you have allowed for emergencies and future goals to the space provided on your plan for family spending (p. 5).

Some large expenses occur seasonally. These include taxes on real estate, personal property, and income; school books and supplies; life, household, and car insurance; fuel; and travel. Other expenses might be car license plates, medical checkups, or Christmas gifts. Perhaps you want a season ticket to baseball games or a concert series. Most of these expenses can be anticipated and included in your budget for the year.

By setting aside a definite amount each month, you spread the cost and have money to meet such expenses when they are due. For example: If you put aside $15 each month earmarked for real estate taxes, in a year you will have $180 to pay your tax assessment.

To determine how much you need to take care of these seasonal expenses this year, use a form similar to the one on page 7.

Debt payments

If you have debts or past-due bills, you will want to plan your budget so you can clear them up.

First, carefully review the way you manage your money. If your family has heavy debts, find the reason. Were debts caused by sickness or other emergencies not likely to be repeated soon? Or are they part of a consistent pattern of buying too much on credit?

If buying too much is the reason, enlist your whole family in a plan to avoid credit buying until debts are paid.

Work out a practical, systematic plan to repay your debts. Begin immediately to earmark at least a small amount for debt payment every payday. Enter the debt payment on your spending plan (p. 5).

Detailed Plan for Set-Asides for Emergencies and Future Goals

Type of fund	Probable total cost	Date desired	Amount to set aside this year	Amount to set aside per month
Emergency	$		$	$
Education				
Home or business [1]				
Home improvement				
Major equipment				
Retirement				
Other goals				
Total	$	xxxxxxxxxxxx	$	$

[1] This fund might include money you set aside to make a downpayment, or money (in addition to fixed mortgage payments) you set aside to reduce remaining interest and principal cost.

Detailed Plan for Seasonal Expenses This Year

Expense	Date needed	Amount	
		Per year	Per month
Taxes		$	$
Insurance			
School expenses			
Fuel			
Vacation			
Other			
Total	xxxxxxxxxxxxxxxxx	$	$

Regular monthly expenses

On your plan, enter the expenses you expect to have each month. You can estimate quite accurately your family's regular—or fixed—expenses for each month. These may include rent or mortgage payments, installment payments, hospital or health insurance, support or regular payments to relatives. There are utility bills for electricity, gas, water, telephone, and garbage collection. Other regular expenses might be board and room for a child away at school, music or dancing lessons, nursery school, or a practical nurse's salary to care for an invalid member of the family.

Day-to-day expenses

You are now ready to plan your day-to-day expenses—those that vary from week to week or month to month. Because these are the most flexible entries in your budget, they are the easiest to cut when you need to economize.

Use your records to estimate how much to spend on food, clothing, transportation, and other budget categories. You may decide to spend more on some categories and adjust your plan accordingly.

Try to fit some of your immediate goals into the category of day-to-day expenses. For instance, school shoes and a blouse for your daughter can go under clothing; a kitchen stool and a scatter rug go under furnishings and equipment.

Some entries under day-to-day expenses might be put in other categories. You may prefer to enter regular contributions to your church or synagogue under regular monthly expenses instead of day-to-day expenses.

Give each member of the family a small allowance that need not be accounted for.

Comparing Expenses and Income

Add the figures in your spending plan (p. 5). Now compare the total with your estimate of income for the planning period.

If the two figures balance—fine.

If your income exceeds your estimate of expenses—this is even better. You may decide to satisfy more of your immediate wants or to increase the amount your family is setting aside for future goals.

If your expenses exceed your income, reevaluate your plan. Adjust the budget. Can you reduce expenses? Can you postpone or drop some items?

Consider ways you can trim expenses. This can be challenging—if your family agrees to cut the budget as a family project. Ask members to suggest economies they are willing to accept.

You may decide to make clothing for the children in order to save enough money to give them music lessons. Or you may drive a small car in order to live in a neighborhood you enjoy.

One way to cut your food budget is to shop for weekend specials. Compare prices before you buy. Use the USDA's food plans—which give examples of good diets at low, moderate, and high cost—as guides to managing your food money and getting a nutritionally adequate diet.

Take a good look at your day-to-day expenses. To trim them, you might—

- Substitute articles that cost less, but serve the same purpose (buy a new slipcover instead of a new sofa).
- Use your own family's skills (refinish furniture; grow vegetables and fruits; wash and set your own hair; make curtains).
- Shop for "specials" and buy in quantities that fit your family's needs (take advantage of seasonal sales—such as household linen "white" sales).
- Make use of free or inexpensive educational and recreational services (enroll in sewing or craft classes, attend free concerts, patronize a public library, camp at public camping sites).

Scan your regular expenses critically. If you do not have enough money for your family's day-to-day needs, you may want to reduce or eliminate installment payments and other fixed obligations. Perhaps your family should also consider converting endowment to a cheaper form of insurance, or moving to a less expensive home. You might exchange a large car for a smaller one that costs less to operate—or even go without a car until you "catch up."

If you are unable to balance your budget by cutting expenses, you may need to increase your family's income.

If the wife has not been employed, she might take a full- or part-time job. However, it is a good idea to compare the added costs of working outside the home—clothing, lunches, transportation, child care—with the added income. Children might babysit, deliver newspapers, or do odd jobs.

You may plan to draw on your reserves at a period when you know income will be particularly low or expenses particularly high. Or you may intentionally spend more than your income when you use the money you have set aside for a special purpose—a new roof, college expenses, a vacation trip to national parks.

You may need to review your goals.

CARRYING OUT THE BUDGET

When you have put your spending plan on paper, try it out.

Develop good buying habits to help you carry out your budget. Take advantage of consumer information that you can use to stretch your dollars. You might look up facts about—

- Adequate diets at low or moderate cost.
- Methods of storing and preparing foods.
- Durability of clothes and fabrics.
- Comparative prices of various grades of merchandise at different outlets.
- Difference between cash and credit prices.
- Credit charges for installment plans (see p. 13), budget accounts, and long-term contracts.

Keeping Records

Keep records; they will tell you if your dollars are giving your family what it really wants and needs.

Make your records simple. You don't need a detailed account of where you spend each nickel. But you do need to know where your money goes.

To keep track of day-to-day expenses, use the sample form on page 11, or a modification of it. Transfer the form to your record book. Make a separate column for each category of expense in your budget. Allow enough space to enter items bought and their cost.

Get frequent reports from everyone who buys for the family. An easy way is to have everyone put receipts

and notations of spending on a spindle each day. Or each member of the family can leave a note on file for the bookkeeper. Some families ask members to note the money they spend and report at a weekly budget session.

At the end of the week, add up the amounts spent and write them in your financial record book. At the end of the month, total the expenditures under each category and compare them with those in your plan.

It's a good idea to keep all financial records together. You may find it helpful to set aside a desk drawer, a box, or other convenient place to put your record book and bills, receipts, and other financial papers.

Evaluating the Plan

At the end of your budget period, compare what you spent with what you planned to spend.

If your spending was quite different from your plan, find out why.

The answer to the question "why?" will help you find ways to improve your next plan.

If your plan did not provide for your family's needs, you will want to revise it.

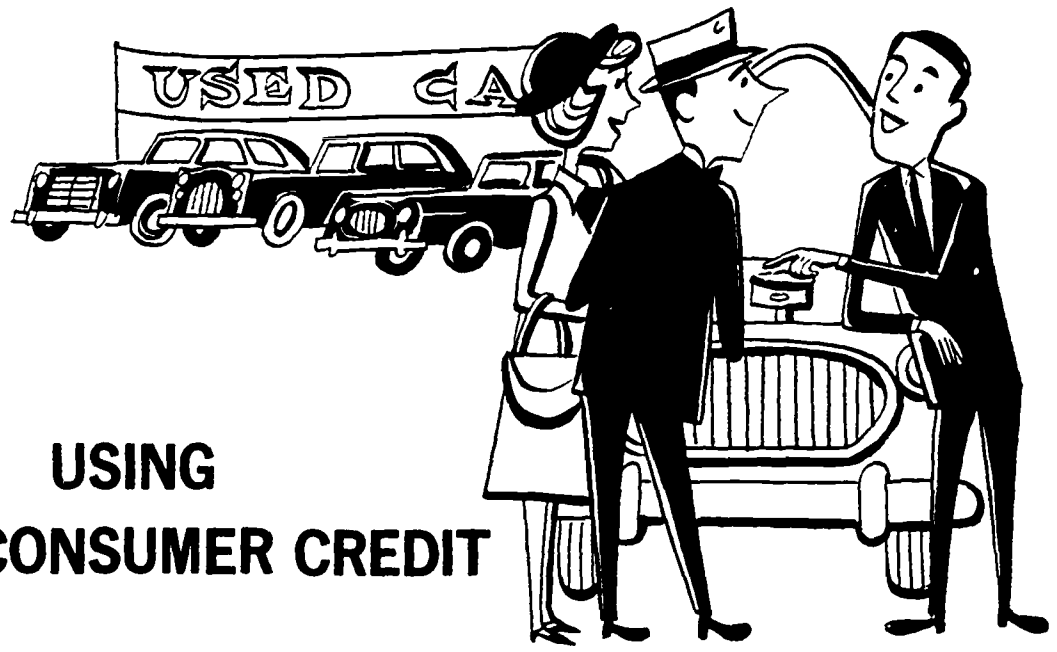
If the plan fitted your needs but you had trouble sticking to it, you will want to use stricter self-discipline and better management next time. Enlist better cooperation within the family.

A budget is something you keep working and reworking until it "fits" your family and satisfies individual members. Do not expect to have a perfect budget the first time you set one up. But with each succeeding budget you can expect improvement.

Although you may be satisfied with your present plan, you will need to change it from time to time. As circumstances change, you will need to reorganize your budget around your new goals, needs, and wants.

Record of Your Expenses

Date	Item (or service) bought	Food and beverages	Household operation and maintenance	Furnishings and equipment	Clothing	Personal	Transportation	Medical care	Recreation and education	Gifts and contributions
		$	$	$	$	$	$	$	$	$
Total	xxxxxxxxxxxxxxxx	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____	$_____



USING CONSUMER CREDIT

The use of credit helps families get the things they need and want. Most families use some form of credit at one time or another, either for convenience or necessity.

Many families can equip their homes with modern conveniences and buy cars sooner if they use installment plans. Families are able to take advantage of special sales for clothing and small household items because they have charge accounts. Or they may use personal installment loans to help in emergencies.

Consumer credit is available from finance companies, banks, credit unions, and retail stores. *It is a service dealers offer, but it costs money. Many families are unaware of what they pay for it.*

If you want to use credit, it is a good idea to compare costs of various plans available.

The cost of credit varies—

- From dealer to dealer.
- With the size of the purchase.
- With the length of the loan period.
- With the credit reputation of the borrower.

Credit charges may be given—

- As a percentage rate.
- In dollars and cents.

It will help you to understand how credit rates vary among financing agencies. The table on page 13 shows the range of rates for commonly used sources of consumer credit.

The extra cost or "dollar cost" of buying on the installment plan is not listed on the price tag. But you can figure this by comparing the credit price with the cash price of the washing machine, TV set, car, or other item you want to buy.

To get the dollar cost of credit, you need the following information: the trade-in allowance, if any; the amount of the downpayment; the amount of the regular payments; the number of payments; and the cash price.

When you have the information—

1. Add all costs—trade-in allowance, downpayment, and regular payments multiplied by the number of payments required—to get the total price you will pay.

2. Subtract the cash price.

The difference is the dollar cost of buying on the installment plan.

Suppose—for example—you are planning to buy a washing machine. Under the dealer's installment plan, you make a $10 downpayment and monthly payments of $9.75 for 24 months. The cash price for the same washing machine is $198.

Figure the dollar cost of using credit as follows:

$9.75×24 monthly payments	$234.00
Downpayment	10.00
Total credit cost of washing machine	$244.00
Cash price of washing machine	$198.00
Difference	$ 46.00

The dollar cost of buying on the installment plan is $46 in this case.

Many dealers offer revolving or "budget" charge accounts. You and the dealer agree on a maximum amount you can buy. Then you pay a definite amount on your account each month, plus a service charge.

Credit charges count up. In general, the longer you take to pay—that is, the smaller your monthly payment—the higher the cost.

Dealers sometimes hide part of the cost of credit in a higher price for their merchandise. In figuring the cost of credit, compare the best price you can get on a credit deal with the best price you can get for cash.

To use consumer credit wisely, make certain that—

- You know how much the use of credit costs.
- You have shopped around and chosen the best available terms.
- You need the item urgently enough to justify the credit cost.
- Your budget can stand the additional payment.

Installment Credit Rates

Financing agency or type of loan	Rates paid by consumer credit users (equivalent percent per year on unpaid balance)	
	Common rate	Range of legal maximum rates
	Percent	*Percent*
Cash lenders:		
Credit unions	12	12
Commercial banks-personal loans	12	12 to 42
Consumer finance companies under small loan laws	30	24 to 48
Illegal lenders	----------	[1] 42 to 1,200
Retail installment financing in 24 States with rate legislation—12-month contract:		
New cars	12	12 to 24
Used cars under 2 years old	(2)	18 to 31
Used cars over 2 years old	(2)	18 to 43
Retail installment financing in States without rate legislation—12-month contract:		
New cars	12	[1] 12 to 120
Used cars	(2)	[1] 19 to 275

[1] No legal maximum here. Figures shown give the range of actual rates reportedly being charged.
[2] Not available.
Source: Mors, W. P., *Consumer Credit Facts for You.* Western Reserve University, Bureau of Business Research. Edition 2. Cleveland, Ohio. 1959.

MORE INFORMATION

Listed below are publications of the U.S. Department of Agriculture that may help you get more for your money. Single copies may be obtained free by sending a post card to the U.S. Department of Agriculture, Washington, D.C. 20250. Please include your ZIP code.

	Order No.
Food Guide for Older Folks	G 17
Family Food Budgeting . . . for Good Meals and Good Nutrition	G 94
Eggs in Family Meals: A Guide for Consumers	G 103
Vegetables in Family Meals: A Guide for Consumers	G 105
Poultry in Family Meals: A Guide for Consumers	G 110
Cheese in Family Meals: A Guide for Consumers	G 112
Beef and Veal in Family Meals: A Guide for Consumers	G 118
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Fruits in Family Meals: A Guide for Consumers	G 125
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How To Buy Cheddar Cheese	G 128
How To Buy Instant Nonfat Dry Milk	G 140
How To Buy Fresh Fruit	G 141
How To Buy Fresh Vegetables	G 143
How To Buy Eggs	G 144
How To Buy Beef Steaks	G 145
How To Buy Beef Roasts	G 146
Cereals and Pasta in Family Meals: A Guide for Consumers	G 150
How To Buy Poultry	G 157
Pork in Family Meals: A Guide for Consumers	G 160
What Young Farm Families Should Know About Credit	F 2135

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ABSTRACT - Developed by a curriculum committee and revised by teachers in the field during the 1967-1968 school year, this teaching guide contains homemaking experiences for boys and girls in the sixth and seventh grades. Units for grade 6 are: (1) Teamwork in the Home, (2) Special Occasions in Our Lives, (3) It Is Your Home Too, and (4) So You Can Sew. Units for grade 7 are: (1) Putting Your Best Foot Forward, (2) Clothes for You, (3) Observing the Special Days, (4) Helping Younger Children, and (5) Time for Eating. Each unit is introduced by an overview, followed by suggestions for starting the unit, generalizations and suggested learning experiences, evaluation techniques, and teaching aids. A section of general teaching aids is included. (SB)

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HOMEMAKING
IN THE SIXTH AND SEVENTH GRADES,

U.S. DEPARTMENT OF HEALTH, EDUCATION
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HOMEMAKING

IN THE SIXTH AND SEVENTH GRADES

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HOMEMAKING IN THE SIXTH AND SEVENTH GRADES

Point of View

Homemaking education recognizes the prerogative of the home as the place where children and adults find security, develop character, and learn a pattern of life. The home is considered the basic unit of democracy, the unit which has the first and longest influence on the person. The homemaking curriculum should develop its offerings in harmony with the home and in view of the interest, needs, and abilities of girls and boys.

The homemaking education program should center about the many aspects of the family and the individuals within the home. Situations faced by the modern family, in a homelike environment, should provide activities which help children achieve physical, emotional, mental, and spiritual well-being in the families of which they are now members. It is observed that children in the upper elementary grades find homemaking of particular interest. They like the activities which a variety of projects offer. The program fills the need for their manipulative endeavors, interests, and growth. The law of readiness is a profound educational principle which can be seen in simple application as girls and boys are offered instruction in home tasks. Homemaking affords daily opportunities for sixth- and seventh-grade children to face practical home problems and to participate in the decision-making process.

Pupil-teacher planning incorporates the democratic method. The value of democratic procedures in school and social situations increases with the realization that they can and should be applied in home living.

It is desirable that sixth- and seventh-grade levels of homemaking should be continuous and flexible in order to adjust to changing home life, and to

different school situations within the city in order to keep pace with the rapidly moving, complex social order of today. All experiences in a family-centered program concerned with homemaking, whether in the home, the classroom, or the community, need to be related if they are to contribute to the maximum development of the individual.

By encouraging broad interests, wholesome attitudes, more discriminating tastes, and by improving skills, homemaking education offers comprehensive experiences which help to develop citizens who are mindful of what makes a real home.

In favorable, homelike environment at school, pupils may develop self-confidence, efficiency, initiative, and cooperation as they experience the joy of working individually or in a group. A variety of home tasks provides opportunities for girls and boys to become involved as they contribute to home and community life.

Since the success of homemaking depends upon the cooperation and interest of every member of the family, preparation for it should be extended to boys and to adults. Therefore, homemaking education should contribute to a better understanding and appreciation of a democratic home in a changing social and economic order.

How to Use This Bulletin

Homemaking in the Sixth and Seventh Grades is the product of the efforts of all the homemaking teachers. It was revised by teachers in the field during the 1967-1968 school year. It is designed to help teachers provide real and vital homemaking experiences for girls and boys in the elementary school.

Every effort has been made to make the format and content of the bulletin attractive, stimulating, practical, and easy to use in the classroom.

An examination of any one of the divisions will illustrate the organization of each unit area, since they are all planned in the same manner. The first section of the outline is for grade six, the second is for grade seven.

Each unit is introduced by an overview for that homemaking area. This overview gives the general point of view, or the main objectives, for teaching the unit in question. In the overview for each unit are listed the major generalizations and the important understandings, habits, and skills for the unit. Following the overview are some suggested ways for starting the actual teaching of the unit.

After the introduction, comes the main body of the unit development. This is presented in two columns. The left-hand column, entitled "Generalizations - Concepts - Teaching Points," gives the content for the homemaking area . The major generalizations are listed by Roman numerals and are in capital letters for easy identification. The right-hand column presents suggested learning activities. In the food, clothing, and special-day units, different activities are suggested to provide in both grades for desirable repetition of skills, and for further extension of understandings important in homemaking. This is thought to be desirable in meeting individual differences and in keeping the experiences new and vital for the children, while, at the same time, building the needed understandings and skills.

Teachers using the bulletin should note that no one grade, either sixth or seventh, can be expected to cover <u>all</u> of the suggested learnings. Indeed, more activities are suggested than it would be possible to cover. Teachers who have other and better ways of solving the problems and developing the essential understandings with girls and boys should feel free to use them. It is expected that the discriminating teacher will select those learning activities which meet the needs and interests of her class members indiviually and as a whole. A few vital experiences, well presented and assimilated

by the children, are desirable for the elementary homemaking class. It is further expected, that by the end of each school year, the girls and the boys in homemaking classes should have had the opportunity to identify some of the essential concepts relating to home and family.

The order in which the "generalizations - concepts - teaching points," together with the related learning activities, are presented is not to be considered the set order for developing the unit. In certain units where skills are being progressively established, it will be found desirable to follow the suggested development rather closely. At other times, two main problems could be unfolding side by side with no loss in continuity for skill development, for example, a clothing project constructed mainly with machine stitching and a hand-sewed article.

The process of developing any related group of learning experiences, commonly known as teaching a unit, has its beginning, development, and ending. The bulletin suggests initiating activities on the introductory pages. It gives many suggestions for development of the understandings and for solving the problems likely to be encountered. A list of separate culminating activities was made for the various units. The execution of an interesting and satisfying ending of an area of study is important. Sometimes the nature of the final learning activity, or project, suggests a natural and desirable finish. Other culminating activities could be:

- Sharing the learnings with parents, friends, and/or teachers,
- Conducting performance demonstrations, and
- Viewing a film related to the unit.

Following the development of each unit is a list of teaching aids. The teaching aids include teacher and pupil references, audio-visual materials, and occasionally some special information for teachers. This section should

become a growing area and teachers are urged to make their bulletins more helpful and up-to-date by noting new materials in the curriculum guide as they discover them and find them useful.

The order in which the teaching units appear in the bulletin itself, is considered desirable for Grade Six during Semester I. The sequence of units in Grade Six, Semester I, and in Grade Seven is not the only order for teaching these units of study. Each teacher using the guide will find it desirable to plan with the regular classroom teacher, the school principal, with her class, and at times with the parents of the children, the time schedule for teaching the homemaking areas. Such planning can result in habits, attitudes, understandings, and skills which are mutually understood and reinforced through home-school cooperation. The order for developing the units may be the order in which they appear in this bulletin, but other sequences for presentation may be found desirable in the local schools with the exception of Grade Six, Semester I. The inclusion of all sixth-grade boys in both homemaking and industrial arts at the beginning of grade six seems highly desirable. One half of the girls and the boys will be in industrial arts while the other half take the homemaking unit, "It's Your Home Too." During the next nine weeks the groups alternate.

The remaining three semesters of the sixth and the seventh grades may or may not develop the same learning areas at the same time. In other words, it may be well to teach sixth-grade clothing during the same block of time that the seventh-grade unit on foods is being offered.

All teachers find added security in making flexible plans. Any program of instruction, as full of possible activities as the homemaking program, profits from the planning and execution of plans that secure a desirable covering of the field. Such plans should be sufficiently long-ranged to give an

overall scope and sequence to the year's work. Teachers considering and experimenting with the content for sixth- and seventh-grade homemaking, have suggested a time allotment to encourage the reasonable coverage for which each teacher feels responsible. The suggested time allotment is not to be considered a hard and fast rule, but is given as a guide to assist teachers in a wise use of their time.

To furnish a quick view of the scope and suggested sequence of content for homemaking for sixth and seventh grades, a chart is included here. The suggested time allotment is given with each unit.

HOMEMAKING IN THE SIXTH AND SEVENTH GRADES

Grade Six

UNIT I. TEAMWORK IN THE HOME
Nine weeks

I. Experiences in homemaking classes at school help girls and boys become better family members.

II. A snack, or quick breakfast, can be an important part of the day's total food requirement.

III. A variety of foods may be prepared and served to meet the nutritional needs of the family.

IV. Looks, feelings, and energy can be improved by wise choice of foods.

V. Participation in home activities satisfies needs of the individual family members.

(Unit I is repeated for the boys and girls who have taken industrial arts during the first nine weeks. Pupils who have completed Unit I in homemaking attend industrial arts classes.)

Grade Seven

UNIT I. PUTTING YOUR BEST FOOT FORWARD
Three weeks

I. Each individual girl has responsibilities for making herself acceptable to others.

II. Caring for personal and family clothing contributes to health, acceptance, and to wise money management for the family.

UNIT II. CLOTHES FOR YOU
Fifteen weeks

I. When a wise choice of color, design, and fabric is made, a garment is more satisfying.

II. Building and understanding a vocabulary of fabric and sewing terms aid in wise clothing selection.

III. With a knowledge of sewing equipment and the sewing machine, clothing construction is made easier.

IV. Garments can be made to extend the wardrobe.

Grade Six

UNIT II. SPECIAL OCCASIONS IN OUR LIVES Two weeks

I. There are many occasions when gifts and courtesies may be extended.

II. Personal services performed for others enrich the lives of all concerned.

III. Gifts can show thought, creativity, and skill.

IV. Showing appreciation for gifts and services received is a part of good manners.

UNIT III. IT IS YOUR HOME TOO Four weeks

I. The home and family make important contributions to our lives.

II. Each family member can help make a happy family.

III. An attractive and orderly home can result when family members work together.

IV. We all want and need good friends and neighbors.

UNIT IV. SO YOU CAN SEW Fourteen weeks

I. An enthusiastic attitude can increase the satisfaction obtained from sewing.

II. Wise choice of fabrics and colors helps to develop individuality.

III. Successful sewing results from skillful hands using good equipment.

Grade Seven

UNIT III. OBSERVING THE SPECIAL DAYS Two weeks

I. Sharing with others helps to make a better person.

II. Gifts made by the giver reflect appreciation and love.

UNIT IV. HELPING YOUNGER CHILDREN Three weeks

I. Knowing a child's needs and growth patterns helps a person to understand and enjoy young children.

II. Older children can help the five- and six-year-old grow and be happy.

III. In order to make his life safe and easy, the five- and six-year-old needs to form certain habits.

IV. Development of the five- and six-year-old is encouraged through their work and play.

UNIT V. TIME FOR EATING Fifteen weeks

I. A balanced diet (food intake) promotes growth, health, and helps improve personal appearance.

II. Food preservation and proper storage help retain nutritive value and keep food safe for eating.

III. Planning, preparing, and serving balanced meals require knowledge of foods, skills for food preparation and serving, and are a source of pleasure, creativity, and satisfaction.

IV. Protein foods can be prepared in ways which keep the nutritive value and make them tasty.

Grade Six

UNIT IV. (Continued)

IV. Various projects using fabrics can develop basic sewing techniques.

Grade Seven

UNIT V. (Continued)

V. Salads and desserts are part of the complete luncheon or dinner and add variety to the meal through texture, flavor, color, form, and consistency.

VI. Meal planning, management, preparation, and serving are important to homemaking and family living.

This bulletin is for you, especially if you are:

- A teacher who is new to teaching homemaking in grades six and seven, and wanting help in orienting yourself to a new curriculum, and in providing appropriate experiences for girls and boys,
- A teacher who wishes to survey, evaluate, or revitalize your program in homemaking,
- A teacher who is looking for more satisfactory ways of teaching, and
- One of the teachers who has shared his ideas and made this bulletin possible.

We sincerely hope that the homemaking experiences which the bulletin will help to provide for girls and boys will contribute to better home living -- the foundation of American life.

UNIT I - TEAMWORK IN THE HOME
(Grade Six)

Suggested Time - Nine Weeks

Overview and Generalizations

The patterns of home and family living have changed due to social and economic reasons. In order to maintain economic security, provide basic family needs, and reach individual and family goals, many mothers work outside the home. This results in all family members assuming the responsibilities for homemaking: father, mother, girls and boys.

The happiest homes are those in which every member participates in the work and the play of the group. Girls and boys should learn to choose their food, clothing, recreation, and friends. It is desirable for them to have homemaking experiences which give help with, and furnish recognition for, these important activities.

This unit is planned to help sixth-grade girls and boys build and acquire these generalizations, understandings, habits, and skills:

Major Generalizations	Understandings, Habits, and Skills
I. Experiences in homemaking classes at school help girls and boys become better family members.	1. Use social graces, including appropriate table manners.
II. A snack or quick breakfast can be an important part of the day's total food requirement.	2. Get along with family members with less friction.
III. A variety of foods may be prepared and served to meet the nutritional needs of the family.	3. Contribute to family by performing home services and duties.
IV. Looks, feelings, and energy can be improved by wise choice of foods.	4. Manage time, materials, and energy more efficiently.
V. Participation in home activities satisfies needs of the individual family members.	5. Make wise choices in the selection and purchase of food.
	6. Prepare foods for family meals.
	7. Appear well groomed and appropriately dressed.

This unit is to be repeated for half the class, girls and boys, who take industrial arts during the first nine weeks the unit is taught.

Suggestions for Starting the Study

- Hold a conference involving the principal, the classroom teacher, and the industrial arts and the homemaking teachers to discuss and clarify the eighteen-week schedule for this unit.
- Display mounted pictures pertaining to the home -- a welcome to homemaking.
- Arrange an attractive bulletin board featuring pictures of family groups participating in home activities.
- Invite mothers, principal, teachers, for a pep talk -- serve light refreshments, or send letter to parents explaining the new unit.

Generalizations-Concepts-Teaching Points	Suggested Activities
I. EXPERIENCES IN HOMEMAKING CLASSES AT SCHOOL CAN HELP GIRLS AND BOYS BECOME BETTER FAMILY MEMBERS.	Show mounted pictures illustrating home and family responsibilities.
A. Homemaking centers about many aspects of family life.	List home responsibilities on the chalkboard.
	Discuss mother's and father's part in the family.
	Illustrate some tasks pupil did during the summer which helped the family.
B. Eating adds to our pleasure and enjoyment.	Demonstrate with pupil help preparation and serving of refreshments. (Instant cocoa, prepared refrigerator cookies, canned biscuits, packaged muffins, frozen fruit juice, cinnamon toast)
C. Correct use of tools and equipment saves time, effort, and materials, and promotes safety.	Plan a "standing party." Hold plate and napkin with refreshments chosen from the above list.
1. Names and location of kitchen tools and appliances	Play an identification game with homemaking tools and equipment. (Have TV tray set up for identification.)
2. Efficient use and care of these tools	Examine cabinets and storage areas at school to learn orderliness and location of tools.
3. Home safety practices	Show filmstrip, F-773 Safety in the Kitchen.

Generalizations-Concepts-Teaching Points	Suggested Activities
	List ways of preventing home accidents.
	Review good practices for use and care of range.
	Locate and plan the proper use of the safety equipment in the homemaking room: - Fire blanket - First-aid kit
D. Dishwashing and cleanup become easier when certain orderly procedures are observed.	Explain proper group organization for cleanup and dishwashing.
1. Caring for the eating area	
2. Dishwashing	Select group to demonstrate washing and drying dishes.
a. Scrape, rinse, stack	
b. Use of hot water and soap or detergent to wash	Consider correct order for washing dishes, i.e., glassware, silverware, china, and cooking utensils.
c. Use of clear, hot water to rinse	Give reasons for good kitchen clean-up habits.
d. Finishing with clean, dry towels	
e. Care of sponge and dish towels	
3. Care of sink, range, refrigerator and table tops	
E. Setting the table correctly is an important part of the meal.	Lay covers for a family meal.
F. Acceptable and pleasant table manners help make us acceptable to family and friends.	Practice or role-play table manners to include correct: - Seating - Beginning the meal - Passing food - Helping yourself - Use of silver - Leaving the table
II. A SNACK OR QUICK BREAKFAST CAN BE AN IMPORTANT PART OF THE DAY'S TOTAL FOOD REQUIREMENT.	List snacks suitable for different occasions. Try to include milk, fruit, raw vegetables, cereals.
A. Snacks and treats can satisfy hunger and energy needs and fit into an adequate diet.	Prepare after-school snacks. Examples: - Sandwich and milk - Plain cookies with fruit juice or milk

Generalizations-Concepts-Teaching Points	Suggested Activities
1. Purposes of a snack a. Satisfy hunger b. Provide energy	- Fruit - Milk
2. Planning and timing the snack so it does not affect the appetite for regular meals	
3. Preparation of a snack a. Abbreviations are used in recipes. b. All standard recipes are based on level, accurate measurements.	Refer to Page 48 in Homemaking, Book One.
B. A nutritious breakfast can be quick and easy.	
1. Breakfast is the most essential meal of the day.	Discuss the meaning of the word, breakfast.
2. Some girls and boys prepare their own breakfast, and breakfast for other members of the family.	Plan a simple breakfast menu. Prepare the menu planned. Suggested menus:
3. A simple breakfast should include: - Fruit - Bread - Beverage	- Banana Dry cereal Milk or - Fruit juice (canned or frozen) Cinnamon toast Milk or cocoa List dishes and silver to be used for the menu chosen. Review, or teach, table setting appropriate for breakfast. Discuss appropriate, simple table decoration. Discuss the importance of setting a pretty table every day. Demonstrate table settings. Review cleanup procedures. List the food eaten for breakfast that morning. Discuss reasons why some breakfasts are adequate, and why additional foods make other breakfasts better meals. Review reasons for eating.

Generalizations-Concepts-Teaching Points	Suggested Activities
III. A VARIETY OF FOODS MAY BE PREPARED TO MEET THE NUTRITIONAL NEEDS OF THE FAMILY.	
A. Adequate food for the day is necessary to:	Name the meals of the day.
1. Satisfy hunger	Introduce the four basic food groups relating them to the three meals.
2. Promote growth and health	Refer to page 45 in Homemaking, Book One.
3. Supply energy, and repair body tissue	
B. A balanced food intake is based on the four important food groups which build a good body and improve personal appearance.	Build menus for a day using food models. Check these with the basic food groups.
1. Meats	Prepare and enjoy a sack lunch. For example: a sandwich, raw vegetable, fruit, cookie.
2. Vegetables and fruits	Demonstrate food wrapping and packing.
3. Dairy foods	
4. Breads and cereals	Plan to buy a serving of milk to add to this sack lunch.
C. Families may vary the usual meal patterns.	List simple meal patterns for the three meals. Example:
1. A luncheon-type meal served in the evening is like a supper.	- Breakfast: See II, B, No. 3. - Luncheon: Soup, sandwich, or salad Raw vegetables Canned fruit Beverage
2. Luncheon, supper, and dinner are often two-course meals.	
3. A protein-rich soup, casserole, or salad may serve as the main dish.	- Dinner: Main dish Green vegetable, or salad Bread, butter Simple dessert Beverage
	Refer to page 57 in Homemaking, Book One.
4. Families vary in meal patterns because of a variety of conditions.	Discuss reasons for eating raw vegetables:
- Food budget	- Variety of texture - More vitamins in raw vegetables

Generalizations-Concepts-Teaching Points	Suggested Activities
- Seasonal foods - Family preference - Family customs - Time required for preparation (working mothers)	- Bright color for eye appeal - Example: carrot, celery, beet, turnip strips, green pepper rings, and radish roses List varieties of food-dishes which could be served for: sandwiches, soups, salads, raw vegetables, main dishes, green vegetables, yellow vegetables, simple desserts. Practice table setting (without food) to learn how to serve a two-course meal.
D. Menus for the three meals are built from the meal patterns.	Plan menus for three meal patterns which sixth-graders could prepare. Refer to pages 55 - 58 in Homemaking, Book One. Study the menus to see if they are balanced meals. Use the Basic Food Charts: "A Guide to Good Eating" and "Foodway to Follow" by the American Institute of Baking, 1959; or "Food for Fitness" and "A Daily Food Guide" by the U. S. Department of Agriculture.
1. Simple breakfasts, or luncheons, are easy to serve.	Choose a menu for breakfast or lunch, thinking of cost, color, texture, ease of preparation, and variety of food and flavor. List on chalkboard, show on bulletin board, or use food models to illustrate menus for the remaining two meals, so that the three meals are seen in a related manner. Plan, prepare, and serve the breakfast and/or luncheon. Include the making of the market list. Evaluate the meal served, and consider ways to improve the planning, preparation, and serving of the next meal. Select the dinner menu to accompany a luncheon served.
2. Girls and boys can learn to cook casserole dishes and other foods for the meal.	Select from the dinner menu a food, or foods, which the entire class may need for practice, such as a quick bread or a simple dessert. Prepare this food.

Generalizations-Concepts-Teaching Points	Suggested Activities
3. Correct vegetable cookery is important for better nutrition and good flavor.	Teach principles of vegetable cookery. Refer to pages 92 and 93 in Homemaking, Book One. Refer to vegetable chart prepared by the Green Giant Company. Prepare frozen, canned, and fresh vegetables for a tasting party, arranging foods in an appetizing manner with appropriate seasoning and garnishes. Example: frozen broccoli, fresh carrots, canned small potatoes with butter, lemon juice, salt, paprika, and parsley.
4. Serving dinner for the family, and/or guests, requires good planning.	Discuss the dinner selected, making a simple score card based on nutrition (basic four), attractiveness of meal, skill in management, and coordination with other two meals of the day. Evaluate the dinner, using the above score card.
IV. LOOKS, FEELINGS AND ENERGY CAN BE IMPROVED BY WISE CHOICE OF FOODS.	
A. Girls and boys can learn to prepare simple cookies or candy to use for refreshments for guests, for a dessert, or for gifts. 1. Selection of easy recipes makes for success. 2. Cost helps to decide the "sweet to eat."	Figure the cost of a candy or cookie recipe. Prepare candy or cookies. (If a recipe is prepared using more than a half-cup of sugar per child, each child may bring sugar or equivalent ingredients for his own recipe, in communities where this is desirable.) Suggested recipes for the candy and cookies: - Candy Surprises, page 73 in Homemaking, Book One - Oatmeal Unbaked Cookies, page 78 in Homemaking, Book One - Ting-a-lings, a recipe in Betty Crocker's Good and Easy Cookbook
B. Wrapping candy or cookies for gifts adds importance to the present.	Arrange for wrapping of candy to take home. (Use aluminum foil pans or boxes lined with wax paper.) Wrap sample for teacher if desired. Demonstrate gift-wrapping or packaging in decorated can

Generalizations-Concepts-Teaching Points	Suggested Activities
C. Eating sweets at the proper time is a wise practice.	
1. Eat sweets after meals to prevent:	
a. Loss of appetite for essential foods	
b. The eating of too much sugar	
c. Excessive tooth decay	Discuss sweets in relation to dental decay.
2. Serve candy for refreshments. (party or company)	
V. PARTICIPATION IN HOME ACTIVITIES SATISFIES NEEDS OF THE INDIVIDUAL FAMILY MEMBERS.	
A. Good grooming makes us more acceptable.	Study "My Reflections" for girls, and "Who Me?" for boys, from the Dairy Council of Greater Kansas City.
1. Personal cleanliness	
2. Mending	Learn to sew on buttons. Refer to page 11 in Homemaking, Book One.
	Demonstrate use of press-on patches.
B. Care of the sewing machine prolongs its use.	Study cleaning and oiling of the machine. Use the sewing machine manual.
	Clean and oil the sewing machine.
	Make a simple project using the sewing machine. Refer to page 12 in Homemaking, Book One.
C. Bed-making is a needed service for the family.	Develop tips to help improve bed-making;
	1. Protect the mattress with a cover or a pad.
	2. Place the first sheet over the mattress cover with the lengthwise center of the sheet in the center of the bed. Tuck the sheet under the mattress at the head, the foot, and sides. Miter each corner unless contour sheets are used.
	3. Place the second sheet on, right side down, matching the centers with a six- to eight-inch turn-back at the head, and half-miter corners at the foot.

Generalizations-Concepts-Teaching Points	Suggested Activities
	4. Blankets or covers go on next, and are half-mitered at the foot.
	5. Fold top sheet back over covers to keep them clean.
	6. Fluff the pillows and place on the bed.
	7. Place spread on top, centered exactly.
	Discuss how the home serves the girl and boy by giving them love, care, and protection.
D. There are other helpful tasks girls and boys can perform in their homes.	List tasks girls and boys could assume. Refer to page 8 in Homemaking, Book One.
1. Girls and boys should feel responsible for orderliness in the home.	Discuss the necessity and method of keeping waste baskets and garbage containers emptied and clean.
2. Girls and boys can help by assuming their share of the cleaning tasks.	Discuss responsibility in keeping bathroom neat and clean. Scour lavatories and sinks.
	Demonstrate different methods of washing windows. Wash mirrors in the homemaking room.
	Discuss the responsibility of sweeping walks and porch in summer and clearing them of snow in winter.
	Point out the necessity for maintaining harmony, cooperation, and respect for privacy in the home.

Culmination and Evaluation

1. Review "Is Food Important," page 44, and note "How Can You Help Buy and Store Foods?", pages 64 - 66 in Homemaking, Book One.

2. Arrange a bulletin board to show some of the "high points" in this unit -- or as introduction to next unit.

3. Use a self-evaluation scale to help evaluate growth in being a better family member.

4. Arrange for pupils to rate themselves on "Doing Your Part," page 9, and on "Being a Good Member of the Home Team," page 8 in Homemaking, Book One.

Teaching Aids

Audiovisual Materials

0-1120 Balance Your Diet for Health and Appearance, 6-12
FO-33 Beef We Eat, 6-12
0-1312 Better Breakfasts, U.S.A., 6-12
00-760 Bread, 2-6
F-3293 Breakfast for B. J., 6-12
0-798 Butter Is Made This Way, 3-7
00-673 Citrus, the Golden Fruit, 4-12
Cooking Series: 6-14
F-769 Understanding Cooking Terms
F-770 Measuring Accurately
F-771 Organizing and Preparing Meals
F-772 Planning Meals for Nutrition
F-773 Safety in the Kitchen
F-774 Serving Meals Attractively
0-623 Cooking Terms and What They Mean, 6-14
0-882 Eat for Health, 2-6
F-946 Eating Out, 6-7
F-1469 Food for Life, 6-12
F-3783 Food Makes the Difference, 1-6
F-138 Getting Along with Your Brothers and Sisters, 6-12
F-22 Getting Along with Your Family, 6-12
Good Health Series:
F-307 You and Your Food, 4-6
0-843 Good Table Manners, 5-9
00-78 Hidden Hunger, 4-6
F-2612 Manners at Home, 1-6
0-99 Menu Planning, 6-12
OX-265 New Story of Milk, 3-12
0-1240 Nutritional Needs of Our Bodies, 4-10
F-1184 A Right Breakfast, 4-9
F-1370 Skimpy and A Good Breakfast, K-6
F-1823 Table Manners, 4-9
FO-41 What Goes Where (Tableware), 6-12
F-1471 Why Eat A Good Breakfast, 4-9
0-811 Young Mother Hubbard, 1-6
00-370 Your Food, 4-9

Books and Pamphlets for Children

Dairy Council of Greater Kansas City, 5200 East 45th Street, Kansas City, Missouri, 64130 (Free)

A Guide to Good Eating
Food and Care for Dental Health
Ready for Breakfast
Who Me?
My Reflections
Animals That Give People Milk
It's Always Breakfast Time Somewhere
Food News
Milk Made the Difference
The Four Food Group Chart

Johnson Wax, Consumer Education Director, Racine, Wisconsin

How to Be Well Groomed from Heel to Toe (Free)

Kansas City, Missouri, Public Schools, Homemaking, Book One, School District, 1966.

Pet Milk Company, Arcade Building, St. Louis, Missouri

Meal Planning Guide (Free)

Wallace Silversmith, Lancaster, Pennsylvania

Etiquette in Everyday Living (The boys like this.) (Free)

Helps for Being at Ease at the Table

1. A menu is a list of foods forming a meal.
2. A course is that portion of a menu which is served at one time.
3. A cover is the linen, glassware, silver, and china placed on the table for each person when the table is set.
4. Sitting or rising from the table is from the left side of the chair.
5. The napkin, if small, should be unfolded and spread on the lap; if large, unfolded once and placed with the fold next to the body.
6. When passing food that is on the table, start to the left.
7. The hostess is always the one to begin eating first.
8. When eating bread, only a small portion at a time is broken off and buttered.

Helps for Being at Ease at the Table (Continued)

9. When using a spoon, dip it from you. Take food from the side of the spoon nearest to the mouth:

   "As little boats put out to sea,

   I dip my spoon away from me."

10. When finished, place the spoon on the service plate at the right of the dish.

11. If the teaspoon has been used with a beverage, it is placed at the right of the cup on the saucer, except when used in stirring and tasting.

12. When the meal is finished, the knife and fork should be placed together diagonally across the plate. Once used, the knife, and/or fork, are placed on the plate in like manner and not on the table.

13. At the close of the meal when at home, refold napkin and place it at left of plate; when a guest and not remaining for another meal, lay the napkin unfolded at the left of the plate. Paper napkins are always left neat, but unfolded, on the table.

14. In giving an introduction, always say a girl's name, or an older person's name, first. Example: "Elsie Brown, may I present my friend, George Smith?"

15. In acknowledging an introduction, say "Hello, Elsie." "How do you you do, George."

UNIT II - SPECIAL OCCASIONS IN OUR LIVES
(Grade Six)

Suggested Time - Two Weeks

Overview and Generalizations

Celebrating special occasions helps to build family unity. A tapestry of memories may be woven through the years that can mean much to family members as they grow older. One important way to celebrate special occasions is through gift giving.

Two-fold satisfaction is acquired from giving, the joy of giving and receiving. The gift itself is not as important as the satisfaction of the giver and recipient.

Something of one's self goes into handmade gifts. Giving of time, or service, is as important as the giving of gifts. There are many occasions when gifts are appropriate.

This unit is planned to help girls build and acquire these generalizations, understandings, habits, and skills:

Major Generalizations	Understandings, Habits, Skills
I. There are many occasions when gifts and courtesies may be extended.	1. Develop consideration for others.
II. Personal services performed for others enrich the lives of all concerned.	2. Create a desire to help others.
III. Gifts can show thought, creativity, and skill.	3. Experience the joy of serving others.
IV. Showing appreciation for gifts and services received is a part of good manners.	4. Become aware of occasions when gifts, or courtesies, are especially appropriate.
	5. Learn to make and prepare simple gifts.
	6. Show appreciation of courtesies extended in appropriate ways.

Suggestions for Starting the Study

- Suggest occasions and reasons for making a gift.
- Consider the likes and dislikes of the person to whom the gift is being given. Discuss cost, time for construction, and suitability of the gift.
- Display articles which could be made by the sixth-grade girl. Girls may also suggest gifts which they would like to make.
- If the unit is used at the time of a special holiday when gifts are extended, use this to introduce the making of a present.

Generalizations-Concepts-Teaching Points	Suggested Activities
I. THERE ARE MANY OCCASIONS WHEN GIFTS AND COURTESIES MAY BE EXTENDED.	Have each girl think of a favorite gift she has received. Bring out:
A. Religious holidays	- Occasion for gift
B. Birthdays, anniversaries	- What made the gift special
C. Mother's Day, Father's Day	- How appreciation could be shown
D. Other occasions	Refer to Chapter II, pages 14-20 in Homemaking, Book One.
II. PERSONAL SERVICES FOR OTHERS ENRICH THE LIVES OF ALL CONCERNED.	
A. Errands for mother	Plan a surprise gift of service for a family member. Report on the success of the surprise.
B. Entertaining younger brother or sister	Make an "animal pillow" for a child's bed.
C. Reading to grandmother	Bring out that "gifts" do not have to be purchased nor cost a great deal of money.
D. Helping Dad with yard work	
III. GIFTS CAN SHOW THOUGHT, CREATIVITY, AND SKILL.	Display articles made from salvaged materials, such as Christmas stocking or boot from an old felt hat; door decoration from Christmas decorations; bells from tin can tops.
A. Gifts may be made for family and friends.	
1. Candy for a family member	Review procedures for candy making. Include: - Preparation for food handling (hands, aprons, towels, hot pad) - Assemble ingredients. - List utensils needed.

Generalizations-Concepts-Teaching Points	Suggested Activities
	- Discuss method. - Measure ingredients. - Complete making of candy according to directions.
- One simple candy recipe which may be used is Butterscotch Krispies.	Refer to page 76 in Homemaking, Book One.
2. Cookies for a gift	Some classes may make cookies for a food gift. Follow recipe using same procedures.
3. A gift made of felt or fabric - Lapel pin - Bookmarks - Guest towel with Swedish weaving	Make a display of gifts made of felt or fabric. Encourage each girl to select one which she will make. Refer to Page 16 in Homemaking, Book One. Note: The type of gift chosen will depend upon the time of year which the gift is made, in order to use the skills which have been developed previously.
B. Attractive wrapping adds importance to a gift.	Display gift-wrapping materials. Cover a box with shelf or gift paper. Use spray paint to decorate a can. Discuss appropriate wrappings for different kinds of gifts.
IV. SHOWING APPRECIATION FOR GIFTS AND SERVICES RECEIVED IS A PART OF GOOD MANNERS.	
A. Appropriate words can show appreciation.	Discuss appropriate ways to show appreciation for a gift or courtesy.
B. Appreciation can be given over the telephone.	Role play giving and receiving a gift or courtesy.
C. "Thank-you" notes show appreciation.	Write a "thank-you" note for a gift received.

Culmination and Evaluation

1. Report on the actual presentation of a gift which the girl has made.

2. Read appropriate thank-you notes which have been written, or received, showing appreciation for a gift or service.

Teaching Aids

Audiovisual Materials

F-1857 Etiquette Series II, 6-10

- Table Setting
- Perfect Party
- Public Appearance
- Away from Home
- Developing Social Maturity

F-2540 Party Themes and Party Recipes, 6-12

Headstart on Homemaking (Filmstrip, free), Mary Blake, Home Service Director, Carnation Company, Department A-18, Los Angeles, California, 90019

Books and Pamphlets for Pupils

American Home Economics Association, 1600 - 20th St., N. W., Washington D.C.
- Family Holidays Around the World, 1965 - $1.50 [20009

American Friends Service Committee, Inc., 160 No. 15th St., Philadelphia, Pennsylvania, 19102
"Children's Program Materials"
- Caring and Sharing at Christmas and Hanukah, 1965 - 25¢
- Friendly Things to Do) Seasonal Packets, 35¢ per packet
- Days of Discovery)

Scholastic Book Services, 50 West 44th St., New York, N. Y., 10036
- Fun with Next to Nothing - Handicrafts for Boys and Girls, TW 525-45¢

References

Dow Chemical Company, The Saran Wrap Way, Chicago, Illinois, 1955.

Golden Press, New York, McCall's GiantGolden Make-It-Book, Latest Edition

Hobby Publications, Superintendent of Documents, Government Printing Office, Washington, D. C. (List of government hobby publications)

Holiday issues of such materials as the following:

- Campbell Soup Company, News from Campbell's Kitchens, Camden, N. J.
- Home Sewing Association, Inc., Home Sewing News, P. O. Box 472, Palmer, Massachusetts
- Quaker Oats Company, Quaker Quotes, Merchandise Mart Plaza, Chicago, Illinois
- Swift and Company, Food News and Views, Chicago, Illinois

Miller, Bruce, Let's Celebrate a Holiday, Riverside, Calif., 1966. 50¢

Roseaman, I. P., Make It Yourself, Charles A. Bennett Co., Inc., Latest Edition

UNIT III - IT IS YOUR HOME TOO
(Grade Six)

Suggested Time - Four Weeks

Overview and Generalizations

There are many housekeeping responsibilities that girls of this age have, no doubt, already assumed. Making these tasks interesting, and deriving joy in accomplishment, becomes a challenge to mothers and teachers.

The girl is encouraged to participate in making and keeping the home clean and orderly. Thus, she gains a sense of sharing in the care of the home as well as in caring for her own belongings and possessions. From these activities, she may realize the importance of getting along with others, and come to feel a sense of security in many situations. Girls are encouraged to value cleanliness, order, and beauty, and appreciate the work and care required to maintain an attractive home.

Through the performance of home tasks, young folk will come to appreciate their role as family members and as citizens in the neighborhood. Self-evaluation should lead to greater understanding of people, consideration of others, and joy in living. Respect for all individuals, regardless of color, creed, size, or age, is a social privilege and responsibility.

This unit is planned to help sixth-grade girls build and acquire these generalizations, understanding, habits, and skills:

Major Generalizations	Understandings, Habits, and Skills
I. The home and family make important contributions to our lives.	1. Understand and appreciate the contributions and importance of each family member.
II. Each family member can help make a happy family.	2. Share the home facilities and equipment with others.
III. An attractive and orderly home can result when family members work together.	3. Assume responsibilities for home tasks and duties.
IV. We all want and need good friends and neighbors.	4. Develop and value personal qualities which make a pleasant family member, a good friend, and neighbor.

This unit suggests problems, or questions, which might be used to organize the development.

Suggestions for Starting the Study

- Read a poem that describes a home and the many activities that are carried on by its family members, such as:

  "Home" by Edgar Guest, or

  "A Prayer for a Little Home" by Florence Bone, taken from "The Best Loved Poems of the American People," selected by Hazel Fellerman.

- Have girls write poems, or paragraphs, about the home.

- Select poems, paragraphs, and quotations about friends and home.

- Display pictures of attractive rooms and homes.

- Arrange a bulletin board display of pictures showing happy family relationships and activities. Snapshots of the girls' own families could be used.

Generalizations-Concepts-Teaching Points	Suggested Activities
I. THE HOME AND FAMILY MAKE IMPORTANT CONTRIBUTIONS TO OUR LIVES.	List the most important things which your family does for you.
A. The home is the place for birth and rearing of children - the new generation.	Check and discuss "What Is a Home?," page 21 in Homemaking, Book One.
B. Early habits, personality, and moral and spiritual values are developed in the family.	Discuss the need and development of: - Family love - Appreciation - Personal acceptance - A sense of security
C. Food, clothing, and shelter are furnished by the home.	
D. The home can provide love, acceptance, appreciation, and a sense of security for the family members.	Write an account of "My Three Wishes for My Family." These may need to be kept private and not discussed before the whole class.
II. EACH FAMILY MEMBER CAN HELP MAKE A HAPPY FAMILY.	Read Chapter III, pages 21-30, in Homemaking, Book One.
A. Family members can develop attitudes and habits which help make a happy home.	Discuss how the sixth-grade girl helps to make a happy home.
1. Love, respect, and harmony within the family group	Show and discuss the following films: 0-538 Family Life 0-566 Your Family

Generalizations-Concepts-Teaching Points	Suggested Activities
2. Consideration shown through good family manners	Role-play situations which show good family manners.
3. Satisfaction in doing things for the family	- The family breakfast
4. Living within the family income	- Going to bed at night
	- Showing appreciation for family services
	- Greetings and good-bys
B. With additional privileges come added responsibilities.	Write a paragraph:
1. Privileges enjoyed by the sixth-grade girl	I can become a better family member by _____.
2. Responsibilities to develop and practice	List good habits and polite phrases which help make good family relations.
a. Encourage the use of good family manners.	Review pages 5 and 6 in Homemaking, Book One.
b. Respect the property and rights of others.	Role-play family plans for sharing such common items as bathroom, radio, television, telephone and the family car.
c. Accept willingly the family chores.	Discuss: What personal satisfactions result from thoughtful actions?
d. Help other family members.	
III. AN ATTRACTIVE AND ORDERLY HOME CAN RESULT WHEN FAMILY MEMBERS WORK TOGETHER.	Discuss: How can I contribute to an attractive, orderly home?
A. There are housekeeping habits which help us to be clean and neat.	Make a list of housekeeping tasks the sixth-grade girl can assume. The following will likely be on the list:
1. Arrange a place for everything, and keep everything in its place.	- Care of personal clothing
	- Organizing for a school-day morning
	- Bed-making
2. Learn quick, easy, and efficient methods of work.	- Garbage and trash disposal
	- Emptying ash trays
3. Assist with the housekeeping.	- Dusting
	- Table setting (to be developed in unit on foods)
	- Dishwashing and drying
	- Care of newspapers, books, and magazines

Generalizations-Concepts-Teaching Points	Suggested Activities
	- Care of pets - Cleaning bathroom after use
	Arrange a personal check list for each pupil. Enlist the mother's help with checking on the girl's performance of these tasks.
B. An attractive, orderly home is free of household pests.	Inspect the homemaking room for signs of pest invasion. Enlist cooperation of the home in home inspection in which the pupil and mother work together.
1. House pests	Refer to page 28, "Away with Household Pests," in Homemaking, Book One.
a. Houseflies	
b. Ants	
c. Roaches	
d. Waterbugs	
e. Mice and other rodents	
f. Clothes moths	
g. Others	
2. Why these are pests	
a. Cleanliness problem	Show food and clothing storage which discourage pests.
b. Disease carriers	
c. Destruction of property	
3. Avoidance and control of pests	Demonstrate use of some commercial pest control agents. Point out the safety factors in use and storage of control agents.
C. Color, arrangement, and art objects help make the home attractive.	
1. Pictures and other art objects can be arranged or hung in a pleasing manner.	Discuss types of pictures for various rooms. Make a list of suggestions for hanging pictures in a pleasing manner.
2. Beauty spots help make the home attractive.	Arrange books, papers, and magazines to illustrate order.
a. Table arrangements	Arrange and care for potted plants in the classroom.
b. Centerpieces	
D. Personal items can be arranged in an orderly manner.	Discuss reasons for orderly arrangement of items; - Safety

Generalizations-Concepts-Teaching Points	Suggested Activities
1. Homemaking room 2. Dresser drawers 3. Clothes closet	- Timesaving - Space conservation - Personal satisfaction Cover, or decorate, boxes for storing small articles. - Egg cartons for jewelry trays - Small boxes covered with contact paper for gloves, socks, and handkerchiefs Collect containers and ideas for storage and arrangement of articles.
IV. WE ALL WANT AND NEED GOOD FRIENDS AND NEIGHBORS.	
A. Value of good friends and neighbors	Discuss the value of having and being a good friend and neighbor.
1. Understanding and love 2. Similar interests 3. Learning from each other 4. Friends who bring out our best	Role-play the making of simple introductions. Use of puppets and dolls may add interest and variety.
B. Being a good friend and neighbor	Plan a party for fifth-grade pupils to introduce them to homemaking. Plan for:
1. Practice the Golden Rule. 2. Getting along with others is an art, easily developed and rewarding. 3. Use gracious manners with friends, neighbors, and people who help and serve us.	- Explaining the general homemaking program - Manners for hosts and hostesses - Simple refreshments, if desired - Use of the brochure "A Look at Homemaking for Boys and Girls"
C. Work and play through organized groups.	
1. Organizations a. Junior Red Cross b. Brownies and Blue Birds c. Girls Scouts d. Campfire Girls e. Church Youth Groups	Review the organized groups to which pupils belong.
2. Good group members working together for greater accomplishments	If time permits, make an article for the Red Cross, or display articles which have been made during the year as a service to others.

Culmination and Evaluation

1. An open house for fifth-grade pupils may be an appropriate conclusion.
2. Review improvements which girls have made in "How to be a good friend."
3. Arrange a "How to do it box." Divide girls into groups. Each group draws a "good manners problem" from the box. After a brief practice period, each group demonstrates the solution of the problem.
4. Plan a "good neighbor" or "friendship" homemaking project which could be carried out during the summer. (Service to others, food for others, home beautification)

Teaching Aids

Audiovisual Materials

OX-213 Best Made Plans, 6-12

F-138 Getting Along with Your Brothers and Sisters, 6-12

F-22 Getting Along with Your Family, 6-12

Good Manners Series, 1-6

F-2612 Manners at Home
F-2613 Manners at School
F-2614 Manners at Parties
F-2615 Manners at Play
F-2616 Manners While Visiting
F-2617 Manners in Public

O-201 Home Electrical Appliances, 6-12

F-310 Insect Pests and Disease, 4-6

F-24 Parents are People Too, 6-12

F-3309 Road to Responsibility (Home Care), 6-12

O-566 Your Family, 1-6

Calgon Corporation, Home Service Center, Box 1346, Pittsburgh, Penna.15230
A Recipe for Clean Clothes (Shows the value of soap, detergents, and water conditioners.)

Evaporated Milk Association, 910 Seventeenth Street, N. W., Washington, D. C., 20006.
Safety Is Up to You (Five frames emphasize the value of cleanliness.)

Audiovisual Materials (Continued)

Fostoria Glass Company, Moundsville, West Virginia
"The Crystal Touch" (A family scene on one frame helps the young girl see her part in the home. Frames related to "crystal decorative touch" would provide much help in understanding "to clean up and straighten up.")

Procter and Gamble Company, P. O. Box 599, Cincinnati, Ohio, 45201
The Road to Responsibility (Frames show children accepting responsibility of care of home. Activities shown are bedmaking, cleaning kitchen floor, bathroom or kitchen walls, cabinets, mirrors, closets, dishes, woodwork.)

Product Information Service, Public Relations Department, Wilmington, Delaware, 19898
Teflon in the Kitchen (Sound filmstrip - shows and tells what teflon is, as well as how to care for it.)

Pyrex, Centura, Corning Ware, Corning, New York
Glass Is a Marvelous Thing (Frames show the use of pieces of Corning Ware used as centerpieces, or bowls as flower holders. Shows how interesting arrangements can be made by combining different size bowls and plates.)

Pamphlets

Best Foods, Division of Corn Products Company, P. O. Box 2455, Grand Central Station, New York, N. Y.
Room Brighteners from Starch, String 'N Things (Directions for making cornstarch ceramics, jewelry, and wall hangings)

Church, Dwight and Company, Inc., 70 Pine Street, New York, N. Y., 11105
Arm and Hammer Baking Soda, Home Economics Department
Use Soda, Gentlest Household Cleaning Aid
Quick Hints with Soda (Lists methods to stop grease fires quickly, how to clean combs and brushes, and how to brighten marble-topped furniture.)

Conso Products Company, Consolidated Foods Corporation, 27 West 23rd St., New York, N. Y., 10010
How to Decorate Almost Anything with Stick-Fast

National Safety Council, 425 North Michigan Avenue, Chicago, Ill., 60611
National Standard Check List for Teaching Home Safety

J. C. Penney Company, Inc., 1301 Avenue of the Americas, New York, N. Y., 10019
Consumer Buying Guide - Bedding, Mattresses and Box Springs, Part II of a series, Fall and Winter, 1967 (Describes kinds of mattresses and how they are made - tells of price, labels, and care of bedding.)

Pamphlets (Continued)

U. S. Department of Health, Education, and Welfare, Food and Drug Administration, Washington, D. C., 20204

Dennis, the Menace Takes a Poke at Poison

First Facts About Drugs, 1963 (Lists good do's and don'ts for drugs. Tells of drug protection.)

Read the Label on Foods, Drugs, Devices, Cosmetics, and Household Chemicals

What Consumers Should Know About Food Standards (FDA describes standards of quality for foods. Feels labeling must tell the truth.)

UNIT IV - SO YOU CAN SEW
(Grade Six)

Suggested Time - Fourteen Weeks

Overview and Generalizations

Sewing is one homemaking area in which to develop skills and to stimulate creativity. Simple sewing, using fabrics, the sewing machine, and some handwork, can open and extend a new area of learning. It is hoped that through these activities, the basic sewing skills will be experienced. Some techniques, basic to all garment construction, will be mastered while the girls experience the joy of making projects in fabrics.

This unit is planned to help pupils build and acquire these generalizations, understandings, habits, and skills:

Major Generalizations	Understandings, Habits, and Skills
I. An enthusiastic attitude can increase the satisfaction obtained from sewing.	1. Make wise choices in the selection of color and fabric.
II. Wise choice of fabrics and colors helps to develop individuality.	2. Assume responsibilities for care and maintenance of equipment.
III. Successful sewing results from skillful hands using good equipment.	3. Develop sewing skills.
IV. Various projects using fabrics can develop basic sewing techniques.	4. Provide an opportunity for creative expressions.
	5. Appreciate well-constructed projects.

Suggestions for Starting the Study

- Display samples of cotton fabric.
- Display articles made from cotton fabrics.
- Demonstrate how fabrics are woven.
- Arrange a bulletin board showing "Cotton Plant to Cotton Fabric."

Generalizations-Concepts-Teaching Points	Suggested Activities
I. AN ENTHUSIASTIC ATTITUDE CAN INCREASE THE SATISFACTION OBTAINED FROM SEWING.	
A. Simple items to sew in homemaking contribute to a successful beginning.	Arrange a bulletin board showing beginning class projects, such as: 1. Place mat 6. Pillow 2. Napkin 7. Pin cushion 3. Tea towel 8. Pot holder 4. Apron 9. Net worm (toy) 5. Sock toy
B. Personal satisfaction may be gained from hand sewing and machine sewing.	Display a sample copy of the Sewing Machine Operator's License. Discuss advantages of hand-sewing projects.
II. WISE CHOICE OF FABRICS AND COLORS HELPS TO DEVELOP INDIVIDUALITY.	
A. Choosing fabric	
1. Cotton fabrics used in projects	Display finished cotton projects, such as aprons and pin cushion.
2. Cotton fabrics can come in various types, such as: - Plain - Prints - Checks - Plaids - Stripes	Display samples of plain, printed, striped, plaid, and checked fabrics. Include types of fabric needed for class projects.
3. Simple fabric terms:	Refer to "Sewing with Fabric" - pages 36-38, Homemaking, Book One.
a. Selvedge	Build needed vocabulary.
b. Raw edge	Make flash cards of vocabulary terms.
c. Grain threads (lengthwise, crosswise, warp, woof)	Make crossword puzzle of vocabulary terms.
d. Fringed edge	Play a game of unscrambling terms.
e. Straightening the fabric	Make samples to illustrate the concepts of sewing terms.
f. Fold of fabric	
B. Choosing color	
1. Color considerations	Study the color chart. Decide on colors which are liked by the girls.
a. Colors available	Decide on the color and use of an article to be made for the table, e.g., fringed place mat, or napkin.
b. Individual tastes	
c. Suitability to project	Make a color wheel using crayons, colored pencils, or swatches of fabric.

Generalizations-Concepts-Teaching Points	Suggested Activities
III. SUCCESSFUL SEWING RESULTS FROM SKILLFUL HANDS USING GOOD EQUIPMENT.	Show film, O-555 Sewing Fundamentals.
A. Each girl needs appropriate sewing equipment for her use.	
1. Selection	
a. Good tools are closely related to good workmanship.	Read page 33 in Homemaking, Book One.
b. Good equipment saves time.	Use a tool identification game.
c. Tools represent an investment of money.	Examine a well-equipped clothing box and learn the name of each item.
2. Care	
a. Equipment can be used for years with good care.	Show the difference in the use of sharp and dull scissors, pins, and needles on cloth.
b. A place for everything and everything in its place helps care for equipment.	Label all personal equipment.
3. Use	Show how to keep tape measure folded and held with a rubber band when not in use.
a. Each tool should be used for its intended purpose.	
b. Proper handling of equipment should result in a finer finished project.	
4. Keeping sewing equipment and tools orderly and accessible	Role-play two ladies ready to sew, with orderly and disorderly sewing boxes - using good equipment and poor equipment.
B. Safety in the clothing laboratory leads to skill and comfort.	
1. Practices to be observed to insure the safety of those in class	
2. Proper use of:	Discuss why it is important to follow precautions when using electrical equipment, shears, needles, and pins.
a. Electrical equipment	
b. Shears	Demonstrate correct manner of carrying shears and of handing them to another person.
c. Needles and pins	
d. Electric irons and ironing board	Demonstrate correct way to plug and unplug electric cords; demonstrate how to store cords.
	Discuss why irons should be cooled before storing.

Generalizations-Concepts-Teaching Points	Suggested Activities
C. Learning to do handwork skillfully is an important part of learning to sew.	Demonstrate threading a crewel needle and a sharp needle. Demonstrate how to secure thread in fabric by the use of three small stitches on top of one another. Show how to hold the needle between thumb and forefinger, pushing with thimble worn on middle finger. See Homemaking, Book One, page 43. Make samples of handwork or make a short project requiring hand stitching. Demonstrate pressing cotton fabrics dry, and with moisture applied. Compare the difference.
D. Sixth-grade girls can learn to use and care for the sewing machine.	Discuss the uses of the sewing machine. List the advantages of owning a sewing machine. Explain the difference between portable and cabinet machines.
1. The sewing machine is a useful, expensive machine, and needs proper use and care.	Practice opening and closing the machine. Emphasize safety in all sewing machine operations.
2. Correct posture and proper lighting will aid in more efficient use of the machine.	Learn to assume a comfortable and efficient position for sewing. Study the sewing machine manufacturer's charts to learn the names of the important parts. Play the Name Game. Prepare the machine for operation. Operate the unthreaded machine. - Starting and stopping - Stopping at a planned place - Stitching on a straight line - Straight stitching in an unlined space - Turning square corners Practice stitching on Singer Sewing Charts or lined notebook paper. Operate threaded machine, using fabric under presser foot. A good order for developing this skill would be: - Select proper weight thread. - Learn to thread the machine using charts for directions.
3. Threading the machine correctly is essential to proper stitching.	

Generalizations-Concepts-Teaching Points	Suggested Activities
	- Fill and thread the bobbin. - Place scrap of fabric under presser foot before stitching. - Lower needle, lower presser foot with threads straight back from needle. - Practice straight stitching and stopping to adjust fabric. - Secure threads by back-tacking or other appropriate methods. To remove fabric from machine: - Stop with take-up lever at highest point. - Raise presser foot. - Pull threads and fabric at least five inches to the left of needle, cutting threads half way between presser foot and last stitch. Discuss difficulties, their cause and remedies. Set up an order for pupils to pass the sewing machine operator's test. - Written test - Practical application test Issue Sewing Machine Operator's License.

Sewing Machine Operator's License

Date _____ School _____

Name _____

Address _____

Grade _____ Teacher _____

The pupil named above has met the requirements for operating the sewing machine safely.

Generalizations-Concepts-Teaching Points	Suggested Activities
4. A clean, properly oiled machine operates better and lasts longer than one which does not have this care.	Demonstrate the process of cleaning and oiling the machine.
	Demonstrate placement of cord and foot control.
5. A sharp needle is needed for good stitching.	Show how to insert a new needle, noting position of the flat side.
IV. VARIOUS PROJECTS USING FABRICS CAN DEVELOP BASIC SEWING TECHNIQUES.	
A. Many simple projects can be made of cotton by beginning sewers.	Choose small projects for added interest and challenge. Suggestions: - Place mat and napkins - Tea towel - Hand towel with Swedish weaving - Pot holder - Pin cushion - Wash cloth purse - Pocket pack tissue cover - Wash cloth pillow - Hairspray cover - Tissue box cover - Letter holder - Sock duck - Bedroom slippers
B. Directions are necessary.	Refer to pages 37-38, in Homemaking, Book One.
1. Following directions accurately is important.	
2. Directions have been worked out for many processes by experts. They make it possible for one who is not familiar with the process to follow through easily and effectively.	Look at the directions for work of various activities, such as making candy, and washing dishes. Discuss how directions make for ease and accuracy.
3. The easiest way to follow directions is to do so by means of a systematic method.	Study direction sheets for making projects from fabrics using the systematic method suggested.

Generalizations-Concepts-Teaching Points	Suggested Activities
	- Read all directions quickly to get the general idea. - Get together the supplies and equipment that are called for. - Read carefully the first step, understand it, then follow it through. - Proceed with the succeeding steps in similar fashion.
C. Measuring accurately is important in sewing.	
1. The units of measurement used in sixth grade are the inch, the foot, and the yard.	Explain measurements by showing and using the yardstick, foot ruler, and tape measure to measure different amounts.
2. The tape measure, yardstick, and ruler are the tools used. The yard is divided into feet and inches, the foot into inches, the inch into 1/2-inch, 1/4-inch, and 1/8-inch. The gauge is a convenient, accurate measuring device.	Make a cardboard yardstick using colors to indicate the different lengths. Show a commercial gauge.
3. Gauges, commercial or cardboard, should be used in various steps in construction with fabrics.	Show pupils a cardboard gauge for 1-inch, 1/2-inch, and 1/4-inch. Illustrate how to make such a gauge. Emphasize replacement of gauge whenever necessary.
D. Sewing projects are made and finished by use of a few basic sewing skills.	Introduce and complete apron, using "Directions for Cutting and Making an Apron," available from the Homemaking Office.
1. Staystitching consists of a row of stitching, usually one-half inch from raw edge.	Illustrate stages of construction of apron with partially completed apron.
2. Turning - made by one fold along edge of fabric.	
3. Hem consists of two turnings of fabric.	
4. Seam - used to join two edges of material together.	Demonstrate pressing of a seam allowance and turnings for a hem over a thin cardboard.
E. Proper pressing is essential to good construction, saves time and improves appearance of hems, seams, and turnings.	Show the difference between ironing and pressing (using moisture).

Teaching Aids

Audiovisual Materials

FO-227 Beauty, Charm and Fashion Modeling, 6-12

F-2605 Clothing Factory, 3-9

O-86 Cotton, 3-7

F-2604 How Cloth Is Made, 3-9

OO-1033 How Is Clothing Made (Story of Mass Production), 3-9

F-2603 Materials for Clothing, 4-9

Sewing Series, 6-12

- F-503 Machine Stitching and Seams
- F-506 Tools for Sewing

Teen-Age Clothing Series, 6-12

- F-776 Care of Your Clothes
- F-778 Grooming
- F-781 Sewing by Hand
- F-782 Sewing Equipment

F-23 What Clothes Should I Wear?, 6-12

F-305 You and Your Clothes, 4-6

Books and Pamphlets for Teachers

Carson, Byrta, How You Look and Dress, Webster Div. of McGraw-Hill, 1959.

Carter, Meg, McCall's 1001 Questions on Sewing, G. P. Putnam's Sons, 1961.

East and Wines, Fashion Your Own, Houghton Mifflin Company, 1964.

Forum, J. C. Penney Company, Inc., 1301 Avenue of the Americas, New York, N. Y., 10019

Jones and Burnham, Junior Homemaking, J. B. Lippincott Company, 1963.

Modern Miss, Simplicity Pattern Company, 200 Madison Ave., New York, N. Y.

Reiff, Florence, Steps in Home Living, Chas. Bennett Company, 1966.

Rowe, Crystal, Keys to Safety in Homemaking, Webster Division of McGraw-Hill Company, 1966.

"Seventeen at School," 320 Park Avenue, New York, N. Y., 10022

Unit Method of Sewing, Iowa Home Economics Association, Iowa State College Press, 1950.

Free and Inexpensive Materials

Manual (student edition if available) for the sewing machine

Stitching Practice Charts, Singer Sewing Machine Company, 302 West Linwood, Kansas City, Missouri, 64111

Threading Chart for Sewing Machine, available through sewing machine manufacturers.

Student Direction Sheets

APRON DIRECTIONS

How to Cut or Tear Apron

1. Look at your fabric and let us learn, or review, some important words in sewing.

2. What are the two finished edges called?

3. Name the lengthwise threads which are woven in the same direction.

4. What are crosswise, raveling threads at the two ends called?

5. How would you describe the unfinished crosswise edges?

6. Fold the cloth in half, lengthwise. Are the edges even? If not, your teacher will demonstrate how to straighten the fabric.

7. Study the apron diagram. Can you answer the questions on it?

8. How many pieces does the diagram show? Prepare 5 small squares of paper. Label.

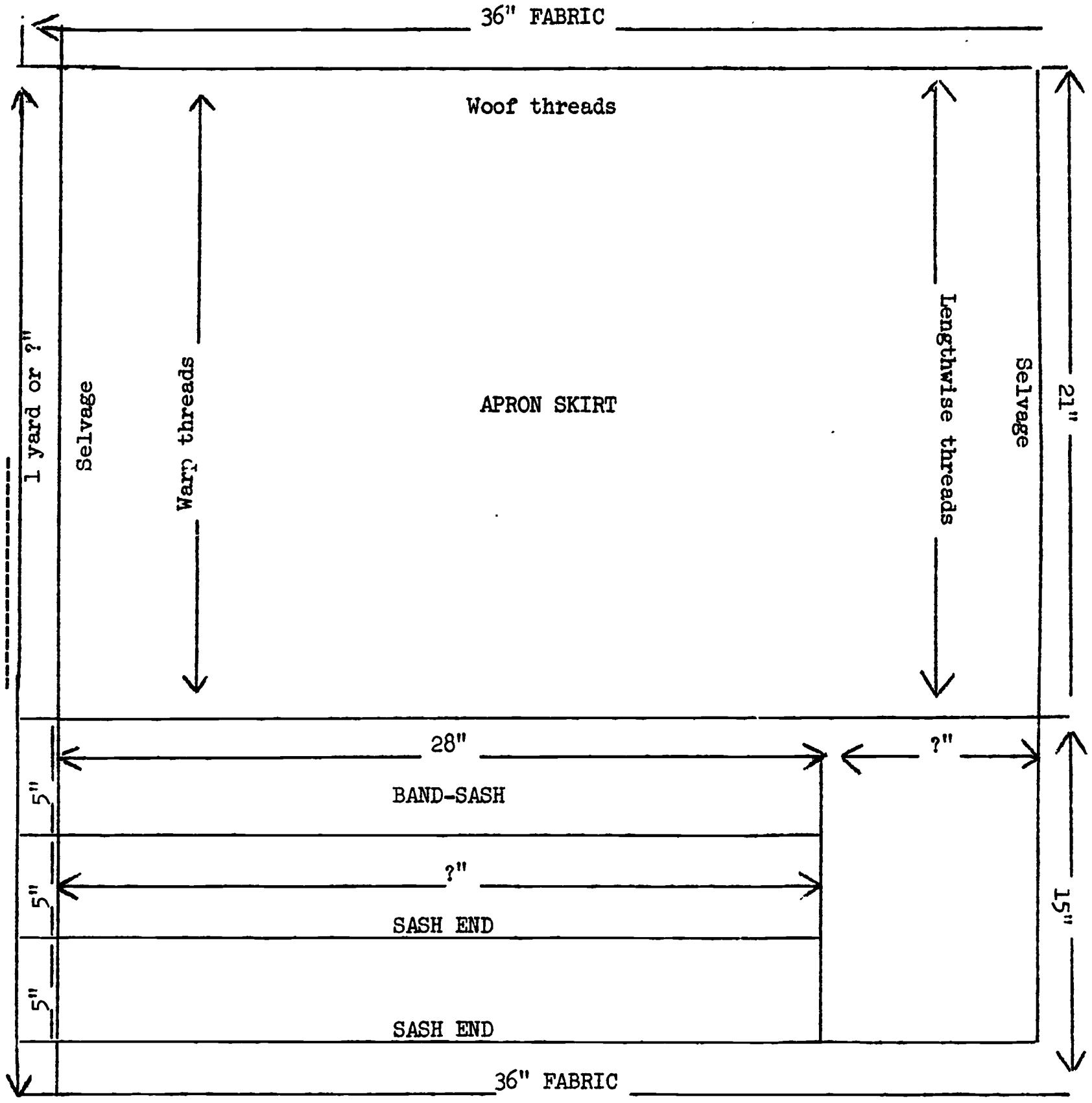
9. Now hold one corner of the fabric in your left hand. Turn so that one selvage is up and in your right hand.

10. Continue to hold the same corner in your left hand. Carefully measure 15-inches along this same selvage. With your right hand, place a pin on the exact mark for teacher to check.

11. If it is right, your teacher will clip the selvage and ask you to tear the fabric all the way across, clipping the opposite selvage.

12. Carefully measure the pieces of your apron. Pin and check each measurement with your teacher. Clip BEFORE you cut or tear A SINGLE PIECE.

(Page 2, Apron Directions)



woof	fold	selvage	diagram	crosswise
warp	inch	thread	fabric	lengthwise

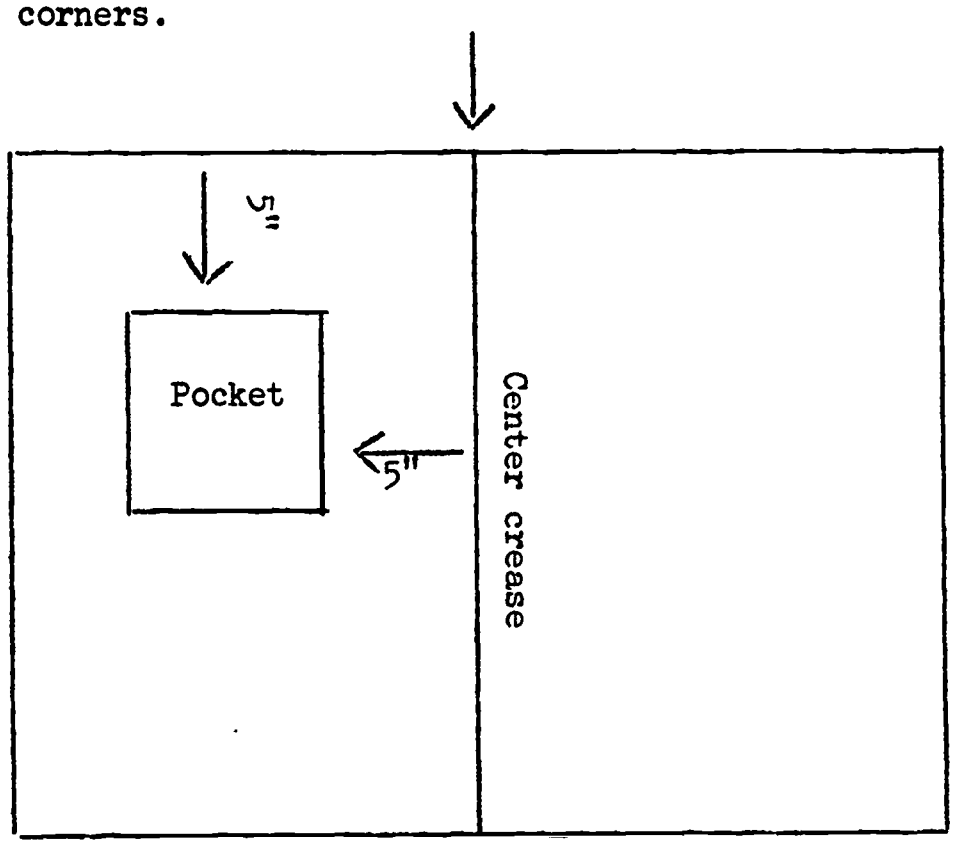
What do these words mean? Identify on fabric.

(Page 3, Apron Directions)

How to Construct or Sew Apron

I. POCKET

1. Stay stitch 1/2-inch across top edge of pocket.
2. Turn on stay-stitching. Press. Edge-stitch the turning.
3. Fold edge over to right side, making a 1-inch hem. Slipstitch.
4. Stay-stitch 1/2-inch along the raw edges, stitching through the 1-inch hem.
5. Turn on stay-stitching to under side. Miter corners. Press.
6. If you wish to design pocket, do so at this point.
7. In applying pocket, first - press apron; fold in half and make a crease down center front.
8. Pin pocket to right side of apron skirt, measuring 5-inches from center crease and 5-inches from top. Check with your teacher.
9. Stitch pocket to apron. Your teacher will demonstrate "stitching" pocket corners.



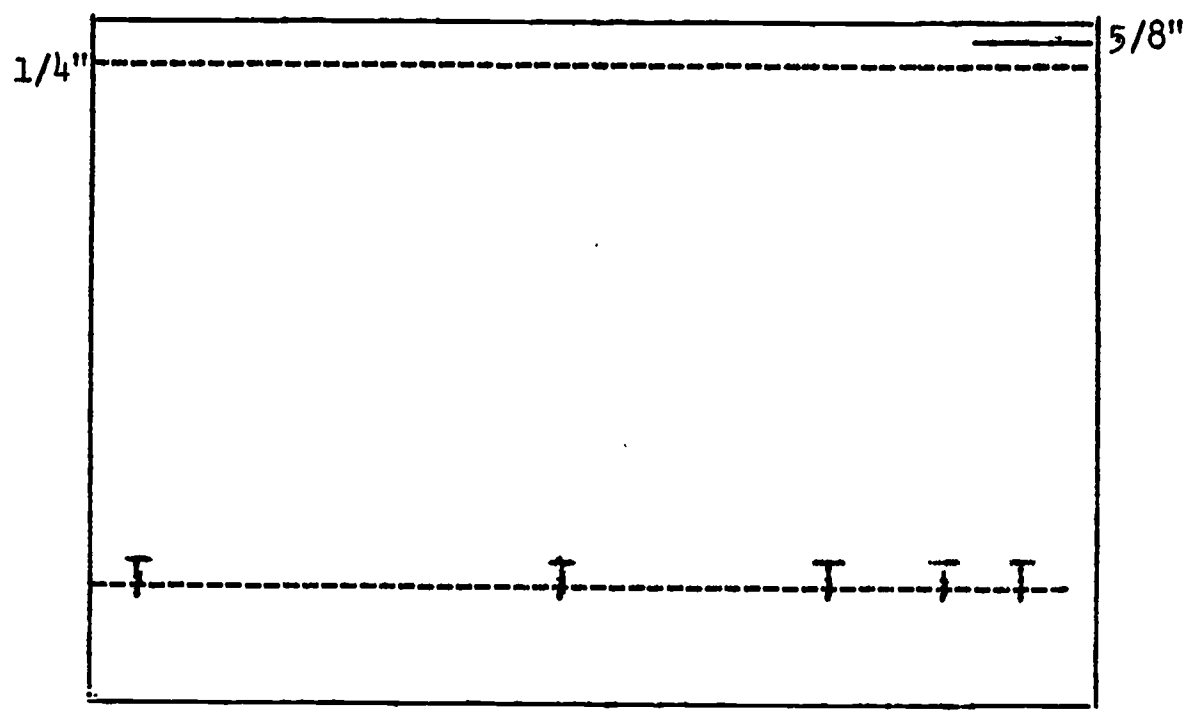
(Page 4, Apron Directions)

II. APRON SKIRT

1. Plan width of hem according to your height and make a gauge for your hem. Check gauge with your teacher.

2. Hem skirt by making a row of stay-stitching 1/2-inch from lower raw edge, beginning at one selvage and ending at the opposite selvage.

3. Make a turning on the lower edge by folding along stay-stitching to wrong side of fabric. Press.



4. Using gauge, press hem toward wrong side. Pin. Place the first 3 pins, noting above diagram, and use enough pins to hold hem in place. Is your hem neat?

5. Make a row of running stitches or machine baste stitches 5/8-inch from top of raw edge.

6. Make a second row of machine baste stitching or running stitches 1/4-inch above the first row. Pull gathers.

7. Wrap thread ends around a pin in a figure 8 (the teacher will help you), until apron skirt top equals band-sash.

(Page 5, Apron Directions)

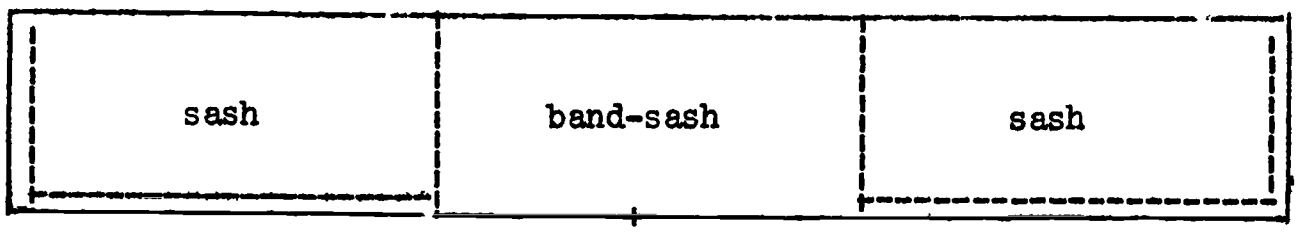
III. BAND-SASH

1. Pin one end of sash to end of band-sash, with raw edges even. Repeat with other end of sash.

2. Make a plain seam by stitching each "end-sash" 5/8-inch from edge. Secure thread at beginning and end of seam. Press seams open.

3. Find center of band-sash by folding in half, crosswise. Mark. Open band-sash.

4. **Fold end sashes and band-sash lengthwise, keeping seams on outside.** Press.



5. Pin raw edges of sashes together, leaving center (band-sash) open between seams.

6. Stitch pinned seams of end sashes. Use 5/8-inch machine gauge as a guide. Secure threads at beginning and end of seams.

7. Make a lapped seam by joining band-sash to apron skirt matching centers with wrong sides together. Your teacher will help you.

8. Pin and stitch the lap seam in place. Press.

IV. SUMMARY

1. Now give your apron a final press. Put it on and look in the mirror.

2. How do you plan to evaluate it? Exhibit it? Pack it for taking home?

3. List the new words you learned. Count the number of new sewing steps you learned.

4. Pin your name on the completed apron and place on the teacher's desk.

NET WORM
(Toy)

Materials:

1 yard net - any suitable color
1 - long, or 2, 6-inch pipe cleaners
Felt:
- 3-inch circle of green, pinked on edge
- 2 - eyes of white
- 2 - small circles of green, for pupils of eyes
- 2 - eyelashes of black
- 1 - red heart for mouth
- 1 - flower, suitable color
- 1/4-yard of 1/4-inch ribbon - color of flower or net

Directions:

Fold net in thirds, crosswise, to make 12-inch strips. Pin to keep straight, and cut on fold.

Fold each strip in thirds to make 4-inch strips. Pin and cut.

Fold each 72-inch strip with ends overlayed in the center. (Will be 35-inches long.)

Press lengthwise to make strip 2-inches wide.

With double thread to match, take 1/4-inch stitches along the crease for 3-inches; draw up and sew through gatherings; continue across 35-inch strip.

Pipe cleaners: Attach the two together and squeeze the ends together. Make a loop at each end and fasten well.

Sew a net strip around the center of pipe cleaner and wrap the thread around tightly and secure end.

Sew net strip together to make ball and sew securely to end loops. Repeat for the other end loop.

Sew three more net strips between each center and end loop.

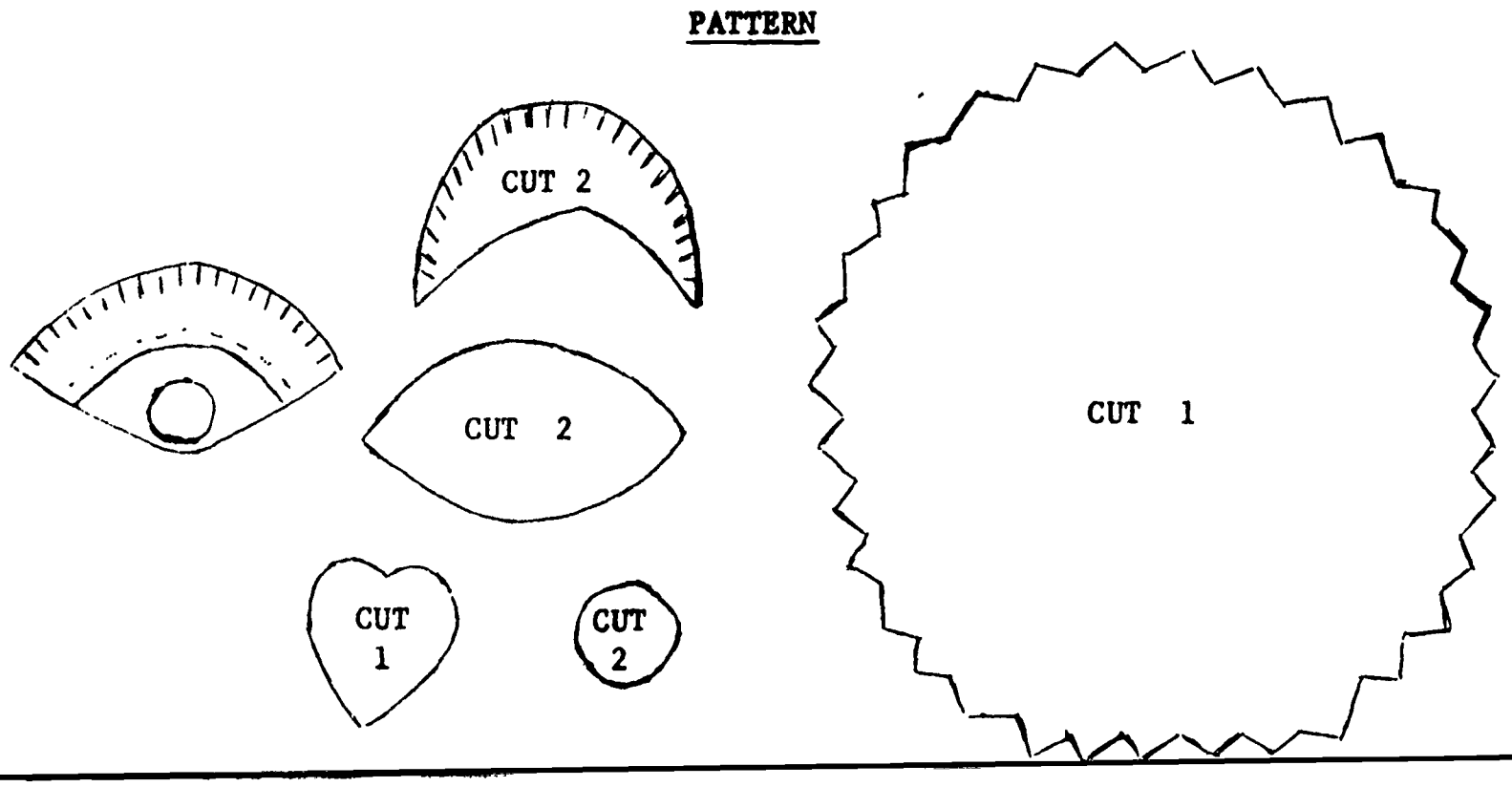
Sew green circle on top of one end of net for hat.

Crease ribbon in center at an angle and sew in center circle.

Attach flower in center of circle securely.

Features: Glue black lashes to white eye, overlapping 1/8-inch; stretch black to fit, to make it curve. Glue green pupils in place. Glue red mouth in place.

PATTERN



SOCK DUCKS

Materials needed: Wool, cotton, or orlon/stretch sock: one size, 8-9$\frac{1}{2}$, for mother duck; one size, 6-7$\frac{1}{2}$, for baby duck. Scraps of felt for tail, feet, beak, and wings (yellow or gold); eyes (black, white, blue). Scraps of checked gingham for bonnet. Thread to match sock. Artificial flower for bonnet trim. Ten or more old nylon stockings to stuff ducks.

Equipment needed: Scissors, pinking shears, pencil, needle, thimble, ruler

Approximate cost: 27¢

Directions for Mother Duck: Cut 1-inch off toe of large sock. *Turn sock inside out and make a running stitch 1/4-inch around cut toe edge. Gather tightly and knot to secure threads. Turn back to right side.

For body: Make an oblong shape 6-inches long and about 3$\frac{1}{2}$ inches in diameter by stuffing one old nylon stocking. **Pack smoothly and firmly. Insert into foot of sock.

For head: Make a 2$\frac{1}{2}$ inch ball of nylon stockings. ***Insert in ankle part of sock. Wind thread around sock between body and head to form neck; tack, and knot thread. Press head in firmly and then fold edges of top opening in; make running stitches all around top; gather tightly and knot to secure thread.

For hair: Cut piece of yellow felt 1$\frac{3}{8}$ inches wide and 1$\frac{1}{2}$ inches long. Slash lengthwise up to 3/8-inches from end; sew to top of head along uncut edge.

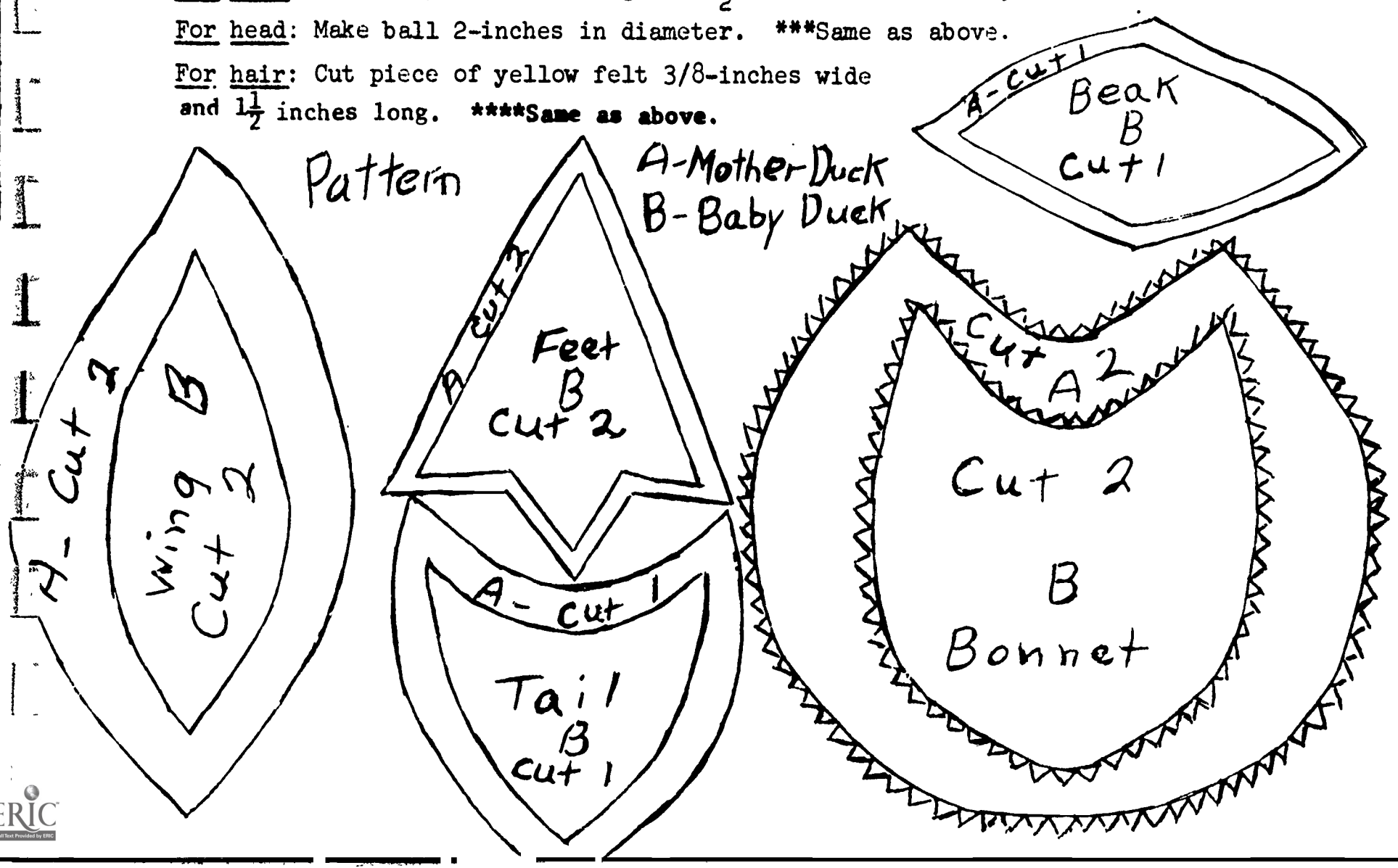
****Cut pattern pieces out of felt and sew (hand tack) to body of duck. Pink and sew bonnets together at edges. Tack bonnet to back part of top of head. For ribbon - cut a strip of gingham 3/8-inches wide and 6-inches long; tack to each side of bonnet and tie a bow. Attach flower to bonnet.

Directions for Baby Duck: Cut 1/2-inches off toe of small sock. Follow same directions as for Mother Duck.*

For body: Make body 4-inches long and 2$\frac{1}{2}$ inches in diameter; **Same as above.

For head: Make ball 2-inches in diameter. ***Same as above.

For hair: Cut piece of yellow felt 3/8-inches wide and 1$\frac{1}{2}$ inches long. ****Same as above.



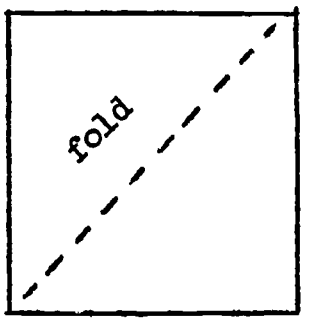
WRIST PINCUSHION

Items needed:

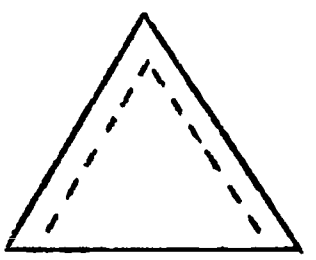
$4\frac{1}{2}$ inch square piece of dark colored, firmly woven fabric
3-inch piece of elastic
Sawdust, or thread ravelings, for filling

Directions:

1. Fold fabric diagonally as shown, with right sides on inside.



2. Stitch a 1/2-inch seam on open edges, leaving an opening of $1\frac{1}{2}$ inches in center of one side. (See diagram.) Mark opening with pins before stitching. Back tack 1/2-inch at beginning and ending of each stitching.



Press back seam allowance at opening.

3. Clip corners and turn right side out. With a pin, pull corners out all the way. Press.

4. Fill with sawdust, nylon hose, or ravelings. Pack tightly, and mold to fit wrist.

5. Thread crewel eye needle with an arm's length of single thread. Your teacher will demonstrate how to stitch opening together. Attach elastic, by using the same overcasting stitch. Fit to your wrist, before stitching second end. Label with name.

UNIT I - PUTTING YOUR BEST FOOT FORWARD
(Grade Seven)

Suggested Time - Three Weeks

Overview and Generalizations

The seventh-grade girl is becoming increasingly aware of her personal appearance, her ability to form friends and relate to her peers, and of her rapid changes from childhood to young adulthood. These interests and needs growing out of the mental, physical, and emotional stages in her development make this year an appropriate time to develop this unit "Putting Your Best Foot Forward." It is hoped that habits, understandings, and skills related to personality development, good grooming, simple laundering, and care of personal clothing can be introduced and reinforced.

It is suggested that the seventh-grade homemaking teacher become familiar with the curriculum emphasis for grade eight. The emphasis here is on the twelve-year-old girl, her friends among her peers, and her family.

This unit is planned to help the seventh-grade girls build and acquire these generalizations, understandings, habits, and skills:

Major Generalizations

I. Each individual girl has responsibilities for making herself acceptable to others.

II. Caring for personal and family clothing contributes to health, acceptance, and to wise money management for the family.

Understandings, Habits, Skills

1. Know and use attractive and appropriate dress within family resource limits.
2. Value a good personality, and grow in self-understanding, and plan for self-improvement.
3. Use pleasant, appropriate manners with friends and family.
4. Evidence personal cleanliness.
5. Understand and use health habits related to food, exercise, rest, and postures.
6. Make simple clothing repairs.
7. Launder clothing by hand and machine.

Suggestions for Starting the Study

- Arrange for each girl to look at herself in a full-length mirror. Guide the discussion into "What can I do with what I have to improve the way I look?"
- Prepare a bulletin board showing seventh-grade girls attractively groomed for school, for church, and for play.
- Confer with the classroom teacher to learn how this unit can best fit into the instruction on health.

Generalizations-Concepts-Teaching Points	Suggested Activities
I. EACH INDIVIDUAL GIRL HAS RESPONSIBILITIES FOR MAKING HERSELF ACCEPTABLE TO OTHERS.	
A. Attractive and appropriate dress helps make us more acceptable to others.	Show by modeling, or through pictures, appropriate dress for occasions which the pupils will be experiencing:
1. For school	- School
2. Party and other special occasions	- Party - Church or other special occasions
3. Play and recreation	- Play and recreation
	Discuss reasons why dress fits the occasion and how time is saved by planning ahead for each day's dress.
	Show pictures of shoes appropriate for the seventh-grade girl.
	Discuss the value of having shoes polished and in good repair.
	Read pages 10-11 in Homemaking, Book One, and pages 15-16 in Homemaking, Book Two.
B. Each person has his own personality which develops, changes, and can be improved.	Discuss "Qualities I like most in others."
1. Habits and traits which make one acceptable	Refer to pages 5-12 in Homemaking, Book Two.
2. Habits and traits which offend	Read a real-life story to the class. Issues of the Readers Digest frequently have articles entitled "Unforgettable Characters." Ask the pupils to point out qualities they admire.
3. Building a personality acceptable to ourselves and to others	

Generalizations-Concepts-Teaching Points	Suggested Activities
	Role-play ways to act when parents forbid an activity.
	Discuss some good traits to develop: - Dependability - Responsibility - Tolerance - Sympathy - Humor - Loyalty - Ability to accept criticism and failure
	Plan a self-improvement habit to build. Report on progress from time to time.
4. Acceptable manners with our friends	Discuss what is meant by good manners.
	Discuss proper way to act in public. Include: - To and from school - Doing errands - Shopping
	Role-play: - Making introductions - Helping a new pupil feel at home in the homemaking class - Giving and receiving a simple invitation, courtesy, or gift
	Discuss attributes in making good conversation. Include: 1. Avoid gossip. 2. Refrain from telling all the details. 3. Speak in a soft voice just so those you are conversing with can hear you. 4. Include everyone in the conversation. 5. Be a good listener. 6. Avoid interruptions.

Generalizations-Concepts-Teaching Points	Suggested Activities
	7. Think of the interests of others when talking.
	8. Look at the person who is speaking.
C. Personal cleanliness helps make one acceptable.	
1. Need for cleanliness	
a. Body perspiration and secretions	Arrange a display of various deodorants and anti-perspirants.
b. Soil from work and play	Discuss the difference between a deodorant and an anti-perspirant.
c. Bacteria and cleanliness	
d. Elimination of body odors	Compare the costs and effectiveness of liquid, powder, paste, and stick deodorants. Decide on the one best suited to individual needs.
e. Personal comfort and cleanliness	Emphasize the fact that all deodorants are not effective for all people.
2. Cleanliness of hands	Review occasions when hands should be washed.
a. Before eating or preparing foods	Demonstrate a way of washing hands and drying them thoroughly. Include the use of hand cream.
b. After toileting	
c. After play - before handling articles which should be kept from soil	
3. Partial baths	Discuss the problem of bathing in the home, such as insufficient hot water and too many people to use the bathroom.
a. Face, hands, neck, ears	
b. Feet	
4. Regular bathing	Discuss the importance of a regular or daily bath and the various kinds - tub, shower, sponge.
	Make a schedule for regular personal care.
5. Care and shampooing of hair	Use pictures, or demonstrations, to illustrate a shampoo and attractive hair styles.
D. General health habits contribute to health and well-being.	List important habits basic to good health and well-being.
1. Balanced diet	
2. Exercise, proper rest	

Generalizations-Concepts-Teaching Points	Suggested Activities
3. Good posture	Practice the seven points of good posture: 1. Feet parallel, weight properly distributed on feet 2. Knees slightly relaxed 3. Chest high 4. Abdomen flat 5. Shoulders relaxed 6. Head up (Stand tall) 7. Chin in Ask the special assistant in physical education to suggest exercises which help poor posture.
II. CARING FOR PERSONAL FAMILY CLOTHING CONTRIBUTES TO HEALTH AND ACCEPTANCE AND TO WISE MANAGEMENT FOR THE FAMILY.	
A. Neat, attractive clothing must be in good repair.	
1. Mending of rips and tears	Show the application of an iron-on patch. Divide class into groups. Let each group demonstrate such repairs as:
2. Fasteners set in place	- Setting hooks and eyes - Setting snaps - Sewing on a button
3. Hems adjusted	- Mending a hem which has partially ripped out
4. Straps adjusted and secured	- Sewing bra or slip strap securely with machine
B. Much of our clothing and other household fabrics can be laundered.	Read pages 12-14 in Homemaking, Book Two.
1. Care of laundering machine and dryer	Demonstrate the operation of the machine and dryer by doing a simple laundry for the homemaking room. Include the proper preparation of the machine for the time when it won't be in use.
2. Laundering procedure with machine	Report on a trip to a "laundromat."

Generalizations-Concepts-Teaching Points	Suggested Activities
a. Sorting clothes: fabric, color, type, degree of soil	Collect pictures of garments used by a small family. Group the pictures for washing. Give reasons for the groupings made.
b. Water: condition and temperature	
c. Detergents and soaps	Display empty containers for a variety of soaps and detergents. Ask each girl to give a "sales talk" for a soap or detergent.
d. Bleaches e. Fabric conditioners	Discuss the variety of laundering agents used in the home.
f. Starching (Items requiring starch; types of starch: cooked, uncooked, concentrated, spray)	Display types of starches. Compare cost. Demonstrate starching of a blouse.
3. Laundering cotton fabrics a. Aprons b. Towels c. Place mats d. Laundry for a small family	Demonstrate the completion of a simulated family laundry. Use articles from the homemaking room or other school items which require laundering. A "sample laundry" using clean, unironed clothing may be desired for these lessons.
4. Drying	
a. Use of dryer	Discuss advantages and disadvantages of the dryer.
b. Hanging of laundry	Allow each pupil to show how to hang articles from the "sample laundry" for drying.
5. Dampening	Allow each girl to dampen and roll a garment to prepare it for ironing. (Place mat, handkerchief) Compare the results of placing dampened clothing in a plastic bag and rolling in a towel.
6. Ironing and/or pressing	Arrange for each girl to iron an article of clothing - skirt, blouse, scarf, handkerchief. Explain an acceptable procedure. Read page 10 in Homemaking, Book One, for an order of procedure in ironing a blouse.
7. Storage of clothes	

Generalizations-Concepts-Teaching Points	Suggested Activities
C. Laundering by hand is desirable for some articles. 1. Hose 2. Drip-dry blouse 3. Slip 4. Sweater	Discuss items which need special laundering. Collect and discuss laundering instructions included with merchandise. Outline a good order of procedure for laundering an article by hand. Include: - Laundering agent - Water temperature - Handling spots which show soil - Rubbing, squeezing, dipping - Rinsing - Drying Note: The emphasis on hand laundry will vary according to the community and the homemaking equipment.

Culmination and Evaluation

- Prepare a "Good Grooming" check sheet as a continuing activity.
- Administer a matching test of laundry products and terms.
- Role-play "Manners with My Friends."

Teaching Aids

Audiovisual Materials

F-2332 Accent on Charm, 6-12
F-26 Are You an Interesting Person?, 7-12
00-728 Body Care and Grooming, 7-12
F-1371 Brush Up on Your Teeth, 4-7
FO-253 Charm by Choice, 6-12
FO-77 Dating Topics for Young Teens, 7-12
F-946 Eating Out, 6-7
F-238 Etiquette Series I, 6-10
- As Others See You
- Home Ground
- School Spirit
- Stepping Out
- Table Talk

Audiovisual Materials (Continued)

F-1867 Etiquette Series II, 6-10
F-1199 Etiquette Series III, 6-12
0-538 Family Life, 7-14
F-3306 Focus on the Family Wash, 6-12
F-25 Getting the Most Out of Your Day, 6-12
00-1084 Girl to Woman, 4-12
0-916 Good Grooming for Girls, 7-12
Good Grooming for Girls Series, 7-14
0-1167 Posture
00-738 Hair Care
00-739 Wardrobe
00-729 Make-Up
Grooming for Girls Series, 7-12
F-481 Your Clothing
F-482 Your Face
F-483 Your Figure
F-484 Your Hands and Feet
F-485 Your Hair
F-486 You and Your Grooming
F-1784 Hands Right, 6-12
0-845 Home Management: Why Budget, 7-12
F-2282 If It Isn't Yours, 7-12
00-455 It's All in Knowing How, 6-12
0-1093 Making the Most of Your Face, 7-12
F-1825 Personal Appearance, 4-9
0-751 Personal Health for Girls, 7-12
F-1822 Personal Relationships, 4-9
F0-187 Pretty as You Please, 6-12
F-313 Science of Personal Appearance, 7-8
F-3302 Teen-aged ? Have Acne, 7-12
F-2536 Toward a Clear Complexion, 5-10
F-3307 Washday Wonders, 6-12
F-1827 You're in Public
F-1291 Your Best You, 6-9
0-567 Your Family Budget, 7-14

Audiovisual Materials (Continued)

Calgon Corporation, Home Service Center, Box 1346, Pittsburg, Pa.,15234

- Recipe for Clean Clothes (Shows steps in laundering; shows stain removal)

Jergens Lotion, Audio Visual School Service, 120 Fulton Avenue, Garden City Park, New York, 11044

- Through the Looking Glass (Promotes care of hair, hands, and face. Considers posture and food in relation to how you look.)

Procter and Gamble, Ivorydale, Ohio

- Wash Day Wonders (Shows how to treat spots of heavy soil, as around the neck and cuffs)

Books and Pamphlets for Pupils

American Sheep Producers Council, 520 Railway Exchange Bldg., Denver, Colorado, 80202

- Characteristics of Woolen and Worsted Fabrics (Identifies woolen yarns and worsted yarns, felting and knitting)

Avon Products, Inc., 30 Rockefeller Plaza, New York, N. Y., 10020

- Teaching Grooming to Teen-Age Girls and Boys, 1967. (Poster or bulletin board suggestions. Quick quizzes on grooming for girls and boys. Booklet for each girl and boy.)

Bristol Myers Products, 45 Rockefeller Plaza, New York, N. Y.

- Give Yourself a Boost (Revised) (Suggests 9 helps to assist a boy be a winner)

Church and Dwight Company, Inc., 70 Pine Street, New York 5, N. Y.

- Use Soda (Arm and Hammer Baking Soda)

Dairy Council of Greater Kansas City, 5200 East 45th St., Kansas City, Mo.

- For Form and Figure
- How Your Body Uses Food, Albert Plitz, 1964. (Story of digestion; food in space; pills or food)
- How Am I Doing?
- My Reflections
- Posture Teaching Aids for Girls
- Postures on Parade

Dial Research Laboratories, Armour and Company, Chicago, Illinois, 1965

- How to Make Good Grooming a Habit (Check list for girls and boys)

Gold Seal Company, Bismark, North Dakota

- Permanent Press Apparel, #14, 1965. (Outline of development of permanent press apparel. Boys slacks on front page. Suggests tips for care.

Books and Pamphlets for Pupils (Continued)

Pendleton Woolen Mills, Home Economics Department, Portland, Oregon, 1967.
- Buying Clothes Wisely (Six points to consider)
- Pressing Wool (Steps in pressing woolens)
- Spotless Woolens (Stain removal suggestions)
- Sweater Care (Buying tips; wearing and cleaning helps)
- Wool Care (Steps in pressing woolens)
- Wool Ways (Subject: pressing wool)

Van Heusen Corporation, Home Economics Department, 417 Fifth Avenue, New York, N. Y., 10016
- Pressing and Ironing Zippers
- What Every Woman Should Know About Men's Fashions

UNIT II - CLOTHES FOR YOU
(Grade Seven)

Suggested Time - Fifteen Weeks

Overview and Generalizations

The current and recent trends in fashion stimulates and creates a great desire within girls to construct a suitable wardrobe for themselves, and to make garments for their families. Therefore, the concept of clothing construction is readily accepted by the seventh grader.

The teaching of clothing construction at this seventh-grade level helps develop some of the skills necessary for proper sewing techniques. It also tends to develop competence in consumer buying and helps to create an interest in further practice of skills learned and an interest in acquiring higher-level skills.

This unit is planned to help seventh-grade girls build and acquire these generalizations, understandings, habits, and skills:

Major Generalizations

I. When a wise choice of color, design, and fabric is made, a garment is more satisfying.

II. Building and understanding a vocabulary of fabric and sewing terms aid in wise clothing selection.

III. With a knowledge of sewing equipment and the sewing machine, clothing construction is made easier.

IV. Garments can be made to extend the wardrobe.

Understandings, Habits, and Skills

1. Make wise choices in the selection of fabrics.
2. Assume responsibility for sharing in the care of classroom and equipment.
3. Develop the ability to use sewing equipment efficiently.
4. Develop and use good work habits.
5. Apply knowledge of fabric and sewing vocabulary to clothing selection.
6. Carry through to completion a simple garment.
7. Create an interest in further sewing.

Suggestions for Starting the Study

- Review articles made of fabric by the girls while in grade six, or at home.
- Arrange a bulletin board showing pictures of the seventh-grade girl attractively dressed for school, play, party, and church.
- Arrange a bulletin board of seventh-grade clothing projects.
- Hold a quick "fashion show" by selecting girls in class who are wearing good color combinations or becoming styles. Ask girls to model for the class.
- Have each girl take a wardrobe inventory.
- View a film as an introduction to the fundamental learnings. A suitable one is Sewing Fundamentals, 0-555.

Generalizations-Concepts-Teaching Points	Suggested Activities
I. WHEN A WISE CHOICE OF COLOR, DESIGN AND FABRIC IS MADE, A GARMENT IS MORE SATISFYING.	
A. Colors help us look attractive.	View the color chart.
1. Primary and secondary colors 2. Shades and tints 3. Color mixing 4. Colors in current popularity	Read pages 15-16 in Homemaking, Book Two.
5. Personal taste, and suitability	Use color swatches, or color bibs, to discover colors that look well on each girl. Decide on colors which fit the wardrobe of each. Make charts of colors which pupil likes to wear. Select the color to use for a skirt.
B. Design in fabric can improve the appearance.	Discuss design of fabrics suitable for level of skill. (Avoid plaids and large prints.)
1. Solids 2. Prints 3. Checks 4. Stripes 5. Border prints 6. Plaids	Collect samples of cotton fabrics. Learn the name of each. Examine colors suitable for fall and for spring. Select examples of design found in the classroom.

Generalizations-Concepts-Teaching Points	Suggested Activities
C. A cotton skirt adds variety to the wardrobe.	Discuss selection of fabric for a cotton skirt.
II. BUILDING AND UNDERSTANDING A VOCABULARY OF FABRIC AND SEWING TERMS AID IN WISE CLOTHING SELECTION.	Discuss variety through change of blouses, sweaters, and jackets. Show on felt board.
A. Fabrics are made from fibers.	Display a bulletin board arrangement of classes of fibers and fabrics.
B. Fiber sources may be animal, synthetic (manmade), or vegetable.	
1. Animal fibers (wool and silk)	
2. Synthetic fibers (rayon, nylon, dacron, and orlon)	
3. Vegetable fibers (cotton, flax and/or linen)	Discuss the development of cotton fibers into a fabric.
	List suitable fabrics for a skirt. Compare cost with ready-made skirt.
	Display a bulletin board arrangement of suitable cotton fabrics for a skirt that is gathered, pleated, or straight (with elastic casing).
C. Cotton is a useful fabric to use in learning to sew.	
1. Some cotton fabrics suitable for beginning projects: percale, broadcloth, gingham, homespun, sailcloth	Have pupils collect swatches suitable for skirts.
2. Characteristics of good cotton fabrics: washable, colorfast, durable, economical, free from sizing	Test several samples of fabrics for fast colors and shrinkage.
3. "Pre-shrunk" (sanforized)	Develop meanings of "pre-shrunk" (shrinkage of three per cent) and "sanforized" (guaranteed to shrink not more than one per cent).
4. Causes of fading: sunlight, heat, perspiration, laundering, and cleaning	List factors that may cause fabrics to fade.
	Collect labels to study shrinkage and fading of fabrics.
D. Fabric is made by weaving two sets of threads on a loom.	Review fabric vocabulary learned in grade six.
1. Warp threads (lengthwise)	Refer to page 24, Homemaking, Book Two.
2. Woof threads (crosswise)	Mount and label pieces of cotton fabric. Show the lengthwise and crosswise threads which indicate grain lines.
3. Grain (determined by lengthwise or crosswise threads)	

Generalizations-Concepts-Teaching Points	Suggested Activities
4. Bias (off-grain line)	Read and discuss pages 20-21 in Homemaking, Book Two.
5. Selvage, the lengthwise, finished edge of fabric (edge of the fabric that will not ravel)	
6. Raw edge - the unfinished edge of fabric	
7. Fringed edge (produced by pulling out the warp thread and leaving the woof, or by pulling out the woof thread and leaving the warp)	Introduce construction of a torn skirt project related to current fashion trends. Some possibilities are the gathered, pleated, or straight skirt with casing. Direction sheets are available from the homemaking office.
8. Straightening fabric	Straighten ends of fabric before starting skirt.
a. Thread perfect	
- Fringing until one woof goes clear across the fabric when pulled	Demonstrate bias when straightening fabric.
- Cutting on a pulled woof thread	Demonstrate straightening of fabric after it is torn into skirt lengths.
b. Grain perfect	Arrange for a review of pressing.
- Stretching across the bias	
III. WITH A KNOWLEDGE OF SEWING EQUIPMENT AND THE SEWING MACHINE, CLOTHING CONSTRUCTION IS MADE EASIER.	
A. Sewing tools which are carefully selected and cared for will be useful a long time.	Assemble sewing tools. See that each pupil has the essential equipment labelled for identification and a convenient box for storage.
1. Correct handling of tools	Have each pupil tell, or demonstrate, how tools have been used since sixth-grade homemaking.
2. Everything in its place	
3. Maintaining good equipment	Plan for sharing of needed tools and equipment.
	Suggest uses and care of scissors.
	Practice placing pins at right angles to raw edges, as an aid in machine and hand sewing.
4. Advantage of crewel eye needles	Show difference in crewel and sharp eye needles.
5. Lightweight and durable thimbles that fit comfortably	Review the use of the thimble and needle. Use game to encourage use of thimble.